ROBOTICS

Product manual

IRC5 Panel Mounted Controller

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Product manual

IRC5 Panel Mounted Controller

Design 14

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Original instructions.

Table of contents

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Overview of this manual

About this manual

This manual contains instructions for:

- installing the controller, mechanically as well as electrically.
- maintenance of the controller.
- mechanical and electrical repair of the controller.

Usage

This manual should be used during:

- installation and preparation work.
- maintenance work.
- repair work.

Who should read this manual?

This manual is intended for:

- installation personnel.
- maintenance personnel.
- repair personnel.

Prerequisites

Maintenance/repair/installation personnel working with an ABB Robot must:

- be trained by ABB and have the required knowledge of mechanical and electrical installation/repair/maintenance work.

References

Reference	Document ID
Product manual - IRC5	*3HAC047136-001*
Operating manual - Emergency safety information	*3HAC027098-001*
Operating manual - IRC5 with FlexPendant	*3HAC050941-001*
Operating manual - RobotStudio	*3HAC032104-001*
Operating manual - Getting started, IRC5 and RobotStudio	*3HAC027097-001*
Operating manual - Troubleshooting IRC5	*3HAC020738-001*
Application manual - MultiMove	*3HAC050961-001*
Application manual - Additional axes and standalone controller	*3HAC051016-001*
Application manual - Force Control	*3HAC050377-001*
Application manual - SafeMove1	*3HAC050974-001*
Application manual - Electronic Position Switches	*3HAC050996-001*
Application manual - Functional safety and SafeMove2	*3HAC052610-001*
Technical reference manual - RAPID Instructions, Functions and Data types	*3HAC050917-001*
Technical reference manual - System parameters	*3HAC050948-001*

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Reference	Document ID
Product specification - Controller IRC5	*3HAC047400-001*
See *Circuit diagrams on page 273*.	

Note

The document numbers that are listed for software documents are valid for RobotWare 6. Equivalent documents are available for RobotWare 5.

Revisions

Revision	Description
-	First edition. Released with the new computer unit, DSQC1000.
A	• Added information on how to install an additional drive module, see *Installation of additional Drive Module on page 117*.
B	• Added the MultiMove switch to the spare parts list, see *Controller parts on page 253*. • Added information on how to route the cables at installation.
C	• New computer unit, DSQC1018, with two PCI slots and no knockout plates. No functional change, but affects illustrations. • Added new section, *Additional cables on page 272*, with drive module cables. • Clarified the use of the WAN port in section *Connectors on the computer unit on page 82*.
D	• Some changes on how the ports can be configured and used is described in section *Connectors on the computer unit on page 82*.
E	Release 15.2. • Minor corrections. • Added safety-related information related to mode switch keys, *Installation of external enabling device on page 121*, *Function tests on page 148*, and *Refurbish*. • Updates in section *Applicable standards on page 244*. • Added section *Safety data on page 18*.
F	Release 16.2. • Added IRB 1200 and 8700 to lists of robots in different places in the manual. • Changed recommended line fusing for some robots at low voltage. • Simplified procedure in section *Replacement of fieldbus adapter in the computer unit on page 179*. • Added information that function tests should be performed after replacing a component. • Changes in the article names for some spare parts. • Updated cable list with revised option numbers in section *Cables customer power/customer signal on page 268*. • Removed section *Refurbish*.

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Revision	Description
G	Release 17.1. • Added sections *Function test of reduced speed control on page 157*, and *About emergency stop on page 29*. • Updated descriptions of stops in section *Protective stop and emergency stop on page 27*. • Updated section *Safety data on page 18*. • Updated list of labels in section *Safety symbols on controller labels on page 24*. • New computer unit DSQC1024 is introduced, see *Computer unit parts on page 257*. • Added limitation about SafeMove in section *Connection of Drive Module Disconnect, by limit switch on page 99*. • Minor corrections.
H	Release 17.2. • Updated list of applicable standards. • Removed all references to computer unit DSQC1024.
J	Release 18.1. • Added section *FlexPendant parts on page 259*. • Safety section restructured. • Added information about disposal of storage media. • Clarified the limitations for Isolated Lan 3 in the section *Isolated LAN 3 or LAN 3 as part of the private network (only for RobotWare 6.01 and later) on page 84*.
K	Release 18.2. • New computer unit DSQC1024 added, see *Computer unit parts on page 257*. • Added note in section *Replacement of SD-card memory in computer unit on page 187*, that SD-card from DSQC1018 cannot be used in DSQC1024.
L	Published in release 19B. The following updates are made in this revision: • Updated spare parts numbers for manipulator cables. • Added sections *Conveyor tracking module on page 115*, *Installation of conveyor tracking module on page 124*, and *Power supply system requirements on page 64*. • Outer dimensions for local I/O units added in section *Scalable I/O devices on page 256*. • Added information in *Connecting cables to the controller on page 58*. • Added information about delays on safety inputs in *Protective stop and emergency stop on page 27*.
M	Published in release 19C. The following updates are made in this revision: • Added information about FlexPendant cables, see *Handling the FlexPendant cables on page 81*.
N	Published in release 19D. The following updates are made in this revision: • Section *Installation of additional Drive Module on page 117* updated with limitations regarding drive unit installations.
P	Published in release 20B. The following updates are made in this revision: • Information regarding power supply system requirements has been improved in sections *Isolation transformer on page 65* and *Mains line filter on page 66*.

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Revision	Description
Q	Published in release 20D. The following updates are made in this revision: • SD card 3HAC061416-003 that is used with computer DSQC1024 added in spare part list for *Computer unit parts on page 257*. • Article numbers for signal cables updated in *Manipulator cables on page 261*.
R	Published in release 21A. The following updates are made in this revision: • Minor corrections in section *Connectors on the computer unit on page 82*. • Local I/O replaced by Scalable I/O in entire manual. • Information added about China RoHS, see *Environmental information on page 240*. • Spare part numbers corrected for manipulators IRB 1600 and 2400 in section *Manipulator cables on page 261*.
S	Published in release 21B. The following updates are made in this revision: • Added a new section on Closing the Automatic Stop circuit, see *Closing the Automatic Stop circuit*.
T	Published in release 21C. The following updates are made in this revision: • The reference to the Euromap circuit diagram is updated to new article number. • Added information, see *AC current in CP/CS on page 59*.
U	Published in release 21D. The following updates are made in this revision: • Updated safety data.
V	Published in release 22A. The following updates are made in this revision: • Updated information about humidity, see *Operating conditions on page 45* and *Storage conditions on page 45*. • Added note about networks and Connected Services, see *Isolated LAN 3 or LAN 3 as part of the private network (only for RobotWare 6.01 and later) on page 84*.
W	Published in release 22C. The following updates are made in this revision: • Added note that decommissioning shall be preceded by a risk assessment. • The rating label on the controller is changed to *full load current*.
X	Published in release 22D. The following updates are made in this revision: • Added information about a new version of the FlexPendant. • Minor corrections in section *Manipulator cables on page 261*. • Added section *Open source and 3rd party components on page 251*.
Y	Published in release 23A. The following updates are made in this revision: • Corrected spare part number for the FlexPendant holder.
Z	Published in release 23B. The following updates are made in this revision: • Removed SafeMove limitation for *Panel Mounted Controller*. • Safety data updated.
AA	Published in release 23D. The following updates are made in this revision: • Spart part for main computer DSQC1094 added in section *Controller parts on page 253*.
AB	Published in release 24A. The following updates are made in this revision: • Information about Ethernet Switch updated in *Control module parts on page 253*. • Information about SD card updated in *Computer unit parts on page 257*.

Product documentation

Categories for user documentation from ABB Robotics

The user documentation from ABB Robotics is divided into a number of categories. This listing is based on the type of information in the documents, regardless of whether the products are standard or optional.

Tip

All documents can be found via myABB Business Portal, *www.abb.com/myABB*.

Product manuals

Manipulators, controllers, DressPack, and most other hardware is delivered with a **Product manual** that generally contains:

- Safety information.
- Installation and commissioning (descriptions of mechanical installation or electrical connections).
- Maintenance (descriptions of all required preventive maintenance procedures including intervals and expected life time of parts).
- Repair (descriptions of all recommended repair procedures including spare parts).
- Calibration.
- Troubleshooting.
- Decommissioning.
- Reference information (safety standards, unit conversions, screw joints, lists of tools).
- Spare parts list with corresponding figures (or references to separate spare parts lists).
- References to circuit diagrams.

Technical reference manuals

The technical reference manuals describe reference information for robotics products, for example lubrication, the RAPID language, and system parameters.

Application manuals

Specific applications (for example software or hardware options) are described in **Application manuals**. An application manual can describe one or several applications.

An application manual generally contains information about:

- The purpose of the application (what it does and when it is useful).
- What is included (for example cables, I/O boards, RAPID instructions, system parameters, software).
- How to install included or required hardware.
- How to use the application.

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- Examples of how to use the application.

Operating manuals

The operating manuals describe hands-on handling of the products. The manuals are aimed at those having first-hand operational contact with the product, that is production cell operators, programmers, and troubleshooters.

Network security

Network security

This product is designed to be connected to and to communicate information and data via a network interface. It is your sole responsibility to provide, and continuously ensure, a secure connection between the product and to your network or any other network (as the case may be).

You shall establish and maintain any appropriate measures (such as, but not limited to, the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB Ltd and its entities are not liable for damage and/or loss related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

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1 Safety

1.1 Safety information

1.1.1 Limitation of liability

Limitation of liability

Any information given in this manual regarding safety must not be construed as a warranty by ABB that the industrial robot will not cause injury or damage even if all safety instructions are complied with.

The information does not cover how to design, install and operate a robot system, nor does it cover all peripheral equipment that can influence the safety of the robot system.

In particular, liability cannot be accepted if injury or damage has been caused for any of the following reasons:

- Use of the robot in other ways than intended.
- Incorrect operation or maintenance.
- Operation of the robot when the safety devices are defective, not in their intended location or in any other way not working.
- When instructions for operation and maintenance are not followed as intended.
- Non-authorized design modifications of the robot.
- Repairs on the robot and its spare parts carried out by in-experienced or non-qualified personnel.
- Foreign objects.
- Force majeure.

Spare parts and equipment

ABB supplies original spare parts and equipment which have been tested and approved for their intended use. The installation and/or use of non-original spare parts and equipment can negatively affect the safety, function, performance, and structural properties of the robot. ABB is not liable for damages caused by the use of non-original spare parts and equipment.

1.1.2 Safety data

About this section

This chapter describes the necessary safety data required by standard EN ISO 13849-1:2015.

Prevailing directives and standards

For the use of industrial robots and how to protect personnel from being injured, special regulations must be fulfilled as described in the following directives and standards:

- Machinery Directive 2006/42/EC
- EN ISO 10218-1:2011
- EN ISO 13849-1:2008 (when explicitly called forth by EN ISO 10218-1:2011 as ISO 13849-1:2006)
- EN ISO 13849-1:2015

Performance level and category

EN ISO 13849-1, which is a B-standard, describes the general concept of performance level (PL) and category. Each machine or machinery is potentially dangerous and can cause personal injury. Based on severity of injury and probability of accident, when using the machine, a certain level of safety performance, so called required performance level (PLr) can be defined, where *level a* represents the lowest risk and *level e* the highest. According to this, the machine must be equipped with safety related parts, meeting the required performance level, to reduce the risk to accepted low level. As specified in EN ISO 10218-1, normally *PL d* is required for robots, but depending on the applications a higher requirement could be needed if a risk analysis will result in *PL e*.

To comply with a certain PLr, in this case *d*, the safety related parts of the robots and controllers must be structurally designed according to specific structure categories and using reliable components.

In EN ISO 13849-1 it is in detail specified what category and components data, which must be met, to fulfill *PL d*. These are:

- Category 3, which is normally fulfilled using double channels
- $MTTF_D$ (Mean Time To dangerous Failure) – high
- DC (Diagnostic Coverage) – low or medium
- CCF (Common Cause Failures) – better than 65 scores according to Annex F

Performance level for ABB IRC5 controller

To verify that robots and controller comply with at least *PL d* a self assessment has been carried out and documented in a *Technical Report*. The essential conclusions are accounted for below.

The safety related parts of robot and controller are e.g. the following stop circuits:

- Enabling device
- Emergency stop on operator panel

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- Emergency stop on FlexPendant
- Limiting robot motion
- Protective stops
- SafeMove
- EPS
- SafeMove2

For the overall design and structure, the category 3 has been verified and meeting the requirements of CCF.

Each of the stop circuits includes different components like enabling switch, panel board, contactor board, relays etc. For each of these the $MTTF_D$ and DC have been calculated according to EN ISO 13849-1 Annex C, D and E resulting in the values as specified in the following table.

See the SISTEMA/ABB FSDT libraries for details of the safety functions.

IRC5 Single and IRC5 Panel Mounted Controller

Safety function	Calculated $MTTF_D$ [years]	DC_{avg}
Emergency stop inputs (operator panel)	112	Medium
Automatic stop input	120	Medium
General stop input	120	Medium
Superior stop input	120	Medium
Limiting switch input (without customer connection)	176	Medium
Three-position enabling device inputs	91	Medium
Emergency stop status outputs	239	Medium
Emergency stop inputs (source external)	101	Medium
SafeMove (option) (without customer connections)	58	Medium
Electronic Position Switches (option) (without customer connections)	105	Medium
SafeMove2 functions (option)		
Protective stop	370	Low
Emergency stop	370	Low
Emergency stop safe fieldbus output	370	Low
Speed supervision	370	Low
Speed supervision safe fieldbus output	370	Low
Position supervision	370	Low
Position supervision safe fieldbus output	370	Low
External power control	88	Low

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1.1.2 Safety data
Continued

Based on the values from the previous table of $MTTF_D$ values, the corresponding PFH_D can be calculated using the Annex K, table K1 of EN ISO 13849-1:2008. These are shown in the following table.

IRC5 Single and IRC5 Panel Mounted Controller

Stop circuit	Calculated PFH_D	PL
Emergency stop inputs (operator panel)	4.29x10E-08	e
Automatic stop input	4.29x10E-08	e
General stop input	4.29x10E-08	e
Superior stop input	4.29x10E-08	e
Limiting switch input (without customer connection)	4.29x10E-08	e
Three-position enabling device inputs	4.94x10E-08	e
Emergency stop status outputs	4.29x10E-08	e
Emergency stop inputs (source external)	4.29x10E-08	e
SafeMove (option) (without customer connections)	1.03x10E-07	d
Electronic Position Switches (option)	4.29x10E-08	e
SafeMove2 functions (option)		
Protective stop	1.01x10E-07	d
Emergency stop	1.01x10E-07	d
Emergency stop safe fieldbus output	1.01x10E-07	d
Speed supervision	1.01x10E-07	d
Speed supervision safe fieldbus output	1.01x10E-07	d
Position supervision	1.01x10E-07	d
Position supervision safe fieldbus output	1.01x10E-07	d
External power control	1.35x10E-07	d

Conclusion according to EN ISO 13849-1:2015

The IRC5 controller safety system has a safety *category 3* with performance level *PL d* according to EN ISO 13849-1 using the simplified method of chapter 4.5.4 of EN ISO 13849-1 and thus fulfils the safety performance requirement of the robot safety standard EN ISO 10218-1.

The *Common Cause Failure* (CCF) is met according to the standard requirements.

1.1.3 Requirements on personnel

General

Only personnel with appropriate training are allowed to install, maintain, service, repair, and use the robot. This includes electrical, mechanical, hydraulics, pneumatics, and other hazards identified in the risk assessment.

Persons who are under the influence of alcohol, drugs or any other intoxicating substances are not allowed to install, maintain, service, repair, or use the robot.

The plant liable must make sure that the personnel is trained on the robot, and on responding to emergency or abnormal situations.

Personal protective equipment

Use personal protective equipment, as stated in the instructions.

1.2 Safety signals and symbols

1.2.1 Safety signals in the manual

Introduction to safety signals

This section specifies all safety signals used in the user manuals. Each signal consists of:

- A caption specifying the hazard level (DANGER, WARNING, or CAUTION) and the type of hazard.
- Instruction about how to reduce the hazard to an acceptable level.
- A brief description of remaining hazards, if not adequately reduced.

Hazard levels

The table below defines the captions specifying the hazard levels used throughout this manual.

Symbol	Designation	Significance
	DANGER	Signal word used to indicate an imminently hazardous situation which, if not avoided, will result in serious injury.
	WARNING	Signal word used to indicate a potentially hazardous situation which, if not avoided, could result in serious injury.
	ELECTRICAL SHOCK	Signal word used to indicate a potentially hazardous situation related to electrical hazards which, if not avoided, could result in serious injury.
	CAUTION	Signal word used to indicate a potentially hazardous situation which, if not avoided, could result in slight injury.
	ELECTROSTATIC DISCHARGE (ESD)	Signal word used to indicate a potentially hazardous situation which, if not avoided, could result in severe damage to the product.
	NOTE	Signal word used to indicate important facts and conditions.

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Symbol	Designation	Significance
	TIP	Signal word used to indicate where to find additional information or how to do an operation in an easier way.

1.2.2 Safety symbols on controller labels

Introduction to safety symbols

Both the manipulator and the controller are marked with labels containing safety symbols and important information about the product. The purpose of the labels is to ensure personal safety for all personnel handling the robot, for example during installation, service, or operation.

The safety symbols are language independent, they only use graphics. The information labels contain information in text. See *Symbols and information on labels on page 24*.

Note

The safety and information labels on the product must be observed.

Symbols and information on labels

Note

The descriptions in this section are generic, the labels can contain additional information such as values.

Label	Description
 xx1400001152	Read the user manual before use.
 xx1800000835	CE label
 xx1400002060	UR certified (component)

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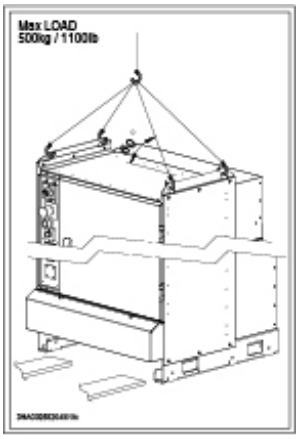
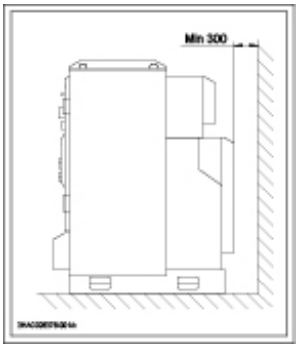
Label	Description
 xx1400002061	UL certified (robot with controller)
 xx1400001163	Rating label (example)
 xx1400001157	Lifting instruction for the IRC5 controller.
 xx1400001155	Required installation space.
 xx1400001151	Electrical shock

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1.2.2 Safety symbols on controller labels

Continued

Label	Description
 xx1400001161	Disconnect incoming mains before servicing the controller.
 xx1400001160	Disconnect incoming mains before servicing the controller (only for welding equipment).
 xx1700000354	Disconnect incoming mains before servicing the controller (for controllers without UL mains switch).
 xx1400001156	High voltage inside the module even if the main switch is in the OFF position.
 xx1400001162	ESD sensitive components inside the controller.

1.3 Robot stopping functions

1.3.1 Protective stop and emergency stop

Robot stopping functions

The robot has protective and emergency stop functions (stop category 0 or 1, in accordance with IEC 60204-1).

Stop category 0	As defined in IEC 60204-1, stopping by immediate removal of power to the machine actuators.
Stop category 1	As defined in IEC 60204-1, a controlled stop with power available to the machine actuators to achieve the stop and then removal of power when the stop is achieved.

A stop function, protective or emergency stop, has a default setting for the stop category, see *Inputs to initiate a protective stop or an emergency stop on page 27*.

The default stop category for a protective or emergency stop can be re-configured.

Activation of external safety rated devices, connected to the robot controller through dedicated discrete safety inputs or safety protocols, will initiate these stop functions.

Inputs to initiate a protective stop or an emergency stop

Inputs to initiate a stop function	Description	Default stop category	Stop category reconfigurable
Emergency Stop (ES)	Input to initiate the emergency stop function. The *Emergency Stop* function is initiated in both automatic and manual mode.	Stop category 0 For deviations, see the product manual for the manipulator.	Yes
Automatic Stop (AS)	Input to initiate the protective stop function *Automatic Stop*. The *Automatic Stop* function is only initiated in automatic mode.	Stop category 1	Yes
General Stop (GS)	Input to initiate the protective stop function *General Stop*. The *General Stop* function is initiated in both manual mode and automatic mode.	Stop category 1	Yes
	Inputs to initiate the protective stop function. The protective stop function can be configured as *Automatic Stop* or *General Stop*. *Automatic Stop* is only initiated in automatic mode. *General Stop* is initiated in both manual mode and automatic mode. [i]	Stop category 1 For deviations, see the product manuals for the controller and the manipulator.	Yes
Superior Stop (SS)	Input to initiate the superior stop function. The *Superior Stop* function is initiated in both manual mode and automatic mode.	Stop category 1	Yes

[i] Depending on controller variant, there can be one or two inputs for the protective stop function. See the product manual for the robot controller.

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1.3.1 Protective stop and emergency stop
Continued

For example, a safety rated output from a presence sensing device, connected to AS / GS, a dedicated discrete protective stop input on the robot controller, will when the protective stop function is configured as Automatic Stop (AS) initiate the protective stop function in automatic mode only.

The emergency stop function is a complementary protective measure and shall not be applied as a substitute for safeguarding measures or safety functions.

Note

For IRC5, a safety input on the panel board that is initiated, must remain active for at least 1.5 s.

Stop category configuration for IRC5

The stop category for the safety input can be configured, see *Technical reference manual - System parameters*.

Safety inputs	System parameter *Function*	Description
Emergency Stop	*SoftES*	*SoftES* is used to configure the emergency stop in automatic and manual mode. The default configuration is *FALSE* (stop category 0).
Automatic Stop	*SoftAS*	*SoftAS* can be used to configure the protective stop in automatic mode either as stop category 0 or category 1. The default configuration is *TRUE* (stop category 1).
General Stop	*SoftGS*	*SoftGS* can be used to configure the protective stop in automatic and manual mode, either as stop category 0 or category 1. The default configuration is *TRUE* (stop category 1).
Superior Stop	*SoftSS*	*SoftSS* can be used to configure the protective stop in automatic and manual mode, either as stop category 0 or category 1. The default configuration is *TRUE* (stop category 1).

1.3.2 About emergency stop

The emergency stop

The purpose of the emergency stop function is to avert actual or impending emergency situations arising from the behavior of persons or from an unexpected hazardous event.

The emergency stop function is to be initiated by a single human action.

The emergency stop function is a complementary protective measure and shall not be applied as a substitute for safeguarding measures and other functions or safety functions.

The effect of an activated emergency stop device is sustained until the actuator of the emergency stop device has been disengaged. This disengagement is only possible by an intentional human action on the device where the command has been initiated. The disengagement of the emergency stop device shall not restart the machinery but only permit restarting.

> **Note**
>
> The emergency stop device on the FlexPendant is operational when the robot is powered. Indicators to be used to verify that the robot is powered are the main switch on the cabinet or the LED indicator on the cabinet when robot is in Motors On Mode.

Recover from emergency stop

1. Inspect the machinery in order to detect the reason for the emergency stop device actuation.
2. Locate and disengage the emergency stop device or devices that initiated the emergency stop function.

1.3.3 Enabling device and hold-to-run functionality

Three-position enabling device

CAUTION

The person using the three-position enabling device is responsible to observe the safeguarded space for hazards due to robot motion and any other hazards related to the robot.

The three-position enabling device is located on the FlexPendant. When continuously held in center-enabled position, the three-position enabling device will permit robot motion and any hazards controlled by the robot. Release of or compression past the center-enabled position will stop the robot motion.

CAUTION

For safe use of the three-position enabling device, the following must be implemented:

- The three-position enabling device must never be rendered inoperational in any way.
- If there is a need to enter safeguarded space, always bring the FlexPendant. This is to enforce single point of control.

Hold-to-run function in manual high speed mode

The hold-to-run function for manual high speed allows movement in conjunction with the three-position enabling device when the button connected to the function is actuated manually. This hold-to-run function can only be used in manual high speed mode. In case of hazard, release or compress the three-position enabling device.

How to use the hold-to-run function for manual high speed mode is described in the operating manual for the controller.

1.4 Robot operating modes

1.4.1 About the manual mode

The manual mode

Manual mode is a control state that allows for the direct control by an operator. The operator will through positioning the three-position enabling device to the center-position allow for movement of the manipulator.

There are two manual modes:

- Manual reduced speed
- Manual high speed (optional)

Safeguard mechanisms

Protective stop function initiated by

- Three-position enabling device (release of or compression past the center-enabled position)
- General Stop, GS

The mode manual reduced speed

The mode manual reduced speed, is used for jogging, teaching, programming and program verification of the robot; it may be the mode selected when performing some maintenance tasks.

In manual reduced speed mode the movement of the TCP is limited to 250 mm/s. In addition, there is a limitation on the maximum allowed speed for each axis.

Manual control of the robot from inside the safeguarded space shall be performed through the FlexPendant.

WARNING

Wherever possible, the manual mode of operation shall be performed with all persons outside the safeguarded space.

Tasks normally performed in mode manual reduced speed

The following tasks are normally performed in manual reduced speed mode.

- Set or reset I/O signals
- Creating and editing RAPID programs
- Modify system parameter values
- Starting, stepping, and stopping program execution
- Jog the manipulator
- Teach or tune programmed manipulator positions

The mode manual high speed

The mode manual high speed, is used for program verification only.

Continues on next page

1.4.1 About the manual mode
Continued

The three-position enabling switch must be pressed to the center-position and the hold-to-run button must be pressed to allow start of program execution, for example, execute movement instructions.

In manual high speed, the initial speed of the movement, does not exceed 250 mm/s, that is limited to a percentage of the programmed speed. The speed can be manually adjusted in steps up to the programmed speed.

When the three-position enabling device is released or fully compressed, the speed is reset to the initial speed, that is, not exceeding 250 mm/s.

WARNING

Wherever possible, the manual mode of operation shall be performed with all persons outside the safeguarded space.

Tasks normally performed in mode manual high speed

The following tasks are normally performed in manual high speed mode.

- Program verification
- Setting program pointer (to Main, to routine, to cursor, to service routine, etc.)
- Starting and stopping program execution
- Stepping program execution
- Manually adjusting speed (0–100%)

1.4.2 About the automatic mode

The automatic mode

Automatic mode is an operating mode in which the robot operates in accordance with the task program(s) and therefore not in manual control by an operator.

Tasks normally performed in automatic mode

The following tasks are typically performed in automatic mode:

- Start and stop of program execution.
- Increase or decrease the speed in between zero and programmed speed.
- Restore backups. Only possible when robot is at stop.
- Load, start, stop, and modify RAPID programs through remote clients.

Safeguard mechanisms

Protective stop function initiated by

- Automatic Stop, AS
- General Stop, GS
- Superior Stop, SS

Note

Prior to allowing the robot to operate in automatic mode, ensure that any suspended safeguards, are returned to full functionality.

1.5 Safety during installation and commissioning

National or regional regulations

The integrator of the robot system is responsible for the safety of the robot system.

The integrator is responsible that the robot system is designed and installed in accordance with the safety requirements set forth in the applicable national and regional standards and regulations.

The integrator of the robot system is required to perform a risk assessment.

Layout

The robot integrated to a robot system shall be designed to allow safe access to all spaces during installation, operation, maintenance, and repair.

If robot movement can be initiated from an external control panel then an emergency stop must also be available.

If the manipulator is delivered with mechanical stops, these can be used for reducing the working space.

A perimeter safeguarding, for example a fence, shall be dimensioned to withstand the following:

- The force of the manipulator.
- The force of the load handled by the robot if dropped or released at maximum speed.
- The maximum possible impact caused by a breaking or malfunctioning rotating tool or other device fitted to the robot.

The maximum TCP speed and the maximum velocity of the robot axes are detailed in the section *Robot motion* in the product specification for the respective manipulator.

Consider exposure to hazards, such as slipping, tripping, and falling.

Hazards due to the working position and posture for a person working with or near the robot shall be considered.

Hazards due to noise emission from the robot needs to be considered.

Consider hazards from other equipment in the robot system, for example, that guards remain active until identified hazards are reduced to an acceptable level.

Allergenic material

See *Environmental information on page 240* for specification of allergenic materials in the product, if any.

Securing the robot to the foundation

The robot must be properly fixed to its foundation/support, as described in the respective product manual.

When the robot is installed at a height, hanging, or other than mounted directly on the floor, there will be additional hazards.

Continues on next page

Using lifting accessories and other external equipment

Ensure that all equipment used during installation, service and all handling of the robot are in correct condition for the intended use.

Electrical safety

Incoming mains must be installed to fulfill national regulations.

The power supply wiring to the robot must be sufficiently fused and if necessary, it must be possible to disconnect it manually from the mains power.

The power to the robot must be turned off with the main switch and the mains power disconnected when performing work inside the controller cabinet. Lock and tag shall be considered.

Hazards due to stored electrical energy in the controller must be considered.

Harnesses between controller and manipulator shall be fixed and protected to avoid tripping and wear.

Wherever possible, power on/off or rebooting the robot controller shall be performed with all persons outside the safeguarded space.

Note

Use a CARBON DIOXIDE (CO_2) extinguisher in the event of a fire in the robot.

Safety devices

The integrator is responsible for that the safety devices necessary to protect people working with the robot system are designed and installed correctly.

When integrating the robot with external devices to a robot system:

- The integrator of the robot system must ensure that emergency stop functions are interlocked in accordance with applicable standards.
- The integrator of the robot system must ensure that safety functions are interlocked in accordance with applicable standards.

Other hazards

A robot may perform unexpected limited movement.

WARNING

Manipulator movements can cause serious injuries on users and may damage equipment.

The risk assessment should also consider other hazards arising from the application, such as, but not limited to:

- Water
- Compressed air
- Hydraulics

End-effector hazards require particular attention for applications which involve close human collaboration with the robot.

Continues on next page

Verify the safety functions

Before the robot system is put into operation, verify that the safety functions are working as intended and that any remaining hazards identified in the risk assessment are mitigated to an acceptable level.

1.6 Safety during operation

Automatic operation

Verify the application in the operating mode manual reduced speed, before changing mode to automatic and initiating automatic operation.

Lock and change of operating mode

To prevent hazard, it is the responsibility of the integrator to make sure that keys used to lock or change the operating mode are handled only by authorized personnel.

An IRC5 controller with a physical key for the mode selector, is designed so that the key fits on all IRC5 controllers, unless unique keys are ordered.

Safety devices not in use

Safety devices that are not connected to the robot or robot system cannot initiate a protective or emergency stop. These must be stored out of sight so that they cannot be mistaken for being in use.

1.7 Safety during maintenance and repair

General

Corrective maintenance must only be carried out by personnel trained on the robot.

Maintenance or repair must be done with all electrical, pneumatic, and hydraulic power switched off, that is, no remaining hazards.

Never use the robot as a ladder, which means, do not climb on the controller, manipulator, including motors, or other parts. There are hazards of slipping and falling. The robot might be damaged.

Make sure that there are no tools, loose screws, turnings, or other unexpected parts remaining after maintenance or repair work.

When the work is completed, verify that the safety functions are working as intended.

Hot surfaces

Surfaces can be hot after running the robot, and touching these may result in burns. Allow the surfaces to cool down before maintenance or repair.

Hazards related to batteries

Under rated conditions, the electrode materials and liquid electrolyte in the batteries are sealed and not exposed to the outside.

There is a hazard in case of abuse (mechanical, thermal, electrical) which leads to the activation of safety valves and/or the rupture of the battery container. As a result under certain circumstances, electrolyte leakage, electrode materials reaction with moisture/water or battery vent/explosion/fire may follow.

Do not short circuit, recharge, puncture, incinerate, crush, immerse, force discharge or expose to temperatures above the declared operating temperature range of the product. Risk of fire or explosion.

Operating temperatures are listed in *Operating conditions on page 45*.

See safety instructions for the batteries in *Material/product safety data sheet - Battery pack* (*3HAC043118-001*).

Related information

See also the safety information related to installation and operation.

1.8 Safety during troubleshooting

General

When troubleshooting requires work with power switched on, special considerations must be taken:

- Safety circuits might be muted or disconnected.
- Electrical parts must be considered as *live*.
- The manipulator can move unexpectedly at any time.

DANGER

Troubleshooting on the controller while powered on must be performed by personnel trained by ABB or by ABB field engineers.

A risk assessment must be done to address both robot and robot system specific hazards.

Related information

See also the safety information related to installation, operation, maintenance, and repair.

1.9 Safety during decommissioning

General

See section *Decommissioning on page 239*.

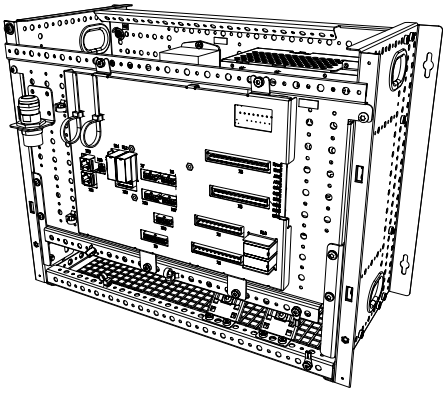
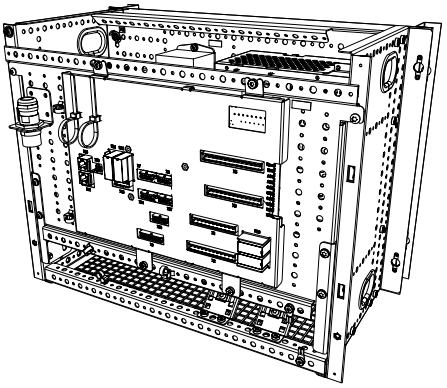
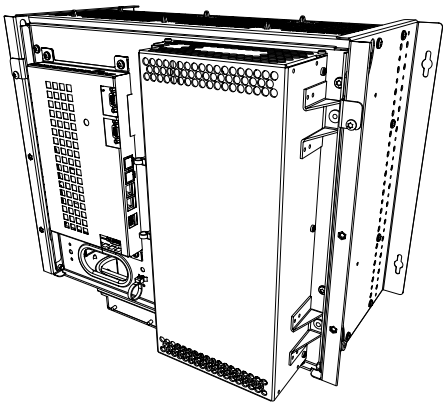
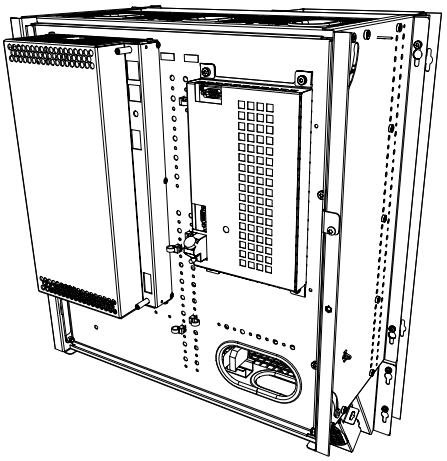
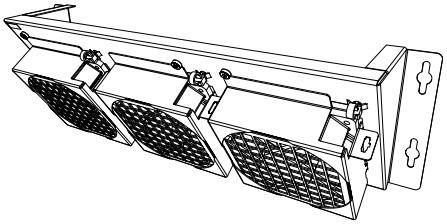
If the robot is decommissioned for storage, take extra precaution to reset safety devices to delivery status.

2 Installation and commissioning

2.1 Overview

General

There are two versions of the IRC5 Panel Mounted Controller(PMC). PMC small is used for small robots and PMC large is used for large robots. The controller always consists of one control module and one drive module.

	PMC small	PMC large
A	 xx1300001963	 xx1300001964
B	 xx1300001961	 xx1300001965
C	 xx1300001962	

A	Control module (with air channel for PMC large).
B	Drive module (different design for PMC small and PMC large).
C	Fan unit (for PMC large this is a part of the drive module.

Continues on next page

The control module contains the computer unit, communication interfaces, FlexPendant connection, service ports and also the system software which includes all basic functions for operation and programming.

The drive module contains the drive system.

Note

When replacing a unit in the controller, report to ABB:

- the serial number
- article number
- revision

of both the replaced unit and the replacement unit.

This is particularly important for the safety equipment to maintain the safety integrity of the installation.

Equipment

The following parts can be delivered with the IRC5 Panel Mounted Controller:

Part. no.	Description	Note
3HAC024244-005	Ethernet cable	Standard
3HAC027818-001	Connection Power supply	Standard
3HAC037824-001	Mains line filter (PMC small)	Standard for PMC small
3HAC024322-001	Mains line filter (PMC large)	Standard for PMC large
3HAC027201-001	Transformer unit	Standard
3HAC028357-001	GTPU 3, 10m cable	Option 701-1 and 701-3
3HAC031683-004	TPU cable, 30m	Option 701-3
3HAC021914-001	Harness - TPU jumper plug	Option 702-1
3HAC14178-1	Customer I/O power supply DSQC 609	Option 727-1
3HAC13398-2	Power supply	Option 728-1
3HAC025600-005	Harness - Drive/Control 4m	Option 761-1
3HAC038406-001	Fan unit	Standard for PMC large Option 882-1 for PMC small
3HAC026486-001	Additional module Digital 24V	Option 816-1
3HAC2588-2	Additional unit Que TRack unit	Option 826-1
3HAC038403-001	EPS board	Option 810-1
3HAC038402-001	SafeMove board	Option 810-2
3HAC024180-001	Multi volt transformer	Option 931-1

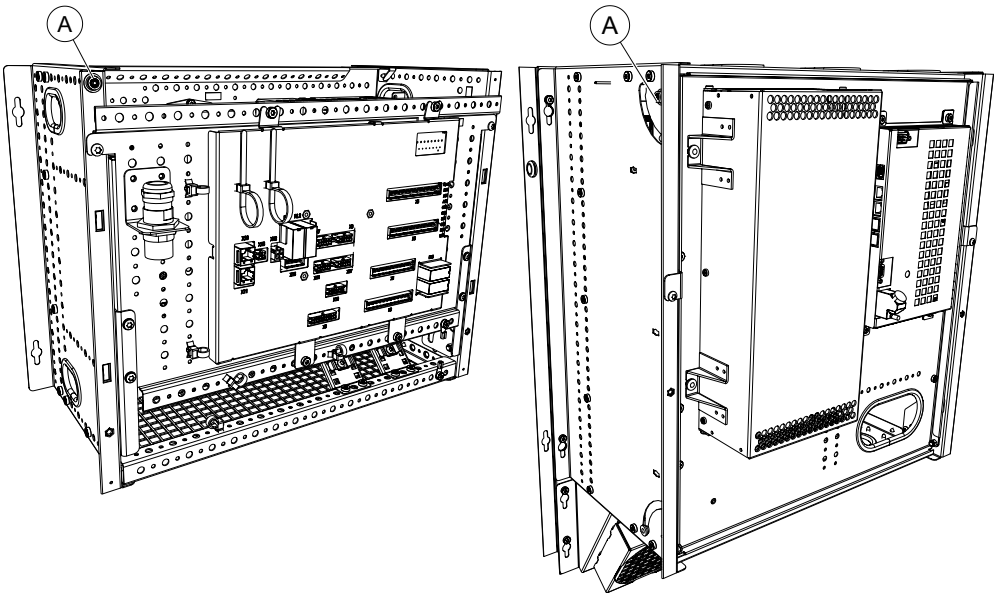
Continues on next page

Note

Because the parts of the IRC5 Panel Mounted Controller can be mounted with varying space apart, there is no guarantee that the standard cables are long enough. In some cases there may be a need to create your own customized cables.

Wrist strap button

The location of the wrist strap button is shown in the following illustration.



A	Wrist strap button

2.2 Installation activities

Prerequisites

The following section details the main steps on how to unload, transport, install and connect the IRC5 Panel Mounted Controller modules.

Overview of the installation

	Action	Detailed in
1	Unpack the delivered IRC5 Panel Mounted Controller.	*Unpacking the controller on page 45*
2	Install the IRC5 Panel Mounted Controller.	*Installation, IRC5 Panel Mounted Controller on page 50*
3	Connect the manipulator to IRC5 Panel Mounted Controller.	
4	Connect power supply to the IRC5 Panel Mounted Controller.	*Connecting power supply to PMC small on page 67* *Connecting power supply to PMC large on page 69*
5	Connect the FlexPendant to the IRC5 Panel Mounted Controller.	*Connecting a FlexPendant on page 80*.
6	Install the safety functions, for example, the emergency stop.	*Connection of the MOTORS ON/MOTORS OFF circuit on page 89* *Connection of external safety relay on page 98* *Closing the Automatic Stop circuit on page 88*
7	Miscellaneous connections.	How to connect buses, for example DeviceNet, is detailed in the respective application manual. How to connect to a network is detailed in section *Connectors on the computer unit on page 82*.
8	If used, install add-ons.	How to install add-ons is detailed in section *Installation of add-ons on page 117*
9	When the installation is complete, perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.	

2.3 Transporting and handling

2.3.1 Unpacking the controller

General

Read the safety regulations and other instructions before unpacking the controller, see *Safety on page 17*.

The installation must be done by qualified installation personnel and should conform to all national and local codes.

When unpacking the cabinet, inspect that it was not damaged during transport.

Note

If the controller is going to be stored before unpacking and installation, read the following information regarding storage conditions.

Storage conditions

The table below shows the recommended storage conditions for the IRC5 controller:

Parameter	Value
Min. ambient temperature	-25°C (-13°F)
Max. ambient temperature	+55°C (+131°F)
Max. ambient temperature (short periods, max 24 h)	+70°C (+158°F)

After storage, the operating conditions inside the controller must be met for at least 6 hours before switching on the controller (see *Operating conditions on page 45*).

The robot controller shall only be stored indoors, in an environment that is dry and dust-free. In addition, wind, temperature fluctuations, and condensation shall be avoided.

Operating conditions

The table below shows the allowed operating conditions for the IRC5 controller:

Parameter	Value
Min. ambient temperature	0°C (32°F)
Max. ambient temperature	+45°C (113°F)

Continues on next page

2.3.1 Unpacking the controller
Continued

Note

The humidity conditions shall apply with the environmental conditions EN 60721-3-3, climatic class 3K3. For temperatures 0-30 °C, the relative humidity must not exceed 85%. For temperatures exceeding 30 °C, the absolute humidity must not exceed 25g/m^3.

If the environmental conditions in EN 60721-3-3, climatic class 3K3, are not possible to meet at the installation site, desiccant bags can be placed inside the controller to achieve corresponding conditions. The desiccant bags must be replaced regularly to maintain approved operating conditions.

Weight of controller

The table below shows the weight for the IRC5 controller:

Controller	Part	Weight
PMC small	Complete controller	max. 40 kg
	Control module	12 kg
	Drive module	22.5 kg
PMC large	Complete controller	max. 60 kg
	Control module	14 kg
	Drive module	40 kg

Weight of additional equipment

The table below shows the weight for equipment used with the IRC5 Panel Mounted Controller:

Equipment	Weight
Transformer	13-51 kg
Inductor	5.2 kg

Protection class

The table below shows the protection classes for the IRC5 controller and the FlexPendant:

Equipment	Protection class
IRC5 Panel Mounted Controller	IP20
FlexPendant	IP54

The Panel Mounted Controller modules must be mounted in a water-proof and air-proof cabinet. Internal cooling is recommended but if that is not possible, a filter shall be used. When used in industrial environment, the cabinet should fulfill IP54. When used in foundry environment, the cabinet should fulfill IP67.

Continues on next page

Cabinet cooling

If the cabinet where the IRC5 Panel Mounted Controller is mounted needs cooling depends on the power dissipation and the surface area of the cabinet. A heat test is necessary to get any exact answers. A rough estimation can be made using the following calculations.

The drive system efficiency is roughly 90%, so the power loss in the drive system is at least near 10%. Note that the power loss in the drive system will increase significantly if the motion cycle contains many frequent and sharp decelerations, which cause very high bleeder power loss. Other equipment in the PMC typically generates another 240W power loss.

For example, a customer RAPID program that creates 2000W output power may generate a power loss of 220W in the drive system. Total power loss is then approximately 460W.

The natural convection from a sheet metal cabinet is calculated as:

$$Q_S = A * k * T$$

Q_s = Heat emitted by the enclosure surface (W)

A = Enclosure area (m^2)

k = Heat transfer coefficient (W/m^2K), where k is approximately 5.5 for a metal sheet cabinet

ΔT=Ti-Tu = Temperature difference (K)

If the natural convection of the enclosure is to small, cooling equipment is needed with cooling capacity according to following formula:

$$Q_e = Q_v - Q_S$$

Q_e = Required cooling output from the cooling unit

Q_v = Installed heat loss

2.3.2 The unit is sensitive to ESD

Description

ESD (electrostatic discharge) is the transfer of electrical static charge between two bodies at different potentials, either through direct contact or through an induced electrical field. When handling parts or their containers, personnel not grounded may potentially transfer high static charges. This discharge may destroy sensitive electronics.

Safe handling

Use one of the following alternatives:

- Use a wrist strap. The wrist strap button is located inside the controller.

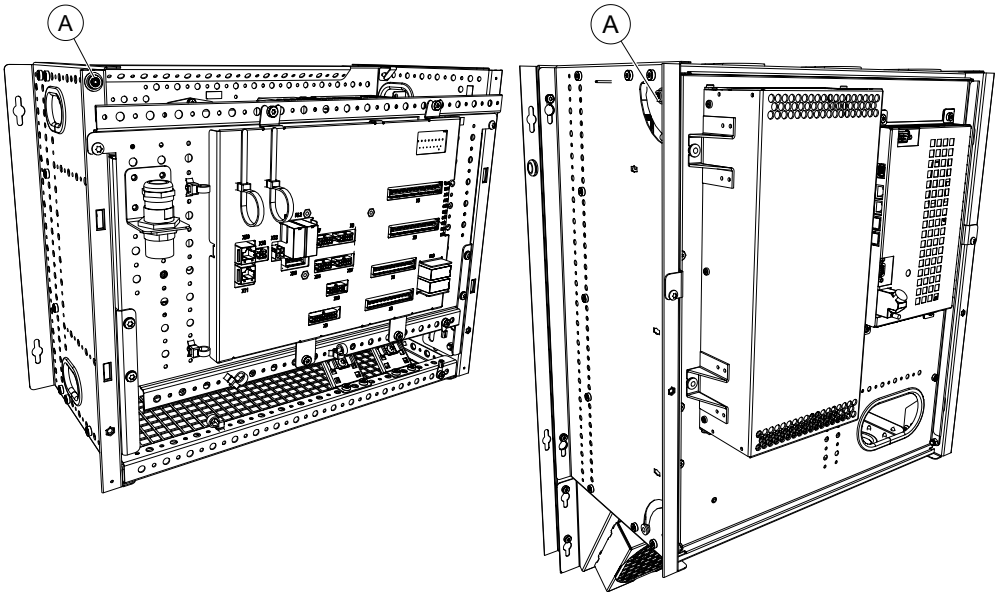
  Wrist straps must be tested frequently to ensure that they are not damaged and are operating correctly.
- Use an ESD protective floor mat.

  The mat must be grounded through a current-limiting resistor.
- Use a dissipative table mat.

  The mat should provide a controlled discharge of static voltages and must be grounded.

Wrist strap button

The location of the wrist strap button is shown in the following illustration.



A	Wrist strap button

There is an additional wrist strap button on the main computer.

2.4 On-site installation

2.4.1 Air channel for PMC large

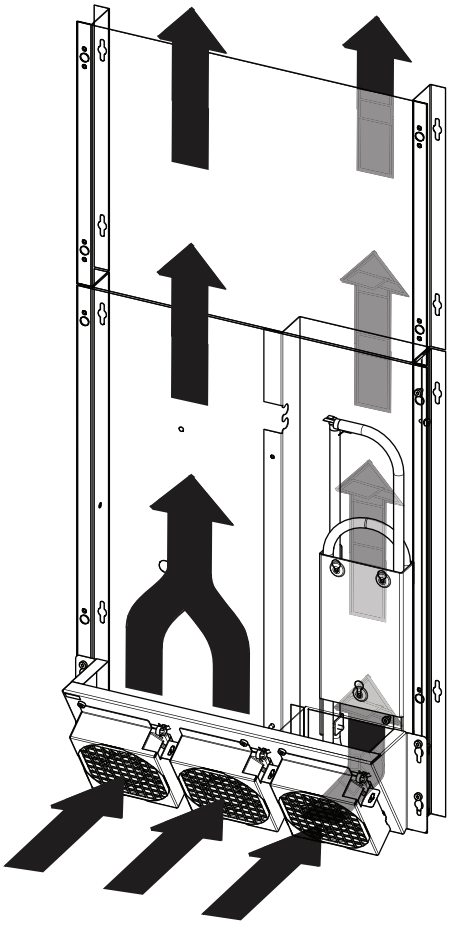
Mount PMC large on the air channel

For PMC large, there is an air channel that must be mounted behind the controller. Make sure that the air can flow freely in the air channel behind the controller as well as through the controller.

If the control module is mounted separately, it can be mounted without the air channel. If it is mounted on top of the drive module, it must be mounted on the air channel so it does not obstruct the air flow.

The air flow

The fan to the right creates an air flow though the air channel behind the controller, where the brake resistor bleeder is located. The two fans to the left creates an air flow though the controller modules.



