ABB SOLAR INVERTERS

PVS980-MWS megawatt station

Hardware manual
List of related manuals

Hardware manuals and guides
PVS980 central inverters hardware manual 3AXD50000026013
PVS980 central inverters commissioning and maintenance manual 3AXD50000046782

Firmware manuals and guides
PVS central inverters firmware manual 3AXD50000026271

Option manuals and guides
ACS-AP-x Assistant control panels user’s manual 3AUA00000085685
Start-up and maintenance PC tool Drive composer user’s manual 3AUA0000094606
FENA-01/-11/-21 Ethernet adapter module user’s manual 3AUA0000093568
FSCA-01 RS-485 adapter module user’s manual 3AUA0000109533
NETA-21 Remote monitoring tool user’s manual 3AUA0000096939

Other manuals and guides
SafeRing/SafePlus 12–24 kV installation and operating instructions 1VDD005976
SafeRing/SafePlus 36 kV installation and operating instructions 1VDD006116
Dry-type transformer: Vacuum cast coil transformers 1LES100028-ZD
Oil-type transformer: Operation and maintenance manual of distribution transformers 1LTR954400-1
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Safety instructions

Contents of this chapter

This chapter contains the safety instructions which you must obey when you install and operate the megawatt stations and do maintenance on the megawatt station. Obey these safety instructions to prevent injury or death, or damage to the equipment.

Use of warnings

Warnings tell you about conditions which can cause injury or death, or damage to the equipment. They also tell you how to prevent the danger.

The manual uses these warning symbols:

<table>
<thead>
<tr>
<th>Warning Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity warning</td>
<td>Electrical hazards which can cause injury or death, or damage to the equipment.</td>
</tr>
<tr>
<td>General warning</td>
<td>Conditions, other than those caused by electricity, which can cause injury or death, or damage to the equipment.</td>
</tr>
<tr>
<td>Electrostatic sensitive devices warning</td>
<td>Risk of electrostatic discharge which can cause damage to the equipment.</td>
</tr>
</tbody>
</table>
Installation, start-up and maintenance safety

Obey these safety instructions which when you install, commission and do maintenance on the megawatt station. If ignored, physical injury or death, or damage to the equipment may occur.

Only authorized electricians can install, start-up and maintain the megawatt station. The working methods, tools and components must obey the IEC regulations.

Always obey the local safety regulations concerning the electrical stations.

The megawatt station is a medium voltage (MV) device and, therefore, it can only be energized and de-energized by an authorized person who has task-specific instructions for the operation of an MV substation and permission from the on-site supervisor in charge of electrical work.

If other people must be near the unit when the door is open, warn them, and give supervision and guidance.

General safety

These instructions are for all personnel who install the megawatt station or do maintenance work on it.

WARNING! Before you do any work, do these safety precaution steps.

1. Clearly identify the work area.
   Read the safety instructions for the work area and the applicable equipment and components. Refer to equipment-specific documentation.

2. Disconnect power sources and prevent connection.
   Disconnect all possible power sources. Lock the disconnectors in the open position and attach a warning notice to them. After power disconnection of the inverters, always wait 10 minutes to let the intermediate circuit capacitors discharge.

3. Use protections against live parts.

4. Take special precautions when you do work near exposed conductors.

5. Measure to make sure that there is no voltage in the components.

6. Do the earthing (grounding) and short circuiting.

7. Make sure that you have a work permit.

Working areas

The megawatt station has several working areas based on the precautions needed for safe working:

- Switchgear compartment
- Transformer compartment
- AC auxiliary panel compartment
- Inverter section

There are separate safety instructions for each of these working areas.
Personal protective equipment (PPE)

Obey all local installation safety standards and rules. This can require the use of arc-proof clothing, arc-proof masks, protective footwear, protective gloves, eye protection and hearing protection. High-power inverter installations have high fault currents. Use appropriate arc-proof clothing (for example, in the US, a rating of 40 cal/cm² is required).

Safety instructions for the switchgear and transformer compartment

WARNING! Do the procedures before you start the work on the switchgear or transformer. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Identify the switchgear and read its safety instructions. Make sure that the capacitive voltage indicators operate in all switchgear bays (all of the phase LEDs are on when the voltage is connected).

2. Disconnect the switchgear from all possible power sources (grid, solar generator and parallel connected stations), prevent connection, lock and attach warnings.
   - Stop the inverters. Open the DC disconnecting switches [-1Q1, -1Q2] from both inverter units, lock them and attach warnings.
   - Set the AC cabinet switch to off, lock it and attach a warning.
   - Set the inverter auxiliary power to off.
   - Open or disconnect the breakers and switches of the AC cabinet.
   - Open the switchgear (V-module) on the transformer side.
   - Set the disconnecting switch on the transformer side of the switchgear to the open position, lock it and attach a warning.
   - Disconnect the switchgear terminals from all possible external power sources (grid and parallel stations). Refer to the user's manual of the switchgear. Prevent reconnection (remove the switchgear C-module key) and attach warnings.

3. Make sure that all shrouds and screens are in place.

4. Make sure that you will not be near any live parts when you do work. Disconnect the live circuits or protect them with shrouds or screens.

5. Make sure that the switchgear is not energized. Read the status of the voltage indicators in all switchgear bays (all phase LEDs which were on at Step 1 are now off).

6. Earth the switchgear and inverters.
   - Turn the earthing switches of the switchgear to the “earthed” position, lock them (remove the switchgear V-module key) and attach warnings. If the station is
connected to parallel stations, make sure that you also turn the applicable earthing switches to the “earthed” position.

- Temporarily ground the switchgear terminals at all possible external power supplies (grid and parallel stations). Refer to the user's manual of the feeding/switchgear device. Lock the terminals and attach warnings.
- Temporarily ground the AC side of the inverters with a suitable temporary grounding set.

7. Open the transformer door with the linked key of the V-module switchgear.

8. Make sure that the transformer is not energized (high voltage terminals, low voltage terminals, any auxiliary power and instrumentation). Use a suitable high-voltage tester only for the high-voltage side, and a multimeter with suitable testing heads for the low-voltage side.

9. Make sure that you have a work permit.
Safety instructions for the inverter and AC cabinet compartment

**WARNING!** Do the procedure before you start the work on the inverter. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Identify the inverter that you need to work on. Read the inverter safety instructions in the *PVS980 central inverters hardware manual* (3AXD50000026013 [EN]).

2. Disconnect the inverters from all power supplies (PV generator, transformer, AUX and UPS), prevent connection and attach warnings.
   - Stop the inverters.
   - Disconnect the inverters from the AC supply (the breaker on the MV side of the main transformer). The AC main switch disconnectors do not remove the voltage from the AC output busbars of the inverter.
   - Disconnect the inverters from the DC power supply (usually the DC circuit breakers of the solar array junction boxes or the DC combiner box). The DC main switches do not remove the voltage from the input busbars of the inverter.
   - Open the AC main disconnection devices (AC breakers or AC switch disconnectors) of all power units of both inverters (1Q4 and 2Q4), the DC main switches of all the power sections (1Q1 and 2Q1), the auxiliary power main switches of all the power sections (1Q10 and 2Q10), the optional 3-phase output main switch (0Q12) and the 1-phase output circuit breakers (0F11 and 0F13).
   - If applicable, open or set to off all auxiliary panel breakers.
   - Make sure that connection is not possible. Lock all of the disconnectors in the open position and attach warnings.
   - After you disconnect the inverter, wait for 5 minutes to let the intermediate circuit capacitors discharge before you continue.

3. Make sure that all shrouds and screens are in place. A shroud or screen can only be removed if it is required to reach the parts that you do work on.

4. Make sure that you are not near any live parts when you do work. Disconnect live circuits or protect them with shrouds or screens.

5. Make sure that the circuit is not energized at the AC and DC terminals of the inverters and other accessible parts in the main circuit. Use a multimeter with suitable testing heads.

6. Temporarily ground the inverter.
   Temporarily ground the (INV1 and INV2) AC and DC sides of the inverter: Connect the AC and DC busbars (in both DC sections) to the PE with a temporary grounding tool.

7. Make sure that you have a work permit.
Safe operation

These warnings are for all personnel who commission, plan the operation, or operate the megawatt station.

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

- Keep all doors of the megawatt station closed during operation. Give the keys only to authorized personnel.
- Before you start the inverter, close the two AC and two DC main switches, auxiliary measurement unit switch 1F3.4, and the internal auxiliary transformer fuse switches, and overload protection switches 1Q10, 1Q11, 2Q10 and 2Q11.
- During operation, do not open the AC or DC main switches.
- Before you adjust the inverter and put it into service, make sure that all of the equipment is suitable for operation.
- The maximum allowed number of power-ups by applying power is five in ten minutes.
- Do not use the inverter in a manner not specified in this manual.

**Note:**
- Spend as little time as possible near the inverters or the medium-voltage components.
- If the Start switch is in the ON position, and the Start command is active, the inverter starts immediately after a fault reset. For more information, refer to the *PVS980 central inverters firmware manual* (3AXD50000026271 [EN]).
- Use the start delay when you start the megawatt station for the first time to let you move away.
- Use a personal computer and the Drive Composer tool with a communication cable of sufficient length when you monitor or adjust inverter parameters during operation.
Introduction to the manual

Contents of this chapter
This chapter describes the intended audience and contents of the manual.

