ABB INDUSTRIAL DRIVES

ACS880 liquid-cooled multidrive cabinets and modules

Electrical planning

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Electrical planning

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3AXD50000048634 Rev D
EN
Original instructions
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Introduction to the manual

Contents of this chapter

This chapter contains general information of the manual, a list of related manuals, and a list of terms and abbreviations.

Applicability

This manual is applicable with the ACS880 liquid-cooled multidrive cabinets and modules.

Safety instructions

WARNING!
Obey the safety instructions given in *ACS880 liquid-cooled multidrive cabinets and modules safety instructions* (3AXD50000048633 [English]). If you ignore the safety instructions, injury or death, or damage to the equipment can occur.

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

Target audience

This manual is intended for people who plan electrical installation of the drive. The reader is expected to know the fundamentals of electricity, wiring, electrical components and electrical schematic symbols.

Terms and abbreviations

Term	Description
ACS-AP-…	Assistant control panel
BCU	Type of control unit
BLCL	Series of LCL-filters, for example BLCL-15-5
Brake unit	Brake chopper modules and the necessary auxiliary equipment, such as control electronics, fusing and cabling
Cabinet	An enclosure that consists of one or more cubicles
CMF	Common mode filtering
Control board	Circuit board in which the control program runs
Control unit	Control board built in a housing (often rail-mountable)
Cubicle	One section of a cabinet-installed drive. A cubicle is typically behind a door of its own.
DC/DC converter	Charges or discharges an external energy storage (such as a battery or capacitor bank) from or into the DC bus
DC/DC converter module	Converter power electronics, related components and DC capacitors enclosed in a metal frame or enclosure. Intended for cabinet installation.
DC/DC converter unit	DC/DC converter module(s) under control of one control board, and related components
DC link	DC circuit between rectifier and inverter
DDCS	Distributed drives communication system protocol
Diode supply module	Diode rectifier and related components enclosed in a metal frame or enclosure. Intended for cabinet installation.
Diode supply unit	Diode supply modules under control of one control board, and related components.
Drive	Frequency converter for controlling AC motors
EMC	Electromagnetic compatibility
Fieldbus adapter module	Device through which the drive is connected to an external communication network, that is, a fieldbus
FSO-12, FSO-21	Optional functional safety modules
IGBT supply module	IGBT bridge and related components enclosed inside a metal frame or enclosure. Intended for cabinet installation.
IGBT supply unit	IGBT supply module(s) under control of one control unit, and related components.
Incoming unit	Part of the cabinet line-up that contains the input power cable terminals. Can also contain switching equipment etc.
Intermediate circuit	DC circuit between rectifier and inverter
Inverter	Converts direct current and voltage to alternating current and voltage.
Inverter module	Inverter bridge, related components and drive DC link capacitors enclosed in a metal frame or enclosure. Intended for cabinet installation.
Inverter unit	Inverter module(s) under control of one control unit, and related components. One inverter unit typically controls one motor.
LCL filter	Inductor-capacitor-inductor filter
Multidrive	Drive for controlling several motors which are typically coupled to the same machinery. Includes one supply unit, and one or several inverter units.
Parameter	In the drive control program, user-adjustable operation instruction to the drive, or signal measured or calculated by the drive. In some (for example fieldbus) contexts, a value that can be accessed as an object, eg, variable, constant, or signal.
SIL	Safety integrity level (1...3) (IEC 61508)
Single drive	Drive for controlling one motor
STO	Safe torque off (IEC/EN 61800-5-2)
Supply module	Rectifier bridge and related components enclosed in a metal frame or enclosure. Intended for cabinet installation.
Supply unit	Supply module(s) under control of one control unit, and related components.
ZCU	Type of control unit

Related documents

Cabinet-installed multidrive manuals

Manual	Code
General manuals	
ACS880 liquid-cooled multidrive cabinets and modules safety instructions	3AXD50000048633
ACS880 liquid-cooled multidrive cabinets and modules electrical planning instructions	3AXD50000048634
ACS880 liquid-cooled multidrive cabinets mechanical installation instructions	3AXD50000048635
CIO-01 I/O module for distributed I/O bus control user's manual	3AXD50000126880
Supply unit manuals	
ACS880-207LC IGBT supply units hardware manual	3AXD50000174782
ACS880 IGBT supply control program firmware manual	3AUA0000131562
ACS880-307LC…+A018 diode supply units hardware manual	3AXD50000579662
ACS880 diode supply control program firmware manual	3AUA0000103295
Inverter unit manuals	
ACS880-107LC inverter units hardware manual	3AXD50000196111
ACS880 primary control program firmware manual	3AUA0000085967
ACS880 primary control program quick start-up guide	3AUA0000098062
Manuals for application programs (Crane, Winder, etc.)	
Brake unit and DC/DC converter unit manuals	
ACS880-607LC 1-phase brake units hardware manual	3AXD50000481491
ACS880-607LC 3-phase dynamic brake units hardware manual	3AXD50000581627
ACS880 (3-phase) brake control program firmware manual	3AXD50000020967
ACS880-1607LC DC/DC converter units hardware manual	3AXD50000431342
ACS880 DC/DC converter control program firmware manual	3AXD50000024671
Option manuals	
ACS880-1007LC liquid cooling unit user's manual	3AXD50000129607
ACS880 +C132 marine type-approved cabinet-built drives supplement	3AXD50000039629
ACS-AP-x assistant control panels user's manual	3AUA0000085685
Drive composer start-up and maintenance PC tool user's manual	3AUA0000094606
Converter module lifting device for drive cabinets hardware manual	3AXD50000210268
Manuals for I/O extension modules, fieldbus adapters, safety options etc.	

You can find manuals on the Internet. See www.abb.com/drives/documents. For manuals not available in the document library, contact your local ABB representative.

Multidrive module manuals

Manual	Code
General manuals	
ACS880 liquid-cooled multidrive cabinets and modules safety instructions	3AXD50000048633
ACS880 liquid-cooled multidrive cabinets and modules electrical planning instructions	3AXD50000048634
Drive modules cabinet design and construction instructions	3AUA0000107668
BCU-02/12/22 control units hardware manual	3AUA0000113605

Manual	Code
CIO-01 I/O module for distributed I/O bus control user's manual	3AXD50000126880
Supply module manuals	
ACS880-204LC IGBT supply modules hardware manual	3AXD50000284436
ACS880 IGBT supply control program firmware manual	3AUA0000131562
ACS880-304LC…+A018 diode supply modules hardware manual	3AXD50000568963
ACS880-304LC…+A019 diode supply modules hardware manual	3AXD50000045157
ACS880 diode supply control program firmware manual	3AUA0000103295
Inverter module manuals and guides	
ACS880-104LC inverter modules hardware manual	3AXD50000045610
ACS880 primary control program firmware manual	3AUA0000085967
ACS880 primary control program quick start-up guide	3AUA0000098062
Brake module and DC/DC converter module manuals	
ACS880-604LC 1-phase brake chopper modules hardware manual	3AXD50000184378
ACS880-604LC 3-phase dynamic brake modules as units hardware manual	3AXD50000581641
ACS880 (3-phase) brake control program firmware manual	3AXD50000020967
ACS880-1604LC DC/DC converter modules hardware manual	3AXD50000371631
ACS880 DC/DC converter control program firmware manual	3AXD50000024671
Option manuals	
ACS880 +C132 marine type-approved drive modules and module packages supplement	3AXD50000037752
ACS880-1007LC liquid cooling unit user's manual	3AXD50000129607
ACX-AP-x assistant control panels user's manual	3AUA0000085685
BAMU-12C auxiliary measurement unit hardware manual	3AXD50000117840
Drive composer start-up and maintenance PC tool user's manual	3AUA0000094606
Drive application programming (IEC 61131-3) manual	3AUA0000127808
Converter module lifting device for drive cabinets hardware manual	3AXD50000210268
Manuals and quick guides for I/O extension modules, fieldbus adapters, safety functions modules, etc.	

