ROBOTICS

Product specification

OmniCore V line

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Product specification

OmniCore V250XT Type B
OmniCore V400XT

OmniCore

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Revision: K

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Table of contents

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Overview of this specification

About this product specification

This product specification describes the properties of the OmniCore V line robot controller in terms of:

- Technical data and dimension
- The fulfilment of standards, safety and operating equipment
- RobotWare OS
- Variants and options

Usage

Product specifications are used to find data and performance about the product, for example to decide which product to buy. How to handle the product is described in the product manual.

The specification is intended for:

- Product managers and product personnel
- Sales and marketing personnel
- Order and customer service personnel

References

Tip

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

Document name	Document ID
Product manual - OmniCore V250XT Type B	*3HAC087112-001*
Circuit diagram - OmniCore V250XT	*3HAC074000-008*
Product manual - OmniCore V400XT	*3HAC081697-001*
Circuit diagram - OmniCore V400XT	*3HAC082020-008*

Revisions

Revision	Description
A	First edition.
B	Published in release 22A with RobotWare 7.6. • Minor changes. • Updated the description for Scalable safety I/O [3037-x]. • Updated the description for Safety Interface [3054-1]. • Updated the option name for Hot swappable FlexPendant [3018-1]. • Updated information about humidity. • The option Externally Guided Motion [3124-1] is available for IRB 910INV. • CC-Link IE Field Basic Device [3066-2].

Continues on next page

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Continued

Revision	Description
C	Published in release 22B with RobotWare 7.7. • Added information of power consumption. • Added 24V customer power supply. • Added introduction of cooling. • Added introduction of *Safety digital base device*. • Added SoftMove [3108-1]. • Added Machining Standard [3418-1] and Machining Premium [3418-2]. • Updated introduction of Safety internal conn. [3054-1]
D	Published in release 22C with RobotWare 7.8. • Added Conv.Tracking unit int. [3041-1]. • Added Conv.Tracking unit ext. [3042-1]. • Technical data for manipulators IRB 460, IRB 660 and IRB6650S added in section "Load current" and "Residual current".
E	Published in release 22D with RobotWare 7.8.1. • Minor changes. • Introduced V250XT Type A, description added in section *Type change of the OmniCore controller on page 199*. • Added the options CAP and DAP [3125-1].
F	Published in release 23A with RobotWare 7.10. • Added image for mains label in technical data section. • Technical data for manipulator IRB 2600 added in section "Load current" and "Residual current". • Updated the list of *System signals on page 36*. • Added PROFIsafe Controller [3023-1]. • Added CAP Premium [3125-2].
G	Published in release 23B with RobotWare 7.10. • *Force Control Interface* [3038-1] phase out. • Added *Production Framework* [1243-1] • Added *Spot welding* [3417-x] • Added *Additional drive units* [3062-1] • Added new option *Production Framework* [3404-1]. • Descriptions of *Mains voltage* [3007-x] updated • Information about options for Integrated Vision cameras and lenses removed. For detailed descriptions of the options and related hardware, see *Product specification - Integrated Vision*.
H	Published in release 23C with RobotWare 7.12. • Added information about power factor. • Added new option *CC-Link IE Field Master* [3066-1].
J	Published in release 23D with RobotWare 7.13. • Introduced V250XT Type B and V400XT. Description added in section *Type change of the OmniCore controller on page 199* and *OmniCore V line on page 13*. • ABB Connected Services is the new name for the functionality previously known as ABB Ability. During a period of time, both names will appear in and on our products. • New options for Connected Services added: Mobile network 4G EU [3013-5] and Mobile network 4G US [3013-6] • New options added: *Motor connection box, 3-axis, BRB* [3069-1x] and *Motor connection box, 6-axis, BRB* [3069-2x]. • Added options for dispensing and arcwelding.

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Revision	Description
K	Published in release 24A with RobotWare 7.14. • Option Tool Control [3109-1] added. • Option [3050-2] 2xCable gland added. • Options [3012-X] for lock variants added. • Options [3070-1] No brake release and [3070-2] Analog brake release added. • Options Base Dig. 16In/16Out (1-2) [3032-1] and Base Dig. 16In/16Out (1-2) [3032-1] updated with information about a second row of I/O units (for V400XT). • Updated protection class of FlexPendant. • Updated information about power factor. • Updated the section *Ethernet & signal interfaces on page 94*. • Updated the section *Ethernet switch on page 79*. • Section *Supported manipulators on page 14* updated with information about IRB 390 and IRB 2400. • Updated the section *Line fusing on page 16*. • Updated the section *Ethernet & signal interfaces on page 94*.

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1 Description of OmniCore controller

1.1 OmniCore V line

General

ABB OmniCore is the industry most versatile and powerful industrial robot controller range, offering increased flexibility and incorporates the latest digital technologies.

OmniCore V Line (Extra Tough) is medium sized controllers within the OmniCore controller family, optimized for medium and large robots in industrial environments, for applications such as machine tending, material handling, arc welding, spot welding, etc.

OmniCore power saving solutions

The OmniCore V line controllers use bi-directional active rectifiers, which reduces waste. Additional benefits are that no extra space is needed, no capacity limitation, and there is no safety risk with energy storage.

The bi-directional rectifier (power supply unit) is always active and does not require any configuration from the user. The savings are highly dependent on the usage of the robot. Aggressive running with high speed and acceleration will generate more savings compared to a slow and easy path/usage of the robot.

The power factor is ~1.00 (~0% reactive power). See also the product specification for the respective manipulator.

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1.1.1 Technical data

Supported manipulators

Manipulator	V250XT Type B	V400XT
IRB 390	✓	✓
IRB 460	✓	✓
IRB 660	✓	✓
IRB 760		✓
IRB 2400	✓	✓
IRB 2600	✓	✓
IRB 4600	✓	✓
IRB 5710, IRB 5720	✓	✓
IRB 6650S	✓	✓
IRB 6660	✓	✓
IRB 6700	✓	✓
IRB 6710, IRB 6720, IRB 6730, IRB 6740	✓	✓
IRB 7600		✓

Dimensions and weight

Parameter	V250XT Type B	V400XT
Width	650 mm	650 mm
Depth	475 mm	475 mm
Height	960 mm	1,140 mm
Weight	85 kg	118 kg

Note

The weight does not include any mounting kits fitted on the controller.

Transportation and storage conditions

Parameter	Value
Minimum ambient temperature	-40°C (-40°F)
Maximum ambient temperature	+55°C (+131°F)
Maximum ambient temperature (less than 24 hrs)	+70°C (+158°F)
Shock and Vibration	In accordance with ETSI EN 300 019-2-2 / Environmental class 2.3 (No severity reduction for horizontal axes)

After storage, the operating conditions inside the controller must be met for at least 6 hours before switching on the controller (see *Operating conditions on page 15*).

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The robot controller shall be stored according to its IP classification (IP54), that is, indoors, in an environment that is dry and dust-free. In addition, wind, temperature fluctuations, and condensation shall be avoided.

Operating conditions

Parameter	Value
Minimum ambient temperature	+5°C (+41°F)
Maximum ambient temperature	+45°C (+113°F)
Maximum ambient altitude	2,000 m
Shock and Vibration	In accordance with ETSI EN 300 019-2-3 / Environmental class 3.5 (3M5) (Random vibration)

Note

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

If the environmental conditions in EN 60721-3-3, climatic class 3K3, are not possible to meet at the installation site, desiccant bags can be placed inside the controller to achieve corresponding conditions. The desiccant bags must be replaced regularly to maintain approved operating conditions.

Protection classes

	Protection class (IEC 60529)
Controller cabinet, inner compartment for electronics	IP54
Controller cabinet, compartment including cooling channel	IP23
FlexPendant	IP65

The cabinet must be closed and sealed when no internal access is required.

If the cabinet is not properly closed and sealed (door and cable grommets), it does not comply with the protection class (IP54) and may affect the following:

- The electromagnetic compatibility (EMC) is affected
- Units inside the cabinet are exposed to dust or moisture. Especially important in cases with high heat and humidity, or much pollution.

Note

To comply with IP54, all openings to the controller cabinet must be sealed. This includes unconnected connectors which must be fitted with covers.

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1.1.1 Technical data
Continued

Airborne noise level

Data	Description	Note
Airborne noise level	The sound pressure level one meter away from each surface of the controller.	Controller in Motors On Mode: < 65 dB(A) Leq Controller in Standby Mode: < 60 dB(A) Leq

Power supply

Mains	Value
Voltage for OmniCore V line	380 VAC-480 VAC, 3-phase
Voltage tolerance	+10%, -15%
Frequency	50/60 Hz
Frequency tolerance	±3%
Short circuit current rating	According to rating label. **Note** For installations according to UL requirements, short circuit current rating is 5 kA.

Line fusing

There is no integrated fuse inside the OmniCore V line controller. Add an external fuse (time-delay) or circuit breaker (class K) according to full load current, as marked on the controller nameplate. The following table shows the recommended rating for an external fuse or circuit breaker.

As baseline there is no integrated fuse or circuit breaker. The option 3008-3 Mains connector/Fuse includes integrated circuit breaker.

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To find the rated voltage and the full load current of the controller, see the name plate on the upper side of the cabinet.

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The rated current means maximum current in ISO Cube rapid when the robot is running at rated voltage 380 VAC. It depends on application (manipulator size, options). See the following table.

Manipulator	Voltage (V)	Current (A)
IRB 390	380 VAC-480 VAC, 3-phase	3x16 A
IRB 460	380 VAC-480 VAC, 3-phase	3x25 A
IRB 660	380 VAC-480 VAC, 3-phase	3x25 A
IRB 760	380 VAC-480 VAC, 3-phase	3x25 A
IRB 2400	380 VAC-480 VAC, 3-phase	3x16 A
IRB 2600	380 VAC-480 VAC, 3-phase	3x16 A
IRB 4600	380 VAC-480 VAC, 3-phase	3x25 A
IRB 5710	380 VAC-480 VAC, 3-phase	3x25 A
IRB 5720	380 VAC-480 VAC, 3-phase	3x25 A
IRB 6650S	380 VAC-480 VAC, 3-phase	3x25 A
IRB 6660	380 VAC-480 VAC, 3-phase	3x25 A
IRB 6700	380 VAC-480 VAC, 3-phase	3x25 A
IRB 6710	380 VAC-480 VAC, 3-phase	3x25 A
IRB 6720	380 VAC-480 VAC, 3-phase	3x25 A
IRB 6730	380 VAC-480 VAC, 3-phase	3x25 A
IRB 6740	380 VAC-480 VAC, 3-phase	3x25 A
IRB 7600	380 VAC-480 VAC, 3-phase	3x25 A

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1.1.1 Technical data
Continued

Note

For information about what controller supports each manipulator, see *Supported manipulators on page 14*.

Residual current

An external earth fault protection (residual current device, RCD) is required. For detailed information on how to select an external earth fault protection, see the respective product manual.

Note

The integrator is responsible to address local electrical requirements.

Drive system

The drive system provides motion power and absorbs excess braking energy when the robot is running.

There is a label for the drive system on the controller. The label contains the specific drive system type information, so the label will vary according to the drive system type.

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The controller drive system shall only be used with specified manipulator variant. The following table shows the mapping list.

Product		Power									
Manipulator	**Controller**	2.5kVA-310V	2.5kVA-370V	3.0kVA-370V	7.0kVA-370V	3.0kVA-370V	480VA-24V	1.2kVA-48V	1.5kVA-48V	13kVA-650V	7.5kVA-650V
IRB 390 IRB 2400 IRB 2600	V250XT				E4	E5					
	V400XT										
IRB 4600 or larger	V250XT									E8	E9
	V400XT										

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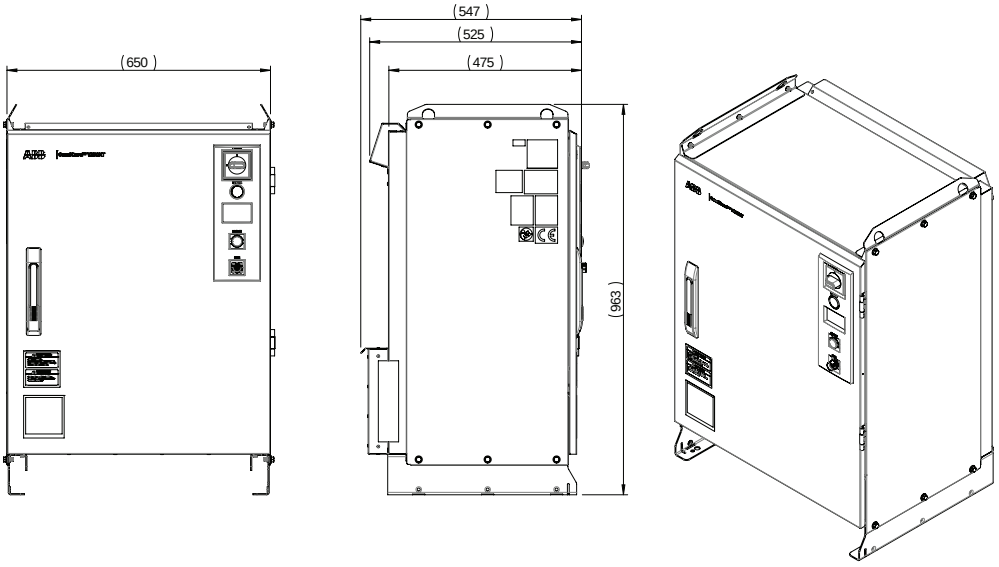
1.1.2 Cabinet design

OmniCore V250XT Type B



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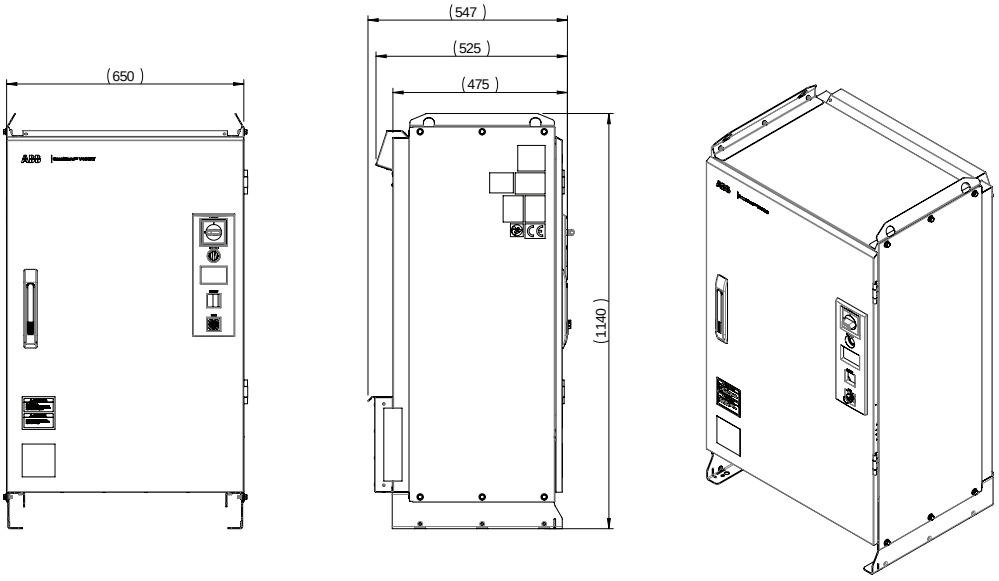
OmniCore V400XT



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2 Safety

2.1 Applicable standards

General

The product is compliant with ISO 10218-1:2011, *Robots for industrial environments - Safety requirements - Part 1 Robots*, and applicable parts in the normative references, as referred to from ISO 10218-1:2011. In case of deviation from ISO 10218-1:2011, these are listed in the declaration of incorporation. The declaration of incorporation is part of the delivery.

Robot standards

Standard	Description
ISO 9283	Manipulating industrial robots – Performance criteria and related test methods
ISO 9787	Robots and robotic devices – Coordinate systems and motion nomenclatures
ISO 9946	Manipulating industrial robots – Presentation of characteristics

Other standards used in design

Standard	Description
IEC 60204-1	Safety of machinery - Electrical equipment of machines - Part 1: General requirements, normative reference from ISO 10218-1
IEC 61000-6-2	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments
IEC 61000-6-4	Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments
ISO 13849-1:2006	Safety of machinery - Safety related parts of control systems - Part 1: General principles for design, normative reference from ISO 10218-1

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2.2 Safety functions

Safety

The safety design of the controller is state of the art. It has a dedicated safety system based on a two-channel circuit which is monitored continuously. If any component fails, the electrical power supplied to the motors is cut off and the brakes engage.

Safety functions	Description
Category 0 Stop	Stop function that immediately removes the power to the motors and applies the brakes.
Category 1 Stop	Stop function that stops the robot using the motors instead of the brakes which leads to a controlled stop where the robot is stopping on the programmed path. This stop is more effective especially on large robots. A category 0 stop will be applied with a 1 second delay after a category 1 stop is triggered.
Protective Stop	The integrator of the cell can connect sensors/equipment which triggers the safety controller to issue a stop the robot using category 0 stop or category 1 stop. The sensor could be placed on the cell door, stopping the robot when the door is opened.
Emergency Stop	If something happens either with the robot system or in a machine near the robot system and the operator presses the emergency stop, then all machines/systems in sight shall be stopped. Emergency Stop status output is available in the basic delivery of OmniCore controller family including all variants. The emergency stop button is integrated in the FlexPendant.
Manual Operation Supervision	In manual reduced speed the robot can be moved using the FlexPendant and the enabling device. The enabling switch must be pressed to maintain safety.
Start / Restart Function	The start / restart function ensures that all safety conditions are met before enabling movement after a stop.
Service Mode	During service of the robot, it must be possible to move the robot without the safety monitoring, for example move the robot without being disturbed by forbidden zones/ranges stopping the robot. When the Service Mode is activated, all safety monitoring is deactivated (muted). The safety is maintained by not allowing service mode to be active in automatic mode. For safety, the enabling device needs to be pressed for moving the robot. The enabling device is integrated in the FlexPendant.
Parameterization	The parameterization consists the following functions. • Configuration of a Safety System • Safety Configuration Integrity Check • Configuration of Zones • Signal Configuration
Hot Swappable FlexPendant	It is possible to remove the FlexPendant while the robot is in automatic mode. This makes it possible to use only one FlexPendant for several robots, where the FlexPendant is only connected occasionally and used for recovering from stops. In manual mode, there is no use of the functionality since it is not possible to do anything with the system without the FlexPendant. The functionality is in therefore deactivated in manual mode.

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Safety functions	Description
Monitored Category 1 Stop	The category 1 stop stops the robot using the motors. The safety controller monitors that the stop is performed, that the retardation is above the limit. If the retardation is less than the limit a category 0 stop is triggered. When the robot has stopped, the power to the motors is removed and the brakes are applied.
Fire safety	The control system complies with the requirement of UL (Underwriters Laboratories) for fire safety.

Operating cycles for safety parts

The expected cycles for safety parts are listed below.

Safety part	Cycles
Enabling device	750 000
Emergency stop (FlexPendant)	750 000

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2.3 Safety data

Prevailing standards and directives

For the use of industrial robots, regulations must be fulfilled as described in the following standards and directives:

- EN ISO 10218-1:2011
- Machinery Directive 2006/42/EC

Related information

For more detailed information, see the product manual for the robot controller.

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3 Installation and maintenance

3.1 Installation

General

The controller is delivered with a standard configuration for the corresponding manipulator, and can be operated immediately after installation. Its configuration is displayed in plain language and can easily be changed using the RobotStudio or the FlexPendant.

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3.2 Maintenance

General

The controller requires only a minimum of maintenance during operation. It has been designed to make it as easy to service as possible.

The controller is enclosed, which means that the electronic circuitry is protected when operating in a workshop environment. The only maintenance parts are cooling fans and optional air filters.

See the product manual for the controller for maintenance activities and intervals.

Functions

The robot has several functions to provide efficient diagnostics and error reports.

Function	Detail
Online supervision	CPU temperature
	AC and DC voltage levels
	Power Supply functions
	UPS capacitor status
	All internal communication channels (cables)
	CMOS battery
	Safety chains (two channel supervision)
	Safety chains (function test)
	Safety switches
	Motor temperatures
	Drive system: communication cable, voltage levels, temperatures, motor current and cable, reference quality
	Measurement system: communication cable, resolver function including cables
	Fieldbus cable (communication and power)
	Fieldbus units (connection, status)
	Program execution and resource handling
Power on	Built-in self-test
Fault tracing support	Computer status LEDs
Error message	Displayed in selected language The message includes the reason for the fault and suggests recovery action
Faults and major events are logged and time-stamped.	This makes it possible to detect error chains and provides the background for any downtime. The log can be saved to file or viewed from PC tools like RobotStudio, Robot Web Services or any OPC client application
Manual test	Commands and service programs in RAPID to test units and functions
Properties	Detailed properties of hardware and software in the controller are available for viewing from FlexPendant or RobotStudio

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4 Controller system

4.1 Communication

Ethernet

The communication includes TCP/IP with network configuration possibilities like:

- DNS, DHCP etc.
- Network file system access using SFTP server
- Control and/or monitoring of controllers by Windows applications built with PC SDK
- Boot/upgrading of controller software via the network or a portable PC
- Communication with RobotStudio
- Connected Services

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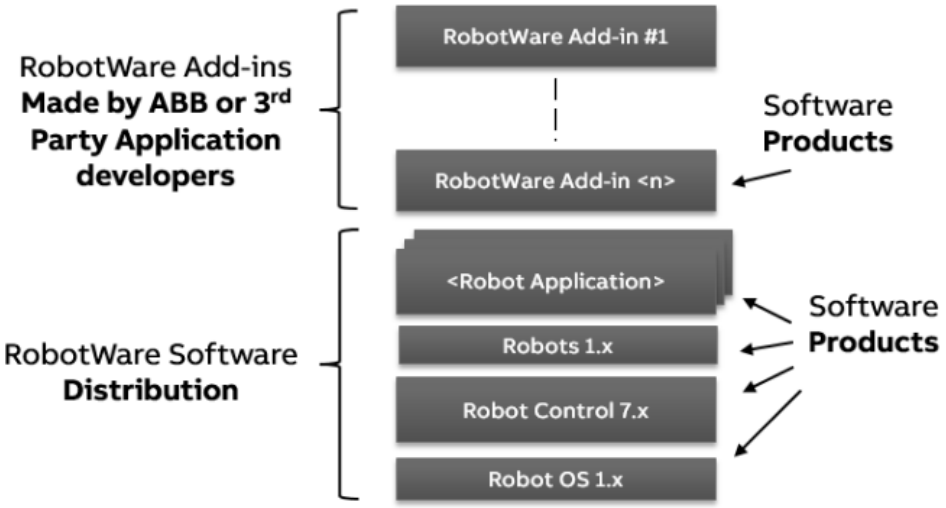
4.2 RobotWare

RobotWare 7

RobotWare 7 is the control software platform that runs on the OmniCore controllers. The distribution consists of several software products.



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Standard features of RobotWare

The RobotWare software distribution contains the standard features for robot control, and selected additional software products. The unique motion control in RobotWare together with the built-in high-level programming language RAPID offers a reliable and flexible performance.

See also *Robot motion on page 32*, *I/O system on page 36*, and *Programming on page 42*.

Motion technology

QuickMove 2nd generation	A unique self-optimizing motion control feature that keeps cycle times to a minimum by ensuring maximum acceleration at every moment. ABB robots cycle times are up to 25% shorter than competitors. See *QuickMove™ on page 32*.
TrueMove 2nd generation	TrueMove ensures that the motion path followed by the robot is the same as the programmed path regardless of the robot speed. See *TrueMove™ on page 32*.
Additional axes	Up to 36 axes can be run from the control system. The robot main axes can be coordinated with external mechanical structures such as work-piece positioners and track-motion devices or gantries. This requires that the controller has additional drive units.
Motion Process modes	Optimize robot behavior based on specific needs, i.e. optimize the performance of the robot for a specific application.
Motion Error Handler	Maintain RAPID execution when motion errors such as collision and singularities occur.

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Programming technology

Error handling	Exceptional robot behavior is ensured through customized error handlers which can be set up to take a certain action depending on error type.

Communications technology

Robot web services	Programming interface based on HTML5 to communicate with robot from any device, regardless of operating system.
Socket messaging	Allows for the exchange TCP/IP messages over a network for machine-to-machine communication.

Service technology

Remote Service enabled	A robot in need of maintenance will, through wireless technology, alert ABB so we can offer quick support. see *Connected Services Gateway on page 78*.
Service Information System	Predicts robot service needs. It includes operating time, calendar time and advanced algorithms for calculation of gearbox services.

General technology

User-authorization system (UAS)	The data, functionality, and commands of a controller are protected by the UAS, which defines the access rights for the individual users of the robot controller.
Power failure support	If the power supply is cut off during operation, the robot restarts at the exact same position and system status as before the power failure.
Modify Installation	Managing RobotWare installation and adding new options has never been as hassle free and easy.
Improved jogging response	Manual robot movement, also known as jogging, is more responsive.
Snapshots	Snapshots are used to create a backup of the current system state. The backup also includes all installed software products, user data, and system internal data. This is a useful tool before making changes to or updating the RobotWare system, which makes it easy to restore old systems and enables fast switching between different systems in a flexible production environment.

RobotWare options and application support

RobotWare comes with various application specific support.

Motion performance

Advanced Robot Motion	Functionality for optimizing the robot's motion control and for minimizing path deviation. See *Advanced robot motion [3100-1] on page 127*.
Absolute Accuracy	Makes your robot even more precise. Perfect for off-line programming and fast replacements of robots. See *Absolute Accuracy [3101] on page 134*.

Motion functions

World Zones	Defines actions when a robot enters a defined area of the working space.The zones can be used to stop the robot from entering a zone, either permanently or only when another robot is working in the zone. See *World Zones [3106-1] on page 137*.

Continues on next page

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Independent Axis	Makes an additional axis (linear or rotating) run independently of the other axes in the robot system. See *Independent Axis [3111-1] on page 146*.
Path Recovery	Stores all system data, when an interrupt occurs (fault message or other) and restores them after necessary actions have been taken. Useful for service interrupts. See *Path Recovery [3113-1] on page 149*.
Collision Detection	Protects equipment and robot from severe damage. It stops the robot if the motion torque values are exceeded. See *Collision detection [3107-1] on page 139*.

Communications

SFTP/FTP and NFS Client	SFTP/FTP/NFS Client makes it possible to read information on a remote hard disk directly from the controller. See *Communication on page 152*.

Engineering tools

Multi-tasking dialog	Run up to 14 RAPID programs simultaneously. Use them for supervision of external equipment, operator or advanced calculations.
Continuous Application Platform	Used for designing continuous path process applications, such as arc welding applications. By using CAP, the development work is much faster and results in robust high performance applications.
Discrete Application Platform	Used for designing discrete point process applications, such as spot-welding applications. By using DAP, the development work is much faster and results in robust high performance applications.
Externally Guided Motion (EGM)	Enables external sensors and controllers to control the robot motion with very fast robot response.

Vision

Integrated Vision interface	Makes the most advanced vision tools an integral part of ABB robots. Enables a variety of applications with minimum experience and programming time. See *Vision interface [3127-1] on page 171*.

Application options

ArcWare	Optimizes the robot for arc welding. The positioning of the robot and the process control and monitoring are handled in one and the same instruction as well as process equipment supervision, error recovery, etc
SpotWare	This option provides dedicated spot weld instructions for fast and accurate positioning combined with gun manipulation, process start and supervision of the weld equipment.
DispenseWare	This option provides support for different types of dispensing processes such as gluing and sealing.
Prepared for PickMaster	PickMaster application are configurable integration of robots, vision systems and conveyors.
RobotWare Force Control	Allows the robot to be contact force controlled. Typically this is useful in assembly and machining.
RobotWare Machining	This is a set of instructions, which facilitate the use of robots for machining applications.

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SafeMove

SafeMove includes a set of easy-to-use tools for fast setup, validation, and commissioning.

Features

Safety fieldbuses	Built-in safety fieldbuses eliminating the need for dedicated hardware for communication with safety equipment such as safety PLCs & light curtains.
Tool position supervision	Protects the operator and enhances machine and equipment safety by supervising the position of the tool.
Tool speed supervision	Protects the operator and enhances machine and equipment safety by supervising the speed of the tool.
Tool orientation supervision	Protects the operator and enhances machine and equipment safety by supervising the orientation of the tool.
Axis position supervision	Protects the surroundings and operators by supervising the axis position.
Axis speed supervision	Protects the surroundings and operators by supervising the axis speed.
Standstill supervision	Supervises the stand-still of robot axes without having to switch the robot to Motors Off. It enables operators to perform tasks in the immediate vicinity of the robot.
Contact application tolerance	Allows the robot to be in contact with work-piece in limited areas. This can for example be used in applications where the robot is used for grinding or during tool change.
Stop functions	Triggers stop of the robot using fieldbus inputs from the safety PLC.
Configuration	Performed in RobotStudio using Visual SafeMove configurator.

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4.3 Robot motion

QuickMove™

The QuickMove™ concept means that a self-optimizing motion control is used. The robot automatically optimizes the motion parameters to achieve the best possible performance throughout the cycle - based on load properties, location in working area, velocity, and direction of movement.

