ABB

ROBOTICS

Product manual

OmniCore standalone controller

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Product manual

OmniCore C30 Type A
OmniCore C90XT Type A
OmniCore E10
OmniCore V250XT Type B
OmniCore V400XT

OmniCore

Document ID: 3HAC095600-001

Revision: A

Original instructions.

Table of contents

Overview of this manual

About this manual

This manual details the setup of a standalone OmniCore controller with a non-ABB manipulator. It should be used together with the manual for additional axes and the product manual for the respective OmniCore controller variant.

Usage

This manual can be used as a brief description of how to install, and configure a standalone controller. Detailed instructions for installation of the controller is available in the respective product manual for the controllers.

This manual also provides information about relevant technical data and system parameters for non-ABB manipulators. Detailed information regarding system parameters, RAPID instructions and so on can be found in the respective reference manual.

Who should read this manual?

This manual is intended for advanced users and integrators.

Prerequisites

The reader should...

- be familiar with industrial robots and their terminology
- be familiar with controller configuration and setup
- be familiar with the mechanical and dynamic properties of the controlled mechanism.

References

Reference	Document ID
Application manual - Additional axes	*3HAC082287-001*
Product manual - OmniCore C30 Type A	*3HAC089064-001*
Product manual - OmniCore C90XT Type A	*3HAC089065-001*
Product manual - OmniCore V250XT Type B	*3HAC087112-001*
Product manual - OmniCore V400XT	*3HAC081697-001*
Application manual - Controller software OmniCore	*3HAC066554-001*
Application manual - Servo Gun Setup	*3HAC086084-001*
Operating manual - RobotStudio	*3HAC032104-001*
Operating manual - OmniCore	*3HAC065036-001*
Technical reference manual - RAPID Instructions, Functions and Data types	*3HAC065038-001*
Technical reference manual - System parameters	*3HAC065041-001*
Application manual - TuneMaster	*3HAC063590-001*
Product specification - Motor Units and Gear Units	*3HAC090259-001*
Product manual - Motor Units and Gear Units	*Document.ID-1*

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Revisions

Revision	Description
A	First edition.

1 Introduction to the standalone controller

1.1 Overview

Intended use

Standalone controller is an ABB controller delivered without an ABB manipulator. The purpose is to build a non-ABB robot, usually to be combined with ABB robots. The controller with mechanical unit shall comply with national and regional regulations, for example, ISO 10218-1:2011 and ISO 10218-2.

Considerations for planning, installation, and commissioning

When the controller is used in a robot system with external axes or a non-ABB manipulator, the system requires configuration and tuning as detailed in this manual. This manual can also be useful when such a system needs to be upgraded.

As external axes and non-ABB manipulators consume more power the drive system needs a more powerful rectifier and capacitor. In addition, suitable drive units must be installed in the controller. The hardware setup must also be configured with software to make the system functional.

The OmniCore standalone controller for non-ABB manipulators is delivered without cables and SMB. However, an SMB from ABB is recommended. Both the SMB and cables can be ordered as spare parts from the customer service organization of ABB.

When planning the design of the final application, the selection of cables, grounding, shielding, isolation, etc. shall be done to fit the intended use. The motors and other equipment must be selected based on your needs.

Basic approach

This is the basic approach to set up a non-ABB manipulator in the robot controller.

- Installation
- Configuration
- Commutation
- Tuning

For a detailed description of how this is done, see the respective section.

For more information on the hardware components see *Hardware on page 69*.

OmniCore standalone controller

The following OmniCore controllers are available as standalone:

- E10
- C30
- C90XT type A
- V250XT type B
- V400XT

Continues on next page

Related information

The product manual for the respective robot controller contains detailed information for the lifecycle of the controller.

- Safety, including safety data and stopping functions
- Descriptions and technical data
- Installation and commissioning
- Maintenance
- Repair
- Decommissioning
- Troubleshooting
- Spare parts

1.2 Definitions

Robot

A robot is a mechanical unit with a tool center point (TCP), programmable in three or more axes. A robot can be programmed both in Cartesian coordinates (x, y and z) of the TCP and in tool orientation.

Single-robot system

A single-robot system can have

- only one motion task
- only one robot
- up to 6 additional axes (which can be grouped in an arbitrary number of mechanical units)
- up to 12 axes in total

> **Tip**
>
> In a single-robot system, semi-independent programming of individual mechanical units or axes can be achieved through the option *Independent Axes*. However, MultiMove is normally preferred when independent programming is desired.

MultiMove system

A MultiMove system can have

- up to 7 motion tasks
- up to 3 robots (3*6=18 axes)
- up to 24 axes, including the maximum 18 robot axes

Regardless of controller combination the limit is set to 3 IRB = 18 axis + total 6 ADU. These ADUs can be used placed in any combination of controllers. If all 6 are used in one V400XT then no ADU can be used in other controllers.

See *Application manual - MultiMove*.

Additional axes

The robot controller can control additional axes besides the robot axes. They can be jogged and coordinated with the movements of the robot. The system may have a single additional axis, for example, a motor, or a set of additional axes such as a two axis positioner.

Standalone controller

Standalone controller means an ABB controller delivered without an ABB manipulator. It can be used for single-robot and MultiMove systems alike. MultiMove makes it possible to configure and run multiple mechanical units on the same main computer.

1.3 General guidelines and limitations

Use integer gear ratio

The transmission gear ratio between motor and arm of a continuously rotating axis shall be an integer in order not to cause calibration problems when updating revolution counters.

When the revolution counter is updated, the number of motor revolutions is reset. In order for the zero position of the motor to coincide with the zero position of the arm, independent of number of revolutions on the arm side, the gear ratio needs to be an integer (not a decimal number).

Example: Gear ratio = 1:81 (not 1:81.73).

This problem will only be visible when updating revolution counters with the arm side rotated n turns from the original zero position. I.e. an axis with mechanical stops will not have this problem.

WARNING

The manual mode peripheral speed of an axis must be restricted to 250mm/s for personal safety reasons. The speed is supervised at three different levels, which means that two system parameters need to be set up. For more information see *Limit peripheral speed of an axis on page 15*.

National or regional regulations

The integrator of the controller is responsible for the safety of the application.

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

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

Limitations

The standalone controller cannot be combined with the SafeMove options.

2 Installation

2.1 Introduction

Overview

This section details how to create and install a standalone controller system to be used with non-ABB manipulator. The basic steps to do this are as follows:

- Find the correct drive unit configuration.
- Find the appropriate kinematic model.
- Install RobotWare and the standalone controller software on your PC.
- Create a standalone controller system with the selected kinematic model.
- Download the system to the robot controller.

This section also details how to modify and distribute a standalone package for easy installation and startup at a customer.

Complete installation instructions

The complete installation instructions for the controller hardware itself is available in the respective product manual.

2.2 Drive unit for non-ABB manipulators

Drive unit configuration

The table shows the different drive units available for non-ABB manipulators.

No of axes	Corresponding robot	Drive units
6	IRB 1100, 1300, 1510, 1520, 1600	TBD
4	IRB 360, IRB 365, IRB 390	TBD
6	IRB 2400, 4400, 4600, 57x0, 6700, 67x0, 77x0, 8700	TBD
4	IRB 460, 660, 760	TBD

For definitions of drive units and power stages see *Drive units on page 74*.

2.3 Limit peripheral speed of an axis

CAUTION

Incorrectly defined parameters will result in incorrect speed. Always verify the speed after changing these parameters.

There is a hazard that the speed 250 mm/s is exceeded in manual reduced speed mode.

Note

This information is applicable for additional (auxiliary/external) axes and non-ABB manipulators.

Calculate parameter values

Two system parameters need to be configured. The parameters belong to the type *Supervision Type* in the configuration topic *Motion* and are expressed in ratio of max speed (1 = 100%).

Teach Max Speed Main

Teach Max Speed Main = (x / *Arm Length*) * (*Transmission Gear Ratio* / *Speed Absolute Max*)

where:

- x is the speed in mm/s
- *Transmission Gear Ratio* belongs to the type *Transmission*.
- *Speed Absolute Max* belongs to the type *Stress Duty Cycle* (rad/s).
- *Arm Length* should be measured from the rotational center of the external axis (meter).

If the result of the calculation exceeds 0.94, use 0.94 instead of the calculated value.

Insert the calculated result at the type *Supervision Type: Teach Max Speed Main*.

Teach Max Speed DSP

Calculate and use the largest value of:

- *Teach Max Speed Main* * 1.20
- *Teach Max Speed Main* + (8 / *Speed Absolute Max*)

Insert the calculated result at the type *Supervision Type*: *Teach Max Speed DSP*.

Example

Given parameter values

Transmission Gear Ratio = 120

Speed Absolute Max = 320 rad/s

Arm Length = 0.5 m

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Calculations

Teach Max Speed Main = (0.25 /*Arm Length*) * (*Transmission Gear Ratio* / *Speed Absolute Max*) = (0.25 / 0.5) * (120 / 320) = 0.188

Teach Max Speed Dsp = max{(*Teach Max Speed Main* * 1.20) , (*Teach Max Speed Main* + (8 / *Speed Absolute Max*))} = max{(0.188 * 1.2) , (0.188 + (8 / 320))} = max {0.226 , 0.213} = 0.226

2.4 Kinematic models

2.4.1 Introduction

Overview

This section describes the different built-in kinematic models available in the controller. It serves as a guideline for choosing the appropriate model for the current robot system.

Model groups

The table below describes the different groups of kinematic models.

Notation:	Indicates:
Area	three to six axes
Linear	two to five axes

Model notation

The specific kinematic models within a model group are designated with a combination of capital letters. The table below details the meaning of this notation.

Notation:	Indicates:
X, Y, Z	linear motion
A, B, C, D, E, F	rotational movement
A(X)	rotational movement around X-axis
A(Y)	rotational movement around Y-axis
A(Z)	rotational movement around Z-axis

Note

The base frame is orientated so that the linear motions are parallel to the directions of the base frame axes X, Y and Z.

Related information

Useful information:

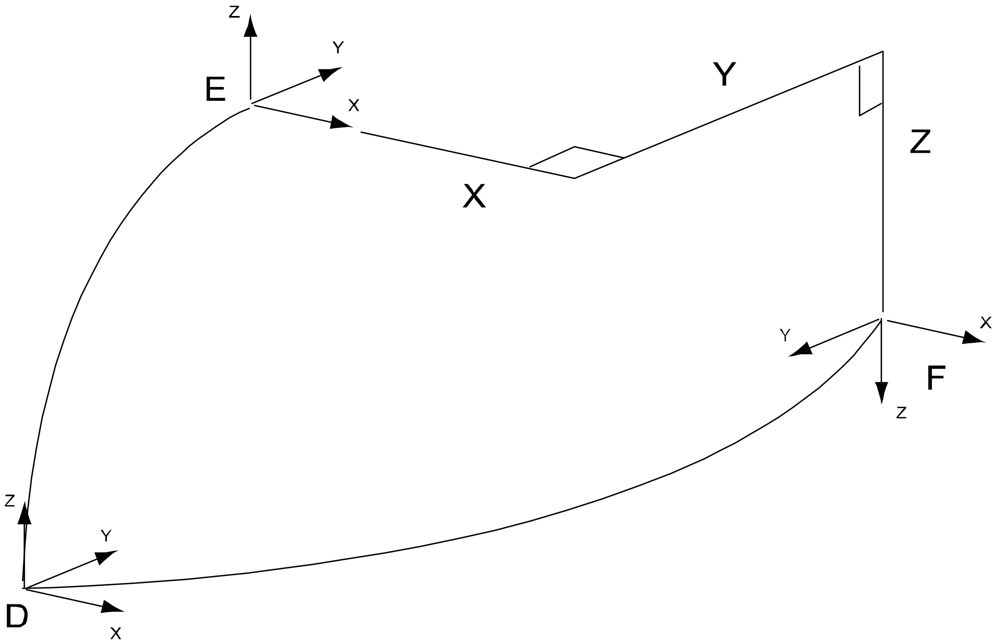
- Read about base and world coordinates in *Operating manual - OmniCore*, section *Jogging*.

2.4.2 Kinematic model XYZ

Description

The kinematic model is based on an area gantry concept, with three linear motions and no rotations.

Illustration



xx0300000614

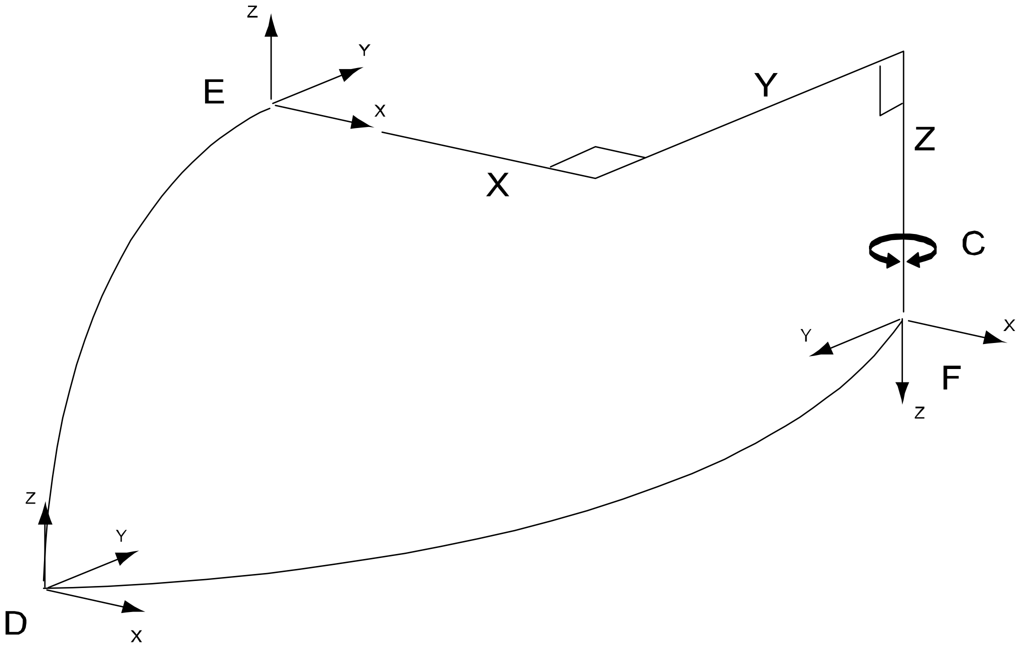
D	World frame
E	Base frame
F	Tool frame
X	X-linear motion
Y	Y-linear motion
Z	Z-linear motion

2.4.3 Kinematic model XYZC(Z)

Description

The kinematic model is based on an area gantry concept, with three linear motions and one rotation.

Illustration



xx0300000616

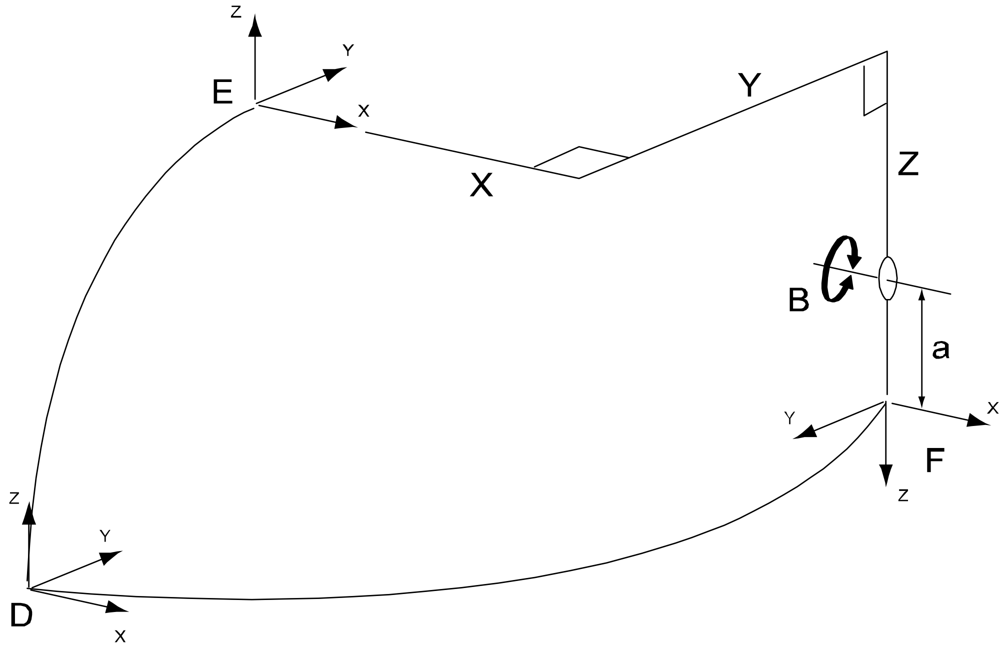
D	World frame
E	Base frame
F	Tool frame
X	X-linear motion
Y	Y-linear motion
Z	Z-linear motion
C	C rotating around Z axis in base frame

2.4.4 Kinematic model XYZB(X)

Description

The kinematic model is based on an area gantry concept, with three linear motions and one rotation.

Illustration



xx0300000617

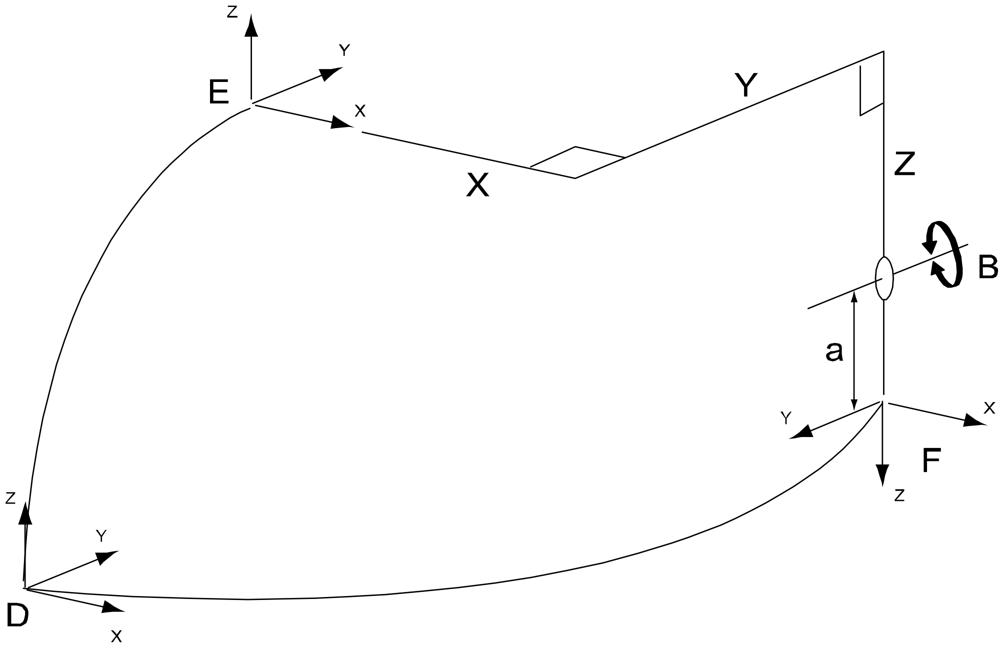
D	World frame
E	Base frame
F	Tool frame
X	X-linear motion
Y	Y-linear motion
Z	Z-linear motion
B	B rotating around X axis in base frame
a	*offset_z* of arm

2.4.5 Kinematic model XYZB(Y)

Description

The kinematic model is based on an area gantry concept, with three linear motions and one rotation.

Illustration



xx0300000618

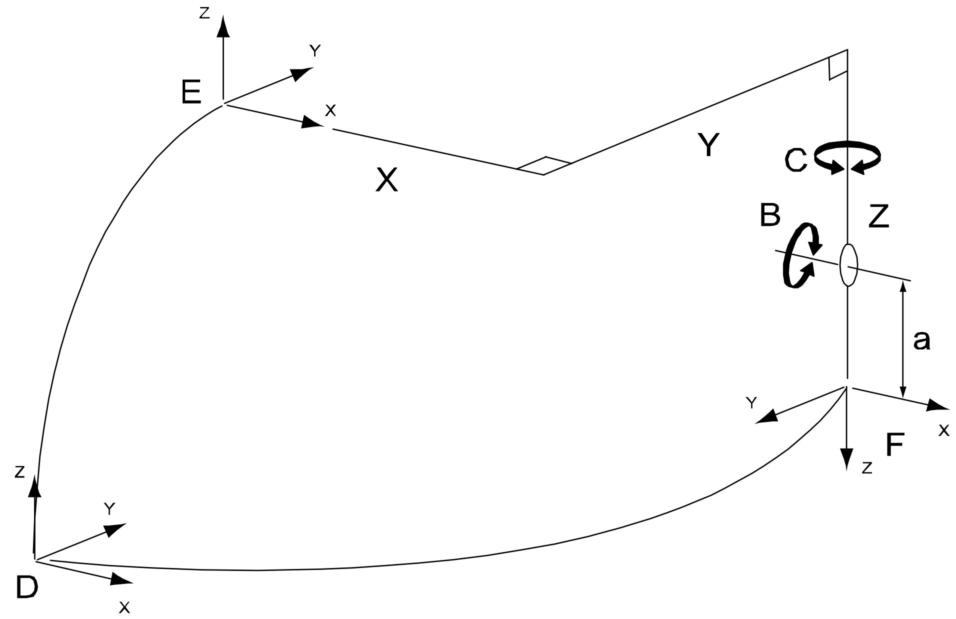
D	World frame
E	Base frame
F	Tool frame
X	X-linear motion
Y	Y-linear motion
Z	Z-linear motion
B	B rotating around Y axis in base frame
a	*offset_z* of arm

2.4.6 Kinematic model XYZC(Z)B(X)

Description

The kinematic model is based on an area gantry concept, with three linear motions and two rotations.

Illustration



xx0500002122

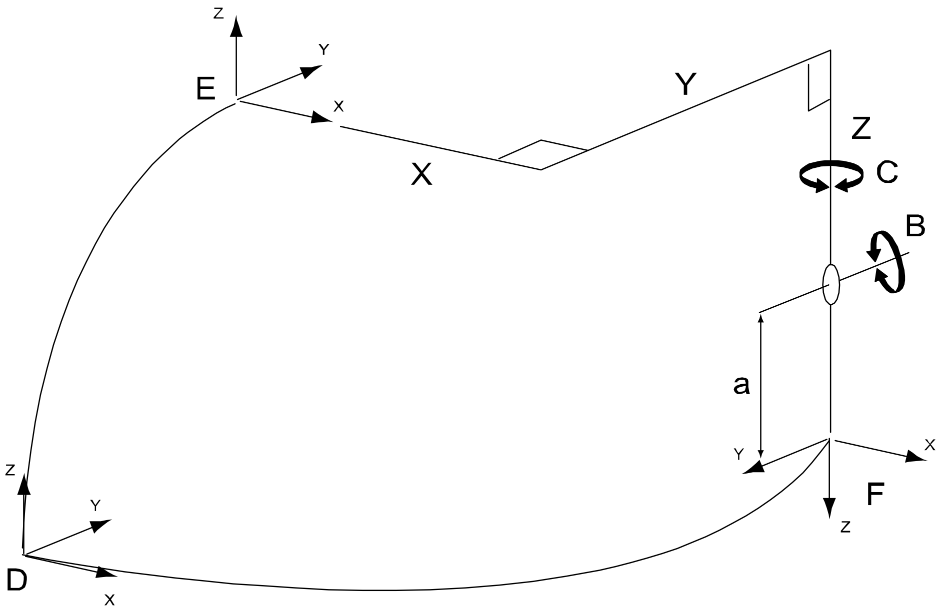
D	World frame
E	Base frame
F	Tool frame
X	X-linear motion
Y	Y-linear motion
Z	Z-linear motion
C	C rotating around Z axis in base frame
B	B rotating around X axis in base frame
a	*offset_z* of arm “robx_6”

2.4.7 Kinematic model XYZC(Z)B(Y)

Description

The kinematic model is based on an area gantry concept, with three linear motions and two rotations.

