ABB MACHINERY DRIVES

ACS380-E drives

Hardware manual

ACS380-E drives

Hardware manual

3AXD50001141677 Rev C
EN
Original instructions
EFFECTIVE: 2025-08-20

Table of contents

4 Mechanical installation

5 Electrical planning

6 Electrical installation – IEC

10 Technical data

11 Dimension drawings

12 Input chokes

13 External EMC filters

14 Resistor braking

15 The Safe torque off function

16 AMIO-02 I/O extension module

Further information

1

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.

Safety messages

These safety messages help to prevent personal injury and damage to the equipment. The hazard levels comply with standard ANSI Z535.6.

The manual uses these warning symbols:

⚠DANGER Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠WARNING Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠CAUTION Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE Is used to address practices not related to physical injury, but which can result in equipment damage.

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.
- 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 electrical installation or maintenance work. Do these steps before you do 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 there is a permanent magnet motor connected 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 high-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 input power terminals of the drive (L1, L2, L3) and the grounding (PE) busbar is zero.
   - Make sure that the voltage between the output power terminals of the drive (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 motor, drive, or 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.
  The brake circuit, including the brake chopper and brake resistor (if it is installed) are also 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

NOTICE Use an antistatic wrist strap 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 motor, drive, or 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:

- 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 you need to start or stop the drive, use the control panel keys or commands through the I/O terminals of the drive or the fieldbus interface.
- 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, and 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 the work. Make sure that no other system, such as a hydraulic crawling drive, can rotate the motor directly or through any mechanical connection such as a belt, nip, rope, or similar.
- Do the steps in Electrical safety precautions (page 16).
- 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

NOTICE 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.

2

Introduction to the manual

Contents of this chapter

The chapter describes the applicability, target audience and purpose of the manual. The chapter contains a list of related manuals and a flowchart for installation and commissioning.

Applicability

This manual is applicable to ACS380-E 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 drives are manufactured in frame sizes (for example, R1). The information that applies only to specific frames is identified with the frame size. Read the frame size from the type designation label of the drive.

Quick installation and commissioning flowchart

Task	See
Identify the frame size.	Type designation key (page 37)
Plan the installation. Do checks for the ambient conditions, ratings, and required cooling airflow.	Electrical planning (page 47) Technical data (page 103)
Examine the delivery.	Examine the delivery (page 40)
If the supply network is not a symmetrically grounded TN-S system, make sure that the drive is compatible with the grounding system.	Grounding system compatibility check – IEC (page 67) Grounding system compatibility check – North America (page 79)
Install the drive.	Installing the drive (page 44)
Route the cables.	Routing the cables (page 57)
Measure the insulation of the input cable, motor, and motor cable.	Measuring the insulation resistance – IEC (page 66) Measuring the insulation resistance – North America (page 78)
Connect the power cables.	Connecting the power cables – IEC (shielded cables) (page 71) Connecting the power cables – North America (wiring in conduits) (page 84)
Connect the control cables.	Connecting the control cables – IEC (page 74) Connecting the control cables – North America (page 87)
Examine the installation.	Installation checklist (page 91)

Task	See
Commission the drive.	Refer to ACS380-E drives quick installation and start-up guide (3AXD50001141653 [English]) and ACS380-E drives firmware manual (3AXD50001204853 [English]).

Terms and abbreviations

Term	Description
AMIO-02	I/O option module
Brake chopper	Conducts the surplus energy from the intermediate circuit of the drive to the brake resistor when necessary. The chopper operates when the DC link voltage exceeds a certain maximum limit. The voltage rise is typically caused by deceleration (braking) of a high inertia motor.
Brake resistor	Dissipates the drive surplus braking energy conducted by the brake chopper to heat
Control unit	Enclosure that contains the control board and related connector boards. The term is also used as a synonym for the control board.
DC link	DC circuit between rectifier and inverter
DC link capacitors	Energy storage which stabilizes the intermediate circuit DC voltage
Drive	Frequency converter for controlling AC motors
EMC	Electromagnetic compatibility
EMIC-30	Standard status display panel for the ACS380-E drive.
EMID-30	Optional control panel for the ACS380-E drive.
Frame, frame size	Physical size of the drive or power module
IGBT	Insulated gate bipolar transistor
Intermediate circuit	DC circuit between rectifier and inverter
Inverter	Converts direct current and voltage to alternating current and voltage.
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
Rectifier	Converts alternating current and voltage to direct current and voltage
RFI	Radio-frequency interference
SIL	Safety integrity level (1…3) (IEC 61508, IEC 62061, IEC 61800-5-2)
STO	Safe torque off (IEC/EN 61800-5-2)

Related documents

For more documentation, go to www.abb.com/drives/documents.

ACS380-E documentation list

3

Operation principle and hardware description

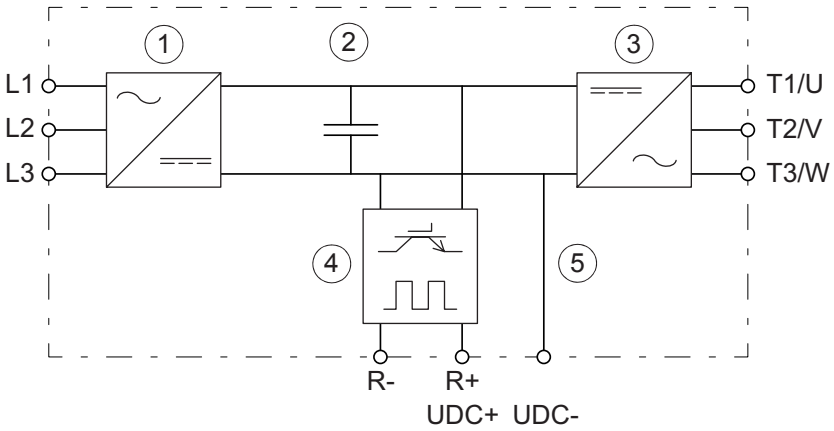
Contents of this chapter

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

Operation principle

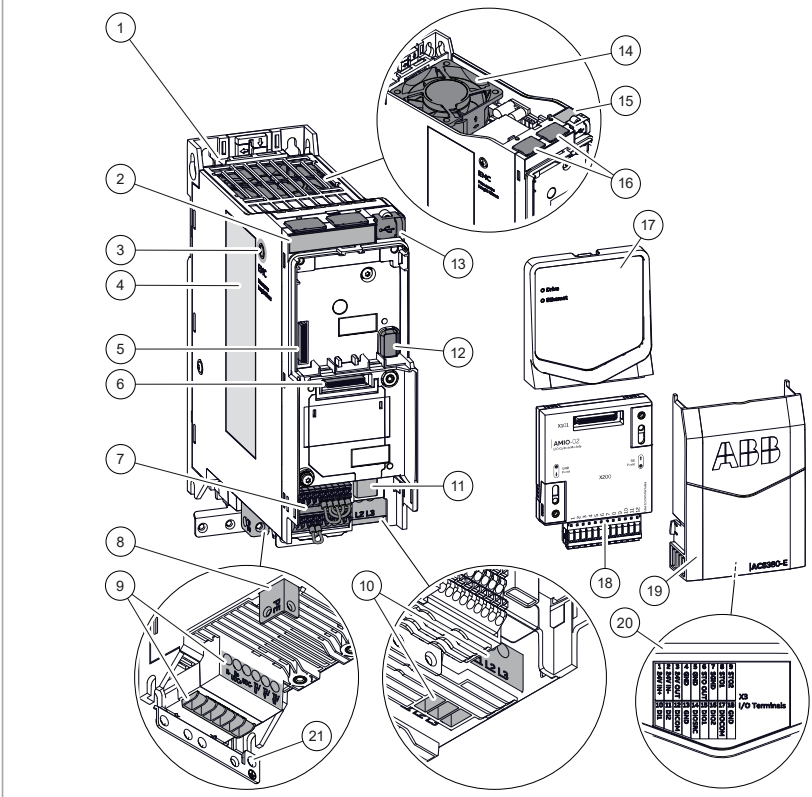
The ACS380-E is a drive to control asynchronous AC induction motors, permanent magnet synchronous motors, and ABB synchronous reluctance motors (SynRM motors). The drive is designed for cabinet installation.

Simplified main circuit diagram



1	Rectifier. Converts alternating current and voltage to direct current and voltage.
2	DC link. DC circuit between the rectifier and inverter.
3	Inverter. Converts direct current and voltage to alternating current and voltage.
4	Brake chopper. Conducts energy from the intermediate DC circuit of the drive to the brake resistor when it is necessary and if an external brake resistor is connected to the drive. The chopper operates when the DC link voltage exceeds a specified limit. This voltage increase is typically caused by the deceleration (braking) of a motor. The user obtains and installs the brake resistor if it is necessary.
5	DC connection (UDC+, UDC-).

Layout



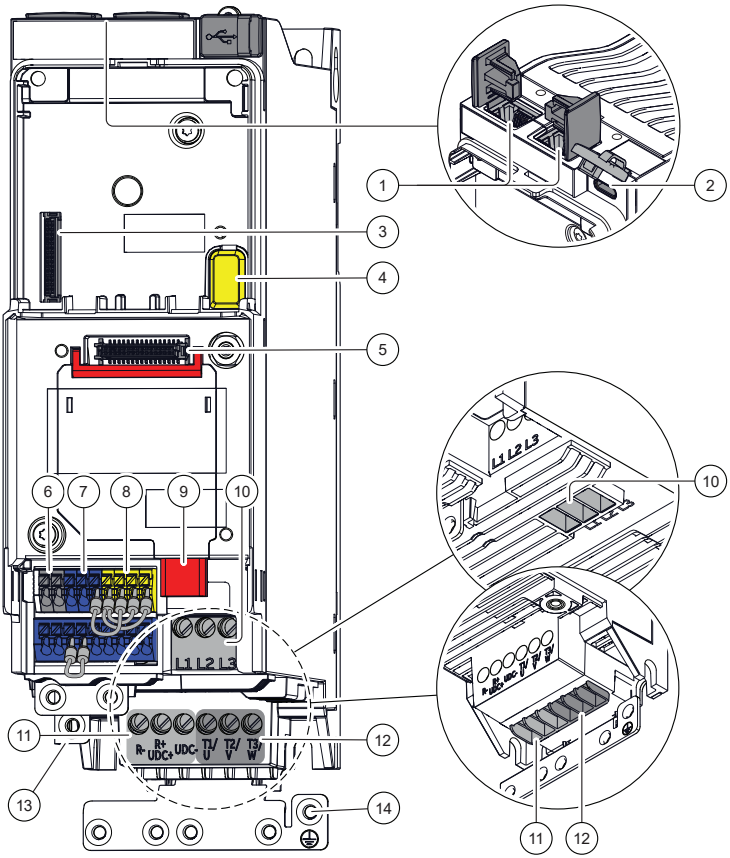
1. Drive base unit	12. Safety option connector cover [1]
2. MAC address label	13. USB-C port [2]
3. EMC filter grounding screw	14. Cooling fan
4. Type designation label	15. Model information label
5. Front panel connector	16. Ethernet ports (X1 and X2)
6. Option module connector	17. Status display panel or optional front panel
7. Control terminals	18. Option module
8. PE terminal (motor)	19. Front cover
9. Brake resistor and motor terminals	20. Control terminal designations
10. Input power terminals	21. PE terminal
11. Eject button for option module	

1) Remove the cover only if a safety option is connected.

2) The USB-C port does not support external memory devices. Do not use the port to supply power to external devices.

Drive connections

Connections of the drive base unit:



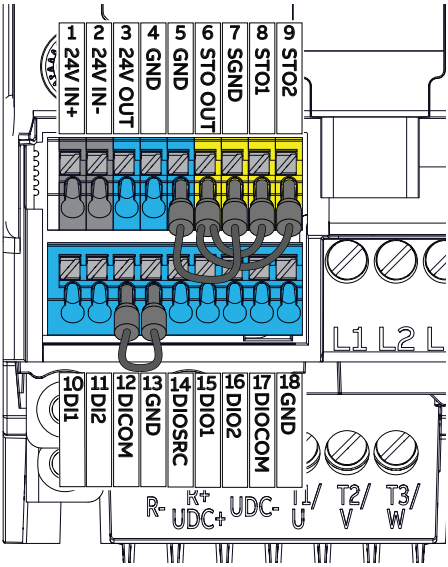
1. Ethernet (RJ45) ports	8. Safe torque off connections
2. USB-C port [1]	9. Option module eject button
3. Front panel connector	10. Input power terminals
4. Safety option connector [2]	11. Brake resistor terminals
5. Option module connector	12. Motor terminals
6. External 24 V DC input	13. PE terminal (motor)
7. Auxiliary 24 V DC output, and digital I/Os	14. PE terminal

1) The USB-C port does not support external memory devices. Do not use the port to supply power to external devices.

2) Remove the cover only if a safety option is connected.

Control connections

Control connections of the base unit:



No.	Terminal	Description	No.	Terminal	Description
1	24V IN+	External 24 V DC input	10	DI1	Digital input 1
2	24V IN-	External 24 V DC common	11	DI2	Digital input 2
3	24V OUT	Auxiliary voltage output +24 V DC	12	DICOM [1)]	Digital input 1 and 2 common
4	GND	Auxiliary voltage output common	13	GND	Ground
5	GND	Ground	14	DIOSRC	Digital output 3 and 4 auxiliary voltage
6	STO OUT	STO 24 V output	15	DIO1	Digital input/output 1
7	SGND [2)]	STO ground	16	DIO2	Digital input/output 2
8	STO1	STO 1 input	17	DIOCOM	Digital input/output 1 and 2 common
9	STO2	STO 2 input	18	GND	Ground

1) Ground wire connection. Determines whether DICOM is isolated from drive GND (the common reference for the digital inputs floats).

2) Ground wire connection. Determines whether SGND is isolated from drive GND (the common reference for the STO ground floats).

USB connection

NOTICE The USB connection does not support external memory devices. Do not use the USB connection to supply power to external devices.

The drive has a USB Type C (USB-C) connection on the front. You can use this connection to connect:

- An external control panel to the drive.
- A PC to the drive to use Drive Composer.

Embedded Ethernet connection

The drive has two RJ45 Ethernet network connections (X1 and X2) at the top.

NOTICE Do not connect the drive to a public data network.

You can control and monitor the drive through the embedded Ethernet network connection with these protocols:

- PROFINET (protocol information: www.profibus.com) (Enabled by default.)
- EtherNet/IP (protocol information: www.odva.org)
- Modbus/TCP (protocol information: modbus.org)

For the specifications of the embedded Ethernet network connection, refer to the technical data.

For more information on the Ethernet connections, refer to the ACS380-E embedded control Ethernet supplement (3AXD50001322762) and the drive firmware manual.

Front panel

NOTICE Do not use the drive without a front panel. Install the Status display panel or an optional front panel before you connect the drive to a power supply.

The drive can have different front panel modules. As standard, the drive comes with the status display panel EMIC-30 (option +J601). Other front panel modules are available as options.

For the front panel module installation instructions, refer to the documentation in the product package and to Installing front panel modules (page 42).

Status display panel

The status display panel (EMIC-30) has two status LEDs:

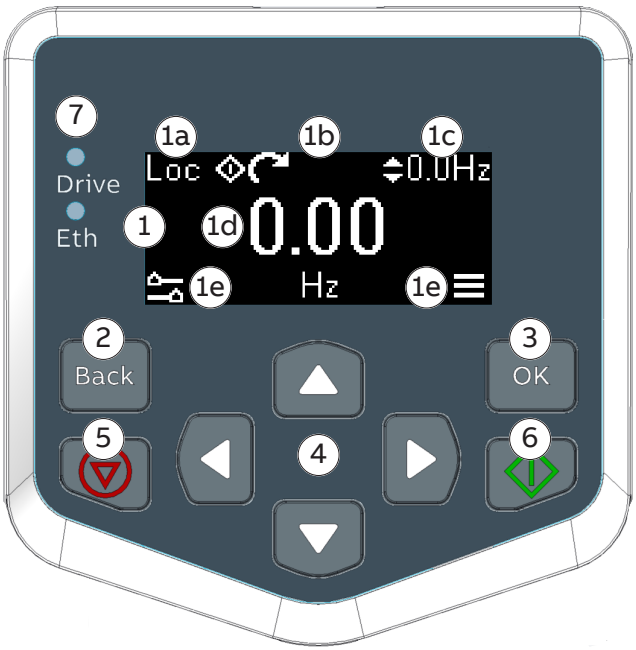
LED	Color/indication	Description
Drive status [Drive]	Off	The drive is not powered.
	Green	The drive operates normally.
	Flashes green	There is an active warning.
	Red	There is an active fault.
Ethernet status [Ethernet/Eth]	Off	The drive is not powered.
	Flashes amber	The drive tries to get IP configuration from the DHCP server.
	Amber	Duplicate address detection is active.
	Flashes green	The drive waits for a protocol request or response or for duplicate address detection to complete. Can be caused by an incomplete network configuration.
	Green	Normal operation.
	Flashes red	No Ethernet link available. Examine the network configuration.
	Red	The Ethernet interface is disabled. Duplicate address detection may have detected an address conflict. Examine the network configuration.

For more information on the Ethernet status indications, refer to the ACS380-E embedded control Ethernet supplement (3AXD50001322762).

Control panel

The optional control panel EMID-30 (+J603) gives the drive a user interface with a display and control keys.

Refer to the drive firmware manual for information on how to use the user interface, start up the drive, and modify settings and parameters.



1	Display (Home view): a) Control location: local or remote b) Status icons c) Reference target value d) Actual measured value e) Left and right softkey actions
2	**Back** key (opens the Options view in the Home view)
3	**OK** key (opens the Menu in the Home view)
4	Arrow keys (menu navigation and setting values)
5	**Stop** key (when the drive is locally controlled)
6	**Start** key (when the drive is locally controlled)
7	Drive and Ethernet status LEDs. For Status LED descriptions, refer to Status display panel (page 31).

The user interface in brief:

- In the Home view, push the **Back** key to open the Options view.
- In the Home view, push the **OK** key to open the Menu.
- Navigate the views with the arrow keys.
- Push the **OK** key to open the highlighted setting or item.
- Use the left and right arrow keys to highlight a value.
- Use the up and down keys to set a value.
- Push the **Back** key to cancel a setting or return to the previous view.

Home view

The Home view shows the reading of one of three measured signals. Select the page with the left and right arrow keys.

The status bar at the top of the Home view shows:

- The control location (Loc for local control and Rem for remote control)
- The status icons
- The reference target value

From the Home view, push the **Back** key to open the Options view and push the **OK** key to open the Menu.

Adjust the current reference value with the up and down arrow keys.

Status icons

Icon	Animation	Description
	None	Local Start/Stop enabled
	None	Stopped
	None	Stopped, start inhibited
	Blinks	Stopped, start commanded but inhibited
	Rotates	Running at reference
	Rotates	Running but not at reference
	Blinks	Running at reference, but reference = 0

Icon	Animation	Description
	Blinks	Drive fault
	None	Local reference setting enabled

Message view

When a fault or warning occurs, the display shows the Message view. The Message view shows the active fault as an icon and a fault code, or a list of the most recent warning codes.

For information on faults and warnings, refer to the drive firmware manual.

To reset a fault, push the **OK** key (with the soft-key label Reset?).

Options view

To open the Options view, push the **Back** key in the Home view.

In the Options view, you can:

- Set the control location
- Set the direction of the motor
- Set the reference
- View the active fault
- View a list of the active warnings.

Menu

To open the Menu, push the **OK** key in the Home view.

To navigate in the Menu, push the up and down arrow keys to move between menu items.

Menu items:

- Motor data view: Enter the motor specifications.
- Motor control view: Set the motor control settings.
- Diagnostics view: Read the active faults and warnings.
- Energy efficiency view: Monitor the efficiency of the drive.
- Parameters view: Open and edit the full list of parameters.

For detailed information on the user interface, refer to the drive firmware manual.

Option modules

The drive supports option modules. For a list of available option modules, refer to Type designation key (page 37).

AMIO-02 I/O option module

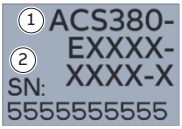
The AMIO-02 I/O option module adds inputs and outputs to the drive. Refer to AMIO-02 I/O extension module (page 183).

Drive labels

The drive has these labels:

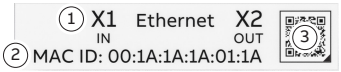
Model information label

The model information label is on top of the drive.

	1. Drive type code 2. Drive serial number

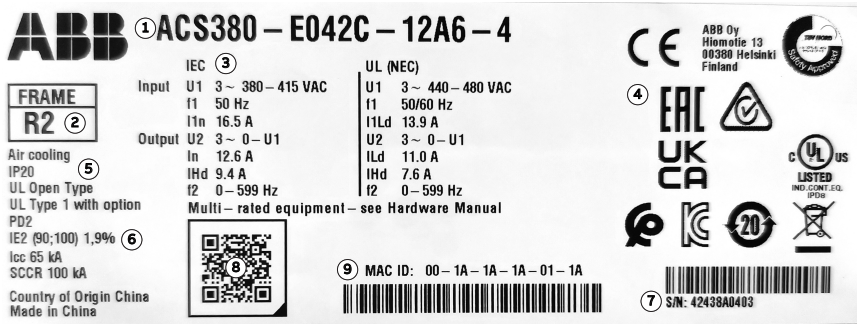
MAC address label

The MAC address label is on the front of the drive.

	1. Ethernet connector designation (X1 and X2) 2. MAC address of the drive 3. QR code for product information

Type designation label

The type designation label is on the left side of the drive.



1	Type designation
2	Frame (size)
3	Nominal ratings
4	Valid markings
5	Degree of protection
6	Losses according to IEC 61800-9-2
7	S/N: Serial number of format MYYWWXXXXX, where M: Manufacturer YY: Year of manufacture: 19, 20, 21, … for 2019, 2020, 2021, … WW: Week of manufacture: 01, 02, 03, … for week 1, week 2, week 3, … XXXX: Running item number that starts each week from 0001.
8	QR code to product information
9	MAC address of the drive

Type designation key

The type designation key shows the specifications and the configuration of the drive.

Basic code

Type code example: ACS380-E042C-01A8-4

Code	Description	
ACS380-E	Product series	
042C-	04	Construction: 04 = Module for cabinet installation
	2	EMC filter variant: 2 = High filtering level, EN 61800-3 category C2
	C	Connectivity: Embedded Ethernet
01A8-	Size. Refer to the technical data.	
4	Input voltage: 4 = 3-phase 380 … 480 V AC	

Option codes

Option codes have a plus sign prefix. The table lists the option codes that were available at the time of publishing. These are subject to change.

Code	Description
Front panel modules	
J601	EMIC-30 status display panel
J603	EMID-30 control panel
I/O extension modules	
L601	AMIO-02 I/O extension module (3×DI, 2×AI, AO)
Services	
P992	Pre-installed options: Drive options are installed at the factory.
P904	Extended warranty: 24 months from commissioning or 30 months from delivery
P909	Extended warranty: 36 months from commissioning or 42 months from delivery

Code	Description
Documentation [1]	
R700	English
R701	German
R702	Italian
R703	Dutch
R704	Danish
R705	Swedish
R706	Finnish
R707	French
R708	Spanish
R709	Portuguese (Portugal)
R711	Russian
R712	Chinese
R713	Polish
R714	Turkish

1) The documentation option code sets the language variants of the hardware manual and firmware manual. The product package has the quick installation and start-up guide in English, French, German, Italian, and Spanish, and in the local language (if it is available).

4

Mechanical installation

Contents of this chapter

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

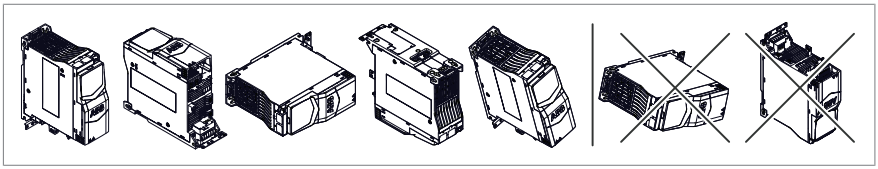
Installation alternatives

You can install the drive:

- With screws onto an assembly plate
- On a DIN installation rail (IEC/EN 60715, top hat type, width 35 mm [1.4 in] × height 7.5 mm [0.3 in])

Installation requirements:

- The drive is designed for cabinet installation and has a degree of protection of IP20 / UL open type as standard.
- Make sure that there is a minimum of 75 mm (3 in) of free space at the top and bottom of the drive (at the cooling air inlet and outlet), measured from the frame.
- You can install several drives side by side.
- You can install the drive tilted to a maximum of 90 degrees, from vertical to fully horizontal orientation.
- Do not install the drive upside down.



- Make sure that the hot exhaust air from drives or equipment does not flow into the cooling inlet of other drives or equipment.

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.
- The installation surface is as close to vertical as possible and strong enough to hold the drive.
- There is sufficient free space around the drive for cooling, maintenance work, and operation. Refer to the free space specifications for the drive.
- 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.

Required tools

To install the drive mechanically, you need these tools:

- Drill and suitable drill bits
- Screwdriver or wrench with a set of suitable bits
- Tape measure and spirit level
- Personal protective equipment, such as eye protection, gloves, and footwear.

Examine the delivery

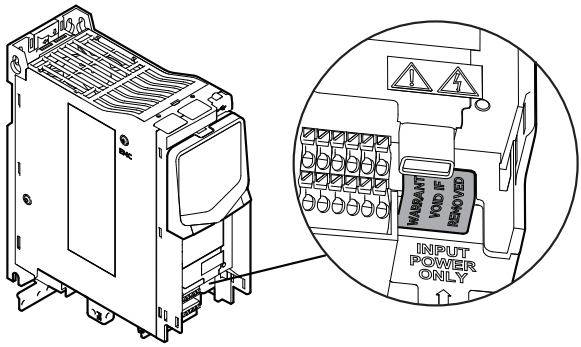
NOTICE Make sure that there are no signs of damage to the delivery package or to its sealing stickers. If you think that the package was opened, contact your supplier.

