ACS800

Hardware Manual
ACS800-01 Drives (0.55 to 200 kW)
ACS800-U1 Drives (0.75 to 200 hp)

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List of related manuals

Drive hardware manuals and guides	Code (English)
ACS800-01/U1 Drives Hardware Manual (0.55 to 200 kW, 0.75 to 200 hp)	*3AFE64382101*
Converter module capacitor reforming instructions	*3BFE64059629*
ACS800-01, -U1, -04 frames R2-R6 EMC filter disconnection	*3AXD00000168163*

Drive firmware manuals and guides	
ACS800 Standard Control Program 7.x Firmware Manual and Adaptive Program Application Guide	*3AFE64527592* *3AFE64527274*
ACS800 Permanent Magnet Synchronous Machine Drive Control Program Supplement to Firmware Manual for ACS800 Standard Control Program 7.x	*3AFE68437890*
ACS800 Master/Follower Application Guide	*3AFE64590430*
ACS800 Pump Control Application Program 7.2 Firmware Manual	*3AFE68478952*
ACS800 Extruder Control Program Supplement	*3AFE64648543*
ACS800 Centrifuge Control Program Supplement	*3AFE64667246*
ACS800 Traverse Control Program Supplement	*3AFE64618334*
ACS800 Winch Control Program (+N698) Firmware Manual	*3AUA0000031177*
ACS800 Rod Pump Light Control Program Firmware Manual	*3AUA0000005304*
etc.	

Option manuals and guides	
ACS800-01/U1/04 + C132 Drives (0.55 to 200 kW, 0.75 to 200 hp) Marine Supplement	*3AFE68291275*
ACS800-01/04/11/31/104/104LC Safe torque off function (+Q967), Application guide	*3AUA0000063373*
AIMA-01 I/O Module Adapter User's Manual	*3AFE64661442*
ACS800 Vibration Damper Installation Guide	*3AFE68295351*
Manuals and quick guides for I/O extension modules, fieldbus adapters, etc.	

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

ACS800-01/U1 manuals

ACS800-01 Drives
0.55 to 200 kW
ACS800-U1 Drives
0.75 to 200 hp

Hardware Manual

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Safety instructions

What this chapter contains

This chapter contains the safety instructions which you must follow when installing, operating and servicing the drive. If ignored, physical injury or death may follow, or damage may occur to the drive, motor or driven equipment. Read the safety instructions before you work on the unit.

Use of warnings and notes

There are two types of safety instructions throughout this manual: warnings and notes. Warnings caution you about conditions which can result in serious injury or death and/or damage to the equipment. They also tell you how to avoid the danger. Notes draw attention to a particular condition or fact, or give information on a subject. The warning symbols are used as follows:

Dangerous voltage warning warns of high voltage which can cause physical injury and/or damage to the equipment.

General warning warns about conditions, other than those caused by electricity, which can result in physical injury and/or damage to the equipment.

Electrostatic discharge warning warns of electrostatic discharge which can damage the equipment.

Hot surface warning warns of hot surfaces which can cause physical injury.

Installation and maintenance work

These warnings are intended for all who work on the drive, motor cable or motor.

WARNING! Ignoring the following instructions can cause physical injury or death, or damage to the equipment:

- **Only qualified electricians are allowed to install and maintain the drive.**
- Never work on the drive, motor cable or motor when main power is applied. After disconnecting the input power, always wait for 5 min to let the intermediate circuit capacitors discharge before you start working on the drive, motor or motor cable.

  Always ensure by measuring with a multimeter (impedance at least 1 Mohm) that:

  1. voltage between drive input phases U1, V1 and W1 and the frame is close to 0 V.
  2. voltage between terminals UDC+ and UDC- and the frame is close to 0 V.
- Do not work on the control cables when power is applied to the drive or to the external control circuits. Externally supplied control circuits may cause dangerous voltages inside the drive even when the main power on the drive is switched off.
- Do not make any insulation or voltage withstand tests on the drive or drive modules.
- When reconnecting the motor cable, always check that the phase order is correct.
- After maintaining or modifying a drive safety circuit or changing circuit boards inside the module, retest the functioning of the safety circuit according to the start-up instructions.
- Do not change the electrical installations of the drive except for the essential control and power connections. Changes may affect the safety performance or operation of the drive unexpectedly. All customer-made changes are on the customer's responsibility.

Note:

- The motor cable terminals on the drive are at a dangerously high voltage when the input power is on, regardless of whether the motor is running or not.
- The brake control terminals (UDC+, UDC-, R+ and R- terminals) carry a dangerous DC voltage (over 500 V).
- Depending on the external wiring, dangerous voltages (115 V, 220 V or 230 V) may be present on the terminals of relay outputs RO1 to RO3 or on the optional AGPS board (Prevention of unexpected start-up).

- The Prevention of unexpected start-up function (option +Q950) does not remove the voltage from the main and auxiliary circuits.
- The Safe torque off function (option +Q967) does not remove the voltage from the main and auxiliary circuits.
- At installation sites above 2000 m (6562 ft), the terminals of the RMIO board and option modules attached to the board do not fulfil the Protective Extra Low Voltage (PELV) requirements stated in EN 50178.

Grounding

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

WARNING! Ignoring the following instructions can cause physical injury, death, increased electromagnetic interference and equipment malfunction:

- Ground the drive, motor and adjoining equipment to ensure personnel safety in all circumstances, and to reduce electromagnetic emission and interference.
- Make sure that grounding conductors are adequately sized as required by safety regulations.
- In a multiple-drive installation, connect each drive separately to protective earth (PE).
- In European CE compliant installations and in other installations where EMC emissions must be minimized, make a 360° high frequency grounding of cable entries in order to suppress electromagnetic disturbances. In addition, connect the cable shields to protective earth (PE) in order to meet safety regulations.
- Do not install a drive with EMC filter option +E202 or +E200 on an ungrounded power system or a high-resistance-grounded (over 30 ohms) power system.

Note:

- Power cable shields are suitable for equipment grounding conductors only when adequately sized to meet safety regulations.
- As the normal leakage current of the drive is higher than 3.5 mA AC or 10 mA DC (stated by EN 50178, 5.2.11.1), a fixed protective earth connection is required. In addition, we recommend that you use:

  • a cross-section of the protective earthing conductor of at least 10 mm^2 Cu or 16 mm^2 Al,
  or
  • an automatic disconnection of the supply in case of discontinuity of the protective earthing conductor,
  or
  • a second protective earthing conductor of the same cross-sectional area as the original protective earthing conductor.

Mechanical installation and maintenance

These instructions are intended for all who install and service the drive.

WARNING! Ignoring the following instructions can cause physical injury or death, or damage to the equipment:

- Handle the unit carefully.
- The drive is heavy. Do not lift it alone. Do not lift the unit by the front cover. Place the unit only on its back.

- Beware of hot surfaces. Some parts, such as heatsinks of power semiconductors, remain hot for a while after disconnection of the electrical supply.
- Make sure that dust from borings and grindings does not enter the drive when installing. Electrically conductive dust inside the unit may cause damage or malfunctioning.
- Ensure sufficient cooling.
- Do not fasten the drive by riveting or welding.

Printed circuit boards

WARNING! Ignoring the following instructions can cause damage to the printed circuit boards:

- The printed circuit boards contain components sensitive to electrostatic discharge. Wear a grounding wrist band when handling the boards. Do not touch the boards unnecessarily.

Fibre optic cables

WARNING! Ignoring the following instructions can cause equipment malfunction and damage to the fibre optic cables:

- Handle the fibre optic cables with care. When unplugging optic cables, always grab the connector, not the cable itself. Do not touch the ends of the fibres with bare hands as the fibre is extremely sensitive to dirt. The minimum allowed bend radius is 35 mm (1.4 in.).

Operation

These warnings are intended for all who plan the operation of the drive or operate the drive.

WARNING! Ignoring the following instructions can cause physical injury or death, or damage to the equipment:

- Before adjusting the drive and putting it into service, make sure that the motor and all driven equipment are suitable for operation throughout the speed range provided by the drive. The drive can be adjusted to operate the motor at speeds above and below the speed provided by connecting the motor directly to the power line.
- Do not activate automatic fault reset functions of the Standard Control Program if dangerous situations can occur. When activated, these functions will reset the drive and resume operation after a fault.
- Do not control the motor with the disconnecting device; instead, use the control panel keys and , or commands via the I/O board of the drive. The maximum allowed number of charging cycles of the DC capacitors (i.e. power-ups by applying power) is five in ten minutes.

Note:

- If an external source for start command is selected and it is ON, the drive (with Standard Control Program) will start immediately after fault reset unless the drive is configured for 3-wire (a pulse) start/stop.
- When the control location is not set to Local (L not shown in the status row of the display), the stop key on the control panel will not stop the drive. To stop the drive using the control panel, press the LOC/REM key and then the stop key .

Permanent magnet motor

These are additional warnings concerning permanent magnet motor drives. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

Note: Controlling a permanent magnet motor is only allowed using the ACS800 Permanent Magnet Synchronous Motor Drive Control Program.

Installation and maintenance work

WARNING! Do not work on the drive when the permanent magnet motor is rotating. Also, when the supply power is switched off and the inverter is stopped, a rotating permanent magnet motor feeds power to the intermediate circuit of the drive and the supply connections become live.

Before installation and maintenance work on the drive:

- Stop the motor.
- Ensure that the motor cannot rotate during work. Prevent the start-up of any drives in the same mechanical group by opening the Prevention of unexpected start switch (option +Q950) or the Safe torque off switch (option +Q967) and padlocking it. Make sure that no other system, like hydraulic crawling drives, are able to rotate the motor directly or through any mechanical connection like felt, nip, rope, etc.
- Ensure that there is no voltage on the drive power terminals:
  Alternative 1) Disconnect the motor from the drive with a safety switch or by other means. Measure that there is no voltage present on the drive input, output or DC terminals (U1, V1, W1, U2, V2, W2, UDC+, UDC-).
  Alternative 2) Measure that there is no voltage present on the drive input, output or DC terminals (U1, V1, W1, U2, V2, W2, UDC+, UDC-). Ground the drive output terminals temporarily by connecting them together as well as to the PE.
  Alternative 3) If possible, both of the above.

Start-up and operation

WARNING! Do not run the motor over the rated speed. Motor overspeed leads to overvoltage which can damage the capacitors in the intermediate circuit of the drive.

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Introduction to this manual

What this chapter contains

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

Intended audience

This manual is intended for people who plan the installation, install, commission, use and service the drive. Read the manual before working on the drive. The reader is expected to know the fundamentals of electricity, wiring, electrical components and electrical schematic symbols.

This manual is written for readers worldwide. Both SI and imperial units are shown. Special US instructions for installations within the United States that must be installed per the National Electrical Code and local codes are marked with (US).

Categorization according to the frame size

Some instructions, technical data and dimensional drawings which concern only certain frame sizes are marked with the symbol of the frame size R2, R3... or R8. The frame size is not marked on the drive designation label. To identify the frame size of your drive, see the rating tables in chapter *Technical data*.

The ACS800-01/U1 is manufactured in frame sizes R2 to R6.

Categorization according to the + code

The instructions, technical data and dimensional drawings which concern only certain optional selections are marked with + codes, e.g. +E202. The options included in the drive can be identified from the + codes visible on the type designation label of the drive. The + code selections are listed in chapter *Operation principle and hardware description* under *Type code*.

Contents

The chapters of this manual are briefly described below.

Safety instructions give safety instructions for the installation, commissioning, operation and maintenance of the drive.

Introduction to this manual lists the steps in checking the delivery and installing and commissioning the drive and refers to chapters/sections in this manual and other manuals for particular tasks.

Operation principle and hardware description describes the drive.

Mechanical installation instructs how to place and mount the drive.

Planning the electrical installation instructs on the motor and cable selection, protections and cable routing.

Electrical installation shows how to wire the drive.

Installation of the AGPS board (Prevention of unexpected start-up, +Q950) contains electrical installation instructions of the optional Prevention of unexpected start-up function (+Q950) of the drive, and gives instructions for starting up, validating and using the function.

Installation of the ASTO board (Safe torque off, +Q967) describes the electrical installation of the optional Safe torque off function (+Q967).

Motor control and I/O board (RMIO) shows the external control connections to the I/O board.

Installation checklist contains a list for checking the mechanical and electrical installation of the drive.

Start-up and use describes the start-up procedure and use of the drive.

Maintenance contains preventive maintenance instructions.

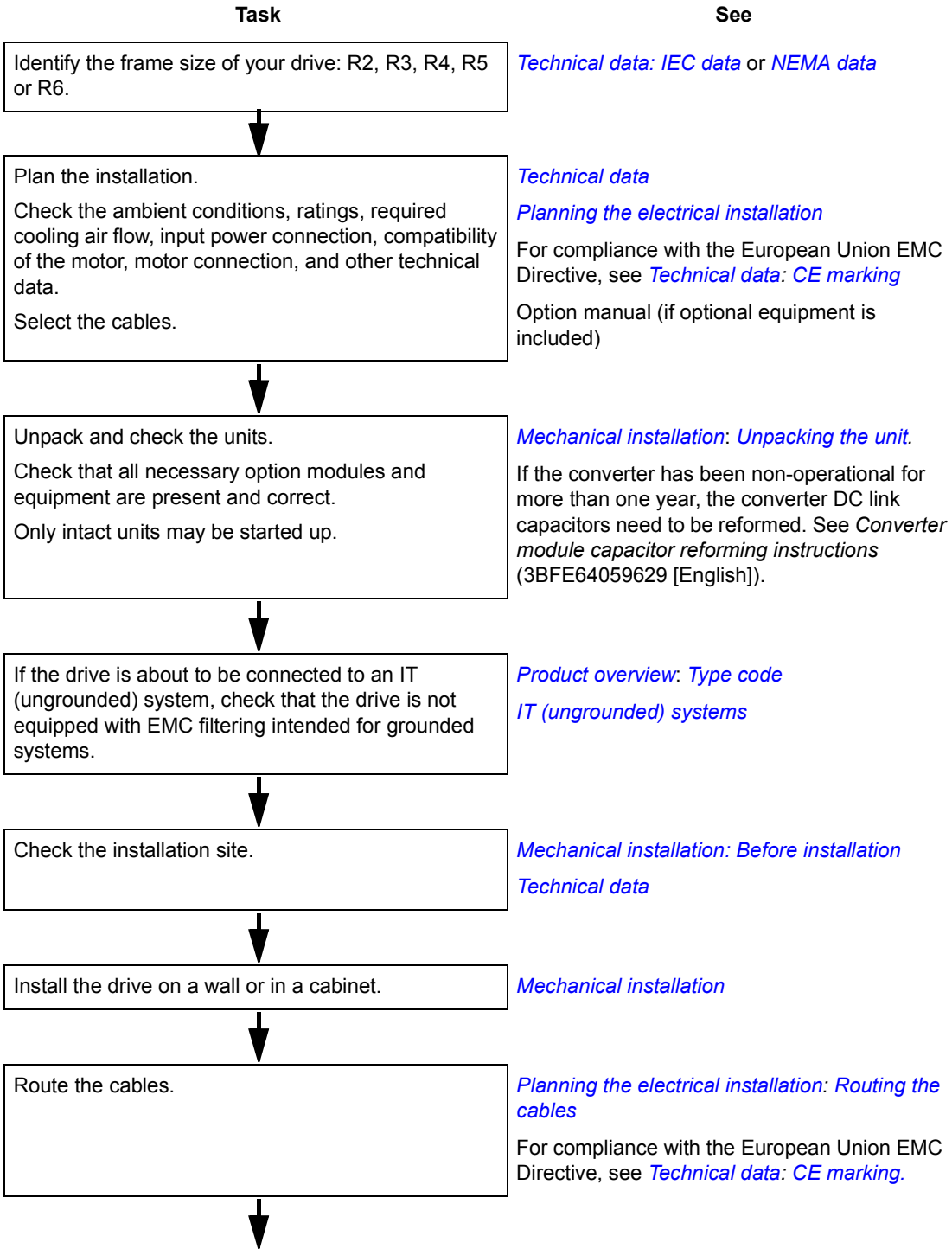
Technical data contains the technical specifications of the drive, e.g. the ratings, sizes and technical requirements, provisions for fulfilling the requirements for CE and other markings and warranty policy.

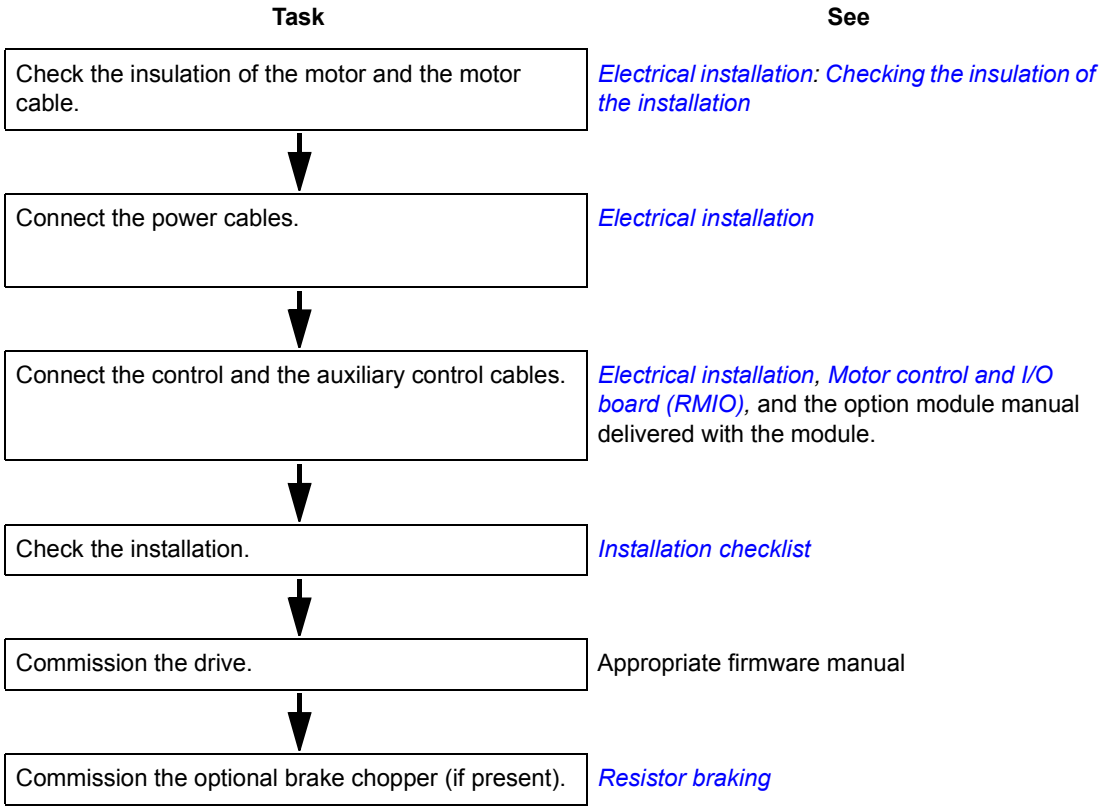
Dimensional drawings contains the dimensional drawings of the drive.

Resistor braking describes how to select, protect and wire brake choppers and resistors. The chapter also contains the technical data.

External +24 V DC power supply for the RMIO board via terminal X34 describes how to connect an external +24 V DC power supply for the RMIO board using terminal X34.

Installation and commissioning flowchart





Terms and abbreviations

Term / Abbreviation	Description
AGPS	Power supply board for IGBT gate driver boards. Used in implementation of the optional Prevention of unexpected start-up function.
AIMA	I/O module adapter. An extension unit for mounting I/O extension modules outside the drive unit.
ASTO	Safe torque off board. An optional board used to implement the Safe torque off function.
CDP 312R	Type of control panel
DDCS	Distributed drives communication system; a protocol used in optical fiber communication.
DTC	Direct torque control
EMC	Electromagnetic compatibility
IGBT	Insulated gate bipolar transistor
IT system	Type of supply network that has no (low-impedance) connection to ground/earth.
POUS	Prevention of unexpected start-up
RAIO	Analog I/O extension module
RCAN	CANopen adapter module
RCNA	ControlNet adapter module
RDCO	DDCS communication module

RDIO	Digital I/O extension module
RDNA	DeviceNet™ adapter module
RECA	EtherCAT adapter module
REPL	Ethernet POWERLINK adapter module
RETA	Ethernet adapter module for Modbus/TCP and EtherNet/IP protocols
RFI	Radio-frequency interference
RIBA	InterBus-S adapter module
RINT	Main circuit board
RLON	LONWORKS® adapter module
RMBA	Modbus adapter module
RMBP	Modbus plus adapter module
RMIO	Supply/motor control and I/O board
RPBA	PROFIBUS-DP adapter module
RRFC	RFI filter board (filter board for meeting the EMC requirements)
RRIA	Resolver adapter module
RTAC	Pulse encoder adapter module
RVAR	Varistor board
STO	Safe torque off
TN system	Type of supply network that provides a direct connection to ground (earth)

Operation principle and hardware description

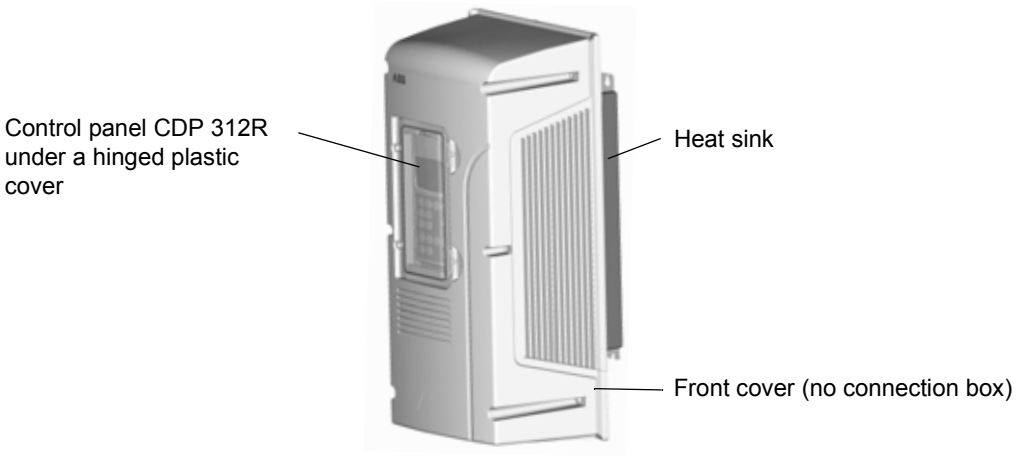
What this chapter contains

This chapter describes the operating principle and construction of the drive in short.

Product overview

The ACS800-01/U1 is a wall mountable drive for controlling AC motors.

IP21 (UL type 1)



IP55 (UL type 12)

Type code

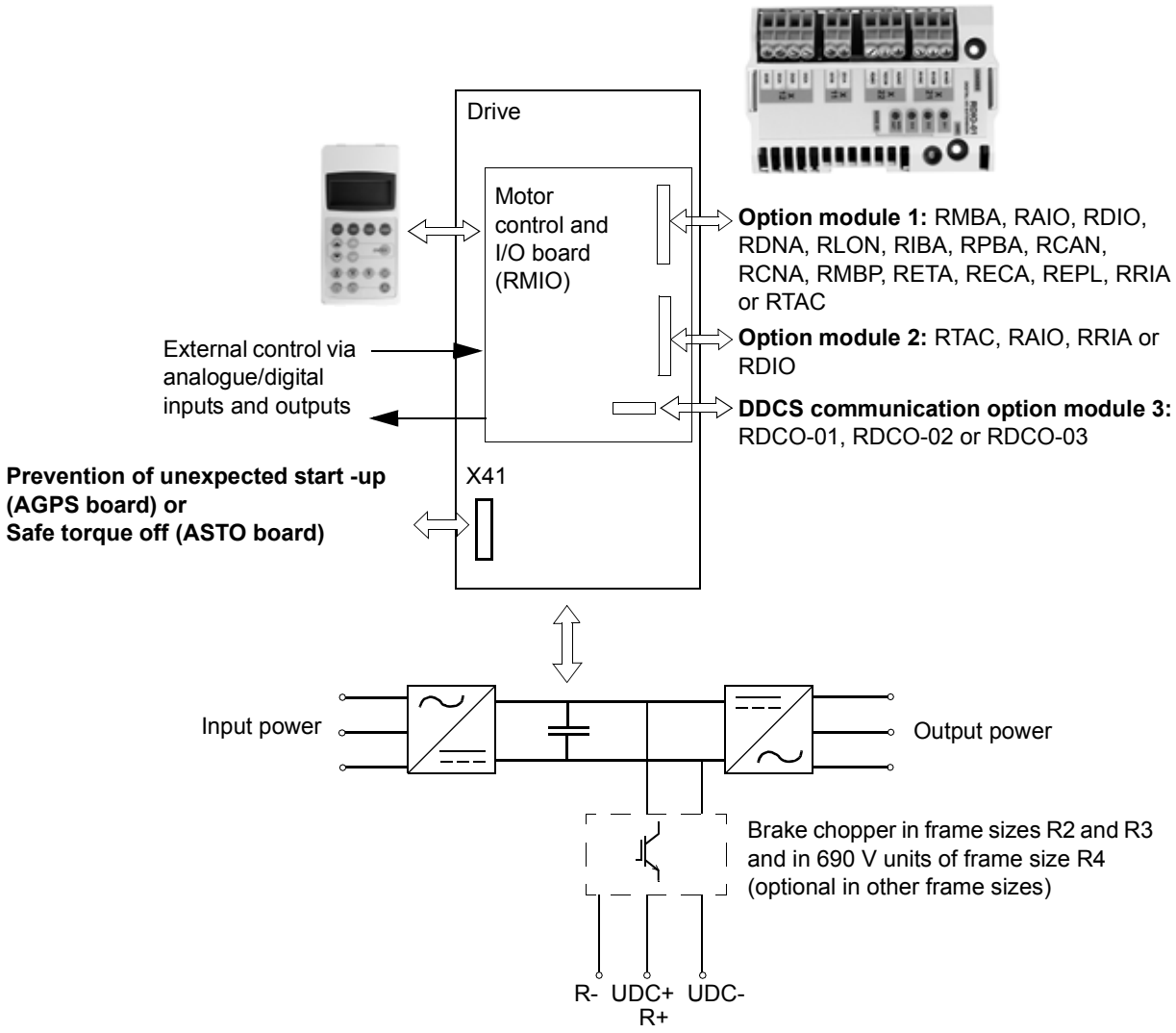
The type code contains information on the specifications and configuration of the drive. The first digits from left express the basic configuration (for example, ACS800-01-0006-5). The optional selections are given thereafter, separated by + signs (for example, +E202). The main selections are described below. Not all selections are available for all types. For more information, refer to *ACS800 Ordering Information* (EN code: 3AFY64556568, available on request).

Selection	**Alternatives**	
Product series	ACS800 product series	
Type	01	Wall mounted. When no options are selected: IP21, control panel CDP 312R, no EMC filter, Standard Control Program, cable connection box (cabling from below), brake chopper in frame sizes R2 and R3 (230/400/500 V units) and in frame size R4 (690 V units), boards without coating, one set of English manuals.
	U1	Wall mounted (USA). When no options are selected: UL type 1, control panel CDP 312R, no EMC filter, US version of the Standard Control Program (three-wire start/stop as default setting), US gland/conduit box, brake chopper in frame sizes R2 and R3 (230/400/500 V units) and in frame size R4 (690 V units), boards without coating, one set of English manuals.
Size	Refer to *Technical data: IEC data* or *NEMA data*.	
Voltage range (nominal rating in bold)	2	208/220/**230**/240 V AC
	3	380/**400**/415 V AC
	5	380/400/415/440/460/480/**500** V AC
	7	525/575/600/**690** V AC
Option codes (+ codes)		
Degree of protection	B056	IP55 / UL type 12
Construction	C131	Vibration dampers
	C132	Marine type approved unit (coated boards included, +C131 required for frame sizes R4 to R6 in wall installations, +C131 not required in cabinet installations)
Resistor braking	D150	Brake chopper
Filter	E200	EMC/RFI filter for second environment TN (grounded) system, drive category C3 (frame sizes R2…R5)
	E202	EMC/RFI filter for first environment TN (grounded) system, drive category C2
	E210	EMC/RFI filter for second environment TN/IT (grounded/ungrounded) system, drive category C3 (frame size R6 only)
Cabling	H358	US/UK gland/conduit box
Control panel	0J400	No control panel
Fieldbus	K...	Refer to *ACS800 Ordering Information* (EN code: 3AFY64556568).
I/O	L...	
Control program	N...	
Manual language	R...	
Safety features	Q950	Prevention of unexpected start-up: AGPS board and 3 m connection cable (not to be used with option +Q967)
	Q967	Safe torque off (STO) function without safety relay: ASTO board and 3 m connection cable (not to be used with option +Q950)
Specialities	P901	Coated boards
	P904	Extended warranty

Main circuit and control

Diagram

This diagram shows the control interfaces and the main circuit of the drive.



Operation

This table describes the operation of the main circuit in short.

Component	Description
six-pulse rectifier	converts the three-phase AC voltage to DC voltage
capacitor bank	energy storage which stabilizes the intermediate circuit DC voltage
IGBT inverter	converts the DC voltage to AC voltage and vice versa. The motor operation is controlled by switching the IGBTs.

Printed circuit boards

The drive contains the following printed circuit boards as standard:

- main circuit board (RINT)
- motor control and I/O board (RMIO)
- EMC filter board (RRFC) when EMC equipment is selected or varistor board (RVAR) otherwise
- control panel (CDP 312R).

Motor control

The motor control is based on the Direct Torque Control (DTC) method. Two phase currents and DC link voltage are measured and used for the control. The third phase current is measured for earth fault protection.

Mechanical installation

What this chapter contains

This chapter contains unpacking instructions, the delivery checklist and the mechanical installation instructions of the drive.

Unpacking the unit

The drive is delivered in either in a cardboard box or in a plywood package. The package also contains:

- connection box (only in IP21 units): screws, clamps and vibration dampers (option +C131)
- box for safety options: ASTO board for the Safe torque off function (option +Q967) or AGPS board for the Prevention of unexpected start-up function (option +Q950)
- plastic bag: screws (M3), clamps and cable lugs (2 mm^2, M3) for grounding the control cable screens, all manuals (hardware manual, appropriate firmware manuals and guides, option module manuals), residual voltage warning stickers and other delivery documents.

The type, size and material of the package depend on the frame size of the drive and the selected options (see section *Package dimensions and weights* on page *117*). The following unpacking instructions are examples.

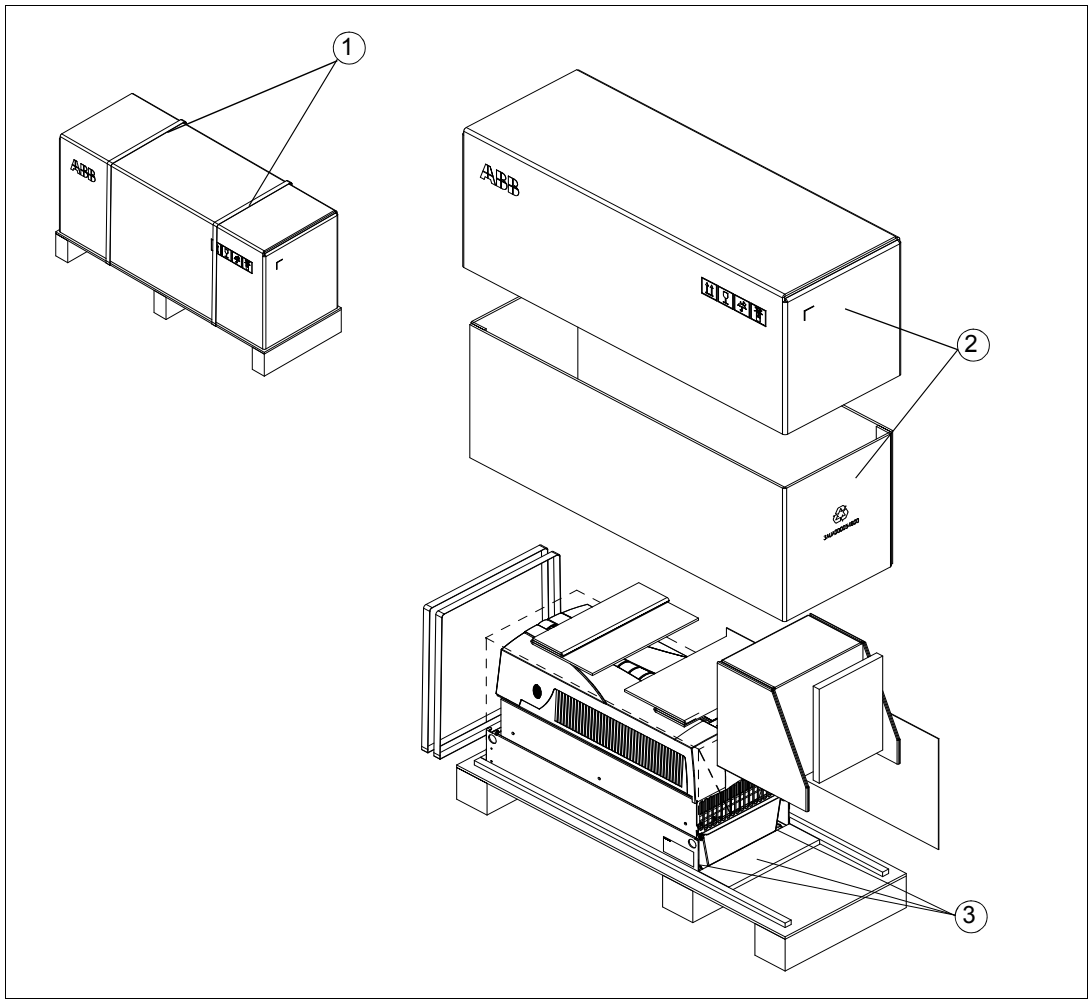
Note: Do not discard any important components that are in the separate cardboard boxes.

Example 1

1. To cut the box into two pieces, pull from the spots marked with arrows.
2. Remove the upper part of the box.
3. Remove the unit and other contents from the box.

Example 2

1. Cut the straps.
2. Remove the outer box and sleeve.
3. Remove the locking sheet and the screws that attach the unit to the bottom pallet.

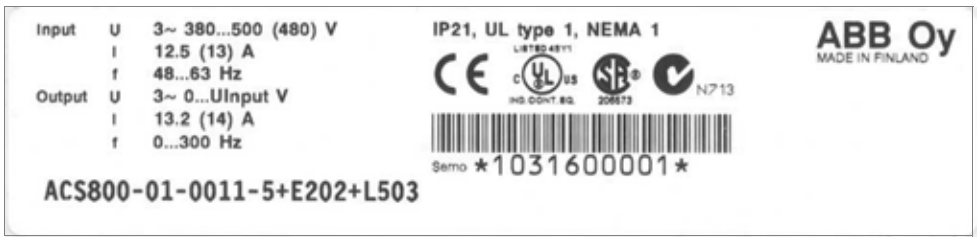


Checking the delivery

Check that all items listed in section *Unpacking the unit* are present.

Check that there are no signs of damage. Before attempting installation and operation, check the information on the type designation label of the drive to verify that the unit is of the correct type. The label includes an IEC and NEMA rating, UL, C-UL, CSA and CE markings, a type code and a serial number, which allow individual recognition of each unit. The first digit of the serial number refers to the manufacturing plant. The next four digits refer to the unit's manufacturing year and week, respectively. The remaining digits complete the serial number so that there are no two units with the same serial number.

The type designation label is attached to the heat sink and the serial number label to the upper part of the back plate of the unit. Example labels are shown below.



Type designation label

Serial number label

Before installation

The drive must be installed in an upright position with the cooling section facing a wall. Check the installation site according to the requirements below. Refer to *Dimensional drawings* for frame details.

Requirements for the installation site

See *Technical data* for the allowed operation conditions of the drive.

Wall

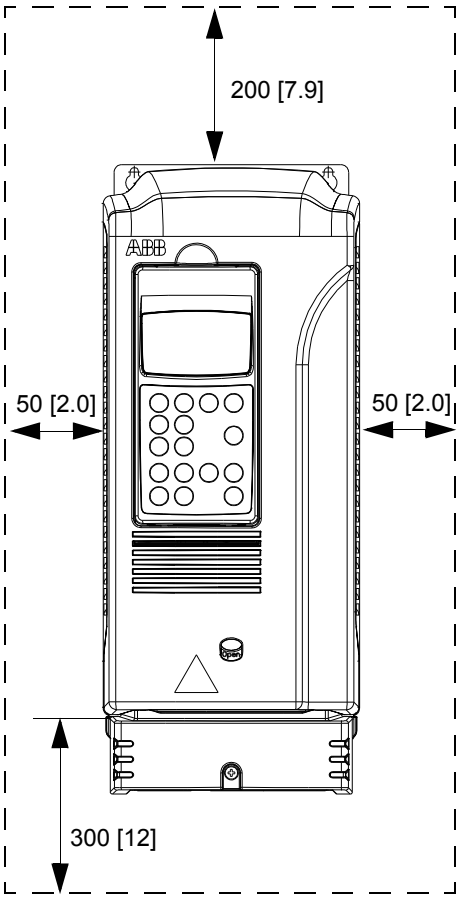
The wall should be as close to vertical as possible, of non-flammable material and strong enough to carry the weight of the unit. Check that there is nothing on the wall to inhibit the installation.

Floor

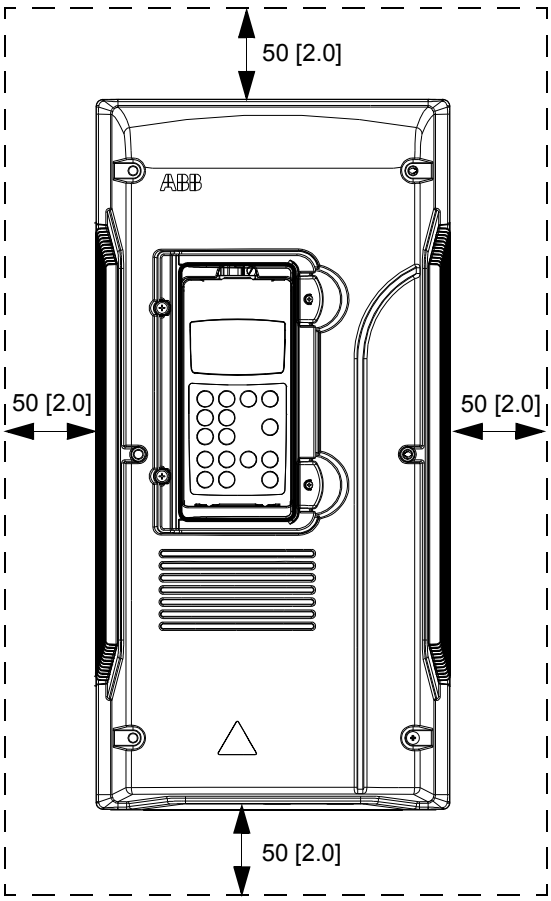
The floor/material below the installation should be non-flammable.

Free space around the unit

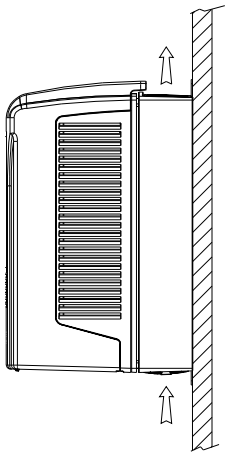
Required free space around the drive to enable cooling air flow, service and maintenance is shown below in millimetres and [inches]. When mounting IP55 units above one another, leave 200 mm (7.9 in.) free space above and below the unit.



IP21 (UL 1)



IP55 (UL 12)

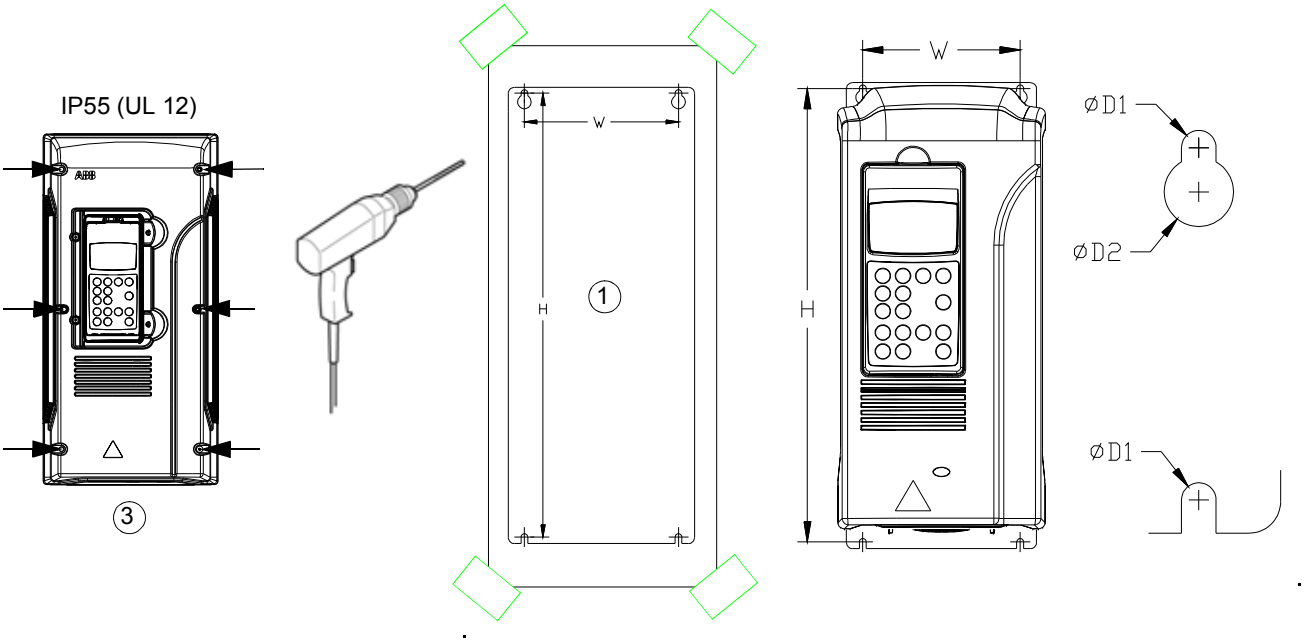


Air flow (side view)

Mounting the drive on the wall

Units without vibration dampers

1. Mark the locations for the four holes. The mounting points are shown in *Dimensional drawings*. In frame sizes R2 to R5 (IP21, UL type 1), use the mounting template cut from the package.
2. Fix the screws or bolts to the marked locations.
3. IP55 (UL type 12) units: Remove the front cover by undoing the fixing screws.
4. Position the drive onto the screws on the wall. **Note:** Lift the drive by its chassis (R6: by its lifting holes), not by its cover.
5. Tighten the screws in the wall securely.



IP55 (UL type 12) marine applications (+C132) of frame sizes R4 to R6

See *ACS800-01/U1 Marine Supplement* [3AFE68291275 (English)].

Units with vibration dampers (+C131)

See *ACS800-01/U1 Vibration Damper Installation Guide* [3AFE68295351 (English)].

UL 12 units

Install the hood delivered with the drive 50 mm (2.0 in.) above the top of unit.

