



Operating manual

General safety information

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Operating manual

General safety information

IRC5

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Original instructions.

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Overview of this manual

About this manual

This manual contains all safety instructions for the manipulators and the controllers. This manual is translated to more languages than the product manuals containing the service instructions.

When handling manipulators, most accidents occur because basic safety rules and precautions are not observed. Through early recognition of potential hazards, accidents can often be avoided. Improper commissioning and operation of the manipulator system is dangerous and can lead to severe injury and even death.

Before working on or with the manipulator system the safety instructions in this manual and the *Operating manual - Emergency safety information* manual should be carefully read and followed. These instructions provide basic rules for safety precautions. The safety labels attached to the manipulator system contain further safety information for the recognition of specific hazards.

Usage

This manual provides important information which is a necessary condition for a safe operation of the manipulator system. Any personnel working with the manipulator system must have easy access to this manual. Therefore, store this manual together with the manipulator system.

For any work in the manipulator system you must use the information in this manual. That is - use this manual when you work with an industrial manipulator and/or the IRC5 manipulator controller from ABB Robotics. Also when you will use the robot applications make sure you have read the safety related information before you start your work.



Note

This manual must always be stored together with the manipulator system to be easy to access!



Note

The manipulator system is built with state of the art components according to recognized safety standards. However, the use can result in serious injury or death to the operator, and cause damage to the manipulator and other property. The manipulator system may only be used for its intended purpose, and only if the manipulator system is in faultless condition, safety precautions are taken into account, and the instructions in the user manuals are followed. Issues that may affect safety must be attended to immediately. The manipulator system may not be used during this time.

Who should read this manual

This manual is intended for:

- Operators

Continues on next page

- Service engineers
- Anyone using or working with the robot system

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.
- read the user documentation before performing any installation or service work on the robot.

References

The documents that are listed below describe the manipulator system in detail, including assembly, service, and safety instructions. All documents are available on the documentation DVD.

Reference	Document ID
<i>Operating manual - Emergency safety information</i>	3HAC027098-001
Product manual for the robot controller	
Product manual for the manipulator	
<i>Operating manual - Getting started, IRC5 and RobotStudio</i>	3HAC027097-001
<i>Operating manual - IRC5 with FlexPendant</i>	3HAC050941-001
<i>Operating manual - Trouble shooting IRC5</i>	3HAC020738-001
Documentation DVD	3HAC032875-001 (DSQC 639 and RobotWare 5.15) 3HAC048193-001 (DSQC1000 and RobotWare 5.61) 3HAC0-001 (DSQC1000 and RobotWare 6.0)



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 revision.
A	Changes/corrections are made in the chapter <i>The IRC5 controller</i> .
B	The following changes and corrections are made: <ul style="list-style-type: none">• List of standards updated, see Applicable standards on page 11.• Updated safety signal graphics for the levels <i>Danger</i> and <i>Warning</i>, see Safety signals in the manual on page 15.• New safety labels on the manipulators, see Safety symbols on product labels on page 17.• Revised terminology: <i>robot</i> replaced with <i>manipulator</i>.• IRC5 Compact Controller added.

Continues on next page

Revision	Description
C	The following changes and corrections are made: <ul style="list-style-type: none"> Clarification for USA and Canada regarding <i>Manual full speed mode (100%)</i>. See Work inside the working range of the robot on page 42, and Safety in manual mode on page 67. Clarification for stops, see Protective stop and emergency stop on page 51. Clarification for Dual Cabinet Controller, see DANGER - Make sure that the main power has been switched off! on page 53.
D	The following changes and corrections are made: <ul style="list-style-type: none"> Added safety label for chain sling with shortener, see Safety symbols on product labels on page 17.
E	The following changes and corrections are made: <ul style="list-style-type: none"> Clarification to verify that the safety functions on the FlexPendant work after a shock, see Handling of FlexPendant on page 65. Minor corrections.
F	Minor corrections.
G	Added WARNING - Safety risks during handling of batteries on page 47 .
H	The manual is updated with the new main computer (DSQC1000), see The IRC5 controllers on page 51 .
J	The following changes and corrections are made: <ul style="list-style-type: none"> Updated descriptions of stops in section Protective stop and emergency stop on page 51. Added information about risks when the robot is installed at a height, see Safety risks during installation and service work on robots on page 33. Added information about operating modes, see About the automatic mode on page 28 and About the manual mode on page 29. Added information about the T10 jogging device. Added information about labels on the controller, see Safety symbols on controller labels on page 23.
K	Added information about collaborative robots.
L	Release 17.1. <ul style="list-style-type: none"> Added section Recover from emergency stops on page 62. Updated descriptions of stops in section Protective stop and emergency stop on page 51.

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1 The manipulator system

1.1 General information

1.1.1 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.

Standards, EN ISO

The product is designed in accordance with the requirements of:

Standard	Description
EN ISO 12100	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN ISO 13849-1	Safety of machinery, safety related parts of control systems - Part 1: General principles for design
EN ISO 13850	Safety of machinery - Emergency stop - Principles for design
EN ISO 10218-1	Robots for industrial environments - Safety requirements -Part 1 Robot
EN ISO 9787	Robots and robotic devices -- Coordinate systems and motion nomenclatures
EN ISO 9283	Manipulating industrial robots, performance criteria, and related test methods
EN ISO 14644-1 ⁱ	Classification of air cleanliness
EN ISO 13732-1	Ergonomics of the thermal environment - Part 1
EN IEC 61000-6-4 (option 129-1)	EMC, Generic emission
EN IEC 61000-6-2	EMC, Generic immunity
EN IEC 60974-1 ⁱⁱ	Arc welding equipment - Part 1: Welding power sources
EN IEC 60974-10 ⁱⁱ	Arc welding equipment - Part 10: EMC requirements
EN IEC 60204-1	Safety of machinery - Electrical equipment of machines - Part 1 General requirements
IEC 60529	Degrees of protection provided by enclosures (IP code)

ⁱ Only robots with protection Clean Room.

ⁱⁱ Only valid for arc welding robots. Replaces EN IEC 61000-6-4 for arc welding robots.

European standards

Standard	Description
EN 614-1	Safety of machinery - Ergonomic design principles - Part 1: Terminology and general principles

Continues on next page

1 The manipulator system

1.1.1 Applicable standards

Continued

Standard	Description
EN 574	Safety of machinery - Two-hand control devices - Functional aspects - Principles for design

Other standards

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 434-14	Industrial robots and robot Systems - General safety requirements

1.1.2 Safety in the manipulator system

Validity and responsibility

The information does not cover how to design, install and operate a complete system, nor does it cover all peripheral equipment that can influence the safety of the entire system. To protect personnel, the complete system must be designed and installed in accordance with the safety requirements set forth in the standards and regulations of the country where the robot is installed.

The users of ABB industrial robots are responsible for ensuring that the applicable safety laws and regulations in the country concerned are observed and that the safety devices necessary to protect people working with the robot system are designed and installed correctly. Personnel working with robot must be familiar with the operation and handling of the industrial robot as described in the applicable documents, for example:

- *Operating manual - IRC5 with FlexPendant*
- *Operating manual - General safety information*¹
- *Product manual*

¹ This manual contains all safety instructions from the product manuals for the robots and the controllers.

The robot system shall be designed and constructed in such a way as to allow safe access to all areas where intervention is necessary during operation, adjustment, and maintenance.

Where it is necessary to perform tasks within the safeguarded space there shall be safe and adequate access to the task locations.

Users shall not be exposed to hazards, including slipping, tripping, and falling hazards.

Connection of external safety devices

Apart from the built-in safety functions, the robot is also supplied with an interface for the connection of external safety devices. An external safety function can interact with other machines and peripheral equipment via this interface. This means that control signals can act on safety signals received from the peripheral equipment as well as from the robot.

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.

Related information

Type of information	Detailed in document	Section
Installation of safety devices	<i>Product manual for the robot</i>	Installation and commissioning
Changing operating modes	<i>Operating manual - IRC5 with FlexPendant</i> <i>Operator's Manual - IRC5P</i>	Operating modes

Continues on next page

1 The manipulator system

1.1.2 Safety in the manipulator system

Continued

Type of information	Detailed in document	Section
Restricting the working space	<i>Product manual for the robot</i>	Installation and commissioning

1.2 Safety terminology

1.2.1 Safety signals in the manual






Introduction to safety signals

This section specifies all dangers that can arise when doing the work described in the user manuals. Each danger consists of:

- A caption specifying the danger level (DANGER, WARNING, or CAUTION) and the type of danger.
- A brief description of what will happen if the operator/service personnel do not eliminate the danger.
- Instruction about how to eliminate danger to simplify doing the work.

