

# ACSM1

## Hardware Manual ACSM1-204 Regen Supply Modules (5.3 to 61 kW)





# ACSM1-204 Regen Supply Modules (5.3 to 61 kW)

## **Hardware Manual**

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# Safety instructions

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## What this chapter contains

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

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**Note:** Also read the safety instructions for the drive.

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## Use of warnings and notes

There are four types of safety instructions used in this manual:



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



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



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



**Hot surface warning** warns of component surfaces that may become hot enough to cause burns if touched.

## Installation and maintenance work

These warnings are intended for all who work on the regen supply module.



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

**Only qualified electricians are allowed to install and maintain the regen supply module.**

- Never work on the regen supply module when input power is applied. After disconnecting the input power, always wait for 5 minutes to let the intermediate circuit capacitors and WFU-xx regen filter module capacitors discharge before you start working on the regen supply module.

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

1. There is no voltage between terminals L1, L2 and L3 and the ground.
  2. There is no voltage between terminals U2, V2 and W2 and the ground.
  3. There is no voltage between terminals UDC+ and UDC– and the ground.
  4. There is no voltage between terminals R+ and R– and the ground.
- Do not work on the control cables when power is applied to the regen supply module or to the external control circuits. Externally supplied control circuits may carry dangerous voltages even when the input power is switched off.
  - Do not make any insulation or voltage withstand tests on the regen supply module.
  - If a regen supply module or WFU-xx regen filter module whose varistors are not disconnected is installed on an IT power system (an ungrounded power system or a high resistance grounded [over 30 ohms] power system), the regen supply module will be connected to earth potential through the varistors. This may cause danger or damage the regen supply module.
  - If a regen supply module or WFU-xx regen filter module whose built-in varistors are not disconnected is installed on an corner-grounded TN system, the regen supply module will be damaged.

### Notes:

- Depending on the external wiring, dangerous voltages (115 V, 220 V or 230 V) may be present on the terminals of the relay output(s) of the regen supply module.



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

- The regen supply module is not field repairable. Never attempt to repair a malfunctioning regen supply module; contact your local ABB representative or Authorized Service Center for replacement.

- Make sure that dust from drilling does not enter the regen supply module during the installation. Electrically conductive dust inside the regen supply module may cause damage or lead to malfunction.
- Ensure sufficient cooling.



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**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.

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## Start-up and operation

These warnings are intended for all who plan the operation of the regen supply module, or start up or operate the regen supply module.



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

- Pressing the STOP button in the control panel or sending an external stop signal does not disconnect the power feed from the regen supply module to the intermediate circuit because the diodes in the supply module conduct electricity even when no control signals are given.
- Do not control the regen supply module with an AC contactor or disconnecting device (disconnecting means); instead, use the control panel or external commands via the I/O board of the regen supply module or a fieldbus adapter. The maximum allowed number of charging cycles of the DC capacitors (i.e. power-ups by applying power) is one per two minutes. The maximum total number of chargings is 100000 for frame sizes A and B, 50000 for frame sizes C and D.

**Notes:**

- When the control location is not set to local, the stop key on the control panel will not stop the regen supply module.



**WARNING!** The surfaces of regen supply module system components become hot when the system is in use.

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# About this manual

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## What this chapter contains

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

## Compatibility

The manual is compatible with ACSM1-204 (frame sizes A to D) and the corresponding WFU-xx regen filter modules.

## Intended audience

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

This manual is written for readers worldwide. Both SI and imperial units are shown wherever appropriate.

## 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 A, B, C or D. The frame size is marked on the regen supply module designation label.

## Categorization according to the + code

The instructions, technical data and dimensional drawings which concern only certain optional selections are marked with + codes, e.g. +L500. The options included in the regen supply module can be identified from the + codes visible on the type designation label of the regen supply module. The + code selections are listed in chapter [The ACSM1-204](#) 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 regen supply module.

*About this manual* lists the steps in checking the delivery and installing and commissioning the regen supply module and refers to chapters/sections in this manual and other manuals for particular tasks.

*The ACSM1-204* describes the regen supply module.

*Planning the cabinet assembly* guides in planning the installation of the regen supply module into a user-defined cabinet.

*Mechanical installation* instructs how to place and mount the regen supply module.

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

*Electrical installation* instructs on how to wire the regen supply module.

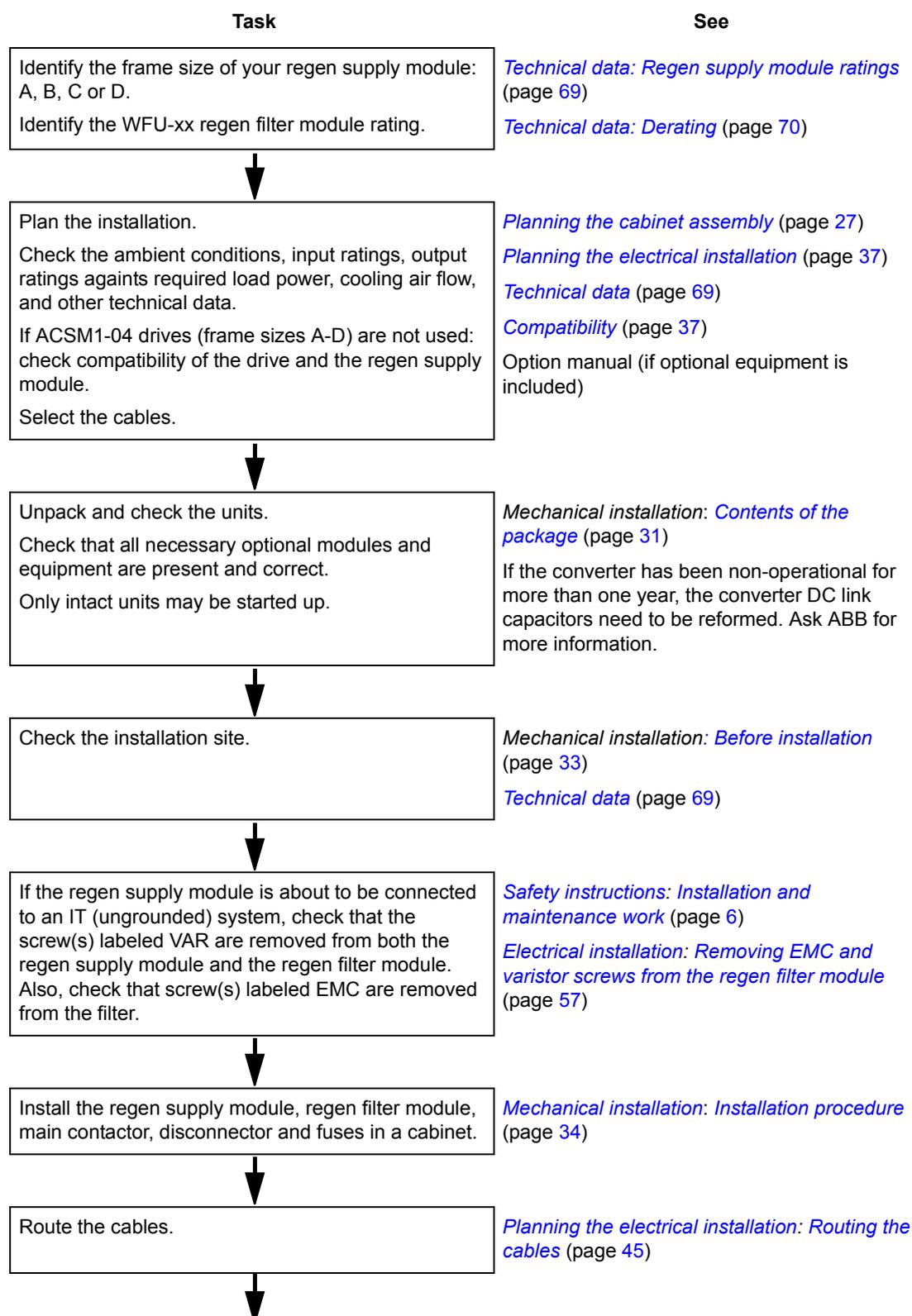
*Installation checklist* contains a list for checking the mechanical and electrical installation of the regen supply module.

*Maintenance* lists periodic maintenance actions along with work instructions.

*Technical data* contains the technical specifications of the regen supply module, e.g. the ratings, sizes and technical requirements, provisions for fulfilling the requirements for CE and other markings.

*Dimension drawings* contains the dimensional drawings of the regen supply module and connected equipment.

## Installation and commissioning flowchart



Task	See
Check the insulation of the supply cable, the DC output cable, and the resistor cable (if present).	<a href="#">Electrical installation: Checking the insulation of the assembly</a> (page 47)
Connect the power cables. Connect the control and the auxiliary control cables.	<a href="#">Electrical installation: Power and control cable connection</a> : (page 48) and <a href="#">Connecting the control cables</a> : (page 54) For optional equipment: <a href="#">Resistor braking</a> (page 83) Manuals for any optional equipment
Check the installation.	<a href="#">Installation checklist</a> (page 59)
Commission the regen supply module.	Appropriate <i>Firmware Manual</i>
Commission the braking chopper if required.	<a href="#">Resistor braking</a> (page 83)
Operating the regen supply module: start, stop, etc.	Appropriate <i>Firmware Manual</i>

## 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.

## Terms and abbreviations

Term/Abbreviation	Explanation
ACSM1-204	Regen supply module.
EMC	Electromagnetic Compatibility.
FIO-01	Optional digital I/O extension for the ACSM1.
FIO-11	Optional analogue I/O extension for the ACSM1.
FCAN-0x	Optional CANopen adapter for the ACSM1.
FDNA-0x	Optional DeviceNet adapter for the ACSM1.
FENA-0x	Optional Ethernet/IP adapter for the ACSM1.
FPBA-0x	Optional PROFIBUS DP adapter for the ACSM1.
Frame (size)	Size of the regen supply module. This manual deals with ACSM1-204 frame sizes A, B, C or D. The frame size is marked on the regen supply module designation label.
I/O	Input/Output.
JCU	The control unit of the regen supply module. The JCU is installed on top of the power unit. The external I/O control signals are connected to the JCU, or optional I/O extensions mounted on it.
JMU	The memory unit attached to the control unit of the regen supply module.
WFU-xx	Regen filter module used with ACSM1-204.



# The ACSM1-204

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## What this chapter contains

This chapter describes the construction and operating principle of the regen supply module in short.

## The ACSM1-204

The ACSM1-204 regen supply module converts three-phase AC voltage and power to DC voltage and power to supply drive modules via DC link.

The ACSM1-204 regen supply module can be used in single drive and multidrive configurations. The regen filter module on the supply side keeps the line side harmonics at a very low level. The regen filter module also includes EMC filtering.

The ACSM1-204 regen supply module can feed power via common DC bus to drive modules, or braking power can be fed back to supply network. By default, the supply module controls the DC voltage 2% above the peak value of the line-to-line voltage. The DC voltage reference can be set also higher by a parameter. Two line currents and the DC voltage are measured and used for the control.

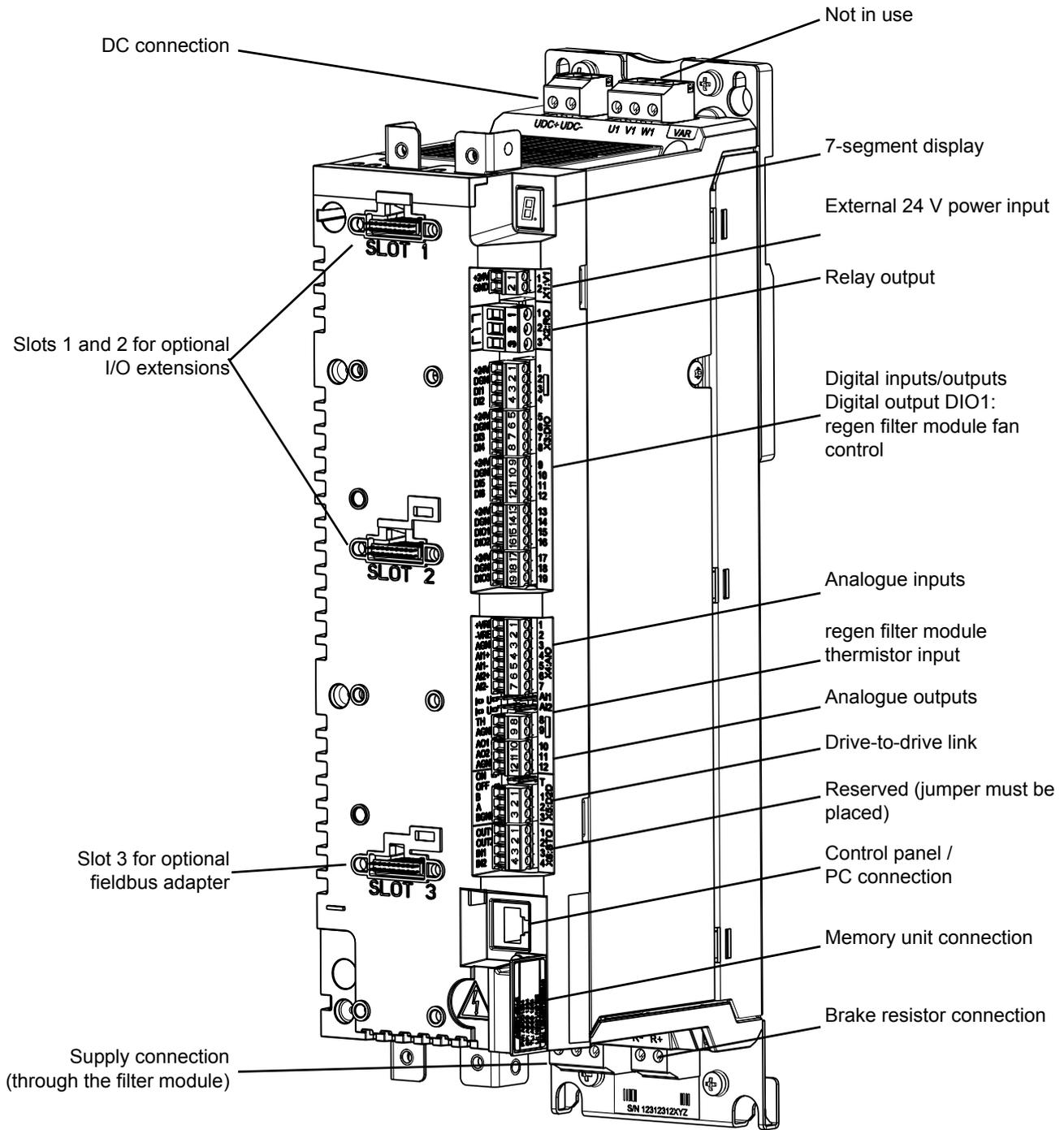
Always use the regen filter module (WFU-xx) with the regen supply module (ACSM1-204). Ensure that the filter is of appropriate size for the regen supply module. See [Derating](#) on page 70 for more information.

The ACSM1-204 either has an air-cooled heatsink, or is to be installed on a cold plate cooling element.

The ACSM1-204 is available in several frame sizes depending on output power. All frame sizes use the same control unit (type JCU).

The installation must be equipped with a main contactor. For more information on main contactors, see [Main contactor](#) on page 39.

**Layout (Frame A shown)**



## WFU-xx regen filter module

The WFU-xx regen filter module is an essential part of the ACSM1-204 regen supply module and it does not work without the filter. The regen supply module uses the filter to actively shape the AC line current to resemble sinusoidal waveform and to filter most of the current ripple at the switching frequency and higher frequencies. The regen supply module used with the filter produces a low-harmonic input current.

By default, the filter is protected against overheating (caused by a faulty fan, for example) with a thermistor. If the filter temperature becomes too high, the regen supply module is automatically stopped. The thermistor must always be connected to the ACSM1-204 thermistor input X4: 8, 9.



**WARNING!** If the overheating protection is removed with parameter settings, the filter may be damaged permanently or cause a fire.

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**Note:** The 24 V DC power supply needed for the cooling fan is not included in the delivery. For selecting a supply, see [Supply voltage requirements for the WFU-xx regen filter module fan](#) on page 72.

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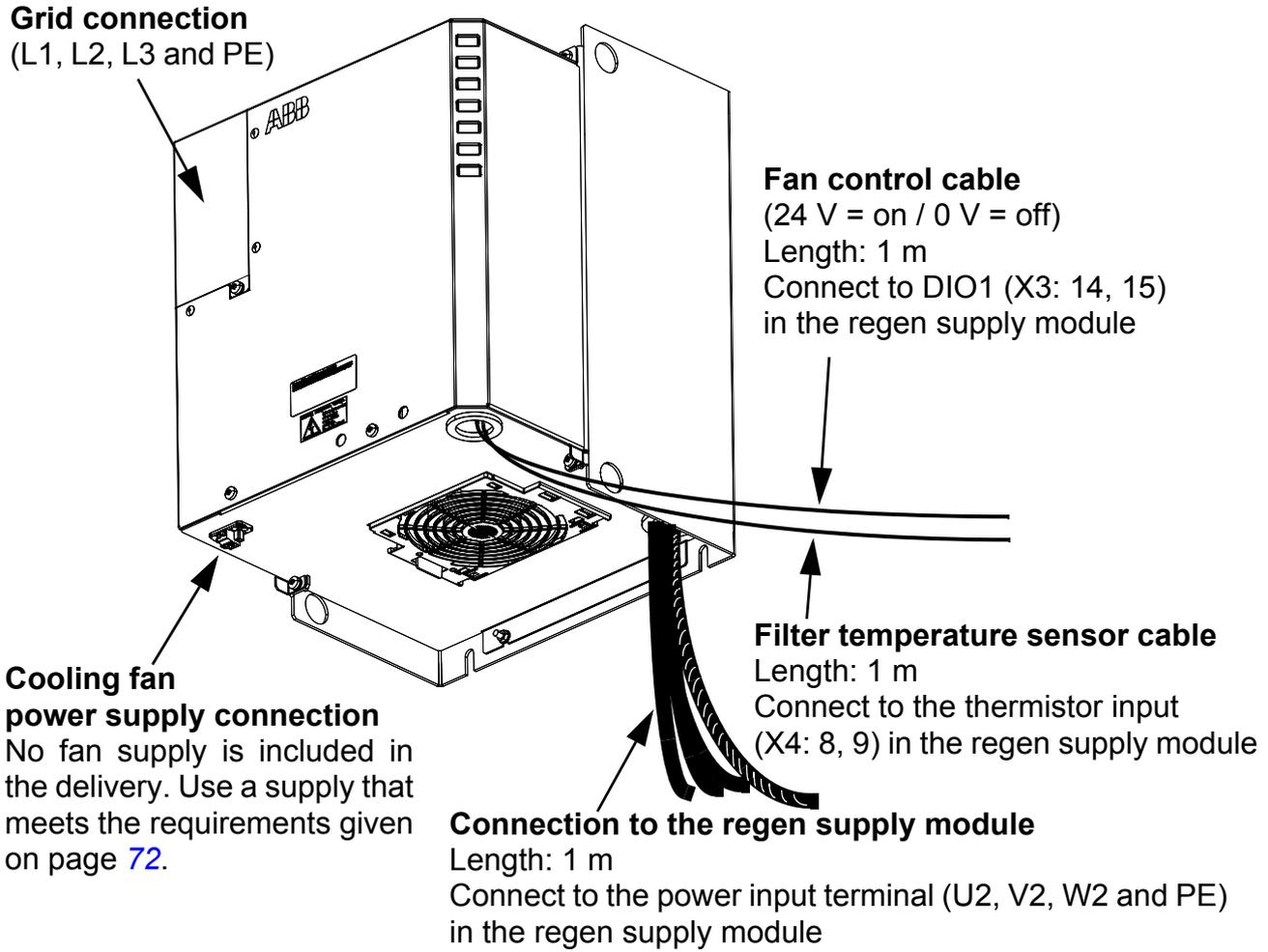
**WARNING!** Use the WFU-xx regen filter module only with an ACSM1-204 regen supply module. Use the filter only with a regen supply module of an appropriate frame size.

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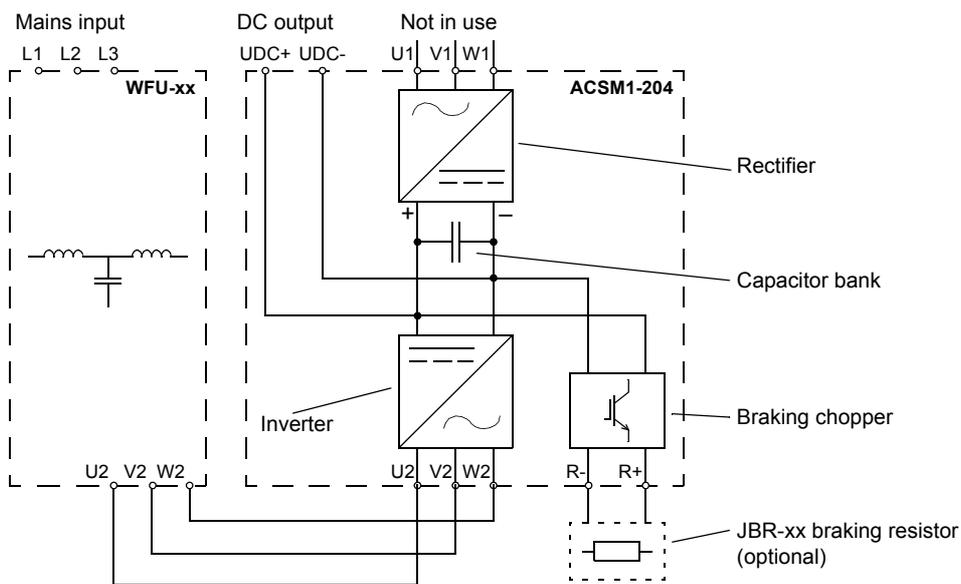
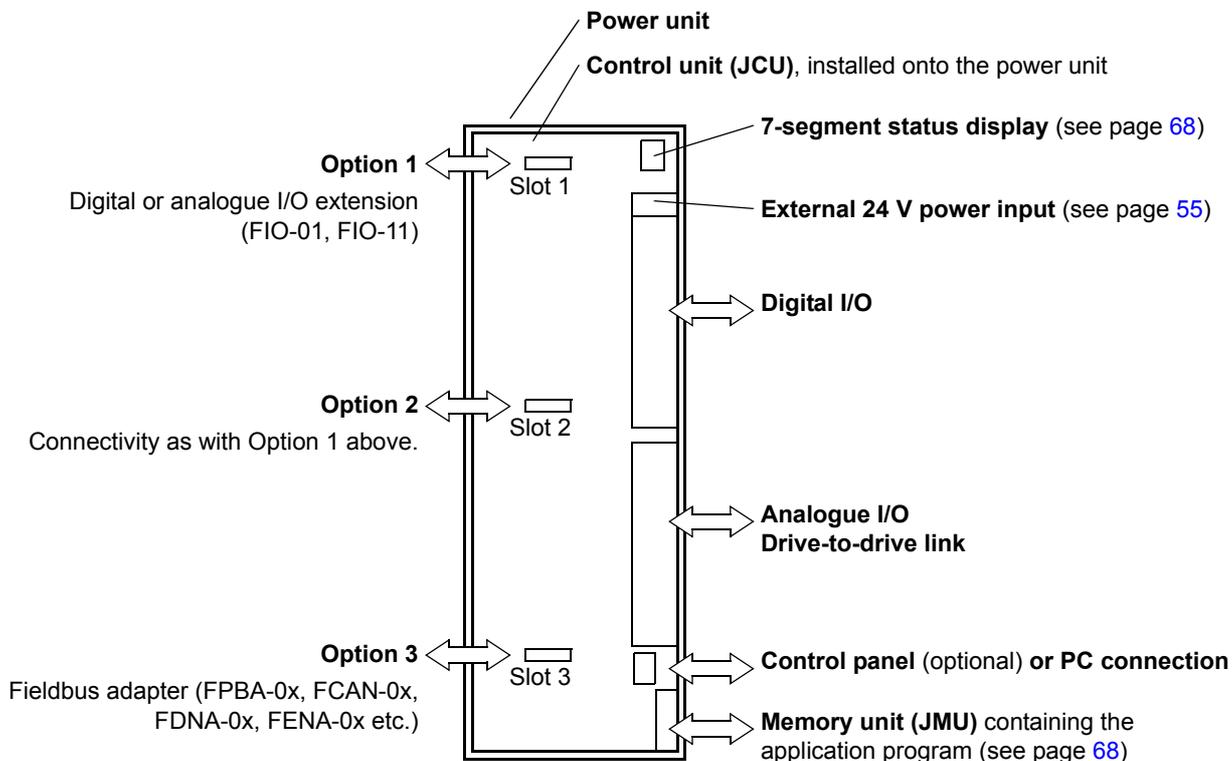
**WARNING!** Do not lengthen the output cables.

---



## Main circuit and control interfaces

The diagram below shows the control interfaces and the main circuit of the regen supply module. For further information on the JCU Control Unit, see the chapter [Electrical installation](#).



## Operation

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

Component	Description
Braking chopper	Conducts the energy generated by a decelerating motor from the DC bus to a braking resistor. The braking chopper is built in the ACSM1; braking resistors are external options.
Braking resistor	Dissipates the braking energy by converting it to heat.
Capacitor bank	Energy storage which stabilizes the intermediate circuit DC voltage.
Inverter	Converts the AC voltage to controlled DC voltage with IGBTs.
Regen filter module	Smooths the line current waveform.
Rectifier	Converts the AC voltage to uncontrolled DC voltage with diodes. The rectifier is not used for regenerative operation.

## Type code

The type code contains information on the specifications and configuration of the regen supply module. The first digits from left express the basic configuration (e.g. ACSM1-204AR-090A-4). The optional selections are given thereafter, preceded by + signs (e.g. +L501). The main selections are described below. Not all selections are necessarily available for all types; refer to *ACSM1 Ordering Information*, available on request.

See also section [Delivery check and regen supply module identification](#) on page 33.

Selection	Alternatives	
<b>Product series</b>	ACSM1 product series	
<b>Type (1)</b>	204	Regen supply module. When no options are selected: IP20, no control panel, braking chopper, coated boards, Quick Guide (multilingual), latest firmware version, Drive SP programming
<b>Type (2)</b>	AR	Air-cooled module (with heatsink), regenerative supply
	CR	Module for "cold plate" mounting (Frame C and D only), regenerative supply
<b>Size</b>	Refer to <i>Technical data: Regen supply module ratings</i> .	
<b>Voltage range</b>	4	380 V, <b>400 V</b> (nominal rating), 415 V, 440 V, 460 V or 480 V AC
+ options		
<b>Fieldbus</b>	K...	+K451: FDNA-01 DeviceNet adapter +K454: FPBA-01 PROFIBUS DP adapter +K457: FCAN-01 CANopen adapter +K458: FSCA-01 Modbus RTU adapter +K466: FENA-01 Ethernet/IP, Modbus/TCP adapter
<b>I/O extensions and feedback interfaces</b>	L...	+L500: FIO-11 analogue I/O extension +L501: FIO-01 digital I/O extension
<b>Memory unit configuration</b>	N...	Solution functions and programs

# Planning the cabinet assembly

---

## What this chapter contains

This chapter guides in planning the installation of a regen supply module into a user-defined cabinet. The issues discussed are essential for safe and trouble-free use of the regen supply module.

