

ABB DRIVES FOR WATER

ACQ80-01 drives

Hardware manual



ACQ80-01 drives

Hardware manual

Table of contents



1. Safety instructions



4. Mechanical installation



6. Electrical installation - IEC



9. Start-up



•	
Contents of this chapter Use of warnings and notes General safety in installation, start-up and maintenance Electrical safety in installation, start-up and maintenance Electrical safety precautions Additional instructions and notes Printed circuit boards Grounding General safety in operation Additional instructions for permanent magnet motor drives Safety in installation, start-up, maintenance Safety in operation	
2 Introduction to the manual	
Contents of this chapter Applicability Target audience Categorization by frame size Quick installation and commissioning flowchart Terms and abbreviations Related documents	23 23 24 24
3 Operation principle and hardware description	
Contents of this chapter Operation principle Block diagram Simplified main circuit diagram Product variants Layout Overview of power and control connections External control connection terminals, frames R4 and R5	
External control connection terminals, frames R6R9 Control panel Control panel door mounting kits Type designation label Locations of the labels on the drive Type designation key Option codes Manual kit ordering codes 4 Mechanical installation	36 37 38
Control panel Control panel door mounting kits Type designation label Locations of the labels on the drive Type designation key Option codes Manual kit ordering codes	36 37 38 39

Examining the installation site	
Necessary tools	
Moving the drive	
Unpacking and examining delivery Frame R4	
Unpacking and examining delivery, frame R5 and R6	
Frame R5 cable box (IP21, UL Type 1)	50
Frame R6 cable box (IP21, UL Type 1)	
Unpacking and examining delivery, frame R7	
Frame R7 cable box (IP21, UL Type 1)	
Unpacking and examining delivery, frames R8 and R9	
Frame R8 cable box (IP21, UL Type 1)	
Frame R9 cable box (IP21, UL Type 1)	
Installing the drive	
Installing the drive vertically, frame R4	
Installing the drive vertically, frame R5	
IP21 (UL Type 1)	
IP21 (UL Type 1), IP55 (UL Type 12)	
Installing the drive vertically, frames R6R9	
IP21 (UL Type 1)	
IP55 (UL Type 12)	
Installing the drive vertically side by side	
Installing the drive horizontally, frames R4R5	
Cabinet installation (options +P940 and +P944)	64
5 Guidelines for planning the electrical installation	
	C٢
Contents of this chapter	
Limitation of liability	
Selecting the main supply disconnecting device	
DC solar PV power supply	CC
Evamining the compatibility of the motor and drive	
Examining the compatibility of the motor and drive	66
Protecting the motor insulation and bearings	66 66
Protecting the motor insulation and bearings	66 66
Protecting the motor insulation and bearings	66 66 66 67
Protecting the motor insulation and bearings	66 66 67 68
Protecting the motor insulation and bearings	66 66 67 68 69
Protecting the motor insulation and bearings	66 66 67 68 69 70
Protecting the motor insulation and bearings	66 66 67 68 69 70 70
Protecting the motor insulation and bearings	66 66 67 68 69 70 70
Protecting the motor insulation and bearings	66 66 67 68 69 70 70 71
Protecting the motor insulation and bearings	66 66 67 68 69 70 70 71
Protecting the motor insulation and bearings Requirements tables Requirements for ABB motors, $P_{\rm n}$ < 100 kW (134 hp) Requirements for ABB motors, $P_{\rm n} \ge 100$ kW (134 hp) Requirements for non-ABB motors, $P_{\rm n} < 100$ kW (134 hp) Requirements for non-ABB motors, $P_{\rm n} \ge 100$ kW (134 hp) Abbreviations Availability of du/dt filter and common mode filter by drive type Additional requirements for explosion-safe (EX) motors Additional requirements for ABB motors of types other than M2_, M3_, M4_, HX_ and AM_	66 66 67 68 69 70 70 71
Protecting the motor insulation and bearings	66 66 67 68 69 70 70 71 71 71
Protecting the motor insulation and bearings	66 66 67 68 69 70 70 71 71 71 71
Protecting the motor insulation and bearings Requirements tables	66 66 67 68 69 70 70 71 71 71 71 71
Protecting the motor insulation and bearings	66 66 67 68 69 70 70 71 71 71 71 71 72
Protecting the motor insulation and bearings	66 66 67 68 69 70 70 71 71 71 71 72 73
Protecting the motor insulation and bearings	66 66 67 68 69 70 70 71 71 71 71 72 73 73
Protecting the motor insulation and bearings	66 66 67 68 69 70 70 71 71 71 71 72 73 73 73



Power cable types	74
Preferred power cable types	
Alternate power cable types	
Not allowed power cable types	
Selecting AC power cables	
Selecting DC power cables	
DC cable sizing	
Power cable shield	
Grounding requirements	
Additional grounding requirements – IEC	
Additional grounding requirements – UL (NEC)	
Routing the cables	
General guidelines – IEC	
Continuous motor cable shield/conduit and metal enclosure for equipment on	
the motor cable	
Separate control cable ducts	
Implementing short-circuit and thermal overload protection	
Protecting the drive and the input power cable in short-circuits	
Protecting the motor and motor cable in short-circuits	
Protecting the motor cables against thermal overload	
Protecting the motor against thermal overload	
Protecting the motor against thermal overload	
sensors	
Protecting the drive against ground faults	
Residual current device compatibility	
Earth connection (grounding) recommendation	
Implementing the emergency stop function	
Implementing the Safe torque off function	
Using power factor compensation capacitors with the drive	
Controlling a contactor between drive and motor	
Implementing an ATEX-certified motor thermal protection	
Implementing the power loss ride-through function	
Using a safety switch between the drive and the motor	
Implementing a bypass connection	
Example bypass connection	
Protecting the contacts of relay outputs	
Limiting relay output maximum voltages at high installation altitudes	
Implementing a motor temperature sensor connection	90
6 Electrical installation – IEC	
Contents of this chapter	91
Required tools	91
Grounding the motor cable shield at the motor end	91
Measuring the insulation	92
Measuring the insulation resistance of the drive	92
Measuring the insulation resistance of the input power cable	
Measuring the insulation resistance of the motor and motor cable	
Grounding system compatibility check	
EMC filter	
Ground-to-phase varistors	
When to disconnect EMC filter or ground-to-phase varistor: TN-S, IT, corner-	
grounded delta and midpoint-grounded delta systems	92
g and a second annual control great annual deposition of the control of the contr	



Reforming the capacitors	
Start-up procedure	137
10 Maintenance	
Contents of this chapter	139
Maintenance intervals	
Description of symbols	
Recommended maintenance intervals after start-up	
Cleaning the exterior of the drive	
Cleaning the heatsink	
Fans	frame
R4	
R4	
Replacing the main cooling fan, IP21 and IP55 (UL Type 1 and UL Type 12) f	
Replacing the auxiliary cooling fan, IP21 and IP55 (UL Type 1 and UL Type	12)
frames R6R9	
Replacing the auxiliary cooling fan, IP55 (UL Type 12) frame R4; IP21 and II	
(UL Type 1 and UL Type 12) frame R5	
Capacitors	
Reforming the capacitors	
Control panel	
LEDs	
Drive LEDs	
Control panel LEDs	
Functional safety components	148
11 Technical data	
Contents of this chapter	149
Electrical ratings	
IEC	
Definitions	
How to calculate required solar cell voltage and short circuit current	
Definitions	
Sizing	
Deratings	
Surrounding air temperature derating, IP21 (UL Type 1)	
Altitude derating	
Switching frequency derating by derating factor	
Switching frequency derating with actual output current values	
Output frequency derating	
Fuses (IEC)	
AC fuses	
uR and aR fuse	
gG fuses	
Input circuit components	156
DC charging circuit	156
DC main circuit breakers	157
MOV	157
DC EMI filter	158

Reverse polarity diodes	158
Alternate short-circuit protection	158
Dimensions, weights and free space requirements	159
Losses, cooling data and noise	
Cooling air flow, heat dissipation and noise for stand-alone drives	164
IEC	164
Terminal and entry data for the power cables	164
IEC	164
Power cables	
Typical power cables, IEC	
Terminal and entry data for the control cables	166
IEC	
Electrical power network specification	
Motor connection data	
Auxiliary circuit power consumption	
Efficiency	
Energy efficiency data (ecodesign)	
Protection classes	
Ambient conditions	
Storage conditions	
Colors	
Materials	
Package materials for small wall-mounted drives and converter modules	
Package materials for large wall-mounted drives and converter modules	
Package materials for options, accessories and spare parts	
Materials of manuals	
Disposal	
Applicable standards	
Markings	
CE marking	
Compliance with the European WEEE Directive 2002/96/EC	
Compliance with the European Machinery Directive 2006/42/EC 2nd Edition	
June 2010 Validating the operation of the Safe torque off function	175
Compliance with the EN 61800-3:2004 + A1:2012	
Definitions	
Category C1	
Category C2	
Category C3	
Category C4	
Design lifetime expectancy	
Disclaimers	
Generic disclaimer	
Cyber security disclaimer	
Declarations of conformity	
12 Dimension drawings	
Contents of this chapter	181
Frame R4, IP21 (UL Type 1)	
Frame R4, IP55 (UL Type 12)	
Frame R4, IP55+E223 (UL Type 12)	
Frame R5, IP21 (UL Type 1)	
→ •	



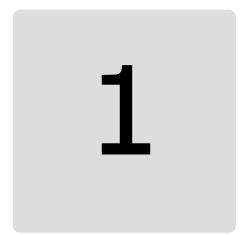
Frame R5, IP55 (UL Type 12)	
Frame R6, IP21 (UL Type 1)	187
Frame R6, IP55 (UL Type 12)	188
Frame R7, IP21 (UL Type 1)	189
Frame R7, IP55 (UL Type 12)	190
Frame R8, IP21 (UL Type 1)	191
Frame R8, IP55 (UL Type 12)	192
Frame R9, IP21 (UL Type 1)	193
Frame R9, IP55 (UL Type 12)	194
EMI filter layout diagram	195
EMI filter layout - Horizontal position	195
EMI filter layout - Vertical position	196
13 Resistor braking	
Contents of this chapter	100
Operation principle and hardware description	
· · · · · · · · · · · · · · · · · · ·	
Resistor braking, frames R4R9	
Planning the braking system	
IEC	
Parameter settings for external braking chopper and resistor	200
14 The Safe torque off function	
Contents of this chapter	201
Description	201
Compliance with the European Machinery Directive and the UK Supply of Ma-	
chinery (Safety) Regulations	
Wiring	203
Connection principle	
Single ACQ80-01 drive, internal power supply	
Single ACQ80-01 drive, external power supply	
Wiring examples	
Single ACQ80-01 drive, internal power supply	
Single ACQ80-01 drive, external power supply	
Multiple ACQ80-01 drives, internal power supply	
Multiple ACQ80-01 drives, external power supply	
Activation switch	
Cable types and lengths	
Grounding of protective shields	
Operation principle	
Start-up including validation test	
Competence	
Validation test reports	
Validation test procedure	
Use	
Maintenance	
Competence	
Perfect proof test procedure	
Simplified proof test procedure	
Fault tracing	
Safety data	
Terms and abbreviations	
Terms and addressations	LIC

	TÜV certificate	.219
15	Optional I/O extension and adapter modules	
Co	ntents of this chapter	221
	IO-01 bipolar analog I/O adapter module	
	Contents of this chapter	
	Product overview	
	Layout	
	Mechanical installation	
	Necessary tools	
	Unpacking and examining the delivery	
	Installing the module	
	Electrical installation	
	Necessary tools	
	Wiring	
	Start-up	
	Setting the parameters	
	Diagnostics	
	LEDs	
	Technical data	
	Isolation areas	
	Dimension drawings IDI-01 115/230 V digital input extension module	
	Contents of this chapter	
	Product overview	
	Layout and connection examples	
	Mechanical installation	
	Necessary tools	
	Unpacking and examining the delivery	
	Installing the module	
	Electrical installation	
	Necessary tools	
	Wiring	
	Start-up	
	Setting the parameters	
	Fault and warning messages	
	Technical data	
	Dimension drawing	
	10D-01 multifunction extension module (external 24 V AC/DC and digital I/O).	
	Contents of this chapter	
	Product overview	
	Layout and example connections	
	Mechanical installation	
	Necessary tools	
	Unpacking and examining the delivery	
	Installing the module	
	Electrical installation	
	Necessary tools	
	Wiring	
	Start-up	
	Setting the parameters	
	Diagnostics	
	- 3 - 3 - 3 - 3 - 3 - 3 - 3 - 3 - 3 - 3	



Technical data	233
Dimension drawing	
CMOD-02 multifunction extension module (external 24 V AC/DC and isolat	ted PTC
interface)	235
Contents of this chapter	235
Product overview	235
Layout and example connections	236
Mechanical installation	236
Necessary tools	
Unpacking and examining the delivery	236
Installing the module	
Electrical installation	237
Necessary tools	237
Wiring	237
Start-up	
Setting the parameters	
Diagnostics	
Faults and warning messages	
LEDs	
Technical data	238
Dimension drawing	
S	
16 Common mode, du/dt and sine filters	
Content of this chapter	241
Common mode filters	
When is a common mode filter needed?	
Common mode filter types	
IEC ratings at <i>U</i> _n = 400 V and 480 V	
du/dt filters	
When is a d <i>u</i> /d <i>t</i> filter needed?	
d <i>u</i> /d <i>t</i> filter types	
IEC ratings at U_n = 400 and 480 V	
Description, installation and technical data of the FOCH filters	
Description, installation and technical data of the NOCH filters	
Sine filters	
IEC ratings at $U_{\rm n}$ = 400 V	
Description, installation and technical data	
= === -,,	

Further information



Safety instructions

Contents of this chapter

This chapter contains the safety instructions which you must obey when you install, start-up, operate and do maintenance work on the drive. If you ignore the safety instructions, injury, death or damage can occur.

Use of warnings and notes

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. Notes show a particular condition or fact, or give information.

The manual uses these warning symbols:



WARNING!

Electricity warning tells about hazards from electricity which can cause injury or death, or damage to the equipment.



WARNING!

General warning tells about conditions other than those caused by electricity, which can cause injury or death, or damage to the equipment.



WARNING!

Electrostatic sensitive devices warning tells you about the risk of electrostatic discharge which can cause damage to the equipment.



General safety in installation, start-up and maintenance

These instructions are for all persons who do work on the drive.



WARNING!

Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.

- Keep the drive in its package until you install it. After unpacking, protect the drive from dust, debris and moisture.
- Use the required personal protective equipment: safety shoes with metal toe cap, safety glasses, protective gloves and long sleeves, etc. Some parts have sharp edges.
- Use a lifting device to lift a heavy drive. Use the designated lifting points. Refer to the dimension drawings.
- Be careful when handling a tall module. The module overturns easily because it is heavy and has a high center of gravity. Whenever possible, secure the module with chains. Do not leave an unsupported module unattended especially on a sloping floor.







- Beware of hot surfaces. Some parts, such as heatsinks of power semiconductors, and brake resistors, can be hot for a period after operation.
- Before the start-up, vacuum clean the area around the drive to prevent the drive cooling fan from drawing dust inside the drive.
- Make sure that debris from drilling, cutting and grinding does not go into the drive during installation. Electrically conductive debris inside the drive can cause damage or malfunction.
- Make sure that there is sufficient cooling. Refer to the technical data.
- Before you connect voltage to the drive, make sure that all covers are in place. Do not remove the covers when voltage is connected.
- Before you adjust the drive operation limits, make sure that the motor and all driven equipment can operate throughout the set operation limits.
- Before you activate the automatic fault reset or automatic restart functions of the drive control program, make sure that no dangerous situations can occur.
 These functions reset the drive automatically and continue operation after a fault or break in the power supply. If these functions are activated, the installation must

be clearly marked as defined in IEC/EN/UL 61800-5-1, subclause 6.5.3, for example, "THIS MACHINE STARTS AUTOMATICALLY".

- The maximum number of drive power-ups is five in ten minutes. Too frequent power-ups can damage the charging circuit of the DC capacitors.
- If the drive has connected safety circuits (for example, Safe torque off or emergency stop), validate them at start-up. Refer to separate instructions for the safety circuits.
- Beware of hot air flow from the cooling outlets.
- Do not cover the air inlet or air outlet when the drive operates.

Note:

- If you select an external source for the start command and it is on, the drive starts immediately after a fault reset unless you configure the drive for pulse start. Refer to the firmware manual.
- If the drive is in remote control mode, you cannot stop or start the drive with the control panel.
- Only authorized persons are permitted to repair a faulty drive.



Electrical safety in installation, start-up and maintenance

Electrical safety precautions

These electrical safety precautions are for all persons who do work on the drive, motor cable or motor.



WARNING!

Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.

If you are not a qualified electrical professional, do not do installation or maintenance work.

Do these steps before you begin any installation or maintenance work.

- 1. Prepare for the work.
 - Make sure that you have a work order.
 - Do an on-site risk assessment or job hazard analysis.
 - Make sure that you have the correct tools available.
 - Make sure that the workers are qualified.
 - Select the correct personal protective equipment (PPE).
 - Stop the drive and motor(s).
- 2. Clearly identify the work location and equipment.
- 3. Disconnect all possible voltage sources. Make sure that connection is not possible. Lock out and tag out.
 - Open the main disconnecting device of the drive.
 - If a permanent magnet motor connects to the drive, disconnect the motor from the drive with a safety switch or by other means.
 - Open the main isolating device of the drive.
 - Disconnect all dangerous external voltages from the control circuits.
 - After you disconnect power from the drive, wait 5 minutes to let the intermediate circuit capacitors discharge before you continue.
- 4. Protect other energized parts in the work location against contact and take special precautions when close to bare conductors.
- 5. Measure that the installation is de-energized. Use a quality voltage tester.
 - Before and after you measure the installation, verify the operation of the voltage tester on a known voltage source.
 - Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding (PE) busbar is zero.
 - Make sure that the voltage between the drive output terminals (U, V, W) and the grounding (PE) busbar is zero.
 - Make sure that the voltage between the drive DC terminals (UDC+ and UDC-) and the grounding (PE) terminal is zero.

Note: If cables are not connected to the drive DC terminals, measuring the voltage from the DC terminal screws can give incorrect results.

- 6. Install temporary grounding as required by the local regulations.
- 7. Ask for a permit to work from the person that is responsible for the electrical installation work.



Additional instructions and notes



WARNING!

Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.

If you are not a qualified electrical professional, do not do installation or maintenance work.

- Make sure that the electrical power network, motor/generator, and environmental conditions agree with the drive data.
- Do not do insulation or voltage withstand tests on the drive.
- If you have a cardiac pacemaker or other electronic medical device, do not go near the area near motor, drive, and the drive power cabling when the drive is in operation. The equipment produces electromagnetic fields that can cause interference in electronic medical devices. This can cause a health hazard.

Note:

- When the drive is connected to the input power, the motor cable terminals and the DC bus are at a dangerous voltage.
 - After you disconnect the drive from the input power, these remain at a dangerous voltage until the intermediate circuit capacitors discharge.
- External wiring can supply dangerous voltages to the relay outputs of the control units of the drive.
- The Safe torque off function does not remove the voltage from the main and auxiliary circuits. The function is not effective against deliberate sabotage or misuse.

Printed circuit boards



WARNING!

Use ESD wristband when you handle printed circuit boards. Do not touch the boards unnecessarily. The boards are sensitive to electrostatic discharge.

Grounding

These instructions are for all persons who are responsible for the grounding of the drive.



WARNING!

Obey these instructions. If you ignore them, injury or death, or equipment malfunction can occur, and electromagnetic interference can increase.

If you are not a qualified electrical professional, do not do grounding work.

- Always ground the drive, the motor and adjoining equipment. This is necessary for personnel safety.
- Make sure that the conductivity of the protective earth (PE) conductors is sufficient
 and that other requirements are met. Refer to the electrical planning instructions
 of the drive. Obey the applicable national and local regulations.



- When you use shielded cables, make a 360° grounding of the cable shields at the cable entries to reduce electromagnetic emission and interference.
- In a multiple-drive installation, connect each drive separately to the protective earth (PE) busbar of the power supply.

General safety in operation

These instructions are for all persons that operate the drive.



WARNING!

Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.

- If you have a cardiac pacemaker or other electronic medical device, do not go near
 the area near motor, drive, and the drive power cabling when the drive is in
 operation. The equipment produces electromagnetic fields that can cause
 interference in electronic medical devices. This can cause a health hazard.
- Give a stop command to the drive before you reset a fault. If you have an external source for the start command and the start is on, the drive starts immediately after the fault reset, unless you configure the drive for pulse start. Refer to the firmware manual.
- Before you activate the automatic fault reset or automatic restart functions of the drive control program, make sure that no dangerous situations can occur. These functions reset the drive automatically and continue operation after a fault or break in the power supply. If these functions are activated, the installation must be clearly marked as defined in IEC/EN/UL 61800-5-1, subclause 6.5.3, for example, "THIS MACHINE STARTS AUTOMATICALLY".

Note:

• If the drive is in remote control mode, you cannot stop or start the drive with the control panel.

Additional instructions for permanent magnet motor drives

Safety in installation, start-up, maintenance

These are additional warnings for permanent magnet motor drives. The other safety instructions in this chapter are also valid.



WARNING!

Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.

If you are not a qualified electrical professional, do not do installation or maintenance work.

 Do not do work on the drive when a rotating permanent magnet motor is connected to it. A rotating permanent magnet motor energizes the drive including its input and output power terminals.



Before installation, start-up and maintenance work on the drive:

- Stop the drive.
- Disconnect the motor from the drive with a safety switch or by other means.
- If you cannot disconnect the motor, make sure that the motor cannot rotate during work. Make sure that no other system, like hydraulic crawling drives, can rotate the motor directly or through any mechanical connection such as belt, nip, rope, etc.
- Do the steps in section Electrical safety precautions (page 18).
- Install temporary grounding to the drive output terminals (T1/U, T2/V, T3/W). Connect the output terminals together as well as to the PE.

During the start-up:

• Make sure that the motor cannot run at overspeed, for example, when it is driven by the load. Motor overspeed causes an overvoltage that can cause damage to the capacitors in the intermediate circuit of the drive.

Safety in operation



WARNING!

Make sure that the motor cannot run at overspeed, for example, when it is driven by the load. Motor overspeed causes an overvoltage that can cause damage to the capacitors in the intermediate circuit of the drive.





Introduction to the manual

Contents of this chapter

This chapter describes the intended audience and contents of the manual. It contains a flowchart of steps in examining the delivery, installing and commissioning the drive. The flowchart refers to chapters/sections in this manual and other manuals.

Applicability

This manual applies to the ACQ80-01 drives.

Target audience

This manual is intended for people who plan the installation, install, commission, and do maintenance work on the drive, or create instructions for the end user of the drive concerning the installation and maintenance of the drive.

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

Categorization by frame size

The ACQ80-01 is manufactured in frame sizes R4 to R9. Some instructions and other information that concern only certain frames are marked with the symbol of the frame (R4...R9). The frame is marked on the type designation label of the drive, see Type designation label (page 36).

Quick installation and commissioning flowchart

Task	See
Identify the frame of your drive: R4 and R5.	Type designation key (page 37)
•	
Plan the installation: select the cables, etc.	Guidelines for planning the electrical installa-
Examine the ambient conditions, ratings and re-	tion (page 65)
quired cooling air flow.	Technical data (page 149)
•]
Unpack and examine the drive.	Mechanical installation (page 41)
Make sure that all necessary optional modules and equipment are present and correct.	
•	
If the drive will be connected to another system than symmetrically grounded TN-S system: Examine if	<u>IEC:</u> Grounding system compatibility check (page 93)
you must disconnect the EMC filter or ground-to-	
phase varistor.	
•	
Install the drive on a wall.	Mechanical installation (page 41)
	
Route the cables.	Routing the cables (page 81)
•	-
Measure the insulation of the input cable and the	IEC: Measuring the insulation (page 92)
motor and the motor cable.	
•]
Connect the power cables.	IEC: Connecting the power cables (page 98)
+	
Connect the control cables.	<u>IEC:</u> Connecting the control cables (page 112)
Check the installation.	Installation checklist (page 135)
•	
Commission the drive.	ACQ80 standard control program firmware manual
	(3AXD50000170654 [English])

Terms and abbreviations

Term	Description	
ACS-AP	Assistant control panel	
BCBL-01	Optional USB to RJ45 cable	
CCA-01	Configuration adapter	
CDPI-01	Communication adapter module	
Drive	Frequency converter for controlling AC motors	
EFB	Embedded fieldbus	
EMC	Electromagnetic compatibility	
FBA	Fieldbus adapter	
FCAN	Optional CANopen® adapter module	
FCNA-01	Optional ControlNet™ adapter module	
FDNA-01	Optional DeviceNet™ adapter module	
FECA-01	Optional EtherCAT® adapter module	

Term	Description
FEIP-21	Optional Ethernet adapter module for EtherNet/IP™
FENA-21	Optional Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET IO protocols, 2-port
FEPL-02	Optional Ethernet POWERLINK adapter module
FMBT-21	Optional Ethernet adapter module for Modbus TCP protocol
FPBA-01	Optional PROFIBUS DP® adapter module
FPNO-21	Optional PROFINET IO adapter module
Frame, frame size	Physical size of the drive or power module
Intermediate circuit	DC circuit between rectifier and inverter
Inverter	Converts direct current and voltage to alternating current and voltage.
Macro	A pre-defined set of default values of parameters in a drive control program.
MOV	Metal Oxide Varistor. A protection component used in power supply circuits.
NETA-21 Remote monitoring tool	
Parameter	In the drive control program, user-adjustable operation instruction to the drive, or signal measured or calculated by the drive. In some (for example fieldbus) contexts, a value that can be accessed as an object. For example, variable, constant, or signal.
PLC	Programmable logic controller
PV	Parameter value Photovoltaic
RFI	Radio-frequency interference
RIIO-01	I/O & EIA-485 module
SIL	Safety integrity level (13) (IEC 61508, IEC 62061, IEC 61800-5-2)
STO	Safe torque off (IEC/EN 61800-5-2)
VOC	Open circuit voltage. Maximum voltage available from a solar cell.

Related documents

Name	Code (English/ Multilingual)	Code (Translation)		
Drive manuals and guides				
ACQ80 standard control program firmware manual	3AXD50000170654			
ACQ80-01 (30 to 200 kW) drives hardware manual	3AXD50001017101			
ACQ80-01 (30 to 200 kW) drives quick installation and startup guide	3AXD50001017217			
ACQ80-04 (0.5 to 22 kW) drives hardware manual	3AXD50000170661			
ACQ80-04 (0.5 to 22 kW) drives quick installation and startup guide	3AXD50000701247B			
ACS-AP-I, -S, -W and ACH-AP-H, -W Assistant control panels user's manual	3AUA0000085685			
Drive modules cabinet design and construction instructions	3AUA0000107668			
Alternate Fuses, MMPs and Circuit Breakers for ABB Drives	3AXD50000645015			
Option manuals and guides				
DPMP-01 mounting platform for control panels	3AUA0000100140			
DPMP-02/03 mounting platform for control panels	3AUA0000136205			
DPMP-04/05 mounting platform for control panels	3AXD50000308484			
FCAN-01 CANopen adapter module user's manual	3AFE68615500			
FECA-01 EtherCAT adapter module user's manual	3AUA0000068940			
FEIP-21 Ethernet/IP adapter module user's manual	3AXD50000158621			

26 Introduction to the manual

Name	Code (English/ Multilingual)	Code (Translation)
FENA-01/-11/-21 Ethernet adapter module user's manual	3AUA0000093568	
FMBT-21 Modbus/TCP adapter module user's manual	3AXD50000158607	
FPBA-01 PROFIBUS DP adapter module user's manual	3AFE68573271	
FSCA-01 RS-485 adapter module user's manual	3AUA0000109533	
Tool and maintenance manuals and guides		
Drive Composer Start-up and maintenance PC tool user's manual	3AUA0000094606	
Converter module capacitor reforming instructions	3BFE64059629	
NETA-21 remote monitoring tool user's manual	3AUA0000096939	
NETA-21 remote monitoring tool installation and start-up guide	3AUA0000096881	

You can find manuals on the Internet. See below for the relevant code/link. For more documentation, go to www.abb.com/drives/documents.



ACQ80-01 manuals

See also,

- Video of ACQ80 solar pump drive.
- QR code on the drive. Scan the QR code to navigate to ABB Access web page and find up-to-date product online data.



Operation principle and hardware description

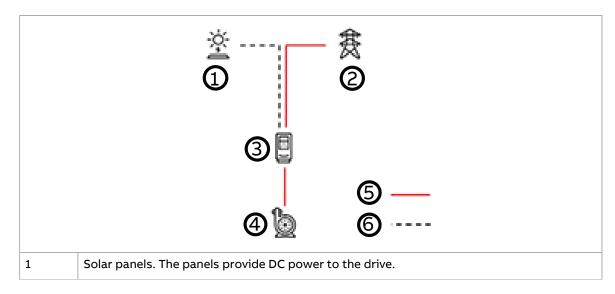
Contents of this chapter

This chapter briefly describes the operation principle and construction of the drive.

Operation principle

The ACQ80-01 is a solar pump drive for controlling asynchronous AC induction motors and permanent magnet synchronous motors. The drive is optimized for cabinet installation.

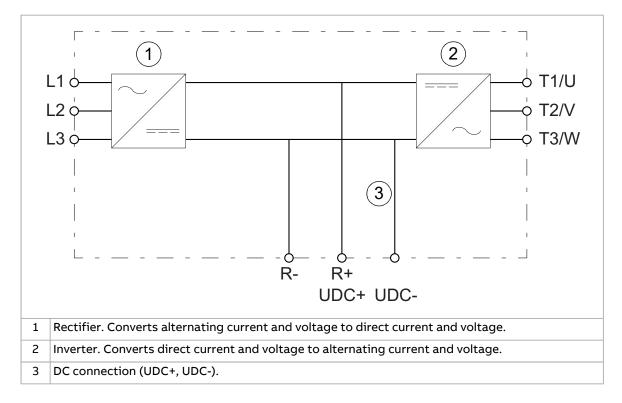
Block diagram



2	Grid power. The grid provides AC power to the drive. To get maximum water flow throughout the day and to reduce grid power consumption, both the grid and solar panel can be connected.
3	ACQ80 drive. The drive comes with built-in Maximum Power Point Tracking (MPPT) logic. The MPPT logic supports the drive to control the pump motor with variable DC power from the solar panels.
4	Pump motor. The motor is powered by ACQ80 drive.
5	AC power.
6	DC power.

Note: ACQ80 drive is intended to be used for speed control of three-phase AC pump motors and is powered from either AC grid or DC solar array or both AC and DC power together. ABB recommends not to use it as an island grid forming inverter or to supply generic single phase or three-phase loads, other than the three-phase AC pump motors.

Simplified main circuit diagram



Product variants

The drive has two product variants:

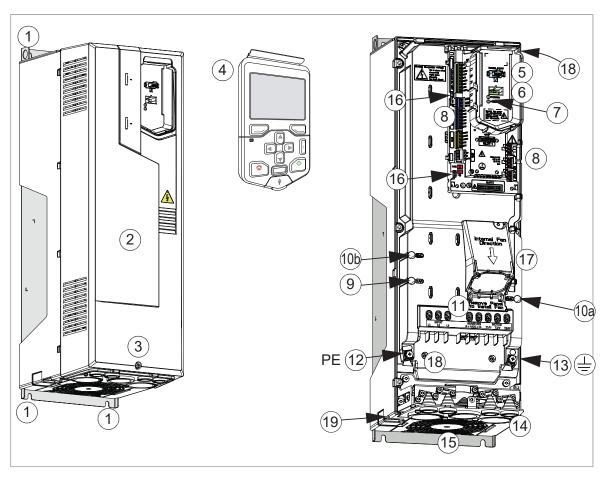
- Standard unit: drive with assistant control panel and RIIO-01 I/O & EIA-485 module For example, ACQ80-01-030kW-4+J400+L540 where J400 indicates assistant control panel and +L450 indicates RIIO module.
- Base unit: drive without control panel and without RIIO-01 I/O & EIA-485 module (ACQ80-01-030kW-4)

- Solar Pump Drive modules, IP20, 400V without control panel and with RIIO (ACQ80-01-030kW-4+L540)
- Solar Pump Drive modules, IP20, 400V with Basic control panel and with RIIO (ACQ80-01-030kW-4+J404+L540) J404 indicates basic control panel.

Layout

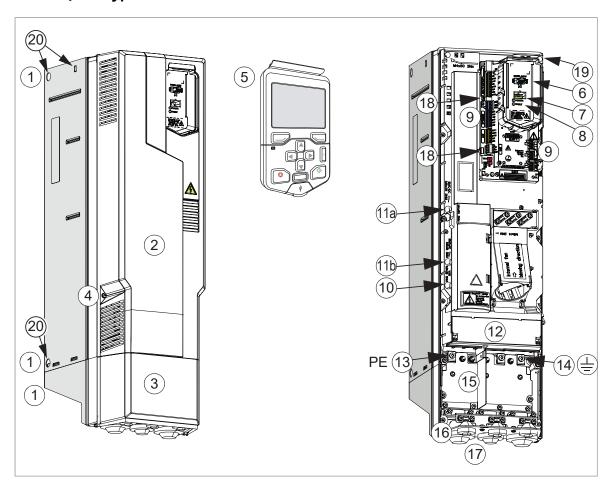
Frame R4

R4 IP21 / UL Type 1



1	Mounting points (4 pieces)	10	Two EMC filter grounding screws (EMC (DC)).	
2	Cover		For disconnecting, see page 96 (IEC).	
3	Cover screw	11	Input power connection (L1, L2, L3), motor connection (T1/U, T2/V, T3/W) and DC connec-	
4	Control panel		tion (UDC+, UDC-)	
5	Control panel connection	12	PE connection (power line)	
6	Cold configuration connection for CCA-01	13	Grounding connection (motor)	
7	Power OK and Fault LEDs. See section	14	Cable entry	
LEDs (page 147).		15	Main cooling fan	
8	I/O connections. See External control connection terminals, frames R4 and R5 (page 33).	16	Cable tie mounts for /I/O cables	
9	Varistor grounding screw (VAR). For disconnecting, see page 96 (IEC).	17	Auxiliary cooling fan. For IP55/UL Type 12 drives only.	
	3, 1 3 , 2,	18	Auxiliary cooling fan connector	
		19	Additional grounding connection	

Frame R5 R5 IP21 / UL Type 1

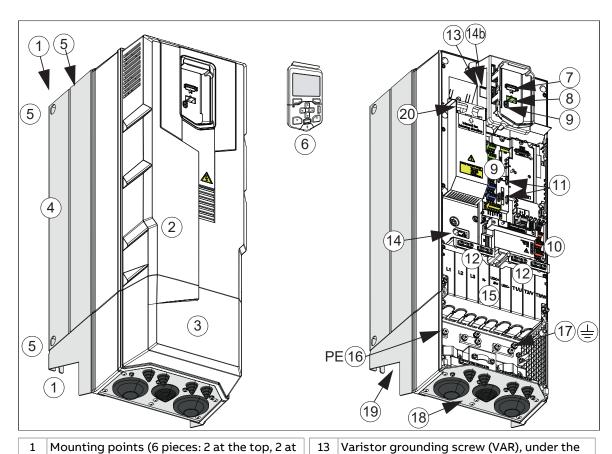


1	Mounting points (6 pieces: 2 at the top, 2 at the bottom of the main part of the frame, 2 at the top of the cable box)	11	Two EMC filter grounding screws, 11a: EMC (DC) and 11b: (EMC (AC). For disconnecting, see page 96 (IEC).
2	Cover	12 Input power connection (L1, L2, L3), motor	
3	Cable/conduit box		connection (T1/U, T2/V, T3/W) and DC connection (UDC+, UDC-)
4	Cover screws (2 pieces)	13	PE connection (power line)
5	Control panel	14	Grounding connection (motor)
6	Control panel connection	15	Cable box plate
7	Cold configuration connection for CCA-01	16	Cable entry
8	Power OK and Fault LEDs. See section LEDs (page 147).	17	Main cooling fan
9	I/O connections. See External control connec-	18	Cable tie mounts for /I/O cables
tion terminals, frames R4 and R5 (page 33).		19	Auxiliary cooling fan connector
10	Varistor grounding screw (VAR). For disconnecting, see page 96 (IEC).		

Frames R6...R9

R6 IP21 / UL Type 1

The layout of a frame R6 drive is presented below. The constructions of frames R6...R9 differ to some extent.



1	the bottom of the main part of the frame, 2 at the top of the cable box)	13
2	Cover	14
3	Cable/conduit box	
4	Heatsink	
5	Lifting points (6 pieces)	15
6	Control panel	
7	Control panel connection	16
8	Cold configuration connection for CCA-01	17
9	Power OK and Fault LEDs. See section	
	LEDs (page 147).	18
10	I/O connections. See External control connection terminals, frames R6R9 (page 34).	19
11	Cable tie mounts for /I/O cables	20
12	Clamps for I/O cable mechanical support	

control panel platform. For disconnecting, see page 96(IEC)

14 Two EMC filter grounding screws, 14a: EMC (DC) under the control panel platform and 14b: (EMC (AC) at the left, above the shroud. For disconnecting, see page 96 (IEC)

15 Shroud. Under the shroud: Input power connection (L1, L2, L3), motor connection (T1/U, T2/V, T3/W) and DC connection (UDC+, UDC-)

16 PE connection (power line)

17 Grounding connection (motor), under the shroud (15)

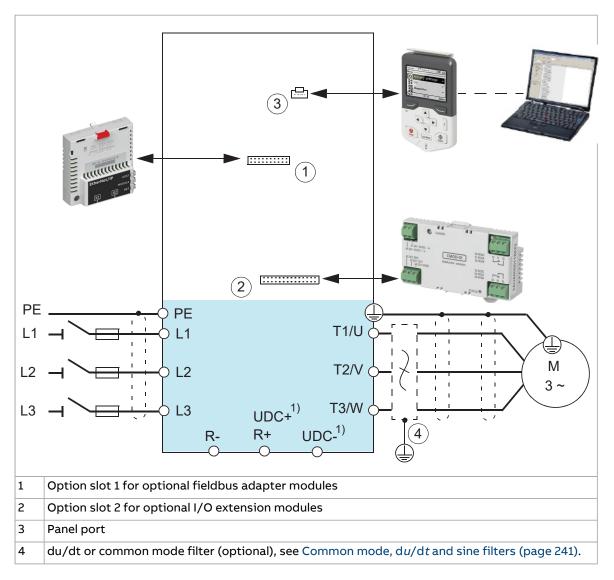
18 Cable entry

19 Main cooling fan

20 Auxiliary cooling fan

Overview of power and control connections

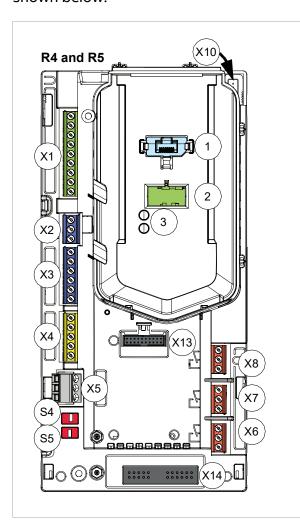
The logical diagram below shows the power connections and control interfaces of the drive.



¹⁾Not in all frame sizes

External control connection terminals, frames R4 and R5

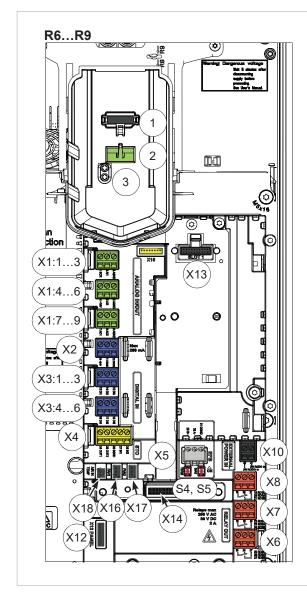
The layout of the external control connection terminals of the R4 and R5 frames is shown below.



	Description
	•
X1	Analog inputs and outputs
X2	Aux. voltage output
Х3	Programmable digital inputs
X4	Safe torque off connection
X5	Embedded fieldbus
Х6	Relay output 3
X7	Relay output 2
X8	Relay output 1
X10	Auxiliary fan connection (IP55)
X13	Option slot 1 (fieldbus adapter modules)
X14	Option slot 2 (I/O extension modules)
S4,S5	Termination switch (S4), bias resistor switch (S5), see Embedded EIA-485 field- bus connection (page 124)
1	Panel port (control panel connection)
2	Cold configuration connection. This connector is used with the CCA-01 configuration adapter.
3	Power OK and Fault LEDs. See section LEDs (page 147).

External control connection terminals, frames R6...R9

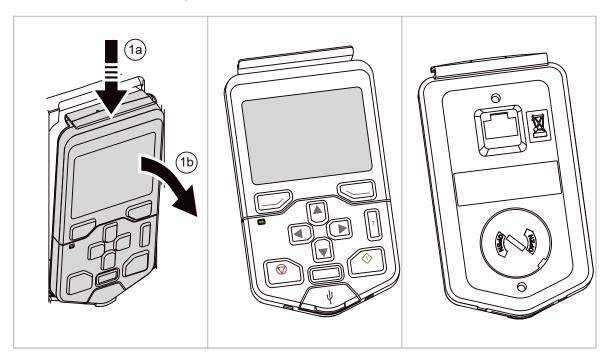
The layout of the external control connection terminals of frames R6...R9 is shown below.



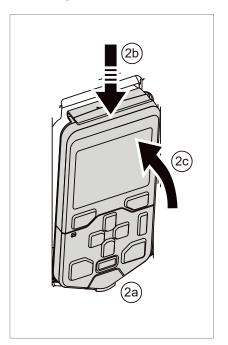
	Description
X1	Analog inputs and outputs
X2	
	Aux. voltage output
Х3	Digital inputs
X4	Safe torque off connection
X5	Connection to embedded EIA-485 fieldbus adapter module
Х6	Relay output 3
Х7	Relay output 2
Х8	Relay output 1
X10	External +24 V AC/DC input connection
X12	Panel connection
X13	Option slot 1 (fieldbus adapter modules)
X14	Option slot 2 (I/O extension modules)
X16	Auxiliary fan 1 connection
X17	Auxiliary fan 2 connection
X18	Air in temperature sensor connection
S4, S5	Termination switch (S4), bias resistor switch (S5), see Embedded EIA-485 fieldbus connection (page 124)
1	Panel port (control panel connection)
2	Cold configuration connection. This connector is used with the CCA-01 configuration adapter.
3	Power OK and Fault LEDs. See section LEDs (page 147).

Control panel

To remove the control panel, press the retaining clip at the top (1a) and pull the panel forward from the top edge (1b).



To install the control panel, put the bottom of the container in position (2a), press the retaining clip at the top (2b) and push the control panel in at the top edge (2c).



For the use of the control panel, see the firmware manual and ACS-AP-I, -S, -W and ACH-AP-H, -W Assistant control panels user's manual (3AUA0000085685 [English]).