Illustration



xx0500002123

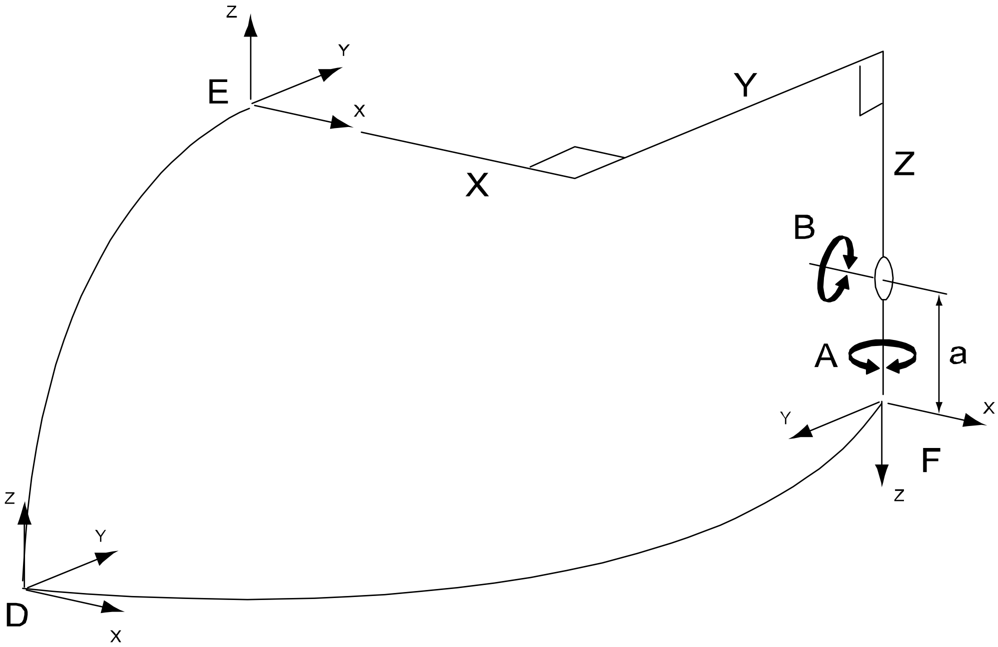
D	World Frame
E	Base Frame
F	Tool Frame
X	X-linear motion
Y	Y-linear motion
Z	Z-linear motion
C	C rotating around Z axis in base frame
B	B rotating around Y axis in base frame
a	*offset_z* of arm "robx_6"

2.4.8 Kinematic model XYZB(X)A(Z)

Description

The kinematic model is based on an area gantry concept, with three linear motions and two rotations.

Illustration



xx0300000619

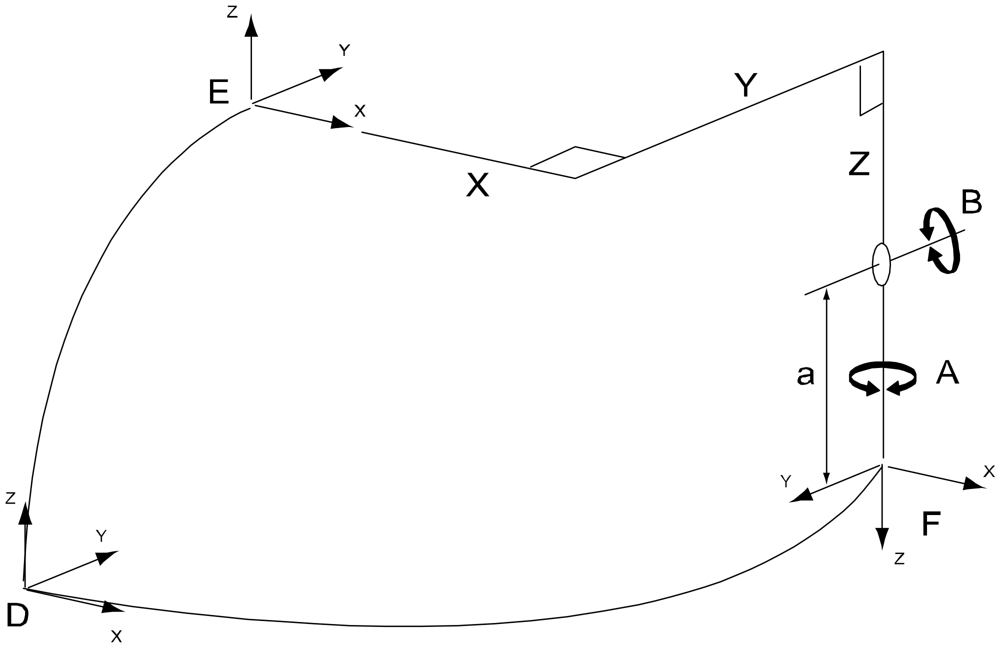
D	World frame
E	Base frame
F	Tool frame
X	X-linear motion
Y	Y-linear motion
Z	Z-linear motion
B	B rotating around X axis in base frame
A	A rotating around Z axis in base frame if B is zero
a	*offset_z* of arm

2.4.9 Kinematic model XYZB(Y)A(Z)

Description

The kinematic model is based on an area gantry concept, with three linear motions and two rotations.

Illustration



xx0300000620

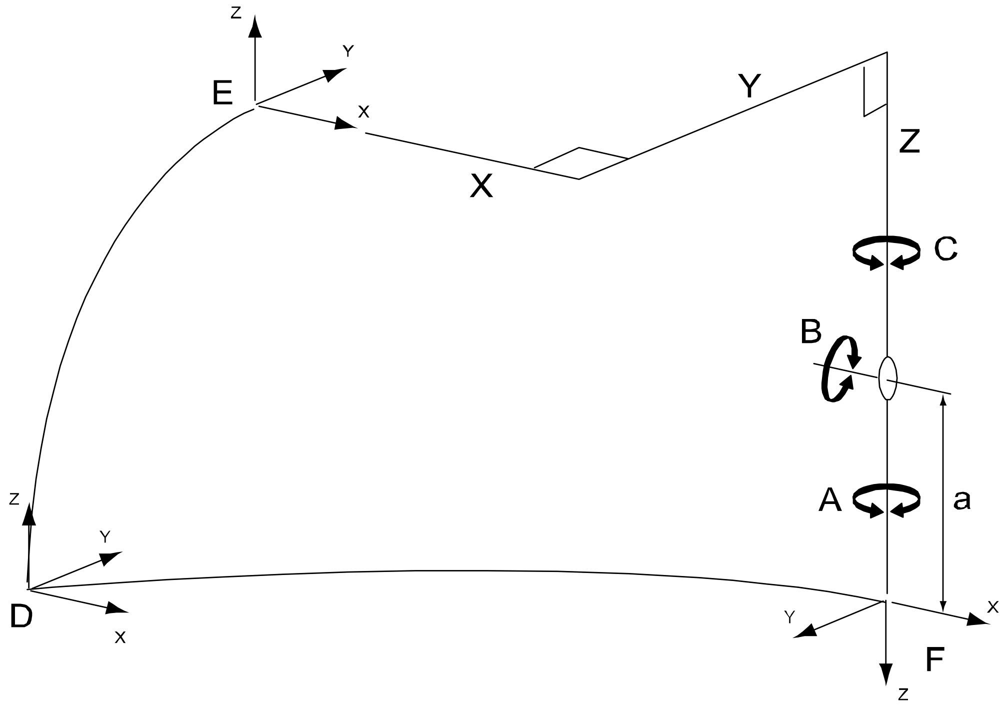
D	World frame
E	Base frame
F	Tool frame
X	X-linear motion
Y	Y-linear motion
Z	Z-linear motion
B	B rotating around Y axis in base frame
A	A rotating around Z axis in base frame if B is zero
a	*offset_z* of arm

2.4.10 Kinematic model XYZC(Z)B(X)A(Z)

Description

The kinematic model is based on an area gantry concept, with three linear motions and three rotations.

Illustration



xx0300000621

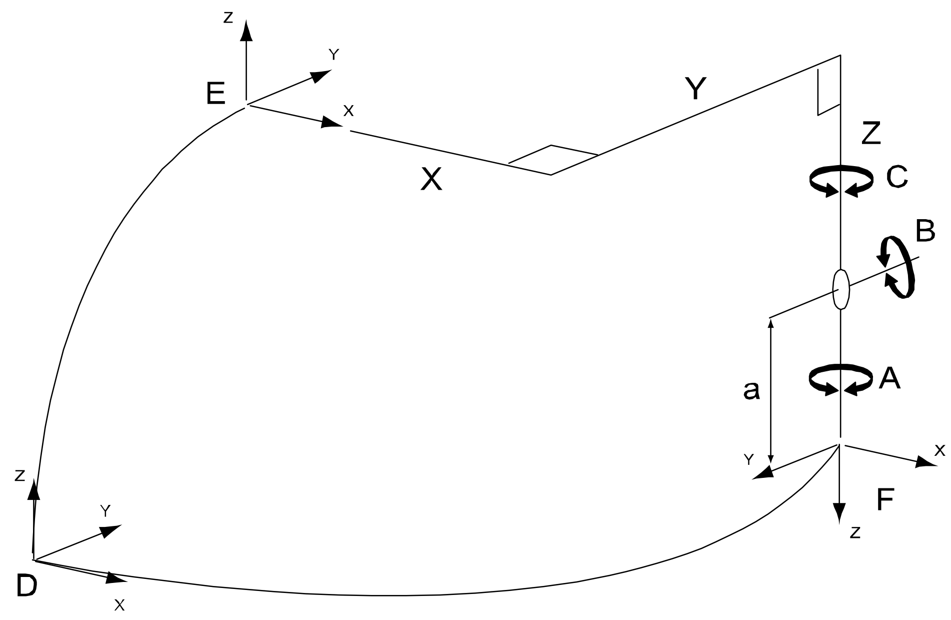
D	World frame
E	Base frame
F	Tool frame
X	X-linear motion
Y	Y-linear motion
Z	Z-linear motion
C	C rotating around Z axis in base frame
B	B rotating around X axis in base frame when C is zero
A	A rotating around Z axis in base frame if B is zero
a	*offset_z* of arm

2.4.11 Kinematic model XYZC(Z)B(Y)A(Z)

Description

The kinematic model is based on an area gantry concept, with three linear motions and three rotations.

Illustration



xx0500002211

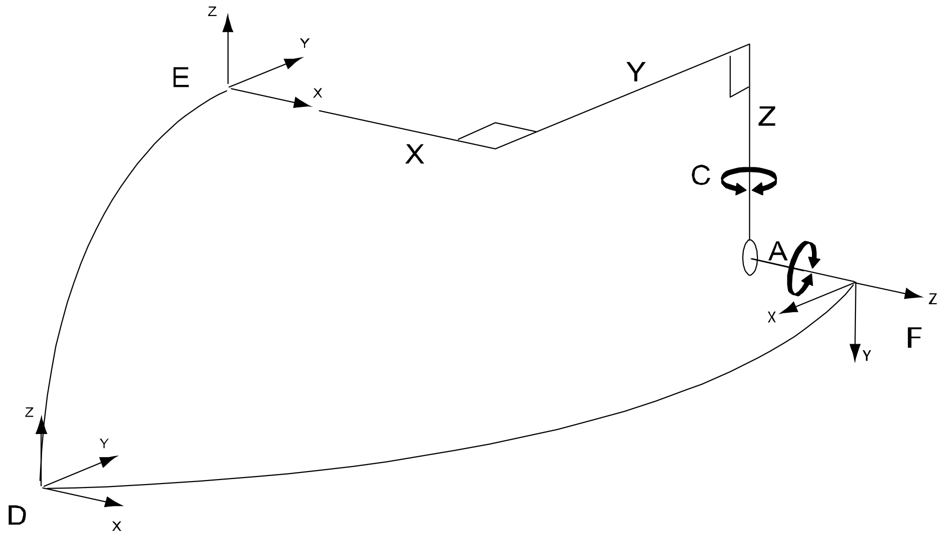
D	World frame
E	Base frame
F	Tool frame
X	X-linear motion
Y	Y-linear motion
Z	Z-linear motion
C	C rotating around Z axis in base frame
B	B rotating around Y axis in base frame when C is zero
A	A rotating around Z axis in base frame if B is zero
a	offset _z of arm ”robx_6”

2.4.12 Kinematic model XYZC(Z)A(X)

Description

The kinematic model is based on an area gantry concept, with three linear motions and two rotations.

Illustration



xx0500002202

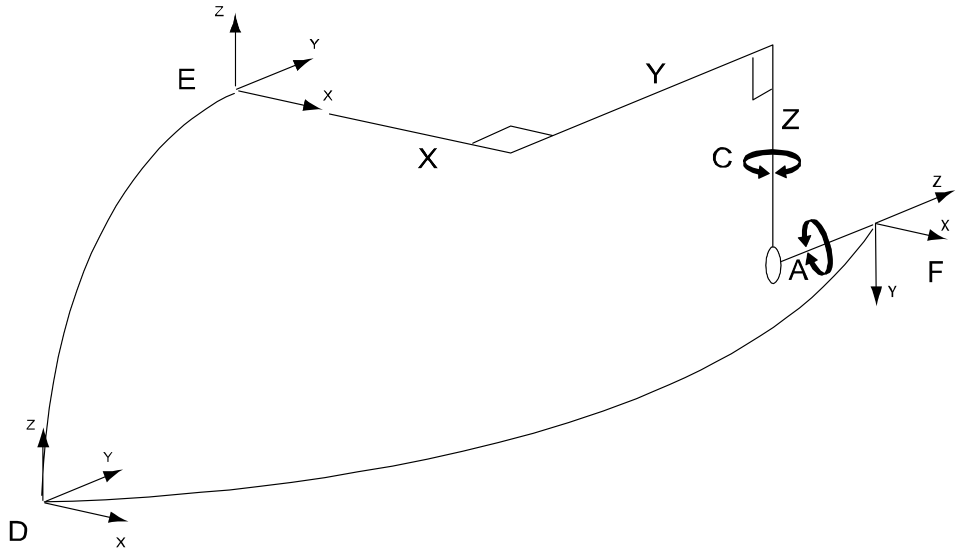
D	World frame
E	Base frame
F	Tool frame
X	X-linear motion
Y	Y-linear motion
Z	Z-linear motion
C	C rotating around Z axis in base frame
A	A rotating around X axis in base frame

2.4.13 Kinematic model XYZC(Z)A(Y)

Description

The kinematic model is based on an area gantry concept, with three linear motions and two rotations

Illustration



xx0500002203

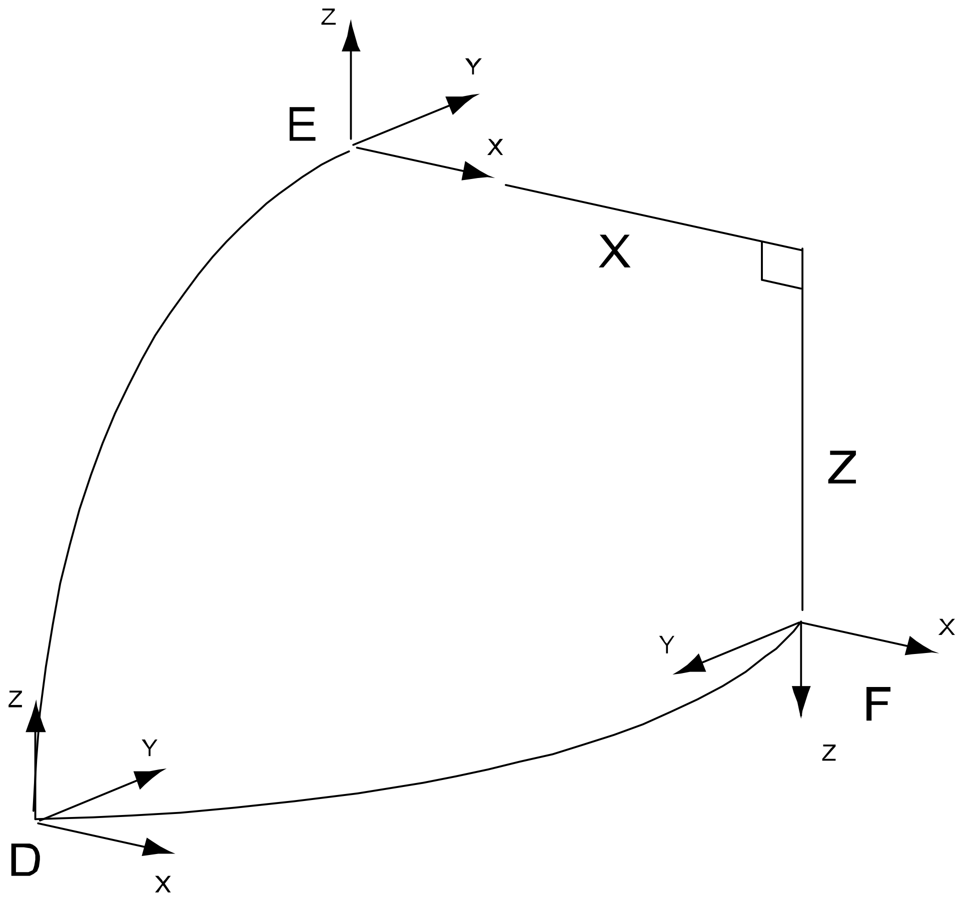
D	World frame
E	Base frame
F	Tool frame
X	X-linear motion
Y	Y-linear motion
Z	Z-linear motion
C	C rotating around Z axis in base frame
A	A rotating around Y axis in base frame

2.4.14 Kinematic model XZ

Description

The kinematic model is based on a linear gantry concept, with two linear motions.

Illustration



xx0500002110

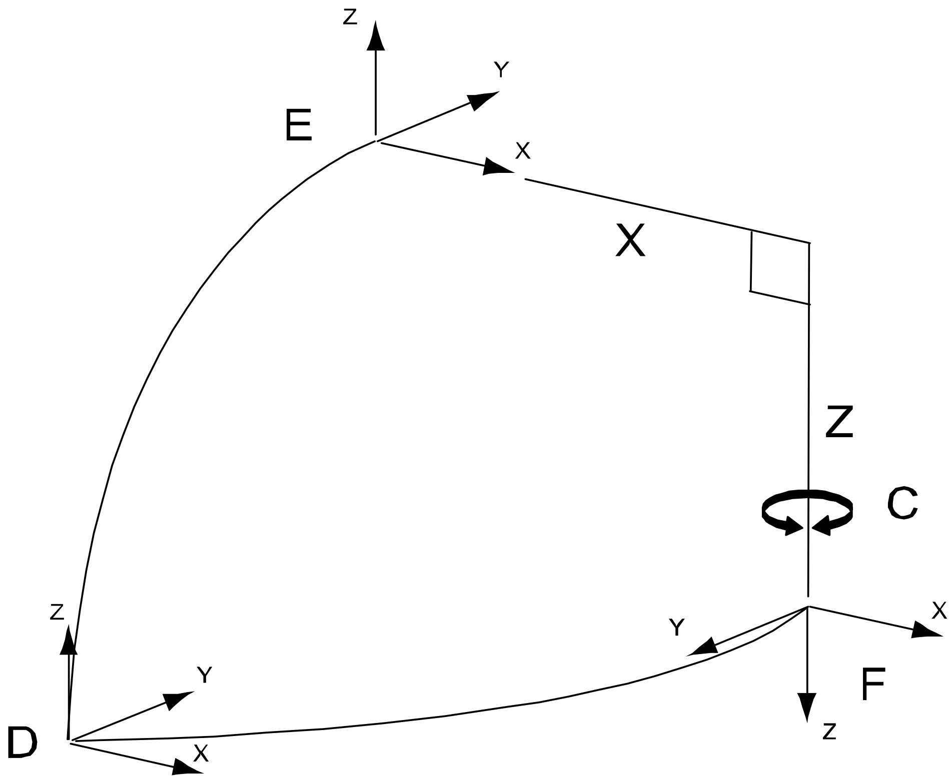
D	World Frame
E	Base Frame
F	Tool Frame
X	X-linear motion
Z	Z-linear motion

2.4.15 Kinematic model XZC(Z)

Description

The kinematic model is based on a linear gantry concept, with two linear motions and one rotation.

Illustration



xx0500002115

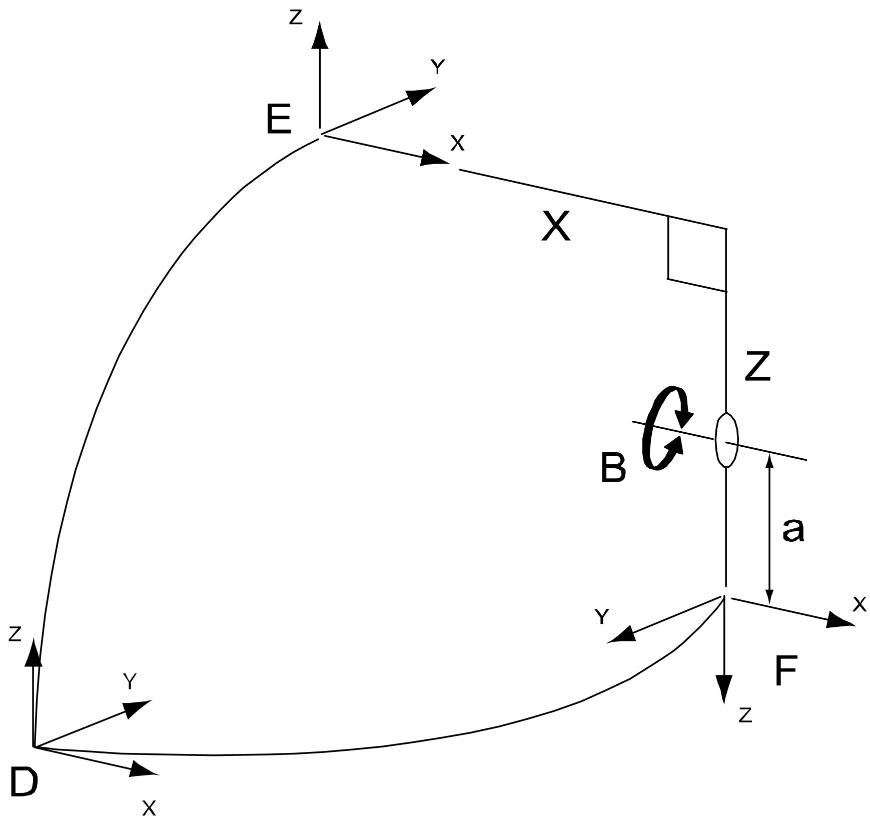
D	World Frame
E	Base Frame
F	Tool Frame
X	X-linear motion
Z	Z-linear motion
C	C rotating around Z axis in base frame

2.4.16 Kinematic model XZB(X)

Description

The kinematic model is based on a linear gantry concept, with two linear motions and one rotation.