Danger levels

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



Symbol	Designation	Significance
 xx0200000022	DANGER	Warns that an accident <i>will</i> occur if the instructions are not followed, resulting in a serious or fatal injury and/or severe damage to the product. It applies to warnings that apply to danger with, for example, contact with high voltage electrical units, explosion or fire risk, risk of poisonous gases, risk of crushing, impact, fall from height, and so on.
 xx0100000002	WARNING	Warns that an accident <i>may</i> occur if the instructions are not followed that can lead to serious injury, possibly fatal, and/or great damage to the product. It applies to warnings that apply to danger with, for example, contact with high voltage electrical units, explosion or fire risk, risk of poisonous gases, risk of crushing, impact, fall from height, etc.
 xx0200000024	ELECTRICAL SHOCK	Warns for electrical hazards which could result in severe personal injury or death.
 xx0100000003	CAUTION	Warns that an accident may occur if the instructions are not followed that can result in injury and/or damage to the product. It also applies to warnings of risks that include burns, eye injury, skin injury, hearing damage, crushing or slipping, tripping, impact, fall from height, etc. Furthermore, it applies to warnings that include function requirements when fitting and removing equipment where there is a risk of damaging the product or causing a breakdown.
 xx0200000023	ELECTROSTATIC DISCHARGE (ESD)	Warns for electrostatic hazards which could result in severe damage to the product.

Continues on next page

1 The manipulator system

1.2.1 Safety signals in the manual

Continued

Symbol	Designation	Significance
 xx0100000004	NOTE	Describes important facts and conditions.
 xx0100000098	TIP	Describes where to find additional information or how to do an operation in an easier way.

1.2.2 Safety symbols on product labels

Introduction to labels

This section describes safety symbols used on labels (stickers) on the product. Symbols are used in combinations on the labels, describing each specific warning. The descriptions in this section are generic, the labels can contain additional information such as values.



Note

The safety and health symbols on the labels on the product must be observed. Additional safety information given by the system builder or integrator must also be observed.




Types of labels

Both the robot and the controller are marked with several safety and information labels, containing important information about the product. The information is useful for all personnel handling the robot system, for example during installation, service, or operation.

The safety labels are language independent, they only use graphics. See [Symbols on safety labels on page 17](#).

The information labels can contain information in text (English, German, and French).

Symbols on safety labels

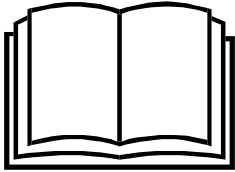
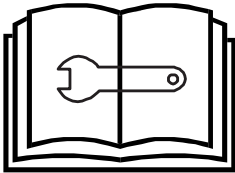
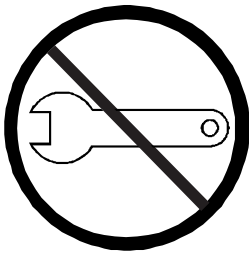
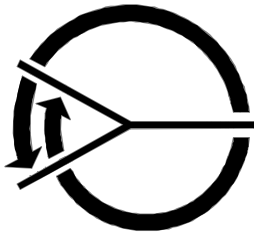

Symbol	Description
 xx0900000812	Warning! Warns that an accident <i>may</i> occur if the instructions are not followed that can lead to serious injury, possibly fatal, and/or great damage to the product. It applies to warnings that apply to danger with, for example, contact with high voltage electrical units, explosion or fire risk, risk of poisonous gases, risk of crushing, impact, fall from height, etc.
 xx0900000811	Caution! Warns that an accident may occur if the instructions are not followed that can result in injury and/or damage to the product. It also applies to warnings of risks that include burns, eye injury, skin injury, hearing damage, crushing or slipping, tripping, impact, fall from height, etc. Furthermore, it applies to warnings that include function requirements when fitting and removing equipment where there is a risk of damaging the product or causing a breakdown.
 xx0900000839	Prohibition Used in combinations with other symbols.

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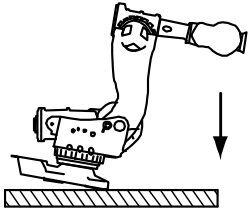

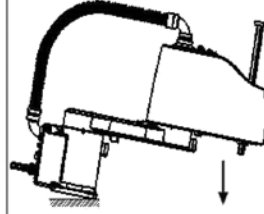



1 The manipulator system

1.2.2 Safety symbols on product labels

Continued

Symbol	Description
 xx0900000813	See user documentation Read user documentation for details. Which manual to read is defined by the symbol: <ul style="list-style-type: none">• No text: <i>Product manual</i>.• EPS: <i>Application manual - Electronic Position Switches</i>.
 xx0900000816	Before disassemble, see product manual
 xx0900000815	Do not disassemble Disassembling this part can cause injury.
 xx0900000814	Extended rotation This axis has extended rotation (working area) compared to standard.
 xx0900000808	Brake release Pressing this button will release the brakes. This means that the robot arm can fall down.

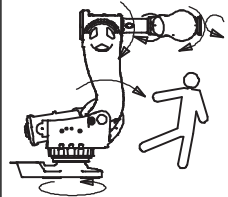
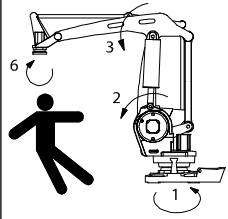
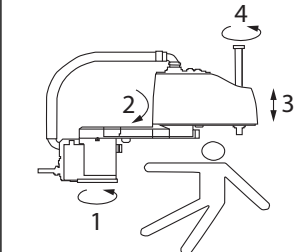

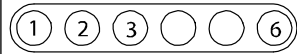

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Symbol	Description
 <p>xx0900000810</p>   <p>3HAC 057068-001</p> <p>xx1500002402</p>	<p>Tip risk when loosening bolts The robot can tip over if the bolts are not securely fastened.</p>
  <p>xx0900000817</p>	<p>Crush Risk of crush injuries.</p>
 <p>xx0900000818</p>	<p>Heat Risk of heat that can cause burns.</p>

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1 The manipulator system

1.2.2 Safety symbols on product labels
Continued

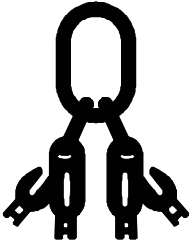

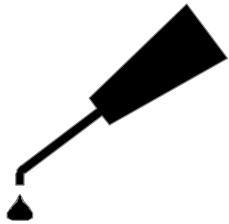



Symbol	Description
 xx0900000819	Moving robot The robot can move unexpectedly.
 xx1000001141	
 xx1500002616	
 xx0900000820	Brake release buttons
 xx1000001140	
 xx0900000821	Lifting bolt

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1 The manipulator system

1.2.2 Safety symbols on product labels

Continued

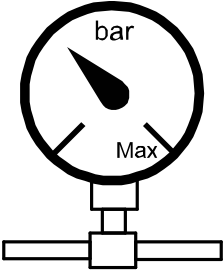
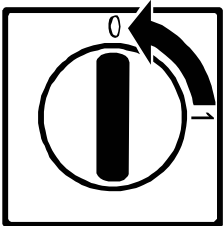

Symbol	Description
 xx1000001242	Chain sling with shortener
 xx0900000822	Lifting of robot
 xx0900000823	Oil Can be used in combination with prohibition if oil is not allowed.
 xx0900000824	Mechanical stop
 xx1000001144	No mechanical stop
 xx0900000825	Stored energy Warns that this part contains stored energy. Used in combination with <i>Do not disassemble</i> symbol.

Continues on next page

1 The manipulator system

1.2.2 Safety symbols on product labels

Continued

Symbol	Description
 xx0900000826	Pressure Warns that this part is pressurized. Usually contains additional text with the pressure level.
 xx0900000827	Shut off with handle Use the power switch on the controller.
 xx1400002648	Do not step Warns that stepping on these parts can cause damage to the parts.

1.2.3 Safety symbols on controller labels

Introduction to labels

This section describes safety symbols used on labels (stickers) on the controller. Symbols are used in combinations on the labels, describing each specific warning. The descriptions in this section are generic, the labels can contain additional information such as values.