See www.abb.com/drives/documents for all manuals on the Internet.

You can find all documentation related to the multidrive modules on the Internet at https://sites-apps.abb.com/sites/lvacdrivesengineeringsupport/content.

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Electrical planning guidelines

Contents of this chapter

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

Limitation of liability

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

Selecting the supply disconnecting device

Cabinet-installed multidrives

The drive is equipped with a main disconnecting device as standard. Depending on the size of the drive, and the selected options, the type of disconnecting device may vary. Examples: switch-disconnector, withdrawable air circuit breaker, etc.

Multidrive modules

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

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

North America

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

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

Other regions

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

Selecting the main contactor (breaker)

Cabinet-installed multidrives

Depending on the drive size, you can order it either with a main contactor (option +F250), or a main breaker (option +F255).

Multidrive modules

You can order a pre-selected main contactor (breaker) from ABB. See the appropriate drive or supply module hardware manual.

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

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

North America

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

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

Other regions

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

Selecting the supply transformer

Cabinet-installed multidrives

Basic guidelines

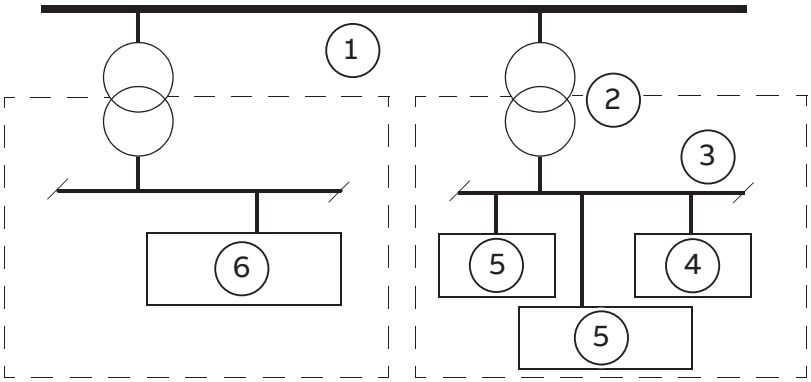
1. Define the apparent power of the transformer:
   - if the drive is equipped with a diode supply unit, or a regenerative supply unit, use this equation:
     S_N (kVA) = 1.32 × sum of the motor shaft powers (kW)
   - if the drive is equipped with an IGBT supply unit, use this equation:
     S_N (kVA) = 1.16 × sum of the motor shaft powers (kW)
2. Define the nominal voltage for the transformer secondary winding according to the nominal input voltage of the drive. See the supply unit hardware manual.
3. Make sure that the transformer complies with the electrical power network specification of the drive. See the appropriate drive or supply unit hardware manual for:
   - nominal input voltage, allowed voltage variation and imbalance
   - nominal frequency and allowed variation
   - short-circuit withstand strength and short-circuit current protection requirements
   - etc.
4. Consider the additional notes below.
5. Contact the transformer manufacturer for more information on the transformer selection.

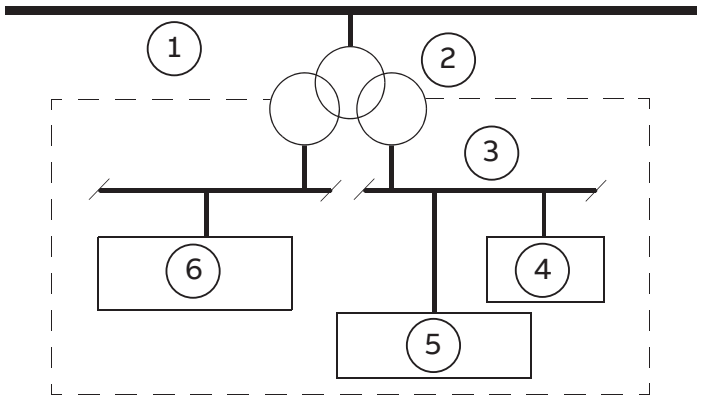
Additional notes

A drive larger than 500 kVA with an IGBT supply unit or a regenerative rectifier unit

Use a two-winding transformer dedicated to drives and motors. Alternatively, use a three-winding transformer, and connect only drives and motors to the same secondary winding.

WARNING!
Do not connect capacitive load (for example: lighting, PCs, PLCs, small power factor compensation capacitors, etc.), to the same transformer secondary winding with drive. It can cause current resonances which can damage the equipment.



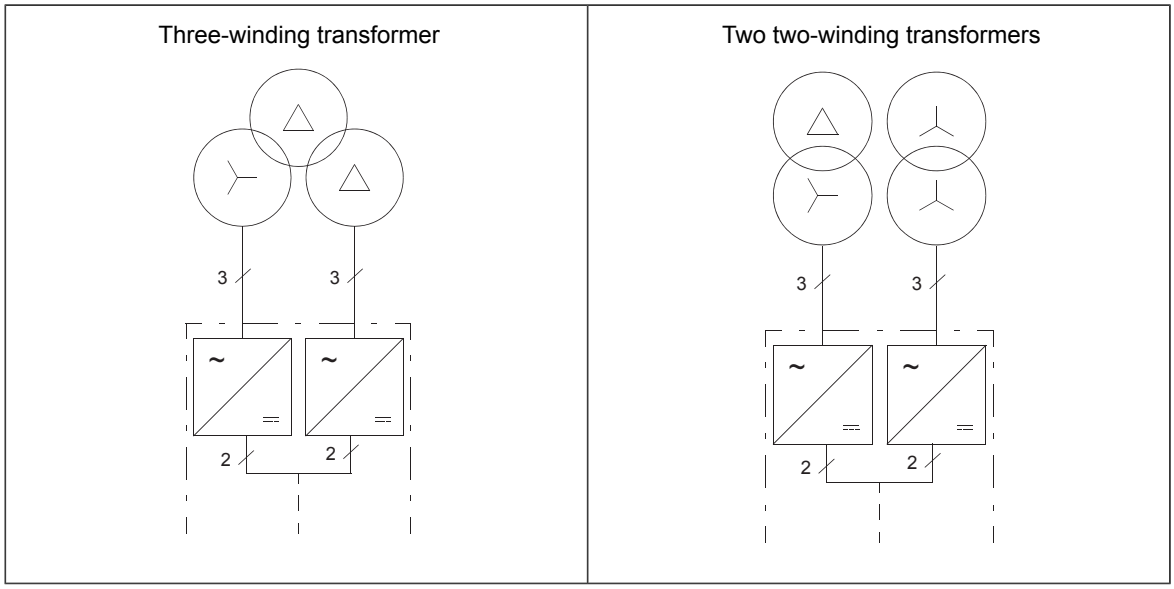


1.	Medium voltage network
2.	Transformer
3.	Low voltage network
4.	Drive
5.	Motors or other drives
6.	Other load (not drives or motors)

A drive with a 12-pulse diode supply unit

Use a three-winding transformer, or two two-winding transformers:

- Connection groups: three-winding trasformer: Dy11d0 (or Dd0y1). Two two-winding transformers: Dy11 and Yy0.
- Phase shift between secondaries: 30° electrical
- Voltage difference between secondaries: < 0.5%
- Short-circuit impedance of secondaries: > 5%
- Short-circuit impedance difference between secondaries: Impedance of transformer windings must be equal, maximum <3% difference of the percentage impedance allowed. (If short-circuit impedance Zk = 5%, variation can be maximum + 0.15%.)
- No grounding of the secondaries
- Static shield is recommended.



