ROBOTICS

Product manual

Motor Units and Gear Units

Trace back information:
Workspace OmniCore and R19C version a16
Checked in 2019-09-16
Skribenta version 5.3.012

Product manual

MU 80, 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: M

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Original instructions.

Table of contents

Overview of this manual

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.

Usage

This manual should be used during:

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

Who should read this manual?

This manual is intended for:

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

Prerequisites

Maintenance/repair/installation personnel working with an ABB Robot must be trained by ABB and have the required knowledge of mechanical and electrical installation/repair/maintenance work.

Product manual scope

The manual covers covers all variants and designs of the motor units and gear units. Some variants and designs may have been removed from the business offer and are no longer available for purchase.

References

Reference	Document ID
Product manual, spare parts - Motor Units and Gear Units	*3HAC040278-001*
Circuit diagram - Motor Units and Gear Units	*3HAC039887-001*
Product specification - Motor Units and Gear Units	*3HAC040147-001*
Operating manual - General safety information [i]	*3HAC031045-001*
Product manual - IRC5 IRC5 with main computer DSQC 639.	*3HAC021313-001*
Product manual - IRC5 IRC5 with main computer DSQC1000.	*3HAC047136-001*
Product manual - IRC5 Panel Mounted Controller	*3HAC027707-001*
Product manual - IRC5 Compact	*3HAC035738-001*

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Reference	Document ID
Operating manual - IRC5 with FlexPendant	*3HAC050941-001*
Operating manual - RobotStudio	*3HAC032104-001*
Technical reference manual - System parameters	*3HAC050948-001*
Application manual - Additional axes and stand alone controller	*3HAC051016-001*
Application manual - TuneMaster	*3HAC063590-001*

i 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: • Added information to use locking mechanism for MID units, see *Installing gear units on page 50*. • Added information about acceleration torque limit for motor units, see *Loading configuration files on page 77*. • Added descriptions of the abbreviations.
B	The following additions and corrections are made: • Added *Tuning the thermal supervision on page 83*. • Added *Safety risks during handling of batteries on page 27*. • Added *Changing the cable harness in the controller on page 76*.
C	The following additions and corrections are made: • The formula for acceleration and deceleration values is corrected, see *Dimensioning gear units on page 79*. • Corrected the quality of attachment screws for gear units, see *Installing gear units on page 50*. • Added *Lubricating the current collector on page 93*. • Added *Changing the cable harness in the controller on page 76*. • Added *Make sure that the main power has been switched off on page 15*. • A new SMB unit and battery is introduced, with longer battery lifetime.
D	The following additions and corrections are made: • The values for $T_{maxgear}$ is updated with physical units, see *Dimensioning gear units on page 79*.
E	Minor corrections.
F	• Updated the path to the template files, see *Loading configuration files on page 77*.
G	Published in release R17.1. The following updates are done in this revision: • Added MU 250. • Added information about Add-In in **Installation Manager**, see *Loading configuration files on page 77*.
H	Published in release R17.2. The following updates are made in this revision: • Caution about removing metal residues added in sections about SMB boards. • Updated list of applicable standards. • Added MU 80.

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Revision	Description
J	Published in release R18.1. The following updates are made in this revision: • Added section, Cut the paint or surface on the robot before replacing parts. • Safety restructured.
K	Published in release R18.2. The following updates are made in this revision: • Changed cable routing for motor power cables on gear unit GU MTD750. • Updated description about assembling transmission elements, see *Assembly by pressing on the pinion on page 68*.
L	Published in release 19B. The following updates are made in this revision: • New touch up color Graphite White available. See *Cut the paint or surface on the robot before replacing parts on page 95*. • New article numbers for manipulator cables in section *Fastening cables on page 53*.
M	Published in release 19C. The following updates are made in this revision: • Added sections *Connections for SC/DC (DM) on page 58*, *Open and close the pivot frame on page 59*, and *Retrofit an interface to the IRC5 controller on page 61*.

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1 Safety

1.1 General safety information

1.1.1 Limitation of liability

Limitation of liability

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

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

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

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

Nation/region specific regulations

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.

To be observed by the supplier of the complete system

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

When integrating the robot with external devices 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.

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1.1.1 Limitation of liability
Continued

The integrator of the final application is required to perform an assessment of the hazards and risks (HRA).

> **Note**
>
> The integrator is responsible for the safety of the final application.

Safe access

The robot system shall be designed 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.

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.

A safety fence is recommended to ensure safeguarded space. Sufficient space must be provided around the manipulator to protect those working with or on it from hazards such as crushing.

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.

Safe handling

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

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

Emergency stop buttons must be positioned in easily accessible places so that the robot can be stopped quickly. If any of the buttons do not stop all the robot workcell motion, each emergency stop button must be marked, if more than one is provided, to indicate its designated safety function.

Grippers/end effectors must be designed so that they do not drop work pieces/tools 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 of the robot could be affected.

1.1.2 Protective stop and emergency stop

Overview

The protective stops and emergency stops are described in the product manual for the controller.

1.2 Safety actions

1.2.1 Fire extinguishing

Note

Use a CARBON DIOXIDE (CO_2) extinguisher in the event of a fire in the manipulator or controller.

1.2.2 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 personal injuries, switch off the main power on the controller before proceeding work.

Note

Switch off all main power switches in a MultiMove system.

1.3 Safety risks

1.3.1 Safety risks during installation and service work on robots

Requirements on personnel

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 install, maintain, repair, or use the robot.

- 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.
- Personnel should be trained on responding to emergency or abnormal situations.

General risks during installation and service

The instructions in the product manual must always be followed.

Never turn the power on to the robot before it is properly fixed and bolted to its foundation/support.

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.

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 remove the power cable to the controller.

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.

Energy stored in the robot for the purpose of counterbalancing certain axes may be released if the robot, or parts thereof, are dismantled.

Never use the robot as a ladder, which means, do not climb on the controller, motors, or other parts during service work. There is a risk of slipping because of the high temperature of the motors and oil spills that can occur on the robot. There is also a risk of the robot being damaged.

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

Safety risks during operational disturbances

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.

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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.

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.

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.

Personal protective equipment

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

Allergenic material

See *Environmental information on page 99* for specification of allergenic materials in the product, if any.

1.3.2 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.

Safe handling

	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 *How to use the hold-to-run function* in the *Operating manual - IRC5 with FlexPendant*.
3	Make sure no personnel are present within the working range of the robot before pressing the start button.	

1.3.3 First test run may cause injury or damage

Description

After installation and performing service activities, there are several safety risks to take into consideration before the first test run.

Safe handling

Use this procedure when performing the first test run after installation, maintenance, or repair.

DANGER

Running the robot without fulfilling the following aspects, may involve a risk of injury and cause severe damage to the robot.

	Action
1	Remove all tools and foreign objects from the robot and its working area.
2	Verify that the robot is properly secured to its position by all screws, before it is powered up.
3	Verify that any safety equipment installed to secure the position or restrict the robot 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, and is out of its reach behind safety fences, or similar.
7	If maintenance or repair has been done, pay special attention to the function of the part that was maintained.

Collision risks

CAUTION

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

1.3.4 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.
- Keep clear of moving parts so that limbs, hands, or fingers do not get trapped or crushed by the robot.
- 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.

1.3.5 Enabling device and hold-to-run functionality

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 teach pendant 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 teach pendant, 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 hold the teach pendant. 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*.

1.3.6 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 during installation, commissioning, and maintenance is guaranteed if the valid regulations are followed.

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.

Voltage related risks, manipulator

A danger of voltage is associated with the manipulator 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).

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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.

1.3.7 The unit is sensitive to ESD

Description

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

Safe handling

	Action	Note
1	Use a wrist strap. The wrist strap button is located inside the controller.	Wrist straps must be tested frequently to ensure that they are not damaged and are operating correctly. • *Product manual - IRC5*
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.

1.3.8 Hot parts may cause burns

Description

During normal operation, many parts become hot. Touching these may cause burns.

There is also a risk of fire if flammable materials are put on hot surfaces.

Safe handling

Always use your hand, at some distance, to feel if heat is radiating from the potentially hot component before actually touching it.

Wait until the potentially hot component has cooled if it is to be removed or handled in any other way.

Do not put anything on hot metal surfaces, e.g. paper or plastic.

1.3.9 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.

1.3.10 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.

Safe handling

Use safety glasses when handling the batteries.

In the event of leakage, wear rubber gloves and chemical apron.

In the event of fire, use self-contained breathing apparatus.

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.

1.3.11 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.

Safe handling

Warning	Description	Elimination/Action
 **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.
 **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.
 **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

Warning	Description	Elimination/Action
 **Do not overfill**	Overfilling of gearbox lubricant can lead to internal over-pressure inside the gearbox which in turn may: • damage seals and gaskets • completely press out seals and gaskets • prevent the robot from moving freely.	Make sure not to overfill the gearbox when filling it with oil or grease. After filling, verify that the level is correct.
 **Specified amount depends on drained volume**	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.	After filling, verify that the level is correct.
 **Contaminated oil in gear boxes**	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.	

1.4 Safety signals and symbols

1.4.1 Safety signals in the manual

Introduction to safety signals

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

- A caption specifying the danger level (DANGER, WARNING, or CAUTION) and the type of danger.
- A brief description of what will happen if the the danger is not eliminated.
- 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
	DANGER	Warns that an accident *will* 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.
	WARNING	Warns that an accident *may* 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.
	ELECTRICAL SHOCK	Warns for electrical hazards which could result in severe personal injury or death.
	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.
	ELECTROSTATIC DISCHARGE (ESD)	Warns for electrostatic hazards which could result in severe damage to the product.