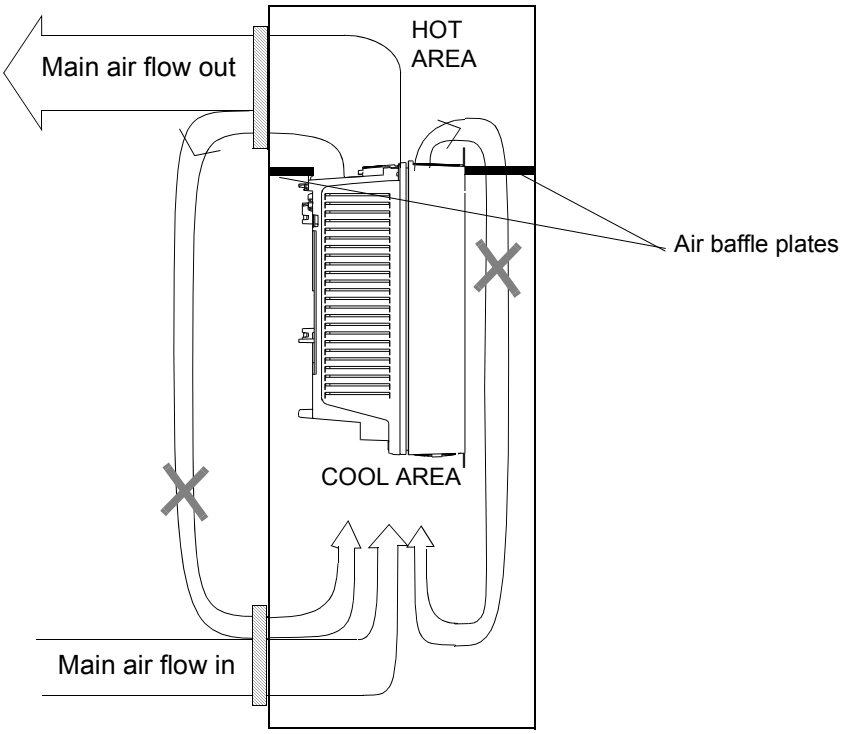
Cabinet installation

For better cooling, it is recommended to remove the front cover if the unit is installed into a cabinet. The required distance between parallel units is five millimetres (0.2 in.) in installations without the front cover. The cooling air entering the unit must not exceed +40 °C (+104 °F).

Preventing cooling air recirculation

Prevent air recirculation inside and outside the cabinet.

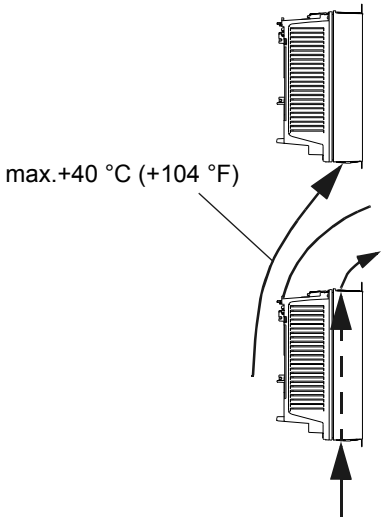
Example



Unit above another

Lead the out-coming cooling air away from the unit above.

Example



Planning the electrical installation

What this chapter contains

This chapter contains the instructions that you must follow when selecting the motor, cables, protections, cable routing and way of operation for the drive system.

Note: 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.

Motor selection and compatibility

1. Select the motor according to the rating tables in chapter *Technical data*. Use the DriveSize PC tool if the default load cycles are not applicable.
2. Check that the motor ratings lie within the allowed ranges of the drive control program:
   - motor nominal voltage is 1/2 ... 2 · U_N of the drive
   - motor nominal current is 1/6 ... 2 · I_{2hd} of the drive in DTC control and 0 ... 2 · I_{2hd} in scalar control. The control mode is selected by a drive parameter.
3. Check that the motor voltage rating meets the application requirements:

Resistor braking	Motor voltage rating
no resistor braking is in use	U_N
frequent or long term brake cycles will be used	U_{ACeq1}

U_N = rated input voltage of the drive
U_{ACeq1} = U_{DC}/1.35
U_{ACeq1} = the equivalent AC power source voltage of the drive in V AC.
U_{DC} = the maximum DC link voltage of the drive in V DC.
For resistor braking: U_{DC}= 1.21 × nominal DC link voltage.
Note: Nominal DC link voltage is U_N × 1.35 in V DC.

See note 7 below the *Requirements table*, page *43*.

4. Consult the motor manufacturer before using a motor in a drive system where the motor nominal voltage differs from the AC power source voltage.
5. Ensure that the motor insulation system withstands the maximum peak voltage in the motor terminals. See the *Requirements table* below for the required motor insulation system and drive filtering.

Example 1: When the supply voltage is 440 V and a drive with a diode supply is operating in motor mode only, the maximum peak voltage in the motor terminals can be approximated as follows: 440 V · 1.35 · 2 = 1190 V. Check that the motor insulation system withstands this voltage.

Protecting the motor insulation and bearings

The output of the drive comprises – regardless of output frequency – pulses of approximately 1.35 times the equivalent mains network voltage with a very short rise time. This is the case with all drives employing modern IGBT inverter technology.

The voltage of the pulses can be almost double at the motor terminals, depending on the attenuation and reflection properties of the motor cable and the terminals. This in turn 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, which can gradually erode the bearing races and rolling elements.

The stress on motor insulation can be avoided by using optional ABB d*u*/d*t* filters. d*u*/d*t* filters also reduce bearing currents.

To avoid damage to motor bearings, the cables must be selected and installed according to the instructions given in the hardware manual. In addition, insulated N-end (non-driven end) bearings and output filters from ABB must be used according to the following table. Two types of filters are used individually or in combinations:

- optional d*u*/d*t* filter (protects motor insulation system and reduces bearing currents).
- common mode filter (mainly reduces bearing currents).

Requirements table

The following table shows how to select the motor insulation system and when an optional ABB d*u*/d*t* filter, insulated N-end (non-driven end) motor bearings and ABB common mode filters are required. Ignoring the requirements or improper installation may shorten motor life or damage the motor bearings and voids the warranty.

Manufacturer	Motor type	Nominal mains voltage (AC line voltage)	Requirement for			
			Motor insulation system	ABB d*u*/d*t* filter, insulated N-end bearing and ABB common mode filter		
				P_N < 100 kW and frame size < IEC 315	**100 kW ≤ P_N < 350 kW or frame size ≥ IEC 315**	**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 frame size ≥ NEMA 500**	**P_N ≥ 469 hp or frame size > NEMA 580**
ABB	Random-wound M2_, M3_ and M4_	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 (cable length ≤ 150 m)	Reinforced	+ d*u*/d*t*	+ d*u*/d*t* + N	+ d*u*/d*t* + N + CMF
		600 V < U_N ≤ 690 V (cable length > 150 m)	Reinforced	-	+ N	+ N + CMF
	Form-wound HX_ and AM_	380 V < U_N ≤ 690 V	Standard	n.a.	+ N + CMF	P_N < 500 kW: + N + CMF
						P_N ≥ 500 kW: + N + CMF + d*u*/d*t*
	Old* form-wound HX_ and modular	380 V < U_N ≤ 690 V	Check with the motor manufacturer.	+ d*u*/d*t* with voltages over 500 V + N + CMF		
	Random-wound HX_ and AM_ **	0 V < U_N ≤ 500 V	Enamelled wire with fibre glass taping	+ N + CMF		
		500 V < U_N ≤ 690 V		+ d*u*/d*t* + N + CMF		
	HDP	Consult the motor manufacturer.				

Manufacturer	Motor type	Nominal mains voltage (AC line voltage)	Requirement for			
			Motor insulation system	ABB d*u*/d*t* filter, insulated N-end bearing and ABB common mode filter		
				P_N < 100 kW and frame size < IEC 315	**100 kW ≤ P_N < 350 kW or frame size ≥ IEC 315**	**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 frame size ≥ NEMA 500**	**P_N ≥ 469 hp or frame size > NEMA 580**
NON-ABB	Random-wound and form-wound	$U_N \leq 420$ V	Standard: $\hat{U}_{LL}$ = 1300 V	-	+ N or CMF	+ N + CMF
		420 V < $U_N \leq$ 500 V	Standard: $\hat{U}_{LL}$ = 1300 V	+ d*u*/d*t*	+ d*u*/d*t* + N or + d*u*/d*t* + CMF	+ d*u*/d*t* + N + CMF
			or			
			Reinforced: $\hat{U}_{LL}$ = 1600 V, 0.2 microsecond rise time	-	+ N or CMF	+ N + CMF
		500 V < $U_N \leq$ 600 V	Reinforced: $\hat{U}_{LL}$ = 1600 V	+ d*u*/d*t*	+ d*u*/d*t* + N or + d*u*/d*t* + CMF	+ d*u*/d*t*+ N + 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	+ d*u*/d*t*	+ d*u*/d*t* + N	+ d*u*/d*t* + N + CMF
			Reinforced: $\hat{U}_{LL}$ = 2000 V, 0.3 microsecond rise time ***	-	N + CMF	N + CMF

* manufactured before 1.1.1998

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

*** If the intermediate DC circuit voltage of the drive is increased from the nominal level by resistor braking or by the IGBT Supply Control Program (parameter selectable function), check with the motor manufacturer if additional output filters are needed in the applied drive operation range.

Note 1: The abbreviations used in the table are defined below.

Abbreviation	Definition
U_N	nominal voltage of the supply network
$\hat{U}_{LL}$	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
N	N-end bearing: insulated motor non-driven end bearing
n.a.	Motors of this power range are not available as standard units. Consult the motor manufacturer.

Note 2: *Explosion-safe (EX) motors*

The motor manufacturer should be consulted regarding the construction of the motor insulation and additional requirements for explosion-safe (EX) motors.

Note 3: *ABB high-output motors 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 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*	+ N + d*u*/d*t*	+ N + d*u*/d*t* + CMF
	or			
	Reinforced	-	+ N	+ N + CMF
600 V < U_N ≤ 690 V	Reinforced	+ d*u*/d*t*	+ N + d*u*/d*t*	+ N + d*u*/d*t* + CMF

Note 4: *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. The table below shows the requirements for random-wound and form-wound non-ABB motors with nominal power smaller than 350 kW. For bigger motors, consult the motor manufacturer.

Nominal AC supply voltage	**Requirement for**		
	Motor insulation system	**ABB d*u*/d*t* filter, insulated N-end bearing and ABB common mode filter**	
		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 + CMF
420 V < $U_N \leq 500$ 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 + CMF
500 V < $U_N \leq 600$ V	Reinforced: $\hat{U}_{LL}$ = 1600 V	+ d*u*/d*t* + (N or CMF)	+ d*u*/d*t* + N + 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 ***	N + CMF	N + CMF

*** If the intermediate DC circuit voltage of the drive is increased from the nominal level by resistor braking, check with the motor manufacturer if additional output filters are needed in the applied drive operation range.

Note 5: *HXR and AMA motors*

All AMA machines (manufactured in Helsinki) for drive systems have form-wound windings. All HXR machines manufactured in Helsinki starting 1.1.1998 have form-wound windings.

Note 6: *ABB motors of types other than M2_, M3_, HX_ and AM_*

Use the selection criteria given for non-ABB motors.

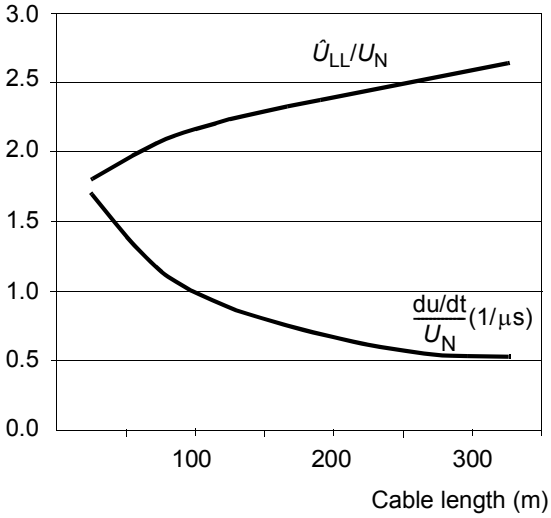
Note 7: *Resistor braking of the drive*

When the drive is in braking mode for a large part of its operation time, the intermediate circuit DC voltage of the drive increases, the effect being similar to increasing the supply voltage by up to 20 percent. The voltage increase should be taken into consideration when determining the motor insulation requirement.

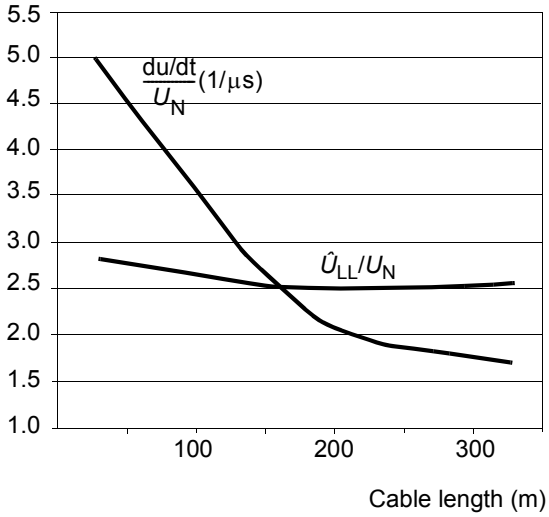
Example: Motor insulation requirement for a 400 V application must be selected as if the drive were supplied with 480 V.

Note 8: *Calculating the rise time and the peak line-to-line voltage*

The peak line-to-line voltage at the motor terminals generated by the drive as well as the voltage rise time depend on the cable length. The requirements for the motor insulation system given in the table are “worst case” requirements covering installations with 30 metre and longer cables. The rise time can be calculated as follows: $\triangle t = 0.8 \cdot \hat{U}_{LL}/(du/dt)$. Read $\hat{U}_{LL}$ and du/dt from the diagrams below. **Multiply** the values of the graph by the supply voltage (U_N). In case of drives with an IGBT supply unit or resistor braking, the $\hat{U}_{LL}$ and du/dt values are approximately 20 % higher.



With du/dt Filter



Without du/dt Filter

Note 9: Sine filters protect the motor insulation system. Therefore, du/dt filter can be replaced with a sine filter. The peak phase-to-phase voltage with the sine filter is approximately 1.5 × U_N.

Note 10: Common mode filter is available as a separate option.

Permanent magnet motor

Only one permanent magnet motor can be connected to the inverter output.

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

Supply connection

Disconnecting device

Install a hand-operated input disconnecting device between the AC power source and the drive. The disconnecting device must be of a type that can be locked to the open position for installation and maintenance work.

EU

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

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

US

The disconnecting device must conform to the applicable safety regulations.

Fuses

See section *Thermal overload and short-circuit protection*.

Main contactor

If used, dimension the contactor according to the nominal voltage and current of the drive. The utilization category (IEC 947-4) is AC-1.

Thermal overload and short-circuit protection

Thermal overload protection of the drive and the input and motor cables

The drive protects itself and the input and motor cables against thermal overload when the cables are dimensioned according to the nominal current of the drive. No additional thermal protection devices are needed.

WARNING! If the drive is connected to multiple motors, a separate thermal overload switch or a circuit breaker must be used for protecting each cable and motor. These devices may require a separate fuse to cut off the short-circuit current.

Thermal overload protection of the motor

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 user can tune the thermal model further by feeding in additional motor and load data.

The most common temperature sensors are:

- motor sizes IEC180…225: thermal switch (e.g. Klixon)
- motor sizes IEC200…250 and larger: PTC or Pt100.

See the firmware manual for more information on the motor thermal protection, and the connection and use of the temperature sensors.

Protection against short-circuit in the motor cable

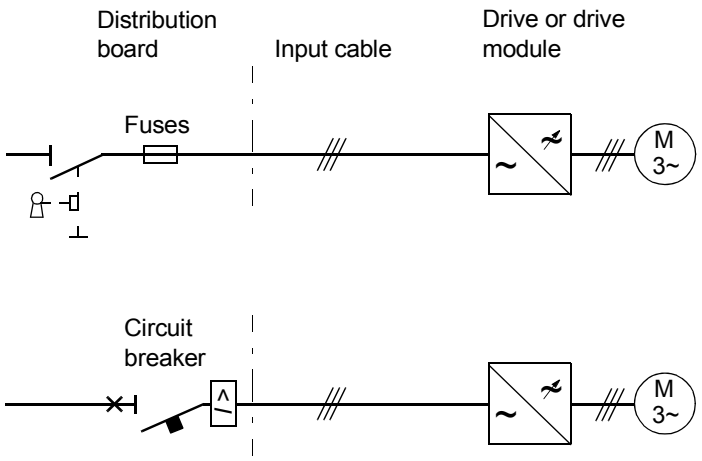
The drive protects the motor cable and motor in a short-circuit situation when the motor cable is dimensioned according to the nominal current of the drive. No additional protection devices are needed.

Protection against short-circuit inside the drive or in the supply cable

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

Circuit diagram

DRIVE IS NOT EQUIPPED WITH INPUT FUSES



Fuses

Size the fuses according to instructions given in chapter *Technical data*. The fuses will protect the input cable in short-circuit situations, restrict drive damage and prevent damage to adjoining equipment in case of a short-circuit inside the drive.Circuit breakers which have been tested by ABB with the ACS800 can be used. Fuses must be used with other circuit breakers. Contact your local ABB representative for the approved breaker types and supply network characteristics.

Circuit breaker

The protective characteristics of circuit breakers depend on the type, construction and settings of the breakers. There are also limitations pertaining to the short-circuit capacity of the supply network.

WARNING! Due to the inherent operating principle and construction of circuit breakers, independent of the manufacturer, hot ionized gases may escape from the breaker enclosure in case of a short-circuit. To ensure safe use, special attention must be paid to the installation and placement of the breakers. Follow the manufacturer's instructions.

Note: Circuit breakers must not be used without fuses in the USA.

Ground fault protection

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 is not a personal safety or a fire protection feature. The ground fault protective function can be disabled with a parameter, refer to the appropriate firmware manual.

The EMC filter of the drive includes capacitors connected between the main circuit and the frame. These capacitors and long motor cables increase the ground leakage current and may cause fault current circuit breakers to function.

Prevention of unexpected start-up (option +Q950)

The drive can be equipped with an optional Prevention of unexpected start-up function according to standards:

- IEC/EN 60204-1:1997,
- ISO/DIS 14118:2000,
- EN 1037:1996,
- EN ISO 12100:2003,
- EN 954-1:1996,
- EN ISO 13849-2:2003.

The Prevention of unexpected start-up (POUS) function disables the control voltage of the power semiconductors, thus preventing the drive from generating the AC voltage required to rotate the motor. By using this function, short-time operations (like cleaning) and/or maintenance work on non-electrical parts of the machinery can be performed without switching off the AC power supply to the drive.

The operator activates the Prevention of unexpected start-up function by opening a switch on a control desk. An indicating lamp on the control desk will light, signalling that the prevention is active. The switch can be locked out.

The user must install on a control desk near the machinery:

- switching/disconnecting device for the circuitry. “Means shall be provided to prevent inadvertent, and/or mistaken closure of the disconnecting device.” EN 60204-1:1997.
- indicating lamp; on = starting the drive is prevented, off = drive is operative.

For connections to the drive, see the circuit diagram delivered with the drive.

WARNING! The Prevention of unexpected start-up function does not disconnect the voltage of the main and auxiliary circuits from the drive. Therefore maintenance work on electrical parts of the drive or the motor can only be carried out after isolating the drive system from the main supply.

Note: The Prevention of unexpected start-up function is not intended for stopping the drive. If the Prevention of unexpected start-up function is activated when the drive is running, the control voltage of the power semiconductors is cut off and the motor coasts to a stop.

For detailed instructions for installation, start-up, use and maintenance of the function, see chapter *Installation of the AGPS board (Prevention of unexpected start-up, +Q950)*.

Safe torque off (option +Q967)

The drive supports the Safe torque off (STO) function according to standards:

- EN 61800-5-2:2007,
- EN ISO 13849-1:2008,
- IEC 61508,
- IEC 61511:2004,
- EN 62061:2005.

The function also corresponds to an uncontrolled stop in accordance with category 0 of EN 60204-1and Prevention of unexpected start-up of EN 1037.

The STO may be used where power removal is required to prevent an unexpected start. The function disables the control voltage of the power semiconductors of the drive output stage, thus preventing the drive from generating the voltage required to rotate the motor (see diagram below). By using this function, short-time operations (like cleaning) and/or maintenance work on non-electrical parts of the machinery can be performed without switching off the power supply to the drive.

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

Note: The Safe torque off function can be used for stopping the drive in emergency stop situations. In the normal operating mode, use the Stop command instead. If the Safe torque off function is activated when the drive is running, the control voltage of the power semiconductors is cut off and the motor coasts to a stop. If this is not acceptable, e.g. causes danger, the drive and machinery must be stopped using the appropriate stopping mode before using this function.

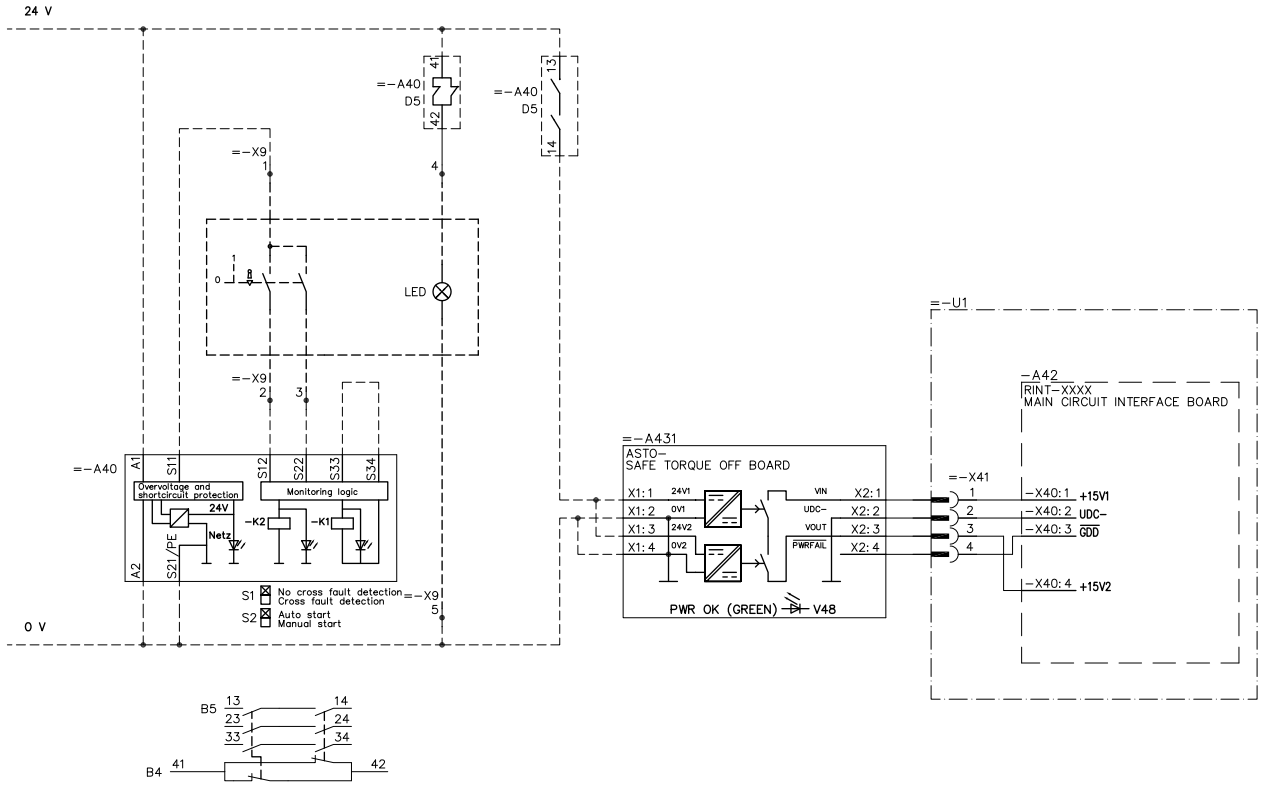
Note concerning permanent magnet motor drives in case of a multiple IGBT power semiconductor failure: In spite of the activation of the Safe torque off function, the drive system can produce an alignment torque which maximally rotates the motor shaft by 180/*p* degrees. *p* denotes the pole pair number.

For more information on the installation of the Safe torque off function, see chapter *Installation of the ASTO board (Safe torque off, +Q967)*.

For more information on the Safe torque off function and the relevant safety data, see *ACS800-01/04/11/31/104/104LC Safe torque off function (+Q967), Application guide* (3AUA0000063373 [English]).

An example circuit diagram is shown below.

Safe torque off circuit diagram



3AUA0000072271

Selecting the power cables

General rules

Dimension the mains (input power) and motor cables **according to local regulations**:

- The cable must be able to carry the drive load current. See chapter *Technical data* for the rated currents.
- The cable must be rated for at least 70 °C (158 °F) maximum permissible temperature of conductor in continuous use. For US, see *Additional US requirements*.
- The inductance and impedance of the PE conductor/cable (grounding wire) must be rated according to permissible touch voltage appearing under fault conditions (so that the fault point voltage will not rise excessively when a ground fault occurs).
- 600 V AC cable is accepted for up to 500 V AC. 750 V AC cable is accepted for up to 600 V AC. For 690 V AC rated equipment, the rated voltage between the conductors of the cable should be at least 1 kV.

For drive frame size R5 and larger, or motors larger than 30 kW (40 hp), symmetrical shielded motor cable must be used (figure below). A four-conductor system can be used up to frame size R4 with up to 30 kW (40 hp) motors, but shielded symmetrical motor cable is always recommended. The shield(s) of motor cable(s) must have 360° bonding at both ends.

Note: When continuous metal conduit is employed, shielded cable is not required. The conduit must have bonding at both ends as with cable shield.

A four-conductor system is allowed for input cabling, but shielded symmetrical cable is recommended. To operate as a protective conductor, the shield conductivity must be as follows when the protective conductor is made of the same metal as the phase conductors:

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

Compared to a four-conductor system, the use of symmetrical shielded cable reduces electromagnetic emission of the whole drive system as well as the stress on motor insulation, bearing currents and wear.

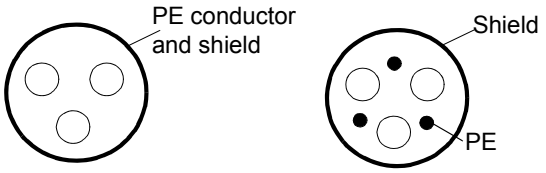
The motor cable and its PE pigtail (twisted shield) should be kept as short as possible in order to reduce high-frequency electromagnetic emission, as well as stray currents outside the cable and capacitive current (relevant in power range below 20 kW).

Alternative power cable types

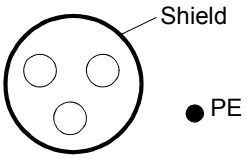
Power cable types that can be used with the drive are represented below.

Recommended

Symmetrical shielded cable: three phase conductors and a concentric or otherwise symmetrically constructed PE conductor, and a shield

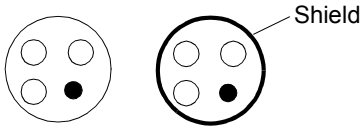


A separate PE conductor is required if the conductivity of the cable shield is < 50% of the conductivity of the phase conductor.



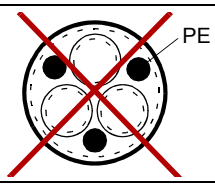
A four-conductor system: three phase conductors and a protective conductor

Not allowed for motor cables



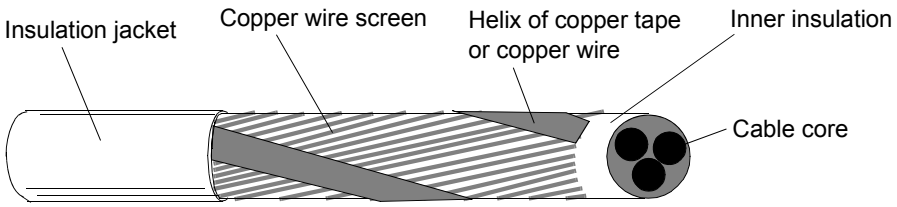
Not allowed for motor cables with phase conductor cross section larger than 10 mm^2 [motors > 30 kW (40 hp)].

The following power cable type is not allowed.

	Symmetrical shielded cable with individual shields for each phase conductor is not allowed on any cable size for input and motor cabling.

Motor cable shield

If the motor cable shield is used as the sole protective earth conductor of the motor, ensure that the conductivity of the shield is sufficient. See section *General rules* above, or IEC 61439-1. To effectively suppress radiated and conducted radio-frequency emissions, the shield conductivity must be at least 1/10 of the phase conductor conductivity. The requirements are easily met with a copper or aluminium 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.



Additional US requirements

Type MC continuous corrugated aluminum armor cable with symmetrical grounds or shielded power cable must be used for the motor cables if metallic conduit is not used. For the North American market, 600 V AC cable is accepted for up to 500 V AC. 1000 V AC cable is required above 500 V AC (below 600 V AC). For drives rated over 100 amperes, the power cables must be rated for 75 °C (167 °F).

Conduit

Separate parts of a conduit must be coupled together, bridge the joints with a ground conductor bonded to the conduit on each side of the joint. Bond the conduits also to the drive enclosure and motor frame. Use separate conduits for input power, motor, brake resistor, and control wiring. When conduit is employed, type MC continuous corrugated aluminium armor cable or shielded cable is not required. A dedicated ground cable is always required.

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

Armored cable / shielded power cable

Six conductor (3 phases and 3 ground) type MC continuous corrugated aluminum armor cable with symmetrical grounds is available from the following suppliers (trade names in parentheses):

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

Shielded power cables are available from Belden, LAPPKABEL (ÖLFLEX) and Pirelli.

Power factor compensation capacitors

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 three phase 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: Ensure that the connection steps are low enough not to cause voltage transients that would trip the drive.
3. Check that the power factor compensation unit is suitable for use in systems with AC drives i.e. harmonic generating loads. In such systems, the compensation unit should typically be equipped with a blocking reactor or harmonic filter.

Equipment connected to the motor cable

Installation of safety switches, contactors, connection boxes, etc.

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

- EU: Install the equipment in a metal enclosure with 360 degrees grounding for the shields of both the incoming and outgoing cable, or connect the shields of the cables otherwise together.
- US: Install the equipment in a metal enclosure in a way that the conduit or motor cable shielding runs consistently without breaks from the drive to the motor.

Bypass connection

WARNING! Never connect the supply power to the drive output terminals U2, V2 and W2. If frequent bypassing is required, employ mechanically connected switches or contactors. Mains (line) voltage applied to the output can result in permanent damage to the unit.

Using a contactor between the drive and the motor

Implementing the control of the output contactor depends on how you select the drive to operate.

When you have selected to use DTC motor control mode, and motor ramp stop, open the contactor as follows:

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

When you have selected to use DTC motor control mode, and motor coast stop, or scalar control mode, open the contactor as follows:

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

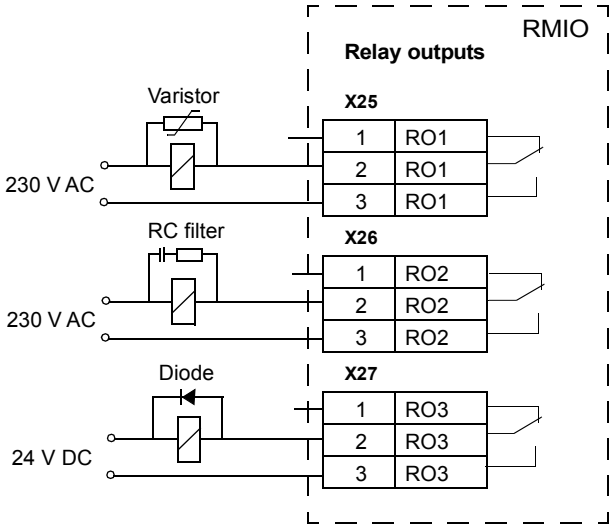
WARNING! When the DTC motor control mode is in use, never open the output contactor while the drive controls the motor. The DTC motor control operates extremely fast, much faster than it takes for the contactor to open its contacts. When the contactor starts opening while the drive controls the motor, the DTC control will try to maintain the load current by immediately increasing the drive output voltage to the maximum. This will damage, or even burn the contactor completely.

Protecting the relay output contacts and attenuating disturbances in case of inductive loads

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

The relay contacts on the RMIO board are protected with varistors (250 V) against overvoltage peaks. In spite of this, it is highly recommended to equip inductive loads with noise attenuating circuits [varistors, RC filters (AC) or diodes (DC)] in order to minimize the EMC emission at switch-off. If not suppressed, the disturbances may connect capacitively or inductively to other conductors in the control cable and form a risk of malfunction in other parts of the system.

Install the protective component as close to the inductive load as possible. Do not install protective components at the RMIO board terminal block.

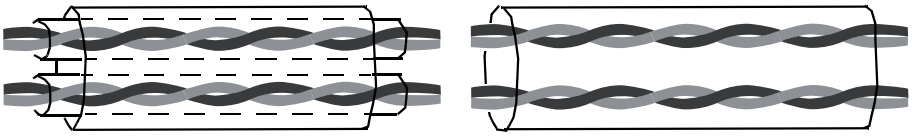


Selecting the control cables

All control cables must be shielded.

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

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



a
A double-shielded twisted pair cable

b
A single-shielded twisted pair cable

Run analogue and digital signals in separate, shielded cables.

Relay-controlled signals, providing their voltage does not exceed 48 V, can be run in the same cables as digital input signals. It is recommended that the relay-controlled signals be run as twisted pairs.

Never mix 24 V DC and 115/230 V AC signals in the same cable.

Relay cable

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

Control panel cable

In remote use, the cable connecting the control panel to the drive must not exceed 3 metres (10 ft). The cable type tested and approved by ABB is used in control panel option kits.

Connection of a motor temperature sensor to the drive I/O

WARNING! IEC 60664 requires double or reinforced insulation between live parts and the surface of accessible parts of electrical equipment which are either non-conductive or conductive but not connected to the protective earth.

To fulfil this requirement, the connection of a thermistor (and other similar components) to the digital inputs of the drive can be implemented in three alternate ways:

1. There is double or reinforced insulation between the thermistor and live parts of the motor.
2. Circuits connected to all digital and analogue inputs of the drive are protected against contact and insulated with basic insulation (the same voltage level as the drive main circuit) from other low voltage circuits.
3. An external thermistor relay is used. The insulation of the relay must be rated for the same voltage level as the main circuit of the drive. For connection, see the firmware manual.

Installation sites above 2000 metres (6562 feet)

WARNING! Protect against direct contact when installing, operating and servicing the RMIO board wiring and option modules attached to the board. The Protective Extra Low Voltage (PELV) requirements stated in EN 50178 are not fulfilled at altitudes above 2000 m (6562 ft).

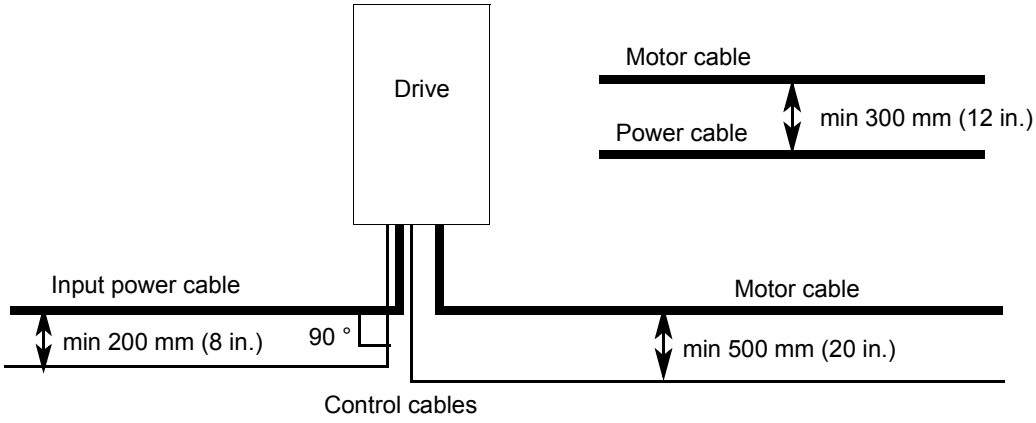
Routing the cables

Route the motor cable away from other cable routes. Motor cables of several drives can be run in parallel installed next to each other. It is recommended that the motor cable, input power cable and control cables be installed on separate trays. Avoid long parallel runs of motor cables with other cables in order to decrease electromagnetic interference caused by the rapid changes in the drive output voltage.

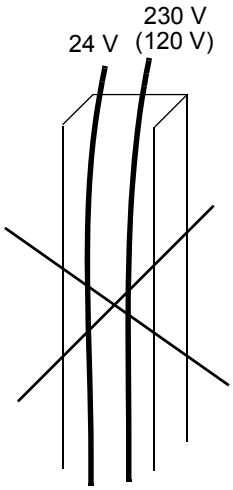
Where control cables must cross power cables make sure they are arranged at an angle as near to 90 degrees as possible. Do not run extra cables through the drive.

The cable trays must have good electrical bonding to each other and to the grounding electrodes. Aluminium tray systems can be used to improve local equalizing of potential.

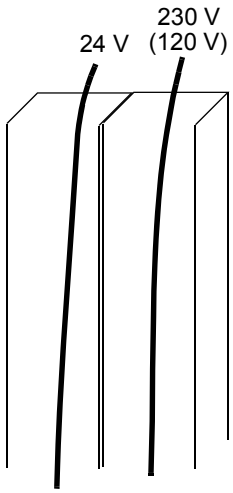
A diagram of the cable routing is shown below.



Control cable ducts



Not allowed unless the 24 V cable is insulated for 230 V (120 V) or insulated with an insulation sleeving for 230 V (120 V).



Lead 24 V and 230 V (120 V) control cables in separate ducts inside the cabinet.

Electrical installation

What this chapter contains

This chapter describes the electrical installation procedure of the drive.

WARNING! The work described in this chapter may only be carried out by a qualified electrician. Follow the *Safety instructions* on the first pages of this manual. Ignoring the safety instructions can cause injury or death.

Make sure that the drive is disconnected from the mains (input power) during installation. If the drive is already connected to the mains, wait for 5 min after disconnecting mains power.

Checking the insulation of the installation

Drive

Do not make any voltage tolerance or insulation resistance tests on any part of the drive as testing can damage the drive. Every drive has been tested for insulation between the main circuit and the chassis at the factory. Also, there are voltage-limiting circuits inside the drive which cut down the testing voltage automatically.

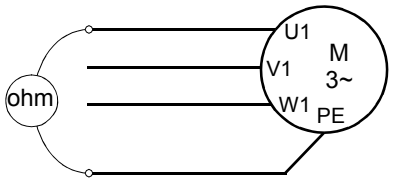
Supply cable

Check the insulation of the supply (input) cable according to local regulations before connecting to the drive.

Motor and motor cable

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

1. Check that the motor cable is connected to the motor, and disconnected from the drive output terminals U2, V2 and W2.
2. Measure the insulation resistance between each phase conductor and the Protective Earth conductor using a measuring voltage of 1000 V DC. The insulation resistance of an ABB motor must exceed 100 Mohm (reference value at 25 °C or 77 °F). For the insulation resistance of other motors, please consult the manufacturer's instructions. **Note:** Moisture inside the motor casing will reduce the insulation resistance. If moisture is suspected, dry the motor and repeat the measurement.



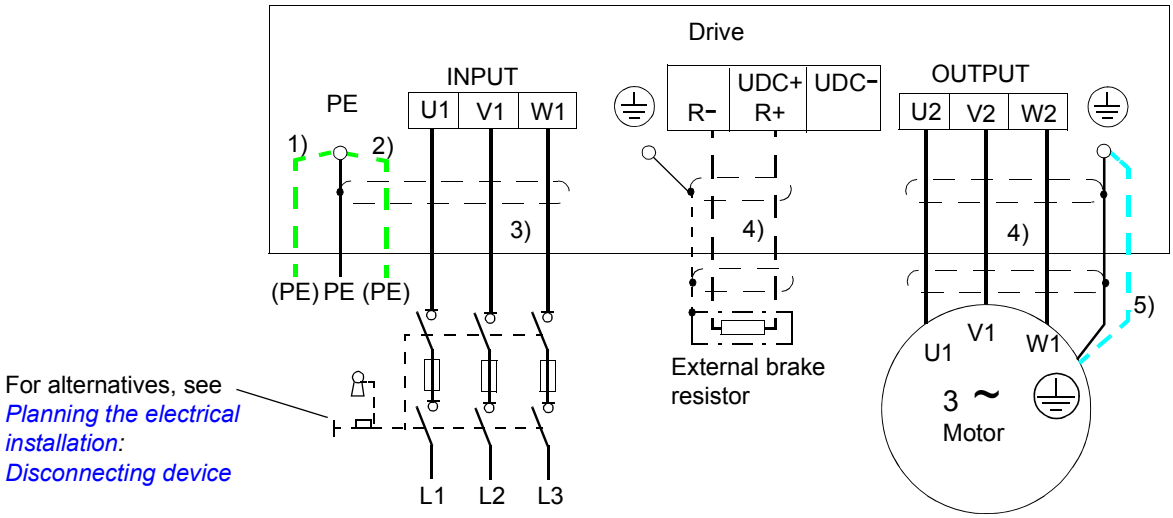
IT (ungrounded) systems

In units with EMC filter options (+E202 or +E200 in the type code), disconnect the filter capacitors before connecting the drive to an ungrounded system. For detailed instructions, see *ACS800-01, -U1, -04 frames R2-R6 EMC filter disconnection* (3AXD00000168163 [English]).

WARNING! If a drive with EMC filter selection +E202 or +E200 is installed on an IT system [an ungrounded power system or a high resistance-grounded (over 30 ohms) power system], the system will be connected to earth potential through the EMC filter capacitors of the drive. This may cause danger or damage the unit.

Connecting the power cables

Diagram



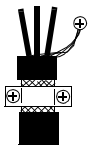
1), 2)

If shielded cable is used (not required but recommended), use a separate PE cable (1) or a cable with a grounding conductor (2) if the conductivity of the input cable shield is < 50% of the conductivity of the phase conductor.

Ground the other end of the input cable shield or PE conductor at the distribution board.

3) 360 degrees grounding recommended if shielded cable

4) 360 degrees grounding required



5) Use a separate grounding cable if the conductivity of the cable shield is < 50% of the conductivity of the phase conductor and there is no symmetrically constructed grounding conductor in the cable (see *Planning the electrical installation*: *Selecting the power cables*).

Note:

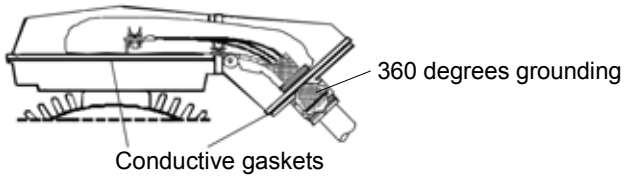
If there is a symmetrically constructed grounding conductor in the motor cable in addition to the conductive shield, connect the grounding conductor to the grounding terminal at the drive and motor ends.

Do not use an asymmetrically constructed motor cable for motors > 30 kW (40 hp). Connecting its fourth conductor at the motor end increases bearing currents and causes extra wear.

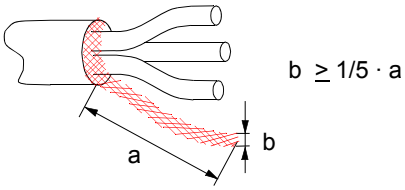
Grounding of the motor cable shield at the motor end

For minimum radio frequency interference:

- ground the cable shield 360 degrees at the lead-through of the motor terminal box



- or ground the cable by twisting the shield as follows: flattened width ≥ 1/5 · length.



Conductor stripping lengths

Strip the conductor ends as follows to fit them inside the power cable connection terminals.

