ACS800

Hardware Manual

ACS800-PC Drives (150 to 600 HP)

ACS800 Single Drive Manuals

HARDWARE MANUALS
(appropriate manual is included in the delivery)

ACS800-04/U4 Hardware Manual 90 to 500 kW (125 to 600 HP) 3AFE64671006 (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-PC Drives
150 to 600 HP

Hardware Manual

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Safety Instructions

What this Chapter Contains

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

Use of Warnings and Notes

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

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

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

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

Special note or recommendation. This symbol is used to highlight especially important information or recommendation for product application.

Installation and Maintenance Work

These warnings are intended for all who work on the drive, motor cable or motor. Ignoring the instructions can cause physical injury or death.

WARNING!

- 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 switching off the power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start working on the drive, the motor or the motor cable.

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

  1. Voltage between drive input phases L1, L2 and L3 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 disconnecting device (means) of the drive does not isolate the input cables and busbars from the main AC supply. Before working inside the cabinet, isolate the input cables and busbars from the main supply with the disconnecting device at the distribution board or with the disconnector of the supply transformer.
- 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.
- The Prevention of Unexpected Start function does not remove the voltage from the main and auxiliary circuits.

WARNING!

- Cover the drive when installing to ensure that dust from drilling or foreign objects do not enter the drive. Electrically conductive dust inside the unit may cause damage or lead to malfunction.
- Ensure sufficient cooling.
- Welding of the cabinet frame is not recommended. However, if electric welding is the only way to mount the cabinet, follow the instructions given in chapter "Mechanical Installation". Ensure that welding fumes are not inhaled. If the welding return wire is connected improperly, the welding circuit may damage electronic circuits in the cabinet.
- When removing the module from the cabinet and manoeuvring it outside the cabinet, prevent it from toppling over by securing it. The drive module is heavy and has a high center of gravity.

WARNING! 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.

Grounding

These instructions are intended for all who are responsible for the grounding of the drive. Incorrect grounding can cause physical injury, death or equipment malfunction and increase electromagnetic interference.

WARNING!

- Ground the drive, the 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).
- Do not install a drive with EMC filter option +E202 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.

Fiber Optic Cables

WARNING! 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. Ignoring the instructions can cause physical injury or death or damage the equipment.

WARNING!

- 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.

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.

Installation and Maintenance Work

Before installation and maintenance work on the drive:

- Disconnect the motor from the drive with a safety switch

and additionally if possible (or)

- lock the motor shaft and ground the motor connection terminals temporarily by connecting them together as well as to the PE. Before grounding, measure that the motor is de-energized.

Operation

Do not run the motor over the rated speed. Motor overspeed leads to overvoltage which may explode the capacitors in the intermediate circuit of the drive.

Table of Contents

Technical Data

Dimensional Drawings

Resistor Braking

About this Manual

What this Chapter Contains

This chapter describes the intended audience and contents of the 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.

Target 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.

The 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 performed per the National Electrical Code and local codes are marked with (US).

Common Chapters for Products

Chapters *"Planning the Electrical Installation"*, *"Motor Control and I/O Board (RMIO)"* and *"Resistor Braking"* apply to the ACS800-01/U1, ACS800-02/U2, ACS800-04/U4, ACS800-07/U7, and ASC800-PC.

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"*.

Categorization According to the + Code

The instructions, technical data and dimensional drawings which concern only certain optional selections are marked with + codes, e.g. +E205. The options included in the drive can be identified from the + codes visible on the type designation label of the drive. The + code selections are listed in chapter *"The ACS800-PC"* 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" introduces this manual.

"The ACS800-PC" describes the drive.

"Mechanical Installation" shows how to move and unpack the delivery and how to fasten the cabinet to the floor.

"Planning the Electrical Installation" instructs on the motor and cable selection, the protections and the cable routing.

"Electrical Installation" instructs how to wire the drive.

"Motor Control and I/O Board (RMIO)" shows external control connections to the motor control and I/O board and its specifications.

"Installation Checklist and Start-Up" helps in checking the mechanical and electrical installation of the drive.

"Maintenance" contains preventive maintenance instructions.

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

"Dimensional Drawings" contains the dimensional drawings of the drive.

"Resistor Braking" describes how to select, protect and wire optional brake choppers and resistors. The chapter also contains technical data.

Installation and Commissioning Flowchart

Task	See
Identify the frame size of your drive: R7 or R8.	“Technical Data / NEMA Ratings”
Plan the installation. Check the ambient conditions, ratings, required cooling air flow, input power connection, compatibility of the motor, motor connection, and other technical data. Select the cables.	*"Technical Data"* *"Planning the Electrical Installation"* Option manual (if optional equipment is included)
Unpack and check the unit. Check that all necessary optional modules and equipment are present and correct. Only intact units may be started up.	“Mechanical Installation: Moving the Unit, Before Installation” If the converter has been non-operational for more than one year, the converter DC link capacitors need to be reformed. Ask ABB for instructions.
Check the installation site.	“Mechanical Installation: Before Installation” *"Technical Data"*
If the drive is about to be connected to an IT (ungrounded) system, check that the drive is not equipped with EMC filter +E202.	“The ACS800-PC: Type Code.” For instructions on how to disconnect the EMC filtering, contact ABB.
Route the cables.	“Planning the Electrical Installation: Routing the Cables”
Check the insulation of the motor and the motor cable.	“Electrical Installation: Checking the Insulation of the Assembly “
Install the drive. Connect the power cables. Connect the control and the auxiliary control cables.	“Mechanical Installation, Electrical Installation, Resistor Braking” (optional)
Check the installation.	*"Installation Checklist and Start-Up"*
Commission the drive.	*"Installation Checklist and Start-Up"*, appropriate firmware manual
Commission the optional brake chopper (if present).	*"Resistor Braking"*

Inquiries

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

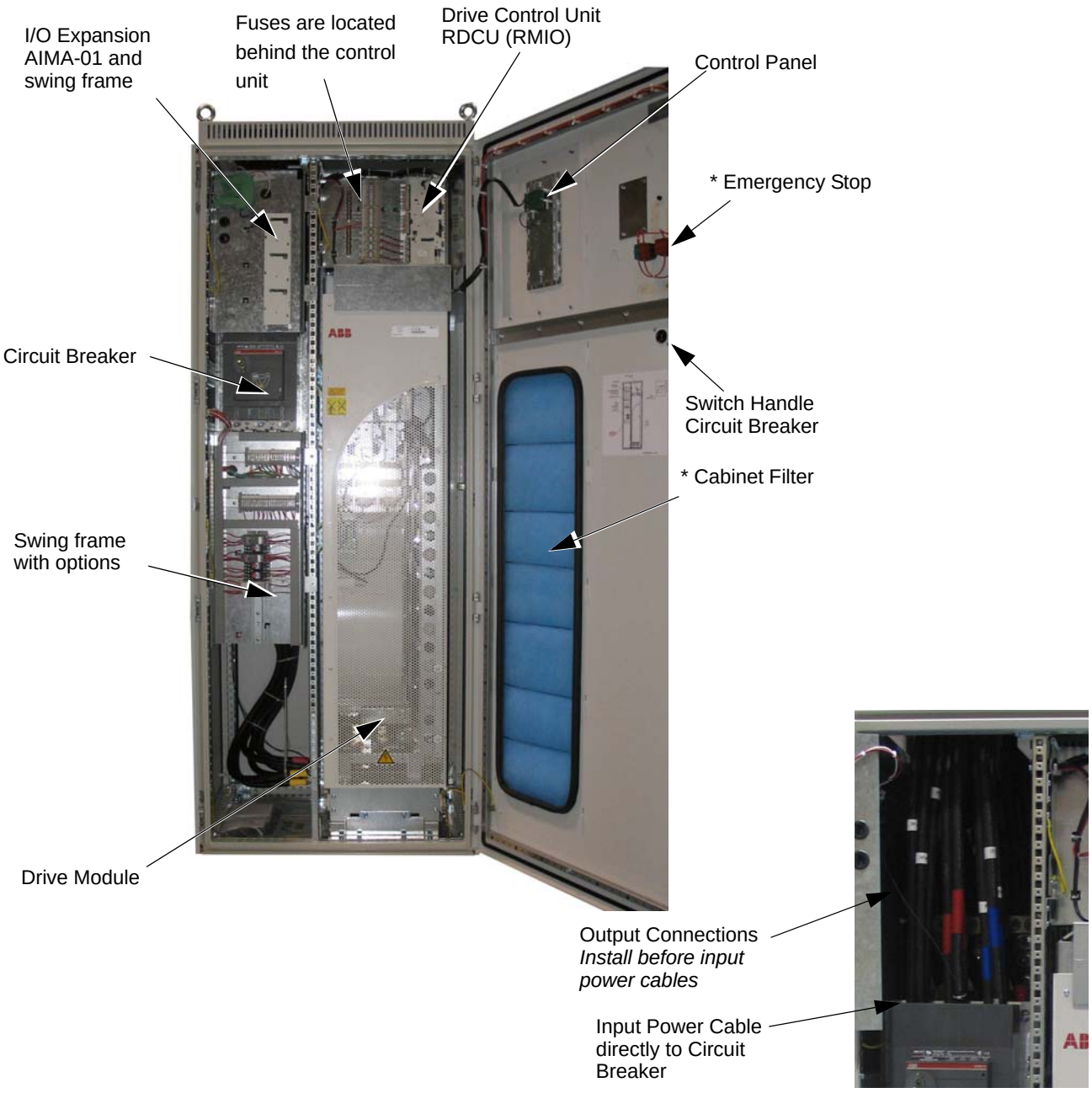
The ACS800-PC

What this Chapter Contains

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

The ACS800-PC

The ACS800-PC is a cabinet-installed drive for controlling AC motors.



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-PC-0170-5). The optional selections are given thereafter, separated by + 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	PC	cabinet built (USA). When no options are selected: 6-pulse diode bridge, UL type 1, circuit breaker with class T/L fuses, control panel CDP312R, US version of the Standard Application Program (three-wire start/stop as default setting), cable conduit entry, common mode filter in frame size R8, 2nd Environment EMC filter in frame R8, boards with coating, one set of manuals.
Size	Refer to Technical Data*:* NEMA Ratings*.*	
Voltage range **(nominal rating in bold)**	5 7	460/480/**500** VAC 525/575/**600**/690 VAC
+ options		
Degree of protection	B054	UL type 1 with filter
	B055	UL type 12
Resistor braking	D150	brake chopper (external resistor)
Line options	F250	line contactor
Cabinet options	G313	output for motor heater (external supply)
Cabling		Only top entry and exit
Fieldbus	K…	Refer to *ACS800 Ordering Information* (EN code: 64556568).
I/O	L504	additional terminal block X2
	L505	thermistor relay (1 or 2 pcs) (Not when +L506)
	L506	Pt100 relay (3 pcs) (Not when +L505)
	L515	I/O Extension Adapter
	L…	Refer to *ACS800 Ordering Information* (EN code: 64556568).
Starter for auxiliary motor fan	M600 M601 M602 M603 M604 M605	1…1.6 A 1.6…2.5 A 2.5…4 A 4…6.3 A 6.3…10 A 10…16 A
Application program	N…	Refer to *ACS800 Ordering Information* (EN code: 64556568).
Safety features	Q950 Q951	prevention of unexpected start emergency stop of category 0 (+F250 required)

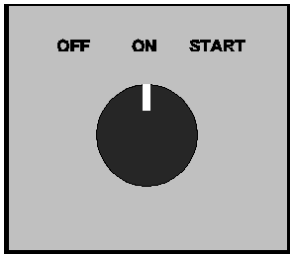
Product Ordering — Special Note

The ACS800-PC-0170-5 through -0440-5 are available with UL Type 1 and UL Type 12. The ACS800-PC-0490-5 through -0610-5 are available with UL Type 12. These units are always supplied with exhaust fan and are not available without the exhaust fan.

Main Circuit and Control

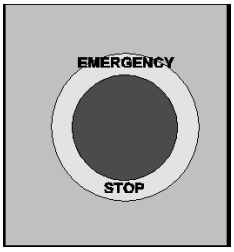
Door Switches

The following switches are mounted on the cabinet door when option F250+Q951 is included:



Operating switch (units with main contactor only)

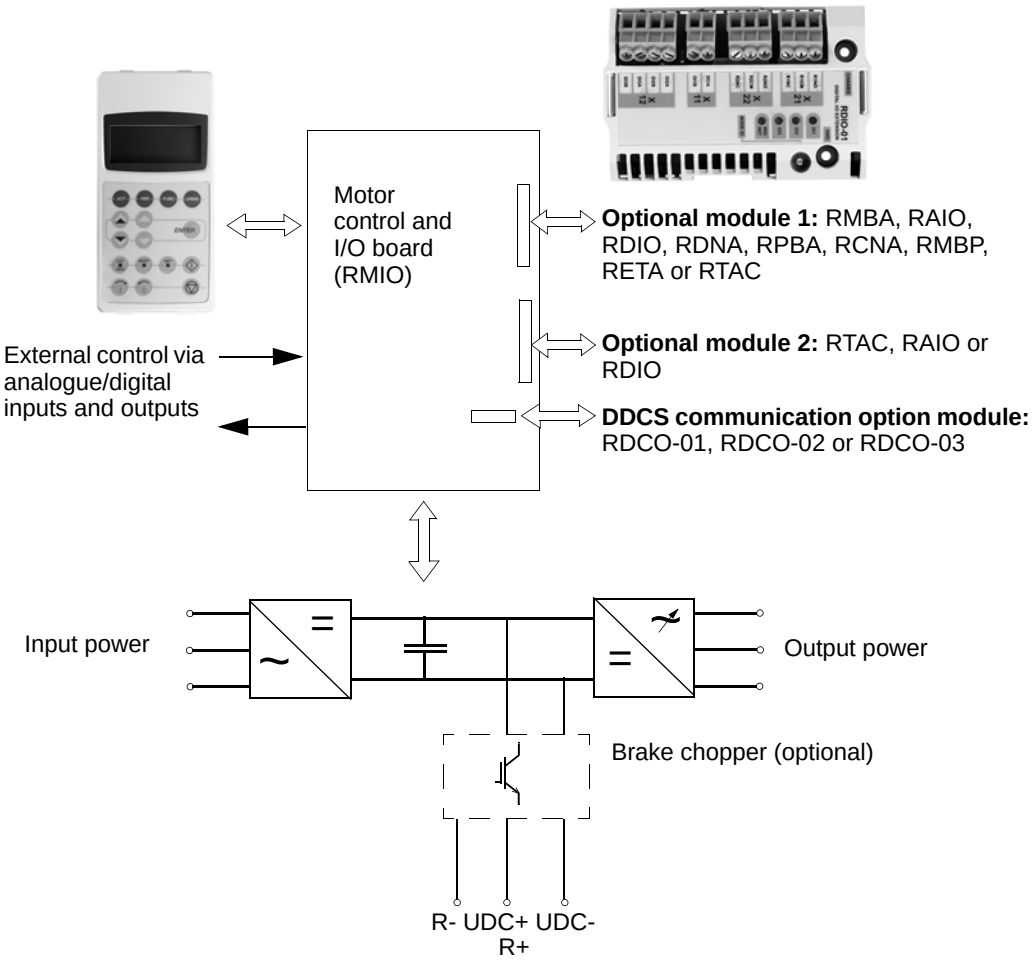
"START" position closes the main contactor; "ON" position keeps the main contactor closed; "OFF" position opens the main contactor.



Emergency stop button (optional)

Diagram

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



Operation

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

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

Printed Circuit Boards

The drive contains the following printed circuit boards as standard:

- Main circuit board (AINT)
- Motor control and I/O board (RMIO) with a fibre optic link to the AINT board
- Input bridge control board (AINP)
- Input bridge protection board (AIBP) which includes varistors and snubbers for the thyristors
- Power supply board (APOW)
- Gate driver control board (AGDR)
- Diagnostics and panel interface board (ADPI)
- Brake chopper control board (ABRC) with option +D150

Motor Control

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

Mechanical Installation

What this Chapter Contains

This chapter describes the mechanical installation procedure of the drive.

Moving the Unit

Move the transport package by truck and pallet truck to the installation site.

WARNING! The ACS800-PC is to be handled and shipped standing up ONLY. This unit is not designed to be laid on its back.

WARNING! Lift the drive by the upper part only using the lifting lugs/bars attached to the top of the unit.

