ROBOTICS

Product Manual

FlexGripper-Claw

Trace back information:
Workspace Robots and Applications version a56 (not checked in)
Published 2019-11-15 at 05:15:13
Skribenta version 5.3.033

Product Manual
FlexGripper-Claw

Document ID: 4GAA40401009901-001
Revision: A

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The original language for this publication is English. Any other languages that are supplied have been translated from English.

Original instructions.

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Table of contents

Overview of this manual

About this manual

This manual provides instructions for the FlexGripper-Claw. Each chapter concerning the FlexGripper-Claw contains information on:

- mechanical structure & working principle
- mechanical /electrical installation
- maintenance
- repair
- trouble shooting
- spare parts

Read through this document carefully, especially the sections about safety, before you start to unpack, install and use the FlexGripper-Claw.

Usage

This manual should be used during:

- installation
- operation
- maintenance work
- repair work

Who should read this manual?

This manual is intended for:

- operators
- installation personnel
- repair and maintenance personnel

Prerequisites

The reader should be:

- familiar with industrial robots and the relevant terminology
- familiar with the equipment
- skilled in mechanical & electrical installation/maintenance/repairs

Organization of chapters

The manual is organized in to the following chapters:

Chapter	Contents
	Safety
	FlexGripper-Claw
	FlexGripper UI

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Continued

References

Reference	Document ID
Product manual - IRB 660	*3HAC025755-001*
Product manual - IRB 460	*3HAC039611-001*
Product manual - IRC5	*3HAC021313-001*

Revision

Revision	Description
-	First edition
A	Restart information is updated to the latest restart mode, such as replacing **I-start** with **Reset System**.

1 Safety

1.1 Introduction

Overview

The safety information in this manual is divided into two categories:

- General safety aspects, important to attend to before performing any service work on the FlexGripper. These are applicable for all service work and are found in *General safety information on page 10*.
- Specific safety information, pointed out in the procedure when the danger is imminent. How to avoid and eliminate the danger is either detailed directly in the procedure, or further detailed in separate instructions, found in *Safety related instructions on page 21*.

Note

This manual includes only the safety information related to this product.

The FlexGripper can be used together with IRB 660 or IRB 460. See the robot and IRC5 controller manuals for more details on safety.

Before beginning work with the robot, make sure you are familiar with the safety regulations described in the manual *Operating manual - General safety information*.

1.2 General safety information

1.2.1 Safety in the robot

Validity and responsibility

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

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

- *Operating manual - IRC5 with FlexPendant*
- *Operating manual - General safety information* [I]
- *Product manual*

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

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

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

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

Connection of external safety devices

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

Limitation of liability

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

Related information

Type of information	Detailed in document	Section
Installation of safety devices	*Product manual for the robot*	Installation and commissioning

Continues on next page

Type of information	Detailed in document	Section
Changing operating modes	*Operating manual - IRC5 with FlexPendant*	Operating modes
Restricting the working space	*Product manual for the robot*	Installation and commissioning
Load limits for tools and workpieces	*Product specification for the robot*	Load diagrams
Configuration of safety module (requires Functional safety options)	*Application manual - Functional safety and SafeMove2*	

1.2.2 Safety risks

1.2.2.1 Safety risks during installation and service work on the FlexGripper

Overview

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

General risks during installation and service

- The instructions in the Product manual in the section *Installation and Commissioning on page 35* must always be followed.
- Emergency stop buttons must be positioned in easily accessible places so that the manipulator can be stopped quickly.
- Those in charge of operations must make sure that safety instructions are available for the installation in question.
- Those who install the FlexGripper must have the appropriate training for the manipulator system in question and in any safety matters associated with it.

Nation/region specific regulations

To prevent injuries and damage during the installation of the manipulator system, the regulations applicable in the country concerned and the instructions of ABB manipulatorics must be complied with.

1.2.2.2 Safety risks related to tools/workpieces

Safe handling

It must be possible to safely turn off tools, such as milling cutters. Make sure that guards remain closed until the cutters stop rotating. It should be possible to release parts manually (valves).

Safe design

FlexGrippers are designed so that they retain workpieces in the event of a power failure or a disturbance to the controller.

1.2.2.3 Safety risks related to high speed

WARNING

Particular care must be taken with the FlexGripper-Claw.

Risk of gripped workpiece uncontrolled gravity drop during high speed movement.

1.2.2.4 Safety risks during operational disturbances

General

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

Qualified personnel

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

Extraordinary risks

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

1.2.2.5 Risks associated with live electric parts

Voltage related risks, general

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

- Although troubleshooting may, on occasion, need to be carried out while the power supply is turned on, the robot must be turned off (by setting the mains switch to OFF) when repairing faults, disconnecting electric leads and disconnecting or connecting units.
- The mains supply to the robot must be connected in such a way that it can be turned off from outside the robot's working space.
- Make sure that one else can turn on the power to the controller and manipulator while you are working with the system. A good method is to always lock the main switch on the controller cabinet with a safety lock.

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

All work must be performed:

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

Voltage related risks, IRC5 controller

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

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

Continues on next page

Voltage related risks, manipulator

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

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

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

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

1.2.3 Safety actions

1.2.3.1 Safety fence dimensions

General

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

Dimensioning

Dimension the fence or enclosure to enable it to withstand the force created if the load being handled by the FlexGripper is dropped or released at maximum speed.

1.2.3.2 Fire extinguishing

Note

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

1.2.3.3 Enabling device and hold-to-run functionality

Three-position enabling device

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

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

Note

To ensure safe use of the teach pendant, the following must be implemented:

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

Hold-to-run function

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

1.3 Safety related instructions

1.3.1 Safety signals in the manual

Introduction to safety signals

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

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

Danger levels

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

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

Continues on next page

1.3.1 Safety signals in the manual
Continued

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

1.3.2 Safety symbols on the FlexGripper labels

Introduction to labels

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

Types of labels

Both the manipulator and the FlexGripper are marked with several safety and information labels, containing important information about the product. The information is useful for all personnel handling the FlexGripper system, for example during installation, service, or operation.The safety labels are language independent, they only use graphics.

Symbols on safety labels

Symbol	Description
	Heat Risk of heat that can cause burns.

1.3.3 Safety guidelines

Safety guidelines while working with FlexGripper

- See the IRB 660 or IRB 460 Product manual for information on safety.
- All persons working in the system must be sufficiently trained. Incorrect installation and/or use can cause injuries to persons and/or damage to equipment.
- Damaged or broken equipment can result in a risk to safety.
- Do not continue to work with the FlexGripper if you find any fault in any parts of it.
- Do not over power the pneumatic devices.
- Use pressure relief valves.
- Repair any air leaks immediately.
- Wear safety glasses when working with pneumatic cylinders. Maintenance, assembling, adjustments and other works on the FlexGripper, such as: replacement of pneumatic cylinders , should only be implemented by skilled and qualified workers, when the FlexGripper is not under air-pressure.
- It should be possible to release parts by manual operation (valves).
- Do not touch the FlexGripper while it is connected to air pressure.
- While assembling, adjusting and working on the FlexGripper, it is mandatory to implement safety regulations so that no fingers or other body parts are in proximity to the moving parts of the FlexGripper. There is risk and danger of injury.
- Do not use temporary arrangements to make the FlexGripper work. This may lead to severe damage.
- Ensure all the bolts have been tightened before starting any operation after maintenance work.
- Ensure no foreign material is lying on the FlexGripper before starting any operation.
- During operation the FlexGripper must be protected by fixed or interlocking guards according to the safety laws and regulations in the country concerned.
- It should not be possible to reach any moving parts when the Flexgripper is operating and the safety guards are fenced and interlocked.

2 FlexGripper-Claw

2.1 Specification

Note

This section describes products the ABB FlexGripper-Claw can lift and the ABB FlexGripper-Claw specifications. Use this information to judge whether the ABB FlexGripper-Claw is suitable to the lift the product in question.

This FlexGripper-Claw handles soft bags which do not have a dense and a rigid structure.

Storage conditions

Ambient temperature	0° C (32° F) - 55° C (131° F)
Relative humidity	Maximum 90%
Explosive environments	Not permitted

Operating conditions

Ambient temperature	5° C (41° F) - 50° C (122° F)
Relative humidity	Maximum 90%
Explosive environments	Not permitted

FlexGripper-Claw weight

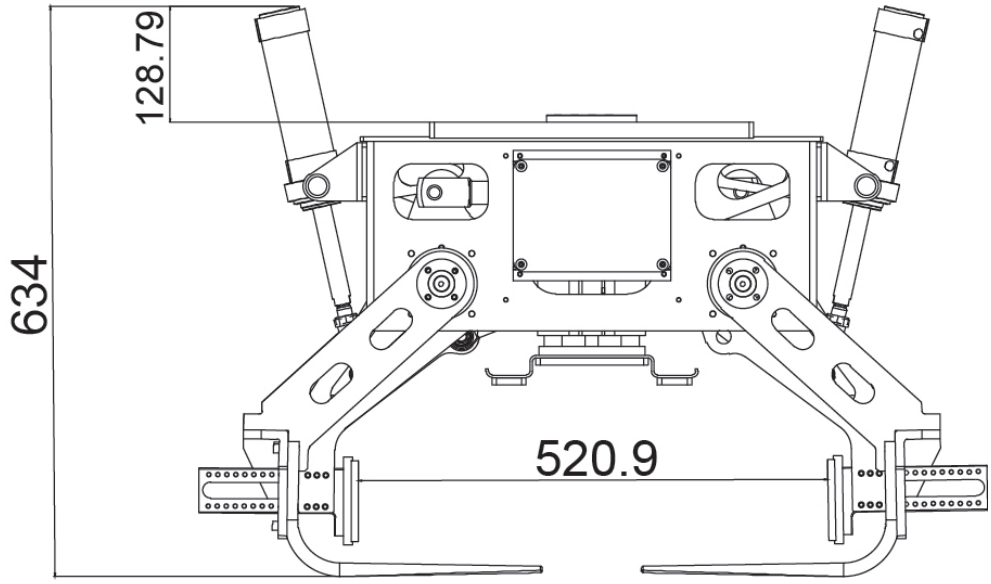
FlexGripper variants	Weight
FlexGripper-Claw	80 kg with side guide. 66 kg without side guide.

Continues on next page

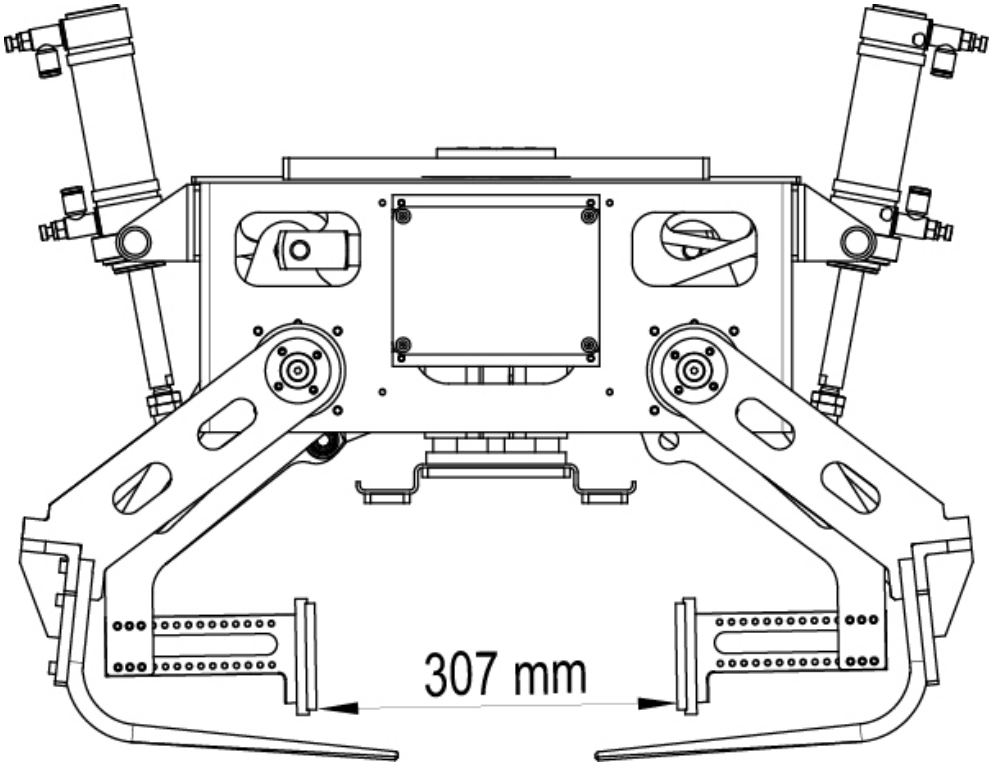
FlexGripper - Claw size

Claws and push plates in the Claw gripper can be adjusted seperately. And the minimum and maximum working range of the push plates are limited by the working range of claws. Different status of the gripper have different sizes.

Size with claws in minimum working position and push plates in maximum working position



Size with claws in minimum working position and push plates in minimum working position



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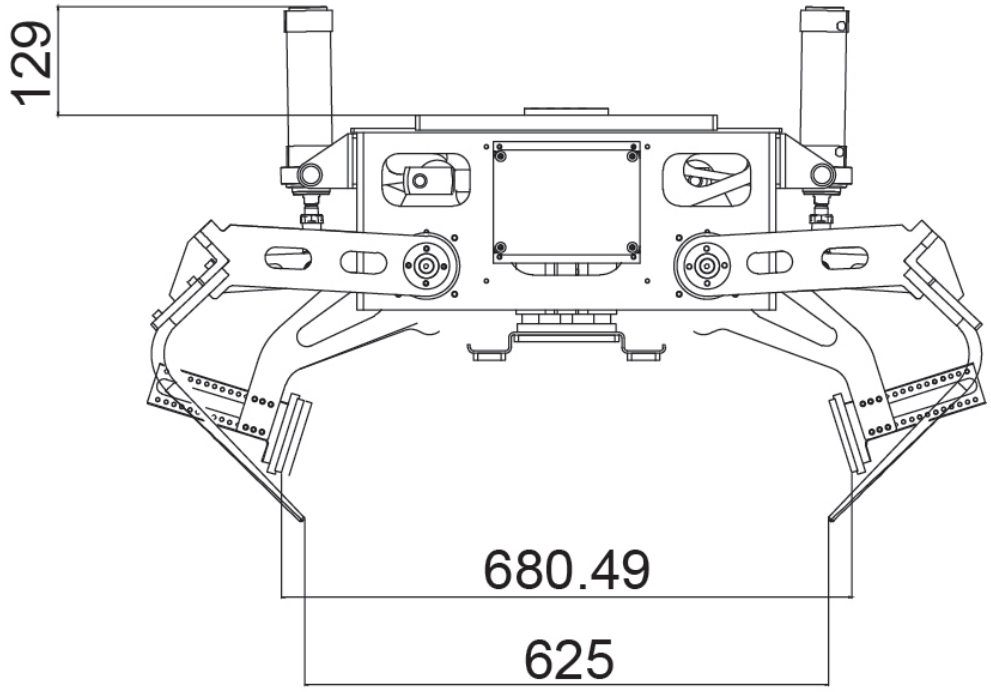
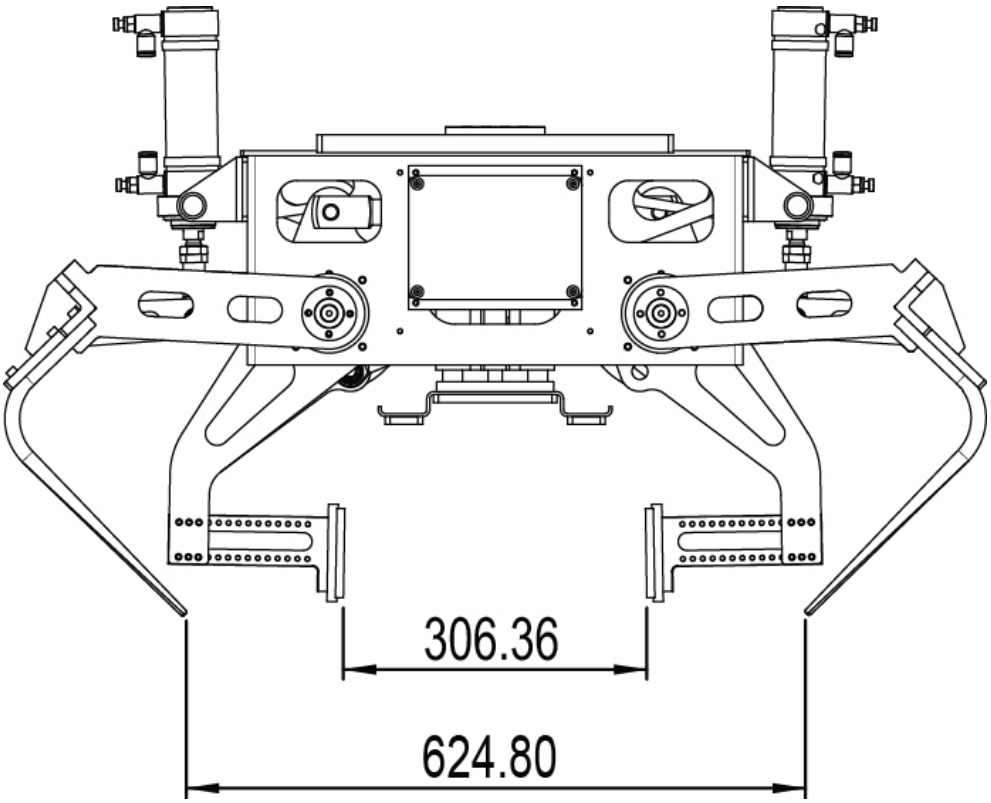
Size with claws in maximum working position and push plates in maximum working position



Size with claws in maximum working position and push plates in minimum working position



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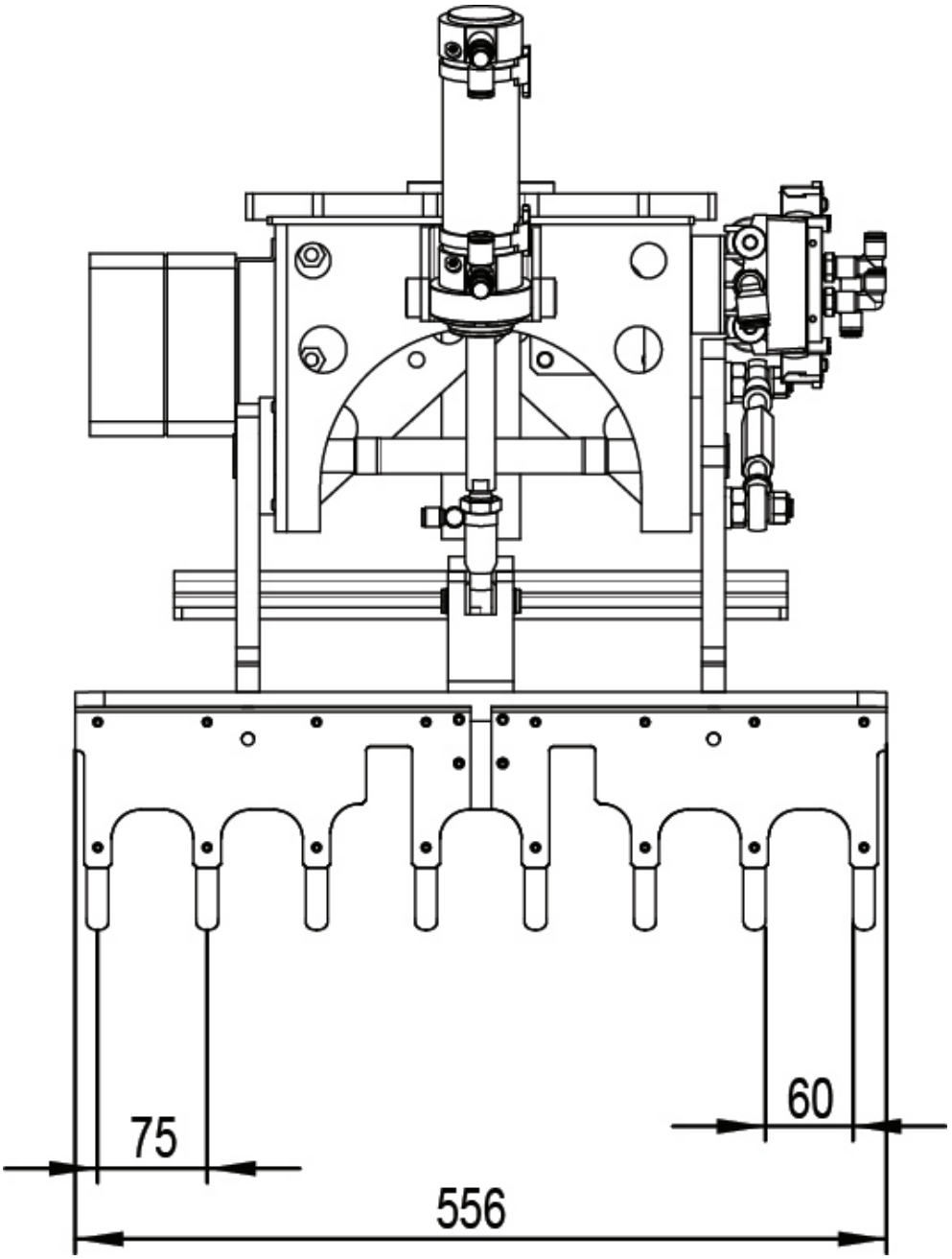
2.1 Specification
Continued

Side view size



Product specification

Bag height range	Bag length range	Bag width range	Max. weight per lift	Handled products
90 - 200 mm	300 - 750 mm	300 - 550 mm	50 kg	1

Continues on next page

Note

Due to variations in size, weight, design, surface, rigidity, porosity and centre of gravity, please judge if your products can be lifted by ABB FlexGrippers according to the above FlexGripper parameters and product specifications.

