ABB machinery drives

Hardware manual
ACS380 drives



Power and productivity
for a better world™

List of related manuals

Drive manuals and guides	Code (English)
ACS380 drives hardware manual	*3AXD50000029274*
ACS380 quick installation and start-up guide	*3AXD50000018553*
ACS380 user interface guide	*3AXD50000022224*
ACS380 firmware manual	*3AXD50000029275*

Option manuals and guides	
ACS-AP-x Assistant control panel user's manual	*3AUA0000085685*

Tool and maintenance manuals and guides	
Drive composer PC tool user's manual	*3AUA0000094606*
Converter module capacitor reforming instructions	*3BFE64059629*

You can find manuals and other product documents in PDF format on the Internet. Refer to *Document library on the Internet* on the inside of the back cover. For manuals not available in the Document library, contact your local ABB representative.

The QR code opens an online listing of the manuals applicable to this product.

Hardware manual

ACS380 drives

Table of contents

1. Safety instructions

4. Mechanical installation

6. Electrical installation

© 2016 ABB Oy. All Rights Reserved.

3AXD50000029274 Rev B
EN
EFFECTIVE: 2016-04-04

Table of contents

List of related manuals 2

1. Safety instructions

Contents of this chapter 13
Use of warnings and notes in this manual 13
General safety in installation, start-up and maintenance 14
Electrical safety in installation, start-up and maintenance 15
Precautions before electrical work 15
Additional instructions and notes 16
Grounding 17
Additional instructions for permanent magnet motor drives 18
Safety in installation, start-up and maintenance 18
General safety in operation 19

2. Introduction to the manual

Contents of this chapter 21
Applicability 21
Target audience 21
Purpose of the manual 21
Contents of this manual 22
Related documents 22
Categorization by frame (size) 22
Quick installation and commissioning flowchart 23

3. Hardware description

Contents of this chapter 27
General description 27
Product variants 27
Hardware overview 28
Control connections 29
Standard variant (I/O and Modbus) (ACS380-04xS) 29
Configured variant (ACS380-04xC) 30
Base variant (ACS380-04xN) 31
Side-mounted options 32
Assistant control panel options 32
PC connection 32
Drive labels 33
Model information label 33
Type designation label 34
Type designation key 35
Operation principle 37
Control panel 38
Home view 39
Message view 40

Options view 40
Menu 40

4. Mechanical installation

Contents of this chapter 41
Examining the installation site 42
Required tools 42
Unpacking the delivery 42
Installing the drive 43
To install the drive with screws 43
To install the drive to a DIN installation rail 44

5. Planning the electrical installation

Contents of this chapter 45
Selecting the supply disconnecting device 45
European Union 45
Other regions 46
Checking the compatibility of the motor and drive 46
Selecting the power cables 46
Typical power cable sizes 47
Recommended power cable types 48
Power cable types for limited use 48
Not allowed power cable types 48
Motor cable shield 49
Additional US requirements 49
Selecting the control cables 51
Shielding 51
Signals in separate cables 51
Signals that can be run in the same cable 51
Relay cable 51
Drive composer PC tool cable 51
Routing the cables 52
Separate control cable ducts 53
Continuous motor cable shield or conduit 53
Implementing short-circuit protection 53
Protecting the drive and input power cable in short-circuits 53
Protecting the motor and motor cable in short-circuits 53
Implementing thermal overload protection 54
Protecting the drive, and the input power and motor cables against thermal overload . . 54
Protecting the motor against thermal overload 54
Protecting the drive against ground faults 54
Residual current device compatibility 54
Implementing the emergency stop function 54
Implementing the Safe torque off function 55
Using a safety switch between the drive and motor 55
Using a contactor between the drive and motor 55
Protecting the contacts of relay outputs 56

6. Electrical installation

Contents of this chapter . . . 57
Warnings . . . 57
Required tools . . . 57
Measuring insulation . . . 58
Drive . . . 58
Input power cable . . . 58
Motor and motor cable . . . 58
Brake resistor assembly . . . 58
Compatibility with IT (ungrounded) and corner-grounded TN systems . . . 59
EMC filter . . . 59
EMC filter disconnection . . . 59
Ground-to-phase varistor . . . 59
Connecting the power cables . . . 60
Connection diagram . . . 60
Connection procedure . . . 61
Connecting the control cables . . . 62
Default I/O connection diagram (ABB standard macro) . . . 63
Fieldbus connection diagram . . . 64
Control cable connection procedure . . . 66
Auxiliary voltage connection . . . 67
Option modules . . . 68
To install a front option . . . 68
To remove a front option . . . 69
To install a side option . . . 69
To remove a side option . . . 69

7. Installation checklist

Contents of this chapter . . . 71
Warnings . . . 71
Checklist . . . 71

8. Maintenance

Contents of this chapter . . . 73
Maintenance intervals . . . 74
Cleaning the heat sink . . . 75
Replacing the cooling fans . . . 76
To replace the cooling fan . . . 76
Servicing the capacitors . . . 78
Capacitor reforming . . . 78

9. Technical data

Contents of this chapter . . . 79
Ratings . . . 80
IEC ratings . . . 80
NEMA ratings . . . 81
Definitions . . . 81
Sizing . . . 81

Derating . . . 82
Surrounding air temperature derating, IP20 . . . 83
Switching frequency derating . . . 83
Altitude derating . . . 83
Fuses (IEC) . . . 84
gG fuses . . . 84
UL fuses . . . 85
gR fuses . . . 86
Dimensions and weights . . . 87
Free space requirements . . . 88
Losses, cooling data and noise . . . 88
Terminal data for the power cables . . . 89
IEC . . . 89
Terminal data for the control cables . . . 90
EMC filters for Category C1 . . . 91
Electric power network specification . . . 92
Motor cable length . . . 93
Motor connection data . . . 93
Control connection data . . . 95
Brake resistor connection . . . 96
Efficiency . . . 96
Degrees of protection . . . 96
Ambient conditions . . . 97
Materials . . . 98
Applicable standards . . . 98
CE marking . . . 99
Compliance with the European Low Voltage Directive . . . 99
Compliance with the European EMC Directive . . . 99
Compliance with the European ROHS Directive . . . 99
Compliance with the European WEEE Directive . . . 99
Compliance with the European Machinery Directive . . . 100
Compliance with EN 61800-3:2004 + A1:2012 . . . 101
Definitions . . . 101
Category C1 . . . 101
Category C2 . . . 101
Category C3 . . . 102
Category C4 . . . 103
UL marking . . . 104
UL checklist . . . 104
CSA marking . . . 104
RCM marking . . . 104
EAC marking . . . 105
Disclaimers . . . 105
Generic disclaimer . . . 105
Cyber security disclaimer . . . 105

10. Dimension drawings

Frame R0 (230 V) . . . 108
Frame R0 (400 V) . . . 109
Frame R1 (230 V) . . . 110

Frame R1 (400 V) . . . 111
Frame R2 (230 V) . . . 112
Frame R2 (400 V) . . . 113
Frame R3 (400 V) . . . 114

11. Resistor braking

Contents of this chapter . . . 115
Operation principle and hardware description . . . 115
Selecting the brake resistor . . . 115
    Reference brake resistors . . . 117
Selecting and routing the brake resistor cables . . . 117
    Minimizing electromagnetic interference . . . 117
    Maximum cable length . . . 118
    EMC compliance of the complete installation . . . 118
Placing the brake resistor . . . 118
Protecting the system in brake circuit fault situations . . . 118
    Protecting the system in cable and brake resistor short-circuit situations . . . 118
    Protecting the system against thermal overload . . . 118
Mechanical installation . . . 119
Electrical installation . . . 119
    Checking the insulation of the assembly . . . 119
    Connection diagram . . . 119
    Connection procedure . . . 119
Start-up . . . 120

12. Safe torque off function

What this chapter contains . . . 121
Description . . . 121
    Compliance with the European Machinery Directive . . . 122
Connection principle . . . 123
    Connection with internal +24 V DC power supply . . . 123
    Connection with external +24 V DC power supply . . . 123
Wiring examples . . . 124
    Activation switch . . . 124
    Cable types and lengths . . . 125
    Grounding of protective shields . . . 125
Operation principle . . . 125
Start-up including acceptance test . . . 126
    Authorized person . . . 126
    Acceptance test reports . . . 126
    Acceptance test procedure . . . 127
Use . . . 128
Maintenance . . . 129
Fault tracing . . . 129
Safety data . . . 130
    Abbreviations . . . 132
    Declaration of conformity . . . 132
    Certificate . . . 132

13. BTAC-02 pulse encoder interface module

Contents of this chapter . . . 133
Safety instructions . . . 133
Hardware description . . . 134
Product overview . . . 134
Layout . . . 134
Mechanical installation . . . 135
Electrical installation . . . 135
Wiring – General . . . 135
Wiring – Encoder power supply interface . . . 137
Wiring – Encoder . . . 138
Start-up . . . 145
Feedback selection . . . 145
Encoder adapter settings . . . 146
Encoder configuration . . . 147
Diagnostics . . . 147
Technical data . . . 148
Encoder interface . . . 148
Back-up power supply for the drive . . . 148
Internal connectors . . . 148
Dimensions . . . 149

14. BREL-01 relay output extension module

Contents of this chapter . . . 151
Safety instructions . . . 151
Hardware description . . . 152
Product overview . . . 152
Layout . . . 152
Mechanical installation . . . 153
Electrical installation . . . 153
Terminal designations . . . 153
Wiring . . . 153
Apply power . . . 153
Start-up . . . 154
Configuration parameters . . . 154
Technical data . . . 156
External connectors . . . 156
Internal connectors . . . 156
Dimensions . . . 156

15. BAPO-01 auxiliary power extension module

Contents of this chapter . . . 157
Safety instructions . . . 157
Hardware description . . . 158
Product overview . . . 158
Layout . . . 158
Mechanical installation . . . 159
Electrical installation . . . 159

Start-up 159
Technical data 160
Voltage and current rating for the auxiliary power supply 160
Power loss 160
Dimensions 160

Further information

Product and service inquiries 161
Product training 161
Providing feedback on ABB Drives manuals 161
Document library on the Internet 161



1

Safety instructions

Contents of this chapter

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



Use of warnings and notes in this manual

Warnings tell you about conditions which can cause injury or death, or damage to the equipment. They also tell you how to prevent the danger. Notes draw attention to a particular condition or fact, or give information on a subject.

The manual uses these warning symbols:

	**Electricity warning** tells you about hazards from electricity which can cause injury or death, or damage to the equipment.
	**General warning** tells you about conditions, other than those caused by electricity, which can cause injury or death, or damage to the equipment.
	**Electrostatic sensitive devices warning** tells you about the risk of electrostatic discharge which can cause damage to the equipment.

General safety in installation, start-up and maintenance

These instructions are for all personnel that install the drive and do maintenance work on it.

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

- Handle the drive carefully.
- Use safety shoes with a metal toe cap.
- Keep the drive in its package or protect it otherwise from dust and burr from drilling and grinding until you install it.
- Vacuum clean the area below the drive before the start-up to prevent the drive cooling fan from drawing the dust inside the drive.
- Protect also the installed drive against dust and burr. Electrically conductive debris inside the drive may cause damage or malfunction.
- Do not cover the air inlet and outlet when the drive runs.
- Make sure that there is sufficient cooling.
- Before you connect voltage to the drive, make sure that the drive covers are on. Keep the covers on during operation.
- 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 automatic fault reset 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.
- The maximum number of drive power-ups is two per minute. Too frequent power-ups can damage the charging circuit of the DC capacitors. The maximum total number of chargings is 15000.
- If you have connected safety circuits to the drive (for example, emergency stop and Safe torque off), validate them at the start up.

Note:

- If you select an external source for start command and it is on, the drive will start immediately after a fault reset, unless you configure the drive for pulse start.
- When the control location is not set to local, the stop key on the control panel does not stop the drive.
- Drives can be repaired only by an authorized person.

Electrical safety in installation, start-up and maintenance

Precautions before electrical work

These warnings are for all personnel 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 electrician, do not do electrical installation or maintenance work. Do these steps before you begin any installation or maintenance work.

1. Clearly identify the work location.
2. Disconnect all possible voltage sources.
   - Open the main disconnector at the power supply of the drive.
   - Make sure that reconnection is not possible. Lock the disconnector to open position and attach a warning notice to it.
   - Disconnect any external power sources from the control circuits before you do work on the control cables.
   - After you disconnect the drive, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you continue.
3. Protect any other energized parts in the work location against contact.
4. Take special precautions when close to bare conductors.
5. Measure that the installation is de-energized.
   - Use a multimeter with an impedance of at least 1 Mohm.
   - Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding terminal (PE) is close to 0 V.
   - Make sure that the voltage between the drive DC terminals (UDC+ and UDC-) and the grounding terminal (PE) is close to 0 V.
6. Install temporary grounding as required by the local regulations.
7. Ask for a permit to work from the person in control of 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 install the drive on an IT system (an ungrounded power system or a high-resistance-grounded [over 30 ohms] power system), disconnect the internal EMC filter; otherwise the system will be connected to ground potential through the EMC filter capacitors. This can cause danger or damage the drive.
  Note: Disconnecting the internal EMC filter increases the conducted emission and reduces the drive EMC compatibility considerably.
- If you connect the drive to an IT system (an ungrounded power system or a high-resistance-grounded [over 30 ohms] power system), disconnect the varistor from ground. Failure to do so can cause damage to the varistor circuit.
- If you install the drive on a corner-grounded TN system, disconnect the internal EMC filter; otherwise the system will be connected to ground potential through the EMC filter capacitors. This will damage the drive.
  Note: Disconnecting the internal EMC filter increases the conducted emission and reduces the drive EMC compatibility considerably.
- Use all ELV (extra low voltage) circuits connected to the drive only within a zone of equipotential bonding, that is, within a zone where all simultaneously accessible conductive parts are electrically connected to prevent hazardous voltages appearing between them. You can accomplish this by a proper factory grounding, that is, make sure that all simultaneously accessible conductive parts are grounded to the protective earth (PE) bus of the building.
- Do not do insulation or voltage withstand tests on the drive.

Note:

- The motor cable terminals of the drive are at a dangerous voltage when the input power is on, regardless of whether the motor is running or not.
- The DC and brake resistor terminals (UDC+, UDC-, R+ and R-) are at a dangerous voltage.
- External wiring can supply dangerous voltages to the terminals of relay outputs.
- 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.

WARNING! Use a grounding wrist band when you handle the printed circuit boards. Do not touch the boards unnecessarily. The components on the boards are sensitive to electrostatic discharge.

Grounding

These instructions are for all personnel who are responsible for the electrical installation, including 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 electrician, do not do grounding work.
- Always ground the drive, the motor and adjoining equipment to the protective earth (PE) bus of the power supply. This is necessary for the personnel safety. Proper grounding also reduces electromagnetic emission and interference.
- In a multiple-drive installation, connect each drive separately to the protective earth (PE) bus of the power supply.
- Make sure that the conductivity of the protective earth (PE) conductors is sufficient. Refer to *Selecting the power cables* on page *46*. Obey the local regulations.
- Connect the power cable shields to the protective earth (PE) terminals of the drive.
- Make a 360° grounding of the power and control cable shields at the cable entries to suppress electromagnetic disturbances.

Note:

- You can use power cable shields as grounding conductors only when their conductivity is sufficient.
- Standard IEC/EN 61800-5-1 (section 4.3.5.5.2.) requires that as the normal touch current of the drive is higher than 3.5 mA AC or 10 mA DC, you must use a fixed protective earth (PE) connection. In addition,
  - install a second protective earth conductor of the same cross-sectional area as the original protective earthing conductor,

  or
  - install a protective earth conductor with a cross-section of at least 10 mm^2 Cu or 16 mm^2 Al,

  or
  - install a device which automatically disconnects the supply if the protective earth conductor breaks.

Additional instructions for permanent magnet motor drives

Safety in installation, start-up and maintenance

These are additional warnings concerning 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 and damage to the equipment can occur.

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

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

- Stop the motor.
- Disconnect the motor from the drive with a safety switch or by other means.
- If you cannot disconnect the motor, make sure that the motor cannot rotate during work. Make sure that no other system, like hydraulic crawling drives, can rotate the motor directly or through any mechanical connection like felt, nip, rope, etc.
- Measure that the installation is de-energized.
  - Use a multimeter with an impedance of at least 1 Mohm.
  - Make sure that the voltage between the drive output terminals (T1/U, T2/V, T3/W) and the grounding (PE) busbar is close to 0 V.
  - Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding (PE) busbar is close to 0 V.
  - Make sure that the voltage between the drive DC terminals (UDC+, UDC-) and the grounding (PE) terminal is close to 0 V.
- 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.

Start-up and operation:

- Make sure that the operator cannot run the motor over the rated speed. Motor overspeed causes overvoltage that can damage or explode the capacitors in the intermediate circuit of the drive.

General safety in operation

These instructions are for all personnel that operate the drive.



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

- Do not control the motor with the disconnector at the drive power supply. Use the control panel start and stop keys or the start/stop commands from an external control device connected through the I/O or fieldbus interface.
- 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 will start immediately after the fault reset, unless you configure the drive for pulse start. See the firmware manual.
- Before you activate automatic fault reset 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.

Note: When the control location is not set to Local, the stop key on the control panel will not stop the drive.





2

Introduction to the manual

Contents of this chapter

The chapter describes the applicability, target audience and purpose of this manual. It describes the contents of this manual. The chapter also has a flowchart for the delivery, installation and commissioning of the drive.

Applicability

The manual applies to ACS380 drives.

Target audience

The reader must know the fundamentals of electricity, wiring, electrical components and electrical schematic symbols.

Purpose of the manual

This manual has the information needed to plan the installation, and install, commission and service the drive.

Contents of this manual

- *Safety instructions* (on page *13*) gives the safety instructions that you must obey when you install, commission, operate and service the drive.
- *Introduction to the manual* (on page *21*) describes the applicability, target audience, purpose and contents of this manual.
- *Hardware description* (on page *27*) describes the operation principle, layout, power connections and control interfaces, type designation information.
- *Mechanical installation* (on page *41*) describes how to examine the installation site, unpack, examine the delivery and install the drive mechanically.
- *Planning the electrical installation* (on page *45*) describes how to plan the electrical installation of the drive.
- *Electrical installation* (on page *57*) describes how to measure the insulation of the assembly and the compatibility with IT (ungrounded) and corner-grounded TN systems. It shows how to connect the power and control cables, install optional modules and connect a PC.
- *Installation checklist* (on page *71*) contains a checklist for the mechanical and electrical installation of the drive before start-up.
- *Maintenance* (on page *73*) contains the preventive maintenance instructions and LED indicator descriptions.
- *Technical data* (on page *79*) contains the technical specifications of the drive.
- *Dimension drawings* (on page *107*) shows the dimension drawings of the drive.
- *Resistor braking* (on page *115*) tells you how to select the brake resistor.
- *Safe torque off function* (on page *121*) describes the STO features, installation and technical data.
- *BTAC-02 pulse encoder interface module* on page *133* describes the optional BTAC-02 module.
- *BREL-01 relay output extension module* on page *151* describes the optional BREL-01 module.
- *BAPO-01 auxiliary power extension module* on page *157* describes the optional BAPO-01 module.

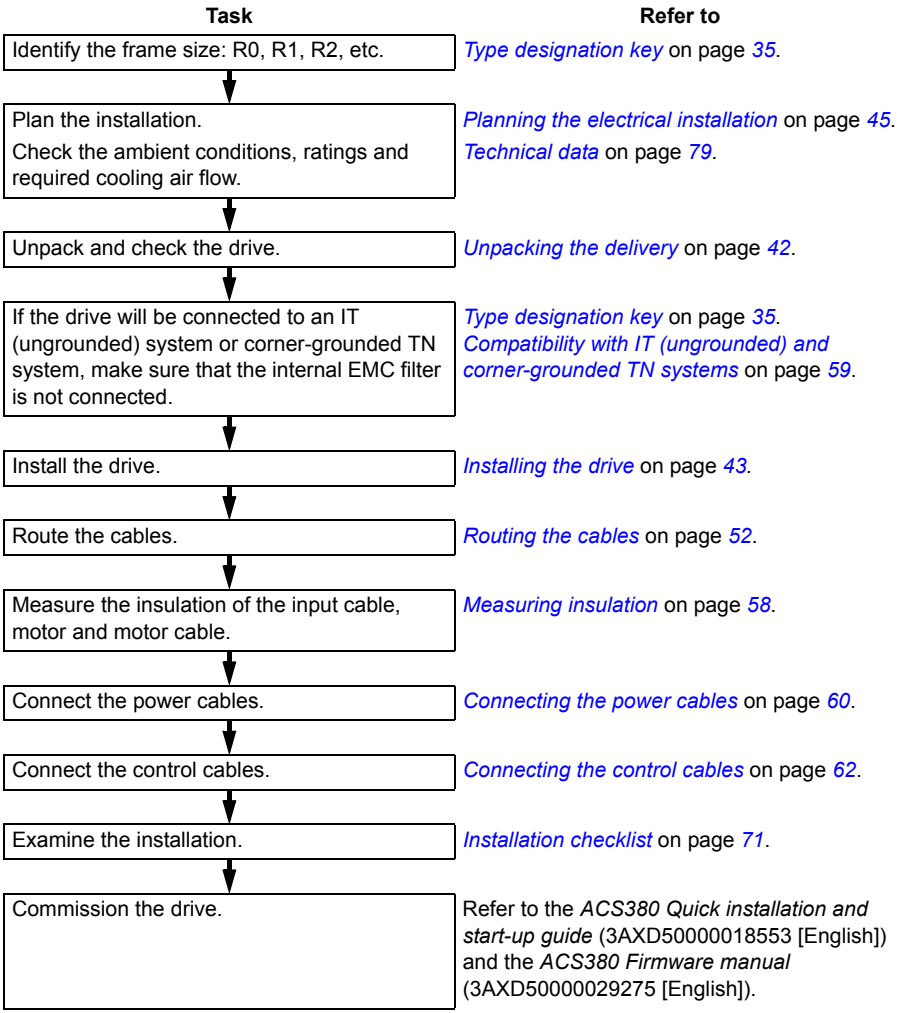
Related documents

Refer to *List of related manuals* on page *2* (the inner front cover).

Categorization by frame (size)

The drive is manufactured in frames (frame sizes) R0, R1, R2, etc. Some instructions and other information which only concern certain frames show the frame size. You can read the frame size from the type designation label on the drive, refer to *Drive labels* on page *33*.

Quick installation and commissioning flowchart



Terms and abbreviations

Term/abbreviation	Explanation
ACS-AP-X	Assistant control panel. An advanced operator keypad for communication with the drive.
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. Essential part of the brake circuit. Refer to *Brake chopper*.
Capacitor bank	Refer to *DC link capacitors*.
Control board	Circuit board in which the control program runs.
BAPO-01	Optional side-mounted auxiliary power extension module
BCAN-11	Optional CANopen interface
BCBL-01	Optional USB to RJ45 cable
BREL-01	Optional side-mounted relay output extension module
BTAC-02	Optional side-mounted pulse encoder interface module
CCA-01	Optional cold configuration adapter
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
EFB	Embedded fieldbus
EMC	Electromagnetic compatibility
FBA	Fieldbus adapter
FCAN-01/-01-M	Optional CANopen adapter module
FCNA-01	Optional ControlNet adapter module
FDNA-01	Optional DeviceNet adapter module
FECA-01/-01-M	Optional EtherCAT adapter module
FENA-11/-21/ -21-M	Optional Ethernet adapter module for EtherNet/IP, Modbus TCP and PROFINET IO protocols
FEPL-02	Optional Ethernet POWERLINK adapter module
FPBA-01/-01-M	Optional PROFIBUS DP adapter module
Frame (size)	Refers to drive physical size, for example, R0 and R1. The type designation label attached to the drive shows the frame of the drive, refer to *Type designation key* on page *35*.
I/O	Input/Output
IGBT	Insulated gate bipolar transistor
Intermediate circuit	Refer to *DC link*.
Inverter	Converts direct current and voltage to alternating current and voltage.
LRFI	Series of optional EMC filters

Term/abbreviation	Explanation
LSW	Least significant word
Macro	Pre-defined default values of parameters in drive control program. Each macro is intended for a specific application.
NETA-21	Optional remote monitoring tool
Network control	With fieldbus protocols based on the Common Industrial Protocol (CIP™), such as DeviceNet and Ethernet/IP, denotes the control of the drive using the Net Ctrl and Net Ref objects of the ODVA AC/DC Drive Profile. For more information, refer to www.odva.org, and the following manuals: • *FDNA-01 DeviceNet adapter module user's manual* (3AFE68573360 [English]) • *FENA-01/-11/-21 Ethernet adapter module user's manual* (3AUA0000093568 [English])
Parameter	User-adjustable operation instruction to the drive, or signal measured or calculated by the drive
PLC	Programmable logic controller
PROFIBUS, PROFIBUS DP, PROFINET IO	Registered trademarks of PI - PROFIBUS & PROFINET International
R0, R1, …	*Frame (size)*
RCD	Residual current device
Rectifier	Converts alternating current and voltage to direct current and voltage.
RFI	Radio-frequency interference
SIL	Safety integrity level. Refer to *Safe torque off function* on page *121*.
STO	Safe torque off. Refer to *Safe torque off function* on page *121*.

3

Hardware description

Contents of this chapter

This chapter describes the operation principle, layout, type designation label and type designation information. It shows a general diagram of the power connections and control interfaces.

General description

The ACS380 is a drive for controlling asynchronous AC induction motors, permanent magnet synchronous motors and ABB synchronous reluctance motors (SynRM motors). It is optimized for cabinet mounting.