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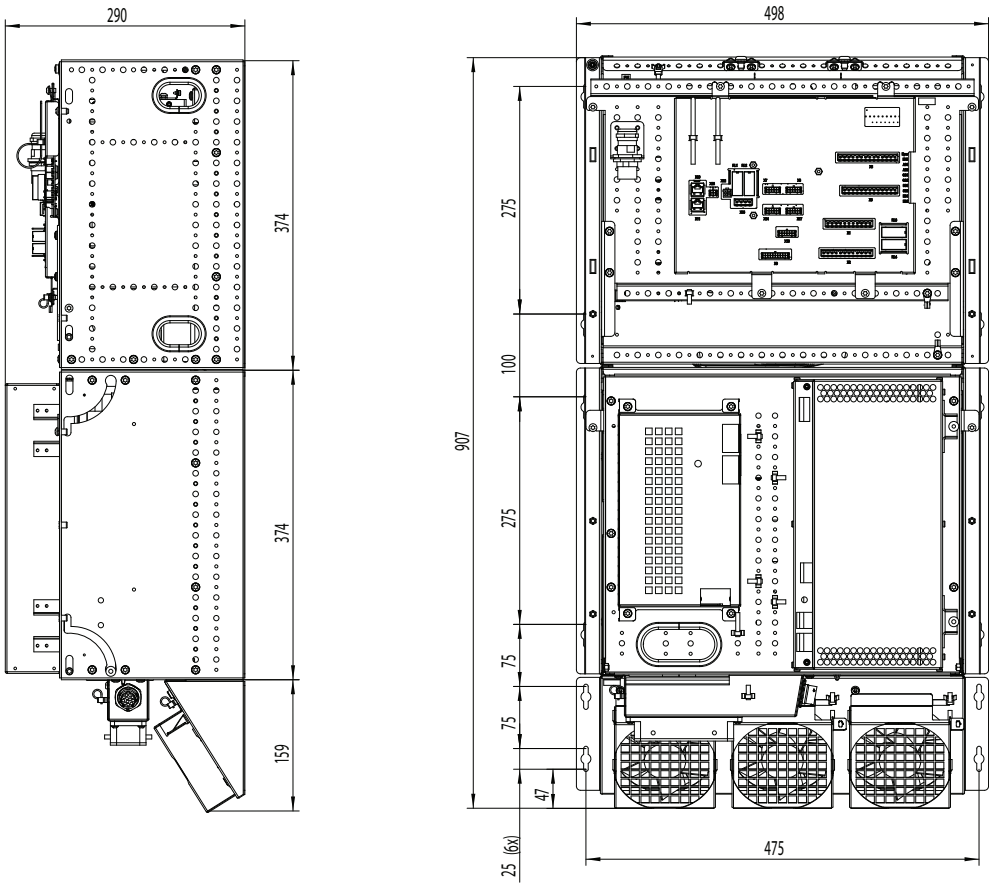
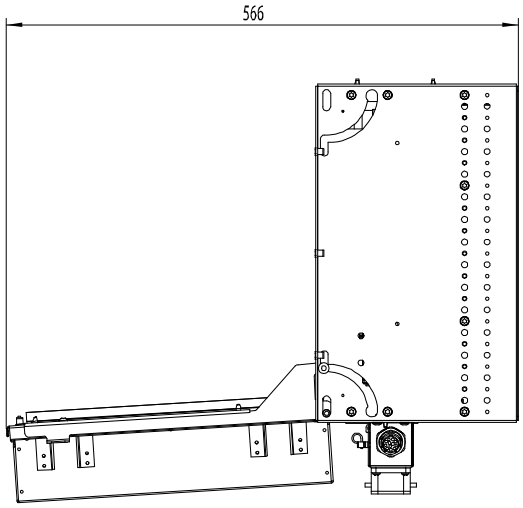
2.4.2 Installation, IRC5 Panel Mounted Controller

Dimensions for PMC small

The illustration below shows the required installation space for the PMC small.



xx0600003314



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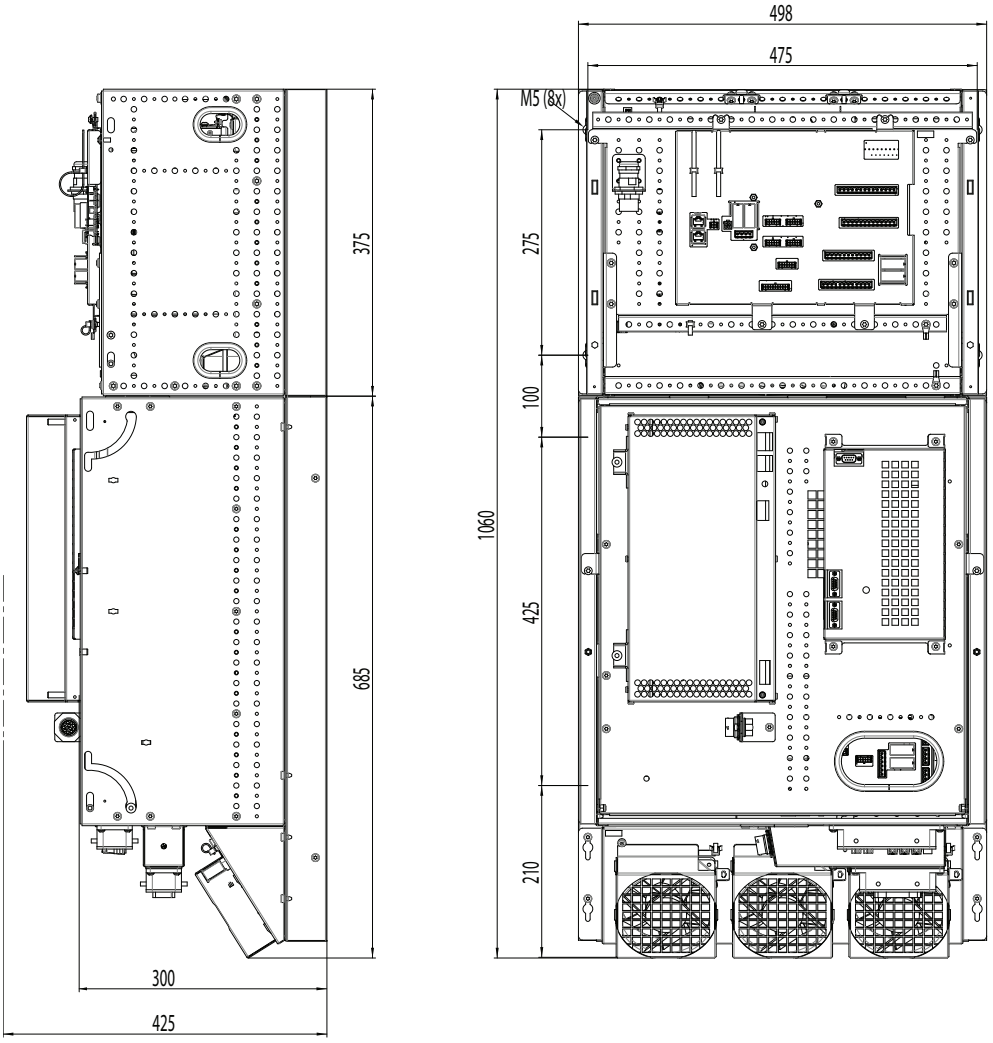
Dimensions for PMC large

The illustration below shows the required installation space for the PMC large.



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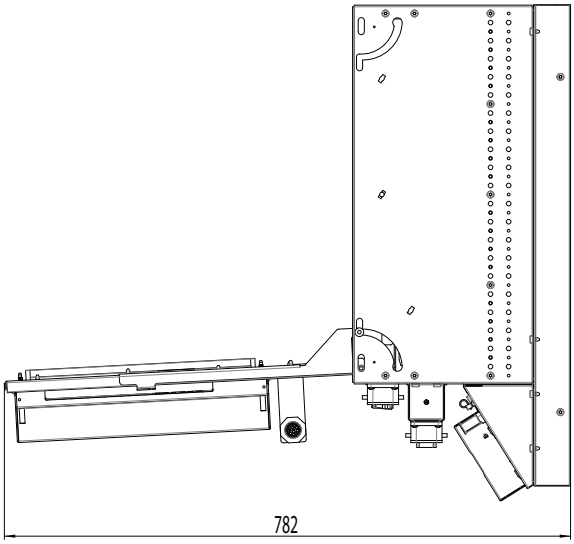
2.4.2 Installation, IRC5 Panel Mounted Controller
Continued



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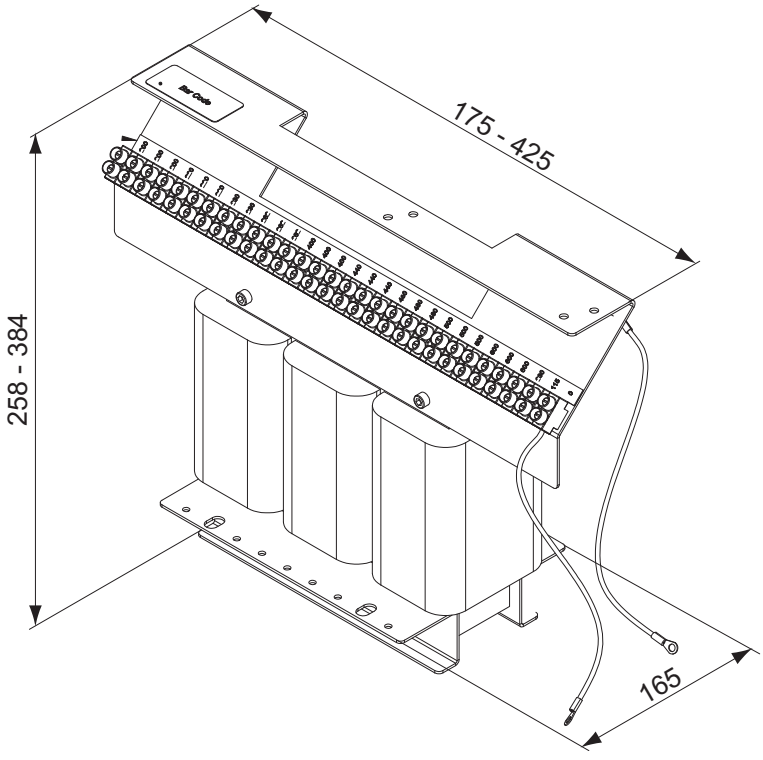
Dimensions for transformers



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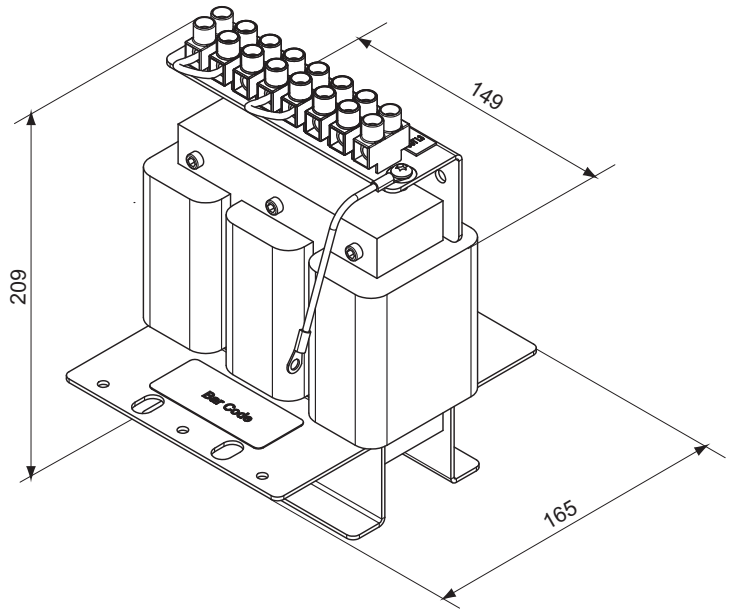
Dimensions for inductor



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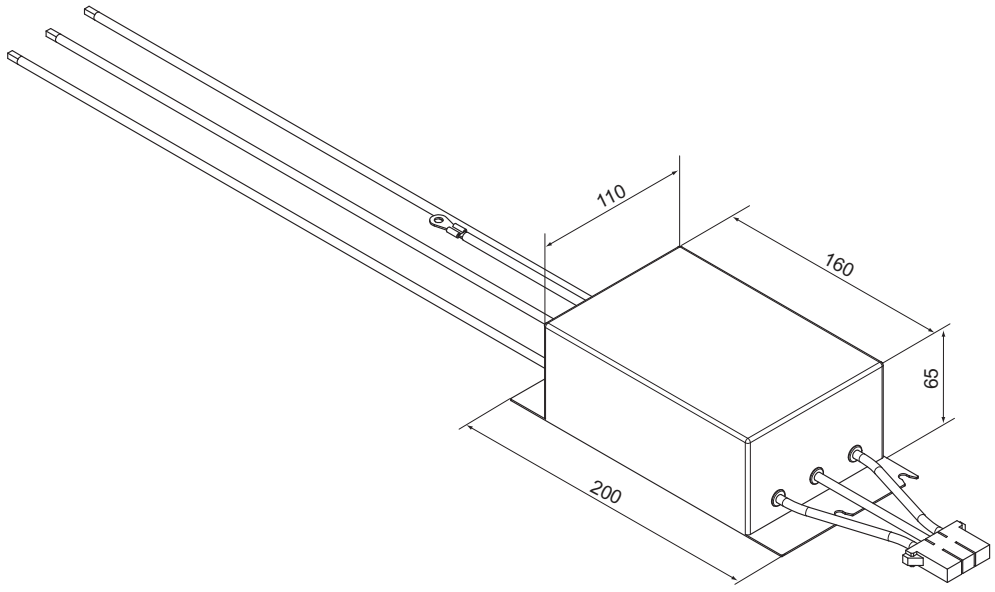
Dimensions for line filter



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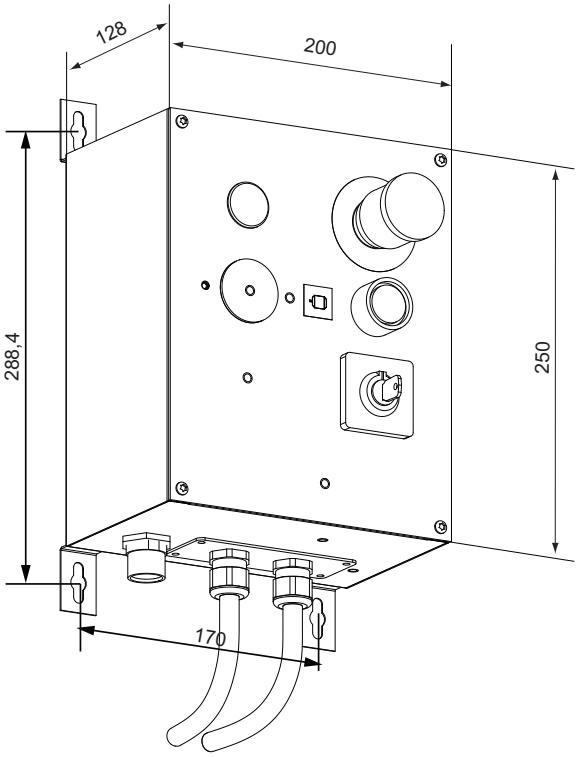
2.4.2 Installation, IRC5 Panel Mounted Controller
Continued

Dimensions for external operator's panel



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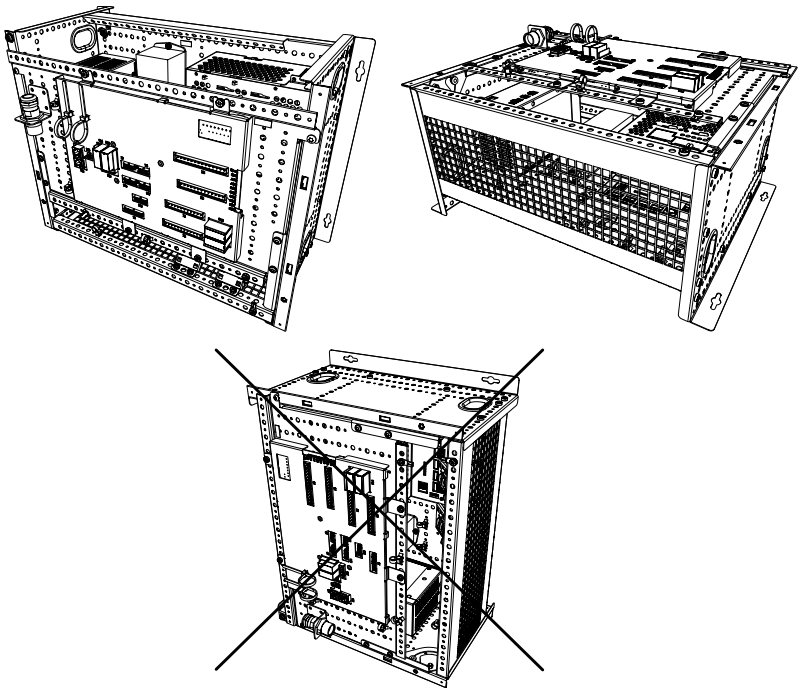
Installation conditions

For the air flow to function properly, the Control Module and the Drive Module of PMC small must be mounted according to following figure.



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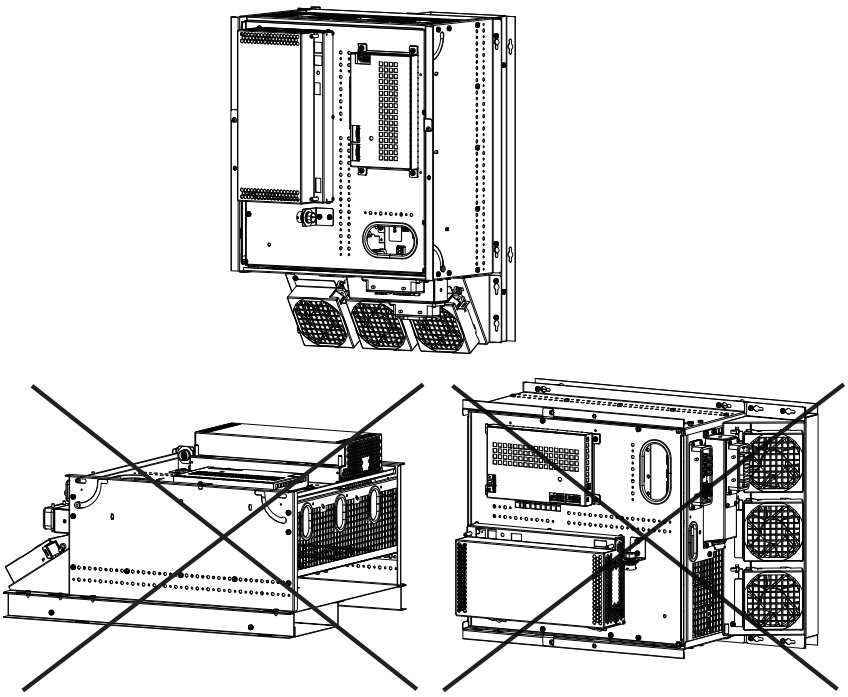
For the air flow to function properly, the Drive Module of PMC large must be mounted in an upright position according to following figure.



xx1100000538

Note

Do not mount the Control Module or Drive Module on a painted surface. The frame of the modules must be connected to earth.

Note

The Control Module and Drive Module must be mounted and connected to the same earth.

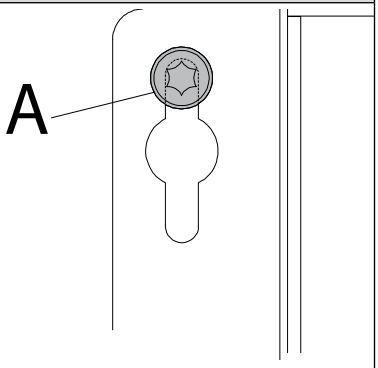
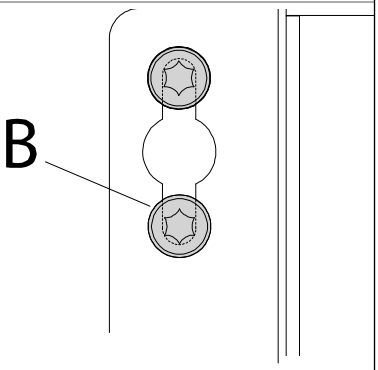
Continues on next page

2.4.2 Installation, IRC5 Panel Mounted Controller
Continued

Installing the modules in a cabinet

The IRC5 Panel Mounted Controller modules should be mounted on a rack system in a cabinet. The recommended minimum depth of the cabinet is 400 mm for PMC small and 500 mm for PMC large. The cabinet must fulfill the requirements specified in *Protection class on page 46*.

The following procedure details how to install the IRC5 Panel Mounted modules.

	Action	Note/Illustration
1	Fit the module on pre-mounted M5 screws (4 pcs).	 xx0600003452 • A: M5 screws (4 pcs)
2	Secure the module with new M5 screws (4 pcs).	 xx0600003453 • B: M5 screws (4 pcs)
3	Fasten the module (M5 screw, 8 pcs)	Tightening torque 4,5 Nm.

Mounting the FlexPendant holder

The FlexPendant holder is available in different versions, that fit different FlexPendant versions. The holder is compatible with the FlexPendant that it is delivered with.

Continues on next page

The holder can be placed horizontally on a flat surface, for example, on top of the controller, or hanging, for example, on a door.

Note

To avoid dropping the FlexPendant from height, the holder should be placed in a comfortable working height.

Always use and store the FlexPendant in such a way that the cable does not become a tripping hazard.

When not using the device, place it so it does not accidentally fall.

2.5 Connections

2.5.1 Connecting cables to the controller

General

A good and proper electrical installation of the robot system is necessary to ensure the best performance and prolong the lifetime of the whole robot system.

This section includes important information on how to connect cables and signals to the controller.

Signal classes

Different rules apply to the different classes when selecting and laying cables. Signals from different classes must not be mixed.

Signal class	Description
Power signals Class 4 (noisy)	Supplies external motors and brakes. Applies to the cables associated with the power inputs and outputs of variable speed drives. Cables carrying strongly interfering signals such as motor cables, DC-link load sharing, unsuppressed inductive loads, DC motors, welding equipment, etc.
Control signals Class 3 (slightly noisy)	Digital operating and data signals (digital I/O, protective stop, etc.). Applies to cables carrying slightly interfering signals: AC power supply (<1 kV), DC power (24 V), power to equipment with RFI/EMI filters, control circuits with resistive or suppressed inductive loads (such as contactors and solenoids), direct-on-line induction motors, etc.
Measurement signals Class 2 (slightly sensitive)	Analog measurement and control signals (resolver and analog I/O). This class covers ordinary analogue signals such as analogue signals (4-20 mA, 0-10V, or signals below 1 MHz), low-speed digital signals (RS232, RS485), digital (on/off) signals, limit switches, encoders, etc.
Data communication signals Class 1 (sensitive)	Gateway (fieldbus) connection, computer link. Applies to cables carrying very sensitive signals. Signals with a full-scale range less than 1 V or 1 mA, and/or a source impedance >1 kOhm, and/or a signal frequency >1 Mhz. For example high-speed digital communication (Ethernet), thermocouples, thermistors, strain gauges and flowmeters.

Selecting cables

All cables laid in the control cabinet must be capable of withstanding 70 °C. In addition, the following rules apply to the cables of certain signal classes:

Signal class	Cable type
Power signals	Shielded cable with an area of at least 0.75 mm² or AWG 18.
Control signals	Shielded cable.
Measurement signals	Shielded cable with twisted pair conductors.
Data communication signals	Shielded cable with twisted pair conductors. A specific cable should be used for field bus connections and Ethernet, according to the standard specification of the respective bus.

Continues on next page

Note

Any local standards and regulations concerning insulation and area must always be complied with.

AC current in CP/CS

For specific applications where the correct cable dimensioning can depend on the relationship between the period of the duty cycle and the thermal time constant of the cable (for example, starting against high-inertia load, intermittent duty), the cable manufacturer can provide information.

Country specific norms have to be included.

The wire is not dimensioned to take care of starting motors or transformers.

The following table shows how much AC current can be supplied with a specific temperature, and the wire size.

Wire size (mm^2//AWG)	AC current			
	40°C//104F	45°C//113F	50°C//122F	52°C//125.6F
Single wire 0.2//24	4.5	4.1	3.7	3.2
Multi wire 2 pair 0.2//24	3.6	3.3	3.0	2.6
Multi wire 4 pair 0.2//24	2.9	2.7	2.4	2.1
Multi wire 6 pair 0.2//24	2.6	2.3	2.1	1.8
Multi wire 9 pair 0.2//24	2.3	2.0	1.8	1.6
Single wire 0.5//20	7.9	7.2	6.5	5.6
Multi wire 2 pair 0.5//20	6.3	5.8	5.2	4.5
Multi wire 4 pair 0.5//20	5.1	4.7	4.2	3.6
Multi wire 6 pair 0.5//20	4.5	4.1	3.7	3.2
Multi wire 9 pair 0.5//20	4.0	3.6	3.2	2.8
Single wire 0.75//18	9.5	8.6	7.8	6.7
Multi wire 2 pair 0.75//18	7.6	6.9	6.2	5.4
Multi wire 4 pair 0.75//18	6.2	5.6	5.1	4.4
Multi wire 6 pair 0.75//18	5.4	4.9	4.4	3.8
Multi wire 9 pair 0.75//18	4.8	4.3	3.9	3.4
Single wire 1.0//17	11.0	10.0	9.0	7.8
Multi wire 2 pair 1.0//17	8.8	8.0	7.2	6.2
Multi wire 4 pair 1.0//17	7.2	6.5	5.9	5.1
Multi wire 6 pair 1.0//17	6.3	5.7	5.1	4.5
Multi wire 9 pair 1.0//17	5.5	5.0	4.5	3.9
0.75//18 three phase	8.6	7.8	7.1	5.6
1.0//17 three phase	10.3	9.4	8.4	6.7

Continues on next page

2.5.1 Connecting cables to the controller
Continued

Route the cables

Routing of cables shall be done in a professional way.

- Cables of different classes, such as signal cables and power cables, must not be routed together as the power cables may introduce noise in the signal cables. The greater the separation distance, the lesser the risk for interference between the cables.
- Robot controller mains supply input cable and robot power cable should be separated even though they belong to the same class.
- If crossing cables from different classes, cables should cross at an angle close to 90 degrees.
- All external cables that are to be connected inside the controller must be shielded in the chassis before entering the cabinet.

Separation distances can be reduced if e.g. dividers are used between cables classes. Manufacturers of cable duct systems can provide information on how reduced separation distances can be achieved using their specific products.

Signal class	Cable type
Power signals	• These signals generate a lot of interference and must be laid separate from control, measurement, and communication signals. • The shielding must be connected to a paint-free part of the panel chassis of the cabinet at both ends of the cable. Any unshielded cable must be as short as possible. • The manipulator power cables are routed on the floor and along the left side of the controller cabinet. • Cables should not be wound up like coils. This could cause an magnetic field disturbing the signals. There will also be a risk of overheating depending on the load.
Control signals	• These signals are very sensitive to interference. To protect these signals they should not be laid along with the power signals. • In the cable, each signal must be twisted with a neutral wire. • The shielding must be connected directly to the chassis at both ends of the cable.
Measurement signals	
Data communication signals	

Shielding cables

When peripheral devices are connected to the robot system, a shielded cable is necessary to reduce coupling of the inner cable conductors to the environment they pass through.

Shielding cable requirements

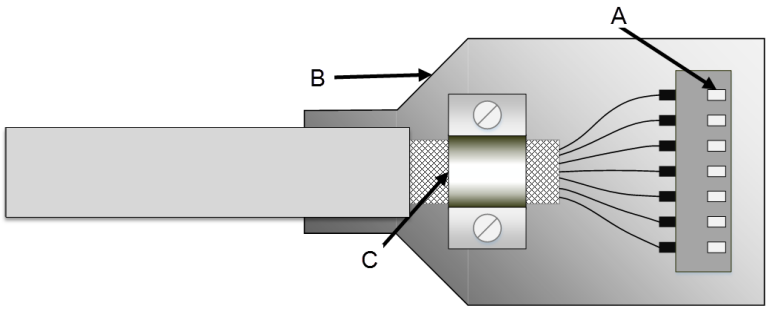
- The best method for shielding is to ground the shield at both ends of the cable, provided the ends grounding are at the same potential.
- If the grounding points have different electric potentials - grounding both ends will create a ground loop allowing unwanted current to flow in the shield. In such cases one end grounding may be used. The grounding point should then be at the robot controller side.
- Cables carrying analog low-level signals is another exception where the shield should be grounded at only one end.

Continues on next page

- Most data network and field bus types have defined grounding topologies. If such grounding schemes exist, they should be followed.
- In complex interference environments, two-layer shielding may be required. The inner shield should be grounded at the controller side only end and the outer shield should be grounded at both ends. The optimum shielding is a combination of foil and braid screens.
- The best connection is one in which the shielding is extended up to and makes a solid 360° connection (shown below) with the ground plane or chassis.

Shielding example

The below example shows the shielding of a d-type connector:



xx1700001320

A A dimpled connector body makes multiple bonds to the mating connector body all around its periphery, 360° bonding.

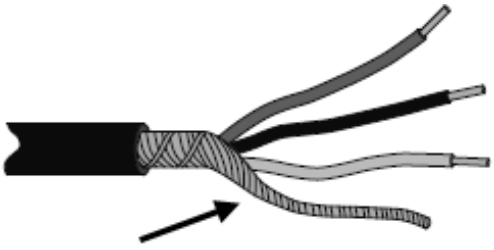
B Metal, or metallized, back shell makes 360° bond to the connector body.

C The cable shield is exposed and 360° clamped to the back shell. A tight fit is a must.

Many other 360° bonding methods and types of 360° shielded connectors are also acceptable.

Shield pigtail termination

Shield pigtail termination, as shown below, shall be avoided. If a pigtail connection cannot be avoided, make it as short as possible.



xx1700001321

Continues on next page

2.5.1 Connecting cables to the controller
Continued

Ground and screen connections

The task of the grounding system is twofold - protective and functional. The primary task is to serve as protective earth (PE) for personal and equipment safety. The secondary task is to serve as a return path for common mode current.

For further information refer to EN 60204-1 and UL 1740.

Grounding requirements

The controller cabinet ground must come from the mains power supply PE.

- The grounding cable color shall be green-yellow.
- The ground for the controller cabinet, robot manipulator and peripheral devices must be the same, preferably an equipotential ground grid (mesh).
- Ground connection points must have stable inter-metallic bonding, like screw fixation. Paint, dirt, rust, and other insulating material must be removed from the contacting surfaces.

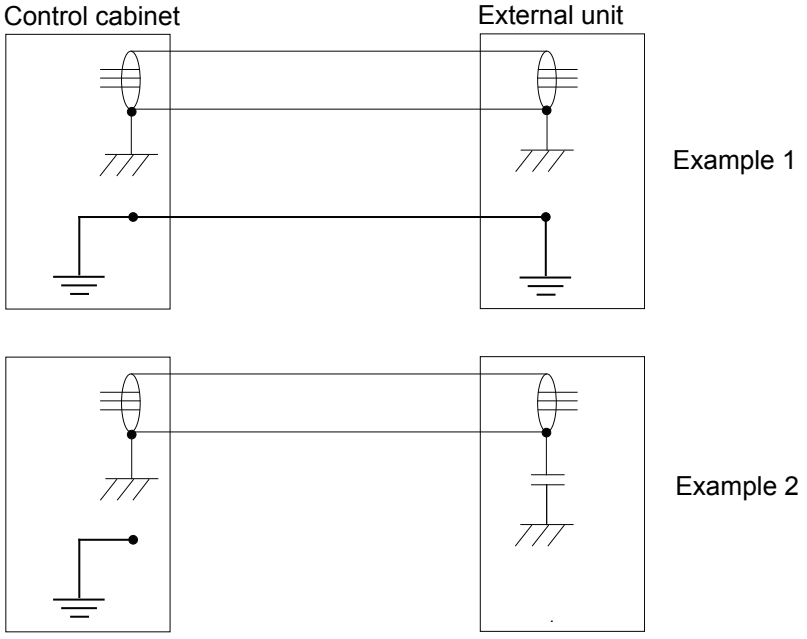
For requirements on the marking of the supply ground connection inside the control cabinet refer to UL 508C. For further details on how grounding systems should be designed refer to IEC 61000-5-2. For details of cross-sectional area of PE refer to IEC 60204-1.

Grounding installation

For information on how to connect protective earth for the manipulator, see the corresponding product manual.

Examples

The following figure shows 2 examples on how protective earth and the signal cable screens can be connected:



xx1200000960

Continues on next page

Example 1:

- Where a good earth connection is available on all units, the best shielding is obtained by grounding all screens at both ends on all units.

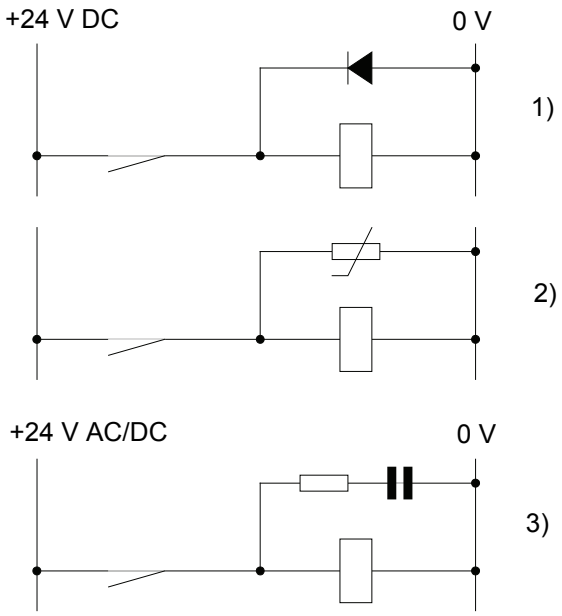
Example 2:

- If the cable is terminated where a good earth connection is not available a noise suppression capacitor can be used. The screens of the 2 cables must be connected as shown in the figure, but not connected to the chassis of the unit.

Interference elimination

Internal relay coils and other units that can generate interference inside the control cabinet are neutralized. External relay coils, solenoids and other units must be clamped in a similar way. The illustration below shows how this can be done.

Note that the turn-off time for DC relays increases after neutralization, especially if a diode is connected across the coil. Varistors give shorter turn-off times. Neutralizing the coils lengthens the life of the switches that control them.



xx1200000961

1 The diode should be dimensioned for the same current as the relay coil, and a voltage of twice the supply voltage.

2 The varistor should be dimensioned for the same energy as the relay coil, and a voltage of twice the supply voltage.

3 When AC voltage is used, the components needs to be dimensioned for >500 V max voltage and 125 V nominal voltage.

The resistor should be 100 Ω, and the capacitor should be 1W 0.1 - 1 µF (typically 0.47 µF).

2.5.2 Power supply system requirements

Definition of the power supply system

IEC 60364 defines three different types of mains grounding using the two-letter codes. These are TN, TT, and IT.

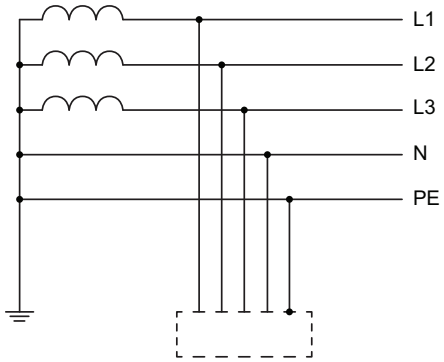
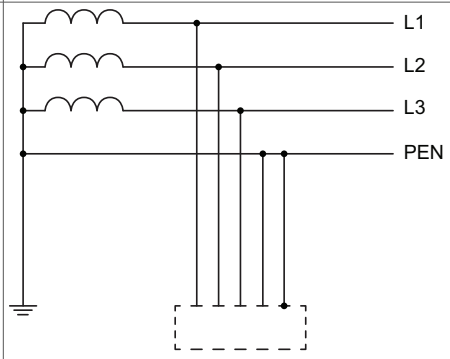
First letter	Type of ground connection
T	Direct connection of one point to ground.
I	Not connected to ground or connected to ground via a high impedance.

Second letter	Connection between ground and the device being supplied
T	Direct connection of one point to ground.
N	Direct connection to neutral at the origin of installation, which is connected to the ground

In the following section the transformer configuration refers to the transformer secondary side. Configuration of the transformer primary side is not discussed in this context.

Recommended power supply systems

The following systems are recommended by ABB:

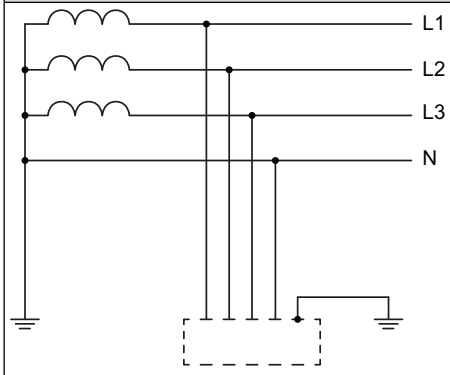
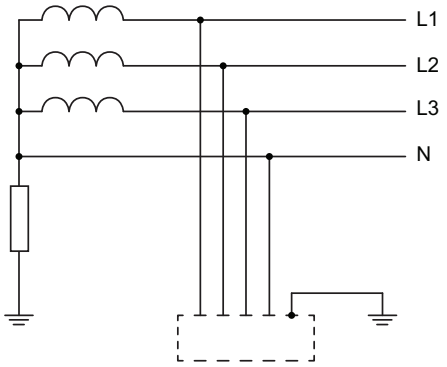
TN–S system	TN–C system
PE and N are separate conductors that are connected together only near the transformer.	A combined PEN conductor is used as both a PE and an N conductor.
 xx1700001310	 xx1700001311

Not recommended power supply systems

The following systems are not recommended by ABB:

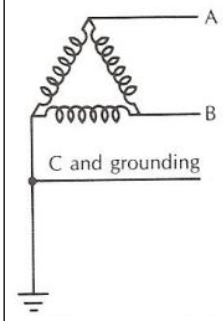
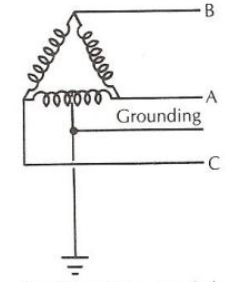
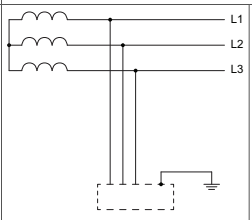
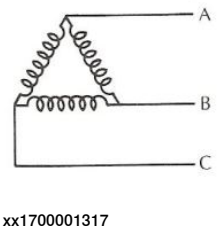
TT system (separate ground rods)	Resistance grounded secondary system
If this kind of system must be used, the grounding path resistance between ground 1 and 2 shall not exceed 0.1 Ohm, for more information refer to UL1740.	If this kind of system must be used, the voltage variations between any line and PE should not exceed ±10% of the nominal line voltage, for more information refer to EN 50160.

Continues on next page

TT system (separate ground rods)	Resistance grounded secondary system
 xx1700001312	 xx1700001313

Not allowed power supply systems

The following systems are not allowed by ABB:

Un-symmetric system		IT system (ungrounded secondary)	
These transformers provide un-symmetric phase voltages with respect to ground. Inherent phase imbalances with respect to ground would put the drive system and mains line filter (if installed) under unacceptable stress.		The voltage between phases and ground is undefined and may cause damage to both drive system and mains line filter (if installed).	
 xx1700001314	 xx1700001315	 xx1700001316	 xx1700001317

Isolation transformer

A three-phase isolation transformer between the mains supply and the control cabinet is required for any of the below conditions:

- Not allowed power supply system used, as mentioned in *Not allowed power supply systems on page 65*.
- When the mains supply is shared with a pressing machine, frequency converter, or other large industry equipment that may cause the power supply characteristics out of standard limits. To some extent, isolation transformers will filter out harmonics, spikes and surges.

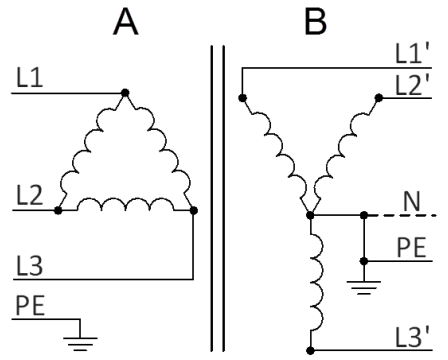
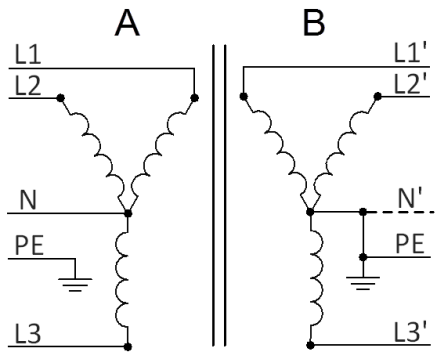
Continues on next page

2.5.2 Power supply system requirements
Continued

For further information refer to regional power supply standards.

Allowed isolation transformer types

The following isolation transformer types are allowed by ABB:

Delta-Wye isolation transformer (△/Y)	Wye-Wye isolation transformer (Y /Y)
 xx1700001318	 xx1700001319
A Primary/input B Secondary/output	

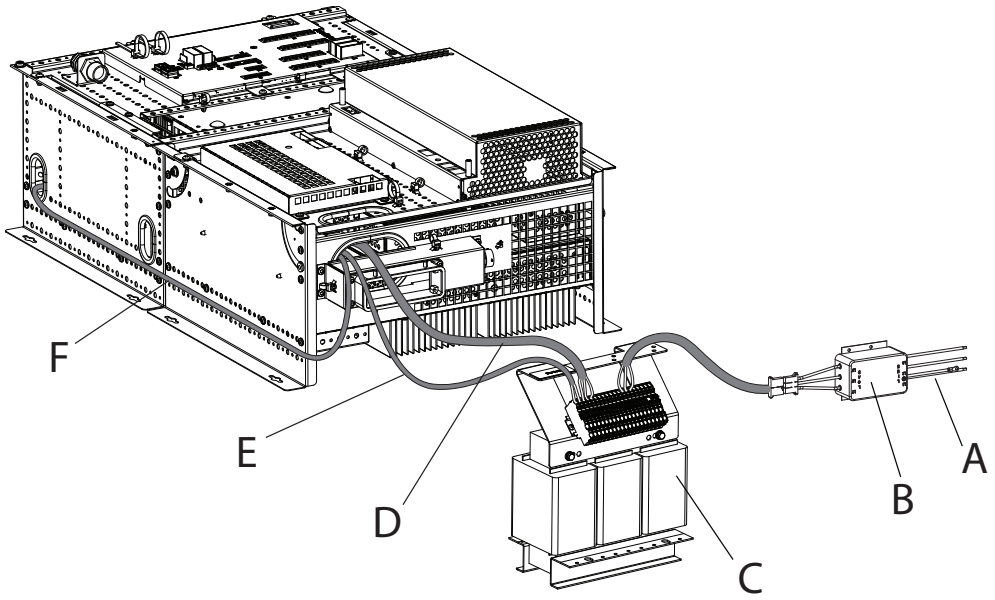
Mains line filter

A mains line filter is included in the IRC5 Panel Mounted controller, ensuring compliance with EN/IEC 61000-6-4.

Additional types of external filters may be used, provided they are approved by regional standards. For further information refer to regional power supply standards.

2.5.3 Connecting power supply to PMC small

Location



xx0600003295

A	Incoming power (3 phase)
B	Line filter
C	Transformer
D	Power supply 3x262V
E	Power supply 230V (2 phase)
F	Power supply 230V from the drive module to the control module

Required equipment

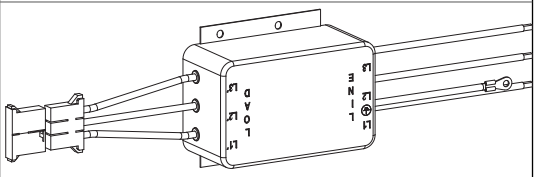
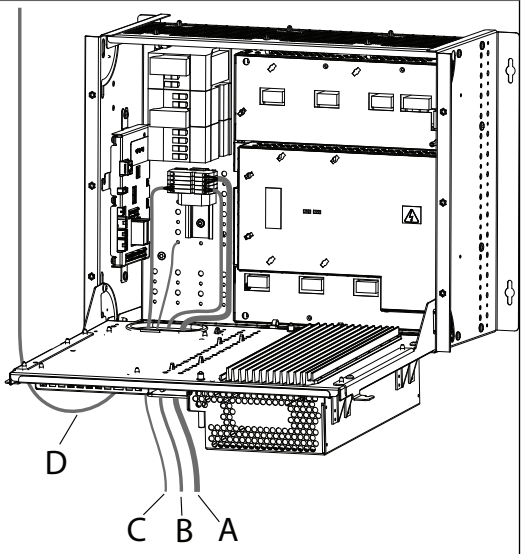
Equipment	Note
Incoming power cable	
Line filter	See *Miscellaneous parts on page 258*.
Mini-Fit Jr Handcrimp tool	Recommendation: 16-24AWG Molex art. no. 063819090 (*www.molex.com*)
Standard toolkit	The contents are defined in section *Standard toolkit, IRC5 on page 249*.
Circuit diagram	See *Circuit diagrams on page 273*.

Continues on next page

2.5.3 Connecting power supply to PMC small
Continued

Connecting incoming power to the Drive Module

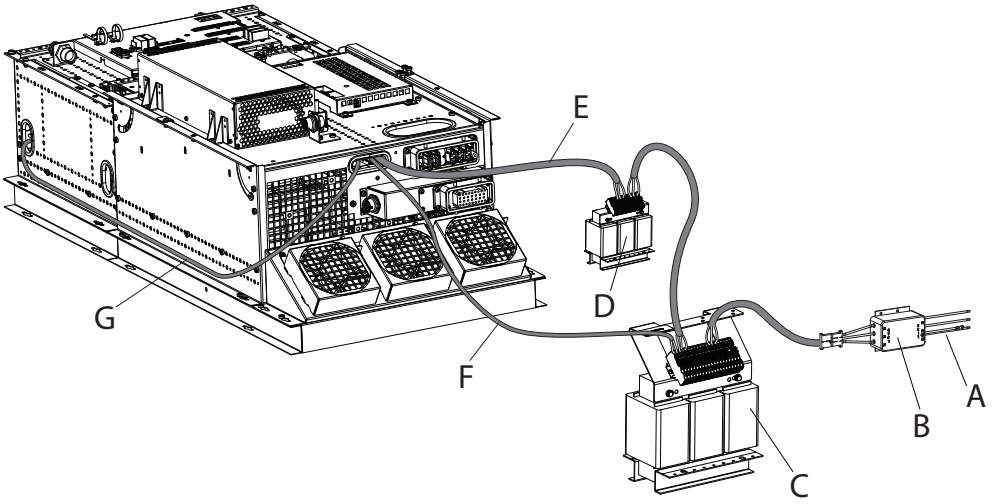
Use this procedure to connect power supply to the drive module.

	Action	Note/illustration
1	Place the line filter and transformer near to the drive module and they must be on the same ground.	
2	Connect the incoming power to the Line filter (LINE).	 xx0600003315
3	Route, strap and connect the three phase wires to XT16:1, 2 and 3.	 xx0600003316 • A: incoming power 3x262V 10A wires • B: incoming 230V wires • C: incoming earth cable • D: outgoing 230V to the Control Module
4	Route, strap and connect the two phase wires to XT16:4 and 5.	**CAUTION** Separate the power supply 2-phase wires from the 3-phase wires. These are disturbing on the Line filter LOAD side.
5	Route, strap and connect the earth cable to PE.	

2.5.4 Connecting power supply to PMC large

Location

The controller is shown lying down in order to show the cables. Please note that the PMC large must be mounted in an upright position.



xx1100000506

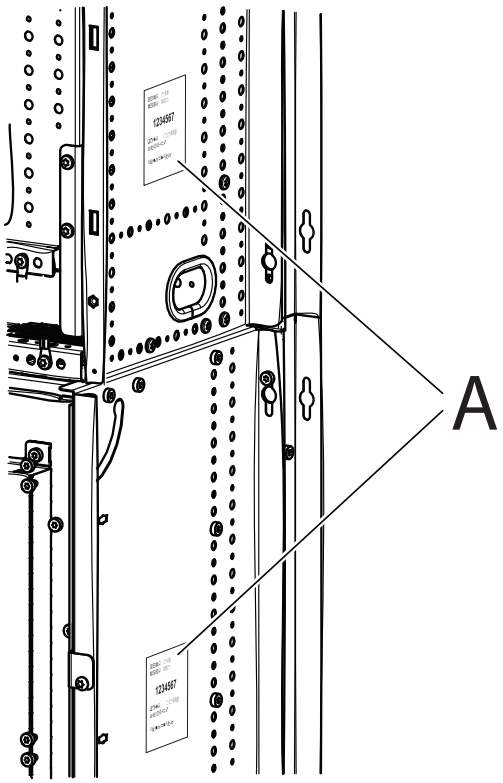
A	Incoming power (3 phase)
B	Line filter
C	Transformer (can be left out for 3-phase if using incoming 3-phase of 400-480V) (can be left out for 2-phase if using incoming single phase of 230V)
D	Inductor
E	Power supply 3 x 400-480V
F	Power supply 230V (2 phase)
G	Power supply 230V from the Drive Module to the Control Module

Continues on next page

2.5.4 Connecting power supply to PMC large
Continued

Rated voltage and current

To find the rated voltage, the full load current, and interrupting capacity of the IRC5 Panel Mounted Controller, see the name plates on the side of the control module and drive module.



xx1300001945

A	Controller name plates

Required equipment

Equipment	Note
Incoming power cable	
Line filter	See *Miscellaneous parts on page 258*.
Mini-Fit Jr Handcrimp tool	Recommendation: 16-24AWG Molex art. no. 063819090 (*www.molex.com*)
Standard toolkit	The contents are defined in section *Standard toolkit, IRC5 on page 249*.
Circuit diagram	See *Circuit diagrams on page 273*.

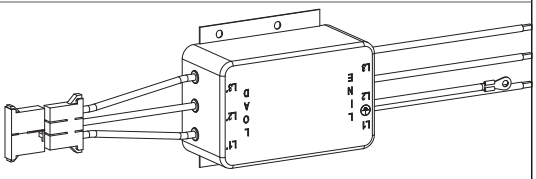
Recommended cables

Cable	Dimensions
230V	1.5-4 mm^2 (AWG 16-12)
400-480V	4-10 mm^2 (AWG 12-7)

Continues on next page

Connecting incoming power to the Drive Module

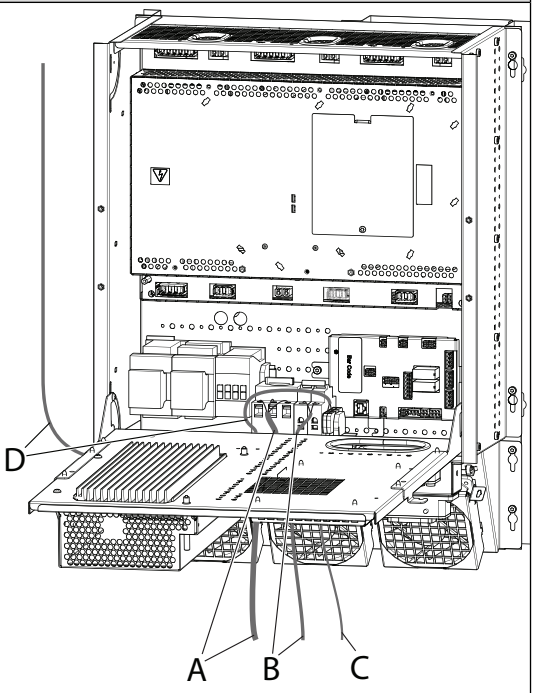
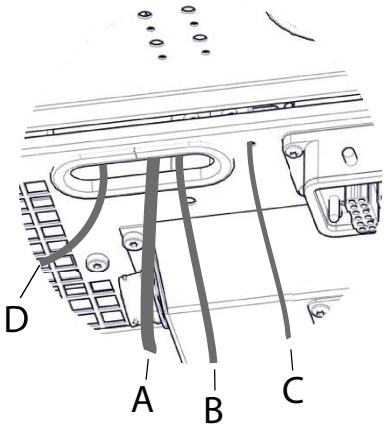
Use this procedure to connect power supply to the drive module.

	Action	Note/illustration
1	Place the line filter and transformer near to the drive module and they must be on the same ground.	
2	Connect the incoming power to the Line filter (LINE).	 xx0600003315

Continues on next page

2.5.4 Connecting power supply to PMC large

Continued

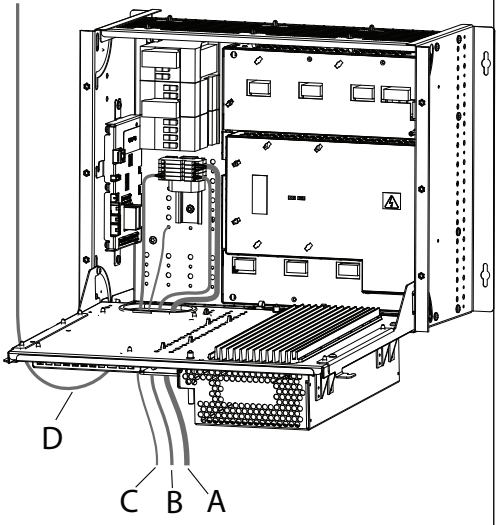
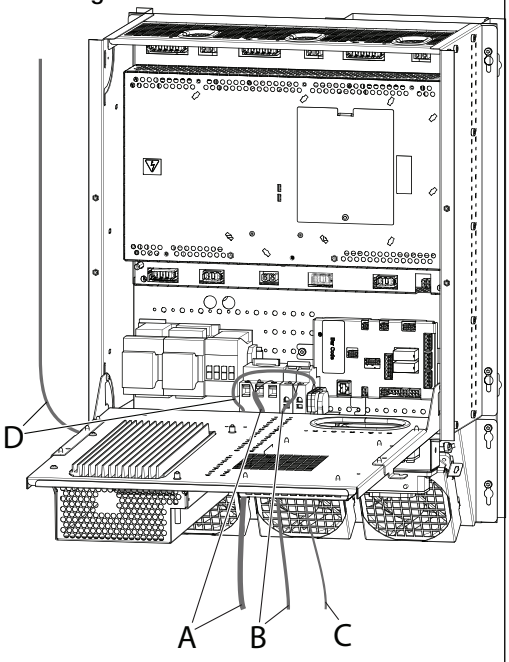
	Action	Note/illustration
3	Route, strap and connect the three phase wires to the 3-phase automatic fuse (F1).	 xx1100000513  xx1100000514 • A: incoming power 3x400V 16A wires • B: incoming 230V wires • C: incoming earth cable • D: outgoing 230V to the Control Module
4	Route, strap and connect the two phase wires to the 2-phase automatic fuse (F2).	**CAUTION** Separate the power supply 2-phase wires from the 3-phase wires. These are disturbing on the Line filter LOAD side.
5	Route, strap and connect the earth cable to PE.	

