ABB MACHINERY DRIVES

ACS355 drives

User’s manual



Type designation key

The type designation contains information on the specifications and configuration of the drive. You find the type designation on the type designation label attached to the drive. The first digits from the left express the basic configuration, for example ACS355-03E-07A3-4. The optional selections are given after that, separated by + signs, for example +J404. The explanations of the type designation selections are described below.

ACS355-03E-07A3-4+J404+...

ACS355 product series

1-phase/3-phase

01 = 1-phase input
03 = 3-phase input

Configuration

E = EMC filter connected, 50 Hz frequency
U = EMC filter disconnected, 60 Hz frequency
See section *Differences between the default values in E and U type drives*.

Output current rating

In format xxAy, where xx indicates the integer part and y the fractional part, eg, 07A3 means 7.3 A.
For more information, see section *Ratings* on page *376*.

Input voltage range

2 = 1-phase 200 … 240 V AC ±10%. This is indicated on the type designation label as typical input voltage level 1 ~ 230 V AC.
OR
3-phase 200 … 240 V AC ±10%. This is indicated on the type designation label as typical input voltage level 3 ~ 230 V AC.
4 = 3-phase 380 … 480 V AC ±10%. This is indicated on the type designation label as typical input voltage level 3 ~ 400/480 V AC.

Options

B063 = IP66/IP67/UL Type 4x enclosure (product variant)
J400 = ACS-CP-A assistant control panel [1)]
J404 = ACS-CP-C basic control panel [1)]
J402 = MPOT-01 potentiometer
K451 = FDNA-01 DeviceNet
K452 = FLON-01 LONWORKS®
K454 = FPBA-01 PROFIBUS DP
K457 = FCAN-01 CANopen
K458 = FMBA-01 Modbus RTU
K462 = FCNA-01 ControlNet
K466 = FENA-01EtherNet/IP / Modbus TCP/PROFINET IO
K469 = FECA-01 EtherCAT
K470 = FEPL-02 Ethernet POWERLINK
K473 = FENA-11EtherNet/IP / Modbus TCP/PROFINET IO
K475 = FENA-21EtherNet/IP / Modbus TCP/PROFINET IO
H376 = Cable gland kit (IP66/IP67/UL Type 4x)
F278 = Input switch kit
C169 = Pressure compensation valve

Extension modules

G406 = MPOW-01 auxiliary power extension module
L502 = MTAC-01 pulse encoder interface module
L511 = MREL-01 output relay module

1) The ACS355 is compatible with panels that have the following panel revisions and panel firmware versions. To find out the revision and firmware version of your panel, see page *76*.

Panel type	Type code	Panel revision	Panel firmware version
Basic control panel	ACS-CP-C	M or later	1.13 or later
Assistant control panel	ACS-CP-A	F or later	2.04 or later
Assistant control panel (Asia)	ACS-CP-D	Q or later	2.04 or later

Note that unlike the other panels, the ACS-CP-D is ordered with a separate material code.

4

Mechanical installation

What this chapter contains

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

Checking the installation site

The drive may be installed on the wall or in a cabinet. Check the enclosure requirements for the need to use the NEMA 1 option in wall installations (see chapter *Technical data* on page *375*).

The drive can be installed in three different ways, depending on the frame size:

a) back mounting (all frame sizes)

b) side mounting (frame sizes R0…R2)

c) DIN rail mounting (all frame sizes).

The drive must be installed in an upright position.

Check the installation site according to the requirements below. Refer to chapter *Dimension drawings* on page *397* for frame details.

Requirements for the installation site

Operation conditions

See chapter *Technical data* on page *375* for the allowed operation conditions of the drive.

Wall

The wall should be as close to vertical and even as possible, of non-flammable material and strong enough to carry the weight of the drive.

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. It is also possible to connect a motor temperature measurement to the drive. The user can tune both the thermal model and the temperature measurement function further by parameters.

The most common temperature sensors are:

- motor sizes IEC 180…225: thermal switch (for example Klixon)
- motor sizes IEC 200…250 and larger: PTC or Pt100.

For more information on the thermal model, see section *Motor thermal protection* on page *148*. For more information on the temperature measurement function, see section *Motor temperature measurement through the standard I/O* on page *157*.

Implementing the Safe torque off (STO) function

See *Appendix: Safe torque off (STO)* on page *419*.

Using residual current devices (RCD) with the drive

ACS355-01x drives are suitable to be used with residual current devices of Type A, ACS355-03x drives with residual current devices of Type B. For ACS355-03x drives, other measures for protection in case of direct or indirect contact, such as separation from the environment by double or reinforced insulation or isolation from the supply system by a transformer, can also be applied.

Using a safety switch between the drive and the motor

It is recommended to install a safety switch between the permanent magnet synchronous motor and the drive output. This is needed to isolate the motor from the drive during maintenance work on the drive.

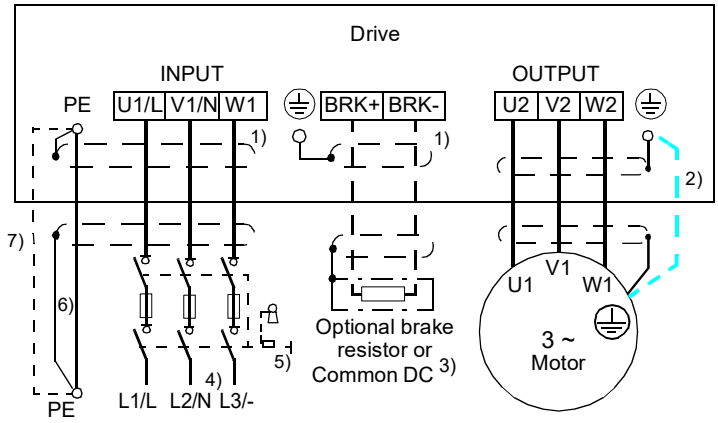
Implementing a bypass connection

WARNING! Never connect the supply power to the drive output terminals U2, V2 and W2. Power line voltage applied to the output can result in permanent damage to the drive.