Keep the drive in its package until you install it. After you remove the drive from its package, protect it from dust, debris, and moisture.

Make sure that these items are in the package:

- Drive base unit
- Front panel (status display panel or ordered optional front panel)
- Front cover
- EMC plate kit
- Accessories kit with installation accessories
- Mounting template for frame sizes R3 and R4
- Ordered options
- Warning sticker sheet
- Safety instructions
- Quick installation and start-up guide
- Hardware and firmware manuals, if they were ordered as options

NOTICE Examine the anti-tamper sticker on the drive to make sure that it has no signs of damage. If there is damage, do not use the drive and contact your supplier.



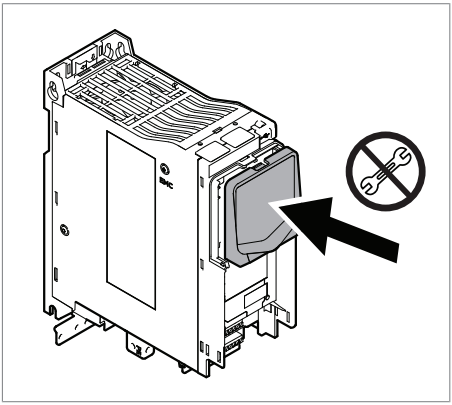
If the package does not contain all of the ordered items or if there is damage to any of the items, contact your supplier.

Installing front panel modules

Refer to the documentation in the product package of the front panel module for the specific installation instructions.

To install the standard status display panel:

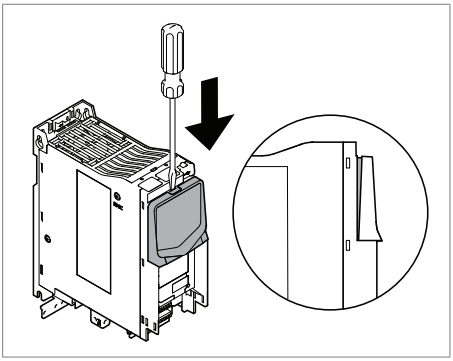
1. Remove the front panel module from its packaging. Read the documentation in the product package for module-specific instructions.
2. If it is in position, remove the front cover.
3. Carefully align the front panel module with the drive. Make sure that the connector aligns correctly.
4. Carefully push the front panel module into position by hand evenly until it locks. Do not use tools.



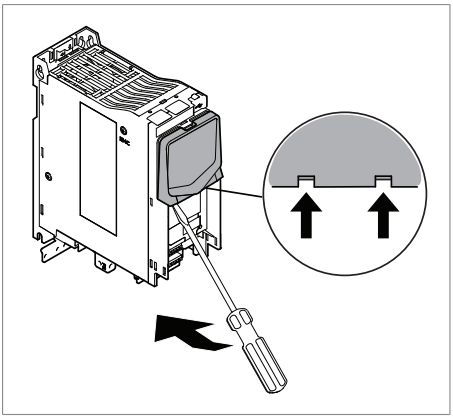
5. Attach the front cover.

To remove a standard status display panel:

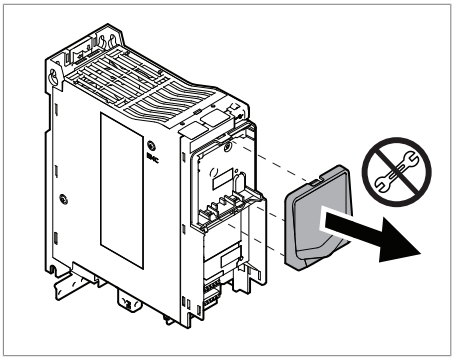
1. If it is in position, remove the front cover.
2. Carefully insert a suitable flat-head screwdriver into the latch slot at the top of the front panel module.



3. Carefully push down with the screwdriver until the top latch opens and the top the the front panel module moves slightly outwards. Do not pull the front panel module.
4. Insert the screwdriver one at a time into the two latch slot at the bottom of the front panel module and carefully twist the screwdriver downwards to open the latches.



5. Pull the front panel module directly out of the slot in the drive. Do not tilt or twist the front panel module.



Installing option modules

Refer to the documentation in the product package of the option module for the installation instructions.

For installation information on the AMIO-02 I/O extension module, refer to AMIO-02 I/O extension module (page 183).

Installing the drive

You can install the drive

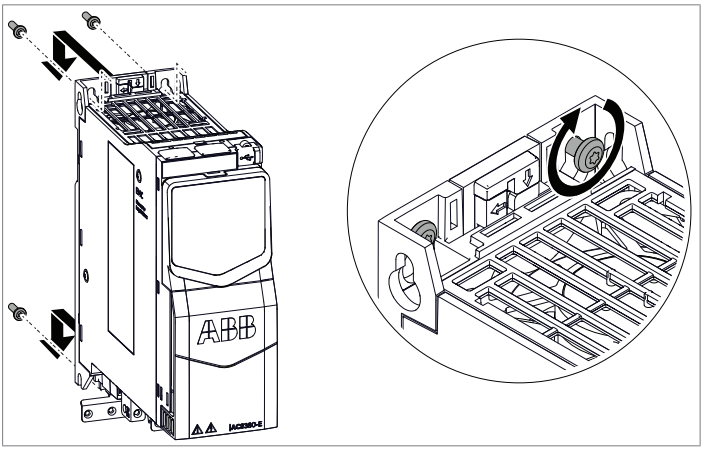
- with screws to a suitable surface
- to a DIN installation rail.

To install the drive with screws

Requirements for installation with screws:

- Use mounting screws that are suitable for the installation surface.
- Install suitable plugs or anchors if the installation surface requires it.
- The optimal machine screws are DIN7985 pan-head screws:
  - M4 for R1 and R2 frame sizes
  - M5 for R3 and R4 frame sizes
- The optimal self-tapping screws are DIN7981 pan-head screws:
  - 4.2 mm for R1 and R2 frame sizes
  - 4.8 mm for R3 and R4 frame sizes
- Depending on the installation location, use thread-locking compound or spring washers.
- Do not tighten the mounting screws too much to prevent damage to the drive.

1. Make marks on the surface for the mounting holes. For frame sizes R3 and R4, use the supplied mounting template. For other frame sizes, refer to the dimension drawings.
2. Drill the holes for the mounting screws.
3. If it is necessary, install anchors or plugs into the holes.
4. Install the mounting screws into the holes. Leave a sufficient gap between the screw head and the installation surface for the drive.
5. Put the drive onto the mounting screws. Start with the mounting screws at the top of the drive.
6. Tighten the mounting screws.

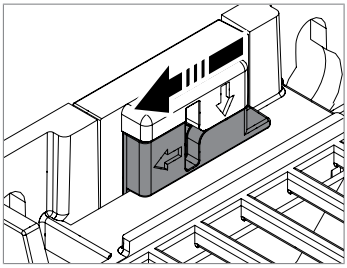


The illustration shows the R1 drive. Use a similar procedure for the other frame sizes.

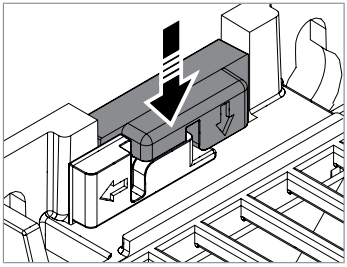
To install the drive to a DIN installation rail

Use an IEC/EN 60715 top hat type installation rail, width × height = 35 × 7.5 mm (1.4 × 0.3 in).

1. Move the locking part to the left.



2. Push and hold the locking button down.



3. Put the top tabs of the drive onto the top edge of the DIN installation rail.
4. Put the drive against the bottom edge of the DIN installation rail.
5. Release the locking button.
6. Move the locking part to the right.
7. Make sure that the drive is correctly installed.

To remove the drive, use a flat-head screwdriver to open the locking part.

5

Electrical planning

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.

- **North America**

Installations must be compliant with NFPA 70 (NEC)[1)] and/or Canadian Electrical Code (CE) along with state and local codes for your location and application.

[1)] National Fire Protection Association 70 (National Electric Code).

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.

Selecting the main contactor

You can equip the drive with a main contactor.

Follow these guidelines when you select a customer-defined main contactor:

- Dimension the contactor according to the nominal voltage and current of the drive. Also consider the environmental conditions such as surrounding air temperature.
- IEC installations: Select contactor with utilization category AC-1 (number of operations under load) according to IEC 60947-4.
- Consider the application life time requirements.

Checking the compatibility of the motor and drive

Use an asynchronous AC induction motor, a permanent magnet synchronous motor, or an ABB synchronous reluctance motor (SynRM motors) with the drive. With the scalar motor control mode, the drive can control several induction motors.

Refer to the rating tables in the technical data to make sure that the motors and the drive are compatible.

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 50).

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.

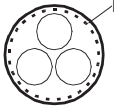
Typical power cable sizes

Refer to the technical data in the applicable hardware manual.

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
 Four-conductor cable in plastic jacket (three phase conductors and PE)	Yes with phase conductor smaller than 10 mm^2 (8 AWG) Cu.	Yes with phase conductor smaller than 10 mm^2 (8 AWG) Cu, or motors up to 30 kW (40 hp). **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 motors up to 30 kW (40 hp)
 Shielded (Al/Cu shield or armor) [1] four-conductor cable (three phase conductors and a PE)	Yes	Yes with motors up to 100 kW (135 hp). A potential equalization between the frames of motor and driven equipment is required.

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	No

Additional guidelines – North America

ABB recommends the use of metallic conduit for power wiring. ABB also recommends the use of symmetrical shielded VFD cable between drive and motor(s).

This table shows examples of methods for wiring the drive. Refer to NFPA 70 (NEC) along with state and local codes for the appropriate methods for your application.

Wiring method	Notes
Conduit - Metallic [1) 2)]	
Electrical metallic tubing: Type EMT	Prefer symmetrical shielded VFD cable. Use separate conduit run for each motor. Do not run input power wiring and motor wiring in the same conduit.
Rigid metal conduit: Type RMC	
Liquid-tight flexible metal electrical conduit: Type LFMC	
Conduit - Non-metallic [2) 3)]	
Liquid-tight flexible non-metallic conduit: Type LFNC	Prefer symmetrical shielded VFD cable. Use separate conduit run for each motor. Do not run input power wiring and motor wiring in the same conduit.
Wireways [2)]	
Metallic	Prefer symmetrical shielded VFD cable. Separate motor wiring from input power wiring and other low voltage wiring. Do not run outputs of multiple drives parallel. Bundle each cable (wiring) together and use separators where possible.

Wiring method	Notes
Free air [2]	
Enclosures, air handlers, etc.	Prefer symmetrical shielded VFD cable. Allowed internally in enclosures when in accordance with UL.

1) Metallic conduit may be used as an additional ground path, provided this path is a solid path capable of handling ground currents.
2) See NFPA NFPA 70 (NEC), UL, and local codes for your application.
3) Non-metallic conduit use underground is allowed; however, these installations inherently have an increased chance for nuisance problems due to the potential for water/moisture in the conduit. Water/moisture in the conduit increases the likelihood of VFD faults or warnings. Proper installation is required to make sure there is no intrusion of water/moisture.

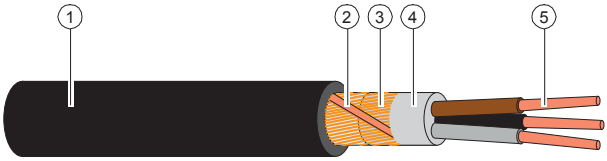
Metal conduit

Couple separate parts of a metal conduit together: bridge the joints with a ground conductor bonded to the conduit on each side of the joint. Also bond the conduits to the drive enclosure and motor frame. Use separate conduits for input power, motor, brake resistor, and control wiring. Do not run motor wiring from more than one drive in the same conduit.

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.



1	Insulation jacket
2	Helix of copper tape or copper wire
3	Copper wire shield
4	Inner insulation
5	Cable core

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 (mm^2)	Minimum cross-sectional area of the corresponding protective earth conductor S_p (mm^2)
S ≤ 16	S [1)]
16 < S ≤ 35	16
35 < S	S/2

1) For the minimum conductor size in IEC installations, refer to Additional grounding requirements – IEC (page 55).

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 mm^2 if the conductor is mechanically protected,
  or
- 4 mm^2 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 mm^2 Cu or 16 mm^2 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 mm^2 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.

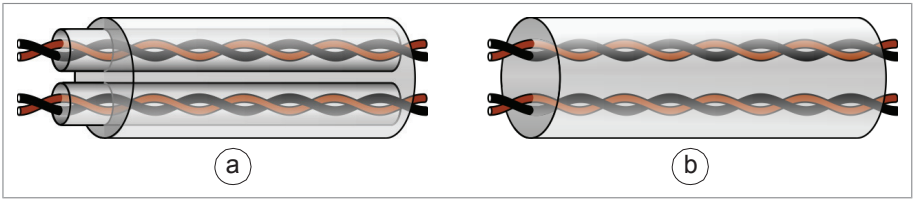
Selecting the control cables

Shielding

Only use shielded control cables.

Use a double-shielded twisted pair cable for analog signals. ABB recommends this type of cable also for the pulse encoder signals. Use one individually shielded pair for each signal. Do not use common return for different analog signals.

A double-shielded cable (a) is the best alternative for low-voltage digital signals, but single-shielded (b) twisted pair cable is also acceptable.



Signals in separate cables

Run analog and digital signals in separate, shielded cables. Do not mix 24 V DC and 115/230 V AC signals in the same cable.

Signals that can be run in the same cable

If their voltage does not exceed 48 V, relay-controlled signals can be run in the same cables as digital input signals. The relay-controlled signals should be run as twisted pairs.

Relay cable

The cable type with braided metallic shield (for example ÖLFLEX by LAPPKABEL, Germany) has been tested and approved by ABB.

Control panel to drive cable

Use EIA-485, Cat 5e (or better) cable with male RJ45 connectors. The maximum length of the cable is 100 m (328 ft).

PC tool cable

Connect the Drive Composer PC tool to the USB-C port of the drive. The maximum length of the cable is 3 m (9.8 ft).

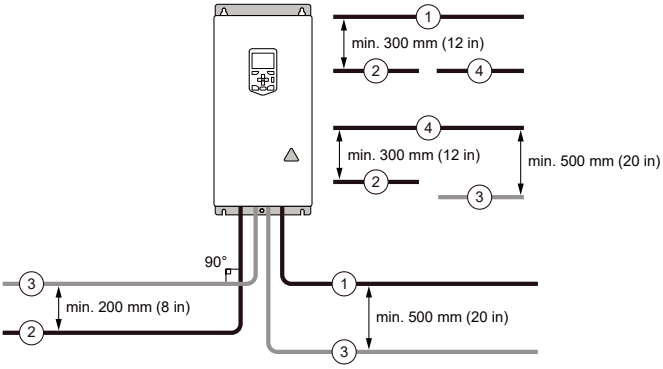
Routing the cables

General guidelines – IEC

- Install the motor cable away from other cables. The motor cables of several drives can be installed in parallel and 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.
- If 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 figure shows the cable routing guidelines with an example drive.

Note: When the motor cable is symmetrical and shielded and has short parallel runs with other cables (< 1.5 m / 5 ft), the required distances between the motor cable and other cables can be reduced by half.



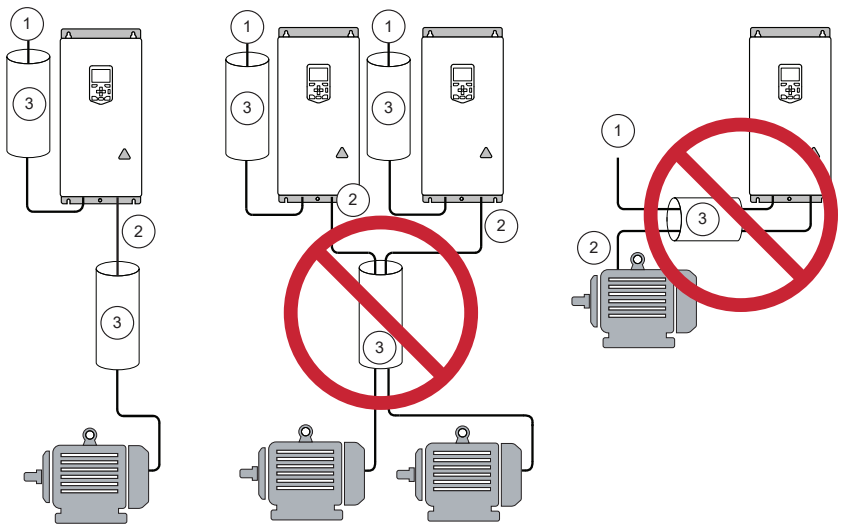
1	Motor cable
2	Input power cable
3	Control cable
4	Brake resistor or chopper cable (if any)

General guidelines – North America

Make sure that the installation is in accordance with national and local codes. Obey these general guidelines:

- Use separate conduits for the input power cables, motor cables, brake resistor cables (optional), and control cables.
- Use separate conduits for each motor.

The figure shows the cable routing guidelines with an example drive.



1	Input power cabling
2	Motor cabling
3	Conduit

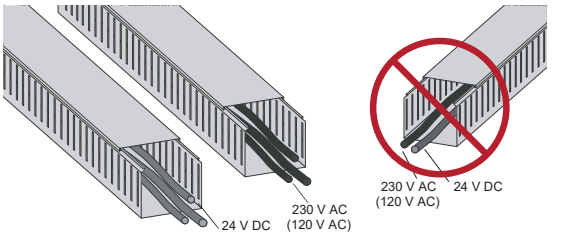
Continuous motor cable shield/conduit and metal enclosure for equipment on the motor cable

To minimize interference 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 strong 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

Install 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 input power cable in short-circuits

Use the fuses specified for the drive in the technical data. Make sure that also the electric power supply network meets the specification (minimum allowed short-circuit current that the fuse selection is based on).

The fuses restrict drive damage and prevent damage to adjoining equipment in case of a short-circuit inside the drive. When located at the distribution board, the fuses also protect the input power cable against short circuits.

See the drive technical data for alternative short-circuit protections.

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 drive, and the input power and motor cables against thermal overload

If the cables have the correct size for the nominal current, the drive protects itself and the input and motor cables against thermal overload. No additional thermal protection devices are needed.

⚠WARNING If the drive is connected to multiple motors, use a separate motor thermal overload device for protecting each motor cable and motor against overload. The drive overload protection is for the sum of the total motor load. It may not trip due to an overload in one motor.

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, refer to 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, refer to the firmware manual.

Implementing a motor temperature sensor connection

WARNING IEC 61800-5-1 requires double or reinforced insulation between the 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:

1. 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 permitted 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 is not more than the maximum permitted voltage over the sensor.

Protecting the drive against ground faults

The drive has internal protection against ground faults in the motor and motor cable. This function is not a personnel safety feature or a fire protection feature. Refer to the drive firmware manual.

Leakage currents and residual current device compatibility

400 V drives support the use of Type A 30 mA and Type B 300 mA residual current devices in front of the mains supply. For reliable operation, use motor cable types recommended in Selecting the power cables (page 49) with a maximum motor cable length of 30 meters.

Note: As standard, the drive has capacitors 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.

If nuisance triggering of residual current devices occurs in the application, try to shorten motor cable length or test residual current devices from alternative manufacturers.

ACS380-E was tested with these residual current circuit breakers by using MCCMK cables:

- ABB F204B-25/0.03 3 0mA
- ABB F204B-25/0.3 300 mA
- Siemens 5SV3342-4 30 mA
- Siemens 5SV3642-4 300 mA

Implementing the Emergency stop function

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

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

Note: Pressing the stop (off) key on the control panel of the drive does not generate an emergency stop of the motor or separate the drive from dangerous potential.

Implementing the Safe torque off function

Refer to The Safe torque off function (page 161).

Using a safety switch between the drive and the motor

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

Implementing the control of a contactor between drive and motor

Implementing the control of the output contactor depends on the motor control mode and stopping method selected.

When you select the vector motor control mode and the motor ramp stop mode, use this operation sequence to open the contactor:

1. Give a stop command to the drive.
2. Wait until the drive decelerates the motor to zero speed.
3. Open the contactor.

NOTICE If vector motor control mode is in use, do not open the output contactor while the drive controls the motor. The motor control operates faster than the contactor, and tries to maintain the load current. This can cause damage to the contactor.

When you select the vector motor control mode and the motor coast stop mode, you can open the contactor immediately after the drive has received the stop command. This is the case also if you use the scalar motor control mode.

6

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 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 or wrench with a set of suitable bits. For motor cable terminals, the recommended screwdriver shaft length is 150 mm (5.9 in).
- Short slotted screwdriver for the I/O terminals
- Torque wrench
- Multimeter and voltage detector
- Personal protective equipment.

Measuring the insulation resistance – IEC

Measuring the insulation resistance of the drive

NOTICE 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

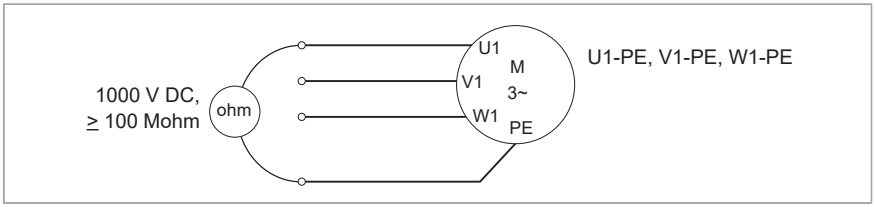
Before you connect the input power cable to the drive, measure its insulation resistance according to local regulations.

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 Electrical safety precautions (page 16) before you start the work.
2. Make sure that the motor cable is disconnected from the drive output terminals.
3. 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.

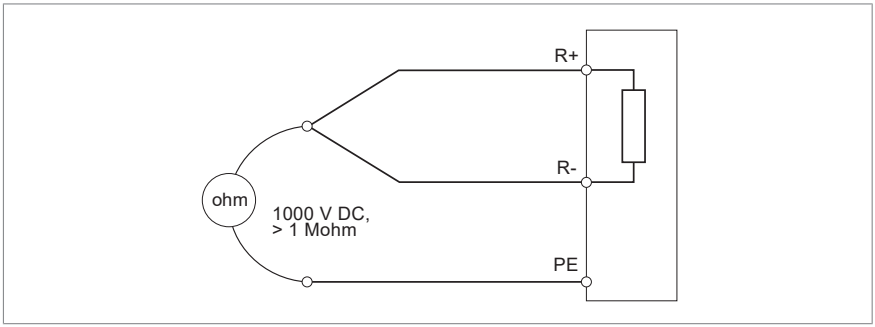
   Note: Moisture inside the motor reduces the insulation resistance. If you think that there is moisture in the motor, dry the motor and do the measurement again.



Measuring the insulation resistance of the brake resistor circuit

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 electrical installation, commissioning or maintenance work.

1. Stop the drive and do the steps in Electrical safety precautions (page 16) before you start the work.
2. Make sure that the resistor cable is connected to the resistor and disconnected from the drive output terminals.
3. At the drive end, connect the R+ and R- conductors of the resistor cable together. Measure the insulation resistance between the conductors and the PE conductor with a measuring voltage of 1000 V DC. The insulation resistance must be more than 1 Mohm.



Grounding system compatibility check – IEC

EMC filter

The drive has an internal EMC filter as standard. You can install a drive with an internal EMC filter connected to a symmetrically grounded TN-S system (center-grounded wye). For other systems, refer to Compatibility of the EMC filter with the grounding system (page 68).

Note: If you disconnect the EMC filter, the electromagnetic compatibility of the drive decreases.

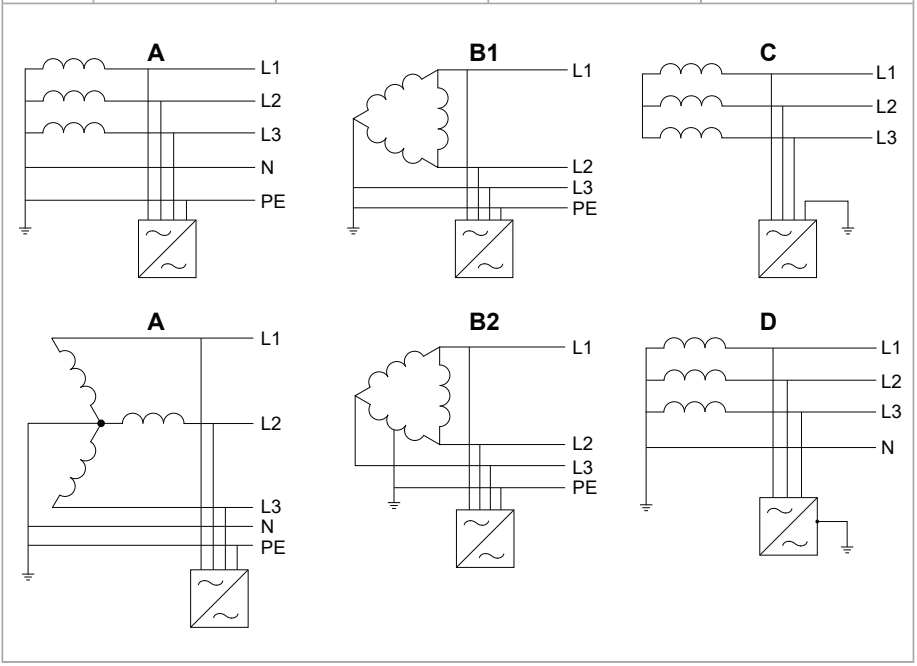
WARNING Do not install a drive with the internal EMC filter connected to a grounding system that the EMC filter is not compatible with (for example, an IT system). The supply network becomes connected to ground potential through the internal EMC filter capacitors, which can cause danger or damage to the drive.

Compatibility of the EMC filter with the grounding system

⚠WARNING If you do not obey these instructions, injury to personnel or damage to the drive can occur.

A metal EMC screw connects the internal EMC filter. The material of the factory-installed screw (plastic or metal) depends on the product variant. Before you connect the drive to the input power, examine the screws and do the necessary actions shown in the table.

