Product manual

FlexPLP IRPLP 220

Product manual

FlexPLP IRPLP 220

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Original instructions.

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Overview

About this manual

This manual contains instructions for:

- the characteristics of the FlexPLP IRPLP 220
- mechanical and electrical installation instructions for the FlexPLP IRPLP 220
- maintenance instructions for the FlexPLP IRPLP 220
- spare parts

Usage

This manual should be used when working during:

- installation, from lifting the FlexPLP IRPLP 220 to its work site and securing it to the foundation, to making it ready for operation
- maintenance work
- repair work

Who should read this manual?

This manual is intended for:

- installation personnel
- maintenance personnel
- repair personnel.

Prerequisites

A maintenance/ repair/ installation personnel working with an ABB FlexPLP IRPLP 220 must:

- be trained by ABB and have the required knowledge of mechanical and electrical installation/repair/maintenance work.

Organization of chapters

The manual is organized in the following chapters:

Chapter	Content
Safety	Safety information that must be read through before performing any installation or service work on the FlexPLP IRPLP 220. Contains general safety aspects as well as more specific information about how to avoid personal injuries and damage to the product.
Product description	Specifications and characteristics of the FlexPLP IRPLP 220.
Unpacking and handling	Information relative to the steps following the reception of the FlexPLP IRPLP 220, until its installation.
Installation and commissioning	Required information about lifting and installation of the FlexPLP IRPLP 220 and installation of cabling.
Calibration	Information about calibration of the system.
Maintenance	Step-by-step procedures that describe how to perform maintenance of the FlexPLP IRPLP 220. Based on a maintenance schedule that may be used in the work of planning periodical maintenance.

Chapter	Content
Decommissioning	Environmental information about the FlexPLP IRPLP 220.
Reference information	Reference information may be useful for the understanding of this manual.
Spare parts	List of the spare parts available for the FlexPLP IRPLP 220.

References

Reference (ABB manuals)	Document ID
Product manual - IRC5	3HAC021313-001
Operating manual - Service Information System	3HAC050944-001
Application manual - Additional axes and stand alone controllers	3HAC051016-001
Operating manual - IRC5 with FlexPendant	3HAC050941-001
Technical reference manual - System parameters	3HAC050948-001
Technical reference manual - RAPID Instructions, Functions and Data types	3HAC050917-001

Revisions

Revision	Description
-	First edition.
A	The following updates are done in this revision: • Minor editorial changed. • Calibration point, without calibration index system removed. • Specification of rack & pinion updated. • Spare parts updated. • **Edit Motor Calibration Offset** added. • Number of the motions changed.
B	Changes made in: • FlexPLP addin is applied to improve the efficiency of calibration and setting offset procedures, see *Working with FlexPLP add-in on page 107*. • Deleted the stroke information, and add protection detail in *About FlexPLP IRPLP 220 on page 33*. • Changed the axis name of nominal payload in *Robustness on page 67*. • Added a contact strategy for customers, see *Workflow for FlexPLP add-in on page 108*. • Added material disposing symbol and related description in *Symbol on page 144*.
C	Changes made in: • Added warning about grease KLÜBER Microlube GB0.

Revision	Description
D	Changes made in: • Restructured the chapter describing the workflow for FlexPLP add-in. • Added the requirement of RobotWare version to perform soft calibration for axes configured with negative stroke direction. • Added the bellow version of the FlexPLP, which are equipped with bellows for dust prevention. • Added ambient temperature information. • Added centralized lubrication mode for both Ballscrew type and Rack & Pinion type.

Product documentation, IRC5

Categories for user documentation from ABB Robotics

The user documentation from ABB Robotics is divided into a number of categories.

This listing is based on the type of information in the documents, regardless of whether the products are standard or optional.

All documents listed can be ordered from ABB on a DVD. The documents listed are valid for IRC5 robot systems.

Product manuals

All hardware, manipulators and controllers will be delivered with a Product manual that contains:

- Safety information
- Installation and commissioning (description of mechanical installation, electrical connections)
- Maintenance (description of all required preventive maintenance procedures including intervals)
- Repair (description of all recommended repair procedures including spare parts)
- Additional procedures, if any (calibration, decommissioning)
- Reference information (article numbers for documentation referred to in Product manual, procedures, lists of tools, safety standards)
- Parts list.
- Foldouts or exploded views.
- Circuit diagrams (or references to circuit diagrams).

Technical reference manuals

The technical reference manuals describe the manipulator software in general and contain relevant reference information.

- **RAPID Overview**: An overview of the RAPID programming language.
- **RAPID Instructions**, **Functions and Data types**: Description of all RAPID instructions, functions and data types.
- **RAPID Kernel**: A formal description of the RAPID programming language.
- **System parameters**: Description of system parameters and configuration workflow.

Application manuals

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

An application manual generally contains information about:

- The purpose of the application (what it does and when it is useful)
- What is included (for example, cables, I/O boards, RAPID instructions, system parameters)

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• How to install included or required hardware.

• How to use the application

• Examples of how to use the application

Operating manuals

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

The group of manuals includes:

• **Emergency safety information**

• **General safety information**

• **Getting started, IRC5 and RobotStudio**

• **IRC5 with FlexPendant**

• **RobotStudio**

• **Introduction to RAPID**

• **Trouble shooting**, for the controller and manipulator.

How to read the product manual

Reading the procedures

The procedures contain references to figures, tools, material and so on. The references are read as described below.

References to figures

The procedures often include references to components or attachment points located on the device/controller. The components or attachment points are marked with italic text in the procedures and completed with a reference to the figure where the current component or attachment point is shown.

The denomination in the procedure for the component or attachment point corresponds to the denomination in the referenced figure.

The table below shows an example of a reference to a figure from a step in a procedure.

	Action	Note
8	Remove the rear attachment screws, gearbox.	Shown in the figure Location of gearbox *on page 136*.

Reference to required equipment

The procedures often include references to equipment (spare parts, tools, and so on.) required for the different actions in the procedure. The equipment is marked with italic text in the procedures and completed with a reference to the section where the equipment is listed with further information, i.e. article number, dimension.

The denomination in the procedure for the component or attachment point corresponds to the denomination in the referenced list.

The table below shows an example of a reference to a list of required equipment, from a step in a procedure.

	Action	Note
3	Fit a new sealing, 2 to the gearbox.	Art. no. is specified in *Required equipment on page 65*.

Safety information

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

For more information, see *Safety on page 13*.

1 Safety

1.1 Introduction

Overview

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

- general safety aspects, important to attend to before performing any service work on the device. These are applicable for all service work and are found in *General safety information on page 14*.

- specific safety information, pointed out in the procedure at the moment of the danger. 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 30*.

1.2 General safety information

1.2.1 Safety in the machine controller system

Validity and responsibility

The information does not cover how to design, install and operate a complete system, nor does it cover all peripheral equipment, which can influence the safety of the total 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 machine controller is installed.

The users of ABB industrial machine controllers 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 machine controller system are designed and installed correctly. Personnel working with machine controllers must be familiar with the operation and handling of the industrial machine controller, described in the applicable documents, e.g. User's Guide and Product Manual.

Connection of external safety devices

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

Limitation of liability

Any information given in this manual regarding safety, must not be construed as a warranty by ABB that the industrial machine controller 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 machine controller	Installation and commissioning
Change operating modes	Operating manual - IRC5 with FlexPendant	Operating modes
Restricting the working space	Product manual for the machine controller	Installation and commissioning
Safety information about the machine controller	Product manual for the machine controller	Safety

1.3 Safety risks

1.3.1 Safety risks during installation and service work

Overview

This section includes information of general safety risks to be considered when performing installation and service work on FlexPLP device.

General risks during installation and service

- The instructions in the Product Manual - Installation and Commissioning must always be followed.
- Emergency stop buttons must be positioned in easily accessible places so that the FlexPLP device 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 FlexPLP device must have the appropriate training for the FlexPLP device 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 FlexPLP device, the regulations applicable in the country concerned and the instructions of ABB Robotics must be complied with.

Non-voltage related risks

- Safety zones, which have to be crossed before admittance, must be set up in front of the FlexPLP's working space. Light beams or sensitive mats are suitable devices.
- Turntables or the like should be used to keep the operator out of the FlexPLP's working space.
- The axes are affected by the force of gravity when the brakes are released. In addition to the risk of being hit by moving FlexPLP parts, you run the risk of being crushed by the FlexPLP axes.
- When dismantling/assembling mechanical units, watch out for falling objects.
- Be aware of stored heat energy in the controller.
- Never use the FlexPLP device as a ladder, i.e. do not climb on the device or other part during service work. There is a serious risk of slipping because of the high temperature of the motors or oil spills that can occur on the device.

To be observed by the supplier of the complete system

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

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

Complete FlexPLP device

Safety risk	Description
Hot components! Removed parts may result in collapse of the device!	⚠ **CAUTION** Motors and gears are HOT after running the device! Touching the motors and gears may result in burns! ⚠ **WARNING** Take any necessary measures to ensure that the device does not collapse as parts are removed, e.g. secure the vertical axis with fixtures if removing driving belt of horizontal axes.

Cabling

Safety risk	Description
Cable packs are sensitive to mechanical damage!	⚠ **CAUTION** The cable packs are sensitive to mechanical damage! They must be handled with care, especially the connectors, in order to avoid damaging them!

Gearboxes and motors

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

1.3.2 Safety risks related to tools/workpieces

Safe handling

It must be possible to safely turn off tools. Make sure that guards remain closed until the tools turn off.

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

Safe design

End effectors must be designed so that they retain workpieces in the event of a power failure or a disturbance of the controller.

> ⚠ **CAUTION**
>
> Ensure that an end effectors is prevented from dropping a workpiece, if such is used.

1.3.3 Safety risks related to pneumatic/hydraulic systems

General

Special safety regulations apply to pneumatic and hydraulic systems.

Residual energy

- Residual energy may be present in these systems. After shutdown, particular care must be taken.
- The pressure in pneumatic and hydraulic systems must be released before starting to repair them.

Safe design

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

1.3.4 Safety risks during operational disturbances

General

- The FlexPLP device is a flexible tool which 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.

1.3.5 Risks associated with live electric parts

Voltage related risks, general

- Although troubleshooting may, on occasion, have to be carried out while the power supply is turned on, the FlexPLP device 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 FlexPLP device must be connected in such a way that it can be turned off outside the device's working space.

Voltage related risks, controller IRC5

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

- Be aware of stored electrical energy (DC link, Ultra Cap unit) in the controller.
- Units inside the controller, e.g. 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 (400-480 VAC and 700 VDC. Note: Capacitors!)
- The drive unit (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 tools, or special power supply units for the machining process.
- The external voltage connected to the control cabinet remains live even when the device is disconnected from the mains.
- Additional connections.

Voltage related risks, FlexPLP

A danger of high voltage is associated with the FlexPLP device 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, see chapter Installation and commissioning in the Product manual).

Voltage related risks, tools, material handling devices, and so on.

Tools, material handling devices, and so on may be live even if the FlexPLP control system is in the OFF position. Power supply cables which are in motion during the working process may be damaged.

1.4 Safety actions related to the FlexPLP

1.4.1 Safety fence dimensions

General

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

Dimensioning

Dimension the fence or enclosure to enable it to withstand the force created if the load being handled by the FlexPLP device is dropped or released at maximum speed. Determine the maximum speed from the maximum velocities of the FlexPLP device axes and from the position at which the FlexPLP device is working in the work cell (see *Technical data on page 39* and *Dimensions on page 42*).

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

1.4.2 Fire extinguishing

> **ℹ️ Note**
>
> Use a CARBON DIOXIDE (CO_2) extinguisher in the event of a fire in the FlexPLP device (or controller)!

1.4.3 Emergency release of the FlexPLP device axes

Description

In an emergency situation, any of the FlexPLP device axes may be released manually by pushing the brake release buttons on the device.

How to release the brakes is detailed in the FlexPLP IRPLP 220 product manual.

- The FlexPLP axes may be moved by using an crane or similar.

Increased injury

Before releasing the brakes, make sure that the weight of the axes do not increase the pressure on the trapped person, further increasing any injury!

1.4.4 Brake testing

When to test

During operation the holding brakes of each axis motor wear normally. A test may be performed to determine whether the brake can still perform its function.

How to test

The function of each axis' motor holding brakes may be checked as detailed below:

1   Run each FlexPLP axis to a position where the combined weight of the FlexPLP axes and any load is maximized (max. static load).

2   Switch the motor to the MOTORS OFF position with the Operating mode selector on the controller.

3   Check that the axis maintains its position.

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

1.4.5 Safe use of the Teach Pendant Unit

> **ℹ Note**
>
> The enabling device is a push button located on the side of the Teach Pendant Unit (TPU) which, when pressed halfway in, takes the system to MOTORS ON. When the enabling device is released or pushed all the way in, the device is taken to the MOTORS OFF state. To ensure safe use of the Teach Pendant Unit, the following must be implemented:
>
> - The enabling device must never be rendered inoperative in any way.
> - During programming and testing, the enabling device must be released as soon as there is no need for the FlexPLP device to move.
> - The programmer must always bring the Teach Pendant Unit with him/her, when entering the FlexPLP's working space. This is to prevent anyone else taking control of the FlexPLP device without the programmer knowing.
> - Do not change Transm. gear ratio or other kinematic parameters from the Teach Pendant Unit or a PC.

1.4.6 Work inside the FlexPLP's working range

> ⚠️ **WARNING**
>
> If work must be carried out within the FlexPLP's work envelope, the following points must be observed:
>
> - The operating mode selector on the controller must be in the manual mode position to render the enabling device operative and to block operation from a computer link or remote control panel.
> - The FlexPLP's speed is limited to max. 200 mm/s when the operating mode selector is in position < 200 mm/s. This should be the normal position when entering the working space. The position 100% "full speed" may only be used by trained personnel who are aware of the risks that this entails.
> - Pay attention to the moving axes of the device! Keep a distance to the axes. Also be aware of any danger that may be caused by tools or other devices mounted on the device or inside the cell.

1.4.7 Translate the information on safety and information labels

Labels on the product

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

Translation possibilities

The labels fitted to the product contain space for adding a fourth language underneath the three standard languages (English, German and French).

Add a local language to the label by:

- using a transparent sticker over the standard label with text added in a fourth language. Drawings detailing the design (text, figure, dimensions) of the standard labels can be ordered from ABB. Notice that each label is identified according to the article number located in the lower corner of the label.

Example of transparent sticker

The figure below shows the location of the free space on one of the labels on the device, where the fourth language can be added. The figure also shows a transparent sticker, containing the text in Swedish.
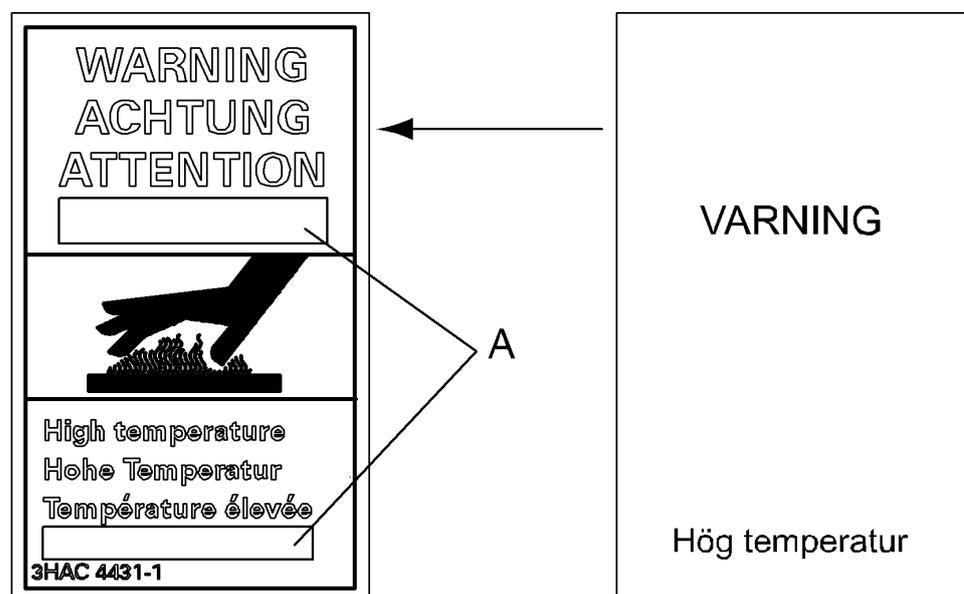
xx1800002104

A	Free space for adding a fourth language

1.5 Safety stops

1.5.1 What is an emergency stop?

Definition of emergency stop

An emergency stop is a state that overrides any other device control, disconnects drive power from the device motors, stops all moving parts, and disconnects power from any potentially dangerous functions controlled by the FlexPLP system.An emergency stop state means that all power is disconnected from the device except for the manual brake release circuits. You must perform a recovery procedure, i.e, resetting the emergency stop button and pressing the Motors On button, in order to return to normal operation.The FlexPLP system can be configured so that the emergency stop results in either:

- An uncontrolled stop, immediately stopping the device actions by disconnecting power from the motors.
- A controlled stop, stopping the device actions with power available to the motors so that the device path can be maintained. When completed, power is disconnected.

The default setting is uncontrolled stop. However, controlled stops are preferred since they minimize extra, unnecessary wear on the device and the actions needed to return the FlexPLP system back to production. Please consult your plant or cell documentation to see how your FlexPLP system is configured.

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

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

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

Classification of stops

The safety standards that regulates automation and equipment defines categories in which each type of stop applies:

If the stop is...	then it is classified as...
uncontrolled	category 0 (zero)
controlled	category 1

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Emergency stop devices

In a FlexPLP system there are several emergency stop devices that can be operated in order to achieve an emergency stop. There are emergency stop buttons available on the FlexPendant and on the controller cabinet (on the Control Module on a Dual Cabinet Controller).There can also be other types of emergency stops on your device, consult your plant or cell documentation to see how your FlexPLP system is configured.

1.6 Safety related instructions

1.6.1 Safety signals in the manual

Introduction to safety signals

This section specifies all dangers that may arise from performing the work detailed in the manual. Each danger is detailed in its own section consisting of:

- A caption specifying the danger level (DANGER, WARNING or CAUTION) and the type of danger.
- A brief description of what will happen if the operator/service personnel do not eliminate the danger.
- An instruction of how to eliminate the danger to facilitate performing the activity at hand.

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	The electrocution or electrical shock symbol indicates 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, and so on. 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)	The electrostatic discharge (ESD) symbol indicates electrostatic hazards which could result in severe damage to the product.

Continues on next page

Symbol	Designation	Significance
	MAGNETIC FIELDS	An intense and/or variable magnetic field can affect or damage certain electrical devices like cardiac pacemakers.
	NOTE	Note symbols alert you to important facts and conditions.
	TIP	Tip symbols direct you to specific instructions, where to find additional information or how to perform a certain operation in an easier way.

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2 Product description

2.1 About FlexPLP IRPLP 220

General

FlexPLP IRPLP 220 is a programmable linear positioner. It is a versatile tool designed for a wide range of industrial applications. In particular, it can be used as a programmable locator for a vehicle reference, to position a locating pin or a clamping unit.

FlexPLP IRPLP 220 is based on modularity design and must be installed on a device or tooling base. It constitutes of one or more linear axes by different combination of horizontal axis and vertical axis. For possible axis combination, see *Axis combinations on page 36*.

Operating system

FlexPLP IRPLP 220 functions with the IRC5 controller and FlexPLP control software RobotWare, which supports every aspect of the FlexPLP system, such as motion control, development and execution of application programs, communication, and so on.

See *Product specification - Controller IRC5 with FlexPendant*.

External wiring

FlexPLP IRPLP 220 uses cable chains to integrate an external electrical wiring and pneumatic tubes. It is easy for maintenance.

Terminology

The following table lists the terms most used in this manual.

Designation	Definition
Axis (or linear axis)	In this document, the term axis is often used to designate a linear axis, i.e., a mechanical unit that possesses a carriage describing movement along a straight line.
Ballscrew	The ballscrew is the mechanical component that transforms rotational movement from the motor into linear movement with little friction.The ballscrew mounted on FlexPLP IRPLP 220 are characterized by their stroke and their dimension D0 x P: 32 x 5. ((D0: nominal diameter; P: Lead)
Gearbox	The gearbox is the mechanical component that change the rotation speed of the motor to the needed rotation speed with little friction.
Carriage	The carriage is the mechanical component that travels along the axis. The carriage table can be used to support a linear axis or the customer equipment.
Control system	Controller such as IRC5.
Horizontal	Parallel to the horizon plane.
Mounting surface	Upper surface of one axis carriage, onto which another axis or a tooling can be mounted. Flange frame on both sides of single PLP unit can be used as mounting surface for clamping

2 Product description

Designation	Definition
SMB	The serial measurement board (SMB) primarily gathers resolver data from the motors. This data is used to measure the speed and position of each axis. It also stores a number of data pertaining to each unit.This data is used by the controller and can be transferred between the SMB and the controller. The serial measurement board is a necessary link between the controller and the PLP motors.
Travel length or Stroke	Maximum displacement of one carriage.
Servo Motor	A motor used for motion control in FlexPLP. A servo motor is paired with an resolver to provide position/speed feedback.
Floor plate	A solid, flat plate used as the main horizontal reference plane and to which the unit must be fastened.
Vertical	Positioned perpendicular to the horizon.
Workpiece	A part that is being worked on. It may be subject to handling, welding, or other operations.

2.2 Product structure

2.2.1 Modular structure

Modularity

FlexPLP IRPLP 220 is designed with high modularity in aspects of strokes, driving type, axis combination, vertical axis mounting method and cable chains direction.
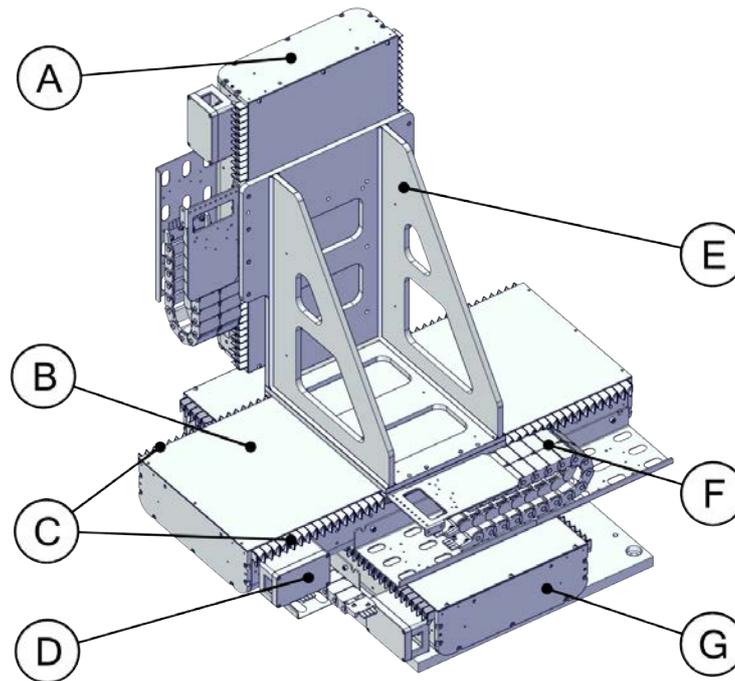
xx2100001833

Item	Description	Note
A	Vertical axis	The vertical axis can be mounted on: • fixed body and moving carriage. • moving body and fixed carriage.
B	Second horizontal axis	The second horizontal axis can only be equipped with the Ballscrew driving type.
C	Bellow	Bellows can be fixed to horizontal axes for dust prevention.
D	Connection box	Power and resolver cable connectors are inside. Each axis has a connection box installed.
E	Interface bracket	Used to assemble the vertical axis and guide cables.
F	Cable chain	External cable chains are used for axes of FlexPLP IRPLP220.
G	First horizontal axis	The first horizontal axis can be equipped with either driving type, Ballscrew or with Rack & Pinion. An axis with Rack & Pinion is made with two or more combined modules and can be used to carry one or several carriages, which can each travel up to 2,100 mm.

Continues on next page

2 Product description

Axis combinations

The following table lists the possible axis combination of FlexPLP IRPLP 220.

Combination	First horizontal axis 1	Second horizontal axis	Vertical axis
1	X [i]		
2			X
3	X	X	
4	X		X
5		X	X
6	X	X	X

[i] For the first horizontal axis, additional modules and carriages can be combined to extend stroke. Contact ABB if combined version is needed.
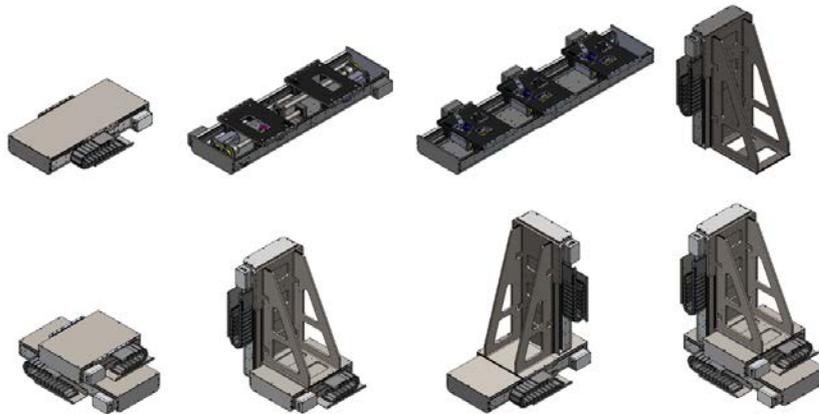
xx1800002107

2.2.2 Driving system types

Driving types

FlexPLP IRPLP 220 axis parts are almost the same except the driving system, which can be the Ballscrew type or Rack & Pinion type. The first horizontal axis can use either type of the driving system. The second horizontal axis and vertical axis only use the Ballscrew type.