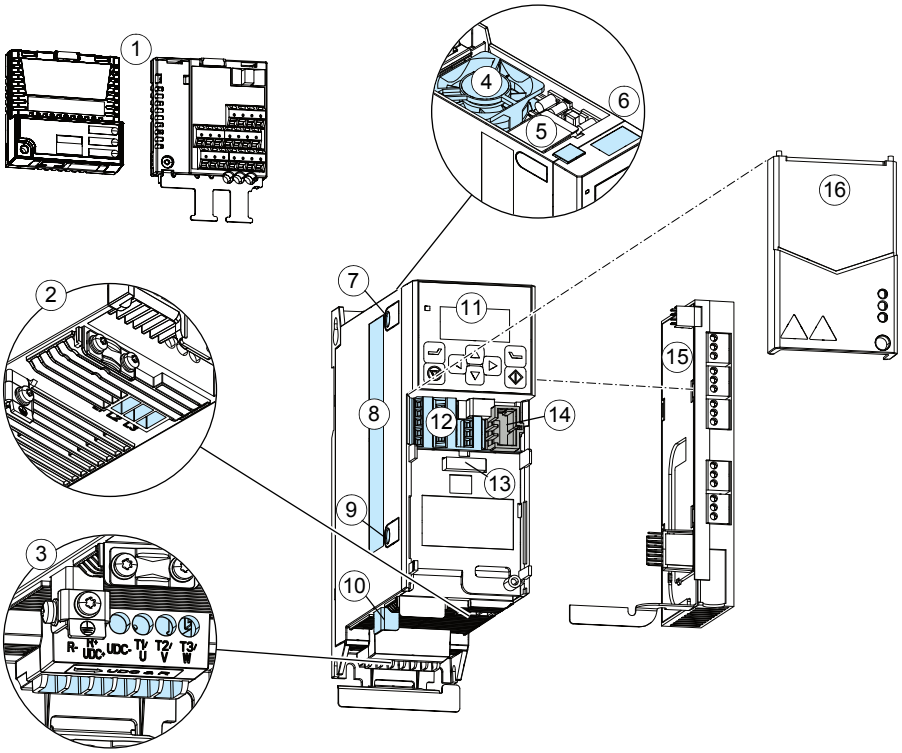
Product variants

The drive has three primary product variants:

- Standard variant (ACS380-04xS) with extended I/O & Modbus module
- Configured variant (ACS380-04xC) for which the extension module, such as the preconfigured fieldbus adapter, is chosen when ordering.
- Base variant (ACS380-04xN) without preinstalled extension modules

Refer to *Type designation key* on page *35*.

Hardware overview

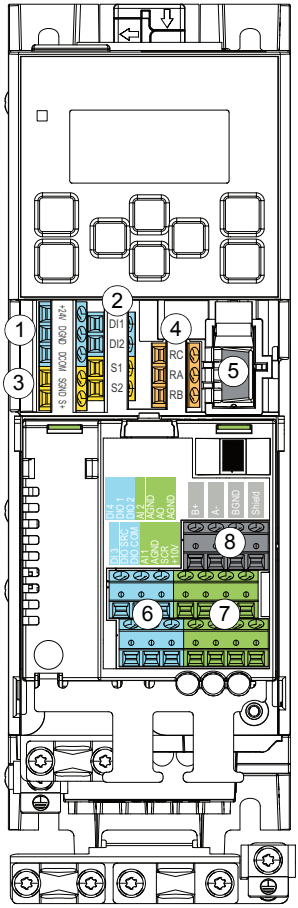


Item	Description	Item	Description
1	Front option modules (I/O and Modbus or Fieldbus module depending on the variant)	9	Varistor grounding screw
		10	PE connection (motor)
		11	Control panel, display and status LED
2	Input power connection terminal	12	Fixed control terminals
3	Motor and braking resistor connection terminal	13	Option slot 1 for communication modules (I/O or Fieldbus modules)
4	Cooling fan	14	Cold configuration connection for CCA-01
5	Panel and PC tool port (RJ45)		
6	Model information label	15	Option slot 2 for side-mounted options
7	EMC filter grounding screw	16	Front cover
8	Type designation label		

Control connections

In addition to the fixed control connections in the base unit, the other control connections depend on the drive variant.

Standard variant (I/O and Modbus) (ACS380-04xS)

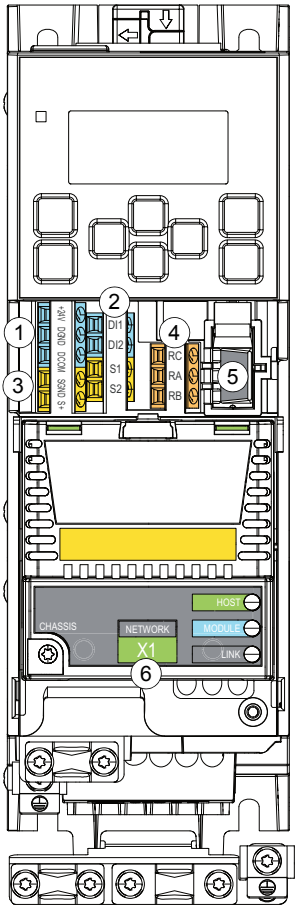


The standard variant has a type code as follows: ACS380-04x**S**. Refer to *Type designation key* on page *35*.

Connections:

1. Auxiliary voltage outputs
2. Digital inputs
3. Safe torque-off connections
4. Relay output connection
5. Cold configuration connection for CCA-01
6. Digital inputs and outputs
7. Analog inputs and outputs
8. EIA-485 Modbus RTU

Configured variant (ACS380-04xC)

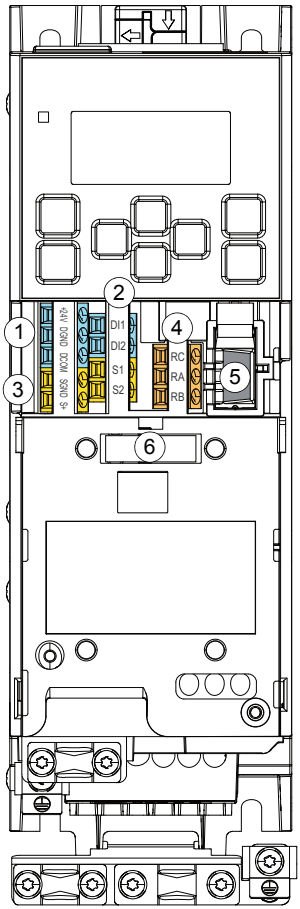


The configured variant has a type code as follows: ACS380-04x**C** followed by an option code that designates the extension module. Use the configured variant to order a product with a specific fieldbus extension module. Refer to *Type designation key* on page *35*.

Connections:

1. Auxiliary voltage outputs
2. Digital inputs
3. Safe torque-off connections
4. Relay output connection
5. Cold configuration connection for CCA-01
6. Fieldbus connections depending on the module

Base variant (ACS380-04xN)



The connections of the base unit:

1. Auxiliary voltage outputs
2. Digital inputs
3. Safe torque-off connections
4. Relay output connection
5. Cold configuration connection for CCA-01
6. Option module slot 1

Side-mounted options

For information on side-mounted optional extension modules, refer to:

- *BTAC-02 pulse encoder interface module* on page *133*
- *BREL-01 relay output extension module* on page *151*
- *BAPO-01 auxiliary power extension module* on page *157*

Assistant control panel options

The drive supports these assistant control panels:

- ACS-AP-I
- ACS-AP-S
- ACS-AP-W
- ACS-BP-S

PC connection

To connect a PC to the drive, use a USB to RJ45 converter. There are 2 alternatives:

1. Use an ACS-AP-I assistant control panel as a converter.

2. Use a USB to RJ45 converter. You can order it from ABB (BCBL-01, 3AXD50000032449).

Connect the cable to the Panel and PC tool port (RJ45) on the top of the drive. Refer to *Hardware overview* on page *28*.

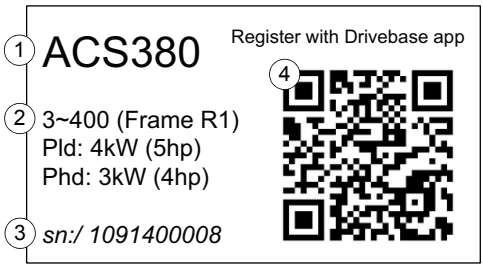
For information on the Drive composer PC tool, refer to *Drive composer PC tool user's manual* (3AUA0000094606 [English]).

Drive labels

The drive has two labels:

- Model information label on the top of the drive
- Type designation label on the left side of the drive

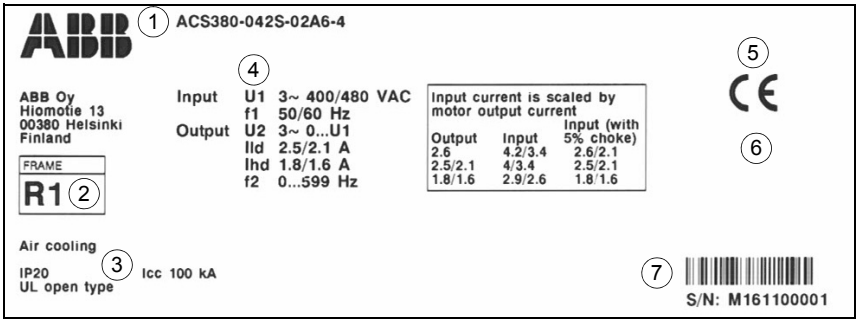
Model information label



No.	Description
1	Drive type
2	Frame size and ratings
3	Serial number
4	QR code to register the drive

Type designation label

This is a sample type designation label.



No.	Description
1	Type designation, refer to *Type designation key* on page *35*.
2	Frame (size)
3	Degree of protection
4	Nominal ratings, refer to *Ratings* on page *80*.
5	Valid markings
6	UL/CSA data. Refer to *Electric power network specification* on page *92*.
7	S/N: Serial number of format MYYWWXXXX, where M: Manufacturer YY: Year of manufacture: 15, 16, 17, … for 2015, 2016, 2017, … WW: Week of manufacture: 01, 02, 03, … for week 1, week 2, week 3, … XXXX: Running item number that starts each week from 0001.

Type designation key

The type designation tells you the specifications and configuration of the drive. The table shows the primary drive variants.

Sample type code: ACS380-042S-02A6-4+XXXX

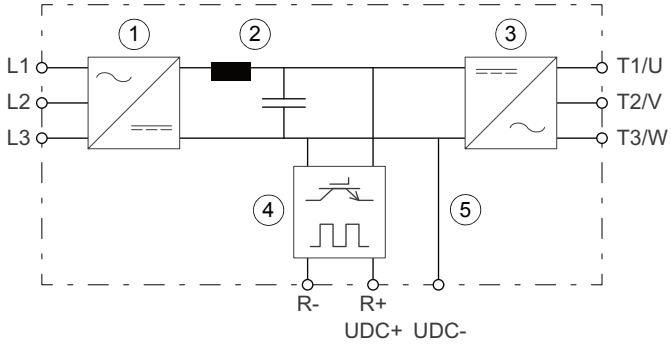
Segment		**A**	**B**	**C**		**D**		**E**		**F**
ACS380	-	04	2	S	-	02A6	-	4	+	Option codes

	Code	**Description**
A	Construction	04 = Module, IP20
B	EMC filter	0 = Low filtering level (EN 61800-3, Class C4 (200 V units) or C3 (400 V units) 2 = High filtering level for First environment (EN 61800-3, Class C2)
C	Connectivity	S = Standard variant (I/O and Modbus) C = Configured variant N = Base variant, without additional connectivity
D	Current rating	For example, 02A6 refers to a nominal output current of 2.6 A.
E	Voltage rating	1 = 1-phase 230 V 4 = 3-phase 380...480 V
F	**Option codes**	
	Fieldbus	+K454 FPBA-01-M preconfigured Profibus-DP protocol +K457 FCAN-01-M preconfigured CANopen protocol +K469 FECA-01-M preconfigured EtherCAT protocol +K475 FENA-21-M preconfigured Profinet protocol (Ethernet/IP or Modbus/TCP built-in) +K495 BCAN-11 CANopen interface
	PC cable	+J431 BCBL-01 PC cable USB to RJ45
	I/O	+L511 BREL-01 External relay option (4x relay) (side option) +L534 BAPO-01 External 24 V DC (side option) +L535 BTAC-02 HTL encoder interface + External 24 V DC (side option) +L538 I/O & Modbus extension module (front option)

	Code	Description	
	Documentation	+R700 English +R701 German +R702 Italian +R703 Dutch +R704 Danish +R705 Swedish +R706 Finnish +R707 French +R708 Spanish +R709 Portuguese (in Portugal) +R711 Russian +R712 Chinese +R714 Turkish	The option code determines the language varaints of the *Hardware manual* and *Firmware manual*. The product package includes the *User interface guide* and *Quick installation and start-up guide* in English, French, German, Italian and Spanish, and in the local language (if it is available).

Operation principle

The figure shows the simplified main circuit diagram of the drive.



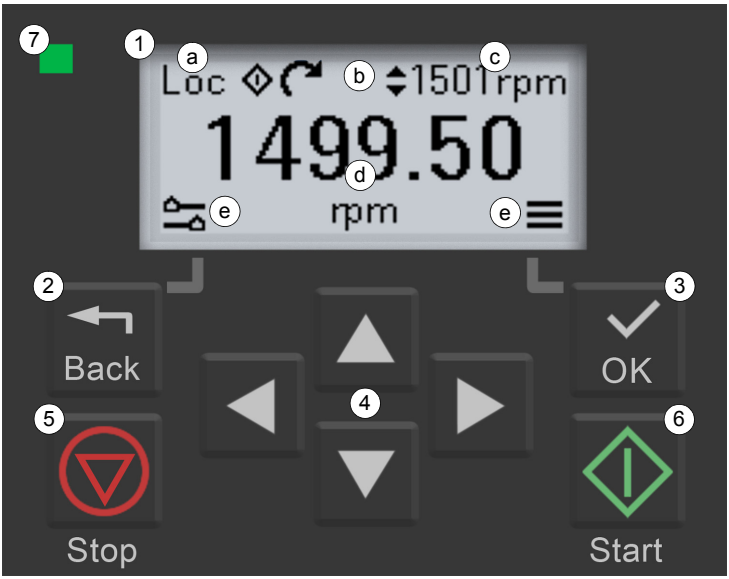
1	Rectifier. Converts alternating current and voltage to direct current and voltage.
2	DC link. DC circuit between rectifier and inverter (choke and capacitor).
3	Inverter. Converts direct current and voltage to alternating current and voltage.
4	Brake chopper. Conducts the surplus energy from the intermediate 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 certain maximum limit. The voltage rise is typically caused by deceleration (braking) of a motor. The user obtains and installs the brake resistor when needed.
5	DC connection (UDC+, UDC-).

Control panel

The drive has an intregrated control panel with a display and control keys.

For quick reference, there is a *ACS380 User interface guide* under (3AXD50000022224 [English]) the main cover of the drive.

Refer to the *ACS380 Firmware manual* (3AXD50000029275 [English]) for information on how to use the 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	Status LED: Steady green: Normal operation Blicking green: Active warning Steady red: Active fault Blinking red: Active fault, set power to off to reset

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

The status icons show the operational status of the drive:

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
	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 either the active fault as an icon and fault code, or a list of the most recent warnings codes.

Refer to the *ACS380 User interface guide* (3AXD50000022224 [English]) or *ACS380 Quick installation and start-up guide* (3AXD50000018553 [English]) for a list of the most typical faults and warnings.

For more detailed fault and warning information, refer to the *ACS380 Firmware manual* (3AXD50000029275 [English]).

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.
- *Control macros* view: Select the connection parameter macro.
- *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 *ACS380 Firmware manual* (3AXD50000029275 [English]).

4

Mechanical installation

Contents of this chapter

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

Installation alternatives

You can install the drive:

- With screws on to a wall
- With screws on to an assembly plate
- On to a DIN installation rail (with the integrated lock)

Installation requirements:

- Make sure that there is a minimum of 75 mm of free space at the top and bottom of the drive (at the cooling air inlet and outlet).
- You can install several drives side by side. Note that side-mounted options require 20 mm of space on the right side of the drive.
- Install R0 drives upright. R0 drive do not have a cooling fan.
- You can install R1, R2 and R3 drives tilted by up to 90 degrees.
- Make sure that the cooling air exhaust at the top of the drive is not below the cooling air inlet at the bottom of the drive.
- Make sure that the hot cooling air from a drive does not go into the cooling inlet of other equipment.
- The drive has an IP20 ingress protection classification for cabinet installation.

Examining the installation site

Make sure that:

- There is sufficient cooling. Refer to *Losses, cooling data and noise* on page *88*.
- The operation conditions meet the specifications in *Ambient conditions* on page *97*.
- The installation surface is as close to vertical as possible, of non-flammable material and strong enough to carry the weight of the drive. Refer to *Dimensions and weights* on page *87*.
- The material above and below the drive is non-flammable.
- There is sufficient free space above and below the drive for service and maintenance.

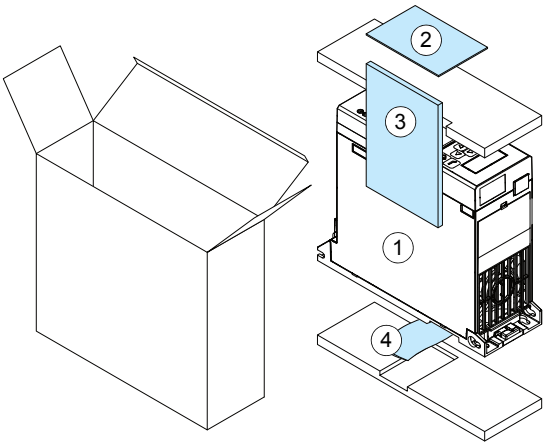
Required tools

To install the drive mechanically, you need the following tools:

- A drill and suitable drill bits
- A screwdriver or wrench with a set of suitable bits
- A tape measure and spirit level
- Personal protective equipment

Unpacking the delivery

The figure shows the drive package with its contents. Make sure that all of the items are present and that there are no signs of damage.



Package contents:

1. Drive
2. Quick installation and start-up guide
3. Hardware and Firmware manuals (optional)
4. Installation accessories

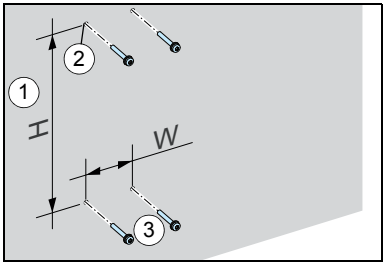
Installing the drive

You can install the drive:

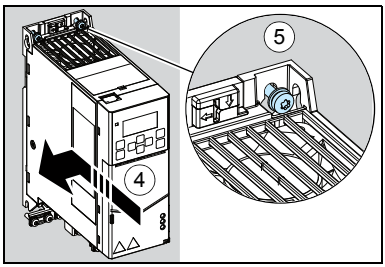
- With screws to a suitable surface (wall or assembly plate)
- To a DIN installation rail with the integrated lock

To install the drive with screws

1. Make marks on to the surface for the mounting holes. Refer to *Dimensions and weights* on page *87*.
2. Make the holes for the mounting screws.
3. Start to tighten the screws into the mounting holes.

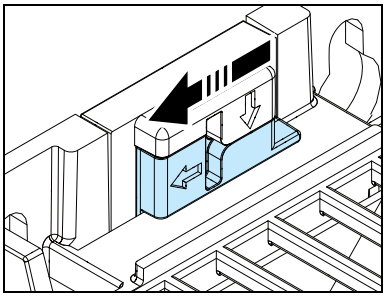


4. Install the drive onto the mounting screws.
5. Tighten the mounting screws.

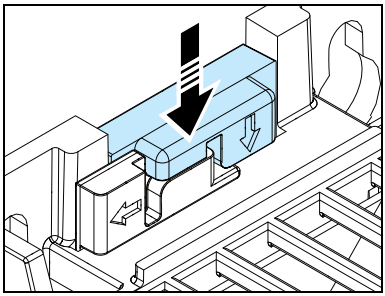


To install the drive to a DIN installation rail

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

Planning the electrical installation

Contents of this chapter

This chapter contains the instructions to plan the electrical installation of the drive, for example, to check the compatibility of the motor and drive, and select the cables, protections as well as cable routing.

Make sure that the installation is designed and done according to the applicable local laws and regulations. ABB does not assume any liability whatsoever for any installation which breaches the local laws and/or other regulations. If the recommendations given by ABB are not followed, the drive may experience problems that the warranty does not cover.

Selecting the supply disconnecting device

Install a hand-operated input disconnecting device between the AC power source and the drive. You must be able to lock the disconnecting device to the open position for installation and maintenance work.

European Union

To meet the European Union Directives, according to standard EN 60204-1, *Safety of Machinery*, the disconnecting device must be one of the following types:

- Switch-disconnector of utilization category AC-23B (EN 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 EN 60947-2.

Other regions

The disconnecting device must conform to the applicable local safety regulations.

Checking the compatibility of the motor and drive

Use an asynchronous AC induction motor, permanent magnet synchronous motor or synchronous reluctance motor (SynRM) with the drive. Several induction motors can be connected to the drive at a time.

Make sure that the motor and the drive are compatible according to the rating table in section *Ratings* on page *80*. The table lists the typical motor power for each drive type.

Selecting the power cables

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

- The input power and the motor cables must be able to carry the corresponding load currents. Refer to *Ratings* on page *80*.
- The cable must be rated for at least 70 °C maximum permissible temperature of conductor in continuous use. For the US, refer to *Additional US requirements* on page *49*.
- The conductivity of the PE conductor must be sufficient, refer to page *46*.
- A 600 V AC cable is accepted for up to 500 V AC.

To comply with the EMC requirements of the CE mark, use an approved cable type. Refer to *Recommended power cable types* on page *48*.

Use a symmetrical shielded cable to decrease:

- The electromagnetic emissions of the drive system.
- The stress on the motor insulation.
- The bearing currents.

Make sure that the protective conductor has adequate conductivity. The table shows the minimum cross-sectional area related to the phase conductor size according to IEC 61439-1, when the phase conductor and the protective conductor are the same material.

Cross-sectional area of the phase conductors S (mm^2)	Minimum cross-sectional area of the protective conductor S_p (mm^2)
$S \leq 16$	S
$16 < S \leq 35$	16
$35 < S$	S/2

Refer to the IEC/EN 61800-5-1 requirement on grounding on page *17*.

Typical power cable sizes

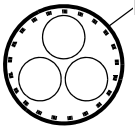
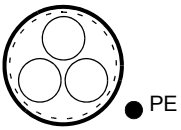
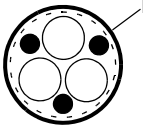
These are the typical cross-sectional area of the power cables at the nominal drive current.

Drive type	Frame	mm^2 (Cu) (1	AWG
1-phase U_N= 200...240 V			
ACS380-04xx-02A4-1	R0	3×1.5 + 1.5	16
ACS380-04xx-03A7-1	R0	3×1.5 + 1.5	16
ACS380-04xx-04A8-1	R1	3×1.5 + 1.5	16
ACS380-04xx-06A9-1	R1	3×1.5 + 1.5	16
ACS380-04xx-07A8-1	R1	3×1.5 + 1.5	16
ACS380-04xx-09A8-1	R2	3×6 + 6	10
ACS380-04xx-12A2-1	R2	3×6 + 6	10
3-phase U_N= 380...480 V			
ACS380-04xx-01A8-4	R0	3×1.5 + 1.5	16
ACS380-04xx-02A6-4	R1	3×1.5 + 1.5	16
ACS380-04xx-03A3-4	R1	3×1.5 + 1.5	16
ACS380-04xx-04A0-4	R1	3×1.5 + 1.5	16
ACS380-04xx-05A6-4	R1	3×1.5 + 1.5	16
ACS380-04xx-07A2-4	R1	3×1.5 + 1.5	16
ACS380-04xx-09A4-4	R1	3×2.5 + 2.5	14
ACS380-04xx-12A6-4	R2	3×2.5 + 2.5	14
ACS380-04xx-17A0-4	R3	3×2.5 + 2.5	14
ACS380-04xx-25A0-4	R3	3×6 + 6	10

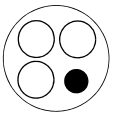
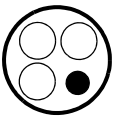
1) This is the size of typical power cable (symmetrical, shielded, three-phase copper cable). Note that for the input power connection, you typically must have two separate PE conductors, i.e., the shield alone is not enough. Refer to *Grounding* on page *17*.

Refer also to *Terminal data for the power cables* on page *89*.

Recommended power cable types

	Symmetrical shielded cable with three phase conductors and a concentric PE conductor as the shield. The shield must meet the requirements of IEC 61439-1, refer to page *46*. Make sure that local/state/country electrical codes permit this cable type.
	Symmetrical shielded cable with three phase conductors and a concentric PE conductor as the shield. A separate PE conductor is required if the shield does not meet the requirements of IEC 61439-1, refer to page *46*.
	Symmetrical shielded cable with three phase conductors and symmetrically constructed PE conductor, and a shield. The PE conductor must meet the requirements of IEC 61439-1, refer to page *46*.

Power cable types for limited use

	A four-conductor system (three phase conductors and a protective conductor on a cable tray) is **not permitted for motor cabling** (it is permitted for input cabling).
	A four-conductor system (three phase conductors and a PE conductor in a PVC conduit) is **permitted for input cabling with a phase conductor cross-section less than 10 mm^2 (8 AWG) or for motors ≤ 30 kW (40 hp)**. Not permitted in the USA.
	Corrugated or EMT cable with three phase conductors and a protective conductor is permitted for motor cabling with a phase conductor cross section less than 10 mm^2 (8 AWG) or for motors ≤ 30 kW (40 hp).

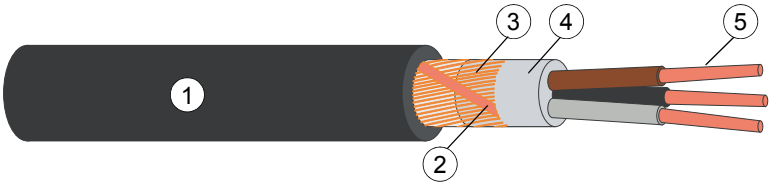
Not allowed power cable types

	Symmetrical shielded cable with individual shields for each phase conductor is not permitted in any cable size for input or motor cabling.

Motor cable shield

If the motor cable shield is the only protective earth conductor of the motor, make sure that the conductivity of the shield is sufficient. Refer to *Selecting the power cables* on page *46* or to IEC 61439-1.

To effectively suppress radiated and conducted radio-frequency emissions, the cable shield conductivity must be at least 1/10 of the phase conductor conductivity. To meet the requirements, use a copper or an aluminum shield. The figure shows the minimum requirements for the motor cable shield. It has 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 emissions and bearing currents.



1	Sheath
2	Copper wire shield
3	Helix of copper tape or copper wire
4	Filling
5	Cable conductors

Additional US requirements

Use type MC continuous corrugated aluminum armor cable with symmetrical grounds or shielded power cable for the motor cables if metallic conduit is not used. For the North American market, 600 V AC cable is accepted for up to 500 V AC. A 1,000 V AC cable is required above 500 V AC (below 600 V AC). The power cables must be rated for 75 °C (167 °F).

Conduit

Couple separate parts of a conduit together: Bridge the joints with a ground conductor that is 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. When a conduit is used, type MC continuous corrugated aluminum armor cable or shielded cable is not required. A dedicated ground cable is always required.

Do not run motor wiring from more than one drive in the same conduit.

