

Product specification Controller IRC5

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**Product specification
Controller IRC5
Design 14**

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Revision: E**

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ABB AB
Robotics Products
Se-721 68 Västerås
Sweden

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Overview of this product specification

About this product specification

It specifies the properties of the IRC5 robot controller in terms of:

- The structure and dimensional prints
- The fulfilment of standards, safety and operating equipment
- RobotWare OS
- I/O system
- Additional motors
- 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.

Users

It is intended for:

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

References

Reference	Document ID
<i>Product specification - Controller software IRC5</i> IRC5 with main computer DSQC1000 and RobotWare 5.6x.	3HAC048264-001
<i>Product specification - Controller software IRC5</i> IRC5 with main computer DSQC1000 and RobotWare 6.	3HAC050945-001
<i>Operating manual - Service Information System</i>	3HAC050944-001
<i>Product specification - Robot user documentation, IRC5 with RobotWare 5</i>	3HAC024534-001
<i>Product specification - Robot user documentation, IRC5 with RobotWare 6</i>	3HAC052355-001

Revisions

Revision	Description
-	First revision
A	<ul style="list-style-type: none">• Minor corrections/update• Two new Force Sensor Package added
B	<ul style="list-style-type: none">• Minor corrections/update• Option 700-8, Compact controller added.• Option 976-1, T10 Jogging device added• Option 983-1, Jokab enabling device added
C	<ul style="list-style-type: none">• Added MultiMove.

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Overview of this product specification

Continued

Revision	Description
D	<ul style="list-style-type: none">The specification is restructured and rewritten to better fit the structure of the specification form.
E	<ul style="list-style-type: none">Referens to <i>Application manual - PROFenergy Device</i> added.List of minimum cycles for safety parts added.Minor corrections/update

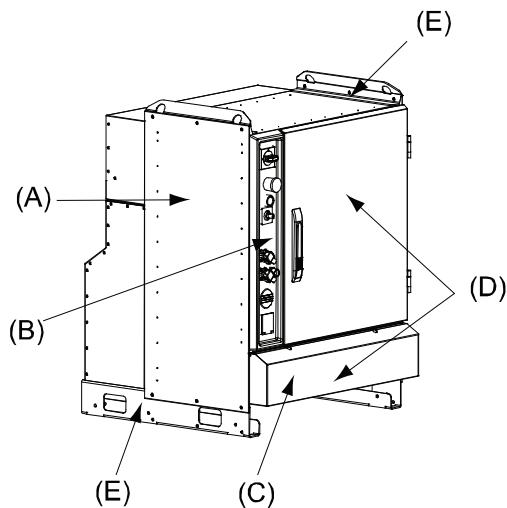
1 Description of the IRC5 controller

1.1 Controller variants

1.1.1 Single cabinet controller

General

The IRC5 controller contains the electronics required to control the manipulator, additional axes and peripheral equipment.



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Pos	Name	Description
A	Controller color	Aluzink
B	Operator's panel	
C	Connector covers	All cable connections at the front, optional covered
D	Controller color, door and connector covers	NCS 2502 B (light grey)
E	Controller color, feet and lifting eyes	Black

Modular design

The IRC5 has a modular design, and can be divided into two modules:

- The drive module, containing the drive system.

Up to three additional drive modules can be connected. For more information, see [Additional drive module on page 15](#) and [MultiMove on page 32](#).

- The control module, containing the control system.

For example the main computer (including one PCIe slot for extension boards), operator's panel, the mains switch, communication interfaces, FlexPendant connection, service ports and some space for customer equipment, for example ABB I/O boards.

The controller also contains the system software, RobotWare-OS, which includes all basic functions for operation and programming, as described further on in this

Continues on next page

1 Description of the IRC5 controller

1.1.1 Single cabinet controller

Continued

chapter. On top of RobotWare-OS it is possible to install a number of options with additional functionality. For description of these options, please see *Product specification - Controller software IRC5*.

Single cabinet controller

The content described above is normally mounted into one single cabinet. The single cabinet offers a compact solution suitable for most applications where there is less need for additional equipment inside.

Additional IRC5 variants

Two additional IRC5 variants are available

- IRC5 Panel Mounted Controller, where the integrator takes care of the encapsulation, see [IRC5 Panel Mounted Controller on page 17](#)
- IRC5 Compact controller, a small footprint controller available for the smaller IRBs, see [IRC5 Compact controller on page 26](#).

Cabinet data

Data	Weight
Single cabinet controller	max 150 kg
Empty cabinet large	42 kg
Data	Volume (H x W x D)
Single cabinet controller	970 x 725 x 710 mm
Empty cabinet large	

For information on ordering empty cabinets, see [Process module on page 116](#).