The following figure shows the main characteristics of the horizontal axis with different driving system. Horizontal axis in either driving system can further equipped with bellows for dust prevention.
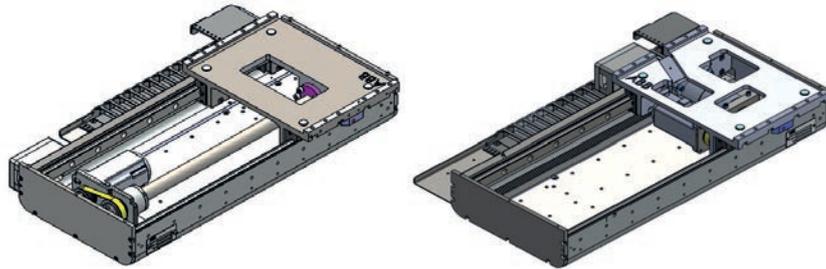
xx1800002108

2.2.3 Vertical axis mounting and cable chain

Vertical axis mounting

The vertical axis of FlexPLP IRPLP 220 axes has two mounting method: body moving or carriage moving. Both the carriage and base body of the axis can be mounted on the triangle bracket. The dimension for two mounting method are the same at lowest position. For body moving, there is an option of tooling flange plate for the top flange.
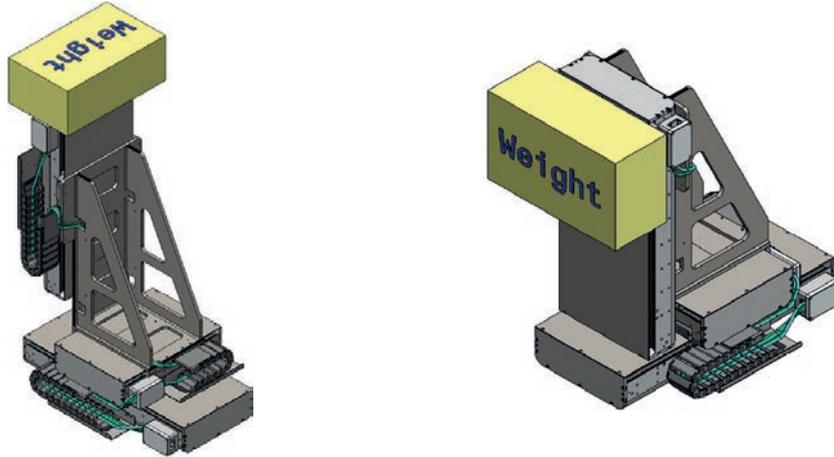
xx1800002109

Cable chain

The cable chain of FlexPLP IRPLP 220 axes can be mounted both on left and right side. If the connector is not moving, there is no need to assemble the cable chain. However, for the second horizontal axis and vertical axis, the mounting method of cable chain should consider the mounting position of the first horizontal axis cable chain for cables routing.
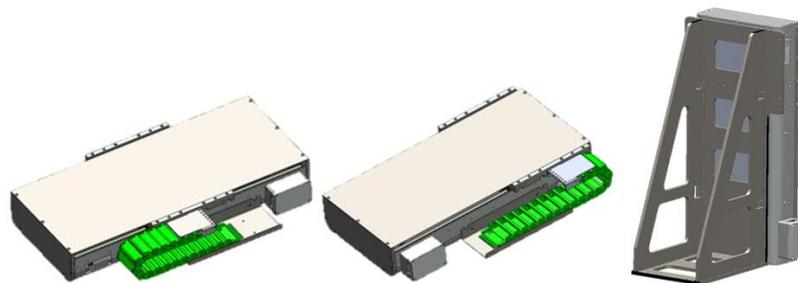
xx1800002110

2.3 Technical data

Stroke

Available stroke for carriages without bellows

The following table lists the available stokes of each axis in two driving types for carriages without bellows.

Rack & Pinion [i]	Ballscrew		
First horizontal axis [ii]	First horizontal axis	Second horizontal axis	Vertical axis
990 mm	190 mm	190 mm	190 mm
1,150 mm	270 mm	270 mm	270 mm
1,630 mm	350 mm	350 mm	350 mm
2,110 mm	430 mm	430 mm	430 mm
	510 mm	510 mm	510 mm
	590 mm	590 mm	
	670 mm		

[i] In option. Rack & Pinion driving type for first horizontal axis; up to 2,110 mm stroke for a single carriage.

[ii] Customizable with an increment step of 480 mm.

Available stroke for carriages with bellows

The following table lists the available stokes of each axis in two driving types for carriages without bellows.

Rack & Pinion	Ballscrew		
First horizontal axis	First horizontal axis	Second horizontal axis	Vertical axis
820 mm	130 mm	130 mm	130 mm
	200 mm	200 mm	200 mm
	270 mm	270 mm	270 mm
	340 mm	340 mm	340 mm
	410 mm	410 mm	410 mm
	480 mm	480 mm	
	550 mm		

The stroke of FlexPLP IRPLP 220 with bellows is shorten because there is a compressed length of the bellow. The following table lists the relationship between the axis stroke and the compressed bellow length.

Stroke with bellows	Length of compressed bellow (with safety distance, 5 mm at each end)
130 mm	35 mm
200 mm	40 mm
270 mm	45 mm
340 mm	50 mm

Continues on next page

2 Product description

Stroke with bellows	Length of compressed bellow (with safety distance, 5 mm at each end)
410 mm	55 mm
480 mm	60 mm
550 mm	65 mm
820 mm	90 mm

Performance

The table lists the overall specification of FlexPLP IRPLP 220.

Specification	Rack and Pinion type	Ballscrew Type		
	Horizontal axis	First horizontal axis	Second horizontal axis	Vertical axis
Repeatability	±0.025 mm [i]	±0.025 mm [i]	±0.025 mm [i]	±0.025 mm [i]
Maximum speed	200 mm/s	200 mm/s	200 mm/s	200 mm/s
Acceleration time	< 0.6 s	< 0.6 s	< 0.6 s	< 0.6 s
Static load	220 kg	220 kg	220 kg	220 kg
Dynamic load	220 kg	220 kg	220 kg	220 kg
Protection class	IP54	IP54	IP54	IP54

[i]   Per ISO9283.

Motor specifications

The Ballscrew type and Rack & Pinion type of FlexPLP IRPLP 220 are using the same servo motor.

The following table lists the specifications of the motor used on FlexPLP IRPLP 220:

Specification	Performance
Power	750 W
Nominal speed	3000 rpm
Voltage	400 V AC
Torque	2.39 Nm
Brake voltage	24 V
Brake torque	2.39 Nm

Weight

The weight of the complete mechanical unit depends on the configuration. Here under are the weight of each axis type and the total weight of each available combination of axis:

Axis type	Stroke without bellows (mm)	Stroke with bellows (mm)	Weight (kg)
Ballscrew	190 mm	130 mm	67 kg
	270 mm	200 mm	72 kg
	350 mm	270 mm	78 kg
	430 mm	340 mm	84 kg
	510 mm	410 mm	89 kg
	590 mm	480 mm	95 kg
	670 mm	550 mm	99 kg
Rack & Pinion	990 mm	820 mm	118 kg
	1,150 mm	NA	206 kg
	1,630 mm	NA	324 kg
	2,110 mm	NA	470 kg
Interface bracket	190 mm	130 mm	33 kg
	270 mm	200 mm	37 kg
	350 mm	270 mm	39 kg
	430 mm	340 mm	43 kg
	510 mm	410 mm	46 kg

Protection class

FlexPLP IRPLP 220 is rated IP54 for electrical components only.

Ambient temperature

Description	Standard/Option	Temperature
IRPLP 220 during operation	Standard	+5°C (41°F) -to +40°C (104°F)
IRPLP 220 during transportation and storage	Standard	-25°C (-13°F) to +55°C (131°F)
For short periods (not exceeding 24 hours)	Standard	Up to +70°C (158°F)

2.4 Dimensions

2.4.1 Dimensions 1-axis FlexPLP IRPLP 220

FlexPLP IRPLP 220 - one horizontal axis

The dimension of FlexPLP IRPLP 220 with one horizontal axis depends on its stroke.

Without bellows

The following figure shows the dimension of FlexPLP IRPLP 220 with one horizontal axis and without bellows.
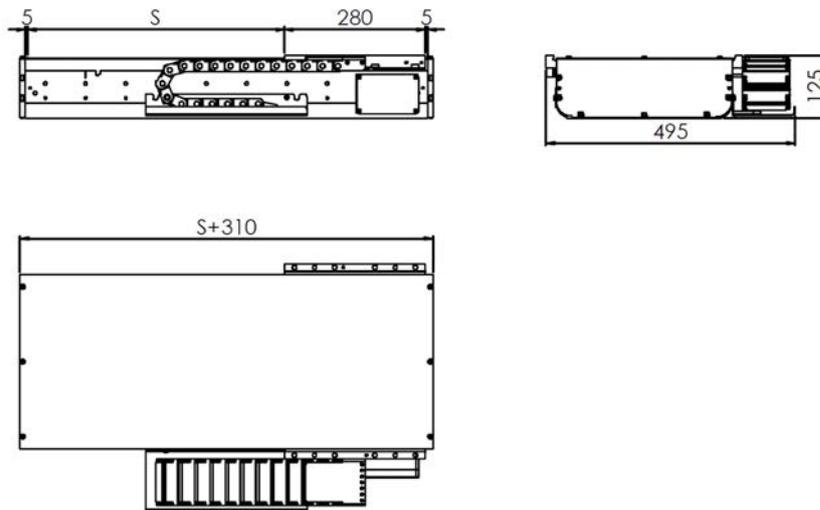
xx1800002111

S	Stroke
	For detailed stroke data, see *Available stroke for carriages without bellows on page 39*.

With bellows

The following figure shows the dimension of FlexPLP IRPLP 220 with one horizontal axis and with bellows.
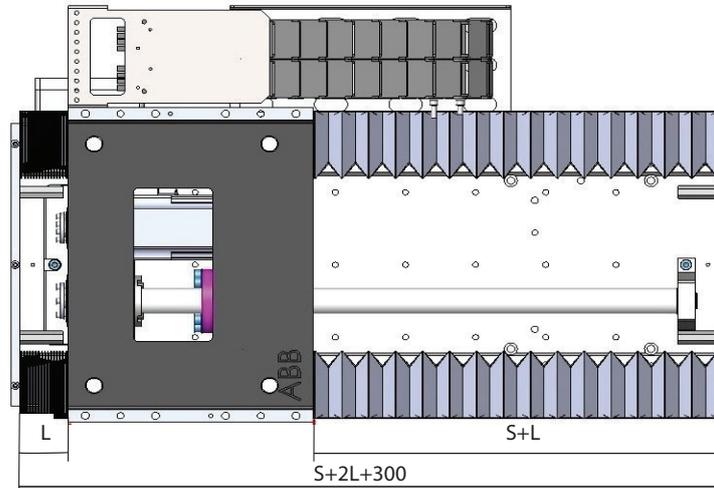
xx2100001632

S	Stroke
	For detailed stroke data, see *Available stroke for carriages with bellows on page 39*.
L	Length of compressed bellow, including safety distance (5 mm)
	For detailed relationship between compressed bellow length and stroke, see *Available stroke for carriages with bellows on page 39*.

FlexPLP IRPLP 220 - one vertical axis

The dimension of FlexPLP IRPLP 220 with one vertical axis depends on its stroke.

2 Product description

The dimensions of the vertical axis in two mounting methods, body moving or carriage moving, are the same when they are at low position.

Without bellows

The following figure shows the dimension of FlexPLP IRPLP 220 with one vertical axis in carriage moving and without bellows. The axis is at low position.

xx2100001682

S	Stroke
	For detailed stroke data, see *Available stroke for carriages without bellows on page 39*.

The following figure shows the dimension of FlexPLP IRPLP 220 with one vertical axis in body moving and without bellows. The axis is at low position.

*For top tooling flange frame, the height is S + 325

xx1800002113

S	Stroke
	For detailed stroke data, see *Available stroke for carriages without bellows on page 39*.

2 Product description

With bellows

The following figure shows the dimension of FlexPLP IRPLP 220 with one vertical axis in carriage moving and with bellows. The axis is at low position.

xx2100001683

S	Stroke
	For detailed stroke data, see *Available stroke for carriages with bellows on page 39*.
L	Length of compressed bellow, including safety distance (5 mm)
	For detailed relationship between compressed bellow length and stroke, see *Available stroke for carriages with bellows on page 39*.

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The following figure shows the dimension of FlexPLP IRPLP 220 with one vertical axis in body moving and with bellows. The axis is at low position.

*For top tooling flange frame, the height is S+2L+315

xx2100001684

S	Stroke
	For detailed stroke data, see *Available stroke for carriages with bellows on page 39*.
L	Length of compressed bellow, including safety distance (5 mm)
	For detailed relationship between compressed bellow length and stroke, see *Available stroke for carriages with bellows on page 39*.

2 Product description

2.4.2 Dimensions 2-axis FlexPLP IRPLP 220

FlexPLP IRPLP 220 - two horizontal axes

The dimensions of FlexPLP IRPLP 220 depend on its strokes of axes.

Without bellows

The following figure shows the dimension of FlexPLP IRPLP 220 with two horizontal axes and without bellows.
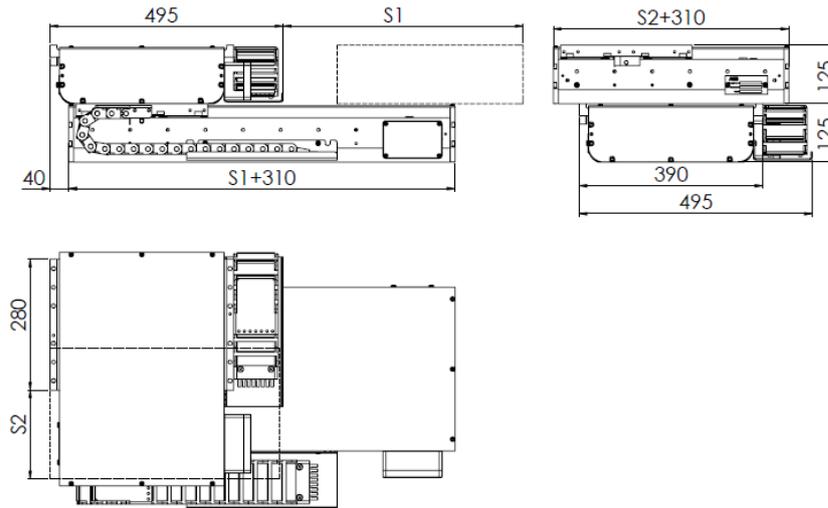
xx1800002114

S1	Stroke of horizontal axis 1
	For detailed stroke data, see *Available stroke for carriages without bellows on page 39*.
S2	Stroke of horizontal axis 2
	For detailed stroke data, see *Available stroke for carriages without bellows on page 39*.

Continues on next page

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With bellows

The following figure shows the dimension of FlexPLP IRPLP 220 with two horizontal axes and with bellows.
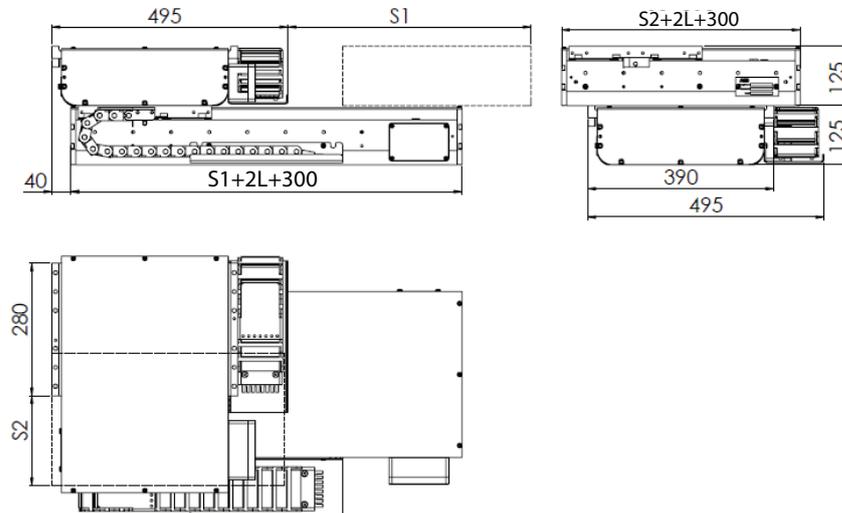
xx2100001819

S1	Stroke of horizontal axis 1
	For detailed stroke data, see *Available stroke for carriages with bellows on page 39*.
S2	Stroke of horizontal axis 2
	For detailed stroke data, see *Available stroke for carriages with bellows on page 39*.
L	Length of compressed bellow, including safety distance (5 mm)
	For detailed relationship between compressed bellow length and stroke, see *Available stroke for carriages with bellows on page 39*.

FlexPLP IRPLP 220 - one horizontal and one vertical axis

The dimensions of FlexPLP IRPLP 220 unit depend on its axes strokes.

2 Product description

2.4.2 Dimensions 2-axis FlexPLP IRPLP 220
Continued

The dimensions of the vertical axis in two mounting methods, body moving or carriage moving, are the same when they are at low position.

Without bellows

The following figure shows the dimension of FlexPLP IRPLP 220 with two axes, one horizontal and one vertical, in carriage moving and without bellows. The axis is at low position.
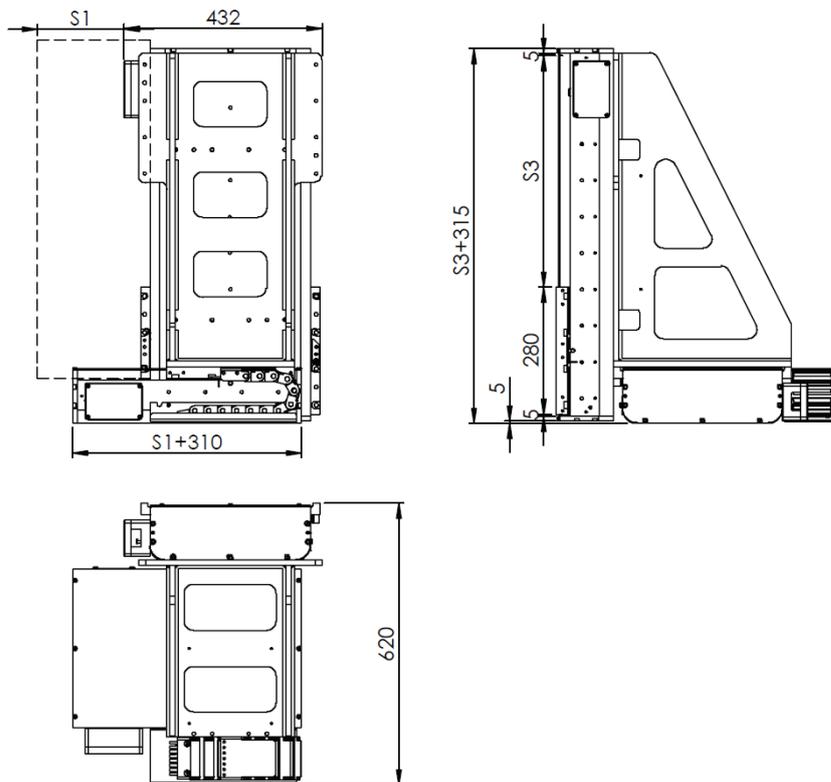
xx2100001820

S1	Stroke of horizontal axis
	For detailed stroke data, see *Available stroke for carriages without bellows on page 39*.
S3	Stroke of vertical axis
	For detailed stroke data, see *Available stroke for carriages without bellows on page 39*.

Continues on next page

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The following figure shows the dimension of FlexPLP IRPLP 220 with two axes, one horizontal and one vertical, in body moving and without bellows. The axis is at low position.

*For top tooling flange frame, the height is S3 + 325

xx1800002116

S1	Stroke of horizontal axis
	For detailed stroke data, see *Available stroke for carriages without bellows on page 39*.
S3	Stroke of vertical axis
	For detailed stroke data, see *Available stroke for carriages without bellows on page 39*.

2 Product description

With bellows

The following figure shows the dimension of FlexPLP IRPLP 220 with two axes, one horizontal and one vertical, in carriage moving and with bellows. The axis is at low position.

xx2100001821

S1	Stroke of horizontal axis
	For detailed stroke data, see *Available stroke for carriages with bellows on page 39*.
S3	Stroke of vertical axis
	For detailed stroke data, see *Available stroke for carriages with bellows on page 39*.
L	Length of compressed bellow, including safety distance (5 mm)
	For detailed relationship between compressed bellow length and stroke, see *Available stroke for carriages with bellows on page 39*.

The following figure shows the dimension of FlexPLP IRPLP 220 with two axes, one horizontal and one vertical, in body moving and with bellows. The axis is at low position.

*For top tooling flange frame,
the height is S3+2L+315

xx2100001822

S1	Stroke of horizontal axis
	For detailed stroke data, see *Available stroke for carriages with bellows on page 39*.
S3	Stroke of vertical axis
	For detailed stroke data, see *Available stroke for carriages with bellows on page 39*.
L	Length of compressed bellow, including safety distance (5 mm)
	For detailed relationship between compressed bellow length and stroke, see *Available stroke for carriages with bellows on page 39*.

2.4.3 Dimensions 3-axis FlexPLP IRPLP 220

FlexPLP IRPLP 220 - three axes

The dimensions of FlexPLP IRPLP 220 unit depend on its axes strokes.

The dimensions of the vertical axis in two mounting methods, body moving or carriage moving, are the same when they are at low position.

Without bellows

The following figure shows the dimension of FlexPLP IRPLP 220 with three axes in carriage moving and without bellows. The axis is at low position.
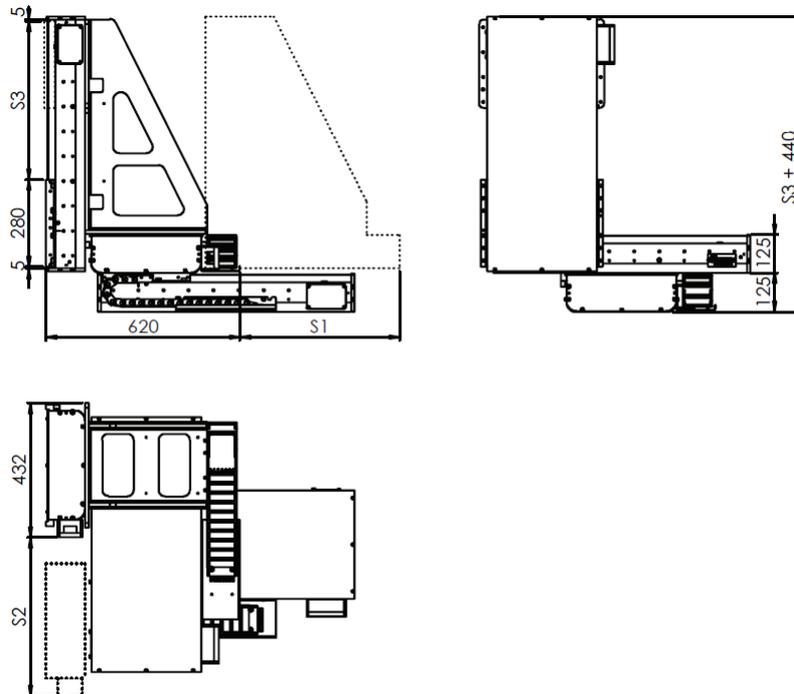
xx2100001827

S1	Stroke of horizontal axis For detailed stroke data, see *Available stroke for carriages without bellows on page 39*.
S3	Stroke of vertical axis For detailed stroke data, see *Available stroke for carriages without bellows on page 39*.

Continues on next page

The following figure shows the dimension of FlexPLP IRPLP 220 with three axes in body moving and without bellows. The axis is at low position.

*For top tooling flange frame, the height is S3 + 450
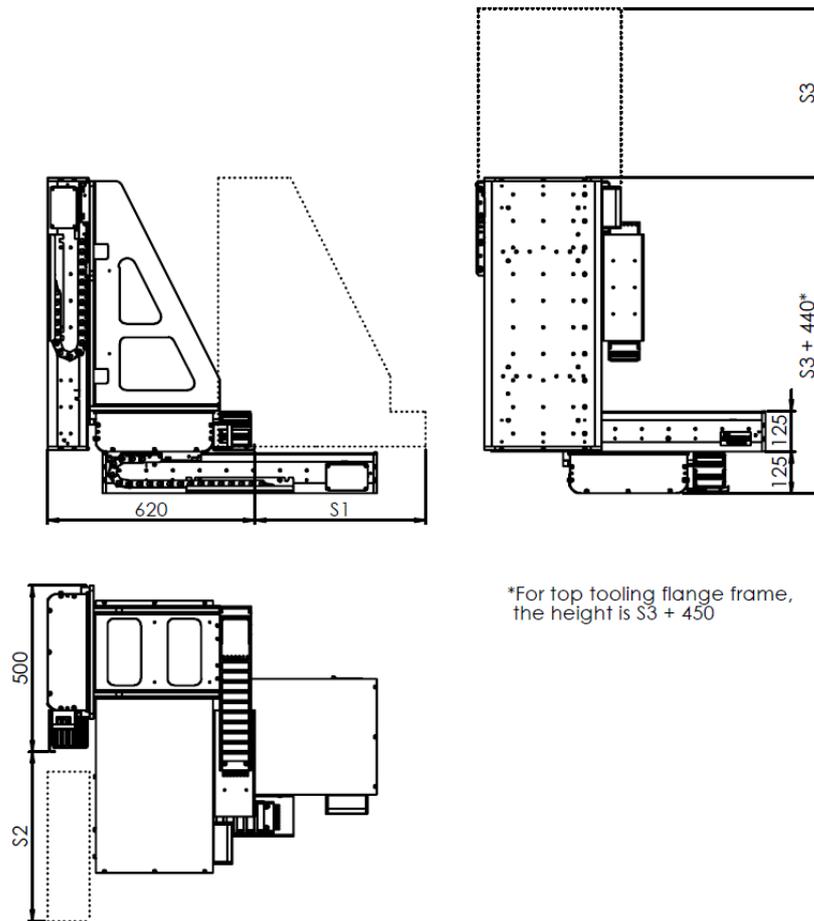
xx1800002118

S1	Stroke of horizontal axis 1
	For detailed stroke data, see *Available stroke for carriages without bellows on page 39*.
S2	Stroke of horizontal axis 2
	For detailed stroke data, see *Available stroke for carriages without bellows on page 39*.
S3	Stroke of vertical axis
	For detailed stroke data, see *Available stroke for carriages without bellows on page 39*.

2.4.3 Dimensions 3-axis FlexPLP IRPLP 220
Continued

With bellows

The following figure shows the dimension of FlexPLP IRPLP 220 with three axes in carriage moving and without bellows. The axis is at low position.
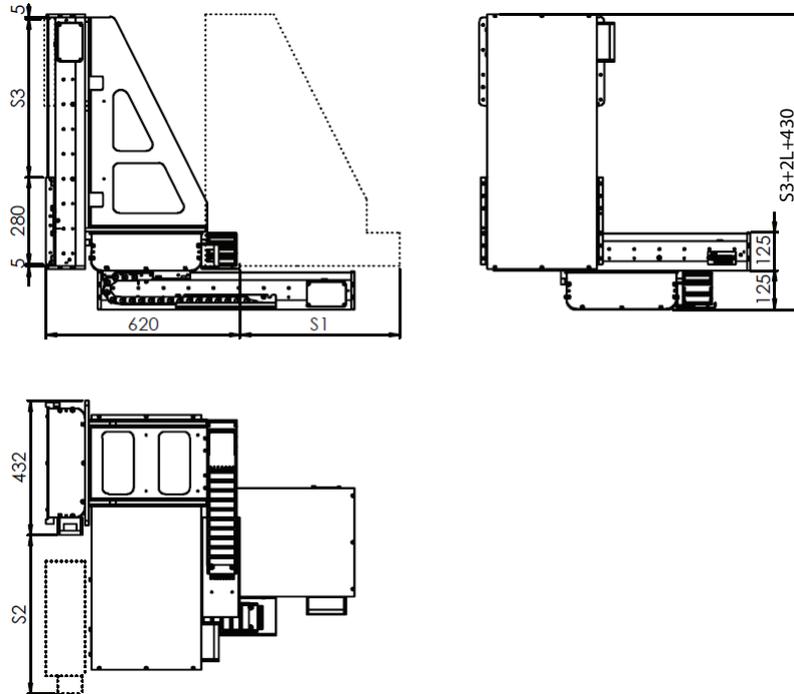
xx2100001828

S1	Stroke of horizontal axis 1
	For detailed stroke data, see *Available stroke for carriages with bellows on page 39*.
S2	Stroke of horizontal axis 2
	For detailed stroke data, see *Available stroke for carriages with bellows on page 39*.
S3	Stroke of vertical axis
	For detailed stroke data, see *Available stroke for carriages with bellows on page 39*.
L	Length of compressed bellow, including safety distance (5 mm)
	For detailed relationship between compressed bellow length and stroke, see *Available stroke for carriages with bellows on page 39*.

The following figure shows the dimension of FlexPLP IRPLP 220 with three axes in body moving and without bellows. The axis is at low position.

