

# Product manual

## Motor Units and Gear Units

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## **Product manual**

**MU 100, MU 200, MU 250, MU 300, MU 400  
MTD 250, MTD 500, MTD 750, MTD 2000, MTD 5000  
MID 500, MID 1000**

**IRC5**

**Document ID: 3HAC040148-001**

**Revision: G**

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# Overview of this manual

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## About this manual

This manual contains instructions for:

- Mechanical and electrical installation of the motor units and gear units.
- Maintenance of the motor units and gear units.
- Mechanical and electrical repair of the motor units and gear units.

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## Usage

This manual should be used during:

- Installation, from installation and connection, to making them ready for operation.
- Maintenance work.
- Repair work and calibration.

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## Who should read this manual?

This manual is intended for:

- Installation personnel.
- Maintenance personnel.
- Repair personnel.

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## 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.

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## Organization of chapters

The manual is organized in the following chapters:

Chapter	Contents
Safety	Safety information that must be read through before performing any installation or service work. Contains general safety aspects as well as more specific information on how to avoid personal injuries and damage to the product.
Installation	Step-by-step procedures and required information for installation.
Configuration	Step-by-step procedures and required information for configuration.
Calibration	Step-by-step procedures for calibration.
Tuning the thermal supervision	Step-by-step procedures for tuning the thermal supervision.
Maintenance	Step-by-step procedures for maintenance. Based on a maintenance schedule that can be used to plan periodical maintenance.
Repair	Step-by-step procedures for repair activities. Based on available spare parts.
Decommissioning	Environmental information about the components.

*Continues on next page*

Chapter	Contents
Reference information	Useful information when performing installation, maintenance, or repair work. Includes lists of necessary tools, additional documents, safety standards and so on. Reference to the spare parts list and the circuit diagrams.

### References

Reference	Document ID
<i>Product manual, spare parts - Motor Units and Gear Units</i>	3HAC040278-001
<i>Circuit diagram - Motor Units and Gear Units</i>	3HAC039887-001
<i>Product specification - Motor Units and Gear Units</i>	3HAC040147-001
<i>Operating manual - General safety information <sup>i</sup></i>	3HAC031045-001
<i>Product manual - IRC5</i> IRC5 with main computer DSQC 639.	3HAC021313-001
<i>Product manual - IRC5</i> IRC5 with main computer DSQC1000.	3HAC047136-001
<i>Product manual - IRC5 Panel Mounted Controller</i>	3HAC027707-001
<i>Product manual - IRC5 Compact</i>	3HAC035738-001
<i>Operating manual - IRC5 with FlexPendant</i>	3HAC050941-001
<i>Operating manual - RobotStudio</i>	3HAC032104-001
<i>Technical reference manual - System parameters</i>	3HAC050948-001
<i>Application manual - Additional axes and stand alone controller</i>	3HAC051016-001

<sup>i</sup> This manual contains all safety instructions from the product manuals for the manipulators and the controllers.

### Revisions

Revision	Description
-	First revision. MU 100, MU 200, and MU 300 replaces MU10, MU20, and MU30.
A	The following additions and corrections are made: <ul style="list-style-type: none"><li>Added information to use locking mechanism for MID units, see <a href="#">Installing gear units on page 40</a>.</li><li>Added information about acceleration torque limit for motor units, see <a href="#">Loading configuration files on page 55</a>.</li><li>Added descriptions of the abbreviations.</li></ul>
B	The following additions and corrections are made: <ul style="list-style-type: none"><li>Added <a href="#">Tuning the thermal supervision on page 61</a>.</li><li>Added <a href="#">WARNING - Safety risks during handling of batteries on page 25</a>.</li><li>Added <a href="#">Changing the cable harness in the controller on page 54</a>.</li></ul>

Continues on next page



Revision	Description
C	<p>The following additions and corrections are made:</p> <ul style="list-style-type: none"><li>• The formula for acceleration and deceleration values is corrected, see <a href="#">Dimensioning gear units on page 57</a>.</li><li>• Corrected the quality of attachment screws for gear units, see <a href="#">Installing gear units on page 40</a>.</li><li>• Added <a href="#">Lubricating the current collector on page 71</a>.</li><li>• Added <a href="#">Changing the cable harness in the controller on page 54</a>.</li><li>• Added <b>DANGER - Make sure that the main power has been switched off!</b> on page 22.</li><li>• A new SMB unit and battery is introduced, with longer battery lifetime.</li></ul>
D	<p>The following additions and corrections are made:</p> <ul style="list-style-type: none"><li>• The values for <math>T_{\text{maxgear}}</math> is updated with physical units, see <a href="#">Dimensioning gear units on page 57</a>.</li></ul>
E	Minor corrections.
F	<ul style="list-style-type: none"><li>• Updated the path to the template files, see <a href="#">Loading configuration files on page 55</a>.</li></ul>
G	<p>Published in release R17.1. The following updates are done in this revision:</p> <ul style="list-style-type: none"><li>• Added MU 250.</li><li>• Added information about Add-In in Installation Manager, see <a href="#">Loading configuration files on page 55</a>.</li></ul>

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# 1 Safety

## 1.1 General safety information

### 1.1.1 Safety risks

#### 1.1.1.1 Safety risks during installation and service work on robots

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##### 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.

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##### 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.

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##### Personal protective equipment

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

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##### 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*

# 1 Safety

## 1.1.1.1 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!	 <b>CAUTION</b> 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*

## 1.1.1.1 Safety risks during installation and service work on robots


*Continued*

Safety risk	Description
Removed parts may result in collapse of the robot!	 <b>WARNING</b> 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	 <b>WARNING</b> 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!	 <b>CAUTION</b> The cable packages are sensitive to mechanical damage. Handle the cable packages and the connectors with care in order to avoid damage.

**Gearboxes and motors**

Safety risk	Description
Gears may be damaged if excessive force is used!	 <b>CAUTION</b> Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!

## 1 Safety

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### 1.1.1.2 CAUTION - Hot parts may cause burns!

### 1.1.1.2 CAUTION - Hot parts may cause burns!

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#### Description

During normal operation, many robot parts become hot, especially the drive motors and gearboxes. Sometimes areas around these parts also become hot. Touching these may cause burns of various severity.

Because of a higher environment temperature, more surfaces on the robot get hot and may result in burns.

---

#### Elimination

The following instructions describe how to avoid the dangers specified above:

	Action	Information
1	Always use your hand, at some distance, to feel if heat is radiating from the potentially hot component before actually touching it.	
2	Wait until the potentially hot component has cooled if it is to be removed or handled in any other way.	

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**1.1.1.3 Risks associated with live electric parts**

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

*Continues on next page*

# 1 Safety

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## 1.1.1.3 Risks associated with live electric parts

*Continued*

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### **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.



### 1.1.2 Safety actions

#### 1.1.2.1 Fire extinguishing



##### Note

Use a CARBON DIOXIDE (CO<sub>2</sub>) extinguisher in the event of a fire in the robot or controller!

# 1 Safety

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## 1.1.2.2 Brake testing

### 1.1.2.2 Brake testing

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#### 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.

## 1.1.3 Safety stops

### 1.1.3.1 What is an emergency stop?

#### Definition of emergency stop

An emergency stop is a function that:

- takes precedence over all other robot controls
- causes all controlled hazards to stop
- removes drive power from the robot actuators
- provides capability for controlling hazards controlled by the robot system
- remains active until it is reset
- shall only be reset by manual action that does not cause a restart after resetting, but shall only permit a restart to occur.

Emergency stops are defined in standards ISO 10218-1 and IEC 60204.

An emergency stop state means that all power is disconnected from the robot except for the manual brake release circuits.

The emergency stop shall function either as a stop category 0 or as a stop category 1. The choice of the stop category of the emergency stop depends on the results of a risk assessment of the machine.

You must perform a recovery procedure to return to normal operation.



#### Note

The emergency stop function may only be used for the purpose and under the conditions for which it is intended.



#### Note

The emergency stop function is intended for immediately stopping equipment in the event of an emergency.



#### Note

Emergency stop should not be used for normal program stops as this causes extra, unnecessary wear on the robot.

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

#### Emergency stop buttons

In a robot system there are several emergency stop buttons that can be operated in order to achieve an emergency stop. There are emergency stop buttons available on the FlexPendant and on the controller cabinet. There can also be other types of emergency stops on your robot. Consult your plant or cell documentation to see how your robot system is configured.

# 1 Safety

## 1.2.1 Safety signals in the manual

## 1.2 Safety related instructions

### 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

Symbol	Designation	Significance
 xx0100000004	NOTE	Describes important facts and conditions.
 xx01000000098	TIP	Describes where to find additional information or how to do an operation in an easier way.

## 1 Safety

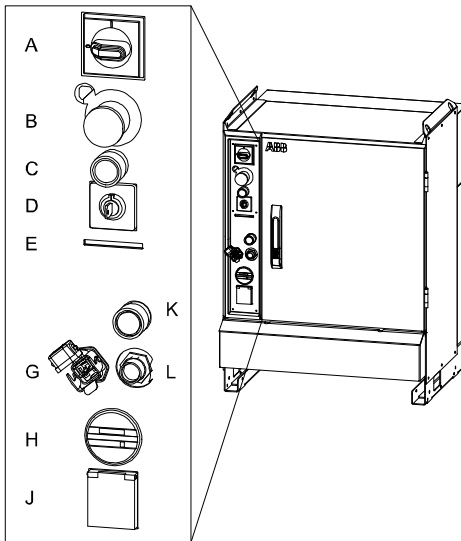
### 1.2.2 DANGER - Make sure that the main power has been switched off!

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

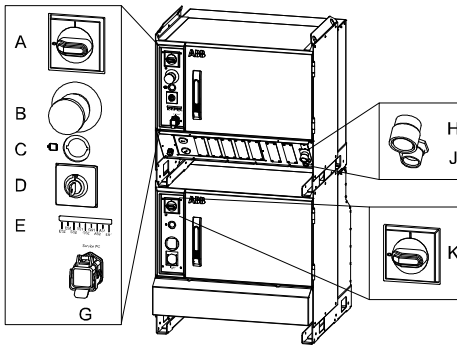
#### Description

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 Single Cabinet Controller

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

#### 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

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

## 1.2.3 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
1	Make sure the power is turned off.
2	Remove the push-button guard, if necessary.
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 in the tube.
4	If a button gets jammed in the depressed position, the alignment of the brake release unit must be adjusted so that the buttons can move freely in their tubes!