2.5.5 Connecting power supply to the control module

Connecting power supply 230V to the control module

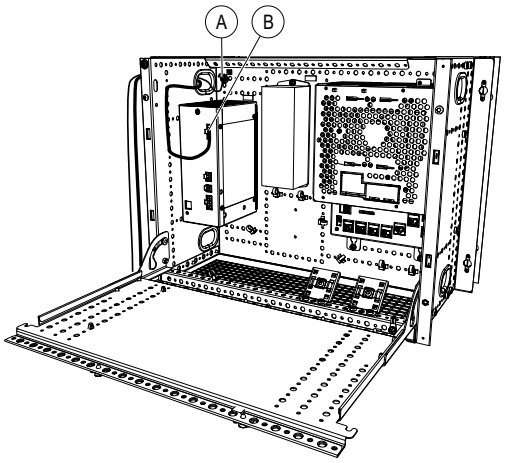
The power to the control module can be provided from the drive module with cable 3HAC038835-001 (rolled up inside the drive module at delivery) or from an external source.

Use this procedure to connect power supply to the control module.

	Action	Note/illustration
1	If using the power supply from the drive module, roll out the power cable from the drive module.	PMC small:  xx0600003316 PMC large:  xx1100000513 • D: 230V power supply from the drive module to the control module

Continues on next page

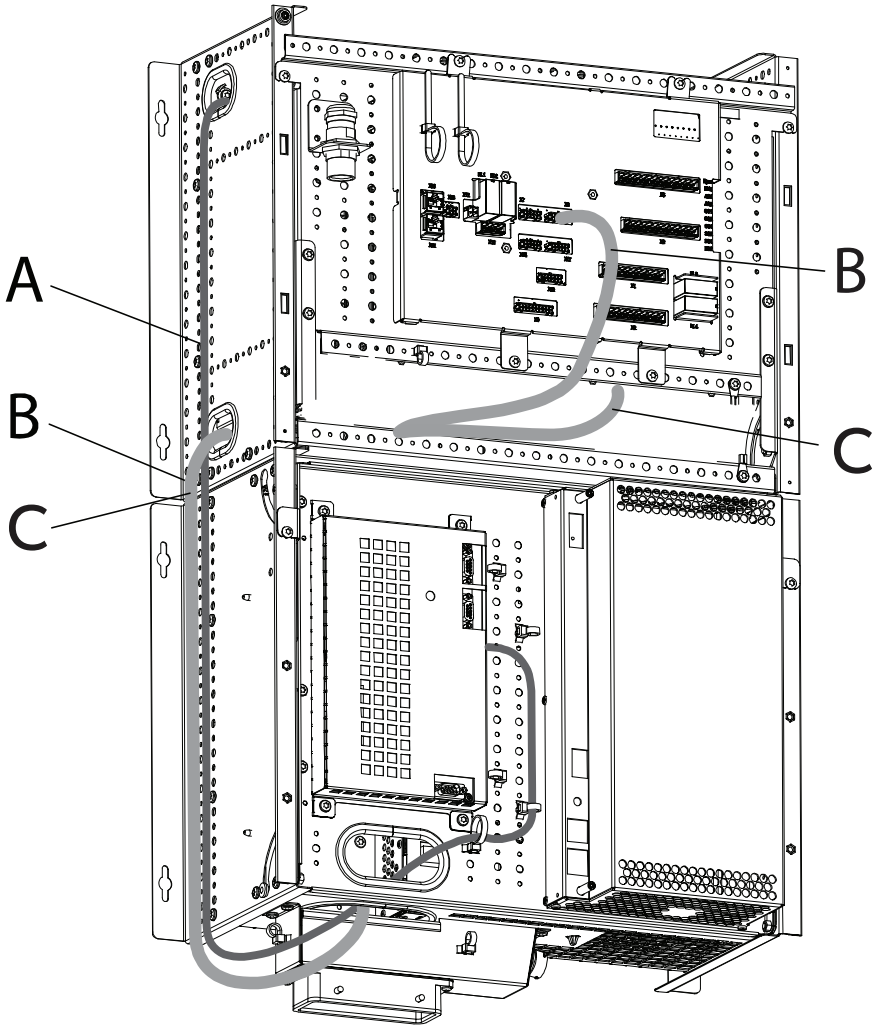
2.5.5 Connecting power supply to the control module
Continued

	Action	Note/illustration
2	Route and strap the power supply 230V 10A cable as the illustration to the right shows.	Control module:  xx1300001946 A Incoming earth B Power supply 230V 10A
3	Connect the power supply 230V 10A cable to the control power supply connector X1. • phase 1 to G2.X1:1 • earth to G2.X1:3 • phase 2 (N) to G2.X1:5	
4	Connect incoming earth to PE.	

2.5.6 Connecting communication cables between IRC5 Panel Mounted Drive Module and control module

Location

PMC small:



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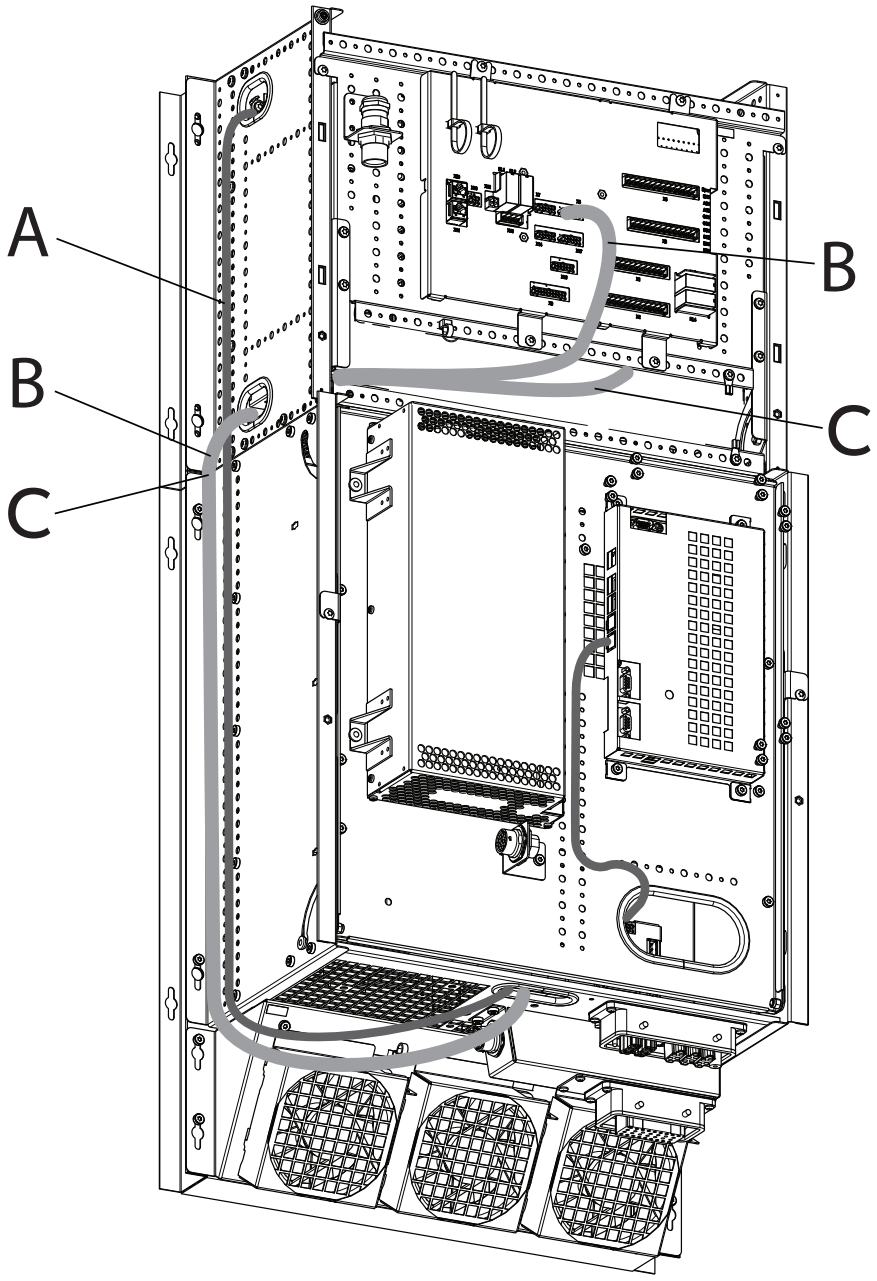
2.5.6 Connecting communication cables between IRC5 Panel Mounted Drive Module and control module
Continued

PMC large:



xx1100000486

A	Ethernet cable
B	Panel board/Contactor interface board cable
C	Harness AUX contact, XP/XS38. Only for SafeMove2.

Required equipment

Equipment	Art. no.	Note
Ethernet cable	3HAC024244-005	
Panel board/Contactor interface board cable	3HAC024201-001	

Continues on next page

2.5.6 Connecting communication cables between IRC5 Panel Mounted Drive Module and control module
Continued

Equipment	Art. no.	Note
Standard toolkit		Described in section Standard toolkit.
Circuit diagram		See *Circuit diagrams on page 273*.

Connecting the Ethernet cable

Use this procedure details connect the Ethernet cable between the drive module and control module.

	Action	Note/Illustration
1	Connect the cable to the Axis computer board connector A42.X2, route and strap the cable as shown in the illustration above.	
2	Connect the cable to the Main computer connector A32.A9.	

Connecting the Panel board/Contactor interface board cable

Use this procedure to connect the panel board/contactor interface board cable between the drive module and control module.

	Action	Note/Illustration
1	Connect the cable to the Contactor interface board connector A43.X1, route and strap the cable as shown in the illustration above.	
2	Connect the cable to the Panel board connector A21.X7.	

Connecting the AUX contact cable for SafeMove2

Use this procedure to connect the harness AUX contact, XP/XS38, cable between the drive module and control module.

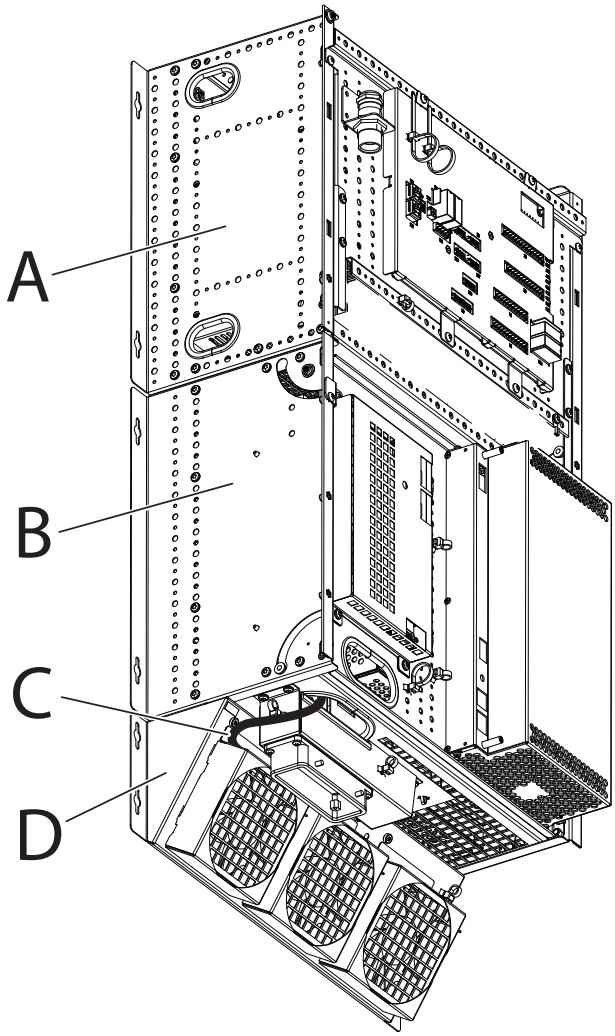
	Action	Note/Illustration
1	Connect the cable to the XS38 connector on the back wall of the control module.	Only the cable supplied together with the SafeMove2 option must be used.
2	Route and strap the cable as shown in the illustration above.	

2.5.7 Connecting fan unit to IRC5 Panel Mounted Drive Module

Note

For PMC large, the fan unit is already connected at delivery.

Location



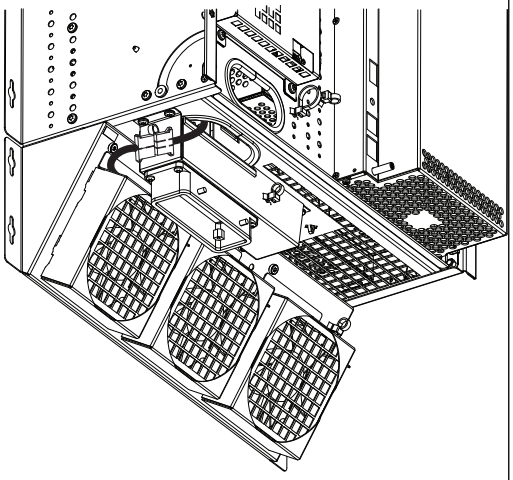
xx0600003323

A	Control module
B	Drive module
C	Fan cable
D	Fan unit

Continues on next page

Connecting fan unit to drive module

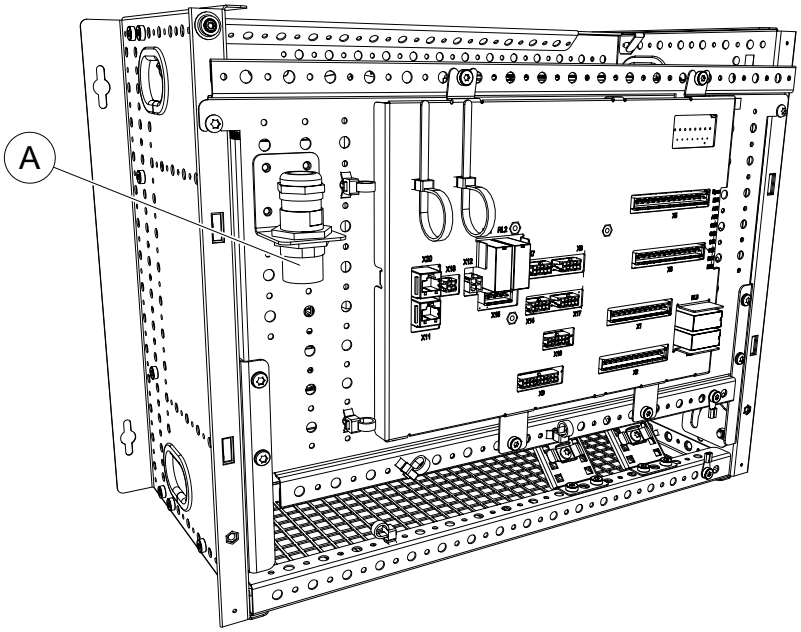
Use this procedure to connect the fan unit to the drive module.

	Action	Note/Illustration
1	Connect fan unit to drive module E1.XP1	 xx0600003324
2	**WARNING** The fan unit must not be covered. Check that nothing covers or block the fan unit.	
3	Temporarily turn the power supply to the modules on. Inspect all fans to make sure they function correctly. Turn the power supply back off.	

2.5.8 Connecting a FlexPendant

Location of FlexPendant connector

The FlexPendant connector on the Panel Mounted Controller is located on the front of the controller.



xx1300001947

A	FlexPendant connector

Connecting a FlexPendant

CAUTION

Always inspect the connector for dirt or damage before connecting it to the controller. Clean or replace any damaged parts.

	Action	Information
1	Locate the FlexPendant socket connector on the controller or operator's panel.	The controller must be in manual mode.
2	Plug in the FlexPendant cable connector.	
3	Screw the connector lock ring firmly by turning it clockwise.	
4	The FlexPendant starts automatically when connected and verifies that it has the correct software installed. If an update is needed, this is shown.	*Updating the add-in FlexPendant SxTPU4 Software on page 81*

Continues on next page

Updating the add-in FlexPendant SxTPU4 Software

> **Note**
>
> The add-in is only available for the FlexPendant with the emergency stop located at the connector. All other FlexPendant versions will automatically update their software via the controller (if needed).

The FlexPendant with the emergency stop located at the connector has an add-in that enables support for different RobotWare versions. This is the **FlexPendant SxTPU4 Software** add-in. The version of the add-in is shown during start-up.

When connecting the FlexPendant, the add-in verifies that it has support for the RobotWare version on the controller. If the RobotWare version is not supported by default, then the add-in requires an update. There are two method to update the FlexPendant add-in. The update is distributed as a software package.

- The update can be installed using a USB drive.
- If the update is available on the controller, then the FlexPendant will update itself when connecting it to the controller.

Once the add-in is updated, the FlexPendant can be connected to other IRC5 controllers with the same RobotWare version without requiring additional updates.

Update using a USB drive

Use the following procedure to update the add-in using a USB drive.

1. Download the update from RobotStudio, in the tab **Add-Ins**.
2. Save the software package (.rspak) on a USB drive in the folder `SxTPU4`, located in the root folder.
3. With the FlexPendant connected to the controller, reset the FlexPendant with the USB drive connected.
4. The update starts automatically and takes approximately 3-4 minutes.

Update from the controller

Use the following procedure to update the add-in from the controller.

1. In RobotStudio, use **Installation Manager 6** to create or update a system on your controller. Add the product *FlexPendantSxTPU4Software*.
2. Connect the FlexPendant to the controller.
3. The update starts automatically and takes approximately 3-4 minutes.

Handling the FlexPendant cables

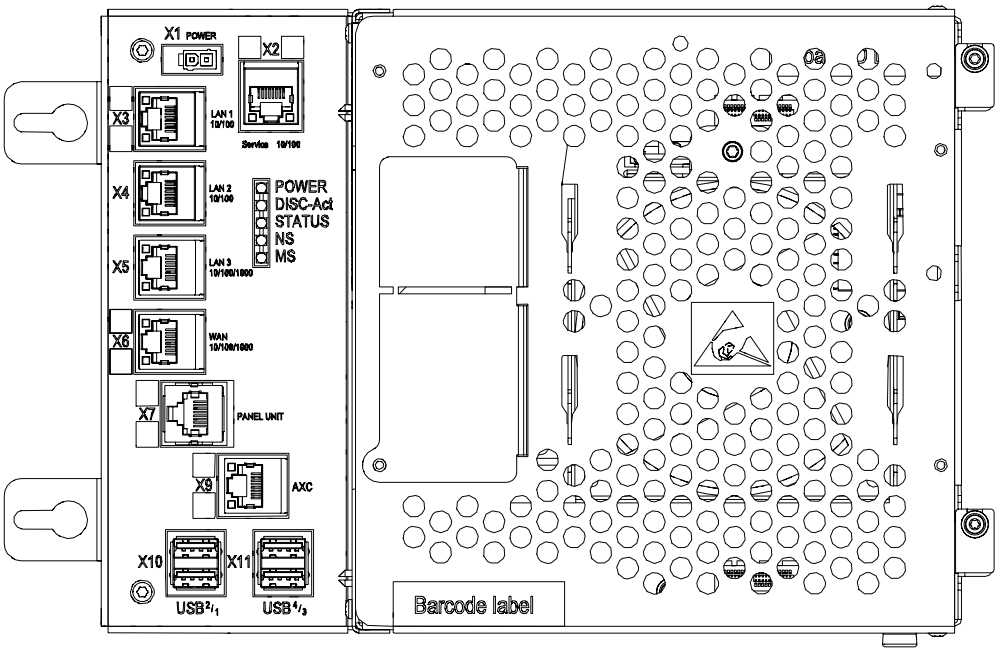
FlexPendant cables are allowed to be rolled up by hand with a minimum bending radius of 10 times the cable diameter. This also applies to the extension cable. For example, if the cable is 9.5 mm then it is allowed to roll it with a radius of 95 mm.

Extension cables are not allowed to be used in chains.

2.5.9 Connectors on the computer unit

Overview of the computer unit

The following illustration shows an overview of the computer unit.



xx1300000608

X1	Power supply
X2 (yellow)	Service (connection of PC).
X3 (green)	LAN1 (connection of FlexPendant).
X4	LAN2 (connection of Ethernet based options).
X5	LAN3 (connection of Ethernet based options).
X6	WAN (connection to factory WAN).
X7 (blue)	Panel unit
X9 (red)	Axis computer
X10, X11	USB ports (4 ports)

Note

It is not supported to connect multiple ports of the main computer (X2 - X6) to the same external switch, unless static VLAN isolation is applied on the external switch.

Service port test middle

The service port is intended for service engineers and programmers connecting directly to the controller with a PC.

Continues on next page

The service port is configured with a fixed IP-address, which is the same for all controllers and cannot be changed, and has a DHCP server that automatically assigns an IP-address to the connected PC.

Note

For more information about connecting a PC to the service port, see section *Connecting a PC to the controller* in *Operating manual - RobotStudio*.

WAN port

The WAN port is a public network interface to the controller, typically connected to the factory network with a public IP address provided by the network administrator.

The WAN port can be configured with fixed IP-address, or DCHP, from the **Boot application** on the FlexPendant. By default the IP-address is blank.

Some network services, like FTP and RobotStudio, are enabled by default. Other services are enabled by the respective RobotWare application.

Note

The WAN port cannot use any of the following IP-addresses which are allocated for other functions on the IRC5 controller:

- 192.168.125.0 - 255
- 192.168.126.0 - 255
- 192.168.127.0 - 255
- 192.168.128.0 - 255
- 192.168.129.0 - 255
- 192.168.130.0 - 255

The WAN port cannot be on a subnet which overlaps with any of the above reserved IP-addresses. If a subnet mask in the class B range has to be used, then a private address of class B must be used to avoid any overlapping. Please contact your local network administrator regarding network overlapping.

See the section about topic *Communication* in *Technical reference manual - System parameters*.

Note

For more information about connecting a PC to the WAN port, see section *Connecting a PC to the controller* in *Operating manual - RobotStudio*.

LAN ports

The LAN 1 port is dedicated for connecting the FlexPendant.

The LAN 2 and LAN 3 ports are intended for connecting network based process equipment to the controller. For example field buses, cameras, and welding equipment.

Continues on next page

2.5.9 Connectors on the computer unit
Continued

LAN 2 can only be used as private network to the IRC5 controller.

Isolated LAN 3 or LAN 3 as part of the private network (only for RobotWare 6.01 and later)

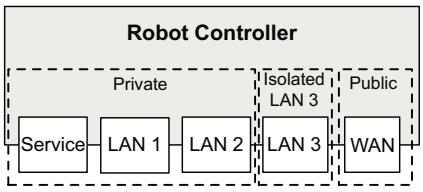
The default configuration is that LAN 3 is configured as an isolated network. This allows LAN 3 to be connected to an external network, including other robot controllers. The isolated LAN 3 network has the same address limitations as the WAN network.

Note

The isolated LAN 3 cannot be used to connect to any HMI device (RobotStudio, Robot Web Services, or PC SDK client) since it does not support the protocol needed for communication.

Note

If isolated LAN 3 network is selected, then it may not be possible to use *Connected Services* on LAN 3 port, depending on which fieldbus protocol is used (EtherNet/IP or PROFINET).

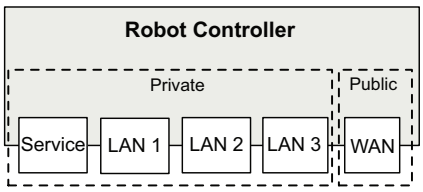


xx1500000393

An alternative configuration is that LAN 3 is part of the private network. The ports Service, LAN 1, LAN 2, and LAN 3 then belong to the same network and act just as different ports on the same switch. This is configured by changing the system parameter *Interface*, in topic *Communication* and type *Static VLAN*, from "LAN 3" to "LAN". See *Technical reference manual - System parameters*.

Note

With this alternate configuration it is possible to use *Connected Services* on LAN 3 as the network is not isolated to one fieldbus protocol.



xx1500000394

Note

For more information and examples of connecting to different networks, see *Application manual - EtherNet/IP Scanner/Adapter* or *Application manual - PROFINET Controller/Device*.

Continues on next page

USB ports

The USB ports are intended for connecting USB memory devices.

Note

It is recommended to use the USB ports USB[1] and USB[2] on the X10 connector for connecting USB memory devices.

The USB ports on the X11 connector are intended for internal use.

2.5.10 Connecting a serial channel to the controller

General

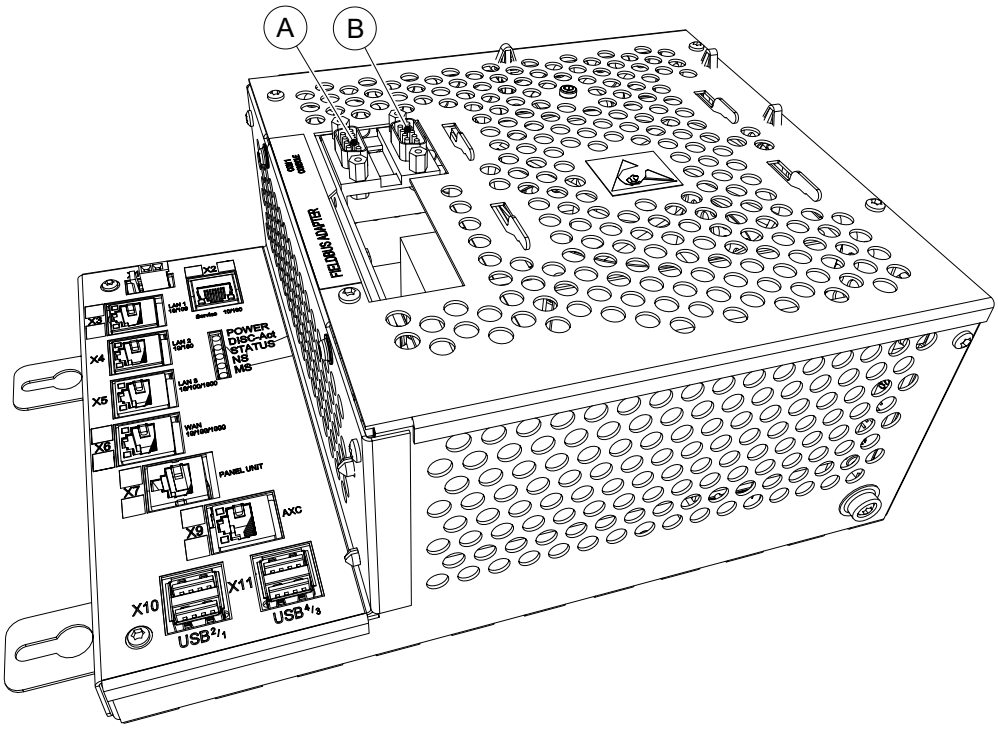
The serial channel is an option. To be able to connect a serial channel to the controller, the main computer needs to be equipped with the expansion board DSQC1003.

The expansion board has one RS232 serial channel, COM1, which can be used to communicate with process equipment.

The expansion board also enables the connection of a fieldbus adapter. For more information on how to connect a fieldbus adapter, see *Definition of fieldbuses, IRC5 on page 109*.

Location

The serial channel connector is located on the expansion board in the computer unit as shown below.



xx1300000610

A	COM1
B	CONSOLE

Note

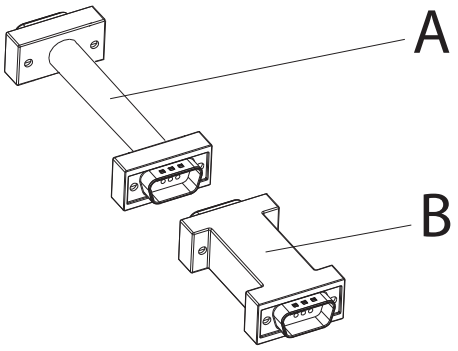
The CONSOLE connector is used for debugging purposes only.

Continues on next page

Conversion of the RS232 channel

The RS232 channel can be converted to RS422 full duplex with an optional adapter, DSQC 615.

The RS422 enables a more reliable point to point communication (differential) over longer distances, from RS232 = 15m to RS422 = 120m.

	Action	Info/Illustration
1	Connect the adapter to the serial channel connector.	A cable is needed between the serial channel connector and the adapter.  xx1300000854 A cable B adapter

2.5.11 Closing the Automatic Stop circuit

Closing the Automatic Stop circuit

The controller is shipped with a default configuration so that the automatic stop circuit is open and the general/superior stop circuit is bypassed (short-circuited). The system can only work in manual mode.

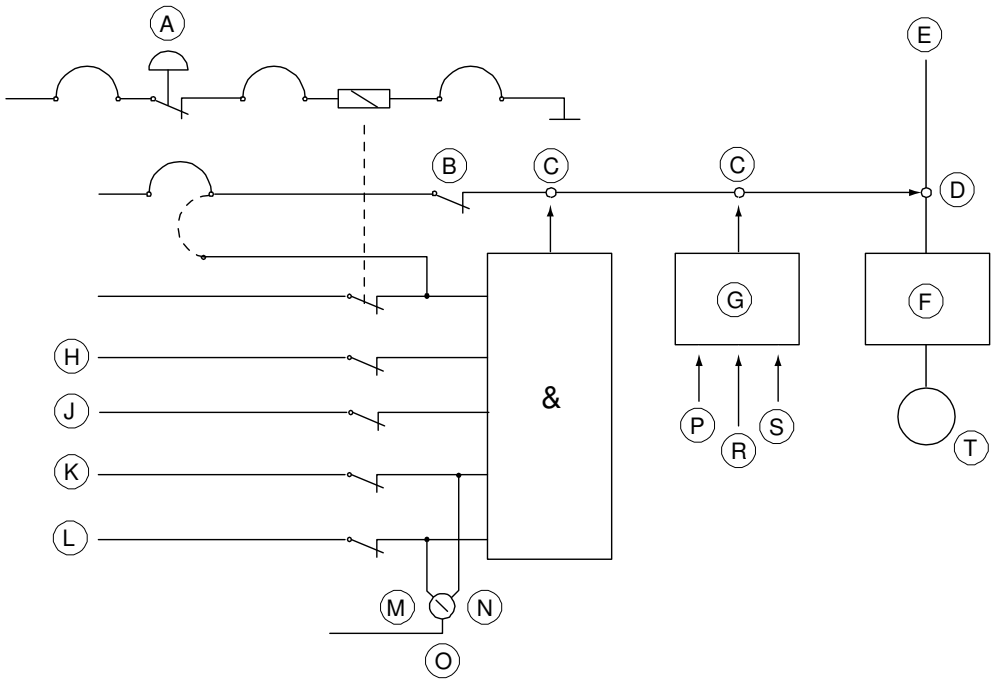
To enable the controller without any additional/external safety equipment, connect the safety circuit. To bypass Automatic stop circuit, 3-pole jumpers are enclosed in bag 3HAC078549-001 with corresponding instruction 3HAC078652-001. See the circuit diagram, *3HAC026871-020*.

2.5.12 Connection of the MOTORS ON/MOTORS OFF circuit

Outline diagram

The MOTORS ON/MOTORS OFF circuit is made up of two identical chains of switches.

The diagram shows one of the chains with the available customer connections, AS, GS, SS, and ES.



xx0100000174

A	ES (emergency stop)
B	LS (Limit switch)
C	Solid state switches
D	Contactor
E	Mains
F	Drive unit
G	Second chain interlock
H	GS (general mode safeguarded space stop)
J	SS (superior stop, same function as GS)
K	AS (Automatic mode safeguarded space stop)
L	ED (FlexPendant three-position enabling device)
M	Manual mode
N	Automatic mode
O	Operating mode selector
P	RUN

Continues on next page

2.5.12 Connection of the MOTORS ON/MOTORS OFF circuit
Continued

R	EN1
S	EN2
T	Motor

Note

Make sure the polarity is correct and that the voltage is not more than 24 V.

Function of the MOTORS ON/MOTORS OFF circuit

The circuit monitors all safety related equipment and switches. If any of the switches is opened, the MOTORS ON/MOTORS OFF circuit switches the power to the motors off.

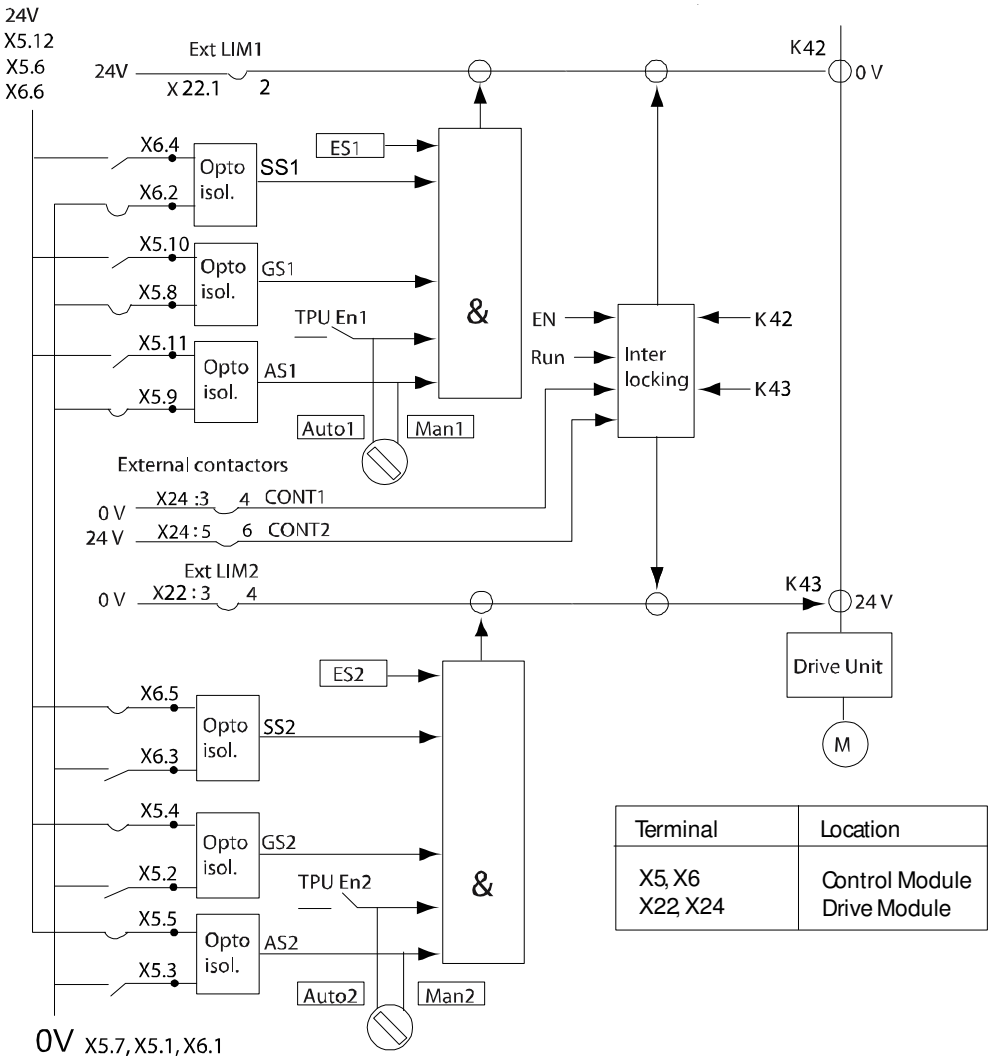
As long as the two channels of AS, GS, SS, and ES are not in identical state, the robot will remain in protective stop and MOTORS OFF mode.

Continues on next page

Connection of safety chains

The diagram below shows the dual channel safety chain.

The supply from internal 24V and 0 V is displayed. For external supply of GS and AS check the circuit diagram.



xx0100000166

Technical data per chain	
Limit switch	Load: 300 mV Max. voltage drop: 1 V
External connectors	Load: 10 mA Max. voltage drop: 4 V
GS/AS/SS load at 24 V	25 mA
GS/AS/SS closed "1"	>18 V
GS/AS/SS open "0"	< 5 V
External supply of GS/AS/SS	Max. + 35 VDC Min. - 35 VDC
GS/AS/SS Filter time	2.0 ms i

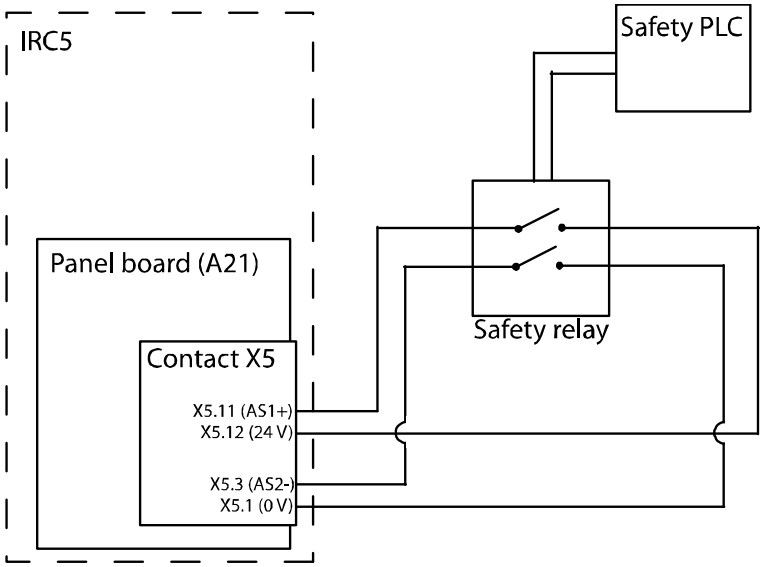
Continues on next page

2.5.12 Connection of the MOTORS ON/MOTORS OFF circuit

Continued

Technical data per chain	
Max. potential in relation to the cabinet earthing and other signal groups.	300 V
Signal class	Control signals

i When connecting for example a safety PLC to a safety stop, make sure that the safety check pulses not exceeds 2.0 ms, otherwise a safety relay must be connected in between. See the following illustration.



xx0800000130

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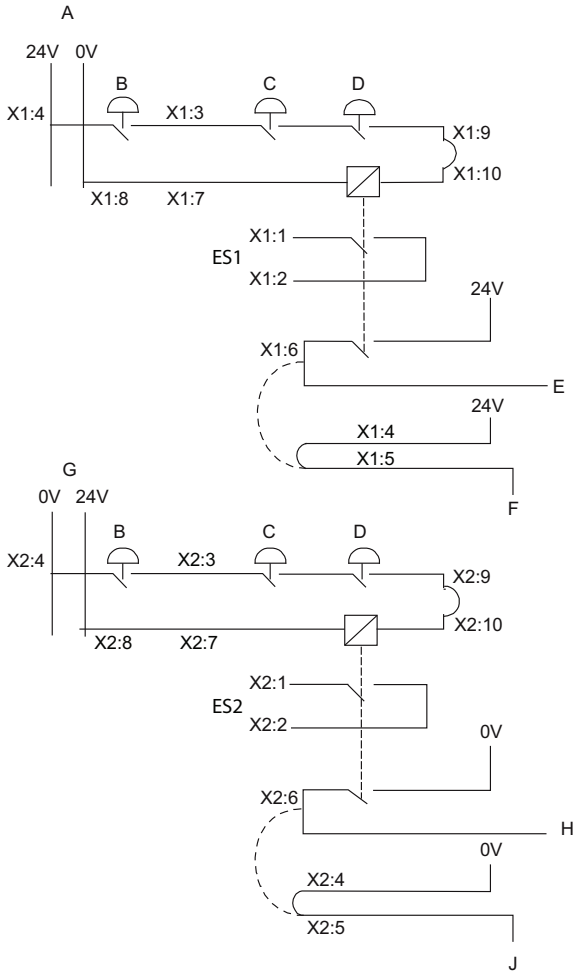
Connection of ES1/ES2 on panel unit

The diagram below shows the terminals for the emergency circuits.

The supply from internal 24V (X1:4/X2:8) and 0V (X1:8/X2:4) is displayed. For an ext. supply, X1:3 / X2:7 is connected to ext. 24V, and X1:7 / X2:3 is connected to ext. 0V.



xx0100000191

A	Internal
B	Ext stop
C	FlexPendant
D	Cabinet
E	ES1 internal
F	Run chain 1 top
G	Internal
H	ES2 internal
J	Run chain 2 top
ES1	Emergency stop output 1
ES2	Emergency stop output 2

Continues on next page

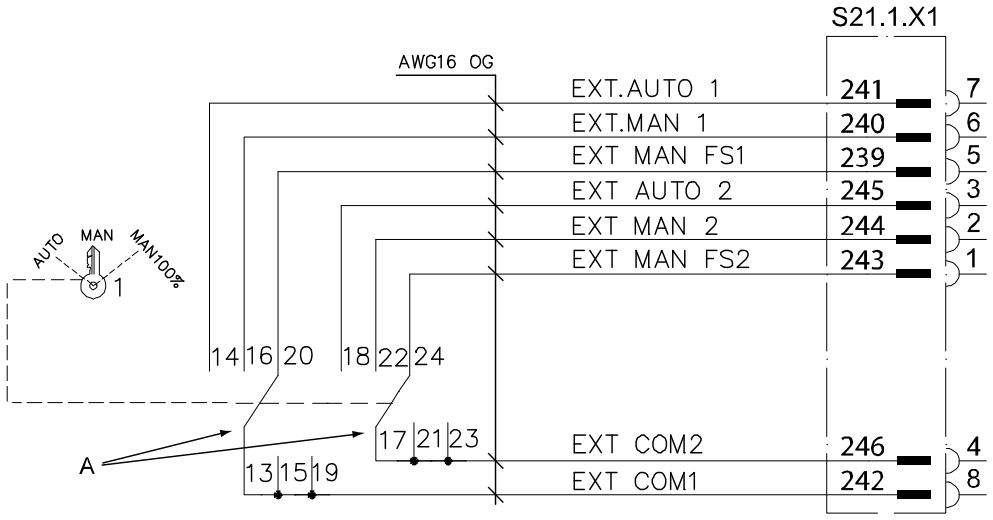
2.5.12 Connection of the MOTORS ON/MOTORS OFF circuit

Continued

Technical data	
ES1 and ES2 max output voltage	120 VAC or 48 VDC
ES1 and ES2 max output current	120 VAC: 4 A 48 VDC L/R: 50 mA 24 VDC L/R: 2 A 24 VDC R load: 8 A
External supply of ES relay	24 VDC ± 10% between terminals X1:3, 7 and X2:7, 3 respectively. **Note** In case of interference, the external supply must be properly filtered.
Rated current per chain	40 mA
Max. potential in relation to the cabinet earthing and other signal groups.	300 V
Signal class	Control signals

Connection to operating mode selector

The illustration below shows the connection of terminals for customer use.



xx0500002092

A	Mode selector

Technical data	
Max. voltage	48 VDC
Max. current	4 A
Max. potential in relation to the cabinet earthing and other signal groups.	300 V
Signal class	Control signals

2.5.13 Programmable stop functions

Stopping functions

There are different methods to stop the robot, in addition to manually initiated stops.

- Stop with system input signals
- Stop with RAPID instructions
- Other stops

Stop with system input signals

In the control system, it is possible to define system input signals to be set/reset through different interactions, for example, through I/O signals. See *Application manual - Controller software IRC5*.

The RAPID program cannot be started when any of the system input signals is high.

Pre-defined system input	Description
Stop	The RAPID program execution is stopped, and the manipulator is stopped on path with no deviation. This stop is similar to a normal program stop using stop button on the FlexPendant.
SoftStop	This is a faster stop of the manipulator than *Stop*. This stop is more stressing for the mechanics than normal stop, therefore there might be a minor deviation on path.
QuickStop	This is a faster stop of the manipulator than *Stop* and *SoftStop*. This stop is more stressing for the mechanics than normal stop or *SoftStop*, therefore there might be a deviation on path.
Stop at End of Cycle	Stops the RAPID program when the complete program is executed, that means when the last instruction in the main routine has been completed.
Stop at End of Instruction	Stops program execution after the current instruction is completed.

All of these stops are performed without using the brakes, and the power is never disconnected. The program execution can be continued directly, for example by activating a start signal if the stop signal is set low.

Note

Only safety rated input signals are allowed to be used for safety.

Continues on next page

2.5.13 Programmable stop functions
Continued

Stop with RAPID instructions

There are several RAPID instructions available that stops the robot.

Instruction	Description	Arguments
SystemStopAction	Stops all robots in all tasks immediately.	\Stop: similar to a normal program stop with stop button. \StopBlock: as above, but to restart the PP has to be moved. \Halt: this is like a category 0 stop, i.e. it will result in motors off state, stop of program execution and robot movements in all motion tasks. The Motors on button must be pressed before the program execution can be restarted.
Stop	The current move instruction will be finished before the robot stops. A restart will continue the program execution.	\NoRegain: the robot will not return to the stop point when restarted, e.g. after having been jogged away. \AllMoveTasks: all robots will be stopped.
StopMove	The current move instruction will be stopped immediately as a normal program stop but the program execution will continue with the next instruction. StartMove must be executed to get the robot moving again.	\Quick: the stop will be a soft stop on path, as described for system input *SoftStop*, otherwise similar to a normal program stop. \AllMotionTasks: all robots will be stopped.
DebugBreak	The current move instruction and the program execution will be stopped immediately as a normal program stop. A restart of the program will continue the program execution.	
EXIT	The current move instruction and the program execution will be stopped immediately as a normal program stop. After stop the Program Pointer is lost and has to be reset to Main.	
EXITCYCLE	The current move instruction and program execution will be stopped immediately. The Program Pointer will be moved to Main and if running mode is continuous, the program will be restarted.	

Continues on next page

Instruction	Description	Arguments
`SearchX`	Search instructions can be programmed with arguments to stop the robot movement close to the point where a search hit was noticed. The program execution will continue with the next instruction.	`\Stop`: the robot will stop as fast as possible. This stop is performed by ramping down motion in each motor separate from each other, and as fast as possible. Since it will be without any coordination, the robot may slide off path fairly much. `\PStop`: the robot will stop like after a normal program stop. `\SStop`: the robot will stop on path but quicker than a normal program stop. This is similar to a system input *SoftStop*. `\Sup`: the robot will continue to the `ToPoint`. If more than one search hit is found, an error will be reported.

RAPID instructions are described in *Technical reference manual - RAPID Instructions, Functions and Data types*.

Other unexpected stops

Type of stop	Description
SysFail	In the control system there is a surveillance and monitoring function that can detect abnormal situations. In such cases a stop will be initiated. The robot controller must be restarted.
Power fail	In the control system there is a monitoring function that can detect power failure. In such cases a stop will be initiated.
Stop at collision	In the control system there is a monitoring function that can detect collisions. In such cases a stop will be initiated.  **WARNING** Special care must be taken when restarting a machine that is stopped due to a collision. The robot might make a limited move when restarted.  **WARNING** The revolution counters might need to be updated after a collision to ensure path accuracy.

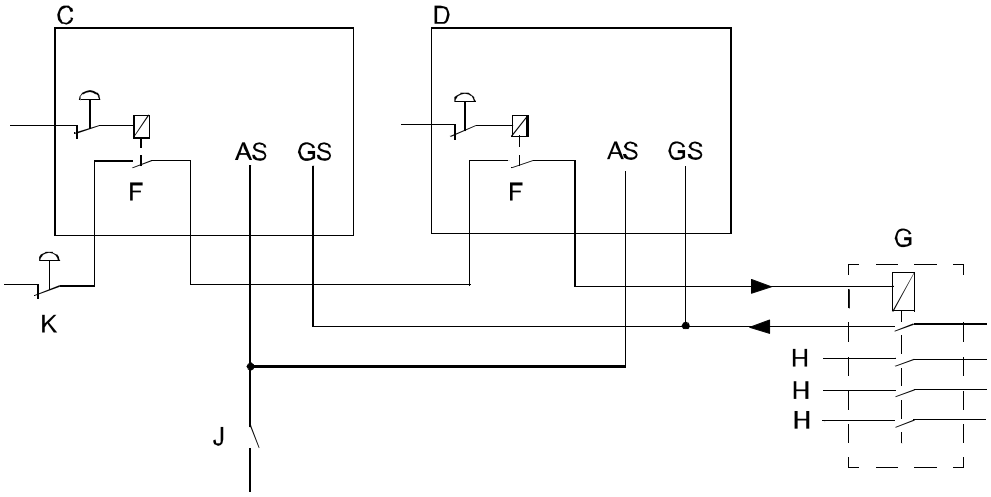
2.5.14 Connection of external safety relay

Description

The motor contactors K42 and K43 in the controller can operate with external equipment if external relays are used.

Connection example

The following figure shows an example of how to connect an external safety relay.



xx0100000246

C	Robot 1
D	Robot 2
F	ES (emergency stop) relay
G	External Safety relay
H	To other equipment
J	Safety gate
K	Cell ES (emergency stop)

2.5.15 Connection of Drive Module Disconnect, by limit switch

General

This function enables you to temporarily disconnect a drive module and deactivate any robot or additional mechanical units connected to this module. The procedures are detailed below.

It is also possible to connect a remote switch to enable a Drive Module Disconnect. The required equipment and procedure for connection of a switch are specified below.

Note

The system diagnostics monitors the connection and disconnection of drive modules, and event log messages regarding these events will be stored in the event log when required. These messages are accessible using the FlexPendant or RobotStudio.

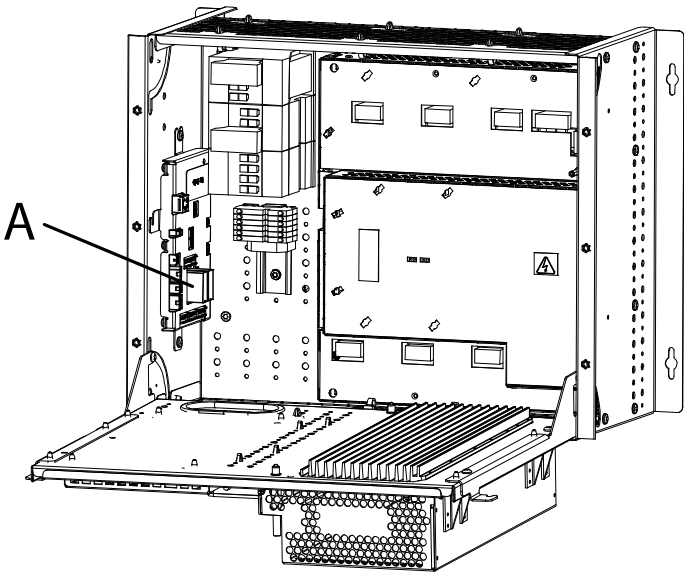
Note

This functionality cannot be used together with SafeMove, option 810-2.

Location

The contactor interface board unit is located in the Panel Mounted Drive Module as shown below.

PMC small:



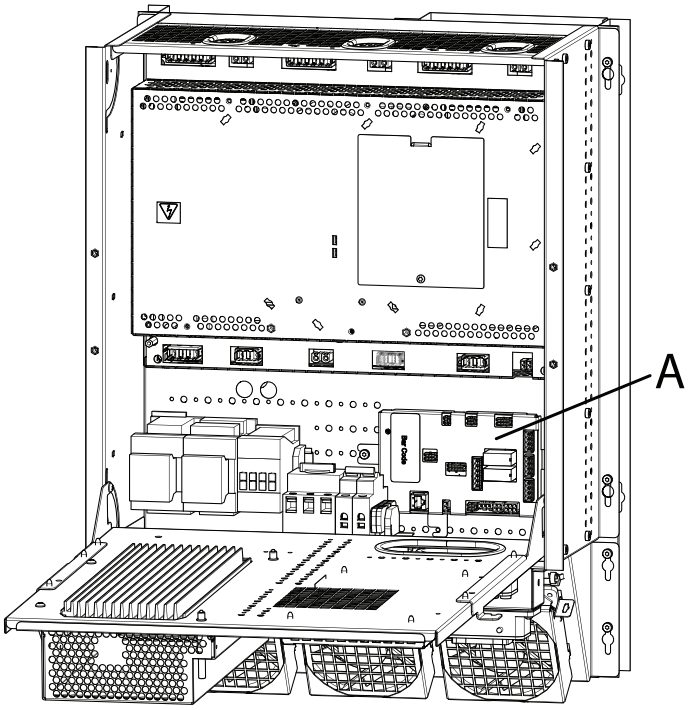
xx0600003241

A	Contactor interface board

Continues on next page

2.5.15 Connection of Drive Module Disconnect, by limit switch
Continued

PMC large:



xx1100000481

A	Contactor interface board

Required equipment

The table below details the required equipment.

Equipment	Note
Wire	AWG20
Switch	24V 0.5A
Operating manual - RobotStudio	
Operating manual - IRC5 with FlexPendant	
Standard toolkit	
Circuit diagram	See *Circuit diagrams on page 273*.

Enabling Drive Module Disconnect in RobotStudio

The following procedures details how to enable the system for Drive Module Disconnect.

	Action
1	In the **Configuration editor** in RobotStudio, select the topic *Motion*.
2	Select the type *Drive Module User Data*.
3	Set the parameter for selected drive module to *YES*.
4	Restart the system.