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

1.4.2 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.

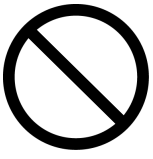
Types of labels

Both the manipulator 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, for example during installation, service, or operation.

The safety labels are language independent, they only use graphics. See *Symbols on safety labels on page 32*.

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

Symbols on safety labels

Symbol	Description
 xx0900000812	**Warning!** Warns that an accident *may* 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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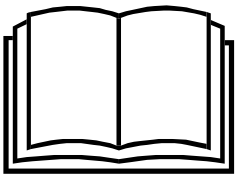
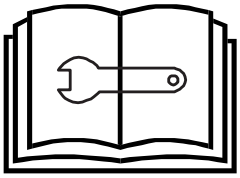
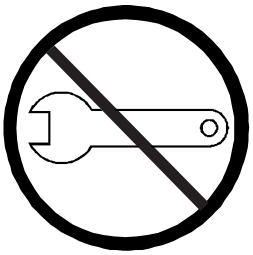
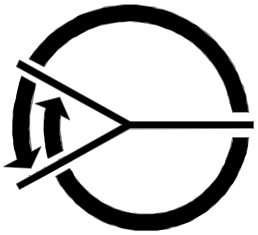
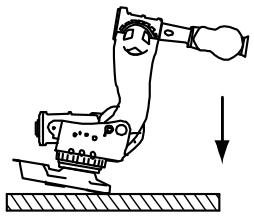
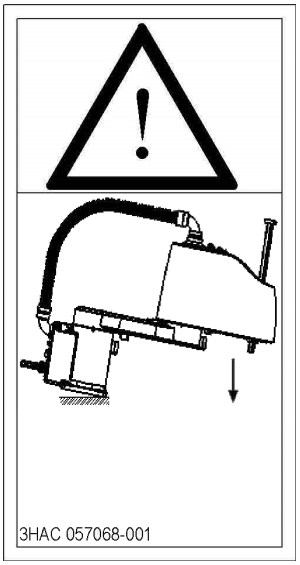
Symbol	Description
 xx0900000813	**See user documentation** Read user documentation for details. Which manual to read is defined by the symbol: • No text: *Product manual*. • EPS: *Application manual - Electronic Position Switches*.
 xx0900000816	**Before disassemble, see product manual**
 xx0900000815	**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.

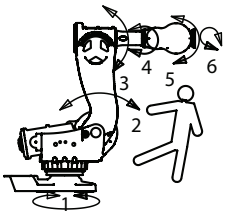
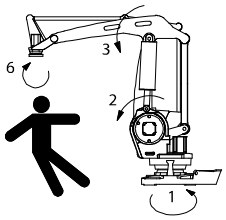
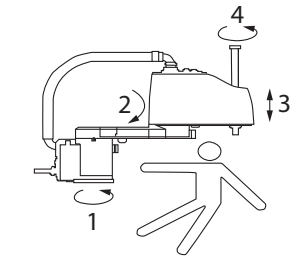
Continues on next page

1.4.2 Safety symbols on product labels

Continued

Symbol	Description
 xx0900000810  xx1500002402	**Tip risk when loosening bolts** The robot can tip over if the bolts are not securely fastened.
  xx0900000817	**Crush** Risk of crush injuries.

Continues on next page

Symbol	Description
 xx0900000818  xx1300001087	**Heat** Risk of heat that can cause burns. (Both signs are used)
 xx0900000819  xx1000001141  xx1500002616	**Moving robot** The robot can move unexpectedly.

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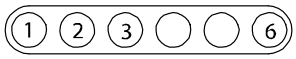
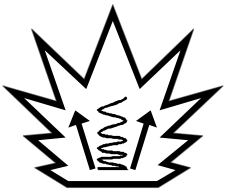
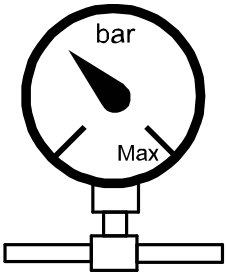
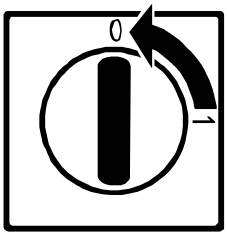
1.4.2 Safety symbols on product labels

Continued

Symbol	Description
 xx0900000820  xx1000001140	**Brake release buttons**
 xx0900000821	**Lifting bolt**
 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**

Continues on next page

Symbol	Description
 xx1000001144	**No mechanical stop**
 xx0900000825	**Stored energy** Warns that this part contains stored energy. Used in combination with *Do not disassemble* symbol.
 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.

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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 73*.

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.

2.2 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 80
- 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 80	1.37
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 47*.

   For gear units, see *Installing gear units on page 50*.
2. Load the configuration files, see *Loading configuration files on page 77*.
3. Testrun with loads. If needed, tune the configuration data, see *Tuning on page 80*.
4. Calibrate, see *Calibration on page 81*.
5. Tune the thermal supervision, see *Tuning the thermal supervision on page 83*.

Related information

Application manual - Additional axes and stand alone controller.

Operating manual - IRC5 with FlexPendant.

Operating manual - RobotStudio.

2.5 Scenarios

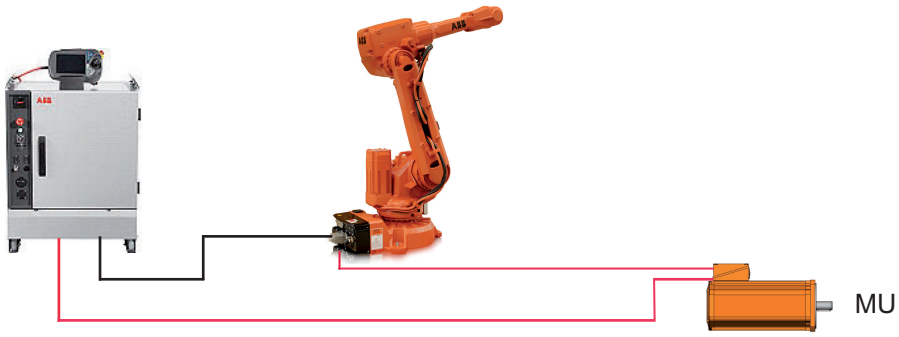
Introduction

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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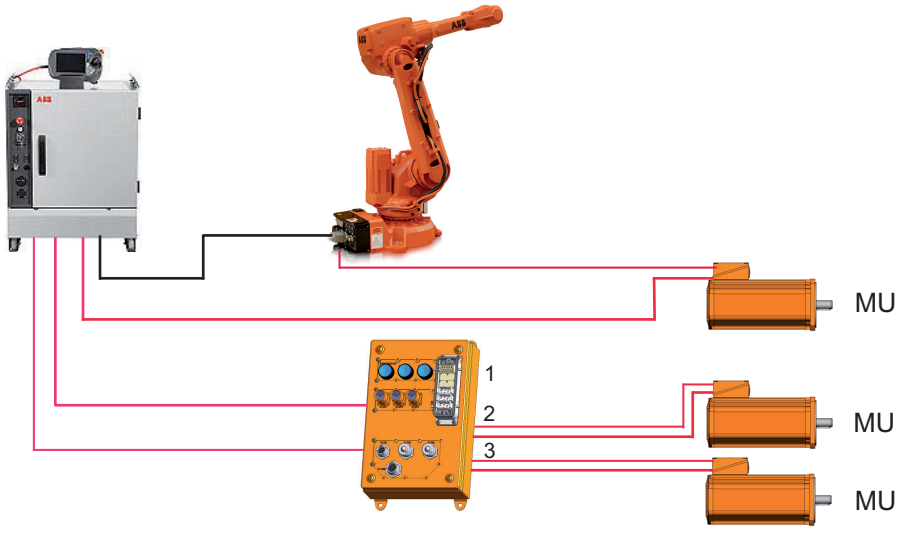
Scenario B:

- 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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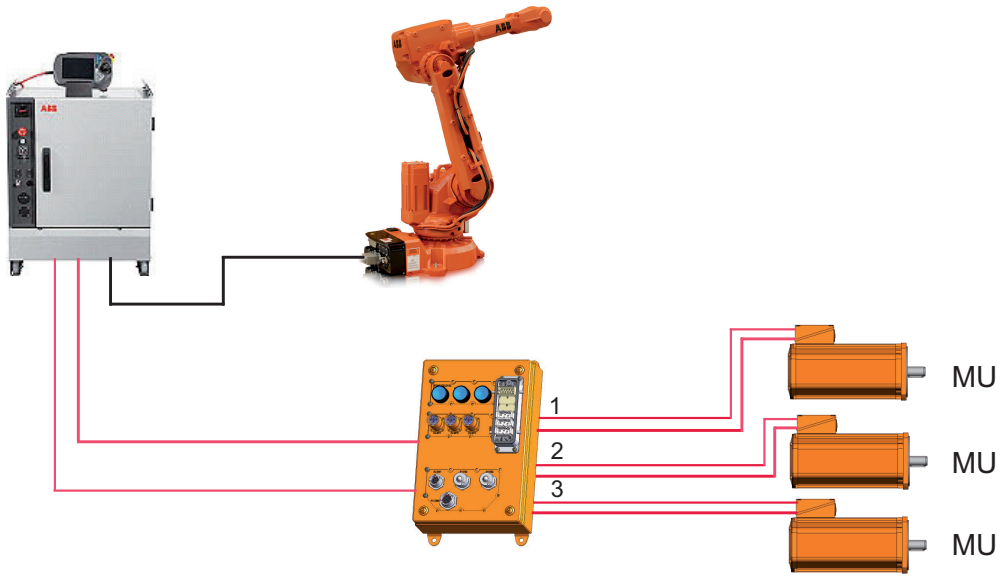
Scenario C:

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



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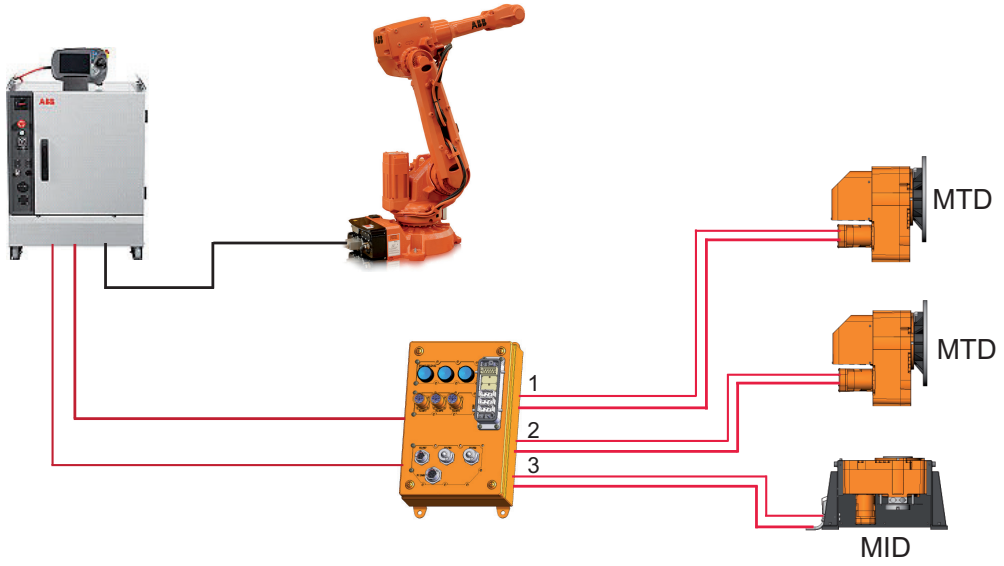
Gear units

Scenario A:

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



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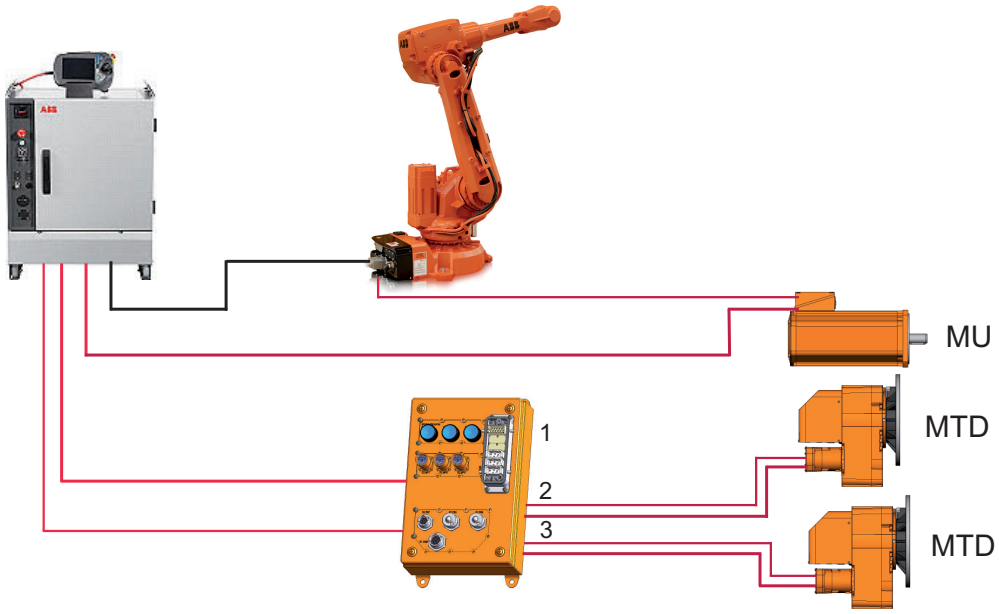
Continues on next page

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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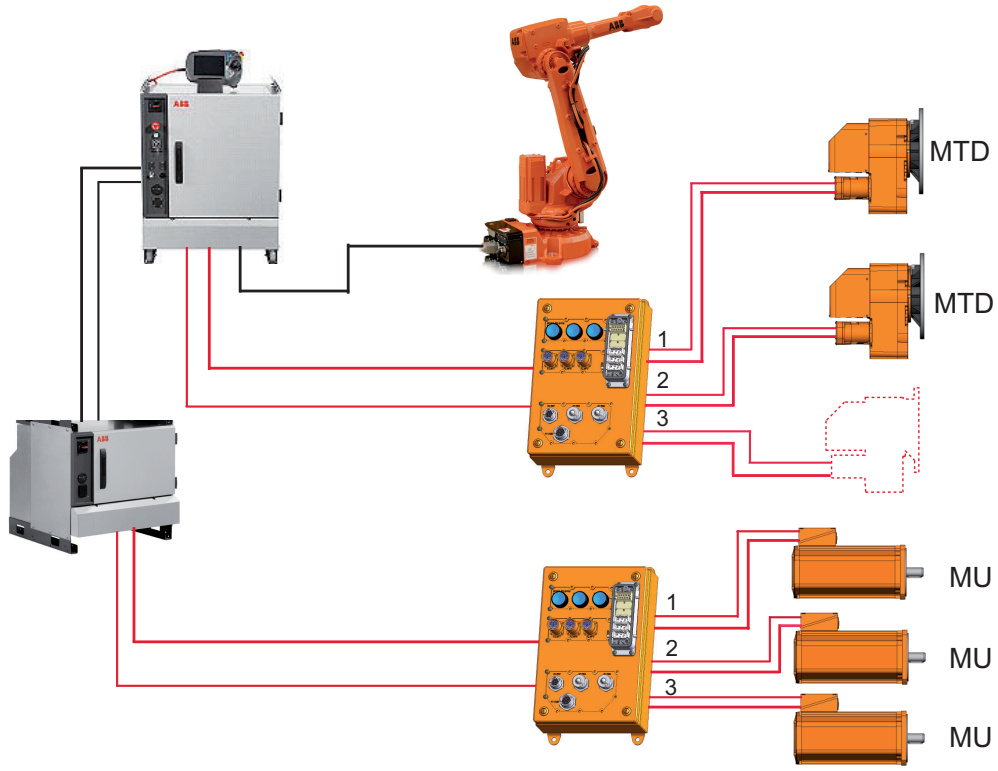
2.5 Scenarios
Continued

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



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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] ±10%
MU 80	M4	4
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

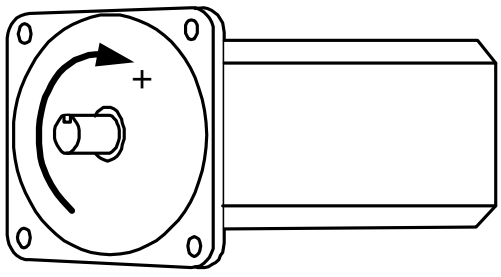
Never overheat the motor. The winding temperature must not exceed 140° C. Check that the temperature on the motor frame is lower than 100°C.

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 73*.

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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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 53*.

	Action	Information
1	Fit the motor in position and secure it with its attachments screws. **CAUTION** When fitting the motor pinion, make sure not to use high force or other methods that can damage the pinion, shaft, or resolver. See *Assembling motor axis and transmission element on page 67*.	**CAUTION** If using the motor unit in direct contact with oil or grease, make sure that the running conditions are suitable for the motor sealing.
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 *Insulation in arc welding stations on page 73*.
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 motor. **Note** Fasten the M23 connector fully. See *Fastening cables on page 53*. **Note** Turn the connectors to avoid breaking the cables. See *Fastening cables on page 53*.	If the controller is not prepared for motor units, then the connector must be replaced, see *Changing the cable harness in the controller on page 76*.
5	Connect the resolver cable from the robot or SMB box to the motor.	
6	If using an SMB box, connect the SMB cable from the controller to the SMB box.	
7	Mark the cables.	
8	Test the brake release buttons.	See *Testing the brake release buttons on page 72*.

Continues on next page

CAUTION

Make sure that the thermal supervision is properly tuned, see *Tuning the thermal supervision on page 83*.

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 73*.

Installing gear units

Use this procedure to install gear units. For cable connections, see *Fastening cables on page 53*.

	Action	Information
1	Fit the gear unit in position and secure it with its attachments screws.	**WARNING** 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 *Insulation in arc welding stations on page 73*.
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.	**Note** Fasten the M23 connectors fully. See *Fastening cables on page 53*.
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: • Assemble the cable kit (3HAC040089-001) according to the instructions delivered with the cable kit. • Connect cables to the controller cabinet. • Connect cables to the SMB box. • Connect cables from the SMB box to the motor units.	
8	Mark the cables.	
9	Install a current collector.	
10	Test the brake release buttons.	See *Testing the brake release buttons on page 72*.
11	Fit and secure the flange to the equipment to be controlled by the gear unit.	