## 1 Safety

### 1.2.4 WARNING - The unit is sensitive to ESD!

### 1.2.4 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.

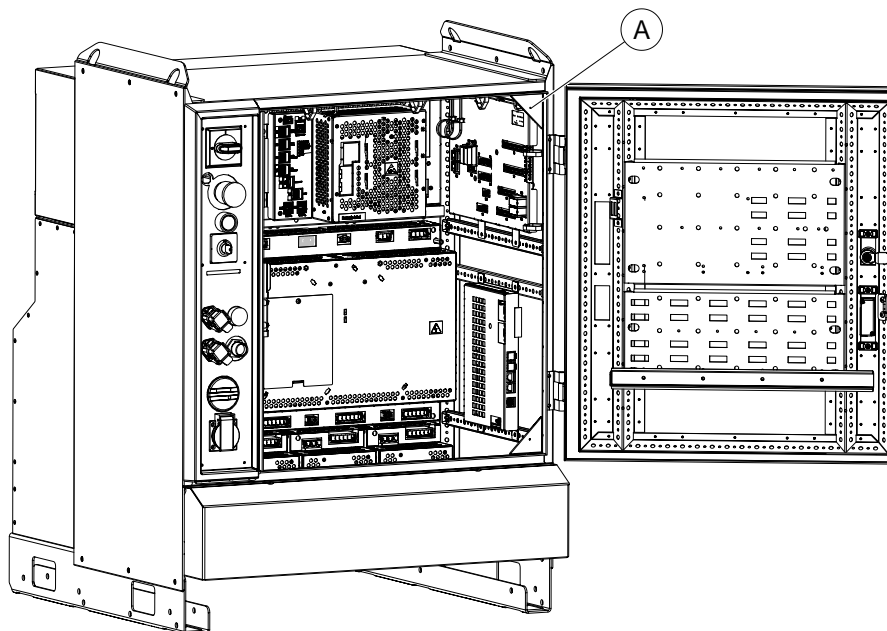
#### Elimination

	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
---	--------------------



## 1.2.5 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.	

## 1 Safety

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

### 1.2.6 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 <b>Hot oil or grease</b>	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 <b>Allergic reaction</b>	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 <b>Possible pressure build-up in gearbox</b>	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*

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

*Continued*

Warning	Description	Elimination/Action
 xx0100000002 <b>Do not overfill</b>	<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"> <li>• damage seals and gaskets</li> <li>• completely press out seals and gaskets</li> <li>• prevent the robot from moving freely.</li> </ul>	<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 <b>Specified amount depends on drained volume</b>	<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 <b>Contaminated oil in gear boxes</b>	<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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## 2 Product overview

### 2.1 Introduction to motor units and gear units

---

**Product overview**

The motor units and gear units function as external axes in the IRC5 system. They are controlled by drive units mounted in the IRC5 controller. The units are designed for optimal performance, installation, and application.

The motor units and gear units use much of the same components and are therefore described together.

---

**SMB box**

The SMB box (optional) contains a serial measurement board (with battery backup) and brake release buttons (optional).

Note that if the motor unit is used in an arc welding station, the SMB box must always be insulated from the weld circuit. See [Insulation in arc welding stations on page 51](#).

---

**Axis selector**

The axis selector (optional) is mounted inside the IRC5 controller and makes it possible to cut the power for selected connected external units. The function is controlled by instructions in the robot program.

## 2 Product overview

---

### 2.2 Motor units

## 2.2 Motor units

---

### Introduction

The motor units are specially designed for ABB's robots and can be used for peripherals requiring servo steered motors that are synchronized with the robot movements.

---

### MU variants

The following motor unit variants are available:

- MU 100
- MU 200
- MU 250
- MU 300
- MU 400

MU stands for *motor unit*.

---

### Product overview

The motor units consist of:

- Motor
- SMB box (optional)
- Axis selector (optional)
- Cables

---

### Prerequisites

- IRC5 requires 3 phase power.
- *Electronic Position Switches* can be used with one motor.
- *SafeMove* can be used with up to three motors.

---

### Technical data

Motor unit	Weight [kg]
MU 100	4.4
MU 200	9.3
MU 250	13.2
MU 300	15
MU 400	27

## 2.3 Gear units

### Introduction

The gear units are divided in two categories, MTD and MID.  
The number in the variant name describes the handling capacity.

### MTD variants

The rotary unit MTD is a modular unit, developed specifically for robot applications and is intended for positioning the workpiece.

- MTD 250
- MTD 500
- MTD 750
- MTD 2000
- MTD 5000

MTD stands for *mechanical turning* unit (D is a generation label).

### MID variants

The station interchange unit MID is a modular unit specifically developed for robot applications and is intended for indexed movement.

- MID 500
- MID 1000

MID stands for *mechanical interchange* unit (D is a generation label).

### Product overview

The gear unit consists of:

- Gearbox
- Motor
- SMB box (optional)
- Axis selector (optional)
- Cables
- Drive Module with modified cable harness (optional)

### Technical data

Gear unit	Weight [kg]
MTD 250	70
MTD 500	180
MTD 750	180
MTD 2000	340
MTD 5000	770
MID 500	170
MID 1000	395

## 2.4 Basic approach

---

### Introduction to basic approach

Depending on the application and system, the setting up procedure for the motor unit or gear unit differs. This manual describes the basic approach and refers to other manuals for more information.

---

### Setting up motor units and gear units

Use this procedure to set up motor units or gear units.

- 1 Mount the motor unit or gear unit, and the SMB box. Connect cables.  
For motor units, see [Installing motor units on page 37](#).  
For gear units, see [Installing gear units on page 40](#).
  - 2 Load the configuration files, see [Loading configuration files on page 55](#).
  - 3 Testrun with loads. If needed, tune the configuration data, see [Tuning on page 58](#).
  - 4 Calibrate, see [Calibration on page 59](#).
  - 5 Tune the thermal supervision, see [Tuning the thermal supervision on page 61](#).
- 

### Related information

*Application manual - Additional axes and stand alone controller.*

*Operating manual - IRC5 with FlexPendant.*

*Operating manual - RobotStudio.*



## 2.5 Scenarios

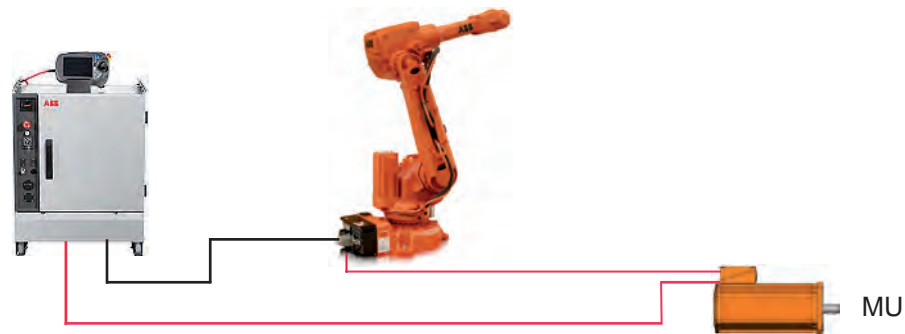
### Introduction

Below are different scenarios described for installation of the units. The axis selector, available as an option inside the controller, allowing to cut the power to the motor units and gear units, will not be shown in the scenarios below.

### Motor units

Scenario A, Lean concept:

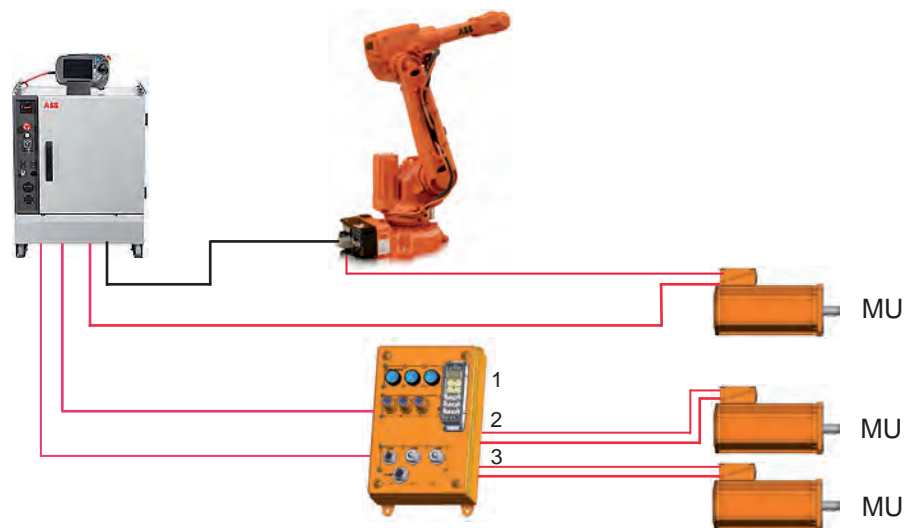
- One motor unit
- No SMB box
- Motor power connected to the IRC5 controller and resolver connected to FB7 at manipulator.