*For top tooling flange farme,
 the height is S3+2L+440

xx2100001829

S1	Stroke of horizontal axis 1
	For detailed stroke data, see *Available stroke for carriages with bellows on page 39*.
S2	Stroke of horizontal axis 2
	For detailed stroke data, see *Available stroke for carriages with bellows on page 39*.
S3	Stroke of vertical axis
	For detailed stroke data, see *Available stroke for carriages with bellows on page 39*.
L	Length of compressed bellow, including safety distance (5 mm)
	For detailed relationship between compressed bellow length and stroke, see *Available stroke for carriages with bellows on page 39*.

3 Unpacking and handling

3.1 Pre-requisites for reception

Pre-requisites

The check-list below details what must be observed before proceeding with the unpacking and/or installation of the FlexPLP:

	Action	Note
1	Make sure that only qualified installation person-nel conforming to all national and local codes are allowed to perform the installation.	
2	Make sure that FlexPLP has not been damaged, by visual inspection.	Specified in *Unpacking and accept-ance on page 60*.
3	Make sure that the lifting device to be used is di-mensioned to handle the weight of FlexPLP.	Specified in *Weight on page 41*.
4	When these prerequisites have been met, FlexPLP may be taken to its storage or installation site.	

3.2 Unpacking and acceptance

> 💡 **Tip**
>
> Before unpacking the unit, quickly check that the package is not damaged, and that the goods are as ordered.

Contents

The content of the delivery package should be detailed on the delivery note.

A standard delivery package generally contains (not including options):

- FlexPLP
- The SMB box(es) and the cables

Inspection

FlexPLP is wrapped in a protective bag. Unpack it and check for any visible transport damage. If FlexPLP is damaged, stop unpacking and contact ABB.

Make sure that all parts of the packing list have been delivered.

Cleaning

If the unit seems to have been contaminated by impurities during the transport, clean them with a clean lint-free cloth.

Identification plate

To identify the delivery, read the identification plates and compare them to the delivery note. There is one identification plate per axis, which displays the axis assembly drawing number, the serial number, and the weight.

The serial number is an alpha-numerical combination of the following types:

IRPLP220X0000 - 00 for the first horizontal axes, IRPLP220Y0000 - 00 for the second horizontal axes, and IRPLP220Z0000 - 00 for the vertical axis.

When FlexPLP IRPLP 220 has more than one axis, the digits are identical on all plates.

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The plates can be found on the sides of FlexPLP IRPLP 220:
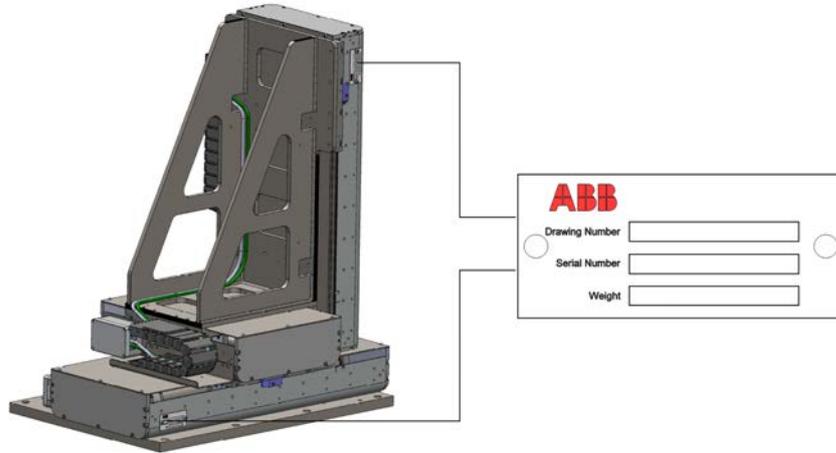
xx1800002119

3.3 Handling/lifting

Safety

> ⚠️ **CAUTION**
>
> Before lifting FlexPLP, read through the safety instructions carefully.

Handling equipment for FlexPLP

No.	Equipment for horizontal axis	Equipment for vertical axis
1	4 pcs Eye-bolts with M8 thread hole xx1800002120	4 pcs Eye-bolts with M8 thread xx1800002121
2	M8 x 25 screw	M8 nuts
3	Lifting straps rated for a minimum of 400 kg	Lifting straps rated for a minimum of 400 kg

> ⚠️ **CAUTION**
>
> Only use straps for lifting FlexPLP. Chains could damage FlexPLP.

Lifting the FlexPLP

Use lifting straps to lift FlexPLP with vertical axis by lifting the interface bracket.

Tighten the eye bolts (A) to the unit as shown on the following picture:
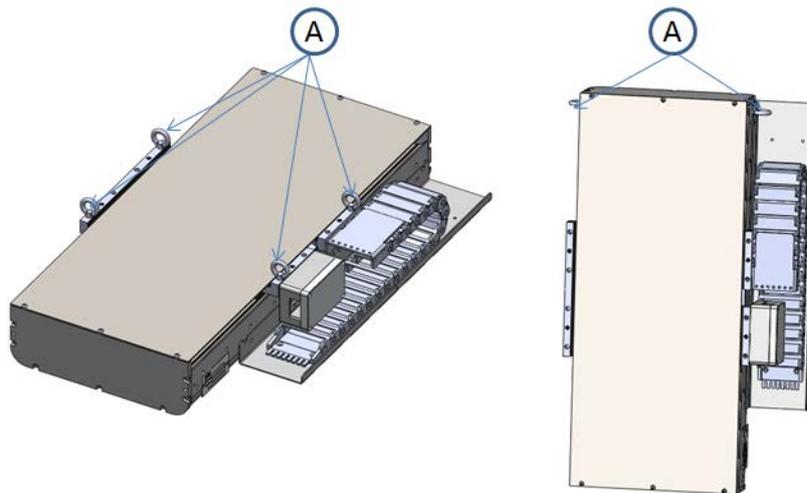
xx1800002122

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For the dimensions and lifting weight, please refer to *Dimensions on page 42* and *Weight on page 41*.

> **ℹ️ Note**
>
> Before lifting FlexPLP IRPLP 220, the carriages of the horizontal axis must be at mid-stroke and the vertical axis must be in low position.

Lifting the Interface bracket

Use lifting straps to lift the interface bracket.

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4 Installation and commissioning

4.1 Introduction

Safety information

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

Read *Safety on page 13* before performing any service work.

Required equipment

Equipment	Note
Handling equipment	Specified in *Handling/lifting on page 62*.
Standard toolkit	Specified in *Standard toolkit on page 150*.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	Specified in *Special tools on page 151*.

Bolts and screws and tightening torques

Specified in *Bolt, screws, tightening torques on page 149*.

4 Installation and commissioning

4.2 Mechanical installation

4.2.1 Introduction

Overview

The FlexPLP IRPLP 220 can be mounted on a floor plate, a tooling frame or another FlexPLP IRPLP 220. The following picture shows the mounting surfaces.
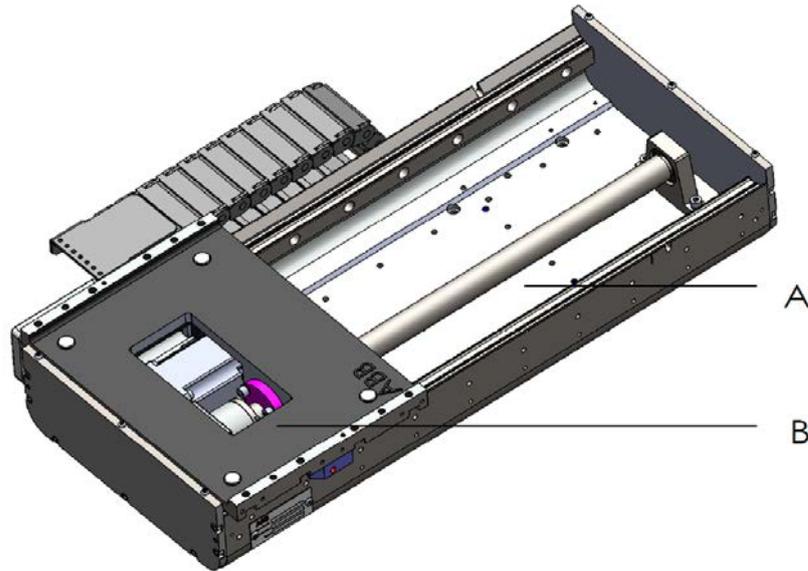
xx1800002123

Item	Name	Description
A	Base body	The base body can be installed on a floor plate, a tooling frame or another FlexPLP IRPLP 220.
B	Mounting surface of FlexPLP IRPLP 220 carriage	Tools, fixtures or another FlexPLP IRPLP 220 axis can be mounted on it.

> **ℹ Note**
>
> FlexPLP IRPLP 220 must be mounted on a machined flat surface.
>
> Carefully check the work area of FlexPLP IRPLP 220 before setting the system into service. Make sure that the area is free of all personnel when the unit moves. Also check that no object is located on the cover plates of FlexPLP IRPLP 220.

> **⚠ WARNING**
>
> Cables and pipes must not be in contact with moving parts.

4.2.2 Mounting surface (fastening of the FlexPLP IRPLP 220 to the floor plate)

Inclination

If FlexPLP IRPLP 220 is mounted on a base plate, the base plate would be mounted horizontally on the ground.

Robustness

The FlexPLP IRPLP 220 must be secured on a mounting surface that is sized to withstand the static loads resulting from the weight of the equipment and the dynamic loads generated by the movements of the carriages and the weight carried.

The table below lists the maximum static loads generated by a FlexPLP IRPLP 220 at nominal payload:

	First horizontal axis	Second horizontal axis	Vertical axis
Load	600 kg	500 kg	220 kg

Holes configuration

The figures below show the countersunk and dowel holes prepared in the base body of the horizontal axis.The unit must be secured with socket head hex screws M8 (DIN 7984) and two 8 mm dowel pins.

The table below gives the detail numbers of holes and dimensions depending on the strokes.

Stroke without bellows (mm)	Stroke with bellows (mm)	Body length L0 (mm)	Pin holes distance L (mm)	Number of countersunk holes	N x M (No. x mm)
190 mm	130 mm	480 mm	240 mm	8	1x80 mm
270 mm	200 mm	560 mm	320 mm	8	1x80 mm
350 mm	270 mm	640 mm	320 mm	8	1x160 mm
430 mm	340 mm	720 mm	400 mm	8	1x160 mm
510 mm	410 mm	800 mm	480 mm	8	1x160 mm
590 mm	480 mm	880 mm	560 mm	8	1x160 mm
670 mm	550 mm	960 mm	640 mm	12	2x160 mm
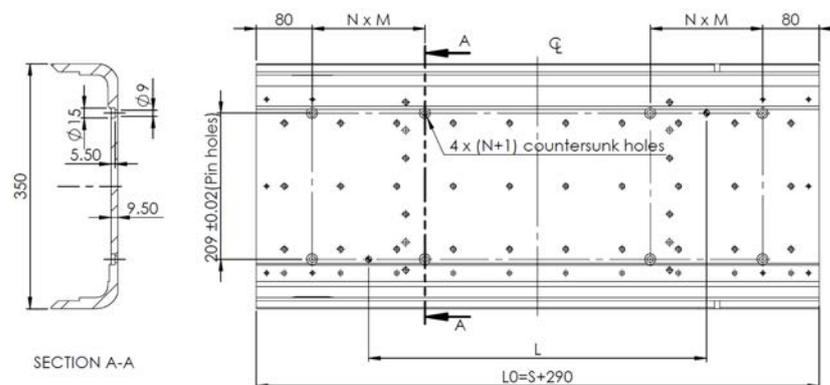
xx1800002124

4.2.2 Mounting surface (fastening of the FlexPLP IRPLP 220 to the floor plate)
Continued

Floor plate

The FlexPLP IRPLP 220 must be secured on a floor plate or a tooling frame. ABB provide the option of standard floor plate. With the standard floor plate, it is convenient for replacement of a whole FlexPLP IRPLP 220 unit. Contact ABB if a floor plate is needed.
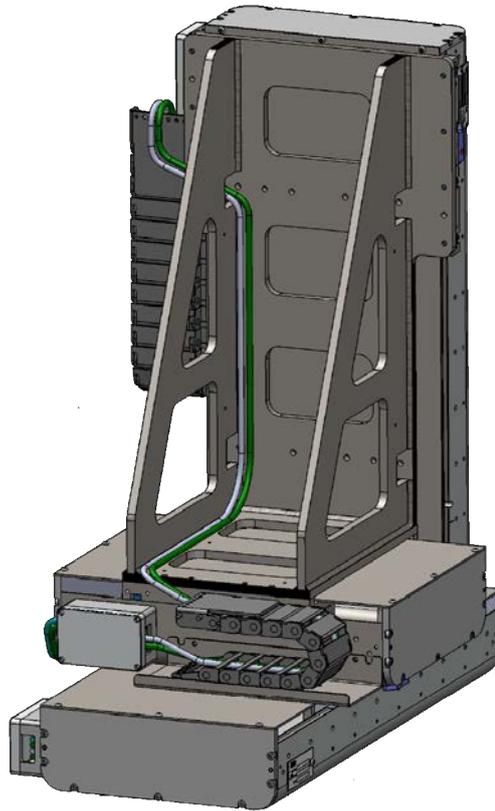
xx1800002125

The table below gives the detailed numbers of holes and dimensions depending on the strokes. For more information about the extra stroke of Rack and Pinion type, contact ABB.

Stroke without bellows (mm)	Stroke with bellows (mm)	Length L0 (mm)	Length L (mm)	Length L1 (mm)	Length L2 (mm)	No. of Ø20 holes	N x M (No. x mm)
190 mm	130 mm	470 mm	240 mm	200 mm	0 mm	6	1x80 mm
270 mm	200 mm	550 mm	320 mm	240 mm	0 mm	6	1x80 mm
350 mm	270 mm	630 mm	320 mm	280 mm	0 mm	6	1x160 mm
430 mm	340 mm	710 mm	400 mm	200 mm	240 mm	8	1x160 mm
510 mm	410 mm	790 mm	480 mm	240 mm	240 mm	8	1x160 mm
590 mm	480 mm	870 mm	560 mm	280 mm	240 mm	8	1x160 mm
670 mm	550 mm	950 mm	640 mm	280 mm	320 mm	8	2x160 mm

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4.2.2 Mounting surface (fastening of the FlexPLP IRPLP 220 to the floor plate)
Continued

The figure below shows the dimensions of the floor plate.
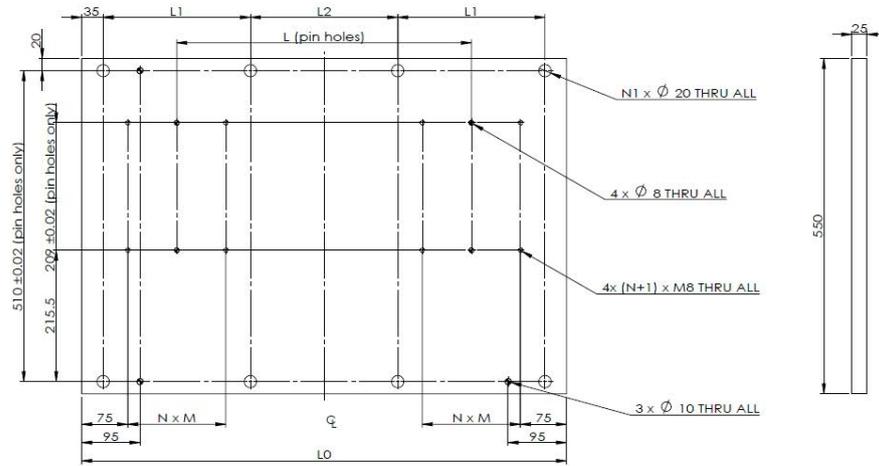
xx1800002126

4.2.3 Mounting surfaces (fastening of an axis or customer equipment)

Mounting surfaces

For all axes have the same structure, the mounting surface of the horizontal and vertical axis carriages are the same. It includes eight Ø9 through holes and four Ø8H7 through holes for the fastening of another axis or the customer equipment.
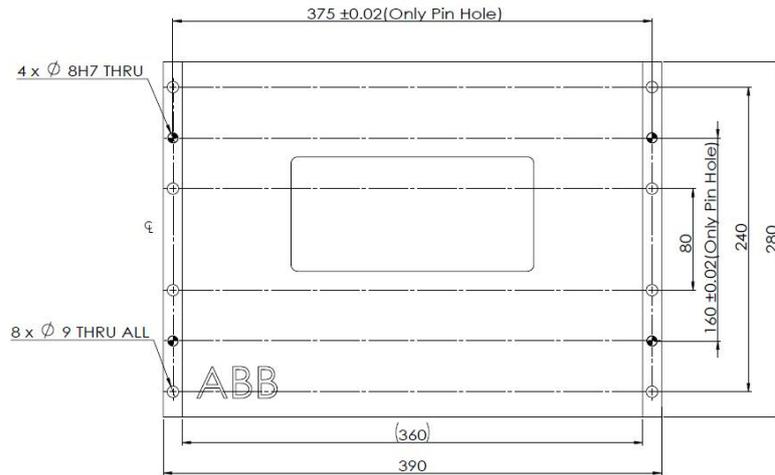
xx1800002127

For vertical axis, the mounting surface for customer equipment has another option where the payload is mounted on the flange. The flange includes an area (the shadowed area in the figure below) where the holes can be drilled according to the customer requirements.
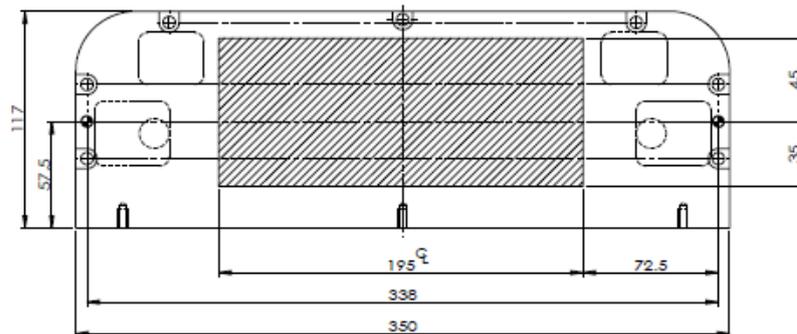
xx1800002128

4.2.4 Jogging axes of a unit with FlexPendant

Jogging properties

To jog is to manually position or move axes using the FlexPendant. It is possible to jog the axes under the following conditions:

- The system has been started.
- No programmed operation is running.
- The system is in Manual mode.
- The enabling device is pressed and the system is in Motors On state.

Any change you make to jogging properties only affects the currently selected mechanical unit. All jogging properties are saved and restored when you return to jog that mechanical unit.

For details, please refer to *Operating manual - IRC5 with FlexPendant* 3HAC050941-001

Select mechanical unit

If the system has more than one unit or additional axes, then it is needed to select which mechanical unit to jog when using the joystick. Each mechanical unit that can be jogged is represented in the mechanical units list. The name of the unit is defined in the system configuration. Each unit also has a symbol that is used in the Status bar.

There are three ways to select mechanical unit.

- Using the Quickset menu Mechanical unit.

On the Quickset menu, tap Mechanical unit, then tap to select a mechanical unit.
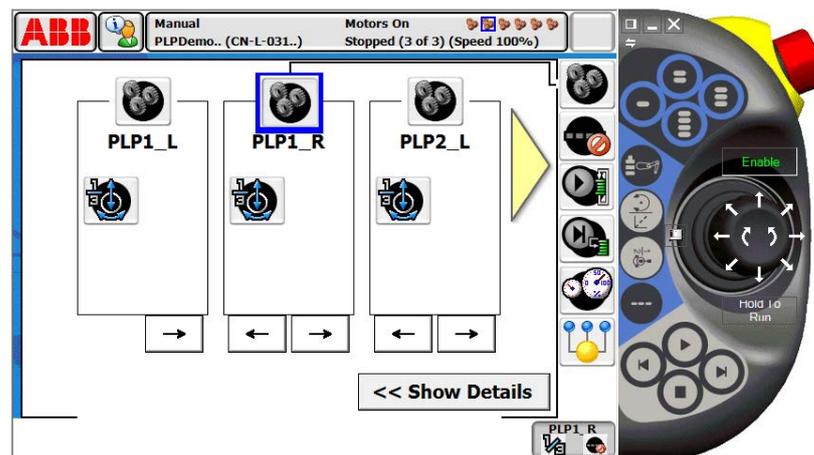
xx1800002129

A	Mechanical unit menu button
B	Mechanical unit, a selected unit is highlighted

- Using the Select mechanical unit button.

Continues on next page

Press the Select mechanical unit button to change unit. One press on the button changes to the next mechanical unit, as steps in a cycle.

xx1800002130

- Using the Jogging window on the ABB menu.

On the ABB menu, tap Jogging. Then tap Mechanical unit.Tap the mechanical unit to be jogged, and then tap OK.

The selected mechanical unit is active until you select another unit, even if you close the Jogging window.
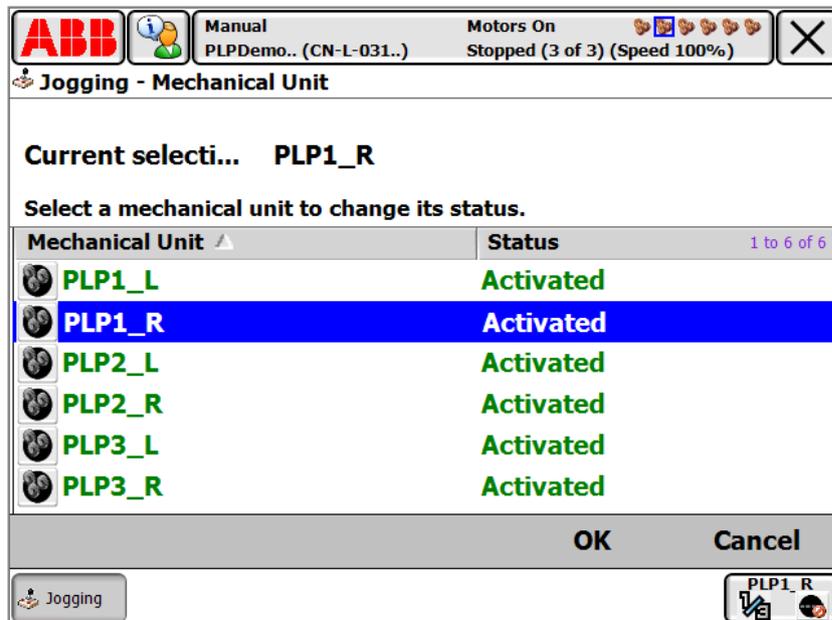
xx1800002131

Jog axis by axis

Jog the linear axis by Joystick, notice the Joystick Directions.

The Joystick Directions area shows how joystick axes correspond to the selected coordinate system's axes. The all axes of PLP can be jogged manually using the

Continues on next page

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joystick. Please check your plant or product documentation to determine the movement patterns for each axis.

```
┌─ Position ──────────────────┐
│                             │
│  1:          0.3  mm        │
│  2:          0.0  mm        │
│  3:          1.5  mm        │
│                             │
│                             │
│     ┌─────────────────┐     │
│     │  Position Format... │   │
│     └─────────────────┘     │
│                             │
└─────────────────────────────┘
┌─ Joystick directions ───────┐
│        ⊕   ⊕→   ⊕↻          │
│                             │
│        2   1   3            │
└─────────────────────────────┘
```
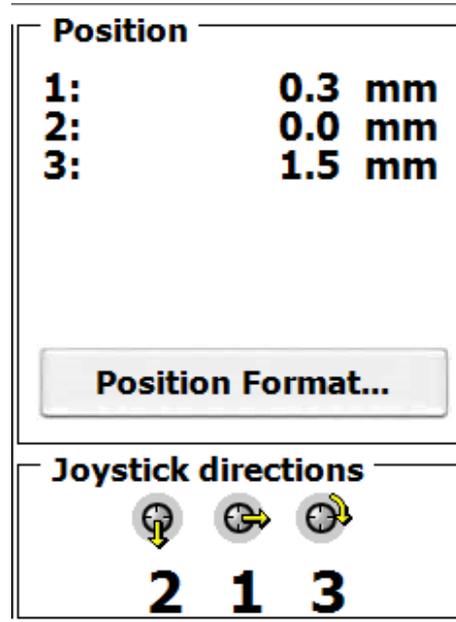
xx1800002132

Incremental movement for precise positioning

Use incremental movement to jog the unit in small steps, which enables precise positioning.

This means that each time the joystick is deflected, the device moves one step (increment). If the joystick is deflected for one or more seconds, a sequence of steps, (at a rate of 10 steps per second), will be performed as long as the joystick is deflected.

In default mode, no increment applies and the axis moves continuously when the joystick is deflected.

There are three ways to select the increment size.

- Using the Quickset menu increments.

On the Quickset menu, tap Mechanical unit, then tap to select a mechanical unit.
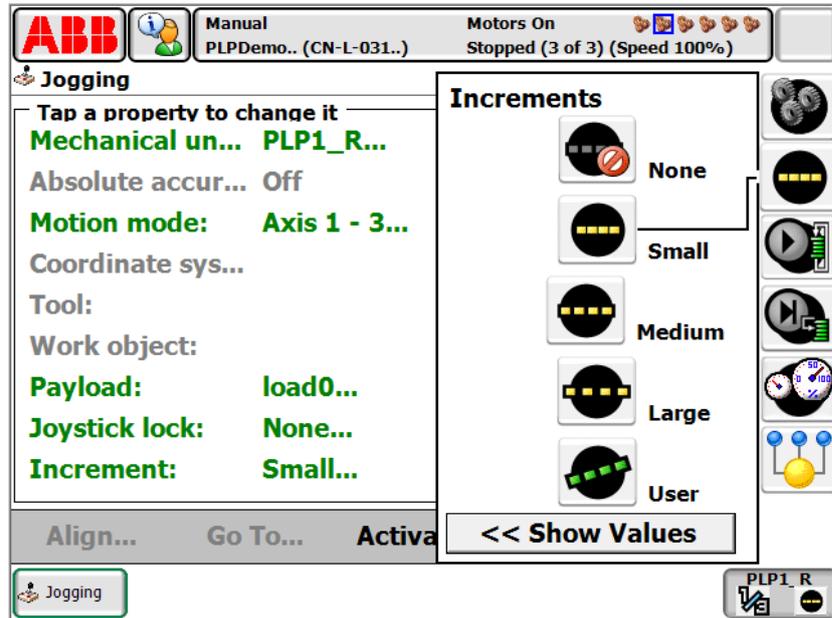
xx1800002133

- Using the Toggle increments button.

Press the Toggle increments button to switch increment size, toggle between no increments and the increment size you previously selected in the Jogging window.

xx1800002134

Using the Jogging window on the ABB menu.