CAUTION

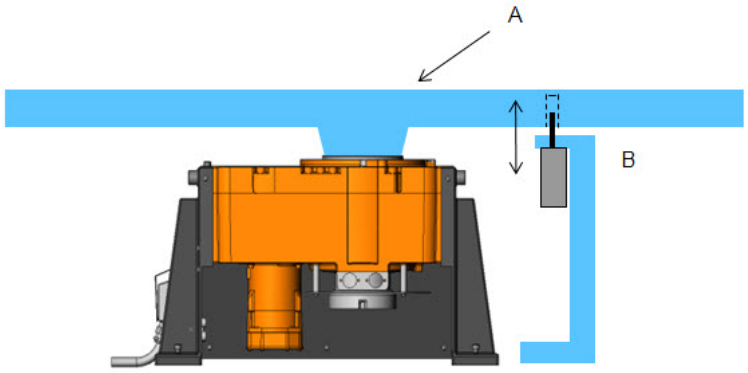
Make sure that the thermal supervision is properly tuned, see *Tuning the thermal supervision on page 83*.

Continues on next page

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 plunch

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.

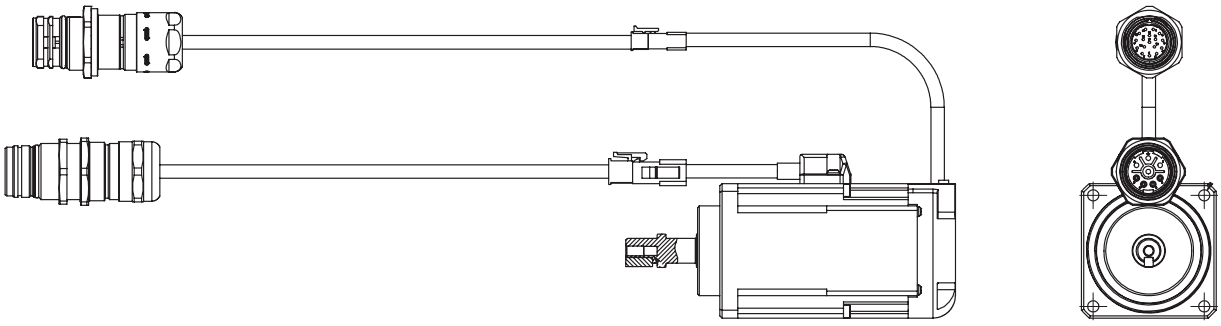
Cable connection	Marking
Motor power cables	MP
Feedback cables	FB

SMB cable

The key pin in plug SMB bus cable (3HAC068917-001, 3HAC068918-001, 3HAC068920-001) must be removed when connecting to XS41 or XS41.2 in the IRC5 controller.

Extended cables for MU 80

MU 80 provides extended power and signal cables.



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3.3 Fastening cables
Continued

Cable lengths are allowed to be shorted by cutting off the connector MP/FB by customers. Always refer to the tables below to prepare new connectors.

Extended power cable

xx1700001372

A	MP
B	MP (M23)

The following table lists the materials used for making new connector MP. The materials are delivered with the MU 80.

Item	Component article number	Qty.
1	3HAC026336-004	1
2	3HAC026345-002	2
3	3HAC026345-001	4

The following table shows the connection between connector MP and connector MP(M23).

Wire type	Description	Pin on Connect-or MP	Pin on Connect-or MP(M23)
1.5 mm^2 wire	U	1	3
1.5 mm^2 wire	V	3	1
1.5 mm^2 wire	W	5	4
1.5 mm^2 wire, GNYE	PE	2	PE
0.5 mm^2 wire	Brake +	4	A
0.5 mm^2 wire	Brake 0V	6	B

Continues on next page

Extended signal cable

xx1700001373

A	FB
B	FB(M23)

The following table lists the materials used for making new connector FB. The materials are delivered with the MU 80.

Item	Component article number	Qty.
1	3HAC6996-8	1
2	3HAC6962-3	6

The following table shows the connection between connector FB and connector FB(M23).

Wire type	Description	Pin on Connector FB	Pin on Connector FB(M23)
Pair 1 BK, AWG24	X	5	1
Pair 1 WHBK, AWG24	X 0V	1	3
Pair 1 BN, AWG24	Y	6	4
Pair 1 WHBN, AWG24	Y 0V	2	2
Pair 1 RD, AWG24	EXC 0V	7	8
Pair 1 WHRD, AWG24	EXC	3	7

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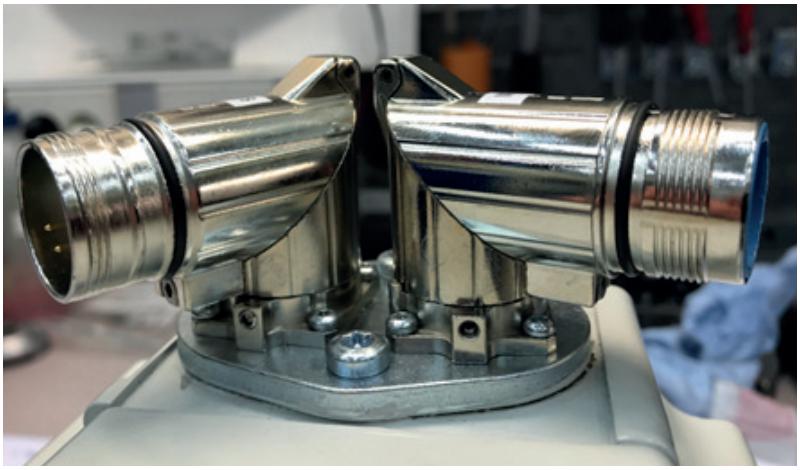
Cable routing for motor power cable GU MTD750

The motor cables for GU MTD750 are possible to turn approximately 45 degrees outwards, to avoid breaking the cables.



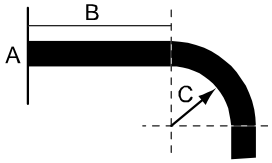
xx1800000601

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.

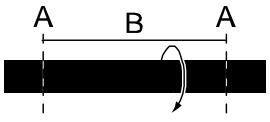


xx1000001397

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 ±180°.



xx1000001398

A	Fastening points or connectors
B	Minimum length is 900mm

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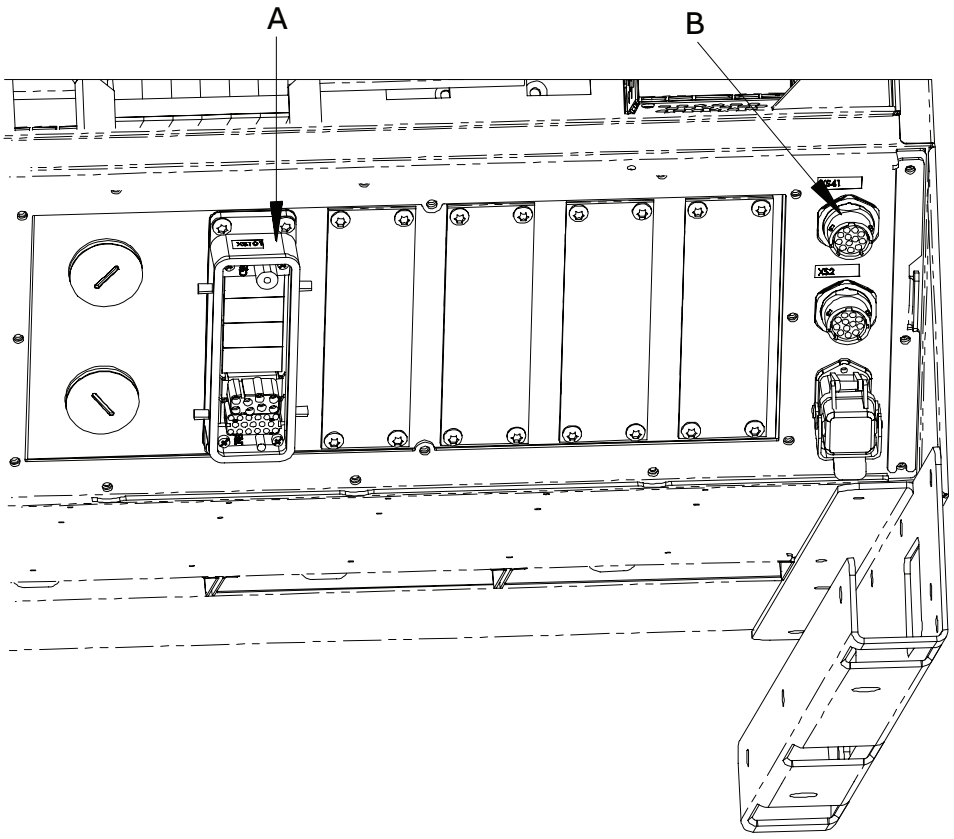
Fastening straps

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

3.4 Connections for SC/DC (DM)

Outputs for MU/GU



xx0900001005

A	XS 102	Motor power
B	XS 41	Resolver signals

3.5 Open and close the pivot frame

Overview

In order to access the components behind the axis selector unit, the pivot frame must be opened.

DANGER

Before commencing any work inside the cabinet, read the safety information in section *Make sure that the main power has been switched off on page 15*.