Continues on next page

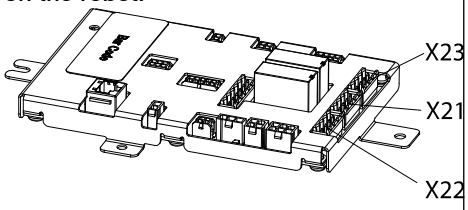
Enabling Drive Module Disconnect with the FlexPendant

The following procedures details how to enable the system for Drive Module Disconnect.

	Action
1	In the **Control panel** on the FlexPendant, tap **Topics**, and select **Motion**.
2	Tap the type *Drive Module User Data*, and then tap to select the drive module.
3	Set the parameter for selected drive module to *YES*.
4	Restart the system.

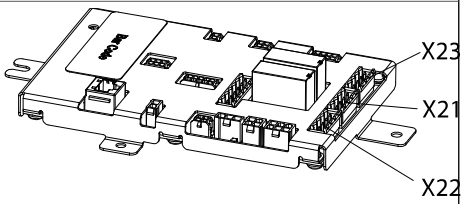
Disconnecting the drive module

Use this procedure to disconnect a drive module.

	Action	Note/illustration
1	Make sure that the system is in the MOTORS_OFF state.	
2	Disconnect the connector X22.	It is also possible to use connector X21, but this is typically used for limit switches on the robot.  xx0600003250

Reconnecting the drive module

Use this procedure to reconnect the drive module.

	Action	Note/illustration
1	Make sure that the system is in the MOTORS_OFF state.	
2	Reconnect the X22 connector.	 xx0600003250
3	Move the program pointer to main in the RAPID-program where the disconnected mechanical units are active.	

Connect a remote switch

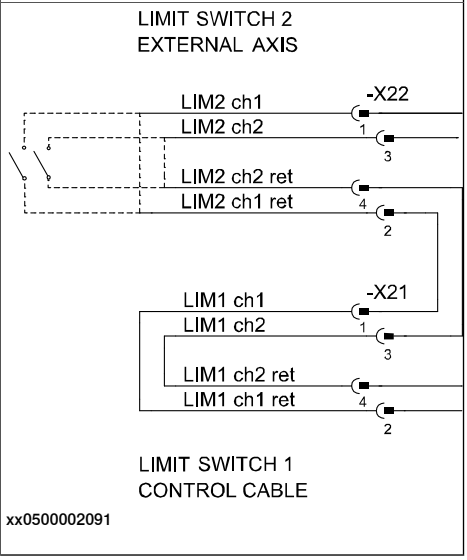
The following procedures details how to connect a remote switch.

	Action	Note/illustration
1	Make sure that the system is in the MOTORS_OFF state.	

Continues on next page

2.5.15 Connection of Drive Module Disconnect, by limit switch

Continued

	Action	Note/illustration
2	Disconnect the jumpers from the connector X22.	
3	Connect the wires to the connector X22 according to the diagram on the right.	

2.5.16 Connecting a Limit switch override push button

DANGER

The Limit switch override is used to disconnect safety limitations. Make sure the Limit switch override function is not active longer than absolutely necessary.

If the option SafeMove is implemented, Limit switch override must never be used at all. The SafeMove safety controller has its own override function.

General

The override circuit enables the possibility to jog an axis out of a forbidden (limited) zone.

Limitations

The switch has to be placed inside the controller to eliminate the risk of electrical noise.

Required equipment

Equipment	Art. no	Note
Contact block (2 pcs)	3SFA 611 610 R1001	ABB CW Control
Push button	1SFA 611 102 R1105	ABB CW Control
Connector X23	3HAC021085-001	
Wire		Cable AWG 20 Blue
Standard toolkit		This is detailed in section *Standard toolkit, IRC5 on page 249*.
Circuit diagram		See *Circuit diagrams on page 273*.

Note

The parts needs to be ordered separately from ABB and are not part of an option package.

Procedure

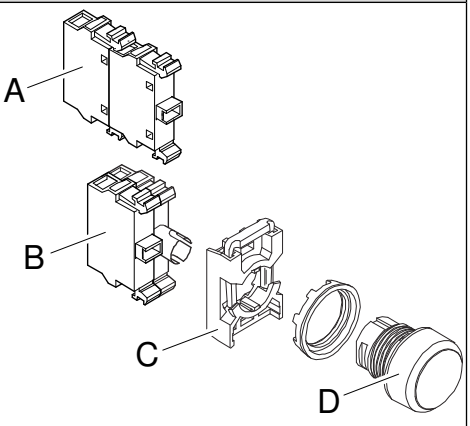
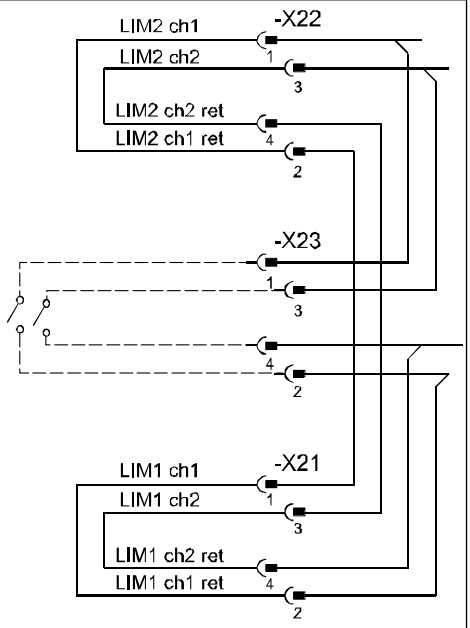
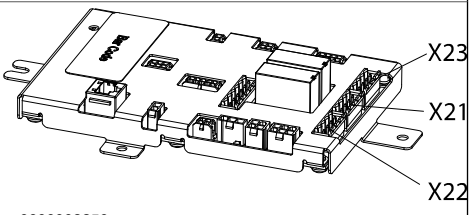
The following procedure details how to connect a Limit switch override circuit in the controller.

	Action	Note/illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	

Continues on next page

2.5.16 Connecting a Limit switch override push button

Continued

	Action	Note/illustration
2	Attach two additional contact blocks on the existing push button (Motors on).	 xx0500002553 • A: Additional contact blocks • B: Existing contact, lamp blocks • C: Holder • D: Push button
3	Connect wires from the contact blocks to the connector according to the diagram to the right.	 xx0500002556
4	Fit the connector to the X23 connector on the contactor interface board.	 xx0600003250

2.6 Drive system

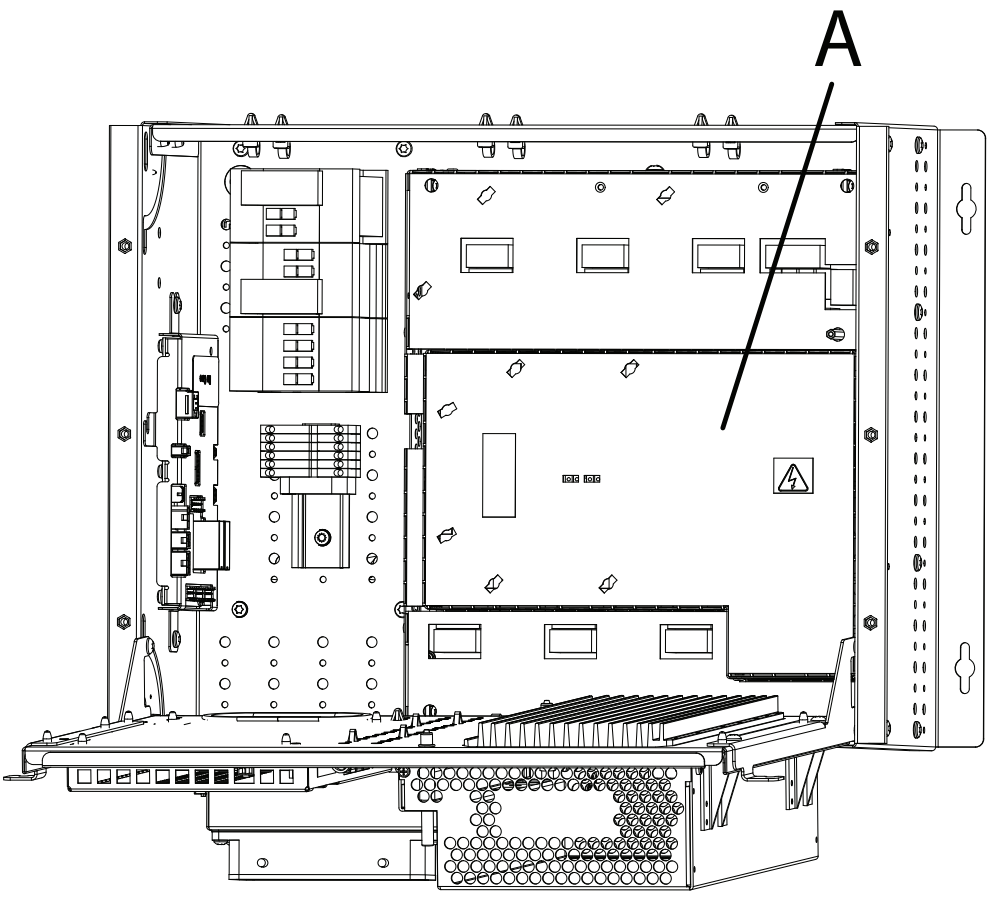
2.6.1 Drive functions, general

General

The robot is powered by power electronics found in the IRC5 Panel Mounted Controller.

Location of drive unit

PMC small:



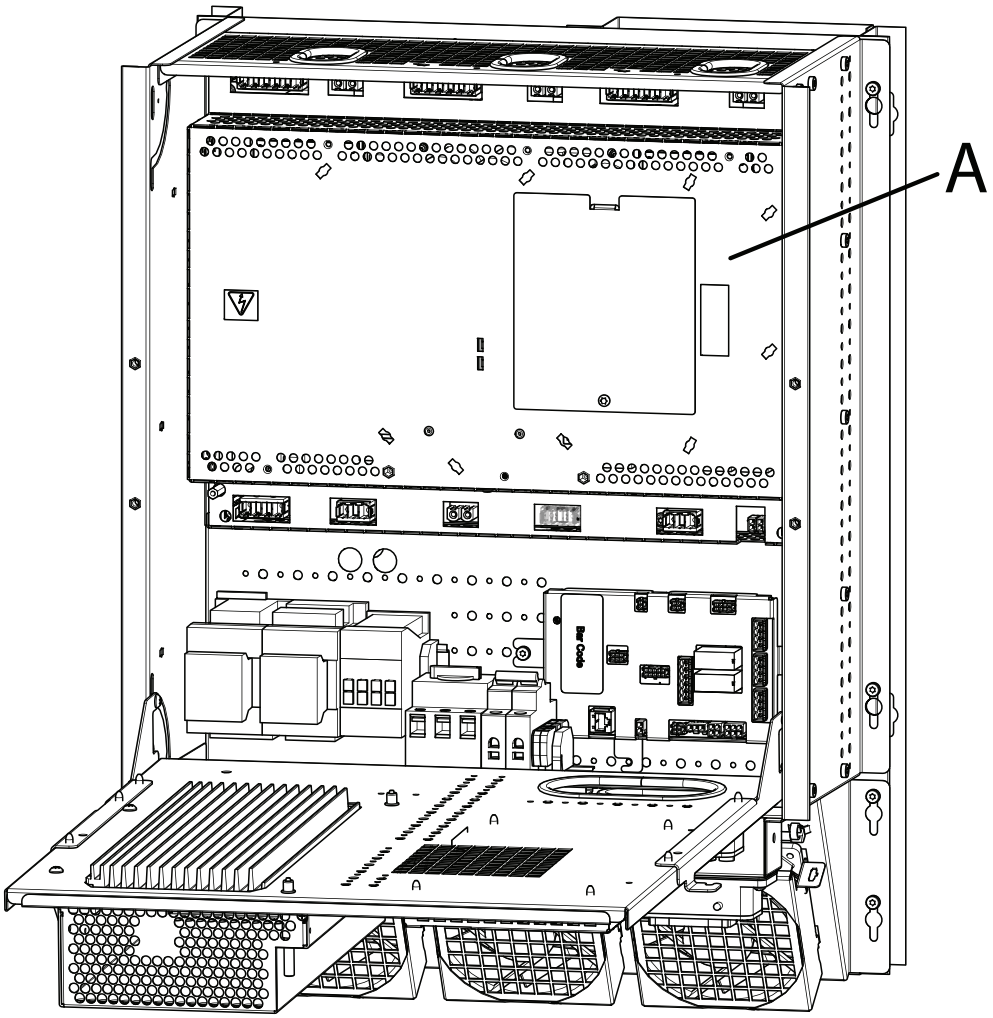
xx0600003244

A	Main Drive Unit

Continues on next page

2.6.1 Drive functions, general
Continued

PMC large:



xx1100000482

A	Main Drive Unit

Replacing drive system parts

How to replace the drive unit for PMC small is described in section *Replacement of drive unit for PMC small on page 190*.

How to replace the drive unit for PMC large is described in section *Replacement of Main Drive Unit for PMC large on page 193*.

2.7 Memory functions

2.7.1 Memory functions

General

The controller is fitted with an SD-card memory containing ABB Boot Application software. The SD-card memory is located inside the computer unit.

For more information on how to replace the SD-card memory, see *Replacement of SD-card memory in computer unit on page 187*.

Note

Only use SD-card memory supplied by ABB.

CAUTION

Reformatting the SD-card or modifying the disk partition can cause irreparable boot-up problems.

2.7.2 Connecting a USB memory

Handling USB

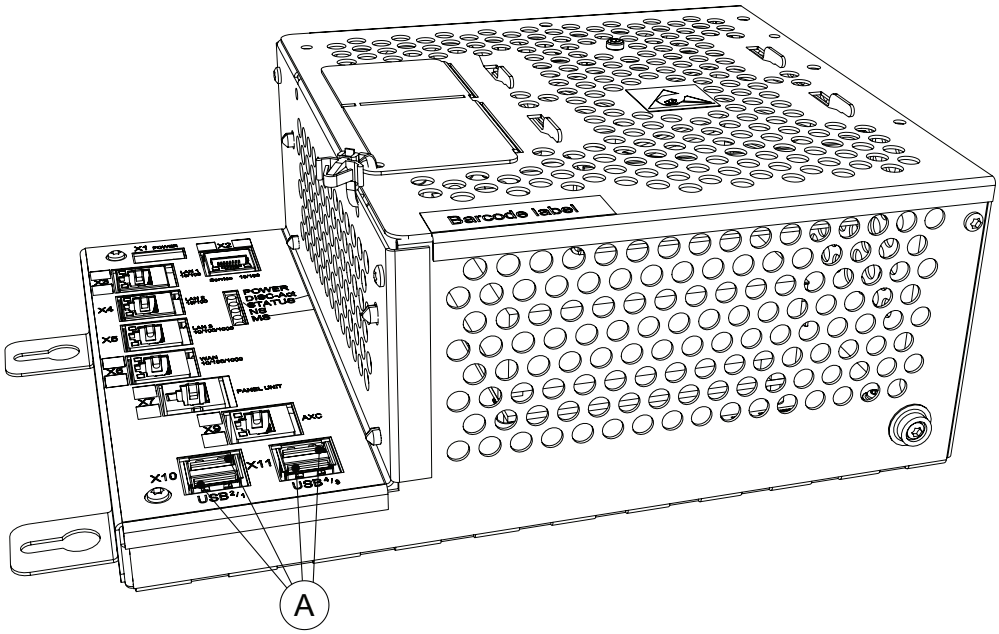
Handling of USB memory is described in *Operating manual - IRC5 with FlexPendant*.

Location on FlexPendant

The USB port on the FlexPendant is located behind a rubber cover.

Location on main computer

The location of the USB ports on the main computer is shown by the following illustration:



xx1300000602

A	USB ports

Note

It is recommended to use the USB ports USB[1] and USB[2] on the X10 connector for connecting USB memory devices.

The USB ports on the X11 connector are intended for internal use.

2.8 I/O system

2.8.1 Definition of fieldbuses, IRC5

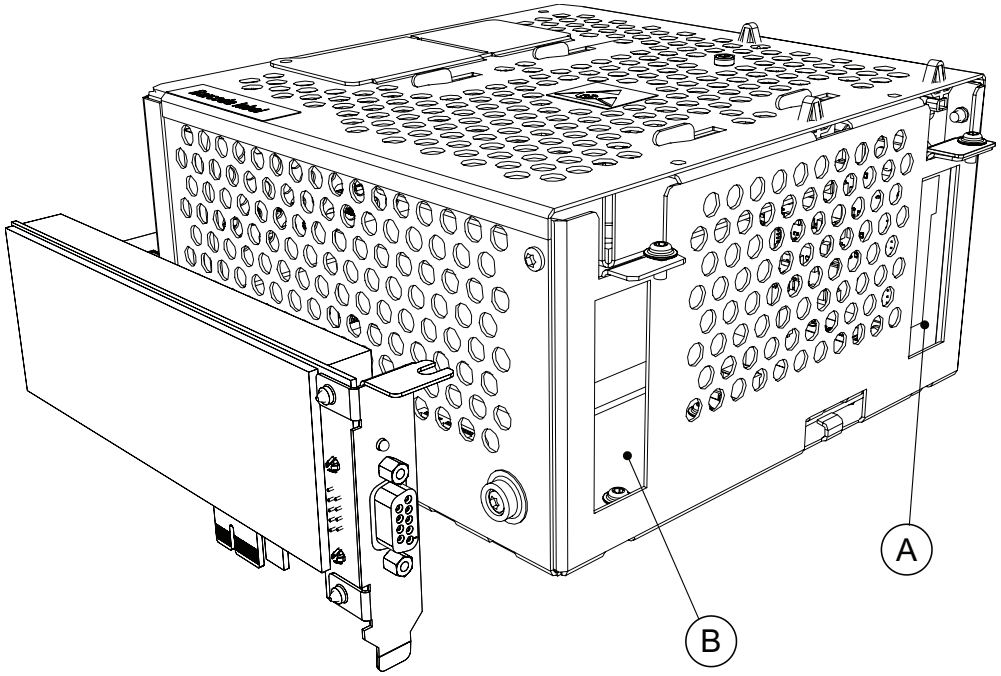
General

The IRC5 Controller may be fitted with a number of different fieldbus adapters and fieldbus master/slave boards.

In the standard form, no fieldbus is mounted to the controller.

Fieldbus master/slave boards

On the main computer unit there are slots available for installing a master/slave board.



xx1600000536

A	Slot for PCIexpress boards
B	Slot for safety module (option SafeMove Pro or SafeMove Basic)

The following master/slave boards are available:

Description	Art. no.	Type designation
PROFIBUS Master PCIexpress	3HAC044872-001	DSQC1005
DeviceNet Master/Slave PCIexpress	3HAC043383-001	DSQC1006

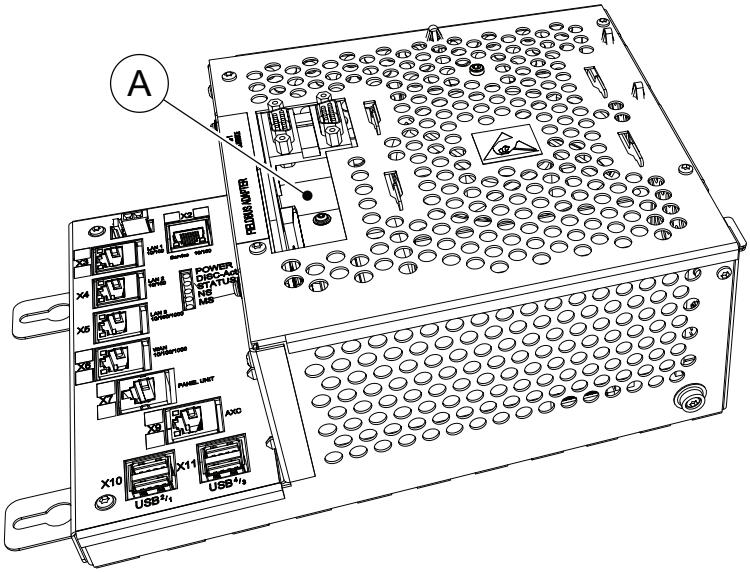
Continues on next page

2.8.1 Definition of fieldbuses, IRC5
Continued

Expansion board for fieldbus adapters

An expansion board needs to be installed to be able to fit a fieldbus adapter. On top of the main computer unit, there is one slot available for installing the expansion board.

The expansion board is also equipped with a serial channel. For more information on how to connect to the serial channel, see *Connecting a serial channel to the controller on page 86*.



xx1300000605

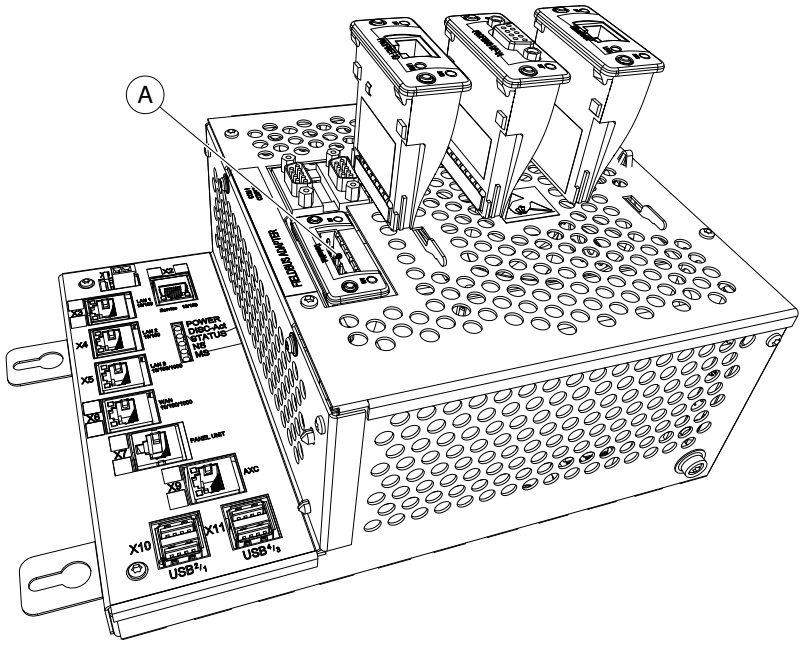
A	Assembled expansion board for fieldbus adapters, without adapter.

Description	Art. no.	Type designation
AnybusCC / RS232 expansion board	3HAC046408-001	DSQC1003

Continues on next page

Fieldbus adapters

The fieldbus adapters are inserted into the expansion board on top of the main computer unit. There is one slot available for installing a fieldbus adapter.



xx1300000604

A	Slot for AnybusCC fieldbus adapters

Following fieldbus adapters are available:

Description	Art. no.	Type designation
AnybusCC DeviceNet slave	3HAC045973-001	DSQC1004
AnybusCC PROFIBUS slave	3HAC026840-001	DSQC 667
AnybusCC Ethernet/IP slave	3HAC027652-014	DSQC 669
AnybusCC PROFINET slave	3HAC031670-001	DSQC 688

References

For more information on how to install and configure the fieldbuses, see the respective fieldbus manual:

Manual title	Art. no.
Application manual - DeviceNet Master/Slave	*3HAC050992-001*
Application manual - DeviceNet Anybus Slave	*3HAC050993-001*
Application manual - EtherNet/IP Anybus Adapter	*3HAC050997-001*
Application manual - EtherNet/IP Scanner/Adapter	*3HAC050998-001*
Application manual - PROFIBUS Anybus Device	*3HAC050965-001*
Application manual - PROFIBUS Controller	*3HAC050966-001*
Application manual - PROFIenergy Device	*3HAC050967-001*

Continues on next page

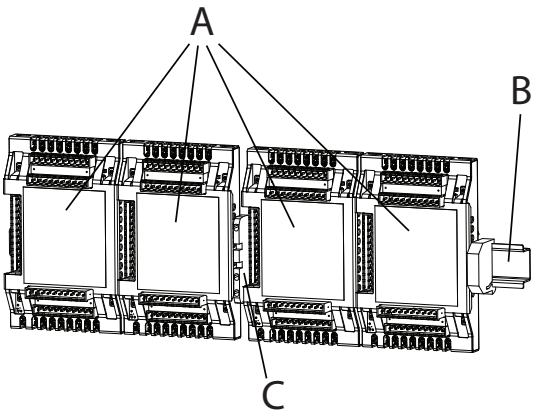
2.8.1 Definition of fieldbuses, IRC5
Continued

Manual title	Art. no.
Application manual - PROFINET Anybus Device	*3HAC050968-001*
Application manual - PROFINET Controller/Device	*3HAC065546-001*

2.8.2 DeviceNet I/O units

General

The IRC5 controller may be fitted with DeviceNet I/O or encoder units. These are configured in an identical way.



xx0600003256

A	I/O or encoder units
B	Mounting rail
C	Connection terminal XT31

Standard configuration

In the standard form, no fieldbus is mounted to the controller.

It is possible to connect any type of DeviceNet compliant I/O unit on the DeviceNet - master bus. All I/O units should comply with the DeviceNet standard and be conformance tested by ODVA.

DeviceNet I/O units and parts

The table below specifies the DeviceNet I/O units:

See *Spare parts on page 253* for the spare part numbers.

Encoder interface units

The table below specifies the encoder interface units:

Description	Art. no.	Note
Encoder interface unit for conveyor tracking	3HNE 01586-1	DSQC 377B

Further information

The table below gives references to additional information:

Information:	Found in:
How to install the DeviceNet I/O units mechanically and electrically.	Fit the expansion board and/or field bus adapter according to *Replacement of expansion board in the computer unit on page 176* and/or *Replacement of fieldbus adapter in the computer unit on page 179*.

Continues on next page

2.8.2 DeviceNet I/O units

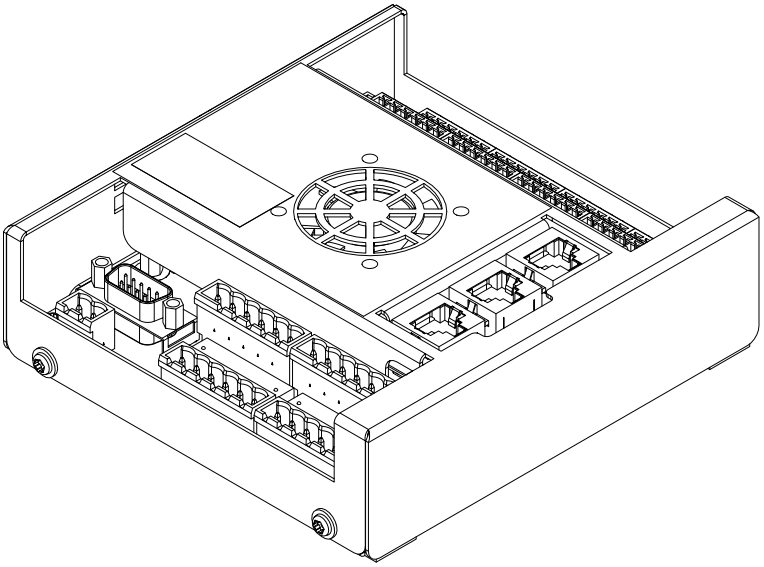
Continued

Information:	Found in:
Allowed configurations of DeviceNet I/O units and how to setup the configurations.	*Technical reference manual - System parameters*
How to install the DeviceNet I/O unit software related in a new system.	The application manual for the different I/O buses respectively, see listing in *Definition of fieldbuses, IRC5 on page 109*.
Detailed descriptions of all available DeviceNet I/O units.	The application manual for the different I/O buses respectively, see listing in *Definition of fieldbuses, IRC5 on page 109*.

2.8.3 Conveyor tracking module

General

The conveyor tracking module, DSQC 2000 CTM-01, is a network based conveyor interface that provides connections for 4 encoders and 8 cameras. The camera connections can also be used for other sensor types, for example photocells. The module uses network communication to share conveyor speed and position data with one or more robot controllers.



xx1800000941

Encoder interface units

The table below specifies the encoder interface units:

Description	Art. no.	Note
DSQC2000 CTM-01	3HNA027579-001	Conveyor tracking module
CONNECTOR KIT - DSQC2000	3HNA029345-001	Connector kit **Note** The connector kit includes contacts for 2 encoders and 4 cameras. Two connector kits are needed to handle additional encoders and cameras.

Continues on next page

2.8.3 Conveyor tracking module
RobotWare - OS
Continued

Further information

The table below gives references to additional information:

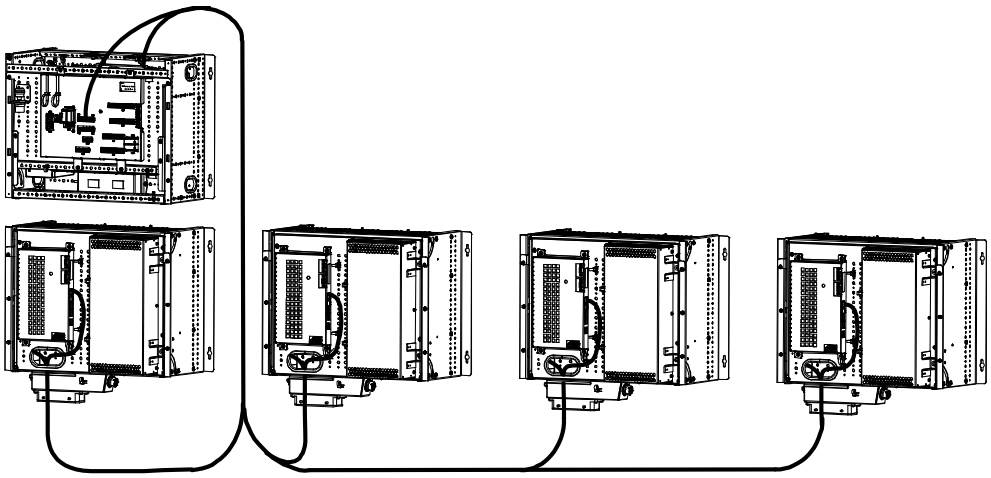
Information:	Found in:
How to install and configure Conveyor Tracking.	*Application manual - Conveyor tracking*, *3HAC050991-001*

2.9 Installation of add-ons

2.9.1 Installation of additional Drive Module

General

To be able to use a MultiMove system, an additional Drive Module is needed. The Panel Mounted Controller is prepared for up to three additional Drive Modules.



xx0600003253

Note

For PMC, drive units for additional motors cannot be installed.

For more information about installing additional Drive Modules, see *Application manual - MultiMove*. For more information about stacking modules and process modules, see *Product specification - Controller IRC5*.

2.9.2 Installation of external operator's panel, IRC5

Overview

External operator’s panels can be either simply a panel or a panel box. See illustrations below.

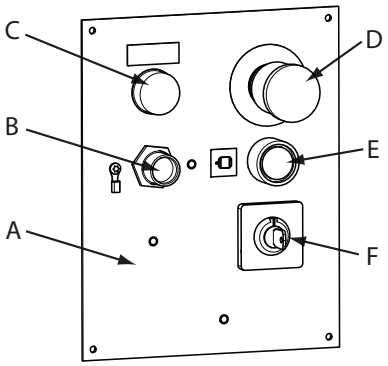
Note

When ordering the external operator's panel as an add-on, the external operator's panel is delivered empty together with labels and blanking plugs.

When installing, the following components must be moved from the controller to the external operator's panel:

- Mode switch
- Motor ON button
- Emergency stop button

External operator’s panel (option 733-3)

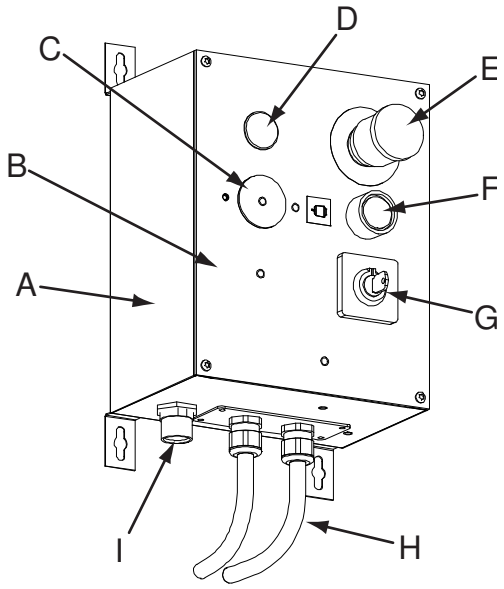


xx1100000522

A	Front panel
B	FlexPendant connector
C	Blanking plug for actuator red
D	Emergency stop button
E	Motor ON button
F	Mode switch

Continues on next page

External operator's panel box (option 733-4)



xx1000000954

A	Wall cabinet
B	Front panel
C	Blanking plug for FlexPendant
D	Blanking plug for actuator red
E	Emergency stop button
F	Motor ON button
G	Mode switch
H	External operator's panel harness
I	FlexPendant connector

Required equipment

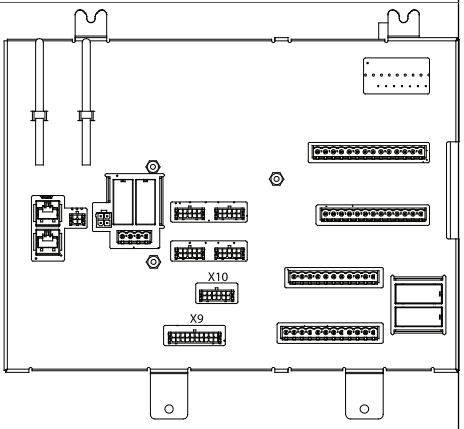
Equipment	Art. no.	Note
External operator's panel (733-3)	3HAC040643-003	
External operator's panel box (733-4)	3HAC040644-003	
External operator's panel cable	3HAC038767-001 3HAC038768-001 3HAC038769-001	7 m 15 m 30 m
Standard toolkit		The contents are defined in section, *Standard toolkit, IRC5 on page 249*
Circuit diagram		See *Circuit diagrams on page 273*.

Continues on next page

2.9.2 Installation of external operator's panel, IRC5
Continued

Procedure

The procedure below details how to install the external control panel.

	Action	Info/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	Disconnect the cable from the ethernet connector for FlexPendant on the computer unit.	
3	Disconnect signal cabling from the panel board unit. Connectors: • A21.X9 • A21.X10	 xx0600003257
4	Connect the ethernet connector A31.X3 for the FlexPendant to the computer unit.	
5	Connect the signal connectors A21.X9 and A21.X10 to the connector X9 and X10 on the panel board unit.	
6	Strap the cabling to the existing cable strapping inside the controller.	
7	Fit the following components to the correct positions on the external operator's panel: • S21.1, Mode switch • S21.2, Motor ON button • S21.3, Emergency stop button	
8	Fit the cabling to the panel box with the four attachment screws.	
9	Attach the XS4 connector to the external operator's panel, and connect the free ends of the harness to the components on the external operator's panel.	See *Circuit diagrams on page 273*.
10	Connect the earth cable.	
11	Strap the cabling on the external operator's panel.	
12	Power on the controller and test the functionality of the Mode switch, Motor ON button, and the Emergency stop button.	

2.9.3 Installation of external enabling device

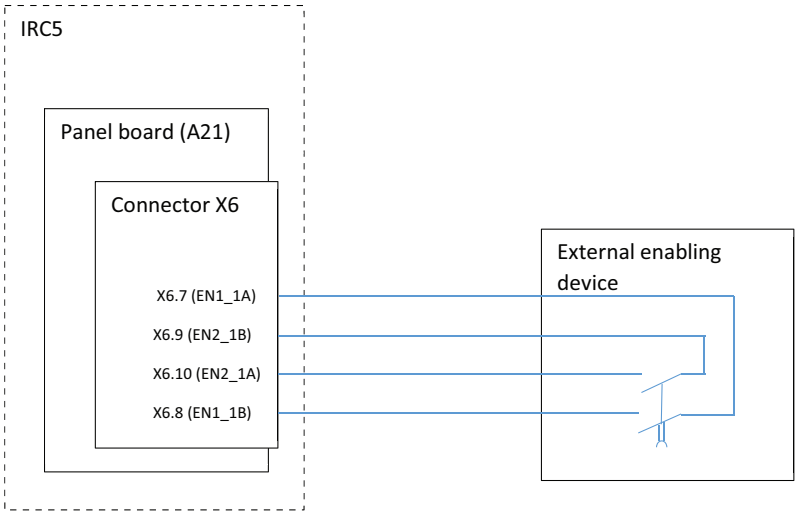
Overview

IRC5 is delivered with one enabling device but have the possibility to connect one additional external enabling device (cannot be ordered from ABB Robotics).

When an external enabling device is used together with the three-position enabling device on the teach pendant, both enabling devices must be enabled to be able to operate the manipulator in manual mode.

Connecting the external enabling device

The external enabling device must be connected to the panel board connector X6 pin 7-10 as shown in the figure below.



xx1500000534

The enabling device chain is enabled if X6 pin 7 is short circuited with X6 pin 8 at the same time as X6 pin 9 is short circuited with X6 pin 10.

Requirement on the external enabling device

The external enabling device connected to IRC5 must have the following characteristics:

- Redundant channels.
- Three-position enabling device. When the enabling device is pressed to the center position the enabling device chain must be enabled. When the enabling device is released or pressed to third position, the enabling device chain must be disabled.
- The enabling device must have a B10 value of at least 100000 cycles (less than 10% chance of failure before 100000 cycles).
- The mean time to dangerous failure ($MTTF_d$) of the external enabling device must be high enough to ensure that the external enabling device together

Continues on next page

with IRC5's enabling device chain is above 55 years. See safety related performance for the enabling device chain below.

Performance of IRC5 original enabling device chain

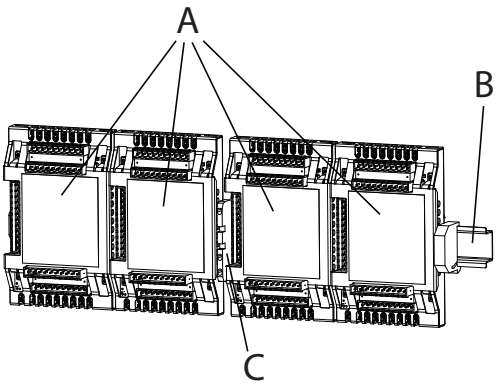
The safety-related performance of the enabling device chain, without the external enabling device, is as follows:

- $MTTF_d$ for IRC5 enabling device chain is 80 years.
- IRC5's enabling device chain's calculated average probability of dangerous failure per hour (PFH_d) is 6.62x10E-08.
- IRC5's enabling device chain's design and structure is category 3.
- IRC5's enabling device chain's Diagnostic Coverage is medium (90% < DCavg < 99%).
- The Common Cause Failure (CCF) is met according to the standard requirements.

2.9.4 Installation of DeviceNet I/O, Gateways and encoder interface units, IRC5

Location

The DeviceNet I/O units, Gateway or encoder interface units to be installed are shown in the illustration below.



xx0600003256

A	I/O units, Gateways or Encoder interface units
B	Mounting rail
C	Connection terminal XT31

Required equipment

Equipment	Article number	Note
DeviceNet I/O units, Gateways or encoder interface units		
Application manual - DeviceNet Master/Slave	*3HAC050992-001*	
Circuit diagram	See *Circuit diagrams on page 273*.	

Fitting

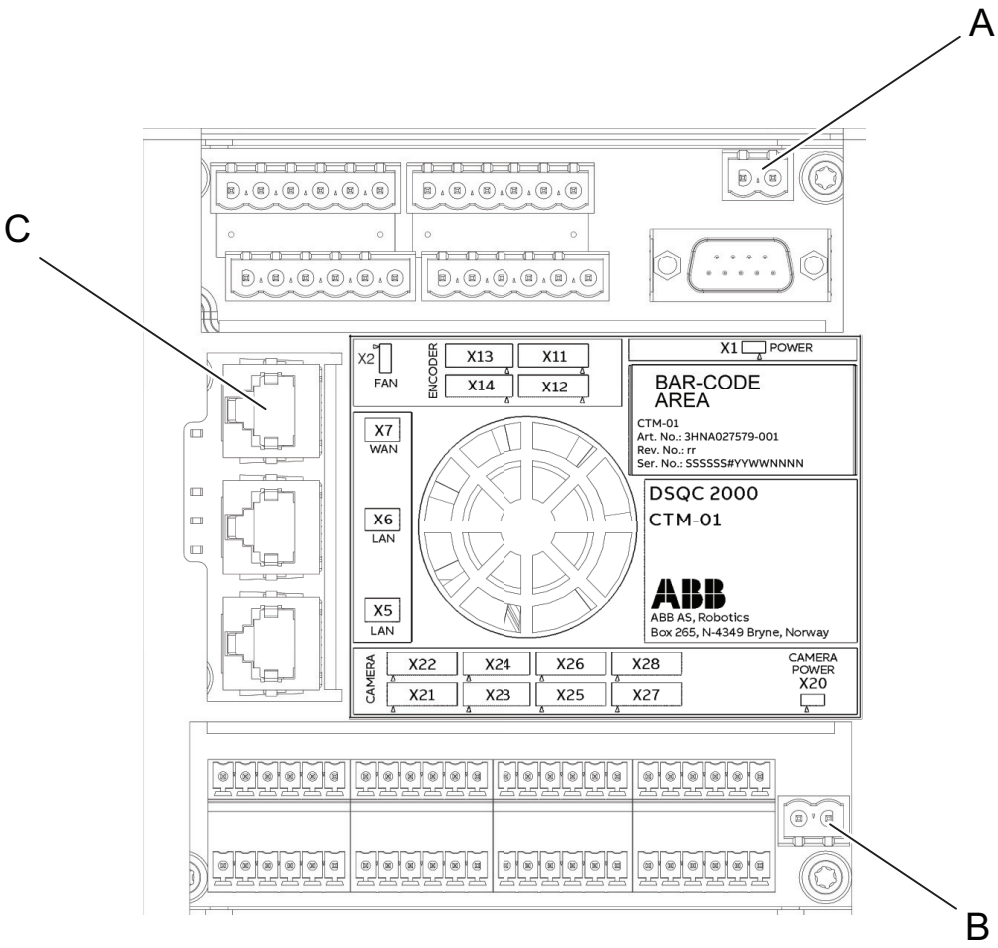
The procedure below details how to fit the units.

	Action	Note/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	Fit the DeviceNetI/O unit by snapping it onto the mounting rail.	
3	Connect the DC supply to the board.	
4	Connect wires to the inputs and output connectors as required.	Described in the Application manual for the respective busses.

2.9.5 Installation of conveyor tracking module

Location

The conveyor tracking module must be powered by a 24V power supply and connected to the Ethernet.



xx1800002638

A	X1, Power inlet 24VDC
B	X20, Optional camera power inlet 24VDC
C	X7 WAN, Ethernet connection

Required equipment

Equipment	Article number	Note
DSQC 2000 CTM-01	3HNA027579-001	
CONNECTOR KIT - DSQC 2000	3HNA029345-001	
Application manual - Conveyor tracking	*3HAC050991-001*	
Standard toolkit		See *Standard toolkit, IRC5 on page 249*.

Continues on next page

Equipment	Article number	Note
Circuit diagram - IRC5 Panel Mounted Controller	*3HAC026871-020*	

Note

The connector kit includes contacts for 2 encoders and 4 cameras. Two connector kits are needed to handle additional encoders and cameras.

Fitting

The procedure below details how to fit the units.

	Action	Note/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Connect 24VDC power supply to X1 (power inlet, main functions) and X20 (optional camera power inlet) on the conveyor tracking module.	External 24VDC power supply is needed for option 1551-1.
4	Connect the Ethernet cable to the connector X7 WAN on the conveyor tracking module.	The WAN port of the CTM must be connected to the same Ethernet network as the robot controllers.
5	Connect wires to the encoder and camera connectors as required.	Described in the *Application manual - Conveyor tracking*.

2.9.6 Installing the EPS board DSQC 646 for Electronic Position Switches

General

To use the option Electronic Position Switches you need to install an EPS board in the robot controller. The procedure below will show how to install this board.

Note

It is not possible to have the options EPS and SafeMove installed at the same time - that is, only one of these two options can be installed and used.

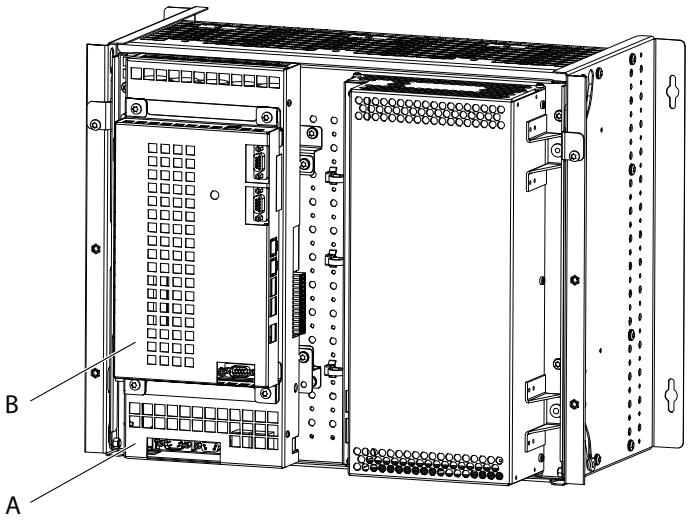
WARNING

The safety controller has passive monitoring, i.e. it does not stop the robot. If an axis is outside its configured range, an output signal goes low. It is the responsibility of the installation personnel to connect the output signals in such a way that the robot is stopped if there is a risk of a dangerous situation.

Illustration

The EPS board should be mounted behind the axis computer.

PMC small:

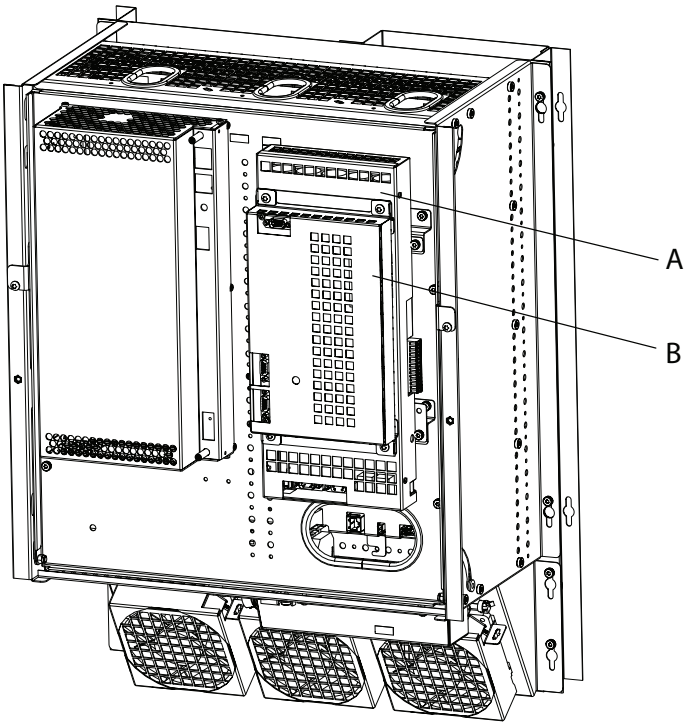


xx1000000979

A	EPS board
B	Axis computer

Continues on next page

PMC large:



xx1100000483

A	EPS board
B	Axis computer

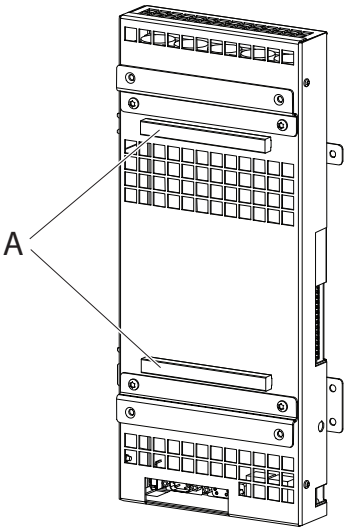
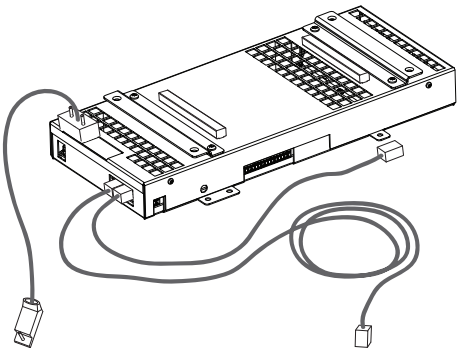
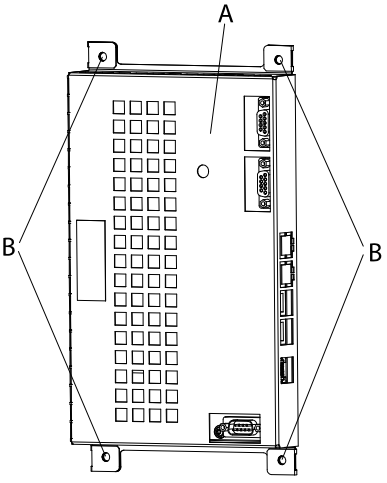
Procedure

The procedure below details how to install an EPS board.