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**Note:** The installation examples in this manual are provided only to help the installer in designing the installation. **Please note that the installation must, however, always be designed and made according to applicable local laws and regulations.** ABB does not assume any liability whatsoever for any installation which breaches the local laws and/or other regulations.

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## Cabinet construction

The cabinet frame must be sturdy enough to carry the weight of the regen supply module components, control circuitry and other equipment installed in it.

The cabinet must protect the regen supply module against contact and meet the requirements for dust and humidity (see the chapter [Technical data](#)).

### Disposition of the devices

For easy installation and maintenance, a spacious layout is recommended. Sufficient cooling air flow, obligatory clearances, cables and cable support structures all require space.

For layout examples, see section [Cooling and degrees of protection](#) below.

### Grounding of mounting structures

Make sure all cross-members or shelves on which supply module system components are mounted are properly grounded and the connecting surfaces left unpainted.

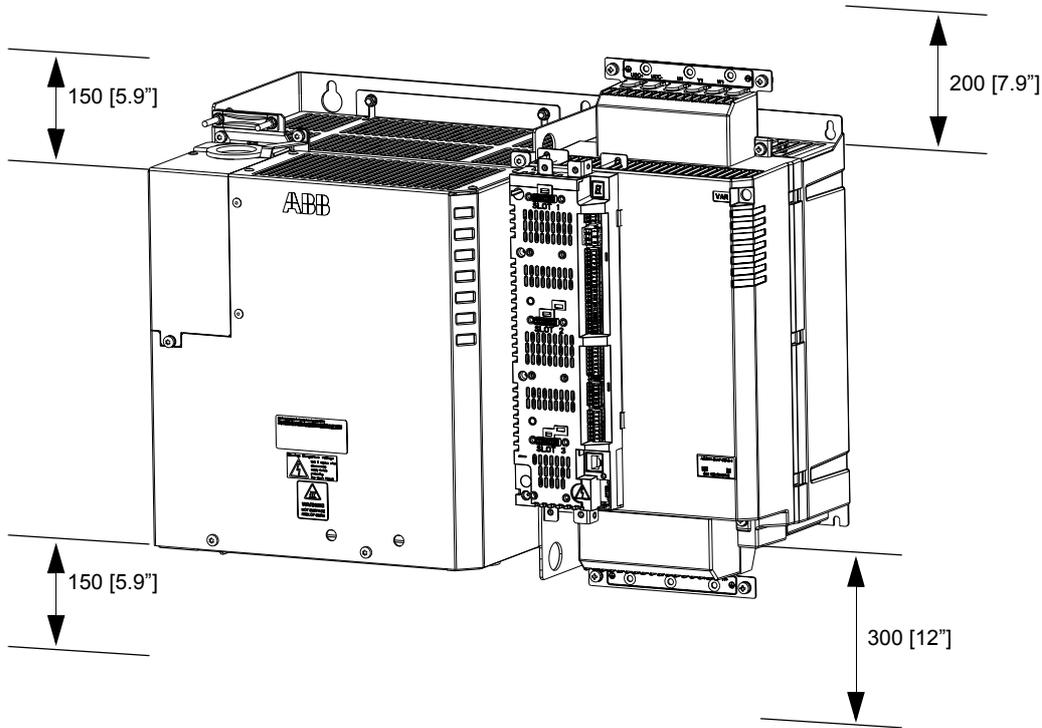
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**Note:** Ensure that the components are properly grounded through their fastening points to the installation base.

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## Free space requirements

The modules and their regen filter modules can be installed side by side. The main dimensions of the regen supply module as well as free space requirements are shown below. For more details, refer to the chapter [Dimension drawings](#).



The temperature of the cooling air entering the unit must not exceed the maximum allowed ambient temperature (see [Ambient conditions](#) in the chapter [Technical data](#)). Consider this when installing heat-generating components (such as other regen supply modules and braking resistors) nearby.

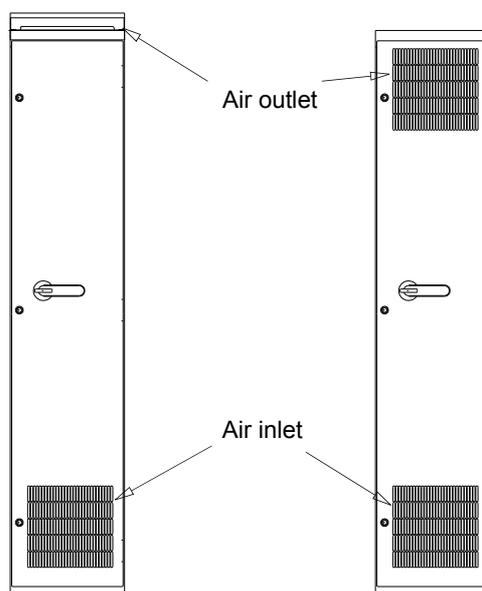
## Cooling and degrees of protection

The cabinet must have enough free space for the components to ensure sufficient cooling. Observe the minimum clearances given for each component.

The air inlets and outlets must be equipped with gratings that

- guide the air flow
- protect against contact
- prevent water splashes from entering the cabinet.

The drawing below shows two typical cabinet cooling solutions. The air inlet is at the bottom of the cabinet, while the outlet is at the top, either on the upper part of the door or on the roof.



Arrange the cooling of the modules so that the requirements given in chapter [Technical data](#) are met:

- cooling air flow  
**Note:** See the values in [Technical data](#) for continuous nominal load.
- allowed ambient temperature
- cold plate specification (for ACSM1-204Cx-xxxx-x only).

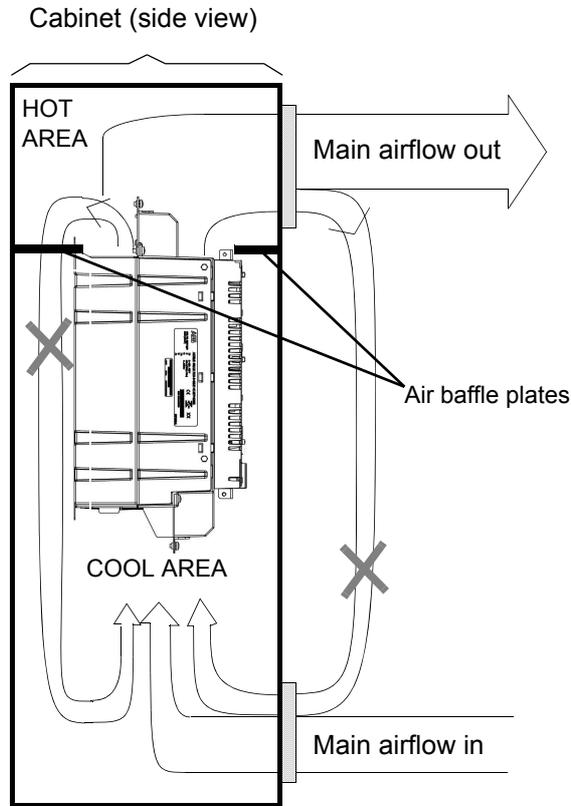
Make sure the air inlets and outlets are sufficient in size. Note that in addition to the power loss of the regen supply module and the WFU-xx regen filter module, the heat dissipated by cables and other additional equipment must also be ventilated.

The internal cooling fans of the modules are usually sufficient to keep the component temperatures low enough in IP22 cabinets.

In IP54 cabinets, thick filter mats are used to prevent water splashes from entering the cabinet. This entails the installation of additional cooling equipment, such as a hot air exhaust fan.

The installation site must be sufficiently ventilated.

## Preventing the recirculation of hot air



### *Outside the cabinet*

Prevent hot air circulation outside the cabinet by leading the outcoming hot air away from the area where the inlet air to the cabinet is taken. Possible solutions are listed below:

- gratings that guide air flow at the air inlet and outlet
- air inlet and outlet at different sides of the cabinet
- cool air inlet in the lower part of the front door and an extra exhaust fan on the roof of the cabinet.

### *Inside the cabinet*

Prevent hot air circulation inside the cabinet with leak-proof air baffle plates. No gaskets are usually required.

## Cabinet heaters

Use a cabinet heater if there is a risk of condensation in the cabinet. Although the primary function of the heater is to keep the air dry, it may also be required for heating at low temperatures. When placing the heater, follow the instructions provided by its manufacturer.

# Mechanical installation

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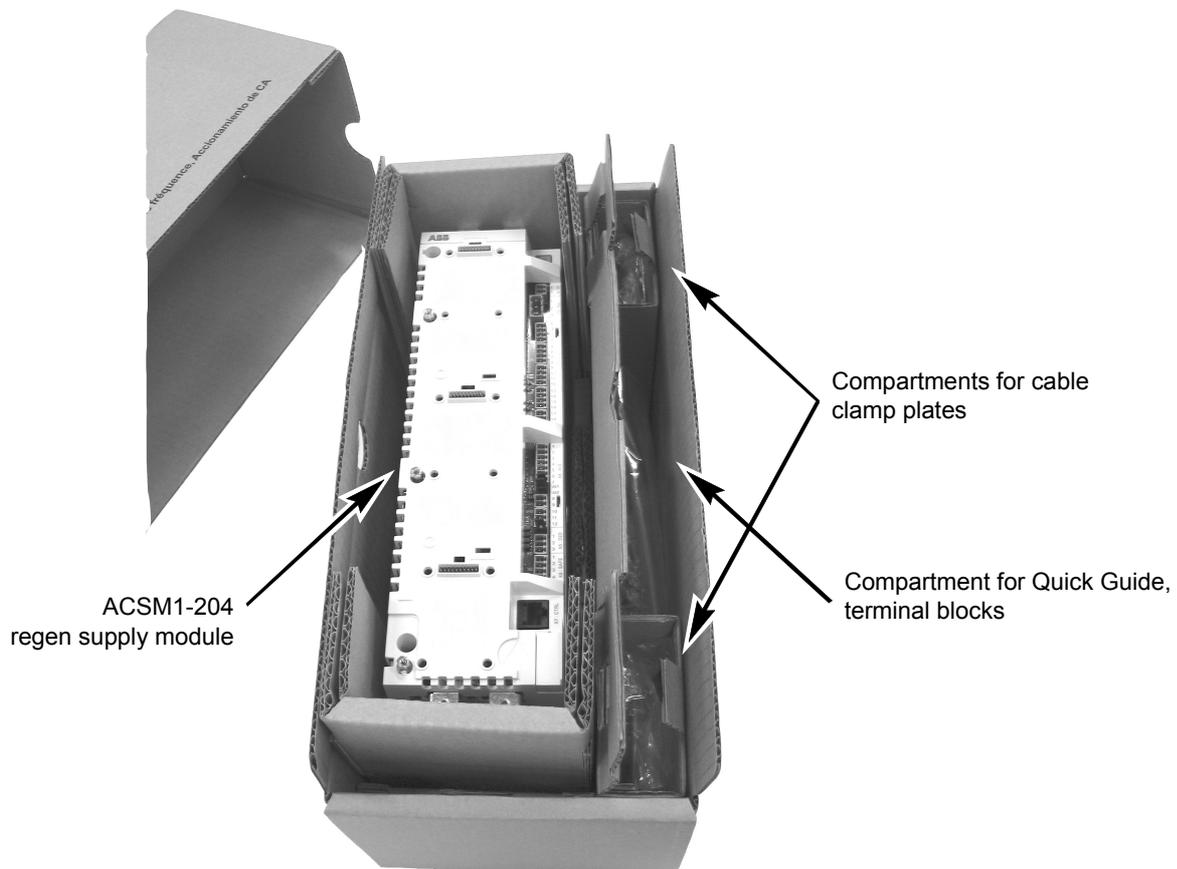
## Contents of the package

The regen supply module is delivered in a cardboard box. To open, remove any banding and lift the top off the box.



The box contains:

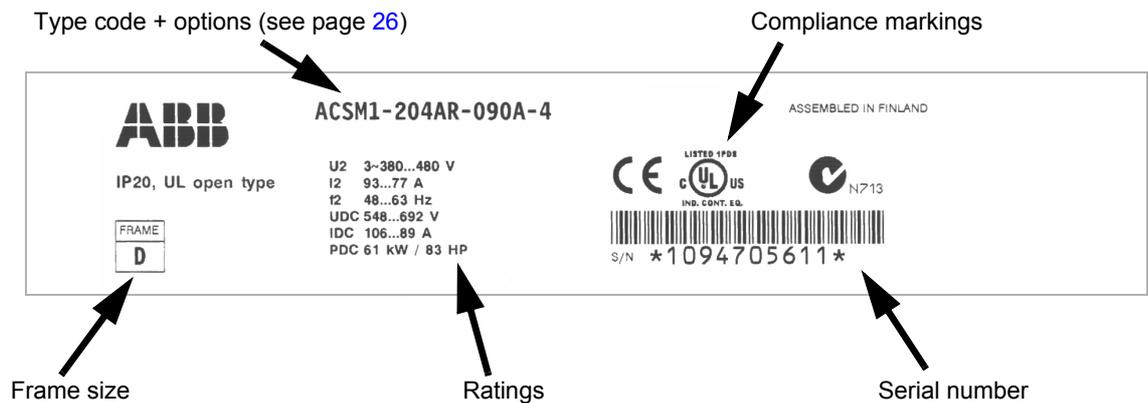
- ACSM1-204 regen supply module, with factory-installed options
- three cable clamp plates (two for power cabling, one for control cabling) with screws
- screw-type terminal blocks to be attached to the headers on the JCU Control Unit and the power unit
- Quick Guide.



## Delivery check and regen supply module identification

Check that there are no signs of damage. Before attempting installation and operation, check the information on the type designation labels of the regen supply module and the WFU-xx regen filter module to verify that the modules are of the correct types. The label is located on the left-hand side of the regen supply module.

### Regen supply module (ACSM1-204) type designation label



The first digit of the serial number refers to the manufacturing plant. The 2nd and 3rd digit indicate the year of manufacture, while the 4th and 5th digits indicate the week. Digits 6 to 10 are a running integer starting every week at 00001.

### Regen filter module (WFU-xx) type designation label



## Before installation

Check the installation site according to the requirements below. Refer to [Dimension drawings](#) for frame details.

### Requirements for the installation site

See [Technical data](#) for the allowed operation conditions of the regen supply module.

The ACSM1-204 is to be mounted in an upright position. The wall the module is to be mounted on must be even, of non-flammable material and strong enough to carry the weight of the module. The floor/material below the module must be non-flammable. The ACSM1-204, WFU-xx filter and the ACSM1-04 drive(s) should be mounted on the same conductive plate on the back wall of the cabinet to achieve full EMC performance.

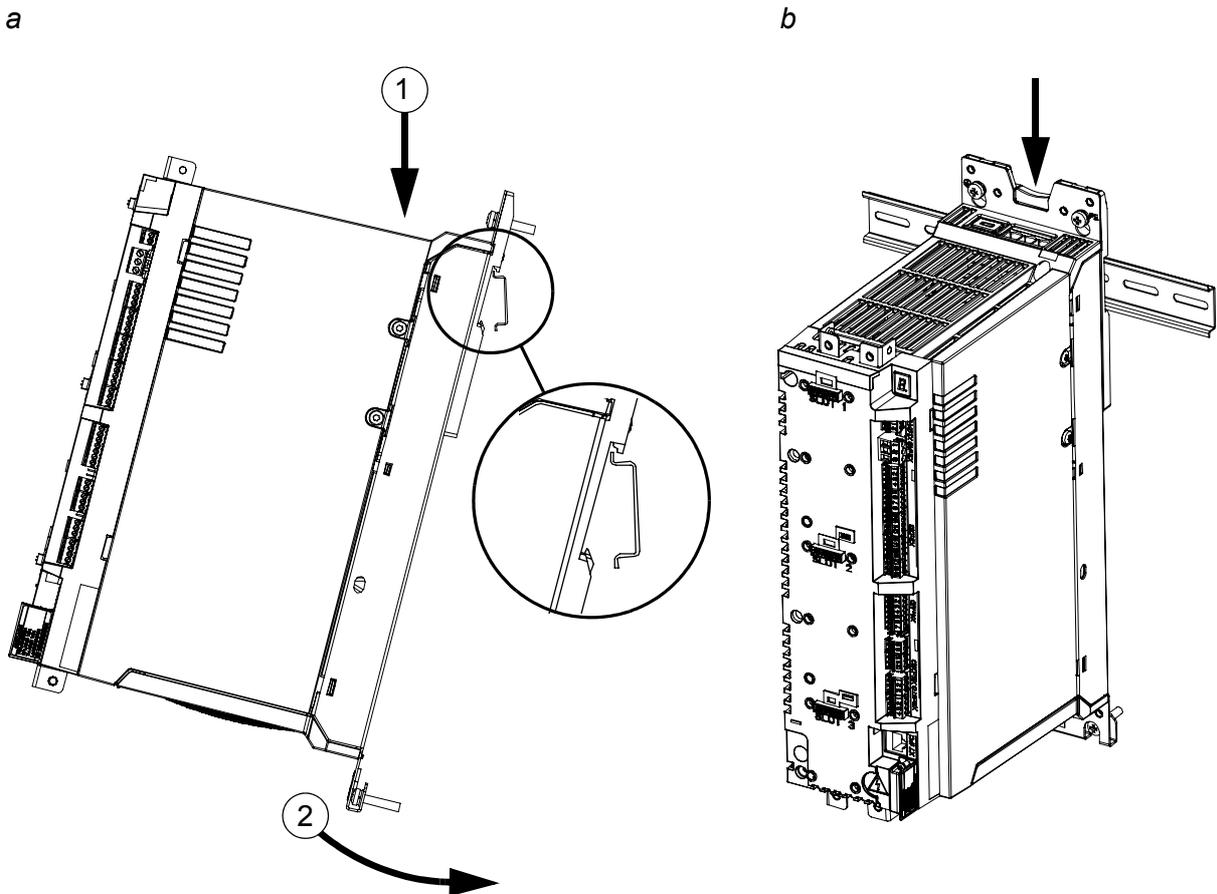
## Installation procedure

### Direct wall mounting of the regen supply module

1. Mark the locations for the four holes. The mounting points are shown in [Dimension drawings](#).
2. Fix the screws or bolts to the marked locations.
3. Position the regen supply module onto the screws on the wall. **Note:** Only lift the regen supply module by its chassis.
4. Tighten the screws.

### DIN rail mounting (Frames A and B only) of the regen supply module

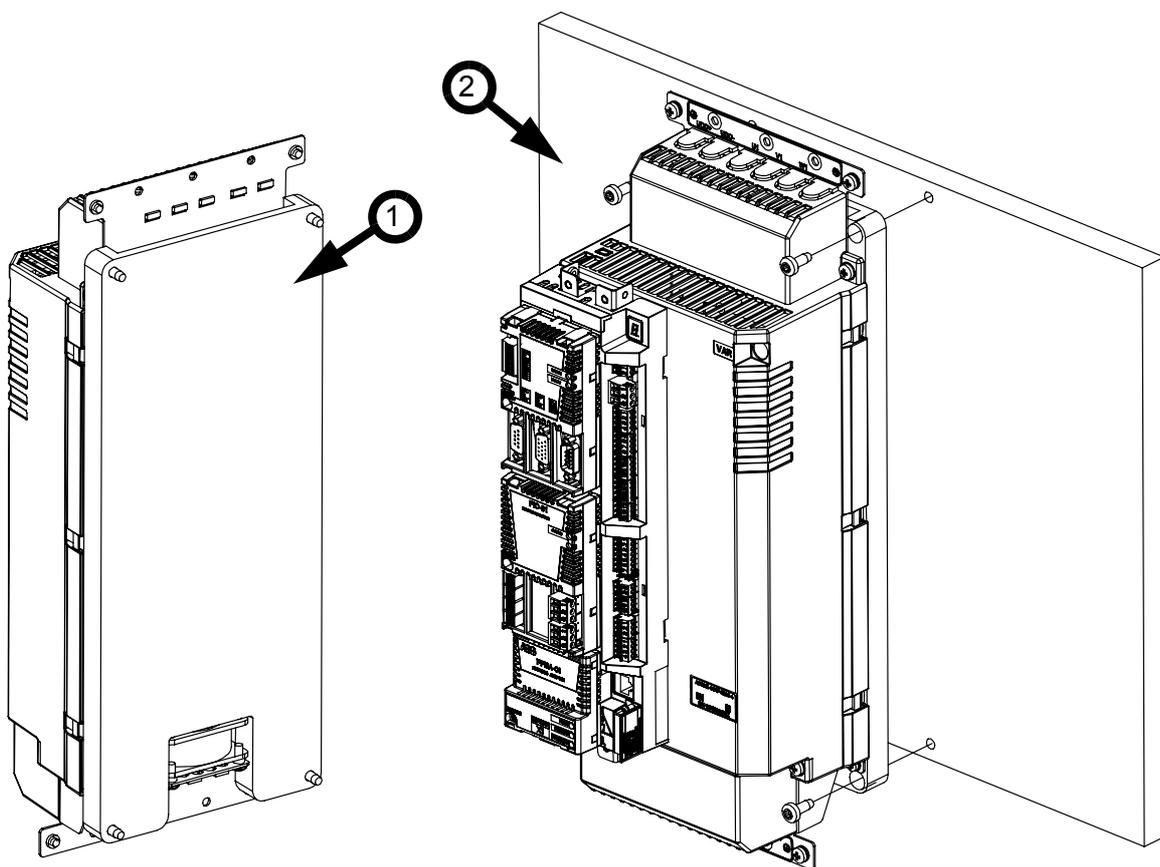
1. Click the regen supply module to the rail as shown in Figure a below. To detach the regen supply module, press the release lever on top of the module as shown in Figure b.
2. Fasten the lower edge of the regen supply module to the mounting base through the two fastening points.



### Cold plate mounting (ACSM1-204Cx-xxxx-x, frames C and D only)

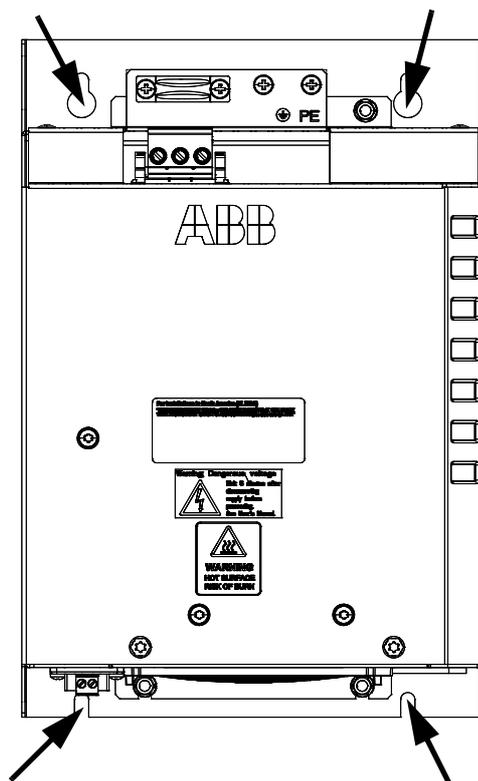
For cold plate cooling characteristics, see page 71.

1. Determine the locations for the four fixing points on the cold plate. The fixing points of the regen supply module are shown in the dimension drawings on page 94 (frame C) or 96 (frame D).
2. Clean the surface of both the regen supply module bottom plate (1) and the cold plate (2) using a cloth and methylated spirit.
3. Apply a thin, uniform layer of thermal compound (e.g. WPS II from Austerlitz Electronic GmbH) over the entire area of the regen supply module bottom plate.
4. Use four M6 (with minimum length of 12 mm) screws to fasten the regen supply module to the cold plate. Tighten the screws to 0.5 N·m (4.4 lbf·in). Wait for at least five minutes to allow the thermal compound to spread out evenly.
5. Tighten the mounting screws to a final torque of 3 N·m (26.5 lbf·in). Wipe off excess thermal compound.



## Installation of the WFU-xx regen filter module

1. Mark the locations for the four holes.
2. Fix the screws or bolts to the marked locations.
3. Position the filter module onto the screws on the wall. **Note:** Only lift the filter module by its chassis.
4. Tighten the screws.



### Braking resistor installation

See the chapter [Resistor braking](#) on page 83.

# Planning the electrical installation

---

## What this chapter contains

This chapter contains the instructions that you must follow when selecting the cables, protections, cable routing and way of operation for the regen supply module. If the recommendations given by ABB are not followed, the regen supply module may experience problems that the warranty does not cover.

---

**Note:** The installation must always be designed and made according to applicable local laws and regulations. ABB does not assume any liability whatsoever for any installation which breaches the local laws and/or other regulations.

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## Compatibility

### ACSM1-04 drives

The ACSM1-204 regen supply module, with an WFU-xx regen filter module of appropriate size, is compatible with ACSM1-04 drives (frame sizes A...D).

---

**Note:** The ACSM1-204 regen supply module is not designed to be started under load. If the DC bus is loaded when the ACSM1-204 tries to start, the start attempt may fail.

---

### Other drive types

The ACSM1-204 regen supply module and WFU-xx regen filter module do not include a charging device capable of providing the initial charging of the drive or inverter modules connected to the DC bus. Depending on the drive type, external charging may be required.



---

**WARNING!** Without initial charging, the ACSM1-204 regen supply module, WFU-xx regen filter module and other devices connected are permanently damaged when the main contactor is closed.

---

Consider the following if a drive type other than the ACSM1-04 is used:

- Check that all the devices that are connected to the DC bus fed by ACSM1-204 regen supply modules can be charged through the DC bus without any external charging device.
- If not, charge the drive externally before connecting it to the DC bus of the ACSM1-204 regen supply module.

## Checking the charging capacity

When the power is switched on in the common DC system, the DC link capacitors in each drive module and regen supply module are charged. The charging current is fed through the supply module(s) connected to the AC. Due to this, the charging capacity of the supply module(s) has to be checked.

The ACSM1 drive and supply modules in frame sizes A-D have a charging circuit in series with the capacitor bank.

- In common DC connection, the charging circuits act in parallel.
- The sum of the charging currents is fed from the supply.

