ACS800

Hardware Manual
ACS800-11 Drives (5.5 to 110 kW)
ACS800-U11 Drives (7.5 to 125 HP)

ACS800 Single Drive Manuals

HARDWARE MANUALS (appropriate manual is included in the delivery)

ACS800-01/U1 Hardware Manual 0.55 to 110 kW (0.75 to 150 HP) 3AFE64382101 (English)

ACS800-01/U1 Marine Supplement 3AFE64291275 (English)

ACS800-02/U2 Hardware Manual 90 to 500 kW (125 to 600 HP) 3AFE64567373 (English)

ACS800-11/U11 Hardware Manual 5.5 to110 kW (7.5 to 125 HP) 3AFE68367883 (English)

ACS800-04 Hardware Manual 0.55 to 132 kW 3AFE68372984 (English)

ACS800-04/04M/U4 Hardware Manual 45 to 560 kW (60 to 600 HP) 3AFE64671006 (English)

ACS800-04/04M/U4 Cabinet Installation 45 to 560 kW (60 to 600 HP) 3AFE68360323 (English)

ACS800-07/U7 Hardware Manual 45 to 560 kW (50 to 600 HP) 3AFE64702165 (English)

ACS800-07/U7 Dimensional Drawings 45 to 560 kW (50 to 600 HP) 3AFE64775421

ACS800-07 Hardware Manual 500 to 2800 kW 3AFE64731165 (English)

ACS800-17 Hardware Manual 75 to 1120 kW 3AFE64681338 (English)

- Safety instructions
- Electrical installation planning
- Mechanical and electrical installation
- Motor control and I/O board (RMIO)
- Maintenance
- Technical data
- Dimensional drawings
- Resistor braking

FIRMWARE MANUALS, SUPPLEMENTS AND GUIDES (appropriate documents are included in the delivery)

Standard Application Program Firmware Manual 3AFE64527592 (English)

System Application Program Firmware Manual 3AFE63700177 (English)

Application Program Template Firmware Manual 3AFE64616340 (English)

Master/Follower 3AFE64590430 (English)

PFC Application Program Firmware Manual 3AFE64649337 (English)

Extruder Control Program Supplement 3AFE64648543 (English)

Centrifuge Control Program Supplement 3AFE64667246 (English)

Traverse Control Program Supplement 3AFE64618334 (English)

Crane Control Program Firmware Manual 3BSE11179 (English)

Adaptive Programming Application Guide 3AFE64527274 (English)

OPTION MANUALS (delivered with optional equipment)

Fieldbus Adapters, I/O Extension Modules etc.

ACS800-11 Drives
5.5 to 110 kW
ACS800-U11 Drives
7.5 to 125 HP

Hardware Manual

3AFE68367883 Rev A EN
EFFECTIVE: 5.1.2005

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.

To which products this chapter applies

This chapter applies to the ACS800-01/U1, ACS800-11/U11, ACS800-02/U2 and ACS800-04/04M/U4 of frame sizes R7 and R8.

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.

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.

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.
- ACS800-02 with enclosure extension: The main switch on the cabinet door does not remove the voltage from the input busbars of the drive. Before working on the drive, isolate the whole drive from the supply.
- The Prevention of Unexpected Start function does not remove the voltage from the main and auxiliary circuits.

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 pick-up.
- 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).
- ACS800-01, ACS800-11: 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.

  ACS800-04 (45 to 560 kW) and ACS800-02 in first environment: make a 360° high frequency grounding of motor cable entries at the cabinet lead-through.
- Do not install a drive with EMC filter option +E202 or +E200 (available for ACS800-01 and ACS800-11 only) 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.

Mechanical installation and maintenance

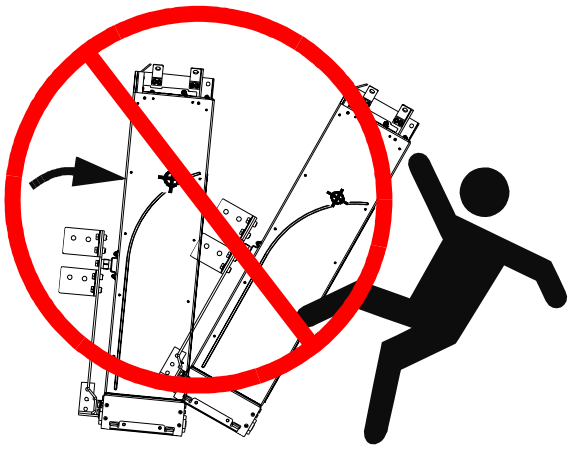
These instructions are intended for all who install and service the drive.

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

- Handle the unit carefully.
- ACS800-01, ACS800-11: 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.

  ACS800-02, ACS800-04: The drive is heavy. Lift the drive by the lifting lugs only. Do not tilt the unit. The unit will overturn from a tilt of about 6 degrees. Use extreme caution when manoeuvring a drive that runs on wheels. **An overturning unit can cause physical injury.**

Do not tilt!



- 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 drilling 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 Application 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 (disconnecting means); 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.
- Do not use the optional Prevention of Unexpected Start function for stopping the drive when the drive is running. Give a Stop command instead.

Note:

- If an external source for start command is selected and it is ON, the drive (with Standard Application 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.

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.
- 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 or output terminals (U1, V1, W1, U2, V2, W2).
  Alternative 2) Measure that there is no voltage present on the drive input or output terminals (U1, V1, W1, U2, V2, W2). 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 may damage or explode the capacitors in the intermediate circuit of the drive.

Controlling a permanent magnet motor is only allowed using the ACS800 Permanent Magnet Synchronous Motor Drive Application Program, or other application programs in scalar control mode.

Table of contents

Mechanical installation

Planning the electrical installation

Electrical installation

Motor control and I/O board (RMIO)

Installation checklist

Operation

Maintenance

Technical data

Dimensional drawings

External +24 V power supply for the RMIO board

About 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).

Other related manuals

Refer to *ACS800 IGBT Supply Control Program Firmware Manual* [3AFE68315735 (English)] for the line-side converter

- program features
- actual signals and parameters
- fault tracing
- fieldbus control.

Note: The parameters of the line-side converter control program need not be set in a normal start-up procedure or in normal use.

See the appropriate application program firmware manual for the motor-side converter

- start-up procedure
- use of the control panel
- program features
- actual signals and parameters
- fault tracing
- fieldbus control.

Note: The ACS800-11/U11 specific parameters are described in the hardware manual in chapter *Operation*.

If the drive will be connected to a common DC bus, see *ACS800 Single Drive Common DC Configurations Application Guide* [3AFE64786555 (English)].

Common chapters for several products

Chapters *Safety instructions*, *Planning the electrical installation* and *Motor control and I/O board (RMIO)* apply to several ACS800 products which are listed at the beginning of the chapters.

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 ACS800-11/U11 is manufactured in frame sizes R5 and R6.

Categorization according to the plus code

The instructions, technical data and dimensional drawings which concern only certain optional selections are marked with plus codes, e.g. +E202. The options included in the drive can be identified from the plus codes visible on the type designation label of the drive. The plus code selections are listed in chapter *The ACS800-11/U11* 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.

About 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.

The ACS800-11/U11 describes the drive.

Mechanical installation instructs in how to place and mount the drive.

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

Electrical installation shows how to wire the drive.

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.

Operation contains guide lines of the start-up and use of the drive, descriptions of ACS800-11/U11 specific parameters and softaware-based fault tracing.

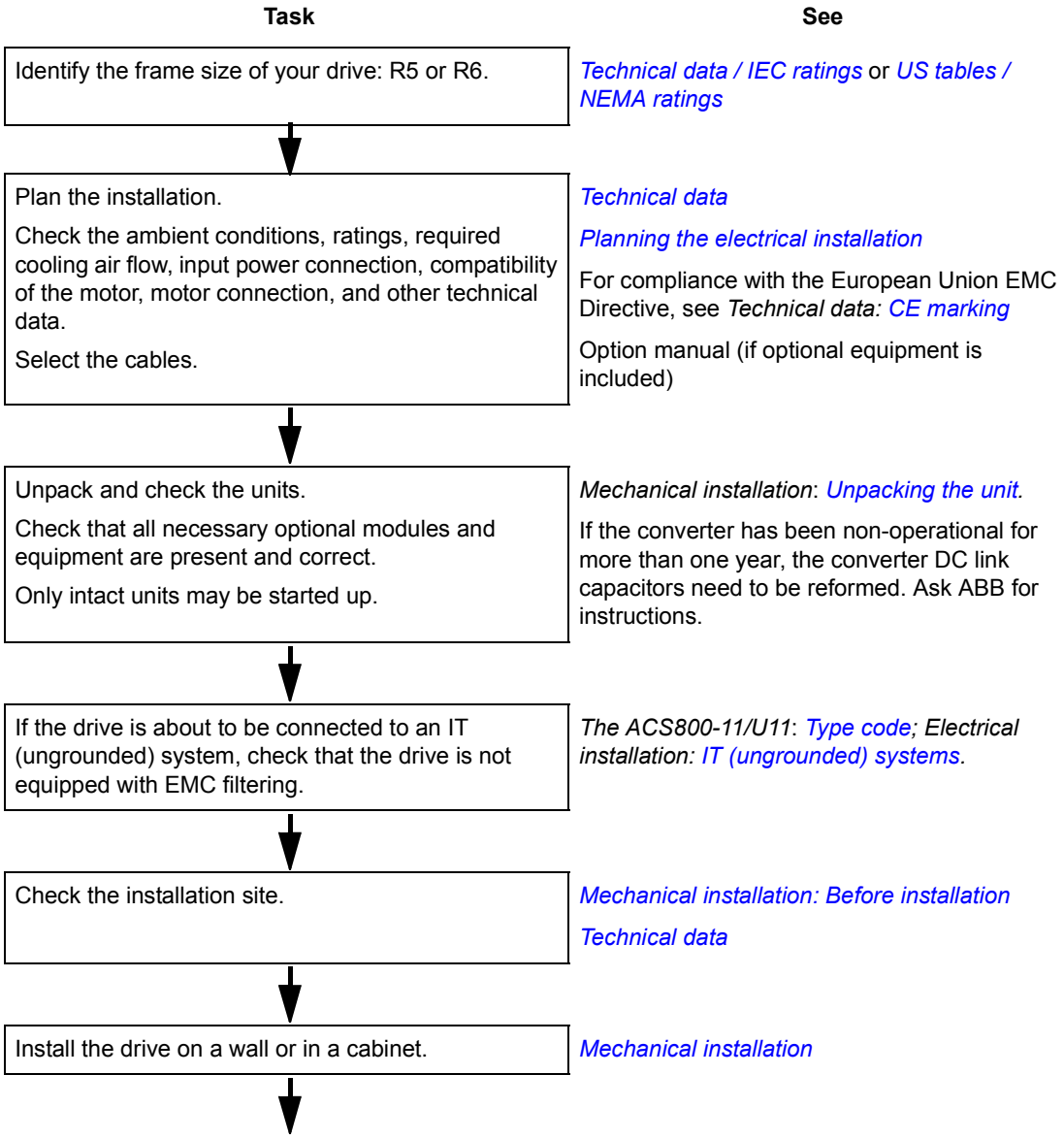
Maintenance contains preventive maintenance instructions.

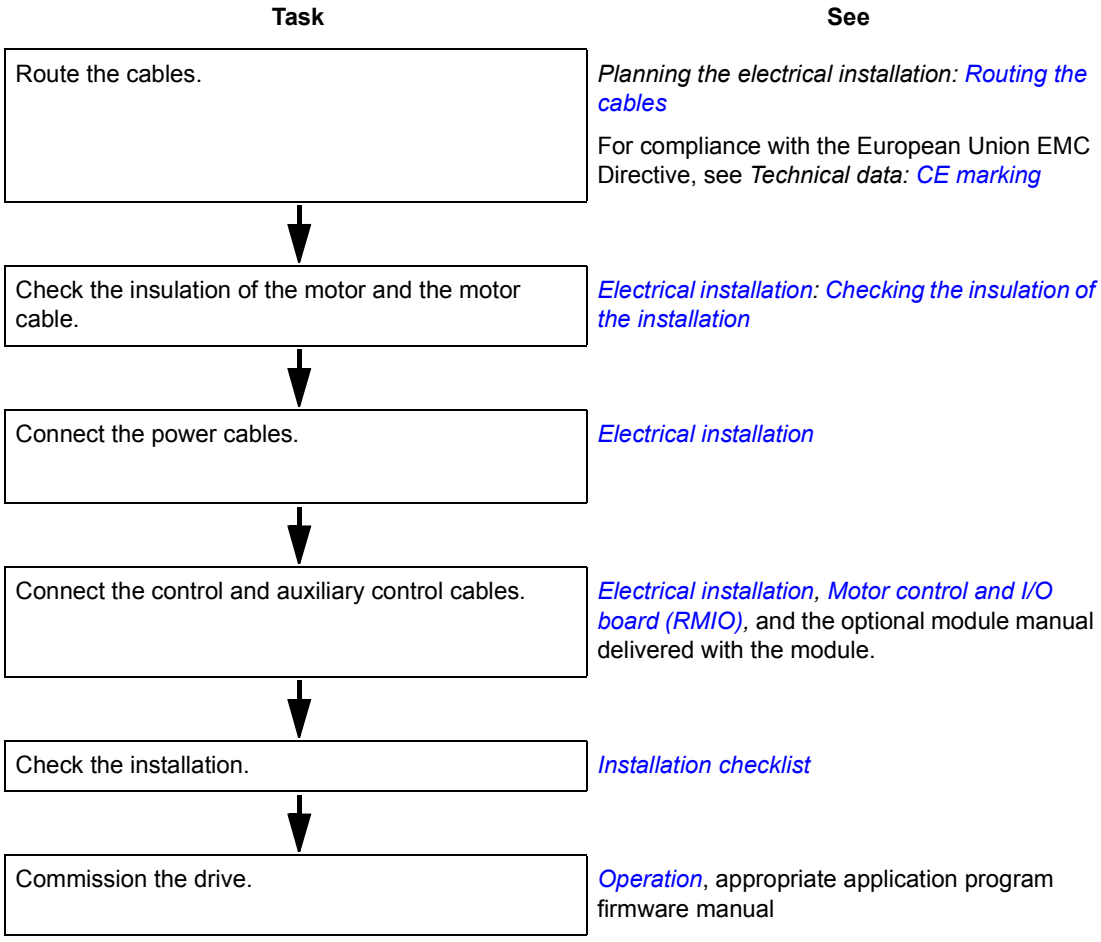
Technical data contains the technical specifications of the drive, e.g. the ratings, sizes and technical requirements, provisions for fulfilling the requirements for CE and other markings and warranty policy.

Dimensional drawings contains the dimensional drawings of the drive.

External +24 V power supply for the RMIO board describes how to connect external +24 V power supply for the RMIO board.

Installation and commissioning flowchart





Inquiries

Address any inquiries about the product to the local ABB representative, quoting the type code and serial number of the unit. If the local ABB representative cannot be contacted, address inquiries to the manufacturing facility.

The ACS800-11/U11

What this chapter contains

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

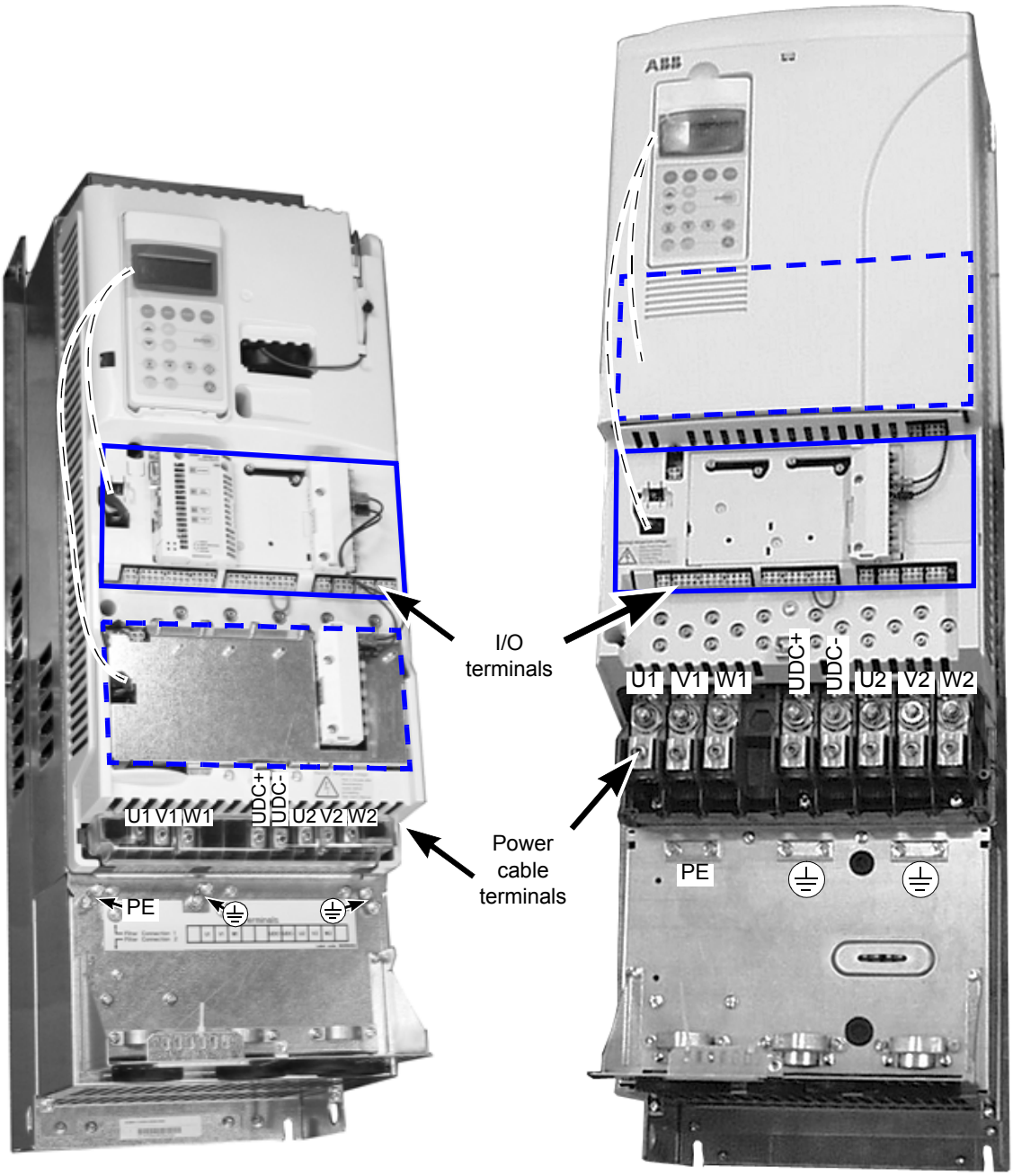
The ACS800-11/U11

The ACS800-1/U11 is a four-quadrant wall mountable drive for controlling AC motors. The main circuit consists of two IGBT converters, a line-side converter and a motor-side converter, integrated into the same frame.