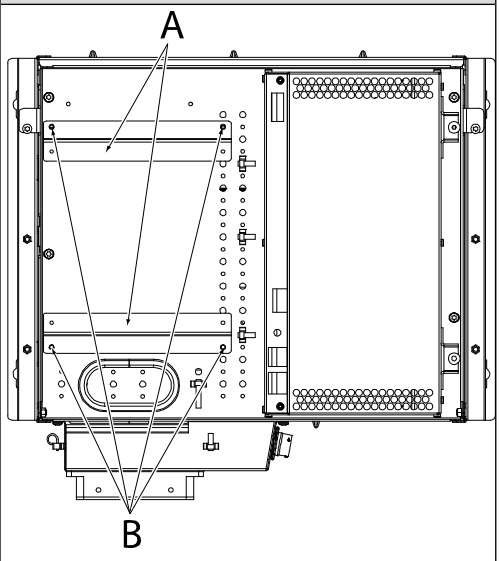
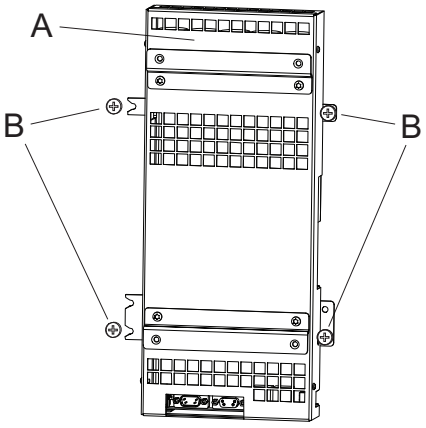
	Action	Note/illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	

Continues on next page

2.9.6 Installing the EPS board DSQC 646 for Electronic Position Switches
Continued

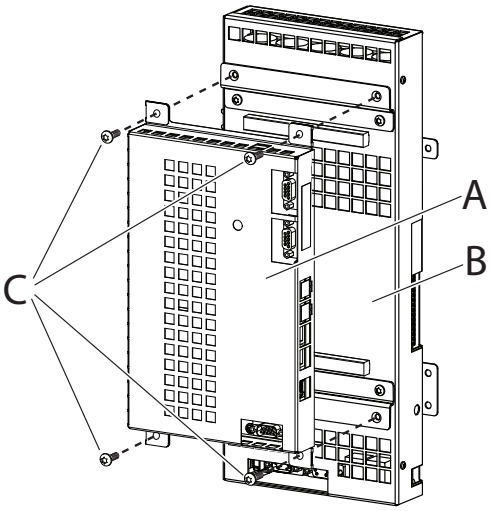
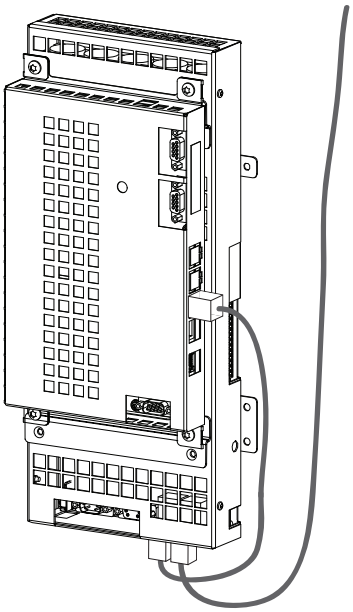
	Action	Note/illustration
3	If not already in place, fit the EMC strips on the EPS board.	 xx0700000087
4	Connect the short SMB cable and both Ethernet cables to the EPS board before mounting the board. These connections may be difficult to reach once the board is mounted. The two Ethernet connectors on the EPS board are interchangeable (it does not matter which is connected to the main computer and which is connected to the axis computer).	 xx0600003303
5	Remove the attachment screws of the axis computer. Lift out the axis computer so that the EPS board can be fitted behind the axis computer.	 xx0900000030 • A: axis computer • B: attachment screws

Continues on next page

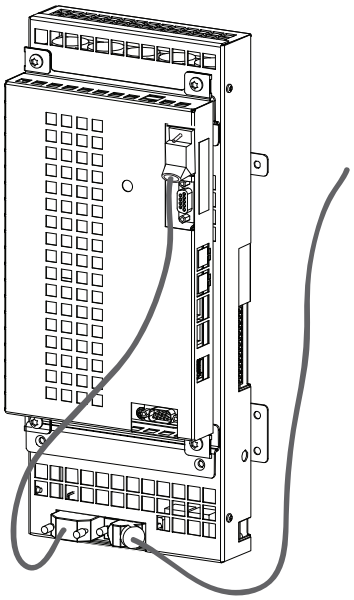
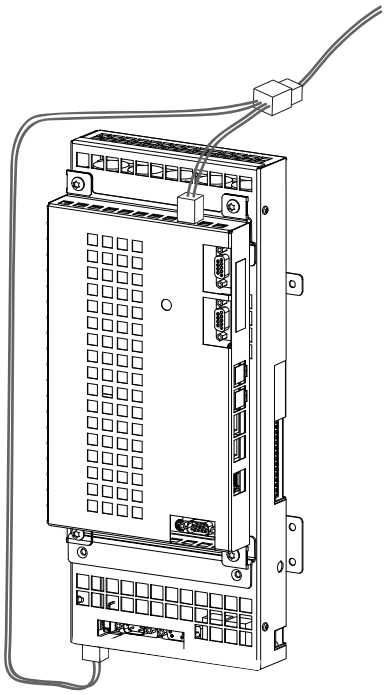
	Action	Note/illustration
6	Only for PMC small: Attach two mounting brackets on the drive module, so that the EPS board can be mounted on these brackets.	 xx1000000981 • A: mounting brackets • B: attachment screws
7	Fit the EPS board in the same place as the axis computer was before.	 xx0600003204 • A: EPS board • B: attachment screws

Continues on next page

2.9.6 Installing the EPS board DSQC 646 for Electronic Position Switches
Continued

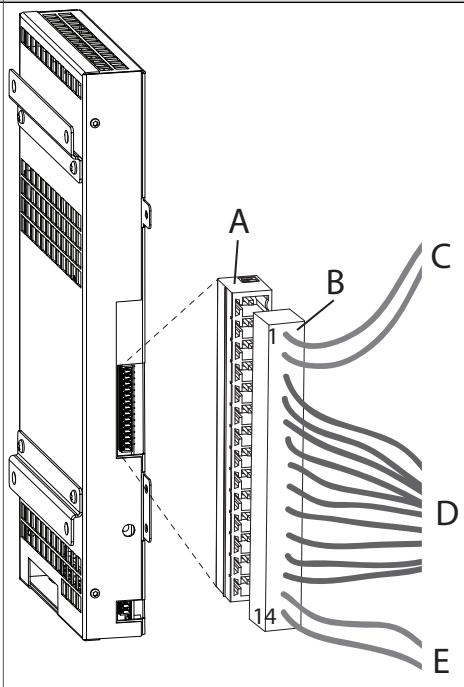
	Action	Note/illustration
8	Fit the axis computer on the EPS board.	 xx0900000438 • A: axis computer • B: EPS board • C: attachment screws
9	Remove the existing Ethernet cable from the axis computer and connect it to the EPS board. Connect the short Ethernet cable between the EPS board and the axis computer.	 xx0600003218

Continues on next page

	Action	Note/illustration
10	Remove the SMB cable from the axis computer and connect it to the EPS board. Connect the SMB cable from the EPS board to the axis computer.	 xx0600003207
11	Remove the power cable from the axis computer and connect it to the split cable. Connect the split cable to the EPS board and the axis computer.	 xx0600003208

Continues on next page

2.9.6 Installing the EPS board DSQC 646 for Electronic Position Switches
Continued

	Action	Note/illustration
12	Connect signal cables to the plug contact, which is then connected to the I/O connector of the EPS board. • Connect a power supply, 24 V to pin 1 and 0 V to pin 2. Check with a voltmeter that the voltage is 24 V between pin 1 and 2 on the Phoenix connector. • Connect the output signals from the EPS board (pin 3-12). • Connect the sync switch signals to pin 13 and 14. If dual channel wiring is not used, connect only pin 14.	 xx0600003209 • A: I/O Connector • B: Plug contact • C: Power supply • D: 5 safe outputs (10 signals) • E: Sync switch (dual signal)

2.9.7 Installing the SafeMove board DSQC 647

General

To use the option SafeMove you need to install a SafeMove board DSQC 647 in the robot controller. The procedure below will show how to install this board.

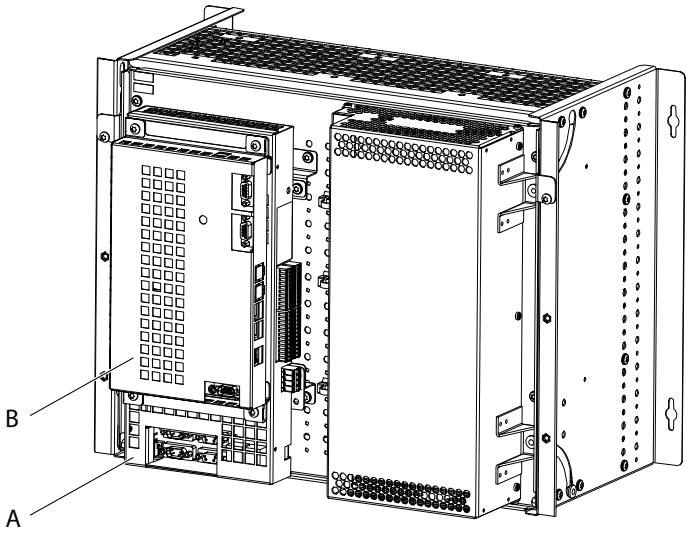
Note

It is not possible to have the options SafeMove and EPS installed at the same time - that is, only one of these two options can be installed and used.

Location

The SafeMove board should be mounted behind the axis computer.

PMC small:



xx1000000980

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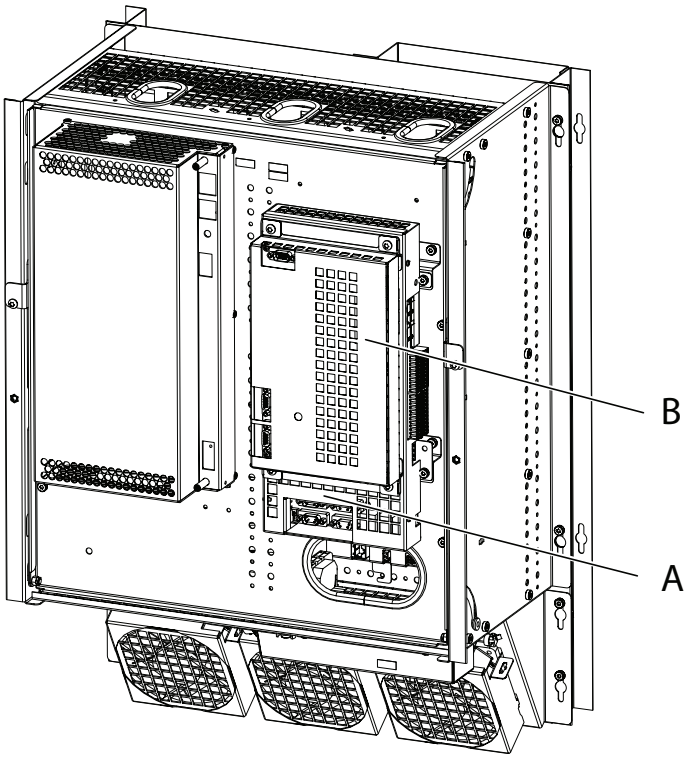
2.9.7 Installing the SafeMove board DSQC 647
Continued

PMC large:



xx1100000499

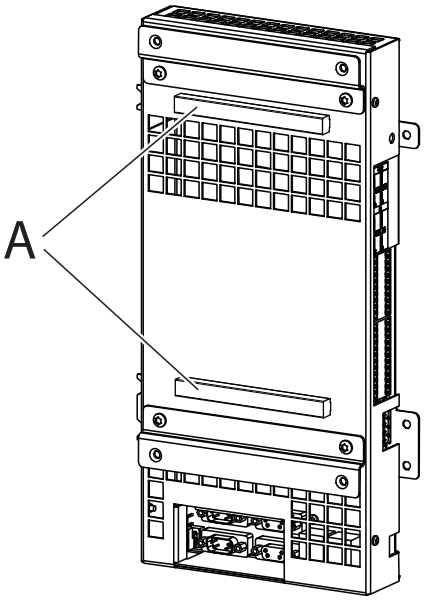
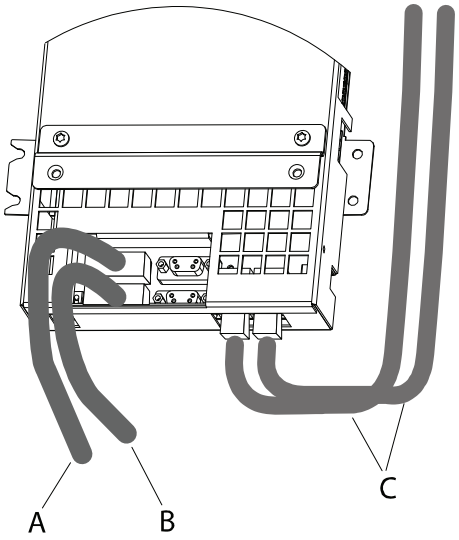
A	SafeMove board
B	Axis computer

Procedure

The procedure below details how to install the SafeMove board.

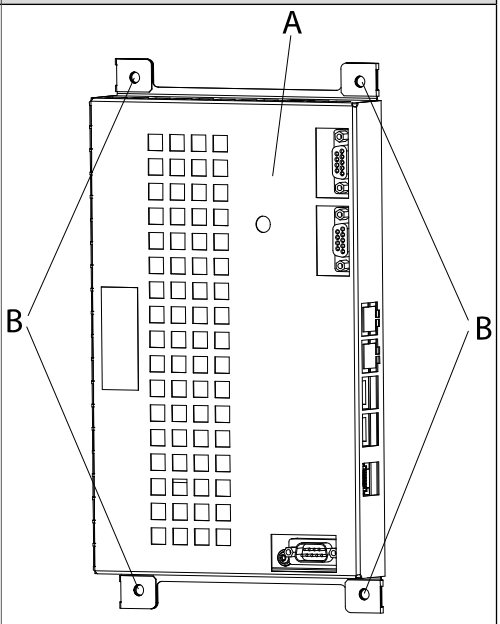
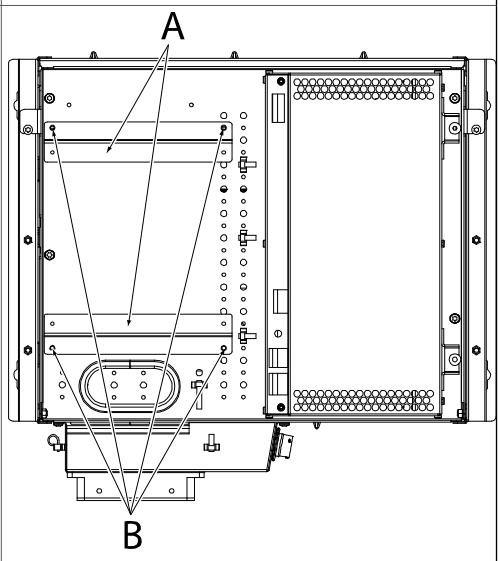
	Action	Note/illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	

Continues on next page

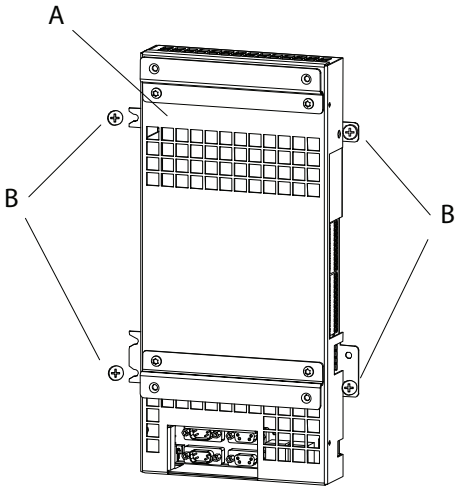
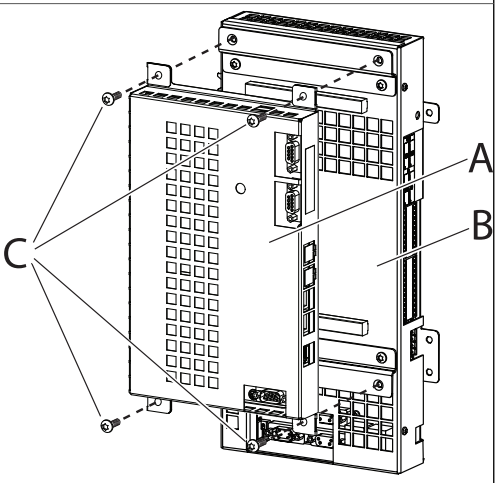
	Action	Note/illustration
3	If not already in place, fit the EMC strips on the SafeMove board.	 xx0800000204 • A: EMC strips
4	Connect both SMB cables and both Ethernet cables to the SafeMove board before mounting the board. These connections may be difficult to reach once the board is mounted. The two Ethernet connectors on the SafeMove board are interchangeable (it does not matter which is connected to the main computer and which is connected to the axis computer).	 xx0800000103 • A: SMB1 cable • B: SMB2 cable • C: Ethernet cables

Continues on next page

2.9.7 Installing the SafeMove board DSQC 647
Continued

	Action	Note/illustration
5	Remove the attachment screws of the axis computer. Lift out the axis computer so that the SafeMove board can be fitted behind the axis computer.	 xx0900000030 • A: axis computer • B: attachment screws (4 pcs)
6	Only for PMC small: Attach two mounting brackets on the drive module, so that the SafeMove board can be mounted on these brackets.	 xx1000000981 • A: mounting brackets • B: attachment screws

Continues on next page

	Action	Note/illustration
7	Fit the SafeMove board in the same place as the axis computer was before.	 xx0800000104 • A: SafeMove board • B: attachments screws (4 pcs)
8	Fit the axis computer on the SafeMove board.	 xx0900000441 • A: Axis computer • B: SafeMove board • C: attachment screws (4 pcs)

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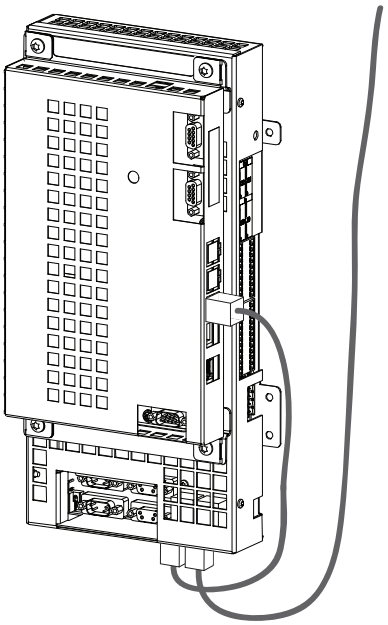
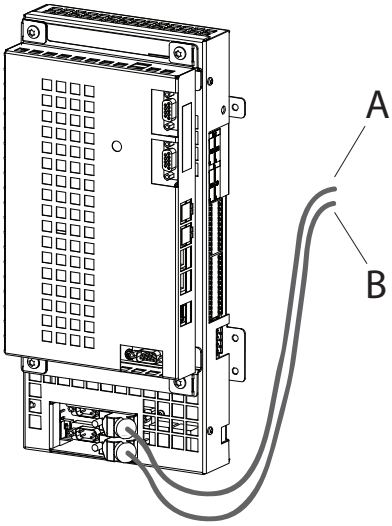
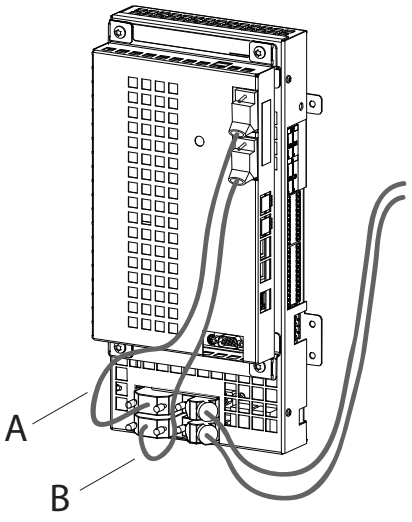
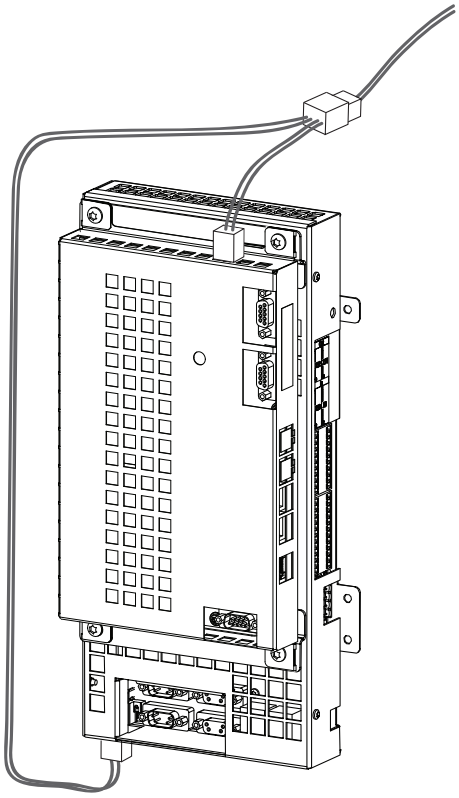
2.9.7 Installing the SafeMove board DSQC 647
Continued

	Action	Note/illustration
9	Remove the existing Ethernet cable from the axis computer and connect it to the EPS board. Connect the short Ethernet cable between the SafeMove board and the axis computer.	 xx0800000018
10	Disconnect the SMB cables from the axis computer and connect them to the SafeMove board.	 xx0800000031 • A: SMB1 cable (robot) • B: SMB2 cable (external axes)

Continues on next page

	Action	Note/illustration
11	Connect the SMB cables from the SafeMove board to the axis computer	 xx0800000032 • A: SMB1 cable • B: SMB2 cable
12	Disconnect the power cable from the axis computer and connect it to the split cable. Connect the split cable to the SafeMove board and the axis computer.	 xx0800000028

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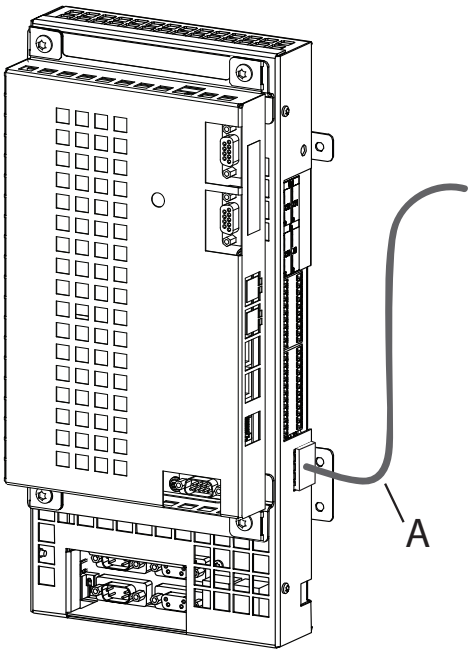
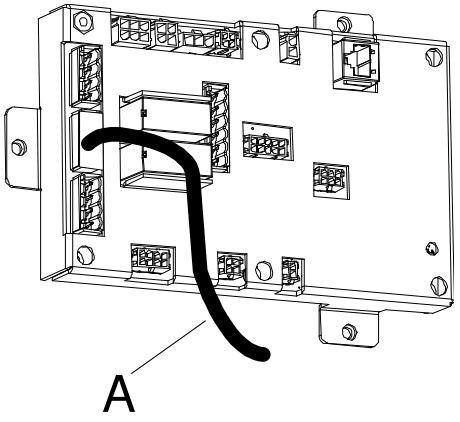
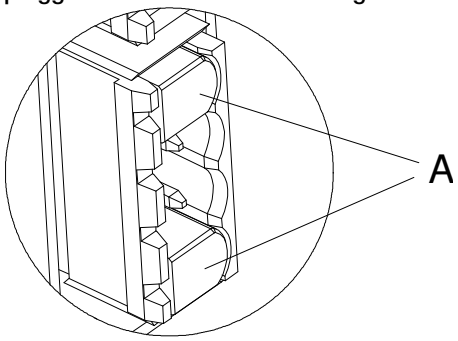
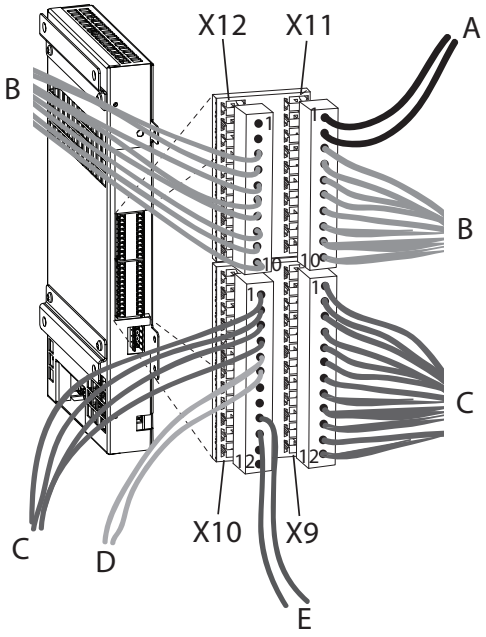
2.9.7 Installing the SafeMove board DSQC 647
Continued

	Action	Note/illustration
13	Connect the limit switch cable between the SafeMove board (X13) and the contactor interface board (X21)	SafeMove board:  xx0800000033 Contactor interface board:  xx0800000105 • A: limit switch cable

Continues on next page

	Action	Note/illustration
14	Mount the plugs in the limit switch override contact (X23) at pin 1 and 4 on the contactor interface board.	The limit switch override contact must be plugged and not used when using SafeMove.  xx0800000035 • A: plug (2pcs)
15	Connect signal cables to the plug contacts, which is then connected to the I/O connector of the SafeMove board.	 xx0700000640 • A: Power supply • B: 8 safe outputs (16 signals) • C: 8 safe inputs (16 signals) • D: Sync switch (dual signal) • E: Override operation input (dual signal)

2.10 Testing

Function tests

When the installation is complete, perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.

3 Maintenance

3.1 Maintenance schedule for the IRC5 controller

General

The controller must be maintained at regular intervals to ensure its function. The activities and intervals are described in this section.

Intervals

Equipment	Maintenance activity	Interval	Detailed in section:
Complete controller modules	Inspection	12 months [i]	*Inspection of the controller on page 144*.
FlexPendant	Cleaning	When needed	*Cleaning the FlexPendant on page 146*.
Emergency stop (operating panel)	Function test	12 months	*Function test of emergency stop on page 148*
Emergency stop (FlexPendant)	Function test	12 months	*Function test of emergency stop on page 148*
Mode switch	Function test	12 months	*Function test of mode switch on page 149*
Enabling device	Function test	12 months	*Function test of three-position enabling device on page 150*
Motor contactors K42, K43	Function test	12 months	*Function test of motor contactors K42 and K43 on page 151*
Brake contactor K44	Function test	12 months	*Function test of brake contactor K44 on page 152*
Auto stop (tested if used)	Function test	12 months	*Function test of Automatic Stop on page 153*
General stop (tested if used)	Function test	12 months	*Function test of General Stop on page 154*
Superior stop (tested if used)	Function test	12 months	*Function test of superior stop on page 155*
Limit switch (tested if used)	Function test	12 months	*Function test of limit switch on page 156*
Reduced speed control	Function test	During commissioning	*Function test of reduced speed control on page 157*.

[i] The interval depends on the working environment of the equipment: a cleaner environment may extend the maintenance interval and vice versa.

Function test after replacement of component

In addition to performing the function tests according to the intervals, function tests should be performed after replacing a component in the controller.

3.2 Inspection activities

3.2.1 Inspection of the controller

Inspection

The procedure below describes how to inspect the IRC5 controller.

WARNING

Please observe the following before commencing any repair work on the IRC5 controller, or units connected to the controller:

- Switch off all electric power supplies with the power switch!
- Before handling, make sure you are grounded through a special ESD wrist bracelet or similar. Many components inside the module are sensitive to ESD (ElectroStatic Discharge) and can be destroyed if exposed to discharge. See the Safety chapter, *The unit is sensitive to ESD on page 48*

	Action	Note/Illustration
1	Inspect all sealing joints and cable glands to make sure they are airtight in order to prevent dust and dirt from penetrating into the controller cabinet.	
2	Inspect connectors and cabling to make sure they are securely fastened and cabling not damaged.	
3	Inspect the drive system fans and air channels in the controller to make sure they are clean.	
4	**WARNING** The fan unit must not be covered. Check that nothing covers or block the fan unit.	
5	After cleaning: • Temporarily turn the power supply to the modules on. • Inspect all fans to make sure they function correctly. • Turn the power supply back off.	
6	Replace any malfunctioning fans as described in *Replacement of drive system fans on page 216*.	

3.3 Cleaning activities

3.3.1 Cleaning of the controller cabinet

Required equipment

Equipment, etc.	Note
Vacuum cleaner	ESD protected

Internal cleaning

	Action	Note/Illustration
1	Clean the cabinet interior with a vacuum cleaner if necessary.	

Cleaning considerations

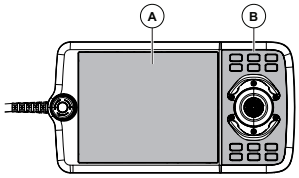
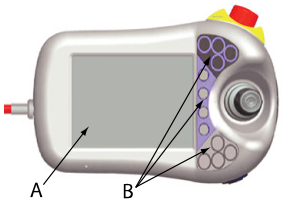
This section specifies some special considerations when cleaning the controller.

- Always use ESD protection.
- Always use cleaning equipment as specified above. Any other cleaning equipment may shorten the life of paint work, rust inhibitors, signs, or labels.
- Always make sure that all protective covers are fitted to the controller before cleaning.
- Never use compressed air or spray with a high pressure cleaner.
- Never leave the door open when cleaning the exterior.

3.3.2 Cleaning the FlexPendant

Location

The surfaces to clean are shown in the illustration below.

FlexPendant with emergency stop button at the connector	FlexPendant with emergency stop button at the outer edge
 xx1800000128	 xx0400000973

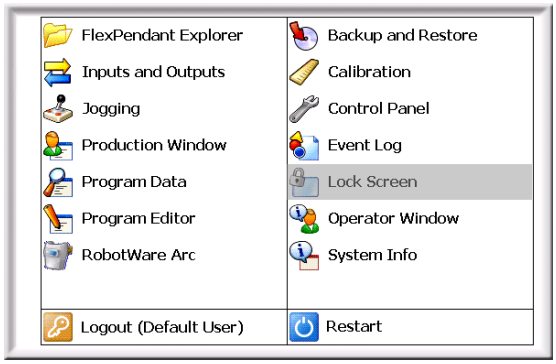
A	Touchscreen
B	Hard buttons

Required equipment

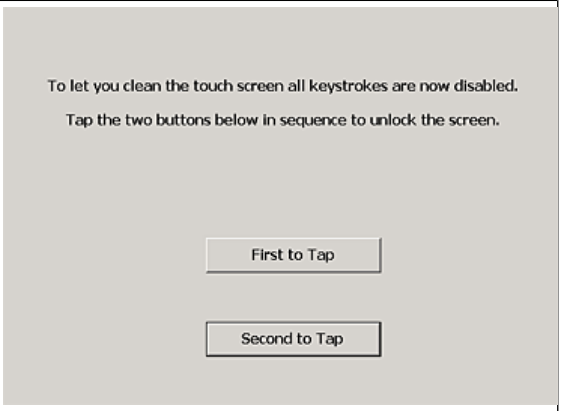
Equipment, etc.	Note
Soft cloth	ESD protected
Water/Mild cleaning agent	

Clean the touch screen

This section describes how to clean the touch screen.

	Action	Info/Illustration
1	Lock the screen.	 en0400001221

Continues on next page

	Action	Info/Illustration
2	It is safe to clean the FlexPendant when the Lock screen appears.	 en0400000658
3	Clean the touch screen and hardware buttons using a soft cloth and water or a mild cleaning agent.	
4	Unlock the screen, by tapping the buttons.	 en0400000658

Cleaning considerations

The section below specifies some special considerations when cleaning the FlexPendant:

- Use ESD Protection
- Use cleaning equipment as specified above. Any other cleaning equipment may shorten the life time of the touch screen.
- Check that all protective covers are fitted to the device before cleaning.
- Make sure that no foreign objects or liquids can penetrate into the device.
- Do not remove any covers before cleaning the FlexPendant.
- Do not spray with a high pressure cleaner.
- Do not clean the device, operating panel and operating elements with compressed air, solvents, scouring agent or scrubbing sponges.

3.4 Function tests

3.4.1 Function test of emergency stop

Overview

Perform this test on the emergency stop button both on the operating panel and on the FlexPendant.

Performing the function test

	Action	Note
1	Make a visual inspection of the emergency stop button to make sure it is not physically damaged.	If any damage is found on the emergency stop button, it must be replaced.
2	Start the robot system.	
3	Press the emergency stop button.	The test is passed if the event message **10013 Emergency stop state** appears in the event log. If either of the following happens, then the test is failed and the root cause must be found: • if the event message **10013 Emergency stop state** does not appear • if the event message **90223 Emergency stop conflict** appears
4	After the test, release the emergency stop button and press the motors on button to reset the emergency stop state.	

3.4.2 Function test of mode switch

2-position mode switch

	Action	Note
1	Start the robot system.	
2	Start with the mode switch in manual mode and then switch the mode switch to auto mode. Run the robot in auto mode.	This test is passed if it is possible to run the robot in auto mode. If it is not possible to run the robot in auto mode, this test is failed and the root cause of the failure must be found.
3	Switch the mode switch to manual mode.	This test is passed if the event message **10015 Manual mode selected** appears in the event log. If the event message **10015 Manual mode selected** is not shown, the test failed and the root cause of the failure must be found.

3-position mode switch

	Action	Note
1	Start the robot system.	
2	Start with the mode switch in manual mode and then switch the mode switch to auto mode. Run the robot in auto mode.	This test is passed if it is possible to run the robot in auto mode. If it is not possible to run the robot in auto mode, this test is failed and the root cause of the failure must be found.
3	Switch the mode switch to manual full speed mode. Run the program in manual full speed mode.	This test is passed if it is possible to run the program in manual full speed mode. If it is not possible to run the program in manual full speed mode, this test is failed and the root cause of the failure must be found.
4	Switch the mode switch to manual mode.	This test is passed if the event message **10015 Manual mode selected** appears in the event log. If the event message **10015 Manual mode selected** is not shown, the test failed and the root cause of the failure must be found.

3.4.3 Function test of three-position enabling device

Performing the function test

	Action	Note
1	Start the robot system and turn the mode switch to manual mode.	
2	Press the three-position enabling device to the middle position and then hold the enabling device in this position.	This test is passed if the event message **10011 Motors ON state** appears in the event log. If either of the following happens, then the test is failed and the root cause must be found: • if the event message **10011 Motors ON state** does not appear • if the event message **90224 Enabling Device conflict** appears
3	While still holding the three-position enabling device pressed, press the enabling device harder to the enable the device's third position.	This test is passed if the event message **10012 Safety guard stop state** appears in the event log. If either of the following happens, then the test is failed and the root cause must be found: • if the event message **10012 Safety guard stop state** does not appear • if the event message **90224 Enabling Device conflict** appears

3.4.4 Function test of motor contactors K42 and K43

Performing the function test

	Action	Note
1	Start the robot system and turn the mode switch to manual mode.	
2	Press the three-position enabling device to the middle position and then hold the enabling device in this position.	This test is passed if the event message **10011 Motors ON state** appears in the event log. If the event message **37001 Motor on activation error** appears, the test is failed and the root cause of the failure must be found.
3	Release the three-position enabling device.	This test is passed if the event message **10012 safety guard stop state** appears in the event log. If the event message **90227 Motor contactor conflict** appears, the test is failed and the root cause of the failure must be found.

3.4.5 Function test of brake contactor K44

Performing the function test

	Action	Note
1	Start the robot system and turn the mode switch to manual mode.	
2	Press the three-position enabling device to the middle position and then hold the enabling device in this position. While having eye contact with the manipulator, move the joystick slightly in any direction to disengage the brakes.	This test is passed if the brakes is disengaged and the manipulator can be moved. If the event message **50056 Joint collision** appears in the event log, the test is failed and the root cause of the failure must be found.
3	Release the three-position enabling device to engage the brakes.	This test is passed if the event message **10012 safety guard stop state** appears in the event log. If the event message **37101 Brake failure** appears, the test is failed and the root cause of the failure must be found.

3.4.6 Function test of Automatic Stop

Performing the function test

	Action	Note
1	Start the robot system and change the operating mode to auto mode.	
2	Activate the Automatic Stop, for example by opening the connected robot cell door, which has interlock connection with Automatic Stop.	The test is passed if the event message **90205 Auto Stop open** appears in the event log. If the event message **90205 Auto Stop open** does not appear or if the event message **90225 Auto Stop conflict** appears in the event log, then the test has failed and the root cause of the failure must be found.

3.4.7 Function test of General Stop

Performing the function test

	Action	Note
1	Start the robot system.	
2	Activate the General Stop.	The test is passed if the event message **90206 General Stop open** appears in the event log. If either of the following happens, then the test is failed and the root cause must be found: • if the event message **90206 General Stop open** does not appear • if the event message **90226 General Stop conflict** appears

3.4.8 Function test of superior stop

Performing the function test

	Action	Note
1	Start the robot system.	
2	Activate the superior stop.	The test is passed if the event message **90215 Superior Stop open** appears in the event log. If either of the following happens, then the test is failed and the root cause must be found: • if the event message **90215 Superior Stop open** does not appear • if the event message **90220 Superior Stop conflict** appears

3.4.9 Function test of limit switch

Testing limit switches on manipulator

This must be tested on all the axes that has mounted limit switches.

	Action	Note
1	Start the robot system.	
2	Jog the axis under test to the limit switch activation position.	The test is passed if the event message **90214 Limit switch open** appears in the FlexPendant log when the axis reaches the limit switch activation position. If either of the following happens, then the test is failed and the root cause must be found: • if the event message **90214 Limit switch open** does not appear • if the event message **90222 Limit switch conflict** appears
3	After the test the robot must be jogged out of the limit switch activation position again. This is done by jogging the robot after pressing the limit switch override push button. See *Connecting a Limit switch override push button on page 103*.	

Testing limit switches for a SafeMove system

Perform validation of the function Safe Axis Speed. See *Application manual - SafeMove1*. If this test is passed the limit switch works as intended.

3.4.10 Function test of reduced speed control

Performing the function test

	Action	Note
1	Start the robot system and change the operating mode to manual.	
2	Create a test program where the robot moves along a known distance with a programmed speed higher than 250 mm/s.	The distance and speed must be adapted to the current installation and robot model.
3	Start the program in manual mode and measure the time it takes for the robot to travel the distance.  **Tip** To get accurate results, use sensors or I/O signals to measure the time.	This test is passed if the speed of the robot does not exceed 250 mm/s, otherwise the test is failed and the root cause of the failure must be found.

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4 Repair

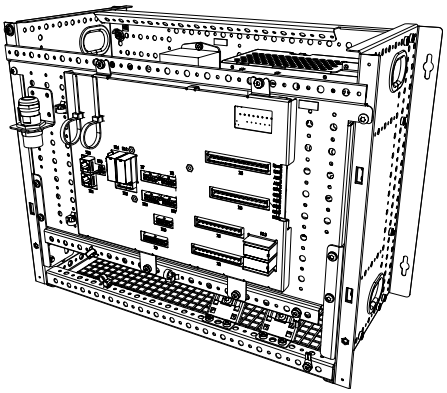
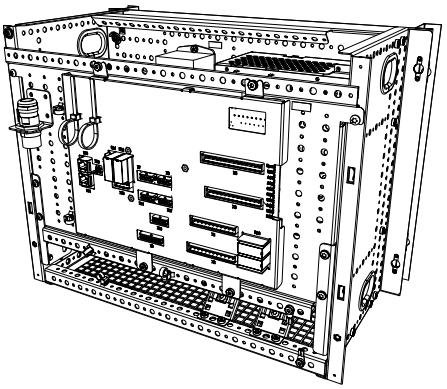
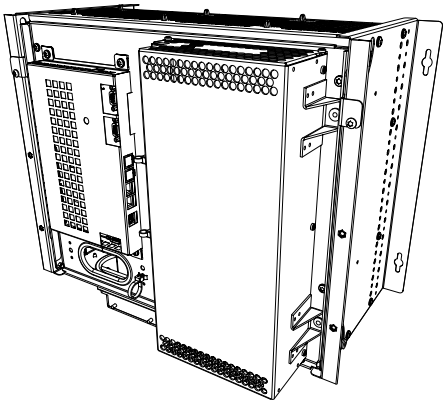
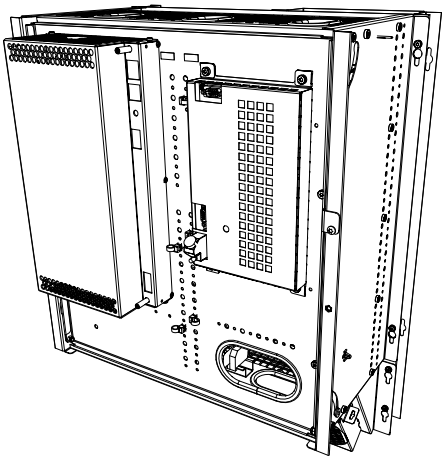
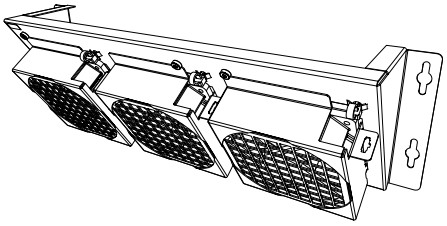
4.1 Overview

General

There are two versions of the IRC5 Panel Mounted Controller. PMC small is used for small robots and PMC large is used for large robots. The controller always consists of one control module and one drive module.

The control module contains the computer unit, communication interfaces, FlexPendant connection, service ports and also the system software which includes all basic functions for operation and programming.

The drive module contains the drive system.

	PMC small	PMC large
A	 xx1300001963	 xx1300001964
B	 xx1300001961	 xx1300001965
C	 xx1300001962	

Continues on next page

A	Control module (with air channel for PMC large).
B	Drive module (different design for PMC small and PMC large).
C	Fan unit (for PMC large this is a part of the drive module).

Note

When replacing a unit in the controller, report to ABB:

- the serial number
- article number
- revision

of both the replaced unit and the replacement unit.

This is particularly important for the safety equipment to maintain the safety integrity of the installation.

Note

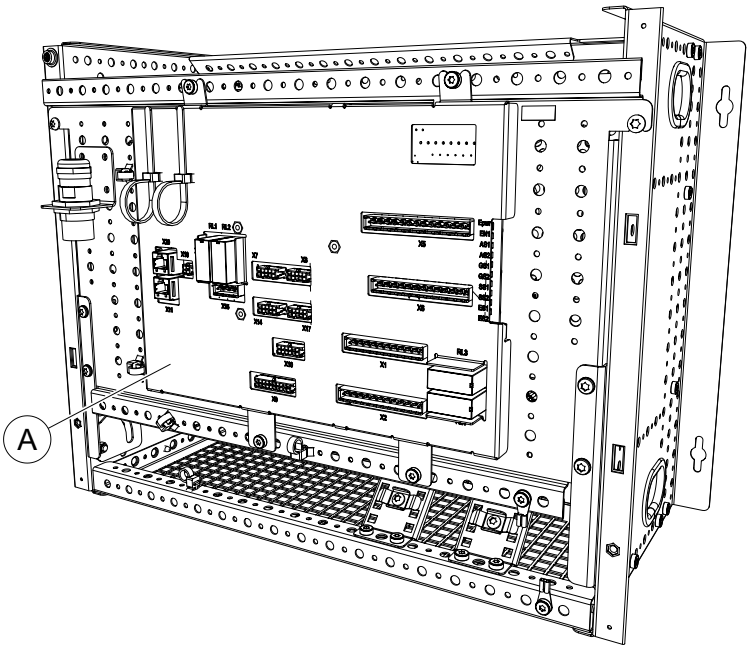
When replacing a part on the IRC5 Panel Mounted Controller, report to your local ABB the serial number, the article number, and the revision of both the replaced unit and the replacement unit.

This is particularly important for safety equipment to maintain the safety integrity of the installation.

4.2 Replacement of panel board

Location

The panel board unit, DSQC 643, is located as shown in the illustration below.



xx1300001948

A	Panel board unit

Required equipment

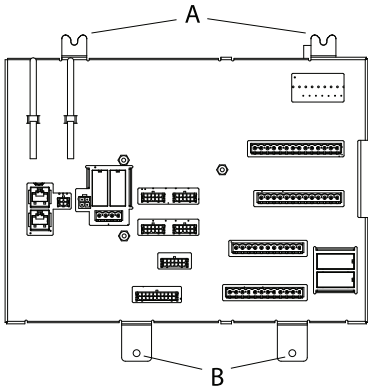
Equipment	Note
Panel board unit	DSQC 643 See *Spare parts on page 253*.
Standard toolkit	The contents are defined in section Standard toolkit!
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.
Circuit diagram	See *Circuit diagrams on page 273*.

Removal

The procedure below details how to remove the panel board unit.

	Action	Note/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	

Continues on next page

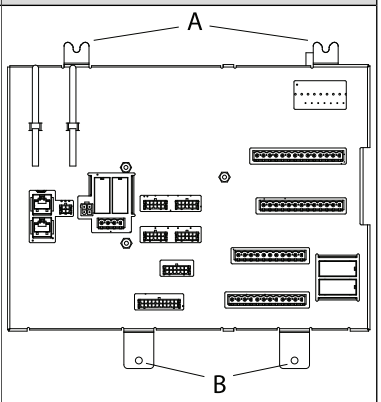
	Action	Note/Illustration
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Disconnect all connectors.	**Note** Make a note of any connections.
4	Remove the lower attachment screws, and remove the Panel Unit.	 xx0600003227 • A: fixed attachments • B: hole for attachment screw

Refitting

The procedure below details how to refit the panel board unit.

	Action	Note/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Refit the panel board unit.	

Continues on next page

	Action	Note/Illustration
4	Refit the lower attachment screws.	 xx0600003227 • A: fixed attachments • B: hole for attachment screw
5	Reconnect all connectors.	
6	Perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.	

4.3 Replacement of I/O units and Gateways

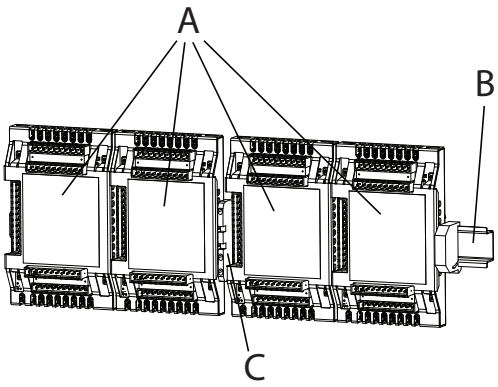
General

A number of I/O units and gateway units may be installed in the controller. These are specified in *DeviceNet I/O units on page 113*.

How to configure the I/O units is detailed in *Operating manual - RobotStudio*.

Location

The location of the I/O units, gateway units, or encoder interface units are shown in the illustration below.



xx0600003256

A	I/O units, Gateways or Encoder interface units
B	Mounting rail
C	Connection terminal XT31

Required equipment

Equipment	Note
A number of units are available.	Specified in section *DeviceNet I/O units on page 113*.
Standard toolkit	The contents are defined in section Standard toolkit!
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.
Circuit diagram	See *Circuit diagrams on page 273*.

Continues on next page

Removal

The procedure below details how to remove the I/O units or gateway units.

	Action	Note/illustration
1	 **DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	 **ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Identify the I/O unit or gateway unit to be replaced.	
4	Disconnect the connectors from the unit.	Note which connector goes where, to facilitate reassembly.
5	Tip the unit away from the mounting rail and remove it.	

Refitting

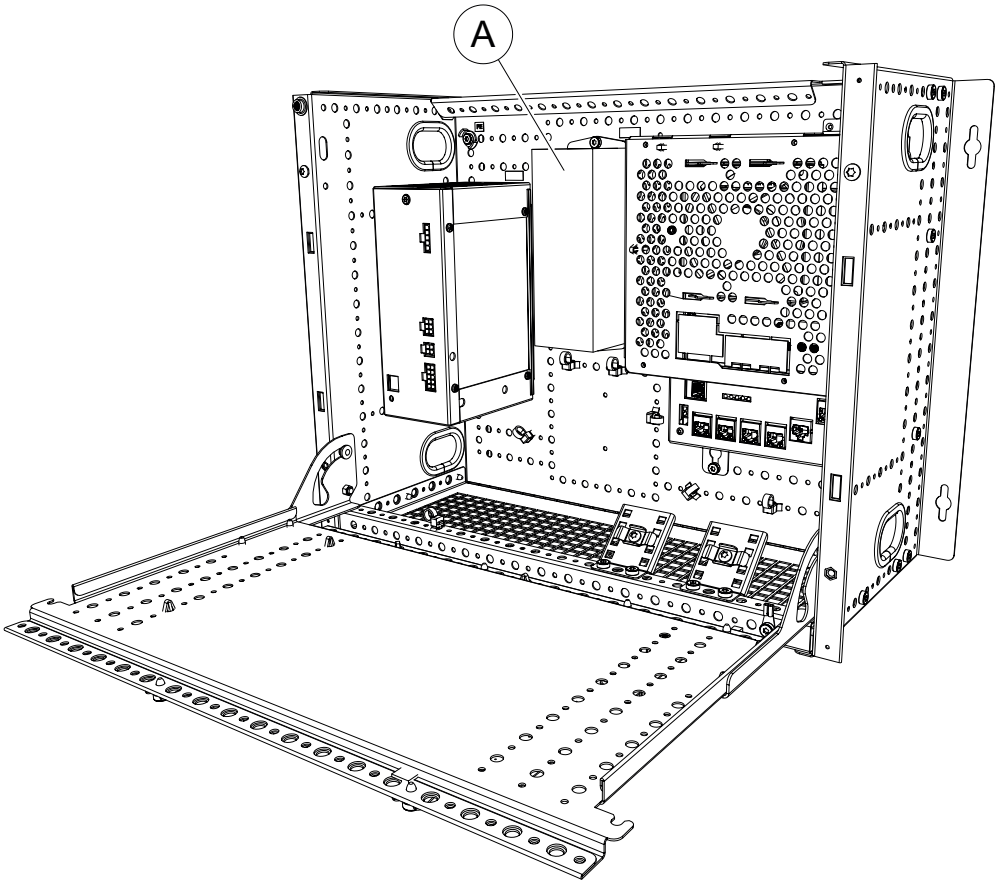
The procedure below details how to refit the I/O units or gateway units.

	Action
1	 **DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.
2	 **ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.
3	Hook the unit back onto the mounting rail and snap it gently in position.
4	Reconnect all connectors disconnected during removal.
5	Perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.

4.4 Replacement of backup energy bank

Location

The illustration below shows the location of the backup energy bank in the IRC5 controller.



xx1300001949

A	Backup energy bank

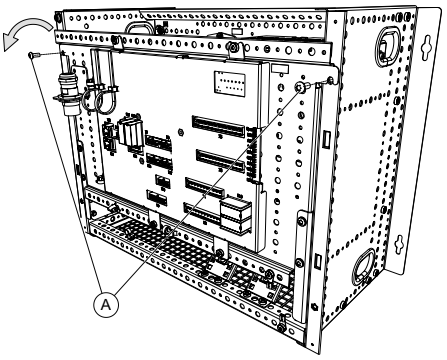
Required equipment

Equipment	Note
Backup energy bank	DSQC 655 See *Control module parts on page 253*.
Standard toolkit	The contents are defined in section Standard toolkit.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.
Circuit diagram	See *Circuit diagrams on page 273*.

Continues on next page

Removal

The procedure below details how to remove the backup energy bank.

	Action	Note/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	Remove the attachment screws and pull the front with the Panel Board Unit in the arrow direction.	 xx1300001950 A attachment screws
3	Disconnect the connector X4 from the distribution board.	
4	Remove the *attachment screw*.	
5	Pull the *backup energy bank* out.	

Refitting

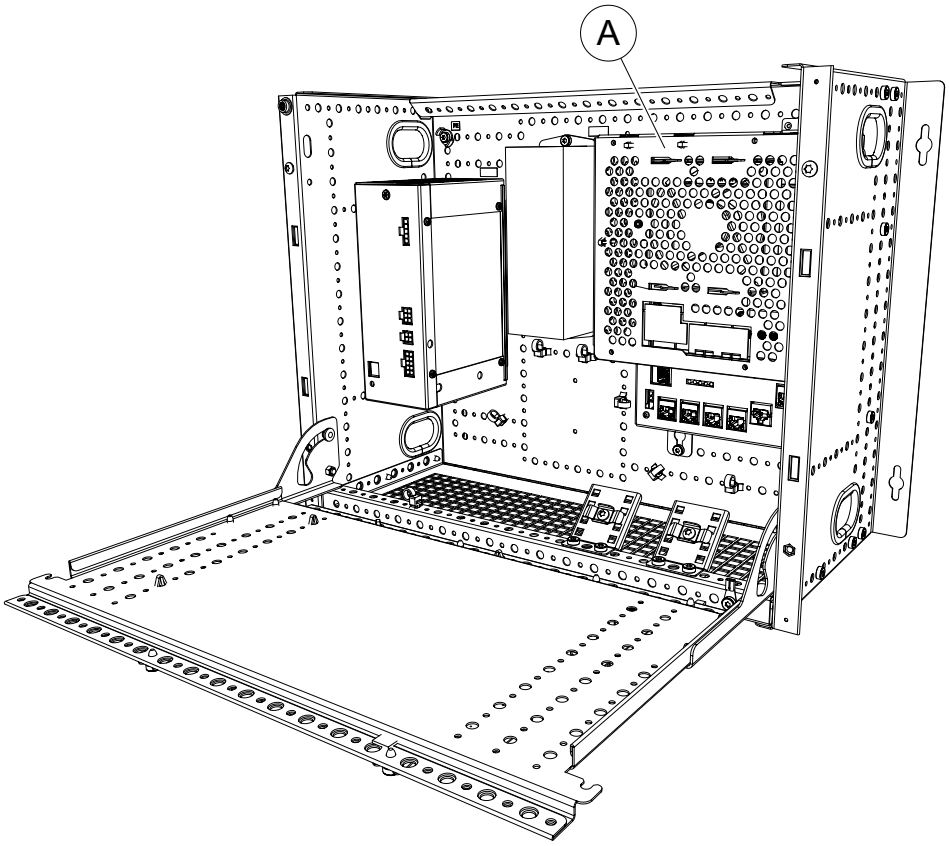
The procedure below details how to refit the backup energy bank.

	Action
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.
2	Refit the new backup energy bank.
3	Refit and tighten the *attachment screw*.
4	Reconnect the connector to the *control power supply* connector X4.
5	Refit the front with the Panel Board Unit.
6	Perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.

4.5 Replacement of computer unit

Location

The computer unit is located as shown in the illustration below.



xx1300001951

A	Computer unit

Required equipment

Equipment	Note
Computer unit	See *Spare parts on page 253*.
Standard toolkit	The contents are defined in section Standard toolkit.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.
Circuit diagram	See *Circuit diagrams on page 273*.