Screw label	Screw material	When to remove the EMC screw		
		Symmetrically grounded TN-S systems, i.e, center-grounded wye (A)	Corner-grounded delta (B1), mid-point-grounded delta (B2) and TT (D) systems	IT systems (ungrounded or high-resistance grounded) (C)
EMC	Metal	Do not remove	Remove	Remove
	Plastic	Do not remove [1)]	Do not remove	Do not remove

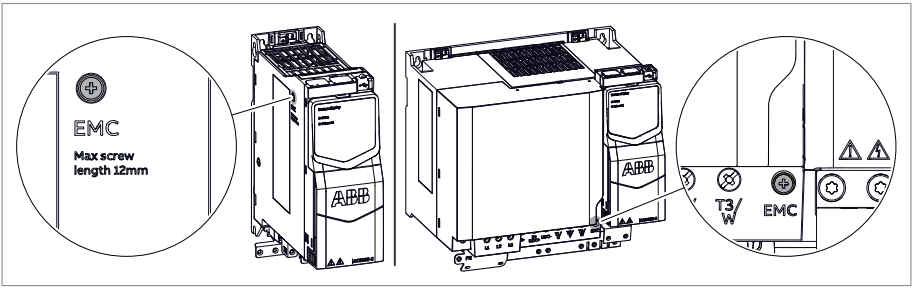


1) Can install the metal screw included in the drive delivery to connect the internal EMC filter.

Disconnecting the EMC filter

Before you continue, refer to Compatibility of the EMC filter with the grounding system (page 68).

To disconnect the EMC filter, remove the metal EMC screw.



Guidelines for installing the drive to a TT system

You can install the drive to a TT system under these conditions:

1. There is a residual current device in the supply system
2. The internal EMC filter is disconnected. If the EMC filter is not disconnected, its leakage current will cause the residual current device to trip.

Note:

- ABB does not guarantee the EMC performance, because the internal EMC filter is disconnected.
- In a TT system, the built-in ground leakage detector may not correctly detect leakage currents.
- In large systems the residual current device can trip without a real 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.

⚠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.

To identify the grounding system, examine the supply transformer connection. Refer to 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.

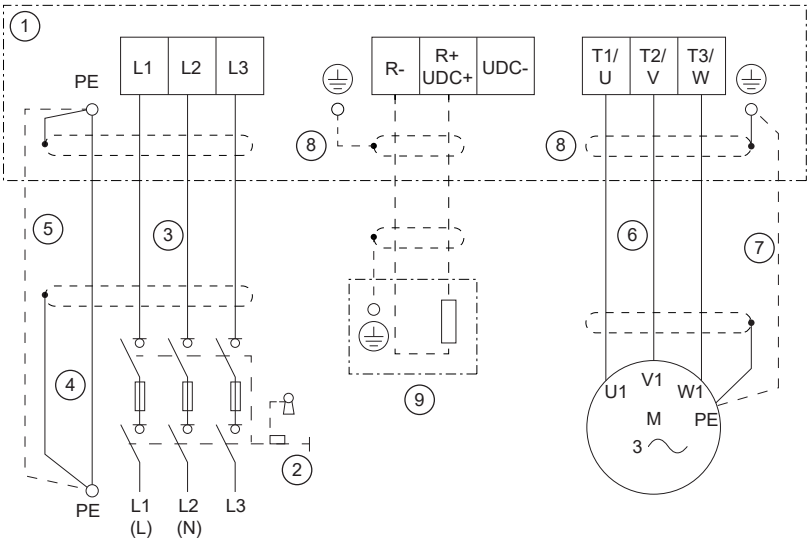
1. input voltage line to line (U_{L-L})
2. input voltage line 1 to ground (U_{L1-G})
3. input voltage line 2 to ground (U_{L2-G})
4. input voltage line 3 to ground (U_{L3-G}).

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
X	0.58·X	0.58·X	0.58·X	TN-S system (symmetrically grounded)
X	1.0·X	1.0·X	0	Corner-grounded delta system (nonsymmetrical)
X	0.866·X	0.5·X	0.5·X	Midpoint-grounded delta system (nonsymmetrical)
X	Varying level versus time	Varying level versus time	Varying level versus time	IT systems (ungrounded or high-resistance-grounded [>30 ohms]) nonsymmetrical
X	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)

Connecting the power cables – IEC (shielded cables)

Connection diagram



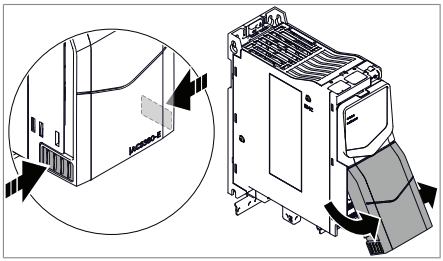
1	Drive
2	Disconnecting device
3	Input power cable
4	Two protective earth (ground) conductors. Drive safety standard IEC/EN 61800-5-1 requires two PE conductors for a fixed connection, if the cross-sectional area of the PE conductor is less than 10 mm^2 Cu or 16 mm^2 Al. For example, you can use the cable shield in addition to the fourth conductor.
5	Separate PE cable (line side). Use a separate grounding cable or a cable with a separate PE conductor for the line side, if the conductivity of the fourth conductor or shield does not meet the requirements for the PE conductor.
6	Motor cable **Note:** ABB recommends a symmetrical shielded cable (VFD cable) as the motor cable.
7	Separate PE cable (motor side). Use a separate grounding cable for the motor side, if the conductivity of the shield is not sufficient, or if there is no symmetrically constructed PE conductor in the cable.
8	360-degree grounding of the cable shield. Required for the motor cable and brake resistor cable (if used), recommended for the input power cable.
9	Brake resistor (optional)

Connection procedure

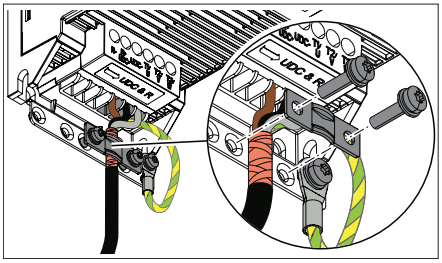
WARNING Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrical professional, do not do installation, commissioning, or maintenance work.

Refer to Terminal data for the power cables (page 121) for the tightening torques.

1. Do the steps in Electrical safety precautions (page 16) before you start the work.
2. If it is installed, remove the front cover. To remove the front cover, squeeze its bottom side edges to free the locking tabs and pull.

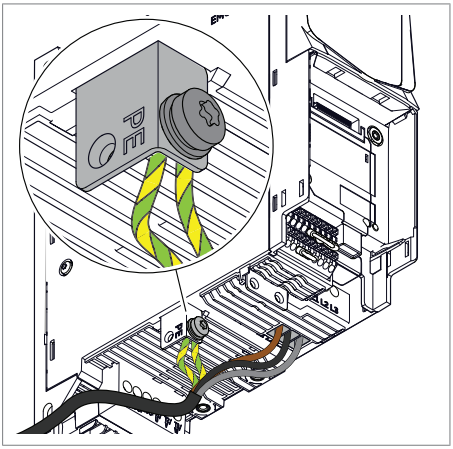


3. Attach the residual voltage warning sticker in the local language to the drive.
4. Strip the motor cable.
5. Ground the motor cable shield under the grounding clamp for 360-degree grounding.



6. Twist the motor cable shield into a bundle, mark it with yellow-green insulation tape, install a cable lug, and connect it to the grounding terminal.
7. Connect the phase conductors of the motor cable to terminals T1/U, T2/V and T3/W.

8. If you use a brake resistor, connect the brake resistor cable to terminals R- and UDC+. Use shielded cable and ground the shield under the grounding clamp for 360-degree grounding.
9. Make sure that the R- and UDC+ terminal screws are tightened. Do this step also if you do not connect cables to the terminals.
10. Strip the input power cable.
11. If the input power cable has a shield, ground the shield under the clamp for 360-degree grounding. Twist the shield also into a bundle, mark it with yellow-green insulation tape, install a cable lug, and connect it to the grounding terminal.

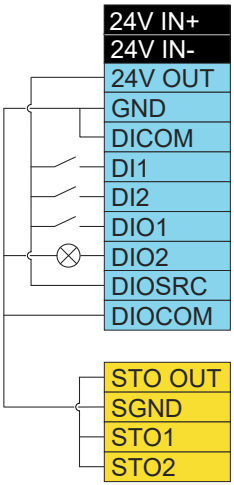


12. Connect the protective earth (ground) conductor(s) of the input power cable to the grounding terminal.
13. Connect the phase conductors of the input power cable to the drive as follows:
    - 3-phase drives: connect the phase conductors to terminals L1, L2, and L3.
14. Mechanically attach the cables with cable ties to prevent mechanical loading at the terminals.
15. Install the front cover.

Connecting the control cables – IEC

Before you connect the control cables, make sure that all of the option modules are installed.

Standard IO connections

Connection	Terminal	Description
	24V IN+	External +24 V DC input
	24V IN-	External +24 V DC common
	24V OUT	Auxiliary voltage output +24 V DC
	GND	Auxiliary voltage output common
	DICOM	Digital input 1 and 2 common
	DI1	Digital input 1
	DI2	Digital input 2
	DIO1	Digital input/output 1
	DIO2	Digital input/output 2
	DIOSRC	Digital output 1 and 2 auxiliary voltage
	DIOCOM	Digital input/output 1 and 2 common
Safe torque off function. Factory connection. Both circuits must be closed for the drive to start.	STO OUT	STO 24 V output
	SGND	STO ground
	STO1	STO 1 input
	STO2	STO 2 input

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

To prevent inductive coupling, keep the signal wire pairs twisted as near to the terminals as possible.

For cable terminal data, refer to Terminal data for the control cables (page 122).

1. Do the steps in Electrical safety precautions (page 16) before you start the work.

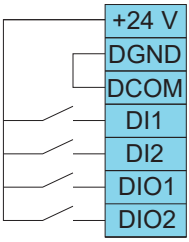
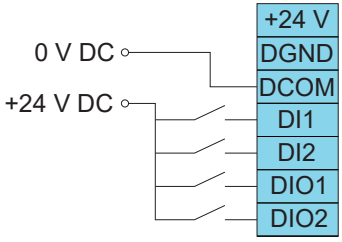
2. To remove the lower front cover, squeeze its bottom sides and pull.
3. If it is applicable, strip a part of the outer shield of the cable for grounding. Use metallic cable ties and 360° grounding to attach the shield to a grounding tab.
4. Strip the control cable conductors.
5. For stranded conductors, install suitable ferrules at the ends of the conductors.
6. Connect the conductors to the control terminals. Push the conductors into the spring-loaded terminal and make sure that they connect correctly.
7. Mechanically attach the control cables with cable ties to prevent mechanical loading at the terminals.

Additional information on the control connections

PNP configuration for digital inputs

Internal and external +24 V power supply connections for PNP (source) configuration are shown in the figures below.

WARNING If you connect DIO1 or DIO2 as shown in the figures below, make sure that they are configured as inputs. If they are configured as outputs, it can cause damage to the equipment.

Internal +24 V power supply	External +24 V power supply
	

STO connection (STO OUT, SGND, STO1 and STO2)

For the drive to start, both STO connections (STO OUT to STO1, STO OUT to STO2, and SGND to GND) must be closed. By default, the terminal block has jumpers to close the circuit. Remove the jumpers before connecting external Safe torque off circuitry to the drive. Refer to The Safe torque off function.

Auxiliary voltage connection (24V IN+, 24V IN-, 24V OUT and GND)

The drive has a 24 V DC auxiliary power supply. You can use it to supply auxiliary power from the drive to external control circuits or option modules.

You can also connect an external power supply to the drive to keep the control board energized when the drive is not energized.

Refer to the technical data for the specifications for the auxiliary power supply terminals (input/output).

To supply power to external control circuits or option modules:

1. Connect the load to the auxiliary power output on the drive (24V OUT and GND terminals).
2. Make sure that you do not exceed the load capacity of the output. Refer to the technical data.

To connect an external auxiliary power supply to the drive, connect it to the 24V IN+ and 24V IN- terminals of the drive. Make sure that the load capacity of the external power supply meets the specification. Refer to the technical data.

Connecting option modules

Refer to the documentation of the option module.

For information on the AMIO-02 I/O extension module, refer to AMIO-02 I/O extension module (page 183).

Connection to a PC

Use the USB-C port at the top of the drive to connect it to a PC.

For information on Drive Composer 3, refer to Drive Composer 3 User's manual (3AXD50001210588 [English]).

7

Electrical installation – North America

Contents of this chapter

This chapter describes how to:

- measure the insulation
- do the grounding system compatibility check
- change the EMC filter 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 or wrench with a set of suitable bits. For motor cable terminals, the recommended screwdriver shaft length is 150 mm (5.9 in).
- Short slotted screwdriver for the I/O terminals
- Torque wrench
- Multimeter and voltage detector

- Personal protective equipment.

Measuring the insulation resistance – North America

Measuring the insulation resistance of the drive

NOTICE 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

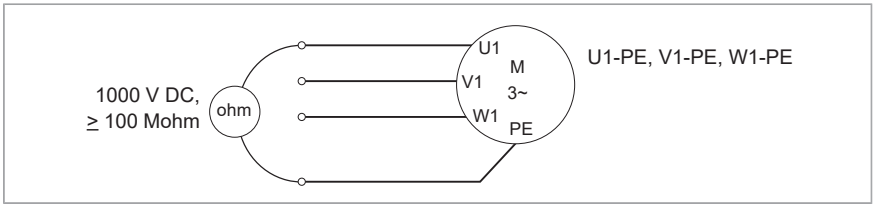
Before you connect the input power cable to the drive, measure its insulation resistance according to local regulations.

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 Electrical safety precautions (page 16) before you start the work.
2. Make sure that the motor cable is disconnected from the drive output terminals.
3. 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.

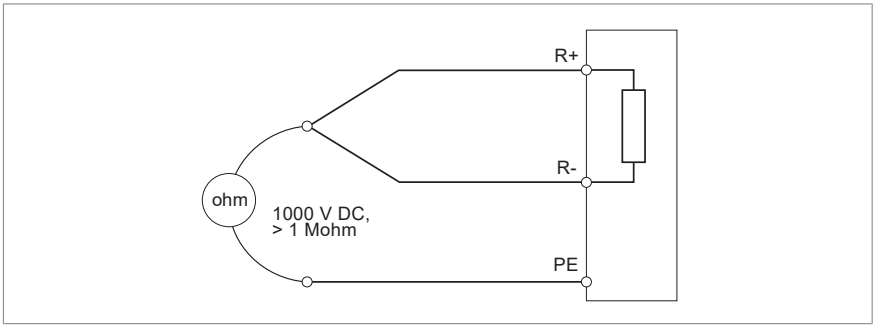
   Note: Moisture inside the motor reduces the insulation resistance. If you think that there is moisture in the motor, dry the motor and do the measurement again.



Measuring the insulation resistance of the brake resistor circuit

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 electrical installation, commissioning or maintenance work.

1. Stop the drive and do the steps in Electrical safety precautions (page 16) before you start the work.
2. Make sure that the resistor cable is connected to the resistor and disconnected from the drive output terminals.
3. At the drive end, connect the R+ and R- conductors of the resistor cable together. Measure the insulation resistance between the conductors and the PE conductor with a measuring voltage of 1000 V DC. The insulation resistance must be more than 1 Mohm.



Grounding system compatibility check – North America

EMC filter

The drive has an internal EMC filter as standard. In the drives sold in North America, the filter is disconnected by default. The filter is typically not necessary in North American installations.

If you are concerned with EMC issues, and install the drive to a symmetrically grounded TN-S system (center-grounded wye), you can connect the internal EMC filter.

Note: When the internal EMC filter is disconnected, the electromagnetic compatibility of the drive is decreased.

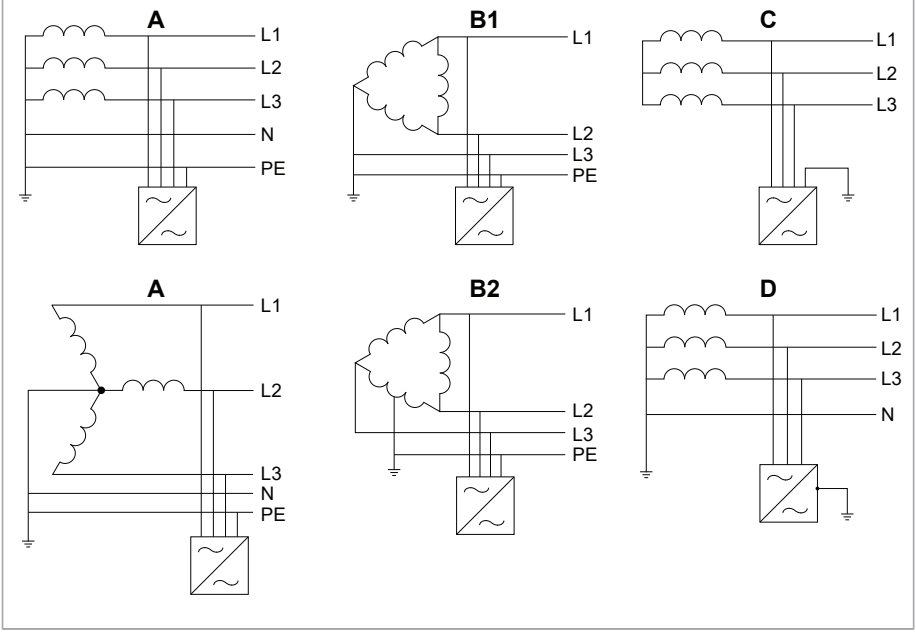
⚠WARNING Do not install a drive with the internal EMC filter connected to a grounding system that the EMC filter is not compatible with (for example, an IT system). The supply network becomes connected to ground potential through the internal EMC filter capacitors, which can cause danger or damage to the drive.

Compatibility of the EMC filter with the grounding system

⚠WARNING If you do not obey these instructions, injury to personnel or damage to the drive can occur.

A metal EMC screw connects the internal EMC filter. The material of the factory-installed screw (plastic or metal) depends on the product variant. Before you connect the drive to the input power, examine the screws and do the necessary actions shown in the table.

Screw label	Screw material	When to remove the EMC screw		
		Symmetrically grounded TN-S systems, i.e, center-grounded wye (A)	Corner-grounded delta (B1), mid-point-grounded delta (B2) and TT (D) systems	IT systems (ungrounded or high-resistance grounded) (C)
EMC	Metal	Do not remove	Remove	Remove
	Plastic	Do not remove [1)]	Do not remove	Do not remove

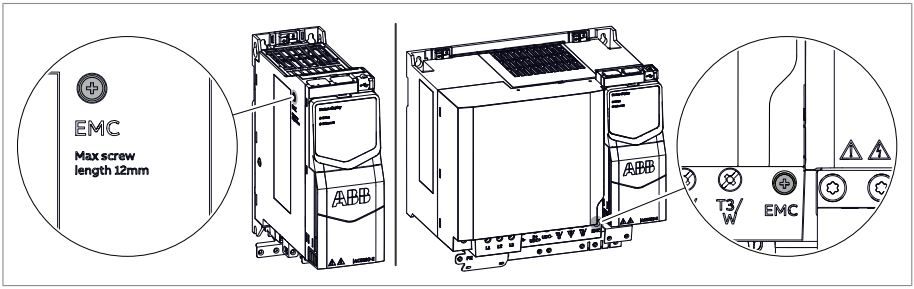


1) Can install the metal screw included in the drive delivery to connect the internal EMC filter.

Disconnecting the EMC filter

Before you continue, refer to Compatibility of the EMC filter with the grounding system (page 81).

To disconnect the EMC filter, remove the metal EMC screw.



Guidelines for installing the drive to a TT system

You can install the drive to a TT system under these conditions:

1. There is a residual current device in the supply system
2. The internal EMC filter is disconnected. If the EMC filter is not disconnected, its leakage current will cause the residual current device to trip.

Note:

- ABB does not guarantee the EMC performance, because the internal EMC filter is disconnected.
- In a TT system, the built-in ground leakage detector may not correctly detect leakage currents.
- In large systems the residual current device can trip without a real 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.

⚠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.

To identify the grounding system, examine the supply transformer connection. Refer to 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_{L-L})
2. input voltage line 1 to ground (U_{L1-G})
3. input voltage line 2 to ground (U_{L2-G})
4. input voltage line 3 to ground (U_{L3-G}).

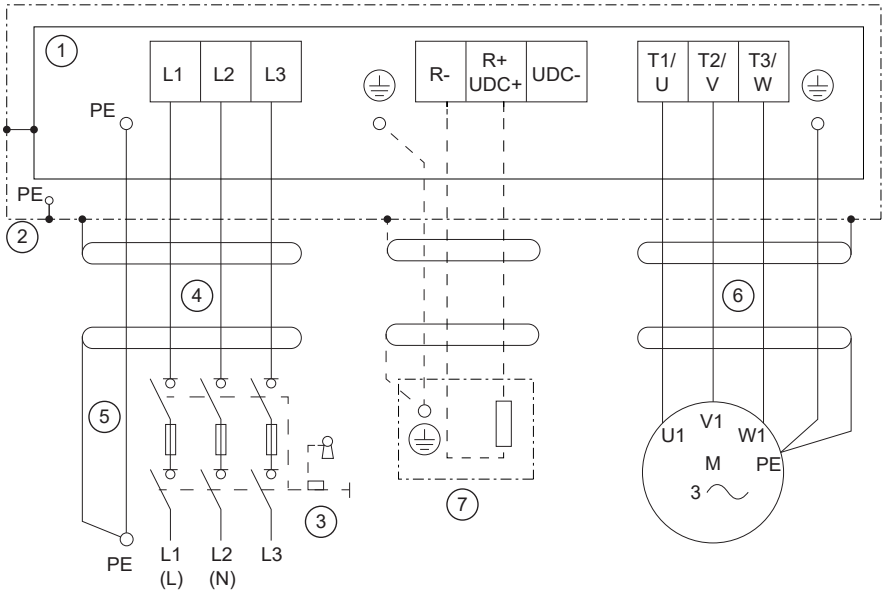
The table below shows the line-to-ground voltages in relation to the line-to-line voltage for each grounding system.

U_{L-L}	U_{L1-G}	U_{L2-G}	U_{L3-G}	Electrical power system type
X	0.58·X	0.58·X	0.58·X	TN-S system (symmetrically grounded)
X	1.0·X	1.0·X	0	Corner-grounded delta system (nonsymmetrical)
X	0.866·X	0.5·X	0.5·X	Midpoint-grounded delta system (nonsymmetrical)
X	Varying level versus time	Varying level versus time	Varying level versus time	IT systems (ungrounded or high-resistance-grounded [>30 ohms]) nonsymmetrical
X	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)

Connecting the power cables – North America (wiring in conduits)

Use insulated wires suitable for installation in electrical conduits. See the National Electric Code and local ordinances.

Connection diagram



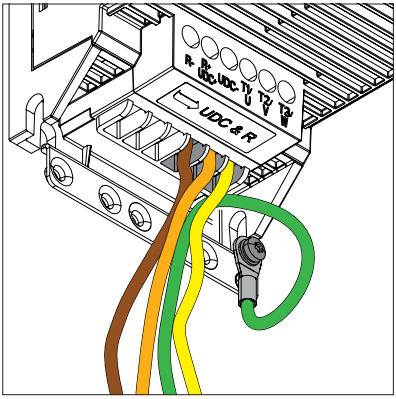
1	Drive
2	Drive enclosure
3	Supply disconnecting device and fuses
4	Input power wiring
5	Protective earth (ground) conductor(s)
6	Motor wiring **Note:** ABB recommends to use a symmetrical shielded cable (VFD cable) as the motor cable.
7	Brake resistor (optional)

Connection procedure

⚠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.

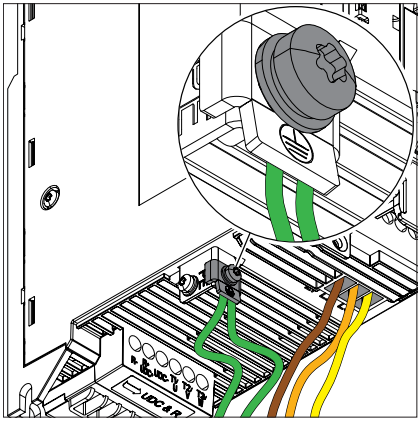
Refer to Terminal data for the power cables (page 121) for the tightening torques.

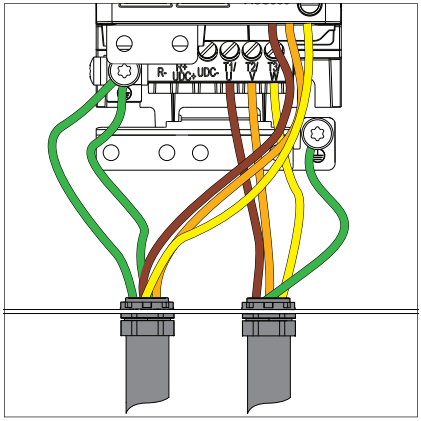
1. Do the steps in Electrical safety precautions (page 16) before you start the work.
2. Install the conduits, and attach them to the cable entry plate of the enclosure that the drive is installed in.
3. Make sure that the conduit is correctly grounded at the cable entry.
4. Strip the conductor ends and pull the conductors through the conduits.
5. Remove the screw on the drive front cover, then lift the front cover up.
6. Attach the residual voltage warning sticker in the local language to the drive.
7. Connect the protective earth (ground) conductor of the motor wiring to the grounding terminal.
8. Connect the phase conductors of the motor wiring to terminals T1/U, T2/V and T3/W.



9. If you use a brake resistor, connect the brake resistor conductors to terminals R- and UDC+.
10. Make sure that the R- and UDC+ terminal screws are tightened. Do this step also if you do not connect cables to the terminals.