IP 21 (UL type 1)

Frame size R6

IP 00 (UL type open)



Frame size R5 without front and connection box covers

Frame size R6 without front and connection box covers

Location of the line-side converter RMIO board

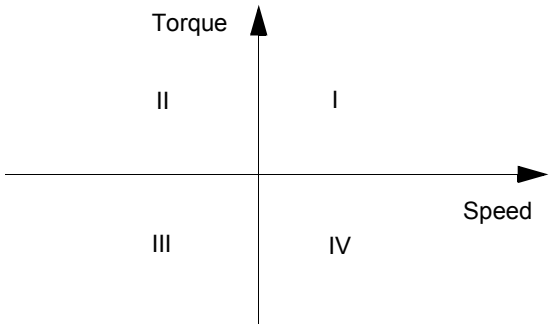
Location of the motor-side converter RMIO board

Terms

Line-side converter: A converter that is connected to the supply network and is capable of transferring energy from the network to the DC link or from the DC link to the network.

Motor-side converter: A converter that is connected to the motor and controls the motor operation.

Four-quadrant operation: Operation of a machine as a motor or generator in quadrants I, II, III and IV as shown below. In quadrants I and III, the machine operates as a motor, whereas in quadrants II and IV as a generator (regenerative braking).



Operation principle

The line-side and motor-side converters consist of six insulated gate bipolar transistors with free wheeling diodes.

The converters have their own control programs. The parameters of both programs can be viewed and changed using one control panel. The control panel can be switched between the converters as described in chapter *Operation*.

Line-side converter

The IGBT supply module rectifies three phase AC current to direct current for the intermediate DC link of the drive. The intermediate DC link is further supplying the motor-side converter that runs the motor. The line filter suppresses the AC voltage and current harmonics.

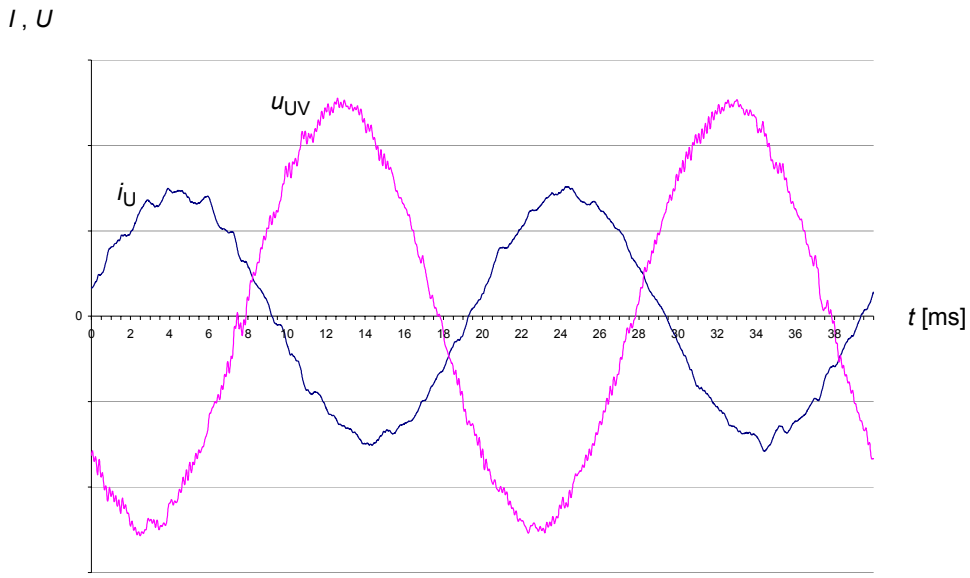
The IGBT supply module is a four-quadrant switching-mode converter, i.e. the power flow through the converter is reversible. By default, the converter controls the DC link voltage to the peak value of the line-to-line voltage. The DC voltage reference can be set also higher by a parameter. The control of the IGBT power semiconductors is based on the Direct Torque Control (DTC) method also used in the motor control of the drive. Two line currents and the DC link voltage are measured and used for the control.

AC voltage and current waveforms

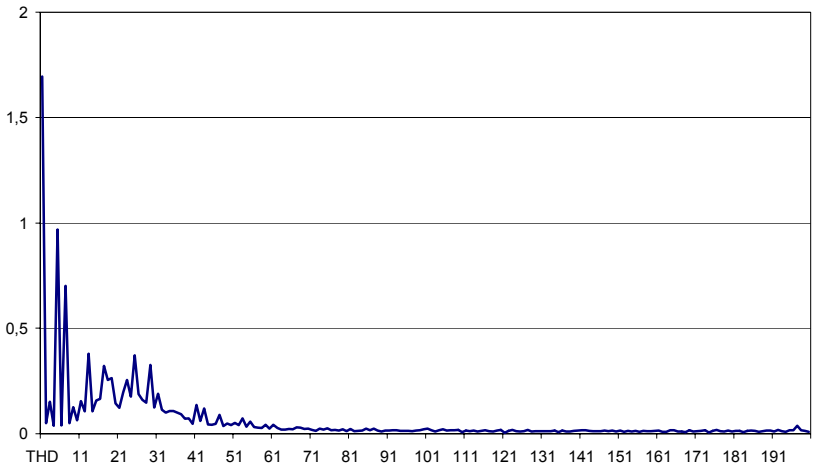
The AC current is sinusoidal at a unity power factor. The IGBT supply unit does not generate characteristic current or voltage overtones like a traditional 6- or 12-pulse bridge does.

The Total Harmonic Distortion (THD) in current is given in chapter *Technical data / Input power connection.* The THD in voltage depends slightly on the Short Circuit Ratio in the Point of Common Coupling (PCC). The high frequency switching and high du/dt slightly distort the voltage waveform at the input of the converter.

Typical line current (i_U) and voltage (u_{UV}) waveforms are shown below (**Note:** The diagrams represent a larger unit than the ACS800-11).



An example spectrum of the voltage distortion at the output of the transformer is shown below. Each harmonic is presented as compared to fundamental voltage (reference value = 1). n denotes the ordinal number of the harmonic.



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.

Printed circuit boards

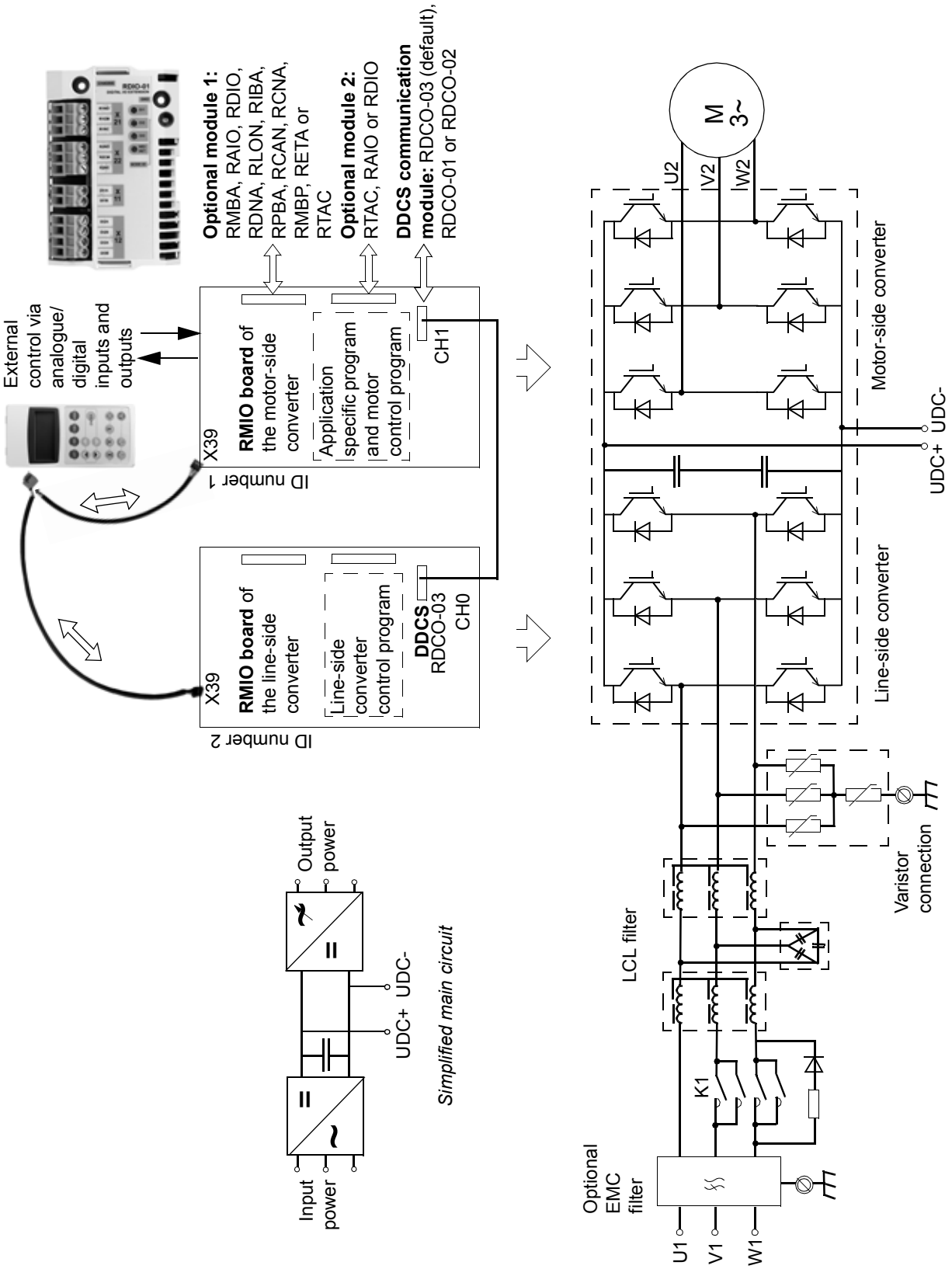
The drive contains the following printed circuit boards as standard:

- main circuit board (GINT)
- motor control and I/O board (RMIO), 2 pcs
- EMC filter unit (GRFCU) when EMC equipment is selected
- filter boards (GRFC or RRFC)
- varistor board (GVAR)
- control panel (CDP 312R)
- current measurement board (GCUR, in frame size R5 only)
- charging diode board (GDIO).

DDCS communication modules

The drive includes an RDCO-03 module in the line-side converter and another RDCO module in the motor-side converter.

Main circuit and control diagram



Type code

The type code contains information on the specifications and configuration of the drive. The first digits from left express the basic configuration (e.g. ACS800-11-0030-5). The optional selections are given thereafter, separated by plus signs (e.g. +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: 64556568, available on request).

Selection	**Alternatives**	
Product series	ACS800 product series	
Type	11	regenerative, wall mounted. When no options are selected: IP 21, Control Panel CDP312R, DDCS communication option module RDCO-03, no EMC filter, Standard Application Program, cable connection box (cabling from below), boards with coating, one set of manuals.
	U11	wall mounted (USA). When no options are selected: UL type 1, Control Panel CDP312R, DDCS communication option module RDCO-03, no EMC filter, US version of the Standard Application Program (three-wire start/stop as default setting), US gland/conduit plate, boards with coating, one set of English manuals.
Size	Refer to *Technical data: IEC ratings.*	
Voltage range (nominal rating in bold)	2	208/220/**230**/240 VAC
	3	380/**400**/415 VAC
	5	380/400/415/440/460/480/**500** VAC
+ options		
Filter	E200	EMC/RFI filter for second environment TN (grounded) system, unrestricted distribution. **Note:** Filter not needed for frame size R6.
	E202	EMC/RFI filter for first environment TN (grounded) system, restricted distribution (the A limits)
Cabling	H358	US/UK gland/conduit plate
Control panel	0J400	no control panel
Fieldbus	K...	Refer to *ACS800 Ordering Information* (EN code: 64556568).
I/O	L...	
Application program	N...	
Manual language	R...	

Mechanical installation

Unpacking the unit

The drive is delivered in a box that also contains:

- plastic bag containing: screws (M3), clamps and cable lugs (2 mm^2, M3) for grounding the control cable screens
- residual voltage warning stickers
- hardware manual
- appropriate firmware manuals and guides
- optional module manuals
- delivery documents.

Delivery check

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, 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 lower part of the back plate of the unit. Example labels are shown below.

Type designation label

Serial number label

Moving the unit

Lift the unit using the lifting holes at the top and bottom.

Lifting a unit of frame size R6

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 chapter *Dimensional drawings* for frame details.

Requirements for the installation site

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

Wall

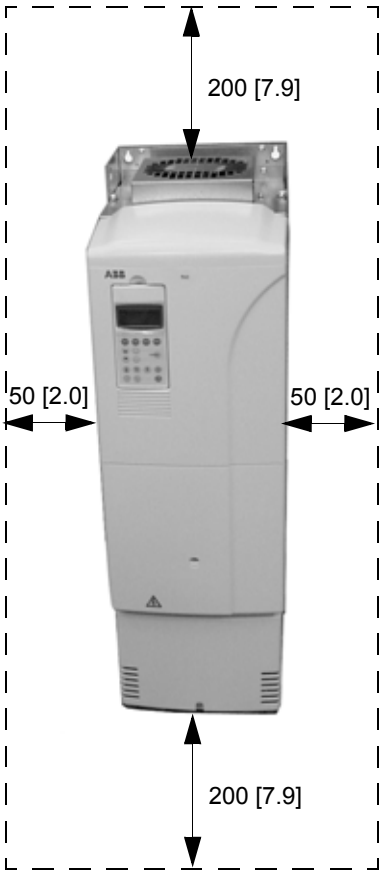
The wall should be as close to vertical as possible, of non-flammable material and strong enough to carry the weight of the unit. Check that there is nothing on the wall to inhibit the installation.

Floor

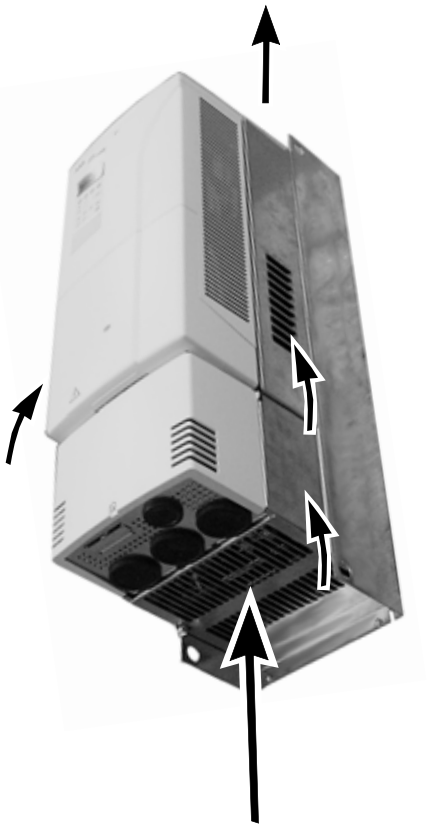
The floor/material below the installation should be non-flammable.

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].



IP 21 (UL 1)



Cooling air flow

Mounting the drive on the wall

1. Mark the locations for the four holes. The mounting points are shown in chapter *Dimensional drawings*.
2. Fix the screws or bolts to the marked locations.
3. Position the drive onto the screws on the wall. **Note:** Lift the drive by its lifting holes, not by its cover.
4. Tighten the screws in the wall securely.

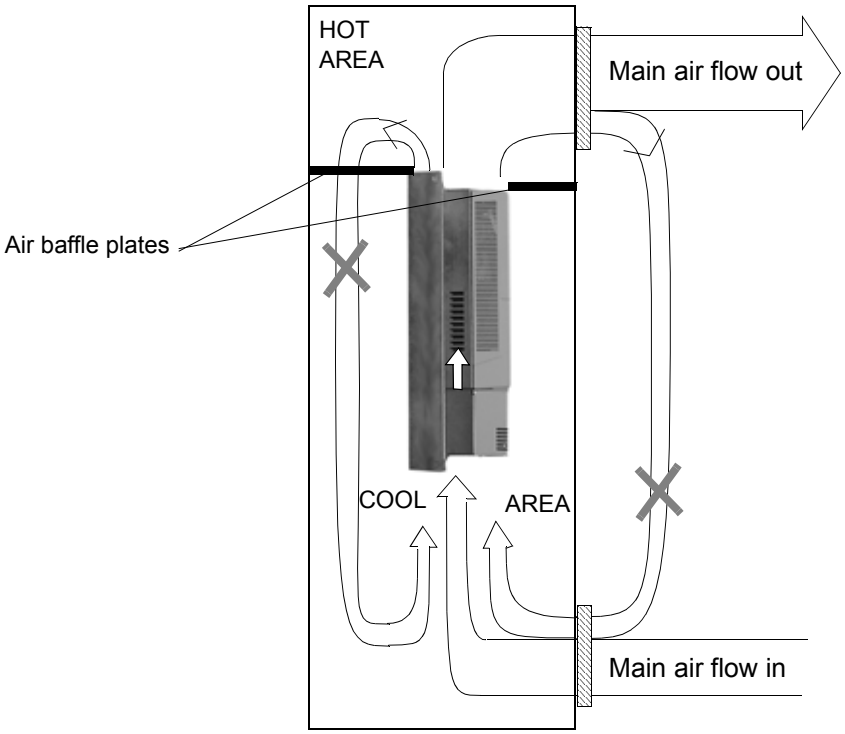
Cabinet installation

The drive can be installed in a cabinet without the plastic front, top and connection box covers and without the lead-through plate. The required distance between parallel units is 50 millimetres (1.97 in.) in installations without the front cover. The cooling air entering the unit must not exceed +40 °C (+104 °F). Contact ABB, if two units are to be installed side by side at a distance smaller than 50 millimetres (1.97 in.), i.e. the side air holes will be covered at one side.