- No parameters have to be adjusted to achieve correct path, orientation, and velocity
- Maximum acceleration is always obtained (acceleration can be reduced, for example when handling fragile parts)
- The number of adjustments that have to be made to achieve the shortest possible cycle time is minimized

TrueMove™

The TrueMove™ concept means that the programmed path is followed - regardless of the speed or operating mode - even after a safeguarded stop, a process stop, a program stop, or a power failure.

The very accurate path and speed are based on advanced dynamic modelling.

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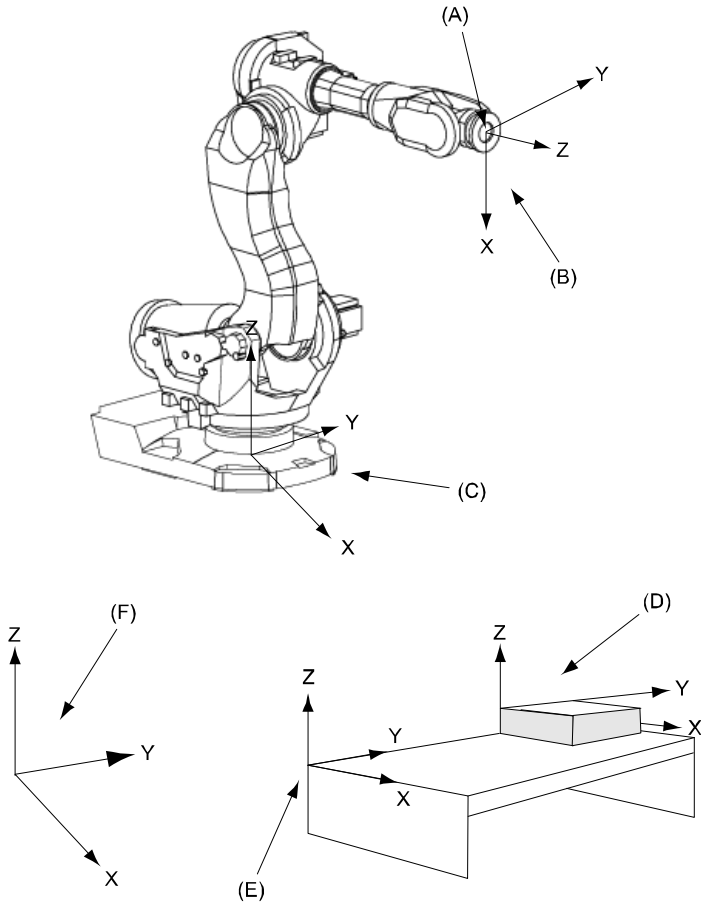
Coordinate systems



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Pos	Description
A	Tool Center Point (TCP)
B	Tool coordinates
C	Base coordinates
D	Object coordinates
E	User coordinates
F	World coordinates

System	Description
Coordinate systems	RobotWare includes a very powerful concept of multiple co-ordinate systems that facilitates jogging, program adjustment, copying between robots, off-line programming, sensor based applications, additional axes co-ordination etc. Full support for TCP (Tool Center Point) attached to the robot or fixed in the cell ("Stationary TCP").
World coordinate system	The world coordinate system defines a reference to the floor, which is the starting point for the other coordinate systems. Using this coordinate system, it is possible to relate the robot position to a fixed point in the workshop. The world coordinate system is also very useful when two robots work together or when using a robot carrier.

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System	Description
Base coordinate system	The base coordinate system is attached to the base mounting surface of the robot.
Tool coordinate system	The tool coordinate system specifies the tool's center point and orientation.
User coordinate system	The user coordinate system specifies the position of a fixture or workpiece manipulator.
Object coordinate system	The object coordinate system specifies how a workpiece is positioned in a fixture or workpiece manipulator. The coordinate systems can be programmed by specifying numeric values or jogging the robot through a number of positions (the tool does not have to be removed). Each position is specified in object coordinates with respect to the tool's position and orientation. This means that even if a tool is changed because it is damaged, the old program can still be used, unchanged, by making a new definition of the tool. If a fixture or workpiece is moved, only the user or object coordinate system has to be redefined.
Stationary TCP	When the robot is holding a work object and working on a stationary tool, it is possible to define a TCP for that tool. When that tool is active, the programmed path and speed are related to the work object.
Program displacement	If the location of a workpiece varies from time to time, the robot can find its position by means of a digital sensor. The robot program can then be modified in order to adjust the motion to the location of the part.

Additional features

System	Description
Program execution	The robot can move in any of the following ways: • Joint motion (all axes move individually and reach the programmed position at the same time). • Linear motion (the TCP moves in a linear path). • Circle motion (the TCP moves in a circular path).
Soft servo	Soft servo - allowing external forces to cause deviation from programmed position - can be used as an alternative to mechanical compliance in grippers, where imperfection in processed objects can occur. Any motors (also additional) can be switched to soft servo mode, which means that it will adopt a spring-like behavior.
Jogging	The robot can be manually operated in any one of the following ways: • Axis-by-axis, that is one axis at a time. • Linearly, that is the TCP moves in a linear path (relative to one of the coordinate systems mentioned above). • Reoriented around the TCP. It is possible to select the step size for incremental jogging. Incremental jogging can be used to position the robot with high precision, since the robot moves a short distance each time the joystick is moved. During manual operation, the current position of the robot and the additional axes can be displayed on the FlexPendant.

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System	Description
Singularity handling	The robot can pass through singular points in a controlled way, that is points where two axes coincide.
Motion supervision	The behavior of the motion system is continuously monitored in regards to position and speed level to detect abnormal conditions and quickly stop the robot if something is not OK. A further monitoring function, Collision Detection, is optional, see option *Collision detection [3107-1] on page 139*.
Big inertia	One side effect of the dynamic model concept is that the system can handle very big load inertias by automatically adapting the performance to a suitable level. For big, flexible objects it is possible to optimize the servo tuning to minimize load oscillation.
Load identification	The robot can automatically identify the load properties and thus ensures a correct dynamic model of the total arm system. This leads to optimum performance and life time, without need for cumbersome manual calculations or measurements. Load identification is available for most robots, and positioners (IRP). For more information, see *Operating manual - OmniCore*. It is also possible to tune the parameters in the mounting stiffness to compensate for a non rigid mounting frame.

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4.4 I/O system

Fieldbus master/slave

There are options available for different fieldbus types and there are separated options for master and slave.

Option	Description	Master/Slave	Number of I/O devices
DeviceNet™	PCIe card certified by ABB included	Yes/Yes	20
PROFINET IO	Software based	Yes/Yes	50
EtherNet/IP	Software based	Yes/Yes	20 (4,049 signals/device)
CC-Link IE Field Basic	Software based	Yes/Yes	N/A

Multiple fieldbuses can be installed and configured on both LAN and WAN in parallel with both master and slave. Limitation: Only one software based master can be used. Maximum total number of I/O devices is 50.

For all bus types commercially available third party I/O devices can be used.

For more information, see *Industrial networks & fieldbuses on page 85*.

System signals

Signals can be assigned to special system functions such as program start, so as to be able to control the robot from an additional panel or PLC. Several signals can be given the same functionality.

Note

For more information on system signals, see *Technical reference manual - System parameters*.

Digital inputs

- Backup
- Collision Avoidance
- Disable backup
- Interrupt
- Limit Speed
- Load
- Load and Start
- Motors Off
- Motors On
- Motors On and Start
- PP to Main
- ProfiSafeOpAck
- Quick Stop
- Reset Execution Error Signal

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- SimMode
- Start
- Start at Main
- Stop
- Stop at End of Cycle
- Stop at End of Instruction
- System Restart
- Trust Revolution Counter
- Verify Local Presence
- Verify Move Robot in Auto
- Write Access

Digital outputs

- Absolute Accuracy Active
- Auto On
- Backup Error
- Backup in Progress
- Collision Avoidance
- Cycle On
- Emergency Stop
- Execution Error
- Limit Speed
- Mechanical Unit Active
- Mechanical Unit Not Moving
- Motion Supervision On
- Motion Supervision Triggered
- Motors Off
- Motors Off State
- Motors On
- Motors On State
- Path Return Region Error
- Power Fail Error
- PP Moved
- Production Execution Error
- Revolution Counter Lost
- Robot In Trusted Position
- Run Chain OK
- SimMode
- Simulated I/O
- SMB Battery Charge Low
- Speed Override

Continues on next page

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- System Input Busy
- TaskExecuting
- TCP Speed
- TCP Speed Reference
- Temperature Warning
- Write Access

Analog outputs

- TCP Speed
- TCP Speed Reference

General I/O

The inputs and outputs can be configured to suit your installation.

- Each signal and unit can be given a name, for example *Gripper*, or *Feeder*
- I/O mapping (that is a physical connection for each signal)
- Polarity (active high or low)
- Cross connections
- Up to 32 digital signals can be grouped together and used as a single signal when, for example, entering a bar code
- Sophisticated error handling
- Selectable trust level (that is what action to take when a unit is "lost")
- Program controlled enabling/disabling of I/O units
- Scaling of analog signals
- Filtering
- Pulsing
- TCP-proportional analog signal
- Programmable delays
- Virtual I/O (for forming cross connections or logical conditions without need for the physical hardware)
- Accurate coordination with motion

Manual functions

Manual functions are available to:

- List all the signal values
- Create your own list of your most important signals
- Manually change the status of an output signal

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Scalable I/O

Introduction

Scalable I/O is a modular, compact, and scalable I/O system that consists of a base unit, which is the minimum configuration, and add-on units. Up to four add-on units can be controlled by a base unit with maintained performance (it may be reduced depending on controller variant), and any combination of add-on units are supported.

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

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

The following I/O devices are available:

- Base module with industrial network connectivity, 16 digital inputs, and 16 digital outputs.
- Add-on module with 16 digital inputs and 16 digital outputs.
- Add-on module with 4 analog inputs and 4 analog outputs.
- Add-on module with 8 digital inputs and 8 relay outputs.

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See *Scalable I/O on page 103*.

Features

- Easy to install.
- Easy to configure in RobotWare with support of the new Plug & Produce interface.
- Compact and scalable.
- Can be mounted inside the controller and/or distributed outside.
- Supports standard DIN-rail mounting.

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4.4 I/O system
Continued

- Galvanically isolated add-on devices.
- Dual port switch for Daisy chaining.

Digital I/O electrical data

Supply voltage	21-28 V DC
Output current, nominal	500 mA per output, short circuit protected
Input voltage levels	0-5 V digital low 15-30 V digital high
Input current	<0.5 mA

Analog I/O electrical data

Input voltage	0 - +10 V
Output voltage	0 - +10 V
Resolution	12 bit

Relay I/O electrical data

Max voltage	230 V AC per contact
Max current	2 A per contact

Safety digital base device

The safety I/O unit *DSQC1042 Safety Digital Base* is a device that can be used to control and monitor machine safety equipment in a system. The device can be used together with the add-on devices. It uses dual channels, meaning that no undetected single fault can lead to loss of safety functions.

For more information, see *Application manual - Scalable I/O*.

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4.5 Memory

DRAM memory

The DRAM memory is used for runtime storage of the system software, volatile data and power fail protected data.

The size and the free space of the DRAM memory can be seen in the window *System Info* on the FlexPendant.

Mass memory

The mass memory is used for permanent storage of firmware, products, system internal data and user data.

The total size and the free space of the mass memory can be seen in the window *System Info* on the FlexPendant.

RAPID memory

The RAPID memory consists of an internal representation of the RAPID programs and data. The memory also contains runtime stacks and data that are needed for the RAPID interpreter.

The RAPID memory is power fail protected and therefore the programs and data do not need to be reloaded after system powered off/on.

The total available memory for user programs can vary depending on the number of installed RobotWare options. The total size of the RAPID memory is statically allocated and will not vary during runtime.

The total size and the free space of the RAPID memory can be seen in the window *System Info* the FlexPendant.

The storage allocated for the programs depends on the type of data and instructions that are used and not on the size of the program files on disk, see *Example of RAPID memory consumption on page 41*.

Example of RAPID memory consumption

For details on RAPID memory consumption, see *Technical reference manual - RAPID kernel*.

Introduction	Robtarget marked (*)	Robtarget named
MoveL or MoveJ	312 bytes	552 bytes

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4.6 Programming

4.6.1 Overview of programming

General

Programming the robot can be done by RAPID programming language and both from the FlexPendant or RobotStudio. Instructions and arguments are picked from lists of appropriate alternatives.

Programming environment

The programming environment can be easily customized:

- Shop floor language can be used to name programs, signals, counters, etc
- New instructions with suitable names can be created
- The most common instructions can be collected in easy-to-use pick lists
- Positions, registers, tool data, or other data, can be created

Programs, parts of programs, and any modifications can be tested immediately without having to translate (compile) the program.

Movements

A sequence of movements is programmed as a number of partial movements between the positions to which you want the robot to move.

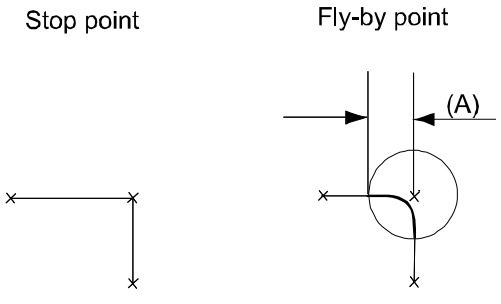
End position

The end position of a movement is selected either by manually jogging the robot to the desired position, by referring to a previously defined position or by defining numeric values.

Position types

A position can be defined either as:

- a stop point, that is the robot reaches the programmed position.
- or a fly-by point, that is the robot passes close to the programmed position. The size of the deviation is defined independently for the TCP, the tool orientation and the additional axes.



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A	User definable distance (in mm).

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Velocity

The velocity may be specified in the following units:

- mm/s
- seconds (time it takes to reach the next programmed position)
- degrees/s (for reorientation of the tool or for rotation of an additional axis)

Program management

When saving a program to disk, the program is a folder containing the program file, and the files that contain the modules. All these files are loaded when loading a program. If needed, other modules can be loaded when executing.

The modules are stored as normal PC text files, which means they can be edited using a standard PC.

Editing programs

Programs can be edited using standard editing commands, that is, cut-and-paste, copy, delete, etc. Individual arguments in an instruction can also be edited using these commands.

A robot position can easily be changed either by:

- jogging the robot to a new position and then pressing *Modify Position* (this registers the new position)
- entering or modifying numeric values

To prevent unauthorized personnel from making program changes, user authorization system can be used.

Testing programs

Several helpful functions can be used when testing programs. For example, it is possible to:

- start from any instruction
- execute an incomplete program
- run a single cycle
- execute forwards/backwards step-by-step
- simulate wait conditions
- temporarily reduce the speed
- change a position

For more information, see *Operating manual - OmniCore* and *Operating manual - RobotStudio*.

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4.6.2 Automatic operation

General

A dedicated production window with commands and information required by the operator is displayed during automatic operation.

The operation procedure can be customized to suit the robot installation by means of user-defined displays and dialogs.

The robot can be ordered to go to a service position when a specific signal is set. After service, the robot is ordered to return to the programmed path and continue program execution.

Special routines

You can also create special routines that will be automatically executed when the power is switched on, at program start and on other occasions. This allows you to customize each installation and to make sure that the robot is started up in a controlled way.

Automatic restore of parameters and I/O at power on

The robot is equipped with absolute measurement, making it possible to operate the robot directly when the power is switched on. For your convenience, the robot saves the used path, program data and configuration parameters so that the program can be easily restarted from where you left off. Digital outputs are also set automatically to the value prior to a power failure if this behavior has been selected.

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4.6.3 RAPID language and programming environment

General

The RAPID language is a well balanced combination of simplicity, flexibility and power. It contains the following concepts:

- Hierarchical and modular program structure to support structured programming and reuse
- Routines can be *Functions* or *Procedures*
- Local or global data and routines
- Data typing, including structured and array data types
- User defined names on variables, routines, and I/O
- Extensive program flow control
- Arithmetic and logical expressions
- Interrupt handling
- Error handling (for exception handling in general, see *Error handling on page 46*)
- User defined instructions (appear as an inherent part of the system)
- Backward handler (user definition of how a procedure should behave when stepping backwards)
- Many powerful built-in functions, for example mathematics and robot specific
- Unlimited language (no maximum number of variables etc., only memory limited). Built-in RAPID support in user interfaces, for example user defined pick lists, facilitate working with RAPID.
- Support for Unicode symbols in strings and comments

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4.6.4 Error handling

General

Many advanced features are available to make fast error recovery possible. The error recovery features easily adapt to a specific installation in order to minimize downtime.

Examples

- Error Handlers (automatic recovery often possible without stopping production)
- Restart on path
- Power failure restart
- Service routines
- Error messages: plain text with remedy suggestions, user defined messages
- Diagnostic tests
- Event logging

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5 Operator interface

5.1 FlexPendant

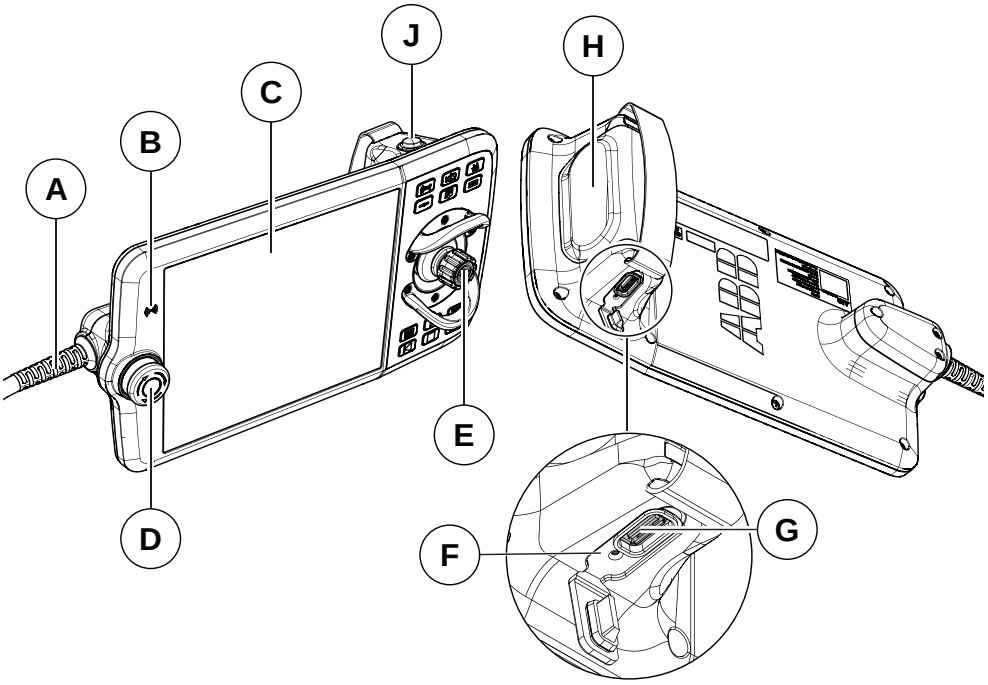
General

The FlexPendant is a handheld operator unit that is used to perform many of the tasks involved when operating a robot system, such as running programs, jogging the manipulator, programming and modifying robot programs, and so on.

The FlexPendant is designed for continuous operation in harsh industrial environment. The touch screen is easy to clean and resistant to water, oil, and accidental welding splashes. The FlexPendant hardware is IP54 rated.

The capabilities of the FlexPendant is dependent on which FlexPendant software options are available.

Main parts of the FlexPendant



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A	Connector
B	RFID reader (functionality not yet implemented)
C	Touchscreen
D	Emergency stop device
E	Joystick
F	Reset button
G	USB port
H	Three-position enabling device

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5.1 FlexPendant
Continued

J	Thumb button. Manual hold to run full speed button [i]

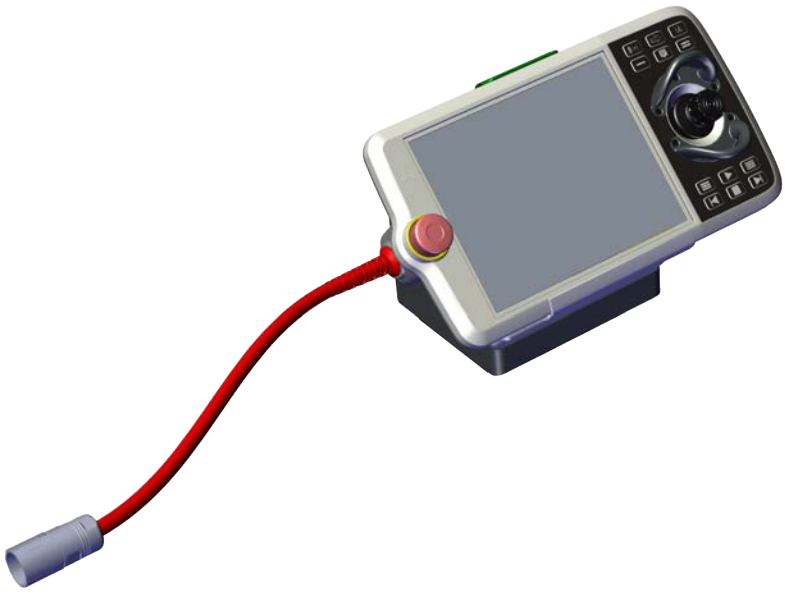
[i] Functionality not available in all markets.

Features	Description
Touchscreen display	An 8" color display which displays text as well as graphical information. User input is entered by pressing menu commands, push buttons etc. with the finger or with the supplied stylus on the display. **Note** If protective gloves are used, these must be compatible with touchscreens when using the FlexPendant.
Manual hold to run full speed button	One of the program execution keys must be pressed continuously when running the program in manual mode with full speed.
Joystick	The 3D joystick is used to jog (move) the robot manually, for example when programming the robot. Large deflections of the joystick will move the robot quickly, smaller deflections will move it more slowly.
Emergency stop button	The robot stops immediately when the button is pressed in.
Left handed users	The display will adapt to left handed users by automatically rotating the display and invert the joystick directions.
IP 54 classification	Protected to dust and splashing of water.

FlexPendant holder

The FlexPendant should always be placed in the holder when it is not used and it is not allowed to use by unauthorized person.

The FlexPendant holder can be split in 2 parts which enables to mount the holder horizontally or vertically. It is possible to hang the FlexPendant holder with the bracket.



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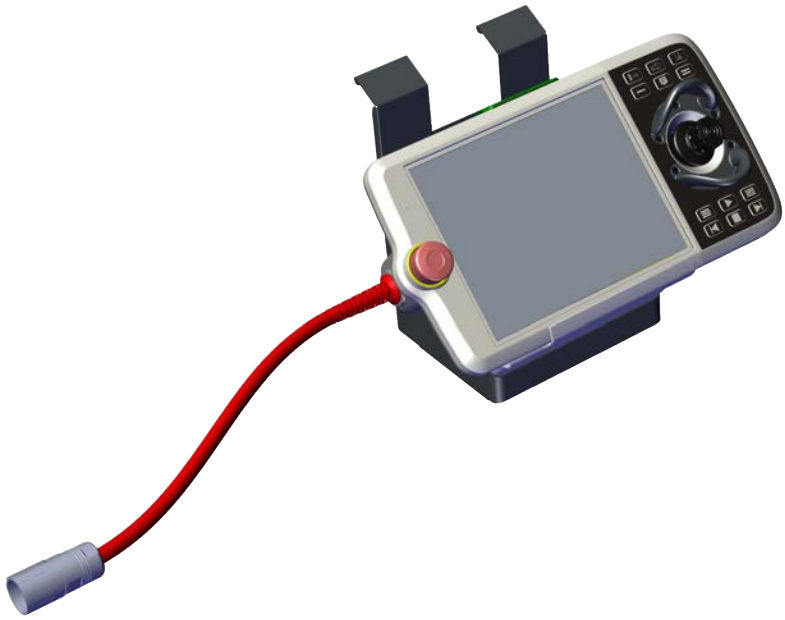

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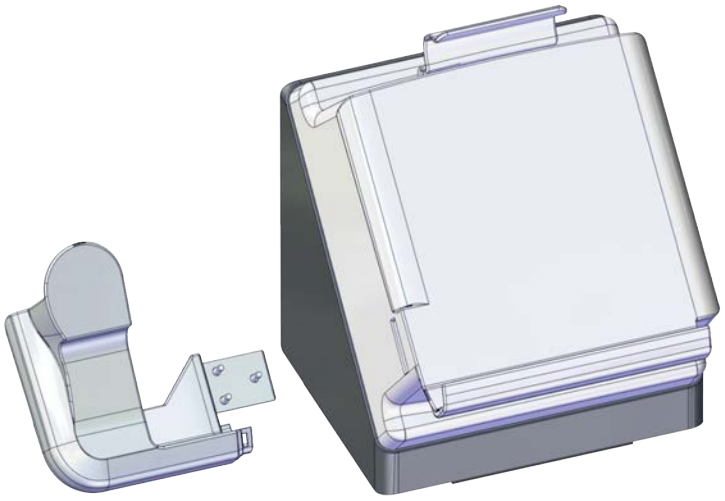
E-stop cover

The E-stop cover can be mounted by users after risk analysis of the finished production cell. See OmniCore product manual - *Mounting the bracket for the emergency stop on the FlexPendant holder* for more details.



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5.1 FlexPendant
Continued

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FlexPendant options

FlexPendant hardware options are separated from the software options/apps.

Hardware options

Hardware options	Description
3016-x FlexPendant	The FlexPendant hardware device. Available with 3, 10, or 30 meters cable length. Requires option FlexPendant base apps [3120-x].
3017-x FlexPend ext cable	Extension cables. Available with 15, 22, or 30 meters cable length.
3018-1 Hot swappable FlexP.	The possibility to remove and attach the FlexPendant during operation. Used to share FlexPendant between several robots. Requires option FlexPendant base apps [3120-x].

See *Human machine interface on page 82*.

Software options

Software options	
3120-1 Limited App Package	Software to be able to jog, calibrate, operate, and work with basic settings.
3120-2 Essential App Package	Additional features making it easy and efficient working with the robot system. Includes 3120-1 Limited App Package.
3151-1 Program Package	The tools needed for creating new programs and configurations on the FlexPendant.

See *FlexPendant base apps on page 156* and *FlexPendant independent apps on page 161*.

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For more information about what functionality is available in the different options, see *FlexPendant applications on page 52*.

Connecting the FlexPendant

The controller must be in manual mode when connecting the FlexPendant.

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

> **CAUTION**
>
> Make sure that the emergency stop button is not pressed in when connecting the FlexPendant.

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5.1.1 FlexPendant applications

The FlexPendant applications

The FlexPendant contains applications for controlling the robot. There are different application packages depending on the options selected for the robot. The *Limited App Package* is always included, unless another app package is selected.

There are more applications available than those listed below. These can be specific for the selected products and options, for example, application software, or applications for controlling grippers and tools.

Code

The **Code** application is used to create new programs, modify existing programs, and so on.

Feature	*Limited App Package* [3120-1]	*Essential App Package* [3120-2]	*Program Package* [3151-1]
Create new programs, edit existing programs			✓
View and edit RAPID modules and RAPID routines			✓
Debug Options PP to main, cursor to program pointer, goto position, call routine, cancel routine, check program, view system data, next move instruction			✓
Teach position (ModPos)			✓
Check for syntactic and semantic error			✓

If the option *Program Package* is not selected then programs must be created and edited using RobotStudio.

Program Data

The **Program Data** application is used to view and edit RAPID data.

Feature	*Limited App Package* [3120-1]	*Essential App Package* [3120-2]	*Program Package* [3151-1]
View and edit RAPID data (program data)			✓
Manage payload data	✓	✓	
Manage tool data	✓	✓	
Manage work object data	✓	✓	

Jog

The **Jog** application is used to jog the ABB industrial robot using an intuitive touch based user interface or using a joystick.

Feature	*Limited App Package* [3120-1]	*Essential App Package* [3120-2]	*Program Package* [3151-1]
Joystick jog	✓	✓	

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Feature	*Limited App Package* [3120-1]	*Essential App Package* [3120-2]	*Program Package* [3151-1]
Touch jog		✓	
Align tool		✓	
Lead-through	✓[1]	✓[1]	
Jog supervision	✓	✓	
GoTo (jog to target)		✓	
3D visualization	✓	✓	

Settings

The **Settings** application is used to configure the general settings of OmniCore controller and FlexPendant. Controller configuration includes Network, ABB Connected Services, Time and Language, Backup, Restore, System diagnostics and so on. FlexPendant configuration includes background settings and programmable keys.

Feature	*Limited App Package* [3120-1]	*Essential App Package* [3120-2]	*Program Package* [3151-1]
System About, hardware devices, software resources	✓	✓	
Network Status, WAN settings, DNS Client	✓	✓	
ABB Connected Services Status, Connected Services status, configure 3G/WiFi/wired Status, Connected Services status, configure 4G/3G/Wi-Fi/wired	✓	✓	
Configure Connected Services	✓	✓	
Backup and Recovery Backup, restore, system diagnostics, restart, reset user data, RobotWare Installation Utilities	✓	✓	
Date & time	✓	✓	
Region & language	✓	✓	
Programmable keys	✓	✓	

I/O

The **I/O** application is used to manage the I/O signals. Signals are configured with system parameters.