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Scenario B:

- One motor unit connected to the IRC5 controller, according to Lean concept above
- SMB box connected to the IRC5 controller
- Two motor units connected to SMB box



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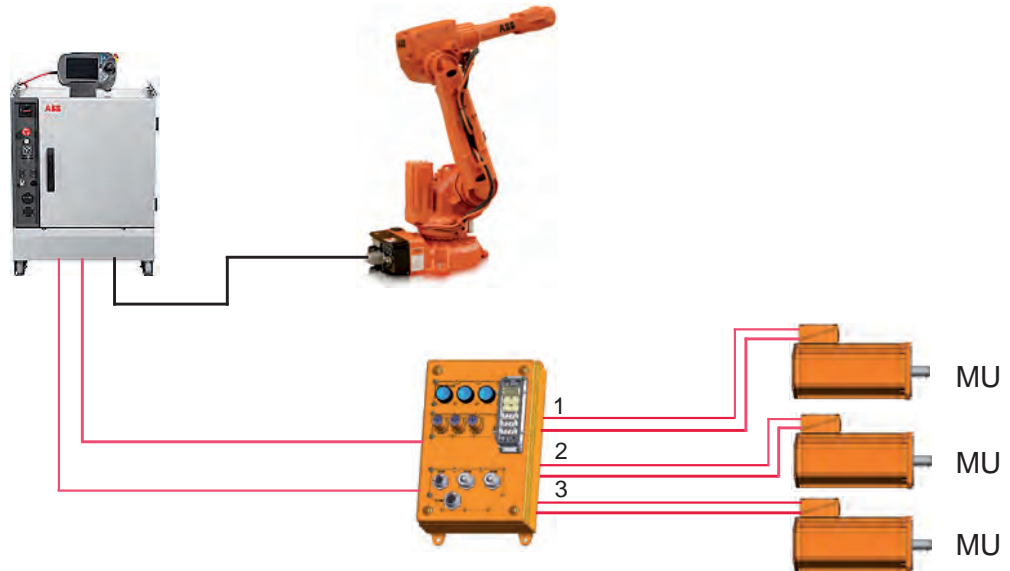
## 2 Product overview

### 2.5 Scenarios

*Continued*

#### Scenario C:

- SMB box connected to the IRC5 controller
- Three motor units connected to one SMB box

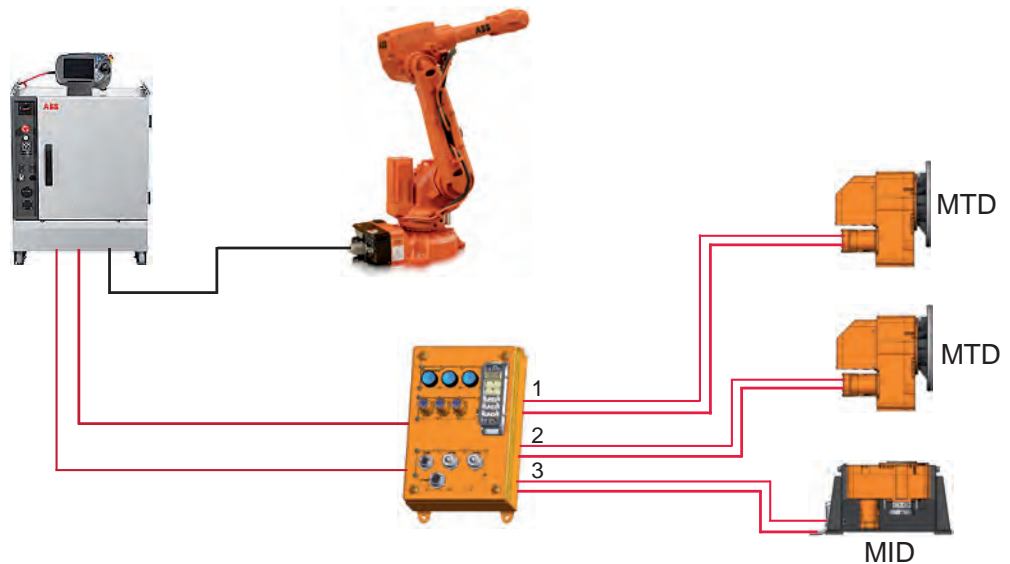


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#### Gear units

#### Scenario A:

- SMB box connected to the IRC5 controller
- Three gear units connected to one SMB box

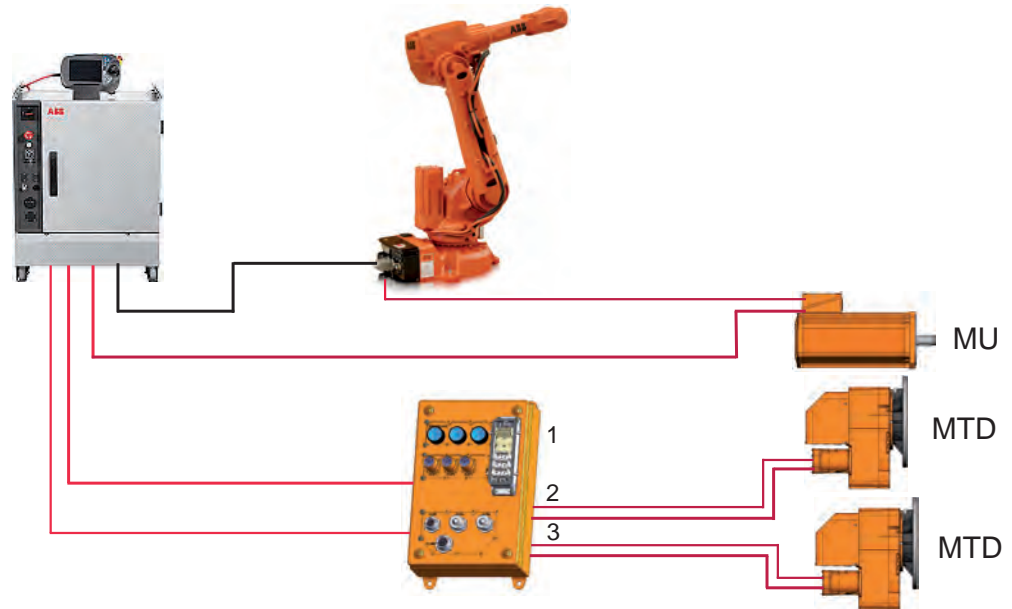


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#### Scenario B:

- One motor unit connected to the IRC5 controller, according to Lean concept
- SMB box connected to the IRC5 controller
- Two gear units connected to one SMB box



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*Continues on next page*

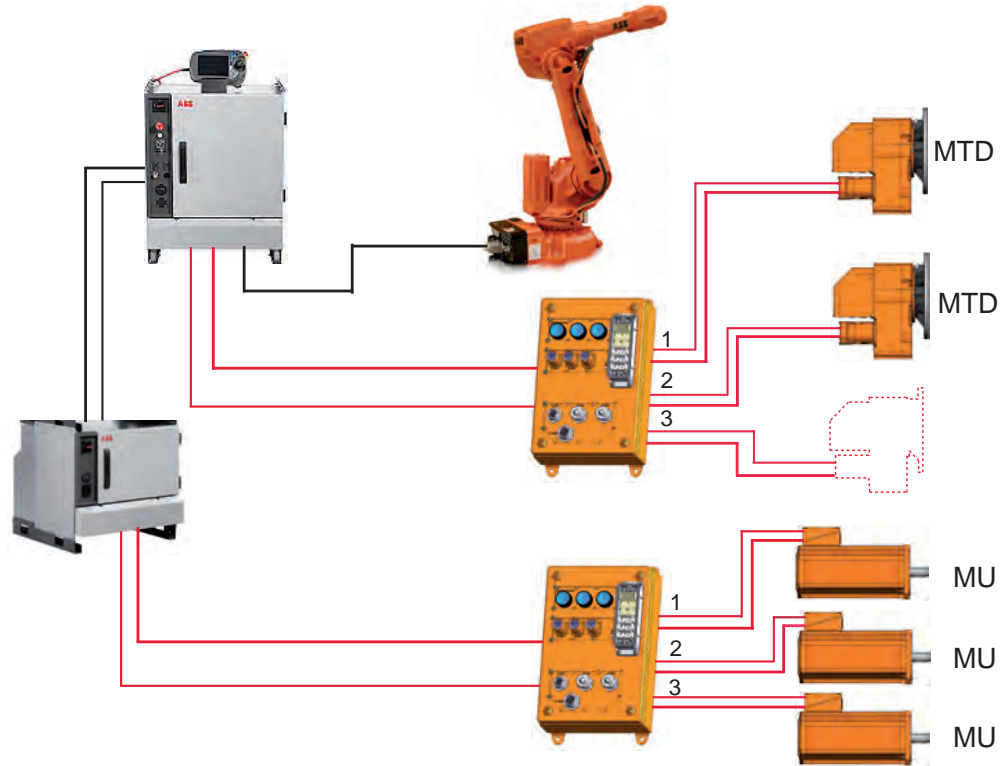
## 2 Product overview

### 2.5 Scenarios

*Continued*

#### Scenario C:

- One SMB box connected to the IRC5 controller
- Two gear units connected to the IRC5 controller, through the SMB box
- One SMB box connected to IRC5 drive module
- Three motor units connected to the IRC5 drive module through the SMB box



xx1000001201

## 3 Installation

### 3.1 Installing motor units

#### Attachment screws

The table shows tightening torques for the attachment screws of the motor units. The values are valid for non-lubricated screws. All screws should be of quality 8.8.

Motor unit	Screw	Tightening torque [Nm] $\pm 10\%$
MU 100	M6	10
MU 200	M8	24
MU 250	M8	24
MU 300	M8	24
MU 400	M10	47

Use washers with minimum hardness 200HV (190HB).

#### Prerequisites



#### CAUTION

Never overheat the motor. The winding temperature must not exceed 140° C. Check that the temperature on the motor frame is lower than 100° C.

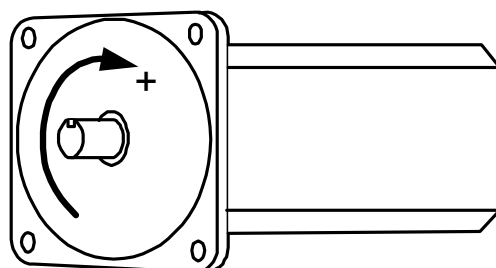


#### WARNING

If the motor unit is used in an arc welding station, the SMB box must always be insulated from the weld circuit. See [Insulation in arc welding stations on page 51](#).

#### Motor connection

Positive electric rotation R -> S -> T -> (U, V, W) results in positive mechanical rotation defined as clockwise direction, seen from the drive shaft side. See illustration below.



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*Continues on next page*

## 3 Installation

### 3.1 Installing motor units

*Continued*

#### Releasing the brakes during installation

To release the motor brake during installation, feed +24V to the connection BRAKEA/B/L, and 0V to the connection BRAKE. See the circuit diagram.






#### CAUTION

Never shift polarity of the brake. If the polarity is shifted, the motor unit will be damaged.

#### Installing motor units

Use this procedure to install motor units. For cable connections, see [Fastening cables on page 43](#).