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One the ABB menu, tap Jogging. Then tap Increment.Tap the desired increment mode, and then tap OK.
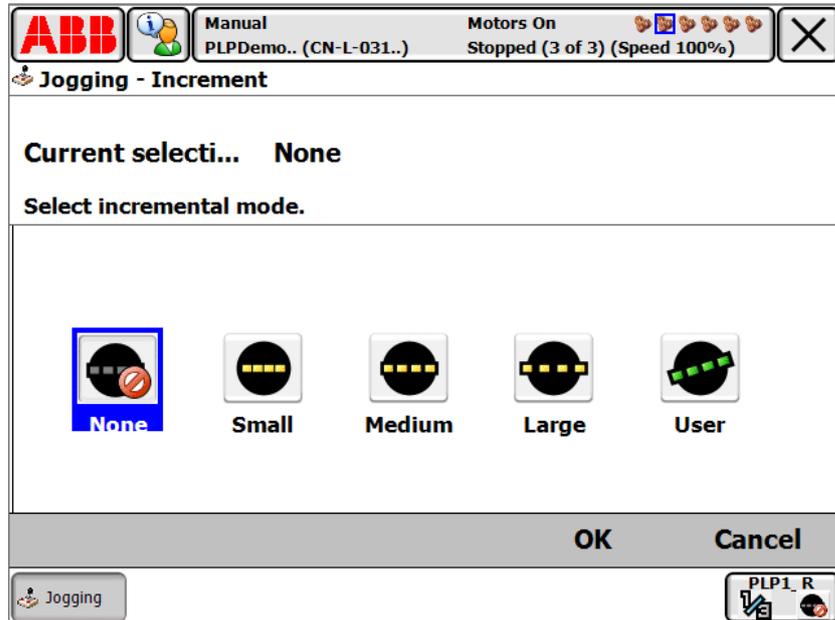
xx1800002135

Choose between small, medium or large increments. You can also define your own increment movement sizes.

4.2.5 Fastening of a unit to the floor plate

Equipment

The required equipment is the standard toolkit, and in particular:

1	Hex keys (Allen keys) 3 and 6 (socket wrenches recommended)
2	Torque wrench used with socket head cap 6 mm. See *Bolt, screws, tightening torques on page 149*.
3	Two dowel pins Ø8 and eight M8 socket head screws for 190-590 stroke unit (twelve M8 socket head screws for 670 mm stroke unit).

Procedure

	Action	Info/Illustration
1	As it is necessary to jog the first horizontal axis carriage to tighten all the screws, you must prepare the equipment (controller, cables, SMB box) necessary to control the unit. See *Cabling on page 16*.	
2	Remove the cover plate (B) of the first horizontal axis by loosening its six M5x10 Class 8.8 fixing screws (A).	 xx1800002136
3	Remove the cover plate by sliding it from one end of FlexPLP IRPLP 220.	 xx1800002137
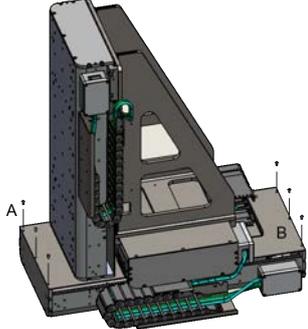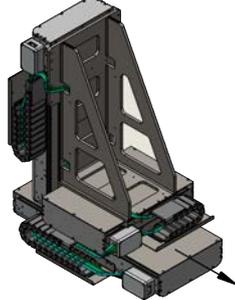
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	Action	Info/Illustration
4	Lift FlexPLP IRPLP 220 and position it on the mounting surface.	xx1800002138
5	Connect the power and resolver cables to the unit. If needed, use the controller's FlexPendant to move the first horizontal axis carriage and clear the access to the countersunk holes and pin holes of the base body.	
6	Secure the first horizontal axis of FlexPLP IRPLP 220 by installing the following fastening parts on the basement body: the two dowel pins Ø8 mm(A) and eight M8 screws with lock washer (B).	xx1800002139
7	Reinstall the first horizontal axis cover.	
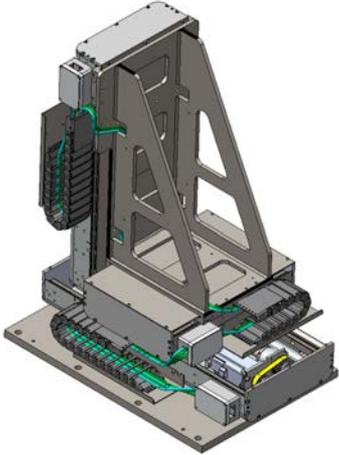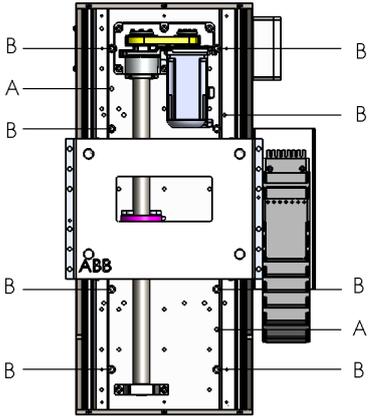
4 Installation and commissioning

4.3 Cabling and control

4.3.1 Connectors and internal equipment wiring

Connectors

> Each axis of FlexPLP IRPLP 220 has its own connection box which containing the power cable connector and the resolver cable connector.

External harness

> FlexPLP IRPLP 220 integrates an external harness of one power cable and one resolver cable for the control of customer equipment.

Quantity	Specification
1	Power cable, with M16 connector
1	Resolver cable, with M16 connector

> Read *Safety on page 13* before performing any service work.

4.3.2 Control architecture

Overview

FlexPLP IRPLP 220 is driven by the IRC5 through a set of cables and a SMB box.

The standard control system includes:

- Controller: IRC5 (A). An IRC5 controller can control up to 36 axes, in up to 7 motion tasks. See *Controller capabilities on page 81*.

- Floor resolver cable, IRC5 to SMB (B), connecting IRC5's XS.2 (SMB connection for single cabinet), A4.XS2 (SMB connection for drive module), XS.41 (SMB connection for external axis of single cabinet), or A4.XS41 (SMB connection for external axis of drive module).

- Floor power cable, IRC5 to SMB (C), having 2 types:

  - 6-axis type, connecting IRC5's XS.1 (robot power connection of single cabinet) or A4.X1 (robot power connection of drive module)

  - 3-axis type, connecting IRC5's XS.7 (power connection for external axis of single cabinet) or A4.X7 (power connection for external axis of drive module).

- SMB Box (D), having 3 types: 1, 3, or 6 axes. Equipped with brake release trigger and back-up battery.

- FlexPLP IRPLP 220 resolver cable, SMB to PLP (E), for 1 axis

- FlexPLP IRPLP 220 power cable, SMB to PLP (F) For 1 axis

Each type of cable is available in a length of 2 m, 5 m, 10 m or 15 m.

Extension cables are available in different lengths.
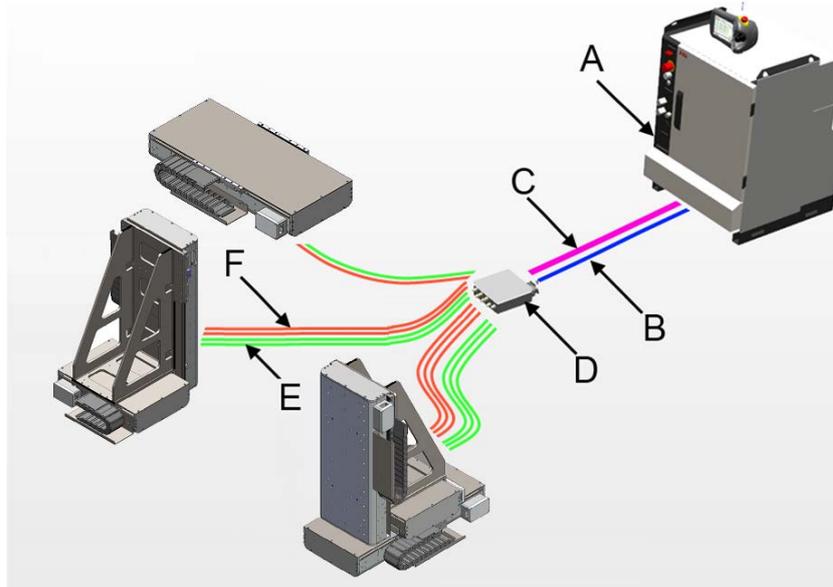
xx1800002140

A	IRC5
B	Floor resolver cable
C	Floor power cable
D	SMB Box
E	FlexPLP IRPLP 220 resolver cable
F	FlexPLP IRPLP 220 power cable

4.3.3 Controller capabilities

General

Depending on its configuration, an IRC5 controller with one drive module can control up to nine axes: six axes controlled by the Main Drive Unit (MDU) and up to three axes controlled by the Additional Drive Units (ADU). Up to three additional drive modules can be added to the controller. For a total of four drive modules, up to thirty-six axes can be driven by an IRC5 controller. Read Product manual - IRC5 (3HAC047136-001).

Furthermore, a controller with Multi-move system can manage up to seven motions tasks, regardless of the number of drive modules. This means that if the system configuration has more that seven FlexPLP IRPLP 220, two or more units must be grouped in one motion task. Read *Application manual - Additional axes and stand alone controller* (3HAC051016-001).

> **ℹ Note**
>
> On one drive module, the axes of one FlexPLP IRPLP 220 unit shouldn't be controlled across the MDU (six first drive units) and the ADU (up to three drive units). For example, a 3-axis FlexPLP IRPLP 220 should not have two axes controlled by the MDU and one axis controlled by one of the ADU.

Configurations: fully occupied drive module

Below are all the configurations in which all of the axes of one drive module are occupied:

#	Main Drive Unit						Additional Drive Units			PLP
	Drive 1	Drive 2	Drive 3	Drive 4	Drive 5	Drive 6	Drive 7	Drive 8	Drive 9	
1	PLP3 axis			PLP3 axis			PLP3 axis			3
2	PLP3 axis			PLP3 axis			PLP2 axis		PLP1 axis	4
3	PLP3 axis			PLP3 axis			PLP1 axis	PLP1 axis	PLP1 axis	5
4	PLP3 axis			PLP2 axis		PLP1 axis	PLP3 axis			4
5	PLP3 axis			PLP2 axis		PLP1 axis	PLP2 axis		PLP1 axis	5
6	PLP3 axis			PLP2 axis		PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	6
7	PLP3 axis			PLP1 axis	PLP1 axis	PLP1 axis	PLP3 axis			5
8	PLP3 axis			PLP1 axis	PLP1 axis	PLP1 axis	PLP2 axis		PLP1 axis	6
9	PLP3 axis			PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	7 [i]
10	PLP2 axis		PLP2 axis		PLP2 axis		PLP3 axis			4

Continues on next page

#	Main Drive Unit						Additional Drive Units			PLP
	Drive 1	Drive 2	Drive 3	Drive 4	Drive 5	Drive 6	Drive 7	Drive 8	Drive 9	
11	PLP2 axis		PLP2 axis		PLP2 axis		PLP2 axis		PLP1 axis	5
12	PLP2 axis		PLP2 axis		PLP2 axis		PLP1 axis	PLP1 axis	PLP1 axis	6
13	PLP2 axis		PLP2 axis		PLP1 axis	PLP1 axis	PLP3 axis			5
14	PLP2 axis		PLP2 axis		PLP1 axis	PLP1 axis	PLP2 axis		PLP1 axis	6
15	PLP2 axis		PLP2 axis		PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	7 [i]
16	PLP2 axis		PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	PLP3 axis			6
17	PLP2 axis		PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	PLP2 axis		PLP1 axis	7 [i]
18	PLP2 axis		PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	8 [i]
19	PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	PLP3 axis			7 [i]
20	PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	PLP2 axis		PLP1 axis	8 [i]
21	PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	PLP1 axis	9 [i]

[i] Configuration in which two or more mechanical units must be grouped in one motion task.

4.3.4 Examples of configurations

System example: One 3-axis FlexPLP IRPLP 220

Below is an example of configuration with one single cabinet IRC5 which controls one 3-axis FlexPLP IRPLP 220 through one 3-axis SMB box. Note that if the controller's XS.1 and XS.2 are already occupied, and if the number of drive units in the controller is enough for all the mechanical units, it is possible to use a power cable for IRC5's XS.7 (3-axis) and a resolver cable for XS.41.
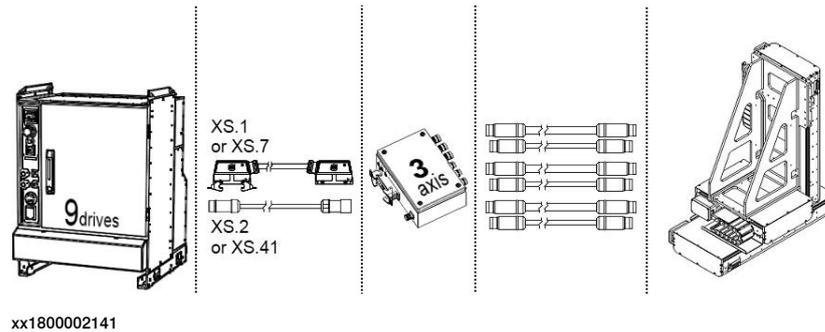
xx1800002141

System example: Two 3-axis FlexPLP IRPLP 220

Below is an example of configuration with one single cabinet IRC5 which controls two 3-axis FlexPLP IRPLP 220 through one 6-axis SMB box.

xx1800002142

System example: Two 3-axis FlexPLP IRPLP 220 and three 1-axis FlexPLP IRPLP 220

Below is an example of configuration with one single cabinet IRC5 (with nine drive units) which controls two 3-axis FlexPLP IRPLP 220 and three 1-axis FlexPLP IRPLP 220 through respectively one 6-axis SMB box and one 3-axis SMB box.
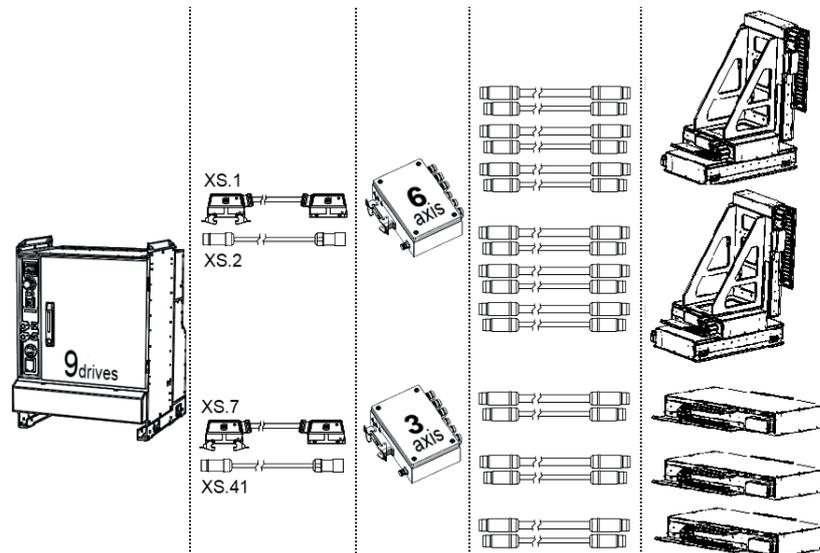
xx1800002143

System example: Four 3-axis FlexPLP IRPLP 220

Below is an example of configuration with one IRC5 (with six drive units) equipped with one additional drive module (also with six drive units), connected with one Ethernet cable and one safety cable. The IRC5 controls four 3-axis FlexPLP IRPLP 220 through two 6-axis SMB box.

xx1800002144

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System example: Six 3-axis FlexPLP IRPLP 220

Below is an example of configuration with one IRC5 (with nine drive units) equipped with one additional drive module (also with nine drive units). The IRC5 controls six 3-axis FlexPLP IRPLP 220 through two 6-axis SMB box, and two 3-axis SMB box.

xx1800002145

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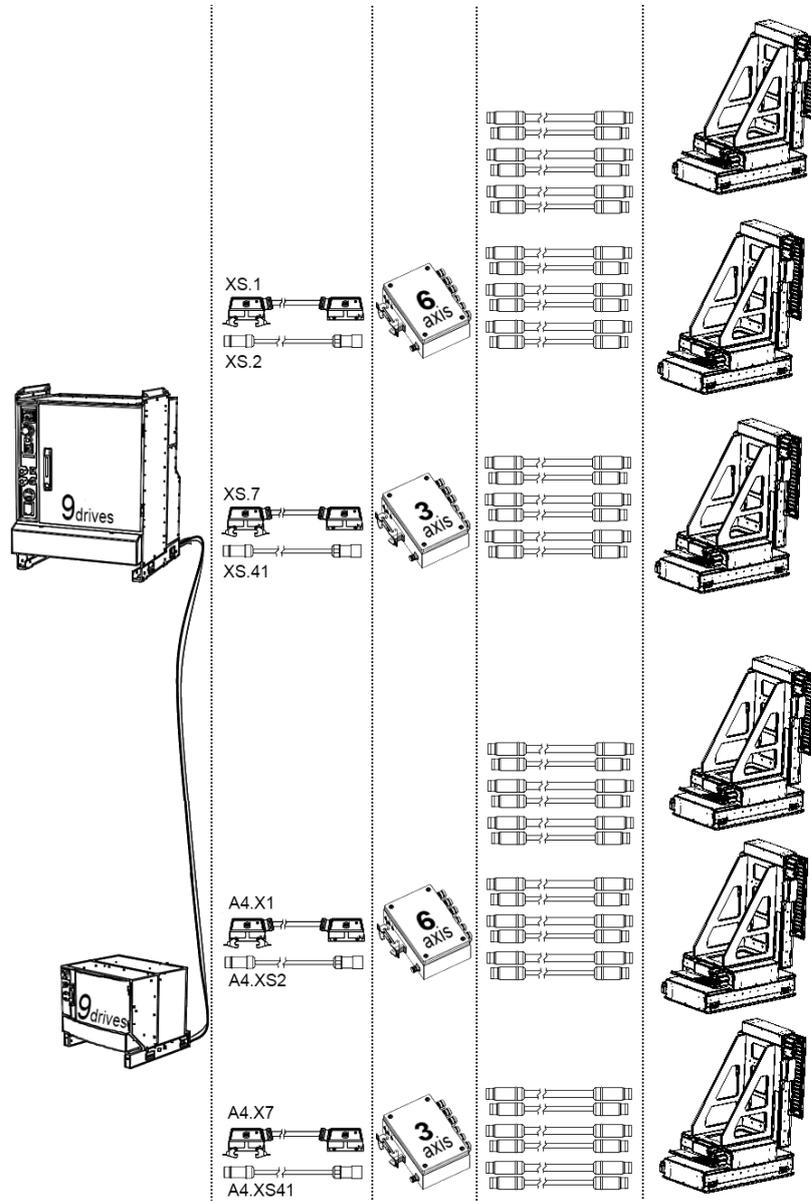
System example: Eight 3-axis FlexPLP IRPLP 220

Below is an example of configuration with one IRC5 (with nine drive units) equipped with two additional drive modules (one with nine drive units and the other one with six drive units), connected with two Ethernet cables and two safety cables. The IRC5 controls eight 3- axis FlexPLP IRPLP 220 through three 6-axis SMB box, and two 3-axis SMB box. Since the system has eight FlexPLP IRPLP 220, three mechanical units or more are grouped in two motion tasks or more.
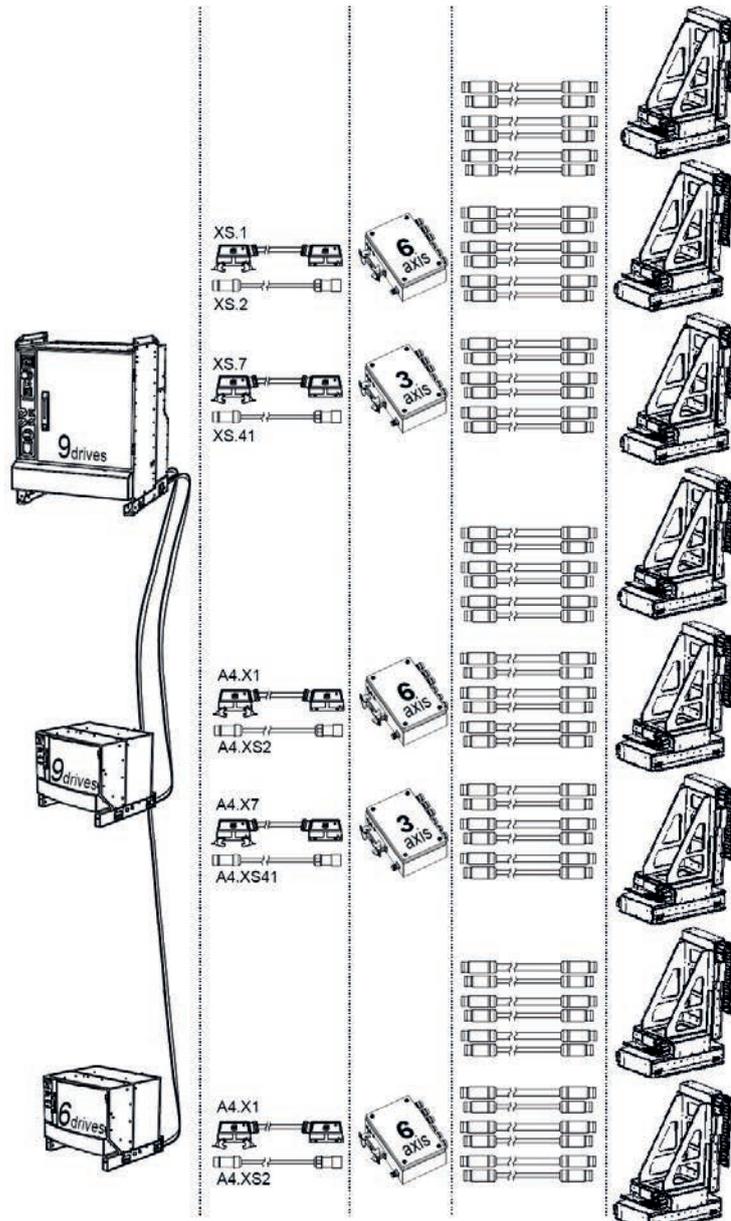
xx1800002146

System example: Four 3-axis FlexPLP IRPLP 220, one 2-axis FlexPLP IRPLP 220, and two 1-axis FlexPLP IRPLP 220

Below is an example of configuration with one IRC5 (with nine drive units) equipped with one additional drive module (with seven drive units). The IRC5 controls four 3-axis FlexPLP IRPLP 220, one 2-axis FlexPLP IRPLP 220, and two 1-axis FlexPLP IRPLP 220 through two 6-axis SMB box, one 3-axis SMB box, and one 1-axis SMB box. Since the system has seven FlexPLP IRPLP 220, two mechanical units or more are grouped in one motion task or more.
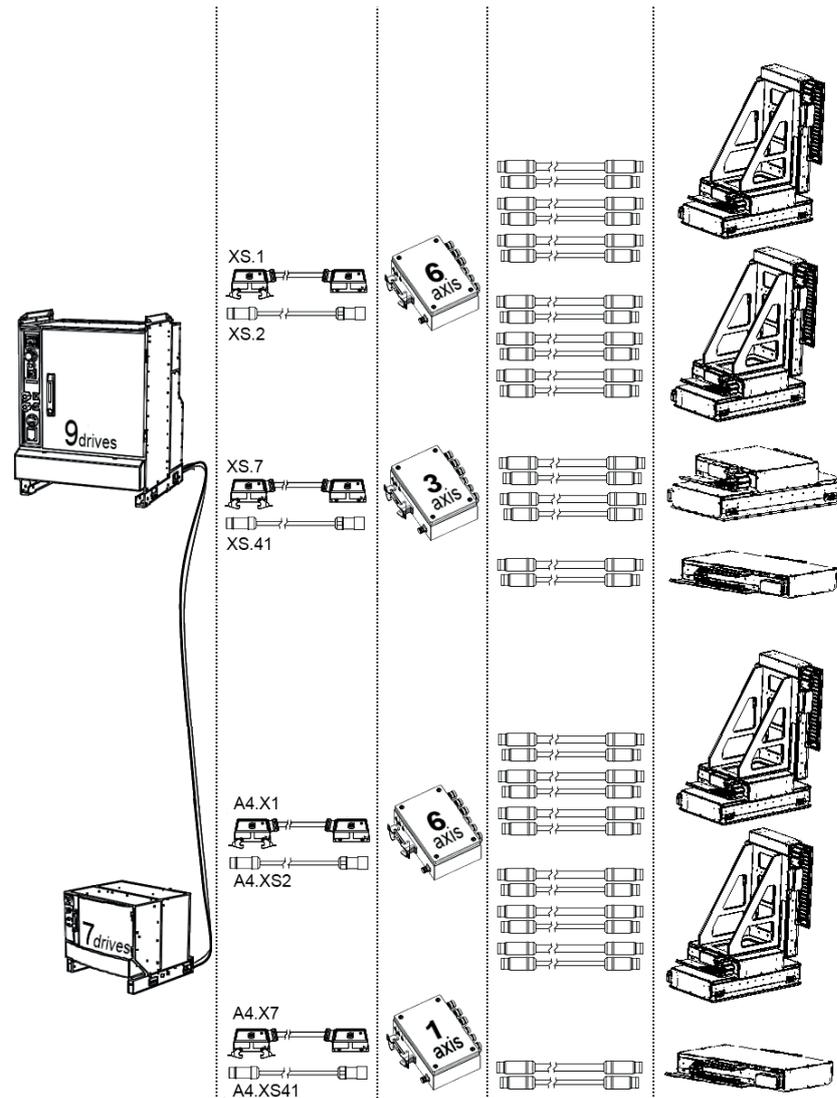
xx1800002147

4.3.5 Configuration files

Overview

In order for the controller to identify that the FlexPLP exists and to control it, configuration files must be loaded into the IRC5 system.

Two files need to be set:

- Motion Control file: MOC.cfg
- System file: SYS.cfg

The Motion control file is provided with the product.

The system file should be set depending on your existing system and the layout.

Detailed instructions regarding the setting and loading of these files can be found in the controller documentation. See:

- *Product manual - IRC5* (3HAC047136-001)
- *Product manual - IRC5 Compact* (3HAC047138-001)
- *Operating manual - IRC5 with FlexPendant* (3HAC050941-001)

Once the parameters are properly set in the system, calibrate the unit(s) as described in *Calibration on page 91*.

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5 Calibration

5.1 Introduction / When to calibrate

General

This chapter includes general information and detailed procedures about the calibration.

When to perform a fine calibration

The fine calibration of the FlexPLP must be done at the first commissioning or after the replacement of mechanical parts such as:

- servomotor
- driving belt/pulley or gear/rack
- ballscrew
- a complete axis

A Ø8 x 50 mm pin is required to perform the fine calibration.

When to update the revolution counters

The FlexPLP axis must be calibrated each time the contents of the revolution counter are changed or lost. This will occur when:

- The battery is discharged
- A resolver error occurs
- The signal between a resolver and measurement board is interrupted (e.g., cable disconnected)
- A FlexPLP axis is moved with the control system disconnected

The revolution counters must also be updated after the device and controller are connected at the first installation.

Power failure

There is no need to calibrate the FlexPLP after a power failure, the backup battery included in the SMB box will store the resolver position until power is restored.

Precautions

> ⚠ **CAUTION**
>
> - If an axis is incorrectly calibrated or if the revolution counter is incorrectly updated, it will cause incorrect positioning, which in turn may cause damage or injury! Check the calibration position very carefully after each update.
> - Before any service work, make sure that nobody stands near the mechanical unit when the carriage moves, and make sure that no object which could get in the way of the carriage or jam between the carriage and the covers.