Preventing cooling air recirculation

Prevent air recirculation inside and outside the cabinet.

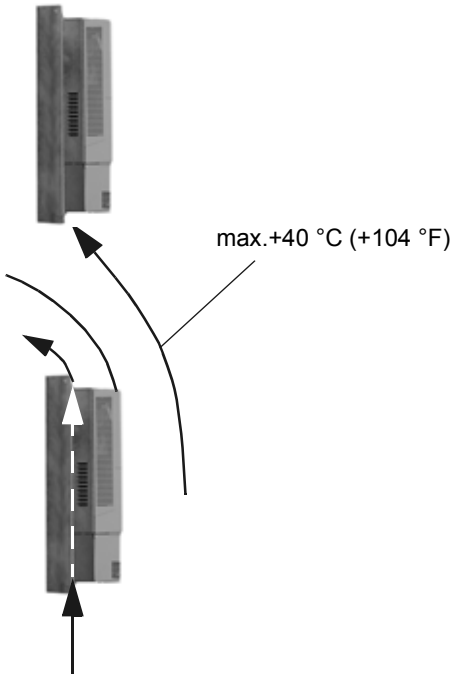
Example



Unit above another

Lead the out-coming hot cooling air away from the air input of the drive 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.

To which products this chapter applies

This chapter applies to the ACS800-01/U1, ACS800-11/U11, ACS800-02/U2, ACS800-04/U4, and ACS800-07/U7 types up to -0610-x.

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:

If the drive is equipped with …	… and …	… then the motor voltage rating should be …
diode supply ACS800-01, -U1, -02, -U2, -04, -04M, -U4 -07, -U7	no resistor braking is in use	U_N
	frequent or long term brake cycles will be used	U_{ACeq1}
IGBT supply ACS800-11, -U11, -17	DC link voltage will not be increased from nominal (parameter setting)	U_N
	DC link voltage will be increased from nominal (parameter setting)	U_{ACeq2}

U_N = Rated input voltage of the drive
U_{ACeq1} = $U_{DC}/1.35$
U_{ACeq2} = $U_{DC}/1.41$

U_{ACeq} is the equivalent AC power source voltage of the drive in VAC.
U_{DC} is the maximum DC link voltage of the drive in VDC.
For resistor braking: U_{DC}= 1.21 × nominal DC link voltage.
For units with IGBT supply: See the parameter value.
(**Note:** Nominal DC link voltage is U_N × 1.35 or U_N × 1.41 in VDC.)

See notes 6 and 7 below the *Requirements table.*

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.

   Example 2: When the supply voltage is 440 V and the drive is equipped with an IGBT supply, the maximum peak voltage in the motor terminals can be approximated as follows: 440 V · 1.41 · 2 = 1241 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 du/dt filters. du/dt 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 du/dt 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 du/dt filter, insulated N-end (non-driven end) motor bearings and ABB common mode filters are required. The motor manufacturer should be consulted regarding the construction of the motor insulation and additional requirements for explosion-safe (EX) motors. Failure of the motor to fulfil the following requirements or improper installation may shorten motor life or damage the motor bearings.

Manufacturer	Motor type	Nominal mains voltage (AC line voltage)	Requirement for			
			Motor insulation system	ABB du/dt 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_ and M3_	U_N ≤ 500 V	Standard	-	+ N	+ N + CMF
		500 V < U_N ≤ 600 V	Standard	+ du/dt	+ du/dt + N	+ du/dt + N + CMF
			or			
			Reinforced	-	+ N	+ N + CMF
		600 V < U_N ≤ 690 V	Reinforced	+ du/dt	+ du/dt + N	+ du/dt + 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 + du/dt
	Old* form-wound HX_ and modular	380 V < U_N ≤ 690 V	Check with the motor manufacturer.	+ du/dt 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		+ du/dt + N + CMF		
NON-ABB	Random-wound and form-wound	U_N ≤ 420 V	Standard: $\hat{U}_{LL}$ = 1300 V	-	+ N or CMF	+ N + CMF
		420 V < U_N ≤ 500 V	Standard: $\hat{U}_{LL}$ = 1300 V	+ du/dt	+ du/dt + N	+ du/dt + N + CMF
					or	
					+ du/dt + CMF	
			or			
			Reinforced: $\hat{U}_{LL}$ = 1600 V, 0.2 microsecond rise time	-	+ N or CMF	+ N + CMF
		500 V < U_N ≤ 600 V	Reinforced: $\hat{U}_{LL}$ = 1600 V	+ du/dt	+ du/dt + N	+ du/dt + N + CMF
					or	
					+ du/dt + CMF	
			or			
			Reinforced: $\hat{U}_{LL}$ = 1800 V	-	+ N or CMF	+ N + CMF
		600 V < U_N ≤ 690 V	Reinforced: $\hat{U}_{LL}$ = 1800 V	+ du/dt	+ du/dt + N	+ du/dt + 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 will be increased from the nominal level by resistor braking or by the IGBT supply unit 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
du/dt	du/dt filter at the output of the drive +E205
CMF	common mode filter +E208
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: *High-output motors and IP 23 motors*

For motors with higher rated output than what is stated for the particular frame size in EN 50347 (2001) and for IP 23 motors, the requirements of ABB random-wound motor series M3AA, M3AP, M3BP are given below. For other motor types, see the *Requirements table* above. Apply the requirements of range **100 kW < P_N < 350 kW** to motors with P_N < 100 kW. Apply the requirements of range **$P_N \geq$ 350 kW** to motors within the range **100 kW < P_N < 350 kW**. In other cases, consult the motor manufacturer.

Manufacturer	Motor type	Nominal mains voltage (AC line voltage)	Requirement for			
			Motor insulation system	ABB du/dt filter, insulated N-end bearing and ABB common mode filter		
				P_N < 55 kW	**55 kW ≤ P_N < 200 kW**	**$P_N \geq$ 200 kW**
				P_N < 74 HP	**74 HP ≤ P_N < 268 HP**	**$P_N \geq$ 268 HP**
ABB	Random-wound M3AA, M3AP, M3BP	$U_N \leq$ 500 V	Standard	-	+ N	+ N + CMF
		500 V < $U_N \leq$ 600 V	Standard	+ du/dt	+ du/dt + N	+ du/dt + N + CMF
			or			
			Reinforced	-	+ N	+ N + CMF
		600 V < $U_N \leq$ 690 V	Reinforced	+ du/dt	+ du/dt + N	+ du/dt + N + CMF

Note 4: *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 5: *ABB motors of types other than M2_, M3_, HX_ and AM_*

Use the selection criteria given for non-ABB motors.

Note 6: *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 7: *Drives with an IGBT supply unit*

If voltage is raised by the drive (this is a parameter selectable function), select the motor insulation system according to the increased intermediate circuit DC voltage level, especially in the 500 V supply voltage range.

Permanent magnet synchronous 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 synchronous motor and the drive output. The switch is needed to isolate the motor during any maintenance work on the drive.

Supply connection

Disconnecting device (disconnecting means)

ACS800-01, ACS800-U1, ACS800-11, ACS800-U11, ACS800-02, ACS800-U2 without enclosure extension, ACS800-04, ACS800-U4

Install a hand-operated input disconnecting device (disconnecting means) 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.

ACS800-U2 with enclosure extension, ACS800-07 and ACS800-U7

These units are equipped with a hand-operated input disconnecting device (disconnecting means) which isolates the drive and the motor from the AC power as standard. The disconnecting device does not, however, isolate the input busbars from the AC power. Therefore, during installation and maintenance work on the drive, the input cables and busbars must be isolated from the input power with a disconnector at the distribution board or at the supplying transformer.

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 means must conform to the applicable safety regulations.

Fuses

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

Thermal overload and short-circuit protection

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.

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.

Mains cable (AC line cable) short-circuit protection

Always protect the input cable with fuses. Size the fuses according to local safety regulations, appropriate input voltage and the rated current of the drive (see *Technical Data)*.

ACS800-01/U1, ACS800-11/U11, ACS800-02/U2 without enclosure extension and ACS800-04/U4

When placed at the distribution board, standard gG fuses (US: CC or T for the ACS800-U1 and ACS800-U11; T or L for the ACS800-U2 and ACS800-U4) 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.

Drive AC fuses (ACS800-07/U7, and ACS800-02/U2 with enclosure extension)

ACS800-07/U7 units and ACS800-02/U2 units with enclosure extension are equipped with standard gG (US: T/L) or optional aR fuses listed in *Technical Data*. The fuses restrict drive damage and prevent damage to adjoining equipment in case of a short-circuit inside the drive.

Operating time of the fuses

Check that the operating time of the fuse is below 0.5 seconds. The operating time depends on the fuse type (gG or aR), supply network impedance and the cross-sectional area, material and length of the supply cable. In case the 0.5 seconds operating time is exceeded with gG fuses (US: CC/T/L), ultrarapid (aR) fuses will in most cases reduce the operating time to an acceptable level. The US fuses must be of the “non-time delay” type.

For fuse ratings, see *Technical Data*.

Circuit breakers

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 approved breaker types and supply network characteristics.

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 without fuses are not recommended 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 *ACS800 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.

Emergency stop devices

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

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

ACS800-02/U2 with enclosure extension and ACS800-07/U7

An emergency stop function is optionally available for stopping and switching off the whole drive. Two stop categories according to IEC/EN 60204-1 (1997) are available: immediate removal of power (Category 0 for ACS800-02/U2 and ACS800-07/U7) and controlled emergency stop (Category 1 for ACS800-07/U7).

Restarting after an emergency stop

After an emergency stop, the emergency stop button must be released and the drive started by turning the operating switch of the drive from position "ON" to "START".

Prevention of Unexpected Start

The drive can be equipped with an optional Prevention of Unexpected Start function according to standards IEC/EN 60204-1: 1997; ISO/DIS 14118: 2000 and EN 1037: 1996.

The Prevention of Unexpected Start function disables the control voltage of the power semiconductors, thus preventing the inverter 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 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 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: When a running drive is stopped by using the Prevention of Unexpected Start function, the drive will stop by coasting. 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.

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 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 VAC cable is accepted for up to 500 VAC. 750 VAC cable is accepted for up to 600 VAC. For 690 VAC 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 recommended.

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 motor bearing currents and wear.

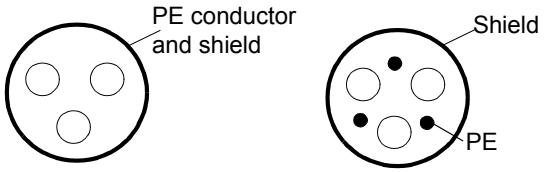
The motor cable and its PE pigtail (twisted shield) should be kept as short as possible in order to reduce electromagnetic emission.

Alternative power cable types

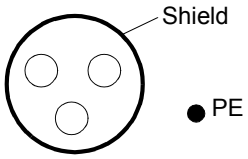
Power cable types that can be used with the drive are represented below.

Recommended

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

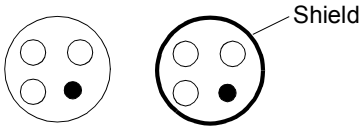


A separate PE conductor is required if the conductivity of the cable shield is < 50 % of the conductivity of the phase conductor.



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

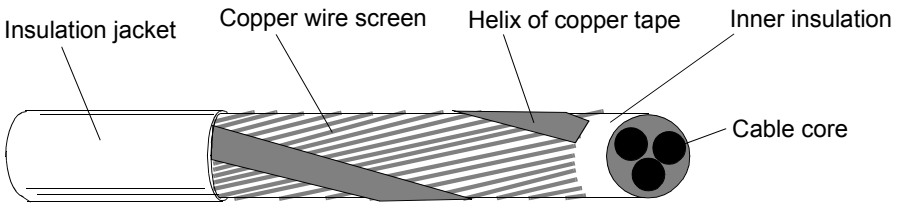
Not allowed for motor cables



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

Motor cable shield

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. 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 VAC cable is accepted for up to 500 VAC. 1000 VAC cable is required above 500 VAC (below 600 VAC). For drives rated over 100 amperes, the power cables must be rated for 75 °C (167 °F).

Conduit

Where conduits must be coupled together, bridge the joint with a ground conductor bonded to the conduit on each side of the joint. Bond the conduits also to the drive enclosure. Use separate conduits for input power, motor, brake resistors, and control wiring. Do not run motor wiring from more than one drive in the same conduit.

Armored cable / shielded power cable

The motor cables can be run in the same cable tray as other 460 V or 600 V power wiring. Control and signal cables must not be run in the same tray as power cables. 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

Do not connect power factor compensation capacitors or surge absorbers to the motor cables between the drive and the motor. They are not designed to be used with drives, and will degrade motor control accuracy. They can cause permanent damage to the drive or themselves due to the rapid changes in the drive output voltage.

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.

Before opening a contactor (DTC control mode selected)

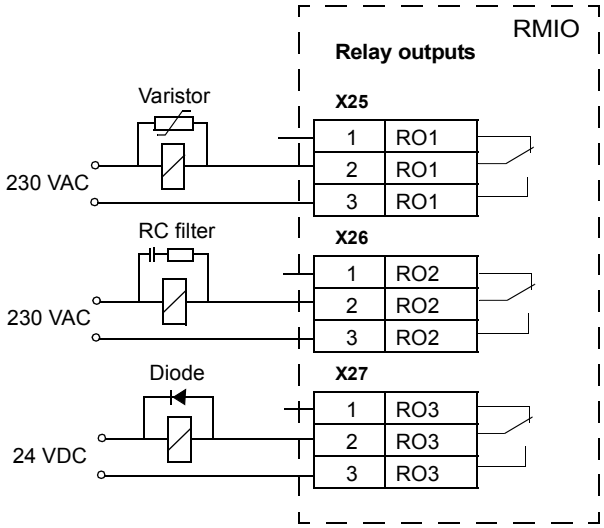
Stop the drive and wait for the motor to stop before opening a contactor between the output of the drive and the motor when the DTC control mode is selected. See the appropriate ACS800 application program firmware manual for the required parameter settings. Otherwise, the contactor will be damaged. In scalar control, the contactor can be opened with the drive running.

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.

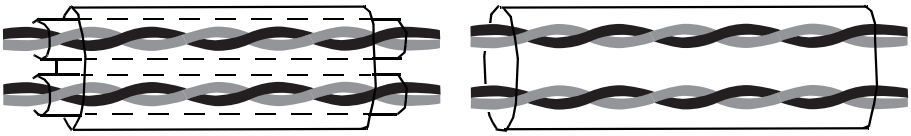


Selecting the control cables

All control cables must be shielded.

Use a double-shielded twisted pair cable (Figure a, e.g. JAMAK by NK Cables, Finland) 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 VDC and 115/230 VAC 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 *ACS800 Firmware Manual*.

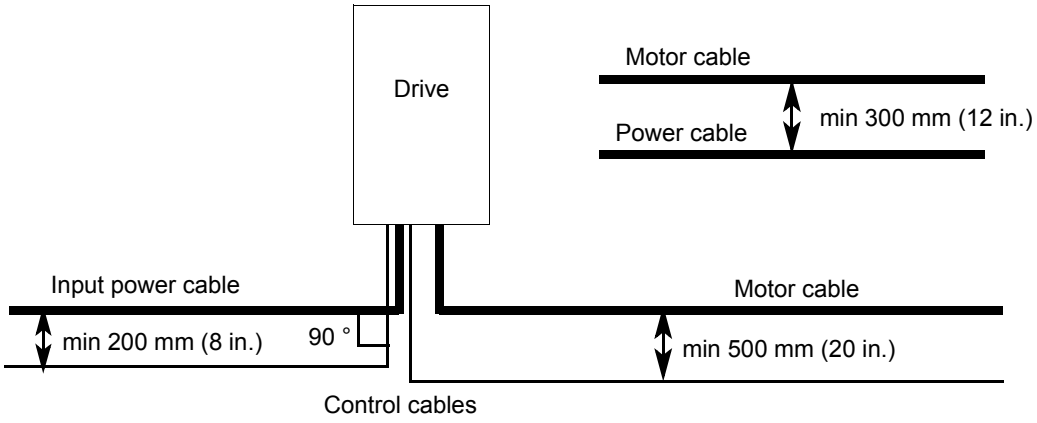
Routing the cables

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.

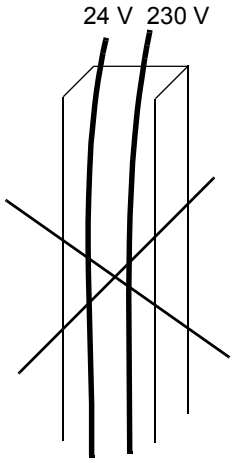
Where control cables must cross power cables make sure they are arranged at an angle as near to 90 degrees as possible. Do not run extra cables through the drive.

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.

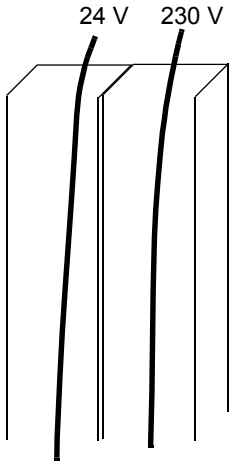
A diagram of the cable routing is shown below.