Applicability
This manual is applicable to PVS980-MWS megawatt stations.

Target audience
This manual is intended for persons who do the work on the megawatt station as follows:
• Transportation
• Storage
• Installation planning
• Installation
• Commissioning
• Use
• Maintenance

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

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

Introduction to the manual – Introduction to the manual.

Hardware description – The operation principle and construction of the megawatt station.

Storing, lifting and transporting – How to store, lift and move the megawatt station.

Mechanical installation – The mechanical installation of the megawatt station.

Electrical installation – The electrical installation of the megawatt station.

Finalizing the installation – A checklist for the mechanical and electrical installation.

Start-up and operation – The start-up procedure and the operation of the megawatt station.

Maintenance – The preventive maintenance instructions of the megawatt station.

Technical data – The technical data for the megawatt station.

Dimension drawings – The dimension drawings of the megawatt station.

Terms and abbreviations

<table>
<thead>
<tr>
<th>Term/Abbreviation</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CV</td>
<td>Construction of switchgear</td>
</tr>
<tr>
<td>LV</td>
<td>Low voltage equipment: 50…1000 V AC</td>
</tr>
<tr>
<td>LVRT</td>
<td>Low-voltage ride through</td>
</tr>
<tr>
<td>MPP</td>
<td>Maximum power point</td>
</tr>
<tr>
<td>MPPT</td>
<td>Maximum power point tracker. MPPT is a technique that solar inverters use to get the maximum possible power from solar panels.</td>
</tr>
<tr>
<td>MV</td>
<td>Medium voltage equipment: 1…35 kV</td>
</tr>
<tr>
<td>MWS</td>
<td>Megawatt station</td>
</tr>
<tr>
<td>SF6</td>
<td>Sulphur hexafluoride. A gas used in the switchgear.</td>
</tr>
<tr>
<td>SWG</td>
<td>Switchgear</td>
</tr>
<tr>
<td>THD</td>
<td>Total harmonic distortion</td>
</tr>
<tr>
<td>TN-S</td>
<td>Earthed power network</td>
</tr>
</tbody>
</table>
Hardware description

Contents of this chapter
This chapter gives a short description of the PVS980-MWS megawatt station.

Product overview
The PVS980-MWS megawatt station includes the equipment needed for the connection of a solar power generator to the medium voltage power grid. The station is into a steel structure that can be transported to a site as a sea container.

The main components of the megawatt station:
- Two inverters which invert the direct current (DC) and voltage from the solar generator into alternating current (AC) and voltage for the power grid. The inverters also control the power flow, and monitor and protect the power generator.
- A transformer which transforms the low voltage from the inverters into a medium voltage for the power grid.
- Switchgear which is the connection point to the power grid. It is also the main protection, switching, breaking and disconnecting equipment on the medium-voltage side of the solar power plant.
- The AC cabinet is the auxiliary cabinet, for the electrical and communication distribution for supply services of the megawatt station.
Hardware description

Layout drawing (dry-type variant)

### Compartments

<table>
<thead>
<tr>
<th>Sec.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Inverter section</td>
</tr>
<tr>
<td>B</td>
<td>Transformer enclosure</td>
</tr>
<tr>
<td>C</td>
<td>Low-voltage enclosure</td>
</tr>
<tr>
<td>D</td>
<td>Medium-voltage enclosure</td>
</tr>
</tbody>
</table>
## Main components

<table>
<thead>
<tr>
<th>Sec.</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>Inverters</td>
</tr>
</tbody>
</table>
|      | 2   | Lead-through holes for DC cabling from solar generator  
               Terminal for the external DC earthing |
| B    | 3   | Transformer |
|      | 4   | Transformer enclosure air inlet |
|      | 5   | Transformer enclosure air outlet |
| C    | 6   | Auxiliary cabinet |
|      | 7   | Communication cabinet (optional) |
|      | 8   | Uninterruptible power supply (UPS) (optional) |
|      | 9   | Lead-through holes for external low-voltage cables |
|      | 10  | Lead-through holes for external communication cables |
| D    | 11  | Medium-voltage switchgear |
|      | 12  | Lead-through holes for medium-voltage power grid cables  
               Terminal for the external earthing |
Hardware description

Layout drawing (oil-type variant)

Compartments

<table>
<thead>
<tr>
<th>Sec.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Inverter section</td>
</tr>
<tr>
<td>B</td>
<td>Transformer enclosure</td>
</tr>
<tr>
<td>C</td>
<td>Low-voltage enclosure</td>
</tr>
<tr>
<td>D</td>
<td>Medium-voltage enclosure</td>
</tr>
</tbody>
</table>
## Main components

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<thead>
<tr>
<th>Sec.</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>Inverters</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Lead-through holes for DC cabling from solar generator</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Terminal for the external DC earthing</td>
</tr>
<tr>
<td>B</td>
<td>3</td>
<td>Transformer</td>
</tr>
<tr>
<td>C</td>
<td>4</td>
<td>Auxiliary cabinet</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Communication cabinet (optional)</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Uninterruptible power supply (UPS) (optional)</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Lead-through holes for external low-voltage cables</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Lead-through holes for external communication cables</td>
</tr>
<tr>
<td>D</td>
<td>9</td>
<td>Medium-voltage switchgear</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Lead-through holes for medium-voltage power grid cables</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Terminal for the external earthing</td>
</tr>
</tbody>
</table>
Main circuit diagram

The general single-line diagram depends on the configuration and options of the unit. Refer to drawing 3AES-SH_4600-01-DW01.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Inverters</td>
</tr>
<tr>
<td>2</td>
<td>Transformer</td>
</tr>
<tr>
<td>3</td>
<td>Switchgear</td>
</tr>
<tr>
<td>4</td>
<td>Auxiliary transformer</td>
</tr>
<tr>
<td>5</td>
<td>AC cabinet fan</td>
</tr>
<tr>
<td>6</td>
<td>AC cabinet heating</td>
</tr>
<tr>
<td>7</td>
<td>External fan 1 (transformer)</td>
</tr>
<tr>
<td>8</td>
<td>External fan 2 (transformer)</td>
</tr>
<tr>
<td>9</td>
<td>Spare</td>
</tr>
<tr>
<td>10</td>
<td>Power socket 1 &amp; 2</td>
</tr>
<tr>
<td>11</td>
<td>Lighting</td>
</tr>
<tr>
<td>12</td>
<td>Communication cabinet (customer)</td>
</tr>
<tr>
<td>13</td>
<td>MWS control equipment (temperature monitoring, transformer fan control and</td>
</tr>
<tr>
<td></td>
<td>switchgear</td>
</tr>
<tr>
<td>14</td>
<td>AC cabinet control system</td>
</tr>
<tr>
<td>15</td>
<td>Spare</td>
</tr>
</tbody>
</table>
Switchgear

The unit is always equipped with medium-voltage switchgear. Type CCV switchgear is used as standard and consists of three modules:

- The first C module is the grid-side module with the grid cable terminals, and a disconnecting and earthing switch.
- The second C module is the grid connection point of the parallel-connected substation.
- The V module is the transformer-side module. It contains the protection relay-controlled circuit breaker, a switch disconnector and an earthing switch.

Other available switchgear types: DeV, CV (motorized or non-motorized) and CCV (motorized or non-motorized)

For more information, refer to the applicable switchgear documentations:
- *SafeRing/SafePlus 12–24 kV installation and operating instructions* (1VDD005976)
- *SafeRing/SafePlus 36 kV installation and operating instructions* (1VDD006116)

The switchgear alternatives:

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Transformer

For information on the transformer, refer to the applicable documentation:
- Dry-type transformer: *Vacuum cast coil transformers* (1LES100028-ZD)
- Oil-type transformer: *Operation and maintenance manual of distribution transformers* (1LTR954400-1)

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Inverter

For information on the inverter, refer to:
- *PVS980 central inverters hardware manual* (3AXD50000026013 [EN])
- *PVS980 central inverters commissioning and maintenance manual* (3AXD50000046782 [EN])
- *PVS980 central inverters firmware manual* (3AXD50000026271 [EN])
Type designation label

The type designation label contains the basic data of the unit. It is located on the inside of the low-voltage compartment door.