Two parallel-connected supply units

See the appropriate supplement for the parallel-connected supply units, or contact ABB for instructions in selecting the transformer(s).

Multidrive modules

IGBT supply modules ACS880-204LC and diode supply modules ACS880-304LC+A018

See the instructions given for the cabinet-installed multidrives.

Diode supply modules ACS880-304LC+A019

The supply modules do not have input chokes. Thus, the supply transformer (or generator) must be dimensioned according to the apparent power of the supply unit (S_n) and the supply transformer impedance Z_k(trafo). The supply nominal impedance Z_k must be at least 5% calculated with nominal apparent power of the supply modules. In a 6-pulse system, the transformer's nominal short-circuit impedance must be according to the following equation. The same impedance requirement also applies to a generator when used as the supply.

$$\frac{S_n}{S_n(\text{trafo})} \times Z_k(\text{trafo}) \geq 5\%$$

Definitions

S_n	ACS880 liquid-cooled multidrive cabinets and modules nominal apparent power
S_n(trafo)	Transformer or generator nominal apparent power
Z_k(trafo)	Transformer or generator nominal short-circuit impedance

Example:

Diode supply unit: ACS880-304LC-1540A-7+A019 → S_n = 1840 kVA

Transformer nominal power is, for example, 2500 kVA

$$Z_k(\text{trafo}) \geq \frac{2500\ \text{kVA}}{1840\ \text{kVA}} \times 5\%$$

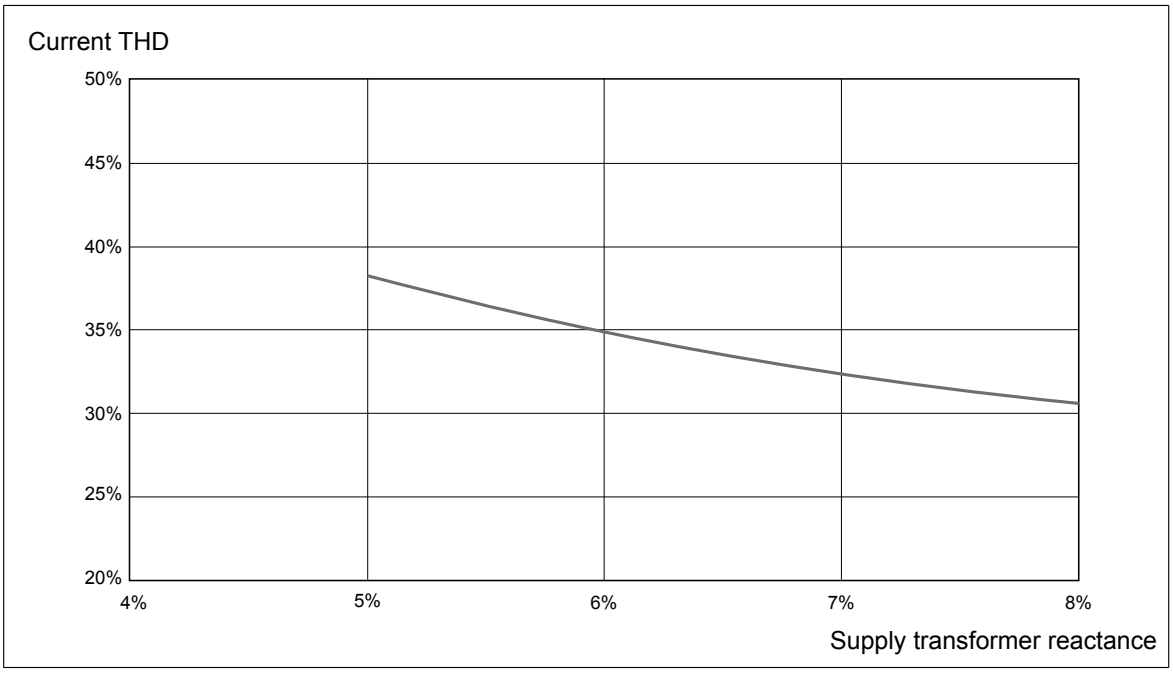
→ Z_k(trafo) ≥ 6.8%

The same rule also applies to 12-pulse transformers when the nominal values are calculated based on the total power of the 12-pulse transformer. If the nominal values are calculated per 6-pulse windings (power per winding is half of the power of the 12-pulse transformer), then half of the reactance (≥ 2.5%) is sufficient.

If the necessary transformer impedance Z_k cannot be fulfilled, it is also possible to install a separate 3-phase AC choke in addition to transformer (or generator) impedance to reach the necessary minimum impedance of 5%. Separate chokes are not available from ABB.

Note: Since the supply modules do not have input chokes, the THD currents and voltages have to be taken into account when dimensioning the system. If necessary, it is also possible to install a separate 3-phase AC choke to reach lower THD levels.

The diagram below shows the typical current THD at nominal current in relation to supply transformer impedance in a 6-pulse connection.



Examining the compatibility of the motor and drive

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

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

Make sure that the motor can be used with an AC drive. See *Requirements table (page 19)*. For basics of protecting the motor insulation and bearings in drive systems, see *Protecting the motor insulation and bearings (page 19)*.

Note:

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

Protecting the motor insulation and bearings

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

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

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

Requirements table

These tables show how to select the motor insulation system and when a drive d*u*/d*t* and common mode filters and insulated N-end (non-drive end) motor bearings are required. Ignoring the requirements or improper installation may shorten motor life or damage the motor bearings and voids the warranty.

This table shows the requirements when an ABB motor is in use.