Illustration



xx0500002111

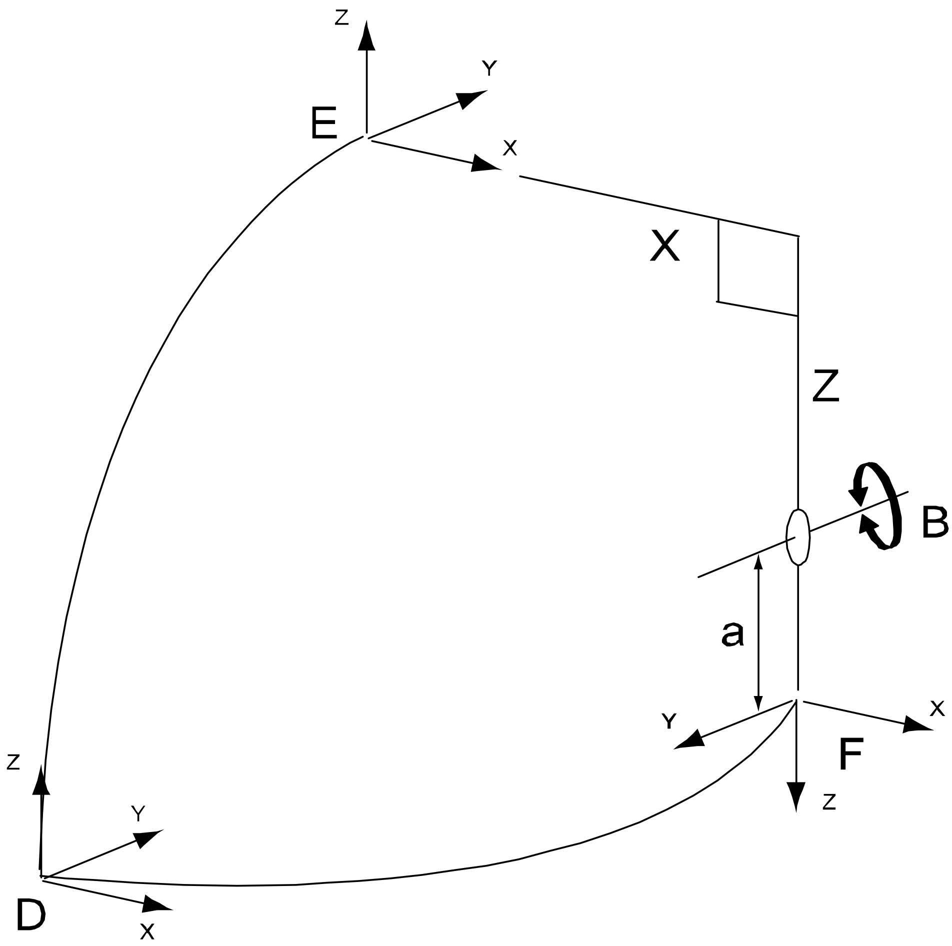
D	World Frame
E	Base Frame
F	Tool Frame
X	X-linear motion
Z	Z-linear motion
B	B rotating around X axis in base frame
a	offset_z of arm “robx_6”

2.4.17 Kinematic model XZB(Y)

Description

The kinematic model is based on a linear gantry concept, with two linear motions and one rotation.

Illustration



xx0500002113

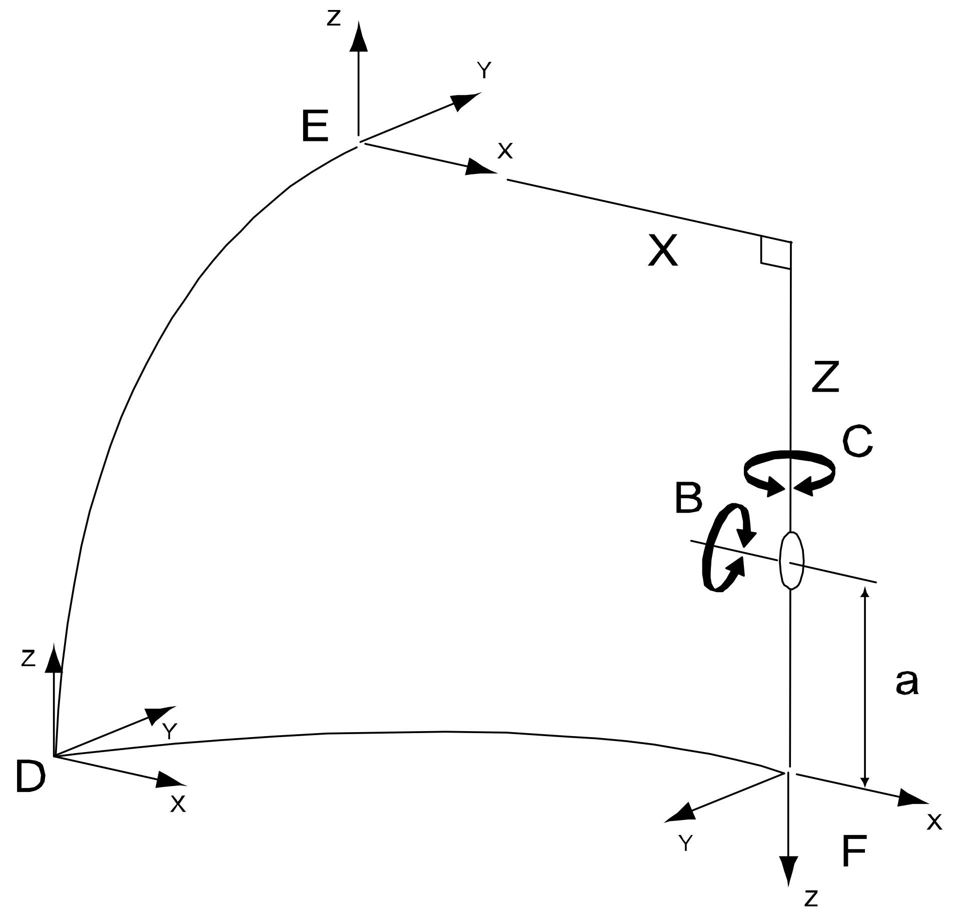
D	World Frame
E	Base Frame
F	Tool Frame
X	X-linear motion
Z	Z-linear motion
B	B rotating around Y axis in base frame
a	offset_z of arm “robx_6”

2.4.18 Kinematic model XZC(Z)B(X)

Description

The kinematic model is based on a linear gantry concept, with two linear motions and two rotations.

Illustration



xx0500002116

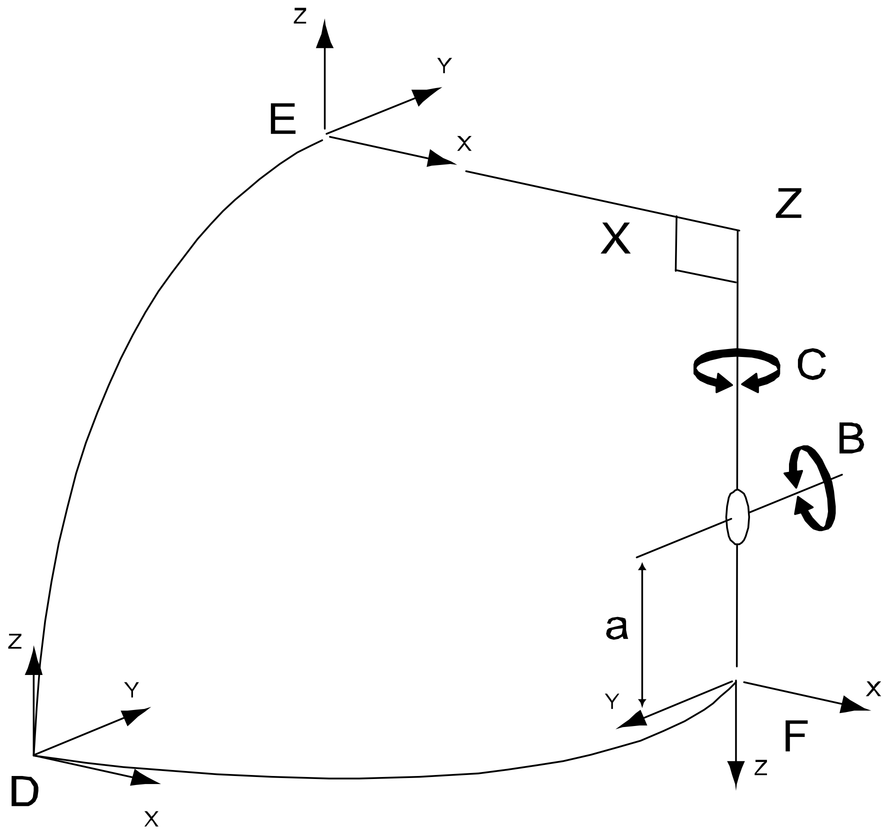
D	World Frame
E	Base Frame
F	Tool Frame
X	X-linear motion
Z	Z-linear motion
C	C rotating around Z axis in base frame
B	B rotating around X axis in base frame
a	offset_z of arm “robx_6”

2.4.19 Kinematic model XZC(Z)B(Y)

Description

The kinematic model is based on a linear gantry concept, with two linear motions and two rotations.

Illustration



xx0500002118

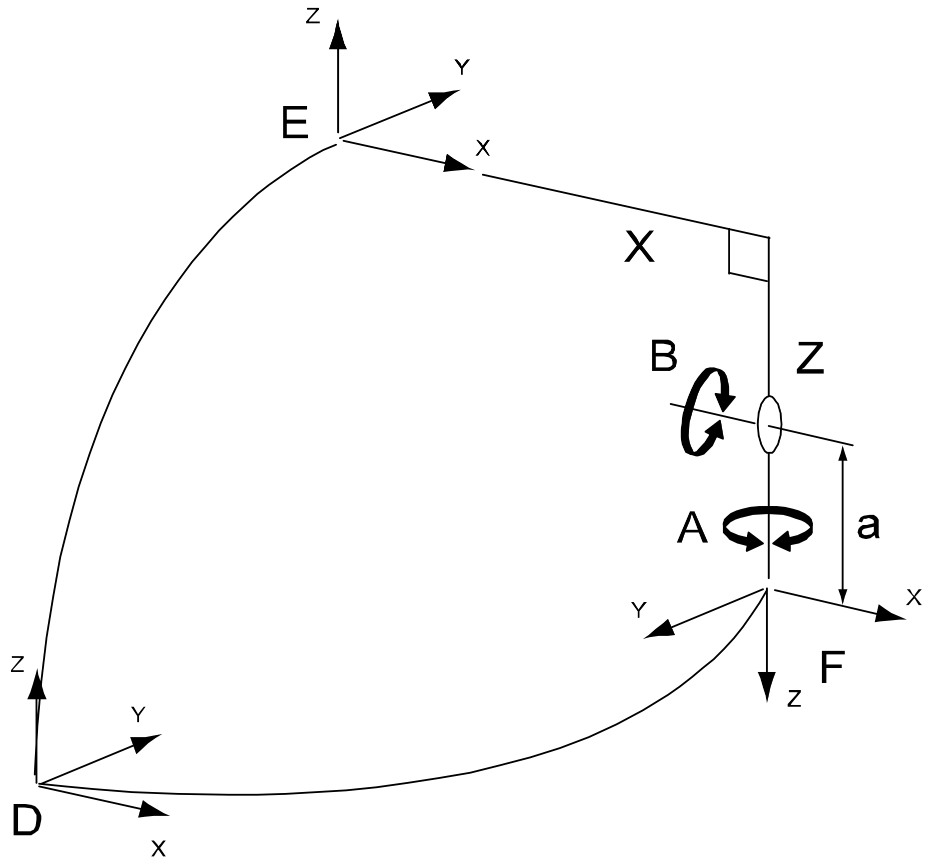
D	World Frame
E	Base Frame
F	Tool Frame
X	X-linear motion
Z	Z-linear motion
C	C rotating around Z axis in base frame
B	B rotating around Y axis in base frame
a	*offset_z* of arm “robx_6”

2.4.20 Kinematic model XZB(X)A(Z)

Description

The kinematic model is based on a linear gantry concept, with two linear motions and two rotations.

Illustration



xx0500002112

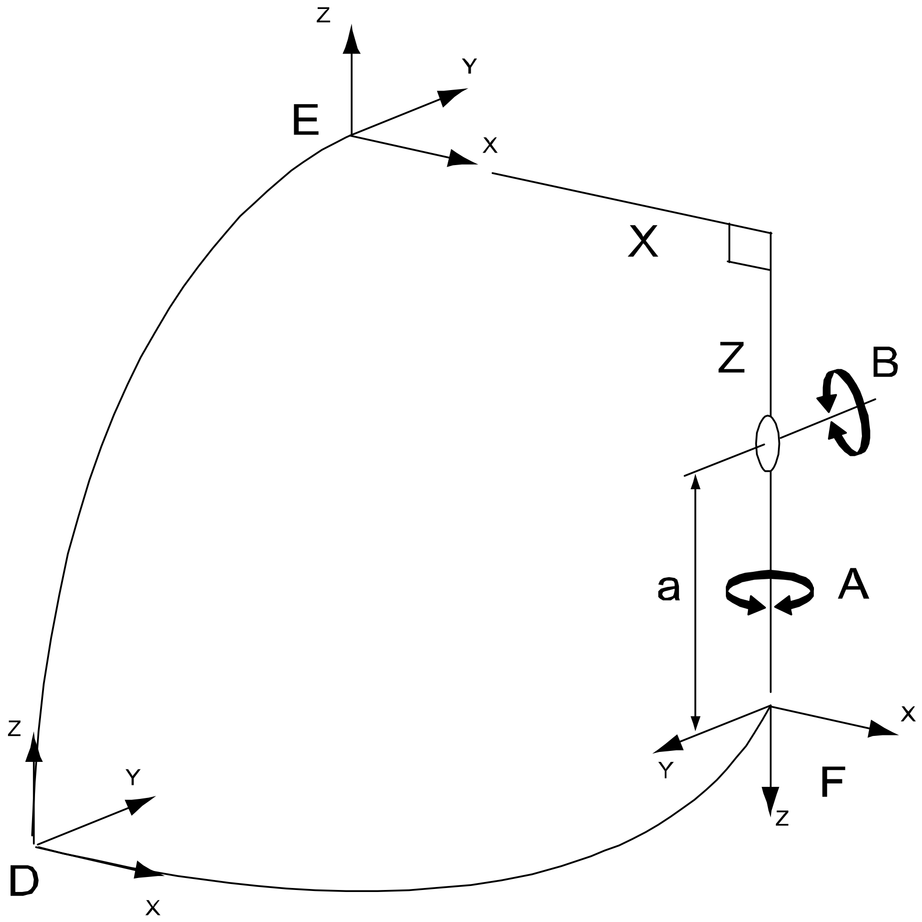
D	World Frame
E	Base Frame
F	Tool Frame
X	X-linerar motion
Z	Z-linear motion
B	B rotating around X axis in base frame
A	A rotating around Z axis in base frame
a	*offset_z* of arm “robx_6”

2.4.21 Kinematic model XZB(Y)A(Z)

Description

The kinematic model is based on a linear gantry concept, with two linear motions and two rotations.

Illustration



xx0500002114

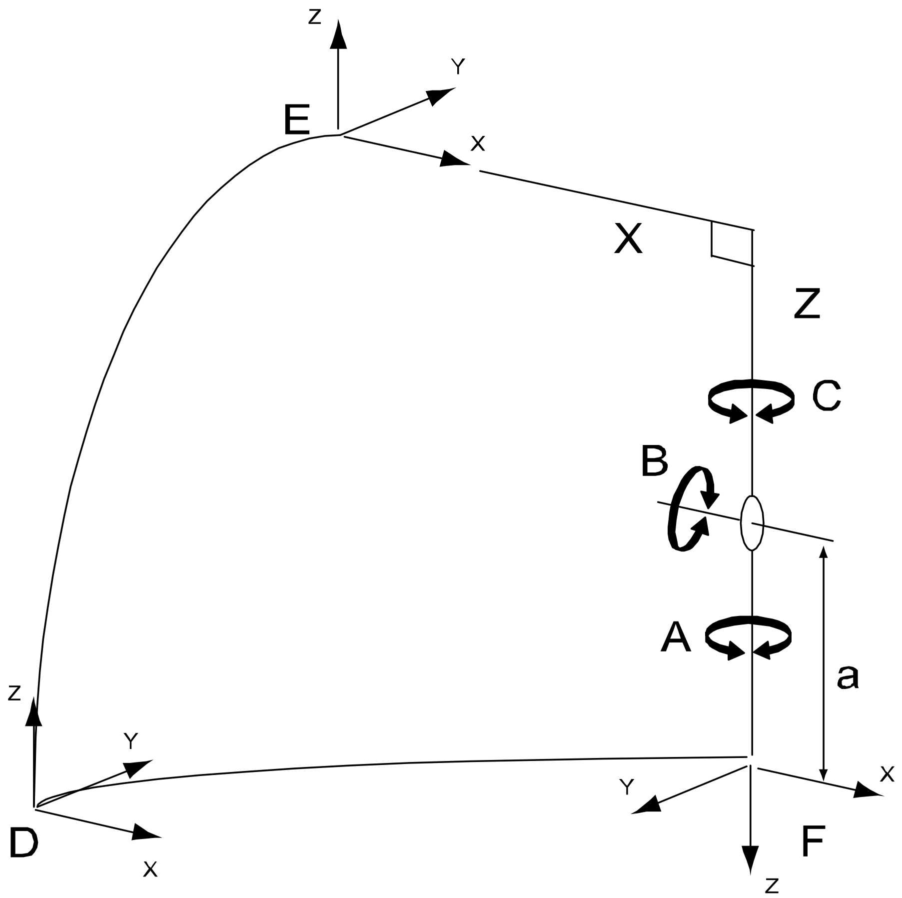
D	World Frame
E	Base Frame
F	Tool Frame
X	X-linear motion
Z	Z-linear motion
B	B rotating around Y axis in base frame
A	A rotating around Z axis in base frame
a	*offset_z* of arm “robx_6”

2.4.22 Kinematic model XZC(Z)B(X)A(Z)

Description

The kinematic model is based on a linear gantry concept, with two linear motions and three rotations.

Illustration



xx0500002117

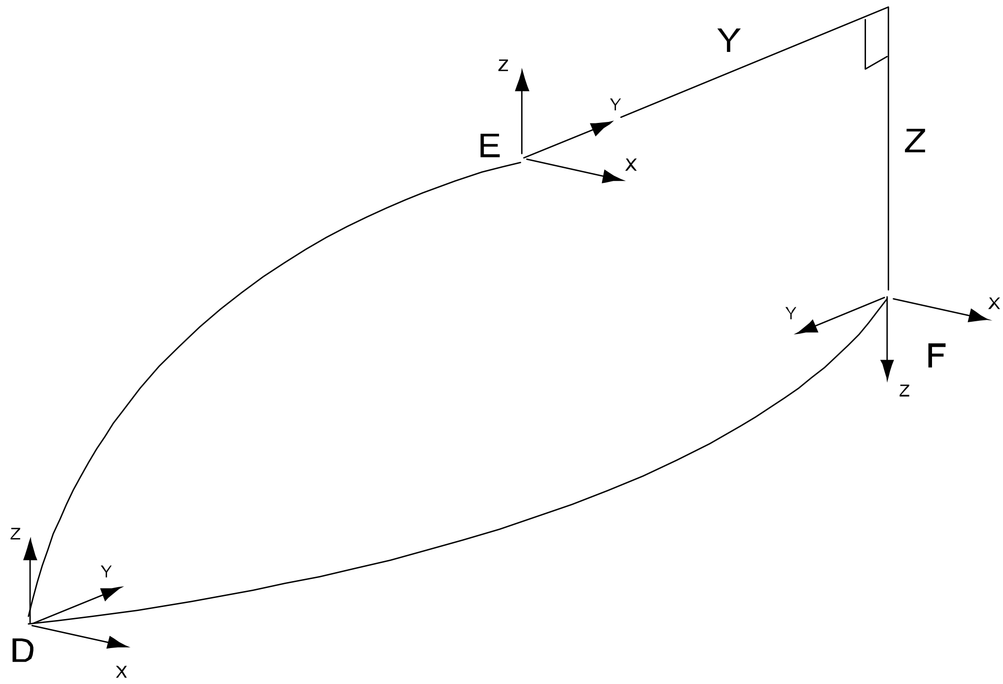
D	World Frame
E	Base Frame
F	Tool Frame
X	X-linear motion
Z	Z-linear motion
C	C rotating around Z axis in base frame
B	B rotating around X axis in base frame if C is zero
A	A rotating around Z axis in base frame
a	*offset_z* of arm “robx_6”

2.4.23 Kinematic model YZ

Description

The kinematic model is based on a linear gantry, with two linear motions and no rotation.

Illustration



xx0300000622

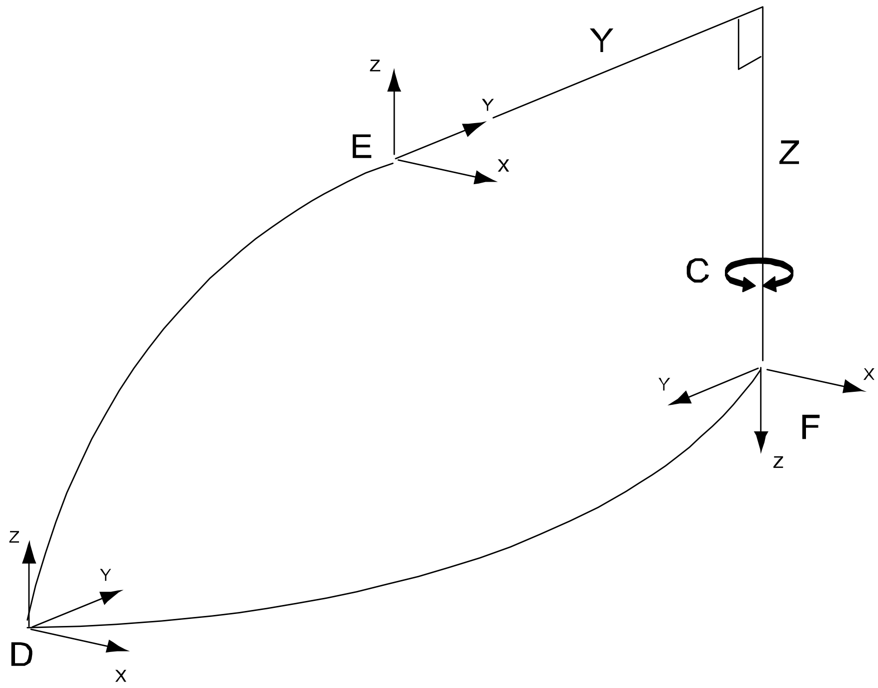
D	World frame
E	Base frame
F	Tool frame
Y	Y-linear motion
Z	Z-linear motion

2.4.24 Kinematic model YZC(Z)

Description

The kinematic model is based on a linear gantry, with two linear motions and one rotation.

Illustration



xx0300000623

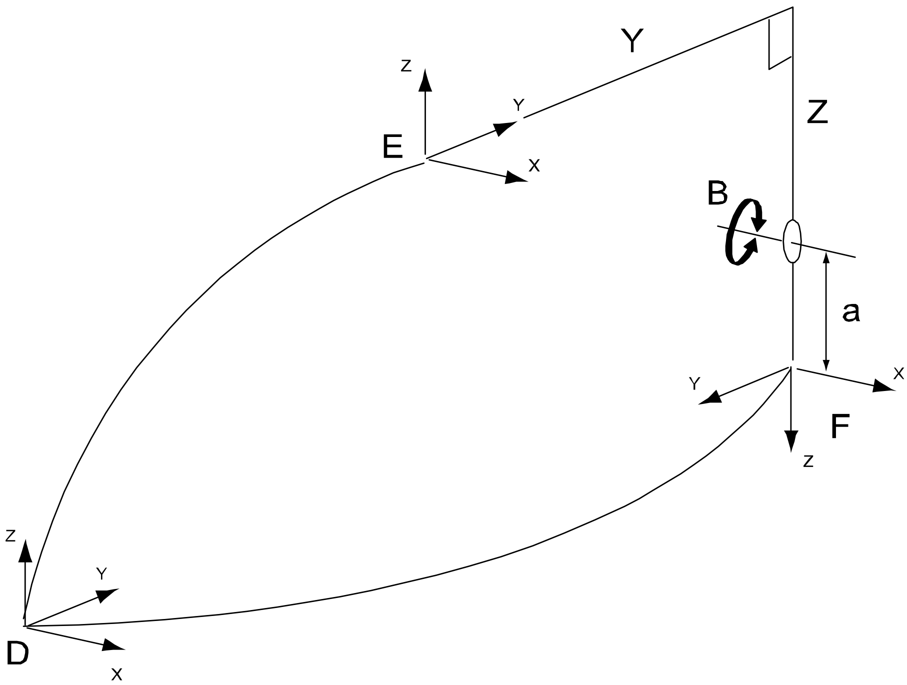
D	World frame
E	Base frame
F	Tool frame
Y	Y-linear motion
Z	Z-linear motion
C	C rotating around Z axis in base frame

2.4.25 Kinematic model YZB(X)

Description

The Y_Z_B(X) is a kinematic model, based on a linear gantry, with two linear motions and one rotation.