PVS980-MWS-xxxx-y-zz+options

SERIAL NUMBER: NNNN
MADE IN SPAIN
MANUFACTURED IN 201x

<table>
<thead>
<tr>
<th>Sec.</th>
<th>Item</th>
<th>Description/options</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Product category</td>
<td>PVS980</td>
</tr>
<tr>
<td>B</td>
<td>Housing type</td>
<td>-MWS (Megawatt station)</td>
</tr>
</tbody>
</table>
| C    | Power rating of the station (nominal rating at 50 °C) | -3636kVA  
    |                            | -3818kVA  
    |                            | -4000kVA  
    |                            | -4182kVA  |
| D    | Low voltage level         | -I: 600 V  
    |                            | -J: 630 V  
    |                            | -K: 660 V  
    |                            | -L: 690 V  |
| E    | Medium voltage level      | -33 kV (12…36 kV)                       |
| F    | Options                   | Plus codes for installed options         |
| G    | Serial nr                 | Unique serial number, for example, 0609310170270 |
| H    | Made in                   | Manufacturing country                    |
| I    | Manufactured in           | Manufacturing year                       |
| J    | Order nr                  | Order number, for example, PC16001       |
## Option codes

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fieldbus</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K458</td>
<td>Modbus RTU adapter</td>
<td>Inverter is equipped with an adapter for Modbus RS485 connections. The used adapter is called FSCA-01. For more details, see FSCA-01 manual.</td>
</tr>
<tr>
<td>K473</td>
<td>Ethernet adapter (Ethernet/IP, Modbus/TCP, PROFINET)</td>
<td>Inverter is equipped with an adapter for Ethernet/IP, Modbus/TCP, PROFINET connectivity. The used adapter is called FENA-11. For more details, see FENA-01/-11/-21 manual.</td>
</tr>
<tr>
<td>K475</td>
<td>Ethernet adapter (Ethernet/IP, Modbus/TCP, PROFINET, 2-port)</td>
<td>Inverter is equipped with an adapter for Ethernet/IP, Modbus/TCP, PROFINET connectivity. The used adapter is called FENA-21. The difference to FENA-11 is that FENA-21 has dual Ethernet ports for daisy chaining the inverters. For more details, see FENA-01/-11/-21 manual.</td>
</tr>
<tr>
<td>K480</td>
<td>Ethernet switch</td>
<td>Inverter is equipped with an Ethernet switch from Phoenix contact. The switch has 2 fiber optics and 6 RJ-45 ports for inverter and auxiliary device connectivity. For more details, see PVS980 Commissioning and maintenance manual and Phoenix contact documentation.</td>
</tr>
<tr>
<td><strong>Remote monitoring</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K486</td>
<td>ABB remote monitoring</td>
<td>Inverter is equipped with an adapter for remote monitoring. The used adapter is called NETA-21. The adapter is mainly intended for small scale power plants. For more details, see NETA-21 manual.</td>
</tr>
<tr>
<td><strong>AC section options</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F296</td>
<td>AC breaker, motorized, remote control (not with +F253)</td>
<td>Inverter is equipped with a controllable, configurable AC breakers (one per power section). Even with the breakers, inverter is always equipped also with AC fuses. This option is not possible with F253, AC disconnector.</td>
</tr>
<tr>
<td>F263</td>
<td>AC surge arrester, high energy, Type 1, complies also with Type 2</td>
<td>Standard Type 2 surge arresters replaced with high energy Type 1 surge arresters that fulfill also Type 2 requirements. Provides better protection for surges.</td>
</tr>
<tr>
<td>G317</td>
<td>AC output with busbar (close coupling) interface</td>
<td>Inverter side has output for direct busbar connection. This provides only the connection point, additional covers and insulations need to be handled by site designer. Dimensioning is suitable only for direct busbar connection, not for cables.</td>
</tr>
<tr>
<td>F253</td>
<td>AC disconnector (not with +F296)</td>
<td>Inverter is equipped with a manual AC disconnectors (one per power section). The disconnectors are meant for isolation purposes and the AC fuses are used for inverter protection. This option is not possible with F296, AC breaker.</td>
</tr>
<tr>
<td><strong>DC section options</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F282</td>
<td>Grounding, positive DC (Functional Grounding)</td>
<td>Positive DC pole is functionally grounded. DC fuses are installed only on the non-grounded terminals.</td>
</tr>
<tr>
<td>F314</td>
<td>Floating DC (fuses on both poles)</td>
<td>Neither DC potentials are grounded, meaning that the input is floating. DC fuses are installed to both DC potentials.</td>
</tr>
</tbody>
</table>
Hardware description

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F304</td>
<td>DC grounding with grounding bypass resistor (only with F282 and F283)</td>
<td>The DC potential (positive or negative) grounding is equipped with parallel bypass resistor. This resistor provides back-up higher impedance grounding if the normal functional grounding would break down.</td>
</tr>
<tr>
<td>8H382</td>
<td>For 8 fuse protected DC inputs</td>
<td>Inverter is equipped with 8 fuse protected DC inputs (4 per power section). Standard fuse size is 400 A.</td>
</tr>
<tr>
<td>12H382</td>
<td>For 9 to 12 fuse protected DC inputs</td>
<td>Inverter is equipped with 12 fuse protected DC inputs (6 per power section). Standard fuse size is 400 A.</td>
</tr>
<tr>
<td>16H382</td>
<td>For 13 to 16 fuse protected DC inputs</td>
<td>Inverter is equipped with 16 fuse protected DC inputs (8 per power section). Standard fuse size is 400 A.</td>
</tr>
<tr>
<td>20H382</td>
<td>For 17 to 20 fuse protected DC inputs</td>
<td>Inverter is equipped with 20 fuse protected DC inputs (10 per power section). Standard fuse size is 250 A.</td>
</tr>
<tr>
<td>24H382</td>
<td>For 21 to 24 fuse protected DC inputs</td>
<td>Inverter is equipped with 24 fuse protected DC inputs (12 per power section). Standard fuse size is 200 A.</td>
</tr>
<tr>
<td>F300</td>
<td>DC Surge arrester, high energy, Type 1, complies also with Type 2</td>
<td>Standard Type 2 surge arresters replaced with high-energy Type 1 surge arresters that fulfill also Type 2 requirements. Provides better protection for surges.</td>
</tr>
<tr>
<td>F305</td>
<td>DC disconnector</td>
<td>Inverter is equipped with a manual DC disconnectors (one per power section). The disconnectors are meant for isolation purposes.</td>
</tr>
<tr>
<td>0F291</td>
<td>No DC fuses. Inverter delivered without DC fuses (with empty slots).</td>
<td>Inverter has no DC fuses installed. Instead, they need to be installed when performing the installation at site.</td>
</tr>
<tr>
<td>G420</td>
<td>Input fuse blown indicator (one common signal per power section)</td>
<td>The DC fuses have micro switches that indicate a blown fuse. The micro switches of each power section are connected in series, meaning that only one warning per power section is signaled to the user. To find out which fuse has actually blow inside the power section, one needs to visually inspect the inverter.</td>
</tr>
<tr>
<td>G417</td>
<td>DC input current measurement from each DC input</td>
<td>All DC inputs have dedicated current sensors to measure the input current. Can be used for additional protection and monitoring. Sometimes referred to as “zone monitoring”.</td>
</tr>
</tbody>
</table>
## Auxiliary power options

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>G429</td>
<td>Terminals for external auxiliary transformer max. 32 A fuse (delivered with max. fuse rating)</td>
<td>Protected 3-phase output terminals for connecting an external auxiliary power transformer. The voltage level for connection is inverter output voltage level. The connection is protected with 32 A/30 A (IEC/UL) fuses. Different fuses are available as an engineered option (+P902).</td>
</tr>
<tr>
<td>G430</td>
<td>Terminals for external auxiliary transformer 35…63 A fuse (delivered with max. fuse rating)</td>
<td>Protected 3-phase output terminals for connecting an external auxiliary power transformer. The voltage level for connection is inverter output voltage level. The connection is protected with 63 A/60 A (IEC/UL) fuses. Different fuses are available as an engineered option (+P902).</td>
</tr>
</tbody>
</table>

## Construction and features

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C184</td>
<td>High-altitude model &gt;2000 m (ASL)</td>
<td>Inverter maximum operating altitude is increased from 2000 m to maximum 4000 m above sea level. Some components inside the inverter are changed. No voltage derating due to this is required.</td>
</tr>
<tr>
<td>G433</td>
<td>Increased FRT capability (only with +G415)</td>
<td>This is available only with internal auxiliary power (+G415). This option increases the inverter tolerance for extremely long low voltages, e.g. over 2 s for less than 60% nominal voltage. Some grid codes require this, for example California Rule 21. The other way to fulfill these grid codes is to use the standard external auxiliary power with an UPS supplying the power.</td>
</tr>
<tr>
<td>C203</td>
<td>Low-temperature variant (minimum operation temperature to -40 °C)</td>
<td>The inverter minimum operation temperature is lowered from -20 °C to -40 °C. Additional heaters are installed inside the inverter.</td>
</tr>
<tr>
<td>G234</td>
<td>C5-M enclosure materials according to ISO 9223 (seaside installations)</td>
<td>The inverter enclosure materials fulfill C5-M requirements of standard ISO 9223. This means in practice that the inverter can be installed on coastal (seaside) areas.</td>
</tr>
</tbody>
</table>

## Safety

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q983</td>
<td>Smoke alarm device inside the inverter</td>
<td>Inverter control section is equipped with a smoke detector. Used as an additional safety feature. Signals a fault if there is smoke inside the control section.</td>
</tr>
</tbody>
</table>

## Warranty

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P926</td>
<td>Extended warranty 24/30 months (commissioning/manufacturing)</td>
<td>Extended warranty for 24/30 months (commissioning/manufacturing)</td>
</tr>
<tr>
<td>P927</td>
<td>Extended warranty 36/42 months (commissioning/manufacturing)</td>
<td>Extended warranty for 36/42 months (commissioning/manufacturing)</td>
</tr>
<tr>
<td>P928</td>
<td>Extended warranty 60/66 months (commissioning/manufacturing)</td>
<td>Extended warranty for 60/66 months (commissioning/manufacturing)</td>
</tr>
</tbody>
</table>
### Hardware description