If frequent bypassing is required, employ mechanically connected switches or contactors to ensure that the motor terminals are not connected to the AC power line and drive output terminals 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”.

Connecting the power cables

Connection diagram



1) 360-degree grounding of the cable shield. Required for the motor cable and brake resistor cable, recommended for the input power cable.

2) Use a separate grounding cable if the conductivity of the cable shield is not sufficient (smaller than the conductivity of the phase conductor) for the protective grounding, or there is no symmetrically constructed grounding conductor in the cable. See section *Selecting the power cables* on page *41*.

3) For more information on Common DC, see *ACS355 Common DC application guide* (3AUA0000070130 [EN]).

4) In one-phase installations, connect phase to L, neutral to N and leave L3/- disconnected.

5) For alternatives, see section *Selecting the supply disconnecting device (disconnecting means)* on page *40*.

6) Use two grounding conductors if the cross-section of a single 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.

7) Use a separate grounding cable (line side) if the conductivity of the fourth conductor or shield is not sufficient for the protective grounding.

Note:

Do not use an asymmetrically constructed motor cable.

If there is a symmetrically constructed grounding conductor in the motor cable in addition to the conductive shield, connect the grounding conductor to the grounding terminal at the drive and motor ends.

Route the motor cable, input power cable and control cables separately. For more information, see section *Routing the cables* on page *45*.

Ratings

Type ACS355- x = E/U [1]	Input [3]		Input with choke [3]		Output					Frame size
	I_{1N}	I_{1N} (480 V) [4]	I_{1N}	I_{1N} (480 V) [4]	I_{2N}	$I_{2,1}$ min/10 min [2]	I_{2max}	P_N		
	A	A	A	A	A	A	A	kW	hp	
1-phase U_N = 230 V (200 … 240 V)										
01x-02A4-2	6.1	-	4.5	-	2.4	3.6	4.2	0.37	0.5	R0
01x-04A7-2	11	-	8.1	-	4.7	7.1	8.2	0.75	1	R1
01x-06A7-2	16	-	11	-	6.7	10.1	11.7	1.1	1.5	R1
01x-07A5-2	17	-	12	-	7.5	11.3	13.1	1.5	2	R2
01x-09A8-2	21	-	15	-	9.8	14.7	17.2	2.2	3	R2
3-phase U_N = 230 V (200 … 240 V)										
03x-02A4-2	4.3	-	2.2	-	2.4	3.6	4.2	0.37	0.5	R0
03x-03A5-2	6.1	-	3.5	-	3.5	5.3	6.1	0.55	0.75	R0
03x-04A7-2	7.6	-	4.2	-	4.7	7.1	8.2	0.75	1	R1
03x-06A7-2	12	-	6.1	-	6.7	10.1	11.7	1.1	1.5	R1
03x-07A5-2	12	-	6.9	-	7.5	11.3	13.1	1.5	2	R1
03x-09A8-2	14	-	9.2	-	9.8	14.7	17.2	2.2	3	R2
03x-13A3-2	22	-	13	-	13.3	20.0	23.3	3	3	R2
03x-17A6-2	25	-	14	-	17.6	26.4	30.8	4	5	R2
03x-24A4-2	41	-	21	-	24.4	36.6	42.7	5.5	7.5	R3
03x-31A0-2	50	-	26	-	31	46.5	54.3	7.5	10	R4
03x-46A2-2	69	-	41	-	46.2	69.3	80.9	11.0	15	R4
3-phase U_N = 400/480 V (380 … 480 V)										
03x-01A2-4	2.2	1.8	1.1	0.9	1.2	1.8	2.1	0.37	0.5	R0
03x-01A9-4	3.6	3.0	1.8	1.5	1.9	2.9	3.3	0.55	0.75	R0
03x-02A4-4	4.1	3.4	2.3	1.9	2.4	3.6	4.2	0.75	1	R1
03x-03A3-4	6.0	5.0	3.1	2.6	3.3	5.0	5.8	1.1	1.5	R1
03x-04A1-4	6.9	5.8	3.5	2.9	4.1	6.2	7.2	1.5	2	R1
03x-05A6-4	9.6	8.0	4.8	4.0	5.6	8.4	9.8	2.2	3	R1
03x-07A3-4	12	9.7	6.1	5.1	7.3	11.0	12.8	3	3	R1
03x-08A8-4	14	11	7.7	6.4	8.8	13.2	15.4	4	5	R1
03x-12A5-4	19	16	11	9.5	12.5	18.8	21.9	5.5	7.5	R3
03x-15A6-4	22	18	12	10	15.6	23.4	27.3	7.5	10	R3
03x-23A1-4	31	26	18	15	23.1	34.7	40.4	11	15	R3
03x-31A0-4	52	43	25	20	31	46.5	54.3	15	20	R4
03x-38A0-4	61	51	32	26	38	57	66.5	18.5	25	R4
03x-44A0-4	67	56	38	32	44	66	77.0	22.0	30	R4

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1) E = EMC filter connected (metal EMC filter screw installed),
U = EMC filter disconnected (plastic EMC filter screw installed), US parametrization.

2) Overloading not allowed through Common DC connection.

3) Input current is based on the rated motor nominal power (P_N), supply network, line inductance and load motor.
Input values with choke can be met with ABB CHK-xx or typical 5% chokes.

4) 480 V values are based on the fact that the motor load current is lower with the same output power.