<table>
<tr><th rowspan="3">Motor type</th><th rowspan="3">Nominal AC line voltage</th><th colspan="4">Requirement for</th></tr>
<tr><th>Motor insulation system</th><th colspan="3">ABB du/dt and common mode filters, insulated N-end motor bearings</th></tr>
<tr><th>P_n < 100 kW and frame size < IEC 315</th><th>100 kW ≤ P_n < 350 kW or IEC 315 ≤ frame size < IEC 400</th><th>P_n ≥ 350 kW or frame size ≥ IEC 400</th></tr>
<tr><th></th><th></th><th>P_n < 134 hp and frame size < NEMA 500</th><th>134 hp ≤ P_n < 469 hp or NEMA 500 ≤ frame size ≤ NEMA 580</th><th>P_n ≥ 469 hp or frame size > NEMA 580</th></tr>
<tr><td rowspan="6">Random-wound M2_, M3_ and M4_</td><td>U_n ≤ 500 V</td><td>Standard</td><td>-</td><td>+ N</td><td>+ N + CMF</td></tr>
<tr><td rowspan="3">500 V < U_n ≤ 600 V</td><td>Standard</td><td>+ du/dt</td><td>+ N + du/dt</td><td>+ N + du/dt + CMF</td></tr>
<tr><td colspan="4">or</td></tr>
<tr><td>Reinforced</td><td>-</td><td>+ N</td><td>+ N + CMF</td></tr>
<tr><td>600 V < U_n ≤ 690 V (cable length ≤ 150 m)</td><td>Reinforced</td><td>+ du/dt</td><td>+ N + du/dt</td><td>+ N + du/dt + CMF</td></tr>
<tr><td>600 V < U_n ≤ 690 V (cable length > 150 m)</td><td>Reinforced</td><td>-</td><td>+ N</td><td>+ N + CMF</td></tr>
<tr><td rowspan="2">Form-wound HX_ and AM_</td><td rowspan="2">380 V < U_n ≤ 690 V</td><td rowspan="2">Standard</td><td rowspan="2">n.a.</td><td rowspan="2">+ N + CMF</td><td>P_n < 500 kW: +N + CMF</td></tr>
<tr><td>P_n ≥ 500 kW: +N + du/dt + CMF</td></tr>
<tr><td>Old [1] form-wound HX_ and modular</td><td>380 V < U_n ≤ 690 V</td><td>Check with the motor manufacturer.</td><td colspan="3">+ N + du/dt with voltages over 500 V + CMF</td></tr>
<tr><td rowspan="2">Random-wound HX_ and AM_ [2]</td><td>0 V < U_n ≤ 500 V</td><td rowspan="2">Enamelled wire with fiber glass taping</td><td colspan="3">+ N + CMF</td></tr>
<tr><td>500 V < U_n ≤ 690 V</td><td colspan="3">+ N + du/dt + CMF</td></tr>
<tr><td>HDP</td><td colspan="5">Consult the motor manufacturer.</td></tr>
</table>

[1] manufactured before 1.1.1998

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

This table shows the requirements when a non-ABB motor is in use.

Motor type	**Nominal AC line voltage**	**Requirement for**			
		Motor insulation system	**ABB d*u*/d*t* and common mode filters, insulated N-end motor bearings**		
			P_n < 100 kW and frame size < IEC 315	**100 kW ≤ P_n < 350 kW or IEC 315 ≤ frame size < IEC 400**	**P_n ≥ 350 kW or frame size ≥ IEC 400**
			P_n < 134 hp and frame size < NEMA 500	**134 hp ≤ P_n < 469 hp or NEMA 500 ≤ frame size ≤ NEMA 580**	**P_n ≥ 469 hp or frame size > NEMA 580**
Random-wound and form-wound	U_n ≤ 420 V	Standard: $\hat{U}_{LL}$ = 1300 V	-	+ N or CMF	+ N + CMF
	420 V < U_n ≤ 500 V	Standard: $\hat{U}_{LL}$ = 1300 V	+ d*u*/d*t*	+ d*u*/d*t* + (N or CMF)	+ N + d*u*/d*t* + CMF
		or			
		Reinforced: $\hat{U}_{LL}$ = 1600 V, 0.2 micro-second rise time	-	+ N or CMF	+ N + CMF
	500 V < U_n ≤ 600 V	Reinforced: $\hat{U}_{LL}$ = 1600 V	+ d*u*/d*t*	+ d*u*/d*t* + (N or CMF)	+ N + d*u*/d*t* + CMF
		or			
		Reinforced: $\hat{U}_{LL}$ = 1800 V	-	+ N or CMF	+ N + CMF
	600 V < U_n ≤ 690 V	Reinforced: $\hat{U}_{LL}$ = 1800 V	+ d*u*/d*t*	+ d*u*/d*t* + N	+ N + d*u*/d*t* + CMF
		Reinforced: $\hat{U}_{LL}$ = 2000 V, 0.3 micro-second rise time [1)]	-	+ N + CMF	+ N + CMF

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

The abbreviations used in the tables are defined below.

Abbr.	**Definition**
U_n	Nominal AC line voltage
$\hat{U}_{LL}$	Peak line-to-line voltage at motor terminals which the motor insulation must withstand
P_n	Motor nominal power
d*u*/d*t*	d*u*/d*t* filter at the output of the drive
CMF	Common mode filter of the drive
N	N-end bearing: insulated motor non-drive end bearing
n.a.	Motors of this power range are not available as standard units. Consult the motor manufacturer.

Availability of d*u*/d*t* filter and common mode filter by drive or inverter type

Product type	Availability of du/dt filter	Availability of common mode filter (CMF)
ACS880-104LC	Standard	Standard
ACS880-107LC	Standard	Standard

Additional requirements for explosion-safe (EX) motors

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

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

Use the selection criteria given for non-ABB motors.

Additional requirements for braking applications

When the motor brakes the machinery, the intermediate circuit DC voltage of the drive increases, the effect being similar to increasing the motor supply voltage by up to 20 percent. Consider this voltage increase when specifying the motor insulation requirements if the motor will be braking a large part of its operation time.

Example: Motor insulation requirement for a 400 V AC line voltage application must be selected as if the drive were supplied with 480 V.

Additional requirements for drives with an IGBT supply unit

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

Additional requirements for ABB high-output and IP23 motors

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

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

Nominal AC supply voltage	Requirement for			
	Motor insulation system	ABB d*u*/d*t* and common mode filters, insulated N-end motor bearings		
		P_n < 100 kW	100 kW ≤ P_n < 200 kW	P_n ≥ 200 kW
		P_n < 140 hp	140 hp ≤ P_n < 268 hp	P_n ≥ 268 hp
U_n ≤ 500 V	Standard	-	+ N	+ N + CMF
500 V < U_n ≤ 600 V	Standard	+ d*u*/d*t*	+ d*u*/d*t* + N	+ d*u*/d*t* + N + CMF
	or			
	Reinforced	-	+ N	+ N + CMF
600 V < U_n ≤ 690 V	Reinforced	+ d*u*/d*t*	+ d*u*/d*t* + N	+ d*u*/d*t* + N + CMF

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

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

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

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

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

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

Additional note for sine filters

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

Selecting the power cables

ACS880-304LC…+A019 diode supply modules: Additional instructions which are not covered in the following sections, are defined in the hardware manual. Obey the power cable selection instructions in *ACS880-304LC…+A019 diode supply modules hardware manual* (3AXD50000045157 [English]).

General guidelines

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

- **Current:** Select a cable capable of carrying the maximum load current and suitable for the prospective short-circuit provided by the supply network. The method of installation and ambient temperature affect the cable current carrying capacity. Obey local regulations and laws.
- **Temperature:** For an IEC installation, select a cable rated for at least 70 °C (158 °F) maximum permissible temperature of conductor in continuous use. For North America, select a cable rated for at least 75 °C (167 °F).
- **Note:** For drives with option +B056 (IP55, UL Type 12), select a cable rated for at least 90 °C (194 °F) maximum permissible temperature of conductor in continuous use.
- **Voltage:** 600 V AC cable is accepted for up to 500 V AC. 750 V AC cable is accepted for up to 600 V AC. 1000 V AC cable is accepted for up to 690 V AC.

To comply with the EMC requirements of the CE mark, use one of the preferred cable types. See *Preferred power cable types (page 25)*.

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

Metal conduit reduces electromagnetic emission of the whole drive system.

The protective conductor must always have an adequate conductivity.