Armored cable or shielded power cable

Six-conductor (three phase and three ground conductors) type MC continuous corrugated aluminum armor cable with symmetrical grounds is available from the following suppliers (trade names in parentheses):

- Anixter Wire & Cable (Philsheath)
- BICC General Corp (Philsheath)
- Rockbestos Co. (Gardex)
- Oaknite (CLX)

Shielded power cables are available from the following suppliers:

- Belden
- LAPPKABEL (ÖLFLEX)
- Pirelli

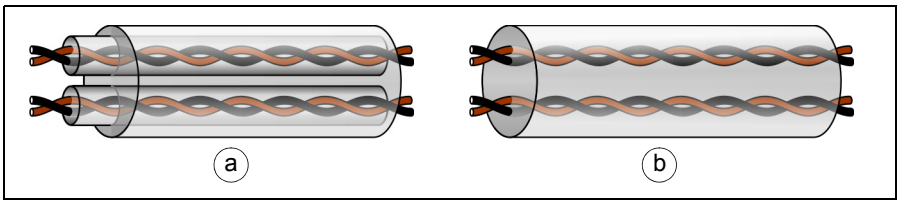
Selecting the control cables

Shielding

Only use shielded control cables.

Use a double-shielded twisted pair cable (a) for analog signals. Use one individually shielded pair for each signal. Do not use a common return for different analog signals.

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



Signals in separate cables

Put analog and digital signals in separate, shielded cables.

Do not mix 24 V 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 in the same cables as digital input signals. The relay-controlled signals should be run as twisted pairs.

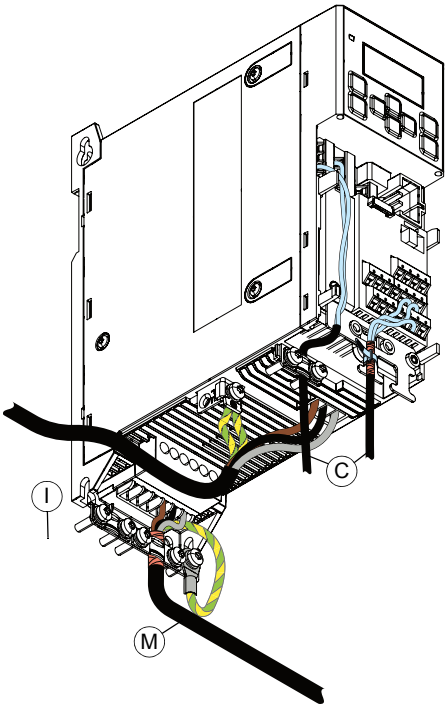
Relay cable

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

Drive composer PC tool cable

Use a USB type A (PC) – type B (control panel) cable. The maximum permitted length of the cable is 3 m (9.8 ft).

Routing the cables



Select the cable routes as follows:

• Put the input power cable (I), motor cable (M) and control cables (C) into separate trays.

• Put the motor cable (M) away from the other cables.

• Make sure that there is a minimum of 200 mm between the input power cable (I) and the control cables (C).

• Make sure that there is a minimum of 500 mm between the motor cable (M) and the control cables (C).

• Make sure that there is a minimum 300 mm between the input power cable (I) and the motor cable (M).

• If the control cables cross the input power or motor cables, put the cables at 90 degrees to each other.

• You can put several motor cables in parallel.

• Do not install other cables in parallel with the motor cables.

• Make sure that the cable trays are electrically bonded to each other and to the electrical ground.

•Make sure that the control cables are approriately supported outside the drive to relieve stress on the cables.

Separate control cable ducts

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

Continuous motor cable shield or conduit

To minimize the emission level when there are safety switches, contactors, connection boxes or similar equipment on the motor cable between the drive and the motor: Install the equipment in a metal enclosure with 360 degree grounding for the shields of both the incoming and outgoing cables, or connect the shields otherwise together. If cabling is put into conduits, make sure that they are continuous.

Implementing short-circuit protection

Protecting the drive and input power cable in short-circuits

Protect the drive and input cable with fuses. For fuse ratings, refer to *Technical data* on page *79*. The fuses protect the input cable, restrict drive damage and prevent damage to adjoining equipment if there is a short-circuit.

For information on circuit breakers, contact ABB for more information.

Protecting the motor and motor cable in short-circuits

If the motor cable has the correct size for the nominal current, the drive protects the motor cable and motor if there is a short-circuit.

Implementing thermal overload protection

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.

WARNING! If the drive is connected to several motors, use a separate circuit breaker or fuses to protect each motor cable and motor against overload. The drive overload protection is tuned for the total motor load. It may not trip due to an overload in one motor circuit only.

Protecting the motor against thermal overload

According to the regulations, the motor must be protected against thermal overload and the current must be switched off when an overload is detected. The drive has 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 or an actual temperature indication given by motor temperature sensors. The user can tune the thermal model by feeding in additional motor and load data.

The most common temperature sensors are:

- For motor sizes IEC180…225: a thermal switch, for example, a Klixon.
- For motor sizes IEC200…250 and larger: a PTC or Pt100 sensor.

Protecting the drive against ground faults

The drive has a ground fault protection function that protects the unit against ground faults in the motor and motor cable. It is not a personnel safety or a fire protection feature.

Residual current device compatibility

The drive can be used with residual current devices of Type B.

Note: The EMC filter of the drive has capacitors between the main circuit and the frame. These capacitors and long motor cables increase the ground leakage current and can cause the fault current circuit breakers to function.

Implementing the emergency stop function

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

Note: The stop key on the control panel of the drive does not generate an emergency stop or separate the drive from dangerous potential.

Implementing the Safe torque off function

Refer to *Safe torque off function* on page *121*.

Using a safety switch between the drive and motor

Install a safety switch between the permanent magnet motor and the drive output. The safety switch isolates the motor from the drive during maintenance work.

Using a contactor between the drive and motor

The control of the output contactor depends on how you use the drive.

When you use the vector control mode and motor ramp stop, open the contactor as follows:

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

When you use the vector control mode and motor coast stop or the scalar control mode, open the contactor as follows:

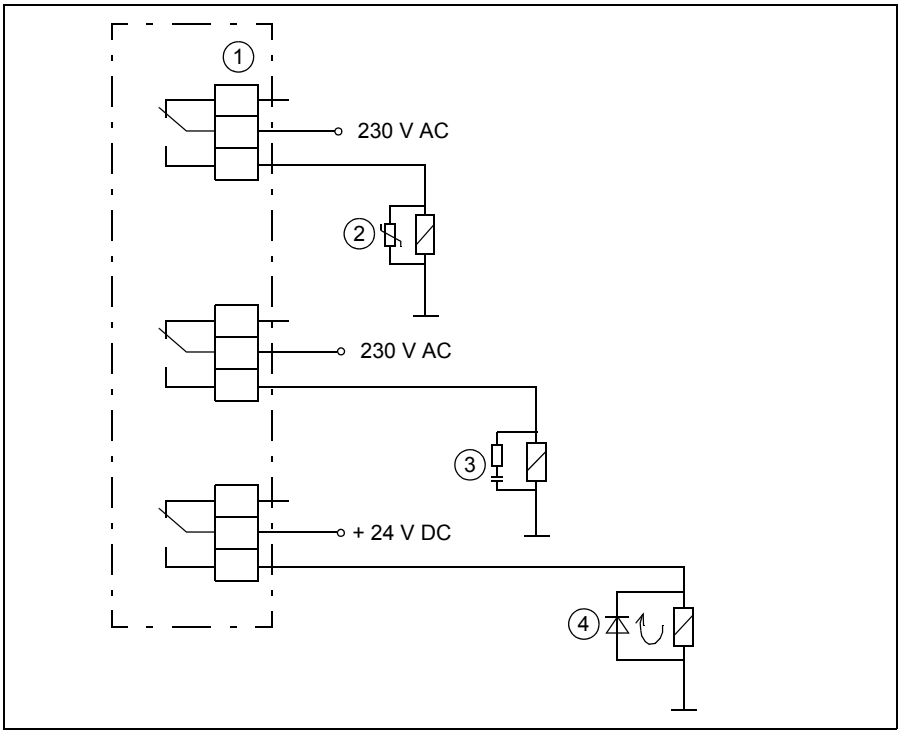
1. Give a stop command to the drive.
2. Open the contactor.

WARNING! In the vector control mode, do not open the output contactor when the drive controls the motor. The vector control operates faster than the contactor opens its contacts. If the contactor starts to open when the drive controls the motor, the vector control tries to maintain the load current and increases the output voltage to the maximum. This can cause damage to the contactor.

Protecting the contacts of relay outputs

Inductive loads (relays, contactors and motors) cause voltage transients when switched off. The voltage transients can connect capacitively or inductively to other conductors and cause a malfunction in the system.

Use a noise attenuating circuit (varistors, RC filters [AC] or diodes [DC]) to minimize the EMC emission of inductive loads at switch-off. Install the noise attenuating circuit as close to the inductive load as possible. Do not install a noise attenuating circuit at the relay output.



1	Relay output
2	Varistor
3	RC filter
4	Diode

6

Electrical installation

Contents of this chapter

The chapter describes how to check the insulation of the installation and the compatibility with IT (ungrounded) and corner-grounded TN systems. It shows how to connect the power and control cables, install optional modules and connect a PC.

Warnings

WARNING! Obey the instructions in *Safety instructions* on page *13*. If you ignore them, injury or death, or damage to the equipment can occur.

WARNING! Make sure that the drive is disconnected from the input power during installation. Before you do work on the drive, wait for 5 minutes after you disconnect the input power.

Required tools

To perform the electrical installation, you need the following tools:

- Wire stripper
- Screwdriver or wrench with a set of suitable bits
- Multimeter and voltage detector
- Personal protective equipment

Measuring insulation

Drive

Do not do voltage tolerance or insulation resistance tests on the drive. The drive was tested for insulation between the main circuit and the chassis at the factory. The drive has voltage-limiting circuits which decrease the testing voltage automatically.

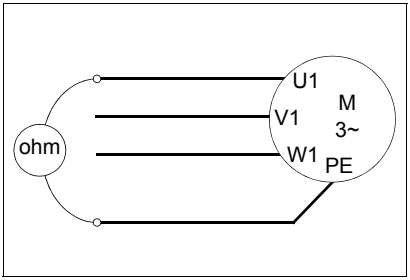
Input power cable

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

Motor and motor cable

Measure the insulation of the motor and motor cable as follows:

1. Make sure that the motor cable is disconnected from the drive output terminals T1/U, T2/V and T3/W.
2. Measure the insulation resistance between the phase conductors and between each phase conductor and the protective earth conductor. Use a measuring voltage of 1,000 V DC. The insulation resistance of an ABB motor must be more than 100 Mohm (reference value at 25 °C or 77 °F). For the insulation resistance of other motors, refer to the manufacturer's instructions.

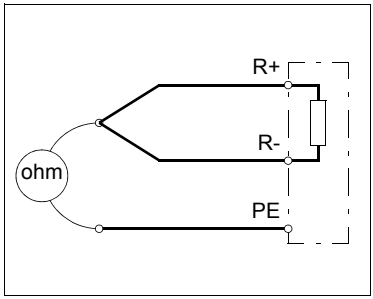


Moisture in the motor casing decreases the insulation resistance. If you think that there is moisture in the motor, dry the motor and measure again.

Brake resistor assembly

Measure the insulation of the brake resistor assembly as follows:

1. Make sure that the resistor cable is connected to the resistor, and disconnected from the drive output terminals R+ and R-.
2. At the drive, connect the R+ and R- conductors of the resistor cable together. Measure the insulation resistance between the combined conductors and the PE conductor with a measuring voltage of 1 kV DC. The insulation resistance must be more than 1 Mohm.



Compatibility with IT (ungrounded) and corner-grounded TN systems

EMC filter

WARNING! Do not use the internal EMC filter of the drive in an IT system (an ungrounded power system or a high-resistance-grounded [over 30 ohms] power system). If you use the internal EMC filter, the system is connected to the ground potential through the EMC filter capacitors. This can cause danger or damage to the drive.

WARNING! Do not use the internal EMC filter of the drive in a corner-grounded TN system. If you use the internal EMC filter, this can cause damage to the drive.

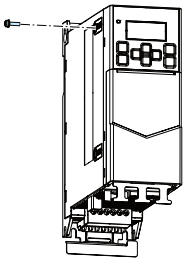
When the internal EMC filter is disconnected, the EMC compatibility of the drive decreases. Refer to *Motor cable length* on page *93*.

EMC filter disconnection

This is applicable only to product variants with an internal EMC filter.

Refer to *Hardware overview* on page *28*.

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



Ground-to-phase varistor

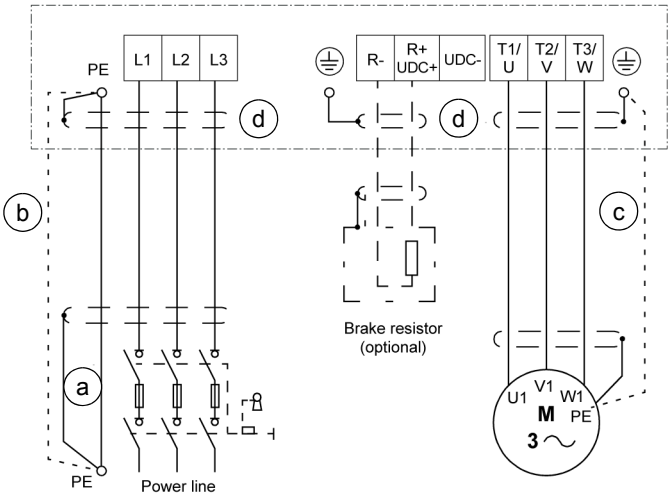
The varistor protects the drive against power line voltage peaks.

WARNING! If you connect the drive to an IT system (an ungrounded power system or a high-resistance-grounded [over 30 ohms] power system), disconnect the varistor from ground. Failure to do so can cause damage to the varistor circuit.

To disconnect the varistor circuit from ground, remove the varistor grounding screw. Refer to *Hardware overview* on page *28*.

Connecting the power cables

Connection diagram



a. Two grounding conductors. Use two conductors, if the cross-section of grounding conductor is less than 10 mm^2 Cu or 16 mm^2 Al (IEC/EN 61800-5-1). For example, use the cable shield in addition to the fourth conductor.

b. Separate grounding cable (line side). Use it if the conductivity of the fourth conductor or shield is not sufficient for the protective grounding.

c. Separate grounding cable (motor side). Use it if the conductivity of the shield is not sufficient for the protective grounding, or there is no symmetrically constructed grounding conductor in the cable.

d. 360-degree grounding of the cable shield. Required for the motor cable and brake resistor cable, recommended for the input power cable.

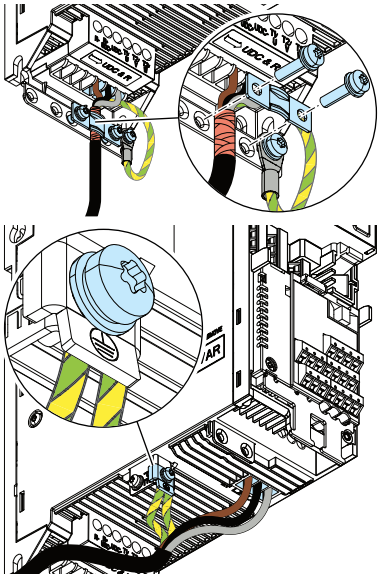
Connection procedure

WARNING! Obey the instructions in chapter *Safety instructions* on page *13*. If you ignore them, injury or death, or damage to the equipment can occur.

WARNING! If the drive is connected to an IT (non-grounded) system or to a corner-grounded TN system, disconnect the EMC filter grounding screw. If the drive is connected to an IT (non-grounded) system, disconnect the varistor grounding screw.

Before you start the work, stop the drive and do the steps in *Precautions before electrical work* on page *15*.

For information on cable routing, refer to *Routing the cables* on page *52*.



1. Strip the motor cable.
2. Ground the motor cable shield under the grounding clamp.
3. Twist the motor cable shield into a bundle, put yellow-green insulation tape on it, fit a cable lug, and connect it to the grounding terminal.
4. Connect the phase conductors of the motor cable to the T1/U, T2/V and T3/W motor terminals. Torque the terminals to 1 N·m (0.7 lbf·ft).
5. If it is applicable, connect the brake resistor cable to the R- and UDC+ terminals. Torque the terminals to 1 N·m (0.7 lbf·ft). Use a shielded cable and ground the shield under the grounding clamp.
6. Strip the input power cable.
7. If the input power cable has a shield, twist it into a bundle, put yellow-green insulation tape on it, fit a cable lug, and connect it to the grounding terminal.
8. Connect the PE conductor of the input power cable to the grounding terminal.
9. If the combined cross-sectional area of the cable shield and PE conductor is not sufficient, use an additional PE conductor.
10. Connect the phase conductors of the input power cable to the L1, L2 and L3 input terminals. Torque the terminals to 1 N·m (0.7 lbf·ft).
11. Mechanically attach all of the cables on the outside of the drive.

Connecting the control cables

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

Refer to *Default I/O connection diagram (ABB standard macro)* on page *63* for the default I/O connections of the ABB standard macro. For other macros, refer to the *ACS380 Firmware manual* (3AXD50000029275 [English]).

Connect the cables as shown in *Control cable connection procedure* on page *66*.

WARNING! Obey the instructions in chapter *Safety instructions* on page *13*. If you ignore them, injury or death, or damage to the equipment can occur.

Before you start the work, stop the drive and do the steps in section *Precautions before electrical work* on page *15*.

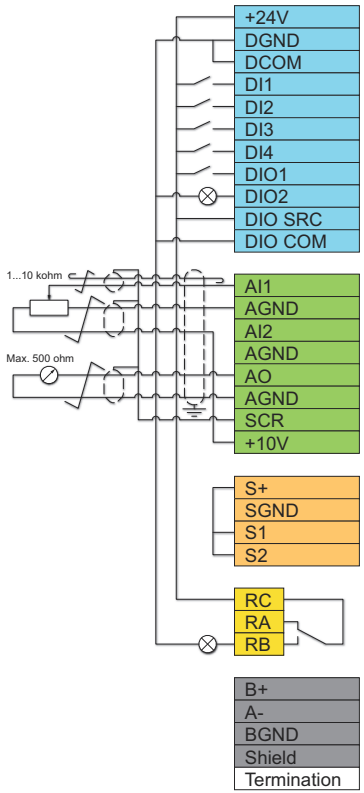
Remove the front cover.

Default I/O connection diagram (ABB standard macro)

This connection diagram is valid for drives with the I/O & Modbus extension module:

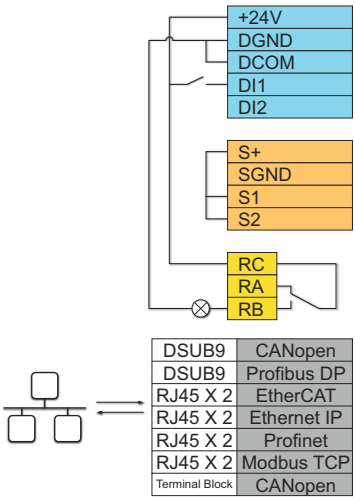
- Standard variant (ACS380-04x**S**)
- Configured variant (ACS380-04x**C**) with the I/O & Modbus extension module (option +L538)

Refer to *Type designation key* on page *35*.

Terminals	Descriptions
	**Digital I/O connections** Aux. voltage output +24 V DC, max. 200 mA Aux. voltage output common Digital input common Stop (0)/Start (1) Forward (0)/Reverse (1) Speed selection Speed selection Digital input function: Ramp set 1 (0)/Ramp set 2 (1) Digital output function: Ready to run (0)/Not ready (1) Digital output auxiliary voltage Digital input/output common **Analog I/O** Output frequency/Speed reference (0...10 V) Analog input circuit common Not configured Analog input circuit common Output frequency (0...20 mA) Analog output circuit common Signal cable shield (screen) Reference voltage **Safe torque off (STO)** Safe torque off function. Connected at factory. Drive starts only when both circuits are closed. Refer to *Safe torque off function* on page *121*. **Relay output** Relay output 1 No fault [Fault (-1)] **EIA-485 Modbus RTU** Embedded Modbus RTU (EIA-485)

Fieldbus connection diagram

This connection diagram is valid for drives with a fieldbus extension module. The type code is ACS380-04x**C** followed by an option code that designates the extension module. Refer to *Type designation key* on page *35*.

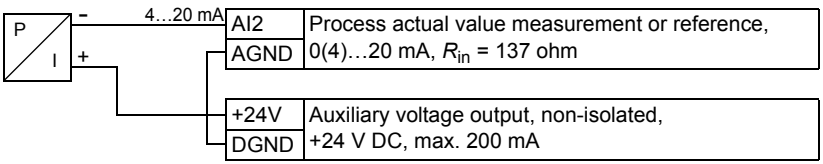
Terminals	Descriptions
	**Aux. voltage output and digital connections** Aux. voltage output +24 V DC, max. 200 mA Aux. voltage output common Digital input common for all Fault reset Not configured **Safe torque off (STO)** Safe torque off function. Connected at factory. Drive starts only when both circuits are closed. Refer to *Safe torque off function* on page *121*. **Relay output** Relay output 1 No fault [Fault (-1)] **Extension module options and connections:** +K457 FCAN-01-M CANopen +K454 FPBA-01-M Profibus DP +K469 FECA-01-M EtherCAT +K475 FENA-21-M Ethernet/IP, Profinet, Modbus TCP +K495 BCAN-11 CANopen interface

Connection examples of two-wire and three-wire sensors

The figures give examples of connections for a two-wire or three-wire sensor/transmitter that is supplied by the auxiliary voltage output of the drive.

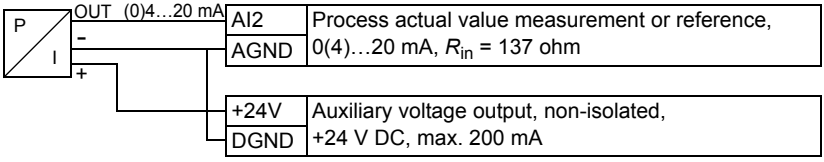
Note: Do not exceed the maximum capability of the auxiliary 24 V (200 mA) output.

Two-wire sensor/transmitter



Note: The sensor is supplied through its current output and the drive feeds the supply voltage (+24 V). The output signal must be 4…20 mA, not 0…20 mA.

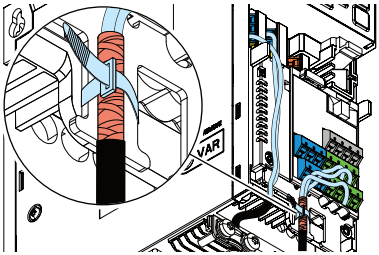
Three-wire sensor/transmitter



Control cable connection procedure

Do the connections according to the macro in use. For the default macro connections, refer to the diagram on page *63*.

Keep the signal wire pairs twisted as near to the terminals as possible to prevent inductive coupling.



1. Strip a part of the outer shield of the control cable for grounding.
2. Use a cable tie to ground the outer shield to the grounding tab.
3. Strip the control cable conductors.
4. Connect the conductors to the correct control terminals. Torque the terminals to 0.5 N·m (0.4 lbf·ft).
5. Connect the shields of the twisted pairs and grounding wires to the SCR terminals. Torque the terminals to 0.5 N·m (0.4 lbf·ft).
6. Mechanically attach the control cables on the outside of the drive.

Auxiliary voltage connection

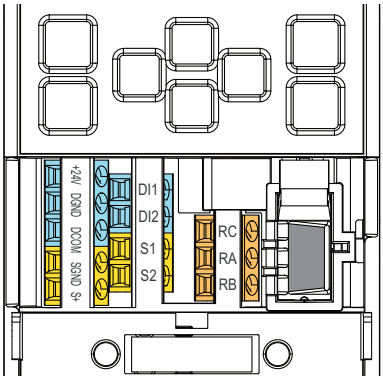
The drive has an auxiliary 24 V DC (±10%) voltage connection. Depending on the application, you can use the connection

- To supply external power to the drive
- To supply power from the drive to external option modules

Connect the external supply or module to the +24V and DGND terminals.

For more information on how to feed auxiliary power to the drive, refer to *BAPO-01 auxiliary power extension module* on page *157*.

For auxiliary voltage input specifications, refer to *Control connection data* on page *95*.



Option modules

Typically, option modules are fitted at the factory according to the drive variant or order.

WARNING! Obey the instructions in chapter *Safety instructions* on page *13*. If you ignore them, injury or death, or damage to the equipment can occur.

The drive has two option module slots:

- Front option: Communication module slot under the front cover.
- Side option: Multifunction extension module slot on the side of the drive.

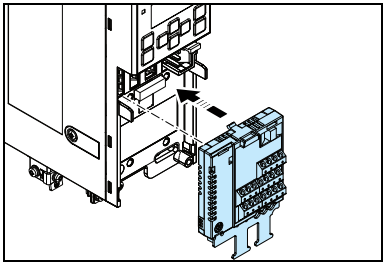
For more information, refer to the option module manual for installation and wiring instructions. For information on the side-mounted options:

- *BTAC-02 pulse encoder interface module* on page *133*
- *BREL-01 relay output extension module* on page *151*
- *BAPO-01 auxiliary power extension module* on page *157*

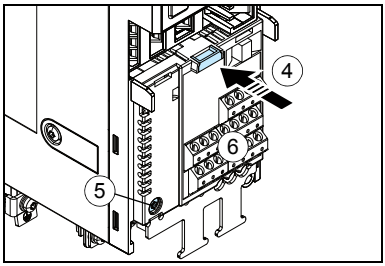
Before you start the work, stop the drive and do the steps in section *Precautions before electrical work* on page *15*.

To install a front option

1. Remove the front cover.
2. Carefully align the option module with Slot 1 in the front of the drive.
3. Fully push the option module into position.



4. Push the plastic locking tab until it locks.
5. Tighten the locking screw.
6. Connect the applicable control cables according to *Connecting the control cables* on page *62*.

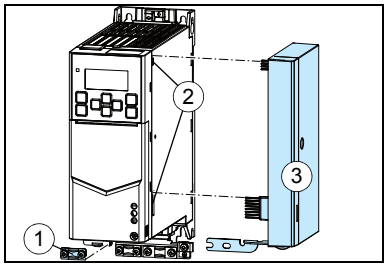


To remove a front option

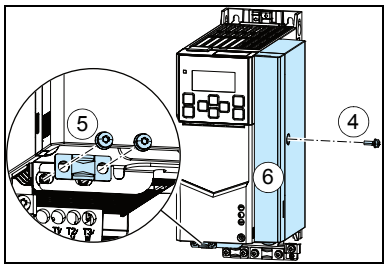
1. Disconnect the control cables from the option module.
2. Loosen the locking screw.
3. Carefully pull the option module to disconnect it. Note that the option module can be tightly in position.

To install a side option

1. Remove the two screws from the front-most grounding clamp at the bottom of the drive.
2. Carefully align the side option with the connectors on the right side of the drive.
3. Fully push the option module into position.



4. Tighten the locking screw of the option module.
5. Attach the grounding bar to the bottom of the side option and to the front ground tab on the drive.
6. Connect the applicable control cables according to *Connecting the control cables* on page *62*.