Before Installation

Check for external damage. If damage exists, immediately document, contact the shipper and contact ABB.

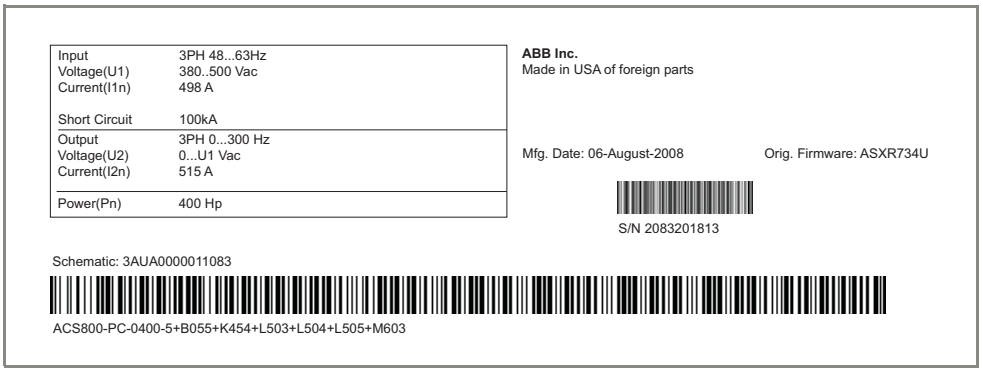
Delivery Check

The drive delivery contains:

- Drive cabinet including factory installed options such as optional modules (inserted onto the RMIO board in the RDCU unit)
- Residual voltage warning stickers
- Hardware manual
- Appropriate firmware manuals and guides
- Appropriate optional module manuals
- Delivery documents.

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 a NEMA rating, 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 located on the inside of the front cover. UL and cUL listing marks are shown on a seperate label.



Type designation label

Requirements for the Installation Site

Check the installation site according to the requirements below. Refer to *ACS800-PC Dimensional Drawings* for frame details. See "Technical Data" for the allowed operation conditions of the drive.

Cooling Air Flow

Provide the drive with the amount of clean cooling air given in "Technical Data" / "NEMA Ratings".

Enclosure Ratings

NEMA 1 (NEMA Standard 7-15-1991)

Type 1 enclosures are intended for indoor use primarily to provided a degree of protection against limited amounts of falling dirt.

UL Type 1 (ANSI/UL50)

Indoor use primarily to provide protection against contact with the enclosed equipment and against a limited amount of falling dirt.

Recommendation

NEMA 1 / UL Type 1 enclosures should be applied to clean environments without circulating dust or other contaminants that may collect on surfaces. Equipment of this enclosure rating should be applied to clean electrical room or installed in another enclosure with higher degree of protection. NEMA 1 / UL Type 1 enclosures typically are not the best selection for installation on industrial factory floors.

NEMA 12 (NEMA Standard 7-15-1991)

Type 12 enclosures are intended for indoor use primarily to provide a degree of protection against circulating dust, falling dirt, and dripping noncorrosive liquids.

UL Type 12 (ANSI/UL50)

Indoor use to provide a degree of protection against dust, dirt, fiber flyings, dripping water, and external condensation of noncorrosive liquids.

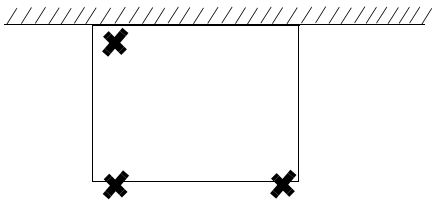
Recommendation

NEMA 12 / UL Type 12 enclosures should be used in environments that contain circulating dust or other contaminant particles. NEMA 12 / UL Type 12 enclosures are recommended for most applications in industrial factory floor where dust is present but spraying liquids are not.

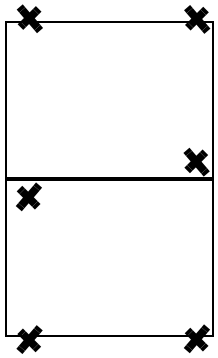
Regular preventative maintenance of filter changing or cleaning is required. Inspect the enclosure and installed equipment for dust or particle build up that may limit cooling, clean as needed.

Fastening the Cabinet to the Floor and Wall

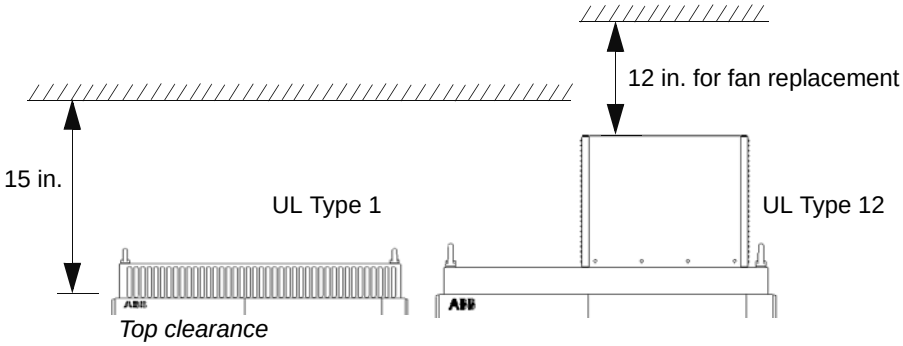
Fasten the cabinet to the floor with the fastening holes inside the cabinet. When fastening at the back is not possible, fasten the cabinet at the top using L-brackets bolted to the holes of the lifting lugs (M12 bolt). The cabinet can be fastened against a wall or back to back with another cabinet. Refer to "Dimensional Drawings" for the horizontal and vertical fastening points. Height adjustment can be done by using metal shims between the bottom frame and floor.



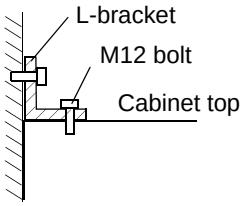
Fastening points when installed back against wall



Fastening points when installed back against back



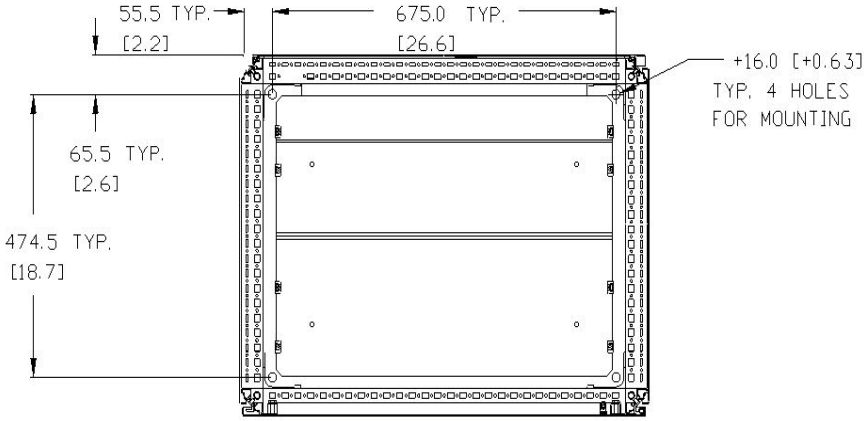
Top clearance



Fastening the cabinet at the top by using L-brackets (side view)

Fastening the Cabinet Through the Holes Inside the Cabinet

The cabinet can be fastened to the floor using the fastening holes inside the cabinet. The maximum allowed distance between the fastening points is 800 mm (31.50 in.).



Fastening bolt: M12 (1/2" to 9/16")
Bottom View

Electric Welding

It is not recommended to fasten the cabinet by welding.

Cabinets without flat bars at the base

If the preferred fastening methods (clamping or bolting through the holes inside the cabinet) cannot be used, proceed as follows:

- Connect the return conductor of the welding equipment to the cabinet frame at the bottom within 0.5 metres of the welding point.

WARNING! If the welding return wire is connected improperly, the welding circuit may damage electronic circuits in the cabinet. The thickness of the zinc coating of the cabinet frame is 100 to 200 micrometres; on the flat bars the coating is approximately 20 micrometers. Ensure that the welding fumes are not inhaled.

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. Always follow local regulations.

Note: 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, ACS800-02/U2, ACS800-04/U4, ACS800-PC, 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:
   - The motor voltage is selected according to the AC voltage feeding the drive when the drive is equipped with a diode input bridge (a non-regenerative drive) and will operate in motor mode (i.e. no braking).
   - The motor nominal voltage is selected according to “the equivalent AC power source voltage of the drive” if the intermediate DC circuit voltage of the drive is increased from the nominal level by resistor braking or by the control program of a regenerative IGBT line-side converter (parameter selectable function).

   The equivalent AC power source voltage for the drive is calculated as follows:

   $U_{ACeq} = U_{DCmax}/1.35$

   where

   U_{ACeq} = equivalent AC power source voltage of the drive

   U_{DCmax} = maximum intermediate DC circuit voltage of the drive

   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: When the supply voltage is 480 V and the drive is operating in motor mode only, the maximum peak voltage in the motor terminals can be approximated as follows: 480 V · 1.35 · 2 = 1296 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:

- Common mode filter (mainly reduces bearing currents).
- du/dt filter (protects motor insulation system and 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_	$U_N \leq 500$ 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
	Form-wound HX_ and AM_	380 V < $U_N \leq 690$ V	Standard	n.a.	+ N + CMF	P_N < 500 kW: + N + CMF
						$P_N \geq 500$ kW: + N + CMF + du/dt
	Old* form-wound HX_ and modular	380 V < $U_N \leq 690$ V	Check with the motor manufacturer.	+ du/dt with voltages over 500 V + N + CMF		
	Random-wound HX_ and AM_ **	0 V < $U_N \leq 500$ V	Enamelled wire with fibre glass taping	+ N + CMF		
		500 V < $U_N \leq 690$ V		+ du/dt + N + CMF		
NON-ABB	Random-wound and form-wound	$U_N \leq 420$ V	Standard: U_{LL} = 1300 V	-	+ N or CMF	+ N + CMF
		420 V < $U_N \leq 500$ V	Standard: U_{LL} = 1300 V	+ du/dt	+ du/dt + N	+ du/dt + N + CMF
					or	
					+ du/dt + CMF	
			or			
			Reinforced: U_{LL} = 1600 V, 0.2 microsecond rise time	-	+ N or CMF	+ N + CMF
		500 V < $U_N \leq 600$ V	Reinforced: U_{LL} = 1600 V	+ du/dt	+ du/dt + N	+ du/dt + N + CMF
					or	
					+ du/dt + CMF	
			or			
			Reinforced: U_{LL} = 1800 V	-	+ N or CMF	+ N + CMF
		600 V < $U_N \leq 690$ V	Reinforced: U_{LL} = 1800 V	+ du/dt	+ du/dt + N	+ du/dt + N + CMF
			Reinforced: 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
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		
				PN < 55 kW	**55 kW < PN < 200 kW**	**PN > 200 kW**
				PN < 74 HP	**74 HP < PN < 268 HP**	**PN > 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 motor cable. 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, ACS800-02, 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, ACS800-U7, and ACS800-PC

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.

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)*.

Drive AC Fuses (Standard on ACS800-PC)

ACS800-PC units are equipped with Fast Acting Current Limiting Class T (JJS-xxx) 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, 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 Class T fuses, 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*.

WARNING! Circuit breakers must not be used without fuses.

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, ACS800-07/U7, and ACS800-PC

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, ACS800-07/U7, and ACS800-PC) 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 (ACS800-07/U7 only)

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 minimum 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.

Note: When continuous conduit is employed, shielded cable is not required.

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
$16 < S \leq 36$	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.

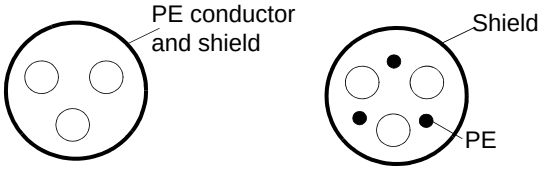
The motor cable and its PE pigtail (twisted shield) should be kept as short as possible in order to reduce electromagnetic emission.

Alternative Power Cable Types

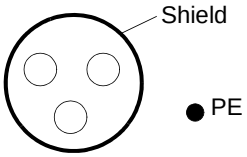
Power cable types that can be used with the drive are represented below.

Recommended

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

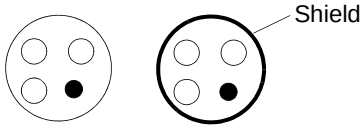


A separate PE conductor is required if the conductivity of the cable shield is < 50 % of the conductivity of the phase conductor.



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

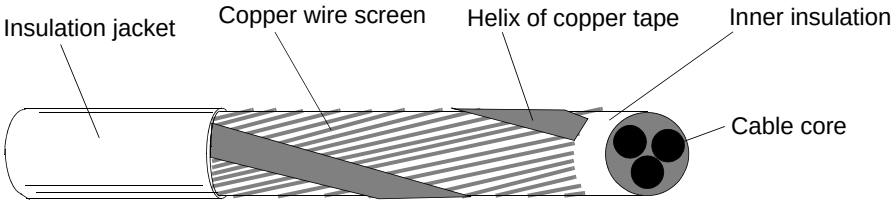
Not allowed for motor cables



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. When conduit is employed, type MC continuous corrugated aluminum armour cable or shielded power cable is not required. A dedicated ground cable is always required.

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

Armored Cable / Shielded Power Cable

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.

If there are power factor compensation capacitors in parallel with the three phase input of the drive, ensure that the capacitors and the drive are not charged simultaneously to avoid voltage surges which might damage the drive system.

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 (i.e. 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)

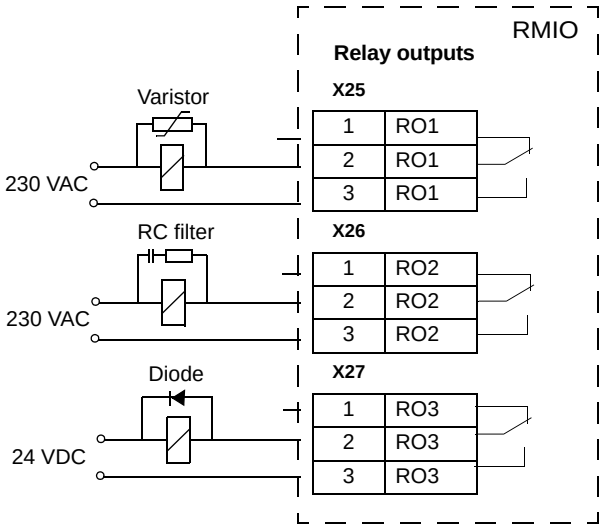
Stop the drive and wait for the motor to stop before opening a contactor between the output of the drive and the motor when the DTC control mode is selected. See the appropriate ACS800 application program firmware manual for the required parameter settings. Otherwise, the contactor will be damaged. In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

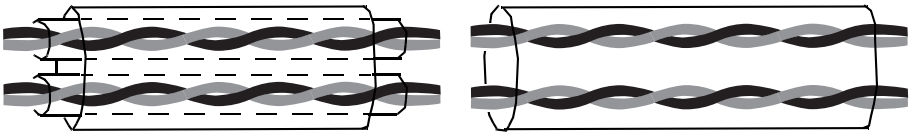


Selecting the Control Cables

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 multipair cable (Figure b) is also usable.



a
A double-shielded twisted pair cable

b
A single-shielded twisted multipair 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 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*.

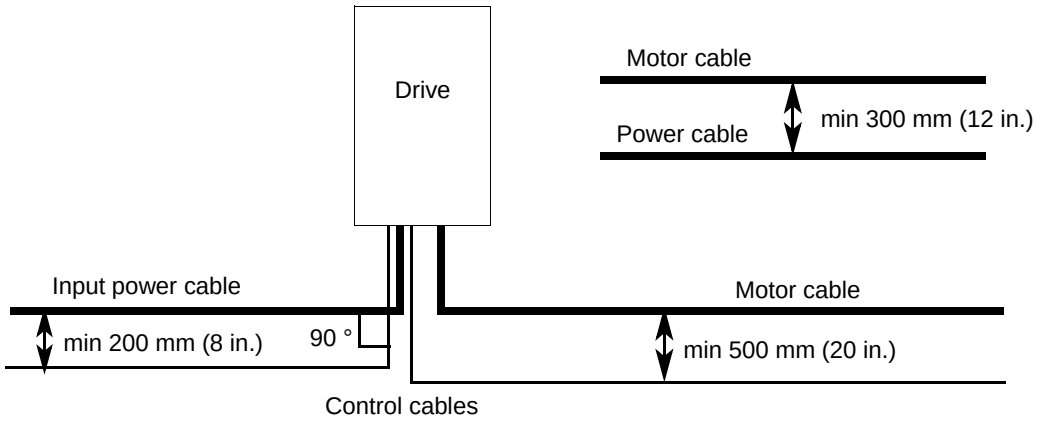
Routing the Cables

Route the motor cable away from other cable routes. Motor cables of several drives can be run in parallel installed next to each other. When shielded or armored cable is used, 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.