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

This table shows the minimum cross-sectional area of the protective conductor related to the phase conductor size according to IEC/UL 61800-5-1 when the phase conductor and the protective conductor are made of the same metal. If this is not so, the cross-sectional

area of the protective grounding conductor shall be determined in a manner which produces a conductance equivalent to that which results from the application of this table.

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

1) To comply with standard IEC/EN 61800-5-1 (UL 61800-5-1)
- use a protective earth conductor with a minimum cross-sectional area of 10 mm^2 Cu or 16 mm^2 Al (as an alternative when aluminum cables are permitted),
  or
- use a second protective earth conductor of the same cross-sectional area as the original protective earth conductor,
  or
- use a device that automatically disconnects the supply if the protective earth conductor is damaged.

If the protective earth conductor is separate (that is, it does not form part of the input power cable or the input power cable enclosure), the minimum cross-sectional area must be:
- 2.5 mm^2 when the conductor is mechanically protected,
  or
- 4 mm^2 when the conductor is not mechanically protected.

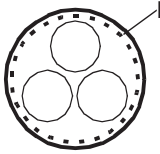
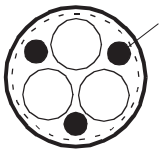
Typical power cable sizes

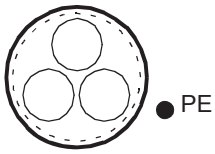
See the technical data.

Power cable types

Preferred power cable types

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

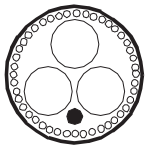
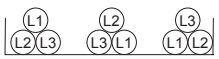
Cable type	**Use as input power cabling**	**Use as motor cabling**
 Symmetrical shielded (or armored) cable with three phase conductors and concentric PE conductor as shield (or armor)	Yes	Yes
 Symmetrical shielded (or armored) cable with three phase conductors and symmetrically constructed PE conductor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

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

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

Alternate power cable types

Exception for ACS880-304LC…+A019 diode supply modules: These power cable types are not allowed.

Cable type	Use as input power cabling	Use as motor cabling
 Four-conductor cabling in metal conduit (three phase conductors and PE), eg, EMT, or four-conductor armored cable	Yes	Yes with phase conductor smaller than 10 mm^2 (8 AWG) Cu, or motors up to 30 kW (40 hp)
 Shielded (Al/Cu shield or armor) [1)] four-conductor cable (three phase conductors and a PE)	Yes	Yes with motors up to 100 kW (135 hp). A potential equalization between the frames of motor and driven equipment is required.
 A single-core cable system: three phase conductors and PE conductor on cable tray  Preferable cable arrangement to avoid voltage or current unbalance between the phases	Yes  **WARNING!** If you use unshielded single-core cables in an IT network, make sure that the non-conductive outer sheath (jacket) of the cables have good contact with a properly grounded conductive surface. For example, install the cables on a properly grounded cable tray. Otherwise voltage may become present on the non-conductive outer sheath of the cables, and there is even a risk of an electric shock.	No

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

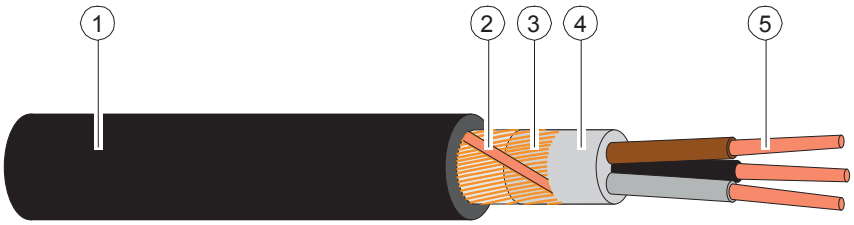
Not allowed power cable types

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

Power cable shield

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

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



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

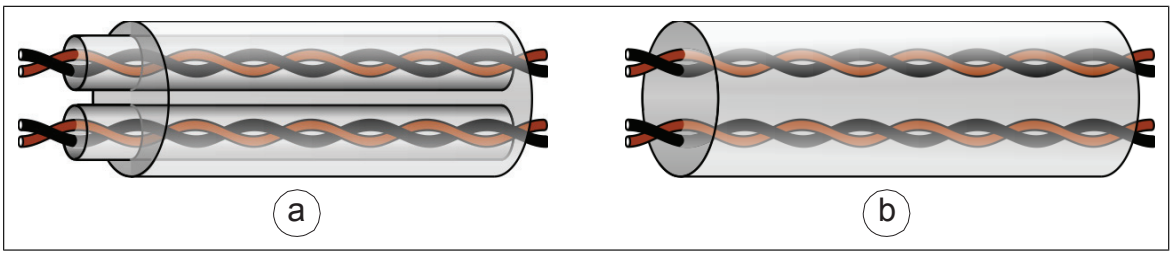
Selecting the control cables

Shielding

Only use shielded control cables.

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

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



Signals in separate cables

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

Signals that can be run in the same cable

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

Relay cable

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

Control panel to drive cable

Use EIA-485 with male RJ-45 connector, cable type Cat 5e or better. The maximum permitted length of the cable is 100 m (328 ft).

PC tool cable

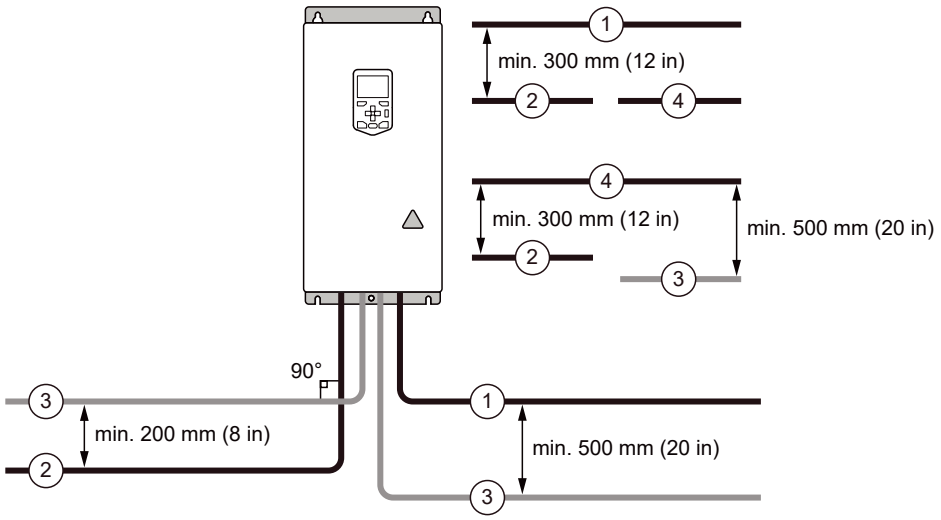
Connect the Drive composer PC tool to the drive through the USB port of the control panel. Use a USB Type A (PC) - Type Mini-B (control panel) cable. The maximum length of the cable is 3 m (9.8 ft).

Routing the cables

General guidelines – IEC

- Route the motor cable away from other cables. Motor cables of several drives can be run in parallel installed next to each other.
- Install the motor cable, input power cable and control cables on separate trays.
- Avoid long parallel runs of motor cables with other cables.
- Where control cables must cross power cables, make sure that they are arranged at an angle as near to 90 degrees as possible.
- Do not run extra cables through the drive.
- Make sure that the cable trays have good electrical bonding to each other and to the grounding electrodes. Aluminum tray systems can be used to improve local equalizing of potential.