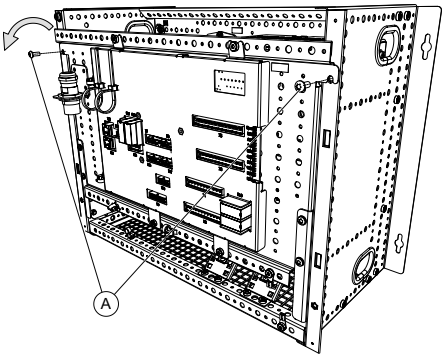
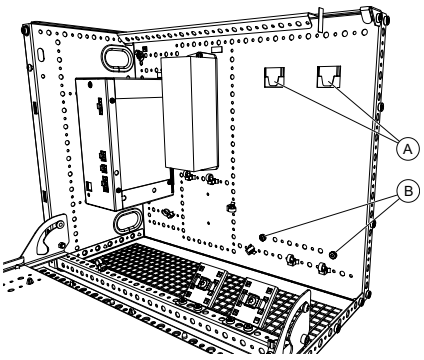
Continues on next page

Removal

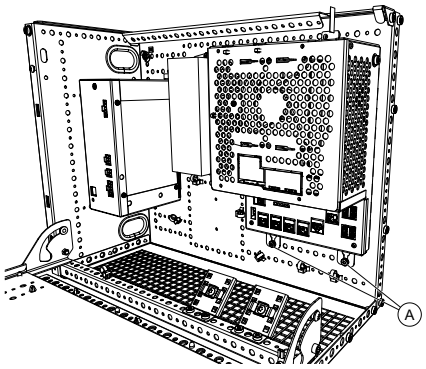
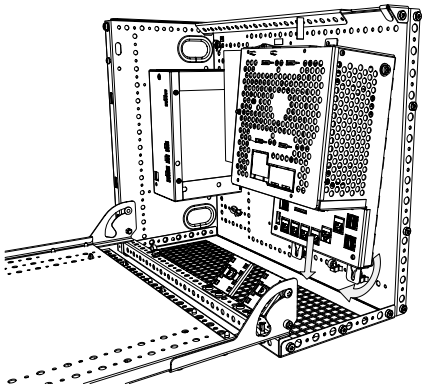
The procedure below details how to remove the computer unit.

Note

If possible, do a backup of the system before removing the computer unit. For information on how to do a backup see *Operating manual - IRC5 with FlexPendant*.

	Action	Note/illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Disconnect all connectors from the computer unit.	
4	Remove the attachment screws and pull the front with the Panel Board Unit in the arrow direction.	 xx1300001950 A attachment screws
5	The computer unit is suspended by latches and attachment screws.	 xx1300001952 A Latches B Attachment screws

Continues on next page

	Action	Note/illustration
6	Support the computer unit beneath by hand and loosen the attachment screws.	 xx1300001953 A Attachment screws
7	Pull the computer unit in the arrow direction.	 xx1300001954 **WARNING** Prevent the computer unit from falling down due to gravity by supporting the computer unit from beneath by hand.

Refitting

The procedure below describes how to refit the computer unit.

Note

After replacing the main computer, the RobotWare system can be reset. It is then necessary to restore a backup. For information on how to restore a backup see *Operating manual - IRC5 with FlexPendant*.

	Action	Note/illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	

Continues on next page

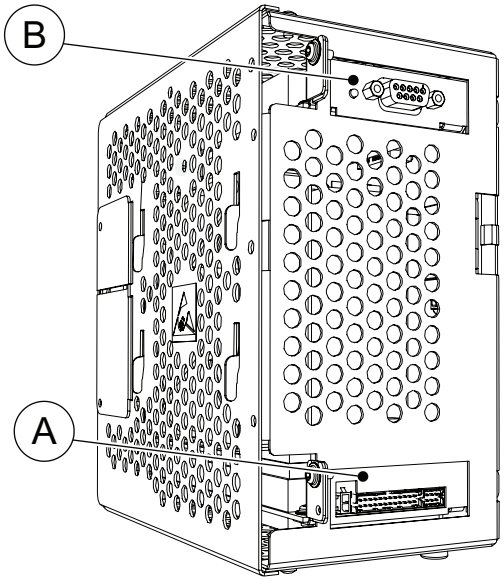
	Action	Note/illustration
2	 **ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Fit the computer unit in position	
4	Tighten the attachment screws.	
5	Reconnect all connectors to the computer unit.	
6	Refit the front with the Panel Board Unit.	
7	Perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.	

4.6 Replacement of PCIexpress boards in the computer unit

Location

The following PCIexpress boards may be fitted in the slots in the computer unit as shown in the figure below:

- DeviceNet Master/Slave
- PROFIBUS-DP Master
- Safety module (second generation SafeMove safety controller)



xx1500001760

A	Safety module DSQC1015
B	PCIexpress slot for other devices.

Required equipment

Equipment	Art. no.	Note
Profibus-DP Master	3HAC044872-001	DSQC1005 Profibus communication is described in *Application manual - PROFIBUS Controller*.
DeviceNet Master/Slave	3HAC043383-001	DSQC1006 DeviceNet communication is described in *Application manual - DeviceNet Master/Slave*.
Safety module	3HAC048858-001	DSQC1015 SafeMove (2nd generation) is described in *Application manual - Functional safety and SafeMove2*.
Standard toolkit		The contents are described in section *Standard toolkit, IRC5 on page 249*.

Continues on next page

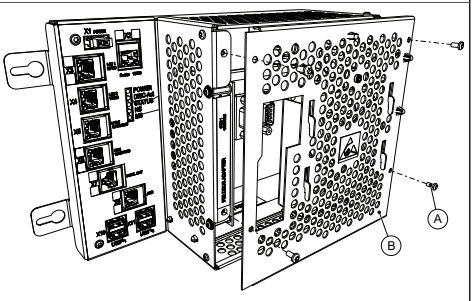
Equipment	Art. no.	Note
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to tools required.

References

Equipment	Art. no.	Note
Application manual - PROFIBUS Controller	*3HAC050966-001*	Contains information on how to configure the system for PROFIBUS devices.
Application manual - DeviceNet Master/Slave	*3HAC050992-001*	Contains information on how to configure the system for DeviceNet devices.
Circuit diagram	See *Circuit diagrams on page 273*.	

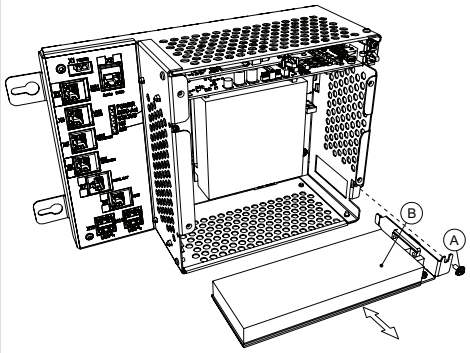
Removal

The procedure below details how to remove a PCIexpress board.

	Action	Note/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Disconnect any cables to/from the PCIexpress board.	**Tip** Make a note of which cables are disconnected.
4	Open the computer unit by removing the attachment screws and lift off the upper cover. Disconnect the fan connector. **CAUTION** Be careful with the fan cable when opening and removing the upper cover. The fan cable must not be stretched.	 xx1300000684 A Attachment screws (4 pcs.) B Upper cover

Continues on next page

4.6 Replacement of PCIexpress boards in the computer unit
Continued

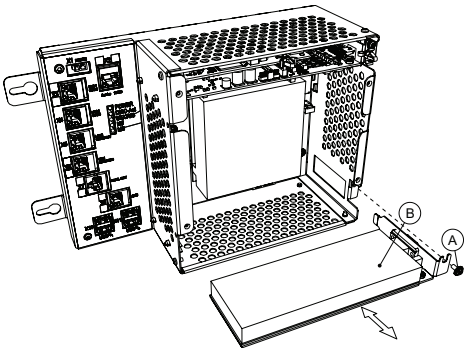
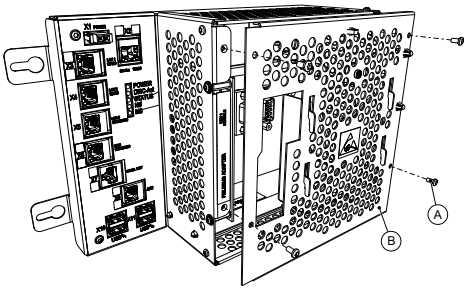
	Action	Note/Illustration
5	Remove the attachment screw on top of the PCIexpress board bracket.	 xx1300000685 A Attachment screw B PCIexpress board
6	Gently pull the board straight out.	**CAUTION** Always grip the board around the edges to avoid damage to the board or its components. **CAUTION** Immediately put the board in an ESD safe bag or similar.

Refitting

The procedure below details how to refit a PCIexpress board.

	Action	Note/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	

Continues on next page

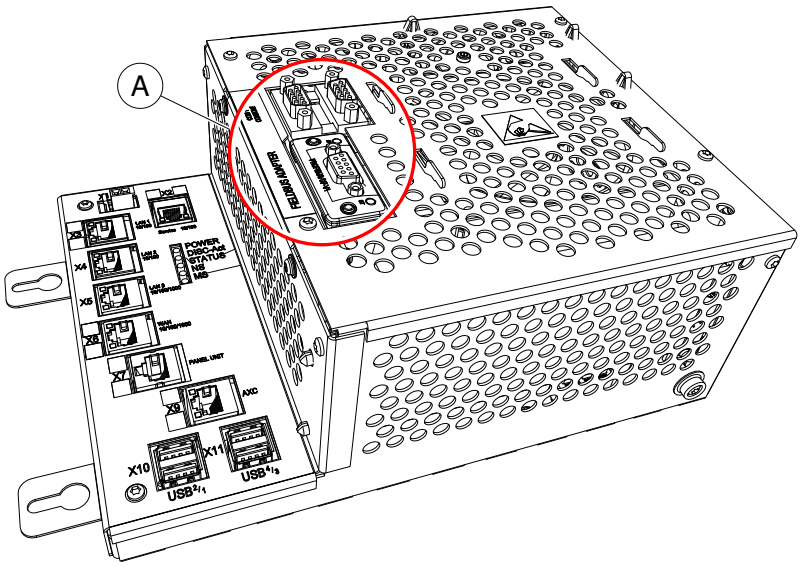
	Action	Note/Illustration
3	Fit the PCIexpress board in position by pushing the PCIexpress board into the socket on the motherboard.	 xx1300000685 A Attachment screw B PCIexpress board **CAUTION** Always grip the board around the edges to avoid damage to the board or its components.
4	Refit the attachment screw on top of the PCIexpress board bracket.	
5	Reconnect any additional cables to the PCIexpress board.	
6	Refit the fan connector and close the computer unit. **CAUTION** Be careful with the fan cable when closing the upper cover. The fan cable must not be squeezed.	 xx1300000684 A Attachment screws (4 pcs.) B Upper cover
7	Make sure the robot system is configured to support the installed PCIexpress board.	
8	Perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.	

4.7 Replacement of expansion board in the computer unit

Location

To connect a serial channel or a fieldbus adapter to the controller, the main computer must be equipped with the expansion board DSQC1003.

The expansion board is located in the computer unit as shown below.



xx1300000860

A	Expansion board with serial channel and one slot for AnybusCC fieldbus adapter.

Required equipment

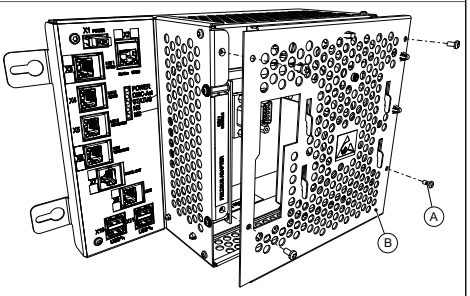
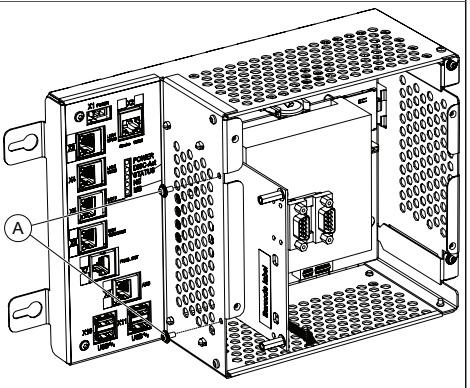
Equipment	Art. no.	Note
Expansion Board	3HAC046408-001	DSQC1003
Standard toolkit		The contents are described in section *Standard toolkit, IRC5 on page 249*.

Removal

The following procedure describes how to remove the expansion board from the computer unit.

	Action	Note/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	

Continues on next page

	Action	Note/Illustration
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Disconnect any cables to/from the fieldbus adapter.	
4	Open the computer unit by removing the attachment screws and lift off the upper cover. Disconnect the fan connector. **CAUTION** Be careful with the fan cable when opening and removing the upper cover. The fan cable must not be stretched.	 xx1300000684 A Attachment screws (4 pcs.) B Upper cover
5	If there is a fieldbus adapter, remove it.	See *Replacement of fieldbus adapter in the computer unit on page 179*.
6	Remove the attachment screws on the computer unit.	 xx1300000859 A Attachment screws (2 pcs)
7	Grip the expansion board and gently pull it straight out.	**CAUTION** Always grip the expansion board around the edges to avoid damage to the board or its components.

Continues on next page

Refitting

The following procedure describes how to refit the expansion board in the computer unit.

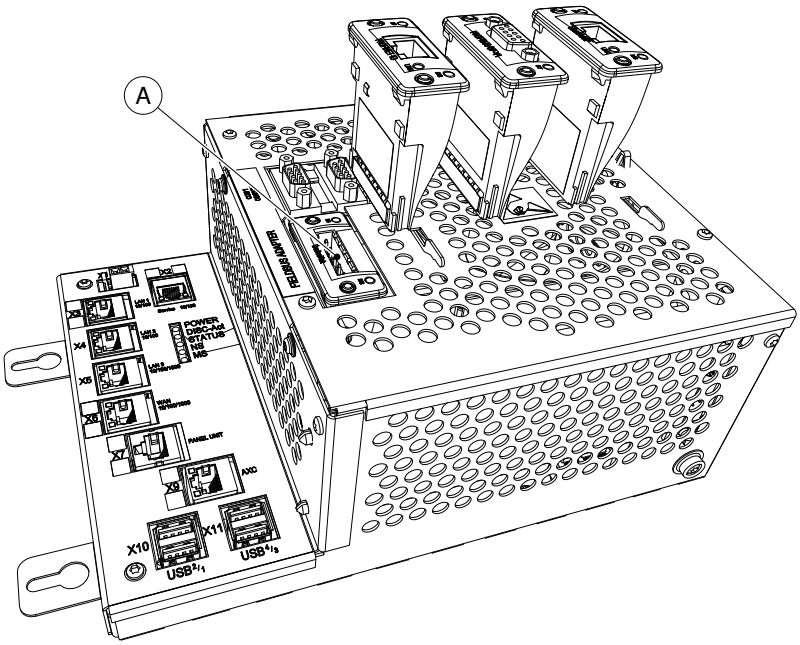
	Action	Note/Illustrator
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Fit the expansion board in position by pushing the expansion board into the connector on the motherboard. **CAUTION** Push carefully so no pins are damaged. Make sure that the expansion board is pushed straight into the connector.	**CAUTION** Always grip the expansion board around the edges to avoid damage to the board or its components.
4	Secure the expansion board in the computer unit with the attachment screws.	
5	Refit the fan connector and close the computer unit. **CAUTION** Be careful with the fan cable when closing the upper cover. The fan cable must not be squeezed.	
6	Reconnect any cable to the fieldbus adapter.	
7	Perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.	

4.8 Replacement of fieldbus adapter in the computer unit

Location

One of the following fieldbus adapters may be fitted in the slot in the computer unit as shown in the figure below:

- AnybusCC EtherNet/IP slave
- AnybusCC PROFIBUS slave
- AnybusCC PROFINET slave
- AnybusCC DeviceNet slave



xx1300000604

A	Slot for AnybusCC fieldbus adapters

Required equipment

Equipment	Art. no.	Note
AnybusCC EtherNet/IP slave fieldbus adapter	3HAC027652-001	DSQC 669 Ethernet/IP communication is described in *Application manual - EtherNet/IP Anybus Adapter*
AnybusCC PROFIBUS slave fieldbus adapter	3HAC026840-001	DSQC 667 PROFIBUS communication is described in *Application manual - PROFIBUS Anybus Device*
AnybusCC PROFINET slave fieldbus adapter	3HAC031670-001	DSQC 688 PROFINET communication is described in *Application manual - PROFINET Anybus Device*

Continues on next page

4.8 Replacement of fieldbus adapter in the computer unit
Continued

Equipment	Art. no.	Note
AnybusCC DeviceNet slave fieldbus adapter	3HAC045973-001	DSQC1004 DeviceNet communication is described in *Application manual - DeviceNet Anybus Slave*.
Standard toolkit		The contents are described in section *Standard toolkit, IRC5 on page 249*.

References

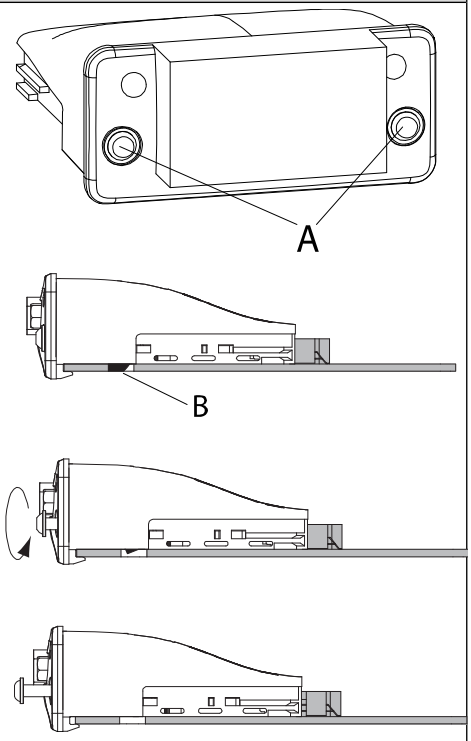
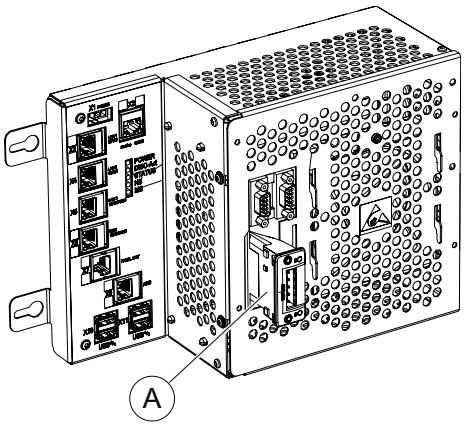
Equipment	Art. no.	Note
Application manual - EtherNet/IP Anybus Adapter	*3HAC050997-001*	Contains information on how to configure the system for EtherNet/IP Fieldbus Adapter DSQC 669.
Application manual - PROFIBUS Anybus Device	*3HAC050965-001*	Contains information on how to configure the system for PROFIBUS Fieldbus Adapter DSQC 667.
Application manual - PROFINET Anybus Device	*3HAC050968-001*	Contains information on how to configure the system for PROFINET Fieldbus Adapter DSQC 688.
Application manual - DeviceNet Anybus Slave	*3HAC050993-001*	Contains information on how to configure the system for DeviceNet Fieldbus Adapter DSQC1004.
Circuit diagram	See *Circuit diagrams on page 273*.	

Removal

The following procedure details how to remove the fieldbus adapter from the computer unit.

	Action	Note/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Disconnect any cables to/from the fieldbus adapter.	

Continues on next page

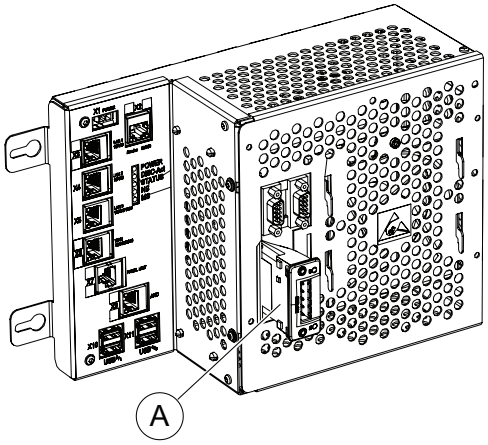
	Action	Note/Illustration
4	Loosen the attachment screws (2 pcs) on front of the fieldbus adapter to release the fastening mechanism. **Note** Only loosen the attachment screws. Do not remove them.	 xx0700000193 A Attachment screws (2 pcs) B Fastening mechanism
5	Grip the loosened attachment screws and gently pull the fieldbus adapter straight out.	 xx1500001755 A Fieldbus adapter

Continues on next page

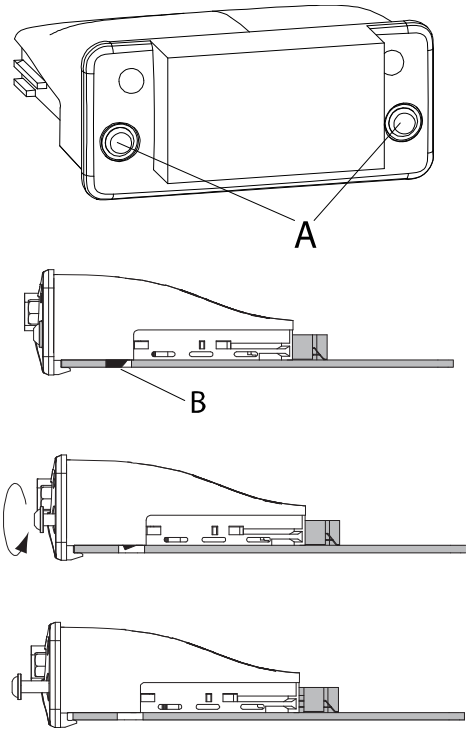
4.8 Replacement of fieldbus adapter in the computer unit
Continued

Refitting

The following procedure details how to refit the fieldbus adapter in the computer unit.

	Action	Note/Illustrator
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Fit the fieldbus adapter in position by pushing the fieldbus adapter along the rails on the motherboard. **CAUTION** Push carefully so no pins are damaged. Make sure that the adapter is pushed straight onto the rails.	 xx1500001755 A Fieldbus adapter **CAUTION** Always grip the fieldbus adapter around the edges to avoid damage to the adapter or its components.

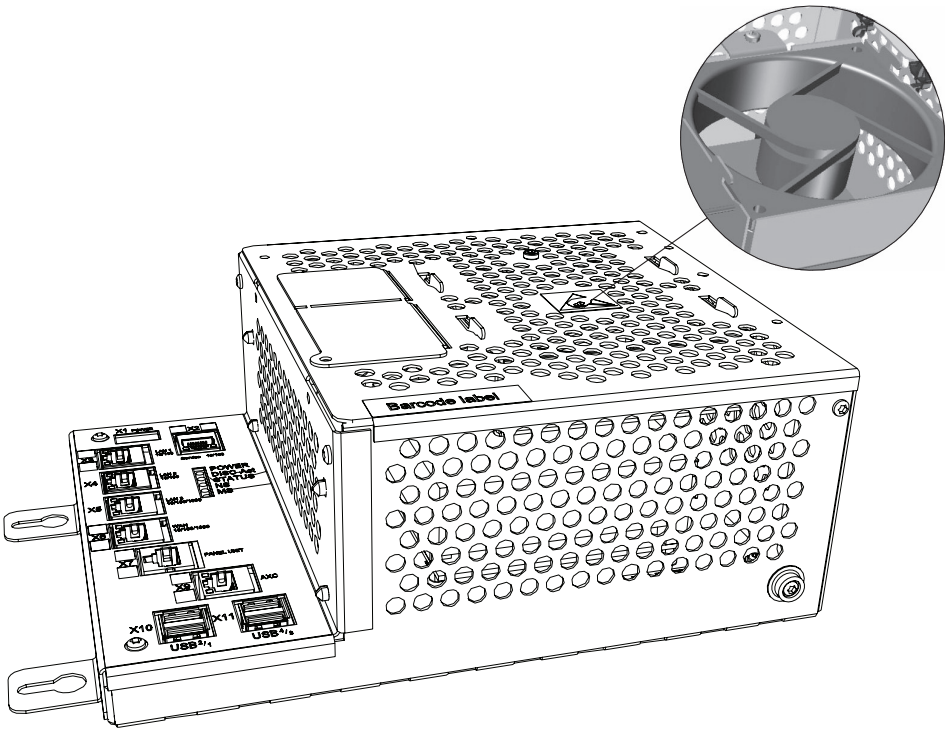
Continues on next page

	Action	Note/Illustrator
4	Secure the fieldbus adapter with its attachment screws (2 pcs).	 xx0700000193 A Attachment screws (2 pcs) B Fastening mechanism
5	Reconnect the cable to the fieldbus adapter.	
6	Make sure the robot system is configured to reflect the fieldbus adapter installed.	
7	Perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.	

4.9 Replacement of fan in computer unit

Location

The computer fan is located under the upper cover as shown in the figure below.



xx1300000687

Required equipment

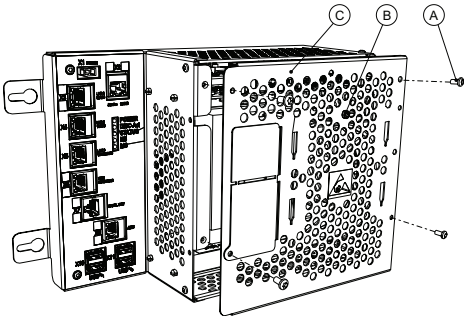
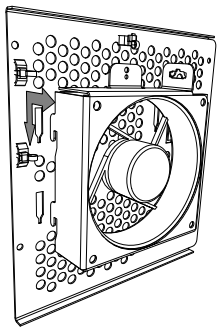
Equipment	Note
Fan	See *Spare parts on page 253*.
Cable straps	
Standard toolkit	The contents are defined in section Standard toolkit.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.
Circuit diagram	See *Circuit diagrams on page 273*.

Removal

The procedure below details how to remove the fan in the computer unit.

	Action	Note/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	

Continues on next page

	Action	Note/Illustration
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Open the computer unit by removing the upper cover attachment screws and lift off the upper cover.	 xx1300000688 A Upper cover attachment screws (4 pcs.) B Fan attachment screw C Upper cover
4	Disconnect the fan connector and remove the cable straps.	**CAUTION** Be careful with the fan cable when opening and removing the upper cover. The fan cable must not be stretched.
5	Remove the fan attachment screw.	
6	Remove the fan from the upper cover.	 xx1300000806

Refitting

The procedure below details how to refit the fan in the computer unit.

	Action	Note/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	

Continues on next page

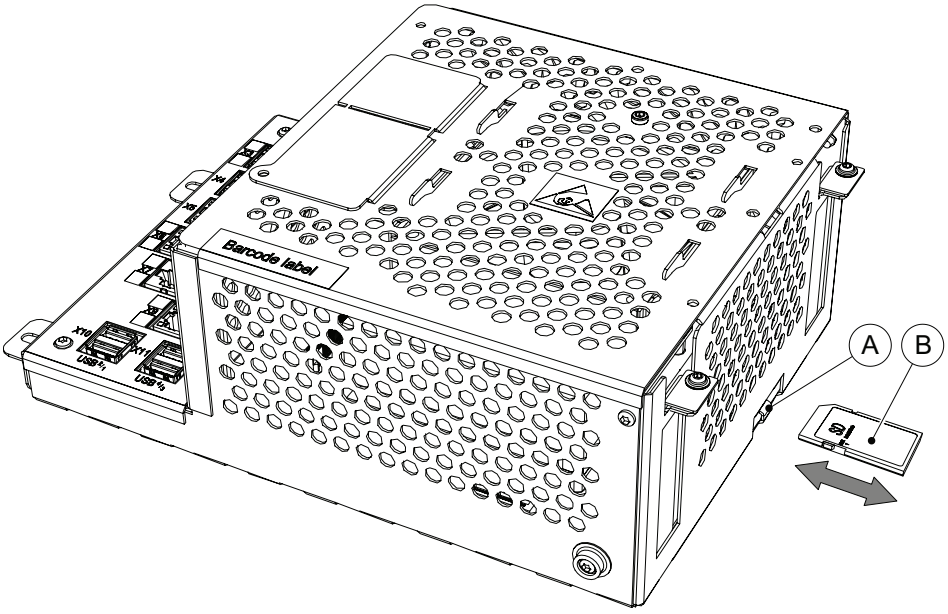
4.9 Replacement of fan in computer unit
Continued

	Action	Note/Illustration
2	 **ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Refit the fan on the upper cover.	
4	Refit the attachment screw.	
5	Strap the fan cable to the upper cover.	 **CAUTION** When strapping the cable make sure that the cable is not stretched or squeezed, and that the cable does not get caught in the fan.
6	Refit the fan connector and close the computer unit.	 **CAUTION** Be careful with the fan cable when closing the upper cover. The fan cable must not be squeezed.
7	Perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.	

4.10 Replacement of SD-card memory in computer unit

Location

The location and orientation of the SD-card memory is shown by the following illustration.



xx1300000807

A	Slot for SD-card memory
B	SD-card memory

Note

Only use SD-card memory supplied by ABB.

Note

The SD-card from the computer unit DSQC1018 cannot be used in the computer unit DSQC1024/DSQC1094. Use the backup and restore function to move data from DSQC1018 to DSQC1024/DSQC1094.

CAUTION

Reformatting the SD-card or modifying the disk partition can cause irreparable boot-up problems.

Continues on next page

4.10 Replacement of SD-card memory in computer unit

Continued

Required equipment

Equipment	Note
SD-card 2GB	See *Spare parts on page 253*. **Note** Only use SD-card memory supplied by ABB. Includes *ABB Boot Application* software to correctly reboot the robot controller.
Standard toolkit	The content is described in section *Standard toolkit, IRC5 on page 249*.

Removal

Use the following procedure to remove the SD-card memory.

	Action
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.
3	Gently push the SD-card memory with your finger until it clicks, and then pull it straight out.

Refitting

Use the following procedure to refit the SD-card memory.

	Action
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.
3	**CAUTION** Make sure that the SD-card memory is correctly oriented before inserting it. Otherwise the SD-card memory or the SD-card memory slot may be damaged.

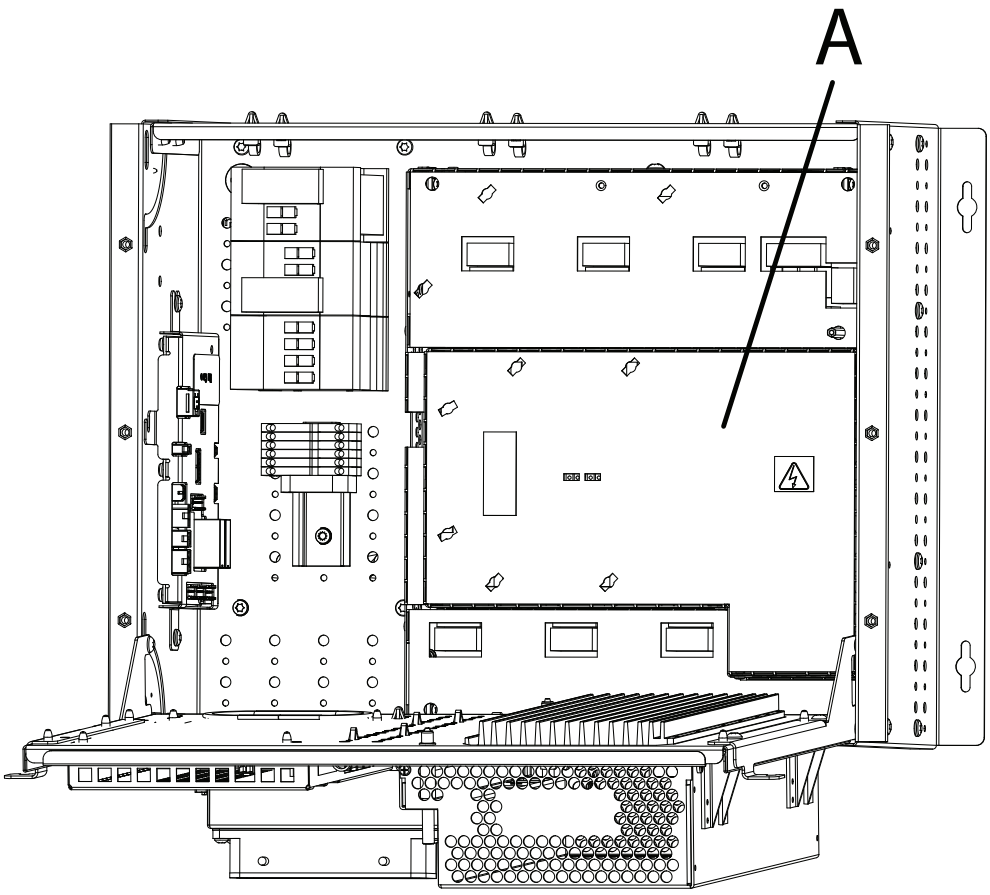
Continues on next page

	Action
4	Gently push the SD-card memory with your finger until it clicks into place.
5	Perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.

4.11 Replacement of drive unit for PMC small

Location

The illustration below shows the location of the drive unit in PMC small.



xx0600003244

A	Main Drive Unit

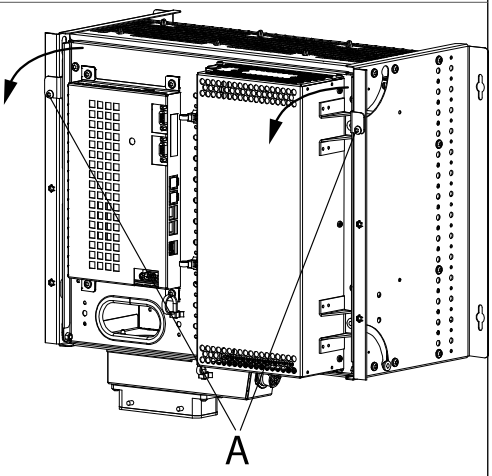
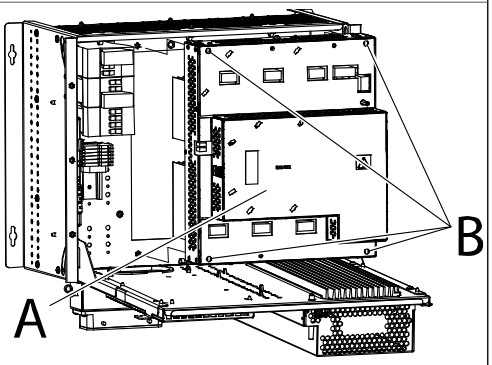
Required equipment

Equipment	Note
Main Drive Unit	See *Drive module parts for PMC small on page 254*.
Standard toolkit	The contents are defined in section *Standard toolkit, IRC5 on page 249*.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.
Circuit diagram	See *Circuit diagrams on page 273*.

Continues on next page

Removal

The procedure below details how to remove the drive unit from PMC small.

	Action	Note/illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	Loosen the attachment screws and pull the front (axis computer/drive system power supply unit) in the arrow direction.	 xx0600003242 • A: attachment screws
3	Disconnect all connectors from the unit to be replaced.	
4	Remove the drive unit after unscrewing its *attachment screws* .	 xx0600003248 Parts: • A: drive unit • B: attachment screws

Continues on next page

Refitting

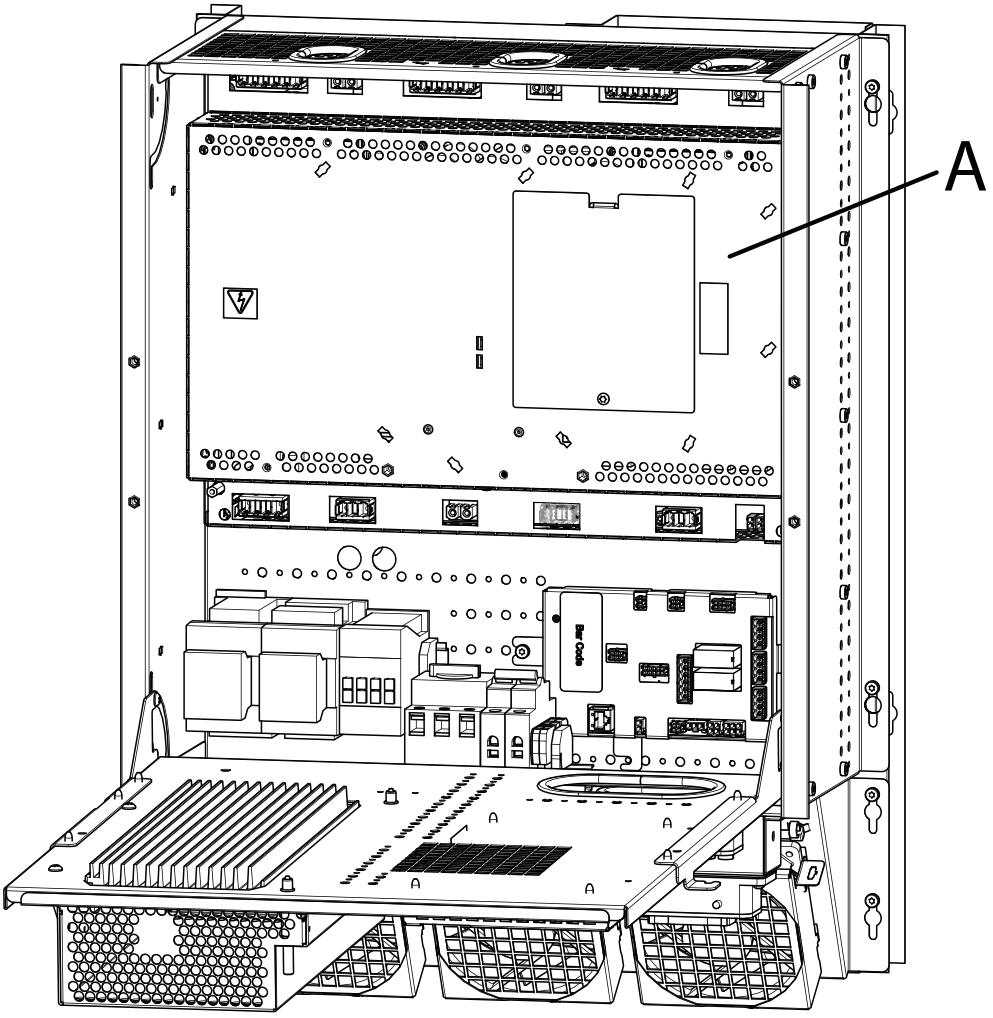
The procedure below details how to refit the drive unit to PMC small.

	Action
1	 **DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.
2	Fit the unit in its intended position and orientation. Secure it with its *attachment screws*.
3	Reconnect any connectors disconnected at removal.
4	Refit the front (axis computer/drive system power supply unit)
5	Perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.

4.12 Replacement of Main Drive Unit for PMC large

Location

The illustration below shows the location of the Main Drive Unit in PMC large.



xx1100000482

A	Main Drive Unit

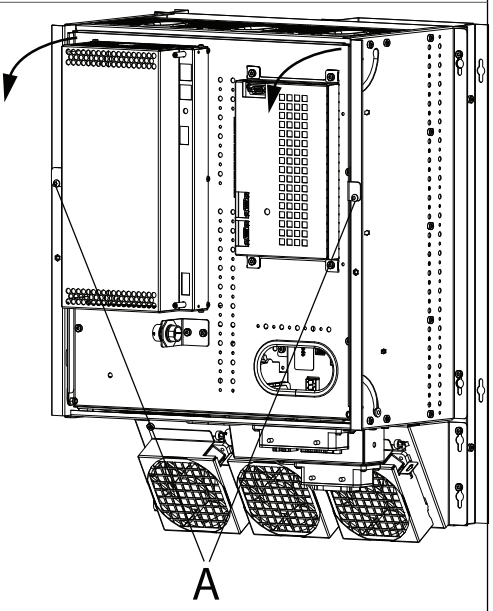
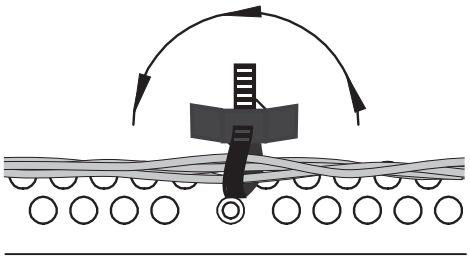
Required equipment

Equipment	Note
Main Drive Unit	See *Drive module parts for PMC large on page 255*.
Standard toolkit	The contents are defined in section *Standard toolkit, IRC5 on page 249*.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.
Circuit diagram	See *Circuit diagrams on page 273*.

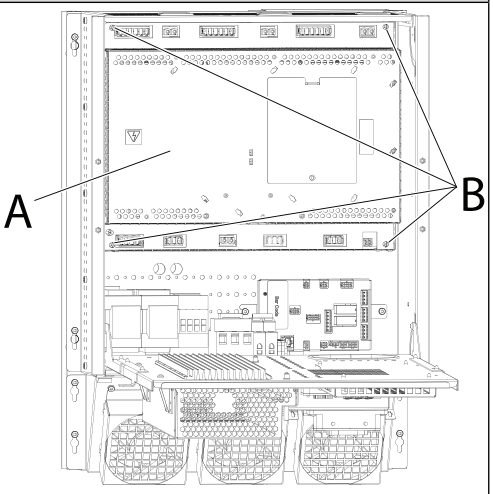
Continues on next page

Removal

The procedure below details how to remove the Main Drive Unit from PMC large.

	Action	Note/illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	Loosen the attachment screws and pull the front (axis computer/drive system power supply unit) in the arrow direction.	 xx1100000488 • A: attachment screws
3	Disconnect all connectors and remove all cables from the unit to be replaced.	**Tip** Loosen the cable from the Main Drive Unit by turning the cable straps in the arrows direction.  xx1100000560

Continues on next page

	Action	Note/illustration
4	Remove the drive unit after unscrewing its *attachment screws* .	 xx1100000489 Parts: • A: drive unit • B: attachment screws

Refitting

The procedure below details how to refit the Main Drive Unit to PMC large.

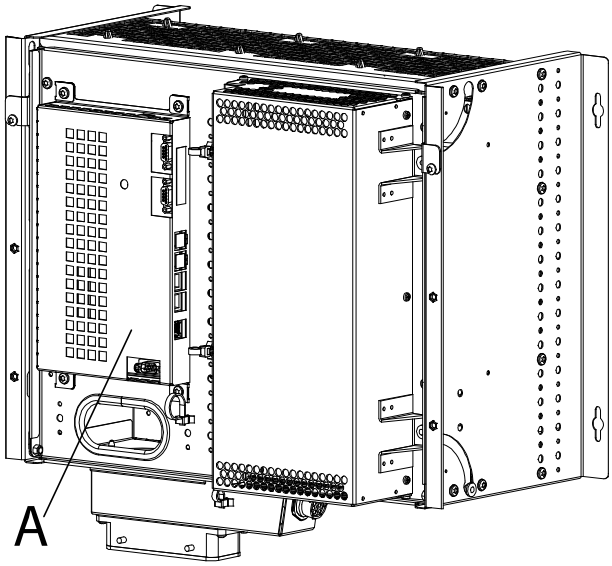
	Action
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.
2	Fit the unit in its intended position and orientation. Secure it with its *attachment screws*.
3	Reconnect any connectors disconnected at removal.
4	Refit the front (axis computer/drive system power supply unit)
5	Perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.

4.13 Replacement of Axis computer

Location

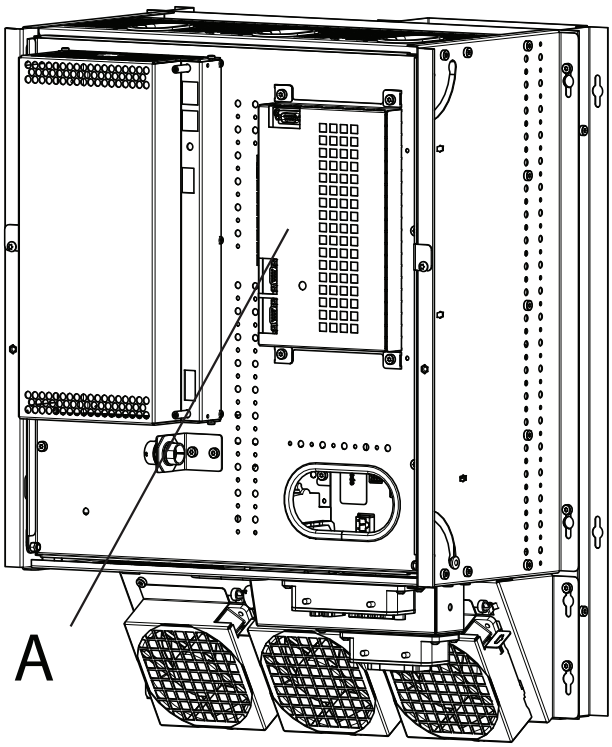
The illustration below shows the location of the axis computer in the controller.

PMC small:



xx0600003240

PMC large:

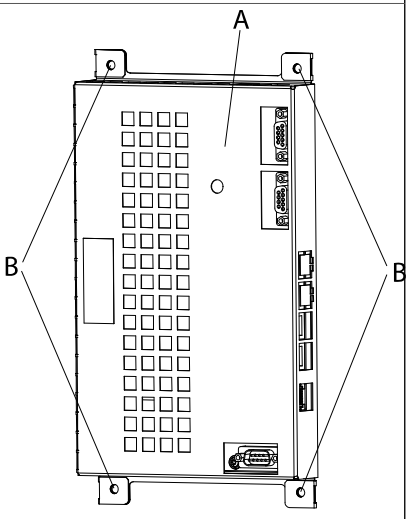


xx1100000492

Continues on next page

Removal

The procedure below details how to remove the axis computer.

	Action	Note/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Disconnect all connectors from the axis computer.	**Tip** Make a note of the connections.
4	Remove the attachment screws.	 xx0900000030 • A: axis computer • B: attachment screws
5	Remove the axis computer.	

Refitting

The procedure below details how to refit the axis computer.

	Action
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.
2	Fit the new axis computer.

Continues on next page

	Action
3	Refit the attachment screws.
4	Reconnect all the connectors.
5	Perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.

4.14 Replacement of EPS board DSQC 646 for Electronic Position Switches

General

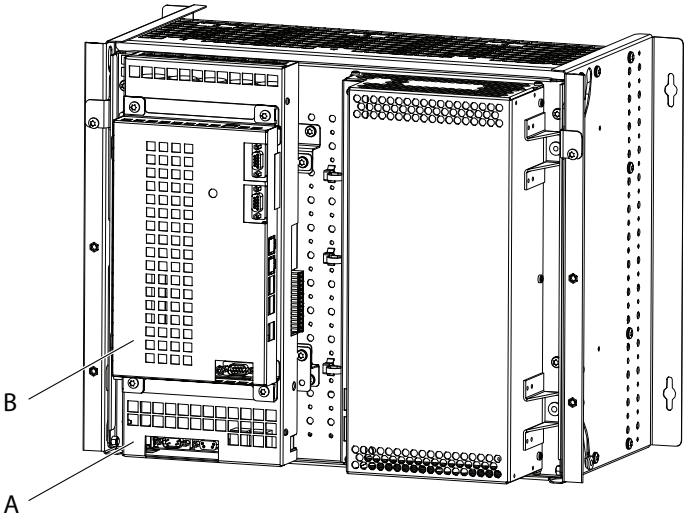
An Electronic Position Switches safety controller, EPS board, is mounted if the option Electronic Position Switches is used.

> **Note**
>
> After replacement of the safety controller, the Electronic Position Switches configuration must be downloaded to the new safety controller and then validated. For more information, see *Application manual - Electronic Position Switches*.

Location

The EPS board is mounted behind the axis computer.

PMC small:



xx1000000979

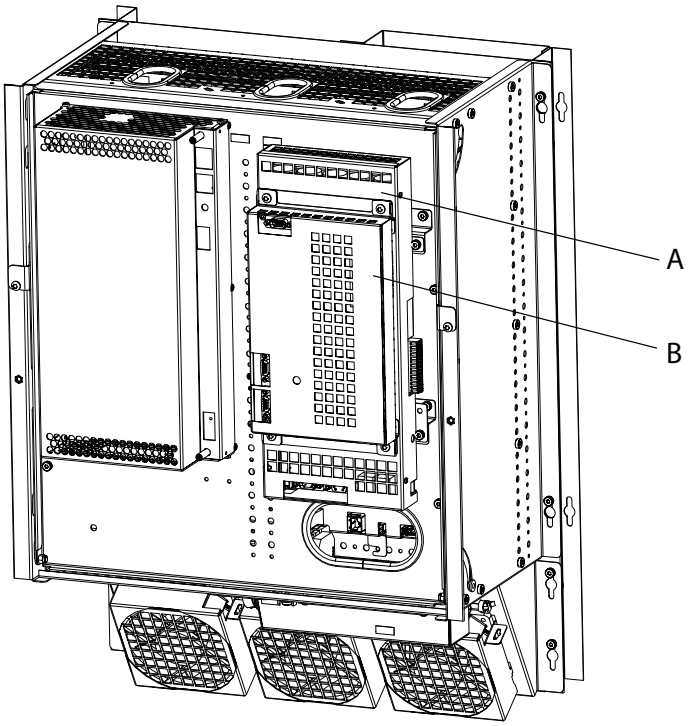
A	EPS board
B	Axis computer

Continues on next page

4.14 Replacement of EPS board DSQC 646 for Electronic Position Switches

Continued

PMC large:



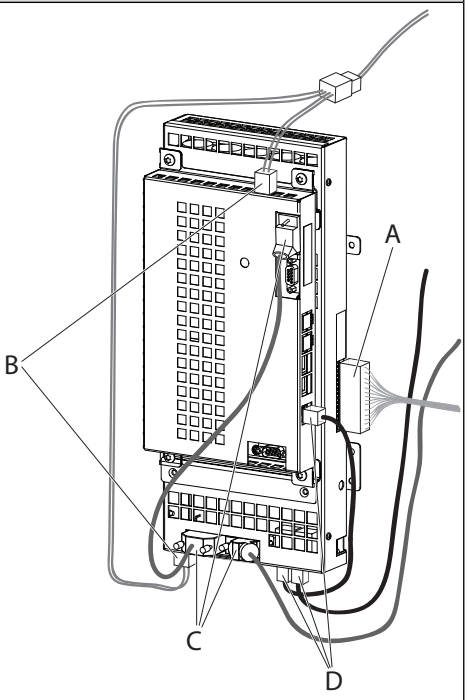
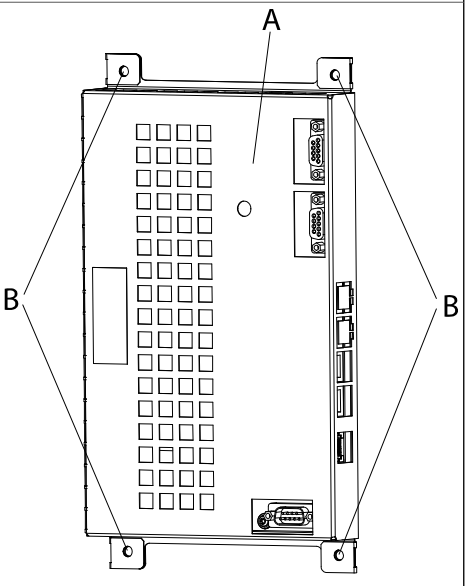
xx1100000483

A	EPS board
B	Axis computer

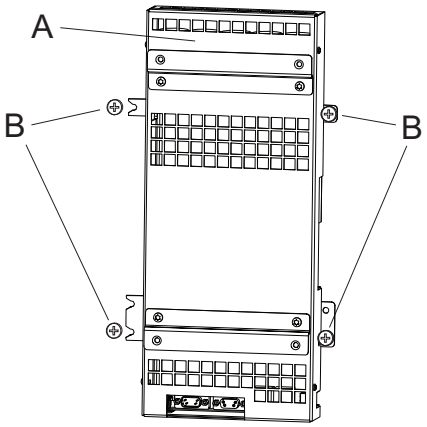
Removal

	Action	Note/illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	

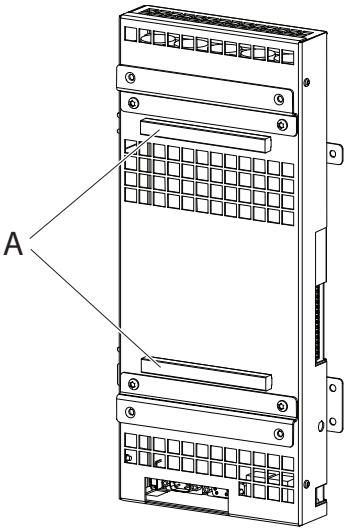
Continues on next page

	Action	Note/illustration
3	Disconnect the following cables connected to the EPS board and axis computer: • Plug contact in I/O connector • Power cables • SMB cables • Ethernet cables	 xx0700000101 A: Plug contact in I/O connector B: Power cables C: SMB cables D: Ethernet cables
4	Remove the attachment screws of the axis computer and remove the axis computer.	 xx0900000030 • A: axis computer • B: attachment screws

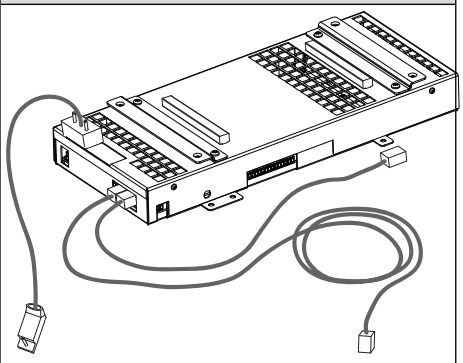
Continues on next page

	Action	Note/illustration
5	Remove the attachment screws of the EPS board and remove the EPS board.	 xx0600003204 • A: EPS board • B: attachment screws

Refitting

	Action	Note/illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	If not already in place, fit the EMC strips on the EPS board.	 xx0700000087

Continues on next page

	Action	Note/illustration
4	Connect the short SMB cable and both Ethernet cables to the EPS board before mounting the board. These connections may be difficult to reach once the board is mounted. The two Ethernet connectors on the EPS board are interchangeable (it does not matter which is connected to the main computer and which is connected to the axis computer).	 xx0600003303
5	Refit the EPS board and the axis computer.	
6	Refit all the cables.	
7	After replacement of the safety controller, the EPS configuration must be downloaded to the new safety controller and then validated. For more information, see *Application manual - Electronic Position Switches*.	
8	Perform the function tests in section *Function tests on page 148* to verify that the basic safety features (e.g. emergency stop) work properly.	