Feature	*Limited App Package* [3120-1]	*Essential App Package* [3120-2]	*Program Package* [3151-1]
Show industrial networks	✓	✓	
View all I/O signals	✓	✓	

1 Only applicable for compatible manipulators, currently IRB 14050 and CRB 15000.

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5.1.1 FlexPendant applications
Continued

Feature	*Limited App Package* [3120-1]	*Essential App Package* [3120-2]	*Program Package* [3151-1]
Display I/O signals with respect to category	✓	✓	
Filter signals	✓	✓	
Sort signals	✓	✓	
Set signals	✓	✓	
Bit values	✓	✓	
Navigate to device specific signals	✓	✓	
Identify device	✓	✓	
Scan EDS	✓	✓	
Activate and deactivate devices	✓	✓	
Start	✓	✓	
Scan	✓	✓	
Firmware upgrade	✓	✓	

Operate

The **Operate** application is used to view the program code while the program is running. Controller data can be configured for viewing the data in the form of dashboards. Updates during production are shown here.

Feature	*Limited App Package* [3120-1]	*Essential App Package* [3120-2]	*Program Package* [3151-1]
View dashboards		✓	
Configure dashboards		✓	
Load and execute RAPID programs	✓	✓	
View loaded RAPID programs	✓	✓	
Teach position (ModPos) of robtargets in loaded RAPID programs	✓	✓	
Reset program pointer to Main	✓	✓	
Show program pointer position	✓	✓	
Show motion pointer position	✓	✓	
Execute service routines	✓	✓	

Calibrate

The **Calibrate** application is used for calibration and definition of frames for ABB robots.

Feature	*Limited App Package* [3120-1]	*Essential App Package* [3120-2]	*Program Package* [3151-1]
Mechanical unit calibration	✓	✓	
Update revolution counters	✓	✓	
Edit motor offset values	✓	✓	
Load motor offset values	✓	✓	

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Feature	*Limited App Package* [3120-1]	*Essential App Package* [3120-2]	*Program Package* [3151-1]
Fine calibration	✓	✓	
Robot memory	✓	✓	
Base frame calibration	✓	✓	
Execute calibration specific service routines	✓	✓	

File Explorer

The File Explorer is a file manager, similar to Windows Explorer, with which you can view, rename, delete, or move files and folders on the controller or on a connected external USB drive.

Note

The file explorer supports operations on the following file formats: TXT, CFG, PNG, XML, ZIP, JPG, MOD, PGF, LOG, and MODX.

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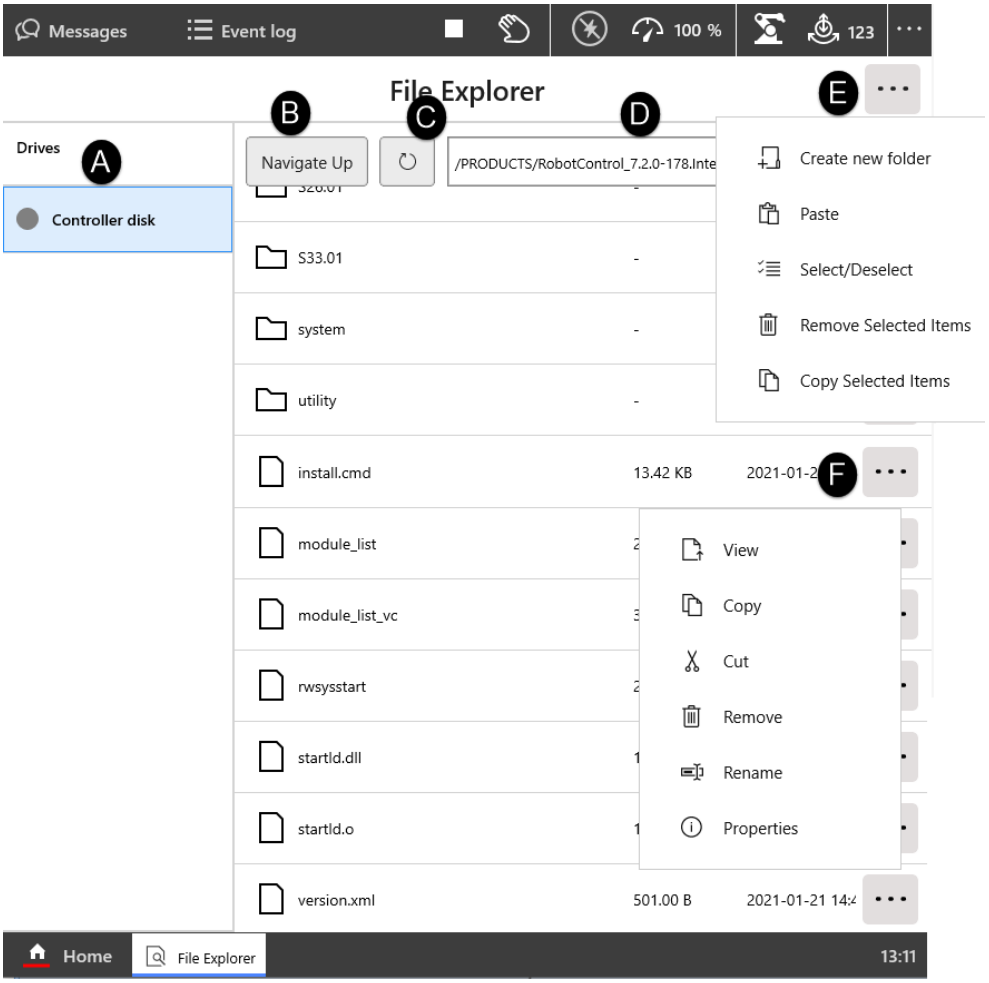
5.1.1 FlexPendant applications
Continued

To manage files and folders, from the Home screen, open **File Explorer**. The file explorer window is displayed. The following image and table provides information regarding the functions available in the file explorer window.



xx2100000050

Label	Description
A	Displays the available drives. If a USB drive is connected to the FlexPendant that is also displayed here.
B	Navigates to the folder up by one level.
C	Refreshes the files and folders.
D	Displays the path of the selected folder.
E	Displays the options available for a selected folder. • **Create new folder**: Creates a new folder in the selected folder. • **Paste**: Pastes the copied files or folders in the selected folder. • **Select/Deselect**: Selects or clear the selection for a set of files and folders. • **Remove Selected Items**: Removes the selected items. • **Copy Selected Items**: Copies the selected items.

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Label	Description
F	Displays the options available for a selected item. • **View**: Allows you to view the selected text or picture files. • **Copy**: Copies the selected item. • **Cut**: Cuts the selected item. • **Remove**: Deletes the selected item. • **Rename**: Changes the name of the selected item. • **Properties**: Displays the properties of the selected item.

Note

The following grants are required for full access to controller disk:

- **Read access to controller disks**
- **Write access to controller disks**

Without the **Read and Write access to controller disks** grant you may get access to some folders in controller disk like `/TEMP` but not all of them.

While moving the file and folders following are the possible scenarios:

- Moving files and folders within the controller disk.
- Moving files and folders from controller to USB drive and vice versa.

Note

It is not possible to move or copy files and folders within a USB drive.

SafeMove

The application **SafeMove** is used to configure some parts of SafeMove. See *Application manual - Functional safety and SafeMove*. For full SafeMove configuration, see *Visual SafeMove* in RobotStudio.

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5.2 RobotStudio

Overview

RobotStudio is a PC application for working efficiently with controller data. RobotStudio can be seen as a companion to the FlexPendant, where the two complement each other and each is optimized for its specific tasks. By exploiting the benefits of this powerful combination, an efficient way of working can be achieved.

The FlexPendant is primarily intended for jogging, teach-in, operation, and touch-up, whereas RobotStudio is ideal for dealing with configuration data, program management, online documentation, and remote access.

RobotStudio acts directly on the active data in the controller. Connection to the controller can be made locally through the service PC connection and, if the controller is equipped with the RobotWare option *RobotStudio Connect [3119-1]*, over a network connection.

The mastership handling system ensures that RobotStudio can only take control of a robot if this is acknowledged from the FlexPendant in manual mode.

The main entry to the functionality of RobotStudio is a robot view explorer. From this you select which robot to work with, in case you have several robots installed, and what parts of the system you want to work with.

RobotStudio basic delivery contains:

- The **Modify Installation** function for creating, installing, and maintaining systems
- A *Configuration Editor* for editing the system parameters of the running system
- A *Program Editor* for online programming
- An *Event Recorder* for recording and monitoring robot events
- Tools for backing up and restoring systems
- An administration tool for user authorization (UAS)
- Other tools for viewing and handling controller and system properties

Access to the full scope of RobotStudio as a powerful off-line programming and simulating tool is ordered separately.

See *Operating manual - RobotStudio* for detailed information.

Configuration Editor

Use the Configuration Editor to make easy and controlled changes of system parameters on a running system.

From the configuration editor you view and edit the system parameters of a specific topic in a controller. The Configuration Editor has direct communication with the controller. This means that changes apply as soon as you complete the command.

For some parameters, however, a restart is required in order for the change to take effect, in which case you will be notified of this.

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Program Editor

With the Program Editor you view and edit programs loaded into the controller's program memory. The Program Editor has built in functionality for making it easier to write the RAPID code when programming a robot.

Event Recorder

With the Event Recorder you can view and save events from controllers in your robot view. You can start one Event Recorder for each controller.

Miscellaneous

RobotStudio has a number of other useful tools, for example:

- Backing up and restoring systems
- Administration tool for User Authorization
- Other tools for viewing and handling controller and system properties, for example monitoring of I/O signals

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6 ABB Connect (ABB Ability Connected Services)

General

ABB Connect is a suite of solutions that provide advanced analytics and proactive, actionable data to optimize and fine-tune performance, to ensure reliability from single robots to entire fleets of robots deployed across several factories.

Note

ABB Connected Services is the new name for the functionality previously known as ABB Ability. During a period of time, both names will appear in and on our products.

All new ABB robots come with a secure and encrypted connection via Ethernet, WiFi, or 3G/4G, between robots controller and ABB Connect cloud to ensure optimal customer data and network security.

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7 Specification of controller & RobotWare options

General

The available options for the controller and for the RobotWare are described in this section.

For details about manipulator options, see the product specification for the respective manipulator.

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7.1 Controller

7.1.1 Controller variant

7.1.1.1 OmniCore V250XT [3000-310]

General

OmniCore V250XT Type B is a versatile controller in OmniCore V line with protection class IP54.

The main objective for this controller is to meet the need for a compact solution for general industry paint, polishing, material handling, machine tending applications, and other applications with requirements for high IP protection class for small robots or relatively power intensive low voltage robots.

Specific characteristics

- Support for manipulators up to IRB 6700
- Up to three additional drive units
- 15 liter optional space inside

See more details in *OmniCore V line on page 13*.

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7.1.1.2 OmniCore V400XT [3000-410]

General

OmniCore V400XT is a versatile controller in OmniCore V line with protection class IP54.

The main objective for this controller is to meet the need for a compact solution for general industry paint, polishing, material handling, machine tending applications, and other applications with requirements for high IP protection class for robot sizes up to IRB 7600 or relatively power intensive low voltage robots.

Specific characteristics

- Support for manipulators up to IRB 7600
- Up to six additional drive units
- 50 liter optional space inside

See more details in *OmniCore V line on page 13*.

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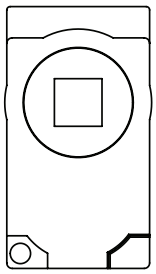
7.1.2 Door lock

Square 6 mm [3012-1]

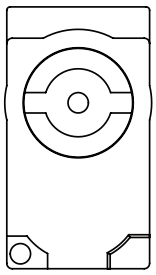
The option *Square 6 mm* [3012-1] is the default lock variant for OmniCore.



xx2400000118

Double bit 3 [3012-2]

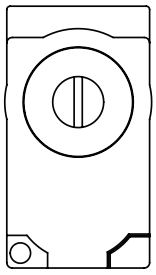
The following lock insert is used for the option *Double bit 3* [3012-2]:



xx2400000119

Slot 1, 2 x 3 [3012-3]

The following lock insert is used for the option *Slot 1, 2 x 3* [3012-3]:



xx2400000120

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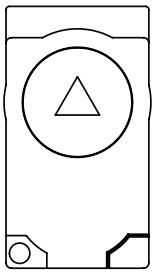
Triangular 6,5 CNOMO [3012-4]

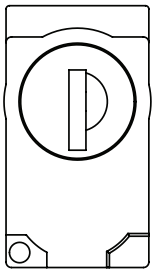
The following lock insert is used for the option *Triangular 6,5 CNOMO* [3012-4]:



xx2400000121

Cylinder E1 [3012-5]

The following lock insert is used for the option *Cylinder E1* [3012-5]:



xx2400000122

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7.2 Environment

7.2.1 Operating temperature

7.2.1.1 Max 45deg [3004-1]

General

The option *Max 45deg* [3004-1] allows room temperature up to 45°C.

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7.2.2 Cooling air filter

General

The air filter module prevents particles from entering air ducts thereby protecting fans and preventing build-up of debris on the drive and power supply heat exchangers, which could reduce the cooling efficiency.

A course or fine filter may be fitted depending on the level of ambient dust.

The air filter module is a serviceable item and should at such come in few variants that are easily replaced by a service technician. The design of the air filter makes it easy to maintain.

The air filter module is available in the two variants: *Moist particle filter* and *Moist dust filter*.

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7.2.2.1 Moist particle filter [3005-1]

General

Moist particles are prevented from entering the air ducts and fans by metal mesh filter. Select when cooling air contains moist particles > 0.5 mm.

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7.2.2.2 Moist dust filter [3005-2]

General

Moist particles are prevented from entering the air ducts and fans by polymeric filter. Select when cooling air contains moist dust.

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7.3 Regional & installation options

7.3.1 Standards

7.3.1.1 UL/CSA [3006-1]

General

The robot and the control system are certified by Underwriters Laboratories to comply with the Safety Standard ANSI/UL 1740-1998 Industrial Robots and Robotic Equipment and CAN/CSA Z 434-94. Law for UL/CSA certification is required in some US states and Canada.

UL (UL listed) means certification of the complete robot product. The option is visualized by a "UL" label attached to the cabinet.

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7.3.2 Mains voltage

7.3.2.1 380-480 V 3~ (±10 %) [3007-3]

General

OmniCore V line controller with IRB 4600, IRB 6700, IRB 5710, and IRB 5720 can be connected to a rated voltage between 380 V and 480 V.

This option is default for IRB 4600, IRB 6700, IRB 5710, and IRB 5720.

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7.3.3 Mains connection type [3008]

7.3.3.1 Cable gland [3008-1]

General

The customer power cable is routed via the cable gland through a pipe up to the mains switch. Protective grounding PE (green/yellow cable) is connected directly to structure.

Note

Basic option - no connector means low cost.

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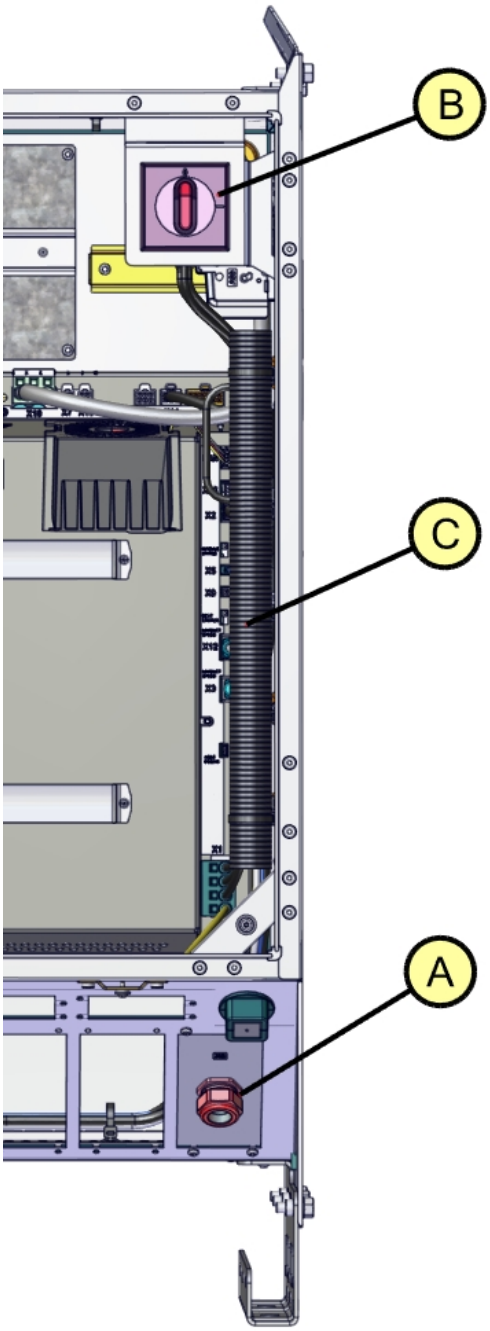

xx2100002286

A	Cable gland
B	Incoming mains switch
C	Cable pipe

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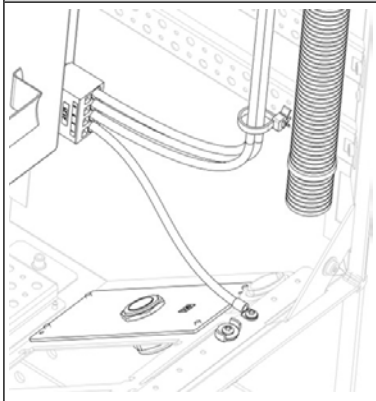
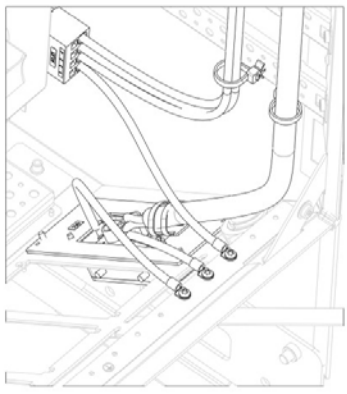
7.3.3.2 Connector [3008-2]

General

Select when a quick power connection in cabinet end is desired, this option saves installation time and time for replacing cabinet.

The customer cable connector (Harting) is included. Compared to 3008-1 the internal cable is already routed to the mains switch inside the cabinet.

xx2100002510

Cable gland [3008-1]	Connector [3008-2]
 xx2100002511	 xx2100002512

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7.3.3.3 Connector/fuse [3008-3]

General

Select when a quick power connection in cabinet end is desired, this option saves installation time and time for replacing cabinet.

The customer cable connector (Harting) is included. Compared to 3008-1 the internal cable is already routed to the mains switch inside the cabinet.

Note

Includes integrated circuit breaker rated for selected Robot mains current.

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7.4 Connectivity & logical power

7.4.1 Connected Services Gateway

General

ABB Ability™ Connected Services provide communication capabilities between robots controller and ABB.

The connectivity can be directed securely through an embedded, wired, Connected Services.

Wired LAN [3013-1]

The option *Wired LAN* for Connected Services uses a wired connection for transferring data.

WiFi [3013-2]

The option *WiFi* for Connected Services uses a WiFi connection for transferring data.

Mobile network [3013-3]

The option *Mobile network* for Connected Services uses a 3G mobile network connection for transferring data. ABB sim card is included but can be replaced by a customer sim card for advanced features.

This option is the default selection.

Mobile network 4G EU [3013-5]

The option *Mobile network 4G EU* for Connected Services uses a 4G mobile network connection for transferring data.

The 4G EU gateway is supported in all European countries, including UK.

ABB sim card is included in the gateway. No customer sim card is required.

Mobile network 4G US [3013-6]

The option *Mobile network 4G EU* for Connected Services uses a 4G mobile network connection for transferring data.

The 4G US gateway is supported in USA and Canada.

ABB sim card is included in the gateway. No customer sim card is required.

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7.4.2 Ethernet switch

7.4.2.1 5 port Ethernet switch [3014-1]

General

The option *5 port Ethernet switch* can be used to connect for example *Conveyor Tracking* modules, *Integrated Vision* cameras, *Scalable I/O* units or other devices from the ABB EcoSystem, such as Grippers.

The Ethernet switch cannot be used for fieldbus options like PROFINET, and does not have a PROFINET certification.

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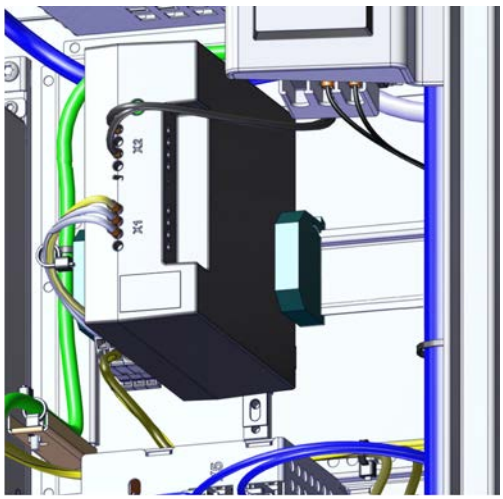
7.4.3 Additional logic 24V power

7.4.3.1 24V 4Amps [3015-2]

General

4A selected due to application/process.

xx1900002151



xx2000000358

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7.4.4 DeviceNet logic 24V power

7.4.4.1 24V 4Amps [3049-1]

General

24V power supply for customer use. One 4Amp unit certified for ODVA (DeviceNet).
It is only needed for supply of external DeviceNet devices.

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Limitations

The option *DiveceNet logic 24V 4Amps* is not possible to order with:

- Option *Additional logic 24V Power* [3015-x]

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7.5 Human machine interface

7.5.1 FlexPendant

FlexPendant [3016]

Color graphic teach pendant with touch screen of resolution 1024 x 768 px.

For more information, see *FlexPendant on page 47*.

Option	Description
3016-1	FlexPendant 3m
3016-2	FlexPendant 10m

Requirements

The option *FlexPendant* requires option *FlexPendant base apps* [3120-x]

For more information, see *FlexPendant base apps on page 156*.

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7.5.2 FlexPendant extension

FlexPend ext cable [3017]

Option	Description
3017-1	FlexPend ext cable 15m
3017-2	FlexPend ext cable 22m
3017-3	FlexPend ext cable 30m

Limitations

The total cable length when order *FlexPendant* [3016-x] together with *FlexPendant extension* [3017-x] is less than or equal to 50m.

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7.5.3 Hot swappable FlexPendant [3018-1]

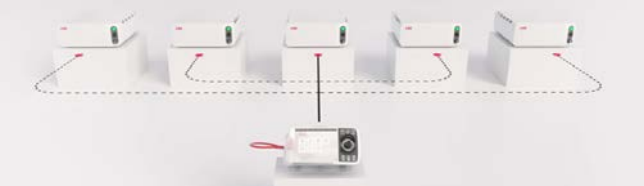
General

With the option *Hot swappable FlexPendant [3018-1]* it is possible to detach and attach the FlexPendant from an OmniCore controller in automatic mode, without interrupting the ongoing process.

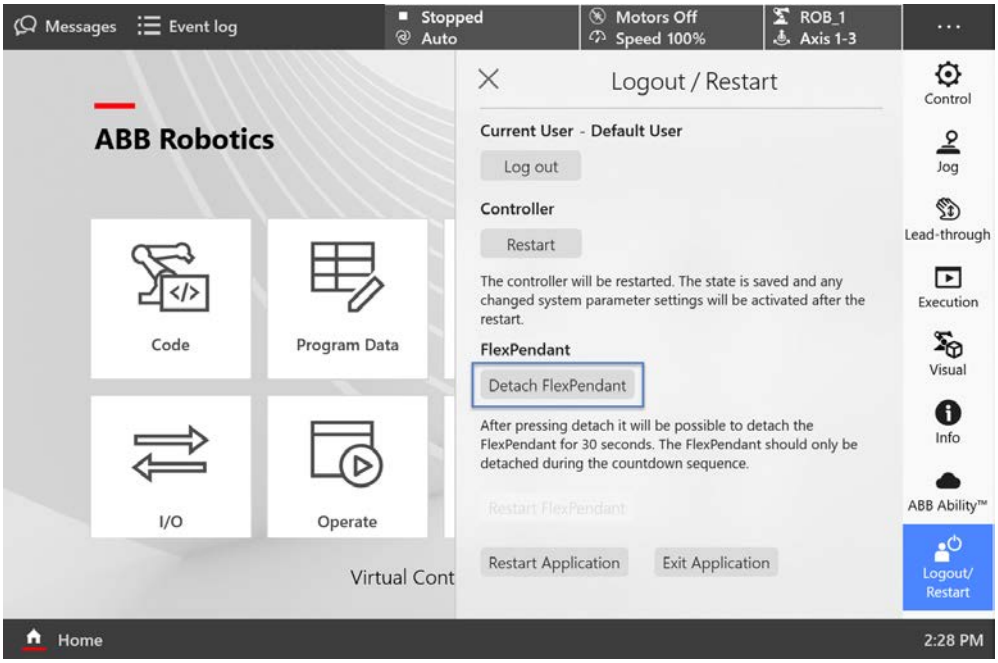
This option is required if the option *FlexPendant [3016-x]* is not selected.

This allows for the following, but not limited to, use cases:

- Avoid damage due to accidental wear (tripping, falling to the ground), when the FlexPendant is not used.
- Avoid damage to the FlexPendant in harsh environment.
- Avoid unintentional user interaction in automatic mode.
- Reusing one FlexPendant on several robots.



xx1800003666



xx1800003667

Requirements

The option *Hot swappable FlexP.* requires option *FlexPendant base apps* [3120-x]

For more information, see *FlexPendant base apps on page 156*.

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7.6 Industrial networks & fieldbuses

7.6.1 PROFINET

7.6.1.1 PROFINET Controller [3020-1]

General

PROFINET is an open standard for Industrial Ethernet. PROFINET satisfies requirements for automation technology. PROFINET solutions can be implemented for factory and process automation, for safety applications, and for the entire range of drive technology right up to clock-synchronized motion control.

PROFINET has a modular design and different PROFINET communication profiles are all combinations of modular elements from the groups transmission technology, communication protocol, and application profiles.

With this option the robot controller can only act as a PROFINET controller on the PROFINET network.

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7.6.1.2 PROFINET Device [3020-2]

General

With this option *PROFINET Device* the robot controller can only act as a PROFINET device with 256 byte inputs and 256 byte outputs on the PROFINET network.

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7.6.1.3 PROFINET Safety Network

7.6.1.3.1 PROFIsafe Controller [3023-1]

General

The robot controller acts as a PROFIsafe controller and host safe I/O devices (F-Devices) directly. The devices are connected to the Public network or I/O network on the main computer.

A RobotWare license with the options *PROFINET SW* [3020-x] and *PROFIsafe Controller* are required to run PROFIsafe on the controller.

Network segment	V250XT Type B	V400XT	Description
Public Network	WAN 1	WAN 1	Wide Area Network that can host a public industrial network.
	WAN 2	WAN 2	
I/O Network	LAN	LAN	Secondary public/factory network. Isolated from WAN.

Requirements

The option *PROFIsafe Controller* requires option *PROFINET Controller* [3020-1].

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7.6.1.3.2 PROFIsafe Device [3023-2]

General

All I/O communication for the SafeMove functionality is done via a safety PLC using PROFIsafe (safe PROFINET). The safety PLC will act as a PROFIsafe controller (F-Host) and the robot controller will act as a PROFIsafe device (F-Device). The PROFIsafe I/O is connected to one of the the Ethernet ports WAN 1, WAN 2, or LAN on the main computer.

A RobotWare license with the options *PROFINET SW* [3020-x] and *PROFIsafe Device* are required to to run PROFIsafe on the controller.

Requirements

The option *PROFIsafe Device* requires option *PROFINET Device* [3020-2].

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7.6.2 EtherNet/IP

7.6.2.1 EtherNet/IP Scanner [3024-1]

General

EtherNet/IP is a communications link to connect industrial devices. The EtherNet/IP (EtherNet Industrial Protocol) is managed by ODVA (Open DeviceNet Vendors Association). It is a well established industrial EtherNet communication system with good real-time capabilities. EtherNet/IP extends commercial off-the-shelf Ethernet to the CIP (Common Industrial Protocol); the same upper-layer protocol and object model found in DeviceNet and ControlNet.

CIP allows EtherNet/IP and DeviceNet system integrators and users to apply the same objects and profiles for plug-and-play interoperability among devices from multiple vendors and in multiple sub-nets. Combined, DeviceNet, ControlNet, and EtherNet/IP promote transparency from sensors to the enterprise software.

With this option the robot controller can only act as an EtherNet/IP scanner on the EtherNet/IP network.

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7.6.2.2 EtherNet/IP Adapter [3024-2]

General

With the option *EtherNet/IP Adapter* the robot controller can only act as a EtherNet/IP Adapter with 509 byte inputs and 505 byte outputs on the EtherNet/IP network.

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7.6.3 CC Link IE Field Basic

7.6.3.1 CC-Link IE FB Master [3066-1]

General

CC-Link IE Field Basic is a communications link for industrial devices. CC-Link IE communication using general-purpose Ethernet technology which can be easily applied to small-scale equipment not requiring high-speed control and is easy to use and develop. Realizing cyclic communication on the CC-Link IE field network by software. The communication can be done simultaneously with standard Ethernet TCP/IP communication (HTTP, FTP, etc.)

CC-Link standard is monitored by CLPA (CC-Link Partner Association).

Features

With this option the robot controller can act as an CC-Link IE Field Basic Master on the Industrial Ethernet network.

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7.6.3.2 CC-Link IE Field Basic Device [3066-2]

General

CC-Link IE Field Basic is a communications link for industrial devices. CC-Link IE communication using general-purpose Ethernet technology which can be easily applied to small-scale equipment not requiring high-speed control and is easy to use and develop. Realizing cyclic communication on the CC-Link IE field network by software. The communication can be done simultaneously with standard Ethernet TCP/IP communication (HTTP, FTP, etc.)