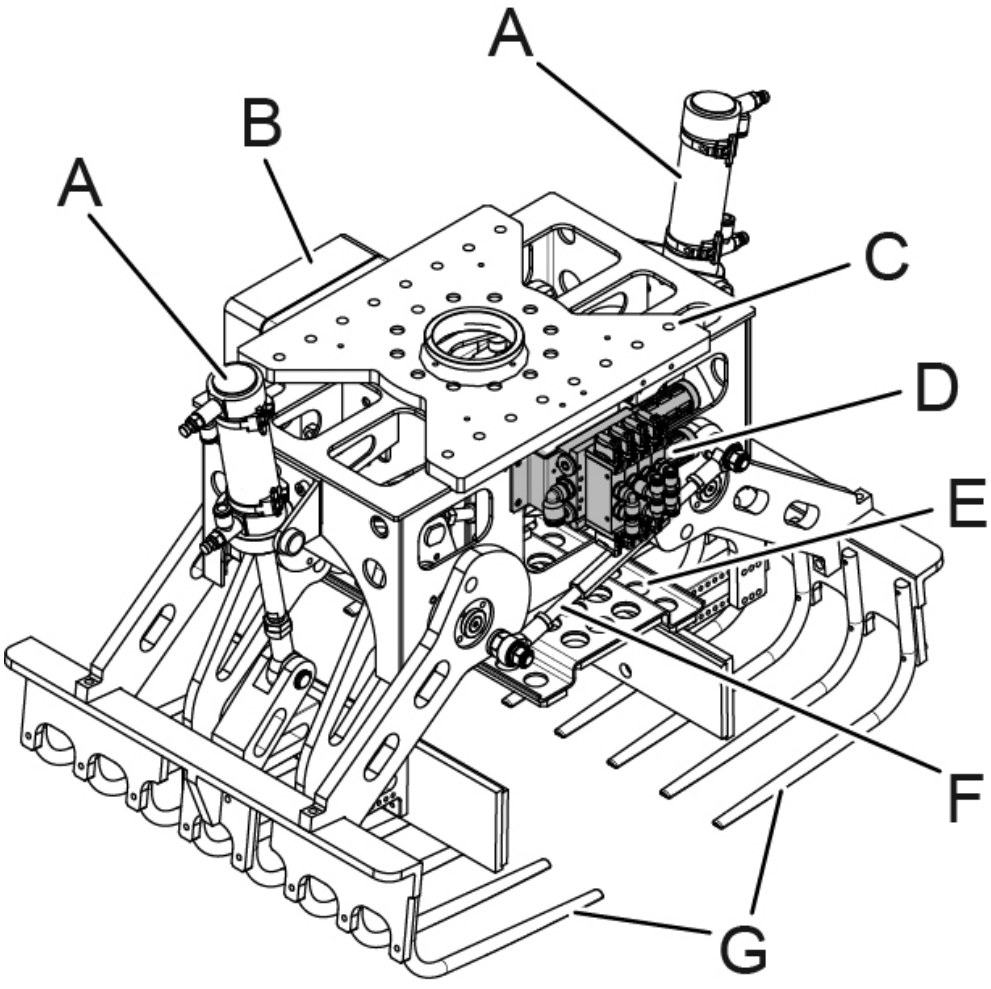
2.2 Mechanical structure & working principle

2.2.1 General

Structure overview

The FlexGripper-Claw lifts products by inserting the claws below the bottom of the product. The press plates press the product on its upper surface to maintain the shape of the bag and to prevent it from slipping when the robot is moving with the FlexGripper. The FlexGripper-Claw has an additional push plate unit which helps in holding the product from its side faces. The push plate assembly is an optional feature which can be added if required.

The action of the press plates and two claws are separately controlled by pneumatic cylinders (operating at 4 - 6 bar).



Pos	Part	Description
A	Pneumatic cylinder	Adjusts the movement of the moving claws. The stroke is 100mm.
B	Terminal box	Signals connections for the FlexGripper.
C	Flange	Installs the FlexGripper to the robot wrist.

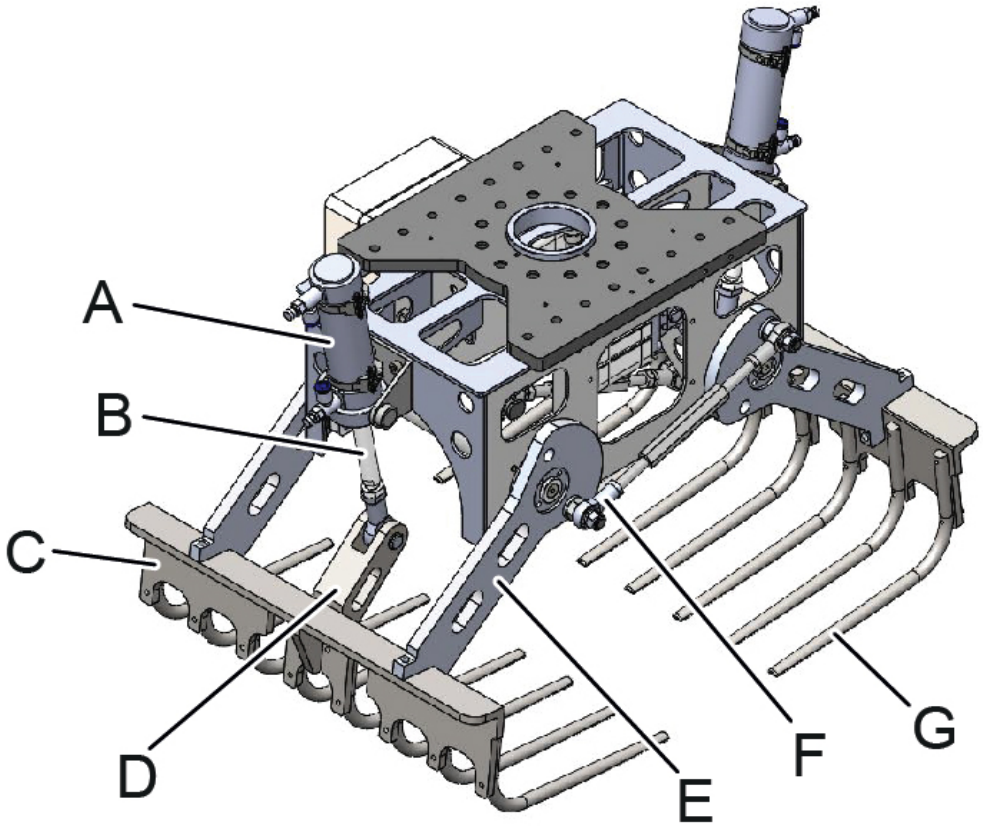
Continues on next page

Pos	Part	Description
D	Solenoid valve unit	Controls compressed air inlet and outlet of the pneumatic cylinders.
E	Top press plate bend with rubber	Press the product on its upper surface to maintain the shape of the bag and to prevent it from slipping when the robot is moving with the Claw gripper. Stroke 125mm.
F	Synchronization rod	Used to make the two claws synchronized reach the close position when the claw gripper is closed.
G	Claw unit	Grips the products and can be adjusted according to the products size.

2.2.2 Claw unit

Claw unit overview

The claw unit is installed on the main frame. Opening and closing of the claw unit is controlled by two pneumatic cylinders. A synchronization rod is used to make the action of two claws synchronized when the gripper is closed.



Pos.	Part	Description
A	Pneumatic cylinder	Used to push the baggage from the side faces.
B	Spherical hinge	Connect the cylinder rod with the bracket.
C	Connect rod	Connects the pneumatic cylinder and supports the claw arm.
D	Bracket	Connect the pneumatic cylinder with the claw.
E	Claw arm	Connect the claw with the main frame.
F	Synchronization rod	Used to make the two claws synchronized reach the close position when the claw gripper is closed.
G	Claw	Used to support the bag from the bottom. Eight fingers on each side. 75mm finger intervals.

2.2.3 Push plate unit

Push plate unit overview

Except for the top press plate pressing on the package, the claw plate unit is used to push the package from two side faces to grasp the package and prevent the bag from slipping corresponding with the gripper. Two push plates are drove by two pneumatic cylinders mounted on the main frame. To ensure the synchronization of the two push plates, a synchronization bar is used. The stroke of the two pneumatic cylinders are 30mm.

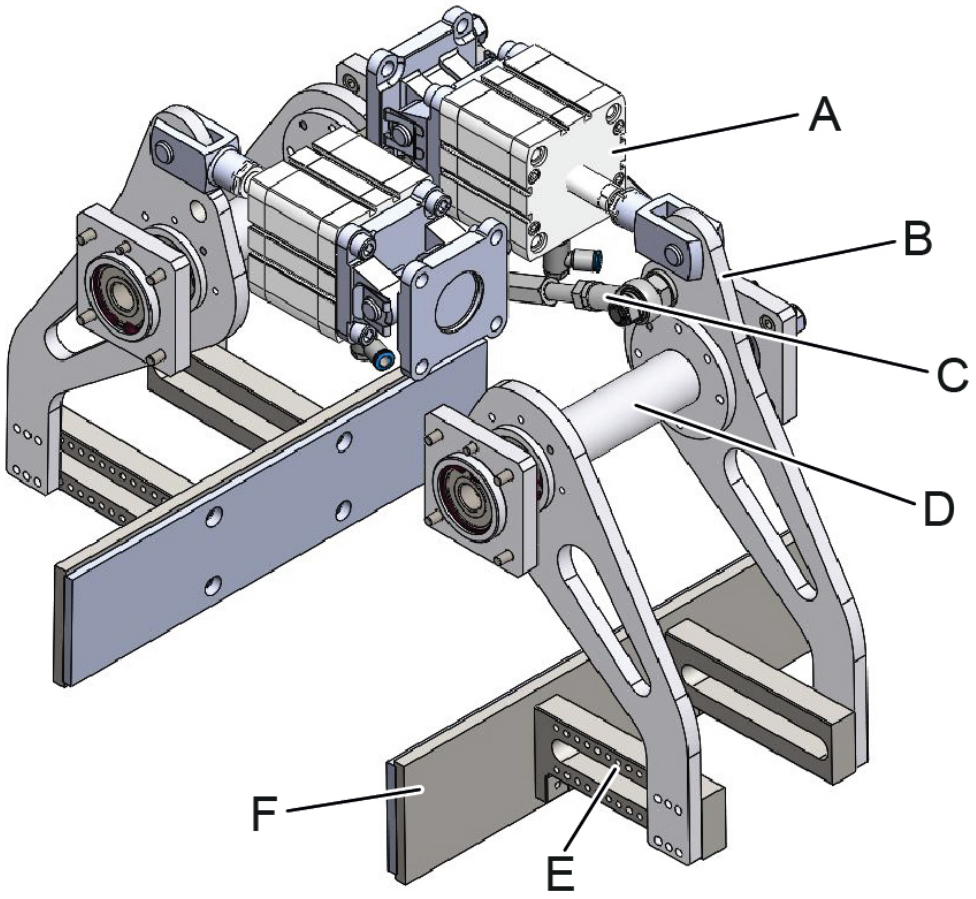


Figure 2.3 Push plate unit

Pos.	Part	Description
A	Pneumatic cylinder	Push and draw back the two push plates.
B	Push plate arm with copper sleve	Used to connect the output shaft of the pneumatic cylinder with the push plates of the claw.
C	Synchronizing rod	Used to make the two push plates synchronized reach the close position when the claw gripper is closed.
D	Rotation tube	Synchronize the moments of the two independent plates connecting to one push plate.
E	Adjusting screw holes	Used to adjust the mounting location of the push plates.
F	Push plate	Push the package form the side face.

Continues on next page

2.2.3 Push plate unit
Continued

There are two lines of adjusting screw holes (Adjusting holes are arranged at the interval of 10mm.) on each claw arm to adjust the mounting location of the push plate assembly (See E in Figure 2.3). The maximum adjustment range for each side are 110 mm. The adjustment should be done symmetrically and the total adjustment range of the gripper is 220mm.

Note

When opening the claw, the claws should first be opened and then the push plates. When close the claw, the push plate should first be closed and then the claw. The operation order of open/close the claw unit and the push plate unit should be observed or it may cause the damage of the gripper.

2.3 Installation and Commissioning

2.3.1 Overview

Overview

This instruction is primarily intended for use when unpacking and installing the gripper for the first time. It also contains information useful during later installation of the FlexGripper.

The new gripper was packed by the standard of sea transportation, land transportation and air transportation on delivery.

Note

Lifting should be done by four people or by a crane.

Do not hold the solenoid valves, terminal box or connectors when lifting the gripper.

The gripper should be installed in an environment without electromagnetic disturbance to ensure the performance of the magnetic proximity switches.

2.3.2 Unpacking

> **Note**
>
> Only 24V power is used in new gripper.
>
> Short circuit protection should be implemented by a fuse in the control cabinet by the customer.

Inspection

The new gripper is supplied in a wooden box. Be sure to stand the package with the upper face upwards. Open the package and check for any visible transport damage. If the new gripper is damaged, contact ABB.

Packing list

Check the following item list in the standard delivery package before proceeding with the installation of the new gripper.

No.	Item	Description
A	Flange	
B	Screws	For IRB460: 6x M10 screws to install the flange to the robot wrist; 16x M6 screws to mount the flange to the new gripper.
		For IRB660: 11x M12 screws to install the flange to the robot wrist; 16x M6 screws to mount the flange to the new gripper.
C	Pre-assembled new gripper	
D	Cables	Compressed air hose (blue).
		Signal cable (Black). For IRB 460: circular connector For IRB 660: harting connector
		Black corrugated pipe as cable protection
E	Cable bracket	

> **Note**
>
> Before installing the new gripper, open the package and take out the flange. Keep the new gripper in the box for the convenience of later installation.If the new gripper is not to be installed immediately, it must be stored. For storage conditions see: *Storage conditions on page 25*.

Pre-requisites for mounting

The checklist below details items that should be observed before the installation of the new gripper.

1. Visually inspect the new gripper to make sure it is not damaged.
2. Make sure the expected operating environment of the new gripper conforms to the specifications described in *Operating conditions on page 25*.

Continues on next page

3 Make sure the area around the robot wrist has no particles that would impede the installation of the new gripper or be dangerous to the operator.

Please adjust the width between the two plates according to the size of the product to be gripped before mounting. For information on the adjustment, please see *Claw unit on page 32*.

DANGER

Before commencing any service work, be sure all the safety clauses have been strictly observed!

Make sure that the power is off before starting any work.

Note

ABB recommend that air connected to the new gripper should be: 4-6 bar, filtered and non-lubricated.

Recommended standard tightening torque

For the torque values needed during installation, please see the following table.

The table below specifies the recommended standard tightening torque for oil-lubricated allen head screws (recommended class 12.9).

Dimension	Tightening torque (Nm) Class 12.9, oil-lubricated
M5	6
M6	10
M8	24
M10	47
M12	82
M16	200

2.3.3 Adjustment

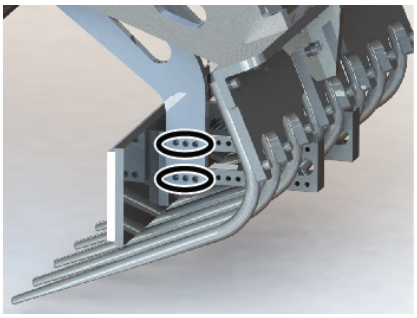
Width between support plates

When delivered, the width between the support plates is set wide enough to make mounting of the new gripper possible. If needed, please refer to the following instructions for how to adjust the width between the two plates according to the size of the product.

Adjustment instructions

DANGER

Turn off all electric power and pneumatic pressure supplies to the gripper!

No	Action	Info/Illustration
1	Loosen the screws holding the push plate assembly (see figure), the width between the two plates can be adjusted to suit the size of the product.	
2	Adjust the width between the plates and tighten the screw. Note and reference to the torque figures table.	

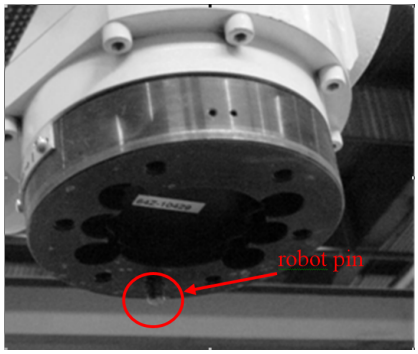
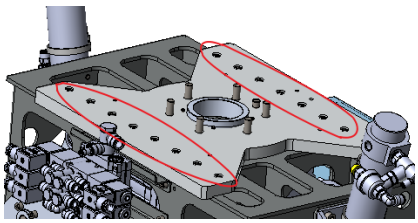
2.3.4 Mounting the new gripper

DANGER

Before commencing any service work, be sure all the safety guidelines have been strictly observed!