The charging circuit data for each supply module ACSM1-204 supply module and ACSM1-04 Drive module are shown in the following tables.

ACSM1-204...	Frame	R	R <sub>min</sub>
		ohm	ohm
-07A0	A	50	25
-016A	B	130	20
-031A	C	66	15
-046A	C	66	10
-090A	D	33	5

ACSM1-04...	Frame	R
		ohm
-02A5, -03A0, -04A0, -05A0, -07A0	A	50
-09A5, -012A, -016A,	B	130
-024A, -031A, -040A, -046A	C	66
-060A, -073A, -090A	D	33

R	Charging resistance of the drive of supply module.
R <sub>min</sub>	The minimum value of the total effective charging resistance allowed for the drive module.

### Single AC input

Calculate the total effective charging resistance  $R_{tot}$  from the drive/supply modules connected to the DC link.

$$R_{tot} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_n}}$$

$R_1 \dots R_n$  are the charging resistance values of each drive module. The following condition must be fulfilled:  $R_{tot} > R_{min}$

## Supply connection

Use a fixed connection to the AC power line.



**WARNING!** As the leakage current of the device typically exceeds 3.5 mA, a fixed installation/connection is required according to IEC 61800-5-1. Additionally, one of the following requirements must be fulfilled:

- a) protective earthing conductor cross-section of at least 10 mm<sup>2</sup> Cu or 16 mm<sup>2</sup> Al,
- b) automatic disconnection of the supply in case of discontinuity of the protective earthing conductor, or
- c) a second protective earthing conductor of the same cross-sectional area as the original protective earthing conductor to the second terminal.

## Main contactor

Install a main contactor on the grid side of the ACSM1-204 regen supply module and WFU-xx regen filter module. The main contactor must be controlled so that it is disconnected always when the regen supply module is not in use, it is stopped or it is faulty. The regen supply module may sustain damage if not disconnected in such a situation.

The contactor can be controlled from the I/O or RO in the JCU of the regen supply module. In this case, external powering for the JCU control unit is needed and should be done by supplying 24V to connector X1 in the JCU of the ACSM1-204.

A contactor is needed for the following reasons:

- If the regen filter module is connected to the grid while the regen supply unit is not modulating/active, there is a risk that the filter responds to disturbance frequencies in a distorted grid and starts resonating, which may cause permanent damage to the regen supply module, filter and equipment connected to the DC bus. If the regen supply module is stopped, faulty or otherwise inactive, it cannot influence the resonance of the filter.
- The regen supply module and regen filter module cannot prevent power flow from the grid to the DC bus and further to the ACSM1-04 drives. Even if the modulation of the ACSM1-204 regen supply module is stopped, the anti-parallel diodes of the inverter bridge in ACSM1-204 enable power flow to the DC bus and to the motor inverters. In other words, merely stopping the regen supply module does not stop the system.
- The regen supply module is not protected against excessive current drawn from the DC bus. If the motoring power (power demanded from the DC bus) exceeds the supplying capability of the regen supply module, it trips. If the current demand remains or increases, the regen supply module is damaged.

## Supply disconnecting device

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

### Europe

If the regen supply module is used in an application which must meet the European Union Machinery Directive according to standard EN 60204-1 Safety of Machinery, the disconnecting device must be one of the following types:

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

### Other regions

The disconnecting means must conform to the applicable safety regulations.

## Thermal overload and short circuit protection

### Thermal overload protection

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

---

**Note:** The regen supply module cannot protect itself against excessive current drawn by the motor drives connected to the DC bus. Take this into account when dimensioning the maximum motor load planned to be supplied by the supply module.

---

### Protection against short-circuit in the supply cable or the regen supply module

Protect the supply cable with fuses or circuit breakers. Fuse recommendations are given in the chapter *Technical data*. When placed at the distribution board, standard IEC gG fuses or UL type T fuses will protect the input cable in short-circuit situations, restrict regen supply module damage and prevent damage to adjoining equipment in case of a short circuit inside the regen supply module.

#### *Operating time of the fuses and circuit breakers*

**Check that the operating time of the fuse is below 0.5 seconds.** The operating time depends on the type, the supply network impedance, and the cross-sectional area, material and length of the supply cable. US fuses must be of the “non-time delay” type.

### *Circuit breakers*

The protective characteristics of circuit breakers depend on the supply voltage as well as the type and construction of the breakers. There are also limitations pertaining to the short-circuit capacity of the supply network. Your local ABB representative can help you in selecting the breaker type when the supply network characteristics are known.

### **Protection against short-circuit in the DC cable**

Protect the DC cable with fuses. Fuse recommendations are given in the chapter [Technical data](#).

### **Protection of the WFU-xx regen filter module against thermal overload**

By default, the regen filter module is also protected against thermal overload. The regen filter module thermistor must be connected in the regen supply module. The thermistor in the regen filter module is monitored by the regen supply module with default settings.

## **Ground fault protection**

The regen supply module is equipped with an internal ground fault protective function to protect the unit against ground faults in the supply and the supply cable. This is not a personal safety or a fire protection feature. The ground fault protective function can be disabled with a parameter, refer to the appropriate *Firmware Manual*.

## **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 regen supply module (or drive) does not generate an emergency stop of the motor or separate the regen supply module or the drives from dangerous potential.

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## Selecting the power cables

### General rules

Dimension the power cables **according to local regulations**.

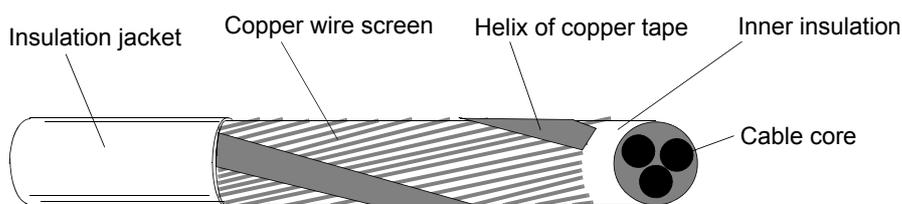
- The cable must be able to carry the regen supply module load current. See the chapter [Technical data](#) for the rated currents.
- The cable must be rated for at least 70 °C (US: 75 °C [167 °F]) maximum permissible temperature of conductor in continuous use.
- The conductivity of the PE conductor must be equal to that of a phase conductor (ie. same cross-sectional area). See also [Supply connection](#) on page 39.
- 600 VAC cable is accepted for up to 500 VAC.
- Refer to the chapter [Technical data](#) for EMC requirements.

A four-conductor system is allowed for input cabling, but shielded symmetrical cable is recommended. Compared to a four-conductor system, the use of symmetrical shielded cable reduces electromagnetic emission of the whole drive system.

### Power cable shield

To function as a protective conductor, the shield must have the same cross-sectional area as a phase conductor when they are made of the same metal.

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. An example 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 the bearing currents.



## Power cables cross-section

### *Cross-sections for mains supply connection cables (regen filter module)*

ACSM1-204	Filter	Min. cross section (L1, L2, L3)			
		EN 60204-1*			NEC**
		B1 (mm <sup>2</sup> )	B2 (mm <sup>2</sup> )	C (mm <sup>2</sup> )	(AWG)
-07A0-4	WFU-01	1.5	1.5	1.5	16
-016A-4	WFU-02	2.5	4	2.5	12
-031A-4	WFU-11	10	10	6	8
-046A-4	WFU-21	16	16	10	6
-090A-4	WFU-22	35	50	35	2

### *Cross-sections for DC connection cables (regen supply module)*

ACSM1-204	Min. cross section (UDC+, UDC-)			NEC** (AWG)
	EN 60204-1*			
	B1 (mm <sup>2</sup> )	B2 (mm <sup>2</sup> )	C (mm <sup>2</sup> )	
-07A0-4	1.5	1.5	1.5	14
-016A-4	4	4	2.5	12
-031A-4	10	10	10	8
-046A-4	16	25	16	6
-090A-4	50	70	50	1

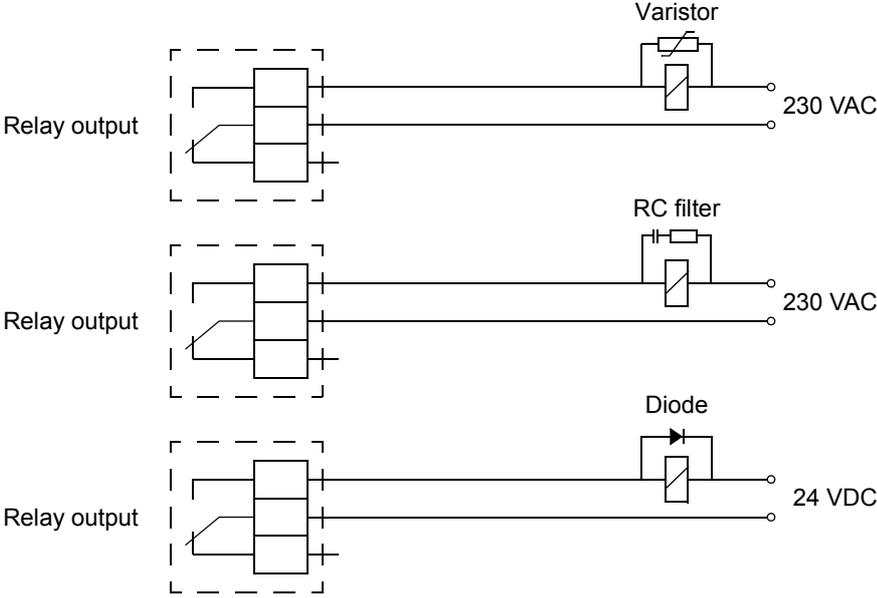
*	Minimum cable cross-section according to EN 60204-1 with different installation methods. The values are valid for PVC-insulated copper cables at an ambient temperature of 40 °C (104 °F).
**	Minimum cable cross-section according to NEC for copper cables rated for 75 °C (167 °F) at an ambient temperature of 40 °C (104 °F).

## 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 output on the regen supply module is protected with varistors (250 V) against overvoltage peaks. In addition, it is highly recommended to equip inductive loads with noise attenuating circuits (varistors, RC filters [AC] or diodes [DC]) in order to minimize the electromagnetic emissions 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, not at the relay output.

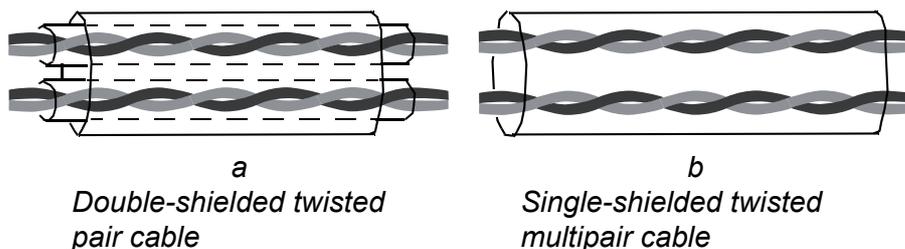


## Selecting the control cables

It is recommended that all control cables be shielded.

Double-shielded twisted pair cable is recommended for analogue signals. Use one individually-shielded pair for each signal. Do not use a common return for different analogue signals.

Double-shielded cable is the best alternative for low-voltage digital signals but single-shielded twisted multipair cable (Figure *b*) is also usable.



Run analogue and digital signals in separate cables.

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

Never mix 24 VDC and 115/230 VAC signals in the same cable.

### Relay cable

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

### Control panel cable

The cable connecting the control panel to the regen supply module must not exceed 3 metres in length. The cable type tested and approved by ABB is used in control panel option kits.

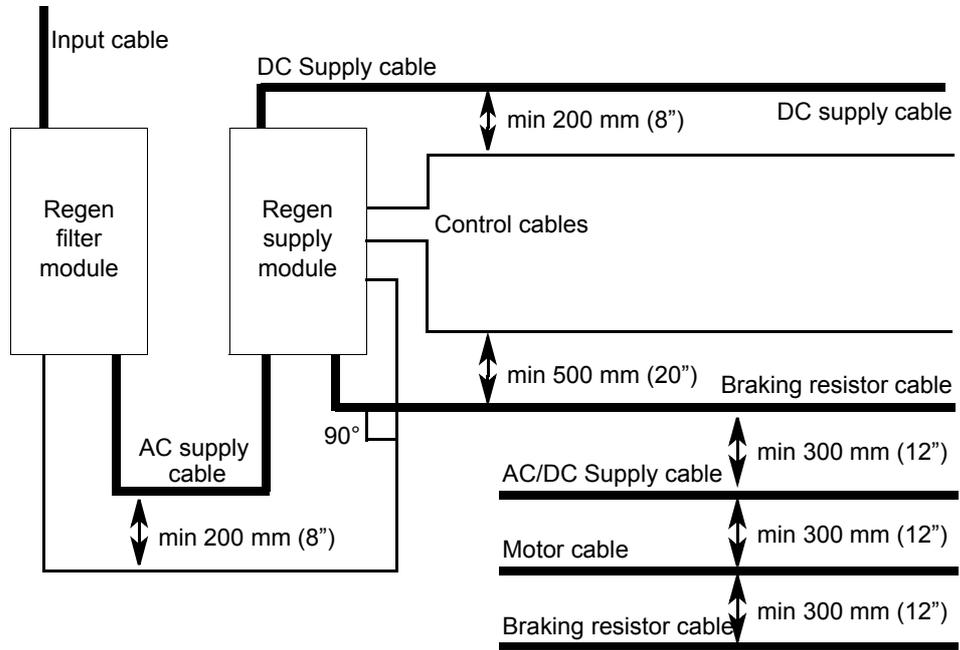
## Routing the cables

Route the DC cabling away from other cable routes.

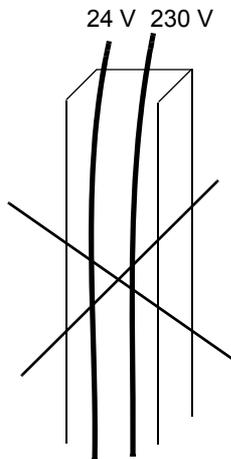
Where control cables must cross power cables make sure they are arranged at an angle as near to 90 degrees as possible. Do not run extra cables through the regen supply module.

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.

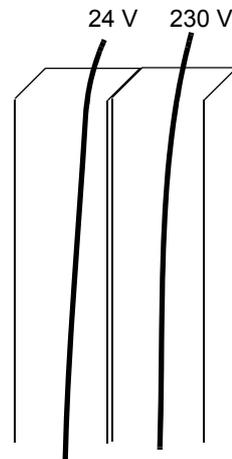
A diagram of the cable routing is below.



**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 regen supply module.



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

Make sure that the regen supply module is disconnected from the supply (input power) during installation. If the regen supply module is already connected to the supply, wait for 5 minutes after disconnecting the input power.

---

## Checking the insulation of the assembly

### Regen supply module and WFU-xx regen filter module

Do not make any voltage tolerance or insulation resistance tests (e.g. hi-pot or megger) on any part of the regen supply module or filter unit as testing can damage them. Every module has been tested for insulation between the main circuit and the chassis at the factory. Also, there are voltage-limiting circuits inside the regen supply module which cut down the testing voltage automatically.

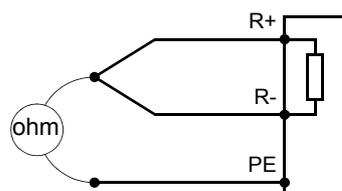
### Supply cable

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

### Braking resistor assembly

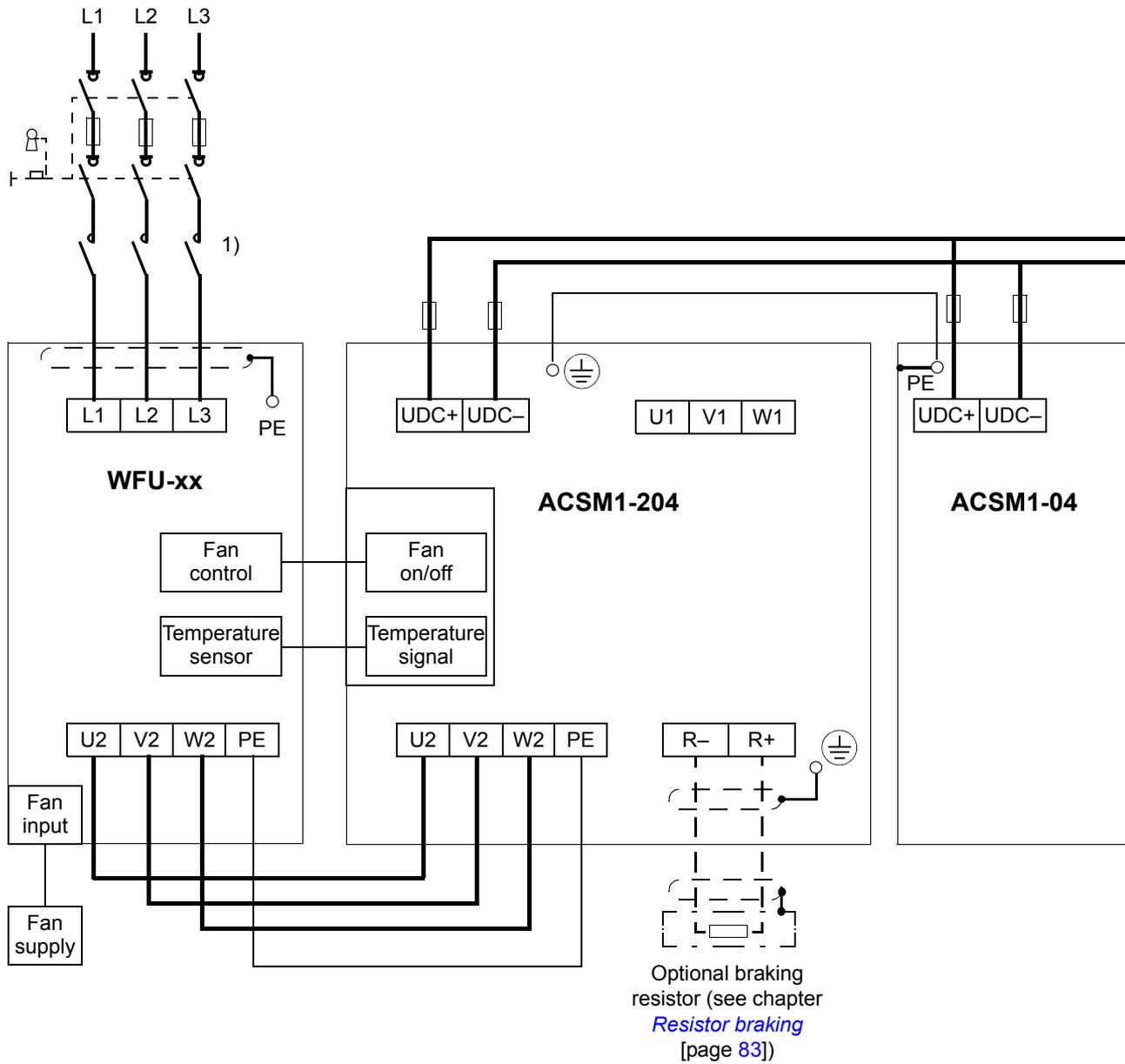
Check the insulation of the braking resistor assembly (if present) as follows:

1. Check that the resistor cable is connected to the resistor, and disconnected from the regen supply module output terminals R+ and R-.
2. At the regen supply module end, connect the R+ and R- conductors of the resistor cable together. Measure the insulation resistance between the combined conductors and the PE conductor by using a measuring voltage of 1 kV DC. The insulation resistance must be higher than 1 Mohm.



## Power and control cable connection

Power and control cable connection diagram



**Notes:**

1) Main contactor and fuses. Not included in the delivery.

## Procedure

For cabling drawings and tightening torques for each frame size, see pages 51 to 53.

1. Frame sizes C and D only: Remove the two plastic connector covers at the top and bottom of the regen supply module. Each cover is fastened with two screws.
2. On IT (ungrounded) systems and corner grounded TN systems, disconnect the internal varistors by removing the screw labelled VAR (located close to the supply terminals on the power unit). Also remove the screws labeled VARISTOR (1 screw) and FILTER (2 screws) in the WFU-xx regen supply module.



**WARNING!** If a regen supply module whose varistors are not disconnected is installed on an IT system (an ungrounded power system or a high resistance grounded [over 30 ohms] power system), the system is connected to earth potential through the varistors of the supply module. This may cause danger or damage the supply module.

If a regen supply module whose varistors are not disconnected is installed on a corner grounded TN system, the regen supply module will be damaged.

3. Fasten the two cable clamp plates included to the regen supply module (see page 50), one at the top, one at the bottom. The clamp plates are identical. Using the cable clamp plates as shown below will provide better EMC compliance, as well as act as a strain relief for the power cables.
4. Strip the power cables so that the shields are bare at the cable clamps.
5. Twist the ends of the cable shield wires into pigtailed.
6. Strip the ends of the phase conductors.
7. Connect the phase conductors of the DC supply cable to the UDC+ and UDC- terminals of the regen supply module.  
Connect the phase conductors of the U2/V2/W2 cable in the WFU-xx regen filter module to the U2, V2 and W2 terminals in the regen supply module.  
Connect the resistor cable conductors (if present) to the R+ and R- terminals.  
With frame size C or D, attach the screw terminal lugs included to the conductors first. Crimp lugs can be used instead of the screw lugs.
8. Tighten the cable clamps onto the bare cable shields.
9. Crimp a cable lug onto each shield pigtail. Fasten the lugs to ground terminals.  
**Note:** Make a compromise between the length of the pigtail and the length of unshielded phase conductors as both should ideally be as short as possible.
10. Cover visible bare shield and pigtail with insulating tape.
11. With frame size C or D, cut suitable slots on the edges of the connector covers to accommodate the AC and DC supply cables. Refit the covers. (Tighten the screws to 3 N·m [25 lbf·in]).
12. Secure the cables outside the unit mechanically.
13. Ground the other end of the supply cable shield or PE conductor(s) at the distribution board.

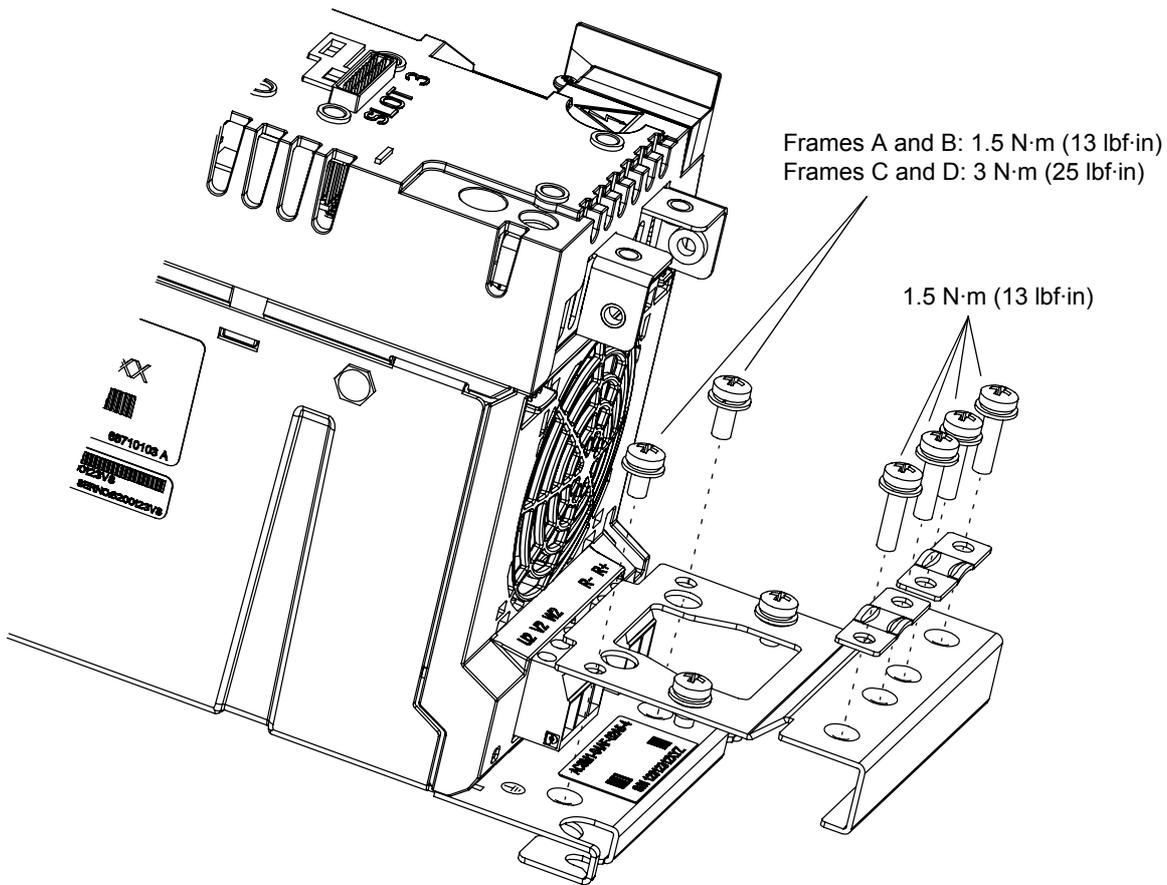
### Installation of power cable clamp plates

Two identical power cable clamp plates are included with the regen supply module. The picture below depicts a frame size A regen supply module; the installation is similar with other frame sizes.