Control cable ducts



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



Lead 24 V and 230 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 the 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

Every drive has been tested for insulation between the main circuit and the chassis (2500 V rms 50 Hz for 1 second) at the factory. Therefore, do not make any voltage tolerance or insulation resistance tests (e.g. hi-pot or megger) on any part of the drive.

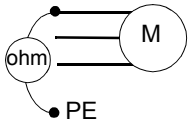
Input cable

Check the insulation of the input cable before connecting it to the drive according to local regulations.

Motor and motor cable

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

1. Check that the motor cable is disconnected from the drive output terminals U2, V2 and W2.



2. Measure the insulation resistances of the motor cable and motor between each phase and the Protective Earth by using a measuring voltage of 1 kV DC. The insulation resistance must be higher than 1 Mohm.

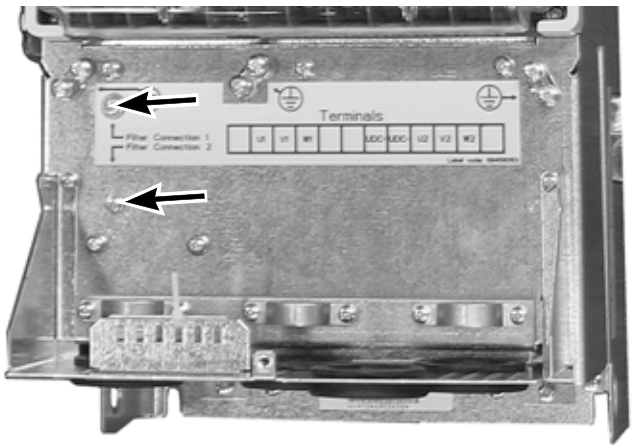
IT (ungrounded) systems

In units with EMC filter options (+E202 and +E200 in the type code), disconnect the filter capacitors before connecting the drive to an ungrounded system.

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.

Disconnecting the EMC filter capacitors

Remove the two screws shown below.

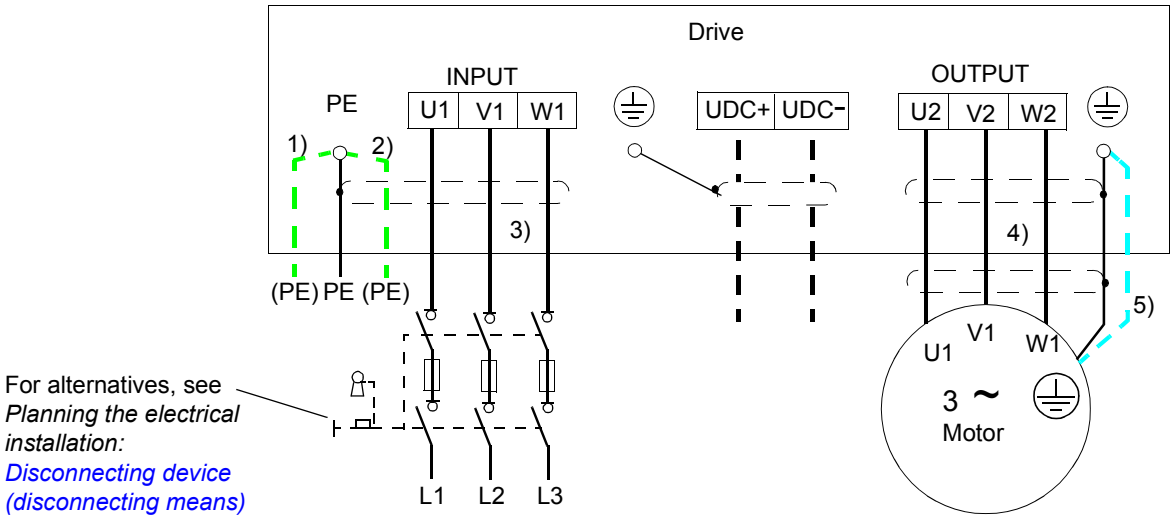


View of frame size R5

Note: When the EMC filter capacitors are disconnected and the motor cable is longer than 100 m (328 ft) the EMC Directive requirements may not be fulfilled in first environment, but are fulfilled in second environment. See chapter *Technical data / CE marking*.

Connecting the power cables

Diagram



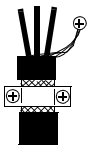
1), 2)

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 is used

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:

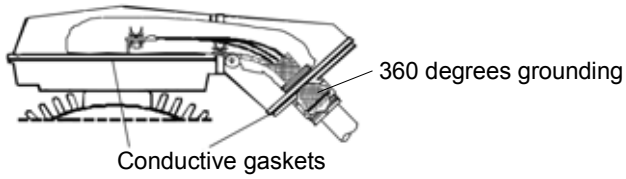
If there is a symmetrically constructed grounding conductor in the motor cable in addition to the conductive shield, connect the grounding conductor to the grounding terminal at the drive and motor ends.

Do not use an asymmetrically constructed motor cable. Connecting its fourth conductor at the motor end increases bearing currents and causes extra wear.

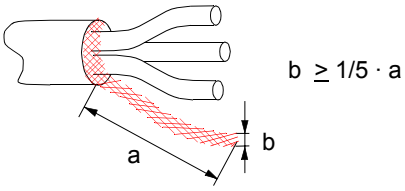
Grounding of the motor cable shield at the motor end

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.
R5	16	0.63
R6	28	1.10

Allowed wire sizes, tightening torques

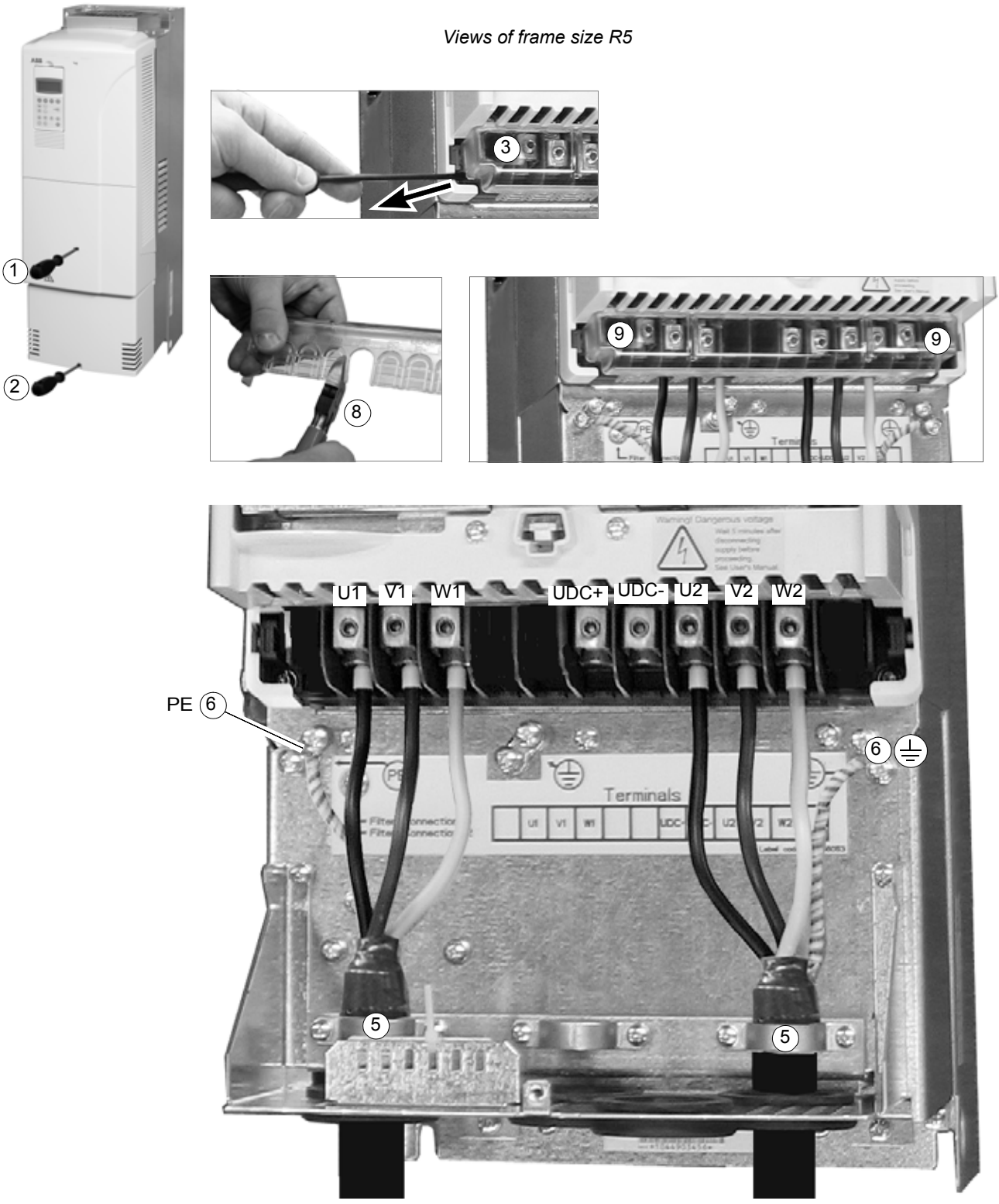
See *Technical data*: *Cable entries*.

Wall installed units (European version)

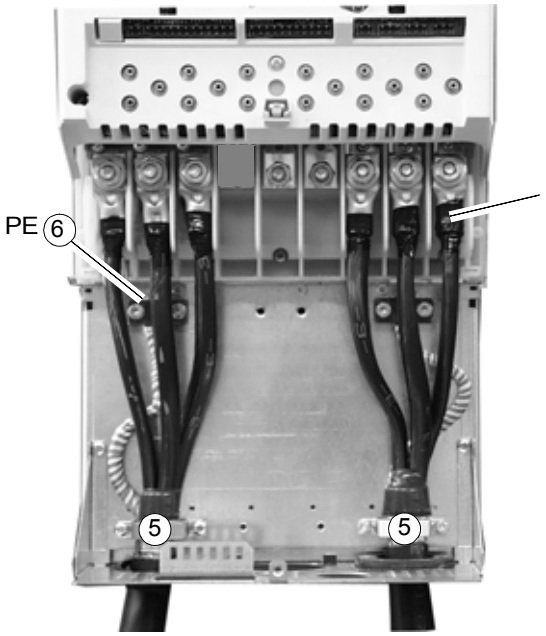
Power cable installation procedure

1. Remove the front cover by releasing the retaining clip with a screw driver and lifting the cover from the bottom outwards.
2. Remove the connection box cover.
3. Remove the clear plastic shroud of the phase conductor terminals.
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 outer sheathing of the cables under the 360 degrees grounding clamps. Fasten the clamps onto the stripped parts of the cables.
6. Tighten the grounding clamps onto the twisted shields of the cables.
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. Cut holes to the clear plastic shroud for the conductors in frame size R5 and in cable lug installations of frame size R6.
9. Press the clear plastic shroud onto the phase conductor terminals.
10. Secure the cables outside the unit mechanically. Connect the control cables as described in section *Connecting the control cables* on page *63*. Fasten the covers, see *Fastening the control cables and covers* on page *66*.

Views of frame size R5



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

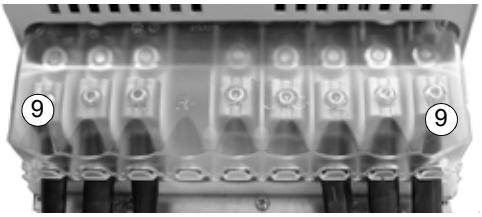


Remove the cable terminals.

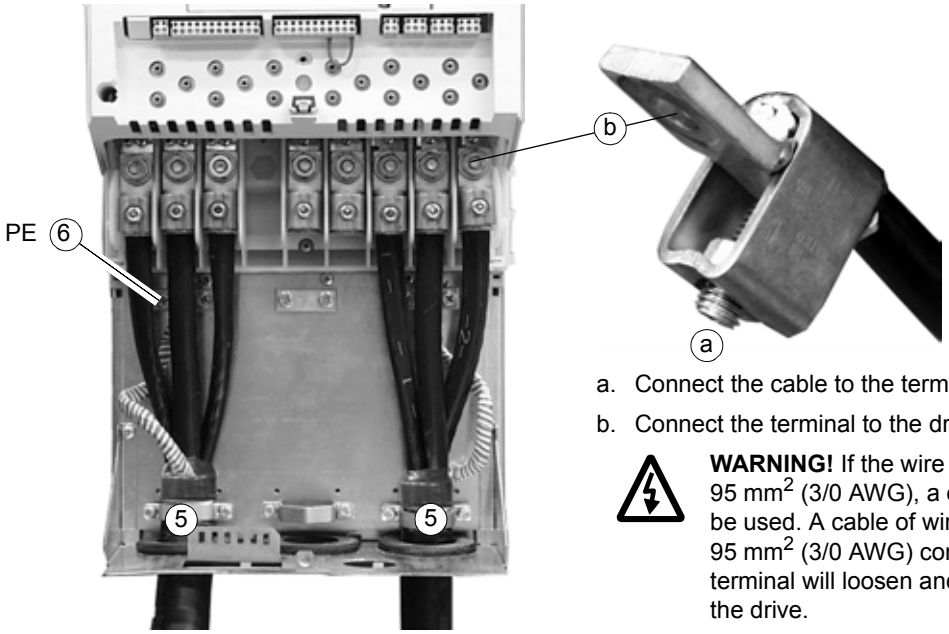
Fasten the cable lugs with screws.

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

Shroud on the cable terminals (cable terminal installation)



Frame size R6: Cable terminal installation [95 to 185 mm^2 (3/0 to 350 AWG)] cables



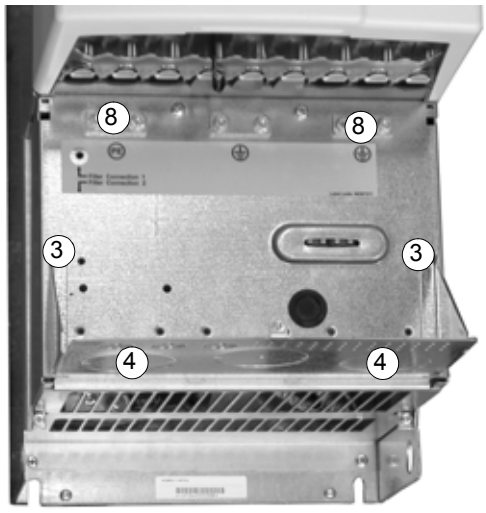
a. Connect the cable to the terminal.

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 by releasing the retaining clip with a screw driver and lifting the cover from the bottom outwards.
2. Remove the connection box cover.



3. Remove the gland plate by undoing the fastening screws.
4. Make the cable entry holes in the gland plate by breaking off the suitable knock-out plates with a screw driver.
5. Fasten the cable glands to the opened holes of the gland plate.
6. Lead the cables through the glands.
7. Fasten the gland plate (3).
8. Connect the grounding conductors of the input and motor cables to the grounding clamps.
9. Remove the clear plastic shroud as shown in section *Power cable installation procedure* on page *58*.
10. 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.

    See *Wall installed units (European version)* for cabling figures. 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		
kcmil/AWG	Manufacturer	Type	Manufacturer	Type	No. of crimps
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

11. Tighten the clamping nuts of the cable glands.

After connecting the control cables, fasten the clear plastic shroud and 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 installed units (IP 00, UL type open)

The drive can be installed in a cabinet without the plastic front, top and connection box covers and without the lead-through plate.

It is recommended:

- to ground the cable shield 360 degrees at the cabinet entry. Grounding with the 360 degrees grounding clamps at the connection box back plate is then not needed.
- to lead the cable unstripped as close to the terminals as possible. Ground the twisted shields of the power cables under the PE and grounding clamps.

Secure the cables mechanically.

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

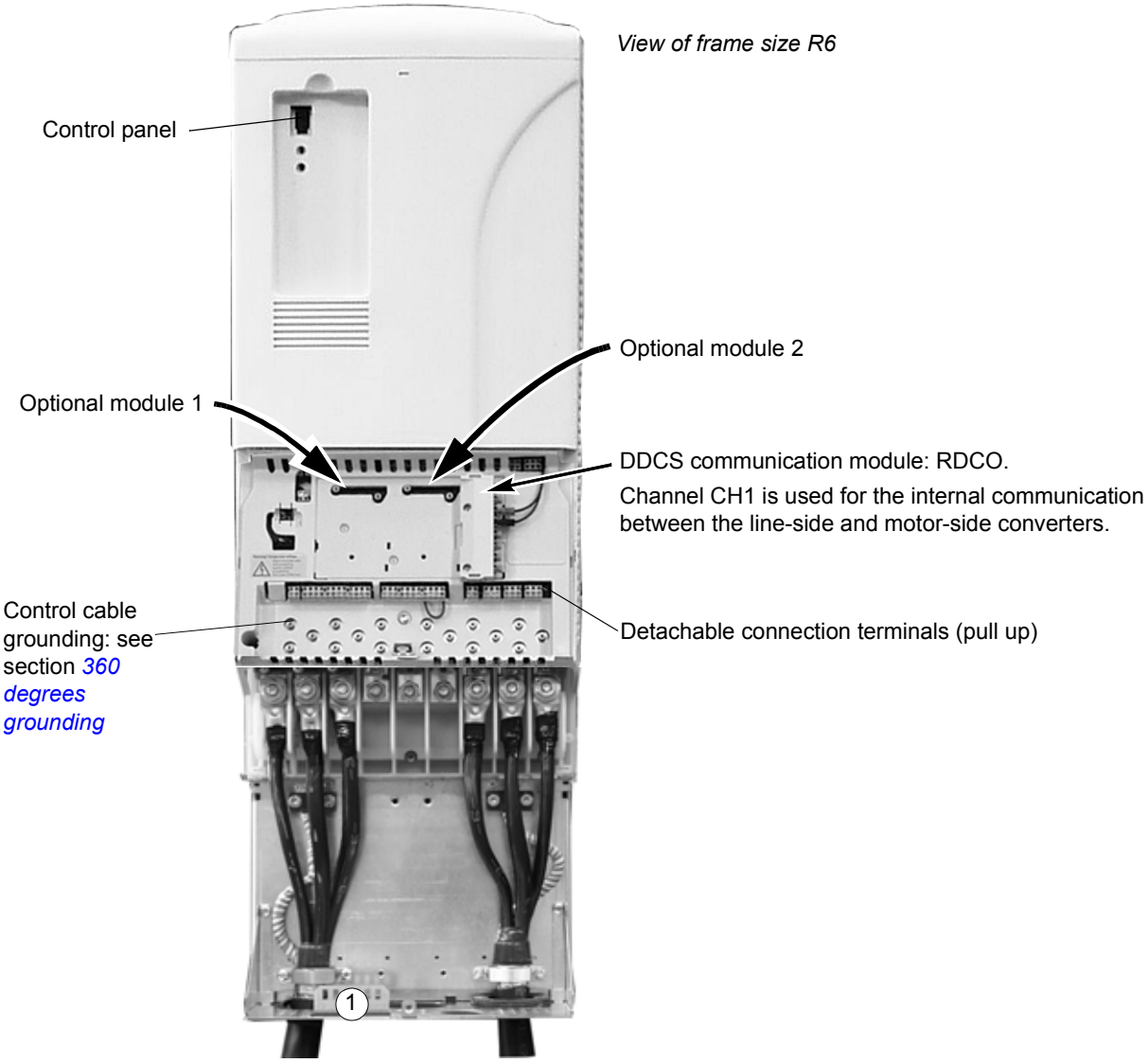
Cover the power cable terminals with the clear plastic shroud as shown in section *Power cable installation procedure* on page *58*.