Illustration



xx0300000624

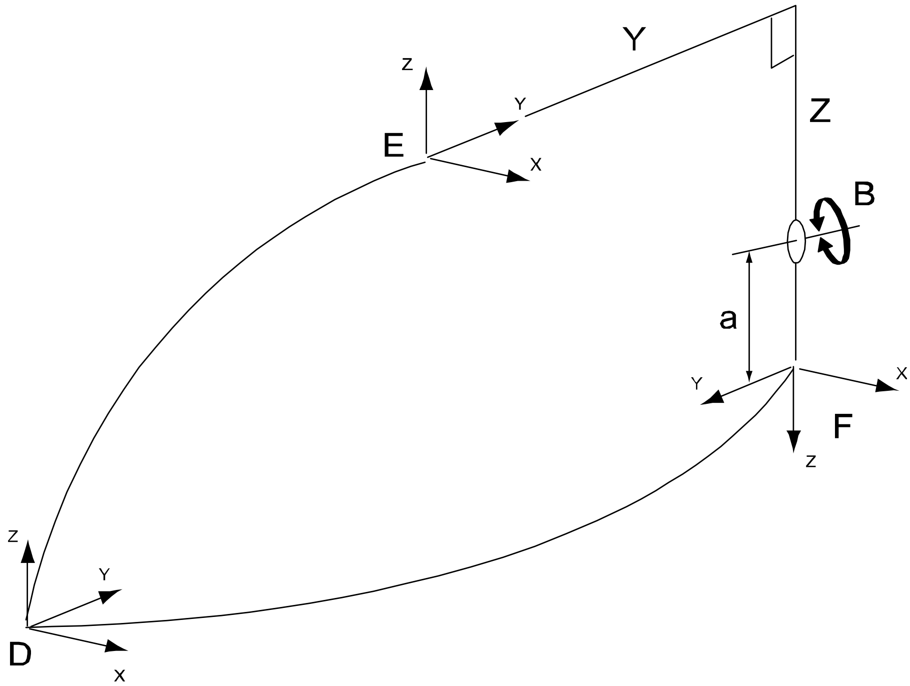
D	World frame
E	Base frame
F	Tool frame
Y	Y-linear motion
Z	Z-linear motion
B	B rotating around X axis in base frame
a	*offset_z* of arm

2.4.26 Kinematic model YZB(Y)

Description

The kinematic model is based on a linear gantry, with two linear motions and one rotation.

Illustration



xx0300000625

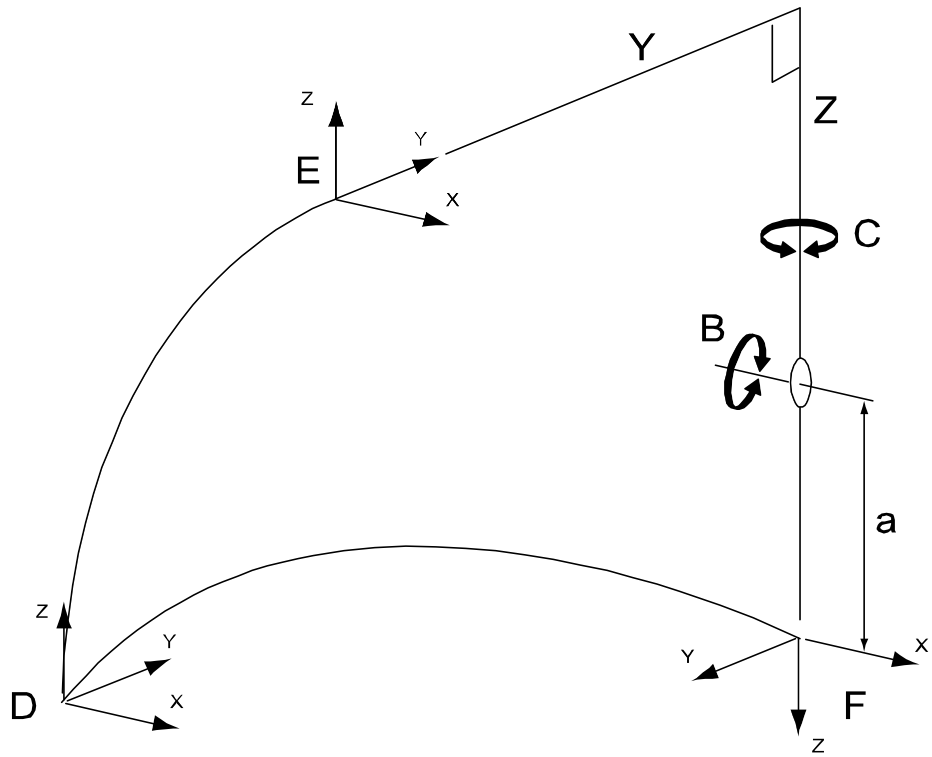
D	World frame
E	Base frame
F	Tool frame
Y	Y-linear motion
Z	Z-linear motion
B	B rotating around Y axis in base frame
a	*offset_z* of arm

2.4.27 Kinematic model YZC(Z)B(X)

Description

The kinematic model is based on a linear gantry concept, with two linear motions and two rotations.

Illustration



xx0500002119

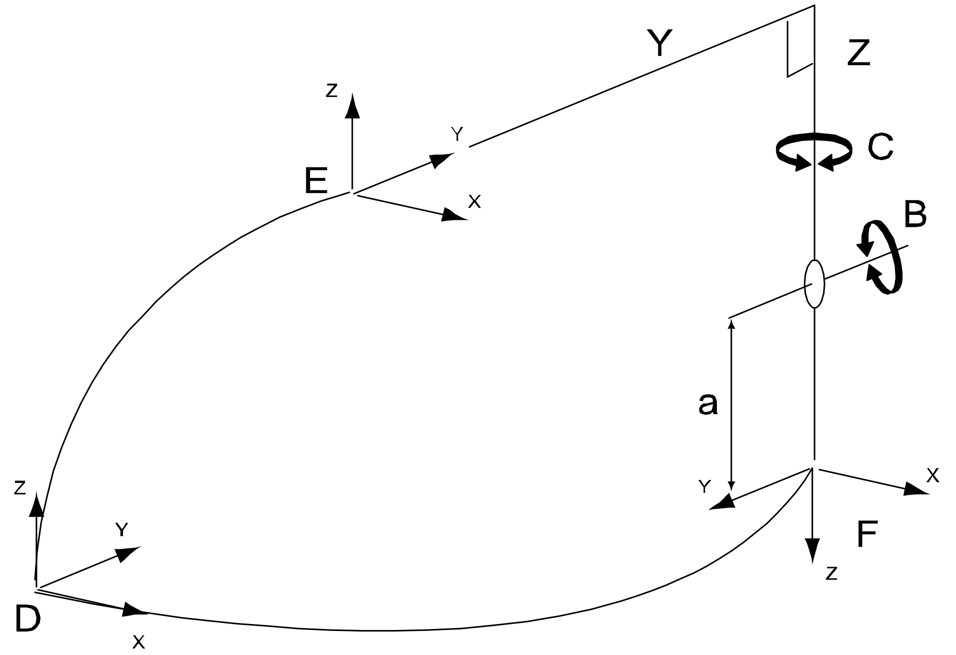
D	World Frame
E	Base Frame
F	Tool Frame
Y	Y-linear motion
Z	Z-linear motion
C	C rotating around Z axis in base frame
B	B rotating around X axis in base frame if C is zero
a	*offset_z* of arm “robx_6”

2.4.28 Kinematic model YZC(Z)B(Y)

Description

The kinematic model is based on a linear gantry concept, with two linear motions and two rotations.

Illustration



xx0500002120

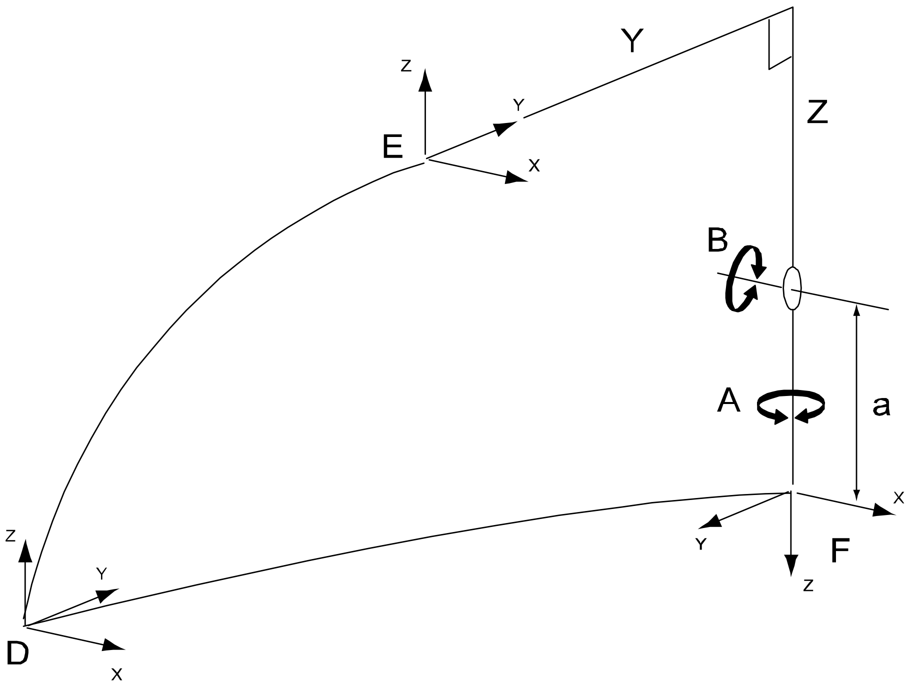
D	World Frame
E	Base Frame
F	Tool Frame
Y	Y-linear motion
Z	Z-linear motion
C	C rotating around Z axis in base frame
B	B rotating around Y axis in base frame
a	offset_z of arm “robx_6”

2.4.29 Kinematic model YZB(X)A(Z)

Description

The kinematic model is based on a linear gantry, with two linear motions and two rotations.

Illustration



xx0300000626

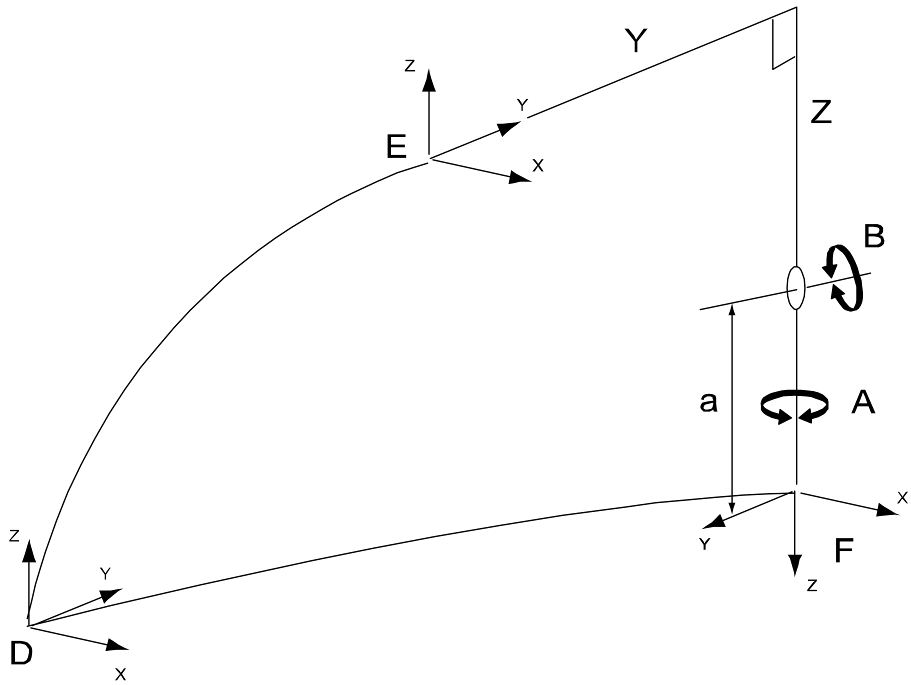
D	World frame
E	Base frame
F	Tool frame
Y	Y-linear motion
Z	Z-linear motion
B	B rotating around X axis in base frame
A	A rotating around Z axis in base frame if B is zero
a	*offset_z* of arm

2.4.30 Kinematic model YZB(Y)A(Z)

Description

The kinematic model is based on a linear gantry, with two linear motions and two rotations.

Illustration



xx0300000627

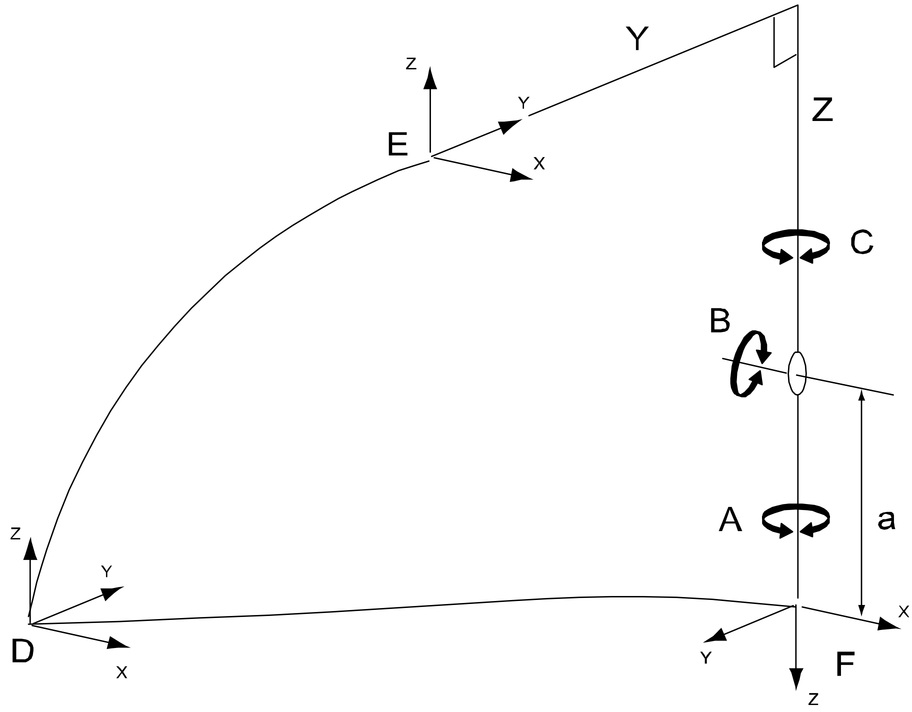
D	World frame
E	Base frame
F	Tool frame
Y	Y-linear motion
Z	Z-linear motion
B	B rotating around Y axis in base frame
A	A rotating around Z axis in base frame if B is zero
a	*offset_z* of arm

2.4.31 Kinematic model YZC(Z)B(X)A(Z)

Description

The kinematic model is based on a linear gantry, with two linear motions and three rotations.

Illustration



xx0300000628

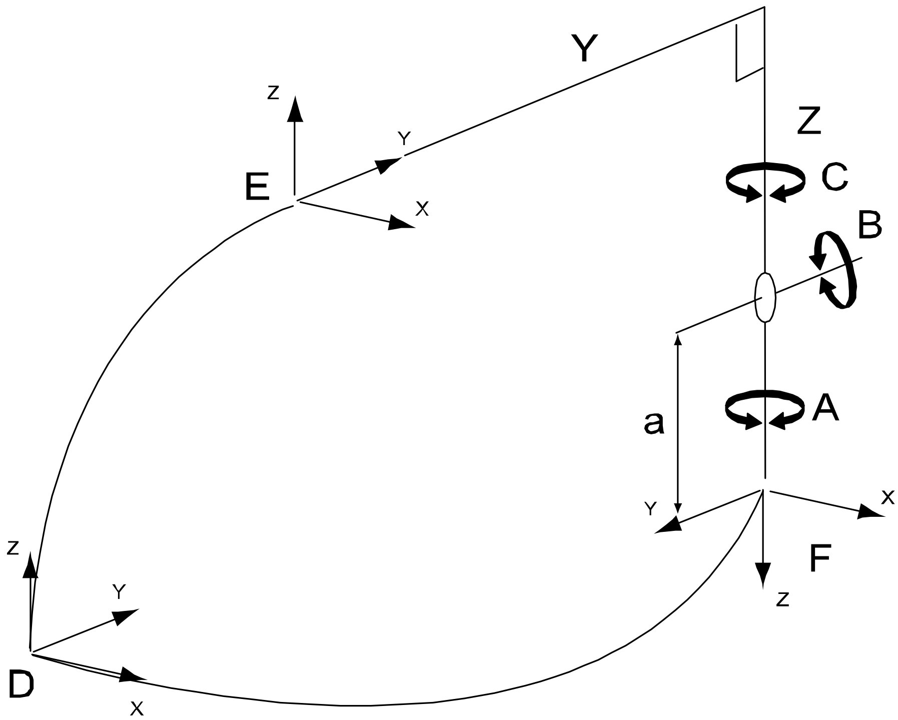
D	World frame
E	Base frame
F	Tool frame
Y	Y-linear motion
Z	Z-linear motion
C	C rotating around Z axis in base frame
B	B rotating around X axis in base frame when C is zero
A	A rotating around Z axis in base frame if B is zero
a	*offset_z* of arm

2.4.32 Kinematic model YZC(Z)B(Y)A(Z)

Description

The kinematic model is based on a linear gantry, with two linear motions and three rotations.

Illustration



xx0500002223

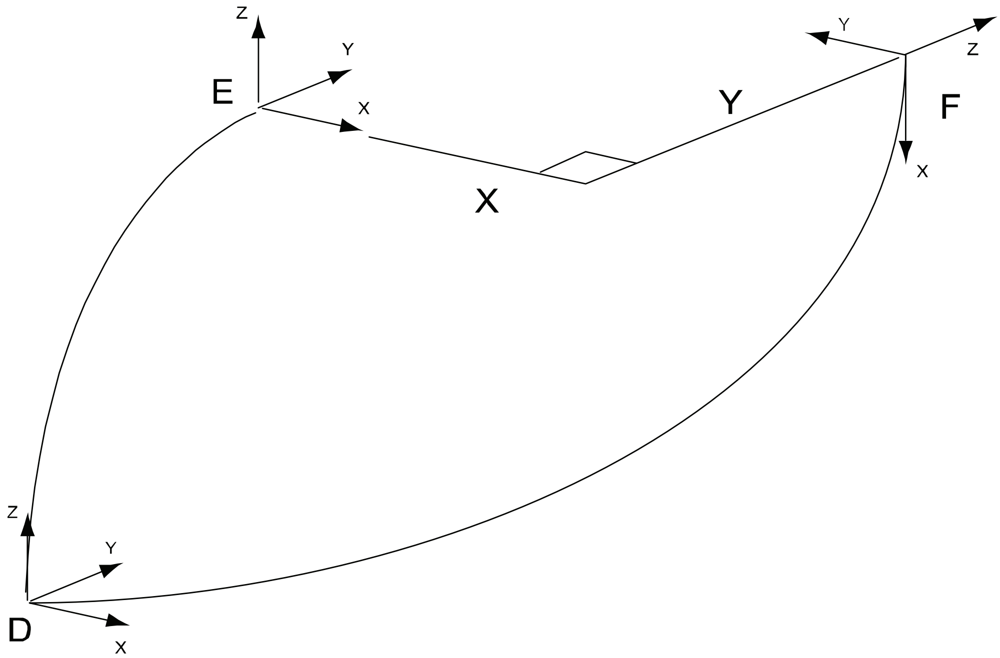
D	World frame
E	Base frame
F	Tool frame
Y	Y-linear motion
Z	Z-linear motion
C	C rotating around Z axis in base frame
B	B rotating around Y axis in base frame when C is zero
A	A rotating around Z axis in base frame if B is zero
a	*offset_z* of arm “robx_6”

2.4.33 Kinematic model XY

Description

The kinematic model is based on an area gantry concept, with two linear motions.

Illustration



xx1900001180

D	World frame
E	Base frame
F	Tool frame
X	X-linear motion
Y	Y-linear motion

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3 Configuration

3.1 Creating a standalone controller system

Overview

This section describes how to create a standalone controller system in RobotStudio.

General procedure

Follow these basic steps to create a standalone controller system.

	Action
1	Install RobotWare, as described in *Operating manual - RobotStudio*.
2	Install the SAC Add-In, available in the **Gallery** tab.
3	Create a standalone controller system using the function **Modify Installation** in RobotStudio, see *Modify Installation procedure on page 51*.

Modify Installation procedure

General information about creating a new system is available in the **Help** menu in RobotStudio. This section gives information specific for the standalone controller option.

CAUTION

Do not turn off the controller while system update is in progress. Doing this may in worst case lead to data corruption in the RobotWare system, in which case it needs to be reinstalled.

	Action
1	In the **Controller** ribbon, select **Installation** and **Modify Installation**.
2	To add add-in packages, select **Software** > **Available** and tap **Include**.
3	The **Included Software** window displays the software that is included in the current RobotWare system. Select one of the following: • Select the product box for the software that should be added to the system. • Deselect the product box to remove the product from the system. **Note** Products may have dependences to certain versions of other products. A product may only be removed if all products that are dependent on it are removed as well. The **Summary** tab shows an overview of all the changes.
4	Select the tab **Options** and then select the option category to be updated, and the corresponding **Options** that should be activated/deactivated for the system. **Note** Linked options will be selected automatically. Conflicting options cannot be selected.
5	In the section **Robot**, select **No IRB**.

Continues on next page

	Action
6	Continue to modify the system, or select **Apply**/**Apply and reset** to confirm and save the changes. **Note** The **Modify Installation** dialog will be closed during the controller update. When the update process is finished, check the event log for information about the update results. A successful update will be indicated in the event log, and if the update has failed, one or more error logs will be generated.
7	If the controller is restarted after selecting **No IRB**, then the configuration files (.cfg) must be modified or loaded.

A full description of the **Modify Installation** dialog is described in *Operating manual - Integrator's guide OmniCore*.

Errors at start up

When the system is ready with start-up, inform yourself on system status by studying the event log on the FlexPendant or in RobotStudio.

A system with non-ABB equipment needs configuration to become functional, and it is even quite likely that your system is in system failure state at this point. Ignore any errors until you are ready with the configuration procedure described in section *Minimal configuration of non-ABB manipulators on page 55*.

If there are remaining errors after configuration is done find out more about error localization in *Application manual - Additional axes*, section *Error handling*.

3.2 Limit peripheral speed of an axis

CAUTION

Incorrectly defined parameters will result in incorrect speed. Always verify the speed after changing these parameters.

There is a hazard that the speed 250 mm/s is exceeded in manual reduced speed mode.

Note

This information is applicable for additional (auxiliary/external) axes and non-ABB manipulators.

Calculate parameter values

Two system parameters need to be configured. The parameters belong to the type *Supervision Type* in the configuration topic *Motion* and are expressed in ratio of max speed (1 = 100%).