11. Connect the protective earth (ground) conductor(s) of the input power wiring to the grounding terminal.
12. Connect the phase conductors of the input power wiring to the drive as follows:
    - 3-phase drives: connect the phase conductors to terminals L1, L2, and L3.





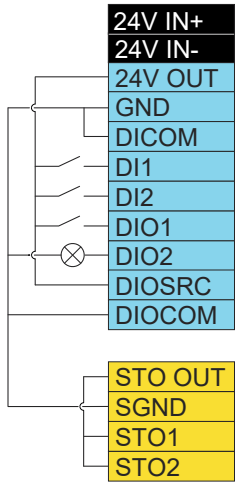
13. Connect the other ends of the conductors.

Connecting the control cables – North America

Control connections

Before you connect the control cables, make sure that all of the option modules are installed.

Standard IO connections

Connection	Terminal	Description
	24V IN+	External +24 V DC input
	24V IN-	External +24 V DC common
	24V OUT	Auxiliary voltage output +24 V DC
	GND	Auxiliary voltage output common
	DICOM	Digital input 1 and 2 common
	DI1	Digital input 1
	DI2	Digital input 2
	DIO1	Digital input/output 1
	DIO2	Digital input/output 2
	DIOSRC	Digital output 1 and 2 auxiliary voltage
	DIOCOM	Digital input/output 1 and 2 common
Safe torque off function. Factory connection. Both circuits must be closed for the drive to start.	STO OUT	STO 24 V output
	SGND	STO ground
	STO1	STO 1 input
	STO2	STO 2 input

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

To prevent inductive coupling, keep the signal wire pairs twisted as near to the terminals as possible.

For cable terminal data, refer to Terminal data for the control cables (page 122).

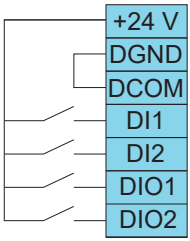
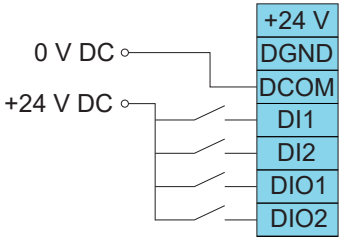
1. Do the steps in Electrical safety precautions (page 16) before you start the work.
2. To remove the lower front cover, squeeze its bottom sides and pull.
3. If it is applicable, strip a part of the outer shield of the cable for grounding. Use metallic cable ties and 360° grounding to attach the shield to a grounding tab.
4. Strip the control cable conductors.
5. For stranded conductors, install suitable ferrules at the ends of the conductors.
6. Connect the conductors to the control terminals. Push the conductors into the spring-loaded terminal and make sure that they connect correctly.
7. Mechanically attach the control cables with cable ties to prevent mechanical loading at the terminals.

Additional information on the control connections

PNP configuration for digital inputs

Internal and external +24 V power supply connections for PNP (source) configuration are shown in the figures below.

⚠WARNING If you connect DIO1 or DIO2 as shown in the figures below, make sure that they are configured as inputs. If they are configured as outputs, it can cause damage to the equipment.

Internal +24 V power supply	External +24 V power supply
	

STO connection (STO OUT, SGND, STO1 and STO2)

For the drive to start, both STO connections (STO OUT to STO1, STO OUT to STO2, and SGND to GND) must be closed. By default, the terminal block has jumpers to close the circuit. Remove the jumpers before connecting external Safe torque off circuitry to the drive. Refer to The Safe torque off function.

Auxiliary voltage connection (24V IN+, 24V IN-, 24V OUT and GND)

The drive has a 24 V DC auxiliary power supply. You can use it to supply auxiliary power from the drive to external control circuits or option modules.

You can also connect an external power supply to the drive to keep the control board energized when the drive is not energized.

Refer to the technical data for the specifications for the auxiliary power supply terminals (input/output).

To supply power to external control circuits or option modules:

1. Connect the load to the auxiliary power output on the drive (24V OUT and GND terminals).
2. Make sure that you do not exceed the load capacity of the output. Refer to the technical data.

To connect an external auxiliary power supply to the drive, connect it to the 24V IN+ and 24V IN- terminals of the drive. Make sure that the load capacity of the external power supply meets the specification. Refer to the technical data.

Connecting option modules

Refer to the documentation of the option module.

For information on the AMIO-02 I/O extension module, refer to AMIO-02 I/O extension module (page 183).

Connection to a PC

Use the USB-C port at the top of the drive to connect it to a PC.

For information on Drive Composer 3, refer to Drive Composer 3 User's manual (3AXD50001210588 [English]).

8

Installation checklist

Contents of this chapter

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

Checklist

⚠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 electrical installation, commissioning or maintenance work.

⚠WARNING Do the steps in Electrical safety precautions (page 16) before you start the work.

Examine the mechanical and electrical installation of the drive before start-up. Do the tasks in the checklist together with a second person.

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. Refer to the type designation label.	☐

Make sure that ...	☑
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 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). Refer to 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.	☐
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.	☐
If an external brake resistor is connected to the drive: There is an adequately sized protective earth (ground) conductor between the brake resistor and the drive, and the conductor is connected to the correct terminal, and the terminals are tightened to the correct torque. Grounding has also been measured according to the regulations.	☐
If an external brake resistor is connected to the drive: The brake resistor cable is connected to the correct terminals, and the terminals are tightened to the correct torque.	☐
If an external brake resistor is connected to the drive: The brake resistor cable is routed away from other cables.	☐

Make sure that ...	☑
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.	☐

9

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)
P	Performance of on/off-site work (commissioning, tests, measurements or other work)
R	Replacement

Recommended maintenance intervals after start-up

Recommended annual actions by the user	
Connections and environment	
Quality of supply voltage	P
Spare parts	
Spare parts	I
DC circuit capacitors reforming for spare modules and spare capacitors	P
Inspections by user	
Tightness of terminals	I
Dustiness, corrosion and temperature	I
Heat sink cleaning	P

Maintenance task/object	Years from start-up						
	3	6	9	12	15	18	21
Cooling fans							
Main cooling fan [1)]	(R)	R (R)	(R)	R (R)	(R)	R (R)	(R)
Functional safety							
Safety function test	I See the maintenance information of the safety function.						
Safety component expiry (Mission time T_M)	20 years						

1) (R) = replacement of component in demanding operating conditions, ie. if surrounding air temperature in continuous operation is over 40 °C (104 °F) or there is a cyclic heavy load.

Note:

- The maintenance and component replacement intervals are valid when the equipment operates within the specified ratings and ambient conditions. ABB recommends annual drive inspections.
- 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 heatsink

The heatsink of the power module (drive, supply, inverter, converter, and so on) collects dust from the cooling air. This can cause overtemperature warnings and faults. When it is necessary, clean the heatsink as follows.

⚠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 electrical installation, commissioning or maintenance work.

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

1. Stop the drive and do the steps in Electrical safety precautions (page 16) before you start the work.
2. Remove the module cooling fan(s). Refer to the separate instructions.
3. Protect the adjacent equipment from dust.
4. Blow dry, clean, and oil-free compressed air from the bottom to the top, and simultaneously use a vacuum cleaner at the air outlet to collect the dust.

   NOTICE Use an antistatic wrist strap and a vacuum cleaner with an antistatic hose and nozzle. A normal vacuum cleaner creates static discharges which can cause damage to circuit boards.
5. Install the cooling fan.

Replacing the cooling fans

Parameter 05.04 Fan on-time counter shows the operating time of the cooling fan. After you replace a fan, reset the fan counter. Refer to the firmware manual.

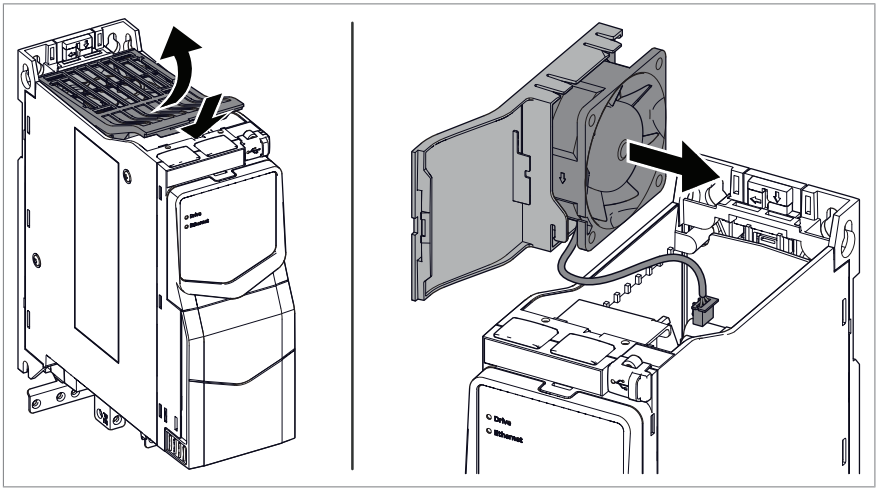
You can get replacement fans from ABB. Use only ABB-specified spare parts.

Replacing the cooling fan, frames R1...R3

⚠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.

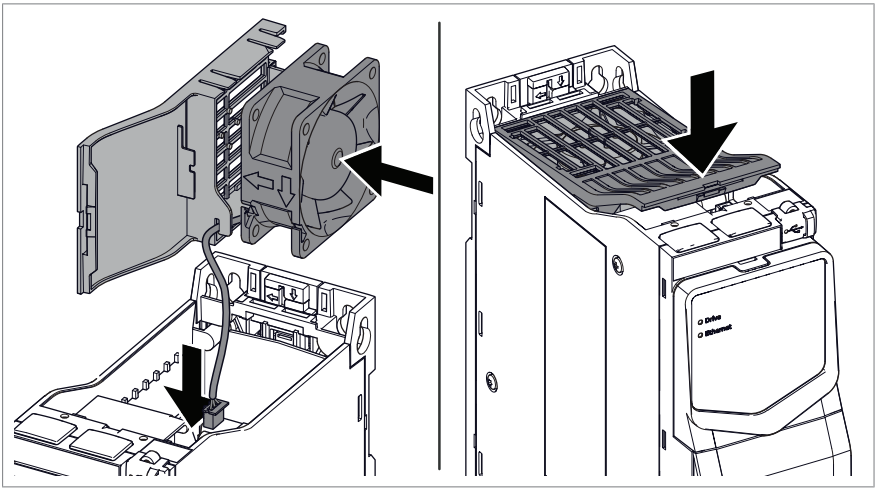
1. Stop the drive and do the steps in Electrical safety precautions (page 16) before you start the work.
2. Carefully open the cooling fan cover with a slotted screwdriver.

Put the head of the screwdriver into the latch slot and carefully tilt the screwdriver towards the front of the drive to free the latch and open the cooling fan cover.



3. Carefully lift the cooling fan cover out of the drive. The cooling fan cover holds the cooling fan.
4. Remove the fan power cable from the cable slot.
5. Disconnect the fan power cable from the drive.
6. Free the cooling fan clips and remove the cooling fan from the fan cover.

7. Install the new cooling fan into the fan cover. Make sure that the airflow is in the correct direction. The air flows in from the bottom of the drive and out from the top of the drive.



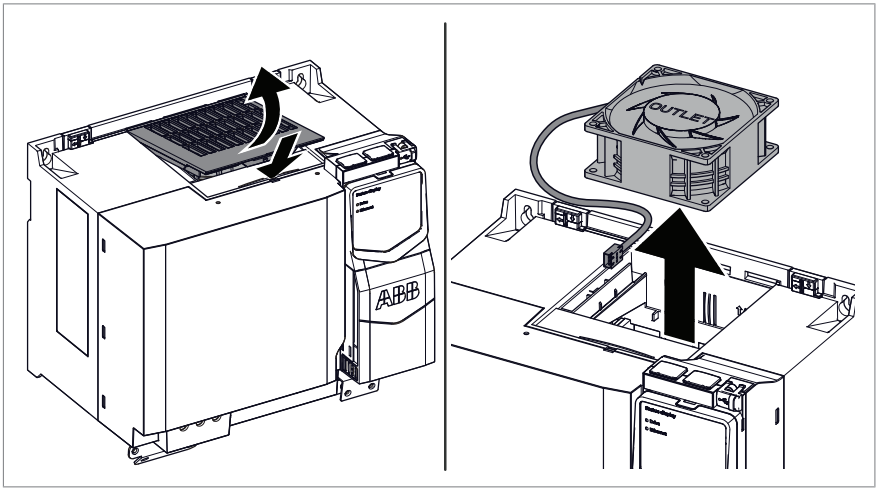
8. Connect the fan power cable of the new cooling fan to the drive.
9. Put the fan power cable into the cable slot.
10. Carefully put the cooling fan cover into position in the drive. Make sure that the fan power cable is routed correctly.
11. Push the cover to lock it into position.

Replacing the cooling fan, frame R4

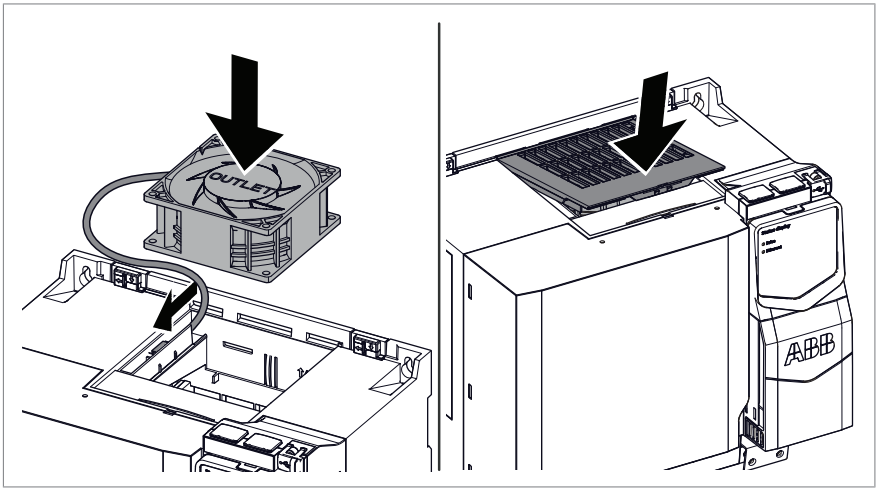
⚠WARNING Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrical professional, do not do installation, commissioning, or maintenance work.

1. Stop the drive and do the steps in Electrical safety precautions (page 16) before you start the work.
2. Carefully open the cooling fan cover with a slotted screwdriver.

Put the head of the screwdriver into the latch slot and carefully tilt the screwdriver towards the front of the drive to free the latch and open the cooling fan cover.



3. Remove the cooling fan cover and set it aside.
4. Lift and pull the cooling fan from its base in the drive.
5. Disconnect the fan power cable from the extension cable connector.
6. Remove the old cooling fan.
7. Connect the fan power cable of the new cooling fan.



8. Install the new cooling fan into the drive. Make sure that the airflow is in the correct direction. The air flows in from the bottom of the drive and out from the top of the drive.
9. Put the cooling fan cover back on to the frame.
10. Push the cover to lock it into position.

Capacitors

The intermediate DC circuit of the drive contains several electrolytic capacitors. The operating time, load, and surrounding air temperature have an effect on the operating life of these capacitors. A lower ambient temperature can increase the operating life of capacitors.

Capacitor failure can cause damage to the unit, 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

Reform the capacitors if the drive was not powered for a year or more (is in storage or is unused). Read the manufacturing date from the type designation label. For the instructions, refer to Capacitor reforming instructions (3BFE64059629 [English]).

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 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. To certify the components, these options exist:

- Renew the whole drive and all optional functional safety modules and components.
- Renew the components in the safety function circuit. In practice, this is economical only with large drives that have replaceable circuit boards and other components such as relays.

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

For more information, contact ABB.

10

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 ratings

Type ACS380-E042C-...	Input current		Output ratings							Frame size
	No choke	With choke	Max. current	Nominal use		Light-duty use		Heavy-duty use		
	I_{1n}	I_{1n}	I_{max}	I_n	P_n	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}	
	A	A	A	A	kW	A	kW	A	kW	
3-phase U_n = 400 V										
01A8-4	2.8	1.8	2.2	1.8	0.55	1.7	0.55	1.2	0.37	R1
02A6-4	3.5	2.6	3.2	2.6	0.75	2.5	0.75	1.8	0.55	R1
03A3-4	4.8	3.3	4.7	3.3	1.1	3.1	1.1	2.6	0.75	R1
04A0-4	6.1	4.0	5.9	4.0	1.5	3.8	1.5	3.3	1.1	R1
05A6-4	8.5	5.6	7.2	5.6	2.2	5.3	2.2	4.0	1.5	R1
07A2-4	10.1	7.2	10.1	7.2	3.0	6.8	3.0	5.6	2.2	R1

Type ACS380-E042C-...	Input current		Output ratings							Frame size
	No choke	With choke	Max. current	Nominal use		Light-duty use		Heavy-duty use		
	I_{1n}	I_{1n}	I_{max}	I_n	P_n	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}	
	A	A	A	A	kW	A	kW	A	kW	
09A4-4	12.9	9.4	13.0	9.4	4.0	8.9	4.0	7.2	3.0	R1
12A6-4	16.5	12.6	16.9	12.6	5.5	12.0	5.5	9.4	4.0	R2
17A0-4	23.4	17.0	22.7	17.0	7.5	16.2	7.5	12.6	5.5	R3
25A0-4	31.8	25.0	30.6	25.0	11.0	23.8	11.0	17.0	7.5	R3
033A-4	40.9	32.0	45.0	32.0	15.0	30.5	15.0	25.0	11.0	R3
038A-4	49.0	38.0	57.6	38.0	18.5	36.0	18.5	32.0	15.0	R4
045A-4	55.7	45.0	68.4	45.0	22.0	42.8	22.0	38.0	18.5	R4
050A-4	55.7	50.0	81.0	50.0	22.0	48.0	22.0	45.0	22.0	R4

UL (NEC) ratings

Type ACS380-E042C-...	Input current		Output ratings					Frame size
	No choke	With choke	Max. current	Light-duty use		Heavy-duty use		
	I_{1Ld}	I_{1Ld}	I_{max}	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}	
	A	A	A	A	hp	A	hp	
3-phase U_n = 480 V								
01A8-4	2.2	1.6	2.2	1.6	0.75	1.1	0.50	R1
02A6-4	2.7	2.1	3.2	2.1	1.0	1.6	0.75	R1
03A3-4	3.9	3.0	4.7	3.0	1.5	2.1	1.0	R1
04A0-4	4.5	3.4	5.9	3.4	2.0	3.0	1.5	R1
05A6-4	6.6	4.8	7.2	4.8	3.0	3.5	2.0	R1
07A2-4	6.2	6.0	10.1	6.0	3.0	4.8	3.0	R1
09A4-4	9.8	7.6	13.0	7.6	5.0	6.0	3.0	R1
12A6-4	13.9	11.0	16.9	11.0	7.5	7.6	5.0	R2
17A0-4	18.8	14.0	22.7	14.0	10.0	11.0	7.5	R3
25A0-4	26.6	21.0	30.6	21.0	15.0	14.0	10.0	R3
033A-4	33.9	27.0	45.0	27.0	20.0	21.0	15.0	R3

Type ACS380-E042C-...	Input current		Output ratings					Frame size
	No choke	With choke	Max. current	Light-duty use		Heavy-duty use		
	I_{1Ld}	I_{1Ld}	I_{max}	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}	
	A	A	A	A	hp	A	hp	
038A-4	41.3	34.0	57.6	34.0	25.0	27.0	20.0	R4
045A-4	46.9	40.0	68.4	40.0	30.0	34.0	25.0	R4
050A-4	46.9	42.0	81.0	42.0	30.0	40.0	30.0	R4

UL Listed drive multiple ratings

National Electric Code (NEC 2020) requires that drive input conductors are sized based on the drive nameplate input current rating and the output conductors are sized based on the full load motor current. There are several scenarios where this sizing procedure is not optimal including multi-motor systems, applications where a larger replacement drive is substituted in an emergency breakdown, and cases where a motor is undersized for the drive. In these situations, power distribution components are often oversized to comply with NEC requirements.

ABB has collaborated with Underwriters Laboratories (UL) to create drive multiple ratings from 50% to 100% in 5% increments for the drive. For more information, refer to Multiple ratings for ABB ACS380-04, ACS580-01, ACQ580-01 and ACS880-01 drives manual supplement (3AXD50000916184 [English]).

Definitions

The ratings are valid at a maximum surrounding air temperature of 50 °C (122 °F), with the default drive switching frequency of 4 kHz (parameter 97.01), and with an installation altitude below 1000 m (3281 ft).

U_n — Nominal input voltage of the drive. For input voltage range U1, refer to Electrical power network specification (page 123).

I_{1n} — Nominal input current with typical motor power P_n. Continuous rms input current, for dimensioning cables and fuses.

I_{1Ld} — Light-duty input current (rms) with typical motor power P_{Ld}, for dimensioning cables and fuses.

I_{max} — Maximum output current. Available for 2 seconds every 10 minutes when the output frequency is less than 9 Hz. Otherwise maximum current is 1.5 × I_{Hd}. Maximum current setting (parameter *30.17*) can also limit the value.

I_n — Nominal output current. Maximum continuous rms output current (no overload).

P_n	Typical motor power in nominal use (no overloading). The kilowatt ratings are applicable to most IEC 4-pole motors.
I_{Ld}	Continuous rms output current. Allows 10% overload for 1 minute every 10 minutes.
P_{Ld}	Typical motor power in light-duty use (10% overload). The kilowatt ratings are applicable to most IEC 4-pole motors. The horsepower ratings are applicable to most NEMA 4-pole motors.
I_{Hd}	Continuous rms output current. Allows 50% overload for 1 minute every 10 minutes.
P_{Hd}	Typical motor power in heavy-duty use (50% overload). The kilowatt ratings are applicable to most IEC 4-pole motors. The horsepower ratings are applicable to most NEMA 4-pole motors.

Sizing

ABB recommends the DriveSize tool for selecting the drive, motor and gear combination (https://new.abb.com/drives/software-tools/drivesize). You can also use the ratings tables.

The minimum recommended nominal current of the motor is 40% of the drive nominal output current (I_n) . If the motor has a lower nominal current rating than this, the drive cannot accurately measure the motor current.

Output derating

The load capacity (I_n, I_{Ld}) decreases in some operation conditions. In operation conditions where full motor power is required, oversize the drive so that the total derated output current is sufficient for the motor to reach full power.

In an environment where more than one type of derating is necessary (for example, high altitude and high temperature), the effects of derating are cumulative.

Note:

- I_{max} is not derated.
- It is possible that also the motor load capacity needs to be derated.
- You can use the DriveSize tool for derating calculations (http://new.abb.com/drives/software-tools/drivesize).

Refer to Surrounding air temperature derating (page 109), Altitude derating (page 109) and Switching frequency derating (page 109) for the derating values.

Example 1, IEC: How to calculate the derated current

The example drive type is ACS380-E042C-17A0-4 with a nominal output current (I_n) of 17 A at 400 V. Calculate the derated output current at a 4 kHz switching frequency, at a 1500 m altitude and at a 55 °C surrounding air temperature.

Switching frequency derating: Derating is not necessary at 4 kHz.

Altitude derating: The derating factor for 1500 m is

$$1 - \frac{1500\ m - 1000\ m}{10000\ m} = 0.95$$

Surrounding air temperature derating: The derating factor for a 55 °C surrounding air temperature is

$$1 - \frac{55\ C - 50\ C}{100\ C} = 0.95$$

Multiply the nominal output current of the drive by all of the applicable derating factors. In this example, the derated output current is:

$$I_n = 17\ A \cdot 0.95 \cdot 0.95 = 15.34\ A$$

Example 1, UL (NEC): How to calculate the derated current

The example drive type is ACS380-E042C-17A0-4 with a light-duty output current (I_{Ld}) of 14 A at 480 V. Calculate the derated output current at 4 kHz switching frequency, at a 6000 ft altitude and at a 131 °F surrounding air temperature.

Switching frequency derating: Derating is not necessary at 4 kHz.

Altitude derating: The derating factor for 6000 ft is

$$1 - \frac{6000\ ft - 3281\ ft}{32810\ ft} = 0.917$$

Surrounding air temperature derating: The derating factor for a 131 °F surrounding air temperature is

$$1 - \frac{131\ F - 122\ F}{180\ F} = 0.95$$

Multiply the drive output current by all of the applicable derating factors. In this example, the derated output current is:

$$I_{Ld} = 14\ A \cdot 0.917 \cdot 0.95 = 12.2\ A$$

Example 2, IEC: How to calculate the required drive

The application requires a nominal motor current of 6.0 A at a switching frequency of 8 kHz. The supply voltage is 400 V, the altitude is 1800 m and the surrounding air temperature is 35 °C.

Altitude derating: The derating factor for 1800 m is

$$1 - \frac{1800\ m - 1000\ m}{10000\ m} = 0.92$$

Surrounding air temperature derating: Derating is not necessary at a 35 °C surrounding air temperature.

To see if the derated output current of a drive is sufficient for the application, multiply the nominal output current (I_n) by all of the applicable derating factors. For example, drive type ACS380-E042C-12A6-4 has a nominal output current of 12.6 A at 400 V.

Switching frequency derating: The derating factor for this drive type is 0.68 at 8 kHz. Calculate the derated drive output current:

$$I_n = 12.6\ A \cdot 0.68 \cdot 0.92 = 7.88\ A$$

In this example, the derated output current is sufficient, because it is more than the required current.

Example 2, UL (NEC): How to calculate the required drive

The application requires a maximum of 12.0 A of motor current with a 10% overload for one minute every ten minutes (I_{Ld}) at a switching frequency of 8 kHz. The supply voltage is 480 V, the altitude is 5500 ft and the surrounding air temperature is 95 °F.

Altitude derating: The derating factor for 5500 ft is

$$1 - \frac{5500\ ft - 3281\ ft}{32810\ ft} = 0.932$$

Surrounding air temperature derating: Derating is not necessary at a 95 °F surrounding air temperature.