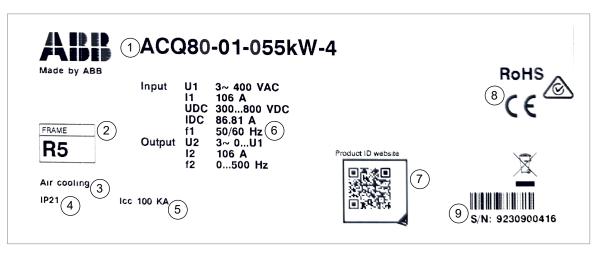
Control panel door mounting kits

You can use a mounting platform to install the control panel on the cabinet door. Mounting platforms for control panels are available as options from ABB. For more information, see

Manual	Code (English)
DPMP-01 mounting platform for control panels installation guide	3AUA0000100140
DPMP-02/03 mounting platform for control panels installation guide	3AUA0000136205
DPMP-04 and DPMP-05 mounting platform for control panels installation guide	3AXD50000308484
DPMP-06 / 07 mounting platform for control panels installation guide	3AXD50000289561

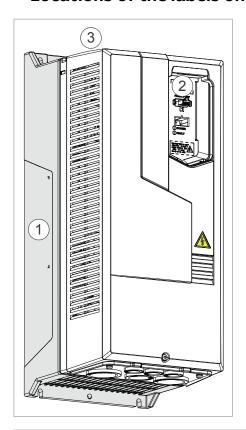
Type designation label

The type designation label includes IEC ratings, appropriate markings and the type designation and serial number, which allow identification of each drive. The type designation label is located on the left side of the drive, see section Locations of the labels on the drive (page 37). An example label is shown below.



No.	Description		
1	Type designation, see section Type designation key (page 37).		
2	Frame (s	ize)	
3	Type of the drive, for example, with Air cooling or Liquid cooling, and so on.		
4	IEC: Icc (I	Rated conditional short-circuit current) = 100 KA	
5	Degree of protection		
6	Nominal ratings in the supply voltage range, see Electrical ratings (page 149), Electrical power network specification (page 167) and Motor connection data (page 167).		
7	Link to the product data sheet		
8	Valid ma	rkings	
9	S/N:	Serial number of format MYYWWXXXXX, where	
	M:	Manufacturing plant	
	YY:	21, 22, 23, for 2021, 2022, 2023,	
	ww:	01, 02, 03, for week 1, week 2, week 3,	
	XXXXX:	Digits making the serial number unique	

Locations of the labels on the drive





Type designation key

The type designation contains information on the specifications and configuration of the drive. You find the type designation on the type designation label attached to the drive. The first digits from the left express the basic configuration, for example, ACQ80-01-055kW-4. The optional selections are given after that, separated by plus signs, for example, +L515. The main selections are described below. Not all selections are available for all types.

Code	Description						
Basic codes							
ACQ80-01	ACQ80-01 Product series						
When no options are selected: Wall mounted, IP21 (UL Type 1), ACS-AP-S Assistant cont panel ACH-AP-H Hand-Off-Auto control panel, choke, EMC C2 filter (internal EMC filter safe torque off, coated boards, cable entry from the bottom, cable box or the cond plate with cable entries, quick installation and start-up guide (multilingual kit).							
Size							
xxxx	See the rating tables						
Voltage rati	ng						
4	2 = 208240 V 4 = 380480 V See the technical data for further information.						

Option codes

Code	Description							
Control	Control panel							
0J400	No control panel							
J400	ACS-AP-S control panel (included as standard)							
J404	ACS-BP-S basic control panel							
J424	Blank control panel cover (no control panel)							
J425	ACS-AP-I control panel							
J429	ACS-AP-W control panel with Bluetooth interface							
Optiona	cards							
K454	FPBA-01 PROFIBUS DP adapter module							
K457	FCAN-01 CANopen adapter module							
K458	FSCA-01 RS-485 (Modbus/RTU) adapter module							
K469	FECA-01 EtherCat adapter module							
K470	FEPL-02 EtherPOWERLINK adapter module							
K475	FENA-21 Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET IO protocols, 2-port							
K490	FEIP-21 EtherNet/IP adapter module							
K491	FMBT-21 Modbus/TCP adapter module							
K492	FPNO-21 PROFINET IO adapter module							
L511	BREL-01 relay output extension module							
L515	FEA-03 I/O extension adapter							
L534	BAPO-01 external 24 V DC power extension module (side option)							
L540	RIIO-01 I/O & EIA-485 module (front option, as standard)							
0L540	Base unit without RIIO-01 I/O & EIA-485 module							
Printed	nanuals							
R700	Printed manuals in English							

Manual kit ordering codes

Hardware and firmware manuals are not included as default. They can be ordered as a kit using the following ordering codes:

Language	Ordering code
EN	3AXD50001017101

Mechanical installation

Contents of this chapter

This chapter tells you how to examine the installation site, examine the delivery, and mechanically install the drive.

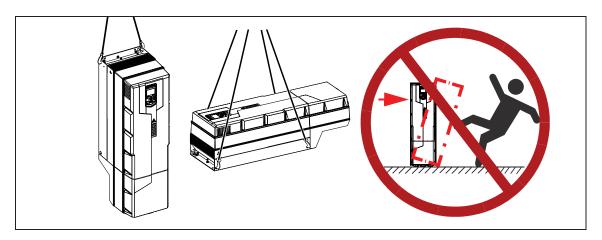


Safety



WARNING!

<u>Frame R5...R9:</u> Lift the drive with a lifting device. Use the lifting eyes of the drive. Do not tilt the drive. **The drive is heavy and its center of gravity is high. An overturning drive can cause physical injury.**



Examining the installation site

Examine the installation site. Make sure that:

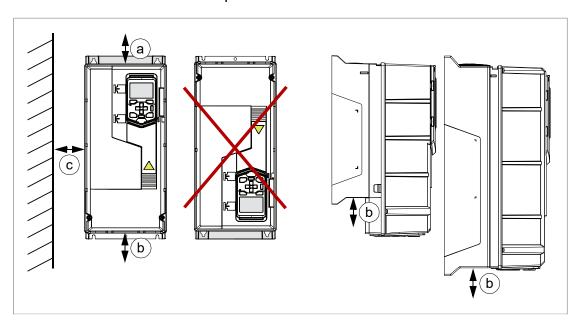
- The installation site is sufficiently ventilated or cooled to remove heat from the drive. Refer to the technical data.
- The ambient conditions of the drive meet the specifications. Refer to the technical data.
- The material behind, above, and below the drive is non-flammable.
- There is sufficient free space around the drive for cooling, maintenance work, and operation. Refer to the free space specifications for the drive.
- Make sure that there are no sources of strong magnetic fields such as high-current single-core conductors or contactor coils near the drive. A strong magnetic field can cause interference or inaccuracy in the operation of the drive.
- The drive cabinet should be IP42 or IP54 and mounted below a solar array or in a closed room so that water never goes into or falls on the drive cabinet.
- A lightning pole is installed near the site (1–2 m [3–7 ft] from the solar structure). This is recommended even if the location is not prone to lightning. Make sure that the height of the lightning pole is more than the total height of the site structure.
- Use two separate earth pits. Use a dedicated earth pit for the lightning rod to ensure isolation from other earthing. Use the second pit for the drive, drive cabinet, pump motor and solar array.
- The length of the cable between the motor and drive is less than 300 m (985 ft). Use a motor choke for cable lengths between 300 m (985 ft) to 350 m (1150 ft). Use a sine filter for cable lengths of more than 350 m (1150 ft).

Installation alternatives

The drive must be installed on the wall or an enclosure. There are three alternative ways to install it:

Vertical

Note: Do not install the drive upside down.





Frame				V	ertical i	installa	tion - Fr	ee spac	:e			
size		IP21 (UL Type 1)						IP55 (UL Type 12)				
	Above (a) ¹⁾		Belov	Below (b) ²⁾		Beside (c) ³⁾		Above (a) ¹⁾ Below (b) ²⁾		v (b) ²⁾	Beside (c) ³⁾	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
R4	53	2.09	200	7.87	150	5.91	53	2.09	200	7.87	150	5.91
R5	75	2.95	200	7.87	150	5.91	100	3.94	200	7.87	150	5.91
R6	155	6.10	300	11.81	150	5.91	155	6.10	300	11.81	150	5.91
R7	155	6.10	300	11.81	150	5.91	155	6.10	300	11.81	150	5.91
R8	155	6.10	300	11.81	150	5.91	155	6.10	300	11.81	150	5.91
R9	200	7.87	300	11.81	150	5.91	200	7.87	300	11.81	150	5.91

¹⁾ Free space above is measured from the frame, not from the hood used in UL Type 12 frames.

Note: The height of the hood for frame R4 and R9 exceeds the requirement of free space above for these frames.

Frame size	Hood height (mm)	Hood height (in)
R4	72	2.83
R9	230	9.06

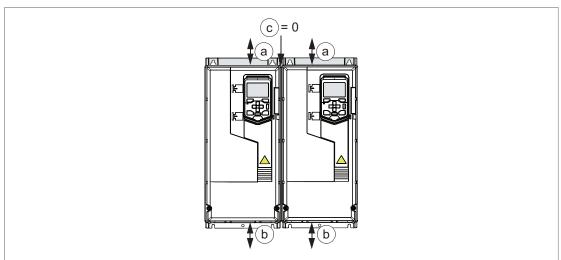
²⁾ Free space below is always measured from the drive frame, not from the cable box.



Note: The recommended free space above and below the drive is for installations where the drive is mounted on a wall indoors. For ABB cabinet-built drives, which are thermally tested and approved for a specified temperature range, free space could vary from this recommendation.



• Vertical side by side or between walls



Frame size	Vertical installation side by side - Free space, IP21 (UL Type 1)							
	Abov	re (a) ¹⁾	Belov	w (b) ²⁾	Between (c) ³⁾			
	mm	in	mm	in	mm	in		
R4	200	7.87	200	7.87	0	0		
R5	200	7.87	200	7.87	0	0		
R6	200	7.87	300	11.8	0	0		
R7	200	7.87	300	11.8	0	0		
R8	200	7.87	300	11.8	0	0		
R9	200	7.87	300	11.8	0	0		

¹⁾ Free space above is measured from the frame, not from the hood used in UL Type 12 frames.

Note: The height of the hood for frame R9 exceeds the requirement of free space above for these frames

Frame size	Hood height (mm)	Hood height (in)		
R9	230	9.06		

- ²⁾ Free space below is always measured from the drive frame, not from the cable box.
- 3) Free space between the drives.

Note: The recommended free space above and below the drive is for installations where the drive is mounted on a wall indoors. For ABB cabinet-built drives, which are thermally tested and approved for a specified temperature range, free space could vary from this recommendation.

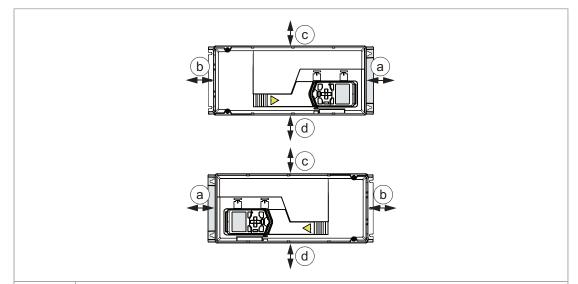


Note 1: You can install IP21/UL Type 1 drives horizontally but the installation meets IP20 requirements only.

 $\textbf{Note 2:} \ \mathsf{IP55/UL} \ \mathsf{Type} \ \mathsf{12} \ \mathsf{drives} \ \mathsf{mounted} \ \mathsf{horizontally} \ \mathsf{meets} \ \mathsf{IP21/UL} \ \mathsf{Type} \ \mathsf{1} \ \mathsf{ratings}.$

Note 2: In the horizontal mounting, the drive is not protected from dripping water.

Note 3: The vibration specification in Ambient conditions (page 170) may not be fulfilled.



Frame	Horizontal installation - Free space								
size		IP21	(IP20)		IP55 (UL Type 12)				
	Abov	re (a)	Below (b) ¹⁾		Above (a)		Below (b) ¹⁾		
	mm	in	mm	in	mm	in	mm	in	
R4	30	1.18	200	7.87	30	1.18	200	7.87	
R5	30	1.18	200	7.87	30	1.18	200	7.87	
Frame	Side up (c)		Side down (d)		Side up (c)		Side down (d)		
size	mm	in	mm	in	mm	in	mm	in	
R4	30	1.18	200	7.87	30	1.18	200	7.87	
R5	30	1.18	200	7.87	30	1.18	200	7.87	

¹⁾ Free space below is always measured from the drive frame, not from the cable box.



Necessary tools

To move a heavy drive, you need a crane, forklift or pallet truck (examine the load capacity).

To lift a heavy drive, you need a hoist.

To install the drive mechanically, you need these tools:

- drill with suitable bits
- screwdriver set (Torx, Phillips, flat and/or Pozidriv, as appropriate)
- torque wrench
- socket set, Hex key set (metric)
- tape measure, if you will not be using the provided mounting template.

Moving the drive

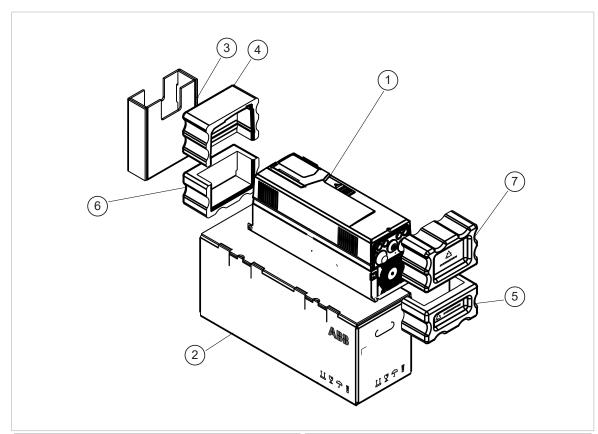
Frames R5...R9: Move the transport package by pallet truck to the installation site.



Unpacking and examining delivery

Frame R4

The figure below shows the layout of the transport package. Examine that all items are present and there are no signs of damage. Read the data on the type designation label of the drive to make sure that the drive is of the correct type. See section Type designation label (page 36).



- 1 Drive
- 2 Cardboard box. Mounting template in the cardboard box.
- 3 Option support:
 - Quick installation and start-up guide
 - Control panel selected in the order (in a separate package) in the option box
 - Possible options in separate packages, if they have been ordered with a plus code, such as for example +K490 (FEIP-21 Twoport EtherNet/IP adapter module) in the option box
- 4 Top cushion5 Bottom cushion6 Bottom cushion

Note: Hardware and firmware manuals can be ordered as a separate kit, see Manual kit ordering codes (page 39)

Top cushion

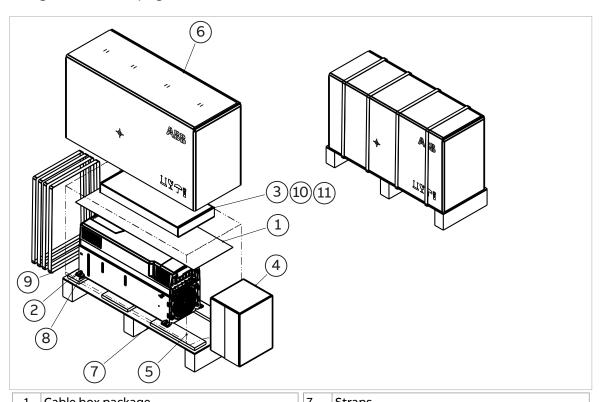
To unpack:

- Open box (2)
- Remove option support (3)
- Remove top cushions (4,7)
- Lift the drive (1) and remove bottom cushions (5,6).

Recycle the package material according to local regulations.



The figure below shows the layout of the transport package. Examine that all items are present and there are no signs of damage. Read the data on the type designation label of the drive to make sure that the drive is of the correct type. See section Type designation label (page 36).



V2)
al

1	Cable box package.
	Note: The cable box is mounted to the IP55 drive module frame at the factory.
2	Drive
3	In the option box
	Quick installation and start-up guide
4	Cardboard box. Mounting template in the cardboard box.
	Note: The cable box is mounted to the IP55 drive module frame at the factory.
5	Stopper
6	Cover protecting film

1	Straps
8	Pallet
9	Control panel selected in the order (in a separate package) in the option box
10	Possible options in separate packages, if they have been ordered with a plus code, such as for example +K490 (FEIP-21 Two-port Ether-Net/IP adapter module) in the option box.

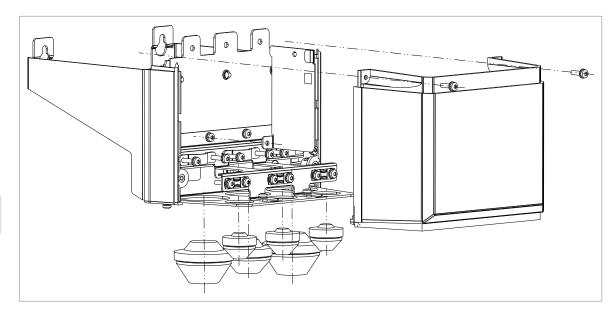
Note: Hardware and firmware manuals can be ordered as a separate kit, see Manual kit ordering codes (page 39)

To unpack:

- Cut the straps (7).
- Remove the cardboard box (4) and option box (3).
- Remove the cover protecting film (6).
- Remove the fixing brackets (2).
- Lift the drive (2).

Frame R5 cable box (IP21, UL Type 1)

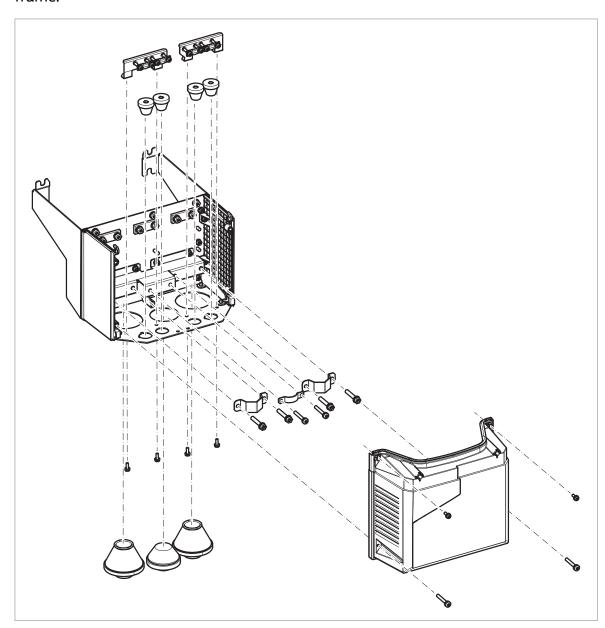
This illustration shows the contents of the cable box package. The package also includes an assembly drawing which shows how to install the cable box to the drive module frame.





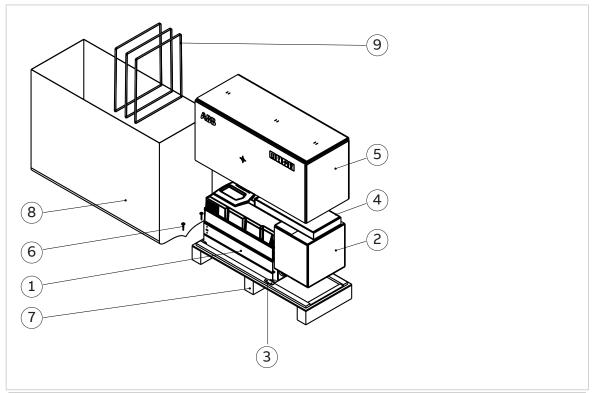
Frame R6 cable box (IP21, UL Type 1)

The figure below shows the contents of the cable box package. The package also includes an assembly drawing which shows how to install the cable box to the drive frame.





Unpacking and examining delivery, frame R7





1	Drive with factory installed options							
2	Cable box (not with option +B056, +C135 or +P944).							
	Note: The cable box is mounted to the IP55 drive module frame at the factory.							
3	Packing brackets, 2 pcs							
4	In the option tray:							
	Quick installation and start-up guide							
5	Cardboard box							
6	Fixing screws, 2 pcs							
7	Pallet							
8	VCI bag for protecting against corrosion							
9	Straps							

To unpack:

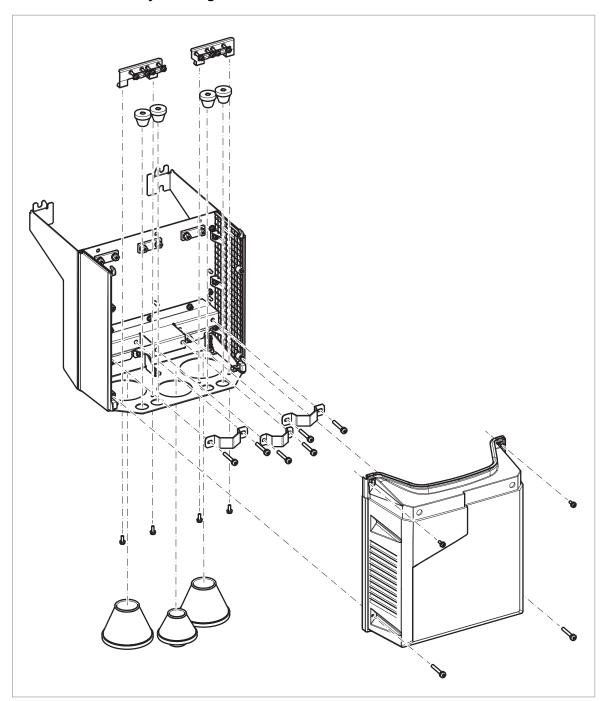
- Cut the straps (9).
- Remove the cardboard box (5) and option tray (4).
- Remove the VCI bag (8).
- Attach lifting hooks to the lifting eyes of the drive (see the figure in section Safety (page 41)).
- Lift the drive with a hoist.

Recycle the package material according to local regulations.



Frame R7 cable box (IP21, UL Type 1)

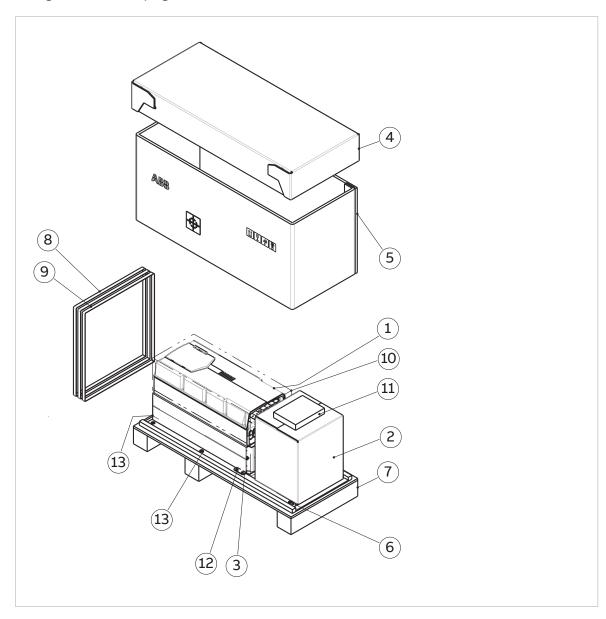
The figure below shows the contents of the cable box package. The package also includes an assembly drawing which shows how to install cable box to the drive frame.





Unpacking and examining delivery, frames R8 and R9

The figure below shows the layout of the transport package. Examine that all items are present and there are no signs of damage. Read the data on the type designation label of the drive to make sure that the drive is of the correct type. See section Type designation label (page 36).





1	Cable box. Power and control cable groundin shelves in a plastic bag, assembly drawing.					
	Note: The cable box is mounted to the IP55 drive module frame at the factory.					
2	Drive with factory installed options					
3	Cardboard box					
4	Straps					
5	VCI bag for protecting against corrosion					
6	Pallet					
7	Stopper					
8	Option tray					
9	In the option tray • Quick installation and start-up guide kit					

	10	Control panel selected in the order (in a separate package) in the option tray North America: Control panel factory installed
	11	Possible options in separate packages, if they have been ordered with a plus code, such as for example +K490 (FEIP-21 Two-port Ether-Net/IP adapter module) in the option box. North America: Options may be ordered as factory installed
1	12	Mounting template on top of the option tray

Note: Hardware and firmware manuals can be ordered as a separate kit, see Manual kit ordering codes (page 39)

To unpack:

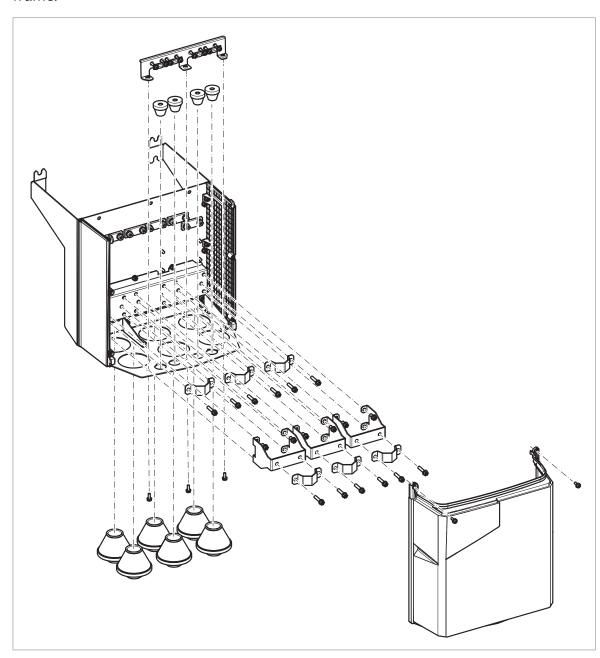
- Cut the straps (4).
- Remove the cardboard box (3) and option tray (8).
- Remove the VCI bag (5).
- Attach lifting hooks to the lifting eyes of the drive (see the figure in section Safety (page 41)).
- Lift the drive with a hoist.

Recycle the package material according to local regulations.



Frame R8 cable box (IP21, UL Type 1)

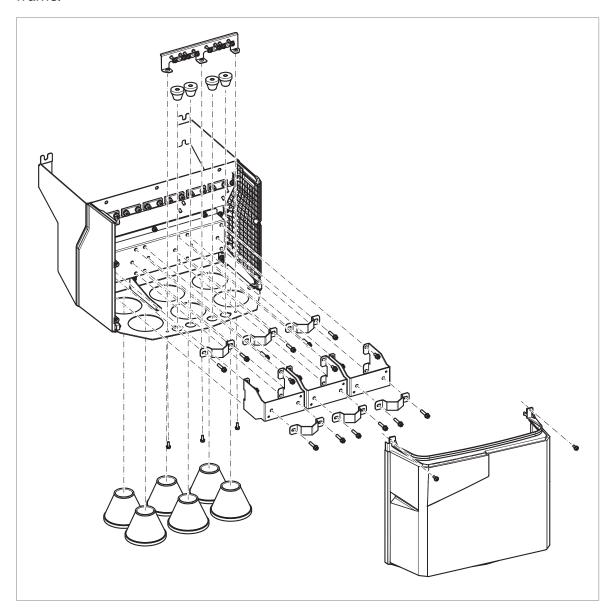
The figure below shows the contents of the cable box package. The package also includes an assembly drawing which shows how to install the cable box to the drive frame.





Frame R9 cable box (IP21, UL Type 1)

The figure below shows the contents of the cable box package. The package also includes an assembly drawing which shows how to install the cable box to the drive frame.



Installing the drive

Installing the drive vertically, frame R4

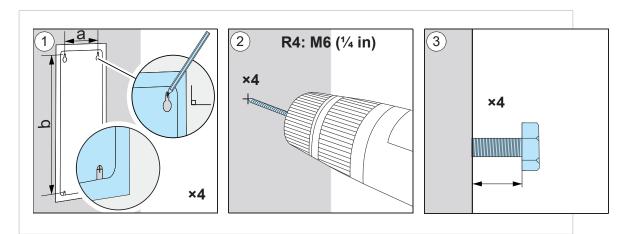
The figures show frame R4 as an example.

Select fasteners and their application to meet local requirements appropriate to wall surface materials, drive weight and application.

- 1. Mark the hole locations using the mounting template included in the package. Do not leave the mounting template under the drive. The drive dimensions and hole locations are also shown in the drawings in chapter id(39347)ACx580-01_Dimension drawings.xml.
- 2. Drill the mounting holes.

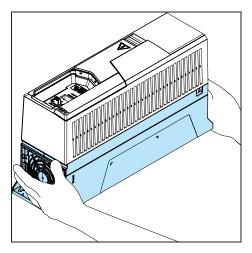


3. Insert anchors or plugs into the holes and start the bolts into the anchors or plugs.



	R4				
	mm in				
a	160	6.30			
b	619	24.37			
Weight IP21	kg	lb			
(UL Type 1)	19.0	41.9			
Weight IP55	kg	lb			
(UL Type 12)	20.0	44.1			

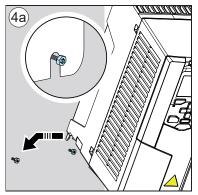
4. Position the drive onto the lower bolts (4a) on the wall to support the weight of the drive. Rotate drive to the wall and place drive over the upper bolts (4b).

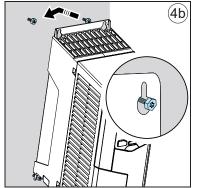


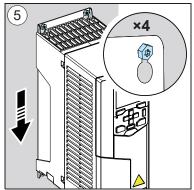


5. Tighten the bolts in the wall securely.





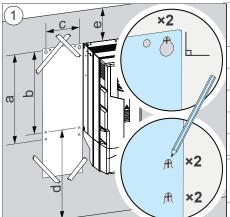




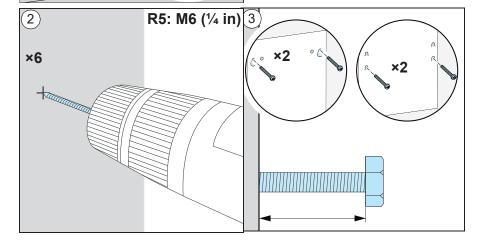
Installing the drive vertically, frame R5

Select fasteners and their application to meet local requirements appropriate to wall surface materials, drive weight and application.

- Mark the hole locations using the mounting template included in the package. Do
 not leave the mounting template under the drive. The drive dimensions and hole
 locations are also shown in the drawings in chapter Dimension drawings (page 181).
- 2. Drill the mounting holes.
- 3. Insert fixing anchors or plugs into the holes. Start the two upper bolts and the two lowest bolts into the anchors or plugs.



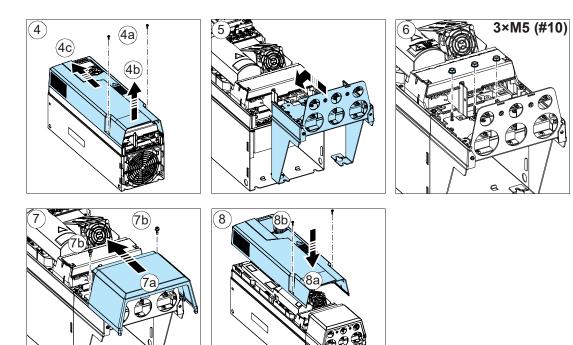
	R5 IP21 (UL Type 1)		R5 IP55 (UL Type 12)			
	mm	in	mm	in		
a	612	24.09	612	24.09		
b	581	22.87	581	22.87		
С	160	6.30	160	6.30		
d >	200	7.87	200	7.87		
e >	100	3.94	100	3.94		
\wedge	kg	lb	kg	lb		
	28.3	62.4	29.0	64.0		



IP21 (UL Type 1)

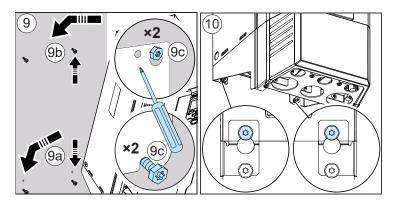


- 4. Remove the front cover: Remove the fastening screws (4a) with a T20 Torx screwdriver and lift the cover from the bottom upwards (4b) and then to the top side (4c).
- 5. Attach the cable box to the drive frame.
- 6. Tighten the box nuts.
- 7. Slide the box cover from the bottom (7a) and tighten the retaining screws (7b).
- 8. Put the tabs at the top of the front cover in their counterparts on the housing and then press at the bottom (8a) and tighten the retaining screws (8b).



IP21 (UL Type 1), IP55 (UL Type 12)

- 9. Position the drive onto the lower bolts (9a) on the wall to support the weight of the drive. Rotate drive to the wall and place drive over the upper bolts (9b). Lift the drive with another person or with a lifting device as it is heavy. Tighten the bolts in the wall securely (9c).
- 10. Tighten the two remaining bolts securely.



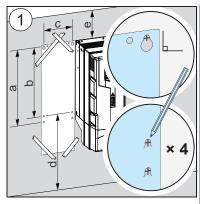


Installing the drive vertically, frames R6...R9

Select fasteners and their application to meet local requirements appropriate to wall surface materials, drive weight and application.

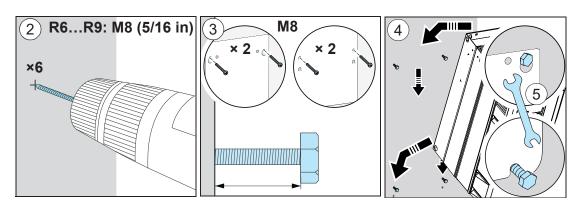
 Mark the hole locations for the six mounting holes using the mounting template included in the package. Do not leave the mounting template under the drive. The drive dimensions and hole locations are also shown in the drawings in chapter Dimension drawings (page 181).

Note: You can use only two bolts instead of four to attach the lower part of the drive.



R6		R	R7		R8		9	
	mm	in	mm	in	mm	in	mm	in
a	571	22.5	623	24.5	701	27.6	718	28.3
b	531	20.9	583	23.0	658	25.9	658	25.9
С	213	8.4	245	9.7	263	10.3	345	13.6
d	300	11.8	300	11.8	300	11.8	300	11.8
е	155	6.1	155	6.1	155	6.19	200	7.9
IP21, UL Type 1	kg	lb	kg	lb	kg	lb	kg	lb
\triangle	42.4	93.5	54	119.1	69	152.2	97	213.9
IP55, UL Type 12	kg	lb	kg	lb	kg	lb	kg	lb
\triangle	43	94.8	56	123.5	77	169.8	103	227.1

- 2. Drill the mounting holes.
- 3. Insert fixing anchors or plugs into the holes and start the bolts into the anchors or plugs.
- 4. Position the drive onto the bolts on the wall. Lift the drive with a lifting device as it is heavy.
- 5. Tighten the top two bolts in the wall securely.

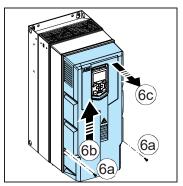


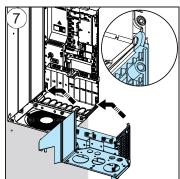
IP21 (UL Type 1)

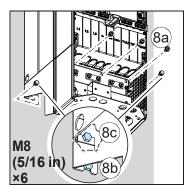
6. Remove the front cover: Remove the fastening screws (a) with a T20 Torx screwdriver, move the cover to the top side (b) and then up (c).



- 7. Attach the cable box to the drive frame.
- 8. Tighten the box bolts: three at the top (8a) and two at the bottom (8b). Also tighten the bottom bolts started in step 3 (8c).



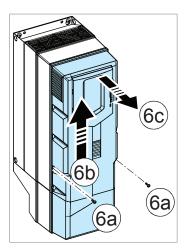






IP55 (UL Type 12)

9. Remove the front cover: Remove the fastening screws (a) with a T20 Torx screwdriver, move the cover to the top side (b) and then up (c).



Installing the drive vertically side by side

Install the drive following the steps in the appropriate section Installing the drive vertically, frame R4 (page 58) or Installing the drive vertically, frame R5 (page 60).

Installing the drive horizontally, frames R4...R5

Install the drive following the steps in the appropriate section Installing the drive vertically, frame R4 (page 58) or Installing the drive vertically, frame R5 (page 60). The drive can be installed either to the left or right side up.

Cabinet installation (options +P940 and +P944)

See:

Name	Code (English)
Drive modules cabinet design and construction instructions	3AUA0000107668



5

Guidelines for planning the electrical installation

Contents of this chapter

This chapter contains guidelines for planning the electrical installation of the drive.

Limitation of liability

The installation must always be designed and made according to applicable local laws and regulations. ABB does not assume any liability whatsoever for any installation which breaches the local laws and/or other regulations. Furthermore, if the recommendations given by ABB are not followed, the drive may experience problems that the warranty does not cover.

Selecting the main supply disconnecting device

You must equip the drive with a main supply disconnecting device which meets the local safety regulations. You must be able to lock the disconnecting device to the open position for installation and maintenance work.

To comply with European Union directives and United Kingdom regulations related to standard EN 60204-1, the disconnecting device must be one of these types:

- switch-disconnector of utilization category AC-23B (IEC 60947-3)
- disconnector that has an auxiliary contact that in all cases causes switching devices to break the load circuit before the opening of the main contacts of the disconnector (EN 60947-3)
- circuit-breaker suitable for isolation in accordance with IEC 60947-2.

DC solar PV power supply

When you perform maintenance or wiring activities in the drive cabinet, make sure that:

- you disconnect the solar PV power supply at the string combiner box level or
- remove the solar PV connections before installing the drive cabinet or
- remove DC fuse inside the drive cabinet or
- switch off the DC main circuit breaker (if available).

Note: DC power is available until the input terminal.

Examining the compatibility of the motor and drive

Use asynchronous AC induction motors, permanent magnet synchronous motors or ABB synchronous reluctance motors (SynRM motors) with the drive.

Select the motor size and drive type from the rating table on basis of the AC line voltage and motor load. You can find the rating table in the appropriate hardware manual. You can also use the DriveSize PC tool.

Make sure that the motor can be used with an AC drive. See Requirements tables (page 66). For basics of protecting the motor insulation and bearings in drive systems, see Protecting the motor insulation and bearings (page 66).

Note:

- Consult the motor manufacturer before using a motor with nominal voltage that differs from the AC line voltage connected to the drive input.
- The voltage peaks at the motor terminals are relative to the supply voltage of the drive, not to the drive output voltage.

Protecting the motor insulation and bearings

The drive employs modern IGBT inverter technology. Regardless of frequency, the drive output comprises pulses of approximately the drive DC bus voltage with a very short rise time. The pulse voltage can almost double at the motor terminals, depending on the attenuation and reflection properties of the motor cable and the terminals. This can cause additional stress on the motor and motor cable insulation.

Modern variable speed drives with their fast rising voltage pulses and high switching frequencies can generate current pulses that flow through the motor bearings. This can gradually erode the bearing races and rolling elements.

du/dt filters protect motor insulation system and reduce bearing currents. Common mode filters mainly reduce bearing currents. Insulated N-end (non-drive end) bearings protect the motor bearings.

Requirements tables

These tables show how to select the motor insulation system and when a drive du/dt and common mode filters and insulated N-end (non-drive end) motor bearings are

required. Ignoring the requirements or improper installation may shorten motor life or damage the motor bearings and voids the warranty.

Requirements for ABB motors, $P_{\rm n}$ < 100 kW (134 hp)

See also Abbreviations (page 70).

Motor type	Nominal AC line	Requirement for		
	voltage	Motor insula- tion system	ABB du/dt and common mode filters, insulate N-end motor bearings	
			P _n < 100 kW and frame size < IEC 315	
			$P_{\rm n}$ < 134 hp and frame size < NEMA 500	
Random-wound	<i>U</i> _n ≤ 500 V	Standard	-	
M2_, M3_ and M4_	500 V < <i>U</i> _n ≤ 600 V	Standard	+ du/dt	
		Reinforced	-	
	$600 \text{ V} < U_{\text{n}} \le 690 \text{ V}$ (cable length \le 150 m)	Reinforced	+ du/dt	
	600 V < $U_n \le 690 \text{ V}$ (cable length > 150 m)	Reinforced	-	
Form-wound HX_ and AM_	$380 \text{ V} < U_{\text{n}} \le 690 \text{ V}$	Standard	N/A	
Old ¹⁾ form-wound HX_ and modular	380 V < <i>U</i> _n ≤ 690 V	Check with the motor manufac- turer.	+ N + d <i>u</i> /d <i>t</i> with voltages over 500 V + CMF	
Random-wound HX_	0 V < <i>U</i> _n ≤ 500 V	Enamelled	+ N + CMF	
and AM_ ²⁾	500 V < <i>U</i> _n ≤ 690 V	wire with fiber glass taping	+ N + d <i>u</i> /d <i>t</i> + CMF	
HDP	Consult the motor manufacturer.			

¹⁾ manufactured before 1.1.1998

 $^{^{2}}$) For motors manufactured before 1.1.1998, check for additional instructions with the motor manufacturer.

Requirements for ABB motors, $P_n \ge 100 \text{ kW}$ (134 hp)

See also Abbreviations (page 70).

Motor type	Nominal AC line	Requirement for			
	voltage	Motor insula- tion system	ABB du/dt and common mode filters, insulated N-end motor bearings		
			100 kW ≤ P _n < 350 kW or IEC 315 ≤ frame size < IEC 400	P _n ≥ 350 kW or frame size ≥ IEC 400	
			134 hp ≤ <i>P</i> _n < 469 hp or NEMA 500 ≤ frame size ≤ NEMA 580	P _n ≥ 469 hp or frame size > NEMA 580	
Random-wound	<i>U</i> _n ≤ 500 V	Standard	+ N	+ N + CMF	
M2_, M3_ and M4_	500 V < <i>U</i> _n ≤ 600 V	Standard	+ N + d <i>u</i> /d <i>t</i>	+ N + d <i>u</i> /d <i>t</i> + CMF	
		Reinforced	+ N	+ N + CMF	
	600 V < U _n ≤ 690 V (cable length ≤ 150 m)	Reinforced	+ N + du/dt	+ N + du/dt + CMF	
	600 V < U _n ≤ 690 V (cable length > 150 m)	Reinforced	+ N	+ N + CMF	
Form-wound HX_	380 V < <i>U</i> _n ≤ 690 V	Standard	+ N + CMF	P _n < 500 kW: +N + CMF	
and AM_				$P_{\rm n} \ge 500 \text{ kW: +N +}$ du/dt + CMF	
Old ¹⁾ form-wound HX_ and modular	380 V < <i>U</i> _n ≤ 690 V	Check with the motor manufac- turer.	+ N + du/dt with volta	ages over 500 V + CMF	
Random-wound HX_	0 V < <i>U</i> _n ≤ 500 V	Enamelled	+ N + CMF + N + du/dt + CMF		
and AM_ ²⁾	500 V < <i>U</i> _n ≤ 690 V	wire with fiber glass taping			
HDP	Consult the motor r	nanufacturer.			
		· .			

manufactured before 1.1.1998
 For motors manufactured before 1.1.1998, check for additional instructions with the motor manufacturer.

Requirements for non-ABB motors, $P_{\rm n}$ < 100 kW (134 hp)

See also Abbreviations (page 70).

Motor type	Nominal AC line	Requirement for		
	voltage	Motor insula- tion system	ABB du/dt and common mode filters, insulated N-end motor bearings	
			P _n < 100 kW and frame size < IEC 315	
			P _n < 134 hp and frame size < NEMA 500	
Random-wound and form-wound	<i>U</i> _n ≤ 420 V	Standard: $\hat{U}_{LL} = 1300 \text{ V}$	-	
	$420 \text{ V} < U_{\text{n}} \le 500 \text{ V}$ $500 \text{ V} < U_{\text{n}} \le 600 \text{ V}$ $600 \text{ V} < U_{\text{n}} \le 690 \text{ V}$	Standard: \hat{U}_{LL} = 1300 V	+ du/dt	
		Reinforced: \hat{U}_{LL} = 1600 V, 0.2 µs rise time	-	
		Reinforced: \hat{U}_{LL} = 1600 V	+ du/dt	
		Reinforced: \hat{U}_{LL} = 1800 V	-	
		Reinforced: \hat{U}_{LL} = 1800 V	+ du/dt	
		Reinforced: \hat{U}_{LL} = 2000 V, 0.3 μs rise time 1)	-	

¹⁾ If the intermediate DC circuit voltage of the drive is increased from the nominal level due to long term resistor braking cycles, check with the motor manufacturer if additional output filters are needed.