Teach Max Speed Main

Teach Max Speed Main = (x / *Arm Length*) * (*Transmission Gear Ratio* / *Speed Absolute Max*)

where:

- x is the speed in mm/s
- *Transmission Gear Ratio* belongs to the type *Transmission*.
- *Speed Absolute Max* belongs to the type *Stress Duty Cycle* (rad/s).
- *Arm Length* should be measured from the rotational center of the external axis (meter).

If the result of the calculation exceeds 0.94, use 0.94 instead of the calculated value.

Insert the calculated result at the type *Supervision Type: Teach Max Speed Main*.

Teach Max Speed DSP

Calculate and use the largest value of:

- *Teach Max Speed Main* * 1.20
- *Teach Max Speed Main* + (8 / *Speed Absolute Max*)

Insert the calculated result at the type *Supervision Type*: *Teach Max Speed DSP*.

Example

Given parameter values

Transmission Gear Ratio = 120

Speed Absolute Max = 320 rad/s

Arm Length = 0.5 m

Continues on next page

Calculations

Teach Max Speed Main = (0.25 /*Arm Length*) * (*Transmission Gear Ratio* / *Speed Absolute Max*) = (0.25 / 0.5) * (120 / 320) = 0.188

Teach Max Speed Dsp = max{(*Teach Max Speed Main* * 1.20) , (*Teach Max Speed Main* + (8 / *Speed Absolute Max*))} = max{(0.188 * 1.2) , (0.188 + (8 / 320))} = max {0.226 , 0.213} = 0.226

3.3 Minimal configuration of non-ABB manipulators

Overview

This section describes basic configuration of non-ABB manipulators.

WARNING

Incorrect definition of system parameters for brakes or additional axes may cause damage to the robot or personal injury.

General approach

For each kinematic model a corresponding set of default configuration files are supplied with the additional option *Standalone Controller*. It is possible to configure system parameters by editing these configuration files directly with a text editor. The recommended way, however, is to use RobotStudio or the FlexPendant.

Configure system parameters

Use RobotStudio to configure the following system parameters for non-ABB manipulators. They all belong to the configuration topic *Motion*. For more information see *Operating manual - RobotStudio*. For more information about the parameters see *Technical reference manual - System parameters* and *Application manual - Additional axes*, section *System parameters*.

	Action	Parameter name
1	Select the type *Robot* and specify name. **Note!** Naming a robot is optional but often convenient.	• Name
2	Select the type *Measurement Channel* and specify:	• Measurement Node
3	Select the type *Arm* and define the limits for the robot's working range. There is one set of parameters for each joint. Specify:	• Upper Joint Bound • Lower Joint Bound • Calibration Position
4	Select the type *Arm Type*. Depending on selected kinematic model, different parameters need to be configured.	*Application manual - Additional axes*
5	Select the type *Transmission* and specify:	• Transmission Gear Ratio • Rotating Move • Transmission Gear High • Transmission Gear Low
6	Select the type *Brake* and specify brake parameters.	*Application manual - Additional axes*
7	Select the type *Drive system* and specify:	• Use Drive Unit
8	Select the type *Motor* and specify:	• Use Motor Type

Continues on next page

	Action	Parameter name
9	Select the type *Motor Type* and specify: **Note!** Values for these parameters can be found in the motor specifications.	• Pole Pairs • Stall Torque • Ke Phase to Phase • Max Current • Phase Resistance • Phase Inductance
10	Select the topic *Motion* and type *Motor Calibration* and define the calibration and commutation offsets. **Tip** This is not required for already commutated motors.	• Calibration Offset • Commutation Offset See Commutation.
11	Select the type *Stress Duty Cycle* and specify:	• Speed Absolute Max • Torque Absolute Max
12	If the system uses MultiMove and has several mechanical units attached to the same drive module further configuration is needed.	See *Setting up a motion planner and a RAPID task on page 57*.
13	Check if any advanced configuration needs to be done.	*Application manual - Additional axes*
14	Fine calibrate the system.	On the FlexPendant tap **Calibration**, select a Mechanical Unit and tap **Fine Calibration**. For more information see *Operating manual - OmniCore*, section *Calibrating*.
15	Tune the system before starting to use it.	See *Application manual - TuneMaster*.

Setting the Arm Type parameters

Arm Type parameters need to be configured if any of the kinematic models below is used:

- Linear Gantry and Area Gantry with B-rotation

Linear Gantry or Area Gantry with B-rotation

Parameters to be changed when using the kinematic model *Linear Gantry* or *Area Gantry with B-rotation*:

For arm...	Parameter name	Description
robx_6 in the default configuration file for kinematic models • XYZB(X) • XYZB(X)A(Z) • XYZC(Z)B(X)A(Z) • YZB(X) • YZB(Y) • YZB(X)A(Z) • etc.	`offset_z`	Length of arm robx_6 (in meter), see the selected *Kinematic models on page 17*.

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Several mechanical units on the same drive module

If the system has several mechanical units attached to the same drive module, the system will come up with the error message **50284 - Cannot activate Mechanical Unit**. This is perfectly normal, as no motion planner or RAPID task has been defined by the system for a second or third mechanical unit on a drive module. This means you need to specify a RAPID task and a motion planner for all mechanical units that are not number one on a drive module. For information on how to do this see *Setting up a motion planner and a RAPID task on page 57*.

Setting up a motion planner and a RAPID task

Suppose the system has two drive modules and three mechanical units, two of which are connected to the first drive module. At system setup motion planner 1 and motion planner 2 have been dedicated to the first mechanical units on the respective drive module. A motion planner for the second mechanical unit on drive module one must be configured manually, using either the FlexPendant or RobotStudio.

The following procedure shows how to do this using the FlexPendant.

	Action
1	Select the configuration topic *Controller* and add a new *Mechanical Unit Group*. Connect it to motion planner 3 and specify the second mechanical unit on drive module one (ROB_12) in the parameter *Mech Unit 1*.
2	To be able to program the mechanical unit you need to create a Rapid task. Select the configuration topic *Controller* and add a new *Task*. Attach it to the mechanical group created in step 1.

3.4 Defining parameters for general kinematics

Overview

It is possible to use general kinematics for most manipulators. A set of template configuration files can be found in *...\utility\AdditionalAxis\DM1\GeneralKinematics.*.

> **Note**
>
> Definition is not possible via the FlexPendant or RobotStudio. PC editing of the configuration files is necessary.

General kinematics for robots

The following needs to be defined.

Type	Description
ROBOT_TYPE	• base_pose_rot_u0, base_pose_rot_u1, base_pose_rot_u2, base_pose_rot_u3 (Rotation between user defined robot base and internal base according to Denavit - Hartenberg definition). • no_of_joints = highest joint number • type **GEN_KIN**
TRANSMISSION	For each arm of the additional robot in question. • **rotating_move** if rotating axes, exclude otherwise
ARM_TYPE	For each arm of the external robot in question. • **length** • **theta_home_position** • **offset_z** • **attitude** For information about the parameters, see *Technical reference manual - System parameters* and *Application manual - Additional axes*, section *System parameters*.

4 Commutation

Overview of commutation

There are two methods to find the commutation value for motors that are not included in the ABB offer.

1. Automatic method, see *Commutation with service routine on page 60*.
2. Manual method, see *Manual commutation on page 62*.

CAUTION

If the motor is not properly commutated, it can rev up and break.

Continues on next page

4.1 Commutation with service routine

Service routine for commutation

The service routine **Commutation** is used to:

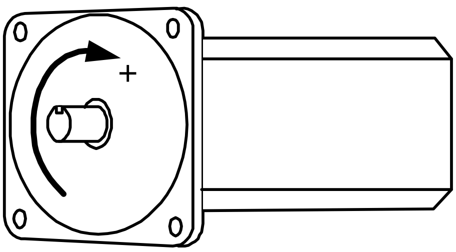
- Find a commutation value for a synchronous permanent magnet motor.
- Verify that the motor phase order is correct.
- Verify that the pole pair parameter value is correct.
- Verify that the resolver connection is correct.

Commutating with the service routine

	Action	Note
1	Start the service routine **Commutation**.	See *Operating manual - OmniCore* section *Programming and testing - Running a service routine*.
2	Examine the order of the motor phase connections.	*Motor phase connection order on page 60*.
3	Examine the resolver connection.	*Resolver connections on page 61*.
4	Move the motor by using the service routine. • For the pre-commutated motor: Make sure that the motor phase connections are connected to the right phase. If yes, then the existing commutation is ok to use. Do not update the commutation offset. • For the non-commutated motor: Commutate the motor by updating the commutation offset.	• *Motor phase connections on page 61*. • *Update commutation offset on page 61*.
5	The commutation is now finished and the motor is ready to use.	

Motor phase connection order

By stepping the motor in positive direction using the service routine, the motor shaft shall turn in counter clockwise direction, if the shaft is seen from the resolver side and clockwise from the drive shaft side.



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If the motor is turning in the wrong direction then the motor phases have been swapped. Try changing RST to SRT, RTS, or TSR.

Continues on next page

Pole pairs parameter

Examine that the pole pairs (*Pole Pairs*) parameter is loaded with the correct value by stepping the motor from the service routine. The motor shall turn 1/16 of a revolution for every step.

Resolver connections

From the service routine step the motor in positive direction. The resolver is connected correctly if the motor angle in the jogging window is increasing. Otherwise check the wiring of the resolver.

Motor phase connections

Using the service routine, move the motor to the commutation position. For best result, commutate without any equipment connected to the motor (a free mounted motor).

There are a number of correct commutation angles (same as *Pole Pairs* parameter). If the difference between the provided commutation angle and the suggested commutation angle is a multiple of 6.283185/number of pole pairs (*Pole Pairs*)- the commutation is ok. Otherwise all motor phases shall be moved one step forward or backward (same order! RST -> STR or TRS).

A commutation value set by the motor manufacturer is normally more accurate than a value updated by the service routine.

Update commutation offset

To get a good commutation position the motor must not be affected by gravity or large friction from equipment connected to the motor. For best result, commutate without any equipment connected to the motor (a free mounted motor).

When the motor is aligned, the resolver commutation parameter can be set. When the parameter is set the database is also updated.

4.2 Manual commutation

General

Before using an additional axis, the motor must be commutated. To do the commutation manually, connect a DC power source between two nodes and then measure the position of the motor.

Note

ABB motors are pre-commutated with the commutation value 1.5708. Therefore, an ABB motor does not require modifying the commutation offset.

Prerequisites

The motor must comply with the specifications in *Motors on page 81*. The resolver must comply with the specifications in *Resolvers on page 87*.

Required material

This is a list of what you need to perform the commutation manually:

Material	Description
PC with TuneMaster	See *Application manual - TuneMaster*.
Power supply	24 V (DC). The power supply should be equipped with a relay that trips at short circuit. Otherwise a fuse will burn every time the power is applied. Check the motor data to see the current required from the power supply.
2 cable sets	Cables to brake release and motor phase. Each cable set includes one plus and one minus cable.
Motor documentation	Motor data sheet and electrical connection drawing.

Measuring the commutation position

This procedure describes how to measure the commutation position of a motor.

	Action
1	Deactivate the axis for the motor to commutate.
2	Switch off the controller.
3	Disconnect the motor cable from the motor.
4	Disconnect the motor from the gear (or in some other way make sure the motor is not affected by external torque and friction).
5	If the motor is using a brake, release it by connecting the power supply to the contact pins for the brake release. See the motor specification for maximum brake current, which contact is for the brake release, and the polarity of the contacts (if any).
6	Make sure that the brake is released by manually turning the motor.

Continues on next page

	Action
7	Connect the power supply with the plus cable to the phase S (V) and the minus cable (0 V) to the to the phase T (W). A short pulse is enough to move the motor to its commutation position. Disconnect the power after the voltage pulse.
8	Connect the power to give another voltage pulse to the motor. If the motor is already in its commutation position it should not move this time.
9	Disconnect the power supply from the brake release, so that the motor brake is engaged.
10	Reconnect the motor cable from the drive unit to the motor.
11	Start the controller.
12	Activate the axis. Do not move any mechanical unit.
13	Configure TuneMaster, selecting mechanical unit and the signal *ResolverAngle* (signal number 1). Zoom in on the signal to read at least 2 decimals. Note that the number of commutation positions are equal to the number of pole pairs. For example, a motor with 2 pole pairs have 2 possible values for this measurement. It does not matter which of the commutation points are measured.
14	Set the measured value to the parameter *Commutator Offset* in the type *Motor Calibration*. Restart the controller.
15	Reconnect the motor to the gear.

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5 Tuning

5.1 Tuning of servo control parameters

Overview

The servo control parameters can be adjusted (tuned) to achieve the best possible motion performance.

Tuning with TuneMaster

The recommended way to perform the tuning is by using the software TuneMaster. How to perform the tuning is described in *Application manual - TuneMaster*.

5.2 Additional tuning

5.2.1 Tuning of the soft servo parameters

General

This section details how to tune the following parameters in the type *Lag Control Master 0*:

- *K Soft Min Factor*
- *K Soft Max Factor*
- *Kp/Kv Ratio Factor*
- *Ramp Time*

Tip

In most applications these parameters do not have to be trimmed and can be left at their default values.

Tuning of K Soft Min Factor

The procedure below details how to make the initial tuning of the parameter *K Soft Min Factor*.

Tip

The movements in this trim procedure should be done close to the point where the soft servo is activated, to minimize the risk of an axis collapsing.

	Action
1	Determine a maximum axis movement for which the axis should not move, when the softness is 100%. Such a movement can be 0.1 rad for a rotating axis.
2	Determine a minimum axis movement for which the axis should move, when the soft-ness is 100%. Such a movement can be 0.2 rad for a rotating axis.
3	Activate the soft servo with softness 100% and perform the two movements.
4	If the axis moves for both movements, the axis is too stiff and *K Soft Min Factor* should be reduced. If the axis does not move for any movement, the axis is too soft and *K Soft Min Factor* should be increased.
5	Repeat step 3 and 4 until the axis does not move for the smaller movement but does move for the bigger movement.

Tuning of K Soft Max Factor

In most cases, *K Soft Max Factor* can be left at its default value (1.0).

If the axis is too stiff at 0% softness, reduce *K Soft Max Factor*. If the axis is too soft at 0% softness, increase *K Soft Max Factor*. The tuning can be made in a similar way as for *K Soft Min Factor*, but with smaller movements.

Continues on next page

Kp/Kv Ratio Factor

Kp/Kv Ratio Factor determines the stability margin for the axis. A value less than 1.0 increases the stability. It is not possible to set this parameter to a value larger than 1.0 since the stability of the axis would be jeopardized.

Ramp Time

If *Ramp Time* is changed, the duration of the activation and deactivation phase will change. A short ramp time can result in a twitch of the axis at activation.

5.2.2 Additional tuning for servo guns

Description in separate manual

The specifics for tuning a servo gun are described in *Application manual - Servo Gun Setup*.

6 Hardware

6.1 Configuration of the drive system

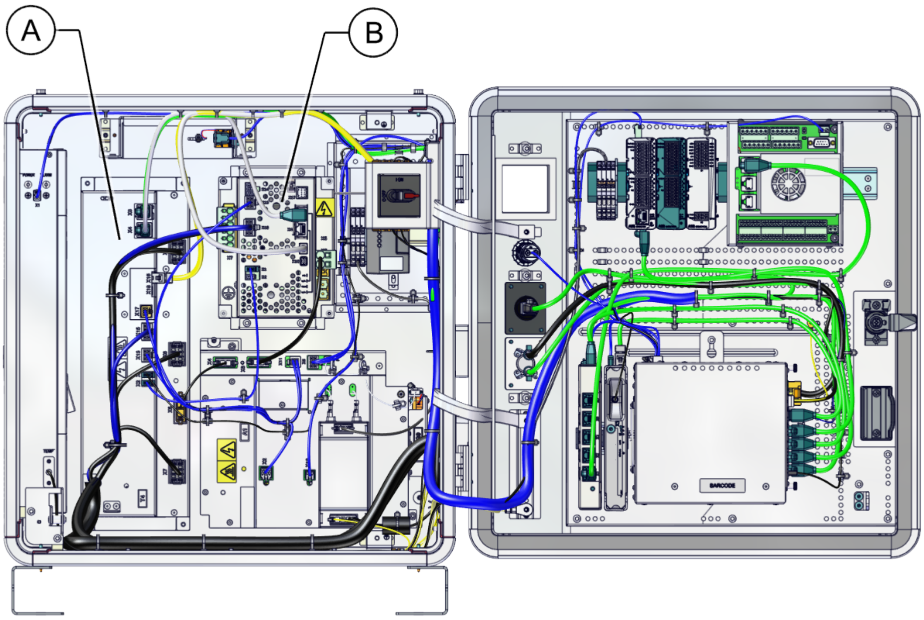
General

The drive system in the OmniCore controller contains one main drive unit and one or more additional drive units.

Location

The location of the drive system in the OmniCore controller is shown in the following images.

C90XT Type A



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A	Main drive unit
B	Additional drive unit (for additional axes)

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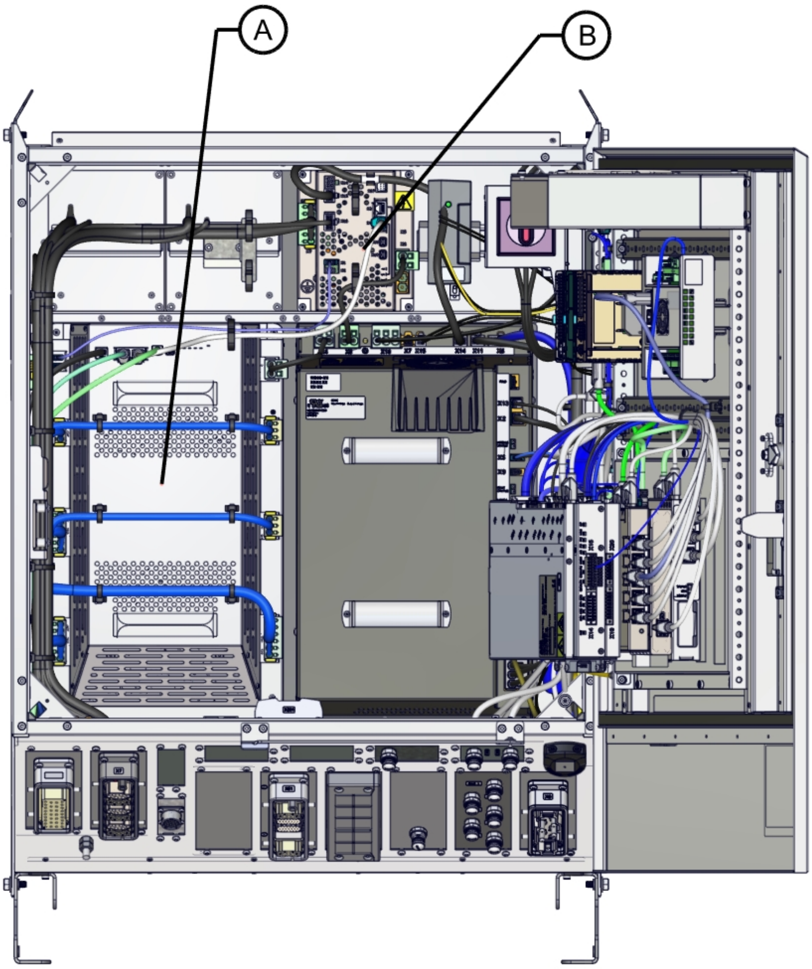
V line (V250XT and V400XT)



xx2200000703

A	Main drive unit
B	Additional drive unit (for additional axes)

For an exact location, see the product manual for the respective controller variant listed in *References on page 7*.

Units

The power unit, drive unit, and additional drive units can be placed in the following positions in the controller.

Position	Identification	Description	Art. no.	Note
1	DCQC3069	Power unit LVHP	3HAC082501-001	
	DCQC3070	Power unit HVHP	3HAC082500-001	
2	DSQC3062	Drive unit HV	3HAC082498-001	
	DSQC3084	Drive unit LV	3HAC083415-001	
3	DSQC3065	Additional drive unit	3HAC064983-001	

Continues on next page

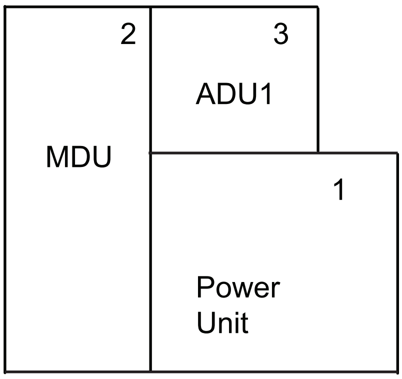
Position	Identification	Description	Art. no.	Note
3-8	DSQC3065	Additional drive units	3HAC082499-001	Positions 6-7-8 are only available for V400XT.

Tip

For exact location and specification of how many additional drive units are allowed, see the product manual for the respective controller variant listed in *References on page 7*.

C90XT Type A

For OmniCore C90XT *Type A*, 1 additional drive unit can be installed in the following position:



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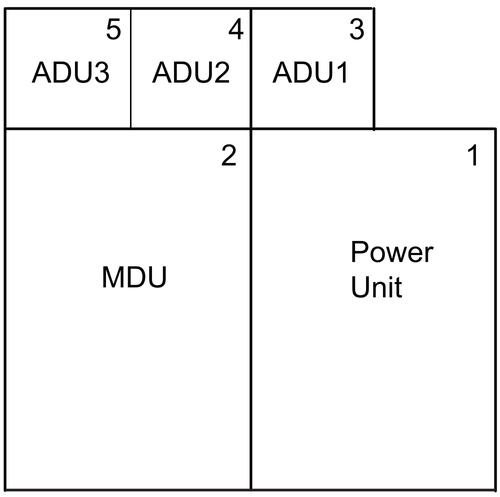
V250XT Type B

For OmniCore V250XT *Type B* with high power drive systems (B4, E4 and E8), up to 3 additional drive units can be installed in the following positions:



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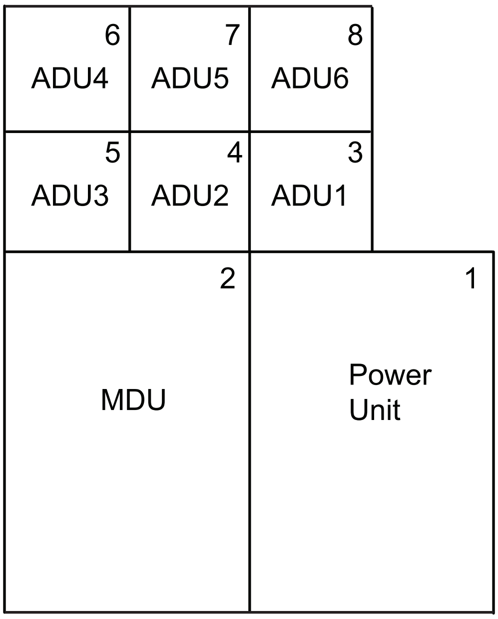
V400XT

For OmniCore V400XT with high power drive systems (B4, E4 and E8), up to 6 additional drive units can be installed, in the following positions:



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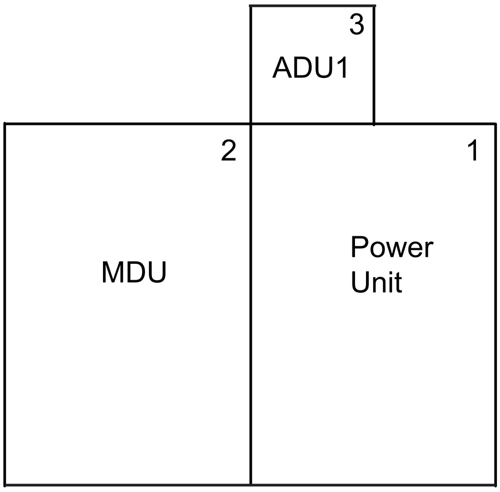
V line, low power

For OmniCore V line controllers with low power drive systems (B5, E5 and E9), 1 additional drive unit can be installed in the following position:



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ADU cables

Description	Art. no.	Note
Harn. 24V_SYS_DRV	3HAC077723-001	
Harn. Drive DC-bus	3HAC066724-001	
Harn. ADU_BRAKE	3HAC074620-001	

Continues on next page

Description	Art. no.	Note
Ethernet harness	3HAC077379-001	

6.2 Drive units

Overview

A Main Drive Unit (MDU) consists of 6 power stages.