To remove a side option

1. Disconnect the control cables from the side option.
2. Open the grounding bar screws.
3. Loosen the locking screw.
4. Carefully remove the side option from the drive. Note that the option module can be tightly in position.



7

Installation checklist

Contents of this chapter

This chapter contains an installation checklist which you must complete before you start up the drive.

Warnings

WARNING! Obey the instructions in chapter *Safety instructions* on page *13*. If you ignore them, injury or death, or damage to the equipment can occur.

Checklist

Do the steps in *Precautions before electrical work* on page *15* before you start the work. Read the checklist together with another person.

☑	**Make sure that …**
☐	The ambient operating conditions meet the specification in *Ambient conditions* on page *97*.
☐	If the drive is connected to an IT (ungrounded) or corner-grounded TN supply network: Internal EMC filter is disconnected. If the drive is connected to an IT (non-grounded) system, disconnect the varistor grounding screw. Refer to *Compatibility with IT (ungrounded) and corner-grounded TN systems* on page *59*.
☐	If the drive is stored over one year: The electrolytic DC capacitors in the DC link of the drive are reformed. Refer to *Servicing the capacitors* on page *78*.

☑	**Make sure that …**
☐	There is an adequately sized protective earth (ground) conductor between the drive and the switchboard.
☐	There is an adequately sized protective earth (ground) conductor between the motor and the drive.
☐	All protective earth (ground) conductors are connected to the correct terminals and the terminals are tightened (pull the conductors to check).
☐	The supply voltage matches the nominal input voltage of the drive. Read the type designation label.
☐	The input power cable is connected to the correct terminals, the phase order is right, and the terminals are tightened. (Pull the conductors to check.)
☐	Appropriate supply fuses and disconnector are installed.
☐	The motor cable is connected to the correct terminals, the phase order is right, and the terminals are tightened. (Pull the conductors to check.)
☐	The brake resistor cable (if present) is connected to the correct terminals, and the terminals are tightened. (Pull the conductors to check.)
☐	The motor cable (and brake resistor cable, if present) is routed away from other cables.
☐	The control cables (if any) are connected.
☐	If a drive bypass connection is used: The direct-on-line contactor of the motor and the drive output contactor are mechanically or electrically interlocked (cannot be closed simultaneously).
☐	There are no tools, foreign objects or dust inside the drive. There is no dust near the air inlet of the drive.
☐	The drive cover is in place.
☐	The motor and the driven equipment are ready for start-up.

8

Maintenance

Contents of this chapter

The chapter contains the preventive maintenance instructions and LED indicator descriptions.

Maintenance intervals

The table shows the maintenance tasks which can be done by the user. The complete maintenance schedule is available at www.abb.com/drivesservices. For more information, speak to your local ABB Service representative (www.abb.com/searchchannels).

Maintenance task/object	Years from start-up													
	0	1	2	3	4	5	6	7	8	9	10	11	12	…
Cooling fans														
Main cooling fan. Refer to page *76*.				(R)			R (R)			(R)			R (R)	
Batteries														
Connections and environment														
Quality of supply voltage		O	O	O	O	O	O	O	O	O	O	O	O	O
Improvements														
Based on product notes				I			I			I			I	
Spare parts														
Spare part stock		I	I	I	I	I	I	I	I	I	I	I	I	I
Reform DC circuit capacitors (spare modules and spare capacitors). Refer to page *78*.		O	O	O	O	O	O	O	O	O	O	O	O	O
Other useful tasks														
Tightness of the cable and busbar terminals. Tighten if needed.		I	I	I	I	I	I	I	I	I	I	I	I	I
Ambient conditions (dustiness, moisture and temperature)		I	I	I	I	I	I	I	I	I	I	I	I	I
Clean the heatsink. Refer to page *75*.		O	O	O	O	O	O	O	O	O	O	O	O	O

Symbols

I **Inspection**, maintenance action if it is necessary

(I) **Inspection** in harsh conditions*, maintenance action if it is necessary

R **Replacement**

(R) **Replacement** in harsh conditions*

O **Other work** (commissioning, tests, measurements, etc.)

* Surrounding air temperature constantly over 40 °C, very dusty or humid conditions, cyclic heavy load, or continuous nominal (full) load.

To maintain the performance and reliability of the drive, examine the drive annually. Contact ABB Service at least once in three years to replace old components.

The recommended maintenance and component replacement intervals are based on operation in specified ambient conditions.

Cleaning the heat sink

The fins of the drive heat sink become dusty from the cooling air. If the heat sink is not clean, this can cause the drive to give overtemperature warnings and faults.



WARNING! Obey the instructions in *Safety instructions* on page *13*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.



WARNING! Use a vacuum cleaner with an antistatic hose and nozzle. A normal vacuum cleaner can cause static discharges which can cause damage to circuit boards.

To clean the heat sink:

1. Stop the drive and disconnect it from the input power.
2. Wait for 5 minutes and measure to make sure that there is no voltage. Refer to *Precautions before electrical work* on page *15*.
3. Remove the cooling fan. Refer to *Replacing the cooling fans* on page *76*.
4. Blow clean, dry and oil free compressed air from the bottom of the heat sink to the top and use a vacuum cleaner at the air outlet to trap the dust.

   If there is a risk that dust can go into other equipment, clean the heat sink in another room.
5. Install the cooling fan.

Replacing the cooling fans

This instruction is applicable only to frame sizes R1, R2 and R3. Frame R0 does not have a cooling fan.

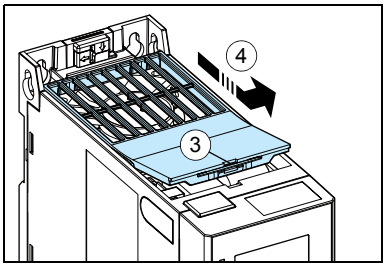
Refer to *Maintenance intervals* on page *74* for the fan replacement interval in normal operating conditions. Parameter 05.04 Fan on-time counter shows the running time of the cooling fan. After you replace the fan, reset the fan counter. Refer to the *ACS380 Firmware manual* (3AXD50000029275 [English]).

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

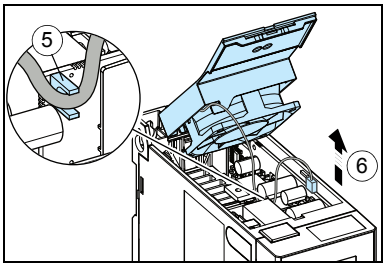
To replace the cooling fan

WARNING! Obey the instructions in *Safety instructions* on page *13*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

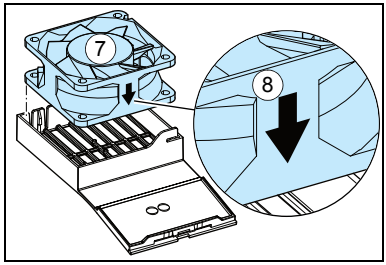
1. Stop the drive and disconnect it from the power line.
2. Wait for 5 minutes and measure to make sure that there is no voltage. Refer to *Precautions before electrical work* on page *15*.
3. Use a suitable flat screwdriver to open the fan cover.
4. Carefully lift the fan cover out of the drive. Note that the fan cover holds the cooling fan.



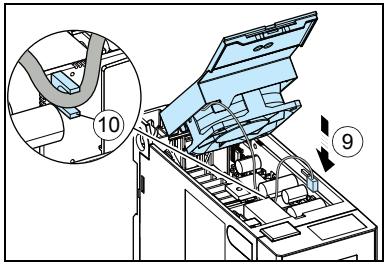
5. Remove the fan power cable from the cable slot in the drive.
6. Disconnect the fan power cable.



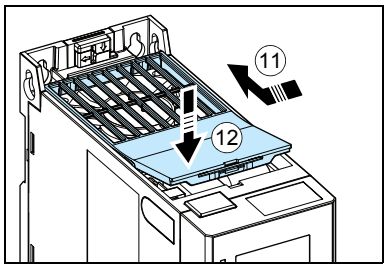
7. Free the fan clips and remove the fan from the fan cover.
8. Install the new fan into the fan cover. Make sure that the air flow is in the correct direction. The air flows in from the bottom of the drive and out from the top of the drive.



9. Connect the fan power cable.
10. Put the fan power cable into the cable slot in the drive.



11. Carefully put the fan cover into position in the drive. Make sure that the fan power cable is routed correctly.
12. Push the cover to lock into position.



Servicing the capacitors

The intermediate DC circuit of the drive has electrolytic capacitors. Their lifespan depends on the operating time and loading of the drive, and the surrounding air temperature.

Capacitor failure can cause damage to the drive and an input cable fuse failure, or a fault in the drive. Contact ABB if you think that a capacitor failed. You can get spare parts from ABB. Use only ABB specified spare parts.

Capacitor reforming

You must reform the capacitors if the drive is stored for a year or more. Refer to *Drive labels* on page *33* to read the manufacturing date from the serial number.

To reform the capacitors, refer to *Converter module capacitor reforming instructions* (3BFE64059629), available on the Internet (go to www.abb.com and enter the code in the Search field).

9

Technical data

Contents of this chapter

The chapter contains the technical specifications of the drive, such as ratings, sizes and technical requirements as well as provisions for fulfilling the requirements for CE, UL and other approval marks.

Ratings

IEC ratings

Type ACS380-04xx	Input rating	Input with choke	Max. current	Output ratings						Frame size
				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	
1-phase U_N = 200…240 V										
02A4-1	5.0	4.2	3.2	2.4	0.37	2.3	0.37	1.8	0.25	R0
03A7-1	7.8	6.4	4.3	3.7	0.55	3.5	0.55	2.4	0.37	R0
04A8-1	10.1	8.3	6.7	4.8	0.75	4.6	0.75	3.7	0.55	R1
06A9-1	14.5	11.9	8.6	6.9	1.10	6.6	1.10	4.8	0.75	R1
07A8-1	16.4	13.5	12.4	7.8	1.5	7.4	1.5	6.9	1.1	R1
09A8-1	20.6	17.0	14.0	9.8	2.2	9.3	2.2	7.8	1.5	R2
12A2-1	25.6	21.1	17.6	12.2	3.0	11.6	3.0	9.8	2.2	R2
3-phase U_N = 380…480 V										
01A8-4	2.9	1.8	2.2	1.8	0.55	1.7	0.55	1.2	0.37	R0
02A6-4	4.2	2.6	3.2	2.6	0.75	2.5	0.75	1.8	0.55	R1
03A3-4	5.3	3.3	4.7	3.3	1.1	3.1	1.1	2.6	0.75	R1
04A0-4	6.4	4.0	5.9	4.0	1.5	3.8	1.5	3.3	1.1	R1
05A6-4	9.0	5.6	7.2	5.6	2.2	5.3	2.2	4.0	1.5	R1
07A2-4	11.5	7.2	10.1	7.2	3.0	6.8	3.0	5.6	2.2	R1
09A4-4	15.0	9.4	13.0	9.4	4.0	8.9	4.0	7.2	3.0	R1
12A6-4	20.2	12.6	16.9	12.6	5.5	12.0	5.5	9.4	4.0	R2
17A0-4	27.2	17.0	22.7	17.0	7.5	16.2	7.5	12.6	5.5	R3
25A0-4	40.0	25.0	30.6	25.0	11.0	23.8	11.0	17.0	7.5	R3

3AXD10000299801.xls

NEMA ratings

Type ACS380-04xx-	Input rating	Input with choke	Output ratings				Frame size
			Nominal use		Heavy-duty use		
	I_{1N}	I_{1N}	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}	
	A	A	A	hp	A	hp	
3-phase U_N = 460 V (440…480 V)							
01A8-4	2.6	1.6	1.6	0.75	1.1	0.50	R0
02A6-4	3.4	2.1	2.1	1.0	1.6	0.75	R1
03A3-4	4.8	3.0	3.0	1.5	2.1	1.0	R1
04A0-4	5.4	3.4	3.4	2.0	3.0	1.5	R1
05A6-4	7.7	4.8	4.8	2.0	3.4	2.0	R1
07A2-4	9.6	6.0	6.0	3.0	4.0	2.0	R1
09A4-4	12.2	7.6	7.6	5.0	4.8	3.0	R1
12A6-4	17.6	11.0	11.0	7.5	7.6	5.0	R2
17A0-4	22.4	14.0	14.0	10.0	11.0	7.5	R3
25A0-4	33.6	21.0	21.0	15.0	14.0	10.0	R3

3AXD10000299801.xls

Definitions

U_N	Nominal supply voltage
I_{1N}	Nominal input current. Continuous rms input current (for dimensioning cables and fuses).
I_{max}	Maximum output current. Available for two seconds at start.
I_N	Nominal output current. Maximum continuous rms output current allowed (no overload).
P_N	Nominal power of the drive. Typical motor power (no overloading). The kilowatt ratings apply to most IEC 4-pole motors. The horsepower ratings apply to most NEMA 4-pole motors.
I_{Ld}	Maximum current with 110% overload, allowed for one minute every ten minutes
P_{Ld}	Typical motor power in light-duty use (110% overload)
I_{Hd}	Maximum current with 150% overload, allowed for one minute every ten minutes
P_{Hd}	Typical motor power in heavy-duty use (150% overload)

Sizing

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

The ratings are valid at a surrounding air temperature of 50 °C (104 °F) for I_N. When the temperature increases, derating is required.

The DriveSize dimensioning tool available from ABB is recommended for selecting the drive, motor and gear combination.

Derating

The load capacity (I_N, I_{Ld}, I_{Hd}; note that I_{max} is not derated) decreases in certain situations. In such situations, where full motor power is required, oversize the drive so that the derated value provides sufficient capacity.

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

Example:

If your application requires continuous 6.0 A of motor current (I_N) at 8 kHz switching frequency, the supply voltage is 400 V and the drive is situated at 1500 m, calculate the appropriate drive size requirement as follows:

Switching frequency derating (page *83*):
From the table, the minimum size required is I_N = 9.4 A.

Altitude derating (page *83*):
The derating factor for 1500 m is 1 - 1/10 000 m · (1500 - 1000) m = 0.95.
The minimum size required becomes then I_N = 9.4 A / 0.95 = 9.9 A.

Referring to I_N in the ratings tables (starting from page *80*), drive type ACS380-04xx-12A6-4 exceeds the I_N requirement of 9.9 A.

Surrounding air temperature derating, IP20

Frame size	Temperature	Derating
R0…R3	up to +50 °C up to +122 °F	No derating
R1…R3	+50…+60 °C +122…+140 °F	For information on the correct derating values, contact your local ABB representative.

Switching frequency derating

Type ACS380-04xx	Current with different switching frequencies (I_{2N} at 50 °C)			
	2 kHz	4 kHz	8 kHz	12 kHz
1-phase U_N = 200…240 V				
02A4-1	2.4	2.4	1.9	1.6
03A7-1	3.7	3.7	2.9	2.4
04A8-1	4.8	4.8	3.9	3.3
06A9-1	6.9	6.9	5.6	4.7
07A8-1	7.8	7.8	6.6	5.8
09A8-1	9.8	9.8	8.3	7.2
12A2-1	12.2	12.2	10.0	8.4
3-phase U_N = 380…480 V				
01A8-4	1.8	1.8	1.2	0.86
02A6-4	2.6	2.6	1.7	1.2
03A3-4	3.3	3.3	2.1	1.6
04A0-4	4.0	4.0	2.6	1.9
05A6-4	5.6	5.6	3.6	2.7
07A2-4	7.2	7.2	4.7	3.5
09A4-4	9.4	9.4	6.1	4.5
12A6-4	12.6	12.6	8.5	6.4
17A0-4	17.0	17.0	11.5	8.6
25A0-4	25.0	25.0	16.8	12.6

3AXD10000299801.xls

Altitude derating

In altitudes 1000…2000 m (3281…6562 ft) above sea level, the derating is 1% for every 100 m (328 ft). For installation above 2000 m (6562 ft), contact ABB.

To calculate the output current, multiply the current in the rating table with the derating factor k, which for x meters (1000 m <= x <= 2000 m) is:

$$k = 1 - \frac{1}{10\,000\ \text{m}} \cdot (x - 1000)\ \text{m}$$

Check the network compatibility restrictions above 1000 m (3281 ft). Check also PELV limitation on relay output terminals above 1000 m (3281 ft).

Fuses (IEC)

The table lists gG, UL, and uR or aR fuses for protection against short-circuit in the input power cable or drive. Either fuse type can be used if it operates rapidly enough. The operating time depends on the supply network impedance, and the cross-sectional area and length of the supply cable. Refer to *Implementing short-circuit protection* on page *53*.

Do not use fuses with a higher current rating than given 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.

gG fuses

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

Type ACS380-04xx	Input current	Min. short-circuit current	Nominal current	I^2t	Voltage rating	ABB type	IEC 60269 size
	A	A	A	A^2s	V		
1-phase U_N = 200…240 V							
02A4-1	5.0	80	10	380	500	OFAF000H10	000
03A7-1	7.8	80	10	380	500	OFAF000H10	000
04A8-1	10.1	128	16	720	500	OFAF000H16	000
06A9-1	14.5	200	20	1500	500	OFAF000H20	000
07A8-1	16.4	200	25	2500	500	OFAF000H25	000
09A8-1	20.6	256	32	2500	500	OFAF000H32	000
12A2-1	25.6	320	35	7000	500	OFAF000H35	000
3-phase U_N = 380…480 V							
01A8-4	2.9	32	4	55	500	OFAF000H4	000
02A6-4	4.2	48	6	110	500	OFAF000H6	000
03A3-4	5.3	48	6	110	500	OFAF000H6	000
04A0-4	6.4	80	10	360	500	OFAF000H10	000
05A6-4	9.0	80	10	360	500	OFAF000H10	000
07A2-4	11.5	128	16	740	500	OFAF000H16	000
09A4-4	15.0	128	16	740	500	OFAF000H16	000
12A6-4	20.2	200	25	2500	500	OFAF000H25	000
17A0-4	27.2	256	32	4500	500	OFAF000H32	000
25A0-4	40.0	320	40	7500	500	OFAF000H40	000

3AXD10000299801.xls

UL fuses

Type ACS380-04xx	Input current	Min. short-circuit current	Nominal current	Voltage rating	Bussmann/ Edison type	Type
	A	A	A	V		
1-phase U_N = 200…240 V						
02A4-1	5.0	80	10	300	JJN/TJN10	UL class T
03A7-1	7.8	80	10	300	JJN/TJN10	UL class T
04A8-1	10.1	128	20	300	JJN/TJN20	UL class T
06A9-1	14.5	200	20	300	JJN/TJN20	UL class T
07A8-1	16.4	200	25	300	JJN/TJN25	UL class T
09A8-1	20.6	256	25	300	JJN/TJN25	UL class T
12A2-1	25.6	320	35	300	JJN/TJN35	UL class T
3-phase U_N = 380…480 V						
01A8-4	2.9	32	6	600	JJS/TJS6	UL class T
02A6-4	4.2	48	6	600	JJS/TJS6	UL class T
03A3-4	5.3	48	6	600	JJS/TJS6	UL class T
04A0-4	6.4	80	10	600	JJS/TJS10	UL class T
05A6-4	9.0	80	10	600	JJS/TJS10	UL class T
07A2-4	11.5	128	20	600	JJS/TJS20	UL class T
09A4-4	15.0	128	20	600	JJS/TJS20	UL class T
12A6-4	20.2	200	25	600	JJS/TJS25	UL class T
17A0-4	27.2	256	35	600	JJS/TJS35	UL class T
25A0-4	40.0	320	40	600	JJS/TJS40	UL class T

3AXD10000299801.xls

gR fuses

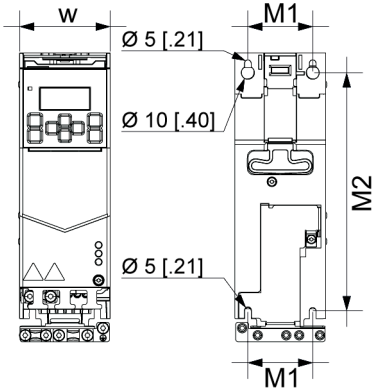
Type ACS380-04xx	Input current	Min. short-circuit current	Nominal current	I^2t	Voltage rating	Bussmann type	IEC 60269 size
	A	A	A	A^2s	V		
1-phase U_N = 200…240 V							
02A4-1	5.0	80	32	275	690	170M2695	00
03A7-1	7.8	80	32	275	690	170M2695	00
04A8-1	10.1	128	40	490	690	170M2696	00
06A9-1	14.5	200	50	1000	690	170M2697	00
07A8-1	16.4	200	63	1800	690	170M2698	00
09A8-1	20.6	256	63	1800	690	170M2698	00
12A2-1	25.6	320	63	1800	690	170M2698	00
3-phase U_N = 380…480 V							
01A8-4	2.9	32	25	125	690	170M2694	00
02A6-4	4.2	48	25	125	690	170M2694	00
03A3-4	5.3	48	25	125	690	170M2694	00
04A0-4	6.4	80	32	275	690	170M2695	00
05A6-4	9.0	80	32	275	690	170M2695	00
07A2-4	11.5	128	40	490	690	170M2696	00
09A4-4	15.0	128	40	490	690	170M2696	00
12A6-4	20.2	200	50	1000	690	170M2697	00
17A0-4	27.2	256	63	1800	690	170M2698	00
25A0-4	40.0	320	80	3600	690	170M2699	00

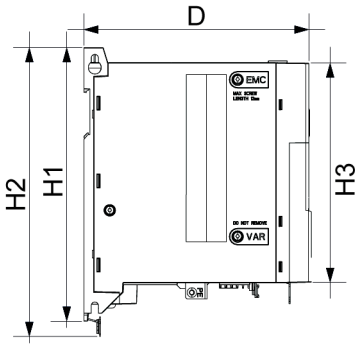
3AXD10000299801.xls

Dimensions and weights

Frame size	Dimensions and weights															
	IP20 / UL type open															
	H1		H2		H3		W		D		M1		M2		Weight	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	kg	lb
R0	205	8.07	220	8.66	170	6.69	70	2.76	174	6.85	50	1.97	191	7.52	1.4	3.1
R1	205	8.07	220	8.66	170	6.69	70	2.76	174	6.85	50	1.97	191	7.52	1.6	3.5
R2	205	8.07	220	8.66	170	6.69	95	3.74	174	6.85	75	2.95	191	7.52	1.9	4.2
R3	205	8.07	220	8.66	170	6.69	169	6.65	174	6.85	TBC	TBC	191	7.52	TBC	TBC

3AXD10000299801.xls





Symbols

H1	Height back
H2	Height back
H3	Height front
W	Width
D	Depth
M1	Mounting hole distance 1
M2	Mounting hole distance 2

Free space requirements

Frame size	Free space requirement					
	Above		Below		On the sides [1]	
	mm	in	mm	in	mm	in
R0	75	3	75	3	0	0
R1	75	3	75	3	0	0
R2	75	3	75	3	0	0
R3	75	3	75	3	0	0

3AXD10000299801.xls

1) You can install the modules side by side, but if you plan to install side-mounted options, leave 20 mm of space to the right side of the module.

Losses, cooling data and noise

Frame size R0 has natural convection cooling. Frame sizes R1…R3 have a cooling fan. The air flow direction is from bottom to top.

The table below specifies the heat dissipation in the main circuit at nominal load and in the control circuit with minimum load (I/O and panel not in use) and maximum load (all digital inputs in the on state and the panel, fieldbus and fan in use). The total heat dissipation is the sum of the heat dissipation in the main and control circuits.

Type ACS380-04xx	Heat dissipation				Air flow	Noise	Frame size
	Main circuit at rated I_{1N} and I_{2N}	Control circuit minimum	Control circuit maximum	Main and control boards maximum			
	W	W	W	W	m^3/h	dB(A)	
1-phase U_N = 200…240 V							
02A4-1	32	17	20	52	TBC	TBC	R0
03A7-1	46	17	20	66	TBC	TBC	R0
04A8-1	59	24	25	84	TBC	TBC	R1
06A9-1	85	24	25	109	TBC	TBC	R1
07A8-1	95	24	25	120	TBC	TBC	R1
09A8-1	115	24	25	140	TBC	TBC	R2
12A2-1	145	24	25	170	TBC	TBC	R2
3-phase U_N = 380…480 V							
01A8-4	26	17	20	46	TBC	TBC	R0
02A6-4	35	24	25	60	TBC	TBC	R1
03A3-4	42	24	25	67	TBC	TBC	R1
04A0-4	50	24	25	75	TBC	TBC	R1
05A6-4	68	24	25	93	TBC	TBC	R1
07A2-4	88	24	25	112	TBC	TBC	R1
09A4-4	115	24	25	139	TBC	TBC	R1
12A6-4	158	24	25	183	TBC	TBC	R2
17A0-4	208	24	25	232	TBC	TBC	R3
25A0-4	322	24	25	346	TBC	TBC	R3

3AXD10000299801.xls

Terminal data for the power cables

IEC

Type ACS380-04xx-	U1, V1, W1 / U2, V2, W2 / BRK+, BRK- / DC+, DC- terminals						PE terminal	
	Min (solid/stranded)		Max (solid/stranded)		Torque		Min.	Torque
	mm^2	AWG	mm^2	AWG	N·m	lbf·in	mm^2	N·m
1-phase U_N = 200…240 V								
02A4-1	0.2/0.2	18	6/6	8	0.5...0.6	5	4.0	1.2
03A7-1	0.2/0.2	18	6/6	8	0.5...0.6	5	4.0	1.2
04A8-1	0.2/0.2	18	6/6	8	0.5...0.6	5	4.0	1.2
06A9-1	0.2/0.2	18	6/6	8	0.5...0.6	5	4.0	1.2
07A8-1	0.2/0.2	18	6/6	8	0.5...0.6	5	4.0	1.2
09A8-1	0.5/0.5	20	16/16	6	1.2...1.5	12.2	4.0	1.2
12A2-1	0.5/0.5	20	16/16	6	1.2...1.5	12.2	4.0	1.2
3-phase U_N = 380…480 V								
01A8-4	0.2/0.2	18	6/6	8	0.5...0.6	5	4.0	1.2
02A6-4	0.2/0.2	18	6/6	8	0.5...0.6	5	4.0	1.2
03A3-4	0.2/0.2	18	6/6	8	0.5...0.6	5	4.0	1.2
04A0-4	0.2/0.2	18	6/6	8	0.5...0.6	5	4.0	1.2
05A6-4	0.2/0.2	18	6/6	8	0.5...0.6	5	4.0	1.2
07A2-4	0.2/0.2	18	6/6	8	0.5...0.6	5	4.0	1.2
09A4-4	0.2/0.2	18	6/6	8	0.5...0.6	5	4.0	1.2
12A6-4	0.2/0.2	18	6/6	8	0.5...0.6	5	4.0	1.2
17A0-4	0.5/0.5	20	16/16	6	1.2...1.5	12.2	4.0	1.2
25A0-4	0.5/0.5	20	16/16	6	1.2...1.5	12.2	4.0	1.2

3AXD10000299801.xls

Terminal data for the control cables

Type ACS380-04xx-	All control cables			
	Wire size		Torque	
	mm^2	AWG	N·m	lbf·in
1-phase U_N = 200…240 V				
02A4-1	0.14...1.5	26...16	0.5...0.6	4.4...5.3
03A7-1	0.14...1.5	26...16	0.5...0.6	4.4...5.3
04A8-1	0.14...1.5	26...16	0.5...0.6	4.4...5.3
06A9-1	0.14...1.5	26...16	0.5...0.6	4.4...5.3
07A8-1	0.14...1.5	26...16	0.5...0.6	4.4...5.3
09A8-1	0.14...1.5	26...16	0.5...0.6	4.4...5.3
12A2-1	0.14...1.5	26...16	0.5...0.6	4.4...5.3
3-phase U_N = 380…480 V				
01A8-4	0.14...1.5	26...16	0.5...0.6	4.4...5.3
02A6-4	0.14...1.5	26...16	0.5...0.6	4.4...5.3
03A3-4	0.14...1.5	26...16	0.5...0.6	4.4...5.3
04A0-4	0.14...1.5	26...16	0.5...0.6	4.4...5.3
05A6-4	0.14...1.5	26...16	0.5...0.6	4.4...5.3
07A2-4	0.14...1.5	26...16	0.5...0.6	4.4...5.3
09A4-4	0.14...1.5	26...16	0.5...0.6	4.4...5.3
12A6-4	0.14...1.5	26...16	0.5...0.6	4.4...5.3
17A0-4	0.14...1.5	26...16	0.5...0.6	4.4...5.3
25A0-4	0.14...1.5	26...16	0.5...0.6	4.4...5.3

3AXD10000299801.xls

EMC filters for Category C1

To comply with EMC limits in the European EMC Directive (standard EN 61800-3) for Category C1 with the maximum motor cable lengths at a 4 kHz switching frequency, use an EMC filter. For information on the correct EMC filters, contact your local ABB representative.