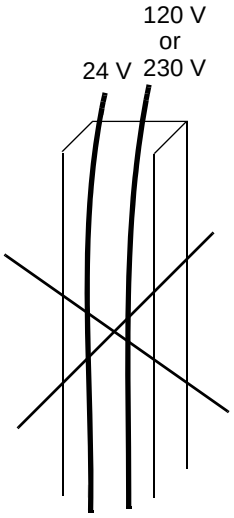
Where control cables must cross power cables make sure they are arranged at an angle as near to 90 degrees as possible. Do not run extra cables through the drive.

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.

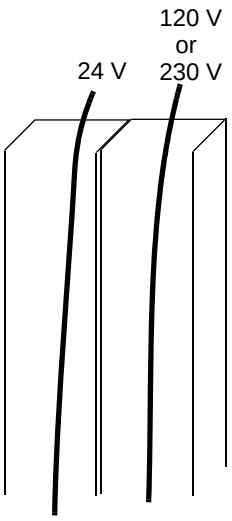
A diagram of the cable routing is shown below.



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! Only qualified electricians are allowed to carry out the work described in this chapter. Follow the *"Safety Instructions"* on the first pages of this manual. Ignoring the safety instructions can cause injury or death.

Before Installation

It (Ungrounded) Systems

A drive equipped with no EMC filter or with EMC filter +E210 is suitable for IT (ungrounded systems). If the drive is equipped with EMC filter +E200 or +E202, disconnect the filter before connecting the drive to an ungrounded system. For detailed instructions on how to do this, please contact your local ABB representative.

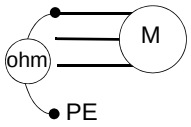
WARNING! If a drive with EMC filter +E200 or +E202 is installed on an IT system [an ungrounded power system or a high resistance-grounded (over 30 ohms) power system], the system will be connected to earth potential through the EMC filter capacitors of the drive. This may cause danger or damage the unit.

Checking the Insulation of the Assembly

Every drive module 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. Check the insulation of the assembly as follows.

WARNING! Check the insulation before connecting the drive to the mains. Make sure that the drive is disconnected from the mains (input power).

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 the 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.

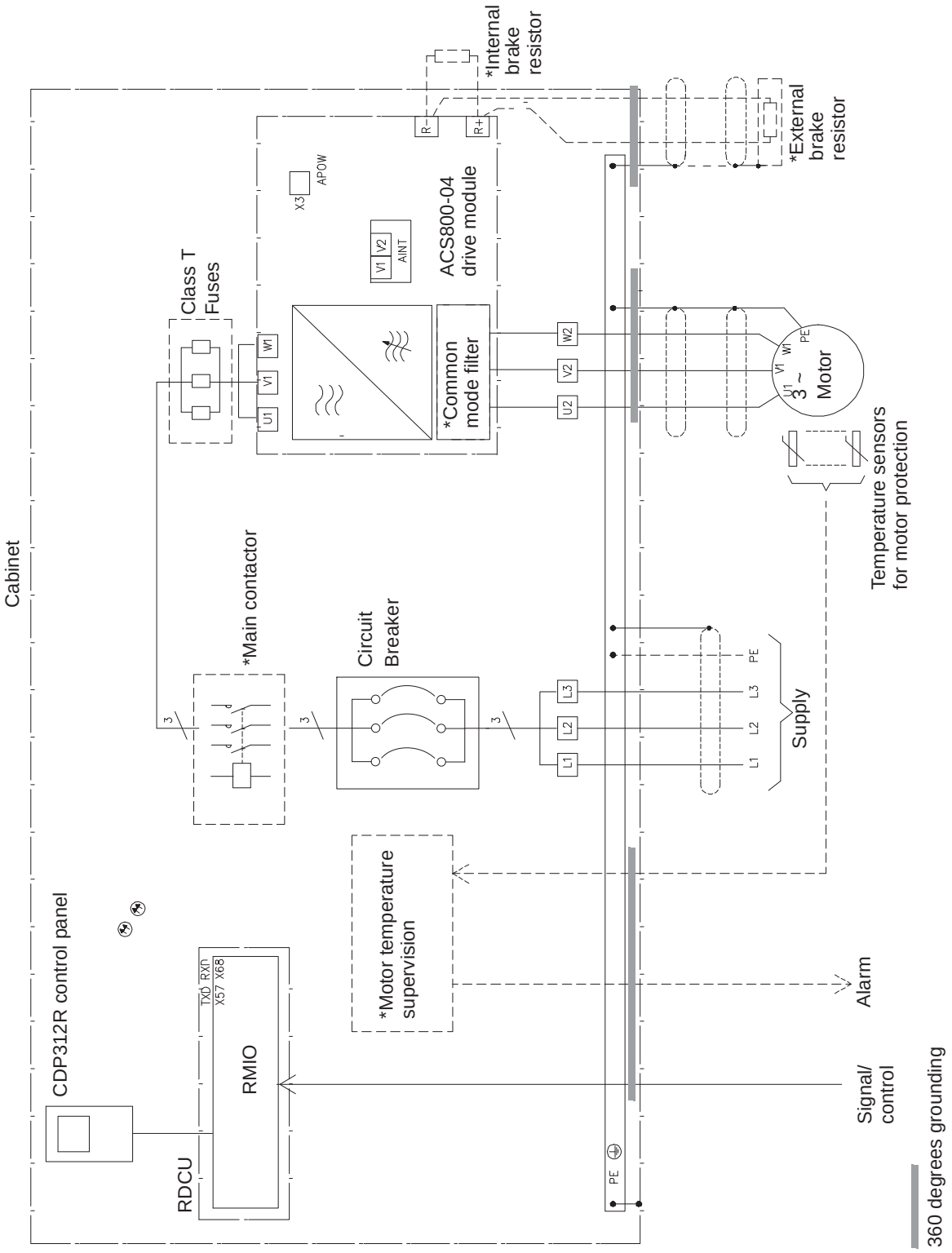


Warning Sticker

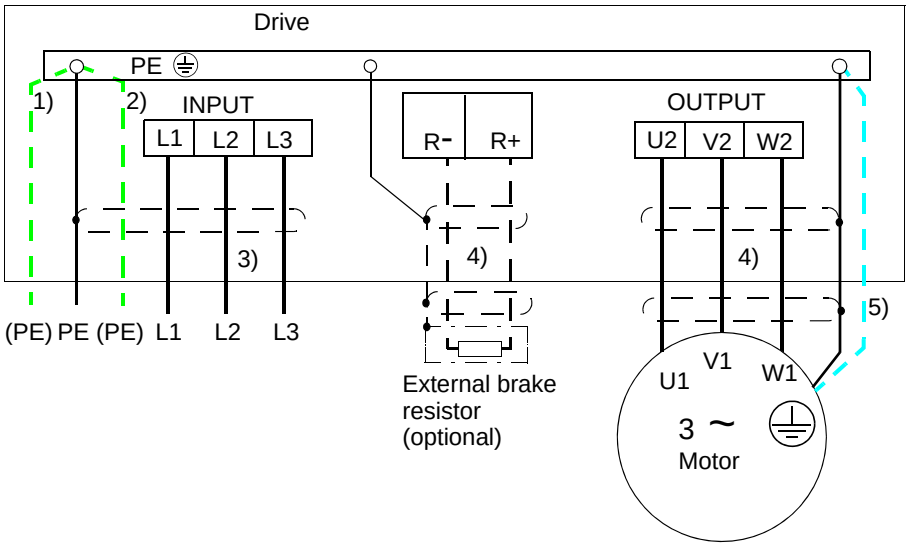
A multi-language sticker is attached onto the drive module cover. Attach the warning sticker in the local language onto the cover of the drive module.

Example Wiring Diagram

The diagram below presents an example for the main wiring. Note that the diagram includes optional components (marked *) which are not always included in the delivery.



Power Cable Connection 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.

360 degrees grounding recommended if shielded cable

360 degrees grounding required

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:

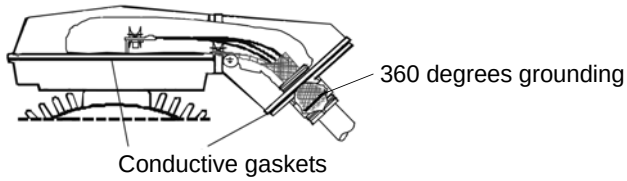
If there is a symmetrically constructed grounding conductor in the motor cable in addition to the conductive shield, connect the grounding conductor to the grounding terminal at the drive and motor ends.

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

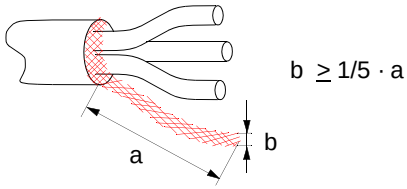
Grounding of the motor cable shield at the motor end

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 $\geq$ 1/5 · length.



Connecting the Power Cables

1. Open the swing-out frame on the top left of the cabinet (if installed)
2. Plan cable access and mark conduit plate accordingly for Input Power (at Front), Output Power (at Rear), and Control wires.
3. Remove the conduit plate from the drive cabinet and cut holes as needed for conduit connections.

NOTE: Never cut metal in our around an equipment cabinet. Metal debris may cause damage to electrical equipment and hazardous condition.

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4. Re-install conduit plate to cabinet and connect all electrical conduits as needed to conduit plate. Do not leave any open holes at the top of the cabinet.
5. Run motor power wires and proper grounding from motor to cabinet.
6. Connect ground cable and power cable shield to ground bar at top of cabinet (inside at back).
7. Connect motor phase conductors to the output power blocks.

   If a Brake Chopper option is not employed, skit to step 11
8. Run power cables from brake resistor to cabinet including the proper grounding cable.
9. Connect ground cable to the ground bar at top of cabinet (inside at back).
10. Connect the brake resistor power cables to the power terminal block in the top left side of the cabinet
11. Run AC power supply cables and proper grounding from supply source.

NOTE: Ensure all power is disabled and employ proper safe disconnect procedures according to local codes.

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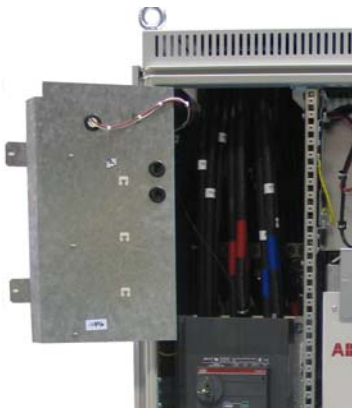
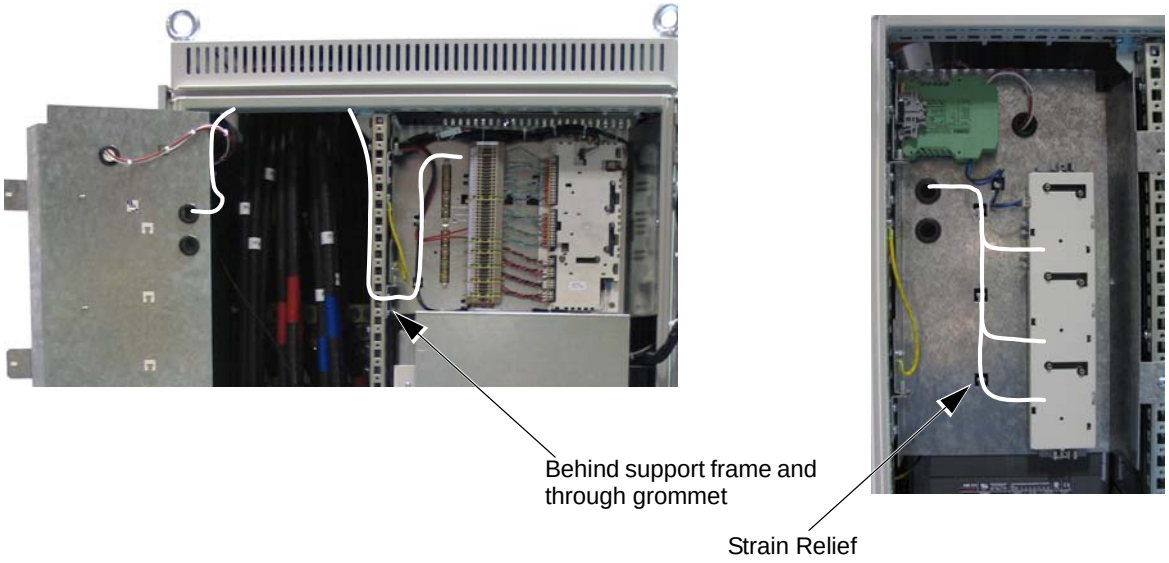
12. Connect ground cable to the ground bar at top of cabinet (inside at back).
13. Connect AC supply phase conductors directly to the input Circuit Breaker.



Connecting the Control Cables

Routing the Cables

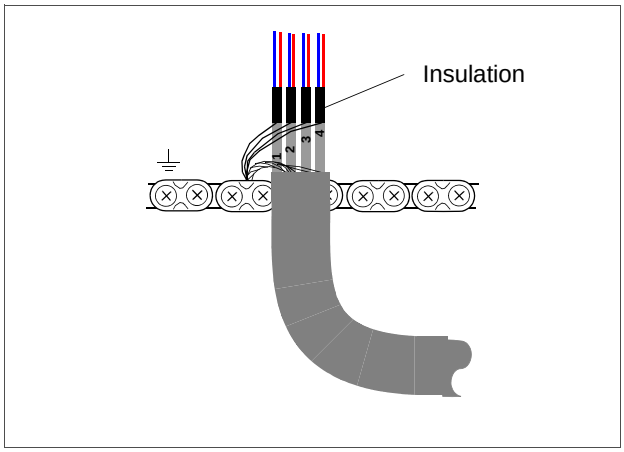
Run the cables to the inside of the cabinet through the conduit plate at the top of the cabinet. The Control cables must be in separate conduit from the power cables.



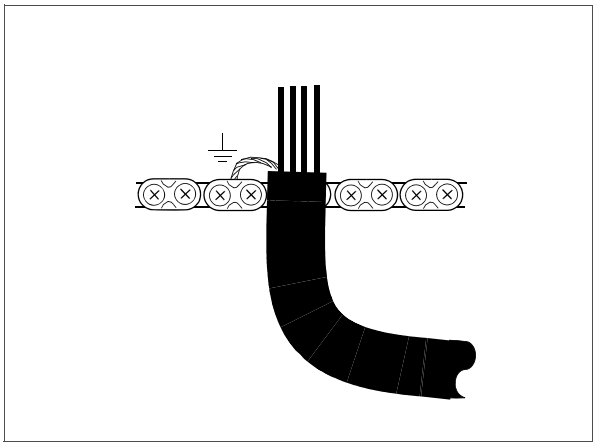
Use protective sleeve wherever the cables are against sharp edges. Allow for slack in the cable at any hinge location to allow the swing frame to open fully. Tie the cables to the available strapping points to provide strain relief.

Connecting the Cables to the I/O Terminals

Connect the conductors to the appropriate detachable terminals of the RMIO board or optional terminal X2 [refer to chapter *"Motor Control and I/O Board (RMIO)"*]. Tighten the screws to secure the connection.



Double-shielded cable



Single-shielded cable

Single-shielded cable: Twist the grounding wires of the outer shield and connect them to the nearest grounding clamp. Double-shielded cable: Connect the inner shields and the grounding wires of the outer shield to the nearest grounding clamp.

Do not connect shields of different cables to the same grounding clamp.