#### Testing (inverters only)

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P945</td>
<td>Full power burn-in factory test</td>
<td>Inverter is operated with nominal power.</td>
</tr>
<tr>
<td>P954</td>
<td>Grid protection factory tests (OV, UV, OF, UF)</td>
<td>Grid protection factory tests (OV, UV, OF, UF)</td>
</tr>
<tr>
<td>P957</td>
<td>Extended grid protection factory tests (OV, UV, OF, UF, regulations)</td>
<td>Extended grid protection factory tests (OV, UV, OF, UF, regulations)</td>
</tr>
<tr>
<td>P958</td>
<td>Harmonics factory test</td>
<td>Harmonics factory test</td>
</tr>
<tr>
<td>P959</td>
<td>Efficiency factory tests</td>
<td>Efficiency factory tests</td>
</tr>
<tr>
<td>P960</td>
<td>Custom factory tests</td>
<td>Custom factory tests</td>
</tr>
</tbody>
</table>

#### Specialities

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P902</td>
<td>Customized</td>
<td>Inverter is customized.</td>
</tr>
<tr>
<td>N840</td>
<td>Limited output power</td>
<td>Inverter output power and/or current is limited (in practice output current) to a pre-defined value based on utility and customer requirements. Additional sticker is attached next to inverter type label that shows the actual limitation value.</td>
</tr>
<tr>
<td>E203</td>
<td>EMC compatibility according to old generic IEC standards and FCC standards</td>
<td>As standard, the inverter fulfills the new EMC limits set by IEC/EN 61000-6-2 and EN 55011. EN 55011 includes limits also on PV side emissions, the old EMC standard does not include this. With +E203, the inverter complies with old EMC standard IEC/EN 61000-6-4 and also FCC CFR 47, Part 15, Subpart B, Class A (radiated only).</td>
</tr>
<tr>
<td>P956</td>
<td>40 °C ratings (maximum active current limited always to 1866 A)</td>
<td>Inverter current is limited to 1866 A and nominal values are referenced in this point. This is a variant used in some markets.</td>
</tr>
</tbody>
</table>
Storing, lifting and transporting

Contents of this chapter

This chapter tells you how to store, lift, and move the megawatt station.

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

- Use only authorized lifting equipment and personnel.
- Do not let anyone go under the load.
- Do not stand on the roof when you attach the lifting slings or during lifting.
- Do not allow slings or hooks to fall onto the roof.

WARNING! Use the original silica gel bags only during transport. Install new silica gel bags for storage.
Storing the megawatt station

**WARNING!** To prevent damage to the megawatt station, keep the delivery packaging and protection canvas on for as long as possible until you install the unit.

- Always store the megawatt station in the upright position.
- To avoid condensation inside the megawatt station, store it indoors in a dry (heated) warehouse. If that is not possible, supply and switch on the internal heaters of the inverters to make sure that the inside temperature is more than the outside temperature.
- Protect the interior of the megawatt station from rainwater and dust. Use covers over the air outlets. Do not open the doors unnecessarily or remove the transportation plates during storage.
- If you remove the megawatt station from the protective packaging and condensation is possible in the storage area:
  - Supply power to the internal heaters to keep the inside temperature of the unit above the outside temperature.
  - If power is not available, add humidity desiccant bags inside the megawatt station. Use desiccant bags, if the unit is stored for more than two weeks without using electric heaters. Hang the desiccant bags approximately 1 m from the floor. Use 500 g desiccant per week. For example, for four weeks of storage, use 2 kg of desiccant bags. Replace the bags with fresh bags every four weeks and do not open the doors unnecessarily during the storage period. Examples of suitable container desiccants: Xdry desiccants “H model” or Clariant “Container Drì®ll-Pole”. When it leaves the factory, the megawatt station has desiccant bags inside.

- Make sure that the ground under the megawatt station is solid, flat, dry and vegetation-free. Make sure that the ground gives support to the megawatt station evenly from below. There must be no twisting or stress. Do not put the megawatt station onto bare ground because this can lead to paint damage and corrosion.
- Keep the megawatt station on wooden support beams. Put them under the four outer corners and a minimum of two points evenly in the middle of the megawatt station.
Lifting the megawatt station

- Protect the corners of the megawatt station against shock.
- Lift the megawatt station from the four lifting eyes in the upper corners or bottom corners, according to ISO 3874 for HQ 40’ type A.
- The minimum rated loading capacity of each sling is 10 tons.
- The minimum length of each sling is 5 m.
- Adjust the lengths of the lifting slings so that the megawatt station does not tilt during the lifting.
- Do not allow the lifting slings to scratch the walls or roof. Damaged paint can lead to corrosion.
- Use a guide wire attached to a lower corner of the megawatt station to prevent rotation.
- Use only authorized lifting equipment and personnel.
- Prevent anybody getting under the load.
- Do not stand on the roof while fastening the lifting slings or while lifting.
- Do not throw slings or hooks onto the roof.

\[ \alpha = >30^\circ \]
Transporting the megawatt station

**WARNING!** Keep the transportation height as low as possible. Make sure that the total height of the transportation is not more than the maximum allowed height for the planned route.

TRANSPORT THE MEGAWATT STATION ON AN OPEN HEAVY-DUTY CHASSIS. DO NOT USE AN ENCLODED TRAILER BECAUSE THIS CAN CAUSE DAMAGE TO THE SURFACE OF THE MEGAWATT STATION.

DO NOT THROW HOOKS OVER THE ROOF. THIS CAN CAUSE DAMAGE TO THE PAINT AND CAUSE CORROSION.

OBEY THESE INSTRUCTIONS:

- Protect the megawatt station with wooden corners, plastic film, etc. The megawatt station is delivered unpacked from the factory as standard.
- Protect the interior of the megawatt station from rainwater with temporary protection plates (anti-typhoon) on the air intakes and outlets.
- The dimensions of the megawatt station are equivalent to a 40 foot HC (High Cube) 1AAA type shipping container. You can transport the megawatt station on a dedicated sea container trailer using the standard container attachment system.
- If you do not use a dedicated sea container trailer, put the megawatt station directly on the transportation chassis to prevent sliding and to keep the total height as low as possible. Use friction enhancement mats (rubber) below the megawatt station. The maximum thickness of a mat is 30 mm. Fasten the megawatt station firmly onto the chassis with heavy-duty transport straps.

**Incoming inspection at arrival**

Examine the megawatt station for transportation damage. Mark and record any damage and tell the local ABB or ABB sales contact immediately. To prevent corrosion, repair surfaces with damaged paint. Refer to ‘To repair the painted surfaces on page 58.

Make sure that the unit corresponds to the delivery list and order. Record deviations and inform the local ABB or ABB sales contact immediately.
Mechanical installation

Contents of this chapter
This chapter describes the mechanical installation of the megawatt station, and gives instructions on how to select the location and build the foundation for the megawatt station. Always obey the local regulations.

Safety
Refer to Safety instructions on page 9.
Before you move the megawatt station, refer to Storing, lifting and transporting on page 29.

Required tools
The tools required to move the megawatt station, fasten it to the foundation, and tighten the connections:

- Crane, forklift, or pallet truck (with sufficient load capacity)
- Pozidriv and Torx (2.5 to 6 mm) screwdrivers with short and long heads or bits
- Torque wrench
- Set of wrenches and sockets
Constructing the foundation

**WARNING!** The pit for the foundation and the foundation must be designed by an experienced civil works engineer. Obey all local rules and regulations.

For detailed foundation drawings, refer to *Dimension drawings* on page 63.

To prevent the risk of corrosion, install the megawatt station higher than its surroundings to prevent surface water from collecting around the megawatt station.

- Tilt the surface of the surrounding ground at least 50 mm per meter (2 in per 40 in). This makes sure that surface water flows away from the megawatt station.
- When you plan the foundation, take into account the local conditions, such as the soil type, frost protection, rain amounts, etc. An improper foundation can cause settling of the megawatt station or difficulty opening the door.
- Take into account the required cable bending radius and installation room.
- ABB recommends that the service platform around the megawatt station is at least one meter (40 in) wide.

Support the megawatt station from the points marked in the footprint layout drawing (refer to *Dimension drawings* on page 63) by using concrete or steel column foundations. The columns or concrete pad foundations are not part of the delivery.

Select the foundations to match the local soil conditions, the load carrying capacity of the ground, and the potential local special requirements (such as the need for earthquake or typhoon anchoring) of the construction area.

Start by making a deep enough hole for the foundation. Always dig down to a frost proof depth and drain the hole. If it is necessary, connect the foundation hole to the general drainage network or lead drainage pipes to a well-drained terrain where the water does not cause harm.
**Preparation of the ground**

1. Make a hole for the foundation and cabling.
2. Use geotextile to prevent mixing of the installation gravel with the surrounding soil.
3. Put coarse gravel at the bottom of the hole and fine gravel at the top.
4. Compress the gravel and soil below the foundation

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fine gravel on top</td>
</tr>
<tr>
<td>2</td>
<td>Coarse gravel</td>
</tr>
<tr>
<td>3</td>
<td>Geotextile</td>
</tr>
<tr>
<td>4</td>
<td>Compressed area, minimum 15000 x 4000 mm</td>
</tr>
<tr>
<td>5</td>
<td>Maximum 560 mm after compression</td>
</tr>
</tbody>
</table>

**Constructing earthing electrode and earthing**

Construct an earthing electrode around the megawatt station foundation.
Placing the MWS on the foundations

**WARNING!** Before you lift the megawatt station onto the foundations, make sure the foundations are well aligned, hardened and stable.