Frame size	Stripping length	
	mm	in.
R2, R3	10	0.39
R4, R5	16	0.63
R6	28	1.10

Allowed wire sizes, tightening torques

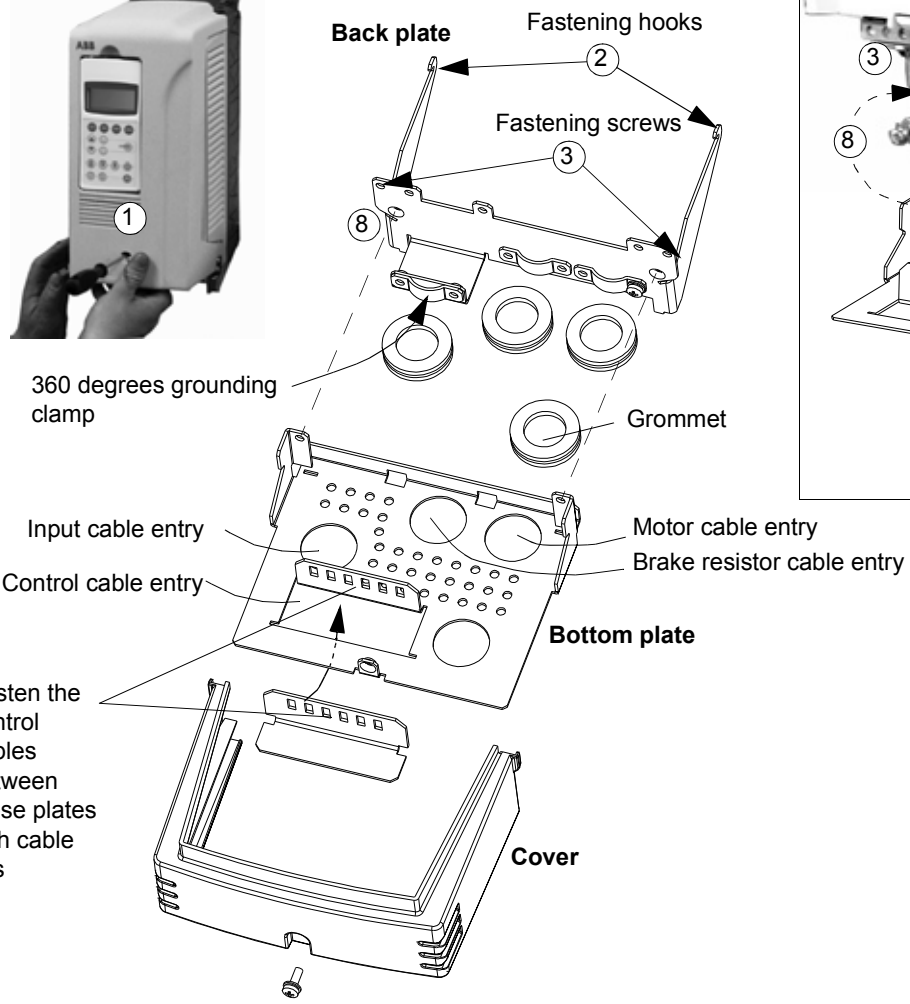
See *Technical data*: *Cable entries*.

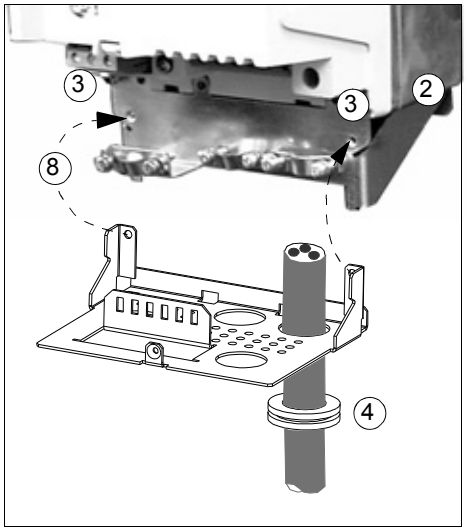
Wall installed units (European version)

Power cable installation procedure

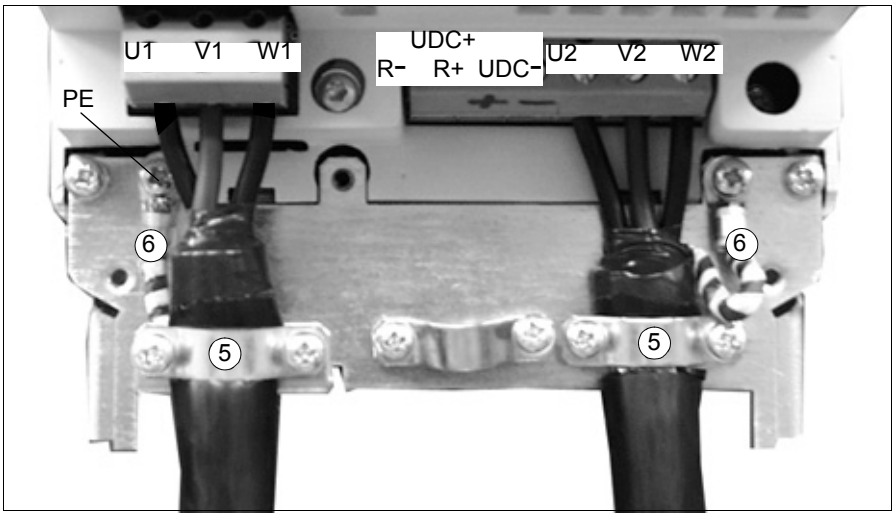
1. Remove the front cover (in frame size R6 the lower front cover) by releasing the retaining clip with a screw driver and lifting the cover from the bottom outwards. For IP55 units, see *Mechanical installation: Mounting the drive on the wall*.
2. Slide the back plate of the connection box to the holes below the drive.
3. Fasten the back plate to the drive frame with two screws / three screws in frame size R6.
4. Cut adequate holes into the rubber grommets and slide the grommets onto the cables. Slide the cables through the holes of the bottom plate.
5. Strip off the plastic sheath of the cable under the 360 degrees grounding clamp. Fasten the clamp onto the stripped part of the cable.
6. Connect the twisted shield of the cable to the grounding terminal. **Note:** Cable lugs are needed in frame sizes R2 and R3.
7. Connect the phase conductors of the mains cable to the U1, V1 and W1 terminals and the phase conductors of the motor cable to the U2, V2 and W2 terminals.
8. Fasten the bottom plate of the connection box with two screws to the already fastened back plate and slide the grommets into their place.
9. Secure the cables outside the unit mechanically. Connect the control cables as described in section *Connecting the control cables*. Fasten the covers (see *Fastening the control cables and covers*).

Connection box (IP21)





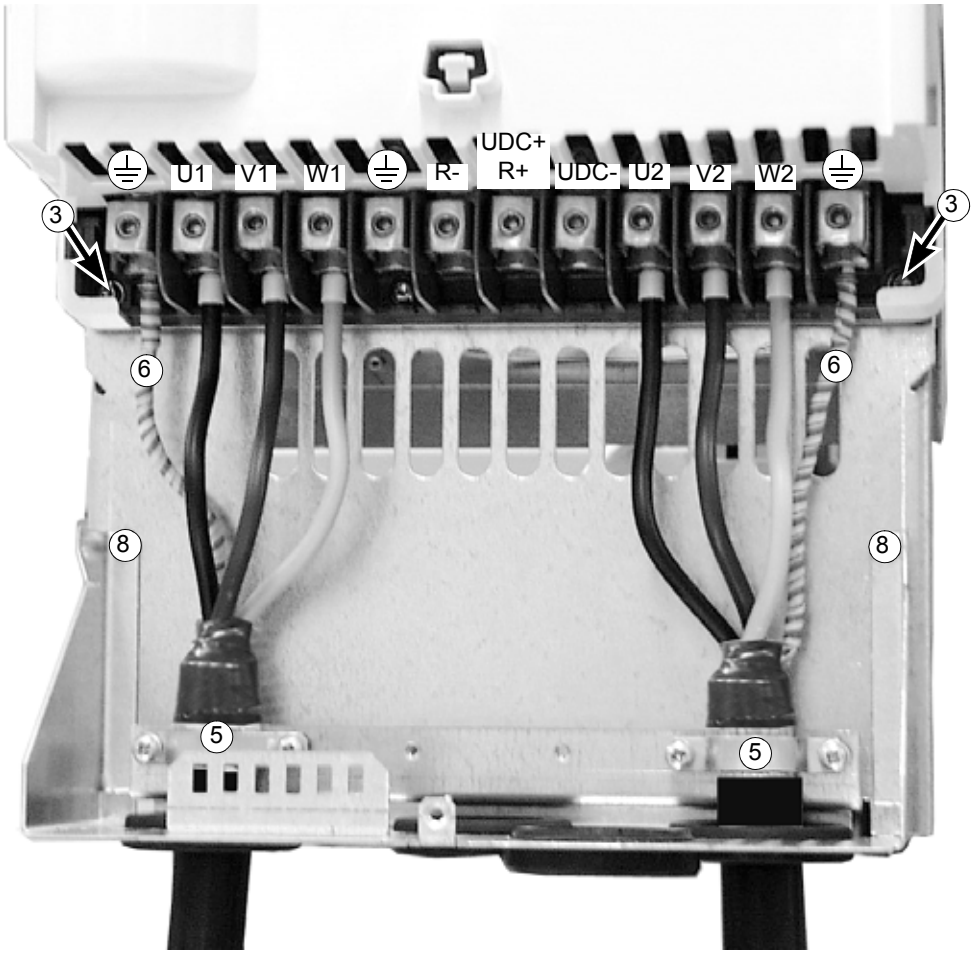
Frame sizes R2 to R4



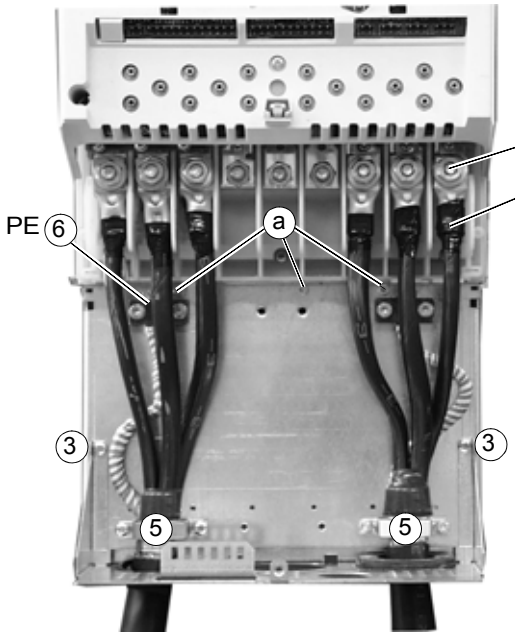
Input power cable

Motor cable

Frame size R5



Frame size R6: Cable lug installation [16 to 70 mm^2 (6 to 2/0 AWG) cables]

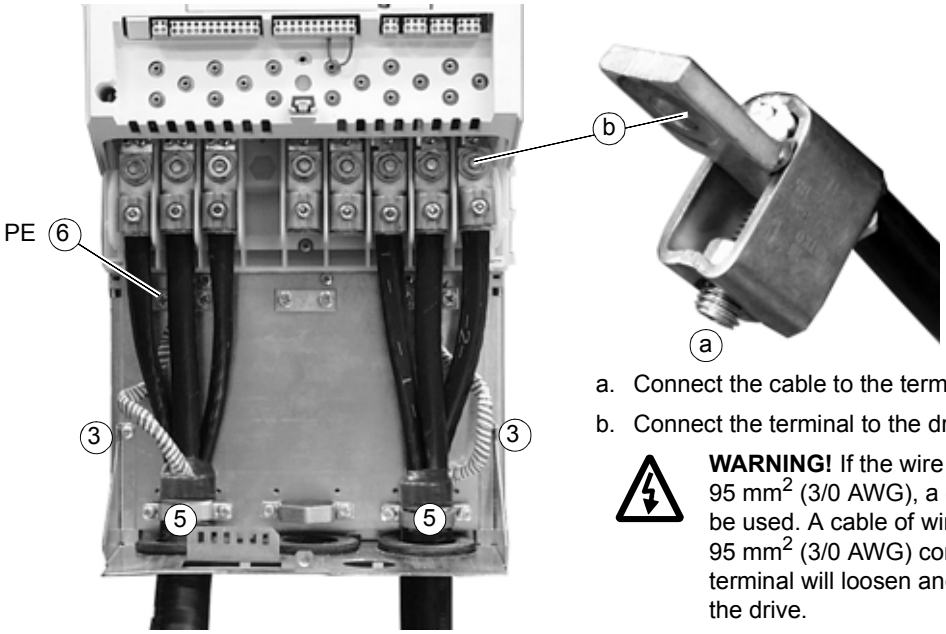


Remove the screw terminals. Fasten the cable lugs to the remaining bolts with M10 nuts.

Isolate the ends of the cable lugs with insulating tape or shrink tubing.

(a) Connection plate fastening screws

Frame size R6: Cable terminal installation [95 to 240 mm^2 (3/0 to 500 MCM) cables]



a. Connect the cable to the terminal.

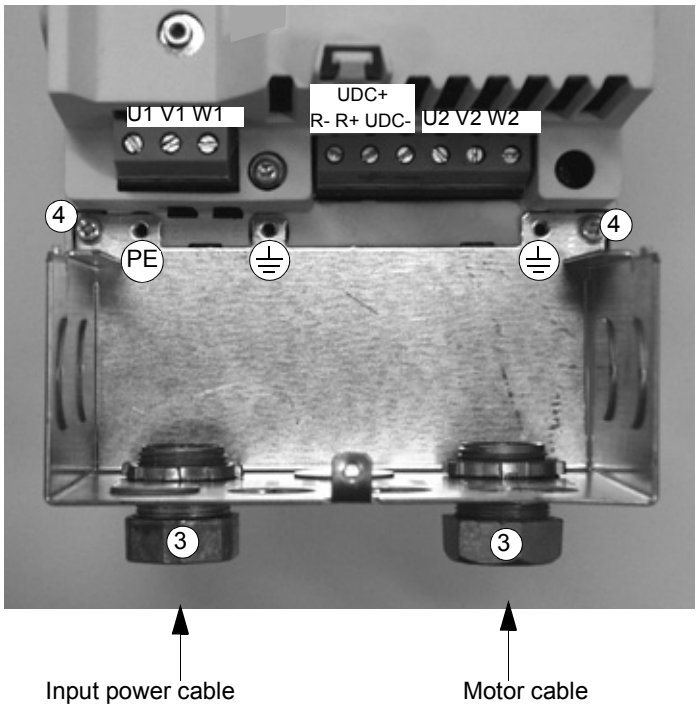
b. Connect the terminal to the drive.

WARNING! If the wire size is less than 95 mm^2 (3/0 AWG), a cable lug must be used. A cable of wire size less than 95 mm^2 (3/0 AWG) connected to this terminal will loosen and may damage the drive.

Wall installed units (US version)

1. Remove the front cover (in frame size R6 the lower front cover) by releasing the retaining clip with a screw driver and lifting the cover from the bottom outwards.
2. Make the cable entry holes in the gland box by breaking off the suitable knock-out plates with a screw driver.
3. Fasten the cable glands to the opened holes of the gland box.
4. Fasten the gland box to the frame with two screws / three screws in frame size R6.

Frame sizes R2 to R4



5. Lead the cables through the glands to the inside of the gland box.
6. Connect the PE conductors of the input and motor cables to the grounding terminal. **Note:** cable lugs are needed in frame sizes R2 and R3. Connect the separate PE conductor (if used) to the grounding terminal.
7. Connect the phase conductors of the input cable to the U1, V1 and W1 terminals and the phase conductors of the motor cable to the U2, V2 and W2 terminals.

   For frame size R6, see *Wall installed units (European version)* / figures for frame size R6. In case of a cable lug installation, use UL listed cable lugs and tools given below or corresponding to meet UL requirements.

Wire size	Compression lug		Crimping tool		
MCM/AWG	Manufacturer	Type	Manufacturer	Type	No. of crimps
6	Burndy	YAV6C-L2	Burndy	MY29-3	1
	Ilsco	CCL-6-38	Ilsco	ILC-10	2
4	Burndy	YA4C-L4BOX	Burndy	MY29-3	1
	Ilsco	CCL-4-38	Ilsco	MT-25	1
2	Burndy	YA2C-L4BOX	Burndy	MY29-3	2
	Ilsco	CRC-2	Ilsco	IDT-12	1
	Ilsco	CCL-2-38	Ilsco	MT-25	1
1	Burndy	YA1C-L4BOX	Burndy	MY29-3	2
	Ilsco	CRA-1-38	Ilsco	IDT-12	1
	Ilsco	CCL-1-38	Ilsco	MT-25	1
	Thomas & Betts	54148	Thomas & Betts	TBM-8	3
1/0	Burndy	YA25-L4BOX	Burndy	MY29-3	2
	Ilsco	CRB-0	Ilsco	IDT-12	1
	Ilsco	CCL-1/0-38	Ilsco	MT-25	1
	Thomas & Betts	54109	Thomas & Betts	TBM-8	3
2/0	Burndy	YAL26T38	Burndy	MY29-3	2
	Ilsco	CRA-2/0	Ilsco	IDT-12	1
	Ilsco	CCL-2/0-38	Ilsco	MT-25	1
	Thomas & Betts	54110	Thomas & Betts	TBM-8	3

8. Tighten the clamping nuts of the cable glands.

After connecting the control cables, fasten the front covers.

Warning sticker

There are warning stickers in different languages inside the packing box of the drive. Attach a warning sticker in the language of your choice onto the plastic skeleton above the power cable terminals.

Cabinet installation (IP21, UL type 1)

The drive can be installed in a cabinet without the connection box and front cover.

It is recommended:

- to ground the cable shield 360 degrees at the cabinet entry
- to lead the cable unstripped as close to the terminals as possible.

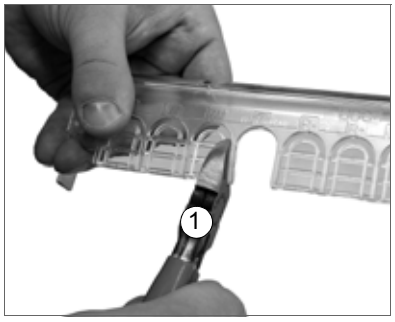
Secure the cables mechanically.

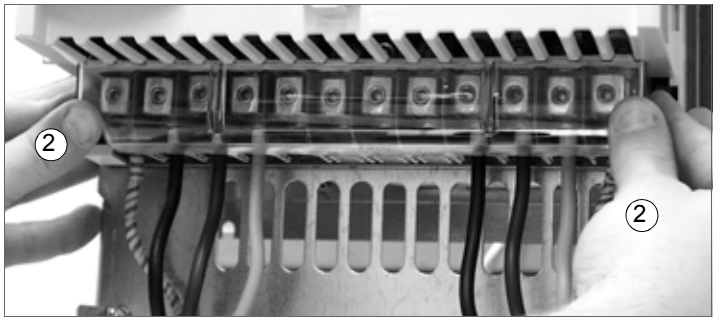
Protect the RMIO board terminals X25 to X27 against contact when input voltage exceeds 50 V AC.

Frame size R5

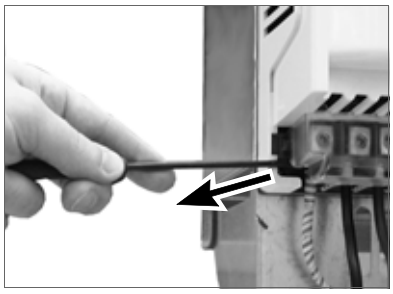
Cover the power cable terminals as follows:

1. Cut holes for the installed cables into the clear plastic shroud.
2. Press the shroud onto the terminals.





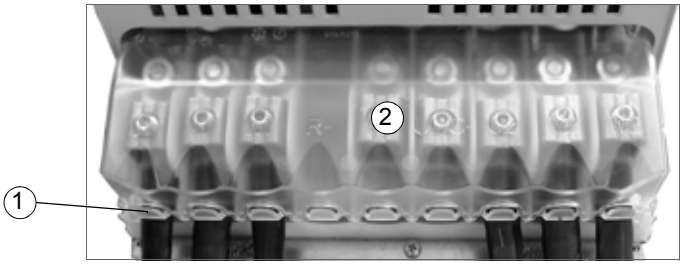
Removal of the shroud with a screw driver:



Frame size R6

Cover the power cable terminals as follows:

1. Cut holes for the installed cables into the clear plastic shroud in cable lug installations.
2. Press the shroud onto the terminals.



View of cable terminal installation

Removal of the shroud by lifting up with a screw driver from the corner:

Connecting the control cables

Lead the cable through the control cable entry (1).

Connect the control cables as described below. Connect the conductors to the appropriate detachable terminals of the RMIO board [refer to chapter *Motor control and I/O board (RMIO)*]. Tighten the screws to secure the connection.

Terminals

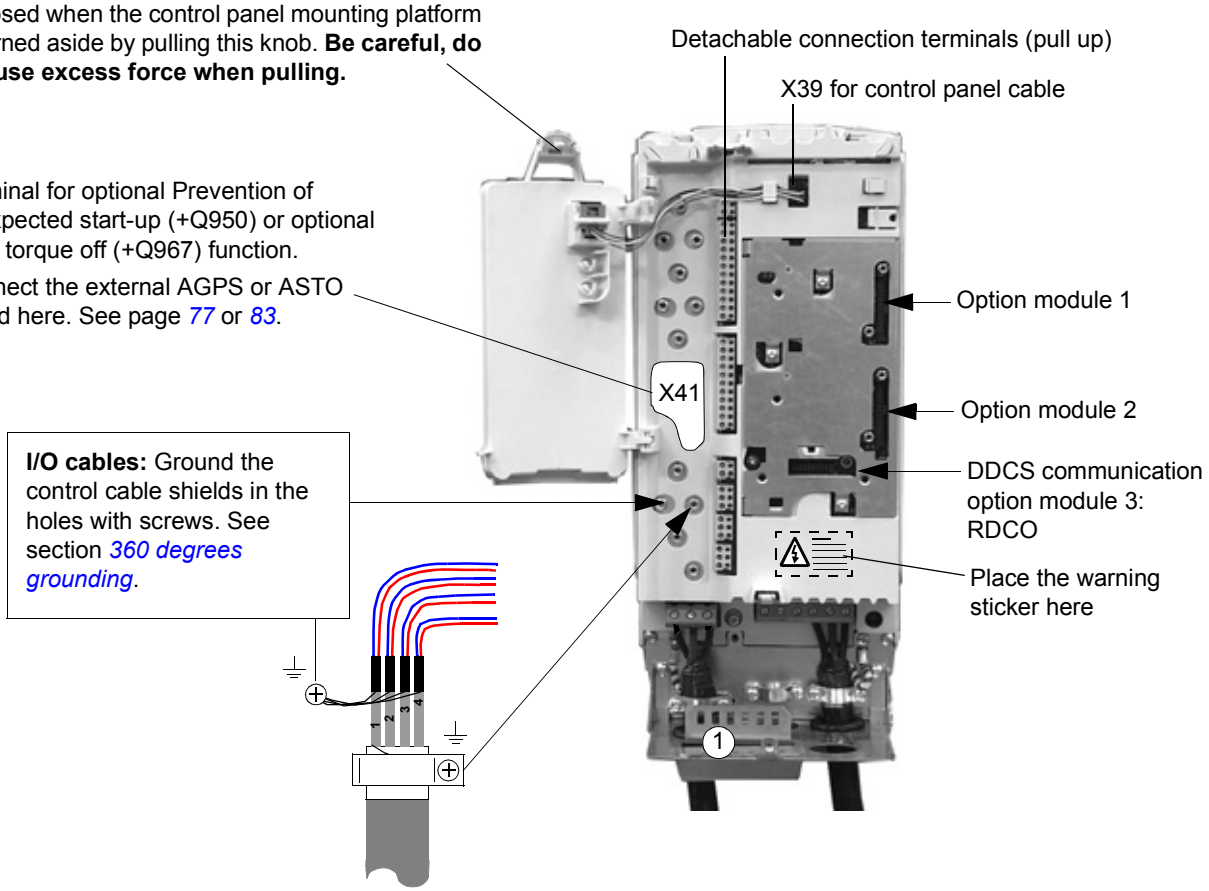
Frame sizes R2 to R4

The control cable connection terminals are exposed when the control panel mounting platform is turned aside by pulling this knob. **Be careful, do not use excess force when pulling.**

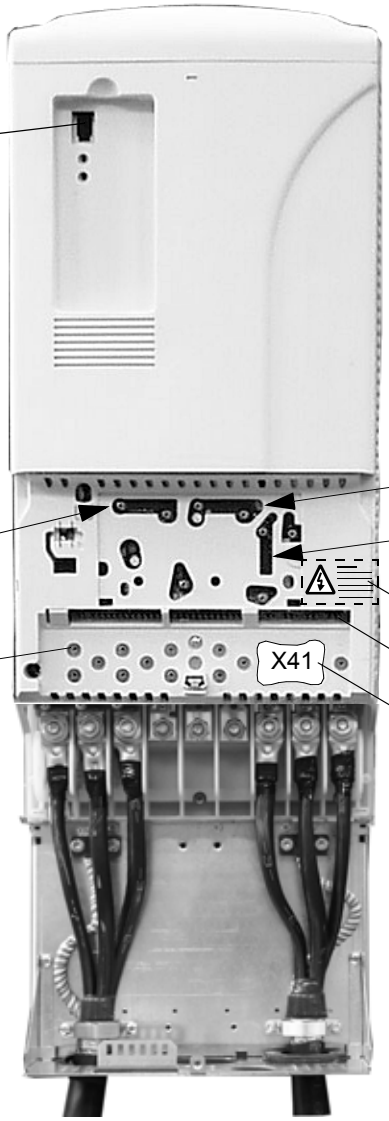
Terminal for optional Prevention of unexpected start-up (+Q950) or optional Safe torque off (+Q967) function.

Connect the external AGPS or ASTO board here. See page *77* or *83*.

I/O cables: Ground the control cable shields in the holes with screws. See section *360 degrees grounding*.



Frame sizes R5 and R6



View of frame size R6

Control panel

Option module 2

Option module 1

DDCS communication option module 3: RDCO

Place the warning sticker here

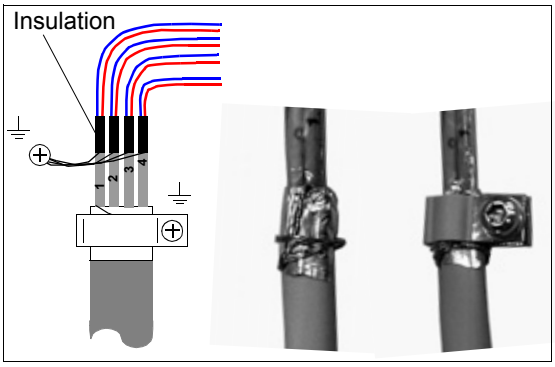
Control cable grounding: see section *360 degrees grounding*

Detachable connection terminals (pull up)

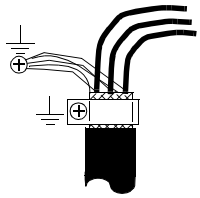
Terminal for optional Prevention of unexpected start-up (+Q950) or optional Safe torque off (+Q967) function.

Connect the external AGPS or ASTO board here. See page *77* or *83*.

360 degrees grounding



Double-shielded cable



Single-shielded cable

When the outer surface of the shield is covered with non-conductive material:

- Strip the cable carefully (do not cut the grounding wire and the shield)
- Turn the shield inside out to expose the conductive surface.
- Wrap the grounding wire around the conductive surface.
- Slide a conductive clamp onto the conductive part.
- Fasten the clamp to the grounding plate with a screw as close as possible to the terminals where the wires are about to be connected.

Connecting the shield wires

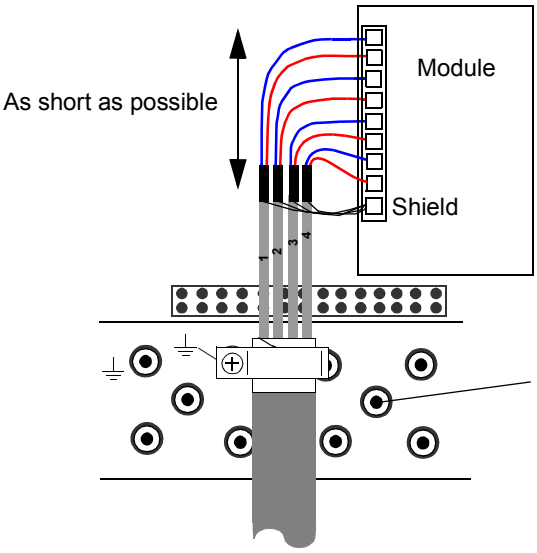
Single-shielded cables: Twist the grounding wires of the outer shield and connect them through the shortest possible route to the nearest grounding hole with a cable lug and a screw. Double-shielded cables: Connect each pair cable shield (twisted grounding wires) with other pair cable shields of the same cable to the nearest grounding hole with a cable lug and a screw.

Do not connect shields of different cables to the same cable lug and grounding screw.

Leave the other end of the shield unconnected or ground it indirectly via a few nanofarads high-frequency capacitor (e.g. 3.3 nF / 630 V). The shield can also be grounded directly at both ends if they are *in the same ground line* with no significant voltage drop between the end points.

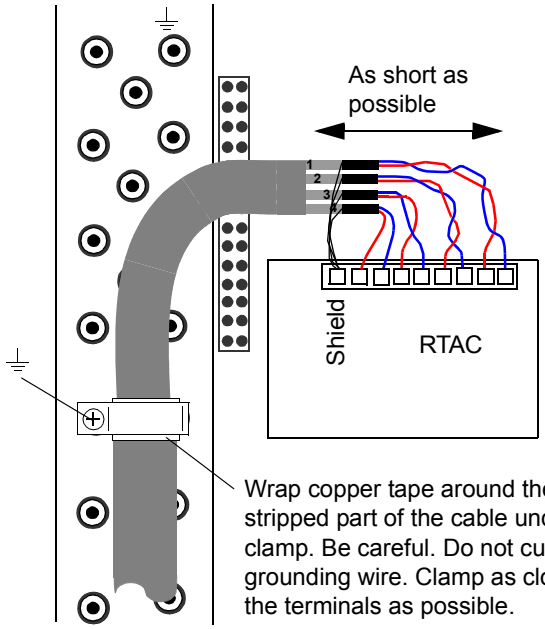
Keep the signal wire pairs twisted as close to the terminals as possible. Twisting the wire with its return wire reduces disturbances caused by inductive coupling.

Cabling of I/O and fieldbus modules



Note: The RDIO module does not include a terminal for cable shield grounding. Ground the pair cable shields here.

Pulse encoder module cabling



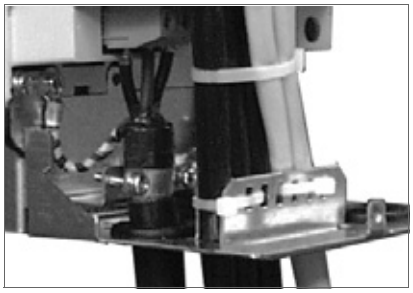
Wrap copper tape around the stripped part of the cable under the clamp. Be careful. Do not cut the grounding wire. Clamp as close to the terminals as possible.

Note 1: If the encoder is of unisolated type, ground the encoder cable at the drive end only. If the encoder is galvanically isolated from the motor shaft and the stator frame, ground the encoder cable shield at the drive and the encoder end.

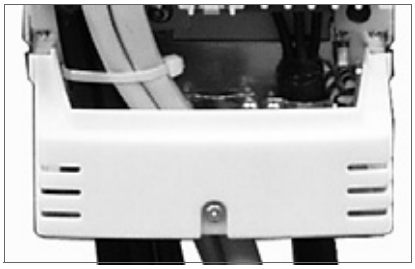
Note 2: Twist the pair cable wires.

Fastening the control cables and covers

When all control cables are connected, fasten them together with cable ties. Units with a connection box: fasten the cables to the entry plate with cable ties. Units with a gland box: tighten the clamping nuts of the cable glands.



Fasten the connection box cover.



Replace the front cover.

Installation of option modules and PC

Option modules (such as fieldbus adapter, I/O extension module and the pulse encoder interface) are inserted in the option module slots of the RMIO board (see *Connecting the control cables*) and fixed with two screws. See the appropriate option module manual for cable connections.

Fibre optic link

A DDCS fibre optic link is provided via the RDCO option module for PC tools, master/follower link and the AIMA-01 I/O module adapter. See chapter *RDCO-01/02/03/04 DDCS communication option modules* on page *169* for the connections. Observe colouring codes when installing fibre optic cables. Blue connectors go to blue terminals, and grey connectors to grey terminals.

Installation of the AGPS board (Prevention of unexpected start-up, +Q950)

What this chapter contains

This chapter describes electrical installation of the optional Prevention of unexpected start-up function (+Q950) of the drive, and gives instructions for starting up, validating and using the function.

Prevention of unexpected start-up (+Q950)

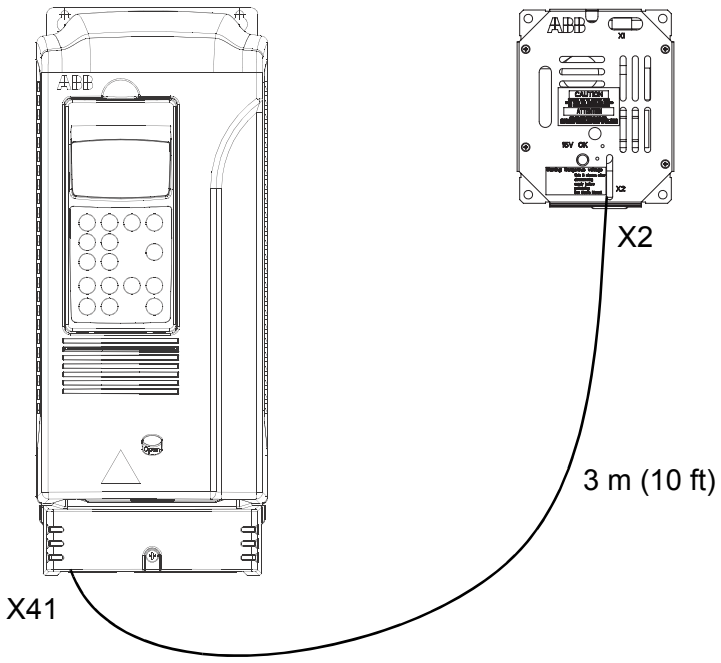
The optional Prevention of unexpected start-up function includes an external AGPS board which is connected to the drive and an external power supply. See also chapter *Prevention of unexpected start-up (option +Q950)*, page *48*.

Installation of the AGPS board

WARNING! Dangerous voltages can be present on the AGPS board even when the 115...230 V AC supply is switched off. Follow the *Safety instructions* on the first pages of this manual and the instruction in this chapter when working on the AGPS board.
Make sure that the drive is disconnected from the mains (input power) and the 115...230 V AC source for the AGPS board is switched off during installation and maintenance. If the drive is already connected to the mains, wait for 5 min after disconnecting mains power.

WARNING! The supply voltage for the AGPS board is 230 V AC. If the board is supplied with 24 V DC, the board is damaged and it needs to be replaced.

The following figure shows how the external AGPS board is connected to the drive. The cable (length 3 m [10 ft]) is delivered with the AGPS board.



See

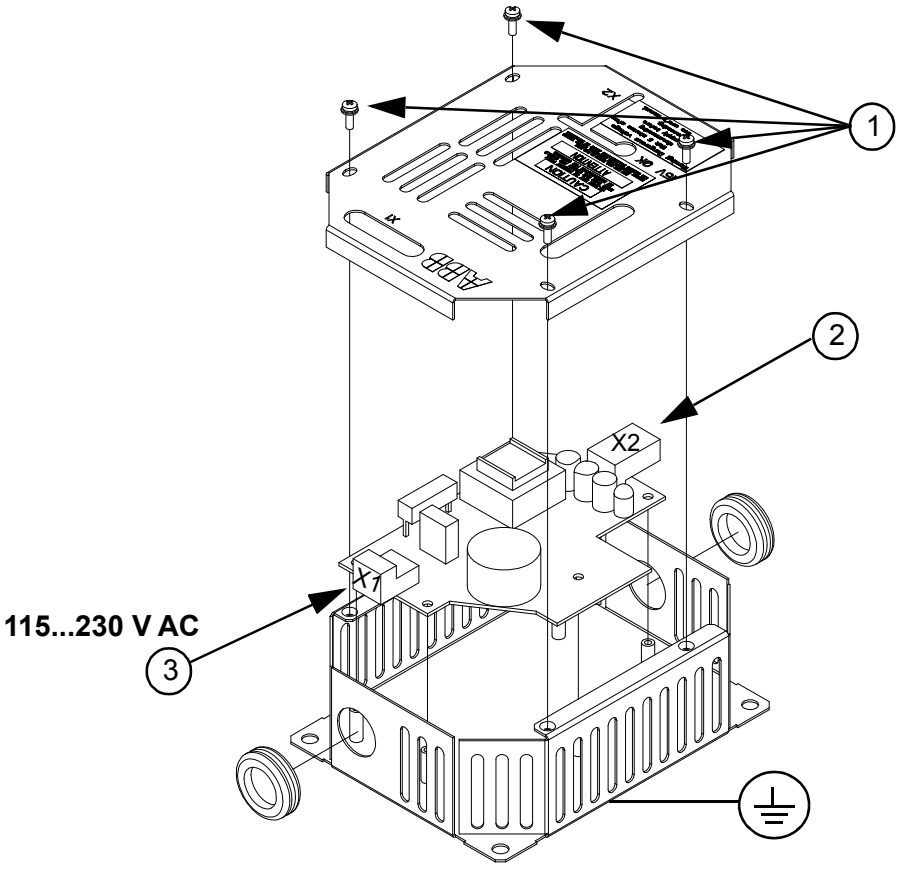
- page *72* for location of terminal X41 of the drive
- page *80* for the circuit diagram
- page *157* for the dimensions of the AGPS board
- page *124* for the technical data of the AGPS-11C board.

Connect the AGPS board as follows:

- Remove the enclosure cover by undoing the fixing screws (1).
- Ground the unit via the bottom plate of the enclosure or via terminal X1:1 of the AGPS board.
- Connect the cable delivered with the kit between terminal X2 of the AGPS board (2) and drive terminal X41.

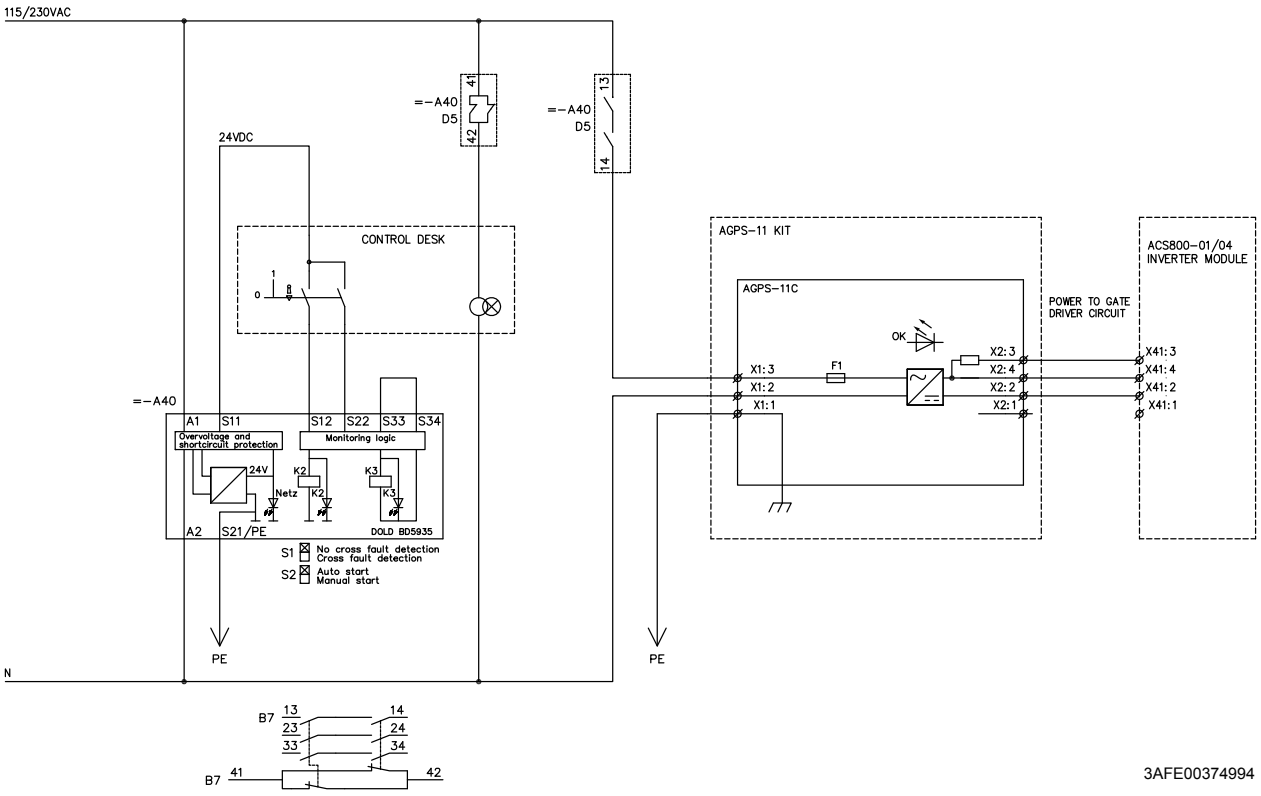
WARNING! Use only the AGPS cable delivered with the kit. Using another cable or modifying the cable may cause a malfunction of the drive.

- Connect a cable between connector X1 of the AGPS board (3) and the 115...230 V AC source.
- Fasten the enclosure cover back with screws.



Circuit diagram

This circuit diagram shows how the AGPS-11 kit is installed.



Start-up and validation

	Action
☐	Follow the safety instructions, see section *Safety instructions* on page *5*.
☐	Ensure that the drive can be run and stopped freely during the start-up.
☐	Stop the drive (if running), switch the input power off and isolate the drive from the power line by a disconnector.
☐	Check the Prevention of unexpected start-up circuit connections against the circuit diagram.
☐	Close the disconnector and switch the power on.
☐	Test the operation of the Prevention of unexpected start-up function when the motor is stopped: • Give a stop command for the drive (if running) and wait until the motor shaft is at standstill. • Activate the Prevention of unexpected start-up function and give a start command for the drive. • Ensure that the drive does not start and the motor stays at standstill. • Deactivate the Prevention of unexpected start-up function.

Use

Activate the function as follows:

- Stop the drive. Use the stop key of the panel (local mode) or give the stop command through the I/O or fieldbus interface.
- Open the switch activating the Prevention of unexpected start-up function of the drive. -> The indication lamp (if installed) is lit.
- Lock the switch to the open position.
- Before starting the work on the machinery, ensure that the motor shaft is at standstill (not freely rotating).

Inactivate the function in reverse order.

Maintenance

After the operation of the circuit is validated at start-up, it does not need any maintenance. However, it is a good practice to check the operation of the function when other maintenance routines of the machinery are carried out.

Dimensional drawing

See page *157*.

Installation of the ASTO board (Safe torque off, +Q967)

What this chapter contains

This chapter describes the electrical installation of the optional Safe torque off function (+Q967) of the drive and the specifications of the board.

Safe torque off (+Q967)

The optional Safe torque off function includes an external ASTO board, which is connected to the drive and an external power supply.

For more information on the Safe torque off function, see section *Safe torque off (option +Q967)* on page *49* and *ACS800-01/04/11/31/104/104LC Safe torque off function (+Q967), Application guide* (3AUA0000063373 [English]).

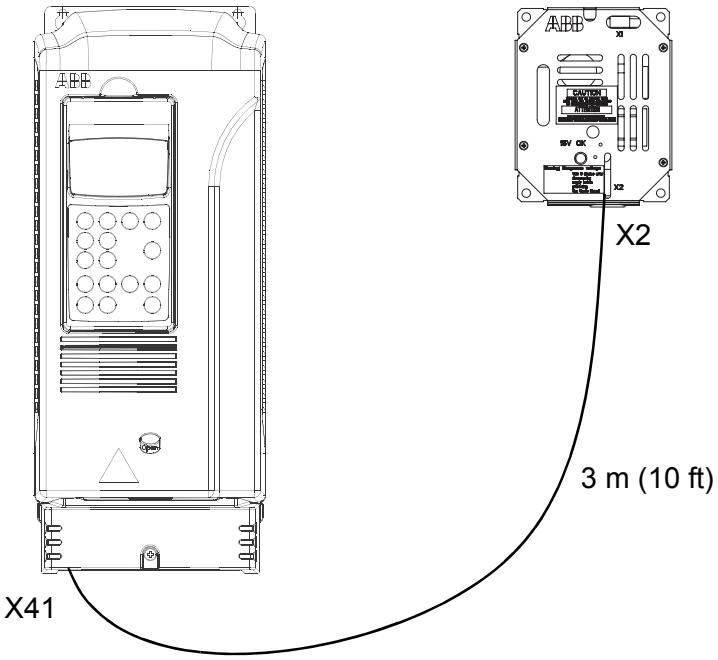
Installation of the ASTO board

WARNING! Dangerous voltages can be present at the ASTO board even when the 24 V DC supply is switched off. Follow the *Safety instructions* on the first pages of this manual and the instruction in this chapter when working on the ASTO board.