5.2 Calibration marks

Calibration mark on side

FlexPLP IRPLP 220 has a calibration index system on side of the carriage for calibration. Each axis has a calibration index system, no matter horizontal or vertical and no matter in which drive type. The axis reaches its calibration position when the calibration hole on the calibration index system aligns with the calibration hole on the base body side. A Ø8 x 50 pin should be inserted into the calibration holes and used to for fine calibration.
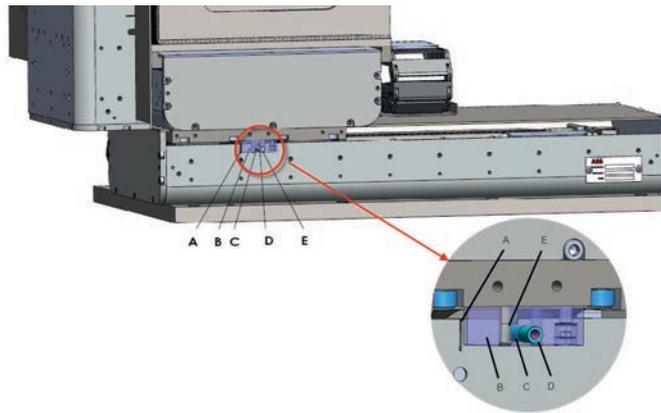
xx1800002148

A	Calibration mark on the side plate of the base
B	Calibration index system
C	Calibration hole on the index system ![i] **Note** To make the calibration hole on the base body visible, the calibration index system is shown in semi-transparent.
D	Calibration pin
E	Calibration hole on base

The following figure takes the calibration index system on side as an example and illustrates the detailed position of calibration holes on the calibration index system.

Continues on next page

The position on the calibration index system is the same for axis without bellows and axis with bellows.
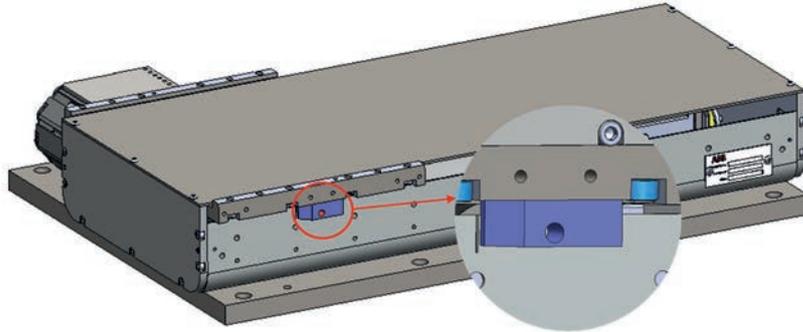
xx1800002149

Calibration mark in middle

FlexPLP IRPLP 220 with bellows can be calibrated using the calibration mark on side by removing the bellows first. If the bellows are not removed, the calibration mark in middle of the base body side can also be used for calibration.
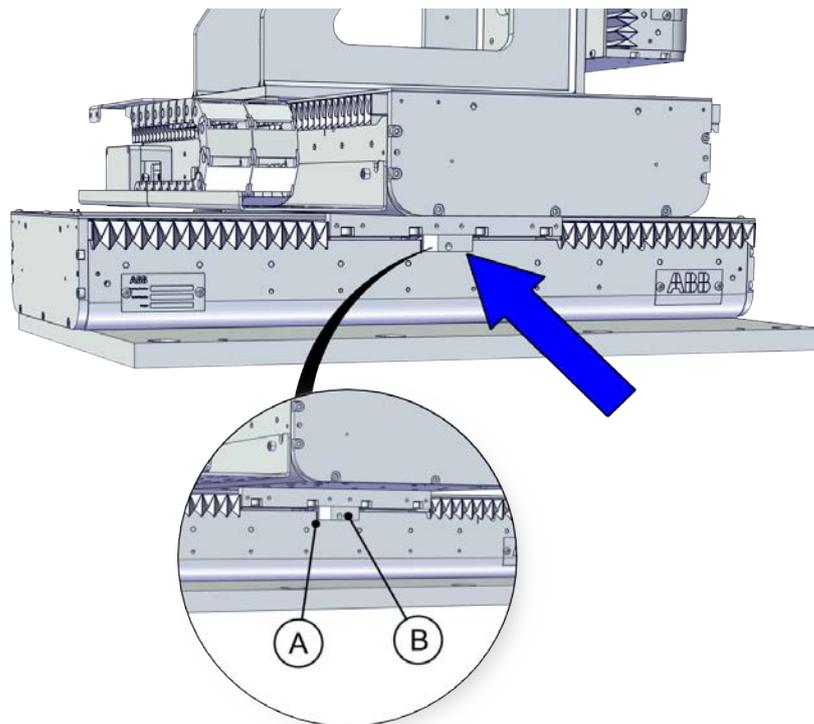
xx2100001951

A	Calibration mark on the side plate of the base
B	Calibration index system

5.3 Editing motor calibration offset

Procedure

Use this procedure to set **Edit Motor Calibration Offset**.

	Action	Info/Illustration
1	On the FlexPendant, tap ABB logo to access the ABB menu and tap **Calibration**.	 xx1800002150
	All mechanical units connected to the system are shown along with their calibration status.	 xx1800002151
2	Tap to select the mechanical unit and then tap to select **Calib.Parameters**.Tap **Edit Motor Calibration Offset**..., a pop-up warning dialog box is displayed. Tap **Yes** to proceed.	 xx1800002152
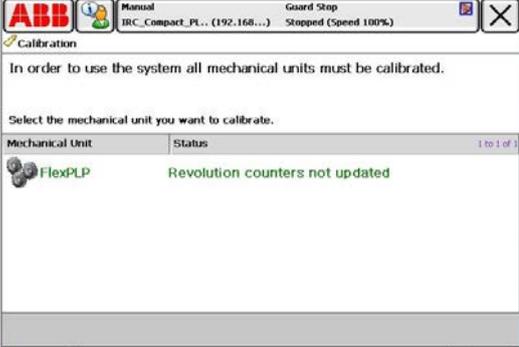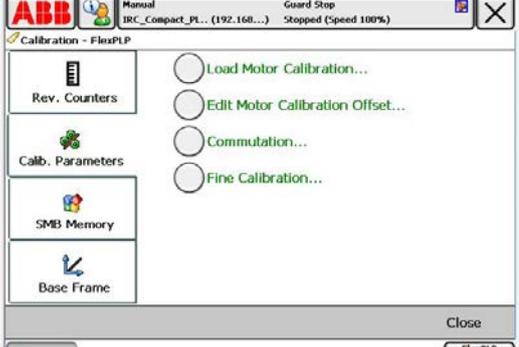
Continues on next page

	Action	Info/Illustration
3	Set the **Offset** value of motor.	xx1800002153
	The new value comes from the **Reslover Value** in the label that attached beside the Identification plate on the Axis.	xx1800002154
4	Tap **OK**. A system dialog box is displayed, warning that new calibration offset values have been saved to the system parameters. To activate these values you need to restart the controller. Do you want to restart the controller now? Tap **Yes** to restart the controller.	xx1800002155
5	Update the revolution counters.	For detailed procedure, see *Update of the revolution counters on page 104*.
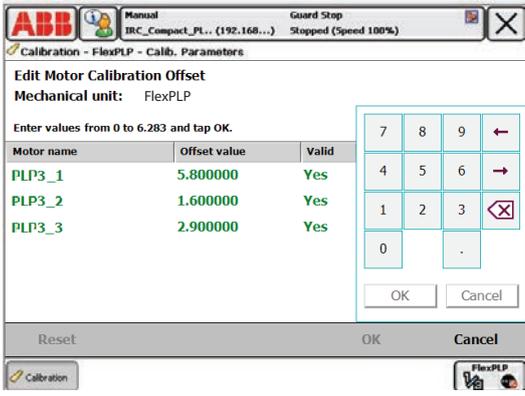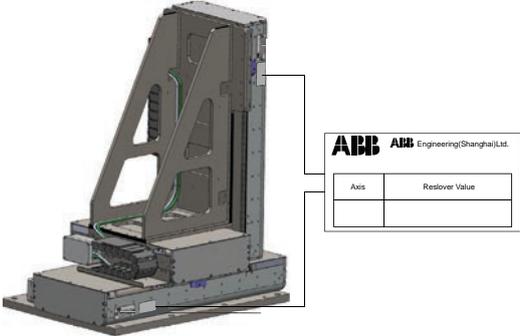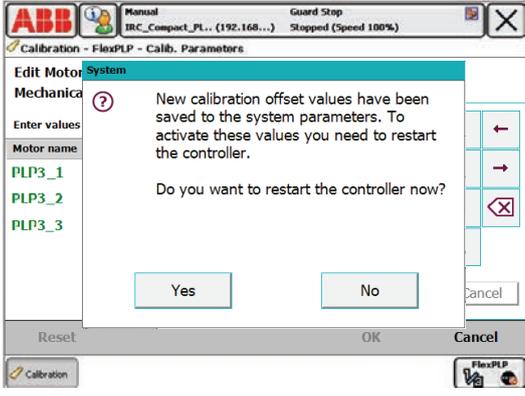
ℹ️ **Note**

After replacing the drive system, reset the resolver value.

5.4 Fine calibration

Procedure with calibration pin

Location of calibration pin

The fine calibration of the FlexPLP with calibration index system must be done with a Ø8 x 50 mm calibration pin.

> 💡 **Tip**
>
> You can order a calibration pin from ABB under the reference number 3HAW050041930. See *Special tools on page 151*.

Procedure

	Action	Info/Illustration
1	Jog the carriage or calibration index system close to the calibration mark using the FlexPendant.	See *Cabling on page 16*.
2	Jog the axis slowly until the two calibration holes are aligned and the calibration pin can be inserted freely.	FlexPLP IRPLP 220 without bellows and the calibration index system on side
		xx1800002156
		FlexPLP IRPLP 220 with bellows and the calibration index system in middle
		xx2100001952
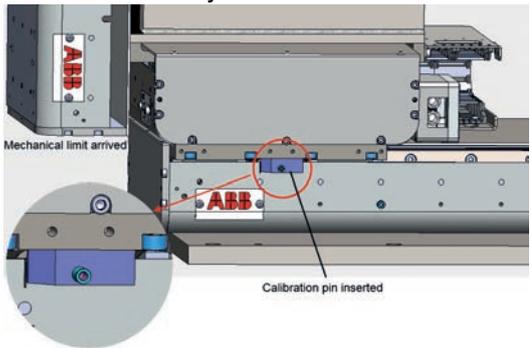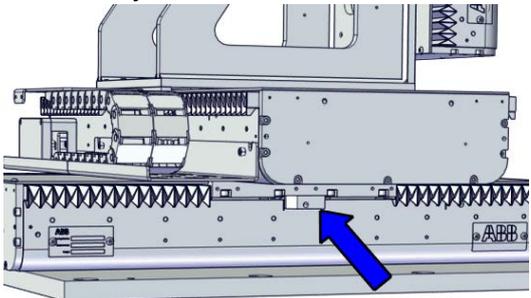
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	Action	Info/Illustration
3	On the FlexPendant, tap on the ABB logo to access the ABB menu and tap on **Calibration**.	xx1800002150
	All mechanical units connected to the system are shown along with their calibration status.	xx1800002151
4	Tap to select the mechanical unit and then tap **Calib.Parameters**. Tap **Fine Calibration**. A dialog box is displayed prompting to performing the actual calibration. A warning that updating the revolution counters can change. Programmed FlexPLP IRPLP 220 positions are also displayed. Tap **Yes** to proceed.	xx1800002152
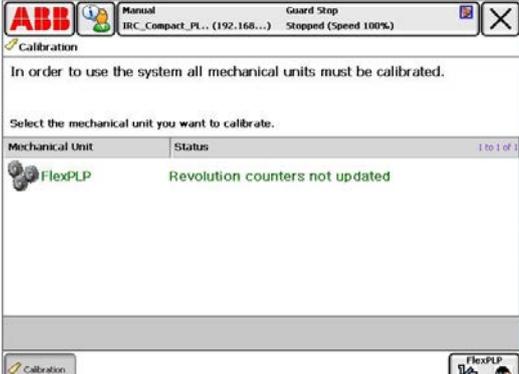
	Action	Info/Illustration
5	Select the check-box for the axis to calibrate.	 xx1800002157
6	Tap **Calibrate**. A dialog box is displayed, warning that calibration of the selected axes will be changed, which cannot be undone: Tap **Calibrate** to proceed. Then a dialog box announcing that the calibration process has started would display. To cancel the calibration, tap **Cancel**	 xx1800002158
7	The axis is calibrated and the system returns to the list of available mechanical units.	 xx1800002159
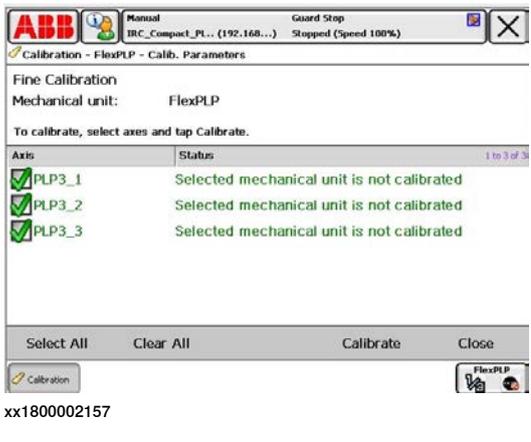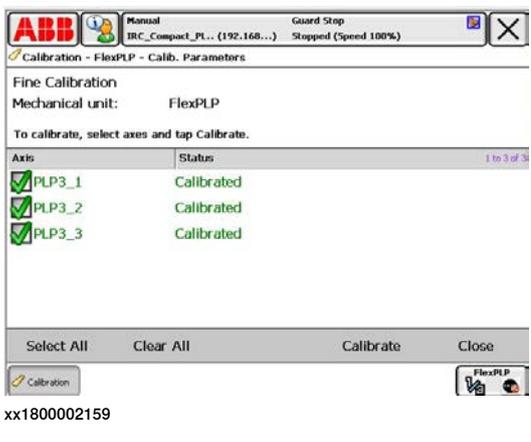
Procedure with soft calibration

Introduction to soft calibration

Soft calibration is a new fine calibration feature which is created to make the calibration easier using an automatic process. During soft calibration, calibration pin is unnecessary.

The system must be fine calibrated under the following circumstance:

- Any parts that affecting the calibration position is replaced.
- During the first commissioning.

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- After any maintenance operation which might affect the position accuracy.

The fine calibration should only be performed by a qualified service engineer.

> **ℹ️ Note**
>
> ABB also provides an additional FlexPendant application **FlexPLP GUI** to calibrate FlexPLP with soft calibration. For more information, see *Working with FlexPLP add-in on page 107*.

Procedure

	Action	Note
1	Jog the carriage or calibration index system close to the calibration mark. **ℹ️ Note** Soft calibration only supports fine calibration at value zero position. Users are not allowed to execute this function when FlexPLP is at the position of maximum stroke or far from the zero position (more than 5 mm away from the calibration mark on side).	
2	On the FlexPendant, tap on the ABB logo to access the ABB menu and tap **Program Editor**.	xx2100001956
3	Select the task for the mechanical unit to be calibrated in the displayed list. The program for the task is displayed.	xx2100001957
4	In the displayed page, tap **Debug**.	xx2100001958
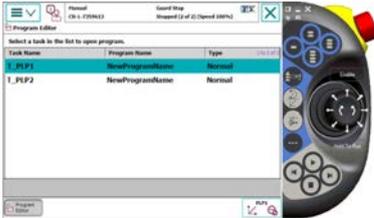
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	Action	Note
5	Tap **PP to Main**.	xx2100001959
6	In the displayed dialog box, tap **Yes**.	xx2100001960
7	Tap **Call Routine**.	xx2100001961
8	In the displayed page, tap **AxisCalibration**.	xx2100001962
9	Hold the three-position enabling device to make the motor on and press the **Start** button to run the program in manual mode.	
10	Tap **Fine**.	xx2100001963
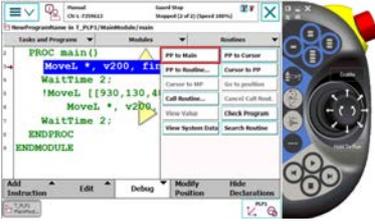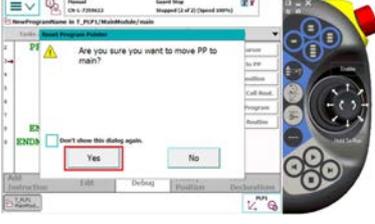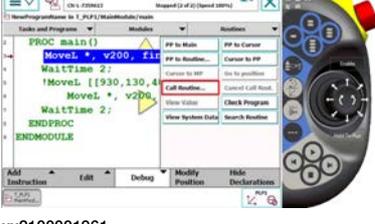
	Action	Note
11	Tap **Calibrate**.	xx2100001964
12	Tap **Next**.	xx2100001965
13	Enter the number of the axis to be calibrated or enter **0** to calibrate all the axes.	xx2100001966
14	Tap **Full Sync** or **Partial Sync**. • **Full Sync**: synchronize all the axes together. • **Partial Sync**: synchronize axes one by one. **Tip** In the following steps, the example of choosing **Partial Sync** is described. The procedure for **Full Sync** is the similar.	xx2100001967
15	Tap **Next**.	xx2100001968
16	Tap **Move**. **Note** Double check the axis position to make sure that the axis is at the position close to the calibration mark (zero position), that is, not larger than 5 mm away from the calibration mark.	xx2100001969
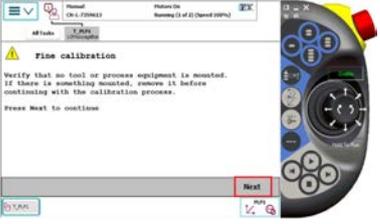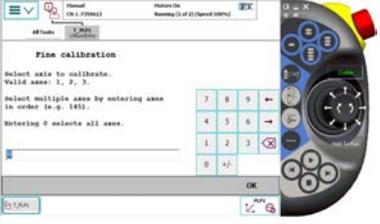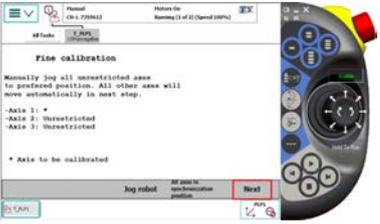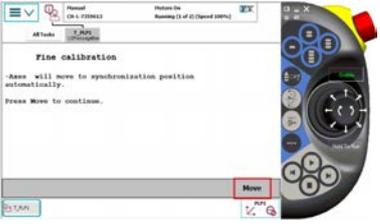
Continues on next page
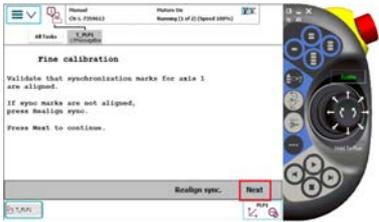
	Action	Note
17	Tap **Next**.	xx2100001970
18	Tap **Move**.	xx2100001971
19	Perform actions instructed in the GUI and then tap **Move**.	xx2100001972
20	Tap **Move**.	xx2100001973
21	Calibration is performed automatically.	xx2100001974
22	Tap **Finish** after the calibration is done.	xx2100001975
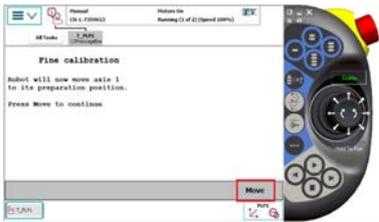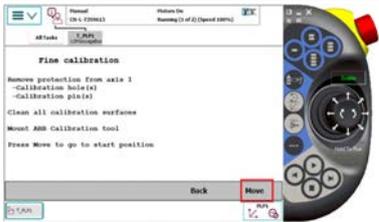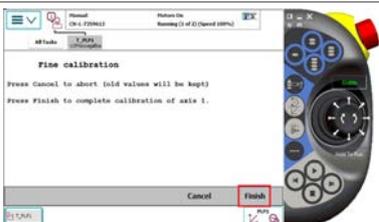
	Action	Note
23	Tap **Next** for calibration of next axis.	xx2100001976

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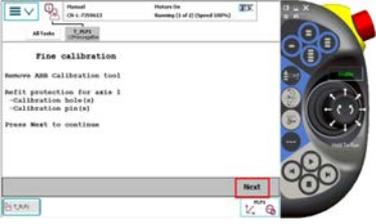
5.5 Update of the revolution counters

Procedure

	Action	Info/Illustration
1	Using the FlexPendant, jog the carriage or calibration index system to the calibration mark.	**FlexPLP IRPLP 220 without bellows and the calibration index system on side** Mechanical limit arrived Calibration marks aligned xx1800002160 **FlexPLP IRPLP 220 with bellows and the calibration index system in middle** xx2100001953
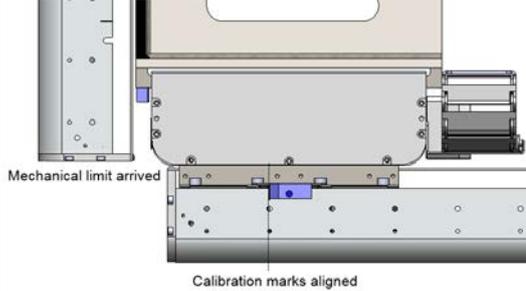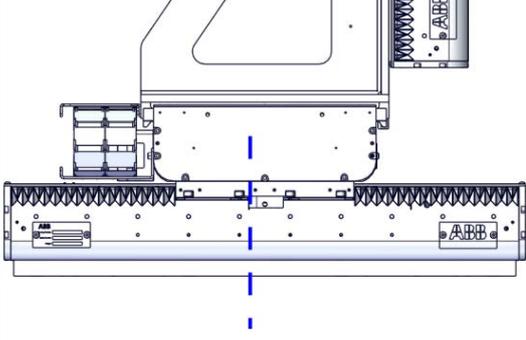
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	Action	Info/Illustration
2	On the FlexPendant, tap the **ABB** logo to access the ABB menu and tap **Calibration**.	xx1800002150
	All mechanical units connected to the system are shown along with their calibration status.	xx1800002151
3	Tap to select the mechanical unit and then tap to select **Rev.Counters**. Tap **Update Revolution counters...**, a dialog box will display warning that updating the revolution counters may change programmed FlexPLP positions. Tap **Yes** to display the axis selection window.	xx1800002161
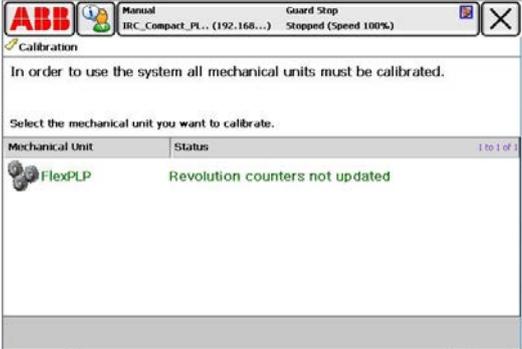
5 Calibration

	Action	Info/Illustration
4	Select the axis to have its revolution counter updated by ticking in the box to its left. Or tapping **Select** all to and then tapping **Update** to update revolution counters for all axes.	 xx1800002162
5	Tap **Update**. A dialog box is displayed, warning that calibration of the selected axes will be changed, which cannot be undone. Tap **Update** to proceed. Tap **Cancel** to cancel.	 xx1800002163
6	Tap **Update** to update the selected revolution counters and remove the tick from the list of axes.	 xx1800002164
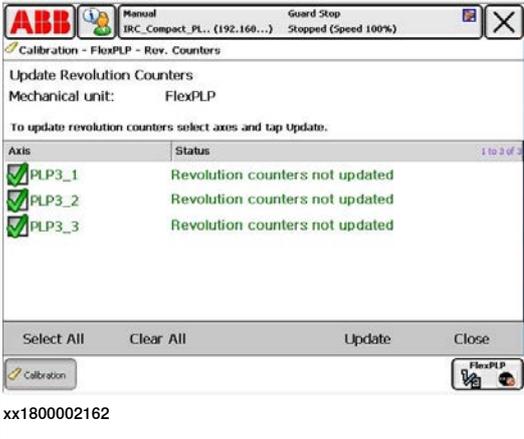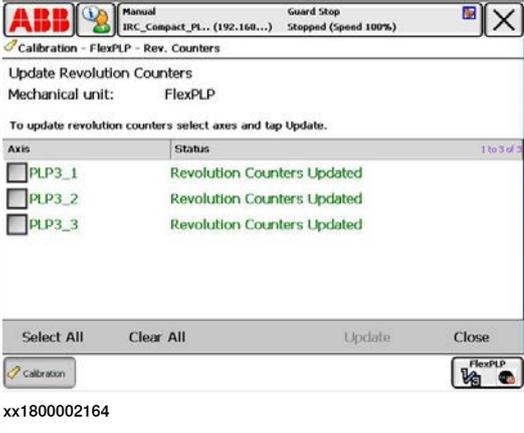
6 Working with FlexPLP add-in

6.1 Introduction

Overview

FlexPLP add-in is an additional software package running in ABB IRC5 system and designed to operate the FlexPLP products. The add-in offers a user-friendly way to achieve common commissioning tasks such as soft calibration and shim offsets management. O

For more information about how to install the add-in using RobotStudio, see *Operating manual - RobotStudio*.

For more information about supported system configuration, see *FlexPLP Add-In Release Note*.

6.2 Workflow for FlexPLP add-in

6.2.1 Loading additional views in FlexPendant

Procedure

Use the following procedure to define additional views that will be allowed when a RAPID program is started in manual mode.

	Action	Note
1	On the FlexPendant, tap **Control Panel** to set and configure parameters.	 xx1800003157
2	Tap **FlexPendant** to configure the Flex-Pendant system.	 xx1800003158
3	Browse the **Property** list and tap **Addition Test View**.	 xx1800003159
4	Select the **FlexPLP GUI** check box and then tap **OK**.	 xx1800003160
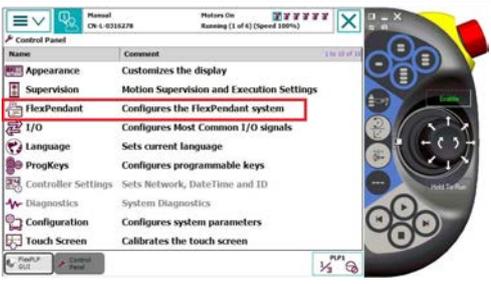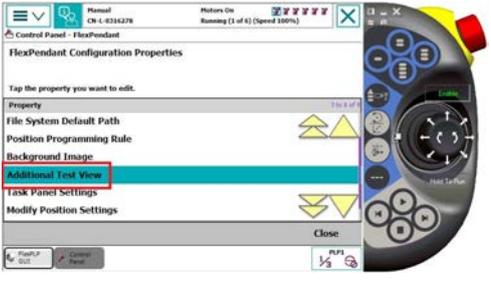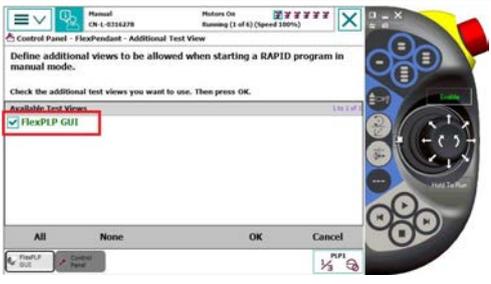
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	Action	Note
5	Tap **FlexPLP GUI** on the left corner to return the GUI navigation page.	xx1800003161 xx1800003162
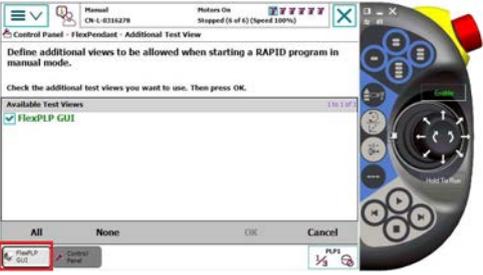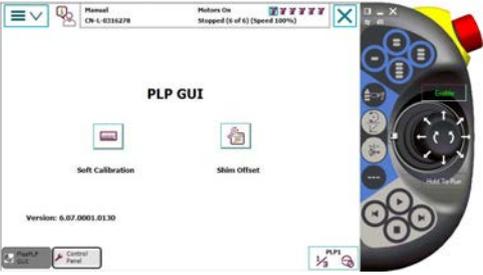
6.2.2 Soft calibration

Login

Before executing soft calibration, users must login the FlexPLP add-in. Otherwise, users are not allowed to use PLP soft calibration function.