Requirements for non-ABB motors, $P_n \ge 100 \text{ kW}$ (134 hp)

See also Abbreviations (page 70).

Motor type	Nominal AC line voltage	Requirement for			
		Motor insula- tion system	ABB du/dt and common mode filters, insulated N-end motor bearings		
			100 kW $\leq P_{\rm n}$ < 350 kW or IEC 315 \leq frame size < IEC 400	P _n ≥ 350 kW or frame size ≥ IEC 400	
			134 hp ≤ <i>P</i> _n < 469 hp or NEMA 500 ≤ frame size ≤ NEMA 580	P _n ≥ 469 hp or frame size > NEMA 580	
Random-wound and form-wound	<i>U</i> _n ≤ 420 V	Standard: $\hat{\mathcal{U}}_{\text{LL}}$ = 1300 V	+ N or CMF	+ N + CMF	
	$420 \text{ V} < U_{\text{n}} \le 500 \text{ V}$ $500 \text{ V} < U_{\text{n}} \le 600 \text{ V}$	Standard: $\hat{U}_{LL} = 1300 \text{ V}$	+ d <i>u</i> /d <i>t</i> + (N or CMF)	+ N + d <i>u</i> /d <i>t</i> + CMF	
		Reinforced: \hat{U}_{LL} = 1600 V, 0.2 μs rise time	+ N or CMF	+ N + CMF	
		Reinforced: \hat{U}_{LL} = 1600 V	+ du/dt + (N or CMF)	+ N + d <i>u</i> /d <i>t</i> + CMF	
		Reinforced: \hat{U}_{LL} = 1800 V	+ N or CMF	+ N + CMF	
	600 V < <i>U</i> _n ≤ 690 V	Reinforced: \hat{U}_{LL} = 1800 V	+ du/dt + N	+ N + d <i>u</i> /d <i>t</i> + CMF	
		Reinforced: \hat{U}_{LL} = 2000 V, 0.3 μs rise time 1)	+ N + CMF	+ N + CMF	

¹⁾ If the intermediate DC circuit voltage of the drive is increased from the nominal level due to long term resistor braking cycles, check with the motor manufacturer if additional output filters are needed.

Abbreviations

Abbr.	Definition
U _n	Nominal AC line voltage
Û _{LL}	Peak line-to-line voltage at motor terminals which the motor insulation must withstand
P _n	Motor nominal power
du/dt	du/dt filter at the output of the drive
CMF	Common mode filter of the drive
N	N-end bearing: insulated motor non-drive end bearing
n.a.	Motors of this power range are not available as standard units. Consult the motor manufacturer.

Availability of du/dt filter and common mode filter by drive type

See chapter Common mode, du/dt and sine filters

Additional requirements for explosion-safe (EX) motors

If you use an explosion-safe (EX) motor, obey the rules in the requirements table above. In addition, consult the motor manufacturer for any further requirements.

Additional requirements for ABB motors of types other than M2_, M3_, M4_, HX_ and AM_

Use the selection criteria given for non-ABB motors.

Additional requirements for the regenerative and low harmonics drives

It is possible to increase the intermediate circuit DC voltage from the nominal (standard) level with a parameter in the control program. If you choose to do this, select the motor insulation system which withstands the increased DC voltage level.

Additional requirements for ABB high-output and IP23 motors

The rated output power of high output motors is higher than what is stated for the particular frame size in EN 50347 (2001).

This table shows the requirements for protecting the motor insulation and bearings in drive systems for ABB random-wound motor series (for example, M3AA, M3AP and M3BP).

Nominal AC supply	Requirement for				
voltage	Motor insulation system	ABB du/dt and cor	nmon mode filters, ir bearings	de filters, insulated N-end motor arings	
		P _n < 100 kW	100 kW ≤ <i>P</i> _n < 200 kW	$P_{\rm n} \ge 200 \text{ kW}$ $P_{\rm n} \ge 268 \text{ hp}$	
		<i>P</i> _n < 140 hp	140 hp ≤ <i>P</i> _n < 268 hp		
<i>U</i> _n ≤ 500 V	Standard	-	+ N	+ N + CMF	
500 V < <i>U</i> _n ≤ 600 V	Standard	+ du/dt	+ d <i>u</i> /d <i>t</i> + N	+ du/dt + N + CMF	
	Reinforced	-	+ N	+ N + CMF	
600 V < <i>U</i> _n ≤ 690 V	Reinforced	+ du/dt	+ d <i>u</i> /d <i>t</i> + N	+ d <i>u</i> /d <i>t</i> + N + CMF	

Additional requirements for non-ABB high-output and IP23 motors

The rated output power of high-output motors is higher than what is stated for the particular frame size in EN 50347 (2001).

If you plan to use a non-ABB high-output motor or an IP23 motor, consider these additional requirements for protecting the motor insulation and bearings in drive systems:

- If motor power is below 350 kW: Equip the drive and/or motor with the filters and/or bearings according to the table below.
- If motor power is above 350 kW: Consult the motor manufacturer.

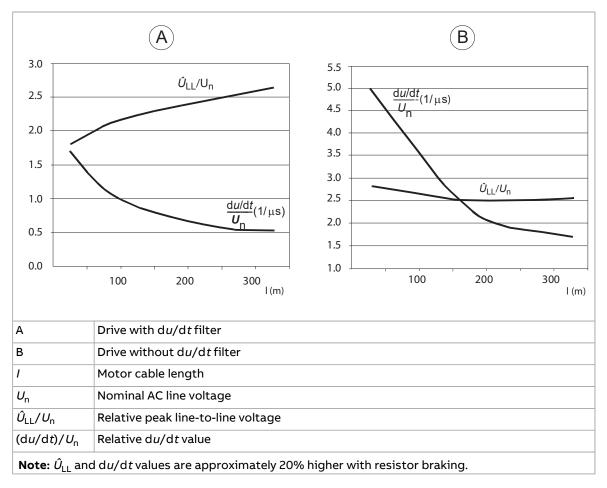
Nominal AC supply voltage	Requirement for		
	Motor insulation system	ABB du/dt and common mode filters, insulated Nend motor bearings	
		P _n < 100 kW or frame size < IEC 315	100 kW < P _n < 350 kW or IEC 315 < frame size < IEC 400
		P _n < 134 hp or frame size < NEMA 500	134 hp < P _n < 469 hp or
			NEMA 500 < frame size < NEMA 580
<i>U</i> _n ≤ 420 V	Standard: \hat{U}_{LL} = 1300 V	+ N or CMF	+ N or CMF
420 V < <i>U</i> _n < 500 V	Standard: \hat{U}_{LL} = 1300 V	+ du/dt + (N or CMF)	+ N + du/dt + CMF
	Reinforced: \hat{U}_{LL} = 1600 V, 0.2 microsecond rise time	+ N or CMF	+ N or CMF
500 V < <i>U</i> _n ≤ 600 V	Reinforced: \hat{U}_{LL} = 1600 V	+ du/dt + (N or CMF)	+ N + du/dt + CMF
	Reinforced: \hat{U}_{LL} = 1800 V	+ N or CMF	+ N + CMF
600 V < <i>U</i> _n ≤ 690 V	Reinforced: \hat{U}_{LL} = 1800 V	+ N + d <i>u</i> /d <i>t</i>	+ N + du/dt + CMF
	Reinforced: \hat{U}_{LL} = 2000 V, 0.3 microsecond rise time ¹⁾	+ N + CMF	+ N + CMF

¹⁾ If the intermediate DC circuit voltage of the drive is increased from the nominal level due to long term resistor braking cycles, check with the motor manufacturer if additional output filters are needed.

Additional data for calculating the rise time and the peak line-to-line voltage

The diagrams below show the relative peak line-to-line voltage and rate of change of voltage as a function of the motor cable length. If you need to calculate the actual peak voltage and voltage rise time considering the actual cable length, proceed as follows:

- Peak line-to line voltage: Read the relative \hat{U}_{LL}/U_n value from the diagram below and multiply it by the nominal supply voltage (U_n) .
- Voltage rise time: Read the relative values \hat{U}_{LL}/U_n and $(du/dt)/U_n$ from the diagram below. Multiply the values by the nominal supply voltage (U_n) and substitute into equation $t = 0.8 \cdot \hat{U}_{LL}/(du/dt)$.



Additional note for sine filters

A sine filter also protects the motor insulation system. The peak phase-to-phase voltage with a sine filter is approximately $1.5 \cdot U_n$.

Selecting the power cables

General guidelines

Select the input power and motor cables according to local regulations.

- **Current:** Select a cable capable of carrying the maximum load current and suitable for the prospective short-circuit current provided by the supply network. The method of installation and ambient temperature affect the cable current carrying capacity. Obey local regulations and laws.
- Temperature: For an IEC installation, select a cable rated for at least 70 °C (158 °F) maximum permissible temperature of conductor in continuous use.
 For North America, select a cable rated for at least 75 °C (167 °F).
 Important: For certain product types or option configurations higher temperature rating may be required. See the technical data for details.
- Voltage: 600 V AC cable is accepted for up to 500 V AC. 750 V AC cable is accepted for up to 600 V AC. 1000 V AC cable is accepted for up to 690 V AC.

To comply with the EMC requirements of the CE mark, use one of the preferred cable types. See Preferred power cable types (page 74).

Symmetrical shielded cable reduces electromagnetic emission of the whole drive system as well as the stress on motor insulation, bearing currents and wear.

Metal conduit reduces electromagnetic emission of the whole drive system.

Typical power cable sizes

See the technical data.

Power cable types

Preferred power cable types

This section shows the preferred cable types. Make sure that the selected cable type also complies with local/state/country electrical codes.

Cable type	Use as input power cabling	Use as motor cabling and as brake resistor cabling
Symmetrical shielded (or armored) cable with three phase conductors and concentric PE conductor as shield (or armor)	Yes	Yes
Symmetrical shielded (or armored) cable with three phase conductors and symmetrically constructed PE conductor and a shield (or armor)	Yes	Yes
Symmetrical shielded (or armored) cable with three phase conductors and a shield (or armor), and separate PE conductor/cable 1)	Yes	Yes

¹⁾ A separate PE conductor is required if the conductivity of the shield (or armor) is not sufficient for the PE use.

Alternate power cable types

Cable type	Use as input power cabling	Use as motor cabling and as brake resistor cabling
	Yes with phase conductor smaller than 10 mm² (8 AWG) Cu.	Yes with phase conductor smaller than 10 mm ² (8 AWG) Cu, or mo- tors up to 30 kW (40 hp).
Four-conductor cable in plastic jacket (three phase conductors and PE)		Note: Shielded or armored cable, or cabling in metal conduit is always recommended to minimize radio frequency interference.
Four-conductor armored cable (three phase conductors and PE)	Yes	Yes with phase conductor smaller than 10 mm ² (8 AWG) Cu, or mo- tors up to 30 kW (40 hp)
	Yes	Yes with motors up to 100 kW (135 hp). A potential equalization between the frames of motor and driven equipment is required.
Shielded (Al/Cu shield or armor) 1) four-conductor cable (three phase conductors and a PE)		

¹⁾ Armor may act as an EMC shield, as long as it provides the same performance as a concentric EMC shield of a shielded cable. To be effective at high frequencies, the shield conductivity must be at least 1/10 of the phase conductor conductivity. The effectiveness of the shield can be evaluated based on the shield inductance, which must be low and only slightly dependent on frequency. The requirements are easily met with a copper or aluminum shield/armor. The cross-section of a steel shield must be ample and the shield helix must have a low gradient. A galvanized steel shield has a better high-frequency conductivity than a non-galvanized steel shield.

Not allowed power cable types

Cable type	Use as input power cabling	Use as motor cabling and as brake resistor cabling
Symmetrical shielded cable with individual shields for each phase conductor		No

Selecting AC power cables

The below table gives the copper cable types with concentric copper shield for the drives with nominal current. The value separated by plus sign means the diameter of PE conductor.

See page Terminal and entry data for the power cables for the cable entry sizes allowed for the selected drive frame size.

ACQ80-01	Frame size	Cu cable type ¹⁾
		mm²
030kW-4	R4	3×25 + 16
037kW-4	R4	3×35 + 16
045kW-4	R4	3×50 + 25
055kW-4	R5	3×70 + 35
075kW-4	R6	3×95 + 50
090kW-4	R7	3×120 + 70
110kW-4	R7	3×150 + 70
132kW-4	R8	2×(3×70+35)
160kW-4	R8	2×(3×95+50)
200kW-4	R9	2×(3×120+70)

¹⁾ The cable sizing is based on max. 6 cables laid on a cable ladder side by side, ambient temperature 30 °C, PVC insulation, surface temperature 70 °C (EN 60204-1 and IEC 60364-5-52/2001). For other conditions, size the cables according to local safety regulations, appropriate input voltage and the load current of the drive. See page Terminal and entry data for the power cables for the accepted cable sizes of the drive.

Selecting DC power cables

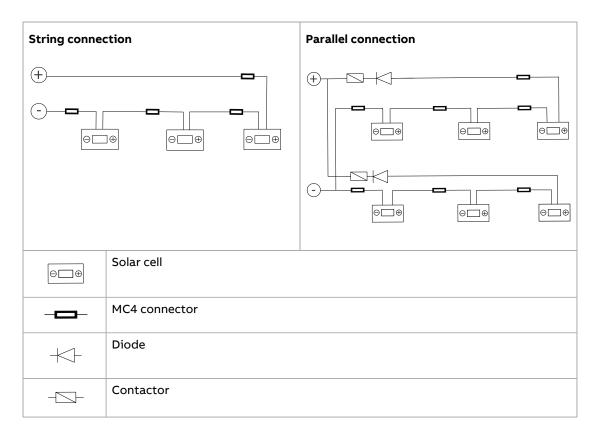
Consider the following conditions when selecting DC power cables:

• Make sure the DC cable can handle 1000 V open circuit voltage(VOC).



WARNING! Open joints in DC power cable wiring can cause damage of equipment or injury or loss of life of personal.

- Use MC4 type male and female connectors for all joints in DC cables between the solar module and drive.
- Use blocking and bypass diodes as per the solar module manufacturer's recommendation and local regulatory.



For more information on DC cables and cable bending rule, blocking and bypass diodes, see DC cable recommendation provided by solar cell manufacturer.

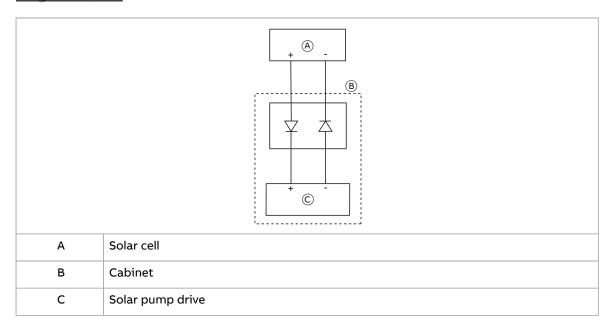
- The maximum length of DC cables between solar cell modules and drive must be decided based on the voltage drop specified by solar cell manufacturer or cable manufacturer.
- The drive needs 560 VDC as Voltage at maximum power (V_{mp)} with motor rated current to operate a 400 VAC motor at nominal speed.
 For information on calculation of required solar cell voltage and short-circuit current (Isc) for a motor at nominal conditions, see page 150.
- Unshielded single-core DC cable can be used inside the cabinet. If the DC cables are running outside the cabinet, use shielded three-core cables. The shield is connected only at one end. Maximum length is four meters.
- Consider DC power cable sizing same as the AC power cable sizing.

DC cable sizing

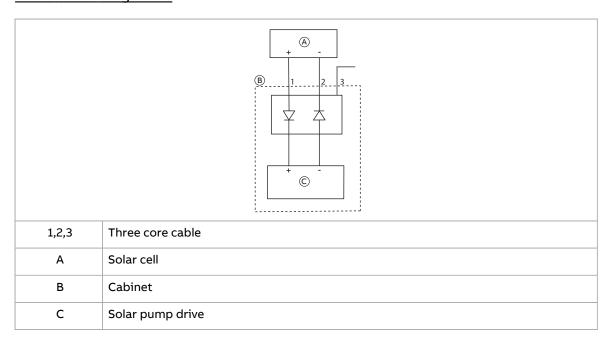
Obey the basic cabling guidelines given for AC drive systems. The most economical power cable for DC systems has an even number of conductors. You can also use a shielded three-core cable. The 2+1 or 1+2 principle of cabling (see in below figures) can be used when three-core cables are installed in large drive systems. Where several power cables are needed, this principle allows power sharing evenly between the cables.

78 Guidelines for planning the electrical installation

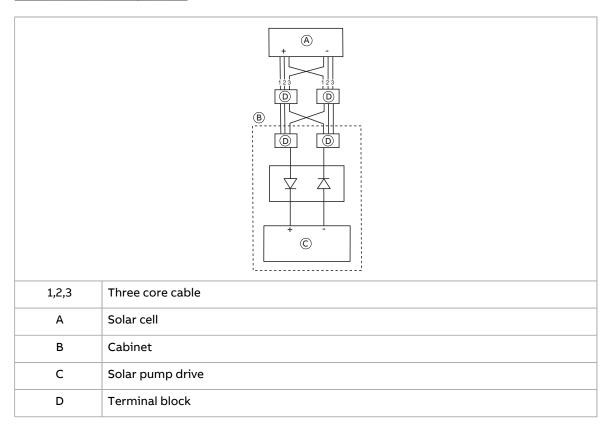
Single core run:



Three core - single run:



Three core - multiple run:



The excitation cable is a heavy source of interference because of the abrupt commutation. Make sure that shielded excitation cables are used to avoid any interference.

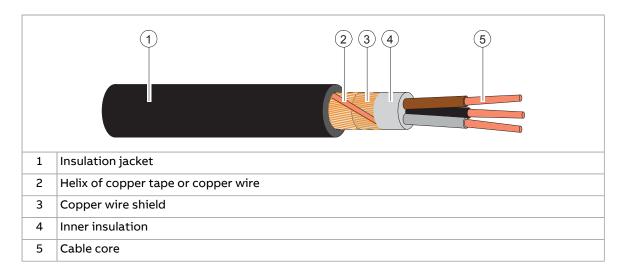
Do not use single-core cables for DC drives.

Make sure that the motors with stator serial winding has a grounding brush on the shaft to avoid bearing problems.

Power cable shield

If the cable shield is used as the sole protective earth (PE) conductor, make sure that its conductivity agrees with the PE conductor requirements.

To effectively suppress radiated and conducted radio-frequency emissions, the cable shield conductivity must be at least 1/10 of the phase conductor conductivity. The requirements are easily met with a copper or aluminum shield. The minimum requirement of the motor cable shield of the drive is shown below. It consists of a concentric layer of copper wires with an open helix of copper tape or copper wire. The better and tighter the shield, the lower the emission level and bearing currents.



Grounding requirements

This section gives general requirements for grounding the drive. When you plan the grounding of the drive, obey all the applicable national and local regulations.

The conductivity of the protective earth conductor(s) must be sufficient.

Unless local wiring regulations state otherwise, the cross-sectional area of the protective earth conductor must agree with the conditions that require automatic disconnection of the supply required in 411.3.2 of IEC 60364-4-41:2005 and be capable of withstanding the prospective fault current during the disconnection time of the protective device. The cross-sectional area of the protective earth conductor must be selected from the table below or calculated according to 543.1 of IEC 60364-5-54.

The table shows the minimum cross-sectional area of the protective earth conductor related to the phase conductor size according to IEC/UL 61800-5-1 when the phase conductor(s) and the protective earth conductor are made of the same metal. If they are different metals, the cross-sectional area of the protective earth conductor must be determined in a manner which produces a conductance equivalent to that which results from the application of this table.

Cross-sectional area of the phase conductors S (mm²)	$\label{eq:minimum} \begin{array}{c} \mbox{Minimum cross-sectional area of the corresponding} \\ \mbox{protective earth conductor} \\ \mbox{S}_{p} \mbox{ (mm}^{2}) \end{array}$
S ≤ 16	S ¹⁾
16 < S ≤ 35	16
35 < S	S/2

 $^{^{1\!} J}$ For the minimum conductor size in IEC installations, refer to Additional grounding requirements – IEC.

If the protective earth conductor is not part of the input power cable or input power cable enclosure, the minimum permitted cross-sectional area is:

- 2.5 mm² if the conductor is mechanically protected, or
- 4 mm² if the conductor is not mechanically protected. If the equipment is cord-connected, the protective earth conductor must be the last conductor to be interrupted if there is a failure in the strain relief mechanism.

Additional grounding requirements – IEC

This section gives grounding requirements according to standard IEC/EN 61800-5-1.

Because the normal touch current of the drive is more than 3.5 mA AC or 10 mA DC:

- the minimum size of the protective earth conductor must comply with the local safety regulations for high protective earth conductor current equipment, and
- you must use one of these connection methods:
 - 1. a fixed connection and:
 - a protective earth conductor with a minimum cross-sectional area of 10 mm² Cu or 16 mm² Al (as an alternative when aluminum cables are permitted),

or

 a second protective earth conductor of the same cross-sectional area as the original protective earth conductor,

or

- a device that automatically disconnects the supply if the protective earth conductor is damaged.
- 2. a connection with an industrial connector according to IEC 60309 and a minimum protective earth conductor cross-section of 2.5 mm² as part of a multi-conductor power cable. Sufficient strain relief must be provided.

If the protective earth conductor is routed through a plug and socket, or similar means of disconnection, it must not be possible to disconnect it unless power is simultaneously removed.

Note: You can use power cable shields as protective earth conductors only when their conductivity is sufficient.

Additional grounding requirements – UL (NEC)

This section gives grounding requirements according to standard UL 61800-5-1.

The protective earth conductor must be sized as specified in Article 250.122 and table 250.122 of the National Electric Code, ANSI/NFPA 70.

For cord-connected equipment, it must not be possible to disconnect the protective earth conductor before power is removed.

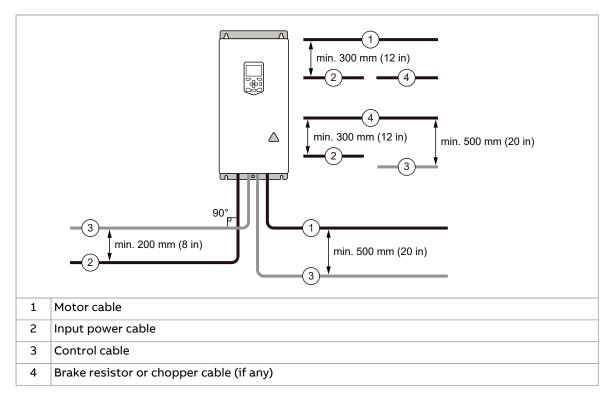
Routing the cables

General guidelines – IEC

- Route the motor cable away from other cables. Motor cables of several drives can be run in parallel installed next to each other.
- Install the motor cable, input power cable and control cables on separate trays.
- Avoid long parallel runs of motor cables with other cables.
- Where control cables must cross power cables, make sure that they are arranged at an angle as near to 90 degrees as possible.

- Do not run extra cables through the drive.
- Make sure that the cable trays have good electrical bonding to each other and to the grounding electrodes. Aluminum tray systems can be used to improve local equalizing of potential.

The following figure illustrates the cable routing guidelines with an example drive.



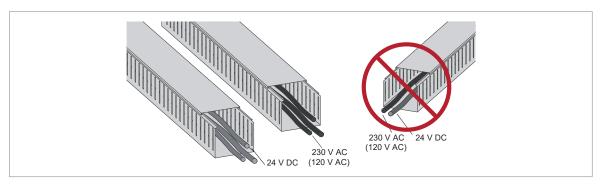
Continuous motor cable shield/conduit and metal enclosure for equipment on the motor cable

To minimize the emission level when safety switches, contactors, connection boxes or similar equipment are installed on the motor cable between the drive and the motor:

- Install the equipment in a metal enclosure.
- Use either a symmetrical shielded cable, or install the cabling in a metal conduit.
- Make sure that there is a good and continuous galvanic connection in the shield/conduit between drive and motor.
- Connect the shield/conduit to the protective ground terminal of the drive and the motor.

Separate control cable ducts

Put 24 V DC and 230 V AC (120 V AC) control cables in separate ducts, unless the 24 V DC cable is insulated for 230 V AC (120 V AC) or insulated with an insulation sleeving for 230 V AC (120 V AC).



Implementing short-circuit and thermal overload protection

Protecting the drive and the input power cable in short-circuits

Protect the drive and the input cable with fuses or a circuit breaker.



Select the fuses or circuit breakers according to local regulations for the input cable protection. Select the fuses or circuit breakers for the drive according to the instructions given in the technical data. The fuses or circuit breakers for the drive protection will restrict drive damage and prevent damage to adjoining equipment in case of a short-circuit inside the drive.

Note: If the fuses or circuit breakers for the drive protection are placed at the distribution board and the input cable is selected according to the nominal input current of the drive given in the technical data, the fuses or circuit breakers protect also the input cable in short-circuit situations, restrict drive damage and prevent damage to adjoining equipment in case of a short-circuit inside the drive. No separate fuses or circuit breakers for the input cable protection are required.



WARNING!

Due to the inherent operating principle and construction of circuit breakers, independent of the manufacturer, hot ionized gases can escape from the breaker enclosure in case of a short-circuit. To make sure of safe use, pay special attention to the installation and placement of the breakers. Obey the manufacturer's instructions.

Protecting the motor and motor cable in short-circuits

The drive protects the motor cable and motor in a short-circuit situation when:

- the motor cable is sized correctly
- · the motor cable type complies with the motor cable selection guidelines by ABB
- the cable length does not exceed the allowed maximum length specified for the drive
- the setting of parameter 99.10 Motor nominal power in the drive is equal with the value given on the motor rating plate.

The electronic power output short-circuit protection circuitry meets the requirements of IEC 60364-4-41:2005 + AMD1:2017.

Protecting the motor cables against thermal overload

The drive protects the motor cables against thermal overload when the cables are sized according to the nominal output current of the drive. No additional thermal protection devices are needed.



WARNING!

If the drive is connected to multiple motors, use a separate overload protection for each motor cable and motor. The drive overload protection is tuned for the total motor load. It may not detect an overload in one motor circuit only.

<u>North America</u>: The local code (NEC) requires an overload protection and a short-circuit protection for each motor circuit. Use, for example:

- manual motor protector
- · circuit breaker, contactor and overload relay or
- fuses, contactor and overload relay.

Protecting the motor against thermal overload

According to regulations, the motor must be protected against thermal overload and the current must be switched off when overload is detected. The drive includes a motor thermal protection function that protects the motor and switches off the current when necessary. Depending on a drive parameter value, the function either monitors a calculated temperature value (based on a motor thermal model) or an actual temperature indication given by motor temperature sensors.

The motor thermal protection model supports thermal memory retention and speed sensitivity. The user can tune the thermal model further by feeding in additional motor and load data.

The most common temperature sensor types are PTC or Pt100.

For more information, see the firmware manual.

Protecting the motor against overload without thermal model or temperature sensors

Motor overload protection protects the motor against overload without using motor thermal model or temperature sensors.

Motor overload protection is required and specified by multiple standards including the US National Electric Code (NEC) and the common UL/IEC 61800-5-1 standard in conjunction with UL/IEC 60947-4-1. The standards allow for motor overload protection without external temperature sensors.

The protection feature of the drive allows the user to specify the class of operation in the same manner as the overload relays are specified in standards UL/IEC 60947-4-1 and NEMA ICS 2.

The motor overload protection supports thermal memory retention and speed sensitivity.

For more information, see drive firmware manual.

Protecting the drive against ground faults

The drive is equipped with an internal ground fault protective function to protect the unit against ground faults in the motor and motor cable. This function is not a personnel safety or a fire protection feature. See the firmware manual for more information.

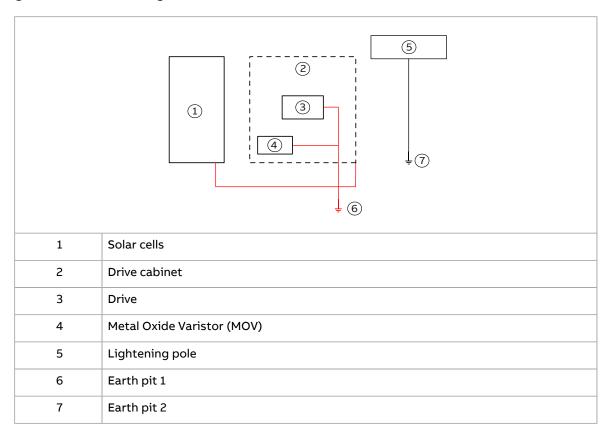
Residual current device compatibility

The drive is suitable for use with residual current devices of Type B.

Note: As standard, the drive contains capacitors connected between the main circuit and the frame. These capacitors and long motor cables increase the ground leakage current and may cause nuisance faults in residual current devices.

Earth connection (grounding) recommendation

Ground the solar cell or if it does not have ground, connect the solar cell body to the ground. See below figure.



Implementing the emergency stop function

For safety reasons, install the emergency stop devices at each operator control station and at other operating stations where the emergency stop may be needed. Implement the emergency stop according to relevant standards.

Note: You can use the Safe torque off function of the drive to implement the Emergency stop function.

Implementing the Safe torque off function

See The Safe torque off function (page 201).

Using power factor compensation capacitors with the drive

Power factor compensation is not needed with AC drives. However, if a drive is to be connected in a system with compensation capacitors installed, note the following restrictions.



WARNING!

Do not connect power factor compensation capacitors or harmonic filters to the motor cables (between the drive and the motor). They are not meant to be used with AC drives and can cause permanent damage to the drive or themselves.

If there are power factor compensation capacitors in parallel with the input of the drive:

- 1. Do not connect a high-power capacitor to the power line while the drive is connected. The connection will cause voltage transients that may trip or even damage the drive.
- 2. If capacitor load is increased/decreased step by step when the AC drive is connected to the power line, make sure that the connection steps are low enough not to cause voltage transients that would trip the drive.
- 3. Make sure that the power factor compensation unit is suitable for use in systems with AC drives, ie, harmonic generating loads. In such systems, the compensation unit should typically be equipped with a blocking reactor or harmonic filter.

Controlling a contactor between drive and motor

The control of the output contactor depends on how you use the drive, that is, which motor control mode and which motor stop mode you select.

Implementing an ATEX-certified motor thermal protection

With option +Q971, the drive provides ATEX-certified safe motor disconnection without contactor using the drive Safe torque off function. To implement the thermal protection of a motor in explosive atmosphere (Ex motor), you must also:

- use an ATEX-certified Ex motor
- order an ATEX-certified thermistor protection module for the drive (option +L537),
 or acquire and install an ATEX-compliant protection relay
- do the necessary connections.

For more information, see:

User's manual	Manual code (English)
CPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537+Q971) user's manual	3AXD50000030058
CPTC-02 ATEX-certified thermistor protection module, instructions for pairing the module with an ATEX-certified drive	3AXD10001243391

Implementing the power loss ride-through function

If the incoming supply voltage is cut off, the drive will continue to operate by utilizing the kinetic energy of the rotating motor. The drive will be fully operational as long as the motor rotates and generates energy to the drive.

If you equip the drive with a main contactor or breaker, make sure that it restores the drive input power after a short break. The contactor must either re-connect after the break automatically, or remain closed over the break. Depending on the contactor control circuit design, this can require an additional hold circuit, uninterruptible auxiliary power supply or auxiliary power supply buffering.

Note: If the power loss lasts so long that the drive trips on undervoltage, a fault reset and a fresh start command is required to continue operation.

Implement the power-loss ride-through function as follows:

- 1. Enable the power-loss ride-through function of the drive (parameter 30.31).
- 2. If the installation is equipped with a main contactor, prevent its tripping at the input power break. For example, use a time delay relay (hold) in the contactor control circuit.
- 3. Enable the automatic restart of the motor after a short power supply break:
 - Set the start mode to automatic (parameter 21.01 or 21.19, depending on the motor control mode being used).
 - Define the automatic restart time (parameter 21.18).



WARNING!

Make sure that a flying restart of the motor will not cause any danger. If you are in doubt, do not implement the power loss ride-through function.

Using a safety switch between the drive and the motor

ABB recommends to install a safety switch between the permanent magnet motor and the drive output. The switch is needed to isolate the motor from the drive during maintenance work on the drive.

Implementing a bypass connection

If bypassing is required, employ mechanically or electrically interlocked contactors between the motor and the drive and between the motor and the power line. Make sure with interlocking that the contactors cannot be closed simultaneously. The installation must be clearly marked as defined in IEC/EN/UL 61800-5-1, subclause 6.5.3, for example, "THIS MACHINE STARTS AUTOMATICALLY".

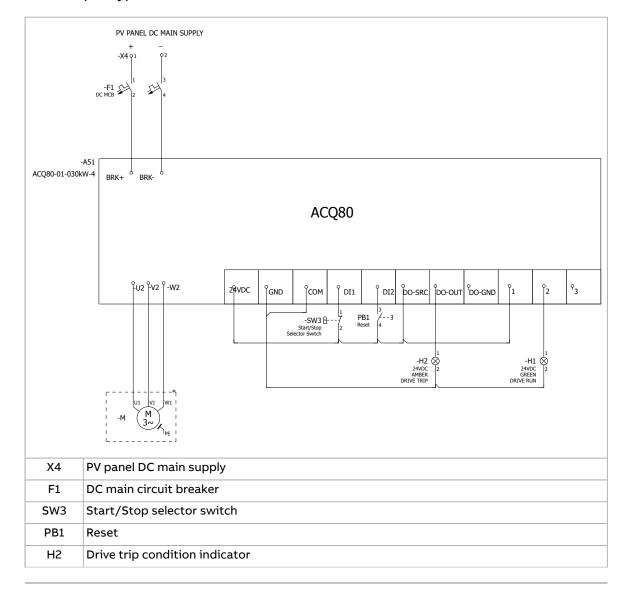


WARNING!

Never connect the drive output to the electrical power network. The connection may damage the drive.

Example bypass connection

An example bypass connection is shown below.

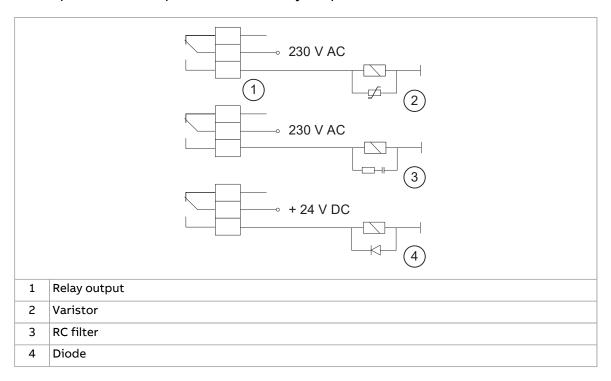


Protecting the contacts of relay outputs

Inductive loads (relays, contactors, motors) cause voltage transients when switched off.

It is highly recommended that inductive loads are equipped with noise attenuating circuits (varistors, RC filters [AC] or diodes [DC]) to minimize the EMC emission at switch-off. If not suppressed, the disturbances can connect capacitively or inductively to other conductors in the control cable and form a risk of malfunction in other parts of the system.

Install the protective component as close to the inductive load as possible. Do not install protective components at the relay outputs.



Limiting relay output maximum voltages at high installation altitudes

See Isolation areas (page 130) for frames R4 and R5 and Isolation areas (page 134) for frames R6...R9.

Implementing a motor temperature sensor connection



WARNING!

IEC 61800-5-1 requires double or reinforced insulation between live parts and accessible parts when:

- the accessible parts are not conductive, or
- the accessible parts are conductive, but not connected to the protective earth.

Obey this requirement when you plan the connection of the motor temperature sensor to the drive.

You have these implementation alternatives:

- If there is double or reinforced insulation between the sensor and the live parts
 of the motor: You can connect the sensor directly to the analog/digital input(s)
 of the drive. See the control cable connection instructions. Make sure that the
 voltage is not more than the maximum allowed voltage over the sensor.
- 2. If there is basic insulation between the sensor and the live parts of the motor, or if the insulation type is not known: You can connect a sensor to a digital input of the drive via an external relay. The sensor and the relay must form a double or reinforced insulation between the motor's live parts and the digital input of the drive. Make sure that the voltage does not exceed the maximum allowed voltage over the sensor.

Electrical installation – IEC

Contents of this chapter

This chapter describes how to:

- · measure the insulation
- do the grounding system compatibility check
- change the EMC filter or ground-to-phase varistor connection
- connect the power and control cables
- install optional modules
- connect a PC.

Required tools

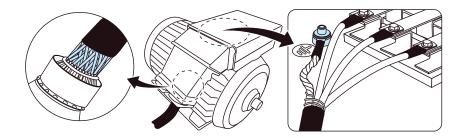
To do the electrical installation, you need these tools:

- wire stripper
- screwdriver set (Torx, Phillips, flat and/or Pozidriv, as appropriate)
- torque wrench.

Grounding the motor cable shield at the motor end

For minimum radio-frequency interference, ground the cable shield 360° at the cable entry of the motor terminal box.





Measuring the insulation

Measuring the insulation resistance of the drive



WARNING!

Do not do voltage withstand or insulation resistance tests on the drive. The tests can cause damage to the drive. Every drive is tested for insulation between the main circuit and the chassis at the factory. Also, there are voltage-limiting circuits inside the drive which cut down the testing voltage automatically.

Measuring the insulation resistance of the input power cable

Before you connect the input power cable to the drive, measure its insulation resistance according to local regulations.

Measuring the insulation resistance of the motor and motor cable

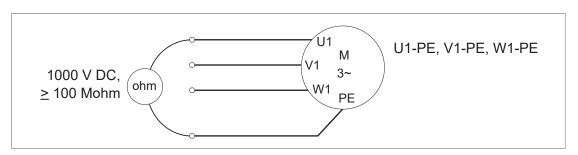


WARNING!

Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrical professional, do not do installation, commissioning or maintenance work.

- 1. Do the steps in section Electrical safety precautions (page 18) before you start the work.
- 2. Make sure that the motor cable is disconnected from the drive output terminals.
- Measure the insulation resistance between each phase conductor and the
 protective earth conductor. Use a measuring voltage of 1000 V DC. The insulation
 resistance of an ABB motor must be more than 100 Mohm (reference value at 25 °C
 [77 °F]). For the insulation resistance of other motors, refer to the manufacturer's
 instructions.

Note: Moisture inside the motor reduces the insulation resistance. If you think that there is moisture in the motor, dry the motor and do the measurement again.





Grounding system compatibility check

The standard drive can be an be installed to a symmetrically grounded TN-S system. For other systems, see sections EMC filter and Ground-to-phase varistors (page 93) below.

EMC filter

A drive with EMC filter connected can be installed to a symmetrically grounded TN-S system. If you install the drive to another system, you may need to disconnect the EMC filter. See sections When to disconnect EMC filter or ground-to-phase varistor: TN-S, IT, corner-grounded delta and midpoint-grounded delta systems (page 93), and Guidelines for installing the drive to a TT system (page 94).



WARNING!

Do not install the drive with the EMC filter connected to a system that the filter is not suitable for. This can cause danger, or damage the drive.

Note: When the internal EMC filter is disconnected, the drive EMC compatibility is considerably reduced. See Motor connection data (page 167).

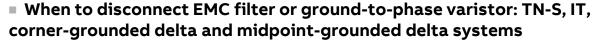
Ground-to-phase varistors

A drive with the ground-to-phase varistor connected can be installed to a symmetrically grounded TN-S system. If you install the drive to another system, you may need to disconnect the varistor. See sections When to disconnect EMC filter or ground-to-phase varistor: TN-S, IT, corner-grounded delta and midpoint-grounded delta systems (page 93), and Guidelines for installing the drive to a TT system (page 94).



WARNING!

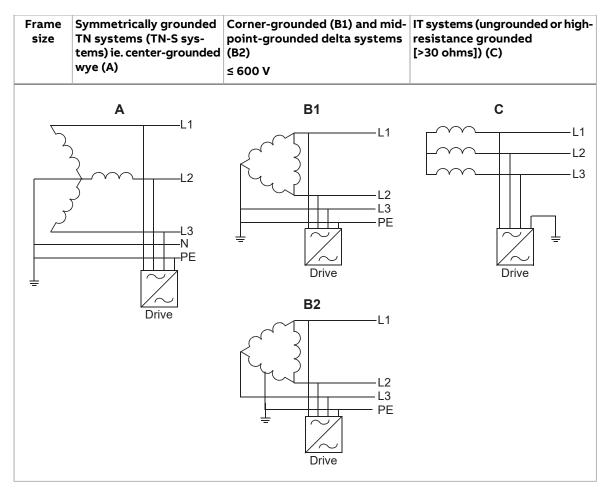
Do not install the drive with the ground-to-phase varistor connected to a system that the varistor is not suitable for. It can cause damage to the varistor circuit.



Requirements for disconnecting EMC filter and varistor and additional requirements for different electrical power systems are given below.

Frame size	Symmetrically grounded TN systems (TN-S sys- tems) ie. center-grounded wye (A)		IT systems (ungrounded or high- resistance grounded [>30 ohms]) (C)
R4R5	Do not disconnect EMC or VAR screws.	Not evaluated ¹⁾	Disconnect EMC screws (2 pcs) and VAR screw.
R6R9	Do not disconnect EMC or VAR screws.	Do not disconnect EMC AC or VAR screws. Disconnect EMC DC screw.	Disconnect EMC screws (2 pcs) and VAR screw.





¹⁾ Frames R4 and R5 are not evaluated for use on corner-grounded systems or midpoint-grounded delta systems by IEC standards.

Note: These are the EMC filter and varistor screws of different drive frame sizes.

Frame size	EMC filter screws	Ground-to-phase varistor screws
R4R5	Two EMC screws	VAR
R6R9	Two EMC screws	VAR

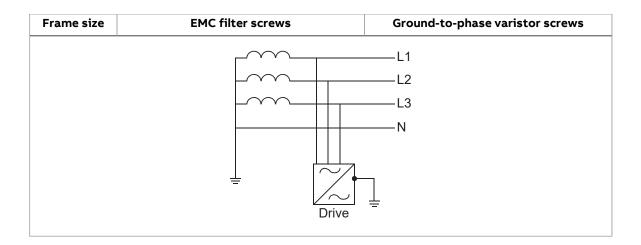
Guidelines for installing the drive to a TT system

The drive can be installed to a TT system under these conditions:

- 1. Residual current device has been installed in the supply system.
- 2. These screws have been disconnected. Otherwise EMC filter and ground-to-phase varistor capacitor leakage current will cause the residual current device to trip.

Frame size	EMC filter screws	Ground-to-phase varistor screws
R4R5	Two EMC screws	VAR
R6R9	Two EMC screws	VAR





Note:

- Because the EMC filter screws have been disconnected, ABB does not guarantee the EMC category.
- ABB does not guarantee the functioning of the ground leakage detector built inside the drive.
- In large systems the residual current device can trip without a reason.



Identifying the grounding system of the electrical power network



WARNING!