Connecting the control cables

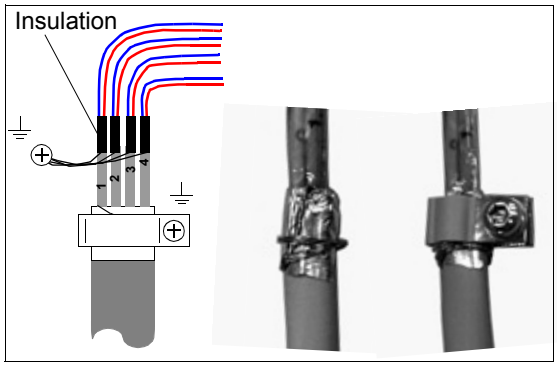
Lead the cable through the control cable entry (1).

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.

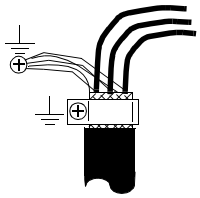
Terminals



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

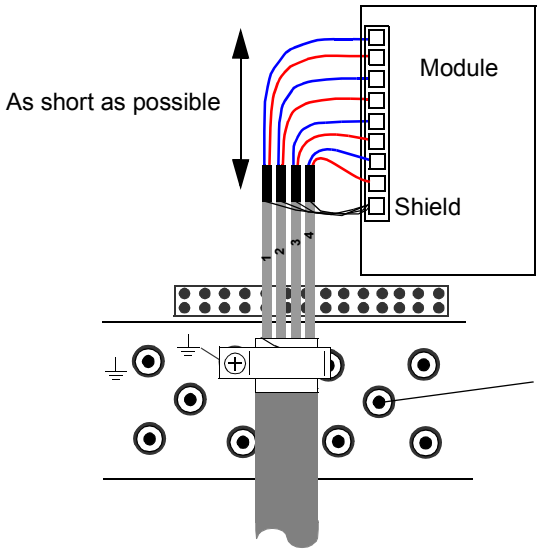
Single-shielded cables: Twist the grounding wires of the outer shield and connect them through the shortest possible route to the nearest grounding hole with a cable lug and a screw. Double-shielded cables: Connect each pair cable shield (twisted grounding wires) with other pair cable shields of the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

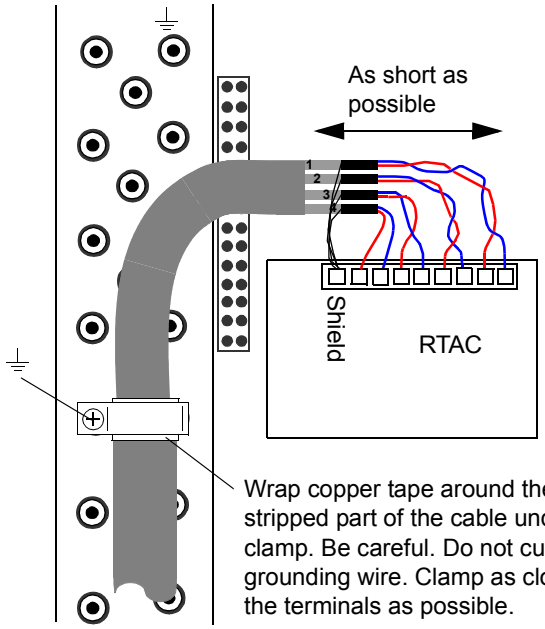
Keep the signal wire pairs twisted as close to the terminals as possible. Twisting the wire with its return wire reduces disturbances caused by inductive coupling.

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

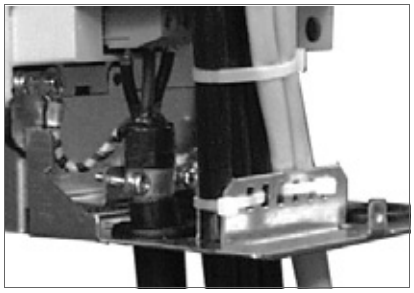


Note1: If the encoder is of unisolated type, ground the encoder cable at the drive end only. If the encoder is galvanically isolated from the motor shaft and the stator frame, ground the encoder cable shield at the drive and the encoder end.

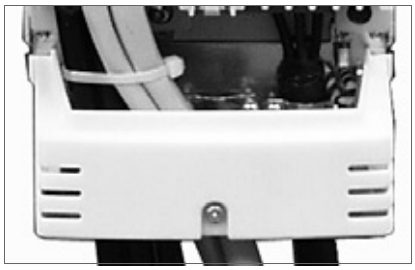
Note 2: Twist the pair cable wires.

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 optional modules and PC

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

Note: Two RDCO modules are provided for the DDCS fibre optic link between the RMIO boards of the line-side and motor-side converters. Channel CH0 of the RDCO-03 module in the line-side converter and channel CH1 of the RDCO module in the motor-side converter are used for the internal communication. In case multiple devices are to be connected to one channel, they must be connected in a ring.

External +24 V power supply for the RMIO board

Refer to chapter *External +24 V power supply for the RMIO board*.

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 Application Program (Factory Macro)
- specifications of the inputs and outputs of the board.

To which products this chapter applies

This chapter applies to ACS800 units which employ the RMIO board.

Note for the ACS800-02 with enclosure extension and the ACS800-07

The connections for the RMIO board shown below apply also to optional terminal block X2 available for the ACS800-02 and ACS800-07. The terminals of the RMIO board are wired to terminal block X2 internally.

Terminals of X2 accept cables from 0.5 to 4.0 mm^2 (22 to 12 AWG). Tightening torque for screw terminals is 0.4 to 0.8 Nm (0.3 to 0.6 lbf ft). For disconnecting wires from spring terminals, use a screw driver with a blade thickness of 0.6 mm (0.024 in.) and width of 3.5 mm (0.138 in.), e.g. PHOENIX CONTACT SZF 1-0,6X3,5.

Note on external power supply

WARNING! If the RMIO board is supplied from an external power source, 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.

External control connections (non-US)

External control cable connections to the RMIO board for the ACS800 Standard Application Program (Factory Macro) are shown below. For external control connections of other application macros and programs, see the appropriate *Firmware Manual*.

RMIO

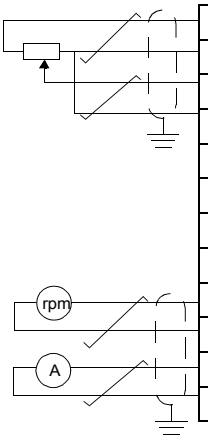
Terminal block size:

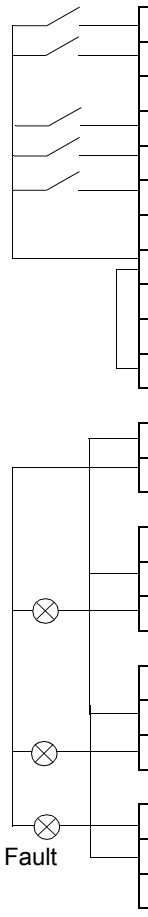
cables 0.3 to 3.3 mm^2 (22 to 12 AWG)

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 VDC, 1 kohm ≤ R_L ≤ 10 kohm
2	– –	2	AGND	
X21		X21		
1	– –	1	VREF+	Reference voltage 10 VDC, 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 VDC 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, non-isolated, 24 VDC 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	

* 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.

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

External control connections (US)

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

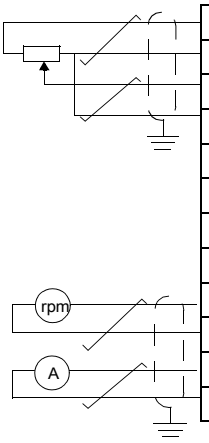
RMIO

Terminal block size:

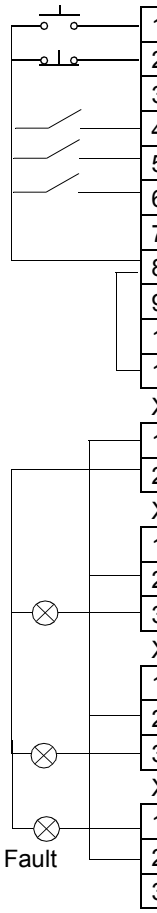
cables 0.3 to 3.3 mm^2 (22 to 12 AWG)

Tightening torque:

0.2 to 0.4 Nm (0.2 to 0.3 lbf ft)



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



* 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.

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

RMIO board specifications

Analogue inputs

	With Standard Application Program 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.
Isolation test voltage	500 VAC, 1 min
Max. common mode voltage between the channels	±15 VDC
Common mode rejection ratio	≥ 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 VDC, 0, -10 VDC ± 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 VDC ± 10 %, short circuit proof
Maximum current	250 mA (shared between this output and optional modules installed on the RMIO)

Analogue outputs

	Two programmable current outputs: 0 (4) to 20 mA, R_L ≤ 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

	With Standard Application Program six programmable digital inputs (common ground: 24 VDC, -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 VDC): short-circuit proof. An external 24 VDC supply can be used instead of the internal supply.
Isolation test voltage	500 VAC, 1 min
Logical thresholds	< 8 VDC ≙ “0”, > 12 VDC ≙ “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 VDC or 250 VAC, 0.4 A at 120 VDC
Minimum continuous current	5 mA rms at 24 VDC
Maximum continuous current	2 A rms
Isolation test voltage	4 kVAC, 1 minute

DDCS fibre optic link

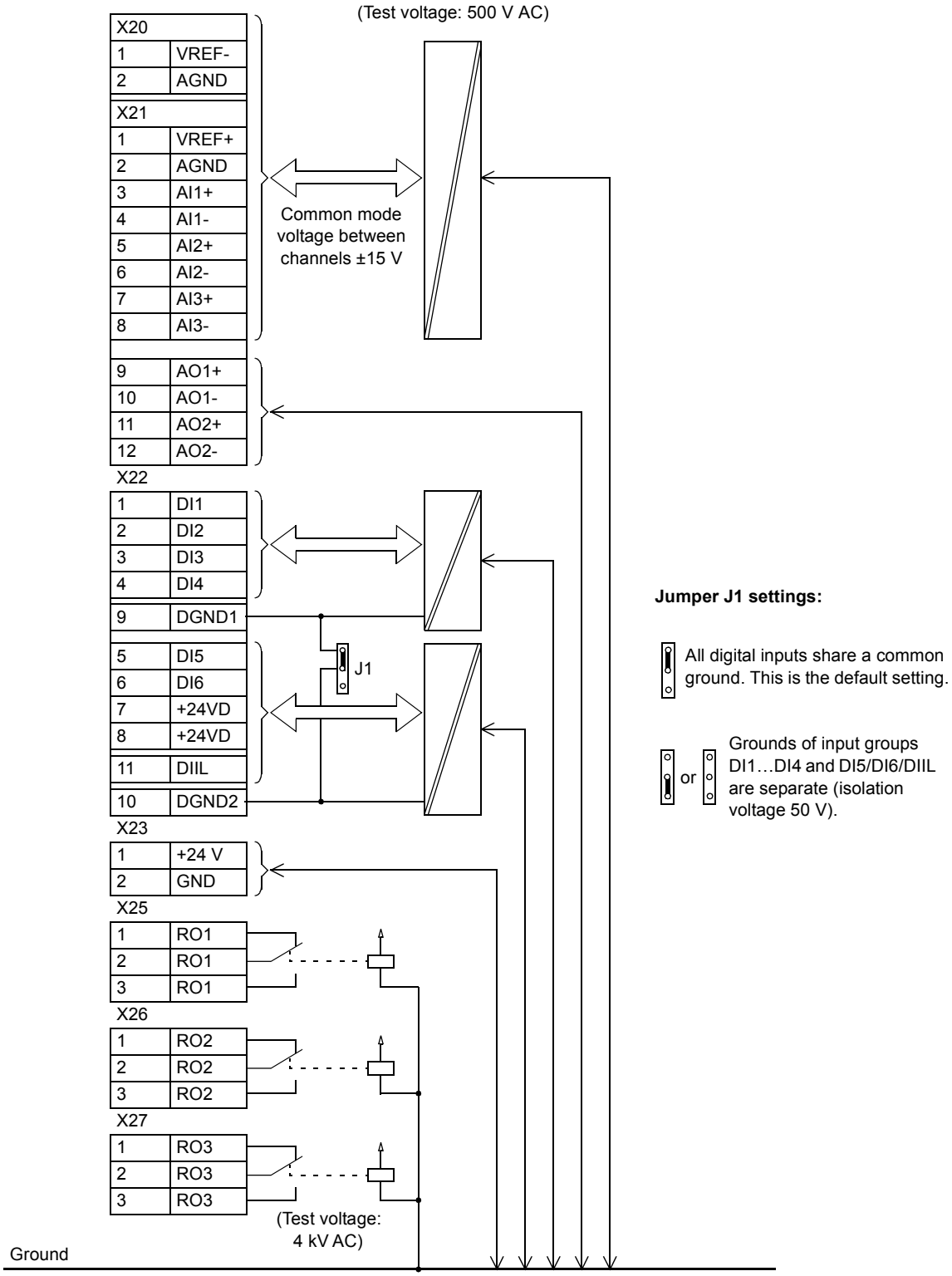
	With optional communication adapter module RDCO. Protocol: DDCS (ABB Distributed Drives Communication System)

24 VDC power input

Voltage	24 VDC ± 10 %
Typical current consumption (without optional modules)	250 mA
Maximum current consumption	1200 mA (with optional modules inserted)

The terminals on the RMIO board as well as on the optional 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.

Isolation and grounding diagram



Installation checklist

Checklist

Check the mechanical and electrical installation of the drive before start-up. Go through the checklist below together with another person. Read the *Safety instructions* on the first pages of this manual before you work on the unit.

	Check
MECHANICAL INSTALLATION	
☐	The ambient operating conditions are allowed. (See *Mechanical installation, Technical data: IEC ratings or US tables / NEMA ratings*)
☐	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 *ACS 600/800 Capacitor Reforming Guide* [64059629 (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.
☐	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.

Operation

What this chapter contains

This chapter describes:

- start-up and use of the drive
- fault tracing of the line-side converter
- control panel control of the line-side and motor-side converter
- descriptions of ACS800-11/U11 specific parameters in the IGBT Supply Control Program (controls the line-side converter) and in the application program (controls the motor-side converter).

For control panel use and motor-side converter fault tracing, see the appropriate application program firmware manual.

Start-up and use

Perform the start-up procedure as described in the appropriate application program firmware manual. **The parameters of the line-side converter control program need not be set in a normal start-up procedure or in normal use.** However, it is recommended to set parameter 16.15 I/O START MODE to DI2 LEVEL:

- if the motor is started and stopped frequently. This prolongs the lifespan of the charging contactor.
- when starting the motor without delay after the start command is required.
- If the drive is connected to a common DC bus. Otherwise, the charging resistor may be damaged.

Note

- By default, the control panel controls the RMIO board of the motor-side converter (ID number 1). If the control panel is set to control the RMIO board of the line-side converter (ID number 2), the drive does not stop by pressing the control panel Stop key in local control mode. Have the control panel control the RMIO board of the motor-side converter in normal use.
- Do not change the ID numbers of the converters from the default settings. If the ID numbers of the line-side and motor side converters are set equal, the control panel stops communicating.

ACS800-11/U11 specific parameters in the IGBT Supply Control Program

The signals and parameters described in the tables below are included in the IGBT Supply Control Program.