To see if the derated output current of a drive is sufficient for the application, multiply the drive output current for light-duty use (I_{Ld}) by all of the applicable derating factors. For example, drive type ACS380-E042C-25A0-4 has an output current of 21 A at 480 V.

Switching frequency derating:The derating factor for this drive type is 0.67 at 8 kHz. Calculate the derated drive output current:

$$I_{Ld} = 21\ A \cdot 0.67 \cdot 0.932 = 13.11\ A$$

In this example, the derated output current is sufficient, because it is more than the required current.

Surrounding air temperature derating

Frame size	Temperature	Derating factor
All	Less than 50 °C (122 °F)	No derating
R1…R3	50…60 °C (122…140 °F)	The output current decreases by 1% for each additional 1 °C (1.8 °F). ACS380-E042C-033A-4: • UL standard installations - output current decreases by 2% for each additional 1 °C (1.8 °F). • IEC standard installations - output current decreases by 1% for each additional 1 °C (1.8 °F).
R4	50…60 °C (122…140 °F)	The output current decreases by 3% for each additional 1 °C (1.8 °F).

Altitude derating

400/480 V drives: At altitudes 1000 … 4000 m (3281 … 13123 ft) above sea level, the derating is 1% for each added 100 m (328 ft) above 1000 m (3281 ft). In addition:

- A maximum altitude of 4000 m (13123 ft) is permitted for these grounding systems: TN-S, TT. A maximum altitude of 2000 m (6562 ft) is permitted for these grounding systems: corner-grounded delta, midpoint-grounded delta, IT (ungrounded).

To calculate the derated output current, multiply the current in the ratings table with the derating factor *k*, which for *x* meters or feet is:

$$k = 1 - \frac{x - 1000\ m}{10000\ m}$$

$$k = 1 - \frac{x - 3281\ ft}{32810\ ft}$$

Switching frequency derating

Derating the drive output current is necessary for high minimum switching frequencies. If you change parameter 97.02 Minimum switching frequency, calculate the derated current. Multiply the drive output current with the applicable derating factor from the table.

Derating is not necessary when you change parameter 97.01 Switching frequency reference.

Frame size R4: If the application is cyclic and the surrounding air temperature is constantly more than 40 °C (104 °F), keep parameter 97.02 Minimum switching frequency at its default value (1.5 kHz). Higher switching frequencies decrease the product life or the performance in the temperature range 40 … 60 °C (104 … 140 °F).

Type ACS380-E042C-...	Derating factor		
	≤ 4 kHz	8 kHz	12 kHz
3-phase U_n = 400 V or 480 V			
01A8-4	1.0	0.65	0.48
02A6-4	1.0	0.65	0.48
03A3-4	1.0	0.65	0.48
04A0-4	1.0	0.65	0.48
05A6-4	1.0	0.65	0.48
07A2-4	1.0	0.65	0.48
09A4-4	1.0	0.65	0.48
12A6-4	1.0	0.68	0.51
17A0-4	1.0	0.68	0.51
25A0-4	1.0	0.67	0.51
033A-4	1.0	0.72	0.55
038A-4	1.0	0.65	0.49
045A-4	1.0	0.66	0.49
050A-4	1.0	0.66	0.49

Derating in case of a phase loss

If there is a phase loss, the drive operates according to parameter 31.21 Supply phase loss.

If No action is selected, the drive eventually overheats or the supply bridge may be damaged if one supply phase is lost, unless 50% derating is done when you dimension the system.

Fuses

The tables list the fuses for protection against short-circuits in the input power cable or drive. The operating time depends on the supply network impedance, and the cross-sectional area and length of the supply cable.

Do not use fuses that have a higher current rating than specified in the table. You can use fuses from other manufacturers, if they meet the ratings, and if the melting curve of the fuse does not exceed the melting curve of the fuse mentioned in the table.

IEC fuses

Either fuse type can be used if it operates rapidly enough.

gG fuses

Make sure that the operating time of the fuse is less than 0.5 seconds. Obey the local regulations.

Type ACS380-E042C-...	Min. short-circuit current [1]	Fuses				
		Nominal current	I^2t	Voltage rating	ABB type	IEC 60269 size
	A	A	A^2s	V		
3-phase U_n = 400 V						
01A8-4	32	4	55	500	OFAF000H4	000
02A6-4	48	6	110	500	OFAF000H6	000
03A3-4	48	6	110	500	OFAF000H6	000
04A0-4	80	10	360	500	OFAF000H10	000
05A6-4	80	10	360	500	OFAF000H10	000
07A2-4	128	16	740	500	OFAF000H16	000
09A4-4	128	16	740	500	OFAF000H16	000
12A6-4	200	25	2500	500	OFAF000H25	000
17A0-4	256	32	4500	500	OFAF000H32	000
25A0-4	400	50	15500	500	OFAF000H50	000
033A-4	504	63	20000	500	OFAF000H63	000
038A-4	640	80	36000	500	OFAF000H80	000
045A-4	800	100	65000	500	OFAF000H100	000
050A-4	800	100	65000	500	OFAF000H100	000

1) Minimum permitted short-circuit current of the electrical power network

gR fuses

Type ACS380-E042C-...	Min. short-circuit current [1]	Fuses				
		Nominal current	I^2t	Voltage rating	Bussmann type	IEC 60269 size
	A	A	A^2s	V		
3-phase U_n = 400 V						
01A8-4	32	25	125	690	170M2694	00
02A6-4	48	25	125	690	170M2694	00
03A3-4	48	25	125	690	170M2694	00
04A0-4	80	32	275	690	170M2695	00
05A6-4	80	32	275	690	170M2695	00
07A2-4	128	40	490	690	170M2696	00
09A4-4	128	40	490	690	170M2696	00
12A6-4	200	50	1000	690	170M2697	00
17A0-4	256	63	1800	690	170M2698	00
25A0-4	400	80	3600	690	170M2699	00
033A-4	504	100	6650	690	170M2700	00
038A-4	640	125	12000	690	170M2701	00
045A-4	800	160	22500	690	170M2702	00
050A-4	800	160	22500	690	170M2702	00

[1] Minimum permitted short-circuit current of the electrical power network

UL (NEC) fuses

The UL-listed fuses in the table are the required branch circuit protection. Fuses must be provided as part of the installation.

Type ACS380-E042C-...	Fuses				
	Nominal current	Voltage rating	Bussmann/ Edison type	Type	Max. fuse rating for group installation [1]
	A	V			A
3-phase U_n = 480 V					
01A8-4	3	600	JJS/TJS3	UL class T	6
02A6-4	6	600	JJS/TJS6	UL class T	25

Type ACS380-E042C-...	Fuses				
	Nominal current	Voltage rating	Bussmann/ Edison type	Type	Max. fuse rating for group installation [1]
	A	V			A
03A3-4	6	600	JJS/TJS6	UL class T	25
04A0-4	6	600	JJS/TJS6	UL class T	25
05A6-4	10	600	JJS/TJS10	UL class T	25
07A2-4	10	600	JJS/TJS10	UL class T	25
09A4-4	15	600	JJS/TJS15	UL class T	25
12A6-4	20	600	JJS/TJS20	UL class T	30
17A0-4	25	600	JJS/TJS25	UL class T	40
25A0-4	35	600	JJS/TJS35	UL class T	40
033A-4	45	600	JJS/TJS45	UL class T	60
038A-4	60	600	JJS/TJS60	UL class T	100
045A-4	60	600	JJS/TJS60	UL class T	100
050A-4	60	600	JJS/TJS60	UL class T	100

[1] Branch circuit short-circuit protection for group installation by fuses: Suitable for motor group installation on a circuit that can deliver no more than 65000 rms symmetrical amperes, 480 V maximum, when protected by class T fuses. The same fuse size is specified for several consecutive drive types. This is possible since the physical structure of the drive types is identical.

1. Fuses are required as part of the installation, are not included in the base drive configuration, and must be provided by others.
2. Fuses with a higher current rating than specified must not be used.
3. The UL-listed fuses recommended by ABB are the required branch circuit protection per NEC. Circuit breakers listed in section Circuit breakers (UL) are also acceptable as branch circuit protection.
4. The recommended size or smaller UL-listed 248 fast-acting, time-delay, or high-speed fuses must be used to maintain the UL listing of the drive. Additional protection can be used. Refer to local codes and regulations.
5. A fuse of a different class can be used at the high fault rating where the I_{peak} and I^2t of the new fuse are not more than those of the specified fuse.
6. UL-listed 248 fast-acting, time-delay, or high-speed fuses from other manufacturers can be used if they meet the same class and rating requirements specified in the rules above.
7. When you install a drive, always obey ABB installation instructions, NEC requirements, and local codes.

8. Alternative fuses can be used if they meet certain characteristics. For permitted fuses, see Branch Circuit Protection for ABB drives manual supplement (3AXD50000645015).

Alternative short-circuit protection

Miniature circuit breakers (IEC)

Note: Miniature circuit breakers with or without fuses in the table below have not been evaluated for use as short-circuit protection in North American (UL) environments. Refer to Miniature circuit breakers (UL) (page 115) for UL compatible models.

The protective characteristics of the circuit breakers depend on the type, construction and settings of the breakers. There are also limitations pertaining to the short-circuit capacity of the supply network. Your local ABB representative can help you in selecting the breaker type when the supply network characteristics are known.

WARNING Pay special attention to the installation and placement of the breakers. Obey the manufacturer's instructions. Hot ionized gases can escape from the breaker enclosure in a short-circuit.

You can use the circuit breakers specified by ABB. You can also use other circuit breakers with the drive if they provide the same electrical characteristics. ABB does not assume any liability whatsoever for the correct function and protection of the circuit breakers not specified by ABB. Furthermore, if the specifications given by ABB are not obeyed, the drive can experience problems the warranty does not cover.

ACS380-E042C-...	Frame 1)	Miniature circuit breaker	Network SCC 2)
		ABB type	kA
3-phase U_n = 400 V			
01A8-4	R1	S303P-B4 / S303P-C4	10
02A6-4	R1	S303P-B6 / S303P-C6	10
03A3-4	R1	S303P-B6 / S303P-C6	10
04A0-4	R1	S303P-B8 / S303P-C8	10
05A6-4	R1	S303P-B10 / S303P-C10	10
07A2-4	R1	S303P-B16 / S303P-C16	10
09A4-4	R1	S303P-B16 / S303P-C16	10
12A6-4	R2	S303P-B25 / S303P-C25	10

ACS380-E042C-...	Frame [1]	Miniature circuit breaker	Network SCC [2]
		ABB type	kA
17A0-4	R3	S303P-B32 / S303P-C32	10
25A0-4	R3	S303P-B50 / S303P-C50	10
033A-4	R3	S303P-B63 / S303P-C63	10
038A-4	R4	S803S-B80	5
045A-4	R4	S803S-B100	5
050A-4	R4	S803S-B100	5

1) Enclosures for all frame sizes must have a solid bottom directly below the drive: Fans (other than internal stirring fans), filters or louvers cannot be directly below the drive but can be mounted in adjacent areas at the bottom of the enclosure.

2) Maximum permitted rated conditional short-circuit current (IEC 61800-5-1) of the electrical power network.

Miniature circuit breakers (UL)

ACS380-E drives are suitable for use on a circuit that can deliver no more than 10 kA symmetrical amperes (RMS) at 240 or 480Y/277 V maximum when they are protected by appropriate circuit breakers in these tables. UL does not require additional fuse protection with these circuit breakers. Circuit breakers are not required to be in the same enclosure as the drive.

ACS380-E042C-...	Frame	Miniature circuit breaker	Minimum enclosure volume [1] [2]
		ABB type	in^3
3-phase U_n = 400 V			
01A8-4	R1	SU203M-C10	1850
02A6-4	R1	SU203M-C10	1850
03A3-4	R1	SU203M-C10	1850
04A0-4	R1	SU203M-C10	1850
05A6-4	R1	SU203M-C10	1850
07A2-4	R1	SU203M-C16	1850
09A4-4	R1	SU203M-C16	1850
12A6-4	R2	SU203M-C25	1850
17A0-4	R3	SU203M-C50	1850
25A0-4	R3	SU203M-C50	1850
033A-4	R3	SU203M-C50	1850
038A-4	R4	-	-

ACS380-E042C-...	Frame	Miniature circuit breaker	Minimum enclosure volume [1] [2]
		ABB type	in³
045A-4	R4	-	-
050A-4	R4	-	-

1) Drives that have an Minimum Enclosure Volume listed must be mounted in an enclosure ≥ Minimum Enclosure Volume specified in this table.

2) When multiple drives that have an Enclosure Minimum Volume specified are installed in the same enclosure, minimum volume of the enclosure is determined by largest Enclosure Minimum Volume of the drives to be placed in the enclosure, plus the volume(s) of each additional drive.

Manual self-protected combination motor controller – Type E USA (UL (NEC))

You can use the ABB Type E manual motor protectors (MMP) MS132 & S1-M3-25, MS165-xx, and MS5100-100 as an alternative to the recommended fuses as a means of branch circuit protection. This complies with the National Electrical Code (NEC). When the correct ABB Type E manual motor protector is selected from the table and used for branch circuit protection, the drive is suitable for use in a circuit that can deliver no more than 65 kA rms symmetrical amperes at the maximum rated voltage of the drive. Refer to the table for the appropriate MMP types and minimum enclosure volume of IP20 / UL open type drive mounted in an enclosure.

If you use a manual motor protector for the branch circuit protection of the drive, install the drive into a metal enclosure.

Note: The UL Listing of drive and MMP combinations applies only to drives that are mounted in appropriately sized metal enclosures that are capable of containing any drive component failure.

Type ACS380-E042C-...	Frame [1]	MMP type [2] [3] [4]	Minimum enclosure volume [5]	
			dm³	in³
3-phase U_N = 480 V				
01A8-4	R1	MS132-4.0 & S1-M3-25 [6]	30.3	1850
02A6-4	R1	MS132-6.3 & S1-M3-25 [6]	30.3	1850
03A3-4	R1	MS132-6.3 & S1-M3-25 [6]	30.3	1850
04A0-4	R1	MS132-10 & S1-M3-25 [6]	30.3	1850
05A6-4	R1	MS132-10 & S1-M3-25 [6]	30.3	1850
07A2-4	R1	MS165-16	30.3	1850
09A4-4	R1	MS165-16	30.3	1850
12A6-4	R2	MS165-20	30.3	1850

Type ACS380-E042C-...	Frame [1]	MMP type [2] [3] [4]	Minimum enclosure volume [5]	
			dm^3	in^3
17A0-4	R3	MS165-32	30.3	1850
25A0-4	R3	MS165-42	30.3	1850
033A-4	R3	MS165-54	30.3	1850
038A-4	R4	MS165-65	75.0	4577
045A-4	R4	MS5100-100 / MS165-73	75.0	4577
050A-4	R4	MS5100-100 / MS165-80	75.0	4577

1) Enclosures for all frame sizes must have a solid bottom directly below the drive: Fans (other than internal stirring fans), filters or louvers cannot be directly below the drive but can be mounted in adjacent areas at the bottom of the enclosure.

2) All manual motor protectors listed are Type E self-protected up to 65 ¯kA, except MS165-80 which is Type E self-protected up to 50 ¯kA. See the ABB manual motor starter catalog (1SBC100214C0201) for complete technical data on the ABB Type E manual motor protectors. In order for these manual motor protectors to be used for branch circuit protection, they must be UL-listed Type E manual motor protectors, otherwise they can be used only as an At Motor Disconnect. “At Motor Disconnect” is a disconnect just ahead of the motor on the load side of the panel.

3) 480Y/277 V wye systems only: Short-circuit protective devices with slash voltage ratings (e.g. 480Y/277 V AC) can be applied only in solidly grounded networks where the voltage from line-to-ground does not exceed the lower of the two ratings (e.g. 277 V AC), and the voltage from line-to-line does not exceed the higher of the two ratings (e.g. 480 V AC).

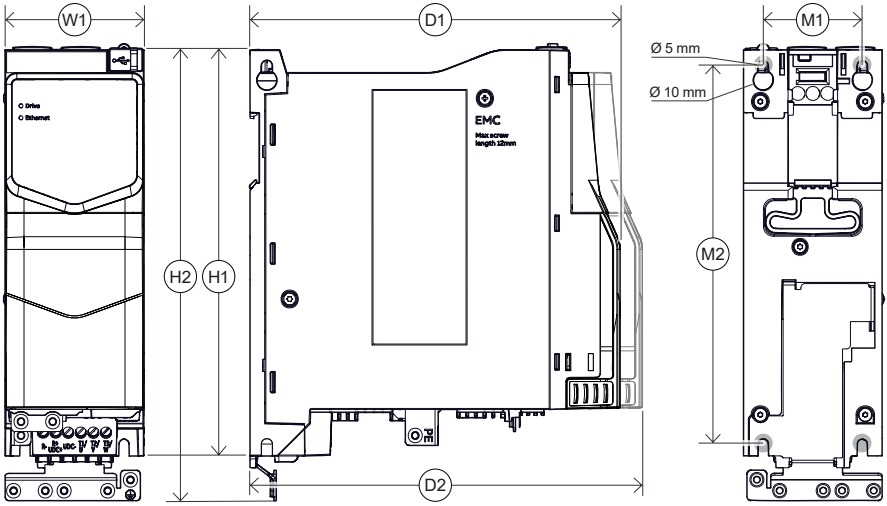
4) Manual motor protectors may require adjusting the trip limit from the factory setting at or above the drive input Amps to avoid nuisance tripping. If the manual motor protector is set to the maximum current trip level and nuisance tripping is occurring, select the next size MMP. (MS132-10 is the highest size in the MS132 frame size to meet Type E at 65 kA; the next size up is MS165-16.)

5) For all drives, the enclosure must be sized to accommodate the specific thermal considerations of the application as well as provide free space for cooling. Refer to the technical data. For UL only: The minimum enclosure volume is specified in the UL listing when applied with the ABB Type E MMP shown in the table. Fuses must be used for wall-mounted drives installed with a UL Type 1 kit.

6) Requires the use of the S1-M3-25 line side feeder terminal with the manual motor protector to meet Type E self-protection class.

Dimensions and weights

Dimensions – IP20 / UL open type



Frame size	Dimensions, IP20 / UL open type													
	H1		H2		W		D1		D2		M1		M2	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
R1	205.0	8.07	227.5	8.96	70.0	2.76	186.8	7.35	198.2	7.80	50.0	1.97	191.0	7.52
R2	205.0	8.07	227.6	8.96	95.0	3.74	186.8	7.35	198.2	7.80	75.0	2.95	191.0	7.52
R3	205.0	8.07	241.3	9.50	170.0	6.69	185.7	7.31	198.2	7.80	148.0	5.83	191.0	7.52
R4	205.0	8.07	240.4	9.46	260.0	10.24	192.0	7.56	203.4	8.01	234.0	9.21	191.0	7.52

H1	Height rear mounting
H2	Height rear total
W	Width
D1	Depth, front cover inner position
D2	Depth, front cover outer position
M1	Mounting hole distance, horizontal
M2	Mounting hole distance, vertical

Weights

The weight of the drive depends on the installed accessories and optional modules. The standard components include the Status display panel and cable clamps. Other front panel options and extension modules can increase the total weight of the drive.

Frame size	Drive without front panel and clamps	Drive with standard components
	kg [lb]	kg [lb]
R1	1.6 [3.5]	1.7 [3.8]
R2	2.2 [4.8]	2.3 [5.0]
R3	3.7 [8.1]	3.8 [8.3]
R4	5.8 [12.7]	5.9 [13.0]

Free space requirements

Frame size	Free space requirements					
	Above drive		Below drive		On both sides	
	mm	in	mm	in	mm	in
R1...R4	75	3	75	3	0	0

Losses, cooling data, and noise

The drives have a cooling fan. The cooling air inlet is at the bottom of the drive and the exhaust vent is at the top of the drive.

Type ACS380-E042C-...	Typical power loss [1)]		Airflow		Noise [2)]	Frame size
	W	BTU/h	m^3/h	CFM	dB(A)	
3-phase U_N = 400/480 V						
01A8-4	36	123	57	33	65	R1
02A6-4	44	150	57	33	65	R1
03A3-4	53	181	57	33	65	R1
04A0-4	58	198	57	33	65	R1
05A6-4	81	276	57	33	65	R1
07A2-4	98	334	57	33	65	R1
09A4-4	134	457	57	33	65	R1

Type ACS380-E042C-...	Typical power loss [1]		Airflow		Noise [2]	Frame size
	W	BTU/h	m^3/h	CFM	dB(A)	
12A6-4	168	573	63	37	65	R2
17A0-4	247	843	128	75	74	R3
25A0-4	388	1324	128	75	74	R3
033A-4	514	1754	128	75	74	R3
038A-4	603	2058	150	88	77	R4
045A-4	628	2143	150	88	77	R4
050A-4	729	2487	150	88	77	R4

1) The table shows the typical drive losses when it operates at 90% of the nominal motor frequency and 100% of the nominal motor current.
2) During operation, the R3 and R4 drives can cause more than 70 dB(A) of noise.

Typical power cable sizes

These are the typical power cable and conductor sizes for use at the nominal drive current.

Note: IEC/EN 61800-5-1 requires two separate PE (ground) conductors for a fixed connection, if the cross-sectional area of the PE conductor is less than 10 mm^2 Cu.

Type ACS380-E042C-...	Cable size, Cu (mm^2) [1]	Conductor size, Cu (AWG)	Frame size
3-phase U_N = 400 V or 480 V			
01A8-4	3×1.5 + 1.5	14	R1
02A6-4	3×1.5 + 1.5	14	R1
03A3-4	3×1.5 + 1.5	14	R1
04A0-4	3×1.5 + 1.5	14	R1
05A6-4	3×1.5 + 1.5	14	R1
07A2-4	3×1.5 + 1.5	14	R1
09A4-4	3×2.5 + 2.5	14	R1
12A6-4	3×2.5 + 2.5	14	R2
17A0-4	3×6 + 6	10	R3
25A0-4	3×6 + 6	10	R3
033A-4	3×10 + 10	8	R3
038A-4	3×16 + 16	6	R4

Type ACS380-E042C-...	Cable size, Cu (mm^2) [1]	Conductor size, Cu (AWG)	Frame size
045A-4	3×25 + 16	4	R4
050A-4	3×25 + 16	4	R4

[1] Symmetrical, shielded, three-phase copper cable.

Terminal data for the power cables

The first table shows the terminal data in SI units. The other tables show the terminal data in imperial units.

Type ACS380-E042C-...	L1, L2, L3, T1/U, T2/V, T3/W, R-, R+/ UDC+			PE		
	Minimum (solid/ stranded)	Maximum (solid/ stranded)	Tightening torque	Minimum (solid/ stranded)	Maximum (solid/ stranded)	Tightening torque
	mm^2	mm^2	N·m	mm^2	mm^2	N·m
3-phase U_n = 400 V						
01A8-4	0.5/0.5	4/2.5	0.5…0.6	4/2.5	6/4	1.2
02A6-4	0.5/0.5	4/2.5	0.5…0.6	4/2.5	6/4	1.2
03A3-4	0.5/0.5	4/2.5	0.5…0.6	4/2.5	6/4	1.2
04A0-4	0.5/0.5	4/2.5	0.5…0.6	4/2.5	6/4	1.2
05A6-4	0.5/0.5	4/2.5	0.5…0.6	4/2.5	6/4	1.2
07A2-4	0.5/0.5	4/2.5	0.5…0.6	4/2.5	6/4	1.2
09A4-4	0.5/0.5	4/2.5	0.5…0.6	4/2.5	6/4	1.2
12A6-4	0.5/0.5	4/2.5	0.5…0.6	4/2.5	6/4	1.2
17A0-4	0.5/0.5	10/10	1.2…1.5	4/2.5	6/4	1.2
25A0-4	0.5/0.5	10/10	1.2…1.5	4/2.5	6/4	1.2
033A-4	0.5/0.5	10/10	1.2…1.5	4/2.5	6/4	1.2
038A-4	0.5/0.5	25/16	2.5…3.7	10/6	25/16	2.9
045A-4	0.5/0.5	25/16	2.5…3.7	10/6	25/16	2.9
050A-4	0.5/0.5	25/16	2.5…3.7	10/6	25/16	2.9

Type ACS380-E042C-...	L1, L2, L3, T1/U, T2/V, T3/W, R-, R+/ UDC+			PE		
	Minimum	Maximum	Tightening torque	Minimum	Maximum	Tightening torque
	AWG	AWG	lbf·in	AWG	AWG	lbf·in
3-phase U_n = 480 V						
01A8-4	18	10	5	12	10	10.6
02A6-4	18	10	5	12	10	10.6
03A3-4	18	10	5	12	10	10.6
04A0-4	18	10	5	12	10	10.6
05A6-4	18	10	5	12	10	10.6
07A2-4	18	10	5	12	10	10.6
09A4-4	18	10	5	12	10	10.6
12A6-4	18	10	5	12	10	10.6
17A0-4	18	6	11…13	12	10	10.6
25A0-4	18	6	11…13	12	10	10.6
033A-4	18	6	11…13	12	10	10.6
038A-4	18	2	22…32	8	4	25.7
045A-4	18	2	22…32	8	4	25.7
050A-4	18	2	22…32	8	4	25.7

Note:

- The minimum specified wire size does not necessarily have sufficient current carrying capacity at maximum load.
- The terminals do not accept a conductor that is one size larger than the maximum specified wire size.
- The maximum number of conductors per terminal is 1.