Make sure that the drive is disconnected from the mains (input power) and the 24 V DC source for the ASTO board is switched off during installation and maintenance. If the drive is already connected to the mains, wait for 5 min after disconnecting mains power.

WARNING! The supply voltage for the ASTO-11C board is 24 V DC. If the board is supplied with 230 V AC, the board is damaged and it needs to be replaced.

The following figure shows how the external ASTO board is connected the drive. The cable (length 3 m [10 ft]) is delivered with the ASTO board.



See

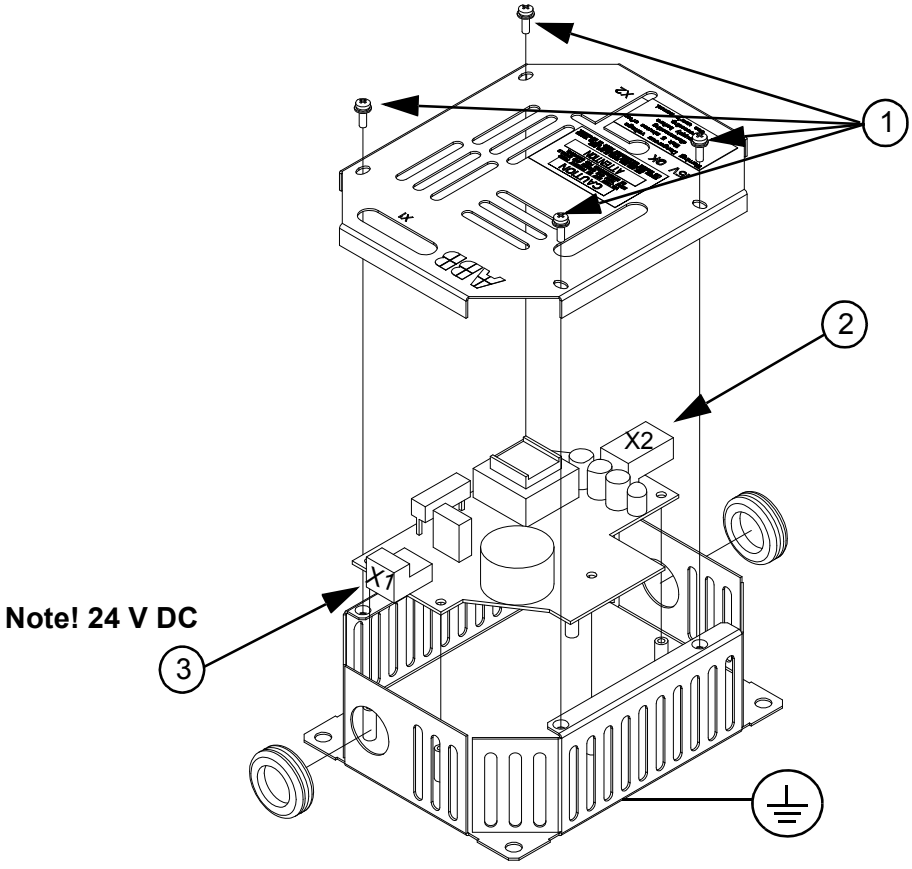
- page *72* for location of terminal X41 of the drive
- page *86* for the circuit diagram
- page *158* for the dimensions of the ASTO-11C board
- page *124* for the technical data of the ASTO-11C board.

Connect the ASTO board as follows:

- Remove the cover of the enclosed ASTO unit by undoing the fixing screws (1).
- Ground the ASTO unit via the bottom plate of the enclosure or via terminal X1:2 or X1:4 of the ASTO board.
- Connect the cable delivered with the kit between terminal X2 of the ASTO board (2) and drive terminal X41.

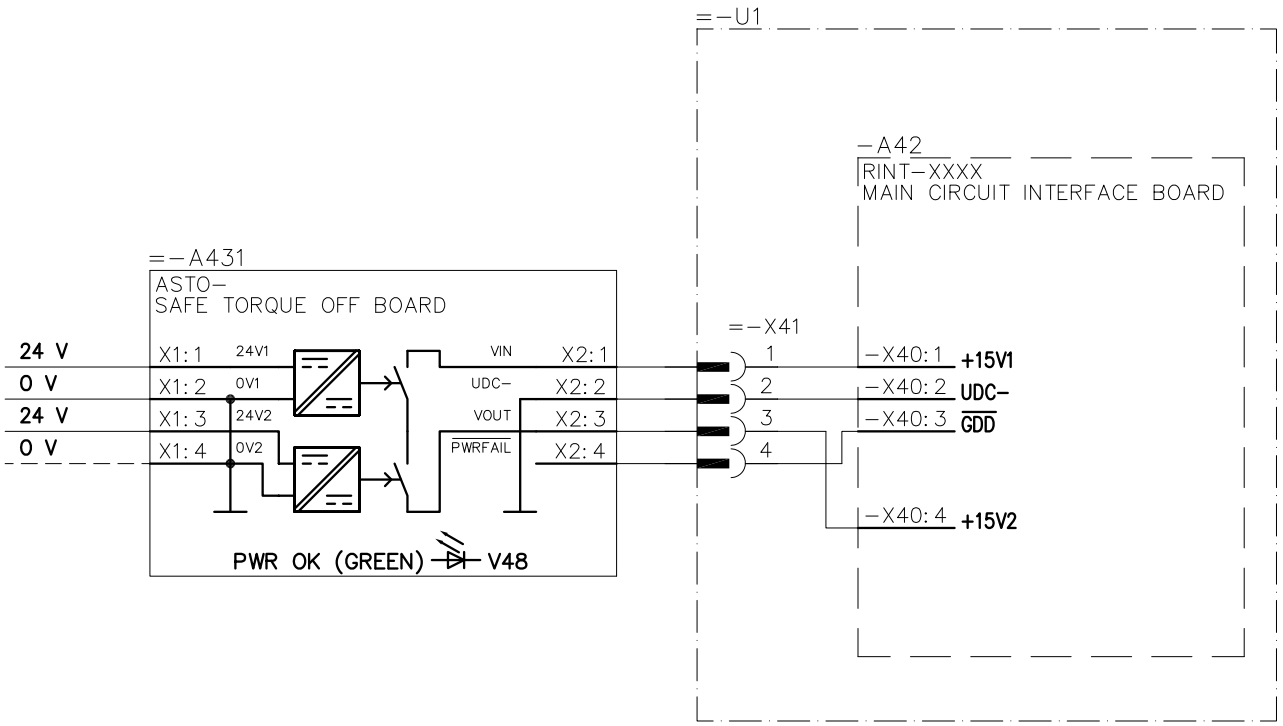
WARNING! Use only the ASTO cable delivered with the kit. Using another cable or modifying the cable may cause a malfunction of the drive.

- Connect a cable between connector X1 of the ASTO board (3) and the 24 V DC source.
- Fasten the cover of the ASTO unit back with screws.



Circuit diagram

The diagram below shows the connection between the ASTO board and the drive when it is ready. For an example diagram of a complete Safe torque off circuit, see page *50*.



3AUA0000072542

Start-up and validation

Validate and start-up the function according to the instructions given in *ACS800-01/04/11/31/104/104LC Safe torque off function (+Q967), Application guide* (3AUA0000063373 [English]).

Dimensional drawing

See page *158*.

Motor control and I/O board (RMIO)

What this chapter contains

This chapter shows

- external control connections to the RMIO board for the ACS800 Standard Control Program (Factory Macro)
- specifications of the inputs and outputs of the board.

Note on terminal labelling

Option modules (Rxxx) may have identical terminal designations with the RMIO board.

Note on external power supply

External +24 V DC power supply for the RMIO board is recommended if

- the application requires a fast start after connecting the input power supply
- fieldbus communication is required when the input power supply is disconnected.

The RMIO board can be supplied from an external power source via terminal X23 or X34 or via both X23 and X34. The internal power supply to terminal X34 can be left connected when using terminal X23.

WARNING! If the RMIO board is supplied from an external power source via terminal X34, the loose end of the cable removed from the RMIO board terminal must be secured mechanically to a location where it cannot come into contact with electrical parts. If the screw terminal plug of the cable is removed, the wire ends must be individually insulated.

Parameter settings

In Standard Control Program, set parameter 16.9 CTRL BOARD SUPPLY to EXTERNAL 24V if the RMIO board is powered from an external supply.

External control connections (non-US)

External control cable connections to the RMIO board for the ACS800 Standard Control Program (Factory Macro) are shown below. For external control connections of other control macros and programs, see the appropriate firmware manual.

RMIO

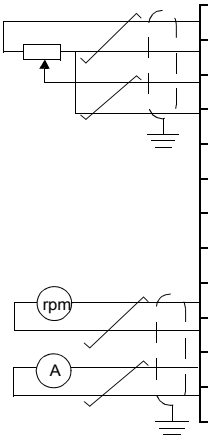
Terminal size:

cables 0.3 to 3.3 mm^2 (22 to 12 AWG)

Tightening torque:

0.2 to 0.4 Nm

(0.2 to 0.3 lbf ft)



X2*	RMIO		
X20	X20		
1	1	VREF-	Reference voltage -10 V DC, 1 kohm ≤ R_L ≤ 10 kohm
2	2	AGND	
X21	X21		
1	1	VREF+	Reference voltage 10 V DC, 1 kohm ≤ R_L ≤ 10 kohm
2	2	AGND	
3	3	AI1+	Speed reference 0(2) ... 10 V, R_{in} = 200 kohm
4	4	AI1-	
5	5	AI2+	By default, not in use. 0(4) ... 20 mA, R_{in} = 100 ohm
6	6	AI2-	
7	7	AI3+	By default, not in use. 0(4) ... 20 mA, R_{in} = 100 ohm
8	8	AI3-	
9	9	AO1+	Motor speed 0(4)...20 mA ≙ 0...motor nom. speed, R_L ≤ 700 ohm
10	10	AO1-	
11	11	AO2+	Output current 0(4)...20 mA ≙ 0...motor nom. current, R_L ≤ 700 ohm
12	12	AO2-	
X22	X22		
1	1	DI1	Stop/Start
2	2	DI2	Forward/Reverse [1]
3	3	DI3	Not in use
4	4	DI4	Acceleration & deceleration select [2]
5	5	DI5	Constant speed select [3]
6	6	DI6	Constant speed select [3]
7	7	+24VD	+24 V DC max. 100 mA
8	8	+24VD	
9	9	DGND1	Digital ground
10	10	DGND2	Digital ground
11	11	DIIL	Start interlock (0 = stop) [4]
X23	X23		
1	1	+24V	Auxiliary voltage output and input, non-isolated, 24 V DC 250 mA [5]
2	2	GND	
X25	X25		
1	1	RO1	Relay output 1: ready
2	2	RO1	
3	3	RO1	
X26	X26		
1	1	RO2	Relay output 2: running
2	2	RO2	
3	3	RO2	
X27	X27		
1	1	RO3	Relay output 3: fault (-1)
2	2	RO3	
3	3	RO3	

Fault

* optional terminal block in ACS800-02 and ACS800-07

[1] Only effective if par. 10.03 is set to REQUEST by the user.

[2] 0 = open, 1 = closed

DI4	Ramp times according to
0	parameters 22.02 and 22.03
1	parameters 22.04 and 22.05

[3] See par. group 12 CONSTANT SPEEDS.

DI5	DI6	Operation
0	0	Set speed through AI1
1	0	Constant speed 1
0	1	Constant speed 2
1	1	Constant speed 3

[4] See parameter 21.09 START INTRL FUNC.
Typically, terminal X22:8 is connected to X22:11 as standard.

[5] Total maximum current shared between this output and option modules installed on the board.

External control connections (US)

External control cable connections to the RMIO board for the ACS800 Standard Control Program (Factory Macro US version) are shown below. For external control connections of other control macros and programs, see the appropriate firmware manual.

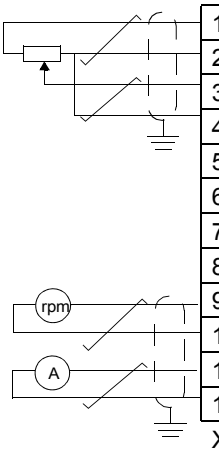
RMIO

Terminal size:

cables 0.3 to 3.3 mm^2 (22 to 12 AWG)

Tightening torque:

0.2 to 0.4 Nm (0.2 to 0.3 lbf ft)



X2*	RMIO		
X20	X20		
1	1	VREF-	Reference voltage -10 V DC, 1 kohm ≤ R_L ≤ 10 kohm
2	2	AGND	
X21	X21		
1	1	VREF+	Reference voltage 10 V DC, 1 kohm ≤ R_L ≤ 10 kohm
2	2	AGND	
3	3	AI1+	Speed reference 0(2) ... 10 V, R_{in} = 200 kohm
4	4	AI1-	
5	5	AI2+	By default, not in use. 0(4) ... 20 mA, R_{in} = 100 ohm
6	6	AI2-	
7	7	AI3+	By default, not in use. 0(4) ... 20 mA, R_{in} = 100 ohm
8	8	AI3-	
9	9	AO1+	Motor speed 0(4)...20 mA ≙ 0...motor nom. speed, R_L ≤ 700 ohm
10	10	AO1-	
11	11	AO2+	Output current 0(4)...20 mA ≙ 0...motor nom. current, R_L ≤ 700 ohm
12	12	AO2-	
X22	X22		
1	1	DI1	Start (⌐‾)
2	2	DI2	Stop (‾⌐)
3	3	DI3	Forward/Reverse [1]
4	4	DI4	Acceleration & deceleration select [2]
5	5	DI5	Constant speed select [3]
6	6	DI6	Constant speed select [3]
7	7	+24VD	+24 V DC max. 100 mA
8	8	+24VD	
9	9	DGND1	Digital ground
10	10	DGND2	Digital ground
11	11	DIIL	Start interlock (0 = stop) [4]
X23	X23		
1	1	+24V	Auxiliary voltage output and input, non-isolated, 24 V DC 250 mA [5]
2	2	GND	
X25	X25		
1	1	RO1	Relay output 1: ready
2	2	RO1	
3	3	RO1	
X26	X26		
1	1	RO2	Relay output 2: running
2	2	RO2	
3	3	RO2	
X27	X27		
1	1	RO3	Relay output 3: fault (-1)
2	2	RO3	
3	3	RO3	

Fault

* optional terminal block in ACS800-U2 and ACS800-U7

1) Only effective if par. 10.03 is set to REQUEST by the user.

2) 0 = open, 1 = closed

DI4	Ramp times according to
0	parameters 22.02 and 22.03
1	parameters 22.04 and 22.05

3) See par. group 12 CONSTANT SPEEDS.

DI5	DI6	Operation
0	0	Set speed through AI1
1	0	Constant speed 1
0	1	Constant speed 2
1	1	Constant speed 3

4) See parameter 21.09 START INTRL FUNC.
Typically, terminal X22:8 is connected to X22:11 as standard.

5) Total maximum current shared between this output and option modules installed on the board.

RMIO board specifications

Analogue inputs

	Two programmable differential current inputs (0 mA / 4 mA ... 20 mA, R_{in} = 100 ohm) and one programmable differential voltage input (-10 V / 0 V / 2 V ... +10 V, R_{in} = 200 kohm).
	The analogue inputs are galvanically isolated as a group.
Insulation test voltage	500 V AC, 1 min
Max. common mode voltage between the channels	±15 V DC
Common mode rejection ratio	$\geq$ 60 dB at 50 Hz
Resolution	0.025% (12 bit) for the -10 V ... +10 V input. 0.5% (11 bit) for the 0 ... +10 V and 0 ... 20 mA inputs.
Inaccuracy	±0.5% (Full Scale Range) at 25 °C (77 °F). Temperature coefficient: ±100 ppm/°C (±56 ppm/°F), max.

Constant voltage output

Voltage	+10 V DC, 0, -10 V DC ± 0.5% (Full Scale Range) at 25 °C (77 °F). Temperature coefficient: ±100 ppm/°C (±56 ppm/°F) max.
Maximum load	10 mA
Applicable potentiometer	1 kohm to 10 kohm

Auxiliary power output

Voltage	24 V DC ± 10%, short circuit proof
Maximum current	250 mA (shared between this output and option modules installed on the RMIO)

Analogue outputs

	Two programmable current outputs: 0 (4) to 20 mA, $R_L \leq$ 700 ohm
Resolution	0.1% (10 bit)
Inaccuracy	±1% (Full Scale Range) at 25 °C (77 °F). Temperature coefficient: ±200 ppm/°C (±111 ppm/°F) max.

Digital inputs

	Six programmable digital inputs (common ground: 24 V DC, -15% to +20%) and a start interlock input. Group isolated, can be divided in two isolated groups (see *Isolation and grounding diagram* below).
	Thermistor input: 5 mA, < 1.5 kohm ⏏ “1” (normal temperature), > 4 kohm ⏏ “0” (high temperature), open circuit ⏏ “0” (high temperature).
	Internal supply for digital inputs (+24 V DC): short-circuit proof. An external 24 V DC supply can be used instead of the internal supply.
Insulation test voltage	500 V AC, 1 min
Logical thresholds	< 8 V DC ⏏ “0”, > 12 V DC ⏏ “1”
Input current	DI1 to DI 5: 10 mA, DI6: 5 mA
Filtering time constant	1 ms

Relay outputs

	Three programmable relay outputs
Switching capacity	8 A at 24 V DC or 250 V AC, 0.4 A at 120 V DC
Minimum continuous current	5 mA rms at 24 V DC
Maximum continuous current	2 A rms
Insulation test voltage	4 kV AC, 1 minute

DDCS fibre optic link

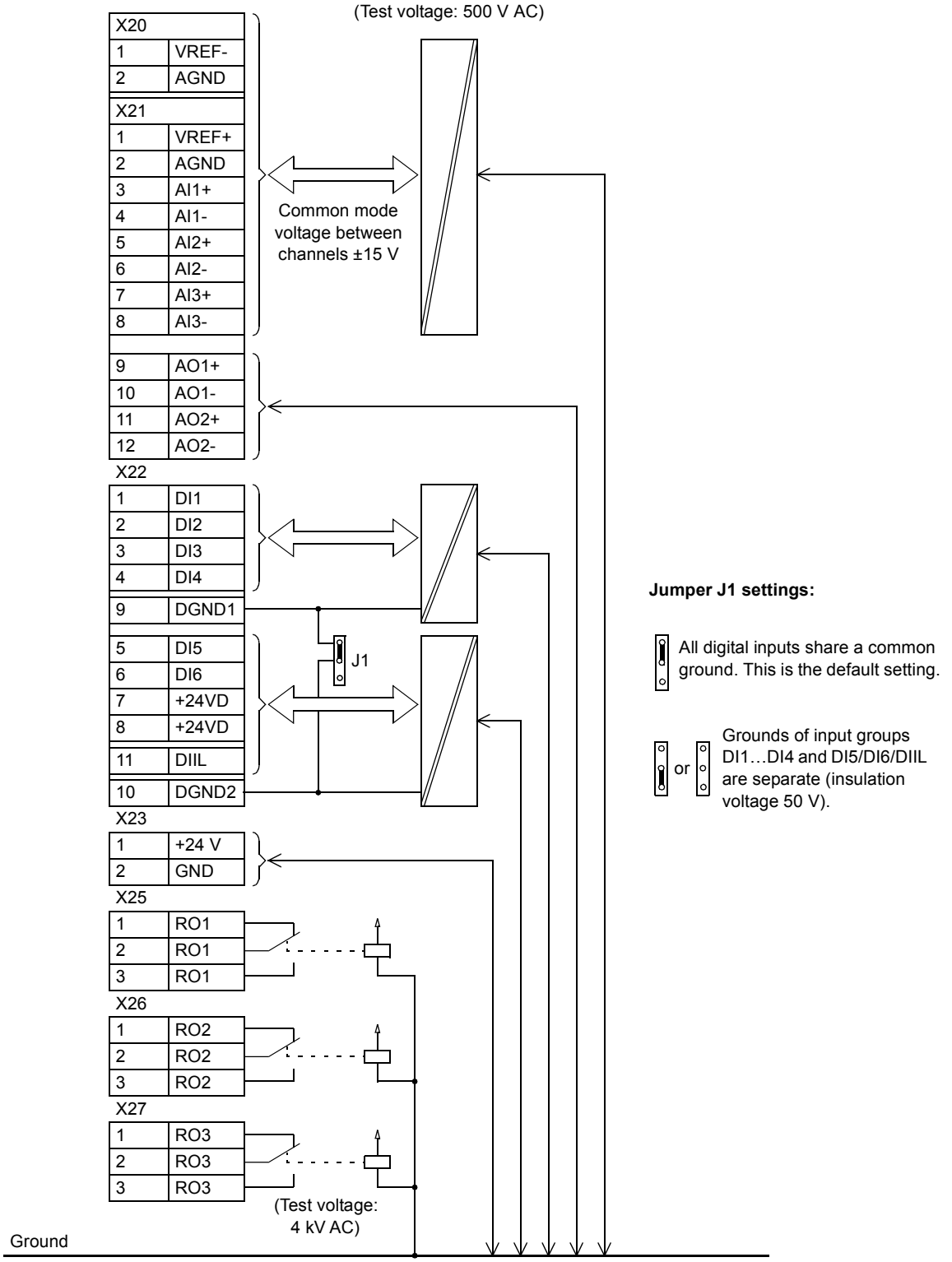
	With optional communication adapter module RDCO. Protocol: DDCS (ABB Distributed Drives Communication System)

24 V DC power input

Voltage	24 V DC ± 10%
Typical current consumption (without option modules)	250 mA
Maximum current consumption	1200 mA (with option modules inserted)

The terminals on the RMIO board as well as on the option modules attachable to the board fulfil the Protective Extra Low Voltage (PELV) requirements stated in EN 50178 provided that the external circuits connected to the terminals also fulfil the requirements and the installation site is below 2000 m (6562 ft). Above 2000 m (6562 ft), see page 58.

Isolation and grounding diagram



Installation checklist

What this chapter contains

This chapter contains an installation checklist.

Checklist

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

WARNING! Only qualified electricians are allowed to commission the drive. Read and follow the *Safety instructions* on the first pages of this manual. Ignoring the safety instructions can cause injury or death.

Check that...
MECHANICAL INSTALLATION
☐ The ambient operating conditions are allowed. (See *Mechanical installation, Technical data: IEC data* or *NEMA data, Ambient conditions*.)
☐ The unit is fixed properly on a vertical non-flammable wall. (See *Mechanical installation.*)
☐ The cooling air will flow freely.
☐ The motor and the driven equipment are ready for start. (See *Planning the electrical installation: Motor selection and compatibility, Technical data: Motor connection*.)
ELECTRICAL INSTALLATION (See *Planning the electrical installation, Electrical installation.*)
☐ The +E202 and +E200 EMC filter capacitors are disconnected if the drive is connected to an IT (ungrounded) system.
☐ The capacitors are reformed if stored over one year, refer to *Converter modules with electrolytic DC capacitors in the DC link, Capacitor reforming instructions* (3BFE64059629 [English]).
☐ The drive is grounded properly.
☐ The mains (input power) voltage matches the drive nominal input voltage.
☐ The mains (input power) connections at U1, V1 and W1 and their tightening torques are OK.
☐ Appropriate mains (input power) fuses and disconnector are installed.
☐ The motor connections at U2, V2 and W2 and their tightening torques are OK.
☐ The motor cable is routed away from other cables.

Check that...	
☐	There are no power factor compensation capacitors in the motor cable.
☐	The external control connections inside the drive are OK.
☐	There are no tools, foreign objects or dust from drilling inside the drive.
☐	Mains (input power) voltage cannot be applied to the output of the drive (with bypass connection).
☐	Drive, motor connection box and other covers are in place.

Start-up and use

What this chapter contains

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

Startup procedure

1. Ensure that the installation of the drive has been checked according to the checklist in chapter Installation checklist, and that the motor and driven equipment are ready for start.
2. Switch the power on and set-up the drive control program according to the start-up instructions given in the drive firmware manual.
3. Validate the Prevention of unexpected start-up function (option +Q950) according to the instructions given in chapter *Installation of the AGPS board (Prevention of unexpected start-up, +Q950)*.
4. Validate the Safe torque off function (option +Q967) according to the instructions given in *ACS800-01/04/11/31/104/104LC Safe torque off function (+Q967), Application guide* (3AUA0000063373 [English]).

Control panel

The user interface of the drive is the control panel (type CDP 312R). For more information on using the control panel, see the firmware manual delivered with the drive.

Removing the control panel

To remove the control panel from the panel holder, press down the locking clip and pull the panel out.

Maintenance

What this chapter contains

This chapter contains preventive maintenance instructions.

Safety

WARNING! Read the *Safety instructions* on the first pages of this manual before performing any maintenance on the equipment. Ignoring the safety instructions can cause injury or death.

Maintenance intervals

If installed in an appropriate environment, the drive requires very little maintenance. This table lists the routine maintenance intervals recommended by ABB.

Interval	Maintenance	Instruction
Every 6 to 12 months (depends on the dustiness of the environment)	Heatsink temperature check and cleaning	See *Heatsink*.
Every year when stored	Capacitor reforming	See *Reforming*.
Every 3 years	Replacement of additional cooling fan in IP55 units and in IP21 units when included	See *Additional fan.*
Every 6 years	Cooling fan replacement	See *Fan*.
Every 10 years	Frame size R4 and up: capacitor replacement	See *Capacitors*.

Consult your local ABB Service representative for more details on the maintenance. On the Internet, go to http://www.abb.com/drives.

Heatsink

The heatsink fins pick up dust from the cooling air. The drive runs into overtemperature warnings and faults if the heatsink is not clean. In a “normal” environment (not dusty, not clean) the heatsink should be checked annually, in a dusty environment more often.

Clean the heatsink as follows (when necessary):

1. Remove the cooling fan (see section *Fan*).
2. Blow clean compressed air (not humid) from bottom to top and simultaneously use a vacuum cleaner at the air outlet to trap the dust. **Note:** If there is a risk of the dust entering adjoining equipment, perform the cleaning in another room.
3. Refit the cooling fan.

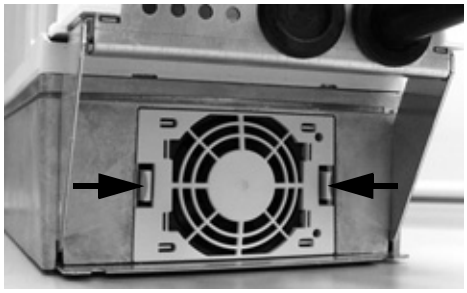
Fan

The lifespan of the cooling fan depends on the drive usage and ambient temperature. See the appropriate ACS800 firmware manual for an actual signal which indicates the hours of usage of the fan. For resetting the running time signal after a fan replacement, refer to the firmware manual.

Fan failure can be predicted by the increasing noise from fan bearings and the gradual rise in the heatsink temperature in spite of heatsink cleaning. If the drive is operated in a critical part of a process, fan replacement is recommended once these symptoms start appearing. Replacement fans are available from ABB. Do not use other than ABB specified spare parts.

Fan replacement (R2, R3)

To remove the fan, release the retaining clips. Disconnect the cable. Install the new fan in reverse order.

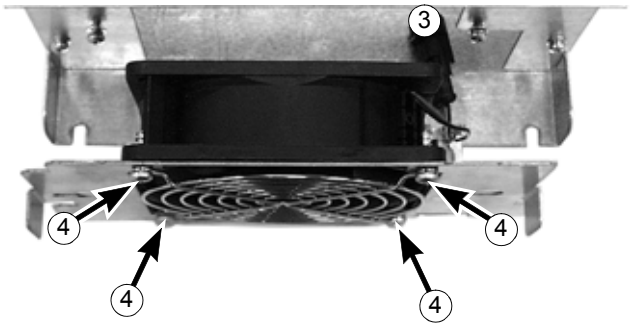


Bottom view

Fan replacement (R4)

1. Loosen the screws that fasten the fan mounting plate to the frame.
2. Push the fan mounting plate to the left and pull it out.
3. Disconnect the fan power cable.
4. Undo the screws that fasten the fan to the fan mounting plate.
5. Install the new fan in reverse order.

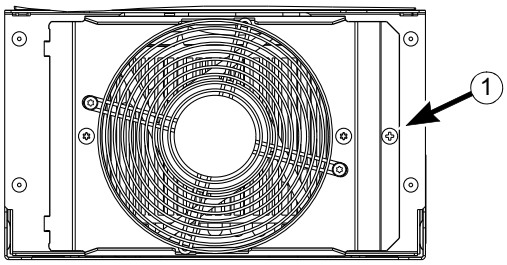
Bottom view



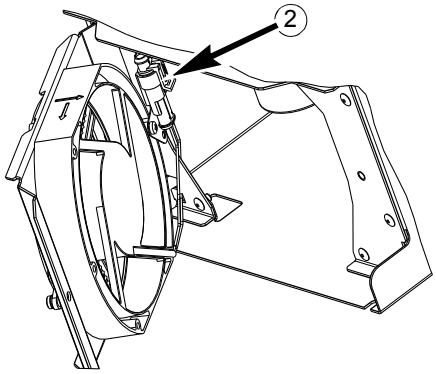
View from above fan plate pulled out

Fan replacement (R5)

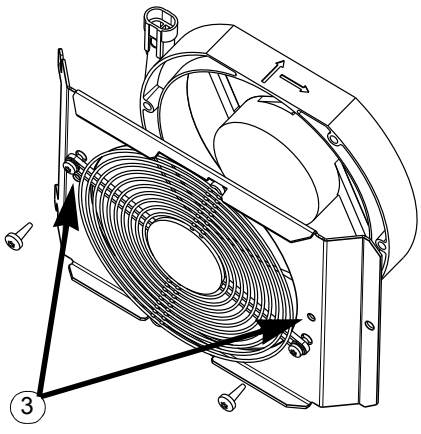
1. Undo the fastening screw.



2. Open the swing-out frame and disconnect the cable.



3. Undo the fastening screws of the fan.

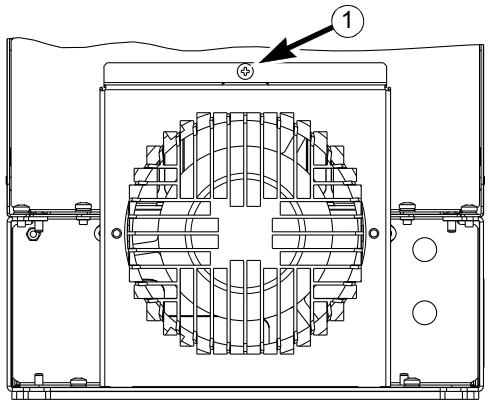


4. Install the new fan in reverse order.

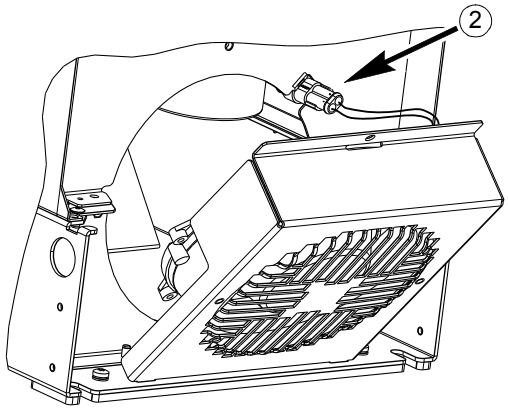
Fan replacement (R6)

Note: In -0205-3 and 0255-5 units, access the fan through the opening in the support frame of the cable connection box.

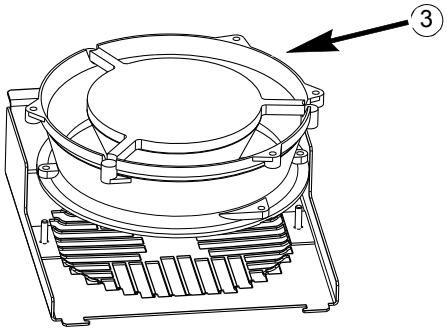
1. Remove the screw attaching the fan casing and let the casing lean down against the limiters.



2. Slide out the cable connector and disconnect it.



3. Take off the casing and replace the fan onto the casing's pins.



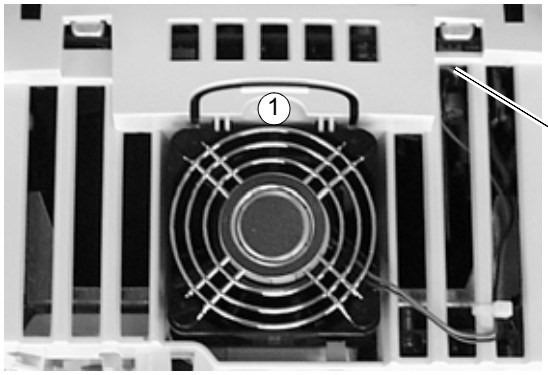
4. Reinstall the casing in reverse order.

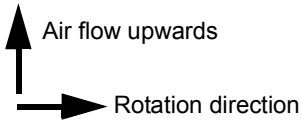
Additional fan

There is an additional cooling fan in all IP55 units and most IP21 units. However, there is no additional fan in the following IP21 units: -0003-3, -0004-3, -0005-3, -0004-5, -0005-5 and -0006-5. The following IP55 units have two additional fans: -0205-3 and -0255-5.

Replacement (R2, R3)

Remove the front cover. To remove the fan, release the retaining clip (1). Disconnect the cable (2, detachable terminal). Install the new fan in reverse order.





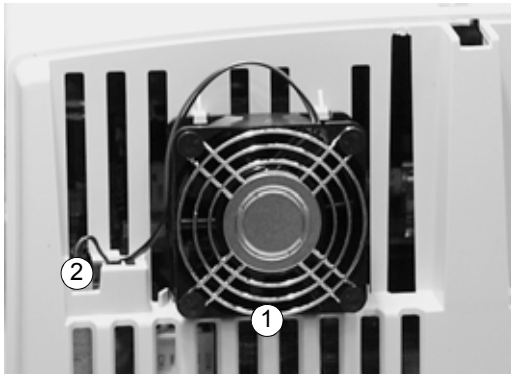
View from above when front cover is removed

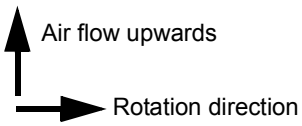
Replacement (R4, R5)

Remove the front cover. The fan is located on the lower right-hand side of the unit (R4) or on the right-hand side of the control panel (R5). Lift the fan out and disconnect the cable. Install the fan in reverse order.

Replacement (R6)

Remove the top cover by lifting it by the rear edge. To remove the fan, release the retaining clips by pulling the back edge (1) of the fan upwards. Disconnect the cable (2, detachable terminal). Install the new fan in reverse order.





View from above when top cover is removed

Capacitors

The drive intermediate circuit employs several electrolytic capacitors. The lifespan depends on drive loading and ambient temperature. Capacitor life can be prolonged by lowering the ambient temperature.

It is not possible to predict a capacitor failure. Capacitor failure is usually followed by a mains fuse failure or a fault trip. Contact ABB if capacitor failure is suspected. Replacements for frame size R4 and up are available from ABB. Do not use other than ABB specified spare parts.

Reforming

Reform (re-age) spare part capacitors once a year according to *Converter modules with electrolytic DC capacitors in the DC link, Capacitor reforming instructions* (3BFE64059629 [English]).

LEDs

This table describes LEDs of the drive.

Where	LED	When the LED is lit
RMIO board *	Red	Drive in fault state
	Green	The power supply on the board is OK.
Control panel mounting platform (with type code selection +0J400 only)	Red	Drive in fault state
	Green	The main +24 V DC power supply for the control panel and the RMIO board is OK.

* The LEDs are not visible in frame sizes R2 to R6.

Technical data

What this chapter contains

This chapter contains the technical specifications of the drive, e.g. the ratings, sizes and technical requirements, provisions for fulfilling the requirements for CE and other markings and warranty policy.

IEC data

Ratings

The IEC ratings for the ACS800-01 with 50 Hz and 60 Hz supplies are given below. The symbols are described below the table.

ACS800-01 size	Nominal ratings		No-overload use	Light-overload use		Heavy-duty use		Frame size	Air flow	Heat dissipation
	$I_{cont.max}$ A	I_{max} A	$P_{cont.max}$ kW	I_{2N} A	P_N kW	I_{2hd} A	P_{hd} kW		m^3/h	W
Three-phase supply voltage 208 V, 220 V, **230 V** or 240 V										
-0001-2	5.1	6.5	1.1	4.7	0.75	3.4	0.55	R2	35	100
-0002-2	6.5	8.2	1.5	6.0	1.1	4.3	0.75	R2	35	100
-0003-2	8.5	10.8	1.5	7.7	1.5	5.7	1.1	R2	35	100
-0004-2	10.9	13.8	2.2	10.2	2.2	7.5	1.5	R2	35	120
-0005-2	13.9	17.6	3	12.7	3	9.3	2.2	R2	35	140
-0006-2	19	24	4	18	4	14	3	R3	69	160
-0009-2	25	32	5.5	24	5,5	19	4	R3	69	200
-0011-2	34	46	7.5	31	7.5	23	5.5	R3	69	250
-0016-2	44	62	11	42	11	32	7.5	R4	103	340
-0020-2	55	72	15	50	11	37	7.5	R4	103	440
-0025-2	72	86	18.5	69	18.5	49	11	R5	250	530
-0030-2	86	112	22	80	22	60	15	R5	250	610
-0040-2	103	138	30	94	22	69	18.5	R5	250	810
-0050-2	141	164	37	132	37	97	30	R6	405	1190
-0060-2	166	202	45	155	45	115	30	R6	405	1190
-0070-2	202	282	55	184	55	141	37	R6	405	1440

ACS800-01 size	Nominal ratings		No-overload use	Light-overload use		Heavy-duty use		Frame size	Air flow	Heat dissipation
	$I_{cont.max}$ A	I_{max} A	$P_{cont.max}$ kW	I_{2N} A	P_N kW	I_{2hd} A	P_{hd} kW		m^3/h	W
Three-phase supply voltage 380 V, **400 V** or 415 V										
-0003-3	5.1	6.5	1.5	4.7	1.5	3.4	1.1	R2	35	100
-0004-3	6.5	8.2	2.2	5.9	2.2	4.3	1.5	R2	35	120
-0005-3	8.5	10.8	3	7.7	3	5.7	2.2	R2	35	140
-0006-3	10.9	13.8	4	10.2	4	7.5	3	R2	35	160
-0009-3	13.9	17.6	5.5	12.7	5.5	9.3	4	R2	35	200
-0011-3	19	24	7.5	18	7.5	14	5.5	R3	69	250
-0016-3	25	32	11	24	11	19	7.5	R3	69	340
-0020-3	34	46	15	31	15	23	11	R3	69	440
-0025-3	44	62	22	41	18.5	32	15	R4	103	530
-0030-3	55	72	30	50	22	37	18.5	R4	103	610
-0040-3	72	86	37	69	30	49	22	R5	250	810
-0050-3	86	112	45	80	37	60	30	R5	250	990
-0060-3	103	138	55	94	45	69	37	R5	250	1190
-0075-3	145	170	75	141	75	100	45	R5	405	1440
-0070-3 *	141	164	75	132	55	97	45	R6	405	1440
-0100-3	166	202	90	155	75	115	55	R6	405	1940
-0120-3	202	282	110	184	90	141	75	R6	405	2310
-0135-3	225	326	110	220	110	163	90	R6	405	2810
-0165-3	260	326	132	254	132	215	110	R6	405	3260
-0205-3	290	351	160	285	160	234	132	R6	405	4200
Three-phase supply voltage 380 V, 400 V, 415 V, 440 V, 460 V, 480 V or **500** V										
-0004-5	4.9	6.5	2.2	4.5	2.2	3.4	1.5	R2	35	120
-0005-5	6.2	8.2	3	5.6	3	4.2	2.2	R2	35	140
-0006-5	8.1	10.8	4	7.7	4	5.6	3	R2	35	160
-0009-5	10.5	13.8	5.5	10	5.5	7.5	4	R2	35	200
-0011-5	13.2	17.6	7.5	12	7.5	9.2	5.5	R2	35	250
-0016-5	19	24	11	18	11	13	7.5	R3	69	340
-0020-5	25	32	15	23	15	18	11	R3	69	440
-0025-5	34	46	18.5	31	18.5	23	15	R3	69	530
-0030-5	42	62	22	39	22	32	18.5	R4	103	610
-0040-5	48	72	30	44	30	36	22	R4	103	810
-0050-5	65	86	37	61	37	50	30	R5	250	990
-0060-5	79	112	45	75	45	60	37	R5	250	1190
-0070-5	96	138	55	88	55	69	45	R5	250	1440
-0105-5	145	170	90	141	90	100	55	R5	405	2150
-0100-5 *	124	164	75	115	75	88	55	R6	405	1940
-0120-5	157	202	90	145	90	113	75	R6	405	2310
-0140-5	180	282	110	163	110	141	90	R6	405	2810
-0165-5	225	326	132	220	132	163	110	R6	405	3260
-0205-5	260	326	160	254	160	215	132	R6	405	3800
-0255-5	290	351	200	285	200	234	160	R6	405	4500

* Type not available any more

ACS800-01 size	Nominal ratings		No-overload use	Light-overload use		Heavy-duty use		Frame size	Air flow	Heat dissipation
	$I_{cont.max}$ A	I_{max} A	$P_{cont.max}$ kW	I_{2N} A	P_N kW	I_{2hd} A	P_{hd} kW		m^3/h	W
Three-phase supply voltage 525 V, 550 V, 575 V, 600 V, 660 V or **690** V										
-0011-7	13	14	11	11.5	7.5	8.5	5.5	R4	103	300
-0016-7	17	19	15	15	11	11	7.5	R4	103	340
-0020-7	22	28	18.5	20	15	15	11	R4	103	440
-0025-7	25	38	22	23	18.5	19	15	R4	103	530
-0030-7	33	44	30	30	22	22	18.5	R4	103	610
-0040-7	36	54	30	34	30	27	22	R4	103	690
-0050-7	51	68	45	46	37	34	30	R5	250	840
-0060-7	57	84	55	52	45	42	37	R5	250	1010
-0070-7	79	104	75	73	55	54	45	R6	405	1220
-0100-7	93	124	90	86	75	62	55	R6	405	1650
-0120-7	113	172	110	108	90	86	75	R6	405	1960
-0145-7	134	190	132	125	110	95	90	R6	405	2660
-0175-7	166	245	160	155	132	131	110	R6	405	3470
-0205-7	190	245	160	180	160	147	132	R6	405	4180

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Symbols

Nominal ratings

$I_{cont.max}$ continuous rms output current. No overload capability at 40 °C (104 °F).

I_{max} maximum output current. Available for 10 s at start, otherwise as long as allowed by drive temperature.

Typical ratings:

No-overload use

$P_{cont.max}$ typical motor power. The power ratings apply to most IEC 60034 motors at the nominal voltage, 230 V, 400 V, 500 V or 690 V.

Light-overload use (10% overload capability)

I_{2N} continuous rms current. 10% overload is allowed for one minute every 5 minutes.

P_N typical motor power. The power ratings apply to most IEC 60034 motors at the nominal voltage, 230 V, 400 V, 500 V or 690 V.

Heavy-duty use (50% overload capability)

I_{2hd} continuous rms current. 50% overload is allowed for one minute every 5 minutes.

P_{hd} typical motor power. The power ratings apply to most IEC 60034 motors at the nominal voltage, 230 V, 400 V, 500 V or 690 V.

Sizing

The current ratings are the same regardless of the supply voltage within one voltage range. 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.

Note 1: The maximum allowed motor shaft power is limited to $1.5 \cdot P_{hd}$, $1.1 \cdot P_N$ or $P_{cont.max}$ (whichever value is greatest). If the limit is exceeded, motor torque and current are automatically restricted. The function protects the input bridge of the drive against overload. If the condition exists for 5 minutes, the limit is set to $P_{cont.max}$.