Terms and abbreviations

Term	Definition
B	Boolean
C	Character string
Def.	Default value
FbEq	Fieldbus equivalent: the scaling between the value shown on the control panel and the integer used in serial communication
I	Integer
R	Real
T.	Data type (see B, C, I, R)

Parameters

No.	Name/Value	Description	T./FbEq	Def.
16 SYSTEM CTR INPUTS		Parameter lock, parameter back-up etc.		
16.15	I/O START MODE	Selects I/O control start mode when par. 98.01 COMMAND SEL is set to I/O.	B	DI2 EDGE
	DI2 EDGE	Starts the line converter by digital input DI2 rising edge. The line converter starts to modulate and the charging resistors will be by-passed when the motor-side converter is started.	0	
	DI2 LEVEL	Starts the line converter by the level of digital input DI2. The line converter starts to modulate and the charging resistors will be by-passed when the line converter RMIO board is powered, its digital input DI2 is ON and there are no faults. **Note:** With the ACS800-11, ACS800-U11 and ACS800-17, this selection changes the value of par. 98.01 COMMAND SEL from the default setting MCW to I/O on the next RMIO board power-up.	1	
31 AUTOMATIC RESET		Automatic fault reset. Automatic resets are possible only for certain fault types and when the automatic reset function is activated for that fault type. The automatic reset function is not operational if the drive is in local control (L visible on the first row of the control panel display). **WARNING!** If the start command is selected and it is ON, the line converter may restart immediately after automatic fault reset. Ensure that the use of this feature will not cause danger. **WARNING!** Do not use these parameters when the drive is connected to a common DC bus. The charging resistors may be damaged in an automatic reset.		
31.01	NUMBER OF TRIALS	Defines the number of automatic fault resets the drive performs within the time defined by parameter 31.02.	I	0
	0 … 5	Number of the automatic resets	0	

No.	Name/Value	Description	T./FbEq	Def.
31.02	TRIAL TIME	Defines the time for the automatic fault reset function. See parameter 31.01.	R	30 s
	1.0 … 180.0 s	Allowed resetting time	100 … 18000	
31.03	DELAY TIME	Defines the time that the drive will wait after a fault before attempting an automatic reset. See parameter 31.01.	R	0 s
	0.0 … 3.0 s	Resetting delay	0 … 300	
31.04	OVERCURRENT	Activates/deactivates the automatic reset for the line converter overcurrent fault.	B	NO
	NO	Inactive	0	
	YES	Active	65535	
31.05	OVERVOLTAGE	Activates/deactivates the automatic reset for the intermediate link overvoltage fault.	B	NO
	NO	Inactive	0	
	YES	Active	65535	
31.06	UNDERVOLTAGE	Activates/deactivates the automatic reset for the intermediate link undervoltage fault.	B	NO
	NO	Inactive	0	
	YES	Active	65535	

Fixed parameters with the ACS800-11, ACS800-U11 and ACS800-17

When the IGBT Supply Control Program is loaded into the ACS800-11, ACS800-U11 or ACS800-17, the following parameters receive the default values given in the table below.

Parameter		Default value	If changed,
11.01	DC REF SELECT	FIELDBUS	the default values will be restored on the next power-up
11.02	Q REF SELECT	PARAM 24.02	
98.01	COMMAND SEL	MCW. **Note:** If par. 16.15 I/O START MODE is set to DI2 LEVEL, the default value is changed to I/O on the next RMIO board power-up.	
98.02	COMM. MODULE	INVERTER	
201.09	PANEL DRIVE ID	2	
202.01	LOCAL LOCK	TRUE	
30.02	EARTH FAULT	FAULT. **Note conserning the ACS800-11:** The line converter is not equipped with earth fault supervision.	the default values will not be restored on the next power-up. Do not change them. If the default values are changed, the drive will not function.
70.01	CH0 NODE ADDR	120	
70.19	CH0 HW CONNECTION	RING	
70.20	CH3 HW CONNECTION	RING	
71.01	CH0 DRIVEBUS MODE	NO	

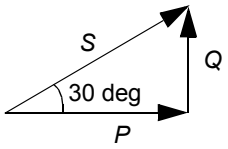
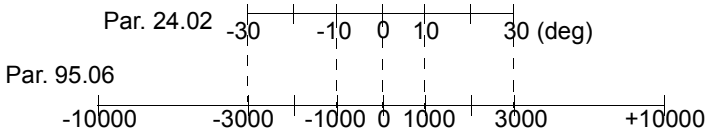
ACS800-11/U11 specific parameters in the application program

The actual signals and parameters described in this section are included in the ACS800 Standard Application Program.

Terms and abbreviations

Term	Definition
Actual signal	Signal measured or calculated by the drive. Can be monitored by the user. No user setting possible.
FbEq	Fieldbus equivalent: The scaling between the value shown on the control panel and the integer used in serial communication.
Parameter	A user-adjustable operation instruction of the drive.

Actual signals and parameters of the line converter in the motor-side converter control program

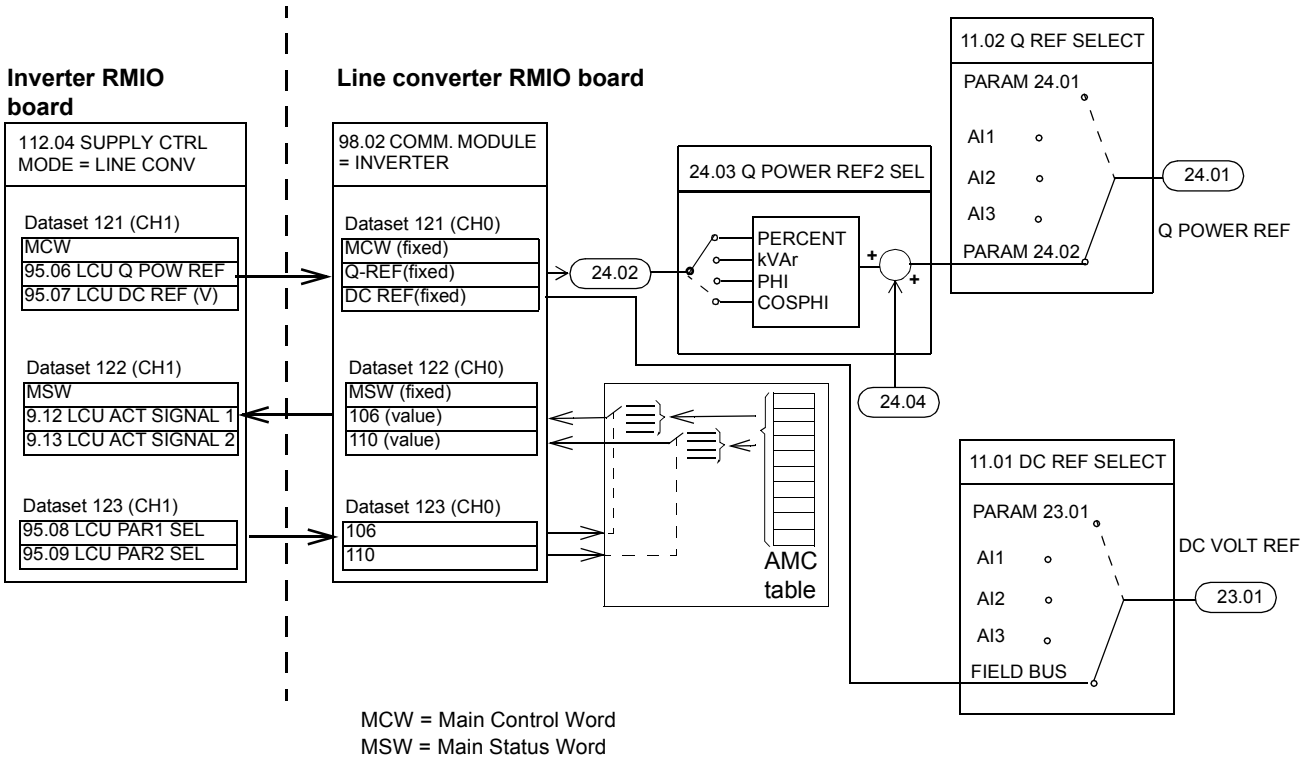
No.	Name/Value	Description	FbEq	Def.
09 ACTUAL SIGNALS		Signals from the line converter.		
09.12	LCU ACT SIGNAL 1	Line converter signal selected by par. 95.08 LCU PAR1 SEL.	1 = 1	106
09.13	LCU ACT SIGNAL 2	Line converter signal selected by par. 95.09 LCU PAR2 SEL.	1 = 1	110
95 HARDWARE SPECIF		Line converter references and actual signal selections.		
95.06	LCU Q POW REF	Reactive power reference for the line converter i.e. the value for par. 24.02 Q POWER REF2 in the IGBT Supply Control Program. Scaling example 1: 10000 equals to a value of 10000 of parameter 24.02 Q POWER REF2 and 100% of par. 24.01 Q POWER REF (i.e. 100% of the converter nominal power given in par. 04.06 CONV NOM POWER) when par. 24.03 Q POWER REF2 SEL is set to PERCENT. Scaling example 2: Par. 24.03 Q POWER REF2 SEL is set to kVAr. A value of 1000 of par. 95.06 equals to 1000 kVAr of par. 24.02 Q POWER REF2. Value of par. 24.01 Q POWER REF is then 100 · (1000 kVAr divided by converter nominal power in kVAr)%. Scaling example 3: Par. 24.03 Q POWER REF2 SEL is set to PHI. A value of 10000 of par. 95.06 equals to a value of 100 deg of parameter 24.02 Q POWER REF2 which is limited to 30 deg. The value of par. 24.01 Q POWER REF will be determined approximately according to the following equation where *P* is read from actual signal 1.09 POWER: $\cos 30 = \frac{P}{S} = \frac{P}{\sqrt{P^2 + Q^2}}$  Positive reference 30 deg denotes capacitive load. Negative reference 30 deg denotes inductive load.  		0
	-10000 ... +10000	Setting range.	1 = 1	
95.07	LCU DC REF (V)	DC voltage reference for line converter i.e. the value for par. 23.01 DC VOLT REF.		0
	0 … 1100	Setting range in volts.	1 = 1 V	
95.08	LCU PAR1 SEL	Selects the line-side converter address from which actual signal 09.12 LCU ACT SIGNAL 1 is read.		106
	0 … 10000	Parameter index.	1 = 1	
95.09	LCU PAR2 SEL	Selects the line-side converter address from which actual signal 09.13 LCU ACT SIGNAL 2 is read.		110
	0 … 10000	Parameter index.	1 = 1	

Fieldbus control interface

Optional fieldbus modules cannot be inserted in the optional module slots of the RMIO board of the line-side converter. Fieldbus control of the line-side converter is performed via the motor-side converter RMIO board as shown in the block diagram below.

Block diagram: reference select

The figure below shows the parameters for DC and reactive power reference selection. AMC table contains actual values and parameters of the line converter.



Connection diagram of the RMIO board in the line-side converter

Internal connections to the RMIO board for the ACS800 IGBT Supply Control Program are shown below. Do not change the connections.

X20

1	VREF-	Reference voltage -10 VDC, 1 kohm ≤ R_L ≤ 10 kohm
2	GND	

X21

1	VREF+	Reference voltage 10 VDC, 1 kohm ≤ R_L ≤ 10 kohm
2	GND	
3	AI1+	By default, not in use. 0(2) ... 10 V, R_{in} > 200 kohm
4	AI1-	
5	AI2+	By default, not in use. 0(4) ... 20 mA, R_{in} = 100 ohm
6	AI2-	
7	AI3+	By default, not in use. 0(4) ... 20 mA, R_{in} = 100 ohm
8	AI3-	
9	AO1+	By default, not in use. 0(4)...20 mA, R_{in} = 100 ohm
10	AO1-	
11	AO2+	By default, not in use. 0(4)...20 mA, R_{in} = 100 ohm
12	AO2-	

[1] non-programmable I/O

X22

1	DI1	Acknowledgement of converter fan [1]
2	DI2	Stop/Start
3	DI3	Acknowledgement from main contactor [1]
4	DI4	By default not in use.
5	DI5	By default not in use.
6	DI6	Reset [1]
7	+24V	+24 VDC max. 100 mA
8	+24V	
9	DGND	Digital ground
10	DGND	Digital ground
11	DI7(DIIL)	By default not in use.

K1

X23

1	+24V	Auxiliary voltage output, non-isolated, 24 VDC 250 mA
2	GND	

X25

1	RO11	Relay output 1: Charging contactor control [1]
2	RO12	
3	RO13	

X26

1	RO21	Relay output 2: fault (-1)
2	RO22	
3	RO23	

X27

1	RO31	Relay output 3: Main contactor control [1]
2	RO32	
3	RO33	

Fault tracing

Flashing messages WARNING, ID:2 or FAULT, ID:2 on the control panel display indicate a warning or fault state in the line-side converter when the control panel controls the motor-side converter:

```
 FAULT, ID:2
ACS 800 0050_5MR
*** FAULT ***
LINE CONV      (FF51)
```

To display the warning or fault identification text, shift the control panel to view the line-side converter as described in section *Changing the control panel to the line-side converter*.

Fault: Same ID numbers

If the ID numbers of the line-side and the motor-side converters are set equal, the control panel stops functioning. To clear the situation:

- Disconnect the panel cable from the RMIO board of motor-side converter.
- Set the ID number of the line-side converter RMIO board to 2. For the setting procedure, see the application program firmware manual.
- Connect the disconnected cable to the RMIO board of the motor-side converter again and set the ID number to 1.

Changing the control panel to the line-side converter

Step	Action	Press key	Display (example)
1.	To enter the Drive Selection Mode **Note:** In local control mode, the motor-side converter trips if parameter 30.02 PANEL LOSS is set to FAULT. Refer to the appropriate application program firmware manual.	DRIVE	ACS 800 0050_5MR ASXR7xxx ID-NUMBER 1
2.	To scroll to ID number 2	▲	ACS 800 0050_5LR IXXR7xxx ID-NUMBER 2
3.	To verify the change to the line-side converter and display the warning or fault text	ACT	2 -> 380.0 V ACS 800 0050_5LR ** FAULT ** DC OVERVOLT (3210)

WARNING! The drive does not stop by pressing the control panel Stop key in local control mode.

Changing the control panel to the motor-side converter

Step	Action	Press key	Display (example)
1.	To enter the Drive Section Mode		ACS 800 0050_5LR IXXR7xxx ID-NUMBER 2
2.	To scroll to ID number 1		ACS 800 0050_5MR ACXR7xxx ID-NUMBER 1
3.	To verify the change to the motor-side converter		1 L -> 0.0 rpm I FREQ 0.00 Hz CURRENT 0.00 A POWER 0.00 %

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.

Maintenance	Interval	Instruction
Capacitor reforming	Every year when stored	See *Reforming*.
Heatsink temperature check and cleaning	Depends on the dustiness of the environment (every 6 to 12 months)	See *Heatsink*.
Change of additional cooling fan	Every three years	See *Additional fan.*
Main cooling fan change	Every six years	See *Main cooling fan*.
Capacitor change	Every ten years	See *Capacitors*.

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 *Main cooling 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. Replace the cooling fan.

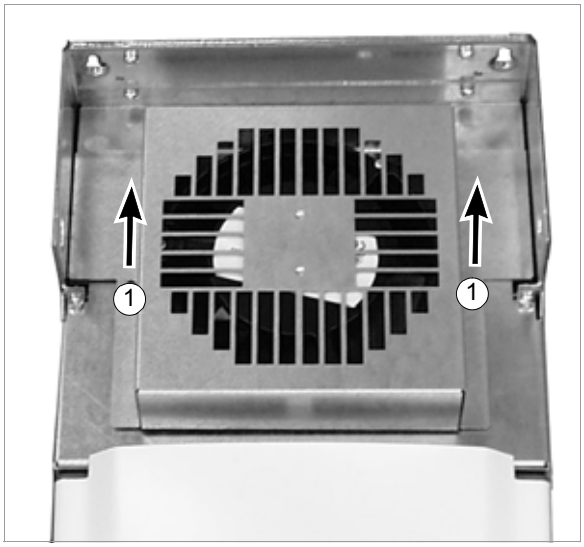
Main cooling fan

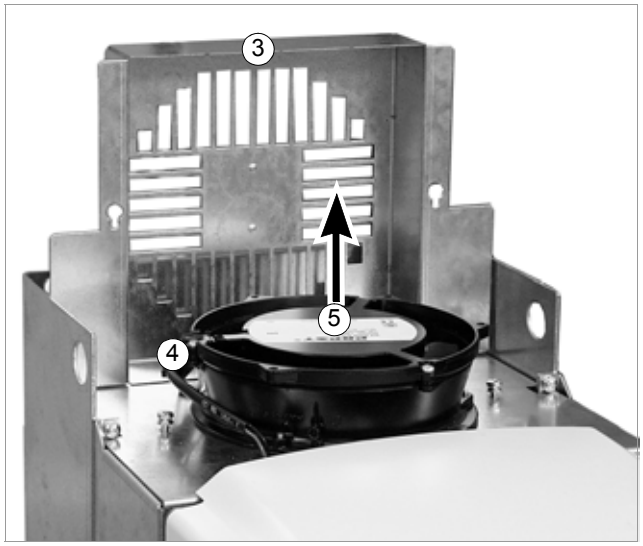
The cooling fan lifespan of the drive is about 50 000 operating hours. The actual lifespan depends on the drive usage and ambient temperature. See the appropriate ACS800 firmware manual for an actual signal which indicates the hours of usage of the fan.

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 (R5, R6)

1. Loosen the fastening screws of the top plate.
2. Push the top plate backwards.
3. Lift the top plate up.
4. Disconnect the fan supply wires (detachable connector).
5. Lift the fan up.
6. Install the new fan in reverse order.





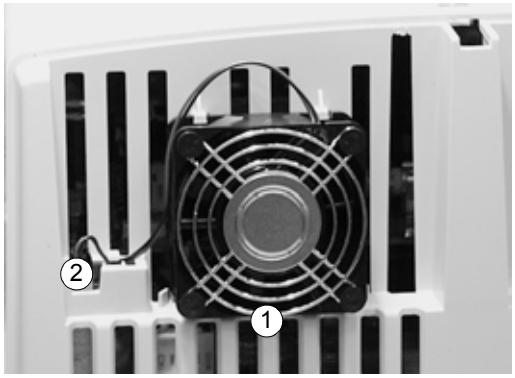
Additional fan

Replacement (R5)

Remove the front cover. The fan is located on the right-hand side of the control panel (R5). Lift the fan out and disconnect the cable. Install the new 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. Their lifespan is from 45 000 to 90 000 hours depending 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 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 *ACS 600/800 Capacitor Reforming Guide* (code: 64059629).