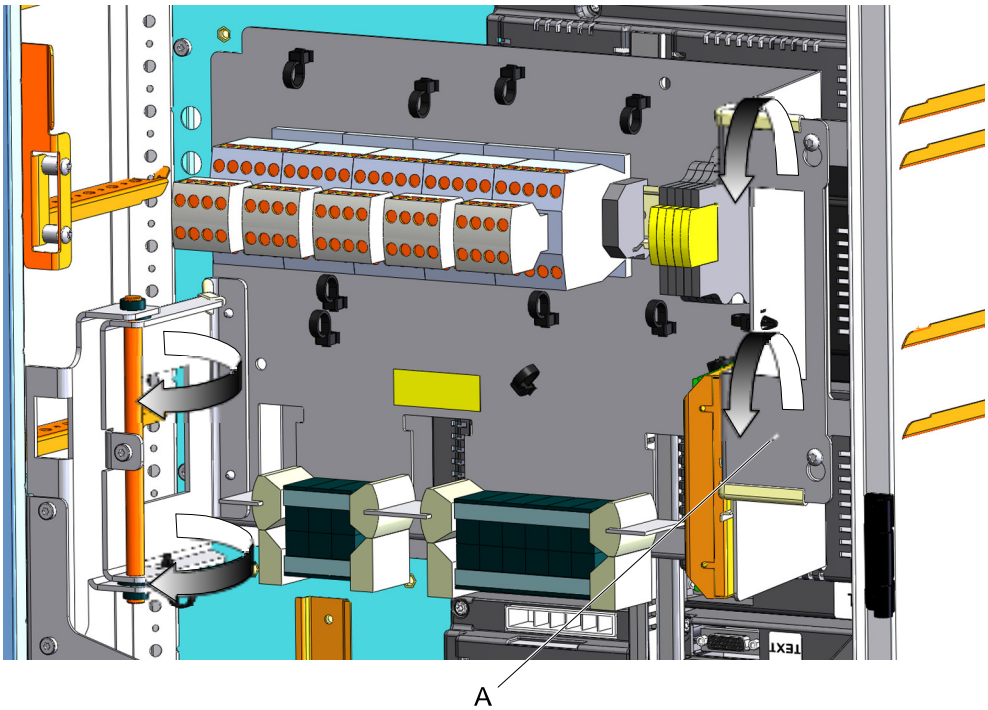
WARNING

The unit is sensitive to ESD. Before handling the unit please read the safety information in the section *The unit is sensitive to ESD on page 24*

Note

Note that the wiring to the pivot frame must be detached before the pivot frame is opened.

Opening the pivot frame



xx0900001051

	Action	Information
1	Open the controller cabinet.	
2	Disconnect the cables on the axis selector unit.	

Continues on next page

3.5 Open and close the pivot frame
Continued

	Action	Information
3	Lift (A) to open the pivot frame with the axis selector plate.	
4	Pull out the pivot frame so that it is fully extended.	

Closing the pivot frame

	Action	Information
1	Secure the pivot frame with the axis selector plate by tightening the two locking screws (pos. A).	
2	Fit the cables on the axis selector unit.	

3.6 Retrofit an interface to the IRC5 controller

Introduction

The below procedure describes how to retrofit an interface for motor units and gear units to an IRC5 controller with drive system 09.

Prerequisites

- An IRC5 Single controller drive system 09 with additional drive units.

  The option *Prepared for MU/GU (946-1)* is strongly recommended.

  > **Note**
  >
  > If the standalone controller was ordered without the option *Prepared for MU/GU*, then one mounting rail is missing. One extra rail is delivered with the MU/GU interface and it is necessary to remove the axis computer and the main drive module to attach the rail.

- The "backbone" harness, *3HAC049197-001 Ext.Axis Brake Harness*, must be installed in the controller.

  Since 2015 all systems with any additional axis are delivered with this new harness. If it is missing the system has to be upgraded before installing the retrofit option.

Part list

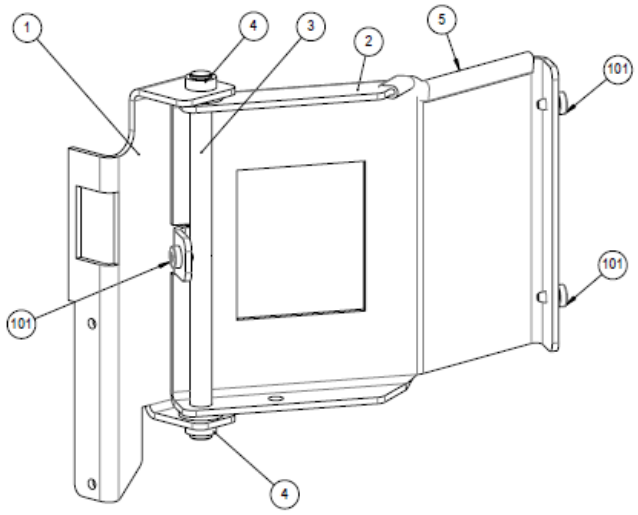
There is no retrofit kit available. Instead, place a new order for options *1313-1 Axis selector* and *1340-1 Harness, axis selector*.

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	

Continues on next page

Assemble the hinge



xx1600000454

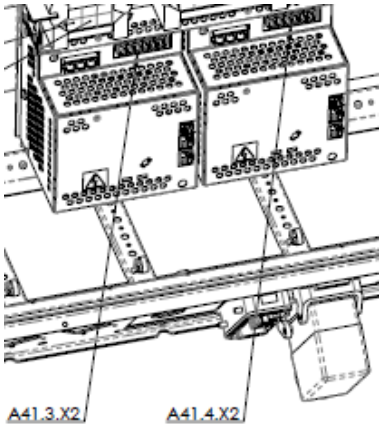
1	Bracket
2	Arm
3	Shaft
4	Plastic bushing
5	Profile
101	Fastite screw

	Action	Note
1	Assemble the plastic bushings in the bracket. **Note** Assemble the bushings from the inside.	 xx1600000455
2	Fit the arm and mount the shaft through the bushings. The bushings are often tight so it is recommended to carefully use a plastic hammer.	
3	Lock the shaft with a screw.	

Continues on next page

	Action	Note
4	Assemble two screws in the rear end of the arm. Do not tighten the screws completely, make sure to leave about 2 mm free space.	

Assemble the interface

	Action	Note
1	Attach the harness drive unit to the additional drive units.	 xx1600000456
2	Attach the SMB2 cable to the X5 connector on the axis computer.	 xx1600000457

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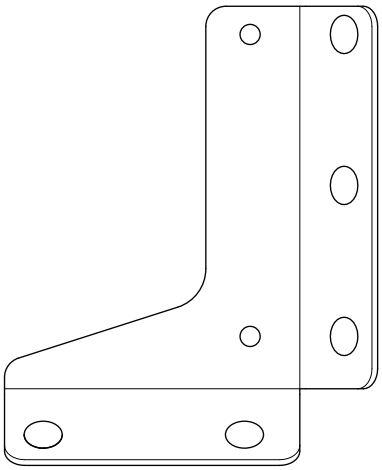
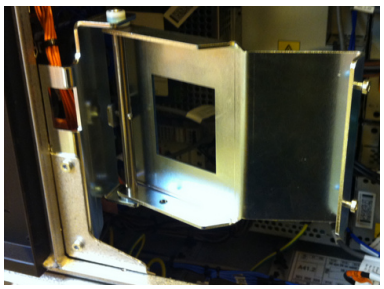
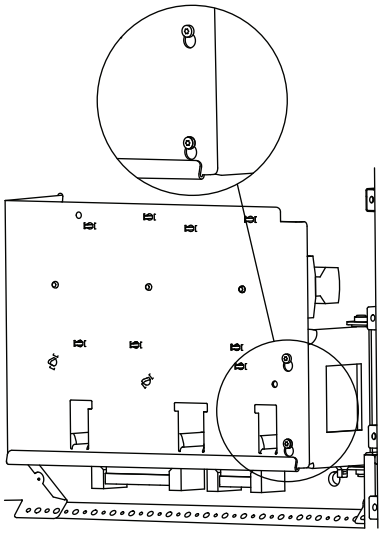
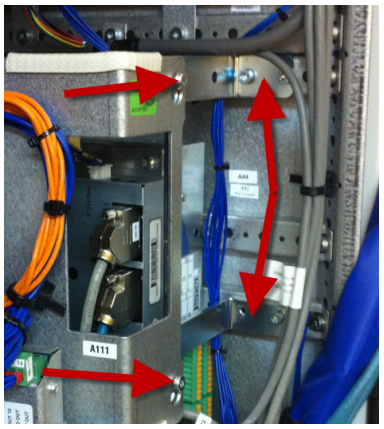
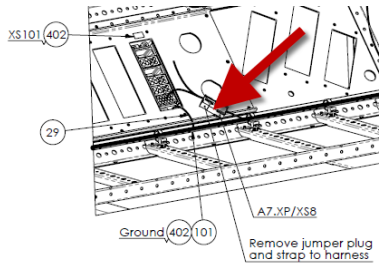
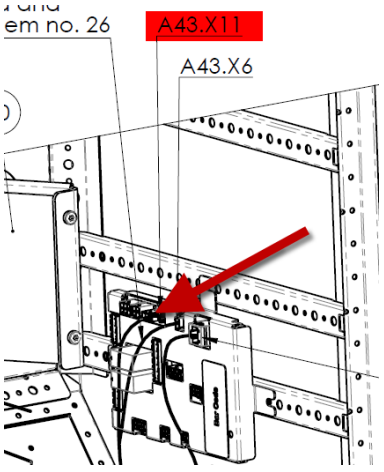
3.6 Retrofit an interface to the IRC5 controller

Continued

	Action	Note
3	Assemble the attachment plate in the cabinet front left corner.	 xx1700001273
4	Attach the hinge to the attachment plate.	 xx1600000460
5	Attach the axis selector to the hinge.	 xx1700001274

Continues on next page

	Action	Note
6	Fit two screws on the lock bracket and attach it to the mounting rails with four screws. **Note** If the standalone controller was ordered without the option *Prepared for MU/GU*, then one mounting rail is missing. One extra rail is delivered with the MU/GU interface and it is necessary to remove the axis computer and the main drive module to attach the rail.	 xx1600000461
7	Locate the connector A7.XS8 in the signal harness from XS102 and connect it to the existing harness in the bottom of the cabinet.	 xx1600000462
8	Locate the connector A43.XS11 in the signal harness from XS102 and connect it to the contactor board at the left side of the cabinet.	 xx1600000463