1. Measure the level of the foundation and the tilting of the surface of the surrounding ground around the foundation. Make sure that you obey the rules in *Constructing the foundation* on page 34.

2. Make sure that the foundation is level. The maximum permitted incline of the foundation below the megawatt station is 0.1 degrees.

3. Lift the megawatt station onto the foundation. Obey the instructions in *Lifting the megawatt station* on page 31. Make sure that the column foundations do not move during lifting and that they remain vertical. The megawatt station must be stable and in direct contact with all of the foundation columns.

4. When the megawatt station is on the foundation, measure the height and inclination of the megawatt station and examine the slope of the surface of the surrounding ground around the megawatt station. Refer to *Constructing the foundation* on page 34.

**WARNING!** Before you start the cabling work, make sure that the installation is stable.

**Unpacking**

Before the installation, unpack the megawatt station from the transportation and storage package. Remove the protective canvas. To prevent damage to the megawatt station, unpack the megawatt station as late as possible before the installation. Refer to *Technical data* on page 61 for the permitted operating conditions, and *Dimension drawings* on page 63.

**Adding the cables**

Add cables and cabling protection. Refer to *Electrical installation* on page 39.
Filling the pit and finalizing the surroundings

1. If required for local frost conditions, add insulation around the column foundations.
2. Fill the hole with fine gravel with a 5 cm/m tilting angle. Leave a 15 cm air gap underneath the megawatt station.
3. To minimise the growth of grass, use geotextile around the station. Put the geotextile 20 cm below the station and about 80 cm around the megawatt station.
4. If the foundation is not larger than the megawatt station and cannot be used as a service platform, install two rows of 500 x 500 mm concrete tiles around all four sides of the megawatt station. The tiles give a dry standing place for service personnel and will prevent the removal of gravel.

WARNING! Prevent damage to the cables when you fill the pit. If it is necessary, use wood or metal shields to provide temporary additional protection.
1. Remove the temporary protectors (1).
2. Add the weather protection hoods (2).
Electrical installation

Contents of this chapter

This chapter has general instructions on earthing and cabling the megawatt station. Obey all local regulations.

Refer to the applicable related documentation, such as, the inverter hardware manuals.

⚠️ **WARNING!** Only an authorized electrician is permitted to install the cabling to the MWS. Obey the safety instructions. Refer to *Safety instructions* on page 9, and the local safety regulations. If ignored, physical injury or death, or damage to the equipment may occur.

⚠️ **WARNING!** Do not do electrical installation work during a thunderstorm.

⚠️ **WARNING!** Make sure that all external cable entries are fully sealed to prevent foreign elements, such as animals, insects, and dust in the station.
Routing the cables

When you route the cables:
- Install the DC power, MV and control cables on separate routes.
- Use separate cable entries for different cable types.
- Make sure that the cable trays are electrically bonded to each other and to the ground.
- Make sure that there is at least 500 mm (20 in.) of separation between the power cables and the control cables.
- If you need to put extra cables through the megawatt station, speak to your ABB representative.

Earthing

Always construct an earthing electrode for the megawatt station. Follow the local regulations. At the minimum, the electrode must meet these requirements:
- Minimum cross-sectional area: 95 mm²
- Installation depth: 500...800 mm from the surface of the soil
- Installation route: Around the megawatt station, 1 m from the outer wall

Connect the earthing electrode to the terminal located at the base of the megawatt station (refer to drawing 3AES-SH_4600-02-DW02). Use joint lubricant to protect the connection point against corrosion. Tightening torque (M12 bolt-InoxA2/3) is 70 N·m.
Protective earthing (grounding) inside the megawatt station

The protective earth (PE) terminals or frames of all of the main components in the megawatt station are connected to the two main PE busbars located at the corners of the building. At the installation site:

• Measure the continuity of all internal PE connections by measuring the conductivity between each protective earth terminal and the main PE busbar.
• Earth the shields, armours and protective conductors of all incoming cabling to the appropriate earthing terminals of the station.

Refer to drawing 3AES-SH_4600-02-DW02 for the factory-installed internal PE connections, and the connection point of the external grounding electrode.

Measuring the insulation resistances

Make sure that the insulation resistances of the external power cables are measured according to the local regulations.

Connecting the DC cabling from the solar generator to the inverters

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⚠️ WARNING! Make sure that the cable entry is sealed to maintain the IP classification of the inverter.

Refer to the PVS980 hardware manual (3AXD50000026013 [EN]) and the wiring diagrams that are delivered with the megawatt station.

To connect the cabling:

1. Remove the covers of the cable entries.
2. Lead the cables into the megawatt station and seal the entry with the gland plates that come with the inverter.
3. Connect the cables to the correct terminals in the inverters. Tighten the connections to the torques given in the PVS980 commissioning and maintenance manual (3AXD50000046782 [EN]).
4. Fill the cable trenches and seal the cable entries (refer to Finalizing the installation on page 43).
Connecting the communication and auxiliary cabling (if equipped)

Refer to the wiring diagrams for communications and the AC cabinet that are delivered with the megawatt station.

To connect the cabling:
1. Remove the covers of the cable entries.
2. Lead the cables into the megawatt station and seal the cable entries.
3. Connect the cables to the correct terminals in the AC cabinet (communication cabinet and AC distribution cabinet).
4. Fill the cable trenches and seal the cable entries (refer to Finalizing the installation on page 43).

Connecting the power grid cabling to the switchgear

Refer to the switchgear manual and the wiring diagrams that are delivered with the unit.
1. Remove the covers of the cable entries.
2. Lead the cables into the megawatt station and seal the cable entries.
3. Terminate the cables according to the cable manufacturer instructions and connect the cables to the switchgear. The standard cable terminations installed in the switchgear are shown in the figure.
4. Fill the cable trenches and seal the cable entries (refer to Finalizing the installation on page 75).

Connect the cables to the correct terminals.
Finalizing the installation

Contents of this chapter
This chapter tells you how to finalize and check the installation of the megawatt station. Obey all local regulations.

⚠️ WARNING! Only an authorized electrician is permitted to install the cabling to the MWS. Obey the Safety instructions on page 9, and the local safety regulations. If you ignore them, physical injury or death, or damage to the equipment may occur.

⚠️ WARNING! Do not do electrical installation work during a thunderstorm.

Finalizing the installation of the megawatt station

- Clean the station of all dirt.
- Repair any damage on the paint surface. Refer to To repair the painted surfaces on page 58.
- Install the external hood for the fan. Refer to Mechanical installation on page 33.
- Install the air inlet rain protection for the transformer compartment.

Seal the cable entries, cover the cable entries with sand and sprinkle a handful of cement over the sand. The cement hardens in a few days and it forms a barrier against small animals and plant growth.
**Landscaping the megawatt station**

You can plant suitable bushes around the megawatt station to landscape it.

Do not plant trees near the megawatt station. If there are bushes, make sure that the compost base is at least two meters from the megawatt station, and that the fully-grown bushes cannot prevent maintenance access. Make sure that the plantation does not discharge dust or seeds that could hinder the cooling air flow.

**Checking the installation of the megawatt station**

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>☐</td>
<td>Operate all mechanical operating functions two times to make sure that they function.</td>
</tr>
<tr>
<td>☐</td>
<td>Examine the paint surface for damage. Repair damaged areas according to the instructions (refer to <em>To repair the painted surfaces</em> on page 58).</td>
</tr>
<tr>
<td>☐</td>
<td>Make sure that the cable inlets are securely installed. Make sure that the unused cable openings have protection caps.</td>
</tr>
<tr>
<td>☐</td>
<td>Make sure that the weather protection hoods are installed and that nothing limits airflow through the air inlets and outlets.</td>
</tr>
<tr>
<td>☐</td>
<td>Examine the earthing (grounding) of the MWS and its components and make sure that it obeys the earthing (grounding) schematic. Pull the earthing wires at the terminals to ensure that the connections are tight.</td>
</tr>
<tr>
<td>☐</td>
<td>Remove all foreign objects such as loose fastenings and tools from the MWS. They can cause short-circuit faults or other damage.</td>
</tr>
<tr>
<td>☐</td>
<td>Make sure that the MWS is clean. Contaminated surfaces will increase the risk of corrosion. Refer to <em>Maintenance</em> on page 51.</td>
</tr>
<tr>
<td>☐</td>
<td>Examine the clearance distances, cable terminations and connections against of the main circuit and compare them to the main circuit diagram. Make sure that all connections are tight.</td>
</tr>
<tr>
<td>☐</td>
<td>Make sure that the required warning labels are attached to the megawatt station.</td>
</tr>
<tr>
<td>☐</td>
<td>Make sure that the insulation resistances of the external power cables are measured according to local regulations.</td>
</tr>
<tr>
<td>☐</td>
<td>Do the installation checks detailed in the device-specific manuals. Refer to the inner front cover.</td>
</tr>
<tr>
<td>☐</td>
<td>Do the inspection procedures that are required by the respective authorities.</td>
</tr>
</tbody>
</table>
Start-up and operation

Contents of this chapter
This chapter describes the start-up procedure of the megawatt station.