Definitions

Input	
I_{1N}	continuous rms input current (for dimensioning cables and fuses)
I_{1N} **(480 V)**	continuous rms input current (for dimensioning cables and fuses) for drives with 480 V input voltage
Output	
I_{2N}	continuous rms current. 50% overload is allowed for one minute every ten minutes.
$I_{2,1\ min/10\ min}$	maximum (50% overload) current allowed for one minute every ten minutes
I_{2max}	maximum output current. Available for two seconds at start, otherwise as long as allowed by the drive temperature.
P_N	typical motor power. The kilowatt ratings apply to most IEC 4-pole motors. The horsepower ratings apply to most NEMA 4-pole motors. This is also the maximum load through the Common DC connection and must not be exceeded.
R0…R4	ACS355 is manufactured in frame sizes R0…R4. Some instructions and other information that only concern certain frame sizes are marked with the symbol of the frame size (R0…R4).

Sizing

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

Note 1: The maximum allowed motor shaft power is limited to $1.5 \cdot P_N$. If the limit is exceeded, motor torque and current are automatically restricted. The function protects the input bridge of the drive against overload.

Note 2: The ratings apply at ambient temperature of 40 °C (104 °F) for I_{2N}.

Note 3: It is important to check that in Common DC systems the power flowing through the common DC connection does not exceed P_N.

Derating

I_{2N}: The load capacity decreases if the installation site ambient temperature exceeds 40 °C (104 °F), the altitude exceeds 1000 meters (3300 ft) or the switching frequency is changed from 4 kHz to 8, 12 or 16 kHz.

Temperature derating, I_{2N}

In the temperature range +40 °C…+50 °C (+104 °F…+122 °F), the rated output current (I_{2N}) is decreased by 1% for every additional 1 °C (1.8 °F). The output current is calculated by multiplying the current given in the rating table by the derating factor.

Example: If the ambient temperature is 50 °C (+122 °F), the derating factor is $100\% - 1\frac{\%}{°C} \cdot 10\ °C = 90\%$ or 0.90. The output current is then $0.90 \cdot I_{2N}$.

Altitude derating, I_{2N}

In altitudes 1000…2000 m (3300…6600 ft) above sea level, the derating is 1% for every 100 m (330 ft).

For 3-phase 200 V drives, the maximum altitude is 3000 m (9800 ft) above sea level. In altitudes 2000…3000 m (6600…9800 ft), the derating is 2% for every 100 m (330 ft).

Switching frequency derating, I_{2N}

The drive derates itself automatically when parameter *2607 SWITCH FREQ CTRL* = 1 (*ON*).

Switching frequency	Drive voltage rating	
	U_N = 200…240 V	U_N = 380…480 V
4 kHz	No derating	No derating
8 kHz	I_{2N} derated to 90%.	I_{2N} derated to 75% for R0 or to 80% for R1…R4.
12 kHz	I_{2N} derated to 80%.	I_{2N} derated to 50% for R0 or to 65% for R1…R4 and maximum ambient temperature derated to 30 °C (86 °F).
16 kHz	I_{2N} derated to 75%.	I_{2N} derated to 50% and maximum ambient temperature derated to 30 °C (86 °F).

When parameter *2607 SWITCH FREQ CTRL* = 2 (*ON (LOAD)*), the drive controls the switching frequency towards the selected switching frequency *2606 SWITCHING FREQ* if the drive's internal temperature allows.

Power cable sizes and fuses

Cable dimensioning for rated currents (I_{1N}) is shown in the table below together with the corresponding fuse types for short-circuit protection of the input power cable. **The rated fuse currents given in the table are the maximums for the mentioned fuse types.** If smaller fuse ratings are used, check that the fuse rms current rating is larger than the rated I_{1N} current given in section *Ratings* on page *376*. If 150% output power is needed, multiply current I_{1N} by 1.5. See also section *Selecting the power cables* on page *41*.

Type ACS355-	Fuses		Size of copper conductor in cablings							
	gG	UL Class T or CC (600 V)	Supply (U1, V1, W1)		Motor (U2, V2, W2)		PE		Brake (BRK+, BRK-)	
x = E/U	A	A	mm^2	AWG	mm^2	AWG	mm^2	AWG	mm^2	AWG
1-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)										
01x-02A4-2	10	10	2.5	14	0.75	18	2.5	14	2.5	14
01x-04A7-2	16	20	2.5	14	0.75	18	2.5	14	2.5	14
01x-06A7-2	16/20 [1]	25	2.5	10	1.5	14	2.5	10	2.5	12
01x-07A5-2	20/25 [1]	30	2.5	10	1.5	14	2.5	10	2.5	12
01x-09A8-2	25/35 [1]	35	6	10	2.5	12	6	10	6	12
3-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)										
03x-02A4-2	10	10	2.5	14	0.75	18	2.5	14	2.5	14
03x-03A5-2	10	10	2.5	14	0.75	18	2.5	14	2.5	14
03x-04A7-2	10	15	2.5	14	0.75	18	2.5	14	2.5	14
03x-06A7-2	16	15	2.5	12	1.5	14	2.5	12	2.5	12
03x-07A5-2	16	15	2.5	12	1.5	14	2.5	12	2.5	12
03x-09A8-2	16	20	2.5	12	2.5	12	2.5	12	2.5	12
03x-13A3-2	25	30	6	10	6	10	6	10	2.5	12
03x-17A6-2	25	35	6	10	6	10	6	10	2.5	12
03x-24A4-2	63	60	10	8	10	8	10	8	6	10
03x-31A0-2	80	80	16	6	16	6	16	6	10	8
03x-46A2-2	100	100	25	2	25	2	16	4	10	8
3-phase U_N = 380…480 V (380, 400, 415, 440, 460, 480 V)										
03x-01A2-4	10	10	2.5	14	0.75	18	2.5	14	2.5	14
03x-01A9-4	10	10	2.5	14	0.75	18	2.5	14	2.5	14
03x-02A4-4	10	10	2.5	14	0.75	18	2.5	14	2.5	14
03x-03A3-4	10	10	2.5	12	0.75	18	2.5	12	2.5	12
03x-04A1-4	16	15	2.5	12	0.75	18	2.5	12	2.5	12
03x-05A6-4	16	15	2.5	12	1.5	14	2.5	12	2.5	12
03x-07A3-4	16	20	2.5	12	1.5	14	2.5	12	2.5	12
03x-08A8-4	20	25	2.5	12	2.5	12	2.5	12	2.5	12
03x-12A5-4	25	30	6	10	6	10	6	10	2.5	12
03x-15A6-4	35	35	6	8	6	8	6	8	2.5	12
03x-23A1-4	50	50	10	8	10	8	10	8	6	10
03x-31A0-4	80	80	16	6	16	6	16	6	10	8
03x-38A0-4	100	100	16	4	16	4	16	4	10	8
03x-44A0-4	100	100	25	4	25	4	16	4	10	8