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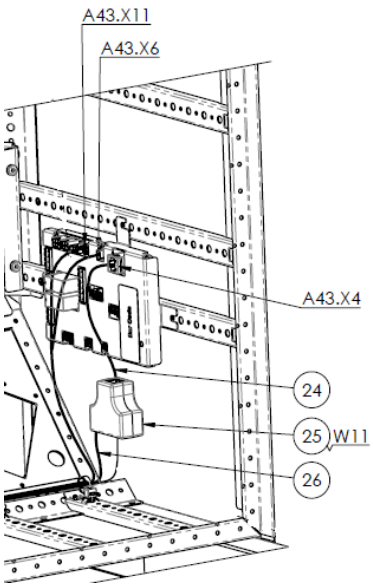
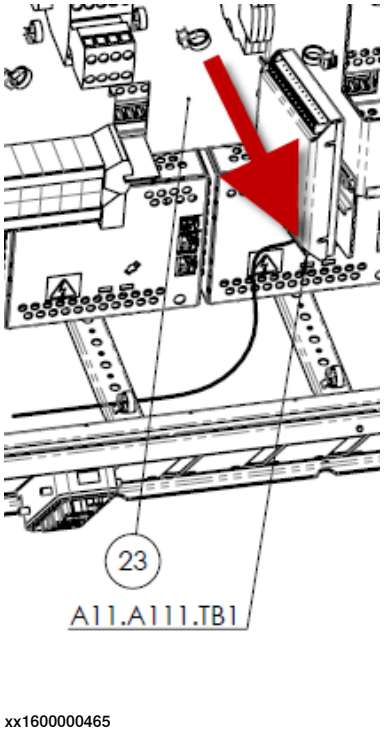
3.6 Retrofit an interface to the IRC5 controller
Continued

	Action	Note
9	Locate the patch cable (item 24), the 3-way connector W11 (item 25), and the I/O cable (item 26). • Remove the existing cable from A43.X4 and connect it to X2 on W11. • Connect the cable item 24 to A43.X4 and W11. • Remove the existing cable from A43.X6 and connect it to A43.X6.1, included in item 26. • Connect A43.X6 on the cable item 26 to the connector board A43.X6. • Connect the W11.X3 connector on cable item 26 to X3 on the W11 connector.	 xx1600000464 • Item 24: *Cable Patch (3HEA802215-001)* • Item 25: *3-way RJ45 8P/8C shielded MPK402 (3HEA802183-001)* • Item 26: *Cable I/O RS485 (3HEA802201-001)*
10	Attach the connectors X1, X2 and A111.TB1 to the axis selector.	
11	Attach the ground cable from the axis selector to the chassis.	 xx1600000465

3.7 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

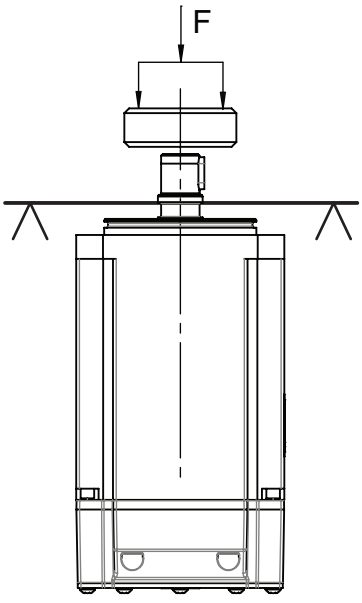
Grease the shaft after assembly to avoid oxidation.

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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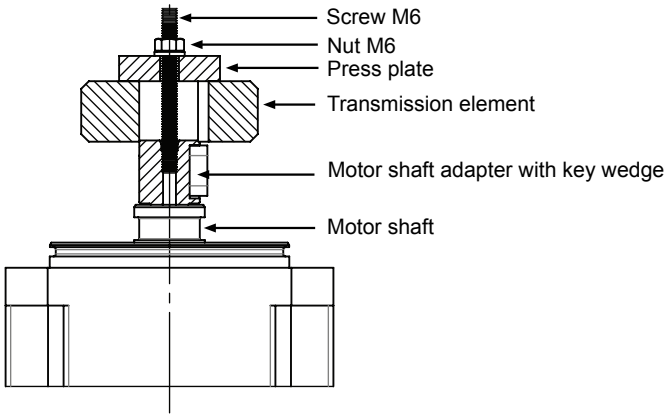
3.7 Handling of motors
Continued

	Maximum allowed axial force (F)
MU 80	15 kN
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.



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Assembly by pressing on the pinion

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

Use the motor flange as a dolly, as shown in the following figure.

CAUTION

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

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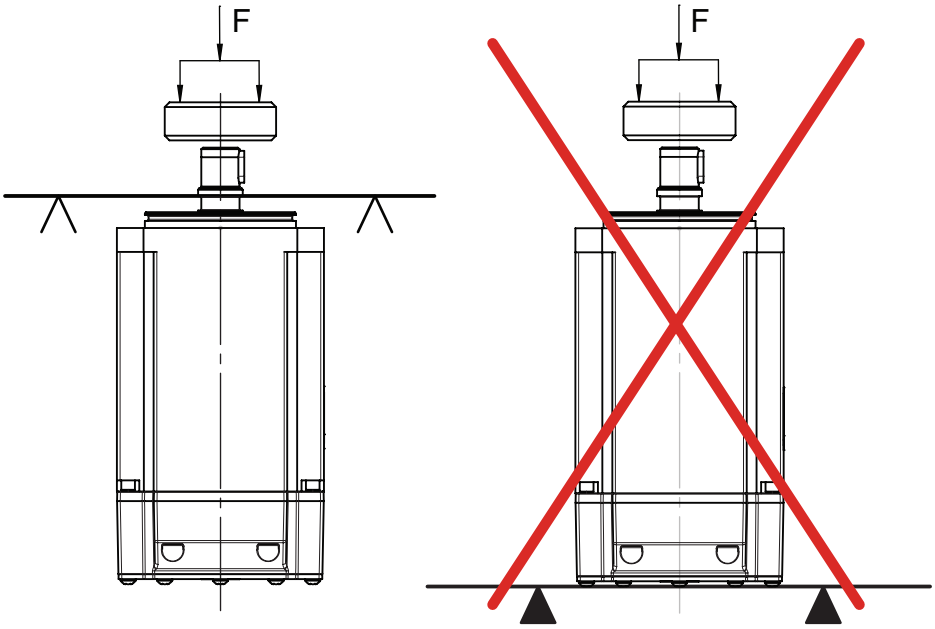

xx1300000315

	Maximum allowed axial force (F)
MU 80	650 N
MU 100	125 N
MU 200	1,963 N
MU 250	1,963 N
MU 300	1,963 N
MU 400	2,825 N

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.

Note

This method is not applicable for MU 80 since it does not have a connection box and the back cover of the motor is not allowed to be opened.

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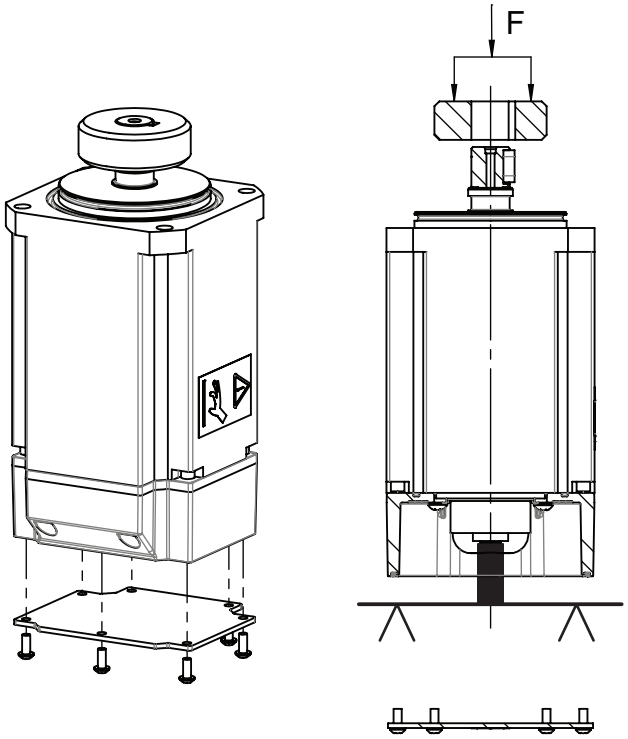
3.7 Handling of motors
Continued



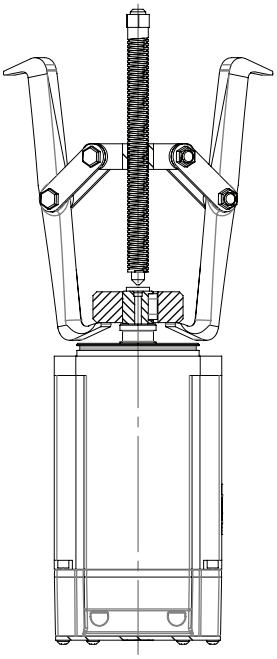
xx1300000316

	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.



xx1300000318

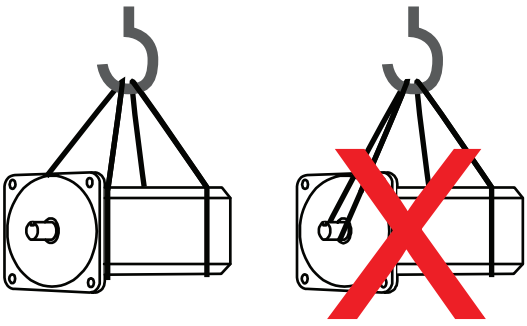
Note

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.



xx1300000231

3.8 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 installed correctly by referring to *Circuit diagram - Motor Units and Gear Units*.