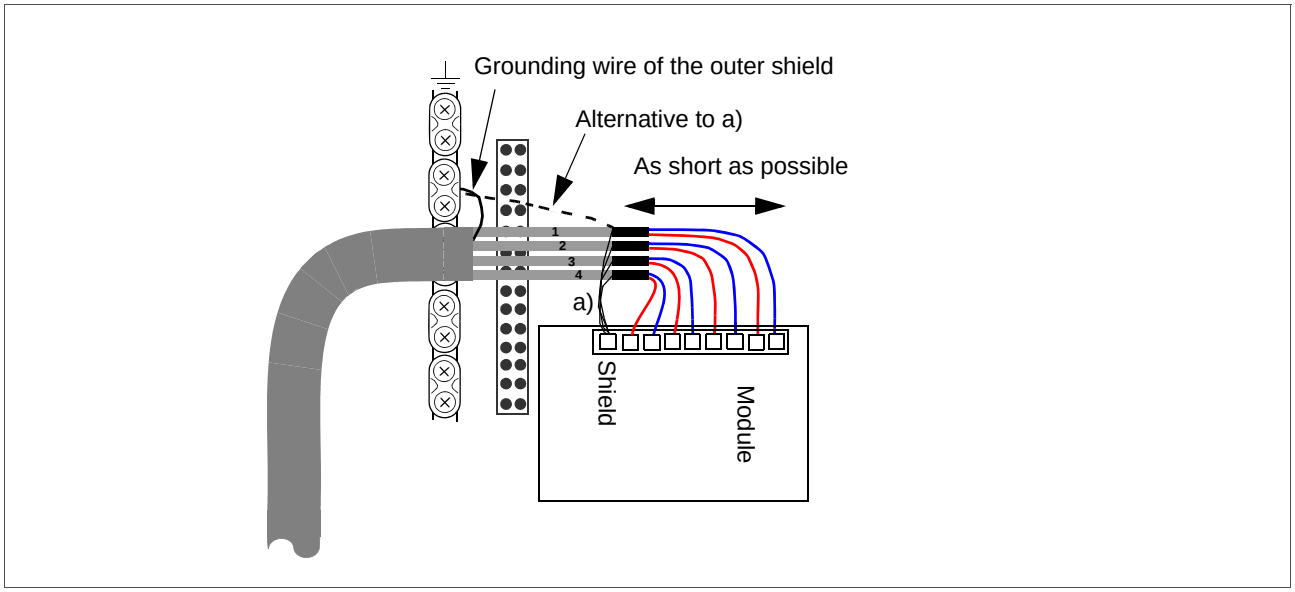
Leave the other end of the shield unconnected or ground it indirectly via a few nanofarads high-frequency capacitor (e.g. 3.3 nF / 630 V). The shield can also be grounded directly at both ends if they are *in the same ground line* with no significant voltage drop between the end points.

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.

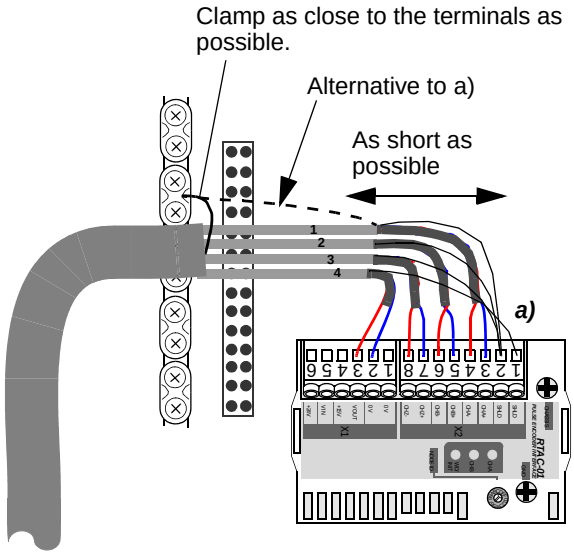
Installation of Optional Modules

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

Cabling of I/O and Fieldbus Modules



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.

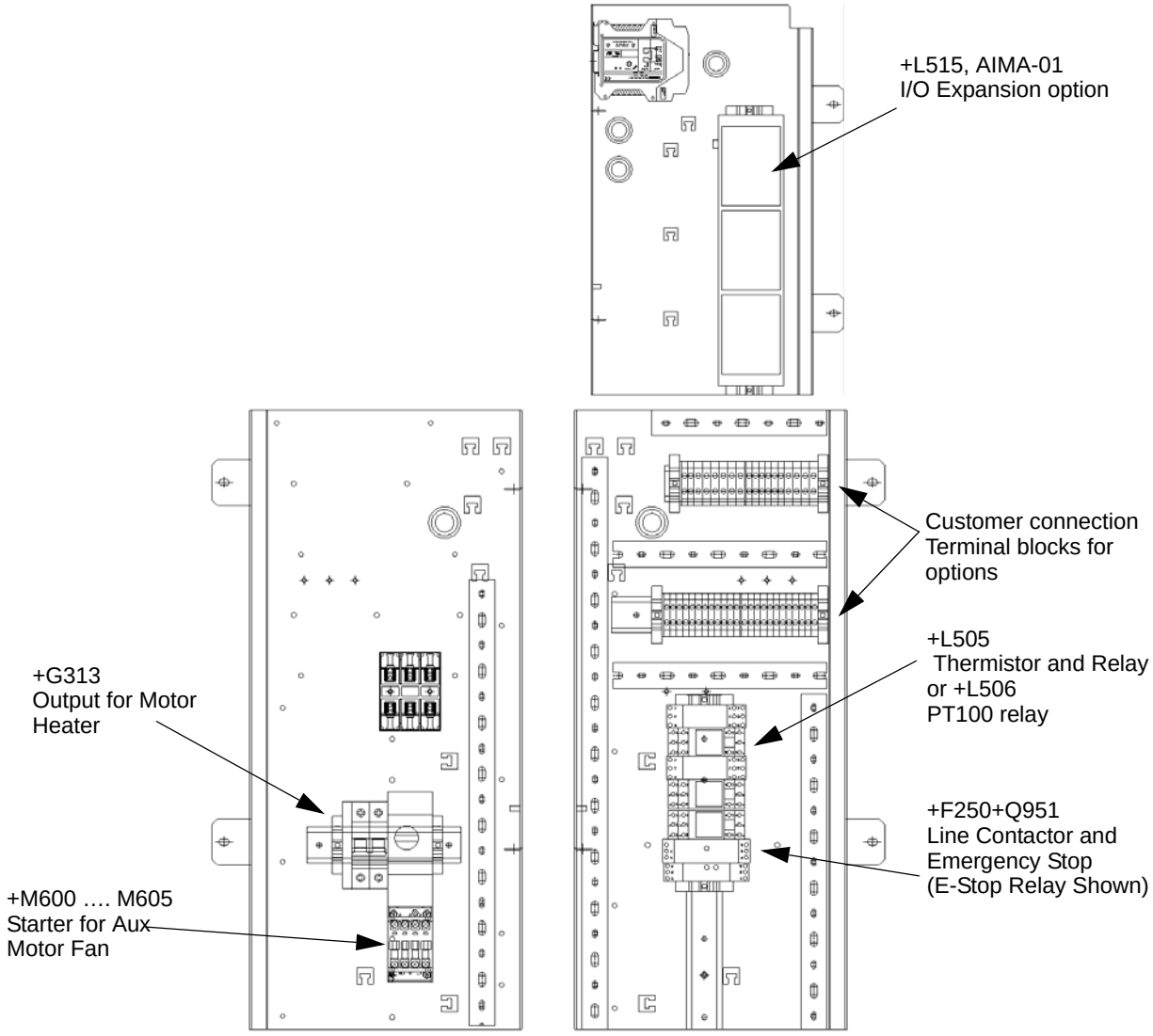
Note 3: The grounding wire of the outer shield of the cable can alternatively be connected to the SHLD terminal of the RTAC module.

Fibre Optic Link

A DDCS fiber optic link is provided via the RDCO optional module for PC tools, master/follower link, NDIO, NTAC, NAIO, AIMA I/O module adapter and fieldbus adapter modules of type Nxxx. See *RDCO User's Manual* [3AFE64492209 (English)] for the connections. Observe color coding when installing fibre optic cables. Blue connectors go to blue terminals, and grey connectors to grey terminals.

When installing multiple modules on the same channel, connect them in a ring.

Layout Drawing of Factory Installed Optional Equipment



Additional Terminal Blocks

	Customer Connection Terminal Blocks - for Options
X5	+F250+Q951 - E-Stop and Line Contactor control
X6	+G313 - Output for Motor Heater (Supply and output)
X7	+M600-M605 - Starter for Aux Motor Fan
X8	+L505 or +2L505 - Thermistor or +L506 - PT100

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, ACS800-07/U7, and ACS800-PC

The connections for the RMIO board shown below apply also to optional terminal block X2 available for the ACS800-02, ACS800-07, and ACS800-PC. 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.

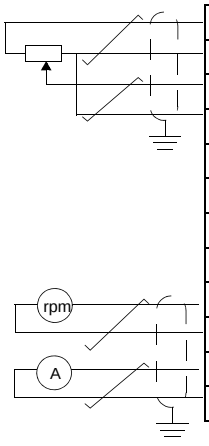
Note on External Power Supply

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

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 22 to 12 AWG
Tightening torque:
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	Start (⎍)
2	2	DI2	Stop (⎍)
3	3	DI3	Forward/Reverse [1]
4	4	DI4	Acceleration & deceleration select [2]
5	5	DI5	Constant speed select [3]
6	6	DI6	Constant speed select [3]
7	7	+24VD	+24 VDC max. 100 mA
8	8	+24VD	
9	9	DGND	Digital ground
10	10	DGND	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	

Fault

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

[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

Analog 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 analog 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	$\geq$ 60 dB at 50 Hz
Resolution	0.025% (12 bit) for the -10 V … +10 V input. 0.5% (11 bit) for the 0 … +10 V and 0 … 20 mA inputs.
Inaccuracy	± 0.5% (Full Scale Range) at 25 °C (77 °F). Temperature coefficient: ± 100 ppm/°C (± 56 ppm/°F), max.

Constant voltage output

Voltage	+10 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)

Analog outputs

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

Digital inputs

	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 fiber optic link

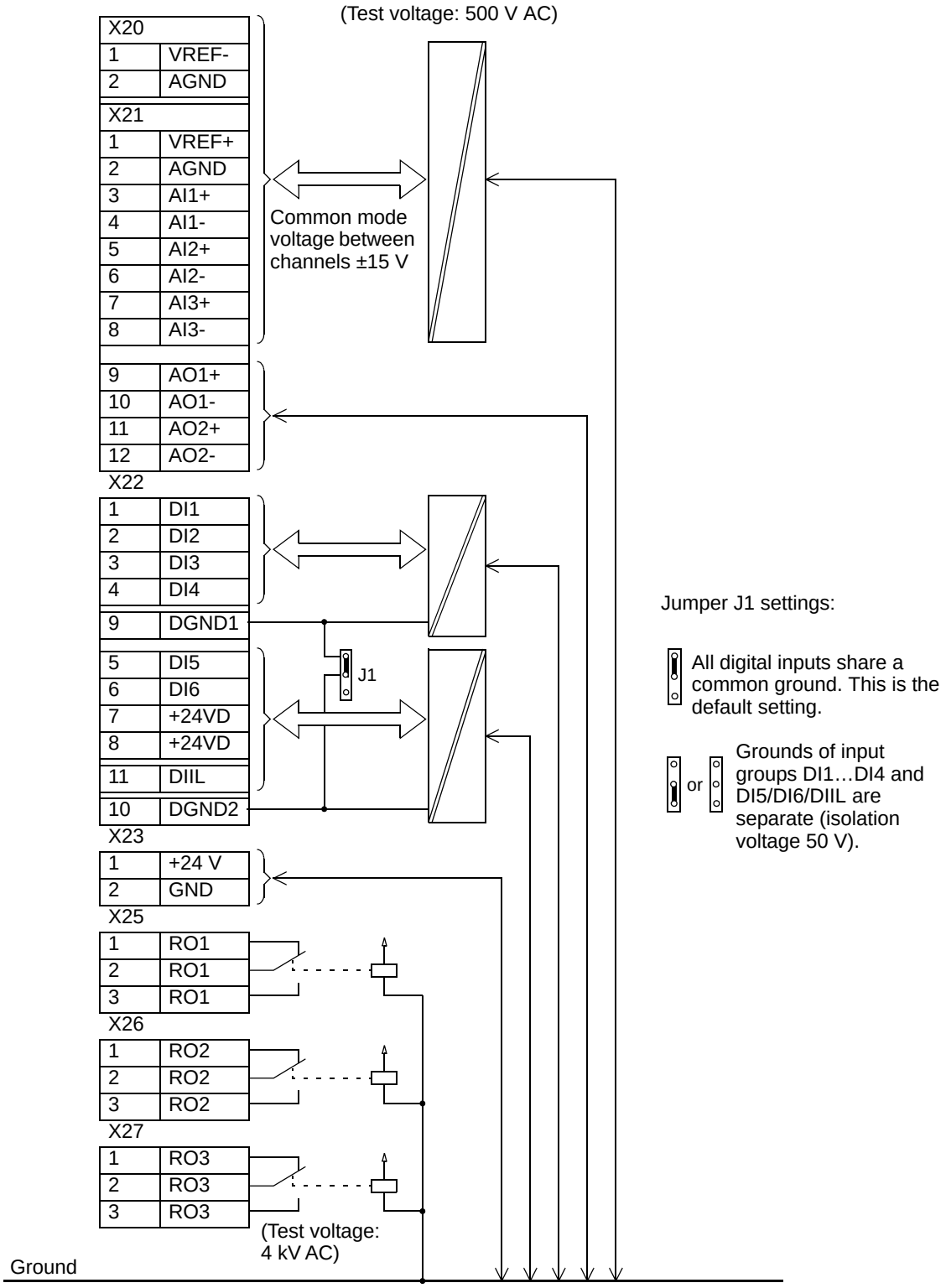
	With optional communication adapter module RDCO. Protocol: DDCS (ABB Distributed Drives Communication System)

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 and Start-Up

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*: *NEMA Ratings*, *Ambient Conditions*.	☐
The unit is fixed properly on floor and a vertical non-flammable wall. See **"Mechanical Installation"**.	☐
The cooling air will flow freely.	☐
ELECTRICAL INSTALLATION See **"Planning the Electrical Installation"**, **"Electrical Installation"**.	
The motor and the driven equipment are ready for start. See *Planning the Electrical Installation*: *Motor Selection and Compatibility*, *Technical Data*: *Motor Connection*.	☐
The +E202 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 L1, L2 and L3 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.	☐
Voltage setting of the brake resistor fan transformer (if present).	☐
There are no power factor compensation capacitors in the motor cable.	☐
The external control connections inside the drive are OK.	☐
There are no tools, foreign objects or dust from drilling inside the drive.	☐
Mains (input power) voltage cannot be applied to the output of the drive (with bypass connection).	☐
Drive, motor connection box and other covers are in place.	☐

Start-Up Procedure

	Action	Additional information
Safety		
☐	Only qualified electricians are allowed to start-up the drive. The safety instructions must be followed during the start-up procedure.	See chapter **"Safety Instructions"**.
Checks with no voltage connected		
☐	Check the tuning of the insulation monitoring device.	Optional device. See delivery specific circuit diagrams and *IRDH265 Operating Manual* by Bender (code: TGH1249).
☐	Pt 100 settings (if present)	
Starting the drive		
☐	Close the switch fuse (main disconnector).	
☐	Units with line contactor: Close the contactor by turning the start switch on the cabinet door from OFF into START position for 2 seconds. Leave the switch to ON position.	
Application program set-up		
☐	Follow the instructions in the *Firmware Manual* to start up the drive and to set the drive parameters.	
On-load checks		
☐	Check that the Prevention of Unexpected Start function (if installed) works: • Start and Stop the drive and wait until the motor has stopped. • Open the Prevention of Unexpected Start switch (mounted on a control desk). The indicating lamp should lit. • Give a Start command. The drive should not start. • Reset the drive from the control panel.	Optional function. See delivery specific circuit diagrams.
☐	Check that the cooling fans rotate freely in the right direction, and the air flows upwards.	A paper sheet set on the intake (door) gratings stays. The fans run noiselessly.
☐	Check the direction of rotation of the motor.	
☐	Check the correct operation of the emergency-stop circuits from each operating location.	

Maintenance

What this Chapter Contains

This chapter contains preventive maintenance instructions.