Only a qualified electrical professional may do the work instructed in this section. Depending on the installation site, the work may even be categorized as live working. Continue only if you are an electrical professional certified for the work. Obey the local regulations. If you ignore them, injury or death can occur.

To identify the grounding system, examine the supply transformer connection. See the applicable electrical diagrams of the building. If that is not possible, measure these voltages at the distribution board, and use the table to define the grounding system type.

- 1. input voltage line to line (U_{1-1})
- 2. input voltage line 1 to ground (U_{L1-G})
- 3. input voltage line 2 to ground (U_{1,2-G})
- 4. input voltage line 3 to ground (U_{13-G}).

The table below shows the line-to-ground voltages in relation to the line-to-line voltage for each grounding system.

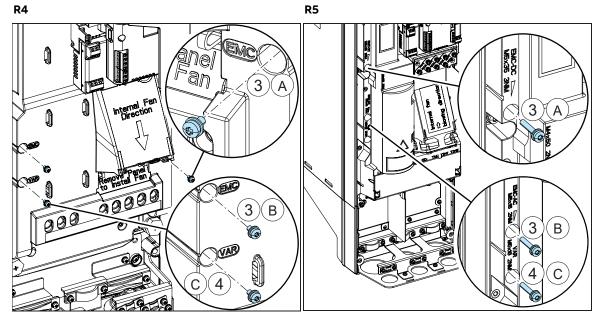
U _{L-L}	U _{L1-G}	U _{L2-G}	U _{L3-G}	Electrical power system type
Х	0.58·X	0.58·X	0.58·X	TN-S system (symmetrically grounded)
Х	1.0·X	1.0·X	0	Corner-grounded delta system (nonsymmetrical)
Х	0.866∙X	0.5·X	0.5·X	Midpoint-grounded delta system (nonsymmetrical)
Х	Varying level versus time	Varying level versus time	Varying level versus time	IT systems (ungrounded or high-resistance- grounded [>30 ohms]) nonsymmetrical
х	Varying level versus time	Varying level versus time	Varying level versus time	TT system (the protective earth connection for the consumer is provided by a local earth electrode, and there is another independently installed at the generator)

Disconnecting internal EMC filter or ground-to-phase varistor - frames R4...R9

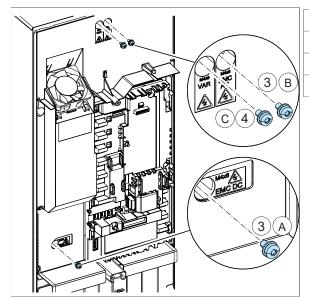
To disconnect the internal EMC filter or ground-to-phase varistor, if needed, do as follows:

- 1. Switch off the power from the drive.
- 2. Open the cover, if not already opened. <u>Frame R4</u>: see page 99 and <u>frame R5</u>: see page 103, <u>frames R6...R9</u>: see page 108..
- 3. To disconnect the internal EMC filter, remove the EMC screw(s).
- 4. To disconnect the ground-to-phase varistor, remove the varistor screw.







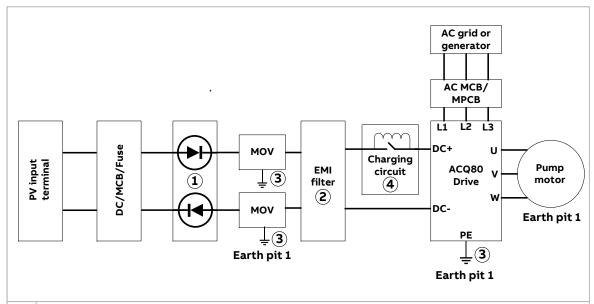


	Screw
Α	EMC (DC)
В	EMC (AC)
С	VAR



Connecting the power cables

Connection diagram



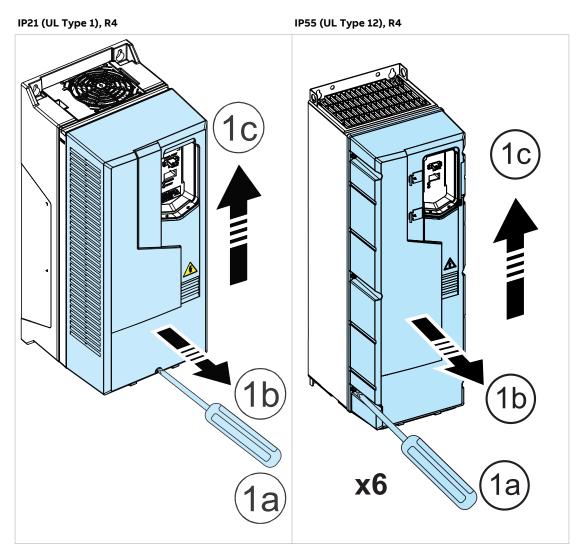
- 1 Reverse polarity diodes. For more information, see section Reverse polarity diodes (page 158).
- 2 EMI filter is optional but is mandatory for EN62920 standard compliance which is required in Europe. For more information, see section Reverse polarity diodes (page 158). To comply to EN62920, refer to EMI filter layout diagram in Dimension drawings (page 181).
- 3 Ground connection should be common for MOV, drive, and pump.
- 4 Frames R6...R9 only: Initially the charging happens through the resistance and once predefine voltage charging is completed then the contactor will be closed.

Note: ACQ80 is intended to be used for speed control of 3-phase AC pump motors and is powered from either AC Grid or DC photo-voltaic array. ABB recommends not to use it as an island grid forming inverter or to supply generic single phase or 3-phase loads, other than 3-phase AC pump motors.



Connection procedure, frame R4

1. Remove the front cover: Loosen the retaining screws with a T20 Torx screwdriver (1a) and lift the cover from the bottom outwards (1b) and then up (1c).





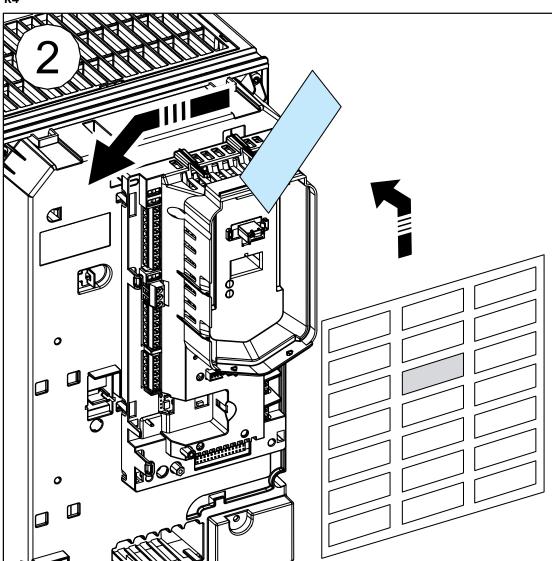


WARNING!

If you install the drive on any other system than symmetrically grounded TN-S system, see Grounding system compatibility check (page 93) if you have to disconnect the EMC filter and ground-to-phase varistor.

2. Attach the residual voltage warning sticker in the local language.

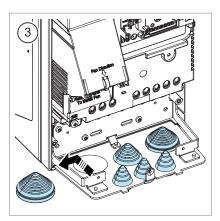
R4





3. Remove the rubber grommets for the motor and input power cables, as well as brake resistor cable, if used.

Remove the grommets for the control cables when you are connecting them.



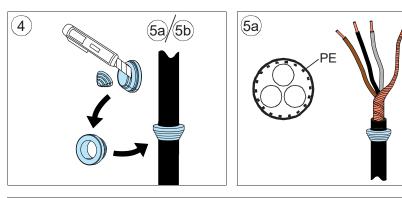
Note: The drive is shipped with grommet cones pointing up. They must be removed and inserted back pointing down.

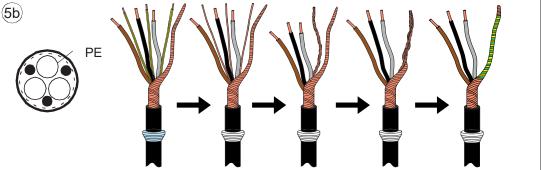
Motor cable

- 4. Cut an adequate hole into the rubber grommet. Slide the grommet onto the cable.
- 5. Prepare the ends of the cable as illustrated in the figures.

Two different motor cable types are shown (5a, 5b).

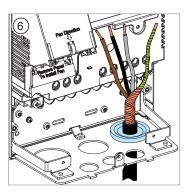
Note: The bare shield will be grounded 360 degrees. Mark the pigtail made from the shield as a PE conductor with yellow-and-green color.



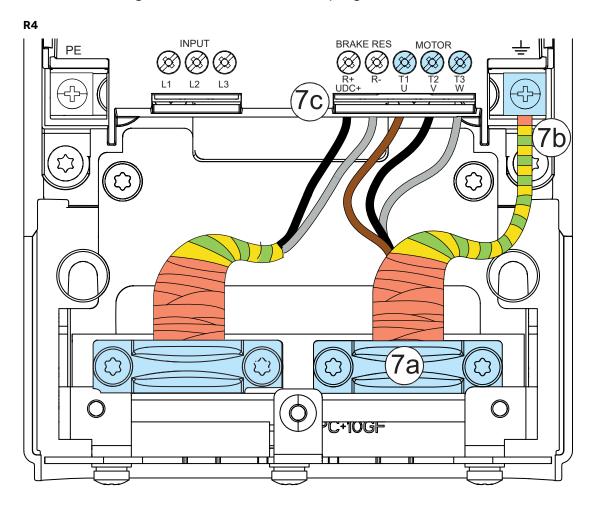




6. Slide the cable through the hole in the cable entry and attach the grommet to the hole.



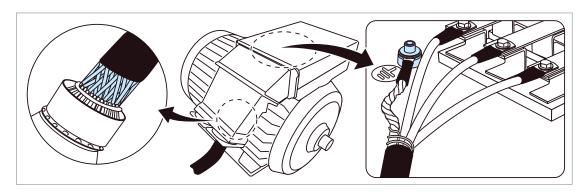
- 7. Connect the motor cable:
 - Ground the shield 360 degrees by tightening the clamp of the power cable grounding shelf onto the stripped part of the cable. (7a)
 - If you need more working space, open the screw (7c) and lift the EMC plate off. Remember to put it back after you have installed motor and input power cables.
 - Connect the twisted shield of the cable to the grounding terminal. (7b)
 - Connect the phase conductors of the cable to the T1/U, T2/V and T3/W terminals. Tighten the screws to the torque given in the table below (7c).





Frame size	R4			
	N·m lbf·ft			
T1/U, T2/V, T3/W	4.0	3.0		
PE, ⊕	2.9	2.1		
<u> </u>	1.2	0.9		

- 8. For wiring, obey PV manufacturer's wiring instructions.
- 9. Secure the cables outside the unit mechanically.
- 10. Ground the motor cable shield at the motor end. For minimum radio frequency interference, ground the motor cable shield 360 degrees at the cable entry of the motor terminal box.



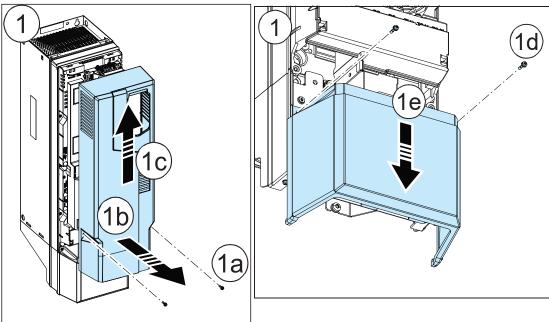
Connection procedure, frame R5

IP21 (UL Type 1)

Remove the module cover: Loosen the retaining screws with a T20 Torx screwdriver
(1a) and lift the cover from the bottom outwards (1b) and then up (1c).

Remove the box cover: Loosen the retaining screws with a screwdriver (1d) and slide the cover downwards (1e).



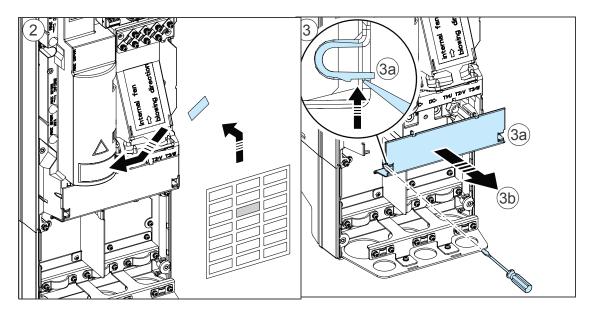




WARNING!

If you install the drive on any other system than symmetrically grounded TN-S system, see Grounding system compatibility check (page 93) if you have to disconnect the EMC filter and ground-to-phase varistor.

- 2. Attach the residual voltage warning sticker in the local language next to the control unit.
- 3. Remove the shroud on the power cable terminals by releasing the clips with a screwdriver (3a) and pulling the shroud out (3b).



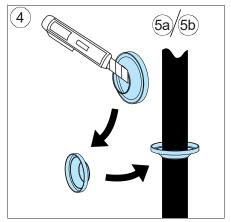


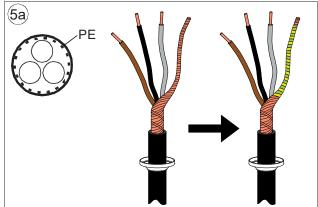
Motor cable

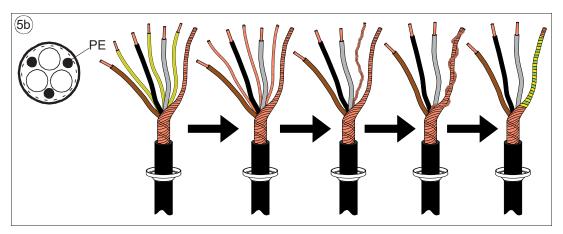
Use symmetrical shielded cable for motor cabling. If the cable shield is the sole PE conductor for drive or motor, make sure that is has sufficient conductivity for the PE.

- 4. Cut an adequate hole into the rubber grommet. Slide the grommet onto the cable.
- 5. Prepare the ends of the motor cable as illustrated in figures 5a and 5b (two different motor cable types are shown). If you use aluminum cables, put grease to the peeled aluminum cable before connecting it to the drive.

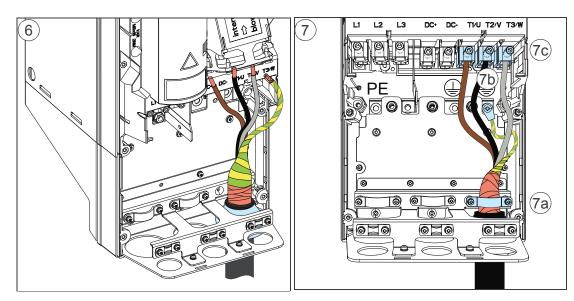
Note: The bare shield will be grounded 360 degrees. Mark the pigtail made from the shield as a PE conductor with yellow-and-green color.







- 6. Slide the cable through the hole of the bottom plate and attach the grommet to the hole.
- 7. Connect the motor cable:
 - Ground the shield 360 degrees by tightening the clamp of the power cable grounding shelf onto the stripped part of the cable (7a).
 - Connect the twisted shield of the cable to the grounding terminal (7b).
 - Connect the phase conductors of the cable to the T1/U, T2/V and T3/W terminals (7c). Tighten the screws to the torque given in the table.

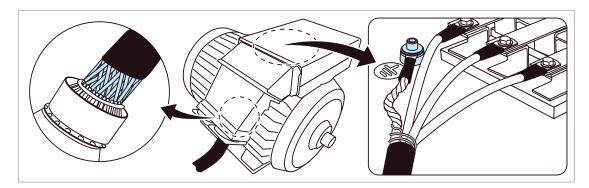




Frame size	size T1/U, T2/V, T3/W		PE, <u>⊕</u>			0	
	N⋅m	lbf∙ft	М	N⋅m	lbf∙ft	N⋅m	lbf∙ft
R5	5.6	4.1	M5	2.2	1.6	1.2	0.9

Input power cable

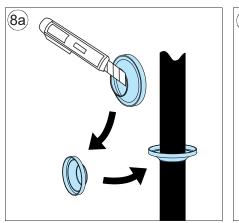
- 8. For wiring, obey PV manufacturer's wiring instructions.
- 9. Secure the cables outside the unit mechanically.
- 10. Ground the motor cable shield at the motor end. For minimum radio frequency interference, ground the motor cable shield 360 degrees at the cable entry of the motor terminal box.

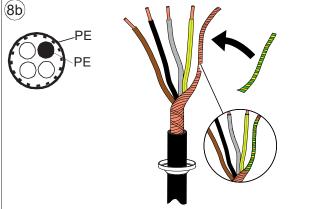


IP55 (UL Type 12)

1. Repeat steps 4...6 for the input power cable

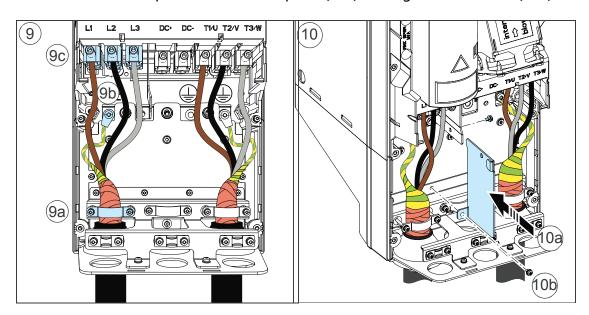




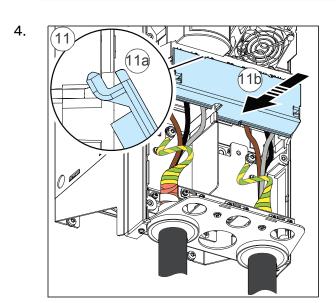


2. Connect the input power cable. Use terminals L1, L2 and L3. Tighten the screws to the torque given in the table.

3. Install the cable box plate. Position the plate (10a) and tighten the screw (10b).



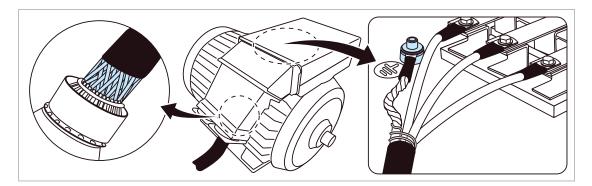
Frame size	L1, L2, L3		PE, <u>⊕</u>			<u> </u>	
	N⋅m	lbf∙ft	М	N⋅m	lbf∙ft	N⋅m	lbf∙ft
R5	5.6	4.1	M5	2.2	1.6	1.2	0.9



Finalization



- 5. Secure the cables outside the unit mechanically.
- 6. Ground the motor cable shield at the motor end. For minimum radio frequency interference, ground the motor cable shield 360 degrees at the cable entry of the motor terminal box.



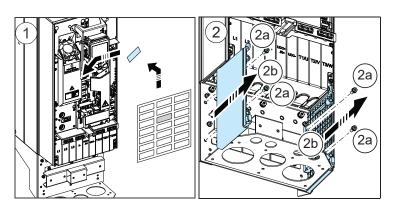
Connection procedure, frames R6...R9



WARNING!

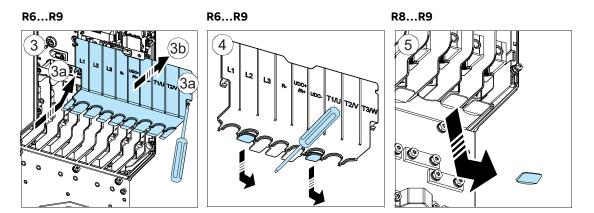
If you install the drive on any other system than symmetrically grounded TN-S system, see Grounding system compatibility check (page 93) if you have to disconnect the EMC filter and ground-to-phase varistor.

- 1. Attach the residual voltage warning sticker in the local language next to the control unit.
- 2. Remove the side plates of the cable box: Remove the retaining screws (2a) and slide the walls out (2b).



- 3. Remove the shroud on the power cable terminals by releasing the clips with a screwdriver (3a) and pulling the shroud out (3b).
- 4. Knock out holes in the shroud for the cables to be installed.
- 5. <u>Frames R8...R9</u>: If you install parallel cables, also knock out holes in the lower shroud for the cables to be installed.

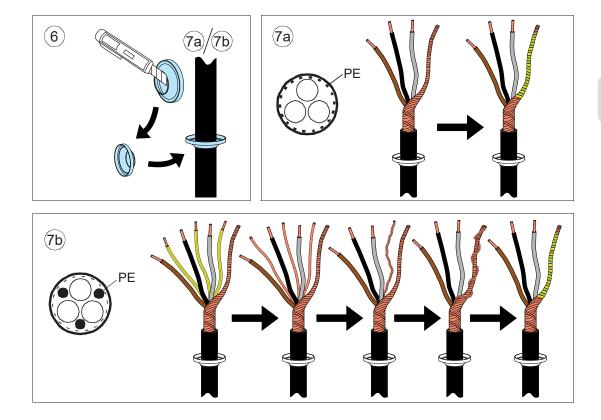




Motor cable

- 6. Cut an adequate hole into the rubber grommet. Slide the grommet onto the cable.
- 7. Prepare the ends of the input power cable and motor cable as illustrated in the figure. If you use aluminum cables, put grease to the peeled aluminum cable before connecting it to the drive. Two different motor cable types are shown in the figures (7a, 7b).

Note: The bare shield will be grounded 360 degrees. Mark the pigtail made from the shield as a PE conductor with yellow-and-green color.



- 8. Slide the cables through the holes in the cable entry and attach the grommets to the holes (the motor cable to the right and the input power cable to the left).
- 9. Connect the motor cable:



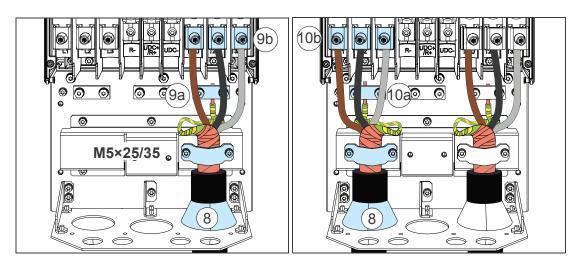
- Ground the shield 360 degrees under the grounding clamps.
- Connect the twisted shield of the cable to the grounding terminal (9a).
- Connect the phase conductors of the cable to terminals T1/U, T2/V and T3/W. Tighten the screws to the torque given in the table (9b).

Note 1 for frames R8...R9: If you connect only one conductor to the connector, ABB recommends that you put it under the upper pressure plate. If you use parallel power cables, put the first conductor under the lower pressure plate and the second under the upper one.

Note 2 for frames R8...R9: The connectors are detachable but ABB does not recommend that you detach them. If you do, detach and reinstall the connectors as described in Detaching and reinstalling the connectors.

Input power cable

10. Connect the input power cable as in step 9. Use terminals L1, L2, L3.



Frame size	L1, L2, L3, T1/U, T2/V, T3/W		PE, <u>⊕</u>		<u> </u>	
	N⋅m	lbf·ft	N⋅m	lbf∙ft	N⋅m	lbf∙ft
R6	30	22	9.8	7.2	1.2	0.9
R7	40	30	9.8	7.2	1.2	0.9
R8	40	30	9.8	7.2	1.2	0.9
R9	70	52	9.8	7.2	1.2	0.9

Detaching and reinstalling the connectors

This is possible but not recommended.

Terminals T1/U, T2/V and T3/W

- Remove the nut that attaches the connector to its busbar.
- Put the conductor under the connector pressure plate and pre-tighten the conductor.
- Put the connector back to its busbar. Start the nut, and turn it at least two rotations by hand.



WARNING!

Before you use tools, make sure that the nut or screw is not cross-threading. Cross-threading can damage the drive and cause danger.



- Tighten the nut to a torque of 30 N·m (22 lbf·ft).
- Tighten the conductor(s) to 40 N·m (30 lbf·ft) for frame R8 or to 70 N·m (52 lbf·ft) for frame R9.

Terminals L1, L2 and L3

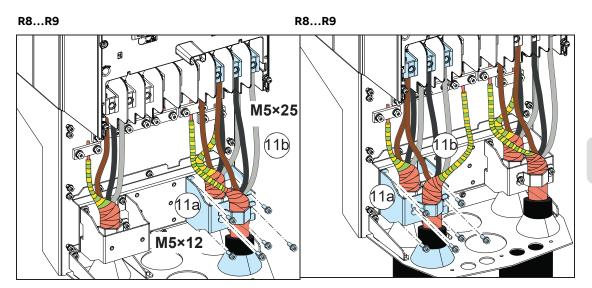
- Remove the combi screw that attaches the connector to its terminal post, and pull the connector off.
- Put the conductor under the connector pressure plate and pre-tighten the conductor.
- Put the connector back onto the terminal post. Start the combi screw, and turn it at least two rotations by hand.

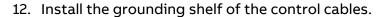


WARNING!

Before you use tools, make sure that the nut or screw is not cross-threading. Cross-threading can damage the drive and cause danger.

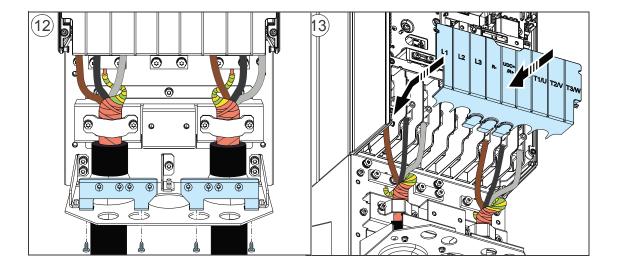
- Tighten the combi screw to a torque of 30 N·m (22 lbf·ft).
- Tighten the conductor(s) to 40 N·m (30 lbf·ft) for frame R8 or to 70 N·m (52 lbf·ft) for frame R9.
- 11. <u>Frames R8...R9</u>: If you install parallel cables, install the second grounding shelf for the parallel power cables (11a). Repeat steps 6...11 (11b).



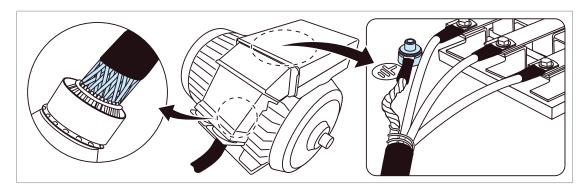


- 13. Reinstall the shroud on the power terminals.
- 14. Secure the cables outside the unit mechanically.





15. Ground the motor cable shield at the motor end. For minimum radio frequency interference, ground the motor cable shield 360 degrees at the cable entry of the motor terminal box.





DC connection

The UDC+ and UDC- terminals are used for DC power connection from the photo voltaic array. The UDC+ and UDC- terminals (as standard in frames R4 and R5) are for using external brake chopper units.

Connecting the control cables

Connection diagram

See Default I/O connection diagram (page 123) for the default I/O connections of the drive.

Control cable connection procedure



WARNING!

Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

- 1. Do the steps in section Electrical safety precautions (page 18) before you start the work.
- 2. Remove the front cover(s) if not already removed. See page 99(R4) and page 103(R5).

Analog signals

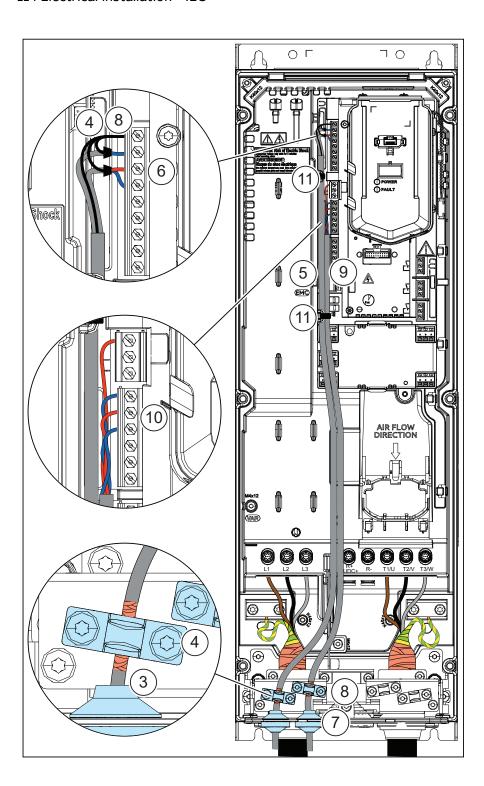
- The figures for frames R4 (page 114) and R5 (page 115) show an example of connecting a cable.
- 3. Cut an adequate hole into the rubber grommet and slide the grommet onto the cable. Slide the cable through a hole in the cable entry and attach the grommet to the hole.
- 4. Ground the outer shield of the cable 360 degrees under the grounding clamp. Keep the cable unstripped as close to the terminals of the control unit as possible. Frame R5: Secure the cables mechanically at the clamps below the control unit. Ground also the pair-cable shields and grounding wire at the SCR terminal.
- 5. Route the cable as shown in the figures for frames R4 (page 114) and R5 (page 115).
- 6. Connect the conductors to the appropriate terminals of the control unit and tighten to 0.5...0.6 N⋅m (0.4 lbf⋅ft).

 Digital signals
 - The figures for frames R4 (page 114) and R5 (page 115) show an example of connecting a cable. Make the connections according to the macro in use.
- 7. Cut an adequate hole into the rubber grommet and slide the grommet onto the cable. Slide the cable through the hole in the cable entry and attach the grommet to the hole.
- 8. Ground the outer shield of the cable 360 degrees under the grounding clamp. Keep the cable unstripped as close to the terminals of the control unit as possible. Frame R5: Secure the cables mechanically at the clamps below the control unit. If you use double-shielded cables, ground also the pair-cable shields and grounding wire at the SCR terminal.
- 9. Route the cable as shown in the figures for frames R4 (page 114) and R5 (page 115).
- 10. Connect the conductors to the appropriate terminals of the control unit and tighten to 0.5...0.6 N·m (0.4 lbf·ft).
- 11. Tie all control cables to the provided cable tie mounts.

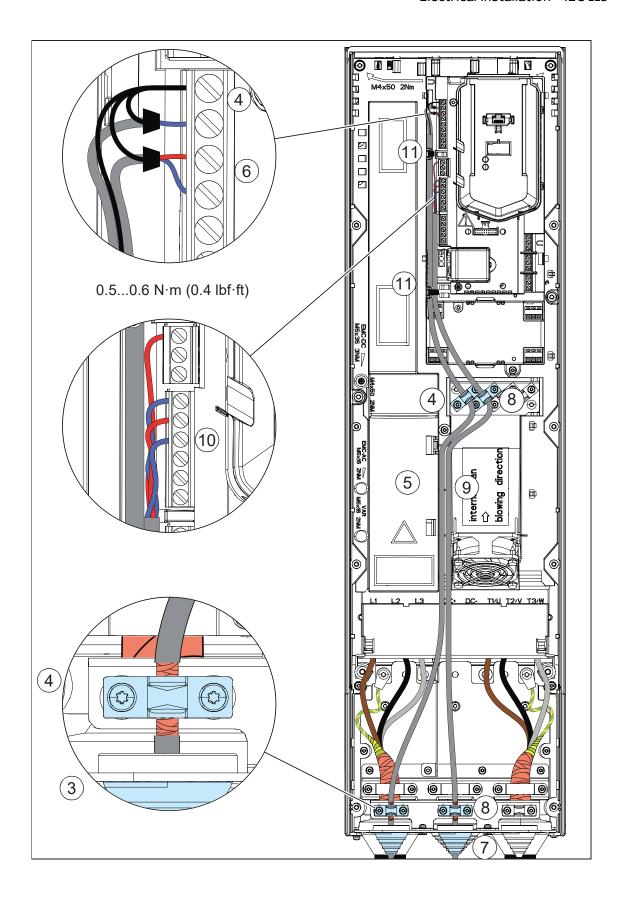
Note:

- Leave the other ends of the control cable shields unconnected or ground them indirectly via a high-frequency capacitor with a few nanofarads, eg, 3.3 nF / 630 V.
 The shield can also be grounded directly at both ends if they are in the same ground line with no significant voltage drop between the end points.
- Keep any signal wire pairs twisted as close to the terminals as possible. Twisting
 the wire with its return wire reduces disturbances caused by inductive coupling.











Installing option modules

Option slot 1 (fieldbus adapter modules)



WARNING!

Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrical professional, do not do installation, commissioning or maintenance work.



WARNING!

Use ESD wristband when you handle printed circuit boards. Do not touch the boards unnecessarily. The boards are sensitive to electrostatic discharge.

Pay attention to the free space required by the cabling or terminals coming to the option modules.

- 1. Stop the drive and do the steps in section Electrical safety precautions (page 18) before you start the work.
- 2. Pull out the lock (a) with a screw driver.

Note: The location of the lock depends on the module type.

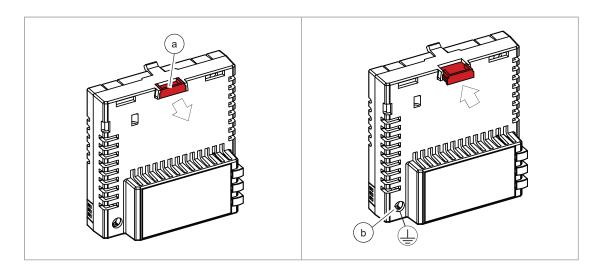
- 3. Install the module to a free option module slot on the control unit.
- 4. Push in the lock (a).
- 5. Tighten the grounding screw (b) to a torque of 0.8 N·m (7 lbf·in).

Note: The screw tightens the connections and grounds the module. It is essential for fulfilling the EMC requirements and for proper operation of the module.



WARNING!

Do not use excessive force, or leave the screw too loose. Over-tightening can cause damage to the screw or module. A loose screw can cause an operation failure.



6. Connect the wiring to the module. Obey the instructions given in the documentation of the module.



If you must remove the option module after it is installed into the drive, use a suitable tool (for example, small pliers) to carefully pull out the lock.

Option slot 2 (I/O extension modules)



WARNING!

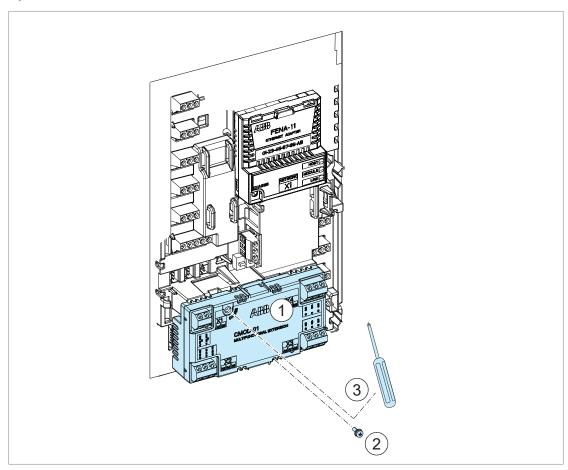
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrical professional, do not do installation, commissioning or maintenance work.



WARNING!

Use ESD wristband when you handle printed circuit boards. Do not touch the boards unnecessarily. The boards are sensitive to electrostatic discharge.

- 1. Put the module carefully into its position on the control unit.
- 2. Tighten the mounting screw.
- 3. Tighten the grounding screw (CHASSIS) to 0.8 N·m (7 lbf·in). The screw grounds the module. This is necessary for fulfilling the EMC requirements and for correct operation of the module.



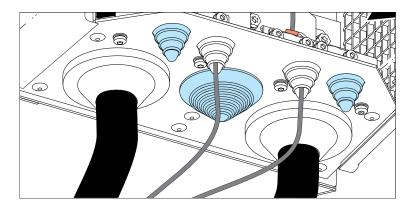
Wiring the optional modules

See the appropriate option module manual or for I/O options the appropriate chapter in this manual.



Reinstalling grommets

<u>UL Type 12:</u> To maintain UL Type 12, reinstall grommets (top of the grommets downwards) to all cable entry holes without conduits.



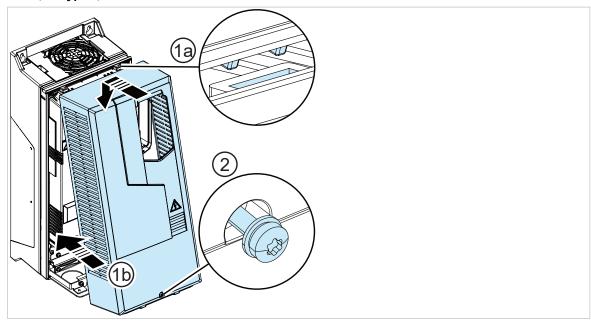


Reinstalling covers

Reinstalling cover, frame R4

- 1. Reinstall the cover: Put the tabs on the cover top in their counterparts on the housing (1a) and the press the cover (1b).
- 2. Tighten the retaining screw at the bottom with a T20 Torx screwdriver.

IP21 (UL Type 1) R4



Reinstalling covers, frame R5

IP21 (UL Type 1)

- 1. <u>Reinstall the box cover</u>: Slide the cover upwards (1a) and tighten the retaining screws (1b) with a T20 Torx screwdriver.
- 2. <u>Reinstall the module cover</u>: Press the cover at the bottom (2a) and tighten the retaining screws (2b).

Connecting a PC



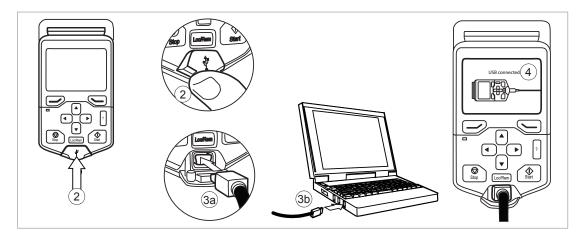
WARNING!

Do not connect the PC directly to the control panel connector of the control unit. It can cause damage.



A PC (with, for example, the Drive Composer PC tool) can be connected as follows:

- 1. To connect a control panel to the unit, either
 - · insert the control panel into the panel holder or platform, or
 - use an Ethernet (eg, Cat 5e) networking cable.
- 2. Remove the USB connector cover on the front of the control panel.
- 3. Connect an USB cable (Type A to Type Mini-B) between the USB connector on the control panel (3a) and a free USB port on the PC (3b).
- 4. The panel will display an indication whenever the connection is active.
- 5. See the documentation of the PC tool for setup instructions.



Connecting a remote panel, or chaining one panel to several drives



You can connect a drive control panel remotely to the drive, or chain the control panel or a PC to several drives on a panel bus with a CDPI-01 communication adapter module. See CDPI-01 communication adapter module user's manual (3AXD50000009929 [English]).

7

Control unit

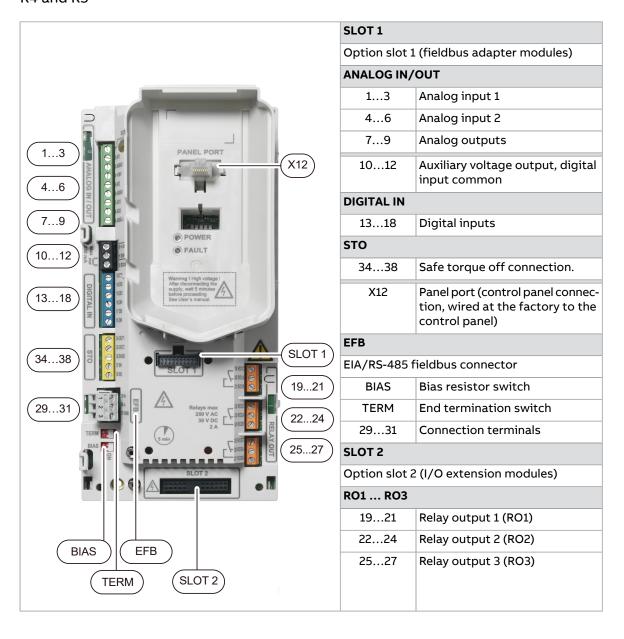
Contents of this chapter

This chapter contains the default I/O connection diagram, descriptions of the terminals and technical data for the drive control unit (CCU-23 and CCU-24).

Layout

The layout of the external control connection terminals on the drive module control unit is shown below.

R4 and R5



Default I/O connection diagram

R4 and R5

	Connectio	n		Term	Description
X1 Reference volta	age and ar	nalog inputs a	and ou	tputs	
			1	SCR	Signal cable shield (screen)
	• -	1	2	Al1	Output frequency reference: 010 V 1) 3)
110 kohm	•	- 2 - 3	3	AGND	Analog input circuit common
		4	4	+10V	Reference voltage 10 V DC
		5	5	AI2	Not configured
	•	6 7	6	AGND	Analog input circuit common
Max. 500 ohm		8	7	AO1	Output frequency: 020 mA
	<u>구</u> - 8)	9	8	AO2	Motor current: 020 mA
	0,		9	AGND	Analog output circuit common
X2 & X3 Aux. volta	ige output	and progran	nmable	e digital inp	uts
			10	+24V	Aux. voltage output +24 V DC, max. 250 mA
Γ		10 11			2)
	6)	12	11	DGND	Aux. voltage output common
		13	12	DCOM	Digital input common for all
7)		14	13	DI1	Stop (0) / Start (1)
	/_	15 16	14	DI2	Forward (0) / Reverse (1)
		17	15	DI3	Constant frequency selection 4)
		18	16	DI4	Constant frequency selection 4)
			17	DI5	Ramp set 1 (0) / Ramp set 2 (1) 5)
			18	DI6	Not configured
X6, X7, X8 Relay o	utputs				
		19	19	RO1C	Ready run
Ready run status	5	20	20	RO1A	250 V AC / 30 V DC
→		21	21	RO1B	2 A
◄		22	22	RO2C	Running
Run status		23	23	RO2A	250 V AC / 30 V DC
→		24 25	24	RO2B	2 A
Fault status		26	25	RO3C	Fault (-1)
~		27	26	RO3A	250 V AC / 30 V DC
	•		27	RO3B	2 A
X5 EIA-485 Modb	us RTU				
	Ī	29	29	B+	
	ł	30	30	A-	Embedded Modbus RTU (EIA-485)
	ł	31	31	DGND	
	ļ	S4	S4	TERM	Serial data link termination switch
	Ī	S5	S 5	BIAS	Serial data link bias resistors switch
X4 Safe Torque O	ff				
232 . 2. 9.00					

Connection		Term	Description
34	34	OUT1	Safe torque off. Factory connection. Both
6 7 7 / 1 3		OUT2	circuits must be closed for the drive to start.Refer to The Safe torque off func-
T T 30	3 6	SGND	tion (page 201).
6) 3	31	IN1	
	38	IN2	

Total load capacity of the Auxiliary voltage output +24V (X2:10) is 6.0 W (250 mA / 24 V DC).

Digital inputs DI1...DI5 also support 10...24 V AC.

Terminal sizes: 0.2 ... 2.5 mm2 (24...14 AWG) (Terminals +24V, DGND, DCOM, B+, A-, DGND, Ext. 24V)

Terminal sizes: 0.14 ... 1.5 mm² (26...16 AWG) (Terminals DI, AI, AO, AGND, RO, STO)

Tightening torques: 0.5 ... 0.6 N·m (4.4 ... 5.3 lbf·in)

Wire strip length 7...8 mm (0.3 in)

Notes:

- 1) Current [0(4)...20 mA, R_{in} = 100 ohm] or voltage [0(2)...10 V, R_{in} >200 kohm]. Change of setting requires changing the corresponding parameter.
- 2) Total load capacity of the Auxiliary voltage output +24V (X2:10) is 6.0 W (250 mA / 24 V) minus the power taken by the option modules installed on the board.
- 3) All is used as a speed reference if vector control is selected.
- 4) <u>In scalar control (default):</u> See **Menu Primary settings Ramps** or parameter group 28 Frequency reference chain.

<u>In vector control:</u> See **Menu - Primary settings - Ramps** or parameter group 23 Speed reference ramp.

