ROBOTICS

Product manual

IRB 14000

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Workspace 23A version a15
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Skribenta version 5.5.019

Product manual

IRB 14000-0.5/0.5

IRC5

Document ID: 3HAC052983-001

Revision: S

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Keep for future reference.

Additional copies of this manual may be obtained from ABB.

Original instructions.

Table of contents

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Overview of this manual

About this manual

This manual contains instructions for:

- mechanical and electrical installation of the robot
- maintenance of the robot
- mechanical and electrical repair of the robot.

Usage

This manual should be used during:

- installation, from lifting the robot to its work site and securing it to the foundation, to making it 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

A 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 IRB 14000. Some variants and designs may have been removed from the business offer and are no longer available for purchase.

Organization of chapters

The manual is organized in the following chapters:

Chapter	Contents
Safety, service	Safety information that must be read through before performing any installation or service work on robot. Contains general safety aspects as well as more specific information on how to avoid personal injuries and damage to the product.
Installation and commissioning	Required information about lifting and installation of the robot.
Maintenance	Step-by-step procedures that describe how to perform maintenance of the robot. Based on a maintenance schedule that may be used to plan periodical maintenance.
Repair	Step-by-step procedures that describe how to perform repair activities of the robot. Based on available spare parts.

Continues on next page

Continued

Chapter	Contents
Calibration information	Procedures that do not require specific calibration equipment. General information about calibration.
Decommissioning	Environmental information about the robot and its components.
Reference information	Useful information when performing installation, maintenance or repair work. Includes lists of necessary tools, additional documents, safety standards, etc.

References

Documentation referred to in the manual, is listed in the table below.

Document name	Document ID
Product manual, spare parts - IRB 14000	*3HAC052984-001*
Product specification - IRB 14000	*3HAC052982-001*
Product manual - Grippers for IRB 14000	*3HAC054949-001*
Operating manual - IRB 14000	*3HAC052986-001*
Circuit diagram - IRB 14000	*3HAC050778-003*
Safety manual for robot - Manipulator and IRC5 or OmniCore controller [i]	*3HAC031045-001*
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*
Product manual - IRC5	*3HAC021313-001*
Technical reference manual - System parameters	*3HAC050948-001*
Application manual - Scalable I/O	*3HAC059109-001*
Application manual - Conveyor tracking	*3HAC050991-001*

[i] This manual contains all safety instructions from the product manuals for the manipulators and the controllers.

Revisions

Revision	Description
-	First edition.
A	The following updates are done in this revision: • Minor editorial changes. • Changed article number for the ESD warning label and added AbsAcc label, see *Inspecting the information labels on page 121*. • Added figures for axis-4, axis-5 and axis-6 motors for removal and refitting of the wave generator. • Added reference to absolute accuracy calibration for some repair procedures.

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Revision	Description
B	The following updates are done in this revision: • Changed tightening torque of axis-7 motor from 0.2 Nm to 0.8 Nm. • Added a tightening torque for the axis-7 cable bracket (0.8 Nm). • Corrected orientation of removal tool on motor in figure that shows fitting of the removal tool on the axis-1 motor. • Corrected the procedure for replacing the axis-6 motor by adding steps for removal of two more covers/padding added. • Corrected figure of the axis-3 motor to show orientation of motor according to motor connector location. • Corrected the procedure for replacing the battery pack by adding step for removal of two more screws on the body cover. • Added a caution signal to be careful not to hit the arms into something while lifting and transporting the robot. • Changed procedure for replacing the field bus adapter. The computer cover does not need to be removed. • Added a step for moving the battery packs from the old drive board onto the new. • Added information about deviations and fulfilment of certain requirements for ISO10218-1:2011, see *Applicable standards on page 432*. • Added safety information for collaborative robots. • Changed torque y and torque z for endurance load and maximum load. • Added information about setting the running speed to 100% before running fine calibration procedure.
C	The following updates are done in this revision: • Figures in procedures about Fitting the wave generator to the motor are updated. • Grease name and volume is moved to Manual Lubrication in gearboxes. • Specification of screws added to section "Reference information". • Screw/nut type and tightening torque added to steps in section "Repair". • Plastic parts are ESD coated; names and spare part numbers are modified. • ABB-supplied main power cables in different interface standards are provided as options. See *Main power cable on page 76*. • Applicable ESD-standards added. • Information added about checking PTFE film before refitting the axis-5 and axis-6 motors, see *Replacing the axis-5 motor on page 218* and *Replacing the axis-6 motor on page 233*.
D	Published in release R16.2. The following updates are made in this revision: • Sections about Replacing axis-1 and axis-7 motor revised. • Safety section about pressure relief valves added. • RT6 safety relay supported and related information added. See *Safety relay (option 1526-X) on page 98*. • Max current added for pin 9 on connector XS7 and XS8. • Added line fusing, rated power, and required equipment information for power connection to the controller. See *Connecting power supply on page 84*. • Re-calibration instruction for replacing hall sensors revised.

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Revision	Description
E	Published in release R17.1. The following updates are made in this revision: • DSQC1000 computer changed to DSQC1018 computer. • Re-calibration instruction for replacing hall sensors revised. • The hall sensor must be replaced if the robot is rebuilt. • Added note about fine calibration, see *Calibrating the robot on page 401*.
F	Published in release R17.2. The following updates are made in this revision: • Information about minimum resonance frequency added. • Bending radius for floor cables added. • Updated list of applicable standards. • Section *Start of robot in cold environments on page 114* added. • Added information about service routine YuMi AbsAcc Recovery in Calibration chapter. • Specified the view of the hole configuration on base. • Updated the value of air supply on controller interface.
G	Published in release R18.1. The following updates are made in this revision: • Safety section restructured. • Clarified the limitations for Isolated Lan 3 in the section *Isolated LAN 3 or LAN 3 as part of the private network (only for RobotWare 6.01 and later) on page 89*. • Information about myABB Business Portal added.
H	Published in release R18.2. The following updates are made in this revision: • Minor additions in the information regarding the service routine YuMi AbsAcc Recovery. • New article number for the YuMi AbsAcc Recovery tool, now complete kit with tool box. • Updated cleaning method. • Updated the figure of the hole configuration on base. • Removed hall sensor replacement procedure because hall sensors are not spare parts any more. • Updated spare part note to axis-5 and -6 motors.
J	Published in release R18.2. The following updates are made in this revision: • Updated references.
K	Published in release 19B. The following updates are made in this revision: • Updated the shipping and transportation position. • Added information about the center of gravity (COG). • Updated precautions for the robot working in contact with the operator. • New chapters added: *Conveyor tracking module on page 103* and *Installation of conveyor tracking module on page 110*. • New chapters added: *Local I/O devices on page 101* and *Installation of Local I/O devices on page 107*.
L	Published in release 20A. The following updates are made in this revision: • Added information about Type A which has a reinforced design. • Clarified and added information in mounting instructions for rotating sealings, see *Mounting instructions for sealings on page 140*.

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Revision	Description
M	Published in release 20B. The following updates are made in this revision: • Updated robot arm dimension. • Updated safety relay information because SSR10M safety relay replaces RT6 safety relay. • Information regarding multiple EtherNet based options removed from section "Connecting a PC and Ethernet based options".
N	Published in release 20D. The following updates are made in this revision: • Updated figure showing the connectors on the interface on the left side panel of the controller. • Added software version requirement for selecting arm configuration of Type A during system installation.
P	Published in release 21B. The following updates are made in this revision: • Information added about China RoHS, see *Environmental information on page 428*. • Added information about joint torques, see *Joint torques on page 51*. • Text regarding diameter of air hoses is updated, see *Controller interface, left side on page 82*. • Added delivery information about the attachment screws, see *Specification, attachment screws and pins on page 66*.
Q	Published in release 22A. The following updates are made in this revision: • Clean Room option added. • Updated information about Gleitmo treated screws, see *Screw joints on page 438*.
R	Published in release 22D. The following updates are done in this revision: • Added information about Wrist Optimization in calibration chapter.
S	Published in release 23A. The following updates are done in this revision: • Added information about maintenance activity of robot overhaul. • Removed certification from UL.

Product documentation

Categories for user documentation from ABB Robotics

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

Tip

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

Product manuals

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

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

Technical reference manuals

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

Application manuals

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

An application manual generally contains information about:

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

Continues on next page

- Examples of how to use the application.

Operating manuals

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

How to read the product manual

Reading the procedures

The procedures contain all information required for the installation or service activity and can be printed out separately when needed for a certain service procedure.

Safety information

The manual includes a separate safety chapter that must be read through before proceeding with any service or installation procedures. All procedures also include specific safety information when dangerous steps are to be performed.

Read more in the chapter *Safety on page 19*.

Illustrations

The product is illustrated with general figures that does not take painting or protection type in consideration.

Likewise, certain work methods or general information that is valid for several product models, can be illustrated with illustrations that show a different product model than the one that is described in the current manual.

Network security

Network security

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

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

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1 Safety

1.1 Safety information

1.1.1 Limitation of liability

Limitation of liability

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

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

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

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

Spare parts and equipment

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

1.1.2 Safety data

About this section

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

Prevailing directives and standards

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

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

Performance level and category

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

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

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

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

Performance level for ABB IRC5 controller

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

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

- Enabling device
- Emergency stop on operator panel

Continues on next page

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

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

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

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

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

Conclusion according to EN ISO 13849-1:2015

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

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

1.1.3 Requirements on personnel

General

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

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

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

Personal protective equipment

Use personal protective equipment, as stated in the instructions.

1.2 Safety signals and symbols

1.2.1 Safety signals in the manual

Introduction to safety signals

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

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

Hazard levels

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

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

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1.2.1 Safety signals in the manual
Continued

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

1.2.2 Safety symbols on manipulator labels

Introduction to symbols

This section describes safety symbols used on labels (stickers) on the manipulator.

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 symbols on the labels on the product must be observed. Additional symbols added by the integrator must also be observed.

Types of symbols

Both the manipulator and the controller are marked with symbols, containing important information about the product. This is important 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 25*.

The information labels can contain information in text.

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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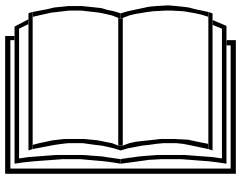
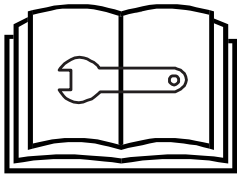
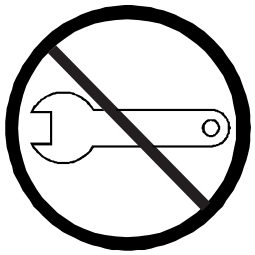
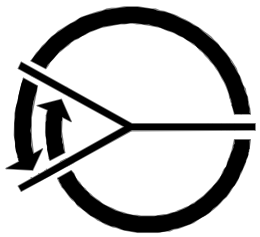
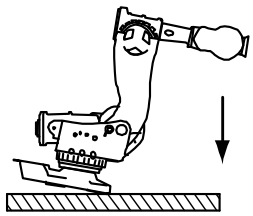
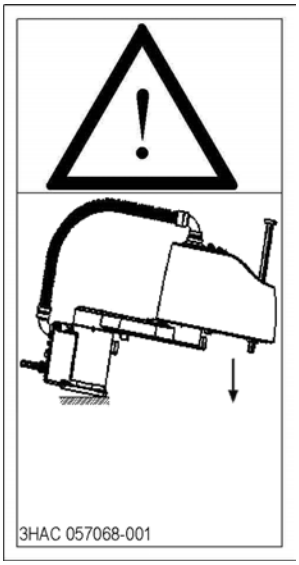
1.2.2 Safety symbols on manipulator labels
Continued

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 disassembly, 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

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.

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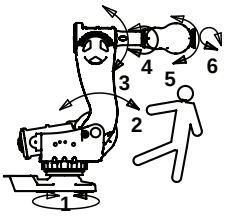
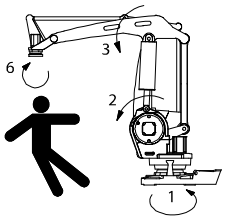
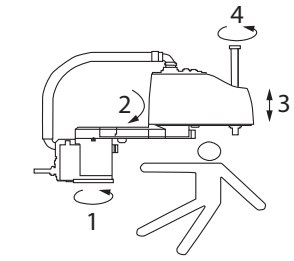
1.2.2 Safety symbols on manipulator labels
Continued

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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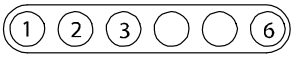
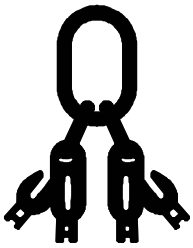
Symbol	Description
 xx0900000820  xx1000001140	**Brake release buttons**
 xx0900000821	**Lifting bolt**
 xx1000001242	**Chain sling with shortener**
 xx0900000822	**Lifting of robot**
 xx0900000823	**Oil** Can be used in combination with prohibition if oil is not allowed.
 xx0900000824	**Mechanical stop**

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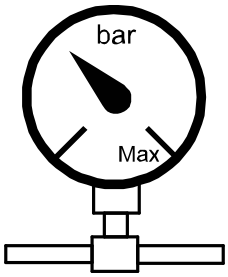
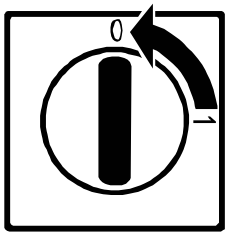
1.2.2 Safety symbols on manipulator labels

Continued

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.

1.2.3 Safety symbols on controller labels

Introduction to safety symbols

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

The safety symbols are language independent, they only use graphics. The information labels contain information in text. See *Symbols and information on labels on page 31*.

Note

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

Symbols and information on labels

Note

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

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

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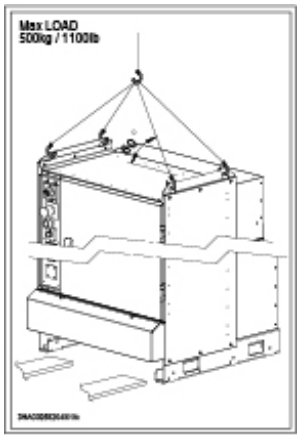
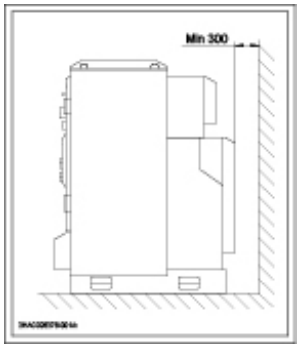
1.2.3 Safety symbols on controller labels

Continued

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

Continues on next page

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

1.3 Robot stopping functions

1.3.1 Protective stop and emergency stop

Robot stopping functions

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

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

A stop function, protective or emergency stop, has a default setting for the stop category, see *Inputs to initiate a protective stop or an emergency stop on page 34*.

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

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

Inputs to initiate a protective stop or an emergency stop

Inputs to initiate a stop function	Description	Default stop category	Stop category reconfigurable Y/N
Emergency Stop (ES)	Input to initiate the emergency stop function. The *Emergency Stop* function is initiated in both automatic and manual mode.	Stop category 0 For deviations, see the product manual for the manipulator.	Y
Automatic Stop (AS)	Input to initiate the protective stop function *Automatic Stop*. The *Automatic Stop*function is only initiated in automatic mode.	Stop category 1	Y
General Stop (GS)	Input to initiate the protective stop function *General Stop*. The *General Stop*function is initiated in both manual mode and automatic mode.	Stop category 1	Y
Superior Stop (SS)	Input to initiate the superior stop function. The *Superior Stop*function is initiated in both manual mode and automatic mode.	Stop category 1	Y

For example, a safety rated output from a presence sensing device, connected to AS / GS, a dedicated discrete protective stop input on the robot controller, will

Continues on next page

when the protective stop function is configured as Automatic Stop (AS) initiate the protective stop function in automatic mode only.

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

Note

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

Stop category configuration for IRC5

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

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

1.4 Safety during installation and commissioning

National or regional regulations

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

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

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

Layout

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

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

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

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

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

Allergenic material

See *Environmental information on page 428* for specification of allergenic materials in the product, if any.

Securing the robot to the foundation

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

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

Electrical safety

Incoming mains must be installed to fulfill national regulations.

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

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

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

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

Note

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

Continues on next page

Safety devices

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

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

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

Other hazards

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

- Water
- Compressed air
- Hydraulics

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

Specific information for YuMi robots

General

The YuMi robot is intended for collaborative applications where contact between robot and the operator is harmless. The robot is designed to comply with ISO 10218-1, §5.10.5. Power and force limiting by inherent design or control. This is achieved by inherent design measures in the robot arm and control system.

Details are given in the following sections. [1]

Mechanical design measures

The power and force of the robot is limited mechanically by:

- Light weight
- Low payload (500 gram)
- Weak drivetrain that can be stopped and overridden by hand
- Soft and round outer shell (Regular inspection of the outer shell is required. See *Inspecting, plastic and padding on page 129*)
- No sharp edges or pinch points

Grippers, end effectors and work pieces

The YuMi gripper from ABB is designed to allow manual release and removal of gripped work pieces. Both servo and vacuum modules can be overridden by manual force.

End tools, such as fingers and suction tools, as well as work pieces handled by the robot, must be designed and chosen so that such contact does not introduce safety hazards.

The integrator shall include grippers, end effectors and work pieces in the risk assessment. See also ISO/TS15066.

[1] See also technote_150918.

Continues on next page

Personal protective equipment

Sensitive body parts, such as the eyes and the larynx, must be protected by personal protective equipment (PPE).

Safety functions

The following safety functions are inherent design measures in the control system, contributing to power and force limiting. The safety functions are category B, performance level b, according to EN ISO 13849-1.

Safety function	Description
Cartesian speed supervision	The Cartesian speed of the elbow (arm check point, ACP) and the wrist (wrist center point, WCP) are supervised. If a limit is exceeded, the robot motion is stopped and a message displayed to the user. The default speed limit can be modified based on the risk assessment of the robot installation. The function is active in both manual and automatic mode. The speed limits are set by system parameters, in the topic *Motion*, type *Robot*.
Protective stop	The safety function removes power from the actuators, and is a stop category 0, according to IEC 60204. The default configuration of the controller is that the emergency stop button on the FlexPendant is routed to the safety function. The controller can be re-configured to have an external device affecting the safety function.

Safety hazards in collaborative application

The arm and gripper must be inspected at frequent intervals to make sure that there are no damages to plastic, padding, or other components.

The arm must not be used without reducing the hazards related to the tool flange.

Pneumatic related hazards

The compressed air used in the robot system must not exceed the rated limit for the manipulator. Use pressure relief valves.

All pipes, hoses and connections within the robot shall be inspected regularly for leaks and damage. Damages must be repaired immediately.

The compressed air used in the robot system might remain after robot main power has been switched off. Compressed air shall be considered in the risk assessment.

Pressure relief valves

The pressure relief valve prevents too much air pressure being built up inside the robot. The air pressure must not exceed the rated limit for the manipulator, or there is a risk of personal injury and mechanical damage.

Pressure relief valves must be kept clean.

Verify the safety functions

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

1.5 Safety during operation

Automatic operation

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

Manually stopping or overriding the arm

The movement of the IRB 14000 arm can be manually be stopped or overridden because the arm is light and the drivetrain power is limited. If the arm is in motion, collision detection can be used help to stop the the arm. If the arm is at standstill, motors or brakes can be manually overridden.

CAUTION

The normal stopping functions of the control system should be used to stop movement, to avoid unnecessary damage and wear to the arm. Push the brake release buttons before manually moving the arm.

Unexpected movement of robot arm

WARNING

Hazards due to the use of brake release devices and/or gravity beneath the manipulator shall be considered.

1.6 Safety during maintenance and repair

1.6.1 Safety during maintenance and repair

General

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

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

Make sure that there are no loose screws, turnings, or other unexpected parts remaining after work on the robot has been performed.

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

Hot surfaces

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

Allergic reaction

Warning	Description	Elimination/Action
 **Allergic reaction**	When working with lubricants there is a risk of an allergic reaction.	Make sure that protective gear like goggles and gloves are always worn.

Gearbox lubricants (oil or grease)

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

 **Note**

Take special care when handling hot lubricants.

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 lubricants there is a risk of an allergic reaction.	Make sure that protective gear like goggles and gloves are always worn.

Continues on next page

Warning	Description	Elimination/Action
 **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.
 **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.

Hazards related to batteries

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

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

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

Operating temperatures are listed in *Operating conditions, robot on page 51*.

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

Related information

See also the safety information related to installation and operation.

1.6.2 Emergency release of the robot axes

Description

In an emergency situation, the brakes on a robot axis can be released manually by pushing a brake release button.

How to release the brakes is described in the section:

- *Manually releasing the brakes on page 68*.

1.6.3 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 axis to a position where the combined weight of the manipulator 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 manipulator does not change position as the motors are switched off, then the brake function is adequate.

> **Note**
>
> It is recommended to run the service routine *BrakeCheck* as part of the regular maintenance, see the operating manual for the robot controller.
>
> For robots with the option SafeMove, the *Cyclic Brake Check* routine is recommended. See the manual for SafeMove in *References on page 10*.

1.7 Safety during troubleshooting

General

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

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

DANGER

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

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

Related information

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

1.8 Safety during decommissioning

General

See section *Decommissioning on page 427*.

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

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2 Installation and commissioning

2.1 Introduction to installation and commissioning

General

This chapter contains assembly instructions and information for installing the IRB 14000 at the working site.

See also the product manual for the robot controller.

The installation must be done by qualified installation personnel in accordance with the safety requirements set forth in the applicable national and regional standards and regulations.

Safety information

Before any installation work is commenced, all safety information must be observed.

There are general safety aspects that must be read through, as well as more specific safety information that describes the danger and safety risks when performing the procedures. Read the chapter *Safety on page 19* before performing any installation work.

Note

Always connect the IRB 14000 and the robot to protective earth and residual current device (RCD) before connecting to power and starting any installation work.

For more information see:

2.2 Unpacking

2.2.1 Pre-installation procedure

Introduction

This section is intended for use when unpacking and installing the robot for the first time. It also contains information useful during later re-installation of the robot.

Prerequisites for installation personnel

Installation personnel working with an ABB product must:

- be trained by ABB and have the required knowledge of mechanical and electrical installation/maintenance/repair work
- conform to all national and local codes.

Checking the pre-requisites for installation

	Action
1	Make a visual inspection of the packaging and make sure that nothing is damaged.
2	Remove the packaging.
3	Check for any visible transport damage. **Note** Stop unpacking and contact ABB if transport damages are found.
4	Clean the unit with a lint-free cloth, if necessary.
5	Make sure that the lifting accessory used (if required) is suitable to handle the weight of the robot as specified in: *Weight, robot on page 48*
6	If the robot is not installed directly, it must be stored as described in: *Storage conditions, robot on page 50*
7	Make sure that the expected operating environment of the robot conforms to the specifications as described in: *Operating conditions, robot on page 51*
8	Before taking the robot to its installation site, make sure that the site conforms to: • *Loads on foundation, robot on page 49* • *Protection classes, robot on page 51* • *Requirements, foundation on page 50*
9	Before moving the robot, please observe the stability of the robot: *Risk of tipping/stability on page 57*
10	When these prerequisites are met, the robot can be taken to its installation site as described in section: *On-site installation on page 59*
11	Install required equipment, if any. • *Installing the signal lamp on page 70*

Weight, robot

The table shows the weight of the robot.

Robot model	Weight
IRB 14000	38 kg

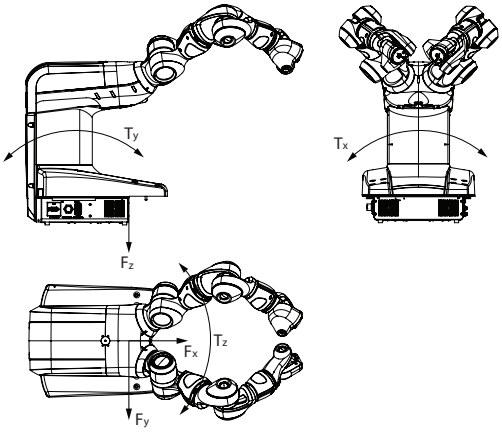
Continues on next page

Note

The weight does not include tools and other equipment fitted on the robot.

Loads on foundation, robot

The illustration shows the directions of the robots stress forces.



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F_x	Force in the X plane
F_y	Force in the Y plane
F_z	Force in the Z plane
T_y	Bending torque the Y plane
T_x	Bending torque the X plane
T_z	Bending torque in the Z plane

The table shows the various forces and torques working on the robot during different kinds of operation.

Note

These forces and torques are extreme values that are rarely encountered during operation. The values also never reach their maximum at the same time!

WARNING

The robot installation is restricted to the mounting options given in following load table(s).

Table mounted

Force	Endurance load (in operation)	Max. load (emergency stop)
Force x	±89 N	±178 N
Force y	±147 N	±294 N
Force z	+380 ±140 N	+380 ±280 N

Continues on next page

2.2.1 Pre-installation procedure
Continued

Force	Endurance load (in operation)	Max. load (emergency stop)
Torque x	±101 Nm	±202 Nm
Torque y	+14 ±98 Nm	+14 ±172 Nm
Torque z	±61 Nm	±122 Nm

Requirements, foundation

The table shows the requirements for the foundation where the weight of the installed robot is included:

Requirement	Value	Note
Flatness of foundation surface	0.1/500 mm	Flat foundations give better repeatability of the resolver calibration compared to original settings on delivery from ABB. The value for levelness aims at the circumstance of the anchoring points in the robot base. In order to compensate for an uneven surface, the robot can be recalibrated during installation. If resolver/encoder calibration is changed this will influence the absolute accuracy.
Maximum tilt	0º	
Minimum resonance frequency	22Hz **Note** It may affect the manipulator lifetime to have a lower resonance frequency than recommended.	The value is recommended for optimal performance. Due to foundation stiffness, consider robot mass including equipment. [i] For information about compensating for foundation flexibility, see the application manual of the controller software, section *Motion Process Mode*.

i The minimum resonance frequency given should be interpreted as the frequency of the robot mass/inertia, robot assumed stiff, when a foundation translational/torsional elasticity is added, i.e., the stiffness of the pedestal where the robot is mounted. The minimum resonance frequency should not be interpreted as the resonance frequency of the building, floor etc. For example, if the equivalent mass of the floor is very high, it will not affect robot movement, even if the frequency is well below the stated frequency. The robot should be mounted as rigid as possibly to the floor.

Disturbances from other machinery will affect the robot and the tool accuracy. The robot has resonance frequencies in the region 10 – 20 Hz and disturbances in this region will be amplified, although somewhat damped by the servo control. This might be a problem, depending on the requirements from the applications. If this is a problem, the robot needs to be isolated from the environment.

Storage conditions, robot

The table shows the allowed storage conditions for the robot:

Parameter	Value
Minimum ambient temperature	-10 °C
Maximum ambient temperature	+55 °C
Maximum ambient temperature (less than 24 hrs)	+55 °C

Continues on next page

Note

After storage, the operating conditions must be met for at least 4 hours before switching on the controller (see *Operating conditions, robot on page 51*).

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

Operating conditions, robot

The table shows the allowed operating conditions for the robot:

Parameter	Value
Minimum ambient temperature	+5 °C [i]
Maximum ambient temperature	+40 °C

[i] At low environmental temperature < 10ºC is, as with any other machine, a warm-up phase recommended to be run with the robot. Otherwise there is a risk that the robot stops or run with lower performance due to temperature dependent oil and grease viscosity.

Note

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

Protection classes, robot

The table shows the available protection types of the robot, with the corresponding protection class.

Protection type	Protection class [I]
Manipulator, protection type Standard	IP30
Manipulator, protection type Clean Room	ISO 5

Joint torques

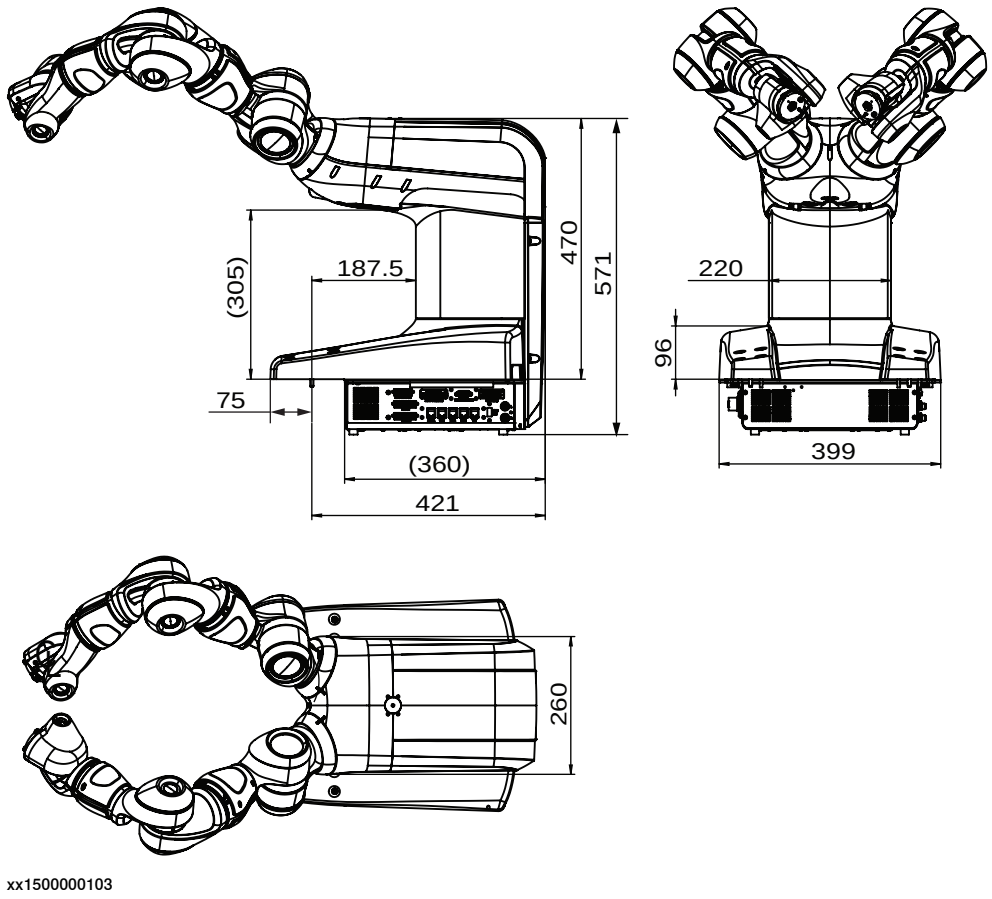
In collaborative applications, the joint torque must be considered in the risk analysis. The following table shows the maximum torque for each joint. The maximum value can be achieved on one axis at a time.

Axis	Maximum joint torque
1	14.6 Nm
2	14.62 Nm
3	6.21 Nm
4	1.0 Nm
5	0.8 Nm
6	0.43 Nm
7	6.25 Nm

2.2.2 Dimensions

Dimensions IRB 14000

Robot



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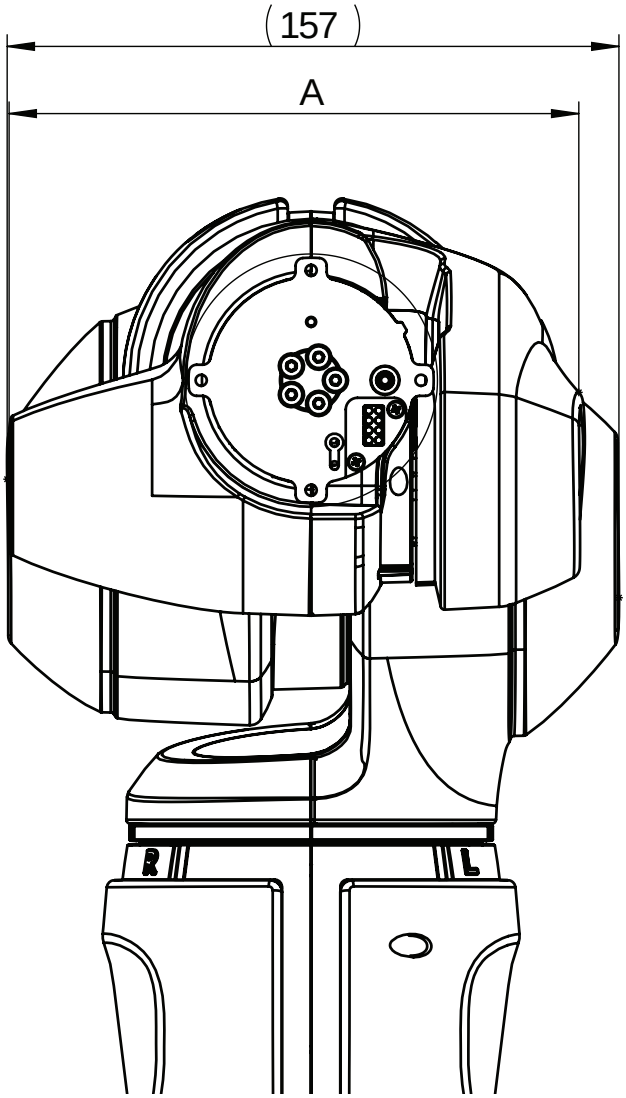
Robot arms



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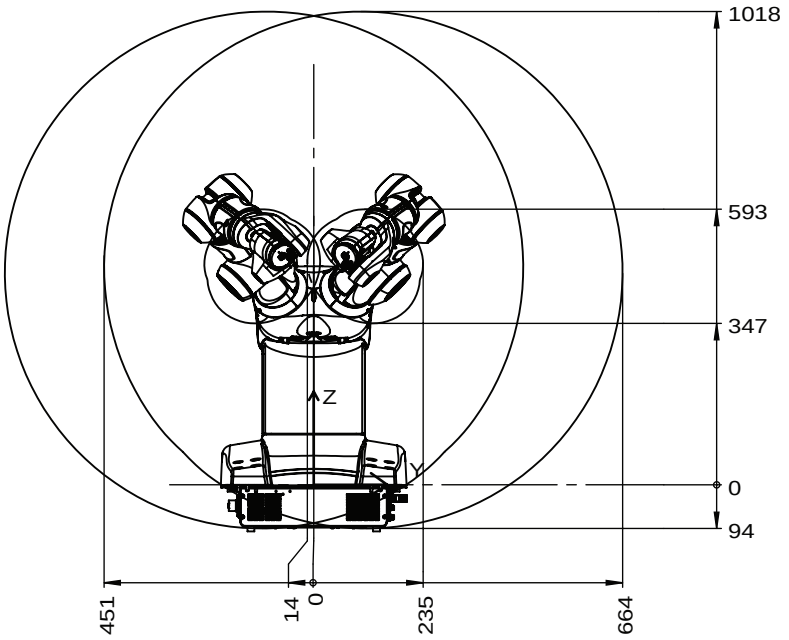
	IRB 14000 (no-type-specified)	IRB 14000 Type A
A	137 mm	146 mm

2.2.3 Working range

Illustration, working range IRB 14000

The illustrations show the unrestricted working range of the robot.

Front view



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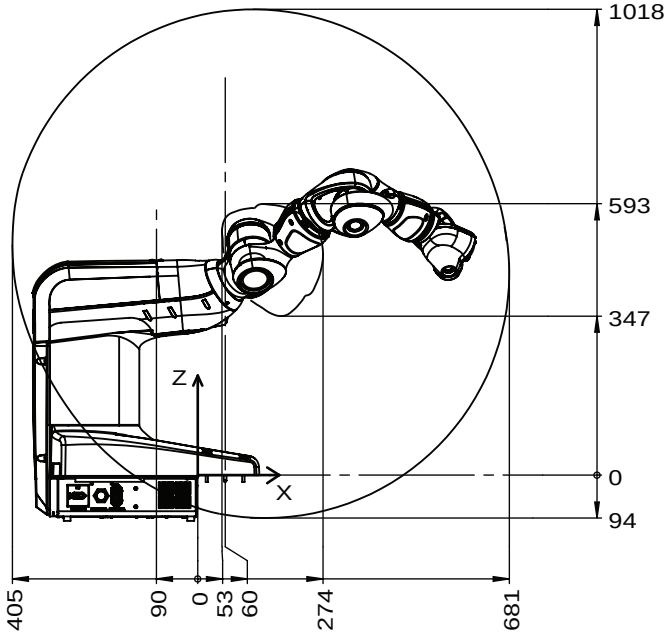
Side view



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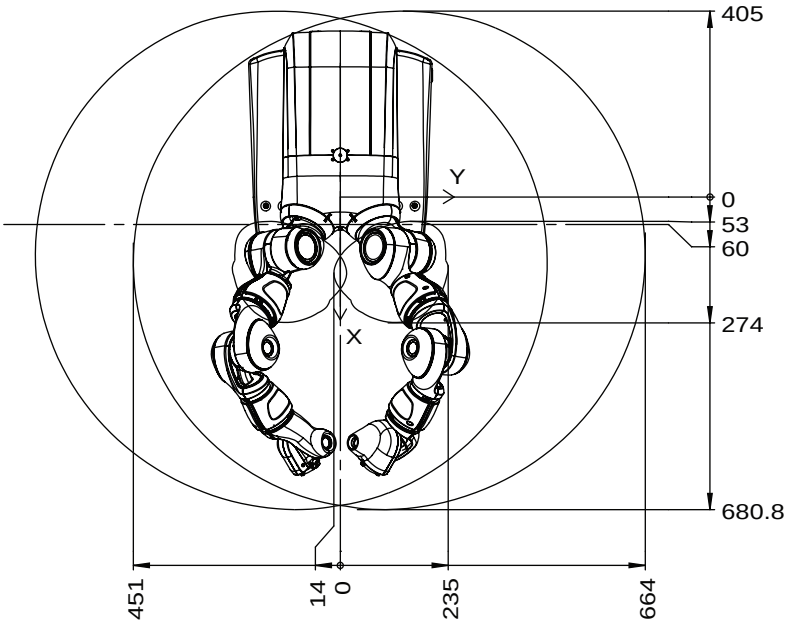
Top view



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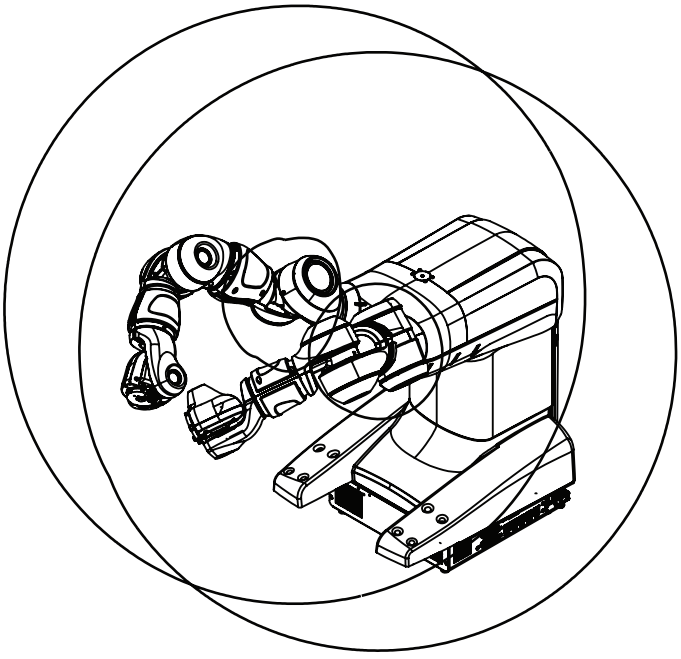
Isometric view



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Robot motion

Axis	Type of motion	Degree of motion
Axis 1	Arm - Rotation motion	-168.5° to +168.5°
Axis 2	Arm - Bend motion	-143.5° to +43.5°
Axis 7	Arm - Rotation motion	-168.5° to +168.5°

Continues on next page

2.2.3 Working range
Continued

Axis	Type of motion	Degree of motion
Axis 3	Arm - Bend motion	-123.5° to +80°
Axis 4	Wrist - Rotation motion	-290° to +290°
Axis 5	Wrist - Bend motion	-88° to +138°
Axis 6	Flange - Rotation motion	-229° to +229°

2.2.4 Risk of tipping/stability

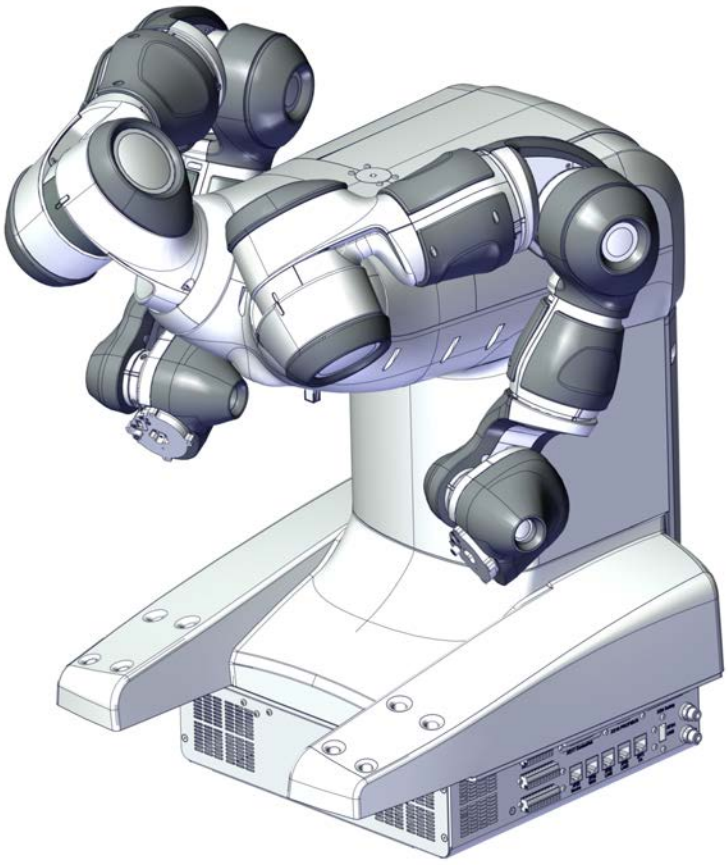
Risk of tipping

Do not change the robot position before securing it to the foundation.

The shipping position is the most stable position.

Shipping and transportation position

This figure shows the robot in its shipping position and transportation position.



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WARNING

The robot will be mechanically unstable if not properly secured to the foundation.

2.2.5 The unit is sensitive to ESD

Description

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

Safe handling

Use one of the following alternatives:

- Use a wrist strap.

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

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

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

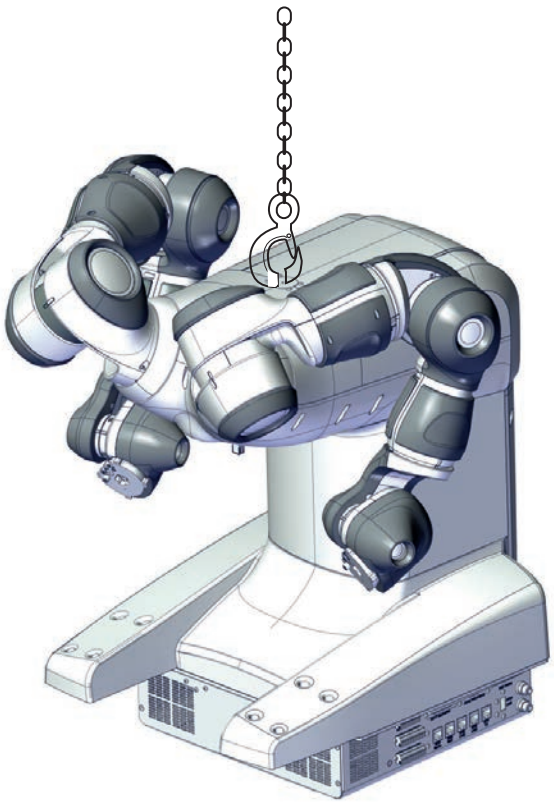
2.3 On-site installation

2.3.1 Lifting the robot with lifting accessories

Introduction

The IRB 14000 is a collaborative robot, the whole robot can be lifted by lifting accessories or lifted manually.

This section contains a general overview of how to lift the complete robot using lifting accessories.



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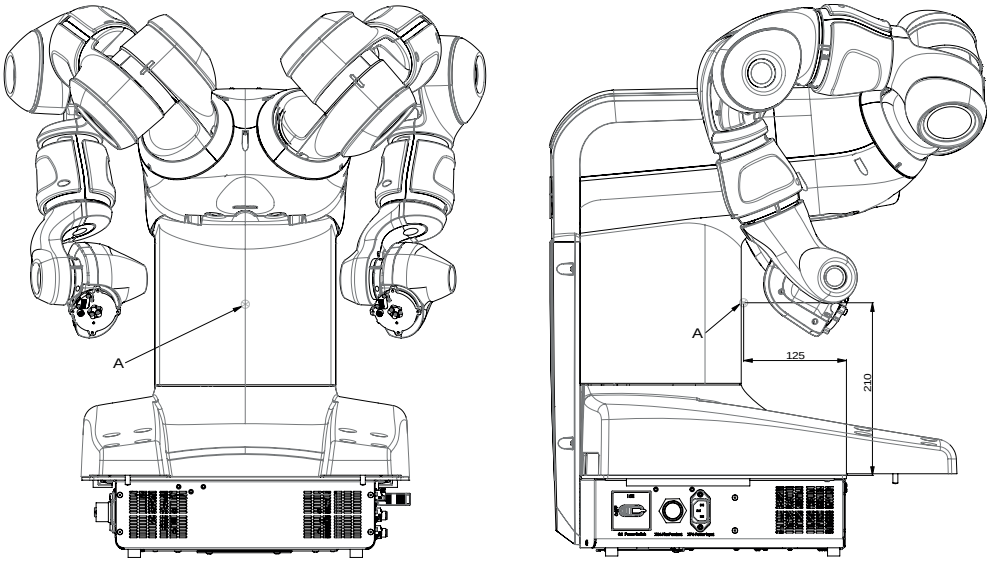
2.3.1 Lifting the robot with lifting accessories
Continued

Center of gravity of the robot

The following figure shows the center of gravity (COG) of the robot. Always keep the robot balanced according to the COG during the robot lifting and transportation.



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A	Center of gravity (COG)

Required equipment

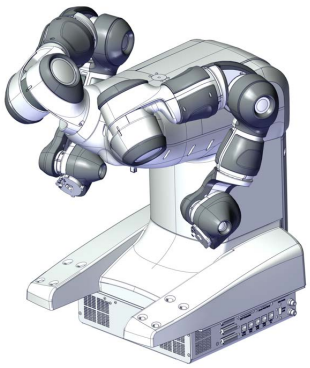
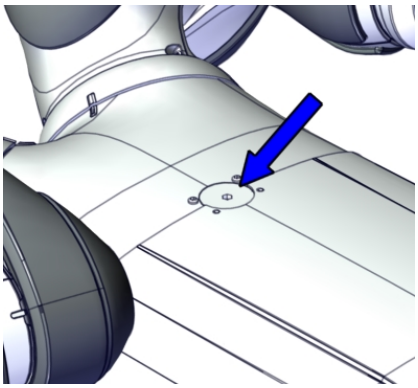
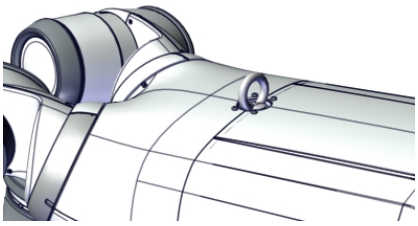
Equipment, etc.	Article number	Note
Overhead crane		
Lifting chain	-	>38 kg (capacity of lifting chain)
Lifting eye M8 DIN580	-	

Lifting the robot

Use the following procedure to lift the robot.

	Action	Note
1	**CAUTION** The IRB 14000 robot weighs 38 kg. All lifting accessories used must be sized accordingly!	

Continues on next page

	Action	Note
2	Move the robot to the appropriate lifting position. **CAUTION** Be careful not to hit the arms into something while lifting and transporting the robot. This could damage the mechanical structure of the arm.	 xx1500000363
3	Remove the threaded cover.	 xx1500000052
4	Fit the lifting eye to the robot.	Lifting eye M8 DIN580  xx1500000626
5	Attach the lifting chain to the lifting eye and to the overhead crane.	
6	Carefully stretch the chain by lifting the crane slowly.	
7	Remove the robot attachment screws (if the robot is fastened).	Screw (8 pcs) of M5x25

Continues on next page

2.3.1 Lifting the robot with lifting accessories
Continued

	Action	Note
8	Raise the overhead crane to lift the robot.	 xx1500000053

2.3.2 Lifting the robot without lifting accessories

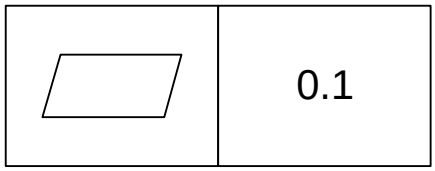
General

This section describes how to lift the robot and move it manually.

	Amount	Note
Persons required for lifting robot	2	

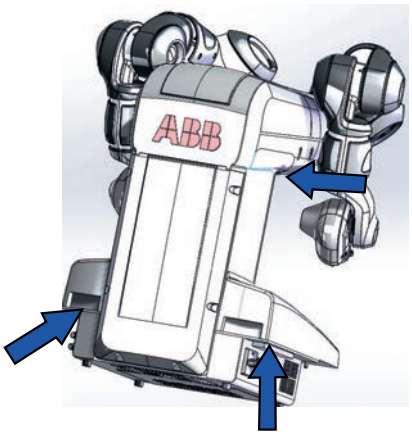
Attachment screws and pins

All hardware is enclosed in the robot delivery.

Suitable screws	M5x25
Quantity	8 pcs
Quality	8.8
Washer	8 pcs, 5.3x10x1
Guide pins	2 pcs, article number 3HNP00449-1
Tightening torque	3.8 Nm ± 0.38 Nm
Level surface requirements	 xx1500000627

Lifting and transporting the robot

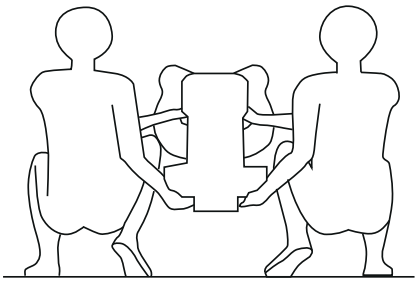
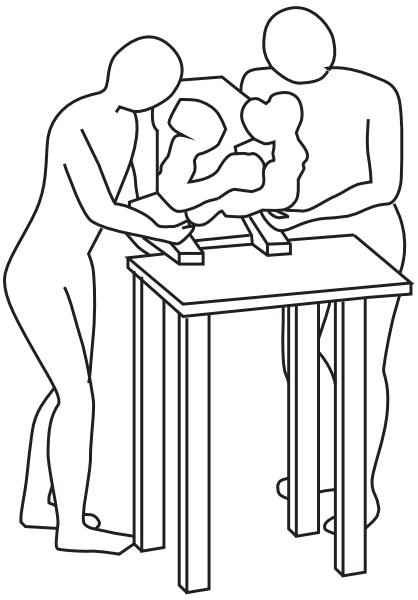
Use this procedure to lift the robot.

	Action	Note
1	**CAUTION** The IRB 14000 robot weighs 38 kg and can be lifted by two persons.	
2	Grasp the hand-holding grooves, one person on each side of the robot.	 xx1400002122

Continues on next page

2.3.2 Lifting the robot without lifting accessories

Continued

	Action	Note
3	Lift the robot with two persons, one on each side of the robot.	 xx1400002119
4	Move the robot to desired position. **CAUTION** Be careful not to hit the arms into something while lifting and transporting the robot. This could damage the mechanical structure of the arm.	
5	Secure the robot on a workbench according to section *Orienting and securing the robot on page 65*.	Screws: 8 pcs M5x25 Washers: 8 pcs, 5.3x10x1  xx1400002021

2.3.3 Orienting and securing the robot

Introduction

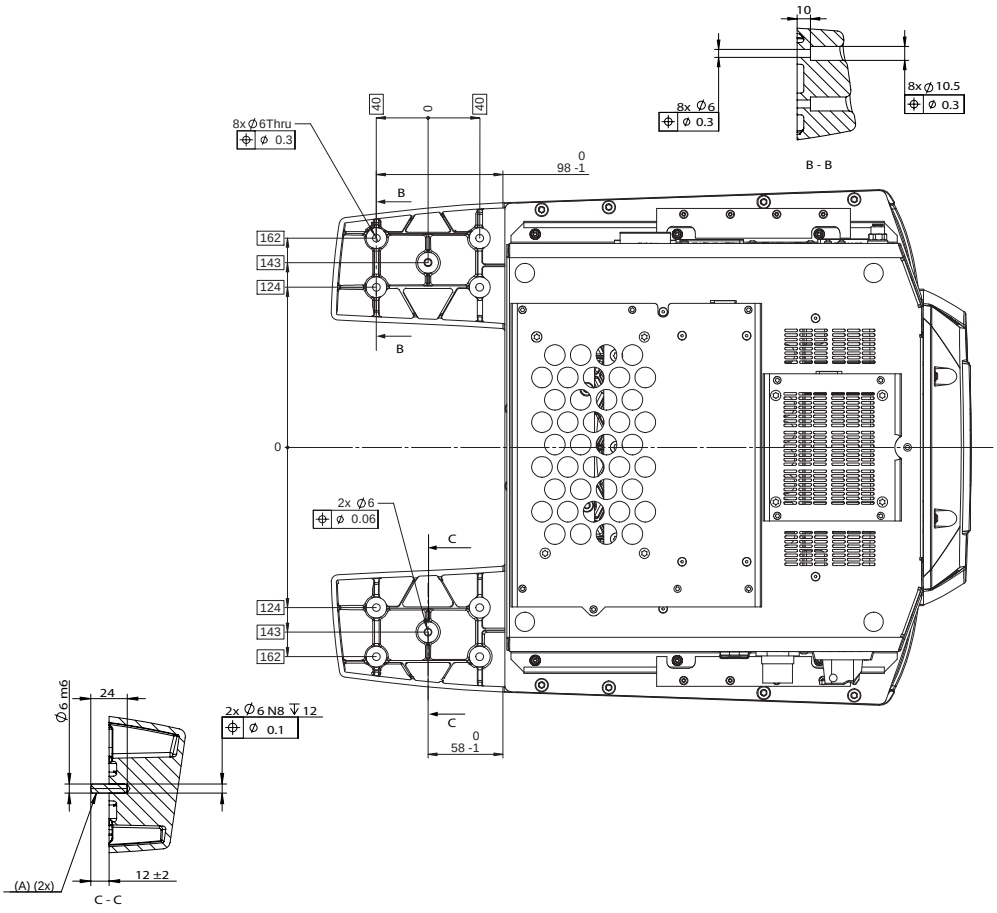
This section details how to orient and secure the robot to the working bench in order to run the robot safely. The requirements made on the workbench are shown in sections:

- *Requirements, foundation on page 50*
- *Loads on foundation, robot on page 49*

Hole configuration, base

There are eight holes on the bottom of the robot body.

The illustration shows the hole configuration used when securing the robot.



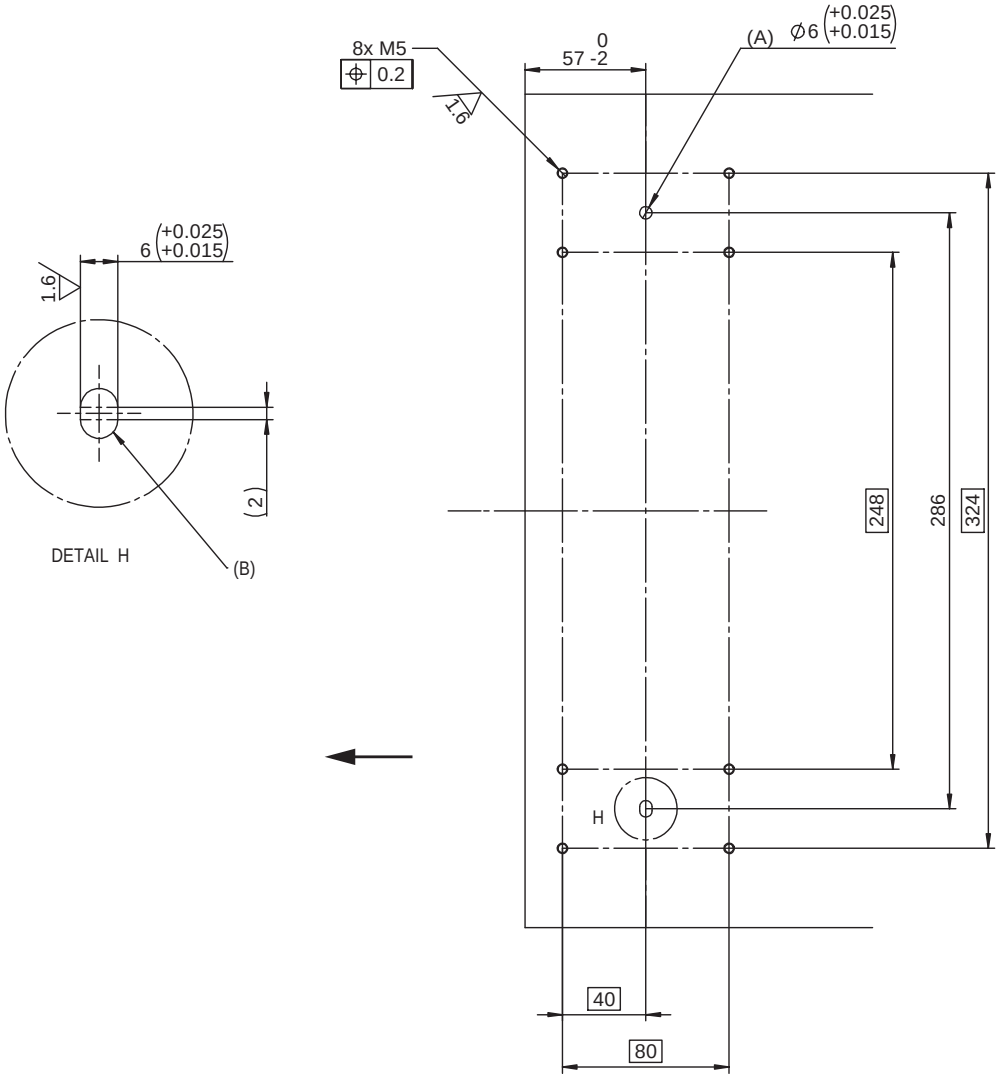
xx1400002124

A	Guide pins, 3HNP00449-1, one is to fit round hole, the other is to fit slot hole.

Continues on next page

2.3.3 Orienting and securing the robot

Continued



xx1400002121

A	Master hole (round)
B	Alignment hole (slot)

Note

The illustration is in top view and the arrow points the front of the robot.

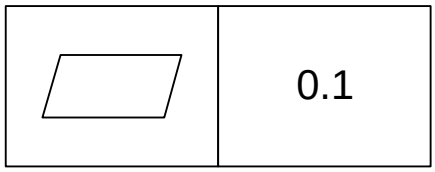
Specification, attachment screws and pins

The table specifies the type of securing screws to be used to secure the robot directly to the foundation. It also specifies the type of pins to be used.

All hardware is enclosed in the robot delivery.

Screws	M5x25
Quantity	8 pcs
Quality	8.8
Washer	8 pcs, 5.3x10x1

Continues on next page

Guide pins	2 pcs, article number 3HNP00449-1
Tightening torque	3.8 Nm ± 0.38 Nm
Level surface requirements	 xx1500000627

Orienting and securing the robot

Use this procedure to orient and secure the robot to a table.

	Action	Information
1	Make sure the installation site for the robot conforms to the specifications in section: • *Pre-installation procedure on page 48*	
2	Prepare the installation site with attachment holes.	The hole configuration of the base is shown in the figure in: • *Hole configuration, base on page 65*
3	**CAUTION** The robot weighs 38 kg. All lifting equipment must be sized accordingly.	
4	**CAUTION** When the robot is put down after being lifted or transported, there is a risk of tipping if not properly secured.	
5	Lift the robot to its installation site. **CAUTION** Be careful not to hit the arms into something while lifting and transporting the robot. This could damage the mechanical structure of the arm.	How to lift the robot is described in section: • *Lifting the robot without lifting accessories on page 63* • *Lifting the robot with lifting accessories on page 59*
6	Make sure there are two pins in the holes in the base.	2 pcs, article number 3HNP00449-1
7	Guide the robot using the pins, while lowering it to mounting position.	Make sure the robot base is correctly fitted onto the pins.
8	Fit the securing screws in the attachment holes of the base.	Screws: M5x25, (8 pcs), quality:8.8. Washers: 8 pcs, 5.3x10x1.
9	Tighten the bolts crosswise to ensure that the base is not distorted.	Tightening torque: 3.8 Nm ± 0.38 Nm

2.3.4 Manually releasing the brakes

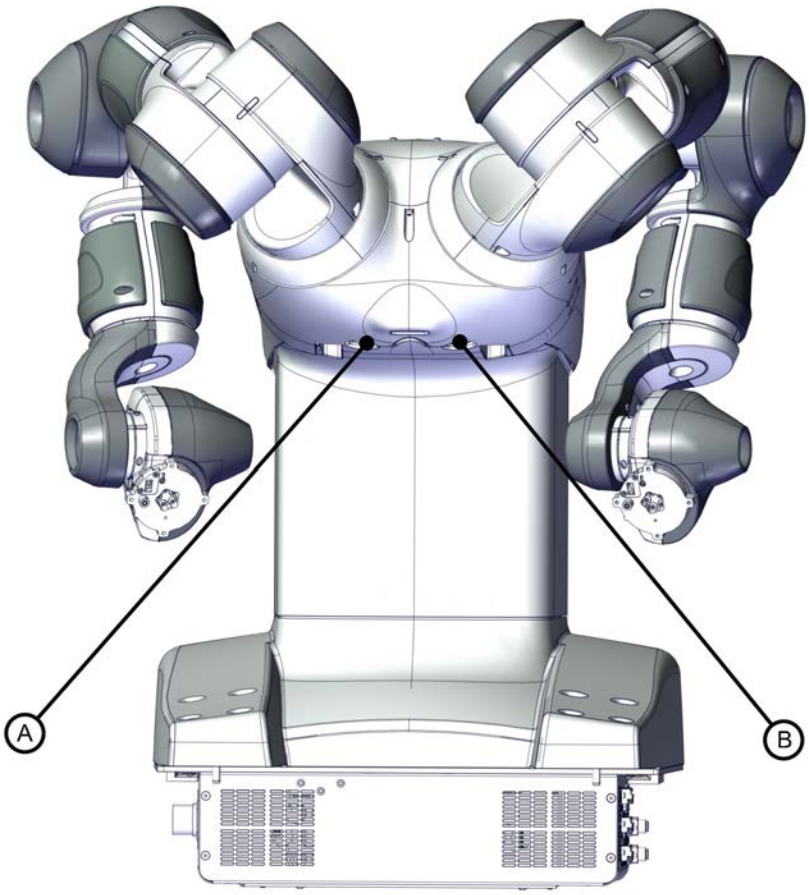
Introduction to manually releasing the brakes

This section describes how to release the holding brakes for the motors of axis 1, axis 2, axis 3, and axis 7.

> **Note**
>
> There is no holding brake for axis 4, axis 5, or axis 6.
>
> When a protective stop or emergency stop is triggered, the axes 4-5-6 will drop as there are no holding brakes.

Location of brake release button

There are two brake release buttons located as shown in the figure.



xx1400002126

A	Brake release button for right arm
B	Brake release button for left arm

Continues on next page

Releasing the brakes

This procedure details how to release the holding brakes when the robot is equipped with an internal brake release unit.

	Action	Note
1	Releasing the brakes with the brake release buttons require that power is supplied to the robot, see *Connecting power and the FlexPendant*.	
2	**CAUTION** When releasing the holding brakes, the robot axes may move very quickly and sometimes in unexpected ways.	
3	Release the holding brake on the arm axes by pressing the button. The brake will function again as soon as the button is released.	

2.3.5 Installing the signal lamp

General

CAUTION

The signal lamp is packed and delivered separately, and should be installed by a system integrator.

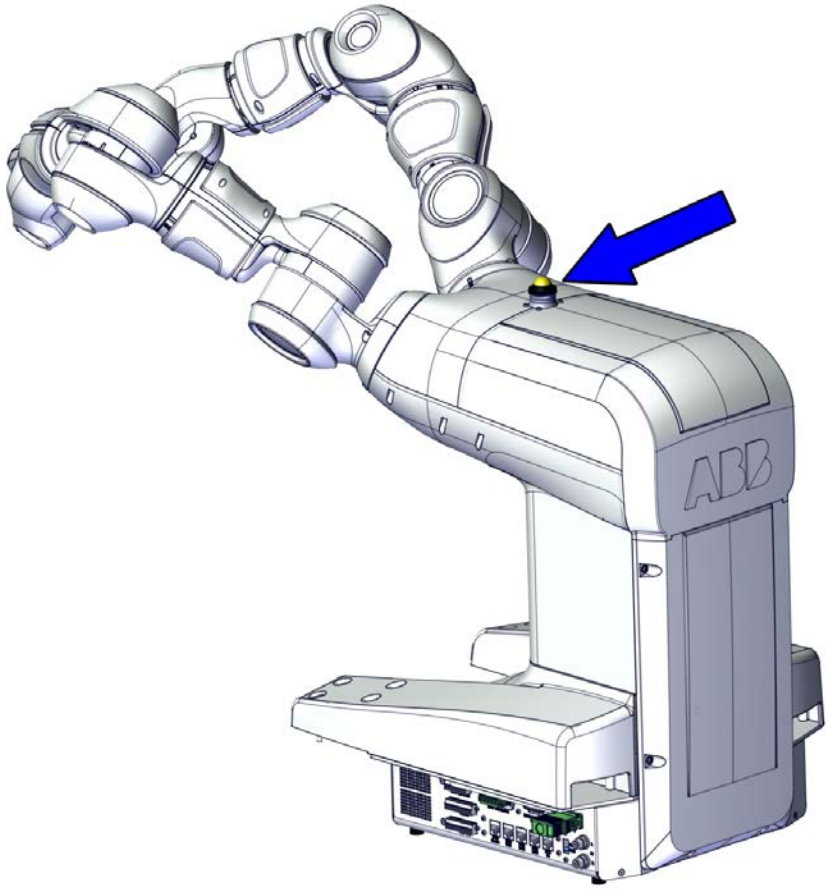
A signal lamp with a yellow fixed light can be installed on the robot or to a suitable fixture at the working area. The lamp signals that motors are powered, and it allows the user to meet UL requirements.

Note

Do not use the signal lamp option in a Clean Room environment.

Location of signal lamp

The signal lamp is located as shown in the figure.



xx1500000051

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Required parts

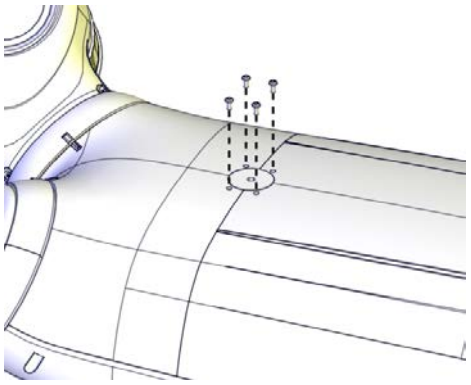
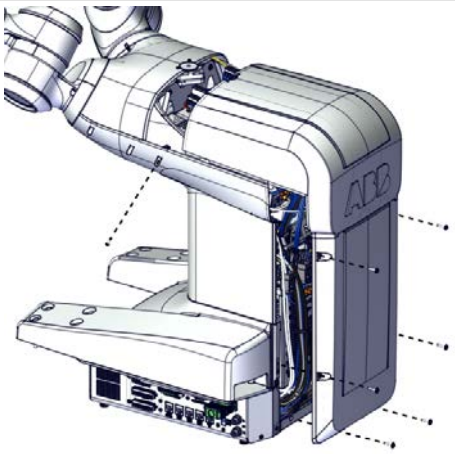
Spare part	Article number	Note
Signal lamp	3HAC053350-001	Includes attachment screws.
Hex socket head cap screw	3HAC050368-005	M2x8 8.8
Torx pan head screw	3HAC050367-005	M3x12 8.8 Gleitmo 605

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.

Installing the signal lamp

Removing the body covers

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	Remove the body cover top screws.	 xx1400002904
3	Remove the body cover.	 xx1500000303

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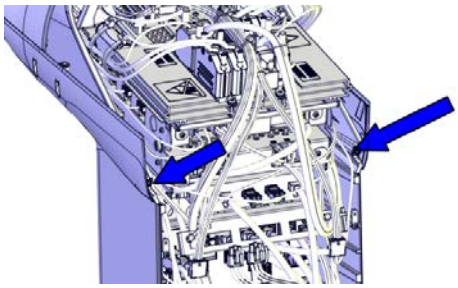
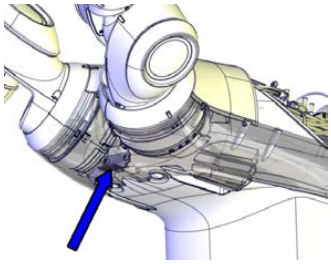
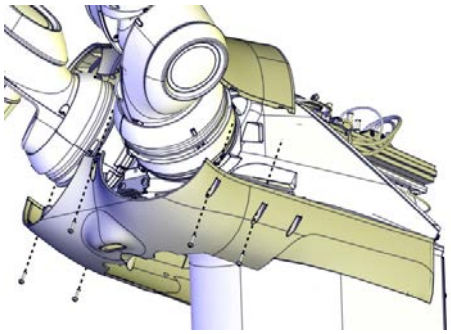
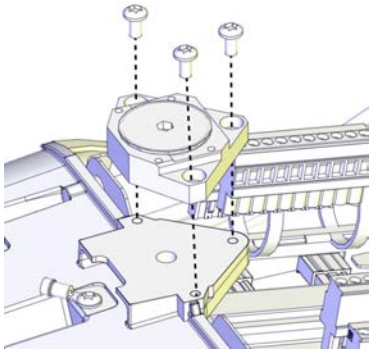
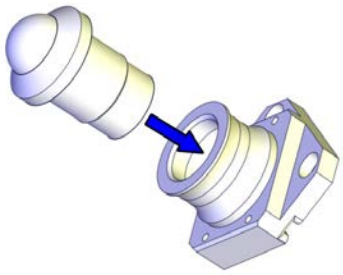
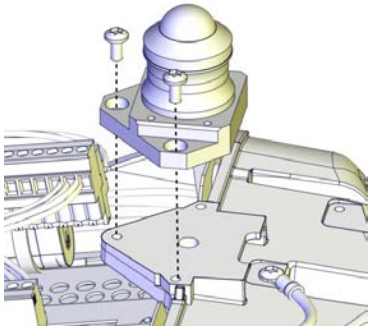
2.3.5 Installing the signal lamp
Continued

	Action	Note
4	Remove the back screws of the lower body cover.	 xx1500000540
5	Remove the front and lower body cover. **Note** Be aware of the tab underneath the cover so it does not get damaged.  xx1500000564	 xx1400002603

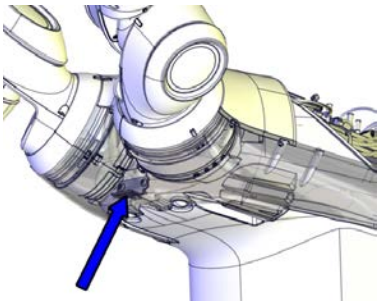
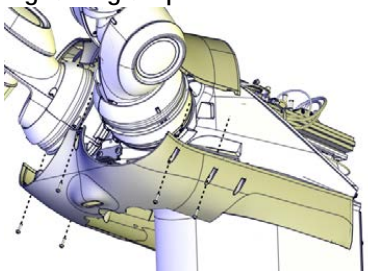
Installing the signal lamp

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the protection cover.	 xx1500000605

Continues on next page

	Action	Note
3	Fit the lamp to the signal lamp base.	 xx1500000615
4	Fit the signal lamp assembly to the robot.	 xx1500000616
5	Connect the lamp cable connector.	
6	The signal lamp is now ready for use and is lit in MOTORS ON mode.	

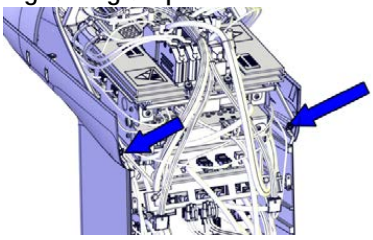
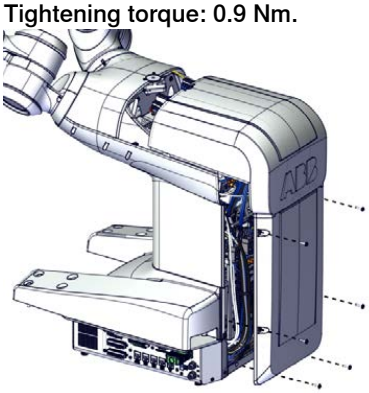
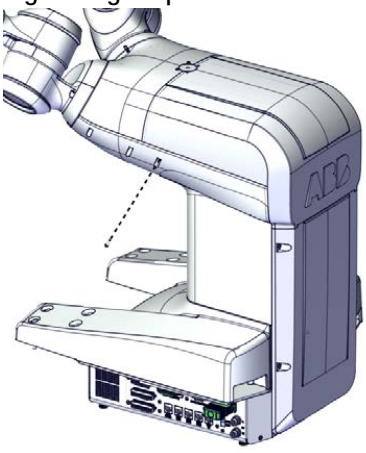
Refitting the body covers

	Action	Note
1	Refit the front and lower body cover. **Note** Be aware of the tab underneath the cover so it does not get damaged.  xx1500000564	Screws: 3HAC050368-005 (5 pcs). Tightening torque: 0.2 Nm.  xx1400002603

Continues on next page

2.3.5 Installing the signal lamp

Continued

	Action	Note
2	Refit the back screws of the lower body cover.	Screws: 3HAC050367-005 (2 pcs). Tightening torque: 0.2 Nm.  xx1500000540
3	Refit the body cover.	Screws: 3HAC050367-005 (6 pcs). Tightening torque: 0.9 Nm.  xx1500000697
4	Refit the two remaining screws of the body cover.	Screws: 3HAC050367-005 (2 pcs). Tightening torque: 0.2 Nm.  xx1500000696

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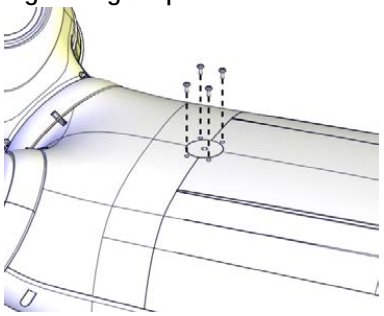
	Action	Note
5	Refit the body cover top screws.	Screws: M3x6 (4 pcs). Tightening torque: 0.2 Nm.  xx1400002904

2.3.6 Electrical connections

2.3.6.1 Robot cabling and connection points

Introduction

Connect the robot and controller to each other after securing them to the foundation. The lists below specify which cables to use for each respective application.

> **DANGER**
>
> Turn off the main power before connecting any cables.

Main cable categories

All cables connected to the robot are divided into the following categories:

Cable category	Description
Main power cable	Supplies power to the robot.
FlexPendant cables	Communication between the FlexPendant and the robot.

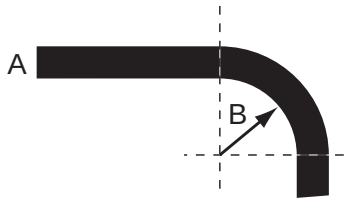
Main power cable

Main power cable can be provided by customer or purchased from ABB as option. The following table lists the ABB-supplied main power cables in different interface standards. Choose as required.

Spare part	Article number
Mains cable with locking system, EU 2m	3HAC056583-001
Mains cable with locking system, UK 2m	3HAC056583-002
Mains cable with locking system, US 6ft	3HAC056583-003
Mains cable with locking system, JP 2m	3HAC056583-004
Mains cable with locking system, CN 2m	3HAC056583-005
Mains cable with locking system, AU 2m	3HAC056583-006

Bending radius for static floor cables

The minimum bending radius is 10 times the cable diameter for static floor cables.



xx1600002016

A	Diameter
B	Diameter x10

2.3.7 Risk of mechanical damage

General

IRB 14000 motors and gears are designed to exert limited power to be safe for the operator. Improper handling might cause mechanical damage to the robot, as the drivetrain and motors are smaller. Axis 5 (wrist) is the smallest and most sensitive.

Use lead-through jogging to manually move the arm without risk of mechanical damage, see *Lead-through on page 78*.

Precautions

IRB 14000 is designed to be safe in contact with the operator, but the following requires some caution.[2]

- Pushing the moving robots gripper or arm with counter force, may damage the drivetrain of the robot. The wrist and the gripper are most sensitive.
- Avoid collisions on the robot wrist or gripper, when axis 5 and its adjacent axes position in a straight line and the robot arm moves at its maximum speed. Collisions will cause gear slippage or damage to axis 5.
- Manually overriding the arm with excessive force. Manual moving should be stopped immediately when the joint reaches its extreme position (i.e. mechanical stop position) to avoid damaging the arm.

2 See also technote_170906.

2.3.8 Lead-through

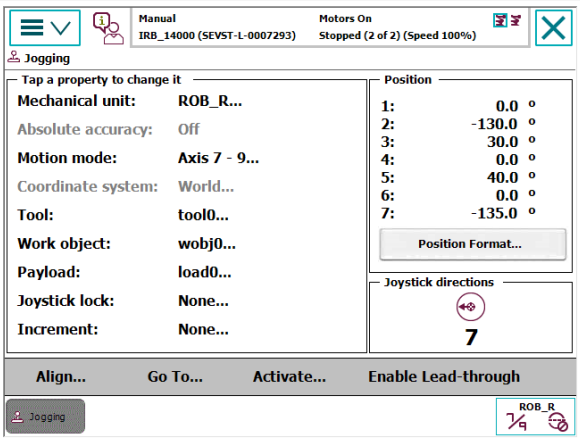
What is lead-through?

The lead-through functionality is available for robots designed for collaborative applications. If lead-through is available, this is shown on the FlexPendant.

Using lead-through, you can grab the robot arm and move it manually to a desired position, as an alternative to jogging.

Using lead-through

Use the following procedure to jog the robot using the lead-through functionality:

	Action	Note/illustration
1	In the jogging window, tap the button **Enable Lead-through**.	 xx1500000006
2	Gently pull the robot arm to the desired position.	You will feel if an axis reaches its end position. Do not try to force the axis beyond this position.

Note

Lead-through is enabled per robot arm. To enable lead-through for both arms, enable one arm and then select the other arm and enable that too.

Note

If the robot is in motors off mode, it will automatically go to motors on when enabling lead-through.

Note

If lead-through is enabled, it will be temporarily disabled during program execution and jogging. This means that it is possible to combine lead-through, jogging, and testing the RAPID program without having to disable the lead-through.

Continues on next page

Note

When using lead-through, it is important that the load is correctly defined. If the load is heavier than defined, the effect will be the same as if you are pulling the robot arm downwards. If the load is lighter than the defined load, the effect will be the same as if you are pulling the robot arm upwards.

2.3.9 Installation of ABB grippers

Installing grippers

The procedure for installation of ABB grippers is described in *Product manual - Grippers for IRB 14000*.

2.4 Controller

2.4.1 Overview

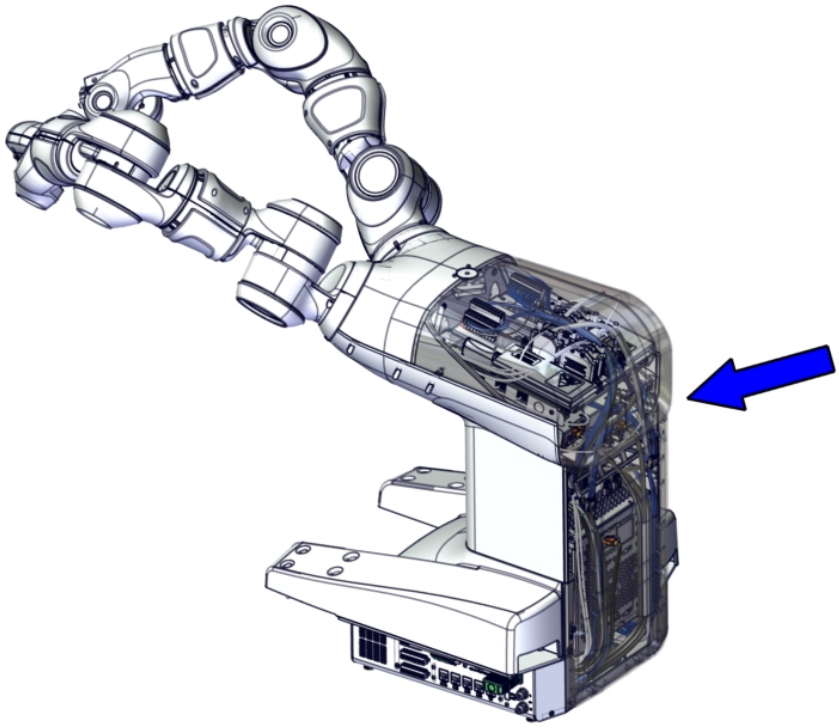
Safety information

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 *Safety manual for robot - Manipulator and IRC5 or OmniCore controller* before performing any service work.

Overview

The IRB 14000 integrated controller is based on the standard IRC5 controller, and contains all functions needed to move and control the robot.



xx1400002127

Note

When replacing a unit in the controller, report the following data to ABB, for both the replaced unit and the replacement unit:

- the serial number
- article number
- revision

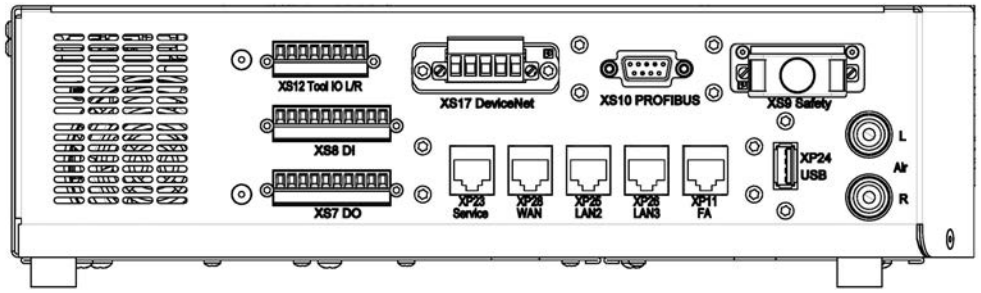
This is particularly important for the safety equipment to maintain the safety integrity of the installation.

Continues on next page

2.4.1 Overview
Continued

Controller interface, left side

The following illustration describes the interface on the left side panel of the controller.