Terminal data for the control cables

Control cable terminal data of the standard drive variant, that is, the base drive unit without options:

- **Conductor (solid or stranded):** 0.2…1.5 mm^2 [24…16 AWG]
- **Stranded conductor with ferrule:** 0.25…1.0 mm^2 [23…17 AWG]
- **Ferrules:** 0.25…1.0 mm^2 [24…18 AWG]

- **Stripping length:** 8.5…9.5 mm [0.33…0.37 in]

Electrical power network specification

<table>
<tr><td>Voltage (U1)</td><td>Input voltage range:
ACS380-E042C-xxxx-4 drives: 3-phase 380 … 480 V AC -15% … +10%</td></tr>
<tr><td>Network type</td><td>Public low-voltage networks. Symmetrically grounded TN-S system, IT (ungrounded), corner-grounded delta. Consult ABB before connecting to other systems (for example, TT, or midpoint grounded delta).</td></tr>
<tr><td>Rated conditional short-circuit current I_{cc} (IEC 61800-5-1)</td><td>65 kA when protected by fuses given in the fuse tables.</td></tr>
<tr><td>Maximum prospective short-circuit current rating (SCCR)
(UL 61800-5-1, CSA C22.2 No. 274-13)</td><td>US and Canada: The drive is suitable for use on a circuit that can deliver no more than 100 kA symmetrical amperes (rms) at 600 V maximum when protected by fuses given in the fuse table.</td></tr>
<tr><td>Harmonic current limits in public network
(IEC/EN 61000-3-2, IEC/EN 61000-3-12)</td><td>Refer to Compliance with the harmonic current limits in a public network (IEC/EN 61000 3-2, IEC/EN 61000-3-12) (page 133).</td></tr>
<tr><td>Input choke</td><td>Refer to Input chokes (page 147) for general guidelines on the use of the choke.
Use an input choke, if the short-circuit capacity of the network at the drive terminals is more than specified in this table:
<table>
<tr><th>Input voltage</th><th>R1, R2</th><th>R3, R4</th></tr>
<tr><td>1-phase 200 … 240 V</td><td>>1.5 kA</td><td>-</td></tr>
<tr><td>3-phase 200 … 240 V</td><td>>5.0 kA</td><td>>7.5 kA</td></tr>
<tr><td>3-phase 380 … 480 V</td><td>>5.0 kA</td><td>>10 kA</td></tr>
</table>
You can use one choke for several drives if the short-circuit capacity at the drive terminals is decreased to the value in the table.</td></tr>
<tr><td>Frequency (f1)</td><td>47 … 63 Hz, maximum rate of change 2%/s</td></tr>
<tr><td>Imbalance</td><td>Max. ±3% of nominal phase-to-phase input voltage</td></tr>
<tr><td>Fundamental power factor (cos phi)</td><td>0.98 (at nominal load)</td></tr>
</table>

Motor connection data

Motor type	Asynchronous AC induction motors, permanent magnet synchronous motors or ABB synchronous reluctance motors (SynRM motors)
Voltage (U2)	0 … U1, 3-phase symmetrical
Short-circuit protection (IEC 61800-5-1, UL 61800-5-1)	The motor output is short-circuit proof by IEC 61800-5-1 and UL 61800-5-1.
Frequency (f2)	0 … 599 Hz
Frequency resolution	0.01 Hz
Current	Refer to the electrical ratings in this manual.
Switching frequency	2, 4, 8, or 12 kHz

Motor cable length

Operational functionality and motor cable length

The drive operates with optimum performance with these maximum motor cable lengths. The values are valid for a 4 kHz switching frequency.

Note: The conducted and radiated emissions of these motor cable lengths do not comply with the EMC requirements of IEC/EN 61800-3.

Frame	Maximum motor cable length	
	m	ft
Standard drive, without external options		
R1…R4	100	328

Note: In multimotor systems, make sure that the calculated sum of all motor cable lengths does not exceed the maximum motor cable length in the table.

EMC compatibility and motor cable length

To comply with the EMC requirements of IEC/EN 61800-3, do not exceed these maximum motor cable lengths. The values are valid for a 4 kHz switching frequency.

Frame	Maximum motor cable length, 4 kHz			
	C1 [1]		C2	
	m	ft	m	ft
With internal EMC filter				
3-phase 380 … 480 V				
R1	-	-	10	33
R2	-	-	10	33
R3	-	-	10	33
R4	-	-	10	33
With optional external EMC filter				
3-phase 380 … 480 V				
R1	30	98	30	98
R1	40	131	40	131
R2	40	131	40	131
R3	40	131	40	131
R4	30	98	30	98

1) Category C1 with conducted emissions only. Radiated emissions are not compatible when measured with the standard emission measurement setup and must be measured on cabinet and machine installations for each case.

Control connection data

Auxiliary voltage connection	Auxiliary voltage output (24V OUT)	+24 V DC ±15%, max. 250 mA
	Auxiliary voltage input (24V IN+, 24V IN-)	+24 V DC ±15%, max. 1000 mA (incl. internal fan load)
Digital inputs (DI1, DI2)	Voltage	12…24 V DC (int. or ext. supply). Max. 30 V DC.
	Type	PNP
	Input impedance	R_{in} = 2 kohm

Programmable digital I/O (DIO1, DIO2)	**As inputs**	
	Voltage	12…24 V DC with internal or external supply. Max. 30 V DC.
	Type	PNP
	Input impedance	R_{in} = 2 kohm
	As outputs	
	Type	Transistor output PNP
	Max. switching voltage	30 V DC
	Max. switching current	70 mA / 30 DC, short-circuit protected
	Frequency	10 Hz … 16 kHz
	Resolution	1 Hz
Safe torque off (STO) interface (SGND, STO OUT, STO1, STO2)	Refer to The Safe torque off function (page 161)	
Control panel/PC connection	USB Type C (USB-C) **Note:** Not for external memory devices.	
Embedded Ethernet network connection (X1 IN, X2 OUT)	Compatibility	Ethernet Standard IEEE802.3/u devices
	Medium	10/100Base-TX with auto-negotiation and auto-MDIX
	Topology	Bus, star, or ring A maximum of 50 nodes in a ring for EtherNet/IP and PROFINET (not applicable to Modbus/TCP).
	Serial communications	Half-duplex or full-duplex
	Maximum segment length	100 m [328 ft]
	Cabling	CAT5e/6 S/FTP, S/STP, or SF/FTP
	Connectors	RJ45

Brake resistor connection data

Short-circuit protection (IEC 61800-5-1, IEC 60439-1, UL 61800-5-1)	The brake resistor output is conditionally short-circuit proof by IEC/EN 61800-5-1 and UL 61800-5-1. Rated conditional short-circuit current is as defined in IEC 60439-1.

Energy efficiency data (ecodesign)

Energy efficiency data according to IEC 61800-9-2 is available from the ecodesign tool (https://ecodesign.drivesmotors.abb.com/).

Protection classes

Degree of protection (IEC/EN 60529)	IP20. Install the drive in a cabinet to fulfill the requirements for shielding from contact.
Enclosure types (UL 61800-5-1)	Open type. For indoor use only.
Overvoltage category (IEC 60664-1)	III
Protective classes (IEC/EN 61800-5-1)	I

Ambient conditions

These are the environmental limits of the drive. Install the drive in a heated indoor environment.

Requirement	Operation installed for stationary use	Storage in the protective package	Transportation in the protective package
Installation site altitude	**400/480 V drives**: 0 … 4000 m (0 … 13123 ft) above sea level (with output derating above 1000 m [3281 ft]) Refer to Output derating (page 106).	-	-

Requirement	Operation installed for stationary use	Storage in the protective package	Transportation in the protective package
Surrounding air temperature	-10 … +50 °C (14 … 122 °F). If the temperature is more than 50 °C (122 °F), output derating is necessary. Refer to Output derating (page 106). No frost permitted.	-40 … +70 °C ±2% (-40 … +158 °F ±2%)	-40 … +70 °C ±2% (-40 … +158 °F ±2%)
Relative humidity	5 … 95%	Max. 95%	Max. 95%
	No condensation permitted. Maximum permitted relative humidity is 60% in the presence of corrosive gases.		
Contamination levels (IEC 60721-3-x)	IEC 60721-3-3: 2002	IEC 60721-3-1: 1997	IEC 60721-3-2: 1997
- Chemical gases	Class 3C2	Class 1C2	Class 2C2
- Solid particles	Class 3S2. No conductive dust permitted.	Class 1S3. (packing must support this, otherwise 1S2)	Class 2S2
Pollution degree (IEC/EN 61800-5-1)	Pollution degree 2	-	-
Sinusoidal vibration (IEC 60068-2-6, Test Fc 2007-12)	frequency 10 … 150 Hz; amplitude ±0.075 mm (0.003 in), 10 … 57,56 Hz; constant peak acceleration 10 m/s^2 (33 ft/s^2), 57,56 … 150 Hz; sweep: 1 oct/min; 10 sweep cycles in each axis with STO active; uncertainty ±5.0%; normal mounting	-	-
Shock/(IEC 60068-2-27, ISTA 1A)	Not permitted	According to ISTA 1A. Max. 100 m/s^2 (330 ft/s^2), 11 ms.	According to ISTA 1A. Max. 100 m/s^2 (330 ft/s^2), 11 ms.
Free fall	-	76 cm (30 in)	76 cm (30 in)

Storage conditions

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

Color

NCS 1502-Y (RAL 9002 / PMS 420 C)

Materials

Drive

Refer to ACS380 drives recycling instructions and environmental information (3AXD50000049465 [English]).

Drive package

- Cardboard
- Molded pulp
- PE (suspension film package, plastic bag)

Package materials for options, accessories and spare parts

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

The materials vary by item type, size, and shape. The typical package is a cardboard box with paper filling or bubble wrap. ESD-safe packaging is used for printed circuit boards and similar items.

Materials of manuals

Printed product manuals are made of recyclable paper.

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.

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

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

To aid recycling, most plastic parts are marked with an appropriate identification code. Components that contain Substances of Very High Concern (SVHCs) are listed in the European Chemicals Agency 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 more information, contact your local ABB distributor or consult the European Chemicals Agency SCIP database to determine which SVHCs are used in the drive and where the components are located.

Contact your local ABB distributor for more information on environmental aspects. End-of-life treatment must obey 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:

EN ISO 13849-1:2023	Safety of machinery – Safety related parts of the control systems – Part 1: general principles for design
EN ISO 13849-2:2012	Safety of machinery – Safety-related parts of the control systems – Part 2: Validation
EN 60204-1:2006 + A1:2009 + 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 • an emergency-stop device • a supply disconnecting device
EN 62061:2005 + AC:2010 + A1:2013 + A2:2015	Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems
EN 61800-3:2004 + A1:2012 IEC 61800-3:2004 + A1:2011	Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods
IEC/EN 61800-5-1:2007+AMD1:2016 EN 61800-5-1:2007+A1:2017+A11:2021	Adjustable speed electrical power drive systems – Part 5-1: Safety requirements – Electrical, thermal and energy
ANSI/UL 61800-5-1:2015	UL Standard for adjustable speed electrical power drive systems – Part 5-1: Safety requirements – Electrical, thermal and energy
CSA C22.2 No. 274-17	Adjustable speed drives
IEC 61800-9-2:2023	Adjustable speed electrical power drive systems (PDS) – Part 9-2: Ecodesign for motor systems – Energy efficiency determination and classification

Markings

CE	CE mark The product complies with the applicable European Union legislation. For fulfilling the EMC requirements, refer to the additional information concerning the drive EMC compliance (IEC/EN 61800-3).

UK CA	UKCA (UK Conformity Assessed) mark The product complies with the applicable United Kingdom legislation (Statutory Instruments). Marking is required for products being placed on the market in Great Britain (England, Wales, and Scotland).

	TÜV Safety Approved mark (functional safety) The product contains Safe torque off and possibly other (optional) safety functions that 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.
	UL Listed mark for USA and Canada The product was tested and evaluated against the relevant North American standards by the Underwriters Laboratories. The marking is valid for rated voltages of up to 600 V.
	RCM mark The product complies with the regulations in Australia and New Zealand specific to EMC, telecommunications, and electrical safety. To comply with the EMC requirements, refer to the additional information on drive EMC compliance (IEC/EN 61800-3).
	CMIM mark The product complies with the safety standards of Morocco for the marketing of toys and electrical products.
	EAC (Eurasian Conformity) mark The product complies with the technical regulations of the Eurasian Customs Union. The EAC mark is required in Russia, Belarus, and Kazakhstan.
	Electronic Information Products (EIP) symbol including an Environment Friendly Use Period (EFUP). The product complies with the People's Republic of China Electronic Industry Standard (SJ/T 11364-2014) about hazardous substances. The EFUP is 20 years. China RoHS II Declaration of Conformity is available from https://library.abb.com.
	WEEE mark At the end of its life, the product should enter the recycling system at an appropriate collection point and not be placed in the normal waste stream.
	KC mark The product complies with the Korean Registration of Broadcasting and Communications Equipment Clause 3, Article 58-2 of Radio Waves Act.

Compliance with the harmonic current limits in a public network (IEC/EN 61000 3-2, IEC/EN 61000-3-12)

3-phase 230 V, 400 V, or 480 V drive with the input choke

The drive complies with IEC 61000-3-12 provided that the short-circuit ratio R_{sce} is more than or equal to 350 at the interface point between the user's supply and the public system. It is the responsibility of the installer or user of the equipment to ensure, by consultation with the distribution network operator if necessary, that the short-circuit ratio R_{sce} is more than or equal to 350.

The R_{sce} value meets the requirement if the short-circuit power at the interface point between the user's supply and the public system is equal or more than the value S_{cs} calculated as follows:

$$S_{cs} = R_{sce} \times S_{eq} = 350 \times \sqrt{3} \times I_{1n} \times U_1$$

where:

S_{cs}	Minimum short-circuit power limit
R_{sce}	Short-circuit ratio
S_{eq}	Equipment (drive) input power
I_{1n}	Drive nominal input current with the input choke
U_1	Drive input voltage

3-phase 230 V, 400 V, or 480 V drive without the input choke

Refer to 1-phase 230 V drive with or without the input choke (page 133).

1-phase 230 V drive with or without the input choke

Do a harmonic current assessment for the whole system that the drive is part of, and make sure that the harmonic current limits are not exceeded at the interface point between the user's supply and the public system. Based on the results, consider the use of the input choke with the drive. If the assessment is not possible, you can connect the drive to the public network if you have permission from the network operator.

Always use the input choke if the short-circuit capacity of the network at the drive input terminals is more than the limit specified for the drive. Refer to **Input choke** (page 123) in Electrical power network specification (page 123).

EMC compliance (IEC/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.

The first environment includes establishments connected to a low-voltage network that supplies buildings used for domestic purposes.

The second environment includes establishments connected to a network that do not supply domestic premises.

Drive of Category C1: Drive with a rated voltage of less than 1000 V that is intended for use in the first environment.

Drive of Category C2: Drive with a rated voltage of less than 1000 V that is 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 with the necessary skills to install or start power drive systems, and includes their EMC aspects.

Drive of Category C3: Drive with a rated voltage of less than 1000 V that is intended for use in the second environment and not intended for use in the first environment.

Drive of Category C4: Drive with a rated voltage equal to or more than 1000 V, or a rated current equal to or more than 400 A, or intended for use in complex systems in the second environment.

Category C1

The drive complies with the conducted emission limits of the standard with these provisions:

1. The optional EMC filter is selected according to External EMC filters (page 151), and the filter is installed as specified in the EMC filter manual.
2. The motor and control cables are selected as specified in this manual. The EMC recommendations are obeyed.
3. The maximum motor cable length does not exceed the specified maximum value. Refer to EMC compatibility and motor cable length (page 125).
4. The drive is installed according to the instructions in this manual.

This product can cause radio-frequency interference. In a residential or domestic environment, supplementary mitigation measures may be required in addition to the requirements listed for CE compliance.

Category C2

This applies to drives with an internal EMC C2 filter.

The drive complies with the standard with these provisions:

1. The motor and control cables are selected as specified in this manual. The EMC recommendations are obeyed.
2. The maximum motor cable length does not exceed the specified maximum. Refer to EMC compatibility and motor cable length (page 125).
3. The drive is installed according to the instructions in this manual.

This product can cause radio-frequency interference. In a residential or domestic environment, supplementary mitigation measures may be required in addition to the requirements listed above for CE compliance.

⚠WARNING Do not install a drive with the internal EMC filter connected to a grounding system that the EMC filter is not compatible with (for example, an IT system). The supply network becomes connected to ground potential through the internal EMC filter capacitors, which can cause danger or damage to the drive.

⚠WARNING To prevent radio-frequency interference, do not use a category C2 drive on a low-voltage public network that supplies domestic premises.

Category C3

This applies to drives with an internal EMC C3 filter.

The drive complies with the standard with these provisions:

1. The motor and control cables are selected as specified in this manual. The EMC recommendations are obeyed.
2. The maximum motor cable length does not exceed the specified maximum value. Refer toEMC compatibility and motor cable length (page 125).
3. The drive is installed according to the instructions in this manual.

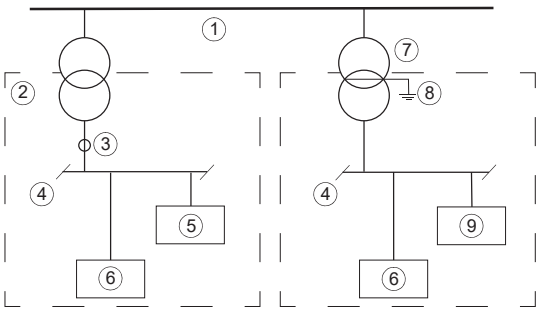
⚠WARNING Do not install a drive with the internal EMC filter connected to a grounding system that the EMC filter is not compatible with (for example, an IT system). The supply network becomes connected to ground potential through the internal EMC filter capacitors, which can cause danger or damage to the drive.

WARNING To prevent radio-frequency interference, do not use a category C3 drive on a low-voltage public network that supplies domestic premises.

Category C4

If the provisions in Categories C1, C2, or C3 are not met, the requirements of the standard can be met as follows:

1. It is ensured that no excessive emission is propagated to neighboring low-voltage networks. In some cases, the inherent suppression in transformers and cables is sufficient. If in doubt, use a supply transformer with static screening between the primary and secondary windings.



1	Medium voltage network
2	Neighboring network
3	Point of measurement
4	Low voltage
5	Equipment (victim)
6	Equipment
7	Supply transformer
8	Static screen
9	Drive

2. An EMC plan to prevent interference 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 as specified in this manual. For the best EMC performance, the EMC recommendations are obeyed.
4. The drive is installed according to the instructions in this manual.

⚠WARNING Do not install a drive with the internal EMC filter connected to a grounding system that the EMC filter is not compatible with (for example, an IT system). The supply network becomes connected to ground potential through the internal EMC filter capacitors, which can cause danger or damage to the drive.

⚠WARNING To prevent radio-frequency interference, do not use a category C4 drive on a low-voltage public network that supplies domestic premises.

UL checklist

⚠WARNING Operation of this drive requires detailed installation and operation instructions provided in the hardware and software manuals. The manuals are provided in electronic format, in the drive package or on the Internet. Keep the manuals with the drive at all times. Hard copies of the manuals can be ordered through the manufacturer.

- Make sure that the drive type designation label includes the applicable marking.
- **DANGER! – Risk of electric shock.** After you disconnect the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start work on the drive, motor, or motor cable.
- Use the drive in a heated, indoor, controlled environment. Install the drive in clean air according to the enclosure classification. The cooling air must be clean, free from corrosive materials, and electrically conductive dust.
- The cables located within the motor circuit must be rated for at least 75 °C.
- The input cable must be protected with fuses or circuit breakers. These protective devices provide branch circuit protection that complies with the national regulations (National Electrical Code (NEC) or Canadian Electrical Code). Obey all applicable local or provincial codes.

  ⚠WARNING An open branch-circuit protective device can be an indication that a fault current was interrupted. To reduce the risk of fire or electric shock, examine all current-carrying parts and other components of the device and replace them if they are damaged.

- The integral solid-state short-circuit protection of the drive does not provide branch circuit protection. Branch circuit protection must be provided as specified in the National Electrical Code and any additional local codes.
- The drive provides motor overload protection. For adjustment information, refer to the firmware manual.

- To maintain the environment integrity of the enclosure, replace the cable grommets with field-installed industrial conduit hubs or closure plates required by the enclosure type (or better).

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 (3AXD10002339591)

Link to Declaration of conformity according to UK Supply of Machinery (Safety) Regulations 2008 (3AXD10002339621)

Link to Declaration of China RoHS II Conformity (3AXD10002478714)

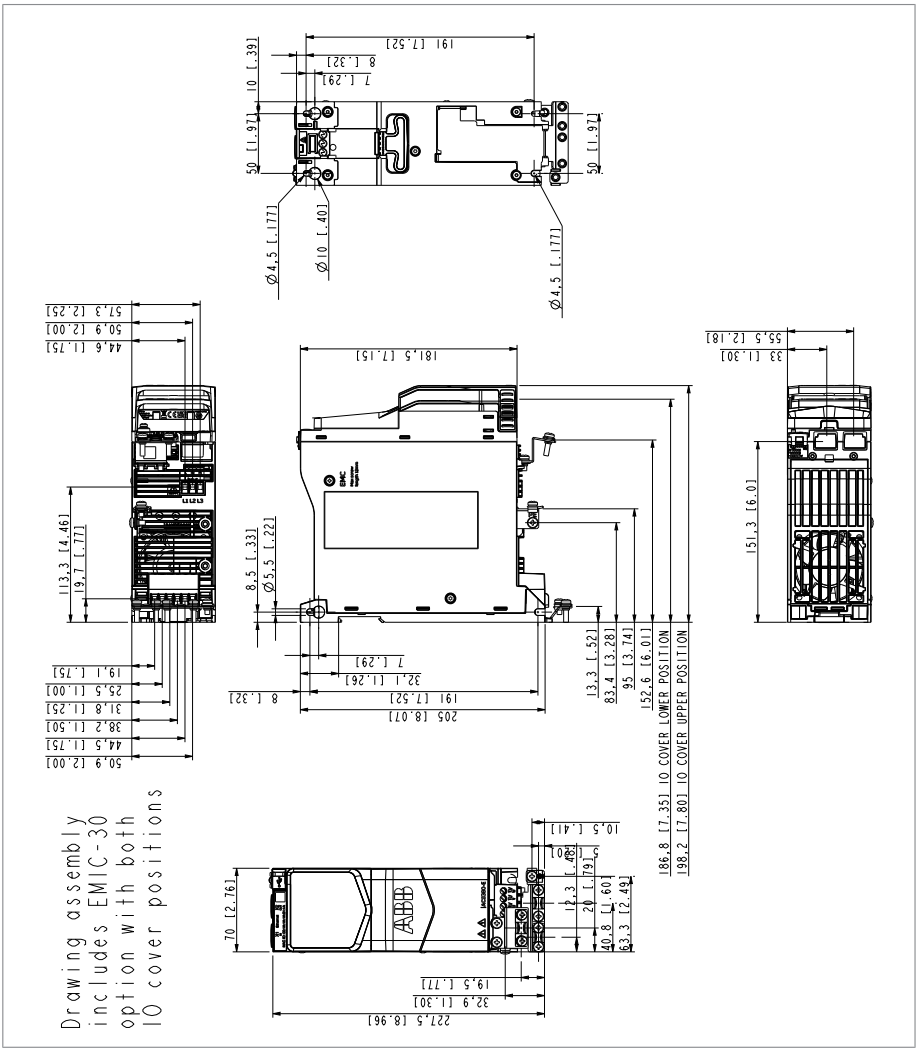
11

Dimension drawings

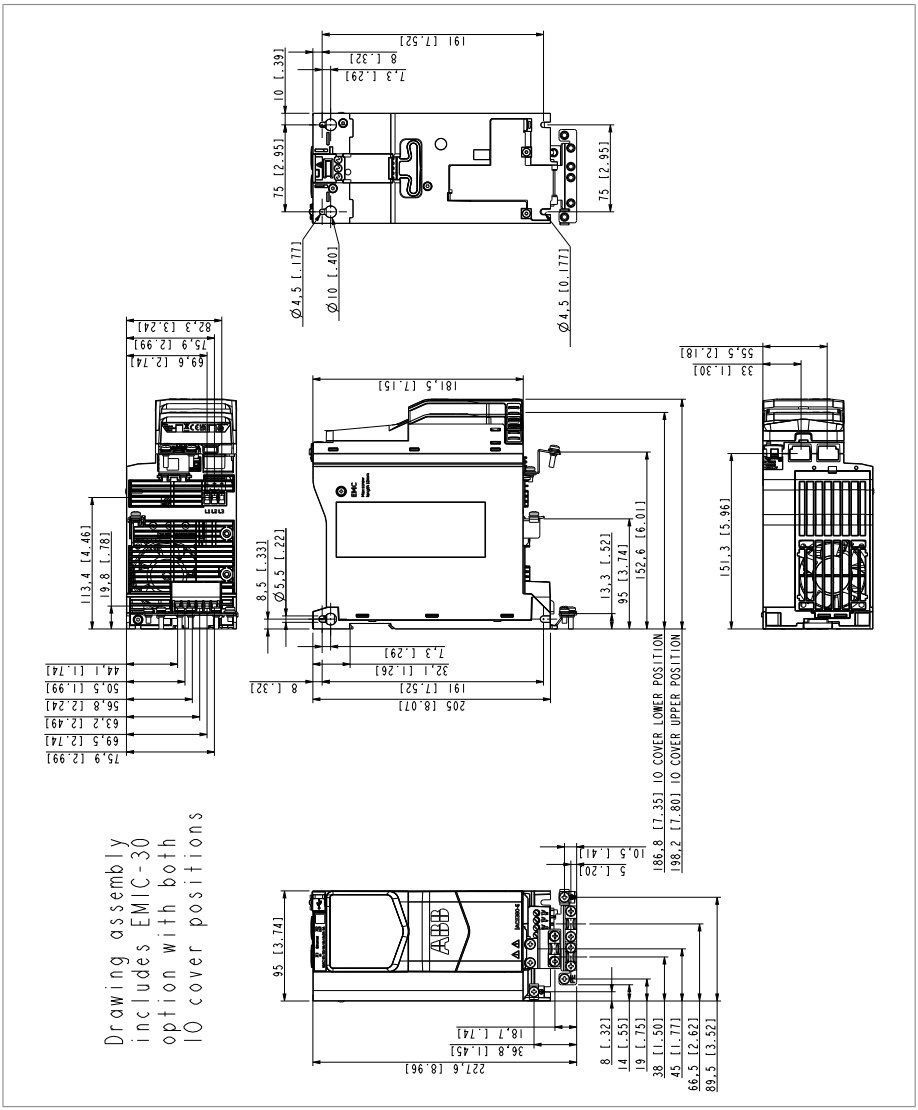
Contents of this chapter

The chapter contains the dimension drawings of the drive. The dimensions are in millimeters and inches.