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



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

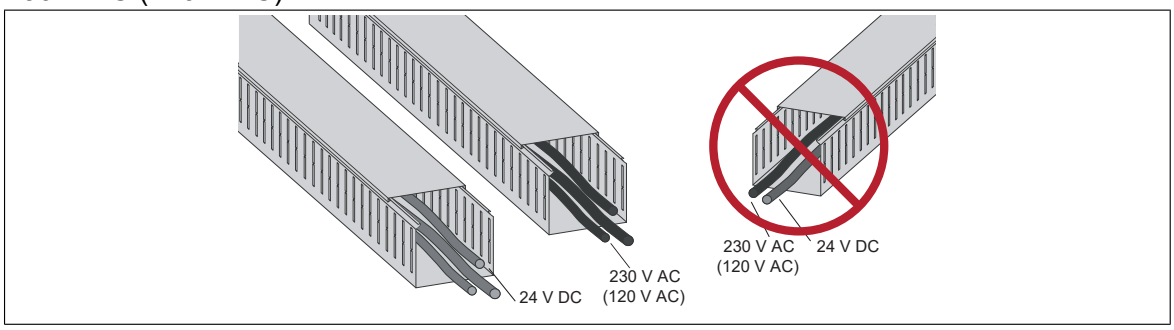
Continuous motor cable shield/conduit or enclosure for equipment on the motor cable

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

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

Separate control cable ducts

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



Implementing thermal overload and short circuit protections

Protecting the drive and input power cables in short-circuit

Cabinet-installed multidrives

To protect the input cable in short-circuit situations, install fuses or a suitable circuit breaker at the supply side of the cabling.

The drive is equipped with fuses as standard. In case of a short-circuit inside the drive, the fuses protect the drive, restrict drive damage, and prevent damage to adjoining equipment.

Multidrive modules

To protect the input power cable in short-circuit situations, install fuses or a suitable circuit breaker at the supply side of the cabling.

To protect the drive in short-circuit situations, install the ABB-specified fuses for the supply unit, inverter units and other units. See the appropriate hardware manuals.

In additon, drive with ACS880-304LC…+A019 supply module: If you use parallel cables, protect each cable against short-circuit individually. Obey the cabling and protection instructions in A*CS880-304LC…+A019 diode supply modules hardware manual* (3AXD50000045157 (Enhglish)).

Protecting the motor and motor cable in short-circuits

The drive protects the motor cable and motor in a short-circuit situation when the motor cable is sized according to the nominal output current of the drive.

Protecting the input power cable against thermal overload

Cabinet-installed multidrives

The drive has overload protection as standard. If the sizing of the input power cable is correct, the drive overload protection protects also the cable against overload. In case of parallel input power cables, it may be necessary to protect each cable separately. Obey the local regulations.

Multidrive modules

Drive with ACS880-304LC…+A018 diode supply module or ACS880-204LC IGBT supply module: The drive has an overload protection as standard when the supply unit, inverter units and other units are sized and installed correctly. See the appropriate hardware manuals. If the sizing of the input power cable is correct, the drive overload protection protects also the cable against overload. In case of parallel input power cables, it may be necessary to protect each cable separately. Obey the local regulations.

Drive with ACS880-304LC…+A019 supply module: To protect the input cable against overload, install fuses or a suitable circuit breaker at the supply side of the cabling. If you use parallel cables, protect each cable against thermal overload individually. Obey the cabling and protection instructions in A*CS880-304LC…+A019 diode supply modules hardware manual* (3AXD50000045157 (Enhglish)).

Protecting the drive against thermal overload

Cabinet-installed multidrives

The drive has overload protection as standard.

Multidrive modules

The drive has an overload protection as standard when the supply unit, inverter units and other units are sized and installed correctly. See the appropriate hardware manuals.

Protecting the motor cables against thermal overload

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

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

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

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

Protecting the motor against thermal overload

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

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

The most common temperature sensor types are PTC or Pt100.

For more information, see the firmware manual.

Protecting the motor against overload without thermal model or temperature sensors

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

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

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

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

For more information, see drive firmware manual.

Implementing a motor temperature sensor connection

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

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

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

You have these implementation alternatives:

1. If there is double or reinforced insulation between the sensor and the live parts of the motor: You can connect the sensor directly to the analog/digital input(s) of the drive. See the control cable connection instructions. Make sure that the voltage does not exceed the maximum allowed voltage over the sensor.
2. If there is basic insulation between the sensor and the live parts of the motor: You can connect the sensor to the analog/digital input(s) of the drive. All other circuits connected to the digital and analog inputs (typically extra-low voltage circuits) must be:
   - protected against contact, and
   - insulated with basic insulation from other low-voltage circuits. The insulation must be rated for the same voltage level as the drive main circuit.

   Note: Extra-low voltage circuits (for example, 24 V DC) typically do not meet these requirements.
   Make sure that the voltage does not exceed the maximum allowed voltage over the sensor.
   As an alternative, you can connect the sensor with basic insulation to the analog/digital input(s) of the drive, if you do not connect any other external control circuits to the drive digital and analog inputs.
3. You can connect the sensor to the drive via an option module. The sensor and the module must form a double or reinforced insulation between the motor live parts and the drive control unit. See *Connecting motor temperature sensor to the drive via an option module (page 33)*. Make sure that the voltage does not exceed the maximum allowed voltage over the sensor.
4. You can connect a sensor to a digital input of the drive via an external relay. The sensor and the relay must form a double or reinforced insulation between the motor live parts and the digital input of the drive. Make sure that the voltage does not exceed the maximum allowed voltage over the sensor.

Connecting motor temperature sensor to the drive via an option module

This table shows:

- option module types that you can use for the motor temperature sensor connection
- insulation or isolation level that each option module forms between its temperature sensor connector and other connectors

- temperature sensor types that you can connect to each option module
- temperature sensor insulation requirement in order to form, together with the insulation of the option module, a reinforced insulation between the motor live parts and the drive control unit.

Option module		Temperature sensor type			Temperature sensor insulation requirement
Type	**Insulation/Isolation**	**PTC**	**KTY**	**Pt100, Pt1000**	
FIO-11	Galvanic isolation between sensor connector and other connectors (including drive control unit connector)	-	x	x	Reinforced insulation
FEN-xx	Galvanic isolation between sensor connector and other connectors (including drive control unit connector)	x	x	-	Reinforced insulation
FAIO-01	Basic insulation between sensor connector and drive control unit connector. No insulation between sensor connector and other I/O connectors.	x	x	x	Basic insulation. Connectors of option module other than sensor connector must be left unconnected.
FPTC-xx [1)]	Reinforced insulation between sensor connector and other connectors (including drive control unit connector).	x	-	-	No special requirement

1) Suitable for use in safety functions (SIL2 / PL c rated).

Implementing a ground fault protecting function

Cabinet-installed multidrives

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

An optional ground fault monitoring device (+Q954) is available for IT (ungrounded) systems. The option includes a ground fault indicator on the drive cabinet door.

Residual current device compatibility

The drive is suitable to be used with residual current devices of Type B.

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

Multidrives modules

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

Residual current device compatibility

The drive is suitable to be used with residual current devices of Type B.

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

Implementing the Emergency stop function

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

Cabinet-installed multidrives

You can order the drive with an emergency stop function (option).

See the appropriate option manual for more information.