Note 2: The ratings apply at an ambient temperature of 40 °C (104 °F). At lower temperatures the ratings are higher (except I_{max}).

Note 3: Use the DriveSize PC tool for a more accurate dimensioning if the ambient temperature is below 40 °C (104 °F) or the drive is loaded cyclically.

Derating

The load capacity (current and power) decreases if the installation site altitude exceeds 1000 metres (3300 ft), or if the ambient temperature exceeds 40 °C (104 °F).

Temperature derating

In the temperature range +40 °C (+104 °F) to +50 °C (+122 °F) the rated output current is decreased 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 · I_{2N} or 0.90 · I_{2hd}.

Altitude derating

In altitudes from 1000 to 4000 m (3300 to 13123 ft) above sea level, the derating is 1% for every 100 m (328 ft). For a more accurate derating, use the DriveSize PC tool. See *Installation sites above 2000 metres (6562 feet)* on page *58*.

Fuses

gG and aR fuses for protection against short-circuit in the input power cable or drive are listed below. Either fuse type may be used if it operates rapidly enough.

Frame sizes R2 to R4

Check from the fuse time-current curve that the operating time of the fuse is below 0.5 seconds. The operating time depends on the supply network impedance and the cross-sectional area and length of the supply cable. The short-circuit current can be calculated as shown below in section *Frame sizes R5 and R6*.

Note 1: See also *Planning the electrical installation*: *Thermal overload and short-circuit protection*. For UL recognized fuses, see *NEMA data* on page *118*.

Note 2: In multicable installations, install only one fuse per phase (not one fuse per conductor).

Note 3: Larger fuses than the recommended ones must not be used.

Note 4: Fuses from other manufacturers can be used if they meet the ratings and the melting curve of the fuse does not exceed the melting curve of the fuse mentioned in the table.

ACS800-01 size	Input current	Fuse					
		A	A^2s	V	Manufacturer	Type	IEC size
Three-phase supply voltage 208 V, 220 V, **230 V** or 240 V							
-0001-2	4.4	10	483	500	ABB Control	OFAF000H10	000
-0002-2	5.2	10	483	500	ABB Control	OFAF000H10	000
-0003-2	6.7	10	483	500	ABB Control	OFAF000H10	000
-0004-2	9.3	16	993	500	ABB Control	OFAF000H16	000
-0005-2	12	16	993	500	ABB Control	OFAF000H16	000
-0006-2	16	20	1620	500	ABB Control	OFAF000H20	000
-0009-2	23	25	3100	500	ABB Control	OFAF000H25	000
-0011-2	31	40	9140	500	ABB Control	OFAF000H40	000
-0016-2	40	50	15400	500	ABB Control	OFAF000H50	000
-0020-2	51	63	21300	500	ABB Control	OFAF000H63	000
Three-phase supply voltage 380 V, **400 V** or 415 V							
-0003-3	4.7	10	483	500	ABB Control	OFAF000H10	000
-0004-3	6.0	10	483	500	ABB Control	OFAF000H10	000
-0005-3	7.9	10	483	500	ABB Control	OFAF000H10	000
-0006-3	10	16	993	500	ABB Control	OFAF000H16	000
-0009-3	13	16	993	500	ABB Control	OFAF000H16	000
-0011-3	17	20	1620	500	ABB Control	OFAF000H20	000
-0016-3	23	25	3100	500	ABB Control	OFAF000H25	000
-0020-3	32	40	9140	500	ABB Control	OFAF000H40	000
-0025-3	42	50	15400	500	ABB Control	OFAF000H50	000
-0030-3	53	63	21300	500	ABB Control	OFAF000H63	000
Three-phase supply voltage 380 V, 400 V, 415 V, 440 V, 460 V, 480 V or **500** V							
-0004-5	4.7	10	483	500	ABB Control	OFAF000H10	000
-0005-5	5.9	10	483	500	ABB Control	OFAF000H10	000
-0006-5	7.7	10	483	500	ABB Control	OFAF000H10	000
-0009-5	10.0	16	993	500	ABB Control	OFAF000H16	000
-0011-5	12.5	16	993	500	ABB Control	OFAF000H16	000
-0016-5	17	20	1620	500	ABB Control	OFAF000H20	000
-0020-5	23	25	3100	500	ABB Control	OFAF000H25	000
-0025-5	31	40	9140	500	ABB Control	OFAF000H40	000
-0030-5	41	50	15400	500	ABB Control	OFAF000H50	000
-0040-5	47	63	21300	500	ABB Control	OFAF000H63	000
Three-phase supply voltage 525 V, 550 V, 575 V, 600 V, 660 V or **690** V							
-0011-7	12	16	1100	690	ABB Control	OFAA000GG16	000
-0016-7	15	20	2430	690	ABB Control	OFAA000GG20	000
-0020-7	21	25	4000	690	ABB Control	OFAA000GG25	000
-0025-7	24	32	7000	690	ABB Control	OFAA000GG32	000
-0030-7	33	35	11400	690	ABB Control	OFAA000GG35	000
-0040-7	35	50	22800	690	ABB Control	OFAA000GG50	000

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Frame sizes R5 and R6

Choose between gG and aR fuses according to the table under *Quick guide for selecting between gG and aR fuses* on page *114*, or verify the operating time by **checking that the short-circuit current of the installation is at least the value given in the fuse table**. The short-circuit current can be calculated as follows:

$$I_{k2\text{-}ph} = \frac{U}{2 \cdot \sqrt{R_c^2 + (Z_k + X_c)^2}}$$

where

$I_{k2\text{-}ph}$ = short-circuit current in symmetrical two-phase short-circuit

U = network line-to-line voltage (U)

R_c = cable resistance (ohm)

$Z_k = z_k \cdot U_N^2/S_N$ = transformer impedance (ohm)

z_k = transformer impedance (%)

U_N = transformer rated voltage (V)

S_N = nominal apparent power of the transformer (kVA)

X_c = cable reactance (ohm).

Calculation example

Drive:

- ACS800-01-0075-3
- supply voltage

Transformer:

- rated power S_N = 600 kVA
- rated voltage (drive supply voltage) U_N = 430 V
- transformer impedance z_k = 7.2%.

Supply cable:

- length = 170 m
- resistance/length = 0.398 ohm/km
- reactance/length = 0.082 ohm/km.

$$Z_k = z_k \cdot \frac{U_N^2}{S_N} = 0.072 \cdot \frac{(430\ \text{V})^2}{600\ \text{kVA}} = 22.19\ \text{mohm}$$

$$R_c = 170\ \text{m} \cdot 0.398\ \frac{\text{ohm}}{\text{km}} = 67.66\ \text{mohm}$$

$$X_c = 170\ \text{m} \cdot 0.082\ \frac{\text{ohm}}{\text{km}} = 13.94\ \text{mohm}$$

$$I_{k2\text{-}ph} = \frac{410\ V}{2 \cdot \sqrt{(67.66\ mohm)^2 + (22.19\ mohm + 13.94\ mohm)^2}} = 2.7\ kA$$

The calculated short-circuit current 2.7 kA is higher than the minimum short-circuit current of the drive gG fuse type OFAF00H160 (2400 A). -> The 500 V gG fuse (ABB Control OFAF00H160) can be used.

Fuse tables for frame sizes R5 and R6

Standard gG fuses								
ACS800-01 size	**Input current**	**Min. short-circuit current [1)]**	**Fuse**					
		A	A	A^2s *	V	Manufacturer	Type	IEC size
Three-phase supply voltage 208 V, 220 V, **230 V** or 240 V								
-0025-2	67	1050	80	34500	500	ABB Control	OFAF000H80	000
-0030-2	81	1480	100	63600	500	ABB Control	OFAF000H100	000
-0040-2	101	1940	125	103000	500	ABB Control	OFAF00H125	00
-0050-2	138	2400	160	200000	500	ABB Control	OFAF00H160	00
-0060-2	163	2850	200	350000	500	ABB Control	OFAF1H200	1
-0070-2	202	3300	224	420000	500	ABB Control	OFAF1H224	1
Three-phase supply voltage 380 V, **400 V** or 415 V								
-0040-3	69	1050	80	34500	500	ABB Control	OFAF000H80	000
-0050-3	83	1480	100	63600	500	ABB Control	OFAF000H100	000
-0060-3	100	1940	125	103000	500	ABB Control	OFAF00H125	00
-0075-3	142	2400	160	200000	500	ABB Control	OFAF00H160	00
-0070-3 **	138	2400	160	200000	500	ABB Control	OFAF00H160	00
-0100-3	163	2850	200	350000	500	ABB Control	OFAF1H200	1
-0120-3	198	3300	224	420000	500	ABB Control	OFAF1H224	1
-0135-3	221	3820	250	550000	500	ABB Control	OFAF1H250	1
-0165-3	254	4510	315	1100000	500	ABB Control	OFAF2H315	2
-0205-3	286	4510	315	1100000	500	ABB Control	OFAF2H315	2

Standard gG fuses								
ACS800-01 size	**Input current**	**Min. short-circuit current [1)]**	**Fuse**					
		A	A	A^2s *	V	Manufacturer	Type	IEC size
Three-phase supply voltage 380 V, 400 V, 415 V, 440 V, 460 V, 480 V or **500** V								
-0050-5	64	1050	80	34500	500	ABB Control	OFAF000H80	000
-0060-5	78	1480	100	63600	500	ABB Control	OFAF000H100	000
-0070-5	95	1940	125	103000	500	ABB Control	OFAF00H125	00
-0105-5	142	2400	160	200000	500	ABB Control	OFAF00H160	00
-0100-5 **	121	2400	160	200000	500	ABB Control	OFAF00H160	00
-0120-5	155	2850	200	350000	500	ABB Control	OFAF1H200	1
-0140-5	180	2850	200	350000	500	ABB Control	OFAF1H200	1
-0165-5	222	3820	250	550000	500	ABB Control	OFAF1H250	1
-0205-5	256	4510	315	1100000	500	ABB Control	OFAF2H315	2
-0255-5	286	4510	315	1100000	500	ABB Control	OFAF2H315	2
Three-phase supply voltage 525 V, 550 V, 575 V, 600 V, 660 V or **690** V								
-0050-7	52	740	63	28600	690	ABB Control	OFAA0GG63	0
-0060-7	58	740	63	28600	690	ABB Control	OFAA0GG63	0
-0070-7	79	1050	80	52200	690	ABB Control	OFAA0GG80	0
-0100-7	91	1480	100	93000	690	ABB Control	OFAA1GG100	1
-0120-7	112	1940	125	126000	690	ABB Control	OFAA1GG125	1
-0145-7	131	2400	160	220000	690	ABB Control	OFAA1GG160	1
-0175-7	162	2850	200	350000	690	ABB Control	OFAA1GG200	1
-0205-7	186	3820	250	700000	690	ABB Control	OFAA2GG250	2

* maximum total I^2t value for 550 V or 690 V

** Type not available any more.

[1)] minimum short-circuit current of the installation

Note 1: See also *Planning the electrical installation*: *Thermal overload and short-circuit protection*. For UL recognized fuses, see *NEMA data* on page *118*.

Note 2: In multicable installations, install only one fuse per phase (not one fuse per conductor).

Note 3: Larger fuses than the recommended ones must not be used.

Note 4: Fuses from other manufacturers can be used if they meet the ratings and the melting curve of the fuse does not exceed the melting curve of the fuse mentioned in the table.

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Ultrarapid (aR) fuses								
ACS800-01 size	**Input current**	**Min. short-circuit current [1)]**	**Fuse**					
		A	A	A^2s	V	Manufacturer	Type	IEC size
Three-phase supply voltage 208 V, 220 V, **230 V** or 240 V								
-0025-2	67	400	100	4650	690	Bussmann	170M1567D	DIN000
-0030-2	81	520	125	8500	690	Bussmann	170M1568D	DIN000
-0040-2	101	695	160	8500	690	Bussmann	170M1569D	DIN000
-0050-2	138	1630	315	80500	690	Bussmann	170M1572D	DIN000
-0060-2	163	1280	315	46500	690	Bussmann	170M3817D	DIN1*
-0070-2	202	1810	400	105000	690	Bussmann	170M3819D	DIN1*
Three-phase supply voltage 380 V, **400 V** or 415 V								
-0040-3	69	400	100	4650	690	Bussmann	170M1567D	DIN000
-0050-3	83	520	125	8500	690	Bussmann	170M1568D	DIN000
-0060-3	100	695	160	8500	690	Bussmann	170M1569D	DIN000
-0075-3	142	1630	315	80500	690	Bussmann	170M1572D	DIN000
-0070-3 **	138	1630	315	80500	690	Bussmann	170M1572D	DIN000
-0100-3	163	1280	315	46500	690	Bussmann	170M3817D	DIN1*
-0120-3	198	1810	400	105000	690	Bussmann	170M3819D	DIN1*
-0135-3	221	2210	500	145000	690	Bussmann	170M5810D	DIN2*
-0165-3	254	2620	550	190000	690	Bussmann	170M5811D	DIN2*
-0205-3	286	2620	550	190000	690	Bussmann	170M5811D	DIN2*
Three-phase supply voltage 380 V, 400 V, 415 V, 440 V, 460 V, 480 V or **500** V								
-0050-5	64	400	100	4650	690	Bussmann	170M1567D	DIN000
-0060-5	78	520	125	8500	690	Bussmann	170M1568D	DIN000
-0070-5	95	520	125	8500	690	Bussmann	170M1568D	DIN000
-0105-5	142	1630	315	80500	690	Bussmann	170M1572D	DIN000
-0100-5 **	121	1630	315	80500	690	Bussmann	170M1572D	DIN000
-0120-5	155	1280	315	46500	690	Bussmann	170M3817D	DIN1*
-0140-5	180	1810	400	105000	690	Bussmann	170M3819D	DIN1*
-0165-5	222	2210	500	145000	690	Bussmann	170M5810D	DIN2*
-0205-5	256	2620	550	190000	690	Bussmann	170M5811D	DIN2*
-0255-5	286	2620	550	190000	690	Bussmann	170M5811D	DIN2*
Three-phase supply voltage 525 V, 550 V, 575 V, 600 V, 660 V or **690** V								
-0050-7	52	400	100	4650	690	Bussmann	170M1567D	000
-0060-7	58	400	100	4650	690	Bussmann	170M1567D	000
-0070-7	79	520	125	8500	690	Bussmann	170M1568D	000
-0100-7	91	695	160	16000	690	Bussmann	170M1569D	000
-0120-7	112	750	200	15000	690	Bussmann	170M3815D	1*
-0145-7	131	1520	350	68500	690	Bussmann	170M3818D	DIN1*
-0175-7	162	1520	350	68500	690	Bussmann	170M3818D	DIN1*
-0205-7	186	1610	400	74000	690	Bussmann	170M5808D	DIN2*

[1)] minimum short-circuit current of the installation

** Type not available any more.

Note 1: See also *Planning the electrical installation*: *Thermal overload and short-circuit protection*. For UL recognized fuses, see *NEMA data* on page *118*.

Note 2: In multicable installations, install only one fuse per phase (not one fuse per conductor).

Note 3: Larger fuses than the recommended ones must not be used.

Note 4: Fuses from other manufacturers can be used if they meet the ratings and the melting curve of the fuse does not exceed the melting curve of the fuse mentioned in the table.

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Quick guide for selecting between gG and aR fuses

The table below is a short cut in selecting between gG and aR fuses. The combinations (cable size, cable length, transformer size and fuse type) in the table fulfil the minimum requirements for the proper operation of the fuse.

ACS800-01 size	Cable type		Supply transformer minimum apparent power S_N (kVA)					
	Copper	Aluminium	Max. cable length with gG fuses			Max. cable length with aR fuses		
			10 m	50 m	100 m	10 m	100 m	200 m
Three-phase supply voltage 208 V, 220 V, **230 V** or 240 V								
-0025-2	3×25 Cu	3×35 Al	31	38	-	27	27	-
-0030-2	3×35 Cu	3×50 Al	44	55	-	33	33	-
-0040-2	3×50 Cu	3×70 Al	58	71	-	41	41	-
-0050-2	3×70 Cu	3×95 Al	72	87	-	55	70	-
-0060-2	3×95 Cu	3×120 Al	85	110	-	65	70	-
-0070-2	3×120 Cu	3×185 Al [1)]	99	120	-	81	81	-
Three-phase supply voltage 380 V, **400 V** or 415 V								
-0040-3	3×25 Cu	3×35 Al	54	57	71	48	48	48
-0050-3	3×35 Cu	3×50 Al	76	82	110	58	58	58
-0060-3	3×50 Cu	3×70 Al	100	110	140	70	70	70
-0075-3	3×70 Cu	3×95 Al [2)]	130	140	160	99	99	140
-0070-3 *	3×70 Cu	3×95 Al	130	140	160	96	96	140
-0100-3	3×95 Cu	3×120 Al	150	160	190	120	120	140
-0120-3	3×120 Cu	3×185 Al [1)]	170	190	210	140	140	140
-0135-3	3×150 Cu	3×240 Al [3)]	200	220	250	160	160	160
-0165-3	3×185 Cu	3×240 Al [3)]	240	260	310	180	180	200
-0205-3	3×240 Cu	2×(3×95) Al [4)]	232	257	310	134	153	196
Three-phase supply voltage 380 V, 400 V, 415 V, 440 V, 460 V, 480 V or **500** V								
-0050-5	3×25 Cu	3×35 Al	67	70	79	56	56	56
-0060-5	3×25 Cu	3×50 Al	95	110	130	68	68	68
-0070-5	3×35 Cu	3×70 Al	130	140	160	83	83	83
-0105-5	3×70 Cu	3×95 Al [2)]	160	170	190	130	130	150
-0100-5 *	3×70 Cu	3×95 Al	160	170	190	110	120	150
-0120-5	3×95 Cu	3×120 Al	190	200	220	140	140	150
-0140-5	3×95 Cu	3×150 Al	190	200	220	160	160	160
-0165-5	3×150 Cu	3×240 Al [3)]	250	260	290	200	200	200
-0205-5	3×185 Cu	3×240 Al [3)]	290	320	360	230	230	230
-0255-5	3×240 Cu	2×(3×95) Al [4)]	289	312	355	167	185	218

[1)] This cable type cannot be used in the drive because the lead-through in the drive is too small.

[2)] This cable type cannot be used in the drive because the cable terminal is too small.

[3)] This cable type cannot be used in the drive because the lead-through in the cable connection box is too small (see the *Dimensional drawings*).

[4)] This cable type cannot be used in the drive because the cable lug is not designed for multiple wires.

* Type not available any more.

ACS800-01 size	Cable type		Supply transformer minimum apparent power S_N (kVA)					
	Copper	Aluminium	Max. cable length with gG fuses			Max. cable length with aR fuses		
			10 m	50 m	100 m	10 m	100 m	200 m
Three-phase supply voltage 525 V, 550 V, 575 V, 600 V, 660 V or **690** V								
-0050-7	3×16 Cu	3×25 Al	65	67	70	63	63	63
-0060-7	3×16 Cu	3×25 Al	70	70	70	70	70	70
-0070-7	3×25 Cu	3×50 Al	95	95	99	95	95	95
-0100-7	3×35 Cu	3×50 Al	130	140	150	110	110	110
-0120-7	3×50 Cu	3×70 Al	180	180	190	140	140	140
-0145-7	3×70 Cu	3×95 Al	220	220	240	160	160	160
-0175-7	3×95 Cu	3×120 Al	260	260	280	200	200	200
-0205-7	3×95 Cu	3×150 Al	340	360	390	230	230	230
Note 1: The supply transformer minimum power in kVA is calculated with a z_k value of 6% and frequency 50 Hz.								
Note 2: This table is not intended for transformer selection - that must be done separately.								

The following parameters may effect on the correct operation of the protection:

- cable length, i.e. the longer the cable the weaker the fuse protection, as the long cable limits the fault current
- cable size, i.e. the smaller the cable the weaker the fuse protection, as the small cable size limits the fault current
- transformer size, i.e the smaller the transformer the weaker the fuse protection, as the small transformer limits the fault current
- transformer impedance, i.e. the higher the z_k the weaker the fuse protection as high impedance limits the fault current.

The protection can be improved by installing a larger supply transformer and/or bigger cables, and in most cases by selecting aR fuses instead of gG fuses. Selection of smaller fuses improves the protection, but may also affect the fuse life time and lead to unnecessary operation of the fuses.

In case of any uncertainty regarding the drive protection, please contact your local ABB.

Cable types

The table below gives copper and aluminium cable types for different load currents. Cable sizing is based on max. 9 cables laid on a cable ladder side by side, ambient temperature 30 °C (86 °F), PVC insulation, surface temperature 70 °C (158 °F) (EN 60204-1 and IEC 60364-5-52:2001). For other conditions, size the cables according to local safety regulations, appropriate input voltage and the load current of the drive.

Copper cables with concentric copper shield		**Aluminium cables with concentric copper shield**	
Max. load current A	**Cable type** mm^2	**Max. load current** A	**Cable type** mm^2
13	3×1.5	61	3×25
18	3×2.5	69	3×35
24	3×4	83	3×50
30	3×6	107	3×70
42	3×10	130	3×95
56	3×16	151	3×120
71	3×25	174	3×150
88	3×35	199	3×185
107	3×50	235	3×240
137	3×70	274	3 × (3×50) *
167	3×95	260	2 × (3×95) *
193	3×120		
223	3×150		
255	3×185		
301	3×240		

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* This cable type cannot be used in this drive because the cable lug is not designed for multiple wires.

Cable entries

Brake resistor, mains and motor cable terminal sizes (per phase), accepted cable diameters and tightening torques are given below.

Frame size	U1, V1, W1, U2, V2, W2, R+, R-				Earthing PE	
	Wire size	Max. cable Ø IP21	Cable Ø IP55	Tightening torque	Wire size	Tightening torque
	mm^2	mm	mm	Nm	mm^2	Nm
R2	up to 16*	21	14...20	1.2...1.5	up to 10	1.5
R3	up to 16*	21	14...20	1.2...1.5	up to 10	1.5
R4	up to 25	29	23...35	2…4	up to 16	3.0
R5	6...70	35	23...35	15	6...70	15
R6	95...240 **†	53 †	30...45 †	20...40	95	8

* 16 mm^2 rigid solid cable, 10 mm^2 flexible stranded cable

** with cable lugs 16...70 mm^2, tightening torque 20...40 Nm. These smaller cable lugs are not included in the delivery. See page 67.

† In -0205-3 and -0255-5 units, the maximum cable diameter is 69 mm (IP21 units) or 40...60 mm (IP55 units).

Dimensions, weights and noise

H1: height with cable connection box

H2: height without cable connection box.

Frame size	IP21					IP55				Noise
	H1	H2	Width	Depth	Weight	Height	Width	Depth	Weight	
	mm	mm	mm	mm	kg	mm	mm	mm	kg	dB
R2	405	370	165	226	9	528	263	241	16	62
R3	471	420	173	265	14	528	263	273	18	62
R4	607	490	240	274	26	774	377	278	33	62
R5	739	602	265	286	34	775	377	308	51	65
R6	880*	700	300	399	67*	923	420	420	77	65

* In -0205-3 and -0255-5 units, H1 is 977 mm and weight is 70 kg.

Package dimensions and weights

Frame size	IP21				IP55			
	H1	Width	Depth	Weight	Height	Width	Depth	Weight
	mm	mm	mm	kg	mm	mm	mm	kg
R2	400	470	270	2	370	620	390	5
R3	430	500	270	2	370	620	390	5
R4	520	560	340	2	410	860	460	5
R5	540	670	350	2	410	860	460	5
R2-R5 with option +Q950 or +Q967	580	930	560	17	580	930	560	17
R6	549	1085	400	15	577	1250	565	20

NEMA data

Ratings

The NEMA ratings for the ACS800-U1 with 60 Hz supplies are given below. The symbols are described below the table. For sizing, derating and 50 Hz supplies, see *IEC data* on page *105*.

ACS800-U1 size	I_{max}	Normal use		Heavy-duty use		Frame size	Air flow	Heat dissipation
		I_{2N}	P_N	I_{2hd}	P_{hd}			
	A	A	hp	A	hp		ft^3/min	BTU/Hr
Three-phase supply voltage 208 V, 220 V, **230 V** or 240 V								
-0002-2	8.2	6.6	1.5	4.6	1	R2	21	350
-0003-2	10.8	8.1	2	6.6	1.5	R2	21	350
-0004-2	13.8	11	3	7.5	2	R2	21	410
-0006-2	24	21	5	13	3	R3	41	550
-0009-2	32	27	7.5	17	5	R3	41	680
-0011-2	46	34	10	25	7.5	R3	41	850
-0016-2	62	42	15	31	10	R4	61	1150
-0020-2	72	54	20 [1)]	42	15 [2)]	R4	61	1490
-0025-2	86	69	25	54	20 [2)]	R5	147	1790
-0030-2	112	80	30	68	25 [2)]	R5	147	2090
-0040-2	138	104	40 [1)]	80	30 [2)]	R5	147	2770
-0050-2	164	132	50	104	40	R6	238	3370
-0060-2	202	157	60	130	50 [2)]	R6	238	4050
-0070-2	282	192	75	154	60 [2)]	R6	238	4910
Three-phase supply voltage 380 V, 400 V, 415 V, 440 V, **460** V or 480 V								
-0004-5	6.5	4.9	3	3.4	2	R2	21	410
-0005-5	8.2	6.2	3	4.2	2	R2	21	480
-0006-5	10.8	8.1	5	5.6	3	R2	21	550
-0009-5	13.8	11	7.5	8.1	5	R2	21	690
-0011-5	17.6	14	10	11	7.5	R2	21	860
-0016-5	24	21	15	15	10	R3	41	1150
-0020-5	32	27	20	21	15	R3	41	1490
-0025-5	46	34	25	27	20	R3	41	1790
-0030-5	62	42	30	34	25	R4	61	2090
-0040-5	72	52	40	37	30 [3)]	R4	61	2770
-0050-5	86	65	50	52	40	R5	147	3370
-0060-5	112	79	60	65	50	R5	147	4050
-0070-5	138	96	75	77	60	R5	147	4910
-0105-5	170	141	100	100	75	R5	238	7340
-0100-5 [5)]	164	124	100	96	75	R6	238	6610
-0120-5	202	157	125	124	100	R6	238	7890
-0140-5	282	180	150	156	125	R6	238	9600
-0205-5	326	245	200	215	150	R6	238	12980

ACS800-U1 size	I_{max}	Normal use		Heavy-duty use		Frame size	Air flow	Heat dissipation
		I_{2N}	P_N	I_{2hd}	P_{hd}			
	A	A	hp	A	hp		ft^3/min	BTU/Hr
Three-phase supply voltage 525 V, **575 V**, 600 V								
-0011-7	14	11.5	10	8.5	7.5	R4	61	1050
-0016-7	19	15	10	11	10	R4	61	1200
-0020-7	28	20	15/20 [4]	15	15 [2]	R4	61	1550
-0025-7	38	23	20	20	20 [2]	R4	61	1850
-0030-7	44	30	25/30 [4]	25	25 [2]	R4	61	2100
-0040-7	54	34	30	30	30 [2]	R4	61	2400
-0050-7	68	46	40	40	40 [2]	R5	147	2900
-0060-7	84	52	50	42	40	R5	147	3450
-0070-7	104	73	60	54	50	R6	238	4200
-0100-7	124	86	75	62	60	R6	238	5650
-0120-7	172	108	100	86	75	R6	238	6700
-0145-7	190	125	125	99	100	R6	238	9100
-0175-7	245	155	150	131	125	R6	238	11850
-0205-7	245	192	200	147	150	R6	238	14300

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[1] Overload may be limited to 5% at high speeds (> 90% speed) by the internal power limit of the drive. The limitation also depends on motor characteristics and network voltage.

[2] Overload may be limited to 40% at high speeds (> 90% speed) by the internal power limit of the drive. The limitation also depends on motor characteristics and network voltage.

[3] Special 4-pole high-efficiency NEMA motor

[4] Higher rating is available with special 4-pole high-efficiency NEMA motor

[5] Type not available any more.

Symbols

Nominal ratings

I_{max} maximum output current. Available for 10 s at start, otherwise as long as allowed by drive temperature.

Normal use (10% overload capability)

I_{2N} continuous rms current. 10% overload is typically allowed for one minute every 5 minutes.

P_N typical motor power. The power ratings apply to most 4-pole NEMA rated motors (230 V, 460 V or 575 V).

Heavy-duty use (50% overload capability)

I_{2hd} continuous rms current. 50% overload is typically allowed for one minute every 5 minutes.

P_{hd} typical motor power. The power ratings apply to most 4-pole NEMA rated motors (230 V, 460 V or 575 V).

Note 1: The ratings apply at an ambient temperature of 40 °C (104 °F). In lower temperatures the ratings are higher (except I_{max}).

Sizing

See page *107*.

Derating

See page *108*.

Fuses

UL class T fuses for branch circuit protection are listed below. Fast acting class T or faster fuses are recommended in the USA.

Check from the fuse time-current curve that the operating time of the fuse is below 0.5 seconds for units of frame sizes R2 to R4 and 0.1 seconds for units of frame sizes R5 and R6. The operating time depends on the supply network impedance and the cross-sectional area and length of the supply cable. The short-circuit current can be calculated as shown in section *Frame sizes R5 and R6* on page *110*.

Note 1: See also *Planning the electrical installation*: *Thermal overload and short-circuit protection*.

Note 2: In multicable installations, install only one fuse per phase (not one fuse per conductor).

Note 3: Larger fuses must not be used.

Note 4: Fuses from other manufacturers can be used if they meet the ratings and the melting curve of the fuse does not exceed the melting curve of the fuse mentioned in the table.

ACS800-U1 type	**Frame size**	**Input current**	**Fuse**				
		A	A	V	Manufacturer	Type	UL class
Three-phase supply voltage 208 V, 220 V, **230 V** or 240 V							
-0002-2	R2	5.2	10	600	Bussmann	JJS-10	T
-0003-2	R2	6.5	10	600	Bussmann	JJS-10	T
-0004-2	R2	9.2	15	600	Bussmann	JJS-15	T
-0006-2	R3	18	25	600	Bussmann	JJS-25	T
-0009-2	R3	24	30	600	Bussmann	JJS-30	T
-0011-2	R3	31	40	600	Bussmann	JJS-40	T
-0016-2	R4	38	50	600	Bussmann	JJS-50	T
-0020-2	R4	49	70	600	Bussmann	JJS-70	T
-0025-2	R5	64	90	600	Bussmann	JJS-90	T
-0030-2	R5	75	100	600	Bussmann	JJS-100	T
-0040-2	R5	102	125	600	Bussmann	JJS-125	T
-0050-2	R6	126	175	600	Bussmann	JJS-175	T
-0060-2	R6	153	200	600	Bussmann	JJS-200	T
-0070-2	R6	190	250	600	Bussmann	JJS-250	T
Three-phase supply voltage 380 V, 400 V, 415 V, 440 V, **460 V** or 480 V							
-0004-5	R2	4.1	10	600	Bussmann	JJS-10	T
-0005-5	R2	5.4	10	600	Bussmann	JJS-10	T
-0006-5	R2	6.9	10	600	Bussmann	JJS-10	T
-0009-5	R2	9.8	15	600	Bussmann	JJS-15	T
-0011-5	R2	13	20	600	Bussmann	JJS-20	T
-0016-5	R3	18	25	600	Bussmann	JJS-25	T
-0020-5	R3	24	35	600	Bussmann	JJS-35	T
-0025-5	R3	31	40	600	Bussmann	JJS-40	T
-0030-5	R4	40	50	600	Bussmann	JJS-50	T
-0040-5	R4	52	70	600	Bussmann	JJS-70	T
-0050-5	R5	63	80	600	Bussmann	JJS-80	T
-0060-5	R5	77	100	600	Bussmann	JJS-100	T
-0070-5	R5	94	125	600	Bussmann	JJS-125	T
-0105-5	R5	138	150	600	Bussmann	JJS-150	T
-0100-5 *	R6	121	150	600	Bussmann	JJS-150	T
-0120-5	R6	155	200	600	Bussmann	JJS-200	T
-0140-5	R6	179	225	600	Bussmann	JJS-225	T
-0205-5	R6	243	350	600	Bussmann	JJS-350	T

ACS800-U1 type	Frame size	Input current	Fuse				
		A	A	V	Manufacturer	Type	UL class
Three-phase supply voltage 525 V, **575 V**, 600 V							
-0011-7	R4	10	20	600	Bussmann	JJS-20	T
-0016-7	R4	13	20	600	Bussmann	JJS-20	T
-0020-7	R4	19	30	600	Bussmann	JJS-30	T
-0025-7	R4	21	30	600	Bussmann	JJS-30	T
-0030-7	R4	29	45	600	Bussmann	JJS-45	T
-0040-7	R4	32	45	600	Bussmann	JJS-45	T
-0050-7	R5	45	70	600	Bussmann	JJS-70	T
-0060-7	R5	51	80	600	Bussmann	JJS-80	T
-0070-7	R6	70	100	600	Bussmann	JJS-100	T
-0100-7	R6	82	125	600	Bussmann	JJS-125	T
-0120-7	R6	103	150	600	Bussmann	JJS-150	T
-0145-7	R6	121	200	600	Bussmann	JJS-200	T
-0175-7	R6	150	200	600	Bussmann	JJS-200	T
-0205-7	R6	188	250	600	Bussmann	JJS-250	T

* Type not available any more.

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Cable types

Cable sizing is based on NEC Table 310-16 for copper wires, 75 °C (167 °F) wire insulation at 40 °C (104 °F) ambient temperature. Not more than three current-carrying conductors in raceway or cable or earth (directly buried). For other conditions, dimension the cables according to local safety regulations, appropriate input voltage and the load current of the drive.

Copper cables with concentric copper shield	
Max. load current A	**Cable type** AWG/MCM
18	14
22	12
31	10
44	8
57	6
75	4
88	3
101	2
114	1
132	1/0
154	2/0
176	3/0
202	4/0
224	250 MCM or 2 × 1
251	300 MCM or 2 × 1/0

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Cable Entries

Brake resistor, input and motor cable (per phase) terminal sizes, accepted cable diameters and tightening torques are given below.

Frame size	U1, V1, W1, U2, V2, W2, R+, R-			Earthing PE	
	Wire size	Knock-out hole Ø (UL type 1)	Tightening torque	Wire size	Tightening torque
	AWG	in.	lbf ft	AWG	lbf ft
R2	up to 6*	1.10	0.9…1.1	up to 8	1.1
R3	up to 6*	1.14	0.9...1.1	up to 8	1.1
R4	up to 4	1.38	1.5…3.0	up to 5	2.2
R5	10…2/0	1.97	11.1	10...2/0	11.1
R6	3/0…500 MCM** †	2.40 †	14.8...29.5	4/0	5.9

* 6 AWG rigid solid cable, 8 AWG flexible stranded cable

** with cable lugs 6...2/0 AWG, tightening torque 14.8...29.5 lbf ft. These smaller cable lugs are not included in the delivery. See page 67.

† In -0205-3 and -0255-5 units, the knockout hole diameter is 3.50 in.

Dimensions, weights and noise

H1: height with gland box

H2: height without gland box.

Frame size	UL type 1					UL type 12				Noise
	H1	H2	Width	Depth	Weight	Height	Width	Depth	Weight	
	in.	in.	in.	in.	lb	in.	in.	in.	lb	dB
R2	15.96	14.57	6.50	8.89	20	20.78	10.35	9.49	34	62
R3	18.54	16.54	6.81	10.45	31	20.78	10.35	10.74	41	62
R4	23.87	19.29	9.45	10.79	57	30.49	14.84	10.94	73	62
R5	29.09	23.70	10.43	11.26	75	30.49	14.84	12.14	112	65
R6	34.65*	27.56	11.81	15.75	148*	36.34	16.52	16.54	170	65

* In -0205-3 and -0255-5 units, H1 is 38.46 in. and weight is 150 lb.

Package dimensions and weights

Frame size	IP21				IP55			
	H1	Width	Depth	Weight	Height	Width	Depth	Weight
	in.	in.	in.	lb	in.	in.	in.	lb
R2	15.7	18.5	10.6	4.4	14.6	22.4	15.4	11
R3	16.9	19.7	10.6	4.4	14.6	22.4	15.4	11
R4	20.5	22.0	13.4	4.4	16.1	33.9	18.1	11
R5	21.26	26.4	13.8	4.4	16.1	33.9	18.1	11
R2-R5 with option +Q950 or +Q967	22.8	36.6	22.0	37	22.8	36.6	22.0	37
R6	21.6	42.7	15.7	33	22.7	49.2	22.2	44

Input power connection

Voltage (U_1)	208/220/230/240 V AC 3-phase ± 10% for 230 V AC units 380/400/415 V AC 3-phase ± 10% for 400 V AC units 380/400/415/440/460/480/500 V AC 3-phase ± 10% for 500 V AC units 525/550/575/600/660/690 V AC 3-phase ± 10% for 690 V AC units
Short-circuit withstand strength (IEC 60439-1)	Maximum allowable prospective short-circuit current is 65 kA when protected by fuses given in the *IEC data* fuse tables.
Short-circuit current protection (UL 508 C CSA C22.2 No. 14-05)	US and Canada: The drive is suitable for use on a circuit capable of delivering not more than 100 kA rms symmetrical amperes at the drive nominal voltage when protected by fuses given in the *NEMA data* fuse table.
Frequency	48 to 63 Hz, maximum rate of change 17%/s
Imbalance	Max. ± 3% of nominal phase to phase input voltage
Fundamental power factor (cos phi$_1$)	0.98 (at nominal load)

Motor connection

Voltage (U_2)
0 to U_1, 3-phase symmetrical, U_{max} at the field weakening point

Frequency
DTC mode: 0 to 3.2 · f_{FWP}. Maximum frequency 300 Hz.

$$f_{FWP} = \frac{U_{Nmains}}{U_{Nmotor}} \cdot f_{Nmotor}$$

f_{FWP}: frequency at field weakening point; U_{Nmains}: mains (input power) voltage; U_{Nmotor}: rated motor voltage; f_{Nmotor}: rated motor frequency

Frequency resolution
0.01 Hz

Current
See section *IEC data.*

Power limit
1.5 · P_{hd}, 1.1 · P_N or $P_{cont.max}$ (whichever value is greatest)

Field weakening point
8 to 300 Hz

Switching frequency
3 kHz (average). In 690 V units 2 kHz (average).

Maximum recommended motor cable length

Sizing method	**Max. motor cable length**	
	DTC control	Scalar control
according to I_{2N} and I_{2hd}	R2 to R3: 100 m (328 ft) R4 to R6: 300 m (984 ft)	R2: 150 m (492 ft) R3 to R6: 300 m (984 ft)
according to $I_{cont.max}$ at ambient temperatures below 30 °C (86 °F)		
according to $I_{cont.max}$ at ambient temperatures above 30 °C (86 °F)	R2: 50 m (164 ft) **Note:** This applies to units with EMC filter also. R3 and R4: 100 m (328 ft) R5 and R6: 150 m (492 ft)	

Note: With cables longer than 100 m (328 ft), the EMC Directive requirements may not be fulfilled. See section *CE marking*.

Efficiency

Approximately 98% at nominal power level

Cooling

Method	Internal fan, flow direction from bottom to top.
Free space around the unit	See chapter *Mechanical installation*.

Degree of protection

	IP21 (UL type 1) and IP55 (UL type 12). Without the connection box and front cover, the unit must be protected against contact according to IP2x [see chapter *Electrical installation*: *Cabinet installation (IP21, UL type 1)*].

AGPS-11C (option +Q950)

Nominal input voltage	115...230 VAC ±10%
Nominal input current	0.1 A (230 V) / 0.2 A (115 V)
Nominal frequency	50/60 Hz
Max. external fuse	16 A
X1 terminal sizes	3 x 2.5 mm^2
Output voltage	15 VDC ±0.5 V
Nominal output current	0.4 A
X2 terminal block type	JST B4P-VH
Degree of protection	IP20
Ambient temperature	0...50 °C (32...122 °F)
Relative humidity	Max. 90%, no condensation allowed
Dimensions (with enclosure)	167 x 128 x 52 mm (height x weight x depth)
Weight (with enclosure)	0.75 kg (1.65 lb)
Approvals	C-UL, US listed

ASTO-11C (option +Q967)

Supply voltage range	+24 V DC +/- 10%
Current consumption	40 mA (20mA per channel)
Supply cable	A single-shielded twisted pair
Maximum cable length	300 m
Conductor min. cross section	0.5 mm^2, 20 AWG
X1 terminal sizes	4 x 2.5 mm^2
Nominal output current	0.4 A
X2 terminal block type	JST B4P-VH
Degree of protection	IP20
Ambient temperature	0...50 °C (32...122 °F)
Relative humidity	Max. 90%, no condensation allowed
Altitude in operation	0…2000 m (6562 ft)
Dimensions (with enclosure)	167 x 128 x 52 mm (height x weight x depth)
Weight (with enclosure)	0.75 kg (1.65 lb)

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 to 4000 m (13123 ft) above sea level [above 1000 m (3281 ft), see section *Derating*] Drives with option +Q967: 0 to 2000 (6562 ft)	-	-
Air temperature	-15 to +50 °C (5 to 122 °F). No frost allowed. See section *Derating*.	-40 to +70 °C (-40 to +158 °F)	-40 to +70 °C (-40 to +158 °F)
Relative humidity	5 to 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.		
	Boards without coating: Chemical gases: Class 3C1 Solid particles: Class 3S2 **Boards with coating:** Chemical gases: Class 3C2 Solid particles: Class 3S2	**Boards without coating:** Chemical gases: Class 1C2 Solid particles: Class 1S3 **Boards with coating:** Chemical gases: Class 1C2 Solid particles: Class 1S3	**Boards without coating:** Chemical gases: Class 2C2 Solid particles: Class 2S2 **Boards with coating:** Chemical gases: Class 2C2 Solid particles: Class 2S2
Atmospheric pressure	70 to 106 kPa 0.7 to 1.05 atmospheres	70 to 106 kPa 0.7 to 1.05 atmospheres	60 to 106 kPa 0.6 to 1.05 atmospheres
Vibration (IEC 60068-2)	Max. 1 mm (0.04 in.) (5 to 13.2 Hz), max. 7 m/s^2 (23 ft/s^2) (13.2 to 100 Hz) sinusoidal	Max. 1 mm (0.04 in.) (5 to 13.2 Hz), max. 7 m/s^2 (23 ft/s^2) (13.2 to 100 Hz) sinusoidal	Max. 3.5 mm (0.14 in.) (2 to 9 Hz), max. 15 m/s^2 (49 ft/s^2) (9 to 200 Hz) sinusoidal
Shock (IEC 60068-2-27)	Not allowed	Max. 100 m/s^2 (330 $ft./s^2$), 11 ms	Max. 100 m/s^2 (330 $ft./s^2$), 11 ms
Free fall	Not allowed	250 mm (10 in.) for weight under 100 kg (220 lb) 100 mm (4 in.) for weight over 100 kg (220 lb)	250 mm (10 in.) for weight under 100 kg (220 lb) 100 mm (4 in.) for weight over 100 kg (220 lb)

Materials

Drive enclosure	• PC/ABS 2.5 mm, colour NCS 1502-Y (RAL 9002 / PMS 420 C) • hot-dip zinc coated steel sheet 1.5 to 2 mm, thickness of coating 100 micrometres • cast aluminium AlSi (R2 and R3) • extruded aluminium AlSi (R4 to R6)
Package	Depends on the frame size and selected options: cardboard, heavy duty cardboard or plywood, EPS cushions (expanded polystyrene), wooden pallet Plastic covering of the package: PE-LD, bands PP or steel.
Disposal	The main parts of the drive can be recycled to preserve natural resources and energy. Product parts and materials should be dismantled and separated. Generally all metals, such as steel, aluminum, copper and its alloys, and precious metals can be recycled as material. Plastics, rubber, cardboard and other packaging material can be used in energy recovery. Printed circuit boards and DC capacitors (C1-1 to C1-x) need selective treatment according to IEC 62635 guidelines. To aid recycling, plastic parts are marked with an appropriate identification code. Contact your local ABB distributor for further information on environmental aspects and recycling instructions for professional recyclers. End of life treatment must follow international and local regulations.