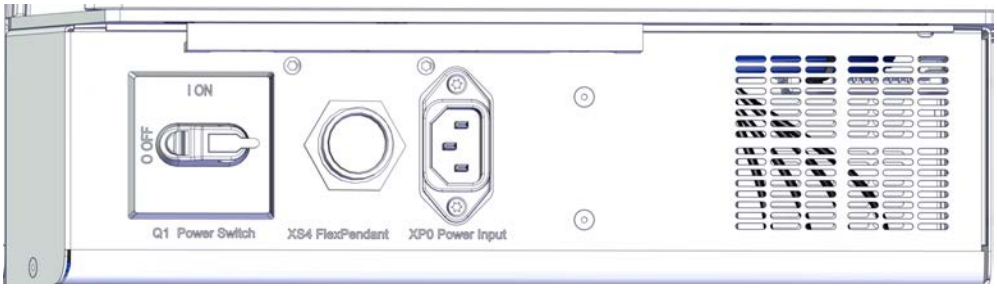
xx1400002129

XS12	Tool I/O, left and right arm 4x4 digital I/O signals to the tool flanges, to be cross connected with XS8 and/or XS9. This is alternative to Ethernet on the tool flange.
XS17	DeviceNet Master/Slave
XS10	Fieldbus adapter PROFIBUS Anybus device (fieldbus adapter option)
XS9	Safety signals
XS8	Digital inputs 8 digital input signals (approx. 5 mA) to the internal I/O board (DSQC 652) Pin number 9 (24 V = max current 3A)
XS7	Digital outputs 8 digital output signals (150 mA/channel) from the internal I/O board (DSQC 652) Pin number 9 (24 V = max current 3A)
XP23	Service
XP28	WAN (connection to factory WAN).
XP25	LAN2 (connection of Ethernet based options).
XP26	LAN3 (connection of Ethernet based options).
XP11	FA = Fieldbus adapter PROFINET or EtherNet/IP (fieldbus adapter option)
XP24	USB port to main computer
Air L	Air supply, left arm Outer diameter of air hose 4 mm; 0.6 MPa air pressure
Air R	Air supply, right arm Outer diameter of air hose 4 mm; 0.6 MPa air pressure

Continues on next page

Controller interface, right side

The following illustration describes the interface on the right side panel of the controller.



xx1400002125

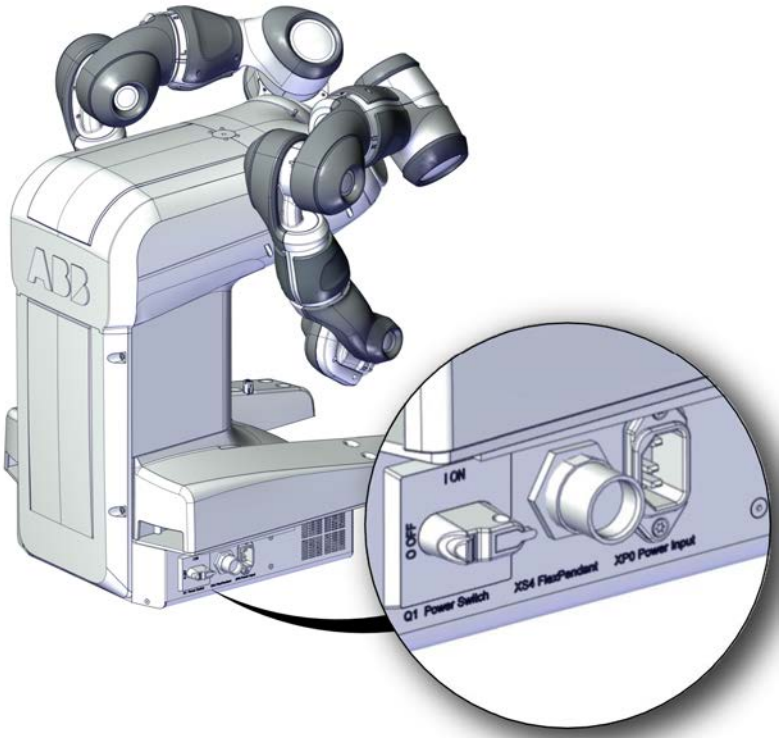
Q1	Power switch
XS4	FlexPendant
XP0	Power input Main AC power connector, IEC 60320-1 C14, 100-240 VAC, 50-60 Hz

2.4.2 Connections

2.4.2.1 Connecting power and the FlexPendant

Overview

The following illustration shows the connectors on the right side of the controller.



xx1500000503

Q1	Power switch
XS4	FlexPendant
XP0	Power input Main AC power connector, IEC 60320-1 C14, 100-240 VAC, 50-60 Hz

Connecting power supply

Line fusing

Line fusing of the IRB 14000 is 5A at 100-240 V.

Rated power

Rated power of the IRB 14000 is 360 W.

Required equipment

Equipment	Note
Power supply cable (single phase)	
External circuit breaker	8A
External earth fault protection at control cables 3 -15m	30mA

Continues on next page

Equipment	Note
External earth fault protection at control cables >15m	300mA
Circuit diagram	See *Circuit diagram - IRB 14000*.

Connecting power to the controller

The following procedure describes how to connect the main power to the controller.

CAUTION

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

Note

This product may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.

	Action	Information
1	Locate the main AC power connector on the right side of the controller.	The power switch must be turned off.
2	Connect the power cable	

Connecting a FlexPendant

The following procedure describes how to connect a FlexPendant to the controller.

CAUTION

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

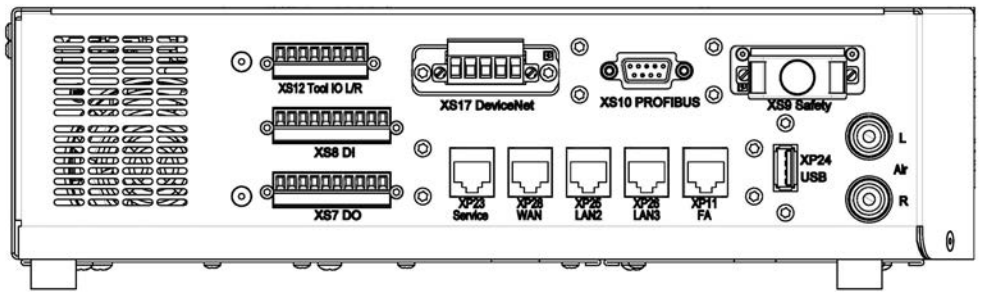
	Action	Information
1	Locate the FlexPendant socket connector on the right side of the controller.	The controller must be in manual mode.
2	Plug in the FlexPendant cable connector.	
3	Screw the connector lock ring firmly by turning it clockwise.	

2.4.2.2 Connecting a PC and Ethernet based options

Introduction

The following connectors on the interface on the left side panel of the controller are directly connected to the Ethernet ports of the IRC5 main computer.

For more information about the functionality of each connector, see *Connectors on the computer unit on page 87*.



xx1400002129

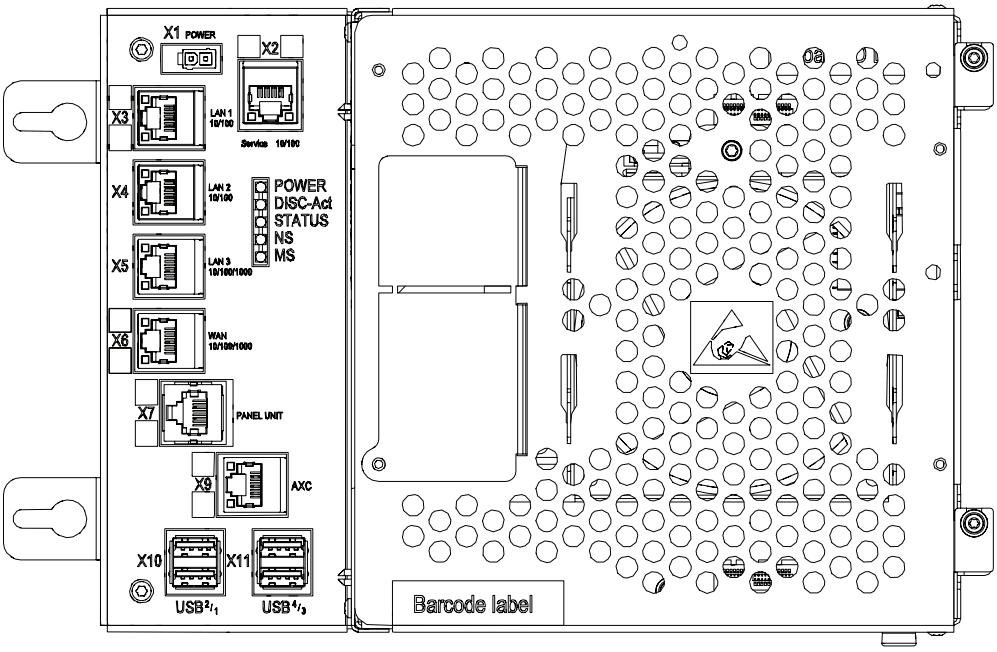
XP23	Service
XP28	WAN (connection to factory WAN).
XP25	LAN2 (connection of Ethernet based options).
XP26	LAN3 (connection of Ethernet based options).
XP24	USB port to main computer

Continues on next page

2.4.2.2.1 Connectors on the computer unit

Overview of the computer unit

The following illustration shows an overview of the computer unit.



xx1300000608

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

Note

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

Service port test middle

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

Continues on next page

2.4.2.2.1 Connectors on the computer unit
Continued

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

Note

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

WAN port

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

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

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

Note

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

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

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

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

Note

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

LAN ports

The LAN 1 port is dedicated for connecting the FlexPendant.

Continues on next page

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

Note

When using IRB 14000 grippers, the following restrictions apply to the usage of LAN2:

- Any external units connected to LAN2 need to have IP addresses on the same subnet as the grippers, network *192.168.125.0/24*.
- If option *841-1 EtherNet/IP Scanner/Adapter* is used for external units (EtherNet/IP scanners or adapters), these units must be connected to LAN2, network *192.168.125.0/24*. These units will share EtherNet/IP network with the IRB 14000 grippers.

Note that option *840-1 EtherNet/IP Anybus Adapter* can be used without restrictions.

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

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

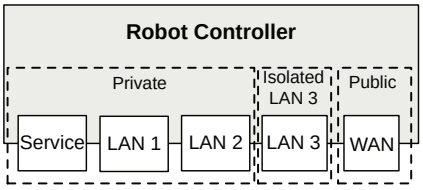
The default configuration is that LAN 3 is configured as an isolated network. This allows LAN 3 to be connected to an external network, including other robot controllers. The isolated LAN 3 network has the same address limitations as the WAN network.

Note

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

Note

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



xx1500000393

An alternative configuration is that LAN 3 is part of the private network. The ports Service, LAN 1, LAN 2, and LAN 3 then belong to the same network and act just as different ports on the same switch. This is configured by changing the system

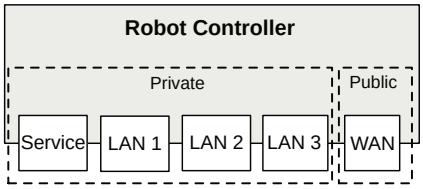
Continues on next page

2.4.2.2.1 Connectors on the computer unit
Continued

parameter *Interface*, in topic *Communication* and type *Static VLAN*, from "LAN 3" to "LAN". See *Technical reference manual - System parameters*.

Note

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



xx1500000394

Note

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

USB ports

The USB ports are intended for connecting USB memory devices.

Note

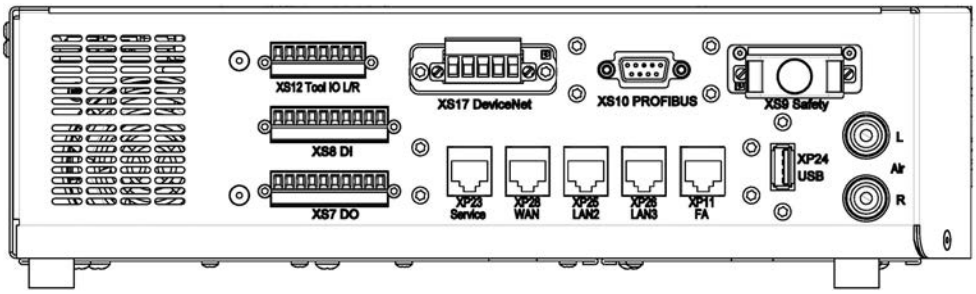
It is recommended to use the USB ports USB[1] and USB[2] on the X10 connector for connecting USB memory devices.

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

2.4.2.3 Connecting I/O signals

Introduction

It is possible to connect digital I/O signals to the IRB 14000 through the connectors on the interface on the left side panel of the controller.



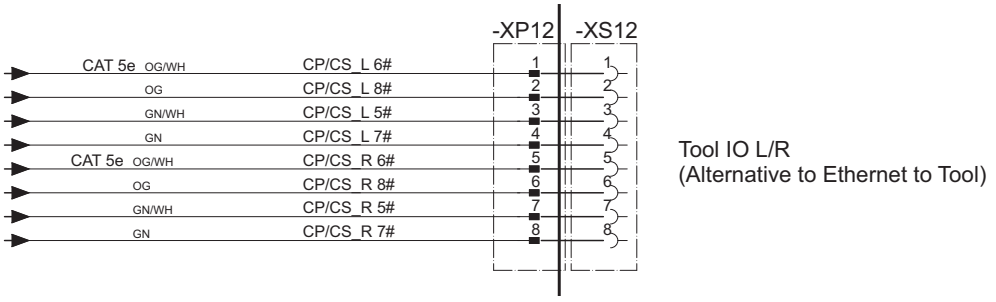
xx1400002129

XS12	Tool I/O, left and right arm 4x4 digital I/O signals to the tool flanges, to be cross connected with XS8 and/or XS9. This is alternative to Ethernet on the tool flange.
XS8	Digital inputs 8 digital input signals to the internal I/O board (DSQC 652) Pin number 9 (24 V = max current 3A)
XS7	Digital outputs 8 digital output signals from the internal I/O board (DSQC 652) Pin number 9 (24 V = max current 3A)

Tool I/O

Tool I/O is an alternative to Ethernet on the tool flange.

When not using Ethernet to the tool flanges it is possible to use the XS12 connector for connecting digital I/O signals instead.



xx1500000012

For more information about connecting the tool I/O, see *Circuit diagram - IRB 14000*.

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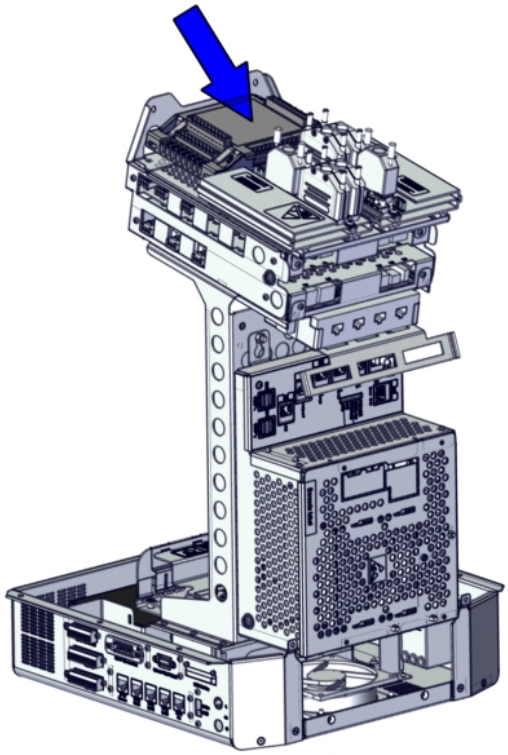
2.4.2.3 Connecting I/O signals
Continued

Digital inputs and outputs

The connectors for digital inputs and outputs on the controller interface are connected to the internal DeviceNet I/O unit in the controller.



xx1500000429

The signals are predefined in the system parameters in topic *I/O System*, with the names `custom_DI_x` and `custom_DO_x`. The customer should change the names to fit the current application.

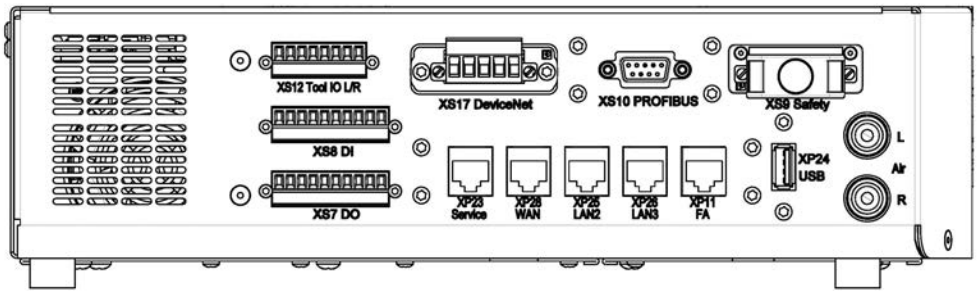
For more information about configuring I/O, see *Application manual - DeviceNet Master/Slave* and *Technical reference manual - System parameters*

2.4.2.4 Connecting fieldbuses

Introduction

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

The following connectors on the interface on the left side panel of the controller are directly connected to the fieldbus connectors on the integrated IRC5 main computer.



xx1400002129

XS17	DeviceNet
XS10	Fieldbus adapter PROFIBUS (fieldbus adapter option)
XP11	Fieldbus adapter PROFINET or EtherNet/IP (fieldbus adapter option)

Note

DeviceNet m/s (option 709-1) is provided at XS17 as default.

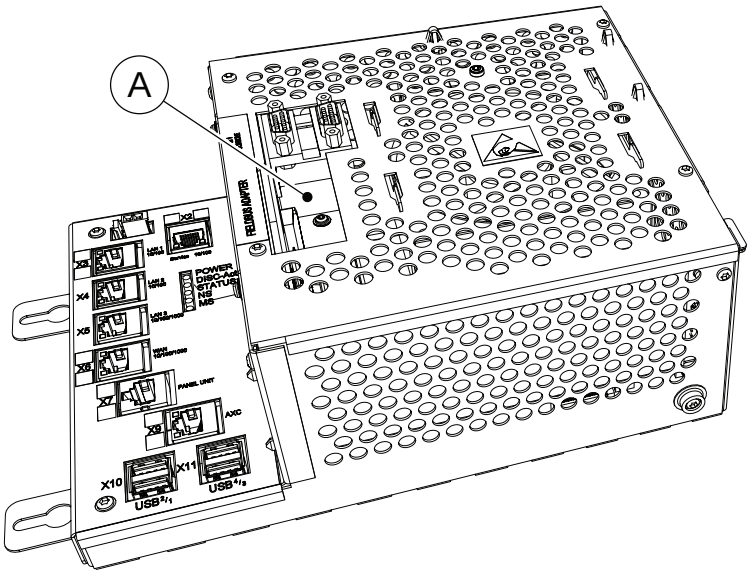
The DeviceNet fieldbus adapter (option 840-4) is not supported by IRB 14000.

Continues on next page

2.4.2.4 Connecting fieldbuses
Continued

Expansion board for fieldbus adapters

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

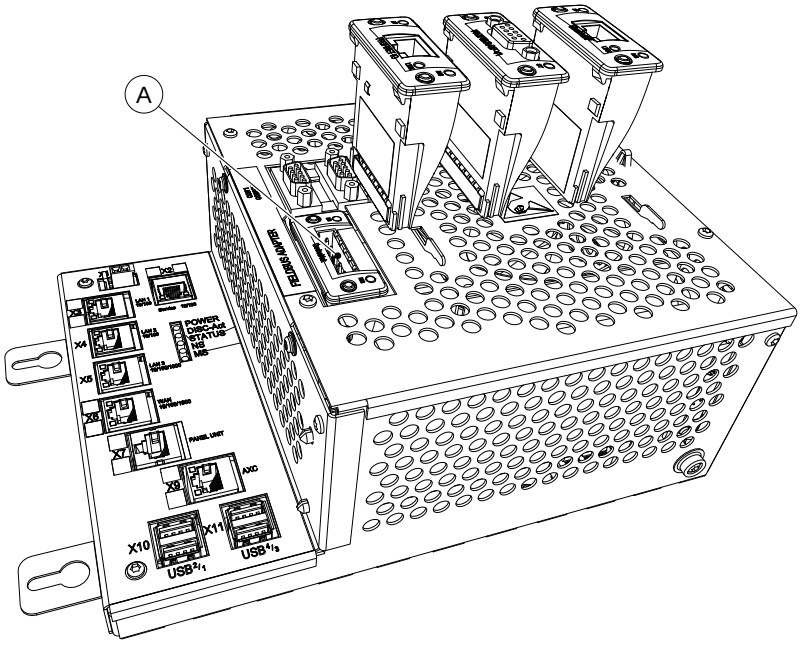


xx1300000605

A	Assembled expansion board for fieldbus adapters, without adapter.

Fieldbus adapters

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



xx1300000604

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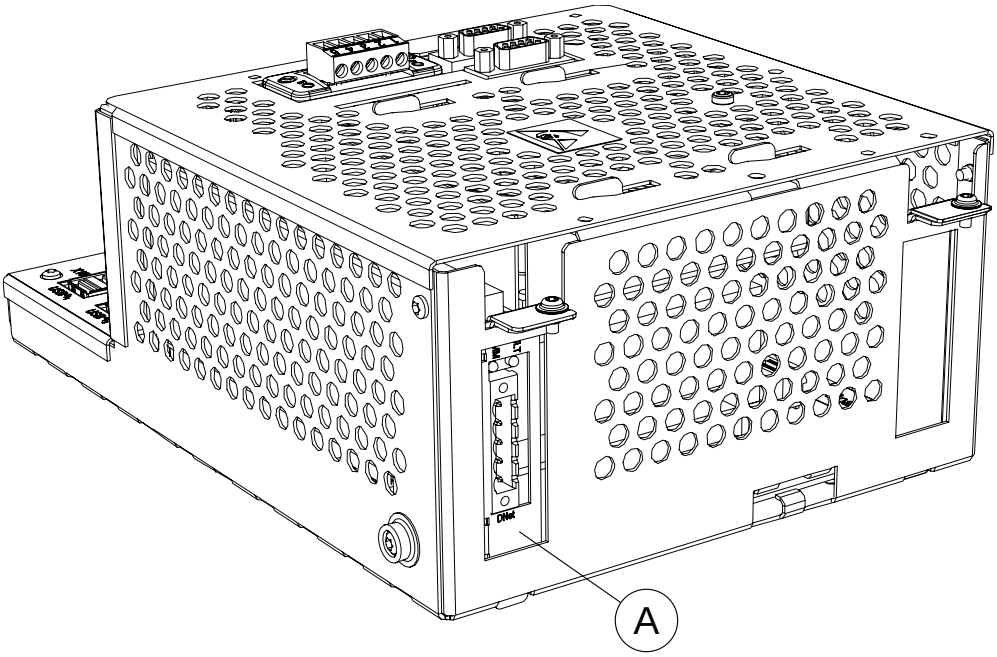
A	Slot for AnybusCC fieldbus adapters

DeviceNet master/slave board

The DeviceNet m/s board is installed the right side of the main computer.



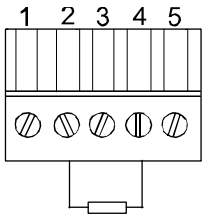
xx1300001968

A	Slot for DeviceNet m/s board

Termination resistors in the DeviceNet bus

Each end of the DeviceNet bus must be terminated with a 121 ohm resistor. The two terminating resistors should be as far apart as possible.

The termination resistor is placed in the cable connector. There is no internal termination on the DeviceNet PCI board. The termination resistor is connected between CANL and CANH - that is, between pin 2 and pin 4 according to the illustration below.



xx0400000674

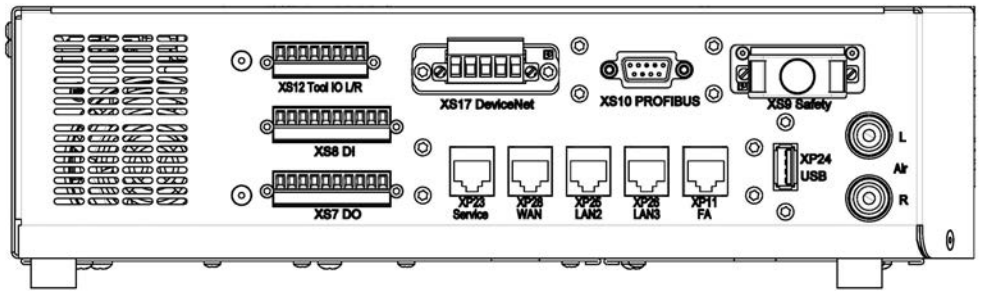
References

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

2.4.2.5 Connecting safety signals

Introduction

The IRB 14000 safety stop signals (SS) are accessed through the safety connector on the interface on the left side panel of the controller. This is covered by a safety bridge connector by default in standalone mode. If the bridge connector is removed, it is external device mode.



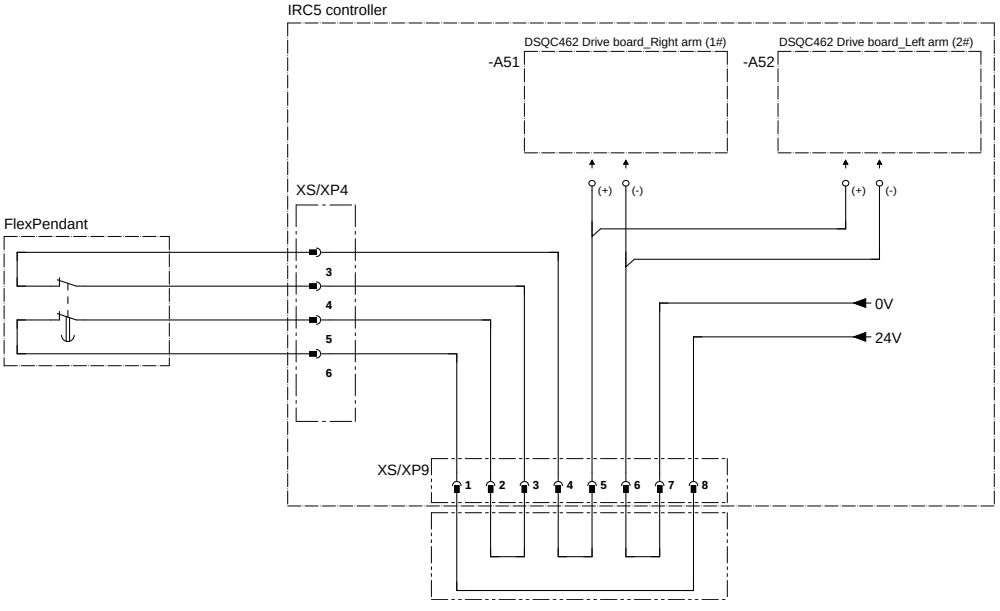
xx1400002129

XS9	Safety signals

Standalone safety

IRB 14000 standalone is not connected to any external safety devices. The safety connector on the foot interface is plugged with a safety bridge connector, that closes both emergency stop channels of the FlexPendant.

The safety stop input on each drive monitors this channel, and triggers a safety stop if the circuit is open or not powered.



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Safety when connected to external devices

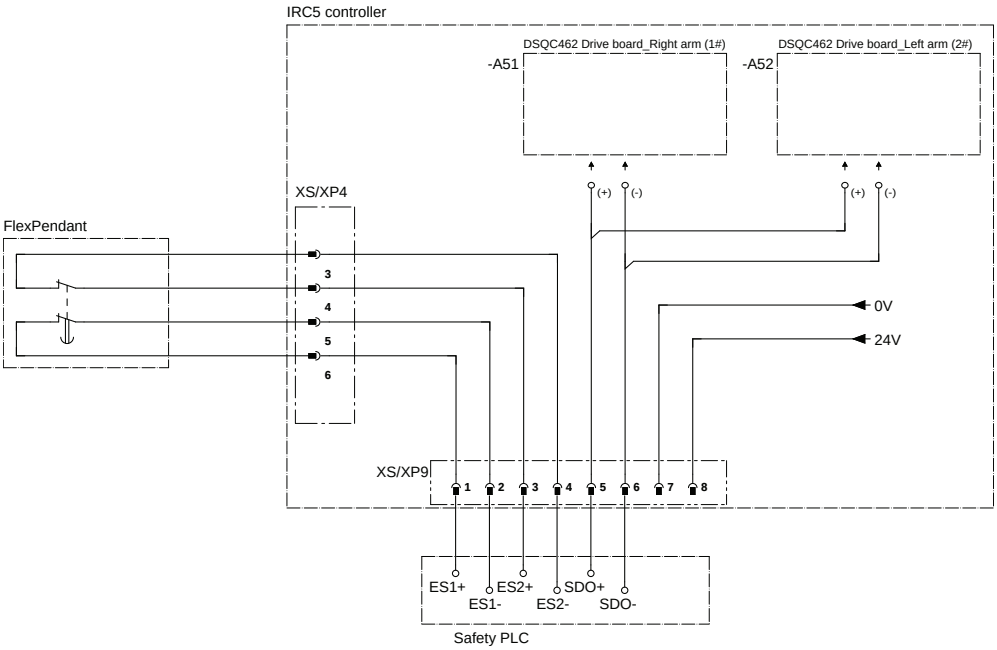
To connect to external safety devices, the safety bridge connector must be removed.

The system integrator shall then use a safety PLC or safety relay to feed and monitor the dual channel emergency stop of the IRB 14000 FlexPendant.

Safety PLC

The safety PLC shall process the input from the IRB 14000 emergency stop, as well as inputs from other safety devices in the cell, and set the necessary outputs to stop machinery in the cell.

Dual channel safety performance can be maintained where such is required. IRB 14000 can be stopped from the safety PLC by routing back a single channel stop signal to the safety connector XS9.



xx1500000014

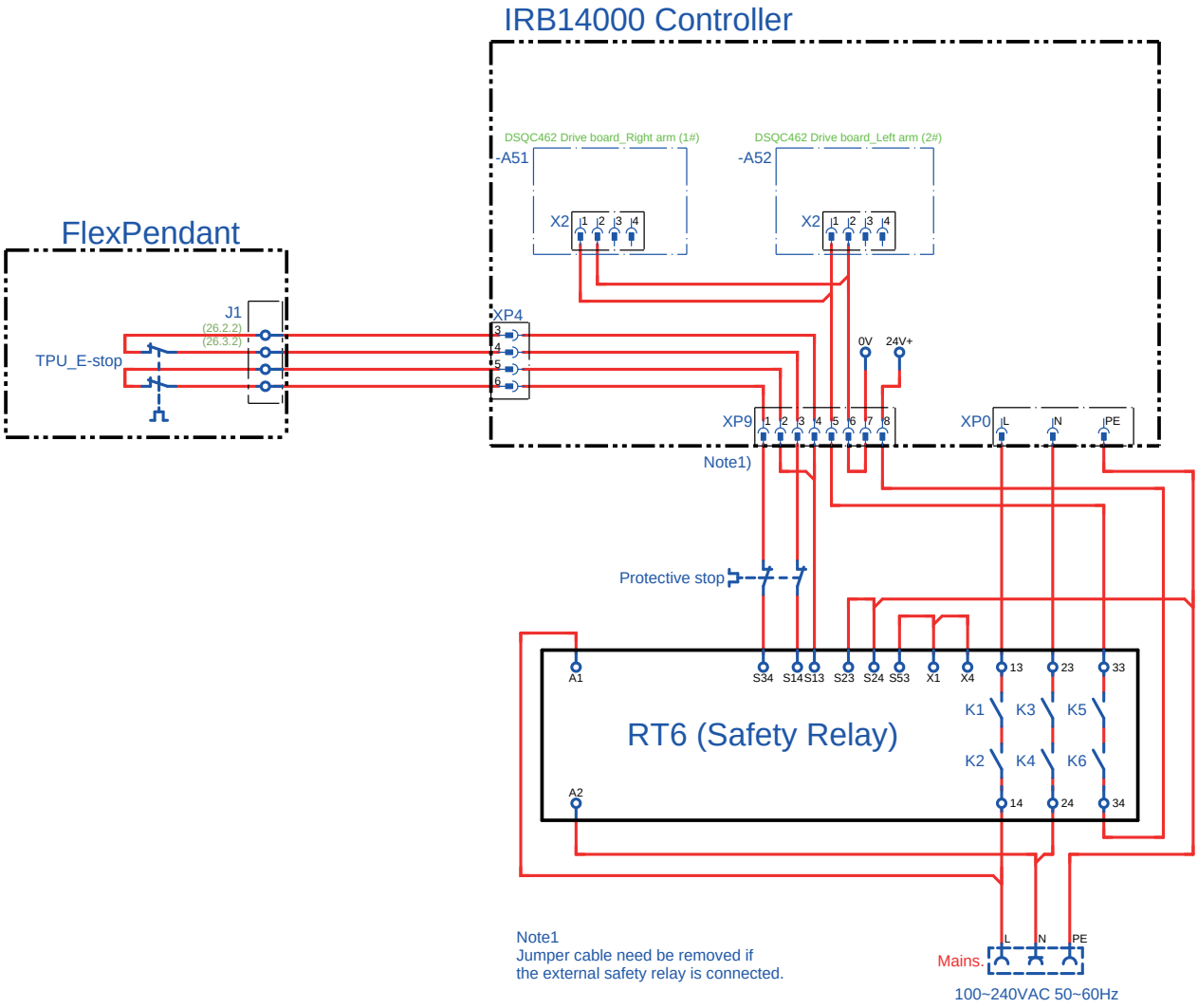
For more information about connecting the safety signals, see *Circuit diagram - IRB 14000*.

Continues on next page

2.4.2.5 Connecting safety signals
Continued

Safety relay (option 1526-X)

Both the external protective stop and IRB 14000 internal emergency stop are daisy-chained and connected directly to the safety relay (option 1526-X) through the safety connector XS9. The safety relay also receives main power inputs and then feeds the inputs to the robot power inlet. Contact ABB for further information.



xx2000000518

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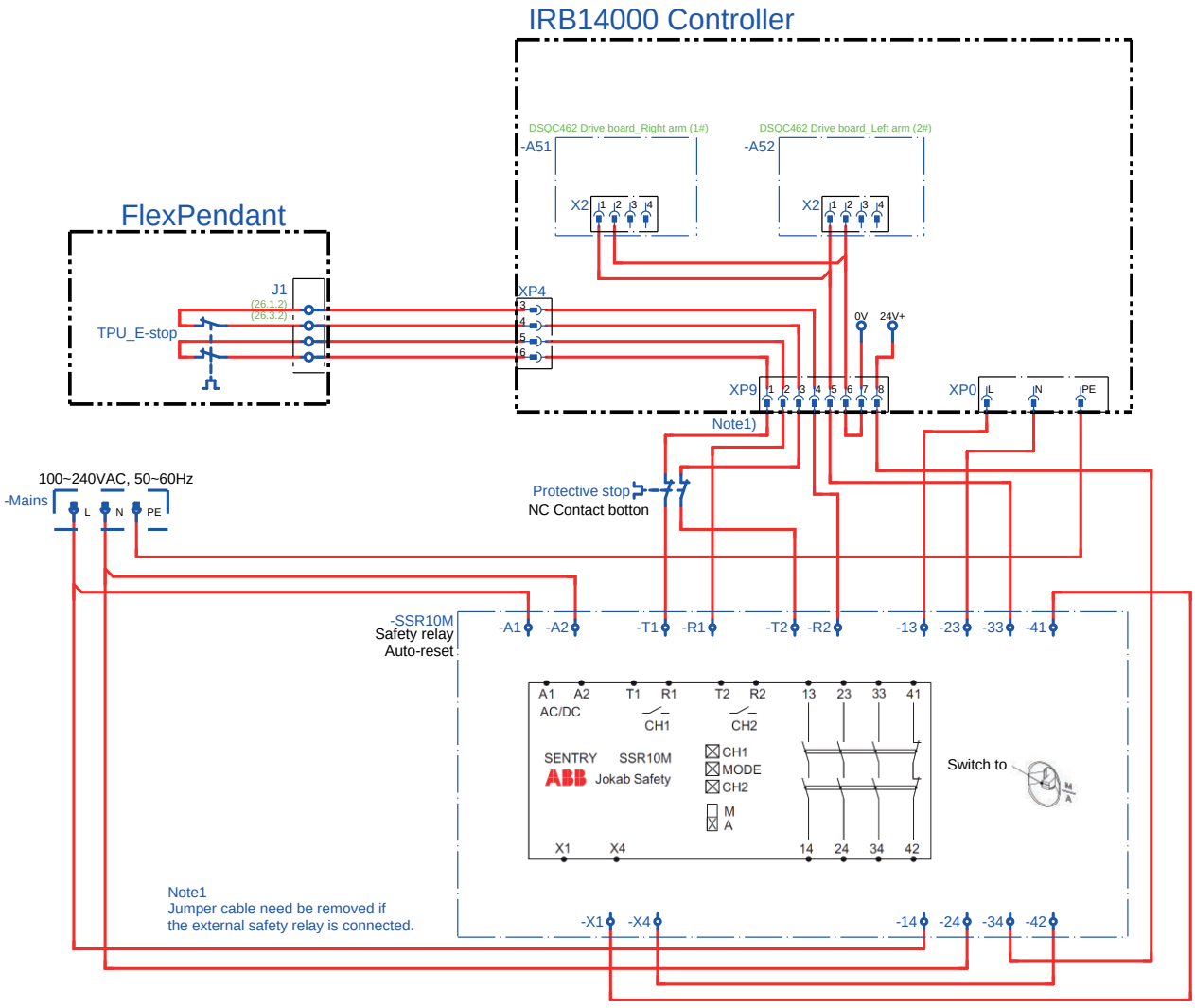
2.4.2.5 Connecting safety signals
Continued



xx2000000519

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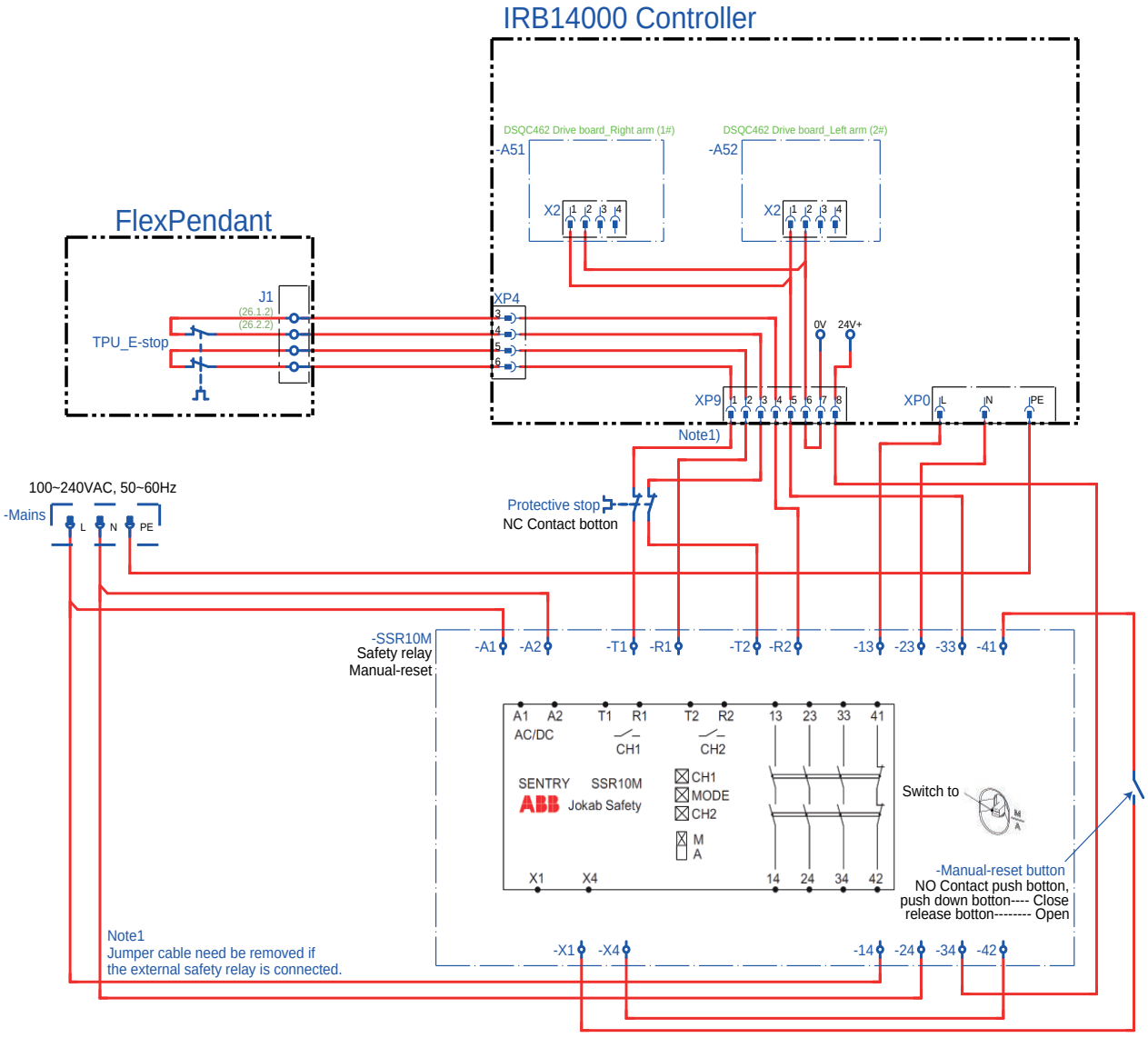
2.4.2.5 Connecting safety signals
Continued



xx2000000520

For more information about connecting the safety signals, see *Circuit diagram - IRB 14000*.

2.4.3 I/O system

2.4.3.1 Local I/O devices

General

ABB Scalable I/O is a modular, compact, and scalable I/O system that consists of a base device, which is the minimum configuration, and add-on devices.

Up to four add-on devices can be controlled by each base device with maintained performance, and any combination of add-on devices is supported.

Communication

The digital base device communicates over the EtherNet/IP communication protocol to the robot controller or to other EtherNet/IP scanners. Up to 20 devices in total can be connected to the robot controller over EtherNet/IP. This includes digital base devices and other third-party I/O devices.

Node commissioning for other EtherNet/IP scanners

For other EtherNet/IP scanners, node commissioning needs to be done either using a dhcp server on the scanner network or setting a static IP address in the device with the help of third-party software. An initial volatile address can be obtained using the reset button. The TCP/IP Object can then be accessed for the purpose of this.

Options

When using the standard *Plug & Produce* interface, no additional RobotWare options or hardware options are required to connect to the robot controller.

When using the RobotWare option *EtherNet/IP Scanner/Adapter*, more configuration possibilities are available.

Device interfaces

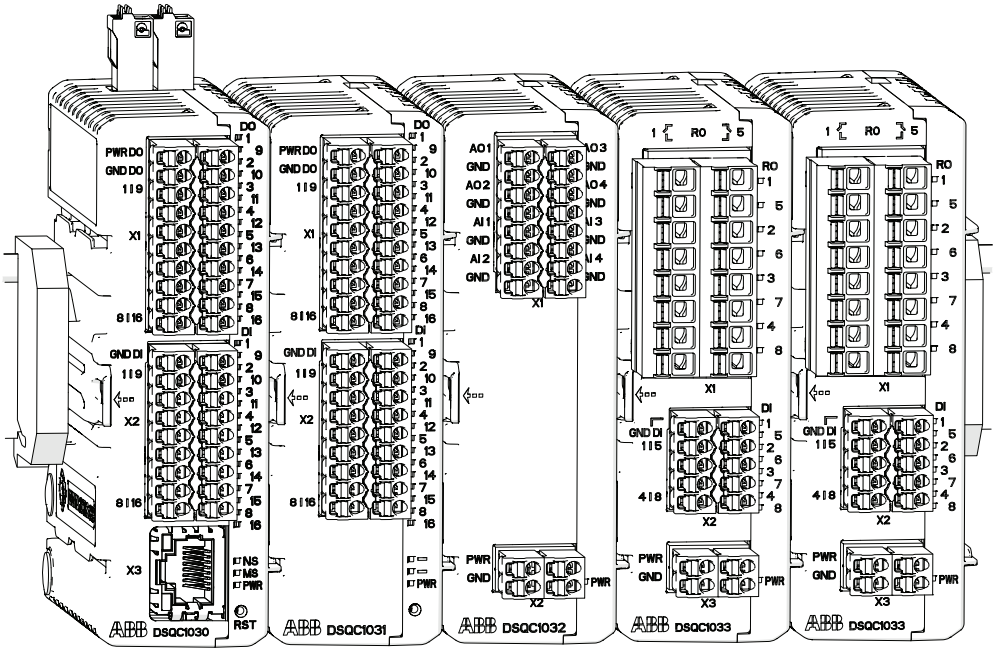
The add-on devices have an optical interface and must be attached to a digital base device. The additional Ethernet port on the base device can be used to daisy chain any Ethernet based equipment on the same network, for example additional digital base devices.

Mounting

The I/O devices are designed to be mounted vertically on a mounting rail in an IP20 protected environment with normal air convention. Forced air is needed if the devices are mounted horizontally.

Continues on next page

2.4.3.1 Local I/O devices
Continued



xx1600002032

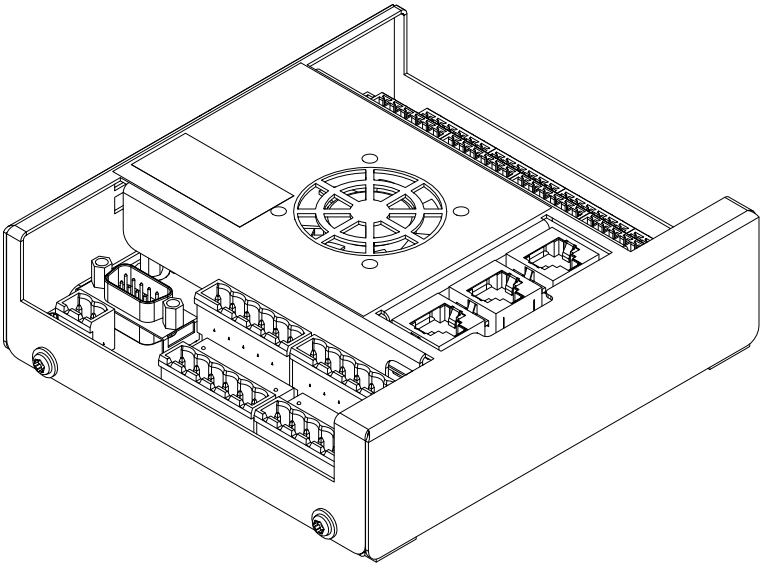
Local I/O devices and parts

For more information about Local I/O device and parts, see *Product manual, spare parts - IRB 14000*.

2.4.3.2 Conveyor tracking module

General

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



xx1800000941

Encoder interface units

The table below specifies the encoder interface units:

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

Continues on next page

2.4.3.2 Conveyor tracking module
Continued

Further information

The table below gives references to additional information:

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

2.4.4 Memory functions

2.4.4.1 SD-card memory

General

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

Note

Only use SD-card memory supplied by ABB.

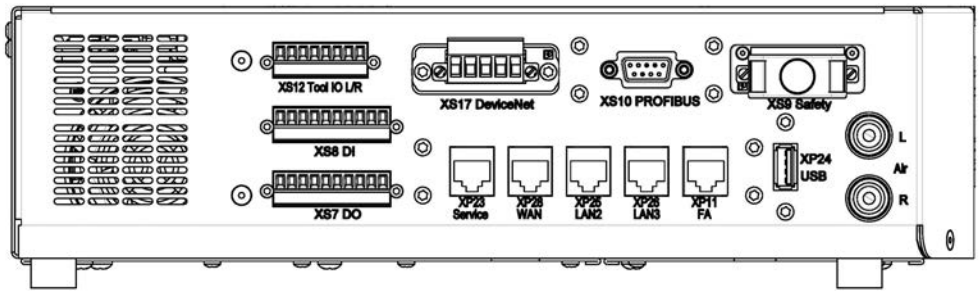
2.4.4.2 Connecting an USB memory

General

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

Location on the controller

The location of the USB port on the controller is shown by the following illustration:



xx1400002129

XP24	USB[1] port to main computer

Location on the FlexPendant

The location of the USB port on the FlexPendant is shown by the following illustration:

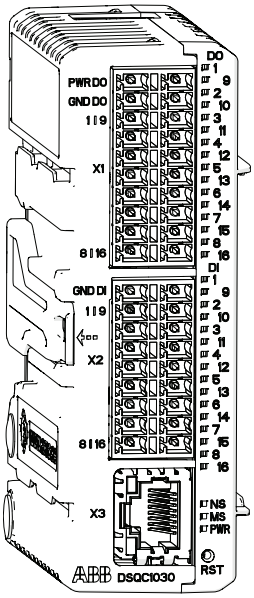
xx1500000701

2.4.5 Installation of add-ons

2.4.5.1 Installation of Local I/O devices

Installation of Local I/O base device

The base device to be installed is shown in the illustration below.



xx1600002033

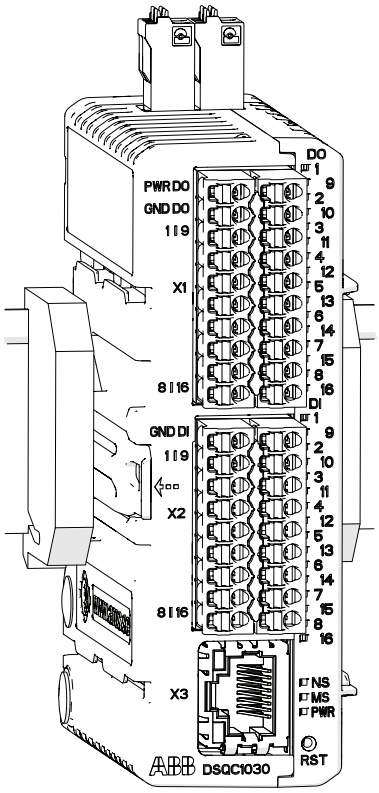
Use this procedure to install the base device.

	Action	Note
1	**DANGER** Before commencing any work inside the cabinet make sure that the main power has been switched off.	

Continues on next page

2.4.5.1 Installation of Local I/O devices

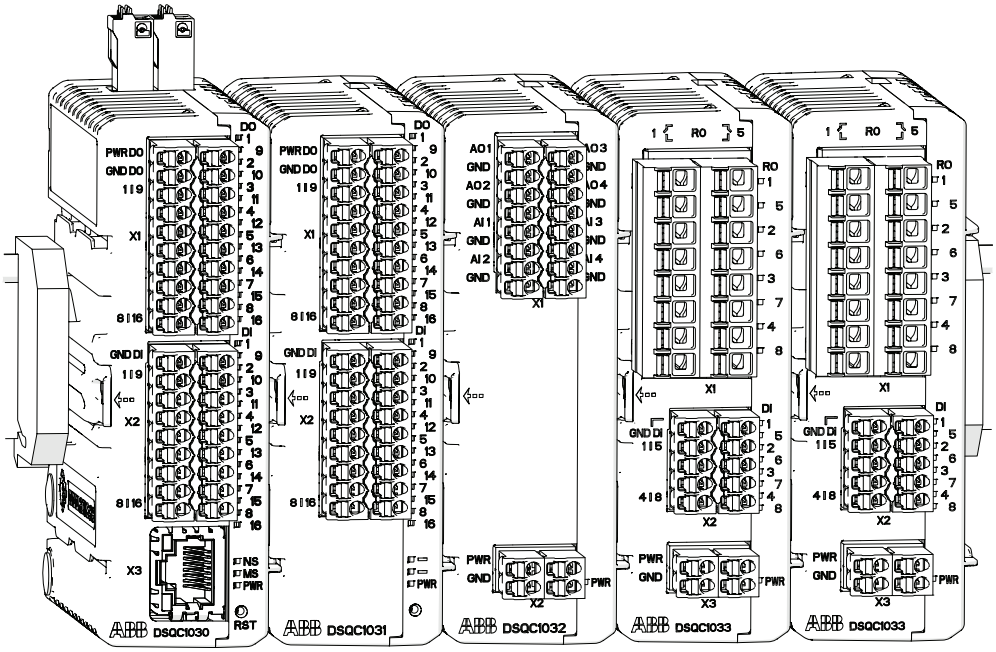
Continued

	Action	Note
2	Fit the device by snapping it onto the mounting rail.	 xx1700000275
3	Connect the Ethernet cable from the robot controller, or the EtherNet/IP scanner, to any of the connectors X3 or X5.	
4	Connect the logic power supply to connector X4.	For information about the pinout, see *Application manual - Scalable I/O*
5	Connect process power supply and GND to the input and output connectors X1 and X2. **Note** The process power supply also powers the optical interface to the add-ons.	**CAUTION** The process power supply must be supplied separately. Connecting the process power supply through the logical power supply connector may damage the device.
6	Connect wires to the inputs and outputs as required.	
7	Configure the device, see *Application manual - Scalable I/O*.	

Continues on next page

Installation of Local I/O add-on device

The add-on devices to be installed and the base device is shown in the illustration below.



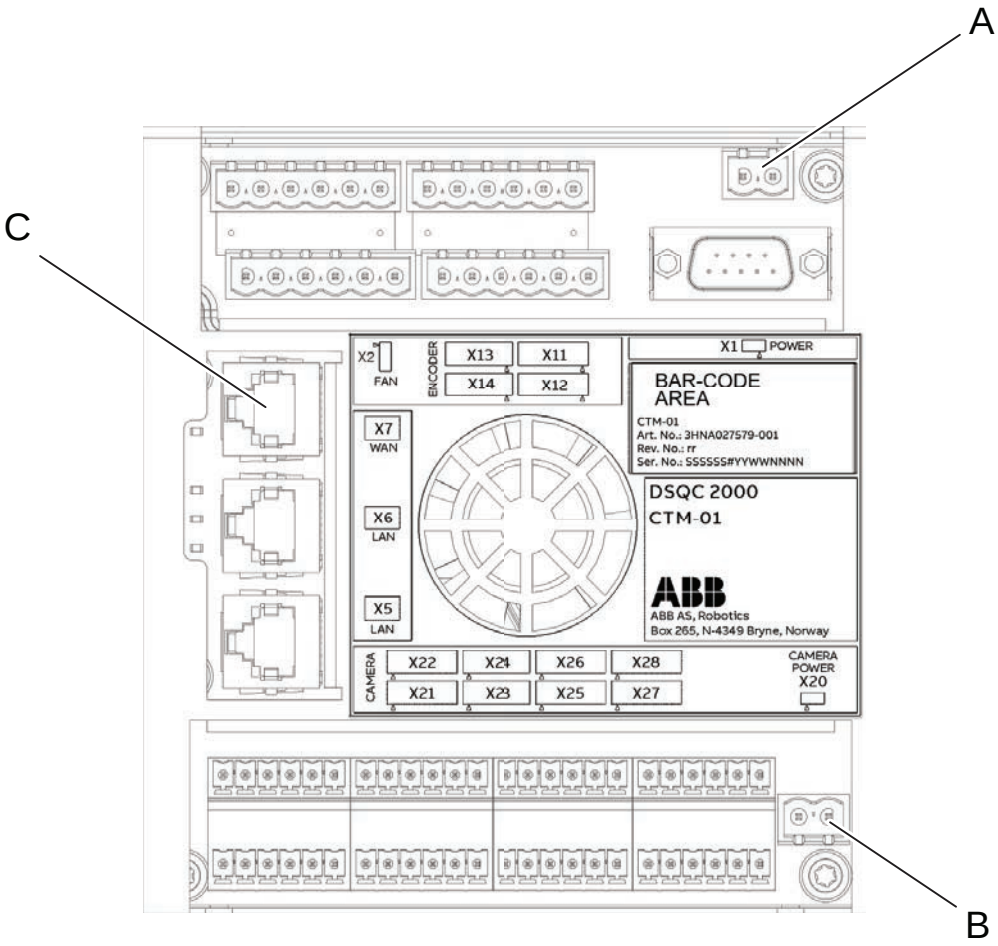
xx1600002032

For more information about installing Local I/O add-on devices, please see *Application manual - Scalable I/O*.

2.4.5.2 Installation of conveyor tracking module

Location

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



xx1800002638

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

Required equipment

Equipment	Article number	Note
DSQC 2000 CTM-01	3HNA027579-001	
CONNECTOR KIT - DSQC 2000	3HNA029345-001	
Standard toolkit	-	See *Standard toolkit on page 440*.

Continues on next page

Note

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

Required document

Document	Document number
Application manual - Conveyor tracking	*3HAC050991-001*
Circuit diagram - IRB 14000	*3HAC050778-003*

Fitting

The procedure below details how to fit the units.

	Action	Note/Illustration
1	**DANGER** Before doing any work inside the cabinet, disconnect the mains power. For more information, see *Electrical safety on page 36*.	
2	**ELECTROSTATIC DISCHARGE (ESD)** 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 58*.	
3	Connect 24VDC power supply to X1 (power inlet, main functions) and X20 (optional camera power inlet) on the conveyor tracking module.	External 24VDC power supply is needed for option 1551-1.
4	Connect the Ethernet cable to the connector X7 WAN on the conveyor tracking module.	The WAN port of the CTM must be connected to the same Ethernet network as the robot controllers.
5	Connect wires to the encoder and camera connectors as required.	Described in the *Application manual - Conveyor tracking*.

2.4.6 What is Cartesian speed supervision?

Definition of Cartesian speed supervision

The Cartesian speed supervision is a safety function that supervises the Cartesian speed of the elbow (arm check point, ACP) and the wrist (wrist center point, WCP). The default speed limit can be modified if needed, based on the risk assessment for the robot installation. If any of the configured speed limits are exceeded, then the robot motion is stopped and a message is displayed.

The Cartesian speed supervision is active in both manual and automatic mode. The setting is defined by system parameters.

2.5 Making robot ready for operation

2.5.1 Additional installation procedure, Clean Room

General

Robots with protection type Clean Room are specially designed to work in a clean room environment.

Clean Room robots are designed to prevent from particle emission from the robot. For example, the maintenance work possible to perform without cracking the paint. The robot is painted with four layers of polyurethane paint. The last layer being a varnish over labels to simplify cleaning. The paint has been tested regarding outgassing of Volatile Organic Compounds (VOC) and been classified in accordance with ISO 14644-8.

Any Clean Room parts that are replaced must be replaced with parts designed for use in Clean Room environments.

Clean Room class 5

According to **IPA test result**, the robot IRB 14000 is suitable for use in Clean Room environment.

Classification of airborne molecular contamination

Parameter				Outgassing amount		
Area (m^2)	Test duration (s)	Temp (°C)	Performed test	Total detected (ng)	Norm based on $1m^2$ and 1s(g)	Classification in accordance to ISO 14644-8
4.5E-03	3600	23	TVOC	2848	1.7E-07	-6.8
4.5E-03	60	90	TVOC	46524	1.7E-04	-3.8

Preparations before commissioning a Clean Room robot

During transport and handling of a Clean Room robot, it is likely that the robot has been contaminated with particles of different kinds. Therefore the robot must be carefully cleaned before installation.

Do not apply force on the plastic covers when lifting the robot! This may result in damage or cracks in the paint around the plastic cover.

2.6 Start of robot in cold environments

Introduction

This section describes how to start the robot in a cold environment if it is not starting the normal way.

Problems with starting the robot

Event message from Motion Supervision

Use this procedure if an event message indicates a problem with Motion supervision at start-up. More information about Motion Supervision is found in *Technical reference manual - System parameters*.

	Action	Note
1	Turn off Motion Supervision.	
2	Start the robot.	
3	When the robot has reached normal working temperature, the Motion Supervision can be turned on again.	

Robot stopping with other event message

Use this procedure if the robot is not starting.

	Action	Note
1	Start the robot with its normal program but with reduced speed.	The speed can be regulated with the RAPID instruction `VelSet`.

Adjusting the speed and acceleration during warm-up

Depending on how cold the environment is and what program is being used, the speed might need to be ramped up until reached maximum. The table shows examples of how to adjust the speed:

Work cycles	`AccSet`	Speed/velocity
3 Work cycles	20, 20	v100 (100 mm/s)
5 Work cycles	40, 40	v400 (400 mm/s)
5 Work cycles	60, 60	v600 (600 mm/s)
5 Work cycles	100, 100	v1000 (1000 mm/s)
More than 5 Work cycles	100, 100	Max.

If the program consists of large wrist movements, it is possible that the reorientation velocity, which is always high in predefined velocities, needs to be included in the ramping up.

2.7 Additional information for IRB 14000

Overview

IRB 14000 is designed to simplify collaborative applications. Therefore some features work somewhat different compared with standard industrial robots. Some of them are listed in this section.

Collision detection for YuMi robots

As default YuMi will have collision detection active at stand still. It also has another stop ramp compared to other robots to be able to release clamping forces.

Note

If the tool data is wrong, false collisions might be triggered and the robot arm might drop a short distance during the stop ramp.

2.8 Test run after installation, maintenance, or repair

Safe handling

Use the following procedure after installation, maintenance, or repair, before initiating motion.

DANGER

Initiating motion without fulfilling the following aspects, may increase the risk for injury or cause 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	Verify that no personnel is leaning on, or have their head or neck close to the robot.
6	Verify that all arm covers and paddings, if any, are properly secured to the robot.
7	If maintenance or repair has been done, verify the function of the part that was maintained.
8	Verify the application in the operating mode manual reduced speed.

3 Maintenance

3.1 Introduction

Structure of this chapter

This chapter describes all the maintenance activities recommended for the IRB 14000.

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 19* before performing any service work.

The maintenance must be done by qualified personnel in accordance with the safety requirements set forth in the applicable national and regional standards and regulations.

Note

If the IRB 14000 is connected to power, always make sure that the IRB 14000 is connected to protective earth and a residual current device (RCD) before starting any maintenance work.

For more information see:

- *Robot cabling and connection points on page 76*.

3.2 Maintenance schedule

3.2.1 Specification of maintenance intervals

Introduction

The intervals are specified in different ways depending on the type of maintenance activity to be carried out and the working conditions of the IRB 14000:

- Calendar time: specified in months regardless of whether the system is running or not.
- Operating time: specified in operating hours. More frequent running means more frequent maintenance activities.
- SIS: specified by the robot's SIS (Service Information System). A typical value is given for a typical work cycle, but the value will differ depending on how hard each part is run.

  The SIS used in M2004 is further described in the *Operating manual - Service Information System*.

Robots with the functionality *Service Information System* activated can show active counters in the device browser in RobotStudio, or on the FlexPendant.

3.2.2 Maintenance schedule

Scheduled and non-predictable maintenance

The robot 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 robot. Any damages must be attended to immediately!

Life of each component

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

Activities and intervals, standard equipment

The table below specifies the required maintenance activities and intervals:

Maintenance activities	Regularly [i]	Every 1 months	Every 6 months	Every 12 months	Every 20,000 hours [ii]	Reference
Cleaning activities						
Cleaning the robot	x					*Cleaning the IRB 14000 on page 136*
Inspection activities						
Inspecting the robot	x					Look for abnormal wear or contamination.
Inspecting the information labels				x		*Inspecting the information labels on page 121*
Inspecting cable harness			x			*Inspecting, cable harness on page 127*
Inspecting plastics and padding	x [iii]	x				*Inspecting, plastic and padding on page 129*
Overhaul						
Overhaul of complete robot					x	

i "Regularly" implies that the activity is to be performed regularly, but the actual interval may not be specified by the robot manufacturer. The interval depends on the operation cycle of the robot, its working environment and movement pattern. Generally, the more contaminated environment, the shorter intervals. The more demanding movement pattern (sharper bending cable harness), the shorter intervals.

ii Operating hours counted by the DTC = Duty time counter.

iii Plastic and padding parts are a safety feature of the robot, that limit impact during collisions. To ensure a maintained safety level of the robot, regular inspections of these parts are necessary.

Continues on next page

3.2.2 Maintenance schedule
Continued

Activities and intervals, optional equipment

The table below specifies the required maintenance activities and intervals:

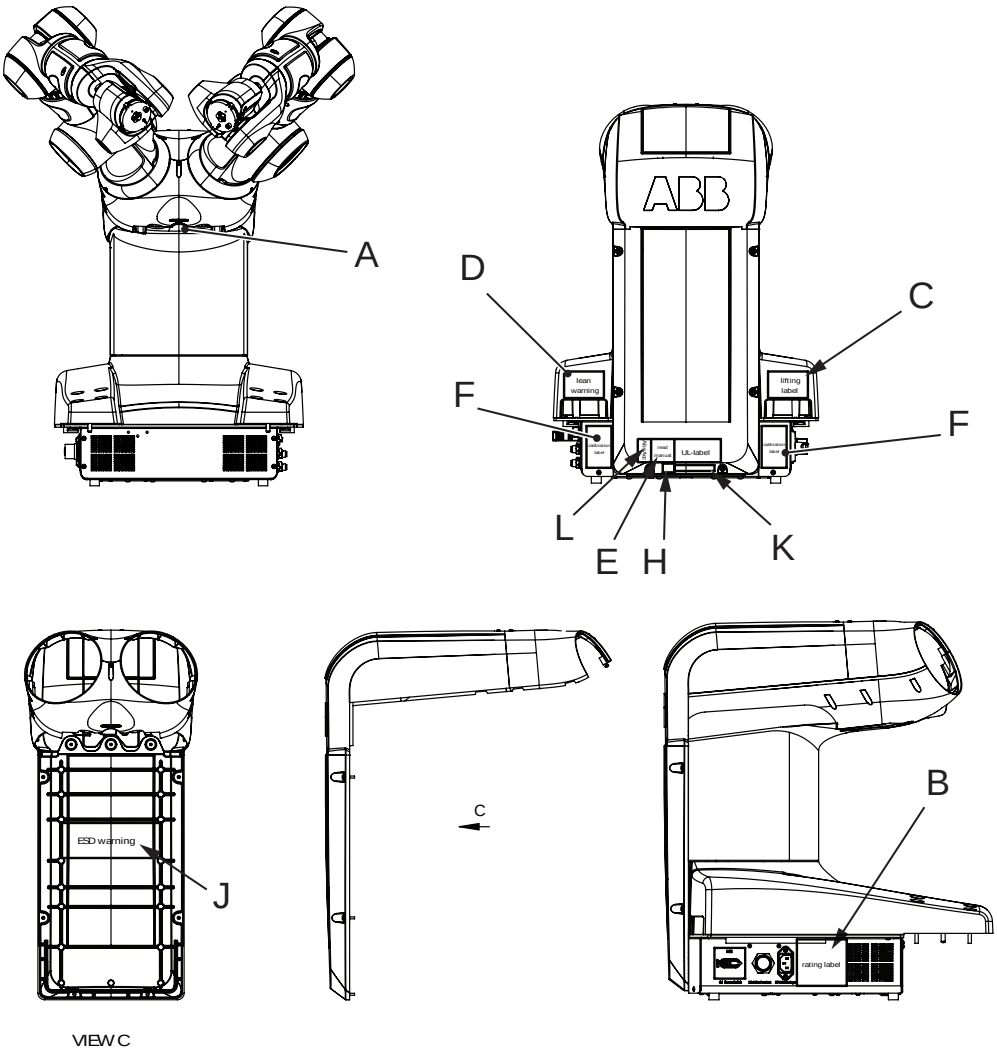
Maintenance activities	Every 12 months	Reference
Inspection activities		
Inspecting the signal lamp	x	*Inspecting, signal lamp on page 125*

3.3 Inspection activities

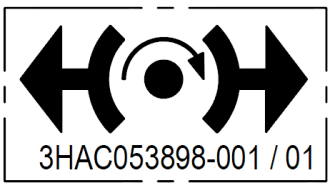
3.3.1 Inspecting the information labels

Location of labels

These figures show the location of the information labels to be inspected. The symbols are described in section *Safety symbols on manipulator labels on page 25*.



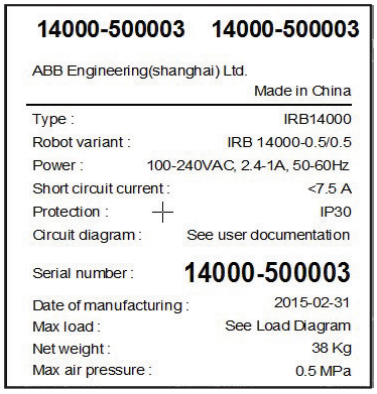
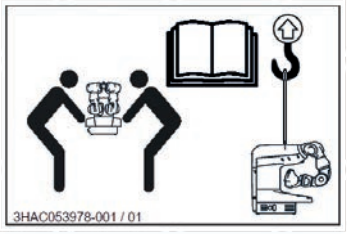
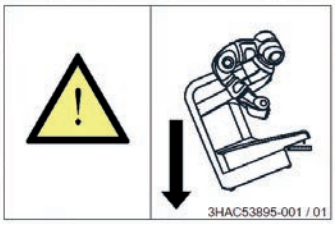
xx1500000720

	Description	Illustration
A	Instruction plate, Brake release	 xx1500000723

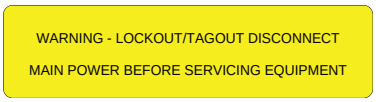
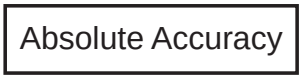
Continues on next page

3.3.1 Inspecting the information labels

Continued

B	Rating label	 xx1500000724
C	Lifting label	 xx1500000725
D	Caution label, Risk of tipping	 xx1500000726
E	Read manual label	 xx1500000727
F	Calibration label	
H	Warning sign, Electrical shock	 xx0200000024

Continues on next page

J	ESD Warning (inside of cover)	 xx0200000023
K	Warning label, Disconnect power before servicing controller	 xx1500000790
L	AbsAcc label	 xx1500001643

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Rating label	3HAB9549-1	
Warning sign	3HAC1589-1	Electrical shock
Caution label	3HAC053895-001	Risk of tipping
Warning label	3HAC055245-001	Disconnect power before servicing controller
Instruction plate	3HAC053898-001	Brake release
Lifting label	3HAC053978-001	
Read manual label	3HAC053979-001	
Calibration label	3HAC13488-1	
ESD Warning	29454254-1	inside of cover

Required tools and equipment

Visual inspection, no tools are required.

Inspecting, labels

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
2	Inspect the labels.	See *Location of labels on page 121*.

Continues on next page

3.3.1 Inspecting the information labels

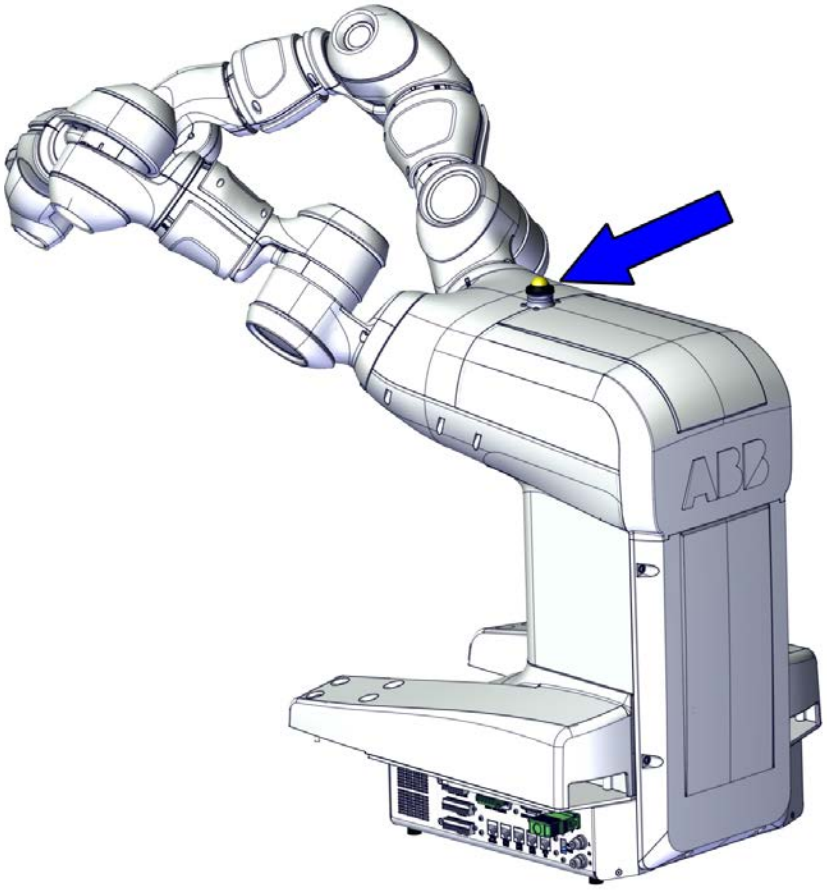
Continued

	Action	Note
3	Replace any missing or damaged labels.	

3.3.2 Inspecting, signal lamp

Location of signal lamp

The signal lamp is located as shown in this figure.



xx1500000051

Required tools and equipment

Equipment, etc.	Art. no.	Note
Signal lamp	3HAC053350-001	To be replaced if damage is detected.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.

Inspecting, signal lamp

Use this procedure to inspect the function of the signal lamp.

	Action	Note
1	Verify that the signal lamp is lit when motors are put in operation ("MOTORS ON").	

Continues on next page

3.3.2 Inspecting, signal lamp

Continued

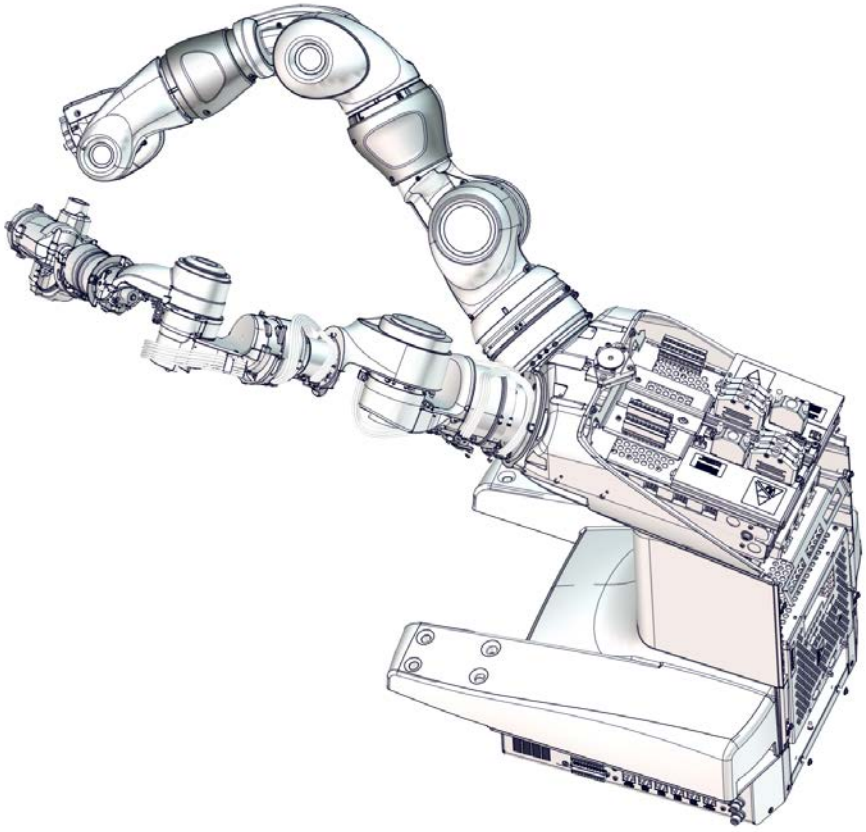
	Action	Note
2	 **DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the inspection work on the robot.	
3	If the lamp is not lit, trace the fault by: • Make sure that the *signal lamp* is not broken. If so, replace it. • Inspect the cable connections. • Inspect the cabling. Replace the cabling if a fault is detected.	Art. no. is specified in section *Required tools and equipment on page 125*. For details about how to replace the signal lamp, see *Installing the signal lamp on page 70*.

3.3.3 Inspecting, cable harness

Location of cable harness

The cable harness for the arm runs undivided from its connection point at the drive unit on the controller, out from the body, throughout the arm to the axis motors and ends up at the tool flange.

In the figure below all covers required to be removed for visual access to the cable harness, are removed.



xx1400002908

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.

Inspecting the cable harness

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

Continues on next page

3.3.3 Inspecting, cable harness

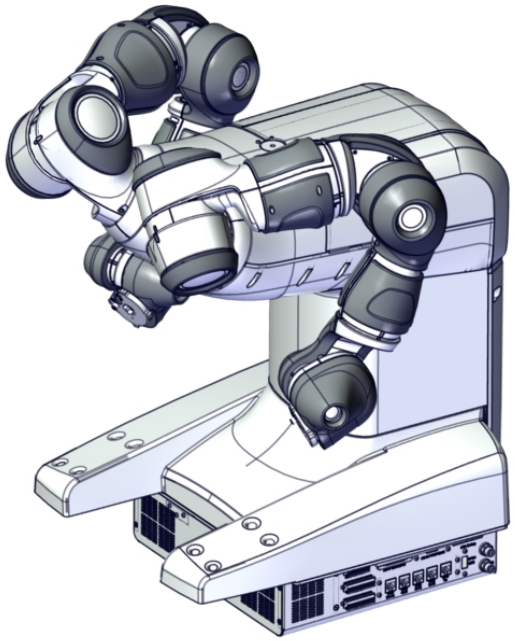
Continued

	Action	Note
2	Remove all covers required to achieve visibility of all cabling.	Information for removal and refitting of covers is found in *Replacing the encapsulation and covers on page 158*.
3	Visually inspect all arm cabling. Look for abrasions, cuts or crush damages. If any damage is detected, replace the complete robot arm.	See *Replacing the complete arm on page 143*.
4	Inspect that the cabling is lubricated properly. If needed, apply grease evenly on the moving part of the cable harness. It is normal that the grease color turns into black.	Grease: Mobil FM222.
5	Refit all covers. If any cover is damaged, it must be replaced. **CAUTION** Be careful not to squeeze any cabling during the refitting procedure.	Replacement information for the covers, such as pare part numbers and tightening torques for the attachment screws are detailed in section *Replacing the encapsulation and covers on page 158*.

3.3.4 Inspecting, plastic and padding

Location of plastic and padding

The plastic and padding are located on the whole arm.



xx1500000507

CAUTION

Plastic and padding parts are a safety feature of the robot, that limit impact during collisions. To ensure a maintained safety level of the robot, regular inspections of these parts are necessary.

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.

Inspecting plastic and padding

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

Continues on next page

3.3.4 Inspecting, plastic and padding

Continued

	Action	Note
2	Visually inspect all plastics and padding parts for damage. If any cover is damaged or cannot perform its protective function for other reasons, it must be replaced.	Spare part numbers and replacement information is found in *Replacing the encapsulation and covers on page 158*.
3	Make sure that all plastic and padding covers are fully fastened. Manually check that the parts are not loose. Tighten, if needed.	Tightening torques are specified in *Replacing the encapsulation and covers on page 158*.

3.4 Replacement/changing activities

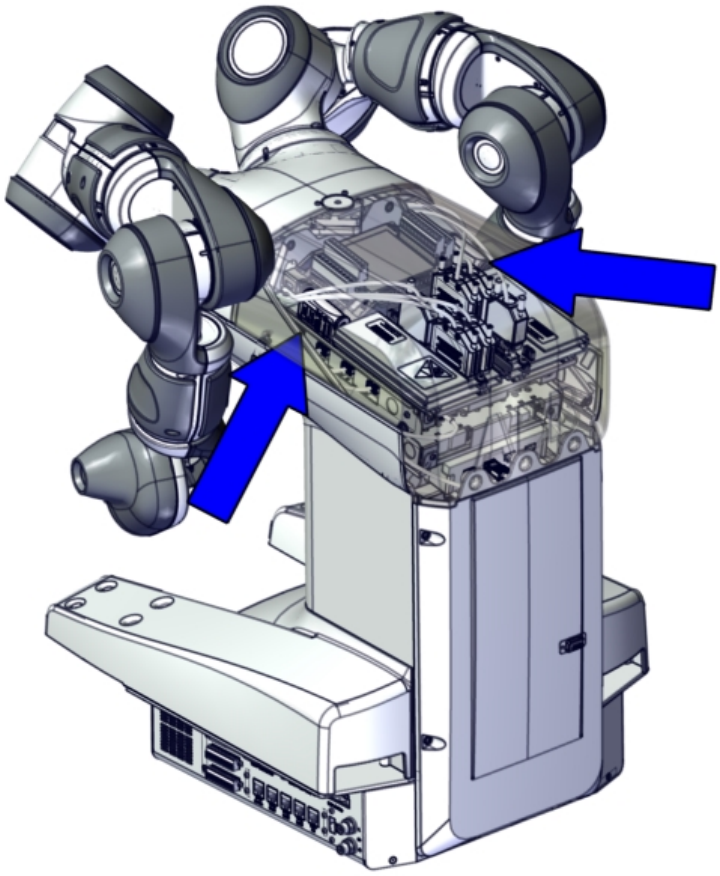
3.4.1 Replacing the battery pack

Note

The battery low alert (38213 **Battery charge low**) is displayed when the battery needs to be replaced. The recommendation to avoid an un-synchronized robot is to keep the power to the controller turned on until the battery is to be replaced.

Location of battery pack

The battery pack is located as shown in the figure.



xx1500000504

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Continues on next page

3.4.1 Replacing the battery pack

Continued

Spare part	Article number	Note
Battery pack	3HAC044075-001	Battery includes protection circuits. Only replace with a specified spare part or an ABB-approved equivalent.

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.

Consumables

Consumable	Article number	Note
Cable ties	-	-

Removing the battery pack

Use this procedure to remove the battery pack.

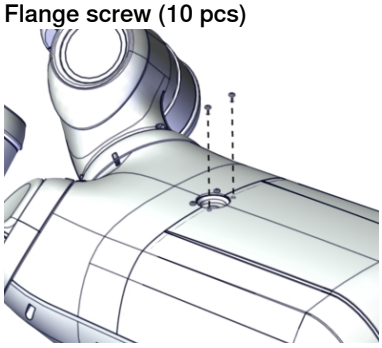
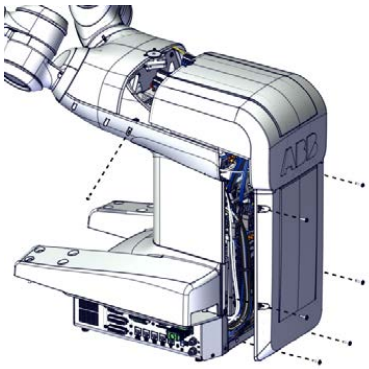
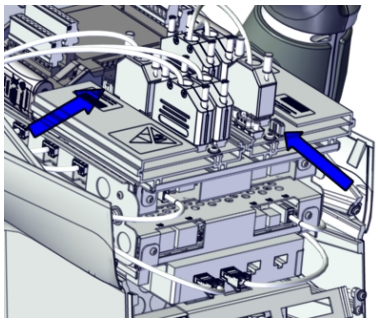
Preparations before removing the battery pack

	Action	Note
1	Move the robot to its calibration position.	This is done in order to facilitate updating of the revolution counter.
2	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

Removing the battery pack

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
2	**WARNING** The unit is sensitive to ESD. Before handling the unit, see *The unit is sensitive to ESD on page 58*.	

Continues on next page

	Action	Note
3	Remove the body cover.	Flange screw (10 pcs)  xx1500000525  xx1500000303
4	Disconnect the battery connector (X3).	 xx1500000505
5	Cut the cable tie that secures the battery and remove the battery.	

Refitting the battery pack

Use these procedures to refit the battery pack.

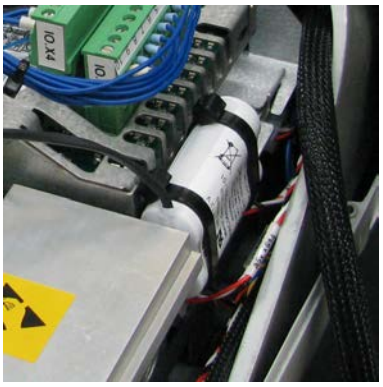
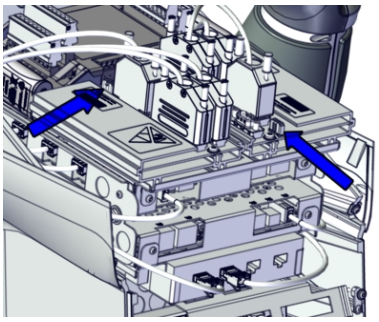
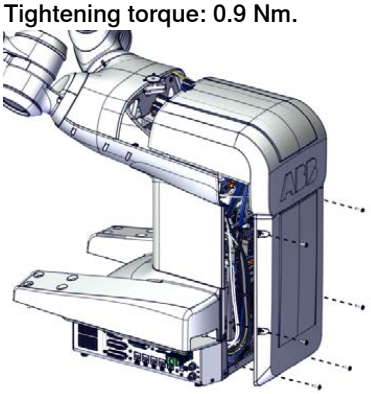
Refitting the battery pack

	Action	Note
1	**WARNING** The unit is sensitive to ESD. Before handling the unit, see *The unit is sensitive to ESD on page 58*.	