WARNING! Only an authorized electrician can install the cabling to the MWS. Obey the safety instructions. Refer to Safety instructions on page 9, and the local safety regulations. If ignored, physical injury or death, or some damage to the equipment may occur.

WARNING! Do not do electrical installation work during thunderstorms. Doing so can result in physical injury and damage to the equipment.

Tools needed
- PC with the Drive Composer tool and the applicable communication cables (for the inverter diagnostics and settings).
- Multimeter for electrical measurements
- Insulation resistance meter. Refer to Measuring the insulation resistances for the measuring voltages and resistance values.
Prerequisites for the start-up

1. Remove the transportation canvas. Use the protection plates if there is a thunderstorm warning.

2. Remove the sling of the medium-voltage switchgear.

3. Remove silica gel bags from the transformer compartment and auxiliary compartment. Remove silica gel bags also from the inverters. Refer to the illustration for the locations of the silica gel bags.

4. When you close the doors, make sure that the sealing gaskets are not caught in the doors. If this occurs, use a screwdriver to carefully free the gasket. Do not cause damage to the paint surface.

5. Refer to Tightening torques on page 52 for information on the torques for each item of the container.
### Start-up procedure

<table>
<thead>
<tr>
<th>Task</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Safety</strong></td>
<td></td>
</tr>
<tr>
<td>✅</td>
<td><strong>WARNING!</strong> Obey the safety instructions during the installation and start-up procedure. Refer to chapter <em>Safety instructions</em> on page 9.</td>
</tr>
<tr>
<td>✅</td>
<td>Only qualified electricians can install and start-up the megawatt station.</td>
</tr>
<tr>
<td><strong>Pre-check for the switchgear (No voltage)</strong></td>
<td></td>
</tr>
<tr>
<td>✅</td>
<td>Visually examine the gas level of the SF6 tank from the gauge.</td>
</tr>
<tr>
<td>✅</td>
<td>Operate all mechanical devices two times</td>
</tr>
<tr>
<td><strong>Pre-check for the transformer (No voltage)</strong></td>
<td></td>
</tr>
<tr>
<td>✅</td>
<td>Do the pre-check tasks for the transformer</td>
</tr>
<tr>
<td><strong>Pre-check for the inverter (No voltage)</strong></td>
<td></td>
</tr>
<tr>
<td>✅</td>
<td>Do the inverter commissioning tasks to be done before setting power to on.</td>
</tr>
<tr>
<td><strong>Pre-check for the AC cabinet (No voltage)</strong></td>
<td></td>
</tr>
<tr>
<td>✅</td>
<td>Do the AC cabinet tasks to be done before setting the power to on.</td>
</tr>
<tr>
<td><strong>Connecting the solar power generator and commissioning the inverters</strong></td>
<td></td>
</tr>
<tr>
<td>✅</td>
<td>Close the disconnecting devices between the solar generator and DC input terminals of the inverter.</td>
</tr>
<tr>
<td>✅</td>
<td>Measure the DC supply voltage at each input terminal of the inverter to verify that the polarity and voltage range conforms to the specifications of the inverter.</td>
</tr>
<tr>
<td>✅</td>
<td>Close the DC disconnectors [-1Q1 and -2Q1] of the first inverter [PVS1].</td>
</tr>
<tr>
<td>✅</td>
<td>Do the inverter commissioning tasks that can be done with only the DC supply connected.</td>
</tr>
<tr>
<td>✅</td>
<td>Repeat the above commissioning tasks for the second inverter [PVS2].</td>
</tr>
<tr>
<td>✅</td>
<td>Simulate transformer faults (unpowered) and make sure that the inverters detect the fault indications and trip accordingly.</td>
</tr>
<tr>
<td>✅</td>
<td>Simulate MV monitoring status signals (unpowered) and make sure that the inverters and/or the SCADA system detects the signals.</td>
</tr>
<tr>
<td><strong>Connecting the megawatt station to the power grid</strong></td>
<td></td>
</tr>
<tr>
<td>✅</td>
<td>Make sure that AC disconnectors [-1Q4 and -2Q4] of both inverters are open.</td>
</tr>
<tr>
<td>✅</td>
<td>Make sure that all checks required by the local power grid owner are done.</td>
</tr>
</tbody>
</table>
Start-up and operation

Start-up procedure for the UPS (optional)

Refer to UPS documentation and the electrical diagrams of the AC cabinet (3AES-SH-4600-14-SP01) that are delivered with the unit.

Start-up procedure:
1. Make sure that all of the AC cabinet breakers are in the OFF or open position.
2. Make sure that there is no voltage in the AC cabinet. Obey the safety rules.
3. Obey the instructions in the UPS documentation.

---

<table>
<thead>
<tr>
<th>Task</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turn the earthing switch at the grid side of the switchgear to the “not earthed” position.</td>
<td></td>
</tr>
<tr>
<td>entic                                           Ask the power grid owner to connect the station to the power grid. Wait until the station has been connected to the power grid before proceeding.</td>
<td>Only authorized personnel are permitted to make the connection.</td>
</tr>
<tr>
<td>Turn the disconnecting switch at the grid side of the switchgear to the closed position.</td>
<td></td>
</tr>
<tr>
<td>Turn the earthing switch at the transformer side of the switchgear to the “not earthed” position.</td>
<td></td>
</tr>
<tr>
<td>Turn the disconnecting switch at the transformer side of the switchgear to the closed position.</td>
<td></td>
</tr>
<tr>
<td>Close the main breaker of the transformer.</td>
<td></td>
</tr>
<tr>
<td>Make sure that the voltage level on the low voltage side of the transformer is correct. Adjust the transformer tap settings if needed.</td>
<td>WARNING! Make sure that the transformer is de-energized before you adjust the tap settings.</td>
</tr>
<tr>
<td>Run the transformer with no load for several hours before you do the tasks under the subsection Connecting the inverters to the AC supply.</td>
<td>Refer to the transformer documentation.</td>
</tr>
<tr>
<td>Observe the transformer for any malfunctions. Monitor the temperature, listen to audible changes, etc.</td>
<td>Refer to the transformer documentation.</td>
</tr>
</tbody>
</table>

Connecting the inverters to the AC supply

Close the AC disconnectors [-1Q4 and -2Q4] of the both inverters.

Do the rest of the inverter commissioning tasks according to the procedure. **PVS980 commissioning and maintenance manual (3AXD50000046782 [EN])**
Start-up procedure for the AC cabinet

Start-up procedure:

1. Make sure that all switches and breakers are in the OFF or open position (downstream of the X0 terminal).
2. Make sure that the voltage indicator LEDs are off.
3. Measure that the voltage level at X0 (L1/L2/L3) is correct (~400 Vph-ph), and change the position of the 89A0 (general breaker) switch to the ON position (in the auxiliary transformer cubicle).
4. Measure that the voltage level at the 98A1 breaker (terminal switch) (1/3/5/7) is correct (~400 Vph-ph / 230 Vph-n) and terminals 2/4/6/8 are free of voltage.
5. Close the FU2 and FU1 holders, keep the other downstream breakers in the open position.
6. Set the position of the 98A1 switch to the ON position (AC distribution cubicle).
7. Make sure that the voltage indicator LEDs (VOLTAGE 400V-L1/L2/L3) are on, the bus bars A1 were energized and the downstream breakers are available to close as required.
9. For the normal operation of the megawatt station is necessary keep open the breakers that are not used.
   - Make sure that the cabinet fans operate normally, according to the thermostat settings (Close 98A1-1).
   - Make sure that the MWS light points (Close 98A1-7) and door limit switches operate.
   - Make sure that the fan operate normally with the manual command selector (Close 98A1-2/3/4).
   - Make sure that the TMD operates normally (refer to the TMD documentation), close 98A1-9 (Control Equipment).
   - Make sure that the switchgear operates normally (refer to the switchgear documentation), close 98A1-9.
10. Keep the other breakers open until use.
50 Start-up and operation
Maintenance

Contents of this chapter
This chapter contains the preventive maintenance instructions for the megawatt station. The instructions given here are intended for personnel who are trained and certified by ABB to perform these tasks.

WARNING! Only an authorized electrician is permitted to do maintenance work on the MWS. Obey the Safety instructions on page 9, and the local safety regulations. If ignored, physical injury or death, or damage to the equipment may occur.

WARNING! Do not do electrical work during a thunderstorm.

Tool list
- Torx drivers
- Philips screwdrivers (PoziDriv)
- Torque wrench
- Set of wrenches and sockets
- Cable and wire strippers
- Crimping tool and cable lugs
- Multimeter
- Personal protective equipment
## Tightening torques

Unless specified otherwise, use the torques given in the tables.