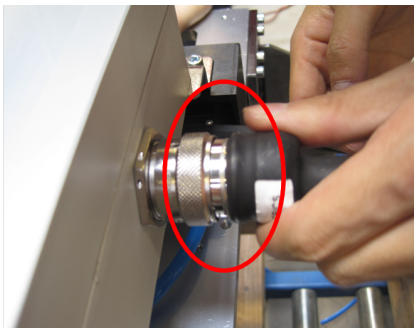
Make sure that the power is switched off before starting any work.

Mounting the new gripper on robot

No	Action	Info/Illustration
1	Locate the wooden package so that it can be reached by the robot. Jog the robot wrist to the correct working height for the operations to be carried out.	
2	Insert the robot pin in the non threaded hole in the robot wrist.	
3	Mount the flange on the robot wrist using the 6 supplied M10 screws and tighten to 47 Nm (or the 11x M12 screws tightened to 80 Nm). **Note** The robot pin is inserted in to the non threaded holes in the robot wrist and flange to guarantee the orientation of the new gripper.	
4	Jog the robot to find the location of the new gripper. Set the robot wrist to a low position (see Robot User's Guide).	
5	Mount the flange to the new gripper frame using the supplied 16×M6 bolts and tighten screws from above downward. **Note** Make sure the locking groove on the flange engages with the frame of the new gripper.	

Continues on next page

2.3.4 Mounting the new gripper
Continued

No	Action	Info/Illustration
6	Attach the cable bracket on the flange and the cable routing to the robot wrist. **Note** Pass the cables through the plastic corrugated pipe which is used as the cable protection.	
7	Connect the power and air cables to the manipulator wrist.	
8	Connect the compressed air supply cable to the valve unit and the power & signal cable to the terminal box.	
9	Jog the robot wrist to lift the new gripper package, then pull down the wooden box and separate it from the new gripper.	
10	Set axis 4 to zero angle position. Manipulate the robot to check if axis 4 can rotate to the position of angle 180 clockwise and anti-clockwise without tensioning of the cables and distortion of the corrugated pipe.	

Continues on next page

Note

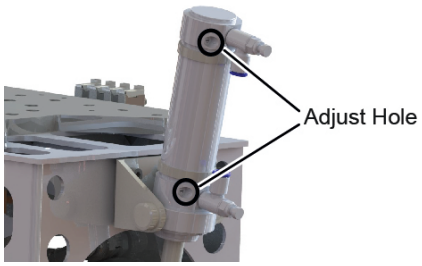
Make sure that the standard tool kit and attached screws, washers and dowels are used during the mounting.

WARNING

The air filter must be placed vertically upward to work properly or sealing rings in the solenoid valve unit and pneumatic cylinders would be damaged and result in air leakage and malfunction of the gripper.

Buffer unit adjustment

For the air pressure of factory may be different, the buffer units of pneumatic cylinders must be adjusted based on field conditions of the users. Users should adjust the buffer unit until the noise and vibration of the gripper has been minimized.

	Action	Info/illustration
1	Adjust the adjust hole of the pneumatic cylinder to maximum position by anticlock-wise direction turning, then clockwise screw the adjust hole until the vibration and noise be in the normal level.	

WARNING

Adjusting the buffer unit of the pneumatic cylinder must be done by professionals. Improperly adjust the buffer unit may result the damage of the gripper.

2.3.5 Commissioning

Note

ABB recommend that air connected to the new gripper should be: 4-6 bar, filtered (5µm), and non-lubricated.

After the electrical and pneumatic connection of the new gripper, test if the new gripper operates correctly.

Note

Only 24V power is used in the new gripper.

Short circuit protection should be implemented by a fuse in the control cabinet by the customer.

CAUTION

Hot parts may cause burns!

Mechanical commissioning

Jog the robot to do the following actions: claw open, push plate open, push plate close, claw close, press plate down, press plate up and check that the new gripper operates correctly.

Pay attention to the following:

- The operation speed and smoothness. If the open and close time of the new gripper-Claw is more than 0.6 s, adjust the throttle valves of the pneumatic cylinders until the operation time is less than 0.6 s. The palletizing cycle time is affected by factors as layout, working path, air pressure and commissioning parameter setting etc..
- Check if the clawing force is suitable to handle the products. A filter-regulator series MC is used to adjust the compressed air pressure of the press plates. The clamping force standard should be the force that the product can be steadily gripped and lifted without falling down.
- Check if any interference exists between cables or robot components.

Rapid routines

Routines	Description
PFPSInitInterrupt()	This routine is called to initialize the interrupt program. The signal 'DI10_02_ClawCylinder1_Closed' is monitored.
PFPS_MainEntry()	This routine is the main entry of the 'Test run' process. It can not be renamed, modified or deleted.
PFPSClawCylinder()	This routine is called when the claw is set to be open or close.
PFPSFixCylinder()	This routine is called when the top press plates go up and down.
PFPSPushCylinder()	This routine is called when the push plates push forward and backward.

Continues on next page

Routines	Description
PFPS_PickUpBox()	This routine is called when the robot goes to pick up boxes.
PFPS_PlaceDownBox()	This routine is called when the robot goes to place down boxes.
exePickPlace()	This routine is called when the robot goes to pick up and place down boxes. The two routines 'PFPS_PickUpBox()' and 'PFPS_PlaceDown-Box()' are called during the process.

Note

The target points 'pHome', 'pPick' and its offsets must be defined and taught firstly.

Note

The claw is open, when 'DO10_02_ClawCylinder1_Close' is set to be '0' and 'DO10_01_ClawCylinder1_Open' is set to be '1'. The claw is close, when 'DO10_02_ClawCylinder1_Close' is set to be '1' and 'DO10_01_ClawCylinder1_Open' is set to be '0'.

PFPSClawCylinder()

```
PROC PFPSClawCylinder()
IF Present (Open) THEN
SetDO DO10_02_ClawCylinder1_Close,0;
SetDO DO10_01_ClawCylinder1_Open,1;
WaitDI DI10_01_ClawCylinder1_Opened,1;
ENDIF
IF Present (Close) THEN
SetDO DO10_01_ClawCylinder1_Open,0;
SetDO DO10_02_ClawCylinder1_Close,1;
WaitDI DI10_02_ClawCylinder1_Closed,1;
ENDIF
ENDPROC
```

PFPSFixCylinder

```
PROC PFPSFixCylinder
IF Present (Up) THEN
SetDO DO10_06_FixCylinder1_Down, 0;
SetDO DO10_05_FixCylinder1_Up, 1;
WaitDI DI10_05_FixCylinder1_Up,1;
ENDIF
IF Present (Down) THEN
SetDO DO10_05_FixCylinder1_Up, 0;
SetDO DO10_06_FixCylinder1_Down, 1;
```

Continues on next page

```
WaitDI DI10_06_FixCylinder1_Down, 1;
ENDIF
ENDPROC
```

> **Note**
>
> The top press plate is up, when 'DO10_06_FixCylinder1_Down' is set to be '0' and 'DO10_05_FixCylinder1_Up' is set to be '1'. The top press plate is down, when 'DO10_06_FixCylinder1_Down' is set to be '1' and 'DO10_05_FixCylinder1_Up' is set to be '0'.

PFPSPushCylinder

```
PROC PFPSPushCylinder
IF Present (Open) THEN
SetDO DO10_08_PushCylinder1_Close, 0;
SetDO DO10_07_PushCylinder1_Open, 1;
WaitDI DI10_07_PushCylinder1_Open, 1;
WaitDI DI10_09_PushCylinder1_Open, 1;
ENDIF
IF Present (Close) THEN
SetDO DO10_07_PushCylinder1_Open, 0;
SetDO DO10_08_PushCylinder1_Close, 1;
WaitDI DI10_08_PushCylinder1_Close, 1;
WaitDI DI10_10_PushCylinder1_Close, 1;
ENDIF
ENDPROC
```

PFPS_PickUpBox()

```
PROC PFPS_PickUpBox()
MoveJ pHome, v100, fine, tPFPSClawGrip\WObj:=wobj0;
TPWrite " Robot move to pick postion! ";
MoveL Offs(pPick,-10,0,100), v100, z20, tPFPSClawGrip\WObj:=wobj0;
MoveL pPick, v100, fine, tPFPSClawGrip\WObj:=wobj0;
GripLoad PFPSLoadFull;
TPWrite " Robot start to pick up box! ";
PFPSClaWCylinder \Close;
IWatch itClaWMonitor1;
PFPSFixCylinder \Down;
WaitTime\InPos, 1;
bPartPicked:=TRUE;
WaitTime\InPos, 0.2;
TPWrite " Robot finish to pick up box! ";
MoveL Offs(pPick,0,0,50), v50, z10, tPFPSClawGrip\WObj:=wobj0;
```

Continues on next page

```
TPWrite " Robot move to home postion! ";
MoveJ pHome, v100, fine, tPFPSClawGrip\WObj:=wobj0;
ENDPROC
```

PFPS_PlaceDownBox()

```
PROC PFPS_PlaceDownBox()
TPWrite " Robot move to place postion! ";
MoveL Offs(pPlace,-10,0,100), v100, z20, tPFPSClawGrip\WObj:=wobj0;
MoveL pPlace, v100, fine, tPFPSClawGrip\WObj:=wobj0;
TPWrite " Robot start to place down box! ";
ISleep itClawMonitor1;
WaitTime\InPos, 0.5;
PFPSClawCylinder \Open;
TPWrite " Robot finish to place box! ";
GripLoad PFPSLoadEmpty;
WaitTime\InPos, 0.2;
TPWrite " Robot finish to place box! ";
MoveL Offs(pPlace,0,0,50), v100, z50, tPFPSClawGrip\WObj:=wobj0;
TPWrite " Robot move to home postion! ";
MoveJ pHome, v100, fine, tPFPSClawGrip\WObj:=wobj0;
ENDPROC
```

Reference Rapid codes

The gripper function can be checked with using rapid codes. Modify the data in rapid codes as needed before using:

```
MODULE MainModule
CONST robtarget
pPick:=[[1509.83,-1023.10,949.73],[1.47514E-06,0.00818497,-0.999967,-1.02733E-06],
[-1,0,-1,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
PERS tooldata
tPFPSClawGrip:=[TRUE,[[0,0,200],[1,0,0,0]],[60,[0,0,200],[1,0,0,0],0,0,8]];
PERS Loaddata
PFPSLoadFull:=[50,[0,0,-100],[0.502933,0.508892,-0.496959,0.491039],2,4,8];
PERS Loaddata PFPSLoadEmpty:=[0.001,[0,0,0.001],[1,0,0,0],0,0,0];
PERS num cycletime:=3.111;
PERS num pace:=0;
PROC main()
var clock MyClock;
MoveJ pPick, vmax, fine,tPFPSClawGrip\WObj:=wobj0;
ConfJ \off;
confl \off;
```

Continues on next page

2.3.5 Commissioning
Continued

```
pace:=0;
clkreset MyClock;
clkstart MyClock;
! zone radius 400mm
for i from 1 to 5 do
PFPSClawCylinder \Close;
PFPSFixCylinder \Down;
GripLoad PFPSLoadFull;
MoveC Offs(pPick,0,117,283),Offs(pPick,0,400,400),vmax,z200,
tPFPSClawGrip\WObj:=wobj0;
MoveL Offs(pPick,0,2000,400), vmax, z200, tPFPSClawGrip\WObj:=wobj0;
MoveL Offs(pPick,0,2000,0), vmax, z200, tPFPSClawGrip\WObj:=wobj0;
PFPSFixCylinder \Up;
PFPSClawCylinder \Open;
GripLoad PFPSLoadEmpty;
!Gripper start to back!
MoveL Offs(pPick,0,2000,400), vmax, z200, tPFPSClawGrip\WObj:=wobj0;
MoveL Offs(pPick,0,400,400), vmax, z200, tPFPSClawGrip\WObj:=wobj0;
MoveC Offs(pPick,0,117,283),pPick, vmax, fine,
tPFPSClawGrip\WObj:=wobj0;
endfor
waituntil\inpos,true;
clkStop MyClock;
cycletime:=clkRead(MyClock)/5;
pace:=3600/cycletime;
ENDPROC
PROC PFPSClawCylinder(\switch Open | switch Close)
IF Present (Open) THEN
SetDO DO10_02_ClawCylinder1_Close,0;
SetDO DO10_01_ClawCylinder1_Open,1;
WaitDI DI10_01_ClawCylinder1_Opened,1;
ENDIF
IF Present (Close) THEN
SetDO DO10_01_ClawCylinder1_Open,0;
SetDO DO10_02_ClawCylinder1_Close,1;
WaitDI DI10_02_ClawCylinder1_Closed,1;
WaitDI DI10_04_ClawCylinder2_Closed,1;
ENDIF
ENDPROC
PROC PFPSFixCylinder(\switch Up | switch Down)
```

Continues on next page

```
IF Present (Up) THEN
SetDO DO10_06_FixCylinder1_Down, 0;
SetDO DO10_05_FixCylinder1_Up, 1;
WaitDI DI10_05_FixCylinder1_Up,1;
ENDIF
IF Present (Down) THEN
SetDO DO10_05_FixCylinder1_Up, 0;
SetDO DO10_06_FixCylinder1_Down, 1;
!WaitDI DI10_06_FixCylinder1_Down,1;
ENDIF
ENDPROC
ENDMODULE
```

Software commissioning

For detailed software commissioning procedure, see New gripper function test .

2.4 Maintenance

2.4.1 General

Overview

This chapter details all maintenance activities recommended for the new gripper. For the torque values needed during maintenance, please see *Recommended standard tightening torque on page 37*.

> **WARNING**
>
> During maintenance, disconnect the mains voltage before any work is started. Even if the voltage is switched off there still remains a safety risk. Pneumatic and electric connections should be disconnected before performing any maintenance activity on the new gripper.

Safety information

Before any service work is started, it is extremely important that all safety information is read and followed! There are general safety aspects that must be read through, as well as more specific safety information that describe danger and safety risks when performing the procedures. Read the chapter *Safety on page 9* before performing any service work.

2.4.2 Regular Inspection of new gripper

General visual inspection

Perform general visual system inspection regularly before starting an operation. Parts that need to be visually inspected regularly (less than a half year and so on) are:

Type	Action
Fastener	Check that the fastener is not lose.
Claw	Check for any distortion of the fingers.
Cable protection	Check the wear extent of the cable protection.
Pneumatic accessory	Regularly check that the piston rods of the cylinders are free from dust particles and check that there is no air leakage. Ensure all the valve terminal connectors are tightened properly and check that there is no air leakage

2.4.3 Regular replacement

Component replacement condition

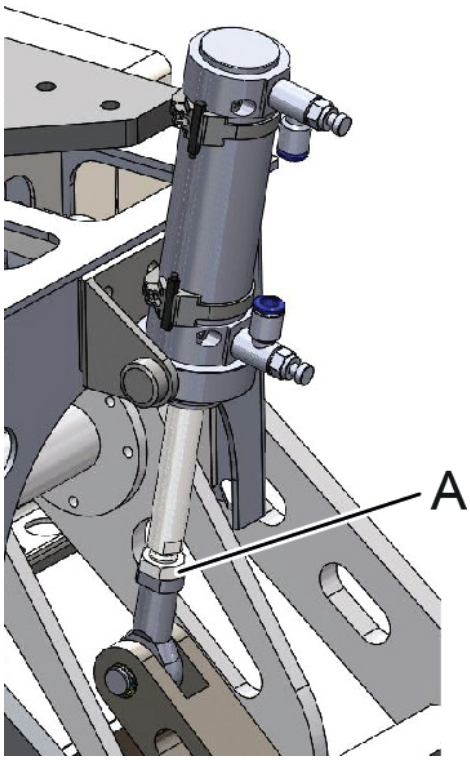
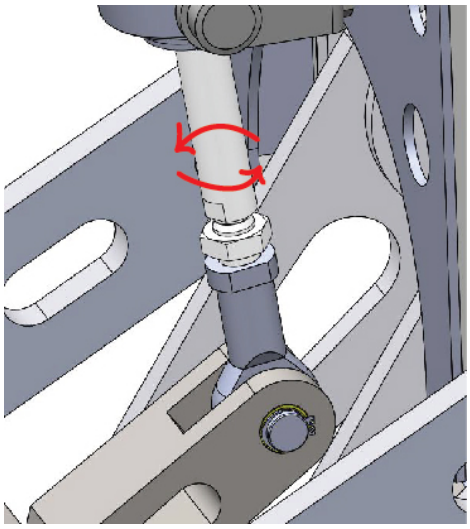
In any of the following situations, the corresponding component should be replaced:

- The copper sleeve in trunnions, push plate arms, claw cylinder brackets and claw arms are weary
- The claw unit/claw finger is distorted
- The corrugated pipe has worn out
- Pins in the gripper have worn out seriously
- Any component that no longer functions correctly
- Any component that has exceeded its lifetime

2.4.4 Regular adjustment

Claw parallelism

Regularly check if the two claws are parallel with each other when they are closed and reach the bottom position. If not, adjust the claw unit until the two claws are parallel.

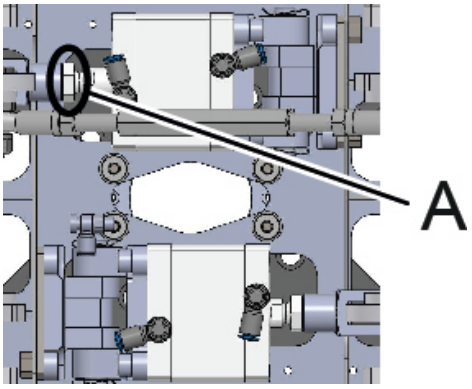
No.	Procedure	Illustration
1	Jog the gripper to first close the push plates and then the claws.	
2	Unscrew the locking nut of the spherical hinge.	 A: locking nut
3	Rotate the piston rod of the pneumatic cylinder using a spanner until the claw become parallel.	

Continues on next page

No.	Procedure	Illustration
4	Screw the locking nut.	

Push plates parallelism

Regularly check if the two push plates are vertically parallel with each other. If not, adjust the push plate unit until the two push plates are parallel.

No.	Procedure	Illustration
1	Jog the gripper to first close the push plates and then the claws.	
	Dismantle the top press plate by unscrew the mounting screws of the top press plate.	
2	Unscrew the locking nut.	 A:locking nut
3	Rotate the piston rod of the pneumatic cylinder using a spanner until the push plate become vertical.Refer to *Claw parallelism on page 51*	
4	Screw the locking nut.	

2.5 Repair

2.5.1 Instruction

Overview

This chapter details all repair activities recommended for the gripper.

Safety information

Before any service work is started, it is extremely important that all safety information is read! 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 specific steps in a procedure. Make sure to read through the chapter *Safety on page 9* before commencing any service work.