Continues on next page

3.4.1 Replacing the battery pack

Continued

	Action	Note
2	Fit the battery and and secure it with a cable tie. **Note** Battery includes protection circuits. Only replace with a specified spare part or with an ABB-approved equivalent.	 xx1500000506
3	Connect the battery connector (X3).	 xx1500000505
4	Refit the body cover.	Tightening torque: 0.9 Nm.  xx1500000697

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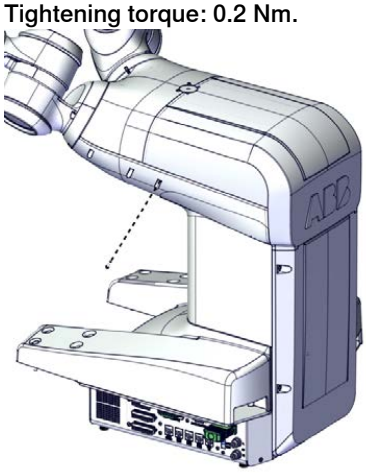
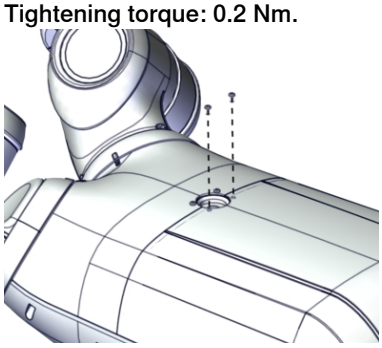
	Action	Note
5	Refit the two remaining screws of the body cover.	Tightening torque: 0.2 Nm.  xx1500000696
6	Refit the attachment screws.	Flange screw (2 pcs) Tightening torque: 0.2 Nm.  xx1500000525

Concluding procedure

	Action	Note
1	Update the revolution counters.	See *Updating revolution counters on page 415*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

3.5 Cleaning activities

3.5.1 Cleaning the IRB 14000

WARNING

Turn off all electrical power supplies to the robot before starting the cleaning.

General

To secure high uptime it is important that the IRB 14000 is cleaned regularly. The frequency of cleaning depends on the environment in which the product works.

Note

Always verify the protection type of the robot before cleaning.

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.
- 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 depending on the protection type.

Protection type	Cleaning method			
	Vacuum cleaner	Wipe with cloth	Rinse with water	High pressure water or steam
Standard	Yes	Yes. With light cleaning detergent (no spirit or isopropyl alcohol is allowed.)	No	No
Clean room	Yes	Yes. With light cleaning detergent, spirit or isopropyl alcohol.	No	No

Continues on next page

Wiping with cloth

Additional cleaning instructions for Clean Room robots

ABB robots with protection types *Clean Room* are designed to be cleaned at a low cleaning frequency, before entering the cleanroom environment, after robot commissioning or during cleanroom maintenance.

Wipe-down cleaning method is recommended. Robot surfaces shall be wiped with clean and low particle emission cleanroom cloth which is soaked in 70% ethanol .

Use the following procedure to clean Clean Room robots:

1. Before cleaning, use the lint free cloth to remove dirt, debris or any other contaminant from the to-be cleaned surfaces.
   - Make sure no visible residues left.
   - Never apply hard forces on or rub against the robot surfaces to remove dirt or debris; otherwise, protective paint layers may be damaged.
2. Wet a clean cloth with the cleaning detergent and then wipe the robot painting surfaces.
   - Make sure no cleaning agents are sprayed onto robot surfaces or into the robot structure.
   - Wipe from the surface center to edge and always in the same direction.
3. Wait a few minutes for detergent volatilization.
   - Make sure no residue of cleaning agents left on the robot surfaces after wipe down cleaning.

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4 Repair

4.1 Introduction

Structure of this chapter

This chapter describes repair activities for the IRB 14000. Each procedure contains the information required to perform the activity, for example spare parts numbers, required special tools, and materials.

> **WARNING**
>
> Repair activities not described in this chapter must only be carried out by ABB.

Report replaced units

> **Note**
>
> When replacing a part on the IRB 14000, report to your local ABB the serial number, the article number, and the revision of both the replaced unit and the replacement unit.
>
> This is particularly important for safety equipment to maintain the safety integrity of the installation.

Safety information

Make sure to read through the chapter *Safety on page 19* before commencing any service work.

> **Note**
>
> If the IRB 14000 is connected to power, always make sure that the IRB 14000 is connected to protective earth and a residual current device (RCD) before starting any repair work.
>
> For more information see:

4.2 General procedures

4.2.1 Mounting instructions for sealings

General

This section describes how to mount different types of sealings.

Equipment

Consumable	Article number	Note
Grease	-	Mobil FM222

Rotating sealings

The procedure below describes how to fit rotating sealings.

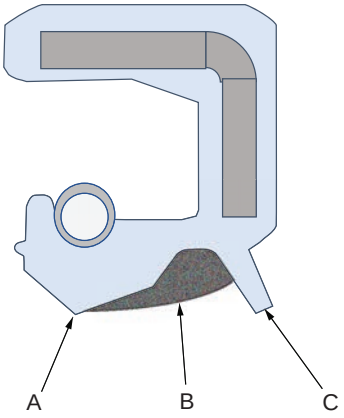
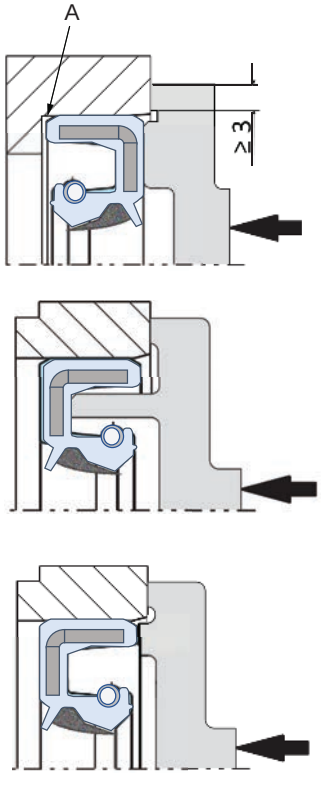
CAUTION

Please observe the following before commencing any assembly of sealings:

- Protect the sealing during transport and mounting, especially the main lip.
- Keep the sealing in its original wrappings or protect it well before actual mounting.
- The fitting of sealings and gears must be carried out on clean workbenches.
- Use a protective sleeve for the main lip during mounting, when sliding over threads, keyways or other sharp edges.

	Action	Note
1	Check the sealing to ensure that: • The sealing is of the correct type. • There is no damage on the main lip.	
2	Inspect the shaft surface before mounting. If scratches or damage are found, the shaft must be replaced since it may result in future leakage. Do not try to grind or polish the shaft surface to get rid of the defect.	

Continues on next page

	Action	Note
3	Lubricate the sealing with grease just before fitting. (Not too early - there is a risk of dirt and foreign particles adhering to the sealing.) Fill 2/3 of the space between the dust lip and the main lip with grease. If the sealing is without dust lip, just lubricate the main lip with a thin layer of grease.	Article number is specified in *Equipment on page 140*.  xx2000000071 **A** Main lip **B** Grease **C** Dust lip
4	Mount the sealing correctly with a mounting tool. Never hammer directly on the sealing as this may result in leakage.	 xx2000000072 **A** Gap
5	Make sure that no grease is left on the robot surface.	

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4.2.1 Mounting instructions for sealings
Continued

Flange sealings and static sealings

The following procedure describes how to fit flange sealings and static sealings.

	Action
1	Check the flange surfaces. They must be even and free from pores. It is easy to check flatness using a gauge on the fastened joint (without sealing compound). If the flange surfaces are defective, the parts may not be used because leakage could occur.
2	Clean the surfaces properly in accordance with the recommendations of ABB.
3	Distribute the sealing compound evenly over the surface, preferably with a brush.
4	Tighten the screws evenly when fastening the flange joint.

O-rings

The following procedure describes how to fit o-rings.

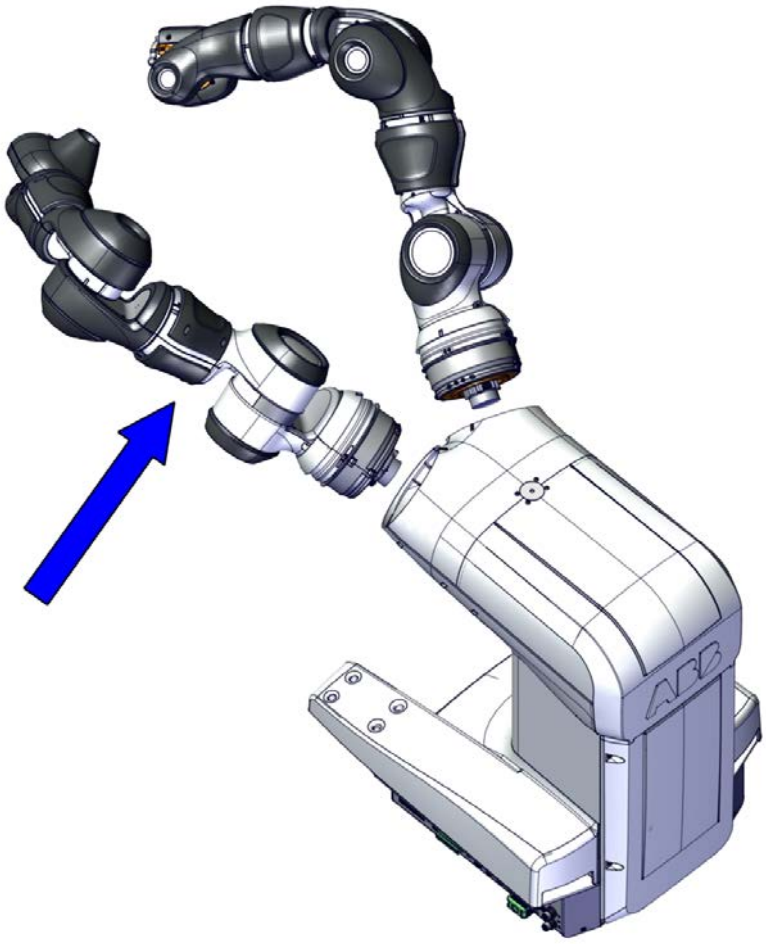
	Action	Note
1	Ensure that the correct o-ring size is used.	
2	Check the o-ring for surface defects, burrs, shape accuracy, or deformation.	Defective o-rings, including damaged or deformed o-rings, may not be used.
3	Check the o-ring grooves. The grooves must be geometrically correct and should be free of pores and contamination.	
4	Lubricate the o-ring with grease.	
5	Tighten the screws evenly while assembling.	
6	Check that the o-ring is not squashed outside the o-ring groove.	
7	Make sure that no grease is left on the robot surface.	

4.3 Arm and arm covers

4.3.1 Replacing the complete arm

Location of the complete arm

The arm is located as shown in the figure.



xx1500000662

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Arm, complete assembly	3HAC074221-001	Complete arm assembly, includes all axes.
Torx pan head screw	3HAC050367-005	M3x12 8.8 Gleitmo 605

Continues on next page

4.3.1 Replacing the complete arm
Continued

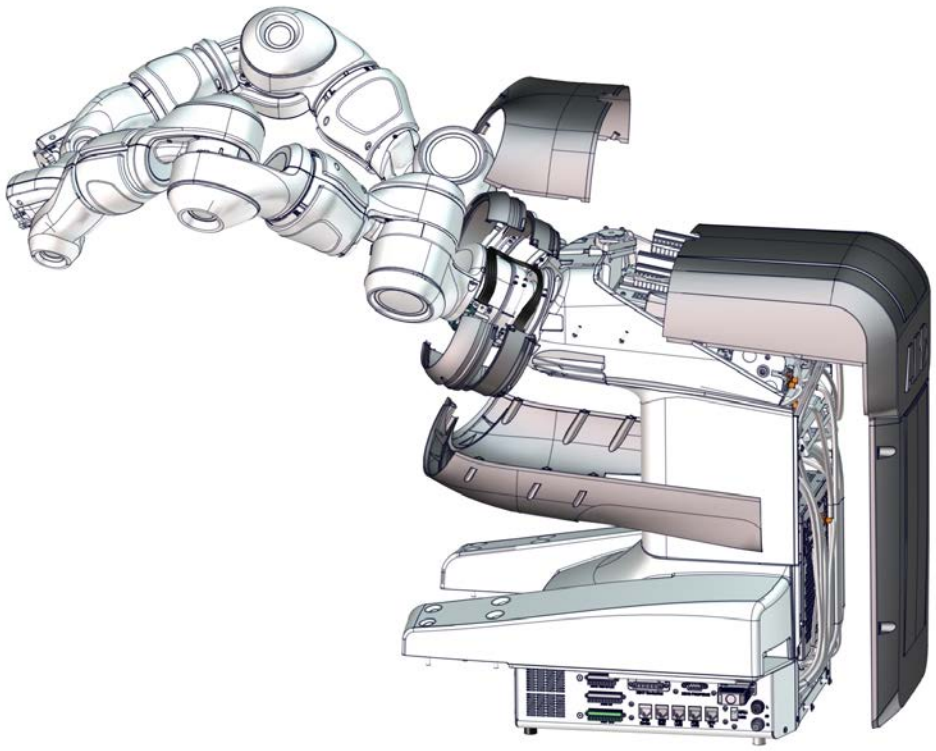
Spare part	Article number	Note
Hex socket head cap screw	3HAC050368-005	M2x8 8.8
Hex socket head cap screw	3HAB3409-232	M4x12 12.9 Lafre 2C2B/FC6.9
Hex socket head cap screw	3HAB3409-233	M2.5x6 12.9 Lafre 2C2B/FC6.9

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.

Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



xx1500000493

Removing the arm

Use these procedures to remove the arm.

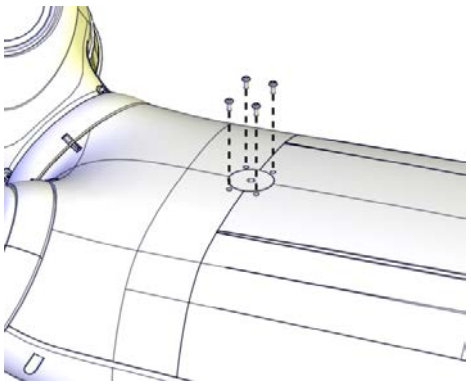
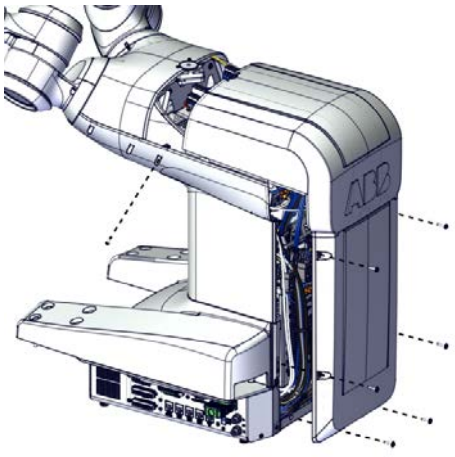
Preparations before removing the arm

	Action	Note
1	Jog the robot so that the covers can be easily accessed and removed.	

Continues on next page

	Action	Note
2	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	

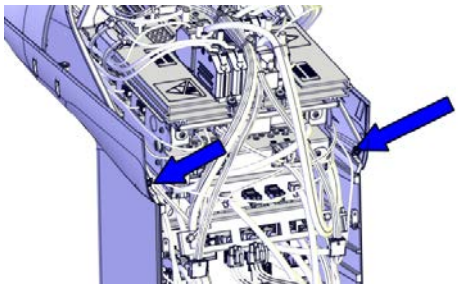
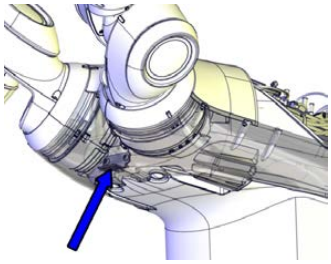
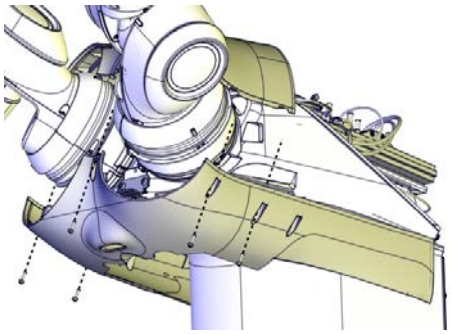
Removing the body covers

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	Remove the body cover top screws.	 xx1400002904
3	Remove the body cover.	 xx1500000303

Continues on next page

4.3.1 Replacing the complete arm

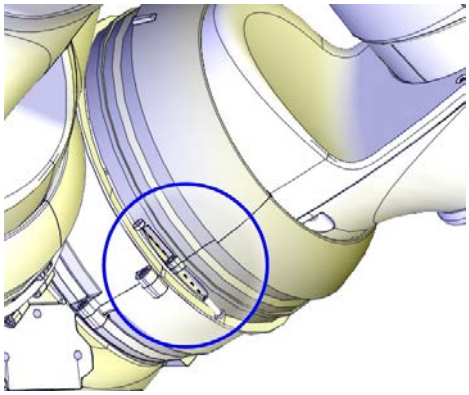
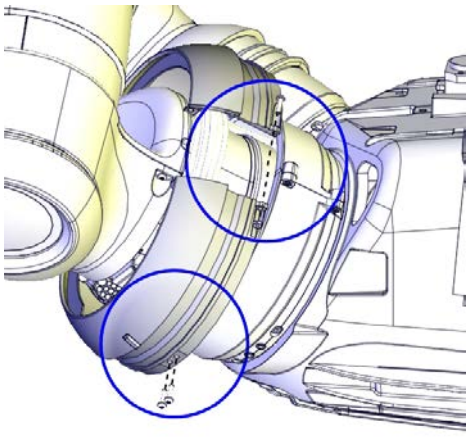
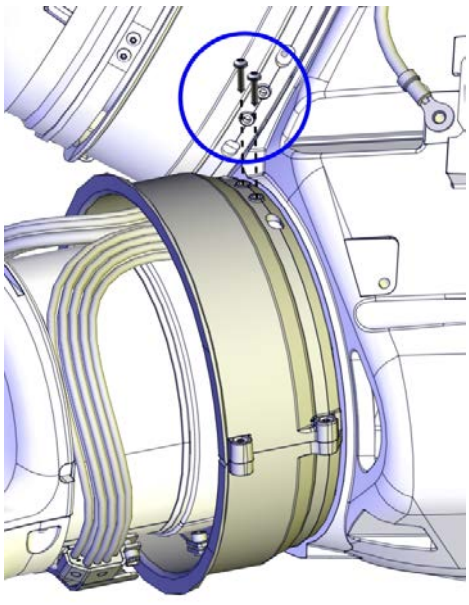
Continued

	Action	Note
4	Remove the back screws of the lower body cover.	 xx1500000540
5	Remove the front and lower body cover. **Note** Be aware of the tab underneath the cover so it does not get damaged.  xx1500000564	 xx1400002603

Removing the axis-1 covers

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	

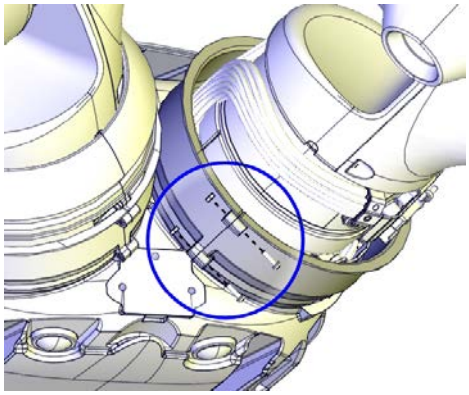
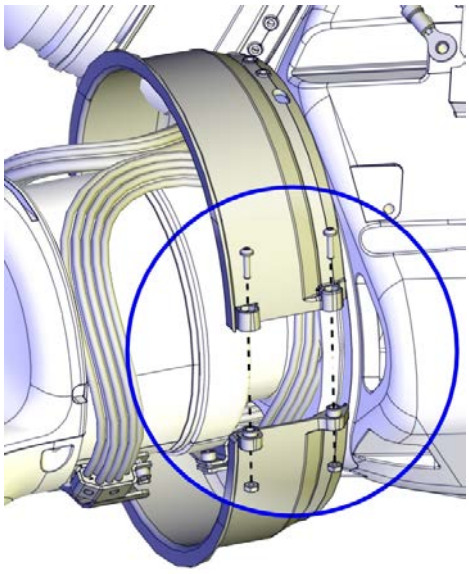
Continues on next page

	Action	Note
2	Remove the upper axis-1 cover. **Note** Be aware of the tab underneath the cover so it does not get damaged.	Screws:M2x8 8.8 (2 pcs).  xx1400002601  xx1400002605
3	Remove the upper screws of the lower axis-1 cover.	 xx1500000565

Continues on next page

4.3.1 Replacing the complete arm

Continued

	Action	Note
4	Turn the lower axis-1 cover in order to access all screws properly and remove the lower axis-1 cover.	Screws:M2x8 8.8 (4 pcs).  xx1400002604  xx1400002606

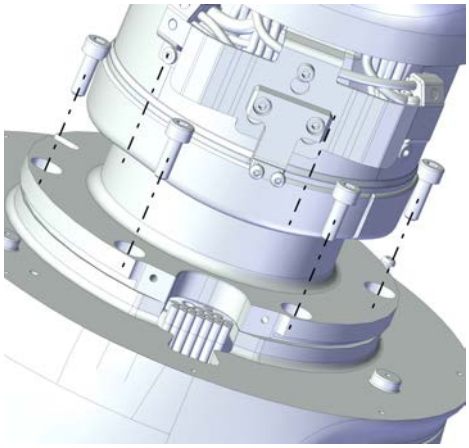
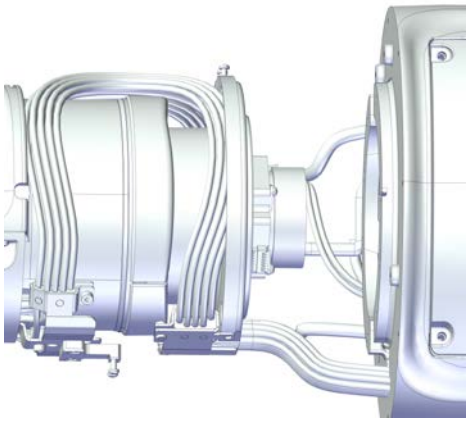
Removing the arm from the body with cabling still connected

Note

Two persons working together are required to perform this procedure.

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	

Continues on next page

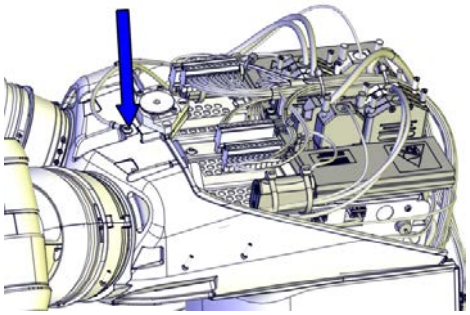
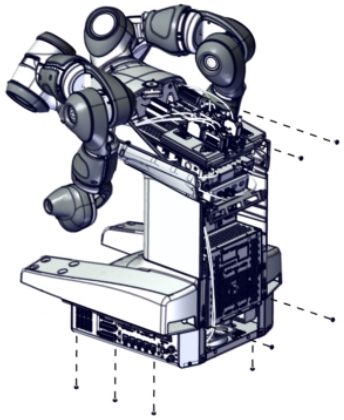
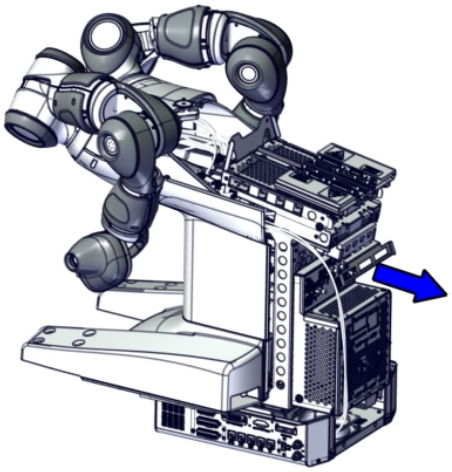
	Action	Note
2	Loosen the cable bracket from the arm by removing the screws.	 xx1800001493
3	Turn on the power to the robot temporarily.	
4	**Note** Two persons working together are required to perform this step. Person 1: Hold the arm. Person 2: Remove the screws that fasten the arm to the body. Release the brakes and rotate axis 1 in order to access all the screws. Move the axes back into original position when all the screws are removed.	 xx1800001494
5	**DANGER** Turn off the electric power supply again.	
6	Remove the arm from the body. **CAUTION** The cabling is still connected inside the robot, be careful not to strain the cables!	 xx1800001495

Continues on next page

4.3.1 Replacing the complete arm

Continued

Disconnecting the arm cabling from the controller

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	Disconnect the earth cable by removing the screw.	 xx1500000601
3	Remove all attachment screws that fasten the controller to the body.	Screws: 10 pcs.  xx1500000364
4	Carefully pull the controller out partially in the rails so that the power and signal connectors can be accessed. **CAUTION** The controller weighs 13 kg. Support the weight of the controller!	 xx1500000365

Continues on next page

	Action	Note
5	Cut necessary cable ties.	
6	Disconnect the power and signal connectors from the controller. Left side: • A52.XS11,12,17,13,14,15,16 • A52.X3 • A52.SMB.X2,X4,X5 • A33.X3 • A2.XSEN • A2.XPCP Right side: • A51.XS11,12,17,13,14,15,16 • A51.X3 • A51.SMB.X2,X4,X5 • A33.X2 • A1.XSEN • A1.XPCP	
7	Disconnect the air hoses from the controller.	

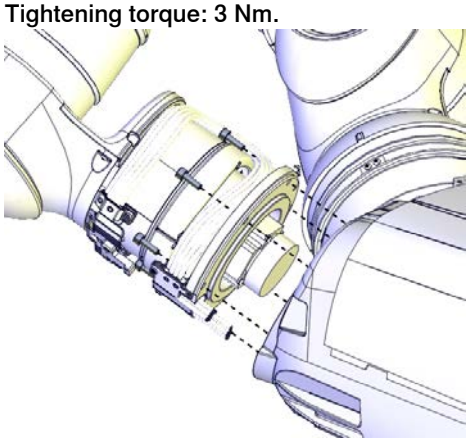
Refitting the arm

Use these procedures to refit the arm.

Refitting the arm to the body

Note

Two persons working together are required to perform this procedure.

	Action	Note
1	Insert the cabling into the body while holding the arm.	
2	Refit the arm and secure with the screws. Some of the screws might not be possible to refit until the cabling is reconnected to the controller and the brakes can be released. Leave these screws for now. **CAUTION** Be careful not to squeeze any cabling during the refitting procedure.	Screw: 3HAB3409-232. (6 pcs) Tightening torque: 3 Nm.  xx1400002608

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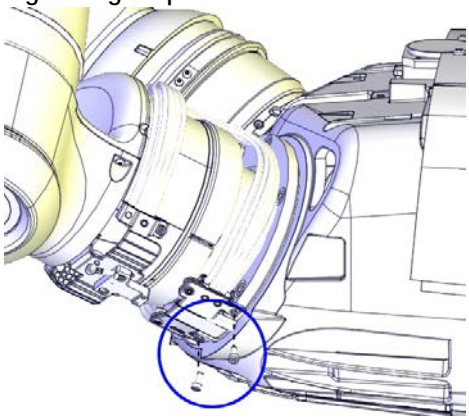
4.3.1 Replacing the complete arm
Continued

	Action	Note
3	Refit the cable bracket to the arm with the screws.	Screw: 3HAB3409-233. (2 pcs) Tightening torque: 0.8 Nm.  xx1400002607

Connecting the arm cabling to the controller

	Action	Note
1	Connect the power and signal connectors to the controller. Left side: • A52.XS11,12,17,13,14,15,16 • A52.X3 • A52.SMB.X2,X4,X5 • A33.X3 • A2.XSEN • A2.XPCP Right side: • A51.XS11,12,17,13,14,15,16 • A51.X3 • A51.SMB.X2,X4,X5 • A33.X2 • A1.XSEN • A1.XPCP	
2	Connect the air hoses to the controller.	
3	Secure the cabling again with cable ties.	
4	Gently push the controller into the robot body completely. **CAUTION** Be careful not to squeeze or damage the cables and air hoses in any way.	

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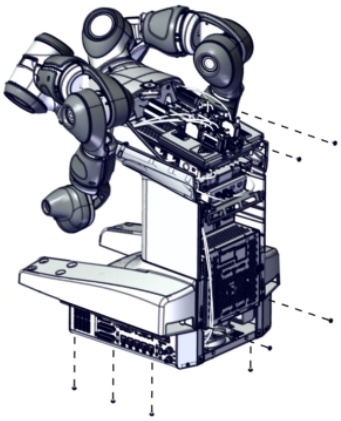
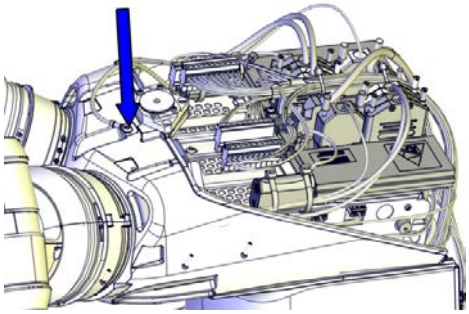
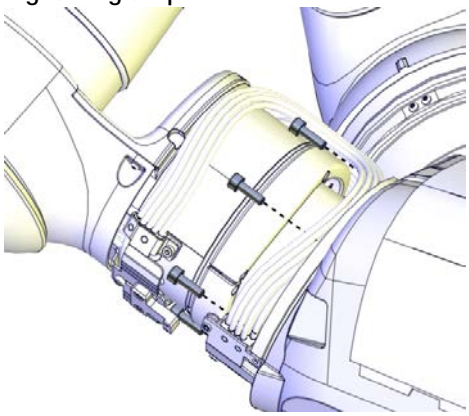
	Action	Note
5	Refit the attachment screws that fasten the controller to the body.	Screw with flange: M3x6 (10 pcs) Tightening torque: 0.9 Nm.  xx1500000364
6	Connect the earth cable with the screw.	M4x8 8.8-A2F (1 pc)  xx1500000601

Refitting the remaining screws between the arm and the body

	Action	Note
1	Turn on the power to the robot temporarily.	
2	Secure any remaining screws that fasten the arm to the body. Release the brakes and rotate axis 1 in order to access all the screws.	Screw: 3HAB3409-232 (6 pcs). Tightening torque: 3 Nm.  xx1500000543
3	Turn off the electric power supply again.	

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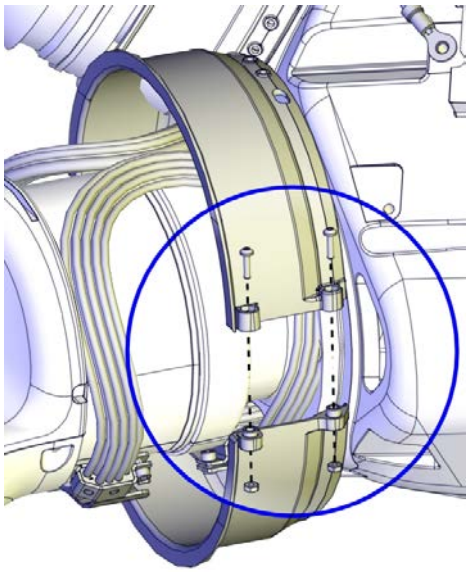
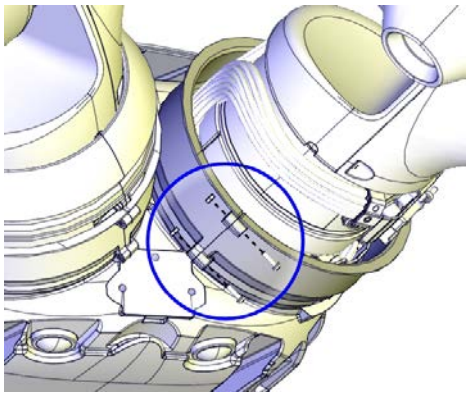
4.3.1 Replacing the complete arm
Continued

Refitting the axis-1 covers

	Action	Note
1	Refit the lower axis-1 cover.	Screws: 3HAC050368-005 (4 pcs). Nuts: 9ADA267-1 (4 pcs). Tightening torque: 0.14 Nm.  xx1400002606  xx1400002604

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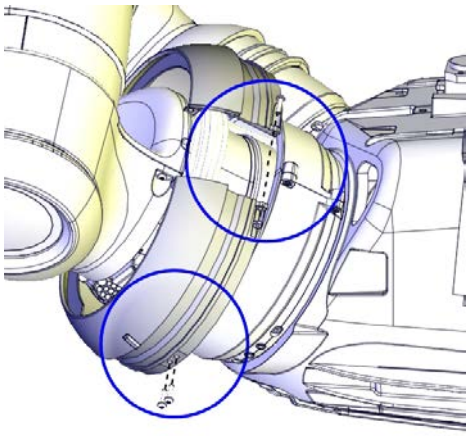
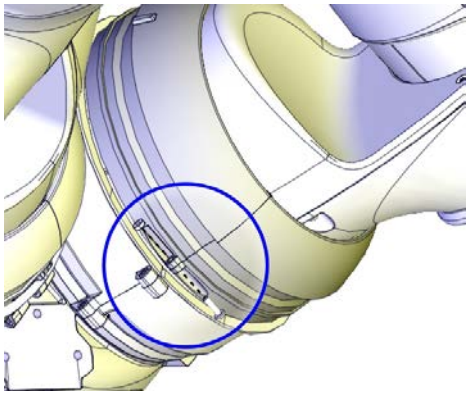
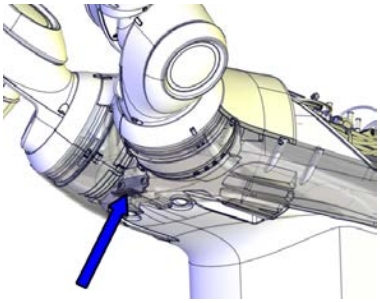
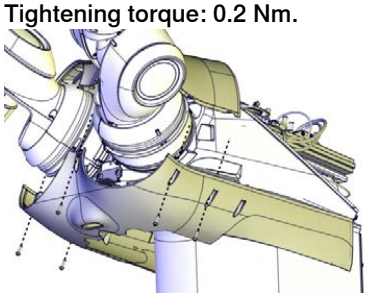
	Action	Note
2	Refit the upper axis-1 cover.	Screws: 3HAC050368-005 (2 pcs). Nuts: 9ADA267-1 (2 pcs). Tightening torque: 0.14 Nm.  xx1400002605  xx1400002601

Refitting the body covers

	Action	Note
1	Refit the front and lower body cover. **Note** Be aware of the tab underneath the cover so it does not get damaged.  xx1500000564	Screws: 3HAC050368-005 (5 pcs). Tightening torque: 0.2 Nm.  xx1400002603

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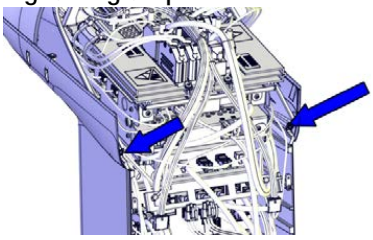
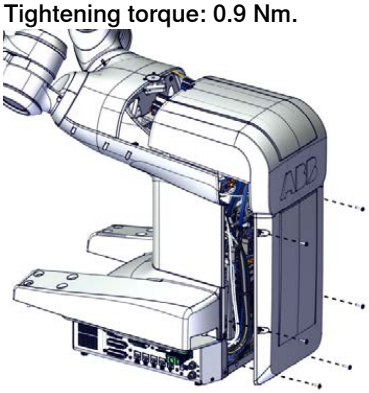
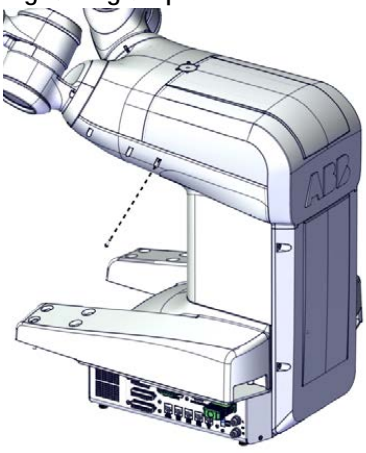
4.3.1 Replacing the complete arm

Continued

	Action	Note
2	Refit the back screws of the lower body cover.	Screws: 3HAC050367-005 (2 pcs). Tightening torque: 0.2 Nm.  xx1500000540
3	Refit the body cover.	Screws: 3HAC050367-005 (6 pcs). Tightening torque: 0.9 Nm.  xx1500000697
4	Refit the two remaining screws of the body cover.	Screws: 3HAC050367-005 (2 pcs). Tightening torque: 0.2 Nm.  xx1500000696

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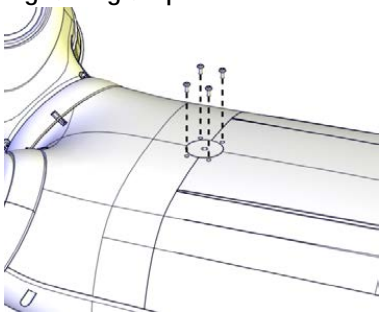
	Action	Note
5	Refit the body cover top screws.	Screws: M3x6 (4 pcs). Tightening torque: 0.2 Nm.  xx1400002904

Concluding procedure

	Action	Note
1	Re-calibrate the robot.	See *Calibration on page 397*.
2	Calibrate the new robot arm for Absolute Accuracy, if the Absolute Accuracy calibration option is valid for the robot.	See *Calibrating the robot for Absolute Accuracy on page 409*.
3	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.3.2 Replacing the encapsulation and covers

Required tools and equipment

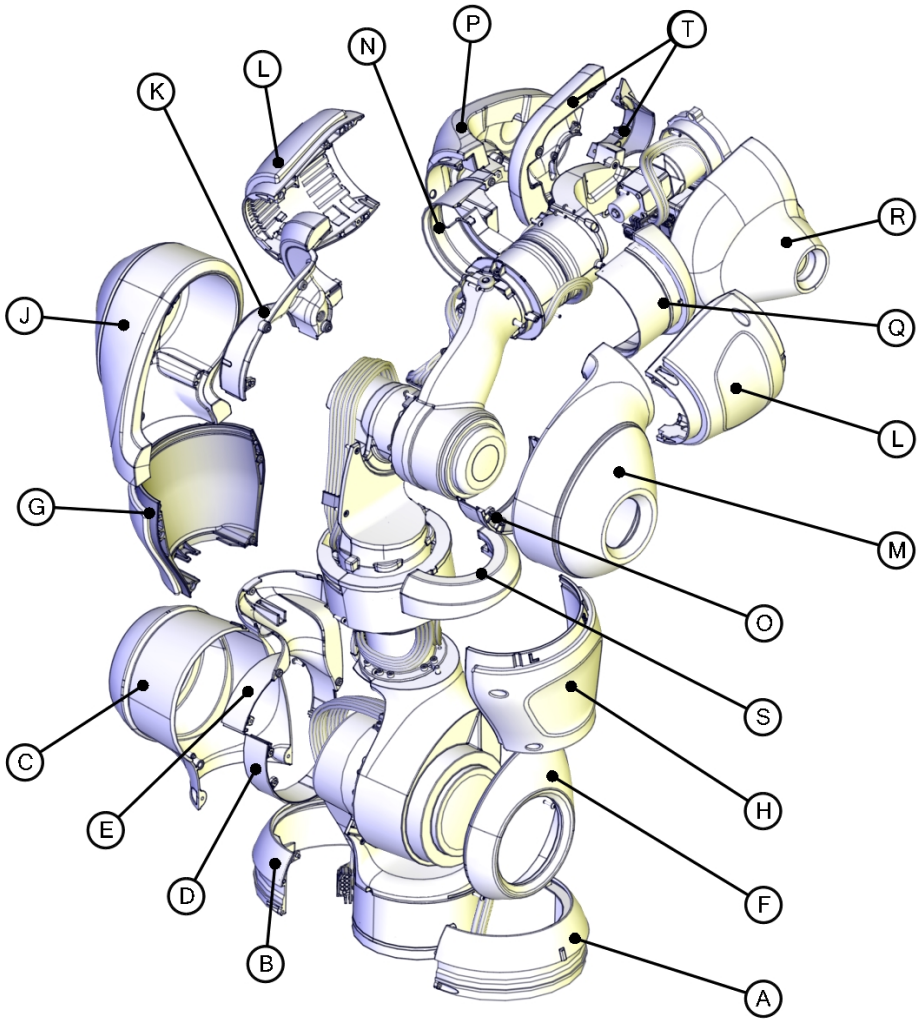
Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.

Consumables

Consumable	Article number	Note
Locking liquid	-	Loctite 454

Replacing the arm covers

Location of arm covers



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Information for replacement

Replace any damaged covers. The table gives input for removal order and shows tightening torques for the cover attachment screws.

	Spare part number	Description	Covers that need to be removed for access	Tightening torque
A	3HAC057718-001 9ADA267-4	Upper axis-1 cover, ESD coated Nut		0.14 Nm
B	3HAC057719-001 9ADA267-4	Upper axis-1 cover, brake, ESD coated Nut		0.14 Nm
C	3HAC050559-001	Lower axis-2 cover, ESD coated		0.14 Nm
D	3HAC057721-001	Axis-2 cable collar, ESD coated	Cover C (3HAC050559-001) Cover E (3HAC057722-001)	0.14 Nm
E	3HAC057722-001	Axis-2 cable cover, ESD coated	Cover C (3HAC050559-001) Cover G (3HAC050529-002) Cover H (3HAC050529-001)	0.14 Nm
F	3HAC050558-001	Axis-2 padding Use locking liquid Loctite 454 when fitting.		-
G	3HAC050529-002	Axis-7 cover, ESD coated		0.14 Nm
H	3HAC050529-001	Axis-7 cover, ESD coated		0.14 Nm
J	3HAC050532-001	Lower axis-3 cover, ESD coated		0.14 Nm
K	3HAC050538-001	Upper axis-3 cover, ESD coated	Cover J (3HAC050532-001) Cover L (3HAC050542-001) Cover M (3HAC050535-001)	0.14 Nm
L	3HAC050542-001	Lower axis-4 cover, ESD coated		0.14 Nm
M	3HAC050535-001	Axis-3 body cover, ESD coated	Cover J (3HAC050532-001) Cover L (3HAC050542-001)	0.14 Nm

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4.3.2 Replacing the encapsulation and covers

Continued

	Spare part number	Description	Covers that need to be removed for access	Tightening torque
N	3HAC049878-001	Axis-4 cable protection	Cover L (3HAC050542-001) Cover P (3HAC050548-001) Cover Q (3HAC050545-001)	0.14 Nm
O	3HAC057727-001	Axis-3 cable collar, ESD coated	Cover J (3HAC050532-001) Cover K (3HAC050538-001) Cover M (3HAC050535-001)	0.14 Nm
P	3HAC050548-001	Upper axis-4 cover, ESD coated	Cover L (3HAC050542-001)	0.14 Nm
Q	3HAC050545-001	Axis-4 body cover, ESD coated	Cover L (3HAC050542-001) Cover N (3HAC049878-001) Cover P (3HAC050548-001)	0.14 Nm
R	3HAC050553-001/3HAC074222-001 [i]	Axis-6 cover, ESD coated		0.2 Nm
S	3HAC050526-001	Axis-7 body padding Use locking liquid Loctite 454 when fitting.		-
T	3HAC041286-001	Cooling flange with padding	Cover P (3HAC050548-001) Cover R () 3HAC050553-001/3HAC074222-001 [ii]	0.2 Nm

i Axis-6 cover 3HAC050553-001 is used with robot no-type-specified while axis-6 cover 3HAC074222-001 is used with robot Type A. See *Robot description on page 423* for robot type.

ii Axis-6 cover 3HAC050553-001 is used with robot no-type-specified while axis-6 cover 3HAC074222-001 is used with robot Type A. See *Robot description on page 423* for robot type.

CAUTION

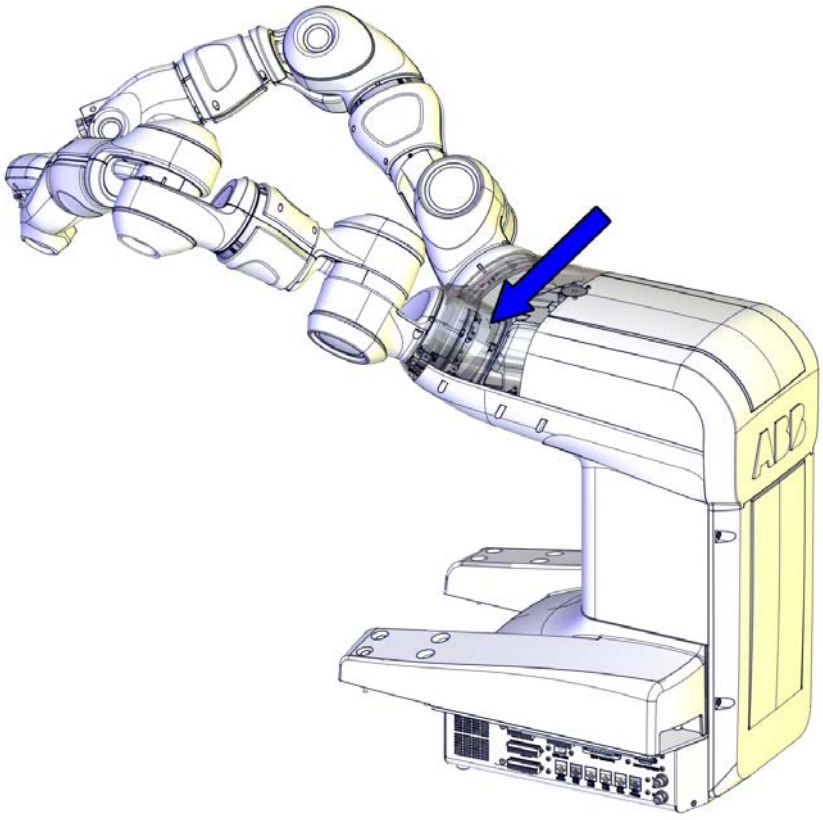
Make sure all safety requirements are met when performing the first test run.
See *Test run after installation, maintenance, or repair on page 116*.

4.4 Motors

4.4.1 Replacing the axis-1 motor

Location of the axis-1 motor

The axis-1 motor is located as shown in the figure.



xx1400002791

Replacing the complete arm

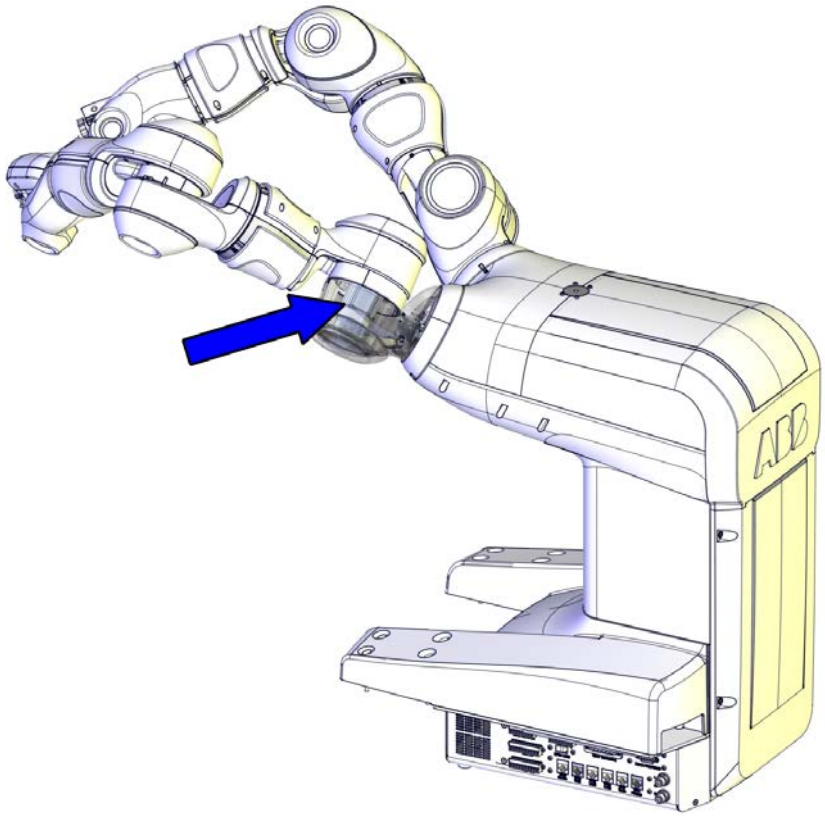
It is recommended to exchange the complete arm in case of a broken axis-1 motor.
See *Replacing the complete arm on page 143*

The axis-1 motor can be replaced by ABB, contact your local ABB for more information.

4.4.2 Replacing the axis-2 motor

Location of the axis-2 motor

The axis-2 motor is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Motor M93	3HAC072394-001	Always use a new o-ring 3HAB3772-137. To be ordered separately.
O-ring	3HAB3772-137	Required to be replaced when removing and refitting the motor.
Hex socket head cap screw	3HAB3409-212	M4x16 12.9 Lafre 2C2B/FC6.9
Hex socket head cap screw	3HAC050368-005	M2x8 8.8
Nut	9ADA267-1	M2 DIN934 8 ELZN

Continues on next page

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.
Removal tool	3HAC054868-001	Used to pull out the motor.
Fixture tool for wave generator M93	3HAC054870-001	

Consumables

Consumable	Article number	Note
Grease	-	Mobil FM222 Used to lubricate o-rings.
Grease		Used to lubricate the wave generator. See *Technical reference manual - Lubrication in gearboxes*
Cleaning agent	-	Isopropanol

Required documents

Document name	Document number	Note
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*	

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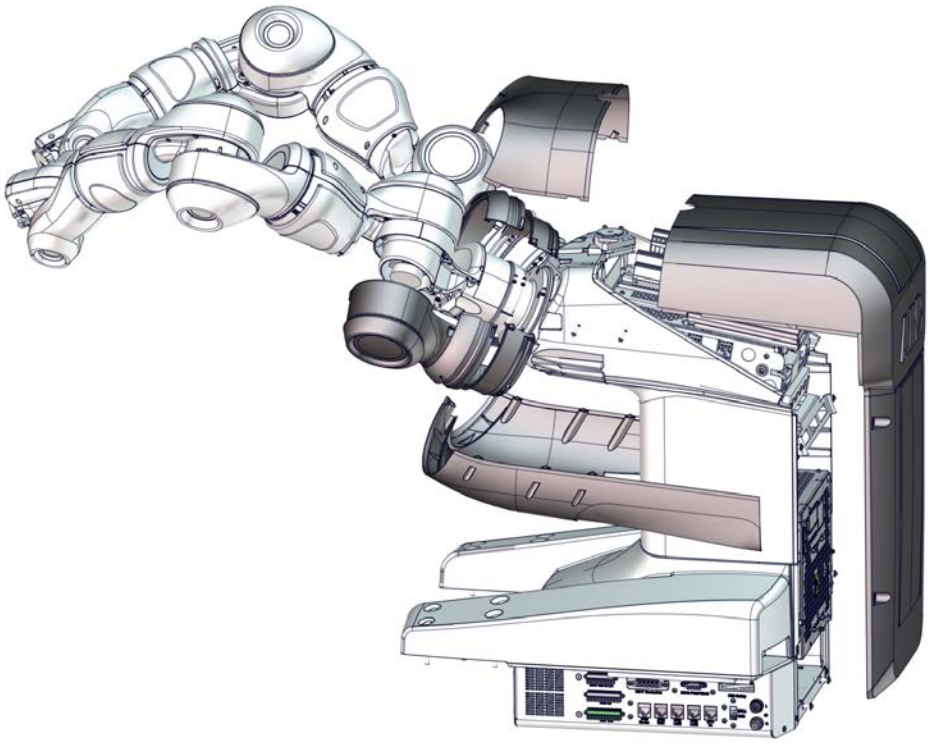
4.4.2 Replacing the axis-2 motor
Continued

Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



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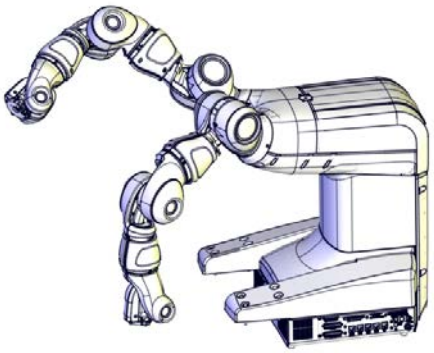
Removing the motor

Use these procedures to remove the axis-2 motor.

Preparations before removing the motor

	Action	Note
1	Jog the robot to the specified position: **Right arm:** • Axis 1: 42° • Axis 2: rotate in positive direction until the axis is secured against the axis-2 mechanical stop. • Axis 7: brake release to position the axis hanging straight down. • Axis 3: brake release to position the axis hanging straight down. • Axis 4: No significance. • Axis 5: No significance. • Axis 6: No significance. **Left arm:** • Axis 1: 120° • Axis 2: rotate in positive direction until the axis is secured against the axis-2 mechanical stop. • Axis 7: brake release to position the axis hanging straight down. • Axis 3: brake release to position the axis hanging straight down. • Axis 4: No significance. • Axis 5: No significance. • Axis 6: No significance.	Figure shows position of left arm:  xx1500000585
2	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	

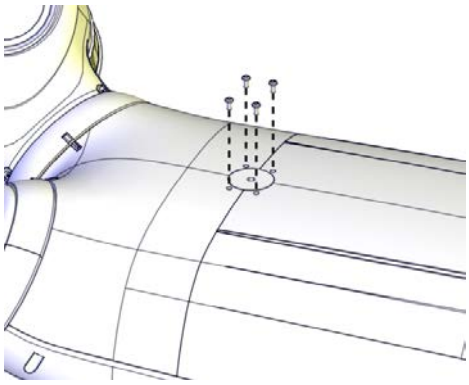
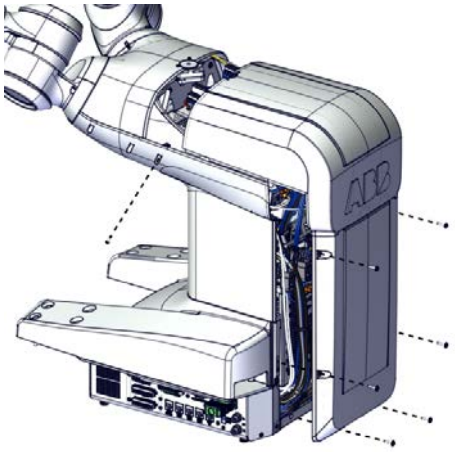
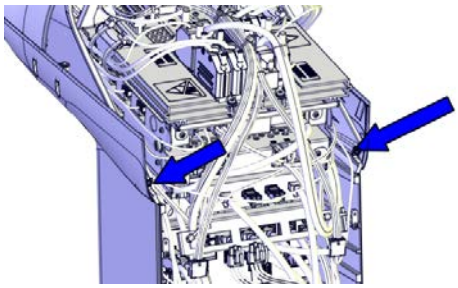
Removing the body covers

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	

Continues on next page

4.4.2 Replacing the axis-2 motor

Continued

	Action	Note
2	Remove the body cover top screws.	 xx1400002904
3	Remove the body cover.	 xx1500000303
4	Remove the back screws of the lower body cover.	 xx1500000540

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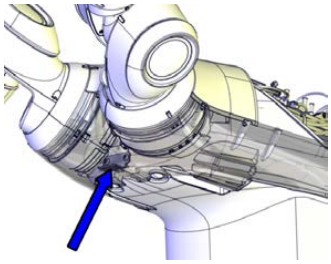
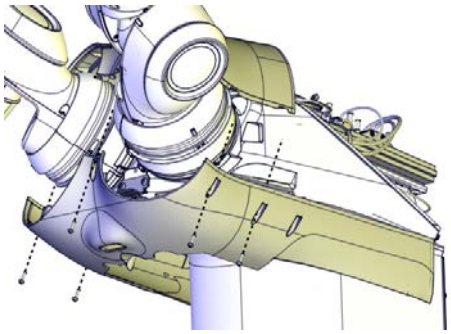
	Action	Note
5	Remove the front and lower body cover. **Note** Be aware of the tab underneath the cover so it does not get damaged.  xx1500000564	 xx1400002603

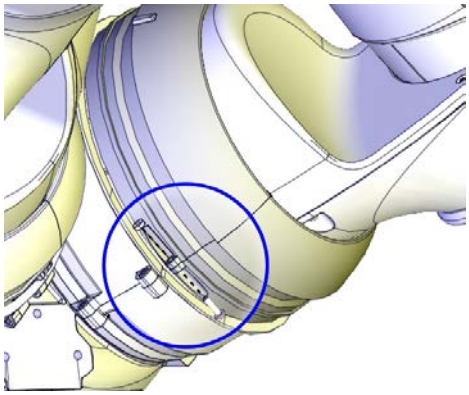
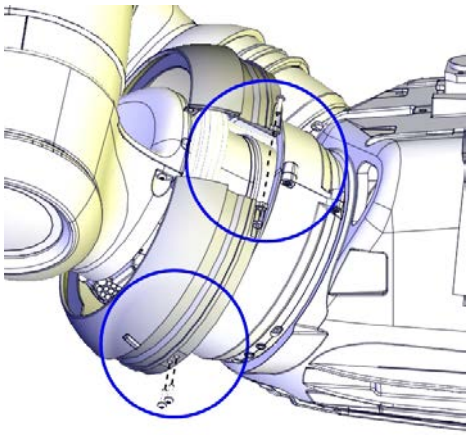
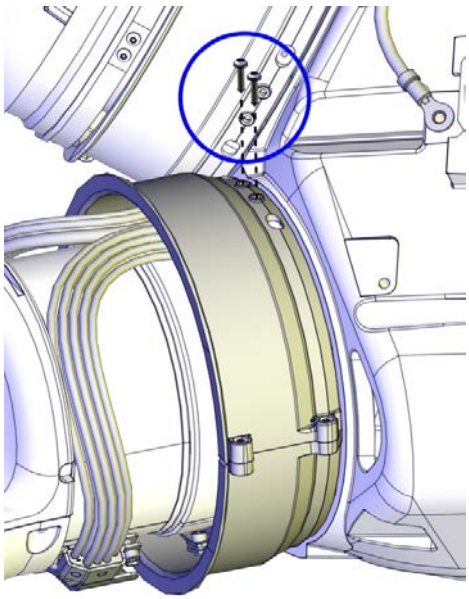
Removing the axis-1 covers

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	

Continues on next page

4.4.2 Replacing the axis-2 motor

Continued

	Action	Note
2	Remove the upper axis-1 cover. **Note** Be aware of the tab underneath the cover so it does not get damaged.	Screws:M2x8 8.8 (2 pcs).  xx1400002601  xx1400002605
3	Remove the upper screws of the lower axis-1 cover.	 xx1500000565

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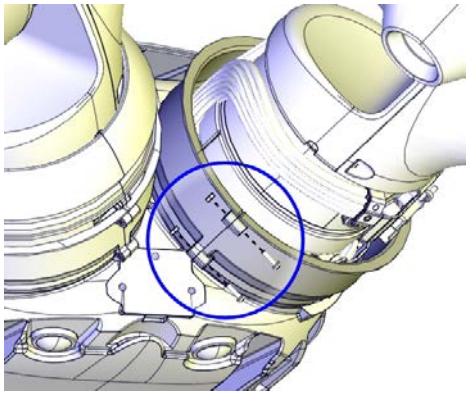
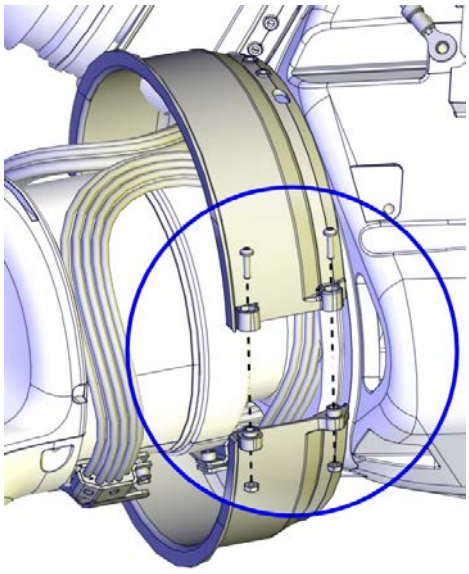
	Action	Note
4	Turn the lower axis-1 cover in order to access all screws properly and remove the lower axis-1 cover.	Screws:M2x8 8.8 (4 pcs).  xx1400002604  xx1400002606

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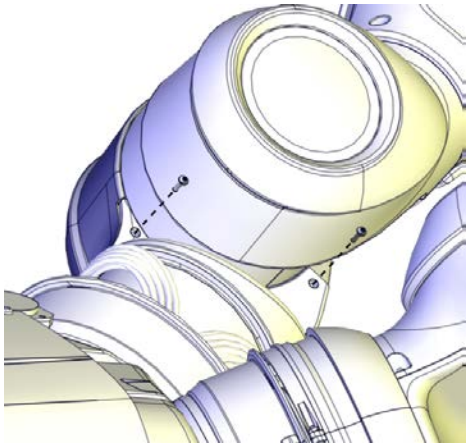
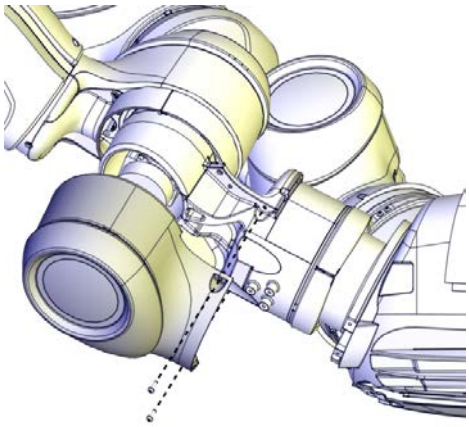
4.4.2 Replacing the axis-2 motor

Continued

Removing the axis-2 covers

	Action	Note
1	Remove the lower axis-2 cover.	 xx1400002612  xx1500000087

Removing the axis-2 motor

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
2	Disconnect the motor connectors. • R1.MP2R / R1.MP2L • R1.FB2R / R1.FB2L	
3	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	

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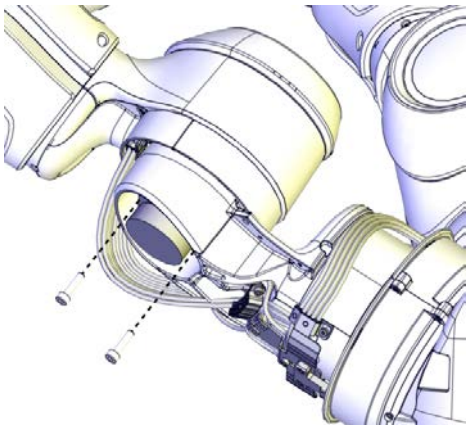
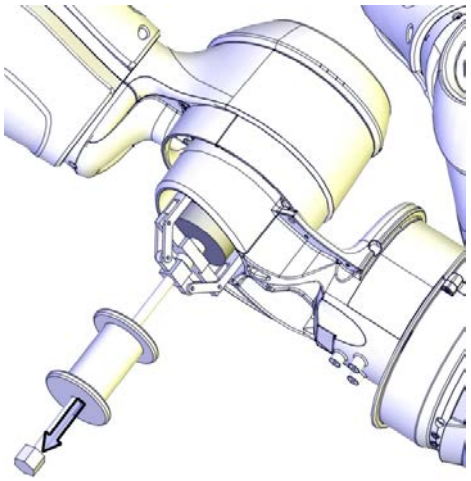
	Action	Note
4	**CAUTION** The gravity will cause the arm to suddenly fall down when the motor is removed, if the axis is not secured. Make sure the axis is secured against the mechanical stop prior to removing the motor.	
5	Move the cabling in order to access the motor screws. Loosen the cable bracket, if needed. Remove the screws.	 xx1500000516
6	Remove the motor by using the removal tool accordingly: 1 Attach the grip arms of the removal tool to the notches on the motor sides. 2 Gently knock the block backwards to the end stop of the pin to carefully knock the motor loose. 3 Pull out the motor. **CAUTION** Lifting the motor out creates a hole into the gear, make sure no dirt falls into the hole.	Removal tool: 3HAC054868-001  xx1500000522

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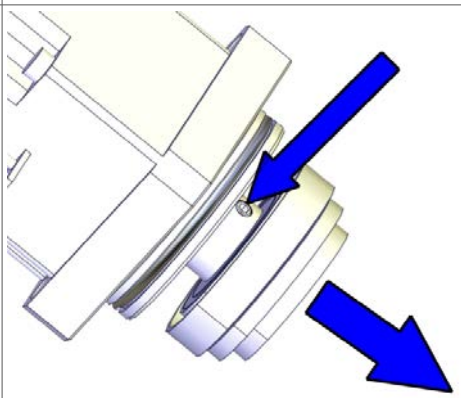
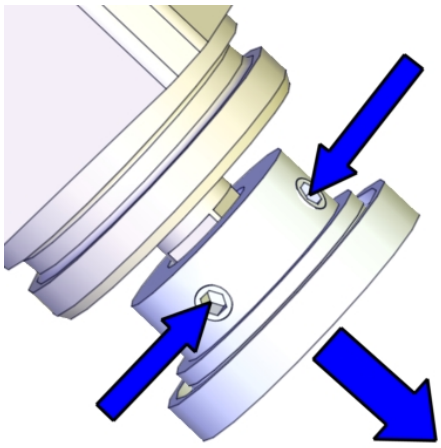
4.4.2 Replacing the axis-2 motor

Continued

Removing the wave generator from the motor

	Action	Note
1	Remove the wave generator from the motor shaft by removing the set screw(s) and then pulling it off the shaft.	
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000515
	Axis 6.	 xx1500001651
2	Place the wave generator on a clean work-bench, if not instantly fitting it to a new motor. **CAUTION** Keep the wave generator clean.	

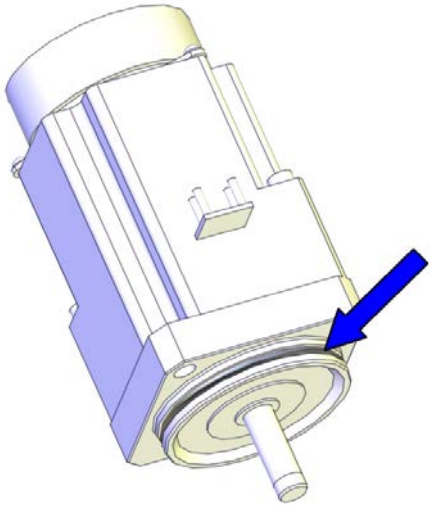
Refitting the motor

Use these procedures to refit the axis-2 motor.

Fitting a new o-ring on the motor

	Action	Note
1	Wipe the o-ring groove of the motor clean.	Motor M93: 3HAC072394-001.

Continues on next page

	Action	Note
2	Fit a new o-ring in the groove. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	O-ring: 3HAB3772-137 Grease: Mobil FM222.  xx1400002611

Fitting the wave generator to the motor

	Action	Note
1	Wipe the contact surfaces of the motor and wave generator clean from any contamination with cleaning agent applied on a cloth or paper.	

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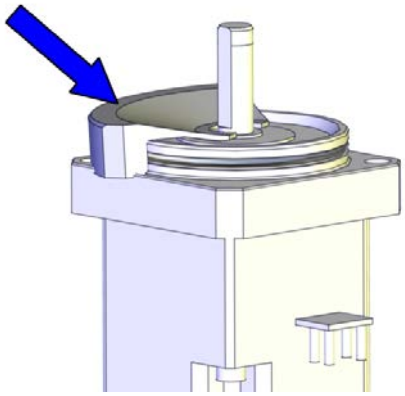
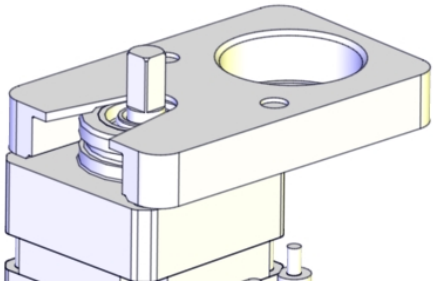
4.4.2 Replacing the axis-2 motor

Continued

	Action	Note
2	Place the fixture tool on the new motor.	
	Axis 1 and axis 2: Fixture tool for wave generator M93, 3HAC054870-001. Axis 7 and axis 3: Fixture tool for wave generator M92, 3HAC054871-001.	 xx1500000527
	Axis 6: Fixture tool for wave generator M91, 3HAC054904-001.	 xx1500001646

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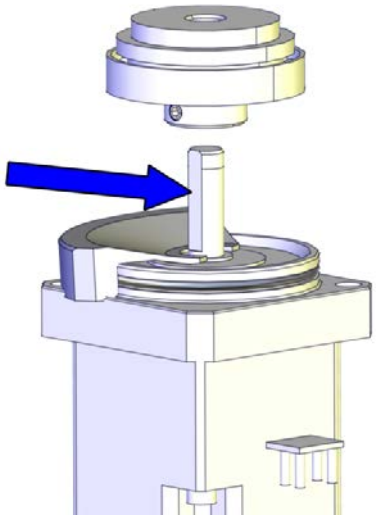
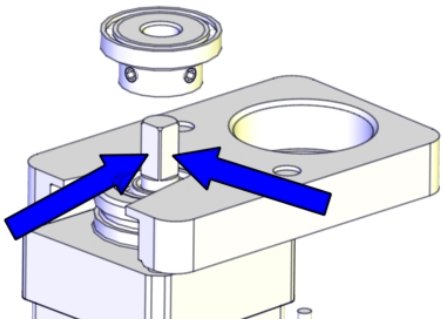
	Action	Note
3	Fit the wave generator to the motor shaft, place it against the distance fixture and secure lightly with the set screw(s). Orient the wave generator so that the set screw will be positioned towards the flat surface on the output axis of the motor. The flat surface is pointed out in the figure.	
	Axis 1, axis 2, axis 3 and axis 7.	 xx1500000528
	Axis 6.	 xx1500001647

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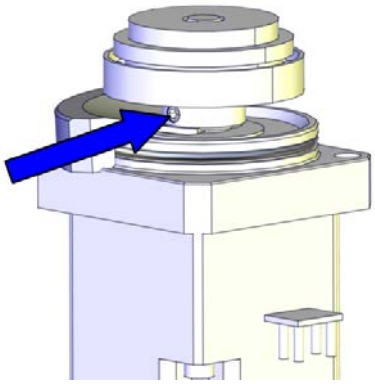
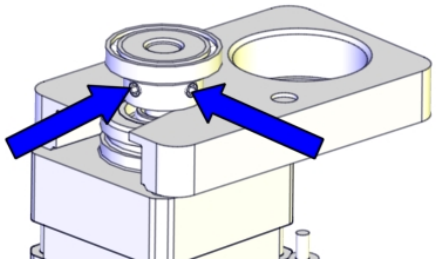
4.4.2 Replacing the axis-2 motor

Continued

	Action	Note
4	Tighten the set screw.	
	Axis 1, axis 2, axis 3 and axis 7.	Screw: M3-set screw (1 pcs). Tightening torque: 0.6 Nm.  xx1500000518
	Axis 6.	Screw: M2-set screw (2 pcs). Tightening torque: 0.2 Nm.  xx1500001648
5	Remove the fixture.	

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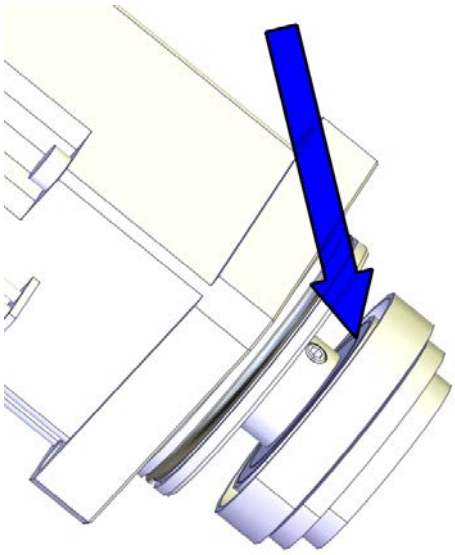
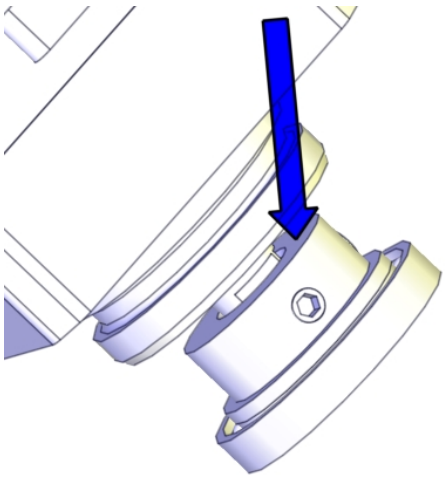
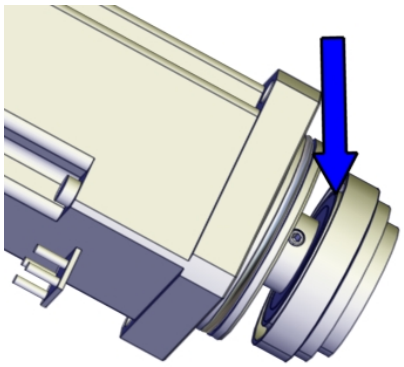
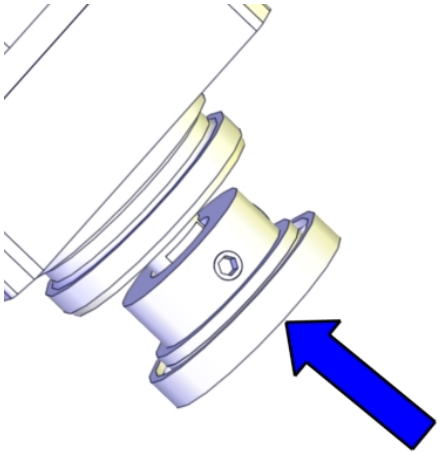
	Action	Note
6	Lubricate the wave generator with grease.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000557
	Axis 6.	 xx1500001649

Continues on next page

4.4.2 Replacing the axis-2 motor

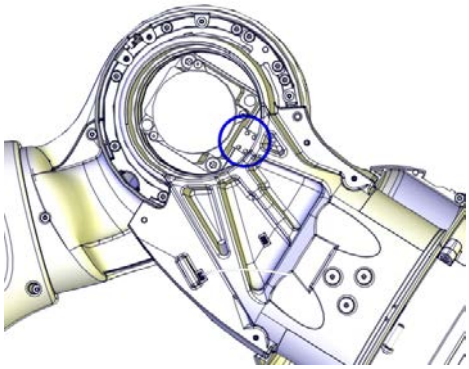
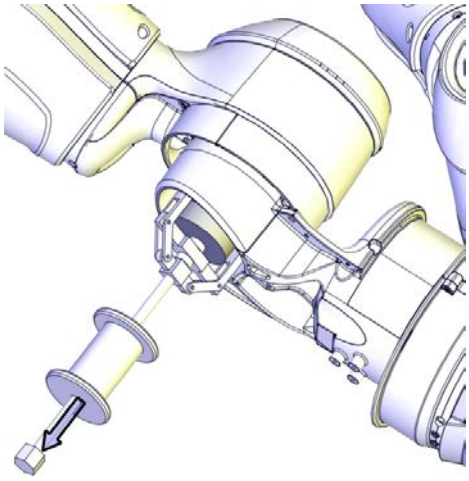
Continued

	Action	Note
7	Spread the grease on the end plane of the bearing to make sure the balls in the bearing are lubricated as well.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000556
	Axis 6.	 xx1500001650

Refitting the axis-2 motor

	Action	Note
1	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	

Continues on next page

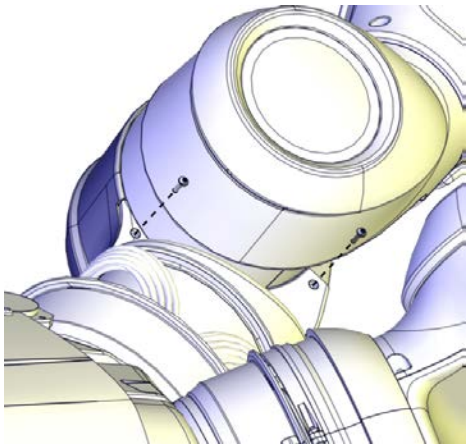
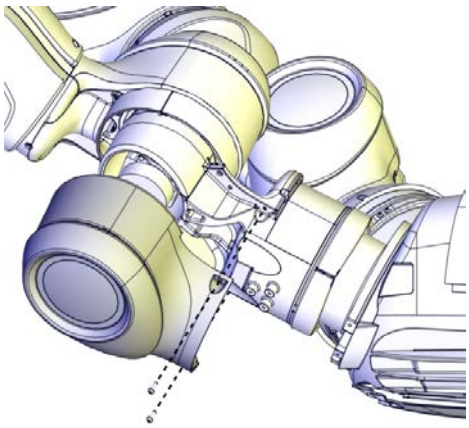
	Action	Note
2	Orient the motor correctly and fit it into the arm. Secure with the screws. **CAUTION** The motor must be inserted gently. If the gears do not mate, rotate the axis carefully back and forth until the gears are mated.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1500000566 Screws: 3HAB3409-212  xx1500000522 Tightening torque: cross-tighten all screws to 1 Nm first, then final cross-tighten to 2.5 Nm.
3	Connect the motor connectors: • R1.MP2R / R1.MP2L • R1.FB2R / R1.FB2L	

Continues on next page

4.4.2 Replacing the axis-2 motor

Continued

Refitting the axis-2 covers

	Action	Note
1	Refit the lower axis-2 cover.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1400002612  xx1500000087

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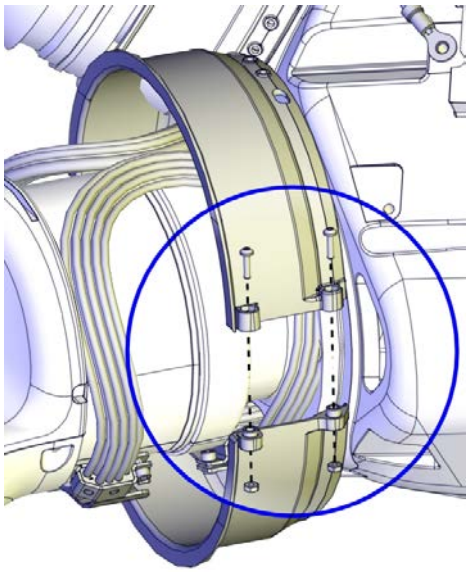
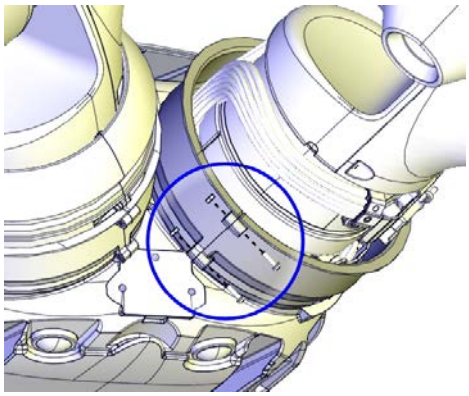
Refitting the axis-1 covers

	Action	Note
1	Refit the lower axis-1 cover.	Screws: 3HAC050368-005 (4 pcs). Nuts: 9ADA267-1 (4 pcs). Tightening torque: 0.14 Nm.  xx1400002606  xx1400002604

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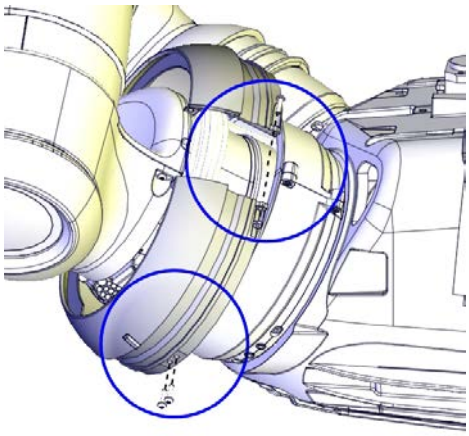
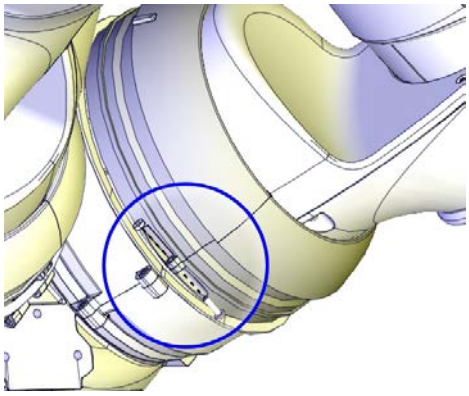
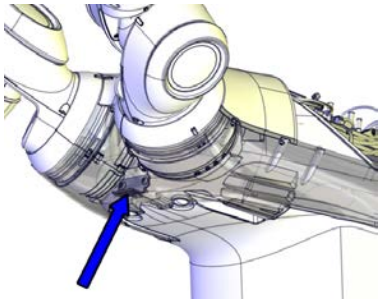
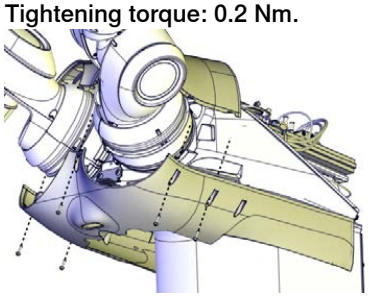
4.4.2 Replacing the axis-2 motor

Continued

	Action	Note
2	Refit the upper axis-1 cover.	Screws: 3HAC050368-005 (2 pcs). Nuts: 9ADA267-1 (2 pcs). Tightening torque: 0.14 Nm.  xx1400002605  xx1400002601

Refitting the body covers

	Action	Note
1	Refit the front and lower body cover. **Note** Be aware of the tab underneath the cover so it does not get damaged.  xx1500000564	Screws: 3HAC050368-005 (5 pcs). Tightening torque: 0.2 Nm.  xx1400002603

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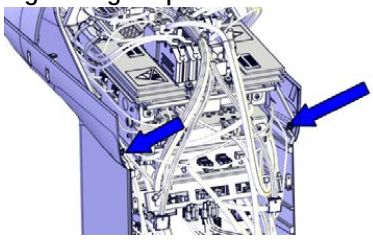
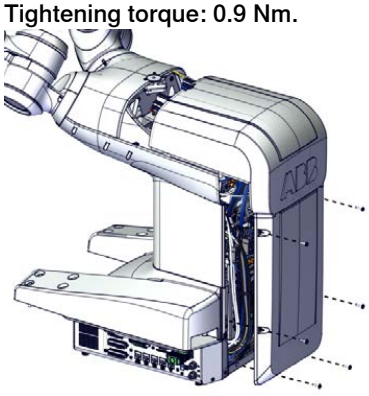
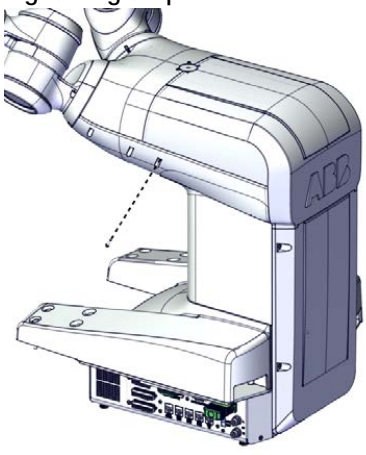
	Action	Note
2	Refit the back screws of the lower body cover.	Screws: 3HAC050367-005 (2 pcs). Tightening torque: 0.2 Nm.  xx1500000540
3	Refit the body cover.	Screws: 3HAC050367-005 (6 pcs). Tightening torque: 0.9 Nm.  xx1500000697
4	Refit the two remaining screws of the body cover.	Screws: 3HAC050367-005 (2 pcs). Tightening torque: 0.2 Nm.  xx1500000696

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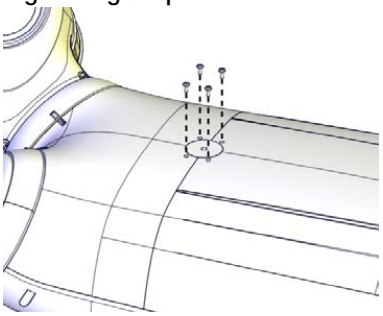
4.4.2 Replacing the axis-2 motor

Continued

	Action	Note
5	Refit the body cover top screws.	Screws: M3x6 (4 pcs). Tightening torque: 0.2 Nm.  xx1400002904

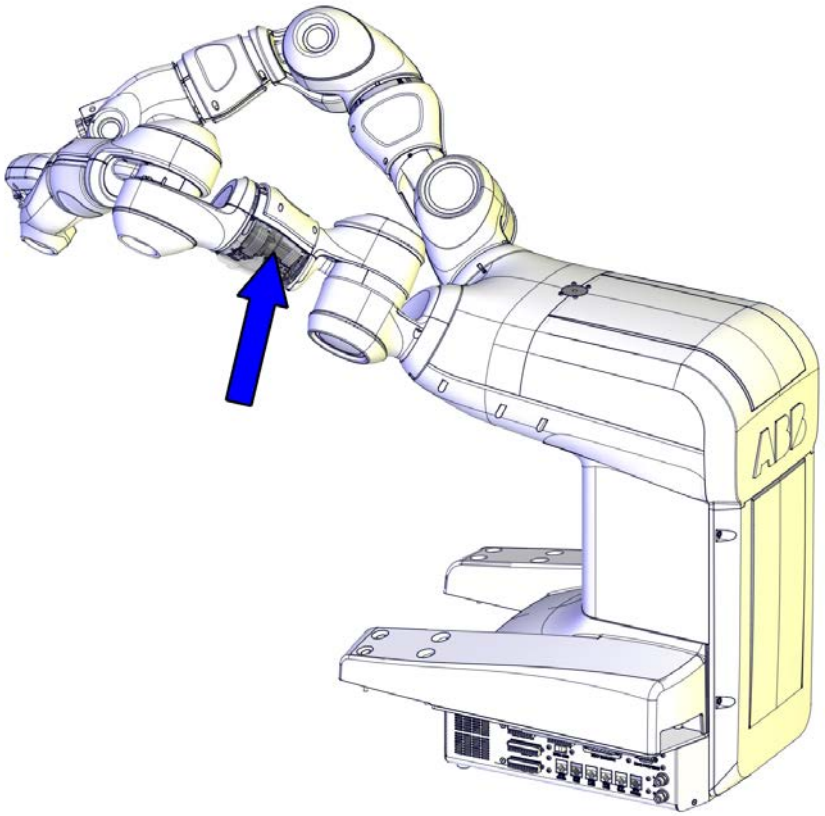
Concluding procedure

	Action	Note
1	Re-calibrate the robot.	See *Calibration on page 397*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.4.3 Replacing the axis-7 motor

Location of the axis-7 motor

The axis-7 motor is located as shown in the figure.



xx1400002793

Replacing the complete arm

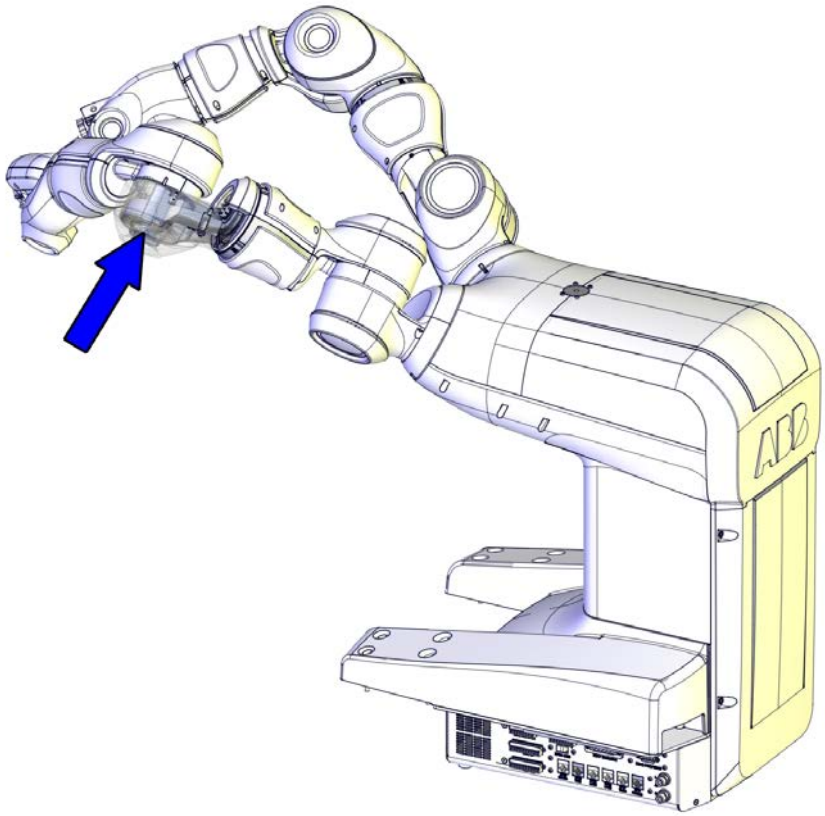
It is recommended to exchange the complete arm in case of a broken axis-7 motor.
See *Replacing the complete arm on page 143*

The axis-7 motor can be replaced by ABB, contact your local ABB for more information.