### Electrical connections

<table>
<thead>
<tr>
<th>Bolts and nuts</th>
<th>Steel: A2-70/A4-70/8.8</th>
<th>Brass</th>
</tr>
</thead>
<tbody>
<tr>
<td>M3</td>
<td>0.9 N·m</td>
<td>-</td>
</tr>
<tr>
<td>M4</td>
<td>2.3 N·m</td>
<td>-</td>
</tr>
<tr>
<td>M5</td>
<td>4.5 N·m</td>
<td>-</td>
</tr>
<tr>
<td>M6</td>
<td>8.0 N·m</td>
<td>5.0 N·m</td>
</tr>
<tr>
<td>M8</td>
<td>20 N·m</td>
<td>12 N·m</td>
</tr>
<tr>
<td>M10</td>
<td>40 N·m</td>
<td>25 N·m</td>
</tr>
<tr>
<td>M12</td>
<td>70 N·m</td>
<td>40 N·m</td>
</tr>
<tr>
<td>M14</td>
<td>110 N·m</td>
<td>60 N·m</td>
</tr>
<tr>
<td>M16</td>
<td>170 N·m</td>
<td>90 N·m</td>
</tr>
<tr>
<td>M18</td>
<td>240 N·m</td>
<td>120 N·m</td>
</tr>
</tbody>
</table>

### Mechanical connections

1) Not applicable to threaded inserts

<table>
<thead>
<tr>
<th>Bolts and nuts</th>
<th>Quality 8.8</th>
<th>A2-70/A4-70</th>
</tr>
</thead>
<tbody>
<tr>
<td>M3</td>
<td>1.21 N·m</td>
<td>0.85 N·m</td>
</tr>
<tr>
<td>M4</td>
<td>2.78 N·m</td>
<td>0.80 N·m</td>
</tr>
<tr>
<td>M5</td>
<td>5.5 N·m</td>
<td>1.60 N·m</td>
</tr>
<tr>
<td>M6</td>
<td>9.5 N·m</td>
<td>2.80 N·m</td>
</tr>
<tr>
<td>M8</td>
<td>23 N·m</td>
<td>6.8 N·m</td>
</tr>
<tr>
<td>M10</td>
<td>46 N·m</td>
<td>14 N·m</td>
</tr>
<tr>
<td>M12</td>
<td>79 N·m</td>
<td>24 N·m</td>
</tr>
<tr>
<td>M14</td>
<td>127 N·m</td>
<td>37 N·m</td>
</tr>
<tr>
<td>M16</td>
<td>198 N·m</td>
<td>56 N·m</td>
</tr>
<tr>
<td>M18</td>
<td>283 N·m</td>
<td>81 N·m</td>
</tr>
<tr>
<td>M20</td>
<td>402 N·m</td>
<td>114 N·m</td>
</tr>
</tbody>
</table>

### Threaded inserts

<table>
<thead>
<tr>
<th>Bolts and nuts</th>
<th>Torque (steel/stainless steel)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M5</td>
<td>7.9 N·m</td>
</tr>
<tr>
<td>M6</td>
<td>12 N·m</td>
</tr>
<tr>
<td>M8</td>
<td>20 N·m</td>
</tr>
<tr>
<td>M10</td>
<td>34 N·m</td>
</tr>
</tbody>
</table>
Maintenance intervals

The recommended maintenance and component replacement intervals are based on the specified operational and environmental conditions. ABB recommends annual inspections for high reliability and performance.

For more information on maintenance, contact your local ABB Service representative.

Recommended annual maintenance actions

ABB recommends that you do these annual inspections to ensure the highest reliability and optimum performance of the unit.

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Visually inspect and do maintenance if it is necessary.</td>
</tr>
<tr>
<td>P</td>
<td>On/off-site performance work (commissioning, tests, measurements, etc.)</td>
</tr>
<tr>
<td>R</td>
<td>Replace the component.</td>
</tr>
</tbody>
</table>

### Target / task

<table>
<thead>
<tr>
<th>Connections and the environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment check</td>
</tr>
</tbody>
</table>

| Spare parts                                                                                     | I |
| Spare parts                                                                                      | I |

| inspections/tasks by the user                                                                 | |
| Dustiness, corrosion and temperature                                                             | I |
| Air inlet and outlet grills                                                                       | I |
| Clean the air filters of the transformer and switchgear compartments                            | I |
| Tightness and cleanliness of the main circuit terminals and earth connections                  | I |
| Condition of the inverters: Door sealing, cooling fan operation.                                | I |
| Clean the heat exchangers of the inverters                                                      | I |
| Operation of the locks, hinges and gaskets                                                      | I |
| Labeling                                                                                         | I |
| Foundation condition (leveling)                                                                | I |

### Recommended maintenance intervals

<table>
<thead>
<tr>
<th>Component</th>
<th>Years from start-up or interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Main cooling fans</td>
<td></td>
</tr>
<tr>
<td>Main channel cooling fans</td>
<td>R</td>
</tr>
<tr>
<td>Cooling fan, LCL filter unit (internal and external)</td>
<td>R</td>
</tr>
<tr>
<td>Cabinet cooling fan</td>
<td></td>
</tr>
<tr>
<td>Main cabinet circulation fans</td>
<td>R</td>
</tr>
<tr>
<td>Control</td>
<td></td>
</tr>
<tr>
<td>Auxiliary power supplies</td>
<td>R</td>
</tr>
<tr>
<td>Auxiliary power buffers</td>
<td>R</td>
</tr>
<tr>
<td>Transformer and switchgear compartment</td>
<td></td>
</tr>
<tr>
<td>Cooling fans</td>
<td>R</td>
</tr>
<tr>
<td>Intake air filters</td>
<td>R</td>
</tr>
<tr>
<td>AC aux cabinet</td>
<td></td>
</tr>
<tr>
<td>Cooling fans</td>
<td>R</td>
</tr>
<tr>
<td>Intake air filters</td>
<td>R</td>
</tr>
<tr>
<td>UPS</td>
<td></td>
</tr>
<tr>
<td>Obey manufacturer instructions</td>
<td></td>
</tr>
</tbody>
</table>

For information on the maintenance on the MV transformer and the RMU, refer to the applicable documentation.
To clean or replace the intake air filters of the transformer

1. Loosen and remove the external screws of the ventilation grille.

2. To open the ventilation grille, pull the top edge.

3. Carefully pull the air filter frame from the ventilation grille.

4. Remove the plastic clips and the air filter support from the air filter frame.

5. Examine and clean the ventilation grille with a vacuum cleaner.

6. Clean the air filters with compressed air or replace the air filters and the plastic clips. Make sure that dust does not go into the megawatt station.

7. Install the air filter frame into the ventilation grille.

8. Close the ventilation grille and tighten the screws.

To remove the technical floor

1. Remove the screws.

2. Lift and remove the technical floor.

Inverter maintenance

For information on the maintenance of the inverters, refer to the PVS980 central inverters commissioning and maintenance manual (3AXD50000046782 [EN]).
To clean the AC cabinet

WARNING! Do the steps in section Safety instructions for the inverter and AC cabinet compartment on page 13. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Clean the floor plates with a vacuum cleaner.
2. Remove the floor plates to access the base of the megawatt station.
3. Clean the base area with a vacuum cleaner.
4. Install the floor plates.
5. Clean the outer surfaces, the AC cabinets and the entire compartment with the vacuum cleaner.

To clean the transformer and switchgear compartments

1. Make sure that the transformer has cooled down before you proceed.
2. Use a vacuum cleaner to clean the floor, doors and interior metal beams. If it is necessary, use a duster or pressurized air to clean locations you cannot reach with the vacuum cleaner.
3. Clean the surface of the transformer with a duster. If there is a lot of dust, use compressed air.
4. Clean the insulators of the transformer.

To examine and clean the hood filters

1. Remove the 3 screws that hold the filter frame.
2. Carefully pull the filter frame out of the hood.
3. Clean the air filters with compressed air or replace the air filters. Make sure that dust does not go into the megawatt station.
4. Put the cleaned filter frame into the hood.
5. Install and tighten the 3 screws.
To replace the transformer room fans
(dry-type transformer only)

1. Set the circuit breaker for the fans and signaling to OFF. Prevent accidental closing of the circuit breaker during the maintenance procedure.
2. Disconnect the supply and signaling cabling.
3. Measure to make sure that the electrical supply is not energized.
4. Remove the fan bolts.
5. Replace the fan.
6. Connect the supply and signaling cabling.
7. Start the fan and make sure that it turns in the correct direction.

To replace the transformer main cooling fans
(dry-type transformer only)

1. Make sure that all power to the main cooling fans is disconnected.
2. Disconnect the cables from the fan power connection. Record the cable wire connection order for the replacement process.
3. Record the position and angle of the main cooling fan.
4. Remove the bolts that hold the main cooling fan.
5. Remove the main cooling fan.
6. Install the new main cooling fan.
7. Install and slightly tighten the bolts that hold the main cooling fan.
8. Adjust the main cooling fan to the correct position and angle.
9. Tighten the bolts to hold the main cooling fan.
10. Connect the cable wires of the fan power connection.
To replace the transformer room circulation fan

1. Make sure that all power to the cooling fans is disconnected.
2. Disconnect the cables from the fan power connection.
3. Remove the screws that hold the circulation fan.
4. Remove the circulation fan.
5. Install the new circulation fan.
6. Install and tighten the screws.

To replace the UPS (if applicable)

Refer to the UPS documentation for more information.

1. Disconnect power from the AC cabinet and the UPS.
2. Measure to make sure that there are no voltages present.
3. Disconnect the UPS connection.
4. Disconnect the battery modules and the applicable cables.
5. Replace the UPS module.