Applicable standards

• EN 50178:1997	*Electronic equipment for use in power installations*
• EN 60204-1:2006 +A1:2009	*Safety of machinery. Electrical equipment of machines. Part 1: General requirements. Provisions for compliance:* The final assembler of the machine is responsible for installing - an emergency-stop device - a supply disconnecting device.
• EN 60529:1991 + corrigendum May 1993 + A1:2000	*Degrees of protection provided by enclosures (IP code)*
• IEC 60664-1:2007	*Insulation coordination for equipment within low-voltage systems. Part 1: Principles, requirements and tests.*
• EN 61800-3:2004	*Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods*
• UL 508C (2002)	*UL Standard for Safety, Power Conversion Equipment, second edition*
• NEMA 250 (2003)	*Enclosures for Electrical Equipment (1000 Volts Maximum)*
• CSA C22.2 No. 14-05 (2005)	*Industrial control equipment*

CE marking

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

Compliance with the European Low Voltage Directive

The compliance with the European Low Voltage Directive has been verified according to standards EN 60204-1 and EN 50178.

Compliance with the European EMC Directive

The EMC Directive defines the requirements for immunity and emissions of electrical equipment used within the European Union. The EMC product standard (EN 61800-3:2004) covers requirements stated for drives. See section *Compliance with EN 61800-3:2004* below.

Compliance with the European Machinery Directive

The drive is an electronic product which is covered by the European Low Voltage Directive. However, the drive can be equipped with the Safe torque off function and other safety functions for machinery which, as safety components, are in the scope of the Machinery Directive. These functions of the drive comply with European harmonized standards such as EN 61800-5-2. The declaration of conformity for each function is in the appropriate function-specific manual.

Compliance with EN 61800-3:2004

Definitions

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

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

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

Drive of category C2: drive of rated voltage less than 1000 V and intended to be installed and commissioned only by a professional when used in the first environment. **Note:** A professional is a person or organisation having necessary skills in installing and/or commissioning 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.

First environment (drive of category C2)

The drive complies with the standard with the following provisions:

1. The drive is equipped with EMC filter +E202.
2. The motor and control cables are selected as specified in the hardware manual.
3. The drive is installed according to the instructions given in the hardware manual.
4. **Maximum cable length is 100 metres.**

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

Note: It is not allowed to install a drive equipped with EMC filter +E202 on IT (ungrounded) systems. The supply network becomes connected to ground potential through the EMC filter capacitors which may cause danger or damage the unit.

Second environment (drive of category C3)

The drive complies with the standard with the following provisions:

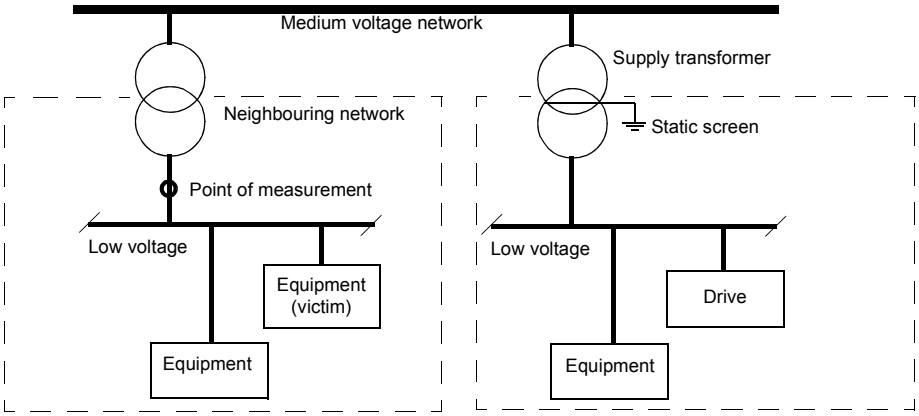
1. Frame sizes R2…R5: The drive is equipped with EMC filter +E200. The filter is suitable for TN (earthed) systems only.
   Frame size R6: The drive is equipped with EMC filter +E210. The filter is suitable for TN (grounded) and IT (ungrounded) systems.
2. The motor and control cables are selected as specified in the hardware manual.
3. The drive is installed according to the instructions given in the hardware manual.
4. **Maximum cable length is 100 metres**.

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.

Second environment (drive of category C4)

If the provisions under *Second environment (drive of category C3)* cannot be met, e.g. the drive cannot be equipped with EMC filter +E200 when installed to an IT (ungrounded) network, the requirements of the standard can be met as follows:

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



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

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.

“C-tick” marking

A “C-tick” mark is attached to each drive in order to verify compliance with the EMC product standard (EN 61800-3:2004), required under the Trans-Tasman Electromagnetic Compatibility Scheme for levels 1, 2 and 3 in Australia and New Zealand. See section *Compliance with EN 61800-3:2004*.

Marine type approvals

The ACS800-01/U1 drives with option +C132 are marine-type-approved.

For more information, see *ACS800-01/U1/04/U4 Marine Supplement* [3AFE68291275 (English)].

UL/CSA markings

The ACS800-01 and ACS800-U1 units of UL type 1 are cULus listed and CSA marked.

UL checklist

- The drive is to be used in a heated, indoor controlled environment. The drive must be installed in clean air according to enclosure classification. Cooling air must be clean, free from corrosive materials and electrically conductive dust. See section *Ambient conditions* for specific limits.
- The maximum ambient air temperature is 40 °C (104 °F) at rated current. The current is derated for 40 to 50 °C (104 to 122 °F).
- The drive is suitable for use on a circuit capable of delivering not more than 100 kA rms symmetrical amperes at the drive nominal voltage (600 V maximum for 690 V units) when protected by fuses given in the NEMA data fuse table. The ampere rating is based on tests done according to UL 508C.
- The cables located within the motor circuit must be rated for at least 75 °C (167 °F) in UL-compliant installations.
- The input cable must be protected with fuses. Circuit breakers must not be used without fuses in the USA. Suitable IEC (class aR) fuses and UL (class T) fuses are listed in this hardware manual.
- For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code (NEC) and any applicable local codes. To fulfil this requirement, use the UL classified fuses.
- For installation in Canada, branch circuit protection must be provided in accordance with the Canadian Electrical Code and any applicable provincial codes. To fulfil this requirement, use the UL classified fuses.
- The drive provides overload protection in accordance with the National Electrical Code (NEC). See the firmware manual for setting. Default setting is off, must be activated at start-up.
- Brake chopper - ABB has brake choppers that, when applied with appropriately sized brake resistors, will allow the drive to dissipate regenerative energy (normally associated with quickly decelerating a motor). Proper application of the brake chopper is defined in chapter *Resistor braking*.

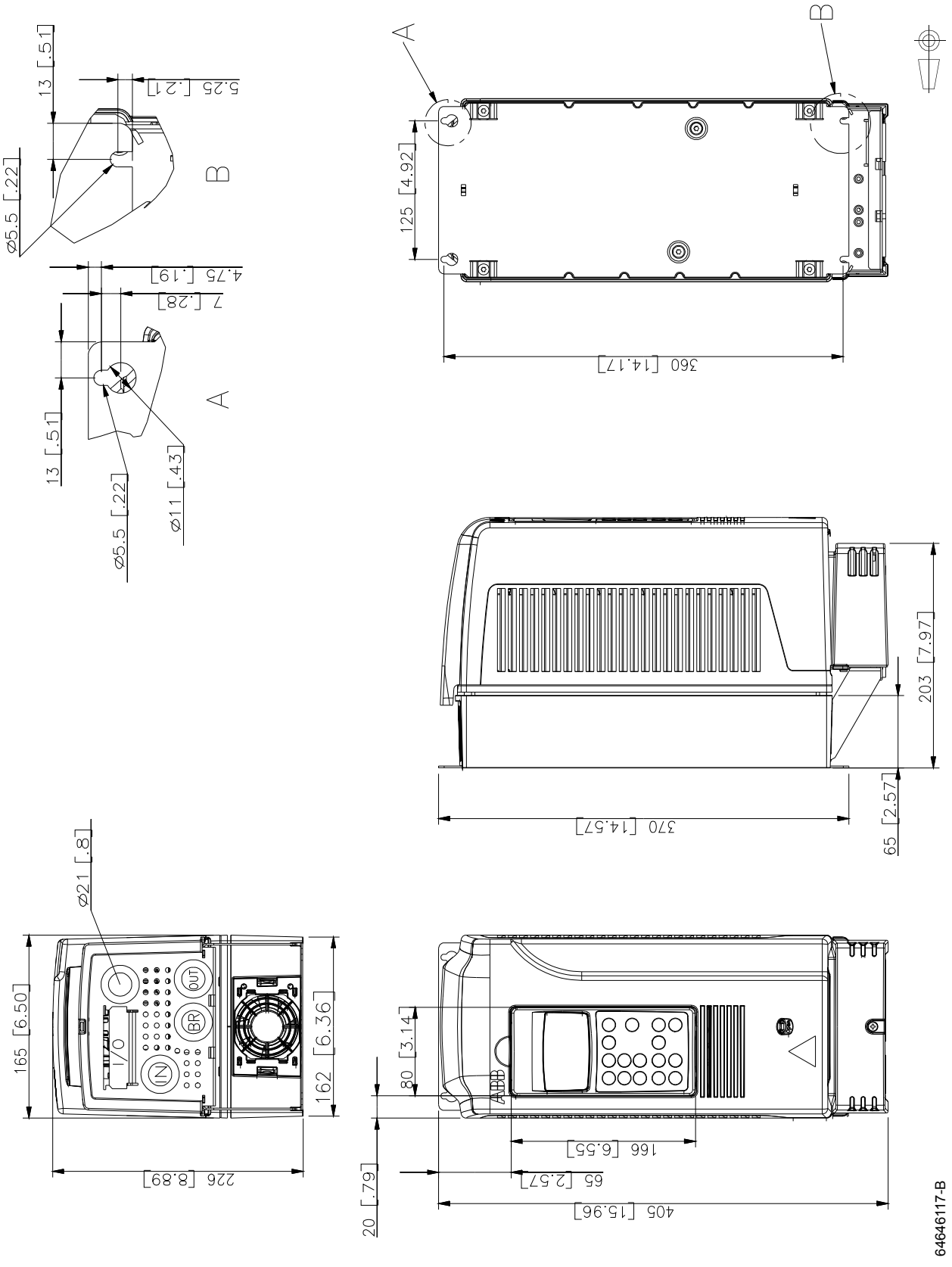
Disclaimer

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.

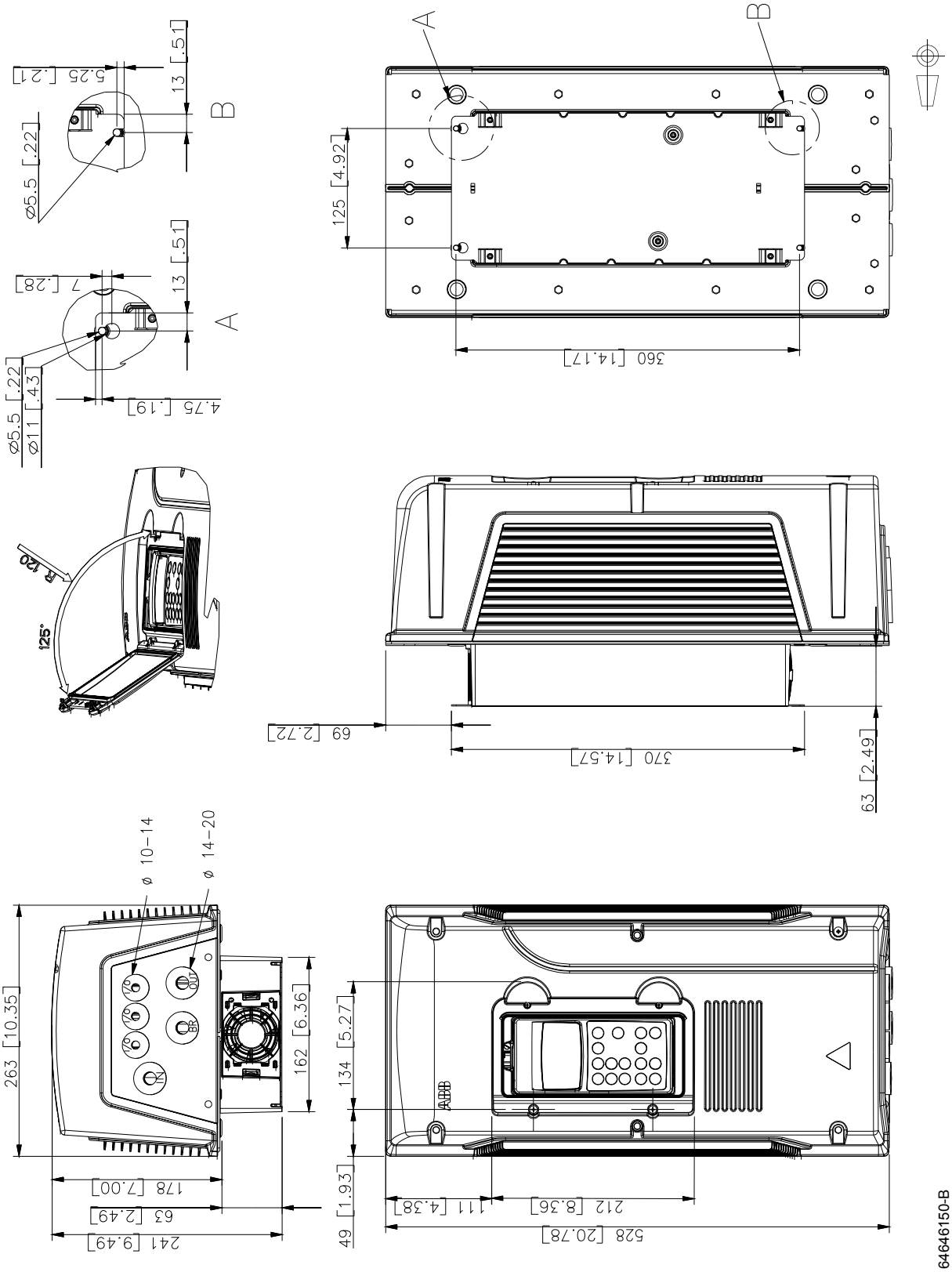
Dimensional drawings

Dimensional drawings of the ACS800-01 are shown below. The dimensions are given in millimetres and [inches].

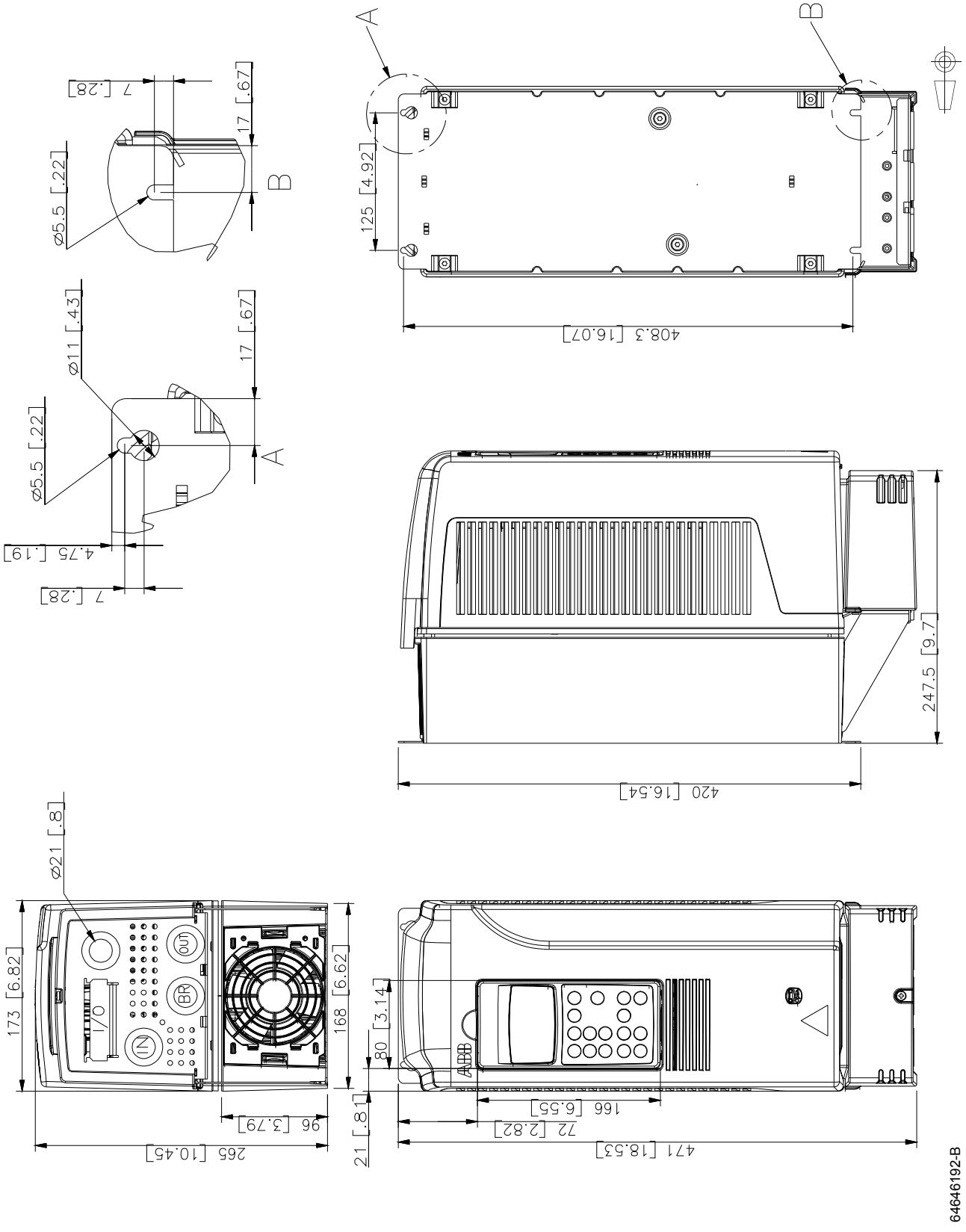
Frame size R2 (IP21, UL type 1)



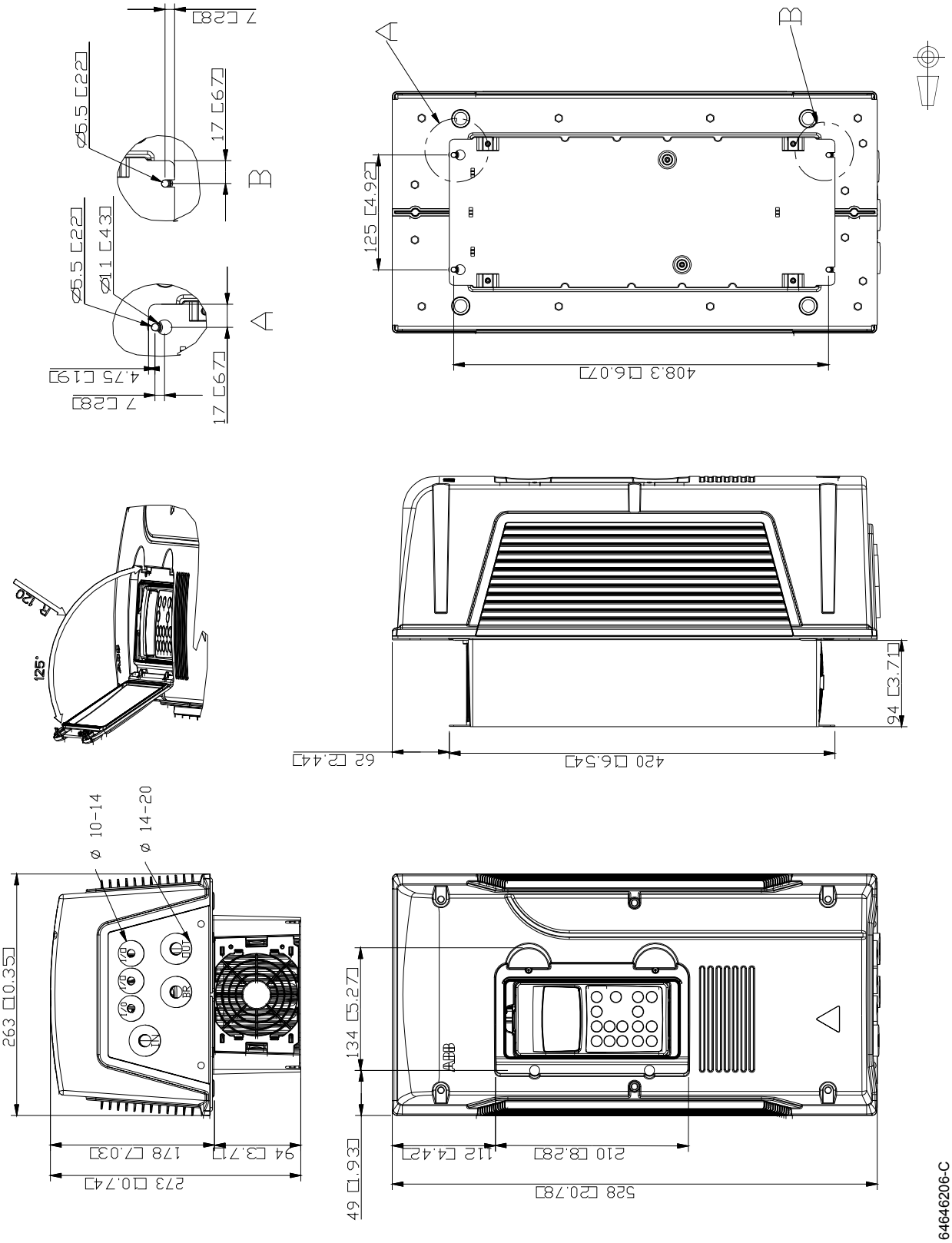
Frame size R2 (IP55, UL type 12)



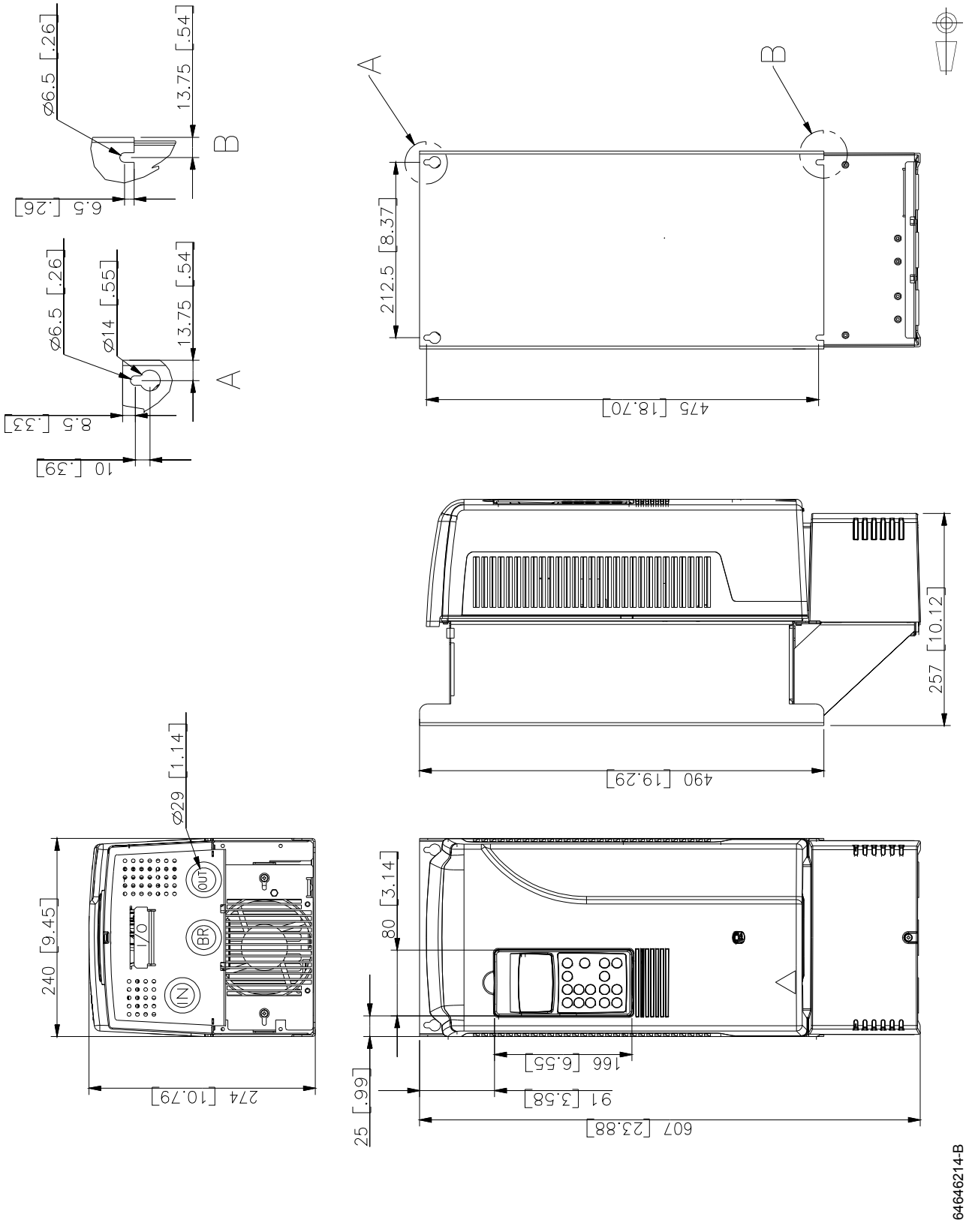
Frame size R3 (IP21, UL type 1)



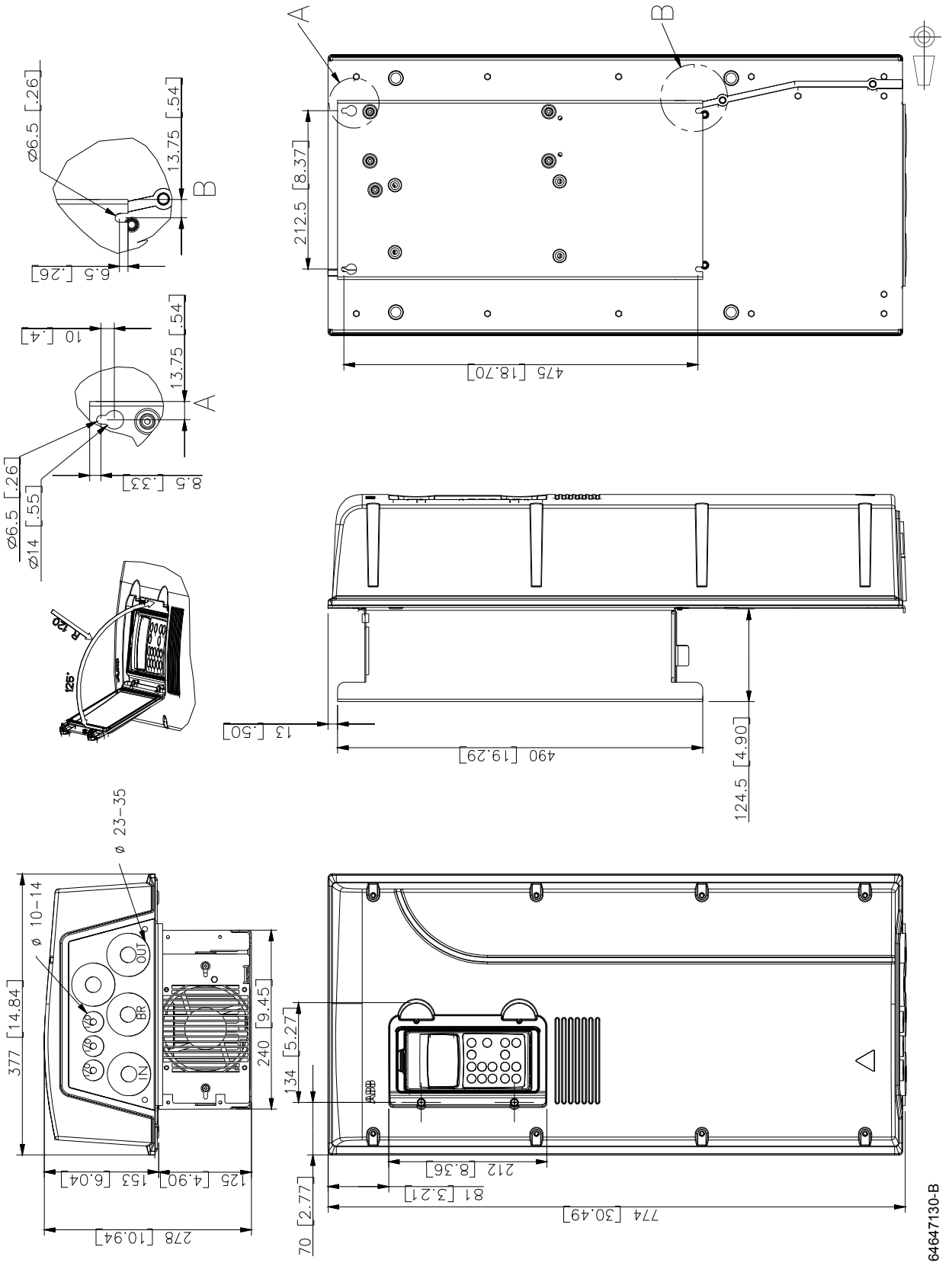
Frame size R3 (IP55, UL type 12)



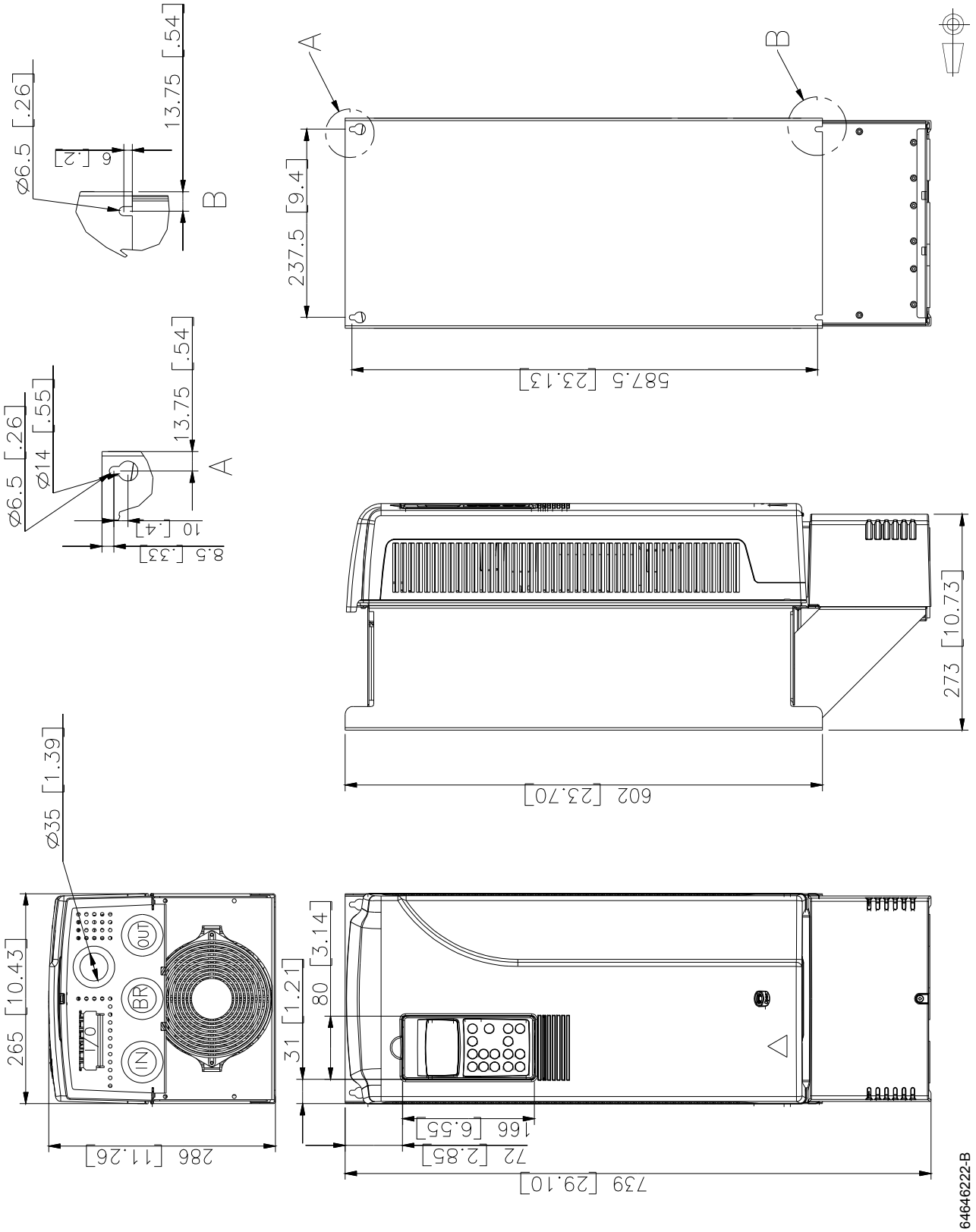
Frame size R4 (IP21, UL type 1)



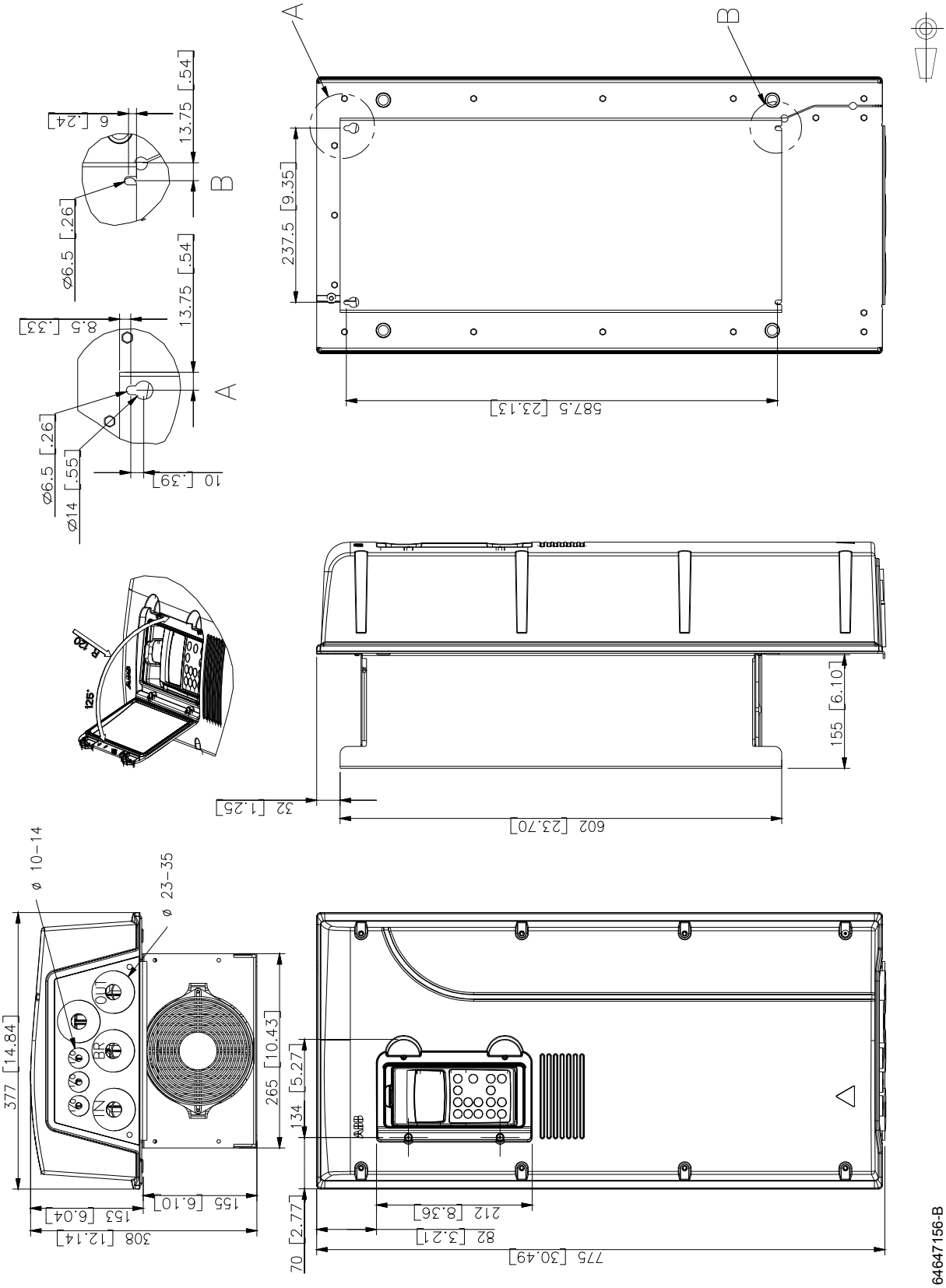
Frame size R4 (IP55, UL type 12)



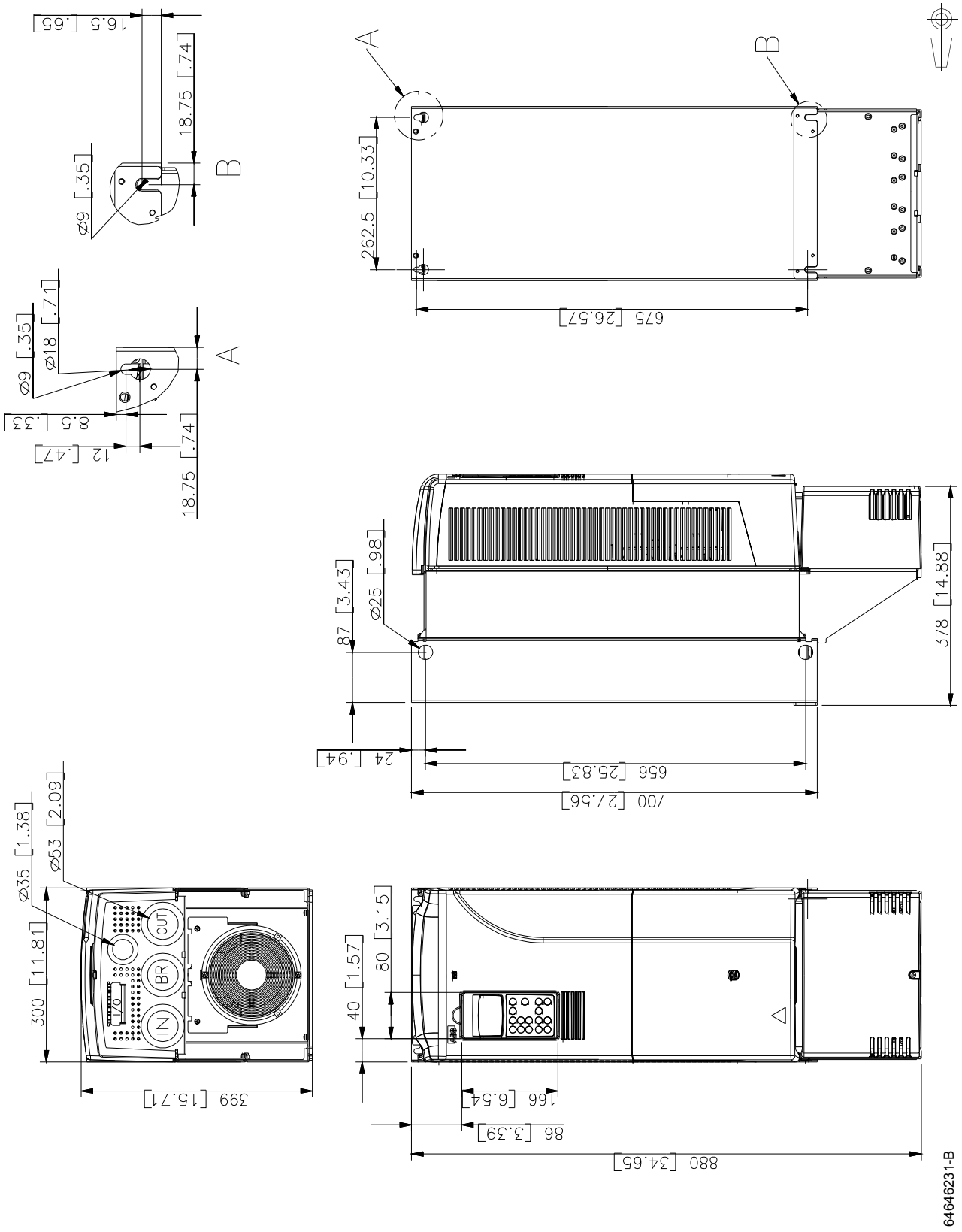
Frame size R5 (IP21, UL type 1)



Frame size R5 (IP55, UL type 12)

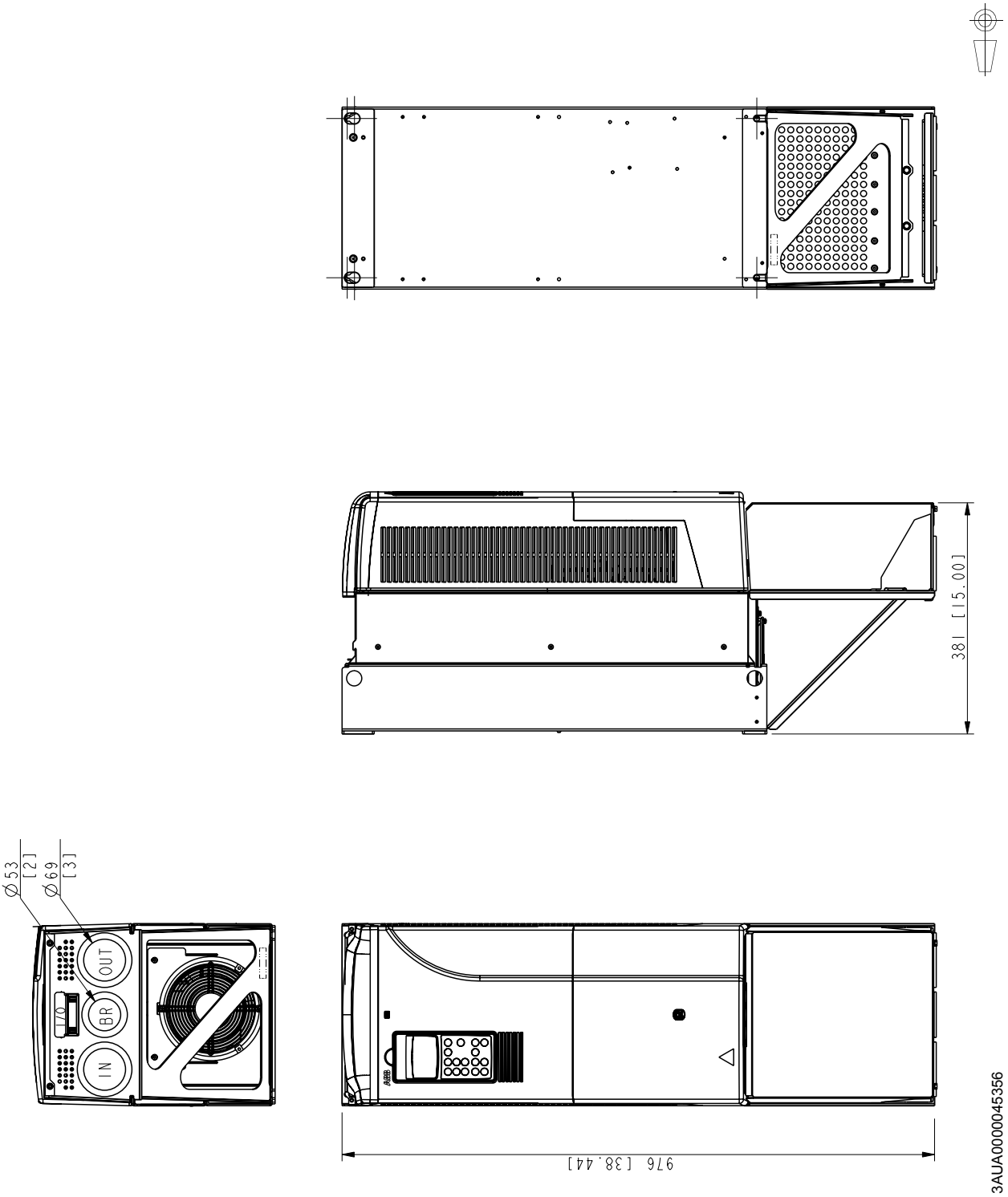


Frame size R6 (IP21, UL type 1)



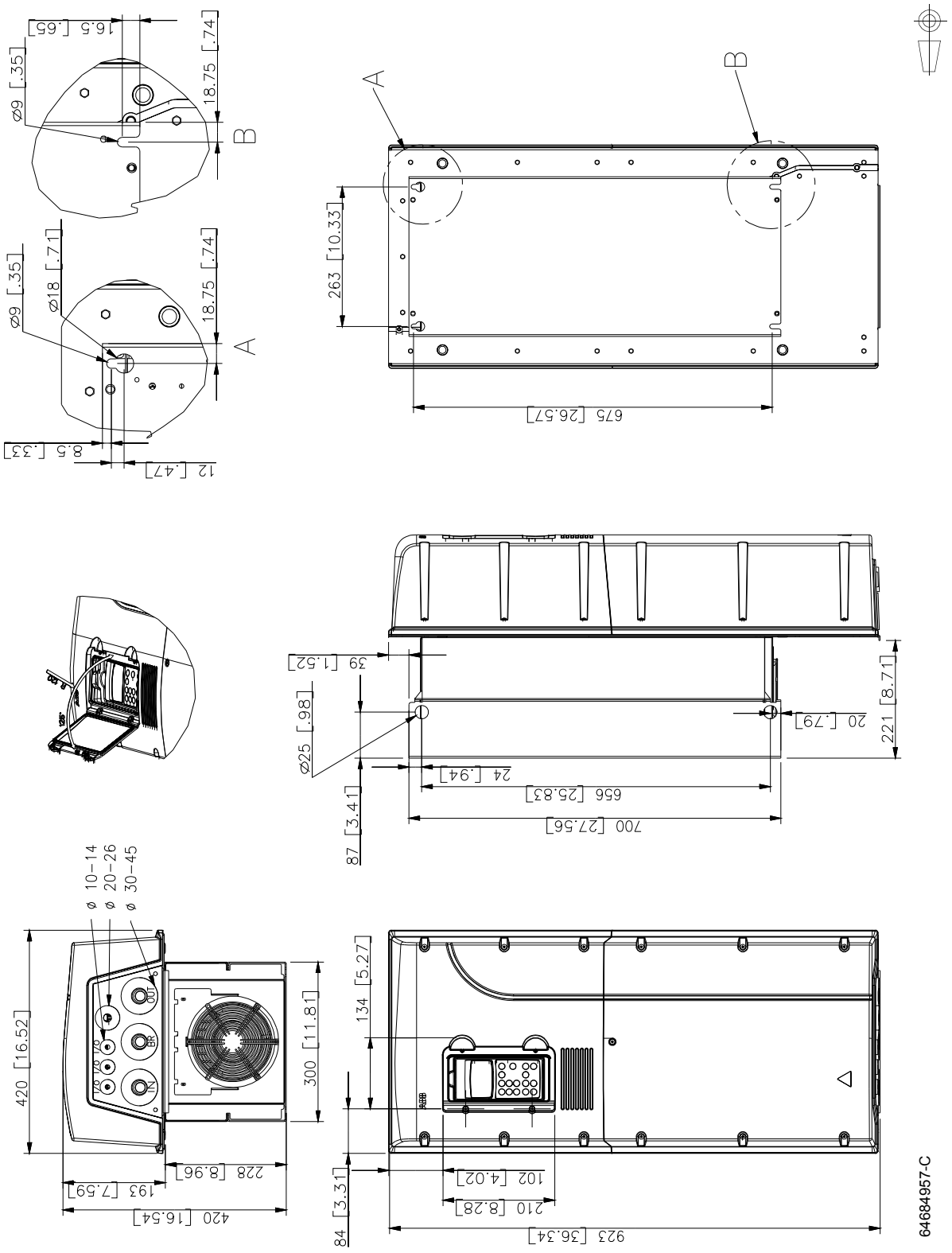
Frame size R6 (IP21, UL type 1), -205-3 and -255-5 units

Note: Only measurements that differ from those of the standard *Frame size R6 (IP21, UL type 1)* are given below.