	Action	Information
1	<p>Fit the motor in position and secure it with its attachments screws.</p> <p> <b>CAUTION</b></p> <p>When fitting the motor pinion, make sure not to use high force or other methods that can damage the pinion, shaft, or resolver. See <a href="#">Assembling motor axis and transmission element on page 45</a>.</p>	<p> <b>CAUTION</b></p> <p>If using the motor unit in direct contact with oil or grease, make sure that the running conditions are suitable for the motor sealing.</p>
2	<p>If using an SMB box, fit and secure the box.</p>	<p>If there is a risk of return currents, then the box must be isolated, see <a href="#">Insulation in arc welding stations on page 51</a>.</p>
3	<p>If using a separate drive module cabinet, connect the cable included with the cabinet.</p>	<p>Assembly instructions are included in the kit.</p>
4	<p>Connect the power cable from the controller or SMB box to the motor.</p> <p> <b>Note</b></p> <p>Fasten the M23 connector fully. See <a href="#">Fastening cables on page 43</a>.</p>	<p>If the controller is not prepared for motor units, then the connector must be replaced, see <a href="#">Changing the cable harness in the controller on page 54</a>.</p>
5	<p>Connect the resolver cable from the robot or SMB box to the motor.</p>	
6	<p>If using an SMB box, connect the SMB cable from the controller to the SMB box.</p>	
7	<p>Mark the cables.</p>	
8	<p>Test the brake release buttons.</p>	<p>See <a href="#">Testing the brake release buttons on page 50</a>.</p>



#### CAUTION

Make sure that the thermal supervision is properly tuned, see [Tuning the thermal supervision on page 61](#).

*Continues on next page*

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### Related information

*Fastening cables on page 43.*

*Handling of motors on page 45.*

*Insulation in arc welding stations on page 51.*

*Circuit diagrams on page 83.*

## 3 Installation

### 3.2 Installing gear units

### 3.2 Installing gear units

#### Attachment screws

The tables show the attachment screws and tightening torques for the gear units. All screws should be of quality 12.9.

#### MTD

Gear unit	Screw	Tightening torque [Nm] ±10%	Minimum thread length in gearbox [mm]
MTD 250	M12	120	29
MTD 500	M20	550	47
MTD 750	M20	550	47
MTD 2000	M20	550	50
MTD 5000	M24	950	37

#### MID

The maximum floor loads in relation to the base coordination system for the MID units are described in *Product specification - Motor Units and Gear Units*.

Gear unit	Screw
MID 500	M16
MID 1000	M20

#### Prerequisites



#### CAUTION

Never overheat the motor. The winding temperature must not exceed 140° C. Check that the temperature on the motor frame is lower than 100° C.




#### WARNING

If the gear unit is used in an arc welding station, the SMB box must always be insulated from the weld circuit. The gearbox is isolated from the motor. See [Insulation in arc welding stations on page 51](#).


#### Installing gear units


Use this procedure to install gear units. For cable connections, see [Fastening cables on page 43](#).

	Action	Information
1	Fit the gear unit in position and secure it with its attachments screws.	 <b>WARNING</b> The gear unit is heavy. Always use properly sized lifting accessories.

*Continues on next page*



	Action	Information
2	If using an SMB box, fit and secure the box.	If there is a risk of return currents, then the box must be isolated, see <a href="#">Insulation in arc welding stations on page 51</a> .
3	If using a separate drive module cabinet, connect the cable included with the cabinet.	Assembly instructions are included in the kit.
4	Connect the power cable from the controller or SMB box to the gear unit.	 <b>Note</b> Fasten the M23 connectors fully. See <a href="#">Fastening cables on page 43</a> .
5	Connect the resolver cable from the robot or SMB box to the gear unit.	
6	If using an SMB box, connect the SMB cable from the controller to the SMB box.	
7	If using drive module cabinet: <ul style="list-style-type: none"> <li>• Assemble the cable kit (3HAC040089-001) according to the instructions delivered with the cable kit.</li> <li>• Connect cables to the controller cabinet.</li> <li>• Connect cables to the SMB box.</li> <li>• Connect cables from the SMB box to the motor units.</li> </ul>	
8	Mark the cables.	
9	Install a current collector.	
10	Test the brake release buttons.	See <a href="#">Testing the brake release buttons on page 50</a> .
11	Fit and secure the flange to the equipment to be controlled by the gear unit.	

 **CAUTION**  
 Make sure that the thermal supervision is properly tuned, see [Tuning the thermal supervision on page 61](#).

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## 3 Installation

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### 3.2 Installing gear units

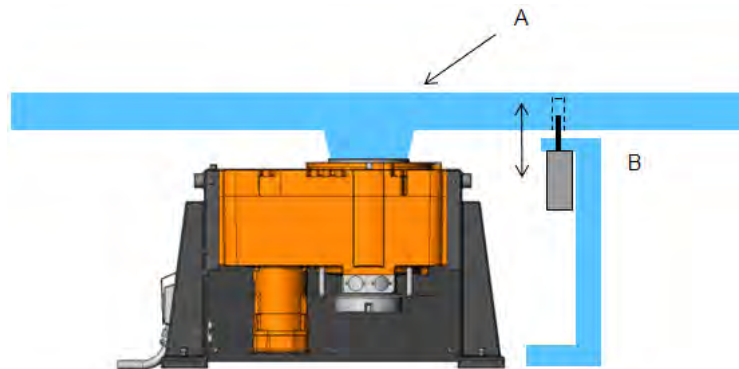
*Continued*

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#### Recommendations for MID units

The station interchange units have endless rotation and are delivered without a locking mechanism. ABB recommends using a pneumatic, externally operated locking pin for locking, to reduce the risk of collision with the end stop. This also relieves the pressure on the station interchange unit.

#### Example



xx1100000478

A	Locally made swing frame
B	Pneumatic plunger

---

#### Related information

[Fastening cables on page 43.](#)

[Insulation in arc welding stations on page 51.](#)

[Circuit diagrams on page 83.](#)

### 3.3 Fastening cables

#### Protecting cables

Protect all flexible cables from weld spatter.

Place the cables so the risk of mechanical wear is minimized.

#### M23 connectors

Wobble the M23 connector body while tightening the connectors to make sure that they are fully fastened.

#### Cable markings

Cable connections are marked with default names on delivery. Add suitable labels or other markings during installation to simplify maintenance.

Cable connection	Marking
Motor power cables	MP
Feedback cables	FB

#### SMB cable

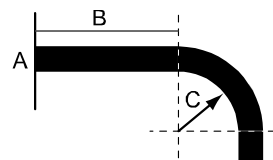
The key pin in plug SMB bus cable (3HAC2493-1, 2530-1, 2566-1) must be removed when connecting to XS41 or XS41.2 in the IRC5 controller.

#### Limitations

The following limitations apply when installing and fastening cables for the motor units or gear units to get best performance and durability.

#### Bending

Make sure that cables are not bent too close to the fastening points or too sharply.

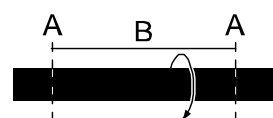


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A	Fastening point or connector
B	Minimum distance from fastening point to bend is 100mm
C	Minimum bending radius is 100mm

#### Twisting

The minimum length between the fastening points is 900mm if the cable will be twisted  $\pm 180^\circ$ .



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*Continues on next page*

### 3 Installation

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#### 3.3 Fastening cables

*Continued*

A	Fastening points or connectors
B	Minimum length is 900mm

#### Fastening straps

Do not over-tighten cables when fastening them with straps.

### 3.4 Handling of motors

#### Assembling motor axis and transmission element

Couplings, pulley, and motor pinion (transmission elements) must be assembled using adequate tools. Otherwise the motor shaft can be distorted which damages the resolver. Never use a hammer, as this will damage the equipment.



#### CAUTION

When fitting the transmission element, make sure not to use high force or other methods that can damage the transmission element, shaft, resolver, or connection box.

The motor axis should be fitted using a press tool or a method with a dolly. Use heating if required.

The maximum allowed press force depends on the assembly method. See the following figures and tables.



#### Note

Grease the shaft after assembly to avoid oxidation.

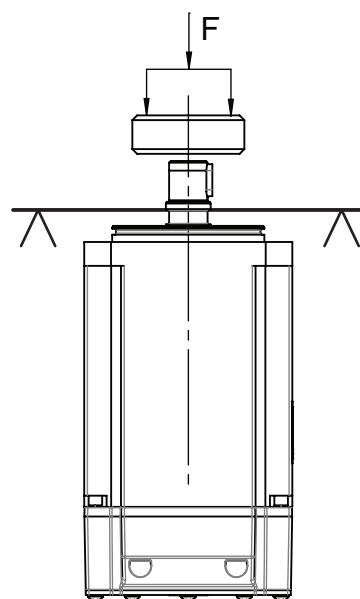
#### Assembly with press tool

Assembly using a press tool with dolly is the best method. The tool can be fitted on the motor shaft as shown in the following figure.



#### Note

This method is not applicable for MU 100 since it does not have a flange on the motor shaft.



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*Continues on next page*

### 3 Installation

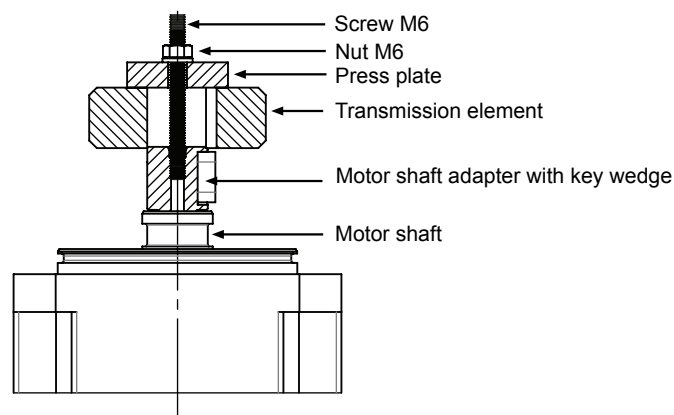
#### 3.4 Handling of motors

*Continued*

	Maximum allowed axial force (F)
MU 100	-
MU 200	40 kN
MU 250	40 kN
MU 300	40 kN
MU 400	60 kN

##### Assembly with nut and bolt

The motor and the transmission element can be assembled with a nut and bolt as shown in the following figure. The transmission element is driven onto the motor shaft by turning the nut. If needed, the transmission element can also be heated.



xx1300000314

##### Assembly by pressing on the pinion

The motor and the transmission element can be assembled by pressing, with or without heat.