CC-Link standard is monitored by CLPA (CC-Link Partner Association).

Features

With this option the robot controller can act as an CC-Link IE Field Basic Device on the Industrial Ethernet network.

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7.6.4 DeviceNet

7.6.4.1 DeviceNet m/s IO

7.6.4.1.1 DeviceNet single ch. [3029-1]

General

The DeviceNet is a communications link to connect industrial devices. It is a simple networking solution that reduces both cost and time to wire and install industrial automation devices, and the direct connectivity provides improved communication between devices. DeviceNet is an open network standard.

- Peer-to-peer data exchange where a DeviceNet product can produce and consume messages
- Master/slave operation defined as a proper subset of peer-to-peer
- A DeviceNet product can function as a master or server, or both

Requirements

The option *DeviceNet single ch.* occupies 1 PCIe slot.

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7.7 Ethernet & signal interfaces

7.7.1 Safety Interface

7.7.1.1 Safety internal conn. [3054-1]

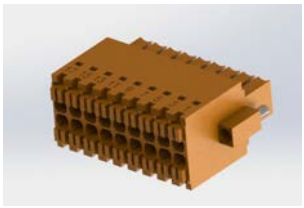
General

The signals are connected directly to the safety board in the main computer in the controller.

Delivery includes internal spring terminal connectors and cable jumpers.

xx2300000501

xx2200000923



xx2200000924

For a full description of all available signals, see the product manual and the circuit diagram.

> **CAUTION**
>
> Safety functions must be verified before use. Safety functions must be tested regularly.

Connector X14

	Description
Connection	Customer Safety Interface: Automatic Stop/General Stop and external Emergency Stop

Continues on next page

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The connector X14 allows for connecting *protective stop* and *emergency stop* devices.

Connector X15

	Description
Connection	Customer Optional Interface

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7.7.2 Cable grommet [3050-1]

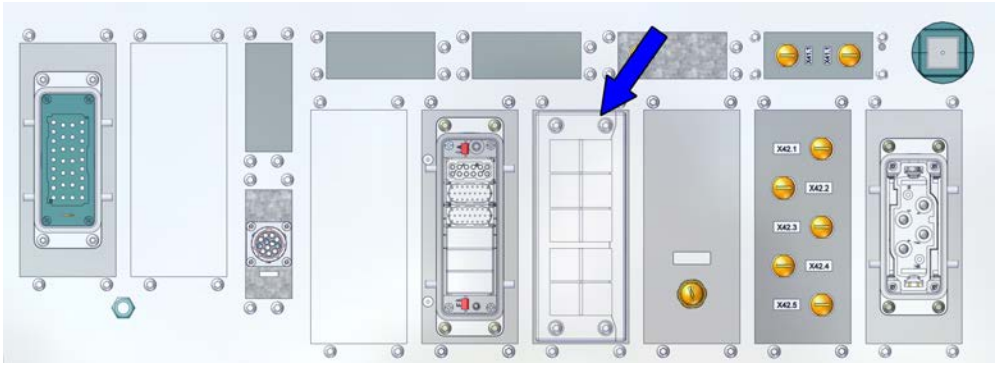
General

The option *Cable grommet* provides for connections of Ethernet-based communication links to external ABB selected devices such as cameras, conveyor tracker, etc.

The technical solutions in this module vary with the number of Ethernet ports that should be available for communication, IP class, and requirements on the Ethernet connector itself (RJ45 or M12).

The option *Cable grommet* provides extended capability for connectivity.

The module also contains 24VDC for external usage and WAN.



xx2100000844

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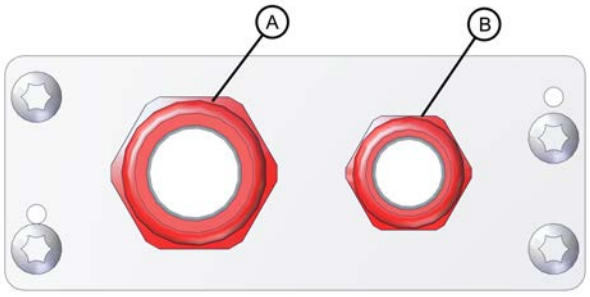
7.7.3 2xCable gland [3050-2]

General

The option *2xCable gland* is used for connection of external process equipment.



xx2400000150

The glands allow for cables of the following dimensions:

Cable gland	Cable diameter (mm)
A	4.5 mm - 6.0 mm
B	11.0 mm - 14.5 mm

The interface is located in the fixed installation panel.

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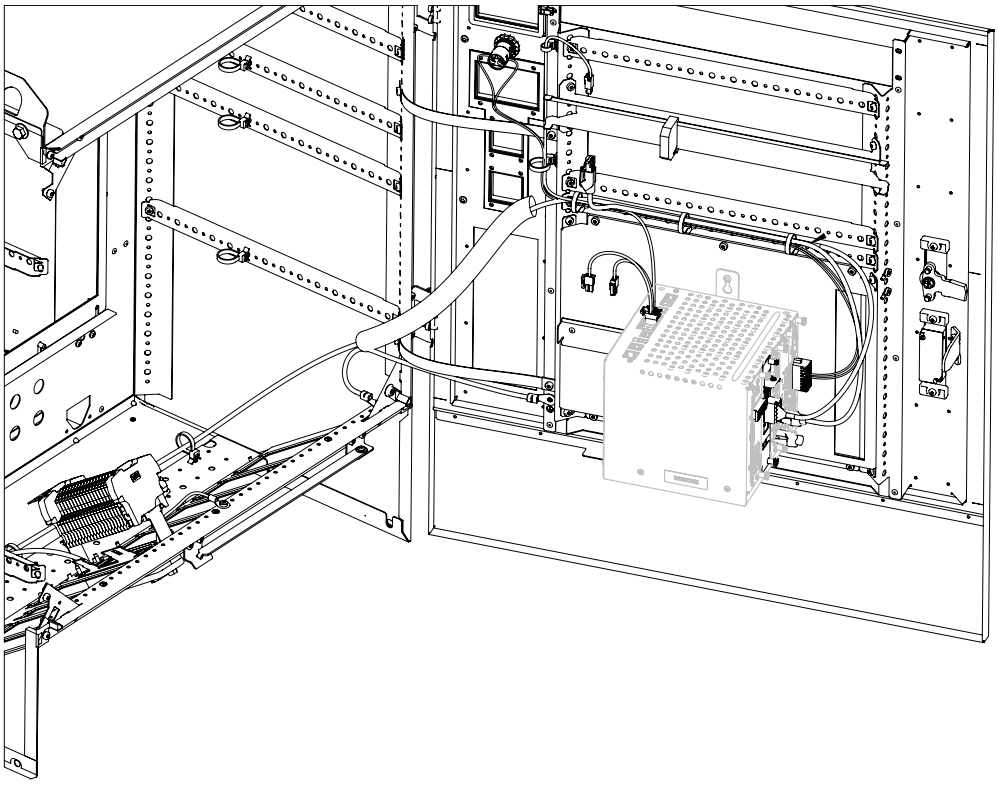
7.7.4 Parallel manip I/O interface

7.7.4.1 Parallel interface 1 [3055-1]

General

Parallel interface allows to connect internal signals within the controller to outside process equipment using a multipurpose connector. It is the interface for robot floor cable and DressPack.



xx2400000278

Limitation

Cannot be combined with DressPack options for IRB 57X0, 6710, 6720, 6730, 6740.

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7.7.4.2 Parallel interface 2 [3055-2]

General

Parallel interface allows to connect internal signals within the controller to outside process equipment using a multipurpose connector. It is the interface for robot floor cable and DressPack.

Limitation

Cannot be combined with DressPack options for IRB 460, 660, 760, 2600, 4600, 6650S, 6660, 6700, 7600.

Requirement

Required by DressPack options for IRB 57X0, 6710, 6720, 6730, 6740.

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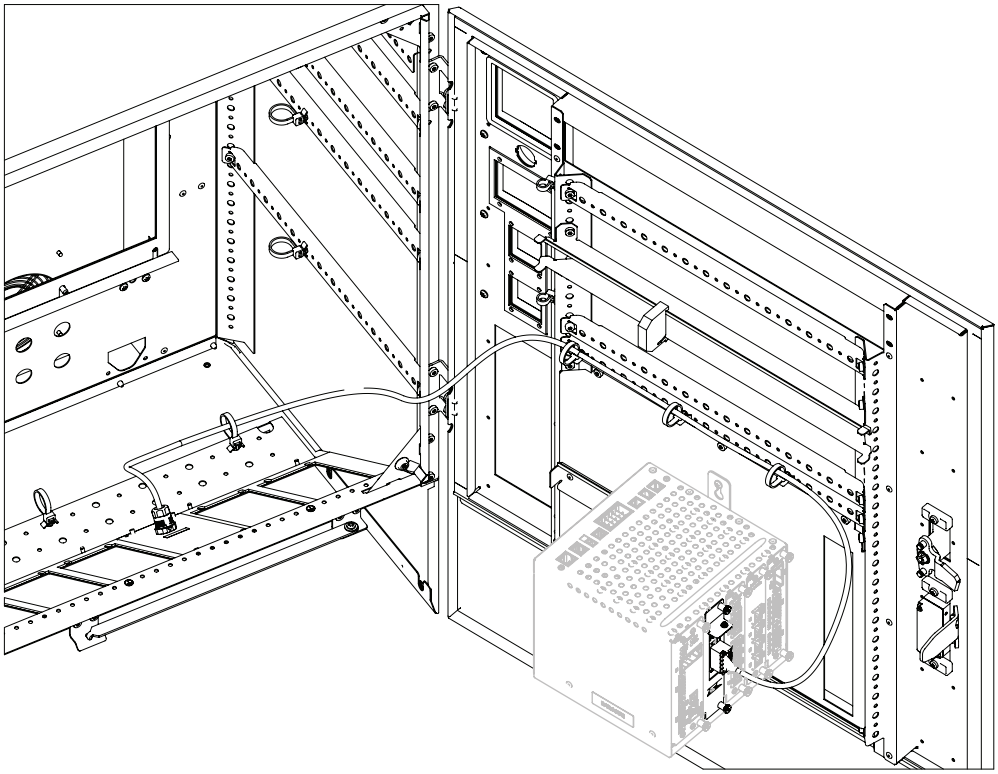
7.7.5 DeviceNet interface

7.7.5.1 DeviceNet interface [3056-1]

General

DeviceNet interface adds a connector on the front of the control cabinet to be used for DeviceNet fieldbus. Internally connected to DeviceNet single channel board.



xx2400000279

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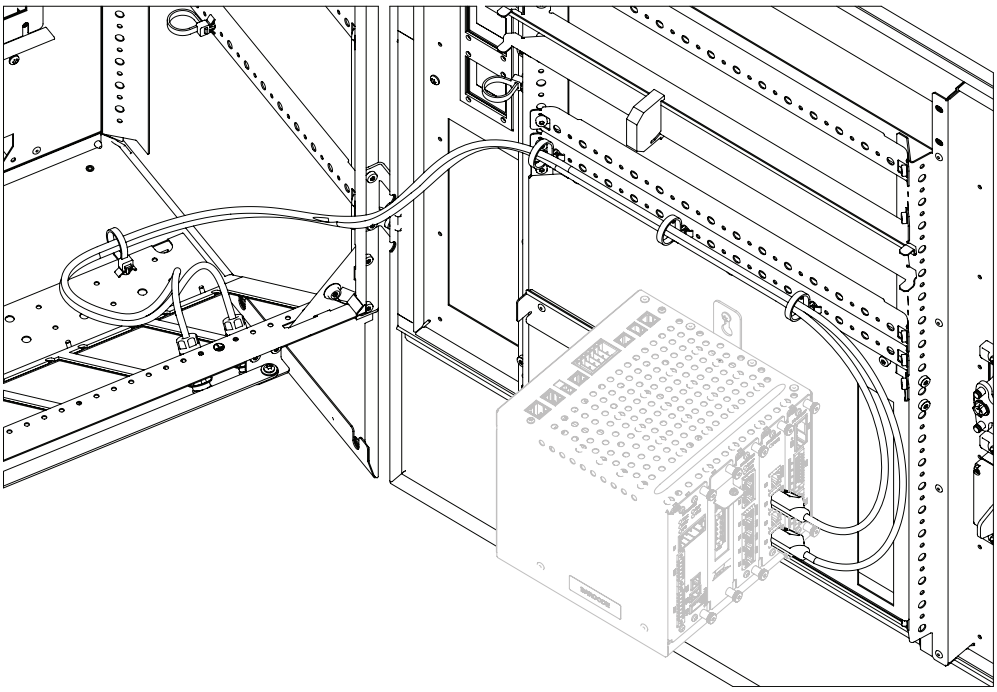
7.7.6 Ethernet 2xM12 X-coded [3060-1]

General

EtherNet 2xM12 adds 2 connectors of M12 standard on the front of the controller cabinet to be used for Industrial Ethernet fieldbuses. Internally connected to 2 EtherNet/IP ports. It is the interface for Robot floor cable and dresspack.



xx2400000280

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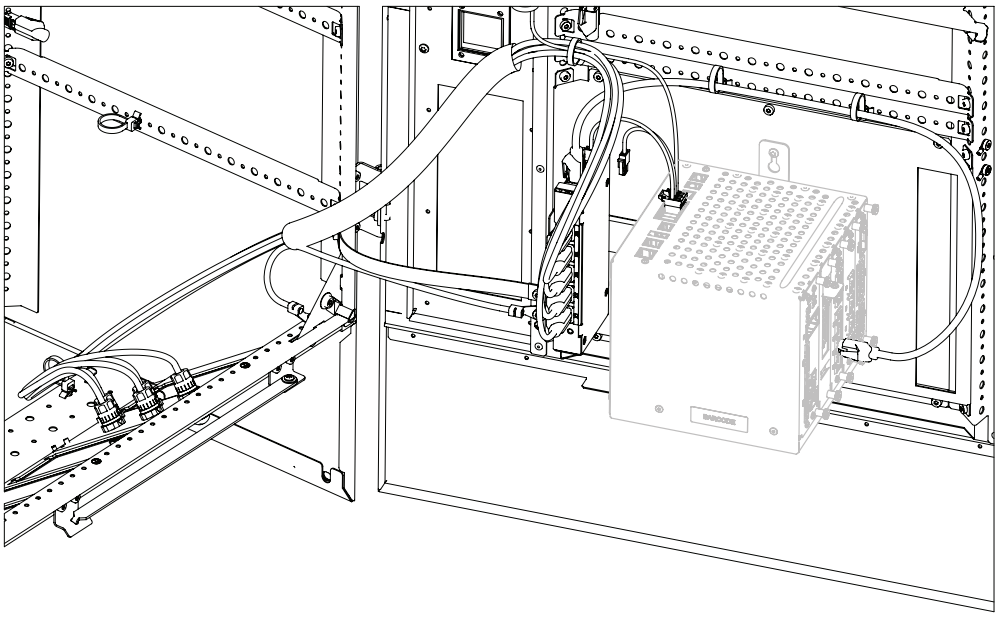
7.7.7 Ethernet 5xM12 X-coded [3061-1]

General

EtherNet 5xM12 adds 5 connectors of M12 standard on the front of the controller cabinet to be used for Industrial Ethernet fieldbuses. Internally connected to 5 EtherNet/IP ports. It is the interface for Robot floor cable and dresspack.



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7.8 Scalable I/O

7.8.1 Scalable I/O Internal

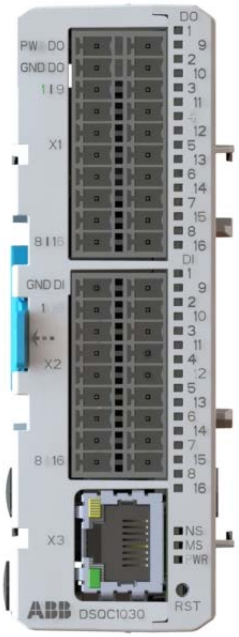
7.8.1.1 Base Dig. 16In/16Out (1-2) [3032-1]

General

DSQC1030 Base unit

24 V Digital with 16 Inputs, 16 Outputs

For more information see *Scalable I/O on page 39*.



xx1800003682

Limitations

Up to two add-on units can be controlled by the base unit, and any combination of add-on units are supported.

For V400XT, a second row of I/O units can be added. This option is not applicable for V250XT.

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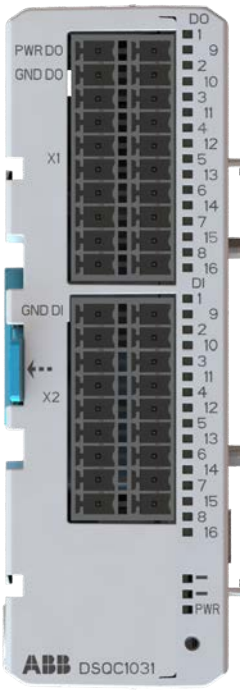
7.8.1.2 Add-on Dig. 16In/16Out [3033-1]

General

DSQC1031

24 V Digital with 16 Inputs, 16 Outputs

For more information, see *Scalable I/O on page 39*.



xx2200000419

Requirements

The option *Add-on Dig. 16In/16Out* requires option *Base Dig. 16In/16Out* [3032-1].

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7.8.1.3 Add-on Analog 4In/4Out [3034-1]

General

DSQC1032

4 Analog Inputs 4 Analog Outputs

For more information, see *Scalable I/O on page 39*.

xx1800003685

Requirements

The option *Add-on Analog 4In/4Out* requires option *Base Dig. 16In/16Out* [3032-1].

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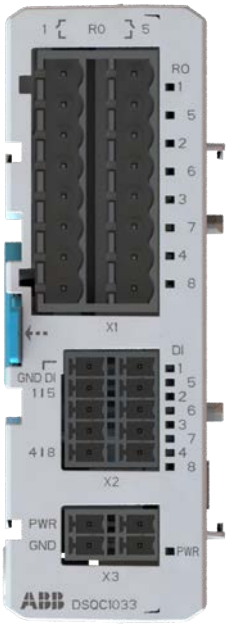
7.8.1.4 Add-on Relay 8In/8Out [3035-1]

General

DSQC1033

8 Digital inputs 8 Relay outputs

For more information, see *Scalable I/O on page 39*.



xx2200000420

Requirements

The option *Add-on Relay 8In/8Out* requires option *Base Dig. 16In/16Out* [3032-1].

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7.8.2 Scalable I/O External

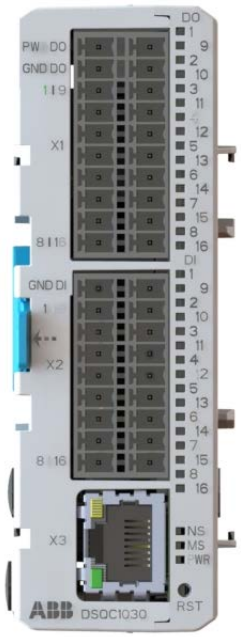
7.8.2.1 Base Dig. 16In/16Out [3032-2]

General

DSQC1030 Base unit

24 V Digital with 16 Inputs, 16 Outputs

For more information, see *Scalable I/O on page 39*.



xx1800003682

Requirements

- Occupies 1 Ethernet port

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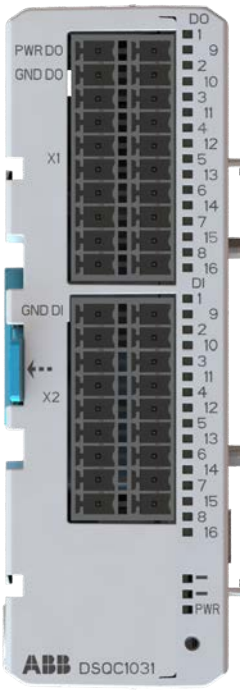
7.8.2.2 Add-on Dig. 16In/16Out [3033-2]

General

DSQC1031

24 V Digital with 16 Inputs, 16 Outputs

For more information, see *Scalable I/O on page 39*.



xx2200000419

Requirements

The option *Add-on Dig. 16In/16Out* requires option *Base Dig. 16In/16Out* [3032-2].

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7.8.2.3 Add-on Analog 4In/4Out [3034-2]

General

DSQC1032

4 Analog Inputs 4 Analog Outputs

For more information, see *Scalable I/O on page 39*.

xx1800003685

Requirements

The option *Add-on Analog 4In/4Out* requires option *Base Dig. 16In/16Out* [3032-2].

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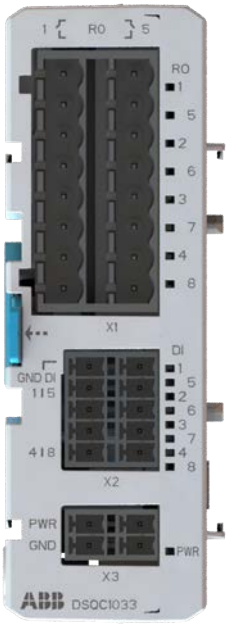
7.8.2.4 Add-on Relay 8In/8Out [3035-2]

General

DSQC1033

8 Digital inputs 8 Relay outputs

For more information, see *Scalable I/O on page 39*.



xx2200000420

Requirements

The option *Add-on Relay 8In/8Out* requires option *Base Dig. 16In/16Out* [3032-2].

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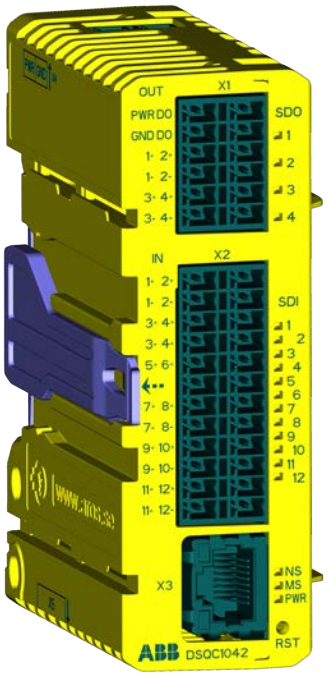
7.8.3 Scalable safety I/O Internal

7.8.3.1 Safe base Dig. 6In/2Out (1-2) [3037-1]

General

The DSQC1042 safety digital base device has 12 inputs and 4 outputs working in dual channel pairs. Due to the dual channel configuration, the device has 6 safe digital inputs and 2 safe digital outputs. The safety digital base device can be combined with up to four additional add-on devices.



xx2100001681

Connector	Description
X1	Digital outputs, process power
X2[i]	Digital inputs
X3	EtherNet
X4	Logic power
X5	EtherNet

i The numbers (printings) on the module only show the I/O numbers (digital input/output). It is not the pin position number for connector X1 or X2 (only I/O number).

For more information see *Application manual - Scalable I/O*.

Limitations

The option *Safe base Dig. 6In/2Out* is not possible to order with option *Base Dig. 16In/16Out* [3032-1].

For V400XT, a second row of I/O units can be added. This option is not applicable for V250XT.

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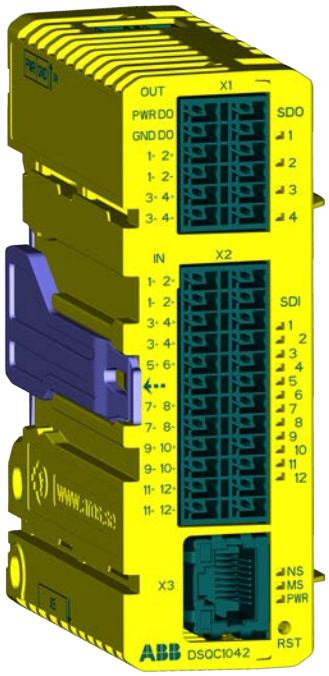
7.8.4 Scalable safety I/O External

7.8.4.1 Safe base Dig. 6In/2Out [3037-2]

General

The DSQC1042 safety digital base device has 12 inputs and 4 outputs working in dual channel pairs. Due to the dual channel configuration, the device has 6 safe digital inputs and 2 safe digital outputs. The safety digital base device can be combined with up to four additional add-on devices.



xx2100001681

Connector	Description
X1	Digital outputs, process power
X2[i]	Digital inputs
X3	EtherNet
X4	Logic power
X5	EtherNet

i The numbers (printings) on the module only show the I/O numbers (digital input/output). It is not the pin position number for connector X1 or X2 (only I/O number).

For more information see *Application manual - Scalable I/O*.

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7.9 Functional Safety

General

OmniCore controller is prepared with the hardware to run keyless mode switch

Continues on next page

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7.9.1 Robot safety supervision

7.9.1.1 SafeMove Basic [3043-1]

General

The option *SafeMove Basic* gives you access to the configurator **Visual SafeMove** in RobotStudio. With **Visual SafeMove** you can:

- configure and visualize supervision functions in a 3D environment
- configure stop functions, such as automatic stop
- configure *Cyclic Brake Check*
- configure safe signals (safe EtherNet communication and I/O)
- configure signal logics
- configure system status outputs

For more information, see *Application manual - Functional safety and SafeMove*.

Included functions	
Supported number of axes	9
Safe ranges	8
Safe zones	1
Axis position supervision	Yes
Contact application support	Yes

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7.9.1.2 SafeMove Pro [3043-2]

General

The option *SafeMove Pro* gives you access to the configurator **Visual SafeMove** in RobotStudio. With **Visual SafeMove** you can:

- configure and visualize supervision functions in a 3D environment
- configure stop functions, such as automatic stop
- configure *Cyclic Brake Check*
- configure safe signals (safe EtherNet communication and I/O)
- configure signal logics
- configure system status outputs

For more information, see *Application manual - Functional safety and SafeMove*.

Included functions	
Supported number of axes	9
Safe ranges	8
Safe zones	16
Tool changer support	Yes (16 tools)
Axis position supervision	Yes
Axis speed supervision	Yes
Tool orientation supervision	Yes
Tool position supervision	Yes
Tool speed supervision	Yes
Stand still supervision	Yes
Contact application support	Yes

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7.9.2 Operation mode selector

7.9.2.1 3 modes Keyless [3044-1]

General

Operator mode selection from the FlexPendant without key switch.

The operational modes to switch between is:

- Auto mode
- Manual mode (reduced speed)
- Manual mode (full speed)

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7.9.2.2 2 modes Keyless [3044-2]

General

Operator mode selection from the FlexPendant without key switch.

The operational modes to switch between is:

- Auto mode
- Manual mode (reduced speed)

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7.10 Additional axes

7.10.1 Additional drive units

Additional drive units [3062-1]

The additional drive unit option is used when the robot controller needs to control additional axes besides the robot axes. These axes are synchronized and, if desired, coordinated with the movement of the robot, which results in high speed and high accuracy.

Drive unit type	Rated current (Amp rms)	Max current (Amp rms)	Input voltage (VDC)
DSQC3065	30	55	370/650 i

i Depending on the type of power unit.

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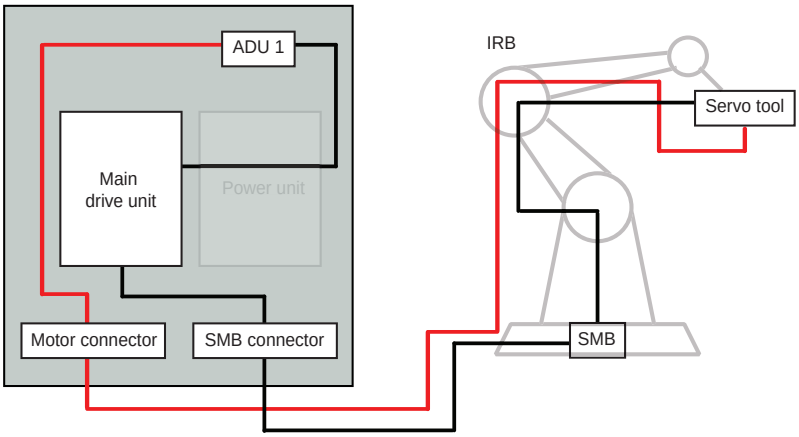
7.10.2 ADU connection to manipulator

Robot held servo tool [3068-1]

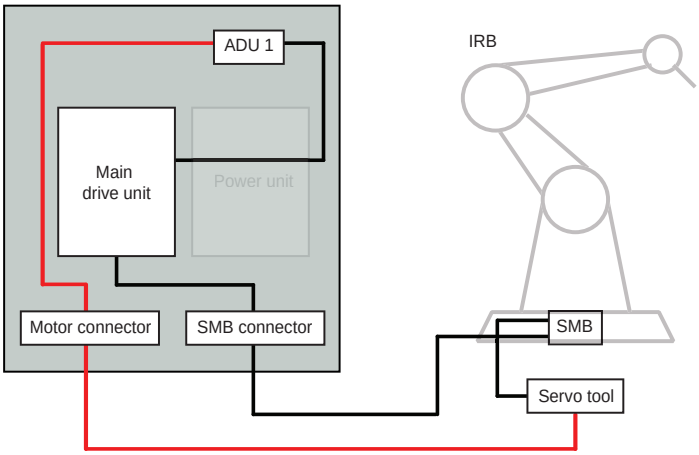
The option *Robot held servo tool [3068-1]* is used for setups with robot held servo tools:



xx2300000931

Stationary servo tool [3068-2]

The option *Stationary servo tool [3068-2]* is used for setups with stationary servo tools:



xx2300000932

If this option is selected, an additional SMB cable is included.

Note

Requires option *On base [3322-1]* (Resolver connection 7th axis).