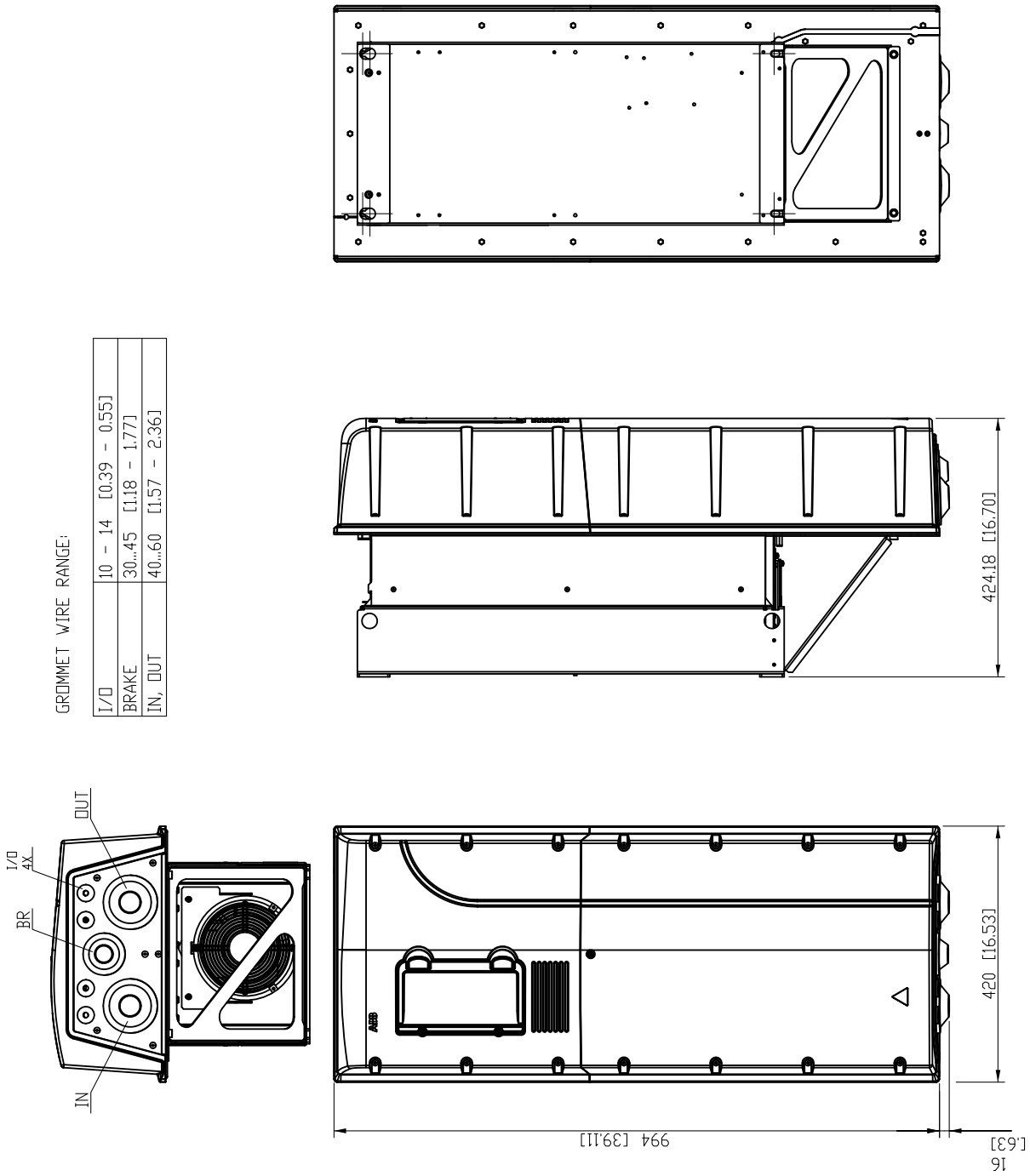


Frame size R6 (IP55, UL type 12)

For types -0205 and -0255-5, see page *143*.



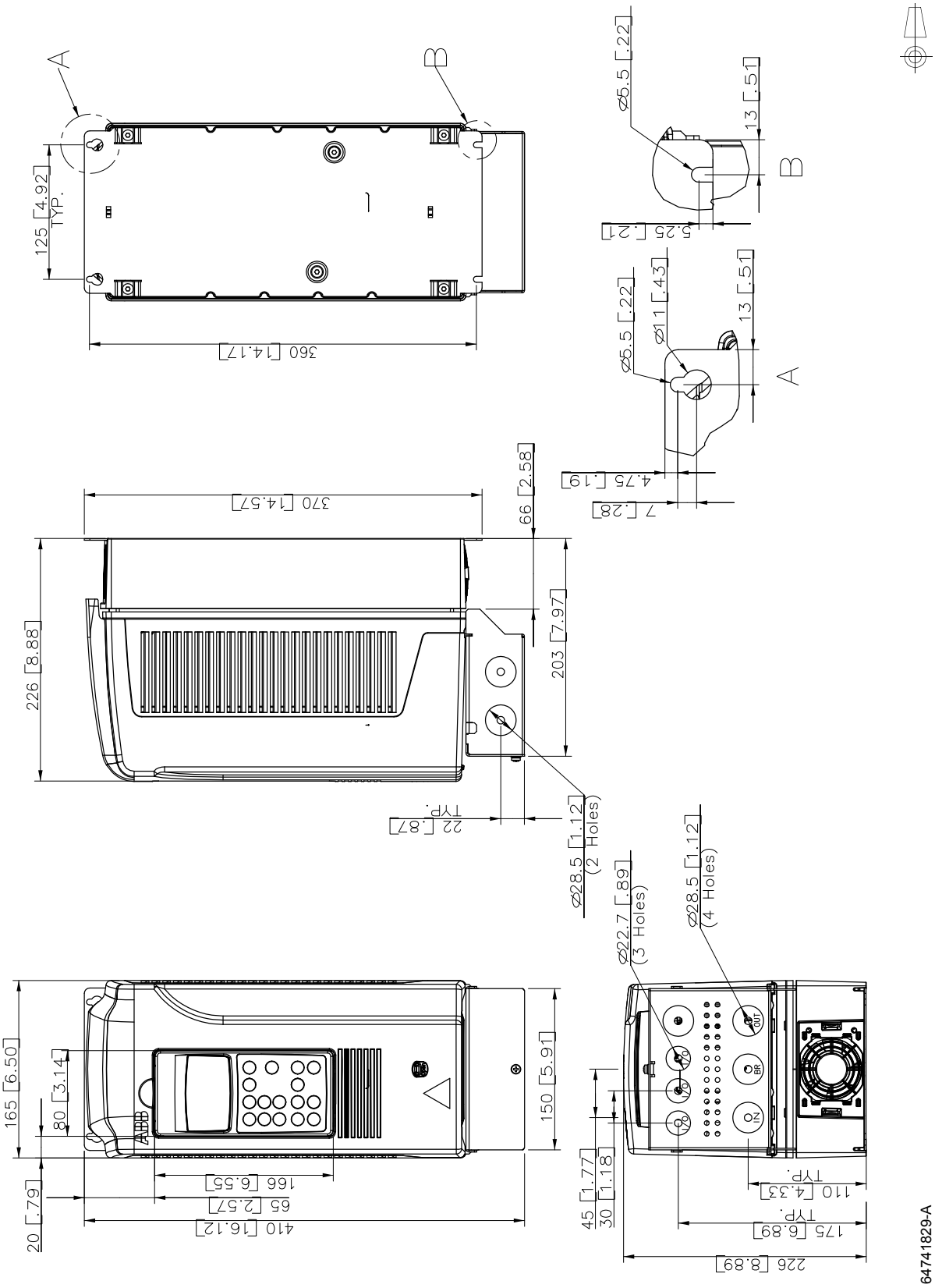
Frame size R6 (IP55, UL type 12) -0205-3 and -0255-5 units



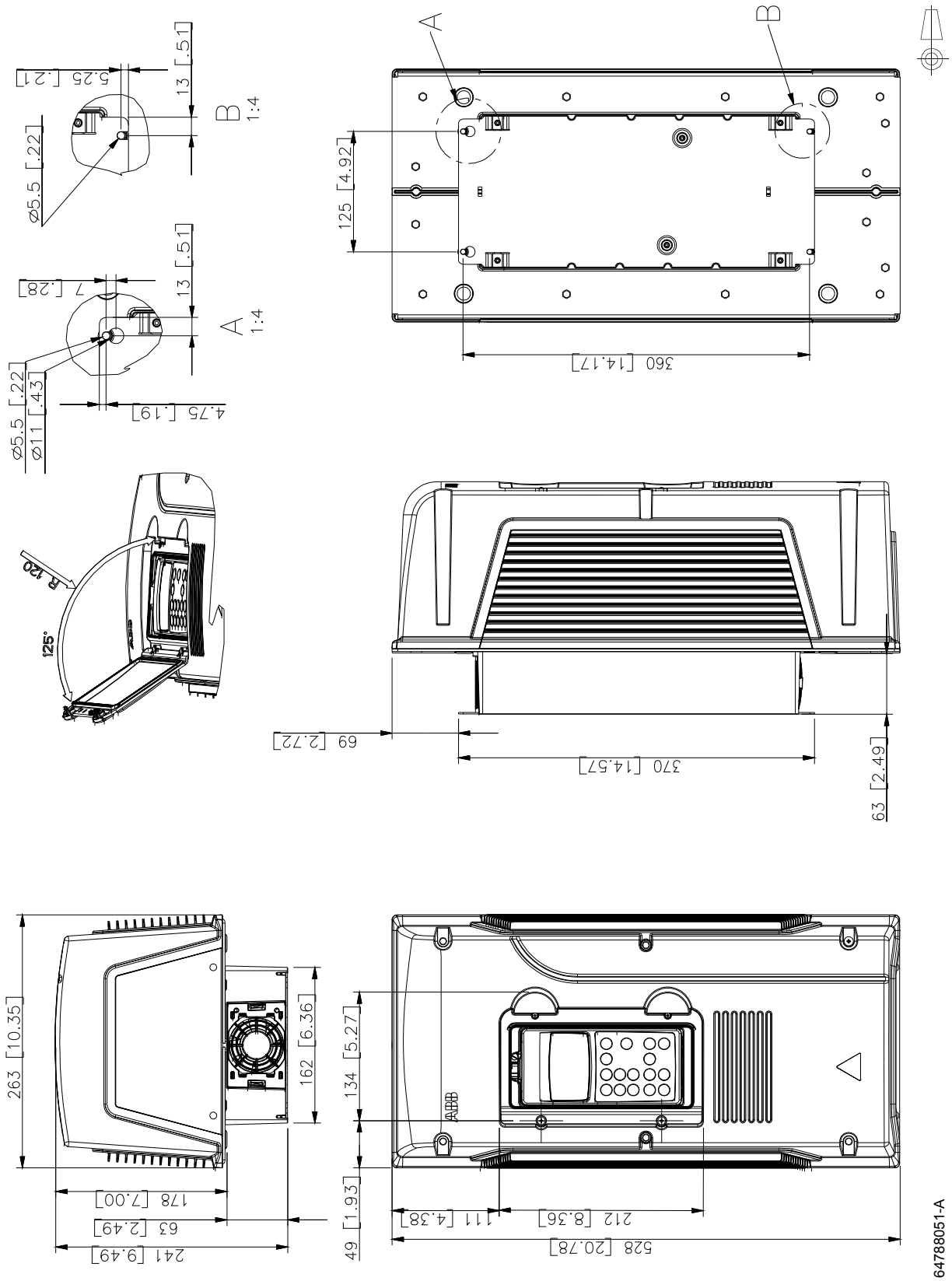
Dimensional drawings (USA)

Dimensional drawings of the ACS800-U1 are shown below. The dimensions are given in millimetres and [inches].

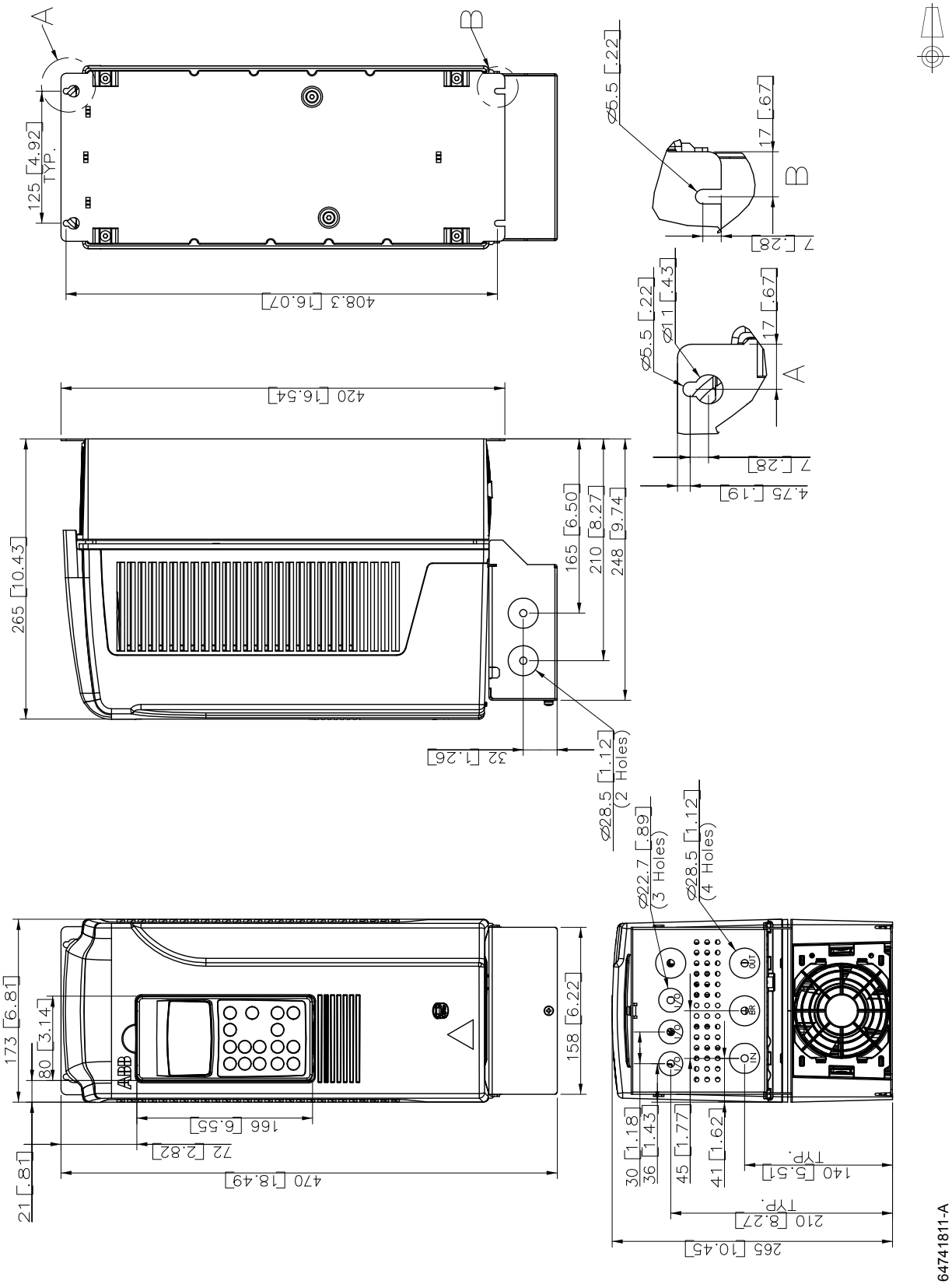
Frame size R2 (UL type 1, IP21)



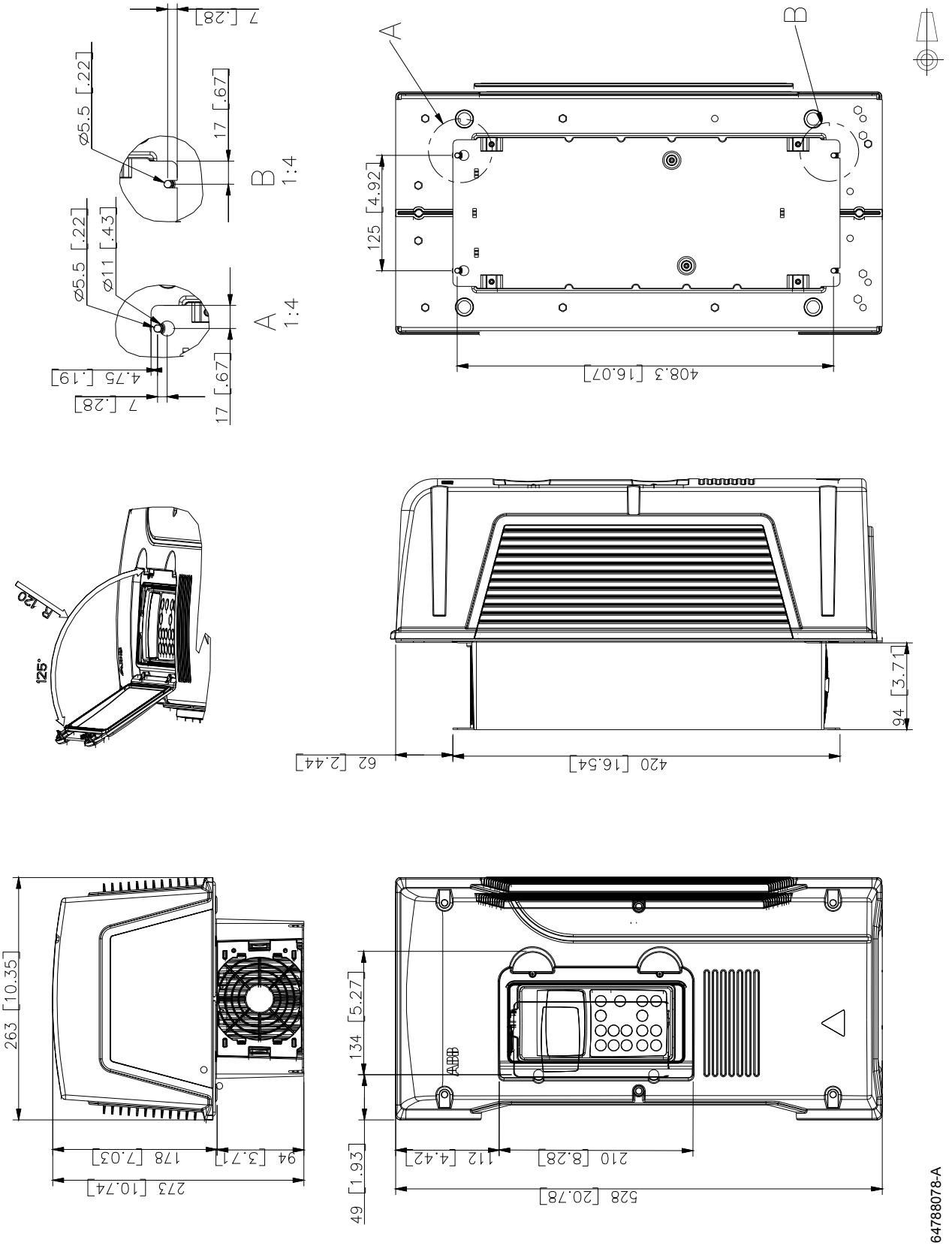
Frame size R2 (UL type 12, IP55)



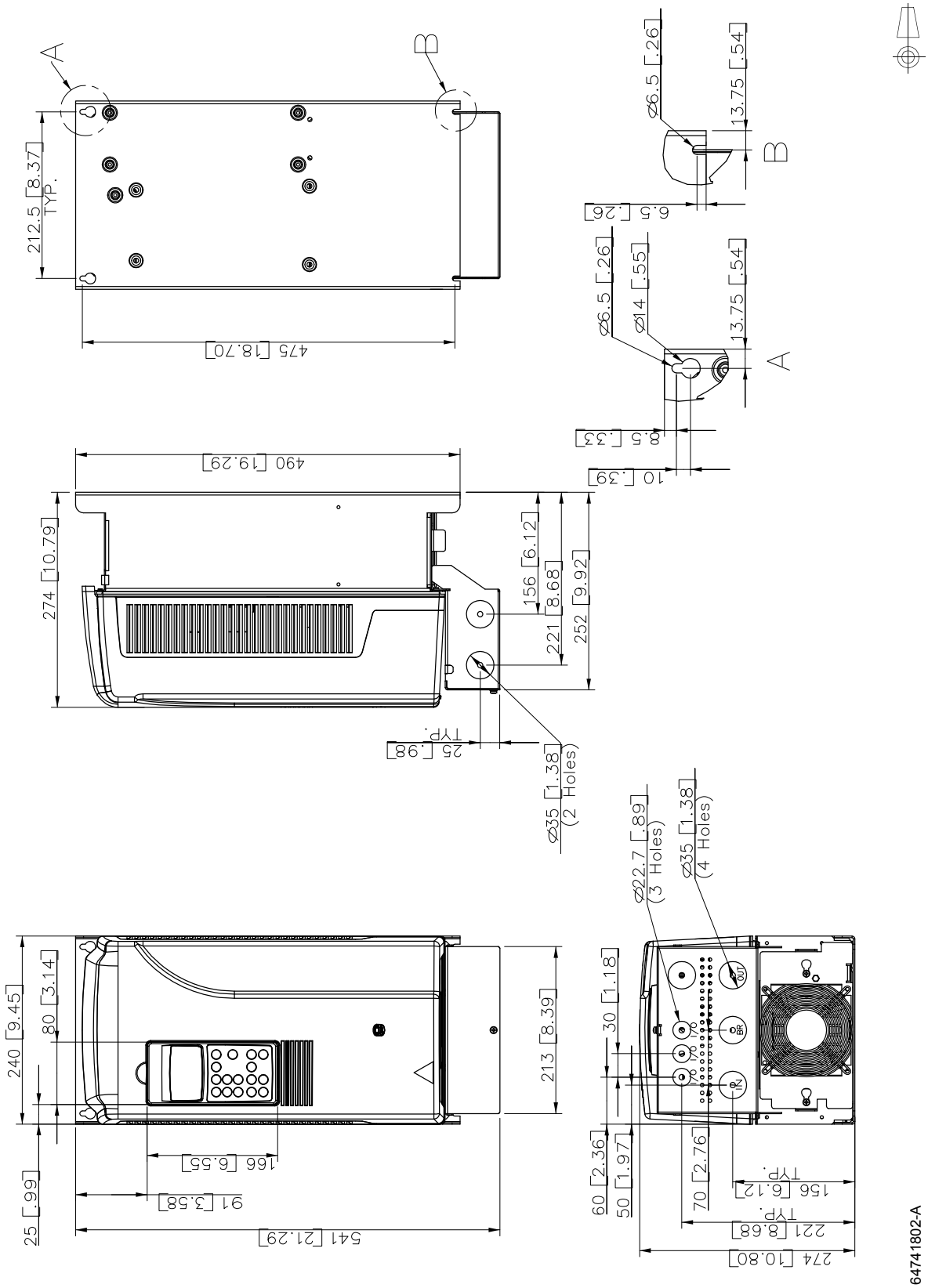
Frame size R3 (UL type 1, IP21)



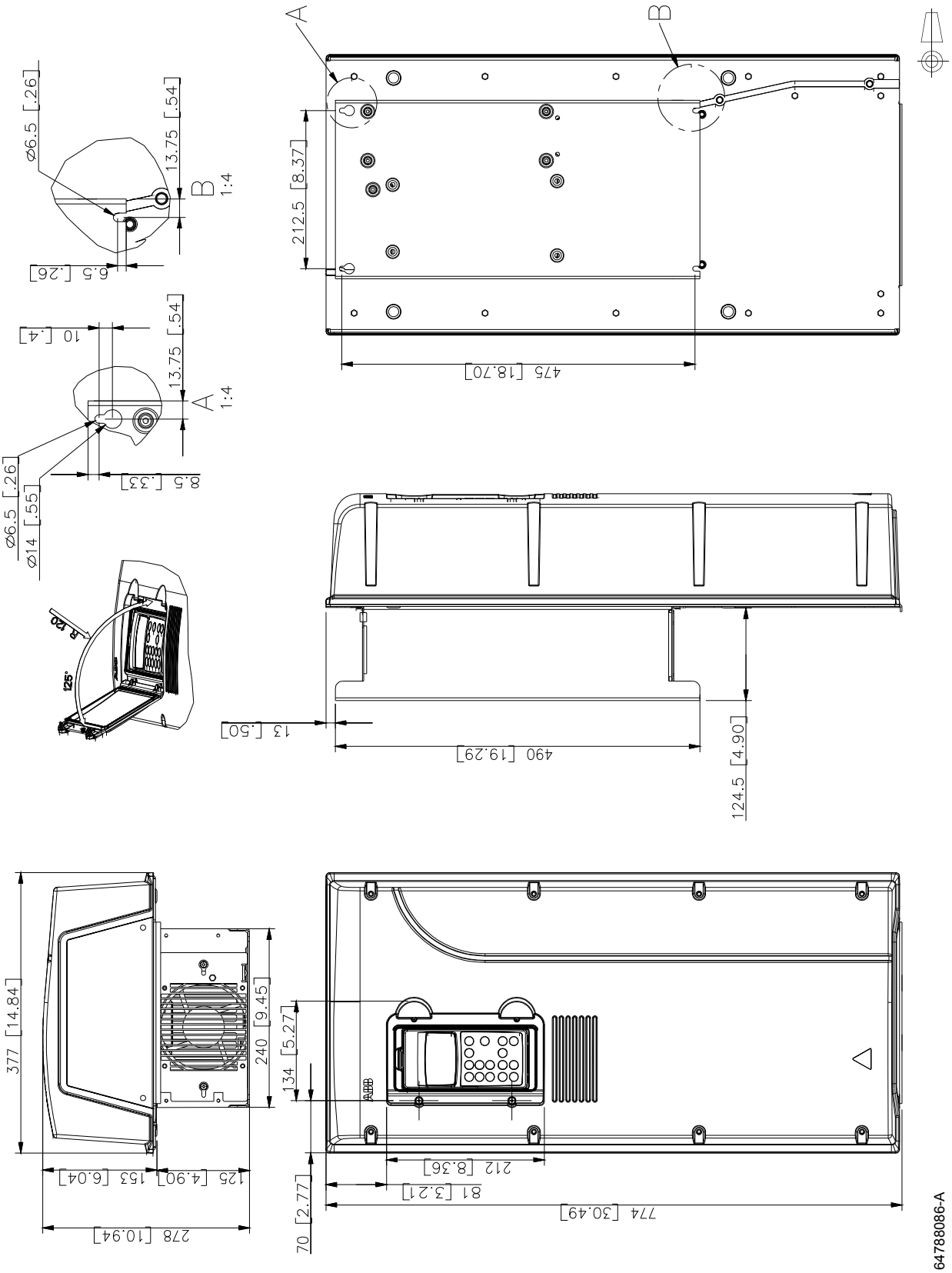
Frame size R3 (UL type 12, IP55)



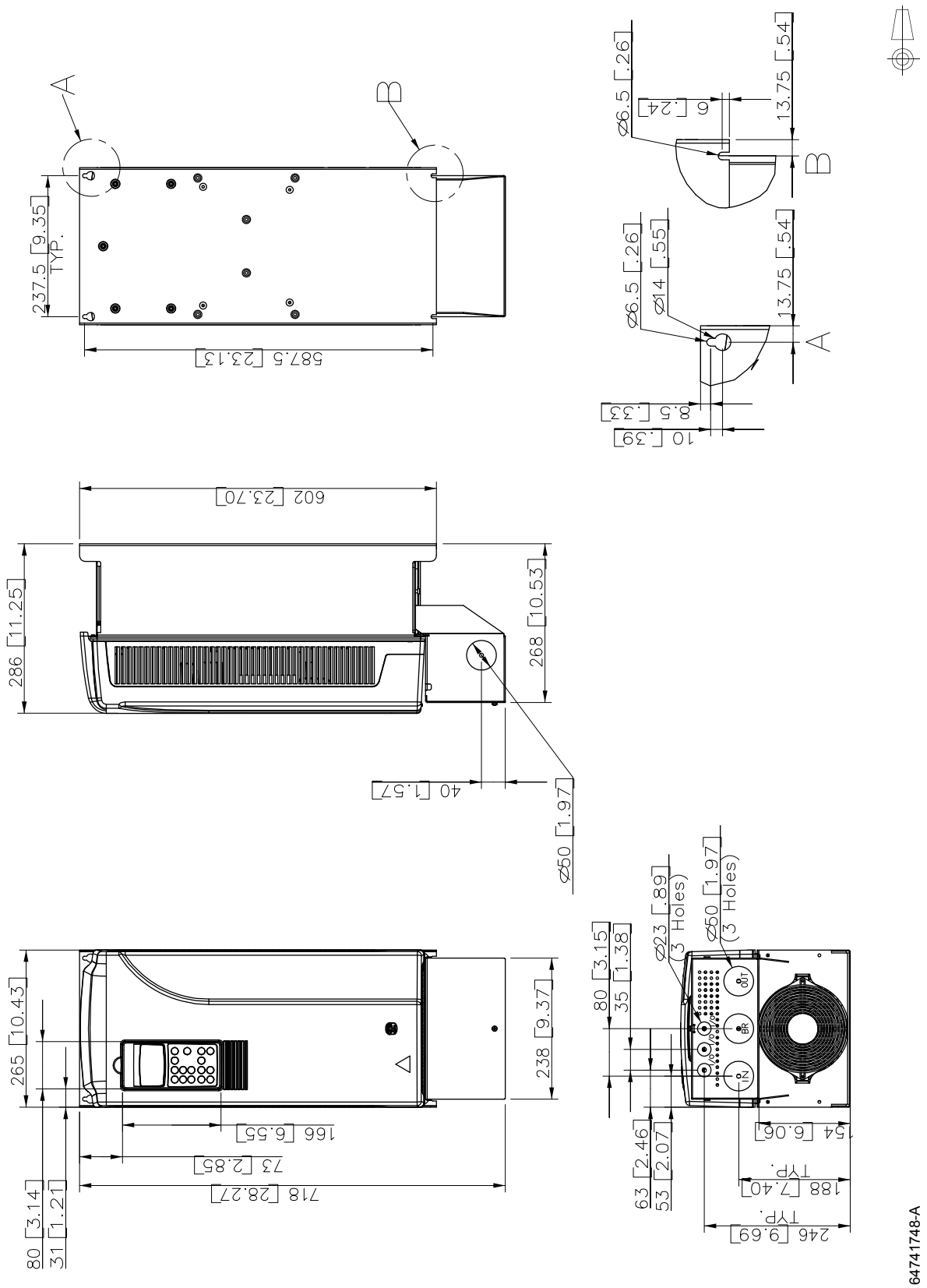
Frame size R4 (UL type 1, IP21)



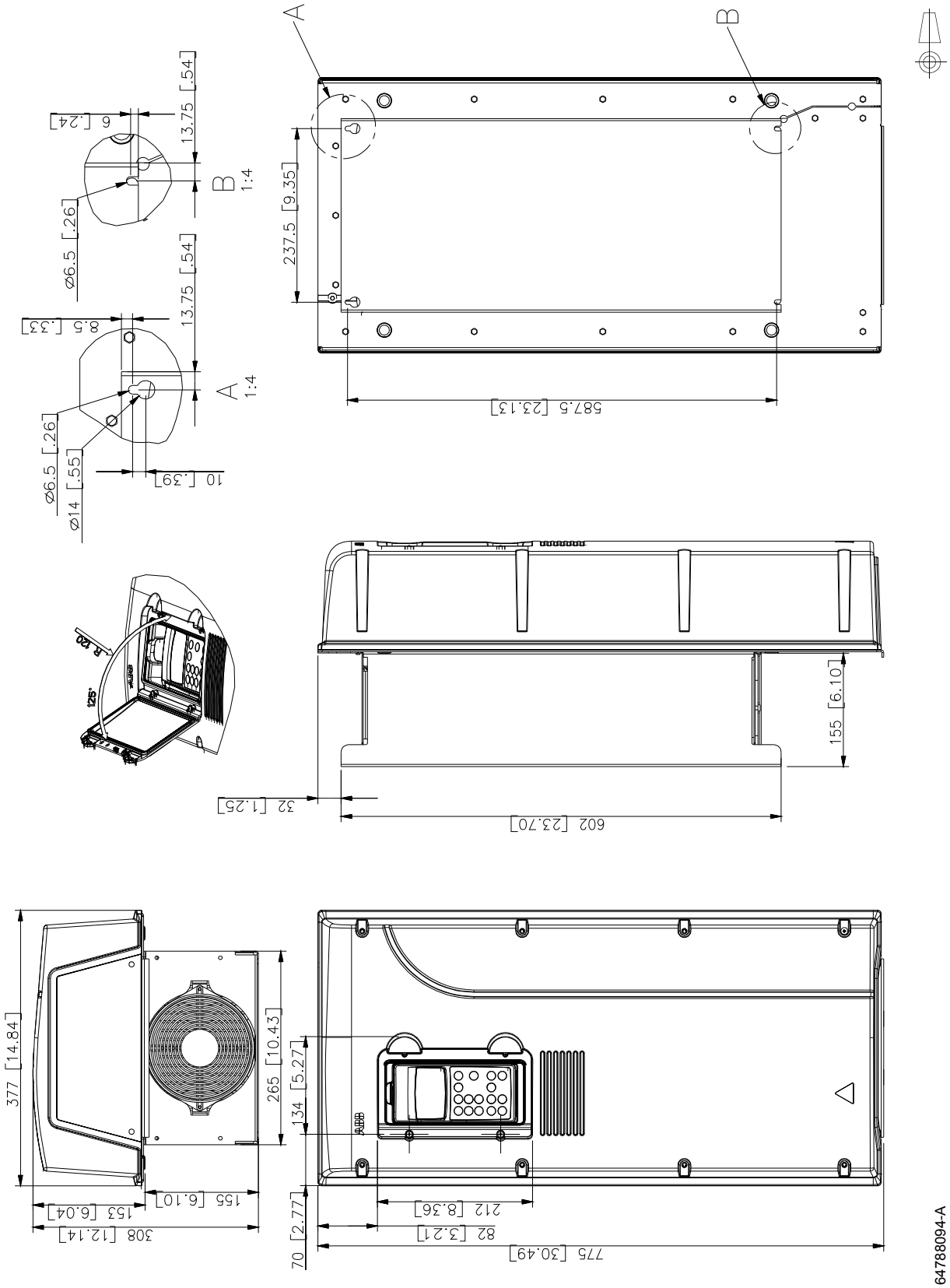
Frame size R4 (UL type 12, IP55)



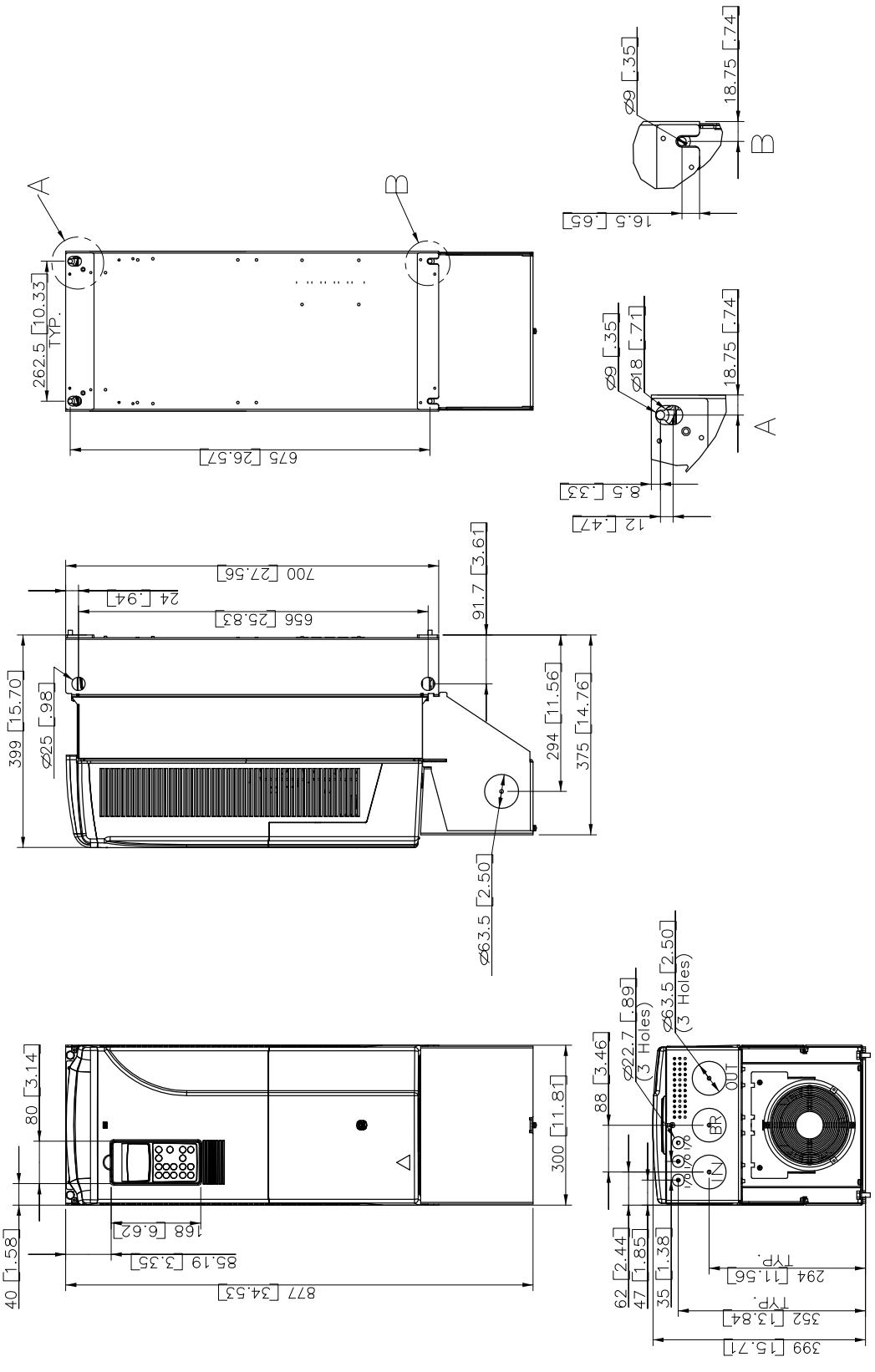
Frame size R5 (UL type 1, IP21)



Frame size R5 (UL type 12, IP55)

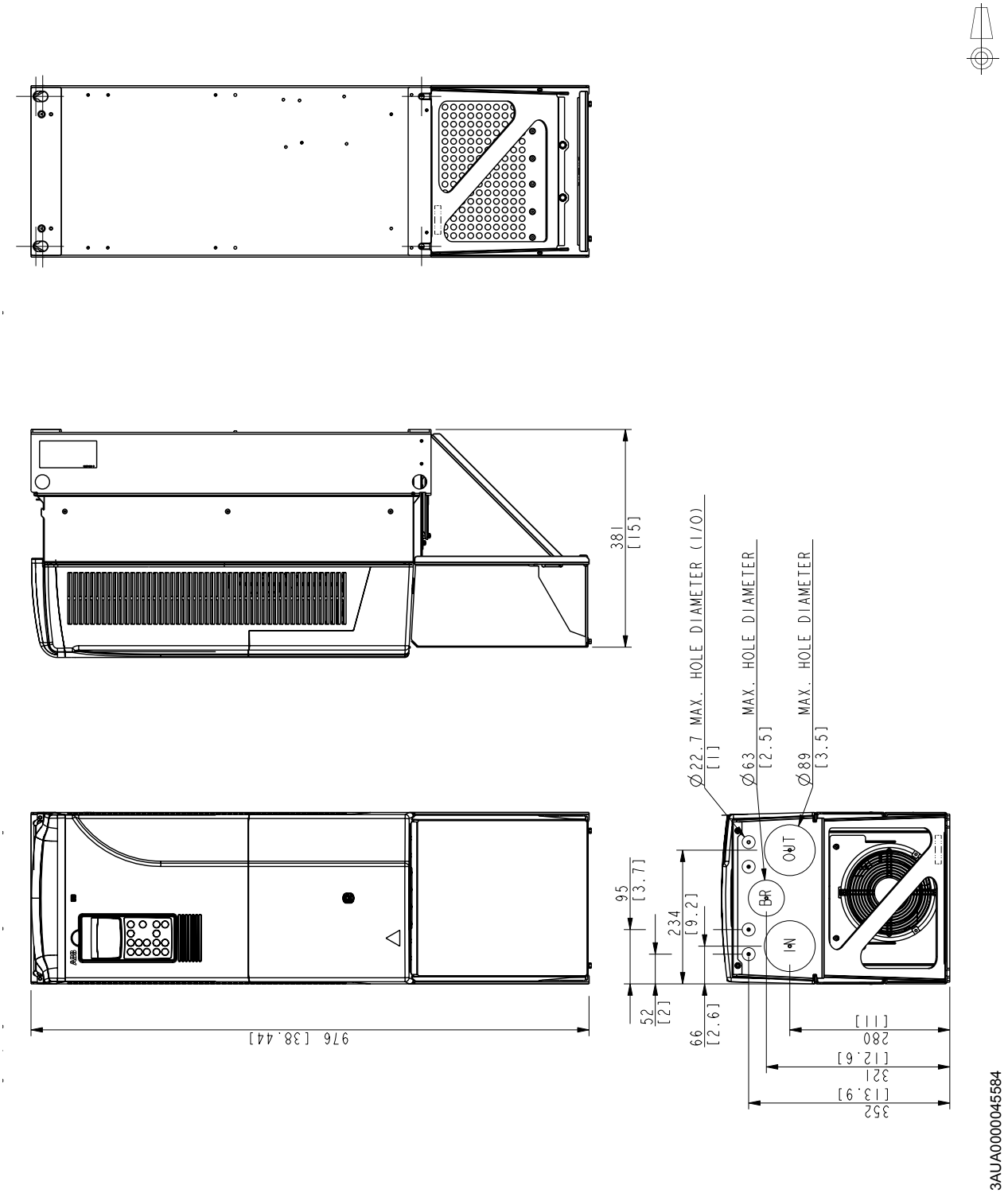


Frame size R6 (UL type 1, IP21)



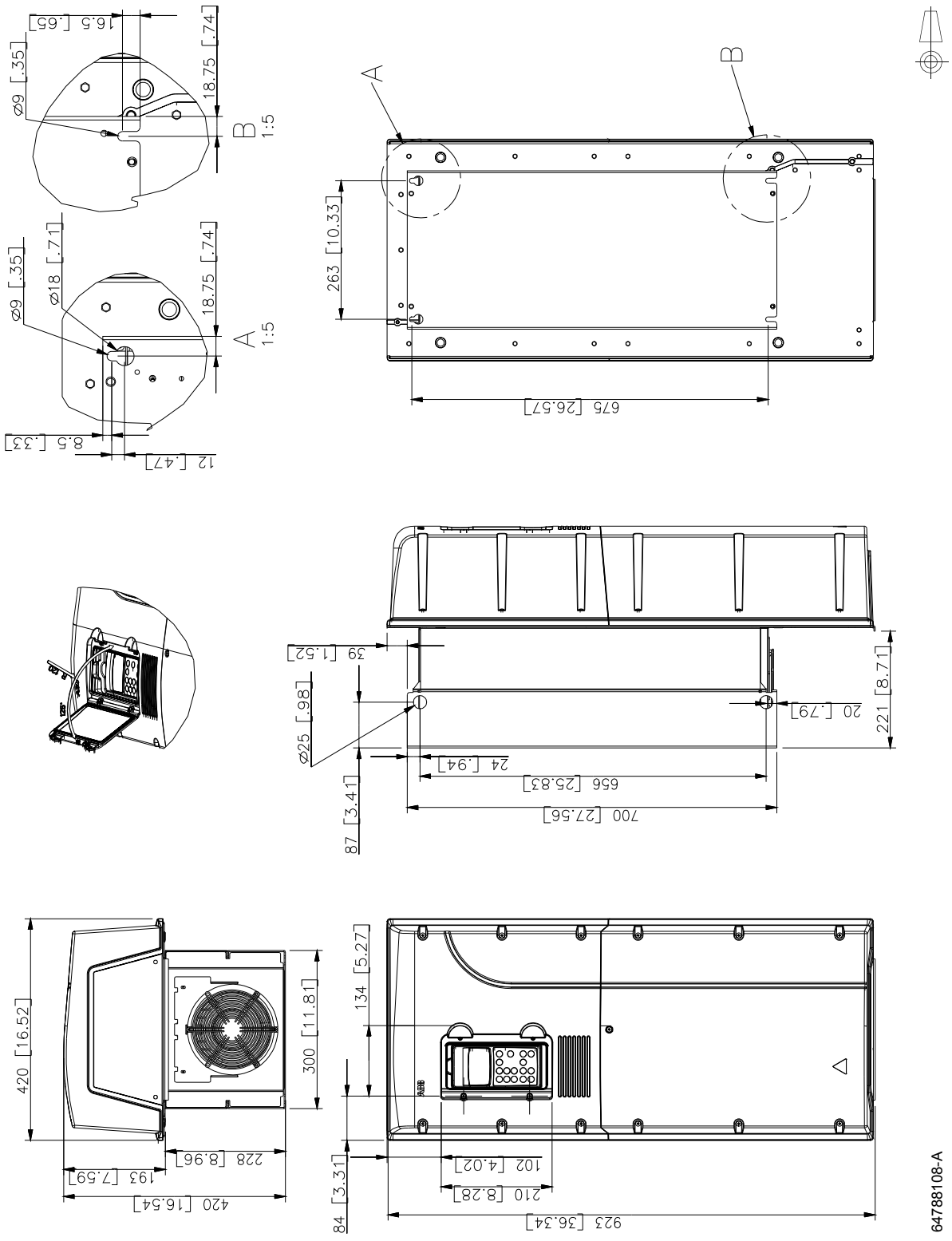
Frame size R6 (UL type 1, IP21) -0205-3 and -0255-5 units

Note: Only measurements that differ from those of the standard *Frame size R6 (UL type 1, IP21)* are given below.