Safety

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

Maintenance Intervals

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

Interval	Maintenance	For instruction, see section
Every 3 months	UL Type 12	Checking and Replacing the Air Filters (min)
	Cleanliness check	Heatsink
Every year when stored	Capacitor reforming	Reforming
Every 6 years	UL Type 12 and all -0490-5 through -0610-5	Replacing the Cabinet Fan
Every 6 years	Drive module cooling fan change (frame size R7)	Replacing the Drive Module Fan (R7)
Every 6 years	Drive module cooling fan change (frame size R8)	Replacing the Drive Module Fan (R8)
Every 10 years	Capacitor change	Capacitors

Air FIlter Material

Enclosure Type	Inlet (door)	Outlet (roof)
UL Type 12	3AUA0000006723 (qty 1)	3AUA0000006722 (qty 2)

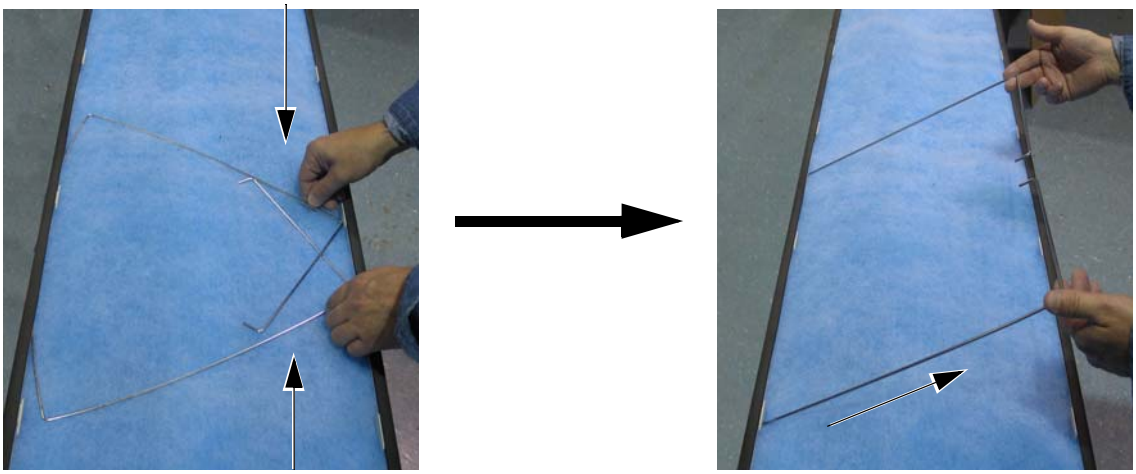
Note: When installing the filter media, the white side must face the outside of the cabinet and the colored side must face the inside of the cabinet.

Checking and Replacing the Air Filters

Check the inlet air filters at a minimal interval of every 3 months and replace as need depending on accumulated dust and the environment. Inlet filters should be changed at a minimum ever year as part of standard preventative maintenance. The inlet (door) filter may be accessed and replaced by the following procedure.

1. While holding the top of the filter frame, pull up on the bottom of the frame. The filter frame will slide up approximately 3/4 inch and can then safely removed by tilting forward and slightly lifting up.

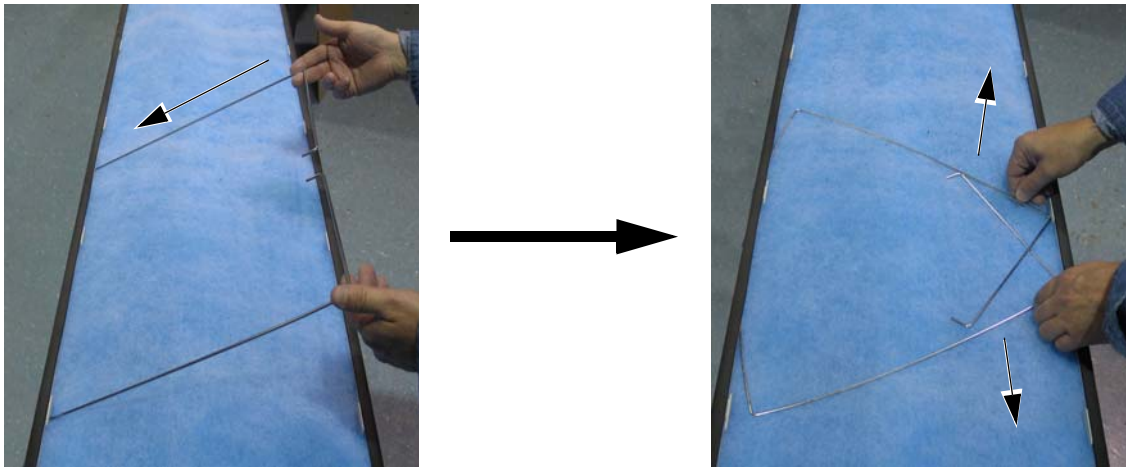
2. Lay the filter frame on a flat work surface. Remove the 3 retaining brackets by squeezing the tabbed corners in towards the middle of each bracket until the bracket clears the filter frame. Save these brackets for replacement. Remove and inspect the filter.

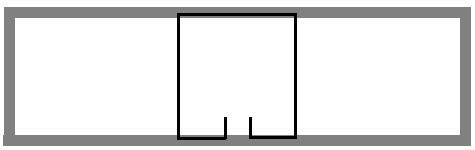


3. Install the replacement filter. Be sure the tuck the filter into the grove around the entire filter frame. This is very important for proper installation.

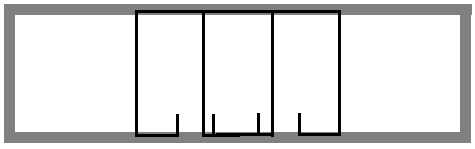
Note: When installing the filter media, the white side must face the outside of the cabinet and the colored side must face the inside of the cabinet.

4. Reinstall the 3 filter restraining brackets. These will prevent the filter from being pulled out of the filter frame. Install the center bracket first and then overlap the center bracket by ½ to the left for the 2nd bracket and ½ to the right for the 3rd bracket.

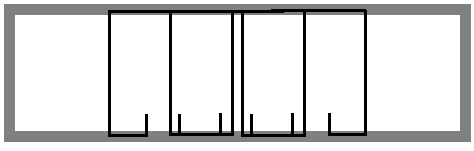




1 Filter retaining bracket

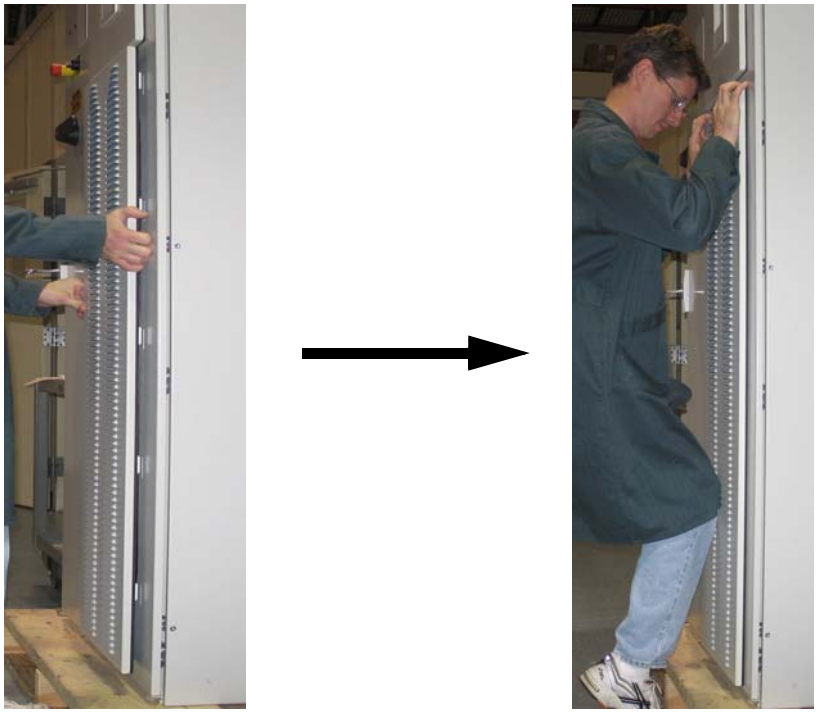


2 Filter retaining brackets



3 Filter retaining brackets

5. Install the filter frame back to the cabinet door. Carefully align the mounting hooks to the slots in the cabinet door. The hooks should be pointing down. Press in at the center of the filter frame with your knee and gently press down with your hands at the top of the frame. The filter frame will slide down approximately ¾ inch and should be sealed securely to the door around the entire filter frame.

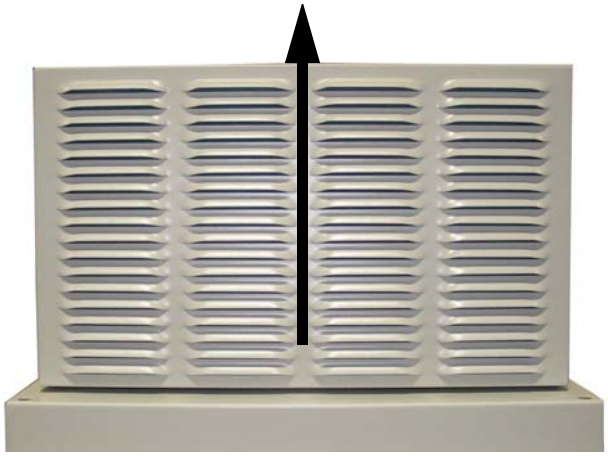


Installation complete.

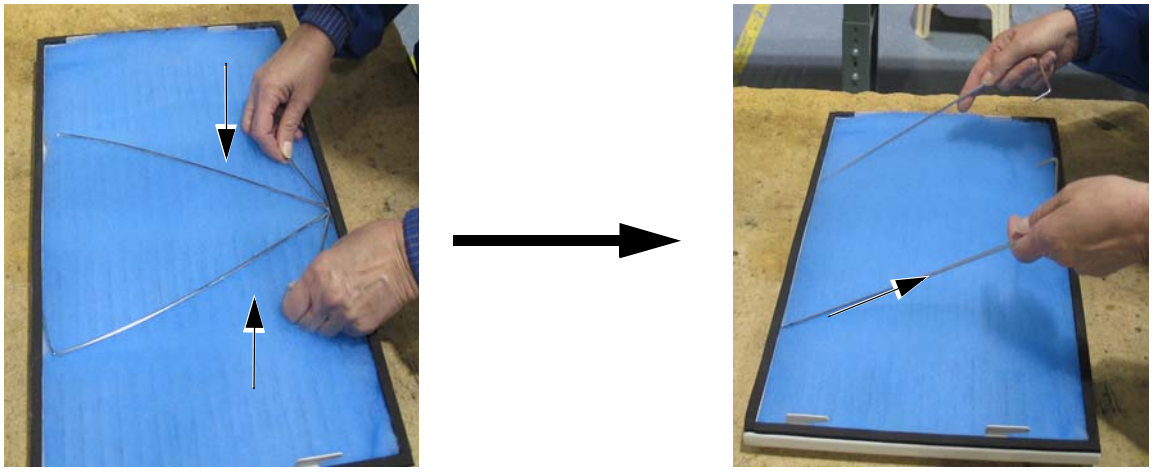
Exhaust Filter for UL Type 12

For UL Type 12 there is also a filter in the exhaust box at the top of the cabinet. Exhaust filters should be inspected every 6 months and replace as needed depending on accumulated dust and the environment. Exhaust filters should be changed at a minimum every year as part of standard preventative maintenance. The UL Type 12 exhaust filter may be accessed and replaced by the following procedure.

1. There are 2 filter frames attached to the filter / fan box on top of the UL Type 12 cabinet. To remove the filter frames, lift up on the filter frame until it slides approximately ¾ inch. Then remove the filter frame. Repeat this process for the other side.



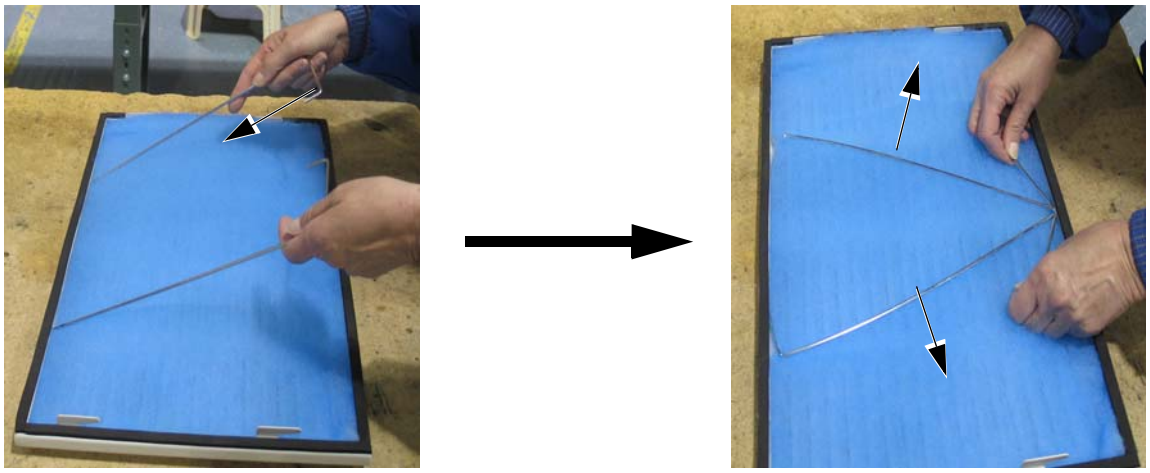
2. Lay the filter frames on a flat work surface. Remove the retaining bracket by squeezing the tabbed corners in towards the middle of the bracket until the bracket clears the filter frame. Save these brackets for replacement. Remove and inspect the filter. Repeat this process for the other side.



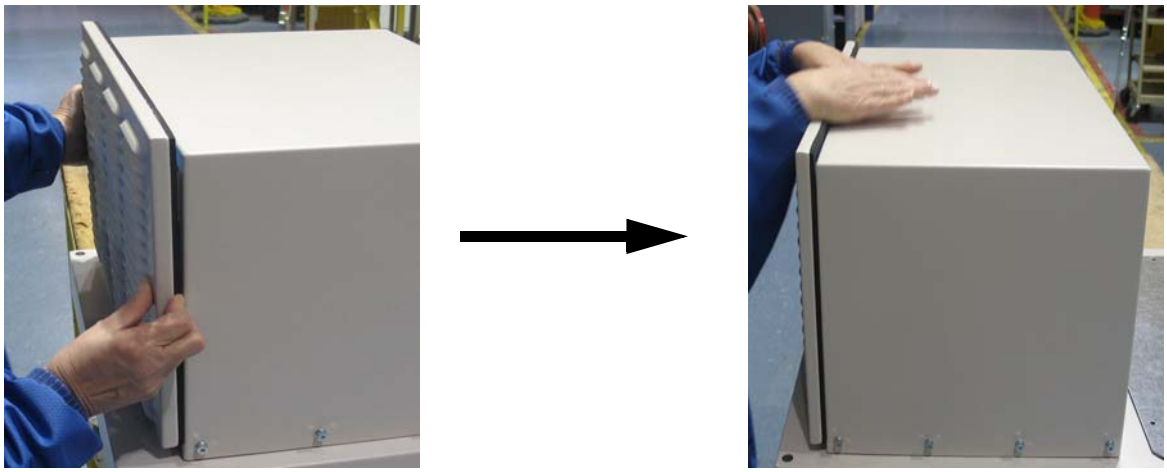
3. Install the replacement filter. Be sure the tuck the filter into the groove around the entire filter frame. This is very important for proper installation. Repeat this process for the other side.

   Note: When installing the filter media, the white side must face the outside of the cabinet and the colored side must face the inside of the cabinet.

4. Reinstall the filter restraining bracket. Insert the solid edge of the bracket first and then flex the open end of the bracket to allow it to clear the filter frame and seat in the channel. Extend the bracket to its relaxed shape “rectangle”. Repeat this process for the other side.



5. Install the filter frame back to the exhaust box on top of the cabinet. Carefully align the mounting hooks to the slots in the exhaust box. The hooks should be pointing down. Press down with your hands at the top of the filter frame. The filter frame will slide down approximately ¾ inch and should be sealed securely to the exhaust box around the entire filter frame. Repeat this process for the other side.



Installation complete.

Heatsink

Disconnect power before servicing the drive or internal cabinet components.

Check the cleanliness of the cabinet and the surroundings. When necessary, clean the interior of the cabinet with a soft brush and a vacuum cleaner.