To seal the door gaskets

For a good seal, apply black filler to all of the door gaskets. Refer to the manufacturers documentation for information on how to use the filler.

You can also use silicon spray to improve the sealing of the gaskets.

To repair the non-painted zinc-coated surfaces

To repair the zinc-coated surfaces, you need:

• Sand paper
• Cleaning towels and liquids
• Zinc-coating: Würth Zinc 300 0892 200 with brush or Zinc Spray Perfect 0893 114 113 (or equivalent)

Refer to the instructions of the material manufacturers.

WARNING! Obey the Safety instructions on page 9, and the local safety regulations. If you ignore them, physical injury or death, or damage to the equipment may occur.

Pay attention to the doors and the lower parts of the walls. These areas have potentially corrosive elements such as dust and humidity.

If there is damage to the zinc-coating:

1. Carefully remove any rust with sand paper.
2. Clean the damaged area and its surroundings.
3. Coat the damaged area with the zinc coat. ABB recommends Würth Zinc 300 due to the thicker coat. On large areas, you can use Würth Zinc Spray Perfect to ease the work and to get an even surface.
To repair the painted surfaces

To repair the painted surfaces, you need:
• Sand paper
• Cleaning towels and liquids (Würth Pro-Clean 0893 140 or equivalent)
• Primer below paint on rusted or deeply scratched surfaces:
  Hempadur Mastic 45880 12170 of 280 microns when wet
• Finishing paint: 55210 RAL 7035 of 100 microns when wet.

Refer to the instructions of the primer and paint manufacturers.

If there is damage to the paint surface, but not to the metal surface (no visible rust):
1. Clean the damaged area first with a suitable detergent and then with clean water.
2. Let the surface dry completely and keep it clean.
3. Apply the first layer of paint to the damaged area. Let it dry thoroughly (12 hours).
4. Apply the second layer of paint to the damaged area.

If there is damage that extends to the metal surface or there is visible rust:
1. Carefully remove the rust with sand paper.
2. Clean the damaged area and its surroundings.
3. Coat the damaged area with the primer. Let it dry thoroughly (24 hours).
4. Apply the first layer of paint to the damaged area. Let it dry thoroughly (12 hours).
5. Apply the second layer of paint to the damaged area.

To repair the painted surfaces of the hoods

For any damage to the surface of the hoods damage, examine its extent:
• For damage such as scratches only on the paint surface, use a two-component polyurethane liquid paint.
• For damage that penetrates the surface coat, apply an epoxy primer paint before the surface paint.

Refer to To repair the painted surfaces on page 58.
To examine and clean the grounding bars and points

To examine and clean the grounding bars and points:

- Examine the condition of the grounding bar and the grounding cables in the switchgear compartment. If there is visible corrosion, remove the cables and remove the corrosion with steel wool. Apply joint compound between the grounding bar and the joint surfaces of the cable terminal.

- Change the spring lock washers. Tighten the cables to the nominal torque values (torque for a M12 bolt is 50 N·m).

- If there is a lot of corrosion, apply protective wax spray on the grounding bar and the cable terminals.

To lubricate the external hinges and locks

To lubricate the external hinges and locks, you need:

- Cleaning materials
- Hinge lubricant: Würth HHS20000 0893 106 (or equivalent)
- Lock lubricant: Würth Maintenance Spray 0893 051 (or equivalent).

Do not use lubricants with silicone.

Lubricate the external hinges and the locks. Wipe off the excess lubricant.
To replace the door limit switch

1. Open the main circuit breaker of the auxiliary panel. Make sure that the circuit breaker cannot be closed accidentally during the maintenance procedure.
2. Measure to make sure that no voltage is connected to the limit switch door and light line.
3. Loosen the limit switch screws.
4. Replace the limit switch according to the sensor manual and verify the appropriate connections and operation.
5. Close the circuit breaker (98A1-2) and make sure that operates correctly.

To set or replace the transformer compartment sensors (thermostat and hygrostat)

1. Set the circuit breaker of the supply line to OFF.
2. Measure to make sure that no voltage is present.
3. To change the settings of the sensors, adjust the dial with a flat screwdriver to be suitable for the local climate.
4. To replace a faulty sensor, obey the instructions in the applicable documentation. Before you start-up the unit, make sure that the sensor operates correctly.
Technical data

For component-specific technical data, refer to the applicable documentation for the components of the megawatt station.

For information on the inverters, refer to the *PVS980 hardware manual* (3AXD50000026013 [EN]).

<table>
<thead>
<tr>
<th>Type designation</th>
<th>3636kVA-I</th>
<th>3818kVA-J</th>
<th>4000kVA-K</th>
<th>4182kVA-L</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximum rating</strong></td>
<td>4000 kVA</td>
<td>4200 kVA</td>
<td>4400 kVA</td>
<td>4600 kVA</td>
</tr>
<tr>
<td><strong>Input data (DC)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum input power ($P_{PV, max}$)</td>
<td>2x 2909 kWp</td>
<td>2x 3056 kWp</td>
<td>2x 3200 kWp</td>
<td>2x 3346 kWp</td>
</tr>
<tr>
<td>DC voltage range, mpp ($U_{DC, mpp}$) @ 35 °C (95 °F)</td>
<td>850...1500 V</td>
<td>893...1500 V</td>
<td>935...1500 V</td>
<td>978...1500 V</td>
</tr>
<tr>
<td>DC voltage range, mpp (@ $S_{nom}$) @ 50 °C (122 °F)</td>
<td>850...1100 V</td>
<td>893...1100 V</td>
<td>935...1100 V</td>
<td>978...1100 V</td>
</tr>
<tr>
<td>Maximum operational DC voltage ($U_{DC, max}$)</td>
<td></td>
<td></td>
<td></td>
<td>1500 V</td>
</tr>
<tr>
<td>Protected DC inputs (parallel)</td>
<td>2x 8 (up to 24 as option)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPPT trackers</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Output data (AC)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal AC output power ($S_{AC, N}$) @ 50 °C (122 °F)</td>
<td>3636 kVA</td>
<td>3810 kVA</td>
<td>4000 kVA</td>
<td>4182 kVA</td>
</tr>
<tr>
<td>Maximum AC output power ($S_{AC, MAX}$) @ 35 °C (95 °F)</td>
<td>4000 kVA</td>
<td>4200 kVA</td>
<td>4400 kVA</td>
<td>4600 kVA</td>
</tr>
<tr>
<td>Medium voltage range ($U_{AC, N}$)</td>
<td>12 kV to 36 kV</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Technical data

<table>
<thead>
<tr>
<th>Type designation</th>
<th>3636kVA-I</th>
<th>3818kVA-J</th>
<th>4000kVA-K</th>
<th>4182kVA-L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output frequency</td>
<td>50/60 Hz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harmonic distortion, current</td>
<td>&lt; 3%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power factor compensation (cos ϕ)</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transformer type</td>
<td>ABB Vacuum cast coil dry type (AF) or ABB Oil immersed type (ONAN)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium voltage switchgear type</td>
<td>ABB SafeRing, SF6-insulated, DeV, CV or CCV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enclosure</td>
<td>Painted steel outdoor enclosure, IP54, C4 corrosion protection</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Efficiency
- Maximum (inverter only): 98.8%
- Euro-eta (inverter only): 98.6%

#### Power consumption
- **In normal operation**: ≤ 5500 W / ≤ 7500 W
- **In stand-by**: ≤ 800 W
- **Aux. voltage for customer use**: 3-phase 400 V/50 Hz, up to 40 kVA

#### Dimensions and weight
- **Width / Height / Depth**: 3180 / 2366 / 1519 mm
  (125.20 / 93.15 / 59.80 in.)
- **Weight approx.**: < 30 t

#### Environmental limits
- **Degree of protection**: Inverter IP56/IP66, UL Type 3R. IP44/54 RMU and dry type transformer housing
- **Ambient temperature range (nominal ratings)**: -20 °C…+50 °C (-4 °F…+122 °F)
- **Maximum altitude (above sea level)**: 1000 m
- **Relative humidity, non-condensing**: 5%...95%
Dimension drawings

Contents of this chapter
This chapter contains dimension drawings with dimensions in millimeters.
External grounding connections
SITE REQUIREMENTS

Place the MW Smart Solar Station a little higher than the surroundings to prevent corrosion caused by surface water collecting against the substation.

- Tilt the surface of the surrounding ground min. 3 cm per meter. This makes sure that there is a proper flow of the surface water away from the substation.
- Consider the local conditions such as frost, rain (humidity) and drought.

The MW Smart Solar Station is heavy. Pay attention to the proper planning and constructing of the foundation. Improper foundation may cause settling of the substation, difficulties to open the doors, etc.

Measure the level of the foundation and the tilting of the surface of the surrounding ground around the foundation. Do not place substation too low!

Measure the straightness of the foundation. Maximum tilting of the foundation surface below the substation is 0.1 degrees.

Notes:

(A) The container perimeter must rests on foundation, so is necessary lower of the corner container according to CORNER DETAIL, above.
General layout

Dimension drawings

12190 mm

2900 mm

2440 mm
Typical single-line diagram
Dimension drawings
Further information

For more information on ABB products and services for solar applications, navigate to www.abb.com/solarinverters.