Electric power network specification

Voltage (U_1)	200/208/220/230/240 V AC 1-phase for 200 V AC drives 380/400/415/440/460/480 V AC 3-phase for 400 V AC drives ±10% variation from converter nominal voltage is allowed as default.
Network type	Public low-voltage networks. TN (grounded), IT (ungrounded) and corner-grounded TN systems.
Rated conditional short-circuit current (IEC 61439-1)	65 kA when protected by fuses given in the fuse tables.
Short-circuit current protection (UL 508C, CSA C22.2 No. 14-05)	US and Canada: The drive is suitable for use on a circuit capable of delivering not more than 100 kA symmetrical amperes (rms) at 480 V maximum when protected by fuses given in the fuse table.
Frequency (f1)	47 to 63 Hz, maximum rate of change 17%/s
Imbalance	Max. ±3% of nominal phase to phase input voltage
Fundamental power factor (cos phi)	0.98 (at nominal load)

Motor connection data

Motor type	Asynchronous induction motor or permanent magnet synchronous motor
Voltage (U_2)	0 to U_1, 3-phase symmetrical, U_{max} at the field weakening point
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	See *Ratings* on page *80*.
Switching frequency	2, 4, 8 or 12 kHz

Motor cable length

Operational functionality and motor cable length

The drive is designed to operate with optimum performance with the following maximum motor cable lengths. The motor cable lengths may be extended with output chokes as shown in the table.

Frame size	Maximum motor cable length	
	m	ft
Standard drive, without external options		
R0	30	100
R1…R3	50	165
With external output chokes		
R0	60	195
R1…R3	100	330

Note: In multimotor systems, the calculated sum of all motor cable lengths must not exceed the maximum motor cable length given in the table.

EMC compatibility and motor cable length

To comply with the European EMC Directive (standard IEC/EN 61800-3), use the following maximum motor cable lengths for 4 kHz switching frequency.

All frame sizes	Maximum motor cable length, 4 kHz	
	m	ft
With internal EMC filter		
First environment (category C2)	10	30
Second environment (category C3)	30 (1	100 (1
With optional external EMC filter		
Second environment (category C3)	30 (at least) (2	100 (at least) (2
First environment (category C2)	10 (at least) (2	30 (at least) (2
First environment (category C1)	10 (at least) (2	30 (at least) (2

1) For R2 400 V frames, the maximum motor cable length is 20 m.

2) The maximum motor cable length is determined by the drive's operational factors. Contact your local ABB representative for the exact maximum lengths when using external EMC filters.

Note 1: The internal EMC filter must be disconnected by removing the EMC screw (see the figure on page *50*) while using the low leakage current EMC filter (LRFI-XX).

Note 2: Radiated emissions are according to C2 with and without an external EMC filter. For 200V frames, a metal enclosure must be used to fulfill radiated emissions C2 limits.

Note 3: Category C1 with conducted emissions only. Radiated emissions are not compatible when measured with standard emission measurement setup and should be checked or measured on cabinet and machine installations case by case.

Control connection data

Analog inputs (AI1, AI2)	Voltage signal, single-ended	0…10 V DC (10% overrange, 11 V DC max.) R_{in} = 221.6 kohm	
	Current signal, single-ended	0…20 mA (10% overrange, 22 mA max.) R_{in} = 137 ohm	
	Inaccuracy	≤ 1.5%, of full scale	
	Overvoltage protection	up to 30 V DC	
	Potentionmeter reference value	10 V DC ±1%, max. load current 10 mA	
Analog output (AO)	Current output mode	0…20 mA (10% overrange, 22 mA max.) into 500 ohm load	
	Voltage output mode	0…10 V DC (10% overrange, 11 V DC max.) into 200 kohm minimum load (resistive)	
	Inaccuracy	≤ 2%, of full scale	
Auxiliary voltage input/output (+24V)	As output	+24 V DC ±10%, max. 200 mA	
	As input	+24 V DC ±10%, max. 1000 mA (incl internal fan load)	
Digital inputs (DI1…DI4)	Voltage	12…24 V DC (int. or ext. supply) Max. 30 V DC.	
	Type	PNP and NPN	
	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 and NPN
		Input impedance	R_{in} = 2 kohm
	As outputs	Type	Transistor output PNP
		Max. switching voltage	30 V DC
		Max. switching current	70 mA / 30 V DC, short-circuit protected
		Frequency	10 Hz…16 kHz
		Resolution	1 Hz
Relay output (RA, RB, RC)	Type	1 From C (NO + NC)	
	Max. switching voltage	250 V AC / 30 V DC	
	Max. switching current	2 A	
Frequency input (FI)	10 Hz…16 kHz DI3 and DI4 can be used as digital or frequency inputs.		
Frequency output (FO)	DIO1 and DIO2 can be used as digital or frequency outputs.		
STO interface (SGND, S+, S1, S2)	Refer to *Safe torque off function* on page *121*.		

Brake resistor connection

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. For correct fuse selection, contact your local ABB representative. Rated conditional short-circuit current as defined in IEC 60439-1.

Efficiency

Approximately 98% at nominal power level.

Degrees of protection

Degree of protection (IEC/EN 60529)	IP20 (cabinet installation) / UL Open Type: Standard enclosure. The drive must be installed in a cabinet to fulfill the requirements for shielding from contact.
Enclosure types (UL508C)	UL Open Type. For indoor use only.
Overvoltage category (IEC 60664-1)	III
Protective classes (IEC/EN 61800-5-1)	I

Ambient conditions

Environmental limits for the drive are given below. The drive is to be used in a heated indoor controlled environment.

	Operation installed for stationary use	**Storage** in the protective package	**Transportation** in the protective package
Installation site altitude	0…2000 m (6600 ft) above sea level (above 1000 m [3300 ft], refer to *Derating* on page *82*) For installation above 2000 m, contact ABB.	-	-
Surrounding air temperature	-10…+60 °C (14…140 °F)(1 No frost allowed. Refer to *Derating* on page *82*. 1) For frame R0, -10…+50 °C (14…122 °F).	-40…+70 °C ±2% (-40…+158 °F ±2%)	-40…+70 °C ±2% (-40…+158 °F ±2%)
Relative humidity	0…95%	Max. 95%	Max. 95%
	No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.		
Contamination levels (IEC 60721-3-3, IEC 60721-3-2, IEC 60721-3-1)	No conductive dust allowed.		
	According to IEC 60721-3-3, chemical gases: Class 3C2 solid particles: Class 3S2. Install the drive according to the enclosure classification. Make sure that the cooling air is clean, and free from corrosive materials and electrically conductive dust.	According to IEC 60721-3-1, chemical gases: Class 1C2 solid particles: Class 1S2	According to IEC 60721-3-2, chemical gases: Class 2C2 solid particles: Class 2S2
Pollution degree (IEC 60950-1)	Pollution degree 2	-	-

Sinusoidal vibration (IEC 60721-3-3)	Tested according to IEC 60721-3-3, mechanical conditions: Class 3M4 2…9 Hz, 3.0 mm (0.12 in) 9…200 Hz, 10 m/s^2 (33 ft/s^2)	-	-
Shock (IEC 60068-2-27, ISTA 1A)	Not allowed	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	Not allowed	76 cm (30 in)	76 cm (30 in)

Materials

Drive enclosure

- PC/ABS 2 mm, PC+10%GF 2.5…3 mm and PA66+25%GF 1.5 mm, all in color NCS 1502-Y (RAL 9002 / PMS 420 C)
- Hot-dip zinc coated steel sheet 1.5 mm, thickness of coating 20 micrometers
- Extruded aluminum AlSi

Package

Corrugated cardboard.

Disposal

The drive contains raw materials that should be recycled to preserve energy and natural resources. The package materials are environmentally compatible and recyclable. All metal parts can be recycled. The plastic parts can either be recycled or burned under controlled circumstances, according to local regulations. Most recyclable parts are marked with recycling marks.

If recycling is not feasible, all parts excluding electrolytic capacitors and printed circuit boards can be landfilled. The DC capacitors contain electrolyte, which is classified as hazardous waste within the EU. They must be removed and handled according to local regulations.

For further information on environmental aspects and more detailed recycling instructions, please contact your local ABB distributor.

Applicable standards

The drive complies with the following standards:

EN ISO 13849-1:2008 + AC:2009	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 IEC 60204-1:2005 + A1:2008	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 + A1:2013 IEC 62061:2005 + A1:2012	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	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. 274-13	Adjustable speed drives

CE marking

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

Compliance with the European Low Voltage Directive

The compliance with the European Low Voltage Directive has been verified according to standard EN 61800-5-1:2007. Declaration is available on the Internet.

Compliance with the European EMC Directive

The EMC Directive defines the requirements for immunity and emissions of electrical equipment used within the European Union. The EMC product standard (EN 61800-3:2004 + A1:2012) covers requirements stated for drives. Refer to *Compliance with EN 61800-3:2004 + A1:2012* on page *101*. The declaration is available on the Internet.

Compliance with the European ROHS Directive

The RoHS Directive defines the restriction of the use of certain hazardous substances in electrical and electronic equipment. The declaration is available on the Internet.

Compliance with the European WEEE Directive

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

Compliance with the European Machinery Directive

The drive includes the Safe torque off function and can be equipped with other safety functions for machinery which, as safety components, are in the scope of the Machinery Directive. These functions of the drive comply with European harmonized standards such as EN 61800-5-2. Refer to *Safe torque off function* on page *121*.

ABB

Declaration of Conformity

(According to Machinery Directive 2006/42/EC)

Manufacturer: ABB Oy, Drives
Address: Hiomotie 13, P.O Box 184, 00381 Helsinki, Finland.

hereby declares that the product

ACS380-04 (frame sizes R0-R2)

with regard to the following safety function

Safe torque off

fulfils all the relevant safety component requirements of EC Machinery Directive 2006/42/EC, when the listed safety function is used for safety component functionality.

The following harmonized standards below were used:

EN 61800-5-2: 2007	*Adjustable speed electrical power drive systems – Part 5-2: Safety requirements - Functional*
EN 62061: 2005 + A1: 2013	*Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*
EN ISO 13849-1: 2008 + AC: 2009	*Safety of machinery – Safety-related parts of control systems. Part 1: General requirements*
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*

Other used standards:

IEC 61508 ed. 2: 2010	Functional safety of electrical / electronic / programmable electronic safety-related systems

The products referred in this Declaration of Conformity fulfil the relevant provisions of the Low Voltage Directive 2006/95/EC and EMC Directive 2004/108/EC. Declaration of conformity according to these directives is available from the manufacturer.

Person authorized to compile the technical file:

Name: Risto Mynttinen
Address: P.O. Box 184, FIN-00381 Helsinki, Finland

Helsinki, 2015-10-19

Mika Pääkkönen
Vice President
ABB Oy

3AXD10000462189

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

Definitions

EMC stands for **E**lectro**m**agnetic **C**ompatibility. It is the ability of electrical/electronic equipment to operate without problems within an electromagnetic environment. Likewise, the equipment must not disturb or interfere with any other product or system within its locality.

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

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

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

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

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

Category C1

The emission limits are complied with the following provisions:

1. The optional EMC filter is selected according to the ABB documentation and installed as specified in the EMC filter manual.
2. The motor and control cables are selected as specified in this manual.
3. The drive is installed according to the instructions given in this manual.
4. For the maximum motor cable length with 4 kHz switching frequency, refer to *Motor cable length* on page *93*.

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

Category C2

Applicable to ACS380-042x with an internal EMC C2 filter.

The emission limits are complied with the following provisions:

1. The motor and control cables are selected as specified in this manual.
2. The drive is installed according to the instructions given in this manual.
3. For the maximum motor cable length with 4 kHz switching frequency, refer to *Motor cable length* on page *93*.

If it is used in a residential or domestic environment, the drive can cause radio-frequency interference. If it is necessary, take measures to prevent interference, in addition to the requirements for the CE compliance.

WARNING! Do not install a drive with the internal EMC filter connected on IT (ungrounded). The supply network becomes connected to ground potential through the internal EMC filter capacitors which may cause danger or damage to the drive. To disconnect the EMC filter, refer to *EMC filter disconnection* on page *59*.

WARNING! Do not install a drive with internal EMC filter connected on corner-grounded TN systems; otherwise the drive will be damaged. To disconnect the EMC filter, refer to *EMC filter disconnection* on page *59*.

Category C3

This is applicable to ACS380-040x-4 drives with an internal EMC C3 filter.

The drive complies with the standard with the following provisions:

1. The motor and control cables are selected as specified in this manual.
2. The drive is installed according to the instructions given in this manual.
3. For the maximum motor cable length with 4 kHz switching frequency, refer to *Motor cable length* on page *93*.

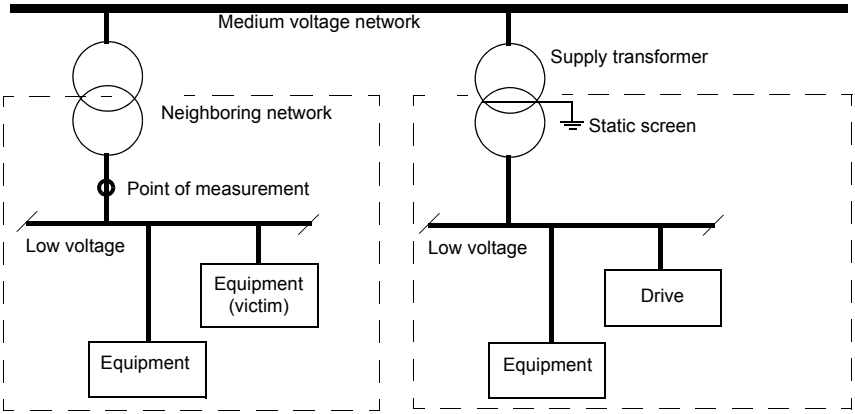
WARNING! To prevent radio-frequency interference, do not use a category C3 drive on a low-voltage public network which supplies domestic premises.

Category C4

This is applicable to ACS380-040x-1 drives.

If the provisions in *Category 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, the supply transformer with static screening between the primary and secondary windings can be used.



2. An EMC plan for preventing disturbances is drawn up for the installation. A template is available from the local ABB representative.
3. The motor and control cables are selected as specified in this manual.
4. The drive is installed according to the instructions given in this manual.

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

UL marking

UL checklist

- Make sure that the drive type designation label includes the cULus Listed marking.
- **CAUTION - Risk of electric shock**. After disconnecting the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start working on the drive, motor or motor cable.
- The drive is to be used in a heated, indoor controlled environment. The drive must be installed in clean air according to the enclosure classification. Cooling air must be clean, free from corrosive materials and electrically conductive dust.
- The maximum ambient air temperature is 50°C (122 °F) at rated current. Except for the R0 frame size, the current is derated for 50 to 60 °C (122 to 140 °F).
- The drive is suitable for use in a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 480 V (or 240 V) maximum when protected by the UL fuses given in the table on page *85*. The ampere rating is based on tests done according to the appropriate UL standard.
- The cables located within the motor circuit must be rated for at least 75 °C (167 °F) in UL-compliant installations.
- Integral solid state short circuit protection does not provide branch circuit protection. The input cable must be protected with fuses. Suitable IEC fuses are listed on page *84* and UL classified fuses on page *85*. These fuses provide branch circuit protection in accordance with the National Electrical Code (NEC) and Canadian Electrical Code. For installation in the United States, also obey any other applicable local codes. For installation in Canada, also obey any applicable provincial codes.
  Note: Circuit breakers must not be used without fuses in the USA. Contact your local representative for suitable circuit breakers.
- The drive provides motor overload protection. For the adjustments, refer to the firmware manual.
- For drive overvoltage category, refer to page *96*. For pollution degree, see page *97*.

CSA marking

CSA marking pending.

RCM marking

RCM marking pending.

EAC marking

EAC marking pending.

Disclaimers

Generic disclaimer

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

Cyber security disclaimer

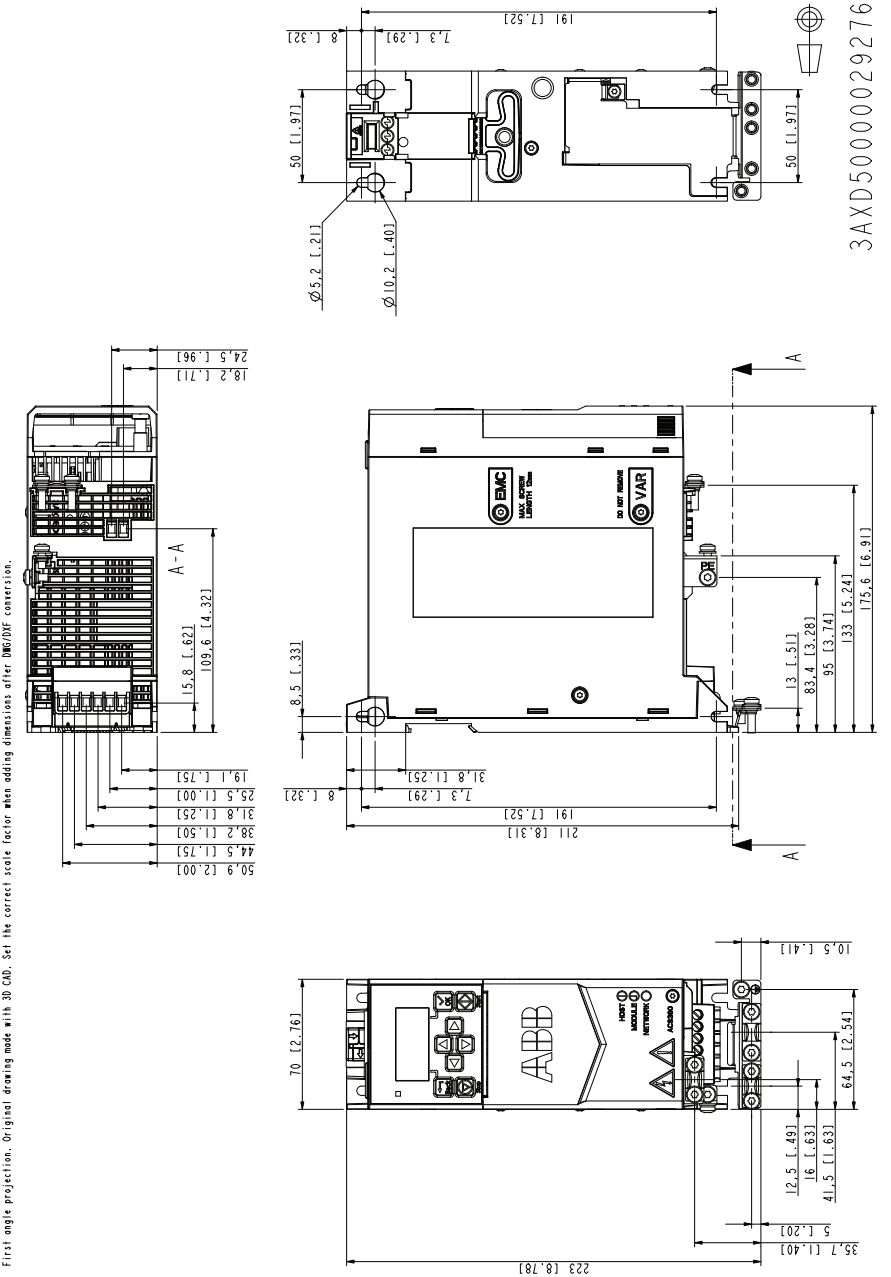
This product is designed to be connected to and to communicate information and data via a network interface. It is Customer's sole responsibility to provide and continuously ensure a secure connection between the product and Customer network or any other network (as the case may be). Customer shall establish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

10

Dimension drawings

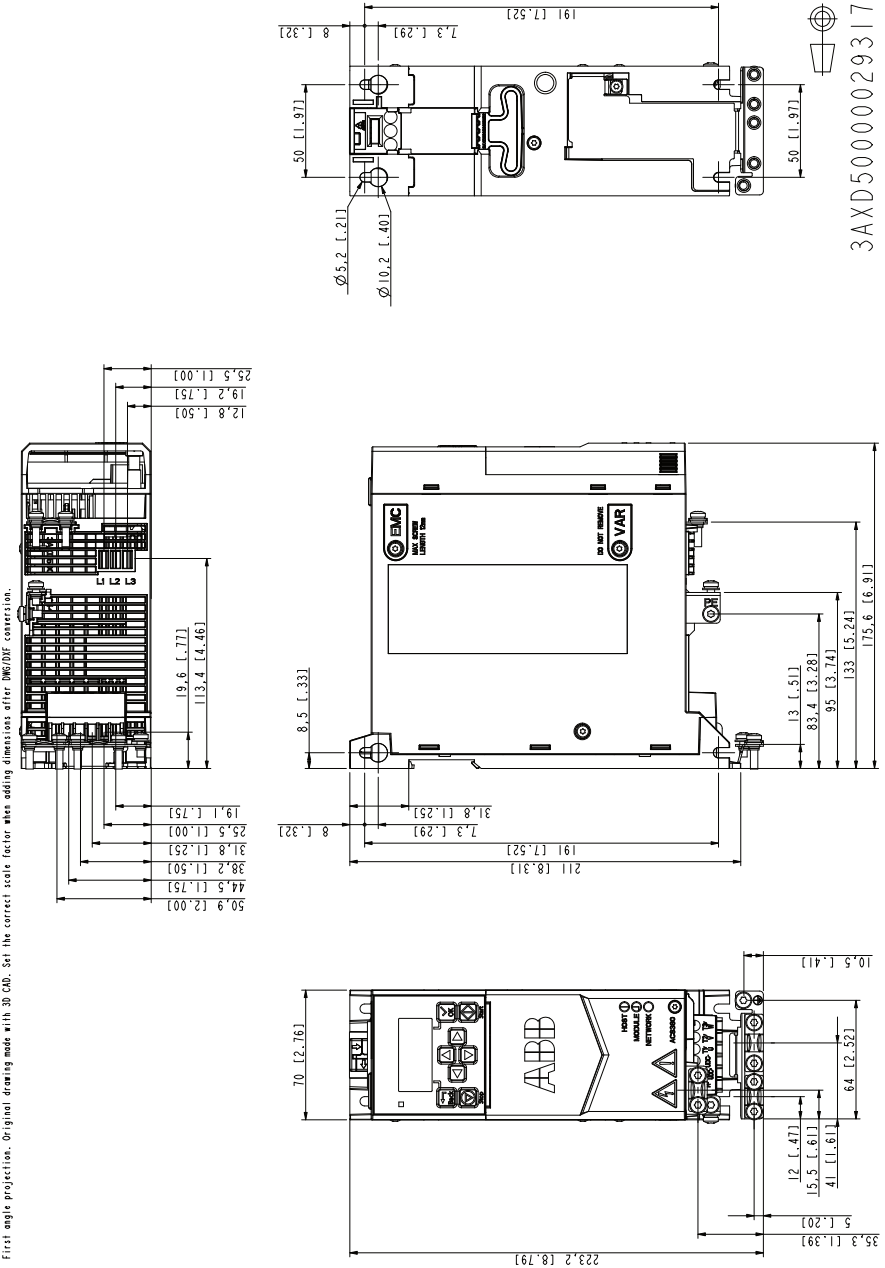
The dimension drawings of ACS380 drive frame sizes R0, R1, R2 and R3. The dimensions are in millimeters and inches.