An Additional Drive Unit (ADU) consists of one power stage.

Voltage for drive units

The following table describes the input voltage and the DC-bus voltage for the different drive units. See also *Requirements for high voltage motors on page 81*.

OmniCore	Drive unit	Power unit	Output voltage to motor (V_{rms}) [i]	Max dc bus voltage (V_{rms})
V250XT V400XT	Drive unit, LV DSQC3084	Power unit, LVLP DSQC3071	nominal 230 V	430 V
V250XT V400XT	Drive unit, HV DSQC3062	Power unit, HVHP DSQC3070	nominal 400 V	800 V
V250XT V400XT	Drive unit, HV DSQC3062	Power unit, HVLP DSQC3072	nominal 400 V	800 V
V250XT V400XT	Drive unit, HV DSQC3062	Power unit, LVLP DSQC3071	nominal 230 V	430 V
V250XT V400XT	Drive unit, HV DSQC3062	Power unit, LVHP DSQC3069A	nominal 230 V	430 V
C90XT Type A	Drive unit, LV DSQC3084	Power unit DSQC3066	nominal 230 V	430 V
V250XT V400XT	Additional drive unit DSQC3065	Power unit, HV	nominal 400 V	800 V
V250XT V400XT C90XT Type A	Additional drive unit DSQC3065	Power unit, LV	nominal 230 V	430 V

i Defined as line to line.

Current limits for drive units

Drive unit	Power stage	Rated current (arms) [i]	Time limited current (arms) [ii]	Max current (arms) [iii]	Time limit for max current (s) [iv]
DSQC3084	inv_6_12	6.4	7.9	11.5	3
DSQC3084	inv_14_24	13.5	16.1	24	3
DSQC3062	inv_17_26	17	23	26	3
DSQC3062	inv_31_54	31	48	54	3
DSQC3065	inv_30_55	30	39	55	3

i The rated current is the maximum current that can be used continuously in the speed range from standstill up to max speed.

ii The time limited current is the maximum current that can be used at standstill during a limited time.

iii The max current during acceleration or deceleration during a limited time (specified by *iv*).

iv The max time for max current during acceleration or deceleration.

Continues on next page

See *Example of ADU load on page 75*.

Brakes

The brake should be connected to the drive unit that controls the additional axis, on connector X15 on the drive unit.

> **CAUTION**
>
> If the brake is not correctly connected, then there is a risk of unexpected movement.

The brake current is displayed on the FlexPendant, in the **Settings** app under **Hardware Devices** -> **Drive Link X** -> **Runtime Information**, for drive unit devices. This data can be used for configuration and troubleshooting.

Drive unit connection

The following table shows the drive unit connection for each drive unit when using configuration template files for standalone axes.

When using a template file, a power stage is connected to a physical output. The label of this output in the electrical circuit diagram is shown in the column "Designation in circuit diagram".

Drive Unit	Template file name (drive unit name)[i]	Power stage	Designation in circuit diagram	Label on unit
DSQC3062	M1 (DMX) M2 (DMX) M3 (DMX) M4 (DMX) M5 (DMX) M6 (DMX)	INV_31_54 INV_17_26 INV_31_54 INV_17_26 INV_31_54 INV_17_26	T4	X7 X10 X8 X11 X9 X12
DSQC3065	M7 (DMX)	INV_30_55	T41-T46	X7

i X= drive module number

Example of ADU load

The ADU is specified to handle 30A_RMS continuous current.

The ADU is specified to handle 39A_RMS as 3s time limited standstill current.

The ADU is specified to handle 55A_RMS as 3s time limited rotating current.

So assume we run at 55A_RMS for 3s, now we need to cool down the inverter using any of the following case in order to be able to run 55A_RMS in 3s again.

- 3.6s with 0A
- 4.6s with 14A
- 10s with 24A
- 30s with 28A

Or something in between 1-4.

Continues on next page

Example of standalone controller load

TBD

6.3 Measurement system

Overview

The OmniCore C90XT Type A can control and measure up to 7 axes at the same time.

The OmniCore V250XT Type B can control and measure up to 9 axes at the same time.

The OmniCore V400XT can control and measure up to 12 axes at the same time.

Serial measurement links

Each drive unit can connect to a serial measurement link, that can be directly connected to the serial measurement board. It can also share a measurement link to another drive unit.

Serial Measurement Board

The standard SMB has seven resolver inputs. These inputs can be used as seven different nodes where the node number normally is equal to the axis number e.g. axis 1 to node 1.

Back-up battery

A back-up battery supplies the SMB with power during power failure. If an axis is moved a small distance during power off, the system is ready for operation, and no synchronization is needed after power on.

Features

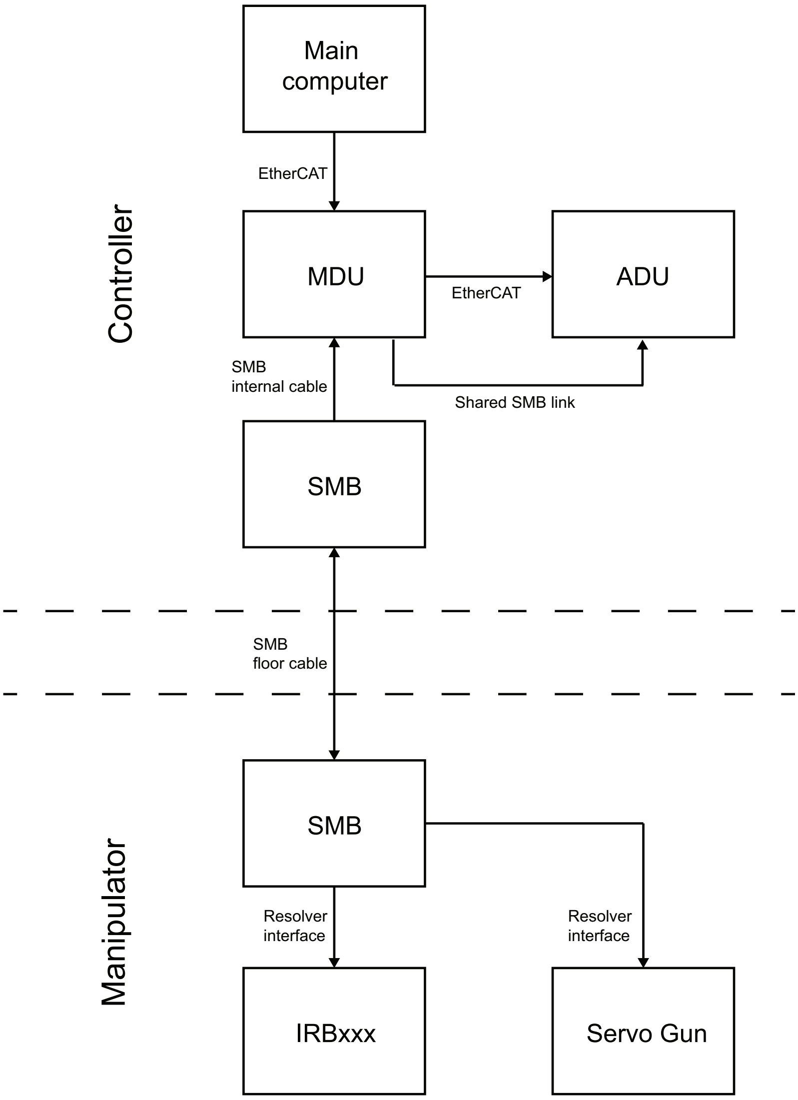
Specifications for the measurement system:

- Each controller cabinet can handle two SMBs divided on two serial links.
- Each serial link can handle up to seven axes using measurement node 1-7.

6.4 Serial measurement link examples

1 ADU + drive unit

The following is an example of a setup with a drive unit (MDU) and one additional drive unit (ADU):



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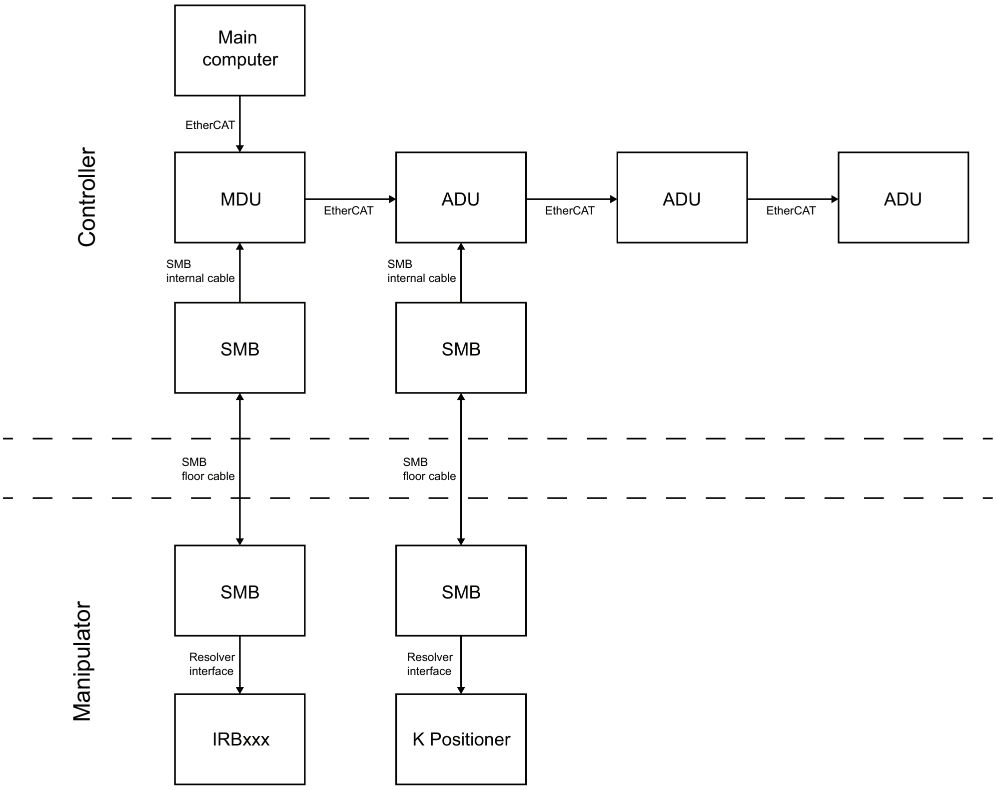
3 ADU + drive unit

The following is an example of a setup with a drive unit (MDU) and three additional drive units (ADU):



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6.5 Equipment for additional axes

Overview

A number of parts needed to install and operate additional axes are available from ABB.

Motor units and gear units offer

The offer consists of:

- Motors
- Motors with gear boxes
- SMB boxes
- Cables

For more information, see the product specification and product manual for the motor units and gear units, listed in *References on page 7*.

6.6 Motors

Overview

The motor units sold by ABB are specifically designed for ABB's robots and can be used for peripherals requiring power-steered motors that are synchronized with the robot movements. The motor units are designed for optimal performance and to facilitate installation and application.

Note

Before a motor is acquired, read also the information on how to calculate the correct motor data, see *Simple dimensioning of the motor on page 84*.

Motor description

Motor shall be a permanent magnet servo-motor of synchronous type intended for three-phase sinusoidal AC voltage, coupled in star (Y) connection.

- the motor should preferably be winded as class F according to IEC 85.
- dielectric strength minimum 1600 V. For low voltage motors connected to drive module. For high voltage motors connected to drive module, see *Requirements for high voltage motors on page 81*
- Measurement signal cables must be separated from motor cables, and cables from temperature sensor and brake.

Requirements for high voltage motors

Third party driveline components (motors and gearboxes) used as external equipment on the large robots (IRB 67x0 and larger) must withstand the voltage stress levels as described in the following.

These data are valid for high voltage motors connected to the drive units:

- High voltage main drive unit DSQC3062
- High voltage additional drive unit DSQC3065

The maximum allowed motor cable length is 30 m. Rise time is expressed as an indicative value at motor terminals.

Converter specifics	
Voltage (Pulse-Width Modulated)	400-480 VAC
DC link maximum voltage	790 VDC (including tolerance: 825 VDC)
Switching frequency	4 kHz
System specifics	
Rise time / dU/dt (indicative value)	0.2 microsec (as defined in IEC 60034-25) / 9 kV/microsec
Requirement for drive line components	
Insulation strength	According to IEC 60034 (i.e. >2000 V)
Voltage stress withstand capability (including PD deterioration effects)	Above withstand level B according to IEC 60034-25, Figure 17 Chapter 7

Continues on next page

Thermal protection

The temperature sensor normally used is of type PTC resistor. A high resistance or open circuit indicates that the temperature of the motor exceeds the rated level. If temperature sensor is not used, the circuit must be strapped. If more than one motor is used, all PTC resistors are connected in series.

The temperature sensor can be connected to X24 on the main computer.

The system input characteristics are:

- High temperature >3500 ohm
- Low temperature <3500 ohm

WARNING

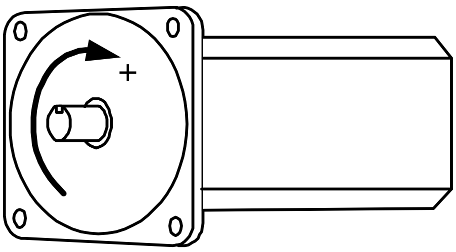
The PTC supervision must be turned on in the configuration by setting the parameter *Enable additional axes ptc supervision* to *TRUE*, in the topic *Motion*, type Drive Module User Data.

Note

For F class winding with maximum temperature of 155ºC, Siemens B59135-M155_A70 can be used.

Motor connection

Positive electric rotation R ->S ->T -> (U, V, W) results in positive mechanical rotation defined as **clock wise** direction, seen from the drive shaft side. See illustration below. For connection and cabling for the motor to the controller, see the product manual for the robot controller listed in *References on page 7*.



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Brake

Select a brake with minimum brake torque, sufficiently large to handle emergency stop when axis is moving downwards with maximum gravity. Check that maximum brake torque does not exceed allowed mechanical stress levels.

Brake release voltage: 24 VDC +/- 10%.

The following maximum current is allowed for the brake release:

- E10: 4.5 A, continuous 3.5 A
- C30 and C90XT: 3.5 A
- V250XT and V400XT: continuous 13 A

Continues on next page

Note

Check the brake release voltage at maximum brake (motor) temperature and maximum allowed wear out for the brake.

Motor types

For more information about the recommended motor types from ABB, see section *Equipment for additional axes on page 80*.

6.7 Simple dimensioning of the motor

Overview

Before connecting a motor, read the general description for motors in chapter *Motors on page 81*

Note

This section is used as a rough dimensioning of the motor, so before installing the motor make sure that it is dimensioned by a professional.

Calculate system performance

Either the motor or the drive unit sets the limitations for the system performance.

Value	Description
Kt_{min}	Motor torque constant (Nm/A_{rms}).
I_{max} drive	Max current for the drive unit (A_{rms}). See *Drive units on page 74*.
I_{max} (motor)	Max current for the motor (A_{rms}).
T_0	Average motor torque (Nm).
I_0	Average drive unit current (A_{rms}). See *Drive units on page 74*.

Calculate T_{max} and $T_{average}$ for the drive unit and the motor, then choose the limiting torque.

Criteria	Calculate the minimum value
T_{max}(system)	= min($Kt_{min} * I_{max}$(drive unit), $Kt_{min} * I_{max}$(motor))
$T_{average}$(system)	= min(T_0(motor), $Kt_{min} * I_0$(drive unit))

Check intermittence

When T_{max} and $T_{average}$ for the system is found, check the thermal load factor. It could be of importance if the additional axis accelerates slowly or if the axis moves with short quick movements without stops. The motor, or the drive unit could be over heated. Observe the planned cycle and calculate the total acceleration time. The other time is treated as static load.

T_{stat} = friction torque + gravitational torque

Value	Description
i	Time in acceleration and deceleration divided by total time
T_{stat}	Static load
1-i	Time in constant speed and standing still (only friction and gravity influences the motor)

Calculate: $T_{rms} = sqrt(T_{max}^2 * i + T_{stat}^2 * (1-i))$

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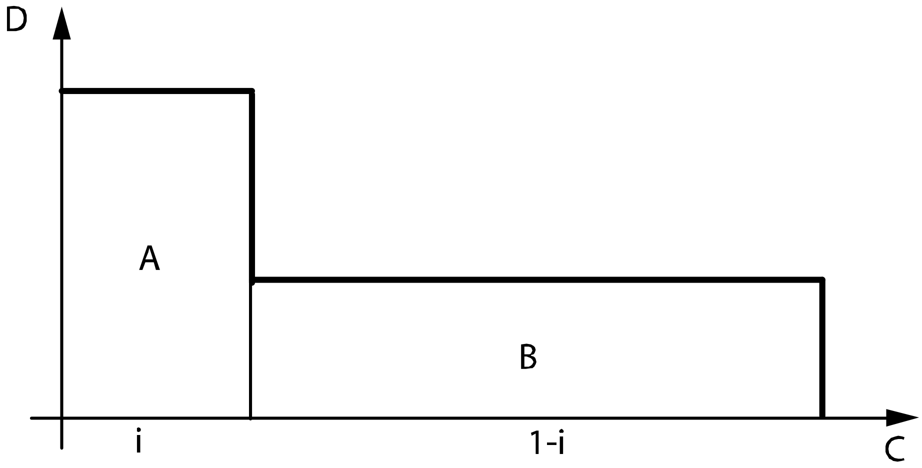

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A	Max torque (T_{max})
B	Static torque (T_{stat})
C	Time
D	Torque

Dimensioning

T_{rms} should be lower than $T_{average}$. Otherwise reduce T_{rms} or change one of the components, drive unit or motor.

Acceleration performance on arm side could now be calculated:

Acceleration = (T_{max} - GravitationalTorque - Friction) / (Inertia * Transmission)

Deceleration = (T_{max} - GravitationalTorque + Friction) / (Inertia * Transmission)

An alternative is to tune the acceleration and deceleration (parameters: *Nominal acceleration* and *Nominal deceleration*) directly on the external axis and find out if the assessable torque (T_{max}) gives desired performance.

If it is impossible to reach desired performance replace the motor or the drive unit.

Example

In this example we use worst case performance which means acceleration against the gravity

T_0	5 (Nm)
Kt_{min}	1.0 (Nm/A)
I_{max} (motor)	15 (A)
I_{max} (drive unit)	10 (A)
I_0 (drive unit)	6 (A)
intermittence	0.1
Transmission (n)	100
Mass (M)	20 (kg)
Friction (F)	2 (Nm)

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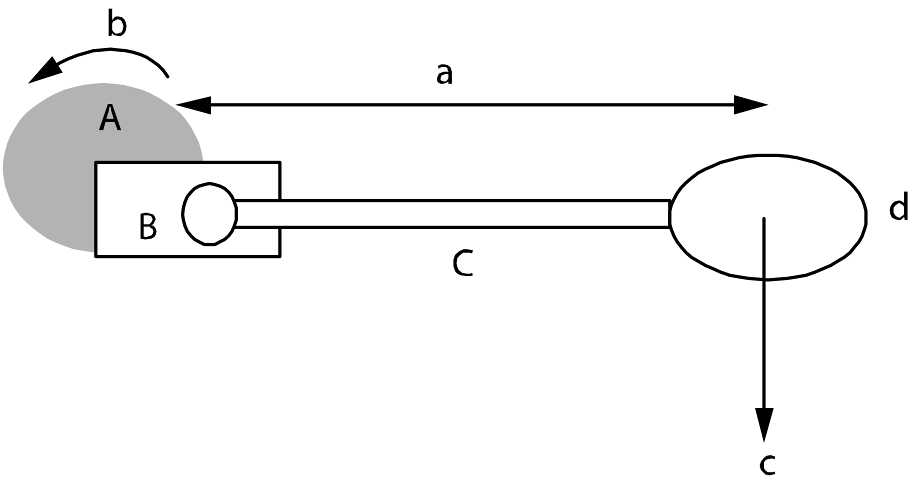
Gravity constant (g)	9.81 (N/kg)
Length to mass (L)	1.0 (meter)
Motor inertia (J_m)	0.005 (kgm^2)



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a	Length to mass (L)
b	Motor inertia (J_m)
c	Mass (M) * GravityConstant (g)
d	Mass of Arm (M)
A	Motor
B	Gearbox
C	Arm

In this example acceleration needs to be 5 rad/s.

Calculations

Gravitational torque = (M*L*g)/n =(20*1*9.81)/100 = 1.96

T_{stat}= FrictionTorque + GravitationalTorque = 2 + 1.96 = 3.96

T_{max} (system) = min (Kt_{min} * I_{max} (drive unit), Kt_{min} * I_{max}(motor) = min(1*10, 1*15)=10

$T_{average}$(system) = min((T_0(motor), Kt_{min}*I_0(drive unit)) = min(5.0, 1*6) = 5.0

T_{rms}= sqrt(T_{max}^2 * i + T_{stat}^2 * (1-i)) = (10^2*0.1+3.96^2*(1-0.1))$^{0.5}$=4.9

T_{rms} is lower than average. No need to change motor or drive unit.

Total moment of inertia on motor side J= J_m+($M*L^2$)/n^2=0.005+($20*1^2$)/100^2=0.007

Acceleration = (T_{max} - GravitationalTorque - Friction)/(J*n) = (10-1.96-2)/(0.007*100)=8.6

Deceleration = T_{max} - GravitationalTorque+Friction)/(J*n)=(10-1.96-2)/(0.007*100)=14.3

Both acceleration and deceleration are within the demand.

6.8 Resolvers

Overview

The resolver is integrated in the motors from ABB. The resolver must be approved by ABB for reliable operation.

Approved resolvers

The following resolvers are approved by ABB

Manufacturer	Article numbers
LTN Servotechnik GmbH	LTN RE-21-1-V02, size 21 LTN RE-15-1-V16, size 15
AG	V23401-U2117-C333, size 21
Tamagawa Seiki Co	TS 2640N141E172, size 21 TS 2640N871E172, size 21 TS 2620N871E172, size 15

Resolver specification

Data	Value	Unit
Single speed resolver		
Operating temperature	-25 to +120	°C
Rated input voltage	5	V_{RMS}
Frequency	4	kHz
Primary (EXC)	Rotor	
Secondary (X, Y)	Stator	
Nominal impedance - Primary (stator winding open) Z_{RO} at 4 kHz	>115	Ω
Nominal impedance - Secondary (rotor winding closed) Z_{SS} at 4 kHz	<440	Ω
Transformation ratio	0.5 ± 20%	
Phase shift out-in	0 ± 10	deg
Max error spread	≤ 10	arcmin
Resolver adjustment (COMOFF)	+90 ± 0.5	deg

The resolver has one rotor and two stator windings. The definition of the output signals are:

E(S1, S3) = 0.5 x E(R1, R2) x cos(resolver angle)

E(S2, S4) = 0.5 x E(R1, R2) x sin(resolver angle)

Note

The resolver must be tested together with a robot system to verify that the resolver also functions during battery mode.