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	Red	Drive in fault state
	Green	The main +24 V power supply for the control panel and the RMIO board is OK.

* The LEDs are not visible

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 ratings

The IEC ratings for the ACS800-11 with 50 Hz and 60 Hz supplies are given below. The symbols are described below the table.

ACS800-11 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										
-0011-2	34	52	7.5	32	7.5	26	5.5	R5	350	505
-0016-2	47	68	11	45	11	38	7.5	R5	350	694
-0020-2	59	90	15	56	15	45	11	R5	350	910
-0025-2	75	118	22	69	18.5	59	15	R5	350	1099
-0030-2	88	144	22	83	22	72	18.5	R5	350	1315
-0040-2	120	168	37	114	30	84	22	R6	405	1585
-0050-2	150	234	45	143	45	117	30	R6	405	2125
-0060-2	169	264	45	157	45	132	37	R6	405	2530
Three-phase supply voltage 380 V, **400 V** or 415 V										
-0016-3	34	52	15	32	15	26	11	R5	350	550
-0020-3	38	61	18.5	36	18.5	34	15	R5	350	655
-0025-3	47	68	22	45	22	38	18.5	R5	350	760
-0030-3	59	90	30	56	30	45	22	R5	350	1000
-0040-3	72	118	37	69	37	59	30	R5	350	1210
-0050-3	86	144	45	83	45	65	30	R5	350	1450
-0060-3	120	168	55	114	55	88	45	R6	405	1750
-0070-3	150	234	75	143	75	117	55	R6	405	2350
-0100-3	165	264	90	157	75	132	75	R6	405	2800
Three-phase supply voltage 380 V, 400 V, 415 V, 440 V, 460 V, 480 V or **500** V										
-0020-5	31	52	18.5	29	18.5	25	15	R5	350	655
-0025-5	36	61	22	34	22.0	30	18.5	R5	350	760
-0030-5	47	68	30	45	30.0	37	22	R5	350	1000
-0040-5	58	90	37	55	37.0	47	30	R5	350	1210
-0050-5	70	118	45	67	45.0	57	37	R5	350	1450
-0060-5	82	144	55	78	45.0	62	37	R5	350	1750
-0070-5	120	168	75	114	75	88	55	R6	405	2350
-0100-5	139	234	90	132	90	114	75	R6	405	2800
-0120-5	156	264	110	148	90	125	75	R6	405	3400

PDM code: 00317419-C

Symbols

Nominal ratings

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

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 34 motors at the nominal voltage, 230 V, 400 V or 500 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 34 motors at the nominal voltage, 230 V, 400 V or 500 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 34 motors at the nominal voltage, 230 V, 400 V or 500 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 momentary motor shaft power is limited to approximately $1.3 \cdot P_{cont.max}$. If the limit is exceeded, motor torque and current are automatically restricted. The function protects the input bridge and LCL filter of the drive against overload.

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 Drive*Size* 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 $0.90 \cdot I_{2N}$ or $0.90 \cdot I_{2hd}$.

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 *Drive*Size PC tool. If the installation site is higher than 2000 m (6600 ft) above sea level, please contact your local ABB distributor or office for further information.

Mains cable fuses

Fuses for short-circuit protection of the mains cable are listed below. The fuses also protect the adjoining equipment of the drive in case of a short-circuit. **Check 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. See also *Planning the electrical installation*: *Thermal overload and short-circuit protection*. For UL recognized fuses, see *US tables*.

Note 1: In multicable installations, install only one fuse per phase (not one fuse per conductor).

Note 2: Larger fuses must not be used.

Note 3: Fuses from other manufacturers can be used if they meet the ratings.

ACS800-11 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							
-0011-2	32	40	9140	500	ABB Control	OFAF000H40	000
-0016-2	44	50	15400	500	ABB Control	OFAF000H50	000
-0020-2	55	63	21300	500	ABB Control	OFAF000H63	000
-0025-2	70	80	34500	500	ABB Control	OFAF000H80	000
-0030-2	82	100	63600	500	ABB Control	OFAF000H100	000
-0040-2	112	125	103000	500	ABB Control	OFAF00H125	00
-0050-2	140	160	200000	500	ABB Control	OFAF00H160	00
-0060-2	157	200	350000	500	ABB Control	OFAF1H200	1
Three-phase supply voltage 380 V, **400 V** or 415 V							
-0016-3	32	40	9140	500	ABB Control	OFAF000H40	000
-0020-3	35	40	9140	500	ABB Control	OFAF000H40	000
-0025-3	44	50	15400	500	ABB Control	OFAF000H50	000
-0030-3	55	63	21300	500	ABB Control	OFAF000H63	000
-0040-3	67	80	34500	500	ABB Control	OFAF000H80	000
-0050-3	80	100	63600	500	ABB Control	OFAF000H100	000
-0060-3	112	125	103000	500	ABB Control	OFAF00H125	00
-0070-3	140	160	200000	500	ABB Control	OFAF00H160	00
-0100-3	153	200	350000	500	ABB Control	OFAF1H200	1
Three-phase supply voltage 380 V, 400 V, 415 V, 440 V, 460 V, 480 V or **500** V							
-0020-5	29	40	9140	500	ABB Control	OFAF000H40	000
-0025-5	33	40	9140	500	ABB Control	OFAF000H40	000
-0030-5	44	50	15400	500	ABB Control	OFAF000H50	000
-0040-5	54	63	21300	500	ABB Control	OFAF000H63	000
-0050-5	65	80	34500	500	ABB Control	OFAF000H80	000
-0060-5	76	100	63600	500	ABB Control	OFAF000H100	000
-0070-5	112	125	103000	500	ABB Control	OFAF00H125	00
-0100-5	129	160	200000	500	ABB Control	OFAF00H160	00
-0120-5	145	200	350000	500	ABB Control	OFAF1H200	1

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* maximum total I^2t value for 550 V

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, PVC insulation, surface temperature 70 °C (EN 60204-1 and IEC 60364-5-2/2001). 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
34	3x6	61	3x25
47	3x10	75	3x35
62	3x16	91	3x50
79	3x25	117	3x70
98	3x35	143	3x95
119	3x50	165	3x120
153	3x70	191	3x150
186	3x95		
215	3x120		
249	3x150		
284	3x185		

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Cable entries

Mains, DC link and motor cable terminal sizes (per phase), accepted cable diameters and tightening torques are given below.

Frame size	U1, V1, W1, U2, V2, W2, UDC+,UDC-			Earthing PE	
	Wire size mm^2	Max. cable Ø IP 21 mm	Tightening torque Nm	Wire size mm^2	Tightening torque Nm
R5	16…70	35	10	16…70	15
R6	95...185 *	53	20…40	95	8

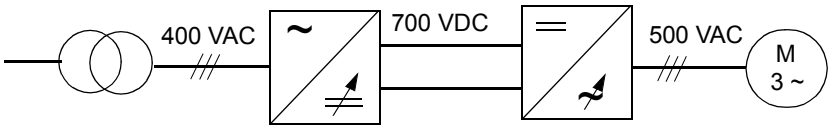
* with cable lugs 16...70 mm^2, tightening torque 20...40 Nm

Dimensions, weights and noise

Frame size	IP 21				Noise
	Height mm	Width mm	Depth mm	Weight kg	 dB
R5	816	265	390	65	70
R6	970	300	439	100	73

Input power connection

Voltage (U_1)	208/220/230/240 VAC 3-phase ± 10 % for 230 VAC units 380/400/415 VAC 3-phase ± 10 % for 400 VAC units 380/400/415/440/460/480/500 VAC 3-phase ± 10 % for 500 VAC units The output voltage can be raised with setting of parameter 23.01 DC VOLT REF. Example: With 400 V supply voltage and 700 VDC intermediate DC circuit voltage, it is possible to run a 500 V motor at the motor nominal voltage.



Prospective short-circuit current (IEC 60439-1, UL 508C)	Maximum allowed prospective short-circuit current in the supply is 65 kA in a second providing that the mains cable of the drive is protected with appropriate fuses. US and Canada: The drive is suitable for use on a circuit capable of delivering not more than 65 kA rms symmetrical amperes at the drive nominal voltage when protected by T class fuses.
Frequency	48 to 63 Hz, maximum rate of change 17 %/s
Imbalance	Max. ± 3 % of nominal phase to phase input voltage
Voltage dips	Max. 25 %
Fundamental power factor (cos phi$_1$)	1.00 (fundamental at nominal load)
Harmonic distortion	THD current < 0.05 · $I_{1cont.max}$ if supply network voltage is not distorted by other loads

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 ratings.*
Power limit	Approximately 1.3 · $P_{cont.max}$
Field weakening point	8 to 300 Hz
Switching frequency	3 kHz (average).
Maximum recommended motor cable length	300 m (984 ft). Additional restriction for units with EMC filtering (type code selections +E202 and +E200): max. motor cable length is 100 m (328 ft). With longer cables the EMC Directive requirements may not be fulfilled.

Efficiency

Approximately 97 % at nominal power level

Cooling

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

Degrees of protection

IP 21 (UL type 1). IPXXD from above. Without front cover, the unit must be protected against contact according to IP 2x [see chapter *Electrical installation*: *Cabinet installed units (IP 00, UL type open)*].

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*]	-	-
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 with coating: Chemical gases: Class 3C2 Solid particles: Class 3S2	**Boards with coating:** Chemical gases: Class 1C2 Solid particles: Class 1S3	**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 60068-2-29)	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 90021 / PMS 420 C) • hot-dip zinc coated steel sheet 1.5 to 2 mm, thickness of coating 100 micrometres • extruded aluminium AlSi
Package	Plywood, bands PP or steel
Disposal	The drive contains raw materials that should be recycled to preserve energy and natural resources. The package materials are environmentally compatible and recyclable. All metal parts can be recycled. The plastic parts can either be recycled or burned under controlled circumstances, according to local regulations. Most recyclable parts are marked with recycling marks. If recycling is not feasible, all parts excluding electrolytic capacitors and printed circuit boards can be landfilled. The DC capacitors (C1-1 to C1-x) contain electrolyte and the printed circuit boards contain lead, both of which are classified as hazardous waste within the EU. They must be removed and handled according to local regulations. For further information on environmental aspects and more detailed recycling instructions, please contact your local ABB distributor.

Applicable standards

	The drive complies with the following standards. The compliance with the European Low Voltage Directive is verified according to standards EN 50178 and EN 60204-1.
• EN 50178 (1997)	Electronic equipment for use in power installations
• EN 60204-1 (1997)	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 (IEC 60529)	Degrees of protection provided by enclosures (IP code)
• IEC 60664-1 (1992)	Insulation coordination for equipment within low-voltage systems. Part 1: Principles, requirements and tests.
• EN 61800-3 (1996) + Amendment A11 (2000)	EMC product standard including specific test methods
• UL 508C	UL Standard for Safety, Power Conversion Equipment, second edition
• NEMA 250 (2003)	Enclosures for Electrical Equipment (1000 Volts Maximum)
• CSA C22.2 No. 14-95	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 (Directive 73/23/EEC, as amended by 93/68/EEC and Directive 89/336/EEC, as amended by 93/68/EEC).

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.

Restricted distribution: mode of sales distribution in which the manufacturer restricts the supply of equipment to suppliers, customers or users who separately or jointly have technical competence in the EMC requirements of the application of drives.

Unrestricted distribution: mode of sales distribution in which the supply of equipment is not dependent on the EMC competence of the customer or user for the application of drives.

Compliance with the 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 + Amendment A11 (2000)] covers requirements stated for drives.

Compliance with the EN 61800-3 + Amendment A11 (2000)

First environment (restricted distribution)

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 (unearthed) systems. The supply network becomes connected to earth potential through the EMC filter capacitors which may cause danger or damage the unit.

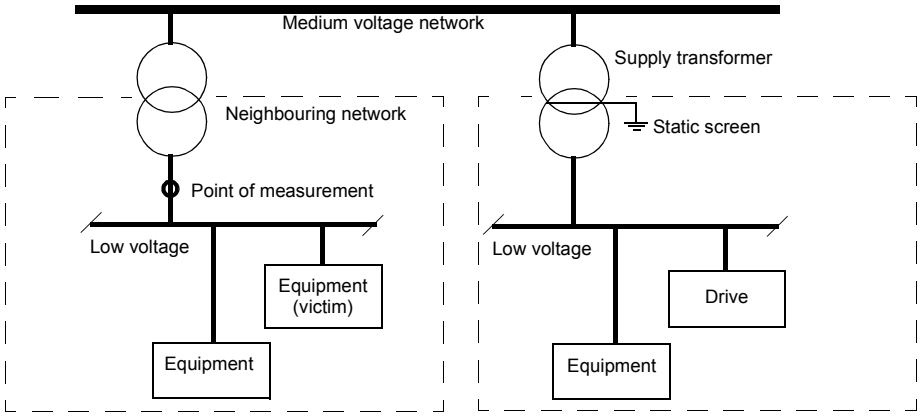
Second environment

The drive complies with the standard with the following provisions:

1. The drive is equipped with EMC filter +E200. The filter is suitable for TN (earthed) networks only.
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.

If the above listed provisions cannot be met, e.g. the drive cannot be equipped with EMC filter +E200 when installed to an IT (unearthed) network, the requirements of the EMC Directive can be met as follows for restricted distribution:

1. It is ensured that no excessive emission is propagated to neighbouring low-voltage networks. In some cases, the natural 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*.

Machinery Directive

The drive complies with the European Union Machinery Directive (98/37/EC) requirements for an equipment intended to be incorporated into machinery.

“C-tick” marking

“C-tick” mark is pending as follows.

“C-tick” marking is required in Australia and New Zealand. A “C-tick” mark is attached to each drive in order to verify compliance with the relevant standard (IEC 61800-3 (1996) – Adjustable speed electrical power drive systems – Part 3: EMC product standard including specific test methods), mandated by the Trans-Tasman Electromagnetic Compatibility Scheme.

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.

The Trans-Tasman Electromagnetic Compatibility Scheme (EMCS) was introduced by the Australian Communication Authority (ACA) and the Radio Spectrum Management Group (RSM) of the New Zealand Ministry of Economic Development (NZMED) in November 2001. The aim of the scheme is to protect the radiofrequency spectrum by introducing technical limits for emission from electrical/ electronic products.

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.

Restricted distribution: mode of sales distribution in which the manufacturer restricts the supply of equipment to suppliers, customers or users who separately or jointly have technical competence in the EMC requirements of the application of drives.

Unrestricted distribution: mode of sales distribution in which the supply of equipment is not dependent on the EMC competence of the customer or user for the application of drives.

Compliance with IEC 61800-3

First environment (restricted distribution)

The drive complies with the limits of IEC 61800-3 with the following provisions:

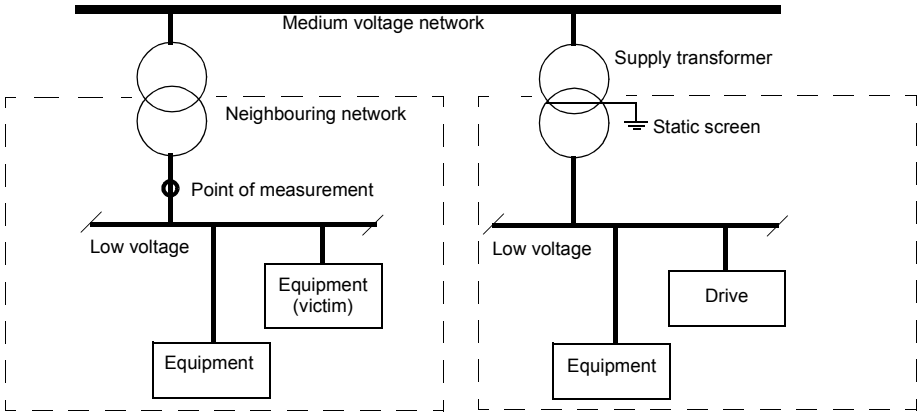
1. The drive is equipped with EMC filter +E202.
2. The drive is installed according to the instructions given in the *Hardware Manual*.
3. The motor and control cables used are selected as specified in the *Hardware Manual*.
4. Maximum cable length is 100 metres.

Note: The drive must not be equipped with EMC filter +E202 when installed to IT (unearthed) systems. The mains becomes connected to earth potential through the EMC filter capacitors. In IT systems this may cause danger or damage the unit.

Second environment

The drive complies with the limits of IEC 61800-3 with the following provisions:

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



2. The drive is installed according to the instructions given in the *Hardware Manual*.
3. The motor and control cables used are selected as specified in the *Hardware Manual*.

Equipment warranty and liability

The manufacturer warrants the equipment supplied against defects in design, materials and workmanship for a period of twelve (12) months after installation or twenty-four (24) months from date of manufacturing, whichever first occurs. The local ABB office or distributor may grant a warranty period different to the above and refer to local terms of liability as defined in the supply contract.

The manufacturer is not responsible for

- any costs resulting from a failure if the installation, commissioning, repair, alternation, or ambient conditions of the drive do not fulfil the requirements specified in the documentation delivered with the unit and other relevant documentation.
- units subjected to misuse, negligence or accident
- units comprised of materials provided or designs stipulated by the purchaser.

In no event shall the manufacturer, its suppliers or subcontractors be liable for special, indirect, incidental or consequential damages, losses or penalties.

This is the sole and exclusive warranty given by the manufacturer with respect to the equipment and is in lieu of and excludes all other warranties, express or implied, arising by operation of law or otherwise, including, but not limited to, any implied warranties of merchantability or fitness for a particular purpose.

If you have any questions concerning your ABB drive, please contact the local distributor or ABB office. The technical data, information and specifications are valid at the time of printing. The manufacturer reserves the right to modifications without prior notice.

US tables

NEMA ratings

The NEMA ratings for the ACS800-U11 and ACS800-11 with 60 Hz supplies are given below. The symbols are described below the table. For sizing, derating and 50 Hz supplies, see *IEC ratings*.