4.4.4 Replacing the axis-3 motor

Location of the axis-3 motor

The axis-3 motor is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Motor M92	3HAC036900-001	Always use a new o-ring 3HAB3772-136. To be ordered separately.
O-ring	3HAB3772-136	Required to be replaced when removing and refitting the motor.
Hex socket head cap screw	3HAB3409-212	M4x16 12.9 Lafre 2C2B/FC6.9
Hex socket head cap screw	3HAC050368-005	M2x8 8.8

Continues on next page

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.
Removal tool	3HAC054869-001	Used to pull out the motor.
Fixture tool for wave generator M92	3HAC054871-001	

Consumables

Consumable	Article number	Note
Grease	-	Mobil FM222 Used to lubricate o-rings.
Grease		Used to lubricate the wave generator. See *Technical reference manual - Lubrication in gearboxes*
Cleaning agent	-	Isopropanol

Required documents

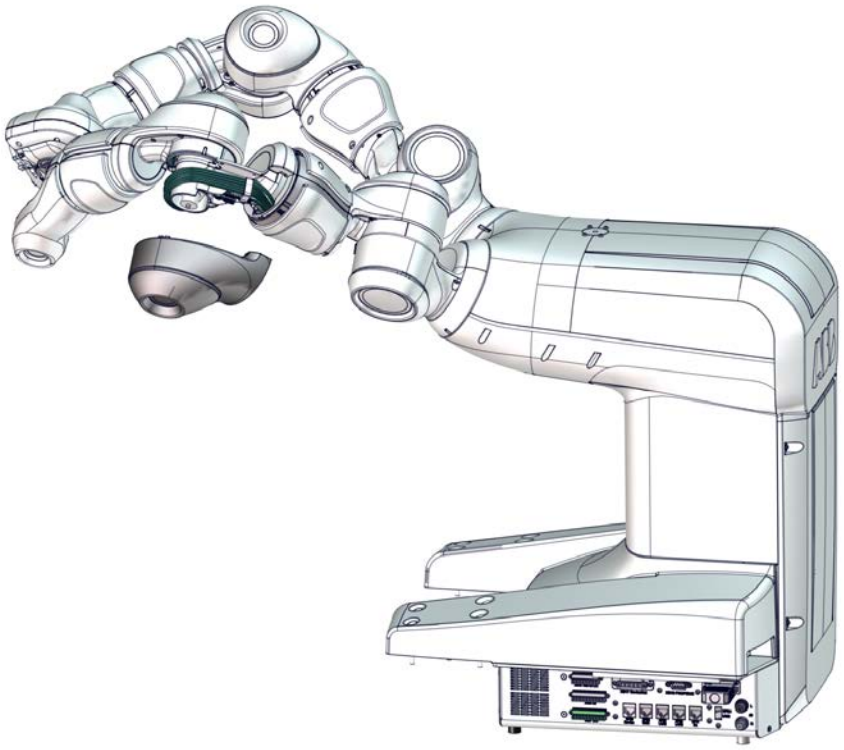
Document name	Document number	Note
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*	

Continues on next page

4.4.4 Replacing the axis-3 motor
Continued

Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



xx1400002862

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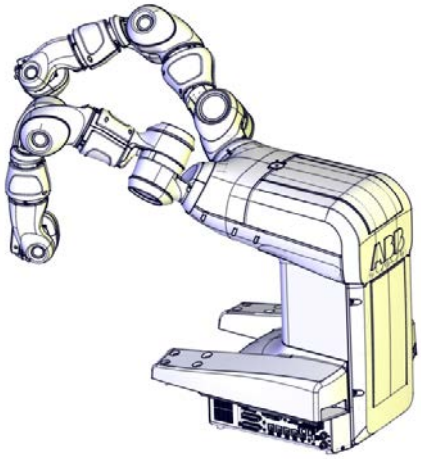
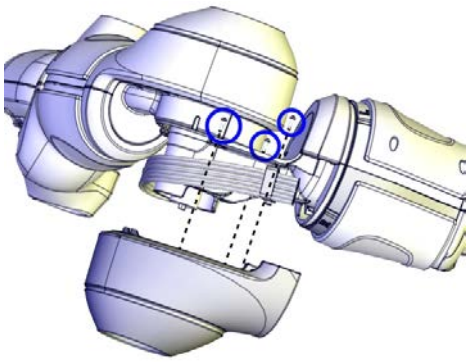
Removing the motor

Use these procedures to remove the axis-3 motor.

Preparations before removing the motor

	Action	Note
1	Jog the robot to the specified position: • Axis 1, axis 7 and axis 2: brake release and rotate so that axis-3 motor shaft is vertical. • Axis 3: rotate in positive direction until the axis is secured against the axis-3 mechanical stop. • Axis 4: No significance. • Axis 5: No significance. • Axis 6: No significance.	The figure shows the specified position on the left arm:  xx1500000586
2	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
3	Remove the lower axis-3 cover.	 xx1400002751

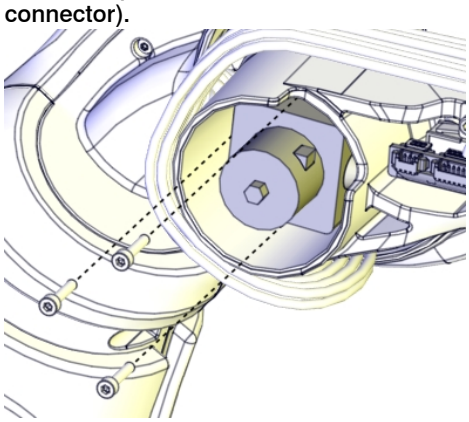
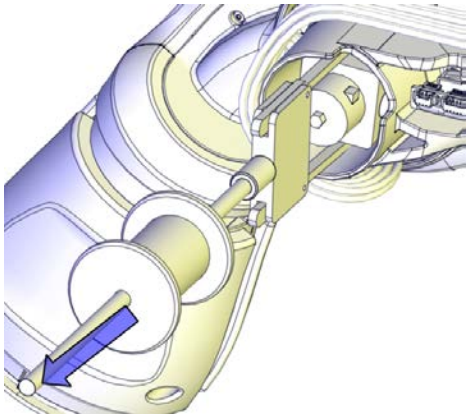
Removing the axis-3 motor

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

Continues on next page

4.4.4 Replacing the axis-3 motor

Continued

	Action	Note
2	Disconnect the motor connectors. • R1.MP3R / R1.MP3L • R1.FB3R / R1.FB3L	
3	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
4	**CAUTION** The gravity will cause the arm to suddenly fall down when the motor is removed, if the axis is not secured. Make sure the axis is secured against the mechanical stop prior to removing the motor.	
5	Remove the screws.	Screws: 3 pcs (no screw underneath the connector).  xx1500000519
6	Remove the motor by using the removal tool accordingly: 1 Attach the grip arms of the removal tool to the notches on the motor sides. 2 Gently knock the block backwards to the end stop of the pin to carefully knock the motor loose. 3 Pull out the motor.	Removal tool: 3HAC054869-001  xx1500000523

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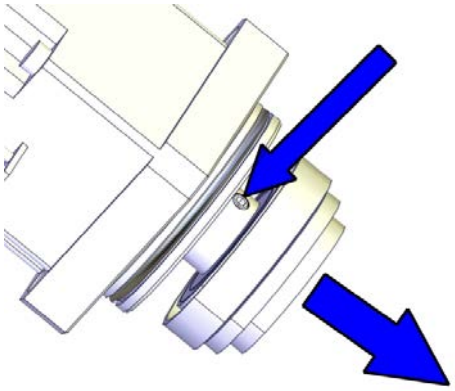
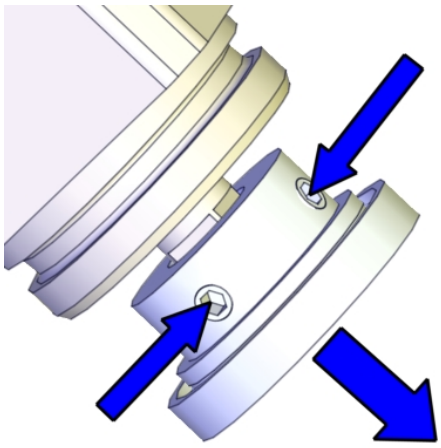
Removing the wave generator from the motor

	Action	Note
1	Remove the wave generator from the motor shaft by removing the set screw(s) and then pulling it off the shaft.	
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000515
	Axis 6.	 xx1500001651
2	Place the wave generator on a clean work-bench, if not instantly fitting it to a new motor. **CAUTION** Keep the wave generator clean.	

Refitting the motor

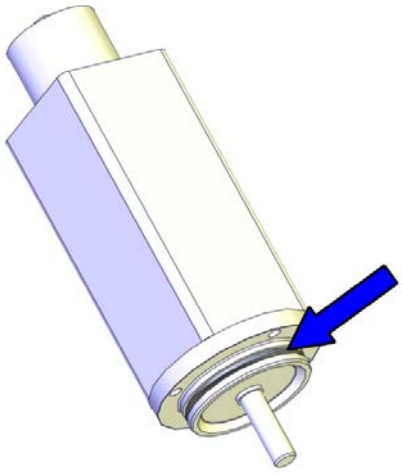
Use these procedures to refit the axis-3 motor.

Fitting a new o-ring on the motor

	Action	Note
1	Wipe the o-ring groove of the motor clean.	Motor M92: 3HAC036900-001.

Continues on next page

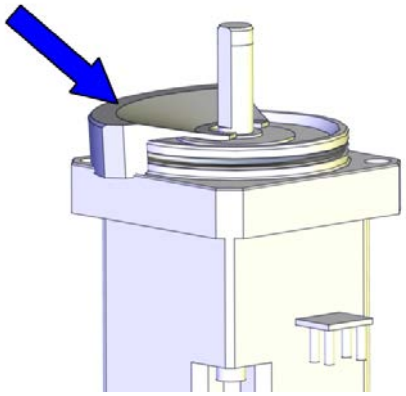
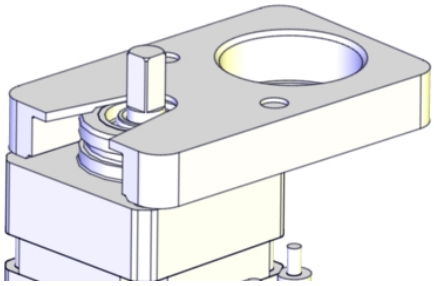
4.4.4 Replacing the axis-3 motor
Continued

	Action	Note
2	Fit a new o-ring in the groove. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	O-ring: 3HAB3772-136 Grease: Mobil FM222.  xx1400002700

Fitting the wave generator to the motor

	Action	Note
1	Wipe the contact surfaces of the motor and wave generator clean from any contamination with cleaning agent applied on a cloth or paper.	

Continues on next page

	Action	Note
2	Place the fixture tool on the new motor.	
	Axis 1 and axis 2: Fixture tool for wave generator M93, 3HAC054870-001. Axis 7 and axis 3: Fixture tool for wave generator M92, 3HAC054871-001.	 xx1500000527
	Axis 6: Fixture tool for wave generator M91, 3HAC054904-001.	 xx1500001646

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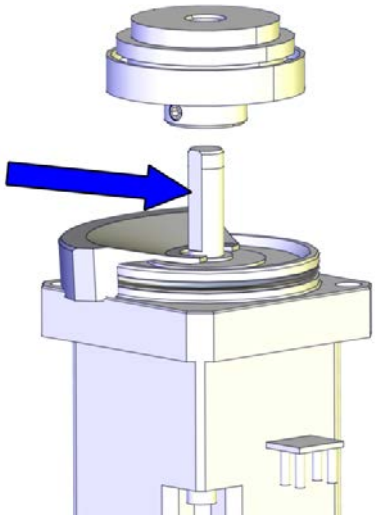
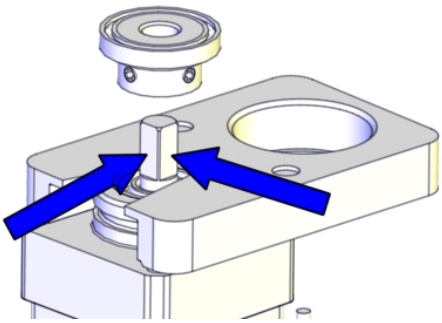
4.4.4 Replacing the axis-3 motor

Continued

	Action	Note
3	Fit the wave generator to the motor shaft, place it against the distance fixture and secure lightly with the set screw(s). Orient the wave generator so that the set screw will be positioned towards the flat surface on the output axis of the motor. The flat surface is pointed out in the figure.	
	Axis 1, axis 2, axis 3 and axis 7.	 xx1500000528
	Axis 6.	 xx1500001647

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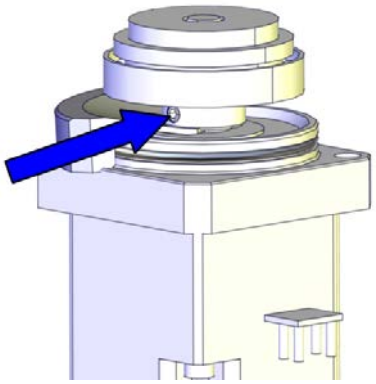
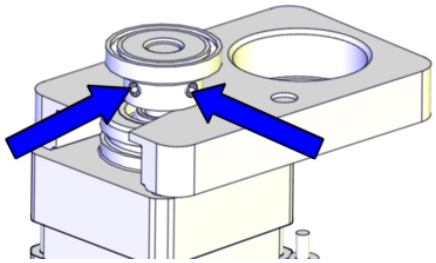
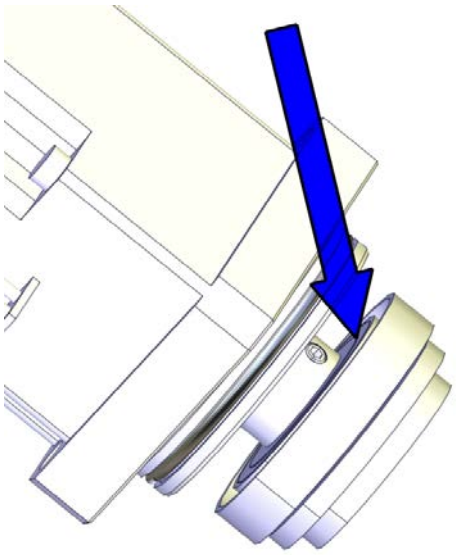
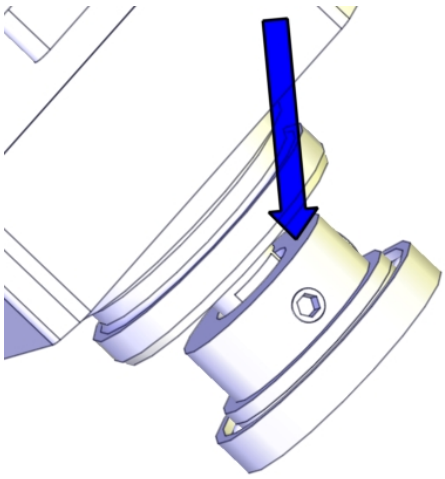
	Action	Note
4	Tighten the set screw.	
	Axis 1, axis 2, axis 3 and axis 7.	Screw: M3-set screw (1 pcs). Tightening torque: 0.6 Nm.  xx1500000518
	Axis 6.	Screw: M2-set screw (2 pcs). Tightening torque: 0.2 Nm.  xx1500001648
5	Remove the fixture.	

Continues on next page

4.4.4 Replacing the axis-3 motor
Continued

	Action	Note
6	Lubricate the wave generator with grease.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000557
	Axis 6.	 xx1500001649

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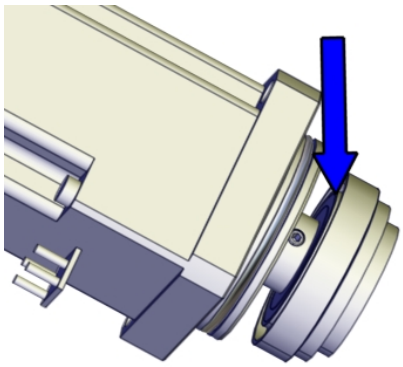
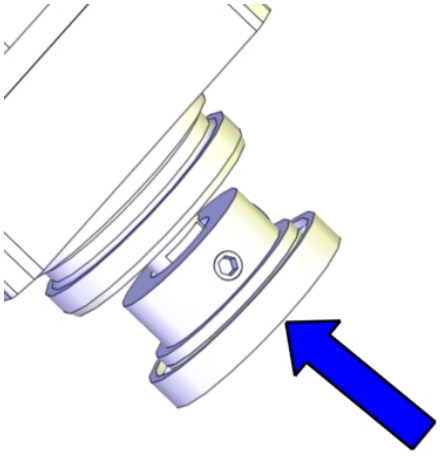
	Action	Note
7	Spread the grease on the end plane of the bearing to make sure the balls in the bearing are lubricated as well.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000556
	Axis 6.	 xx1500001650

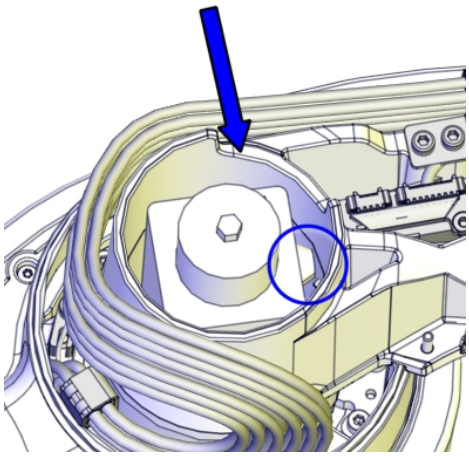
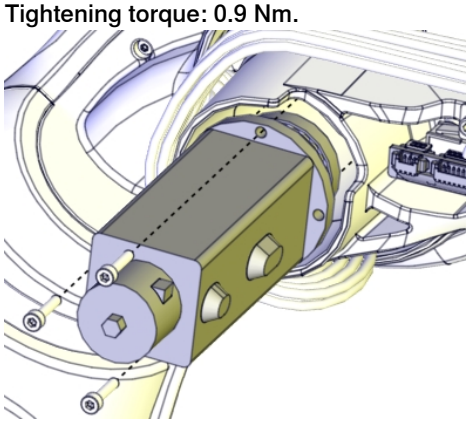
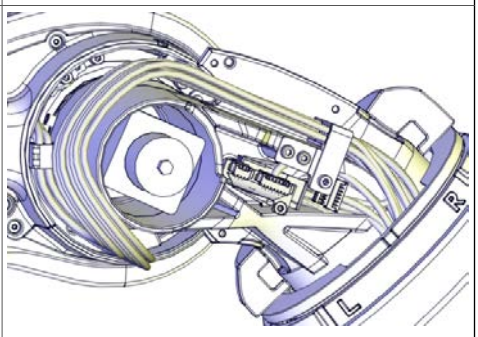
Refitting the axis-3 motor

	Action	Note
1	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	

Continues on next page

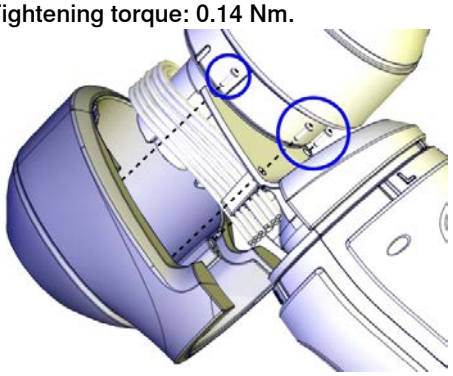
4.4.4 Replacing the axis-3 motor

Continued

	Action	Note
2	Orient the motor correctly and fit it into the arm. Secure with the screws. **CAUTION** The motor must be inserted gently. If the gears do not mate, rotate the axis carefully back and forth until the gears are mated.	Motor orientation: orient the motor so that the motor connector faces the big notch at the arm mounting flange.  xx1500000567 Screws: 3HAB3409-212 (3 pcs) (no screw underneath the connector). Tightening torque: 0.9 Nm.  xx1400002752
3	Connect the motor connectors: • R1.MP3R / R1.MP3L • R1.FB3R / R1.FB3L	
4	Route and secure the cabling according to the figure. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	 xx1500000573

Continues on next page

Refitting the covers

	Action	Note
1	Refit the lower axis-3 cover. **CAUTION** Be careful not to squeeze any cabling during the refitting procedure.	Lower axis-3 cover, ESD coated: 3HAC050532-001 Screws: 3HAC050368-005 (3 pcs). Tightening torque: 0.14 Nm.  xx1400002753

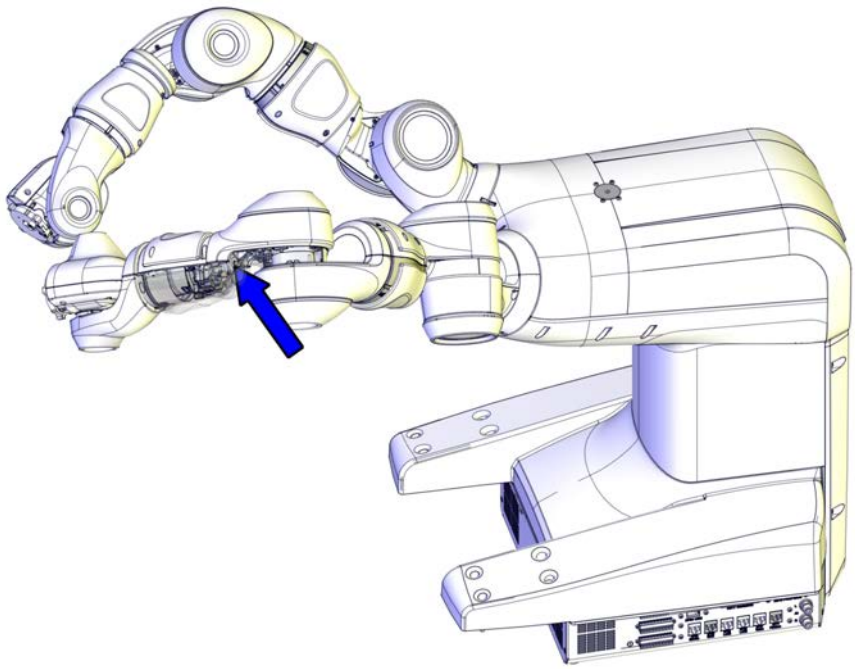
Concluding procedure

	Action	Note
1	Re-calibrate the robot.	See *Calibration on page 397*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.4.5 Replacing the axis-4 motor

Location of the axis-4 motor

The axis-4 motor is located as shown in the figure.



xx1400002795

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Motor M91	3HAC036950-001	Always use a new o-ring 3HAB3772-138. To be ordered separately.
O-ring	3HAB3772-138	Required to be replaced when removing and refitting the motor.
Flange	3HAC072381-001	
O-ring on flange	3HAB3772-119	Replace if damaged.
Hex socket head cap screw	3HAC050368-005	M2x8 8.8
Torx pan head screw	3HAC050367-039	M2x30 8.8 Gleitmo 605
Small head screw	3HAC072396-001	M2x16 12.9
Washer	3HAC073135-001	2.2x4.5x0.3

Continues on next page

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.
Fixture tool for wave generator M91	3HAC054904-001	Used for axes 4 and 5 of IRB 14000 no-type-specified and axis 6 of both robot types. See *Robot description on page 423* for robot type.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.
Fixture tool for wave generator M91 (IRB 14000 Type A)	3HAC074531-001	Used for axes 4 and 5 of IRB 14000 Type A. See *Robot description on page 423* for robot type.

Consumables

Consumable	Article number	Note
Grease	-	Mobil FM222 Used to lubricate o-rings.
Grease		Used to lubricate the wave generator. See *Technical reference manual - Lubrication in gearboxes*
Cleaning agent	-	Isopropanol

Required documents

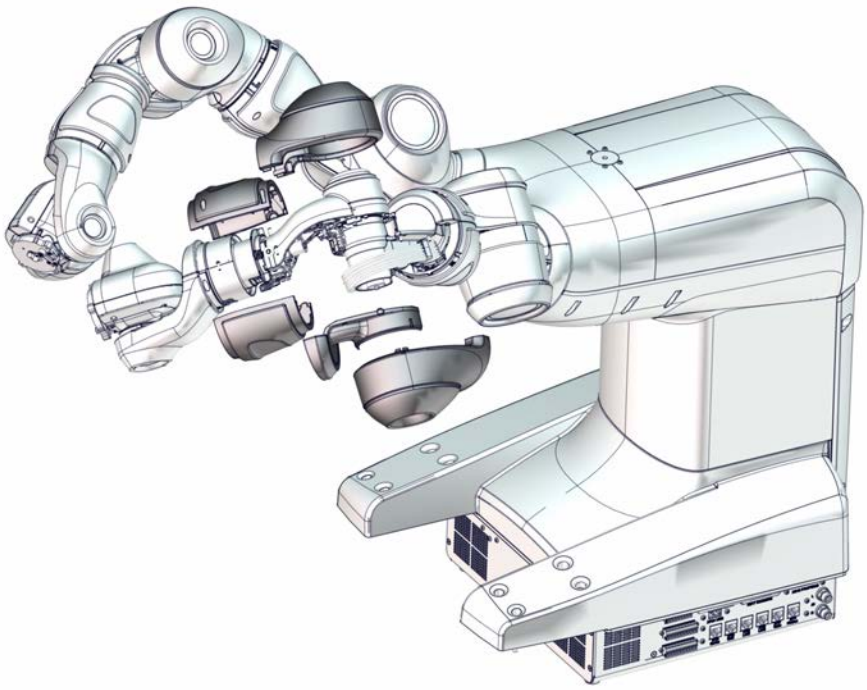
Document name	Document number	Note
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*	

Continues on next page

4.4.5 Replacing the axis-4 motor
Continued

Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



xx1400002863

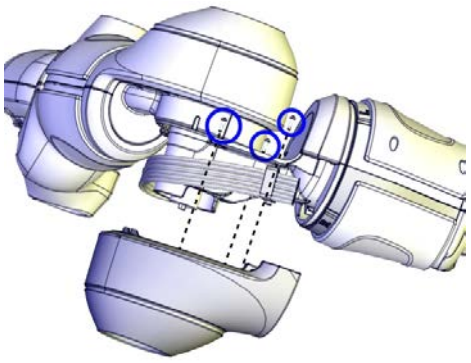
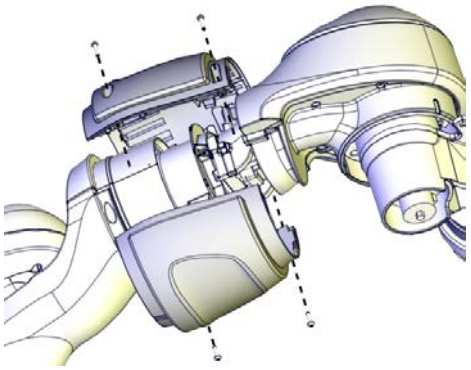
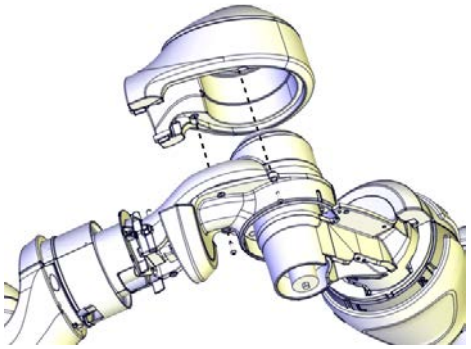
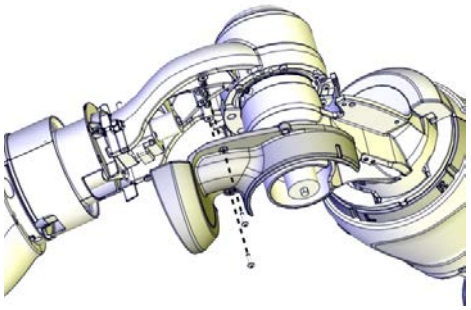
Removing the motor

Use these procedures to remove the axis-4 motor.

Preparations before removing the motor

	Action	Note
1	Jog the robot so that the axis-3 and axis-4 covers can be easily accessed and removed.	
2	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

Continues on next page

	Action	Note
3	Remove the lower axis-3 cover.	 xx1400002751
4	Remove the lower axis-4 cover.	 xx1400002756
5	Remove the axis-3 body cover.	 xx1400002754
6	Remove the upper axis-3 cover.	 xx1400002755

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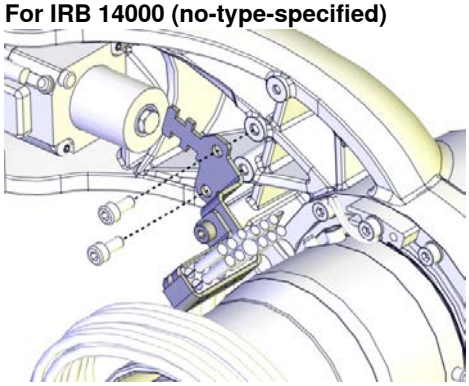
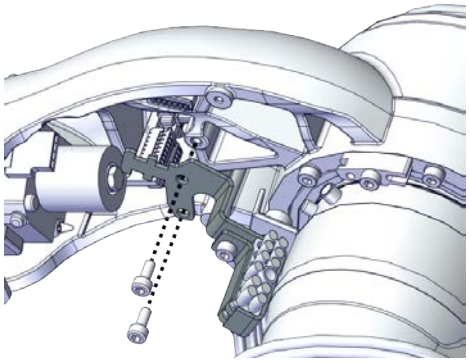
4.4.5 Replacing the axis-4 motor

Continued

Removing the axis-4 motor

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
2	Remove the upper axis-3 cable bracket.	**For IRB 14000 (no-type-specified)**  xx1400002757 **For IRB 14000 Type A**  xx1900002068
3	Disconnect the motor connectors. • R1.MP4R / R1.MP4L • R1.FB4R / R1.FB4L	
4	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	

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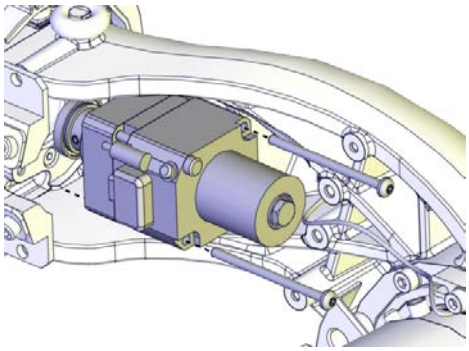
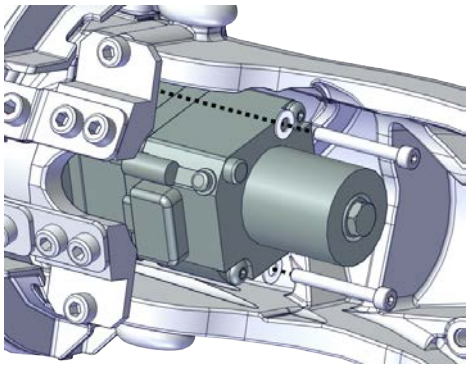
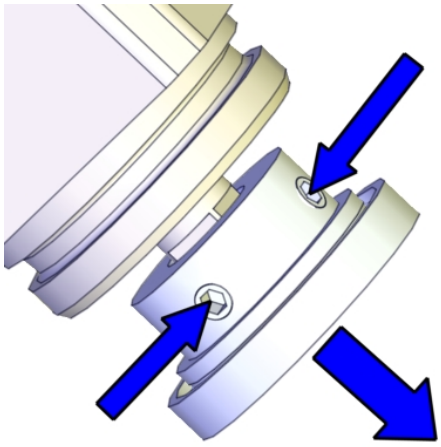
	Action	Note
5	**For IRB 14000 (no-type-specified)** Remove the screws and lift the motor out carefully.	 xx1400002758
6	**For IRB 14000 Type A** Remove the flange screws and washers, and lift the motor together with the flange and wave generator out carefully.	 xx1900002069

Removing the wave generator from the motor (IRB 14000 no-type-specified)

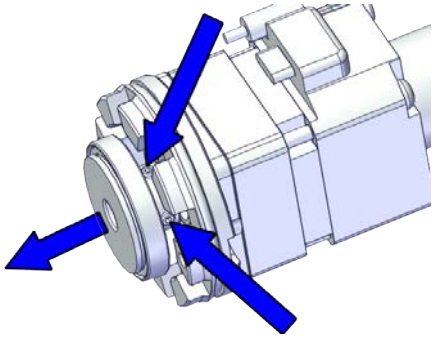
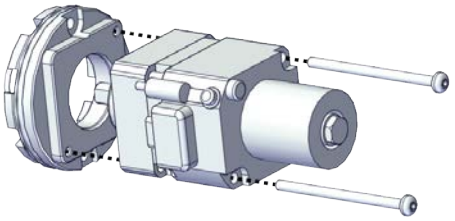
	Action	Note
1	Remove the wave generator from the motor shaft by removing the set screw(s) and then pulling it off the shaft.	 xx1500001651
2	Place the wave generator on a clean work-bench, if not instantly fitting it to a new motor. **CAUTION** Keep the wave generator clean.	

Continues on next page

4.4.5 Replacing the axis-4 motor

Continued

Removing the flange and wave generator from the motor (IRB 14000 Type A)

	Action	Note
1	Remove the wave generator from the motor shaft by removing the set screw(s) and then pulling it off the shaft.	 xx1900002070
2	Place the wave generator on a clean work-bench, if not instantly fitting it to a new motor. **CAUTION** Keep the wave generator clean.	
3	Remove the flange.	 xx1900002071

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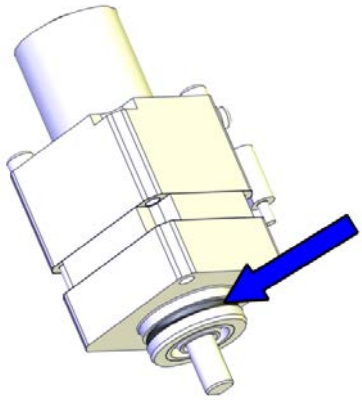
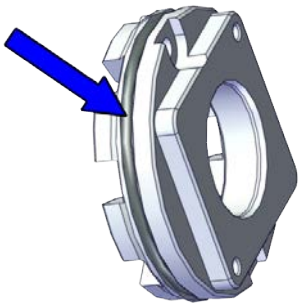
Refitting the motor

Use these procedures to refit the axis-4 motor.

Checking the o-ring

	Action	Note
1	Check that the o-ring on the motor is properly seated in its groove and that it is not damaged. Replace if damaged. **Tip** If needed, lubricate the o-ring with some grease for a better fitting in the groove.	Motor M91: 3HAC036950-001. O-ring: 3HAB3772-138 Grease: Mobil FM222.  xx1400002759
2	**For IRB 14000 Type A** Check that the o-ring on the flange is properly seated in its groove and that it is not damaged. Replace if damaged. **Tip** If needed, lubricate the o-ring with some grease for a better fitting in the groove.	Flange: 3HAC072381-001. O-ring on flange: 3HAB3772-119 Grease: Mobil FM222.  xx1900002072

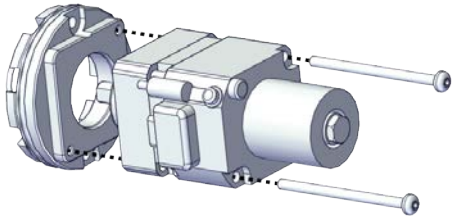
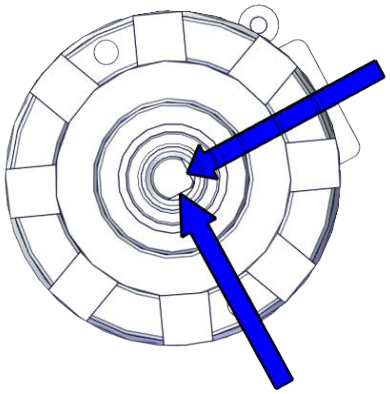
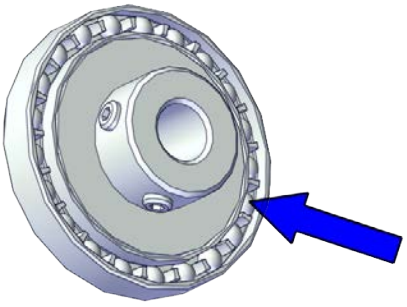
Fitting the wave generator to the motor (IRB 14000 Type A)

	Action	Note
1	Wipe the contact surfaces of the motor, flange and wave generator clean from any contamination with cleaning agent applied on a cloth or paper.	

Continues on next page

4.4.5 Replacing the axis-4 motor

Continued

	Action	Note
2	Refit the motor to the flange.	Screws: 3HAC050367-039 (2 pcs). Tightening torque: 0.3 Nm.  xx1900002071
3	Orient the output axis of the motor so that the flat surfaces on the output axis are positioned towards the gaps on the flange.	 xx1900002073
4	Lubricate the wave generator with grease.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.  xx1900002074

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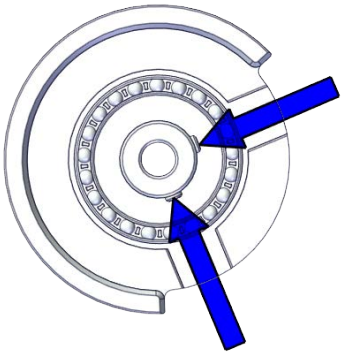
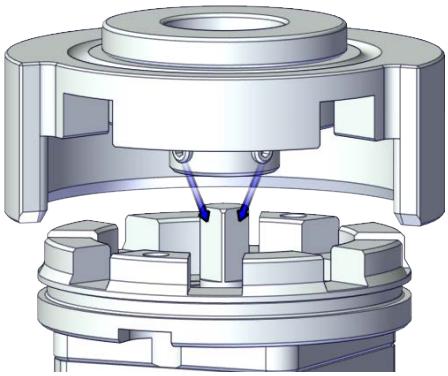
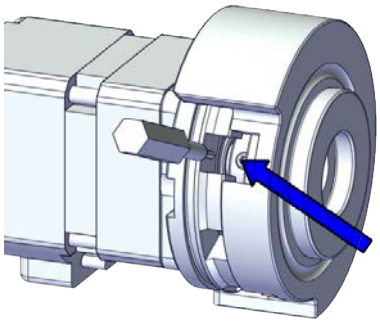
	Action	Note
5	Place the wave generator to the fixture tool. Orient the wave generator so that the set screws are positioned towards the gaps on the fixture tool. **Tip** Use a magnet on the other side of the fixture tool to prevent the wave generator drop from the tool.	 xx1900002075
6	Fit the wave generator to the motor shaft, place the fixture tool against the flange. Orient the wave generator so that the set screws are positioned towards the flat surface on the output axis of the motor and accessible from the aligned gaps on the fixture tool and flange.	 xx1900002076
7	Tighten the set screws.	Screw: M2-set screw (2 pcs). Tightening torque: 0.2 Nm.  xx1900002077

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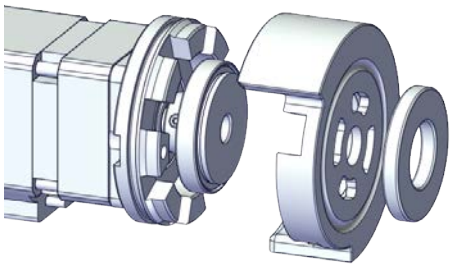
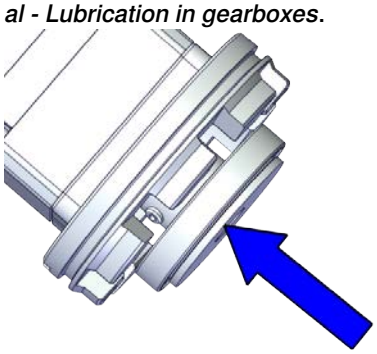
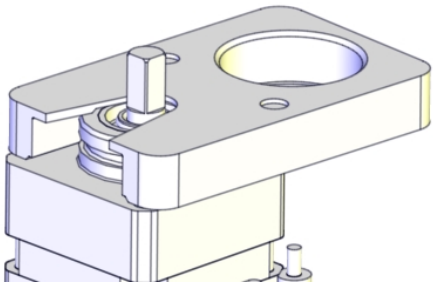
4.4.5 Replacing the axis-4 motor
Continued

	Action	Note
8	Remove the fixture.	 xx1900002078
9	Spread the grease on the end plane of the bearing to make sure the balls in the bearing are lubricated as well.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.  xx1900002079

Fitting the wave generator to the motor (IRB 14000 no-type-specified)

	Action	Note
1	Wipe the contact surfaces of the motor and wave generator clean from any contamination with cleaning agent applied on a cloth or paper.	
2	Place the fixture tool on the new motor.	 xx1500001646

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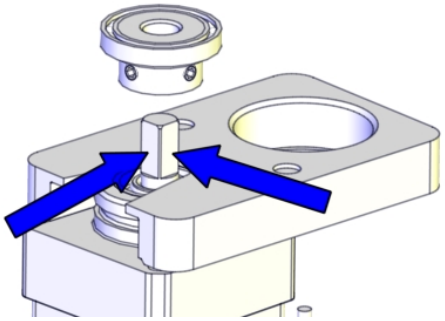
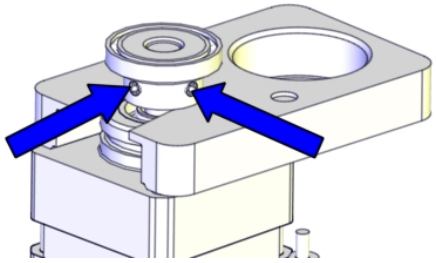
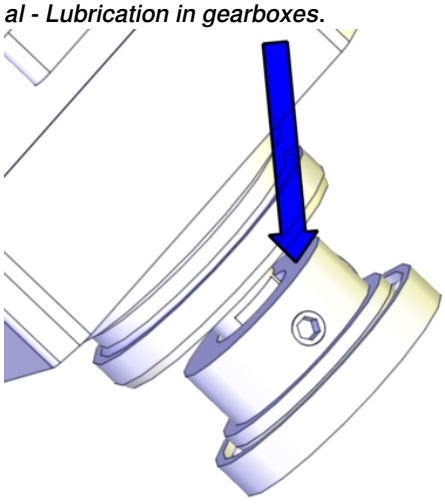
	Action	Note
3	Fit the wave generator to the motor shaft, place it against the distance fixture and secure lightly with the set screw(s). Orient the wave generator so that the set screw will be positioned towards the flat surface on the output axis of the motor. The flat surface is pointed out in the figure.	 xx1500001647
4	Tighten the set screw.	Screw: M2-set screw (2 pcs). Tightening torque: 0.2 Nm.  xx1500001648
5	Remove the fixture.	
6	Lubricate the wave generator with grease.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.  xx1500001649

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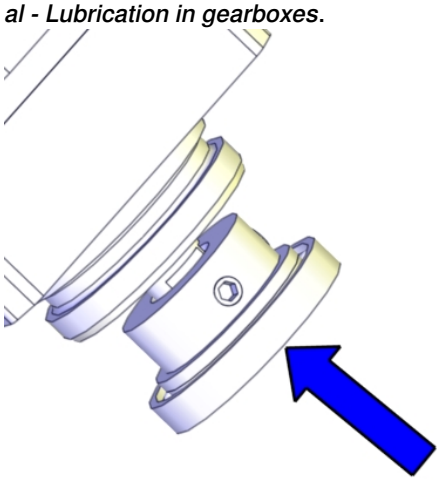
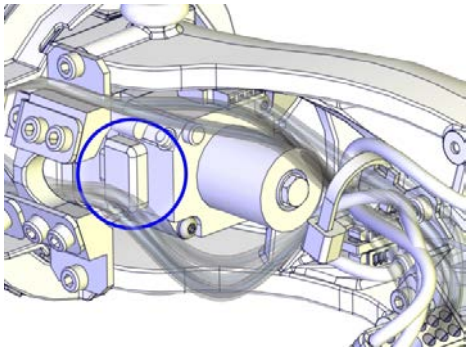
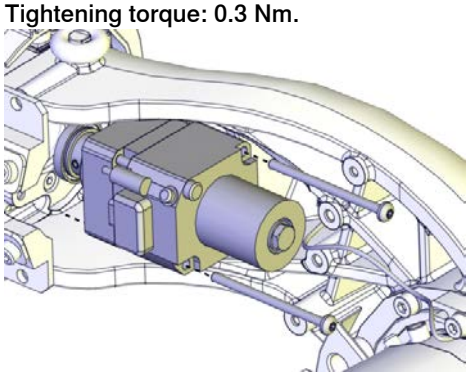
4.4.5 Replacing the axis-4 motor
Continued

	Action	Note
7	Spread the grease on the end plane of the bearing to make sure the balls in the bearing are lubricated as well.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.  xx1500001650

Refitting the axis-4 motor

	Action	Note
1	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	

Continues on next page

	Action	Note
2	**For IRB 14000 (no-type-specified)** Orient the motor correctly and fit it into the arm. Secure with the screws. **CAUTION** The motor must be inserted gently. If the gears do not mate, rotate the axis carefully back and forth until the gears are mated.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1500000568 Screws: 3HAC050367-039 (2 pcs). Tightening torque: 0.3 Nm.  xx1400002758

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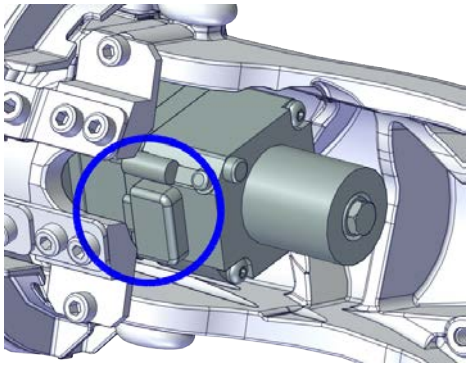
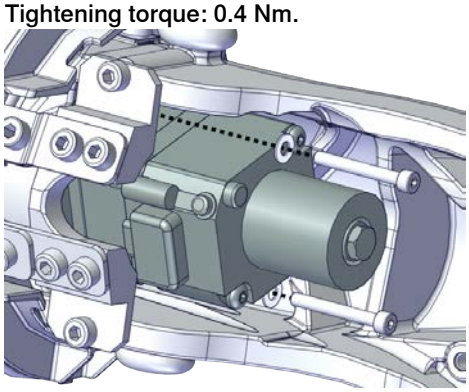
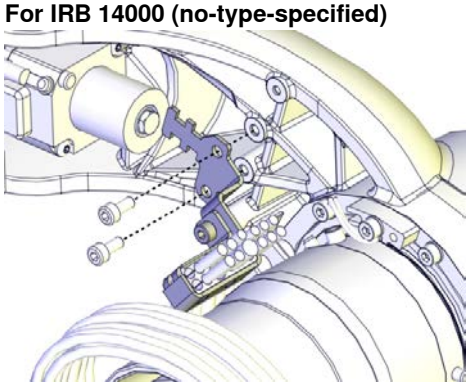
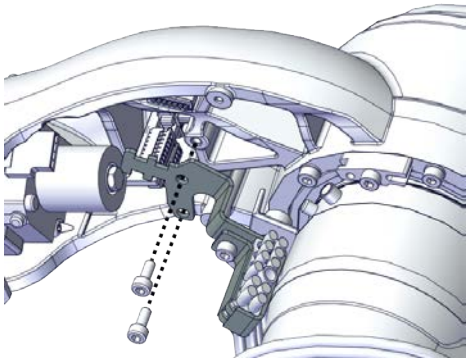
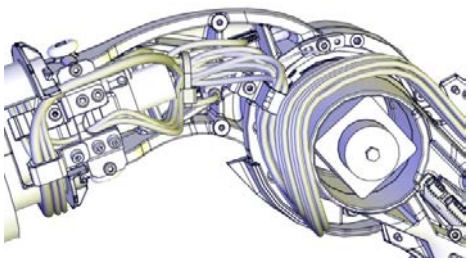
4.4.5 Replacing the axis-4 motor

Continued

	Action	Note
3	**For IRB 14000 Type A** Orient the motor correctly and fit it into the arm. Secure the flange with the screws and washers. **CAUTION** The motor must be inserted gently. If the gears do not mate, rotate the axis carefully back and forth until the gears are mated.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1900002080 Screws: 3HAC072396-001 (2 pcs). Washers: 3HAC073135-001 (2 pcs). Tightening torque: 0.4 Nm.  xx1900002069
4	Connect the motor connectors: • R1.MP4R / R1.MP4L • R1.FB4R / R1.FB4L	

Continues on next page

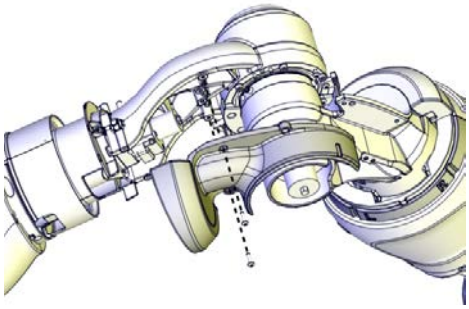
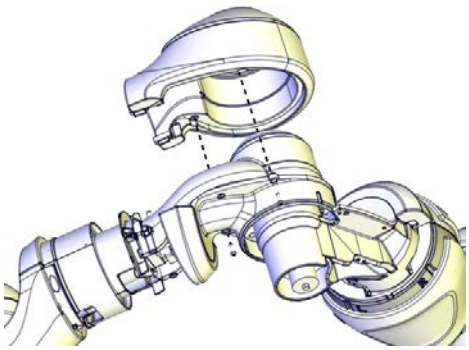
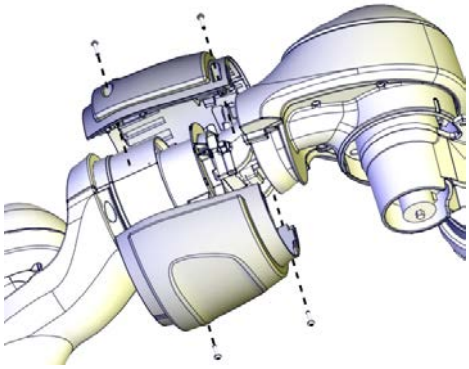
	Action	Note
5	Refit the upper axis-3 cable bracket.	Screws: 3HAB3409-233 (2 pcs). Tightening torque: 0.3 Nm. **For IRB 14000 (no-type-specified)**  xx1400002757 **For IRB 14000 Type A**  xx1900002068
6	Route and secure the cabling according to the figure. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	 xx1500000583

Continues on next page

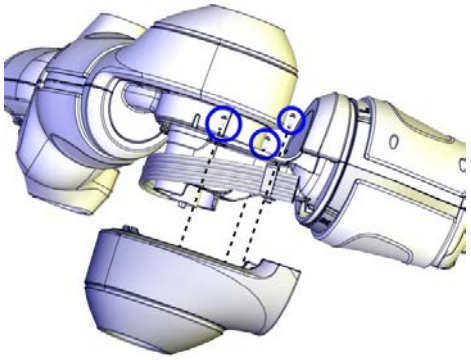
4.4.5 Replacing the axis-4 motor

Continued

Refitting the covers

	Action	Note
1	Refit the upper axis-3 cover.	Screws: 3HAC050368-005 (2 pcs). Tightening torque: 0.14 Nm.  xx1400002755
2	Refit the axis-3 body cover.	Screws: 3HAC050368-005 (2 pcs). Tightening torque: 0.14 Nm.  xx1400002754
3	Refit the lower axis-4 cover.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1400002756

Continues on next page

	Action	Note
4	Refit the lower axis-3 cover. **CAUTION** Be careful not to squeeze any cabling during the refitting procedure.	Screws: 3HAC050368-005 (3 pcs). Tightening torque: 0.14 Nm.  xx1400002751

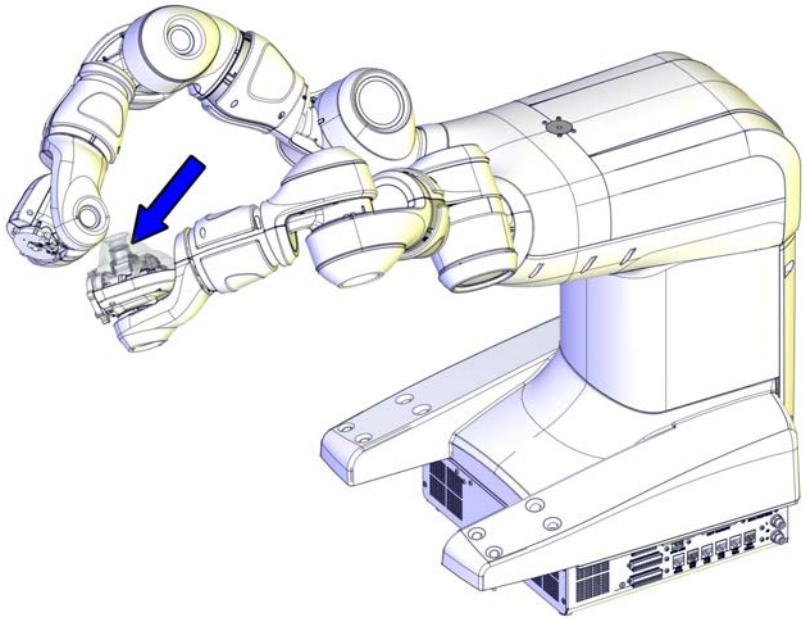
Concluding procedure

	Action	Note
1	Re-calibrate the robot.	See *Calibration on page 397*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.4.6 Replacing the axis-5 motor

Location of the axis-5 motor

The axis-5 motor is located as shown in the figure.



xx1400002796

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Motor M91	3HAC036950-001	Always use a new o-ring 3HAB3772-138. To be ordered separately.
O-ring	3HAB3772-138	Required to be replaced when removing and refitting the motor.
Flange	3HAC072381-001	
O-ring on flange	3HAB3772-119	Replace if damaged.
PTFE film on axis-5 and axis-6 motors	3HAC051316-001	Replace if damaged. Used only on axis-5 motor of IRB 14000 no-type-specified and axis-6 motor of both robot types. See *Robot description on page 423* for robot type.
Hex socket head cap screw	3HAC050368-005	M2x8 8.8

Continues on next page

Spare part	Article number	Note
Torx pan head screw	3HAC050367-039	M2x30 8.8 Gleitmo 605
Small head screw	3HAC072396-001	M2x16 12.9
Washer	3HAC073135-001	2.2x4.5x0.3

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.
Fixture tool for wave generator M91	3HAC054904-001	Used for axes 4 and 5 of IRB 14000 no-type-specified and axis 6 of both robot types. See *Robot description on page 423* for robot type.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.
Fixture tool for wave generator M91 (IRB 14000 Type A)	3HAC074531-001	Used for axes 4 and 5 of IRB 14000 Type A. See *Robot description on page 423* for robot type.

Consumables

Consumable	Article number	Note
Grease	-	Mobil FM222 Used to lubricate o-rings.
Grease		Used to lubricate the wave generator. See *Technical reference manual - Lubrication in gearboxes*
Cleaning agent	-	Isopropanol

Required documents

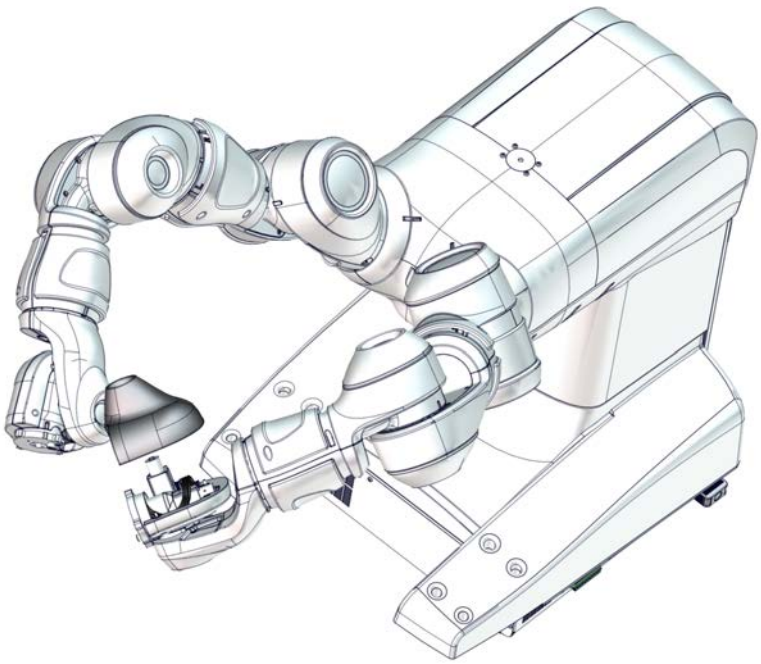
Document name	Document number	Note
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*	

Continues on next page

4.4.6 Replacing the axis-5 motor
Continued

Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



xx1400002864

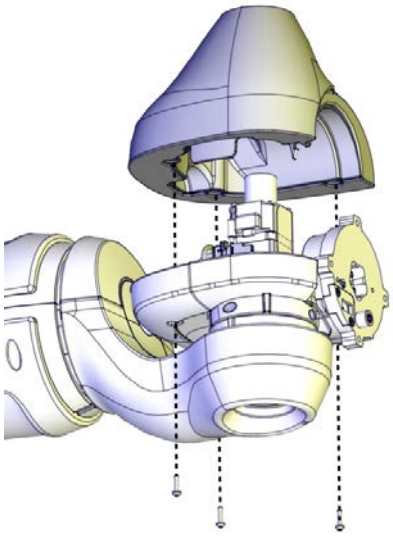
Removing the motor

Use these procedures to remove the axis-5 motor.

Preparations before removing the motor

	Action	Note
1	Jog the robot so that the wrist cover points upward.	
2	Jog axis 6 clockwise (facing the tool flange) to the limiting position -229° so that the cable will stay in place when removing the cover.	
3	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

Continues on next page

	Action	Note
4	Remove the axis-6 cover. Rotate axis 5 manually so that all screws can be accessed.	 xx1400002760

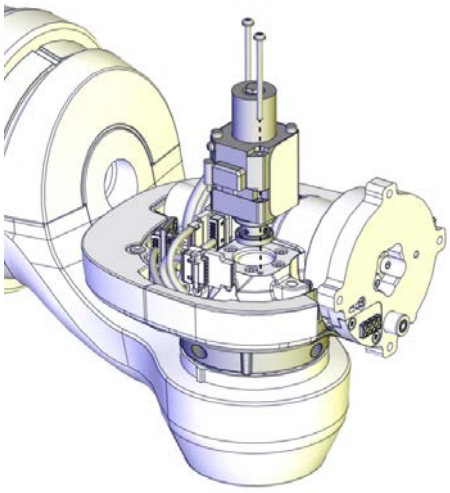
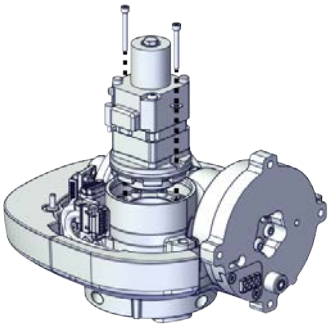
Removing the axis-5 motor

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
2	Disconnect the motor connectors. Cut some cable ties, if needed. • R1.MP5R / R1.MP5L • R1.FB5R / R1.FB5L	
3	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	

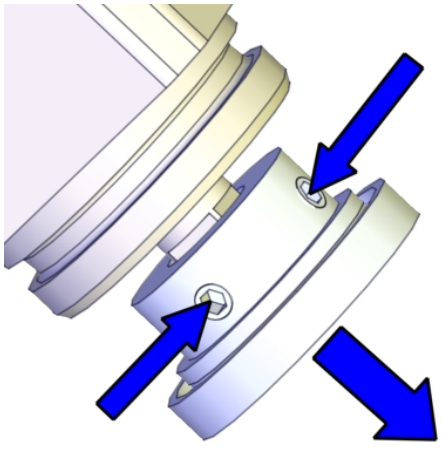
Continues on next page

4.4.6 Replacing the axis-5 motor

Continued

	Action	Note
4	**For IRB 14000 (no-type-specified)** Remove the screws and lift the motor out carefully.	 xx1400002790
5	**For IRB 14000 Type A** Remove the flange screws and washers, and lift the motor together with the flange and wave generator out carefully.	 xx1900002141

Removing the wave generator from the motor (IRB 14000 no-type-specified)

	Action	Note
1	Remove the wave generator from the motor shaft by removing the set screw(s) and then pulling it off the shaft.	 xx1500001651

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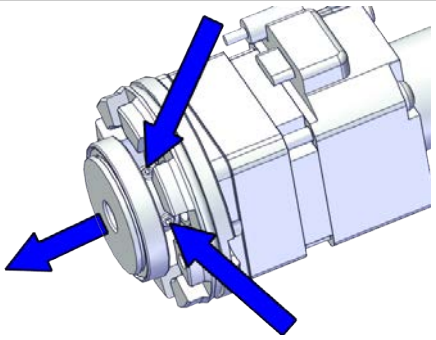
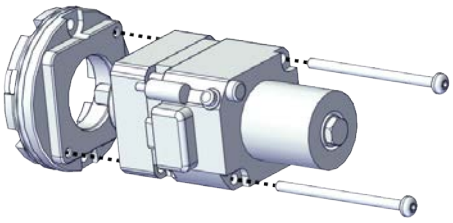
	Action	Note
2	Place the wave generator on a clean work-bench, if not instantly fitting it to a new motor. **CAUTION** Keep the wave generator clean.	

Removing the flange and wave generator from the motor (IRB 14000 Type A)

	Action	Note
1	Remove the wave generator from the motor shaft by removing the set screw(s) and then pulling it off the shaft.	 xx1900002070
2	Place the wave generator on a clean work-bench, if not instantly fitting it to a new motor. **CAUTION** Keep the wave generator clean.	
3	Remove the flange.	 xx1900002071

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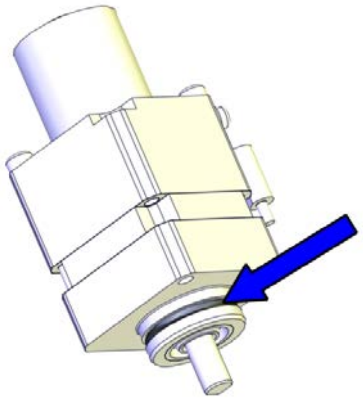
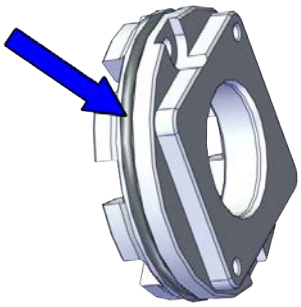
4.4.6 Replacing the axis-5 motor
Continued

Refitting the motor

Use these procedures to refit the axis-5 motor.

Checking the o-ring

	Action	Note
1	Check that the o-ring is properly seated in its groove and that it is not damaged. Replace if damaged. **Tip** If needed, lubricate the o-ring with some grease for a better fitting in the groove.	Motor M91: 3HAC036950-001. O-ring: 3HAB3772-138 Grease: Mobil FM222.  xx1400002759
2	**For IRB 14000 Type A** Check that the o-ring on the flange is properly seated in its groove and that it is not damaged. Replace if damaged. **Tip** If needed, lubricate the o-ring with some grease for a better fitting in the groove.	Flange: 3HAC072381-001. O-ring on flange: 3HAB3772-119 Grease: Mobil FM222.  xx1900002072

Fitting the wave generator to the motor (IRB 14000 Type A)

	Action	Note
1	Wipe the contact surfaces of the motor, flange and wave generator clean from any contamination with cleaning agent applied on a cloth or paper.	

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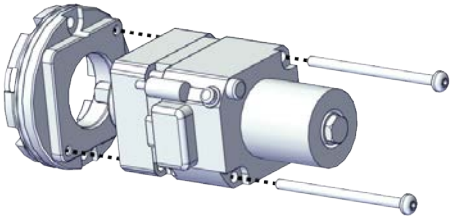
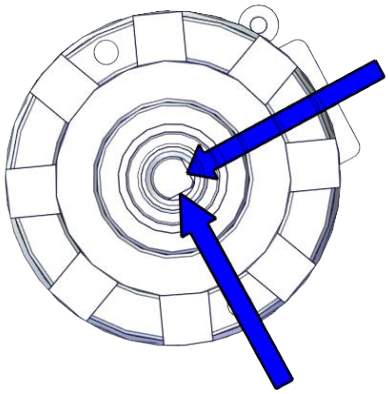
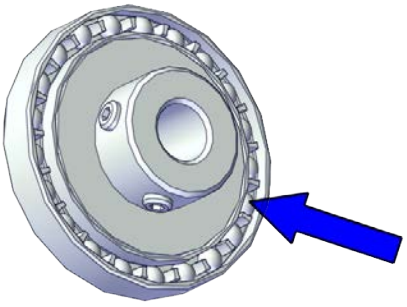
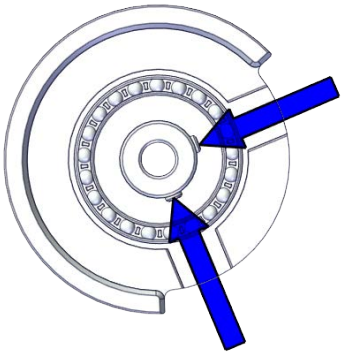
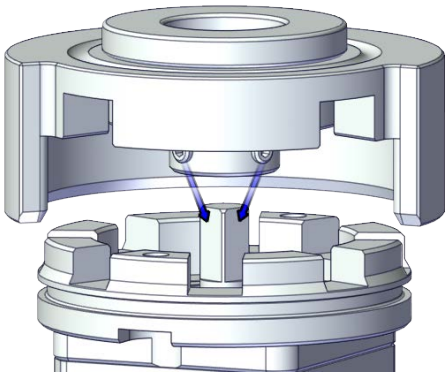
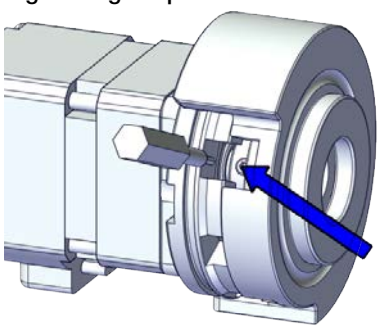
	Action	Note
2	Refit the motor to the flange.	Screws: 3HAC050367-039 (2 pcs). Tightening torque: 0.3 Nm.  xx1900002071
3	Orient the output axis of the motor so that the flat surfaces on the output axis are positioned towards the gaps on the flange.	 xx1900002073
4	Lubricate the wave generator with grease.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.  xx1900002074

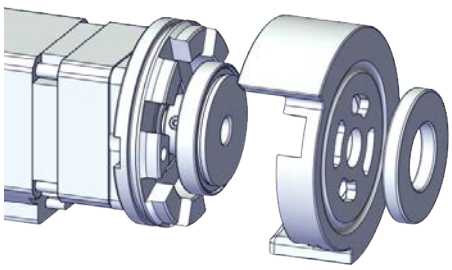
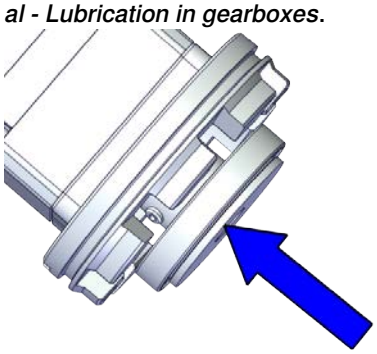
Continues on next page

4.4.6 Replacing the axis-5 motor

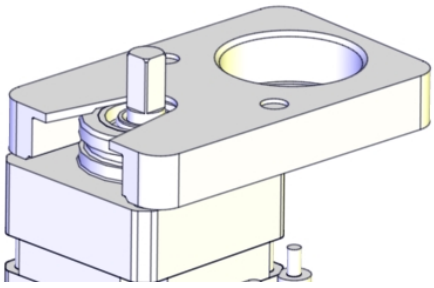
Continued

	Action	Note
5	Place the wave generator to the fixture tool. Orient the wave generator so that the set screws are positioned towards the gaps on the fixture tool. **Tip** Use a magnet on the other side of the fixture tool to prevent the wave generator drop from the tool.	 xx1900002075
6	Fit the wave generator to the motor shaft, place the fixture tool against the flange. Orient the wave generator so that the set screws are positioned towards the flat surface on the output axis of the motor and accessible from the aligned gaps on the fixture tool and flange.	 xx1900002076
7	Tighten the set screws.	Screw: M2-set screw (2 pcs). Tightening torque: 0.2 Nm.  xx1900002077

Continues on next page

	Action	Note
8	Remove the fixture.	 xx1900002078
9	Spread the grease on the end plane of the bearing to make sure the balls in the bearing are lubricated as well.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.  xx1900002079

Fitting the wave generator to the motor (IRB 14000 no-type-specified)

	Action	Note
1	Wipe the contact surfaces of the motor and wave generator clean from any contamination with cleaning agent applied on a cloth or paper.	
2	Place the fixture tool on the new motor.	 xx1500001646

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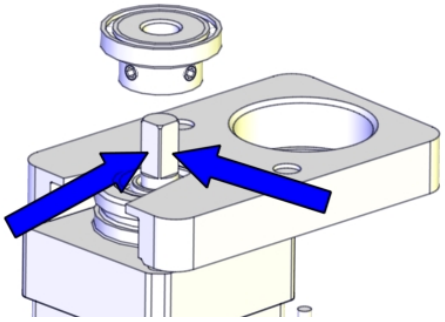
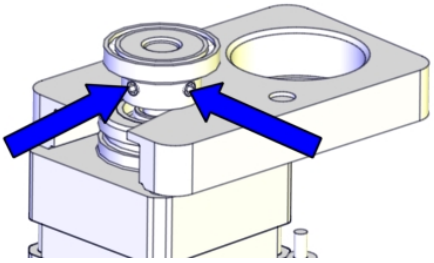
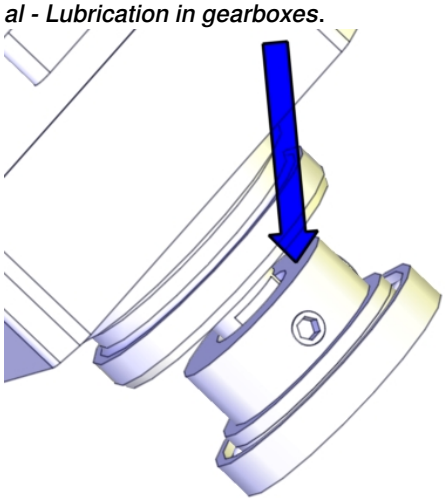
4.4.6 Replacing the axis-5 motor

Continued

	Action	Note
3	Fit the wave generator to the motor shaft, place it against the distance fixture and secure lightly with the set screw(s). Orient the wave generator so that the set screw will be positioned towards the flat surface on the output axis of the motor. The flat surface is pointed out in the figure.	 xx1500001647
4	Tighten the set screw.	Screw: M2-set screw (2 pcs). Tightening torque: 0.2 Nm.  xx1500001648
5	Remove the fixture.	
6	Lubricate the wave generator with grease.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.  xx1500001649

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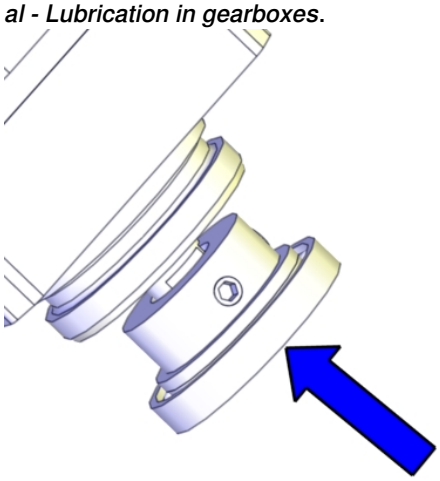
	Action	Note
7	Spread the grease on the end plane of the bearing to make sure the balls in the bearing are lubricated as well.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.  xx1500001650

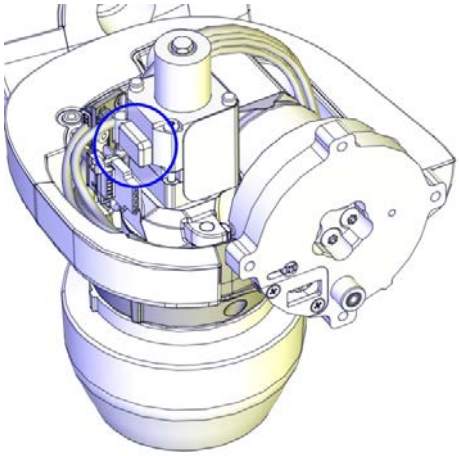
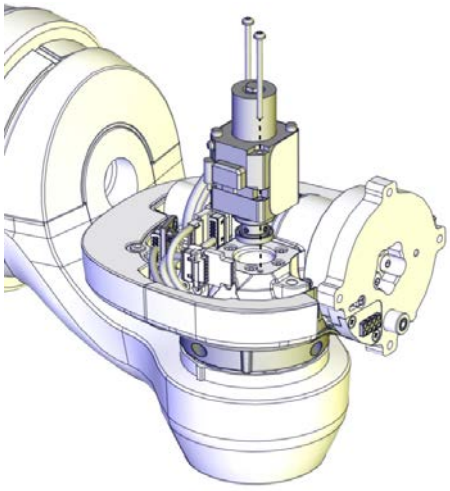
Refitting the axis-5 motor

	Action	Note
1	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
2	**For IRB 14000 (no-type-specified)** Check the PTFE film. Replace if damaged.	PTFE film on axis-5 and axis-6 motors: 3HAC051316-001

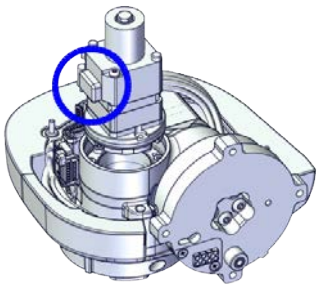
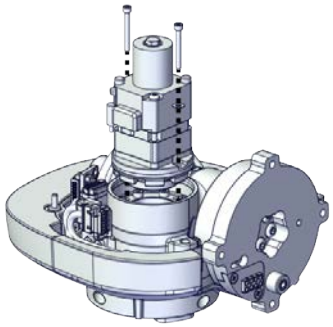
Continues on next page

4.4.6 Replacing the axis-5 motor

Continued

	Action	Note
3	**For IRB 14000 (no-type-specified)** Orient the motor correctly and fit it into the arm. Secure with the screws. **CAUTION** The motor must be inserted gently. If the gears do not mate, rotate the axis carefully back and forth until the gears are mated.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1500000569 Screws: 3HAC050367-039 (2 pcs). Tightening torque: 0.3 Nm.  xx1400002790

Continues on next page

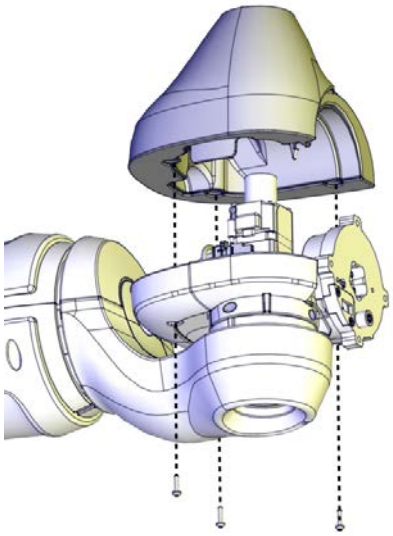
	Action	Note
4	**For IRB 14000 Type A** Orient the motor correctly and fit it into the arm. Secure the flange with the screws and washers. **CAUTION** The motor must be inserted gently. If the gears do not mate, rotate the axis carefully back and forth until the gears are mated.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1900002142 Screws: 3HAC072396-001 (2 pcs). Washers: 3HAC073135-001 (2 pcs). Tightening torque: 0.4 Nm.  xx1900002141
5	Connect the motor connectors: • R1.MP5R / R1.MP5L • R1.FB5R / R1.FB5L	

Continues on next page

4.4.6 Replacing the axis-5 motor

Continued

Refitting the covers

	Action	Note
1	Refit the axis-6 cover.	Screws: 3HAC050368-005 (3 pcs). Tightening torque: 0.2 Nm.  xx1400002760

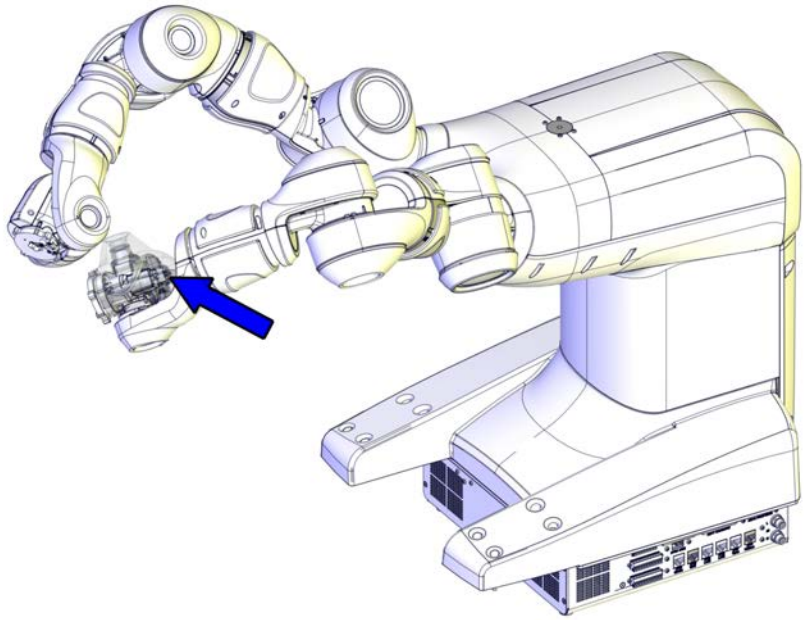
Concluding procedure

	Action	Note
1	Re-calibrate the robot.	See *Calibration on page 397*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.4.7 Replacing the axis-6 motor

Location of the axis-6 motor

The axis-6 motor is located as shown in the figure.



xx1400002797

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Motor M91	3HAC036950-001	Always use a new o-ring 3HAB3772-138. To be ordered separately.
O-ring	3HAB3772-138	Required to be replaced when removing and refitting the motor.
PTFE film on axis-5 and axis-6 motors	3HAC051316-001	Replace if damaged. Used only on axis-5 motor of IRB 14000 no-type-specified and axis-6 motor of both robot types. See *Robot description on page 423* for robot type.
Torx pan head screw	3HAC050367-039	M2x30 8.8 Gleitmo 605
Hex socket head cap screw	3HAC050368-005	M2x8 8.8

Continues on next page

4.4.7 Replacing the axis-6 motor
Continued

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.
Fixture tool for wave generator M91	3HAC054904-001	Used for axes 4 and 5 of IRB 14000 no-type-specified and axis 6 of both robot types. See *Robot description on page 423* for robot type.