> **ℹ Note**
>
> User can only execute soft calibration in manual mode. Soft calibration is disabled in automatic mode.

	Action	Note
1	On the **PLP GUI** page, tap **Soft Calibration**.	xx1800003105
2	Select the checkbox of the specific PLP to be calibrated. **ℹ Note** Only one checkbox is allowed to be selected at the same time.	
3	Tap **Commissioning** or **Start Calib**.	xx1800003106
4	Tap **ABC...** to open the keyboard, and input the initial password at the first time when you login. **ℹ Note** The initial password is set by ABB. Please contact your local ABB service, _flexlean.sales@cn.abb.com_, for more information.	xx1800003107
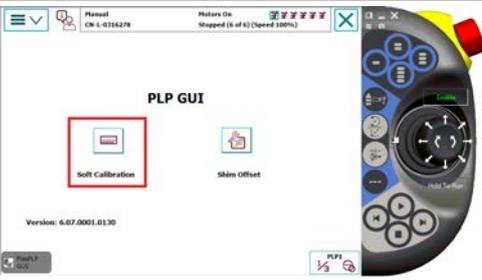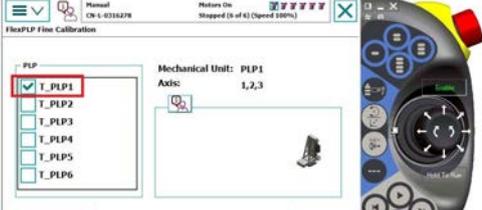
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	Action	Note
5	If you want to change the password, tap **Change...** on the right bottom.	xx1800003151 xx1800003124
6	If you want to change the password but you forget the old one you set before, tap **Reset** to change the password to the initial one.	xx1800003152 xx1800003150
7	Tap **Login**. ℹ️ **Note** After successful login, the **Login** button turns to the **Logout** button. If the password is incorrect, a message pops up, prompting entering the correct password. If the PLP GUI application is closed, the login status will be expired.	xx1800003109
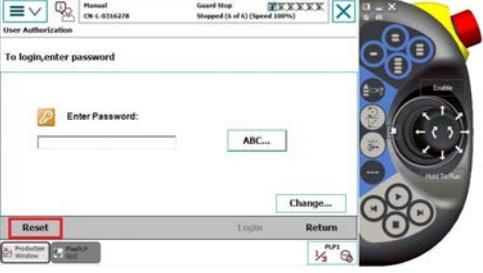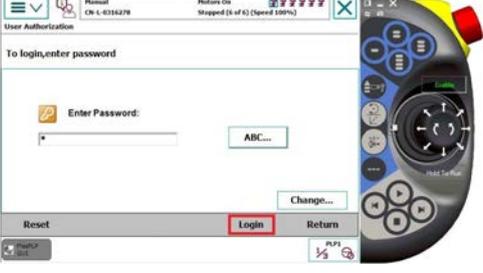
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Commissioning

With **Commissioning** function, position can be precisely measured by external measuring system. The complete process is handled with user wizard.

The commissioning main menu is a list of commands with which user can run any of them for further measurement and setting.

Axis Measurement

FlexPLP will move towards the start position, middle position, and the end position respectively on each axis. The external measuring system will record these coordinates and angular. The background program will precisely calculate the compensation on transmission. With the collected data, user can reset the data of transmission and radian of arm angle to improve accuracy through **Set Transmission** and **Set Arm Angle** command.

Angular Measurement

FlexPLP will move to the calibration position first. Afterwards, the robot will select nine positions, which are the zero, half stroke, and the whole stroke on each axis. The external measuring system will measure the angular of each axis according to these samples. According to collected data, user can verify and reset the parameters to improve the precision of this system.

BaseFrame Measurement

FlexPLP will move to the calibration position first. Afterwards, the robot will move to 8 endpoints in the base frame one by one, which are (0,0,0), (0,0,z), (x,0,0), (x,0,z), (x,y,0), (x,y,z), (0,y,0), and (0,y,z). The external measuring system helps measure corresponding base frame coordinate of these points. According to the coordinate, user can reset the new value of X, Y, Z, Rx, Ry, Rz with **Set Frames** command.

Set Transmission

User can set the transmission rate of each axis in MOC according to the measurement of axis with following procedures.

	Action	Note
1	Select **Set Transmission**.	xx1800003164

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	Action	Note
2	Press the START button to continue the process.	 xx1800003165
3	Select **OK** for next step.	 xx1800003166
4	After inputting the new transmission of three axes measured by external measuring system, select **OK** to confirm the value of new transmission.	 xx1800003167
5	Select **OK** to confirm the setting.	 xx1800003168
6	Select **OK** to finish the procedure.	 xx1800003169
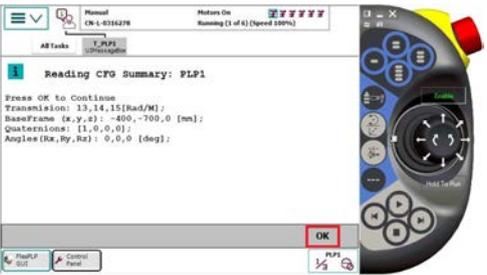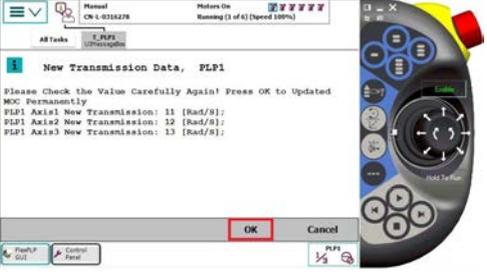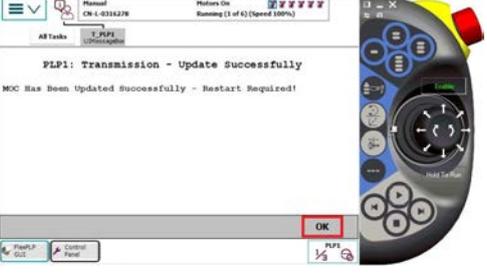
6.2.2 Soft calibration
Continued

Set Arm Angle

User can update new radian of three axes in MOC according to the measurement of angular with following procedures.

	Action	Note
1	Select **Set Arm Angle**.	xx1800003170
2	Press the START button to continue the processes.	xx1800003206
3	Select **OK** for the next step.	xx1800003207
4	After inputting the new arm angle of three axes measured by external measuring system, select **OK** to confirm the value.	xx1800003208
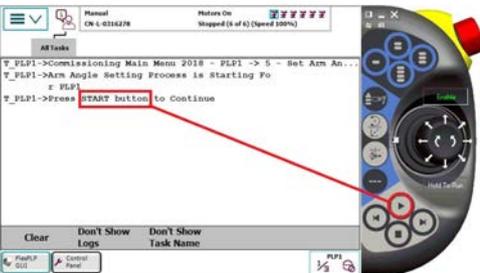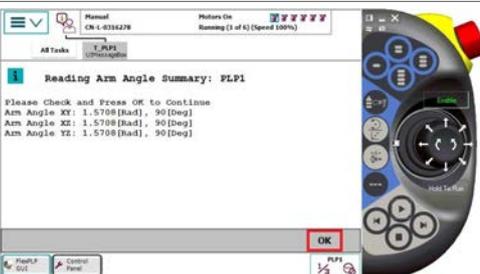
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	Action	Note
5	Select **OK** to confirm the setting.	xx1800003209
6	Select **OK** to verify the updating again.	xx1800003210
7	Select **OK** to finish the procedure.	xx1800003211
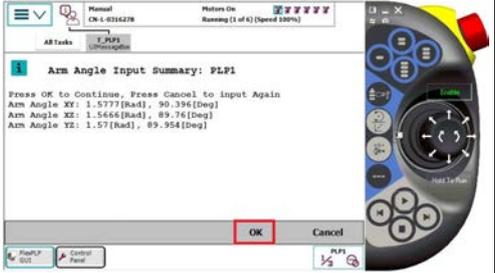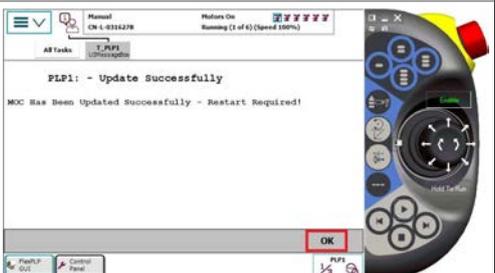
Set Frames

When base frame of FlexPLP is set after serial measurements and compensations, user can update base frame in MOC according to the measurement of base frame.

	Action	Note
1	Select **Set Frames**.	xx1800003212

6.2.2 Soft calibration
Continued

	Action	Note
2	Press the START button to continue the processes.	xx1800003213
3	After choosing the frame which to be updated, select **OK** to confirm it.	xx1800003214
4	Input X, Y, Z, Rx, Ry, Rz values.	xx1800003215
5	Select **OK** to finish the procedure.	xx1800003216
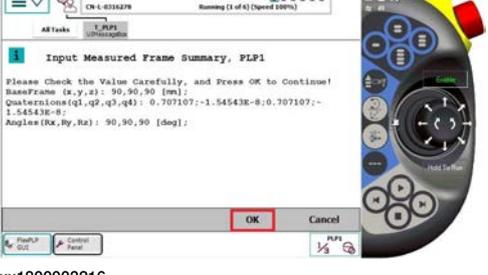
Move to CalibPos

With this command, the robot will move to the calibration position through jointing its axes to zero.

	Action	Note
1	Select **Move to CalibPos**.	 xx1800003223
2	The FlexPLP moves to calibration position.	 xx1800003221 xx1800003222
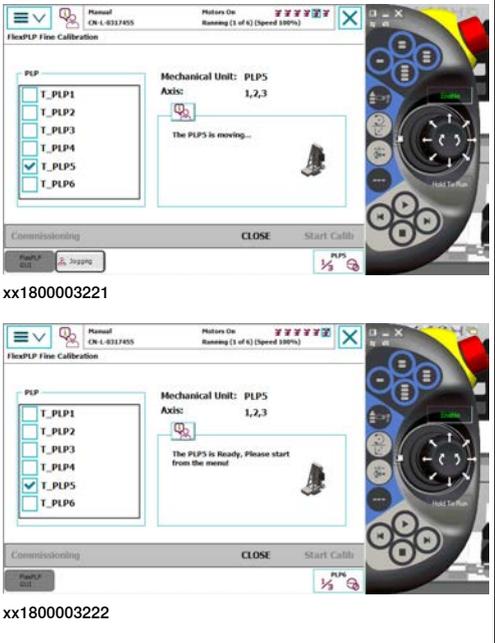
Move to ZeroPos

The robot will move to the zero position of the base frame coordinate with linear movement.

	Action	Note
1	Select **Move to ZeroPos**.	 xx1800003217

Continues on next page

6.2.2 Soft calibration
Continued

	Action	Note
2	Choose **2- Base Zero**, select **OK** to confirm the setting.	 xx1800003218

Starting calibration

Use the following procedure to calibrate the FlexPLP.

	Action	Note
1	Select the checkbox of the specific Flex-PLP to be calibrated. **Note** No more than one checkbox is allowed to select at the same time.	
2	Tab **Start Calib** at the right corner.	xx1800003111
3	Tab **Fine** on the bottom to calibrate the selected mechanical unit. **Note** User must jog the robot to its calibration mark before updating revolution counter. Furthermore, before starting fine calibration, the revolution counter must be updated completely.	 xx1800003112
4	Tap **Calibrate**.	 xx1800003113
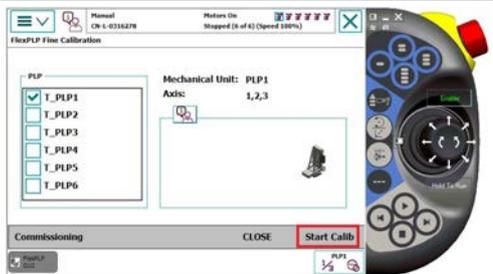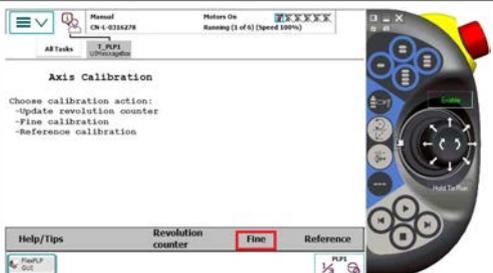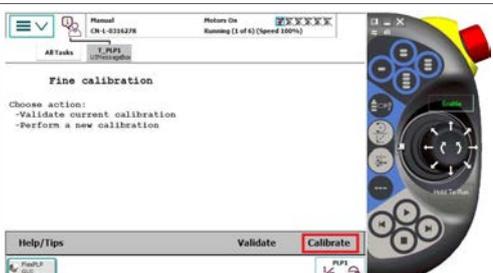
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	Action	Note
5	Input the axis which you want to calibrate and then tap **OK**. ![i] **Note** If you want to calibrate all the axes, please input **0**. ![i] **Note** Axes configured with negative stroke direction can only be calibrated in RobotWare 6.09 and later.	xx1800003115
6	Tap **Move** or **Next** according to the prompts on the FlexPendant.	xx1800003116 xx1800003117
7	The fine calibration operation is completed. ![i] **Note** Soft calibration only supports fine calibration at value zero position. Users are not allowed to execute this function when FlexPLP is at the position of maximum stroke or far from the zero position (more than 5 mm away from the calibration mark on side). ![i] **Note** Soft calibration would be in failure because of FlexPLP mechanical problems. To remove this issue, see *Installation and commissioning on page 65*.	xx1800003119 xx1800003219
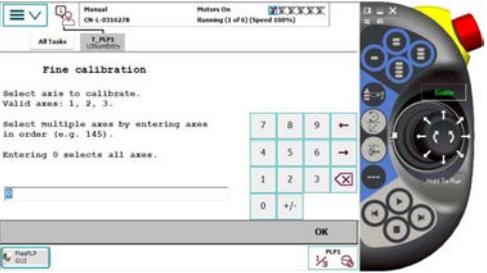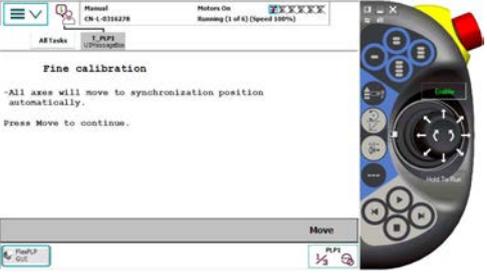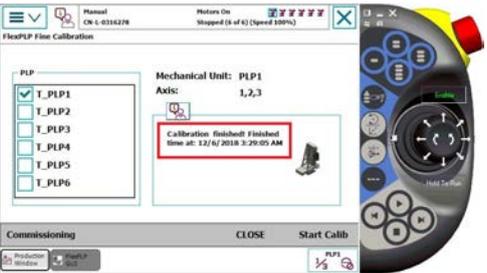
6.2.3 Shim offset

Function

FlexPLP robot path targets can fit different types of car body. New feature is designed for user to configure specific offset and apply to different PLP applications.

To fit different types of car body, several size of shims are installed manually to set offset position for different car bodies. But this strategy wastes a lot of time and labor force.

After the new shim offset function applied, shims were never used to improve precision. The background program can calculate shim offset values for PLP paths automatically through input offset value for PLP robots. This feature is designed to give user a more effective way to change and position work piece. No additional hardware is needed because friendly user interface takes everything easily to configure shim offset parameters.

Procedures

Login

Before executing offset setting, user must login the FlexPLP addin application. Otherwise user is not allowed to use PLP shim offset function.

> **ℹ Note**
>
> User can only execute shim offset in manual mode. Shim offset is disabled in automatic mode.

This procedure describes the login steps that need to be performed when using the shim offset function.

	Action	Note
1	The main interface for FlexPLP addin displays at the menu of FlexPendant. User can directly launch the application and find the entrance of the feature.	xx1800003103
2	Select the **PlexPLP GUI**, and the PlexPLP addin is opened.	xx1800003104
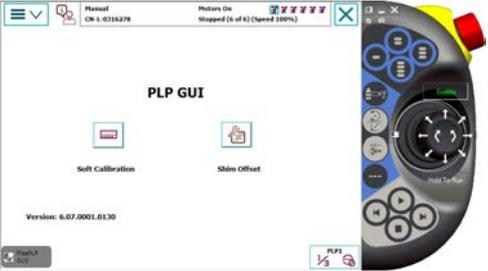
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	Action	Note
3	Tap **Shim Offset**.	 xx1800003121
4	Tap **Login**. ![i] **Note** The PLP robot station layout is customized. Generally, the number of PLP robots in a station is 4 or 6. Their positions are relative to the world coordinate system.	 xx1800003122 xx1800003220
5	Tap **ABC...** to open the keyboard, and input the initial password at the first time when you login. ![i] **Note** The initial password is set by ABB. Please contact your local ABB service, *flexlean.sales@cn.abb.com*, for more information.	 xx1800003123
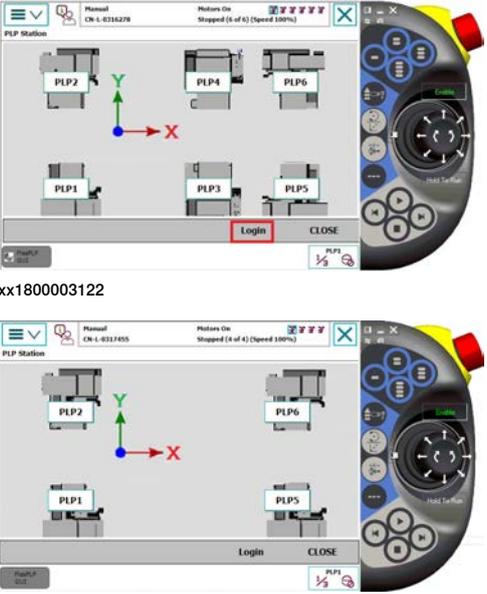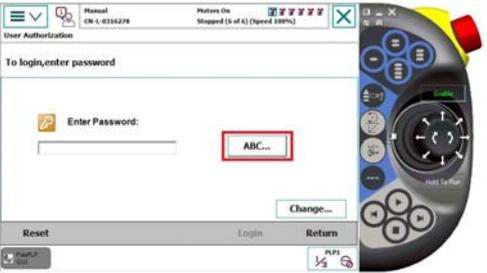
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	Action	Note
6	If you want to change the password, tap **Change...** on the right bottom.	xx1800003151 xx1800003124
7	If you want to change the password but you forget the old one you set before, tap **Reset** to change the password to the initial one.	xx1800003152 xx1800003150
8	Tap **Login**. **Note** If password is valid, **Login** button will turn to **Logout**. Otherwise, password invalid warning message will come out. If turn off the PLP GUI application, **Login** will be expired.	xx1800003125
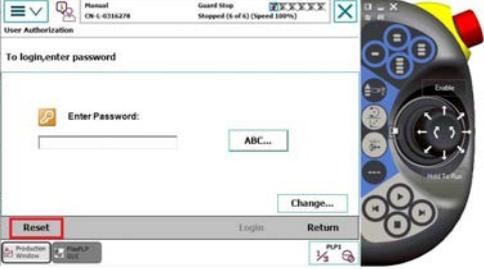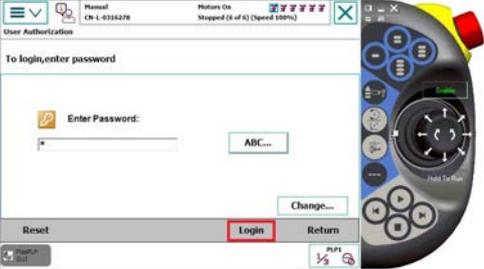
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Model Settings

The **Model Settings** window includes 4 types of car body for user to choose. User can customize different target position compensation solutions for PLP groups.

After choosing the car body and suitable PLP unit according to system option, the offset value was set accordingly.

	Action	Note
1	All the car bodies are listed for user to select. In a new created system, the default car body list includes Car Body 1, Car Body 2, Car Body 3, and Car Body 4.	 xx1800003126
2	User can modify the car body name through selecting **Change Name....**	 xx1800003153
3	PLP robots are listed for user to choose.	 xx1800003127
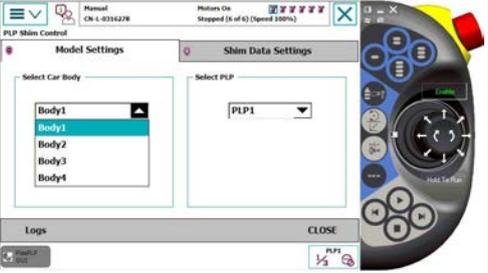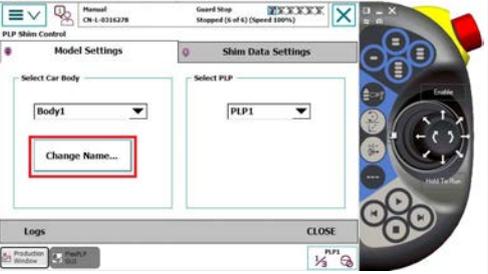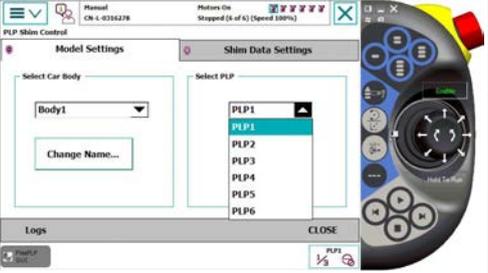
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6.2.3 Shim offset
Continued

Shim Data Settings

Configuring the shim offsets as the solution for improving the precision when combining PLP robot and car body. Shim offset values are defined by user on HMI, which are on x, y, and z directions. The background program enables the PLP robot moving to a suitable position with configured offset values automatically.

The function of **Shim Data Setting** is shown in the figure.
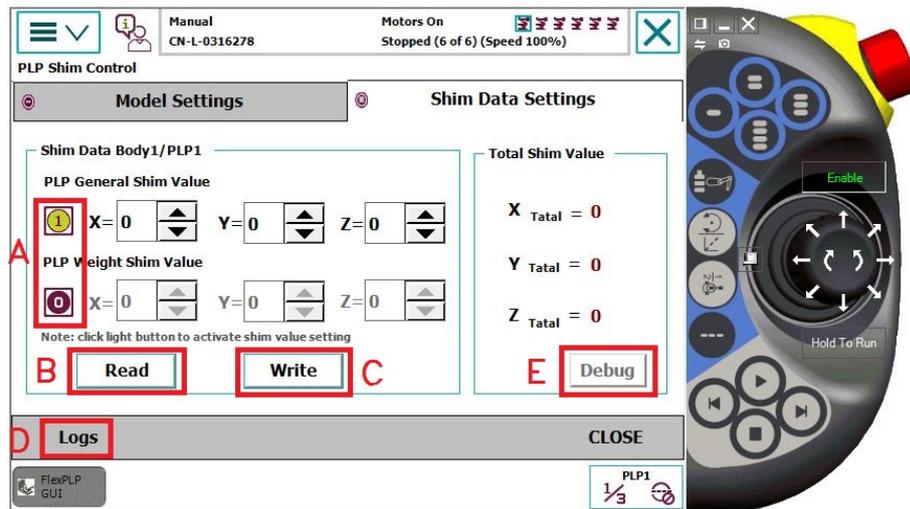
xx1800003154

The value of **PLP General Shim Value** and **PLP Weight Shim Value** constitute the **Total Shim Value**.

	Name	Function Description
A	Switch	The switches indicate the status of PLP shim data. The total offset value is the sum of general shim value and the weight shim value. • If the switch turns red, and displays **0**, the shim data of this switch will not be added into the total shim value. • If the switch turns green, and displays **1**, the shim data of this switch will be effective.
B	Read	**Read** function is used to read offset value from current controller system.
C	Write	**Write** function is used to record the active offset values that user set on GUI through the current controller system.
D	Logs	**Logs** function is used to check the record of shim data values which helps user tracking the change history.
E	Debug	**Debug** function is used to verify the shim offset value. This function ensures the selected PLP robot moving from current position to the set position.

> ℹ️ **Note**
>
> The limitation of shim offset value on x,y, and z is from -10 mm to 10 mm (only one decimal allowed). Both **PLP General Shim Value** and **PLP Weight Shim Value** are within this limitation.

Continues on next page

This procedure describes the setting data steps that need to be performed when using the shim offset function.

	Action	Note
1	Select **Write** to record active offset value that user inputs on GUI to current controller system.	 xx1800003128
2	Select **OK** for next step.	 xx1800003129
3	Select **Debug** to check if offset tuning is correct and satisfactory. ![i] **Note** Value of shim offsets is the sum of all types of shim offset that user defined.	 xx1800003139
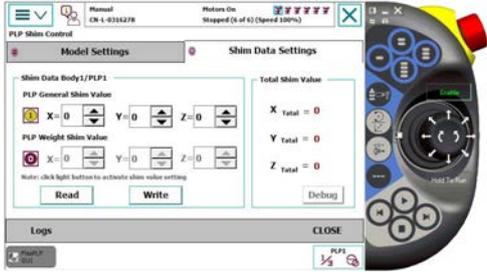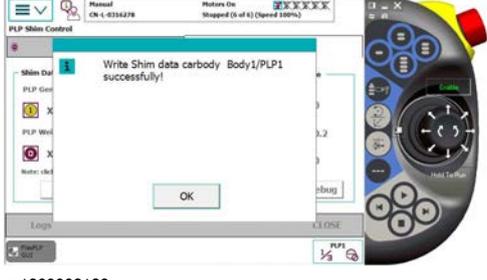
	Action	Note
4	The PLP robot will move to the setting position from previous position with offset. Select **Yes** to confirm the offset setting. **ℹ️ Note** If select **No**, the robot will move back to the original position.	 xx1800003130
	ℹ️ Note If the offset value is out of the work range of robot, there will be a warning message as shown in the figure. Select **Acknowledge** at the right corner of the warning page to close the warning. The next step is: • Select **Yes** to move back to the original position • Select **No** to keep the current position without any movement.	 xx1800003156 xx1800003155
5	Select **Logs** to check the record of shim data values. It can help user tracking the change history	 xx1800003140 xx1800003224
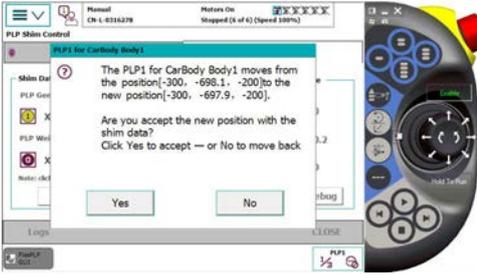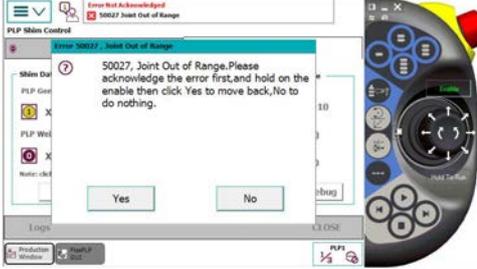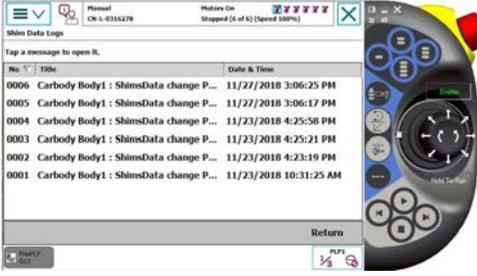
7 Maintenance

7.1 Introduction

General

This chapter details all maintenance activities recommended for the FlexPLP.