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	**WARNING** 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.	

3.9 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.

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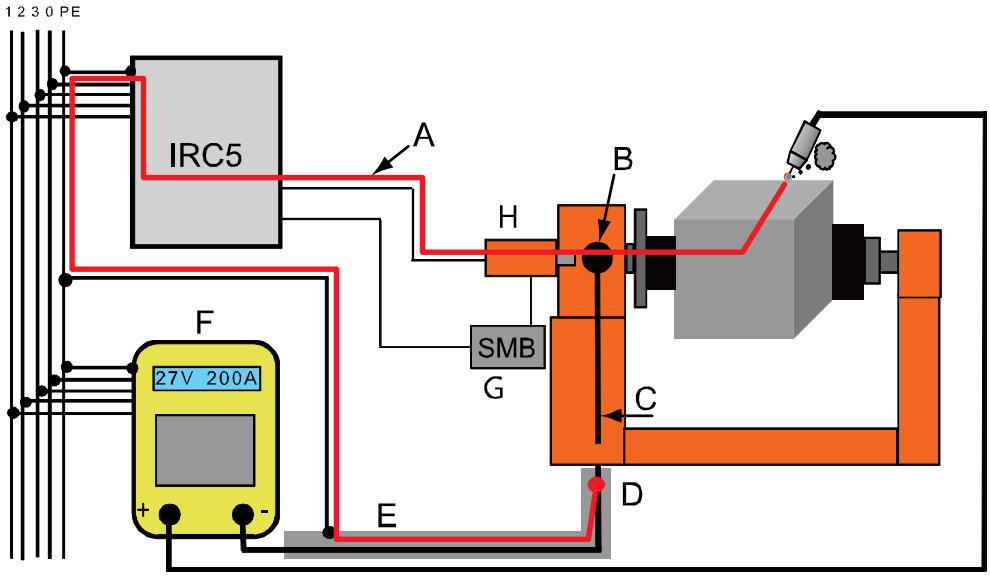
3.9 Insulation in arc welding stations

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

3.10 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, *Circuit diagram - Motor Units and Gear Units*.

3.11 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	**DANGER** Before commencing any work inside the cabinet, please observe the safety information in section *Make sure that the main power has been switched off on page 15*.	
2	Remove the cable harness for the XS.7 contact.	
3	Refit the new cable harness.	*Circuit diagram - Motor Units and Gear Units*

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 79*. 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

- 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 `readme.txt` to verify which files to use.	All files are included in the folder `...\utility\...` 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 *Tuning on page 80*.

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

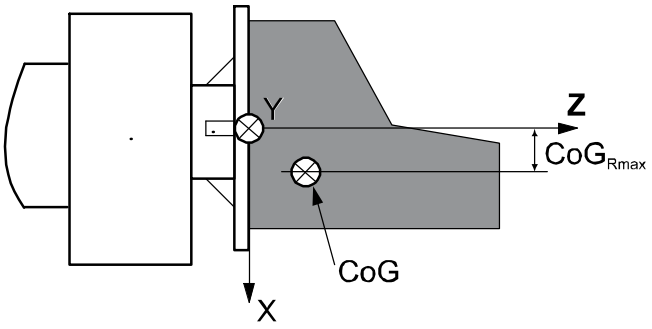
4.2 Dimensioning gear units

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 79*.

$$(T_{maxgear} - m * g * CoG_{Rmax}) / (m * CoG_{Rmax}^2 + J_{0z})$$



xx1100000104

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

CoG_{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 $T_{maxgear}$ values from the table for the calculation.

Gear unit	$T_{maxgear}$ (max torque on arm side) (Nm)	Recommended maximum acceleration and deceleration (rad/s^2)
MTD 250	480	4
MTD 500	1,100	3
MTD 750	1,950	3
MTD 2000	5,000	0.8
MTD 5000	11,400	0.5
MID 500	1,950	2.4
MID 1000	5,000	1.1

Related information

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

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 in the RobotWare distribution, 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.

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.

Robot calibration is described in *Operating manual - IRC5 with FlexPendant*, and in the product manual for the robot.

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*.

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 **ABB** menu, tap **Calibration**.	
3	Tap to select the mechanical unit.	
4	Tap **Fine Calibration**.	
5	Tap to select the axis and then tap **Calibrate**.	

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 **ABB** menu, tap **Calibration**.	
3	Tap **Rev. Counters** and then tap **Update Revolution Counters**.	
4	Tap to select the axis and then tap **Update**.	

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6 Tuning the thermal supervision

Thermal supervision

The motor units (except MU 80 and 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 (*Max Temperature Robot*)	+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. Topic *Motion*, type *Motion System*.
Thermal supervision (*Thermal Supervision Sensitivity Ratio*)	0.5 to 2	1.0	Topic *Motion*, type *Supervision*.

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 TuneMaster.	T_{stator_rise}= Measured motor body temperature + 35 – actual ambient temperature 35 is the approximate difference between the motor body temperature and the stator temperature.

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	Action	Information
3	If T_{stator_rise} is larger than the thermal model temperature rise, then increase the thermal supervision sensitivity ratio. If T_{stator_rise} is smaller than the thermal model temperature rise, then decrease the thermal supervision sensitivity ratio.	**Tip** You can use the ratio between T_{stator_rise} and the thermal model temperature rise, when estimating how much the Thermal supervision sensitivity ratio should be changed.
4	If T_{stator_rise} + *Max temperature robot* > 130 °C (max allowed is 140 °C, hot motor warnings will appear at 130 °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

Application manual - TuneMaster

7 Maintenance

7.1 Introduction

Structure of this chapter

This chapter describes all the maintenance activities recommended for the motor units and gear units.

It is based on the maintenance schedule found 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, including required tools and materials.

The procedures are gathered in different sections and divided according to the maintenance activity.

Safety information

Observe all safety information before conducting any service work.

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 motor units and gear units is connected to power, always make sure that the motor units and gear units is connected to protective earth before starting any maintenance work.

For more information see:

- *Product manual - IRC5*

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	-	*Cleaning the motor units and gear units on page 92*
Inspection	Cables	Running	*Inspecting cables on page 87*
Inspection	MU250 drain holes **Note** Only MU250 has drain holes.	Running	*Inspecting MU250 drain holes on page 88*
Lubrication	Current collector	400 hours	*Lubricating the current collector on page 93*
Replacement	Battery pack, measurement system of type RMU101 or RMU102 (3-pole battery contact)	36 months or battery low alert [i]	*Replacing SMB battery on page 89*
Replacement	Battery pack, measurement system with 2-pole battery contact, e.g. DSQC633A	Battery low alert [ii]	*Replacing SMB battery on page 89*

i 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.

ii 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

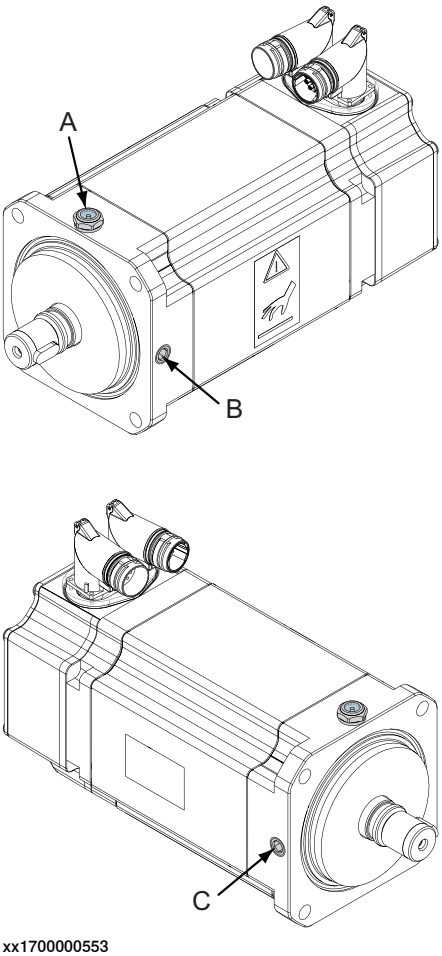
Use this procedure to inspect cables.

	Action	Information
1	 **DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply 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.	

7.4 Inspecting MU250 drain holes

Inspecting MU250 drain holes

Use this procedure to inspect MU250 drain holes.

	Action	Information
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	Inspect the drain hole from the glass cover in the middle.	 xx1700000553 Parts: • A: Drain hole with glass cover • B: Drain hole with stop screw • C: Drain hole with stop screw
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.