4.15 Replacement of SafeMove board DSQC 647

General

A SafeMove safety controller, SafeMove board, is mounted if the option SafeMove is used.

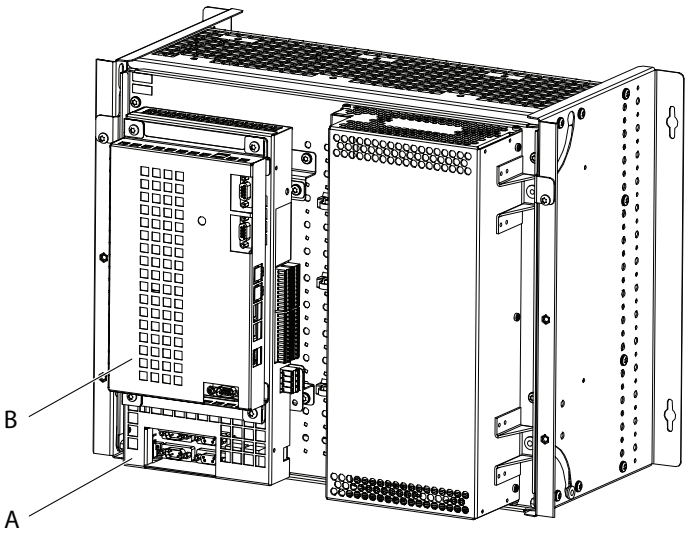
Note

After replacement of the safety controller, the SafeMove configuration must be downloaded to the new safety controller and then validated. For more information, see *Application manual - SafeMove1*.

Location

The SafeMove board is mounted behind the axis computer.

PMC small:

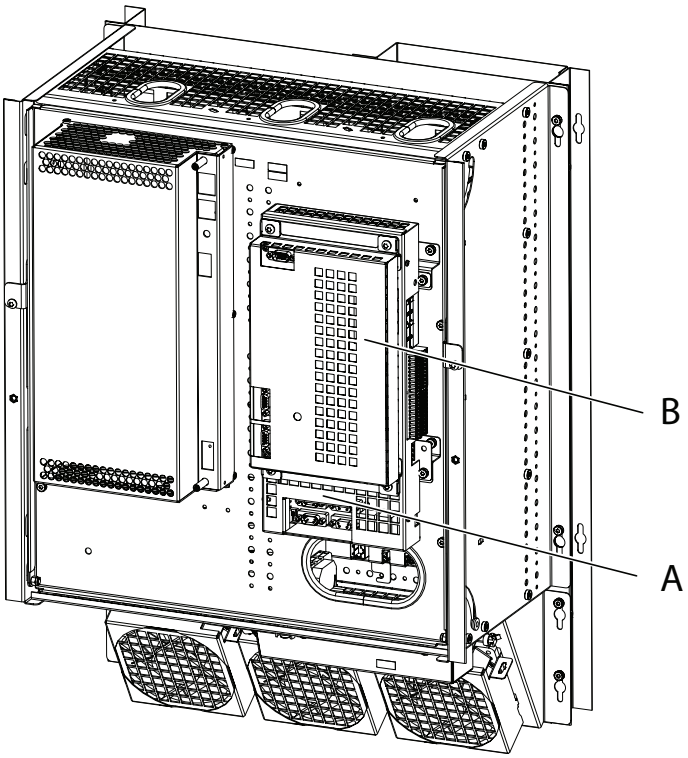


xx1000000980

A	SafeMove board
B	Axis computer

Continues on next page

PMC large:



xx1100000499

A	SafeMove board
B	Axis computer

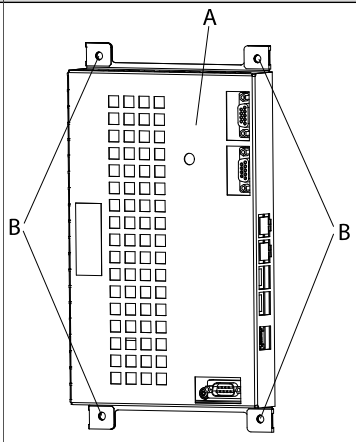
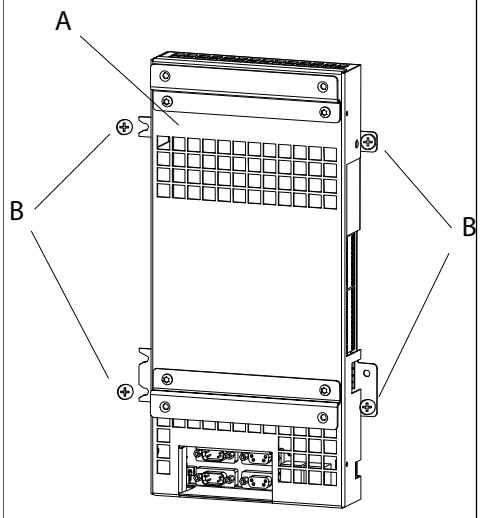
Removal

The procedure below details how to remove the SafeMove board.

	Action	Note/illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Disconnect the cables connected to the SafeMove board and the cables between the SafeMove board and the axis computer.	

Continues on next page

4.15 Replacement of SafeMove board DSQC 647
Continued

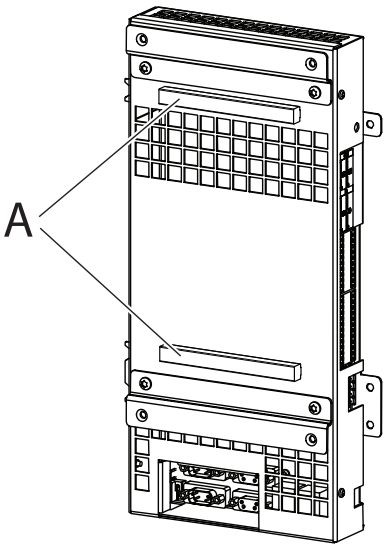
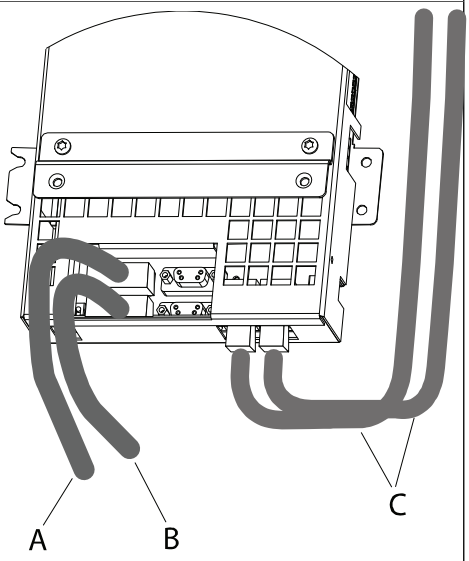
	Action	Note/illustration
4	Remove the attachment screws of the axis computer and remove the axis computer.	 xx0900000030 • A: axis computer • B: attachment screws (4 pcs)
5	Remove the attachment screws of the SafeMove board and remove the SafeMove board.	 xx0800000104 • A: SafeMove board • B: attachment screws (4 pcs)

Refitting

The procedure below details how to refit the SafeMove board.

	Action	Note/illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	

Continues on next page

	Action	Note/illustration
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	If not already in place, fit the EMC strips on the SafeMove board.	 xx0800000204 • A: EMC strips
4	Connect both SMB cables and both Ethernet cables to the SafeMove board before mounting the board. These connections may be difficult to reach once the board is mounted. The two Ethernet connectors on the SafeMove board are interchangeable (it does not matter which is connected to the main computer and which is connected to the axis computer).	 xx0800000103 • A: SMB1 cable • B: SMB2 cable • C: Ethernet cables
5	Refit the SafeMove board and the axis computer.	
6	Refit all cables.	

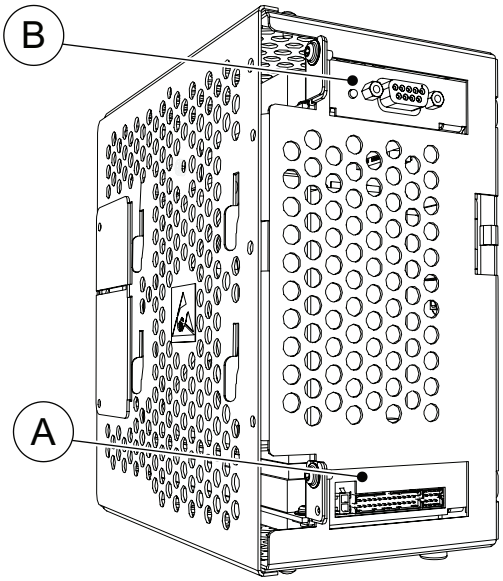
Continues on next page

	Action	Note/illustration
7	After replacement of the safety controller, the SafeMove configuration must be downloaded to the new safety controller and then validated. For more information, see *Application manual - SafeMove1*.	
8	Perform the function tests in section *Function tests on page 148* to verify that the basic safety features (e.g. emergency stop) work properly.	

4.16 Replacement of Safety module DSQC1015 for SafeMove

Location

The Safety module DSQC1015 is a PCIexpress board that is located inside the IRC5 main computer unit.



xx1500001760

A	Safety module DSQC1015
B	PCIexpress slot for other devices.

Required equipment

Equipment	Note
DSQC1015 Safety module	3HAC048858-001
Standard toolkit	The contents are defined in section *Standard toolkit, IRC5 on page 249*.
Circuit diagram	See *Circuit diagrams on page 273*.

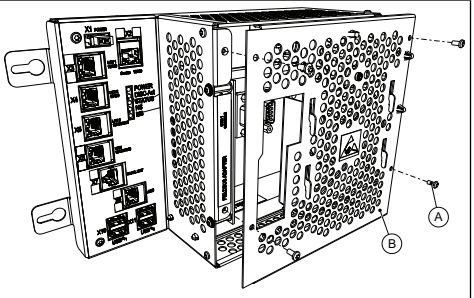
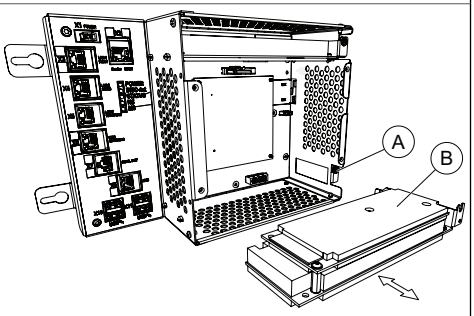
Removing the Safety module

	Action	Note/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	

Continues on next page

4.16 Replacement of Safety module DSQC1015 for SafeMove

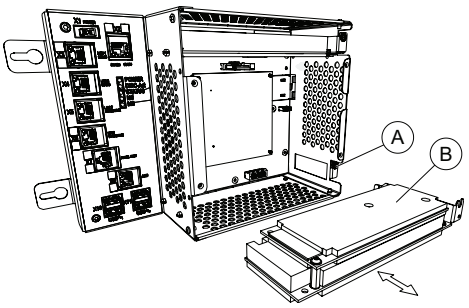
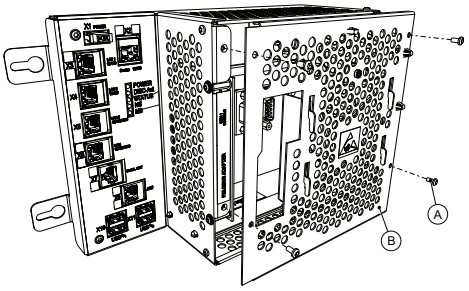
Continued

	Action	Note/Illustration
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Open the computer unit by removing the attachment screws and lift off the cover. Disconnect the fan connector. **CAUTION** Be careful with the fan cable when opening and removing the upper cover. The fan cable must not be stretched.	 xx1300000684 A Attachment screws (4 pcs.) B Cover
4	Remove the attachment screw on top of the slot bracket.	
5	Remove the Safety module by pulling it out of the socket on the motherboard.	 xx1500001761 A Attachment screw B Safety module **CAUTION** Always grip the board around the edges to avoid damage to the board or its components.

Refitting the Safety module

	Action	Note/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	

Continues on next page

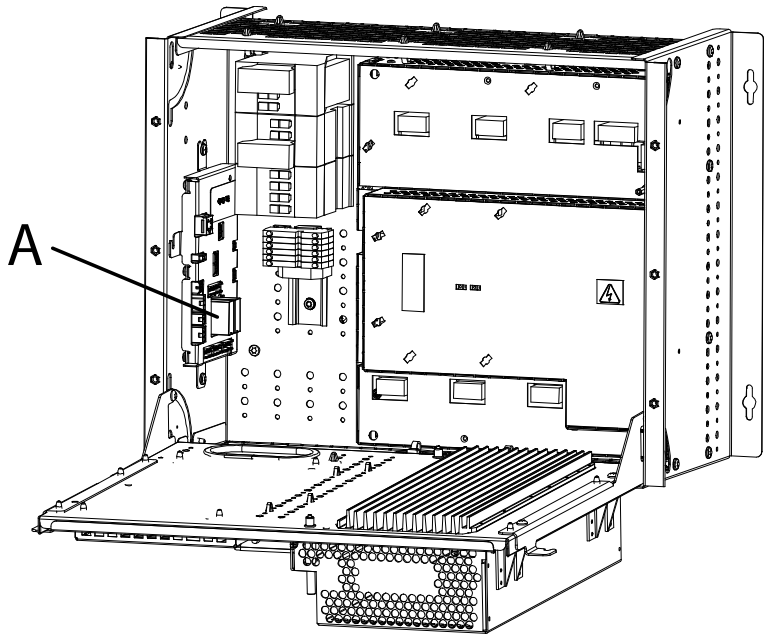
	Action	Note/Illustration
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Fit the Safety module in position by pushing it into the socket on the motherboard.	 xx1500001761 A Attachment screw B Safety module **CAUTION** Always grip the board around the edges to avoid damage to the board or its components.
4	Refit the attachment screw on top of the Safety module bracket.	
5	Refit the fan connector and close the computer unit. **CAUTION** Be careful with the fan cable when closing the cover. The fan cable must not be squeezed.	 xx1300000684 A Attachment screws (4 pcs.) B Cover
6	Perform the function tests in section *Function tests on page 148* to verify that the basic safety features (e.g. emergency stop) work properly.	
7	Perform a synchronization.	See *Application manual - Functional safety and SafeMove2*.
8	Perform a Cyclic Brake Check.	See *Application manual - Functional safety and SafeMove2*.
9	Lock the SafeMove configuration file.	See *Application manual - Functional safety and SafeMove2*.

4.17 Replacement of Contactor Interface Board

Location

The illustration below shows the location of the contactor interface board in the controller.

PMC small:



xx0600003241

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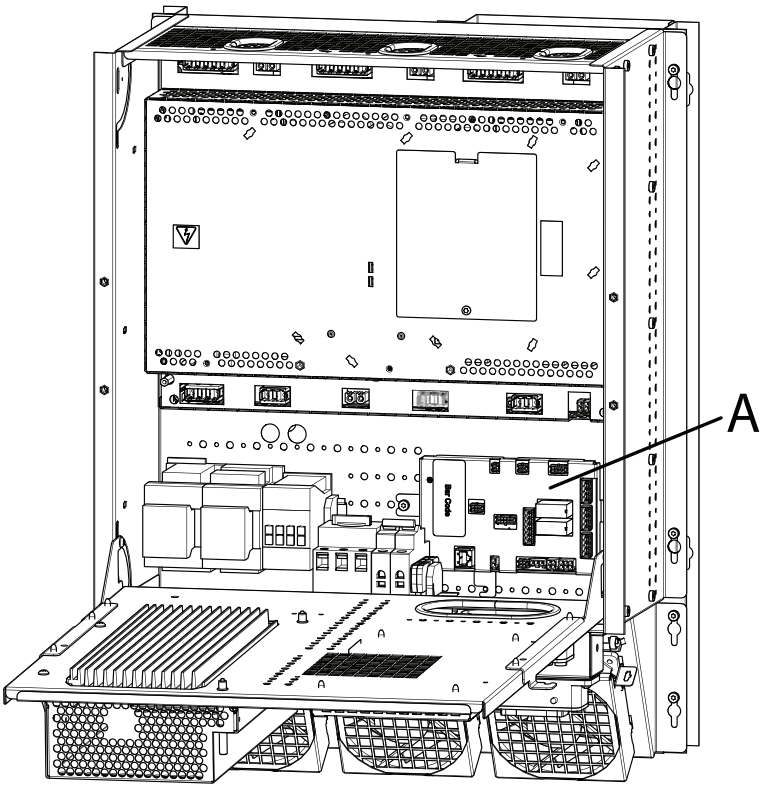
PMC large:



xx1100000481

A	Contactor interface board

Required equipment

Equipment	Note
Contactor Interface board	DSQC 611 See *Spare parts on page 253*.
Standard toolkit	The contents are defined in section Standard toolkit.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.
Circuit diagram	See *Circuit diagrams on page 273*.

Removal

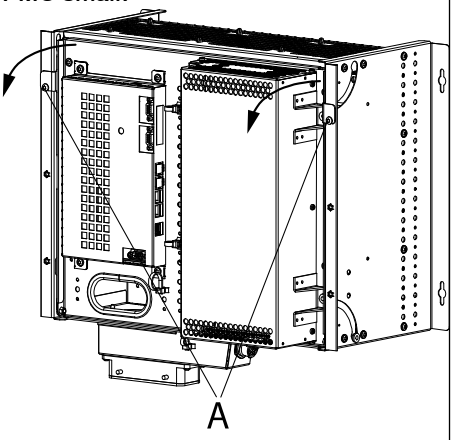
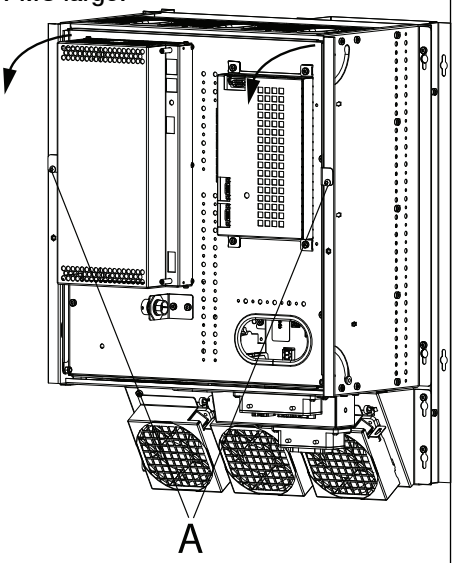
The procedure below details how to remove the contactor board.

	Action	Note/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	

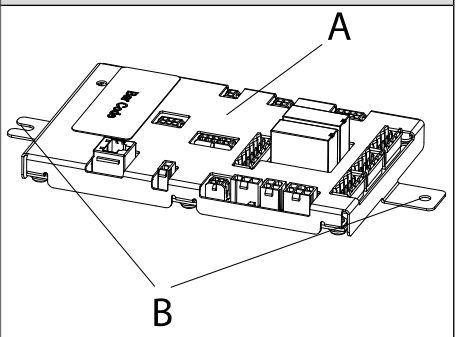
Continues on next page

4.17 Replacement of Contactor Interface Board

Continued

	Action	Note/Illustration
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Loosen the attachment screws and pull the front (axis computer/drive system power supply unit) in the arrow direction.	PMC small:  xx0600003242 PMC large:  xx1100000488 • A: attachment screws
4	Disconnect all connectors.	**Tip** Make a note of any connections.

Continues on next page

	Action	Note/Illustration
5	Remove the attachment screws.	 xx0600003243 • A: contactor interface board • B: attachment screws
6	Remove the contactor interface board.	

Refitting

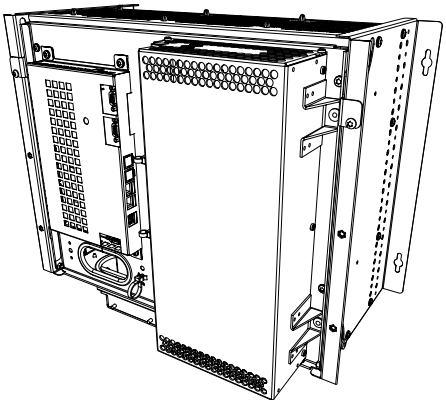
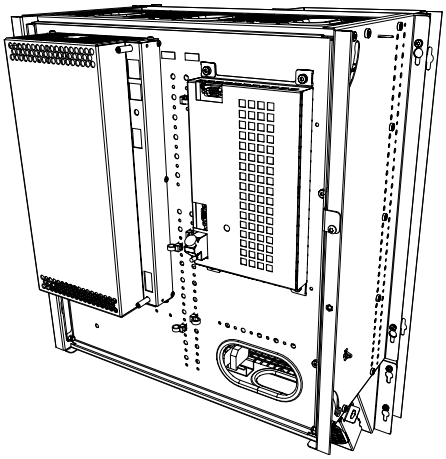
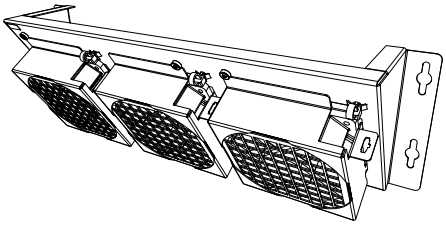
The procedure below details how to refit the contactor board.

	Action	Note/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Refit the contactor interface board.	
4	Refit the attachment screws.	
5	Reconnect all connectors.	
6	Refit the front (with axis computer/drive system power supply unit).	
7	Perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.	

4.18 Replacement of drive system fans

Location

The illustration below shows the location of the fan unit in the controller.

	PMC small	PMC large
A	 xx1300001961	 xx1300001965
B	 xx1300001962	

A	Drive Module (different design for PMC small and PMC large).
B	Fan unit (for PMC large this is a part of the Drive Module.

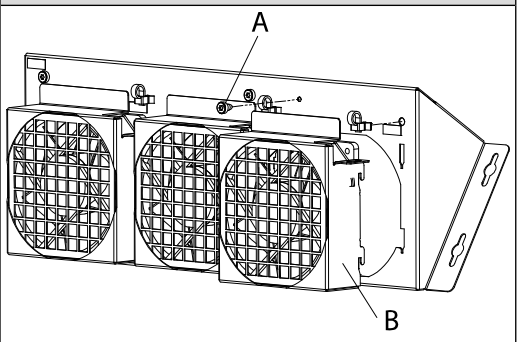
Required equipment

Equipment	Note
Fan	See *Spare parts on page 253*.
Standard toolkit	The contents are defined in section Standard toolkit.
Other tools and procedures may be required. see references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.
Circuit diagram	See *Circuit diagrams on page 273*.

Removal

	Action	Note/illustration
1	Disconnect the fan cable.	

Continues on next page

	Action	Note/illustration
2	Remove the attachment screw.	 xx0600003328 • A: attachment screw • B: fan
3	Push the fan unit upwards and remove it.	
4	Remove attachment screws and remove the cover from the fan.	

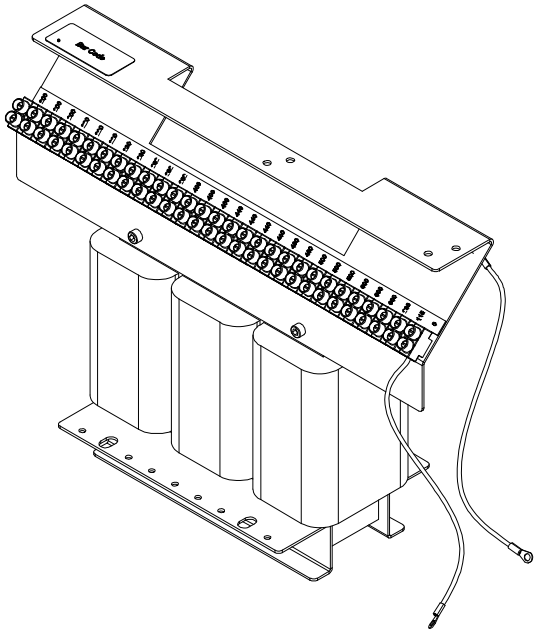
Refitting

	Action
1	Refit the fan to the cover.
2	Refit the fan unit.
3	Reconnect the fan cable.
4	Perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.

4.19 Replacement of transformer unit

Location

The illustration below shows the transformer unit.



xx0600003259

Required equipment

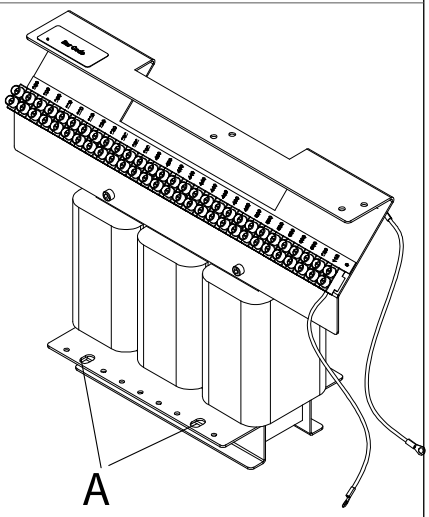
Equipment	Note
Transformer unit	13kVA, 6kVA, 4.2kVA, 1.2kVA See *Spare parts on page 253*.
Standard toolkit	The contents are defined in section Standard toolkit
Circuit diagram	See *Circuit diagrams on page 273*.

Removal

The following procedures details how to remove the transformer unit.

	Action	Note/illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	**WARNING** The transformer weighs between 15 and 40 kg, use a hoist and lifting slings.	

Continues on next page

	Action	Note/illustration
3	Disconnect the two grounding wires (gnye, blue).	
4	Disconnect the mains power supply wires.	**Note** Make a note of the terminal to which each of the wires are connected. This will facilitate reconnection to the same terminal.
5	Remove the two transformer attachment screws.	 xx0600003260 • A: attachment screw (2pcs)
6	Lift the transformer unit out with lifting slings and a hoist.	

Refitting

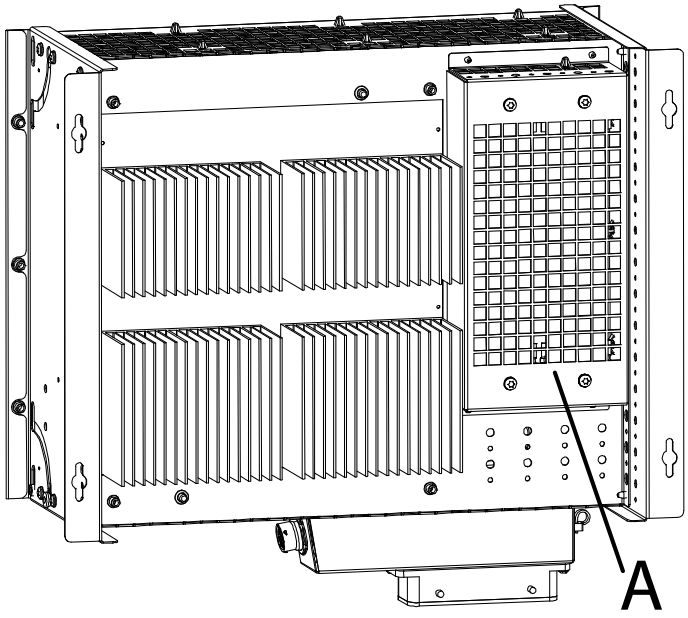
The following procedure details how to refit the transformer unit.

	Action
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.
2	**WARNING** The transformer weighs between 15 and 40 kg, use a hoist and lifting slings.
3	Fit the new transformer in place with a hoist and lifting slings.
4	Refit the attachment screws.
5	Reconnect the mains power supply wires and grounding wires.
6	Perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.

4.20 Replacement of brake resistor bleeder for PMC small

Location

The illustration below shows the location of the brake resistor bleeder in the PMC small. Note! The brake resistor bleeder is placed on the back of the drive module.



xx0600003251

A	Brake resistor bleeder

Required equipment

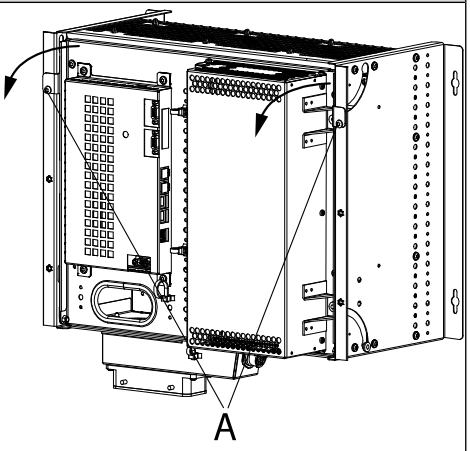
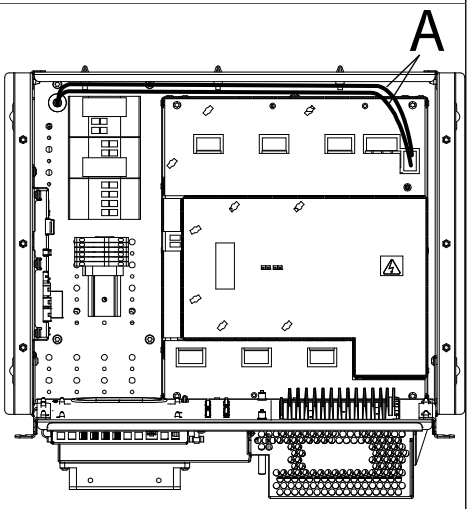
Equipment	Note
Brake resistor bleeder	See *Drive module parts for PMC large on page 255*.
Standard toolkit	The contents are defined in section Standard toolkit
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.
Circuit diagram	See *Circuit diagrams on page 273*.

Removal

The following procedure details how to remove the brake resistor bleeder.

	Action	Note/illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	

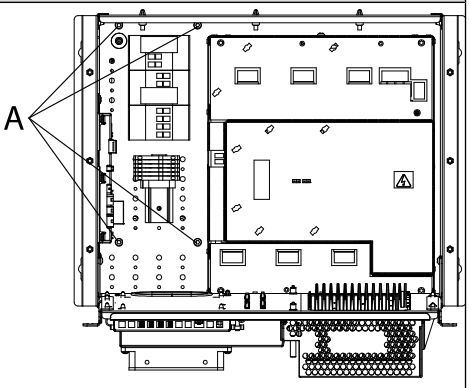
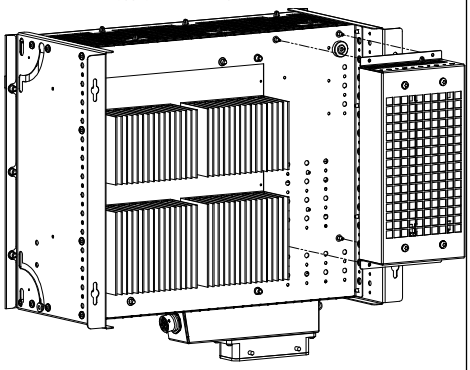
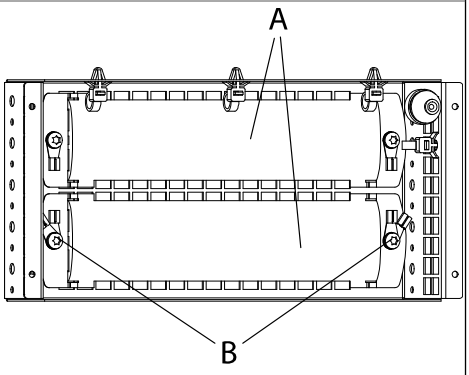
Continues on next page

	Action	Note/illustration
2	Remove the attachment screws and pull the front (axis computer/drive system power supply unit) in the arrow direction.	 xx0600003242 • A: attachment screws
3	Disconnect all the cables from the drive module.	NOTE! Make a note of any connections.
4	Remove the drive module.	
5	Remove the Contactor interface board.	See *Replacement of Contactor Interface Board on page 212*
6	Disconnect the brake resistor bleeder cables.	 xx0600003291 • A: brake resistor bleeder cable

Continues on next page

4.20 Replacement of brake resistor bleeder for PMC small

Continued

	Action	Note/illustration
7	Remove the attachment screws for the brake resistor bleeder unit and remove the unit.	 xx0600003252 • A: attachment screws  xx0600003329
8	Remove the attachment nuts.	 xx0600003330 • A: bleeder • B: attachment nut (2 pcs)
9	Remove the bleeder.	

Refitting

The following procedure details how to refit the brake resistor bleeder

	Action
1	Refit the bleeder and attachment nuts.
2	Refit the brake resistor bleeder unit to the drive module.
3	Refit the attachment screws (10 pcs)
4	Reconnect the brake resistor bleeder cables.

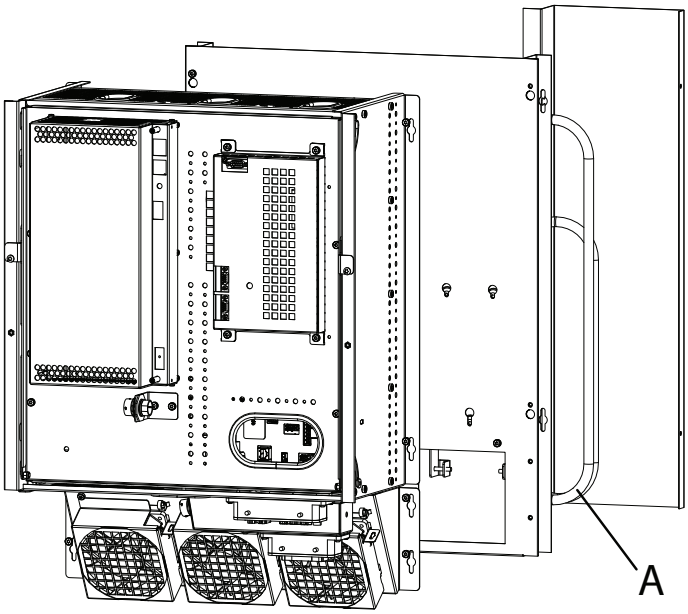
Continues on next page

	Action
5	Refit the Contactor interface board.
6	Refit the drive module.
7	Reconnect all connectors and cables to the drive module.
8	Refit the front (axis computer/drive system power supply).
9	Perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.

4.21 Replacement of brake resistor bleeder for PMC large

Location

The illustration below shows the location of the brake resistor bleeder in the PMC large. The brake resistor bleeder is located in the air channel behind the drive module.



xx1100000523

A	Brake resistor bleeder

Required equipment

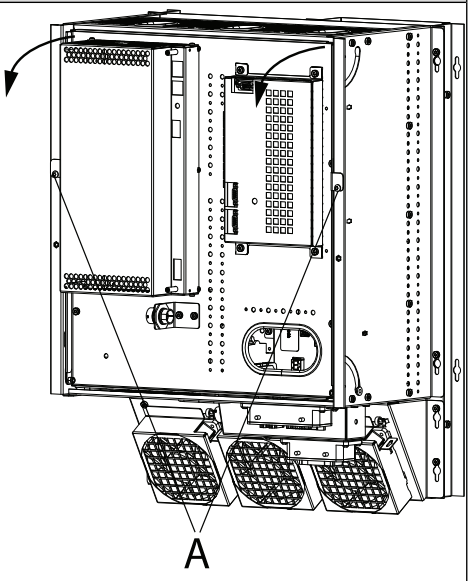
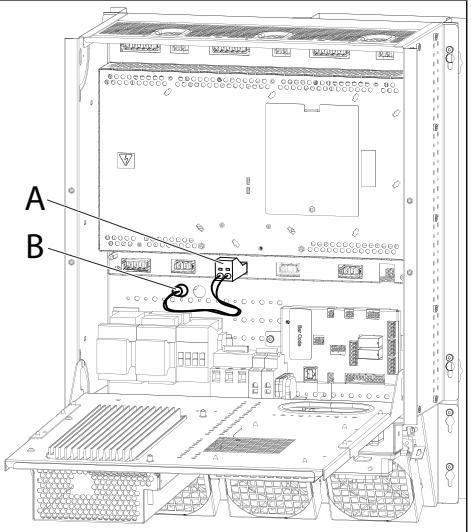
Equipment	Note
Brake resistor bleeder	See *Drive module parts for PMC large on page 255*.
Standard toolkit	The contents are defined in section Standard toolkit
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.
Circuit diagram	See *Circuit diagrams on page 273*.

Removal

The following procedure details how to remove the brake resistor bleeder.

	Action	Note/illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	

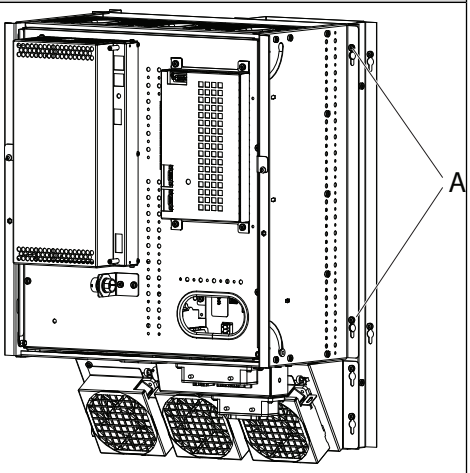
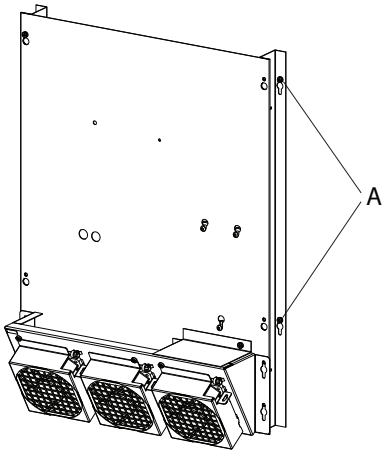
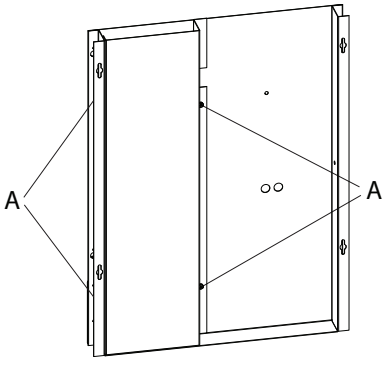
Continues on next page

	Action	Note/illustration
2	Remove the attachment screws and pull the front (axis computer/drive system power supply unit) in the arrow direction.	 xx1100000488 • A: attachment screws
3	Disconnect all the cables from the drive module.	**Note** Make a note of any connections.
4	Disconnect the brake resistor bleeder cables from the connector to let the cables though the cable gland.	 xx1100000524 • A: brake resistor bleeder cable connector • B: cable gland

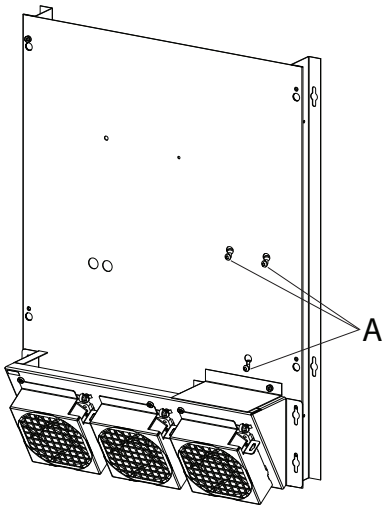
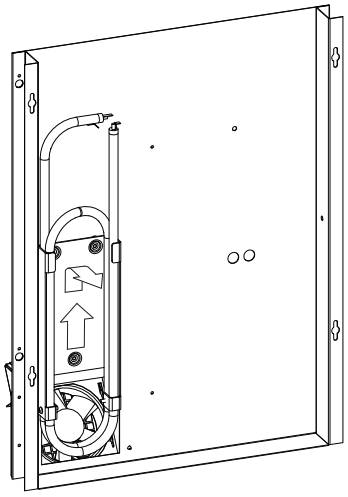
Continues on next page

4.21 Replacement of brake resistor bleeder for PMC large

Continued

	Action	Note/illustration
5	Remove the drive module from the air channel.	 xx1100000525 • A: attachment screws (4 pcs)
6	Remove the air channel.	 xx1100000526 • A: attachment screws (4 pcs)
7	Remove the plate on the back of the air channel.	 xx1100000527 • A: attachment screws

Continues on next page

	Action	Note/illustration
8	Loosen the attachment screws for the brake resistor bleeder.	 xx1100000529 • A: attachment screws
9	Lift and remove the brake resistor bleeder.	 xx1100000530

Refitting

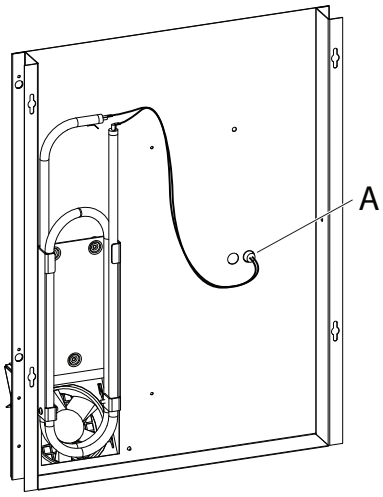
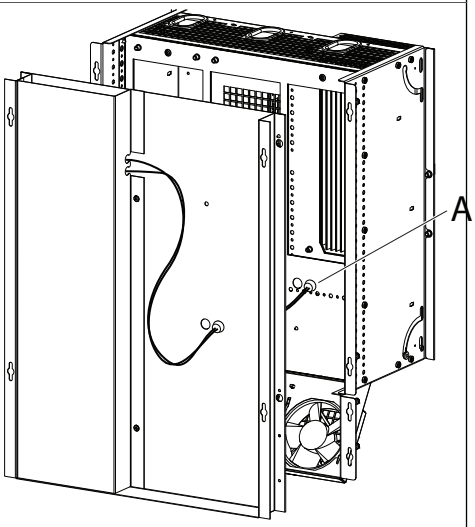
The following procedure details how to refit the brake resistor bleeder

	Action	Note/illustration
1	Refit the bleeder to the air channel plate.	
2	Tighten the attachment screws for the brake resistor bleeder.	

Continues on next page

4.21 Replacement of brake resistor bleeder for PMC large

Continued

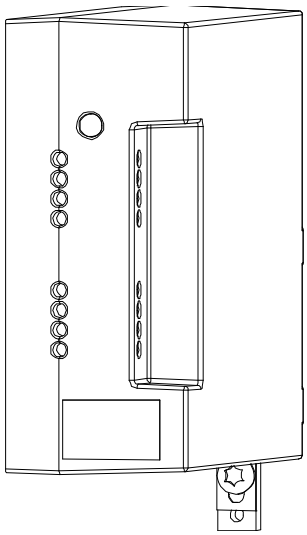
	Action	Note/illustration
3	Guide the brake resistor cables though the cable gland of the air channel.	 xx1100000531 Cable gland
4	Refit the plate on the back of the air channel.	
5	Refit the air channel.	
6	Guide the brake resistor bleeder cable through the cable gland into the drive module.	 xx1100000532 Cable gland into drive module
7	Refit the drive module on the air channel.	
8	Reconnect all connectors and cables to the drive module.	
9	Perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.	

4.22 Replacement of power supply

4.22.1 Replacement of customer I/O power supply

Location

The customer I/O power supply is shown in the following illustration.



xx0600003258

Required equipment

Equipment	Article number	Note
Customer I/O power supply	3HAC14178-1	DSQC 609
Standard toolkit		The contents are defined in section Standard toolkit.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.
Circuit diagram	See *Circuit diagrams on page 273*.	

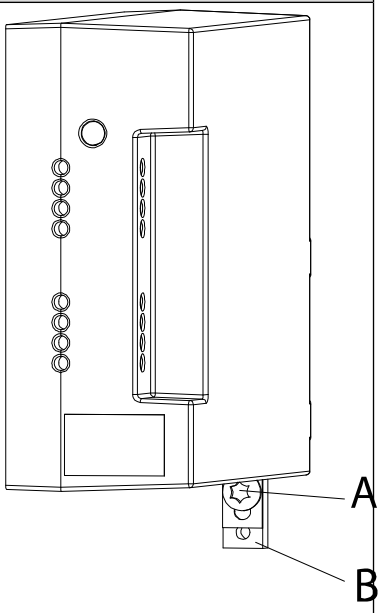
Removal

The procedure below details how to remove the customer I/O power supply.

	Action	Note/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	Loosen the terminal screws for each connected wire. Remove wires from the terminals.	

Continues on next page

4.22.1 Replacement of customer I/O power supply
Continued

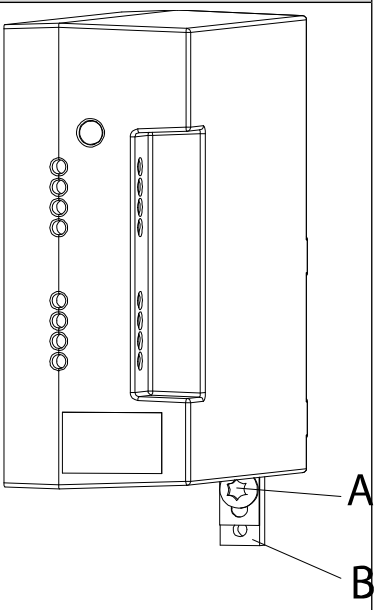
	Action	Note/Illustration
3	Loosen the DIN-lock fixing screw.	 xx0700000124 • A: DIN-lock fixing screw • B: DIN-lock lever
4	Pull the DIN-lock lever downwards to release the power supply unit.	
5	Remove the power supply unit.	

Refitting

The procedure below details how to refit the customer I/O power supply.

	Action	Note/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	Refit the new power supply unit on the DIN-rail.	

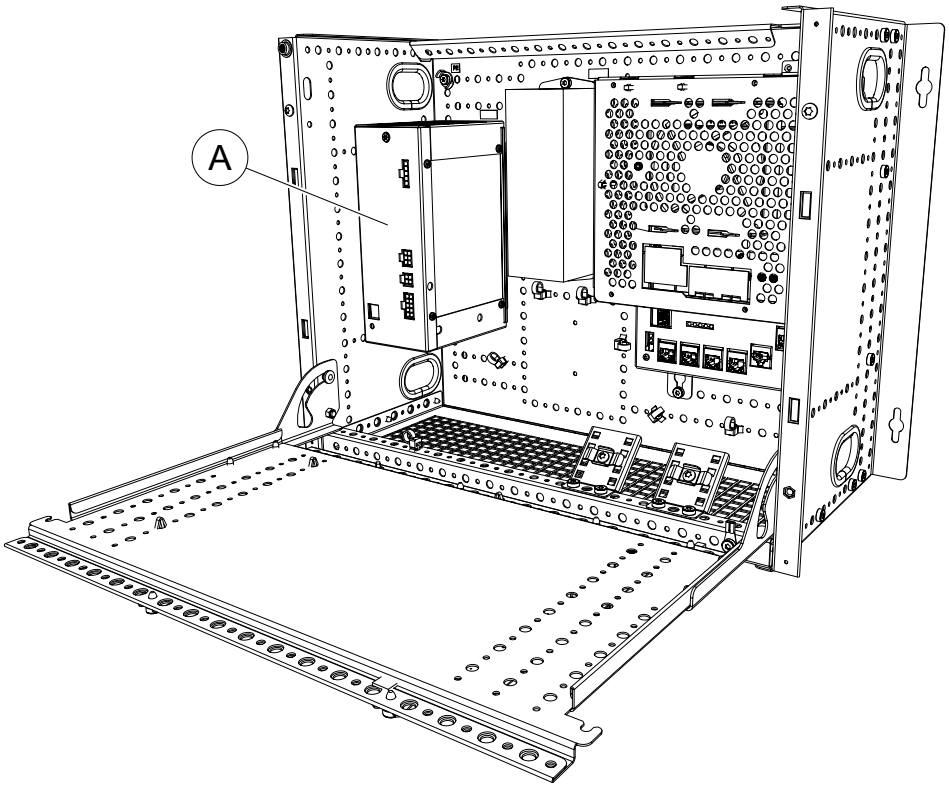
Continues on next page

	Action	Note/Illustration
3	Fasten the DIN-lock fixing screw.	 xx0700000124 • A: DIN-lock fixing screw • B: DIN-lock lever
4	Refit all wires in the screw terminals.	
5	Fasten the screw terminal screws with correct torque.	
6	Perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.	

4.22.2 Replacement of control power supply

Location

The control power supply is located as shown the illustration below.



xx1300001958

A	Control power supply

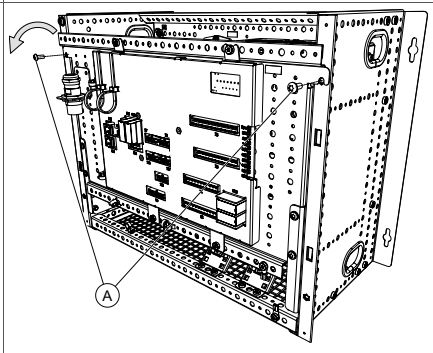
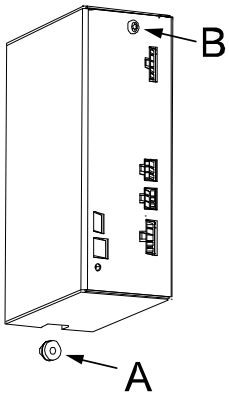
Required equipment

Equipment	Spare part no.	Note
Control Power Supply	3HAC12928-1	DSQC 604
Standard toolkit		The contents are defined in section Standard toolkit!
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.
Circuit diagram		See *Circuit diagrams on page 273*.

Continues on next page

Removal

The procedures below details how to remove the control power supply.

	Action	Note/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	Remove the attachment screws and pull the front with the Panel Board Unit in the arrow direction.	 xx1300001950 A attachment screws
3	Disconnect the connectors X1 - X4 on the control power supply.	
4	Loosen the attachment screw and push the power supply up to release it from the cap nut.	 xx0600003229 A cap nut B attachment screw
5	Remove the power supply unit.	

Refitting

The procedures below details how to refit the control power supply.

	Action
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.

Continues on next page

4.22.2 Replacement of control power supply

Continued

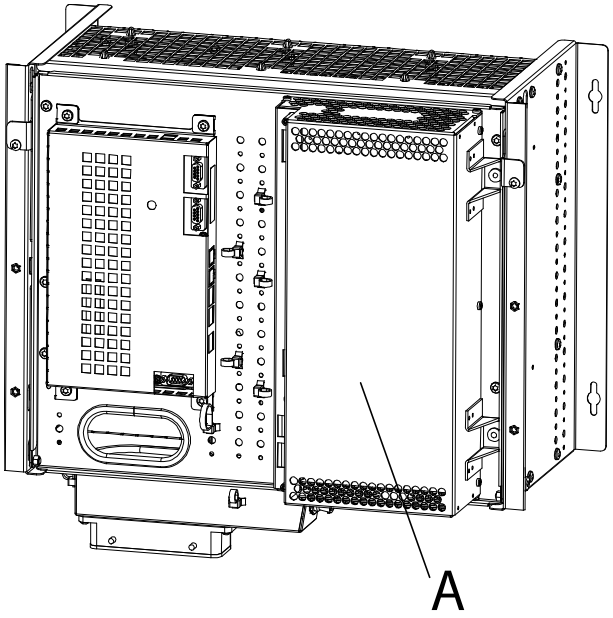
	Action
2	Refit the control power supply.
3	Lock the unit in place by tighten the attachment screw.
4	Reconnect the connectors X1 - X4.
5	Refit the front with the Panel Board Unit.
6	Perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.