Note






The safety and health symbols on the labels on the product must be observed. Additional safety information given by the system builder or integrator must also be observed.

Types of labels

Both the robot and the controller are marked with several safety and information labels, containing important information about the product. The information is useful for all personnel handling the robot system, for example during installation, service, or operation.

The information labels can contain information in text (English, German, and French).

Symbols on safety labels


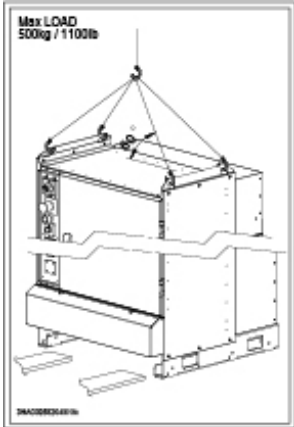
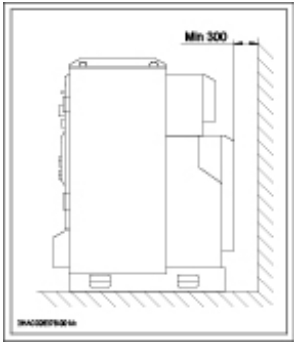

Label	Description
 xx1400001151	Electrical shock
 xx1400001162	ESD sensitive components inside the controller.
 xx1400001161	Disconnect power supply before servicing the controller.
 xx1400001160	Disconnect power supply before servicing the controller (only for welding equipment).
 xx1700000354	Disconnect power supply before servicing the controller (for controllers without UL mains switch).

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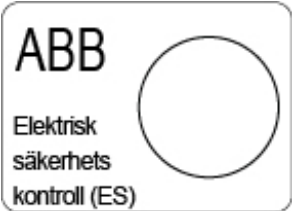



1 The manipulator system

1.2.3 Safety symbols on controller labels

Continued

Label	Description
 <p>xx1400001156</p>	High voltage inside the module even if the main switch is in the OFF position.
 <p>xx1400001157</p>	Lifting instruction for the IRC5 controller.
 <p>xx1400001155</p>	Required installation space.
 <p>xx1400001154</p>	QR code for <i>ABB Basic Care</i> service agreement.


Continues on next page

Label	Description
 <p>xx1400001152</p>	Read the user manual before servicing.
 <p>xx1400001158</p>	Electrical safety check of the robot system (internal).
 <p>xx1400001159</p>	Functional test of the robot system (internal).
 <p>xx1400001163</p>	Rating label
 <p>xx1400002060</p>	UR certified (component)

1 The manipulator system

1.2.3 Safety symbols on controller labels

Continued

Label	Description
 <p>xx1400002061</p>	UL certified (robot with controller)
 <p>xx1700000355</p>	SafeMove label (for <i>SafeMove Basic</i> and <i>SafeMove Advanced</i> software).
 <p>xx1700000353</p>	Safety UL label (for the <i>Functional Safety</i> solution together with UL mark).

1.3 Working in a safe manner

1.3.1 Safety tools

Safeguarding mechanisms

Your robot system can be equipped with a vast range of safeguards such as door interlocks, safety light curtains, safety mats, and others. The most common is the door interlock of the robot cell that temporarily stops the robot if you open it.

The controller has three separate safeguarding mechanisms, the *general mode safeguarded stop* (GS), the *automatic mode safeguarded stop* (AS) and the *superior safeguarded stop* (SS).

Safeguards connected to...	are...
the GS mechanism	always active regardless of the operating mode.
the AS mechanism	only active when the system is in automatic mode.
the SS mechanism	always active regardless of the operating mode.

Please consult your plant or cell documentation to see how your robot system is configured and where the safeguarding mechanisms are placed and how they work.

Safety supervision

The emergency stop and safeguarding mechanisms are supervised so that any failure is detected by the controller and the robot is stopped until the problem is solved.

Built-in stop functions

The controller continuously monitor hardware and software functionality. If any problems or errors are detected the robot is stopped until the problem has been solved.

If the failure is...	then...
simple and can easily be solved	a simple program stop is issued (SYSSTOP).
minor and can be solved	a SYSHALT is issued which results in a protective stop.
major, for instance concerns broken hardware	a SYSFAIL is issued which results in an emergency stop. The controller must be restarted in order to return to normal operation.

Restricting the robot's working range

The robot's working range can be restricted by means of mechanical stops or software functions, or by a combination of both.

Please consult your plant or cell documentation to see how your robot system is configured.

1 The manipulator system

1.3.2 About the automatic mode

1.3.2 About the automatic mode

What is the automatic mode?

In automatic mode the safety function of the three-position enabling device is bypassed so that the manipulator is allowed to move without human intervention.

The automatic mode is the operating mode in which the robot control system operates in accordance with the task program, with functional safeguarding measures. This mode enables controlling the manipulator for example by using the I/O signals on the controller. An input signal may be used to start and stop a RAPID program, another to activate the motors on the manipulator.



WARNING

Prior to selecting automatic mode, any suspended safeguards shall be returned to their full functionality.

Tasks normally performed in the automatic mode

The following tasks are normally performed in automatic mode.

- Starting and stopping processes.
- Loading, starting, and stopping RAPID programs.
- Returning the manipulator to its path when returning to operation after an emergency stop.
- Backing up the system.
- Restoring backups.
- Cleaning tools.
- Preparing or replacing work objects.
- Performing other process oriented tasks.

Limitations in automatic mode

Jogging is not possible in automatic mode. There may be other specific tasks that should not be performed in automatic mode.

Please consult your plant or system documentation to find out which specific tasks should not be performed in automatic mode.

1.3.3 About the manual mode

What is the manual mode?

In manual mode the manipulator movement is under manual control. The three-position enabling device must be pressed to activate the motors of the manipulator, that is, enabling movement.

The manual mode is used when programming and for program verification.

In some robots, there are two manual modes, the *manual reduced speed* mode and the *manual full speed* mode.

Safety in manual mode

When in manual mode the manipulator is operated with personnel in close proximity. Maneuvering an industrial manipulator is potentially dangerous and therefore maneuvers should be performed in a controlled fashion.

What is the manual reduced speed mode?

In manual reduced speed mode the movement is limited to 250 mm/s. In addition, there is a limitation on the maximum allowed speed for each axis. These axis limitations are robot dependent and cannot be changed.

The three-position enabling device must be pressed to activate the motors of the manipulator.



WARNING

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

What is the manual full speed mode?

The manual full speed mode is used for program verification only.

In manual full speed mode the initial speed limit is up to, but not exceeding, 250 mm/s. This is achieved by limiting the speed to 3% of the programmed speed. Through manual control the speed can be increased up to 100%.

The three-position enabling device must be pressed to activate the motors of the manipulator, and the hold-to-run button must be pressed to start program execution.



WARNING

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

Continues on next page

1 The manipulator system

1.3.3 About the manual mode

Continued

Note that the manual full speed mode is optional and therefore not available in all robots.



Note

As per the updated standard, ISO 10218-1:2011 *Robots and robotic devices – Safety requirements for industrial robots – Part 1 Robots*, the following adaptations are made to the manual full speed mode.

- Resetting the speed to 250 mm/s every time the three-position enabling device is re-initiated by placing the switch in the center-enabled position after either having been released or fully compressed.
- Editing RAPID programs and jogging the manipulator are disabled.

Tasks normally performed in manual reduced speed mode

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

- Jogging the manipulator back on its path when returning to operation after an emergency stop
- Correcting the value of I/O signals after error conditions
- Creating and editing RAPID programs
- Starting, stepping, and stopping program execution, for example while testing a program
- Tuning programmed positions

Tasks normally performed in manual full speed mode

As per the standard, ISO 10218-1:2011, the following tasks can be performed in the manual full speed mode.

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

The following tasks cannot be performed in the manual full speed mode:

- Changing system parameter values
- Editing system data

1.4 Safety risks

1.4.1 Risks associated with live electric parts

Voltage related risks, general

Work on the electrical equipment of the robot must be performed by a qualified electrician in accordance with electrical regulations.

- Although troubleshooting may, on occasion, need to be carried out while the power supply is turned on, the robot must be turned off (by setting the main switch to OFF) when repairing faults, disconnecting electric leads and disconnecting or connecting units.
- The main supply to the robot must be connected in such a way that it can be turned off from outside the working space of the robot.
- Make sure that no one else can turn on the power to the controller and robot while you are working with the system. A good method is to always lock the main switch on the controller cabinet with a safety lock.