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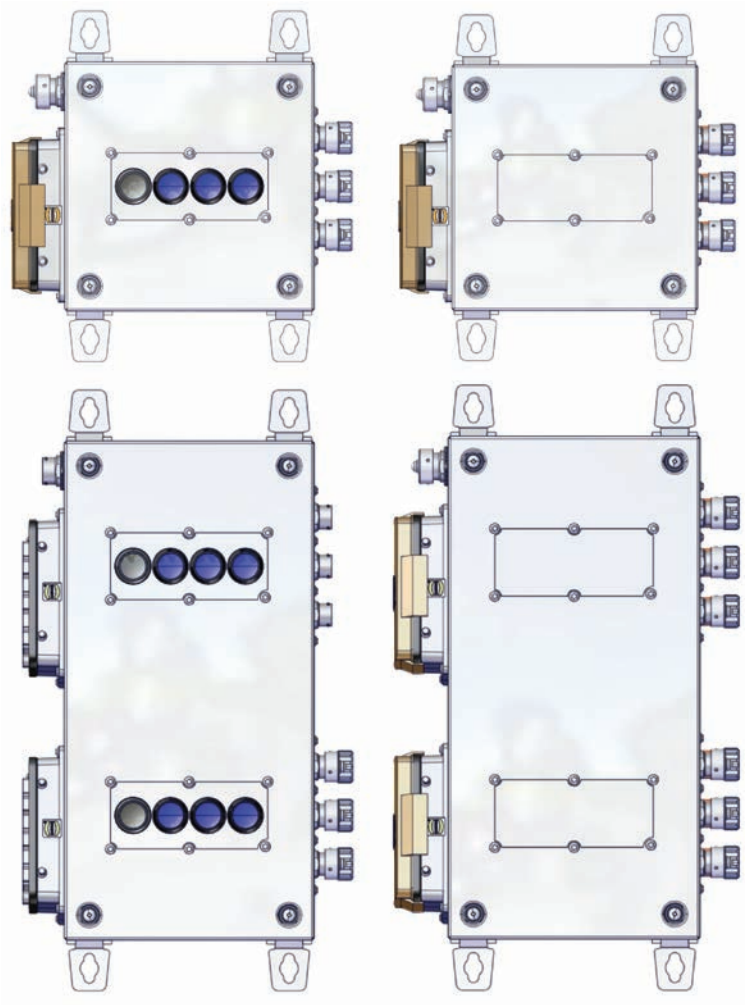
7.10.3 Motor connection kit

General

Depending on the selected option, the motor connection box allows the connection of one to six motor units and/or gear units to the OmniCore controller (drive module).

The motor connection box can be located 7, 15, or 22 meters from the cabinet. Motor units and gear units can be connected to the motor connection box through flexible cables with lengths of 7, 15, or 22 meters. The motor connection box can be equipped with brake release buttons, one for each motor unit.



xx2300001671

Installation requirements

- If third party motors are to be used, a quenching circuit must be installed.

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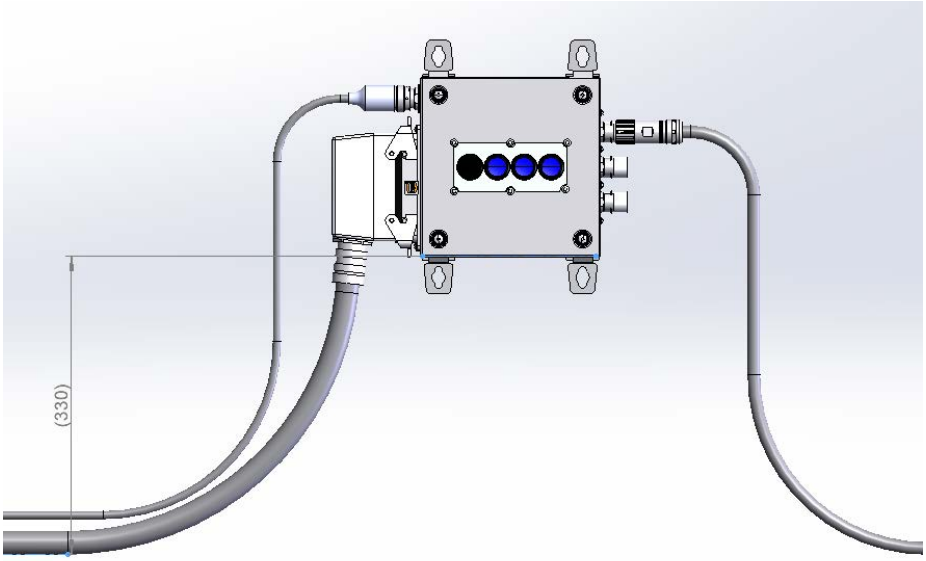
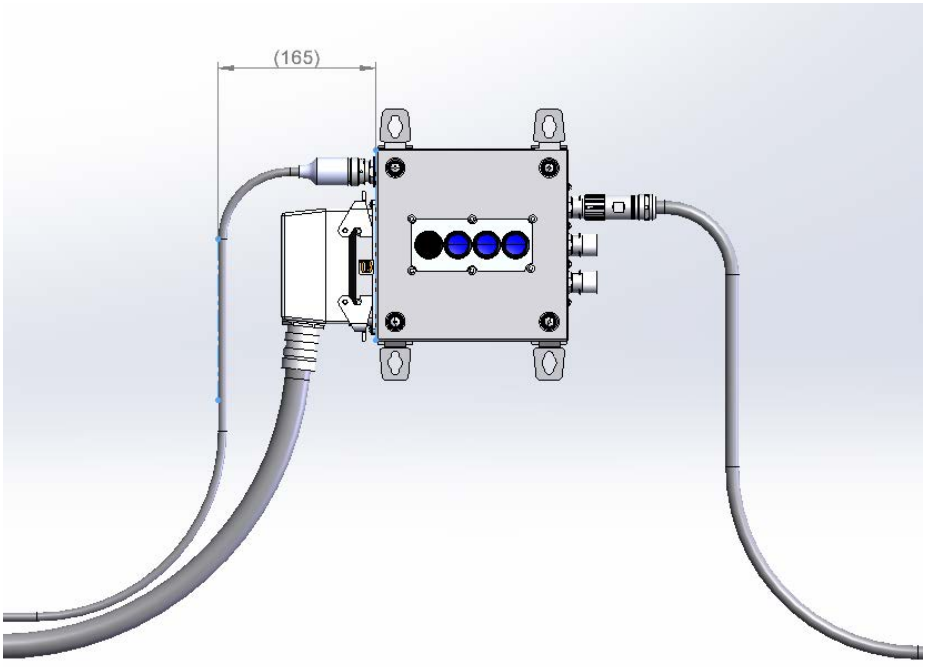
- The following minimum space is required beside the motor connection box due to stiffness of floor cables:



xx2300001741



xx2300001742

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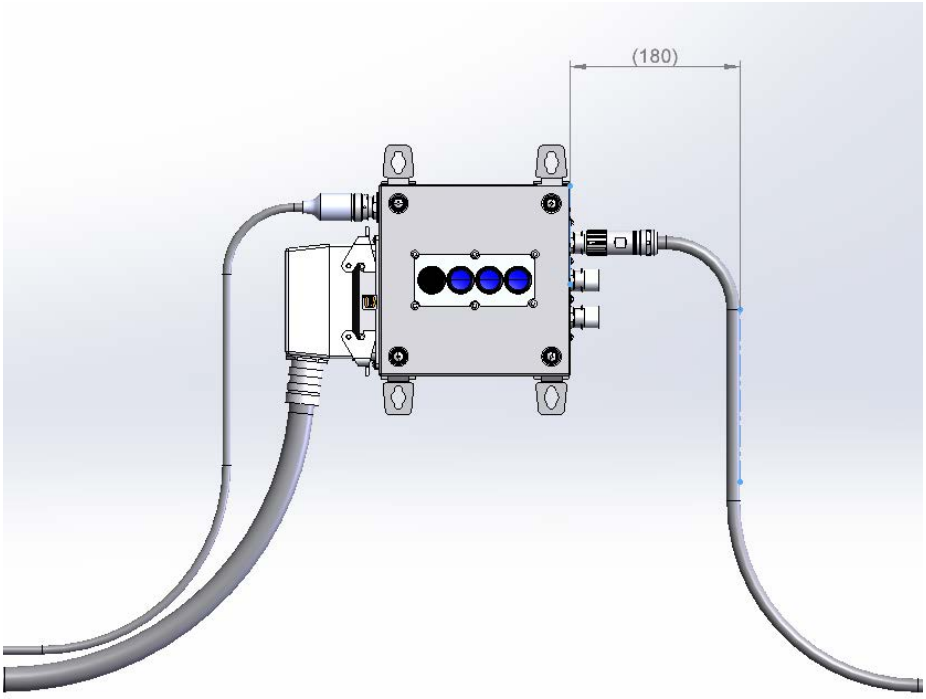
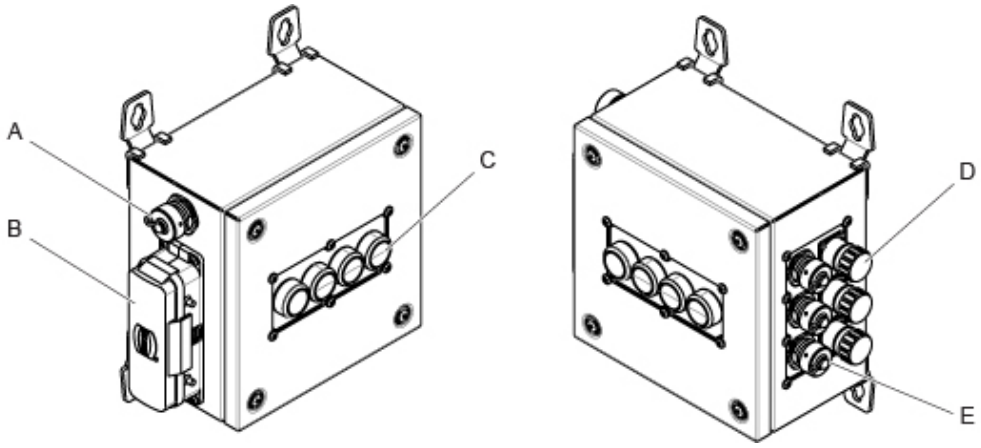
7.10.3 Motor connection kit
Continued



xx2300001743

Motor connection box, 3-axis [3069-1x]

Overview



xx2300001719

A	Cable harness resolver, bus
B	Cable harness power, axis 1-3
C	Brake release buttons (optional)
D	Cable harness motor power, axis 1-3
E	Resolver signal, axis 1-3

Continues on next page

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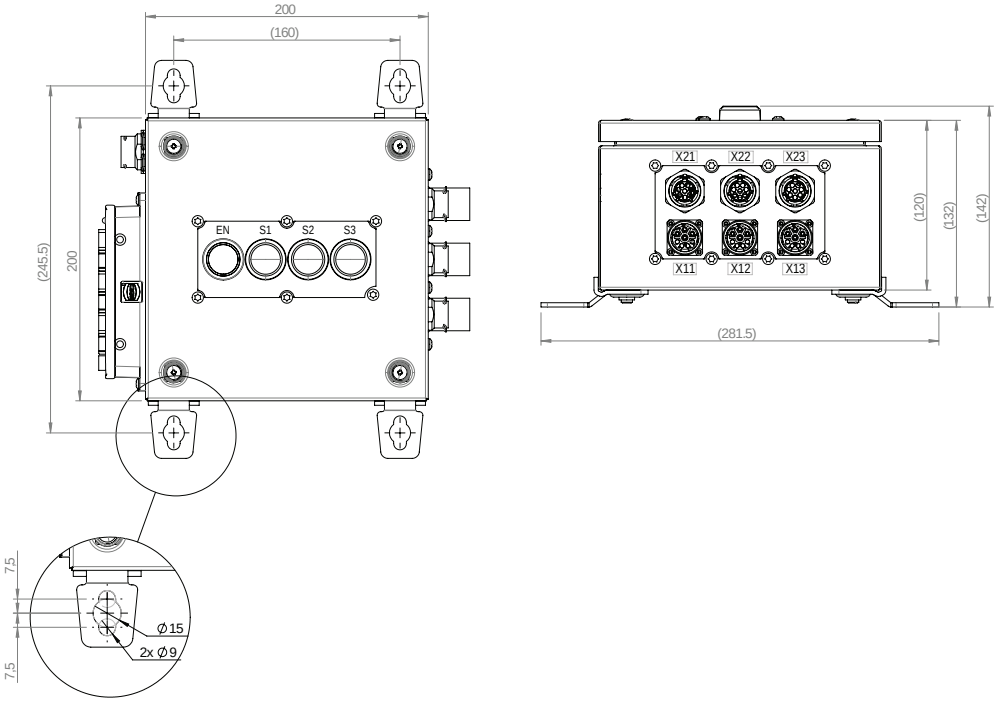
Dimensions

The graphic below shows the dimensions of the motor connection box.



xx2300001736

Option description

The option *Connection box [3069-1x]* includes the following:

- 1 Motor connection box, 3-axis
- 1 External axis power harness
- 1 SMB cable

Cable length

Length of cables is determined by the selected option, see below:

Option	Cable length
Connection box [3069-12]	7 m
Connection box [3069-13]	15 m
Connection box [3069-14]	22 m

Continues on next page

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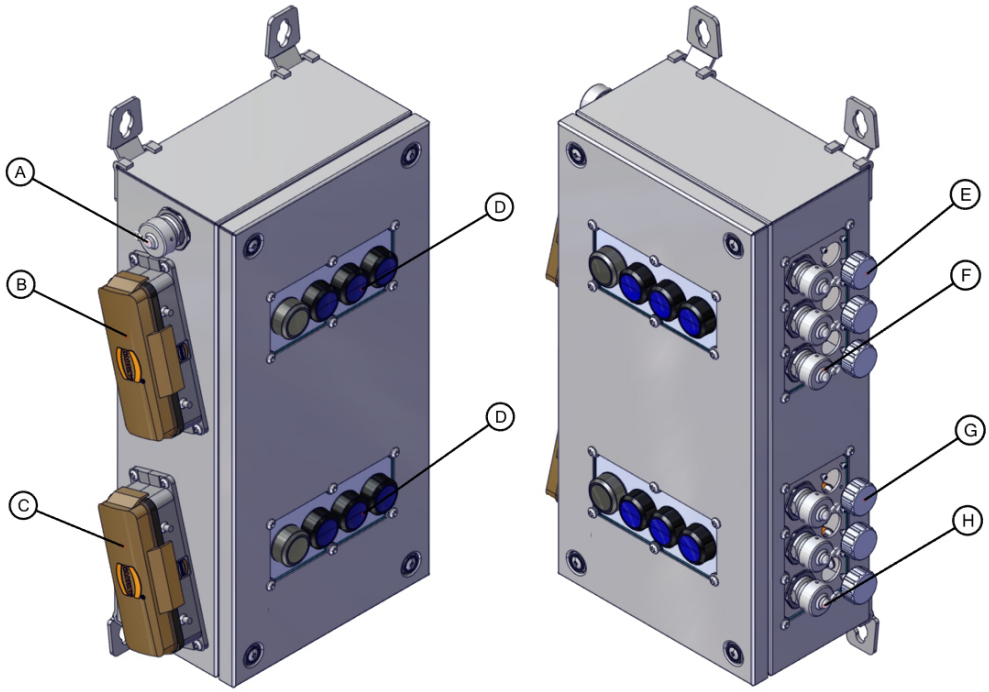
7.10.3 Motor connection kit
Continued

Motor connection box, 6-axis [3069-2x]

Overview



xx2300001718

A	Cable harness resolver, bus
B	Cable harness power, axis 1-3
C	Cable harness power, axis 4-6
D	Brake release buttons (optional)
E	Cable harness motor power, axis 1-3
F	Resolver signal, axis 1-3
G	Cable harness motor power, axis 4-6
H	Resolver signal, axis 4-6

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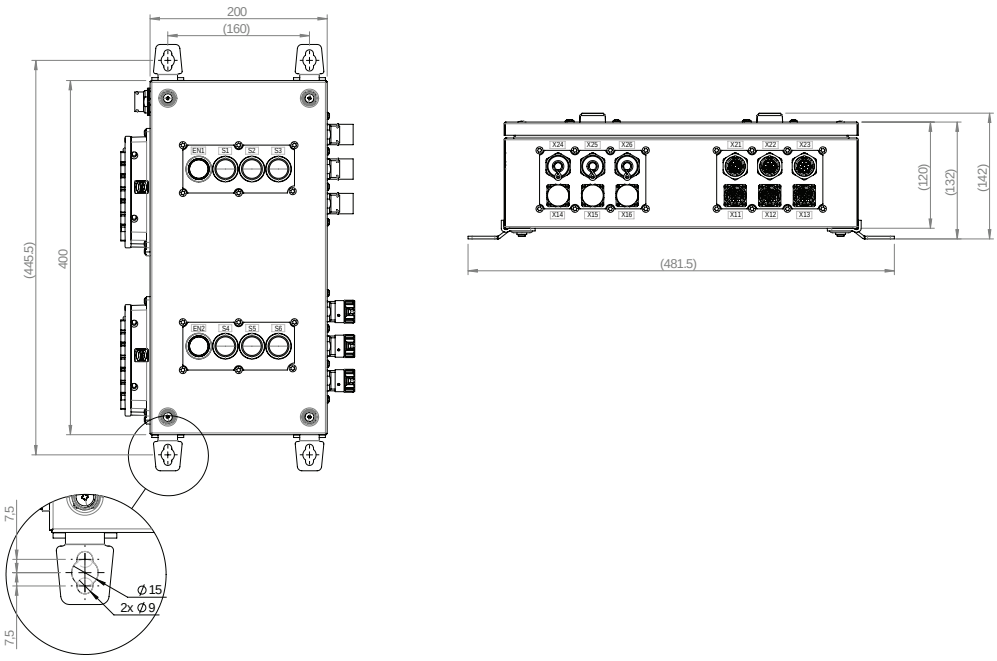
Dimensions

The graphic below shows the dimensions of the motor connection box.



xx2300001737

Option description

The option *Connection box [3069-2x]* includes the following:

- 1 Motor connection box, 3-axis
- 2 External axis power harnesses
- 1 SMB cable

Cable length

Length of cables is determined by the selected option, see below:

Option	Cable length
Connection box [3069-22]	7 m
Connection box [3069-23]	15 m
Connection box [3069-24]	22 m

No brake release [3070-1]

The option *No brake release* is selected for motor connection boxes without brake release buttons.

Analog brake release [3070-2]

The option *Analog brake release* is selected for motor connection boxes with brake release buttons.

Continues on next page

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7.10.3 Motor connection kit
Continued

Motor Connector Plug [3072-1]

The option *Motor Connector Plug* is applicable when PTC supervision is activated in system configuration and when any of the motor outputs on the Motor Connection Box are not used.

The PTC supervision signal must be a closed circuit (when the supervision is activated).

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7.11 Motion Performance

7.11.1 Advanced robot motion

7.11.1.1 Advanced robot motion [3100-1]

About Advanced robot motion

The option *Advanced robot motion* gives you access to:

- *Advanced Shape Tuning*, see *Advanced Shape Tuning on page 128*.
- *Wrist Move*, see *WristMove on page 132*.
- Changing *Motion Process Mode* from RAPID, see *Motion Process Mode on page 130*.

Continues on next page

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7.11.1.1.1 Advanced Shape Tuning

General

> **Note**
>
> This functionality is included in the option *Advanced robot motion*, see *Advanced robot motion [3100-1] on page 127*.

Advanced Shape Tuning offers the possibility to compensate for frictional effects that might appear at low speed cutting robot motion (10-100 mm/s). This is especially useful when cutting advanced shapes, for example, small circles, or other similar applications when path accuracy is crucial. Friction tuning can be used to improve path accuracy of the robot in cutting applications.

The option gives the user access to tuning parameters and the possibility to change the tuning parameters for each axis during program execution with RAPID commands in the robot program. The option also includes RAPID instructions for automatic fine tuning of friction level for each specific shape. The software automatically repeats the movement until the best friction level for each axis has been found. After the tuning has been completed each robot axis has a unique set of tuning values for each shape. The tuning is performed by the user and for each specific shape.

Features

- Very accurate path performance for advanced motion at low speed, e.g. shape cutting
- Automatic tuning of the friction level using RAPID
- Access to tuning parameters
- Tuning axis by axis
- Change tuning from RAPID program

Application

Friction effects typically arise when cutting small, advanced shapes like for example circles. The major source of friction effects comes changing direction of axis movement. The effects appear in the form of up to 0.5 mm path deviations.

Typical applications are cutting of small shapes, such as holes, slots, rectangles. Other applications may be high precision gluing or dispense of small geometries.

Performance

Using *Advanced Shape Tuning*, typically a 0.5 mm path deviation can be reduced to about 0.1 mm. This however, requires careful tuning of the friction level (see *Operating manual - OmniCore* for tuning procedure, and the instruction `TuneServo` described in *Technical reference manual - RAPID Instructions, Functions and Data types*). Note that even with careful tuning, there is no guarantee that "perfect" paths will always be generated.

Continues on next page

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Requirements

There are no hardware or software requirements for this option.

RAPID instructions

RAPID instructions included in this option:

Instruction	Description
FricIdInit	Instruction to start the friction level identification
FricIdEvaluate	Function that will return the friction level that produced the best results
FricIdSetFricLevels	Instruction to set friction levels

Change of tuning from RAPID is done with standard parameters.

Instruction	Description
TuneServo	*Technical reference manual - RAPID Instructions, Functions and Data types*

Limitations

- The movement sequence for which friction tuning is done must begin and end with a fine point.
- The tuning process requires about 15 iterations of the movement per axis.
- The movement sequence between `FricIdInit` and `FricIdEvaluate` cannot be longer than 4 seconds.

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7.11.1.1.2 Motion Process Mode

Purpose

The purpose of Motion Process Mode is to simplify application specific tuning, i.e. to optimize the performance of the robot for a specific application.

For most applications the default mode is the best choice.

Tip

If the default mode does not give sufficient accuracy, first test to use *Accuracy mode*, and if that is not sufficient, use *Low speed accuracy*.

Available motion process modes

A motion process mode consists of a specific set of tuning parameters for a robot. Each tuning parameter set, that is each mode, optimizes the robot tuning for a specific class of applications.

There following modes are predefined:

- *Optimal cycle time mode* – this mode gives the shortest possible cycle time and is normally the default mode.
- *Accuracy mode* – this mode improves path accuracy. The cycle time will be slightly increased compared to *Optimal cycle time mode*.
- *Low speed accuracy mode* – this mode improves path accuracy. The cycle time will be slightly increased compared to *Accuracy mode*.
- *Low speed stiff mode* - this mode is recommended for contact applications where maximum servo stiffness is important. Could also be used in some low speed applications, where a minimum of path vibrations is desired. The cycle time will be increased compared to *Low speed accuracy mode*.
- *Press tending mode* – Changes the *Kv Factor*, *Kp Factor* and *Ti Factor* in order to mitigate tool vibrations. This mode is primarily intended for use in press tending applications where flexible grippers with a large extension in the y-direction are used.
- *Collaborative mode* – This mode is recommended for collaborative applications where robot should run smoothly. The cycle time will be increased compared to optimal cycle time mode. This will only have any effect on GoFa CRB 15000.

There are also four modes available for application specific user tuning:

- *MPM User mode 1 – 4*

Selection of mode

The default mode is automatically selected and can be changed by changing the system parameter *Use Motion Process Mode* for type *Robot*.

Changing the *Motion Process Mode* from RAPID is only possible if the option *Advanced Robot Motion* is installed. The mode can only be changed when the robot is standing still, otherwise a fine point is enforced.

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The following example shows a typical use of the RAPID instruction `MotionProcessModeSet`.

```
MotionProcessModeSet OPTIMAL_CYCLE_TIME_MODE;
! Do cycle-time critical movement
MoveL *, vmax, ...;
...

MotionProcessModeSet ACCURACY_MODE;
! Do cutting with high accuracy
MoveL *, v50, ...;
...
```

Limitations

- The *Motion Process Mode* concept is currently available for all six- and seven-axes robots except paint robots with TrueMove1.
- The *Mounting Stiffness Factor* parameters are only available for the following robots:

  IRB 120, IRB 140, IRB 1200, IRB 1520, IRB 1600, IRB 2600, IRB 4600, IRB 6620 (not LX), IRB 6640, IRB 6700.
- For IRB 1410, only the *Accset* and the geometric accuracy parameters are available.
- The following robot models do not support the use of *World Acc Factor* (i.e. only *World Acc Factor = -1* is allowed):

  IRB 340, IRB 360, IRB 540, IRB 1400, IRB 1410

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7.11.1.1.3 WristMove

General

> **Note**
>
> This functionality is included in the option *Advanced robot motion*, see *Advanced robot motion [3100-1] on page 127*.

WristMove is an interpolation method that only uses two axes to perform the movement. It is favorable to use in applications where one need to improve the accuracy for small shapes, for example in cutting applications. For shapes like small holes, the friction effects from the main axes (axes 1-3) of the robot may cause path deviations. *WristMove* is a method to limit the axes movement to only use two wrist axes, and thereby minimizing the friction effects on the path. In addition, a movement with *WristMove* interpolation is faster than corresponding movement without *WristMove* as less robot weight needs to be moved. The user can define which axis pair to be used for the specific movement.

Features

- Interpolation method to only use a pair of two axes. Allowable combinations, Axis5/Axis6, Axis4/Axis5 or Axis4/Axis6
- Support for any shape consisting of circular arc and straight lines, e.g. holes, slots, rectangles, etc.
- Lead in - Lead out -> any shape
- Activate interpolation mode prior to shape generation
- Used together with RAPID instruction `CirPathMode` and movement instructions for circular arcs, that is, `MoveC`, `TrigC`, `CapC`, etc
- Straight line segments can be achieved using `MoveC` with collinear targets.

Application

WristMove is an option that can be used in cutting applications, like laser cutting, water jet cutting, routing, etc, to improve the accuracy for small shapes. The solution is a flexible, easy-to-use software feature that can be applied in any application where the robot needs to perform small shape movements.

The option can help to reduce path deviations up to or above 50% in favorable circumstances.

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Performance

WristMove is especially useful in cutting small holes, or other similar movements, with radius up to 25 mm. For these kinds of movements one can expect an accuracy of about ±0.1 mm when using *WristMove* at normal cutting speeds. This accuracy is the radial deviation between the actual movement and the programmed circle. This however, requires careful usage of the *WristMove* option (see *Operating manual - OmniCore* for details, and the instruction `CirPathMode` described in *Technical reference manual - RAPID Instructions, Functions and Data types*). Note that even with careful usage, there is no guarantee that "perfect" paths will always be generated.

WristMove can potentially improve cycle time as a movement with *WristMove* is faster than a corresponding movement without *WristMove* interpolation. The reason is that less robot weight needs to be moved in order to achieve the movement.

Requirements

There are no additional hardware or software requirements for this option.

RAPID instructions

There are no RAPID instructions included in this option.

Change of interpolation mode is done by setting parameters in RAPID instruction `CirPathMode`.

Limitations

- *WristMove* cannot be used if the work object is moving
- *WristMove* cannot be used if the robot is mounted on a track that is moving
- Can only use movement instructions for circular arcs, that is, `MoveC`, `TrigC`, `CapC` etc
- When cutting holes, or other shapes, the edges will be conical depending on the robot movement and the distance between tool and workobject
- The tool's height above the surface and the distance to the cutting point will vary during the cut due to the movement of only two axes
- *WristMove* cannot be used on robots with non-spherical wrist, for example, GoFa or YuMi

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7.11.2 Absolute Accuracy [3101]

Purpose

Absolute Accuracy is a calibration concept that improves TCP accuracy. The difference between an ideal robot and a real robot can be several millimeters, resulting from mechanical tolerances and deflection in the robot structure. *Absolute Accuracy* compensates for these differences.

Here are some examples of when this accuracy is important:

- Exchangeability of robots
- Offline programming with no or minimum touch-up
- Online programming with accurate movement and reorientation of tool
- Programming with accurate offset movement in relation to eg. vision system or offset programming
- Re-use of programs between applications

The option *Absolute Accuracy* is integrated in the controller algorithms and does not need external equipment or calculation.

> **Note**
>
> The performance data is applicable to the corresponding RobotWare version of the individual robot.

What is included

Every *Absolute Accuracy* robot is delivered with:

- compensation parameters saved in the robot memory
- a birth certificate representing the *Absolute Accuracy* measurement protocol for the calibration and verification sequence.

A robot with *Absolute Accuracy* calibration has a label with this information on the manipulator.

Absolute Accuracy supports floor mounted, wall mounted, and ceiling mounted installations. The compensation parameters that are saved in the robot memory differ depending on which Absolute Accuracy option is selected.

When is *Absolute Accuracy* being used

Absolute Accuracy works on a robot target in Cartesian coordinates, not on the individual joints. Therefore, joint based movements (e.g. `MoveAbsJ`) will not be affected.

If the robot is inverted, the Absolute Accuracy calibration must be performed when the robot is inverted.

Absolute Accuracy active

Absolute Accuracy will be active in the following cases:

- Any motion function based on robtargets (e.g. `MoveL`) and ModPos on robtargets
- Reorientation jogging

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- Linear jogging
- Tool definition (4, 5, 6 point tool definition, room fixed TCP, stationary tool)
- Work object definition

Absolute Accuracy not active

The following are examples of when Absolute Accuracy is not active:

- Any motion function based on a jointtarget (`MoveAbsJ`)
- Independent joint
- Joint based jogging
- Additional axes
- Track motion

> **Note**
>
> In a robot system with, for example, an additional axis or track motion, the Absolute Accuracy is active for the manipulator but not for the additional axis or track motion.