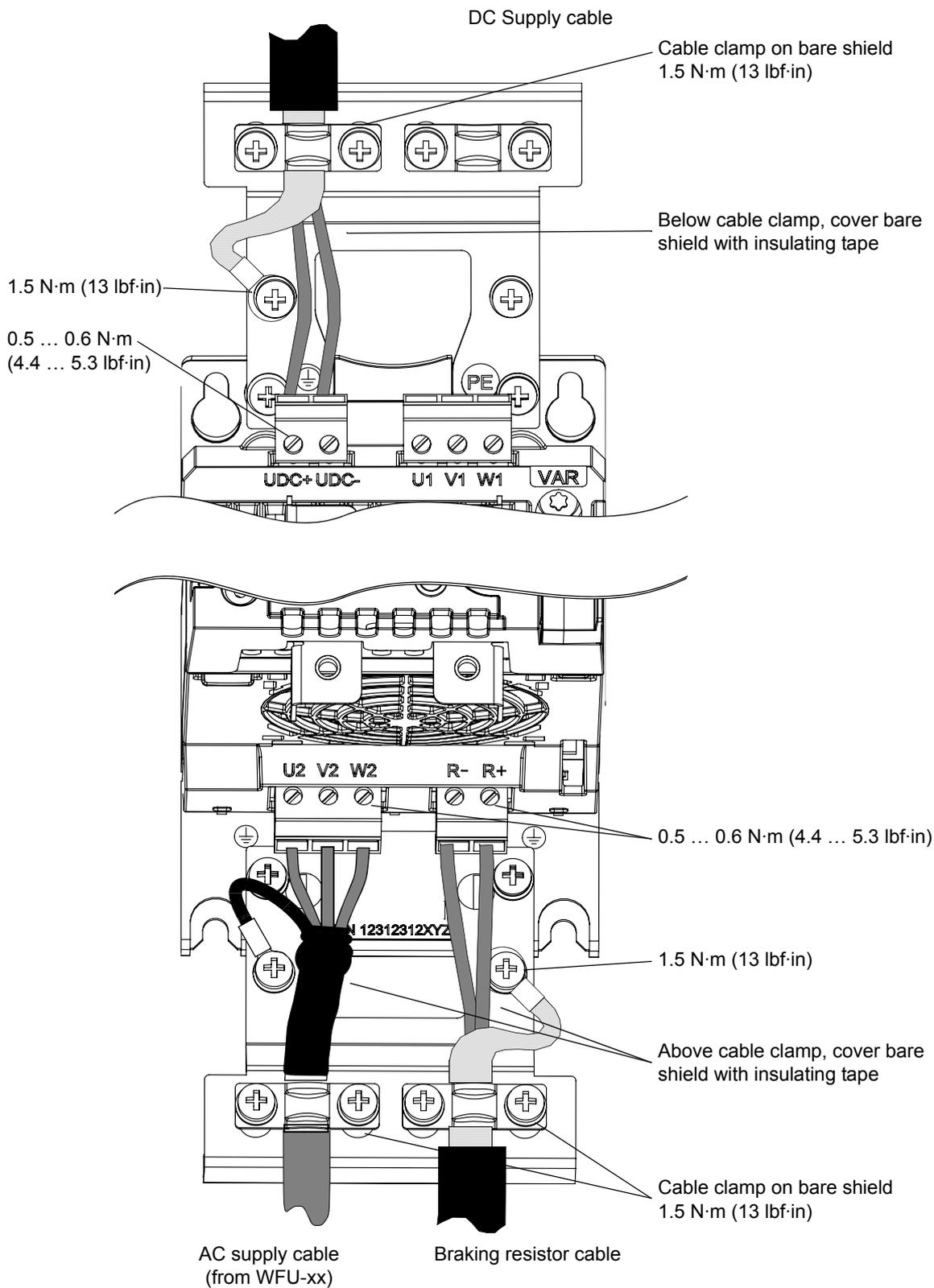
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**Note:** Pay attention to supporting the cables adequately within the installation enclosure especially if not using the cable clamps.

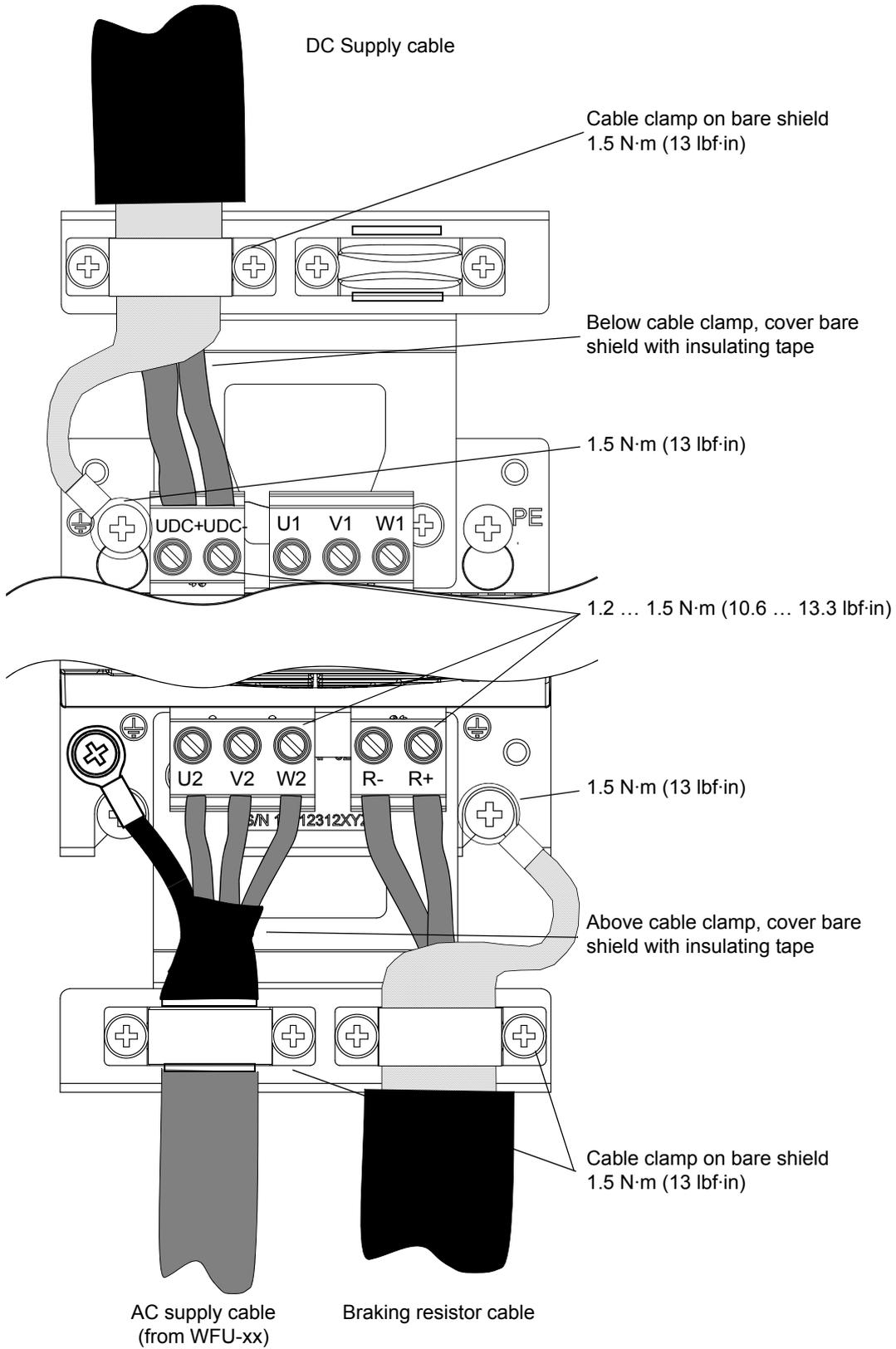
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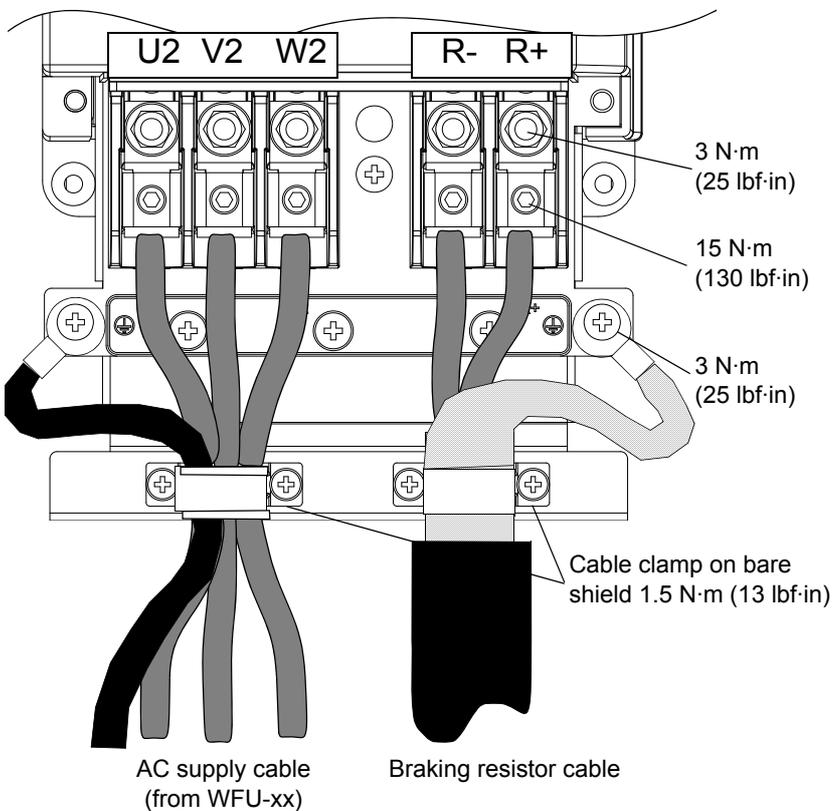
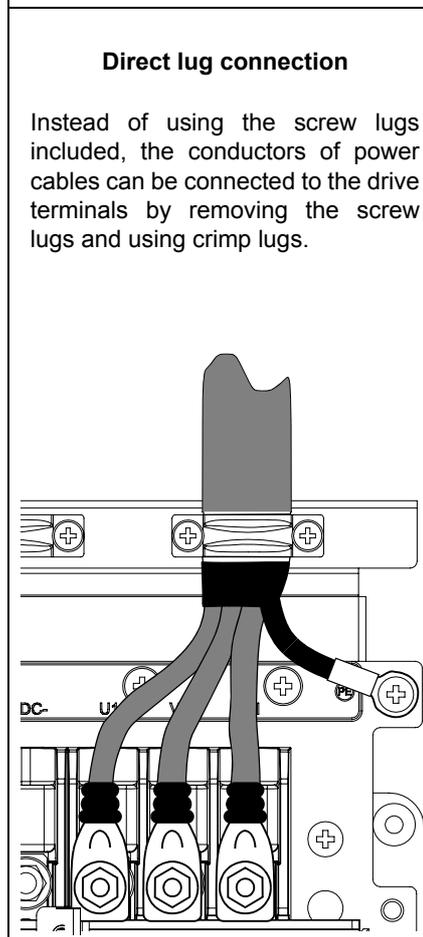
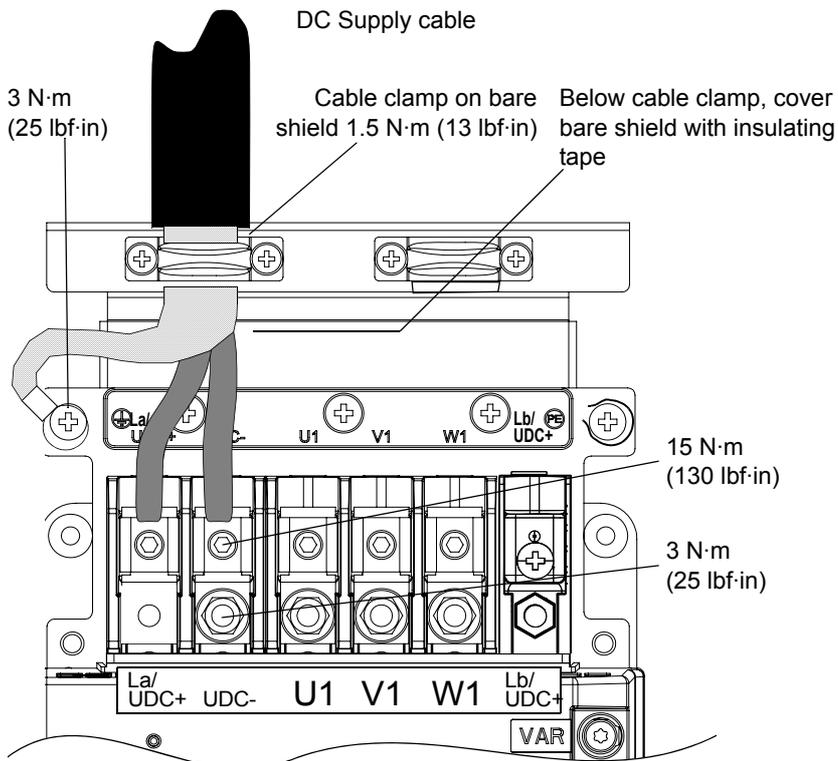
Power cable connection – frame size A



Power cable connection – frame size B



**Power cable connection – frame sizes C and D (connector covers removed)**



# Connecting the control cables

## Control connections to the JCU Control Unit

**Notes:**

\*Total maximum current: 200 mA

1) WFU-xx cooling fan control

2) WFU-xx temperature supervision

The wiring shown is for demonstrative purposes only. Refer to the appropriate *Firmware Manual* for default I/O assignments.

Further information of the usage of the connectors and jumpers are given in the text; more details are available in the chapter *Technical data*.

**Wire sizes and tightening torques:**

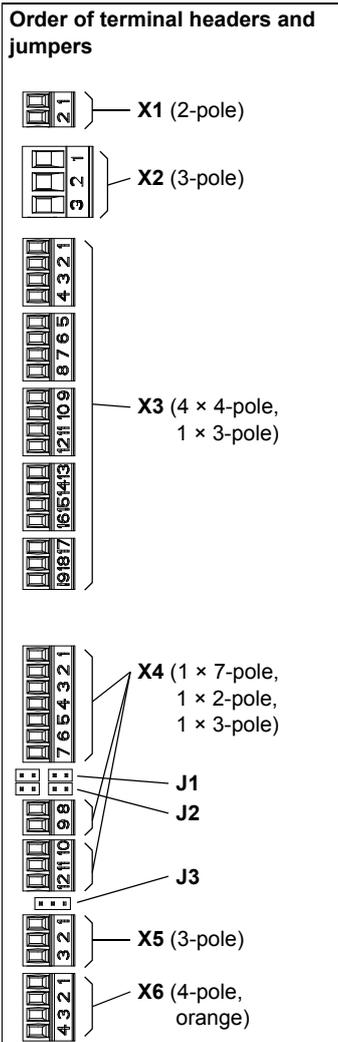
X2: 0.5 ... 2.5 mm<sup>2</sup> (24...12 AWG).

Torque: 0.5 N·m (5 lbf·in)

X3, X4, X5, X6:

0.5 ... 1.5 mm<sup>2</sup> (28...14 AWG).

Torque: 0.3 N·m (3 lbf·in)

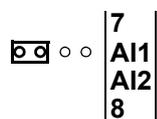


		<b>X1</b>	
External power input 24 V DC, 1.6 A	+24VI	1	
	GND	2	
		<b>X2</b>	
Relay output 250 V AC / 30 V DC 2 A	NO	1	
	COM	2	
	NC	3	
		<b>X3</b>	
+24 V DC*	+24VD	1	
Digital I/O ground	DGND	2	
Digital input 1: Stop/start (EXT2)	DI1	3	
Digital input 2: EXT1/EXT2	DI2	4	
+24 V DC*	+24VD	5	
Digital I/O ground	DGND	6	
Digital input 3: Fault reset	DI3	7	
Digital input 4: Force stop	DI4	8	
+24 V DC*	+24VD	9	
Digital I/O ground	DGND	10	
Digital input 5: Not connected	DI5	11	
Digital input 6: Not connected	DI6	12	
+24 V DC*	+24VD	13	
Digital I/O ground	DGND	14	
Digital input/output 1: Fan control signal (output)	DIO1	15	
Digital input/output 2: Running (output)	DIO2	16	
+24 V DC*	+24VD	17	
Digital I/O ground	DGND	18	
Digital input/output 3: Fault (output)	DIO3	19	
		<b>X4</b>	
Reference voltage (+)	+VREF	1	
Reference voltage (-)	-VREF	2	
Ground	AGND	3	
Analogue input 1 (Not connected) Current/Voltage	AI1+	4	
	AI1-	5	
Analogue input 2 (Not connected)	AI2+	6	
	AI2-	7	
AI1 current/voltage selection	J1		
AI2 current/voltage selection	J2		
Thermistor input	TH	8	
Ground	AGND	9	
Analogue output 1 (current)	AO1 (I)	10	
Analogue output 2 (voltage)	AO2 (U)	11	
Ground	AGND	12	
		<b>X5</b>	
Drive-to-drive link termination	J3		
Drive-to-drive link. See separate section below.	B	1	
	A	2	
	BGND	3	
		<b>X6</b>	
Not in use. Both circuits must be closed for the regen supply module to start. See separate section below.	OUT1	1	
	OUT2	2	
	IN1	3	
	IN2	4	
Control panel connection			
Memory unit connection			

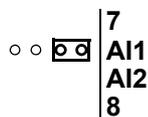
### Jumpers

J1 – Determines whether Analogue input AI1 is used as a current or voltage input.

Current

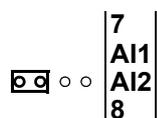


Voltage

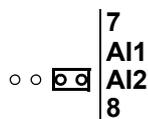


J2 – Determines whether Analogue input AI2 is used as a current or voltage input.

Current



Voltage



J3 – Drive-to-drive link termination. Must be set to the ON position when the regen supply module is the last unit on the link.

Termination ON



Termination OFF



### External power supply for the JCU Control Unit (X1)

External +24 V (minimum 1.6 A) power supply for the JCU Control Unit can be connected to terminal block X1. Using an external supply is recommended if

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

### Drive-to-drive link (X5)

Reserved.

### X6 (not in use)

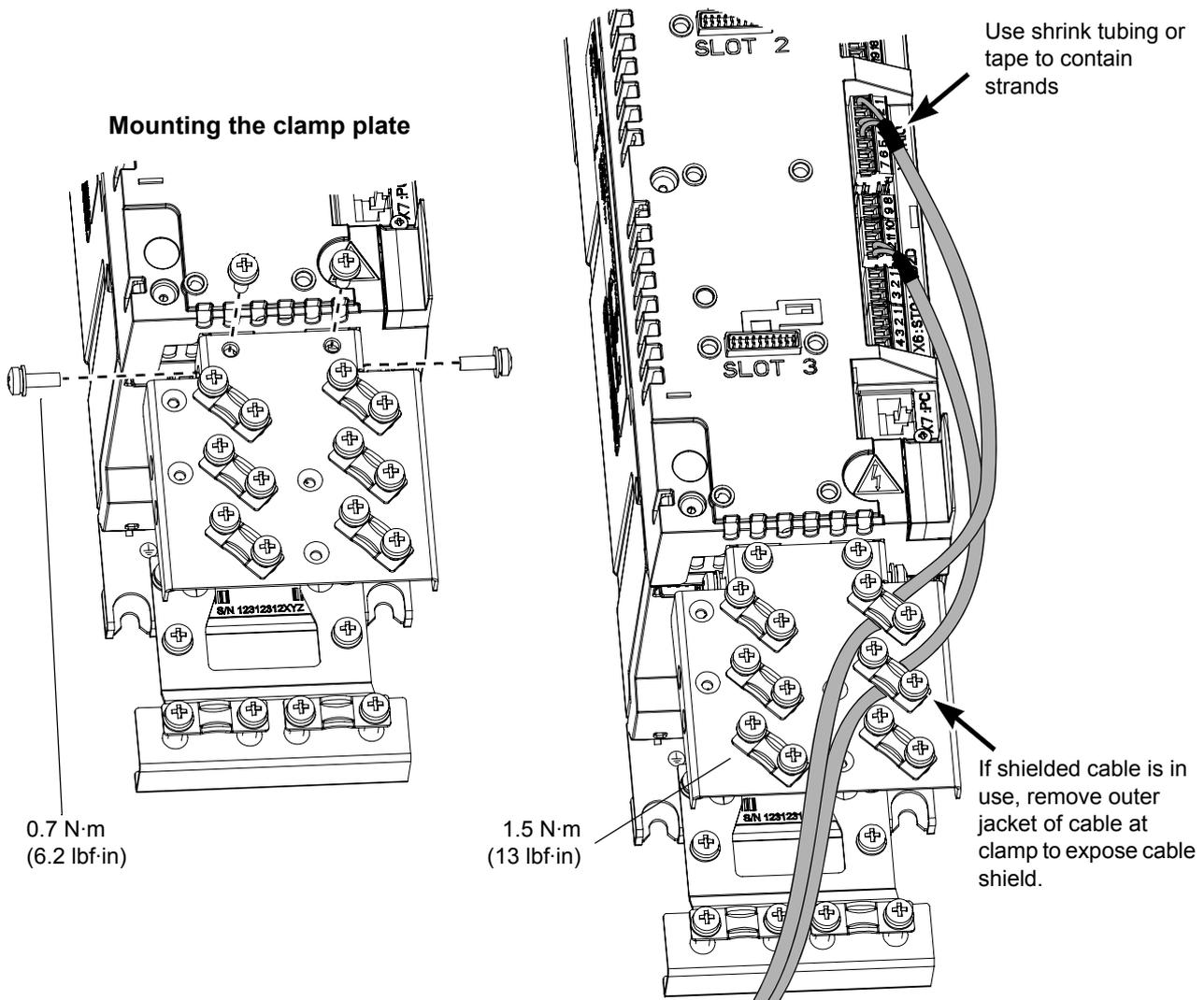
The X6 connector must be short-circuited with a jumper for the regen supply module to start. The appropriate jumper is included in the delivery.

## Control cable grounding

The shields of all control cables connected to the JCU Control Unit must be grounded at the control cable clamp plate. Use four M4 screws to fasten the plate as shown below left. The plate can be fitted either at the top or bottom of the regen supply module.

The shields should be continuous as close to the terminals of the JCU as possible. Only remove the outer jacket of the cable at the cable clamp so that the clamp presses on the bare shield. At the terminal block, use shrink tubing or insulating tape to contain any stray strands. The shield (especially in case of multiple shields) can also be terminated with a lug and fastened with a screw at the clamp plate. 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 any 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 options

Options such as fieldbus adapters and I/O extensions are inserted into slots on the JCU Control Unit. See page 25 for the available slots; see the appropriate option manual for specific installation and wiring instructions.

## Removing EMC and varistor screws from the regen filter module

On IT (ungrounded) systems, and corner grounded TN systems, the EMC and varistor screws must be removed from the regen filter module.

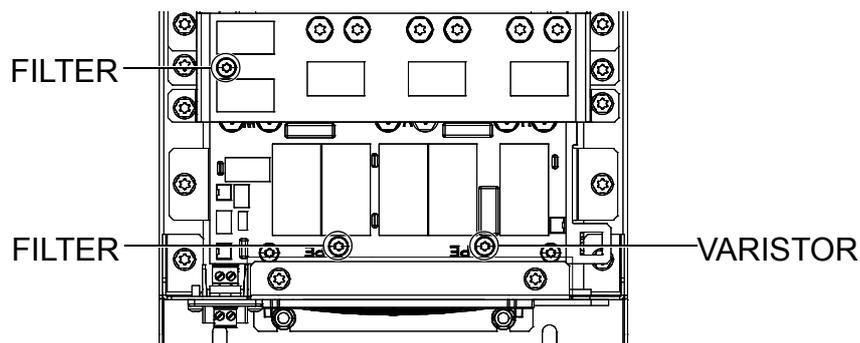
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**Note:** When the internal EMC filter is disconnected, the regen supply is not EMC compatible.

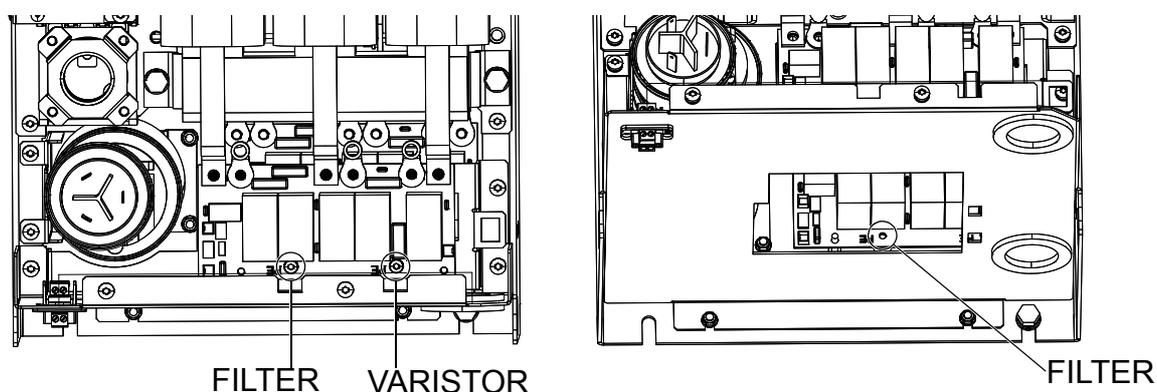
---

1. Remove the cover of the regen filter module.  
WFU-11, WFU-21 and WFU-22 only: Remove the fan.
2. Remove the two screws labeled FILTER and one screw labeled VARISTOR. The locations of the screws are shown in the pictures below.
3. Re-install the cover.  
WFU-11, WFU-21 and WFU-22 only: Re-install the fan.

WFU-01, WFU-02

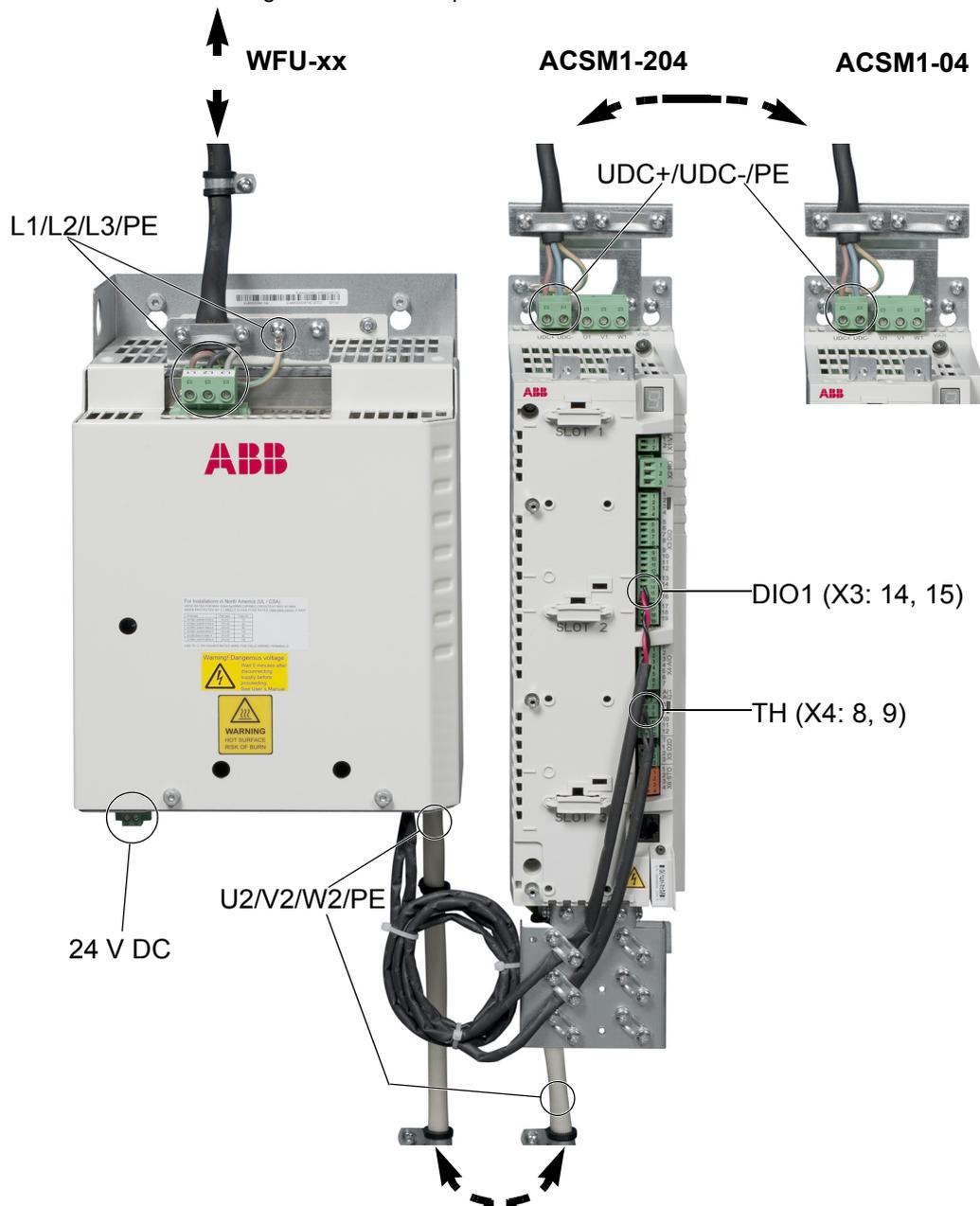


WFU-21, WFU-22



## Installation example

The figure below shows power and control connections in an installation example.