The necessary protection for the electrical equipment and robot system during construction, commissioning, and maintenance is guaranteed if the valid regulations are followed.

All work must be performed:

- by qualified personnel
- on machine/robot system in deadlock
- in an isolated state, disconnected from power supply, and protected against reconnection.

Voltage related risks, IRC5 controller

A danger of high voltage is associated with, for example, the following parts:

- Be aware of stored electrical energy (DC link, Ultracapacitor bank unit) in the controller.
- Units such as I/O modules, can be supplied with power from an external source.
- The main supply/main switch
- The transformers
- The power unit
- The control power supply (230 VAC)
- The rectifier unit (262/400-480 VAC and 400/700 VDC. Note: capacitors!)
- The drive unit (400/700 VDC)
- The drive system power supply (230 VAC)
- The service outlets (115/230 VAC)
- The customer power supply (230 VAC)
- The power supply unit for additional tools, or special power supply units for the machining process.

Continues on next page

1 The manipulator system

1.4.1 Risks associated with live electric parts

Continued

- The external voltage connected to the controller remains live even when the robot is disconnected from the mains.
- Additional connections.

Voltage related risks, robot

A danger of high voltage is associated with the robot in:

- The power supply for the motors (up to 800 VDC).
- The user connections for tools or other parts of the installation (max. 230 VAC).

Voltage related risks, tools, material handling devices, etc.

Tools, material handling devices, etc., may be live even if the robot system is in the OFF position. Power supply cables which are in motion during the working process may be damaged.

2 The industrial manipulators

2.1 Safety risks

2.1.1 Safety risks during installation and service work on robots

Overview

This section includes information on general safety risks to be considered when performing installation and service work on the robot.

These safety instructions have to be read and followed by any person who deals with the installation and maintenance of the robot. Only persons who know the robot and are trained in the operation and handling of the robot are allowed to maintain the robot. Persons who are under the influence of alcohol, drugs or any other intoxicating substances are not allowed to maintain, repair, or use the robot.

General risks during installation and service

- The instructions in the product manual in the chapters *Installation and commissioning*, and *Repair* must always be followed.
- Emergency stop buttons must be positioned in easily accessible places so that the robot can be stopped quickly.
- Those in charge of operations must make sure that safety instructions are available for the installation in question.
- Those who install or service/maintain the robot must have the appropriate training for the equipment in question and in any safety matters associated with it.

Spare parts and special equipment

ABB does not supply spare parts and special equipment which have not been tested and approved by ABB. The installation and/or use of such products could negatively affect the structural properties of the robot and as a result of that affect the active or passive safety operation. ABB is not liable for damages caused by the use of non-original spare parts and special equipment. ABB is not liable for damages or injuries caused by unauthorized modifications to the robot system.

Personal protective equipment

Always use suitable personal protective equipment, based on the risk assessment for the robot installation.

Nation/region specific regulations

To prevent injuries and damages during the installation of the robot, the regulations applicable in the country concerned and the instructions of ABB Robotics must be complied with.

Continues on next page

2 The industrial manipulators

2.1.1 Safety risks during installation and service work on robots

Continued

Non-voltage related risks


- Make sure that no one else can turn on the power to the controller and robot while you are working with the system. A good method is to always lock the main switch on the controller cabinet with a safety lock.
- Safety zones, which must be crossed before admittance, must be set up in front of the robot's working space. Light beams or sensitive mats are suitable devices.
- Turntables or the like should be used to keep the operator out of the robot's working space.
- If the robot is installed at a height, hanging, or other than standing directly on the floor, there may be additional risks than those for a robot standing directly on the floor.
- The axes are affected by the force of gravity when the brakes are released. In addition to the risk of being hit by moving robot parts, there is a risk of being crushed by the parallel arm (if there is one).
- Energy stored in the robot for the purpose of counterbalancing certain axes may be released if the robot, or parts thereof, are dismantled.
- When dismantling/assembling mechanical units, watch out for falling objects.
- Be aware of stored heat energy in the controller.
- Never use the robot as a ladder, which means, do not climb on the robot motors or other parts during service work. There is a serious risk of slipping because of the high temperature of the motors and oil spills that can occur on the robot.
- Never use the robot as a ladder, which means, do not climb on the manipulator motors or other parts during service work. There is a risk of the robot being damaged.

To be observed by the supplier of the complete system



When integrating the robot with external devices and machines:

- The supplier of the complete system must ensure that all circuits used in the safety function are interlocked in accordance with the applicable standards for that function.
- The supplier of the complete system must ensure that all circuits used in the emergency stop function are interlocked in a safe manner, in accordance with the applicable standards for the emergency stop function.


Complete robot

Safety risk	Description
Hot components!	 CAUTION Motors and gearboxes are HOT after running the robot! Touching motors and gearboxes may result in burns! With a higher environment temperature, more surfaces on the manipulator will get HOT and may also result in burns.

Continues on next page

Safety risk	Description
Removed parts may result in collapse of the robot!	 WARNING Take any necessary measures to ensure that the robot does not collapse as parts are removed. For example, secure the lower arm according to the repair instruction if removing the axis-2 motor.
Removed cables to the measurement system	 WARNING If the internal cables for the measurement system have been disconnected during repair or maintenance, then the revolution counters must be updated.

Cabling

Safety risk	Description
Cable packages are sensitive to mechanical damage!	 CAUTION The cable packages are sensitive to mechanical damage. Handle the cable packages and the connectors with care in order to avoid damage.

2 The industrial manipulators

2.1.2 Safety risks related to tools/work pieces

2.1.2 Safety risks related to tools/work pieces

Safe handling

It must be possible to safely turn off tools, such as milling cutters, etc. Make sure that guards remain closed until the cutters stop rotating.

It should be possible to release parts by manual operation (valves).

Safe design

Grippers/end effectors must be designed so that they retain work pieces in the event of a power failure or a disturbance to the controller.

Unauthorized modifications of the originally delivered robot are prohibited. Without the consent of ABB it is forbidden to attach additional parts through welding, riveting, or drilling of new holes into the castings. The strength could be affected.



CAUTION

Ensure that a gripper is prevented from dropping a work piece, if such is used.

2.1.3 Safety risks related to pneumatic/hydraulic systems

General

Special safety regulations apply to pneumatic and hydraulic systems.



Note

All components that remain pressurized after separating the machine from the power supply must be provided with clearly visible drain facilities and a warning sign that indicates the need for pressure relief before adjustments or performing any maintenance on the robot system.

Residual energy

- Residual energy can be present in these systems. After shutdown, particular care must be taken.
- The pressure must be released in the complete pneumatic or hydraulic systems before starting to repair them.
- Work on hydraulic equipment may only be performed by persons with special knowledge and experience of hydraulics.
- All pipes, hoses, and connections have to be inspected regularly for leaks and damage. Damage must be repaired immediately.
- Splashed oil may cause injury or fire.

Safe design

- Gravity may cause any parts or objects held by these systems to drop.
- Dump valves should be used in case of emergency.
- Shot bolts should be used to prevent tools, etc., from falling due to gravity.

2 The industrial manipulators

2.1.4 Safety risks during operational disturbances

2.1.4 Safety risks during operational disturbances

General

- The industrial robot is a flexible tool that can be used in many different industrial applications.
- All work must be carried out professionally and in accordance with the applicable safety regulations.
- Care must be taken at all times.

Qualified personnel

Corrective maintenance must only be carried out by qualified personnel who are familiar with the entire installation as well as the special risks associated with its different parts.

Extraordinary risks

If the working process is interrupted, extra care must be taken due to risks other than those associated with regular operation. Such an interruption may have to be rectified manually.

2.2 Safety actions

2.2.1 Safety fence dimensions

General

Install a safety cell around the robot to ensure safe robot installation and operation.

Dimensioning

The fence or enclosure must be dimensioned to withstand the force created if the load being handled by the robot is dropped or released at maximum speed.

Determine the maximum speed from the maximum velocities of the robot axes and from the position at which the robot is working in the work cell (see the section *Robot motion* in the *Product specification*).

Also consider the maximum possible impact caused by a breaking or malfunctioning rotating tool or other device fitted to the robot.

2 The industrial manipulators

2.2.2 Brake testing

2.2.2 Brake testing

When to test

During operation, the holding brake of each axis normally wears down. A test can be performed to determine whether the brake can still perform its function.