The module heatsink fins pick up dust from the cooling air. The drive runs into overtemperature warnings and faults if the heatsink is not clean. When necessary, contact ABB for cleaning of the heatsink (frame sizes R7 and R8).

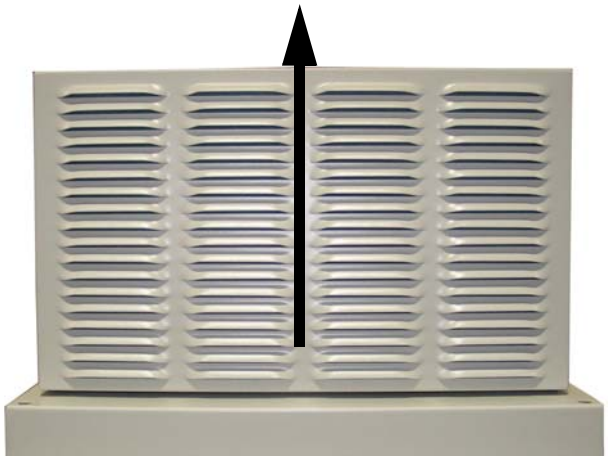
Fans

The lifespan of the cooling fan of the drive module is about 50,000 hours. The actual lifespan depends on the running time of the fan, ambient temperature and dust concentration. See the appropriate ACS800 firmware manual for the actual signal which indicates the running time of the cooling fan.

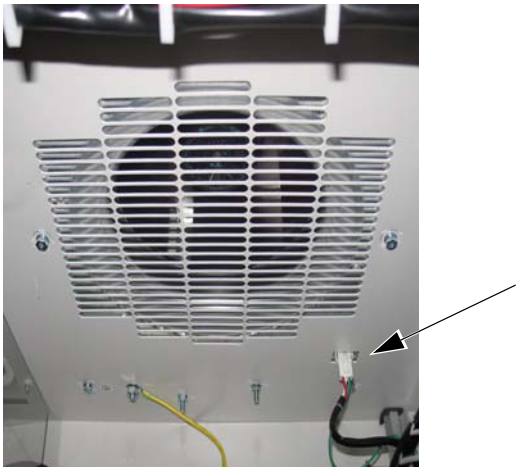
Replacement fans are available from ABB. Do not use other than ABB-specified spare parts.

Replacing the Cabinet Fan

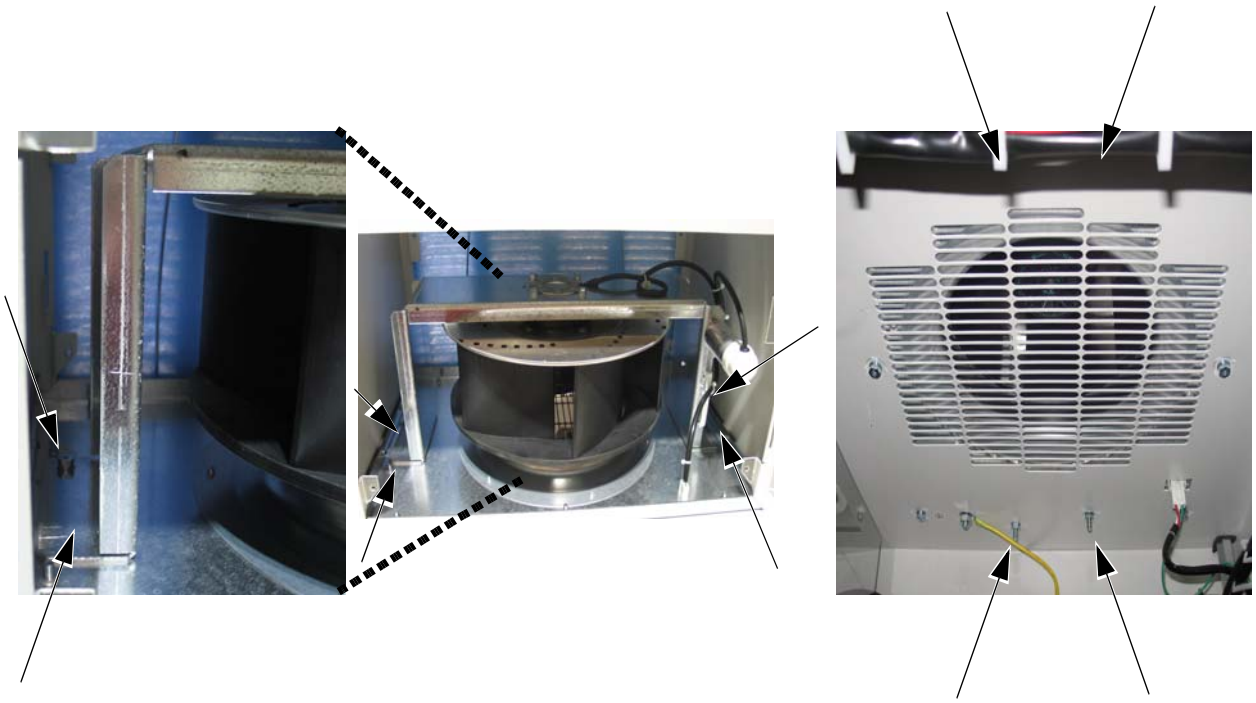
1. Remove the left and right filter frames of the exhaust fan box by lifting them upwards.



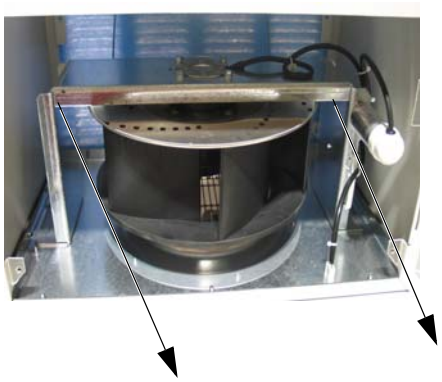
2. Disconnect the fan supply connector from the cabinet roof (top right Inside the cabinet).



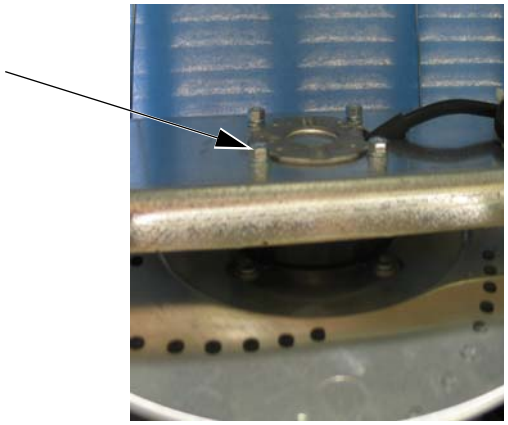
3. Loosen and remove the four fastening screws at the corners of the fan frame. The screw are through bolts with nuts on the inside of the cabinet. (Do not drop the hardware into the drive).



4. Remove the fan and fan frame as one unit.



5. Disconnect the fan wiring and capacitor from the fan frame. Then remove the four screws attaching the fan to the fan frame. Remove the old fan.



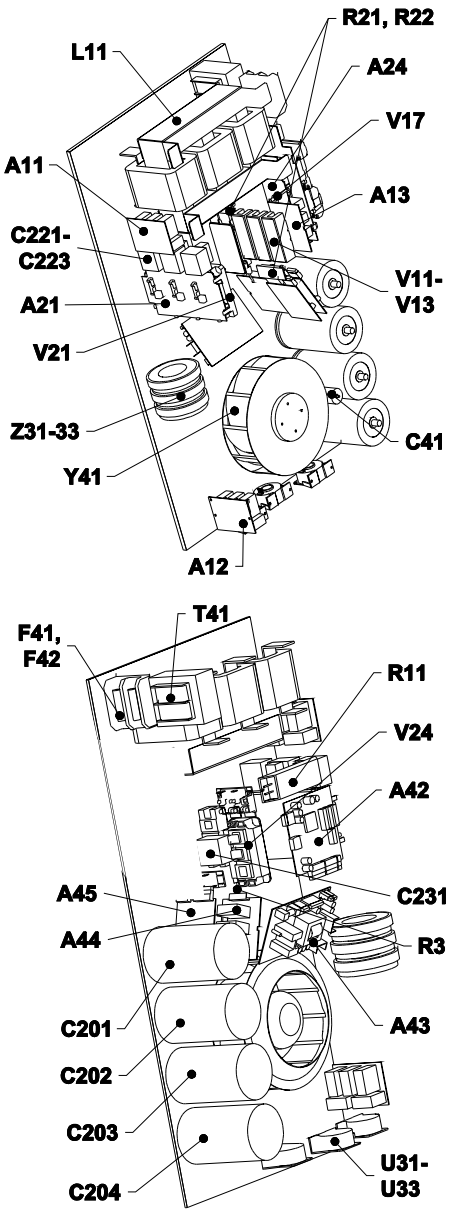
6. Install the new fan and capacitor with the replacement part for ABB in the reverse order of the above. Ensure the fan is centered on the velocity stack and rotates freely.

Layout of the Drive Module

The layout stickers of the drive module are shown below. The stickers show all possible components. Not all of them are present in each delivery. Components that need to be changed regularly are listed below:

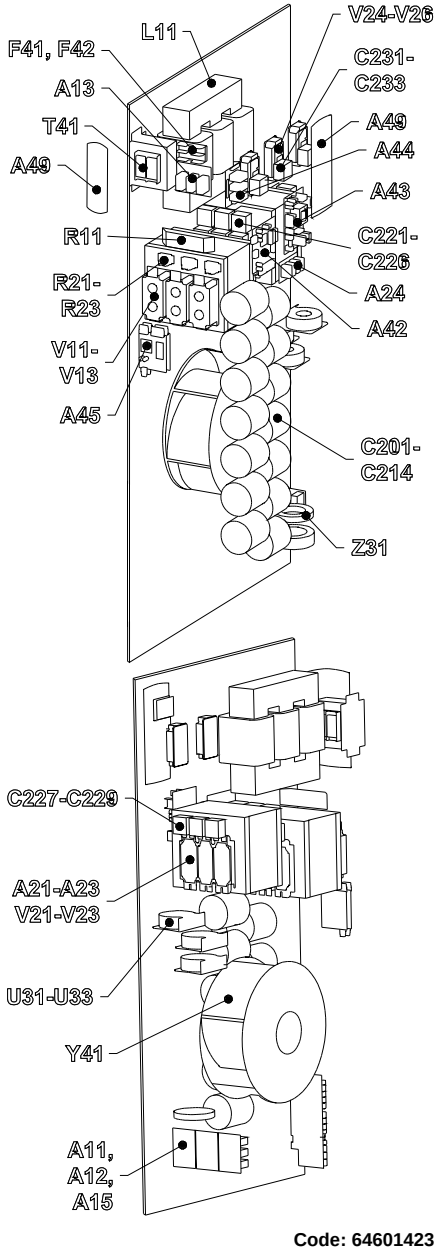
Designation	Component
Y41	Cooling fan
C_	Capacitors

R7



Code: 64572261

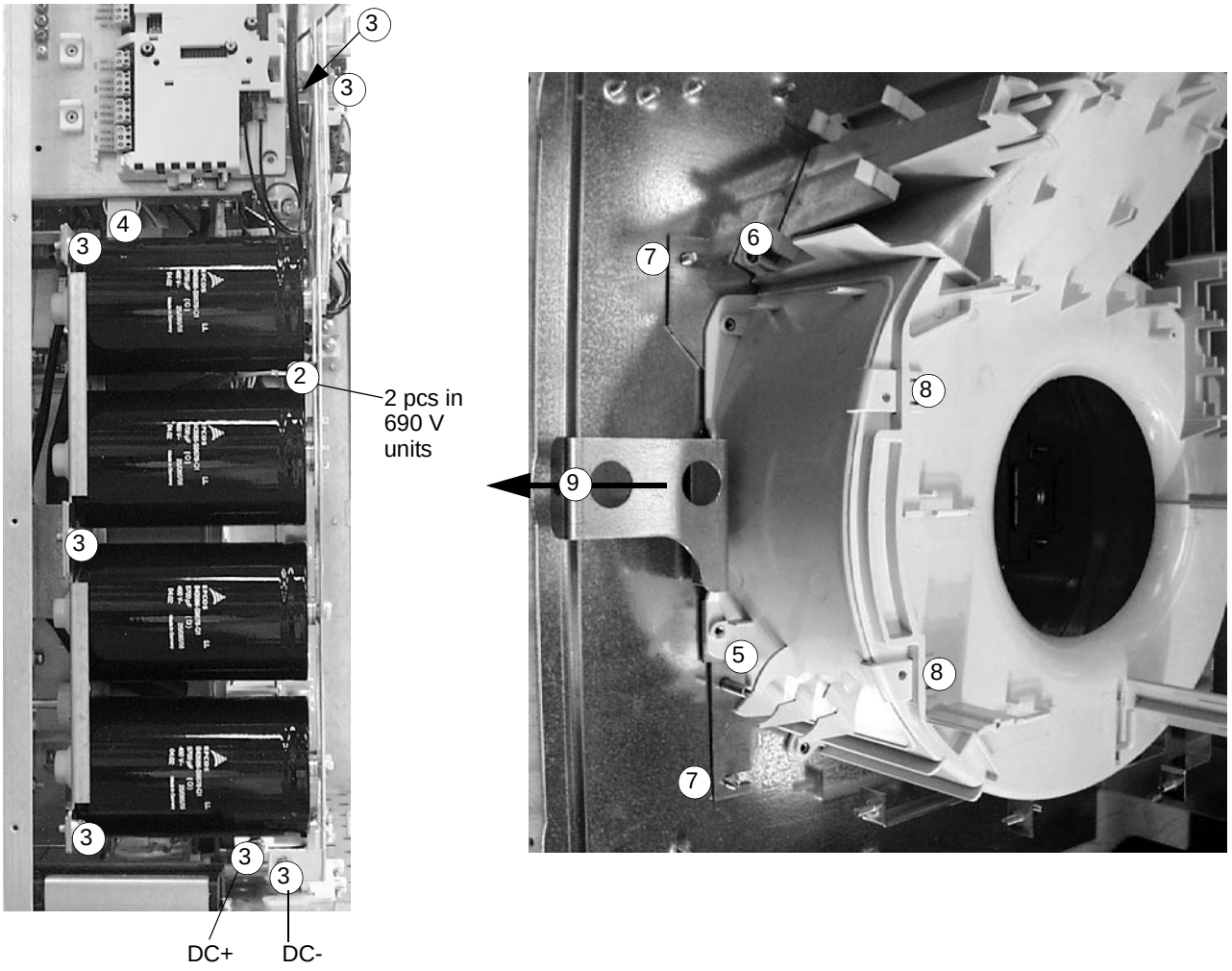
R8



Code: 64601423

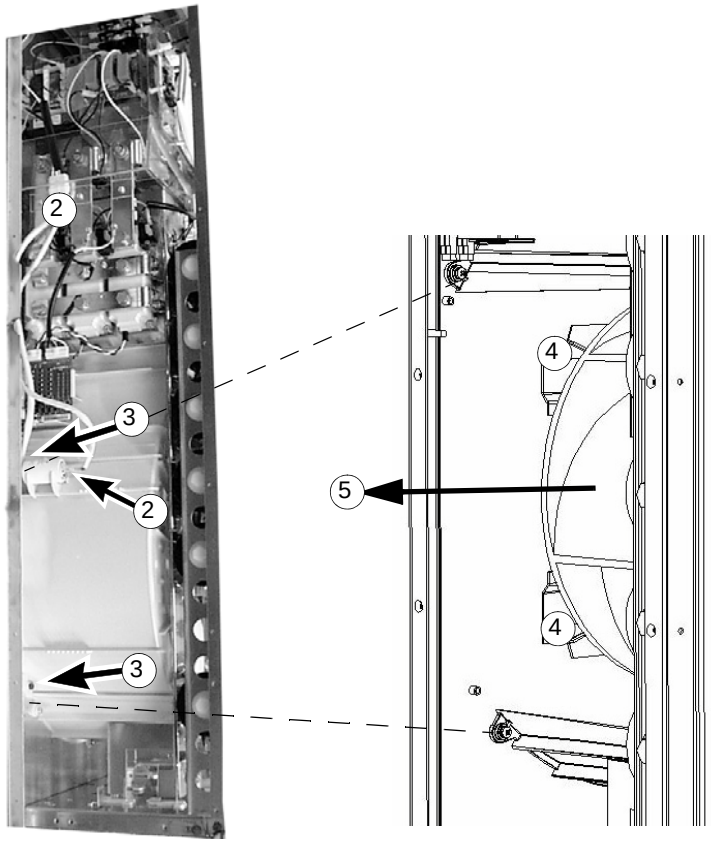
Replacing the Drive Module Fan (R7)

1. Remove the front cover.
2. Disconnect the discharging resistor wire(s).
3. Remove the DC capacitor pack by undoing the red fixing screws and pulling the pack out.
4. Disconnect the fan supply wires (detachable connector).
5. Disconnect the fan capacitor wires.
6. Disconnect the AINP board wires from connectors X1 and X2.
7. Undo the red fixing screws of the fan cassette.
8. Press the snap-on holders to release the side cover.
9. Lift the handle and pull the fan cassette out.
10. Install the new fan and fan capacitor in reverse order to the above.