Name	Code
Emergency stop, stop category 0 (option +Q951) for ACS880 multidrives user's manual	3AUA0000119885
Emergency stop, stop category 1 (option +Q952) for ACS880 multidrives user's manual	3AUA0000119886
Emergency stop, stop category 0 (option +Q963) for ACS880 multidrives user's manual	3AUA0000119891
Emergency stop, stop category 1 (option +Q964) for ACS880 multidrives user's manual	3AUA0000119893
Emergency stop, configurable stop category 0 or 1 (option +Q979) for ACS880 multidrives user's manual	3AUA0000145933

Multidrive modules

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

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

Implementing the Safe torque off function

The safe torque off (STO) input is available as standard in all inverter units. See the inverter unit hardware manual for implementing the Safe torque off function.

Implementing the Prevention of unexpected start-up function

Cabinet-installed multidrives

You can order the drive with a Prevention of unexpected start-up (POUS) function. The POUS function disables the control voltage of the power semiconductors of the drive (inverter) output stage. This prevents the drive from generating the torque required to rotate the motor. POUS enables a short-time maintenance work (like cleaning) on the non-electrical parts of the machinery without switching off and disconnecting the drive.

See the appropriate option manual for more information.

Name	Code
Prevention of unexpected start-up (option +Q957) for ACS880 multidrives user's manuall	3AUA0000119894
Prevention of unexpected start-up (option +Q950) for ACS880 multidrives user's manuall	3AUA0000145934

Multidrive modules

POUS is not available as an option from ABB. The cabinet builder can use the Safe torque off function of the inverter modules to implement the Prevention of unexpected start-up function.

Implementing the Safely-limited speed function

Cabinet-installed multidrives

You can order the drive with Safely-limited speed function with the encoder interface (option +Q965). The function enables the user to safely operate close to the machine by lowering the speed automatically.

For multidrives, there is also a version without the encoder interface available (option +Q966).

See the appropriate option manual for more information.

Name	Code
Safely-limited speed with the encoder interface (option +Q965) for ACS880 multidrives user's manual	3AXD50000019728
Safely-limited speed without the encoder interface (option +Q966) for ACS880 multidrives user's manual	3AUA0000145935

Multidrive modules

Safely-limited speed function is not available as an option from ABB. However, the cabinet builder can implement it with an optional safety module available from ABB. See *Implementing the functions provided by the FSO-xx safety functions module (page 36)*.

Implementing the functions provided by the FSO-xx safety functions module

Cabinet-installed multidrives

You can order the drive with an FSO-12 or FSO-21 safety functions module (option +Q972 or +Q973) which enables the implementation of functions such as Safe brake control (SBC), Safe stop 1 (SS1), Safe stop emergency (SSE), Safely limited speed (SLS) and Safe maximum speed (SMS).

The settings of the FSO-xx module have default values when delivered from the factory. The wiring of the external safety circuit and configuration of the FSO-xx module are the responsibility of the user.

The FSO-xx module reserves the standard Safe torque off (STO) connection of the drive control unit. STO can still be utilized by other safety circuits through the FSO-xx.

See the appropriate manual for more information.

Name	Code
FSO-12 safety functions module user's manual	3AXD50000015612
FSO-21 safety functions module user's manual	3AXD50000015614

Multidrive modules

You can order a safety functions module from ABB. The cabinet builder can use the module for implementing various safety functions.

Implementing the functions provided by the FSPS-21 PROFIsafe safety functions module

Cabinet-installed multidrives

You can order the drive with an FSPS-21 PROFIsafe safety functions module (option +Q986), which provides PROFINET and PROFIsafe connection to the drive and has two safety functions integrated into it: Safe torque off (STO) and Safe stop 1, time monitored (SS1-t). With the module, it is possible to control the drive via PROFINET and safely stop the drive via PROFIsafe.

The Safe torque off function can be controlled with PROFIsafe. When using FSPS-21 PROFIsafe safety functions module, other safety functions are not available. Use of PROFIsafe and PROFINET is also possible by using FPNO-21 and FSO-xx option modules.

The settings of the module have default values when delivered from the factory. The wiring and configuration of the FSPS-21 module are the responsibility of the user.

For more information, see *FSPS-21 PROFIsafe safety functions module user's manual* (3AXD50000158638 [English]).

Multidrive modules

You can order the PROFIsafe safety functions module from ABB. The cabinet builder can use the module for implementing following safety functions: Safe torque off (STO) and Safe stop 1, time monitored (SS1-t).

Supplying power for the auxiliary circuits

Cabinet-installed multidrives

The drive can be equipped with an auxiliary voltage transformer (option +G344) and cooling fan transformer(s) (option +G451). By default, they are supplied externally.

The user must supply these options from external power sources:

- +G300/+G301: Cabinet heaters and/or lighting (230 or 115 V AC; external fuse)
- +G307: Connection for an external uninterruptible power supply (230 or 115 V AC; external fuse)

Multidrive modules

The cabinet installer must connect an auxiliary power supply for the drive. Auxiliary power is needed, for example, by the control units and cabinet fan(s). See the appropriate hardware manuals for the auxiliary power consumptions, connections, etc.

Using power factor compensation capacitors with the drive

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

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

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

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

Using a safety switch between the drive and the motor

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

Implementing the control of a contactor between drive and motor

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

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

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

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

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

Implementing a bypass connection

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

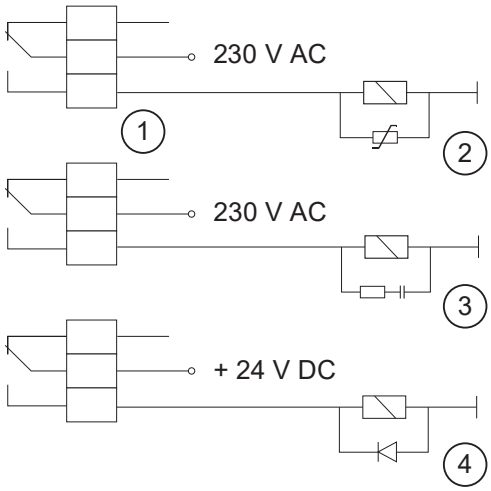
Bypass connection is available as a factory-installed option for some cabinet-installed drive types. Consult ABB for more information.

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

Protecting the contacts of relay outputs

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

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



1	Relay output
2	Varistor
3	RC filter
4	Diode

3

Standards and markings

Contents of this chapter

The chapter contains a list of applicable standards, a list of markings, compliance information (European directives) and the disclaimers.