# Installation checklist

---

## Checklist

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

Check
<p><b>MECHANICAL INSTALLATION</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> The regen supply module and regen filter module types are correct and the filter is of the appropriate size for the supply module. (See <a href="#">Type code</a>, <a href="#">Technical data: Derating</a>, <a href="#">Ambient conditions</a>.)</li> <li><input type="checkbox"/> The ambient operating conditions are allowable. (See <a href="#">Mechanical installation</a>, <a href="#">Technical data: Regen supply module ratings</a>, <a href="#">Ambient conditions</a>.)</li> <li><input type="checkbox"/> The unit is fastened properly to the cabinet. (See <a href="#">Planning the cabinet assembly</a> and <a href="#">Mechanical installation</a>.)</li> <li><input type="checkbox"/> The cooling air will flow freely.</li> </ul> <p><b>ELECTRICAL INSTALLATION</b> (See <a href="#">Planning the electrical installation</a>, <a href="#">Electrical installation</a>.)</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> The VAR screw is removed if the regen supply module is connected to an IT (ungrounded) supply network.</li> <li><input type="checkbox"/> The screws labeled VARISTOR (1 screw) and FILTER (2 screws) are removed from the regen filter module.</li> <li><input type="checkbox"/> The capacitors are reformed if stored over one year (ask local ABB representative for more information).</li> <li><input type="checkbox"/> The regen supply module is grounded properly.</li> <li><input type="checkbox"/> The supply (input power) voltage matches the regen supply module nominal input voltage.</li> <li><input type="checkbox"/> The input cable is connected to L1/L2/L3 of the regen filter module and the terminals are tightened to specified torque.</li> <li><input type="checkbox"/> The U2/V2/W2 cable in the WFU-xx regen filter module is connected to U2/V2/W2 of the regen supply module and the terminals are tightened to specified torque.</li> <li><input type="checkbox"/> The DC supply cable is connected to UDC+/UDC- and the terminals are tightened to specified torque.</li> <li><input type="checkbox"/> Appropriate supply (input power) fuses and disconnecter are installed.</li> <li><input type="checkbox"/> Appropriate DC fuses are installed.</li> </ul>

**Check**

- The braking resistor (if present) is connected to R+/R-, and the terminals are tightened to specified torque.
- The external control connections to the JCU Control Unit are OK.
- There are no tools, foreign objects or dust from drilling inside the drive.
- The supply (input power) voltage cannot be applied to the output of the drive through a bypass connection.
- All covers are in place.

# 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 regen supply module requires very little maintenance. This table lists the routine maintenance intervals recommended by ABB.

Maintenance	Interval	Instruction
Capacitor reforming	Every year of storage	See <i>Reforming the DC capacitors of the regen supply module</i> .
Heatsink temperature check and cleaning	Depends on the dustiness of the environment (every 6 to 12 months)	See <i>Heatsink</i> .
Cooling fan change	<b>Every 6 years</b> if the ambient temperature does not exceed 40 °C (104 °F). <b>Every 3 years</b> if the ambient temperature is higher than 40 °C (104 °F).	See <i>Cooling fan</i> .
WFU-filter capacitors	<b>Every 12 years</b> if the ambient temperature does not exceed 40 °C (104 °F). <b>Every 6 years</b> if the ambient temperature is higher than 40 °C (104 °F) and cyclic heavy load or continuous nominal load.	See <i>Replacing the WFU-xx filter capacitor (WFU-21 and WFU-22)</i> .
WFU-filter cooling fan change	<b>Every 6 years</b> if the ambient temperature does not exceed 40 °C (104 °F). <b>Every 3 years</b> if the ambient temperature is higher than 40 °C (104 °F).	See <i>Replacing the cooling fan of the WFU filter</i> .

Consult your local ABB Service representative for more details on the maintenance. On the Internet, go to [www.abb.com/drives](http://www.abb.com/drives) and select *Drive Services – Maintenance and Field Services*.

## Heatsink

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

Clean the heatsink as follows (when necessary):

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

## Cooling fan

The actual lifespan of the cooling fan depends on the regen supply module usage and ambient temperature. Fan failure can be predicted by the increasing noise from fan bearings and the gradual rise in the heatsink temperature in spite of heatsink cleaning. If the regen supply module is operated in a critical part of a process, fan replacement is recommended once these symptoms start appearing. Replacement fans are available from ABB. Do not use other than ABB-specified spare parts.

### Fan replacement (Frames A and B)

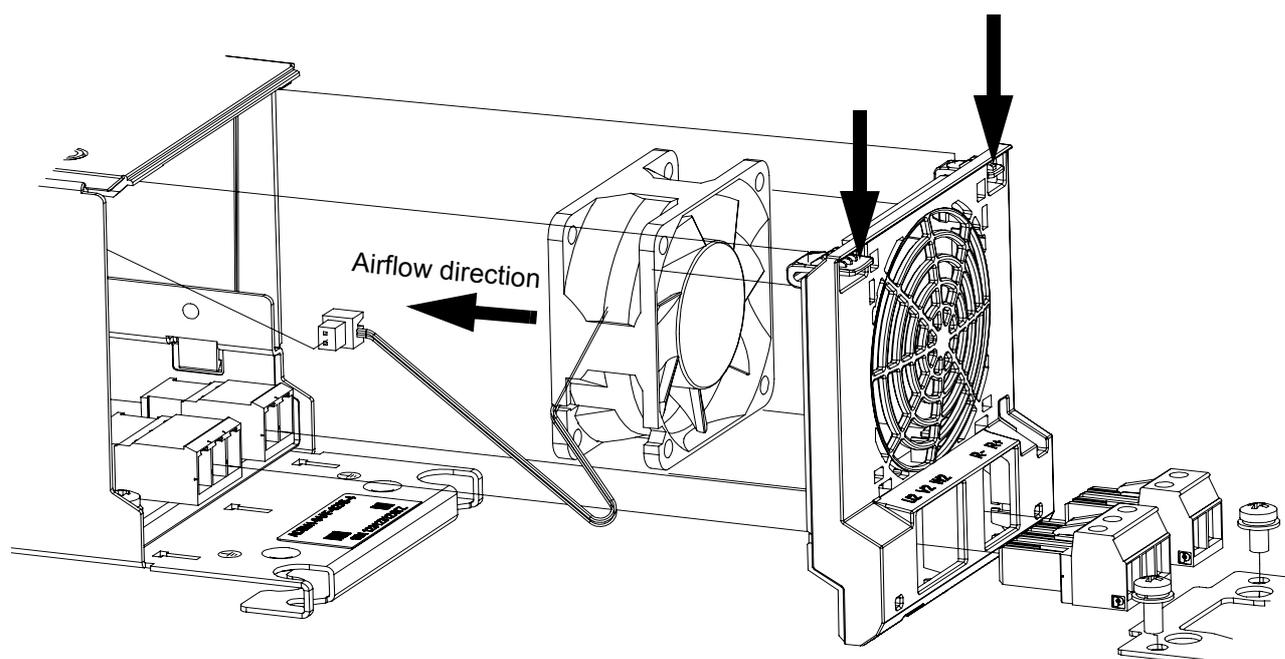
Detach the power cable clamp plate and terminal blocks. Release the retaining clips (arrowed) carefully using a screwdriver. Pull the fan holder out. Disconnect the fan cable. Carefully bend the clips on the fan holder to free the fan.

Install new fan in reverse order.

---

**Note:** The airflow direction is bottom-to-top. Install the fan so that the airflow arrow points up.

---



**Fan replacement (Frames C and D, ACSM1-204Ax-xxxx-x)**

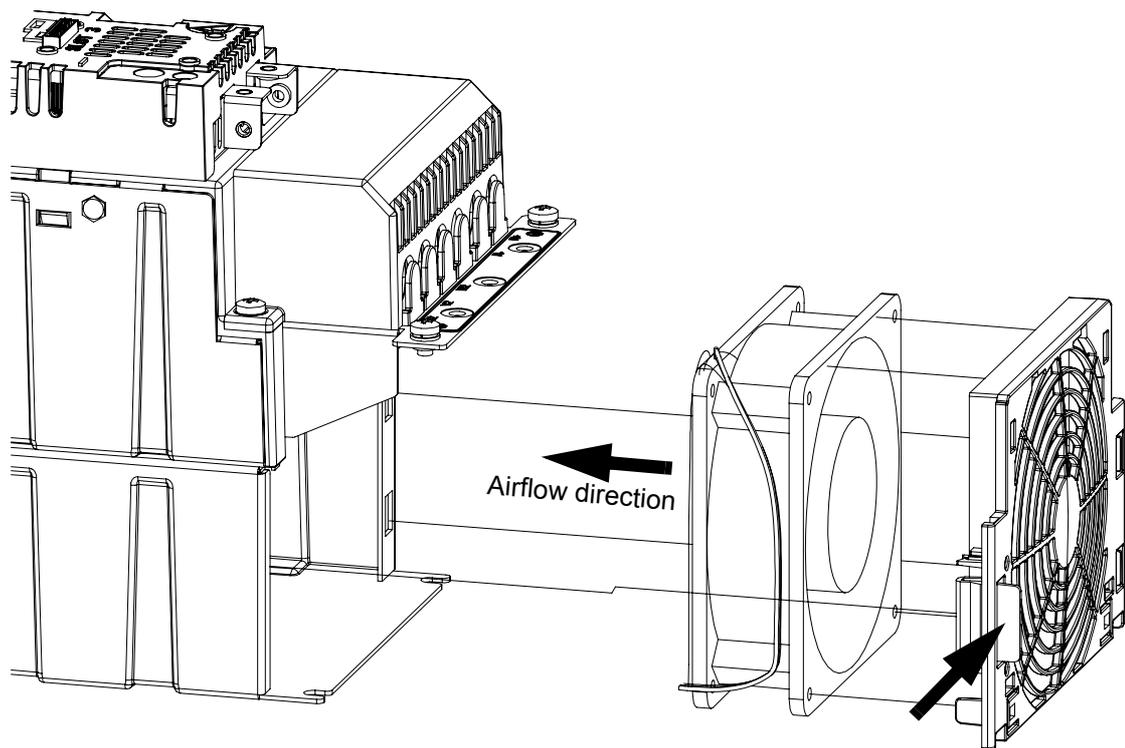
To remove the fan, release the retaining clip (arrowed) carefully using a screwdriver. Pull the fan holder out. Disconnect the fan cable. Carefully bend the clips on the fan holder to free the fan.

Install new fan in reverse order.

---

**Note:** The airflow direction is bottom-to-top. Install the fan so that the airflow arrow points up.

---



**Fan replacement (Frames C and D, ACSM1-204Cx-xxxx-x)**

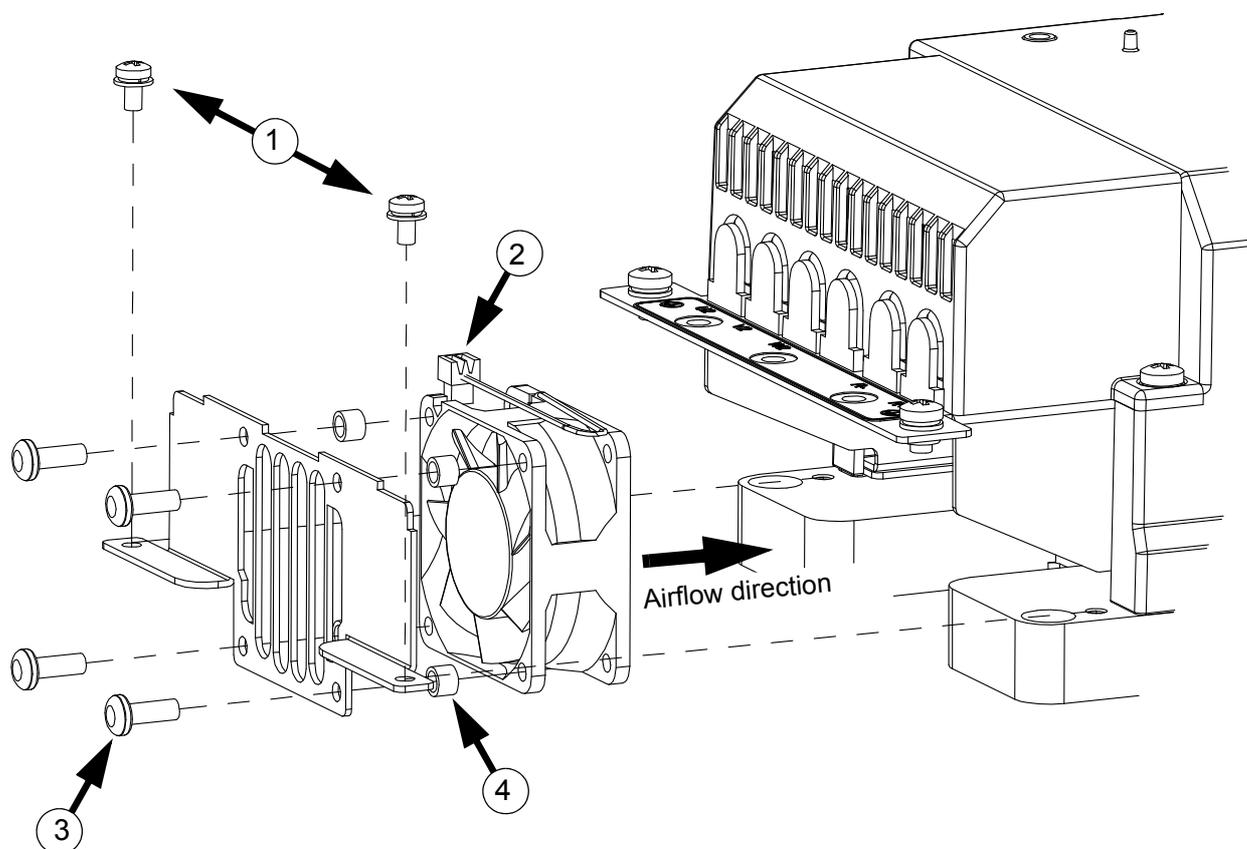
Unfasten the fan holder by removing the two screws marked (1) in the drawing below. Pull the fan holder out and disconnect the wire plug (2). Remove the four screws (3) to release the fan from the holder. Use the spacers (4) to mount the new fan.

Install new fan in reverse order.

---

**Note:** The airflow direction is bottom-to-top. Install the fan so that the airflow arrow points up.

---



## Replacing the cooling fan of the WFU filter

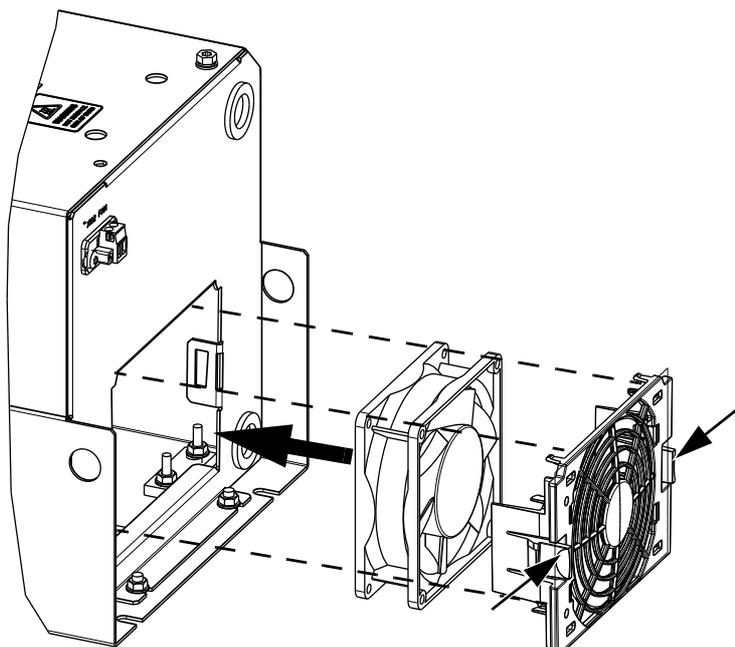
To remove the fan, release the retaining clips (arrowed). Pull the fan holder out. Disconnect the fan cable. Carefully bend the clips on the fan holder to free the fan. Install a new fan in reverse order.

---

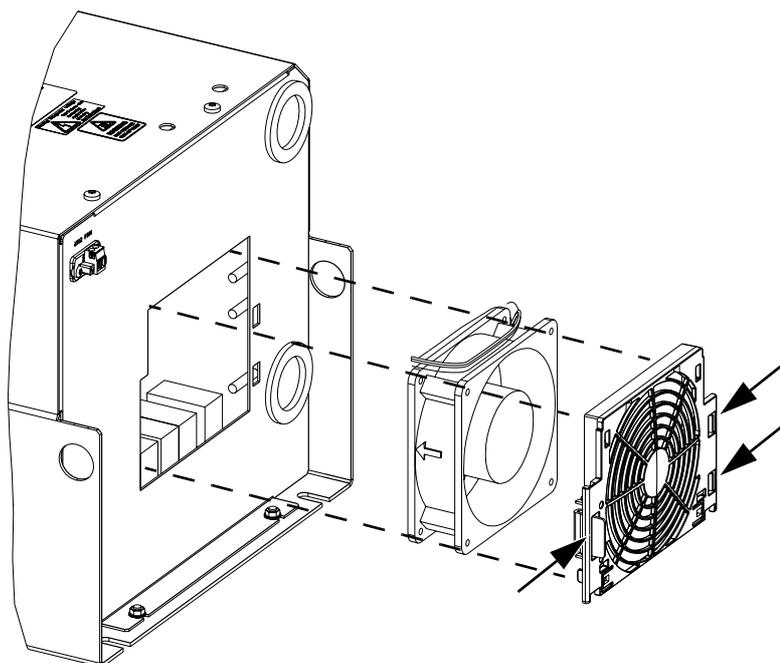
**Note:** The airflow direction is bottom-to-top. Install the fan so that the airflow arrow points up.

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WFU-01 and WFU-02



WFU-21 and WFU-22



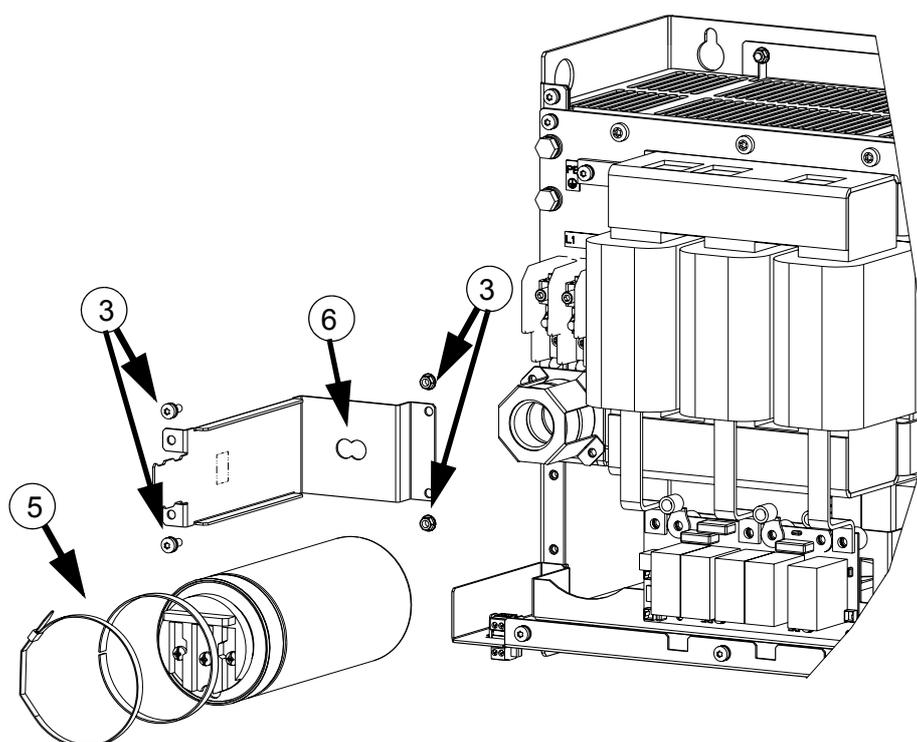
## Replacing the WFU-xx filter capacitor (WFU-21 and WFU-22)

1. Remove the cover.
2. Disconnect the three cables.
3. Unfasten the four screws.
4. Lift the capacitor out of the filter module.
5. Remove the rings.
6. Unfasten the nut at the bottom of the capacitor so you can detach the capacitor from the plate.
7. Install a new capacitor in opposite order.

---

**Note:** When installing a new capacitor, you can connect the three cables in any order.

---



## Reforming the DC capacitors of the regen supply module

The DC capacitors must be reformed if the regen supply module has been stored for a year or more. See page 33 for information on finding out the manufacturing date. For information on reforming the capacitors, contact your local ABB representative.

## Other maintenance actions

### Transferring the memory unit to a new regen supply module

When a regen supply module is replaced, the parameter settings can be retained by transferring the memory unit from the defective regen supply module to the new module.



**WARNING!** Do not remove or insert a memory unit when the regen supply module is powered.

After power-up, the regen supply module will scan the memory unit. If a different application program or different parameter settings are detected, they are copied to the regen supply module. This may take a few moments; the LED display will read “L” while copying is in progress.

## The 7-segment display on the JCU Control Unit

The following table describes the indications given by the 7-segment display on the JCU Control Unit. Multi-character indications are displayed as repeated sequences of characters.

Display	Meaning
L	Loading application program or data from the memory unit. This is the normal display immediately after powering up the regen supply module.
□	Normal operation – regen supply module stopped.
↻	(Rotating display) Normal operation – regen supply module running.
“E” followed by four-digit error code	System error. 9001, 9002 = Control unit hardware failure. 9003 = No memory unit connected. 9004 = Memory unit failure. 9007, 9008 = Loading of firmware from memory unit failed. 9009...9018 = Internal error. 9019 = Contents of memory unit corrupted. 9020 = Internal error. 9021 = Program versions of memory unit and regen supply module incompatible. 9102...9108 = Internal error.
“A” followed by four-digit error code	Alarm generated by the application program. For error codes, see the Firmware Manual.
“F” followed by four-digit error code	Fault generated by the application program. For error codes, see the Firmware Manual.

# Technical data

---

## What this chapter contains

This chapter contains the technical specifications of the regen supply module, e.g. the ratings, sizes and technical requirements, and provisions for fulfilling the requirements for CE and other markings.

## Regen supply module ratings

---

**Note:** All values are valid at an ambient temperature of 40 °C (104 °F) with default settings.

---

### Input connection (AC)

Supply module type ACSM1-204xR...	Frame size	Filter type	$S_N$ (kVA)	$I_2$ (A)		$I_{2max}$ (A)
				400 V AC	480 V AC	
-07A0-4	A	WFU-01	5.5	8	6.6	14.7
-016A-4	B	WFU-02	12.5	18	15	28
-031A-4	C	WFU-11	24	35	29	54
-046A-4	C	WFU-21	34	50	41	81
-090A-4	D	WFU-22	64	93	77	150

### Output connection (DC)

Supply module type ACSM1-204xR...	Frame size	Filter type	$P_{DC}$		$I_{DC}$ (A)	
			(kW)	(hp)	400 V AC	480 V AC
-07A0-4	A	WFU-01	5.3	7.2	9.2	7.7
-016A-4	B	WFU-02	12	16.3	21	17
-031A-4	C	WFU-11	23	31	40	34
-046A-4	C	WFU-21	33	45	57	48
-090A-4	D	WFU-22	61	83	106	89

$S_N$	Nominal input power.
$I_2$	Continuous input current at nominal power with defined supply voltage ( $U_2$ ).
$I_{2max}$	Maximum short-time input current.
$P_{DC}$	Nominal DC output power with supply voltage range 400...480 V AC.
$I_{DC}$	Continuous DC current at nominal power with defined supply voltage. $U_{DC} = 577$ V DC when $U_2 = 400$ V AC. $U_{DC} = 692$ V DC when $U_2 = 480$ V AC.

## Derating

The continuous output currents stated above must be derated if any of the following conditions apply:

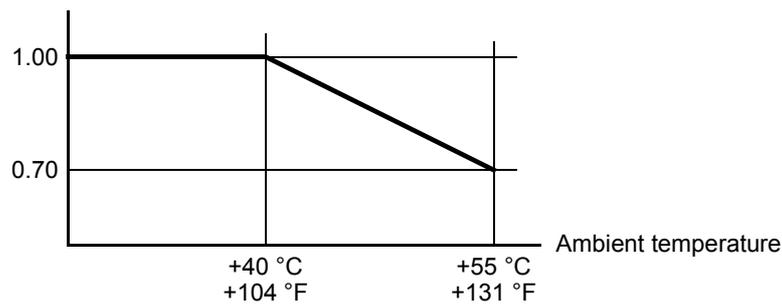
- the ambient temperature exceeds +40 °C (+104 °F)
- the regen supply module is installed higher than 1000 m above sea level.