It is based on the maintenance schedule specified in *Maintenance schedule on page 129*. The schedule contains information about required maintenance activities including intervals and refers to procedures for the activities.

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

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

Safety information

Observe all safety information before conducting any service work!

There are general safety aspects that must be read through, as well as more specific safety information that describe danger and safety risks when performing the procedures. Read *Safety on page 13* before performing any service work.

Precautions

The precautions below should be observed before proceeding with the maintenance of the FlexPLP:

> ⚠ **CAUTION**
>
> • Before any intervention on the mechanical and electrical components, all power supplies to the FlexPLP as well as to other machines within the danger zone must be turned off.
> • If required, the main switch should be locked.
> • Make sure that the pneumatic system is not pressurized.
> • Use only original ABB spare parts. The use of unauthorized parts or others than original parts will void the warranty.

Required equipment

Equipment	Note
Handling equipment	Specified in *Handling/lifting on page 62*.
Standard toolkit	Specified in *Standard toolkit on page 150*.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	Specified in *Special tools on page 151*.

Bolts and screws and tightening torques

Specified in *Bolt, screws, tightening torques on page 149*.

7.1 Introduction
Continued

Maintenance position

Before proceeding any service work, FlexPLP IRPLP 220 must be in its maintenance position: horizontal axes carriages on their mid-stroke and vertical axis carriage in low position.

The mounting method of the vertical axis showing below is carriage plate fixed with the triangle bracket.
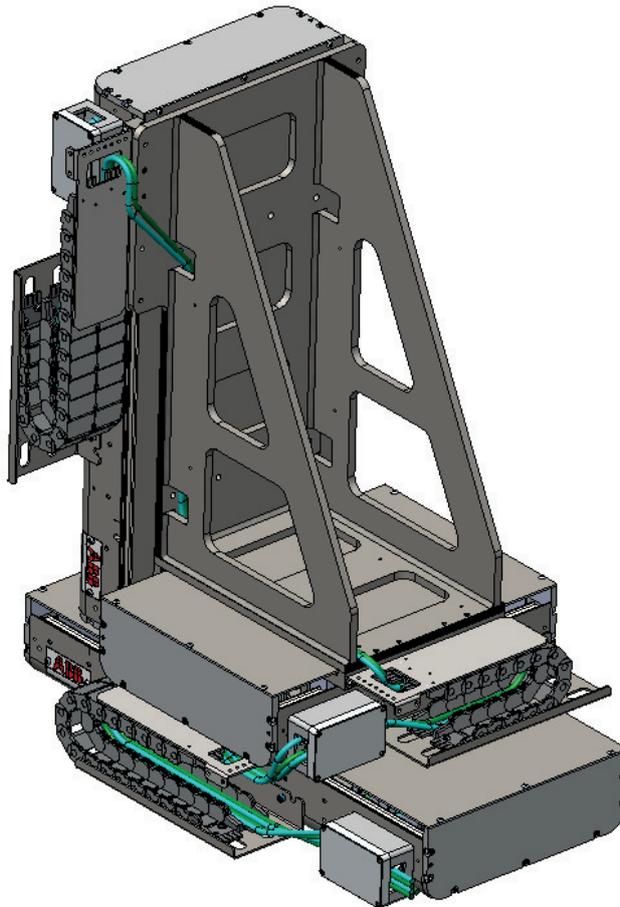
xx1800002165

7.2 Maintenance schedule

The FlexPLP IRPLP 220 must be maintained regularly to ensure proper function. The maintenance activities and intervals are described in the table below.

Unexpected event may also give rise to inspections of the product. Any damage must be attended immediately!

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

Item	Maintenance	Interval	More info.
General condition	Covers removed, inspect the condition of the unit and clean it thoroughly	1 month	*Inspection on page 130*
Cables and connectors	Look for wear or damages.	1 month	
cable chains	Look for wear or damages.	1 month	
Linear guide and ball bearing blocks	Inspect, clean, and lubricate. Manually jog the carriage to both ends of the stroke limit.	3 month or every 100 km	*Lubrication on page 131*
Ballscrew	Inspect, clean, and lubricate	3 month or every 100 km	
Driving belt	• Look for premature wear. • Measure the belt tension and adjust it if necessary. • Replace the belt in case of apparent damage.	1 year	*Driving belt (tension check, adjustment and replacement) on page 135*
Pinion and rack and gearbox	Inspect, clean, lubricate, and check temperature.	3 month or every 100 km	Using a thermodetector to check the temperature. Make sure that the temperature is lower than 90°C.
SMB box backup battery	Replace the battery	Battery low alert [i]	*SMB battery pack replacement on page 140*

[i] Battery low alert (38213 Battery charge low) is displayed when remaining backup capacity (robot powered off) is less than two months. Typical lifetime of a new battery is 36 months if the robot is powered off 2 days/week or 18 months if the robot is powered off 16 h/day. The lifetime can be extended (approx. 3 times) for longer production breaks by a battery shutdown service routine. See *Operating manual - IRC5 with FlexPendant* (3HAC050941-001) for instructions.

7.3 Inspection

General

A thorough inspection of the FlexPLP IRPLP 220 should be done at least once a year.

All covers removed, clean the unit with a lint free cloth.

> ⚠️ **CAUTION**
>
> Before any intervention on the mechanical and electrical components, all power supplies to FlexPLP IRPLP 220 as well as to other machines within the danger zone must be turned off. Remember to go first through the inspections that require the system to be live (e.g., test of all electrical functions and search for abnormal noise).

Emergency stop

To check the emergency stop function, the unit must be stationary. Press the emergency stop button and perform the procedure for restart after an emergency stop as detailed in the controller documentation.

Electrical functions

Test all the electrical functions.

Make sure that each carriage can reach the limits of its stroke.

Abnormal noise

Look for any abnormal noise, e.g., bearing noise.

Cables

Inspect all cables. If a cable is damaged due to wear or pinching, replace it. If a cable rubs against sharp edges, extend the cable so that it hangs freely.

Contacts

Make sure that all connectors are properly connected.

Cable chain

Check the condition of the cable chain and in particular the state of the mechanical links and the fastening points (carriage and base plate).

7.4 Lubrication

General

Location of lubrication ports on the FlexPLP IRPLP 220 differs depending on the driving type. The lubrication mode may also be different according to the actual order time, that is, non-centralized mode or centralized lubrication mode. Refer to the instructions in this section to locate the lubrication ports and perform the lubrication in proper method.

The lubrication is required once each year.

> ⚠️ **WARNING**
>
> Use lithium soap grease, class NLGI 0, with a mineral oil base, doped with EP (extreme pressure) additives. The base oil viscosity must be ISO VG68 to ISO VG 100.Grease doped with EP additives is absolutely necessary, due to high loads on blocks.

Equipment	Note
Lubricant	CASTROL Longtime PD0
Lubricant	TOTAL Multis EP 0

Lubrication of Ballscrew type

Non-centralized lubrication mode

For Ballscrew type of FlexPLP IRPLP 220 in non-centralized lubrication mode, each axis of FlexPLP IRPLP 220 has five lubrication ports: four on the ball bearing blocks, and one on the ballscrew nut.

To access the lubrication ports of the horizontal axis, make sure that the carriage is in maintenance position (mid-stroke) and remove the upper covers, side covers and bellows (if any).

If necessary, clean the ballscrew and/or the linear guides with a lint-free cloth and slightly lubricate them with a brush.

Use a manual pump to inject grease in the five nipples. If difficult to reach the nut grease nipple for small strokes, try to move the carriage to the end. If necessary, remove the flange.
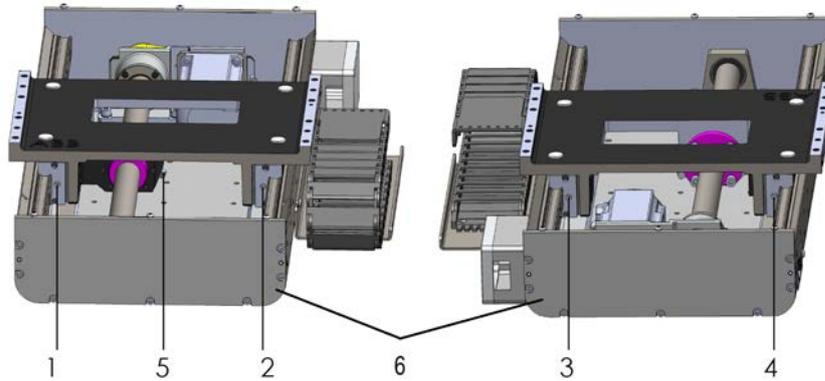
xx1800002166

Ports 1-4	Ball bearing blocks
Port 5	Ballscrew nut
Port 6	Flange

Centralized lubrication mode

For Ballscrew type of FlexPLP IRPLP 220 in centralized lubrication mode, each axis of FlexPLP IRPLP 220 has two external lubrication ports.
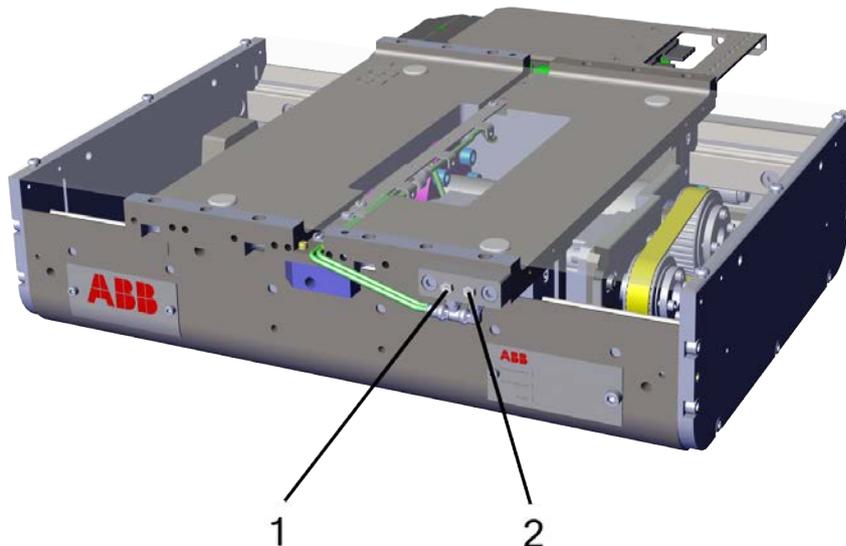
xx2300000022

Ports 1 and 2 are used to lubricate the ballscrew unit and four ball bearing blocks, respectively.

Continues on next page

Use an oil gun to fill in the grease through the ports, with a recommended grease amount of 50 ml or when excessive grease could be observed at the ports.

Lubricate ports of Rack & Pinion type

Non-centralized lubrication mode

For Rack and Pinion type of FlexPLP IRPLP 220 in non-centralized lubrication mode, each axis of FlexPLP IRPLP 220 has four lubrication ports on the four ball bearing blocks and the rack needs lubrication.
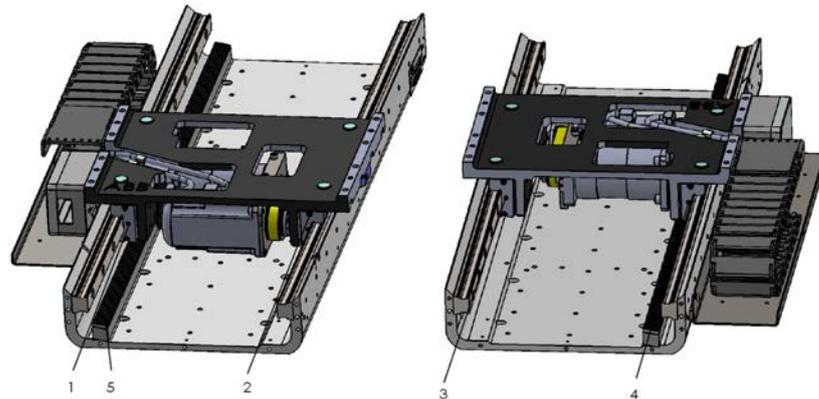
xx1800002167

Ports 1, 2, 3, 4	Ball bearing blocks
Ports 5	Rack

7.4 Lubrication
Continued

Centralized lubrication mode

For Rack and Pinion type of FlexPLP IRPLP 220 in centralized lubrication mode, each axis of FlexPLP IRPLP 220 has two external lubrication ports.
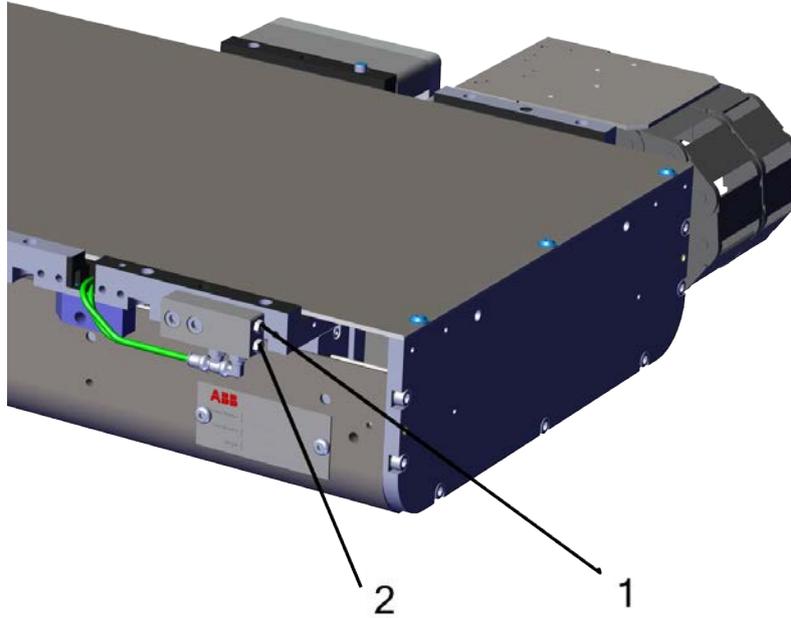
xx2300000023

Ports 1 and 2 are used to lubricate the rack and four ball bearing blocks, respectively.

Use an oil gun to fill in the grease through the ports, with a recommended grease amount of 50 ml or when excessive grease could be observed at the ports.

7.5 Driving belt (tension check, adjustment and replacement)

Inspection

To inspect the driving belt of an horizontal axis, remove the upper cover.

To inspect the belt of a vertical axis, it is necessary to remove the axis from the horizontal axis or surface place to which it is attached.
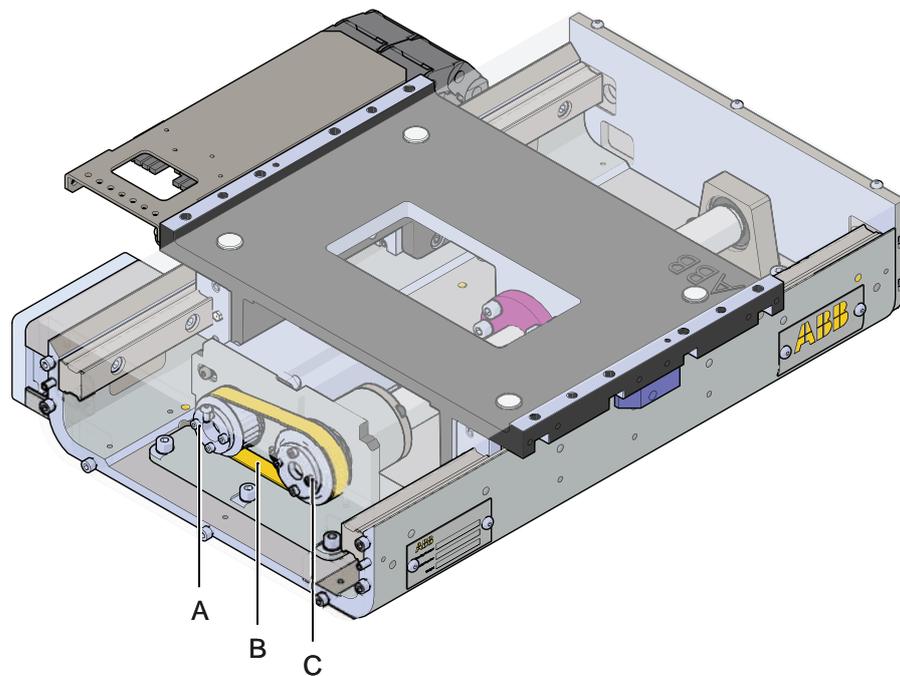
xx1800002168

A	Motor shaft pulley
B	Driving belt
C	Ballscrew shaft pulley

7.5 Driving belt (tension check, adjustment and replacement)
Continued
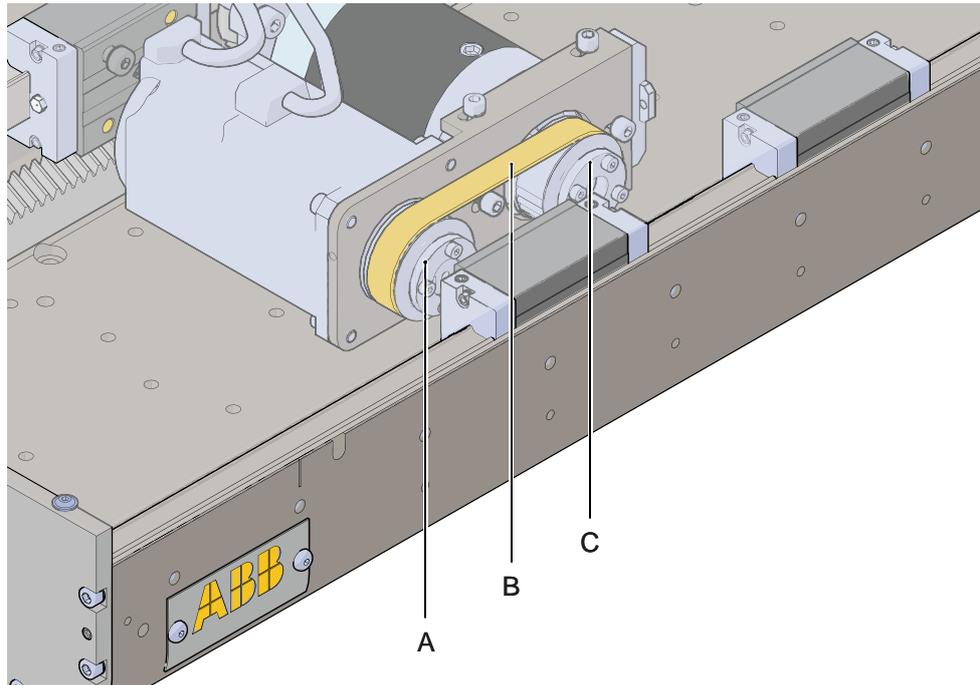
xx1800002169

A	Motor shaft pulley
B	Driving belt
C	Gearbox shaft pulley

Belt wear is normal and the presence of a reasonable quantity of black dust should not be alarming. If however the belt shows signs of significant wear, it should be replaced (*Spare parts on page 153*). In any case, you should measure the tension of the belt and, if necessary, adjust it.

Tension of the belt

The easiest and most reliable method to measure the belt tension is to use a tension gauge with an optical resonance frequency meter, such as the Continental CONTITECH VSM-1.

Below is the correct value for the belt tension

Item	Belt resonance frequency
Ballscrew	185 Hz ± 5 Hz
Rack & Pinion	175 Hz ± 5 Hz

> 💡 **Tip**
>
> You can order a tension gauge (Continental CONTITECH VSM-1) from **ABB** under the reference number 3HAW050009048. See *Special tools on page 151*.

Adjustment or replacement of the belt of Ballscrew unit

	Action	Note
1	FlexPLP IRPLP 220 must be in maintenance position (horizontal carriage at mid stroke, vertical axis in low position).	
2	For vertical axis, remove the eight M8 screws and two dowel pins Ø 8 mm from the vertical axis and take it off the interface bracket. Lay the axis horizontally on the worktable.	xx1800002170
3	Remove the upper cover to clear the access to the belt. **Note** For IRPLP 220 with bellows, remove the bellows first.	
4	Measure the tension of the belt (A), preferably with a tension gauge. If the tension is out of range, slightly loosen the four M6 (B) screws on motor mounting bracket.	C B A xx1800002171
5	Assembly an adjusting hex cap M5 screw (C) and slightly tighten or loosen the screw using a 8 mm wrench adjust the belt to desired tension. When the desired tension is achieved, tighten the four motor mounting bracket screw and check the tension again. Remove the adjusting M5 screw (C) Put the cover back.	
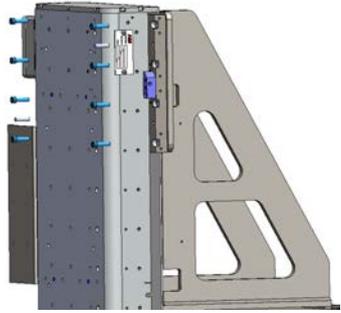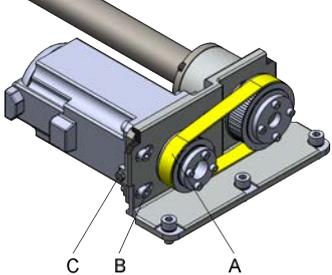
7.5 Driving belt (tension check, adjustment and replacement)
Continued

	Action	Note
6	If a replacement of the belt and/or the pulley is needed, remove the end flange to clear access to the locking device (A). Remove the locking screws and screw them in the adjacent holes to pull the device out. Remove the motor mounting bracket screws to loosen the belt and extract the belt and pulleys (B).	 A B xx1800002172
7	To re-assemble, proceed in opposite order. Make sure, • The belt is perfectly aligned on the two pulleys. • The locking device screws must be tightened in a gradual uniform way, increasing the torque on each equally to 5 Nm.	
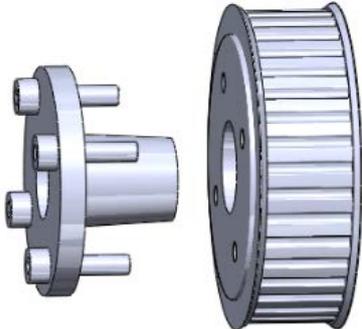
Adjustment or replacement of the belt of Rack & Pinion unit

	Action	Note
1	FlexPLP IRPLP220 must be in maintenance position (horizontal carriage at mid stroke).	
2	Remove the upper cover to clear the access to the belt. ℹ️ **Note** For IRPLP 220 with bellows, remove the bellows first.	
3	Measure the tension of the belt (A), preferably with a tension gauge. If the tension is out of range, slightly loosen the four M6 (B) screws on motor mounting bracket.	 xx1800002173
4	Assembly an adjusting M5 screw (C) and slightly tighten the adjusting M5 screw (C) using a M4 hexagonal spanner to adjust the belt to desired tension. When the desired tension is achieved, tighten the four motor mounting bracket screw and check the tension again. Remove the adjusting M5 screw (C). Put the cover back.	
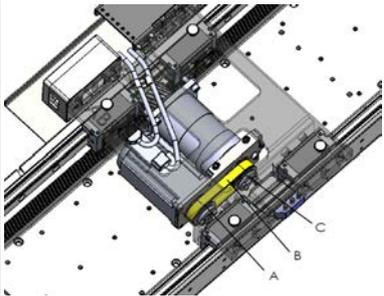
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	Action	Note
5	If a replacement of the belt is needed, loosen and remove the belt.	
6	If a replacement of the pulley is need, loosen the belt and remove the end flange.	 xx1800002172 xx1800002174
7	Use plastic rail to protect rail blocks (C) and take out the carriage system. Clear access to the locking device (A). Remove the locking screws and screw them in the adjacent holes to pull the device out. Remove the motor mounting bracket screws to loosen the belt and extract the belt and pulleys (B).	
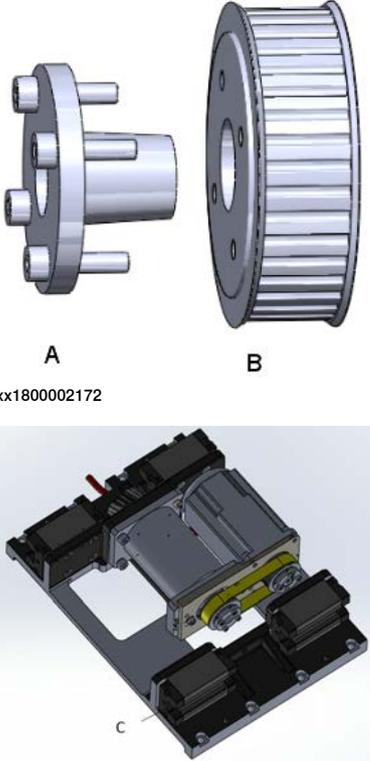
8	To re-assemble, proceed in opposite order.
	Make sure,
	  • The belt is perfectly aligned on the two pulleys.
	  • The locking device screws must be tightened in a gradual uniform way, increasing the torque on each equally to 5 Nm.	

7.6 SMB battery pack replacement

General

The SMB box uses a battery for the memory backup in order to maintain position data. The battery reference number is 3HAC16831-1.

The battery should be replaced:

- Every three years.
- When the battery is going flat. This is generally shown by an error code on the FlexPendant screen (38213). Information about error codes can be found in the FlexPendant documentation.

> ℹ️ **Note**
>
> In a new system the batteries are charged to full capacity after a few hours in STANDBY mode.

Instructions

Replace the SMB battery as follows:

	Action
1	Position all of the carriages at the calibration mark. See *Calibration marks on page 92*.
2	Switch off the power on the SMB box. ⚠️ **WARNING** Turn off all electric power and pneumatic pressure supplies to the unit!
3	Open the SMB box and locate the battery.
4	Cut the plastic straps.
5	Unplug the 2 wires cable from the board and remove the battery pack.
6	Place the new battery pack, plug the connector on the board, and secure the pack with straps.
7	Close the SMB box, switch on the power.
8	Update the revolution counters of each axis.

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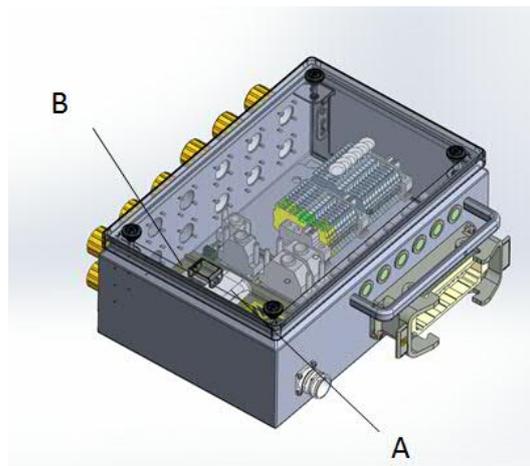
xx1800002178

A	Battery
B	Board

7.7 Repair information

Replacement of critical parts

Some critical components require to be replaced by properly trained ABB personnel.

In the case of failure of the parts listed below, please contact ABB in order to arrange an onsite repair by an ABB technician, or send the unit (or axis) for "exchange repair":

- The ballscrew
- The motors
- The gearbox
- The racks and pinion
- The added rails

> ⚠️ **WARNING**
>
> If you want to replace parts by your own technician, please contact ABB for detailed replacement documentation and make sure all the repair works will be conducted by trained and qualified personals. You should always perform safety risk assessment before conducting any repair works. In no event shall ABB be liable for incidental or consequential damages arising from repair works by your own technician.