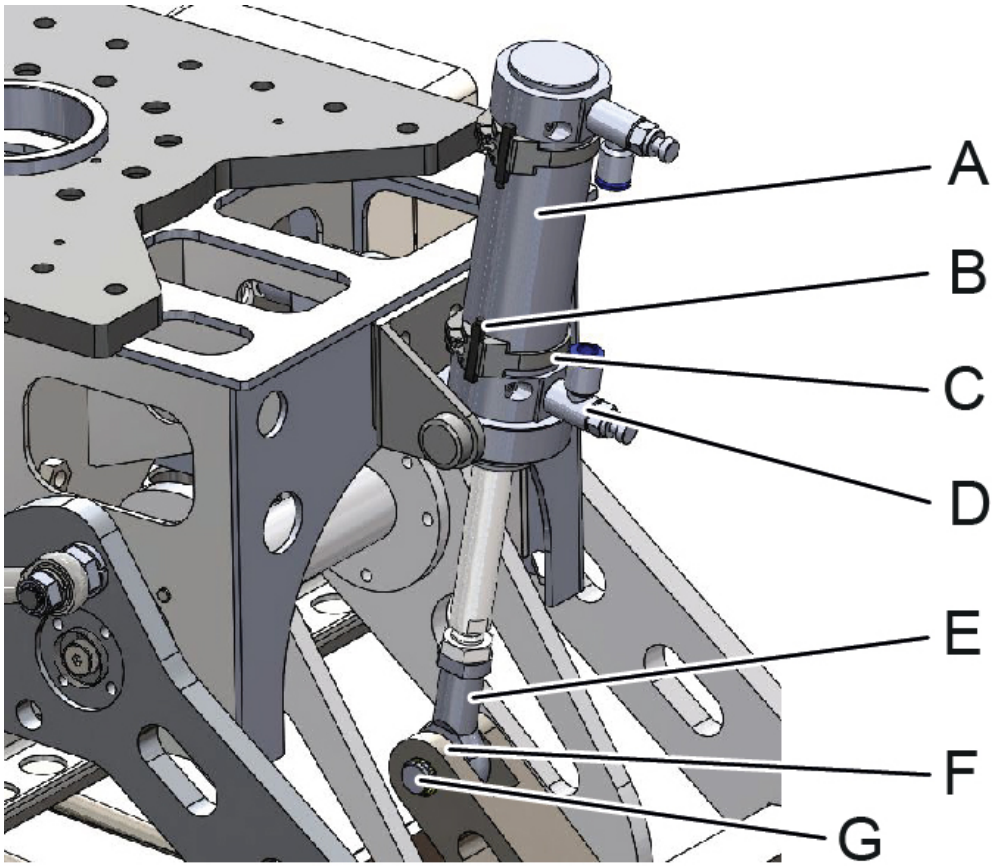
Note

Make sure that the gripper is disconnected from the mains power supply before starting any repair work.

2.5.2 Pneumatic cylinder

2.5.2.1 Replacing the cylinder of the claw

Location of cylinder



Position	Part
A	Pneumatic cylinder
B	Magnetic proximity switch
C	Limit switch strap
D	Speed controller
E	Spherical hinge
F	Bracket
G	Pin

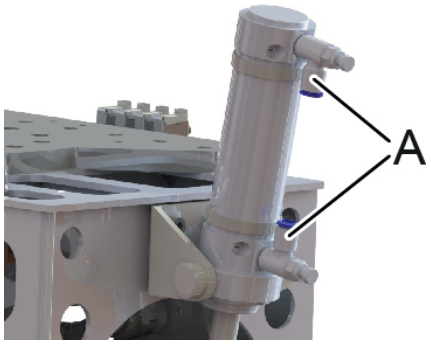
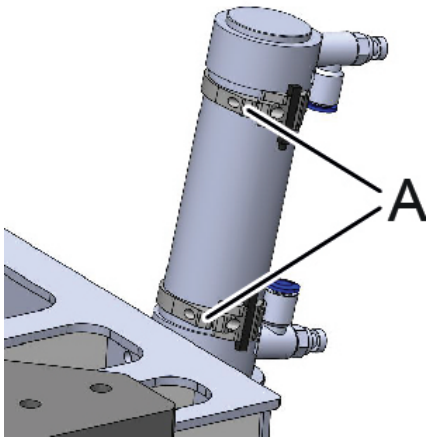
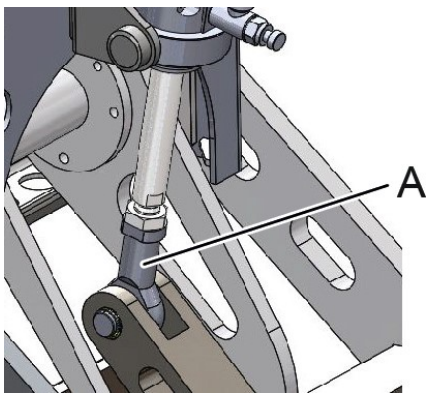
Procedure

Use this procedure to remove the cylinder.

DANGER

Turn off all electric power and pneumatic pressure supplies to the gripper!

Continues on next page

	Action	Note
1	Drain the air from the cylinder.	Disconnect air cable on cylinder.
2	Remove speed controller assemblies.	 Parts A: Quick exhaust valve assembly
3	Loosen the small bolt and pull out the magnetic proximity switch from the limit switch strap. Remove the limit switch strap.	 Parts: A: Small bolt
4	Remove the pin of the spherical hinge from the bracket by removing the jump rings on the pin.	 Parts: A: Spherical hinge

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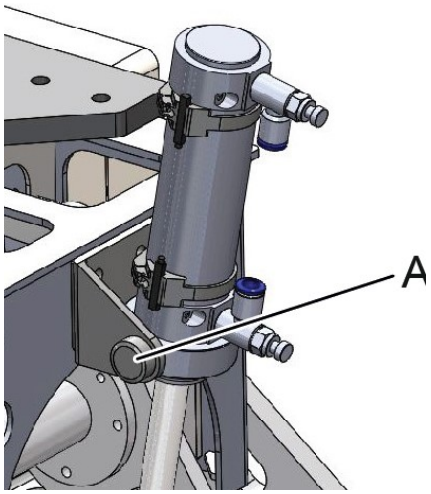
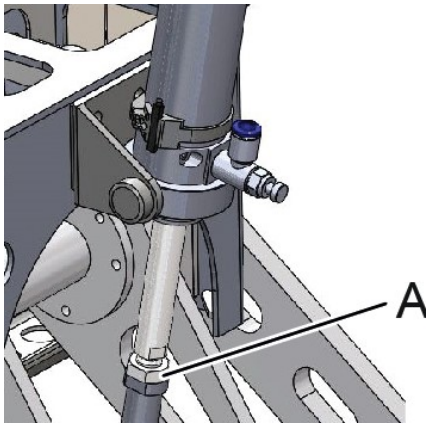
2.5.2.1 Replacing the cylinder of the claw

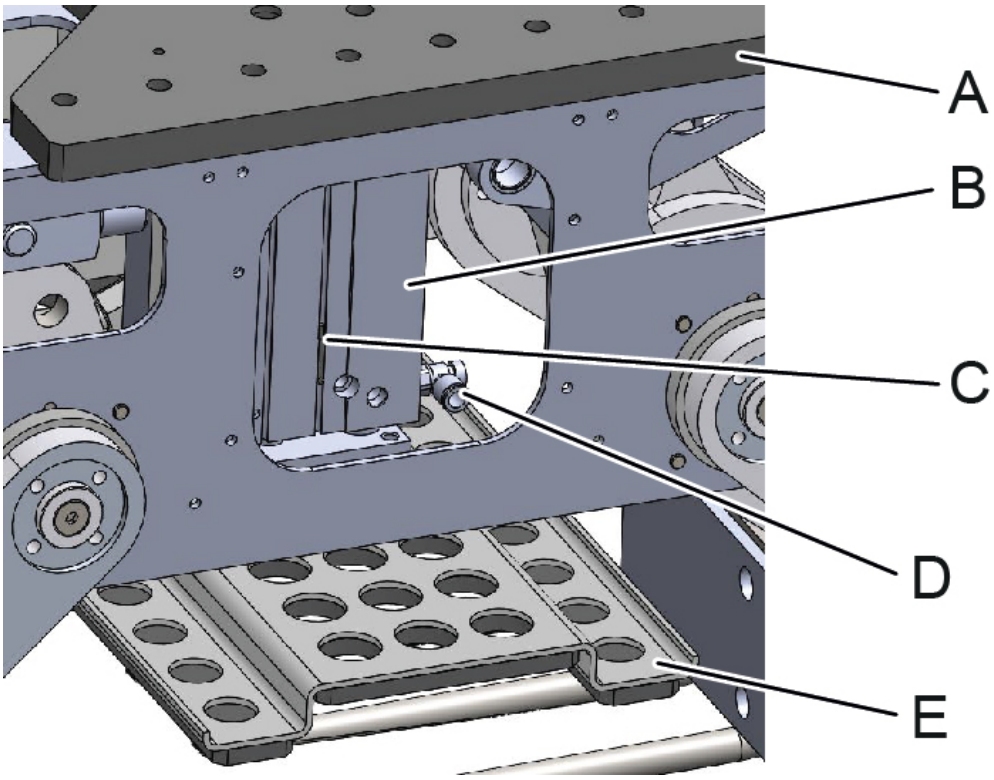
Continued

	Action	Note
5	Loosen bolt on the trunnion and remove the cylinder from the gripper with the spherical hinge connected.	 Parts: A: Bolt of trunnion
6	Loosen the locking nut and remove the spherical hinge.	 Parts: A: Locking nut
7	The pneumatic cylinder is removed.	

2.5.2.2 Replacing the cylinder of the top press plate

Cylinder Location

The cylinder of the top press plate is located as shown in the figure.



Position	Part
A	Mounting flange of the gripper
B	Pneumatic cylinder
C	Magnetic proximity switch
D	Speed controller
E	Top push plate bend with rubber

Procedure

Use this procedure to remove the cylinder.

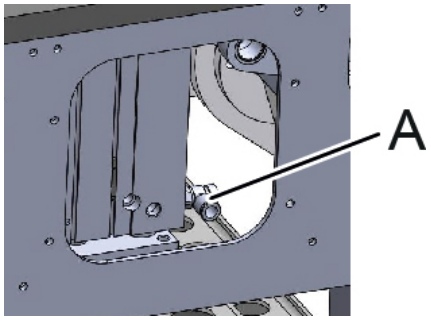
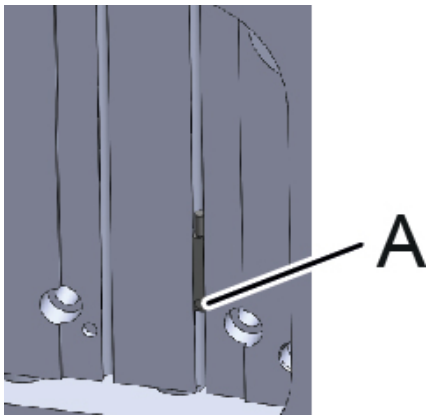
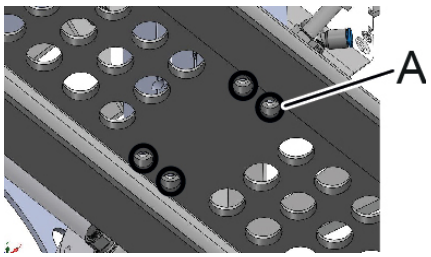
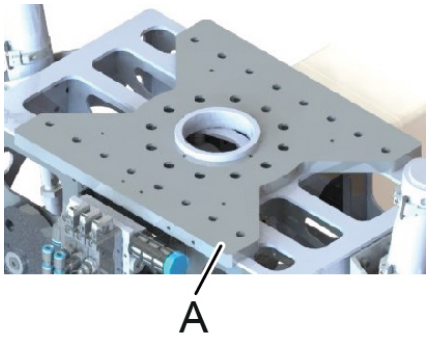
DANGER

Turn off all electric power and pneumatic pressure supplies to the gripper!

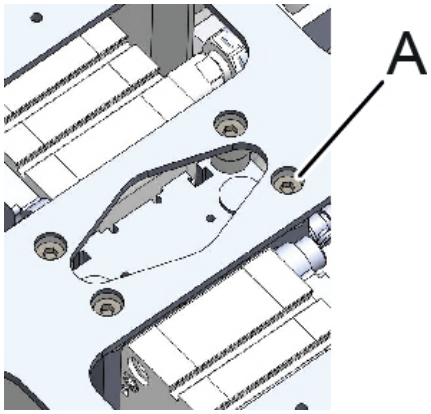
	Action	Note
1	Drain the air from the cylinder.	Disconnect air cable on cylinder.

Continues on next page

2.5.2.2 Replacing the cylinder of the top press plate
Continued

	Action	Note
2	Remove the speed controller for plastic tubes.	 Parts: A: Super rapid fittings for plastic tubes.
3	Remove magnetic proximity switches by unscrew the smallscrews.	 Parts: A: screw
4	Remove the top push plate by loose the four mounting screwoftheplate.	 Parts: A: mounting screw
5	Remove the mounting flange of the gripper by unscrew the mounting screws.	 A: mounting screws

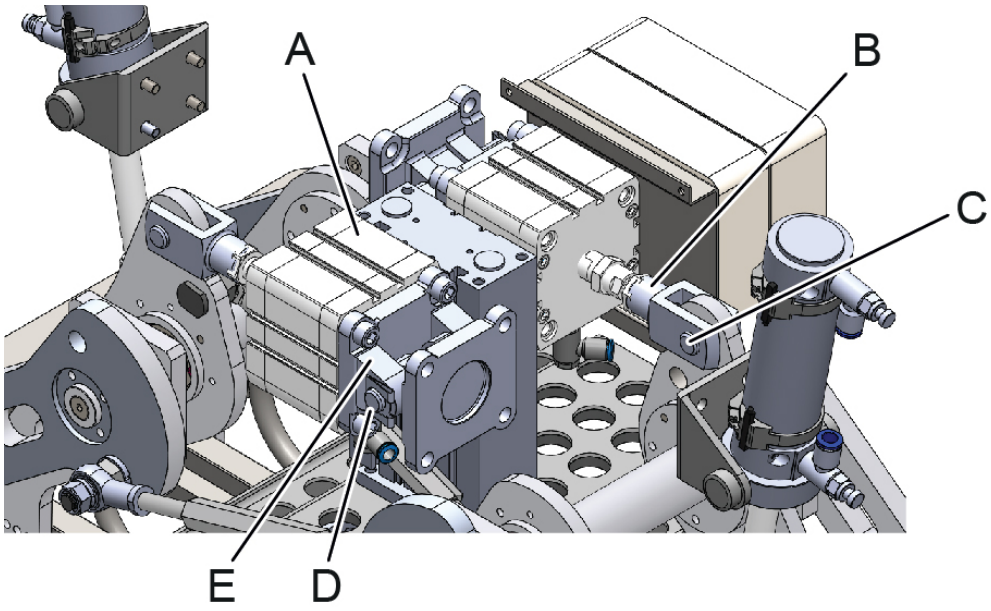
Continues on next page

	Action	Note
6	remove the mounting screw of the pneumatic cylinder by unscrew the four mounting screws.	 A:mounting screw of the pneumatic cylinder
7	Remove the pneumatic cylinder.	

2.5.2.3 Replacing the cylinder of push plates

Cylinder location

The cylinder of push plates are located as shown in the figure.



Position	Part
A	Pneumatic cylinder
B	Rod fork end Mod.G
C	Pin of the rod fork end Mod.G
D	Trunnion to connect the pneumatic cylinder with the main frame.
E	Trunnion

Procedure

Use this procedure to replace the cylinder.

DANGER

Turn off all electric power and pneumatic pressure supplies to the gripper!

	Description	Illustration
1	Dismantle the top press plate.	
2	Remove the proximity switches on the pneumatic cylinder. Dismantle the pin of the rod fork end Mod.G from the push arm.	For details to remove the proximity switches, please see *Magnetic proximity switch on page 62*
3	Dismantle the pneumatic cylinder together with the rod fork end Mod.G from the main frame by remove the pin on the trunnion.	

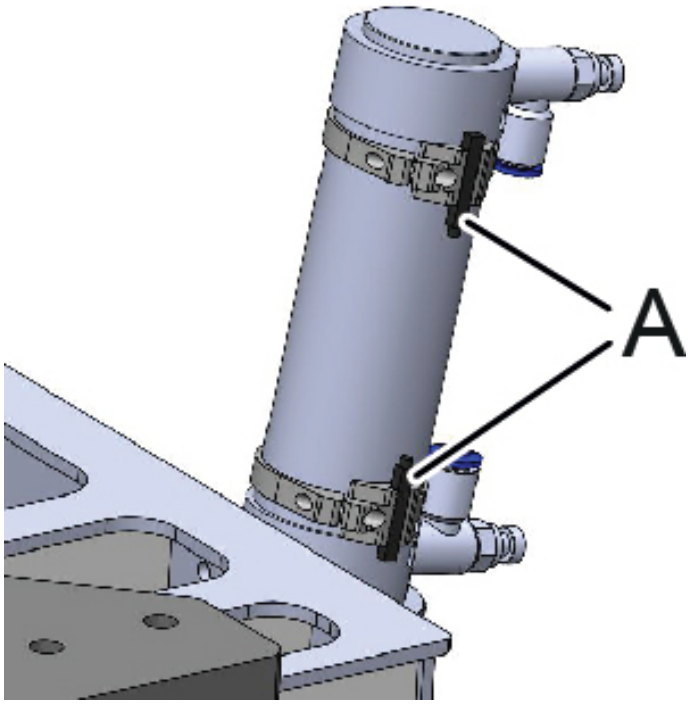
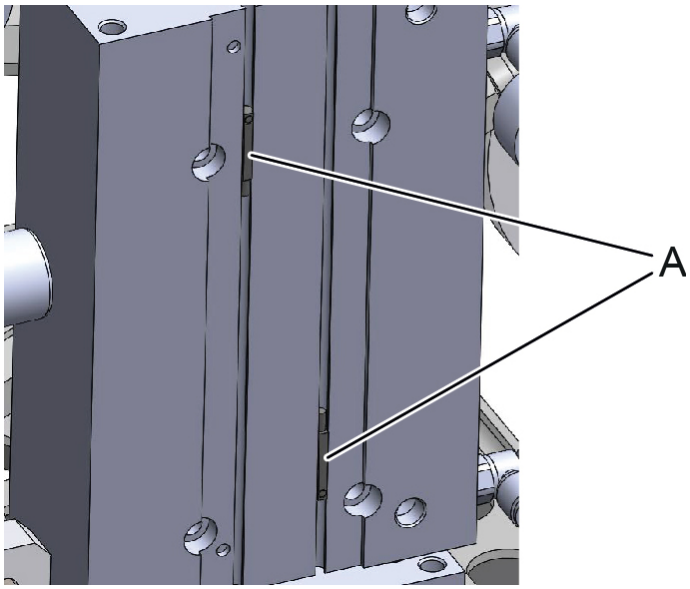
Continues on next page

	Description	Illustration
4	Unscrew the lock nut and dismantle the rod fork end Mod.G from the pneumatic cylinder.	
5	The pneumatic cylinder is dismantled. Install the rod fork end Mod.G on the new pneumatic cylinder.	
6	Mount the new cylinder on the main frame by the pin on the trunnion.	
7	Insert the pin of the rod fork end Mod.G to install the rod fork end Mod.G on the push plate arm.	
8	Adjust the lock nut to make the two push plates be vertical and be parallel with each other in the close position of the gripper.	For details to adjust the lock nut, see *Push plates parallelism on page 52*

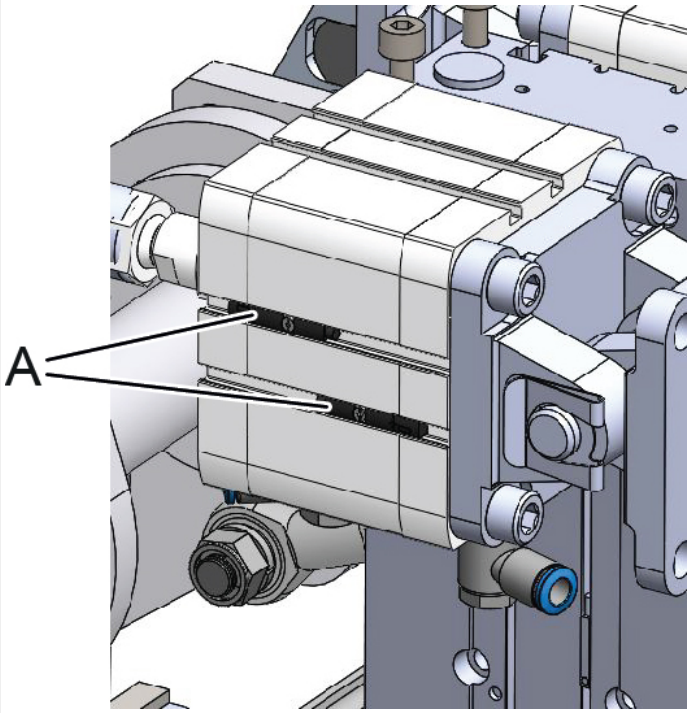
2.5.3 Magnetic proximity switch

Location

The magnetic proximity switches are located as shown in the figure.