**Note:** The final derating factor is a multiplication of all applicable derating factors.

### *Ambient temperature derating*

In the temperature range +40...55 °C (+104...131 °F), the continuous output current is derated linearly as follows:

Derating factor



### *Altitude derating*

At altitudes from 1000 to 4000 m (3300 to 13123 ft) above sea level, the derating is 1% for every 100 m (328 ft). For a more accurate derating, use the DriveSize PC tool.

**Note:** If the installation site is higher than 2000 m (6600 ft) above sea level, connection of the regen supply module to an ungrounded (IT) or corner-grounded delta network is not allowed.

## Dimensions and weights

See also the chapter [Dimension drawings](#).

### Regen supply module

Frame size	Height (without cable clamp plates) mm (in.)	Height (with cable clamp plates) mm (in.)	Width mm (in.)	Depth mm (in.)	Depth (with options installed on JCU) mm (in.)	Weight kg (lbs)
A	364 (14.33)	474 (18.66)	90 (3.54)	146 (5.75)	169 (6.65)	2.8 (6.2)
B	380 (14.96)	476 (18.74)	100 (3.94)	223 (8.78)	246 (9.69)	4.8 (10.6)
C	467 (18.39)	558 (21.97)	165 (6.50)	225 (8.86)	248 (9.76)	10 (22)
D	467 (18.39)	558 (21.97)	220 (8.66)	225 (8.86)	248 (9.76)	17 (37.5)

**Note:** The wiring to the I/O options requires some 50 mm (2") of additional depth.

### Regen filter module

Regen filter module	Height mm (in.)	Width mm (in.)	Depth mm (in.)	Weight kg (lbs)
WFU-01	315 (12.4)	213 (8.4)	218 (8.6)	11 (24.5)
WFU-02				14 (30.5)
WFU-11	386* (15.2)	288* (11.3)	272* (10.7)	35* (77.2)
WFU-21	406 (16.0)	318 (12.5)	299 (11.8)	45 (99.2)
WFU-22				51 (112.4)

\* Preliminary value

## Cooling characteristics, noise levels

Regen supply module	Regen filter module	Power loss W	Air flow (ACSM1-204A) m <sup>3</sup> /h	Air flow (ACSM1-204C) m <sup>3</sup> /h	Noise level dB
ACSM1-204...					
-07A0	WFU-01	220	24	-	60
-016A	WFU-02	500	48	-	60
-031A	WFU-11	970*	*	*	*
-046A	WFU-21	1390	200	24	71
-090A	WFU-22	2580	290	24	71

\* Preliminary value or value not available yet

### Cold plate cooling characteristics (ACSM1-204Cx-xxxx-x only)

The ratings stated at the beginning of this chapter are achieved provided that the hot-spot temperature of the cold plate is kept below 65 °C (140 °F) and that the regen supply module is installed according to the instructions in this manual.

A suitable cold plate is, for example, the Rittal DCP 8616.xxx (Direct Cooling Package) intended for Rittal TS8 enclosures. If the incoming coolant temperature is below 50 °C (122 °F), and the flow is at least 5 dm<sup>3</sup>/min, the cooling is adequate. The temperature rise of the coolant due to the regen supply module is approximately 1...2 K maximum.

The ACSM1-204Cx-xxxx-x has an internal fan to cool the circuit boards. The heat dissipation into air is approximately 200 W.

## Supply voltage requirements for the WFU-xx regen filter module fan

No fan supply is included the delivery. Choose a supply according to the following requirements for supply voltage and current.

Filter	Frame size	Supply voltage	Current demand, nominal
WFU-01	0	24V ± 5%	0.32A
WFU-02			
WFU-11	1		*
WFU-21	2		1.67A
WFU-22			
* Value not available yet			

## AC supply cable fuses

Fuses for short circuit protection of the supply cable are listed below. The fuses also protect the adjoining equipment of the regen supply module in case of a short circuit. Check that the operating time of the fuse is below 0.5 seconds. The operating time depends on the supply network impedance and the cross-sectional area and length of the supply cable. For information on cables, see [Power cables cross-section](#) on page 43. See also chapter [Planning the electrical installation](#).

**Note:** Do not use fuses with a higher current rating.

Supply module type ACSM1- 204xx...	Input current (A)	IEC fuse			UL fuse		
		Rated current (A)	Voltage (V)	Class	Rated current (A)	Voltage (V)	UL Class
-07A0-4	8	16	500	gG	15	600	T
-016A-4	18	25	500	gG	25	600	T
-031A-4	35	50	500	gG	50	600	T
-046A-4	50	80	500	gG	80	600	T
-090A-4	93	160	500	gG	150	600	T

PDM-00425726

## DC cable fuses

In the common DC system each DC connection must be equipped with fuses. Fuses are needed in both branches (+ / -). The recommended fuse current ratings based on the DC power ratings of regen supply modules are shown in the table below.

---

**Note:** Do not use fuses with a higher current rating.

---

Supply module type ACSM1- 204xx...	DC current (A)	IEC fuse			UL fuse		
		Rated current (A)	Voltage (V)	Class	Rated current (A)	Voltage (V)	Class
-07A0-4	9.2	16	690	aR	Values not available yet		
-016A-4	21	32	690	aR			
-031A-4	40	63	690	aR			
-046A-4	57	100	690	aR			
-090A-4	106	160	690	aR			

PDM-00425726

## AC input (supply) connection

---

<b>Voltage (<math>U_2</math>)</b>	380 ... 480 V AC $\pm 10\%$ , 3-phase
<b>Frequency</b>	50 ... 60 Hz $\pm 5\%$
<b>Network type</b>	Grounded (TN, TT) or ungrounded (IT). <b>Note:</b> Connection to an ungrounded (IT) or corner-grounded delta network is not allowed at altitudes of 2000 m (6600 ft) or higher.
<b>Imbalance</b>	Max. $\pm 3\%$ of nominal phase to phase input voltage
<b>Fundamental power factor (cos <math>\phi_1</math>)</b>	1.0 (power factor controlled to this value with default settings)
<b>Terminals</b>	Frame A: Detachable screw terminal block for 0.25 ... 4 mm <sup>2</sup> wire. Frame B: Detachable screw terminal block for 0.5 ... 6 mm <sup>2</sup> wire. Frames C and D: Screw lugs for 6...70 mm <sup>2</sup> wire included. Suitable crimp lugs can be used instead.
<b>Harmonic distortion</b>	Harmonic distortion / Line current: THD (Total harmonic distortion) < 5 % k (Distortion factor) < 5 %

## DC connection

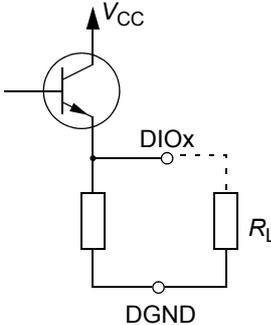
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<b>Voltage (<math>U_{DC}</math>)</b>	548 ... 692 V DC $\pm 10\%$ ( $U_{DC} > 1.44 \cdot U_2$ )
<b>Ratings</b>	See <a href="#">Regen supply module ratings</a> on page 69.
<b>Terminals</b>	Frame A: Detachable screw terminal block for 0.25 ... 4 mm <sup>2</sup> wire. Frame B: Detachable screw terminal block for 0.5 ... 6 mm <sup>2</sup> wire. Frames C and D: Screw lugs for 6...70 mm <sup>2</sup> wire included. Suitable crimp lugs can be used instead.
<b>Maximum number of drive modules</b>	Combined nominal power demand of the drive modules connected to the DC bus may not exceed the power rating of the supply modules. Check also the charging capacity of the supply modules as instructed in <a href="#">Checking the charging capacity</a> on page 38.
<b>Maximum DC cable length</b>	Maximum DC cable length between the supply module (ACSM1-204) and drive module (ACSM1-04) is 10 m.

## JCU Control Unit

---

<b>Power supply</b>	24 V ( $\pm 10\%$ ) DC, 1.6 A Supplied from the power unit of the regen supply module, or from external power supply through connector X1 (pitch 3.5 mm, wire size 1.5 mm <sup>2</sup> ).
<b>Relay output (X2)</b>	Connector pitch 5 mm, wire size 2.5 mm <sup>2</sup> 250 V AC / 30 V DC, 2 A Protected by varistors
<b>Digital inputs DI1...DI6 (X3)</b>	Connector pitch 3.5 mm, wire size 1.5 mm <sup>2</sup> Logic levels: "0" < 5 V, "1" > 15 V $R_{in}$ : 2.0 kohm Filtering: Adjustable, 0.25 ms min. (see also <i>Firmware Manual</i> )

<p><b>Digital inputs/outputs</b> <b>DIO1...DIO3 (X3).</b></p> <p>Input/output mode selection by parameters.</p> <p>DIO2 can be configured as a frequency input (0...32 kHz). DIO3 can be configured as a frequency output. See <i>Firmware Manual</i>, parameter group 12.</p>	<p>Connector pitch 3.5 mm, wire size 1.5 mm<sup>2</sup></p> <p><u>As inputs:</u> Logic levels: "0" &lt; 5 V, "1" &gt; 15 V <math>R_{in}</math>: 2.0 kohm Filtering: Adjustable, 0.25 ms min. (see also <i>Firmware Manual</i>)</p> <p><u>As outputs:</u> Total output current limited by auxiliary voltage outputs to 200 mA Output type: Open emitter</p>
	
<p><b>Analogue inputs AI1 and AI2 (X4).</b></p> <p>Current/voltage input mode selection by jumpers. See page 55.</p>	<p>Connector pitch 3.5 mm, wire size 1.5 mm<sup>2</sup></p> <p>Current input: -20...20 mA, <math>R_{in}</math>: 100 ohm Voltage input: -10...10 V, <math>R_{in}</math>: 200 kohm Differential inputs, common mode <math>\pm 20</math> V Sampling interval per channel: 0.25 ms Filtering: Adjustable, 0.25 ms min. (see also <i>Firmware Manual</i>) Resolution: 11 bit + sign bit Inaccuracy: 1% of full scale range</p>
<p><b>Thermistor input (X4)</b></p>	<p>Connector pitch 3.5 mm, wire size 1.5 mm<sup>2</sup></p> <p>Input devices: PTC or KTY84 thermistor Up to three PTCs can be connected in series KTY84 thermistor: Inaccuracy 5 °C No safety insulation (see page 47)</p>
<p><b>Analogue outputs AO1 and AO2 (X4)</b></p>	<p>Connector pitch 3.5 mm, wire size 1.5 mm<sup>2</sup></p> <p>AO1 (current): 0...20 mA, <math>R_{load} &lt; 500</math> ohm AO2 (voltage): -10...10 V, <math>R_{load} &gt; 1</math> kohm Frequency range: 0...800 Hz Resolution: 11 bit + sign bit Inaccuracy: 2% of full scale range</p>
<p><b>Reference voltage (VREF) for analogue inputs</b></p>	<p>Connector pitch 3.5 mm, wire size 1.5 mm<sup>2</sup></p> <p>10 V <math>\pm 1\%</math> and -10 V <math>\pm 1\%</math>, <math>R_{load} &gt; 1</math> kohm</p>
<p><b>Drive to drive link (X5)</b></p>	<p>Connector pitch 3.5 mm, wire size 1.5 mm<sup>2</sup></p> <p>Physical layer: RS-485 Termination by jumper</p>
<p><b>X6 terminal block</b></p>	<p>Connector pitch 3.5 mm, wire size 1.5 mm<sup>2</sup></p> <p>For the regen supply module to start, both connections (OUT1 to IN1, and OUT2 to IN2) must be closed</p>
<p><b>Control panel / PC connection (X7)</b></p>	<p>Connector: RJ-45 Cable length &lt; 3 m</p>

## Efficiency

Approximately 96% at nominal power level (combined value with ACSM1-204 and WFU-xx)

## Cooling

<b>Method</b>	Internal fan, flow from bottom to top. Air-cooled heatsink, or cold plate mounting.
<b>Free space around the unit</b>	See chapter <a href="#">Planning the cabinet assembly</a> .

## Degrees of protection

IP20 (UL open type). See chapter [Planning the cabinet assembly](#).

## Ambient conditions

Environmental limits for the regen supply module are given below. The regen supply module is to be used in a heated, indoor, controlled environment.

	<b>Operation</b> installed for stationary use	<b>Storage</b> in the protective package	<b>Transportation</b> in the protective package
<b>Installation site altitude</b>	0 to 4000 m (6600 ft) above sea level. [See also section <a href="#">Altitude derating</a> on page 70.]	-	-
<b>Air temperature</b>	-10 to +55°C (14 to 131°F). No frost allowed. See section <a href="#">Derating</a> on page 70.	-40 to +70°C (-40 to +158°F)	-40 to +70°C (-40 to +158°F)
<b>Relative humidity</b>	0 to 95%	Max. 95%	Max. 95%
	No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.		
<b>Contamination levels</b> (IEC 60721-3-3, IEC 60721-3-2, IEC 60721-3-1)	No conductive dust allowed. According to IEC 60721-3-3: Chemical gases: Class 3C2 Solid particles: Class 3S2 The regen supply module must be installed in clean air according to enclosure classification. Cooling air must be clean, free from corrosive materials and electrically conductive dust.	According to IEC 60721-3-1: Chemical cases: Class 1C2 Solid particles: Class 1S2	According to IEC 60721-3-2: Chemical cases: Class 2C2 Solid particles: Class 2S2
<b>Sinusoidal vibration</b> (IEC 60721-3-3)	Tested according to IEC 60721-3-3, mechanical conditions: Class 3M4 2...9 Hz: 3.0 mm (0.12") 9...200 Hz: 10 m/s <sup>2</sup> (33 ft/s <sup>2</sup> )	-	-
<b>Shock</b> (IEC 60068-2-27, ISTA 1A)	-	According to ISTA 1A. Max. 100 m/s <sup>2</sup> (330 ft/s <sup>2</sup> ), 11 ms	According to ISTA 1A. Max. 100 m/s <sup>2</sup> (330 ft/s <sup>2</sup> ), 11 ms
<b>Free fall</b>	Not allowed	76 cm (30")	76 cm (30")

## Materials

<b>Regen supply module enclosure</b>	<ul style="list-style-type: none"> <li>PC/ABS, colour NCS 1502-Y (RAL 9002 / PMS 420 C)</li> <li>hot-dip zinc coated steel sheet</li> <li>extruded aluminium AlSi.</li> </ul>
<b>Packaging</b>	Corrugated cardboard, PP bands.

**Disposal**

The regen supply module 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 contain electrolyte, which is classified as hazardous waste within the EU. They must be removed and handled according to local regulations.

For further information on environmental aspects and more detailed recycling instructions, please contact your local ABB distributor.

**Applicable standards**


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	The regen supply module complies with the following standards, provided that only ACSM1-04 drives (frame sizes A-D) are used with them. The compliance with the European Low Voltage Directive is verified according to standards EN 50178 and EN 60204-1.
• EN 50178 (1997)	Electronic equipment for use in power installations
• IEC 60204-1 (2005), modified	Safety of machinery. Electrical equipment of machines. Part 1: General requirements. <i>Provisions for compliance:</i> The final assembler of the machine is responsible for installing - an emergency-stop device - a supply disconnecting device - the ACSM1-204 into a cabinet.
• EN 60529: 1991 (IEC 60529)	Degrees of protection provided by enclosures (IP code)
• IEC 60664-1 (2007), Edition 2.0	Insulation coordination for equipment within low-voltage systems. Part 1: Principles, requirements and tests.
• IEC 61800-3 (2004)	Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods.
• EN 61800-5-1 (2003)	Adjustable speed electrical power drive systems. Part 5-1: Safety requirements. Electrical, thermal and energy <i>Provisions for compliance:</i> The final assembler of the machine is responsible for installing the ACSM1-204 in a cabinet that is protected to IP2X (IP3X for top surfaces for vertical access). Approval pending.
• UL 508C (2002), Third Edition	UL Standard for Safety, Power Conversion Equipment.
• NEMA 250 (2008)	Enclosures for Electrical Equipment (1000 Volts Maximum)
• CSA C22.2 No. 14-05 (2005)	Industrial Control Equipment. Approval pending.

## CE marking

A CE mark is attached to the regen supply module to verify that the regen supply module 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 2004/108EC).

### Compliance with the European Low Voltage Directive

The compliance with the European Low Voltage Directive has been verified according to standards EN 50178, EN 61800-5-1 and EN 60204-1.

### Compliance with the European EMC Directive

The cabinet builder is in responsible for the compliance of the drive system with the European EMC Directive. For information on items to consider, see:

- Subsections [Compliance with EN 61800-3 \(2004\), category C2](#); [Compliance with EN 61800-3 \(2004\), category C3](#); and [Compliance with EN 61800-3 \(2004\), category C4](#) below
- The chapter [Planning the electrical installation](#) in this manual
- *Technical Guide No. 3 – EMC Compliant Installation and Configuration for a Power Drive System* (3AFE61348280 [English]).

### Definitions

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

*First environment* includes domestic premises. It also includes establishments directly connected without intermediate transformers to a low-voltage network which supplies buildings used for domestic purposes.

*Second environment* includes all establishments other than those directly connected to a low-voltage network which supplies buildings used for domestic purposes.

*Drive of category C2.* Power drive system with rated voltage less than 1000 V which is neither a plug-in device nor a movable device and, when used in the first environment, is intended to be installed and commissioned only by a professional.

*Drive of category C3.* Power drive system with rated voltage less than 1000 V, intended for use in the second environment and not intended for use in the first environment.

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

### Compliance with EN 61800-3 (2004), category C2

The regen supply module meets the requirements of the EMC Directive with the following provisions:

1. The regen supply module is equipped with a WFU-xx regen filter module of the correct type.
2. The motor and control cables are selected as specified in the chapter [Planning the electrical installation](#) in the *ACSM1-04 Drives Hardware Manual* (3AFE68797543 [English]).
3. The supply cable, DC cable and control cables are selected as specified in the chapter [Planning the electrical installation](#).
4. The regen supply module and regen filter module are installed according to the instructions given in this manual, and the drive(s) have been installed according to instructions given in their respective hardware manual.
5. The regen supply module, regen filter module and drive(s) are installed on the same conductive back wall.
6. The regen supply module is used as a supply unit for motor ACSM1-04 drive(s), frame sizes A...D.

7. Total motor cable length of drives connected to the DC bus does not exceed the following values:

Supply module type ACSM1-204xx...	Filter type	Max. length	
		Frame size of the drives connected to DC bus:	
		A and B frames only	A...D
-07A0-4	WFU-01	100 m	n/a*
-016A-4	WFU-02	100 m	n/a*
-031A-4	WFU-11	**	**
-046A-4	WFU-21	150 m	50 m
-090A-4	WFU-22	150 m	50 m

\* These supply module types cannot be used with drives of frame sizes C...D.  
\*\* Values not available yet.



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

### Compliance with EN 61800-3 (2004), category C3

The regen supply module meets the requirements of the EMC Directive with the following provisions:

1. The regen supply module is equipped with a WFU-xx regen filter module of the correct type.
2. The motor and control cables are selected as specified in the chapter *Planning the electrical installation* in the *ACSM1-04 Drives Hardware Manual* (3AFE68797543 [English]).
3. The supply cable, DC cable and control cables are selected as specified in the chapter *Planning the electrical installation*.
4. The regen supply module and regen filter module are installed according to the instructions given in this manual, and the drive(s) have been installed according to instructions given in their respective hardware manual.
5. The regen supply module, regen filter module and drive(s) are installed on the same conductive back wall.
6. The regen supply module is used as a supply unit for motor ACSM1-04 drive(s), frame sizes A...D.
7. Total motor cable length of drives connected to the DC bus does not exceed the following values:

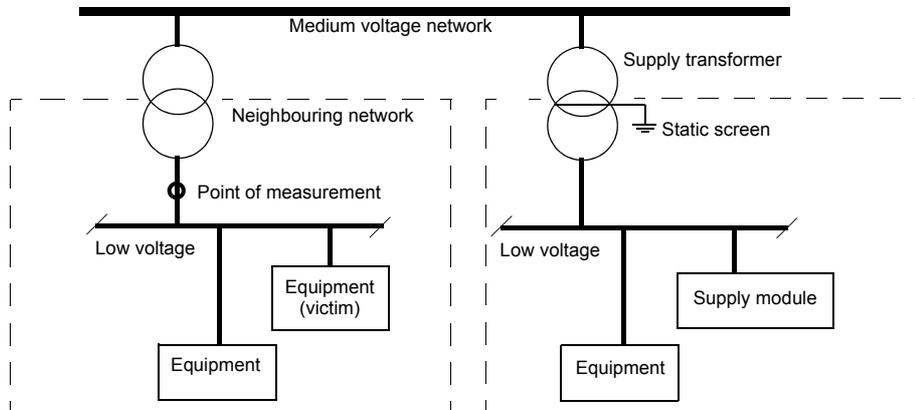
Supply module type ACSM1-204xx...	Filter type	Max. length	
		Frame size of the drives connected to DC bus:	
		A and B frames only	A...D
-07A0-4	WFU-01	100 m	n/a*
-016A-4	WFU-02	100 m	n/a*
-031A-4	WFU-11	**	**
-046A-4	WFU-21	150 m	100 m
-090A-4	WFU-22	150 m	100 m

\* These supply module types cannot be used with drives of frame sizes C...D.  
\*\* Values not available yet.

### Compliance with EN 61800-3 (2004), category C4

The regen supply module meets the requirements of the EMC Directive with the following provisions:

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



2. An EMC plan for preventing disturbances is drawn up for the installation. A template is available from the local ABB representative.
3. The motor cables are selected as specified in the chapter *Planning the electrical installation* in the *ACSM1-04 Drives Hardware Manual*.
4. The DC and control cables are selected as specified in the chapter *Planning the electrical installation*.
5. The regen supply module is installed according to the instructions given in this manual.

## Compliance with the Machinery Directive

The regen supply module is intended to be incorporated into machinery to constitute machinery covered by Machinery Directive (98/37/EC) and does therefore not in every respect comply with the provisions of the directive. For more information, see the Declaration of Incorporation by ABB Drives (code 6884199).

## C-Tick marking

See the type designation label for the valid markings of your drive.

C-Tick marking is required in Australia and New Zealand. A C-Tick mark is attached to the drive to verify compliance with the relevant standard (IEC 61800-3 (2004) – Adjustable speed electrical power drive systems – Part 3: EMC product standard including specific test methods), mandated by the Trans-Tasman Electromagnetic Compatibility Scheme.

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

### Compliance with IEC 61800-3 (2004)

See page [78](#).

## UL marking

See the type designation label for the valid markings of your regen supply module.

## UL checklist

**Input power connection** – See section [AC input \(supply\) connection](#) on page 74.

**Disconnecting device (Disconnecting means)** – See section [Main contactor](#) on page 39.

**Ambient conditions** – The regen supply module is to be used in a heated indoor controlled environment. See section [Ambient conditions](#) on page 76 for specific limits.

**Input cable fuses** – For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code (NEC) and any applicable local codes. To fulfill this requirement, use the UL classified fuses given in section [AC supply cable fuses](#) on page 72.

For installation in Canada, branch circuit protection must be provided in accordance with the Canadian Electrical Code and any applicable provincial codes. To fulfil this requirement, use the UL classified fuses given in section [AC supply cable fuses](#) on page 72.

**Power cable selection** – See section [Selecting the power cables](#) on page 42.

**Power cable connections** – For the connection diagram and tightening torques, see section [Power and control cable connection](#) on page 48.

**Control connections** – For the connection diagram and tightening torques, see section [Connecting the control cables](#) on page 54.

**Overload protection** – The regen supply module provides overload protection in accordance with the National Electrical Code (US).

**Braking** – The ACSM1-204 has an internal braking chopper. When applied with appropriately sized braking resistors, the braking chopper will allow the regen supply module to dissipate regenerative energy (normally associated with quickly decelerating a motor). Braking resistor selection is discussed in the chapter [Resistor braking](#) on page 83.

**UL standards** – See section [Applicable standards](#) on page 77.

## U.S. patents

This product is protected by one or more of the following US patents:

4,920,306	5,301,085	5,463,302	5,521,483	5,532,568	5,589,754
5,612,604	5,654,624	5,799,805	5,940,286	5,942,874	5,952,613
6,094,364	6,147,887	6,175,256	6,184,740	6,195,274	6,229,356
6,252,436	6,265,724	6,305,464	6,313,599	6,316,896	6,335,607
6,370,049	6,396,236	6,448,735	6,498,452	6,552,510	6,597,148
6,600,290	6,741,059	6,774,758	6,844,794	6,856,502	6,859,374
6,922,883	6,940,253	6,934,169	6,956,352	6,958,923	6,967,453
6,972,976	6,977,449	6,984,958	6,985,371	6,992,908	6,999,329
7,023,160	7,034,510	7,036,223	7,045,987	7,057,908	7,059,390
7,067,997	7,082,374	7,084,604	7,098,623	7,102,325	7,109,780
7,164,562	7,176,779	7,190,599	7,215,099	7,221,152	7,227,325
7,245,197	7,250,739	7,262,577	7,271,505	7,274,573	7,279,802
7,280,938	7,330,095	7,349,814	7,352,220	7,365,622	7,372,696
7,388,765	D503,931	D510,319	D510,320	D511,137	D511,150
D512,026	D512,696	D521,466	D541,743S	D541,744S	D541,745S
D548,182S	D548,183S				

Other patents pending.



# Resistor braking

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## What this chapter contains

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

## Braking choppers and resistors with the ACSM1-204

The regen supply module is used for feeding braking energy back to the network, and thus a braking resistor is usually not needed. However, if it is possible that the braking capacity of the regen supply module is temporarily exceeded, a braking resistor may be installed to increase braking capacity.

---

**Note:** Braking resistor(s) can also be installed to the ACSM1-04 drive(s) connected to the same dc-bus.

---

### Braking choppers

ACSM1-204 regen supply modules have a built-in braking chopper as standard equipment. The regen supply module controls the DC-bus voltage and keeps it within limits by default. However, if the braking capacity of the regen supply module is exceeded during braking, the DC-bus voltage increases.

When the braking chopper is enabled and a resistor is connected, the chopper starts conducting when the DC-link voltage of the regen supply module reaches 780 V. The maximum braking power is achieved at 840 V.

The braking chopper of a regen supply module or drive connected to the DC bus can be used to increase the braking capacity of the system to, for example, cover peaks in the braking capacity.

### Braking resistor selection

Pre-selected resistors are available from ABB as shown in the table below. If the listed resistor is not sufficient for the application, a custom resistor can be selected within the limits imposed by the internal braking chopper of the ACSM1-204. The following rules apply:

- The resistance of the custom resistor must be at least  $R_{\min}$ . The braking power capacity with different resistance values can be calculated from the following formula

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

where UDC equals 840 V.