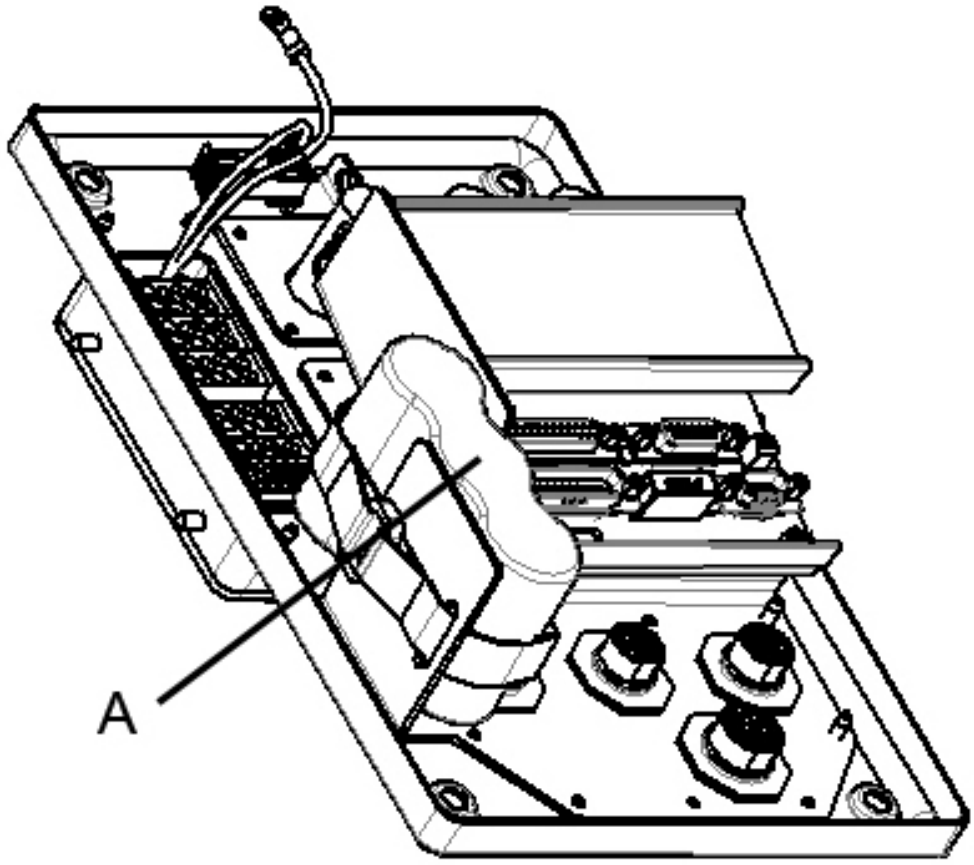
For an SMB board with 2-pole battery contact, the typical lifetime of a new battery is 36 months if the robot is powered off 2 days/week or 18 months if the robot is powered off 16 h/day. The lifetime can be extended for longer production breaks with a battery shutdown service routine. See *Operating manual - IRC5 with FlexPendant* for instructions.

WARNING

See instructions for batteries, *Safety risks during handling of batteries on page 27*.

Continues on next page

Location of SMB battery



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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	 **DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	 **ELECTROSTATIC DISCHARGE (ESD)** Before handling the unit, see *The unit is sensitive to ESD on page 24*.	
3	Open the cover on the SMB box.  **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	
4	Pull out the *battery* and disconnect the battery cable.	
5	Fit the new *battery* and connect the battery cable.	
6	Close the SMB box.	
7	Update the revolution counters.	See *Calibration on page 81*.
8	Dispose of the old battery.	See *Environmental information on page 99*.

7.6 Cleaning the motor units and gear units

WARNING

Turn off all electrical power supplies to the manipulator before entering its work space.

General

To secure high uptime it is important that the motor units and gear units is cleaned regularly. The frequency of cleaning depends on the environment in which the product works.

Special cleaning considerations

This section specifies some special considerations when cleaning the robot.

- Always use cleaning equipment as specified. Any other cleaning equipment may shorten the life of the robot.
- Always check that all protective covers are fitted to the robot before cleaning.
- Never point the water jet at connectors, joints, sealings, or gaskets.
- Do not use compressed air to clean the robot.
- Never use solvents that are not approved by ABB to clean the robot.
- Do not spray from a distance closer than 0.4 m.
- Do not remove any covers or other protective devices before cleaning the robot.

Cleaning methods

The following table defines what cleaning methods are allowed.

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

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 22*
- *Safety risks during installation and service work on robots on page 16*

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.	**Note** Amount of grease: 12 ml.

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8 Repair

8.1 Cut the paint or surface on the robot before replacing parts

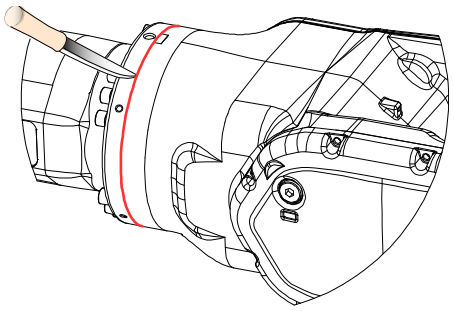
General

Follow the procedures in this section whenever breaking the paint of the robot during replacement of parts.

Required equipment

Equipment	Spare parts	Note
Cleaning agent		Ethanol
Knife		
Lint free cloth		
Touch up paint Standard/Foundry Plus	3HAC067974-001	Graphite White
Touch up paint Standard/Foundry Plus	3HAC037052-001	ABB Orange

Removing

	Action	Description
1	Cut the paint with a knife in the joint between the part that will be removed and the structure, to avoid that the paint cracks.	 xx0900000121
2	Carefully grind the paint edge that is left on the structure to a smooth surface.	

8.2 Replacing SMB board

WARNING

See safety instructions for batteries, *Safety risks during handling of batteries on page 27*.

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 *Spare parts and exploded views on page 104*.

Removing the SMB board

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

	Action	Information
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	**ELECTROSTATIC DISCHARGE (ESD)** Before handling the unit, see *The unit is sensitive to ESD on page 24*.	
3	Open the cover on the SMB box. **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	
4	Disconnect the cables.	
5	Remove the screws holding the plate.	Keep the toothed washers.
6	Pull out the plate.	

Continues on next page

	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 *Environmental information on page 99*.

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 *Calibration on page 81*.

8.3 Repair in the motor connection box

Motor connection box

The motor connection box can be opened to replace equipment.

Note

MU 80 does not have a connection box.

Note

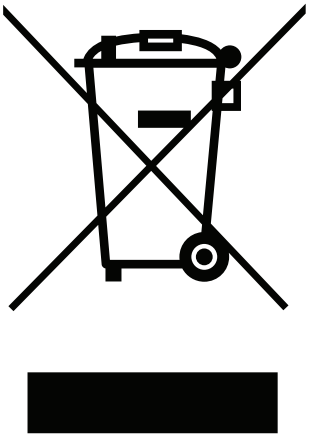
When assembling the connection box to the motor or the top cover to the connection box, make sure that the o-ring is in the groove.

9 Decommissioning

9.1 Environmental information

Symbol

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



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Hazardous material

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

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

Material	Example application
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.

Continues on next page

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.

10 Reference information

10.1 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 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN ISO 13849-1:2015	Safety of machinery, safety related parts of control systems - Part 1: General principles for design
EN ISO 13850:2015	Safety of machinery - Emergency stop - Principles for design
EN ISO 10218-1:2011	Robots for industrial environments - Safety requirements -Part 1 Robot
ISO 9787:2013	Robots and robotic devices -- Coordinate systems and motion nomenclatures
ISO 9283:1998	Manipulating industrial robots, performance criteria, and related test methods
EN ISO 14644-1:2015[i]	Classification of air cleanliness
EN ISO 13732-1:2008	Ergonomics of the thermal environment - Part 1
EN 61000-6-4:2007 + A1:2011 IEC 61000-6-4:2006 + A1:2010 (option 129-1)	EMC, Generic emission
EN 61000-6-2:2005 IEC 61000-6-2:2005	EMC, Generic immunity
EN IEC 60974-1:2012[ii]	Arc welding equipment - Part 1: Welding power sources
EN IEC 60974-10:2014[ii]	Arc welding equipment - Part 10: EMC requirements
EN IEC 60204-1:2006	Safety of machinery - Electrical equipment of machines - Part 1 General requirements
IEC 60529:1989 + A2:2013	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 614-1:2006 + A1:2009	Safety of machinery - Ergonomic design principles - Part 1: Terminology and general principles

Continues on next page

10.1 Applicable standards
Continued

Standard	Description
EN 574:1996 + A1:2008	Safety of machinery - Two-hand control devices - Functional aspects - Principles for design

10.2 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	

10.3 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.

10.4 Circuit diagrams

Overview

The circuit diagrams are not included in this manual, but are available for registered users on myABB Business Portal, *www.myportal.abb.com*.

See the article numbers in the tables below.

Controllers

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

Robots

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

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10.4 Circuit diagrams
Continued

Product	Article numbers for circuit diagrams
Circuit diagram - IRB 6640	*3HAC025744-001*
Circuit diagram - IRB 6650S	*3HAC13347-1* *3HAC025744-001*
Circuit diagram - IRB 6660	*3HAC025744-001* *3HAC029940-001*
Circuit diagram - IRB 6700	*3HAC043446-005*
Circuit diagram - IRB 7600	*3HAC13347-1* *3HAC025744-001*
Circuit diagram - IRB 14000	*3HAC050778-003*
Circuit diagram - IRB 910SC	*3HAC056159-002*

Other hardware

Product	Article numbers for circuit diagrams
Circuit diagram - Motor Units and Gear Units	*3HAC039887-001*

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ABB AB, Robotics
Robotics and Motion
S-721 68 VÄSTERÅS, Sweden
Telephone +46 (0) 21 344 400

ABB AS, Robotics
Robotics and Motion
Nordlysvegen 7, N-4340 BRYNE, Norway
Box 265, N-4349 BRYNE, Norway
Telephone: +47 22 87 2000

ABB Engineering (Shanghai) Ltd.
Robotics and Motion
No. 4528 Kangxin Highway
PuDong District
SHANGHAI 201319, China
Telephone: +86 21 6105 6666

ABB Inc.
Robotics and Motion
1250 Brown Road
Auburn Hills, MI 48326
USA
Telephone: +1 248 391 9000

abb.com/robotics

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