Position 1	
Position 2	

Continues on next page

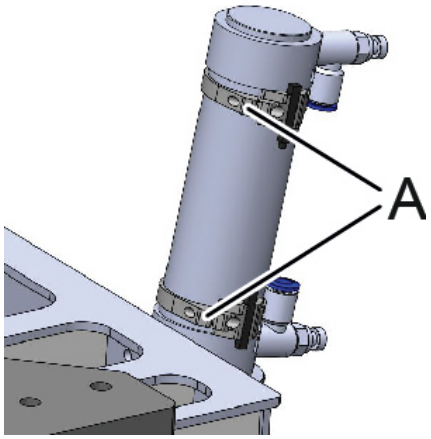
Position 3	
A	Magnetic proximity switch

Replace magnetic proximity switches in position 1

Use this procedure to replace magnetic proximity switches of the claw cylinder.

DANGER

Turn off all electric power and pneumatic pressure supplies to the gripper!

	Action	Note
1	Loosen the small screw and pull out the magnetic proximity switch.	 Parts: A: Small screw
2	Open the terminal box and remove the cable.	See circuit diagram for details.
3	Remove the magnetic proximity switch.	

Continues on next page

2.5.3 Magnetic proximity switch
Continued

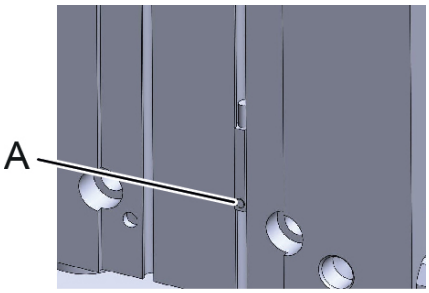
	Action	Note
4	Mount the new proximity switch with the small screw and connect its cables to the terminal box	See circuit diagram for details.

Replace magnetic proximity switches in position 2

Use this procedure to remove magnetic proximity switches of the top press plate cylinder.

DANGER

Turn off all electric power and pneumatic pressure supplies to the gripper!

	Action	Note
1	Loosen the small screw and pull out the magnetic proximity switch from the limit switch strap.	Parts: A: Small bolt 
2	Open the terminal box and remove the cable.	See circuit diagram for details.
3	Remove the magnetic proximity switch.	
4	Mount the new proximity switch with the small screw and connect its cables to the terminal box.	See circuit diagram for details.

Replace magnetic proximity switches in position 3

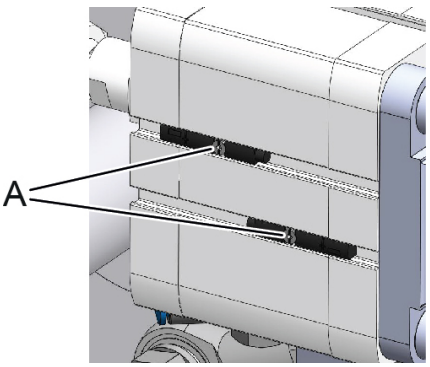
Use this procedure to remove magnetic proximity switches on the pneumatic cylinder of push plates.

DANGER

Turn off all electric power and pneumatic pressure supplies to the gripper!

	Action	Note
1	Dismantle the top press plate.	

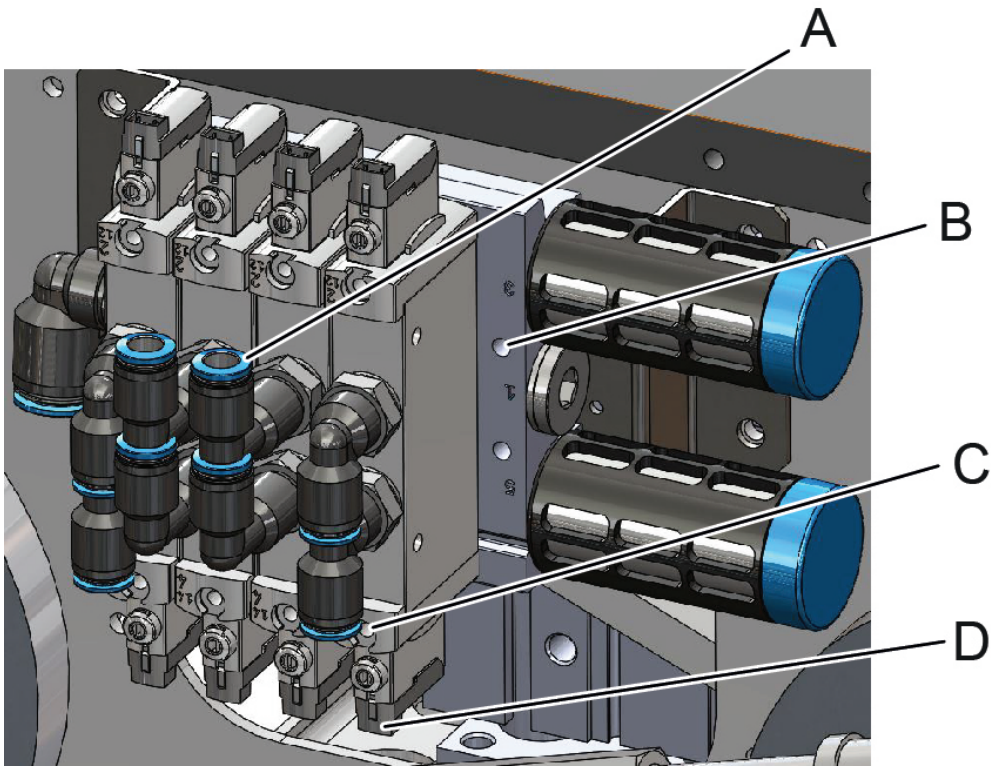
Continues on next page

	Action	Note
2	Loosen the small screw and pull out the magnetic proximity switch.	 Parts: A: Small screw
3	Open the terminal box and remove the cable.	See circuit diagram for details.
4	Remove the magnetic proximity switch.	
5	Mount the new proximity switch with the small screw and connect its cables to the terminal box.	See circuit diagram for details.

2.5.4 Solenoid valve

Location

The solenoid valve unit is located as shown in the figure.



Position	Part
A	Mounting screws
B	Super rapid fittings for plastic tubes
C	Mounting screw of switches
D	Switch of the valve unit connecting to the power supply

Procedure

Use this procedure to replace the solenoid valve.

DANGER

Turn off all electric power, pneumatic pressure supplies to the gripper!

	Action	Note
1	Drain the air from the cylinder	Pull out air cable
2	Remove super rapid fittings for plastic tubes	
3	Unscrew the mounting screws of the switches for the valve units and unplug the switches.	

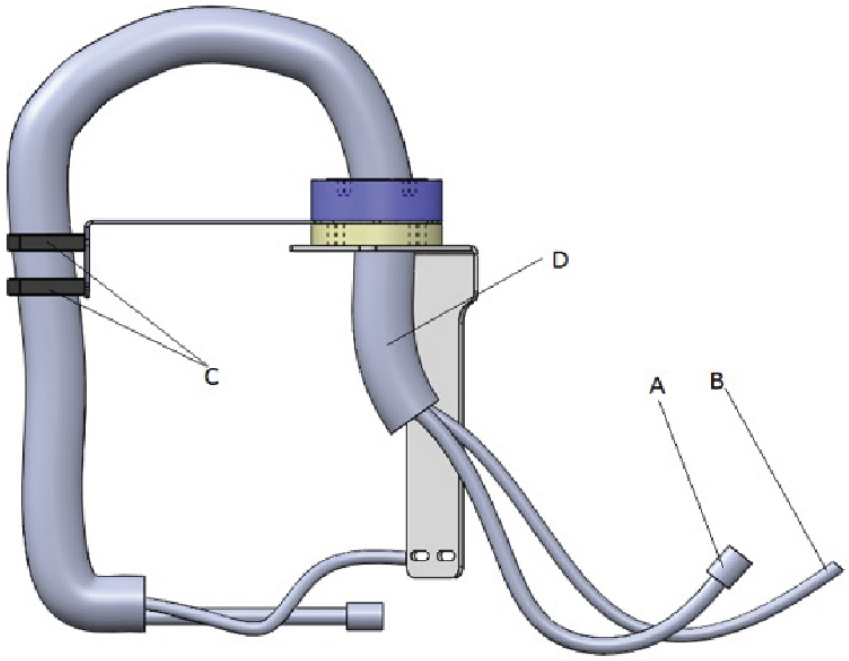
Continues on next page

	Action	Note
4	Unscrew the mounting screws of the valve units and remove the solenoid valve.	
5	Install the new solenoid valve with reversed steps.	

2.5.5 Dress cable

Location

The dress cable is located as shown in the figure.



Position	Part
A	Electrical cable
B	Main Compressed air hose
C	Corrugated pipe clip
D	Dress cable

Procedure

Use this procedure to replace the Dress Cable.

DANGER

Turn off all electric power, pneumatic pressure supplies to the gripper!

	Action	Note
1	Drain the air from the cylinders..	Pull out air cable
2	Pull out the main compressed air hose from two sides.	
3	Pull out electrical cable from both sides (one side the Gripper terminal box and the other side the robot axis 6).	
4	Open corrugated pipe clip.	
5	Remove Dress cable.	

Continues on next page

	Action	Note
6	Install the new dreww cable with reversed steps.	

2.6 Trouble shooting

2.6.1 Start-up failures

Consequences

Problems starting the system

Symptoms and causes

- LEDs on the sensors do not lit.
- Air hose hangs loosely on the gripper.

Recommended actions

	Action	Info/illustration
1	Make sure the robot system has started up and correctly is connected.	
2	Make sure the air source is open.	
3	Make sure the gripper cable and air hose are correctly connected to the dress cable.	
4	Make sure the gripper cable is correctly connected to the terminal box on the gripper.	

2.6.2 Gripper not responding

Consequences

The gripper cannot be operated using the FlexPendant.

Recommended actions

	Action	Info/illustration
1	Make sure the gripper system has started up.	
2	Make sure the connection to the I/O board is correct.	
3	Make sure that there is no air leakage.	

2.6.3 Wrong movement

Consequences

The fault can cause severe injuries or death to personnel in the area or severe damage to the manipulator and/or surrounding equipment.

Symptoms and causes

The movement of the gripper part is not as expected during commissioning.

Recommended actions

	Action	Info/illustration
1	Make sure the connection to the I/O board is correct.	
2	Check the connection in the terminal box.	

2.6.4 Low performance

Consequences

Claw and push plate movement is sluggish and sometimes stalls.

Symptoms and causes

- Connection error
- Low air pressure
- Excessive friction

Recommended actions

	Action	Info/illustration
1	Make sure the electrical and air connections are correctly and firmly connected.	
2	Make sure the air pressure is between 4 bar and 6 bar.	
3	Make sure there is not excessive friction between moving parts (See *Mechanical noise and vibration on page 75*).	

2.6.5 Problem jogging the gripper

Consequences

Gripper can not reach the rotation range.

Symptoms and causes

Cable or air hose routing.

Recommended actions

	Action	Info/illustration
1	Make sure the cable and air hose are correctly routed.	

2.6.6 Mechanical noise and vibration

Consequences

- Failing bearings affect the palletizing accuracy, and in severe cases, the workpiece may fall down uncontrolledly.
- The gripper part or workpiece may fall down.
- Vibration would result in the reduction of the life cycle of the pneumatic cylinder and affect the palletizing accuracy.

Symptoms and causes

- Worn bearings
- Loose bolts
- Worn steel sleeve in the trunnion assemly or lack of lubrication between the steel sleeve and the trunnion.
- The buffer mechanism of pneumatic cylinders are unproperly adjusted.

Recommended actions

Action for worn bearings:

	Action	Info/illustration
1	Determine which bearing is emitting the noise.	
2	Make sure the bearing has sufficient lubrication.	
3	Replace the bearing to a new one.	

Action for loose bolts:

	Action	Info/illustration
1	Determine which bearing is emitting the noise.	
2	Tighten the bolts to the recommended torque.	

Action for worn steel sleeve or lacking of lubrication:

	Action	Info/illustration
1	Periodically inject lubrication between the steel sleeve and the trunnion.	
2	If worn serisouly, replace the trunnion assembly.	

For action for unproperly adjusted buffer mechanism of cylinders, please refer to *Buffer unit adjustment on page 41*:

2.6.7 Workpiece drop down

Consequences

The fault can cause severe injuries or death to personnel in the area or severe damage to the manipulator and/or surrounding equipment.

Symptoms and causes

- Air leakage in the cylinder.
- Faulty air connection or air leakage caused by the faulty blocking valve.

Recommended actions

	Action	Info/illustration
1	Check if the blocking valve and the cylinder works well.	
2	Check the air hose connection.	

2.6.8 No Input signal detected

Consequences

Can not run work program.

Symptoms and causes

- No signal detected in UI. LEDs not lit on the I/O board.
- Faulty connection.

Recommended actions

	Action	Info/illustration
1	Make sure the LEDs sensors are lit and all the connections are firmly connected.	
2	Check the connection on the I/O board.	

2.6.9 Package displacement

Consequences

Package displaced even with the top press plates pushed down.

Symptoms and causes

- Worn rubber over the top press plates and push plates.
- Push plates are not vertical.

Recommended actions

For worn rubber:

	Action	Info/Illustration
1	Check the rubber on the top press plates and push plates.	
2	If the rubber has worn, replace it.	

For push plate not vertical:

	Action	Info/Illustration
1	Check the two push plates are vertical or not.	
2	If not, adjust the push plate according to *Push plates parallelism on page 52*.	

2.7 Decommissioning

2.7.1 Introduction

Introduction

This section contains information to consider when to take the gripper out of operation. It deals with how to handle potentially dangerous components and potentially hazardous materials.

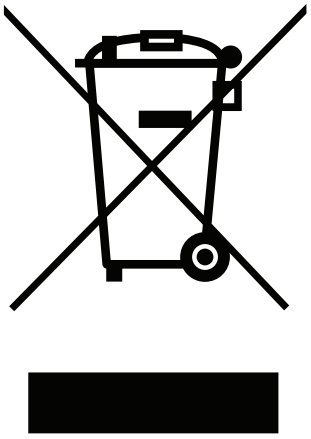
General

All used grease, oils and dead batteries must be disposed of in accordance with the current legislation of the country in which the gripper units are installed. If the gripper units are partially or completely disposed of, the various parts must be grouped together according to their nature (that 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 gripper units are installed.

2.7.2 Environmental information

Symbol

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



xx1800000058

Hazardous material

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

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

Material	Example application
Copper	Cables
Cast iron/nodular iron	Claw
Steel	Screws, base-frame, and so on.
Plastic/rubber	Cables, connectors, and so on
Aluminium	Flange

2.7.3 Environmental information

Hazardous material

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

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

Material	Example application
Copper	Cables
Steel	Screws, base-frame, and so on
Stainless steel	Claw
Plastic/rubber (PVC)	Cables, connectors, and so on
Aluminium	Flange

Oil and grease

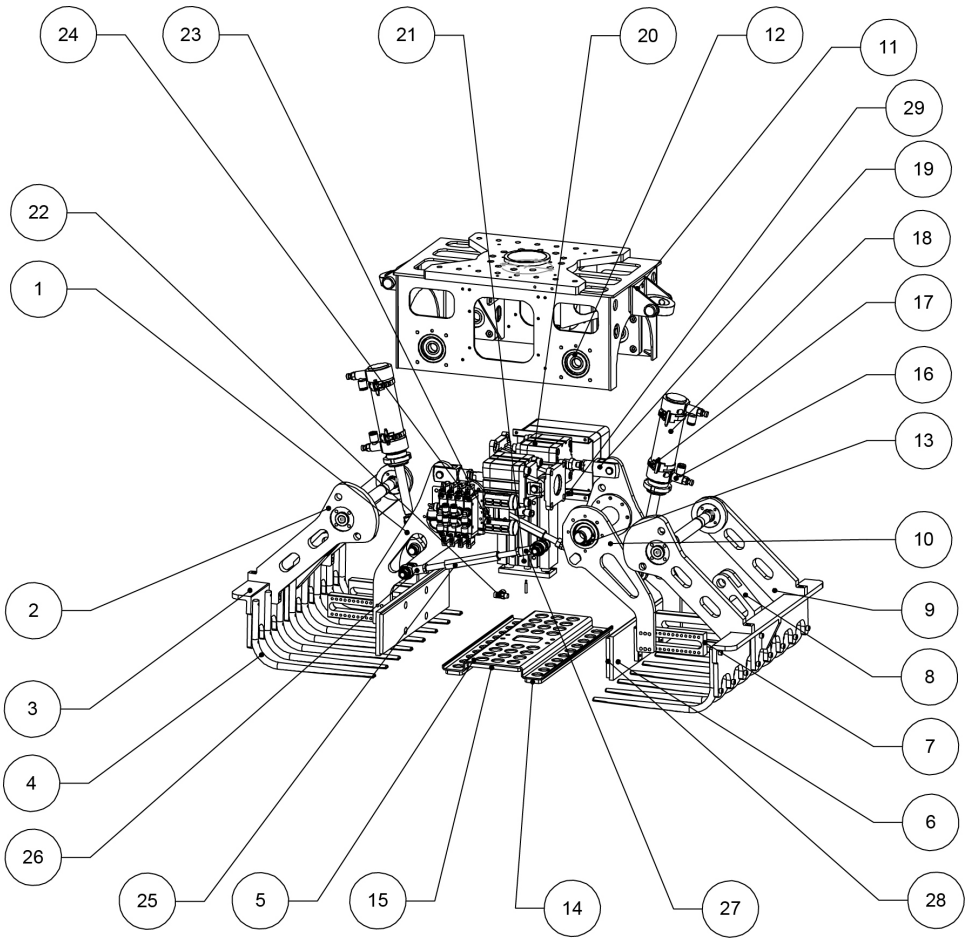
Where possible, arrange for the oil and grease to be recycled. Dispose of via an authorized person/contractor in accordance with local regulations. Do not dispose of oil and grease near lakes, ponds, ditches, down drains or onto soil. Incineration must be carried out under controlled conditions in accordance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

Also note that:

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

2.8 Spare parts

Illustration



Spare parts list

Position	Part No.	Description	Quantity	Remark
1	3HAC045883-002	PUSH PLATE ARM B	2	
2	3HAC045904-001	CLAW ARM FRONT	1L/1R	
3	3HAC045908-001	L SHAPE BASE	2	
4	3HAC045912-001	CLAW MACHIN-ING(BENDING)	16	
5	3HAC045911-001	TOP PRESS PLATE BEND	2	
6	3HAC045909-001	CLAMP PLATE(WITHOUT RUBBER)	2	WEAR AND TEAR COMPONENT
7	3HAC045910-001	ADJUSTING BRACKET ASSY	2L/2R	
8	3HAC045903-001	BRACKET WITH S-CYLINDER WITH SLEEVE	2	

Continues on next page

Position	Part No.	Description	Quantity	Remark
9	3HAC045903-001	CLAW ARM BACK	1L/1R	
10	3HAC045885-001	PUSH PLATE ARM F	2	
11	SBN-50/63	SWIVEL MOUNTING	2	
12	B6304ZZ	BALL BEARING	4	
13	B6205ZZ	BALL BEARING	4	
14	3HAC045866-001	RUBBER FOR TOP PRESS PLATE BEND SIDE	2	WEAR AND TEAR COMPONENT
15	3HAC045867-001	RUBBER FOR TOP PRESS PLATE BEND MIDDLE	1	WEAR AND TEAR COMPONENT
16	534339	One-way flow Control Valve	4	WEAR AND TEAR COMPONENT
17	543872	READ SWITCH	8	WEAR AND TEAR COMPONENT
18	193994	ROUND CYLINDER	2	WEAR AND TEAR COMPONENT
19	6146	ROD CLEVIS	2	WEAR AND TEAR COMPONENT
20	536357	COMPACT CYLINDER	2	WEAR AND TEAR COMPONENT
21	MGPM40-125AZ-M9BWL	RODLESS CYLINDER	1	WEAR AND TEAR COMPONENT
22	AS2201F-01-08SA	FLOW CONTROLLER	2	WEAR AND TEAR COMPONENT
23	2309	SILENCER	2	WEAR AND TEAR COMPONENT
24	564212	SOLENOID VAVLE	4	WEAR AND TEAR COMPONENT
25	LBRFN12-246	Rod End Coupling Rods	2	
26	PHSC12	Rod End Bearing	2	WEAR AND TEAR COMPONENT
27	PHSCL12	Rod End Bearing	2	WEAR AND TEAR COMPONENT
28	3HAC045917-001	RUBBER FOR CLAMPING PLATE	2	WEAR AND TEAR COMPONENT
29	534337	One-way flow Control Valve	4	WEAR AND TEAR COMPONENT

2.9 Circuit diagram

Electrical and pneumatic diagram

For Electrical and pneumatic circuit diagram of FlexGripper-Claw see *Link*

3 FlexGripper UI

3.1 Software installation

3.1.1 Installing FlexGripper UI Flexpendant application

Note

Only 24V power is used in FlexGripper.