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Considerations

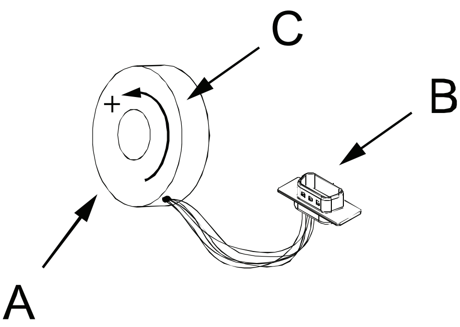
The following technical information must be considered before the installation:

- The maximum allowed resolver cable length is 30 m, from the resolver to the serial measurement board (SMB).
- A resolver cable consists of six wires. Two wires for excitation, and two wires each for the X and Y signals
- Use a shielded, AWG 24, max 55pF/m cable.
- To avoid disturbances in the signals due to magnetic fields generated by the brake it is recommended to use non-magnetic motor shaft.

Note

The unshielded part of the resolver cable must be as short as possible, less than 100 mm, and be well separated from the motor cables, more than 20 mm.

Resolver connection



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A	Resolver
B	9 pin D-sub
C	Positive motor direction

Normally in ABB motors, resolvers are connected to the internal cable in robot by a 9 pin D-sub connector, with pins at the resolver side.

When the motor rotates in a positive direction, the resolver rotates mechanically in a negative direction, as the resolver is mounted at the opposite side of the drive shaft side.

To deliver electrically positive rotation the y-winding connection S2 and S4 has changed place.

9 pin D-sub	SMB input	Resolver connection	Color resolver wires
6	X	S1	Red
1	X 0V	S3	Black
7	Y	S4	Blue
2	Y 0V	S2	Yellow
3	EXC	R1	Red/White
8	EXC 0V	R2	Yellow/White

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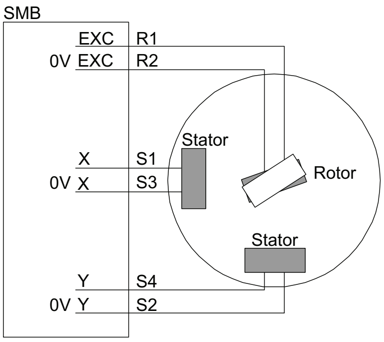

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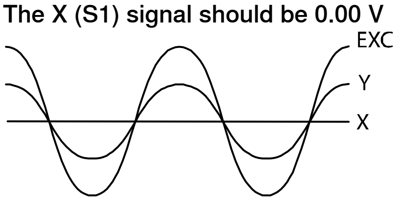
Resolver direction

Motor angle	X (S1)	Y (S4)
0	Maximum in phase with EXC	0
+90	0	Maximum in phase with EXC

Commutation

Commutation can be done in several ways. The following method is one of the possible methods.

	Action	Info/Illustration
1	Turn the motor to commutation by feeding positive current into power winding S with T connected to ground (R is not connected). For detailed description, follow the first part of the procedure in *Manual commutation on page 62*.	The number of different commutation positions that the motor can turn to is the same as the number of pole pairs.
2	Select a resolver commutation position enabling the resolver cables to be routed in the best possible way.	
3	Feed a 4 kHz sinus signal to the EXC (R1) input of the resolver.	
4	Connect an oscilloscope to EXC (R1), X (S1) and Y (S4).	
5	Adjust the commutation position to +90 degrees +/-0.5 degrees by turning the resolver.	The Y (S4) signal should be at max output and with the same phase as the EXC (R1) feeding signal. The X (S1) signal should be 0.00 V  xx0500001401

6.9 Serial measurement cables and connections

Overview

This section details the cables and connection between the resolver and the serial measurement board.

Signal classes

The cabling must comply with a valid signal class "measurement signals" see the cable requirements in the product manual for the robot controller. The enclosure for external serial measurement board/boards must comply with enclosure class IP54, in accordance with IEC 144 and IEC 529.

Note

It is very important that the noise level on the measurement signals from the additional axes is kept as low as possible, to prevent bad performance, that is, keep motor and resolver cables apart. Correct shielding and ground connections of cables, measurement boards and resolvers is essential.

Considerations

The **X**, **Y**, **0V X** and **0V Y**:

- Signals are used to connect resolvers to a serial measurement board.

The **EXC** and **0V EXC**:

- are used for common supply for all resolvers, parallel connected.

Resolver:

- 1 - 3, should always be connected to EXC 1.
- 4 - 7, should always be connected to EXC 2.

Note

Maximum allowed length on the serial measurement cable is 50 meters.

For motor cables, see *Motors on page 81*.

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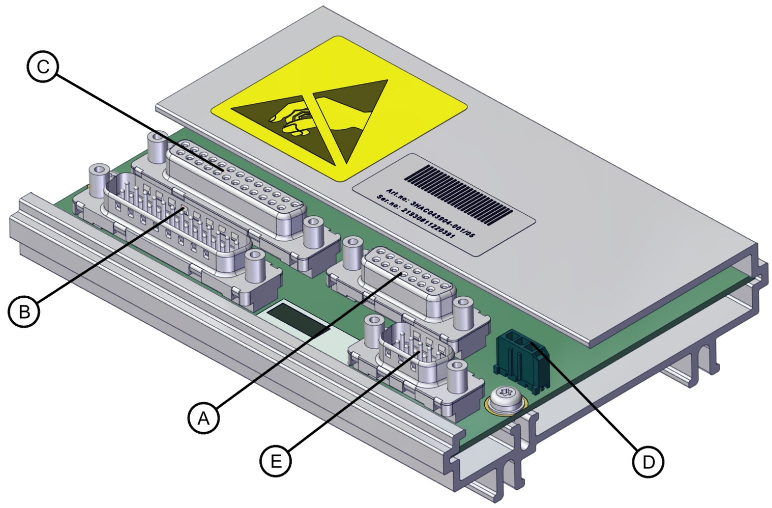
Illustration DSQC 633C



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A	R2.SMB 1-2 (D-sub 15 socket)
B	R2.SMB 1-4 (D-sub 25 pin)
C	R2.SMB 3-6 (D-sub 25 socket)
D	R2.G
E	R2.SMB (D-sub 9 pin)

Connections to SMB DSQC 633C

Contact point	R2.G	R2.SMB	R2.SMB 1-2	R2.SMB 1-4	R2.SMB 3-6
1	+BAT	GND	GND	GND	GND
2	0V BAT	-	0V EXC2	X1	X4
3		0V	0V EXC1	Y1	Y4
4		SDO-N	Y7	X2	X5
5		SDI-N	X7	Y2	Y5
6		-	Y1	0V EXC1	0V EXC2
7		+24V	X1	0V EXC1	0V EXC2
8		SDO	-	0V EXC1	0V EXC2
9		SDI	EXC2	X3	X6
10			EXC1	Y3	Y6
11			0V Y7	X4	X3
12			0V X7	Y4	Y3
13			0V Y1	0V EXC2	0V EXC1
14			0V X1	0V X1	0V X4
15				0V Y1	0V Y4
16				0V X2	0V X5
17				0V Y2	0V Y5

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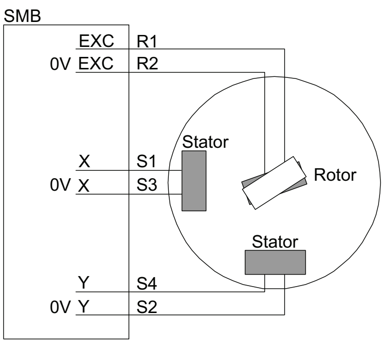
Contact point	R2.G	R2.SMB	R2.SMB 1-2	R2.SMB 1-4	R2.SMB 3-6
18				EXC1	EXC2
19				EXC1	EXC2
20				EXC1	EXC2
21				0V X3	0V X6
22				0V Y3	0V Y6
23				0V X4	0V X3
24				0V Y4	0V Y3
25				EXC2	EXC1

Explanation

Term	Description
SDO	serial communication output
SDI	serial communication input
+BAT	Battery +
0V BAT	Battery 0V
BATLD	Not to be used
BATSUP	Not to be used
EXC1	excitation power to resolver number 1, 2, 3
EXC2	excitation power to resolver number 4, 5, 6, (7)
+24V	24 V power
0 V	0 V power
X1	Input x-stator node 1
Y1	Input y-stator node 1

Illustration

The connection point on the resolver corresponds to the connection table above.



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Example

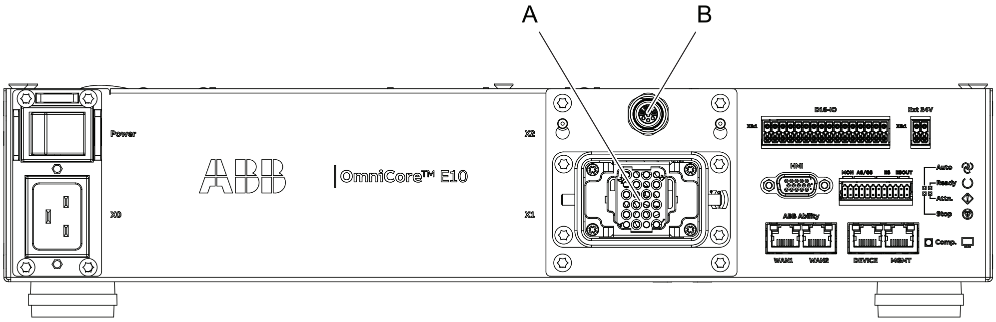
To connect from resolver to SMB, use input 7 (node 7). Connect to contact R2.SMB 1-2.

Signals	Contact point SMB	Contact point resolver
EXC 2	9	3
EXC 2, 0 V	2	8
X7	5	6
X7, 0 V	12	1
Y7	4	7
Y7, 0 V	11	2

6.10 OmniCore interface and connectors

6.10.1 E10 connectors

E10 - Overview



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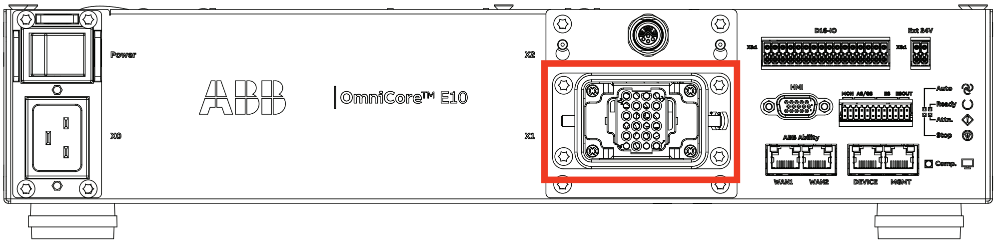
Label	Description
A	Motor connection, X1
B	SMB connector, X2

E10 - Motor power from main drive unit



xx2500000973

See connector X1 in circuit diagram.

Matching mating connector example:

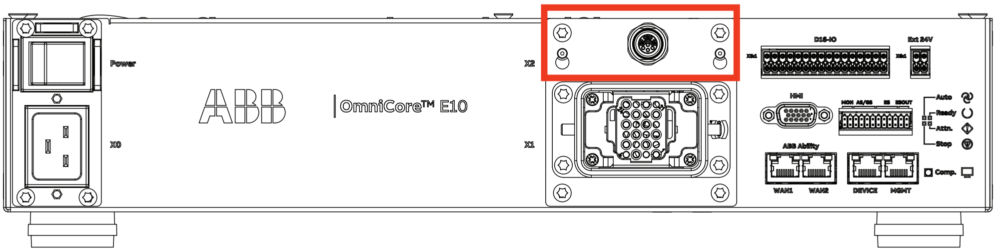
Hood (x1)	
Manufacturer	Harting
Series of hoods/housings	Han® EMC/B
Size	6 B
Locking type	Single locking lever
Article number	19 62 806 0556

Insert (x1)	
Manufacturer	Harting
Series of hoods/housings	Han DD®
Termination method	Crimp termination
Gender	Male

Continues on next page

Insert (x1)	
Size	6 B
Number of contacts	24
Article number	09 16 024 3001

E10 – SMB for main drive unit



xx2500000974

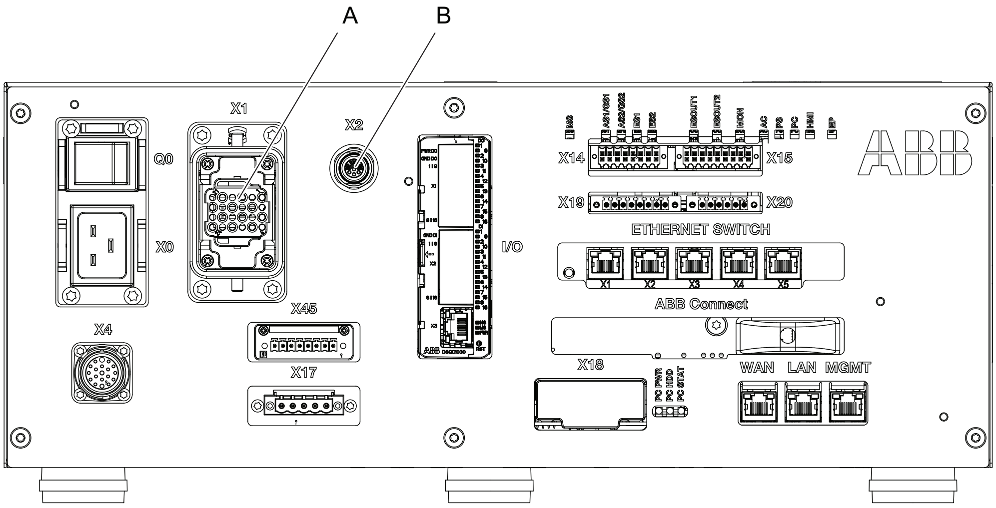
See connector X2 in circuit diagram.

Matching mating connector example:

Connector (x1)	
Manufacturer	Harting
Series/type	M12
Coding	Y
Number of contacts	8 (4+4)
Gender	Male
Article number	21 03 861 1805

6.10.2 C30 connectors

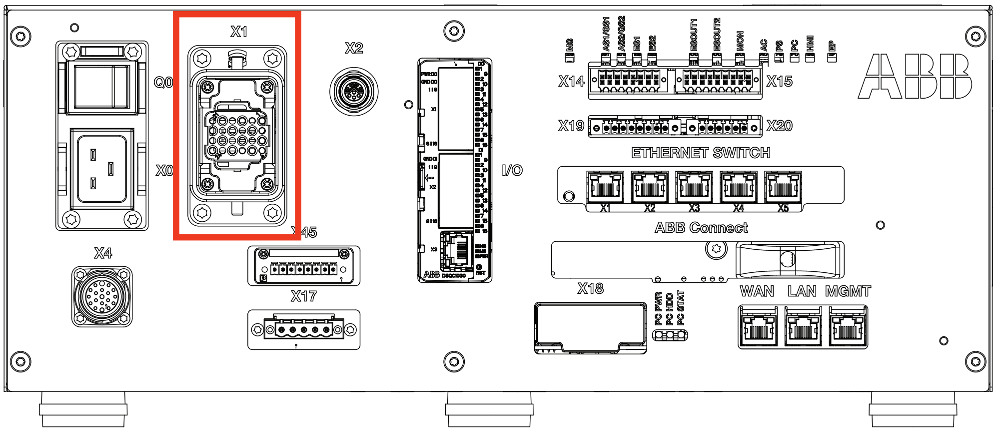
C30 - Overview



xx2500000969

Label	Description
A	Motor connection, X1
B	SMB connector, X2

C30 - Motor power from main drive unit



xx2500000970

See connector X1 in circuit diagram.

Matching mating connector example:

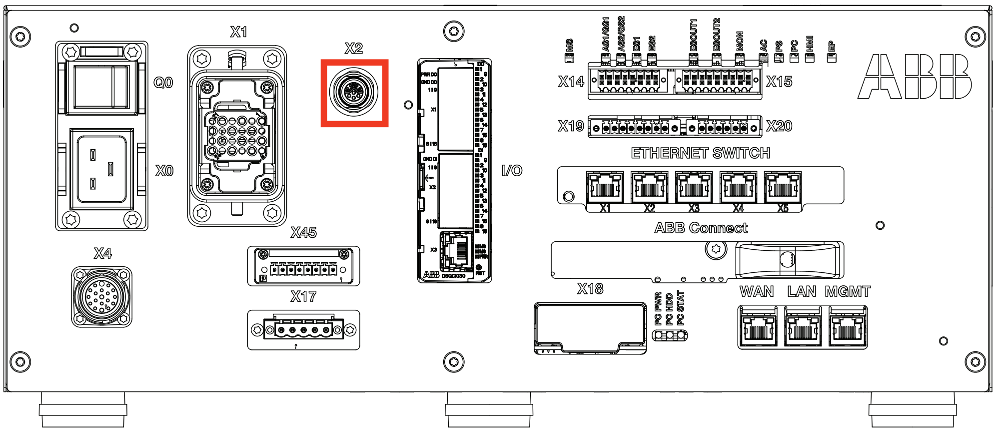
Hood (x1)	
Manufacturer	Harting
Series of hoods/housings	Han® EMC/B
Size	6 B
Locking type	Single locking lever

Continues on next page

Hood (x1)	
Article number	19 62 806 0556

Insert (x1)	
Manufacturer	Harting
Series of hoods/housings	Han DD®
Termination method	Crimp termination
Gender	Male
Size	6 B
Number of contacts	24
Article number	09 16 024 3001

C30 – SMB for main drive unit



xx2500000971

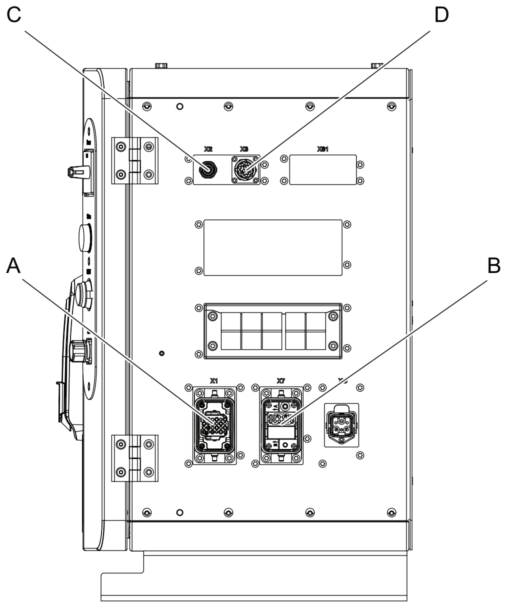
See connector X2 in circuit diagram.

Matching mating connector example:

Connector (x1)	
Manufacturer	Harting
Series/type	M12
Coding	Y
Number of contacts	8 (4+4)
Gender	Male
Article number	21 03 861 1805

6.10.3 C90XT connectors

C90XT - Overview

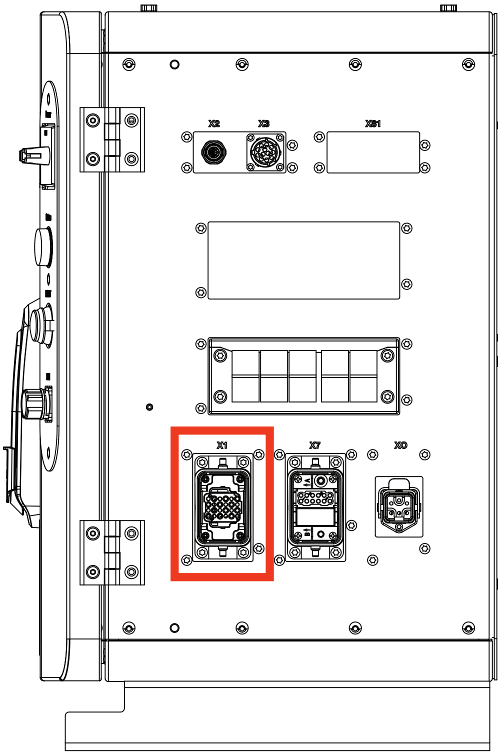


xx2500000961

Label	Description
A	Motor connection, X1
B	Additional axis power, drive 1-3, X7
C	SMB connector, X2
D	SMB connector, X3

Continues on next page

C90XT - Motor power from main drive unit



xx2500000962

See connector X1 in circuit diagram.

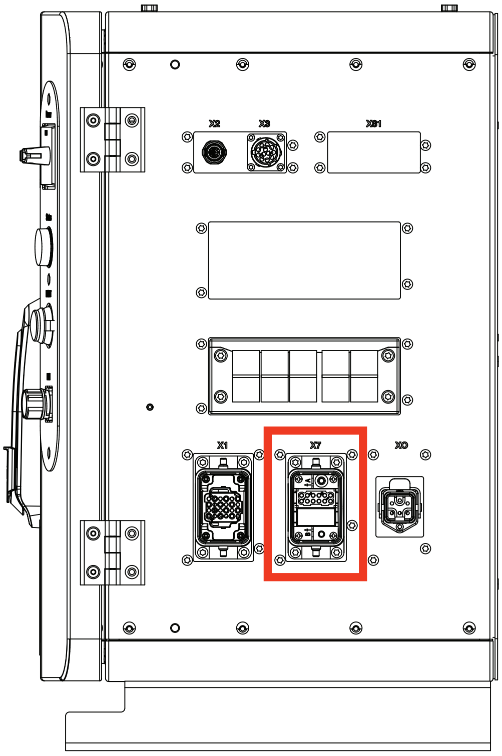
Matching mating connector example:

Hood (x1)	
Manufacturer	Harting
Series of hoods/housings	Han® EMC/B
Size	6 B
Locking type	Single locking lever
Article number	19 62 806 0556

Insert (x1)	
Manufacturer	Harting
Series of hoods/housings	Han DD®
Termination method	Crimp termination
Gender	Male
Size	6 B
Number of contacts	24
Article number	09 16 024 3001

Continues on next page

C90XT - Motor power from additional drive unit 1



xx2500000963

See connector X7 in circuit diagram.

Matching mating connector example:

Hood (x1)	
Manufacturer	Harting
Series of hoods/housings	Han® EMC/B
Size	6 B
Locking type	Single locking lever
Article number	19 62 806 0557

Insert (x1)	
Manufacturer	Harting
Series of hoods/housings	Han DD®
Termination method	Crimp termination
Gender	Male
Number of contacts	12
Article number	09 14 012 3002

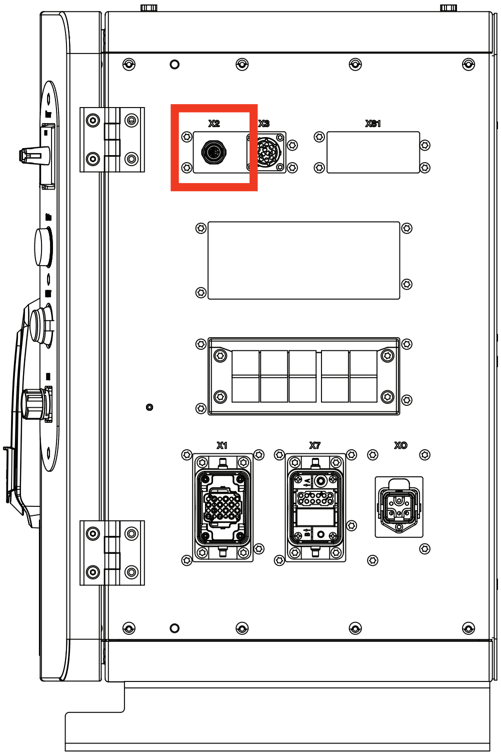
Hinged frame (x1)	
Manufacturer	Harting
Series of hoods/housings	Han-Modular®
Size	6 B

Continues on next page

Hinged frame (x1)	
Description of the accessory	for 2 modules, A ... B
Article number	09 14 006 0361

Insert (x1)	
Manufacturer	Harting
Series	Han® Dummy module
Article number	09 14 000 9950

C90XT – SMB for main drive unit



xx2500000964

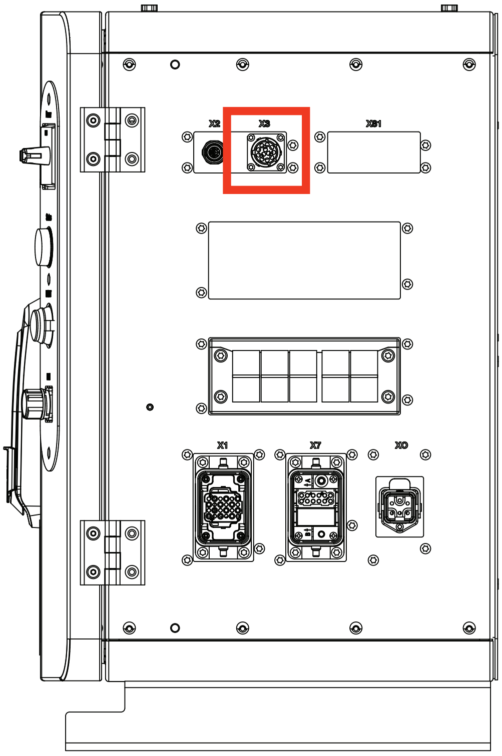
See connector X2 in circuit diagram.