Applicable standards

C	M	Standard	Information
European and international electrical safety and functional safety standards			
×	×	EN 61800-5-1:2007, IEC 61800-5-1:2007 + A1:2016	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy
×		IEC 60204-1:2016, EN 60204-1:2018	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
×	×	IEC 61800-5-2:2016, EN 61800-5-2:2007	Adjustable speed electrical power drive systems - Part 5-2: Safety requirements – Functional
×	×	EN 62061:2005 + AC:2010 + A1:2013 + A2:2015, IEC 62061:2015	Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems
×	×	EN ISO 13849-1:2015	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design
×	×	EN ISO 13849-2:2012	Safety of machinery - Safety-related parts of control systems - Part 2: Validation
×	×	IEC 61508 ed.2: 2010	Functional safety of electrical /electronic / programmable electronics safety-related systems
×	×	IEC 60146-1-1:2009, EN 60146-1-1:2010	Semiconductor converters - General requirements and line commutated converters - Part 1-1: Specification on basic requirements
×		IEC 60529:1989/A2:2013, EN 60529:1991/A2:2013	Degrees of protection provided by enclosures (IP code)
×		IEC 61439-1:2011, EN 61439-1:2011	Low-voltage switchgear and controlgear assemblies - Part 1: General rules Only for Clause 10.11.5.3 (incoming circuit tested for short circuit withstand).
×	×	IEC 62477-1:2012	Safety requirements for power electronic converter systems and equipment - Part 1: General
EMC performance			
×		EN 61800-3:2004 + A1:2012	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods
×	×	IEC 61326-3-1:2017	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) - General industrial applications
×		IEC 60533:2015	Electrical and electronic installations in ships - Electromagnetic compatibility (EMC) - Ships with a metallic hull
North American product safety standards			
×		UL 508A 1st edition:2001	Industrial Control Panels [TS3]
	×	UL 840 3rd edition:2005	Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment
×		UL 50 12th edition:2007	Enclosures for Electrical Equipment, Non-Environmental Considerations [TS4]
	× [1)]	UL 61800-5-1 1st edition:2012	Adjustable speed electrical power drive systems

1) Check availability from ABB.

C Cabinet-installed multidrives

M Multidrives modules

Markings

CE	CE mark Product complies with the applicable European Union legislation. For fulfilling the EMC requirements, see the additional information concerning the drive EMC compliance (IEC/EN 61800-3).
EAC	EAC (Eurasian Conformity) mark Product complies with the technical regulations of the Eurasian Customs Union. EAC mark is required in Russia, Belarus and Kazakhstan.
	WEEE mark At the end of life the product should enter the recycling system at an appropriate collection point and not placed in the normal waste stream.
	TÜV Safety Approved mark (functional safety) Product contains Safe Torque Off and possibly other (optional) safety functions which are certified by TÜV according to the relevant functional safety standards. Applicable to drives and inverters; not applicable to supply, brake or DC/DC converter units or modules.
	RCM mark Product complies with Australian and New Zealand requirements specific to EMC, telecommunications and electrical safety. For fulfilling the EMC requirements, see the additional information concerning the drive EMC compliance (IEC/EN 61800-3).
	Electronic Information Products (EIP) green mark The product complies with *the People's Republic of China Electronic Industry Standard* (SJ/T 11364-2014). The product does not contain toxic and hazardous substances or elements above the maximum concentration values, and it is an environmentally-friendly product which can be recycled.

EMC compliance (IEC/EN 61800-3:2004 + A2012)

Definitions

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

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

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

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

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

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

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

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

Category C3

The drive complies with the radiated emission limits of C3 category with these provisions:

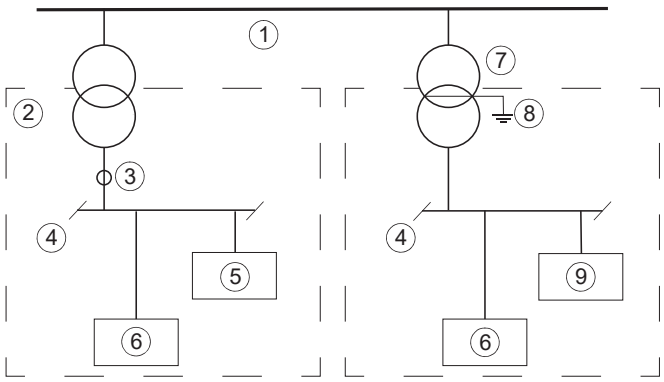
1. The supply unit is C3-compliant:
   - Cabinet-installed multidrive: Supply unit is equipped with the filter option +E210.
   - Multidrive modules: Supply modules have the C3-compliant filtering installed as standard.
2. The motor and control cables are selected, and routed according to the electrical planning guidelines of the drive. The EMC recommendations are obeyed.
3. The drive is installed according to its installation instructions. The EMC recommendations are obeyed.
4. Motor cable length (for any inverter unit) does not exceed 100 meters (328 ft).
   Note: ABB has done the type testing with a 100 meter (328 ft) cabling.

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

Category C4

The drive complies with the C4 category with these provisions:

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



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

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

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

EU Declaration of Conformity (Machinery Directive)

EU Declaration of Conformity

Machinery Directive 2006/42/EC

We
Manufacturer: ABB Oy
Address: Hiomotie 13, 00380 Helsinki, Finland.
Phone: +358 10 22 11
declare under our sole responsibility that the following products:

Frequency converters and **frequency converter components**

ACS880-04, -14, -34 (frames nxR8i)

ACS880-04XT, -04FXT

ACS880-07, -17, -37, -107

ACS880-104

ACS880 multidrives

ACS880-104LC (frames nxR8i)

ACS880-07CLC, -07LC, -17LC, -37LC, -107LC (frames nxR8i)

ACS880 liquid-cooled multidrives

identified with serial numbers beginning with 1 or 8

with regard to the safety functions

Safe torque off

Safe motor temperature with FPTC-01 module (option code +L536)

Safe Stop 1 (SS1-t) with FSPS-21 module (+Q986)

Safe stop 1 (SS1-t and **SS1-r), Safe stop emergency, Safely-limited speed, Safe maximum speed, Safe brake control, Prevention of unexpected start-up**, with FSO-12 module (option code +Q973)

Safe stop 1 (SS1-t and **SS1-r), Safe stop emergency, Safely-limited speed, Safe maximum speed, Safe brake control, Safe Speed monitor, Safe direction, Prevention of unexpected start-up**, with FSO-21 and FSE-31 modules (option codes +Q972 and +L521)

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ACS880-07, -17, -37, -07CLC and ACS880 multidrives: Prevention of unexpected start-up (option codes +Q950; +Q957), **Emergency stop** (option codes +Q951; +Q952; +Q963; +Q964; +Q978; +Q979), **Safely-limited speed** (option codes +Q965; Q966)

are in conformity with all the relevant safety component requirements of EU Machinery Directive 2006/42/EC, when the listed safety functions are used for safety component functionality.

The following harmonized standards have been applied:

EN 61800-5-2:2007	Adjustable speed electrical power drive systems – Part 5-2: Safety requirements - Functional
EN 62061:2005 + AC:2010 + A1:2013 + A2:2015	Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems
EN ISO 13849-1:2015	Safety of machinery – Safety-related parts of control systems. Part 1: General principles for design
EN ISO 13849-2:2012	Safety of machinery – Safety-related parts of the control systems. Part 2: Validation
EN 60204-1:2018	Safety of machinery – Electrical equipment of machines – Part 1: General requirements

The following other standard has been applied:

IEC 61508:2010, parts 1-2	Functional safety of electrical / electronic / programmable electronic safety-related systems
IEC 61800-5-2:2016	Adjustable speed electrical power drive systems – Part 5-2: Safety requirements - Functional

The products referred in this Declaration of conformity fulfil the relevant provisions of other European Union Directives which are notified in Single EU Declaration of conformity 3AXD10000497305.

Person authorized to compile the technical file:
Name and address: Vesa Tiihonen, Hiomotie 13, 00380 Helsinki, Finland

Helsinki, 18 Sep 2020

Signed for and on behalf of:

Peter Lindgren
Vice President, ABB Oy

Vesa Tiihonen
Manager, Product Engineering and Quality

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Approvals

Consult ABB.

Disclaimers

Generic disclaimer

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

Cybersecurity 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.

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 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.

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