Consumables

Consumable	Article number	Note
Grease	-	Mobil FM222 Used to lubricate o-rings.
Grease		Used to lubricate the wave generator. See *Technical reference manual - Lubrication in gearboxes*
Cleaning agent	-	Isopropanol

Required documents

Document name	Document number	Note
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*	

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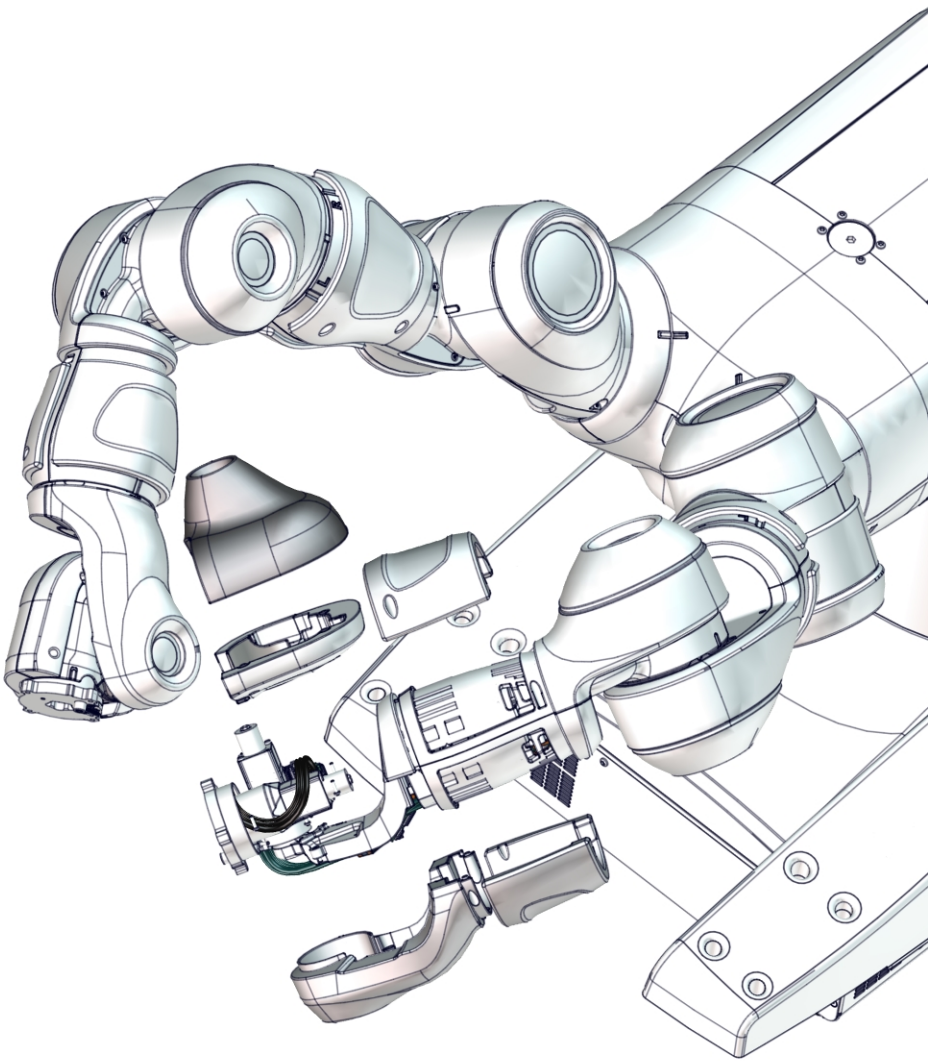
Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



xx1400002865

Removing the motor

Use these procedures to remove the the axis-6 motor.

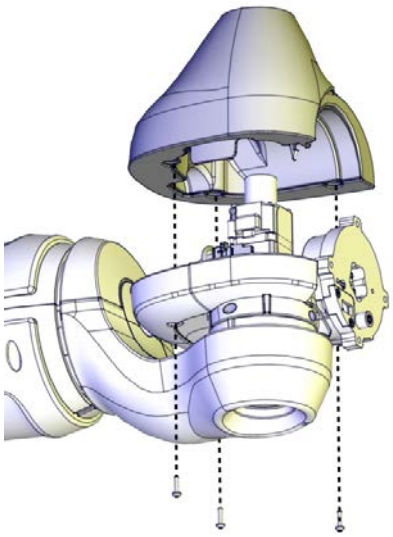
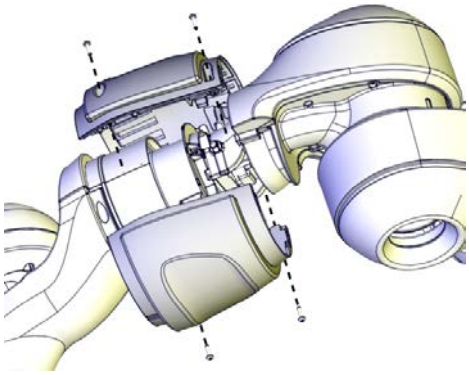
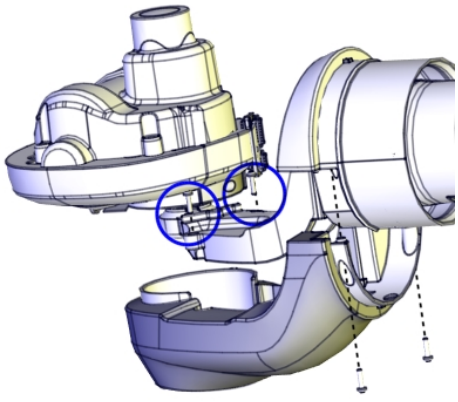
Preparations before removing the motor

	Action	Note
1	Jog the robot so that the wrist is easily accessed.	
2	Jog axis 6 clockwise (facing the tool flange) to the limiting position -229° so that the cable will stay in place when removing the cover.	

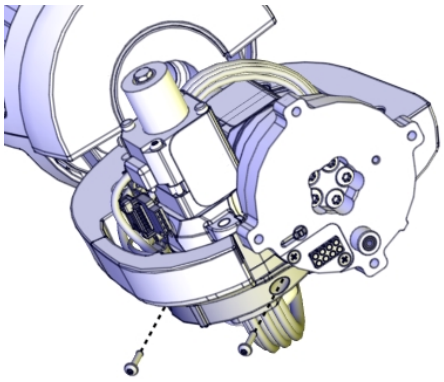
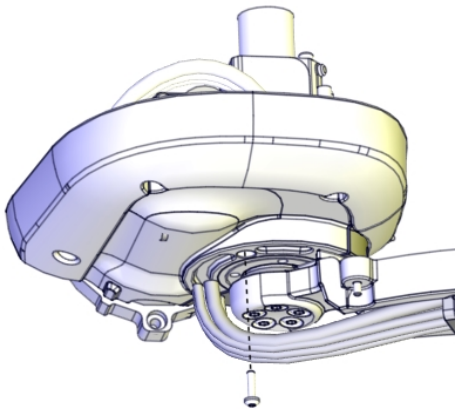
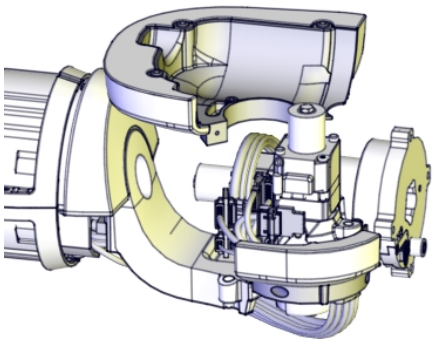
Continues on next page

4.4.7 Replacing the axis-6 motor

Continued

	Action	Note
3	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
4	Remove the wrist cover. Rotate axis 5 manually so that all screws can be accessed.	 xx1400002760
5	Remove the lower axis-4 cover.	 xx1500000360
6	Remove the upper axis-4 cover.	 xx1500001735

Continues on next page

	Action	Note
7	Remove the screws for the inner part of the cooling flange.	 xx1400002867  xx1500000602
8	Remove the inner part of the cooling flange.	 xx1500000541

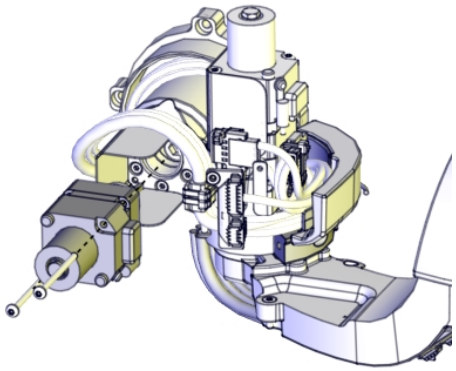
Removing the axis-6 motor

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

Continues on next page

4.4.7 Replacing the axis-6 motor

Continued

	Action	Note
2	Disconnect the motor connectors. Cut some cable ties, if needed. • R1.MP6R / R1.MP6L • R1.FB6R / R1.FB6L	
3	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
4	Remove the screws and lift the motor out carefully.	 xx1500000542

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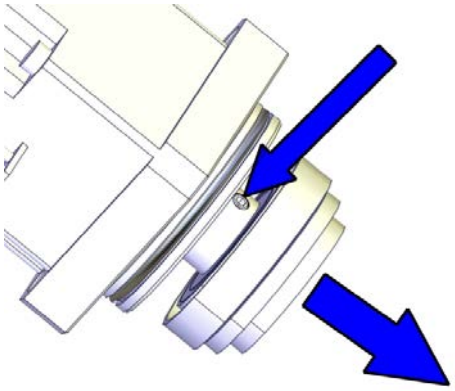
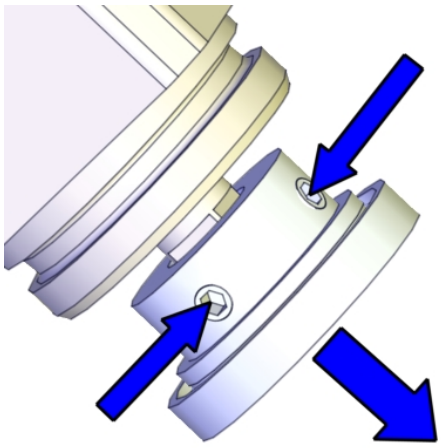
Removing the wave generator from the motor

	Action	Note
1	Remove the wave generator from the motor shaft by removing the set screw(s) and then pulling it off the shaft.	
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000515
	Axis 6.	 xx1500001651
2	Place the wave generator on a clean work-bench, if not instantly fitting it to a new motor. **CAUTION** Keep the wave generator clean.	

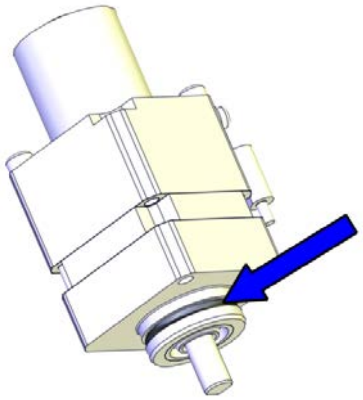
Continues on next page

4.4.7 Replacing the axis-6 motor
Continued

Refitting the motor

Use these procedures to refit the axis-6 motor.

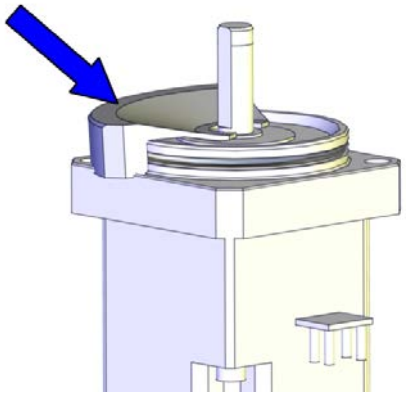
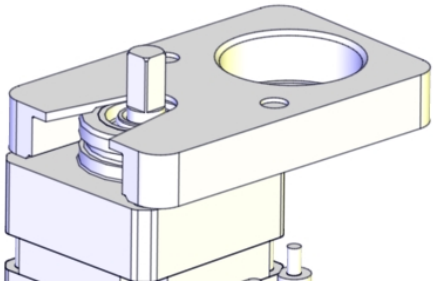
Checking the o-ring on the motor

	Action	Note
1	Check that the o-ring is properly seated in its groove and that it is not damaged. Replace if damaged. **Tip** If needed, lubricate the o-ring with some grease for a better fitting in the groove.	Motor M91: 3HAC036950-001. O-ring: 3HAB3772-138 Grease: Mobil FM222.  xx1400002759

Fitting the wave generator to the motor

	Action	Note
1	Wipe the contact surfaces of the motor and wave generator clean from any contamination with cleaning agent applied on a cloth or paper.	

Continues on next page

	Action	Note
2	Place the fixture tool on the new motor.	
	Axis 1 and axis 2: Fixture tool for wave generator M93, 3HAC054870-001. Axis 7 and axis 3: Fixture tool for wave generator M92, 3HAC054871-001.	 xx1500000527
	Axis 6: Fixture tool for wave generator M91, 3HAC054904-001.	 xx1500001646

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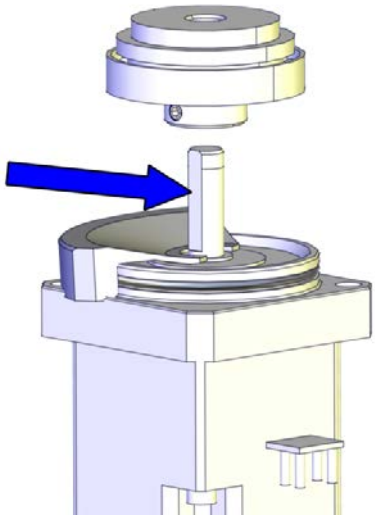
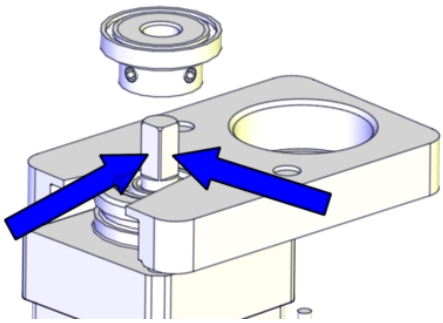
4.4.7 Replacing the axis-6 motor

Continued

	Action	Note
3	Fit the wave generator to the motor shaft, place it against the distance fixture and secure lightly with the set screw(s). Orient the wave generator so that the set screw will be positioned towards the flat surface on the output axis of the motor. The flat surface is pointed out in the figure.	
	Axis 1, axis 2, axis 3 and axis 7.	 xx1500000528
	Axis 6.	 xx1500001647

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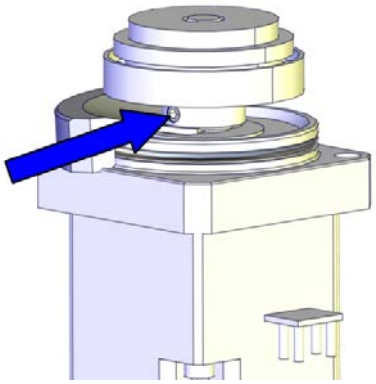
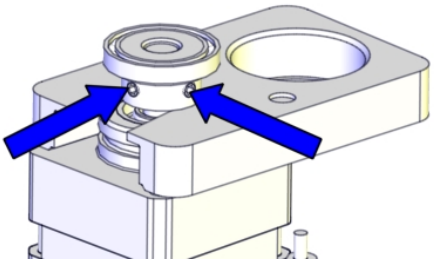
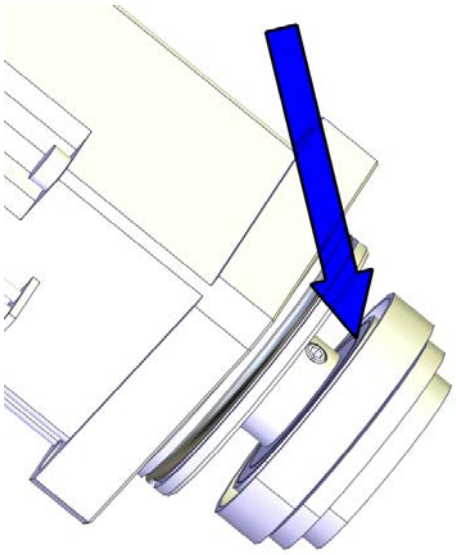
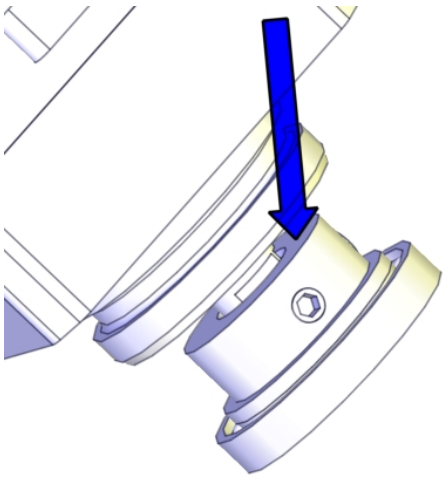
	Action	Note
4	Tighten the set screw.	
	Axis 1, axis 2, axis 3 and axis 7.	Screw: M3-set screw (1 pcs). Tightening torque: 0.6 Nm.  xx1500000518
	Axis 6.	Screw: M2-set screw (2 pcs). Tightening torque: 0.2 Nm.  xx1500001648
5	Remove the fixture.	

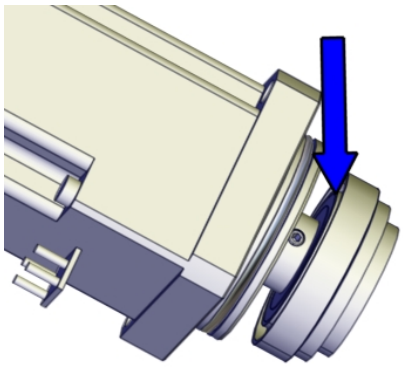
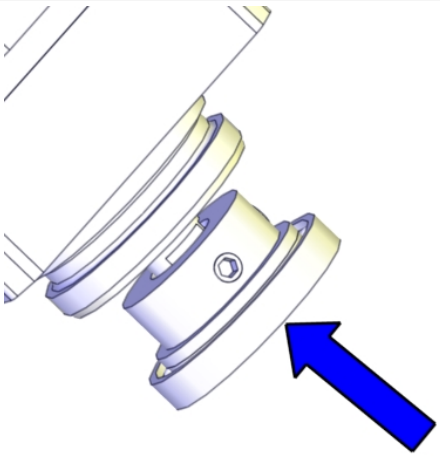
Continues on next page

4.4.7 Replacing the axis-6 motor

Continued

	Action	Note
6	Lubricate the wave generator with grease.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000557
	Axis 6.	 xx1500001649

Continues on next page

	Action	Note
7	Spread the grease on the end plane of the bearing to make sure the balls in the bearing are lubricated as well.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000556
	Axis 6.	 xx1500001650

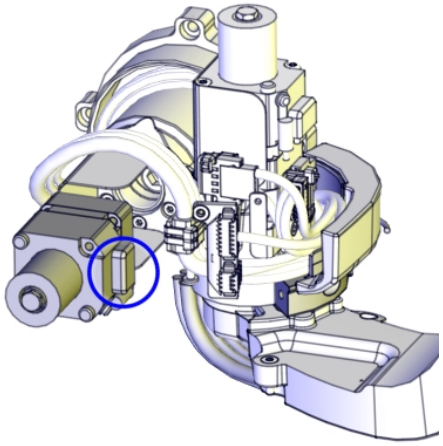
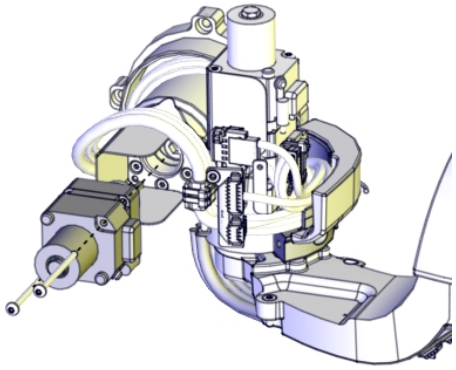
Refitting the axis-6 motor

	Action	Note
1	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
2	Check the PTFE film. Replace if damaged.	PTFE film on axis-5 and axis-6 motors: 3HAC051316-001

Continues on next page

4.4.7 Replacing the axis-6 motor

Continued

	Action	Note
3	Orient the motor correctly and fit it into the arm. Secure with the screws. **CAUTION** The motor must be inserted gently. If the gears do not mate, rotate the axis carefully back and forth until the gears are mated.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1500000570 Screws: 3HAC050367-039 (2 pcs). Tightening torque: 0.3 Nm.  xx1500000542
4	Connect the motor connectors: • R1.MP6R / R1.MP6L • R1.FB6R / R1.FB6L	

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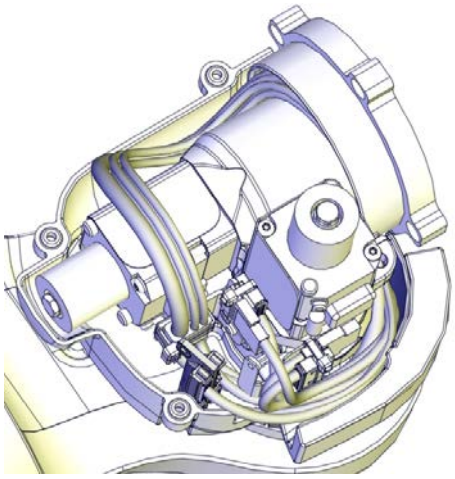
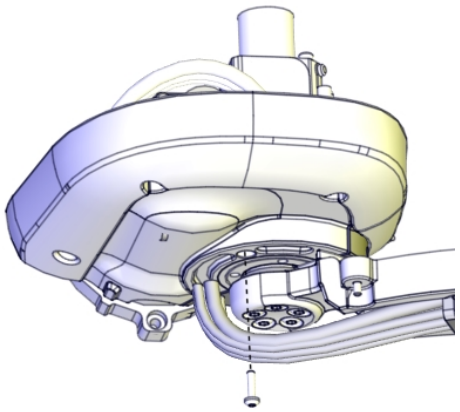
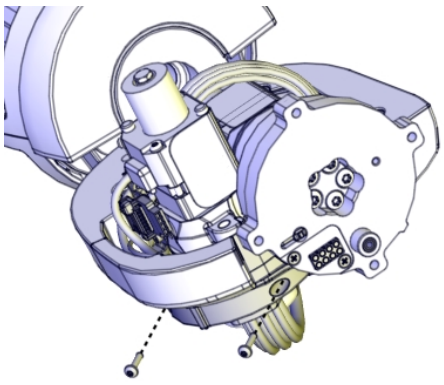
	Action	Note
5	Route and secure the cabling according to the figure. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	 xx1500000584

Refitting the covers

	Action	Note
1	Refit the cooling flange.	Screws: 3HAC050368-005 (3 pcs). Tightening torque: 0.2 Nm.  xx1500000602  xx1400002867

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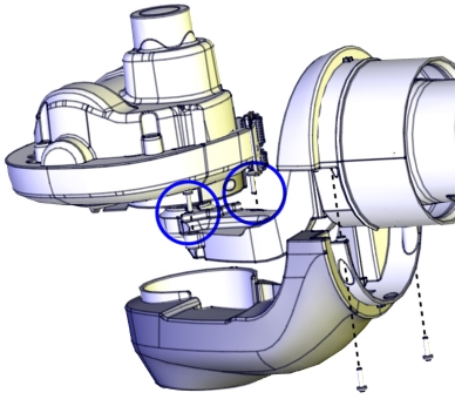
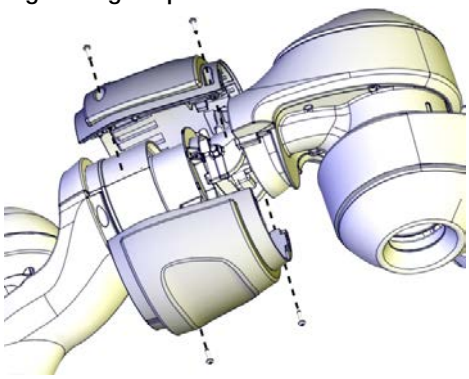
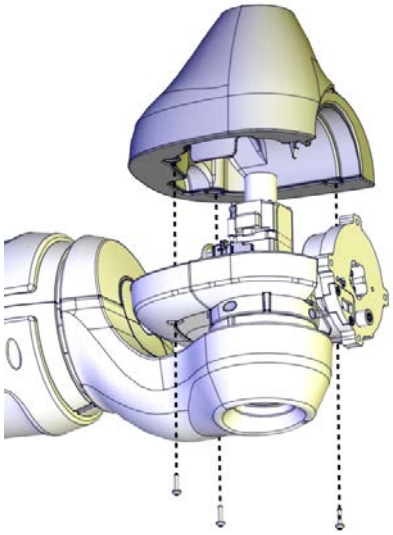
4.4.7 Replacing the axis-6 motor

Continued

	Action	Note
2	Refit the upper axis-4 cover.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1500001735
3	Refit the lower axis-4 cover.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1500000360
4	Refit the axis-6 cover.	Screws: 3HAC050368-005 (3 pcs). Tightening torque: 0.2 Nm.  xx1400002760

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Concluding procedure

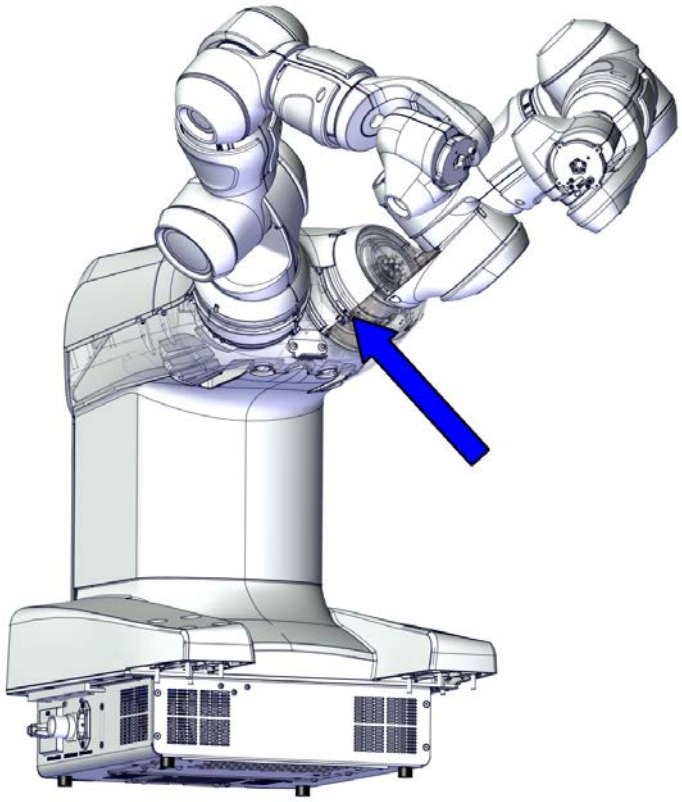
	Action	Note
1	Re-calibrate the robot.	See *Calibration on page 397*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.5 Mechanical stops

4.5.1 Replacing the axis-1 mechanical stop

Location of the mechanical stop

The mechanical stop is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Mechanical stop for axis 1	3HAC047602-001	
Hex socket head cap screw	3HAC050368-005	M2x8 8.8
Torx pan head screw	3HAC050367-005	M3x12 8.8 Gleitmo 605
Hex socket head cap screw	3HAB3409-241	M2.5x12 12.9 Lafre 2C2B/FC6.9

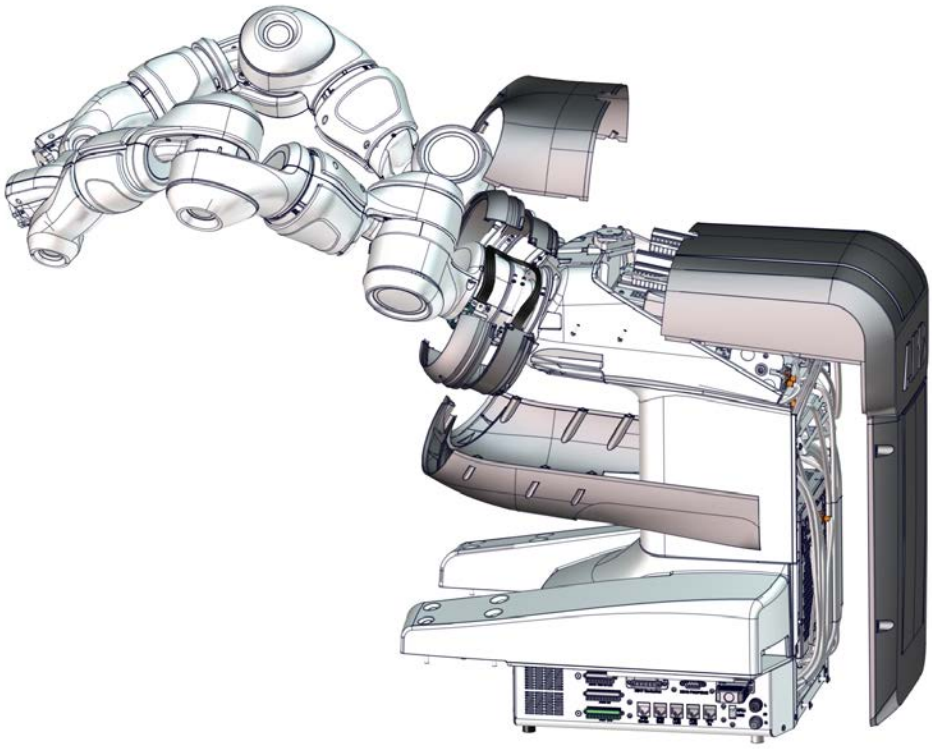
Continues on next page

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.

Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



xx1500000493

Removing the mechanical stop

Use these procedures to remove the mechanical stop.

Preparations before removing the mechanical stop

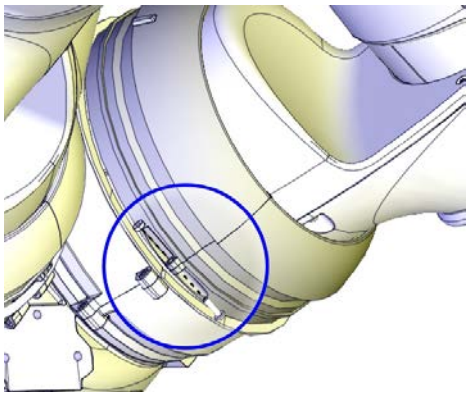
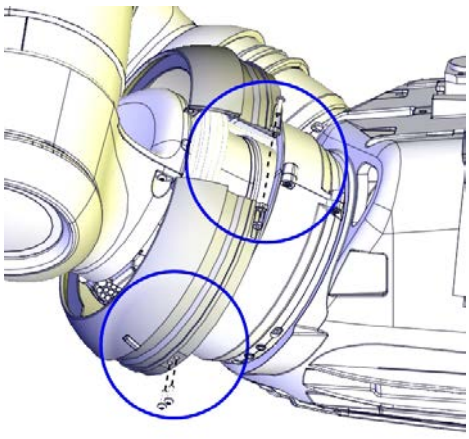
	Action	Note
1	Jog the robot so that the covers can be easily accessed and removed.	
2	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

Continues on next page

4.5.1 Replacing the axis-1 mechanical stop

Continued

Removing the axis-1 covers

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	Remove the upper axis-1 cover. **Note** Be aware of the tab underneath the cover so it does not get damaged.	Screws:M2x8 8.8 (2 pcs).  xx1400002601  xx1400002605

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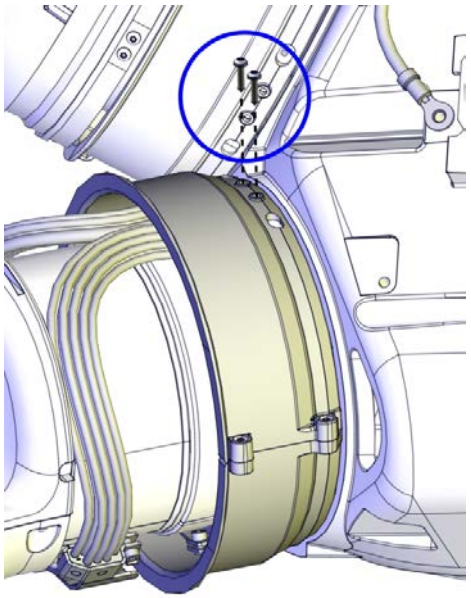
	Action	Note
3	Remove the upper screws of the lower axis-1 cover.	 xx1500000565

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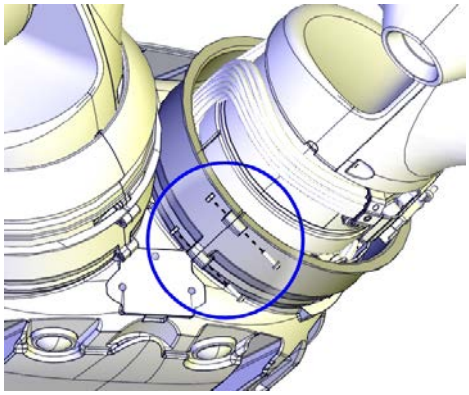
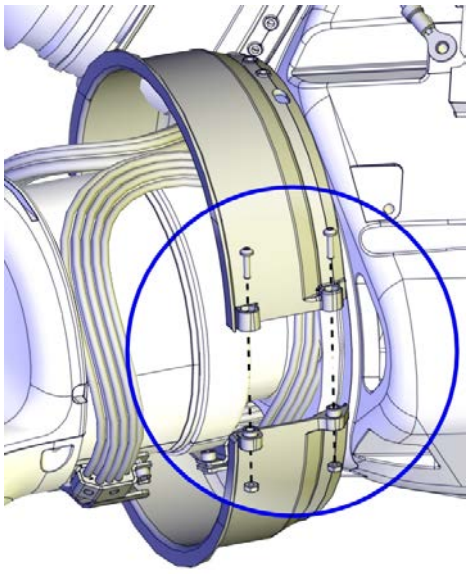
4.5.1 Replacing the axis-1 mechanical stop

Continued

	Action	Note
4	Turn the lower axis-1 cover in order to access all screws properly and remove the lower axis-1 cover.	Screws:M2x8 8.8 (4 pcs).  xx1400002604  xx1400002606

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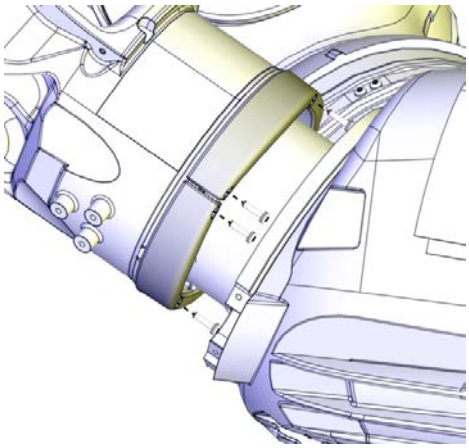
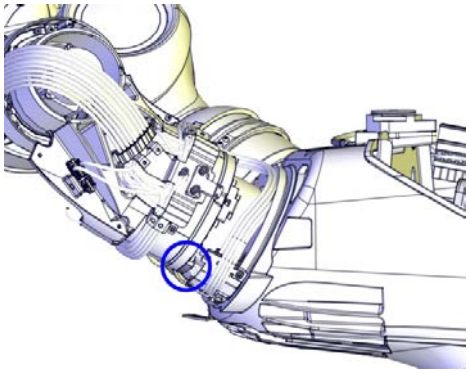
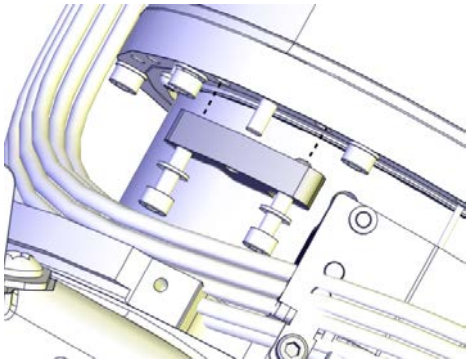
Removing the remaining covers

	Action	Note
1	Remove the axis-1 cable protection. **Tip** In order to access the screws it is helpful to release the brakes and manually move the robot arm. Temporarily turn on the power to the robot and release the brakes.	Screws:3HAC050368-005 (6 pcs).  xx1500000412

Removing the axis-1 mechanical stop

	Action	Note
1	Turn on the power to the robot temporarily.	
2	Release the brakes and rotate axis 1 in order to access the mechanical stop.	 xx1500000735
3	**DANGER** Turn off the electric power supply again.	
4	Remove the mechanical stop by removing the two screws and washers.	 xx1500000738

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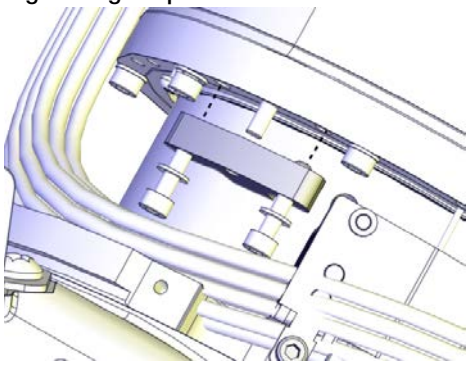
4.5.1 Replacing the axis-1 mechanical stop
Continued

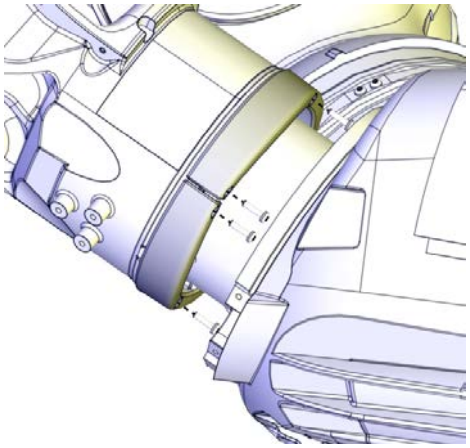
Refitting the mechanical stop

Use these procedures to refit the mechanical stop.

Refitting the axis-1 mechanical stop

	Action	Note
1	Refit the mechanical stop with the screws and washers.	Mechanical stop for axis 1: 3HAC047602-001 Screws: 3HAB3409-241 (2 pcs). Tightening torque: 0.4 Nm.  xx1500000738

Refitting the covers

	Action	Note
1	Refit the axis-1 cable protection. **Tip** In order to access the screws it is helpful to release the brakes and manually move the robot arm. Temporarily turn on the power to the robot and release the brakes.	Screws: 3HAC050367-005 (6 pcs). Tightening torque: 0.14 Nm.  xx1500000412

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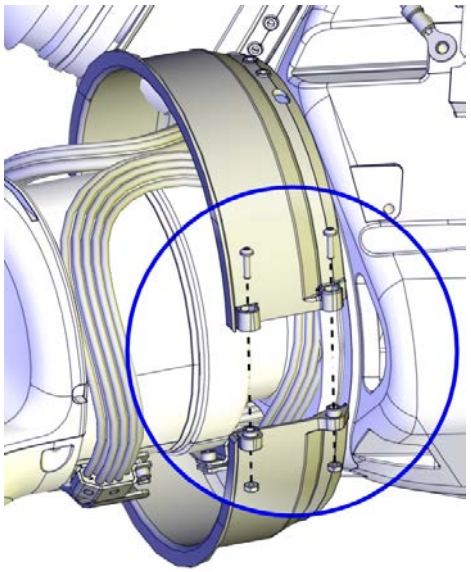
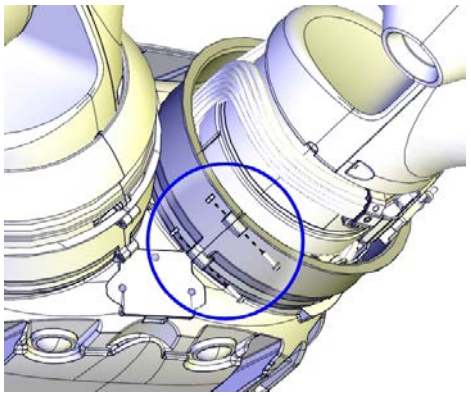
Refitting the axis-1 covers

	Action	Note
1	Refit the lower axis-1 cover.	Screws: 3HAC050368-005 (4 pcs). Nuts: 9ADA267-1 (4 pcs). Tightening torque: 0.14 Nm.  xx1400002606  xx1400002604

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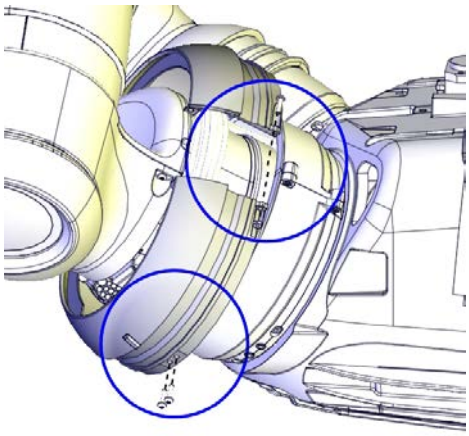
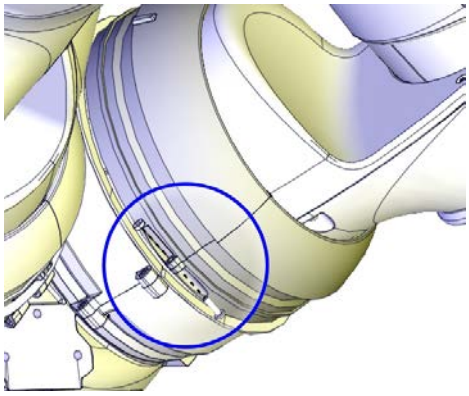
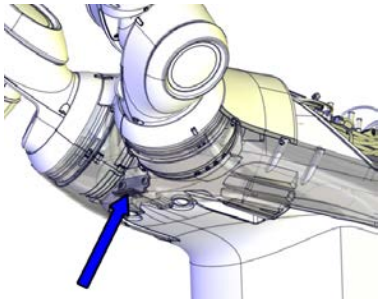
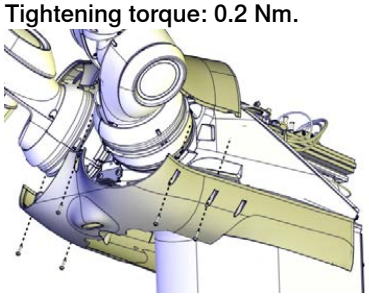
4.5.1 Replacing the axis-1 mechanical stop

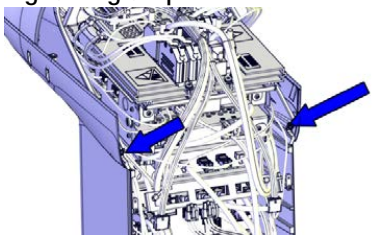
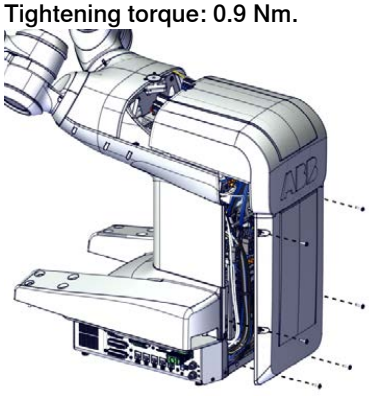
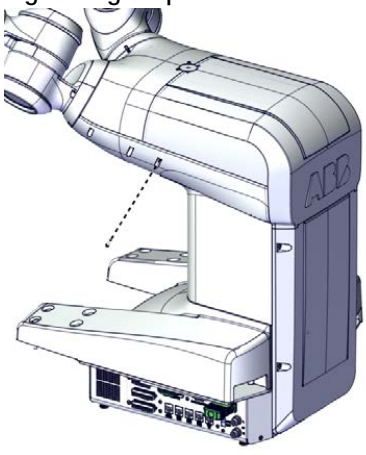
Continued

	Action	Note
2	Refit the upper axis-1 cover.	Screws: 3HAC050368-005 (2 pcs). Nuts: 9ADA267-1 (2 pcs). Tightening torque: 0.14 Nm.  xx1400002605  xx1400002601

Refitting the body covers

	Action	Note
1	Refit the front and lower body cover. **Note** Be aware of the tab underneath the cover so it does not get damaged.  xx1500000564	Screws: 3HAC050368-005 (5 pcs). Tightening torque: 0.2 Nm.  xx1400002603

Continues on next page

	Action	Note
2	Refit the back screws of the lower body cover.	Screws: 3HAC050367-005 (2 pcs). Tightening torque: 0.2 Nm.  xx1500000540
3	Refit the body cover.	Screws: 3HAC050367-005 (6 pcs). Tightening torque: 0.9 Nm.  xx1500000697
4	Refit the two remaining screws of the body cover.	Screws: 3HAC050367-005 (2 pcs). Tightening torque: 0.2 Nm.  xx1500000696

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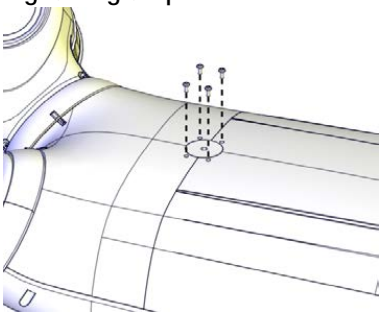
4.5.1 Replacing the axis-1 mechanical stop

Continued

	Action	Note
5	Refit the body cover top screws.	Screws: M3x6 (4 pcs). Tightening torque: 0.2 Nm.  xx1400002904

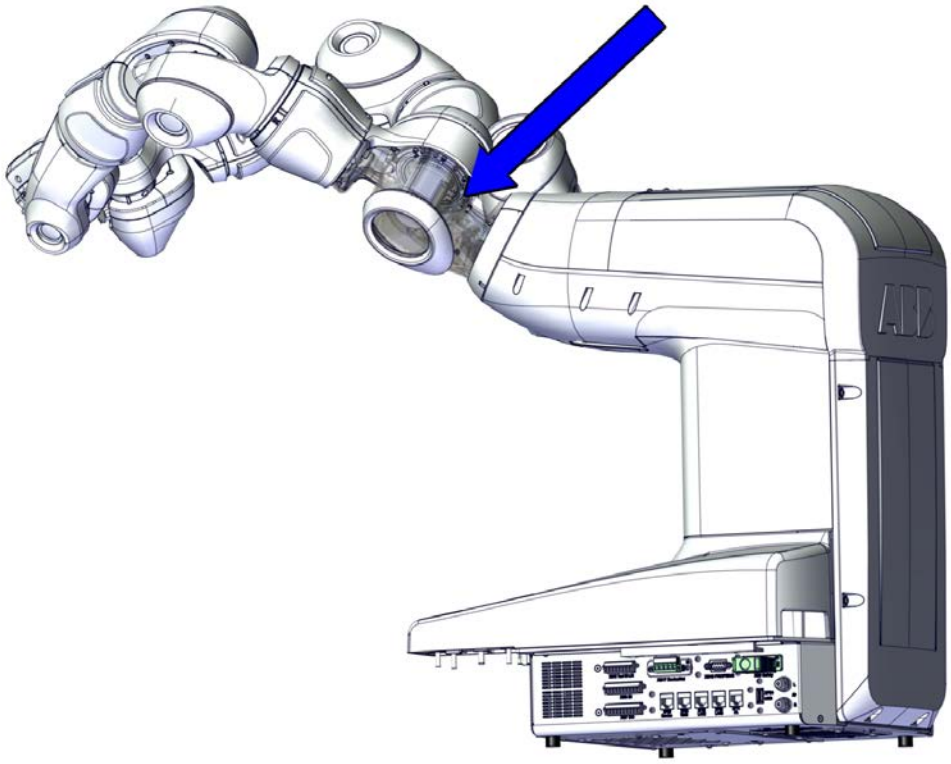
Concluding procedure

	Action	Note
1	Re-calibrate the robot.	See *Calibration on page 397*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.5.2 Replacing the axis-2 mechanical stop

Location of the mechanical stop

The mechanical stop is located as shown in the figure.



xx1500000740

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Mechanical stop for axis 2	3HAC047602-001	
Hex socket head cap screw	3HAC050368-005	M2x8 8.8
Hex socket head cap screw	3HAB3409-241	M2.5x12 12.9 Lafre 2C2B/FC6.9

Required tools and equipment

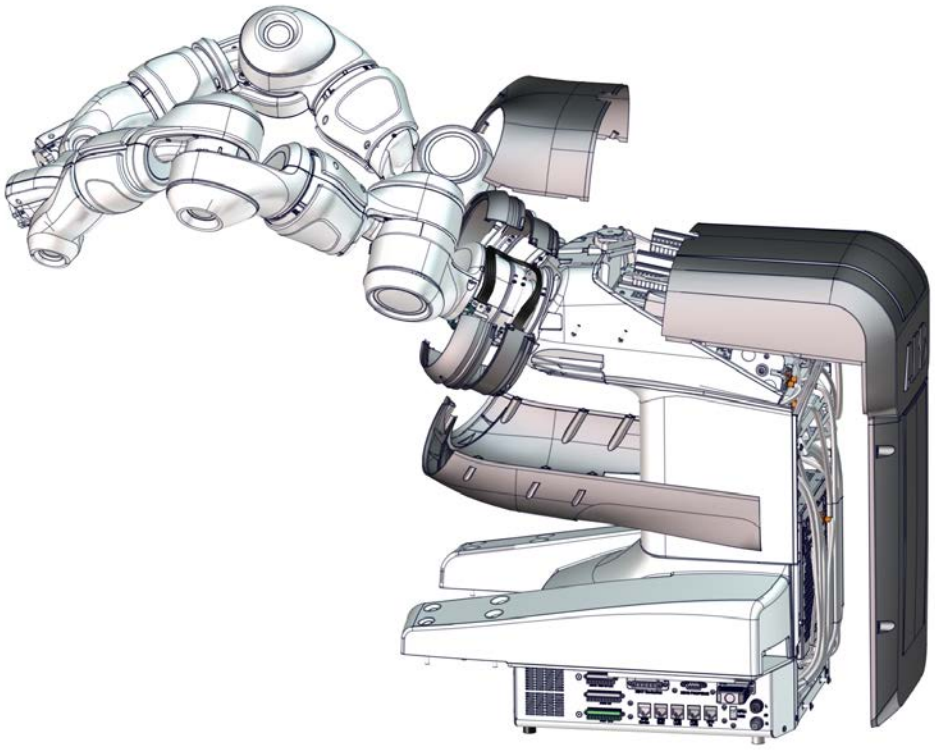
Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.

Continues on next page

4.5.2 Replacing the axis-2 mechanical stop
Continued

Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



xx1500000493

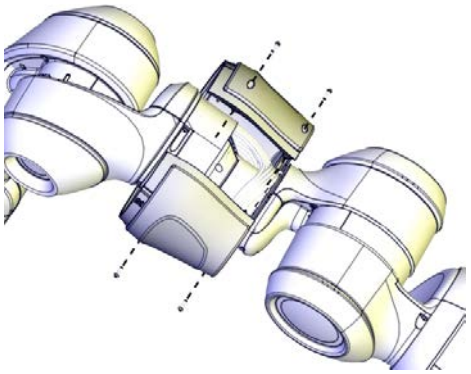
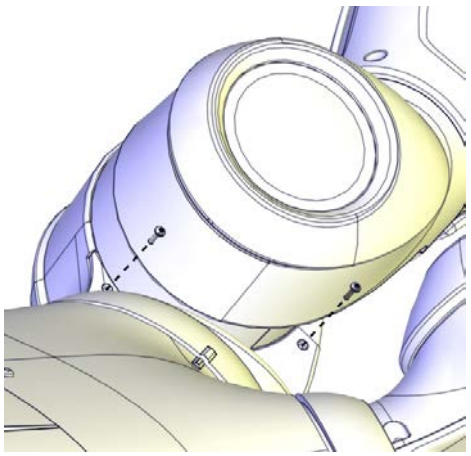
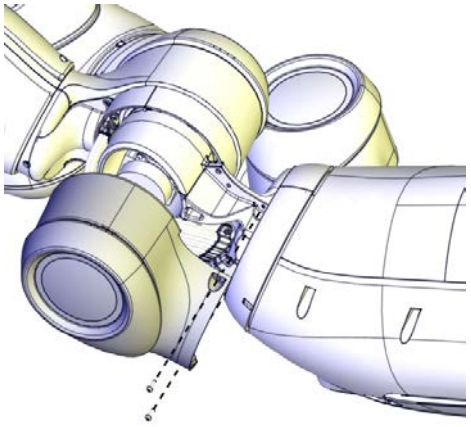
Removing the mechanical stop

Use these procedures to remove the mechanical stop.

Preparations before removing the mechanical stop

	Action	Note
1	Jog the robot so that the covers can be easily accessed and removed.	
2	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

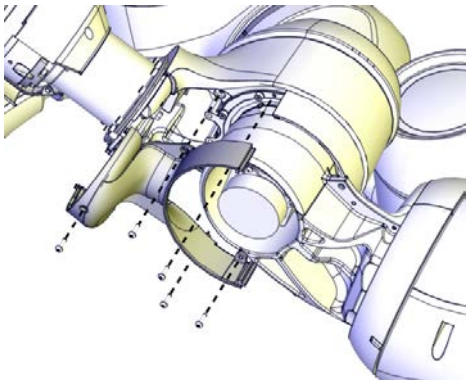
Continues on next page

	Action	Note
3	Remove the axis-7 cover.	 xx1400002691
4	Remove the lower axis-2 cover.	 xx1400002614  xx1400002615

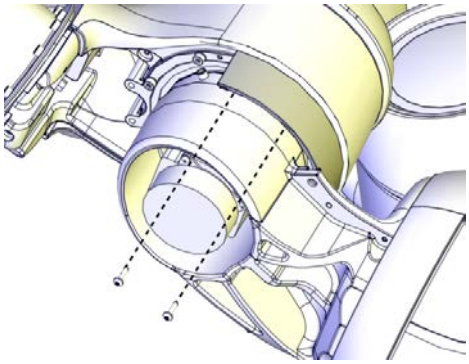
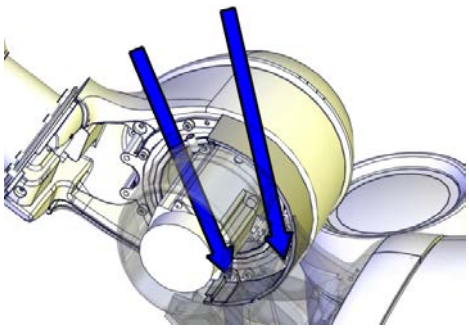
Continues on next page

4.5.2 Replacing the axis-2 mechanical stop

Continued

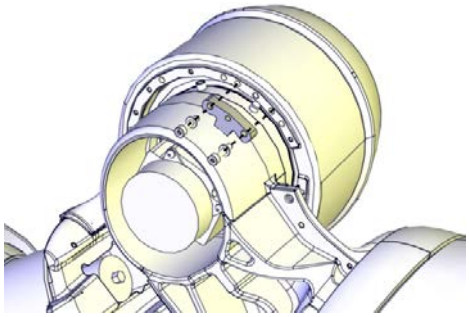
	Action	Note
5	Remove the axis-2 cable cover.	 xx1500000256

Removing the axis-2 cable collar

	Action	Note
1	Remove the two accessible screws of the axis-2 cable collar.	 xx1500000486
2	Turn on the power to the robot temporarily.	
3	Release the brakes and rotate axis 2 in order to access the two remaining axis-2 cable collar screws.	 xx1500000487
4	**DANGER** Turn off the electric power supply again.	
5	Remove the two screws and remove the cable collar.	

Continues on next page

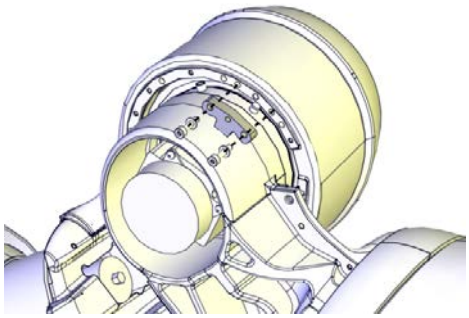
Removing the axis-2 mechanical stop

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
2	Remove the mechanical stop by removing the two screws and washers.	 xx1500000488

Refitting the mechanical stop

Use these procedures to refit the mechanical stop.

Refitting the axis-2 mechanical stop

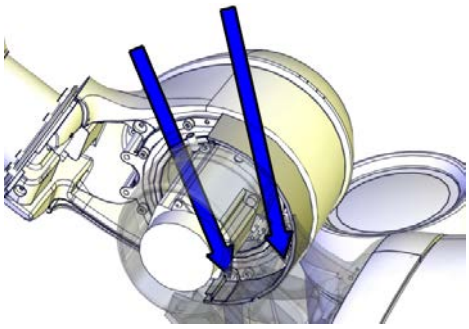
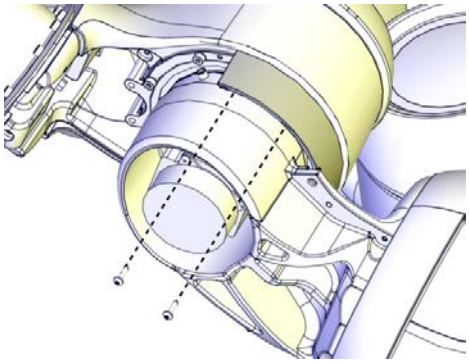
	Action	Note
1	Refit the mechanical stop with the screws and washers.	Mechanical stop for axis 2: 3HAC047602-001 Screws: 3HAB3409-241 (2 pcs). Tightening torque: 0.4 Nm.  xx1500000488

Continues on next page

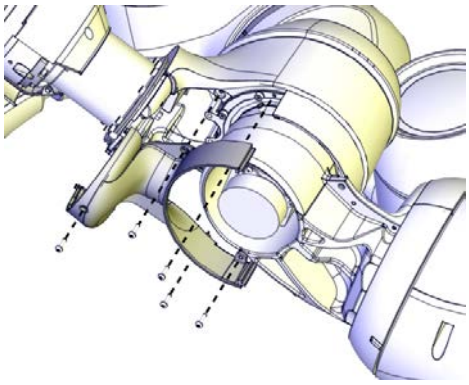
4.5.2 Replacing the axis-2 mechanical stop

Continued

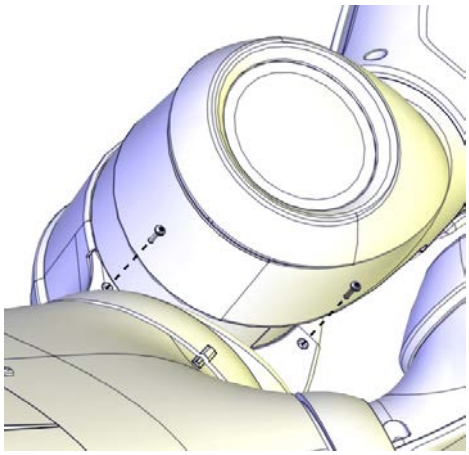
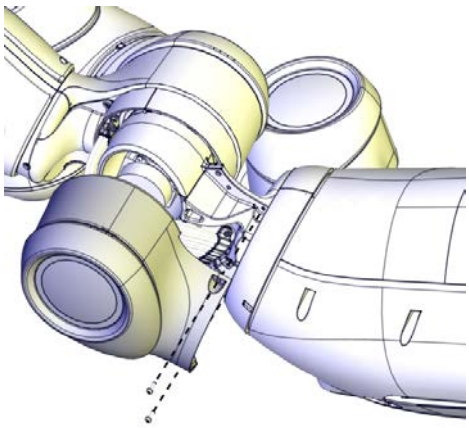
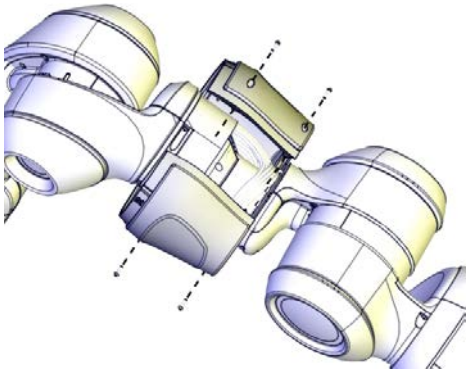
Refitting the axis-2 cable collar

	Action	Note
1	Refit the cable collar with the screws. **Tip** In order to access the screws it is helpful to release the brakes and manually move the robot arm. Temporarily turn on the power to the robot and release the brakes.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1500000487  xx1500000486

Refitting the covers

	Action	Note
1	Refit the axis-2 cable cover.	Screws: 3HAC050368-005 (5 pcs). Tightening torque: 0.14 Nm.  xx1500000256

Continues on next page

	Action	Note
2	Refit the lower axis-2 cover.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1400002614  xx1400002615
3	Refit the axis-7 cover.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1400002691

Concluding procedure

	Action	Note
1	Re-calibrate the robot.	See *Calibration on page 397*.

Continues on next page

4.5.2 Replacing the axis-2 mechanical stop

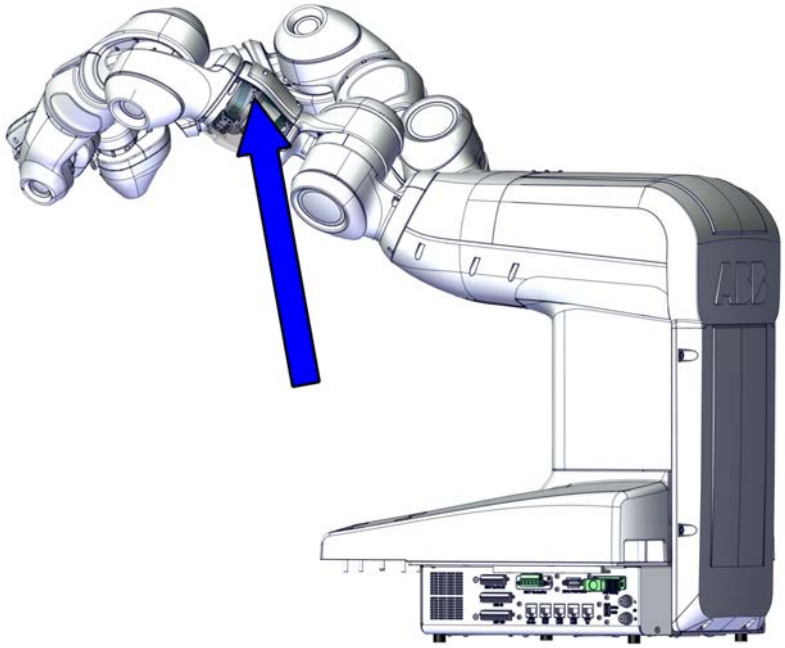
Continued

	Action	Note
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.5.3 Replacing the axis-7 mechanical stop

Location of the mechanical stop

The mechanical stop is located as shown in the figure.



xx1500000748

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Mechanical stop for axis 7	3HAC047603-001	
Hex socket head cap screw	3HAB3409-241	M2.5x12 12.9 Lafre 2C2B/FC6.9
Hex socket head cap screw	3HAC050368-005	M2x8 8.8

Required tools and equipment

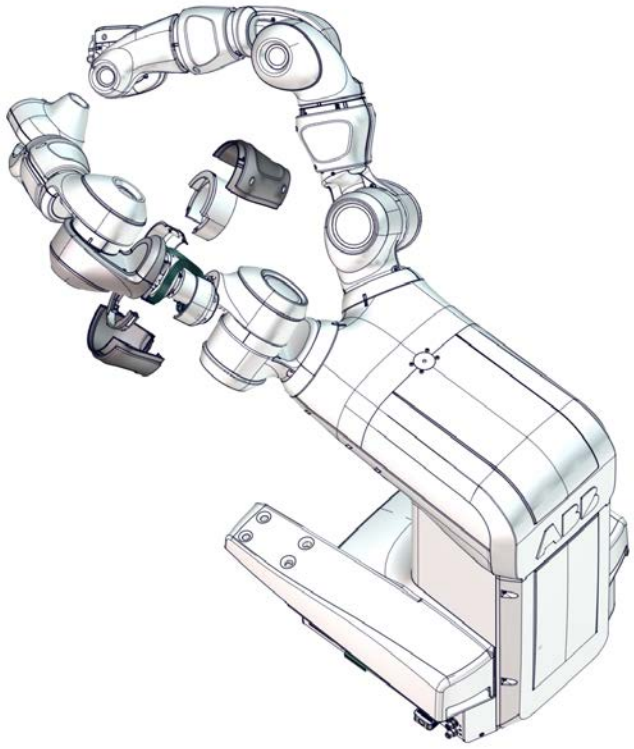
Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.

Continues on next page

4.5.3 Replacing the axis-7 mechanical stop
Continued

Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



xx1500000749

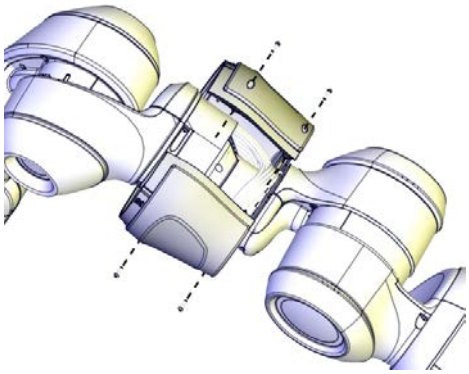
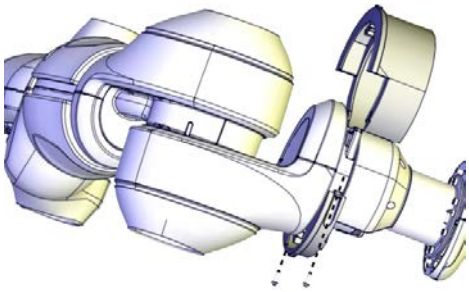
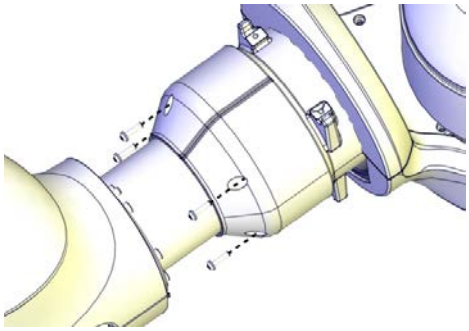
Removing the mechanical stop

Use these procedures to remove the mechanical stop.

Preparations before removing the mechanical stop

	Action	Note
1	Jog the robot so that the covers can be easily accessed and removed.	
2	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

Continues on next page

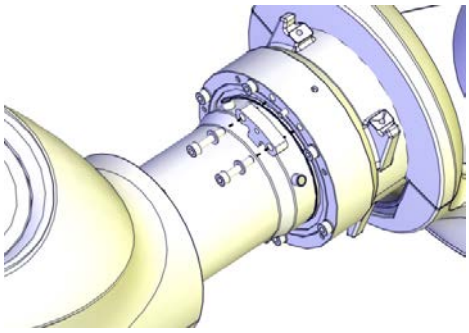
	Action	Note
3	Remove the axis-7 cover.	 xx1400002691
4	Remove the axis-7 ring (two parts).	 xx1500000742
5	Remove the axis-7 inner cable protection.	 xx1500000743

Removing the axis-7 mechanical stop

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

Continues on next page

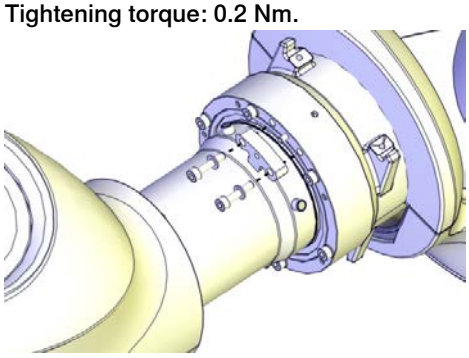
4.5.3 Replacing the axis-7 mechanical stop
Continued

	Action	Note
2	Remove the mechanical stop by removing the two screws and washers.	 xx1500000747

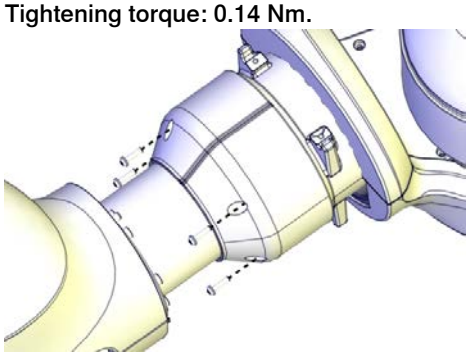
Refitting the mechanical stop

Use these procedures to refit the mechanical stop.

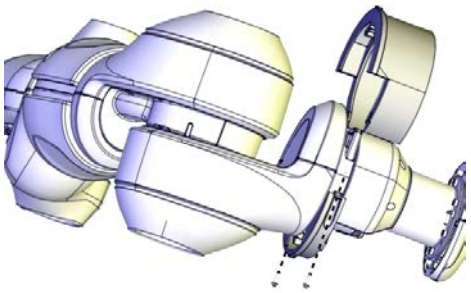
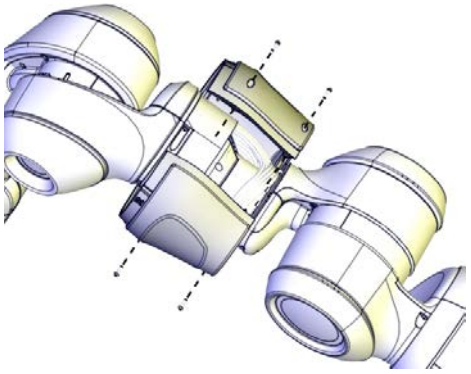
Refitting the axis-7 mechanical stop

	Action	Note
1	Refit the mechanical stop with the screws and washers.	Mechanical stop for axis 7: 3HAC047603-001 Screws: 3HAB3409-241 (2 pcs). Tightening torque: 0.2 Nm.  xx1500000747

Refitting the covers

	Action	Note
1	Refit the axis-7 inner cable protection.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1500000743

Continues on next page

	Action	Note
2	Refit the axis-7 ring (two parts).	Screws: 3HAC050368-005 (2 pcs). Tightening torque: 0.14 Nm.  xx1500000742
3	Refit the axis-7 cover.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1400002691

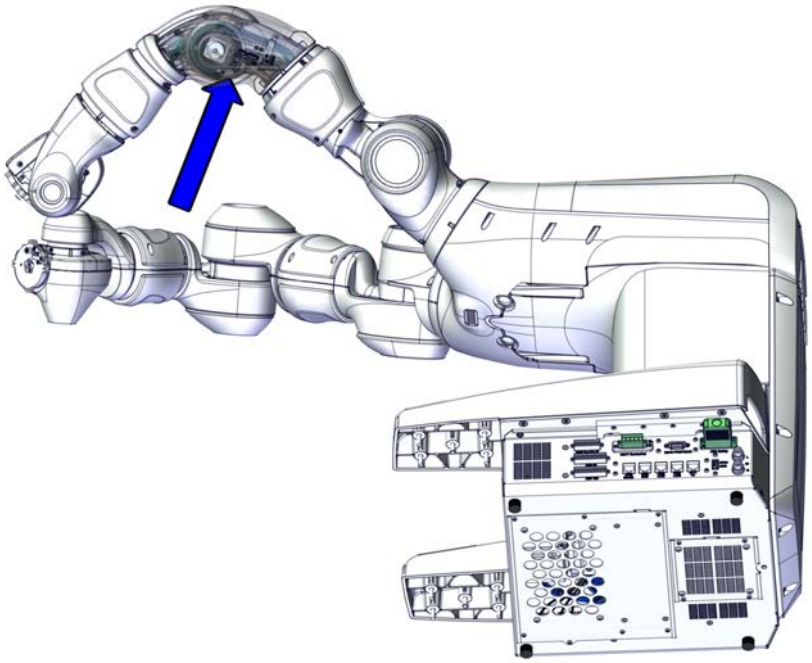
Concluding procedure

	Action	Note
1	Re-calibrate the robot.	See *Calibration on page 397*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.5.4 Replacing the axis-3 mechanical stop

Location of the mechanical stop

The mechanical stop is located as shown in the figure.



xx1500000750

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Mechanical stop for axis 3	3HAC047603-001	
Hex socket head cap screw	3HAB3409-241	M2.5x12 12.9 Lafre 2C2B/FC6.9
Hex socket head cap screw	3HAC050368-005	M2x8 8.8

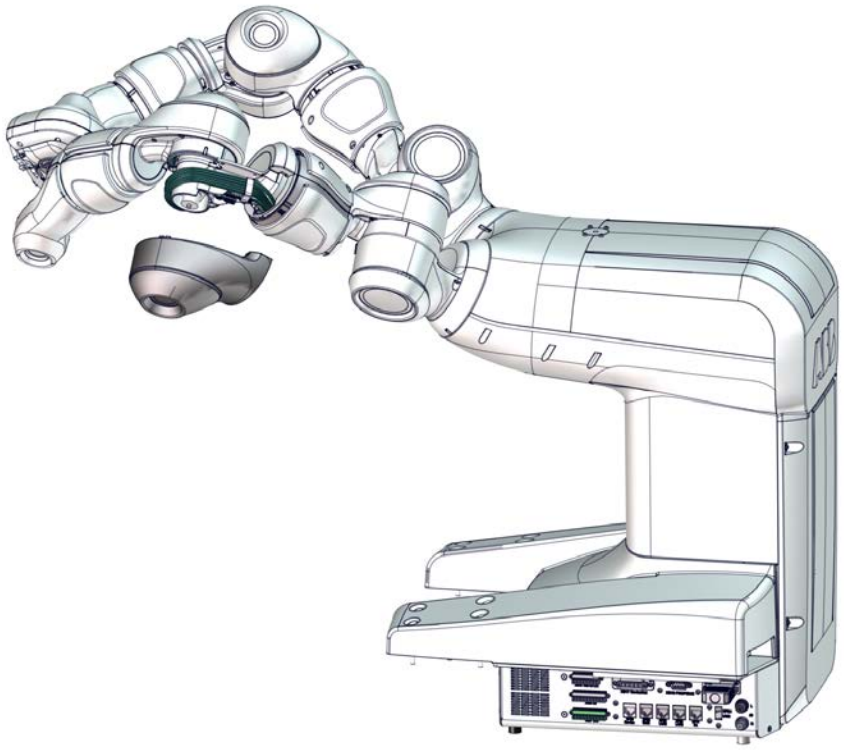
Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.

Continues on next page

Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



xx1400002862

Removing the mechanical stop

Use these procedures to remove the mechanical stop.

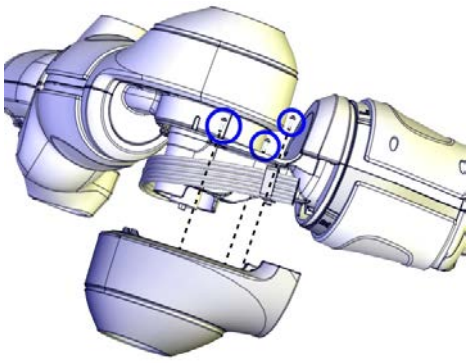
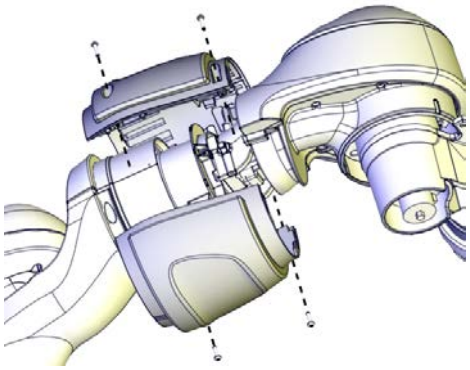
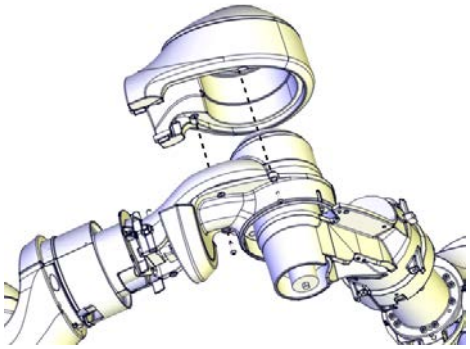
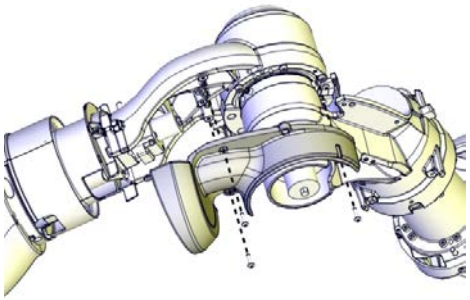
Preparations before removing the mechanical stop

	Action	Note
1	Jog the robot so that the covers can be easily accessed and removed.	
2	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

Continues on next page

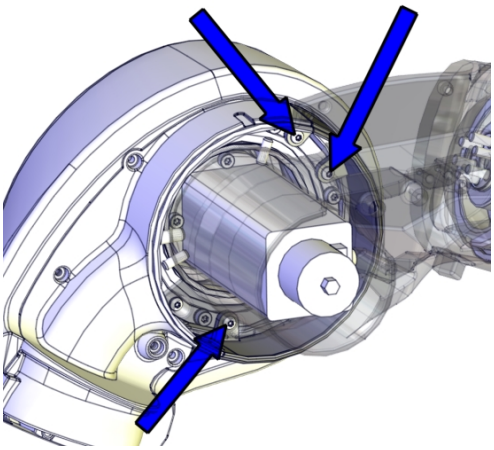
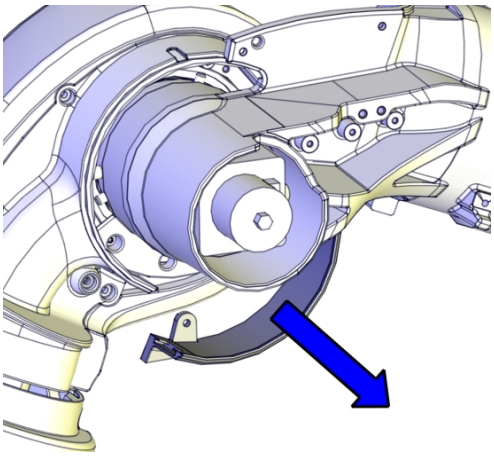
4.5.4 Replacing the axis-3 mechanical stop

Continued

	Action	Note
3	Remove the axis-3 cover.	 xx1400002751
4	Remove the lower axis-4 cover.	 xx1400002756
5	Remove the axis-3 body cover.	 xx1500000091
6	Remove the upper axis-3 cover.	 xx1500000093

Continues on next page

Removing the axis-3 cable collar

	Action	Note
1	Turn on the power to the robot temporarily.	
2	Release the brakes and rotate axis 3 in order to access the axis-3 cable collar screws.	 xx1500000489
3	**DANGER** Turn off the electric power supply again.	
4	Remove the screws and remove the cable collar.	 xx1500000756

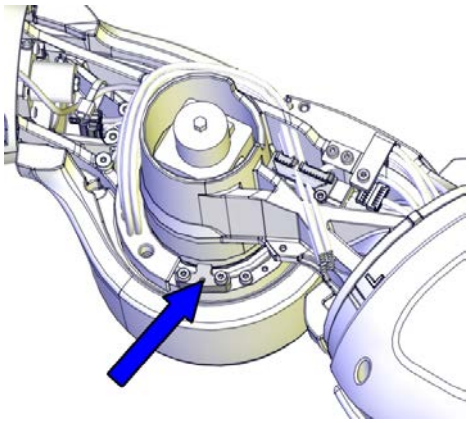
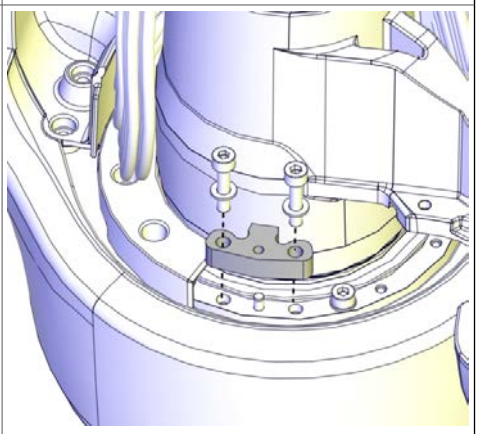
Removing the axis-3 mechanical stop

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
2	Turn on the power to the robot temporarily.	

Continues on next page

4.5.4 Replacing the axis-3 mechanical stop

Continued

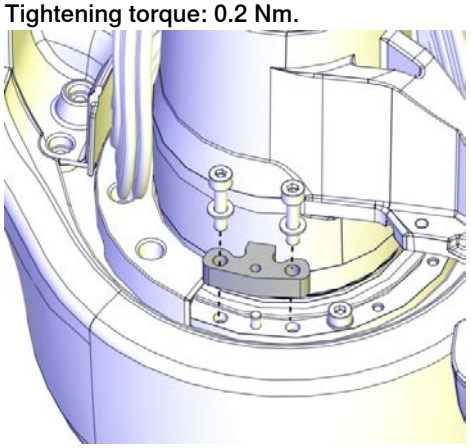
	Action	Note
3	Release the brakes and rotate axis 3 in order to access the axis-3 mechanical stop.	 xx1500000755
4	**DANGER** Turn off the electric power supply again.	
5	Remove the mechanical stop by removing the two screws and washers.	 xx1500000753

Continues on next page

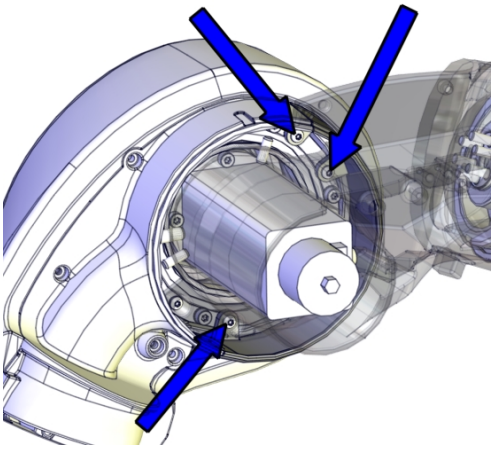
Refitting the mechanical stop

Use these procedures to refit the mechanical stop.