Short circuit protection should be implemented by a fuse in the control cabinet by the customer.

Robot controller configuration requirement

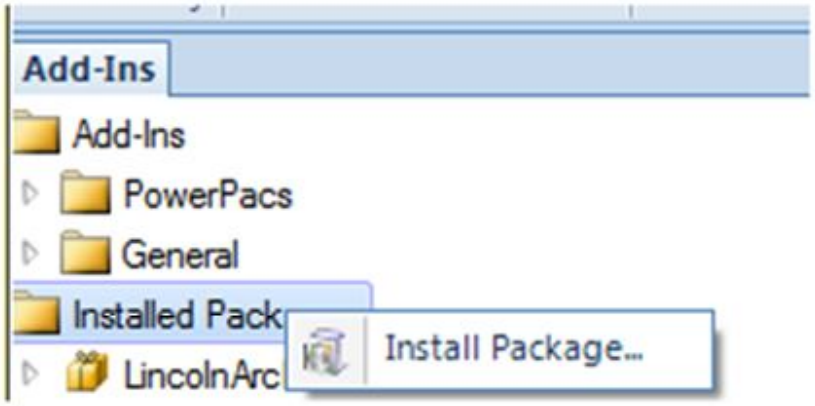
Hardware	DSQC652 or DSQC1030 board.
RobotWare	Robotware 6.0 or later, including 617-1 FlexPendent interface

FlexGripper UI FlexPendant application installation

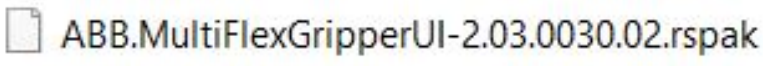
Add-in

Use the following procedure to build a system using RW Addin package using installation manager for RW6 version.

- Open RobotStudio and navigate to the Addin tab. From the ribbon press "Install Package".



- Browse to the Robot manifest File (rmf) for the multiflexgripperui_2.03.0028.00 Add-in. This is done only if a new Add-in is needed.



- The system should be upgraded by un installing the previous multiflexgripperui Add-in.

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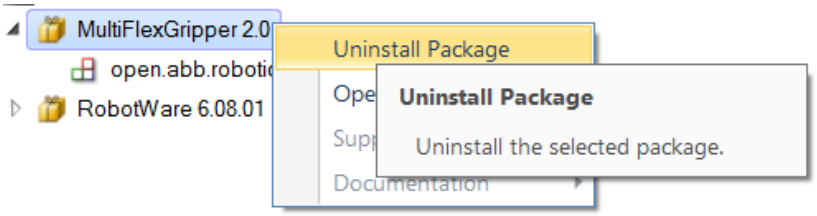
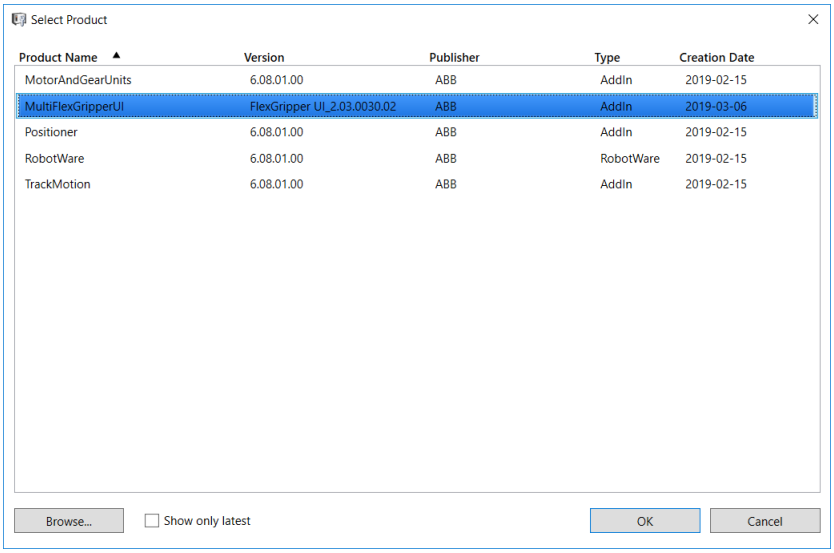
3.1.1 Installing FlexGripper UI Flexpendant application
Continued

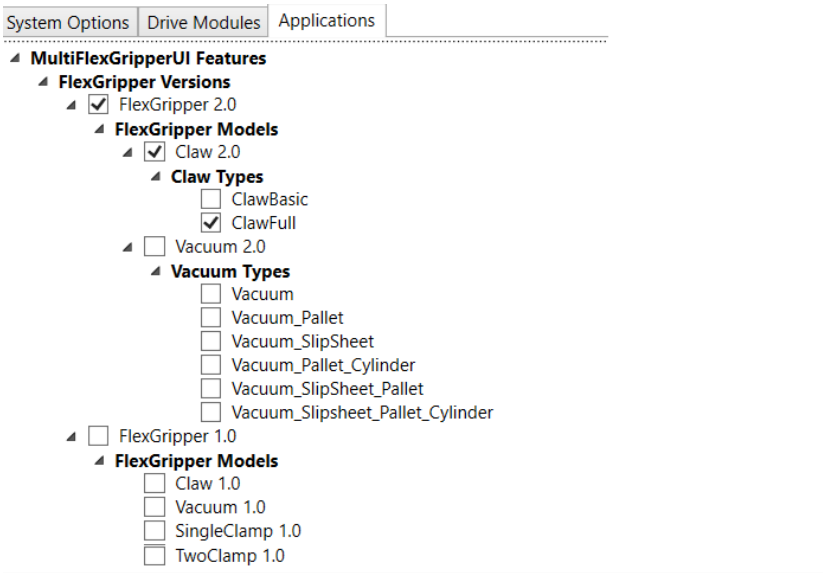
- Connect the system to the robot controller.Open the installation manager.



- Select the product MultiFlexGripperUI from the list



- License of the newly added feature should be selected in addition to the existing robotware license. Large end customers have the option for selecting the site-license.
- Build the system with the options required.



- Download the system

Continues on next page

- Restart the Controller

3.1.2 I/O signal configuration

I/O signal list

FlexGripper-Claw signal configuration

I/O signal	I/O board	Controller	Electric box		
			Signal	24V	0V
DO10_01_ClampCyl1_Open	DO01	XT5.1.1	26	-	41
DO10_02_ClampCyl1_Close	DO02	XT5.1.2	27	-	42
DO10_03_ClawCyl2_Open	DO03	XT5.1.3	28	-	43
DO10_04_ClawCyl2_Close	DO04	XT5.1.4	29	-	44
DO10_05_PushCyl3_Up	DO05	XT5.1.5	30	-	45
DO10_06_PushCyl3_Down	DO06	XT5.1.6	31	-	46
(DO10_07_Spare)	DO07	XT5.1.9	32	-	47
(DO10_08_Spare)	DO08	XT5.1.10	33	-	48
(DO10_09_Spare)	DO09	XT5.1.11	34	-	49
(DO10_10_Spare)	DO10	XT5.1.12	35	-	50
DI10_01_Clamp-Cyl1_Left_Open	DI01	XT6.1	1	16	-
DI10_02_Clamp-Cyl1_Left_Close	DI02	XT6.2	2	17	-
DI10_03_Clamp-Cyl1_Right_Open	DI03	XT6.3	3	18	-
DI10_04_Clamp-Cyl1_Right_Close	DI04	XT6.4	4	19	-
DI10_05_Claw-Cyl2_Left_Open	DI05	XT5.2.1	5	20	-
DI10_06_Claw-Cyl2_Left_Close	DI06	XT5.2.2	6	21	-
DI10_07_Claw-Cyl2_Right_Open	DI07	XT5.2.3	7	22	-
DI10_08_Claw-Cyl2_Right_Close	DI08	XT5.2.4	8	23	-
DI10_09_PushCyl3_Down	DI09	XT5.2.5	9	24	-
		XT5.3.5			
		XT5.3.6			

3.1.3 Back-up and Reset System

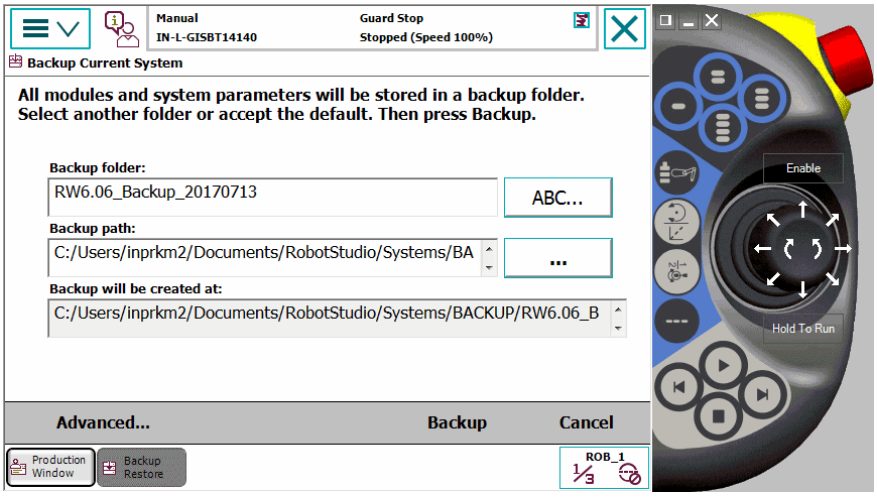
When do I need to backup the system?

We recommend performing a backup:

- *Before* installing new RobotWare.
- *Before* making any major changes to instructions and/or parameters to make it possible to return to the previous setting.
- *After* making any major changes to instructions and/or parameters and testing the new settings to retain the new successful setting.

Back up the system

This section describes how to back up the system.

	Action
1	Tap the **ABB** menu and then tap **Backup and Restore**.
2	Tap **Backup Current System**. A display showing the selected path is shown. If a default path has been defined, this is shown.  xx0300000441 **Note** • By default, a name for the Backup folder is created which can be renamed by the user later. • While renaming, ensure that the name does not start with a space. • If the folder name starts with a space, a warning dialog appears.
3	Is the displayed backup path the correct one? If YES: Tap **Backup** to perform the backup to the selected directory. A backup file named according to the current date is created. If NO: Tap **...** to the right of the backup path and select directory. Then tap **Backup**. A backup folder named according to the current date is created.

Continues on next page

Restart and return to the default setting using the restart mode Reset System

Note

After I-start, the system state will be resumed but any changes done to system parameters and other settings will be lost. Instead, system parameters and other settings are read from the originally installed system on delivery. Therefore it is important to always make a back up before I-start.

Use this procedure to restart the system using the restart mode **Reset System**:

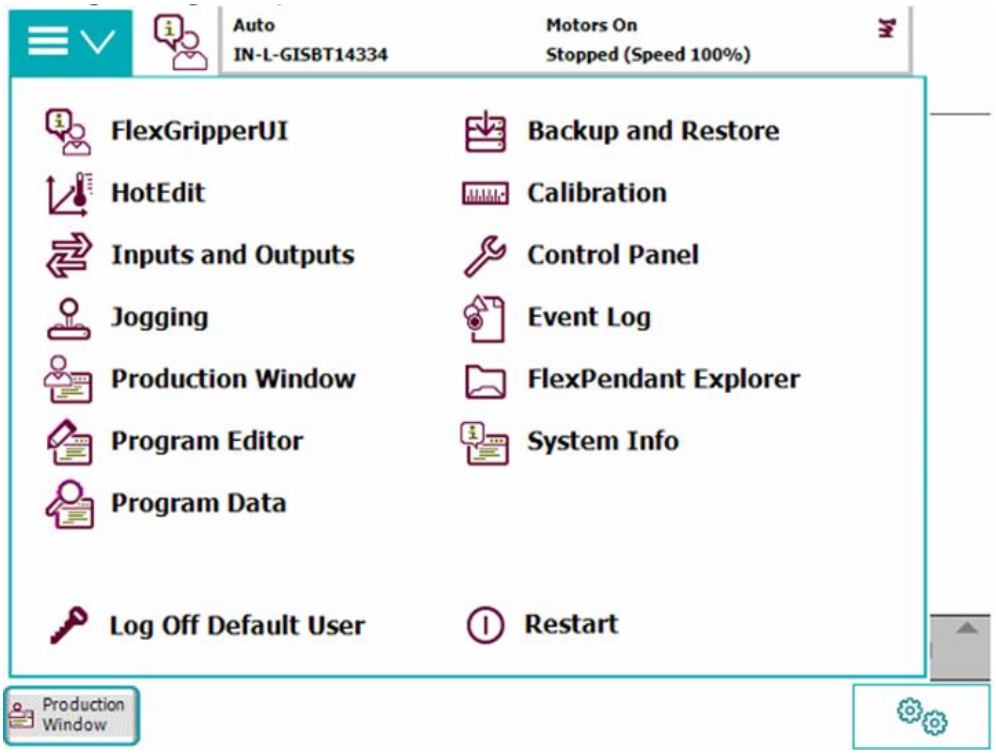
1. Make a backup of the system.
2. On the ABB menu, tap **Restart**. The restart page is displayed.
3. Tap **Advanced...** to select restart method. The select restart method dialog is displayed.
4. Tap **Reset System**, then tap **OK**.
5. Restore the backup system.

3.2 Operation

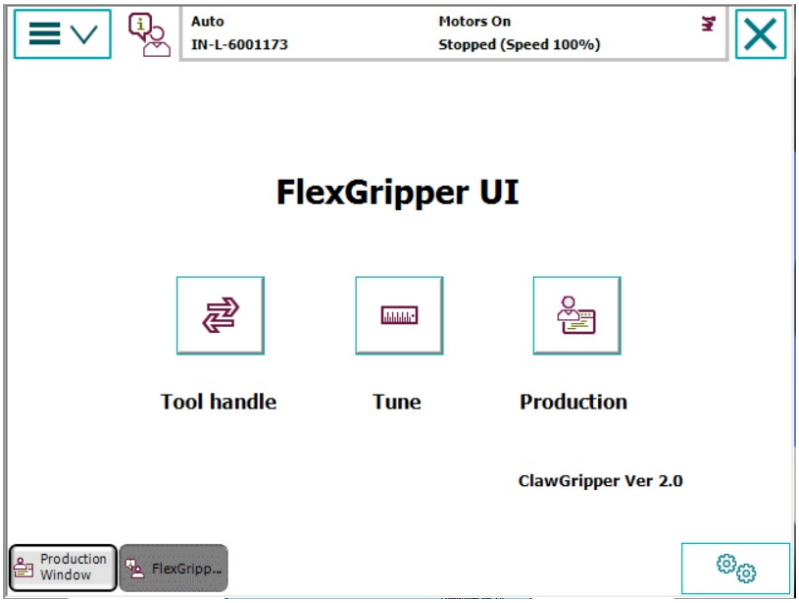
3.2.1 FlexGripper UI main interface

UI introduction

Enter FlexGripper UI



The FlexGripper UI has three function blocks: Tool handle, TCP edit and Production which you can see after entering the main interface.