How to test

The function of the holding brake of each axis motor may be verified as described below:

- 1 Run each robot axis to a position where the combined weight of the robot arm and any load is maximized (maximum static load).
- 2 Switch the motor to the MOTORS OFF.
- 3 Inspect and verify that the axis maintains its position.

If the robot does not change position as the motors are switched off, then the brake function is adequate.

2.2.3 Risk of disabling function "Reduced speed 250 mm/s"



Note

Do not change *Transm gear ratio* or other kinematic system parameters from the FlexPendant or a PC. This will affect the safety function "Reduced speed 250 mm/s".

2 The industrial manipulators

2.2.4 Work inside the working range of the robot

2.2.4 Work inside the working range of the robot



WARNING

If work must be carried out within the work area of the robot, then the following points must be observed:

- The operating mode selector on the controller must be in the manual mode position to render the three-position enabling device operational and to block operation from a computer link or remote control panel.
- The maximum speed of the robot is limited to 250 mm/s when the operating mode selector is in the position *Manual mode with reduced speed*. This should be the normal position when entering the working space.
The position *Manual mode with full speed (100%)* may only be used by trained personnel who are aware of the risks that this entails. *Manual mode with full speed (100%)* is not available in USA or Canada.
- Pay attention to the rotating axes of the robot. Keep away from axes to not get entangled with hair or clothing. Also, be aware of any danger that may be caused by rotating tools or other devices mounted on the robot or inside the cell.
- Test the motor brake on each axis, according to the section [Brake testing on page 40](#).
- To prevent anyone else from taking control of the robot, always put a safety lock on the cell door and bring the three-position enabling device with you when entering the working space.



WARNING

NEVER, under any circumstances, stay beneath any of the robot's axes! There is always a risk that the robot will move unexpectedly when robot axes are moved using the three-position enabling device or during other work inside the working range of the robot.

2.2.5 Signal lamp (optional)

Description

A signal lamp with a yellow fixed light can be mounted on the robot, as a safety device.

Function

The lamp is active in MOTORS ON mode.

Further information

Further information about the MOTORS ON/MOTORS OFF mode may be found in the product manual for the controller.

2 The industrial manipulators

2.3.1 DANGER - Moving robots are potentially lethal!

2.3 Safety related instructions

2.3.1 DANGER - Moving robots are potentially lethal!

Description

Any moving robot is a potentially lethal machine.

When running, the robot may perform unexpected and sometimes irrational movements. Moreover, all movements are performed with great force and may seriously injure any personnel and/or damage any piece of equipment located within the working range of the robot.

Elimination

	Action	Note
1	Before attempting to run the robot, make sure all emergency stop equipment is correctly installed and connected.	Emergency stop equipment such as gates, tread mats, light curtains, etc.
2	Usually the hold-to-run function is active only in manual full speed mode. To increase safety it is also possible to activate hold-to-run for manual reduced speed with a system parameter. The hold-to-run function is used in manual mode, not in automatic mode.	How to use the hold-to-run function is described in section <i>How to use the hold-to-run function</i> in the <i>Operating manual - IRC5 with FlexPendant</i> .
3	Make sure no personnel are present within the working range of the robot before pressing the start button.	

2.3.2 DANGER - First test run may cause injury or damage!

Description

Since performing a service activity often requires disassembly of the robot, there are several safety risks to take into consideration before the first test run.

Elimination

Follow the procedure below when performing the first test run after a service activity, such as repair, installation, or maintenance.



DANGER

Running the robot without fulfilling the following aspects, may cause severe damage to the robot.

	Action
1	Remove all service tools and foreign objects from the robot and its working area.
2	Verify that the robot is secured to its position, see installation section in the product manual for the robot.
3	Verify that any safety equipment installed to secure the robot arm position or restrict the robot arm motion during service activity is removed.
4	Verify that the fixture and work piece are well secured, if applicable.
5	Install all safety equipment properly.
6	Make sure all personnel are standing at a safe distance from the robot, that is out of its reach behind safety fences, and so on.
7	Pay special attention to the function of the part that previously was serviced.

Collision risks



CAUTION

When programming the movements of the robot, always identify potential collision risks before the first test run.

Mechanical stops will not always stop the movements of the robot completely.

2 The industrial manipulators

2.3.3 WARNING - The brake release buttons may be jammed after service work

2.3.3 WARNING - The brake release buttons may be jammed after service work

Description

The brake release unit has push-buttons for the brake release of each axis motor. When service work is performed inside the SMB recess that includes removal and refitting of the brake release unit, the brake release buttons may be jammed after refitting.

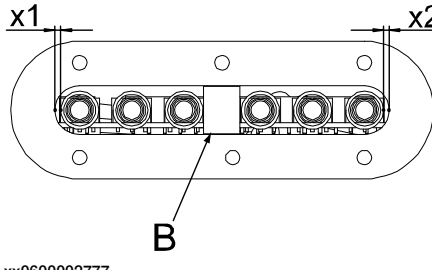


DANGER

If the power is turned on while a brake release button is jammed in depressed position, the affected motor brake is released! This may cause serious personal injuries and damage to the robot.

Elimination

To eliminate the danger after service work has been performed inside the SMB recess, follow the procedure below.

	Action	Note
1	Make sure the power is turned off.	
2	Refit the push button guard, if removed.	
3	Verify that the push-buttons of the brake release unit are working by pressing them down, one by one. Make sure none of the buttons are jammed by the push button guard!	
4	If a button gets jammed in the depressed position, the alignment of the push button unit must be adjusted so that the buttons can move freely! Remove the push button guard and: <ul style="list-style-type: none">• Make sure the centering piece (B) is properly fitted to the unit. (The piece aligns the unit vertically.)• Adjust the unit sideways so that the measurements x1 and x2 in the figure to the right do not differ more than 1 mm from each other.	 xx0600002777
5	Refit the push button guard and check the buttons again by pressing them down, one by one.	

2.3.4 WARNING - Safety risks during handling of batteries

Description

Under normal conditions of use, the electrode materials and liquid electrolyte in the batteries are not exposed to the outside, provided the battery integrity is maintained and seals remain intact.

There is a risk of exposure only in case of abuse (mechanical, thermal, electrical) which leads to the activation of safety valves and/or the rupture of the battery container. Electrolyte leakage, electrode materials reaction with moisture/water or battery vent/explosion/fire may follow, depending upon the circumstances.



Note

Appropriate disposal regulations must be observed.

Elimination

	Action	Note
1	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.	
2	Use safety glasses when handling the batteries.	
3	In the event of leakage, wear gloves and chemical apron.	
4	In the event of fire, use self-contained breathing apparatus.	

2 The industrial manipulators

2.3.5 WARNING - Safety risks during work with gearbox lubricants (oil or grease)

2.3.5 WARNING - Safety risks during work with gearbox lubricants (oil or grease)

Description

When handling gearbox lubricants, there is a risk of both personal injury and product damage occurring. The following safety information must be regarded before performing any work with lubricants in the gearboxes.



Note

When handling oil, grease, or other chemical substances the safety information of the manufacturer must be observed.



Note

When aggressive media is handled, an appropriate skin protection must be provided. Gloves and goggles are recommended.



Note




Appropriate disposal regulations must be observed.



Note

Take special care when handling hot lubricants.




Warnings and elimination

Warning	Description	Elimination/Action
 xx0100000002 Hot oil or grease	Changing and draining gearbox oil or grease may require handling hot lubricant heated up to 90 °C.	Make sure that protective gear like goggles and gloves are always worn during this activity.
 xx0100000002 Allergic reaction	When working with gearbox lubricant there is a risk of an allergic reaction.	Make sure that protective gear like goggles and gloves are always worn.
 xx0100000002 Possible pressure build-up in gearbox	When opening the oil or grease plug, there may be pressure present in the gearbox, causing lubricant to spray from the opening.	Open the plug carefully and keep away from the opening. Do not overfill the gearbox when filling.