[1] If 50% overload capacity is needed, use the larger fuse alternative.

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Fuses (IEC)

Check that the operating time of the fuse is below 0.5 seconds. The operating time depends on the fuse type, the supply network impedance as well as the cross-sectional area, material and length of the supply cable. In case the 0.5 seconds operating time is exceeded with the gG fuses, ultra rapid (aR) fuses will in most cases reduce the operating time to an acceptable level.

Note 1: Larger fuses must not be used when the input power cable is selected according to this table.

Note 2: Choose the correct fuse size according to the actual input current which depends on the input line voltage and the input choke selection.

Note 3: Other fuse types can be used if they meet the ratings and the melting curve of the fuse does not exceed the melting curve of the fuse mentioned in this table.

Fuses (UL)

UL class T fuses for branch circuit protection per NEC are listed in the table above. Fast acting class T or faster fuses are recommended in the USA.

1. The UL listed fuses in this manual tables are the required branch circuit protection per NEC.
2. Fuses are required as part of the installation. Fuses are not included in the base drive configuration and must be provided by others.
3. Fuses with a higher current rating than specified must not be used.
4. Fuses with a lower current rating than specified may be used if they are of the same voltage and are UL 248 listed fast acting or high-speed fuses.
5. A fuse of a different class can be used at the high fault rating where the I_{peak} and I_{2t} of the new fuse is not greater than that of the specified fuse.
6. Recommended drive fuses must be used to maintain drive UL listing. Additional protection can be used. Refer to local codes and regulations.
7. When installing a drive always follow installation instructions and NEC requirements.
8. UL 248 listed, fast acting or high-speed fuses from other manufacturers can be used if they meet the rating requirements specified in the rules above.

Alternate short-circuit protection

You can use the ABB Type E manual motor protectors MS132 & S1-M3-25, MS165-xx and MS5100-100 as an alternate to the recommended fuses as a means of branch circuit protection. This is in accordance with the National Electrical Code (NEC).

When the correct ABB Type E manual motor protector is selected from the table and used for branch circuit protection, the drive is suitable for use in a circuit capable of delivering no more than 65 kA RMS symmetrical amperes at the drive’s maximum rated voltage. See the following table for the appropriate ratings. See the MMP rating

table for the minimum enclosure volume of IP20 open type ACS355 mounted in an enclosure.

Drives with and without NEMA 1 enclosure kits are included in the UL file. The MMP selections in the table are also valid for drives having a NEMA 1 enclosure kit installed.

Type ACS355-	Input Amps	Frame size	MMP type E[1,2)]	Min. encl. vol.[5)]	
				dm^3	cu in
1-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)					
01x-02A4-2	6.1	R0	MS132-6.3 & S1-M3-25[3)]	18.9	1152
01x-04A7-2	11.0	R1	MS165-16	18.9	1152
01x-06A7-2	16.0	R1	MS165-20	18.9	1152
01x-07A5-2	17.0	R2	MS165-20	-	-
01x-09A8-2	21.0	R2	MS165-25	-	-
3-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)[4)]					
03x-02A4-2	4.3	R0	MS132-6.3 & S1-M3-25[3)]	18.9	1152
03x-03A5-2	6.1	R0	MS132-6.3 & S1-M3-25[3)]	18.9	1152
03x-04A7-2	7.6	R1	MS132-10 & S1-M3-25[3)]	18.9	1152
03x-06A7-2	11.8	R1	MS165-16	18.9	1152
03x-07A5-2	12.0	R1	MS165-16	18.9	1152
03x-09A8-2	14.3	R2	MS165-16	-	-
03x-13A3-2	22.0	R2	MS165-25	-	-
03x-17A6-2	25.0	R2	MS165-32	-	-
03x-24A4-2	41.0	R3	MS165-54	-	-
03x-31A0-2	50.0	R4	MS165-65	-	-
03x-46A2-2	69.0	R4	MS5100-100	-	-
3-phase U_N = 380, 400, 415 V[4)]					
03x-01A2-4	2.2	R0	MS132-2.5 & S1-M3-25[3)]	18.9	1152
03x-01A9-4	3.6	R0	MS132-4.0 & S1-M3-25[3)]	18.9	1152
03x-02A4-4	4.1	R1	MS132-6.3 & S1-M3-25[3)]	18.9	1152
03x-03A3-4	6.0	R1	MS132-6.3 & S1-M3-25[3)]	18.9	1152
03x-04A1-4	6.9	R1	MS132-10 & S1-M3-25[3)]	18.9	1152
03x-05A6-4	9.6	R1	MS132-10 & S1-M3-25[3)]	18.9	1152
03x-07A3-4	12.0	R1	MS165-16	18.9	1152
03x-08A8-4	14.0	R1	MS165-16	18.9	1152
03x-12A5-4	19.0	R3	MS165-20	-	-
03x-15A6-4	22.0	R3	MS165-25	-	-
03x-23A1-4	31.0	R3	MS165-32	-	-
03x-31A0-4	52.0	R4	MS165-65	-	-
03x-38A0-4	61.0	R4	MS165-65	-	-
03x-44A0-4	67.0	R4	MS5100-100	-	-