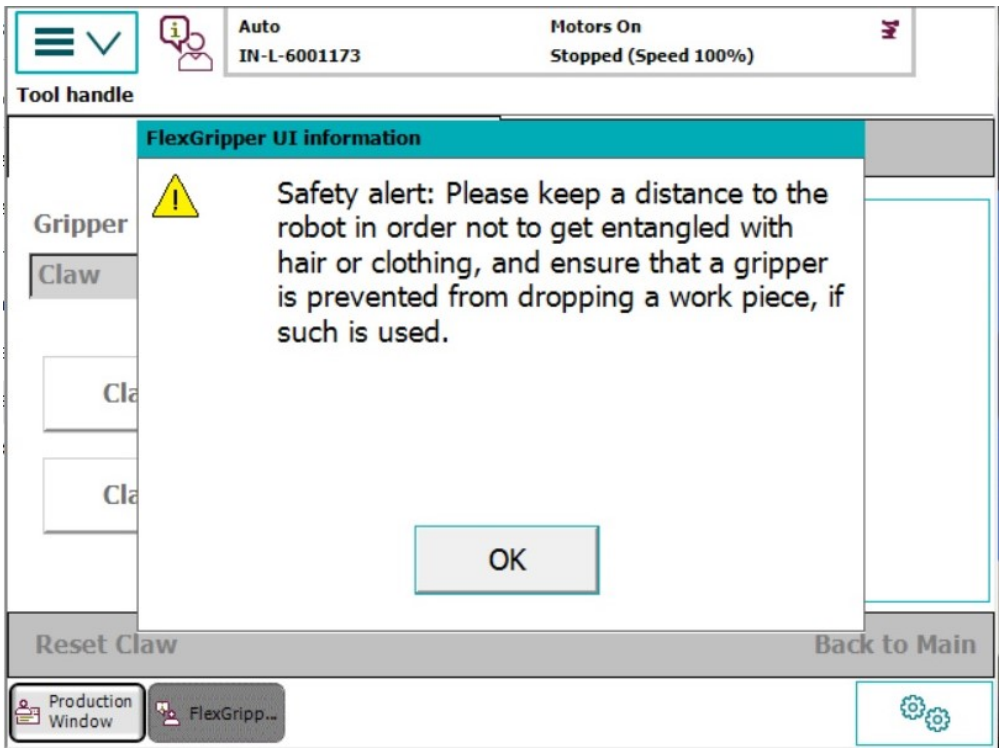


3.2.2 Tool handle

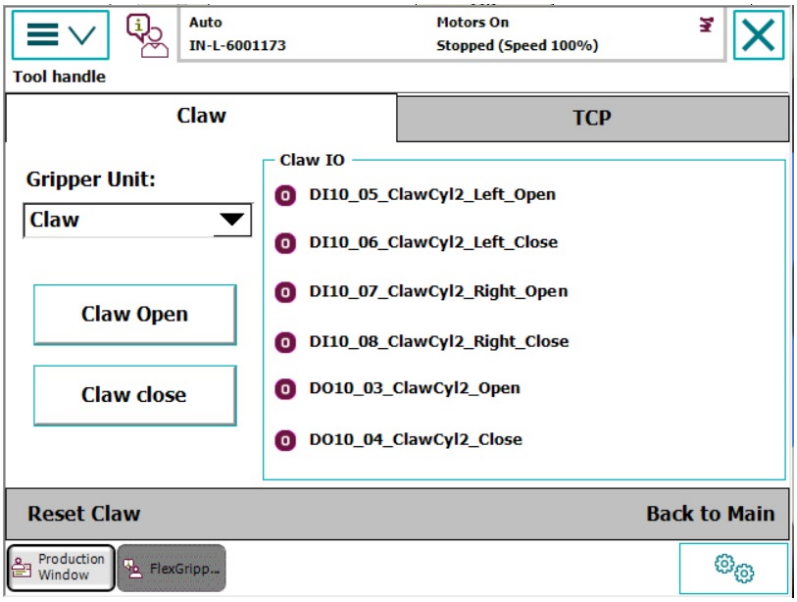
3.2.2.1 FlexGripper Claw function test

FlexGripper claw function test

Touch the Tool handle button, the following interface shows with a safety alert warning the danger could result from the robot operation.



Press OK, the following screen shows:



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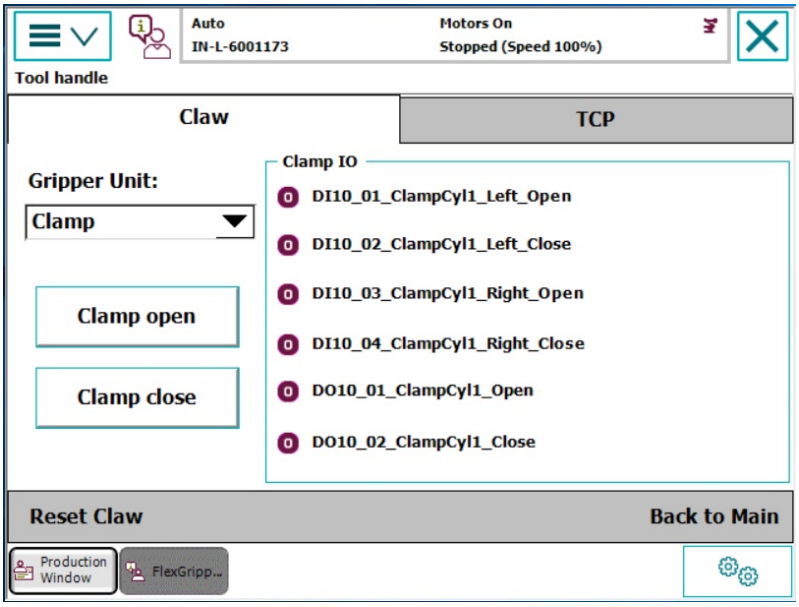
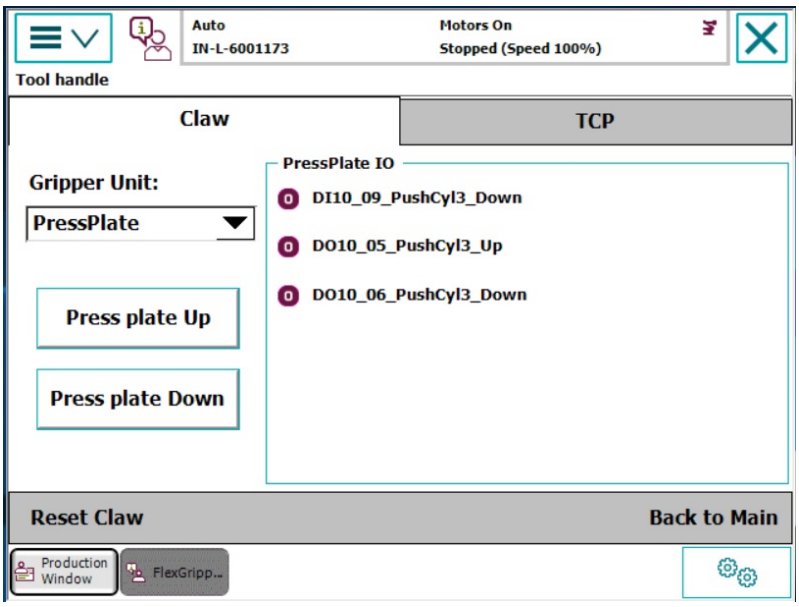




You can operate the functions displayed and check if the corresponding signals status is correct. The functions displayed are Claw open, Claw close, Press plate up and Press plate down.

Function and signal status (FlexGripper-Claw)

Button Name	Description	Signal status
Claw Open	To Open the claw.	DDO10_03_ClawCyl2_Open button lights up and change to 1
Claw Close	To Close the claw.	DO10_04_ClawCyl2_Close button lights up and change to 1
Clamp Open	To Open the clamp	DO10_01_ClampCyl1_Open

Continues on next page

3.2.2.1 FlexGripper Claw function test

Continued

Button Name	Description	Signal status
Clamp Close	To Close the clamp	DO10_02_ClampCyl1_Close
Push Plate Up	To pull out the two push plate cylinders and push down the push plate.	DO10_05_PushCyl3_Up button lights up and change to 1
Push Plate Down	To pull back two push plate cylinders and pull back the push plate.	DO10_06_PushCyl03_Down button lights up and change to 1

Note

After entering the main interface and touching any of the buttons, a warning message would shows prompting converting to manual mode.

Switch the control mode from auto mode to manual mode, the operations are now available. Touch Back to Main button, the interface returns to the main interface.

3.2.2.2 TCP edit

TCP configuration

Note: The TCP configuration includes three elements: TASK, Storage type and Scope.

Their scopes are:

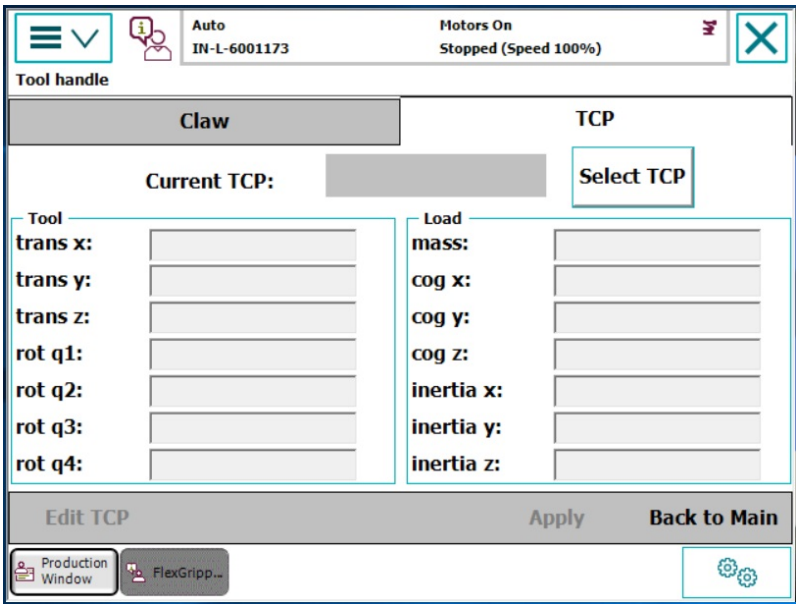
Task: T_ROB1

Storage type: Persistent and variable

Scope: Task, Global and Local

If the scope and storage type of the TCP is not correct it can not be monitored.

Touch TCP tab, the following interface would shows:

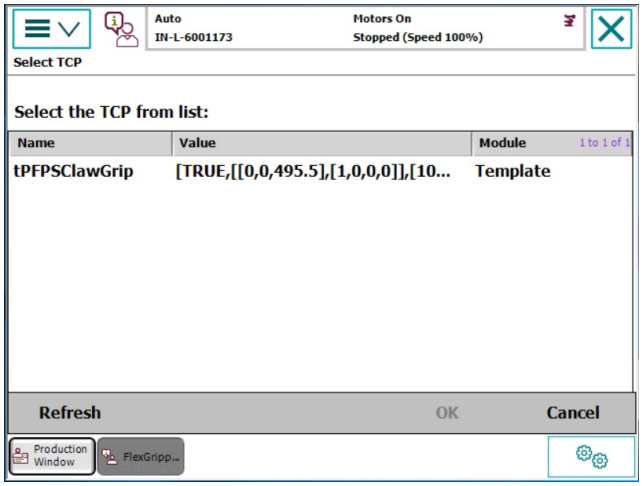


The grey column indicates data columns are not editable. The white columns indicate they are in editable mode.

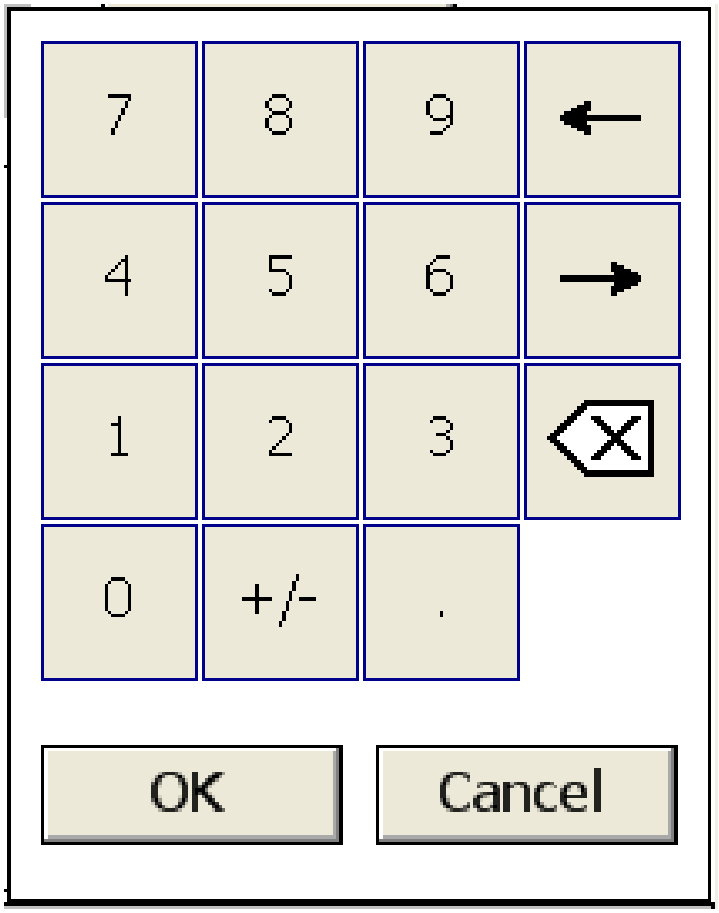
Continues on next page

3.2.2.2 TCP edit
Continued

TCP operation

Action	Procedure
Select TCP	Touch Select TCP button, then the TCP list shows.  Select the TCP needed, and touch OK. The related parameters of the TCP are automatically loaded into the Tool field on the left and the Load field on the right.

Continues on next page

Action	Procedure
Edit TCP	Choose the “Edit TCP” button, the column turns from grey to white indicating the content is editable. Choose one field, a soft keyboard shows which is used to input TCP data.  The soft keyboard consists of 0-9 numbers, positive/negative sign (+/-), decimal point, and an arrow left/right symbol used to move cursor left/right. The cross button has the function of backspace. For data description and valid data scope, see Table TCP Parameter description, After the editing, touch OK to confirm the editing. Then touch Apply, the editing is saved which is indicated by the data input columns turning grey.

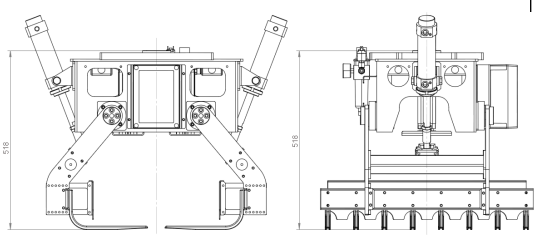
Continues on next page

3.2.2.2 TCP edit
Continued

TCP Parameter description

Type	Parameter	Description
Tool	trans x	The X-value of TCP position in mm
	trans y	The Y-value of TCP position in mm
	trans z	The Z-value of TCP position in mm
	rot q1	The q1 value in the quaternion (q1, q2, q3, q4) of the orientation of the tool coordinate system
	rot q2	The q2 value in the quaternion (q1, q2, q3, q4) of the orientation of the tool coordinate system
	rot q3	The q3 value in the quaternion (q1, q2, q3, q4) of the orientation of the tool coordinate system
	rot q4	The q4 value in the quaternion (q1, q2, q3, q4) of the orientation of the tool coordinate system
Load	mass	The weight of the tool in kg.
	cog x	The X-value of the center of gravity of the tool load (x, y and z) in mm
	cog y	The Y-value of the center of gravity of the tool load (x, y and z) in mm
	cog z	The Z-value of the center of gravity of the tool load (x, y and z) in mm
	inertia x	The X-value of the moments of inertia of the tool relative to its center of mass around the tool load coordinate axes in kgm2
	inertia y	The Y-value of the moments of inertia of the tool relative to its center of mass around the tool load coordinate axes in kgm2
	inertia z	The Z-value of the moments of inertia of the tool relative to its center of mass around the tool load coordinate axes in kgm2

Default TCP of FlexGrippers

FlexGripper type	Default TCP value	Default TCP location illustration
FlexGripper-Claw	[TRUE, [[0,0,500], [1,0,0,0]], [60, [5.3,0.5,233], [1,0,0,0],0,0,1.735]]	

Continues on next page

Note

The default TCP is only valid when no product is gripped by the FlexGripper. After the product is gripped, the TCP location should be adjusted according to the new center of gravity.

If the user wants to add a TCP themselves, they can add a TCP in the program. Then the newly added TCP can be shown in the TCP list when tapping Select TCP in the TCP interface.

3.2.3 Tune

3.2.3.1 Position Tune

Function and scope

The position tune function is used to fine tune the robot target location as the pick/place location and home location.

Note: The robot target configuration includes three elements: TASK, Storage type and Scope.

Their scopes are:

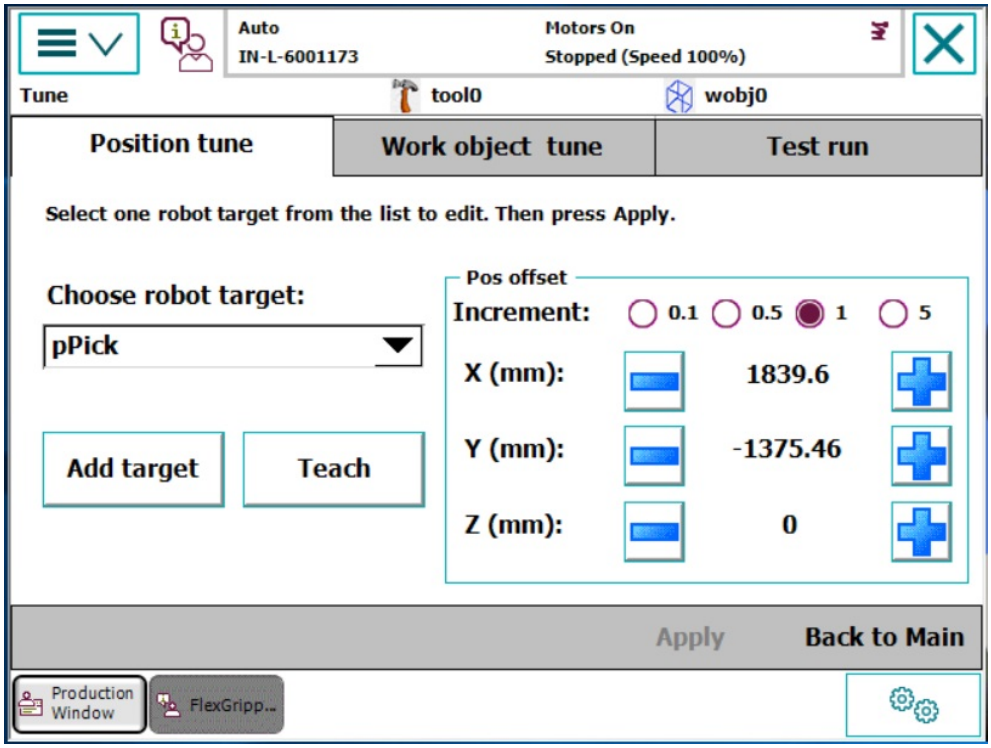
Task: T_ROB1

Storage type: Persistent and variable

Scope: Task, Global and Local

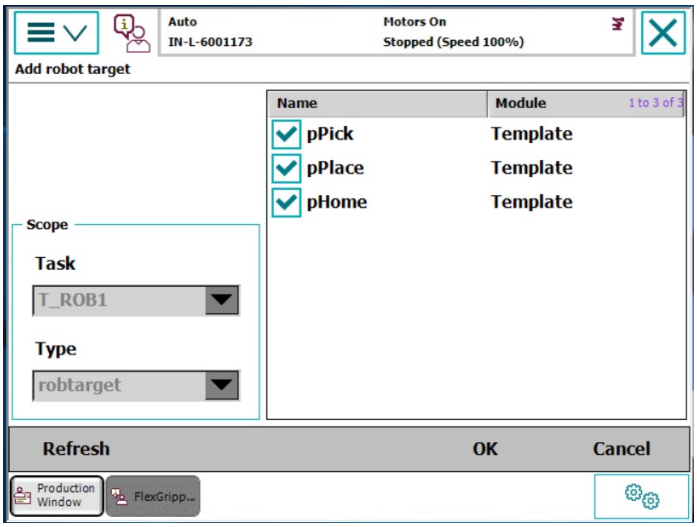
If the scope and storage type of the robot target is not correct it can not be monitored.

Touch the Tune button in the FlexGripper UI main interface, and enter the Tune interface. By default, there are three robot targets listed: pPick, pPlace and pHome.



Continues on next page

Robot target edit

Action	Procedure
Add target	Touch the Add target button, in the screen shown, the left side shows the target contribution, i.e. Task, Type, the right side shows the target list with the module described. Select the target needed, which is then ticked in the square before its name.  The targets listed are selected by default. Touch the target to remove the tick and deselect a target. Select OK, the selected targets are added to the Choose robot target column.
Teach target	Touch the Teach button, the selected robot target position is taught. Meanwhile the corresponding parameters of the TCP are automatically loaded into the Pos offset column.
Target position offset	After target teach, if the robot doesn't reach the exact position, the offset function can be used to fine tune the robot target. In the Pos offset column, touching the plus sign increases the position in mm and the minus sign decreases it. The increment unit can be adjusted in 0.1mm, 0.5mm, 1mm or 5mm. After the offset, touch Apply, the offset target is saved.