Continues on next page

2.3.5 WARNING - Safety risks during work with gearbox lubricants (oil or grease)

Continued

Warning	Description	Elimination/Action
 xx0100000002 Do not overfill	<p>Overfilling of gearbox lubricant can lead to internal over-pressure inside the gearbox which in turn may:</p> <ul style="list-style-type: none"> • damage seals and gaskets • completely press out seals and gaskets • prevent the robot from moving freely. 	<p>Make sure not to overfill the gearbox when filling it with oil or grease!</p> <p>After filling, verify that the level is correct.</p>
 xx0100000004 Specified amount depends on drained volume	<p>The specified amount of oil or grease is based on the total volume of the gearbox. When changing the lubricant, the amount refilled may differ from the specified amount, depending on how much has previously been drained from the gearbox.</p>	<p>After filling, verify that the level is correct.</p>
 xx0100000003 Contaminated oil in gear boxes	<p>When draining the oil make sure that as much oil as possible is drained from the gearbox. The reason for this is to drain as much oil sludge and metal chips as possible from the gearbox. The magnetic oil plugs will take care of any remaining metal chips.</p>	

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3 The IRC5 controllers

3.1 Protective stop and emergency stop

Overview

Protective stops and emergency stops are defined by standards IEC 60204-1:2005 and EN ISO 10218-1:2011.

Stops can be in *category 0* or *category 1*.

Stop category 0	As defined in IEC 60204, stopping by immediate removal of power to the machine actuators (i.e. an uncontrolled stop. In IRC5 this is implemented by removing power immediately in the drive units.
Stop category 1	As defined in IEC 60204, a controlled stop with power available to the machine actuators to achieve the stop and then removal of power when the stop is achieved. In IRC5 this is implemented by removing power in the drive units after about 1 second using the servos to stop the machine.

Inputs to initiate a protective stop or an emergency stop

There are several safety inputs available to initiate a protective stop or an emergency stop. All these safety inputs are of structure category 3 as described in EN ISO 13849-1.

These safety inputs will initiate a stop of category 0 or category 1.

Safety inputs to initiate a stop	Description
Protective stop in automatic mode	The safety input <i>Automatic Stop</i> is only operational in automatic mode. The default configuration is stop category 1.
Protective stop in automatic and manual mode	There are two safety inputs to initiate a protective stop in both automatic and manual mode. It is the safety input <i>General Stop</i> and the safety input <i>Superior Stop</i> . The default configuration is stop category 1.
Emergency stop	The <i>Emergency Stop</i> is operational in both automatic and manual mode. The default configuration is stop category 0.

To modify the configuration of the stop category, see *Technical reference manual - System parameters*.

Protective stop

Protective stops are activated through the dedicated safety inputs *Automatic Stop*, *General Stop*, and *Superior Stop*, on the controller. For example, the protective inputs are connected to safety outputs of presence sensing devices. This is to provide safeguarding.

See *Installation and commissioning in Product manual - IRC5*.

Continues on next page

3 The IRC5 controllers

3.1 Protective stop and emergency stop

Continued

Emergency stop

The emergency stop function shall not be applied as a substitute for safeguarding measures and other safety functions but should be designed for use as a complementary protective measure. (See ISO 13850.)



Note

Emergency stop must not be used for protective stop or program stop as this causes extra, unnecessary wear on the robot.

For how to perform program stops, see section *Stopping programs* in *Operating manual - IRC5 with FlexPendant*.

Depending on selected options for the robot, the number of emergency stops can vary. See documentation for the robot and the complete machine.

Other methods to stop the robot

There are also other methods to stop the robot. See:

- *Installation and commissioning in Product manual - IRC5*
- *Technical reference manual - System parameters*
- *Technical reference manual - RAPID Instructions, Functions and Data types.*

3.2.1 DANGER - Make sure that the main power has been switched off!

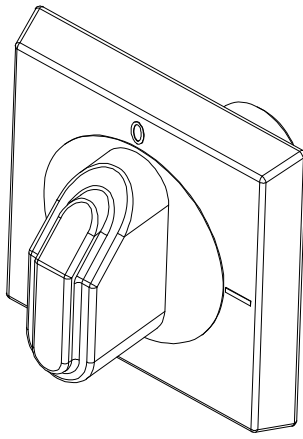
3.2 Safety related instructions

3.2.1 DANGER - Make sure that the main power has been switched off!

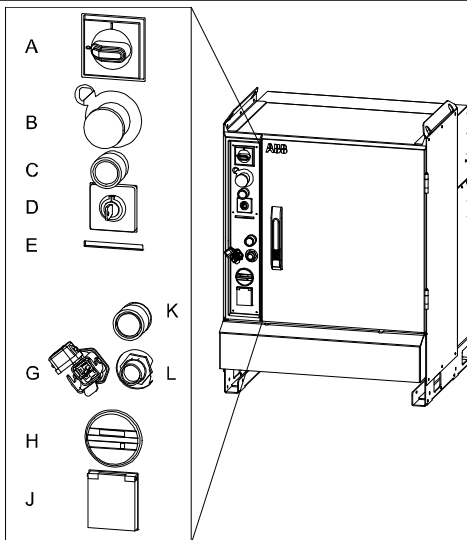
Description

Working with high voltage is potentially lethal. Persons subjected to high voltage may suffer cardiac arrest, burn injuries, or other severe injuries. To avoid these dangers, do not proceed working before eliminating the danger as detailed below.

Elimination, IRC5 Panel Mounted Controller

	Action	Note/illustration
1	Switch off the main switch for the controller.	 xx0600003255

Elimination, IRC5 Single Cabinet Controller

	Action	Note/illustration
1	Switch off the main switch on the controller cabinet.	 xx0600002782 A: Main switch

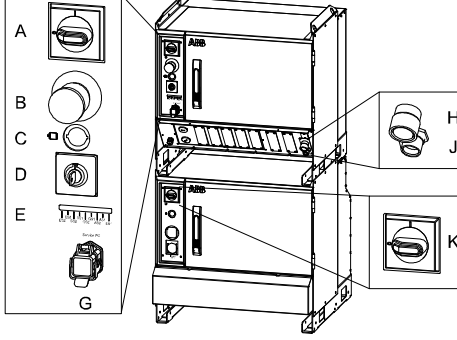
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3 The IRC5 controllers

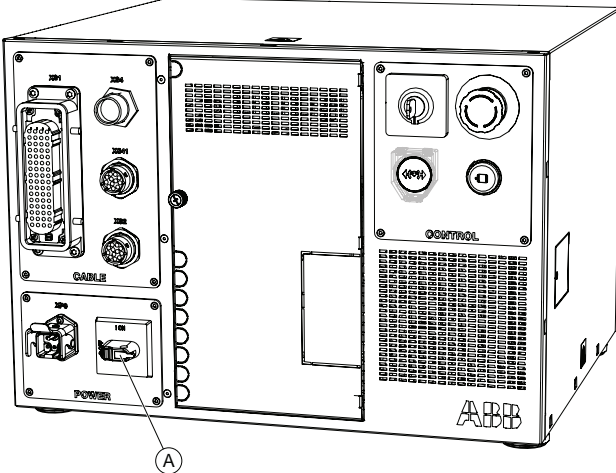
3.2.1 DANGER - Make sure that the main power has been switched off!

Continued

Elimination, IRC5 Dual Cabinet Controller

	Action	Note/illustration
1	Switch off the main switch on the Drive Module.	 <p>xx0600002783</p> <p>K: Main switch, Drive Module</p>
2	Switch off the main switch on the Control Module.	A: Main switch, Control Module

Elimination, IRC5 Compact Controller

	Action	Note/illustration
1	Switch off the main power switch on the controller cabinet.	<p>Note that the position of the main switch can vary depending on the year model.</p>  <p>xx0900000313</p> <p>A: Main power switch</p>
2	Disconnect the input power cable from the wall socket.	