**WARNING!** Never use a braking resistor with a resistance below the value specified for the particular regen supply module type. The regen supply module and the chopper are not able to handle the overcurrent caused by the low resistance.

- The maximum braking power must not exceed  $P_{brmax}$  at any point
- The average braking power must not exceed  $P_{brcont}$
- The braking energy must not exceed the energy dissipation capacity of the selected resistor
- It is highly recommended that the resistor be protected from thermal overload; see the section [Contactor protection of regen supply module](#) below.

### Chopper data / Resistor selection table

The ratings apply at an ambient temperature of 40°C (104°F).

Supply module type ACSM1-204xx...	Internal braking chopper			Example braking resistor			
	$P_{brcont}$ (kW)	$P_{brmax}$ (kW)	$R_{min}$ (ohm)	Type	$R$ (ohm)	$P_n$ (W)	$E_{pulse}$ (kJ)
-07A0-4	2.6	5.5	120	JBR-01 (Danotherm CAR 155 D T 414 120R)	120	105	22
-016A-4	9.0	14.6	40	JBR-04 (Danotherm CBR-V 210 D T 415 40R)	40	360	73
-031A-4	18.0	30.7	20	JBR-05 (Danotherm CBR-V 330 D T 415 20R)	20	570	77
-046A-4	26.4	43.9	13	JBR-06	13	790	132
-090A-4				(Danotherm CBR-V 460 D HT 415 13R)			

PDM-425726

$P_{brcont}$  The internal chopper will withstand this continuous braking power. The braking is considered continuous if the braking time exceeds 30 seconds.

$P_{brmax}$  Maximum braking power of the chopper. The chopper will withstand this braking power for 1 second within every 10 seconds. **Note:** The listed resistors will withstand this braking power for 1 second within every 120 seconds.

$R_{min}$  The minimum allowed resistance of the braking resistor.

$R$  Resistance of the listed resistor.

$P_n$  Continuous power (heat) dissipation of the listed resistor when cooled naturally in a vertical position.

$E_{pulse}$  Energy pulse the listed resistor will withstand.

The braking resistors are protected to IP20. Refer to page 99 for dimensions, wire sizes and tightening torques for the resistors.

## Resistor installation and wiring

All resistors must be installed outside the regen supply module in a place where they are cooled sufficiently, do not block the airflow to other equipment, or dissipate hot air into the air inlets of other equipment.



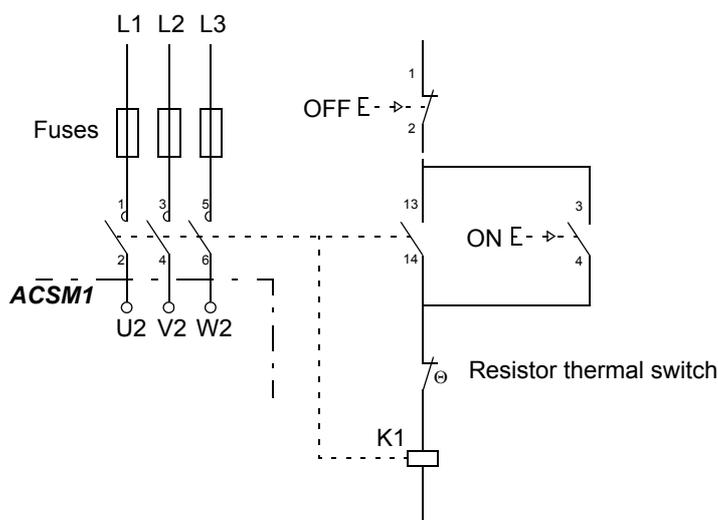
**WARNING!** The materials near the braking resistor must be non-flammable. The surface temperature of the resistor may rise above 200 °C (400 °F), and the temperature of the air flowing from the resistor is hundreds of degrees Celsius. Protect the resistor against contact.

The maximum length of the resistor cable(s) is 20 m (65 ft). For the connections, see section [Power and control cable connection](#) on page 48.

### Contactor protection of regen supply module

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

Below is a simple example wiring diagram.



## Braking circuit commissioning

For more information, see the appropriate *Firmware Manual*.

- Enable the braking chopper function. Please note that a braking resistor must be connected when the chopper is enabled
- Switch off the overvoltage control of the regen supply module
- Adjust any other relevant parameters in group 48.



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

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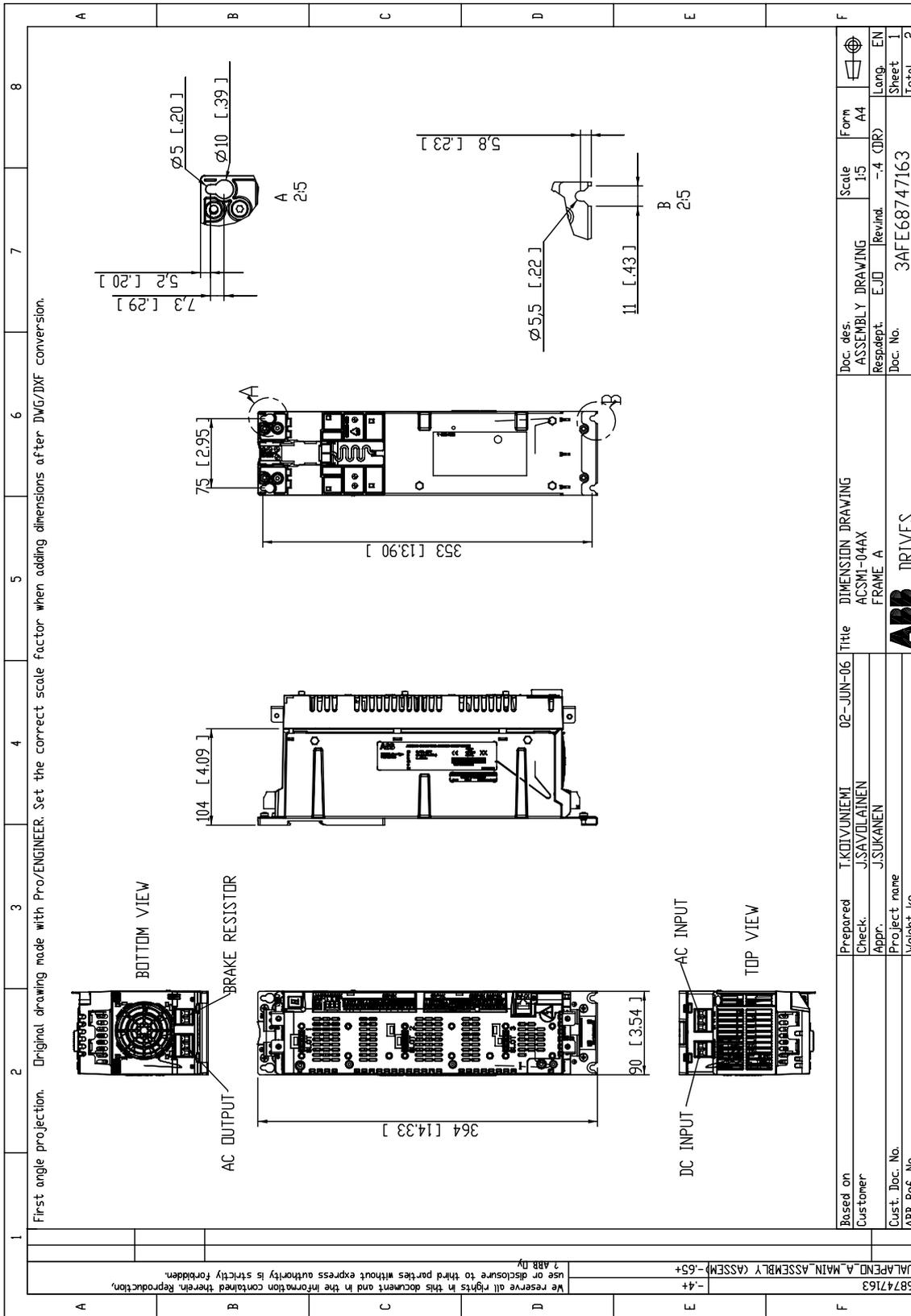
# Dimension drawings

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## What this chapter contains

Dimension drawings of the ACSM1-204 and related accessories are shown below. The dimensions are given in millimetres and [inches].

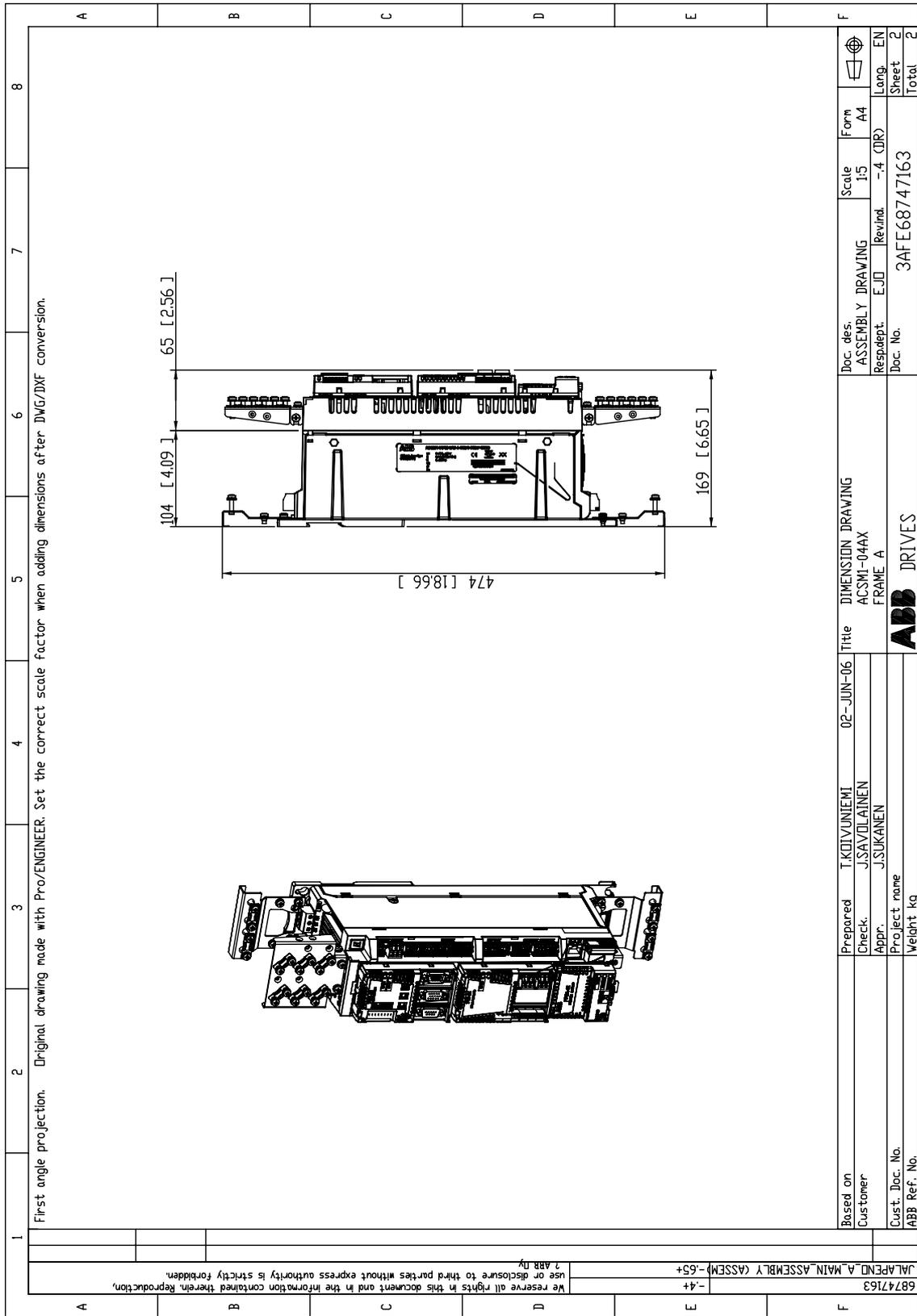
Frame size A



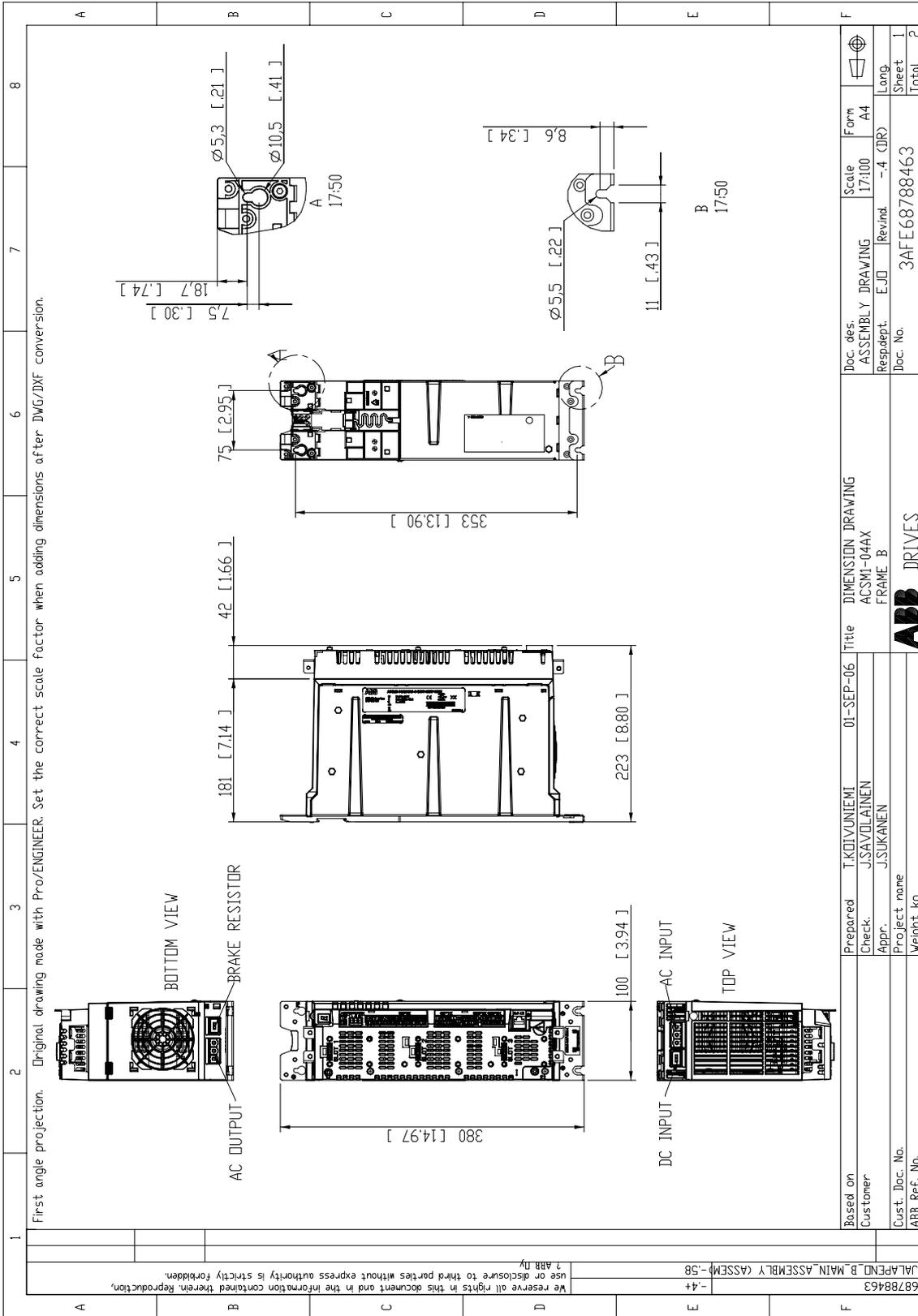
1 First angle projection. 2 Original drawing made with Pro/ENGINEER. Set the correct scale factor when adding dimensions after DWG/DXF conversion.

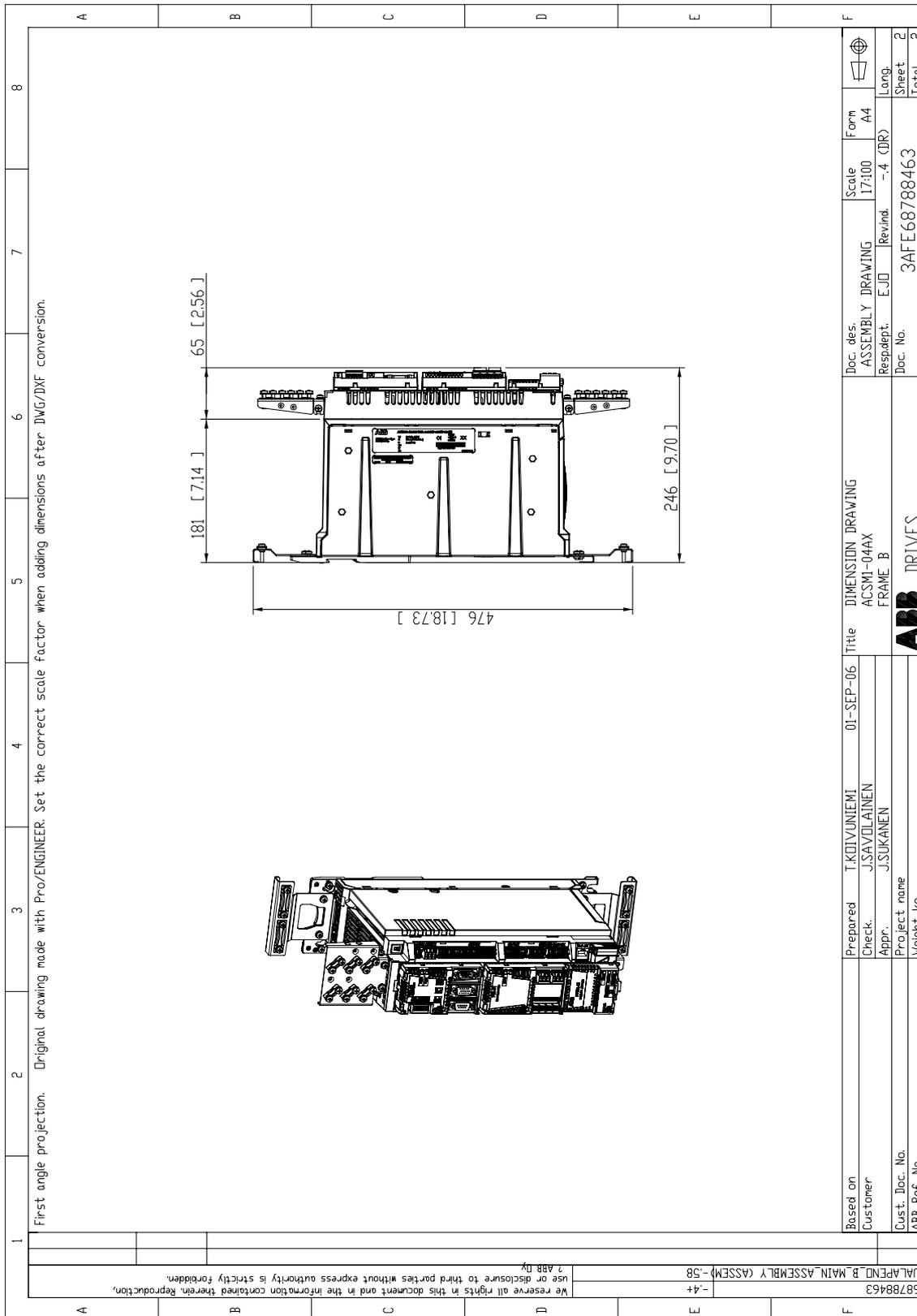
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Doc. des.	ASSEMBLY DRAWING	Scale	1:5	Form	A4
Responsible	EJU	Revised	-4 (DR)	Long.	EN
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				Total	2



# Frame size B



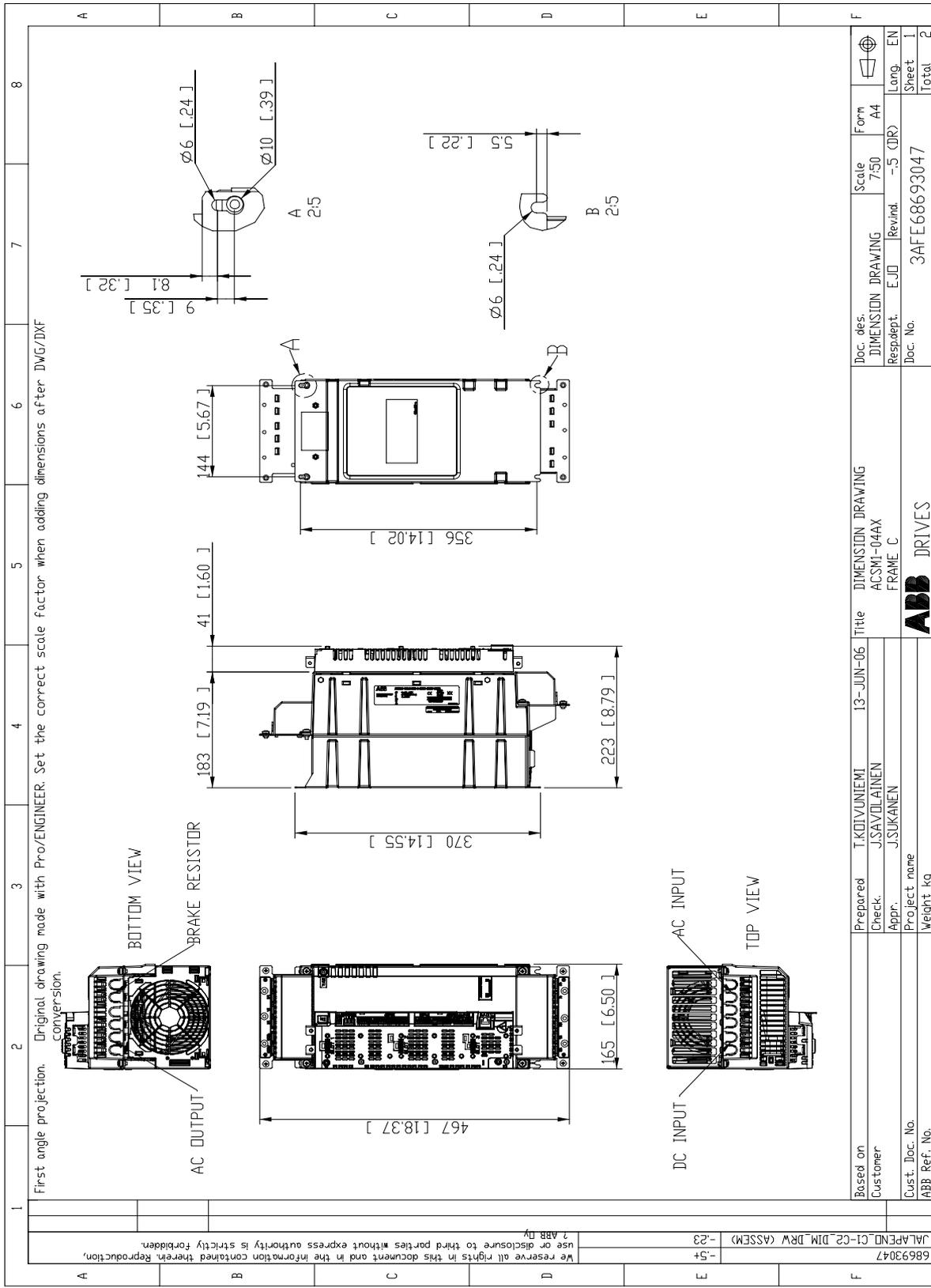


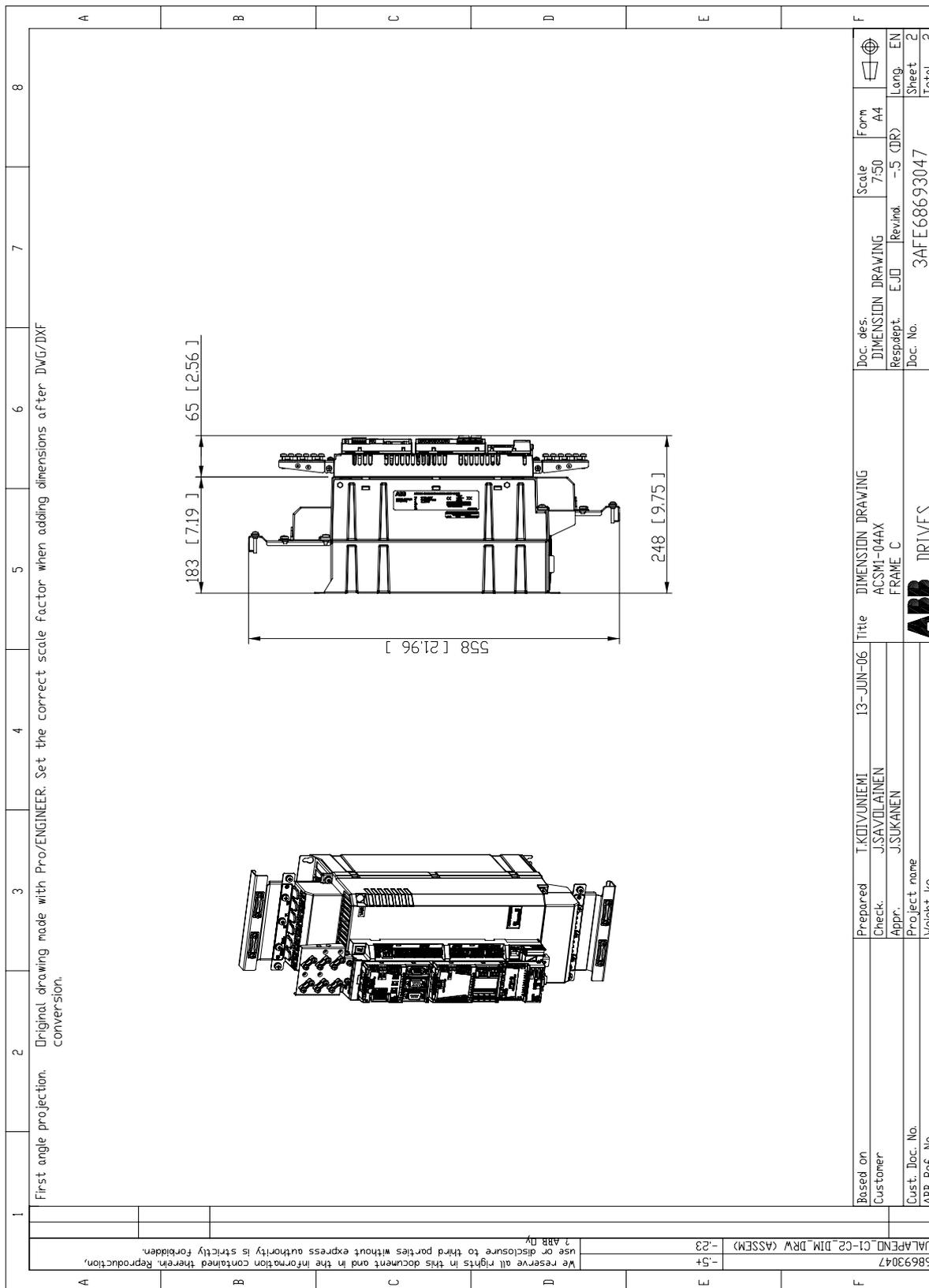
1 First angle projection. Original drawing made with Pro/ENGINEER. Set the correct scale factor when adding dimensions after DWG/DXF conversion.