3.2.3.2 Work object tune

Function and scope

A work object is a coordinate system used to describe the position of a work piece. The work object consists of two frames: a user frame and an object frame. All programmed positions will be related to the object frame. The object frame is related to the user frame and the user frame is related to the world coordinate system.

Note: The work object configuration includes three elements: TASK, Storage type and Scope.

Their scopes are:

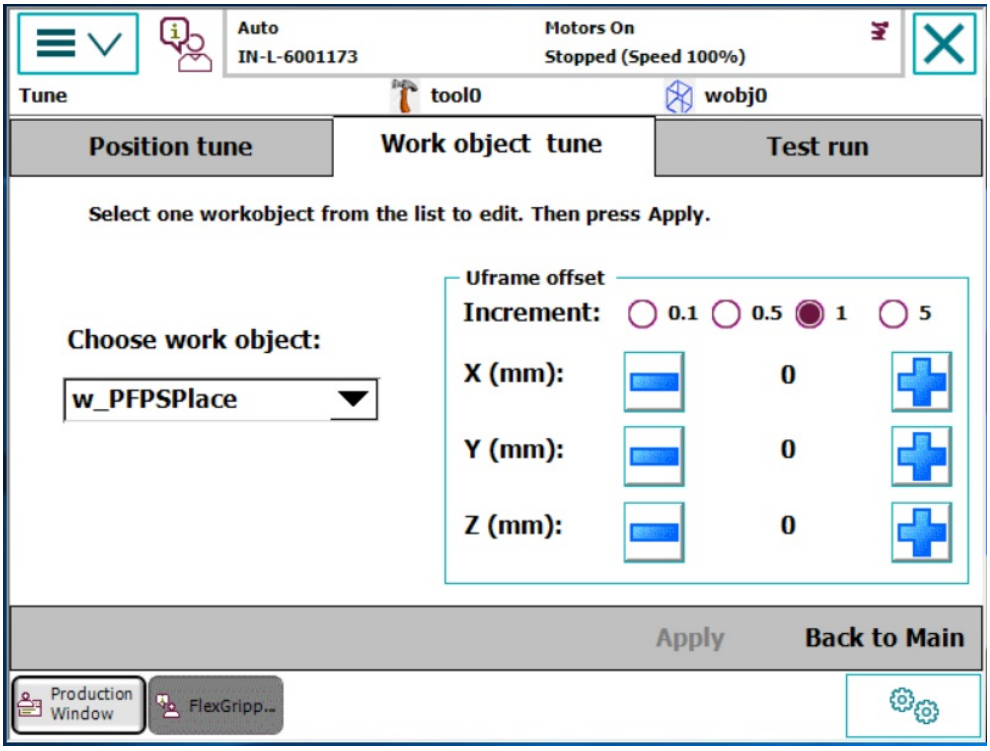
Task: T_ROB1

Storage type: Persistent and variable

Scope: Task, Global

If the scope and storage type of the work object is not correct it can not be monitored.

Touch the Work object tune tab to enter the work object tune interface.



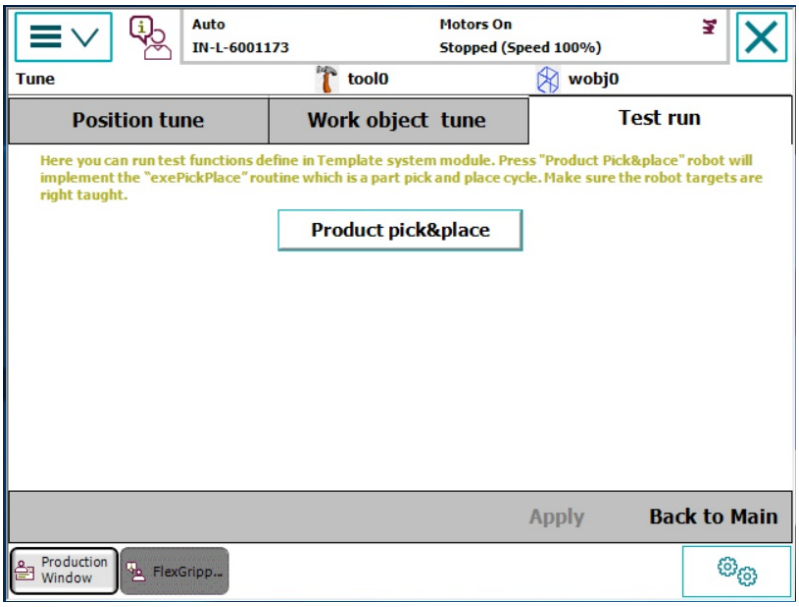
Work object tune operation

Action	Procedure
Choose work target	Choose work object from the drop down list on the left. The work object (x, y, z) in mm shows up on the right.
Tune the work object	Touch the minus button to decrease the value and the plus button to increase the value. The tuning unit can be 0.1mm, 0.5mm, 1mm or 5 mm. After editing, touch Apply, the modification is saved.

3.2.3.3 Test run

Function

After the TCP edit, Position tune and work object tune, the functions defined in the Template system module can be tested in Test run.



Press the Product Pick&place button, the robot implements the exePickPlace routing which includes a part pick and place cycle.

Note

When pressing the test buttons, a message shows prompting you to press the run button. Press the run button. Before the test, the TCP should be edited according to the real payload in test run, and all the robot target positions must be accurate.

3.2.4 Production

3.2.4.1 Production monitor

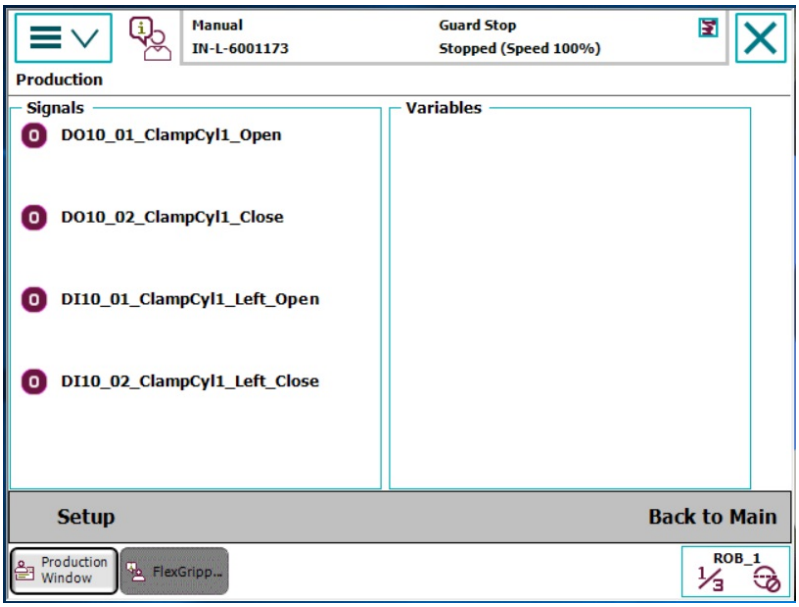
Overview

The production interface shows monitor signals on the left and monitor variables on the right. Users can monitor the production by the status of signals and variables. Users can check if the signal status or variable status is correct. If it is not in the right condition, check the corresponding equipment.

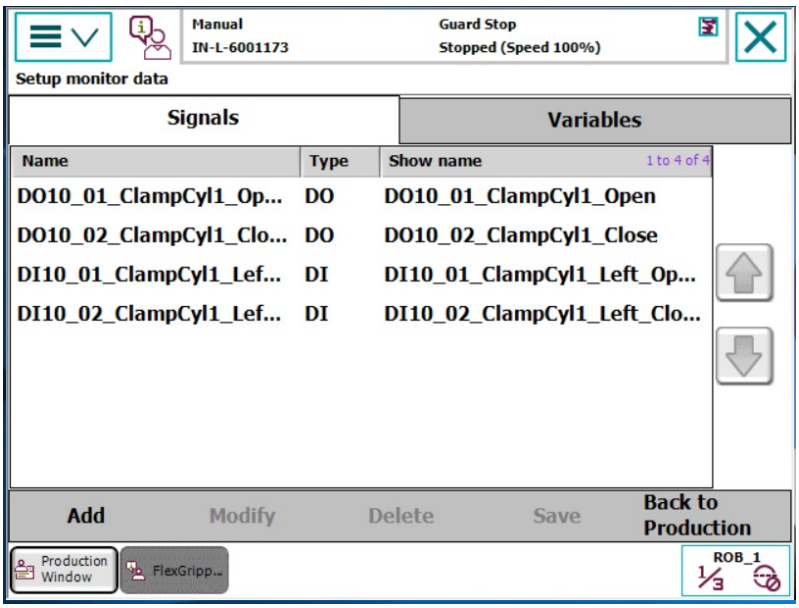
3.2.4.2 Setup

Function

The production interface shows monitor signals on the left and monitor variables on the right. The monitoring signals and variables shown can be set by the Setup function.



Touch the Setup button, the interface with signal list shows.



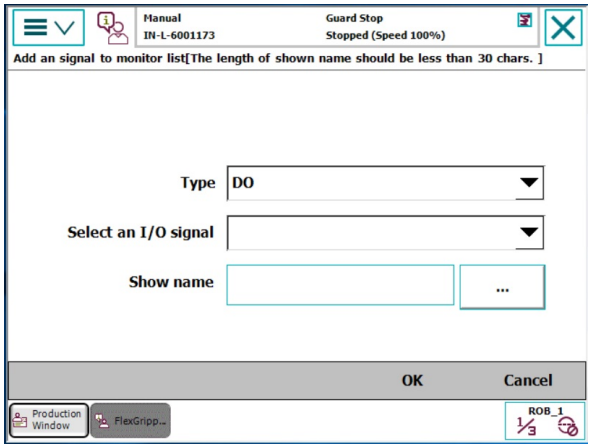
After selecting one of the signals, using the two arrows buttons (see the picture above) on the right to choose former signals or signals below.

Use the yellow double triangle/single triangle buttons to go to the first/last page or to move the page up/down.

Continues on next page

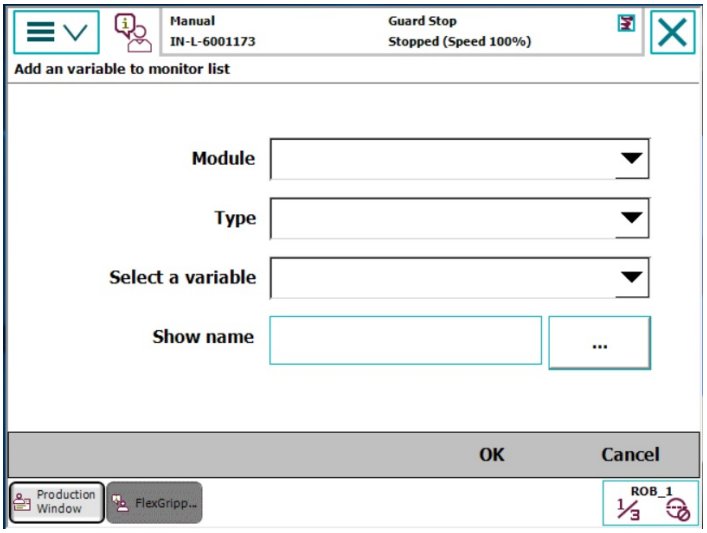
3.2.4.2 Setup
Continued

Signal edit

Action	Procedure
Add signal	Touch Add button, then choose signal type, the signal to be added and edit its shown name by touching the button with an ellipsis sign.  A soft keyboard shows. Choose signal type for the signal to be added, edit its name by touching the button with an ellipsis. Type in the signal name. The signal name should be no longer than 25 characters which can only include numbers, letters and underline sign. Note: No more than 12 signals can be added.
Modify signal	Select the signal to be modified and press the Modify button. You can then modify its type, signal and name in the dropdown list or the soft keyboard. Press cancel if no modification is needed.
Delete signal	Select the signal to be deleted and press delete. The signal is then deleted from the monitor signal list.

Continues on next page

Variable edit

Action	Procedure
Add variable	Touch Add button, the following interface shows:  Choose the module followed by the variable type to be added from the dropdown list. You can edit its name by selecting the button with the ellipsis. A soft keyboard shows with which you can enter the variable name. Note: The variable shown name should be no longer than 25 characters which can include numbers, letters and the underline sign. Note: No more than 12 variables can be added.
Modify variable	Select the variable to be modified and press the modify button. The variable, its module, type and name can be modified in the drop drop-down list or by using the soft keyboard. Select cancel if no modification is needed.
Delete variable	Select the variable to be deleted and press delete. The variable is deleted from the monitor variable list.

When you have finished editing, select Save to save any changes. Press the Back to Production button to return to the Production main interface.

Note

The variable configuration includes three elements: TASK, Storage type and Scope.

Their scopes are:

Task: T_ROB1;

Scope: Global, Task and local

Storage type: only Persistent

If the scope and storage type of the variable is not correct it can not be monitored.

3.3 Trouble shooting

Variable can not be monitored

Description	Can not monitor the variables
Possible reason	• The scope of variable is not correct • The storage type of variable is not correct
Solution	• Make sure the variable and the storage type are correct

The valid scope of variables is:

Task: T_ROB1;

Scope: Global, Task and local

Storage type: Persistent

TCP can not be edited

Description	Can not edit the TCP
Possible reason	• The scope of the TCP is not correct • The storage type of the TCP is not correct
Solution	• Make sure the scope and the storage type are correct

The valid scope of TCP is:

Task: T_ROB1;

Scope: Global, Task and local

Storage type: Persistent and Variable

Robot target can not be edited

Description	Can not edit the robot target
Possible reason	• The scope of the robot target is not correct • The storage type of the robot target is not correct
Solution	• Make sure the scope and the storage type are correct

The valid scope of robot target is:

Task: T_ROB1;

Scope: Global, Task and local

Storage type: Persistent and Variable

Work object can not be edited

Description	Can not edit the work object
Possible reason	• The scope of the work object is not correct • The storage type of the robot target is not correct
Solution	• Make sure the scope and the storage type are correct

The valid scope of the work object is:

Task: T_ROB1;

Scope: Global, Task

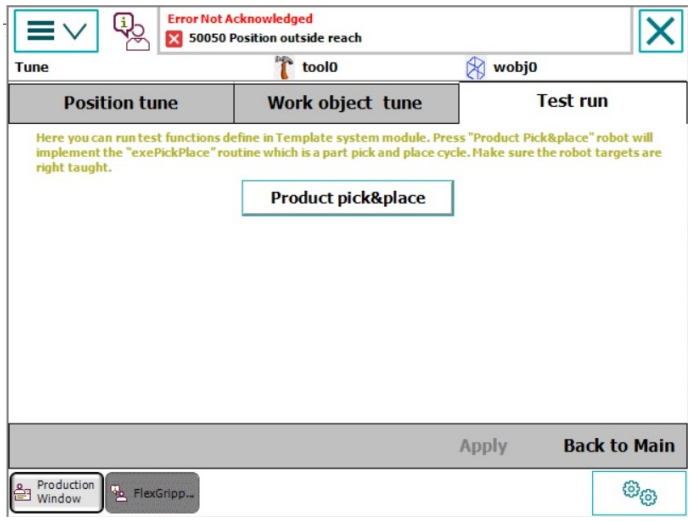
Continues on next page

Storage type: Persistent and Variable

FlexGripper UI icon can not be displayed on the ABB main menu of the FlexPendant

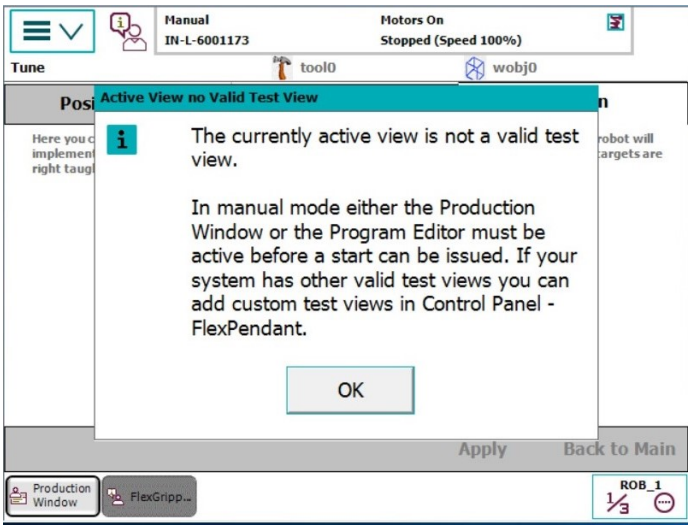
Description	Can not display FlexGripper UI icon on FlexPendant
Possible reason	• The FlexGripper UI FlexPendant application is installed incorrectly. • The FlexPendant Interface option is not selected when creating a robot system.
Solution	Check if the FlexGripper UI option is selected for the current system from ABB main menu->SystemInfo->SystemProperties->Additional Option on the FlexPendant. If the option is not displayed in the list, reinstall the TrueView application.

Position out of reach

Description	
Possible reason	Robot target position is out of reach of the robot.
Solution	Check and change the robot target position to a valid scope.

Continues on next page

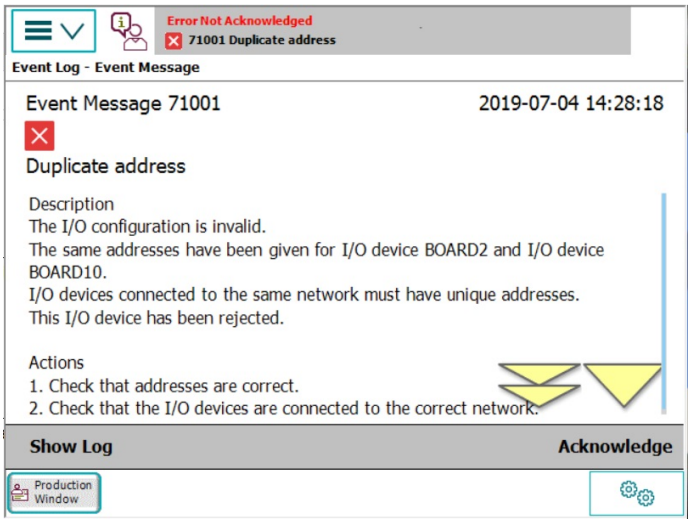
Active view no valid test view

Description	
Possible reason	The current test view is not a valid test view.
Solution	Enter Control panel->Flexpendant-> AdditionalTestView, check if the test view of the FlexGripper UI is selected.

Two many views

Description	When all the 6 places of the task bar are occupied by views, a warning message box will pop up when clicking on the GUI icon.
Possible reason	Too many views are opened at the same time.
Solution	Close one or more of the views not in use.

Duplicated address

Description	
Possible reason	Two I/O units with the same addresses are named with 'BOARD10'.
Solution	Enter Control panel->Configration-> Unit->BOARD10, edit the addresses name to BOARD11.

Continues on next page

	Before software installation, edit the content 'DN_Address 10' to 'DN_Address 11' in EIO_claw.cfg. For example, C:\Program Files\ABB Industrial IT\Robotics IT\MediaPool\MultiFlexGripperUI\Sys-par\Ver2.0_EIO\EIO_Claw.cfg.

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