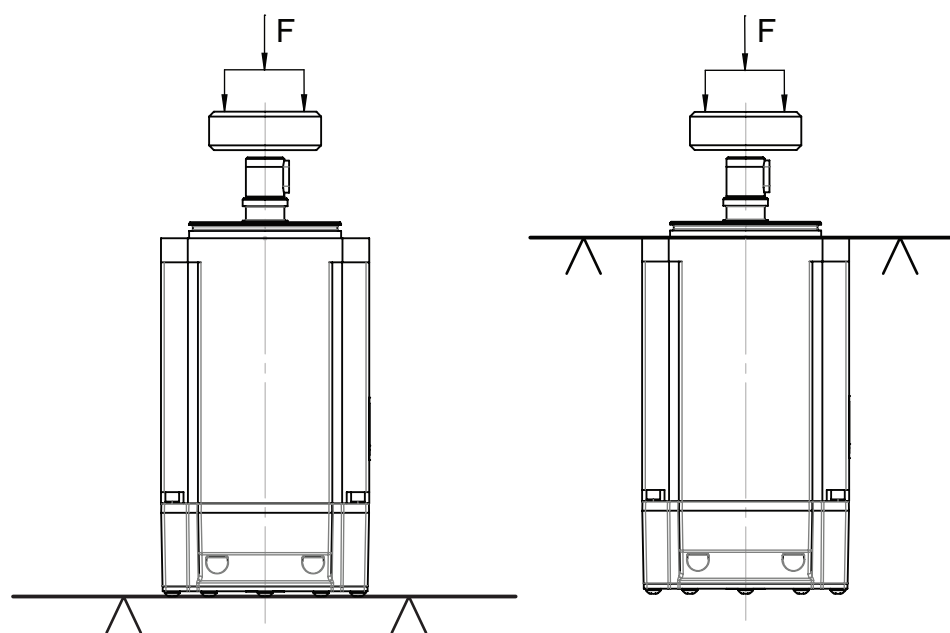
Use the screw heads in the connection box or the motor flange as a dolly, as shown in the following figures.



#### CAUTION

Make sure that the contact surfaces between the motor and the dolly distribute the press force evenly.

*Continues on next page*



xx1300000315

	Maximum allowed axial force (F)
MU 100	125 N
MU 200	1963 N
MU 250	1963 N
MU 300	1963 N
MU 400	2825 N

*Continues on next page*

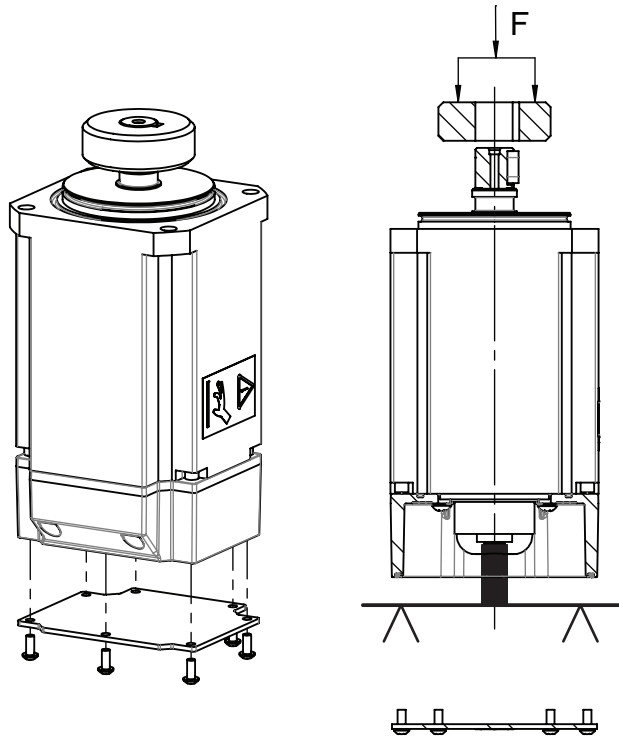
### 3 Installation

#### 3.4 Handling of motors

*Continued*

##### Assembly with open back cover

If no press tool with dolly is available, the back cover of the motor can be opened so that some other flat and stable object can be used as dolly directly on the motor shaft. Make sure not to press on the resolver.



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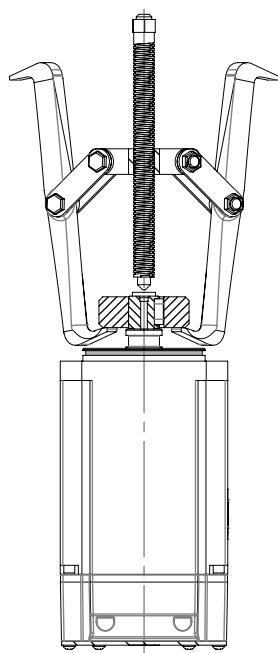
	Maximum allowed axial force (F)
MU 100	10 kN
MU 200	20 kN
MU 250	20 kN
MU 300	20 kN
MU 400	30 kN

*Continues on next page*



#### Disassembling the transmission element from the motor

Use a puller tool to disassemble the the transmission element from the motor axis.



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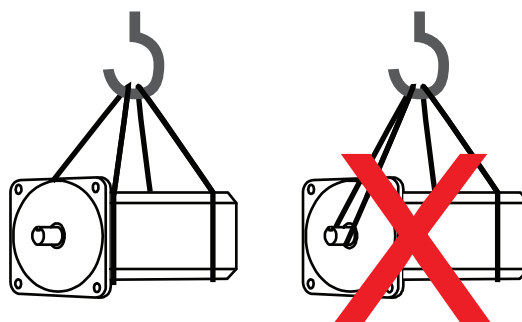
#### Note

Place a shim or washer on the shaft end for protection, so that the puller tool does not press directly on the shaft.

#### Lifting motors

Use lifting accessories that are accordingly sized for the motor.

When lifting the motor with roundslings, never place the sling around the motor shaft.



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## 3 Installation

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### 3.5 Testing the brake release buttons

### 3.5 Testing the brake release buttons

---

#### Introduction to testing brake release buttons

The brake release buttons should be tested before mounting loads or external equipment.

---


#### Prerequisites

The motor unit or gear unit must be installed.  
The brake release button must be connected.  
There must be power available to the controller.

---

#### Testing the brake release buttons

Use this procedure to test the brake release buttons.

	Action	Information
1	Turn on the power to the controller.	
2	 <b>WARNING</b> When releasing the holding brakes, the axes can move very quickly and sometimes in unexpected ways! Make sure no personnel is near or beneath an axis!	
3	Press the brake release button.	When the brake is released, the axis should be possible to move.
4	Verify that the correct motor brake was released.	

### 3.6 Insulation in arc welding stations

---

#### Galvanic insulation from the weld circuit

If using the motor unit or gear unit in an arc welding cell, the return currents must be properly taken care of. The SMB box must always be insulated from the weld circuit.

#### Gear units

The rotary units (MTD) and the station interchange units (MID) have the motor galvanically insulated from the weld circuit, that is, there is no connection between the weld circuit and protective earth.

#### SMB box

The SMB box is connected to protective earth and must always be mounted galvanically insulated from the weld circuit.

#### Motor units

The motor units are connected to protective earth. When using the motor units in work piece positioners or other equipment connected to the weld circuit there will be a connection between the weld circuit and protective earth.

To avoid malfunction:

- Verify that good contact is established between the welding power source and work piece positioner.
- Never disconnect the weld return cable.
- Verify that the current collector, if used, is working properly and has a low voltage drop.

---

#### Hazardous scenario

The following graphic shows a hazardous scenario with two faults causing the weld current to flow in protective earth.

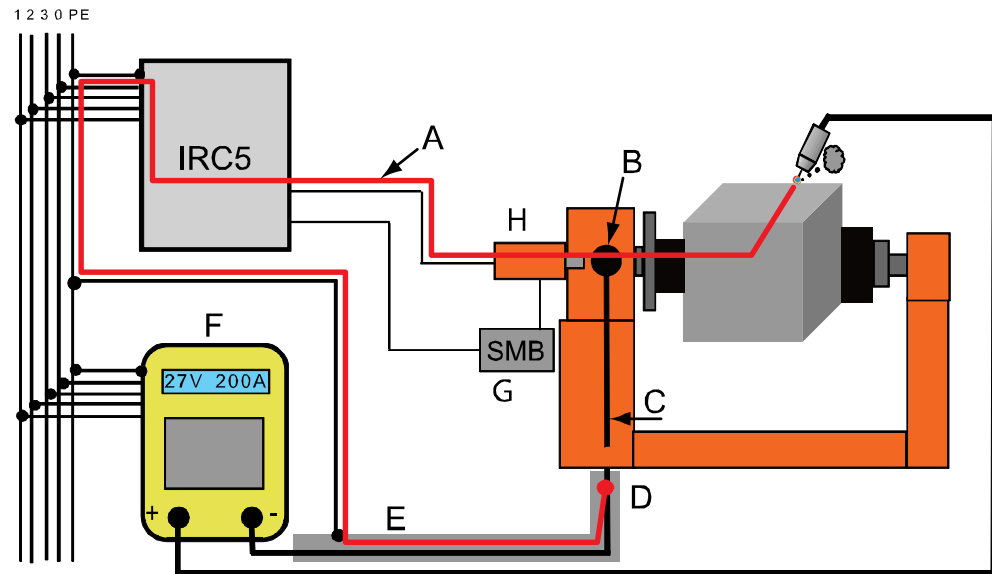
- The weld return cable is disconnected from the work piece positioner.
- The weld return cable has contact with protective earth, in this case a cable channel made of metal.

*Continues on next page*

### 3 Installation

#### 3.6 Insulation in arc welding stations

*Continued*



xx1100000103

A	Weld return current in protective earth
B	Current collector
C	The weld return cable is disconnected from the work piece positioner
D	The weld return cable has contact with protective earth
E	Cable channel made of metal
F	Power source
G	SMB box galvanically insulated from the weld circuit
H	Motor unit's protective earth connected to the weld circuit

### 3.7 Installing non ABB brake release buttons

---

#### Brake release buttons

The motor units are prepared for installing other brake release buttons than those supplied in the SMB box.