Refitting the axis-3 mechanical stop

	Action	Note
1	Refit the mechanical stop with the screws and washers.	Mechanical stop for axis 3: 3HAC047603-001 Screws: 3HAB3409-241 (2 pcs). Tightening torque: 0.2 Nm.  xx1500000753

Refitting the axis-3 cable collar

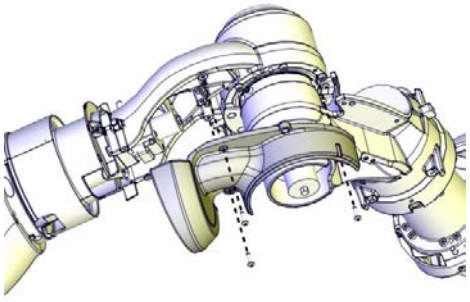
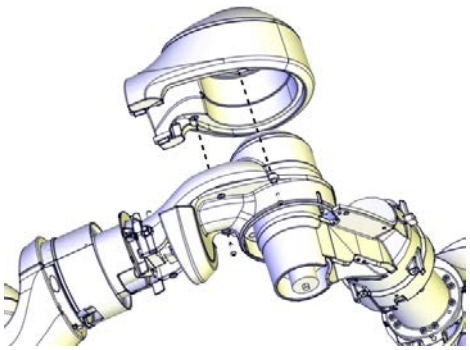
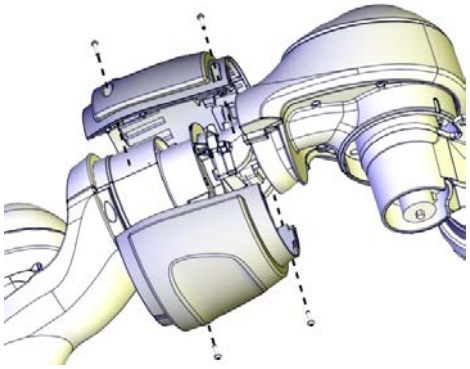
	Action	Note
1	Refit the cable collar. **Tip** In order to access the screws it is helpful to release the brakes and manually move the robot arm. Temporarily turn on the power to the robot and release the brakes.	Screws: 3HAC050368-005 (3 pcs). Tightening torque: 0.14 Nm.  xx1500000489

Continues on next page

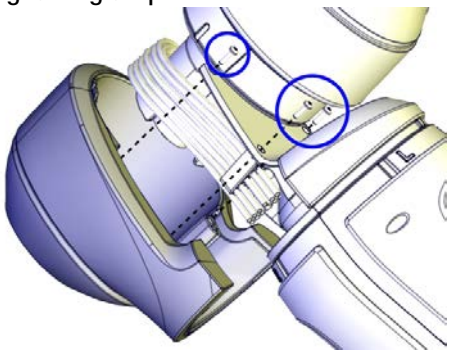
4.5.4 Replacing the axis-3 mechanical stop

Continued

Refitting the covers

	Action	Note
1	Refit the upper axis-3 cover.	Screws: 3HAC050368-005 (3 pcs). Tightening torque: 0.14 Nm.  xx1500000093
2	Refit the axis-3 body cover.	Screws: 3HAC050368-005 (2 pcs). Tightening torque: 0.14 Nm.  xx1500000091
3	Remove the lower axis-4 cover.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1400002756

Continues on next page

	Action	Note
4	Refit the axis-3 cover. **CAUTION** Be careful not to squeeze any cabling during the refitting procedure.	Screws: 3HAC050368-005 (3 pcs). Tightening torque: 0.14 Nm.  xx1400002753

Concluding procedure

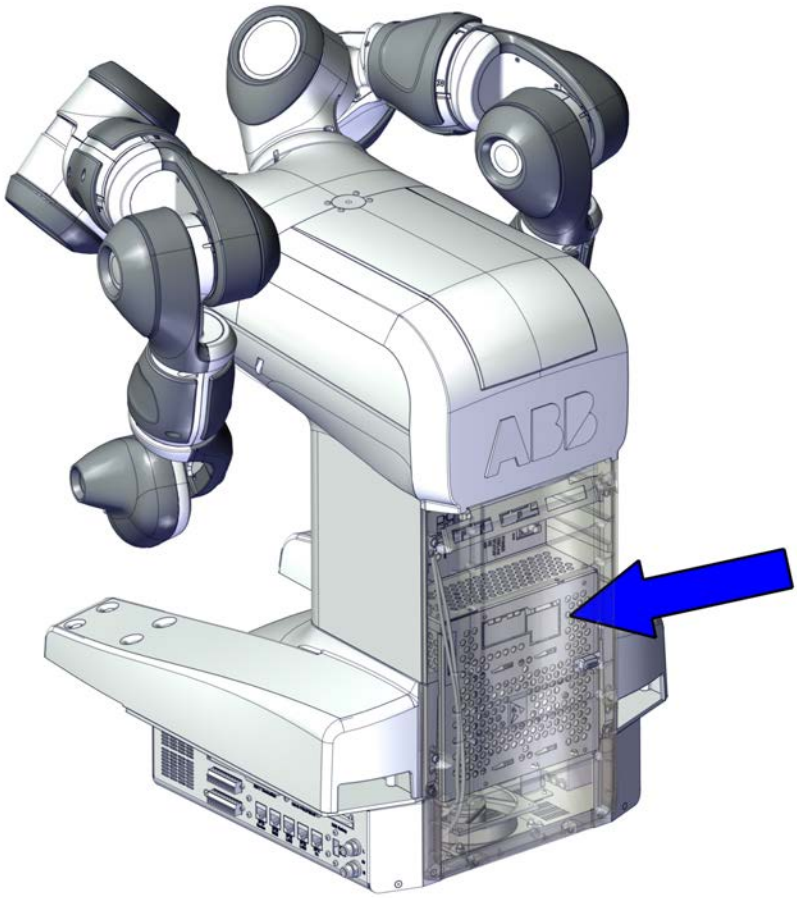
	Action	Note
1	Re-calibrate the robot.	See *Calibration on page 397*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.6 Controller

4.6.1 Replacing the computer

Location of the computer

The computer is located as shown in the figure.



xx1500000369

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
DSQC1018 Computer	3HAC050363-001	
Torx pan head screw	3HAC050367-005	M3x12 8.8 Gleitmo 605

Continues on next page

Required consumables

Consumable	Article number	Note
Cable ties	-	

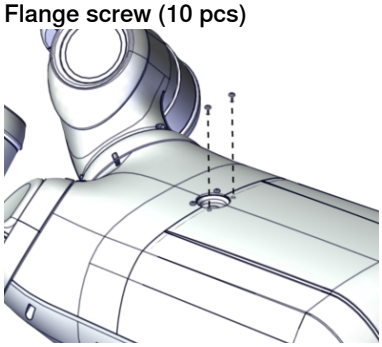
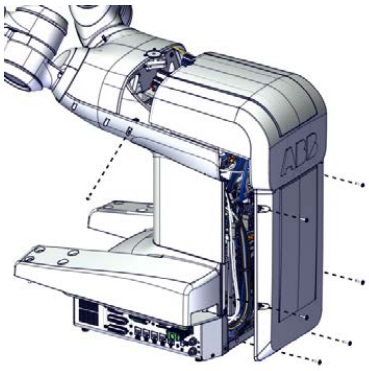
Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.
Trolley	-	

Removing the computer

Use these procedures to remove the computer.

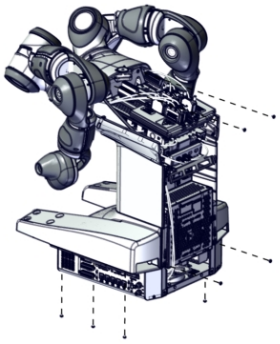
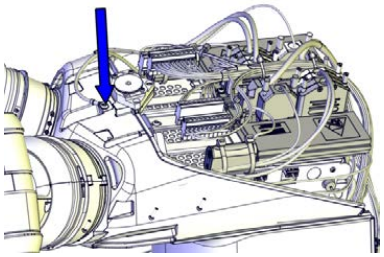
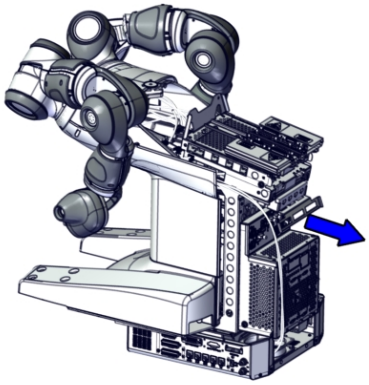
Pulling the controller out partially

	Action	Note
1	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	
2	Remove the body cover. **ELECTROSTATIC DISCHARGE (ESD)** The equipment is sensitive to ESD. Before handling the equipment please read the safety information in the section *The unit is sensitive to ESD on page 58*	Flange screw (10 pcs)  xx1500000525  xx1500000303

Continues on next page

4.6.1 Replacing the computer

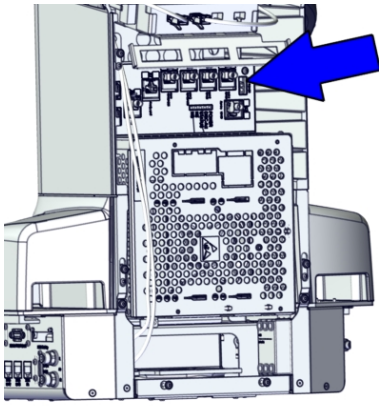
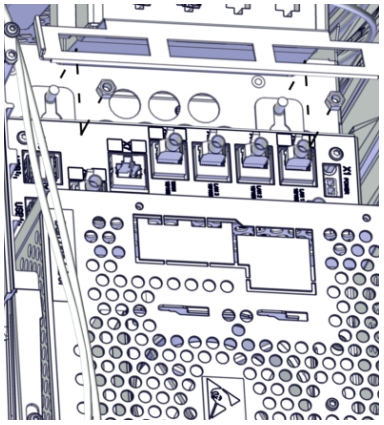
Continued

	Action	Note
3	Remove the attachment screws that fasten the controller to the body.	 xx1500000364
4	Put a trolley beneath the controller.	
5	Disconnect the grounding cable.	 xx1500000601
6	Carefully pull the controller partially out in the rails. **CAUTION** The cabling is still connected inside the robot, so be careful not to strain the cables!	 xx1500000365

Removing the computer

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	

Continues on next page

	Action	Note
2	Separate the cabling in front of the computer, cut cable ties if necessary. **CAUTION** Be careful not to bend or break the cables and air hoses.	
3	Disconnect the connectors: • A31.USB (X10) • A31.X9 (X9) • A31.X6 (X6) • A31.X5 (X5) • A31.X4 (X4) • A31.X3 (X3) • A31.XS1 (X1) • A31.SERVICE (X2)	 xx1500000371
4	Cut cable ties from the disconnected cables if necessary.	
5	(Depending on which connection is installed) Disconnect the connector: • Profibus/S: A32.2 • Ethernet/IP/S: A32.1 • ProfiNet/S: A32.3	
6	Loosen the nuts holding the computer.	 xx1500000386 Nut 9ADA267-5 M5 Steel 8-A2F
7	Gently push the computer upwards a little bit to release the latches from the recesses.	
8	Disconnect the connection (underneath computer): A35.J1 D-NET	
9	Tilt the computer out and remove it from the controller.	

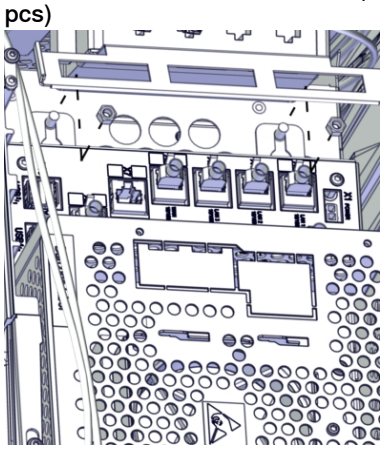
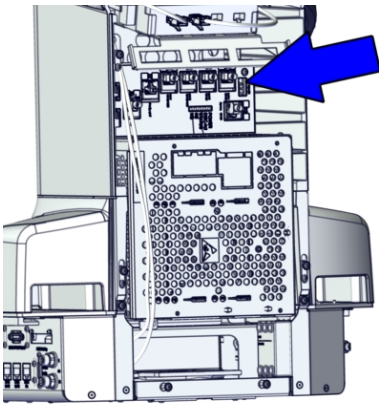
Continues on next page

4.6.1 Replacing the computer

Continued

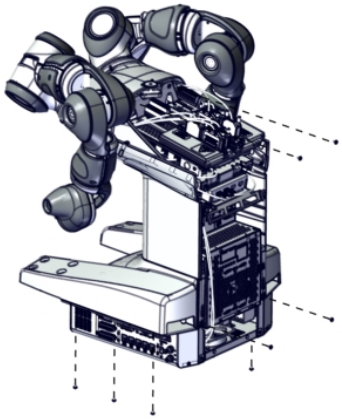
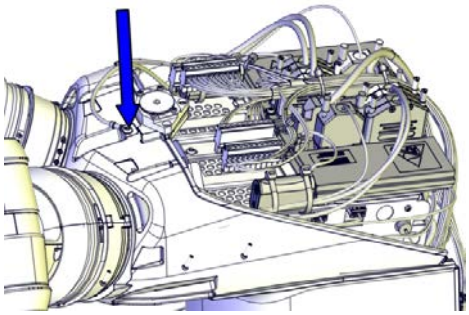
Refitting the computer

Refitting the computer

	Action	Note
1	Fit the computer.	DSQC1018 Computer: 3HAC050363-001
2	Connect the and tighten the connector (underneath computer) A35.J1 D-NET	
3	Slide the computer downwards to fit the latches in the recesses.	
4	Tighten the nuts, holding the computer.	Nut: 9ADA267-4 M4 Steel 8-A2F (3 pcs)  xx1500000386
5	(Depending on which connection is installed) Connect the connector: • Profibus/S: A32.2 • Ethernet/IP/S: A32.1 • ProfiNet/S: A32.3	
6	Connect the connectors: • A31.USB (X10) • A31.X9 (X9) • A31.X6 (X6) • A31.X5 (X5) • A31.X4 (X4) • A31.X3 (X3) • A31.XS1 (X1) • A31.SERVICE (X2)	 xx1500000371
7	Fasten the cabling with cable ties. **CAUTION** Be careful not to bend or break the cables and air hoses.	

Continues on next page

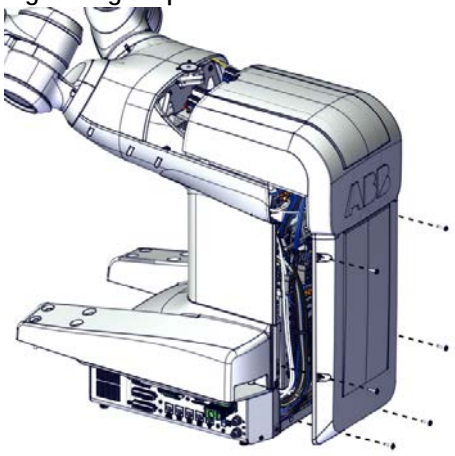
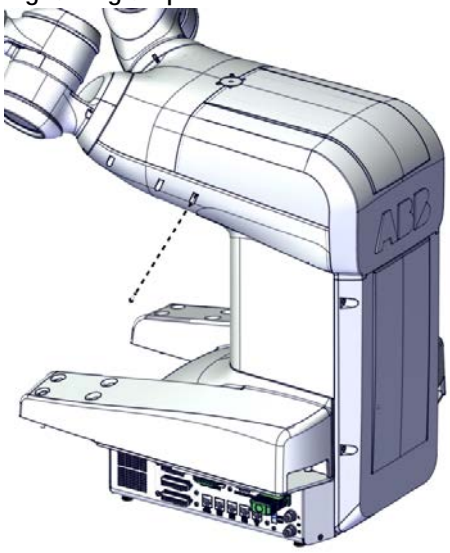
Pushing the controller in and fastening it

	Action	Note
1	Gently push the controller into the robot body completely. **CAUTION** Be careful not to squeeze or damage the cables and air hoses in any way.	
2	Refit the attachment screws that fasten the controller to the body.	Screws: 3HAC16446-4 (10 pcs). Tightening torque: 0.9 Nm.  xx1500000364
3	Connect the grounding cable.	 xx1500000601

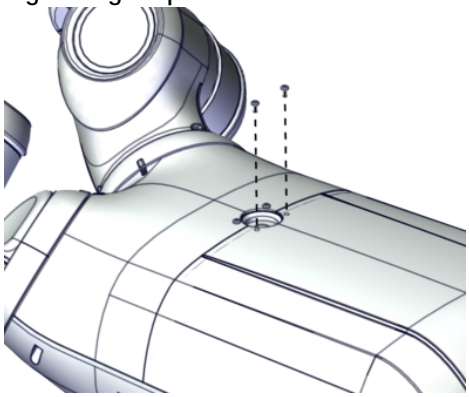
Continues on next page

4.6.1 Replacing the computer

Continued

	Action	Note
4	Refit the body cover with the attachment screws.	Screws: 3HAC052487-001 (6 pcs). Tightening torque: 0.9 Nm  xx1500000697
5	Refit the two remaining screws of the body cover.	Screws: 3HAC050367-005 (2 pcs). Tightening torque: 0.2 Nm  xx1500000696

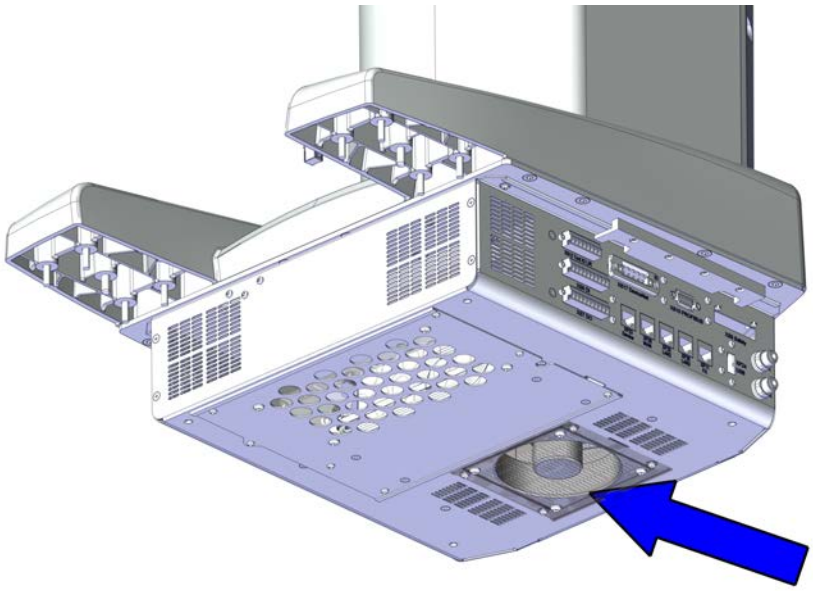
Continues on next page

	Action	Note
6	Refit the attachment screws.	Screws: M3x6 8.8-A2F (2 pcs). Tightening torque: 0.2 Nm  xx1500000525
7	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.6.2 Replacing the controller fan

Location of the controller fan

The controller fan is located as shown in the figure.



xx1500000309

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Fan with receptacle	3HAC026525-001	

Required tools and equipment

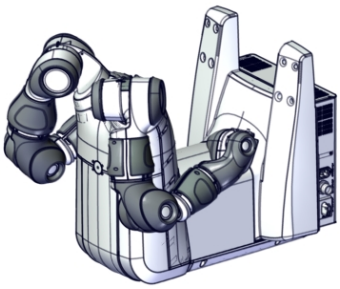
Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.
Trolley	-	

Continues on next page

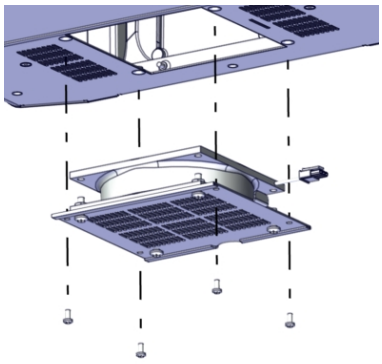
Removing the fan

Use this procedure to remove the fan.

Preparations before removing the fan

	Action	Note
1	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	
2	Check if there is enough space beneath the robot to remove the bottom cover. If not: • Place the robot in its calibration position. • Remove the fastening screws. • Put the robot on a flat and stable surface in the following position:	 xx1500000370

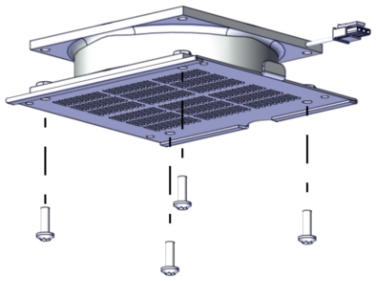
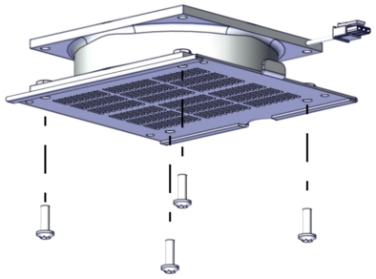
Removing the fan

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	Remove the bottom cover. **CAUTION** Be careful not to damage the cables.	 xx1500000310
3	Disconnect the fan connector: • E1.XS1	

Continues on next page

4.6.2 Replacing the controller fan
Continued

Replacing the fan

	Action	Note
1	Remove the attachment screws.	 xx1500000311
2	Remove the fan.	
3	Fit the new fan on the bottom cover and tighten the attachment screws.	Fan with receptacle: 3HAC026525-001  xx1500000311

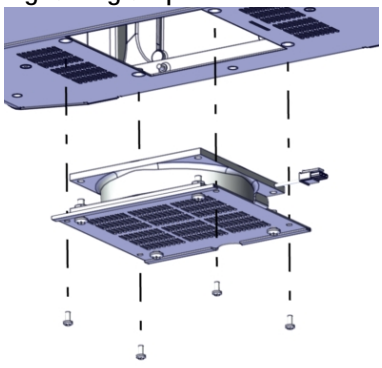
Refitting the fan

Use this procedure to refit the fan.

Refitting the fan

	Action	Note
1	Connect the fan connector. • E1.XS1	

Continues on next page

	Action	Note
2	Refit the bottom cover and tighten the screws. **CAUTION** Be careful not to damage the cables.	Screws: M3x6 8.8-A2F (4 pcs). Tightening torque: 0.2 Nm  xx1500000310

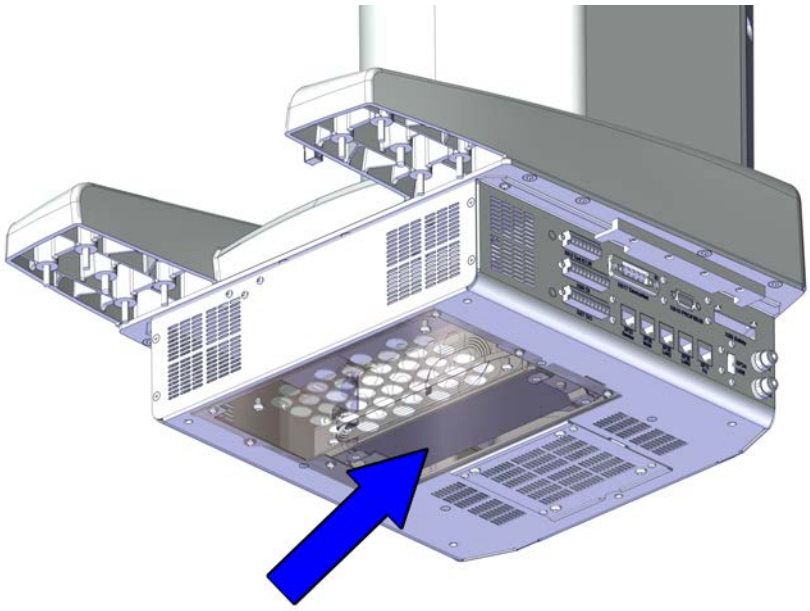
Concluding procedure

	Action	Note
1	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.6.3 Replacing the capacitor bank

Location of the capacitor bank

The capacitor bank is located as shown in the figure.



xx1500000265

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Capacitor bank	3HAC025562-001	

Required consumables

Consumable	Article number	Note
Cable ties	-	If removed

Required tools and equipment

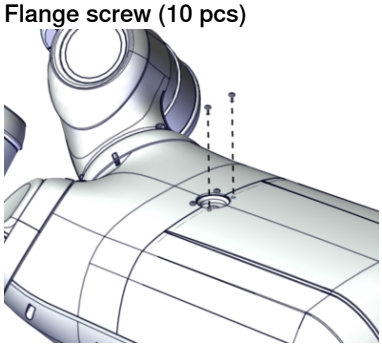
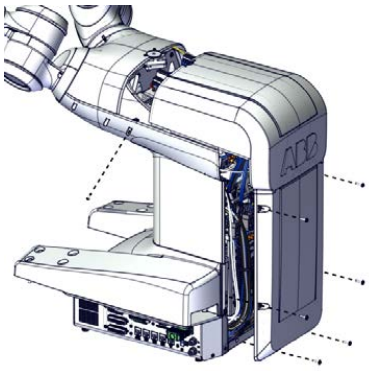
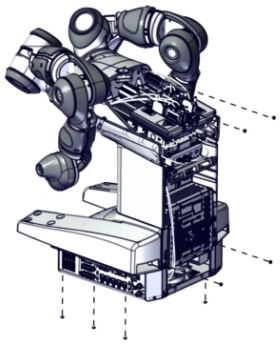
Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.
Trolley	-	

Continues on next page

Removing the capacitor bank

Use this procedure to remove the capacitor bank.

Pulling the controller out partially

	Action	Note
1	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	
2	Remove the body cover. **ELECTROSTATIC DISCHARGE (ESD)** The equipment is sensitive to ESD. Before handling the equipment please read the safety information in the section *The unit is sensitive to ESD on page 58*	Flange screw (10 pcs)  xx1500000525  xx1500000303
3	Remove the attachment screws that fasten the controller to the body.	 xx1500000364
4	Put a trolley beneath the controller.	

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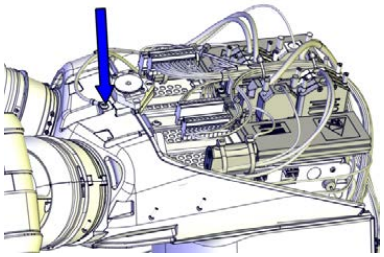
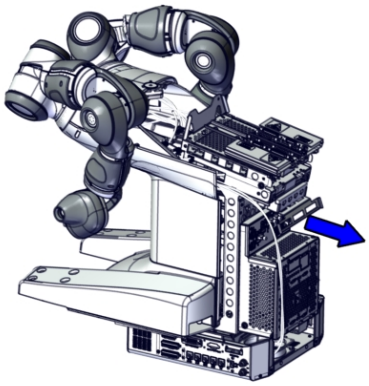
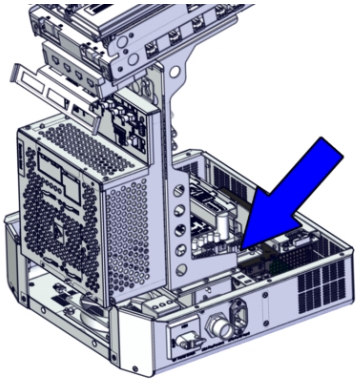
4.6.3 Replacing the capacitor bank

Continued

	Action	Note
5	Disconnect the grounding cable.	 xx1500000601
6	Carefully pull the controller partially out in the rails. **CAUTION** The cabling is still connected inside the robot, so be careful not to strain the cables!	 xx1500000365

Removing the capacitor bank

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	Disconnect the capacitor bank connector, cut cable ties if necesssary: • PDB.X7	 xx1500000307

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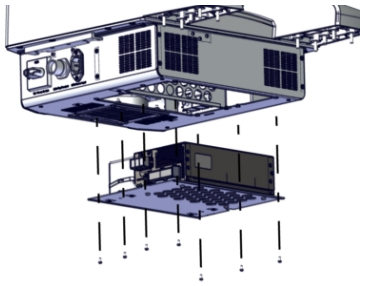
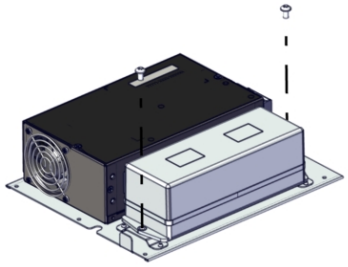
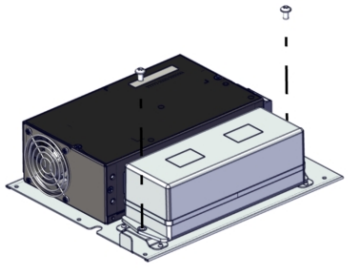
	Action	Note
3	Remove the bottom cover. **CAUTION** Be careful not to damage the cables.	 xx1500000268
4	Remove the attachment screws.	 xx1500000305

Refitting the capacitor bank

Use this procedure to refit the capacitor bank.

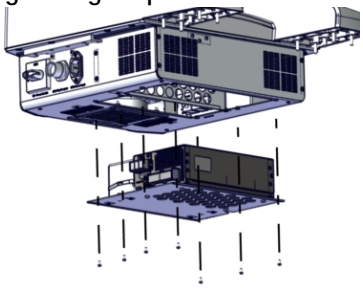
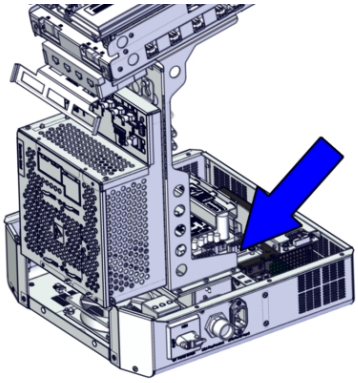
Refitting the capacitor bank

	Action	Note
1	Place the new capacitor bank and tighten the attachment screws.	Capacitor bank: 3HAC025562-001 Screws: M5x8 8.8-A2F (4 pcs). Tightening torque: 0.8 Nm  xx1500000305

Continues on next page

4.6.3 Replacing the capacitor bank

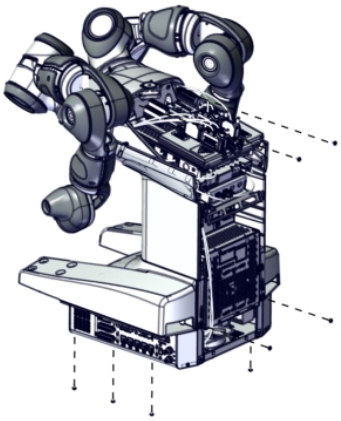
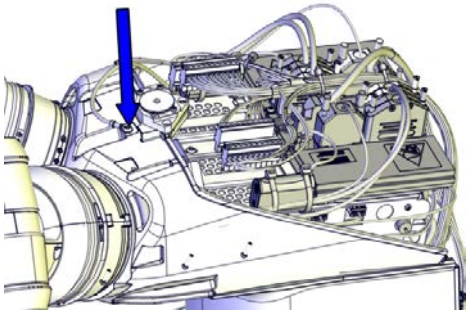
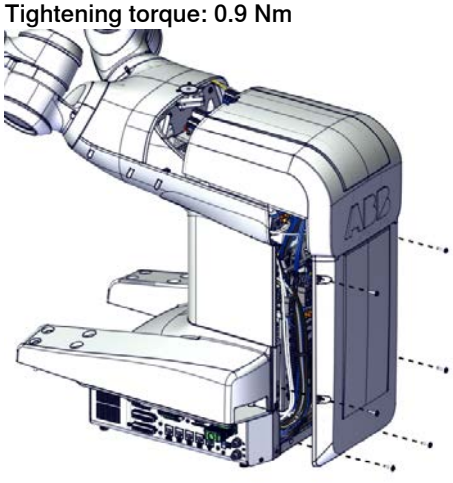
Continued

	Action	Note
2	Refit the bottom cover and tighten screws. **CAUTION** Be careful not to damage the cables.	Screws: M3x6 8.8-A2F (7 pcs). Tightening torque: 0.2 Nm  xx1500000268
3	Route cables and connect capacitor bank connector: • PDB.X7	 xx1500000307
4	Fasten cables with cable ties. **CAUTION** Be careful not to bend or break the cables.	

Pushing the controller in and fastening it

	Action	Note
1	Gently push the controller into the robot body completely. **CAUTION** Be careful not to squeeze or damage the cables and air hoses in any way.	

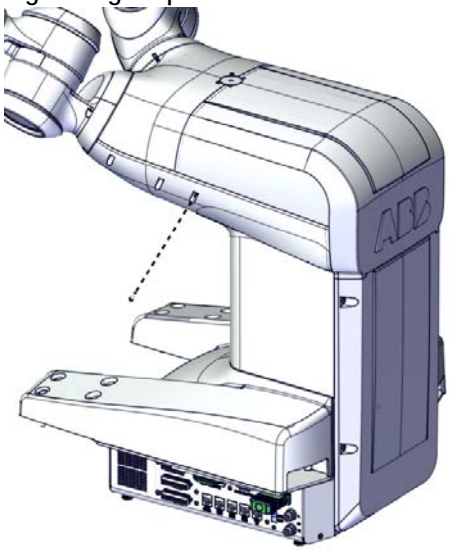
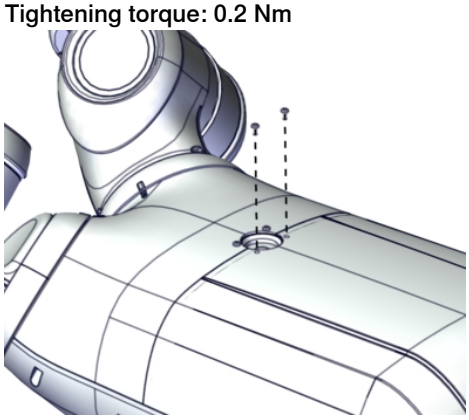
Continues on next page

	Action	Note
2	Refit the attachment screws that fasten the controller to the body.	Screws: 3HAC16446-4 (10 pcs). Tightening torque: 0.9 Nm.  xx1500000364
3	Connect the grounding cable.	 xx1500000601
4	Refit the body cover with the attachment screws.	Screws: 3HAC052487-001 (6 pcs). Tightening torque: 0.9 Nm  xx1500000697

Continues on next page

4.6.3 Replacing the capacitor bank

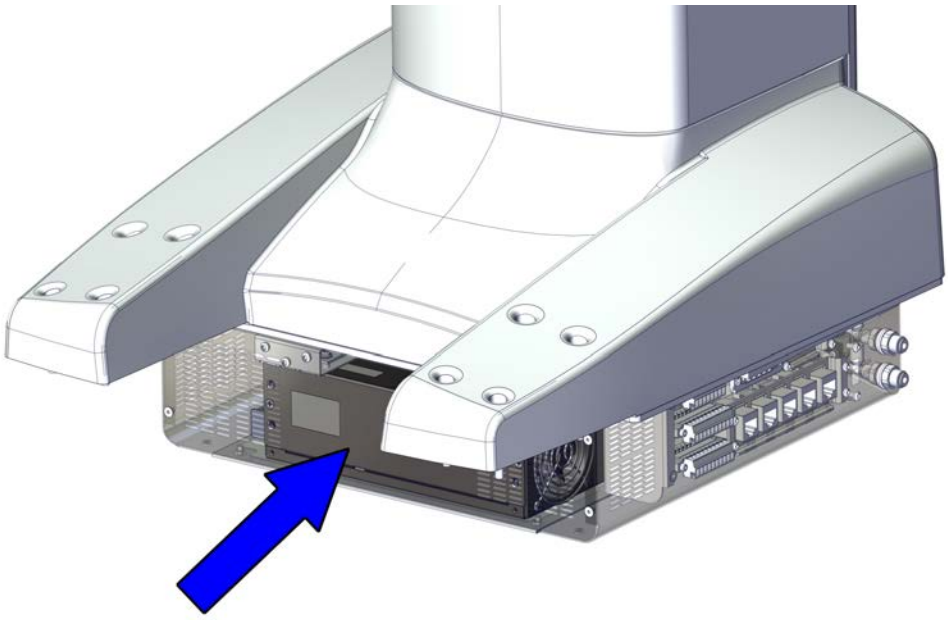
Continued

	Action	Note
5	Refit the two remaining screws of the body cover.	Screws: 3HAC050367-005 (2 pcs). Tightening torque: 0.2 Nm  xx1500000696
6	Refit the attachment screws.	Screws: M3x6 8.8-A2F (2 pcs). Tightening torque: 0.2 Nm  xx1500000525
7	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.6.4 Replacing the power supply

Location of the power supply

The power supply is located as shown in the figure.



xx1500000306

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Power supply	3HAC047966-001	

Required consumables

Consumable	Article number	Note
Cable ties		If removed

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.
Trolley	-	

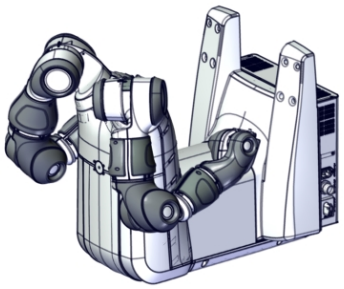
Continues on next page

4.6.4 Replacing the power supply
Continued

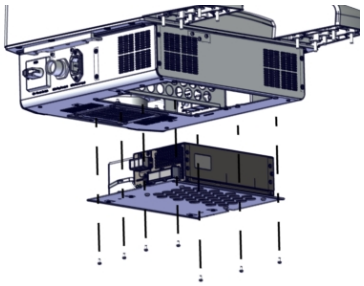
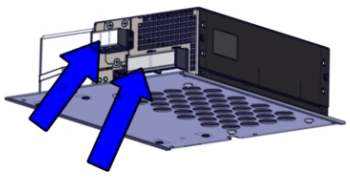
Removing the power supply

Use this procedure to remove the power supply.

Preparations before removing the power supply

	Action	Note
1	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	
2	Check if there is enough space beneath the robot to remove the bottom cover. If not: • Place the robot in its calibration position. • Remove the fastening screws. • Put the robot on a flat and stable surface in the following position:	 xx1500000370

Removing the power supply

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	Remove the bottom cover. **CAUTION** Be careful not to damage the cables.	 xx1500000268
3	Remove the plastic covers on the connectors on the side of the power supply.	 xx1500000286

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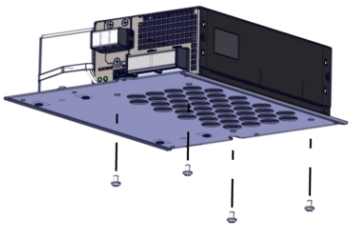
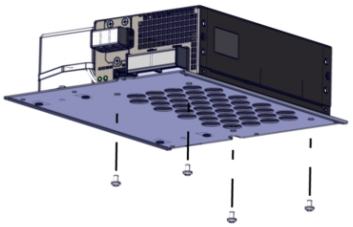
	Action	Note
4	Disconnect the cables, cut cable ties if necessary: • G1.SK2 • G1.(-) • G1.(+) • G1.N • G1.L • GND	
5	Remove the attachment screws that fastens the power supply.	 xx1500000287

Refitting the power supply

Use this procedure to refit the power supply.

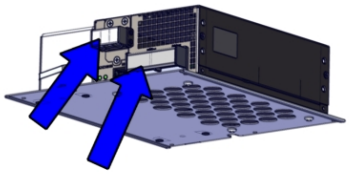
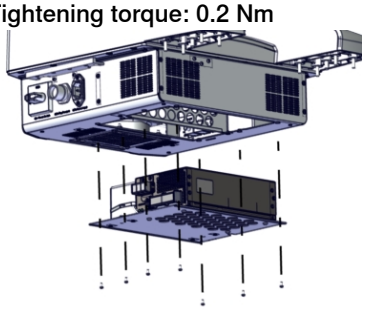
Refitting the power supply

	Action	Note
1	Place the new power supply on the bottom cover and tighten the attachment screws.	Power supply: 3HAC047966-001 Screws: M4x6 8.8-A2F (7 pcs). Tightening torque:  xx1500000287
2	Connect the cables on the side of the power supply. • G1.SK2 • G1.(-) • G1.(+) • G1.N • G1.L • GND	
3	Fasten the cables with cable ties.	

Continues on next page

4.6.4 Replacing the power supply

Continued

	Action	Note
4	Refit the plastic covers over the connectors on the side of the power supply.	 xx1500000286
5	Refit the bottom cover and tighten screws. **CAUTION** Be careful not to damage the cables.	Screws: M3x6 8.8-A2F (7 pcs). Tightening torque: 0.2 Nm  xx1500000268

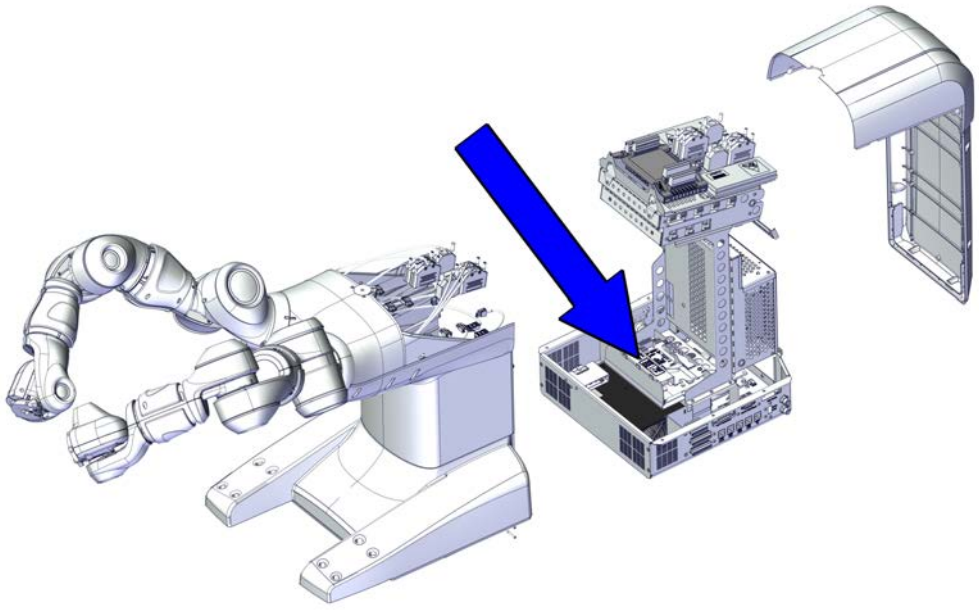
Concluding procedure

	Action	Note
1	If robot was put down for repair: • Fit the robot on the table • Fasten the robot with the attachment screws.	Screw M5x25 (8 pcs) Quality: 8.8 Tightening torque: 3.8 Nm ± 0.38 Nm
2	Recalibrate the robot.	See *Calibration on page 397*.
3	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.6.5 Replacing the power distribution board

Location of the power distribution board

The power distribution board is located as in the figure.



xx1500000269

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
DSQC 662 Power distribution board	3HAC026254-001	

Required consumables

Consumable	Article number	Note
Cable ties	-	If removed

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.
Trolley	-	

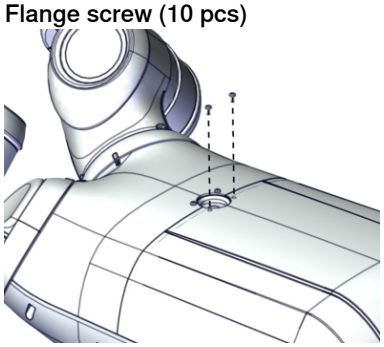
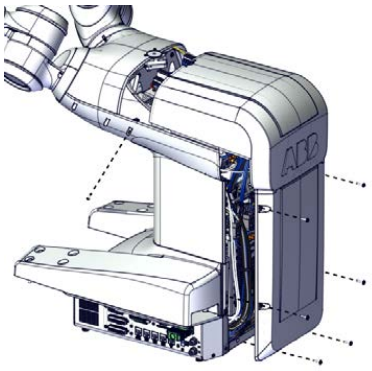
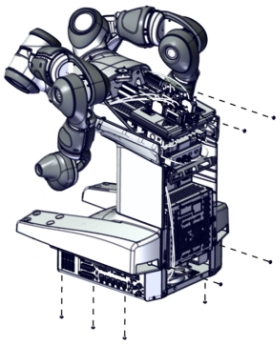
Continues on next page

4.6.5 Replacing the power distribution board
Continued

Removing the power distribution board

Use this procedure to remove the power distribution board.

Pulling the controller out partially

	Action	Note
1	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	
2	Remove the body cover. **ELECTROSTATIC DISCHARGE (ESD)** The equipment is sensitive to ESD. Before handling the equipment please read the safety information in the section *The unit is sensitive to ESD on page 58*	Flange screw (10 pcs)  xx1500000525  xx1500000303
3	Remove the attachment screws that fasten the controller to the body.	 xx1500000364
4	Put a trolley beneath the controller.	

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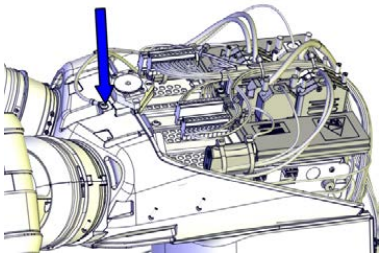
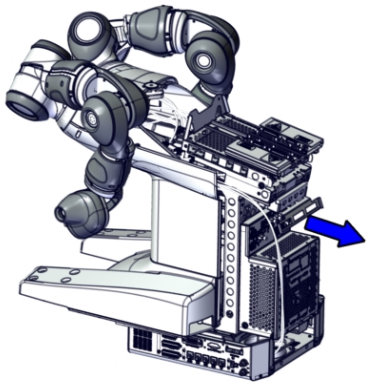
	Action	Note
5	Disconnect the grounding cable.	 xx1500000601
6	Carefully pull the controller partially out in the rails. **CAUTION** The cabling is still connected inside the robot, so be careful not to strain the cables!	 xx1500000365

Removing the power distribution board

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	Cut cable tie at (X8).	**Tip** Take a photography of the cable placements to use at refit.
3	Disconnect the connectors: • G2.X8 (X8) • G2.XS2 (X2) • G2.XS1 (X1) • G2.XS3 (X3) • G2.XS6 (X6) • G2.XS5 (X5) • G2.XS7 (X7) • G2.XS4 (X4)	

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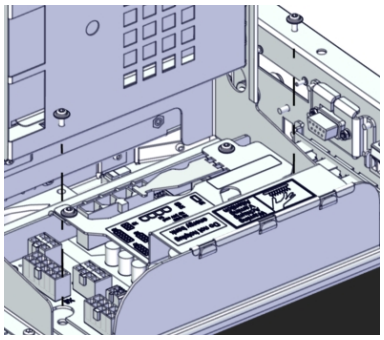
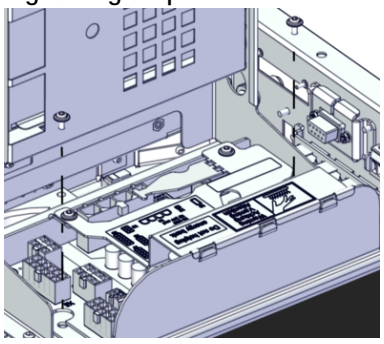
4.6.5 Replacing the power distribution board
Continued

	Action	Note
4	Loosen the left attachment screw and remove the right attachment screw.	 xx1500000308
5	Slide the power distribution board to the right.	
6	Lift the power distribution board out.	

Refitting the power distribution board

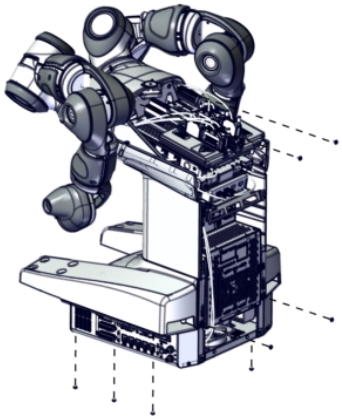
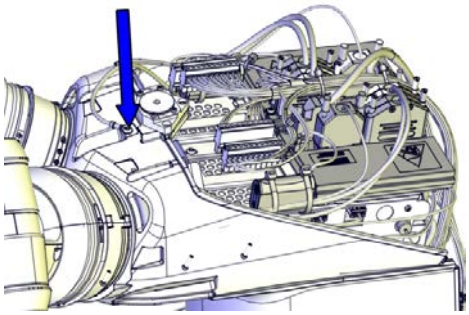
Use this procedure to refit the power distribution board.

Refitting the power distribution board

	Action	Note
1	Place the power distribution board and slide it to the left.	DSQC 662 Power distribution board: 3HAC026254-001
2	Tighten the left attachment screw and refit the right attachment screw.	Screws: M3x6 (2 pcs). Tightening torque: 0.9 Nm.  xx1500000308
3	Connect the connectors: • G2.X8 (X8) • G2.XS2 (X2) • G2.XS1 (X1) • G2.XS3 (X3) • G2.XS6 (X6) • G2.XS5 (X5) • G2.XS7 (X7) • G2.XS4 (X4)	
4	Put two cable ties around the plate and the G2.X8 connector.	

Continues on next page

Pushing the controller in and fastening it

	Action	Note
1	Gently push the controller into the robot body completely. **CAUTION** Be careful not to squeeze or damage the cables and air hoses in any way.	
2	Refit the attachment screws that fasten the controller to the body.	Screws: 3HAC16446-4 (10 pcs). Tightening torque: 0.9 Nm.  xx1500000364
3	Connect the grounding cable.	 xx1500000601

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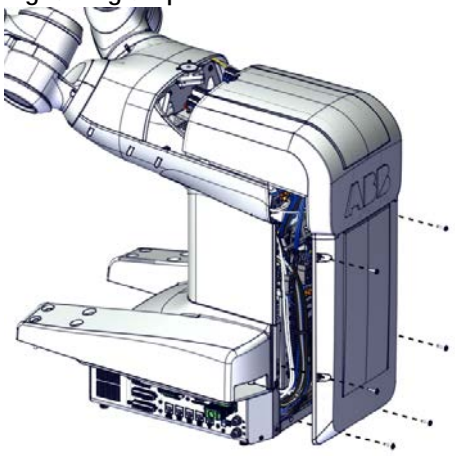
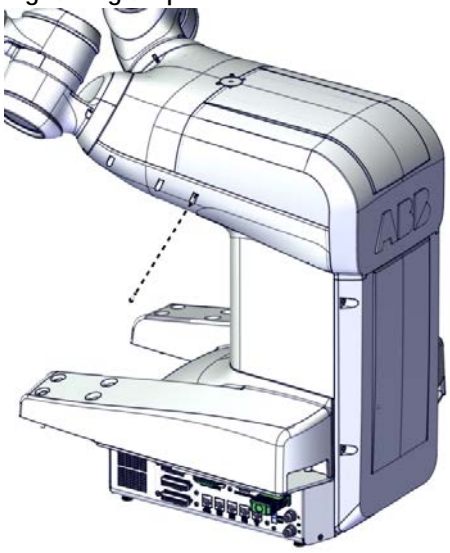
4.6.5 Replacing the power distribution board
Continued

	Action	Note
4	Refit the body cover with the attachment screws.	Screws: 3HAC052487-001 (6 pcs). Tightening torque: 0.9 Nm  xx1500000697
5	Refit the two remaining screws of the body cover.	Screws: 3HAC050367-005 (2 pcs). Tightening torque: 0.2 Nm  xx1500000696

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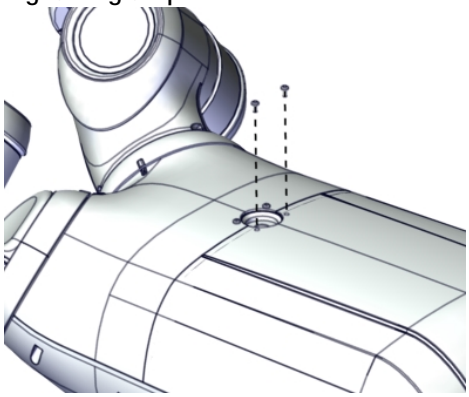
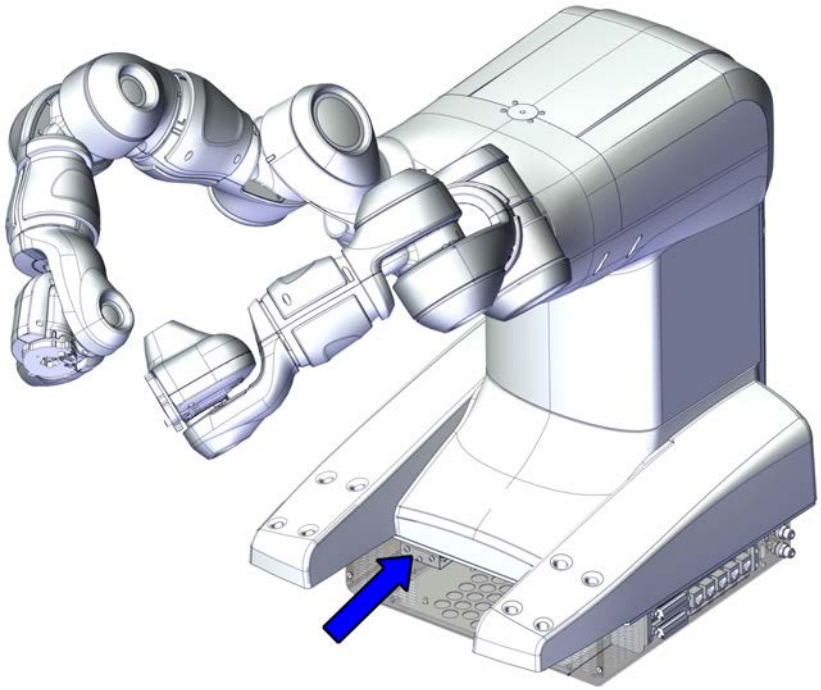
	Action	Note
6	Refit the attachment screws.	Screws: M3x6 8.8-A2F (2 pcs). Tightening torque: 0.2 Nm  xx1500000525
7	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.6.6 Replacing the external power distribution board

Location of the external power distribution board

The external power distribution board is located as shown in the figure.



xx1500000399

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
DSQC 461 PDB ext unit	3HAC049570-001	

Required tools and equipment

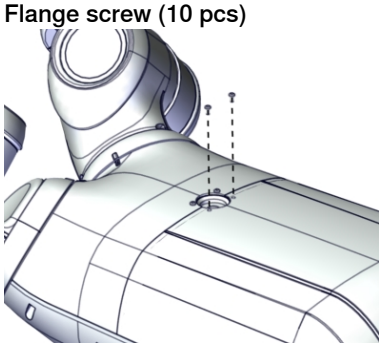
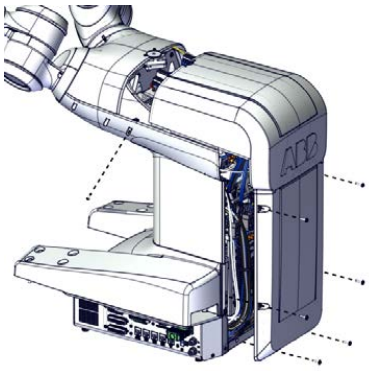
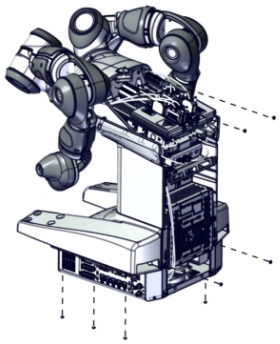
Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.
Trolley	-	

Continues on next page

Removing the external power distribution board

Use this procedure to remove the external power distribution board.

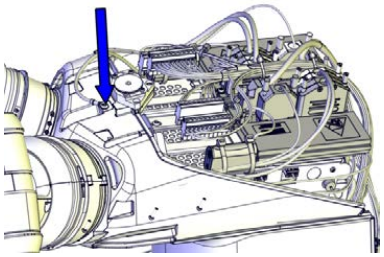
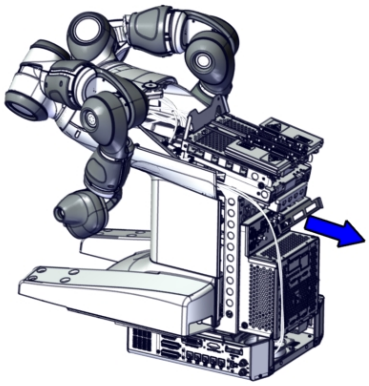
Pulling the controller out partially

	Action	Note
1	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	
2	Remove the body cover. **ELECTROSTATIC DISCHARGE (ESD)** The equipment is sensitive to ESD. Before handling the equipment please read the safety information in the section *The unit is sensitive to ESD on page 58*	Flange screw (10 pcs)  xx1500000525  xx1500000303
3	Remove the attachment screws that fasten the controller to the body.	 xx1500000364
4	Put a trolley beneath the controller.	

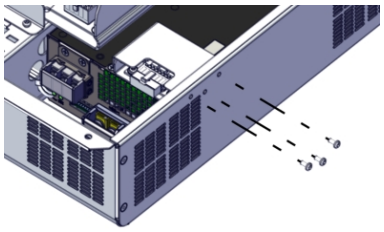
Continues on next page

4.6.6 Replacing the external power distribution board

Continued

	Action	Note
5	Disconnect the grounding cable.	 xx1500000601
6	Carefully pull the controller partially out in the rails. **CAUTION** The cabling is still connected inside the robot, so be careful not to strain the cables!	 xx1500000365

Removing the external power distribution board

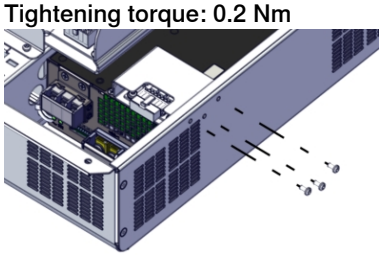
	Action	Note
1	Disconnect the connector G2.1.X1.	
2	Remove the attachment screws.	 xx1500000400

Continues on next page

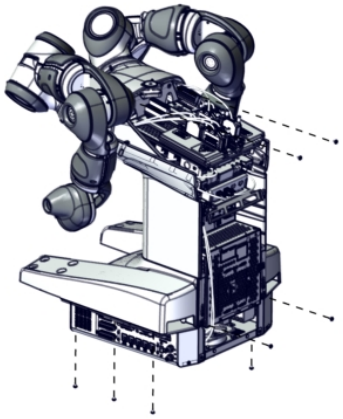
Refitting the external power distribution board

Use this procedure to refit the external power distribution board.

Refitting the external power supply

	Action	Note
1	Fit the external power distribution board and tighten the attachment screws.	DSQC 461 PDB ext unit: 3HAC049570-001 Screws: M3x6 8.8-A2F (3 pcs). Tightening torque: 0.2 Nm  xx1500000400
2	Connect the connector G2.1.X1.	
3	Place the cabling flat to be able to push the controller back into the robot.	

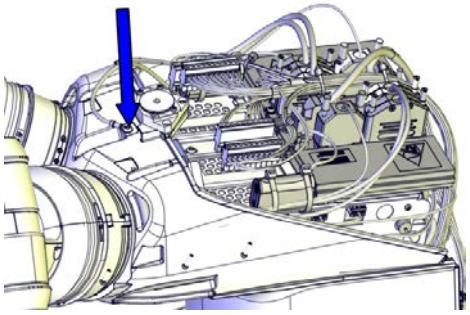
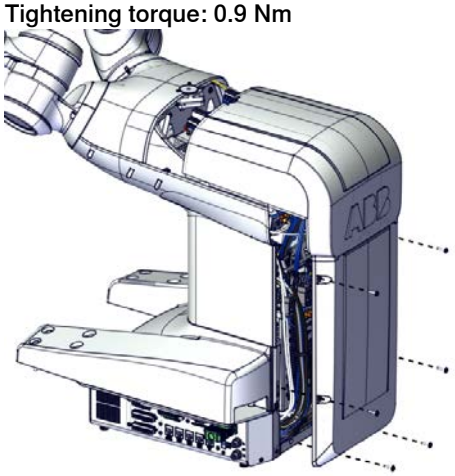
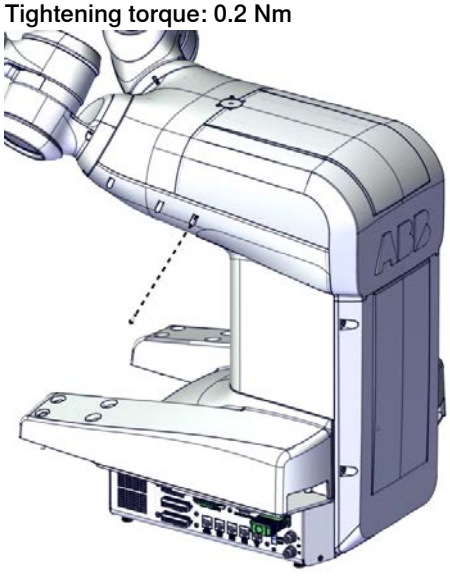
Pushing the controller in and fastening it

	Action	Note
1	Gently push the controller into the robot body completely. **CAUTION** Be careful not to squeeze or damage the cables and air hoses in any way.	
2	Refit the attachment screws that fasten the controller to the body.	Screws: 3HAC16446-4 (10 pcs). Tightening torque: 0.9 Nm.  xx1500000364

Continues on next page

4.6.6 Replacing the external power distribution board

Continued

	Action	Note
3	Connect the grounding cable.	 xx1500000601
4	Refit the body cover with the attachment screws.	Screws: 3HAC052487-001 (6 pcs). Tightening torque: 0.9 Nm  xx1500000697
5	Refit the two remaining screws of the body cover.	Screws: 3HAC050367-005 (2 pcs). Tightening torque: 0.2 Nm  xx1500000696

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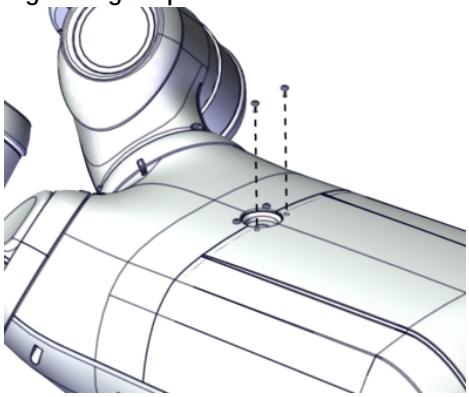
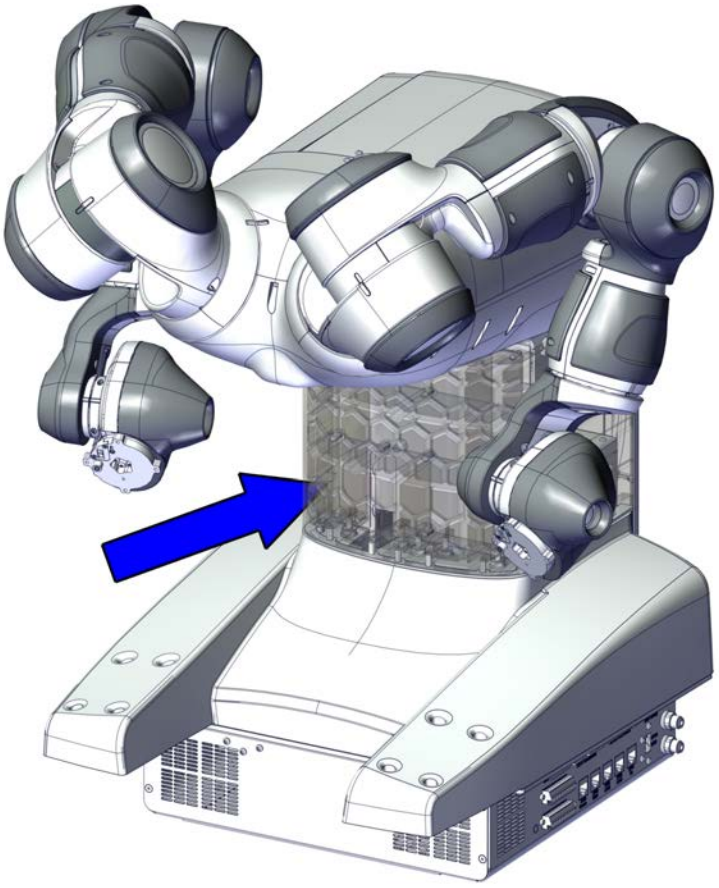
	Action	Note
6	Refit the attachment screws.	Screws: M3x6 8.8-A2F (2 pcs). Tightening torque: 0.2 Nm  xx1500000525
7	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.6.7 Replacing the axis computer

Location of the axis computer

The axis computer is located as shown in the figure.



xx1500000351

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
DSQC1013 Axis computer	3HAC049969-001	

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.

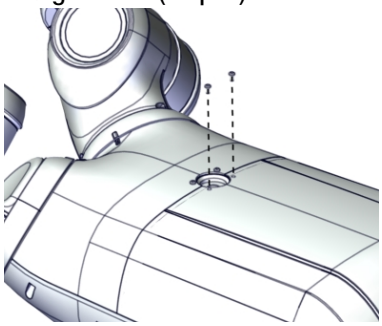
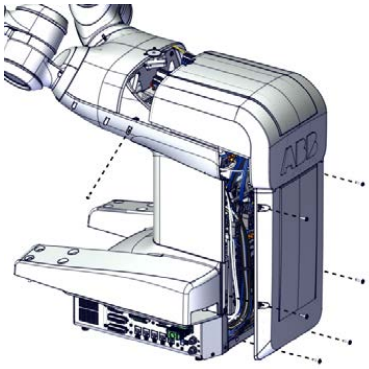
Continues on next page

Equipment, etc.	Article number	Note
Trolley	-	

Removing the axis computer

Use this procedure to remove the axis computer.

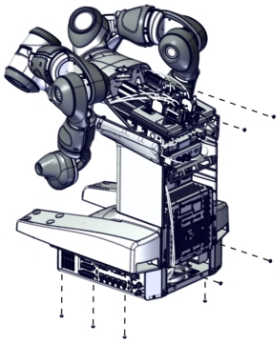
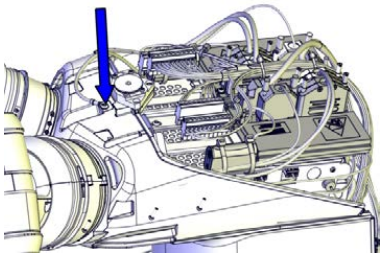
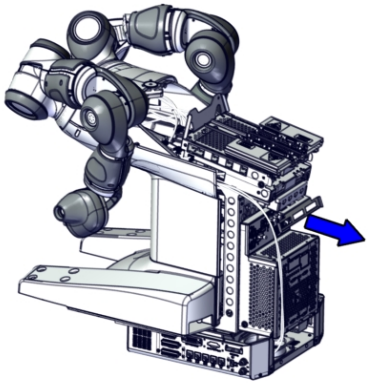
Pulling the controller out partially

	Action	Note
1	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	
2	Remove the body cover. **ELECTROSTATIC DISCHARGE (ESD)** The equipment is sensitive to ESD. Before handling the equipment please read the safety information in the section *The unit is sensitive to ESD on page 58*	Flange screw (10 pcs)  xx1500000525  xx1500000303

Continues on next page

4.6.7 Replacing the axis computer

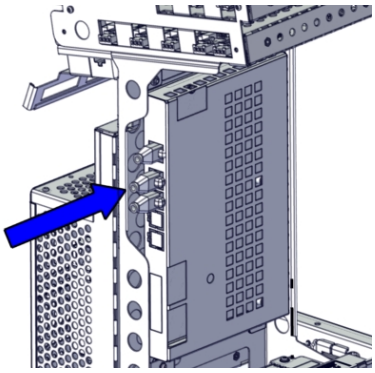
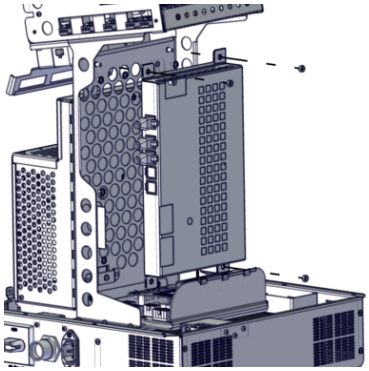
Continued

	Action	Note
3	Remove the attachment screws that fasten the controller to the body.	 xx1500000364
4	Put a trolley beneath the controller.	
5	Disconnect the grounding cable.	 xx1500000601
6	Carefully pull the controller partially out in the rails. **CAUTION** The cabling is still connected inside the robot, so be careful not to strain the cables!	 xx1500000365

Removing the axis computer

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** 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 58*	

Continues on next page

	Action	Note
3	Disconnect the connectors: • A42.X4 (X4 Measurement link 1) • A42.X5 (X5 Measurement link 2)	
4	Disconnect the connectors: • A42.X2 (X2) • A42.X11 (X11)	 xx1500000352
5	Remove the attachment nuts.	 xx1500000353 Nut 9ADA267-4M4 Steel 8-A2F
6	Disconnect the connector: • A42.XS1 (X1, underneath)	

Refitting the axis computer

Use this procedure to refit the axis computer.

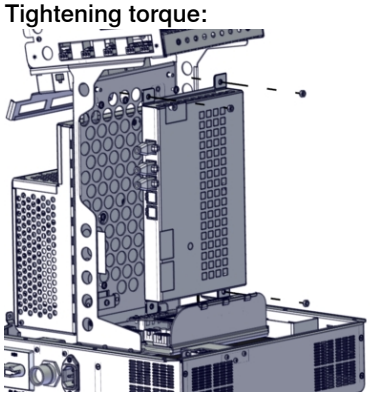
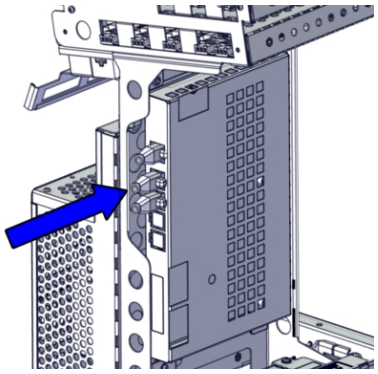
Refitting the axis computer

	Action	Note
1	Connect the connector: • A42.XS1 (X1, underneath)	

Continues on next page

4.6.7 Replacing the axis computer

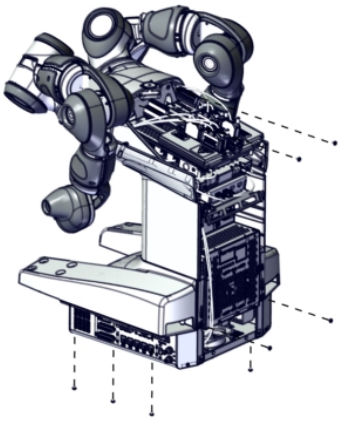
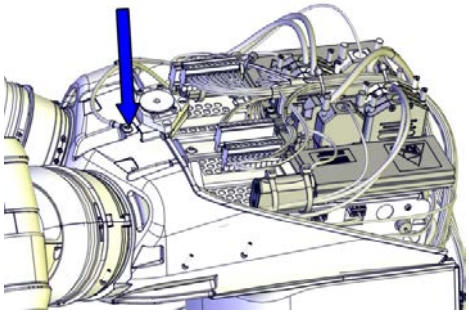
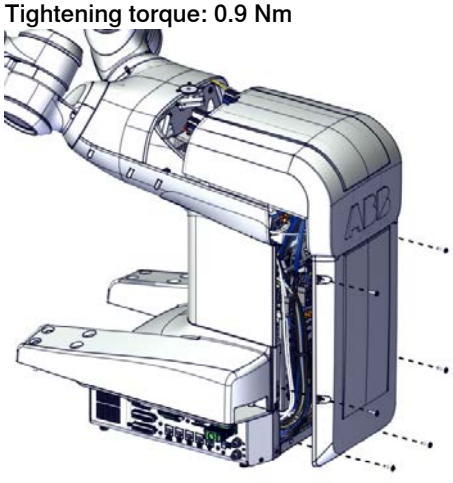
Continued

	Action	Note
2	Fit the new axis computer and tighten nuts.	DSQC1013 Axis computer: 3HAC049969-001 Nut: M4 Steel 8-A2F (3 pcs). 9ADA267-4 Tightening torque:  xx1500000353
3	Connect the connectors: • A42.X11 (X11) • A42.X2 (X2)	 xx1500000352
4	Connect the connectors: • A42.X4 (X4 Measurement link 1) • A42.X5 (X5 Measurement link 2)	

Pushing the controller in and fastening it

	Action	Note
1	Gently push the controller into the robot body completely. **CAUTION** Be careful not to squeeze or damage the cables and air hoses in any way.	

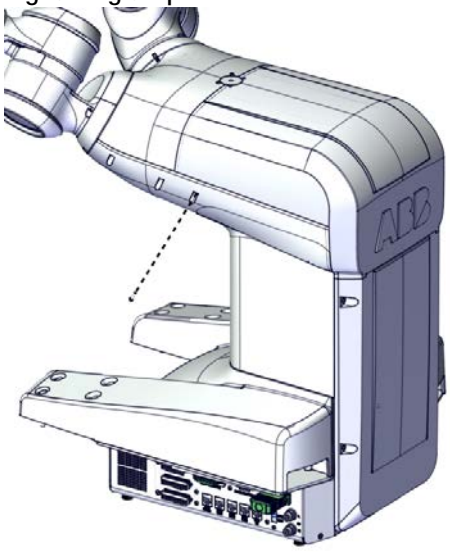
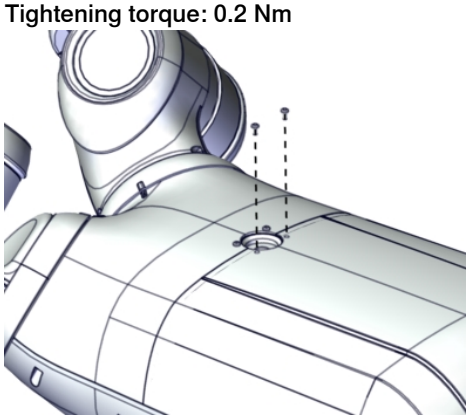
Continues on next page

	Action	Note
2	Refit the attachment screws that fasten the controller to the body.	Screws: 3HAC16446-4 (10 pcs). Tightening torque: 0.9 Nm.  xx1500000364
3	Connect the grounding cable.	 xx1500000601
4	Refit the body cover with the attachment screws.	Screws: 3HAC052487-001 (6 pcs). Tightening torque: 0.9 Nm  xx1500000697

Continues on next page

4.6.7 Replacing the axis computer

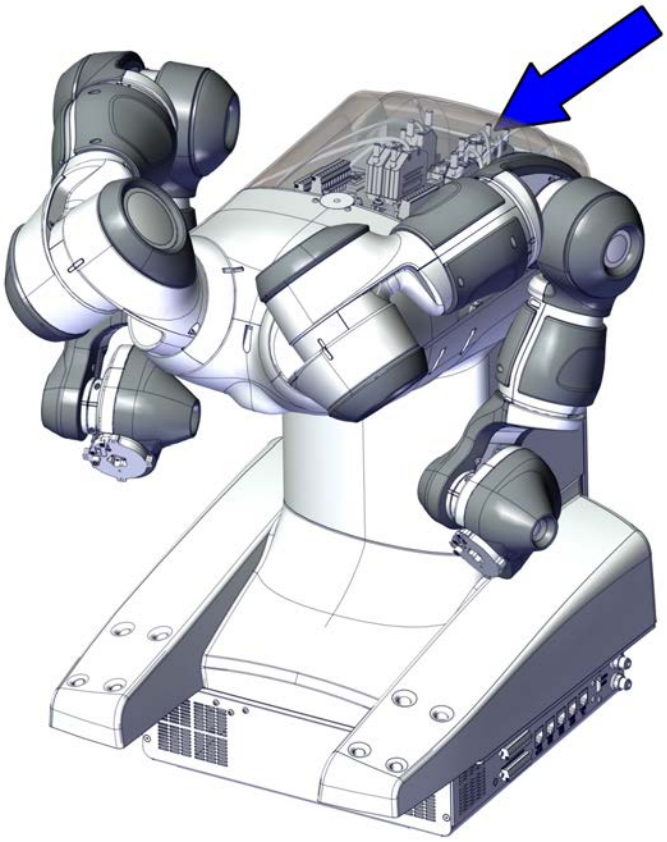
Continued

	Action	Note
5	Refit the two remaining screws of the body cover.	Screws: 3HAC050367-005 (2 pcs). Tightening torque: 0.2 Nm  xx1500000696
6	Refit the attachment screws.	Screws: M3x6 8.8-A2F (2 pcs). Tightening torque: 0.2 Nm  xx1500000525
7	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.6.8 Replacing the left arm's drive board

Location of the drive board

The drive board is located as shown in the figure.



xx1500000413

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
DSQC 462 Drive board	3HAC047960-001	

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.

Continues on next page

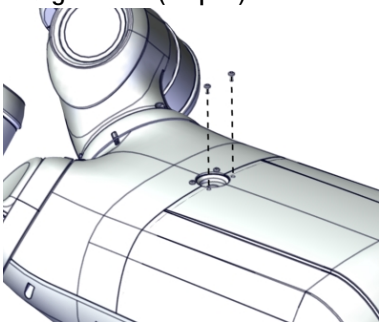
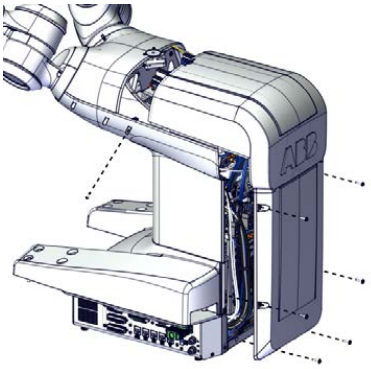
4.6.8 Replacing the left arm's drive board
Continued

Equipment, etc.	Article number	Note
Trolley	-	

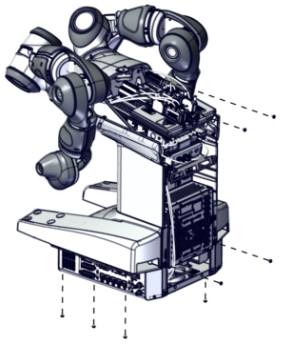
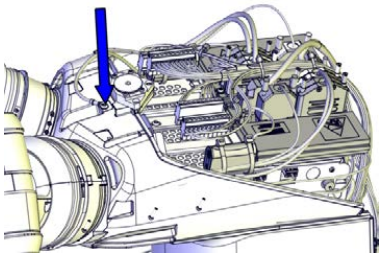
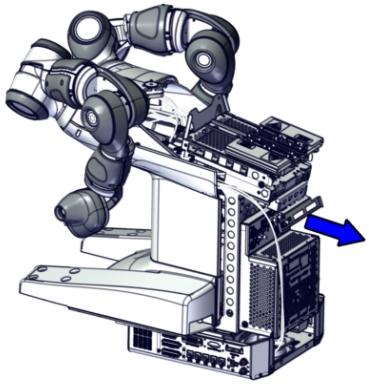
Removing the left arm's drive board

Use this procedure to remove the drive board.

Pulling the controller out partially

	Action	Note
1	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	
2	Remove the body cover. **ELECTROSTATIC DISCHARGE (ESD)** The equipment is sensitive to ESD. Before handling the equipment please read the safety information in the section *The unit is sensitive to ESD on page 58*	Flange screw (10 pcs)  xx1500000525  xx1500000303

Continues on next page

	Action	Note
3	Remove the attachment screws that fasten the controller to the body.	 xx1500000364
4	Put a trolley beneath the controller.	
5	Disconnect the grounding cable.	 xx1500000601
6	Carefully pull the controller partially out in the rails. **CAUTION** The cabling is still connected inside the robot, so be careful not to strain the cables!	 xx1500000365

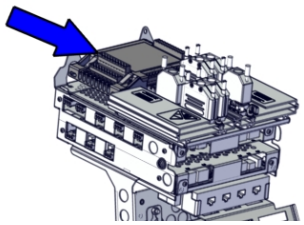
Removing the I/O board

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	

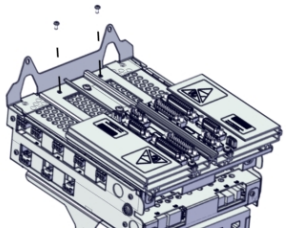
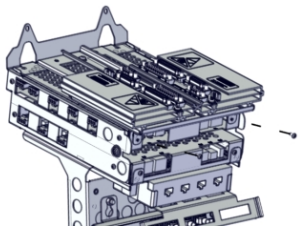
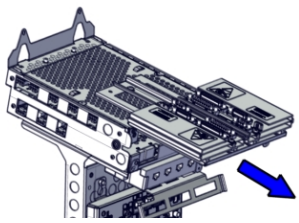
Continues on next page

4.6.8 Replacing the left arm's drive board

Continued

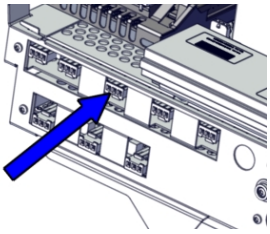
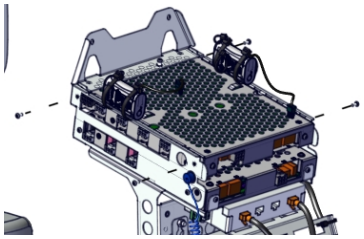
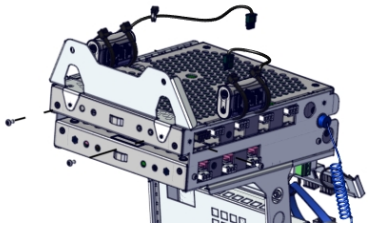
	Action	Note
2	Carefully snap the I/O board loose (it is rail mounted).	 xx1500000415

Removing the SMB board

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	Disconnect the battery connector (X3)	
3	Remove two attachment screws.	 xx1500000417
4	Remove two attachment screws on the side.	 xx1500000420
5	Gently pull the SMB unit out to loosen the latches from the recesses.	 xx1500000421

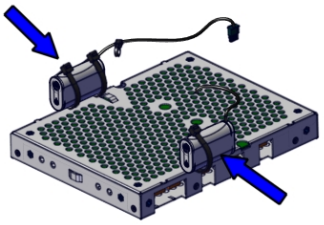
Continues on next page

Removing the left arm's drive board

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** 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 58*	
3	Disconnect the connectors: Left side: • A5X.XS11 • A5X.XS12 • A5X.XS17 • A5X.XS13 Right side: • A5X.XS14 • A5X.XS15 • A5X.XS16	 xx1500000368
4	Disconnect the connectors: • A52.X1 • A52.X2 • A52.X3 • A52.X6	
5	Disconnect the connector: • A52.X9	
6	Remove four attachment screws.	 xx1500000426
7	Remove two attachment screws.	 xx1500000427
8	Pull out the left arm's drive board.	

Continues on next page

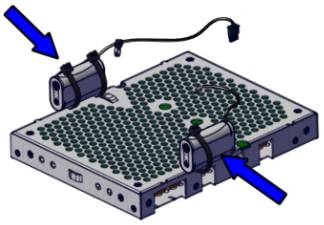
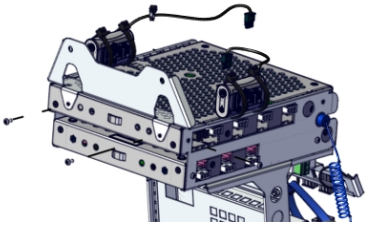
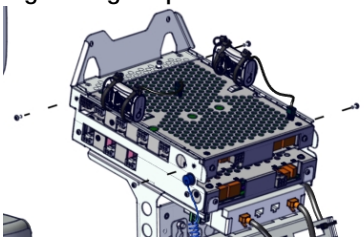
4.6.8 Replacing the left arm's drive board
Continued

	Action	Note
9	Remove the battery packs from the drive board and install them on the new drive board.	 xx1500002101

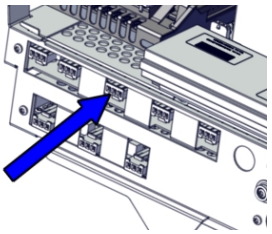
Refitting the left arm's drive board

Use this procedure to refit the drive board.

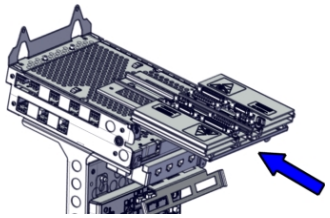
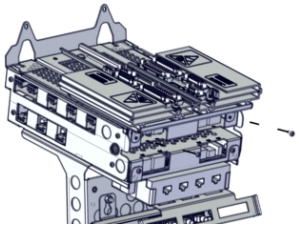
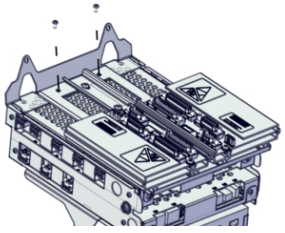
Refitting the left arm's drive board

	Action	Note
1	Fit the battery packs from the old drive board onto the new drive board.	 xx1500002101
2	Fit the new drive board.	DSQC 462 Drive board: 3HAC047960-001
3	Refit the two attachment screws.	Screws: M3x6 8.8-A2F (2 pcs). Tightening torque: 0.2 Nm  xx1500000427
4	Refit four attachment screws.	Screws: M3x6 8.8-A2F (4 pcs). Tightening torque: 0.2 Nm  xx1500000426
5	Connect the connector: • A52.X9	

Continues on next page

	Action	Note
6	Connect the connectors: • A52.X1 • A52.X2 • A52.X3 • A52.X6	
7	Connect the connectors: Left side: • A5X.XS11 • A5X.XS12 • A5X.XS17 • A5X.XS13 Right side: • A5X.XS14 • A5X.XS15 • A5X.XS16	 xx1500000368

Refitting the SMB board

	Action	Note
1	Gently push the SMB unit to fasten the latches in the recesses.	DSQC633D measurement board: 3HAC048550-001  xx1500000422
2	Tighten two attachment screws on the side.	Screws: M3x6 8.8-A2F (2 pcs). Tightening torque: 0.2 Nm  xx1500000420
3	Tighten two attachment screws.	Screws: M3x6 8.8-A2F (2 pcs). Tightening torque: 0.2 Nm  xx1500000417
4	Connect the battery connector (X3).	