Type ACS355-	Input Amps	Frame size	MMP type E[1,2)]	Min. encl. vol.[5)]	
				dm^3	cu in
3-phase U_N = 440, 460, 480 V[4)]					
03x-01A2-4	1.8	R0	MS132-2.5 & S1-M3-25[3)]	18.9	1152
03x-01A9-4	3.0	R0	MS132-4.0 & S1-M3-25[3)]	18.9	1152
03x-02A4-4	3.4	R1	MS132-4.0 & S1-M3-25[3)]	18.9	1152
03x-03A3-4	5.0	R1	MS132-6.3 & S1-M3-25[3)]	18.9	1152
03x-04A1-4	5.8	R1	MS132-6.3 & S1-M3-25[3)]	18.9	1152
03x-05A6-4	8.0	R1	MS132-10 & S1-M3-25[3)]	18.9	1152
03x-07A3-4	9.7	R1	MS132-10 & S1-M3-25[3)]	18.9	1152
03x-08A8-4	11.0	R1	MS165-16	18.9	1152
03x-12A5-4	16.0	R3	MS165-20	-	-
03x-15A6-4	18.0	R3	MS165-20	-	-
03x-23A1-4	26.0	R3	MS165-32	-	-
03x-31A0-4	43.0	R4	MS165-54	-	-
03x-38A0-4	51.0	R4	MS165-65	-	-
03x-44A0-4	56.0	R4	MS165-65	-	-

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1) All manual motor protectors listed are Type E self-protected up to 65 kA. See ABB publication 2CDC131085M0201 – Manual Motor Starters – North American Applications for complete technical data on the ABB Type E manual motor protectors. In order for these manual motor protectors to be used for branch circuit protection, they must be UL listed Type E manual motor protectors, otherwise they can be used only as an At Motor Disconnect. “At Motor Disconnect” is a disconnect just ahead of the motor on the load side of the panel.

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

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

4) 480Y/277V delta systems only: Short-circuit protective devices with slash voltage ratings (e.g. 480Y/277 V AC) can be applied only in solidly grounded networks where the voltage from line-to-ground does not exceed the lower of the two ratings (e.g. 277 V AC), and the voltage from line-to-line does not exceed the higher of the two ratings (e.g. 480 V AC). The lower rating represents the device’s interrupting capability per pole.

5) For all drives, the enclosure must be sized to accommodate the specific thermal considerations of the application as well as provide free space for cooling. See section *Free space requirements* on page *383*. For UL only: The minimum enclosure volume is specified in the UL listing when applied with the ABB Type E MMP shown in the table. ACS355 drives are intended to be mounted in an enclosure unless a NEMA-1 kit is added.

Dimensions, weights and free space requirements

Dimensions and weights

Frame size	Dimensions and weights											
	IP20 (cabinet) / UL open											
	H1		H2		H3		W		D		Weight	
	mm	in	mm	in	mm	in	mm	in	mm	in	kg	lb
R0	169	6.65	202	7.95	239	9.41	70	2.76	161	6.34	1.2	2.6
R1	169	6.65	202	7.95	239	9.41	70	2.76	161	6.34	1.4	3.0
R2	169	6.65	202	7.95	239	9.41	105	4.13	165	6.50	1.8	3.9
R3	169	6.65	202	7.95	236	9.29	169	6.65	169	6.65	3.1	6.9
R4	181	7.13	202	7.95	244	9.61	260	10.24	169	6.65	5.2	11.5

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Frame size	Dimensions and weights									
	IP20 / NEMA 1									
	H4		H5		W		D		Weight	
	mm	in	mm	in	mm	in	mm	in	kg	lb
R0	257	10.12	280	11.02	70	2.76	169	6.65	1.6	3.5
R1	257	10.12	280	11.02	70	2.76	169	6.65	1.8	3.9
R2	257	10.12	282	11.10	105	4.13	169	6.65	2.2	4.8
R3	260	10.24	299	11.77	169	6.65	177	6.97	3.7	8.2
R4	270	10.63	320	12.60	260	10.24	177	6.97	5.8	12.9

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Symbols
IP20 (cabinet) / UL open
H1 height without fastenings and clamping plate
H2 height with fastenings, without clamping plate
H3 height with fastenings and clamping plate
IP20 / NEMA 1
H4 height with fastenings and connection box
H5 height with fastenings, connection box and hood

Weight is calculated as the measured drive weight + cable clamps + 50 g (for component tolerances).