#### Installing non ABB brake release buttons

Use connection BRAKE PB. See the connections in the circuit diagram.

#### Related information

*[Circuit diagrams on page 83.](#)*

## 3 Installation

### 3.8 Changing the cable harness in the controller

### 3.8 Changing the cable harness in the controller

#### Cable harness

The cable harness for the seventh axis must be replaced if a motor unit is added to a controller that is delivered without any of the motor unit options.




#### Note

The procedure depends on the motor variant, if an axis selector is used etc. Use the action scenarios in the circuit diagram as reference during the installation of the cable harness.

#### Changing the cable harness

Use this procedure to change the cable harness in the controller.

	Action	Note
1	 <b>DANGER</b> Before commencing any work inside the cabinet, please observe the safety information in section <i><b>DANGER - Make sure that the main power has been switched off!</b></i> on page 22.	
2	Remove the cable harness for the XS.7 contact.	
3	Refit the new cable harness.	<i>Circuit diagram - Motor Units and Gear Units</i>

## 4 Configuration

### 4.1 Loading configuration files

#### Introduction to configuration files

Template configuration files are included in the delivery with the motor units and gear units. The configurations for motor units and gear units can be tuned before running in production to optimize performance.

The template files are located in the following directory in the RobotWare installation:

- ... \RobotPackages\RobotWare\_RPK\_<version>\utility\MotorUnits\
- ... \RobotPackages\RobotWare\_RPK\_<version>\utility\GearUnits\



#### Note

Navigate to the RobotWare installation folder from the RobotStudio **Add-Ins** tab, by right-clicking on the installed RobotWare version in the **Add-Ins** browser and selecting **Open Package Folder**.



#### Tip

In RobotWare 6.05 (and later) the Add-In for motor units and gear units can be selected directly in **Installation Manager**. The tuning is done after installation.

#### Limitations

The values for acceleration and deceleration used in the template files might need to be verified. For gear units see [Dimensioning gear units on page 57](#). For motor units, see *Application manual - Additional axes and stand alone controller*.

For MID gear units, the working range must be carefully tested and if needed redefined. If the defined value is wrong, there is a risk that the MID crashes into the end stop.

#### Acceleration torque limit for motor units

The acceleration torque limit for the motor units is by default reduced to protect connected equipment. The acceleration torque limit can be increased, see *Product specification - Motor Units and Gear Units*.

Redefine the system parameter *Torque Absolute Max* in the type *Stress Duty Cycle* (topic *Motion*) to increase the acceleration torque limit.

#### File name convention

The configuration files use a naming convention, based on the following data:

- Configuration topic
- Type of unit
- Drive unit and drive module (system parameters *Drive Unit* and *Drive Module*)

*Continues on next page*

## 4 Configuration

---

### 4.1 Loading configuration files

*Continued*

- Measurement link, board position, and measurement node (system parameters *Measurement Link*, *Board Position*, and *Measurement Node*)

For example, `MOC_MU100_M7DM1_L1B1N7.cfg`, defines:

- Topic *Motion*
- Motor unit MU 100
- Drive unit 7 and drive module 1
- Measurement link 1, board position 1, and measurement node 7

---

### Loading configuration files

Use this procedure to load configuration files.

	Action	Information
1	In RobotStudio, load the configuration files for the motor units and the gear units. Open the file <code>readme.txt</code> to verify which files to use.	All files are included in the folder <code>...\utility\...</code> in the RobotWare installation.
2	If using an axis selector, load the configuration files for the axis selector after the files for the motor units and gear units are loaded. Use the add and replace duplicates option to overwrite existing parameters.	
3	Tune the motor.	See <a href="#">Tuning on page 58</a> .

---

### Related information

*Operating manual - RobotStudio.*

*Application manual - Additional axes and stand alone controller.*

Configuration files and standard system parameters are described in *Technical reference manual - System parameters*.



## 4.2 Dimensioning gear units

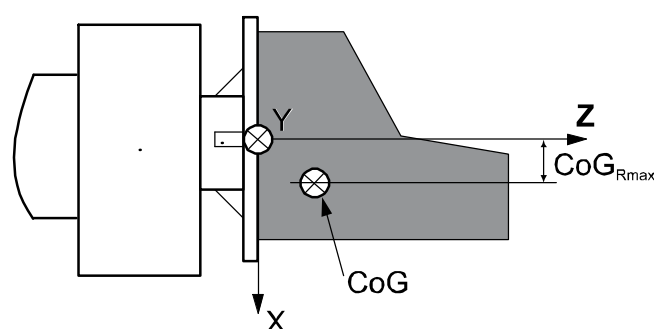
### Acceleration and deceleration values

To secure that gear units will not run too hard and damage the gear box, the acceleration and deceleration of the axis on the arm side must be calculated.

This calculation will give a maximum value for the system parameters *Nominal Acceleration* and *Nominal Deceleration*. The value can be lowered if the acceleration is too fast, see *Application manual - Additional axes and stand alone controller*.

Do not use values higher than the recommended maximum acceleration, see [Maximum gearbox torques on page 57](#).

$$(T_{\max\text{gear}} - m * g * \text{CoG}_{\text{Rmax}}) / (m * \text{CoG}_{\text{Rmax}}^2 + J_{0z})$$



xx1100000104

$J_{0z}$  is the moment of inertia around the Z axis at the center of gravity (CoG).

$\text{CoG}_{\text{Rmax}}$  is the radial distance in X and Y directions between the Z axis and the center of gravity (CoG).

Define the system parameters *Nominal Acceleration* and *Nominal Deceleration* in the type *Acceleration Data* in the topic *Motion*, based on the calculations.

### Maximum gearbox torques

Use the  $T_{\max\text{gear}}$  values from the table for the calculation.

Gear unit	$T_{\max\text{gear}}$ (max torque on arm side) (Nm)	Recommended maximum acceleration and deceleration (rad/s <sup>2</sup> )
MTD 250	480	4
MTD 500	1100	3
MTD 750	1950	3
MTD 2000	5000	0.8
MTD 5000	11400	0.5
MID 1.1	1950	2.4
MID 2.1	5000	1.1

### Related information

Dimensioning of motors is described in *Application manual - Additional axes and stand alone controller*.

## 4 Configuration

---

### 4.3 Tuning

### 4.3 Tuning

---

#### Introduction to tuning

The template configuration files can be tuned to optimize the performance. The configuration data is preferably tuned using *TuneMaster*, or as described for additional axes, see *Application manual - Additional axes and stand alone controller*.

#### TuneMaster

*TuneMaster* is an easy to use PC tool to optimize the motion performance. *TuneMaster* is included on the RobotWare DVD, in the folder *Tools*. How to use *TuneMaster* is described in the help file included in the installation.

#### Basic approach for tuning

How to tune depends on the tools used. However, the following steps apply:

- 1 Testrun without loads to verify if tuning is needed.
- 2 Testrun with loads.
- 3 If needed, tune the configuration data and repeat steps 1-2.

#### Related information

*Application manual - Additional axes and stand alone controller.*

*Operating manual - IRC5 with FlexPendant.*

*Operating manual - RobotStudio.*

*Technical reference manual - System parameters.*

*TuneMaster* help file.

## 5 Calibration

### When to calibrate

Mechanical units must be calibrated after installation, if parts of the transmission are replaced, or if the resolver memory is lost.

Fine calibration defines the calibration zero position and updates the revolution counters.

### Calibration position

Any position can be defined as the calibration zero position but it must be possible to move the axis to this position with good precision repeatedly. For example, this can be a mechanical stop or another indicator that clearly shows the position.

### Fine calibrating mechanical units

Use this procedure to fine calibrate the mechanical units.

	Action	Note
1	Move the mechanical unit to a suitable zero position for calibration.	Mark the zero position for future reference.
2	On the FlexPendant <b>ABB</b> menu, tap <b>Calibration</b> .	
3	Tap to select the mechanical unit.	
4	Tap <b>Fine Calibration</b> .	
5	Tap to select the axis and then tap <b>Calibrate</b> .	

### Updating revolution counters

Use this procedure to update revolution counters.

	Action	Note
1	Move the mechanical unit to the zero position for calibration.	
2	On the FlexPendant <b>ABB</b> menu, tap <b>Calibration</b> .	
3	Tap <b>Rev. Counters</b> and then tap <b>Update Revolution Counters</b> .	
4	Tap to select the axis and then tap <b>Update</b> .	

### Related information

Calibration is described in *Operating manual - IRC5 with FlexPendant*.

Commutation of motors is described in *Application manual - Additional axes and stand alone controller*.

Coordinated positioners and user frames are described in *Application manual - Additional axes and stand alone controller*.

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## 6 Tuning the thermal supervision

### Thermal supervision

The motor units (except MU 100) and the gear units are protected from overload by a thermal supervision. If the motor temperature is close to the defined maximum temperature then the system shows a warning. If the maximum temperature is exceeded then the unit will stop.

For optimal efficiency, the thermal supervision should be tuned for the environment in which the system is installed.

### System parameters

The maximum temperature for the robot and the thermal supervision sensitivity ratio are defined by the system parameters. The values can be changed using the *Control Panel* on the FlexPendant.

System parameter	Allowed values	Default value	Note
Maximum temperature ( <i>Max Temperature Robot</i> )	+5 °C to +52°C	+45°C	The value should be set to the maximum expected ambient temperature for the MU, MTD, MID, and manipulator. <i>Topic Motion</i> , type <i>Motion System</i> .
Thermal supervision ( <i>Thermal Supervision Sensitivity Ratio</i> )	0.5 to 2	1.0	<i>Topic Motion</i> , type <i>Supervision</i> .



#### Note

The system must be restarted after modifying the system parameters for the changes to take effect.



#### CAUTION

Never let the motor body temperature exceed 105°C. It may cause motor damages.

### Tuning the thermal supervision


Use this procedure to tune the thermal supervision.

	Action	Information
1	Start the motor and run the toughest expected cycle.	
2	Monitor the motor body temperature and the thermal model temperature rise (test signal number 190), in the <i>Test signal viewer</i> .	$T_{\text{stator\_rise}}$ = Measured motor body temperature + 35 – actual ambient temperature 35 is the approximate difference between the motor body temperature and the stator temperature.