DI5 Ramp		Parameters		
	set	Scalar control (default)	Vector control	
0	1	28.72 Freq acceleration time 1 28.73 Freq deceleration time 1	23.12 Acceleration time 1 23.13 Deceleration time 1	
1	2	28.74 Freq acceleration time 2 28.75 Freq deceleration time 2	23.14 Acceleration time 2 23.15 Deceleration time 2	

- 5) Connected with jumpers at the factory.
- 6) Use shielded twisted-pair cables for digital signals.
- 7) Ground the outer shield of the cable 360° under the grounding clamp on the grounding shelf, and the pair-cable shields and grounding wire at the grounding terminal (SCR) of the control unit.
- 8) WARNING! Connect an external AC power supply (24 V AC) only to control unit connectors 40 and 41. If you connect it to connector AGND, DGND or SGND, damage to the power supply or control unit can occur.

Additional information on the control connections

Embedded EIA-485 fieldbus connection

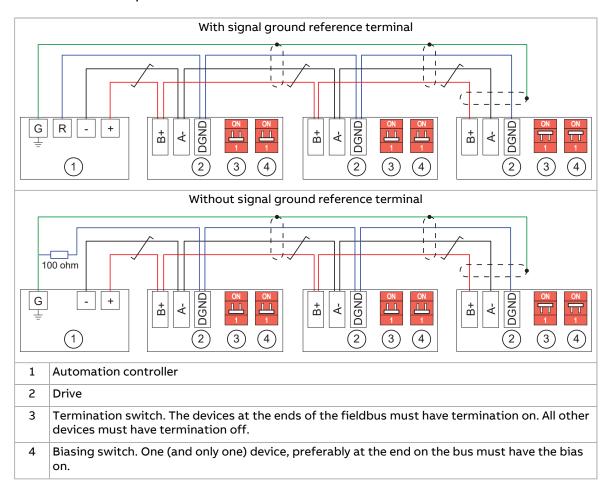
The EIA-485 network uses shielded, twisted-pair cable with a characteristic impedance of 100 ... 130 ohm for data signaling. The distributed capacitance between conductors

is less than 100 pF per meter (30 pF per foot). Distributed capacitance between conductors and shield is less than 200 pF per meter (60 pF per foot). Foil or braided shields are acceptable.

Connect the cable to the EIA-485 terminal on the . Obey these wiring instructions:

- Attach the cable shields together at each drive, but do not connect them to the drive.
- Connect the cable shields only to the grounding terminal in the automation controller.
- Connect the signal ground (DGND) conductor to the signal ground reference terminal in the automation controller. If the automation controller does not have a signal ground reference terminal, connect the signal ground conductor to the cable shield through a 100 ohm resistor, preferably near the automation controller.

Connection examples are shown below.

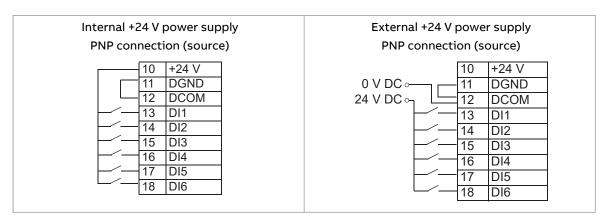


Connecting motor temperature sensors to the drive

IEC/EN 60664 requires double or reinforced insulation between the control unit and the live parts of the motor. To achieve this, use an CMOD-02 I/O extension module or CPTC-02 ATEX-certified thermistor protection module. Refer to section Implementing a motor temperature sensor connection and chapter CMOD-02 multifunction extension module (external 24 V AC/DC and isolated PTC interface) (page 235).

PNP configuration for digital inputs (X2 & X3)

Internal and external +24 V power supply connections for PNP configuration are shown in the figure below.

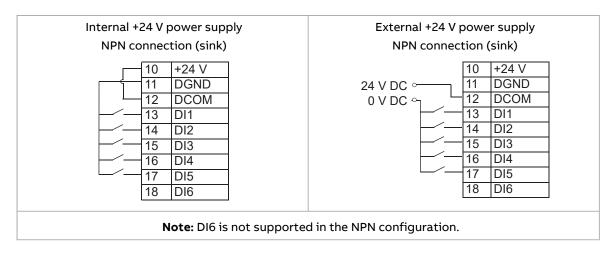




WARNING! Connect an external AC power supply (24 V AC) only to control unit connectors 40 and 41. If you connect it to connector AGND, DGND or SGND, damage to the power supply or control unit can occur.

NPN configuration for digital inputs (X2 & X3)

Internal and external +24 V power supply connections for NPN configuration are shown in the figure below.

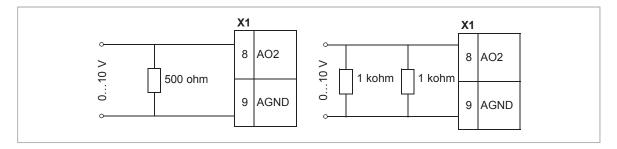




WARNING! Connect an external AC power supply (24 V AC) only to control unit connectors 40 and 41. If you connect it to connector AGND, DGND or SGND, damage to the power supply or control unit can occur.

Connection for obtaining 0...10 V from analog output 2 (AO2)

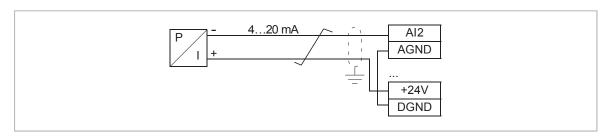
To obtain 0...10 V from analog output AO2, connect a 500 ohm resistor (or two 1 kohm resistors in parallel) between analog output AO2 and analog common ground AGND.



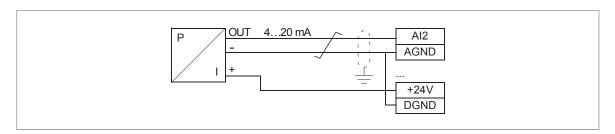
Connection examples of two-wire and three-wire sensors to analog input (AI2)

Note: The maximum capability of the auxiliary voltage output (24 V DC [250 mA]) must not be exceeded.

An example of a two-wire sensor/transmitter supplied by the drive auxiliary voltage output is shown below. Set the input signal to 4...20 mA, not 0...20 mA.



An example of a three-wire sensor/transmitter supplied by the drive auxiliary voltage output is shown below. The sensor is supplied through its current output and the drive feeds the supply voltage (+24 V DC). Thus the output signal must be 4...20 mA, not 0...20 mA.



DI5 as frequency input

For setting the parameters for the digital frequency input, see the firmware manual.

Safe torque off (X4)

For the drive to start, both connections (+24 V DC to IN1 and +24 V DC to IN2) must be closed. By default, the terminal block has jumpers to close the circuit.

Remove the jumpers before connecting an external Safe torque off circuitry to the drive. See also chapter The Safe torque off function (page 201).

Note: Only 24 V DC can be used for STO. Only PNP input configuration can be used.

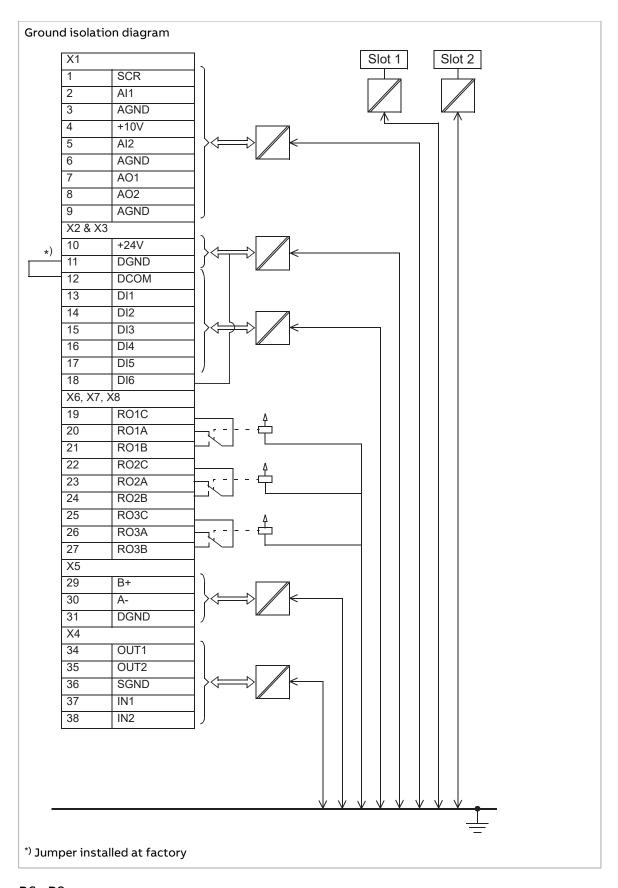
Technical data

R4 and R5

External power supply through option module CMOD-01 or CMOD-02	Maximum power: 25 W, 1.04 A at 24 V AC/DC ±10% as standard Terminal size: 0.2 2.5 mm ² (24 14 AWG)
+24 V DC output (Term. 10)	Total load capacity of this outputs is 6.0 W (250 mA / 24 V) minus the power taken by the option modules installed on board. Terminal size: 0.2 2.5 mm² (24 14 AWG)
Digital inputs DI1DI6 (Term. 1318)	Input type: NPN/PNP Terminal size: 0.14 1.5 mm ² (26 16 AWG)
(Term. 1516)	DI1DI4 (Term. 1316) 12/24 V DC logic levels: "0" < 4 V, "1" > 8 V R _{in} : 3 kohm
	Hardware filtering: 0.04 ms, digital filtering: 2 ms sampling
	DI5 (Term.17) Can be used as a digital or frequency input. $12/24 \text{ V DC}$ logic levels: "0" < 4 V, "1" > 8 V R_{in} : 3 kohm Max. frequency: 16 kHz Symmetrical signal (duty cycle D = 0.50)
	DI6 (Term.18)
	Can be used as a digital or PTC input. 12/24 V DC logic levels: "0" < 3 V, "1" > 8 V R_{in} : 3 kohm
	Max. frequency: 16 kHz Symmetrical signal (duty cycle D = 0.50)
	Hardware filtering: 0.04 ms, digital filtering: 2 ms sampling
	Note: DI6 is not supported in the NPN configuration. PTC mode – PTC thermistor can be connected between DI6 and +24 V DC: < 1.5 kohm = '1' (low temperature), > 4 kohm = '0' (high temperature), open circuit = '0' (high temperature). DI6 is not a reinforced/double insulated input. Connecting the motor PTC sensor to this input requires usage of a reinforced/double insulated PTC sensor inside the motor
Relay outputs RO1RO3 (Term. 1927)	250 V AC / 30 V DC, 2 A. Terminal size: 0.14 1.5 mm² (26 16 AWG) See section Isolation areas (page 130).
Analog inputs Al1 and Al2 (Term. 2 and 5)	Current/voltage input mode selected with a parameter, see Connecting motor temperature sensors to the drive (page 125). Current input: $0(4)$ 20 mA, $R_{\rm in}$: 100 ohm Voltage input: $0(2)$ 10 V, $R_{\rm in}$: > 200 kohm Terminal size: 0.14 1.5 mm² (26 16 AWG) Inaccuracy: typical $\pm 1\%$, max. $\pm 1.5\%$ of full scale
	Inaccuracy for Pt100 sensors: 10 °C (50 °F)
Analog outputs AO1 and AO2 (Term. 7 and 8)	Current/voltage output mode for AO1 selected with a parameter, see Connection for obtaining 010 V from analog output 2 (AO2) (page 126). Current output: 020 mA, $R_{\rm load}$: < 500 ohm Voltage input: 010 V, $R_{\rm load}$: > 100 kohm (AO1 only) Terminal size: 0.14 1.5 mm² (26 16 AWG)
	Inaccuracy: ±1% of full scale (in voltage and current modes)
Reference voltage output for analog inputs +10V DC (Term. 4)	Max. 20 mA output Inaccuracy: ±1%

Embedded fieldbus (X5)	Connector pitch 5 mm, maximum wire size 2.5 mm² (14 AWG) Physical layer: EIA-485 Cable type: Shielded twisted pair cable with twisted pair for data and a wire or pair for signal ground, nominal impedance 100165 ohms, for example Belden 9842 Transmission rate: 9.6 115.2 kbit/s Termination by switch
Safe torque off (STO) inputs IN1 and IN2 (Term. 37 and 38)	24 V DC logic levels: "0" < 5 V, "1" > 13 V R _{in} : 2.47 kohm Terminal size: 0.14 1.5 mm ² (26 16 AWG)
Control panel - drive connection	EIA-485, male RJ-45 connector, max. cable length 100 m (328 ft)
Control panel - PC connection	USB Type Mini-B, max. cable length 2 m (6.5 ft)

Isolation areas X1 AI/AO X2 24 V **GND** X3 DΙ SLOT1 X4 2 STO 11111111111 X8 RO1 X7 Х5 RO2 **EFB** X6 RO3 3 SLOT2 1 Panel port 2 Fieldbus extension 3 I/O extension Reinforced insulation (IEC/EN 61800-5-1:2007, UL 61800-5-1 First edition) Functional insulation (IEC/EN 61800-5-1:2007, UL 61800-5-1 First edition) Below altitudes 4000 m (13123 ft): The terminals on the control unit fulfill the Protective Extra Low Voltage (PELV) requirements (EN 50178): There is reinforced insulation between the user terminals which only accept ELV voltages and terminals that accept higher voltages (relay outputs).



R6...R9

External power supply	Maximum power: 36 W, 1.50 A at 24 V AC/DC ±10% as standard
Term. 40, 41	Terminal size: 0.14 2.5 mm ² (26 14 AWG)

+24 V DC output (Term. 10)	Total load capacity of this outputs is 6.0 W (250 mA / 24 V) minus the power taken by the option modules installed on board. Terminal size: 0.14 2.5 mm ² (26 14 AWG)
Digital inputs DI1DI6 (Term. 1318)	Input type: NPN/PNP Terminal size: 0.14 2.5 mm ² (26 14 AWG)
	DI1DI4 (Term. 1316) 12/24 V DC logic levels: "0" < 4 V, "1" > 8 V R _{in} : 3 kohm
	Hardware filtering: 0.04 ms, digital filtering: 2 ms sampling
	DI5 (Term.17) Can be used as a digital or frequency input. 12/24 V DC logic levels: "0" < 4 V, "1" > 8 V $R_{\rm in}$: 3 kohm Max. frequency: 16 kHz Symmetrical signal (duty cycle D = 0.50)
	<u>DI6 (Term.18)</u>
	Can be used as a digital or PTC input. 12/24 V DC logic levels: "0" < 3 V, "1" > 8 V R _{in} : 3 kohm
	Max. frequency: 16 kHz Symmetrical signal (duty cycle D = 0.50)
	Hardware filtering: 0.04 ms, digital filtering: 2 ms sampling
	Note: DI6 is not supported in the NPN configuration. PTC mode – PTC thermistor can be connected between DI6 and +24 V DC: < 1.5 kohm = '1' (low temperature), > 4 kohm = '0' (high temperature), open circuit = '0' (high temperature). DI6 is not a reinforced/double insulated input. Connecting the motor PTC sensor to this input requires usage of a reinforced/double insulated PTC sensor inside the motor
Relay outputs RO1RO3 (Term. 1927)	250 V AC / 30 V DC, 2 A. Terminal size: 0.14 2.5 mm ² (26 14 AWG) See section Isolation areas (page 134).
Analog inputs Al1 and Al2 (Term. 2 and 5)	Current/voltage input mode selected with a parameter, see Connecting motor temperature sensors to the drive (page 125). Current input: $0(4)$ 20 mA, R_{in} : 100 ohm Voltage input: $0(2)$ 10 V, R_{in} : > 200 kohm Terminal size: 0.14 2.5 mm² (26 14 AWG) Inaccuracy: typical $\pm 1\%$, max. $\pm 1.5\%$ of full scale
	Inaccuracy for Pt100 sensors: 10 °C (50 °F)
Analog outputs AO1 and AO2 (Term. 7 and 8)	Current/voltage output mode for AO1 selected with a parameter, see Connection for obtaining 010 V from analog output 2 (AO2) (page 126). Current output: 020 mA, $R_{\rm load}$: < 500 ohm Voltage input: 010 V, $R_{\rm load}$: > 100 kohm (AO1 only) Terminal size: 0.14 2.5 mm² (26 14 AWG) Inaccuracy: ±1% of full scale (in voltage and current modes)
Reference voltage output for analog inputs +10V DC (Term. 4)	Max. 20 mA output Inaccuracy: ±1%
Safe torque off (STO) inputs IN1 and IN2 (Term. 37 and 38)	24 V DC logic levels: "0" < 5 V, "1" > 13 V R _{in} : 2.47 kohm Terminal size: 0.14 2.5 mm ² (26 14 AWG)

Embedded fieldbus (X5)	Connector pitch 5 mm, maximum wire size 2.5 mm² (14 AWG) Physical layer: EIA-485 Cable type: Shielded twisted pair cable with twisted pair for data and a wire or pair for signal ground, nominal impedance 100165 ohms, for example Belden 9842 Transmission rate: 9.6 115.2 kbit/s Termination by switch
Control panel - drive connection	EIA-485, male RJ-45 connector, max. cable length 100 m (328 ft)
Control panel - PC connection	USB Type Mini-B, max. cable length 2 m (6.5 ft)

Isolation areas SLOT 1 1...3 AI1 4...6 AI2 7...8 ΑO 10...12 24 V **GND** 13...15 DI 16...18 DI **EFB** 34...38 EIA/R5-485 STO 40, 41 • • • Ext. 24 V SLOT 2 19...21 • • • RO1 (1)22...24 • • • RO2 25...27 RO3 1 Panel port 2 Power unit connection at the bottom of the control unit Reinforced insulation (IEC/EN 61800-5-1:2007, UL 61800-5-1 First edition) Functional insulation (IEC/EN 61800-5-1:2007, UL 61800-........... 5-1 First edition) The terminals on the control unit fulfill the Protective Extra Low Voltage (PELV) requirements (EN 50178): There is reinforced insulation between the user terminals which only accept ELV voltages and terminals that accept higher voltages (relay outputs). Note: There is functional insulation also between the individual relay outputs.

Note: There is reinforced insulation on the power unit.

Ground isolation diagram

*) Jumper installed at factory



Installation checklist

Contents of this chapter

This chapter contains a checklist for the mechanical and electrical installation of the drive.

Checklist

Examine the mechanical and electrical installation of the drive before start-up. Go through the checklist together with another person.



WARNING!

Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrical professional, do not do installation, commissioning or maintenance work.



WARNING!

Do the steps in section Electrical safety precautions (page 18) before you start the work.

Make sure that	
The ambient operating conditions meet the drive ambient conditions specification and enclosure rating (IP code).	
The supply voltage matches the nominal input voltage of the drive. See the type designation label.	
The insulation resistance of the input power cable, motor cable and motor is measured according to local regulations and the manuals of the drive.	
The drive is attached securely on an even, vertical and non-flammable wall.	
The drive is installed in a shaded location with proper protection from rain and external elements.	
The drive cabinet is having a rating IP54 or higher.	

136 Installation checklist

Make sure that	$\overline{\vee}$
The cooling air can flow freely in and out of the drive.	
If the drive is connected to a network other than a symmetrically grounded TN-S system: You have done all the required modifications (for example, you may need to disconnect the EMC filter or ground-to-phase varistor) the electrical installation instructions.	
Appropriate AC fuses and main disconnecting device are installed.	
There is an adequately sized protective earth (ground) conductor(s) between the drive and the switchboard, the conductor is connected to correct terminal, and the terminal is tightened to the correct torque.	
Grounding has also been measured according to the regulations.	
Solar array direction, earth connection, DC cable connection and usage of string combiner box aligns with the solar array manufacturer's guidelines.	
Solar array size is sufficient with respect to the required AC voltage and temperature conditions of the location.	
The input power cable is connected to the correct terminals, the phase order is correct, and the terminals are tightened to the correct torque.	
There is an adequately sized protective earth (ground) conductor between the motor and the drive. The conductor is connected to the correct terminal, and the terminal is tightened to the correct torque.	
Grounding has also been measured according to the regulations.	
The motor cable is connected to the correct terminals, the phase order is correct, and the terminals are tightened to the correct torque.	
The motor cable is routed away from other cables.	
No power factor compensation capacitors are connected to the motor cable.	
The control cables are connected to the correct terminals, and the terminals are tightened to the correct torque.	
If a drive bypass connection will be used: The direct-on-line contactor of the motor and the drive output contactor are either mechanically and/or electrically interlocked, that is, they cannot be closed at the same time. A thermal overload device must be used for protection when bypassing the drive. Refer to local codes and regulations.	
There are no tools, foreign objects or dust from drilling inside the drive.	
The area in front of the drive is clean: the drive cooling fan cannot draw any dust or dirt inside.	
Drive covers and the terminal box cover of the motor are in place.	
The motor and the driven equipment are ready for power-up.	
The MC4 DC terminals between Drive and solar modules/string combiner box are disconnected	
Until the solar array is fully configured and sting combiner box connection is completed (if used), solar array MC4 terminals to drive is not connected.	
A string combiner box is used to combine multiple strings when you use multiple strings to meet require current rating of motor.	
Output of string combiner box is only two cables, DC+ and DC Do not try to use drive terminals for combining multiple strings.	



Start-up

Contents of this chapter

This chapter describes the start-up procedure of the drive.

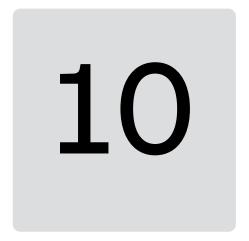
Reforming the capacitors

The capacitors must be reformed if the drive has not been powered (either in storage or unused) for a year or more. The manufacturing date is on the type designation label. For information on reforming the capacitors, refer to Capacitor reforming instructions (3BFE64059629 [English]).

Start-up procedure

- 1. Run setup of the drive control program according to the start-up instructions given in ACQ80-01 (30 to 55 kW) drives quick installation guide (3AXD50001017217 [English]) or in the firmware manual.
 - For drives with resistor braking: See also chapter Resistor braking (page 199).
 - For SynRM motor drives: Set bit 2 of parameter 95.21 HW options word 2 to SynRM.
 - For sine filters: See Sine filter hardware manual (3AXD50000016814 [English]).
- 2. Validate the Safe torque off function according to the instructions given in chapter The Safe torque off function (page 201).
- 3. Validate the safety function (option +Q986) as described in FSPS-21 PROFIsafe safety functions module user's manual (3AXD50000158638 [English]).

 $\langle 1 \rangle$



Maintenance

Contents of this chapter

This chapter contains maintenance instructions.

Maintenance intervals

The tables show the maintenance tasks that can be done by the end user. For the ABB Service offering, contact your local ABB Service representative (new.abb.com/contact-centers).

Description of symbols

Action	Description
I	Inspection (visual inspection and maintenance action if needed)
Р	Performance of on/off-site work (commissioning, tests, measurements or other work)
R	Replacement

Recommended maintenance intervals after start-up

Action	Description
Р	Quality of supply voltage
I	Spare parts
Р	Capacitor reforming for spare modules and spare capacitors, see Capacitors (page 147)
I	Tightness of terminals
I	Dustiness, corrosion or temperature
I	Heatsink cleaning, see Cleaning the heatsink (page 141)

Component		Years from start-up						
	3	6	9	12	15	18	21	
Cooling								
Fans, IP21 (UL Type 1) frames R4 to R9								
Main cooling fan R4: page 143, R5: page 144		R		R		R		
Auxiliary cooling fan for circuit boards R4 v2 drive type 089A-4: page146		R		R		R		
Auxiliary cooling fan (LONGLIFE) for circuit boards, R5: page146, R6R9: page145.			R			R		
Fans, IP55 (UL Type 12) frames R4 to R9								
Main cooling fan R4: page 143, R5: page 144		R		R		R		
Auxiliary cooling fan (LONGLIFE) for circuit boards R4 and R5: page146, R6R9: page145.			R			R		
Aging								
Control panel battery: page 147			R			R		
Functional safety								
Safety function test	I See the maintenance information of the safety function.							
Safety component expiry (Mission time, $T_{\rm M}$)		20 years						

Note:

- The maintenance and component replacement intervals are based on the assumption that the equipment operates within the specified ratings and ambient conditions. ABB recommends annual drive inspections to ensure the highest reliability and optimum performance.
- Long-term operation near the specified maximum ratings or ambient conditions may require shorter maintenance intervals for certain components. Contact your local ABB Service representative for additional maintenance recommendations.

Cleaning the exterior of the drive



WARNING!

Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrical professional, do not do installation, commissioning or maintenance work.

- 1. Stop the drive and do the steps in section Electrical safety precautions (page 18) before you start the work.
- 2. Clean the exterior of the drive. Use:
 - vacuum cleaner with an antistatic hose and nozzle
 - soft brush
 - dry or damp (not wet) cleaning cloth. Moisten with clean water, or mild detergent (pH 5...9 for metal, pH 5...7 for plastic).



WARNING!

Prevent water from entering the drive. Never use excessive amount of water, a hose, steam, etc.

Cleaning the heatsink

The heatsink of the power module (drive, supply, inverter, converter, etc.) pick up dust from the cooling air. This can cause overtemperature warnings and faults. When necessary, clean the heatsink as follows.



WARNING!

Use the required personal protective equipment. Wear protective gloves and long sleeves. Some parts have sharp edges.



WARNING!

Use a vacuum cleaner with antistatic hose and nozzle, and wear a grounding wristband. Using a normal vacuum cleaner creates static discharges which can damage circuit boards.

- Stop the drive and do the steps in section Electrical safety precautions (page 18) before you start the work.
- 2. Remove the module cooling fan(s). See the separate instructions.
- 3. Protect the adjacent equipment from dust.
- 4. Blow dry, clean and oil-free compressed air from bottom to top and simultaneously use a vacuum cleaner at the air outlet to trap the dust.
- 5. Reinstall the cooling fan.

Fans

See Maintenance intervals (page 139) for the fan replacement interval in average operation conditions.

Parameter 05.04 Fan on-time counter indicates the running time of the cooling fan. Reset the counter after a fan replacement. See the firmware manual.

In a speed-controlled fan, the speed of the fan matches the cooling needs. This increases the life span of the fan.

Main fans are speed controlled. When the drive is stopped, the main fan runs at low speed until the drive cools down. IP21 (UL Type 1) frame R5 and all IP55 (UL Type 12) frames have auxiliary fans that are not speed controlled and run all the time when the control unit is powered.

Replacement fans are available from the manufacturer. Do not use other than specified spare parts.

Replacing the main cooling fan, IP21 and IP55 (UL Type 1 and UL Type 12) frame R4

<u>A</u>.

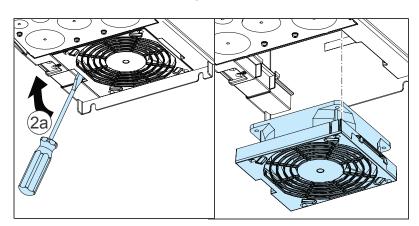
WARNING!

Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

1. Stop the drive and disconnect it from the power line. Wait for 5 minutes and then make sure by measuring that there is no voltage. See section Electrical safety precautions (page 18) before you start the work.

R4

- 1. Lever the fan assembly off the drive frame with for example a screwdriver (2a) and pull out the fan assembly (2b).
- 2. Install the fan assembly in reverse order.



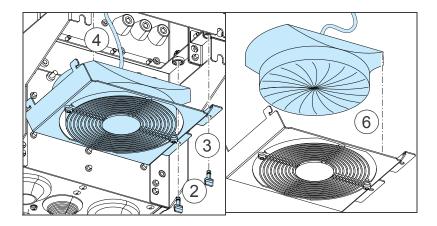
Replacing the main cooling fan, IP21 and IP55 (UL Type 1 and UL Type 12) frame R5



WARNING!

Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

- Stop the drive and disconnect it from the power line. Wait for 5 minutes and then
 make sure by measuring that there is no voltage. See section Electrical safety
 precautions (page 18) before you start the work.
- 2. Remove the two mounting screws of the fan mounting plate at the bottom of the drive.
- 3. Pull the fan mounting plate down from the side edge.
- 4. Unplug the fan power supply wires from the drive.
- 5. Lift the fan mounting plate off.
- 6. Remove the fan from the mounting plate.
- 7. Install the new fan in reverse order.



Replacing the auxiliary cooling fan, IP21 and IP55 (UL Type 1 and UL Type 12) frames R6...R9

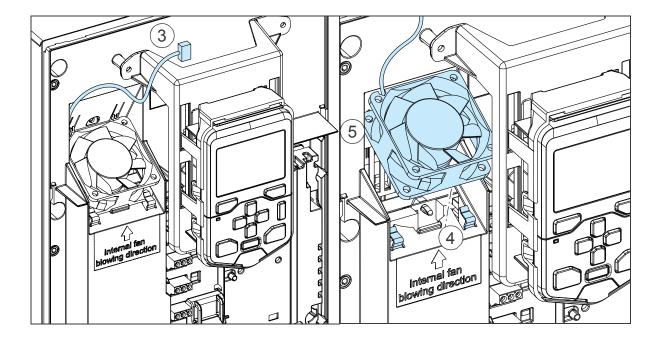
/\$\\!\

WARNING!

Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

- Stop the drive and disconnect it from the power line. Wait for 5 minutes and then
 make sure by measuring that there is no voltage. See section Electrical safety
 precautions (page 18) before you start the work.
- 2. Remove the front cover (see section IP21 (UL Type 1) (page 62)).
- 3. Unplug fan power supply wires from the drive.
- 4. Release the retaining clips.
- 5. Lift the fan off.
- 6. Install the new fan in reverse order.

Note: Make sure that the arrow on the fan points up.



Replacing the auxiliary cooling fan, IP55 (UL Type 12) frame R4; IP21 and IP55 (UL Type 1 and UL Type 12) frame R5

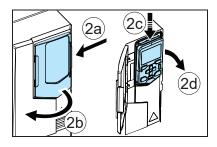


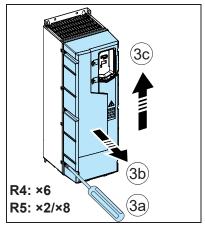
WARNING!

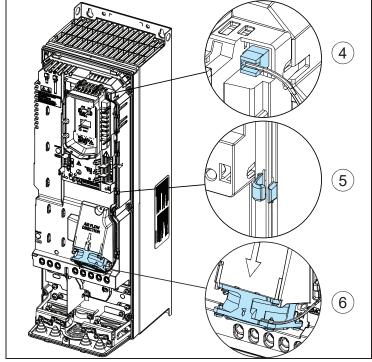
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

- 1. Stop the drive and disconnect it from the power line. Wait for 5 minutes and then make sure by measuring that there is no voltage. See section Electrical safety precautions (page 18) before you start the work.
- 2. Remove the control panel: Press the retaining clip of the IP55 panel cover (2a) and open the cover (2b). Press the retaining clip of the control panel at the top (2c) and pull it forward from the top edge (2d)
- 3. Remove the front cover: Loosen the retaining screws (R4:6 pieces, R5: IP21 2 pieces; IP55 8 pieces) with a screwdriver (3a) and lift the cover from the bottom outwards (3b) and then up (3c).
- 4. Unplug the fan power supply wires from the drive.
- 5. Detach the fan cable from the clips.
- 6. Pull the fan off.
- 7. Install the new fan in reverse order.

Note: Make sure that the arrow on the fan points down.







Capacitors

The intermediate DC circuit of the drive contains several electrolytic capacitors. Operating time, load, and surrounding air temperature have an effect on the life of the capacitors. Capacitor life can be extended by decreasing the surrounding air temperature.

Capacitor failure is usually followed by damage to the unit and an input cable fuse failure, or a fault trip. If you think that any capacitors in the drive have failed, contact ABB.

Reforming the capacitors

The capacitors must be reformed if the drive has not been powered (either in storage or unused) for a year or more. The manufacturing date is on the type designation label. For information on reforming the capacitors, refer to Capacitor reforming instructions (3BFE64059629 [English]).

Control panel

Refer to ACS-AP-I, -S, -W Assistant control panels user's manual (3AUA0000085685 [English]).

Refer to ACS-BP-S basic control panels user's manual (3AXD50000032527 [English]).

LEDs

Drive LEDs

There is a green POWER and a red FAULT LED on the front of the drive. They are visible through the panel cover but invisible if a control panel is attached to the drive. The table below describes the drive LED indications.

Drive LEDs POWER and FAULT, on the front of the drive, under the control panel / panel cover If a control panel is attached to the drive, switch to remote control (otherwise a fault will be generated), and then remove the panel to be able to see the LEDs

LEDs off	LED lit ar	d steady	LED blinking			
No power	Green (POWER)	Power supply on the board OK	Green (POWER)	Blinking: Drive in an alarm state Blinking for one second: Drive selected on the control panel when multiple drives are connected to the same panel bus.		
	Red (FAULT)	Active fault in the drive. To reset the fault, press RESET from the control panel or switch off the drive power.	Red (FAULT)	Active fault in the drive. To reset the fault, switch off the drive power.		

Control panel LEDs

The control panel has one LED. The table below describes the control panel LED indications. For more information see ACS-AP-I, -S, -W and ACH-AP-H, -W Assistant control panels user's manual (3AUA0000085685 [English]).

Control	oanel LED	, at the left edge of the control panel	I			
LED off	LED lit a	and steady	LED blinking/flickering			
has no power	Green	Drive functioning normally. Connection between the drive and control panel may be faulty or lost, or the panel and drive may be incompatible. Check the control panel display.	Green	Blinking: Active warning in the drive Flickering: Data transferred between the PC tool and drive through the USB connection of the control panel		
	Red	 Check the display to see where the fault is. Active fault in the drive. Reset the fault. Active fault in another drive in the panel bus. Switch to the drive in question and check and reset the fault. 	Red	Active fault in the drive. To reset the fault, cycle the drive power.		
			Blue	Panels with a Bluetooth interface only. Blinking: Bluetooth interface is enabled. It is in discoverable mode and ready for pairing. Flickering: Data is transfered through the Bluetooth interface of the control panel.		

Functional safety components

The mission time of functional safety components is 20 years which equals the time during which failure rates of electronic components remain constant. This applies to the components of the standard Safe torque off circuit as well as any modules, relays and, typically, any other components that are part of functional safety circuits.

The expiry of mission time terminates the certification and SIL/PL classification of the safety function. The following options exist:

- Renewal of the whole drive and all optional functional safety module(s) and components.
- Renewal of the components in the safety function circuit. In practice, this is
 economical only with larger drives that have replaceable circuit boards and other
 components such as relays.

Note that some of the components may already have been renewed earlier, restarting their mission time. The remaining mission time of the whole circuit is however determined by its oldest component.

Contact your local ABB service representative for more information.



Technical data

Contents of this chapter

This chapter contains the technical specifications of the drive including the ratings, sizes and technical requirements, provisions for fulfilling the requirements for CE, UL and other approval marks.

Electrical ratings

IEC

ACQ80-	Frame	Nominal	Nominal			Ot	ıtput ratir	ngs	
01		input	DC input	rent / _{max}	Nominal use			Heavy-duty use	
		I _{1N}			I _N	P _n		I _{Hd}	P _{Hd}
		Α	Α	Α	Α	kW	hp	Α	kW
3-phase <i>U</i> _n	= 400 V (3	80480 V)	,					,
030kW-4	R4	62	75.88	81	62	30	40	45	22
037kW-4	R4	73	89.35	110	73	37	50	61	30
045kW-4	R4	89	108.93	130	89	45	60	72	37
055kW-4	R5	106	129.74	157	106	55	75	87	45
075kW-4	R6	145	177.47	178	145	75	100	105	55
090kW-4	R7	169	206.85	247	169	90	125	145	75
110kW-4	R7	206	252.14	287	206	110	150	169	90
132kW-4	R8	246	301.1	350	246	132	200	206	110
160kW-4	R8	293	358.62	418	293	160	200	246	132
200kW-4	R9	363	444.3	498	363	200	300	293	160
	1		1	1		1	ЗАХ	D1000065	1180.xls I

See definitions and notes in section Definitions (page 150)

Definitions

 $\it U_{\rm n}$ Nominal output voltage of the drive. For input voltage range [$\it U_{\rm 1}$, see section Electrical

power network specification (page 167). 50 Hz for IEC ratings and

I_{1N} Nominal input current (rms) at 40 °C (104 °F).

I_{Dc} Nominal DC input current

 I_{max} Maximum output current. Available for two seconds at start.

IN Nominal output current. Maximum continuous rms output current allowed (no overload).

P_n Nominal power of the drive. Typical motor power (no overload). The kilowatt ratings

apply to most IEC 4-pole motors. The horsepower ratings apply to most NEMA 4-pole

motors.

I_{Hd} Maximum current with 50% overload, allowed for one minute every ten minutes.

1) Maximum current with 30% overload, allowed for one minute every ten minutes.

2) Maximum current with 25% overload, allowed for one minute every ten minutes.

P_{Hd} Typical motor power in heavy-duty use (50% overload).

How to calculate required solar cell voltage and short circuit current

To calculate, required solar cell voltage and short circuit current (ISC) for a motor at solar cell nominal conditions

Solar array V_{mp}/V_{mpp} = Motor nominal voltage * 1.35

Solar array I_{mp} = Drive nominal current * 0.817

I_{DC} = Drive nominal current /0.817

Note: Make sure that V_{mp}/V_{mpp} of solar array does not exceed 600 VDC and VOC does not exceed 800 VDC.

Definitions

 $oldsymbol{V_{mp}}$ Voltage at maximum power $oldsymbol{V_{mpp}}$ Maximum power point voltage

*I*_{mp} Current at maximum power

I_{DC} Nominal DC input current

 $m{V_{OC}}$ Short circuit current $m{V_{OC}}$ Open circuit voltage $m{V_{DC}}$ Direct current voltage

Sizing

Drive sizing is based on the rated motor current, voltage and power. To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current. Also the rated power of the drive must be higher than or equal to the rated motor power. The power ratings are the same regardless of the supply voltage within one voltage range.

Note: The nominal values of I_N apply to the ambient temperature of 40 °C (122 °F). Derating is needed above this temperature.

Note: The DriveSize dimensioning PC tool available from ABB (http://new.abb.com/drives/software-tools/drivesize) is recommended for selecting the drive, motor and gear combination.

Deratings

The output load capacity (I_2 , I_{Ld} , I_{Hd} ; note that I_{max} is not derated) decreases in certain situations. In situations, where full motor power is required, oversize the drive so that the total derated output current provides sufficient capacity to supply the required nominal voltage to run the motor.

Note: The DriveSize dimensioning PC tool available from ABB (http://new.abb.com/drives/software-tools/drivesize) is also suitable for derating.

Note: If several situations are present at a time, the effects of derating are cumulative:

 I_2 (derated) or I_{Ld} (derated) or I_{Hd} (derated) = (I_2 or I_{Ld} or I_{Hd}) x (switching frequency derating) x (altitude derating) x (ambient temperature derating), where no derating = 1.0.

Note: The motor may have a derating on it too.

Example 1, IEC: How to calculate the derated current

The IP21 / UL Type 1 drive type is ACQ80-01-030kW-4, which has a nominal output current ($I_{\rm N}$) of 62 A. Calculate the derated drive output current at 4kHz switching frequency, at 1500 m altitude and at 50 °C ambient temperature as follows:

- 1. Switching frequency derating by derating factor (page 153): No derating needed for 4 kHz.
- 2. Altitude derating (page 152):

The derating factor for 1500 m is 1 - 1/10 000 m \cdot (1500 - 1000) m = 0.95. The derated drive output current becomes = 0.95 \cdot 62 A = 58.9 A.

3. Surrounding air temperature derating, IP21 (UL Type 1) (page 152): The derating factor for 50 °C ambient temperature = 0.90. The derated drive output current becomes = $0.90 \cdot 58.9 \text{ A} = 53.01 \text{ A}$.

Example 2, IEC: How to calculate the required drive

The application requires a nominal motor current of 50.0 A at a switching frequency of 8 kHz. The supply voltage is 400 V and the drive is situated at an altitude of 1800 m and the surrounding air temperature is 35 °C.

Altitude derating: The derating factor for 1800 m is:
$$1-\frac{1800m-1000m}{10000m}=0.92$$

The minimum size required becomes

$$\frac{50}{0.92} = 54.34A$$

No derating needed for 35 °C ambient temperature.

To see if the derated output current of a drive is sufficient for the application, multiply the nominal output current (I_N) by the applicable derating factor.

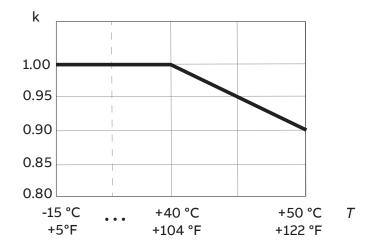
For example,

- if drive type has a nominal output current (I_N) of 62 A at 400 V. The switching frequency derating factor for this drive type is 0.82 at 8 kHz.
 The calculated derated drive output current is 62 A * 0.82 = 50.84 A at 8 kHz, which is not sufficient.
- if drive type has a nominal output current (I_N) of 88 A at 400 V. The switching frequency derating factor for this drive type is 0.71 at 8 kHz.
 The calculated derated drive output current is 88 A * 0.71 = 62.48 A at 8 kHz, which is the required drive size.

Surrounding air temperature derating, IP21 (UL Type 1)

IP21 (UL Type 1) drive types, other than the exceptions below

In the temperature range +40...50 °C (+104...122 °F), the rated output current is derated by 1% for every added 1 °C (1.8 °F). The output current can be calculated by multiplying the current given in the rating table by the derating factor (k, in the diagram below).



Altitude derating

In altitudes 1000...4000 m (3300...13120 ft) above sea level, the derating is 1% for every 100 m (330 ft).

Note: There are special considerations in corner-grounded installations above 2000 m. Contact your local ABB representative for further information.

The output current is calculated by multiplying the current given in the rating table by the derating factor k, which for x meters (1000 m <= x <= 4000 m) is:

$$K = 1 - 1/10000m * (X - 1000)m$$

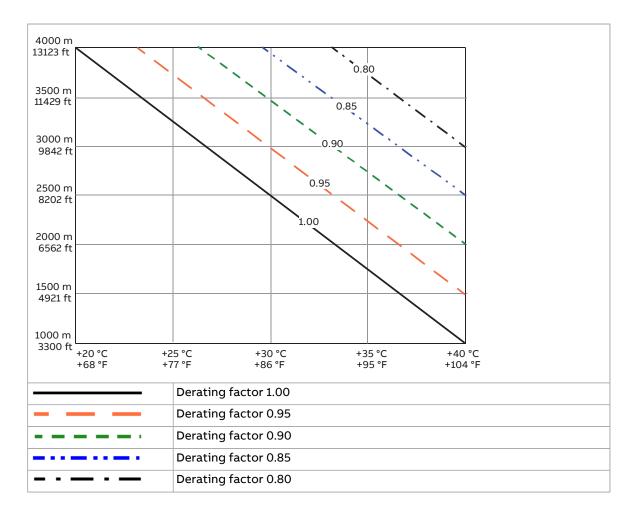
Altitude and surrounding air temperature

At altitudes from 1000...4000 m (3281...13123 ft) above sea level and temperature +40 °C (+104 °F), the derating is 1 percentage point for every additional 100 m (328 ft).

If surrounding air temperature is below +40 °C, the derating can be reduced by 1.5 percentage point for every 1 °C reduction in temperature.

A few combined altitude and temperature derating curves for 1000...4000 m are shown below. For example, if the temperature is 30 °C, the derating factor is 1 - 1.5% \cdot 10 = 0.85.