JALAPEND_B_MAIN_ASSEMBLY (ASSEM) -58	-4+	We reserve all rights in this document and in the information contained therein. Reproduction, use or disclosure to third parties without express authority is strictly forbidden. © ABB Oy
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Cust. Doc. No. 68788463	Check JSAYDLAINEN	01-SEP-06	Resdept. EJD	-4 (DR)	Lang. Sheet 2	
ABB Ref. No.	Appr. JSUKAINEN	Project name	Doc. No. 3AFE68788463		Total 2	

# Frame size C (air-cooled module)

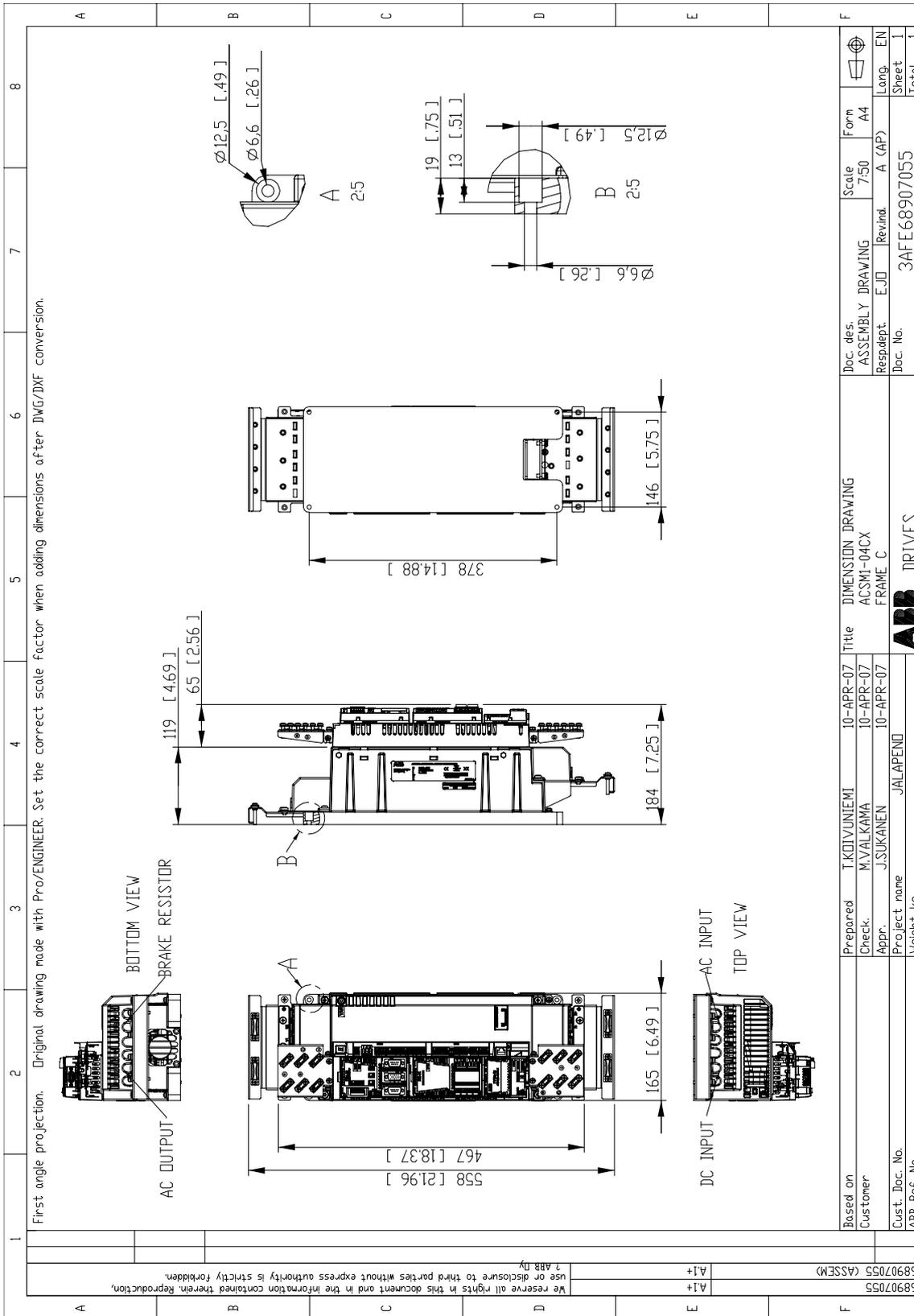




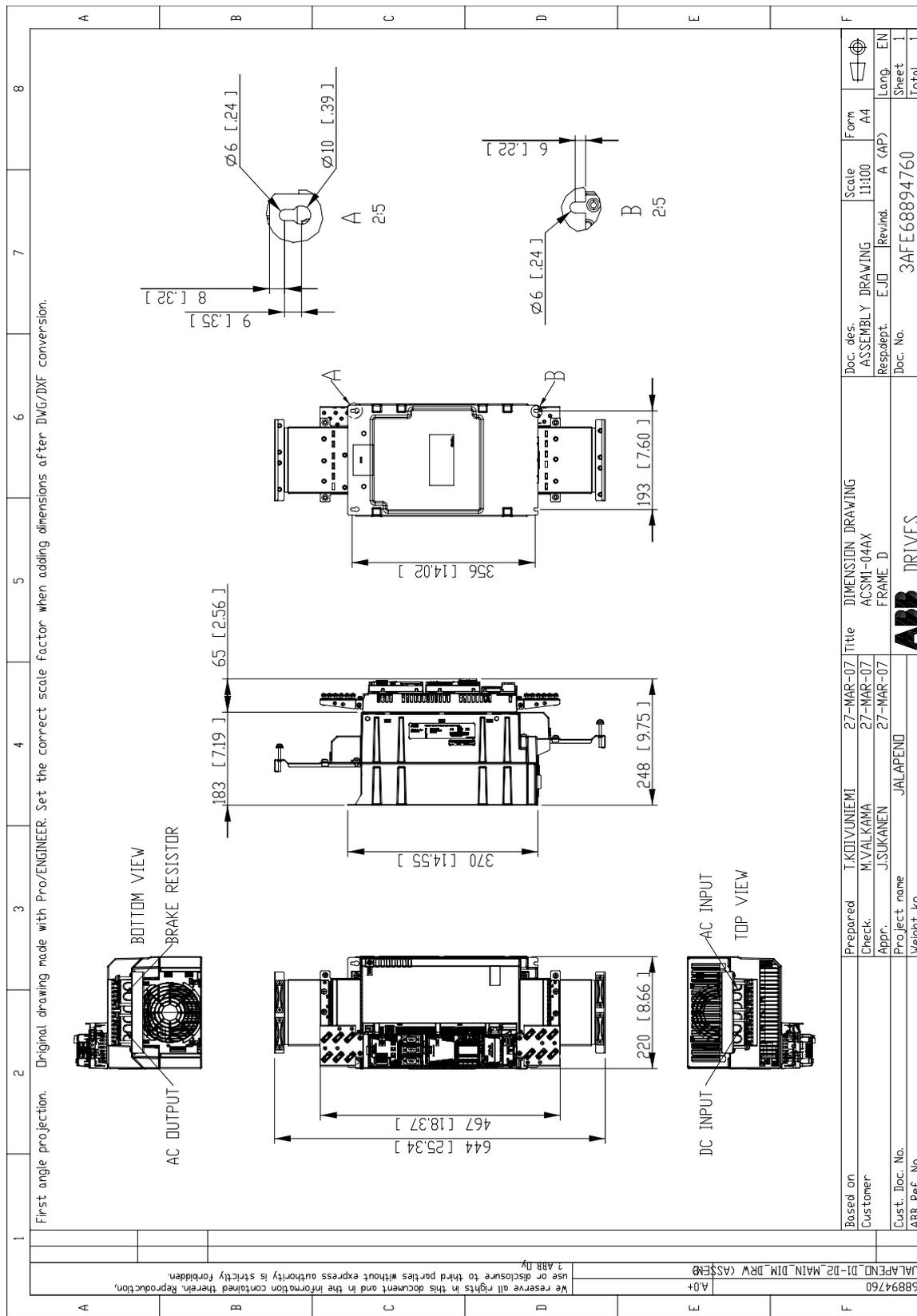
1 First angle projection. Original drawing made with Pro/ENGINEER. Set the correct scale factor when adding dimensions after DWG/DXF conversion.

68693047		JALAPENDI C1-C2 DIM DRW (ASSEMB)		-23		ABB Oy	
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Based on Customer		Prepared T.KOIVUNIEMI		13-JUN-06		Title DIMENSION DRAWING	
Customer		Check. J.SAVOLAINEN		ACSMI-04AX		Doc. des. DIMENSION DRAWING	
Cust. Doc. No.		Appr. JSUKANEN		FRAME C		Responsible E.JU	
ABB Ref. No.		Project name		3AFE68693047		Scale 7:50	
		Weight kg		ABB DRIVES		Form A4	
						Rev. -5 (DR)	
						Doc. No. 3AFE68693047	
						Lang. EN	
						Sheet 2	
						Total 2	

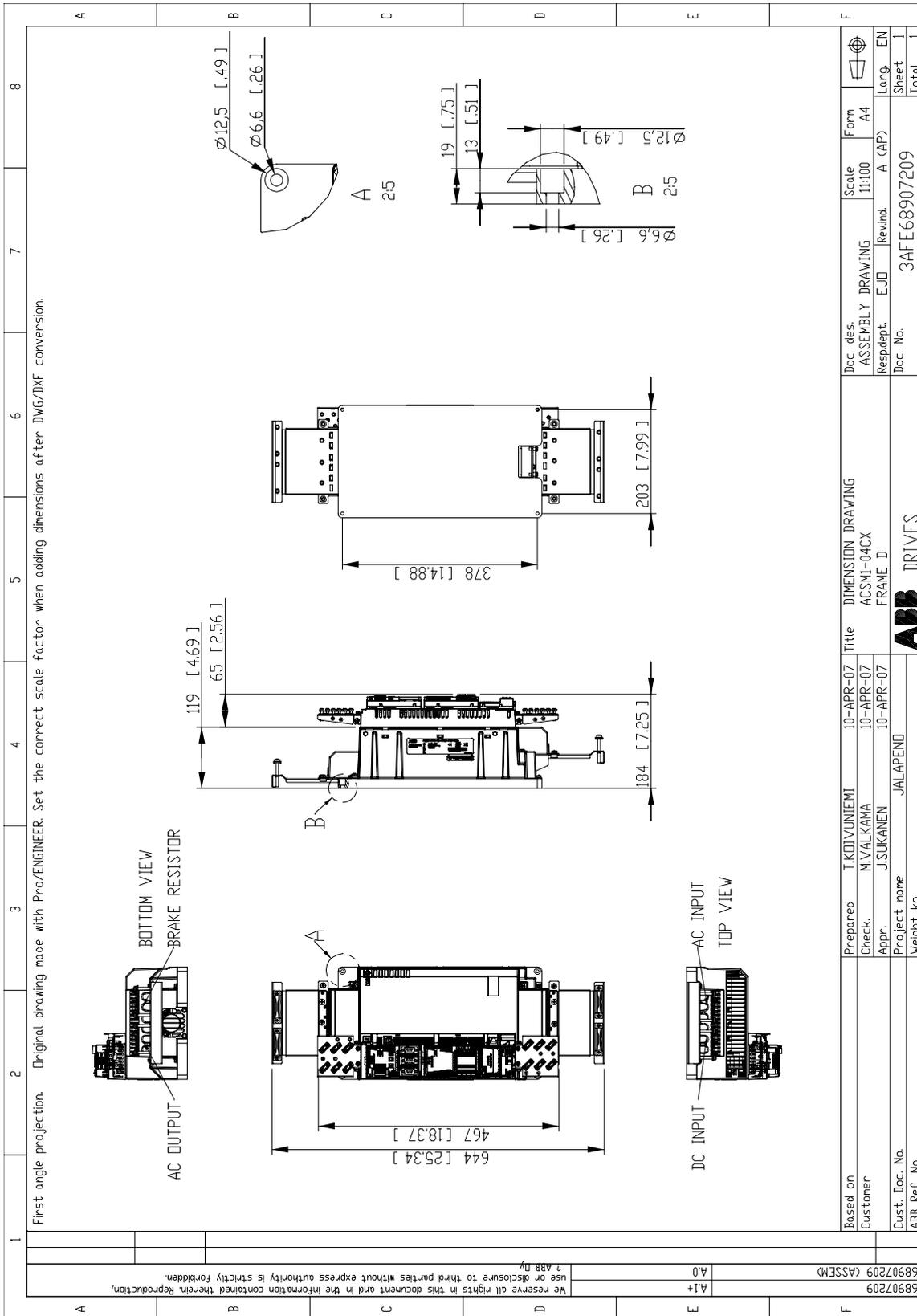
# Frame size C (for cold plate mounting)



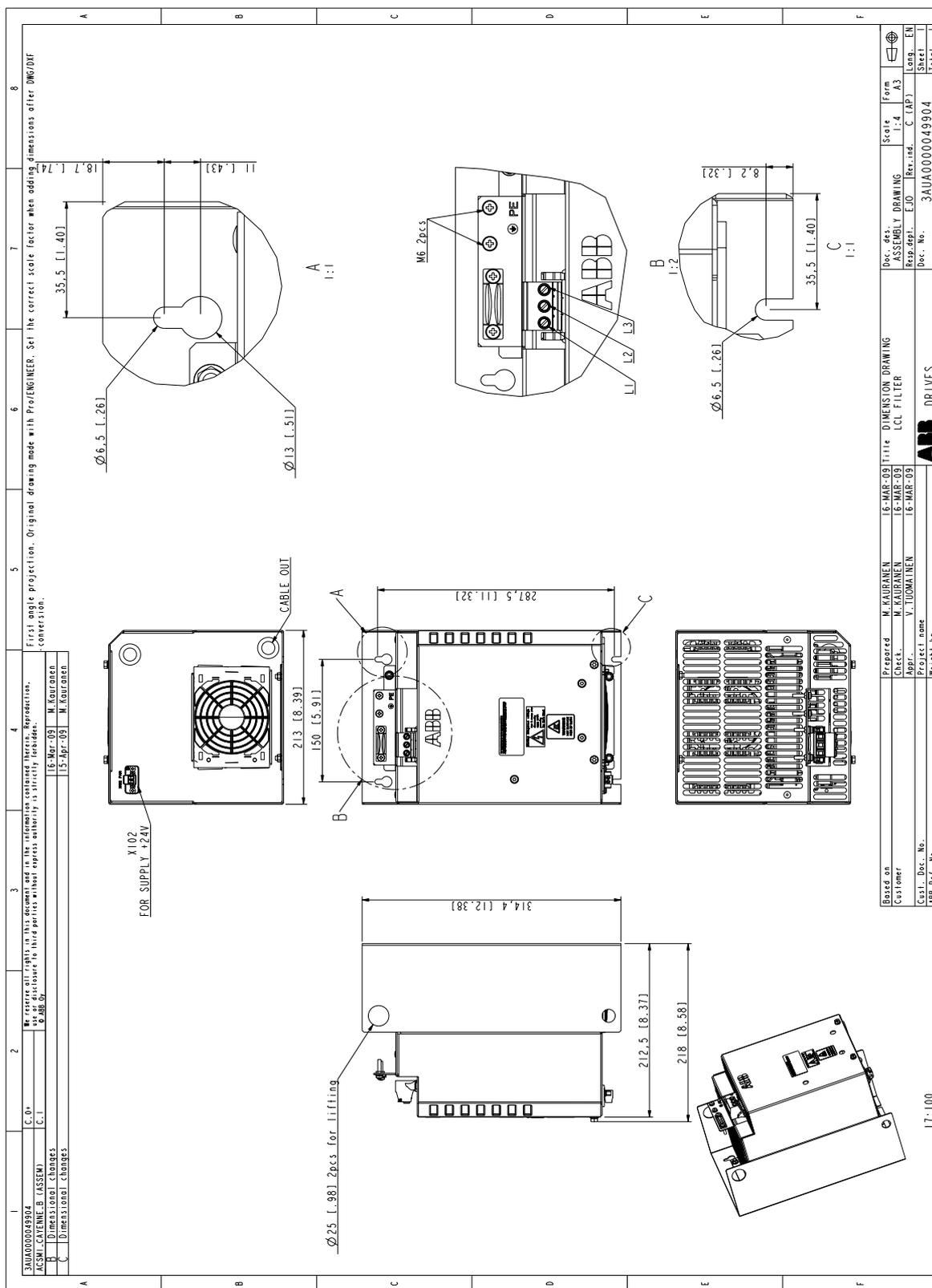
# Frame size D (air-cooled module)



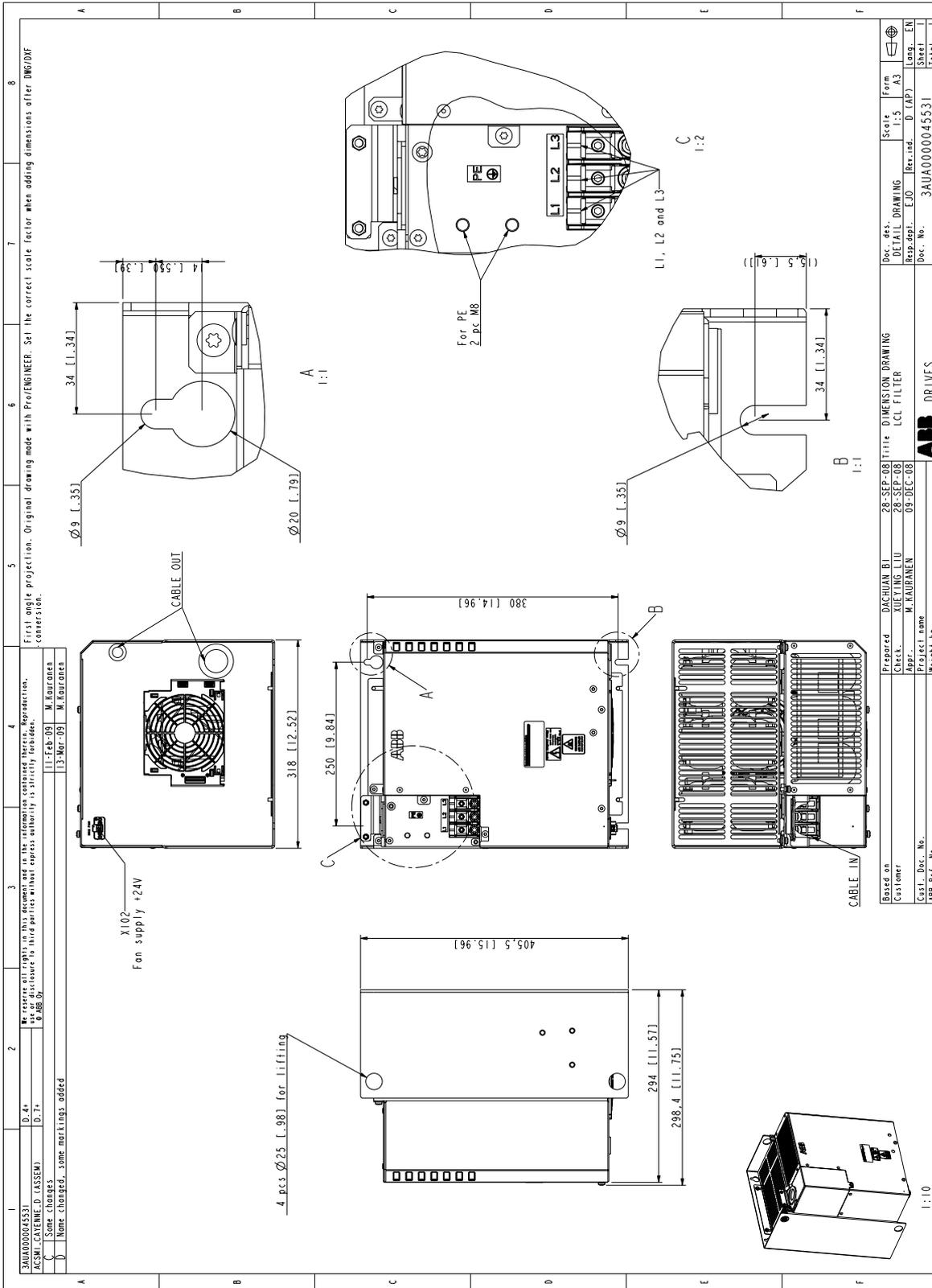
# Frame size D (for cold plate mounting)



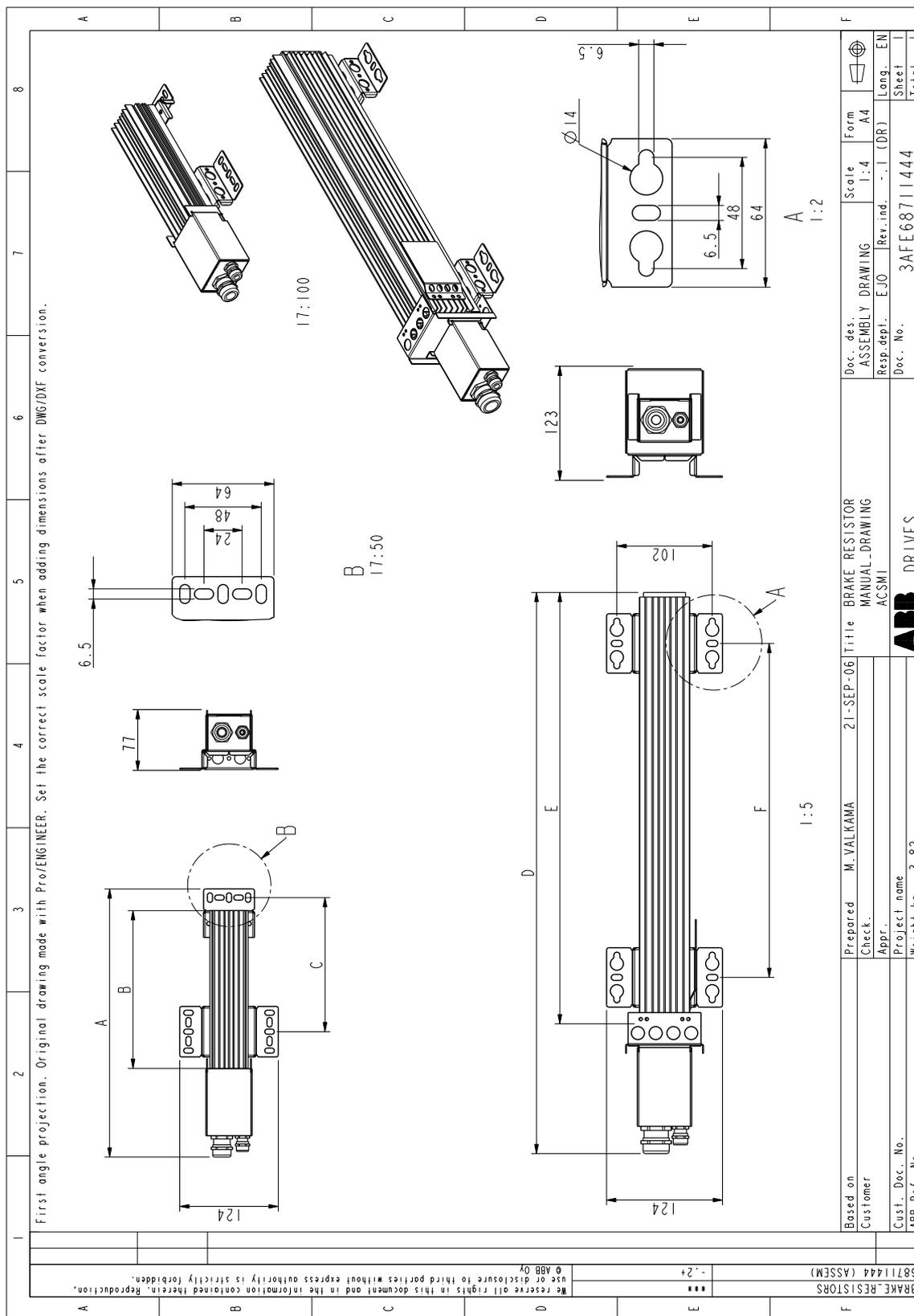
# Regen filter module (types WFU-01 and WFU-02)



# Regen filter module (types WFU-21 and WFU-22)



# Braking resistors (type JBR-xx)



<b>JBR-xx dimensions</b>						
<b>Parameter</b>	<b>Resistor type</b>					
	<b>JBR-01</b>	<b>JBR-03</b>	<b>JBR-04</b>	<b>JBR-05</b>	<b>JBR-06</b>	
Dim. <b>A</b> mm (in.)	295 (11.61)	340 (13.39)	-	-	-	-
Dim. <b>B</b> mm (in.)	155 (6.10)	200 (7.87)	-	-	-	-
Dim. <b>C</b> mm (in.)	125 (4.92)	170 (6.69)	-	-	-	-
Dim. <b>D</b> mm (in.)	-	-	345 (13.58)	465 (18.31)	595 (23.43)	
Dim. <b>E</b> mm (in.)	-	-	210 (8.27)	330 (12.99)	460 (18.11)	
Dim. <b>F</b> mm (in.)	-	-	110 (4.33)	230 (9.06)	360 (14.17)	
<b>Weight</b> kg (lbs)	0.75 (1.7)	0.8 (1.8)	1.8 (4.0)	3.0 (6.6)	3.9 (8.6)	
<b>Max. wire size – Main terminals</b>	10 mm <sup>2</sup> (AWG6)					
<b>Tightening torque – Main terminals</b>	1.5 ... 1.8 N·m (13 ... 16 lbf·in)					
<b>Max. wire size – Thermal switch terminals</b>	4 mm <sup>2</sup> (AWG12)					
<b>Tightening torque – Thermal switch terminals</b>	0.6 ... 0.8 N·m (5.3 ... 7.1 lbf·in)					





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