*Continues on next page*

## 6 Tuning the thermal supervision

Continued

	Action	Information
3	<p>If <math>T_{\text{stator\_rise}}</math> is larger than the thermal model temperature rise, then increase the thermal supervision sensitivity ratio.</p> <p>If <math>T_{\text{stator\_rise}}</math> is smaller than the thermal model temperature rise, then decrease the thermal supervision sensitivity ratio.</p>	 <b>Tip</b> You can use the ratio between $T_{\text{stator\_rise}}$ and the thermal model temperature rise, when estimating how much the Thermal supervision sensitivity ratio should be changed.
4	If $T_{\text{stator\_rise}} + \text{Max temperature robot} > 130\text{ °C}$ (max allowed is $140\text{ °C}$ , hot motor warnings will appear at $130\text{ °C}$ ) consider actions to reduce the temperature, for example improving the cooling, reducing the average torque, or choosing a larger motor unit or gear unit.	

### Related information

*Technical reference manual - System parameters*

*Test Signal Viewer* is included on the RobotWare DVD, in the folder *Tools*. How to use Test Signal Viewer is described in the help file included in the installation.

## 7 Maintenance

### 7.1 Introduction to maintenance

---

#### Structure of this chapter

This chapter describes all maintenance activities recommended for the products.

It is based on the maintenance schedule located at the beginning of the chapter.

The schedule contains information about required maintenance activities including intervals and refers to procedures for the activities.

Each procedure contains all the information required to perform the activity, which is required tools and materials.

---

#### Safety information

Before any service work is commenced, it is extremely important that all safety information is observed!

There are general safety aspects that must be read through, as well as more specific safety information that describes the danger and safety risks when performing the procedures. Read the chapter [Safety on page 11](#) before performing any service work.



#### Note

If the robot is connected to power, always make sure that the robot is connected to *earth* before starting any maintenance work!

## 7 Maintenance

### 7.2 Maintenance schedule

### 7.2 Maintenance schedule

#### Introduction


The equipment must be maintained regularly to ensure proper function. The maintenance activities and intervals are specified in the table below.

Non-predictable situations also give rise to inspections of the equipment. Any damages must be attended to immediately!

The inspection intervals do not specify the life of each component.

#### Activities and intervals

The table below specifies the required maintenance activities and intervals:

Maintenance activity	Equipment	Interval	Detailed in section
Cleaning	Motor units and gear units	-	<a href="#">Cleaning on page 70</a>
Inspection	Cables	Running	<a href="#">Inspecting cables on page 65</a>
Inspection	MU250 drain holes  <b>Note</b> Only MU250 has drain holes.	Running	<a href="#">Inspecting MU250 drain holes on page 66</a>
Lubrication	Current collector	400 hours	<a href="#">Lubricating the current collector on page 71</a>
Replacement	Battery pack, measurement system of type RMU101 or RMU102 (3-pole battery contact)	36 months or battery low alert <sup>i</sup>	<a href="#">Replacing SMB battery on page 67</a>
Replacement	Battery pack, measurement system with 2-pole battery contact, e.g. DSQC633A	Battery low alert <sup>ii</sup>	<a href="#">Replacing SMB battery on page 67</a>

<sup>i</sup> The battery low alert (38213 **Battery charge low**) is displayed when the battery needs to be replaced. The recommendation to avoid an unsynchronized robot is to keep the power to the controller turned on until the battery is to be replaced.

See the replacement instruction for more details.


<sup>ii</sup> The battery low alert (38213 **Battery charge low**) is displayed when remaining backup capacity (robot powered off) is less than 2 months. The typical lifetime of a new battery is 36 months if the robot is powered off 2 days/week or 18 months if the robot is powered off 16 h/day. The lifetime can be extended with a battery shutdown service routine. See *Operating manual - IRC5 with FlexPendant* for instructions.



## 7.3 Inspecting cables

### Inspecting cables

Use this procedure to inspect cables.

	Action	Information
1	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the robot working area.	
2	Make an overall visual inspection of the cables to detect wear or damage.	
3	Check the connectors.	
4	Check that all brackets and straps are properly attached.	
5	Replace the cables if wear, cracks, or damage is detected.	


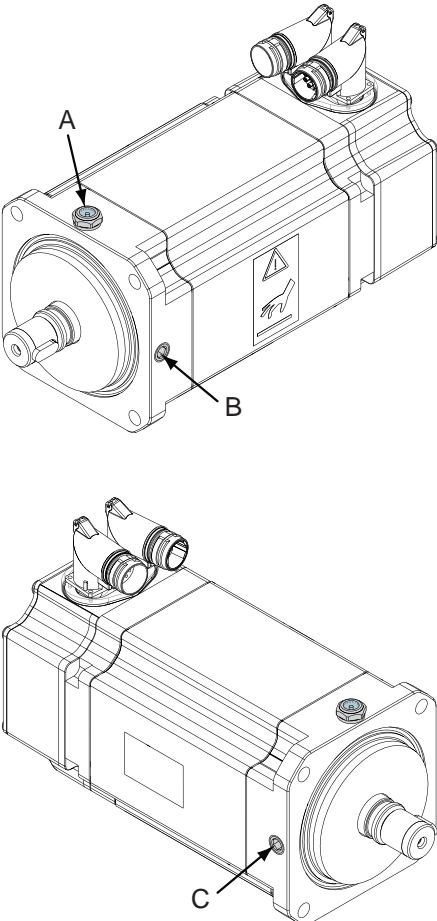
## 7 Maintenance

### 7.4 Inspecting MU250 drain holes

### 7.4 Inspecting MU250 drain holes

#### Inspecting MU250 drain holes

Use this procedure to inspect MU250 drain holes.

	Action	Information
1	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"><li>• electric power supply</li><li>• hydraulic pressure supply</li><li>• air pressure supply</li></ul> to the robot, before entering the robot working area.	
2	Inspect the drain hole from the glass cover in the middle.	  xx1700000553 <b>Parts:</b> <ul style="list-style-type: none"><li>• A: Drain hole with glass cover</li><li>• B: Drain hole with stop screw</li><li>• C: Drain hole with stop screw</li></ul>
3	Replace the MU250 if oil leakage is detected in the middle drain hole.	
4	Check that the stop screws for the other two drain holes are properly attached.	
5	Secure or reassemble the stop screws if any loose or missing.	

## 7.5 Replacing SMB battery



### Note

The battery low alert (38213 **Battery charge low**) is displayed when the battery needs to be replaced. The recommendation to avoid an unsynchronized robot is to keep the power to the controller turned on until the battery is to be replaced. For an SMB board with 3-pole battery contact (RMU101 3HAC044168-001 or RMU102 3HAC043904-001), the lifetime of a new battery is typically 36 months. For an SMB board with 2-pole battery contact, the typical lifetime of a new battery is 36 months if the robot is powered off 2 days/week or 18 months if the robot is powered off 16 h/day. The lifetime can be extended for longer production breaks with a battery shutdown service routine. See *Operating manual - IRC5 with FlexPendant* for instructions.



### WARNING

See instructions for batteries, [WARNING - Safety risks during handling of batteries on page 25](#).

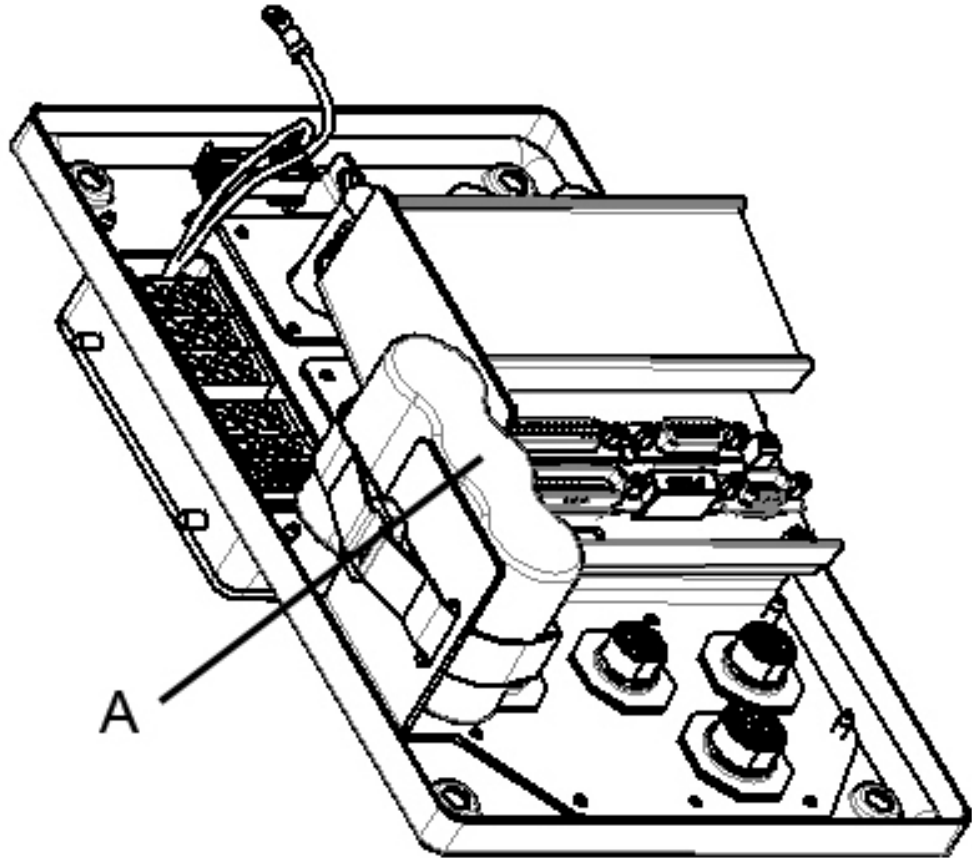
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## 7 Maintenance

### 7.5 Replacing SMB battery

*Continued*

#### Location of SMB battery



xx1000001415

A	SMB battery
---	-------------



#### Note




There are two variants of SMB units and batteries. One with 2-pole battery contact and one with 3-pole battery contact. The variant with the 3-pole battery contact has longer lifetime for the battery.