Matching mating connector example:

Connector (x1)	
Manufacturer	Harting
Series/type	M12
Coding	Y
Number of contacts	8 (4+4)
Gender	Male
Article number	21 03 861 1805

Continues on next page

C90XT – SMB for additional drive unit 1



xx2500000965

See connector X3 in circuit diagram.

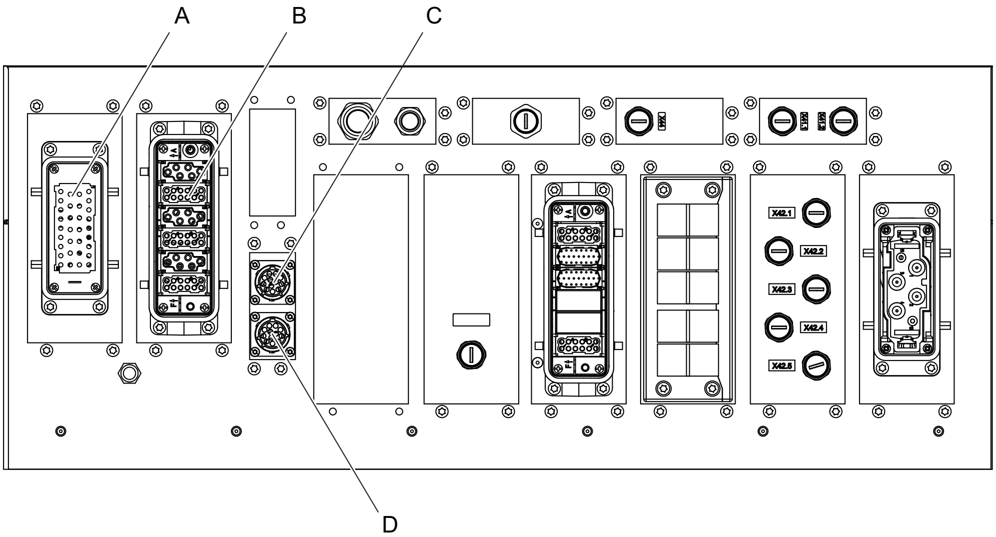
Matching mating connector example:

Connector (x1)	
Manufacturer	Souriau
Series	UTO
Number of contacts	12
Locking type	Bayonet
Article number	UT061412PH04

Connector (x1)	
Manufacturer	Amphenol
Series	ecomate
Number of contacts	12
Locking type	Bayonet
Article number	RT061412PNH

6.10.4 V250XT connectors

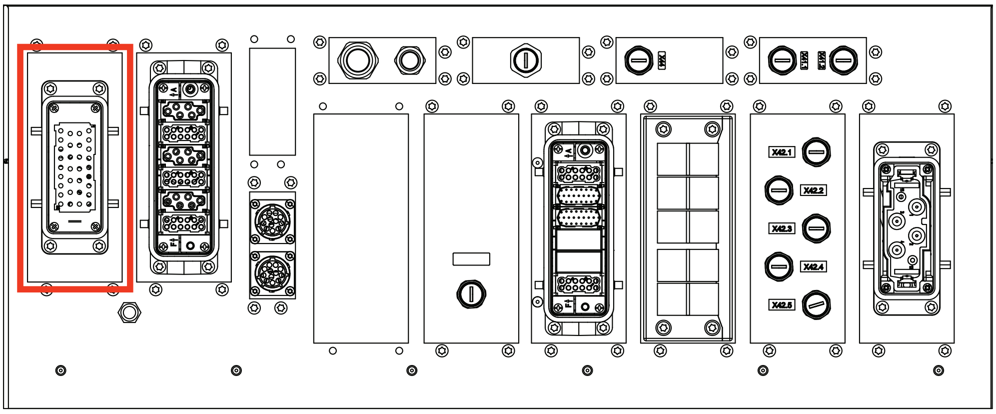
V250XT - Overview



xx2500000956

Label	Description
A	Motor connection, X1
B	Additional axis power, drive 1-3, X7
C	SMB connector, X3
D	SMB connector, X2

V250XT - Motor power from main drive unit



xx2500000957

See connector X1 in circuit diagram.

Matching mating connector example:

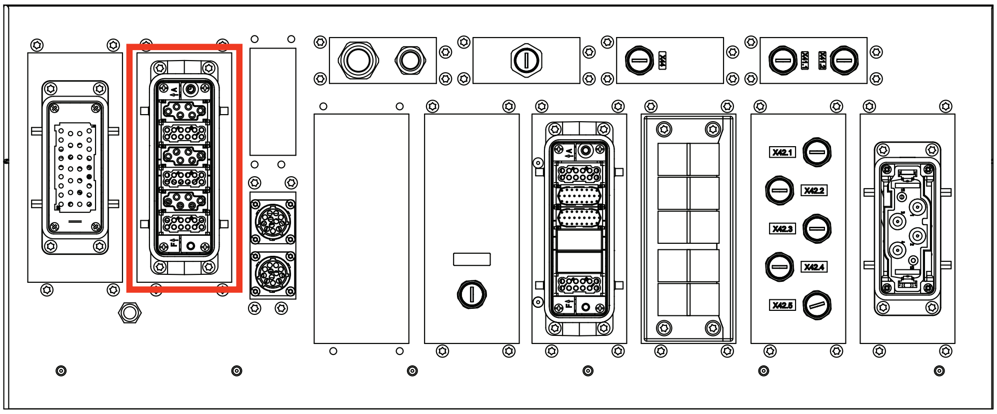
Hood (x1)	
Manufacturer	Harting
Series of hoods/housings	Han® EMC/B

Continues on next page

Hood (x1)	
Size	16 B
Locking type	Double locking lever
Article number	19 62 816 0538

Insert (x1)	
Manufacturer	Harting
Series of hoods/housings	Han® EE
Termination method	Crimp termination
Gender	Male
Size	16 B
Number of contacts	32
Article number	09 32 032 3001

V250XT - Motor power from additional drive unit 1-3



xx2500000958

See connector X7 in circuit diagram.

Matching mating connector example:

Hood (x1)	
Manufacturer	Harting
Series of hoods/housings	Han® EMC/B
Size	24 B
Locking type	Double locking lever
Article number	19 62 824 0538

Insert (x3)	
Manufacturer	Harting
Series	Han DD® module
Termination method	Crimp termination
Gender	Male
Number of contacts	12

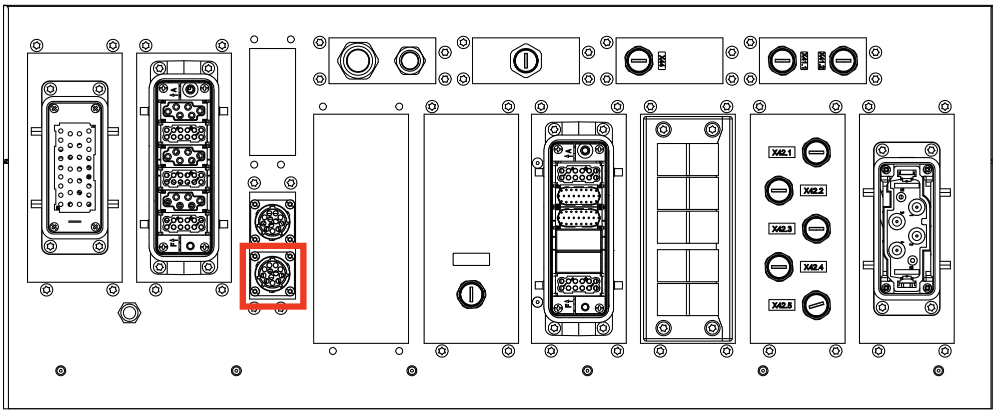
Continues on next page

Insert (x3)	
Article number	09 14 012 3002

Hinged frame (x1)	
Manufacturer	Harting
Series of hoods/housings	Han-Modular®
Size	24 B
Description of the accessory	for 6 modules, A ... F
Article number	09 14 024 0371

Insert (x3)	
Manufacturer	Harting
Series	Han E® module
Termination method	Crimp termination
Gender	Male
Number of contacts	6
Article number	09 14 000 9950

V250XT – SMB for main drive unit



xx2500000959

See connector X2 in circuit diagram.

Matching mating connector example:

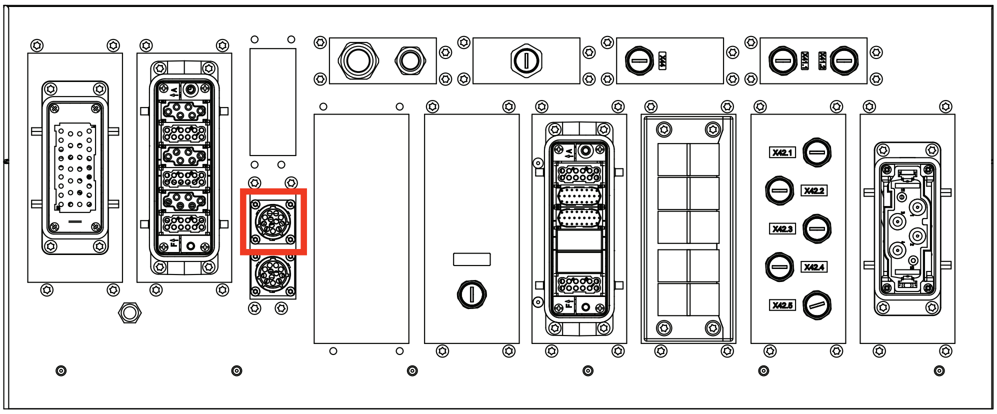
Connector (x1)	
Manufacturer	Souriau
Series/type	UTO
Number of contacts	12
Locking type	Bayonet
Article number	UT061412PH04

Connector (x1)	
Manufacturer	Amphenol

Continues on next page

Connector (x1)	
Series	ecomate
Number of contacts	12
Locking type	Bayonet
Article number	RT061412PNH

V250XT – SMB for additional drive unit 1-3



xx2500000960

See connector X3 in circuit diagram.

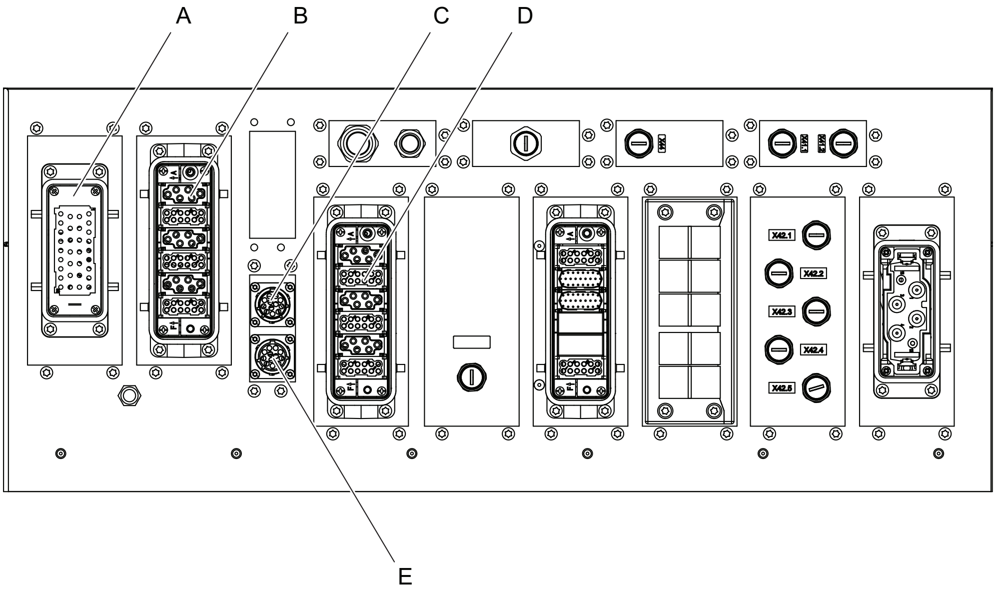
Matching mating connector example:

Connector (x1)	
Manufacturer	Souriau
Series	UTO
Number of contacts	12
Locking type	Bayonet
Article number	UT061412PH04

Connector (x1)	
Manufacturer	Amphenol
Series	ecomate
Number of contacts	12
Locking type	Bayonet
Article number	RT061412PNH

6.10.5 V400XT connectors

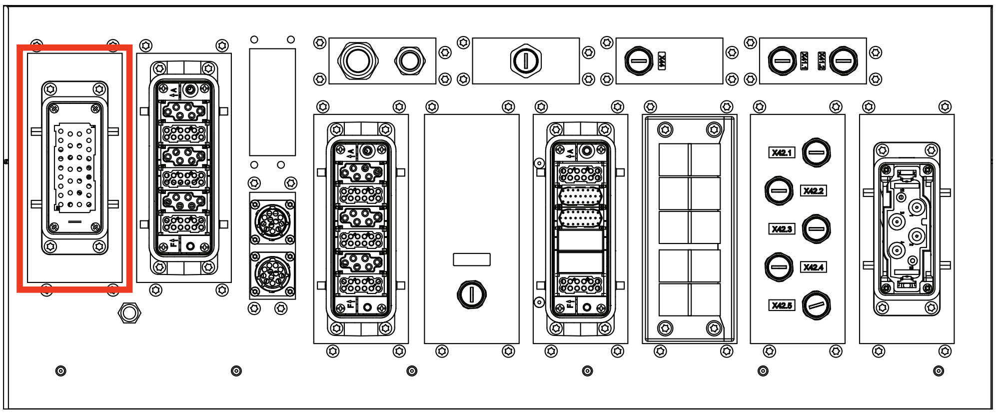
V400XT - Overview



xx2500000949

Label	Description
A	Motor connection, X1
B	Additional axis power, drive 1-3, X7
C	SMB connector, X3
D	Additional axis power, drive 4-6, X7
E	SMB connector, X2

V400XT - Motor power from main drive unit



xx2500000950

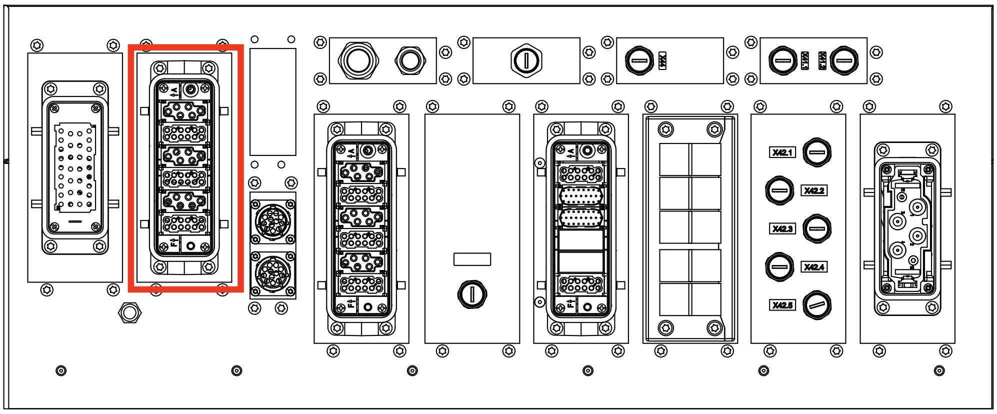
See connector X1 in circuit diagram.

Matching mating connector example:

Hood (x1)	
Manufacturer	Harting
Series of hoods/housings	Han® EMC/B
Size	16 B
Locking type	Double locking lever
Article number	19 62 816 0538

Insert (x1)	
Manufacturer	Harting
Series of hoods/housings	Han® EE
Termination method	Crimp termination
Gender	Male
Size	16 B
Number of contacts	32
Article number	09 32 032 3001

V400XT - Motor power from additional drive unit 1-3



xx2500000951

See connector X7 in circuit diagram.

Matching mating connector example:

Hood (x1)	
Manufacturer	Harting
Series of hoods/housings	Han® EMC/B
Size	24 B
Locking type	Double locking lever
Article number	19 62 824 0538

Insert (x3)	
Manufacturer	Harting

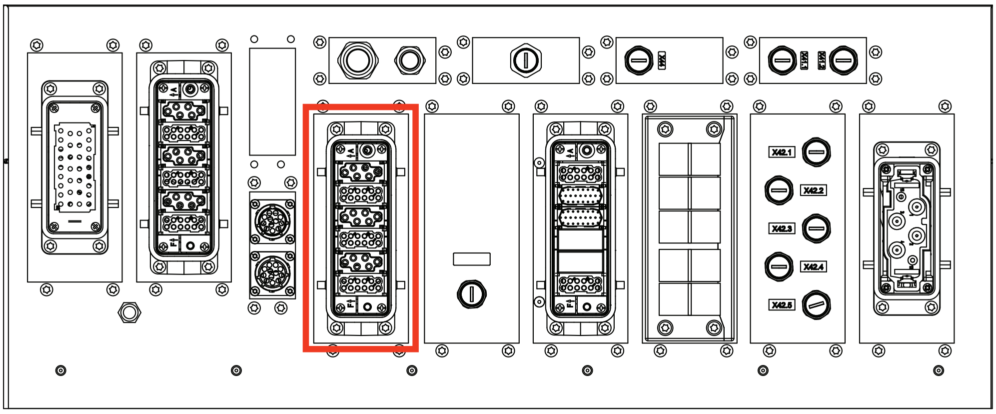
Continues on next page

Insert (x3)	
Series	Han DD® module
Termination method	Crimp termination
Gender	Male
Number of contacts	12
Article number	09 14 012 3002

Hinged frame (x1)	
Manufacturer	Harting
Series of hoods/housings	Han-Modular®
Size	24 B
Description of the accessory	for 6 modules, A ... F
Article number	09 14 024 0371

Insert (x3)	
Manufacturer	Harting
Series	Han E® module
Termination method	Crimp termination
Gender	Male
Number of contacts	6
Article number	09 14 006 3001

V400XT - Motor power from additional drive unit 4-6



xx2500000952

See connector X7 in circuit diagram.

Matching mating connector example:

Hood (x1)	
Manufacturer	Harting
Series of hoods/housings	Han® EMC/B
Size	24 B
Locking type	Double locking lever

Continues on next page

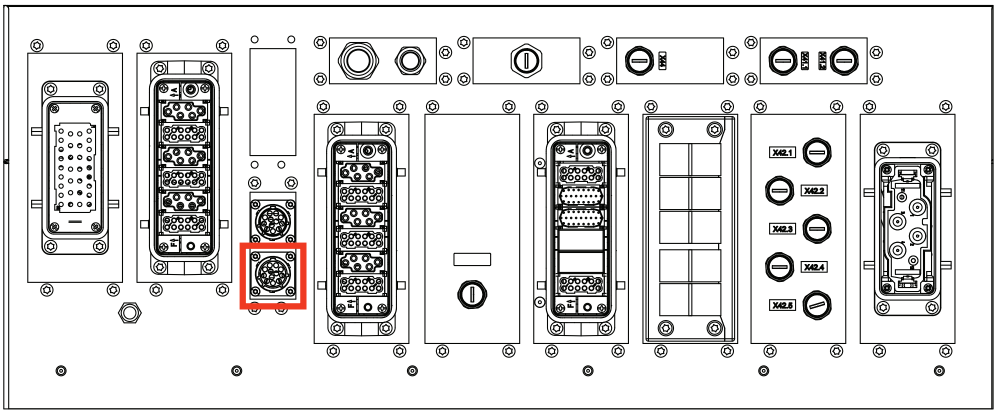
Hood (x1)	
Article number	19 62 824 0538

Insert (x3)	
Manufacturer	Harting
Series	Han DD® module
Termination method	Crimp termination
Gender	Male
Number of contacts	12
Article number	09 14 012 3002

Hinged frame (x1)	
Manufacturer	Harting
Series of hoods/housings	Han-Modular®
Size	24 B
Description of the accessory	for 6 modules, A ... F
Article number	09 14 024 0371

Insert (x3)	
Manufacturer	Harting
Series	Han E® module
Termination method	Crimp termination
Gender	Male
Number of contacts	6
Article number	09 14 006 3001

V400XT – SMB for main drive unit



xx2500000953

See connector X2 in circuit diagram.

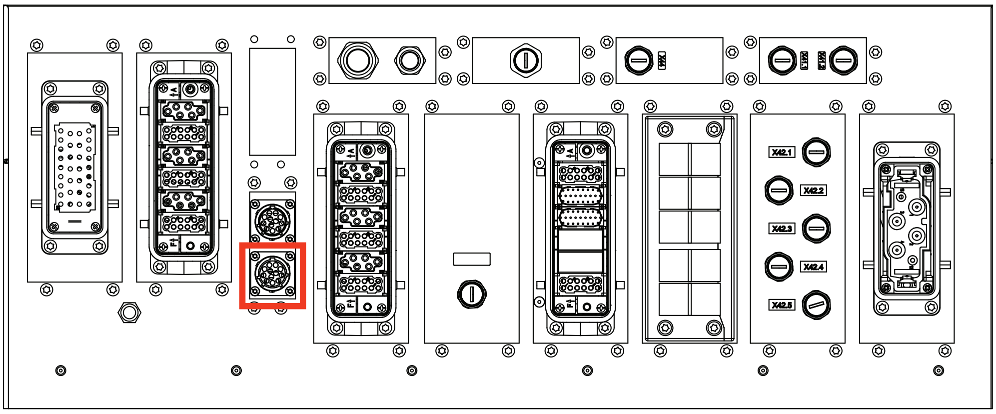
Continues on next page

Matching mating connector example:

Connector (x1)	
Manufacturer	Souriau
Series/type	UTO
Number of contacts	12
Locking type	Bayonet
Article number	UT061412PH04

Connector (x1)	
Manufacturer	Amphenol
Series	ecomate
Number of contacts	12
Locking type	Bayonet
Article number	RT061412PNH

V400XT – SMB for additional drive unit 1-3



xx2500000954

See connector X3 in circuit diagram.

Matching mating connector example:

Connector (x1)	
Manufacturer	Souriau
Series	UTO
Number of contacts	12
Locking type	Bayonet
Article number	UT061412PH04

Connector (x1)	
Manufacturer	Amphenol
Series	ecomate
Number of contacts	12

Continues on next page

Connector (x1)	
Locking type	Bayonet
Article number	RT061412PNH

6.10.6 Cable specifications

Cable area

The following table describes the cable area requirements for high and low voltage applications:

Voltage level	Cable area
High voltage	3G x 6 mm^2 or AWG10
Low voltage	3C x 2.5 mm^2 or AWG14

Note

Cables and connectors shall comply with IEC 60204.

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Index

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