Frame R0 (230 V)

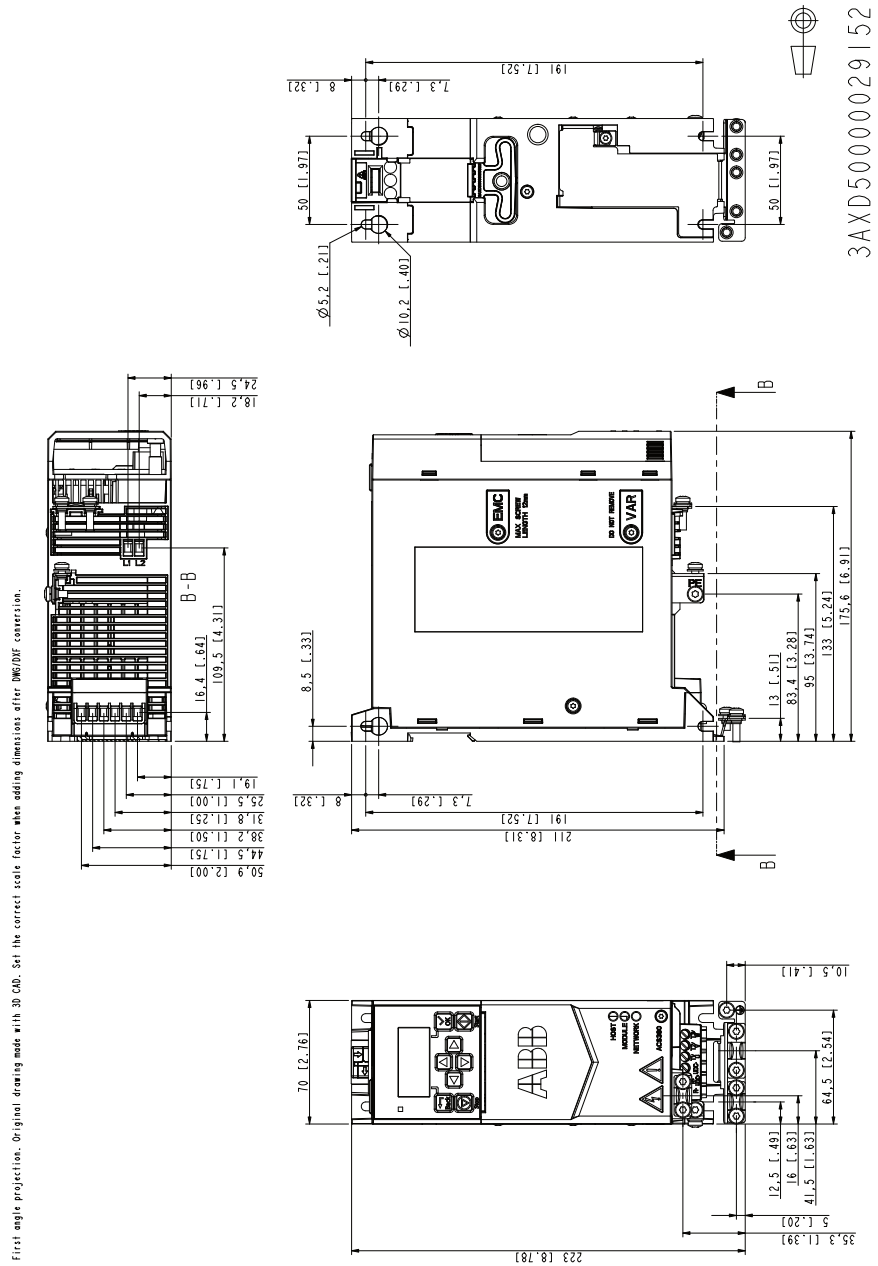


First angle projection. Original drawing made with 3D CAD. Set the correct scale factor when adding dimensions after DWG/DXF conversion.

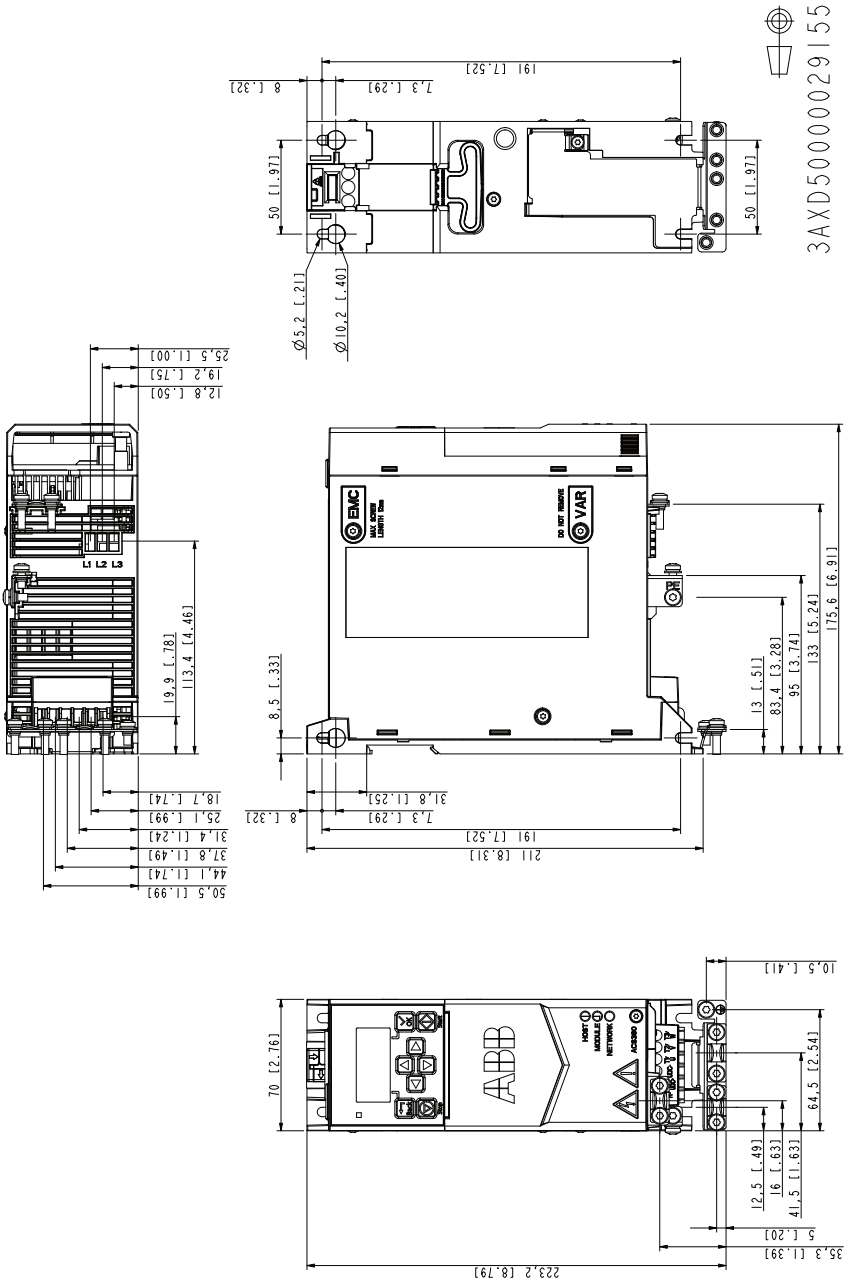
Frame R0 (400 V)



Frame R1 (230 V)

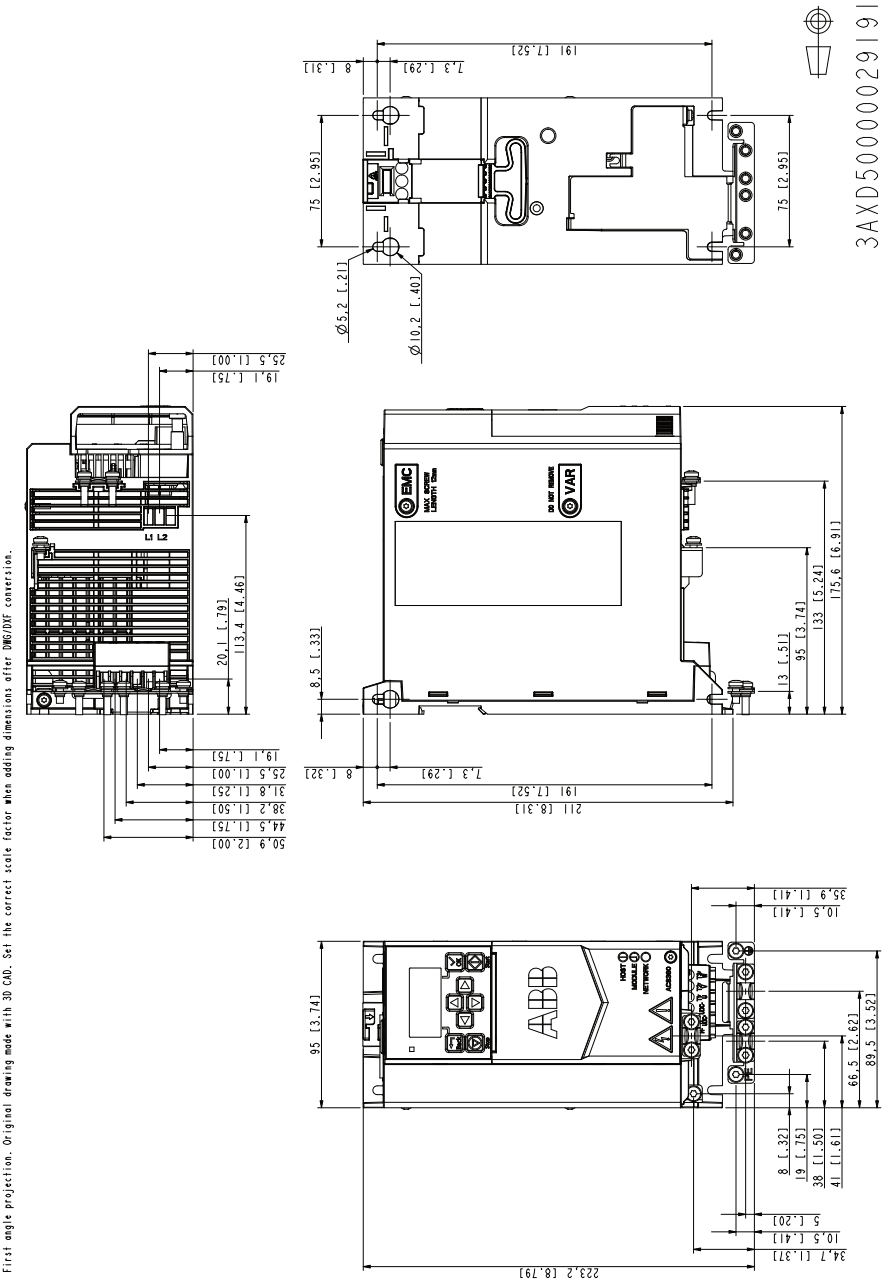


Frame R1 (400 V)

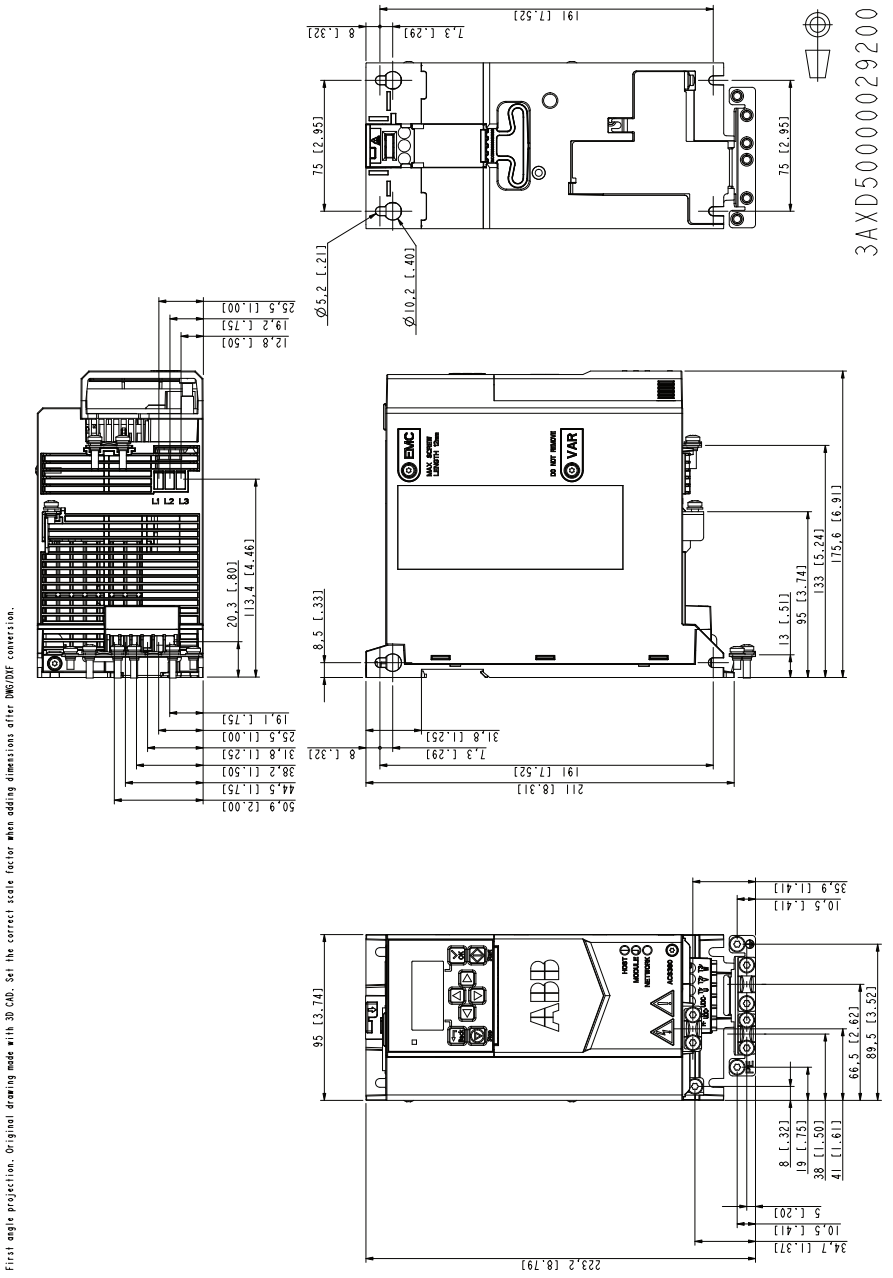


First angle projection. Original drawing made with 3D CAD. Set the correct scale factor when adding dimensions after DWG/DXF conversion.

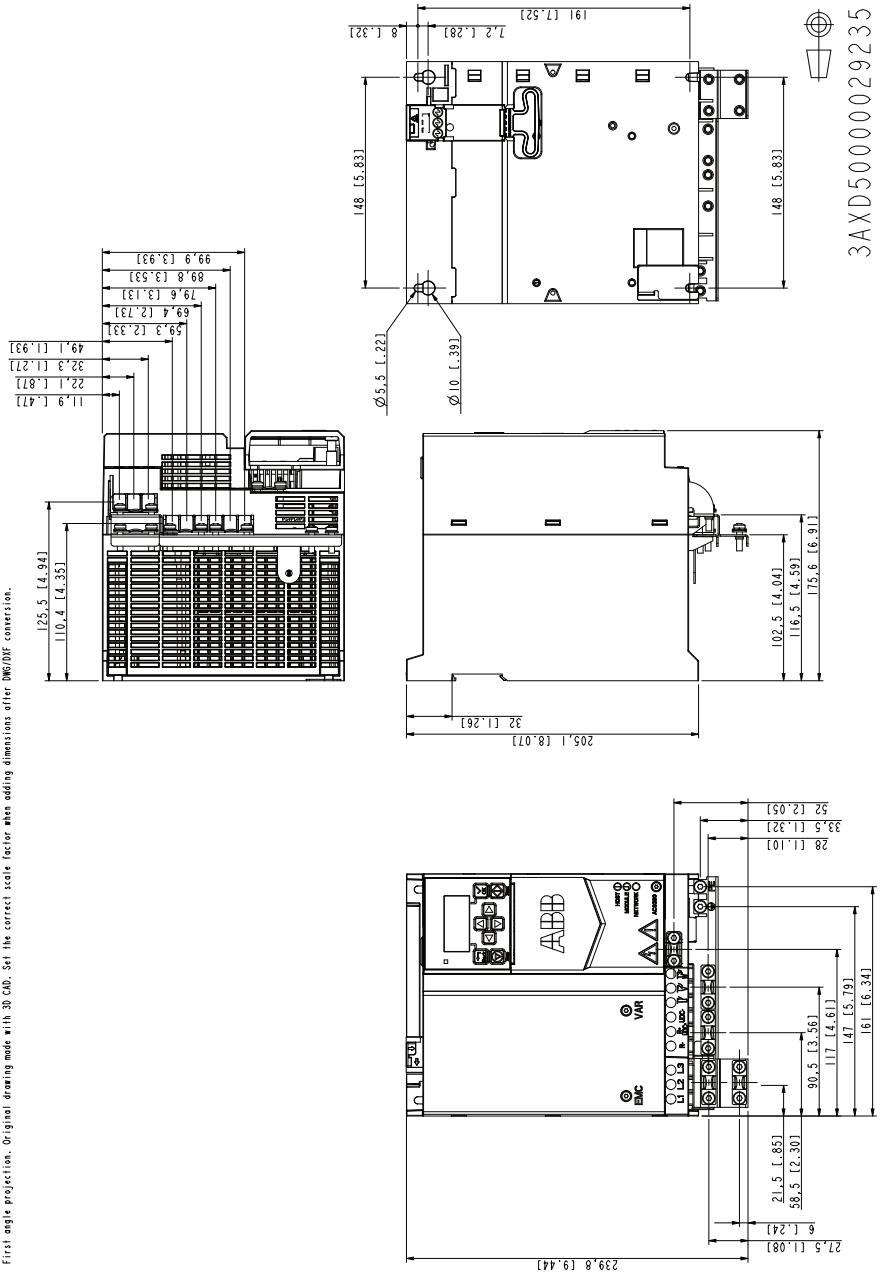
Frame R2 (230 V)



Frame R2 (400 V)



Frame R3 (400 V)



11

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.

Operation principle and hardware description

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

Selecting the brake resistor

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

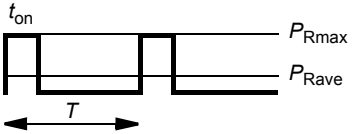
1. Determine the required maximum braking power P_{Rmax} for the application. P_{Rmax} must be smaller than P_{BRmax} given in the table on page *116* for the used drive type.
2. Calculate resistance R with Equation 1.
3. Calculate energy E_{Rpulse} with Equation 2.
4. Select the resistor so that the following conditions are met:
   - The rated power of the resistor must be greater 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:

Eq. 1. U_N = 200…240 V: $R = \frac{150000}{P_{Rmax}}$

U_N = 380…415 V: $R = \frac{450000}{P_{Rmax}}$

U_N = 415…480 V: $R = \frac{615000}{P_{Rmax}}$



Eq. 2. $E_{Rpulse} = P_{Rmax} \cdot t_{on}$

Eq. 3. $P_{Rave} = P_{Rmax} \cdot \frac{t_{on}}{T}$

For conversion, use 1 hp = 746 W.

where

R = calculated brake resistor value (ohm). Make sure that: $R_{min} < R < R_{mxx}$.
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} = length of the braking pulse (s)
T = length of the braking cycle (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 ACS380-04xx	R_{min}	R_{max}	P_{BRcont}		P_{BRmax}		Reference resistor types	Braking time [1]
	ohm	ohm	kW	hp	kW	hp	Danotherm	s
1-phase U_N = 200…240 V								
02A4-1	32.5	468	0.25	0.33	0.38	0.50	CBH 360 C T 406 210R or CAR 200 D T 406 210R	Refer to braking resistor manufacturer's documentation
03A7-1	32.5	316	0.37	0.50	0.56	0.74		
04A8-1	32.5	213	0.55	0.75	0.83	1.1		
06A9-1	32.5	145	0.75	1.00	1.1	1.5	CBR-V 330 D T 406 78R UL	
07A8-1	32.5	96.5	1.10	1.50	1.7	2.2		
09A8-1	32.5	69.9	1.50	2.00	2.3	3.0	CBR-V 560 D HT 406 39R UL	
12A2-1	19.5	47.1	2.20	3.00	3.3	4.4		
3-phase U_N = 380…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	Refer to braking resistor manufacturer's documentation
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	-	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	CBR-V 560 D HT 406 39R UL	
25A0-4	23	39	7.50	10.00	11.25	15.00		

3AXD10000299801.xls

1) The maximum permitted braking cycle of the braking resistor differs from the that of the drive.

P_{BRmax} – The maximum braking capacity of the drive 1/10min (P_{BRcont} * 150%), must exceed the desired braking power.

P_{BRcont} – The maximum braking capacity of the drive, must exceed the desired braking power.

Selecting and routing the brake resistor cables

Use a shielded cable specified in section *Terminal data for the power cables* on page *89*.

Minimizing electromagnetic interference

Follow these rules in order to minimize electromagnetic interference caused by the rapid current changes in the resistor cables:

- Install the cables away from other cable routes.
- Avoid long parallel runs with other cables. The minimum parallel cabling separation distance should be 0.3 meters.
- Cross the other cables at right angles.
- Keep the cable as short as possible in order to minimize the radiated emissions and stress on chopper IGBTs. The longer the cable the higher the 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).

EMC compliance of the complete installation

ABB has not verified that the EMC requirements are fulfilled with external user-defined brake resistors and cabling. The EMC compliance of the complete installation must be considered by the customer.

Placing the brake resistor

Install the resistors outside the drive in a place where they will cool.

Arrange the cooling of the resistor in a way that:

- There is no danger of overheating to the resistor or nearby materials.
- The surrounding air temperature does not exceed the allowed maximum.

Supply the resistor with cooling air/water according to the resistor manufacturer's instructions.

WARNING! The materials near the brake resistor must be non-flammable. The surface temperature of the resistor is high. Air flowing from the resistor is of hundreds of degrees Celsius. If the exhaust vents are connected to a ventilation system, ensure that the material withstands high temperatures. Protect the resistor against physical contact.

Protecting the system in brake circuit fault situations

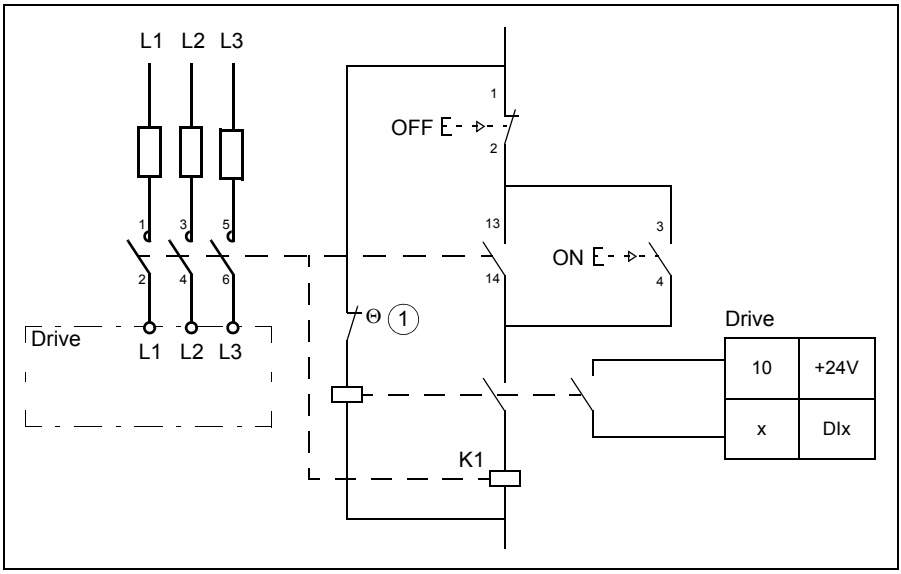
Protecting the system in cable and brake resistor short-circuit situations

The input fuses will also protect the resistor cable when it is identical with the input cable.

Protecting the system against thermal overload

Equipping the drive with a main contactor is highly recommended for safety reasons. Wire the contactor so that it opens in case the resistor overheats. This is essential for safety since the drive will not otherwise be able to interrupt the main supply if the chopper remains conductive in a fault situation. An example wiring diagram is shown below. We recommend that you use resistors equipped with a thermal switch (1) inside the resistor assembly. The switch indicates overtemperature and overload.

We recommend that you also wire the thermal switch to a digital input of the drive.



Mechanical installation

Refer to the resistor manufacturer's instructions.

Electrical installation

Checking the insulation of the assembly

Follow the instructions given in section *Brake resistor assembly* on page *Brake resistor assembly*.

Connection diagram

See section *Connecting the power cables* on page *60*.

Connection procedure

See section *Connecting the power cables* on page *60*.

Connect the thermal switch of the brake resistor as described in section *Protecting the system against thermal overload* on page *118*.

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.



WARNING! Disconnect the braking resistor, if it not enabled in the parameter settings.

12

Safe torque off function

What this chapter contains

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, to construct safety or supervision circuits that stop the drive in case of danger. Another possible application is a prevention of unexpected start-up switch 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.

Note: The Safe torque off function does not disconnect the voltage from the drive, see the warning on page *128*.

When activated, the Safe torque off function disables the control voltage of the power semiconductors of the drive output stage (A, see diagram on page *124*), 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 of the drive complies with these standards:

Standard	Name
EN 60204-1:2006 + AC:2010	*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 61326-3-1:2008	*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 61511:2003	*Functional safety – Safety instrumented systems for the process industry sector*
IEC/EN 61800-5-2:2007	*Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional*
IEC/EN 62061:2005 + AC:2010	*Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*
EN ISO 13849-1:2008 + AC:2009	*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*

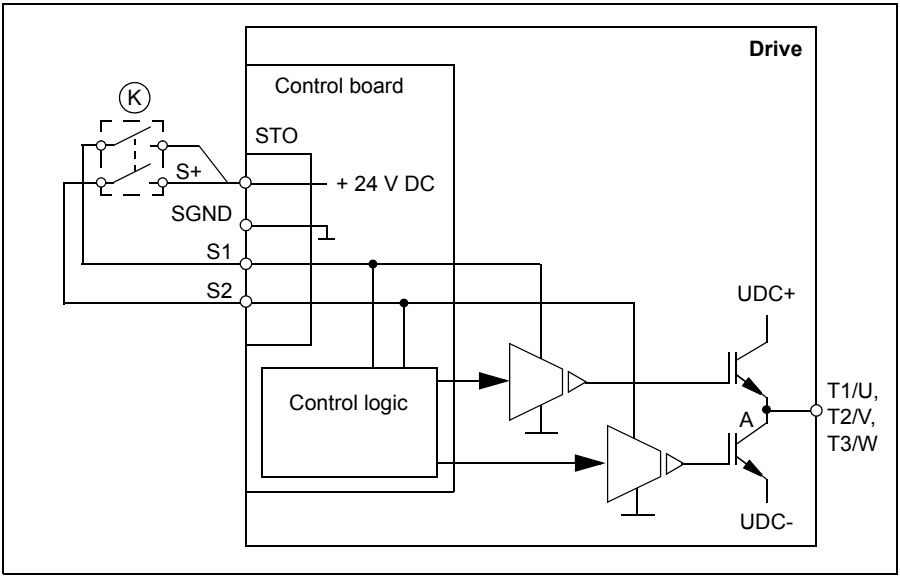
The function also corresponds to Prevention of unexpected start-up as specified by EN 1037:1995 + A1:2008 and Uncontrolled stop (stop category 0) as specified in EN 60204-1:2006 + AC:2010.