Free space requirements

Frame size	Free space required					
	Above		Below		On the sides	
	mm	in	mm	in	mm	in
R0…R4	75	3	75	3	0	0

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Losses, cooling data and noise

Losses and cooling data

Frame size R0 has natural convection cooling. Frame sizes R1…R4 are provided with an internal 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 ACS355-x = E/U	Heat dissipation			Air flow	
	Main circuit	Control circuit			
	Rated I_{1N} and I_{2N}	Min	Max		
	W	W	W	m^3/h	ft^3/min
1-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)					
01x-02A4-2	25	6.1	22.7	-	-
01x-04A7-2	46	9.5	26.4	24	14
01x-06A7-2	71	9.5	26.4	24	14
01x-07A5-2	73	10.5	27.5	21	12
01x-09A8-2	96	10.5	27.5	21	12
3-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)					
03x-02A4-2	19	6.1	22.7	-	-
03x-03A5-2	31	6.1	22.7	-	-
03x-04A7-2	38	9.5	26.4	24	14
03x-06A7-2	60	9.5	26.4	24	14
03x-07A5-2	62	9.5	26.4	21	12
03x-09A8-2	83	10.5	27.5	21	12
03x-13A3-2	112	10.5	27.5	52	31
03x-17A6-2	152	10.5	27.5	52	31
03x-24A4- 2	250	16.6	35.4	71	42
03x-31A0-2	270	33.4	57.8	96	57
03x-46A2-2	430	33.4	57.8	96	57

Type ACS355-x = E/U	Heat dissipation			Air flow	
	Main circuit	Control circuit			
	Rated I_{1N} and I_{2N}	Min	Max		
	W	W	W	m^3/h	ft^3/min
3-phase U_N = 380…480 V (380, 400, 415, 440, 460, 480 V)					
03x-01A2-4	11	6.6	24.4	-	-
03x-01A9-4	16	6.6	24.4	-	-
03x-02A4-4	21	9.8	28.7	13	8
03x-03A3-4	31	9.8	28.7	13	8
03x-04A1-4	40	9.8	28.7	13	8
03x-05A6-4	61	9.8	28.7	19	11
03x-07A3-4	74	14.1	32.7	24	14
03x-08A8-4	94	14.1	32.7	24	14
03x-12A5-4	130	12.0	31.2	52	31
03x-15A6-4	173	12.0	31.2	52	31
03x-23A1-4	266	16.6	35.4	71	42
03x-31A0-4	350	33.4	57.8	96	57
03x-38A0-4	440	33.4	57.8	96	57
03x-44A0-4	530	33.4	57.8	96	57

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Noise

Frame size	Noise level
	dBA
R0	<30
R1	50…62
R2	50…62
R3	50…62
R4	<62

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Terminal and lead-through data for the power cables

Frame size	Max. cable diameter for NEMA 1				U1, V1, W1, U2, V2, W2, BRK+ and BRK-				PE			
	U1, V1, W1, U2, V2, W2		BRK+ and BRK-		Terminal size		Tightening torque		Clamp size		Tightening torque	
	mm	in	mm	in	mm^2	AWG	N·m	lbf·in	mm^2	AWG	N·m	lbf·in
R0	16	0.63	16	0.63	4.0/6.0	10	0.8	7	25	3	1.2	11
R1	16	0.63	16	0.63	4.0/6.0	10	0.8	7	25	3	1.2	11
R2	16	0.63	16	0.63	4.0/6.0	10	0.8	7	25	3	1.2	11
R3	29	1.14	16	0.63	10.0/16.0	6	1.7	15	25	3	1.2	11
R4	35	1.38	29	1.14	25.0/35.0	2	2.5	22	25	3	1.2	11

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Terminal and lead-through data for the control cables

Conductor size		Tightening torque	
Min/Max	Min/Max		
mm^2	AWG	N·m	lbf·in
0.25/1.5	24/16	0.5	4.4

Electric power network specification

Voltage (U_1)	ACS355-xxxx-1 drives: 1-phase 200 … 240 V AC ±10%. This is indicated on the type designation label as typical input voltage level 1 ~ 230 V AC. ACS355-xxxx-3 drives: 3-phase 200 … 240 V AC ±10%. This is indicated on the type designation label as typical input voltage level 3 ~ 230 V AC. ACS355-xxxx-3 drives: 3-phase 380 … 480 V AC ±10%. This is indicated on the type designation label as typical input voltage level 3 ~ 400/480 V AC.
Short-circuit capacity	Maximum allowed prospective short-circuit current at the input power connection as defined in IEC 61439-1:2009 and UL 508C is 100 kA. The drive is suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes at the drive maximum rated voltage.
Frequency	50/60 Hz ± 5%, maximum rate of change 17%/s
Imbalance	Max. ±3% of nominal phase-to-phase input voltage

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 508C)	The motor output is short-circuit proof by IEC 61800-5-1 and UL 508C.
Frequency	0…599 Hz
Frequency resolution	0.01 Hz
Current	See section *Ratings* on page *376*.
Power limit	$1.5 \cdot P_N$
Field weakening point	10…599 Hz
Switching frequency	4, 8, 12 or 16 kHz (in scalar control)
Speed control	See section *Speed control performance figures* on page *145*.
Torque control	See section *Torque control performance figures* on page *146*.

Maximum recommended motor cable length

Operational functionality and motor cable length

The drive is designed to operate with optimum performance with the following maximum motor cable lengths. 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…R4	50	165
With external output chokes		
R0	60	195
R1…R4	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		
Second environment (category C3 [1])	30	100
With optional external EMC filter		
Second environment (category C3 [1])	30 (at least) [2]	100 (at least) [2]
First environment (category C2 [1])	30 (at least) [2]	100 (at least) [2]
First environment (category C1 [1])	10 (at least) [2]	30 (at least) [2]

[1] See the terms in section *Definitions* on page *393*.

[2] Maximum motor cable length is determined by the drive's operational factors. Contact your local ABB representative for the

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.