4.22.3 Replacement of drive system power supply

Location

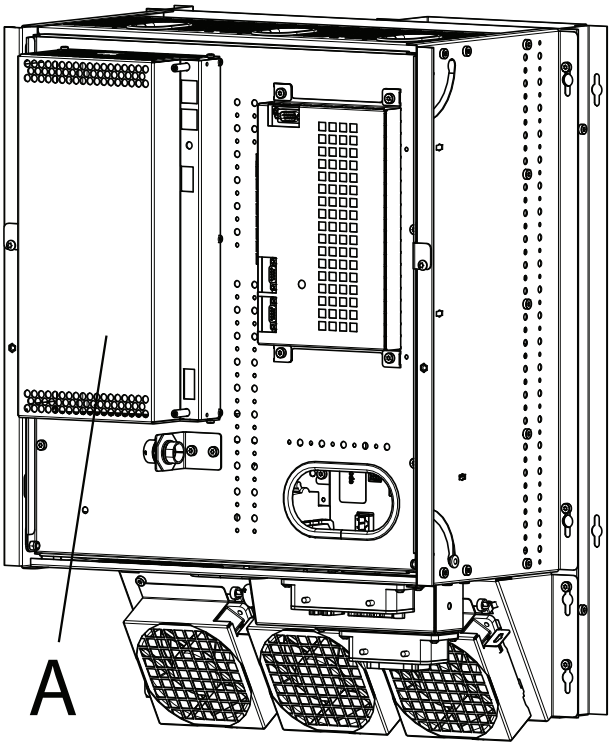
The illustration below shows the location of the drive system power supply in the IRC5 controller.

PMC small:



xx0600003239

PMC large:



xx1100000496

Continues on next page

4.22.3 Replacement of drive system power supply

Continued

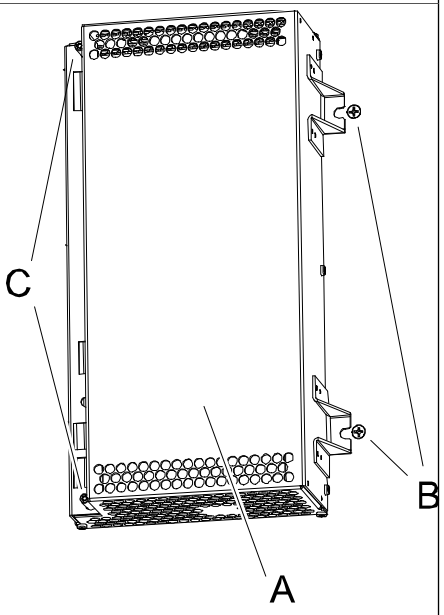
A	Drive system power supply

Required equipment

Equipment	Spare part no.	Note
Drive system power supply	3HAC026289-001	DSQC 626A Only for PMC small.
Drive system power supply	3HAC020466-001	DSQC 627
Standard toolkit		The contents are defined in section Standard toolkit!
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.
Circuit diagram		See *Circuit diagrams on page 273*.

Removal

The procedure below describes how to remove the drive system power supply.

	Action	Note/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.	
2	Disconnect all connectors from the unit.	 xx1000000960 A drive system power supply B cup nut (2 pcs) C attachment screw (2 pcs)
3	Loosen the attachment screws.	

Continues on next page

	Action	Note/Illustration
4	Pull the power supply unit to the side to release it from the cap nuts, and remove it.	

Refitting

The procedure below details how to refit the drive system power supply.

	Action
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 35*.
2	Refit the power supply by sliding the recesses in beneath the cap nuts.
3	Tighten the attachment screws.
4	Reconnect all connectors to the unit.
5	Perform the function tests in section *Function tests on page 148* to verify that the safety features work properly.

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5 Decommissioning

5.1 Introduction to decommissioning

Introduction

This section contains information to consider when taking a product, robot or controller, out of operation.

It deals with how to handle potentially dangerous components and potentially hazardous materials.

> **Note**
>
> The decommissioning process shall be preceded by a risk assessment.

Disposal of materials used in the robot

All used grease/oils and dead batteries **must** be disposed of in accordance with the current legislation of the country in which the robot and the control unit are installed.

If the robot or the control unit is partially or completely disposed of, the various parts **must** be grouped together according to their nature (which is all iron together and all plastic together), and disposed of accordingly. These parts **must** also be disposed of in accordance with the current legislation of the country in which the robot and control unit are installed.

See also *Environmental information on page 240*.

Disposal of storage media

Before disposal of any storage equipment (anything from an SD card to a complete controller), make sure that all sensitive information has been deleted.

> **Tip**
>
> To remove all data from the SD card, use the **Clean Disk** function (part of **Recovery Disk** function) in RobotStudio. See *Operating manual - RobotStudio*.

Transportation

Prepare the robot or parts before transport, this to avoid hazards.

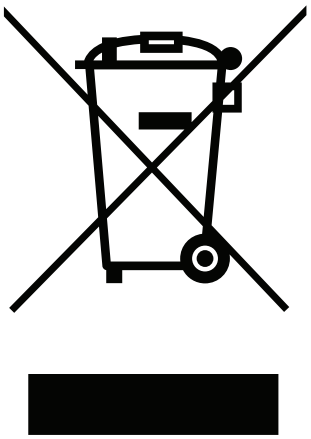
5.2 Environmental information

Introduction

ABB robots contain components in different materials. During decommissioning, all materials should be dismantled, recycled, or reused responsibly, according to the relevant laws and industrial standards. Robots or parts that can be reused or upcycled helps to reduce the usage of natural resources.

Symbol

The following symbol indicates that the product must not be disposed of as common garbage. Handle each product according to local regulations for the respective content (see table below).



xx1800000058

Materials used in the product

The table specifies some of the materials in the product and their respective use throughout the product.

Dispose components properly according to local regulations to prevent health or environmental hazards.

Material	Example application
Aluminium	Heat sinks on power supplies and drive units
Batteries, Lithium	Main computer
Brominated flame retardants	Electronics
Copper	Cables
Lead	Electronics
Plastic/rubber	Cables, connectors, etc.
Steel	Cabinet structure, plates, screws, etc.

Continues on next page

China RoHS symbol

The following symbol shows the information to hazardous substances and the environmental protection use period of IRC5 Panel Mounted Controller according to "Management Methods for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products (SJ/T 11364-2014) ".

xx1900000803

Green symbol with "e" in it: The product does not contain any hazardous substances exceeding concentration limits and is a green environmentally friendly product which can be recycled.

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6 Reference information

6.1 Introduction

General

This chapter includes general information, complementing the more specific information in the different procedures in the manual.

6.2 Applicable standards

Note

The listed standards are valid at the time of the release of this document. Phased out or replaced standards are removed from the list when needed.

General

The product is designed in accordance with ISO 10218-1:2011, Robots for industrial environments - Safety requirements -Part 1 Robots, and applicable parts in the normative references, as referred to from ISO 10218-1:2011. In case of deviations from ISO 10218-1:2011, these are listed in the declaration of incorporation which is part of the product delivery.

Normative standards as referred to from ISO 10218-1

Standard	Description
ISO 9283:1998	Manipulating industrial robots - Performance criteria and related test methods
ISO 10218-2	Robots and robotic devices - Safety requirements for industrial robots - Part 2: Robot systems and integration
ISO 12100	Safety of machinery - General principles for design - Risk assessment and risk reduction
ISO 13849-1:2006	Safety of machinery - Safety related parts of control systems - Part 1: General principles for design
ISO 13850	Safety of machinery - Emergency stop - Principles for design
IEC 60204-1	Safety of machinery - Electrical equipment of machines - Part 1: General requirements

Deviations from ISO 10218-1:2011 for IRC5 with MultiMove

A deviation exists towards ISO 10218-1:2011, paragraph *5.9 Control of simultaneous motion*, for the option MultiMove. See the application manual for MultiMove.

Region specific standards and regulations

Standard	Description
ANSI/RIA R15.06	Safety requirements for industrial robots and robot systems
ANSI/UL 1740	Safety standard for robots and robotic equipment
CAN/CSA Z 434-03	Industrial robots and robot Systems - General safety requirements

Other standards used in design

Standard	Description
ISO 9787:2013	Robots and robotic devices -- Coordinate systems and motion nomenclatures
IEC 61000-6-2	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments

Continues on next page

Standard	Description
IEC 61000-6-4	Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments
ISO 13732-1:2006	Ergonomics of the thermal environment - Part 1
IEC 60974-1:2012[i]	Arc welding equipment - Part 1: Welding power sources
IEC 60974-10:2014[i]	Arc welding equipment - Part 10: EMC requirements
ISO 14644-1:2015[ii]	Classification of air cleanliness
IEC 60529:1989 + A2:2013	Degrees of protection provided by enclosures (IP code)

i Only valid for arc welding robots. Replaces IEC 61000-6-4 for arc welding robots.
ii Only robots with protection Clean Room.

6.3 Unit conversion

Converter table

Use the following table to convert units used in this manual.

Quantity	Units		
Length	1 m	3.28 ft.	39.37 in
Weight	1 kg	2.21 lb.	
Weight	1 g	0.035 ounces	
Pressure	1 bar	100 kPa	14.5 psi
Force	1 N	0.225 lbf	
Moment	1 Nm	0.738 lbf-ft	
Volume	1 L	0.264 US gal	

6.4 Screw joints

General

This section details how to tighten the various types of screw joints on the controller.

The instructions and torque values are valid for screw joints comprised of metallic materials and do *not* apply to soft or brittle materials.

Tightening torque

Before tightening any screw, note the following:

- Determine whether a standard tightening torque or special torque is to be applied. The standard torques are specified in the tables below. Any special torques are specified in the Repair, Maintenance or Installation procedure description. Any special torque specified overrides the standard value.
- Use the *correct tightening torque* for each type of screw joint.
- Only use *correctly calibrated* torque keys.
- Always *tighten the joint by hand,* and never use pneumatical tools.
- Use the *correct tightening technique*, i.e. *do not* jerk. Tighten the screw in a slow, flowing motion.
- Maximum allowed total deviation from the specified value is **10%!**

The table below specifies the recommended standard tightening torque for *oil-lubricated screws* with *slotted or cross-recess heads.*

Dimension	Tightening torque (Nm) Class 4.8, oil-lubricated
M2.5	0.25
M3	0.5
M4	1.2
M5	2.5
M6	5.0

6.5 Weight specifications

Definition

In all repair and maintenance instructions, weights of the components handled are sometimes specified. All components exceeding 22 kg (50 lbs) are high-lighted in this way.

To avoid injury, ABB recommends the use of lifting equipment when handling components with a weight exceeding 22 kg.

Example

Below is an example of how a weight specification is presented:

> **CAUTION**
>
> The transformer weighs 55 kg! All lifting equipment used must be sized accordingly!

6.6 Standard toolkit, IRC5

General

All service (repair, maintenance and installation) instructions contain lists of tools required to perform the specified activity. All special tools, that is, all tools that are not considered as standard tools as defined below, are listed in their instructions respectively.

This way, the tools required are the sum of the Standard Toolkit and any tools listed in the instructions.

Contents, standard toolkit, IRC5

Tool	Remark
Screw driver, Torx	Tx10
Screw driver, Torx	Tx20
Screw driver, Torx	Tx25
Ball tipped screw driver, Torx	Tx25
Screw driver, flat blade	4 mm
Screw driver, flat blade	8 mm
Screw driver, flat blade	12 mm
Screw driver	Phillips-1
Box spanner	8 mm

6.7 Lifting accessories and lifting instructions

General

Many repair and maintenance activities require different pieces of lifting accessories, which are specified in each procedure.

The use of each piece of lifting accessories is *not* detailed in the activity procedure, but in the instruction delivered with each piece of lifting accessories.

The instructions delivered with the lifting accessories should be stored for later reference.

6.8 Open source and 3rd party components

Open source and 3rd party components

ABB products use software provided by third parties, including open source software. The following copyright statements and licenses apply to various components that are distributed inside the ABB software. Each ABB product does not necessarily use all of the listed third party software components. Licensee must fully agree and comply with these license terms or the user is not entitled to use the product. Start using the ABB software means accepting also referred license terms. The third party license terms apply only to the respective software to which the license pertains, and the third party license terms do not apply to ABB products. With regard to programs provided under the GNU general public license and the GNU lesser general public license licensor will provide licensee on demand, a machine-readable copy of the corresponding source code. This offer is valid for a period of three years after delivery of the product.

ABB software is licensed under the ABB end user license agreement, which is provided separately.

RobotWare

For RobotWare, there is license information in the folder **licenses** in the RobotWare distribution package.

OpenSSL

This product includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit. (http://www.openssl.org/)

This product includes cryptographic software written by Eric Young (eay@cryptsoft.com).

This product includes software written by Tim Hudson (tjh@cryptsoft.com).

CTM

For OIeOS, the Linux based operating system used on the conveyor tracking module (CTM), a list of copyright statements and licenses is available in the file /**etc**/**licenses.txt** located on the CTM board and accessible via the console port or by downloading the file over SFTP.

For the CTM application, a list of copyright statements and licenses is available in the file /**opt**/**ABB.com**/**ctm**/**licenses.txt** located on the CTM board and accessible via the console port or by downloading the file over SFTP.

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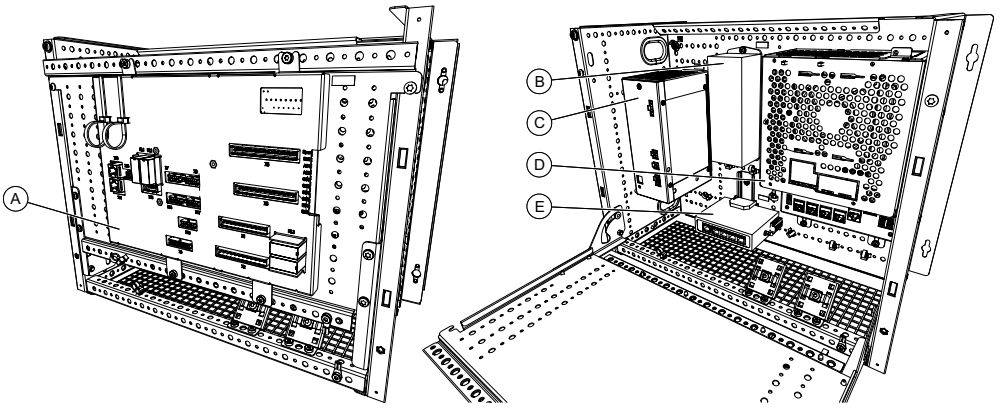
7 Spare parts

7.1 Controller parts

Control module parts

The illustration below shows the placement of the control module parts in the recommended spare part list.



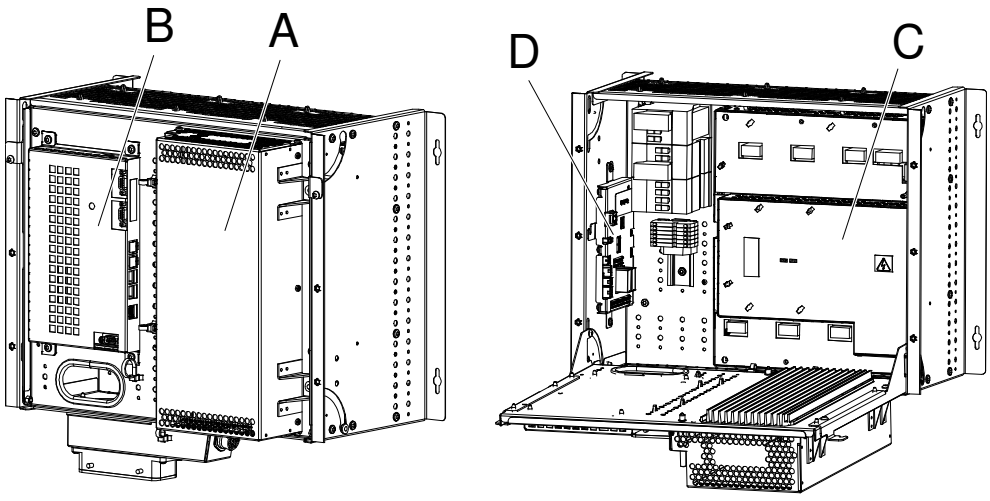
xx1300001959

	Spare part no.	Description	Note
A	3HAC024488-001	Panel board unit	DSQC 643
B	3HAC025562-001	Backup energy bank	DSQC 655
C	3HAC12928-1	Control power supply	DSQC 604
D	See *Computer unit parts on page 257*.		
E	3HAC045976-001	DSQC1007 Eth. switch (MultiMove)	DSQC1007
	3HAC024244-001	Ethernet cable cross conn	
	3HAC021377-001	Bridge connector for panel board	
	3HAC024000-001	Bridge connector for panel board X1	
	3HAC024000-002	Bridge connector for panel board X2	
	3HAC024000-003	Bridge connector for panel board X6	
	3HAC024000-004	Bridge connector for panel board X5	
	3HAC082466-001	Ethernet switch (for IRC5 and PMC)	

Continues on next page

Drive module parts for PMC small

The illustration below shows the placement of the drive module parts in the recommended spare part list.



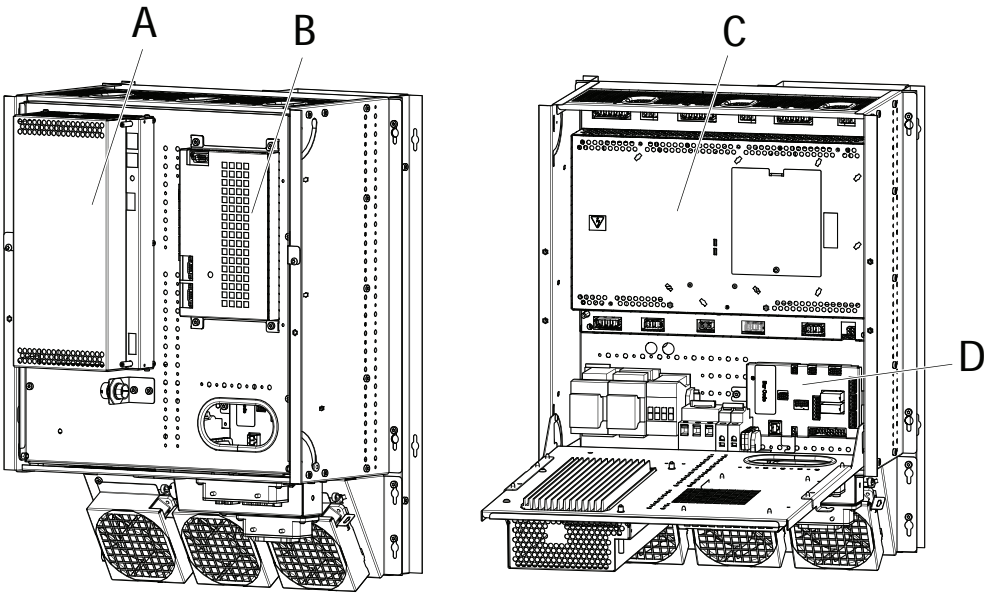
xx0600003334

	Spare part no.	Description	Note
A	3HAC026289-001	Drive system power supply	DSQC 626A
	3HAC020466-001	Drive system power supply ext.	DSQC 627
B	3HAC029157-001	Axis computer unit	DSQC 668
C	3HAC035301-001	Main Drive Unit	DSQC 618
D	3HAC13389-2	Contactor interface board	DSQC 611
	3HAC038808-001	Brake resistor bleeder	IRB 140, 340, 360
	3HAC037753-001	Brake resistor bleeder	IRB 260
	3HAC038440-001	Harness-Power supply/Drive	
	3HAC024254-005	Ethernet cable strait con	

Continues on next page

Drive module parts for PMC large

The illustration below shows the placement of the drive module parts in the recommended spare part list.



xx1100000500

	Spare part no.	Description	Note
A	3HAC020466-001	Drive system power supply ext.	DSQC 627
B	3HAC029157-001	Axis computer unit	DSQC 668
C	3HAC029818-001	Main Drive Unit	DSQC 663
D	3HAC13389-2	Contactor interface board	DSQC 611
	3HAC032586-001	Brake resistor bleeder	
	3HAC038440-001	Harness-Power supply/Drive	
	3HAC024254-007	Ethernet cable strait con	

DeviceNet I/O System parts

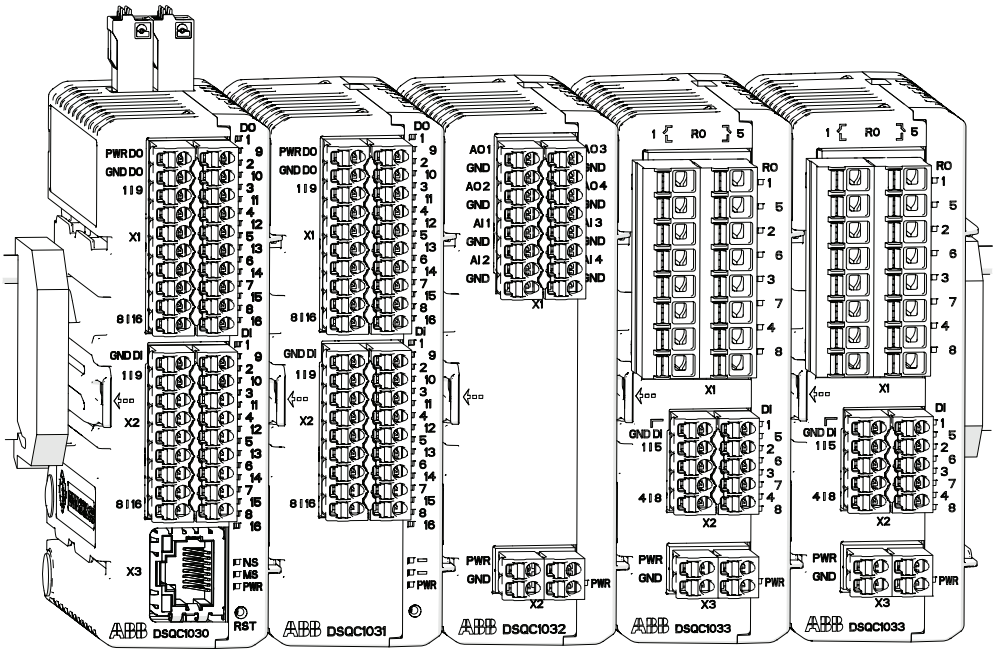
The table below details parts in the recommended spare part list.

	Spare part no.	Description	Type
A	3HAC025784-001	ADCombi I/O unit	DSQC 651
A	3HAC025917-001	Digital I/O unit	DSQC 652

Continues on next page

Scalable I/O devices

The illustration below shows the base device and connected add-on devices.



xx1600002032

Spare part no.	Description	Type
3HAC058663-001	Digital base, 16 digital inputs, 16 digital outputs	DSQC1030
3HAC058664-001	Digital add-on, 16 digital inputs, 16 digital outputs	DSQC1031
3HAC058665-001	Analog add-on, 4 analog inputs, 4 analog outputs	DSQC1032
3HAC058666-001	Relay add-on, 8 digital inputs, 8 relay outputs	DSQC1033

The main dimensions for the I/O devices are 75x36x101 (Length x Width x Height).

Additional parts

Spare part no.	Description
3HAC060919-001	Connectors digital base/add-on
3HAC060925-001	Connectors analog add-on
3HAC060926-001	Connectors relay add-on
3HAC062073-001	DIN bracket

Ext I/O parts

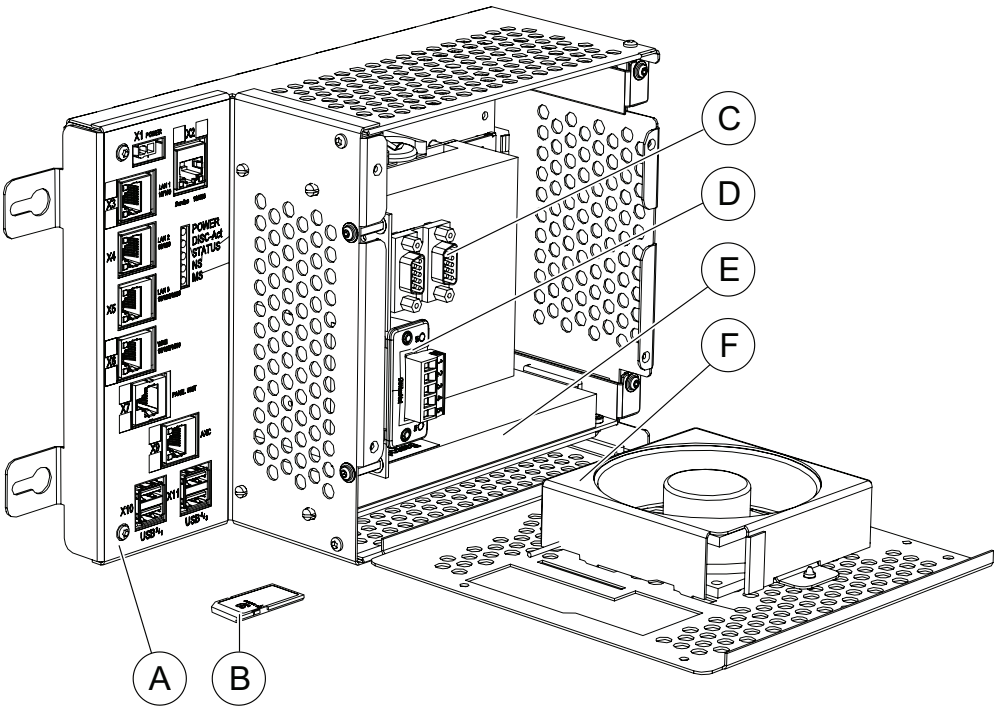
The table below details parts in the recommended spare part list.

	Spare part no.	Description	Note
	3HAC026486-001	Additional Module Dig 24V	
	3HAC026486-002	Additional Module AD Combi	

Continues on next page

Computer unit parts

The illustration below shows the placement of the computer unit parts in the recommended spare part list.



xx1300000851

	Spare part no.	Description	Type
A	3HAC042766-001	Computer unit (1 PCI slot)	DSQC1000
A	3HAC050363-001	Computer unit (2 PCI slots)	DSQC1018
A	3HAC058366-001	Computer unit (2 PCI slots) Recommended for RobotWare 6.08 and later versions.	DSQC1024
A	3HAC087348-001	Computer unit (2 PCI slots) Recommended for RobotWare 6.15 and later versions. **Note** Previous revisions might be supported. Contact you local ABB office for information.	DSQC1094
B	3HAC061416-003	SD card	Used with computer DSQC1000, DSQC1018, DSQC1024, DSQC1094
C	3HAC046408-001	Expansion Board complete	DSQC1003
D	3HAC031670-001	PROFINET Slave Fieldbus Adapter	DSQC 688
D	3HAC026840-001	PROFIBUS Slave Fieldbus Adapter	DSQC 667
D	3HAC027652-001	Ethernet/IP Slave Fieldbus Adapter	DSQC 669

Continues on next page

	Spare part no.	Description	Type
D	3HAC045973-001	DeviceNet Slave Fieldbus Adapter	DSQC1004
E	3HAC043383-001	DeviceNet Master/Slave PCIexpress	DSQC1006
E	3HAC044872-001	PROFIBUS-DP Master PCIexpress	DSQC1005
F	3HAC026525-001	Fan	-
-	3HAC14944-1	RS-232/422 Converter	DSQC 615

Miscellaneous parts

The table below shows parts in the recommended spare part list.

	Spare part no.	Description	Note
	3HAC029105-001	Fan	
	3HAC037824-001	Line filter for PMC small	
	3HAC024322-001	Line filter for PMC large	
	3HAC037015-001	Transformer unit 400-480V	1.2 kVA
	3HAC037016-001	Transformer unit 200-220V	4.2 kVA
	3HAC037017-001	Transformer unit 400V	4.2 kVA
	3HAC037018-001	Transformer unit 440-600V	4.2 kVA
	3HAC024180-001	Transformer unit 200-600V	6 kVA
	3HAC024138-001	Transformer unit 200-600V	13 kVA
	3HAC024144-001	Inductor (Reactor unit)	
	3HAC024125-001	Harness-XP10/T1	
	2CDS253001R0104	3-pol automatic fuse	
	1SCA02235R6610	Switch	
	3HAC026222-003	Main switch	
	3HAC026222-003	Handle for 6 mm switch	
	3HAC021914-001	Harness-TPU Jumper plug	
	3HAC14178-1	Customer I/O Power supply	DSQC 609
	3HNE 01586-1	Conveyor Tracking Unit	DSQC 377B
	3HNA027579-001	CTM-01 Conveyor Tracking Module	DSQC2000

7.2 FlexPendant parts

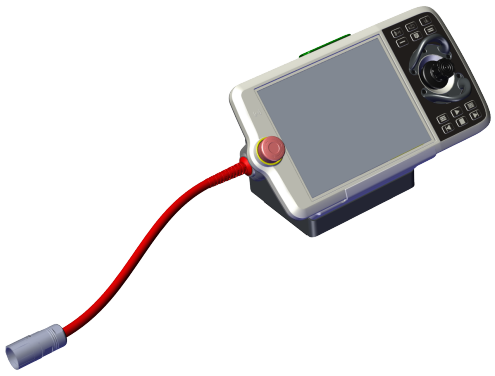
FlexPendant versions

The FlexPendant is available in different versions, as the hardware has been updated over the years. The exact appearance on the graphics might therefore differ slightly from reality.

> **Note**
>
> The different versions support many, but not all, versions of the IRC5 controllers/RobotWare versions. Contact your local ABB office for more information about compatibility.

The FlexPendant holder is available in different versions, that fit different FlexPendant versions. The holder is compatible with the FlexPendant that it is delivered with.

FlexPendant with emergency stop at the connector



xx2100001802

Article number	Description
3HAC085598-001	FlexPendant 10 m
3HAC085598-002	FlexPendant 30 m
3HAC084673-001	10 m cable for FlexPendant
3HAC084673-002	30 m cable for FlexPendant
3HAC055665-002	FlexPendant extension cable 15 m
3HAC055665-003	FlexPendant extension cable 22 m
3HAC055665-004	FlexPendant extension cable 30 m
3HAC079391-001	TPU Holder asm (assembly)

The extension cables cannot be used together with an external operator panel (option 733-3 or 733-4).

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FlexPendant with emergency stop at the outer edge

xx0300000449

Article number	Description
3HAC028357-001	FlexPendant with cable 10 m
3HAC031683-001	Cable 10 m for FlexPendant
3HAC031683-004	Cable 30 m for FlexPendant
3HAC055665-002	FlexPendant extension cable 15 m
3HAC055665-003	FlexPendant extension cable 22 m
3HAC055665-004	FlexPendant extension cable 30 m
3HAC033498-001	FlexPendant holder
3HAC033596-002	FlexPendant holder upper part
3HAC025042-001	Cable holder bracket
3HAC026357-001	Cable bracket
3HAC035075-001	Set of stylus
3HAC028357-050	TPU hand strap

The extension cables cannot be used together with an external operator panel (option 733-3 or 733-4).

7.3 Manipulator cables

7.3.1 Manipulator cables

Signal cables, IRB 120

Art. no.	Description	Option no.
3HAC035320-001	Robot cable, signal 3 m	210-1
3HAC2493-1	Robot cable, signal 7 m	210-2
3HAC2530-1	Robot cable, signal 15 m	210-3

Signal cables, IRB 1510

Art. no.	Description	Option no.
3HAC068917-001	Robot cable, signal 7 m	210-2
3HAC068918-001	Robot cable, signal 15 m	210-3

Signal cables, IRB 1200, 1410, 1520, 1600, 2600, 460, 4600, 6700, 6790, 8700

Art. no.	Description	Option no.
3HAC2493-1	Control cable signal 7 m	210-2
3HAC2530-1	Control cable signal 15 m	210-3
3HAC2540-1	Control cable signal 22 m	210-4
3HAC2566-1	Control cable signal 30 m	210-5

Signal cables, IRB 260, 660, 760, 2400, 4400, 6620, 6640, 6650S, 6660, 6650S, 7600

Art. no.	Description	Option no.
3HAC7998-1	Control cable signal 7 m	210-2
3HAC7998-2	Control cable signal 15 m	210-3
3HAC7998-3	Control cable signal 22 m	210-4
3HAC7998-4	Control cable signal 30 m	210-5

Cable packages for IRB 140 (including signal, power and customer cables)

Art. no.	Description	Option no.
3HAC7996-1	Control cable power 3 m	210-1
3HAC7996-5	Control cable power 7 m	210-2
3HAC7996-6	Control cable power 15 m	210-3
3HAC7996-7	Control cable power 22 m	210-4
3HAC7996-8	Control cable power 30 m	210-5

Continues on next page

7.3.1 Manipulator cables
Continued

Power cables, IRB 1410, 1600 (type A)[1]

Art. no.	Description	Option no.[i]
3HAC2492-1	Control cable power 7 m	Standard: 210-2 and 287-4
3HAC2529-1	Control cable power 15 m	Standard: 210-3 and 287-4
3HAC2539-1	Control cable power 22 m	Standard: 210-4 and 287-4
3HAC2564-1	Control cable power 30 m	Standard: 210-5 and 287-4
3HAC9038-1	Control cable power 7 m	Foundry: 210-2 and 287-3 Wash: 210-2 and 287-5
3HAC9038-2	Control cable power 15 m	Foundry: 210-3 and 287-3 Wash: 210-3 and 287-5
3HAC9038-3	Control cable power 22 m	Foundry: 210-4 and 287-3 Wash: 210-4 and 287-5
3HAC9038-4	Control cable power 30 m	Foundry: 210-5 and 287-3 Wash: 210-5 and 287-5

i The option number depends on the protection type of the manipulator.

Power cables, IRB 1200, 1510, 1520

Art. no.	Description	Option no.
3HAC040503-007	Control cable power 3 m	210-1 (only for IRB 1200)
3HAC040503-001	Control cable power 7 m	210-2
3HAC040503-002	Control cable power 15 m	210-3
3HAC040503-003	Control cable power 22 m	210-4 (only for IRB 1200)
3HAC040503-004	Control cable power 30 m	210-5 (only for IRB 1200)

Power cables, IRB 120

Cable	Art. no.	Option no.
3HAC032694-001	Robot cable power 3 m	210-1
3HAC032695-001	Robot cable power 7 m	210-2
3HAC032696-001	Robot cable power 15 m	210-3

Power cables, IRB 260, 1600 (type B)[2]

Art. no.	Description	Option no.[i]
3HAC9038-1	Control cable power 7 m	Foundry: 210-2 and 287-3 Wash: 210-5 and 287-5
3HAC9038-2	Control cable power 15 m	Foundry: 210-3 and 287-3 Wash: 210-5 and 287-5
3HAC9038-3	Control cable power 22 m	Foundry: 210-4 and 287-3 Wash: 210-5 and 287-5

1 **IRB 1600/1660ID in standard protection, is available in type A and type B. For details about the robot types, see product manual for the robot.**

2 **IRB 1600/1660ID in standard protection, is available in type A and type B. For details about the robot types, see product manual for the robot.**

Continues on next page

Art. no.	Description	Option no. [i]
3HAC9038-4	Control cable power 30 m	Foundry: 210-5 and 287-3 Wash: 210-5 and 287-5

[i] The option number depends on the protection type of the manipulator.

Power cables, IRB 360, 390

Art. no.	Description	Option no.
3HAC029903-001	Control cable, power and signal 3 m	(435-80 or 435-81 or 435-82)
3HAC029903-002	Control cable, power and signal 7 m	(435-80 or 435-81 or 435-82)
3HAC029903-003	Control cable, power and signal 15 m	(435-80 or 435-81 or 435-82)
3HAC029903-004	Control cable, power and signal 22 m	(435-80 or 435-81 or 435-82)
3HAC029903-005	Control cable, power and signal 30 m	(435-80 or 435-81 or 435-82)
3HAC038411-001	Control cable, power and signal, stainless contact screws, 3 m	(435-80 or 435-81 or 435-82)
3HAC038411-002	Control cable, power and signal, stainless contact screws, 7 m	(435-80 or 435-81 or 435-82)
3HAC038411-003	Control cable, power and signal, stainless contact screws, 15 m	(435-80 or 435-81 or 435-82)
3HAC038411-004	Control cable, power and signal, stainless contact screws, 22 m	(435-80 or 435-81 or 435-82)
3HAC038411-005	Control cable, power and signal, stainless contact screws, 30 m	(435-80 or 435-81 or 435-82)

Power cable, IRB 2400

Note

Depending on whether the manipulator is built before or after 2018-05, the connection interface differs and, the choice of manipulator cable must be made accordingly. Check the interface and select cable according to the following tables.

Before May 2018

Art. no.	Description	Option no. [i]
3HAC2492-1	Control cable power 7 m	Standard: 210-2 and 287-4
3HAC2529-1	Control cable power 15 m	Standard: 210-3 and 287-4
3HAC2839-1	Control cable power 22 m	Standard: 210-4 and 287-4
3HAC2564-1	Control cable power 30 m	Standard: 210-5 and 287-4
3HAC9038-1	Control cable power 7 m	Foundry: 210-2 and 287-3 Wash: 210-5 and 287-5
3HAC9038-2	Control cable power 15 m	Foundry: 210-3 and 287-3 Wash: 210-5 and 287-5
3HAC9038-3	Control cable power 22 m	Foundry: 210-4 and 287-3 Wash: 210-5 and 287-5

Continues on next page

7.3.1 Manipulator cables
Continued

Art. no.	Description	Option no.[i]
3HAC9038-4	Control cable power 30 m	Foundry: 210-5 and 287-3 Wash: 210-5 and 287-5

i The option number depends on the protection type of the manipulator.

From May 2018

Art. no.	Description	Option no.[i]
3HAC9038-1	Control cable power 7 m	Standard: 210-2 and 287-4 Foundry: 210-2 and 287-3 Wash: 210-5 and 287-5
3HAC9038-2	Control cable power 15 m	Standard: 210-3 and 287-4 Foundry: 210-3 and 287-3 Wash: 210-5 and 287-5
3HAC9038-3	Control cable power 22 m	Standard: 210-4 and 287-4 Foundry: 210-4 and 287-3 Wash: 210-5 and 287-5
3HAC9038-4	Control cable power 30 m	Standard: 210-5 and 287-4 Foundry: 210-5 and 287-3 Wash: 210-5 and 287-5

i The option number depends on the protection type of the manipulator.

Power cables, IRB 4400

Art. no.	Description	Option no.[i]
3HAC2512-1	Control cable power 7 m	Standard: 210-2 and 287-4 Clean room: 210-2 and 287-1
3HAC2535-1	Control cable power 15 m	Standard: 210-3 and 287-4 Clean room: 210-3 and 287-1
3HAC2560-1	Control cable power 22 m	Standard: 210-4 and 287-4 Clean room: 210-4 and 287-1
3HAC2572-1	Control cable power 30 m	Standard: 210-5 and 287-4 Clean room: 210-5 and 287-1
3HAC8182-1	Control cable power 7 m	Foundry: 210-2 and 287-3 Wash: 210-2 and 287-5
3HAC8182-2	Control cable power 15 m	Foundry: 210-3 and 287-3 Wash: 210-3 and 287-5
3HAC8182-3	Control cable power 22 m	Foundry: 210-4 and 287-3 Wash: 210-4 and 287-5
3HAC8182-4	Control cable power 30 m	Foundry: 210-5 and 287-3 Wash: 210-5 and 287-5

i The option number depends on the protection type of the manipulator.

Power cable, IRB 460, 660, 760, 2600, 4600, 6620, 6640, 6650S, 6660, 6700, 7600, 8700

Art. no.	Description	Option no.
3HAC026787-001	Control cable power 7 m	(435-6 or 435-18 or 435-24 or 435-36) and 210-2

Continues on next page

Art. no.	Description	Option no.
3HAC026787-002	Control cable power 15 m	(435-6 or 435-18 or 435-24 or 435-36) and 210-3
3HAC026787-003	Control cable power 22 m	(435-6 or 435-18 or 435-24 or 435-36) and 210-4
3HAC026787-004	Control cable power 30 m	(435-6 or 435-18 or 435-24 or 435-36) and 210-5

Note

IRB 8700 requires two power cables.

Power cables, IRB 6790

Cable	Art. no.	Option no.
3HAC063487-001	Robot cable power 7 m	210-2
3HAC063488-001	Robot cable power 15 m	210-3
3HAC063489-001	Robot cable power 22 m	210-4

7.3.2 Fan cables

Large manipulators

Art. no.	Description	Note
3HAC022723-001	Harness - Axis 1&2 cooling	(87-1 or 88-1 or 89-1) and 210-2
3HAC022723-004	Harness - Axis 1&2 cooling	(87-1 or 88-1 or 89-1) and 210-3
3HAC022723-005	Harness - Axis 1&2 cooling	(87-1 or 88-1 or 89-1) and 210-4
3HAC022723-006	Harness - Axis 1&2 cooling	(87-1 or 88-1 or 89-1) and 210-5
3HAC023599-001	Harness - Axis 1 cooling	IRB 6700

7.3.3 CP/CS Harness

CP/CS for IRB 2600, 460, 4600, 660, 6620, 6640, 6650S, 6700, 760, 7600, 8700

Art. no.	Description	Option no.
3HAC022957-001	Harness CP/CS L=7m	94-1
3HAC022957-002	Harness CP/CS L=15m	94-2
3HAC022957-006	Harness CP/CS L=22m	94-3
3HAC022957-003	Harness CP/CS L=30m	94-4

CP/CS/Profibus for IRB 2600, 460, 4600, 660, 6620, 6640, 6650S, 6700, 760, 7600, 8700

Art. no.	Description	Option no.
3HAC022988-001	Harness CP/CS, PROFIB L=7m	92-2
3HAC022988-002	Harness CP/CS, PROFIB L=15m	92-3
3HAC022988-006	Harness CP/CS, PROFIB L=22m	92-4
3HAC022988-003	Harness CP/CS, PROFIB L=30m	92-5

CP/CS DeviceNet for IRB 2600, 460, 4600, 660, 6620, 6640, 6650S, 6700, 760, 7600, 8700

Art. no.	Description	Option no.
3HAC022978-001	Harness CP/CS, DeviceNet L=7m	90-2
3HAC022978-002	Harness CP/CS, DeviceNet L=15m	90-3
3HAC022978-006	Harness CP/CS, DeviceNet L=22m	90-4
3HAC022978-003	Harness CP/CS, DeviceNet L=30m	90-5

Ethernet/PROFINET cable for IRB 2600, 460, 4600, 660, 6620, 6640, 6650S, 6700, 760, 7600, 8700

Art. no.	Description	Option no.
3HAC031924-001	Connection of Ethernet, L=7m	859-1
3HAC031924-002	Connection of Ethernet, L=15m	859-2
3HAC031924-003	Connection of Ethernet, L=22m	859-3
3HAC031924-004	Connection of Ethernet, L=30m	859-4

Ethernet/PROFINET cable for IRB 1200

Art. no.	Description	Option no.
3HAC055518-001	Connection of Ethernet, L=3m	859-9
3HAC055518-002	Connection of Ethernet, L=7m	859-1
3HAC055518-003	Connection of Ethernet, L=15m	859-2
3HAC055518-004	Connection of Ethernet, L=22m	859-3
3HAC055518-005	Connection of Ethernet, L=30m	859-4

7.3.4 Cables customer power/customer signal

IRB 1200

Art. no.	Description	Option no.
3HAC049089-001	Cable CP/CS 3 m	16-1 and 94-6
3HAC049089-004	Cable CP/CS 7 m	16-1 and 94-1
3HAC049089-005	Cable CP/CS 15 m	16-1 and 94-2
3HAC049089-006	Cable CP/CS 22 m	16-1 and 94-3
3HAC049089-007	Cable CP/CS 30 m	16-1 and 94-4

IRB 1400

Art. no.	Description	Option no.
3HAC3346-1	Cable CP/CS 7 m	16-1 and 17-5 and 94-1
3HAC3347-1	Cable CP/CS 15 m	16-1 and 17-5 and 94-2
3HAC3348-1	Cable CP/CS 22 m	16-1 and 17-5 and 94-3
3HAC3349-1	Cable CP/CS 30 m	16-1 and 17-5 and 94-4

IRB 2400

Note

Depending on whether the manipulator is built before or after 2018-05, the connection interface differs and, the choice of manipulator cable must be made accordingly. Check the interface and select cable according to the following tables.

Before May 2018

Art. no.	Description	Option no.[i]
3HAC3353-1	Cable CP/CS 7 m	Standard: 94-1, 16-1 and 287-4
3HAC3354-1	Cable CP/CS 15 m	Standard: 94-2, 16-1 and 287-4
3HAC3355-1	Cable CP/CS 22 m	Standard: 94-3, 16-1 and 287-4
3HAC3356-1	Cable CP/CS 30 m	Standard: 94-1, 16-1 and 287-4
3HAC8183-1	Cable CP/CS 7 m	Foundry: 94-1, 16-1 and 287-3 Wash: 94-1, 16-1 and 287-5
3HAC8183-2	Cable CP/CS 15 m	Foundry: 94-2, 16-1 and 287-3 Wash: 94-2, 16-1 and 287-5
3HAC8183-3	Cable CP/CS 22 m	Foundry: 94-3, 16-1 and 287-3 Wash: 94-3, 16-1 and 287-5
3HAC8183-4	Cable CP/CS 30 m	Foundry: 94-4, 16-1 and 287-3 Wash: 94-4, 16-1 and 287-5

i The option number depends on the protection type of the manipulator.

Continues on next page

From May 2018

Art. no.	Description	Option no.[i]
3HAC8183-1	Cable CP/CS 7 m	Standard: 94-1, 16-1 and 287-4 Foundry: 94-1, 16-1 and 287-3 Wash: 94-1, 16-1 and 287-5
3HAC8183-2	Cable CP/CS 15 m	Standard: 94-2, 16-1 and 287-4 Foundry: 94-2, 16-1 and 287-3 Wash: 94-2, 16-1 and 287-5
3HAC8183-3	Cable CP/CS 22 m	Standard: 94-3, 16-1 and 287-4 Foundry: 94-3, 16-1 and 287-3 Wash: 94-3, 16-1 and 287-5
3HAC8183-4	Cable CP/CS 30 m	Standard: 94-4, 16-1 and 287-4 Foundry: 94-4, 16-1 and 287-3 Wash: 94-4, 16-1 and 287-5

[i] The option number depends on the protection type of the manipulator.

IRB 4400

Art. no.	Description	Option no.[i]
3HAC3353-1	Cable CP/CS 7 m	Standard: 94-1, 16-1 and 287-4 Clean: 94-1, 16-1 and 287-1
3HAC3354-1	Cable CP/CS 15 m	Standard: 94-2, 16-1 and 287-4 Clean: 94-2, 16-1 and 287-1
3HAC3355-1	Cable CP/CS 22 m	Standard: 94-3, 16-1 and 287-4 Clean: 94-3, 16-1 and 287-1
3HAC3356-1	Cable CP/CS 30 m	Standard: 94-4, 16-1 and 287-4 Clean: 94-4, 16-1 and 287-1
3HAC8183-1	Cable CP/CS 7 m	Foundry: 94-1, 16-1 and 287-3 Wash: 94-1, 16-1 and 287-5 Foundry Prime: 94-1, 16-1 and 287-6
3HAC8183-2	Cable CP/CS 15 m	Foundry: 94-2, 16-1 and 287-3 Wash: 94-2, 16-1 and 287-5 Foundry Prime: 94-2, 16-1 and 287-6
3HAC8183-3	Cable CP/CS 22 m	Foundry: 94-3, 16-1 and 287-3 Wash: 94-3, 16-1 and 287-5 Foundry Prime: 94-3, 16-1 and 287-6
3HAC8183-4	Cable CP/CS 30 m	Foundry: 94-4, 16-1 and 287-3 Wash: 94-4, 16-1 and 287-5 Foundry Prime: 94-4, 16-1 and 287-6

[i] The option number depends on the protection type of the manipulator.

IRB 1600

Art. no.	Description	Option no.
3HAC8183-1	Cable CP/CS 7 m	94-1, 16-1 and 17-5
3HAC8183-2	Cable CP/CS 15 m	94-2, 16-1 and 17-5

Continues on next page

7.3.4 Cables customer power/customer signal
Continued

Art. no.	Description	Option no.
3HAC8183-3	Cable CP/CS 22 m	94-3, 16-1 and 17-5
3HAC8183-4	Cable CP/CS 30 m	94-4, 16-1 and 17-5

IRB 260

Art. no.	Description	Option no.
3HAC8183-1	Cable CP/CS 7 m	94-1 and 16-1
3HAC8183-2	Cable CP/CS 15 m	94-2 and 16-1
3HAC8183-3	Cable CP/CS 22 m	94-3 and 16-1
3HAC8183-4	Cable CP/CS 30 m	94-4 and 16-1

IRB 360, 390

Art. no.	Description	Option no.[i]
3HAC14860-1	Cable CP/CS 7 m	218-9 and 94-1
3HAC14860-2	Cable CP/CS 15 m	218-9 and 94-2
3HAC14860-3	Cable CP/CS 22 m	218-9 and 94-3
3HAC14860-4	Cable CP/CS 30 m	218-9 and 94-4

i The option number depends on the protection type of the manipulator.

7.3.5 Other customer cables

IRB 360

Art. no.	Description	Option no.[i]
3HAC030198-001	Internal Customer cable 3 m	218-5 and 94-6
3HAC030198-002	Internal Customer cable 7 m	218-5 and 94-1
3HAC030198-003	Internal Customer cable 15 m	218-5 and 94-2
3HAC030198-004	Internal Customer cable 22 m	218-5 and 94-3
3HAC030198-005	Internal Customer cable 30 m	218-5 and 94-4

[i] The option number depends on the protection type of the manipulator.

7.3.6 Additional cables

Drive module cables

Cable	Art. no.	Option no.
3HAC025600-001	Cable between control module and drive module: L=1.7 m	
3HAC025600-005	Cable between control module and drive module: L=4 m	761-1
3HAC025600-006	Cable between control module and drive module: L=30 m	761-3

8 Circuit diagrams

8.1 Circuit diagrams

Overview

The circuit diagrams are not included in this manual, but are available for registered users on myABB Business Portal, *www.abb.com/myABB*.

See the article numbers in the tables below.

Controllers

Product	Article numbers for circuit diagrams
Circuit diagram - IRC5 Panel Mounted Controller	*3HAC026871-020*

Manipulators

Product	Article numbers for circuit diagrams
Circuit diagram - IRB 120	*3HAC031408-003*
Circuit diagram - IRB 140 type C	*3HAC6816-3*
Circuit diagram - IRB 260	*3HAC025611-001*
Circuit diagram - IRB 360	*3HAC028647-009*
Circuit diagram - IRB 390	*3HAC060545-009*
Circuit diagram - IRB 460	*3HAC036446-005*
Circuit diagram - IRB 660	*3HAC025691-001*
Circuit diagram - IRB 760	*3HAC025691-001*
Circuit diagram - IRB 1200	*3HAC046307-003*
Circuit diagram - IRB 1410	*3HAC2800-3*
Circuit diagram - IRB 1600/1660 (with IRC5)	*3HAC021351-003*
Circuit diagram - IRB 1510	*3HAC087368-003*
Circuit diagram - IRB 1520	*3HAC039498-007*
Circuit diagram - IRB 2400	*3HAC6670-3*
Circuit diagram - IRB 2600	*3HAC029570-007*
Circuit diagram - IRB 4400/4450S	*3HAC9821-1*
Circuit diagram - IRB 4600	*3HAC029038-003*
Circuit diagram - IRB 6620	*3HAC025090-001*
Circuit diagram - IRB 6620 / IRB 6620LX	*3HAC025090-001*
Circuit diagram - IRB 6640	*3HAC025744-001*
Circuit diagram - IRB 6650S	*3HAC13347-1* *3HAC025744-001*
Circuit diagram - IRB 6660	*3HAC025744-001* *3HAC029940-001*

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8.1 Circuit diagrams
Continued

Product	Article numbers for circuit diagrams
Circuit diagram - IRB 6700 / IRB 6790	*3HAC043446-005*
Circuit diagram - IRB 7600	*3HAC13347-1* *3HAC025744-001*
Circuit diagram - IRB 14000	*3HAC050778-003*
Circuit diagram - IRB 910SC	*3HAC056159-002*

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