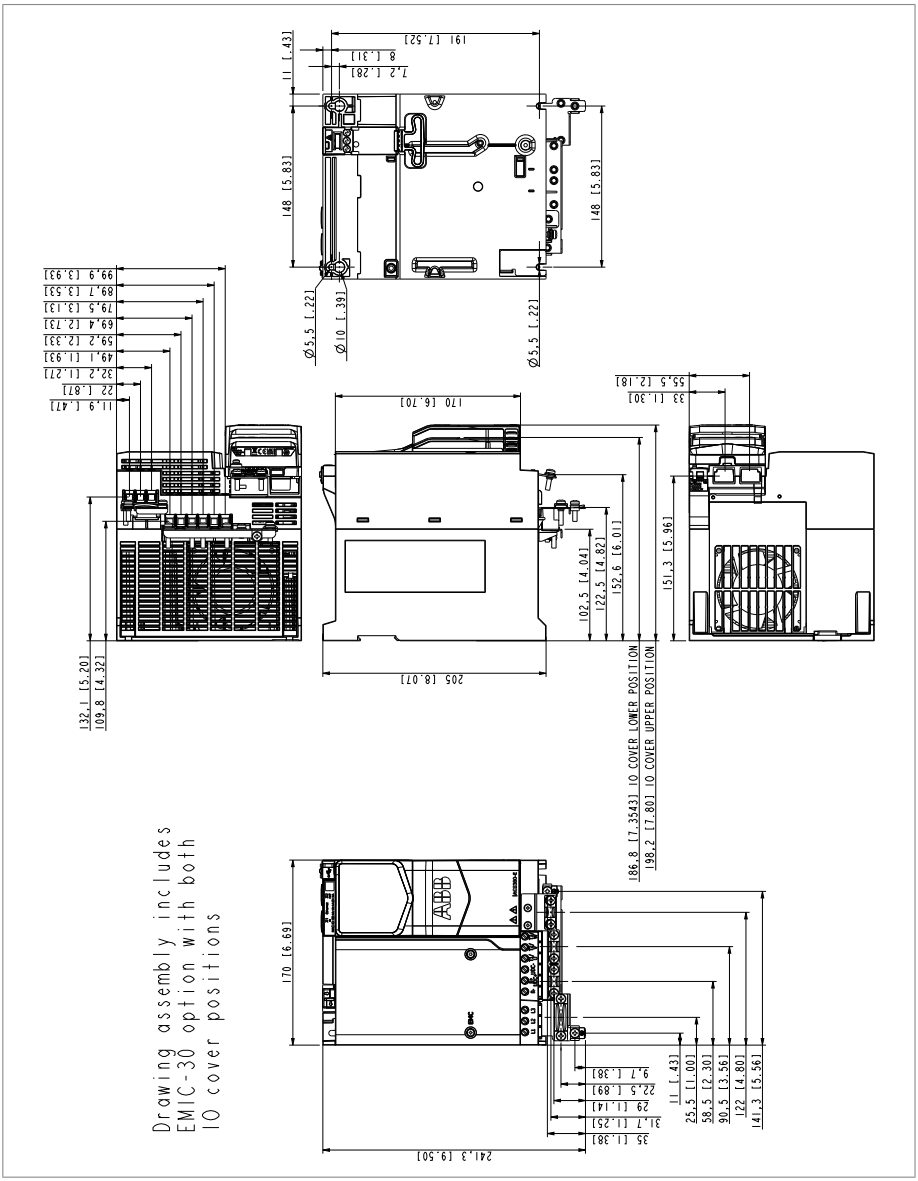
Frame R1


Drawing assembly
includes EMIC-30
option with both
IO cover positions

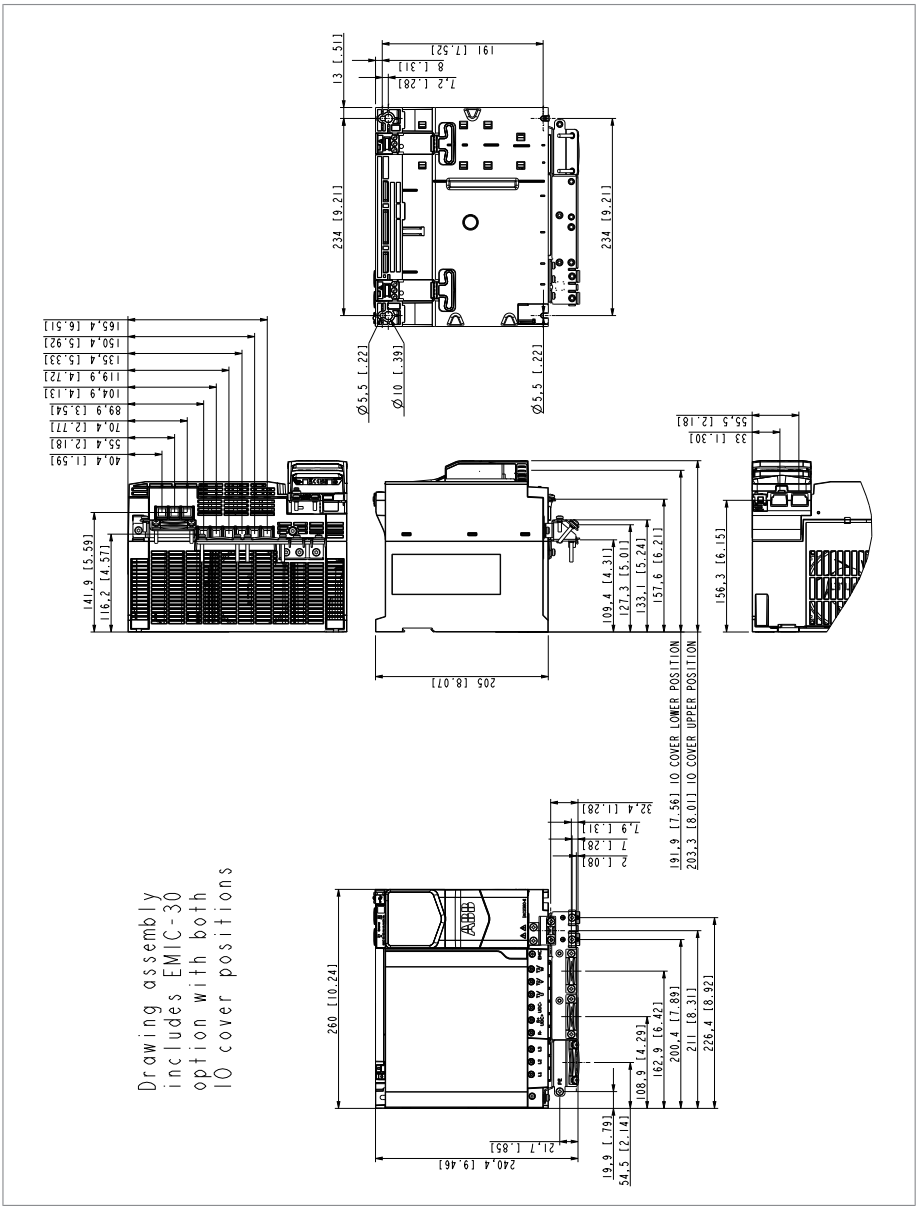
Frame R2


Drawing assembly includes EMIC-30 option with both IO cover positions
IO COVER LOWER POSITION
IO COVER UPPER POSITION

Frame R3


Drawing assembly includes
EMIC-30 option with both
IO cover positions
191 [7.52]
148 [5.83]
Ø5,5 [.22]
Ø10 [.39]
170 [6.70]
205 [8.07]
186,8 [7.3543] IO COVER LOWER POSITION
198,2 [7.80] IO COVER UPPER POSITION
241,3 [9.50]

Frame R4


Drawing assembly
includes EMIC-30
option with both
IO cover positions
234 [9.21]
234 [9.21]
13 [.51]
8 [.31]
7.2 [.28]
191 [7.52]
Ø5.5 [.22]
Ø10 [.39]
Ø5.5 [.22]
165.4 [6.51]
150.4 [5.92]
135.4 [5.33]
119.9 [4.72]
104.9 [4.13]
89.9 [3.54]
70.4 [2.77]
55.4 [2.18]
40.4 [1.59]
141.9 [5.59]
116.2 [4.57]
205 [8.07]
109.4 [4.31]
127.3 [5.01]
133.1 [5.24]
157.6 [6.21]
33 [1.30]
55.5 [2.18]
156.3 [6.15]
191.9 [7.56] IO COVER LOWER POSITION
203.3 [8.01] IO COVER UPPER POSITION
32.4 [1.28]
7.9 [.31]
7 [.28]
2 [.08]
260 [10.24]
108.9 [4.29]
162.9 [6.42]
200.4 [7.89]
211 [8.31]
226.4 [8.92]
21.7 [.85]
240.4 [9.46]
19.9 [.79]
54.5 [2.14]

12

Input chokes

Contents of this chapter

This chapter describes how to select and install input chokes for the drive. The chapter also contains the technical data of the input chokes.

When is an input choke necessary?

Determine the need for an external input choke at the drive power input on a case-by-case basis. The input chokes are used:

- to protect the drive in networks with high short-circuit capacity. Refer to **Input choke** (page 123) in Electrical power network specification (page 123).
- to reduce harmonic current emissions. Refer to Compliance with the harmonic current limits in a public network (IEC/EN 61000 3-2, IEC/EN 61000-3-12) (page 133).
- to reduce the rms value of input current. Refer to Maximum input current (page 147).
- to reduce supply disturbance and low-frequency interference
- in common DC configurations.

Maximum input current

Input current (I_1) of the drive depends on these items:

- motor actual shaft power and efficiency

- power output (or input) via DC connection to other drives in the common DC setup
- network impedance (short circuit capacity) effect on total harmonics content of the input current. Refer to Electrical power network specification (page 123) for more information.

Below are the maximum continuous input current values (rms) allowed for different drive types. If the actual continuous input current is higher (eg, due to very low efficiency of the motor), it is possible to use an input choke to reduce the input current rms value.

Selecting an input choke

Select the input choke according to the drive type.

The degree of protection of an input choke is IP20. Refer to Dimensions (page 149) for dimensions, wire sizes and tightening torques.

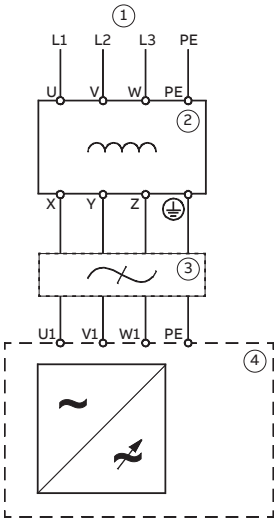
Guidelines for installing an input choke

Obey these guidelines when you install the input choke:

- If an external EMC filter is also installed, connect the input choke between the supply and the filter.
- For optimal operation of the choke, fasten the drive and the choke on the same conductive surface.
- Make sure that the choke does not prevent the airflow through the drive module, and that the hot air rising from the choke cannot enter the air inlet of the drive module.
- Keep the cable between the drive and the choke as short as possible.

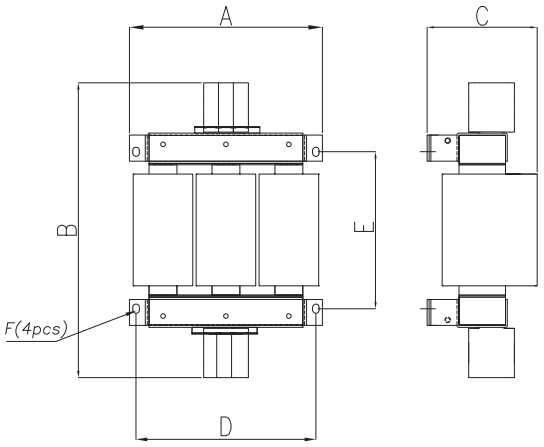
⚠WARNING The input choke is hot when in use and for some time after the use.

Connection diagram



1	AC supply
2	Input choke
3	External EMC filter (if present)
4	Drive

Dimensions



	Input choke type							
	CHK-01	CHK-02	CHK-03	CHK-04	CHK-05	CHK-06	CHK-07	CHK-08
Dim A mm (in.)	120 (4.72)	150 (5.91)	150 (5.91)	150 (5.91)	207 (8.15)	207 (8.15)	249 (9.80)	249 (9.80)
Dim B mm (in.)	146 (5.75)	175 (6.89)	175 (6.89)	175 (6.89)	272 (10.71)	326 (12.83)	326 (12.83)	346 (13.62)
Dim C mm (in.)	79 (3.11)	86 (3.39)	100 (3.94)	100 (3.94)	154 (6.06)	154 (6.06)	167 (6.57)	167 (6.57)
Dim D mm (in.)	77 (3.03)	105 (4.13)	105 (4.13)	105 (4.13)	193 (7.60)	193 (7.60)	235 (9.25)	235 (9.25)
Dim E mm (in.)	114 (4.49)	148 (5.83)	148 (5.83)	148 (5.83)	118 (4.65)	169 (6.65)	125 (4.92)	147 (5.79)
F screw size	M5	M5	M5	M5	M6	M6	M6	M6
Weight kg (lbs)	1.8 (4.0)	3.8 (8.4)	5.4 (11.9)	5.2 (11.5)	10 (22)	12 (26.5)	14 (31)	16 (35)
Wire size Main terminals mm^2 (AWG)	0.5…10 (20…6)	0.5…10 (20…6)	0.5…10 (20…6)	0.5…10 (20…6)	1.5…35 (16…0)	1.5…35 (16…0)	25…50 (6…0)	25…50 (6…0)
Tightening torque Main terminals N·m (lbf·in)	1.5 (13)	1.5 (13)	1.5 (13)	1.5 (13)	3.2 (28)	3.2 (28)	6 (53)	6 (53)
PE/Chassis terminals	M4	M5	M5	M5	M6	M6	M6	M8
Tightening torque PE/Chassis terminals N·m (lbf·in)	3 (26)	4 (35)	4 (35)	4 (35)	8 (70)	8 (70)	8 (70)	15 (135)

13

External EMC filters

Contents of this chapter

This chapter describes how to select external EMC filters for the drive.

Selecting the external EMC filter

If you use an external EMC filter, you must disconnect the internal EMC filter. Refer to the electrical installation instructions.

Select the external EMC filter according to the drive type:

Type ACS380-E042C-...	EMC filter type	
	ABB order code	Schaffner order code
3-phase U_N = 400 V		
01A8-4	RFI-32	FN 3258-16-44
02A6-4	RFI-32	FN 3258-16-44
03A3-4	RFI-32	FN 3258-16-44
04A0-4	RFI-32	FN 3258-16-44
05A6-4	RFI-32	FN 3258-16-44
07A2-4	RFI-32	FN 3258-16-44
09A4-4	RFI-32	FN 3258-16-44
12A6-4	RFI-33	FN 3258-30-33
17A0-4	RFI-33	FN 3258-30-33

Type ACS380-E042C-...	EMC filter type	
	ABB order code	Schaffner order code
25A0-4	RFI-33	FN 3258-30-33
033A-4	RFI-34	FN 3258-100-35
032A-4	RFI-34	FN 3258-100-35
038A-4	RFI-34	FN 3258-100-35
045A-4	RFI-34	FN 3258-100-35
050A-4	RFI-34	FN 3258-100-35

Refer to EMC compatibility and motor cable length (page 125) and EMC compliance (IEC/EN 61800-3:2004 + A1:2012) (page 134).

14

Resistor braking

Contents of this chapter

The chapter describes how to select the brake resistor and cables, protect the system, connect the brake resistor, and enable resistor braking.

Safety

WARNING Do not do work on the brake resistor or the resistor cable when the drive is energized. A dangerous voltage is present in the resistor circuit, even when the brake chopper is not operating, or when it is disabled by a parameter.

Operation principle

The brake chopper handles the extra energy generated by the motor during a quick deceleration. The extra energy increases the DC link voltage of the drive. The chopper connects the brake resistor to the DC link whenever the voltage is more than the operation limit of the chopper. The energy consumed by the resistor losses lowers the voltage until it is less than the limit at which the chopper stops.

Selecting the brake resistor

Drives have a built-in brake chopper as standard equipment. The brake resistor is selected using the table and equations shown in this section.

1. Determine the required maximum braking power P_{Rmax} for the application. P_{Rmax} must be smaller than P_{BRmax}. Refer to Reference brake resistors (page 155).

2. Calculate resistance *R* with Equation 1.
3. Calculate energy E_{Rpulse} with Equation 2.
4. Select the resistor so that the following conditions are met:
   - The rated power of the resistor must be more than or equal to P_{Rmax}.
   - Resistance *R* must be between R_{min} and R_{max} given in the table for the used drive type.
   - The resistor must be able to dissipate energy E_{Rpulse} during the braking cycle *T*.

Equations for selecting the resistor:

Equation 1

When the drive supply voltage is 200 ... 240 V:

$$R = \frac{150\ 000}{P_{Rmax}}$$

When the drive supply voltage is 380 … 415 V:

$$R = \frac{450\ 000}{P_{Rmax}}$$

When the drive supply voltage is 415 ... 480 V:

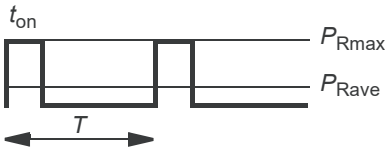
$$R = \frac{615\ 000}{P_{Rmax}}$$

Equation 2

$$E_{Rpulse} = P_{Rmax} \cdot t_{on}$$

Equation 3

$$P_{Rave} = P_{Rmax} \cdot \frac{t_{on}}{T}$$



For conversion, use 1 hp = 746 W.

R	Calculated brake resistor value (ohm). Make sure that: $R_{min} < R < R_{max}$
P_{Rmax}	Maximum power during the braking cycle (W)
P_{Rave}	Average power during the braking cycle (W)
E_{Rpulse}	Energy conducted into the resistor during a single braking pulse (J)
t_{on}	Braking time (one cycle) (s)
T	Braking cycle time (s)

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.

Reference brake resistors

Type ACS380-E042C-...	R_{min}	R_{max}	P_{BRcont}		P_{BRmax}		Example resistor types [1] [2]
	ohm	ohm	kW	hp	kW	hp	Danotherm
3-phase U_N = 400/480 V							
01A8-4	99	933	0.37	0.50	0.56	0.74	CBH 360 C T 406 210R or CAR 200 D T 406 210R
02A6-4	99	628	0.55	0.75	0.83	1.10	
03A3-4	99	428	0.75	1.00	1.13	1.50	
04A0-4	99	285	1.10	1.50	1.65	2.20	
05A6-4	99	206	1.50	2.00	2.25	3.00	
07A2-4	53	139	2.20	2.00	3.30	4.40	CBR-V 330 D T 406 78R UL
09A4-4	53	102	3.00	3.00	4.50	6.00	
12A6-4	32	76	4.00	5.00	6.00	8.00	
17A0-4	32	54	5.50	7.50	8.25	11.00	CBT-H 560 D HT 406 39R
25A0-4	23	39	7.50	10.00	11.25	15.00	
033A-4	16	33	11.00	15.00	17	22.00	CBT-H 560 D HT 406 19R
038A-4	6	24	15.00	20.00	23	30.00	CBT-H 760 D HT 406 16R
045A-4	6	20	18.50	25.00	28	37.00	
050A-4	6	20	22.00	30.00	30	40.00	

1) Braking cycle differs from that of the drive. Refer to brake resistor manufacturer's documentation.
2) If brake resistors from other manufacturers are used, the characteristics must agree with the values in the table.

Definitions

P_{BRmax} The maximum braking capacity of the drive, when the length of the braking pulse is at most 1 minute for each 10 minutes (P_{BRcont} × 1.5). Must be more than the desired braking power.

P_{BRcont} The continuous braking capacity of the drive

R_{max} The maximum resistance value of the brake resistor that can provide P_{BRcont}

R_{min} The minimum permitted resistance value of the brake resistor

Selecting and routing the brake resistor cables

Use a shielded cable specified in the technical data.

Minimizing electromagnetic interference

Make sure that the installation complies with the EMC requirements. Obey these rules to minimize electromagnetic interference caused by the rapid voltage and current changes in the resistor cables:

- Shield the brake resistor cable. Use shielded cable or a metallic enclosure. If you use unshielded single-core cables, route them inside a cabinet that efficiently suppresses the radiated emissions.
- Install the cables away from other cable routes.
- Avoid long parallel runs with other cables. The minimum parallel cabling separation distance is 0.3 meters (1 ft).
- Cross the other cables at 90° angles.
- Keep the cable as short as possible to minimize the radiated emissions and stress on the brake chopper. A longer cable produces more radiated emissions, inductive load, and voltage peaks over the IGBT semiconductors of the brake chopper.

Maximum cable length

The maximum length of the resistor cable(s) is 10 m (33 ft).

Selecting the installation location for the brake resistors

Protect the open (IP00) brake resistors against contact. Install the brake resistor in a place where it cools effectively. Arrange the cooling of the resistor so that:

- no danger of overheating is caused to the resistor or nearby materials, and
- the temperature of the space that the resistor is in does not go above the allowed maximum value.

⚠WARNING The materials near the brake resistor must be non-flammable. The surface temperature of the resistor is high. Airflow from the resistor can have a high temperature. If the exhaust vents connect to a ventilation system, make sure that the material withstands high temperatures. Protect the resistor against contact.

Protecting the system in brake circuit fault situations

Protecting the system in cable and brake resistor short-circuit situations

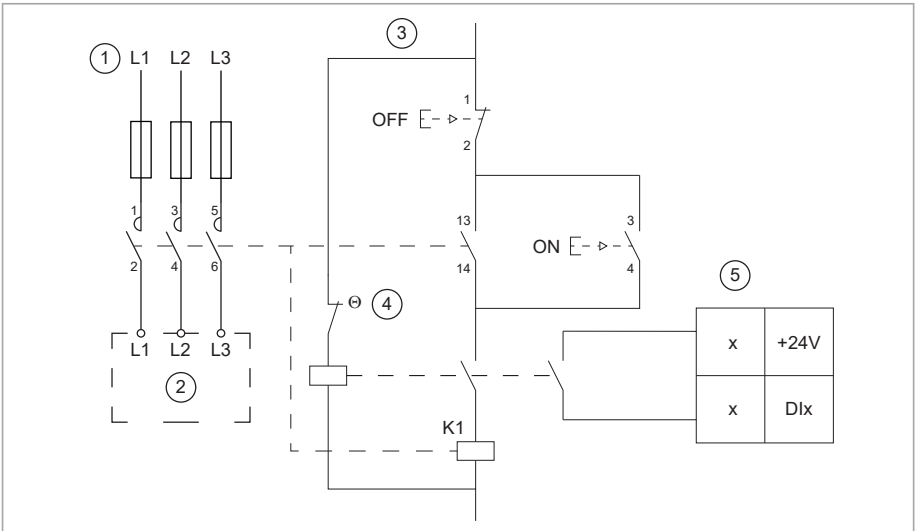
The drive input fuses also protect the resistor cable when it is identical to the input power cable.

Protecting the system against thermal overload

The drive has a brake thermal model that protects the brake resistor against overload. ABB recommends that you enable the thermal model at start up.

ABB recommends that you use a main contactor with the drive for safety reasons even when you have enabled the resistor thermal model. Connect the contactor so that it opens if the resistor overheats. This is essential for safety, since the drive will not otherwise be able to interrupt the main supply if the chopper conducts in a fault situation. The figure shows an example connection diagram. ABB recommends that you use resistors equipped with a thermal switch (1) in the resistor assembly. The switch indicates overtemperature.

ABB recommends that you connect the thermal switch to a digital input of the drive, and configure the input to cause a fault trip at resistor overtemperature indication.



1	Drive input power connection with a main contactor
2	Drive
3	Main contactor control circuit

4	Brake resistor thermal switch
5	Digital input. Monitors the brake resistor thermal switch.

Mechanical and electrical installation of brake resistor

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 Stop the drive and do the steps in Electrical safety precautions (page 16) before you start the work.

Mechanical installation

Refer to the resistor manufacturer's instructions.

Electrical installation

Measuring the insulation

See the electrical installation instructions of the drive.

Connecting power cables

See the electrical installation instructions of the drive.

Connection the control cables

Connect the thermal switch of the brake resistor as described in Protecting the system against thermal overload (page 157).

Start-up

Set the following parameters:

1. Disable the overvoltage control of the drive with parameter 30.30 Overvoltage control.
2. Set the source of parameter 31.01 External event 1 source to point to the digital input where the thermal switch of the brake resistor is wired.
3. Set parameter 31.02 External event 1 type to Fault.
4. Enable the brake chopper by parameter 43.06 Brake chopper enable. If Enabled with thermal model is selected, set also the brake resistor overload protection parameters 43.08 and 43.09 according to the application.
5. Check the resistance value of parameter 43.10 Brake resistance.

With these parameter settings, the drive generates a fault and coasts to a stop on brake resistor overtemperature.

15

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
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 13849-1:2023	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

Refer to the technical data.