3.2.2 WARNING - 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.

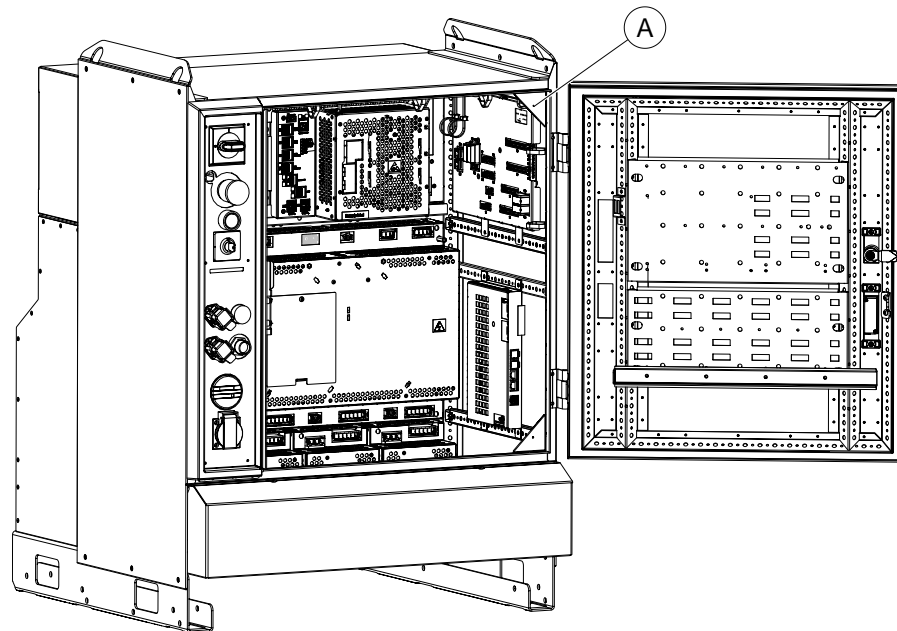
Elimination

	Action	Note
1	Use a wrist strap.	Wrist straps must be tested frequently to ensure that they are not damaged and are operating correctly.
2	Use an ESD protective floor mat.	The mat must be grounded through a current-limiting resistor.
3	Use a dissipative table mat.	The mat should provide a controlled discharge of static voltages and must be grounded.

Location of wrist strap button

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

IRC5



xx1300000856

A	Wrist strap button
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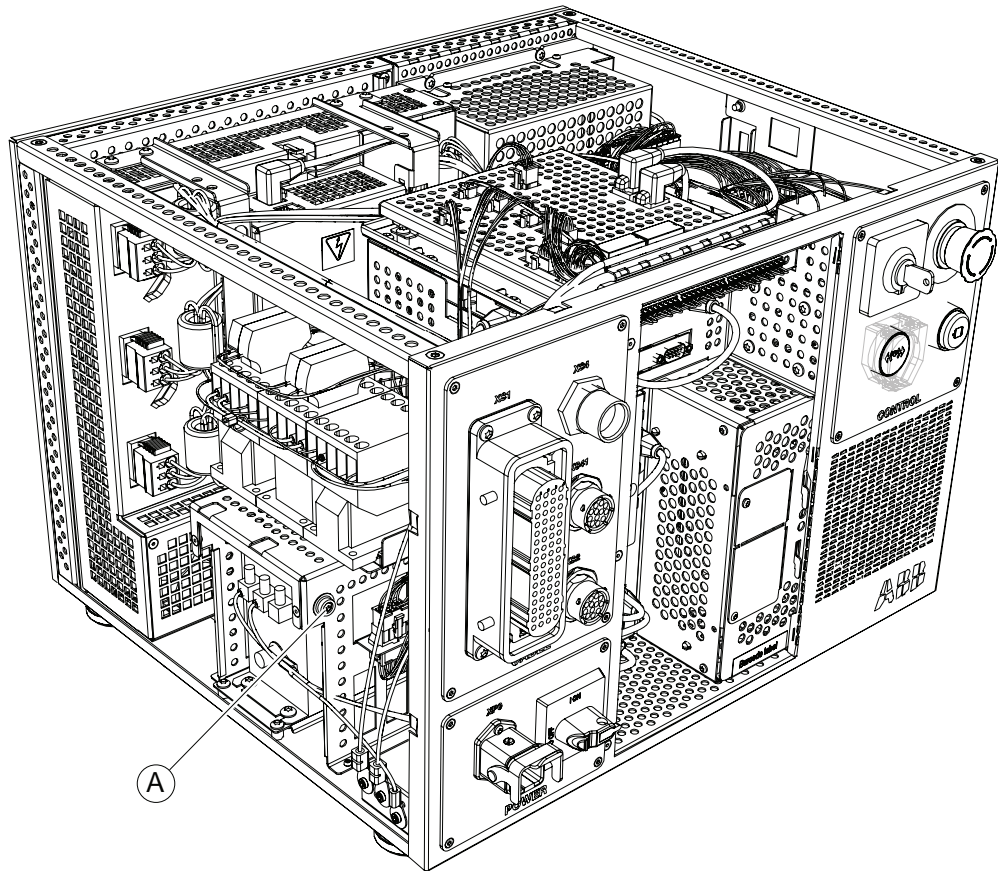
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3 The IRC5 controllers

3.2.2 WARNING - The unit is sensitive to ESD!

Continued

IRC5 Compact Controller

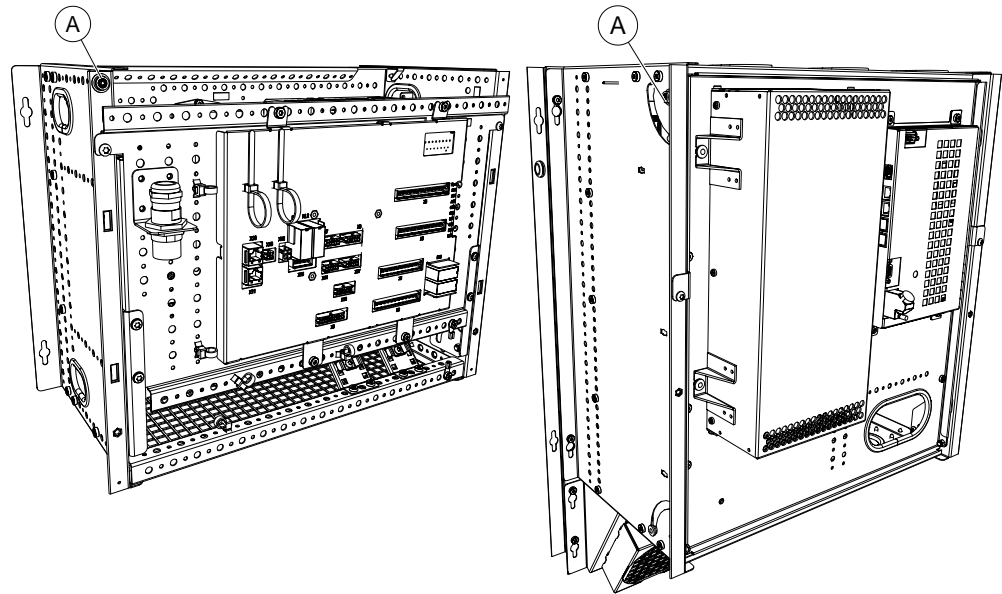


xx1400001622

A	Wrist strap button
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Continues on next page

Panel Mounted Controller



xx1300001960

A	Wrist strap button
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3 The IRC5 controllers

3.2.3 CAUTION - Never stand on or use the cabinet as a ladder

3.2.3 CAUTION - Never stand on or use the cabinet as a ladder

Description

To avoid personal injury or damaging the product, it is never allowed to stand on the cabinet. Nor is it allowed to use the cabinet as a ladder.

3.2.4 CAUTION - Make sure that there are no loose screws or turnings

3.2.4 CAUTION - Make sure that there are no loose screws or turnings

Description

To avoid damaging the product, make sure that there are no loose screws, turnings or other parts inside the cabinet after work has been performed.

3 The IRC5 controllers

3.2.5 CAUTION - Close the cabinet door

3.2.5 CAUTION - Close the cabinet door

Description

The cabinet door must be closed properly when the robot system is in production. If a door is not properly closed, the cabinet does not comply with the protection class IP54 or IP20. The shield for Electro Magnetic Compatibility is also affected if the door is not properly closed.



Note

To comply with IP54 all openings to the controller cabinet must be covered. This includes unconnected connectors which must be fitted with covers.

3.2.6 CAUTION - Hot components in controller

Description

Units and heat sinks are HOT after running the robot!

Touching the units and heat sinks may result in burns!

With higher environment temperature more surfaces on the controller get HOT and may result in burns.

3 The IRC5 controllers

3.2.7 Recover from emergency stops

3.2.7 Recover from emergency stops

Overview

Recovering from an emergency stop is a simple but important procedure. This procedure ensures that the robot system is not returned to production while maintaining a hazardous condition.

Reset the latch of emergency stop buttons

All push-button style emergency stop devices have a latching feature that must be released in order to remove the emergency stop condition of the device.

In many cases this is done by twisting the push-button as marked, but there are also devices where you pull the button to release the latch.

Reset automatic emergency stop devices

All automatic emergency stop devices also have some kind of latching feature that must be released. Consult your plant or cell documentation to see how your robot system is configured.