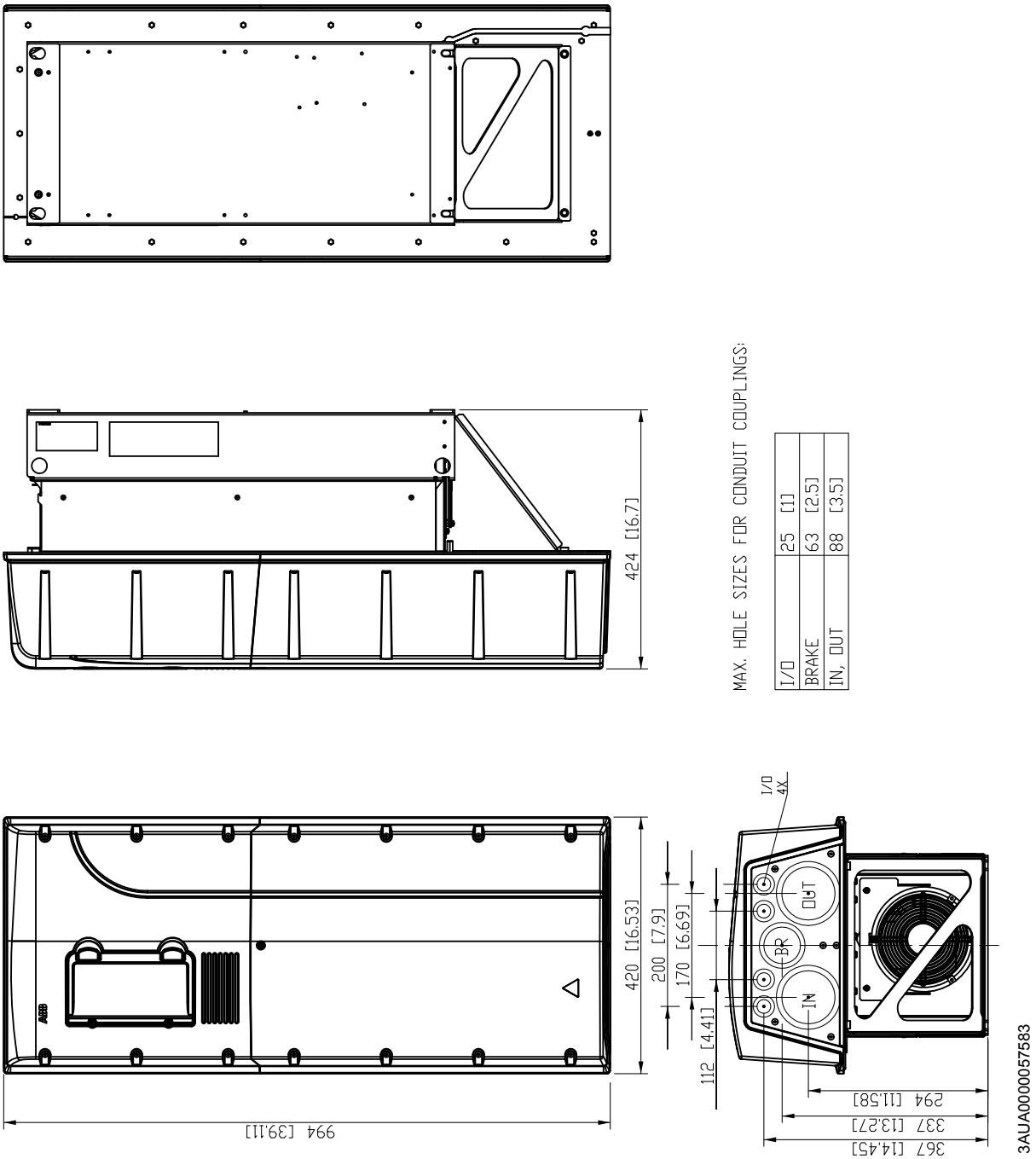


Frame size R6 (UL type 12, IP55)

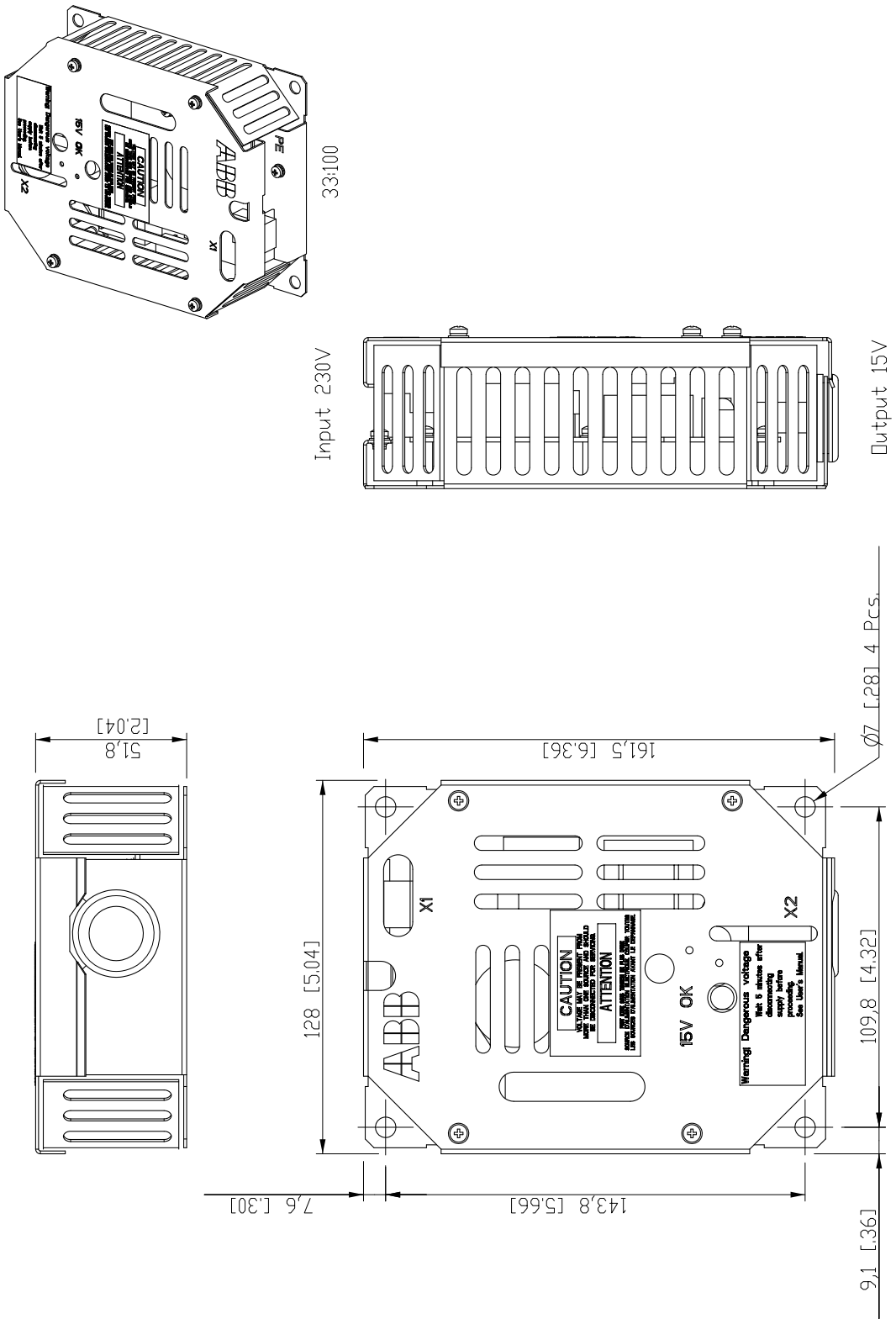
For types -0205 and -0255-5, see page *156*.



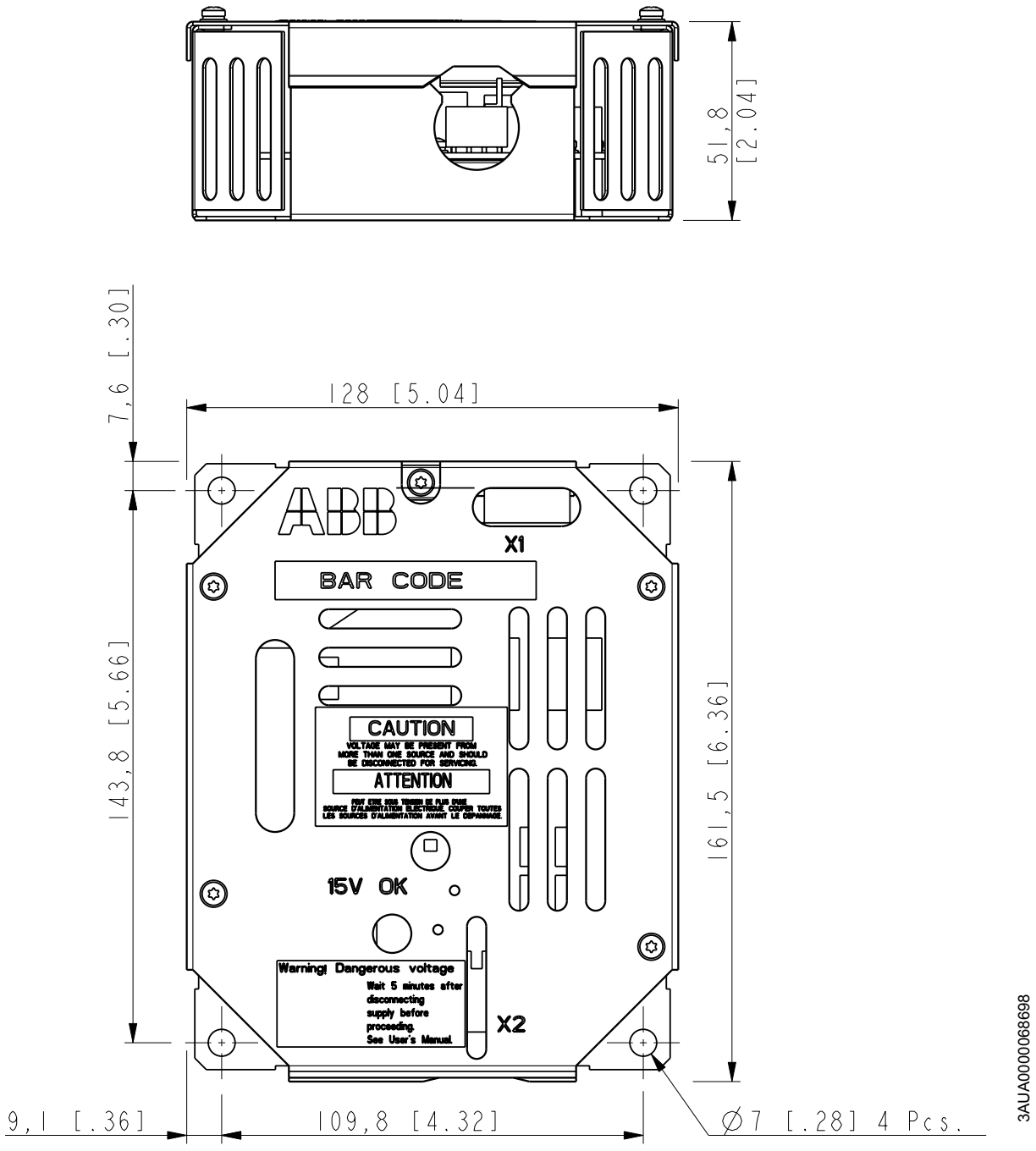
Frame size R6 (UL type 12, IP55) -0205-3 and -0255-5 units



AGPS board (option +Q950)



ASTO board with enclosure (option +Q967)



Resistor braking

What this chapter contains

This chapter describes how to select, protect and wire brake choppers and resistors. The chapter also contains the technical data.

Availability of brake choppers and resistors for the ACS800

Frame R2 and R3 drives and 690 V units of frame size R4 have a built-in brake chopper as standard equipment. For other units, brake choppers are optionally available as built-in units, indicated in the type code by +D150.

Resistors are available as add-on kits.

Selecting the correct drive/chopper/resistor combination

1. Calculate the maximum power *(P_{max})* generated by the motor during braking.
2. Select a suitable drive / brake chopper / brake resistor combination for the application according to the following tables (take account of other factors in the drive selection also). The following condition must be met:

   $$P_{br} \geq P_{max}$$

   where

   P_{br} denotes P_{br5}, P_{br10}, P_{br30}, P_{br60}, or P_{brcont} depending on the duty cycle.

3. Check the resistor selection. The energy generated by the motor during a 400-second period must not exceed the resistor heat dissipation capacity E_R.

   If the E_R value is not sufficient, it is possible to use a four-resistor assembly in which two standard resistors are connected in parallel, two in series. The E_R value of the four-resistor assembly is four times the value specified for the standard resistor.

Note: A resistor other than the standard resistor can be used provided that:

- its resistance is not lower than the resistance of the standard resistor.

WARNING! Never use a brake resistor with a resistance below the value specified for the particular drive / brake chopper / resistor combination. The drive and the chopper are not able to handle the overcurrent caused by the low resistance.

- the resistance does not restrict the braking capacity needed, that is,

$$P_{max} < \frac{U_{DC}^2}{R}$$

where

P_{max}	maximum power generated by the motor during braking
U_{DC}	voltage over the resistor during braking, e.g., 1.35 · 1.2 · 415 V DC (when supply voltage is 380 to 415 V AC), 1.35 · 1.2 · 500 V DC. (when supply voltage is 440 to 500 V AC) or 1.35 · 1.2 · 690 V DC (when supply voltage is 525 to 690 V AC).
R	resistor resistance (ohm)

- the heat dissipation capacity *(E_R)* is sufficient for the application (see step 3 above).

Optional brake chopper and resistor(s) for the ACS800-01/U1

The nominal ratings for dimensioning the brake resistors for the ACS800-01 and ACS800-U1 are given below at an ambient temperature of 40 °C (104 °F).

ACS800-01 type **ACS800-U1 type**	**Braking power of the chopper and the drive**	**Brake resistor(s)**			
	P_{brcont} (kW)	**Type**	**R (ohm)**	**E_R (kJ)**	**P_{Rcont} (kW)**
230 V units					
-0001-2	0.55	SACE08RE44	44	210	1
-0002-2	0.8	SACE08RE44	44	210	1
-0003-2	1.1	SACE08RE44	44	210	1
-0004-2	1.5	SACE08RE44	44	210	1
-0005-2	2.2	SACE15RE22	22	420	2
-0006-2	3.0	SACE15RE22	22	420	2
-0009-2	4.0	SACE15RE22	22	420	2
-0011-2	5.5	SACE15RE13	13	435	2
-0016-2	11	SAFUR90F575	8	1800	4.5
-0020-2	17	SAFUR90F575	8	1800	4.5
-0025-2	23	SAFUR80F500	6	2400	6
-0030-2	28	SAFUR125F500	4	3600	9
-0040-2	33	SAFUR125F500	4	3600	9
-0050-2	45	2xSAFUR125F500	2	7200	18
-0060-2	56	2xSAFUR125F500	2	7200	18
-0070-2	68	2xSAFUR125F500	2	7200	18

ACS800-01 type ACS800-U1 type	Braking power of the chopper and the drive	Brake resistor(s)			
	P_{brcont} (kW)	Type	R (ohm)	E_R (kJ)	P_{Rcont} (kW)
400 V units					
-0003-3	1.1	SACE08RE44	44	210	1
-0004-3	1.5	SACE08RE44	44	210	1
-0005-3	2.2	SACE08RE44	44	210	1
-0006-3	3.0	SACE08RE44	44	210	1
-0009-3	4.0	SACE08RE44	44	210	1
-0011-3	5.5	SACE15RE22	22	420	2
-0016-3	7.5	SACE15RE22	22	420	2
-0020-3	11	SACE15RE22	22	420	2
-0025-3	23	SACE15RE13	13	435	2
-0030-3	28	SACE15RE13	13	435	2
-0040-3	33	SAFUR90F575	8	1800	4.5
-0050-3	45	SAFUR90F575	8	1800	4.5
-0060-3	56	SAFUR90F575	8	1800	4.5
-0075-3	70	SAFUR80F500	6	2400	6
-0070-3 *	68	SAFUR80F500	6	2400	6
-0100-3	83	SAFUR125F500	4	3600	9
-0120-3	113	SAFUR125F500	4	3600	9
-0135-3	132	SAFUR200F500	2.7	5400	13.5
-0165-3	132	SAFUR200F500	2.7	5400	13.5
-0205-3	160	SAFUR200F500	2.7	5400	13.5
500 V units					
-0004-5	1.5	SACE08RE44	44	210	1
-0005-5	2.2	SACE08RE44	44	210	1
-0006-5	3.0	SACE08RE44	44	210	1
-0009-5	4.0	SACE08RE44	44	210	1
-0011-5	5.5	SACE08RE44	44	210	1
-0016-5	7.5	SACE15RE22	22	420	2
-0020-5	11	SACE15RE22	22	420	2
-0025-5	15	SACE15RE22	22	420	2
-0030-5	28	SACE15RE13	13	435	2
-0040-5	33	SACE15RE13	13	435	2
-0050-5	45	SAFUR90F575	8	1800	4.5
-0060-5	56	SAFUR90F575	8	1800	4.5
-0070-5	68	SAFUR90F575	8	1800	4.5
-0105-5	83	SAFUR80F500	6	2400	6
-0100-5 *	83	SAFUR125F500	4	3600	9
-0120-5	113	SAFUR125F500	4	3600	9
-0140-5	135	SAFUR125F500	4	3600	9
-0165-5	160	SAFUR125F500	4	3600	9
-0205-5	160	SAFUR125F500	4	3600	9
-0255-5	200	SAFUR200F500	2.7	5400	13.5

ACS800-01 type ACS800-U1 type	Braking power of the chopper and the drive	Brake resistor(s)			
	P_{brcont} (kW)	Type	R (ohm)	E_R (kJ)	P_{Rcont} (kW)
690 V units					
-0011-7	8	SACE08RE44	44	210	1
-0016-7	11	SACE08RE44	44	210	1
-0020-7	16	SACE08RE44	44	210	1
-0025-7	22	SACE08RE44	44	210	1
-0030-7	28	SACE15RE22	22	420	2
-0040-7	22/33 [1)]	SACE15RE22	22	420	2
-0050-7	45	SACE15RE13	13	435	2
-0060-7	56	SACE15RE13	13	435	2
-0070-7	68	SAFUR90F575	8	1800	4.5
-0100-7	83	SAFUR90F575	8	1800	4.5
-0120-7	113	SAFUR80F500	6	2400	6
-0145-7	160	SAFUR80F500	6	2400	6
-0175-7	160	SAFUR80F500	6	2400	6
-0205-7	160	SAFUR80F500	6	2400	6

* Type not available any more.

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P_{brcont} The drive and the chopper will withstand this continuous braking power. The braking is considered continuous if the braking time exceeds 30 s.
Note: Check that the braking energy transmitted to the specified resistor(s) in 400 seconds does not exceed E_R.

R Resistance value for the listed resistor assembly. **Note:** This is also the minimum allowed resistance for the brake resistor.

E_R Short energy pulse that the resistor assembly withstands every 400 seconds. This energy will heat the resistor element from 40 °C (104 °F) to the maximum allowable temperature.

P_{Rcont} Continuous power (heat) dissipation of the resistor when placed correctly. Energy E_R dissipates in 400 seconds.

1) 22 kW with standard 22 ohm resistor and 33 kW with 32…37 ohm resistor

All brake resistors must be installed outside the drive. The SACE brake resistors are built in an IP21 metal housing. The SAFUR brake resistors are built in an IP00 metal frame. **Note:** The SACE and SAFUR resistors are not UL listed.

Resistor installation and wiring

All resistors must be installed outside the drive module in a place where they will cool.

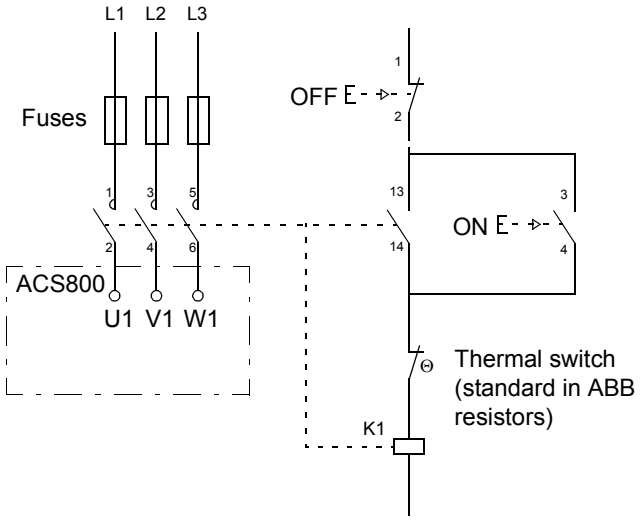
WARNING! The materials near the brake resistor must be non-flammable. The surface temperature of the resistor is high. Air flowing from the resistor is of hundreds of degrees Celsius. Protect the resistor against contact.

Use the cable type used for drive input cabling (refer to chapter *Technical data)* to ensure the input fuses will also protect the resistor cable. Alternatively, two-conductor shielded cable with the same cross-sectional area can be used. The maximum length of the resistor cable(s) is 10 m (33 ft). For the connections, see the power connection diagram of the drive.

Protection of frame sizes R2 to R5 (ACS800-01/U1)

It is highly recommended to equip the drive with a main contactor for safety reasons. Wire the contactor so that it opens in case the resistor overheats. This is essential for safety since the drive will not otherwise be able to interrupt the main supply if the chopper remains conductive in a fault situation.

Below is a simple example wiring diagram.

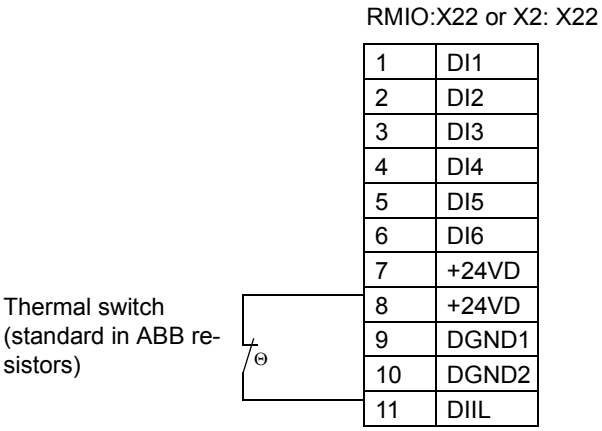


Protection of frame size R6

A main contactor is not required for protecting against resistor overheating when the resistor is dimensioned according to the instructions and the internal brake chopper is in use. The drive will disable power flow through the input bridge if the chopper remains conductive in a fault situation. **Note:** If an external brake chopper (outside the drive module) is used, a main contactor is always required.

A thermal switch (standard in ABB resistors) is required for safety reasons. The cable must be shielded and not longer than the resistor cable.

With Standard Control Program, wire the thermal switch as shown below. By default, the drive will stop by coasting when the switch opens.



For other control programs, the thermal switch may be wired to a different digital input. Programming of the input to trip the drive by “EXTERNAL FAULT” may be needed. See the appropriate firmware manual.

Brake circuit commissioning

For Standard Control Program:

- Enable the brake chopper function (parameter 27.01).
- Switch off the overvoltage control of the drive (parameter 20.05).
- Check the resistance value setting (parameter 27.03).
- Frame size R6: Check the setting of parameter 21.09. If stop by coasting is required, select OFF2 STOP.

For the use of the brake resistor overload protection (parameters 27.02...27.05), consult an ABB representative.

WARNING! If the drive is equipped with a brake chopper but the chopper is not enabled by parameter setting, the brake resistor must be disconnected because the protection against resistor overheating is then not in use.

For settings of other control programs, see the appropriate firmware manual.

Note: Some brake resistors are coated with oil film for protection. At the start-up, the coating burns off and produces a little bit of smoke. Ensure proper ventilation at the start-up.

External +24 V DC power supply for the RMIO board via terminal X34

What this chapter contains

This chapter describes how to connect an external +24 V DC power supply for the RMIO board via terminal X34. For the current consumption of the RMIO board, see chapter *Motor control and I/O board (RMIO)*.

Note: External power is easier to supply to the RMIO board via terminal X23, see chapter *Motor control and I/O board (RMIO)*.

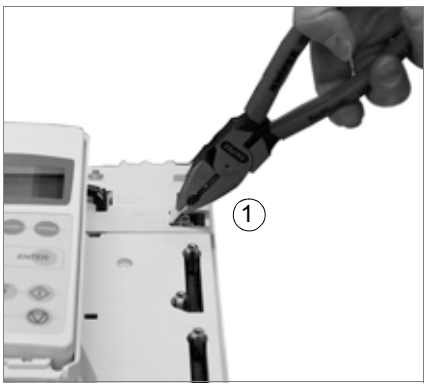
Parameter settings

In Standard Control Program, set parameter 16.09 CTRL BOARD SUPPLY to EXTERNAL 24V if the RMIO board is powered from an external supply.

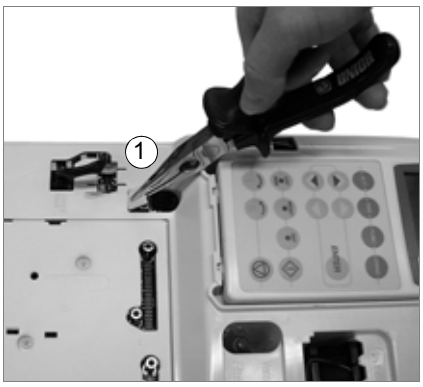
Connecting +24 V DC external power supply

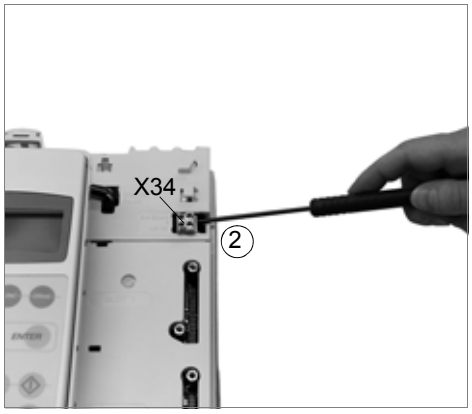
1. Break off the tab covering the +24 V DC power input connector with pliers.
2. Lift the connector upwards.
3. Disconnect the wires from the connector (keep the connector for later use).
4. Isolate the ends of the wires individually with insulating tape.
5. Cover the isolated ends of the wires with insulating tape.
6. Push the wires inside the skeleton.
7. Connect the wires of the +24 V DC external power supply to the disconnected connector:
   if a two-way connector, + wire to terminal 1 and - wire to terminal 2
   if a three-way connector, + wire to terminal 2 and - wire to terminal 3.
8. Plug the connector in.

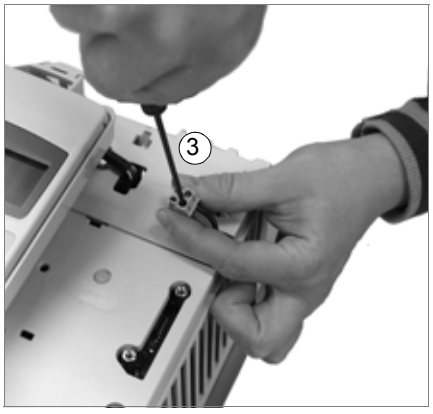
Frame sizes R2 to R4

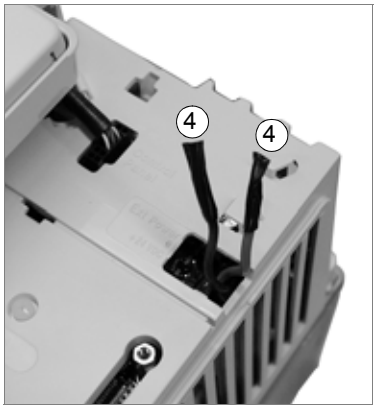


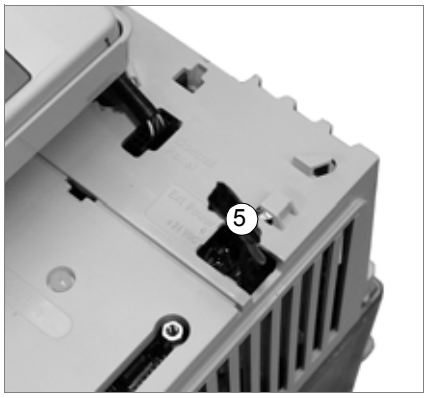
Frame sizes R5 and R6

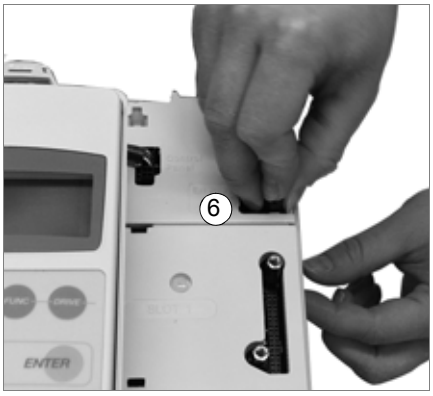


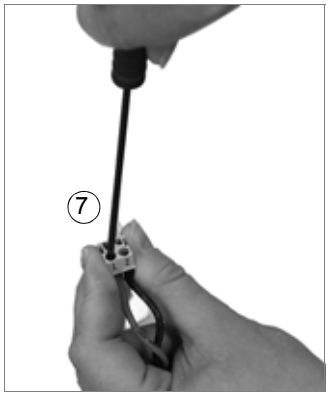


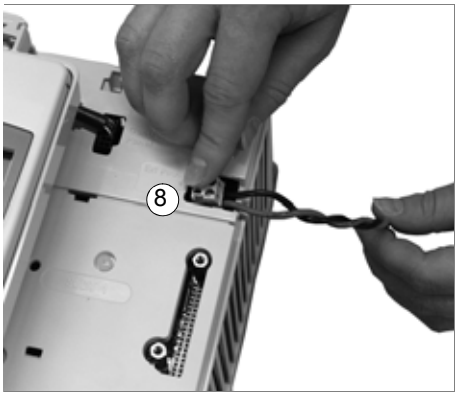


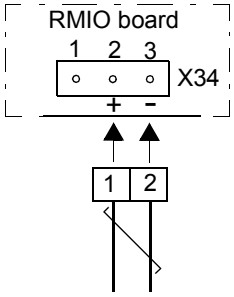




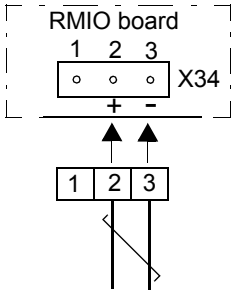








Connection of a two-way connector



Connection of a three-way connector

RDCO-01/02/03/04 DDCS communication option modules

What this chapter contains

This chapter contains a description of the RDCO-0x DDCS communication option modules connections and the technical specifications of the RDCO-0x modules.

Overview

The RDCO-0x DDCS Communication options are add-on modules for the

- RMIO Motor Control and I/O board (also part of RDCU control units)
- BCU control units.

RDCO modules are available factory-installed as well as retrofit kits.

The RDCO module includes the connectors for fiber optic DDCS channels CH0, CH1, CH2 and CH3. The usage of these channels is determined by the application program; see the *Firmware Manual* of the drive. However, the channels are normally assigned as follows:

CH0 – overriding system (eg. fieldbus adapter)

CH1 – I/O options and supply unit

CH2 – Master/Follower link

CH3 – PC tool (ACS800 only*).*

There are several types of the RDCO. The difference between the types is the optical components. In addition, each type is available with a coated circuit board, this being indicated by a "**C**" suffix, eg. RDCO-03C.

Module type	Optical component type			
	CH0	CH1	CH2	CH3
RDCO-01(C)	10 MBd	5 MBd	10 MBd	10 MBd
RDCO-02(C)	5 MBd	5 MBd	10 MBd	10 MBd
RDCO-03(C)	5 MBd	5 MBd	5 MBd	5 MBd
RDCO-04(C)	10 MBd	10 MBd	10 MBd	10 MBd

The optical components at both ends of a fiber optic link must be of the same type for the light intensity and receiver sensitivity levels to match. Plastic optical fiber (POF) cables can be used with both 5 MBd and 10 MBd optical components. 10 MBd components also enable the use of Hard Clad Silica (HCS) cables, which allow longer connection distances thanks to their lower attenuation.

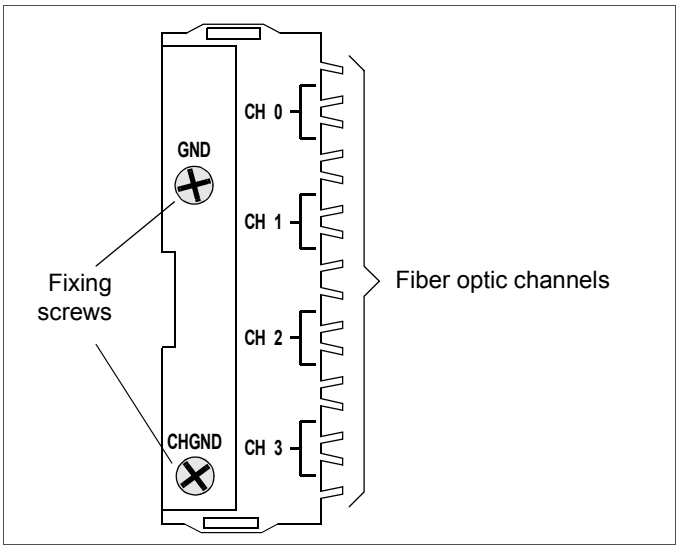
Note: The optical component type does not reflect the actual communication speed.

Delivery check

The option package contains:

- RDCO-0x module
- Two screws (M3×8)
- This document.

Module layout



Installation

WARNING! All electrical installation and maintenance work on the drive should be carried out by qualified electricians only.
The drive and adjoining equipment must be properly earthed.

Do not work on a powered drive. Before installation, switch off the mains and other dangerous voltages (eg. from external control circuits) to the drive. After switching off the mains, always allow the intermediate circuit capacitors 5 minutes to discharge before starting work on the frequency converter. It is a good practice to check (with a voltage indicating instrument) that the drive is in fact discharged before beginning work.
There may be dangerous voltages inside the drive from external control circuits even when the drive mains power is shut off. Exercise appropriate care when working on the unit. Neglecting these instructions may cause physical injury or death.

WARNING! The component boards of the drive contain integrated circuits that are extremely sensitive to electrostatic discharge (ESD). Wear an earthing wrist band when handling component boards. Do not touch the boards unnecessarily. Do not remove any board from its antistatic packaging until required.

WARNING! Handle the fiber optic cables with care. The maximum long term tensile load is 1 N; the minimum short term bend radius is 35 mm. Do not touch the ends of the fibers with bare hands as the fiber is extremely sensitive to dirt.
Use rubber grommets at cable entries to protect the cables.

The RDCO-0x module is to be inserted into the position marked “DDCS” on the drive. On installation, the signal and power connection to the drive is automatically made through a 20-pin connector.

The module is held in place with plastic retaining clips and two screws. The screws also provide the earthing of module, and interconnect the GND signals of the module and the control board.

Installation procedure

1. Access the optional module slots on the drive. Whenever necessary, refer to the *Hardware Manual* of the drive for instructions on removing any covers.
2. Insert the module carefully into the slot marked with “DDCS” (BCU control unit slot 4) on the control board until the retaining clips lock the module into position.
3. Fasten the screws included in the package. Note that correct installation of the screws is essential for fulfilling the EMC requirements and for proper operation of the module.
4. Lead the fiber optic cables from the external device to the appropriate channel(s) of the RDCO. Inside the drive, route the cables as shown in its *Hardware Manual*. Make sure the cables are not kinked or laid against sharp edges. Observe colour coding so that transmitters are connected to receivers and vice versa. In case multiple devices are to be connected to one channel, they must be connected in a ring.

Technical data

Module types: RDCO-01(C), RDCO-02(C), RDCO-03(C), RDCO-04(C)

Degree of protection: IP20

Ambient conditions: The applicable ambient conditions specified for the drive in its *Hardware Manual* are in effect.

Connectors:

- 20-pin pinheader
- 4 transmitter/receiver connector pairs for fiber optic cable. Type: Agilent Technologies Versatile Link. Communication speed: 1, 2 or 4 Mbit/s

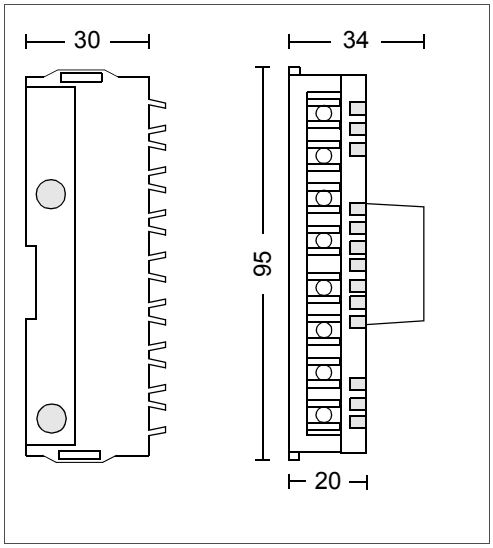
Operating voltage: +5 V DC ±10%, supplied by the control unit of the drive.

Current consumption: 200 mA max.

Electromagnetic immunity: IEC 1000-4-2 (limits: industrial, second environment); IEC 1000-4-3; IEC 1000-4-4; IEC 1000-4-6

Electromagnetic emissions: EN 50081-2; CISPR 11

Dimensions (mm):



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 www.abb.com/drives and select *Training courses*.

Providing feedback on ABB Drives manuals

Your comments on our manuals are welcome. Go to www.abb.com/drives and select *Document Library – Manuals feedback form (LV AC drives)*.

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