Continues on next page

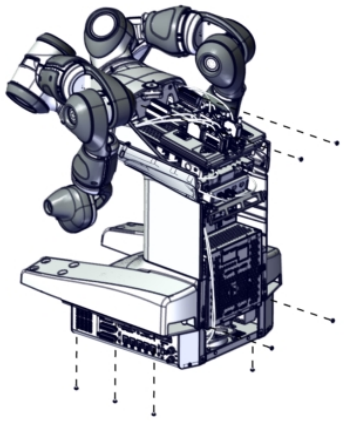
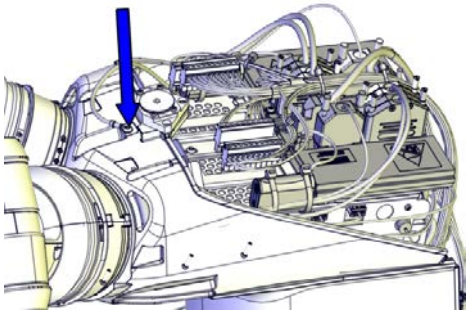
4.6.8 Replacing the left arm's drive board

Continued

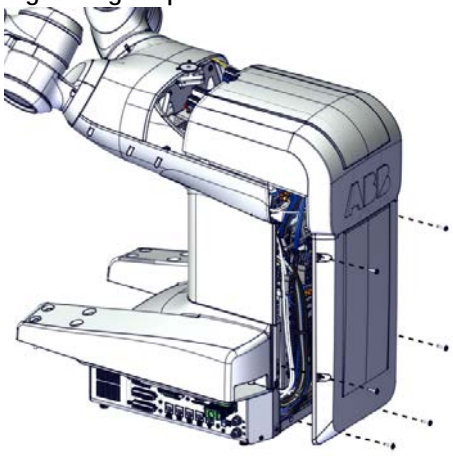
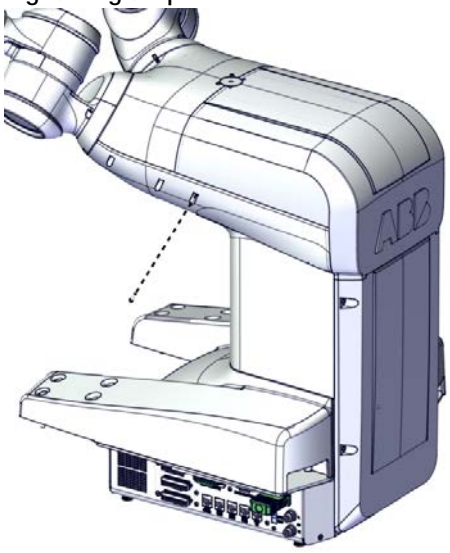
Refitting the I/O board

	Action	Note
1	Snap on the I/O board to the mounting rail.	Digital 24V I/O DSQC 652: 3HAC025917-001

Pushing the controller in and fastening it

	Action	Note
1	Gently push the controller into the robot body completely. **CAUTION** Be careful not to squeeze or damage the cables and air hoses in any way.	
2	Refit the attachment screws that fasten the controller to the body.	Screws: 3HAC16446-4 (10 pcs). Tightening torque: 0.9 Nm.  xx1500000364
3	Connect the grounding cable.	 xx1500000601

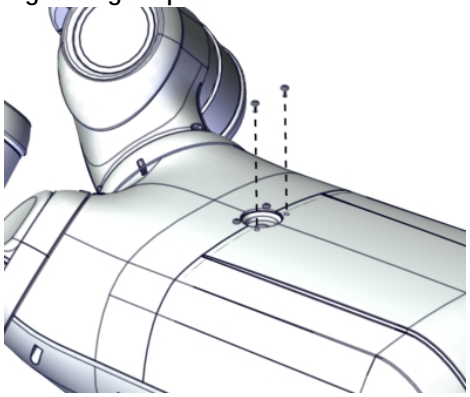
Continues on next page

	Action	Note
4	Refit the body cover with the attachment screws.	Screws: 3HAC052487-001 (6 pcs). Tightening torque: 0.9 Nm  xx1500000697
5	Refit the two remaining screws of the body cover.	Screws: 3HAC050367-005 (2 pcs). Tightening torque: 0.2 Nm  xx1500000696

Continues on next page

4.6.8 Replacing the left arm's drive board

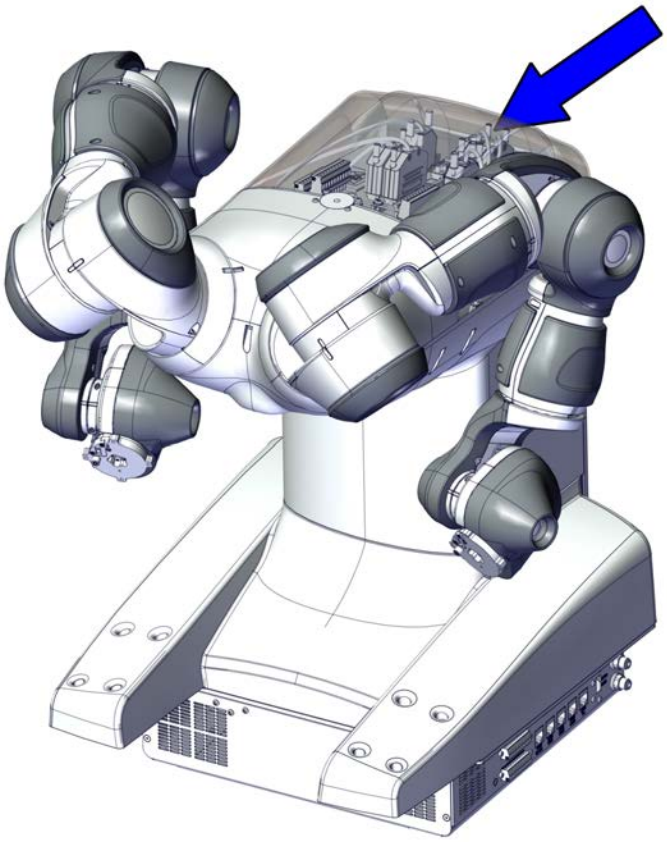
Continued

	Action	Note
6	Refit the attachment screws.	Screws: M3x6 8.8-A2F (2 pcs). Tightening torque: 0.2 Nm  xx1500000525
7	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.6.9 Replacing the right arm's drive board

Location of the drive board

The drive board is located as shown in the figure.



xx1500000413

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
DSQC 462 Drive board	3HAC047960-001	

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.

Continues on next page

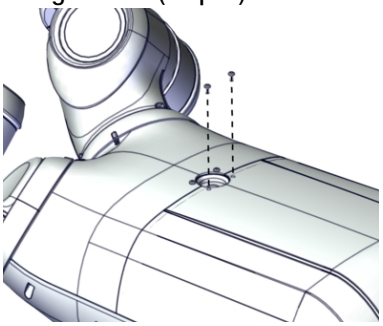
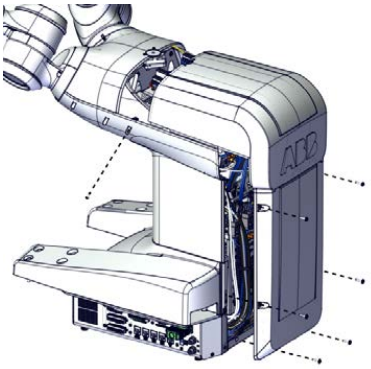
4.6.9 Replacing the right arm's drive board
Continued

Equipment, etc.	Article number	Note
Trolley	-	

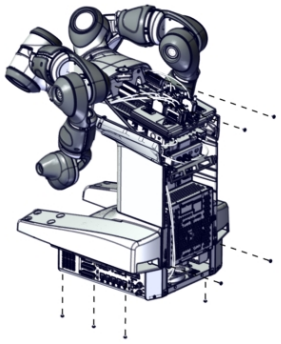
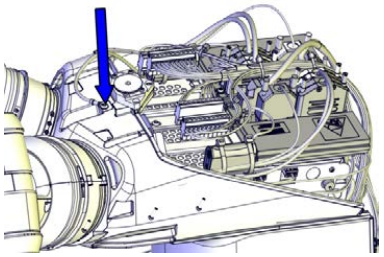
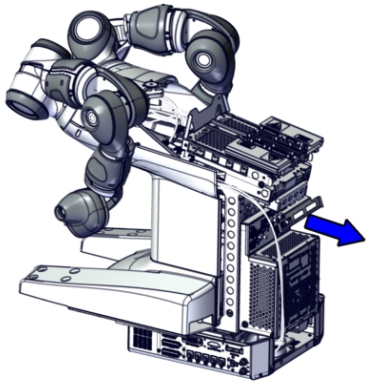
Removing the right arm's drive board

Use this procedure to remove the drive board.

Pulling the controller out partially

	Action	Note
1	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	
2	Remove the body cover. **ELECTROSTATIC DISCHARGE (ESD)** The equipment is sensitive to ESD. Before handling the equipment please read the safety information in the section *The unit is sensitive to ESD on page 58*	Flange screw (10 pcs)  xx1500000525  xx1500000303

Continues on next page

	Action	Note
3	Remove the attachment screws that fasten the controller to the body.	 xx1500000364
4	Put a trolley beneath the controller.	
5	Disconnect the grounding cable.	 xx1500000601
6	Carefully pull the controller partially out in the rails. **CAUTION** The cabling is still connected inside the robot, so be careful not to strain the cables!	 xx1500000365

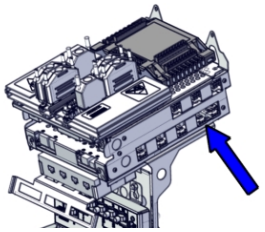
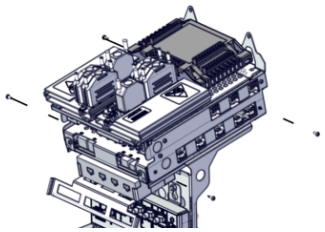
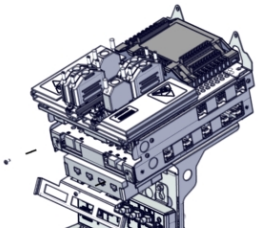
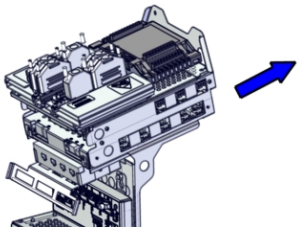
Removing the right arm's drive board

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** 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 58*	

Continues on next page

4.6.9 Replacing the right arm's drive board

Continued

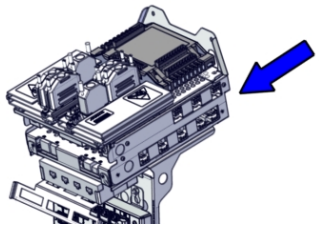
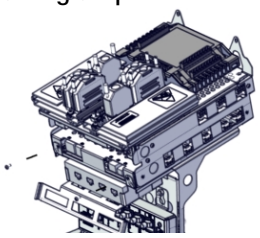
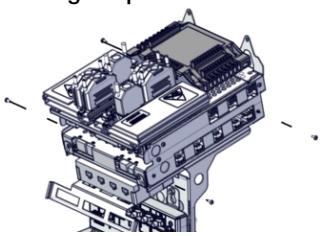
	Action	Note
3	Disconnect the cables from the right arm's drive board: Right side: • A5X.XS11 • A5X.XS12 • A5X.XS17 • A5X.XS13 Left side: • A5X.XS14 • A5X.XS15 • A5X.XS16	 xx1500000428
4	Disconnect the connectors: • A51.X8 • A51.X9	
5	Disconnect the connectors: • A51.X1 • A51.X2 • A51.X3 • A51.X6	
6	Remove four attachment screws.	 xx1500000430
7	Remove two attachment screws.	 xx1500000431
8	Put the EtherNet switch bracket downwards.	
9	Gently pull the drive board out.	 xx1500000432

Continues on next page

Refitting the right arm's drive board

Use this procedure to refit the drive board.

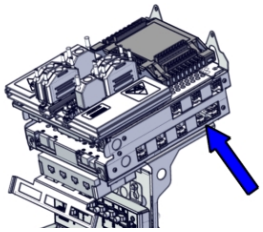
Refitting the right arm's drive board

	Action	Note
1	Gently push the new drive board into the bracket.	DSQC 462 Drive board: 3HAC047960-001  xx1500000433
2	Refit the ethernet switch bracket.	
3	Refit two attachment screws.	Screws: M3x6 8.8-A2F (2 pcs). Tightening torque: 0.2 Nm  xx1500000431
4	Refit four attachment screws.	Screws: M3x6 8.8-A2F (4 pcs). Tightening torque: 0.2 Nm  xx1500000430
5	Connect the connectors: • A51.X1 • A51.X2 • A51.X3 • A51.X6	
6	Connect the connectors: • A51.X8 • A51.X9	

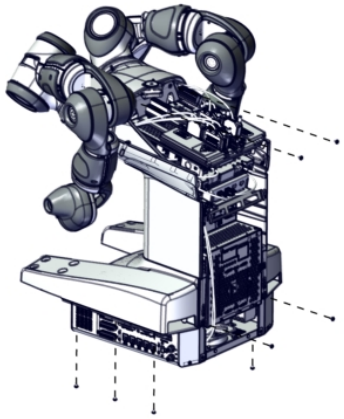
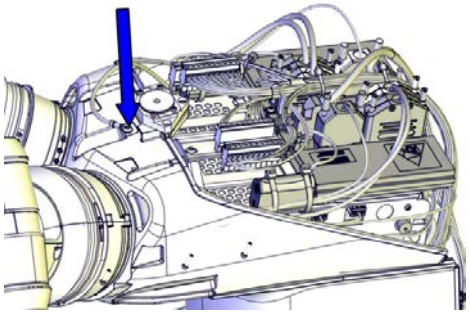
Continues on next page

4.6.9 Replacing the right arm's drive board

Continued

	Action	Note
7	Connect the cables from the right arm's drive board: Right side: • A5X.XS11 • A5X.XS12 • A5X.XS17 • A5X.XS13 Left side: • A5X.XS14 • A5X.XS15 • A5X.XS16	 xx1500000428

Pushing the controller in and fastening it

	Action	Note
1	Gently push the controller into the robot body completely. **CAUTION** Be careful not to squeeze or damage the cables and air hoses in any way.	
2	Refit the attachment screws that fasten the controller to the body.	Screws: 3HAC16446-4 (10 pcs). Tightening torque: 0.9 Nm.  xx1500000364
3	Connect the grounding cable.	 xx1500000601

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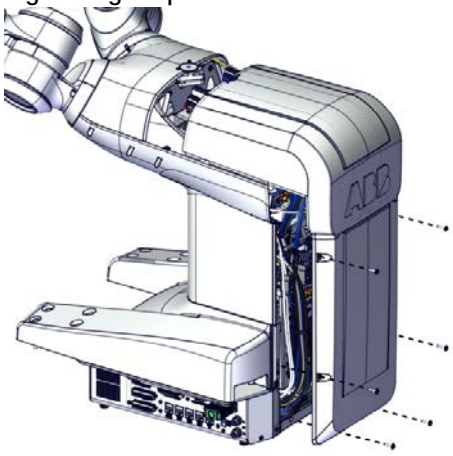
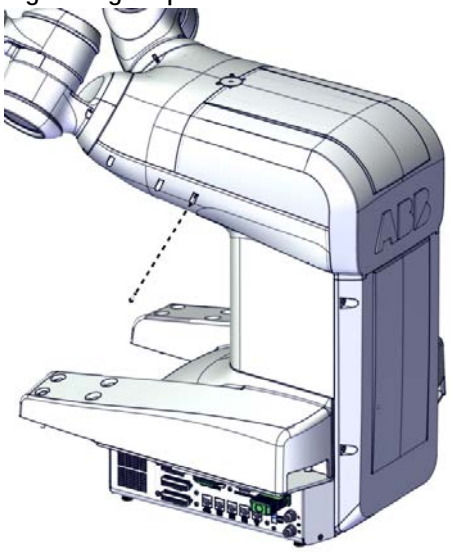
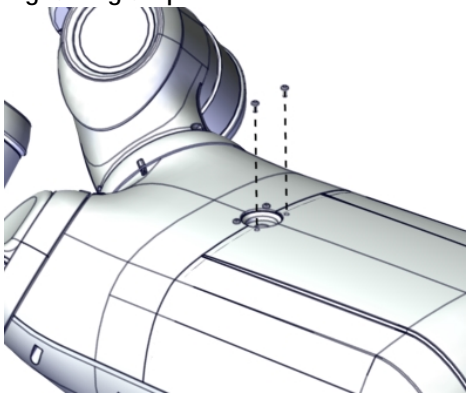
	Action	Note
4	Refit the body cover with the attachment screws.	Screws: 3HAC052487-001 (6 pcs). Tightening torque: 0.9 Nm  xx1500000697
5	Refit the two remaining screws of the body cover.	Screws: 3HAC050367-005 (2 pcs). Tightening torque: 0.2 Nm  xx1500000696

Continues on next page

4.6.9 Replacing the right arm's drive board

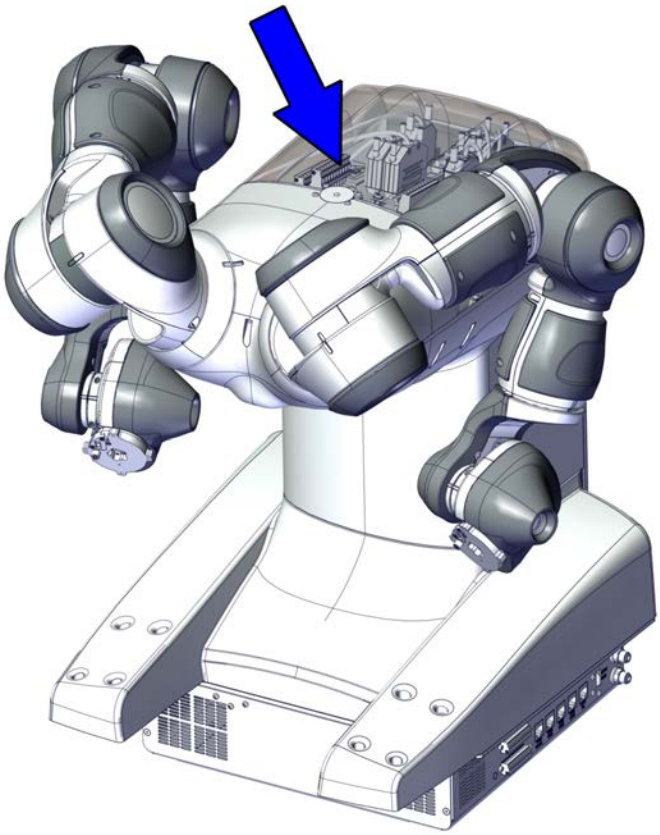
Continued

	Action	Note
6	Refit the attachment screws.	Screws: M3x6 8.8-A2F (2 pcs). Tightening torque: 0.2 Nm  xx1500000525
7	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.6.10 Replacing the I/O board

Location of the I/O board

The I/O board is located as shown in the figure.



xx1500000401

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Digital 24V I/O DSQC 652	3HAC025917-001	

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.

Continues on next page

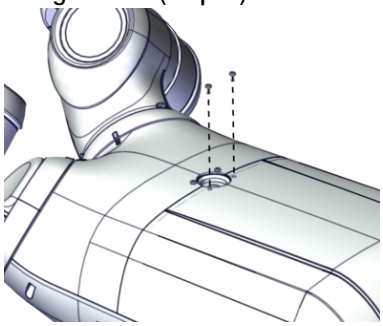
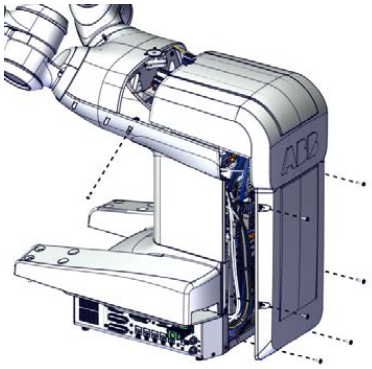
4.6.10 Replacing the I/O board
Continued

Equipment, etc.	Article number	Note
Trolley	-	

Removing the I/O board

Use this procedure to remove the I/O board.

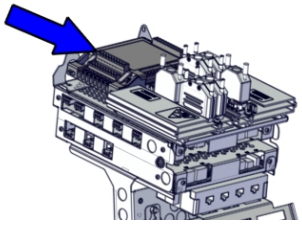
Remove the body cover

	Action	Note
1	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	
2	Remove the body cover. **ELECTROSTATIC DISCHARGE (ESD)** 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 58*	Flange screw (10 pcs)  xx1500000525  xx1500000303

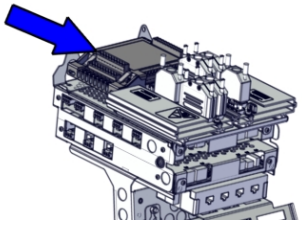
Removing the I/O connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	

Continues on next page

	Action	Note
2	**ELECTROSTATIC DISCHARGE (ESD)** 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 58*	
3	Disconnect connectors: • IO.X1 (X1) • IO.X2 (X2) • IO.X3 (X3) • IO.X4 (X4) • IO.X5 (X5)	 xx1500000415

Removing the I/O board

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	Carefully snap the I/O board loose (it is rail mounted).	 xx1500000415

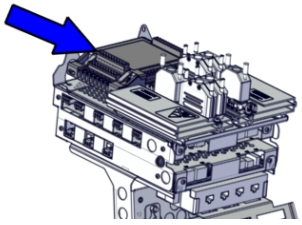
Refitting the I/O board

Use this procedure to refit the I/O board.

Refitting the I/O board

	Action	Note
1	Snap on the I/O board to the mounting rail.	Digital 24V I/O DSQC 652: 3HAC025917-001

Refitting the I/O connectors

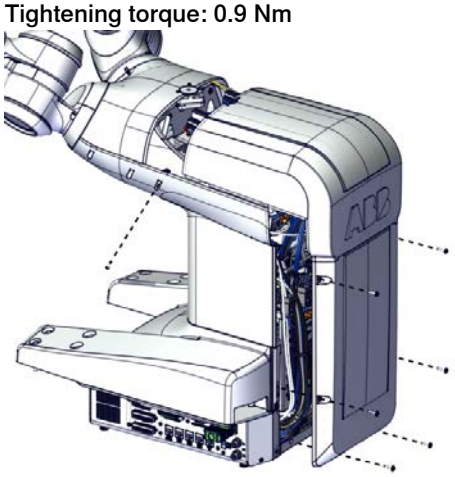
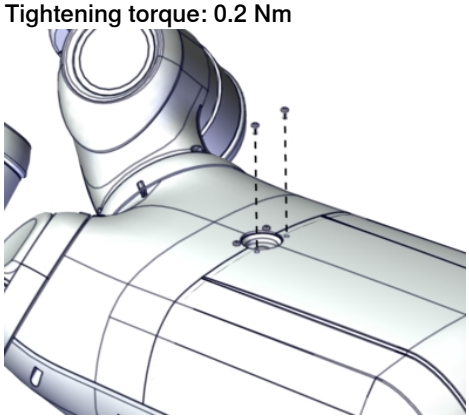
	Action	Note
1	Connect the connectors: • IO.X5 (X5) • IO.X1 (X1) • IO.X2 (X2) • IO.X3 (X3) • IO.X4 (X4)	 xx1500000415

Continues on next page

4.6.10 Replacing the I/O board

Continued

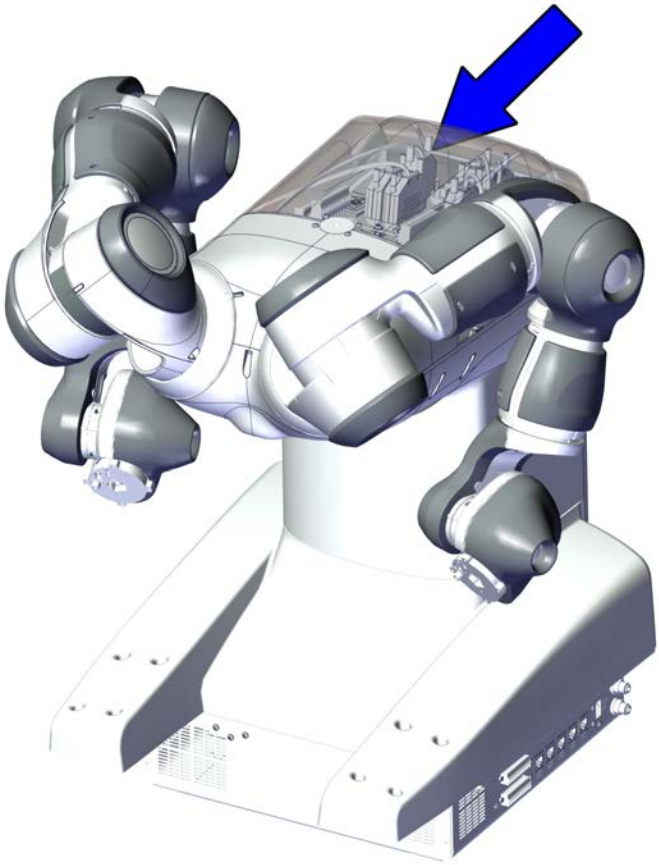
Refitting the body cover

	Action	Note
1	Refit the body cover with the attachment screws.	Screws: 3HAC052487-001 (8 pcs) Tightening torque: 0.9 Nm  xx1500000303
2	Refit the attachment screws.	Screws: M3x6 8.8-A2F (2 pcs). Tightening torque: 0.2 Nm  xx1500000525
3	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.6.11 Replacing the SMB boards

Location of the SMB board

The SMB board is located as shown in the figure.



xx1500000414

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
DSQC633D measurement board	3HAC048550-001	

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.

Continues on next page

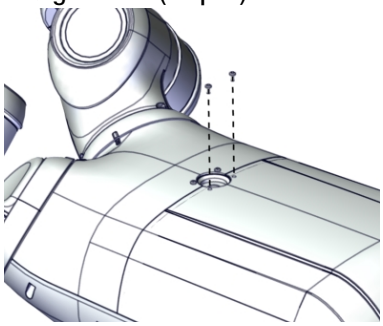
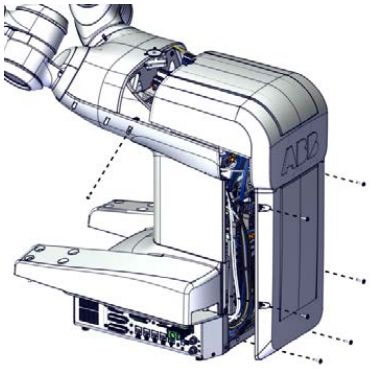
4.6.11 Replacing the SMB boards
Continued

Equipment, etc.	Article number	Note
Trolley	-	

Removing the SMB board

Use this procedure to remove the SMB board.

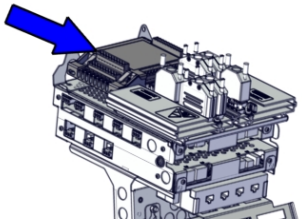
Remove the body cover

	Action	Note
1	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	
2	Remove the body cover. **ELECTROSTATIC DISCHARGE (ESD)** 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 58*	Flange screw (10 pcs)  xx1500000525  xx1500000303

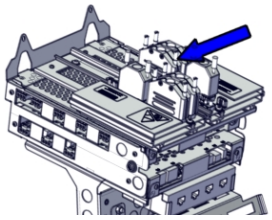
Removing the I/O board

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	

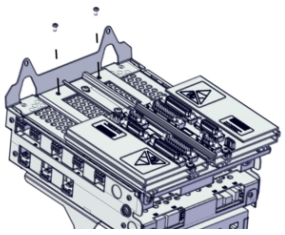
Continues on next page

	Action	Note
2	Carefully snap the I/O board loose (it is rail mounted).	 xx1500000415

Removing the SMB connectors

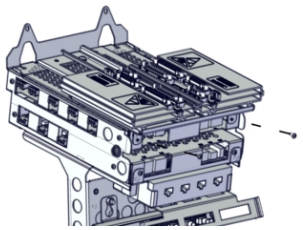
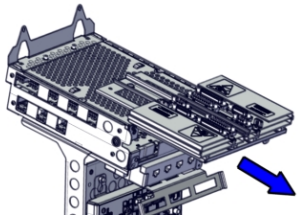
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit please read the safety information in the section *The unit is sensitive to ESD on page 58*	
3	Disconnect the connectors (left and/or right side): • A5X.SMB.X4 • A5X.SMB.X5 • A5X.SMB.X2 • A52.SMB.X1	 xx1500000416

Removing the SMB board

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	Disconnect the battery connector (X3)	
3	Remove two attachment screws.	 xx1500000417

Continues on next page

4.6.11 Replacing the SMB boards
Continued

	Action	Note
4	Remove two attachment screws on the side.	 xx1500000420
5	Gently pull the SMB unit out to loosen the latches from the recesses.	 xx1500000421

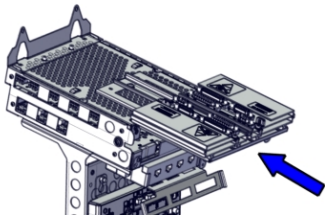
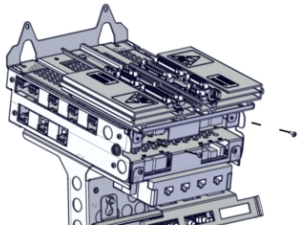
Replacing the SMB board

	Action	Note
1	Remove the screws to remove left or right SMB board from bracket.	
2	Refit the new SMB board to the bracket and fasten with four screws.	

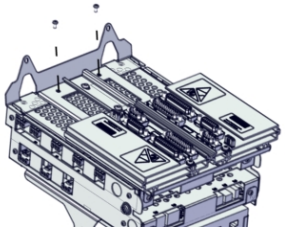
Refitting the SMB board

Use this procedure to refit the SMB board.

Refitting the SMB board

	Action	Note
1	Gently push the SMB unit to fasten the latches in the recesses.	DSQC633D measurement board: 3HAC048550-001  xx1500000422
2	Tighten two attachment screws on the side.	Screws: M3x6 8.8-A2F (2 pcs). Tightening torque: 0.2 Nm  xx1500000420

Continues on next page

	Action	Note
3	Tighten two attachment screws.	Screws: M3x6 8.8-A2F (2 pcs). Tightening torque: 0.2 Nm  xx1500000417
4	Connect the battery connector (X3).	

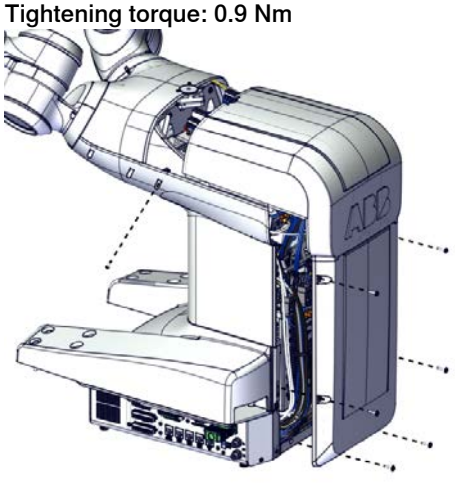
Refitting SMB connectors

	Action	Note
1	Connect the connectors (left and/or right side): • A5X.SMB.X4 • A5X.SMB.X5 • A5X.SMB.X2 • A52.SMB.X1	

Refitting the I/O board

	Action	Note
1	Snap on the I/O board to the mounting rail.	Digital 24V I/O DSQC 652: 3HAC025917-001

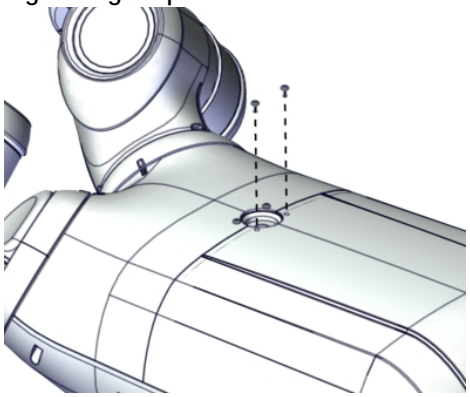
Refitting the body cover

	Action	Note
1	Refit the body cover with the attachment screws.	Screws: 3HAC052487-001 (8 pcs) Tightening torque: 0.9 Nm  xx1500000303

Continues on next page

4.6.11 Replacing the SMB boards

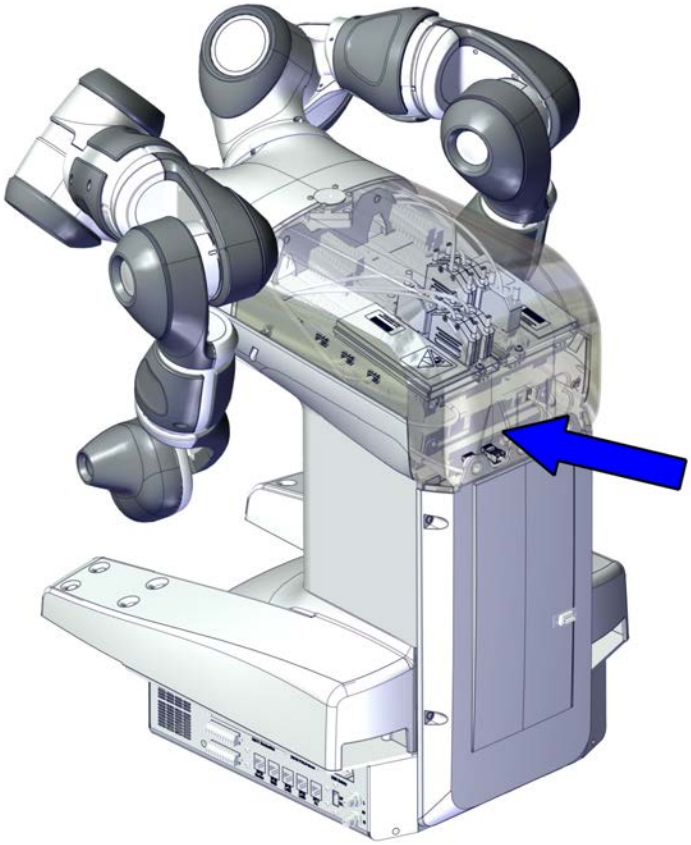
Continued

	Action	Note
2	Refit the attachment screws.	Screws: M3x6 8.8-A2F (2 pcs). Tightening torque: 0.2 Nm  xx1500000525
3	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.6.12 Replacing the EtherNet switch

Location of the EtherNet switch

The EtherNet switch is located as shown in the figure.



xx1500000423

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Ethernet switch 5p	3HAC034884-001	

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.

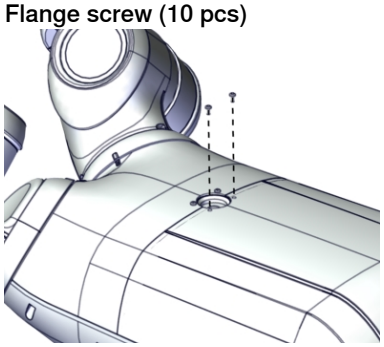
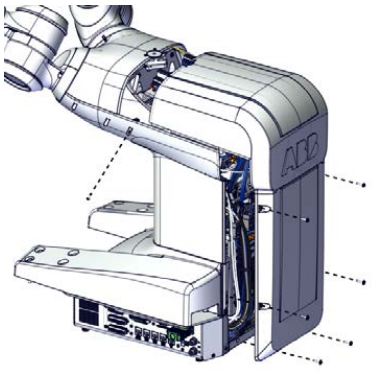
Continues on next page

4.6.12 Replacing the EtherNet switch
Continued

Removing the EtherNet switch

Use this procedure to remove the EtherNet switch.

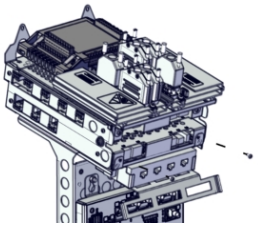
Removing the body cover

	Action	Note
1	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	
2	Remove the body cover.	Flange screw (10 pcs)  xx1500000525  xx1500000303

Removing the EtherNet switch

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	Disconnect the connectors (cut cable ties if necessary): • A33.X2 (X2) • A33.X3 (X3)	

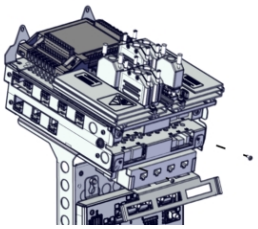
Continues on next page

	Action	Note
3	Remove two attachment screws.	 xx1500000424
4	Gently pull out the EtherNet switch and the holder to remove the latches from the recesses.	
5	Disconnect the connector: • A33.X1 • A33.X6 • A33.X5	
6	Pull out the EtherNet switch from the holder.	

Refitting the EtherNet switch

Use this procedure to refit the EtherNet switch.

Refitting the EtherNet switch

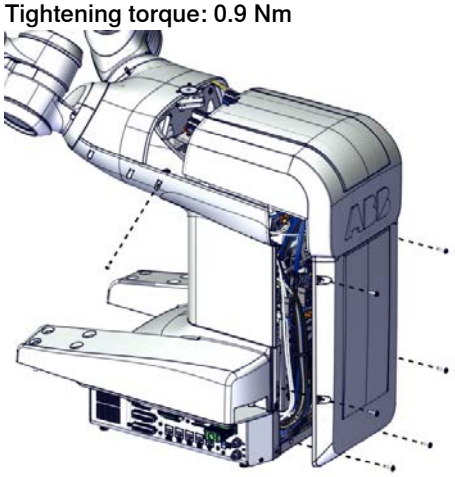
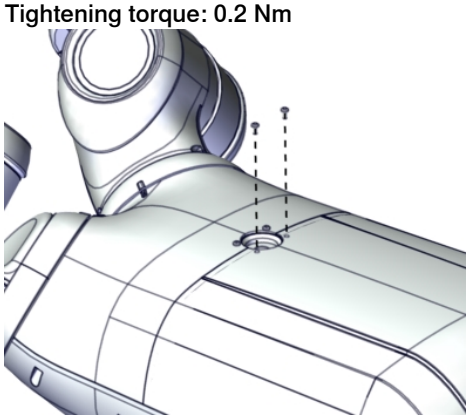
	Action	Note
1	Fit the new ethernet switch in the holder.	Ethernet switch 5p: 3HAC034884-001
2	Connect the connectors: • A33.X1 • A33.X5 • A33.X6	
3	Gently push the holder latches into the recesses.	
4	Tighten two attachment screws.	 xx1500000424
5	Connect the connectors: • A33.X2 (X2) • A33.X3 (X3)	

Continues on next page

4.6.12 Replacing the EtherNet switch

Continued

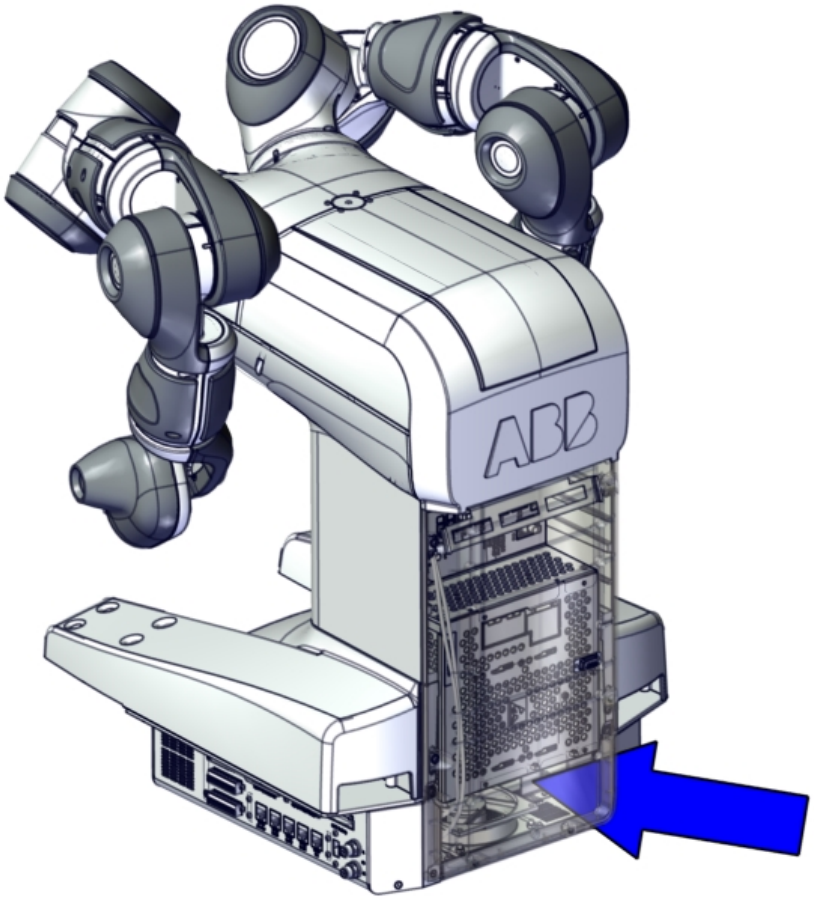
Refitting the body cover

	Action	Note
1	Refit the body cover with the attachment screws.	Screws: M3x16 8.8 (8 pcs) Tightening torque: 0.9 Nm  xx1500000303
2	Refit the attachment screws.	Screws: M3x6 8.8-A2F (2 pcs). Tightening torque: 0.2 Nm  xx1500000525
3	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.6.13 Replacing the mass memory card

Location of the mass memory card

The mass memory card is located as shown in the figure.



xx1500000561

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Mass memory with boot loader	3HAC047184-003	

Required tools and equipment

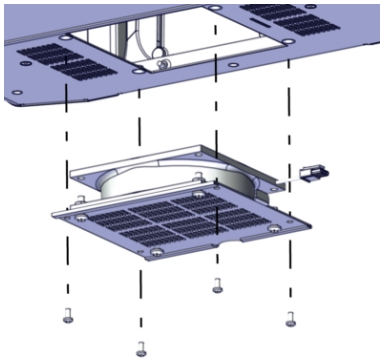
Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.

Continues on next page

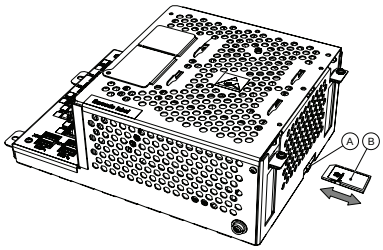
4.6.13 Replacing the mass memory card
Continued

Removing the mass memory card

Removing the fan

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	Remove the bottom cover. **CAUTION** Be careful not to damage the cables.	 xx1500000310
3	Disconnect the fan connector: • E1.XS1	

Removing the mass memory card

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** 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 58*	
3	Gently push the memory card until it clicks and then pull the card straight out.	 xx1300000807 A Slot for memory card B Mass memory card

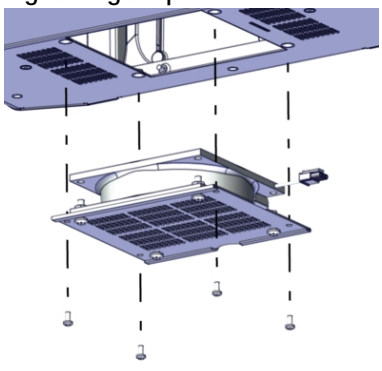
Continues on next page

Refitting the mass memory card

Refitting the mass memory card

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** 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 58*	
3	**CAUTION** Make sure that the memory card is oriented correctly before inserting it. Otherwise the memory card or the memory slot may be damaged.	
4	Gently push the memory card with the finger until it clicks into place.	Mass memory with boot loader: 3HAC047184-003

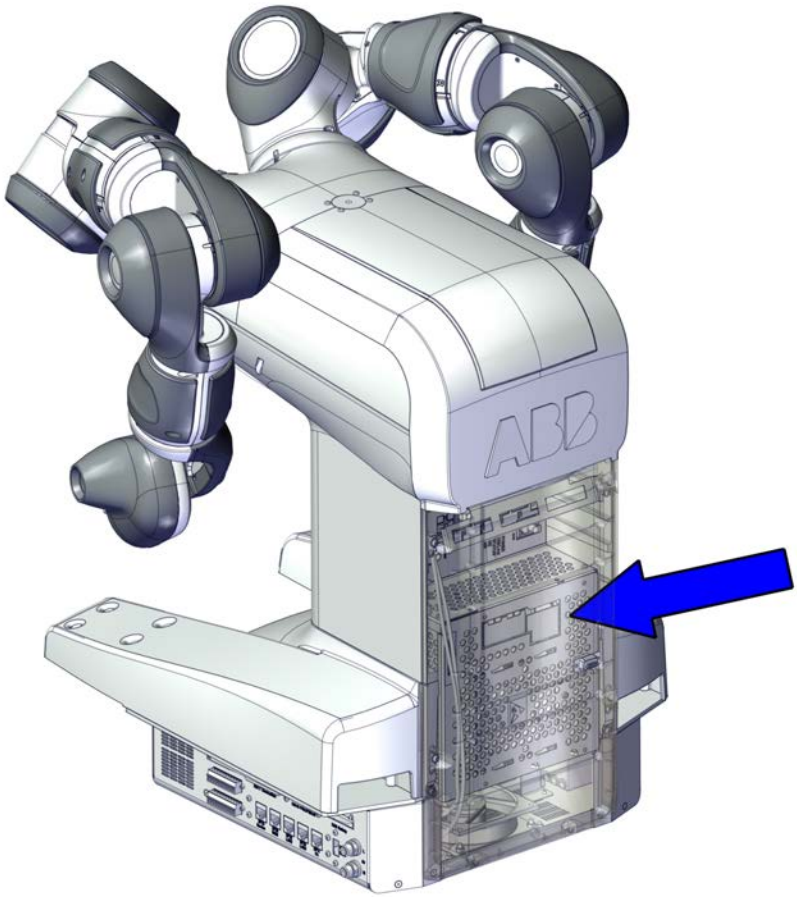
Refitting the fan

	Action	Note
1	Connect the fan connector. • E1.XS1	
2	Refit the bottom cover and tighten the screws. **CAUTION** Be careful not to damage the cables.	Screws: M3x6 8.8-A2F (4 pcs). Tightening torque: 0.2 Nm  xx1500000310

4.6.14 Replacing the expansion board complete

Location of the expansion board complete

The expansion board complete is located as shown in the figure.



xx1500000369

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
DSQC1003 Expansion board complete	3HAC046408-001	

Required tools and equipment

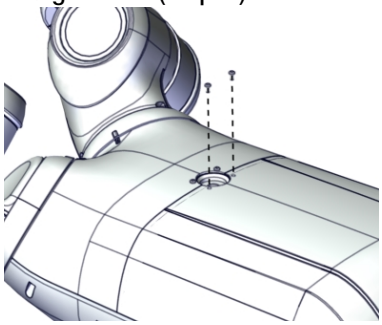
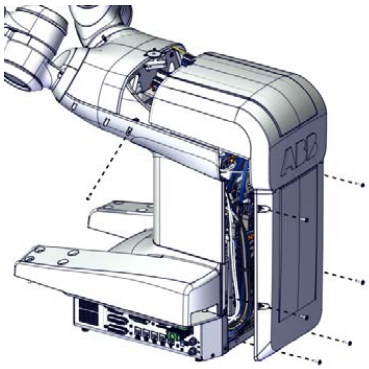
Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.

Continues on next page

Equipment, etc.	Article number	Note
Trolley	-	

Removing the computer

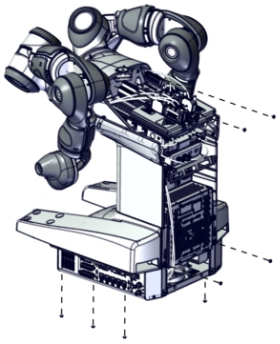
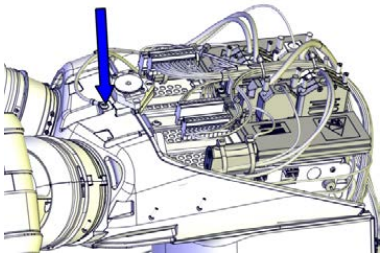
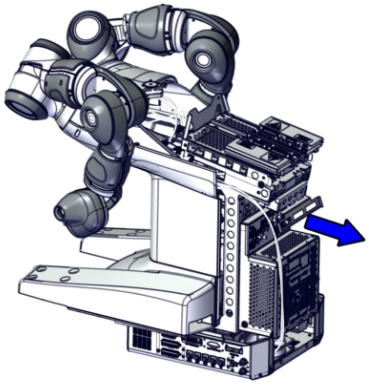
Pulling the controller out partially

	Action	Note
1	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	
2	Remove the body cover. **ELECTROSTATIC DISCHARGE (ESD)** The equipment is sensitive to ESD. Before handling the equipment please read the safety information in the section *The unit is sensitive to ESD on page 58*	Flange screw (10 pcs)  xx1500000525  xx1500000303

Continues on next page

4.6.14 Replacing the expansion board complete

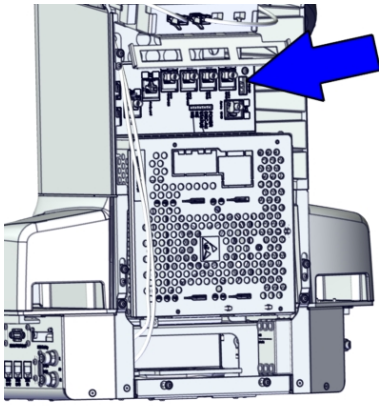
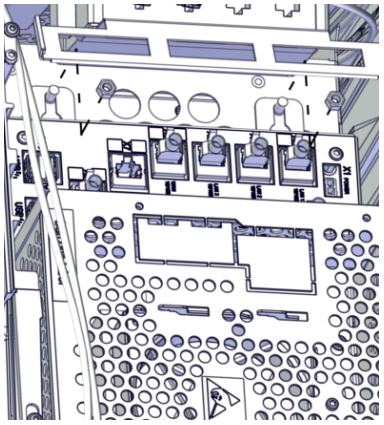
Continued

	Action	Note
3	Remove the attachment screws that fasten the controller to the body.	 xx1500000364
4	Put a trolley beneath the controller.	
5	Disconnect the grounding cable.	 xx1500000601
6	Carefully pull the controller partially out in the rails. **CAUTION** The cabling is still connected inside the robot, so be careful not to strain the cables!	 xx1500000365

Removing the computer

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	

Continues on next page

	Action	Note
2	Separate the cabling in front of the computer, cut cable ties if necessary. **CAUTION** Be careful not to bend or break the cables and air hoses.	
3	Disconnect the connectors: • A31.USB (X10) • A31.X9 (X9) • A31.X6 (X6) • A31.X5 (X5) • A31.X4 (X4) • A31.X3 (X3) • A31.XS1 (X1) • A31.SERVICE (X2)	 xx1500000371
4	Cut cable ties from the disconnected cables if necessary.	
5	(Depending on which connection is installed) Disconnect the connector: • Profibus/S: A32.2 • Ethernet/IP/S: A32.1 • ProfiNet/S: A32.3	
6	Loosen the nuts holding the computer.	 xx1500000386 Nut 9ADA267-5 M5 Steel 8-A2F
7	Gently push the computer upwards a little bit to release the latches from the recesses.	
8	Disconnect the connection (underneath computer): A35.J1 D-NET	
9	Tilt the computer out and remove it from the controller.	

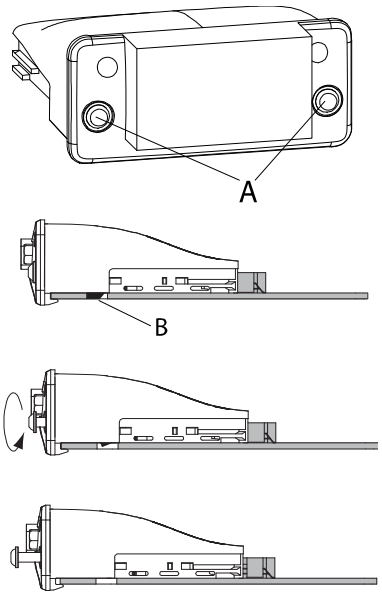
Continues on next page

4.6.14 Replacing the expansion board complete
Continued

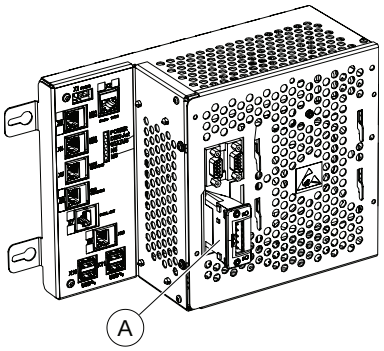
Removing the expansion board complete

Use this procedure to remove the expansion board complete.

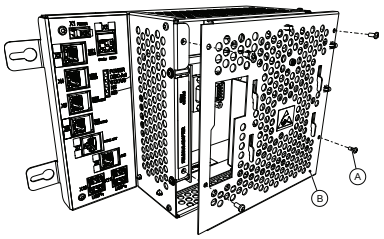
Removing the fieldbus adapter

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** 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 58*	
3	(Depending on which connection is installed) Disconnect the connector: • Profibus/S: A32.2 • Ethernet/IP/S: A32.1 • ProfiNet/S: A32.3	
4	Loosen the attachment screws (2 pcs) on front of the fieldbus adapter to release the fastening mechanism. **Note** Do not remove the attachment screws, only loosen them.	 xx0700000193 A Attachment screw (2 pcs) B Fastening mechanism

Continues on next page

	Action	Note
5	Grip the loosened attachment screws and gently pull the fieldbus adapter straight out.	 xx1500001755

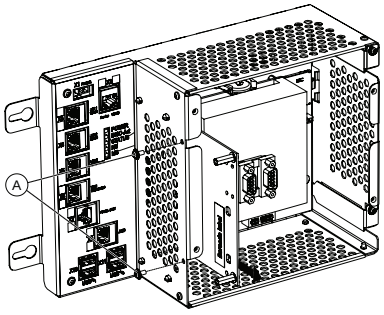
Opening the computer

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** 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 58*	
3	(Depending on which connection is installed) Disconnect the connector: • Profibus/S: A32.2 • Ethernet/IP/S: A32.1 • ProfiNet/S: A32.3	
4	Open the computer unit by removing the attachment screws and lift the cover off. **CAUTION** Be careful not to stretch the fan cable.	 xx1300000684 A: Attachment screw (4 pcs) B: Cover
5	Disconnect the fan connector.	

Continues on next page

4.6.14 Replacing the expansion board complete
Continued

Removing the expansion board complete

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** 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 58*	
3	Remove the attachment screws on the computer unit.	 xx1300000859 A: Attachment screw (2 pcs)
4	Grip the expansion board and gently pull it straight out. **CAUTION** Always grip the expansion board around the edges to avoid damage to the board or its components.	

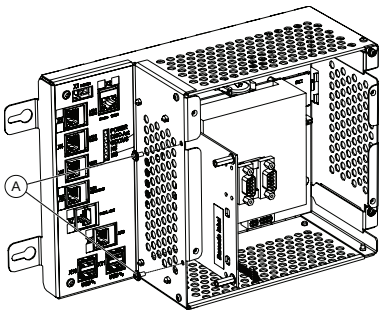
Refitting the expansion board complete

Use this procedure to refit the expansion board complete.

Refitting the expansion board complete

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** 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 58*	

Continues on next page

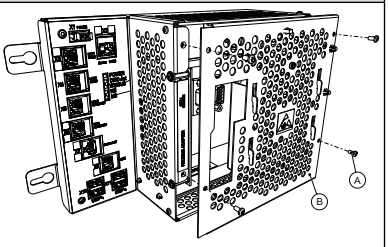
	Action	Note
3	Fit the expansion board complete by pushing it into the connector on the motherboard. **CAUTION** Always grip the expansion board around the edges to avoid damage to the board or its components. **CAUTION** Push carefully so no pins are damaged. Make sure that the expansion board is pushed straight into the connector.	DSQC1003 Expansion board complete: 3HAC046408-001
4	Fasten the expansion board complete with the attachment screws.	 xx1300000859 A — Attachment screw (2 pcs)

Closing the computer

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** 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 58*	
3	Connect the fan connector. **CAUTION** Be careful not to stretch or squeeze the fan cable.	

Continues on next page

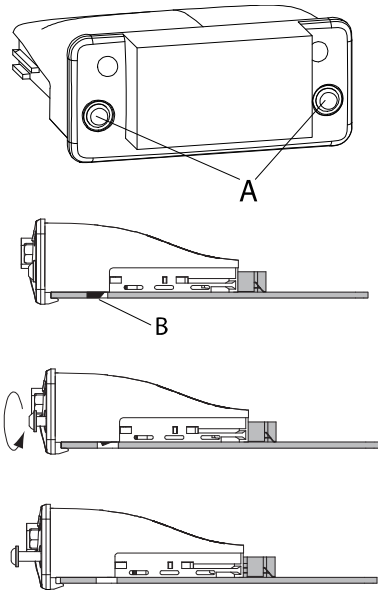
4.6.14 Replacing the expansion board complete
Continued

	Action	Note
4	Fasten the computer cover with its attachment screws.	 xx1300000684 A: Attachment screw (4 pcs) B: Cover
5	(Depending on which connection is installed) Connect the connector: • Profibus/S: A32.2 • Ethernet/IP/S: A32.1 • ProfiNet/S: A32.3	
6	Make sure the robot system is configured to reflect the installed parts.	

Refitting the fieldbus adapter

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** 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 58*	
3	Fit the fieldbus adapter by pushing it along the rails on the motherboard. **CAUTION** Always grip the fieldbus adapter around the edges to avoid damage to the adapter or its components. **CAUTION** Make sure that the adapter is pushed straight onto the rails. Push carefully so no pins are damaged.	

Continues on next page

	Action	Note
4	Fasten the fieldbus adapter with its attachment screws.	 xx0700000193 A: Attachment screw (2 pcs) B: Fastening mechanism
5	(Depending on which connection is installed) Connect the connector: • Profibus/S: A32.2 • Ethernet/IP/S: A32.1 • ProfiNet/S: A32.3	
6	Make sure the robot system is configured to reflect the installed parts.	

Refitting the computer

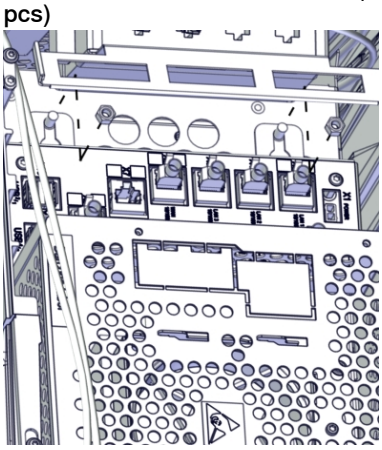
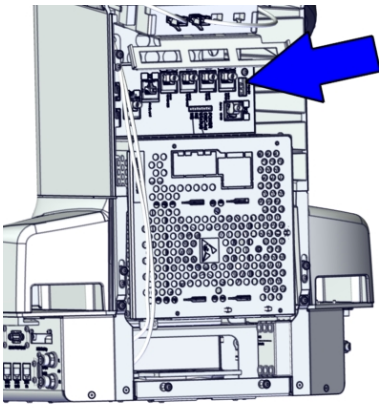
Refitting the computer

	Action	Note
1	Fit the computer.	DSQC1018 Computer: 3HAC050363-001
2	Connect the and tighten the connector (underneath computer) A35.J1 D-NET	
3	Slide the computer downwards to fit the latches in the recesses.	

Continues on next page

4.6.14 Replacing the expansion board complete

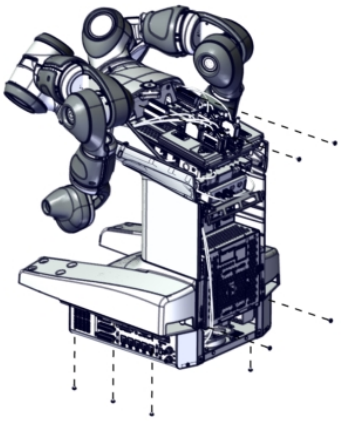
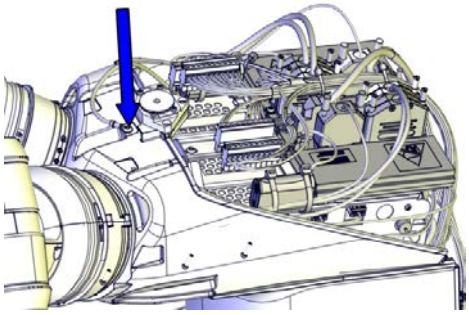
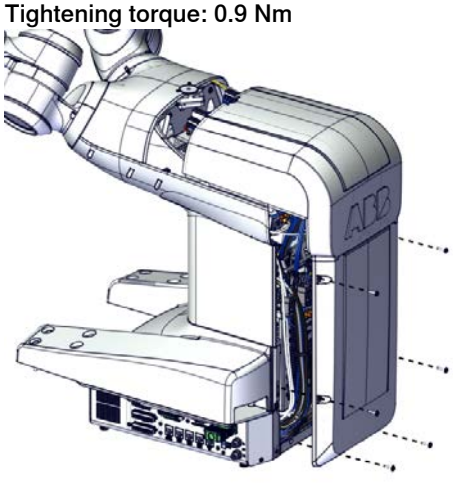
Continued

	Action	Note
4	Tighten the nuts, holding the computer.	Nut: 9ADA267-4 M4 Steel 8-A2F (3 pcs)  xx1500000386
5	(Depending on which connection is installed) Connect the connector: • Profibus/S: A32.2 • Ethernet/IP/S: A32.1 • ProfiNet/S: A32.3	
6	Connect the connectors: • A31.USB (X10) • A31.X9 (X9) • A31.X6 (X6) • A31.X5 (X5) • A31.X4 (X4) • A31.X3 (X3) • A31.XS1 (X1) • A31.SERVICE (X2)	 xx1500000371
7	Fasten the cabling with cable ties. **CAUTION** Be careful not to bend or break the cables and air hoses.	

Pushing the controller in and fastening it

	Action	Note
1	Gently push the controller into the robot body completely. **CAUTION** Be careful not to squeeze or damage the cables and air hoses in any way.	

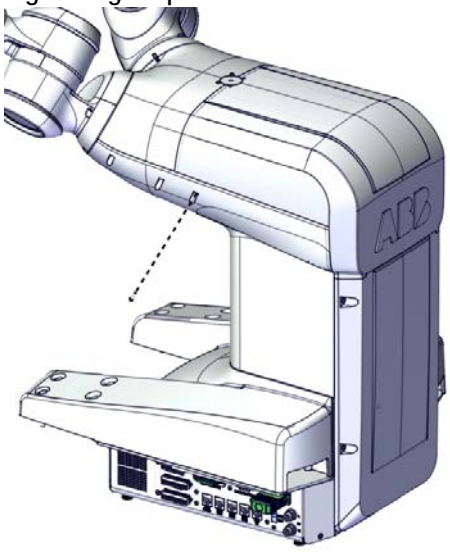
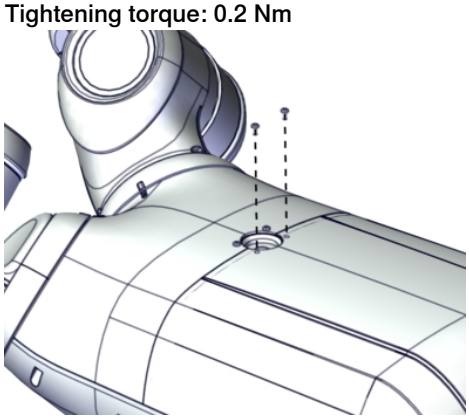
Continues on next page

	Action	Note
2	Refit the attachment screws that fasten the controller to the body.	Screws: 3HAC16446-4 (10 pcs). Tightening torque: 0.9 Nm.  xx1500000364
3	Connect the grounding cable.	 xx1500000601
4	Refit the body cover with the attachment screws.	Screws: 3HAC052487-001 (6 pcs). Tightening torque: 0.9 Nm  xx1500000697

Continues on next page

4.6.14 Replacing the expansion board complete

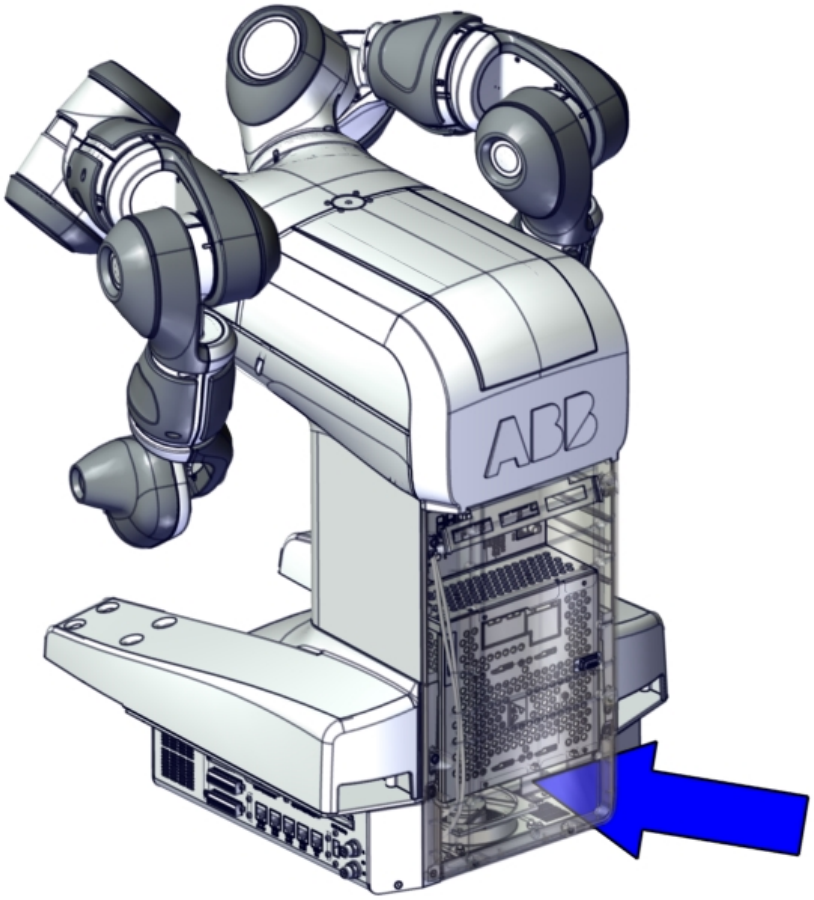
Continued

	Action	Note
5	Refit the two remaining screws of the body cover.	Screws: 3HAC050367-005 (2 pcs). Tightening torque: 0.2 Nm  xx1500000696
6	Refit the attachment screws.	Screws: M3x6 8.8-A2F (2 pcs). Tightening torque: 0.2 Nm  xx1500000525
7	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.6.15 Replacing the DeviceNet master

Location of the DeviceNet master

The DeciveNet master is located as shown in the figure.



xx1500000561

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
DSQC1006 DeviceNet Master PCI-E	3HAC043383-001	

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.

Continues on next page

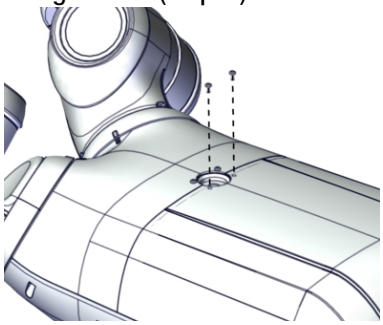
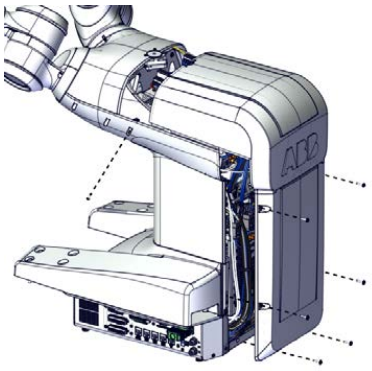
4.6.15 Replacing the DeviceNet master

Continued

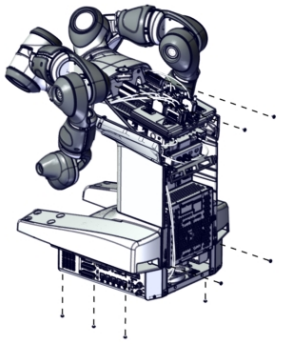
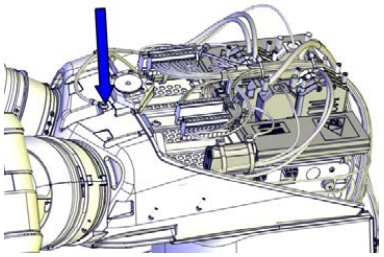
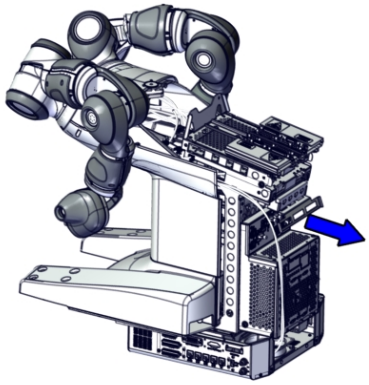
Equipment, etc.	Article number	Note
Trolley	-	

Removing the computer

Pulling the controller out partially

	Action	Note
1	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	
2	Remove the body cover. **ELECTROSTATIC DISCHARGE (ESD)** The equipment is sensitive to ESD. Before handling the equipment please read the safety information in the section *The unit is sensitive to ESD on page 58*	Flange screw (10 pcs)  xx1500000525  xx1500000303

Continues on next page

	Action	Note
3	Remove the attachment screws that fasten the controller to the body.	 xx1500000364
4	Put a trolley beneath the controller.	
5	Disconnect the grounding cable.	 xx1500000601
6	Carefully pull the controller partially out in the rails. **CAUTION** The cabling is still connected inside the robot, so be careful not to strain the cables!	 xx1500000365

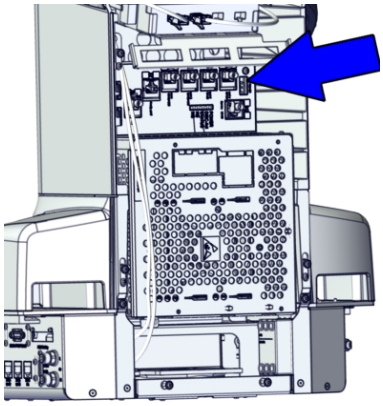
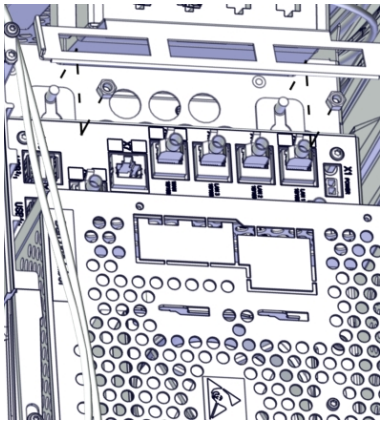
Removing the computer

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	

Continues on next page

4.6.15 Replacing the DeviceNet master

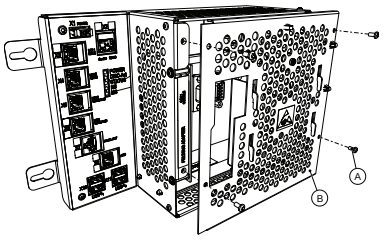
Continued

	Action	Note
2	Separate the cabling in front of the computer, cut cable ties if necessary. **CAUTION** Be careful not to bend or break the cables and air hoses.	
3	Disconnect the connectors: • A31.USB (X10) • A31.X9 (X9) • A31.X6 (X6) • A31.X5 (X5) • A31.X4 (X4) • A31.X3 (X3) • A31.XS1 (X1) • A31.SERVICE (X2)	 xx1500000371
4	Cut cable ties from the disconnected cables if necessary.	
5	(Depending on which connection is installed) Disconnect the connector: • Profibus/S: A32.2 • Ethernet/IP/S: A32.1 • ProfiNet/S: A32.3	
6	Loosen the nuts holding the computer.	 xx1500000386 Nut 9ADA267-5 M5 Steel 8-A2F
7	Gently push the computer upwards a little bit to release the latches from the recesses.	
8	Disconnect the connection (underneath computer): A35.J1 D-NET	
9	Tilt the computer out and remove it from the controller.	

Continues on next page

Removing the DeviceNet master

Opening the computer

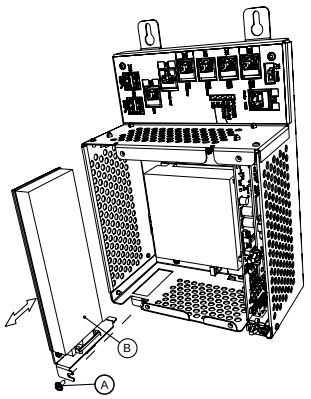
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit please read the safety information in the section *The unit is sensitive to ESD on page 58*	
3	(Depending on which connection is installed) Disconnect the connector: • Profibus/S: A32.2 • Ethernet/IP/S: A32.1 • ProfiNet/S: A32.3	
4	Open the computer unit by removing the attachment screws and lift the cover off. **CAUTION** Be careful not to stretch the fan cable.	 xx1300000684 A: Attachment screw (4 pcs) B: Cover
5	Disconnect the fan connector.	

Removing the DeviceNet master

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** 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 58*	

Continues on next page

4.6.15 Replacing the DeviceNet master
Continued

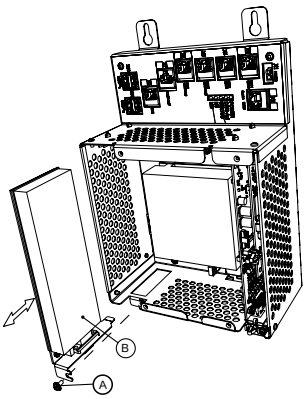
	Action	Note
3	Remove the attachment screw on the DeviceNet master bracket.	 xx1500000728 A – Attachment screw B – DeviceNet master board
4	Gently pull the board straight out. **CAUTION** Always grip the board around the edges to avoid damage to the board or its components. **ELECTROSTATIC DISCHARGE (ESD)** Immediately put the board in an ESD safe bag or similar.	

Refitting the DeviceNet master

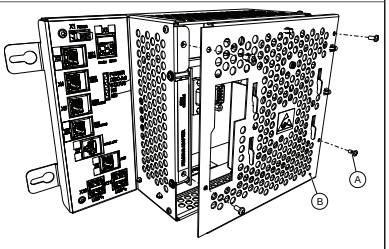
Refitting the DeviceNet master

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** 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 58*	

Continues on next page

	Action	Note
3	Fit the DeviceNet master board by pushing it into the socket on the motherboard. **CAUTION** Always grip the board around the edges to avoid damage to the board or its components.	 xx1500000728 A – Attachment screw B – DeviceNet master board
4	Refit the attachment screw on the DeviceNet master bracket.	

Closing the computer

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** 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 58*	
3	Connect the fan connector. **CAUTION** Be careful not to stretch or squeeze the fan cable.	
4	Fasten the computer cover with its attachment screws.	 xx1300000684 A – Attachment screw (4 pcs) B – Cover

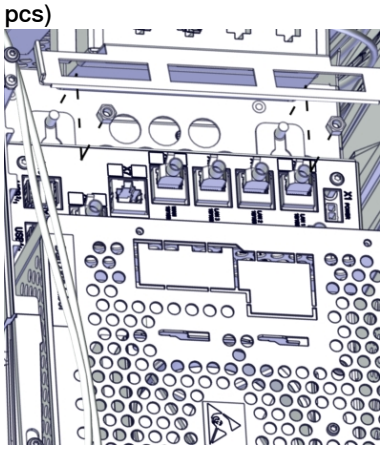
Continues on next page

4.6.15 Replacing the DeviceNet master
Continued

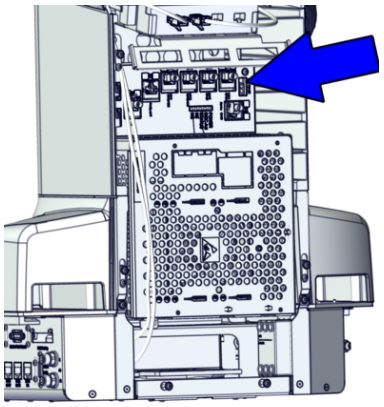
	Action	Note
5	(Depending on which connection is installed) Connect the connector: • Profibus/S: A32.2 • Ethernet/IP/S: A32.1 • ProfiNet/S: A32.3	
6	Make sure the robot system is configured to reflect the installed parts.	

Refitting the computer

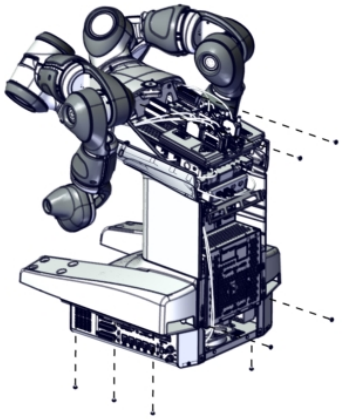
Refitting the computer

	Action	Note
1	Fit the computer.	DSQC1018 Computer: 3HAC050363-001
2	Connect the and tighten the connector (underneath computer) A35.J1 D-NET	
3	Slide the computer downwards to fit the latches in the recesses.	
4	Tighten the nuts, holding the computer.	Nut: 9ADA267-4 M4 Steel 8-A2F (3 pcs)  xx1500000386
5	(Depending on which connection is installed) Connect the connector: • Profibus/S: A32.2 • Ethernet/IP/S: A32.1 • ProfiNet/S: A32.3	

Continues on next page

	Action	Note
6	Connect the connectors: • A31.USB (X10) • A31.X9 (X9) • A31.X6 (X6) • A31.X5 (X5) • A31.X4 (X4) • A31.X3 (X3) • A31.XS1 (X1) • A31.SERVICE (X2)	 xx1500000371
7	Fasten the cabling with cable ties. **CAUTION** Be careful not to bend or break the cables and air hoses.	

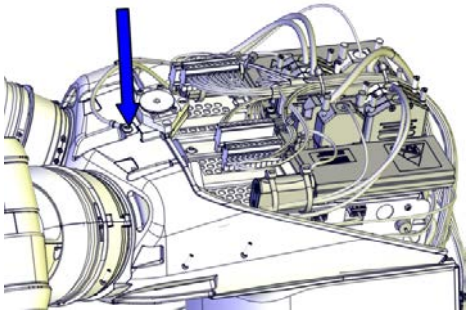
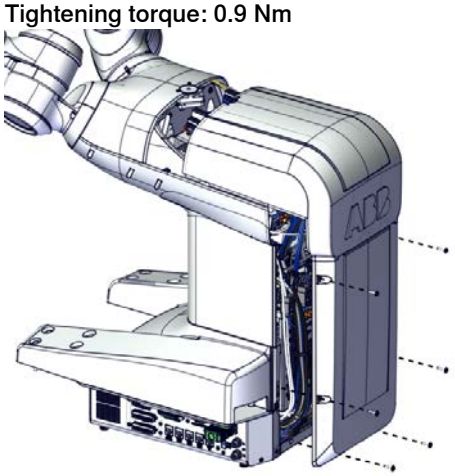
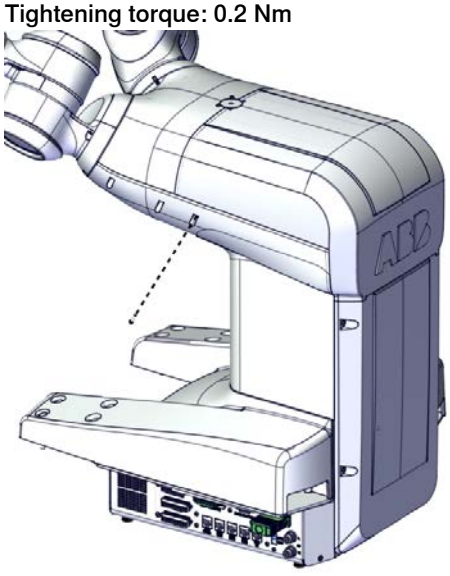
Pushing the controller in and fastening it

	Action	Note
1	Gently push the controller into the robot body completely. **CAUTION** Be careful not to squeeze or damage the cables and air hoses in any way.	
2	Refit the attachment screws that fasten the controller to the body.	Screws: 3HAC16446-4 (10 pcs). Tightening torque: 0.9 Nm.  xx1500000364

Continues on next page

4.6.15 Replacing the DeviceNet master

Continued

	Action	Note
3	Connect the grounding cable.	 xx1500000601
4	Refit the body cover with the attachment screws.	Screws: 3HAC052487-001 (6 pcs). Tightening torque: 0.9 Nm  xx1500000697
5	Refit the two remaining screws of the body cover.	Screws: 3HAC050367-005 (2 pcs). Tightening torque: 0.2 Nm  xx1500000696

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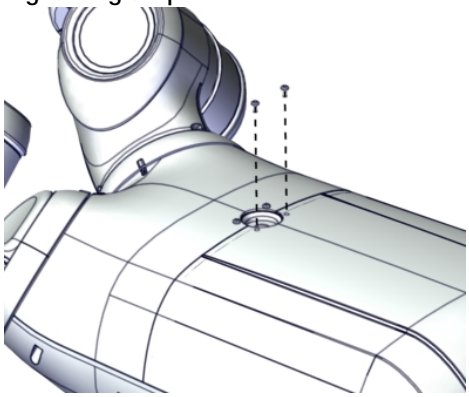
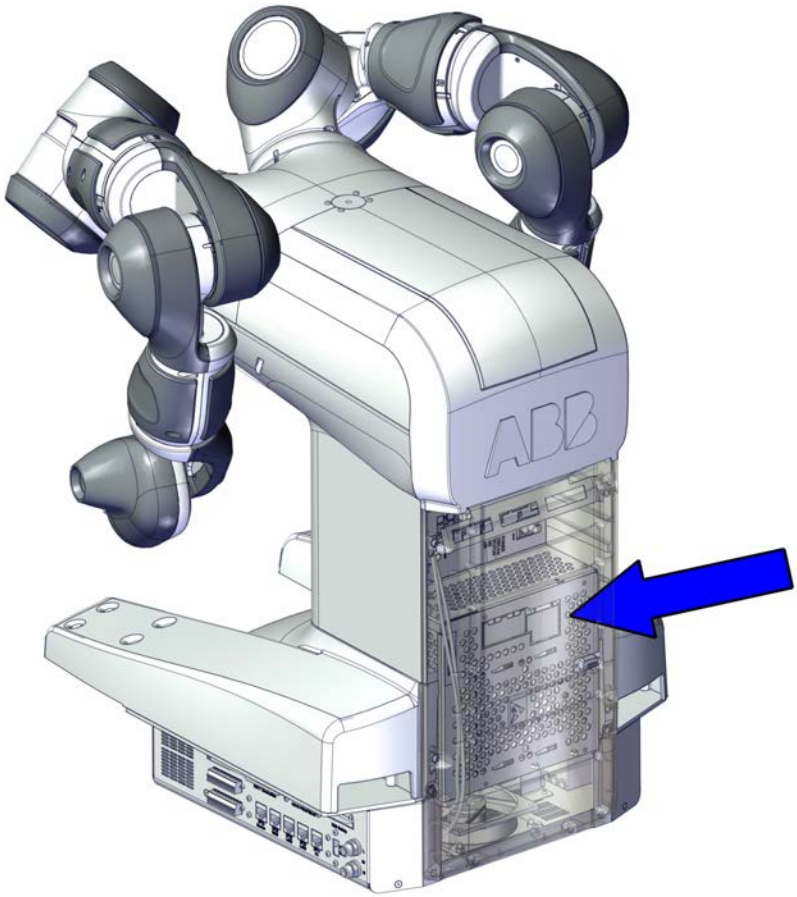
	Action	Note
6	Refit the attachment screws.	Screws: M3x6 8.8-A2F (2 pcs). Tightening torque: 0.2 Nm  xx1500000525
7	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.6.16 Replacing the fieldbus adapter

Location of the fieldbus adapter

The fieldbus adapter is located as shown in the figure.



xx1500000369

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
DSQC667 Profibus Fieldbus adapter	3HAC026840-001	
DSQC688 PROFINET FA	3HAC031670-001	
DSQC669 Ethernet Slave AnyBus adapter	3HAC027652-001	

Continues on next page

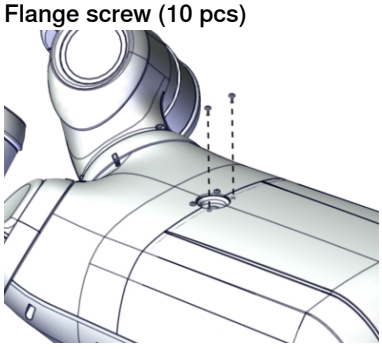
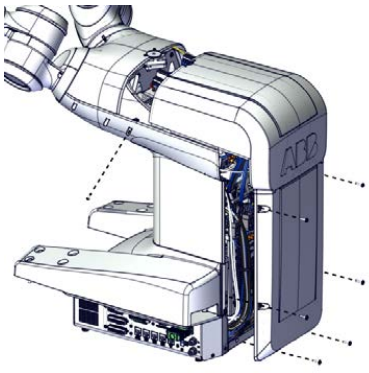
Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.
Trolley	-	

Removing the fieldbus adapter

Use this procedure to remove the fieldbus adapter.