Recover from emergency stops

	Action
1	Make sure the hazardous situation that resulted in the emergency stop condition no longer exists.
2	Locate and reset the device or devices that gave the emergency stop condition.
3	Press the Motors On button to recover from the emergency stop condition.

4 The jogging device

4.1 Working in a safe manner

4.1.1 For your own safety

General principles

A few simple principles should be followed in order to operate the robot system safely:

- Always operate the robot system in manual mode if personnel are inside safeguarded space.
- Always bring the jogging device along when you enter safeguarded space so that robot control is in your hands.
- Watch out for rotating or moving tools such as milling cutters and saws. Make sure those are stopped before you approach the robot.
- Watch out for hot surfaces both on work pieces as well as on the robot system. The robot's motors can become fairly hot if run for a long time.
- Watch out for grippers and objects gripped. If the gripper is opened the work piece could fall and cause injuries or damage equipment. The gripper can be very powerful and can also cause injuries if not operated in a safe manner.
- Watch out for hydraulic and pneumatic systems and live electric parts. Even with power off residual energy in such circuits can be very dangerous.

Disconnected jogging device

Always put away a disconnected jogging device safe from any robot cell or controller to avoid that a disconnected unit is used when trying to stop the robot in a hazardous situation.



CAUTION

A disconnected jogging device should be stored in such a way that it cannot be mistaken for being connected to the controller.

Custom jogging device connections

Any means of connecting the jogging device with other than the supplied cable and its standard connector must not render the emergency stop button inoperative. Always test the emergency stop button to make sure it works if a custom connection cable is used.

4 The jogging device

4.1.2 Safe use of the jogging device

4.1.2 Safe use of the jogging device

Three-position enabling device

The three-position enabling device is a manually operated, constant pressure push-button which, when continuously activated in one position only, allows potentially hazardous functions but does not initiate them. In any other position, hazardous functions are stopped safely.

The three-position enabling device is of a specific type where you must press the push-button only half-way to activate it. In the fully in and fully out positions, operating the robot is impossible.



Note

The three-position enabling device is a push-button located on the jogging device which, when pressed halfway in, switches the system to MOTORS ON. When the enabling device is released or pushed all the way in, the manipulator switches to the MOTORS OFF state.

To ensure safe use of the jogging device, the following must be implemented:

- The enabling device must never be rendered inoperational in any way.
- During programming and testing, the enabling device must be released as soon as there is no need for the robot to move.
- Anyone entering the working space of the robot must always bring the jogging device with him/her. This is to prevent anyone else from taking control of the robot without his/her knowledge.

Hold-to-run function

The hold-to-run function allows movement when a button connected to the function is actuated manually and immediately stops any movement when released. The hold-to-run function can only be used in manual mode.

How to operate the hold-to-run function for IRC5 is described in *Operating manual - IRC5 with FlexPendant*.

4.1.3 Handling of FlexPendant

Handling of FlexPendant

The FlexPendant is a high-quality handheld terminal equipped with highly sensitive state-of-the-art electronics. To avoid malfunctions or damage through improper handling, follow these instructions during operation.

The FlexPendant may only be used for the purposes mentioned in this manual. The FlexPendant was developed, manufactured, tested and documented in accordance with applicable safety standards. If you follow the instructions regarding safety and use as described in this manual, the product will, in the normal case, neither cause personal injury nor damage to machinery and equipment.

Handling and cleaning

- Handle with care. Do not drop, throw, or give the FlexPendant strong shock. It can cause breakage or failure.
- If the FlexPendant is subjected to shock, always verify that the safety functions (three-position enabling device and emergency stop) work and are not damaged.
- When not using the device, hang it on the wall bracket provided for storage so it does not accidentally fall.
- Always use and store the FlexPendant in such a way that the cable does not become a tripping hazard.
- Never use sharp objects (such as screwdriver or pen) for operating the touch screen. This could damage the touch screen. Instead use your finger or a stylus (located on the back on FlexPendant with USB port).
- Clean the touch screen regularly. Dust and small particles can clog the touch screen and cause it to malfunction.
- Never clean the FlexPendant with solvents, scouring agent, or scrubbing sponges. Use a soft cloth and a bit of water or mild cleaning agent.
See Product manual - IRC5, section Cleaning the FlexPendant.
- Always close the protective cap on the USB port when no USB device is connected. The port can break or malfunction if exposed to dirt or dust.



CAUTION

A disconnected FlexPendant should be stored in such a way that it cannot be mistaken for being connected to the controller.

Cabling and power supply

- Turn off the power supply before opening the cable entrance area of the FlexPendant. Otherwise the components could be destroyed or undefined signals could occur.
- Make sure that nobody trips over the cable to prevent the device from falling to the ground.
- Take care not to squeeze and thus damage the cable with any object.

Continues on next page

4 The jogging device

4.1.3 Handling of FlexPendant

Continued

- Do not lay the cable over sharp edges since this can damage the cable sheath.

Waste disposal

Observe the national regulations when disposing of electronic components! When replacing components, please dispose of used components properly.

Foreseeable misuse of three-position enabling device

Foreseeable misuse means that it is not allowed to jam the three-position enabling device in the enabling position. The foreseeable misuse of the enabling device must be restricted.

When releasing and then pressing the three-position enabling device again, make sure to wait for the system to go to Motors Off state before pressing again. Otherwise you will receive an error message.

4.1.4 Safety in manual mode

What is the manual mode?

In manual mode the manipulator movement is under manual control. The three-position enabling device must be pressed to activate the motors of the manipulator, that is, enabling movement.

The manual mode is used when creating and verifying programs, and when commissioning a manipulator system.

There are two manual modes:

- Manual reduced speed mode, usually called manual mode.
- Manual full speed mode (not available in USA or Canada).

What is the manual full speed mode?

In manual full speed mode, the manipulator can move in programmed speed but only under manual control.

Operating speed

In manual reduced speed mode the movement is limited to 250 mm/s.

When in manual mode the manipulator is operated with personnel in close proximity. Maneuvering an industrial manipulator is potentially dangerous and therefore maneuvers should be performed in a controlled fashion.

In manual full speed mode, the manipulator can move in programmed speed but only under manual control. The manual full speed mode should only be used while all personnel are outside safeguarded space and only by specifically trained personnel extra aware of the implied risks.

Bypassed safeguard mechanisms

Automatic mode safeguarded stop (AS) mechanisms are bypassed while operating in manual mode.

The three-position enabling device

In **manual mode** the motors of the manipulator are activated by the three-position enabling device on the FlexPendant. This way the manipulator can only move as long as the device is pressed.

In order to run a program in manual full speed mode it is necessary, for safety reasons, to keep pressing both the three-position enabling device and the Start button. This hold-to-run function also applies when stepping through a program in manual full speed mode.

The three-position enabling device is designed so that its push-button must be pressed just half-way to activate the motors of the manipulator. Both in its all-out and full-in positions the manipulator will not move.

Continues on next page

4 The jogging device

4.1.4 Safety in manual mode

Continued

The hold-to-run function

The hold-to-run function allows stepping or running a program in manual full speed mode. Note that jogging does not require the hold-to-run function, regardless of operating mode. The hold-to-run function can also be activated for manual reduced speed mode.

4.1.5 Safety in automatic mode

What is the automatic mode?

The automatic mode is used for running the robot program in production.

In automatic mode the safety function of the three-position enabling device is bypassed so that the manipulator is allowed to move without human intervention.

Active safeguard mechanisms

Both the general mode stop (GS) mechanisms, the automatic mode stop (AS) mechanisms, and the superior stop (SS) are all active while operating in automatic mode.

Coping with process disturbances

Process disturbances may not only affect a specific manipulator cell but an entire chain of systems even if the problem originates in a specific cell.

Extra care must be taken during such a disturbance since that chain of events may create hazardous operations not seen when operating the single manipulator cell. All remedial actions must be performed by personnel with good knowledge of the entire production line, not only the malfunctioning manipulator.

Process disturbance examples

A manipulator picking components from a conveyer might be taken out of production due to a mechanical malfunction, while the conveyer must remain running in order to continue production in the rest of the production line. This means, of course, that extra care must be taken by the personnel preparing the manipulator in close proximity to the running conveyor.

A welding manipulator needs maintenance. Taking the welding manipulator out of production also means that a work bench as well as a material handling manipulator must be taken out of production to avoid personnel hazards.

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