8 Decommissioning

Safety information

Before any service work is commenced, it is extremely important that all safety information is observed! Read *Safety on page 13* before performing any service work.

Precautions

The precautions below should be observed before proceeding with the decommissioning of the FlexPLP:

> ⚠ **CAUTION**
>
> • All power supplies to the FlexPLP as well as to other machines within the danger zone must be turned off.Make sure that the pneumatic circuit is not pressurized.
> • If required, the main switch should be locked.

Required equipment

Equipment	Note
Handling equipment	Specified in *Handling/lifting on page 62*.
Standard toolkit	Specified in *Standard toolkit on page 150*.

8 Decommissioning

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).
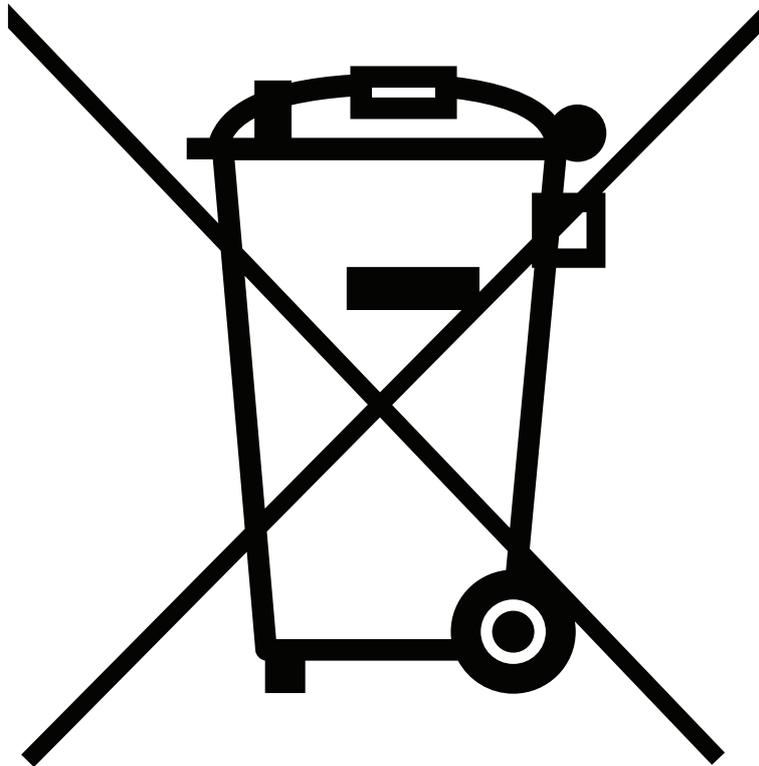
xx1800000058

Hazardous material

The table specifies some of the materials in the product and their respective use throughout the product. Dispose of the components properly to prevent health or environmental hazards.

Material	Example application
Aluminum	Connector box, and so on.
Copper alloy	Cable, motor, and so on.
Steel	Gears, screws, nuts, and so on.
Plastic / Rubber (PVC)	Cables, connectors, belt, and so on.

Continues on next page

Oil and grease

Where possible, arrange for the oil and grease to be recycled. Dispose of oil and grease 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.

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9 Reference information

9.1 Introduction

General

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

9.2 Unit conversion

Converter table

Use the following table to convert units used in this manual.

Quantity	Units		
Length	1 m	3.28 ft.	39.37 in
Weight	1 kg	2.21 lb.	
Weight	1 g	0.035 ounces	
Pressure	1 bar	100 kPa	14.5 psi
Force	1 N	0.225 lbf	
Moment	1 Nm	0.738 lbf-ft	
Volume	1 L	0.264 US gal	

9.3 Bolt, screws, tightening torques

Bolt and screws

Before tightening any screw or bolt, observe the following:

- Determine whether a standard tightening torque or special torque is to be applied. The standard torques are specified in the following tables. Any special torques are specified in the repair, maintenance or installation procedure descriptions. Any special torque specified overrides the standard torque! Use the correct tightening torque for each type of screw joint.

- Only use correctly calibrated torque wrench.

- Always tighten the joint by hand, and never use pneumatic tools.Use the correct tightening technique, tighten the screw in a slow, flowing motion.Maximum allowed total deviation from the specified value is 10%!

> **Note**
>
> Unless indicated otherwise, the bolts used on (or provided with) the FlexPLP are of class 8.8.

> **Note**
>
> Unless indicated otherwise, all bolts must be free of oil or grease and tightened with a mild thread-locker such as Loctite 243.

Standard tightening torques

The following table specifies the recommended standard tightening torques for hex screws and socket head hex screws:

Screw thread size	M5	M6	M8	M10	M12
Tightening torque CLASS 8.8	5.5 Nm	9.5 Nm	23 Nm	46 Nm	79 Nm
Tightening torque CLASS 10.9	8.1 Nm	14 Nm	34 Nm	67 Nm	116 Nm
Tightening torque CLASS 12.9	9.5 Nm	16.4 Nm	40 Nm	79 Nm	136 Nm

The following table specifies the recommended standard tightening torque for water and air connectors when one or both connectors are made of brass:

Dimension (unit: inch)	Tightening torque Nm - Nominal	Tightening torque Nm - Minimal	Tightening torque Nm - Maximum
1/8	12 Nm	8 Nm	15 Nm
1/4	15 Nm	10 Nm	20 Nm
3/8	20 Nm	15 Nm	25 Nm
1/2	40 Nm	30 Nm	50 Nm
3/4	70 Nm	55 Nm	90 Nm

9.4 Standard toolkit

General

All service (repairs, maintenance and installation) procedures contain lists of tools required to perform the specified activity.

All special tools required are listed directly in the procedures while all the tools that are considered standard are gathered in the standard toolkit and defined in the table below.

This way, the tools required are the sum of the standard toolkit and any tools listed in the instruction.

Contents, standard toolkit

Qty	Tool
1	Set of spanners
1	Hex keys (Allen key) 3 mm, 4 mm, 5 mm, and 6 mm
1	Torque wrench 5 Nm-25 Nm
1	Ratchet head for torque wrench 1/4"
1	Socket head cap 4 mm, 5 mm and 6 mm socket 1/4" bit L 20 mm (for socket head cap screws - ISO 4762)
1	Plastic mallet
1	Dowel Pin remover
1	Mild thread-locker (Recommended: Loctite 243)

9.5 Special tools

General

All service instructions contain lists of tools required to perform the specified activity. The required tools are a sum of standard tools, defined in the section *Standard toolkit on page 150*, and of special tools, listed directly in the instructions and also gathered in this section.

Special tools

The following tables specify the special tools required during several of the service procedures. The tools are also specified directly in the corresponding section of instructions in the Product manual.

For operations on pneumatic connectors, the special tools are as follows.

Qty	Tool	Product
1	Thread sealant for conical fittings	Loctite 577

For operations on electrical parts, the special tools are as follows.

Qty	Tool	Product
1	Wire strippers	
1	Cable cutters	

Special tools available from ABB

The following table specifies the special tools required during several of the service procedures. The tools may be ordered separately and are also specified directly in concerned instructions in the Product manual.

Qty	Tool	Product
1	Tension gauge	3HAW050009048
2	Calibration pin Ø8 x 50 mm	3HAW050041930

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10 Spare parts

10.1 Introduction

General

This chapter specifies all spare parts and replacement articles of the FlexPLP. It is divided in 5 sections:

- Spare parts for ballscrew unit axes.
- Spare parts for Rack and Pinion axes, which share most of their components with ballscrew units.
- Spare parts for bellows.
- Spare parts for covers.
- Electrical parts: SMB boxes, static cables.

Some spare parts must be chosen according to the strokes of your PLP.

In any case, contact ABB if you do not know what type of material is required for your PLP.

10.2 Spare parts - Ballscrew type

Main parts
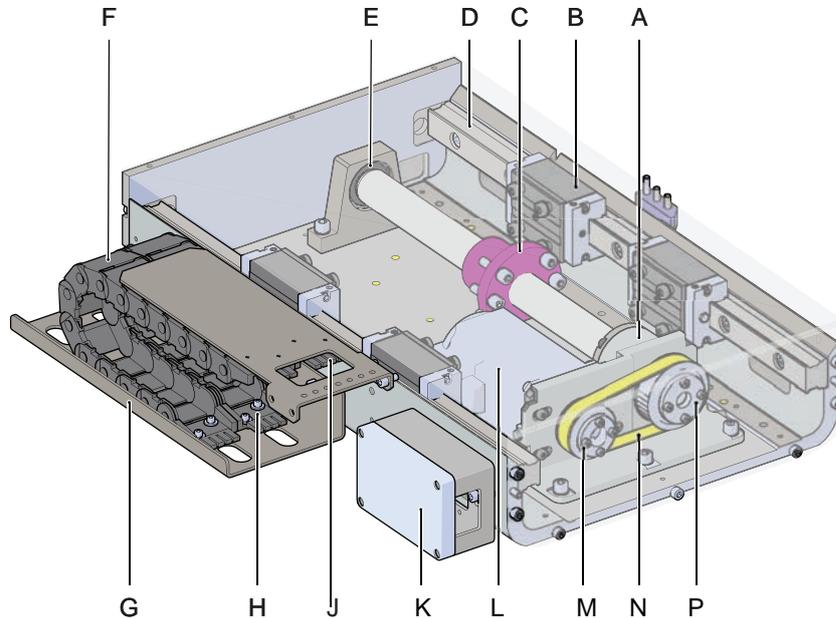
xx1800002175

Item	Quant-ity	ABB part reference no.	Note
A	2	3HAW050041890	Bearing
B	4	3HAW050041850	Linear ball bearing block
C	1	3HAW050041871	Ballscrew stroke 190 mm type Dia. 32x5
		3HAW050041872	Ballscrew stroke 270 mm type Dia. 32x5
		3HAW050041873	Ballscrew stroke 350 mm type Dia. 32x5
		3HAW050041874	Ballscrew stroke 430 mm type Dia. 32x5
		3HAW050041875	Ballscrew stroke 510 mm type Dia. 32x5
		3HAW050041876	Ballscrew stroke 590 mm type Dia. 32x5
		3HAW050041877	Ballscrew stroke 670 mm type Dia. 32x5
D	2	3HAW050041851	Rail stroke 190 mm
		3HAW050041852	Rail stroke 270 mm
		3HAW050041853	Rail stroke 350 mm
		3HAW050041854	Rail stroke 430 mm
		3HAW050041855	Rail stroke 510 mm
		3HAW050041856	Rail stroke 590 mm
		3HAW050041857	Rail stroke 670 mm
E	1	3HAW050041895	Bearing
F	26 [i]	3HAW050041803	Chain link 14.3.038
G	1	3HAW050041825-7035	Tray

Continues on next page

Product manual - FlexPLP IRPLP 220
3HAW050041018-001 Revision: D

Item	Quantity	ABB part reference no.	Note
H	2	3HAW050041804	Chain fixed end 114.3.1PZ
J	2	3HAW050041805	Chain moving end 114.3.2PZ
K	1	3HAW050041823	Cable box
L	1	3HAW050041970	Motor
M	1	3HAW050041897	Pulley - motor shaft
N	1	3HAW050041899	Driving belt
P	1	3HAW050041898	Pulley - ballscrew shaft

i   The number of chain link depends on strokes: 26 for stroke 190 mm, 28 for stroke 270 mm, 32 for stroke 350 mm, 34 for stroke 430 mm, 36 for stroke 510 mm, 40 for stroke 590 mm and 42 for stroke 670 mm.

> **Note**
>
> Contact ABB if you do not know whether your FlexPLP requires:
> - Material for strokes
> - Ballscrew type or Rack & Pinion type

Centralized lubrication parts

> **Note**
>
> Spare parts illustrated in following figure are based on grease adding from left side.
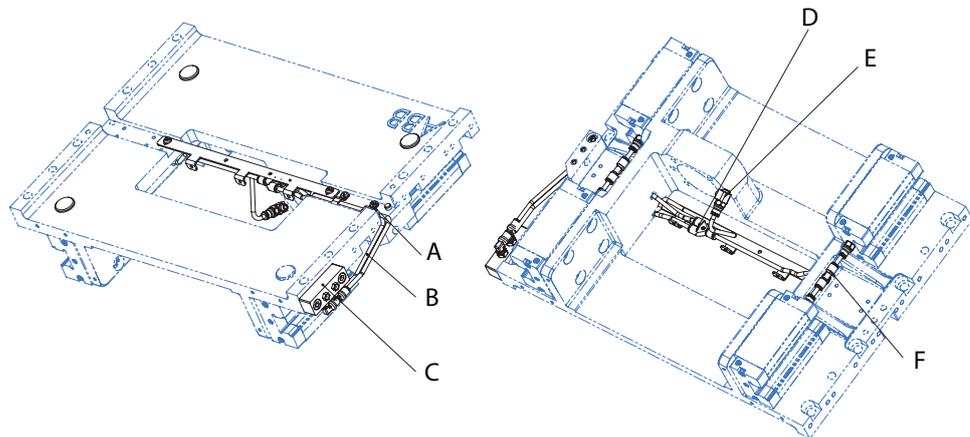
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Item	Quantity	ABB part reference no.	Note
A	2	3HAW050040545	Pipe clamp
B	1	3HAW050040889	Pipe
C	2	3HAW050040465	Nipple
	2	3HAW050040884	Stud fitting

Continues on next page

10.2 Spare parts - Ballscrew type
Continued

Item	Quantity	ABB part reference no.	Note
D	1	3HAW050041518	Y connector
E	1	3HAW050041819	Fitting
	1	3HAW050041519	Plug
	1	3HAW050041879	O-ring
F	2	3HAW050040883	T connector
	4	3HAW050041517	Fitting

The number of chain link depends on strokes: 26 for stroke 190 mm, 28 for stroke 270 mm, 32 for stroke 350 mm, 34 for stroke 430 mm, 36 for stroke 510 mm, 40 for stroke 590 mm and 42 for stroke 670 mm.

10.3 Spare parts - Rack & Pinion type

Main parts

The outside components of the two types of FlexPLP IRPLP 220 are same, such as the outside cable chain, rails with linear ball bearing blocks. So here only the spare parts that are different with the Ballscrew type of FlexPLP IRPLP 220 will be described. For ABB reference no.of cable chain and other parts, please refer to *Spare parts - Ballscrew type on page 154*.
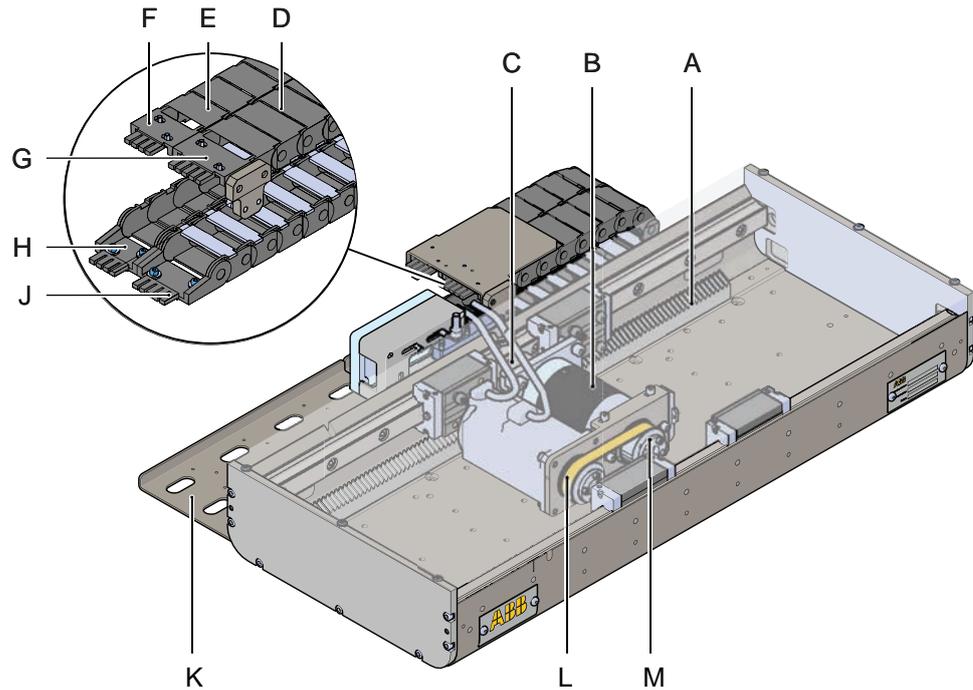
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Item	Quantity	ABB part reference no.	Note
A[i]	1	3HAW050041881	Rack stroke 990 mm, 1,150 mm, 2,110 mm
	1	3HAW050041882	Rack stroke 990 mm
	1	3HAW050041711	Rack stroke 1,150 mm£¬ 1,630 mm
	2	3HAW050041881	Rack stroke 1,630 mm
	2	3HAW050041711	Rack stroke 2,110 mm
B	1	3HAW050041920	Gearbox
C	1	3HAW050041924	Pinion
D	26[ii]	3HAW050041977	Chain link 14.4.038
E	26[ii]	3HAW050041803	Chain link 14.4.038
F	1	3HAW050041805	Chain moving end 114.3.2PZ
G	1	3HAW050041979	Chain moving end 114.4.2PZ
H	1	3HAW050041804	Chain fixed end 114.3.1PZ

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10.3 Spare parts - Rack & Pinion type
Continued

Item	Quant-ity	ABB part reference no.	Note
J	1	3HAW050041978	Chain fixed end 114.4.1PZ
K	2	3HAW050041808-7035	Tray
L	1	3HAW050041922	Driving belt
M	1	3HAW050041921	Pulley - gearbox shaft

i   For example, stroke 1,630 mm, the rack is combined by one 3HAW050041711 and two 3HAW050041881.

ii The number of chain link depends on strokes: 26 for stroke 990 mm, 29 for stroke 1,150 mm, 37 for stroke 1,630 mm and 45 for stroke 2,110 mm.

Centralized lubrication parts

> ℹ️ **Note**
>
> Spare parts illustrated in following figure are based on grease adding from left side.
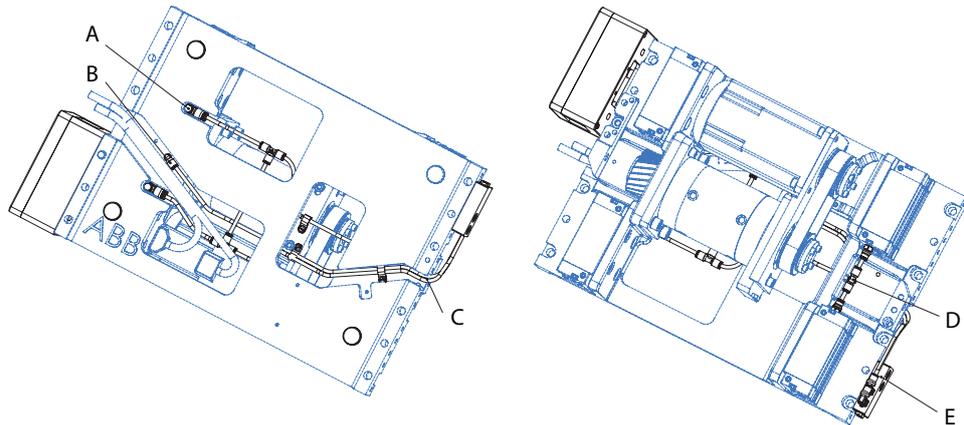
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Item	Quant-ity	ABB part reference no.	Note
A	2	3HAW050041512	Fitting
B	1	3HAW050041607	Fitting
C	1	3HAW050040889	Pipe
D	3	3HAW050040883	T connector
	2	3HAW050041517	Fitting
E	2	3HAW050040884	Stud fitting
	2	3HAW050040465	Nipple

10.4 Spare parts - Bellow

Bellows
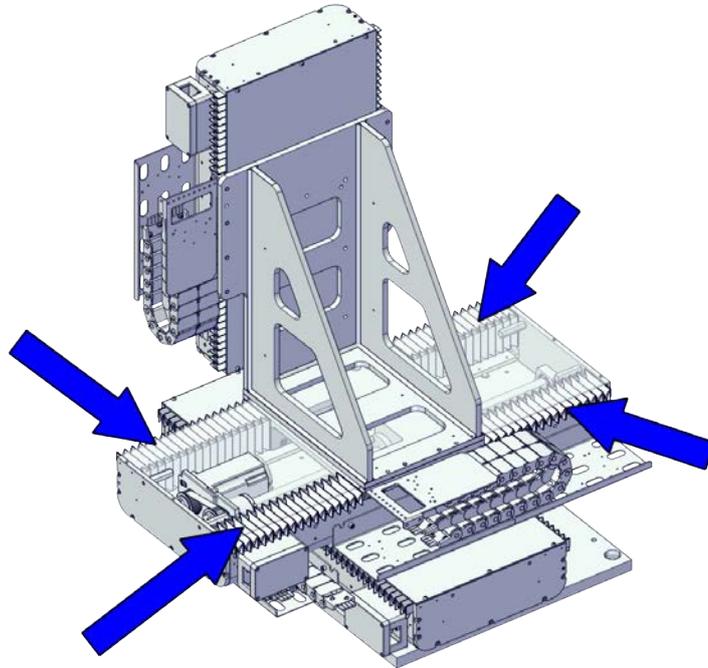
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Item	Quant-ity	ABB part reference no.	Note
-	4	3HAW050041787	Rail stroke 190 mm
		3HAW050041787	Rail stroke 270 mm
		3HAW050041787	Rail stroke 350 mm
		3HAW050041784	Rail stroke 430 mm
		3HAW050041785	Rail stroke 510 mm
		3HAW050041786	Rail stroke 590 mm
		3HAW050041787	Rail stroke 670 mm
		3HAW050041788	Rail stroke 880 mm

10.5 Covers
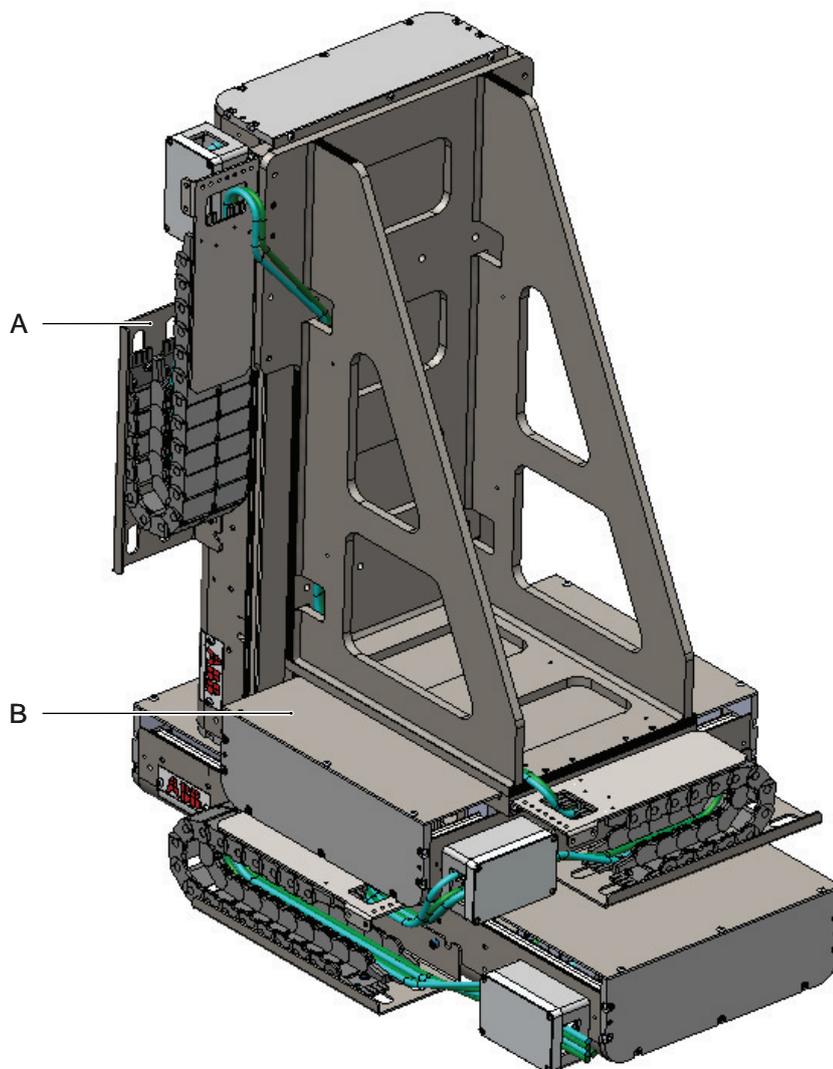
Covers

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Item	Quantity	ABB part reference no.	Note
A	1 or 2	3HAW050041825-7035	Cable tray (Ballscrew)
		3HAW050041808-7035	Cable tray (Rack & Pinion)
B	1 per axis	3HAW050041841-7035	Cover stroke 190 mm
		3HAW050041842-7035	Cover stroke 270 mm
		3HAW050041843-7035	Cover stroke 350 mm
		3HAW050041844-7035	Cover stroke 430 mm
		3HAW050041845-7035	Cover stroke 510 mm
		3HAW050041846-7035	Cover stroke 590 mm
		3HAW050041847-7035	Cover stroke 670 mm

10.6 Cables

Cables: from controller to SMB box

ABB part reference no.	Description
3HAW050008612-005	6 axis resolver static cable XS41-2 5 m
3HAW050008612-010	6 axis resolver static cable XS41-2 10 m
3HAW050008612-015	6 axis resolver static cable XS41-2 15 m
3HAW050008614-005	3 axis motor static cable XP7 400-600 V 5 m
3HAW050008614-010	3 axis motor static cable XP7 400-600 V 10 m
3HAW050008614-015	3 axis motor static cable XP7 400-600 V 15 m
3HAW050008616-005	6 axis motor static cable XP1 400 V 5 m
3HAW050008616-010	6 axis motor static cable XP1 400 V 10 m
3HAW050008616-015	6 axis motor static cable XP1 400 V 15 m

SMB boxes

ABB part reference no.	Description
3HAW050008651	SMB box 6 axis M2011 (Does not include board & battery! Order in addition 3HAC044168-001 and 3HAC044075-001)
3HAW050008605	SMB box 3 axis M2008 (Does not include board & battery! Order in addition 3HAC044168-001 and 3HAC044075-001)
3HAC044168-001	Main board for SMB box
3HAC044075-001	Battery for SMB box
3HAW050008607	PTC Shunt M2008

Cables: from SMB box to mechanical unit

Quantity	ABB part reference no.	Description
1 per axis	3HAW050041981-002	1 Resolver Static M2008 2 m
1 per axis	3HAW050041981-005	1 Resolver Static M2008 5 m
1 per axis	3HAW050041981-010	1 Resolver Static M2008 10 m
1 per axis	3HAW050041981-015	1 Resolver Static M2008 15 m
1 per axis	3HAW050041980-002	1 Motor Static or Extension M2008 2 m
1 per axis	3HAW050041980-005	1 Motor Static or Extension M2008 5 m
1 per axis	3HAW050041980-010	1 Motor Static or Extension M2008 10 m
1 per axis	3HAW050041980-015	1 Motor Static or Extension M2008 15 m

ABB

ABB AB
Robotics & Discrete Automation
S-721 68 VÄSTERÅS, Sweden
Telephone +46 (0) 21 344 400

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

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

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

abb.com/robotics