For a more accurate derating, use the DriveSize PC tool.



Note: Check the supply network compatibility restrictions above 2000 m (6562 ft), see **Installation site altitude** (page 170). Check also PELV limitation on relay output terminals above 2000 m (6562 ft), see section *Isolation areas* in Technical data (page 127) for frames R4 and R5.

Switching frequency derating by derating factor

The output current is calculated by multiplying the current given in the rating table by the derating factor given in the table below.

Note: If you change the minimum switching frequency with parameter 97.02, derate according to the table below. Changing parameter 97.01 does not require derating.

IEC

ACQ80- 01	Frame size	Derating factor (k) for the minimum switching frequencies at 40 °C (+104 °F)								
		1 kHz	2 kHz	2 kHz 4 kHz		12 kHz				
3-phase <i>U</i> _n	= 400 V			Į.						
030kW-4	R4	1	1	1	0.82	0.64				
037kW-4	R4	1	1	1	0.73	0.55				
045kW-4	R4	1	1	1	0.71	0.57				
075kW-4	R6	1	0.97	0.84	0.66	0.52				
090kW-4	R7	1	0.98	0.89	0.71	0.53				
132kW-4	R8	1	0.96	0.82	0.61	0.45				

ACQ80- 01	Frame size	Derating factor (k) for the minimum switching frequencies (+104 °F)							
		1 kHz	2 kHz	4 kHz	8 kHz	12 kHz			
200kW-4	R9	1	0.95	0.79	0.58	0.43			

Switching frequency derating with actual output current values

These tables show the output current values with different switching frequencies. Note that other derating factors, for example ambient temperature and altitude, may also affect to the output current.

IEC

ACQ80- 01	Frame size	Nominal output	Nominal o	Nominal output current ($I_{ m N}$) for the minimum switching frequencies at 40 °C (+104 °F)								
		I _N	1 kHz	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz				
		Α	Α	Α	Α	Α	Α	Α				
3-phase U _n	= 400 V	,	'	'	,		,					
030kW-4	R4	62	62	62	62	51	39.7	N/A				
037kW-4	R4	73	73	73	73	53	40.2	N/A				
045kW-4	R4	88	88	88	88	62	50	N/A				
055kW-4	R5	106	106	106	106	75	60	N/A				
075kW-4	R6	145	145	145	145	96	75	N/A				
090kW-4	R7	169	169	169	169	120	90	N/A				
110kW-4	R7	206	206	206	206	146	109	N/A				
132kW-4	R8	246	246	246	246	150	111	N/A				
160kW-4	R8	293	293	293	293	179	132	N/A				
200kW-4	R9	363	363	363	363	211	156	N/A				

Output frequency derating

Output frequency derating applies for ratings up to ACQ80-01-055kW-4 (R5). Inverter output current is limited by the following factor k below 5 Hz absolute inverter output frequency f_abs.

 $k = 2/3 + 1/3 \cdot (f \text{ abs } / 5 \text{ Hz})$

Fuses (IEC)

gG as well as DC fuses for protection against short-circuit in the input power cable or drive are listed below. Either fuse type can be used for frames R4 and R5 if it operates rapidly enough. The operating time depends on the supply network impedance and the cross-sectional area and length of the supply cable.

Note 1: See also Implementing short-circuit and thermal overload protection (page 83).

Note 2: Fuses with higher current rating than the recommended ones must not be used.

Note 3: Fuses from other manufacturers can be used if they meet the ratings and the melting curve of the fuse does not exceed the melting curve of the fuse mentioned in the table.

AC fuses

uR and aR fuse

Drive type ACQ80-01	Minimum	Input cur- rent	uR and aR							
ACQ80-01	short cir- cuit cur- rent ¹⁾	rent	Rated cur- rent I _N	l²t	Rated voltage	Bussmann designation type	IEC 60269 size			
	Α	Α	A	A ² s	v	-3,5-3				
3 phases U _N =	400 V (380	.480 V)								
030kW-4	380	62	100	4650	690	170M1567	000			
037kW-4	480	73	125	8500	690	170M1568	000			
045kW-4	700	89	160	16000	690	170M1569	000			
055kW-4	1280	106	315	46500	690	170M3817	1			
075kW-4	1280	145	315	46500	690	170M3817	1			
090kW-4	1800	169	450	105000	690	170M5809	2			
110kW-4	2210	206	500	145000	690	170M5810	2			
132kW-4	3010	246	630	275000	690	170M5812	2			
160kW-4	4000	293	800	490000	690	170M6812D	3			
200kW-4	5550	363	1000	985000	690	170M6814D	3			
						3AXD1000	0715646.xls			

¹⁾ minimum short-circuit current of the device

gG fuses

ACQ80- 01	Minimum	Input cur-			gG (IEC 60	0269)					
01	short cir- cuit cur- rent ¹⁾	rent	Rated cur- rent I _N	l²t	Rated voltage	ABB designation type	IEC 60269 size				
	A	A	A	A ² s	V						
3 phases U _N = 400 V (380480 V)											
030kW-4	800	62	80	37500	500	OFAF000H80	000				
037kW-4	1000	73	100	65000	500	OFAF000H100	000				
045kW-4	1000	88	100	65000	500	OFAF000H100	000				
055kW-4	1300	106	125	103000	500	OFAF000H125	00				
075kW-4	1700	145	160	185000	500	OFAF000H160	00				
090kW-4	3300	169	250	600000	500	OFAF000H250	0				
110kW-4	5500	206	315	710000	500	OFAF000H315	1				
132kW-4	6400	246	355	920000	500	OFAF000H355	1				
160kW-4	7800	293	425	1300000	500	OFAF000H425	2				

ACQ80- 01	Minimum	Input cur- rent	gG (IEC 60269)							
01	short cir- cuit cur- rent ¹⁾	rent	Rated cur- rent I _N		Rated voltage	ABB designation type	IEC 60269 size			
	A	Α	A	A ² s	V					
200kW-4	9400	363	500	2000000	500	OFAF2H500	-			
3AXD10000715646.xls										

¹⁾ minimum short-circuit current of the device

Input circuit components

ACQ80- 01	Input cur- rent (A)	DC cur- rent	DC MCB	DC fuse	DC di- ode	AC MCCB	AC input contact- or	AC fuse	Fuse base
075KW-4	145	177.5	T4D/PV 250 4p F F 1100V DC	170M4010	IRK 162	XT2 160 TMA In 160A	AF116	170M3816	1
090KW-4	169	206.9	T4D/PV 250 4p F F 1100V DC	170M5008	IRK 230	XT4 250 TMA In 200A	AF140	170M3817	1
110KW-4	206	252.1	T5D/PV 500 4p F F 1100V DC	170M5009	IRK 230	XT4 250 TMA In 250A	AF146	170M3818	1
132KW-4	246	301.1	T5D/PV 500 4p F F 1100V DC	170M5011	IRK 330	T5 400 TMA In 320A	AF190	170M5809	2
160KW-4	293	358.6	T5D/PV 500 4p F F 1100V DC	170M5012	IRK 330	T5 400 TMA In 320A	AF205	170M5810	2
200KW-4	363	444.3	T5D/PV 500 4p F F 1100V DC	170M6012	IRK 500	T5 400 TMA In 400A	AF265	170M5812	2

DC charging circuit

ACQ80- 01	Input cur- rent (A)	Charging fuse	Charging contactor	Resist- ance	Capacit- ance	Resistance de- scription	Quantity
075KW-4	145	170M2673-20A	A30-30-10	36	2600	CAV 120 C 410 36R	1
090KW-4	169	170M2673-20A	A30-30-10	36	3800	CAV 120 C 410 36R	1
110KW-4	206	170M2673-20A	A30-30-10	36	3800	CAV 120 C 410 36R	1
132KW-4	246	170M2673-20A	A30-30-10	18	5600	CAV 120 C 410 36R	parallel 2

ACQ80- 01	Input cur- rent (A)	Charging fuse	Charging contactor	Resist- ance	Capacit- ance	Resistance de- scription	Quantity
160KW-4	293	170M2673-20A	A30-30-10	18	5600	CAV 120 C 410 36R	parallel 2
200KW-4	363	170M2673-20A	A30-30-10	18	8800	CAV 120 C 410 36R	parallel 2

DC main circuit breakers

ACQ80- 01	Minimum short circuit current ¹⁾	Input current	Calculated DC current	Rated voltage	DC MCB 4-pole	Part number
	A	Α	A	V		
3-phase UN	I = 380480 V	,			*	
030kW-4	380	62	50.654	690	S802PV-S93 (ABB)	2CCP842001R1639
037kW-4	480	73	59.641	690	S802PV-S93 (ABB)	2CCP842001R1639
045kW-4	480	88	71.896	690	T1D/PV 160 4p F FC Cu 1100V DC	1SDA069816R1
055kW-4	700	106	86.602	690	T1D/PV 160 4p F FC Cu 1100V DC	1SDA069816R1
075kW-4	1000	145	250	690	170M3816	1
090kW-4	1280	169	315	690	170M3817	1
110kW-4	1520	206	350	690	170M3818	1
132kW-4	2050	246	450	690	170M5809	2
160kW-4	2200	293	500	690	170M5810	2
					3.4	XD10000715646.xls

¹⁾ minimum short-circuit current of the device

Note: ABB recommends to use above fuses for reverse polarity protection between ACQ80 drive and solar array/solar string.

MOV

Ordering code	Type code (TDK)	VRMS	VDC	i _{max}	W _{max}	P _{max}
B72220P3351K101	S20K350E3K1	350	460	12000	335	1.00
B72220P3381K101	S20K385E3K1	385	505	12000	370	1.00
B72220P3421K101	S20K420E3K1	420	560	12000	405	1.00

DC EMI filter

Ordering code	Rated current (55°C)	Rated current (40°C)	Typical inverter AC power rating	IP class
	Α	Α	kW	
FN2200-25-33	25	28	10	IP20
FN2200-50-34	50	57	20	IP20
FN2200-75-34	75	86	30	IP20

Reverse polarity diodes

ACQ80- 01	Diode type code (International rectifier make)	Quantity required with heatsink
030kW-4	IRKE 71 - 1200V	2
037kW-4	IRKE 91	2
045kW-4	IRKE 91	2
055kW-4	IRKE 162	2
075kW-4	IRKE 230	2
090kW-4	IRKE 230	2
110kW-4	IRKE 330	2
132kW-4	IRKE 330	2
160kW-4	IRKE 500	2
200kW-4	IRKE 500	2

Alternate short-circuit protection

The table below lists MCB circuit breakers that can be used with the drive.

ACQ80- 01	MCBs					
01	ABB type	Max. short-cir- cuit	Tmax frame XT / T class	Tmax rat- ing	Electronic release	SACE ordering code for breaker and release unit
		I _{sc}				
		kA	A	Α	A	
3-phase <i>U</i> _N	= 380480 V		•			
030kW-4	S 803S-B/C 80	50	N/A	N/A	N/A	N/A
037kW-4	S 803S-B/C 80	50	N/A	N/A	N/A	N/A
045kW-4	S 803S-B/C 100	50	N/A	N/A	N/A	N/A
055kW-4	S 803S-B/C 125	50	N/A	N/A	N/A	N/A

ACQ80-	MCBs					
01	ABB type	Max. short-cir- cuit	Tmax frame XT / T class	Tmax rat- ing	Electronic release	SACE ordering code for breaker and release unit
		I _{sc}				
		kA	Α	Α	A	
075kW-4	XT4 L 250 Ekip LS/I In=250 3p F F	65	XT4	250	250	1SDA068555R1
090kW-4	XT4 L 250 Ekip LS/I In=250 3p F F	65	XT4	250	250	1SDA068555R1
110kW-4	T4 L 320 PR221DS- LS/I In=320 3p F F	65	T4	320	320	1SDA054141R1
132kW-4	T5 L 400 PR221DS- LS/I In=400 3p F F	65	T5	400	400	1SDA054365R1
160kW-4	T5 L 630 PR221DS- LS/I In=630 3p F F	65	T5	630	630	1SDA054420R1
200kW-4	T5 L 630 PR221DS- LS/I In=630 3p F F	65	T5	630	630	1SDA054420R1
	'				3.	AXD10000715646.xls A

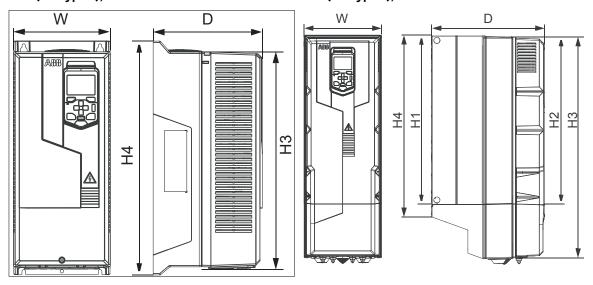
Dimensions, weights and free space requirements

Frame						Dime	ensions	and we	ights					
size				IP21				UL Type 1						
	H1	H2	Н3	H4	W	D	Wei ght	H1	H2	Н3	Н4	W	D	Wei ght
	mm	mm	mm	mm	mm	mm	kg	in	in	in	in	in	in	lb
R4	_*)	_*)	600	636	203	257	19.0	_*)	_*)	23.62	25.04	7.99	10.12	41.9
R5	596	596	732	633	203	295	28.3	23.46	23.46	28.82	24.90	7.99	11.61	62.4
R6	548	549	727	589	252	369	42.4	21.57	21.63	28.62	23.20	9.92	14.53	93.5
R7	600	601	880	641	284	370	54	23.62	23.67	34.65	25.25	11.18	14.57	119.1
R8	680	677	965	721	300	393	69	26.77	26.66	37.99	28.39	11.81	15.47	152.1
R9	680	680	955	741	380	418	97	26.77	26.77	37.60	29.19	14.96	16.46	213.9

^{*)} Frames with an integrated cable/conduit box

IP21 (UL Type 1), R4

IP21 (UL Type 1), R5...R9



Symbols

IP21 / UL Type 1

H1 R5....R9: Height back without cable/conduit box

H2 R5....R9: Height front without cable/conduit box

H3 R4: Height front, R5...R9: Height front with cable/conduit box

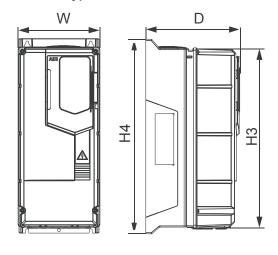
H4 R4: Height back, R5...R9: Height back with cable/conduit box

W Width

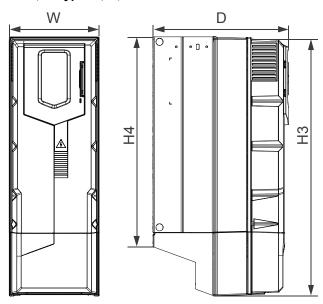
D Depth

Frame					Di	mensio	ns and	l weigl	nts				
size		IP55						UL	UL Type 12				
	Н3	H4	W	D	Weight	Н3	H4	H5	W	D	Weight	НН	HW
	mm	mm	mm	mm	kg	in	in	in	in	in	lb	in	in
R4	600	636	203	265	20.0	23.62	25.04	27.03	7.99	10.43	44.1	2.83	8.59
R5	732	633	203	320	29.0	28.82	24.90	32.01	7.99	12.60	64.0	3.15	8.58
R6	727	589	252	380	43.0	28.61	23.20	34.81	9.92	14.96	94.8	6.10	11.46
R7	880	641	284	381	56.0	34.65	25.25	40.86	11.18	15.00	123.5	6.10	13.00
R8	965	721	300	452	77	37.99	28.39	44.23	11.81	17.80	169.8	6.10	13.80
R9	955	741	380	477	103	37.60	29.19	46.75	14.96	18.78	227.1	9.06	16.95

IP55 (UL Type 12)¹⁾, R4

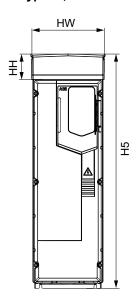


IP55 (UL Type 12)¹⁾, R5...R9

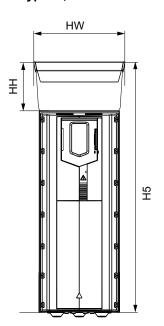


 $^{1)}$ IP55 / UL Type 12 without hood

UL Type 12, R4...R5



UL Type 12, R6...R9



Symbols

H3 R4: Height front, R5...R9: Height front with cable/conduit box

H4 R4: Height back, R5...R9: Height back with cable/conduit box

W Width

D Depth

HH Hood height

HW Hood width

Frame size	Dimensi	Dimensions and weights with main switch and EMC C1 filter options (+F278, +F316, +E223), IP55												
	Н	13)	Weight										
	mm in mm in mm in									lb				
R4	879	34.61	665	26.18	206	8.11	286	11.26	23.3	51.5				
R5	1023	40.28	626	24.65	203	7.99	342	13.46	33.0	72.8				

Frame size										
	Н		\ \ \	N	Г)1	D2		D3	
	mm	in	mm	in	mm	in	mm	in	mm	in
R4	776	30.55	290	11.42	120	4.74	137	5.41	191	7.53
R5	776	30.55	290	11.42	124	4.89	173	6.81	191	7.53
R6	672	26.46	374	14.72	194	7.63	170	6.67	191	7.53
R7	722	28.43	406	15.98	198	7.67	169	6.65	211	8.32
R8	814	32.01	433	17.46	202	7.95	184	7.22	209	8.22
R9	804	31.65	502	19.76	204	8.03	209	8.21	226	8.91

H Height with flange

W Width with flange

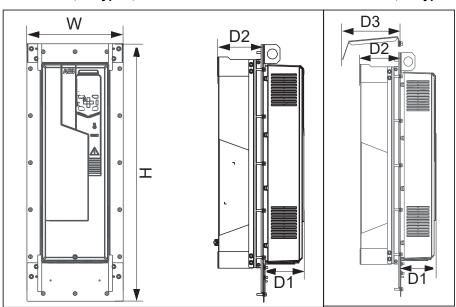
D1 Depth of the drive outwards from the outer surface of the flange plate

Depth of the drive inwards from the outer surface of the flange plate

Depth of the hood inwards from the outer surface of the flange plate (UL Type 12 only)

R4...R9 IP21 (UL Type 1)

R4...R9 IP55 (UL Type 12)



Frame					Free s	pace, IP	21 (UL 1	ype 1)				
size		Vertica	l mount	ing star	nd alone	!	Vertical mounting side by side					
	Above		Above Below		Bes	Beside		Above		w ¹⁾	Between	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
R4	53	2.09	200	7.87	150	5.91	200	7.87	200	7.87	0	0
R5	75	2.95	200	7.87	150	5.91	200	7.87	200	7.87	0	0
R6	155	6.10	300	11.8	150	5.91	200	7.87	300	11.8	0	0
R7	155	6.10	300	11.8	150	5.91	200	7.87	300	11.8	0	0
R8	155	6.10	300	11.8	150	5.91	200	7.87	300	11.8	0	0
R9	200	7.87	300	11.8	150	5.91	200	7.87	300	11.8	0	0

1) Free space below is always measured from the drive frame, not from the cable box.

Frame size		Free space, IP21 (UL Type 1) 1)											
Size		Horizontal mounting											
	Abo	ve ²⁾	Belov	_v 2) ,3)	Between ²⁾								
	mm	in	mm	in	mm	in							
R4	30	1.18	200	7.87	30/200	1.18/7.87							
R5	30	1.18	200	1.18/7.87									

Note: Horizontal installation meets IP20 requirements only.
 For definition, see the figure on page 45
 Free space below is always measured from the drive frame, not from the cable box.

Frame	Free space, IP55 (UL Type 12)											
size	Vertical mounting stand alone							Vertica	l mount	ing side	by side	
	Ab	ove	Bel	ow	Bes	side	Ab	ove	Belo	w ¹⁾	Betv	veen
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
R4	53	2.09	200	7.87	150	5.91	200	7.87	200	7.87	0	0
R5	100	3.94	200	7.87	150	5.91	200	7.87	200	7.87	0	0
R6	155	6.10	300	11.8	150	5.91	200	7.87	300	11.8	0	0
R7	155	6.10	300	11.8	150	5.91	200	7.87	300	11.8	0	0
R8	155	6.10	300	11.8	150	5.91	200	7.87	300	11.8	0	0
R9	200	7.87	300	11.8	150	5.91	200	7.87	300	11.8	0	0

¹⁾ Free space below is always measured from the drive frame, not from the cable box.

Frame size			Free spa	ace, IP55 (UL	Type 12) ¹⁾	
			Но	rizontal mou	nting	
	Abo	ve ²⁾	Below ²⁾ , ²⁾		Between ²⁾	
	mm	in	mm	in	mm	in
R4	30	1.18	200	7.87	30/200	1.18/7.87
R5	30	1.18	200	7.87	30/200	1.18/7.87

See the figures in section Installation alternatives (page 42).

Note: IP55/UL Type 12 drive mounted horizontally meets IP21/ UL Type 1 ratings.
 Free space below is always measured from the drive frame, not from the cable box.

Note: IP55 (UL Type 12) does not imply that the drive can be installed outside/outdoors. To install outside, contact your local ABB representative directly for specific instructions (3AXD10000425906). The warranty will be void if installed outdoors without using these special instructions.

Losses, cooling data and noise

The air flow direction is from bottom to top.

Cooling air flow, heat dissipation and noise for stand-alone drives

The table below specifies the heat dissipation in the main circuit at nominal load and in the control circuit with minimum load (I/O, options and panel not in use) and maximum load (all digital inputs and relays in the ON state, and the panel, fieldbus and fan in use). The total heat dissipation is the sum of the heat dissipation in the main and control circuits. Use the maximum heat dissipation when designing cabinet or electrical room cooling needs.

IEC

ACQ80-	Typical heat dissipation ¹⁾		Air	flow	Noise	Frame size
01	W	BTU/h	m³/h	CFM	dB(A)	
3-phase <i>U</i> _n	= 400 or 480 V					•
030kW-4	867	2958	134	79	69	R4
037kW-4	1114	3801	134	79	69	R4
045kW-4	1139	3886	139	82	63	R5
055kW-4	1290	4402	139	82	63	R5
075kW-4	1960	6688	435	256	67	R6
090kW-4	2021	6896	450	265	67	R7
110kW-4	2785	9503	450	265	67	R7
132kW-4	3131	10683	550	324	65	R8
160kW-4	4071	13891	550	324	65	R8
200kW-4	4834	16494	1150	677	68	R9

¹⁾ Typical drive losses when it operates at 90% of the motor nominal frequency and 100% of the drive nominal output

Terminal and entry data for the power cables

IEC

Input, motor, resistor and DC cable entries, maximum wire sizes (per phase) and terminal screw sizes and tightening torques (7) are given below.

Frame	Cable ent	ries	L1, L2, L3, T1,	/U, T2/V, T3/W termi	inals	Grounding	terminals
size	Per cable type	Ø ¹⁾	Min wire size (sol- id/ stranded) ²⁾	Max wire size (solid/stranded)	Τ	Max wire size	Τ
	pcs	mm	mm²	mm²	N∙m	mm²	N⋅m
3-phase L	J _n = 400 or 4	180 V					

Frame	Cable ent	ries	L1, L2, L3, T1,	L1, L2, L3, T1/U, T2/V, T3/W terminals				
size	Per cable type	Ø ¹⁾	Min wire size (sol- id/ stranded) ²⁾	Max wire size (solid/stranded)	Τ	Max wire size	Τ	
	pcs	mm	mm²	mm²	N⋅m	mm²	N⋅m	
R4	1	45	0.5/0.5	50	4.0	35/35	2.9	
R5	1	45	6	70	5.6	35/35	2.2	
R6	1	45	25	150	30	185	9.8	
R7	1	54	95	240	40	185	9.8	
R8	2	45	2x50	2x150	40	2x185	9.8	
R9	2	54	2x95	2x240	70	2x185	9.8	

¹⁾ Maximum cable diameter accepted. For the entry plate hole diameters, see chapter Dimension drawings (page 181).

Note: For the tightening torques of the grounding terminals, see sections Connection procedure, frame R4 (page 99) and Connection procedure, frame R5 (page 103).

Frame	Cable entries		R+,	R+, R-, UDC+ and UDC- terminals					
size	Per cable g ¹⁾ type		Min wire size (sol- id/ stranded) ²⁾	Max wire size (sol- id/stranded)	T (Wire screw)				
	pcs	mm	mm²	mm²	Screw/Bolt	N∙m			
3-phase <i>L</i>	J _n = 400 or 48	80 V							
R4	1	39	0.5/0.5	50	-	4.0			
R5	1	39	6	70	M5	5.6			
R6	1	45	25	150	M8	30			
R7	1	54	95	240	M10	30			
R8	2	45	2x50	2x150	M10	40			
R9	2	54	2x95	2x240	M12	70			

¹⁾ Maximum cable diameter accepted. For the entry plate hole diameters, see chapter Dimension drawings (page 181).

²⁾ Note: Minimum wire size does not necessarily have enough current capability for full load. Make sure the installation complies with local laws and regulations.

Frame size	Screwdrivers for the terminals of the main circuit
R4	PH2

Power cables

Typical power cables, IEC

The table below gives copper cable types with concentric copper shield for the drives with nominal current. The value separated by the plus sign means the diameter of the PE conductor.

See page 164 for the cable entry sizes allowed for the selected drive frame size.

²⁾ Note: Minimum wire size does not necessarily have enough current capability for full load. Make sure the installation complies with local laws and regulations.

ACQ80-	Frame	Cu cable type ¹⁾	Al cable type ¹⁾ , ²⁾
01	size –	mm²	mm²
3-phase U _n	= 400 V		
030kW-4	R4	3×25 + 16	-
037kW-4	R4	3×35 + 16	-
045kW-4	R5	3×50 + 25	-
055kW-4	R5	3×70 + 35	-
075kW-4	R6	3×95 + 50	-
090kW-4	R7	3×120 + 70	-
110kW-4	R7	3×150 + 70	-
132kW-4	R8	2×(3×70 + 35)	-
160kW-4	R8	2×(3×95 + 50)	-
200kW-4	R9	2×(3×120 + 70)	-

¹⁾ The cable sizing is based on max. 6 cables laid on a cable ladder side by side, ambient temperature 30 °C, PVC insulation, surface temperature 70 °C (EN 60204-1 and IEC 60364-5-52/2001). For other conditions, size the cables according to local safety regulations, appropriate input voltage and the load current of the drive. See page 164 for the accepted cable sizes of the drive.

Temperature: For IEC, select a cable rated for at least 70 °C maximum permissible temperature of conductor in continuous use.

Voltage: 600 V AC cable is accepted for up to 500 V AC.

Terminal and entry data for the control cables

IEC

Control cable entries, wire sizes and tightening torques (7) are given below.

Frame	Cable	Cable entries		Control cable entries and terminal sizes						
size	Holes	Max cable size	, ,	GND, EXT. 24V inals	' ' ' '	RO, STO termin- lls				
			Wire size	7	Wire size	Τ				
	pcs	mm	mm²	N⋅m	mm²	N⋅m				
3-phase L	V _n = 400 or 48	30 V	,	,						
R4	4	17	0.22.5	0.50.6	0.141.5	0.50.6				
R5	3	17	0.22.5	0.50.6	0.141.5	0.50.6				
R6	4	17	0.142.5	0.50.6	0.142.5	0.50.6				
R7	4	17	0.142.5	0.50.6	0.142.5	0.50.6				
R8	4	17	0.142.5	0.50.6	0.142.5	0.50.6				
R9	4	17	0.142.5	0.50.6	0.142.5	0.50.6				

Aluminum cables can be used with $U_{\rm n}$ = 230 V frame R5 only.

Electrical power network specification

Voltage (U_1)

• ACQ80-01-xxxx-4 drives: Input voltage range 3~ 380...480 V AC +10%...-15%.

This is indicated in the type designation label as typical input voltage levels 3~ 400/480 V AC.

Network type

Public low voltage networks. Symmetrically grounded TN-S system, IT (ungrounded), corner-grounded delta, midpoint-grounded delta and TT systems, see sections:

IEC: When to disconnect EMC filter or ground-to-phase varistor: TN-S, IT, corner-grounded delta and midpoint-grounded delta systems (page 93) and Guidelines for installing the drive to a TT system (page 94).

Note: Frames R4 and R5 cannot be used in corner-grounded or midpoint-grounded delta systems.

Rated conditional short-circuit current I_{cc} (IEC 61800-5-1)

Frequency (f_1)

Imbalance

Fundamental power factor (cos phi₁)

Minimum short-circuit power (IEC/EN 61000-3-12)

Maximum allowable prospective short-circuit current is 65 kA when protected by fuses given in the fuse tables

47 to 63 Hz. This is indicated in the type designation label as typical input frequency level f1 (50/60 Hz).

Max. ± 3% of nominal phase to phase input voltage

0.98 (at nominal load)

The minimum short-circuit power Sce given for each drive type for the Rsce (transformer short circuit ratio) value of 350.

ACQ80-	Input rating	Min. short c	ircuit power	Frame size
01		400 V	480 V	•
	<i>I</i> ₁	Ssc	Ssc	
	Α	MVA	MVA	
3-phase <i>U</i> _n =	400 V and 48	30 V, IEC rati	ngs	
030kW-4	62	15.0	15.1	R4
037kW-4	73	17.7	18.9	R4
045kW-4	88	21.3	22.4	R4
055kW-4	106	25.7	27.9	R5
075kW-4	145	35.2	36.1	R6
090kW-4	169	41.0	45.4	R7
110kW-4	206	50.0	52.4	R7
132kW-4	246	59.7	69.8	R8
160kW-4	293	71.1	75.7	R8
200kW-4	363	88.0	105.1	R9

Motor connection data

Motor types

Asynchronous AC induction motors, permanent magnet motors and synchronous reluctance motors

Short-circuit current protection (IEC/EN 61800-5-1)

The drive provides solid state short circuit protection for the motor connection per IEC/EN 61800-5-1 and UL 61800-5-1.

Frequency (f_2)

0...500 Hz. This is indicated in the type designation label as output frequency level f_2 (0...500 Hz).

Frequency resolution

0.01 Hz

Current

See section Electrical ratings (page 149).

Switching frequency

2 kHz, 4 kHz (default), 8 kHz, 12 kHz

Maximum recommended motor cable length

Operational functionality and motor cable length

The drive is designed to operate with optimum performance with the following maximum motor cable lengths.

Note: Conducted and radiated emissions of these motor cable lengths do not comply with EMC requirements.

Frame	Maxi	Maximum motor cable length, 4 kHz						
size	Scalar	control	Vector control					
	m	ft	m	ft				
Standard dri	Standard drive, without external options							
R4	300	990	300	990				
R5	300	990	300	990				
R6	300	990	300	990				
R7	300	990	300	990				
R8	300	990	300	990				
R9	300	990	300	990				

Note:

- 1. In multimotor systems, the calculated sum of all motor cable lengths must not exceed the maximum motor cable length given in the table.
- 2. Longer motor cables cause a motor voltage decrease which limits the available motor power. The decrease depends on the motor cable length and characteristics. Contact your local ABB representative for more information.
- 3. When using longer motor cables than 50 m (165 ft), 8 and 12 kHz switching frequencies are not allowed. With motor cable length over 100 m, disconnect EMC DC screw if applicable.
- Acceptable motor cable length for motor manufactures may be different. Check with specific motor manufacturer for maximum allowable distance.

EMC compatibility and motor cable length

To comply with the European EMC Directive (standard EN 61800-3), use the following maximum motor cable lengths at 4 kHz switching frequency. See the table below.

Frame size	Maximum motor o	able length, 4 kHz
	m	ft
EMC limits for Cate	gory C2 ¹⁾	
Standard drive with	an internal EMC filter.	
See notes 1, 2 and 3.		
R4	100	330
R5	100	330
R6	150	492
R7	150	492
R8	150	492
R9	150	492
EMC limits for Cate	gory C3 ¹⁾	
Standard drive with	an internal EMC filter.	
See notes 3 and 4.		
R4	150	492
R5	150	492
R6	150	492
R7	150	492
R8	150	492
R9	150	492

¹⁾ See the terms in section Definitions (page 176)

Note:

- Radiated and conducted emissions are according to category C2 with an internal EMC filter. The internal EMC filter must be connected.
- 2. Categories C1 and C2 meet requirements for connecting equipment to the public low-voltage networks.
- 3. Not applicable to 600 V ratings.
- Radiated and conducted emissions are according to category C3 with an internal EMC filter. The internal EMC filter must be connected.

Auxiliary circuit power consumption

Maximum external power supply:

Frames R4 and R5: 25 W, 1.04 A at 24 V AC/DC (with option modules CMOD-01, CMOD-02)

Frames R6...R9: 36 W, 1.50 A at 24 V AC/DC (as standard, terminals 40...41)

Efficiency

Approximately 98% at nominal power level. The efficiency is not calculated according to IEC 61800-9-2.

Energy efficiency data (ecodesign)

Energy efficiency data according to IEC 61800-9-2 is available from the ecodesign tool (https://ecodesign.drivesmotors.abb.com). The drive complies with the IE efficiency class IE2.



Protection classes

Degrees of protection (IEC/EN 60529)	IP21 (standard)
Enclosure types (UL 50/50E)	UL Type 1
Overvoltage category (IEC/EN 60664-1)	III
Protective class (IEC/EN 61800-5-1)	

Ambient conditions

Environmental limits for the drive are given below. The drive is to be used in a heated, indoor, controlled environment. All printed circuit boards are conformal coated.

	Operation installed for stationary use	Storage in the package	Transportation in the package
Installation site altitude	 04000 m (13123 ft) above sea level 1) 02000 m (6561 ft) above sea level 2) Output derated above 1000 m (3281 ft), see section Altitude derating (page 152). 	-	-
Air temperature	-15+50 °C (5122 °F). 015 °C (325 °F): No frost allowed. See sec- tion Electrical rat- ings (page 149).		-40+70 °C (-40+158 °F)

Relative humidity	595%	Max. 95%	Max. 95%				
		No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.					
Contamination levels	IEC 60721-3-3: 2002: Classification of environmental conditions - Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use of weather protected locations	IEC 60721-3-1: 1997	IEC 60721-3-2: 1997				
Chemical gases	Class 3C2	Class 1C2	Clas	s 2C2			
Solid particles	Class 3S2. No conductive dust allowed.	Class 1S3 (packing must support this, otherwise 1S2)	Class 2S2				
Pollution degree (IEC/EN 60664-1)	Pollution degree 2	-	-	-			
Atmospheric pressure	70106 kPa 0.71.05 atmospheres	70106 kPa 0.71.05 atmospheres		60106 kPa 0.61.05 atmospheres			
Vibration(IEC 60068-2)	Max. 1 mm (0.04 in) (513.2 Hz), max. 7 m/s² (23 ft/s²) (13.2100 Hz) sinusoid- al	-	-				
Vibration(ISTA)	-	R4 (ISTA 1A): Displacement, 25 mm peak to peak, 14200 vibratory impacts R5R9 (ISTA 3E): Random, overall Grms level					
		of 0.52					
Shock/Drop (ISTA)	Not allowed	R4 (ISTA 1A): Drop, 6 faces, 3 edges and 1 corner					
		Weight range		mm	in		
		010 kg (022 lb)		760	29.9		
		1019 kg (2242 lb)		610 460	24.0		
		1928 kg (4262 lb) 2841 kg (6290 lb)		340	18.1		
		2541 kg (0230 lb) 340 13.4					
		R5R9 (ISTA 3E): Shock, incline impact: 1.1 m/s (3.61 ft/s)					
		Shock, rotational edge drop: 200 mm (7.9 ir			nm (7.9 in)		

¹⁾ For symmetrically grounded TN-S systems, TT systems, and ungrounded or symmetrically high-resistance grounded IT systems. See also section Limiting relay output maximum voltages at high installation altitudes (page 89).

Note: There are special considerations in corner-grounded installations above 2000 m. Contact your local ABB representative for further information.

Storage conditions

Store the drive in humidity controlled enclosed environments. Keep the drive in its package.

²) For corner-grounded delta systems, midpoint-grounded delta systems and corner-grounded (via high resistance) IT systems.

Colors

Drive enclosure

- NCS 1502-Y (RAL 9002 / PMS 1C Cool Grey), RAL 9002 and PMS 425 C.
- NCS 1502-Y

Materials

Package materials for small wall-mounted drives and converter modules

- Cardboard
- Molded pulp
- EPP (foam)
- PP (strapping)
- PE (plastic bag).

Package materials for large wall-mounted drives and converter modules

- Cardboard heavy duty quality with wet strength glue
- Plywood
- Wood
- PP (strapping)
- PE (VCI foil)
- Metal (fixing clamps, screws).

Package materials for options, accessories and spare parts

- Cardboard
- Kraft paper
- PP (straps)
- PE (film, bubble wrap)
- Plywood, wood (only for heavy components).

Materials vary according to the item type, size and shape. Typical package consists of a cardboard box with paper filling or bubble wrap. ESD-safe packing materials are used for printed circuit boards and similar items.

Materials of manuals

Printed product manuals are made of recyclable paper. Product manuals are available on the Internet.

Disposal

The main parts of the drive can be recycled to preserve natural resources and energy. Product parts and materials should be dismantled and separated.

Generally all metals, such as steel, aluminum, copper and its alloys, and precious metals can be recycled as material. Plastics, rubber, cardboard and other packaging material can be used in energy recovery.

Printed circuit boards and DC capacitors need selective treatment according to IEC 62635 guidelines.

To aid recycling, most plastic parts are marked with an appropriate identification code. In addition, components containing substances of very high concern (SVHCs) are listed in European Chemicals Agency's SCIP database. SCIP is the database for information on Substances of Concern In articles as such or in complex objects (Products) established under the Waste Framework Directive (2008/98/EC). For further information, contact your local ABB distributor or consult European Chemicals Agency's SCIP database to find out which SVHCs are used in the drive, and to find out where those components are located.

Contact your local ABB distributor for further information on environmental aspects. End of life treatment must follow international and national regulations.

For more information on ABB end of life services, refer to new.abb.com/service/end-of-life-services.

Applicable standards

The drive complies with the following standards. The compliance with the European Low Voltage Directive is verified according to standard EN 61800-5-1.

EN 60204-1:2018, EN 60204-1:2006 + AC:2010

Safety of machinery. Electrical equipment of machines. Part 1: General requirements. Provisions for compliance:

The final assembler of the machine is responsible for installing

- · emergency-stop device
- · supply disconnecting device.

IEC 60146-1-1:2009 EN 60146-1-1:2010

Semiconductor converters - General requirements and line commutated converters - Part 1-1: Specification of basic requirements

+ AMD2: 2013.

IEC 60529:1989 + AMD1:1999 Degrees of protection provided by enclosures (IP code)

EN 60529:1991 + A1:2000 + A2: 2013

IEC 61000-3-2:2018. EN 61000-3-2:2014

Electromagnetic compatibility (EMC) - Limits for harmonic current emissions (input current > 16 A per phase)

EN 61000-3-12:2011

Electromagnetic compatibility (EMC) – Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current input current > 16 A and < 75 A per phase

This drive complies with the standard provided that the short-circuit power Ssc is greater than or equal to the minimum short-circuit power given for the drive (listed for each drive type on page 167) at the interface point between the user's supply and the public system. It is the responsibility of the installer or user of the drive to ensure, by consultation with the distribution network operator if necessary, that the drive is connected only to a supply with a short-circuit power Ssc greater than or equal to

the minimum short-circuit power given for the drive.

IEC/EN 61800-3:2017

Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods

IEC/EN 61800-5-1:2007

Adjustable speed electrical power drive systems. Part 5-1: Safety require-

ments - electrical, thermal and energy

174 Technical data

IEC/EN 61800-9-2:2017 Adjustable speed electrical power drive systems. Part 9-2: Ecodesign for

power drive systems, motor starters, power electronics and their driven applications – Energy efficiency indicators for power drive systems and

motor starters

IEC 60664-1:2007 Insulation coordination for equipment within low-voltage systems. Part

1: Principles, requirements and tests.

UL 61800-5-1: 1st edition Standard for Safety, Adjustable Speed Electrical Power Drive Systems –

Part 5-1: Safety Requirements – Electrical, Thermal and Energy

CSA C22.2 No. 274-17 Adjustable speed drives

Markings

These markings are attached to the drive:



CE mark

Product complies with the applicable European Union legislation. For fulfilling the EMC requirements, see the additional information concerning the drive EMC compliance (IEC/EN 61800-3).

RoHS

Restriction of Hazardous Substances (RoHS) mark

Product complies with the applicable European Union legislation. The product does not contain any hazardous electrical or electronic substances, and it is an environmentally-friendly product which can be recycled.



TÜV Safety Approved mark (functional safety)

Product contains Safe torque off and possibly other (optional) safety functions which are certified by TÜV according to the relevant functional safety standards. Applicable to drives and inverters; not applicable to supply, brake or DC/DC converter units or modules.



RCM mark

Product complies with Australian and New Zealand requirements specific to EMC, telecommunications and electrical safety. For fulfilling the EMC requirements, see the additional information concerning the drive EMC compliance (IEC/EN 61800-3).



WEEE mark

At the end of life the product should enter the recycling system at an appropriate collection point and not placed in the normal waste stream.



Solar Impulse mark

Product complies with Solar Impulse Foundation's regulations.

CE marking

A CE mark is attached to the drive to verify that the drive follows the provisions of the European Low Voltage, EMC and RoHS Directives. The CE marking also verifies that the drive, in regard to its safety functions (such as Safe torque off), conforms with the Machinery Directive as a safety component.

Compliance with the European WEEE Directive 2002/96/EC

The WEEE Directive defines the regulated disposal and recycling of electric and electrical equipment.

Compliance with the European Machinery Directive 2006/42/EC 2nd Edition – June 2010

Validating the operation of the Safe torque off function

See chapter The Safe torque off function (page 201).

Compliance with the EN 61800-3:2004 + A1:2012

Definitions

EMC stands for Electromagnetic Compatibility. It is the ability of electrical/electronic equipment to operate without problems within an electromagnetic environment. Likewise, the equipment must not disturb or interfere with any other product or system within its locality.

First environment includes establishments connected to a low-voltage network which supplies buildings used for domestic purposes.

Second environment includes establishments connected to a network not supplying domestic premises.

Drive of category C1: drive of rated voltage less than 1000 V and intended for use in the first environment.

Drive of category C2: drive of rated voltage less than 1000 V and intended to be installed and started up only by a professional when used in the first environment.

Note: A professional is a person or organization having necessary skills in installing and/or starting up power drive systems, including their EMC aspects.

Drive of category C3: drive of rated voltage less than 1000 V and intended for use in the second environment and not intended for use in the first environment.

Drive of category C4: drive of rated voltage equal to or above 1000 V, or rated current equal to or above 400 A, or intended for use in complex systems in the second environment.

Category C1

The emission limits are complied with the following provisions:

- The optional EMC C1 filter is selected according to the documentation and installed as specified in the EMC C1 filter manual. See Main switch and EMC C1 filter options (+F278, +F316, +E223) installation supplement for ACS580-01, ACH580-01 and ACQ580-01 frames R1 to R5 (3AXD50000155132 [Multilingual]).
 Only available for IP55 (+B056) frames R4 and R5, up to 55 kW.
- 2. The motor and control cables are selected as specified in this manual.
- 3. The drive is installed according to the instructions given in this manual.
- 4. The maximum motor cable length with 2 kHz switching frequency is 10 m.



WARNING!