RAPID instructions

There are no RAPID instructions included in this option.

Performance data

The performance data is described in the product specification for the respective manipulator.

Limitations

and [3101-4] are not possible to select for IRB 1100 and IRB 1300.

Absolute Accuracy cannot be selected for robots with the option *Inverted*.

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7.12 Motion Supervision

7.12.1 Motion supervision bundle

7.12.1.1 Motion supervision bundle [3105-1]

About Motion supervision bundle

The option *Motion supervision bundle* gives you access to the included options:

- *World Zones*, see *World Zones [3106-1] on page 137*
- *Collision detection*, see *Collision detection [3107-1] on page 139*
- *Collision avoidance*, see *Collision avoidance [3150-1] on page 140*

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7.12.2 World Zones

7.12.2.1 World Zones [3106-1]

General

The option *World Zones* is used to define in which area in space the TCP is operating, or the current joint configuration.

Features

- Set input/output signal, when TCP or joint within or outside zone
- Stop robot when reaching a zone border
- Cubical, Cylindrical, Spherical and Joint zones
- Set I/O when the robot is in home position and configuration
- Automatic activation at start-up or activated/deactivated from RAPID program
- Active in automatic and manual mode

Application

Application	Description
Home position	When the robot is started from a PLC, the PLC will check that the robot is inside the volume of the home configuration. In this way other equipment may move safely in the cell.
Protection of equipment	A zone may enclose other cell equipment, and thus prevent the robot from moving into that area.
Robots working in the same area	Handshaking between robots ensures that only one robot at a time is working within a zone. This functionality also ensures efficiency in these operations, since robots can be put waiting for another robot to finish its work within the zone and immediately enter the zone, when the first is finished.

Performance

For safety reasons, this software function shall not be used for protection of personnel. Use hardware protection equipment.

Requirements

There are no software or hardware requirements for this option.

RAPID instructions

RAPID instructions included in this option:

Instruction	Description
WZBoxDef	Define a cubical world zone
WZCylDef	Define a cylindrical world zone
WZLimSup	Activate world zone limit supervision
WZSphDef	Define a sphere-shaped world zone
WZDOSet	Activate world zone digital output
WZDisable	Deactivate world zone supervision

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7.12.2.1 World Zones [3106-1]
Continued

Instruction	Description
WZEnable	Activate world zone supervision
WZFree	Erase world zone supervision
WZHomeJointDef	Define a global zone in joint coordinates
WZLimJointDef	Define a global zone in joint coordinates, for limitation of work area

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7.12.3 Collision detection

7.12.3.1 Collision detection [3107-1]

General

Collision detection is a software option, which reduces collision impact forces on the robot. In this way, the robot and external equipment can be protected from severe damage.

Features

- Protection of robot and equipment
- Protection from collisions from any direction
- Robot movement stops and the robot moves back, along the programmed path
- Can reduce the collision force to 30%

Application

Abnormal torque levels on any robot axis (for additional axes, only positioners listed below are covered) are detected and will cause the robot to stop quickly and thereafter back off to relieve forces between the robot and environment.

Performance

The sensitivity (with default tuning) is comparable to the mechanical alternative (mechanical clutch) and it is in most cases much better. In addition, *Collision detection* has the advantages of no added stick-out and weight, no need for connection to the e-stop circuit, no wear, the automatic backing off after collision and, finally, the adjustable tuning.

Tuning is normally not required, but the sensitivity can be changed from RAPID or manually. *Collision detection* can also be switched off completely for part of a program. This may be necessary when strong process forces are acting on the robot.

RAPID instructions

RAPID instruction included in this option:

Instruction	Description
MotionSup	Changing the sensitivity of the collision detection or activating/deactivating the function.

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7.12.4 Collision avoidance

7.12.4.1 Collision avoidance [3150-1]

General

Collision avoidance is a software option that enables the possibility to stop the robot before colliding with fixed objects, such as fences, the floor or equipment in the cell. A collision model for the objects need to be built and downloaded to the controller using RobotStudio.

Features

The *Collision avoidance* feature monitors the geometries of the robot and its work envelope and stops the robot before a possible collision. The static geometry surrounding the robot can also be included in the configuration. This is useful where object positions are dynamically created during runtime by cameras or sensors. The predicted collision can be visualized in the RobotStudio Online Monitor.

Collision avoidance is active during jogging and program execution. The Collision Prediction supports convex geometries such as points, line segments, and convex polygons. Non-convex objects must be split into smaller parts that can be approximated.

Application

This feature can be activated in RobotStudio where it is also possible to define the objects that should be supervised.

For more information, see *Application manual - Controller software OmniCore* and *Operating manual - RobotStudio*.

Performance

The *Collision avoidance* is optimized for and runs on the controller in the motion planner to be able to stop the robot before colliding with monitored objects.

Limitations

CAUTION

Collision Avoidance shall not be used for safety of personnel.

- Paint robots are not supported.
- *Collision Avoidance* cannot be used in manual mode together with responsive jogging. The system parameter *Jog Mode* must be changed to *Standard*.
- Only stationary/non-moving objects can be configured with a trigger signal. A trigger signal must correspond to a group signal. Furthermore, each collision object must have its own trigger signal.
- There is no support for applications that do corrections to the path, such as conveyor tracking, WeldGuide, Force Control, SoftMove, SoftAct etc.

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RAPID instructions

There are no RAPID instructions related to this option but it is possible to enable and disable the function using the digital output signal *Collision_Avoidance*. By setting *Collision_Avoidance* to 0 the function is disabled. It is recommended to enable it (set *Collision_Avoidance* to 1) as soon as the work is done that required Collision Avoidance to be disabled.

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7.13 Motion Functions

7.13.1 SoftMove

7.13.1.1 SoftMove [3108-1]

General

SoftMove is a cartesian soft servo option that allows the robot to be compliant or floating in order to adjust to external forces or variations in work objects. *SoftMove* can lower the stiffness of the robot in one or several pre-defined cartesian direction(s) (in relation to either the tool or the work object) while keeping the original behavior in the other directions. The behavior of the softness is controlled by two parameters *Stiffness* and *Damping*. With *SoftMove*, the robot is compliant in the specified direction(s) only which facilitates high accuracy and reliability. The option reduces robot programming time and enables effective interaction between robot and machine, which reduces cycle time.

Features

SoftMove is used to set up softness in one of the following directions:

- one of the Cartesian directions (x, y or z)
- one of the Cartesian planes (xy, xz or yz)
- all directions (xyz)
- the plane xy and rotational around the z axis

Applications

Machine tending of different machines, for example die casting machines, injection moulding machines, machine tools, etc. Extraction of parts from machine

- Insertion of parts into the machine – robot holds or pushes
- Extraction of parts from machine
- Placing/picking a work object in a tool
- Placing a molded or cast part in a fixture
- Tool exchanging on peripheral machines
- Absorbing of shocks and vibrations

Assembly functions

- Framing - a robot holds and presses a part towards the rest of the car body while another process attaches the part to the body
- Simple assembly functions not requiring searching or fitting

Welding

- Hold-and-Weld
- Hotplate welding

Press tending

- Follow movement of press

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Polishing/Grinding

- Simple polishing and grinding applications with low process forces not requiring process feedback

RAPID instructions

See *Application manual - SoftMove*.

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7.14 Motor Control

7.14.1 Tool Control [3109-1]

General

Tool Control can be used to control a servo tool, for example in a spot weld application or servo driven grippers. *Tool Control* makes it possible to close the tool to a specific plate thickness and force, and maintain the force during the process until the tool is requested to be opened.

Target users are advanced system integrators who want to develop customer specific application software, such as spot welding packages.

Features

- Position control (gap)
- Force control
- Dynamic and kinematic model (tool configured as external axis)
- Quick Start code package

Performance

The tool is configured as an external axis, which ensures optimal performance, regarding path following and speed. (Dynamic and kinematic model)

The option *Tool Change* can be added to the system in order to allow a switch between two or more servo tools which will then utilize the same drive unit and measurement board.

Requirements

A specific servo tool parameter file must be installed in the controller for each servo tool. The parameter file is optimized for each system, regarding system behavior and motion/process performance.

For information on drive module & measurement board see *Application manual - Additional axes*.

RAPID instructions

RAPID instructions included in this option:

Instruction	Description
STClose	Close a servo tool with a predefined force an thickness
STOpen	Open a servo tool
STCalib	Calibrate a servo tool
STTune	Tune motion parameters for a servo tool
STTuneReset	Reset tuned motion parameters
STIsClosed	Test if a servo tool is closed
STIsOpen	Test if a servo tool is open
STCalcTorque	Calculate the motor torque for a servo tool

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Instruction	Description
STCalcForce	Calculate the programmable force for a servo tool

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7.14.2 Independent Axis

7.14.2.1 Independent Axis [3111-1]

General

The option *Independent Axis* is used to make an external axis (linear or rotating) run independently of the other axes in the robot system.

The option also includes the function *Axis Reset*, which can reset the axis position counter from RAPID. *Axis Reset* is useful for repeated maneuvers, where mechanical reset of the axis (mechanically turning back the axis) would mean loss of cycle time in the process.

Note

In the current version, additional axis is not supported.

Features

- Movement of an axis, independent of the robot motion
- Independent movements, programmed with absolute or relative positions
- Continuous rotational/linear movement of an axis
- Speed regulation of the independent axis
- Reset of Axis position counter (axes 4, 6 and additional (rotating) axes)

Application

Application	Description
Axis Reset	When polishing, a large work area is sometimes needed on the robot axis 6 in order to be able to carry out final polishing without stopping. Assume that the axis has rotated 3 turns, for example. It can now be reset using this function, without having to physically rotate it back again, this will reduce cycle times. Pick and place - In a pick and place operation using, the rotation angle of axis 4 can increase and move towards the limit. Instead of moving axis 4 back to zero angle it can be reset saving cycle time in the application.

Performance

The movements will be made with the same performance as additional axes without *Independent Axis*.

Requirements

There are no software or hardware requirements for this option.

Limitations

If an axis has a gear ratio which is not an integer number, fine calibration is required after resetting the revolution counter on the serial measurement board, if a precise axis position is needed in the application.

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Internal and customer cabling and equipment may limit the ability to use independent axis functionality on axis 4 and 6.

The option is not possible to use together:

- 4 axis robots, for example IRB 910INV
- *Robot safety supervision* options [3043-x]

For information about what capability a specific robot's axis 4/6 has, contact ABB.

RAPID instructions and functions

RAPID instructions included in this option:

Instructions	Description
IndCMove	Running an axis continuously
IndDMove	Running an axis independently a specified distance
IndRMove	Running an axis Independently to a position within one revolution, without taking into consideration the number of turns the axis had rotated earlier
IndAMove	Running an axis Independently to an absolute position
IndReset	Change an axis to dependent mode and/or reset the working area

RAPID functions included in this option:

Instructions	Description
IndInpos	Checking whether or not an independent axis has reached the programmed position
IndSpeed	Checking whether or not an independent axis has reached the programmed speed

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7.15 RAPID Program Features

7.15.1 Program feature bundle

7.15.1.1 Program feature bundle [3112-1]

About Program feature bundle

The option *Program feature bundle* gives you access to the included options:

- *Path Recovery*, see *Path Recovery [3113-1] on page 149*
- *Multitasking*, see *Multitasking [3114-1] on page 150*

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7.15.2 Path Recovery

7.15.2.1 Path Recovery [3113-1]

General

The option *Path Recovery* is used to store all system data, when an interrupt occurs (fault message or other) and restore them after necessary actions have been taken.

Features

- Store path data (all current system information)
- Restore path data (all system information, as was before interrupt/fault)

Application

Application	Description
Service of process equipment	When an error message occurs, the position/path data can be stored and the robot moves automatically to a service area. After service, the robot moves back to the exact same position, including all system data and continues welding.

Performance

There is no performance data available for this option.

Requirements

There are no software or hardware requirements for this option.

RAPID instructions

RAPID instructions included in this option:

Instruction	Description
StorePath	Stores the path when an interrupt occurs
RestorePath	Restores the path after an interrupt
PathRecStart	Start the path recorder
PathRecStop	Stop the path recorder
PathRecMoveBwd	Move path recorder backwards
PathRecMoveFwd	Move path recorder forward

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7.15.3 Multitasking

7.15.3.1 Multitasking [3114-1]

General

The option *Multitasking* gives the possibility of executing up to 20 programs (tasks) in parallel, including the main program. *Multitasking* can be used to control peripheral equipment or other processes concurrently with robot motion.

Features

- Automatic start at power on
- START/STOP commands for task execution
- Tasks are programmed using standard RAPID instructions
- Priorities can be set between tasks
- Communications between tasks using signal presistent data or Rapid Message Queue

Application

Application	Description
Supervision	A task can be used to continuously monitor certain signals even when the main program has stopped, thus taking over the job traditionally allocated to a PLC.
Operator dialogue	An operator dialogue might be required at the same time as the robot is performing, for example welding. By putting this operator dialogue into a parallel task, the operator can specify input data for the next work cycle without having to stop the robot.
Control of external equipment	The robot can control a piece of external equipment in parallel with the normal program execution.

Performance

It is possible to configure if the task shall react on START/STOP requests or if it shall start automatically. In the later case it will not stop at emergency stops, which can be useful for some applications.

Note

The response time of *Multitasking* does not match that of a PLC. *Multitasking* is primary intended for less demanding tasks.

The longer time is for cases when heavy calculation of movement is performed.

Requirements

There are no software or hardware requirements for this option.

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RAPID instructions

RAPID instructions included in this option:

Instruction	Description
WaitSyncTask	Synchronize several program tasks at a special point in each program.
IRMQMessage	Orders RMQ interrupts for a data type
RMQFindSlot	Find a slot identity from the slot name
RMQGetMessage	Get an RMQ message
RMQGetMsgData	Get the data part from an RMQ message
RMQGetMsgHeader	Get header information from an RMQ message
RMQSendMessage	Send an RMQ data message
RMQSendWait	Send an RMQ data message and wait for a response
RMQGetSlotName	Get the name of an RMQ client

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7.16 Communication

7.16.1 File Transfer Protocol

7.16.1.1 FTP & SFTP Client [3116-1]

General

The option *FTP & SFTP Client* makes it possible to read information from a remote computer, directly from the controller.

Once the application protocol is configured, the remote computer can be accessed in the same way as the controller's internal hard disk.

Performance

There is no performance data available for this option.

Requirements

The external computer must have an FTP or an SFTP server.

The FTP client has been validated against the following FTP servers:

- FileZilla
- ServU
- MS IIS
- Linux Ubuntu

The SFTP client has been validated against the following SFTP servers:

- Rebex
- Complete
- Cerberus

RAPID instructions

There are no RAPID instructions included in this option.

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7.16.2 Network File System

7.16.2.1 NFS Client [3117-1]

General

The option *NFS client* (Network File System) makes it possible to read information from a remote computer, directly from the controller.

Once the application protocol is configured, the remote computer can be accessed in the same way as the controller's internal hard disk.

Performance

There is no specific performance data available for this option.

Requirements

The external computer must have an NFS server.

RAPID instructions

There are no RAPID instructions included in this option.

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7.16.3 IoT Gateway

7.16.3.1 IoT Data Gateway [3154-1]

General

The option *IoT Data Gateway* [3154-1] is needed to enable IoT Gateway to communicate with RobotWare.

IoT Gateway is an application that share information from the robot controller with other parts of the process/production unit. The information can be configured according to the OPC UA standard format or MQTT with a customer defined format.

The IoT Gateway application software is deployed/installed on a customer Windows PC or Server, connected to the same network as the robot controller(s) and can access data from multiple robot controllers at the same time (each robot controller require to have the option *IoT Data Gateway*).

The application software package is available for download at the ABB Developer Center (robotstudio.com), *https://developercenter.robotstudio.com*

In the download package, an Application manual (3HAC078375-001) and video tutorial are available illustrating the configuration and usage of the IoT Gateway.

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7.17 User Interaction Application

7.17.1 RobotStudio Connect

7.17.1.1 RobotStudio Connect [3119-1]

General

RobotStudio is the programming, configuration and commissioning tool for OmniCore controllers. RobotStudio acts directly on the active data in the controller and enables activities like RAPID programming, update/booting of the systems software and system configuration. Connecting RobotStudio directly to the local management port is enabled by default, but connecting RobotStudio over a public network requires option *RobotStudio Connect* [3119-1].

Features

This option allows RobotStudio to connect to the robot using the public network interface (WAN)

Application

This feature is applicable for the RobotStudio PC product.

Performance

There is no performance data available for this feature

Requirements

There are no additional software or hardware requirements for this feature

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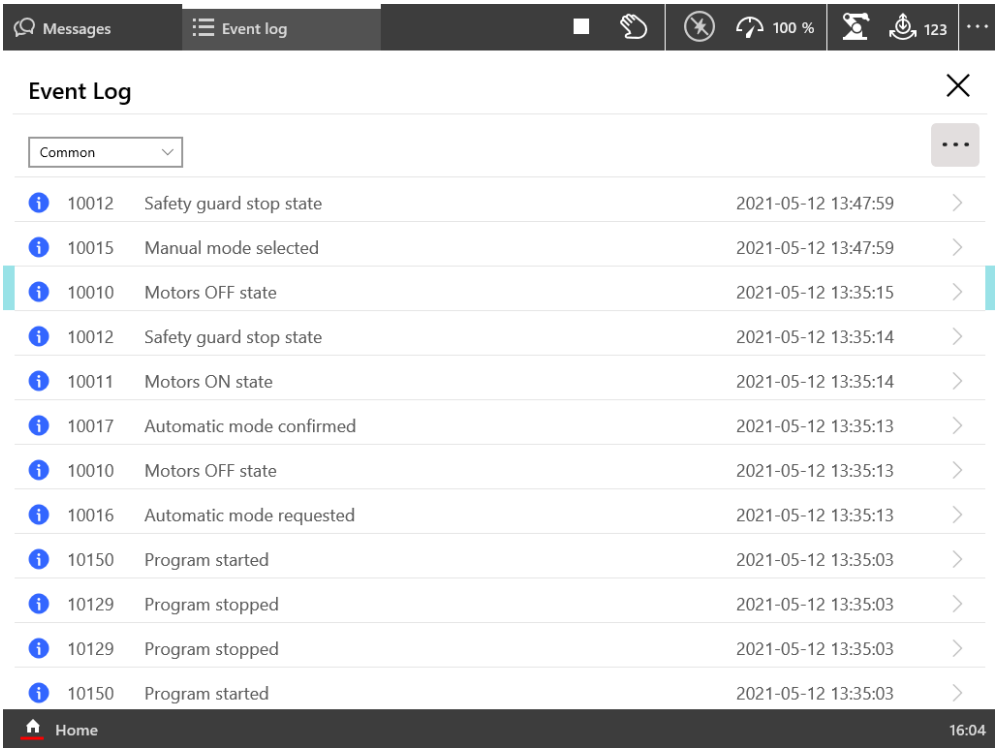
7.17.2 FlexPendant base apps

7.17.2.1 Limited app package [3120-1]

General

The option *Limited app package* contains base functionality to operate the robot system. This base version of software for the FlexPendant allows for the most crucial functionality, like jogging the robot, calibration of the robot, basic operation (start, stop, loading programs), read and write I/O signals, event log and operator messages.

For more information about what functionality is available in this option, see *FlexPendant applications on page 52*.



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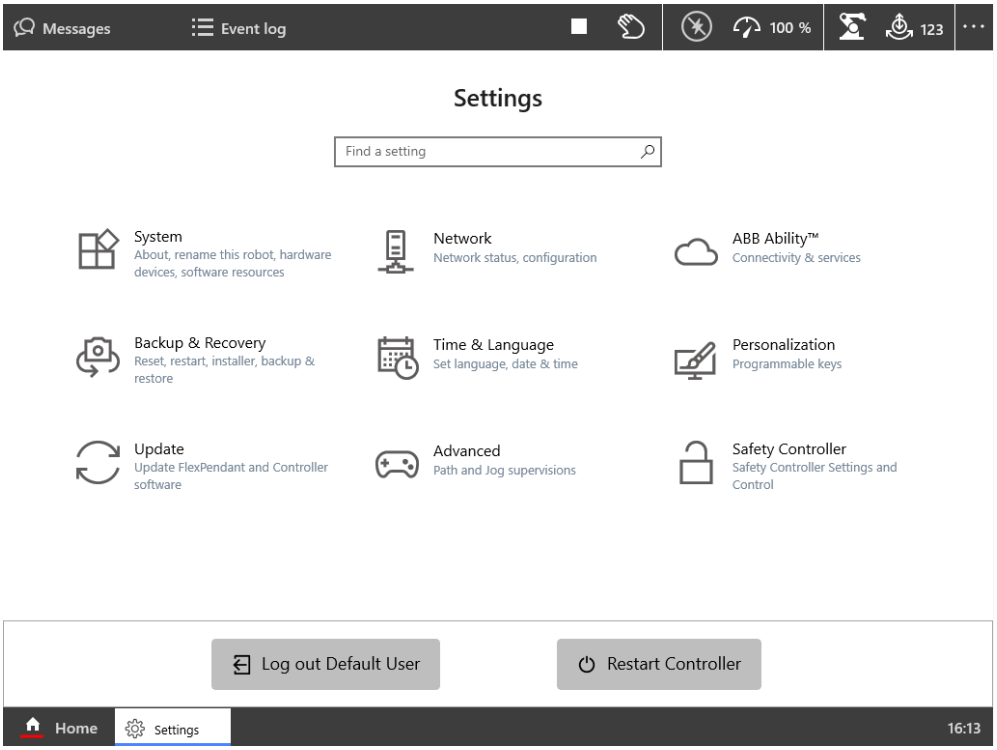

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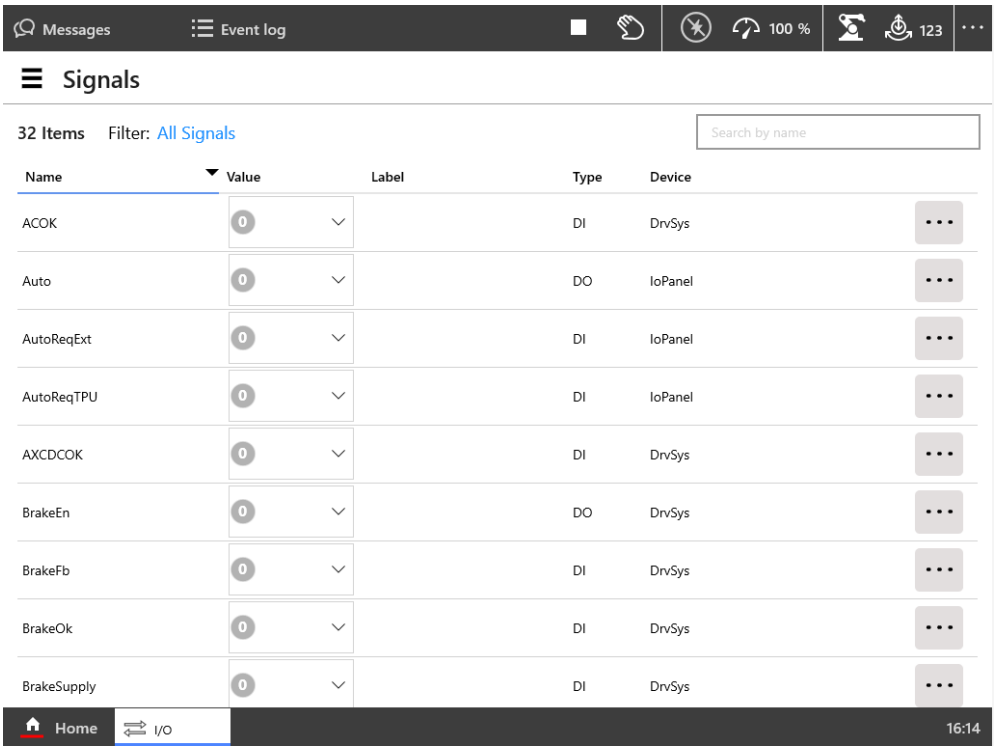

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7.17.2.1 Limited app package [3120-1]

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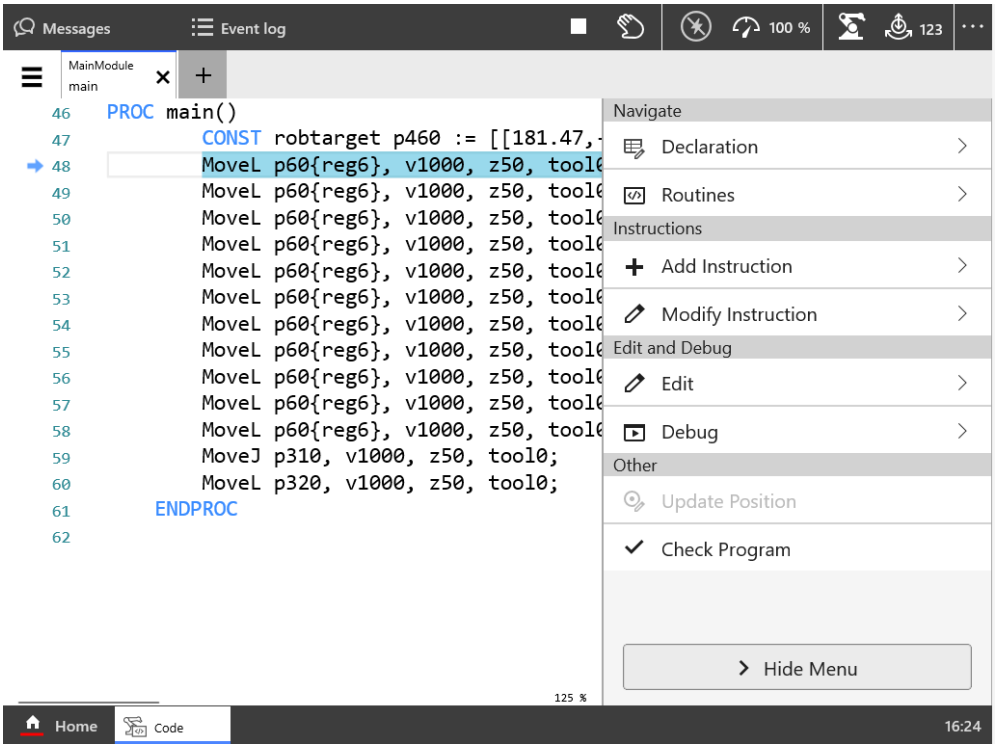

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7.17.2.2 Essential app package [3120-2]

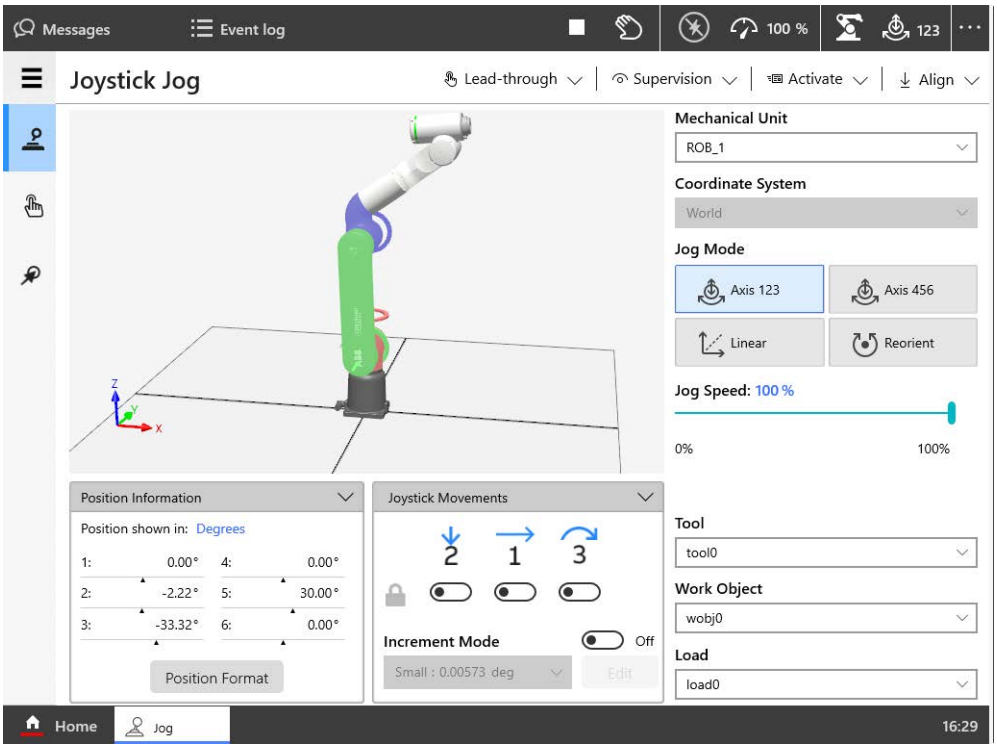
General

The option *Essential app package* includes features that will make it easy and efficient to work with the robot system.

Jog functionality is improved with 3D illustrations, and dashboards makes it easy to view the system status at a glance.

The option *Essential app package* includes option *Limited app package* [3120-1].

For more information about what functionality is available in this option, see *FlexPendant applications on page 52*.