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 **X1A: 2 and 5** **(AI1 and AI2)**	Voltage signal,	unipolar	0 (2)…10 V, R_{in} = 675 kohm
		bipolar	-10…10 V, R_{in} = 675 kohm
	Current signal,	unipolar	0 (4)…20 mA, R_{in} = 100 ohm
		bipolar	-20…20 mA, R_{in} = 100 ohm
	Potentiometer reference value (X1A: 4)		10 V ± 1%, max. 10 mA, R < 10 kohm
	Resolution		0.1%
	Accuracy		±2%
Analog output **X1A: 7** **(AO)**			0 (4)…20 mA, load < 500 ohm
Auxiliary voltage **X1A: 9**			24 V DC ± 10%, max. 200 mA
Digital inputs **X1A: 12…16** **(DI1…DI5)**	Voltage		12…24 V DC with internal or external supply. Max. voltage for digital inputs 30 V DC.
	Type		PNP and NPN
	Input impedance,		
	X1A: 12…15		R_{in} = 2 kohm
	X1A: 16		R_{in} = 4 kohm
Frequency input **X1A: 16** **(DI5)**	X1A: 16 can be used either as a digital or as a frequency input.		
	Frequency		Pulse train 0…10 kHz with 50% duty cycle. 0…16 kHz between two ACS355 drives.
Relay output **X1B: 17…19** **(RO 1)**	Type		NO + NC
	Max. switching voltage		250 V AC / 30 V DC
	Max. switching current		0.5 A / 30 V DC; 5 A / 230 V AC
	Max. continuous current		2 A rms
Digital output **X1B: 20…21** **(DO)**	Type		Transistor output PNP
	Max. switching voltage		30 V DC
	Max. switching current		100 mA / 30 V DC, short-circuit protected
	Frequency		10 Hz …16 kHz
	Resolution		1 Hz
	Accuracy		0.2%
Frequency output **X1B: 20…21** **(FO)**	X1A: 20…21 can be used either as a digital or as a frequency output.		
STO interface **X1C: 23…26**	See *Appendix: Safe torque off (STO)* on page *419*.		

Clearance and creepage distance

Clearance and creepage distance between I/O connections and the main circuit is 5.5 mm (0.20 in). This meets the requirement for the reinforced insulation of overvoltage category 3 when the installation altitude is below 2000 m (6562 ft). (EC 61800-5-1).

Brake resistor connection

Short-circuit protection (IEC 61800-5-1, IEC 60439-1, UL 508C)	The brake resistor output is conditionally short-circuit proof by IEC/EN 61800-5-1 and UL 508C. For correct fuse selection, contact your local ABB representative. Rated conditional short-circuit current as defined in IEC 60439-1 and the Short-circuit test current by UL 508C is 100 kA.

Common DC connection

Maximum power through common DC connection is equal to the drive nominal power. See *ACS355 Common DC application guide* (3AUA0000070130 [English]).

Efficiency

Approximately 95 to 98% at nominal power level, depending on the drive size and options.

Degrees of protection

IP20 (cabinet installation) / UL open: Standard enclosure. The drive must be installed in a cabinet to fulfil the requirements for shielding from contact.

IP20 / NEMA 1: Achieved with an option kit (MUL1-R1, MUL1-R3 or MUL1-R4) including a hood and a connection box.

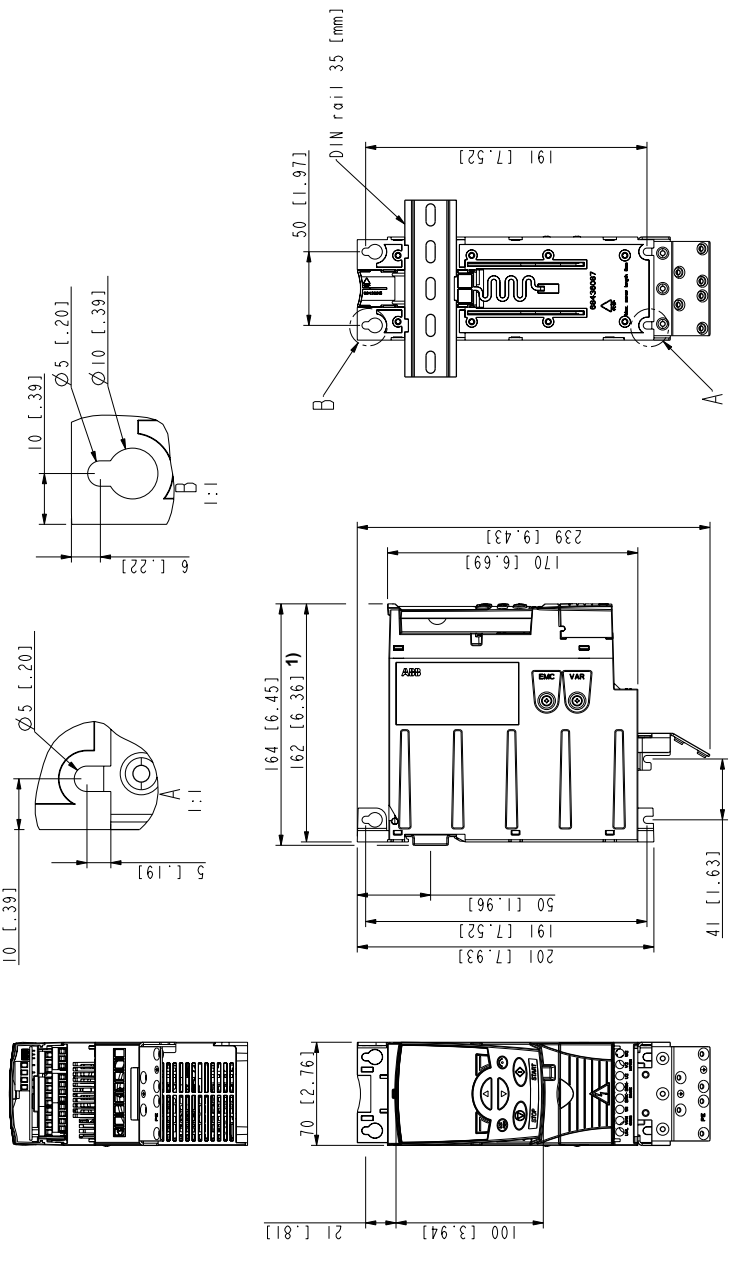
Ambient conditions

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], see section *Derating* on page *378*)	-	-
Air temperature	-10 … +50 °C (14 … 122 °F). No frost allowed. See section *Derating* on page *378*.	-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. **Note:** The drive must be installed in clean air according to enclosure classification. **Note:** Cooling air must be clean, 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
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)	-	-