Compliance with the European Machinery Directive

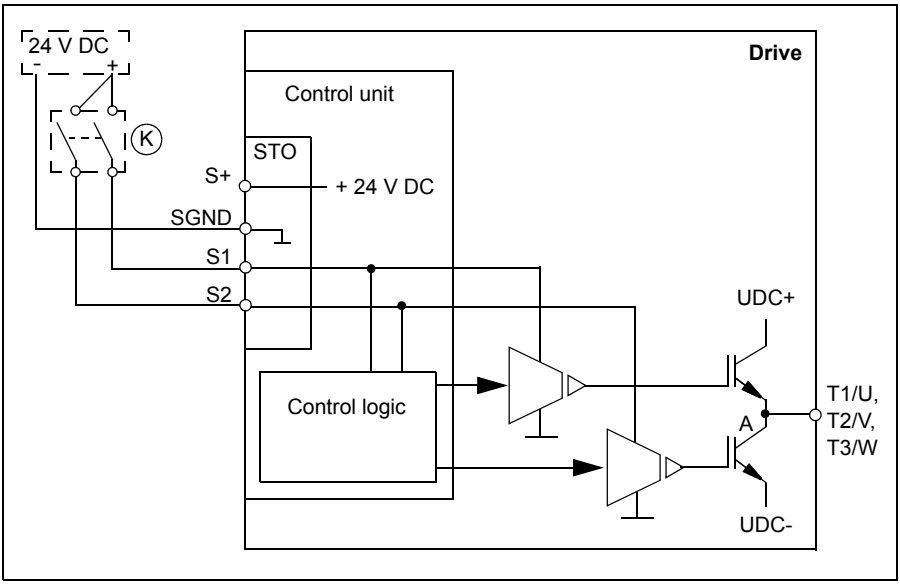
See section *Compliance with the European Machinery Directive* on page 100.

Connection principle

Connection with internal +24 V DC power supply

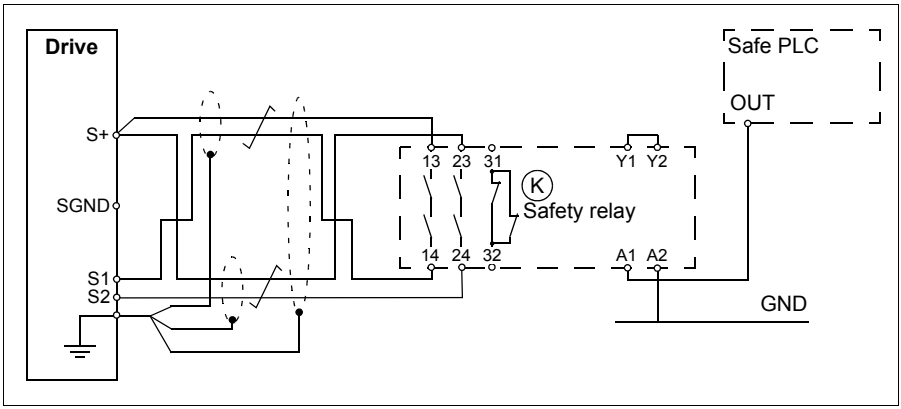


Connection with external +24 V DC power supply

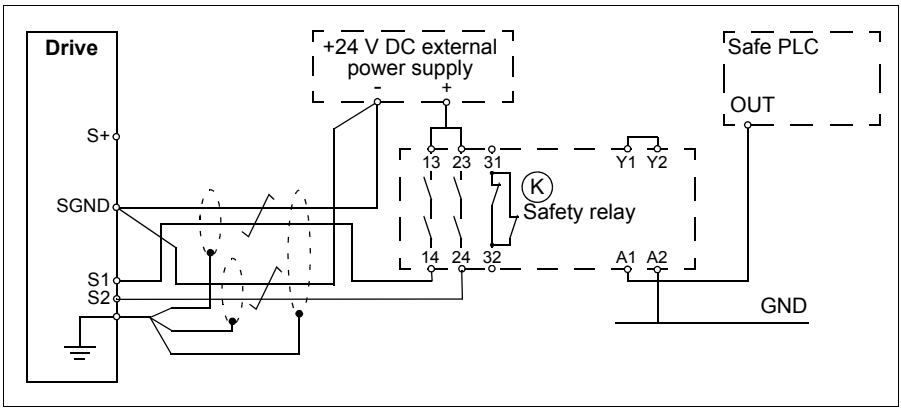


Wiring examples

An example of a Safe torque off wiring with internal +24 V DC power supply is shown below.



An example of a Safe torque off wiring with external +24 V DC power supply is shown below.



Activation switch

In the wiring diagram above (page *124*), the activation switch has the designation (K). This represents a component such as a manually operated switch, an emergency stop push button switch, or the contacts of a safety relay or safety PLC.

- If a manually operated activation switch is used, the switch must be of a type that can be locked out to the open position.
- Inputs IN1 and IN2 must open/close within 200 ms of each other.

Cable types and lengths

- Double-shielded twisted-pair cable is recommended.
- Maximum cable length 100 m (328 ft) between activation switch (K) and drive control unit.

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

Note: The voltage at the INx terminals of each drive must be at least 13 V DC to be interpreted as “1”. Pulse tolerance of input channels is 1 ms.

Grounding of protective shields

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

Operation principle

1. The Safe torque off activates (the activation switch is opened, or safety relay contacts open).
2. The STO inputs IN1 and IN2 on the drive control board de-energize.
3. The STO cuts off the control voltage from the drive IGBTs.
4. The control program generates an indication as defined by parameter 31.22 STO indication run/stop.

   The parameter selects which indications are given when one or both Safe torque off (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. 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 new start command is required to start the drive.

Start-up including acceptance 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 an acceptance test. The acceptance test must be performed

- at initial start-up of the safety function
- after any changes related to the safety function (circuit boards, wiring, components, settings, etc.)
- after any maintenance work related to the safety function.

Authorized person

The acceptance test of the safety function must be carried out by an authorized person with expertise and knowledge of the safety function. The test must be documented and signed by the authorized person.

An authorized person is an individual with authorization from the machine builder or end user to carry out, report and sign off the safety function validation / acceptance testing on behalf of the machine builder or end user.

Acceptance test reports

Signed acceptance 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 acceptance tests performed due to changes or maintenance shall be logged into the logbook.

Acceptance test procedure

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

Action	☑
 **WARNING!** Follow the *Safety instructions*, page *13*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.	☐
Ensure that the drive 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 by a disconnector.	☐
Check the Safe torque off circuit connections against the wiring diagram.	☐
Close the disconnector and switch the power on.	☐
Test the operation of the STO function when the motor is stopped. • Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill. Ensure 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 STO indication run/stop. For the description of the warning, refer to the *ACS380 firmware manual* (3AXD50000029275 [English]). • Give a start command to verify that the STO function blocks the drive's operation. The drive displays a warning. 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 ensure 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 STO indication run/stop. For the description of the warning, refer to the *ACS380 firmware manual* (3AXD50000029275 [English]). • Reset any active faults and try to start the drive. • Ensure 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.	☐
Document and sign the acceptance 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. STO inputs on the drive control unit de-energize, and the drive control unit cuts off the control voltage from the drive IGBTs.
3. The control program generates an indication as defined by parameter 31.22 STO indication run/stop.
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 main supply.



WARNING! (With permanent magnet motors only) In case of a multiple IGBT power semiconductor failure, the drive system can produce an alignment torque which maximally rotates the motor shaft by 180/*p* degrees 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 unit.
- 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 2 years. The test procedure is given in section *Acceptance test procedure* (page *127*).

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, follow the test given in section *Acceptance test procedure* (page *127*).

Use only ABB approved spare parts.

Fault tracing

The indications given during the normal operation of the Safe torque off function are selected by parameter 31.22 STO indication run/stop.

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 “STO hardware failure” fault. An attempt to use the STO in a non-redundant manner, for example activating only one channel, will trigger the same reaction.

See the drive firmware manual 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 does not apply if both STO channels are not used.

Type ACS380-04xx	IEC 61508 and IEC/EN 61800-5-2						
	SIL	SC	PFH_d (1/h)	HFT	SFF (%)	T1 (a)	PFD
1-phase U_N = 200…240 V							
02A4-1	3	3	8.91E-9	1	96.1	20	7.40E-5
03A7-1	3	3	8.91E-9	1	96.1	20	7.40E-5
04A8-1	3	3	8.91E-9	1	96.1	20	7.40E-5
06A9-1	3	3	8.91E-9	1	96.1	20	7.40E-5
07A8-1	3	3	8.91E-9	1	96.1	20	7.40E-5
09A8-1	3	3	8.91E-9	1	96.1	20	7.40E-5
12A2-1	3	3	8.91E-9	1	96.1	20	7.40E-5
3-phase U_N = 380…480 V							
01A8-4	3	3	8.00E-9	1	98.7	20	6.68E-5
02A6-4	3	3	8.00E-9	1	98.7	20	6.68E-5
03A3-4	3	3	8.00E-9	1	98.7	20	6.68E-5
04A0-4	3	3	8.00E-9	1	98.7	20	6.68E-5
05A6-4	3	3	8.00E-9	1	98.7	20	6.68E-5
07A2-4	3	3	8.00E-9	1	98.7	20	6.68E-5
09A4-4	3	3	8.00E-9	1	98.7	20	6.68E-5
12A6-4	3	3	8.00E-9	1	98.7	20	6.68E-5
17A0-4	3	3	8.00E-9	1	98.7	20	6.68E-5
25A0-4	3	3	8.00E-9	1	98.7	20	6.68E-5

3AXD10000299801.xls

Type ACS380-04xx	IEC 61508 and IEC/EN 61800-5-2				IEC/EN 62061	IEC61511
	PL rating	CCF (%)	$MTTF_d$[1] (a)	DC[2] (%)	SILCL	SIL
1-phase U_N = 200…240 V						
02A4-1	e	80	2243	>90	3	3
03A7-1	e	80	2243	>90	3	3
04A8-1	e	80	2243	>90	3	3
06A9-1	e	80	2242	>90	3	3
07A8-1	e	80	2242	>90	3	3
09A8-1	e	80	2243	>90	3	3
12A2-1	e	80	2243	>90	3	3

Type ACS380-04xx	IEC 61508 and IEC/EN 61800-5-2				IEC/EN 62061	IEC61511
	PL rating	CCF (%)	$MTTF_d$[1] (a)	DC[2] (%)	SILCL	SIL
3-phase U_N = 380…480 V						
01A8-4	e	80	2569	>90	3	3
02A6-4	e	80	2569	>90	3	3
03A3-4	e	80	2568	>90	3	3
04A0-4	e	80	2568	>90	3	3
05A6-4	e	80	2568	>90	3	3
07A2-4	e	80	2568	>90	3	3
09A4-4	e	80	2568	>90	3	3
12A6-4	e	80	2568	>90	3	3
17A0-4	e	80	2569	>90	3	3
25A0-4	e	80	2569	>90	3	3

3AXD10000299801.xls

1) Use 100 years to calculate a safety loop.
2) According to EN ISO 13849-1 table E.1

- The following temperature profile is used in safety value calculations:
  - 670 on/off cycles per year with ΔT = 71.66 °C
  - 1340 on/off cycles per year with ΔT = 61.66 °C
  - 30 on/off cycles per year with ΔT = 10.0 °C
  - 32 °C board temperature at 2.0% of time
  - 60 °C board temperature at 1.5% of time
  - 85 °C board temperature at 2.3% of time
- 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 reaction time (shortest detectable break): 1 ms
- STO response time: 5 ms (typical), 10 ms (maximum)
- Fault detection time: Channels in different states for longer than 200 ms
- Fault reaction time: Fault detection time +10 ms
- STO fault indication (parameter 31.22) delay: <500 ms
- STO warning indication (parameter 31.22) delay: <1000 ms
- Maximum cable length 100 m (328 ft) between activation switch (K) and drive control unit.
- The voltage at the INx terminals of each drive must be at least 13 V DC to be interpreted as “1”. Pulse tolerance of input channels is 1 ms.

Abbreviations

Abbr.	Reference	Description
CCF	EN ISO 13849-1	Common cause failure (%)
DC	EN ISO 13849-1	Diagnostic coverage
FIT	IEC 61508	Failure in time: 1E-9 hours
HFT	IEC 61508	Hardware fault tolerance
$MTTF_d$	EN ISO 13849-1	Mean time to dangerous failure: (The total number of life units) / (the number of dangerous, undetected failures) during a particular measurement interval under stated conditions
PFD	IEC 61508	Probability of failure on demand
PFH_D	IEC 61508	Probability of dangerous failures per hour
PL	EN ISO 13849-1	Performance level. Levels a…e correspond to SIL
SC	IEC 61508	Systematic capability
SFF	IEC 61508	Safe failure fraction (%)
SIL	IEC 61508	Safety integrity level (1…3)
SILCL	EN 62061	Maximum SIL (level 1…3) that can be claimed for a safety function or subsystem
STO	IEC/EN 61800-5-2	Safe torque off
T1	IEC 61508	Proof test interval

Declaration of conformity

Declaration of conformity is available on the Internet. Refer to *Document library on the Internet* on the inside of the back cover.

Certificate

TÜV certificate is pending.

13

BTAC-02 pulse encoder interface module

Contents of this chapter

This chapter contains a description and technical data of the optional BTAC-02 pulse encoder interface module and describes how to start up the module.

Safety instructions



WARNING! Obey the instructions in *Safety instructions* on page *13*. If you ignore them, injury or death, or damage to the equipment can occur.

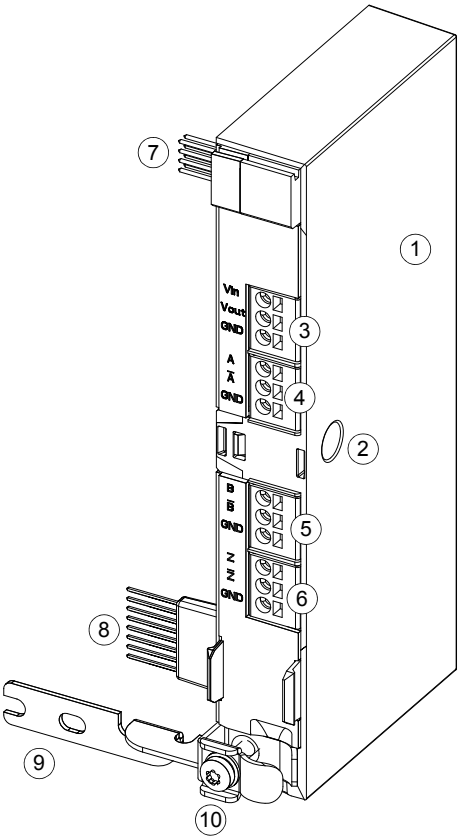
Hardware description

Product overview

The BTAC pulse encoder interface module (option +L535) adds a digital pulse encoder interface to the drive. Use a pulse encoder, if you need accurate speed or position (angle) feedback from the motor shaft. The BTAC module supplies power to the encoder. For more information, refer to *Wiring – Encoder power supply interface* on page *137*.

The BTAC module has the features of the BAPO-01 auxiliary power extension module. It provides back-up power to the drive. For more information, refer to *BAPO-01 auxiliary power extension module* on page *157*.

Layout



1. BTAC module
2. Locking screw hole
3. X103 connector
4. X104 connector
5. X105 connector
6. X106 connector
7. Internal X100 connector
8. Internal X102 connector
9. Grounding rail
10. Grounding screw

Mechanical installation

Refer to *To install a side option* on page *69*.

Electrical installation

WARNING! Obey the instructions in *Safety instructions* on page *13*. If you ignore them, injury or death, or damage to the equipment can occur.

Wiring – General

Connect the pulse encoder to the BTAC module with cables as specified in this table.

Cable	Max. connector size		Maximum cable length	
4 × (2+1) double shielded twisted pair cable with individual and overall shields	2.5 mm^2	12 AWG	100 m*	330 ft

* If the encoder supply voltage is less than 10 V, the maximum cable length is 50 m.

Terminal designations

The encoder user interface of the BTAC module consists of four 1×3-pin terminal blocks.

Use this table for reference when you wire the BTAC module and encoder terminals.

Identification				Description
BTAC	**Encoder**			
X103				
VIN	V_{CC}/PWR			External power supply input
VOUT	V_{CC}/PWR			Power supply output for the encoder
GND	0 V / GND			External power and encoder ground
X104				
A	1	A	A+	Encoder signal A + terminal
$\overline{A}$	$\overline{1}$	$\overline{A}$	A-	Encoder signal A - terminal
GND	-	-	-	Encoder ground
X105				
B	2	B	B+	Encoder signal B + terminal
$\overline{B}$	$\overline{2}$	$\overline{B}$	B-	Encoder signal B - terminal
GND	-	-	-	Encoder ground
X106				
Z	3	Z	Z+	Encoder signal Z + terminal
$\overline{Z}$	$\overline{3}$	$\overline{Z}$	Z-	Encoder signal Z - terminal
GND	-	-	-	Encoder ground.

Channels				Description
BTAC	**Encoder**			
A	1	A	A+	• Maximum signal frequency: 200 kHz • Signal levels:
$\overline{A}$	$\overline{1}$	$\overline{A}$	A-	
B	2	B	B+	
$\overline{B}$	$\overline{2}$	$\overline{B}$	B-	
Z	3	Z	Z+	
$\overline{Z}$	$\overline{3}$	$\overline{Z}$	Z-	

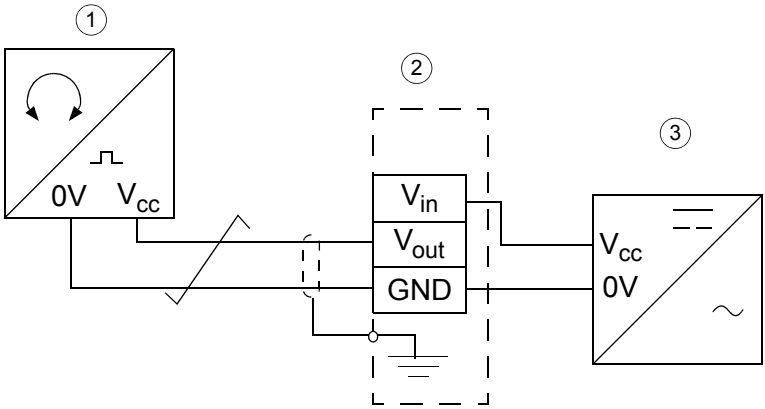
Encoder supply voltage	Logic “1”	Logic “0”
5 V	>2.5 V	<1.9 V
15 V	>7.5 V	<5.3 V
24 V	>12.1 V	<8.3 V

- Decision levels are automatically defined based on the daisy chained power supply voltage level.
- Input channels are isolated from the logic and ground.
- When the drive runs in the Forward direction, channel A should lead channel B by 90° (electrical).
- Channel Z: One pulse per revolution (used in positioning applications only).

Wiring – Encoder power supply interface

Connect the encoder power supply via the BTAC module. The same power supply feeds power to the signal interface of the BTAC module. For the voltage and current rating, refer to *Encoder interface* on page *148*.

If you use a 24 V encoder, you can use the 24 V DC power supply of the drive for the encoder and BTAC module. Make sure that you do not exceed the load capacity. Refer to *Auxiliary voltage connection* on page *67*.



1. Encoder
2. BTAC module
3. Encoder power supply

Use the following table to determine if you can use the drive's supply. Add the missing figures and sum all: the sum value must not exceed the total load capacity of the drives' supply.

Loads with the drive's 24 V DC supply			**mA**
Number of digital inputs used		× 15 mA each	
BTAC-02			50 mA
Encoder current requirement =			
Total requirements for any other user connection(s) to drive's 24 V DC =			
Total (must be less than the maximum load capacity of the drive's 24 V DC supply) =			

Wiring – Encoder

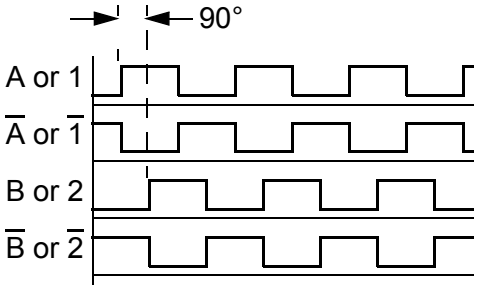
1. Remove the connector cover.
2. Determine the encoder wiring configuration:
   - Refer to *Phasing* on page *139* to determine if the encoder has a normal pulse order – encoder channel A pulse leads channel B pulse.
   - Refer to *Encoder output types* on page *140* to determine the encoder output type.
   - For push-pull types, refer to the manufacturer's recommendation for the connection. You can use single-ended or differential output.
3. Refer to *Wiring diagrams – Push-pull type encoder output*, *Wiring diagrams – Open collector (sinking) encoder output* or *Wiring diagrams – Open emitter (sourcing) encoder output* on pages *141*…*144* to select the appropriate diagram, and wire the encoder.

   Notes:
   - Normally, ground the cable shield only at the drive end.
   - Do not route the encoder cables in parallel to power (for example, motor) cables.
4. Verify correct encoder phasing. Refer to *Phasing* on page *139*.

Phasing

When the encoder is connected correctly, running the drive in the *Forward* (positive speed reference) direction should produce a positive encoder speed feedback.

Option A: Oscilloscope test. On incremental encoders, the two output channels, typically A and B or 1 and 2, are 90° (in phase) apart from each other. When rotated clockwise, in most encoders channel A leads channel B. To determine the leading channel, refer to the encoder documentation or use an oscilloscope.



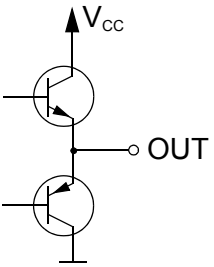
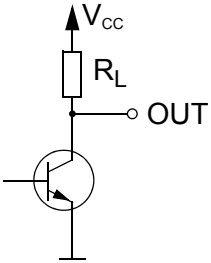
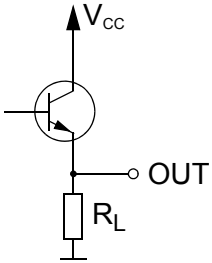
Diagrams show normal phasing:
Pulse A leads (rises earlier than) pulse B.

Connect the encoder output channel that leads when the drive runs *Forward* to BTAC terminal A. Connect the output channel that trails to BTAC terminal B.

Option B: Functional test. For this test:

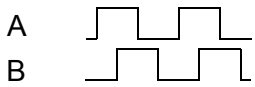
- Temporarily, switch the drive to the scalar mode [parameter 99.04 Motor ctrl mode = 1 (SCALAR)].
- Run the drive in the forward direction.
- Verify that parameter 90.13 Enc1 revol extension increases in the positive direction.
- If not, switch the A/$\overline{A}$ (or 1/$\overline{1}$) connections.

Encoder output types

Push-pull	Open collector (sinking)	Open emitter (sourcing)
		
V_{CC} = Encoder input power supply voltage R_L = Load resistor at encoder output channel		

Wiring diagrams – Push-pull type encoder output

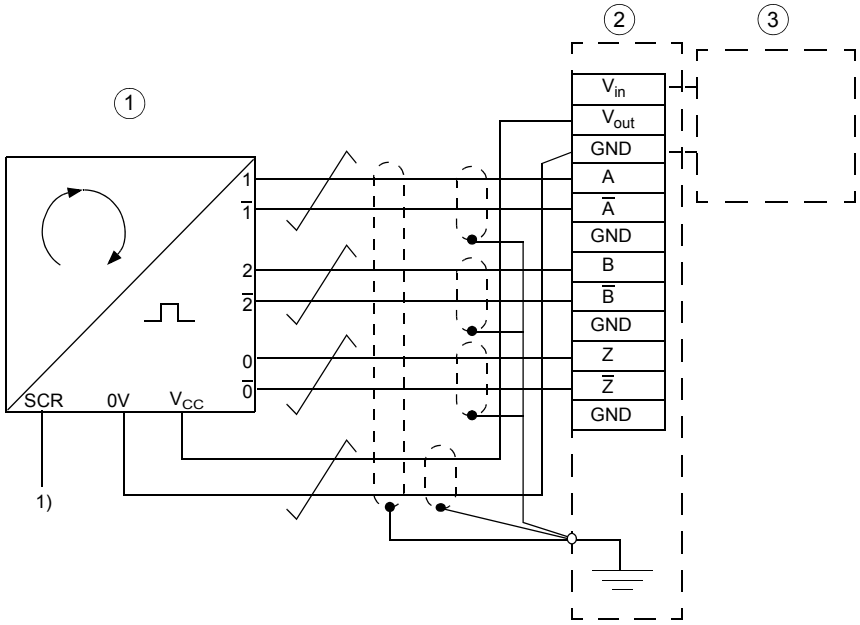
Diagram assumes normal pulse order in Forward rotation: Pulse A leads.



For encoders with pulse B leading, change the diagram:

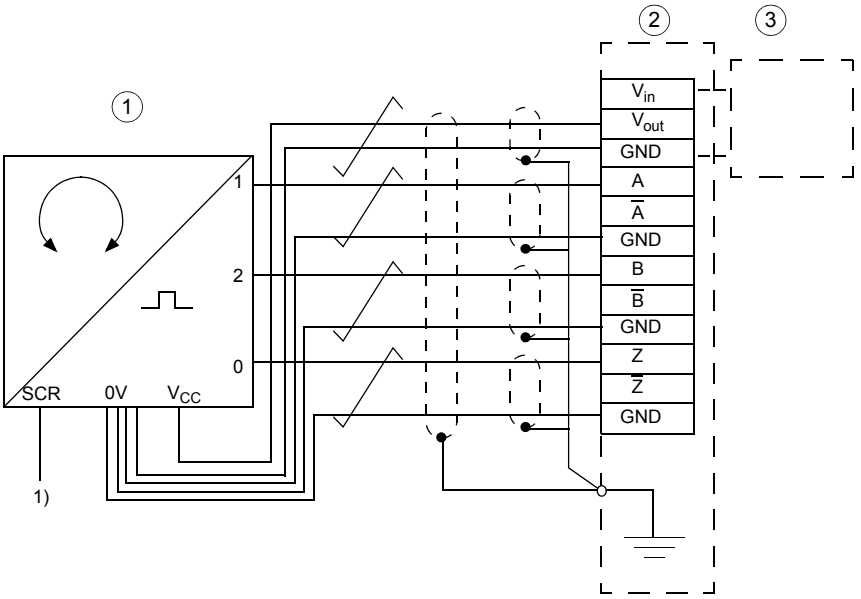
- Wire encoder A and B to BTAC terminals B and A, respectively.
- Wire encoder $\overline{A}$ and $\overline{B}$ (if present) to BTAC terminals $\overline{B}$ and $\overline{A}$, respectively.