Wiring

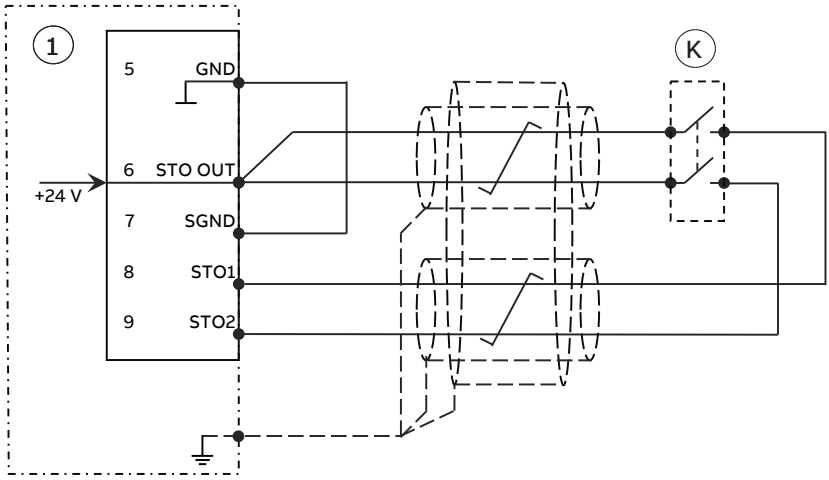
For the electrical specifications of the STO connection, see the technical data of the control unit.

Note:

- Both STO inputs (STO1 and STO2) must be in use. Otherwise, no SIL/PL classification is given.
- Pay special attention to prevent potential failure modes in the wiring. For example, use a shielded cable. For fault exclusion measures for wiring, refer to EN ISO 13849-2:2012, table D.4.

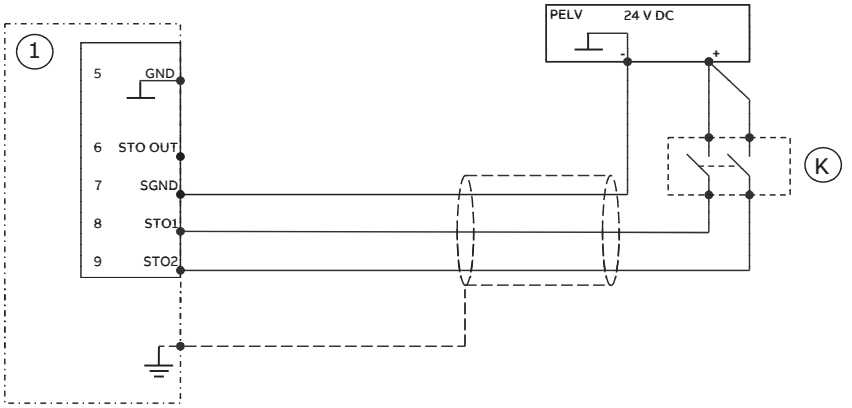
Wiring examples

Single ACS380-E drive, internal power supply



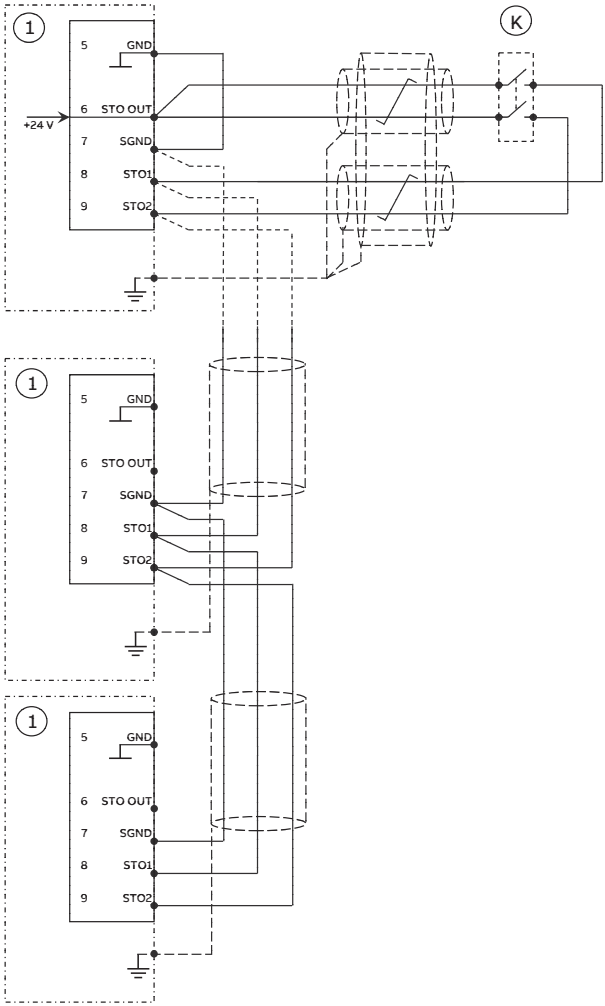
1	Drive
K	Activation switch

Single ACS380-E drive, external power supply



1	Drive
K	Activation switch

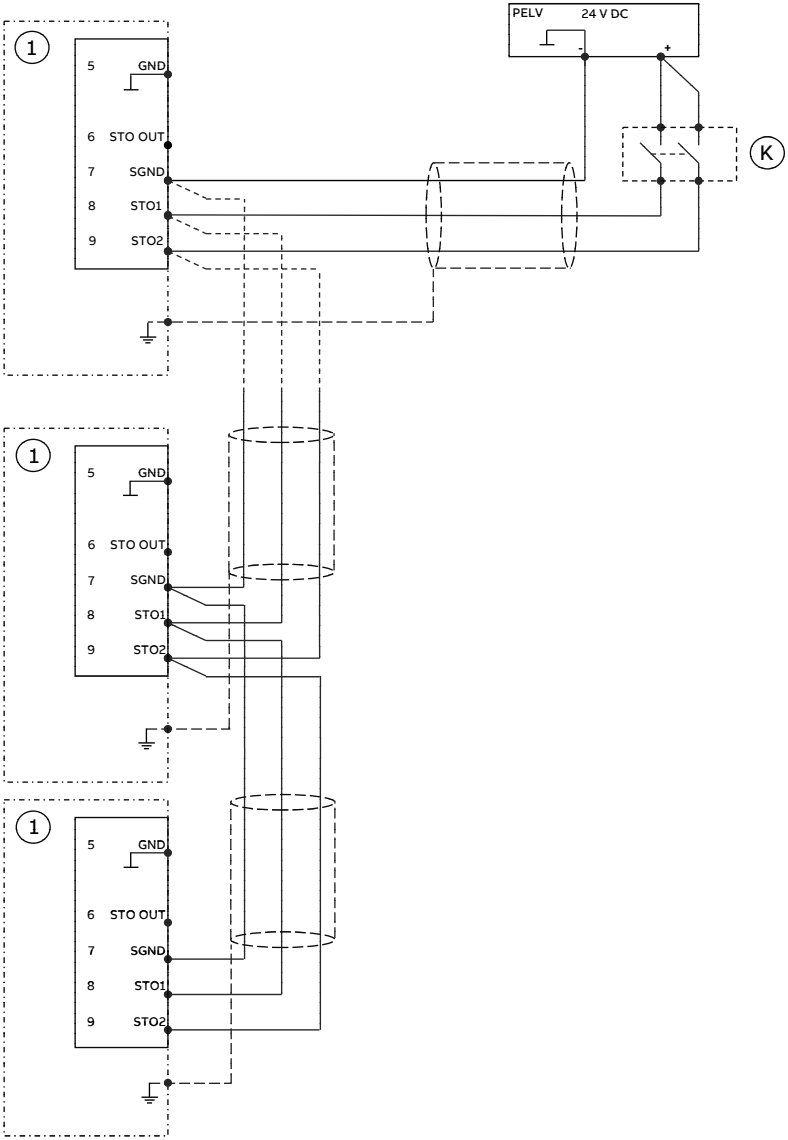
Multiple ACS380-E drives, internal power supply



1	Drive
K	Activation switch

Note: When you use the STO OUT signal of the drive, the maximum number of connected drives is 5.

Multiple ACS380-E drives, external power supply



1	Drive
K	Activation switch

Activation switch

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.

- 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.

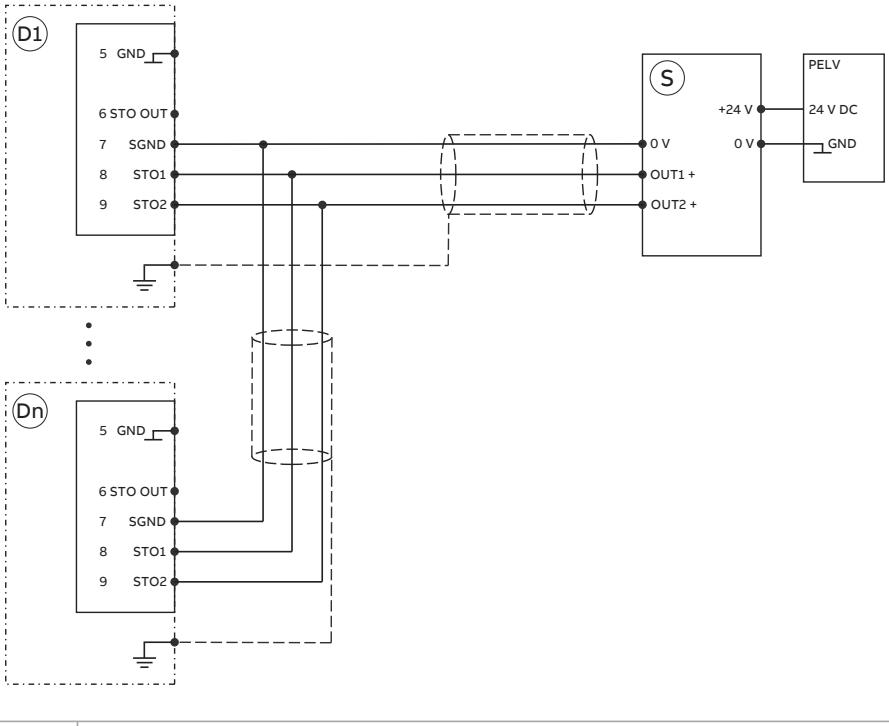
Safety PLC connection

There are two methods to connect a safety PLC to the Drive STO. For connection information, refer to the technical data of the safety PLC manufacturer. Make sure that the safety PLC is powered by a PELV power supply.

You can connect one or more drives to a safety PLC output. Consider the safety PLC digital output current capability and safety calculations (PFH/PFD) when you design a system.

Safety PLC +/+ connection to ACS380-E drives

The STO inputs of the drive connect to the safety PLC "+" outputs, and the STO SGND connects to the 0 V terminal of the safety PLC.

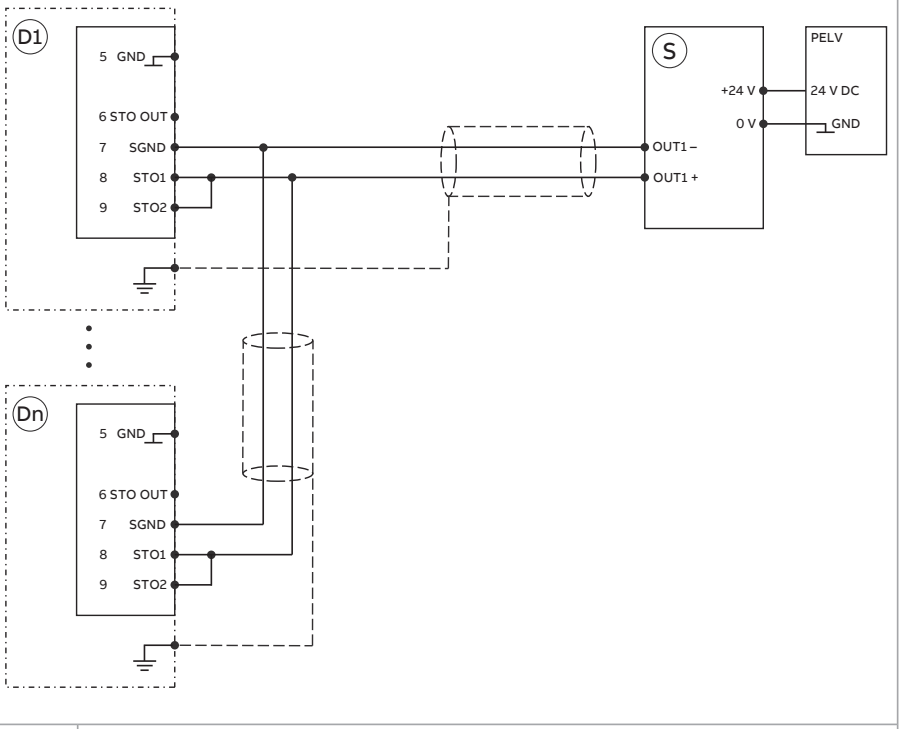


D1...Dn	Drives
S	Safety PLC

Note: Safety sensors typically use the +/+ connection with an OSSD output and can be connected to the STO input of the drive. Refer to the documentation of the safety sensor.

Safety PLC +/- connection to ACS380-E drives

Both of the drive STO inputs connect to a single safety PLC "+" output, and the STO SGND connects to the "-" output of the safety PLC.



D1...Dn	Drives
S	Safety PLC

Cable types and lengths

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

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 (refer to 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.	☐

Action	☑
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 (refer to 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.	☐
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 (refer to 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 (refer to 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 (refer to 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

1. 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 (refer to 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: Refer to Safety data (page 178). It is assumed that all dangerous failures of the STO circuit are detected by the proof test. To perform the proof test, do the Validation test procedure (page 172).

Note: Refer also to 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 Validation test procedure (page 172).

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.

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.

Refer to 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	PFH [1/h]	PFD_{avg} (T_1 = 2 a)	PFD_{avg} (T_1 = 5 a)	PFD_{avg} (T_1 = 10 a)	PFD_{avg} (T_1 = 20 a)	$MTTF_D$ [a]	DC [%]	SFF [%]	Cat.	HFT	CCF	T_M [a]
3-phase U_N = 400/480 V															
R1...R4 IEC61508	3	3	-	3.00E-09	3.00E-05	6.00E-05	1.20E-04	2.40E-04	-	-	60 to <90	-	1	-	20
R1...R4 ISO13849	-	-	e	3.00E-09	-	-	-	-	100	≥90	-	3	-	80	20
3AXD10001317952 A															

- The STO is a type A 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
  - 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

Term or abbreviation	Reference	Description
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 a…e 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 (1…3)
SFF	IEC 61508	Safe failure fraction (%)
SIL	IEC 61508	Safety integrity level (1…3)
STO	IEC/EN 61800-5-2	Safe torque off
T_1	IEC 61508-6	Proof test interval. 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 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_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
λ_{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.

16

AMIO-02 I/O extension module

Contents of this chapter

This chapter contains a description and technical data of the optional AMIO-02 I/O extension module.

Safety instructions

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

Hardware description

Product overview

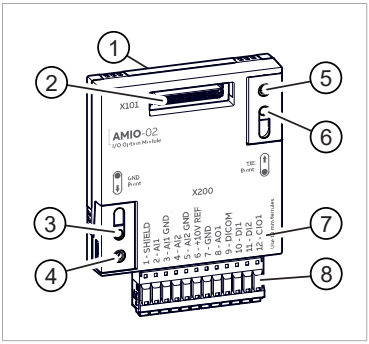
AMIO-02 (option +L538) is an input/output extension module.

AMIO-02 functions:

- 2 unipolar differential analog inputs.
  Input range: 0…11 V in voltage mode and 0…22 mA in current mode. Mode selection with firmware parameter.
- 1 unipolar analog output.
  Output range: 0…11 V in voltage mode and 0…22 mA in current mode. Mode selection with firmware parameter.
- 2 digital inputs. Supports both source and sink operation.

- 1 configurable input: Digital input, frequency input (10 Hz…16 kHz), or counter input. Supports both source and sink operation.
- +10 V reference output
- Digital input logic low and high that conforms to PLC standard IEC 61131.
  Logic high: 15…24 V DC
  Logic low: 0…5 V DC
- Refer to firmware parameter group 14 for the applicable parameters.

Layout



1. Option module connector (to the drive control unit)
2. Option module slot (for additional option module)
3. Sliding threaded fixing point for grounding
4. Grounding screw/threaded grounding point (GND Point)
5. Fixing screw/threaded fixing point (TIE Point)
6. Sliding threaded fixing point for attachment only
7. Designations for I/O terminal X200
8. Removable I/O terminal connector

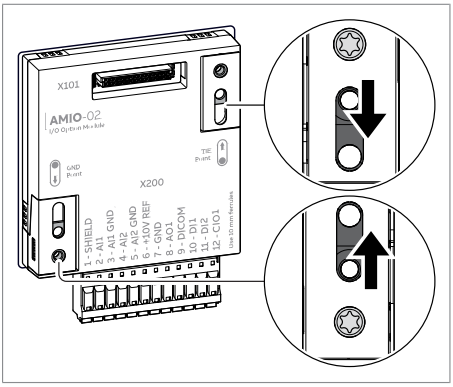
Mechanical installation and removal

⚠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.

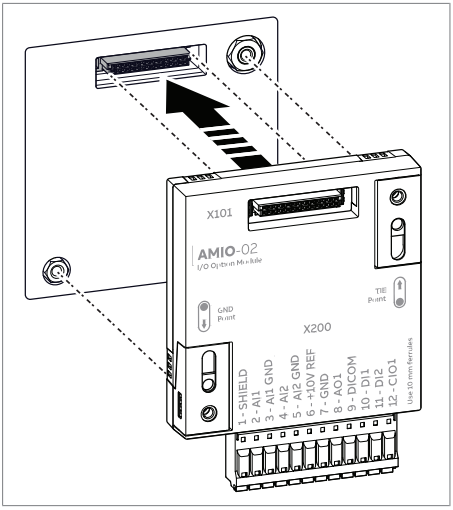
Refer to the quick installation guide in the product package.

To install the AMIO-02 I/O extension module:

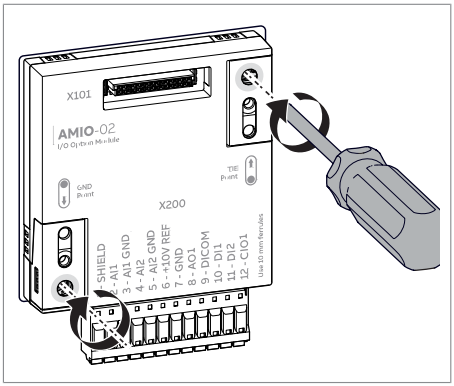
1. Stop the drive and do the steps in Electrical safety precautions (page 16) before you start the work.
2. Before you install the AMIO-02 I/O extension module, make sure that the threaded sliders are in the correct positions so that you can see the screw heads.



3. Carefully put the AMIO-02 I/O extension module on top of the option module slot of the drive.
4. Carefully push the AMIO-02 I/O extension module from the top near the option module connector until it fully connects to the drive.



5. Tighten the fixing screw (TIE Point) in the top right corner of the AMIO-02 I/O extension module to 0.5 N·m.



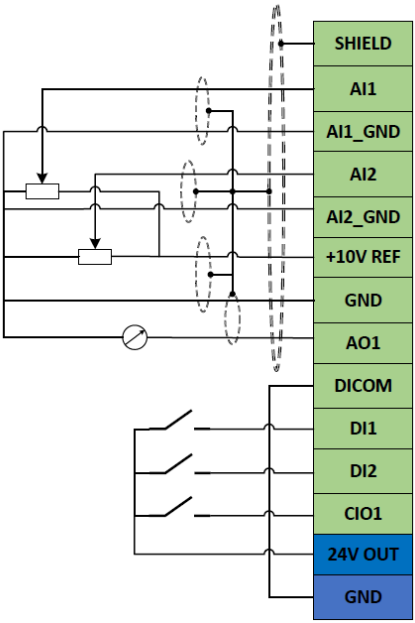
6. Tighten the grounding screw (GND Point) in the bottom left corner of the AMIO-02 I/O extension module to 0.5 N·m.
7. Move the threaded sliders for both the grounding screw and the fixing screw so that you can see the threaded holes.

To remove the AMIO-02 I/O extension module:

1. Stop the drive and do the steps in Electrical safety precautions (page 16) before you start the work.
2. Remove the control wires from the X200 terminal on the AMIO-02 I/O extension module.
3. Move the threaded sliders for the grounding point (GND Point) and fixing point (TIE Point) so that you can see the screw heads.
4. Loosen the fixing screw (TIE Point) in the top right corner of the AMIO-02 I/O extension module.
5. Loosen the grounding screw (GND Point) in the bottom left corner of the AMIO-02 I/O extension module.
6. Push the option module eject button of the drive and carefully pull the AMIO-02 I/O extension module from the top near the option module connector to remove it.
   To prevent damage to the drive and option module, do not pull the AMIO-02 I/O extension module from the bottom.

Electrical installation

The AMIO-02 I/O extension module has a removable I/O terminal connector with spring clamps. Use ferrules on multistranded conductor ends.

Connection	Terminal		Description
	1	SHIELD	Signal cable shield
	2	AI1	Analog input 1 (0...11 V / 0...22 mA)
	3	AI1 GND	Analog input 1 common
	4	AI2	Analog input 2 (0...11 V / 0...22 mA)
	5	AI2 GND	Analog input 2 common
	6	+10VREF	Reference voltage +10 V DC (max. 10 mA)
	7	GND	Ground for +10 V REF and AO1
	8	AO1	Analog output 1 (0...11 V / 0...22 mA)
	9	DICOM	Digital input common
	10	DI1	Digital input 1. Supports source and sink operation. Logic high >15 V DC and logic low <5 V DC.
	11	DI2	Digital input 2. Supports source and sink operation. Logic high >15 V DC and logic low <5 V DC.
	12	CIO1	Configurable input 1: Digital input 3, freq. input (10 Hz...16 kHz) or counter input
	Terminals on the drive base unit:		
	3	24VOUT	Auxiliary voltage output +24 V DC
	4	GND	Auxiliary voltage output common

Start-up

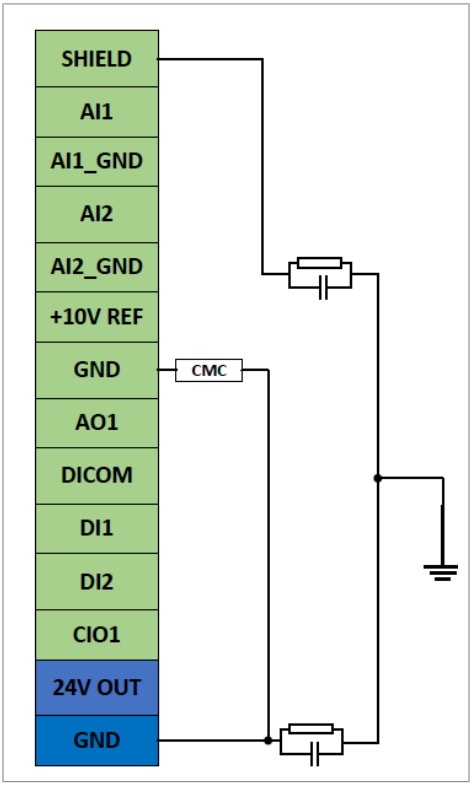
The drive identifies the AMIO-02 I/O extension module automatically. To configure the inputs and outputs, refer to parameter group 14 in the drive firmware manual.

Technical data

Control connection data:

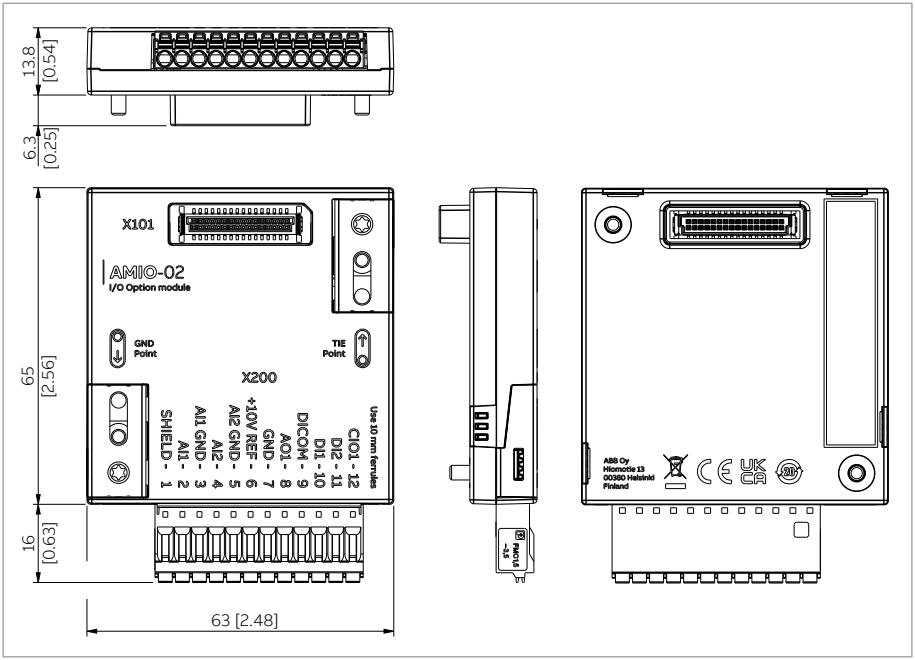
- Spring-type terminals in removable connectors.
- Conductor size accepted by the terminals: 0.2…1.5 mm^2 (24…16 AWG).
- Use 10 mm long ferrules on multistranded conductor ends.

Internal connections of GND and SHIELD terminals



Note: The analog inputs are differential inputs: AI1 GND and AI2 GND are not directly connected to the internal ground.

Dimensions


13.8
[0.54]
6.3
[0.25]
65
[2.56]
16
[0.63]
63 [2.48]
X101
AMIO-02
I/O Option module
GND
Point
TIE
Point
X200
SHIELD - 1
AI1 - 2
AI1 GND - 3
AI2 - 4
AI2 GND - 5
+10V REF - 6
GND - 7
AO1 - 8
DICOM - 9
DI1 - 10
DI2 - 11
CIO1 - 12
Use 30 mm ferrules
ABB Oy
Hiomotie 13
00380 Helsinki
Finland

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 new.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.

CIP a4 (frozen)
PDF-A5
Created 2025-08-20, 12:30:06

www.abb.com/drives

3AXD50001141677C

3AXD50001141677 Rev C (EN)
2025-08-20