Airborne noise level

Airborne noise level	Description
Sound pressure level outside	< 70 dB (A) Leq (acc. to the working space Machinery directive 2006/42/EG)

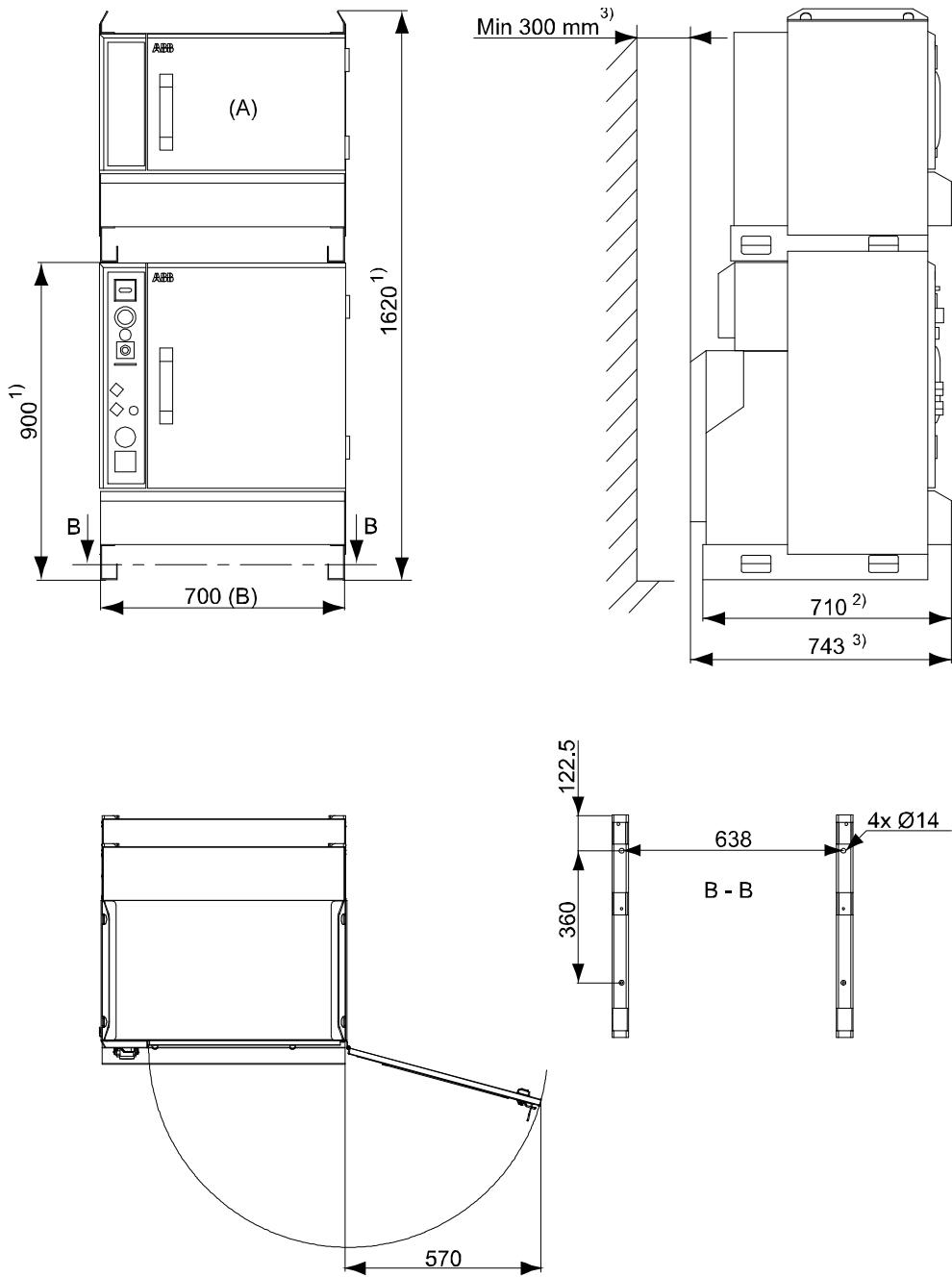
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1 Description of the IRC5 controller

1.1.1 Single cabinet controller

Continued

Single cabinet - different views



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Pos	Description
A	Optional process module for Single cabinet controller
B	725 for build in

Pos	Description
1	For wheel option, add 10 mm to the height
2	For service access to the rear, add 250 mm to the depth
3	Optional moist dust filter

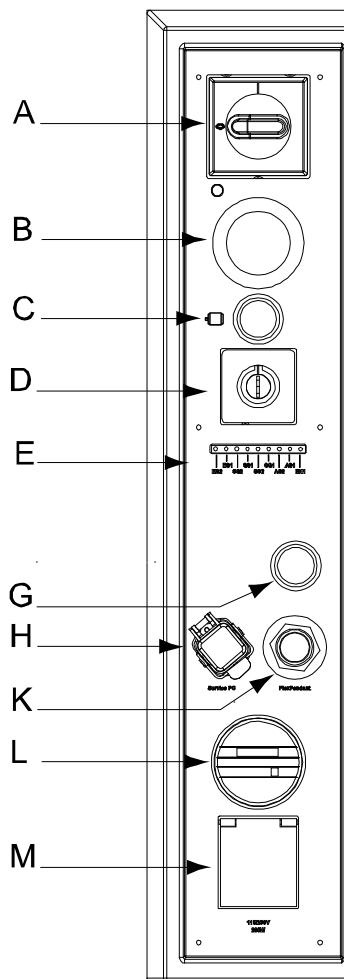
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1 Description of the IRC5 controller