In a domestic environment, this product may cause radio inference, in which case supplementary mitigation measures may be required.

Category C2

The emission limits are complied with the following provisions:

- 1. The motor and control cables are selected as specified in this manual.
- 2. The drive is installed according to the instructions given in this manual.
- 3. For the maximum motor cable length with 4 kHz switching frequency, see **Maximum** recommended motor cable length (page 168).



WARNING!

The drive may cause radio interference if used in residential or domestic environment. The user is required to take measures to prevent interference, in association to the requirements for the CE compliance listed above, if necessary.

Note: Do not install a drive with the EMC filter connected to a system that the filter is not suitable for. This can cause danger, or damage the drive.

Note: Do not install the drive with the ground-to-phase varistor connected to a system that the varistor is not suitable for. It can cause damage to the varistor circuit.

If you install the drive to any other system than symmetrically grounded TN-S system, you may need to disconnect the EMC filter or the ground-to-phase varistor. See sections:

IEC: Grounding system compatibility check (page 93)

Category C3

The drive complies with the standard with the following provisions:

- 1. The motor and control cables are selected as specified in this manual.
- 2. The drive is installed according to the instructions given in this manual.
- 3. For the maximum motor cable length with 4 kHz switching frequency, see page Maximum recommended motor cable length (page 168)



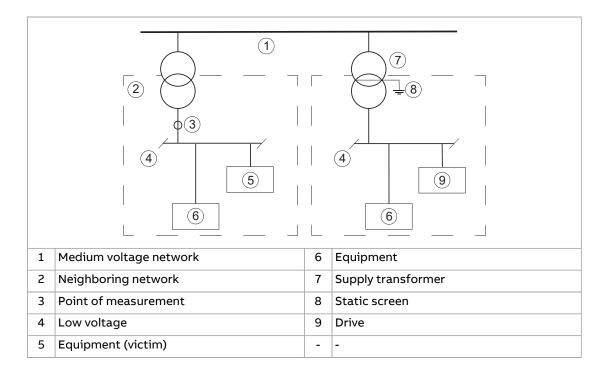
WARNING!

A drive of category C3 is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if the drive is used on such a network.

Category C4

The drive complies with the C4 category with these provisions:

 It is made sure that no excessive emission is propagated to neighboring low-voltage networks. In some cases, the natural suppression in transformers and cables is sufficient. If in doubt, a supply transformer with static screening between the primary and secondary windings can be used.



- 2. An EMC plan for preventing disturbances is drawn up for the installation. A template is available in Technical guide No. 3 EMC compliant installation and configuration for a power drive system (3AFE61348280 [English]).
- 3. The motor and control cables are selected, and routed according to the electrical planning guidelines of the drive. The EMC recommendations are obeyed.
- 4. The drive is installed according to its installation instructions. The EMC recommendations are obeyed.



WARNING!

A drive of category C4 is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if the drive is used on such a network.

Design lifetime expectancy

The design lifetime expectancy of the drive and its overall components exceeds ten (10) years in normal operating environments. In some cases, the drive can last 20 years or more. To achieve a long lifetime for the product the manufacturer's instructions for sizing the drive, installation, operational conditions and preventive maintenance schedule shall be followed.

Disclaimers

Generic disclaimer

The manufacturer shall have no obligation 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.

Declarations of conformity



Link to Declaration of conformity according to EU Machinery Directive 2006/42/EU (3AXD10000715412)

12

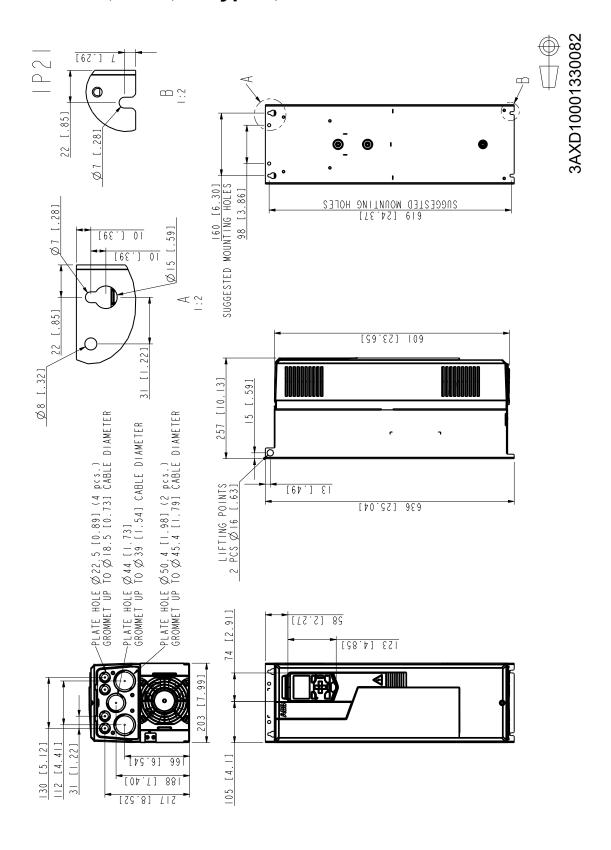
Dimension drawings

Contents of this chapter

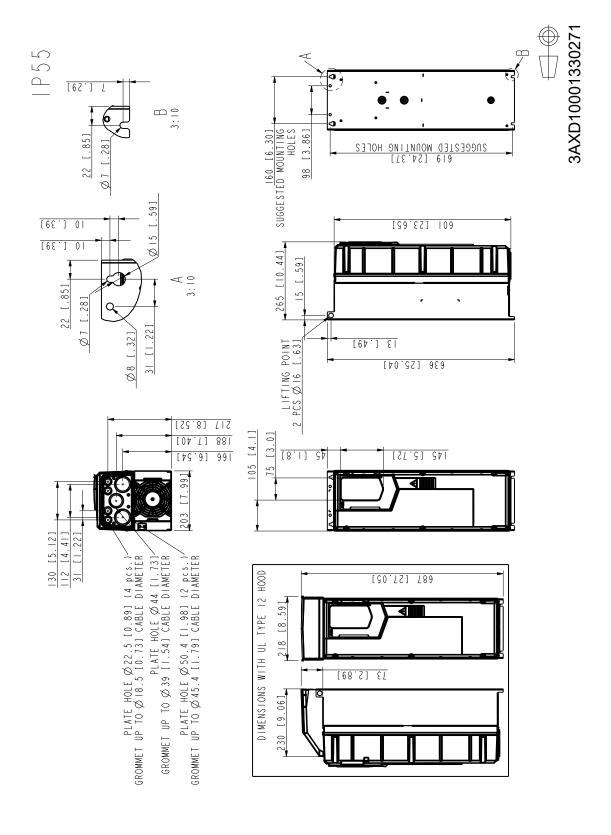
This chapter shows the dimension drawings of the ACQ80-01.

Note: The dimensions are given in millimeters and [inches].

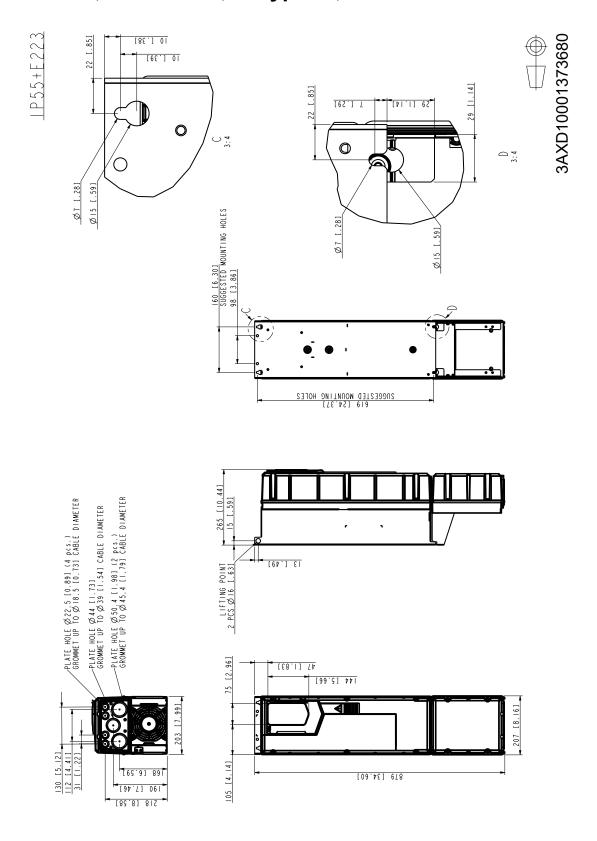
Frame R4, IP21 (UL Type 1)



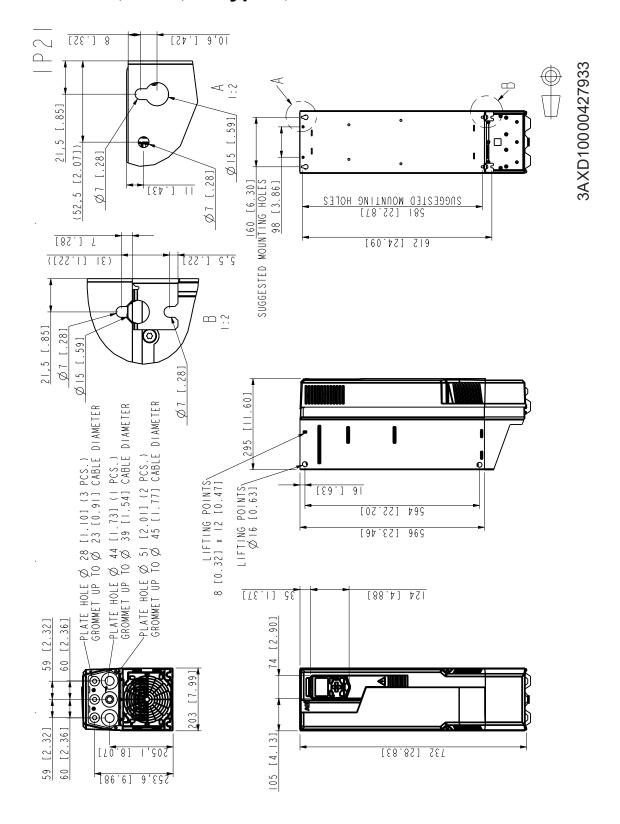
Frame R4, IP55 (UL Type 12)



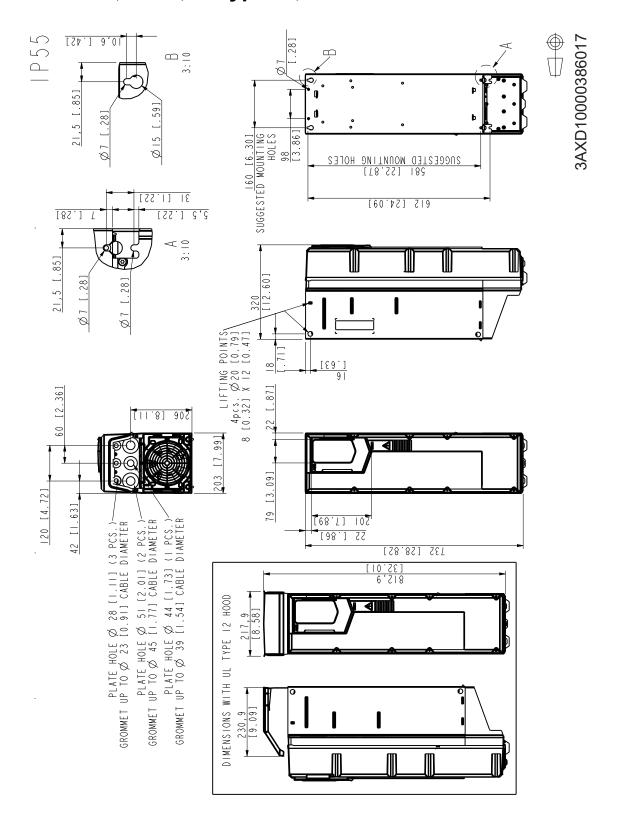
Frame R4, IP55+E223 (UL Type 12)



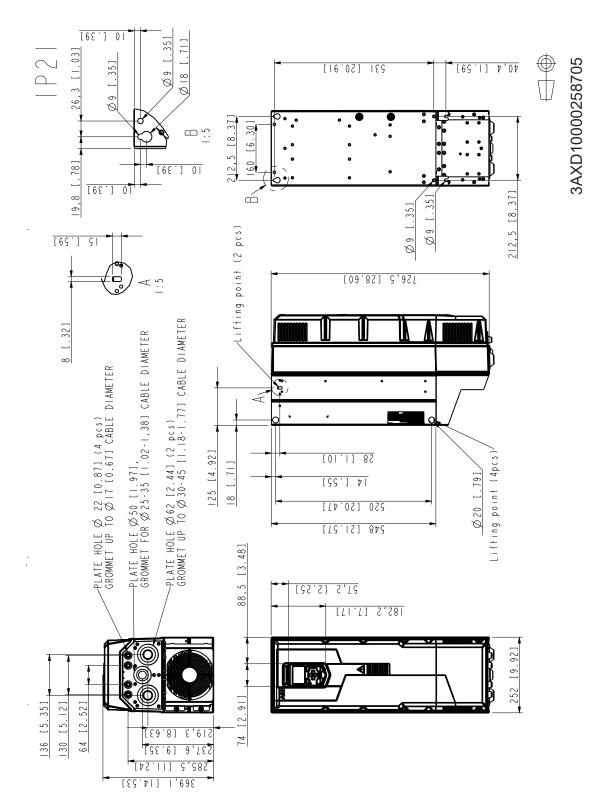
Frame R5, IP21 (UL Type 1)



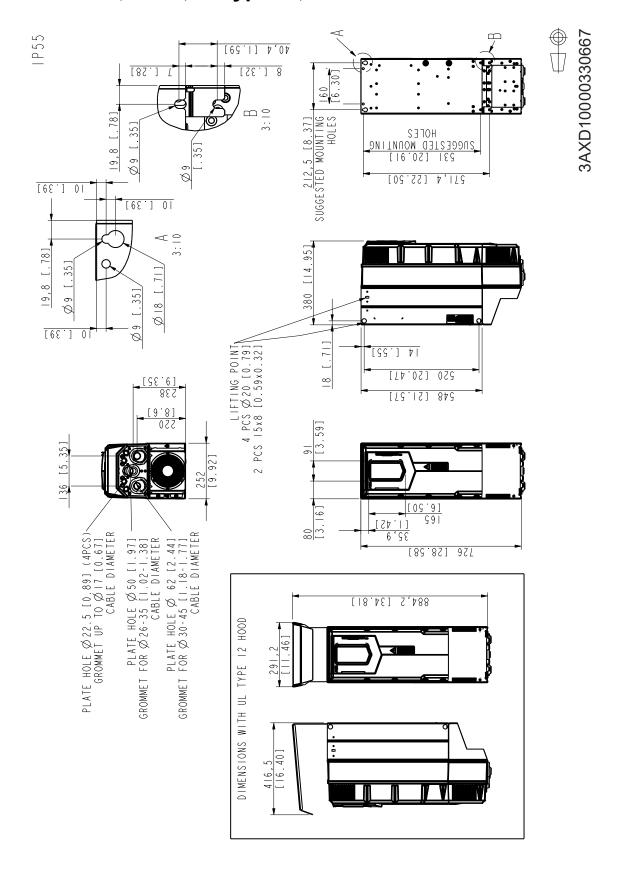
Frame R5, IP55 (UL Type 12)



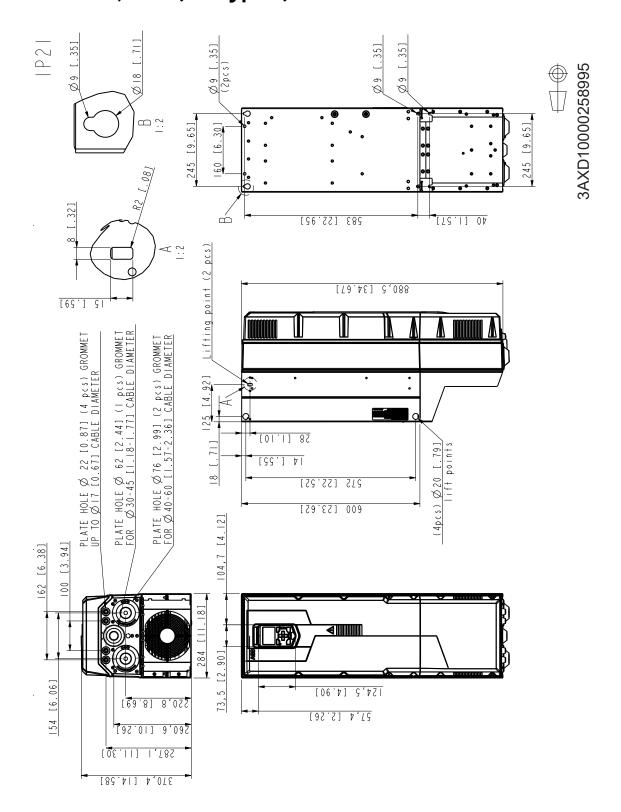
Frame R6, IP21 (UL Type 1)



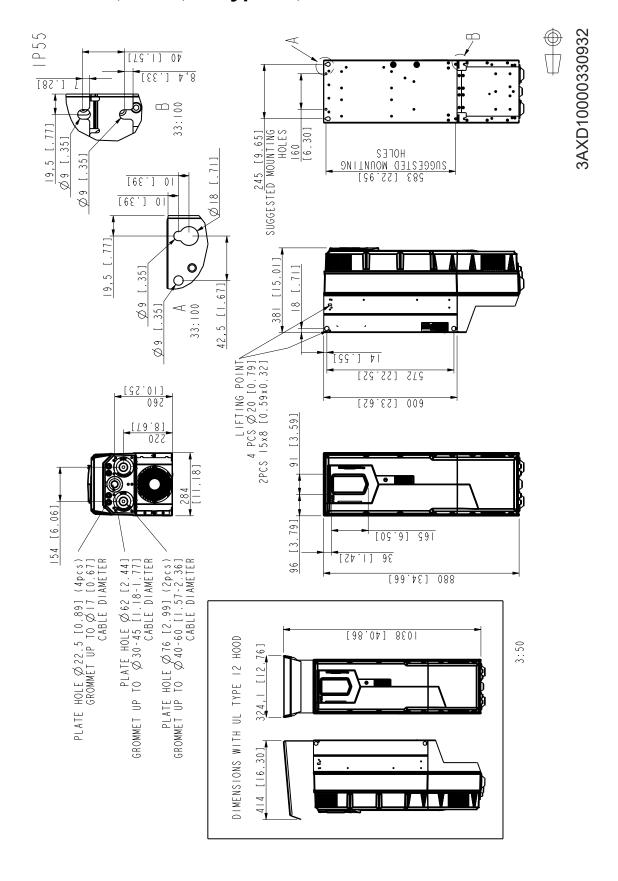
Frame R6, IP55 (UL Type 12)



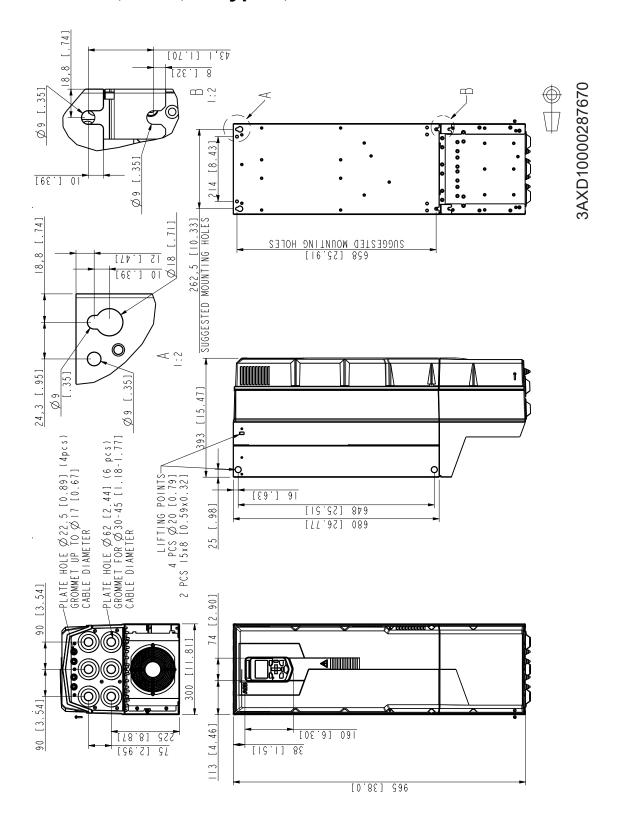
Frame R7, IP21 (UL Type 1)



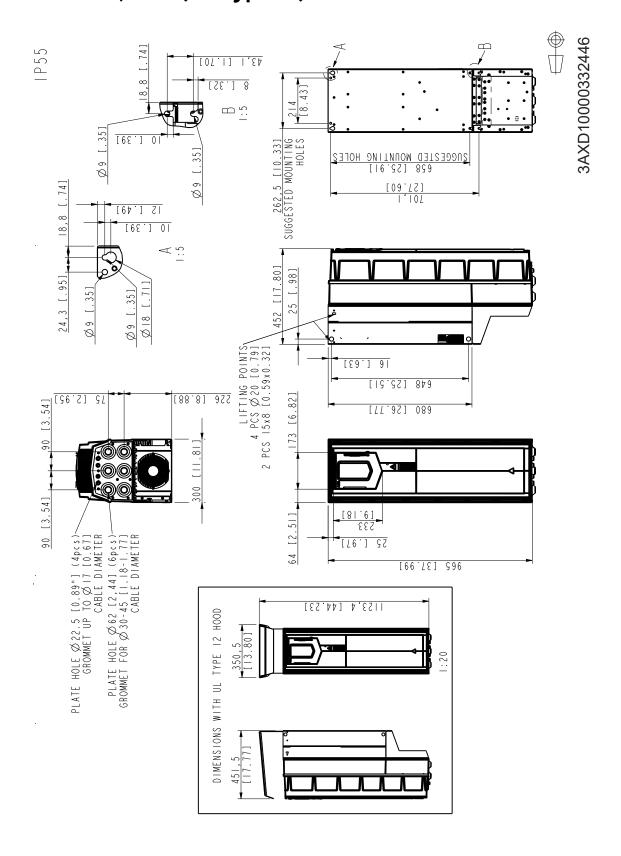
Frame R7, IP55 (UL Type 12)



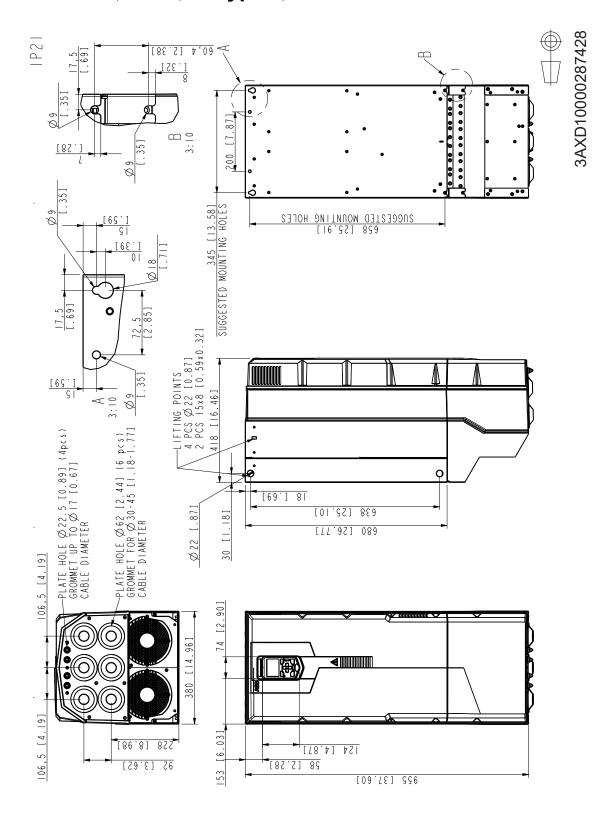
Frame R8, IP21 (UL Type 1)



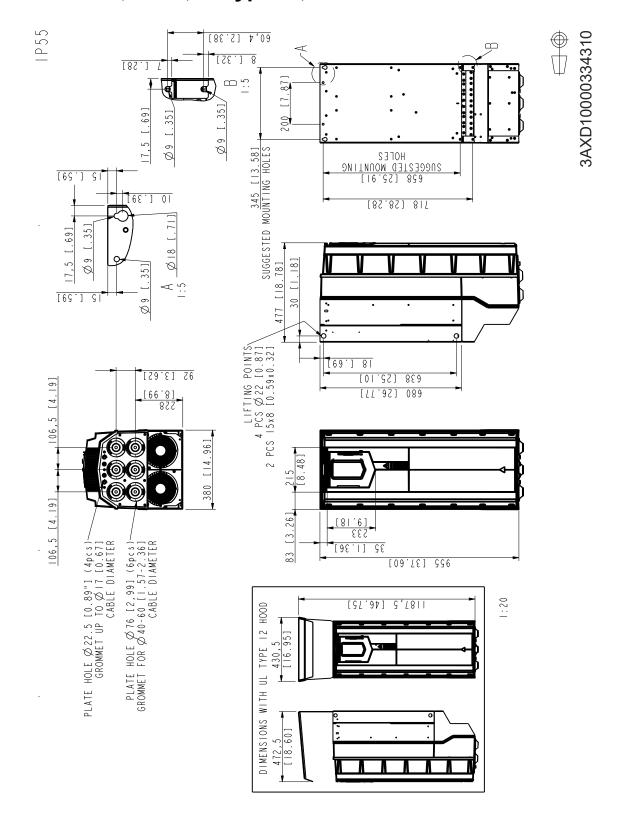
Frame R8, IP55 (UL Type 12)



Frame R9, IP21 (UL Type 1)

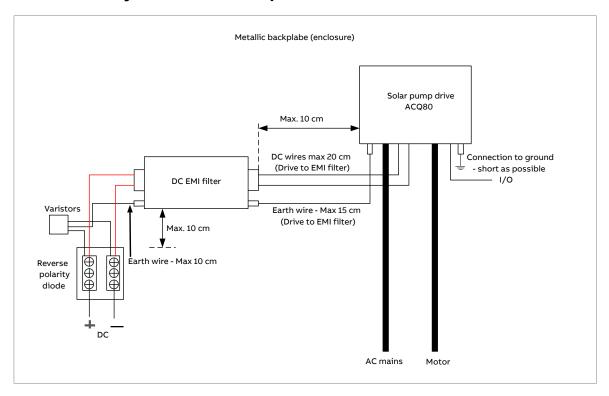


Frame R9, IP55 (UL Type 12)



EMI filter layout diagram

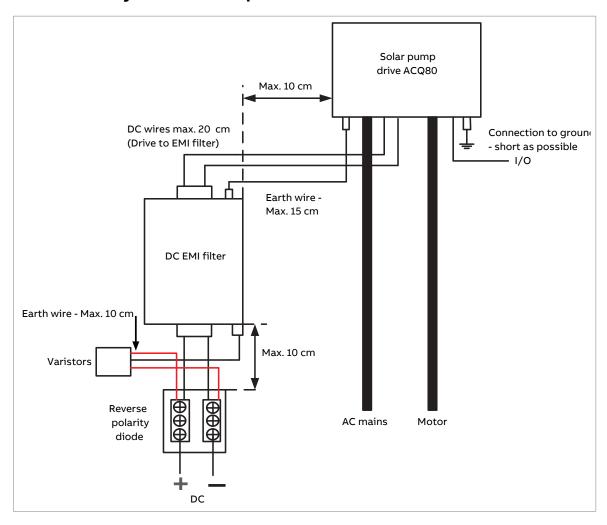
■ EMI filter layout - Horizontal position

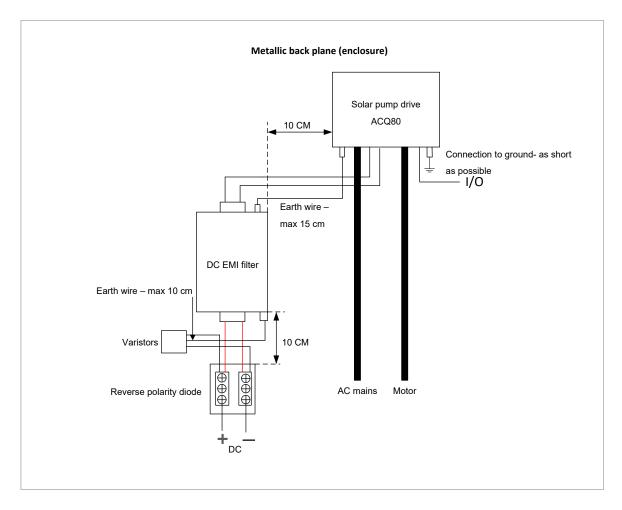


Note:

- Keep AC, DC and motor cables separated to avoid interferences.
- Do not connect reverse polarity diodes directly to ground.

■ EMI filter layout - Vertical position





Note:

- Keep AC, DC and motor cables separated to avoid interferences.
- Do not connect reverse polarity diodes directly to ground.

Resistor braking

Contents of this chapter

This chapter contains information and instructions on resistor braking, brake choppers and brake resistors.

Operation principle and hardware description

The brake chopper handles the energy generated by a decelerating motor. The chopper connects the brake resistor to the intermediate DC circuit whenever the voltage in the circuit exceeds the limit defined by the control program. Energy consumption by the resistor losses lowers the voltage until the resistor can be disconnected.

Resistor braking, frames R4...R9

Planning the braking system

Frames R4...R9 need external brake choppers and resistors. The table below lists suitable choppers and resistors.

IEC

ACQ80-01	Brake chopper	R _{min}	R _{max}	P _{BRmax}	Reference resistor types 1)
3-phase <i>U</i> _n = 2	30 V				
076A-2	NBRA-658	2.6	7.0	21	SAFUR125F500
089A-2	NBRA-658	2.0	5.6	26	SAFUR125F500
115A-2	NBRA-658	2.0	4.7	31	SAFUR125F500
144A-2	NBRA-658	2.0	3.4	43	SAFUR200F500
171A-2	NBRA-658	1.3	2.8	53	SAFUR200F500

ACQ80-01	Brake chopper	R _{min}	R _{max}	P _{BRmax}	Reference resistor types 1)
		ohm	ohm	kW	_
213A-2	NBRA-658	1.3	2.3	64	2xSAFUR210F575
276A-2	NBRA-658	0.9	1.9	78	2xSAFUR210F575
3-phase <i>U</i> _n = 4	00 or 480 V (380	0415 V, 4	440480 \	V)	
062A-4	ACS-BRK-D	7.8	18.1	30	Built in with the brake chopper
073A-4	ACS-BRK-D	7.8	13.1	42	Built in with the brake chopper
088A-4	ACS-BRK-D	7.8	10.7	51	Built in with the brake chopper
106A-4	NBRA-658	1.3	8.7	63	SAFUR125F500
145A-4	NBRA-658	1.3	7.1	77	SAFUR125F500
169A-4	NBRA-658	1.3	5.2	105	SAFUR200F500
206A-4	NBRA-658	1.3	4.3	126	SAFUR200F500
246A-4	NBRA-658	1.3	3.5	156	2xSAFUR125F500
293A-4	NBRA-658	1.3	2.9	187	2xSAFUR210F575
363A-4	NBRA-659	0.7	2.4	227	2xSAFUR200F500
430A-4	NBRA-659	0.7	1.9	284	2xSAFUR200F500
490A-4					

¹⁾ Other resistors can be used if they meet the minimum resistance value and required power values.

Symbols	
R _{min}	= minimum allowed brake resistor that can be connected to the brake chopper
R _{max}	= maximum allowed brake resistor that allows P _{BRmax}
P _{BRmax}	= maximum braking capacity of the drive, must exceed the desired braking power.



WARNING!

Do not use a brake resistor with a resistance below the minimum value specified for the particular drive. The drive and the internal chopper are not able to handle the overcurrent caused by the low resistance.

Parameter settings for external braking chopper and resistor

Disable the overvoltage control of the drive with parameter 30.30 Overvoltage control.

Disable parameter 43.06 Braking chopper function as parameter group 43 Brake chopper is used for internal braking chopper and resistor only.

The Safe torque off function

Contents of this chapter

This chapter describes the Safe torque off (STO) function of the drive and gives instructions for its use.

Description

The Safe torque off function can be used, for example, as the final actuator device of safety circuits (such as an emergency stop circuit) that stop the drive in case of danger. Another typical application is a prevention of unexpected start-up function that enables short-time maintenance operations like cleaning or work on non-electrical parts of the machinery without switching off the power supply to the drive.

When activated, the Safe torque off function disables the control voltage for the power semiconductors of the drive output stage, thus preventing the drive from generating the torque required to rotate the motor. If the motor is running when Safe torque off is activated, it coasts to a stop.

The Safe torque off function has a redundant architecture, that is, both channels must be used in the safety function implementation. The safety data given in this manual is calculated for redundant use, and does not apply if both channels are not used.

The Safe torque off function complies with these standards:

Standard	Name
IEC 60204-1:2021 EN 60204-1:2018	Safety of machinery – Electrical equipment of machines – Part 1: General requirements
IEC 61000-6-7:2014	Electromagnetic compatibility (EMC) – Part 6-7: Generic standards – Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations

Standard	Name
IEC 61326-3-1:2017	Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General industrial applications
IEC 61508-1:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements
IEC 61508-2:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems
IEC 61511-1:2017	Functional safety – Safety instrumented systems for the process industry sector
IEC 61800-5-2:2016 EN 61800-5-2:2007	Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional
EN IEC 62061:2021	Safety of machinery – Functional safety of safety-related control systems
EN ISO 13849-1:2015	Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design
EN ISO 13849-2:2012	Safety of machinery – Safety-related parts of control systems – Part 2: Validation

The function also corresponds to Prevention of unexpected start-up as specified by EN ISO 14118:2018 (ISO 14118:2017), and Uncontrolled stop (stop category 0) as specified in EN/IEC 60204-1.

■ Compliance with the European Machinery Directive and the UK Supply of Machinery (Safety) Regulations

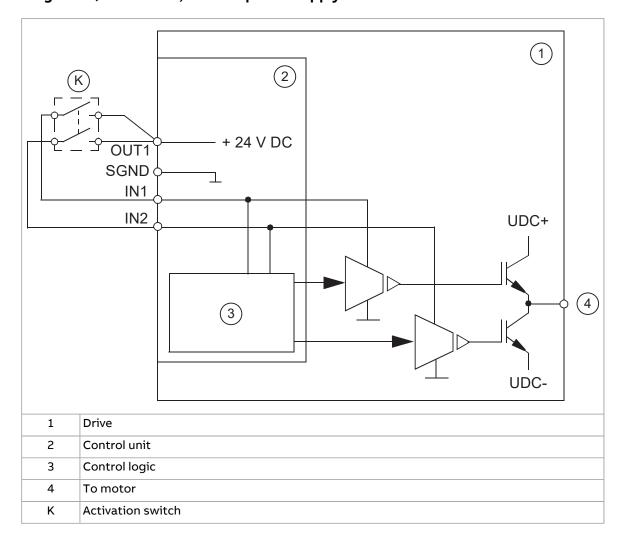
See the technical data.

Wiring

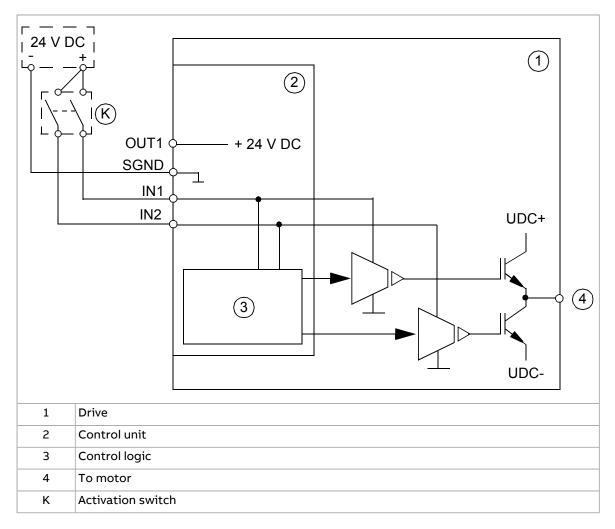
For the electrical specifications of the STO connection, see the technical data of the control unit.

Connection principle

Single ACQ80-01 drive, internal power supply

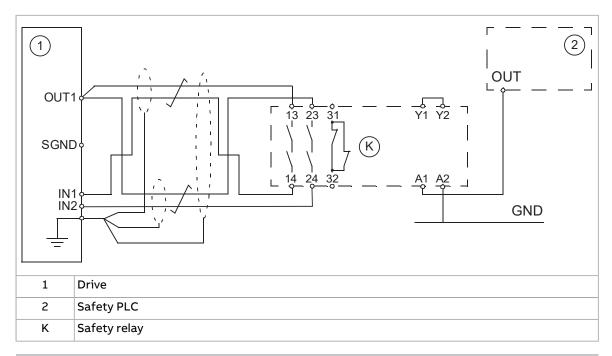


Single ACQ80-01 drive, external power supply

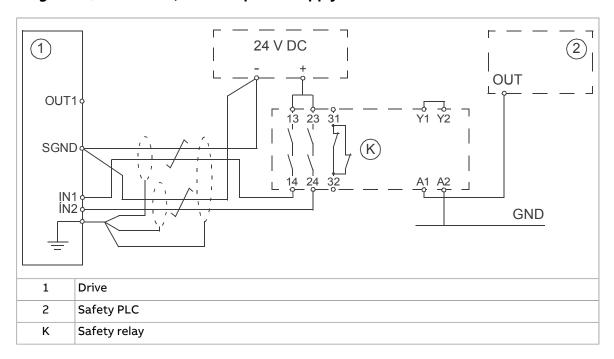


Wiring examples

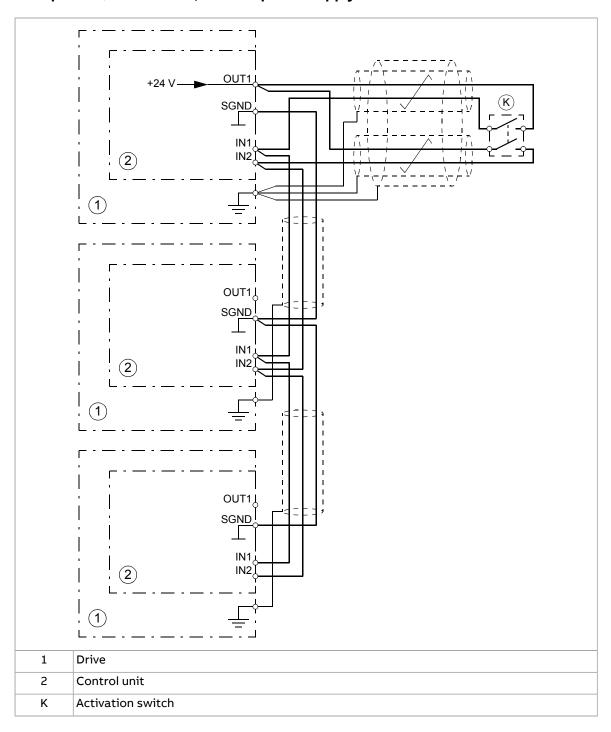
Single ACQ80-01 drive, internal power supply



Single ACQ80-01 drive, external power supply



Multiple ACQ80-01 drives, internal power supply



24 V DC SGND IN1 IN2 OUT1 SGND IN1 IN₂ ر OUT1 SGND IN2 Drive 2 Control unit

Multiple ACQ80-01 drives, external power supply

Activation switch

Activation switch

Κ

In the wiring diagrams, the activation switch has the designation [K]. This represents a component such as a manually operated switch, an emergency stop push button switch, or the contacts of a safety relay or safety PLC.

- In case a manually operated activation switch is used, the switch must be of a type that can be locked out to the open position.
- The contacts of the switch or relay must open/close within 200 ms of each other.

Cable types and lengths

- ABB recommends double-shielded twisted-pair cable.
- Maximum cable lengths:
 - 300 m (1000 ft) between activation switch [K] and drive control unit
 - 60 m (200 ft) between external power supply and control unit

Note: A short-circuit in the wiring between the switch and an STO terminal causes a dangerous fault. Therefore, it is recommended to use a safety relay (including wiring diagnostics) or a wiring method (shield grounding, channel separation) which reduces or eliminates the risk caused by the short-circuit.

Note: The voltage at the STO input terminals of the drive must be at least 13 V DC to be interpreted as "1".

The pulse tolerance of the input channels is 1 ms.

Grounding of protective shields

- Ground the shield in the cabling between the activation switch and the control unit at the control unit only.
- Ground the shield in the cabling between two control units at one control unit only.

Operation principle

- 1. The Safe torque off activates (the activation switch is opened, or safety relay contacts open).
- 2. The STO inputs of the drive control unit de-energize.
- 3. The control unit cuts off the control voltage from the output IGBTs.
- 4. The control program generates an indication as defined by parameter 31.22 (see the firmware manual of the drive).

The parameter selects which indications are given when one or both STO signals are switched off or lost. The indications also depend on whether the drive is running or stopped when this occurs.

Note: This parameter does not affect the operation of the STO function itself. The STO function will operate regardless of the setting of this parameter: a running drive will stop upon removal of one or both STO signals, and will not start until both STO signals are restored and all faults reset.

Note: The loss of only one STO signal always generates a fault as it is interpreted as a malfunction of STO hardware or wiring.

5. The motor coasts to a stop (if running). The drive cannot restart while the activation switch or safety relay contacts are open. After the contacts close, a reset may be needed (depending on the setting of parameter 31.22). A new start command is required to start the drive.

Start-up including validation test

To ensure the safe operation of a safety function, validation is required. The final assembler of the machine must validate the function by performing a validation test. The test must be performed

- 1. at initial start-up of the safety function
- 2. after any changes related to the safety function (circuit boards, wiring, components, settings, replacement of inverter module, etc.)
- 3. after any maintenance work related to the safety function
- 4. after a drive firmware update
- 5. at the proof test of the safety function.

Competence

The validation test of the safety function must be carried out by a competent person with adequate expertise and knowledge of the safety function as well as functional safety, as required by IEC 61508-1 clause 6. The test procedures and report must be documented and signed by this person.

Validation test reports

Signed validation test reports must be stored in the logbook of the machine. The report shall include documentation of start-up activities and test results, references to failure reports and resolution of failures. Any new validation tests performed due to changes or maintenance shall be logged into the logbook.

Validation test procedure

After wiring the Safe torque off function, validate its operation as follows.

Action	
WARNING! Obey the safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.	
Make sure that the motor can be run and stopped freely during start-up.	
Stop the drive (if running), switch the input power off and isolate the drive from the power line using a disconnector.	
Check the STO circuit connections against the wiring diagram.	
Close the disconnector and switch the power on.	
Test the operation of the STO function when the motor is stopped.	
• Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill. Make sure that the drive operates as follows:	
 Open the STO circuit. The drive generates an indication if one is defined for the 'stopped' state in parameter 31.22 (see the firmware manual). Give a start command to verify that the STO function blocks the drive's operation. The motor should not start. Close the STO circuit. 	
Reset any active faults. Restart the drive and check that the motor runs normally.	