Replacing the Drive Module Fan (R8)

1. Remove the front cover.
2. Disconnect the fan capacitor and power supply wires.
3. Undo the red fastening screws of the plastic side cover of the fan. Shift the cover to the right to free its right-hand edge and lift the cover off.
4. Undo the red fastening screws of the fan.
5. Lift the fan out of the cabinet.
6. Install the new fan and fan capacitor in reverse order to the above.



Capacitors

The drive intermediate circuit employs several electrolytic capacitors. Their lifespan is at least 90 000 hours depending on the operating time of the 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 damage to the unit and an input cable 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 (English)].

Replacing the Capacitor Pack (R7)

Replace the capacitor pack as described in section "Replacing the Drive Module Fan (R7)".

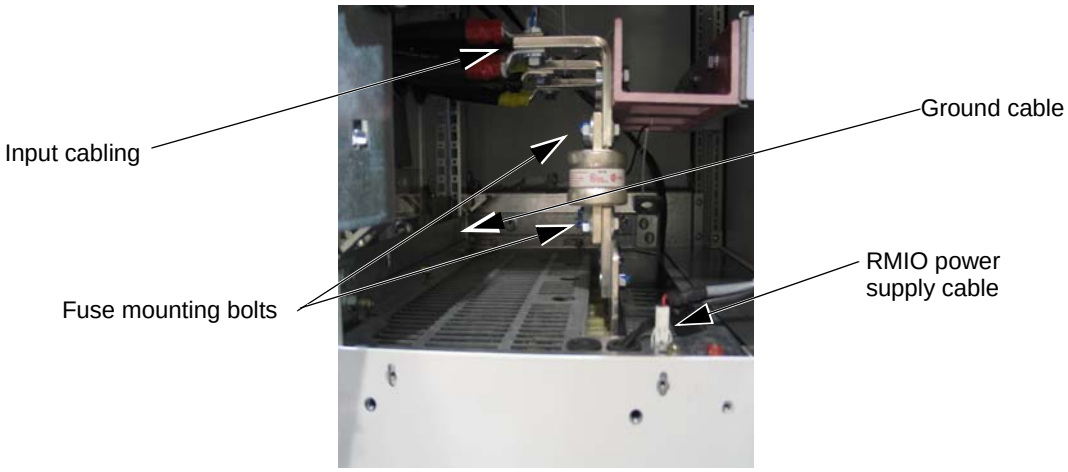
Replacing the Capacitor Pack

1. Remove the module from the cabinet as described in section "Replacing the Drive Module".
2. Remove the front cover. Remove the profiled side plate.
3. Disconnect the discharging resistor wires.
4. Undo the red fastening screws.
5. Lift the capacitor pack out.
6. Install the new capacitor pack in reverse order to the above.

R8 Frame pictured.

Replacing the Drive Module

1. Disconnect and lock out power according to local codes.
2. Open top right swing frame above module.



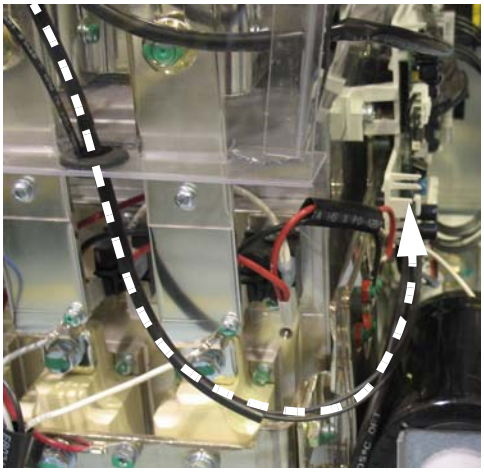
3. Disconnect and remove input fuses. Ensure no hardware is dropped in the module.
4. Disconnect ground cable at top - back - left of module.
5. Disconnect low voltage (RMIO) power supply cable (see step 2 picture).
6. On the left side of the cabinet, open the lower swing panel, if it is there. Disconnect all output power connection, including the motor output phases and, if included, the DC Bus or Brake Chopper connections.

7. Remove front cover of drive module.

8. Remove Fiber Optic cable from internal connection of drive. When removing the fiber optic cables, pull on the connector, not the cable. Carefully route through the grommets and be very careful not to kink or touch the ends of the fiber optic cables. Any contaminants on the fiber optic cables will reduce signal integrity and may result in failure.

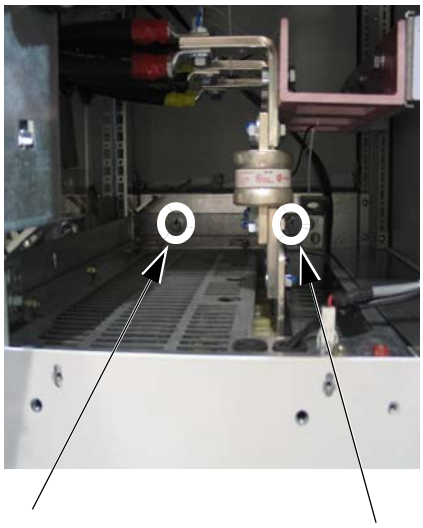
Recommendation

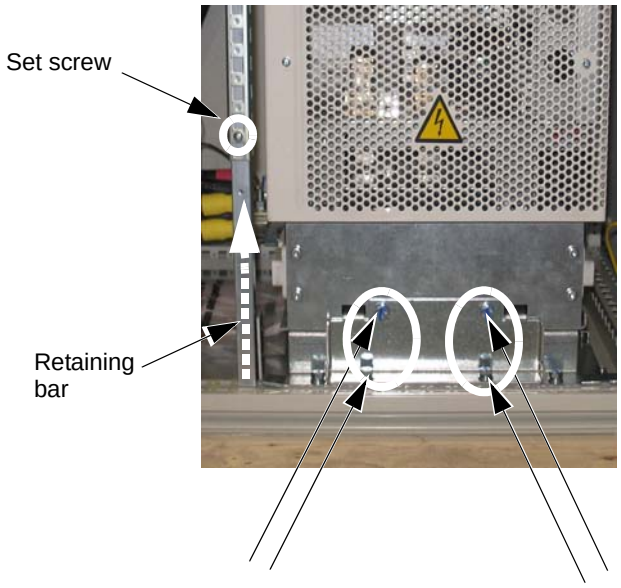
Never touch the ends of a fiber optic cable.



9. Review the above and ensure all the above listed steps are complete and all power and control connections are disconnected.

10. Remove the two mounting bolts at the back top of the module. Then remove the four mounting bolts at the front bottom of the module. If this is a frame R8 module, the cabinet framing set screw must be loosened so the retaining bar can be raised to clear the output bus bars.





11. Remove the lower mounting bracket from its position after the four screws are removed. The module is now free and may be removed from the cabinet. The module is on a roller rack frame in the cabinet.

Recommendation

Be very careful removing the module. Frame R7 modules weigh 200 lbs and frame R8 modules weigh 450 lbs. Both are top heavy.

The module may be slid onto a forklift and should be secured before moving.

12. With the removed module in a secure position, remove the bus bar fuse stubs from the top of the module and install them on the replacement module before installing the new module in the ACS800-PC cabinet.
13. Install the new module in the reverse order of removal. Secure the module to the cabinet before beginning power and control connections. Torque and check all connections before applying power.

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.
AINT board	V204 (green)	+5 V voltage of the board is OK.
	V309 (red)	Prevention of unexpected start is ON.
	V310 (green)	IGBT control signal transmission to the gate driver control boards is enabled.

Technical Data

What this Chapter Contains

This chapter contains the technical specifications of the drive, e.g. the ratings, sizes and technical requirements, markings, and warranty policy.

NEMA Ratings

The NEMA ratings for the ACS800-PC with 60 Hz supplies are given below. The symbols are described below the table.

ACS800-PC	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 380 V, 400 V, 415 V, 440 V, **460 V**, 480 V								
-0170-5	326	192	150	162	125	R7	318	10100
-0210-5	384	240	200	192	150	R7	318	12900
-0260-5	432	286	250	224	150	R7	318	15300
-0270-5	480	316	250	240	200	R8	718	15350
-0300-5	568	361	300	302	250	R8	718	18050
-0320-5	588	435	350	340	250	R8	718	23250
-0400-5	588	510	400	370	300	R8	718	26650
-0440-5	840	545	450	490	400	R8	718	25950
-0490-5	840	590	500	515 [1)]	450	R8	718	27600
-0550-5	1017	670	550	590 [1)]	500	R8	718	31100
-0610-5	1017	704	600	590 [1)]	500	R8	718	33000

PDM code: 00096931-G

[1)] 50% overload is allowed for one minute every five minutes if ambient temperature is less than 30 °C (86 °F). 40% overload is allowed if ambient temperature is 40 °C (104 °F).

Symbols

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
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

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

Input Cable Fuses

The drive is equipped for branch circuit protection per NEC with standard T/L fuses listed below. The fuses restrict drive damage and prevent damage to adjoining equipment 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 fuse type (T/L), supply network impedance and the cross-sectional area, material 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 multi-cable 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 and specifications.

Note 4: Circuit breakers must not be used without fuses.

ACS800-PC type	Input current	Fuse				
	A	A	V	Manufacturer	Type	UL class
Three-phase supply voltage 440 V, 460 V, or 480 V						
-0170-5	191	250	600	Bussmann	JJS-400	T
-0210-5	243	300	600	Bussmann	JJS-400	T
-0270-5	299	500	600	Bussmann	JJS-400	T
-0300-5	336	500	600	Bussmann	JJS-400	T
-0320-5	424	500	600	Bussmann	JJS-600	T
-0400-5	498	600	600	Bussmann	JJS-600	T
-0440-5	543	800	600	Bussmann	JJS-800	T
-0490-5	590	800	600	Bussmann	JJS-800	T
-0550-5	669	800	600	Bussmann	JJS-800	T
-0610-5	702	800	600	Bussmann	JJS-800	T

PDM code: 00096931-G

Power Connection Terminals

The following tables show maximum wire size and required tightening torque for incoming power, motor and grounding terminals

480 Volt, Terminals

480 Volt		Base Drive Frame Size	Power Wiring Data			
HP	Type Code		Circuit Breaker	Motor Terminals	Ground Lugs	(+D150) Brake Resistor Terminals BR+ BR-
150	ACS800-PC-0170-5	R7	2 x 250 MCM 274 in-lbs	350 MCM 350 in-lbs	5 Bus Bar Holes (13/32” Bolts)	500 MCM 500 in-lbs
200	ACS800-PC-0210-5	R7				
250	ACS800-PC-0270-5	R8		2 x 250 MCM 500 in-lbs		
300	ACS800-PC-0300-5	R8	2 x 500 MCM 274 in-lbs	2 x 500 MCM 500 in-lbs		
350	ACS800-PC-0320-5	R8				
400	ACS800-PC-0400-5	R8				
450	ACS800-PC-0440-5	R8	3 x 400 MCM 375 in-lbs			
500	ACS800-PC-0490-5	R8				
550	ACS800-PC-0550-5	R8		3 x 400 MCM 500 in-lbs		
600	ACS800-PC-0610-5	R8				

Dimensions and Weights

Refer to dimensional drawings on page 93 and 94.

UL/CSA Markings

The ACS800-PC UL and cUL listed.

The drive is suitable for use on a circuit capable of delivering not more than 100 kA rms symmetrical amperes at the drive nominal voltage (480V maximum).

The drive provides overload protection in accordance with the National Electrical Code (US). See *ACS800 Firmware Manual* for setting. Default setting is off; the setting 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.

ABB brake choppers, when applied with appropriately sized brake resistors, will allow the drive to dissipate regenerative energy (normally associated with quickly decelerating a motor). Proper application of the brake chopper is defined in chapter **"Resistor Braking"**. This can be applied to a single drive or multiple drives with DC bus connected to allow a sharing of regenerative energy.

Sizing

The current ratings are the same regardless of the supply voltage within one voltage range. To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current.

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

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

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

Derating

The load capacity (current and power) decreases if the installation site altitude exceeds 1000 metres (3281 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 $0.90 \cdot I_{2N}$, $0.90 \cdot I_{2hd}$ or $0.90 \cdot I_{cont.max}$.

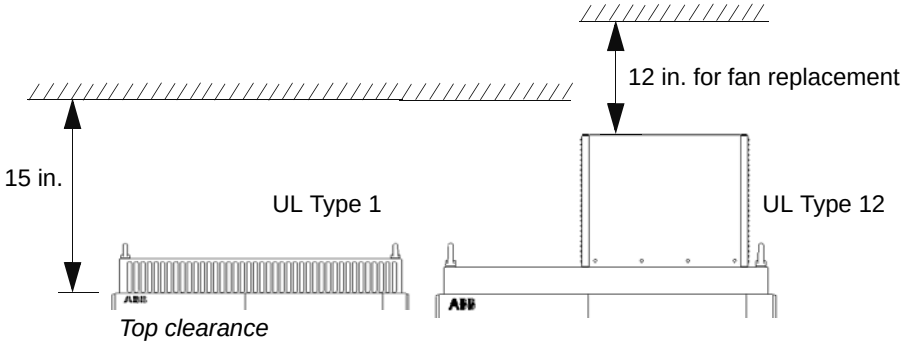
Altitude derating

At altitudes from 1000 to 4000 m (3281 to 13123 ft) above sea level, the derating is 1% for every 100 m (328 ft). For a more accurate derating, use the DriveSize PC tool. If the installation site is higher than 2000 m (6562 ft) above sea level, please contact your local ABB distributor or office for further information.

Free Space Around the Unit

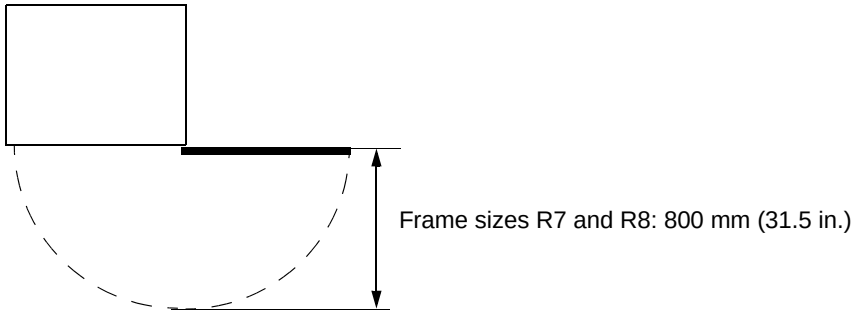
Frame size	Required free space around the unit for cooling		
	Front	Side	Above*
	in.	in.	in.
R6	6	-	15
R7	6	-	15
R8	6	-	15

* measured from the base plate of the cabinet top



Top clearance

Space requirement for the door opening:



Input Power Connection

Voltage (L_1)	440/460/480/500 VAC 3-phase ± 10% for 500 VAC units
Prospective short-circuit current	The drive is suitable for use in a circuit capable of delivering not more than 100,000 symmetrical amperes (rms) at 480 V.
Frequency	48 to 63 Hz, maximum rate of change 17%/s
Imbalance	Max. ± 3% of nominal phase to phase input voltage
Fundamental power factor (cos phi$_1$)	0.98 (at nominal load)

Motor Connection

Voltage (U_2)	0 to L_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 **"NEMA Ratings"**.
Power limit	1.5 · P_{hd}, 1.1 · P_N or $P_{cont.max}$ (whichever value is greatest)
Field weakening point	8 to 300 Hz
Switching frequency	3 kHz (average). In 690 V units 2 kHz (average).
Maximum recommended motor cable length	

Type code (EMC equipment)	Max. motor cable length	
	DTC control	Scalar control
-	300 m (984 ft)	300 m (984 ft)
+E202 *, +E210 *	100 m (328 ft)	100 m (328 ft)

* Motor cable longer than 100 m (328 ft) is allowed but then the EMC Directive requirements may not be fulfilled.