Frame sizes R0 and R1, IP20 (cabinet installation) / UL open

R1 and R0 are identical except for the fan at the top of R1.



1) Extension modules add 26 mm (1.02 in) to the depth measure.

Frame sizes R0 and R1, IP20 (cabinet installation) / UL open

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Appendix: Safe torque off (STO)

What this appendix contains

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

Description

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

When activated, the Safe torque off function disables the control voltage of the power semiconductors of the drive output stage (A, see diagrams on page *421*), 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
IEC 60204-1:2018	*Safety of machinery – Electrical equipment of machines – Part 1: General requirements*
IEC 61000-6-7:2014	*Electromagnetic compatibility (EMC) – Part 6-7: Generic standards – Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations*
IEC 61326-3-1:2017	*Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General industrial applications*
IEC 61508-1:2010	*Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements*
IEC 61508-2:2010	*Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems*
IEC 61511:2016	*Functional safety – Safety instrumented systems for the process industry sector*
IEC 61800-5-2:2016 EN 61800-5-2:2007	*Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional*
IEC 62061:2005 + A1:2012 + A2:2015 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 control systems – Part 2: Validation*

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

Compliance with the European Machinery Directive

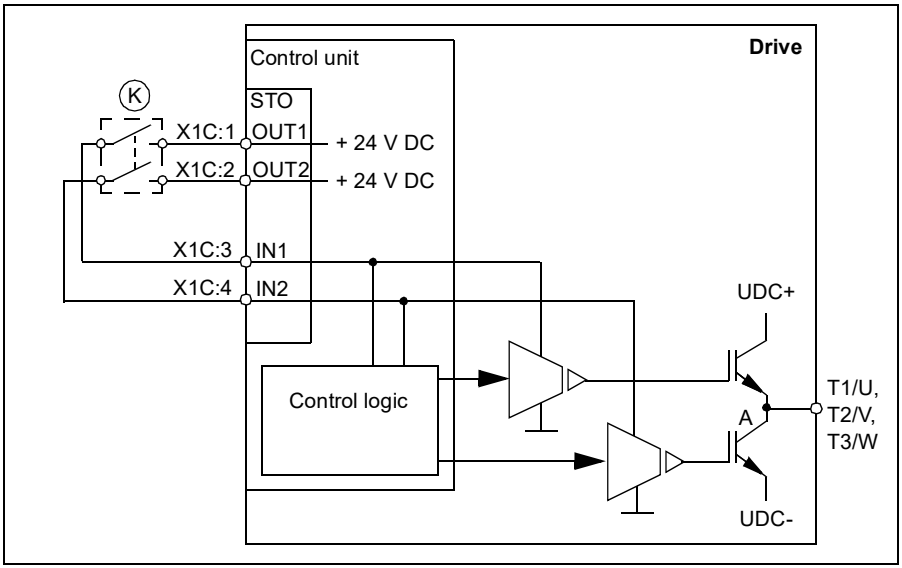
See section *Compliance with the Machinery Directive* on page 396.

Wiring

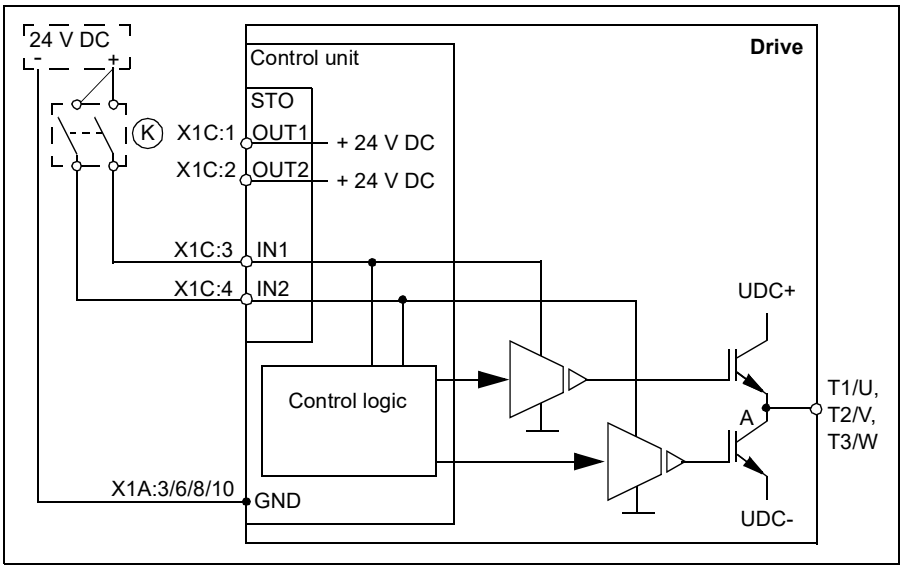
For information on the specifications of the STO connection, see the technical data of the control unit.

Connection principle

Single ACS355 drive, internal power supply



Single ACS355 drive, external power supply



Wiring examples

Single ACS355 drive, internal power supply