Action	
Test the operation of the STO function when the motor is running.	
 Start the drive and make sure the motor is running. Open the STO circuit. The motor should stop. The drive generates an indication if one is defined for the 'running' state in parameter 31.22 (see the firmware manual). Reset any active faults and try to start the drive. Make sure that the motor stays at a standstill and the drive operates as described above in testing the operation when the motor is stopped. Close the STO circuit. Reset any active faults. Restart the drive and check that the motor runs normally. 	
 Test the operation of the failure detection of the drive. The motor can be stopped or running. Open the 1st input channel of the STO circuit. If the motor was running, it should coast to a stop. The drive generates an FA81 fault indication (see the firmware manual). Give a start command to verify that the STO function blocks the drive's operation. The motor should not start. Open the STO circuit (both channels). Give a reset command. Close the STO circuit (both channels). Reset any active faults. Restart the drive and check that the motor runs normally. Open the 2nd input channel of the STO circuit. If the motor was running, it should coast to a stop. The drive generates an FA82 fault indication (see the firmware manual). Give a start command to verify that the STO function blocks the drive's operation. The motor should not start. Open the STO circuit (both channels). Give a reset command. Close the STO circuit (both channels). Reset any active faults. Restart the drive and check that the motor runs normally. 	
Document and sign the validation test report which verifies that the safety function is safe and accepted for operation.	

Use

- Open the activation switch, or activate the safety functionality that is wired to the STO connection.
- 2. The STO inputs on the drive control unit de-energize, and the control unit cuts off the control voltage from the output IGBTs.
- 3. The control program generates an indication as defined by parameter 31.22 (see the firmware manual of the drive).
- 4. The motor coasts to a stop (if running). The drive will not restart while the activation switch or safety relay contacts are open.
- 5. Deactivate the STO by closing the activation switch, or resetting the safety functionality that is wired to the STO connection.
- 6. Reset any faults before restarting.



WARNING!

The Safe torque off function does not disconnect the voltage of the main and auxiliary circuits from the drive. Therefore maintenance work on electrical parts of the drive or the motor can only be carried out after isolating the drive from the supply and all other voltage sources.



WARNING!

The drive cannot detect or memorize any changes in the STO circuitry when the drive control unit is not powered or when the main power to the drive is off. If both STO circuits are closed and a level-type start signal is active when the power is restored, it is possible that the drive starts without a fresh start command. Take this into account in the risk assessment of the system.



WARNING!

Permanent magnet or synchronous reluctance [SynRM] motors only:

In case of a multiple IGBT power semiconductor failure, the drive can produce an alignment torque which maximally rotates the motor shaft by 180/p degrees (with permanent magnet motors) or 180/2p degrees (with synchronous reluctance [SynRM] motors) regardless of the activation of the Safe torque off function. p denotes the number of pole pairs.

Notes:

- If a running drive is stopped by using the Safe torque off function, the drive will
 cut off the motor supply voltage and the motor will coast to a stop. If this causes
 danger or is not otherwise acceptable, stop the drive and machinery using the
 appropriate stop mode before activating the Safe torque off function.
- The Safe torque off function overrides all other functions of the drive.
- The Safe torque off function is ineffective against deliberate sabotage or misuse.
- The Safe torque off function has been designed to reduce the recognized hazardous conditions. In spite of this, it is not always possible to eliminate all potential hazards. The assembler of the machine must inform the final user about the residual risks.

Maintenance

After the operation of the circuit is validated at start-up, the STO function shall be maintained by periodic proof testing. In high demand mode of operation, the maximum proof test interval is 20 years. In low demand mode of operation, the maximum proof test interval is 10 years; see section Safety data (page 216).

There are two alternative procedures for proof testing:

- Perfect proof testing. It is assumed that all dangerous failures of the STO circuit are detected during the test. PFD_{avg} values for STO with the perfect proof testing procedure are given in the safety data section.
- Simplified proof testing. This procedure is faster and simpler than perfect proof testing. Not all dangerous failures of the STO circuit are detected during the test. The PFD_{avg} value for STO with the simplified proof testing procedure is given in the safety data section.

Note: The proof testing procedures are only valid for proof testing (periodic test, item 5 under section Start-up including validation test) but not for re-validation after changes made in the circuit. Re-validation (items 1...4 under Start-up including validation test) must be done according to the initial validation procedure.

Note: See also the Recommendation of Use CNB/M/11.050 (published by the European co-ordination of Notified Bodies) concerning dual-channel safety-related systems with electromechanical outputs:

- When the safety integrity requirement for the safety function is SIL 3 or PL e (cat. 3 or 4), the proof test for the function must be performed at least every month.
- When the safety integrity requirement for the safety function is SIL 2 (HFT = 1) or PL d (cat. 3), the proof test for the function must be performed at least every 12 months.

The STO function of the drive does not contain any electromechanical components.

In addition to proof testing, it is a good practice to check the operation of the function when other maintenance procedures are carried out on the machinery.

Include the Safe torque off operation test described above in the routine maintenance program of the machinery that the drive runs.

If any wiring or component change is needed after start-up, or the parameters are restored, do the test given in section Validation test procedure (page 210).

Use only spare parts approved by ABB.

Record all maintenance and proof test activities in the machine logbook.

Competence

The maintenance and proof test activities of the safety function must be carried out by a competent person with adequate expertise and knowledge of the safety function as well as functional safety, as required by IEC 61508-1 clause 6.

Perfect proof test procedure

Action	
WARNING! Obey the safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.	
 Test the operation of the STO function. If the motor is running, it will stop during the test. Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill. Make sure that the drive operates as follows: Open the STO circuit. The drive generates an indication if one is defined for the 'stopped' state in parameter 31.22 (see the firmware manual). Close the STO circuit. Reset any active faults. Restart the drive and check that the motor runs normally. 	
 Test the operation of the failure detection of the drive. The motor can be stopped or running. Open the 1st input channel of the STO circuit. If the motor was running, it should coast to a stop. The drive generates an FA81 fault indication (see the firmware manual). Open the STO circuit (both channels). Give a reset command. Close the STO circuit (both channels). Reset any active faults. Open the 2nd input channel of the STO circuit. If the motor was running, it should coast to a stop. The drive generates an FA82 fault indication (see the firmware manual). Open the STO circuit (both channels). Give a reset command. Close the STO circuit (both channels). Reset any active faults. Restart the drive and check that the motor runs normally. 	
Document and sign the test report to verify that the safety function has been tested according to the procedure.	

Simplified proof test procedure

Action	
WARNING! Obey the safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.	
 Test the operation of the STO function. If the motor is running, it will stop during the test. Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill. Make sure that the drive operates as follows: Open the STO circuit. The drive generates an indication if one is defined for the 'stopped' state in parameter 31.22 (see the firmware manual). Close the STO circuit. Reset any active faults. Restart the drive and check that the motor runs normally. 	
Document and sign the test report to verify that the safety function has been tested according to the procedure.	

Fault tracing

The indications given during the normal operation of the Safe torque off function are selected by drive control program parameter 31.22.

The diagnostics of the Safe torque off function cross-compare the status of the two STO channels. In case the channels are not in the same state, a fault reaction function is performed and the drive trips on an FA81 or FA82 fault. An attempt to use the STO in a non-redundant manner, for example activating only one channel, will trigger the same reaction.

See the firmware manual of the drive control program for the indications generated by the drive, and for details on directing fault and warning indications to an output on the control unit for external diagnostics.

Any failures of the Safe torque off function must be reported to ABB.

Safety data

The safety data for the Safe torque off function is given below.

Note: The safety data is calculated for redundant use, and applies only if both STO channels are used.

Frame size SIL SC PL	SIL	SC	귑	SFF	$\begin{array}{c} PFH \\ (T_1 = 20 \ a) \end{array}$	PFD _{avg}	PFD _{avg}	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	MTTF _D DC) (%)	Cat.	井	CCF	ΓΣ (Cat. HFT CCF (2) (1/h)	λ _{Diag_s}	λ _{Diag_d}
				?	(1/h)	(11 - Ea)	(11 - 2 a)	(11 - 10 a)		8				B		(E/+)	(1)
3-phase $U_{\rm N} = 400/480 {\rm V}$	= 4	000	480	>													
R4	m	m	a	^99	7	.59E-09 2.28E-05 5.67E-05		1.14E-04	2870	≥90	m	н	80	20	1.53E-08	80 20 1.53E-08 6.06E-08 2.89E-08	2.89E-08
R5	m	m	a	^99	2.59E-09 2.28E-05 5.68E-05	2.28E-05	5.68E-05	1.14E-04	2868	≥90	m	н	80	20	1.40E-12	80 20 1.40E-12 6.43E-08 1.40E-10	1.40E-10
3-phase $U_{\rm N}$ = 500 V	1 = 5(00 \															
R4	m	m	a	^99	2	2.28E-05	.59E-09 2.28E-05 5.68E-05	1.14E-04	2870	≥90	m	н	80	20	80 20 1.53E-08	60.61	28.94
R5	m	m	Φ	×99	2.59E-09	2.28E-05	2.28E-05 5.68E-05	1.14E-04	2868	≥90	m	н	80	20	20 1.53E-08	60.61	28.94
R6	m	m	Φ	> 99	3.92E-09	3.44E-05	8.59E-05	3.92E-09 3.44E-05 8.59E-05 1.72E-04	4802	≥90	m	н	80	20	80 20 1.40E-12	64.33	0.14
R7	m	m	Φ	> 99	m	3.44E-05	.92E-09 3.44E-05 8.59E-05 1.72E-04	1.72E-04	4802	≥90	က	н	80	20	20 1.40E-12	64.33	0.14
88	m	m	Φ	> 99	4.22E-09	3.69E-05 9.24E-05	9.24E-05	1.85E-04	2805	≥ 30	m	н	80	20	20 3.00E-12	195.87	0.30
R9	m	m	a	> 99		3.69E-05	4.22E-09 3.69E-05 9.24E-05 1.85E-04	1.85E-04	2805	≥90	m	н	80	20	80 20 3.00E-12	195.87	0.30
															m	3AXD10001613533 C	613533 C

- The STO is a type B safety component as defined in IEC 61508-2.
- Relevant failure modes:
 - The STO trips spuriously (safe failure)
 - The STO does not activate when requested
 - A fault exclusion on the failure mode "short circuit on printed circuit board" has been made (EN 13849-2, table D.5). The analysis is based on an assumption that one failure occurs at one time. No accumulated failures have been analyzed.
- STO response times:
 - STO reaction time (shortest detectable break): 1 ms
 - STO response time: 2 ms (typical), 5 ms (maximum)
 - Fault detection time: Channels in different states for longer than 200 ms
 - Fault reaction time: Fault detection time + 10 ms.
- Indication delays:
 - STO fault indication (parameter 31.22) delay: < 500 ms
 - STO warning indication (parameter 31.22) delay: < 1000 ms.

Terms and abbreviations

Term or abbreviation	Reference	Description
Cat.	EN ISO 13849-1	Classification of the safety-related parts of a control system in respect of their resistance to faults and their subsequent behavior in the fault condition, and which is achieved by the structural arrangement of the parts, fault detection and/or by their reliability. The categories are: B, 1, 2, 3 and 4.
CCF	EN ISO 13849-1	Common cause failure (%)
DC	EN ISO 13849-1	Diagnostic coverage (%)
HFT	IEC 61508	Hardware fault tolerance
MTTF _D	EN ISO 13849-1	Mean time to dangerous failure: (Total number of life units) / (Number of dangerous, undetected failures) during a particular measurement interval under stated conditions
PFD _{avg}	IEC 61508	Average probability of dangerous failure on demand, that is, mean unavailability of a safety-related system to perform the specified safety function when a demand occurs
PFH	IEC 61508	Average frequency of dangerous failures per hour, that is, average frequency of a dangerous failure of a safety related system to perform the specified safety function over a given period of time
PFH _{diag}	IEC/EN 62061	Average frequency of dangerous failures per hour for the diagnostic function of STO
PL	EN ISO 13849-1	Performance level. Levels ae correspond to SIL
Proof test	IEC 61508, IEC 62061	Periodic test performed to detect failures in a safety-related system so that, if necessary, a repair can restore the system to an "as new" condition or as close as practical to this condition
SC	IEC 61508	Systematic capability (13)
SFF	IEC 61508	Safe failure fraction (%)
SIL	IEC 61508	Safety integrity level (13)
STO	IEC/EN 61800-5-2	Safe torque off

Term or abbreviation	Reference	Description
<i>T</i> ₁	IEC 61508-6	Proof test interval. \mathcal{T}_1 is a parameter used to define the probabilistic failure rate (PFH or PFD) for the safety function or subsystem. Performing a proof test at a maximum interval of \mathcal{T}_1 is required to keep the SIL capability valid. The same interval must be followed to keep the PL capability (EN ISO 13849) valid. See also section Maintenance.
T _M	EN ISO 13849-1	Mission time: the period of time covering the intended use of the safety function/device. After the mission time elapses, the safety device must be replaced. Note that any $T_{\rm M}$ values given cannot be regarded as a guarantee or warranty.
λ_{Diag_d}	IEC 61508-6	Dangerous failure rate (per hour) of the diagnostics function of STO
$\lambda_{\text{Diag_s}}$	IEC 61508-6	Safe failure rate (per hour) of the diagnostics function of STO

■ TÜV certificate

The TÜV certificate is available on the Internet.

Optional I/O extension and adapter modules

Contents of this chapter

This chapter describes how to install and start up the optional CAIO-01,CHDI-01, CMOD-01 and CMOD-02 IO multifunction extension modules. The chapter also contains diagnostics and technical data.

CAIO-01 bipolar analog I/O adapter module

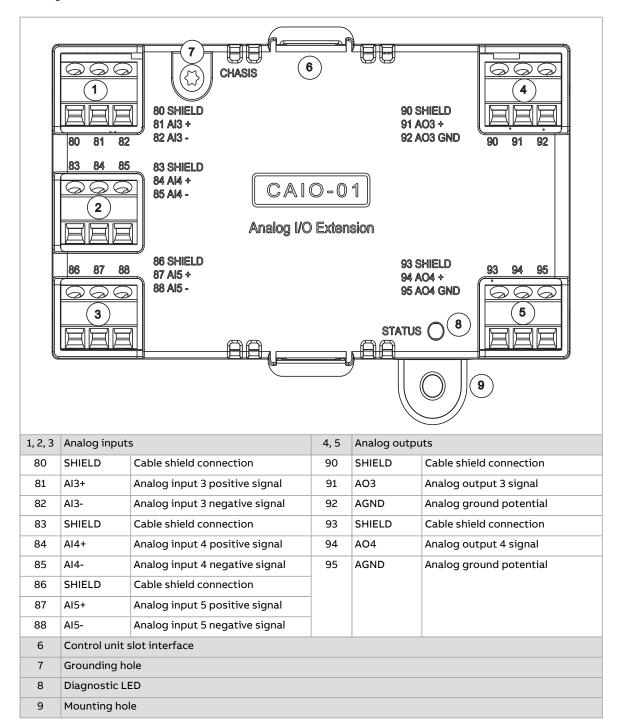
Contents of this chapter

This chapter describes how to install and start up the optional CAIO-01 multifunction extension module. The chapter also contains diagnostics and technical data.

Product overview

The CAIO-01 bipolar analog I/O module expands the inputs and outputs of the drive control unit. It has three bipolar current/voltage inputs and two unipolar current/voltage outputs. The inputs can handle positive and negative signals. The way the drive interprets the negative range of the inputs depends on the parameter settings of the drive. The voltage/current selection of the inputs is done with a parameter.

Layout



Mechanical installation

Necessary tools

Screwdriver and a set of suitable bits.

Unpacking and examining the delivery

- 1. Open the option package. Make sure that the package contains:
 - the option module
 - a mounting screw.
- 2. Make sure that there are no signs of damage.

Installing the module

See section Installing option modules (page 116).

Electrical installation



WARNING!

Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

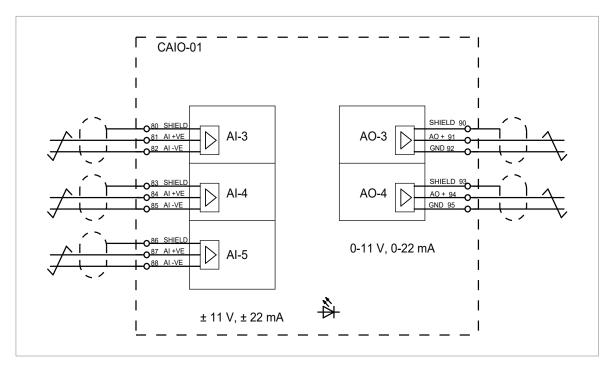
Stop the drive and do the steps in section Electrical safety precautions (page 18) before you start the work.

Necessary tools

Screwdriver and a set of suitable bits.

Wiring

Connect the external cables to the applicable module terminals. Ground the outer shield of the cables to the SHIELD terminal.



Start-up

Setting the parameters

- 1. Power up the drive.
- 2. If no warning is shown,
 - make sure that the value of both parameters 15.01 Extension module type and 15.02 Detected extension module is CAIO-01.

If warning A7AB Extension I/O configuration failure is shown,

- make sure that the value of 15.02 is CAIO-01
- set the value of parameter 15.01 to CAIO-01.

You can now see the parameters of the extension module in group 15 I/O extension module.

3. Set the parameters of analog inputs AI3, AI4, AI5 or analog outputs AO3 or AO4 to applicable values, see the firmware manual.

<u>Example:</u> To connect supervision 1 to AI3 of the extension module:

- Select the mode of the supervision function (32.05 Supervision function 1).
- Set limits for the supervision function (32.09 Supervision 1 low and 32.10 Supervision 1 high).
- Select the supervision action (32.06 Supervision 1 action).
- Connect 32.07 Supervision 1 signal to 15.52 Al3 scaled value.

Diagnostics

LEDs

The adapter module has one diagnostic LED.

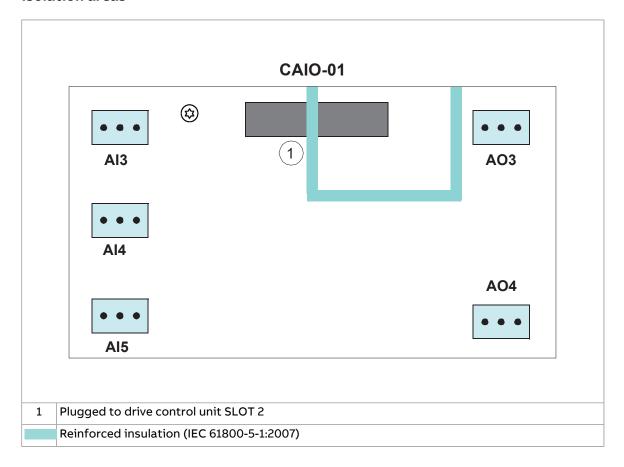
Color	Description
Green	The adapter module is powered up.
Red	There is no communication with the drive control unit or the adapter module has detected an error.

Technical data

Installation	Into slot 2 of drive control unit	
Degree of protection	IP20 / UL 1 Type	
Ambient conditions	See the drive technical data.	
Package	Cardboard	
Analog inputs (8082, 8385, 8688)		
Maximum wire size	1.5 mm ²	
Input voltage (AI+ and AI-)	-11 V +11 V	
Input current (AI+ and AI-)	-22 mA +22 mA	
Input resistance	>200 kohm (voltage mode), 100 ohm (current mode)	
Optional cable shield connections		
Analog outputs (9092, 9395)		
Maximum wire size	1.5 mm ²	
Output voltage (AO+ and AO-)	0 V +11 V	

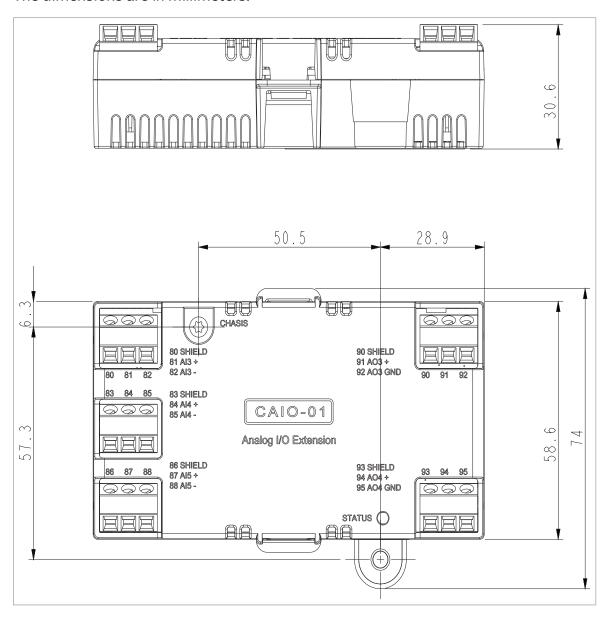
Output current (AO+ and AO-)	0 mA +22 mA
Output resistance	< 20 ohm
Recommended load	>10 kohm
Inaccuracy	± 1% Typical, ± 1.5% Max of full-scale value
Optional cable shield connections	

Isolation areas



Dimension drawings

The dimensions are in millimeters.



CHDI-01 115/230 V digital input extension module

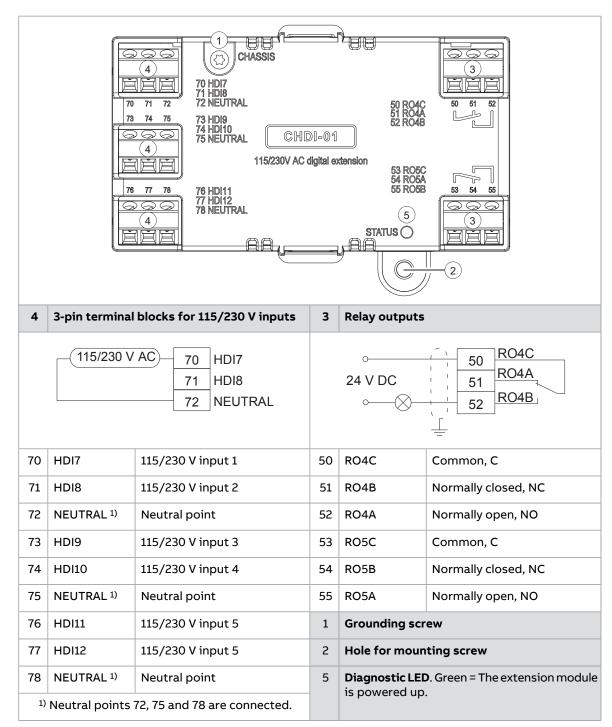
Contents of this chapter

This chapter describes how to install and start up the optional CHDI-01 multifunction extension module. The chapter also contains diagnostics and technical data.

Product overview

The CHDI-01 115/230 V digital input extension module expands the inputs of the drive control unit. It has six high voltage inputs and two relay outputs.

Layout and connection examples



Mechanical installation

Necessary tools

Screwdriver and a set of suitable bits.

Unpacking and examining the delivery

- 1. Open the option package. Make sure that the package contains:
 - the option module
 - a mounting screw.
- 2. Make sure that there are no signs of damage.

Installing the module

See section Installing option modules (page 116).

Electrical installation



WARNING!

Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

Stop the drive and do the steps in section Electrical safety precautions (page 18) before you start the work.

Necessary tools

Screwdriver and a set of suitable bits.

Wiring

Connect the external control cables to the applicable module terminals. Ground the outer shield of the control cables 360° under the grounding clamp on the grounding shelf.

Start-up

Setting the parameters

- 1. Power up the drive.
- 2. If no warning is shown,
 - make sure that the value of both parameters 15.01 Extension module type and 15.02 Detected extension module is CHDI-01.

If warning the A7AB Extension I/O configuration failure is shown,

- make sure that the value of parameter 15.02 is CHDI-01.
- set parameter 15.01 value to CHDI-01.

You can now see the parameters of the extension module in parameter group 15 I/O extension module.

3. Set the parameters of the extension module to applicable values.

Parameter setting example for relay output

This example shows how make the relay output RO4 of the extension module indicate the reverse direction of rotation of the motor with a one-second delay.

Parameter	Setting
15.07 RO4 source	Reverse
15.08 RO4 ON delay	1 s
15.09 RO4 OFF delay	1 s

Fault and warning messages

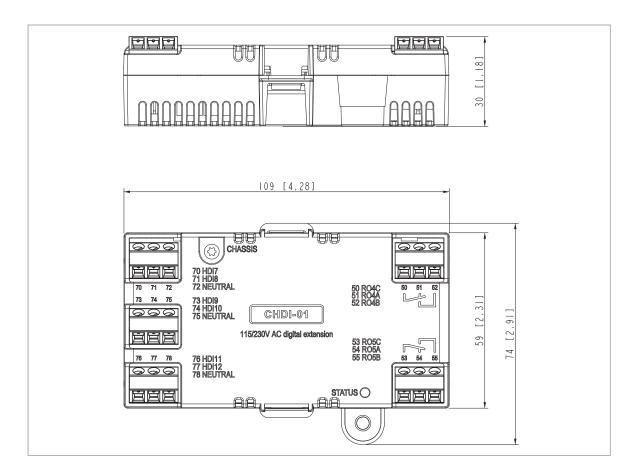
Warning A7AB Extension I/O configuration failure.

Technical data

Installation	Into an option slot on the drive control unit
Degree of protection	IP20 / UL Type 1
Ambient conditions	See the drive technical data.
Package	Cardboard
Reley outputs (5052, 5	355)
Maximum wire size	1.5 mm ²
Minimum contact rating	12 V / 10 mA
Maximum contact rating	250 V AC / 30 V DC / 2 A
Maximum breaking capacity	1500 VA
115/230 V inputs (7078	3)
Maximum wire size	1.5 mm ²
Input voltage	115 to 230 V AC ±10%
Maximum current leak- age in digital off state	2 mA
Isolation areas	
	CHDI-01
	HDI 1 RO4
	HDI
1	Plugged to drive SLOT2
	Reinforced insulation (IEC 61800-5-1:2007)
1 = 1	Functional insulation (IEC 61800-5-1:2007)

Dimension drawing

The dimensions are in millimeters and [inches].



CMOD-01 multifunction extension module (external 24 V AC/DC and digital I/O)

Contents of this chapter

This chapter describes how to install and start up the optional CMOD-01 multifunction extension module. The chapter also contains diagnostics and technical data.

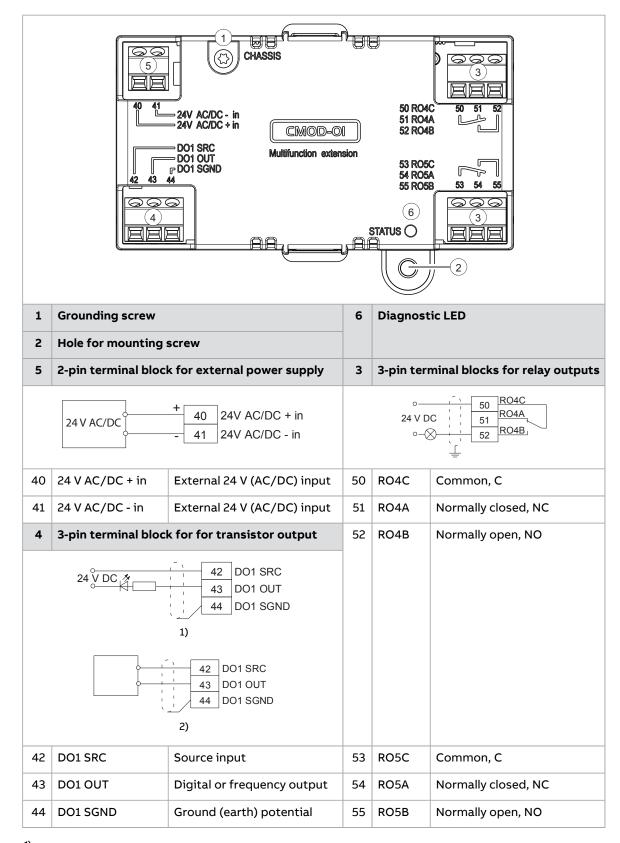
Product overview

The CMOD-01 multifunction extension module (external 24 V AC/DC and digital I/O) expands the outputs of the drive control unit. It has two relay outputs and one transistor output, which can operate as a digital or frequency output.

In addition, the extension module has an external power supply interface, which can be used to power up the drive control unit in case the drive power supply is not on. If you do not need the backup power supply, you do not have to connect it because the module is powered from the drive control unit by default.

With CCU-24 control unit, a CMOD-01 module is not necessary for external 24 V AC/DC supply connection. The external supply is connected directly to terminals 40 and 41 on the control unit.

Layout and example connections



¹⁾ Digital output connection example

²⁾ An externally supplied frequency indicator which provides, for example:

a 40 mA / 12 V DC power supply for the sensor circuit (CMOD frequency output) suitable voltage pulse input (10 Hz ... 16 kHz).

Mechanical installation

Necessary tools

Screwdriver and a set of suitable bits.

Unpacking and examining the delivery

- 1. Open the option package. Make sure that the package contains:
 - the option module
 - a mounting screw.
- 2. Make sure that there are no signs of damage.

Installing the module

See section Installing option modules (page 116).

Electrical installation



WARNING!

Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

Stop the drive and do the steps in section Electrical safety precautions (page 18) before you start the work.

Necessary tools

Screwdriver and a set of suitable bits

Wiring

Connect the external control cables to the applicable module terminals. Ground the outer shield of the control cables 360° under the grounding clamp on the grounding shelf



WARNING!

Do not connect the +24 V AC cable to the control unit ground when the control unit is powered using an external 24 V AC supply.

Start-up

Setting the parameters

- Power up the drive.
- 2. If no warning is shown,
 - make sure that the value of both parameters 15.01 Extension module type and 15.02 Detected extension module is CMOD-01.

If the warning A7AB Extension I/O configuration failure is shown,

- make sure that the value of parameter 15.02 is CMOD-01.
- set the parameter 15.01 value to CMOD-01.

You can now see the parameters of the extension module in parameter group 15 I/O extension module.

3. Set the parameters of the extension module to applicable values.

Examples are given below.

Parameter setting example for relay output

This example shows how make relay output RO4 of the extension module indicate the reverse direction of rotation of the motor with a one-second delay.

Parameter	Setting
15.07 RO4 source	Reverse
15.08 RO4 ON delay	1 s
15.09 RO4 OFF delay	1 s

Parameter setting example for digital output

This example shows how to make digital output DO1 of the extension module indicate the reverse direction of rotation of the motor with a one-second delay.

Parameter	Setting
15.22 DO1 configuration	Digital output
15.23 DO1 source	Reverse
15.24 DO1 ON delay	1 s
15.25 DO1 OFF delay	1 s

Parameter setting example for frequency output

This example shows how to make digital output DO1 of the extension module indicate the motor speed 0...1500 rpm with a frequency range of 0...10000 Hz.

Parameter	Setting
15.22 DO1 configuration	Frequency output
15.33 Freq out 1 source	01.01 Motor speed used
15.34 Freq out 1 src min	0
15.35 Freq out 1 src max	1500.00
15.36 Freq out 1 at src min	0 Hz
15.37 Freq out 1 at src max	10000 Hz

Diagnostics

Faults and warning messages

Warning A7AB Extension I/O configuration failure.

LEDs

The extension module has one diagnostic LED.

Color	Description
Green	The extension module is powered up.

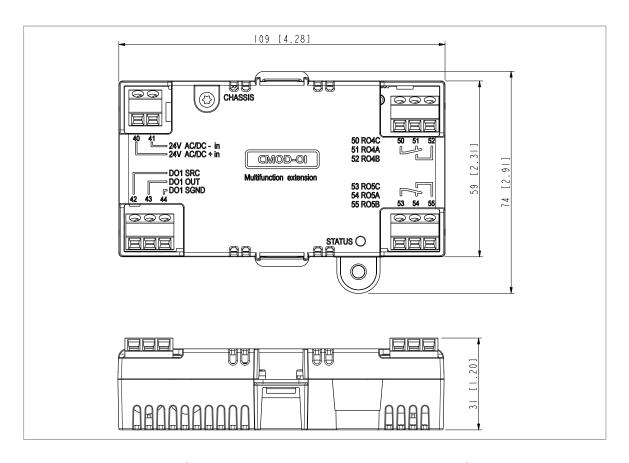
Technical data

Installation	Into an option slot on the drive control unit	
Degree of protection	IP20 / UL Type 1	
Ambient conditions	See the drive technical data.	

Package	Cardboard			
Reley outputs (5052, 5355)				
Maximum wire size	1.5 mm ²			
Minimum contact rating	12 V / 10 mA			
Maximum contact rating				
Maximum breaking capacity				
Transistor output (424	4)			
Maximum wire size	1.5 mm ²			
Туре	Transistor output PNP			
Maximum load	4 kohm			
Maximum switching voltage	30 V DC			
Maximum switching cur- rent	100 mA / 30 V DC, short-circuit protected			
Frequency	10 Hz 16 kHz			
Resolution	1 Hz			
Inaccuracy	0.2%			
External power supply (4	041)			
Maximum wire size	1.5 mm ²			
Input voltage	24 V AC / V DC ±10% (GND, user potential)			
Maximum power consumption	25 W, 1.04 A at 24 V DC			
Isolation areas				
	CMOD-01			
24	V _{in} (1) RO4			
•	RO5			
1	Plugged to drive SLOT2			
	Reinforced insulation (IEC 61800-5-1:2007)			
1 8 8 1	Functional insulation (IEC 61800-5-1:2007)			

Dimension drawing

The dimensions are in millimeters and [inches].



CMOD-02 multifunction extension module (external 24 V AC/DC and isolated PTC interface)

Contents of this chapter

This chapter describes how to install and start up the optional CMOD-02 multifunction extension module. The chapter also contains diagnostics and technical data.

Product overview

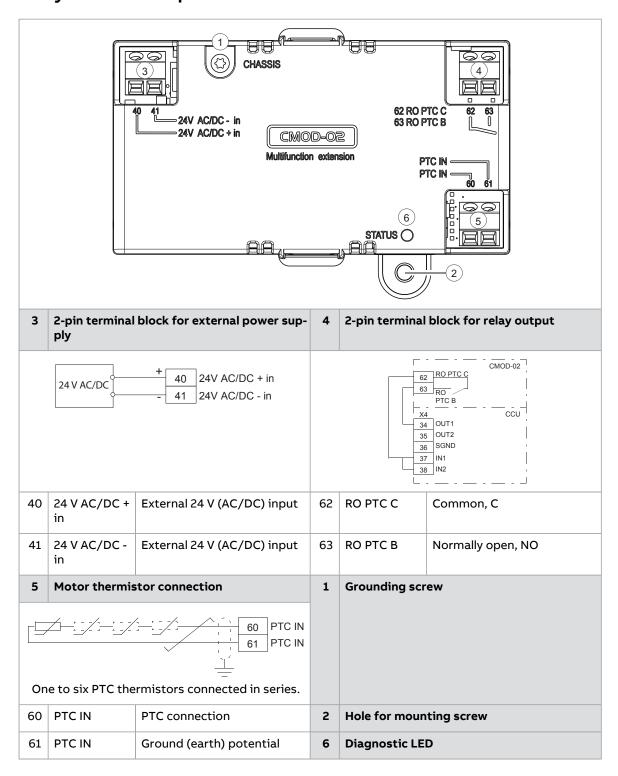
The CMOD-02 multifunction extension module (external 24 V AC/DC and isolated PTC interface) has a motor thermistor connection for supervising the motor temperature and one relay output, which indicates the thermistor status. In case the thermistor overheats, the drive trips on motor overtemperature. If Safe torque off tripping is required, the user must wire the overtemperature indication relay to the certified Safe torque off input of the drive.

In addition, the extension module has an external power supply interface, which can be used to power up the drive control unit in case the drive power supply is not on. If you do not need the back-up power supply, you do not have to connect it because the module is powered from the drive control unit by default.

There is reinforced insulation between the motor thermistor connection, the relay output and the drive control unit interface. Thus, you can connect a motor thermistor to the drive through the extension module.

With CCU-24 control unit, a CMOD-02 module is not necessary for external 24 V AC/DC supply connection. The external supply is connected directly to terminals 40 and 41 on the control unit.

Layout and example connections



Mechanical installation

Necessary tools

Screwdriver and a set of suitable bits.

Unpacking and examining the delivery

1. Open the option package. Make sure that the package contains:

- the option module
- a mounting screw.
- 2. Make sure that there are no signs of damage.

Installing the module

See section Installing option modules (page 116).

Electrical installation



WARNING!

Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

Stop the drive and do the steps in section Electrical safety precautions (page 18) before you start the work.

Necessary tools

Screwdriver and a set of suitable bits

Wiring

Connect the external control cables to the applicable module terminals. Ground the outer shield of the control cables 360° under the grounding clamp on the grounding shelf



WARNING!

Do not connect the +24 V AC cable to the control unit ground when the control unit is powered using an external 24 V AC supply.

Start-up

Setting the parameters

- 1. Power up the drive.
- 2. If no warning is shown,
 - make sure that the values of both parameters 15.01 Extension module type and 15.02 Detected extension module are CMOD-02.

If the warning A7AB Extension I/O configuration failure is shown,

- make sure that the value of parameter 15.02 is CMOD-02.
- set the parameter 15.01 value to CMOD-02.

You can now see the parameters of the extension module in parameter group 15 I/O extension module.

Diagnostics

Faults and warning messages

Warning A7AB Extension I/O configuration failure.

LEDs

The extension module has one diagnostic LED.

Color	Description
Green	The extension module is powered up.

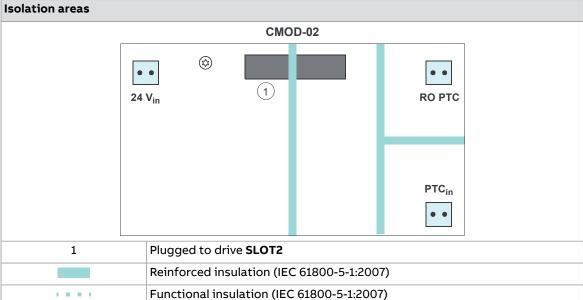
Technical data

Installation	Into option slot 2 on the drive control unit		
Degree of protection	IP20 / UL Type 1		
Ambient conditions	See the drive technical data.		
Package	Cardboard		
Motor thermistor connection (6061)			
Maximum wire size	1.5 mm ²		
Supported standards	DIN 44081 and DIN 44082		
Triggering threshold	3.6 kohm ±10%		
Recovery threshold	1.6 kohm ±10%		
PTC terminal voltage	≤ 5.0 V		
PTC terminal current	< 1 mA		
Short-circuit detection	< 50 ohm ±10%		

The PTC input is reinforced/double insulated. If the motor part of the PTC sensor and wiring are reinforced/double insulated, voltages on the PTC wiring are within SELV limits.

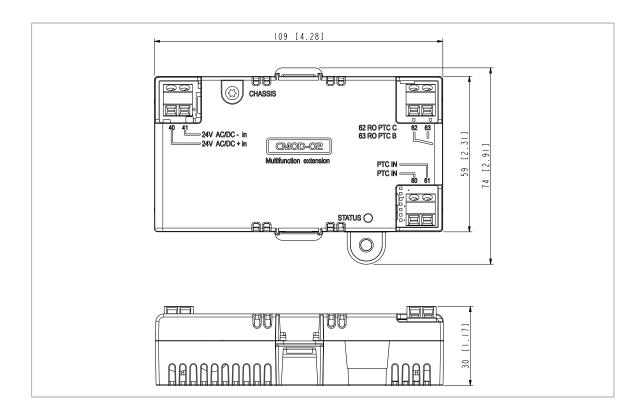
If the motor PTC circuit is not reinforced/double insulated (ie, it is basic insulated), it is mandatory to use reinforced/double insulated wiring between the motor PTC and CMOD-02 PTC terminal.

Relay output (6263)				
Maximum wire size	1.5 mm ²			
Maximum contact rating	50 V AC / 30 V DC / 5 A			
Maximum breaking capacity	1000 VA			
External power supply (4041)				
Maximum wire size	1.5 mm ²			
Input voltage	24 V AC / V DC ±10% (GND, user potential)			
Maximum power consumption	25 W, 1.04 A at 24 V DC			
Isolation areas				



Dimension drawing

The dimensions are in millimeters and [inches].



Common mode, du/dt and sine filters

Content of this chapter

This chapter describes how to select external filters for the drive.

Common mode filters

When is a common mode filter needed?

See section Examining the compatibility of the motor and drive (page 66).

Common mode filter kits are available from ABB, see the table on page 241. A kit includes three wound cores. For installation instructions of the cores, see the instruction included in the core package.

Common mode filter types

IEC ratings at U_n = 400 V and 480 V

For common mode filters for smaller drive types, contact your local representative.

ACQ80- 01	Common mode filters ABB drives	Frame size
030kW-4	64315811	R4
037kW-4	64315811	R4
045kW-4	64315811	R5
055kW-4	64315811	R5
075kW-4	3AXD50000017269	R6
090kW-4	3AXD50000017270	R7
110kW-4	3AXD50000017270	R7
132kW-4	3AXD50000018001	R8

ACQ80- 01	Common mode filters ABB drives	Frame size
160kW-4	3AXD50000018001	R8
200kW-4	3AXD50000017940	R9

du/dt filters

■ When is a du/dt filter needed?

See section Examining the compatibility of the motor and drive (page 66).

■ d*u*/d*t* filter types

IEC ratings at U_n = 400 and 480 V

ACQ80-	d <i>u</i> /d <i>t</i> filters	Frame
01	ABB drives	size
030kW-4	NOCH0070-6x	R4
037kW-4	NOCH0120-6x	R4
045kW-4	NOCH0120-6x	R5
055kW-4	NOCH0120-6x	R5
075kW-4	FOCH0260-70	R6
090kW-4	FOCH0260-70	R7
110kW-4	FOCH0260-70	R7
132kW-4	FOCH0260-70	R8
160kW-4	FOCH0260-70	R8
200kW-4	FOCH0320-50	R9

Description, installation and technical data of the FOCH filters

See FOCH du/dt filters hardware manual (3AFE68577519 [English]).

Description, installation and technical data of the NOCH filters

See AOCH and NOCH du/dt filters hardware manual (3AFE58933368 [English]).

Sine filters

• IEC ratings at U_n = 400 V

ACQ80- 01	Current sine filter mode	Sine filter type		Frame
	I _{2, sine}	IP00	IP21	size
030kW-4	62	B84143V0064R231	B84143V0066R229 + B84143Q0010R229	R4
037kW-4	73	B84143V0064R231	B84143V0066R229 + B84143Q0010R229	R4
045kW-4	88	B84143V0077R231	B84143V0095R229 + B84143Q0012R229	R5
055kW-4	106	B84143V0091R231	B84143V0095R229 + B84143Q0012R229	R5
075kW-4	145	B84143V0145R231	B84143V0162S229 + B84143Q0014R229	R6
090kW-4	169	B84143V0209R231	B84143V0162S229 + B84143Q0014R229	R7
110kW-4	206	B84143V0209R231	B84143V0230S229 + B84143Q0016R229	R7
132kW-4	246	B84143V0209R231	B84143V0230S229 + B84143Q0016R229	R8
160kW-4	293	B84143V0249R231	B84143V0390S229 + B84143Q0018R229	R8
200kW-4	363	B84143V0390S229	B84143V0390S229 + B84143Q0018R229	R9

Description, installation and technical data

See Sine filters hardware manual (3AXD50000016814 [English]).

Further information

Product and service inquiries

Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to www.abb.com/contact-centers.

Product training

For information on ABB product training, navigate to new.abb.com/service/training.

Providing feedback on ABB manuals

Your comments on our manuals are welcome. Navigate to forms.abb.com/form-26567.

Document library on the Internet

You can find manuals and other product documents in PDF format on the Internet at www.abb.com/drives/documents.



www.abb.com/drives