Efficiency

Approximately 98% at nominal power level

Cooling

Method Internal fan, flow direction from front to top

Filter material

	Inlet (door)	Outlet (roof)
UL Type 12	3AUA0000006723 (qty 1)	3AUA0000006722 (qty 2)

Note: When installing the filter media, the white side must face the outside of the cabinet and the colored side must face the inside of the cabinet

Free space around the unit See **"Free Space Around the Unit"**.

Cooling air flow See **"NEMA Ratings"**.

Degrees of Protection

UL type 1, UL type 1 Filtered, UL type 12

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). See section **"Derating"**.	-40 to +70 °C (-40 to +158 °F)	-40 to +70 °C (-40 to +158 °F)
Relative humidity	5 to 95%	Max. 95%	Max. 95%
	No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.		
Contamination levels (IEC 60721-3-3, IEC 60721-3-2, IEC 60721-3-1)	No conductive dust allowed.		
	Boards without coating: Chemical gases: Class 3C1 Solid particles: Class 3S2 **Boards with coating:** Chemical gases: Class 3C2 Solid particles: Class 3S2	**Boards without coating:** Chemical gases: Class 1C2 Solid particles: Class 1S3 **Boards with coating:** Chemical gases: Class 1C2 Solid particles: Class 1S3	**Boards without coating:** Chemical gases: Class 2C2 Solid particles: Class 2S2 **Boards with coating:** Chemical gases: Class 2C2 Solid particles: Class 2S2
Atmospheric pressure	70 to 106 kPa 0.7 to 1.05 atmospheres	70 to 106 kPa 0.7 to 1.05 atmospheres	60 to 106 kPa 0.6 to 1.05 atmospheres
Vibration (IEC 60068-2)	Max. 1 mm (0.04 in.) (5 to 13.2 Hz), max. 7 m/s^2 (23 ft/s^2) (13.2 to 100 Hz) sinusoidal	Max. 1 mm (0.04 in.) (5 to 13.2 Hz), max. 7 m/s^2 (23 ft/s^2) (13.2 to 100 Hz) sinusoidal	Max. 3.5 mm (0.14 in.) (2 to 9 Hz), max. 15 m/s^2 (49 ft/s^2) (9 to 200 Hz) sinusoidal
Shock (IEC 60068-2-29)	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	100 mm (4 in.) for weight over 100 kg (220 lb)	100 mm (4 in.) for weight over 100 kg (220 lb)

Materials

Cabinet	Hot-dip zinc coated 1.5 mm thick steel sheet (thickness of coating approximately 20 micrometers). Polyester thermosetting powder coating (thickness approximately 80 micrometers) on visible surfaces. Color RAL 7035 light beige semigloss.
Busbars	Tin-plated copper
Package	Wood. Plastic covering of the package: PE-LD, 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 will be classified as hazardous waste. They must be removed and handled according to local regulations.

Applicable Standards

The drive complies with the standards below.

• UL 508C	UL Standard for Safety, Power Conversion Equipment, second edition
• UL 508A	UL Standard for Industrial Control Panels, first 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 inverter module and indicates that 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). The ACS800-PC drive with circuit breaker package is intended for use in North America and has been qualified to only the appropriate North American standards.

Contact your local ABB distributor for information on functionally equivalent ABB products that have been qualified to the IEC standards and EN requirements

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.

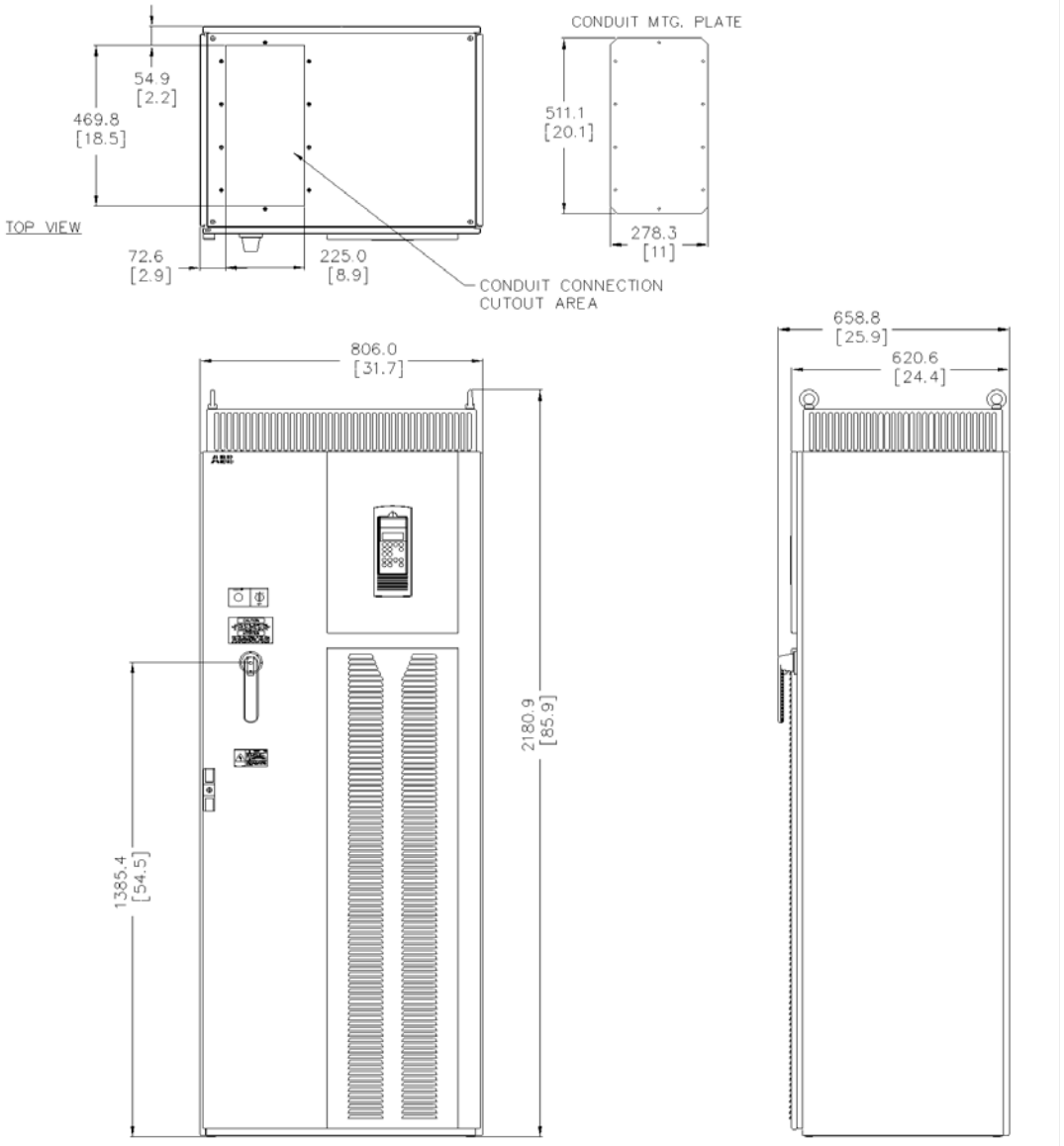
In no event shall the manufacturer, its suppliers or subcontractors be liable for special, indirect, incidental or consequential damages, losses or penalties.

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 not

Dimensional Drawings

UL Type 1 Dimensional Drawing

-0170-5 through -0440-5 UL Type 1



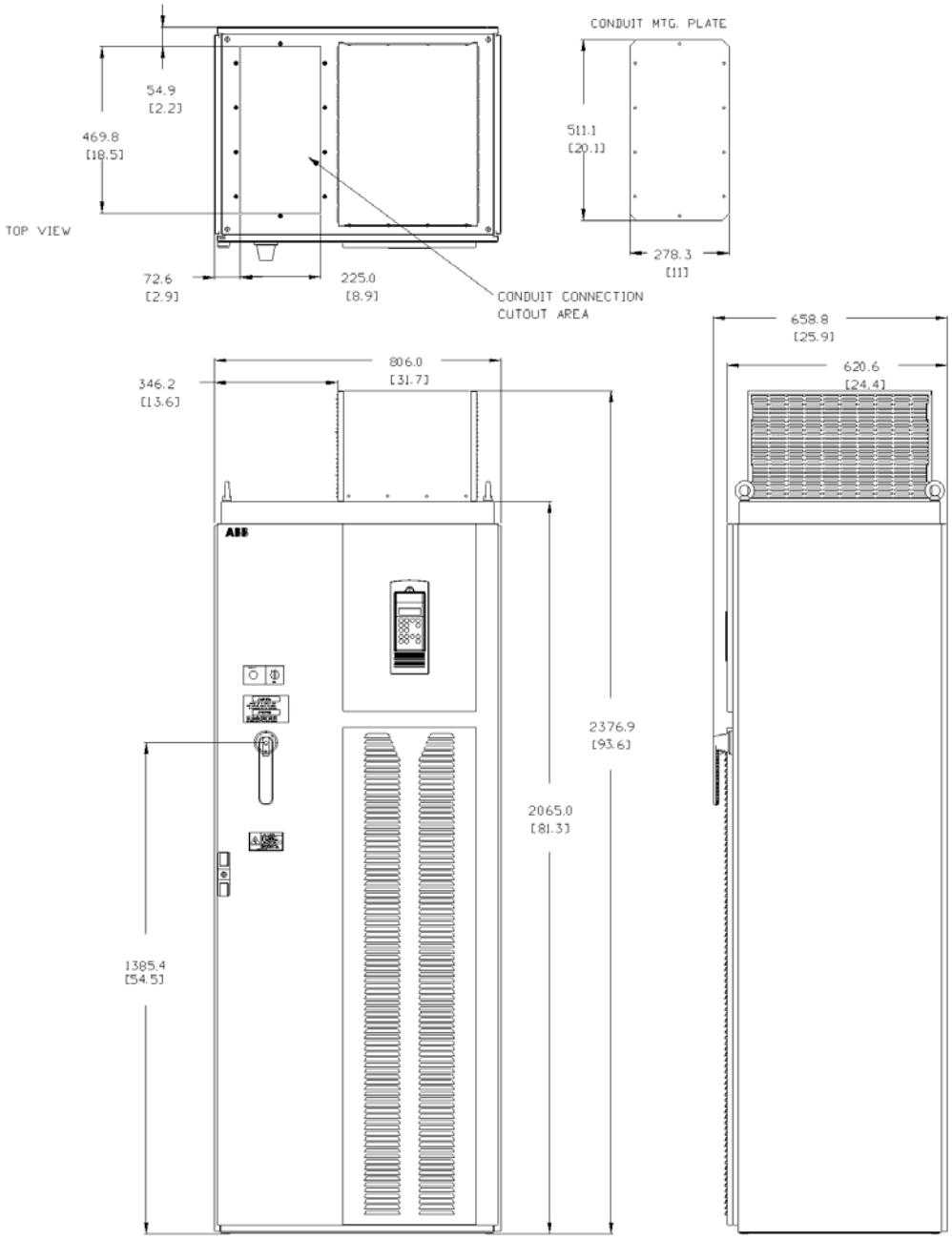
Frame	Height	Width	Depth	Weight
R7	85.9 in	31.7 in	25.9 in	695 lb
R8	85.9 in	31.7 in	25.9 in	945 lb

Example dimensional drawings with dimensions in millimeters and [inches].

UL Type 12 Dimensional Drawing

-0170-5 through -0610-5 UL Type 12

Note: -0490-5 through -0610-5 are only available in UL Type 12 enclosure



Example dimensional drawings with dimensions in millimeters and [inches].

Frame	Height	Width	Depth	Weight
R7	93.6 in	31.7 in	25.9 in	740 lb
R8	93.6 in	31.7 in	25.9 in	990 lb

Resistor Braking

What this Chapter Contains

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

To Which Products this Chapter Applies

This chapter applies to the ACS800-01/U1 (frame sizes R2 to R6), ACS800-02/U2 (frame sizes R7 and R8), ACS800-04/U4 (frame sizes R7 and R8), ACS800-07/U7 (frame sizes R6, R7 and R8), and ACS800-PC.

Availability of Brake Choppers and Resistors for the ACS800

Frame R2 and R3 drives have a built-in brake chopper as standard equipment. For frames R4 and up, brake choppers are optionally available as built-in units, indicated in the type code by +D150.

Resistors are available as add-on kits.

How to Select the Correct Drive/Chopper/Resistor Combination

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

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

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

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

- The resistance does not restrict the braking capacity needed, i.e.,

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

where

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

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

Optional Brake Chopper and Resistor(s) for the ACS800-U2, ACS800-U4, ACS800-PC and ACS800-07/U7

The nominal ratings for dimensioning the brake resistors for the ACS800-U2, ACS800U4, ACS800-PC and ACS800-07/U7 are given below at an ambient temperature of 40 °C (104 °F).

ACS800 type		Duty Cycle=3s on, 27s off			Duty Cycle=10s on, 50s off			Duty Cycle=30s on, 180s off		
kVA	**Frame**	**Part No**	**Rohm**	**Watts**	**Part No**	**Rohm**	**Watts**	**Part No**	**Rohm**	**Watts**
0170-5	R7	ABB-48431-271	2.9	14.2k	ABB-48431-272	2.9	16.3k	ABB-48431-273	2.9	23.5k
0210-5	R7	ABB-48431-271	2.9	14.2k	ABB-48431-273	2.9	23.5k	ABB-48431-274	2.9	29.0k
0260-5	R7	ABB-48431-271	2.9	14.2k	ABB-48431-273	2.9	23.5k	ABB-48431-274	2.9	29.0k
0320-5	R8	ABB-48431-331	2.2	17.8k	ABB-48431-332	2.2	26.6k	ABB-48431-334	2.2	40.1k
0400-5	R8	ABB-48431-393	1.7	24.5k	ABB-48431-395	1.7	46.3k	ABB-48431-396	1.7	58.1k
0440-5	R8	ABB-48431-480	1.2	32.7k	ABB-48431-482	1.2	60.8k	ABB-48431-484	1.2	81.1k
0490-5	R8	ABB-48431-514	1.0	34.2k	ABB-48431-517	1.0	67.6k	ABB-48431-518	1.0	90.0k
0550-5	R8	ABB-48431-514	1.0	34.2k	ABB-48431-517	1.0	67.6k	ABB-48431-518	1.0	90.0k
0610-5	R8	ABB-48431-515	1.0	40.0k	ABB-48431-518	1.0	90.0k	ABB-48431-518	1.0	90.0k

Resistor Installation and Wiring

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

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

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

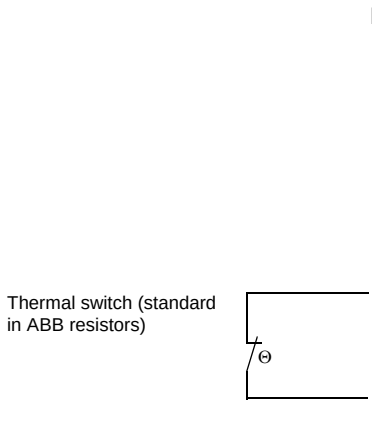
Protection of Frame Sizes R7 and R8 (ACS800-U2, ACS800-U4, ACS800-PC, ACS800-U7/07)

A main contactor is not required for protecting against resistor overheating when the resistor is dimensioned according to the instructions and the internal brake chopper is in use. The drive will disable power flow through the input bridge if the chopper remains conductive in a fault situation.

Note: If an external brake chopper (outside the drive module) is used, a main contactor is always required.

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

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



RMIO:X22 or X2: X22

1	DI1
2	DI2
3	DI3
4	DI4
5	DI5
6	DI6
7	+24VD
8	+24VD
9	DGND1
10	DGND2
11	DIIL

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

Brake Circuit Commissioning

For Standard Application Program:

- Enable the brake chopper function (parameter 27.01).
- Switch off the overvoltage control of the drive (parameter 20.05).
- Check the resistance value setting (parameter 27.03).
- Frame sizes R7 and R8: Check the setting of parameter 21.09. If stop by coasting is required, select OFF2 STOP.

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

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

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

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