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7.17.2.2 Essential app package [3120-2]

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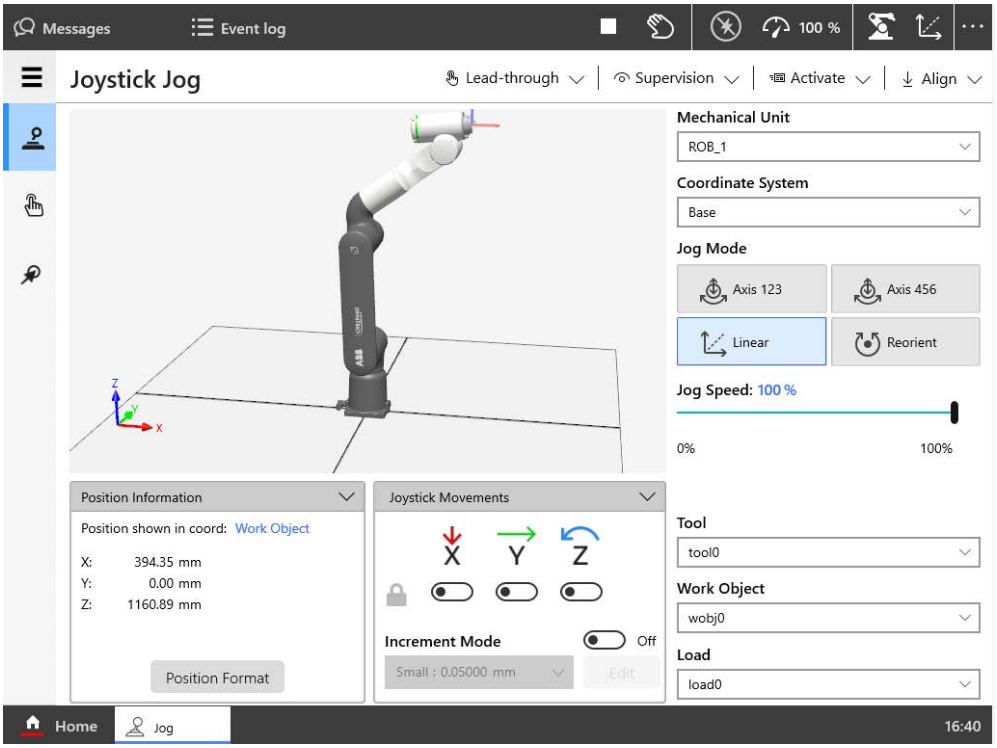

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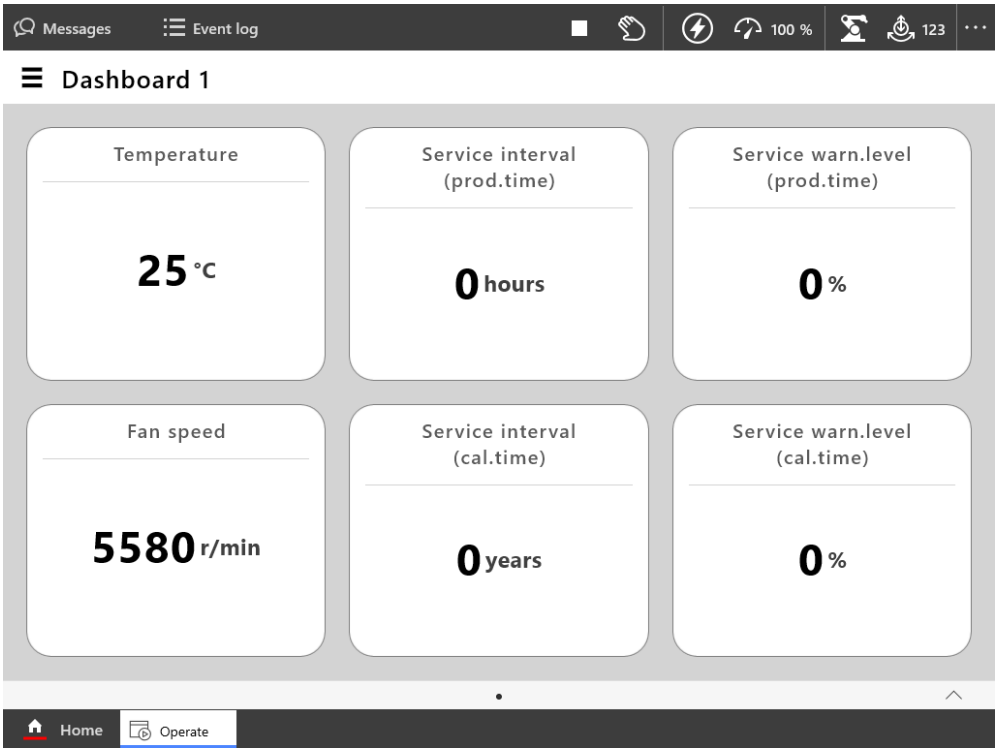

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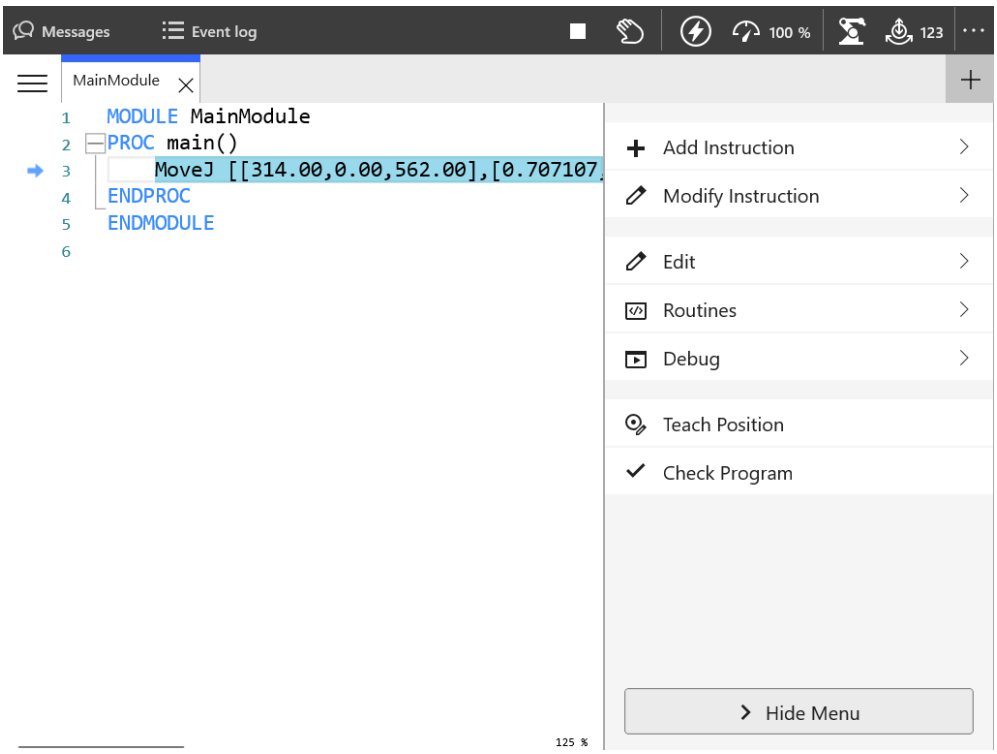
7.17.3 FlexPendant independent apps

7.17.3.1 Program package [3151-1]

General

The option *Program package* is required in order to create new and edit existing RAPID programs on the FlexPendant. If the program package is not selected with the FlexPendant, RobotStudio must instead be used on a separate PC to create and edit RAPID programs.

For more information about what functionality is available in this option, see *FlexPendant applications on page 52*.



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7.17.3.1 Program package [3151-1]

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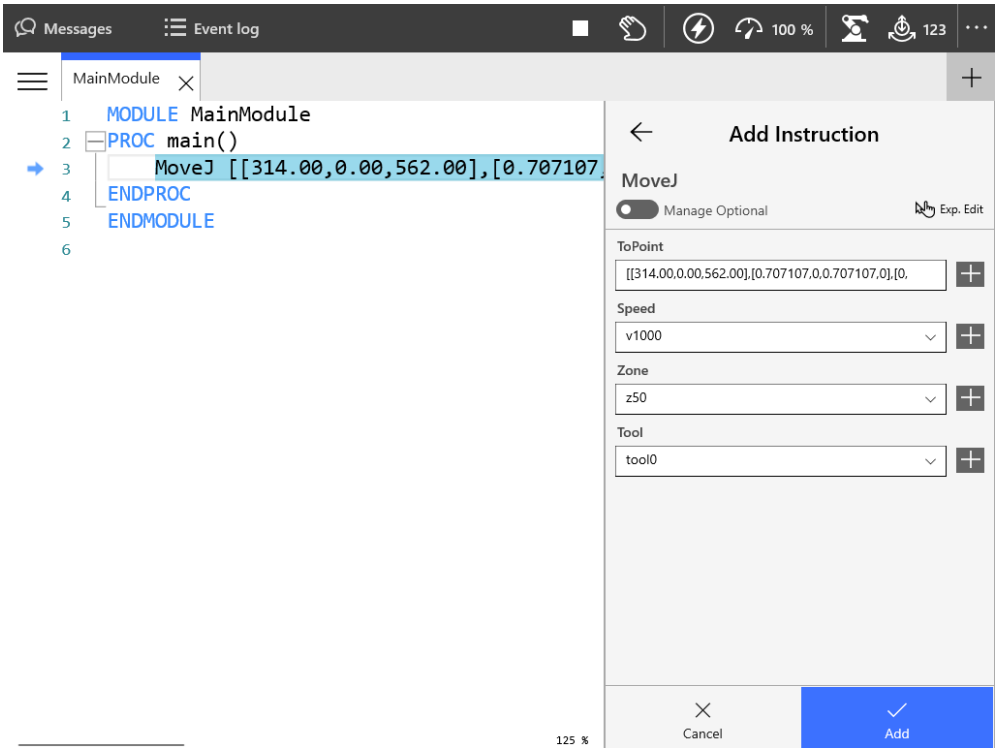

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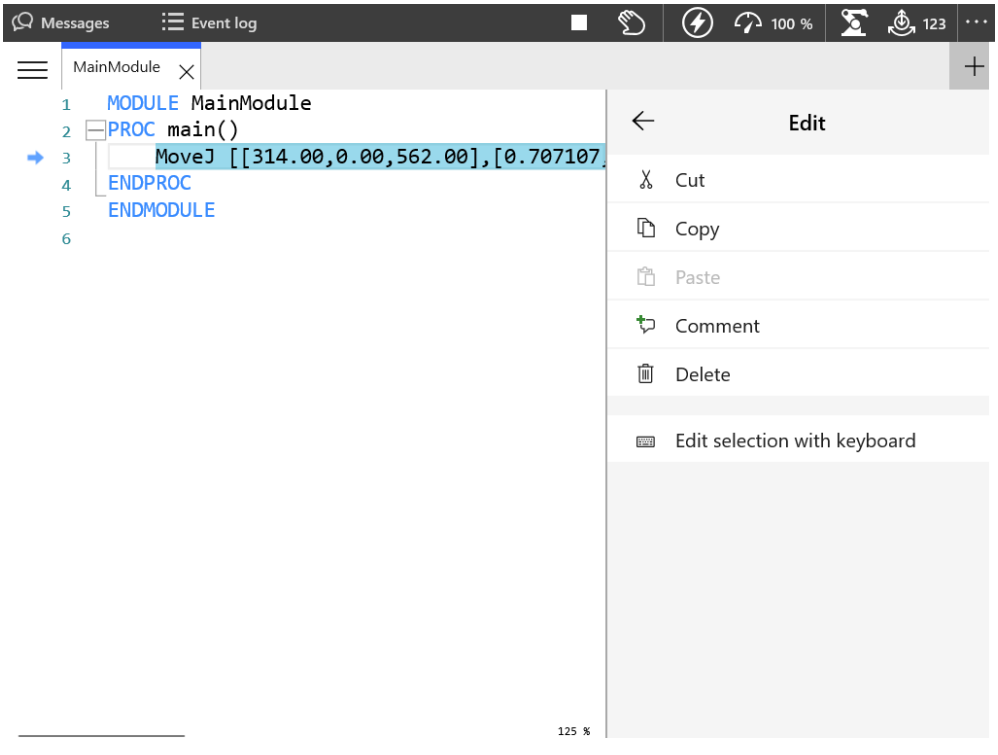

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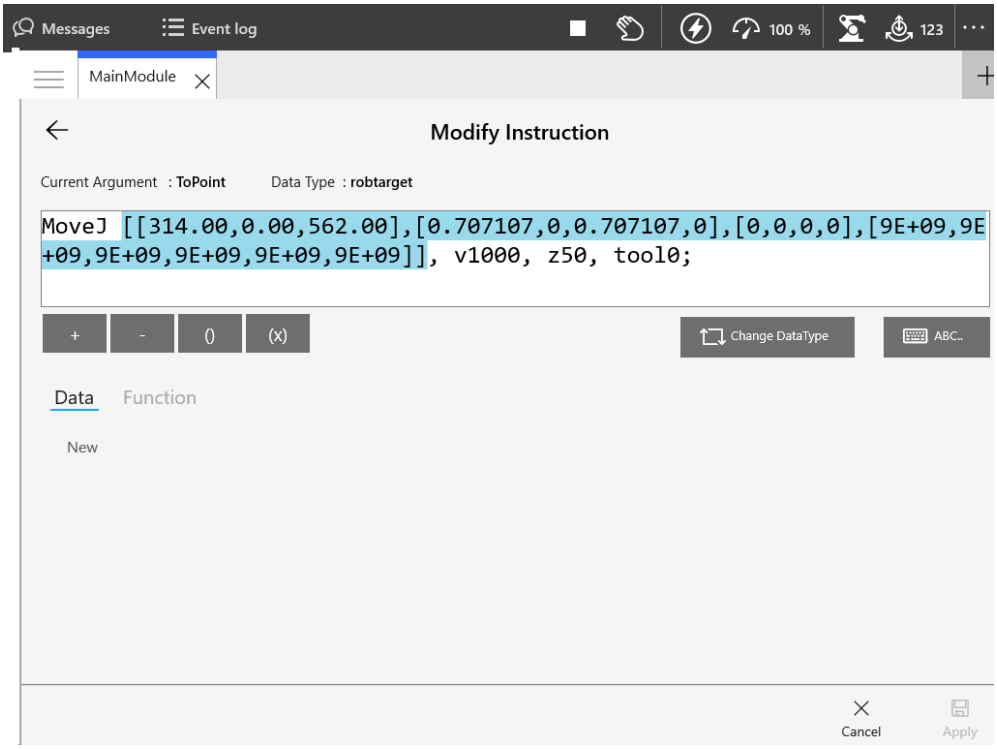

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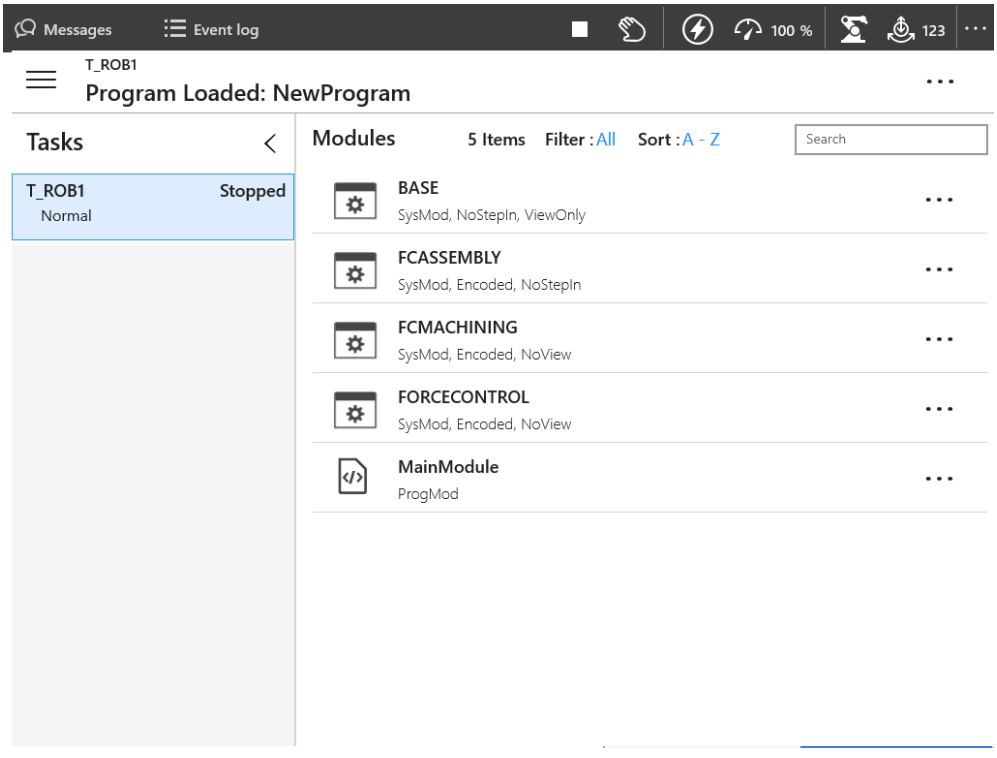

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Requirements

The option *Program package* requires option *FlexPendant base apps* [3120-x].

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7.17.3.1 Program package [3151-1]
Continued

Limitations

The FlexPendant options are not tied to the FlexPendant hardware, but instead to OmniCore controller. This means a FlexPendant runs the apps licensed to the controller its connected to.

The same shared FlexPendant can accordingly have different apps on different robots.

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7.18 Engineering Tools

7.18.1 RobotWare Add-in

7.18.1.1 RobotWare Add-In prepared [3121-1]

General

The option *RobotWare Add-In prepared* makes it possible to run licensed Add-Ins from 3rd party developers on the robot controller.

Features

Add-Ins allow to create installable additional software packages that extend the capabilities offered by RobotWare, making ABB's robot controllers even smarter and even more user-friendly. Creating RobotWare Add-Ins is also the recommended way for 3rd party developers to add new features into RobotWare.

An Add-In can include a number of RAPID modules, system modules, or program modules which hold the basic code for the Add-In. The Add-In also includes some files for loading and configuration at start up. The Add-In may also include .xml files with event log messages in different languages.

An Add-In can also consist of more advanced coding, such as *C#* code, for FlexPendant applications. For more advanced coding, use RobotStudio SDK applications.

Note

The RobotWare option *RobotWare Add-In prepared* is only needed for licensed Add-Ins. It is not needed for open Add-Ins or Add-Ins delivered together with RobotWare, for example track motion and positioners.

For more information, see *Application manual - RobotWare add-ins*.

Application

Add-Ins can be used for any application, equipment, or functionality that extends the capabilities offered by RobotWare.

Performance

There is no performance data available for this option.

Requirements

Unlicensed, open, Add-Ins

What you need from ABB to package and run your own open Add-In is:

- RobotWare Add-In Packaging tool

Licensed Add-Ins

What you need from ABB to package and run your own licensed Add-In is:

- RobotWare Add-In Packaging tool

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7.18.1.1 RobotWare Add-In prepared [3121-1]
Continued

- a licence certificate for the RobotWare Add-In Packaging tool for your Add-In name
- RobotWare option *RobotWare Add-In prepared*

To license the Add-In, you will also need:

- License Generator
- a publisher certificate
- a licensing certificate for the License Generator

RAPID instructions

There are no RAPID instructions included in this option.

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7.18.2 Path Corrections

7.18.2.1 Path Corrections [3123-1]

General

The option *Path Correction* changes the robot path according to the user input. The robot can thus follow/track a contour, such as an edge or a seam.

The performance is limited by RAPID, which provides the corrections. When the correction is written with `CorrWrite`, it is taken into account immediately. The path corrections are entered from the RAPID program. *Path Corrrection* have to be made in the path coordinate system.

Path correction can be used with CAP, RobotWare Arc, linear move instructions, `Trigg` instructions, and `Search` instructions.

Features

- Adjust a robot path at a user set offset
- Read current path offset
- Change path on the fly

Application

Application	Description
Path offset	Mainly used in arc welding, to adjust a welding path.

Performance

Minimum offset: 0.1 mm.

Requirements

There are no additional software or hardware requirements for this option.

RAPID instructions

RAPID instructions included in this option:

Instruction	Description
CorrCon	Activating path correction
CorrDisCon	Deactivating path correction
CorrRead	Read current path correction
CorrWrite	Changing path correction
CorrClear	Removes all correction generators

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7.18.3 Externally Guided Motion

7.18.3.1 Externally Guided Motion [3124-1]

General

The option *Externally Guided Motion* (EGM) offers three different features:

- EGM Position Stream is available for input via UDP sockets only. It provides the possibility to periodically send planned and actual mechanical unit (e.g. robot, positioner, track motion …) position data from the robot controller to an external device. The message contents is specified by the Google Protobuf definition file egm.proto. The cyclic communication channel (UDP) can be executed in the high-priority network environment of the robot controller which ensures a stable data exchange up to 250 Hz.
- EGM Position Guidance is designed for advanced users and provides a low level interface to the robot controller, by by-passing the path planning that can be used when high responsiveness to robot movements are needed. EGM can be used to read positions from and write positions to the motion system at a high rate, every 4 ms with a control lag of 10–20 ms depending on the robot type. The references can either be specified using joint values or cartesian values. The cartesian data can be relative to any work object for robots.
- EGM Path Correction gives the user the possibility to correct a programmed robot path. The device or sensor that is used to measure the actual path has to be mounted on the tool flange of the robot and it must be possible to calibrate the sensor frame.

  The corrections are performed in the path coordinate system, which gets its x-axis from the tangent of the path, the y-axis is the cross product of the path tangent, and the z-direction of the active tool frame and the z-axis is the cross product of x-axis and y-axis.

  EGM Path correction has to start and end in a fine point. The sensor measurements can be provided at multiples of about 48 ms.

Features

The RobotWare option *Externally Guided Motion* gives you access to:

- Instructions to start and stop EGM Position Stream.
- Instructions to set up, activate, and reset EGM Position Guidance.
- Instructions to set up, activate, and reset EGM Path Correction.
- Instructions to initiate EGM Position Guidance movements, synchronized with RAPID execution or not, and to stop them.
- Instructions to perform EGM Path Correction movements.
- A function to retrieve the current EGM state.
- System parameters to configure EGM and set default values.
- Support of *Absolute Accuracy*.

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Application

The purpose of EGM Position Stream is to provide external equipment with the current and planned positions of mechanical units that are controlled by the robot controller.

Some example of applications are:

- Laser Welding, where the Laser head is controlling the Laser beam dynamically.
- Any robot mounted equipment that controls the "robot"-TCP with an external controller.

The purpose of EGM Position Guidance is to use external devices to generate position data for one or several robots. The robots will be moved to that given position.

Some examples of applications are:

- Place an object (e.g. car door or window) at a location (e.g. car body) that was given by an external sensor.
- Bin picking. Pick objects from a bin using an external sensor to identify the object and its position.

The purpose of EGM Path Correction is to use external robot mounted devices to generate path correction data for one or several robots. The robots will be moved along the corrected path, which is the programmed path with added measured corrections.

Some examples of applications are:

- Seam tracking.
- Tracking of objects moving near a known path.

Performance

EGM Position Stream can be used to read positions from and write positions to the motion system at a high rate, every 4 ms.

EGM Position Guidance can be used to read positions from and write positions to the motion system at a high rate, every 4 ms with a control lag of 10–20 ms depending on the robot type.

EGM Path Correction can handle sensor measurements at a rate of about 48 ms.

Requirements

External devices communicating with the controller via Analog Signals, Group signals or an Ethernet link (UDP). For the Ethernet link, the application protocol (UdpUc – UDP UniCast) is used.

Limitations

Limitations for EGM Position Stream

- EGM Position Stream is available with UdpUc communication only.
- Tool data and load data cannot be changed dynamically during an active position stream.

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7.18.3.1 Externally Guided Motion [3124-1]
Continued

- Absolute Accuracy is not supported if streaming is started using `EGMStreamStart`, but it is supported if it started using `EGMActXXX\StreamStart`.
- EGM Position Stream is not compatible with EGM Path Correction.
- It is not allowed to activate or deactivate mechanical units if EGM Position Stream is active.

Limitations for EGM Position Guidance

- Has to start and to end in a fine point.
- The first movement that is performed after a controller restart cannot be an EGM movement.
- Pose mode supports 6-axis robots, 4-axis palletizer robots, YuMi robots, and SCARA robots.
- It is not possible to perform linear movements using EGM Position Guidance, since EGM Position Guidance does not contain interpolator functionality. The actual path of the robot will depend on the robot configuration, the start position, and the generated position data.
- There is a limitation of one mechanical unit per motion task.
- It is not possible to use EGM Position Guidance to guide a mechanical unit in a moving work object.
- If the robot ends up near a singularity, i.e. when two robot axes are nearly parallel, the robot movement will be stopped with an error message. In that situation the only way is to jog the robot out of the singularity.
- When EGM is active, Motion Supervision can behave differently than during normal movements. The recommended action after a collision is to disable EGM and start the EGM sequence from the beginning.

Limitations for EGM Path Correction

- Supports only 6-axis robots.
- Has to start and to end in a fine point.
- The external device has to be robot mounted.
- Corrections can only be applied in the path coordinate system.
- Only position correction in y and z can be performed. It is not possible to perform orientation corrections, nor corrections in x (which is the path direction/tangent).
- When EGM is active, Motion Supervision can behave differently than during normal movements. The recommended action after a collision is to disable EGM and start the EGM sequence from the beginning.

RAPID instructions

For information about the included RAPID instructions, functions, and data types see *Application manual - Controller software OmniCore*.

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7.19 Vision and sensor

7.19.1 Vision

7.19.1.1 Vision interface [3127-1]

General

ABB's Integrated Vision system provides a robust and easy-to-use vision system for general purpose Vision Guided Robotics (VGR) applications.

The system includes a complete software and hardware solution that is fully integrated with the robot controller and the RobotStudio programming environment. The vision capability is based on the Cognex In-Sight® smart camera family, with embedded image processing and an Ethernet communication interface.

RobotStudio is equipped with a vision programming environment that exposes the full palette of Cognex EasyBuilder® functionality with robust tools for 2D part location, part inspection, and identification. The RAPID programming language is extended with dedicated instructions and error tracing for camera operation and vision guidance.

For more information about the option *Integrated Vision*, see *Product specification - Integrated Vision*.

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7.19.1.2 Prepared for Visual servoing

General

Visual Servoing is a PC-based software which allows to increase the robot accuracy for high precision assembly and alignment applications.

Visual servoing involves the use of one or more cameras and a computer vision system to control the position of the robot's end-effector relative to the work piece as required by the task.

Features

- Enabling 6-axis robots for high precision assembly
- Improved alignment speed compared to traditional look-then-move approach.
- Reduced variance of alignment speed compared to look-then-move approach.
- Easy commissioning with auto calibration and tuning for servoing purpose.
- Compatible with a wide number of vision sensors.

Application

Assembly for high accuracy needed applications, especially in Electronics.

- Assembly applications
- Alignment of components
- Picking/placing a work object in a tool
- Placing a part in a fixture

Requirements

The option *Prepared for Visual Servoing* requires option *EGM [3124-1]*.

Limitations

High Accuracy assembly only verified for IRB 1100.

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7.19.2 Conveyor

7.19.2.1 Conveyor Tracking

7.19.2.1.1 Conveyor Tracking [3103-1]

General

The option *Conveyor Tracking* (also known as line tracking) contains functionality which makes the robot follow a work object on a moving conveyor. While tracking the conveyor, the programmed TCP path and speed, relative to the work object, will be maintained even when the conveyor speed is changing slowly.

Features

- Linear and circular conveyors
- Up to 4 conveyors simultaneously. Switch between tracking the one or the other
- Up to 254 objects can be organized in an object queue that can be manipulated by RAPID instructions
- Possibility to define a start window on the conveyor where an object must be enter before tracking of the object can start
- A maximum tracking distance may be specified
- If the robot is mounted on a parallel track motion, the system can be configured such that the track will follow the conveyor and maintain the relative position to the conveyor
- Tracking of a conveyor can be activated *on the fly*, that is it is not necessary to stop in a fine point

Application

Any application where conveyors are used for example painting, arc welding, picking and other applications.

Performance

In automatic mode, at 150 mm/s constant conveyor speed, the tool center point (TCP) of the robot will stay within +/- 2 mm of the path as seen with no conveyor motion. This is valid as long as the robot is within its dynamic limits with the added conveyor motion. This figure depends on the calibration of the robot and conveyor and is applicable for linear conveyor tracking only.

RAPID instructions

RAPID instructions included in this option:

Instruction	Description
WaitWObj	Connects to a work object in the start window
DropWObj	Disconnects from the current object

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7.19.2.2 Conv.Tracking unit int. [3041-1]

General

Encoder interface unit for conveyor tracking (DSQC2000). The network based conveyor interface provides connections for 4 encoders and 8 cameras. Network communication is used to share conveyor speed and position data with one or more robot controllers. It can be located inside a robot controller. Each of the encoder inputs supports one 2 phase encoder. Each of the camera connections consists of one digital sync input, one 24V digital trigger output and a camera power output. The camera connection may also be used for other kind of sync input sources, for example, photocells.

The option *Conv.Tracking unit int.* requires:

- *Conveyor Tracking* [3103-1] (the RobotWare option) which makes the robot follow a work object on a moving conveyor.