ACS800-U11 size ACS800-11 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								
-0011-2	52	32	10	26	7.5	R5	206	1730
-0016-2	68	45	15	38	10	R5	206	2380
-0020-2	90	56	20	45	10	R5	206	3110
-0025-2	118	69	25	59	15	R5	206	3760
-0030-2	144	83	30	72	20	R5	206	4500
-0040-2	168	114	40	84	25	R6	238	5420
-0050-2	234	143	50	117	30	R6	238	7260
-0060-2	264	157	60	132	40	R6	238	8650
Three-phase supply voltage 380 V, 400 V, 415 V, 440 V, **460** V or 480 V								
-0020-5	52	29	20	25	15	R5	206	2240
-0025-5	61	34	25	30	20	R5	206	2600
-0030-5	68	45	30	37	25	R5	206	3420
-0040-5	90	55	40	47	30	R5	206	4140
-0050-5	118	67	50	57	40	R5	206	4960
-0060-5	144	78	60	65**	50	R5	206	5980
-0070-5	168	114	75	88	60	R6	238	8030
-0100-5	234	132	100	114	75	R6	238	9570
-0120-5	264	156*	125	125	100	R6	238	11620

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* allowed with motor power ≤ 125 HP and a reactive power reference of 0

** allowed with motor power ≤ 50 HP and a reactive power reference of 0

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 or 460 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 or 460 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}).

Input cable fuses

The ratings of UL listed fuses for branch circuit protection are listed below. The fuses also prevent damage to the adjoining equipment of the drive in case of a short-circuit inside the drive. **Check 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 fuses must be of the “non-time delay” type. See also *Planning the electrical installation*: *Thermal overload and short-circuit protection*.

Note 1: In multicable installations, install only one fuse per phase (not one fuse per conductor).

Note 2: Larger fuses must not be used.

Note 3: Fuses from other manufacturers can be used if they meet the ratings.

ACS800-U11 type **ACS800-11 type**	**Input current**	**Fuse**				
	A	A	V	Manufacturer	Type	UL class
Three-phase supply voltage 208 V, 220 V, **230 V** or 240 V						
-0011-2	32	40	600	Bussmann	JJS-40	T
-0016-2	44	70	600	Bussmann	JJS-70	T
-0020-2	55	80	600	Bussmann	JJS-80	T
-0025-2	70	90	600	Bussmann	JJS-90	T
-0030-2	82	100	600	Bussmann	JJS-100	T
-0040-2	112	150	600	Bussmann	JJS-150	T
-0050-2	140	200	600	Bussmann	JJS-200	T
-0060-2	157	200	600	Bussmann	JJS-200	T
Three-phase supply voltage 380 V, 400 V, 415 V, 440 V, **460 V**, 480 V or 500 V						
-0020-5	29	40	600	Bussmann	JJS-40	T
-0025-5	33	50	600	Bussmann	JJS-50	T
-0030-5	44	70	600	Bussmann	JJS-70	T
-0040-5	54	80	600	Bussmann	JJS-80	T
-0050-5	65	90	600	Bussmann	JJS-90	T
-0060-5	76	100	600	Bussmann	JJS-100	T
-0070-5	112	150	600	Bussmann	JJS-150	T
-0100-5	129	200	600	Bussmann	JJS-200	T
-0120-5	145	200	600	Bussmann	JJS-200	T

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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/kcmil
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 x 1
251	300 MCM or 2 x 1/0
273	350 MCM or 2 x 2/0

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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, UDC+, UDC-**			**Grounding PE**	
	Wire size AWG	**Wire Ø (UL type 1)** in.	**Tightening torque** lbf ft	**Wire size** AWG	**Tightening torque** lbf ft
R5	4...2/0	1.39	11.1	4...2/0	11.1
R6	3/0 ... 350 MCM *	2.09	14.8...29.5	4/0	5.9

* with cable lugs 6...2/0 AWG, tightening torque 14.8...29.5 lbf ft

Dimensions and weights

Frame size	**UL type 1**			
	Height in.	**Width** in.	**Depth** in.	**Weight** lb
R5	32.03	10.43	15.35	143
R6	38.19	11.81	17.28	220

UL/CSA markings

C-UL US listing and CSA marking are pending for the ACS800-U11 and ACS800-11 units of UL type 1.

UL

The drive is suitable for use on a circuit capable of delivering not more than 65 kA rms symmetrical amperes at the drive nominal voltage (600 V maximum for 690 V units) when protected by T class fuses.

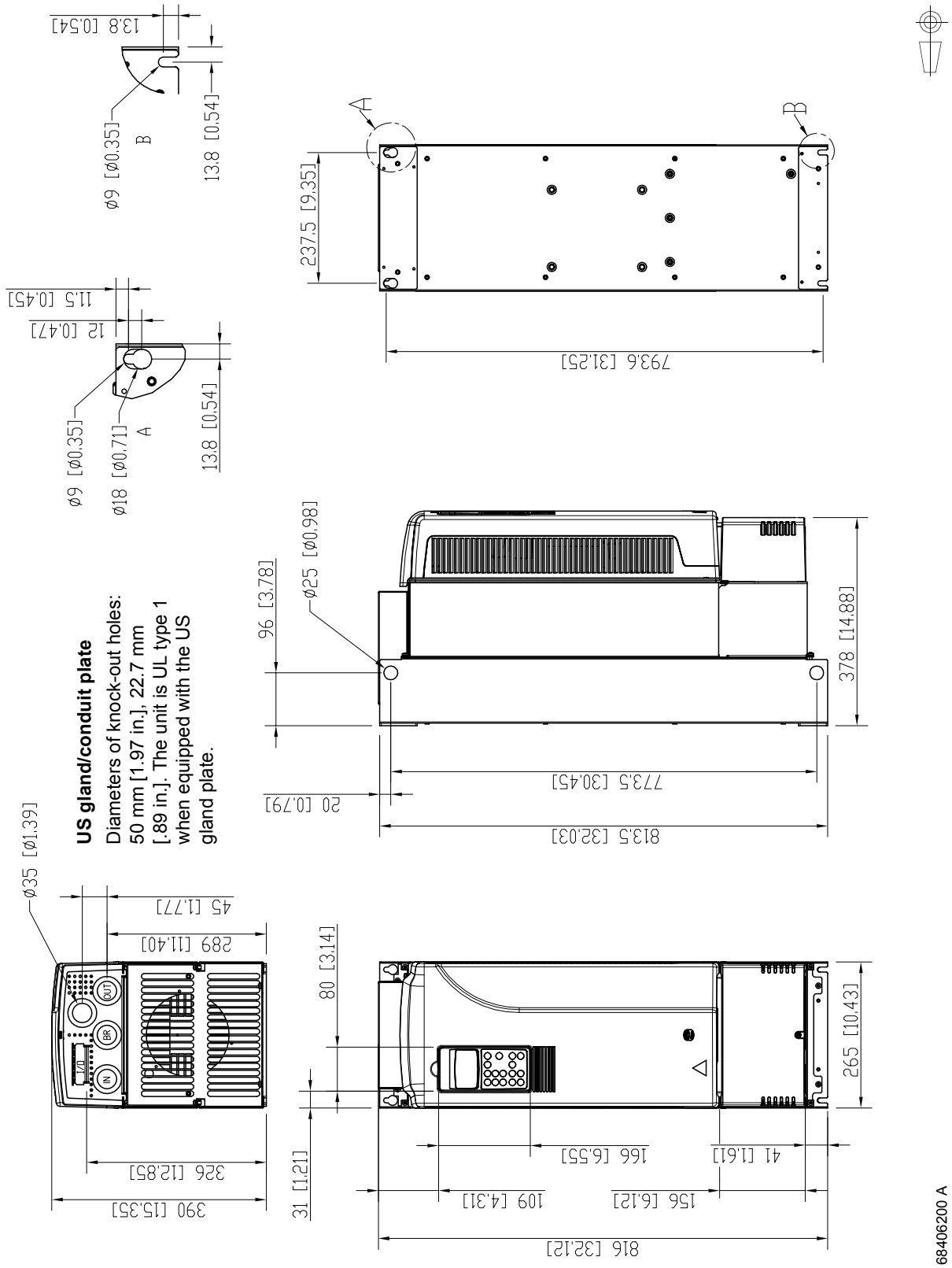
The drive provides overload protection in accordance with the National Electrical Code (US). See *ACS800 Firmware Manual* for setting. Default setting is off, must be activated at start-up.

The drives are to be used in a heated indoor controlled environment. See section *Ambient conditions* for specific limits.

Dimensional drawings

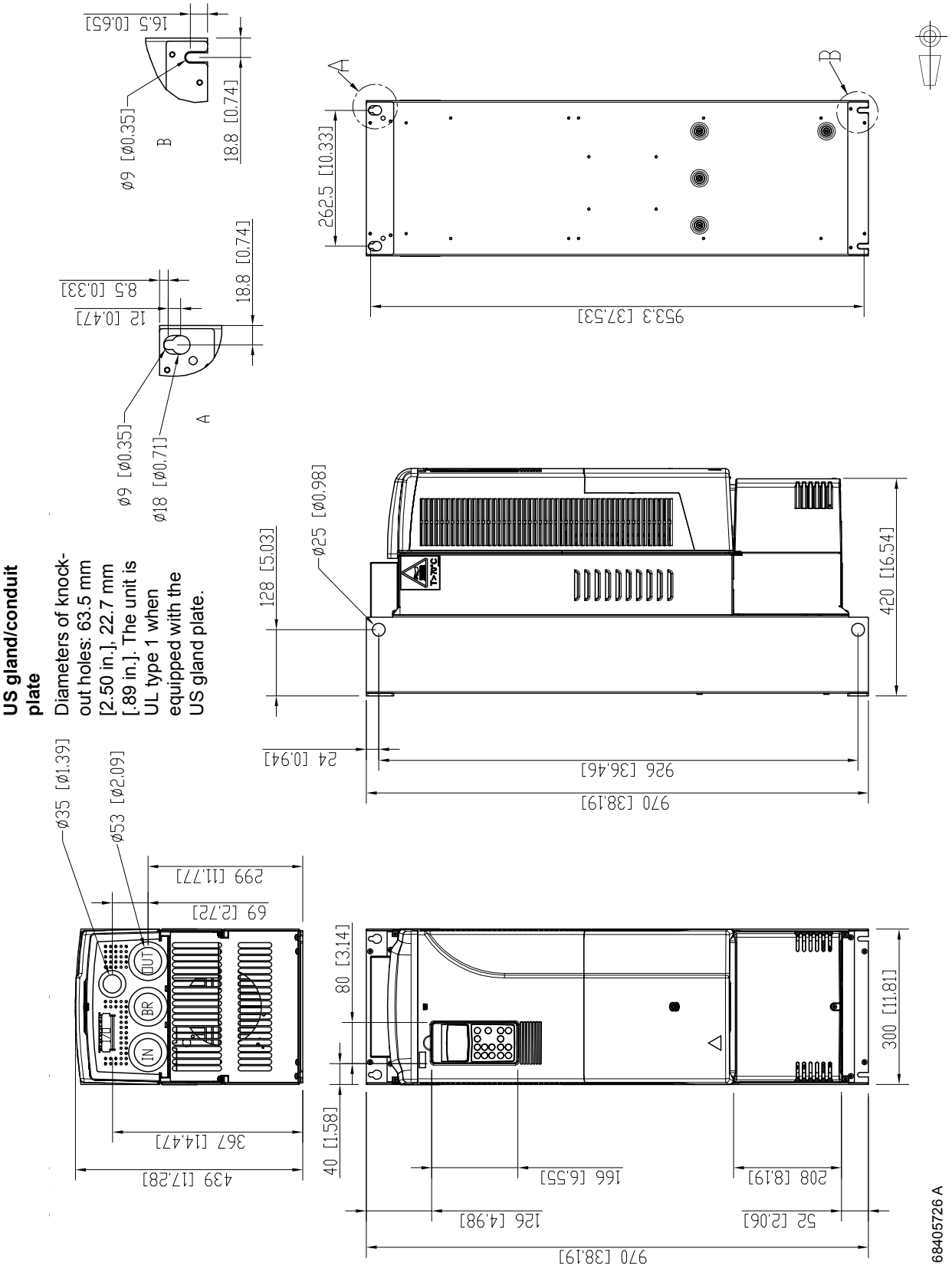
The dimensions are given in millimetres and [inches].

Frame size R5 (IP 21, UL type open)



US gland/conduit plate
Diameters of knock-out holes: 50 mm [1.97 in.], 22.7 mm [.89 in.]. The unit is UL type 1 when equipped with the US gland plate.

Frame size R6 (IP 21, UL type open)



External +24 V power supply for the RMIO board

What this chapter contains

This chapter describes how to connect external +24 V power supply to the RMIO board of the motor-side converter. For instructions on how to supply external +24 V also to the RMIO board of line-side converter, please contact ABB.

When to use

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

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

For current consumption of the RMIO board, see chapter *Motor control and I/O board (RMIO)*.

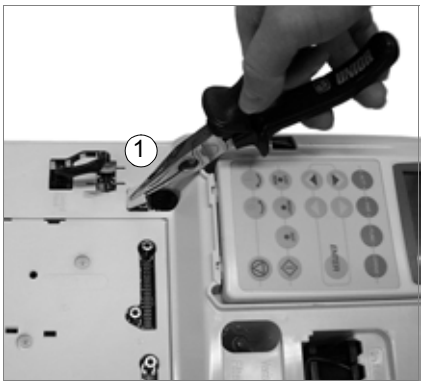
Parameter settings

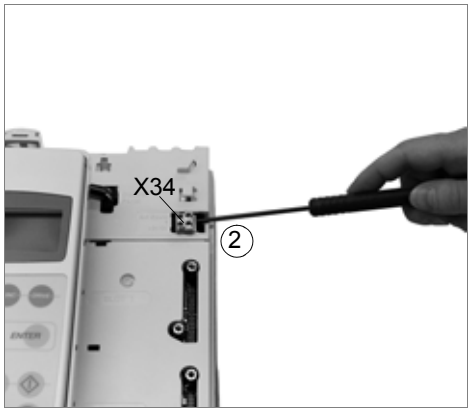
In Standard Application Program, set parameter 16.9 CTRL BOARD SUPPLY to EXTERNAL 24V if the RMIO board is powered from an external supply.

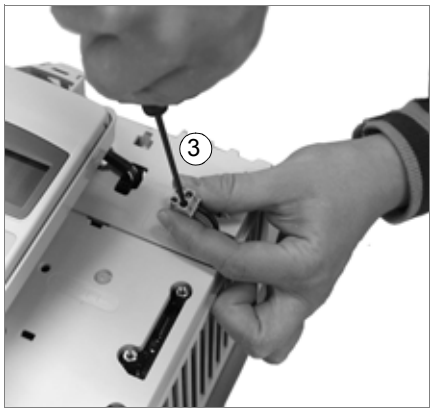
Connecting +24 V external power supply

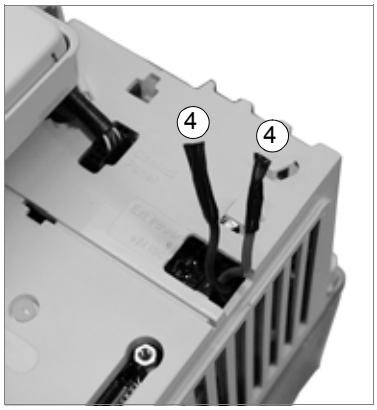
1. Break off the tab covering the +24 VDC power input connector with pliers.
2. Lift the connector upwards.
3. Disconnect the wires from the connector (keep the connector for later use).
4. Isolate the ends of the wires individually with insulating tape.
5. Cover the isolated ends of the wires with insulating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

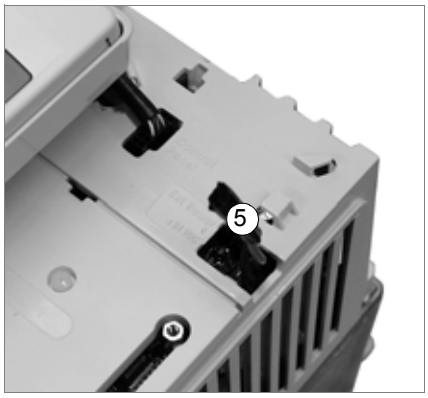
Frame sizes R5 and R6







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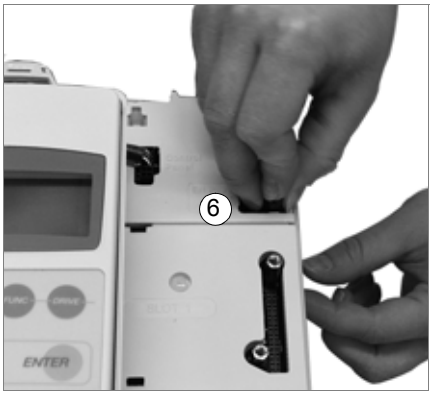
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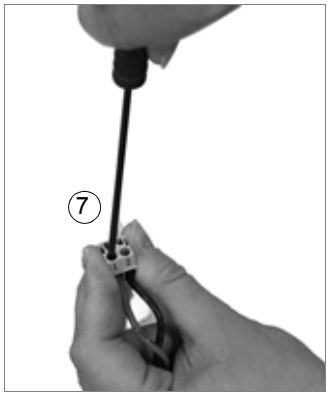
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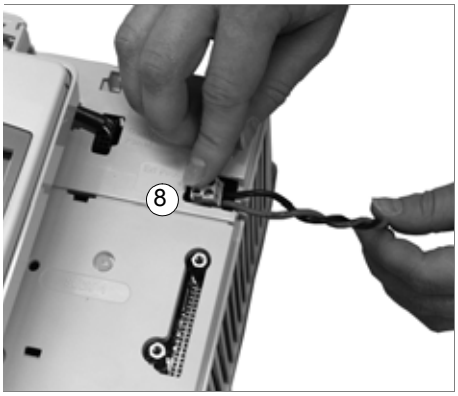
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