Remove the body cover

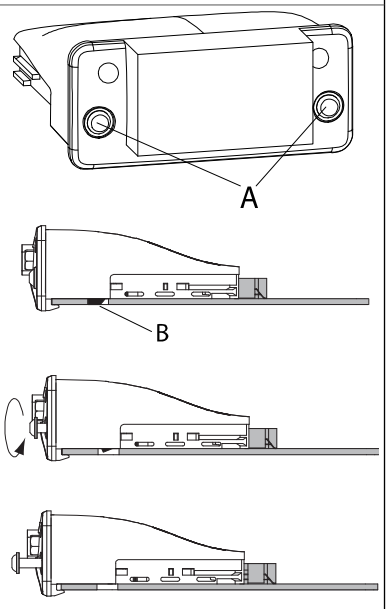
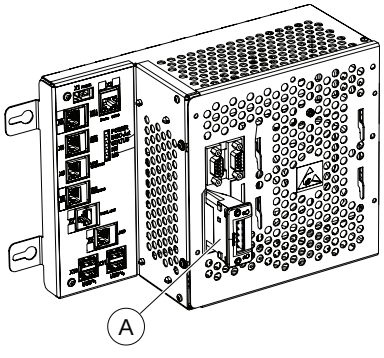
	Action	Note
1	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	
2	Remove the body cover. **ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit please read the safety information in the section *The unit is sensitive to ESD on page 58*	Flange screw (10 pcs)  xx1500000525  xx1500000303

Continues on next page

4.6.16 Replacing the fieldbus adapter

Continued

Removing the fieldbus adapter

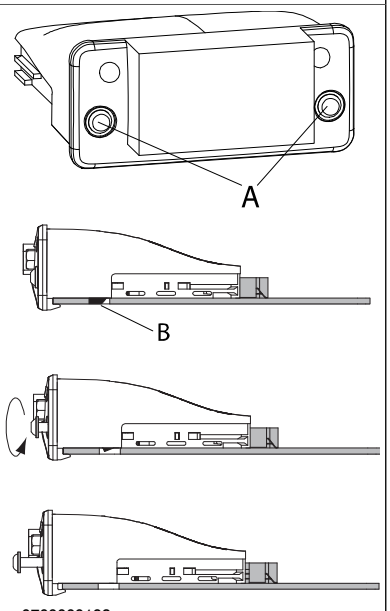
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit please read the safety information in the section *The unit is sensitive to ESD on page 58*	
3	(Depending on which connection is installed) Disconnect the connector: • Profibus/S: A32.2 • Ethernet/IP/S: A32.1 • ProfiNet/S: A32.3	
4	Loosen the attachment screws (2 pcs) on front of the fieldbus adapter to release the fastening mechanism. **Note** Do not remove the attachment screws, only loosen them.	 xx0700000193 A Attachment screw (2 pcs) B Fastening mechanism
5	Grip the loosened attachment screws and gently pull the fieldbus adapter straight out.	 xx1500001755

Continues on next page

Refitting the fieldbus adapter

Use this procedure to refit the fieldbus adapter.

Refitting the fieldbus adapter

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** 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 58*	
3	Fit the fieldbus adapter by pushing it along the rails on the motherboard. **CAUTION** Always grip the fieldbus adapter around the edges to avoid damage to the adapter or its components. **CAUTION** Make sure that the adapter is pushed straight onto the rails. Push carefully so no pins are damaged.	
4	Fasten the fieldbus adapter with its attachment screws.	 xx0700000193 A: Attachment screw (2 pcs) B: Fastening mechanism

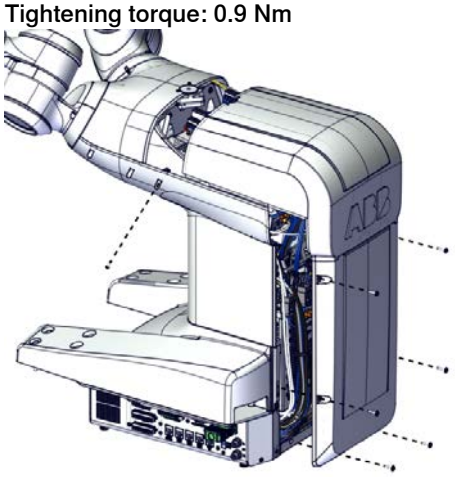
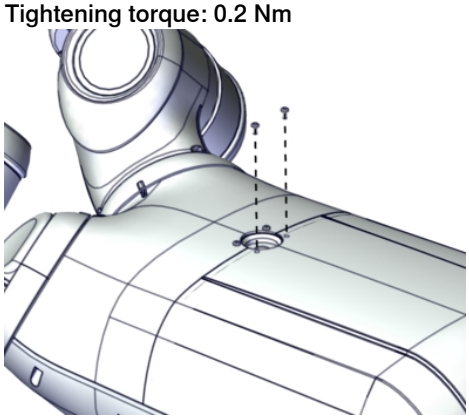
Continues on next page

4.6.16 Replacing the fieldbus adapter

Continued

	Action	Note
5	(Depending on which connection is installed) Connect the connector: • Profibus/S: A32.2 • Ethernet/IP/S: A32.1 • ProfiNet/S: A32.3	
6	Make sure the robot system is configured to reflect the installed parts.	

Refitting the body cover

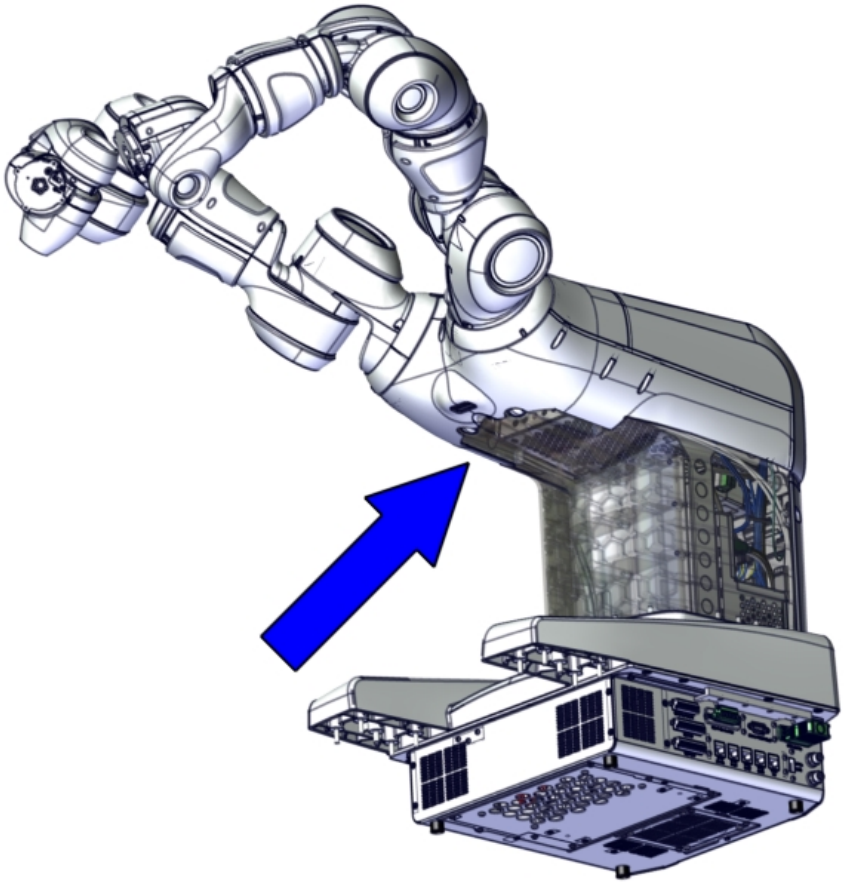
	Action	Note
1	Refit the body cover with the attachment screws.	Screws: 3HAC052487-001 (8 pcs) Tightening torque: 0.9 Nm  xx1500000303
2	Refit the attachment screws.	Screws: M3x6 8.8-A2F (2 pcs). Tightening torque: 0.2 Nm  xx1500000525
3	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

4.7 Brake release harness

4.7.1 Replacing the brake release harness

Location of the brake release harness

The brake release harness is located as shown in the figure.



xx1500000737

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Brake release harness	3HAC038361-001	Includes brake release button and harness.

Continues on next page

4.7.1 Replacing the brake release harness

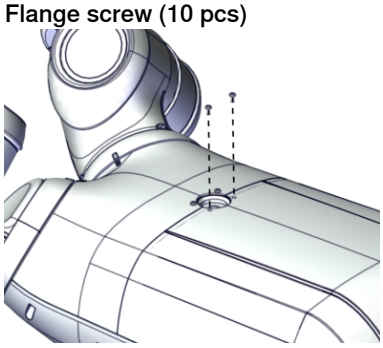
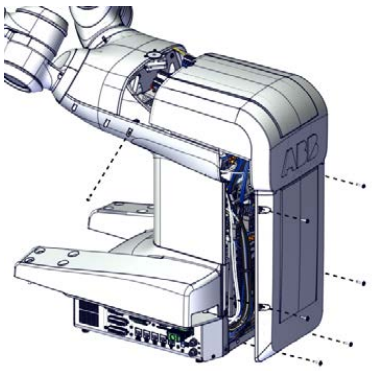
Continued

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 440*.
Trolley	-	

Removing the brake release harness

Pulling the controller out partially

	Action	Note
1	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	
2	Remove the body cover. **ELECTROSTATIC DISCHARGE (ESD)** The equipment is sensitive to ESD. Before handling the equipment please read the safety information in the section *The unit is sensitive to ESD on page 58*	Flange screw (10 pcs)  xx1500000525  xx1500000303

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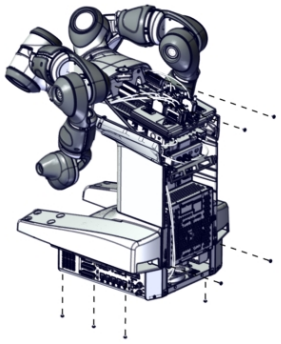
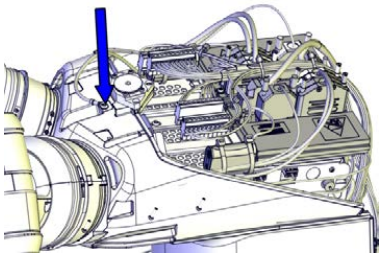
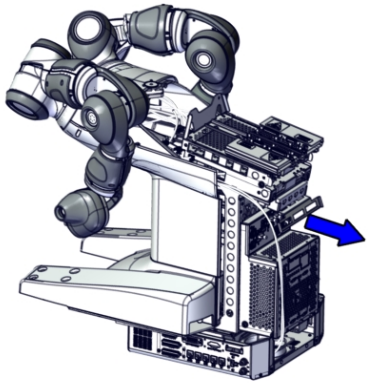
	Action	Note
3	Remove the attachment screws that fasten the controller to the body.	 xx1500000364
4	Put a trolley beneath the controller.	
5	Disconnect the grounding cable.	 xx1500000601
6	Carefully pull the controller partially out in the rails. **CAUTION** The cabling is still connected inside the robot, so be careful not to strain the cables!	 xx1500000365

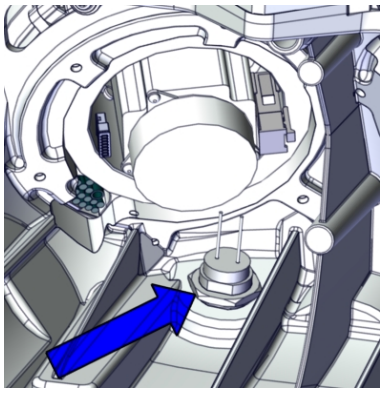
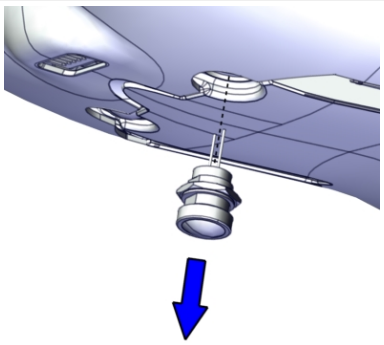
Removing the brake release harness

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	Disconnect the brake release harness connector.	

Continues on next page

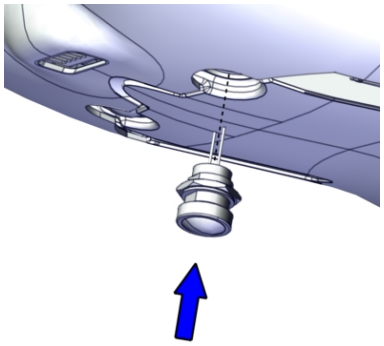
4.7.1 Replacing the brake release harness

Continued

	Action	Note
3	Remove the nut.	 xx1500000744
4	Carefully pull the brake release button out downwards.	 xx1500000745

Refitting the brake release harness

Refitting the brake release harness

	Action	Note
1	Gently push and pull the brake release harness through the mounting hole. **CAUTION** Be careful not to bend or break the cables.	Brake release harness, 3HAC038361-001  xx1500000746

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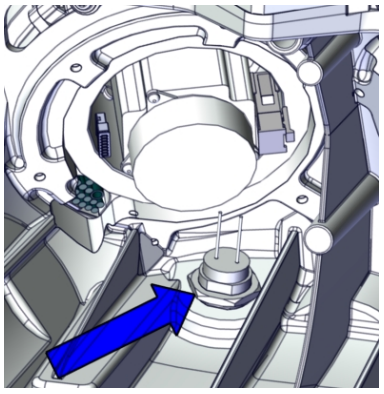
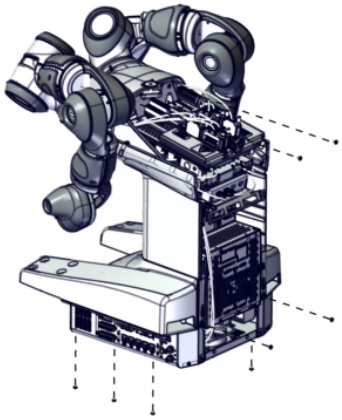
	Action	Note
2	Refit the nut.	 xx1500000744
3	Connect the brake release harness connector.	

Pushing the controller in and fastening it

	Action	Note
1	Gently push the controller into the robot body completely. **CAUTION** Be careful not to squeeze or damage the cables and air hoses in any way.	
2	Refit the attachment screws that fasten the controller to the body.	Screws: 3HAC16446-4 (10 pcs). Tightening torque: 0.9 Nm.  xx1500000364

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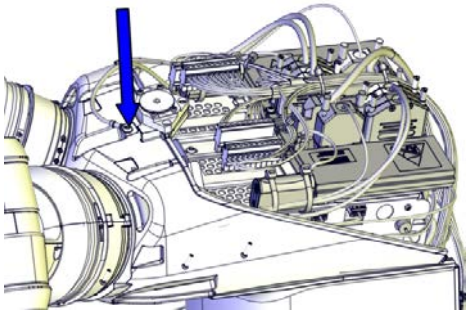
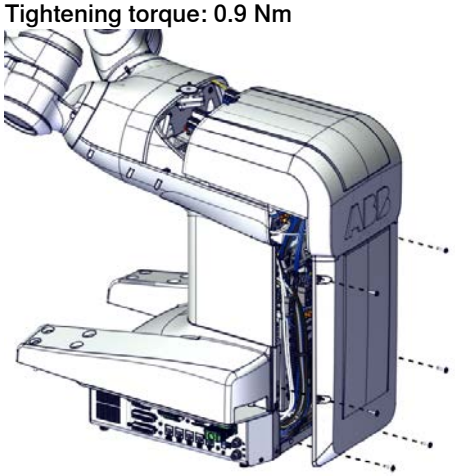
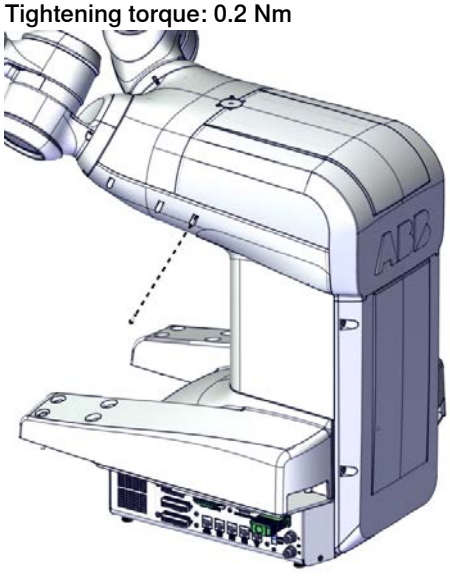
4.7.1 Replacing the brake release harness

Continued

	Action	Note
3	Connect the grounding cable.	 xx1500000601
4	Refit the body cover with the attachment screws.	Screws: 3HAC052487-001 (6 pcs). Tightening torque: 0.9 Nm  xx1500000697
5	Refit the two remaining screws of the body cover.	Screws: 3HAC050367-005 (2 pcs). Tightening torque: 0.2 Nm  xx1500000696

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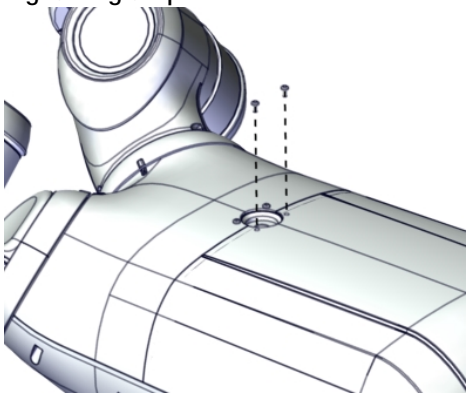
	Action	Note
6	Refit the attachment screws.	Screws: M3x6 8.8-A2F (2 pcs). Tightening torque: 0.2 Nm  xx1500000525
7	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 116*.	

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5 Calibration

5.1 Introduction

General

This chapter includes information about the calibration method.

When the robot system must be re-calibrated, it is done with special calibration tools and according to this section.

When to calibrate

The system must be calibrated if any of the following situations occur.

The resolver values are changed

If resolver values are changed, the robot must be re-calibrated using the calibration method described in section *Calibrating the robot on page 401*.

If the robot has *Absolute Accuracy* calibration, it is also recommended, but not always necessary to calibrate for new absolute accuracy.

The resolver values will change when parts affecting the calibration position are replaced on the robot, for example motors or parts of the transmission.

The revolution counter memory is lost

If the revolution counter memory is lost, the counters must be updated. See *Updating revolution counters on page 415*. This will occur when:

- The battery is discharged
- A resolver error occurs
- The signal between a resolver and measurement board is interrupted
- A robot axis is moved with the control system disconnected

The revolution counters must also be updated after the robot and controller are connected at the first installation.

The robot is rebuilt

If the robot is rebuilt, for example, after a crash, replacing hall sensor or when the reach ability of a robot is changed, it needs to be re-calibrated for new resolver values.

If the robot has *Absolute Accuracy* calibration, it needs to be calibrated for new absolute accuracy after fine calibration has been performed.

5.2 Calibration method

Overview

This section specifies the different types of calibration and the calibration methods that are supplied by ABB.

Type of calibration

Type of calibration	Description	Calibration method
Standard calibration	The calibrated robot is positioned with the TCP linked to the calibration surface at the robot base, with hall sensor technology.	Fine calibration
Absolute Accuracy calibration	Based on standard calibration, and besides positioning the robot at home position, the Absolute Accuracy calibration also compensates for: • Mechanical tolerances in the robot structure • Deflection due to load Absolute Accuracy calibration focuses on positioning accuracy in the Cartesian coordinate system for the robot. Absolute Accuracy calibration data is found on the SMB in the robot. A robot calibrated with Absolute accuracy has a sticker next to the identification plate of the robot. To regain 100% absolute accuracy performance, the robot must be re-calibrated for Absolute Accuracy!  xx0400001197	CalibWareField YuMi AbsAcc Recovery[i] Only available for RW6.05.01 and later. Downgrading RW again after calibration is possible without losing calibration data.

[i] Valid for calibrating a new spare part arm, if accurate data is available for the other arm.

Fine calibration method

With the fine calibration method, the robot's TCP is linked to the robot base with hall sensor. Under this condition, all the seven joints' positions are pre-determined, and all of the axes can be calibrated at the same time.

The fine calibration method is used for all IRB 14000 robots and is the recommended method in order to achieve proper performance.

Calibration order of axes: axis 1-2-3-4-5-6-7.

CalibWareField

Absolute Accuracy calibration with CalibWareField requires specific laser equipment. Contact ABB Service for more information.

Continues on next page

YuMi AbsAcc Recovery

When replacing a complete arm of the IRB 14000 robot, Absolute Accuracy can be recovered by using the Absolute Accuracy of the arm that has not been replaced. Service routine YuMiAbsAccRecovery and YuMi AbsAcc Recovery tool (3HAC063555-001) are required. See *Calibrating the robot for Absolute Accuracy on page 409*.

Note

YuMi AbsAcc Recovery is dependent on accurate Absolute Accuracy data for the existing (not-replaced) arm, and can therefor only be used a limited number of times if both the left and the right robot arm are replaced repeatedly (must not be done at the same time). The data loses some of its accuracy each time it is recovered using Absolute Accuracy of an arm that is not calibrated with CalibWare/CalibWareField. Because of this, it is recommended to always redefine the work object after running YuMi AbsAcc Recovery.

It is recommended to make a new Absolute Accuracy calibration of the robot using CalibWareField instead, if the arms have been replaced cross-wise more than four times. Contact ABB Service for calibration with CalibWareField after the limited times of replacements have been reached.

5.3 Calibration scale and correct axis position

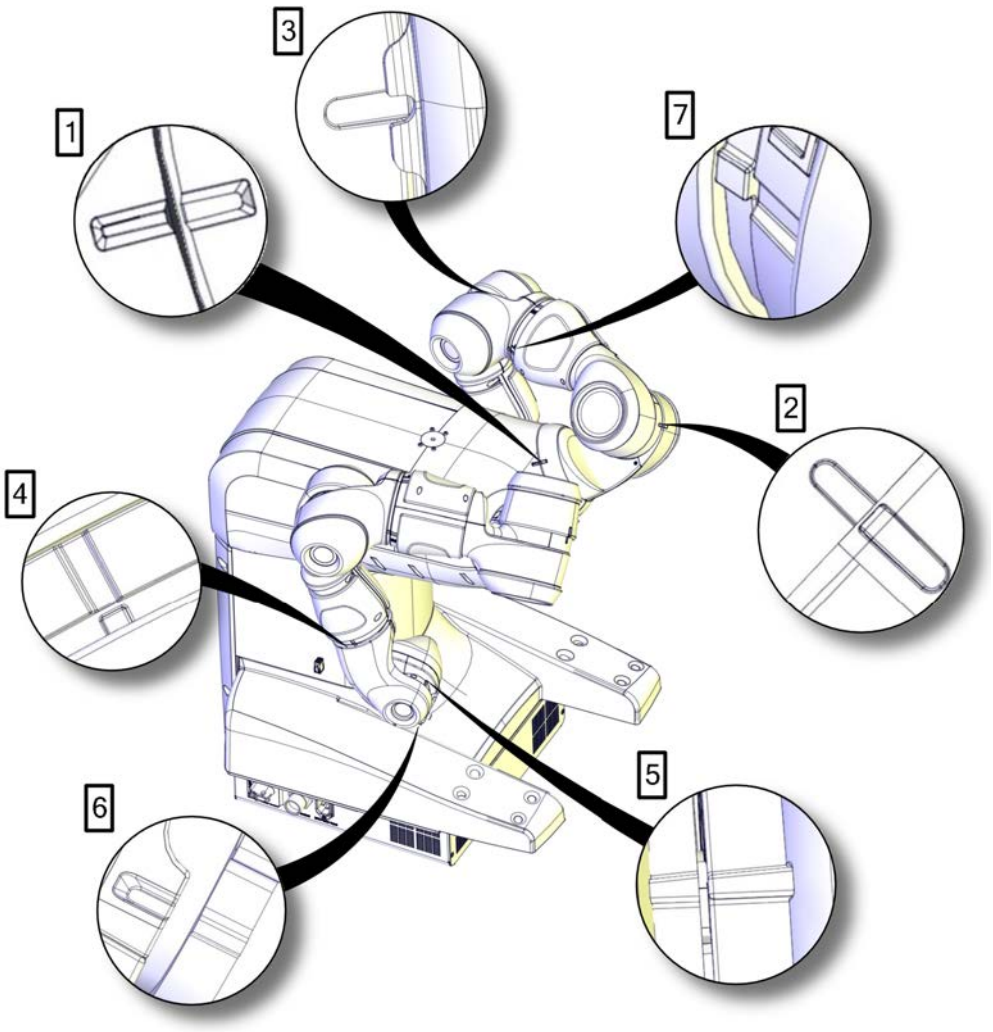
Introduction

This section specifies the calibration scale positions and/or correct axis positions.

Calibration scales/marks

This illustration shows the positions of the calibration scales and marks on the robot.

The number next to the enlargement corresponds to the axis number.



xx1500000526

5.4 Calibrating the robot

Exact axis positions in degrees

The table below specifies the exact axis positions in degrees.

See *Calibration scale and correct axis position on page 400* for figures.

Axis	IRB 14000 ROB_R	IRB 14000 ROB_L
1	0°	0°
2	-130°	-130°
3	30°	30°
4	0°	0°
5	40°	40°
6	0°	0°
7	-135°	135°

Calibrating the robot with fine calibration procedure

Note

Fine calibration should only be done without any tool mounted.

Perform the fine calibration of the robot when the calibration status is **Not calibrated**.

Moving the robot to its calibration position

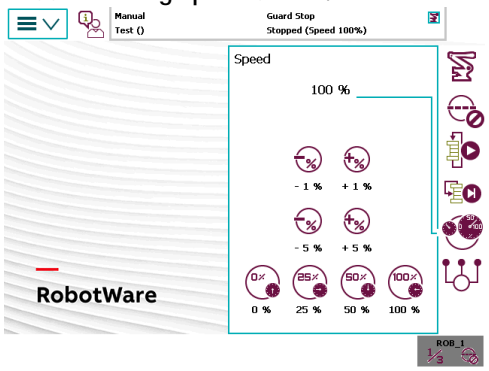
	Action	Note
1	**CAUTION** When releasing the holding brakes, the robot axes may move very quickly and sometimes in unexpected ways!	
2	Release the brakes of the robot arm to be calibrated and move the arm manually so that the synchronization mark of each joint is aligned. The robot now stands in its calibration position.	The synchronization marks are shown in *Calibration scale and correct axis position on page 400*. There is a tolerance for the joint position. The edge of a mark should be at least within the area of the opposite mark.

Continues on next page

5.4 Calibrating the robot

Continued

Setting the running speed to 100%

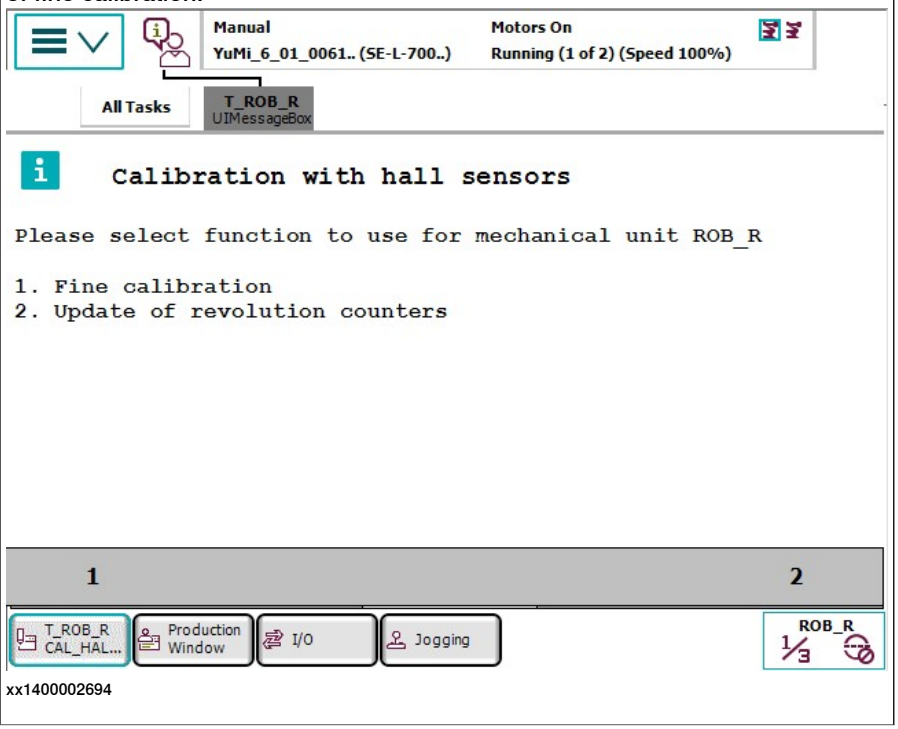
	Action	Note
1	Set the running speed to 100%.  en0300000470	

Selecting the Calibration with hall sensors (CalHall) routine

	Action	Note
1	Open the **Program Editor** on the FlexPendant.	
2	Select the task that corresponds to the robot arm to be calibrated. Tap **Open**.	
3	If necessary, create a new program. This needs to be done if no existing program is available.	
4	Select **Debug** and tap **PP to Main**.	
5	Select **Debug** and tap **Call Routine...**	
6	Select **CalHall**.	
7	Go to **Motor On** and press the **Start button**.	

Continues on next page

Selecting the function Fine calibration

	Action
1	In the calibration with hall sensors routine (CalHall), tap **1** to select the function of fine calibration.  xx1400002694

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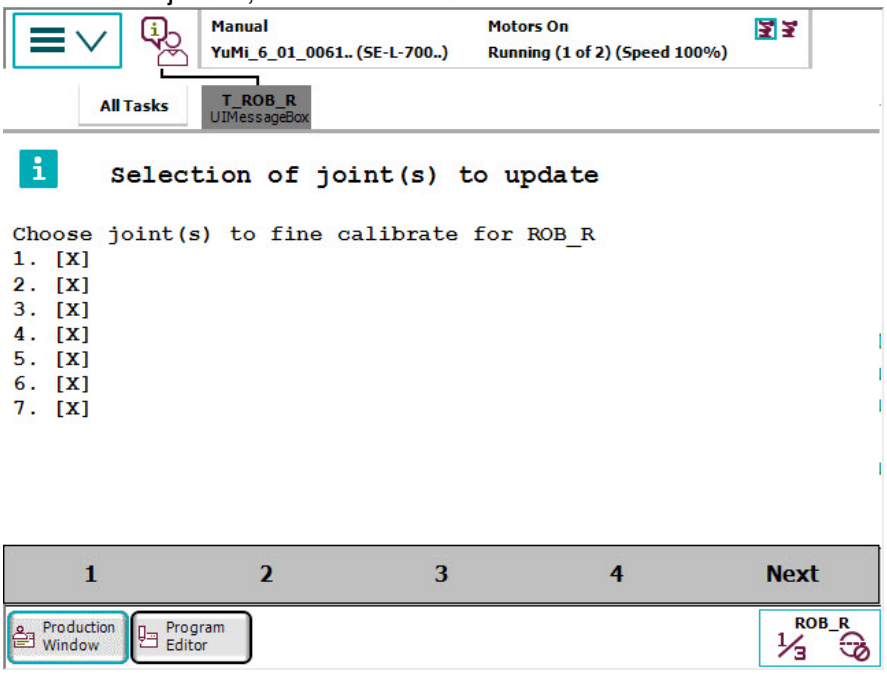
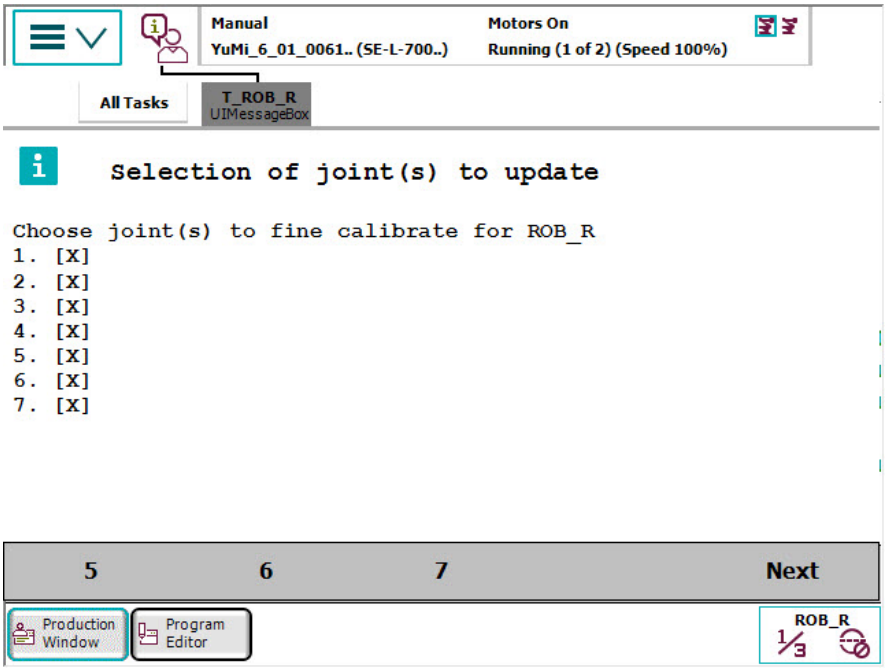
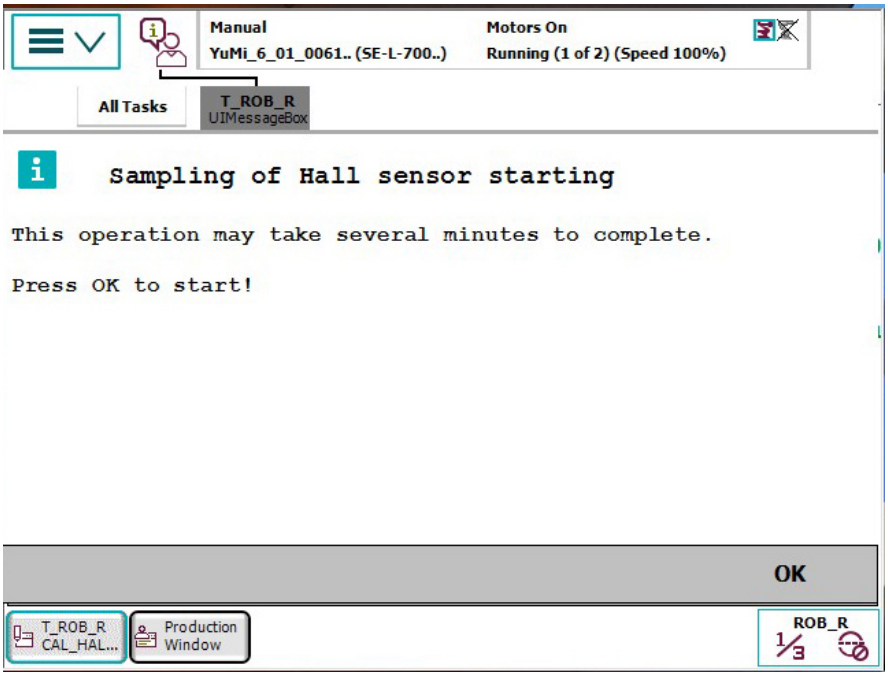
	Action
2	Tap to select which joint(s) to fine calibrate. Joints 1, 2, 3 and 4 are selectable in the first window. Tap **Next** to open the second window where joints 5, 6 and 7 are selectable.  xx1500000658  xx1500000659

Continues on next page

Running the fine calibration procedure

	Action
1	Tap **OK** to start the sampling procedure of the hall sensor. One at a time, each selected joint now rotates back and forth several times to calculate and find the exact position where the hall sensor is aligned with the magnet. Calibration order: axis 1-2-3-4-5-6-7. **Note** This procedure may take several minutes.  xx1400002697

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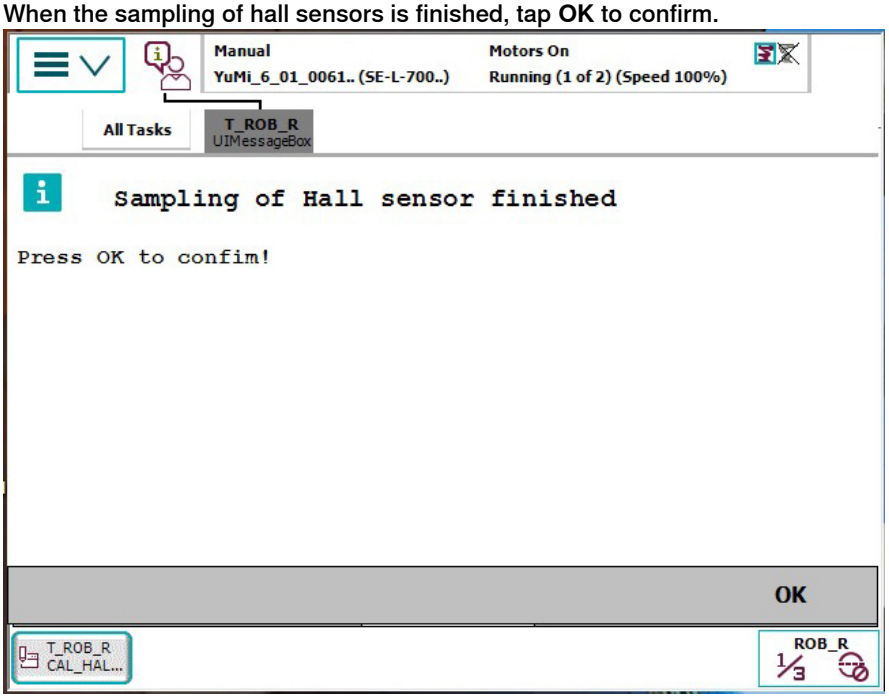
	Action
2	When the sampling of hall sensors is finished, tap **OK** to confirm.  xx1400002898

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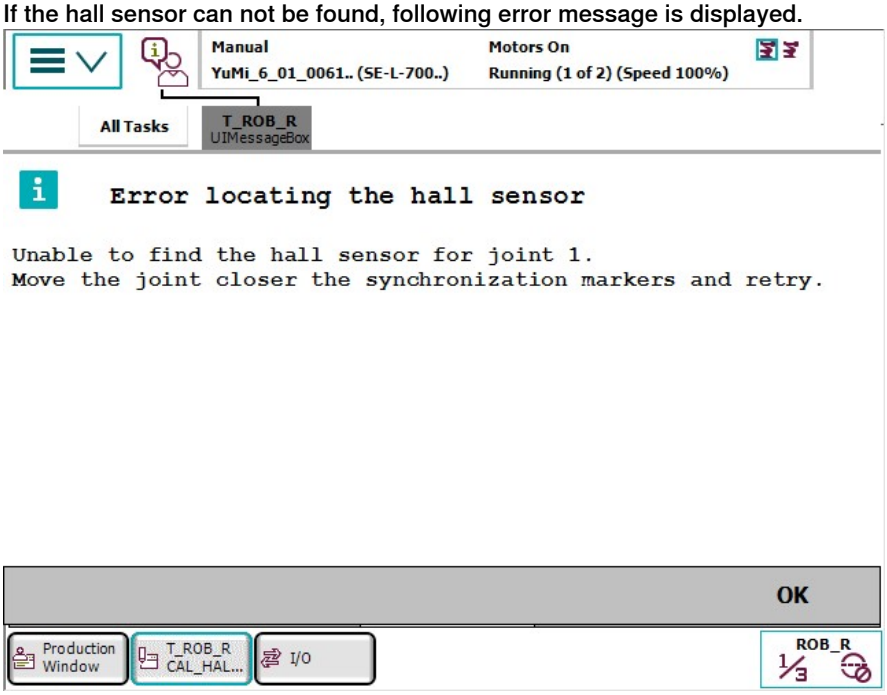
	Action
3	If the hall sensor can not be found, following error message is displayed.  xx1400002698 There can be several causes for this error. • The joints are not sufficiently aligned according to the synchronization marks. Move the joints so that the synchronization marks are aligned. Tap **OK** and restart the fine calibration procedure. The joints prior to the joint that stopped the calibration procedure are calibrated and do not need to be calibrated again. Joints coming after the joint that stopped the calibration procedure has not been calibrated. (Calibration order: axis 1-2-3-4-5-6-7.) • The hall sensor is defect. Perform troubleshooting of I/O signals. Possible replacement of hall sensor may be required.

Checking the synchronization position of all axes

	Action	Note
1	Jog each axis to its exact synchronization position in degrees using the FlexPendant.	Degrees are specified in *Exact axis positions in degrees on page 401*.
2	Check that the synchronization marks on each axis are aligned with each other. Are they aligned within the tolerances? The edge of a mark should be at least within the area of the opposite mark. • If yes, the calibration is verified and the robot is correctly calibrated. No more action needed. • If no, then move the robot to calibration position again and repeat the fine calibration procedure. *Moving the robot to its calibration position on page 401* *Running the fine calibration procedure on page 405*	

Continues on next page

5.4 Calibrating the robot
Continued

After calibration

	Action	Note
1	Refit any tools or customer cables previously removed from the arm.	

5.5 Calibrating the robot for Absolute Accuracy

Description of Absolute Accuracy option

The Absolute Accuracy option is integrated in the controller algorithms for compensation of the difference between the ideal and the real robot, and does not need external equipment or calculation. Absolute Accuracy is a RobotWare option and includes an individual calibration of the robot (mechanical arm). Absolute Accuracy is a TCP calibration to reach a good positioning in the Cartesian coordinate system.

Methods for Absolute Accuracy calibration

If parts of the mechanical structure of a robot with Absolute Accuracy option are replaced, the robot needs to be re-calibrated for Absolute Accuracy, after fine calibration has been performed.

Method for Absolute Accuracy calibration	When to use
CalibWare	After replacement of one or both arms, or part of the arm structures. Requires specific laser equipment. Contact ABB Service for more information.
YuMi AbsAcc Recovery	After replacement of one complete arm and if accurate Absolute Accuracy data is available for the other arm. Only available for RW6.05.01 and later. Downgrading RW again after calibration is possible without losing calibration data. See *Calibrating a new robot arm with YuMiAbsAccRecovery on page 410*.

Required equipment and software

Equipment	Article number	Note
YuMi AbsAcc Recovery tool	3HAC063555-001	Attachment screws (8 pcs, M2.5x8) are enclosed with the tool. Handle and store the tool with care. If the tool is damaged in any way it must be replaced.
Absolute Accuracy data for arm	-	Enclosed in the spare part delivery.

Continues on next page

Calibrating a new robot arm with YuMiAbsAccRecovery

Use this procedure to restore Absolute Accuracy for the new robot arm.

> **Note**
>
> YuMi AbsAcc Recovery is dependent on accurate Absolute Accuracy data for the existing (not-replaced) arm, and can therefor only be used a limited number of times if both the left and the right robot arm are replaced repeatedly (must not be done at the same time). The data loses some of its accuracy each time it is recovered using Absolute Accuracy of an arm that is not calibrated with CalibWare/CalibWareField. Because of this, it is recommended to always redefine the work object after running YuMi AbsAcc Recovery.
>
> It is recommended to make a new Absolute Accuracy calibration of the robot using CalibWareField instead, if the arms have been replaced cross-wise more than four times. Contact ABB Service for calibration with CalibWareField after the limited times of replacements have been reached.

Preparations before running routine YuMiAbsAccRecovery

	Action	Note
1	Calibrate the new robot arm with fine calibration procedure, as selected in CalHall routine.	See *Calibration on page 397*.
2	Verify that fine calibration data is correct for the other arm.	
3	Load Absolute Accuracy calibration data for the new robot arm, enclosed in the spare part delivery.	
4	Verify that Absolute Accuracy calibration data is correct for the other arm.	
5	Remove any gripper or tool from the robot arms.	

Selecting the routine YuMiAbsAccRecovery

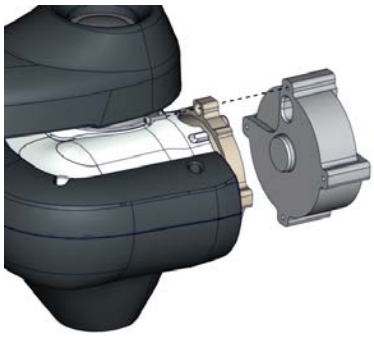
	Action	Note
1	Open the **Program Editor** on the FlexPendant.	
2	Select the task that corresponds to any of the robot arms. Tap **Open**.	
3	If necessary, create a new program. This needs to be done if no existing program is available.	
4	Select **Debug** and tap **PP to Main**.	
5	Repeat *step 1* to *4* for the task that corresponds to the other robot arm.	
6	Select **Debug** and tap **Call Routine...**	
7	Select **YuMiAbsAccRecovery**.	
8	Repeat *step 6* to *7* for the task that corresponds to the other robot arm.	
9	Press the **Start button**.	

Continues on next page

Running the routine YuMiAbsAccRecovery

	Action
1	Follow the instructions on the FlexPendant to run the **YuMiAbsAccRecovery** routine. Below is an overview of the steps on the FlexPendant: 1 Verify that absolute accuracy data is correct for both robot arms. 2 Verify that fine calibration data is correct for both robot arms. 3 Robot arms move to tool installation position. 4 Fit the YuMi AbsAcc Recovery tool. See *Fitting the calibration tool to the robot arms on page 411*. 5 Position and confirm that joint angles are positioned as specified on the FlexPendant. See figure *Robot arm position for YuMiAbsAccRecovery on page 412*. 6 Select for which arm to perform **YuMi AbsAcc Recovery**. 7 Confirm arm selection by visual test. 8 **YuMi AbsAcc Recovery** is performed. The robot arms will move around for a few minutes taking measurements. 9 Save a copy of the moc.cfg configuration file. 10 Perform **PP to Main** after the routine has closed.
2	Remove the YuMi AbsAcc Recovery tool from the robot arms and refit any gripper or tool previously removed.
3	It is recommended to always redefine the work object after running YuMi AbsAcc Recovery.

Fitting the calibration tool to the robot arms

	Action	Note
1	Fit the calibration tool to one of the arms with four screws. Rotate the turning disc to access each screw hole.	Attachment screws: M2.5x8. Enclosed with the tool.  xx1700001249

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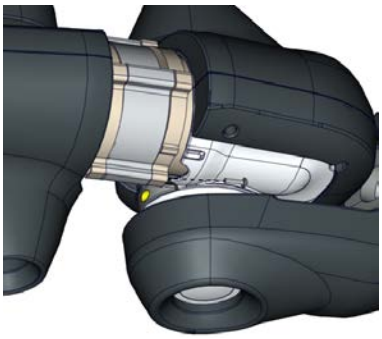
	Action	Note
2	Bring the other arm to the tool and secure it with four screws. Rotate the turning disc to access each screw hole.	Attachment screws: M2.5x8. Enclosed with the tool.  xx1700001250

Robot arm position for YuMiAbsAccRecovery

The figure shows the position into which the robot arms should be moved, after the YuMi AbsAcc Recovery tool has been installed. The joint angles will be specified on the FlexPendant.

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A	YuMi AbsAcc Recovery tool

5.6 Calibrating with Wrist Optimization method

When to run Wrist Optimization

Wrist Optimization routine is run to improve TCP reorientation performance.

Calibrating the robot with standard calibration method overwrites the optimized positions of axes 4, 5. Re-run the **Wrist Optimization** routine after standard calibration to re-achieve the optimized positions of the wrist axes.

Overview of the calibration procedure on the FlexPendant

The actual instructions of how to perform the calibration procedure and what to do at each step is given on the FlexPendant. You will be guided through the calibration procedure, step by step.

Use the following list to learn about the calibration procedure before running the RobotWare program on the FlexPendant. It gives you a brief overview of the calibration procedure sequence.

After the calibration method has been called for on the FlexPendant, the following sequence will be run.

1 Choose calibration routine Wrist Optimization.

2 Modify targets for 4-point tool frame definition, in Wrist Optimization routine.

> **Tip**
>
> Select positions with large reorientations around the TCP. For best results, make sure that axis 4 and 5 have large movements.

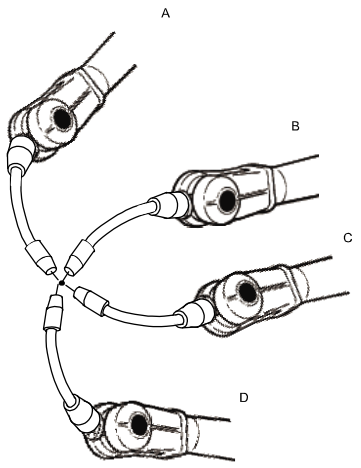
a Jog the robot to an appropriate position, A, for the first approach point.

Use small increments to accurately position the tool tip as close to the reference point as possible.

b Tap **Modify Position** to define the point.

c Repeat for each approach point to be defined, positions B, C, and D.

Jog away from the fixed world point to achieve the best result. Just changing the tool orientation will not give as good a result.



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3 Improved calibration data to the wrist axes is identified and presented.

4 Optimized positions for the wrist axes are presented.

Continues on next page

5 The robot moves to the optimized positions for the wrist axes and automatically overwrites previous calibration data.

WARNING

Robot moves automatically when pressing **Calibrate**.

6 Wrist optimization is finished.

7 Redefine / verify TCP for all tools.

5.7 Updating revolution counters

Introduction

This section describes how to do a rough calibration of each robot axis, which updates the revolution counter value for each axis using the FlexPendant.

The procedure can be summarized accordingly:

1 Manually move the manipulator to the calibration position.
2 Select the Calibration with hall sensors (CalHall) routine.
3 Select the function Update of revolution counters.
4 Store the revolution counter setting.

Each step is described in detail in following sections.

Step 1 - Manually moving the manipulator to the calibration position

	Action	Note
1	**CAUTION** When releasing the holding brakes, the robot axes may move very quickly and sometimes in unexpected ways!	
2	Release the brakes of the robot arm to be calibrated and move the arm manually so that the synchronization mark of each joint is aligned. The robot now stands in its calibration position.	The synchronization marks are shown in *Calibration scale and correct axis position on page 400*. There is a tolerance for the joint position. The edge of a mark should be at least within the area of the opposite mark.

Step 2 - Selecting the Calibration with hall sensors (CalHall) routine

	Action	Note
1	Open the **Program Editor** on the FlexPendant.	
2	Select the task that corresponds to the robot arm to be calibrated. Tap **Open**.	
3	If necessary, create a new program. This needs to be done if no existing program is available.	
4	Select **Debug** and tap **PP to Main**.	
5	Select **Debug** and tap **Call Routine...**	
6	Select **CalHall**.	
7	Go to **Motor On** and press the **Start button**.	

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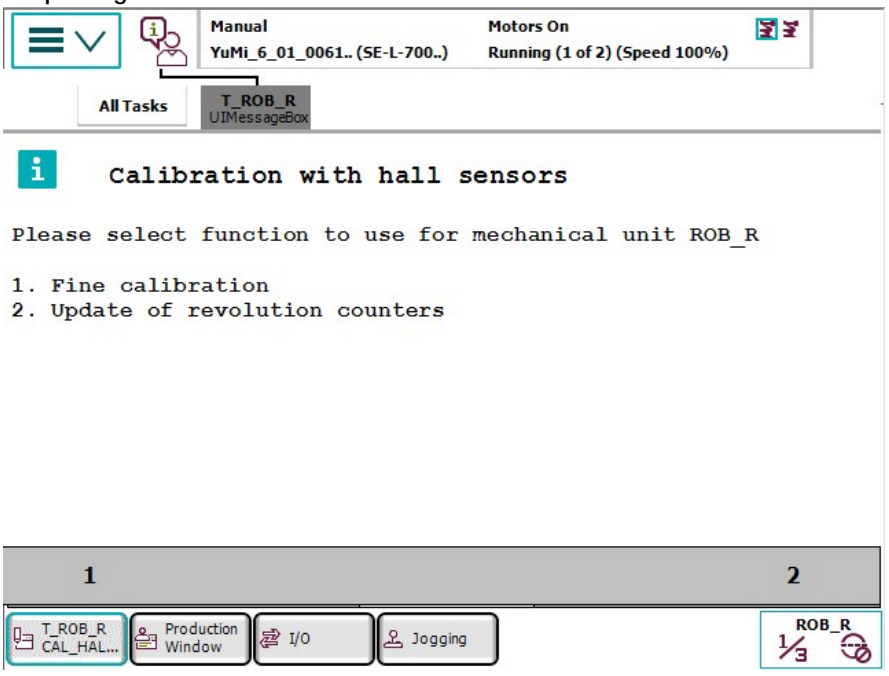
Step 3 - Selecting the function Update of revolution counters

	Action
1	In the calibration with hall sensors routine (CalHall), tap **2** to select the function of updating the revolution counters.  xx1400002694

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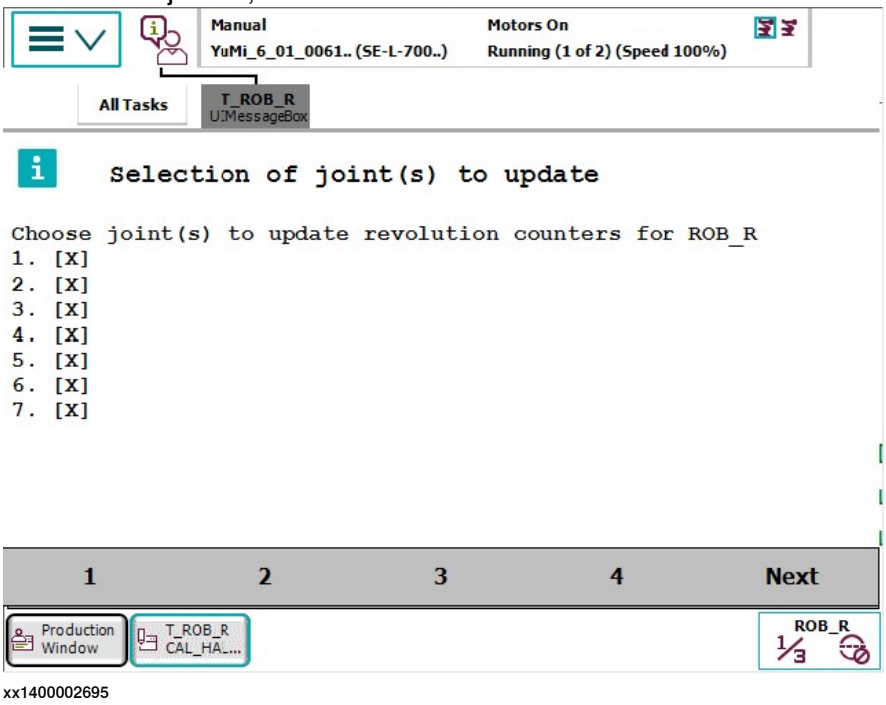
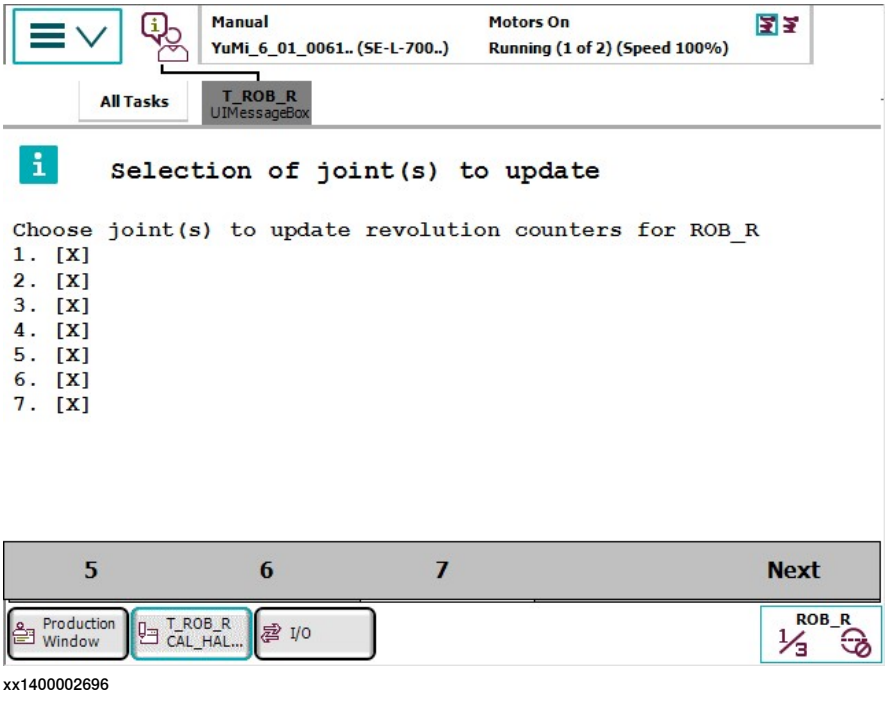
	Action
2	Tap to select which joint(s) to update revolution counters for. Joints 1, 2, 3 and 4 are selectable in the first window. Tap **Next** to open the second window where joints 5, 6 and 7 are selectable.  xx1400002695  xx1400002696

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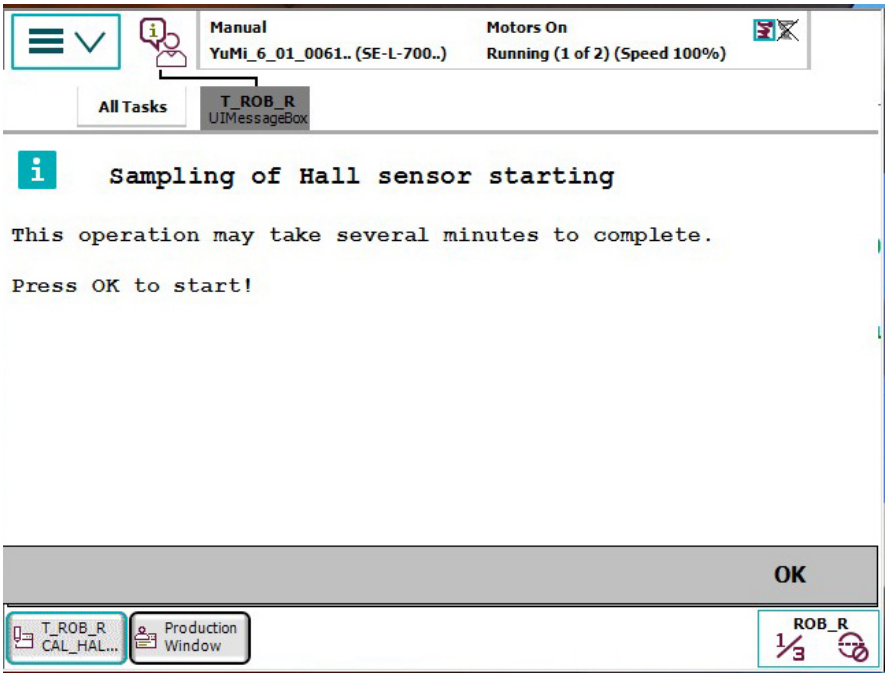
Step 4 - Storing the revolution counter setting

	Action
1	Tap **OK** to start the sampling procedure of the hall sensor. One at a time, each selected joint now rotates back and forth several times to calculate and find the exact position where the hall sensor is aligned with the magnet. Calibration order: axis 1-2-3-4-5-6-7. **Note** This procedure may take several minutes.  xx1400002697

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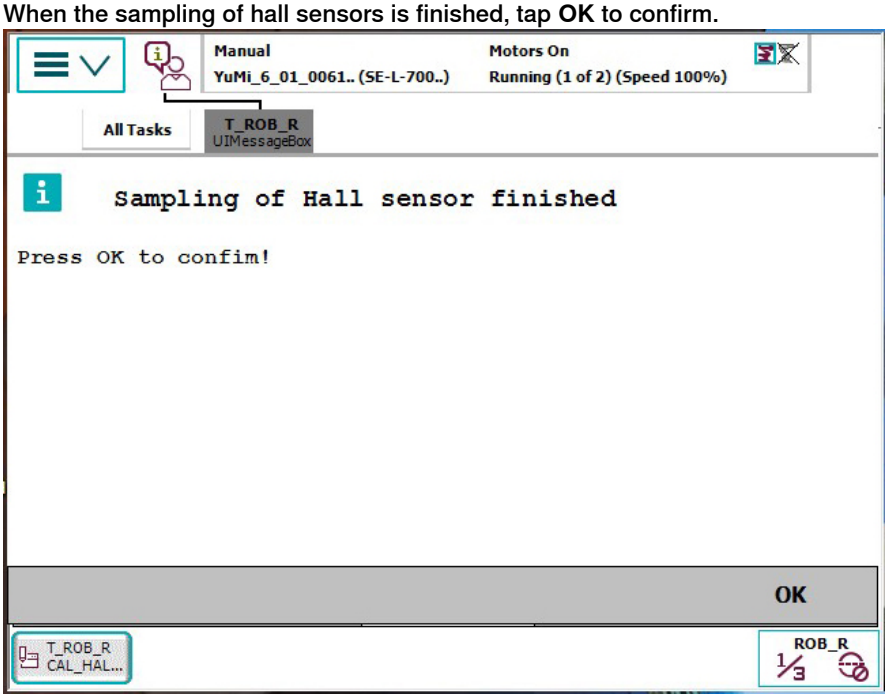
	Action
2	When the sampling of hall sensors is finished, tap **OK** to confirm.  xx1400002898

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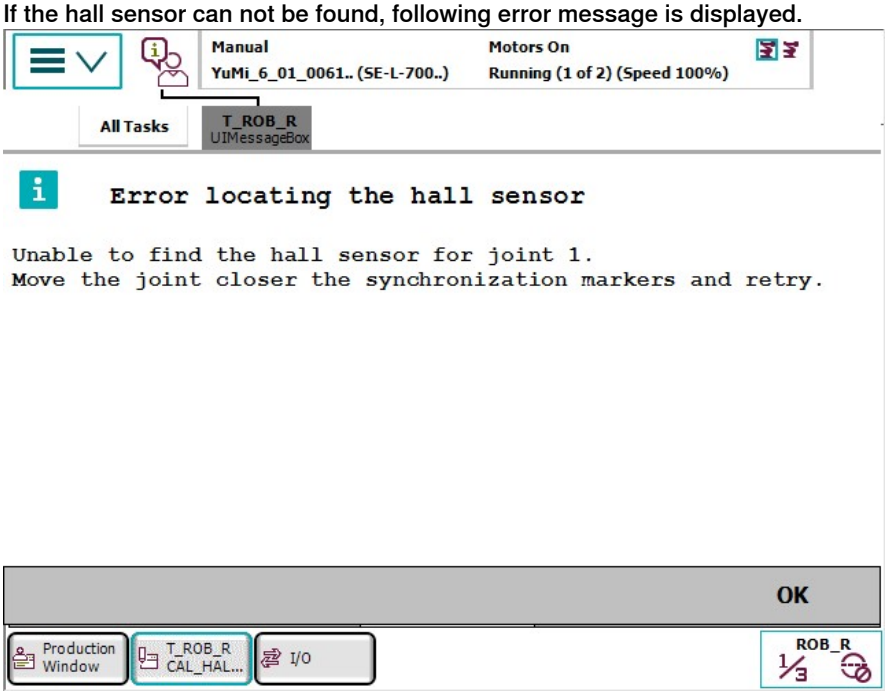
	Action
3	If the hall sensor can not be found, following error message is displayed.  xx1400002698 There can be several causes for this error. • The joints are not sufficiently aligned according to the synchronization marks. Move the joints so that the synchronization marks are aligned. Tap **OK** and restart the fine calibration procedure. The joints prior to the joint that stopped the calibration procedure are calibrated and do not need to be calibrated again. Joints coming after the joint that stopped the calibration procedure has not been calibrated. (Calibration order: axis 1-2-3-4-5-6-7.) • The hall sensor is defect. Perform troubleshooting of I/O signals. Possible replacement of hall sensor may be required.

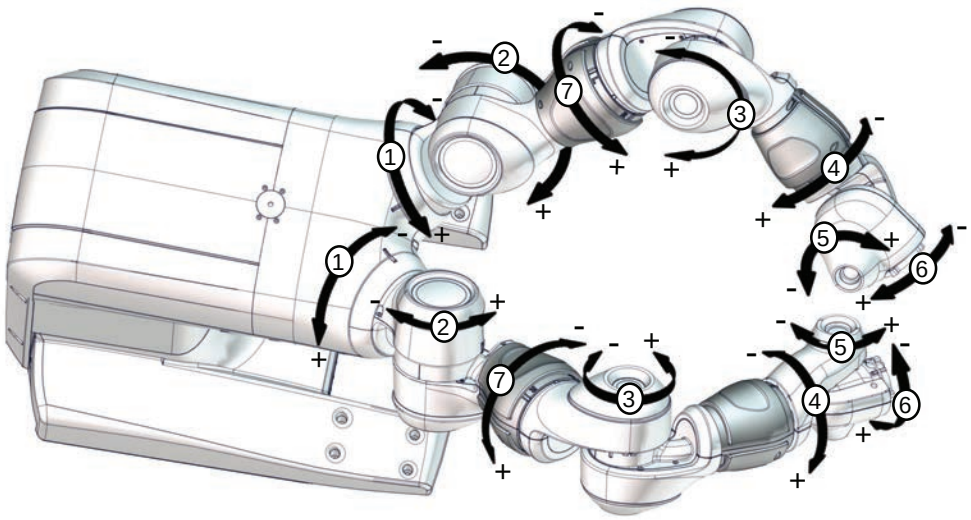
5.8 Calibration movement directions for all axes

Overview

When calibrating, the axis must consistently be run towards the calibration position in the same direction in order to avoid position errors caused by backlash in gears and so on. Positive directions are shown in the graphic below.

This is normally handled by the robot calibration software.

Calibration movement directions, 7 axes



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5.9 Verifying the calibration position

Introduction

Verify the calibration position of the robot before beginning any programming of the robot system. This may be done:

- Using a `MoveAbsJ` instruction with argument according to calibration position degrees on all axes.
- Using the **Jogging** window on the FlexPendant.

Using a `MoveAbsJ` instruction

Use this procedure to create a program that runs all the robot axes to their calibration position.

	Action	Note
1	On ABB menu tap **Program editor**.	
2	Create a new program.	
3	Use **MoveAbsJ** in the **Motion&Proc** menu.	

4	Create the following program for the right arm:
	`MoveAbsJ [[0,-130,30,0,40,0], [-135,9E9,9E9,9E9,9E9,9E9]] \NoEOffs, v1000, fine, tool0;`
	Create the following program for the left arm:
	`MoveAbsJ [[0,-130,30,0,40,0], [135,9E9,9E9,9E9,9E9,9E9]] \NoEOffs, v1000, fine, tool0;`	

5	Run the program in manual mode.	
6	Verify that the calibration marks for the axes align correctly. If they do not, then update the revolution counters.	See *Calibration scale and correct axis position on page 400* and *Updating revolution counters on page 415*.

Using the jogging window

Use this procedure to jog the robot to the calibration position for all axes.

	Action	Note
1	On the **ABB** menu, tap **Jogging**.	
2	Tap **Motion mode** to select group of axes to jog.	
3	Tap to select the axis to jog, axis 1, 2, or 3.	
4	Manually run the robots axes to a position where the axis position value read on the FlexPendant, is equal to the calibration position degrees.	Degrees are specified in *Exact axis positions in degrees on page 401*.
5	Verify that the calibration marks for the axes align correctly. If they do not, then update the revolution counters!	See *Calibration scale and correct axis position on page 400* and *Updating revolution counters on page 415*.

6 Robot description

6.1 Robot type description

Type A of IRB 14000

The difference between IRB 14000 and IRB 14000 Type A is that the Type A has a reinforced design on the arm.

As a result of this, the following parts differ between types:

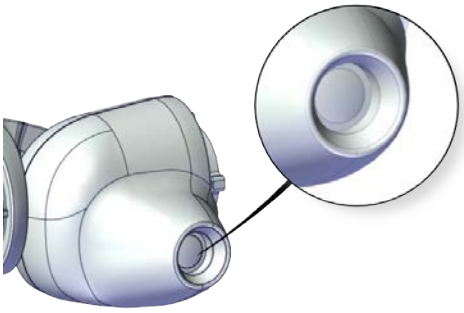
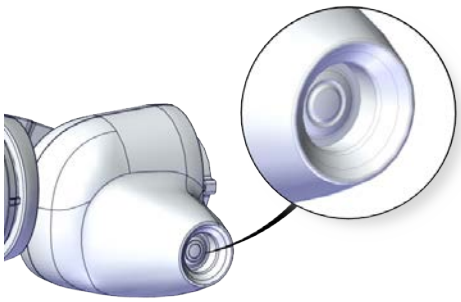
- Motor brake, axis 1 and axis 2
- Gearbox, axis 4 and axis 5
- Mechanical design, axis 4 and axis 5
- Cable harness design

Those robots in original design are simply named IRB 14000 (no-type-specified).

How to know which type the robot is?

The following characteristics can be used to figure out the robot type.

Axis 5 appearance

IRB 14000 (no-type-specified)	IRB 14000 Type A
 xx1900001956	 xx1900001957

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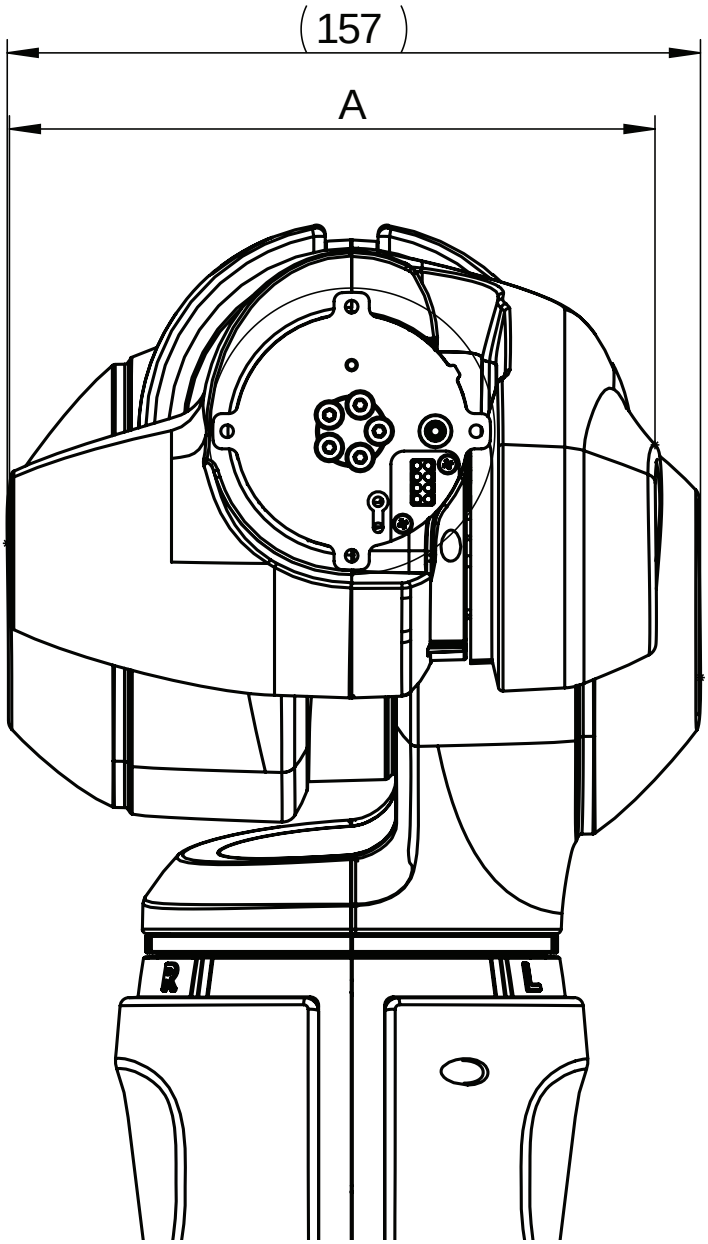
6.1 Robot type description
Continued

Robot dimension



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	IRB 14000 (no-type-specified)	IRB 14000 Type A
A	137 mm	146 mm

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Arm configuration during system installation

The robot type must be correctly selected when setting the arm configuration during system installation, otherwise, unexpected motion error or performance issues may occur.

Type A is available for selection as below only in RobotStudio 2019.5.3 or later and RobotWare 6.10.2 or later.

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7 Decommissioning

7.1 Introduction to decommissioning

Introduction

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

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

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

Disposal of materials used in the robot

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

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

See also *Environmental information on page 428*.

Transportation

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

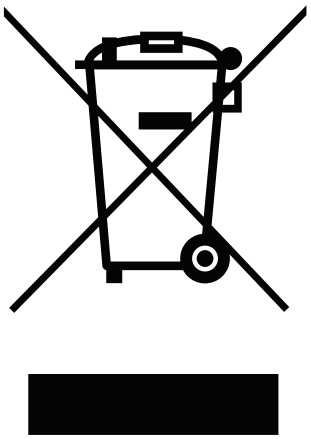
7.2 Environmental information

Introduction

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

Symbol

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



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Materials used in the product

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

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

Material	Example application
Aluminium	Base, body, arm, etc
Batteries, Lithium	Serial measurement board
Copper	Cables, motors
Foam	Covers
Magnalium	
Magnesium	Wrist casting, upper arm, back cover, tool flange, etc
Neodymium	Brakes, motors
Oil, grease	Gears, cables, etc
Plastic/rubber	Cables, connectors, covers, etc
Steel	Gears, screws, washers, brackets

Continues on next page

Oil and grease

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

Also note that:

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

7.3 Scrapping of robot

Note

The decommissioning process shall be preceded by a risk assessment.

Important when scrapping the robot

DANGER

The risk assessment should consider hazards arising in the decommissioning, such as, but not limited to:

- Always remove all batteries. If a battery is exposed to heat, for example from a blow torch, it will explode.
- Always remove all oil/grease in gearboxes. If exposed to heat, for example from a blow torch, the oil/grease will catch fire.
- When motors are removed from the robot, the robot will collapse if it is not properly supported before the motor is removed.
- A used robot does not have the same performance as on delivery. Springs, brakes, bearings, and other parts might be worn or broken.

8 Reference information

8.1 Introduction

General

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

8.2 Applicable standards

Note

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

General

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

Normative standards as referred to from ISO 10218-1

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

Deviations from ISO 10218-1:2011 for IRB 14000

ISO 10218-1:2011 was developed with conventional industrial robots in mind. Deviations from the standard are motivated for IRB 14000 in the table below. More information about ISO 10218-1 compliance is given in *technote_150918*.

The IRB 14000 is by default always in collaborative operation.

Requirement	Deviation for IRB 14000	Motivation
§5.4 Performance level d and structure category 3.	The robot fulfills performance level b with structure category B.	The alternative paragraph §5.4.3 for other safety-related control system performance is used instead of §5.4.2. A comprehensive risk assessment has resulted in performance requirement of PL b, Cat B.
§5.7.1 Mode selector which can be locked in each position.	The mode selector is implemented in software on FlexPendant.	Automatic and manual mode are usability features for IRB 14000, but not safety features. Locking the operating mode does not contribute to a necessary risk reduction. [i]

Continues on next page

Requirement	Deviation for IRB 14000	Motivation
§5.7.3 & §5.8.3 Enabling device	The enabling device on FlexPendant is not active.	The IRB 14000 robot is intended for collaborative applications where contact between robot and the operator is harmless. An enabling device does not further contribute to a risk reduction.
§5.7.3 & §5.8.5 Initiating automatic operation	It is possible to activate manipulator automatic operation from the FlexPendant.	The IRB 14000 robot is intended for collaborative applications where contact between robot and the operator is harmless. An auto initiation requirement does not further contribute to a risk reduction.
§5.12.1 Limiting the range of motion by adjustable stops (§5.12.2) or by safety functions (§5.12.3).	IRB 14000 does not have adjustable mechanical stops or provisions to install non-mechanical limiting devices.	The IRB 14000 robot is intended for collaborative applications where contact between robot and the operator is harmless. Limiting the working range is then not necessary for risk reduction. Note that PPE (Personal Protective Equipment) may be required. See *Personal protective equipment on page 38*.

i The selector is replaced by a selection through software and user authorities can be set to restrict the use of certain functions of the robot (e.g. access codes).

Region specific standards and regulations

Standard	Description
ANSI/RIA R15.06	Safety requirements for industrial robots and robot systems
ANSI/UL 1740	Safety standard for robots and robotic equipment
CAN/CSA Z 434-03	Industrial robots and robot Systems - General safety requirements
ANSI/ESD S20.20:2007	Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)

Other standards used in design

Standard	Description
ISO 9787:2013	Robots and robotic devices -- Coordinate systems and motion nomenclatures
IEC 61000-6-2	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments
IEC 61000-6-4	Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments
ISO 13732-1:2006	Ergonomics of the thermal environment - Part 1
IEC 60974-1:2012[i]	Arc welding equipment - Part 1: Welding power sources
IEC 60974-10:2014[i]	Arc welding equipment - Part 10: EMC requirements
ISO 14644-1:2015[ii]	Classification of air cleanliness
IEC 60529:1989 + A2:2013	Degrees of protection provided by enclosures (IP code)
IEC 61340-5-1:2010	Protection of electronic devices from electrostatic phenomena - General requirements

Continues on next page

8.2 Applicable standards

Continued

Standard	Description
ISO/TS 15066	Robots and robotic devices - Safety requirements - Industrial collaborative workspace

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

8.3 Unit conversion

Converter table

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

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

8.4 Specification of screws

Screws handled as spare part

The screws listed have special treatment and must be ordered as spare parts if lost or damaged.

Article number	Screw	Dimension, class and treatment
3HAB3409-14	Hex socket head cap screw	M5x16 12.9 Lafre 2C2B/FC6.9
3HAB3409-212	Hex socket head cap screw	M4x16 12.9 Lafre 2C2B/FC6.9
3HAB3409-224	Hex socket head cap screw	M3x12 12.9 Lafre 2C2B/FC6.9
3HAB3409-232	Hex socket head cap screw	M4x12 12.9 Lafre 2C2B/FC6.9
3HAB3409-233	Hex socket head cap screw	M2.5x6 12.9 Lafre 2C2B/FC6.9
3HAB3409-241	Hex socket head cap screw	M2.5x12 12.9 Lafre 2C2B/FC6.9
3HAB3410-23	Hex socket head cap screw	M2x6 12.9 Gleitmo 605
3HAB3410-25	Hex socket head cap screw	M2x10 12.9 Gleitmo 605
3HAC050367-005	Torx pan head screw	M3x12 8.8 Gleitmo 605
3HAC050367-006	Torx pan head screw	M3x16 8.8 Gleitmo 605
3HAC050367-039	Torx pan head screw	M2x30 8.8 Gleitmo 605
3HAC050368-005	Hex socket head cap screw	M2x8 8.8
3HAC16446-4	Screw with flange	M3x6
3HAC052487-001	Torx head screw with flange	M3x16 8.8
3HAC072396-001	Small head screw	M2x16 12.9
3HAC073135-001	Washer	2.2x4.5x0.3

Screws not handled as spare parts

The screws listed have no special treatment and can be bought locally if lost or damaged.

Article number	Screw	Dimension, class and treatment
9ADA195-4	Torx pan head screw	
9ADA618-22	Torx pan head screw	M3x6 8.8-A2F
9ADA618-31	Torx pan head screw	M4x6 8.8-A2F
9ADA618-32	Torx pan head screw	M4x8 8.8-A2F
9ADA618-34	Torx pan head screw	M4x12 8.8-A2F
9ADA618-41	Torx pan head screw	M5x6 8.8 Fe/Zn 5c
9ADA618-44	Torx pan head screw	M5x12 A2-70
9ADA618-47	Torx pan head screw	M5x25 8.8-A2F
9ADA624-24	Torx pan head screw	M3x10 8.8-A2F
9ADA624-45	Torx pan head screw	M5x16 8.8-A2F
9ADA267-1	Nut	M2 DIN934 8 ELZN
9ADA267-4	Nut	M4 Steel 8-A2F

Continues on next page

Article number	Screw	Dimension, class and treatment
9ADA267-5	Nut	M5 Steel 8-A2F

8.5 Screw joints

General

This section describes how to tighten the various types of screw joints on ABB robots.

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

UNBRAKO screws

UNBRAKO is a special type of screw recommended by ABB for certain screw joints. It features special surface treatment (Gleitmo as described below) and is extremely resistant to fatigue.

Whenever used, this is specified in the instructions, and in such cases, *no other type of replacement screw* is allowed. Using other types of screws will void any warranty and may potentially cause serious damage or injury.

Gleitmo treated screws

Gleitmo is a special surface treatment to reduce the friction when tightening the screw joint. It is recommended by ABB for M6-M20 screw joints. Screws treated with Gleitmo may be reused 3-4 times before the coating disappears. After this the screw must be discarded and replaced with a new one.

When handling screws treated with Gleitmo, protective gloves of **nitrile rubber** type should be used.

Generally, screws are lubricated with *Gleitmo 603* mixed with *Geomet 500* or *Geomet 702* in proportion 1:3. *Geomet* thickness varies according to screw dimensions, refer to the following.

Dimension	Lubricant	Geomet thickness
M6-M20 (any length except M20x60)	*Gleitmo 603 + Geomet 500*	3-5 µm
M6-M20 (any length except M20x60)	*Gleitmo 603 + Geomet 720*	3-5 µm
M20x60	*Gleitmo 603 + Geomet 500*	8-12 µm
M20x60	*Gleitmo 603 + Geomet 720*	6-10 µm

Screws lubricated in other ways

Screws lubricated with Molykote 1000 or Molykote P1900 should *only* be used when specified in the repair, maintenance or installation procedure descriptions.

In such cases, proceed as follows:

1 Apply lubricant to the screw thread.
2 Apply lubricant between the plain washer and screw head.
3 Tighten to the torque as described in the procedures.

Lubricant	Article number
Molykote 1000 (molybdenum disulphide grease)	3HAC042472-001
Molykote P1900 (molybdenum disulphide grease)	3HAC070875-001

8.6 Weight specifications

Definition

In installation, repair, and maintenance procedures, weights of the components handled are sometimes specified. All components exceeding 22 kg (50 lbs) are highlighted in this way.

To avoid injury, ABB recommends the use of a lifting accessory when handling components with a weight exceeding 22 kg. A wide range of lifting accessories and devices are available for each manipulator model.

Example

Following is an example of a weight specification in a procedure:

	Action	Note
	CAUTION The arm weighs 25 kg. All lifting accessories used must be sized accordingly.	

8.7 Standard toolkit

General

All service (repairs, maintenance, and installation) procedures contains lists of tools required to perform the specified activity.

All special tools required are listed directly in the procedures while all the tools that are considered standard are gathered in the standard toolkit and defined in the following table.

This way, the tools required are the sum of the standard toolkit and any tools listed in the instruction.

Contents, standard toolkit

Quant-ity	Tool
1	Torque screwdriver JOFAST 70-ICP range 0.07-0.70 Nm [i]
1	Torque screwdriver JOFAST 170-ICP range 0.17-1.70 Nm *i*
1	Torque screwdriver JOFAST 450-ICP range 0.45-4.50 Nm *i*
1	Torque screwdriver TLS1360 range 2.5-13.6 Nm *i*
1	Screw bit (3 mm--1/4")
1	Screw bit (3 mm--1/4"(ball head))
1	Screw bit (2 mm--1/4")
1	Screw bit (2 mm--1/4"(ball head))
1	Screw bit (TX6--1/4")
1	Screw bit (1.5 mm--1/4")
1	Screw bit (1.5 mm--1/4"(ball head))
1	Screw bit (1.0 mm--1/4")
1	Screw bit (TX10--1/4")
1	Screw bit (TX20--1/4")
1	Screw bit (4 mm--1/4")
1	Screw bit (4 mm--1/4"(ball head))
1	Wrench 7 mm
1	Wrench 8 mm

[i] The standard torque screwdriver should be calibrated to the torque value specified in the repair procedures, in advance.

8.8 Special tools

General

All service instructions contain lists of tools required to perform the specified activity. The required tools are a sum of standard tools, defined in the section *Standard toolkit on page 440*, and of special tools, listed directly in the instructions and also gathered in this section.

Special tools

Note

If the replacing procedure is not listed in the table below, only standard tools are needed for the procedure.

Tools and equipment with spare part number: (These tools can be ordered from ABB)		Axis-1 motor	Axis-2 motor	Axis-7 motor	Axis-3 motor	Axis-4 motor	Axis-5 motor	Axis-6 motor
Removal tools								
3HAC054868-001	Removal tool	1	1					
3HAC054869-001	Removal tool			1	1			
Lifting accessories								
-	Lifting eye M8 DIN580							
Fixtures								
3HAC054870-001	Fixture tool for wave generator M93	1	1					
3HAC054871-001	Fixture tool for wave generator M92			1	1			
3HAC054904-001	Fixture tool for wave generator M91					1 [i]	1 *[i]*	1
3HAC074531-001	Fixture tool for wave generator M91 (IRB 14000 Type A)					1 [ii]	1 *[ii]*	
3HAC074529-001	Machined screw driver					1 [iii]	1 *[iii]*	

i Required for IRB 14000 (no-type-specified). See *Robot description on page 423* for robot type.
ii Required for IRB 14000 Type A. See *Robot description on page 423* for robot type.
iii Used together with fixture tool for wave generator M91 on axes 4 and 5.

8.9 Lifting accessories and lifting instructions

General

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

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

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

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