Differential connection



1. Encoder
2. BTAC module
3. Encoder power supply

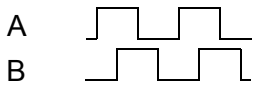
Single-ended connection



1. Encoder
2. BTAC module
3. Encoder power supply

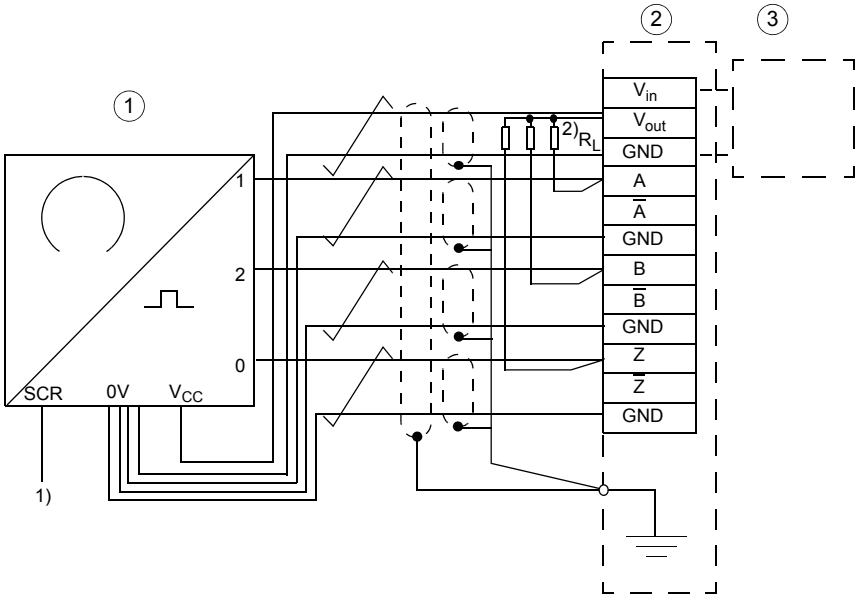
Wiring diagrams – Open collector (sinking) encoder output

Diagram assumes normal pulse order in Forward rotation: Pulse A leads.



For encoders with pulse B leading, change the diagram:

- Wire encoder A and B to BTAC terminals B and A, respectively.



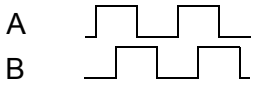
1. Encoder
2. BTAC module
3. Encoder power supply
4. Three identical resistors

The resistor size depends on the encoder power supply V_{in} = VOUT:

V_{in}= 30 V	R_L = 2.7…3.0 kohm, 0.5 W
V_{in}= 24 V	R_L = 1.8…2.2 kohm, 0.5 W
V_{in}= 15 V	R_L = 1.0…1.5 kohm, 0.5 W
V_{in}= 5 V	R_L = 390…470 ohm, 0.125 W

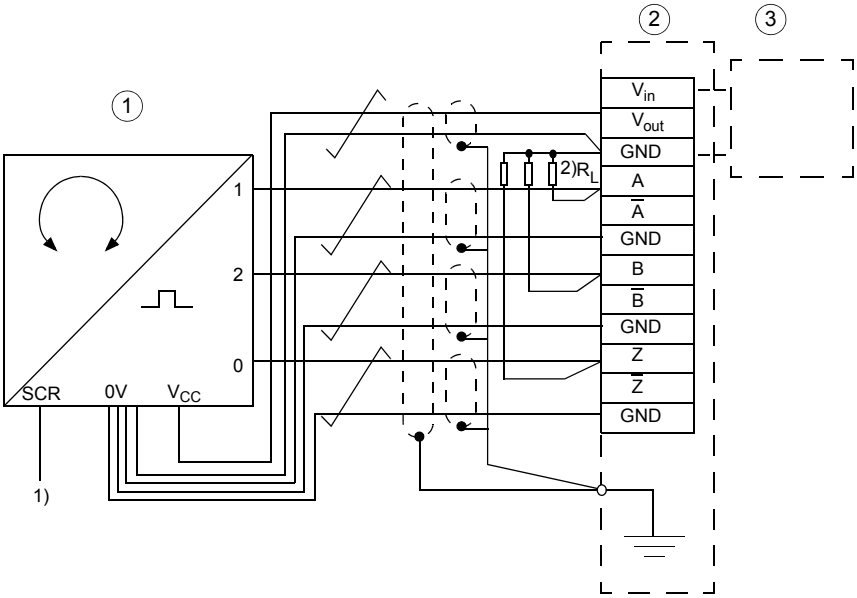
Wiring diagrams – Open emitter (sourcing) encoder output

Diagram assumes normal pulse order in Forward rotation: Pulse A leads.



For encoders with pulse B leading, change the diagram:

- Wire encoder A and B to BTAC terminals B and A, respectively.



1. Encoder
2. BTAC module
3. Encoder power supply
4. Three identical resistors

The resistor size depends on the encoder power supply V_{in} = VOUT:

V_{in}= 30 V	R_L = 2.7…3.0 kohm, 0.5 W
V_{in}= 24 V	R_L = 1.8…2.2 kohm, 0.5 W
V_{in}= 15 V	R_L = 1.0…1.5 kohm, 0.5 W
V_{in}= 5 V	R_L = 390…470 ohm, 0.125 W

Apply power

1. Turn on the input power to the drive.
2. Continue with *Start-up* on page *145*.

Start-up

To configure the operation of the BTAC module:

1. Power up the drive.
2. Set group 90 *Feedback selection*, 91 *Encoder adapter settings* and 92 *Encoder configuration* parameters described on pages *145*…*147*.

Feedback selection

Use these parameters to select feedback or display feedback from the encoder.

No.	Name/Value	Description	Def/FbEq16/32
90 Feedback selection			
90.01	Motor speed for control	Displays the estimated or measured motor speed that is used for motor control, ie. final motor speed feedback selected by parameter 90.41 Motor feedback selection and filtered by 90.42 Motor speed filter time. This parameter is read-only.	-
	-32768…32767	Motor speed used for control.	1=1 rpm/ 100=1 rpm
90.02	Motor position	Displays the motor position (within one revolution) received from the source selected by parameter 90.41 Motor feedback selection.	
	0 … 1 rev	Motor position.	32767=1 rev/ 100000000=1 rev
90.10	Enc1 speed	Displays encoder 1 speed in rpm. This parameter is read-only.	-
	-32768…32767	Encoder 1 speed.	1=1 rpm/ 100=1 rpm
90.11	Enc1 position	Displays the actual position of encoder 1 within one revolution. This parameter is read-only.	-
	0 … 1 rev	Encoder 1 position within one revolution.	32767=1 rev/ 100000000=1 rev
90.13	Enc1 revol extension	Displays the revolution counter extension. The counter is incremented when encoder position wraps around in the positive direction, and decremented in the negative direction. The parameter is effective only if the position is absolute.The parameter value is updated for both single-turn and multiturn encoders. This parameter is read-only.	na/1=1

No.	Name/Value	Description	Def/FbEq16/32
90.41	Motor feedback sel	Selects the source of motor speed and motor position used as feedbacks for speed control and motor model.	estimate
	estimate	A calculated speed estimate	0
	Encoder 1	Actual speed measured by encoder 1.	1
90.42	Motor speed filt time	Defines a filter time for motor speed feedback used for control.	3 ms
	0 … 10000 ms	Motor speed filter time.	1=1 ms/1=1 ms
90.45	Motor feedback fault	Selects how the drive reacts to loss of measured motor feedback.	Fault
	Fault	Drive trips on a 7301 Motor speed feedback fault.	0
	Warning	Drive generates a A7B0 Motor speed feedback warning and continues operation using estimated feedbacks. **Note:** Before using this setting, test the stability of the speed control loop with estimated feedback by running the drive on estimated feedback (see 90.41 Motor feedback sel).	1
90.46	Force open loop	Defines the speed feedback used for motor control.	No
	No	The motor model uses the feedback selected by 90.41 Motor feedback sel.	0
	Yes	The motor model uses the calculated speed estimate (regardless of the setting of 90.41 Motor feedback sel, which in this case only selects the source of feedback for the speed controller).	1
90.47	Enable motor encoder drift detection	Enables motor encoder drift detection	Yes
	No	Does not generate an error if encoder drift is detected.	0
	Yes	Generates fault 7301 Motor speed feedback if encoder drift is detected.	1

Encoder adapter settings

These parameters display the configuration of the encoder interface modules.

No.	Name/Value	Description	Def/FbEq16/32
91 Enc adapter settings			
91.10	Enc par refresh	Validates any changed encoder interface module parameters. This is needed for any parameter changes in groups 90…92 to take effect. After refreshing, the value reverts automatically to Done. **Note:** The parameter cannot be changed while the drive is running.	Done
	Done	Refreshing done.	0
	Configure	Refreshing.	1

Encoder configuration

This parameter group selects the settings for the encoder.

No.	Name/Value	Description	Def/FbEq16/32
92 Encoder 1 configuration			
92.10	Pulses/rev	Defines the TTL or HTL pulse number per revolution.	32
	0…65535		1=1

Diagnostics

With parameter 90.45 Motor feedback fault, you can select how the drive reacts when it detects that the encoder signal is lost.

- 90.45 = 0 (Fault) – The drive generates a fault (7301 Motor speed feedback), and the motor coasts to a stop.
- 90.45 = 1 (Warning) – The drive generates a warning (A7B0 Motor speed feedback) and continues operation using estimated feedbacks.

If the drive generates this fault or warning:

Code (hex)	Fault/Warning	Cause
7301	Motor speed feedback	No motor speed feedback is received.
	4	Drift detected. Check for slippage between encoder and motor.
	3FC	Incorrect motor feedback configuration
	3FD	Incorrect motor speed
A7B0	Motor speed feedback	No motor speed feedback is received
	4	Encoder drift detected. Check for slippage between encoder and motor.
	3FC	Incorrect motor feedback configuration
	3FD	Incorrect motor speed

Technical data

Encoder interface

The encoder user interface is isolated with reinforced insulation from the DC-potential.

Encoder type

- Incremental, TTL/HTL encoders
- Differential, single-ended, open collector, and open emitter encoder outputs (refer to *Encoder output types* on page *140*)
- Three channels A, B and Z
- Maximum pulse frequency: 200 kHz
- Encoder power supply range: 5…30 V

For the input signal levels, refer to *Terminal designations* on page *136*.

Encoder interface connectors

Four 3-pin (1×3) spring-clamp type terminal blocks, tin plated, 2.5 mm^2 wire size, pitch 5.0 mm.

For the terminals, refer to *Terminal designations* on page *136*.

Cable

The maximum permitted cable length is 100 m.

Encoder and BTAC module power supply

- 50 mA (BTAC) + encoder current consumption (refer to the encoder data sheet)
- Voltage: 5…30 V DC (Depends on the encoder. Refer to the encoder data sheet.)

Back-up power supply for the drive

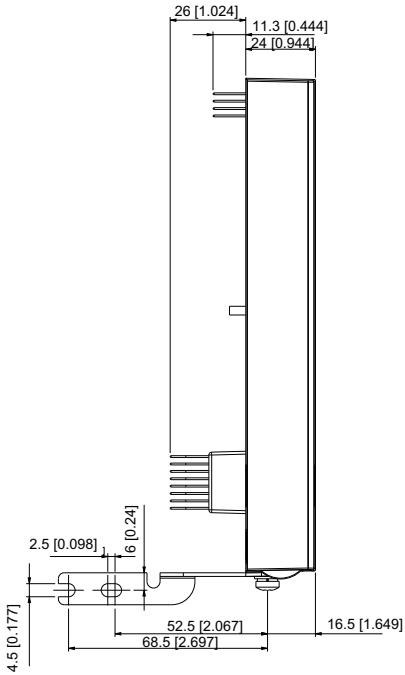
Refer to *Auxiliary voltage connection* on page *67*.

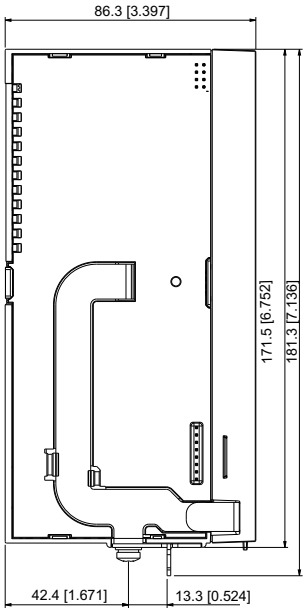
Internal connectors

Connector X102 provides encoder interface signals to the drive control board.
Connector X102 data: 1×8 pin header, pitch 2.54 mm, height 33.53 mm.

Connector X100 serves as power supply interface between the BTAC module and the drive's control board. It provides back-up power supply in main power loss situations.
Connector X100 data: 2×4 pin header, pitch 2.54 mm, height 15.75 mm.

Dimensions





3AXD50000031154 rev. A

14

BREL-01 relay output extension module

Contents of this chapter

This chapter contains a description and technical data of the optional BREL-01 relay output extension module.

Safety instructions



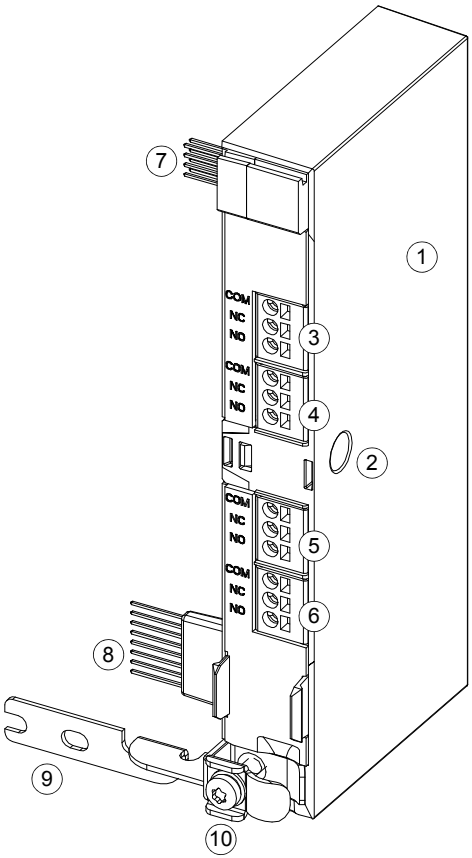
WARNING! Obey the instructions in *Safety instructions* on page *13*. If you ignore them, injury or death, or damage to the equipment can occur.

Hardware description

Product overview

BREL-01 relay output extension module (option +L511) adds four relay outputs to the drive.

Layout



1. BREL module
2. Locking screw hole
3. X103 connector
4. X104 connector
5. X105 connector
6. X106 connector
7. Internal X100 connector
8. Internal X102 connector
9. Grounding rail
10. Grounding screw

Mechanical installation

Refer to *To install a side option* on page *69*.

Electrical installation

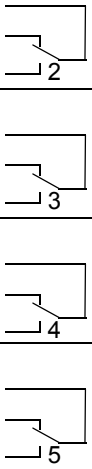
WARNING! Obey the instructions in *Safety instructions* on page *13*. If you ignore them, injury or death, or damage to the equipment can occur.

Terminal designations

The relay interface of the BREL module consists of four 1×3-pin terminal blocks.

Use this table for reference when you wire the terminals.

Identification		Description
X103		Output relays 2-5: • Max. switching voltage: 250 V AC / 30 V DC • Max. switching current: 2 A Galvanically isolated. Inductive loads (such as contactor coils): Protect the relay contacts as recommended in *Protecting the contacts of relay outputs* on page *56*.
1	COM	
2	NC	
3	NO	
X104		
1	COM	
2	NC	
3	NO	
X105		
1	COM	
2	NC	
3	NO	
X106		
1	COM	
2	NC	
3	NO	



Wiring

Use 0.5 to 2.5 mm^2 (20 to 14 AWG) cable with an appropriate voltage rating for digital signals.

Refer to *Terminal designations* on page *153* and connect control wires to the BREL module.

Apply power

1. Turn on the input power to the drive.
2. Continue with *Start-up* on page *154*.

Start-up

To configure the operation of the relays added with the BREL module:

1. Power up the drive.
2. Set the parameter 15.01 Extension module type to 5 (BREL).
3. Use the control panel on the drive and set the parameters for relay outputs 2 to 5 in 15 I/O extension module. Refer to *ACS380 Firmware manual* (3AXD50000029275 [English]) for parameter descriptions.

Configuration parameters

The configuration parameters of the BREL module are in group 15 I/O extension module.

No.	Name/Value	Description	Def/FbEq16/32
15 I/O extension module			
15.01	Extension module type	Sets the connected side-mounted extension module.	None
	BREL	Basenut relay extension module	5
15.02	Detected extension module	I/O extension module detected on the drive.	None
	BREL	Basenut relay extension module	5
15.04	RO status	Status of the relay outputs.	1=1
	Bit 0 RO2	Relay 2 output status. 1 = open / 0 = closed	
	Bit 1 RO3	Relay 3 output status. 1 = open / 0 = closed	
	Bit 2 RO4	Relay 4 output status. 1 = open / 0 = closed	
	Bit 3 RO5	Relay 5 output status. 1 = open / 0 = closed	
15.05	RO force selection	Selection of relay outputs for forcing.	1=1
	Bit 0 RO2	Relay 2 output status. 1 = selected to force / 0 = normal	
	Bit 1 RO3	Relay 3 output status. 1 = selected to force / 0 = normal	
	Bit 2 RO4	Relay 4 output status. 1 = selected to force / 0 = normal	
	Bit 3 RO5	Relay 5 output status. 1 = selected to force / 0 = normal	
15.06	RO forced data	Relay output forcing.	1=1
	Bit 0 RO2	Relay 2 output status. 1 = open / 0 = closed	
	Bit 1 RO3	Relay 3 output status. 1 = open / 0 = closed	
	Bit 2 RO4	Relay 4 output status. 1 = open / 0 = closed	
	Bit 3 RO5	Relay 5 output status. 1 = open / 0 = closed	
15.07	RO2 source	Relay output 2 source selection.	
		Relay output 2 is open.	0
		Relay output 2 is closed	1
		For complete parameter list, refer to *ACS380 Firmware manual* (3AXD50000029275 [English])	...

No.	Name/Value	Description	Def/FbEq16/32
15.08	RO2 ON delay	Sets the activation delay for relay output 2.	0.0 s
	0.0...3000.0 s	Activation delay for relay output 2.	10 = 1 s
15.09	RO2 OFF delay	Sets the deactivation delay for relay output 2.	0.0 s
	0.0...3000.0 s	Deactivation delay for relay output 2.	10 = 1 s
15.10	RO3 source	Relay output 3 source selection.	
		Relay output 3 is open.	0
		Relay output 3 is closed	1
		For complete parameter list, refer to *ACS380 Firmware manual* (3AXD50000029275 [English])	...
15.11	RO3 ON delay	Sets the activation delay for relay output 3.	0.0 s
	0.0...3000.0 s	Activation delay for relay output 3.	10 = 1 s
15.12	RO3 OFF delay	Sets the deactivation delay for relay output 3.	0.0 s
	0.0...3000.0 s	Deactivation delay for relay output 3.	10 = 1 s
15.13	RO4 source	Relay output 4 source selection.	
		Relay output 4 is open.	0
		Relay output 4 is closed	1
		For complete parameter list, refer to *ACS380 Firmware manual* (3AXD50000029275 [English])	...
15.14	RO4 ON delay	Sets the activation delay for relay output 4.	0.0 s
	0.0...3000.0 s	Activation delay for relay output 4.	10 = 1 s
15.15	RO4 OFF delay	Sets the deactivation delay for relay output 4.	0.0 s
	0.0...3000.0 s	Deactivation delay for relay output 4.	10 = 1 s
15.16	RO5 source	Relay output 5 source selection.	
		Relay output 5 is open.	0
		Relay output 5 is closed	1
		For complete parameter list, refer to *ACS380 Firmware manual* (3AXD50000029275 [English])	...
15.17	RO5 ON delay	Sets the activation delay for relay output 5.	0.0 s
	0.0...3000.0 s	Activation delay for relay output 5.	10 = 1 s
15.18	RO5 OFF delay	Sets the deactivation delay for relay output 5.	0.0 s
	0.0...3000.0 s	Deactivation delay for relay output 5.	10 = 1 s

Technical data

External connectors

Four 3-pin (1×3) spring-clamp type terminal blocks, tin plated, 2.5 mm^2 wire size, pitch 5.0 mm.

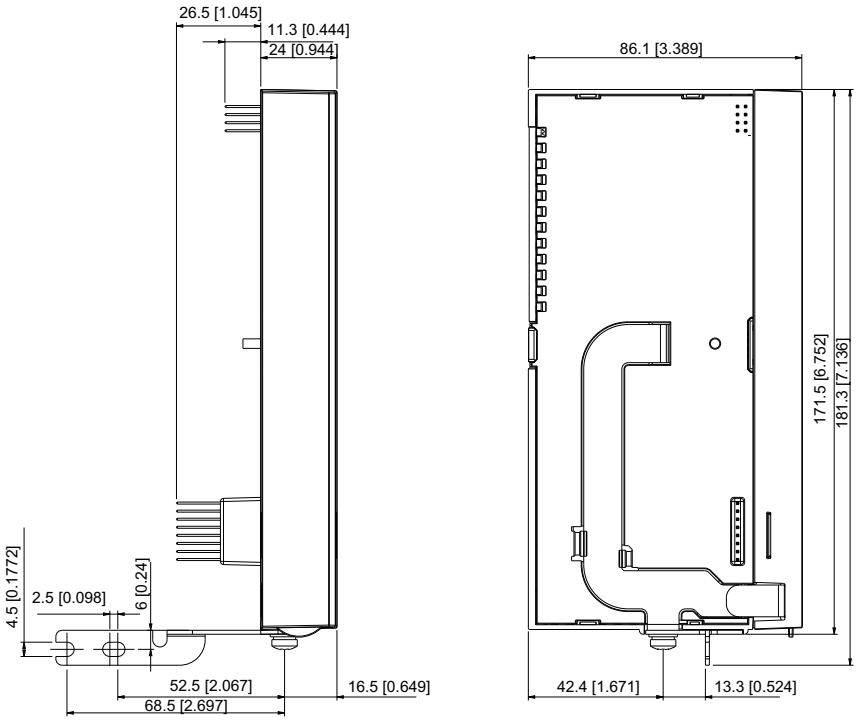
For the terminal markings, refer to *Terminal designations* on page *153*.

Internal connectors

Connector X102 provides relay control signals from the control board:
1×8 pin header, pitch 2.54 mm, height 33.53 mm.

Connector X100 is not in use in BREL:
2×4 pin header, pitch 2.54 mm, height 15.75 mm.

Dimensions



3AXD50000031148 rev. A

15

BAPO-01 auxiliary power extension module

Contents of this chapter

This chapter contains a description and technical data of the optional BAPO-01 auxiliary power extension module. The chapter also contains references to the relevant other content elsewhere in the manual.

Safety instructions

WARNING! Obey the instructions in *Safety instructions* on page *13*. If you ignore them, injury or death, or damage to the equipment can occur.

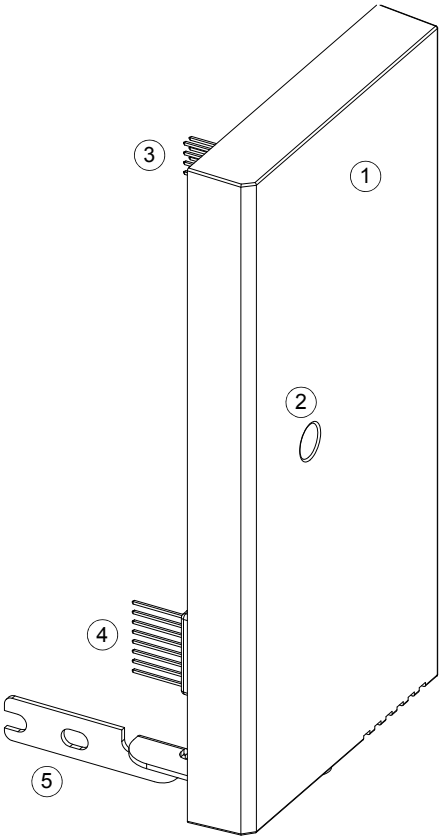
Hardware description

Product overview

The BAPO-01 auxiliary power extension module (option +L534) enables the use of an external auxiliary power supply with the drive. You need an external auxiliary power supply to keep the drive on during a power outage. Connect the auxiliary voltage supply to the +24V and DGND terminals on the drive.

If you change the drive parameters when the control board is energized with the BAPO module, force parameter saving with parameter 96.07 PARAM SAVE by setting the value to (1) SAVE. Otherwise, changed data will not be saved.

Layout



1. BAPO module
2. Locking screw hole
3. Internal X100 connector
4. Internal X102 connector
5. Grounding rail

Mechanical installation

Refer to *To install a side option* on page *69*.

Electrical installation

Connect the auxiliary voltage supply to the +24V and DGND terminals on the drive. Refer to *Auxiliary voltage connection* on page *67*. The BAPO module has internal connections to provide back-up power to the control board (I/O, fieldbus).

Start-up

To configure the BAPO module:

1. Power up the drive.
2. Set the parameter 95.04 Control board supply to 1 (External 24V).

Technical data

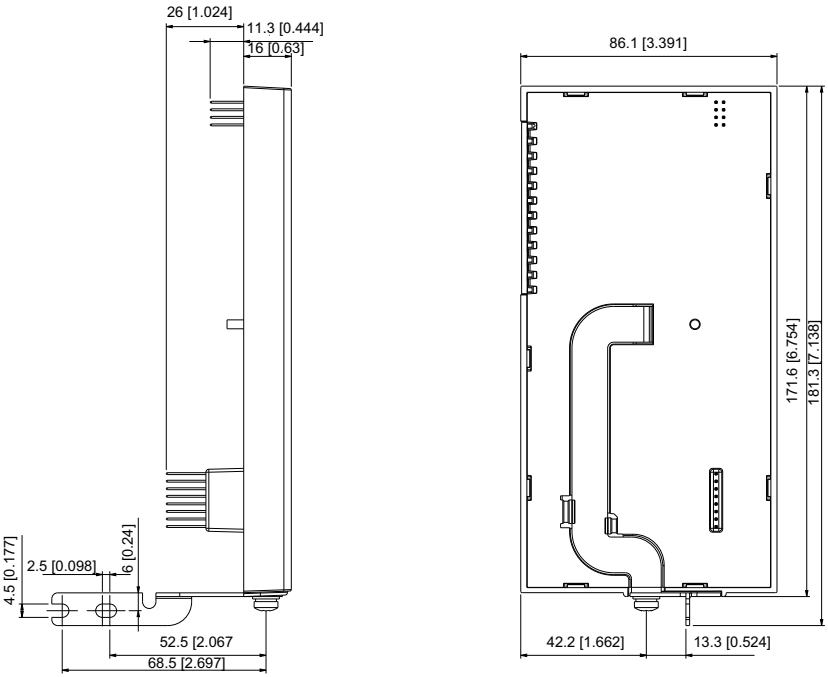
Voltage and current rating for the auxiliary power supply

Refer to *Auxiliary voltage connection* on page *67*.

Power loss

Power losses with maximum load 4 W.

Dimensions



3AXD50000031166 rev. A

Further information

Product and service inquiries

Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to www.abb.com/searchchannels.

Product training

For information on ABB product training, navigate to new.abb.com/service/training.

Providing feedback on ABB Drives manuals

Your comments on our manuals are welcome. Navigate to new.abb.com/drives/manuals-feedback-form.

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.

Contact us

www.abb.com/drives
www.abb.com/drivespartners

3AXD50000029274 Rev B (EN) 2016-04-04

Power and productivity
for a better world™