It is important that the SMB unit uses the correct battery. Make sure to order the correct spare parts. Do not replace the battery contact!

*Continues on next page*

#### Replacing SMB battery

Use this procedure to replace the SMB battery.

	Action	Information
1	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the robot working area.	
2	 xx0200000023  <b>WARNING</b> The unit is sensitive to ESD. Before handling the unit please read the safety information in the section <a href="#">WARNING - The unit is sensitive to ESD! on page 24</a>	
3	Open the cover on the SMB box.	
4	Pull out the <i>battery</i> and disconnect the battery cable.	
5	Fit the new <i>battery</i> and connect the battery cable.	
6	Close the SMB box.	
7	Update the revolution counters.	See <a href="#">Calibration on page 59</a> .
8	Dispose of the old battery.	See <a href="#">Environmental information on page 77</a> .

## 7 Maintenance

---

### 7.6 Cleaning

### 7.6 Cleaning

---

#### Introduction to cleaning

To secure high uptime it is important that the equipment is cleaned regularly. The frequency of cleaning depends on the working environment.

---

#### Cleaning activities

This instruction specifies allowed cleaning methods

Cleaning method	Note
Vacuum cleaner	Yes
Wipe with cloth	Yes. With light cleaning detergent.
Rinse with water	Yes. It is highly recommended that water contains a rust prevention solution and that the robot is dried afterwards.
High pressure water or steam	No

---

#### Cables

Movable cables need to be able to move freely:

- Remove waste material, for example sand, dust, and chips, if it prevents cable movement.
  - Clean the cables if they have a crusty surface for example from dry release agents.
- 

#### Do's and don'ts!

The section below specifies some special considerations when cleaning.

##### Always!

- Always use cleaning equipment as specified above! Any other cleaning equipment may shorten the life of the equipment.
- Always check that all protective covers are fitted before cleaning!

##### Never!

- Never point the water jet at connectors, joints, sealings or gaskets!
- Never use compressed air to clean the equipment!
- Never use solvents that are not approved by ABB to clean the equipment!
- Never spray from a distance closer than 0.4m!
- Never remove any covers or other protective devices before cleaning the equipment!

## 7.7 Lubricating the current collector



### DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- [Risks associated with live electric parts on page 15](#)
- [Safety risks during installation and service work on robots on page 11](#)


### Current collector

The function of the current collector is to transfer the weld current through the rotary unit. This takes place through a spring-loaded contact bar against the shaft. The contact bar needs to be lubricated approximately after 400 hours of operation. This should be done using a special grease, P34 from Nies, article number: 0501869-001.

### Required equipment

Equipment	Note
Grease	Grease type: P34 from Nies. Article number: 0501869-001.
Standard tools	
Grease gun	

### Lubricating the current collector

	Action	Information
1	Lubricate the current collector using a grease gun.	 <b>Note</b> Amount of grease: 12 ml.

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## 8 Repair

### 8.1 Replacing SMB board



#### WARNING

See safety instructions for batteries, [WARNING - Safety risks during handling of batteries on page 25](#).

#### Required equipment



#### Note




There are different variants of SMB units and batteries. The variant with the 3-pole battery contact has longer lifetime for the battery.

It is important that the SMB unit uses the correct battery. Make sure to order the correct spare parts. Do not replace the battery contact!

Equipment	Note
SMB board	See <a href="#">Spare parts and exploded views on page 82</a> .

#### Removing the SMB board

Use this procedure to remove the SMB board in the SMB box.

	Action	Information
1	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the robot working area.	
2	 xx0200000023  <b>WARNING</b> The unit is sensitive to ESD. Before handling the unit please read the safety information in the section <a href="#">WARNING - The unit is sensitive to ESD! on page 24</a>	
3	Open the cover on the SMB box.	
4	Disconnect the cables.	
5	Remove the screws holding the plate.	Keep the toothed washers.
6	Pull out the plate.	

*Continues on next page*

## 8 Repair

---

### 8.1 Replacing SMB board

*Continued*

	Action	Information
7	Loosen the four nuts holding the SMB board.	The nuts do not have to be removed, only loosened.
8	Pull out the SMB board.	
9	Dispose of the old SMB board.	See <a href="#">Environmental information on page 77</a> .

---

### Refitting the SMB board

Use this procedure to refit the SMB board in the SMB box.

	Action	Information
1	Place the new SMB board on the mounting plate.	
2	Check that the toothed washer is in place and fasten the nuts fully.	
3	Refit the plate and fasten the screws fully.	Cross tighten the screws to make sure the sealing is tight.
4	Connect the cables and close the cover.	
5	Update the revolution counters.	See <a href="#">Calibration on page 59</a> .

## 8.2 Repair in the motor connection box

---

### Motor connection box

The motor connection box can be opened to replace equipment.



#### Note

When assembling the connection box to the motor or the top cover to the connection box, make sure that the o-ring is in the groove.

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## 9 Decommissioning

### 9.1 Environmental information

#### Hazardous material

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

Dispose components properly to prevent health or environmental hazards.

Material	Example application
Batteries, NiCad or Lithium	Serial measurement board
Copper	Cables, motors
Cast iron/nodular iron	Gear housings
Steel	Gears, screws, shafts, brackets, and so on.
Neodymium	Brakes, motors
Plastic/rubber	Cables, connectors, and so on.
Oil, grease	Gearboxes
Aluminium	Motor housings

#### Oil and grease

Where possible, arrange for oil and grease to be recycled. Dispose of via an authorized person/contractor in accordance with local regulations. Do not dispose of oil and grease near lakes, ponds, ditches, down drains, or onto soil. Incineration must be carried out under controlled conditions in accordance with local regulations.

Also note that:

- Spills can form a film on water surfaces causing damage to organisms. Oxygen transfer could also be impaired.
- Spillage can penetrate the soil causing ground water contamination.

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# **10 Reference information**

## **10.1 Introduction**

---

**General**

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

## 10 Reference information

### 10.2 Applicable standards

### 10.2 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.

#### 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 <sup>i</sup>	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 <sup>ii</sup>	Arc welding equipment - Part 1: Welding power sources
EN IEC 60974-10 <sup>ii</sup>	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)

<sup>i</sup> Only robots with protection Clean Room.

<sup>ii</sup> 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
EN 574	Safety of machinery - Two-hand control devices - Functional aspects - Principles for design



## 10.3 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	

## 10 Reference information

---

### 10.4 Spare parts and exploded views

### 10.4 Spare parts and exploded views

---

#### Introduction

Spare parts and exploded views are not included in the manual but delivered as a separate document on the documentation DVD. Article number for *Product manual, spare parts - Motor Units and Gear Units* is 3HAC040278-001.

## 10.5 Circuit diagrams

### Overview

The circuit diagrams are not included in this manual, but delivered as separate documents on the documentation DVD. See the article numbers in the tables below.

### Controllers

Product	Article numbers for circuit diagrams
<i>Circuit diagram - IRC5</i>	<i>3HAC024480-011</i>
<i>Circuit diagram - IRC5 Compact</i>	<i>3HAC049406-003</i>
<i>Circuit diagram - IRC5 Panel Mounted Controller</i>	<i>3HAC026871-020</i>
<i>Circuit diagram - Euromap</i>	<i>3HAC024120-004</i>
<i>Circuit diagram - Spot welding cabinet</i>	<i>3HAC057185-001</i>

### Robots

Product	Article numbers for circuit diagrams
<i>Circuit diagram - IRB 120</i>	<i>3HAC031408-003</i>
<i>Circuit diagram - IRB 140 type C</i>	<i>3HAC6816-3</i>
<i>Circuit diagram - IRB 260</i>	<i>3HAC025611-001</i>
<i>Circuit diagram - IRB 360</i>	<i>3HAC028647-009</i>
<i>Circuit diagram - IRB 460</i>	<i>3HAC036446-005</i>
<i>Circuit diagram - IRB 660</i>	<i>3HAC025691-001</i>
<i>Circuit diagram - IRB 760</i>	<i>3HAC025691-001</i>
<i>Circuit diagram - IRB 1200</i>	<i>3HAC046307-003</i>
<i>Circuit diagram - IRB 1410</i>	<i>3HAC2800-3</i>
<i>Circuit diagram - IRB 1600/1660</i>	<i>3HAC021351-003</i>
<i>Circuit diagram - IRB 1520</i>	<i>3HAC039498-007</i>
<i>Circuit diagram - IRB 2400</i>	<i>3HAC6670-3</i>
<i>Circuit diagram - IRB 2600</i>	<i>3HAC029570-007</i>
<i>Circuit diagram - IRB 4400/4450S</i>	<i>3HAC9821-1</i>
<i>Circuit diagram - IRB 4600</i>	<i>3HAC029038-003</i>
<i>Circuit diagram - IRB 6400RF</i>	<i>3HAC8935-1</i>
<i>Circuit diagram - IRB 6600 type A</i>	<i>3HAC13347-1</i> <i>3HAC025744-001</i>
<i>Circuit diagram - IRB 6600 type B</i>	<i>3HAC13347-1</i> <i>3HAC025744-001</i>
<i>Circuit diagram - IRB 6620</i>	<i>3HAC025090-001</i>
<i>Circuit diagram - IRB 6620 / IRB 6620LX</i>	<i>3HAC025090-001</i>
<i>Circuit diagram - IRB 6640</i>	<i>3HAC025744-001</i>

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## 10 Reference information

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### 10.5 Circuit diagrams

*Continued*

Product	Article numbers for circuit diagrams
<i>Circuit diagram - IRB 6650S</i>	<i>3HAC13347-1</i> <i>3HAC025744-001</i>
<i>Circuit diagram - IRB 6660</i>	<i>3HAC025744-001</i> <i>3HAC029940-001</i>
<i>Circuit diagram - IRB 6700</i>	<i>3HAC043446-005</i>
<i>Circuit diagram - IRB 7600</i>	<i>3HAC13347-1</i> <i>3HAC025744-001</i>
<i>Circuit diagram - IRB 14000</i>	<i>3HAC050778-003</i>
<i>Circuit diagram - IRB 910SC</i>	<i>3HAC056159-002</i>

---

### Other hardware

Product	Article numbers for circuit diagrams
<i>Circuit diagram - Motor Units and Gear Units</i>	<i>3HAC039887-001</i>

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