General	
Power supply input	24 VDC (-15/+20%), typically 200 mA (current not including power outputs)
Operating temperature	+5 °C - +65 °C
Ethernet LAN	2 switched LAN ports, 100Mbit
Ethernet WAN	1 WAN port, 100Mbit

Encoders	4 pcs (X11-X14)
Power output	24 VDC, max 120 mA With connection discovery and overload protection/diagnostic (floating pins will stay at discovery voltage of 10V at off state)
Frequency	0-20 kHz
Input current	5.2 mA at 24 VDC
Voltage levels	15 VDC < '1' < 30 VDC, -3 VDC< '0' < 5 VDC
Supported Encoder types	PNP, NPN, and Push-Pull

The following encoder is verified: Lenord & Bauer GEL 262.

Cameras	8 pcs (X21-X28)
Camera power output	Supplied from X20 camera power inlet. Normally 24VDC With overload protection

Sync input signal	
Power output	24 VDC, 120 mA With overload protection
Frequency	0-20 kHz
Input Current	5.2 mA at 24 VDC
Voltage levels	15 VDC < '1' < 30 VDC, -3 VDC< '0' < 5 VDC
Supported input types	PNP and Push-Pull

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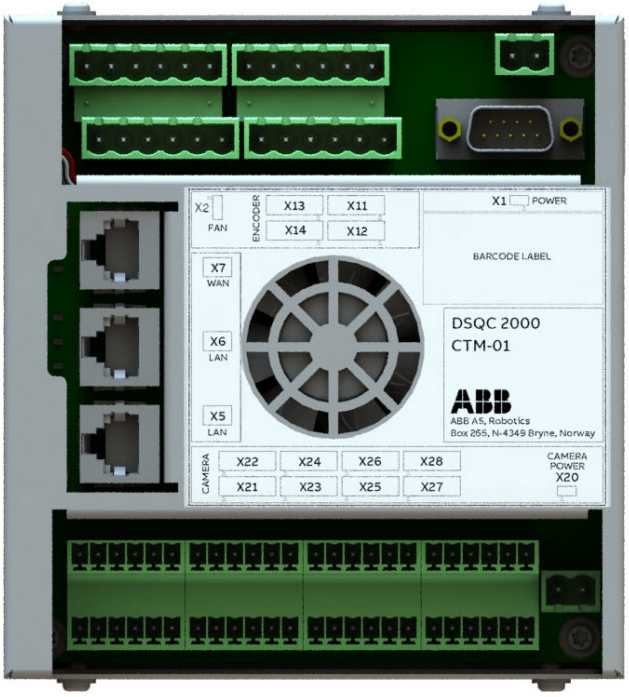
Trigger output	
Digital output	24 VDC , max 120 mA With connection discovery and overload protection/diagnostic. (Floating pins will stay at discovery voltage of 10V at off state)
Minimum load	0.1 mA



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Requirements

The option Conv.Tracking unit int. requires:

- Option *Conveyor Tracking* [3103-1] or *PickMaster Ready* [3152-x]
- Occupies 1 Ethernet port

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7.19.2.3 Conv.Tracking unit ext. [3042-1]

General

Encoder interface unit for conveyor tracking (DSQC2000). It is provided as a separate unit from the controller and needs to be installed in a separate, customized cabinet.

The network based conveyor interface provides connections for 4 encoders and 8 cameras. Network communication is used to share conveyor speed and position data with one or more robot controllers. Each of the encoder inputs supports one 2 phase encoder. Each of the camera connections consists of one digital sync input, one 24V digital trigger output and a camera power output. The camera connection may also be used for other kind of sync input sources, for example, photocells.

The option *Conv.Tracking unit Ext.* requires:

- *Conveyor Tracking* [3103-1] (the RobotWare option) which makes the robot follow a work object on a moving conveyor.

General	
Power supply input	24 VDC (-15/+20%), typically 200 mA (current not including power outputs)
Operating temperature	+5°C - +65°C
Ethernet LAN	2 switched LAN ports, 100Mbit
Ethernet WAN	1 WAN port, 100Mbit

Encoders	**4 pcs (X11-X14)**
Power output	24 VDC, max 120 mA With connection discovery and overload protection/diagnostic (floating pins will stay at discovery voltage of 10V at off state)
Frequency	0-20 kHz
Input current	5.2 mA at 24 VDC
Voltage levels	15 VDC < '1' < 30 VDC, -3 VDC< '0' < 5 VDC
Supported Encoder types	PNP, NPN, and Push-Pull

The following encoder is verified: Lenord & Bauer GEL 262.

Cameras	**8 pcs (X21-X28)**
Camera power output	Supplied from X20 camera power inlet. Normally 24VDC With overload protection

Sync input signal	
Power output	24 VDC, 120 mA With overload protection
Frequency	0-20 kHz
Input Current	5.2 mA at 24 VDC
Voltage levels	15 VDC < '1' < 30 VDC, -3 VDC< '0' < 5 VDC

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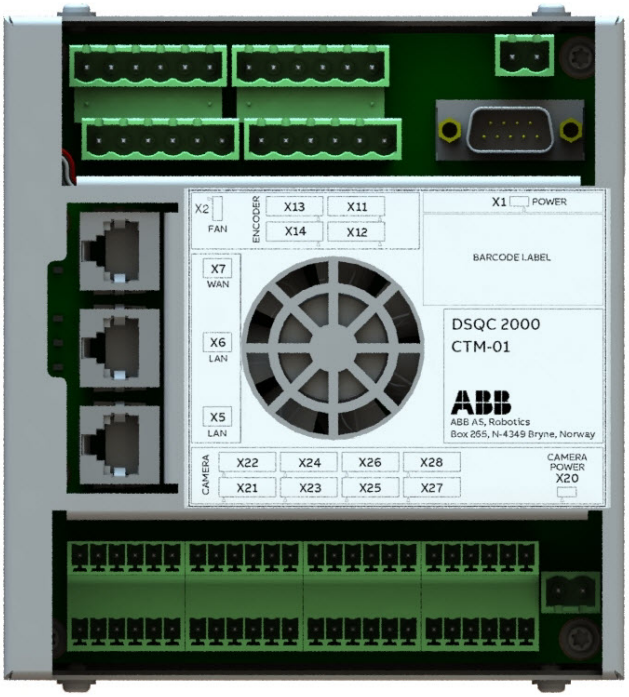
Sync input signal	
Supported input types	PNP and Push-Pull

Trigger output	
Digital output	24 VDC , max 120 mA With connection discovery and overload protection/diagnostic. (Floating pins will stay at discovery voltage of 10V at off state)
Minimum load	0.1 mA



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Requirements

The option *Conv.Tracking unit ext.* requires:

- Option *Conveyor Tracking* [3103-1] or *PickMaster Ready* [3152-x]
- Occupies 1-2 Ethernet port(s)

Limitations

The possible order combinations of option *Conv.Tracking unit int.* and option *Conv.Tracking unit ext.* is up to two units.

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7.20 Packaging

7.20.1 PickMaster Twin

7.20.1.1 PickMaster Ready

7.20.1.1.1 PickMaster Cell Ready [3152-1]

General

The option *PickMaster Cell Ready*

- Checked by PickMaster Runtime when connecting to a robot, during commissioning when configuring position source and when starting a recipe
- The license is needed to enable PickMaster Runtime with vision for one robot
- Digital I/O is needed for PickMaster functions
- The option is used with Conveyor Tracking options: *Conv. Tracking unit ent.* [3041-1], *Conv. Tracking unit ext.* [3042-1]

Includes RobotWare options

- *Conveyor Tracking* [3103-1]
- *PickMaster Vision Ready* [3153-1]

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7.20.1.1.2 PickMaster Robot Ready [3152-2]

General

The option *PickMaster Robot Ready*

- Checked by PickMaster Runtime when connecting to one robot without vision and when starting a recipe
- The license is needed for a robot to be included in PickMaster Runtime
- Digital I/O is needed for PickMaster functions
- The option is used with Conveyor Tracking options: *Conv. Tracking unit ent.* [3041-1], *Conv. Tracking unit ext.* [3042-1]

Includes RobotWare option

- *Conveyor Tracking* [3103-1]

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7.20.1.2 PickMaster Vision

7.20.1.2.1 PickMaster Vision Ready [3153-1]

General

The option *PickMaster Vision Ready*

- Checked by PickMaster Runtime during commissioning when configuring position source and when starting a recipe
- The License is needed to receive positions generated by a sensor, either the standard vision or External Sensor
- Valid for multiple sensor driven position sources
- The option is included in *PickMaster Cell Ready* [3152-1]

Requirements

The option *PickMaster Vision Ready* requires option *PickMaster Robot Ready* [3152-2]

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7.21 Application Spot welding

7.21.1 Spot welding [3417-x]

7.21.1.1 Spot option and features

The Spot options

Spot is a general and flexible software platform for creation of customized and easy to use function packages for different types of spot welding systems and process equipment.

There are three different main **Spot** options supporting spot welding.

- The *Spot Welding Standard* option provides support for sequential welding with **one servo gun**, robot held or stationary. Can also be used for servo guns without mechanical equalizing systems.
- The *Spot Welding Premium* option provides support for sequential welding with **one servo gun**. It is also possible to install multi process support for **up to four servo guns** at the same time. Can also be used for servo guns without mechanical equalizing systems using different software features included.
- The *Spot Welding Premium+* option has the same functionality as **Spot Welding Premium**, but also with the possibility to search with the movable gun arm to compensate for varying geometry and access to process related data via a log file or RAPID interface.

All Spot options provides dedicated spot welding instructions for fast and accurate positioning combined with gun manipulation, process start and supervision of the different gun equipment.

Communication with the external welding equipment is done with standard I/O interface.

The Spot options are general and can be extensively customized. They have a default "template" functionality after installation, that can easily be customized to fit the surrounding equipment's by changing I/O signals, configuration data from RobotStudio.

Distribution

The Spot Welding software is distributed as a separate RobotWare add-in product, SpotWare for OmniCore. This allows for independent release cycles not dependent on the RobotWare releases.

Any version of the product can be downloaded from the RobotStudio Add-Ins Gallery.

Spot Welding requires a license for one of the following options:

- [3417-1] Spot Welding Standard
- [3417-2] Spot Welding Premium
- [3417-3] Spot Welding Premium+

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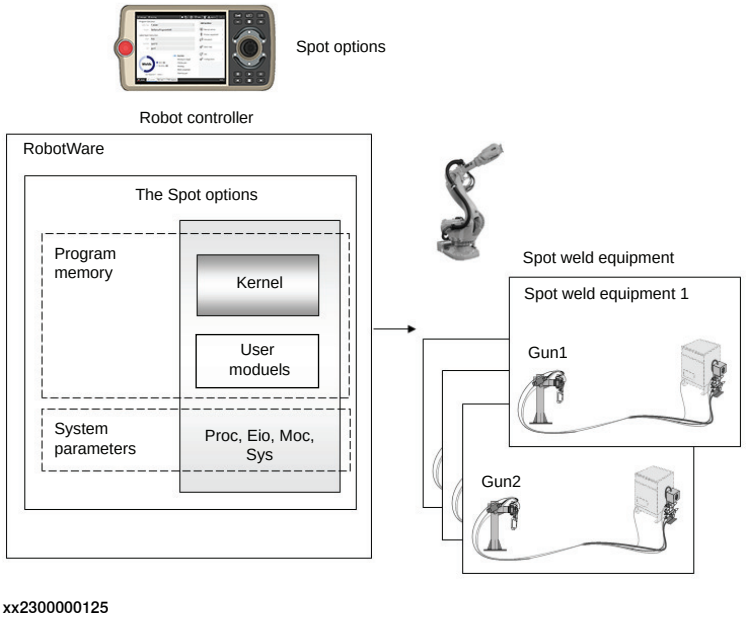
7.21.1.1 Spot option and features
Continued

Overview of the Spot options

The Spot software can be customized to handle different types of process equipment, the picture below shows schematic examples of different spot welding system variants.



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Features

The Spot software packages contains the following features:

- Fast and accurate positioning using the unique *QuickMove* and *TrueMove* concept.
- Gun pre-closing, gun closing will be synchronized with robot reaching the weld position to save cycle time.
- Software equalizing functions.
- Support for mechanical gun equalizing systems.
- Support functions for tip wear management.
- Constant or changeable gun force during welding for servo guns.
- Gravity compensation of gun force during welding.
- Calibration functions for servo guns.
- Detection of missing or improper plates for servo guns.
- Reverse execution with gun control.
- Manual actions for welding and gun control.
- Support for fast tool changing between up to 8 different servo guns. Note that this requires the option *3110-1 Servo Tool Change* (Included in *3417-2 Spot Welding Premium* and *3417-3 Spot Welding Premium Plus*) .
- Support for simultaneous welding with up to **four** guns at the same time. Note that this requires the option *3417-2 Spot Welding Premium* or *3417-3 Spot Welding Premium Plus*.

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- Several simulation possibilities for test purposes.
- Weld error recovery with automatic rewelding.
- Wide customizing possibilities, process data types, spotdata, gundata, such as weld counters and tip wear data, for each used gun.
- Built in error handling and possibility for customizable user-defined supervision and error recovery.
- A dedicated Spot operator interface on the FlexPendant.
- Possibility to run some Spot functionality without a robot selected, i.e. a stand alone controller system.
- Possibility for weld process data access. Note that option *3417-3 Spot Welding Premium Plus* is required.
- Possibility to search with the movable gun arm to compensate for varying geometry. Note that option *3417-3 Spot Welding Premium Plus* is required.

SpotWare Servo Equalizing Features

For the Spot Servo Equalizing configuration the gun equalizing features are embedded in the Spot Servo process software. Spot Servo Equalizing allows you to solve spot welding gun equalizing without mechanical equalizing hardware on the weld gun and thus provides an opportunity to reduce investment cost and improve productivity. Removed hardware on the gun also reduces weight, and in addition, no gravitational influence means easier optimizing when programming the robot path.Furthermore, with the Spot Servo Equalizing software instead of mechanical equalizing, less spare parts are required and lower maintenance costs are achieved. Spot Servo Equalizing is valid for:

- Robot mounted C- and X-type guns
- Pedestal C- and X-type guns
- Tool changing between guns with different equalizing data
- Weld position touch up - Simplifies adjustment of the programmed weld positions.
- Release of the fixed gun arm - Automatic gun arm release from the welded sheets when the robot is moving among weld points.
- Gun arm deflection compensation - The robot program compensates for the gun arm deflection automatically.
- Tip wear measurement and compensation - The robot program automatically compensates the weld gun TCP (Tool Center Point) for tip wear without using external sensors.
- The equalizing type (mechanical or software) is determined by data set in the gundata for each used gun.

Application

The RobotWare Spot option can be used in any spot welding process. The robot's movement and the spot welding process are controlled from the instructions SpotL/SpotJ and SpotML/SpotMJ.

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7.21.1.1 Spot option and features
Continued

The spot welding process is specified by:

- Spot and equipment specific data types
- Spot and equipment specific process configuration
- The I/O configuration
- RAPID routines and global data for customizing purposes
- User modules

Spot instructions

Both the robot movement and the control of the spot weld equipment are embedded in the basic spot weld instructions `SpotL` and `SpotJ`. These are used for sequential welding and are available in all spot welding options. If welding with several guns simultaneously then `SpotML` or `SpotMJ` has to be used.

Instruction	Used to
`SpotL`	Control the motion, gun closure/opening and the welding process. Move the TCP along a linear path and perform a spot welding at the end position.
`SpotJ`	Control the motion, gun closure/opening and the welding process. Move the TCP along a non-linear path and perform a spot welding at the end position.
`SpotML`	Control the motion, gun closure/opening and 1 - 4 welding processes. Move the TCP along a linear path and perform spot welding with 1 - 4 gun equipments at the end position. Only available in option *3417-2 Spot Welding Premium* or *3417-3 Spot Welding Premium* Plus.
`SpotMJ`	Control the motion, gun closure/opening and 1 - 4 welding processes. Move the TCP along a non-linear path and perform spot welding with 1 - 4 gun equipments at the end position. Only available in option *3417-2 Spot Welding Premium* or *3417-3 Spot Welding Premium* Plus.
`IndGunMove`	Set the servo gun in independent mode and thereafter move the gun to a specific independent position.
`IndGunMoveReset`	Reset the independent mode for servo gun.
`SetForce`	Close the gun a predefined time then open the gun.
`OpenHighLift`	Open the pneumatic gun to the highlift position (large gap).
`CloseHighLift`	Close the pneumatic gun to the work stroke position (small gap).
`CalibL`	Calibrate the servo gun during linear movement to the programmed position.
`CalibJ`	Calibrate the servo gun during non-linear movement to the programmed position.
`Calibrate`	Calibrate the servo gun in current position without movement.
`STTune`	Tune motion parameters for the servo gun.
`STTuneReset`	Reset tuned motion parameters for the servo gun.
`MeasureWearL`	Measure the tip wear and recalculates the TCP.
`ReCalcTCP`	Measure the tip wear and recalculates the TCP.

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Limitations

- Spot Servo Equalizing can only be applied during sequent welding (not with several guns simultaneously, SpotML).

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7.21.2 Servo Tool Change [3110-1]

General

Servo Tool Change enables an on-line change of tools (external axes), for a certain drive- and measurement system. The control is switched between the axes by switching the motor cables from one servomotor to another. The switch is performed on-line during production.

Main advantages:

- Flexibility in the production process. One robot handles several tools.
- Minimized equipment. A single drive-measurement system shared by many tools.

Features

- On-line change of tools
- Up to 8 different tools

Application

Application	Description
Servo gun changing	Robot held servo guns, designed for different reach and weld forces, equipped with different brands and sizes of servo motors, may be held and operated by a robot, switching from one servo gun to another.
Servo Tool Change	Can be used as an independent option, or as an addition to the RobotWare Spot Servo options.

Performance

When switching tools, the following steps are performed (switching from Axis 1 to Axis 2):

- Axis 1 is deactivated using the RAPID instruction `DeactUnit`
- Axis 1 is disconnected from the motor cables
- Axis 2 is connected to the motor cables
- Axis 2 is activated using RAPID instruction `ActUnit`
- After activation, axis 2 is ready to run

The motor position at the moment of deactivation of one axis is saved and restored next time the axis is activated.

Note

The motor position must not change more than half a motor revolution, when the axis is disconnected. In RobotWare Spot Servo, there is a calibration routine, which handles larger position changes.

Requirements

Servo Tool Change requires a mechanical wrist interface, a tool changer.

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A MOC service parameter, *Disconnect deactive* (type *Measurement channel*), must be defined as *YES* for each tool (external axis) used with this function.

Limitations

- *Servo Tool Change* can be used up to 8 different tools but is limited by 14 axes in total for the drive module. For example, if the robot is on a track motion or if another additional axis is connected to a drive module it reduces the number of allowed tools that can be used with servo disconnect.

RAPID instructions

There are no RAPID instructions included in this option.

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7.22 Application Dispensing

7.22.1 Dispensing

Dispensing Standard [3419-1]

DispenseWare for OmniCore is a software package that provides support for different types of dispensing processes such as gluing, sealing and similar.

The DispenseWare application provides fast and accurate positioning combined with a flexible process control. Communication with the dispensing equipment is carried out by digital and analog outputs.

DispenseWare is a package that can be extensively customized. User data and routines can be adapted to suit a specific dispensing equipment and environmental situation.

Features

- Dispensing instructions for both linear and circular paths.
- Fast and accurate positioning and process control.
- Handling of on/off guns as well as proportional guns.
- Speed proportional or constant analog outputs.
- Four different gun equipment can be handled in the same program, each controlled by 1-5 digital output signals and/or 1-2 analog output signals.
- Possibility to use different anticipated times for the digital and analog signals.
- Equipment delay compensation for the TCP speed proportional analog signals.
- Dispensing in wet or dry mode.
- Possibility to restart an interrupted dispense sequence.
- Possibility to automatically reduce the robot acceleration/deceleration during dispensing.
- Wide customizing possibilities.

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7.23 Application Arc welding

7.23.1 Arc welding

7.23.1.1 ArcWare for OmniCore

General

ArcWare for OmniCore is a software package for arc welding. It is distributed as a RobotWare Add-In and can be downloaded by means of RobotStudio. The package also contains a special function package *ArcWare for Collaborative robot CRB15000 (GoFa)*.

ArcWare has support for *Standard I/O welder interface*, *External RW Add-In loaded welder* and *Simulated welder*. Support of some specific power source brands is available as separate Add-Ins that can be downloaded by means of RobotStudio.

Arc welding Standard [3416-1]

Arc welding Standard supports the following functionality:

- ArcWare Base
- Fronius TPSi
- Torch Services
- Standard I/O welder

All configuration and programming for these arc welding options is done in add-ins that are downloaded from RobotStudio.

Arc welding Premium [3416-2]

The Premium level includes all functionality from the Standard level, in addition to the premium functionality.

Arc welding Premium supports the following functionality:

- SmarTac
- BullsEye
- WireSense for Fronius

All configuration and programming for these arc welding options is done in add-ins that are downloaded from RobotStudio.

RAPID instructions

See *Application manual - Product.ProductName* and *Application manual - BullsEye*.

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7.24 Application Engineering

7.24.1 CAP and DAP Standard [3125-1]

General

Continuous Application Platform Standard (CAP) and Discrete Application Platform Standard (DAP) is a software platform for time-critical applications where a continuous process, for example, arc welding must be synchronized with the TCP movement of the robot, or where a discrete process shall be performed at specific robot positions, for example, spot welding.

Target users are advanced application software engineers and system integrators, for example for arc welding, laser welding, laser cutting, spot welding, drilling, measuring, quality control, etc.

The main advantages are achieved in the following areas:

- Development time
- Program execution time
- Similar look and feel between applications
- Stable software kernel

Features

- Special RAPID instructions and data types
- A single instruction for motion and process execution
- Combination of fine point positioning with the execution of up to 4 parallel processes
- Specialized process for monitoring of external process device, like spot welding controllers
- Supports encapsulation of the process and motion, in shell-routines provided to the end-user
- Flying start/flying end support

Application

Creation of advanced application software with a continuous or discrete process, for example, arc welding, laser cutting, laser welding, spot welding, drilling, measuring, quality control, etc.

Performance

The platform is designed to have an internal kernel, administrating the fast and quality secured application demands. The kernel calls RAPID routines, which are prepared by the application developer to fulfill the specific tasks. The application developer regulates the degree of flexibility of the end-user, by hiding process complexity.

Requirements

The option *Multitasking* is required for Discrete Application Platform (DAP) functionality if more than 1 DAP process is used.

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RAPID instructions

See *Application manual - Continuous Application Platform* and *Application manual - Discrete Application Protocol*.

Limitations

It is not possible to use CAP and DAP together.

CAP and DAP can only be used on 6-axis robots and CRB 15000.

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7.24.2 CAP and DAP Premium [3125-2]

General

The Premium level includes all functionality from the Standard level, in addition to the premium functionality.

For a description of the Standard level, see *CAP and DAP Standard [3125-1] on page 190*.

Features: Tracking Interface

The *Tracking Interface* feature for CAP makes it possible to use external equipment as source of robot path corrections. The interface is easy to access: either by using analog input or output signals, or simply RAPID persistent data to provide corrections. The interface is set up simply using a RAPID instruction. Some areas of use are e.g. height control for Plasma welding or TIP TIG welding.

- At-Point-Tracking controlled by analog input signals.
- At-Point-Tracking controlled by analog output signals.
- At-Point-Tracking controlled by persistent variables.

The *Tracking Interface* can be used together with CAP.

Limitations

It is not possible to use CAP and DAP together.

CAP and DAP can only be used on 6-axis robots and CRB 15000.

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7.24.3 Production Framework [3404-1]

General

Production Framework is a customizable modular platform for order based external control of an ABB robot system.

It shares some features with the older product *Production Manager* but is generally more focused on providing a flexible and customizable platform rather than a provided-as-is fixed solution.

The main purpose of the framework is to handle orders from an external source, typically a PLC in charge of managing the various equipment in the cell. These orders are then executed by the framework by running user-specified RAPID routines.

Features

- Safely transferring orders from the TRAP execution level to normal execution level
- A state-based production loop
- Events, which can be used by the programmer to run code at various times in the production loop, or when certain system events occur
- Multi-tasking and MultiMove abstraction layer for easier (compared to using the basic RAPID API) synchronization of orders and events that are running on several RAPID tasks
- Aborting orders
- Enqueueing orders
- Customizable order constraints
- General logging
- Traceability
- Running independently on any RAPID task, including background tasks
- Flexible architecture with customizable features

Add-In distributed

This option requires an Add-In (Production Framework), available through the RobotStudio Add-In repository.

Requirements

- Multitasking [3114-1]

Limitations

Not together with product: CRB 1100, CRB 1300

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7.25 Application Machining

7.25.1 Machining Standard [3418-1]

General

Machining Software provides the auto-calibration function that allows users to define calibration toolkits (eg. probe), cutters, external axis and work objects. The calibrated data can be copied to and reused in RAPID for other projects, which simplifies the calibration process.

> **Note**
>
> The Machining Software application on FlexPendant is only supported by OmniCore controllers operating in RobotWare 7.*X*.

Key features

Machining Standard provides the following main features:

- Web-based access to machining projects (using PC)
- Dedicated Machining application for working with machining projects (using FlexPendant)
- Auto-calibration on calibration toolkit, cutters, external axis and work objects

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7.25.2 Machining Premium [3418-2]

General

Machining Software complements the Machining PowerPac - Machining Functionality (hereinafter referred as Machining PowerPac) add-in in RobotStudio. After creating programs in Machining PowerPac, users can synchronize or load the programs to Machining Software and then perform program tuning in web browser on PC or in the dedicated Machining application on FlexPendant. Different from Machining PowerPac that provides offline programming functions, Machining Software can load the tuned programs to the connected controller (virtual or real) directly. This improves programming efficiency and reduce the onsite commissioning time.

Note

The Machining Software application on FlexPendant is only supported by OmniCore controllers operating in RobotWare 7.*X*.

Key features

Machining Premium provides the following main features:

- Web-based access to machining projects (using PC)
- Dedicated Machining application for working with machining projects (using FlexPendant)
- Tunning programs created by either Machining PowerPac or Machining Software itself including path smoothing and instruction editing
- Auto-calibration on calibration toolkit, cutters, external axis and work objects

Versions

Machining Software provides two versions, Machining Standard (option 3418-1) and Machining Premium (option 3418-2), with different user access to functions. The following table lists the main functions to which the two options can access.

Function		Standard	Premium
File operations	File loading	X	X
	File export	X	X
Program tuning	Path smoothing		X
	Wave path setting		X
	Instruction editing		X
Auto-calibration	Toolkit calibration	X	X
	Cutter calibration	X	X
	Work object calibration	X	X

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7.25.2 Machining Premium [3418-2]
Continued

Note

Only one version can be installed on a controller at a time.

For the web-based Machining Software, if the version is changed, clean the browser cache and restart the browser to make the new version take effect. Otherwise, a version incompatibility message will be displayed.

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7.26 Warranty

Warranty

For the selected period of time, ABB will provide spare parts and labor to repair or replace the non-conforming portion of the equipment without additional charges. During that period, it is required to have a yearly *Preventative Maintenance* according to ABB manuals to be performed by ABB. If due to customer restrains no data can be analyzed with ABB Connected Services for robots with OmniCore controllers, and ABB has to travel to site, travel expenses are not covered. The *Extended Warranty* period always starts on the day of warranty expiration. Warranty Conditions apply as defined in the *Terms & Conditions*.

Note

This description above is not applicable for option *Stock warranty* [438-8]

Option	Type	Description
438-1	Standard warranty	Standard warranty is 12 months from *Customer Delivery Date* or latest 18 months after *Factory Shipment Date*, whichever occurs first. Warranty terms and conditions apply.
438-2	Standard warranty + 12 months	Standard warranty extended with 12 months from end date of the standard warranty. Warranty terms and conditions apply. Contact Customer Service in case of other requirements.
438-4	Standard warranty + 18 months	Standard warranty extended with 18 months from end date of the standard warranty. Warranty terms and conditions apply. Contact Customer Service in case of other requirements.
438-5	Standard warranty + 24 months	Standard warranty extended with 24 months from end date of the standard warranty. Warranty terms and conditions apply. Contact Customer Service in case of other requirements.
438-6	Standard warranty + 6 months	Standard warranty extended with 6 months from end date of the standard warranty. Warranty terms and conditions apply.
438-7	Standard warranty + 30 months	Standard warranty extended with 30 months from end date of the standard warranty. Warranty terms and conditions apply.
438-8	Stock warranty	Maximum 6 months postponed start of standard warranty, starting from factory shipment date. Note that no claims will be accepted for warranties that occurred before the end of stock warranty. Standard warranty commences automatically after 6 months from *Factory Shipment Date* or from activation date of standard warranty in WebConfig. **Note** Special conditions are applicable, see *Robotics Warranty Directives*.

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8 Type change of the OmniCore controller

General

This section describes major design changes that are not backward compatible and still represents the same product with same functionality.

V250XT Type B

The V250XT Type B is introduced since 23D release, product specification revision J.

In V250XT Type B, a new main computer is introduced.

The main computer unit, DSQC1095, integrates a computing module, a robot safety controller, and a robot signal exchange proxy. It has separated AS/GS inputs for better flexibility and potential free E-stop-status output. It supports EtherCAT communication and provides extension slots for future extended functionality.

For more details, see *Product manual - OmniCore V250XT Type B*.

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Index

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