1.1.1 Single cabinet controller

Continued

Operator's panel



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Pos	Name
A	Mains switch and remote control of power to Drive modules
B	Emergency stop - if pressed in, turn to release
C	MOTORS ON
D	Operating mode selector
E	Safety chain LEDs (option)
G	FlexPendant Hot Plug pushbutton (option)
H	Service PC connection
K	FlexPendant connection
L	Duty Time Counter (option)
M	Service outlet 115/230V, 200W (option)

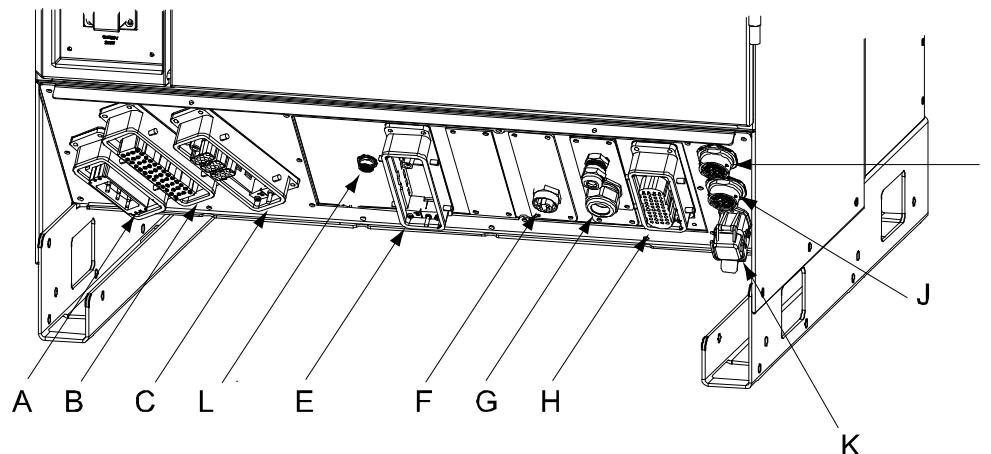
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1 Description of the IRC5 controller

1.1.1 Single cabinet controller

Continued

Cabinet connectors



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Pos	Description
A	Power inlet, option 752-2
B	Manipulator motor cable
C	Power to additional motors, XS101
E	Floor cables for manipulator custom power and signals
F	DeviceNet™ on front, option 730-1 and Remote Service antenna connector
G	Cable glands for external operator's panel
H	External connection of safety signals, option 731-2
I	To SMB for additional motors XS41
J	Manipulator SMB cable
K	LAN Ethernet RJ45 on connector plate, option 707-1
L	Ethernet M12 on connector plate, option 906-1

Connector parts additional motors

The controller can include, in addition to drive system for a 4-6 axes robot, equipment to control up to three additional motors. The connection to additional motors is collected in one industrial connector type Harting Han-Modular® (XS101), see [Cabinet connectors on page 13](#).

When ABB motors or positioners are ordered, the connector is included with the cabling. For other cases, find part numbers in table below.

Pcs	Part	Harting part No.	Miltronics part No.
1	Cable gland		52 01 5700
1	Hood	09 30 024 0531	
1	Hinged frame for 6 modules	09 14 024 0313	
2-3	Dummy module	09 14 000 9950	
2-3	6 pole module	09 14 006 3001	
2	12 pole module	09 14 012 3001	

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1 Description of the IRC5 controller

1.1.1 Single cabinet controller

Continued

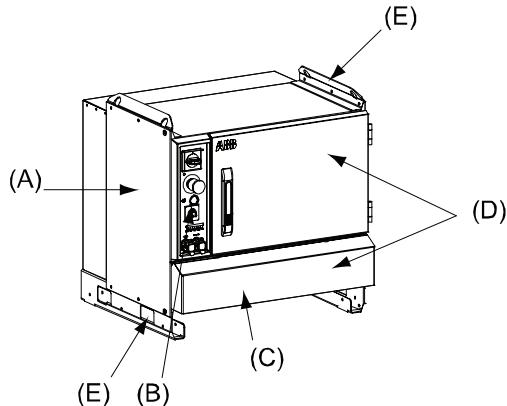
Pcs	Part	Harting part No.	Miltronics part No.
<15	Pin	09 15 000 6101	
<15	Pin	09 33 000 6107	
<10	Pin	09 15 000 6106	

1.1.2 Additional drive module

General

Additional drive modules can be ordered together with the single controller to control additional axes or additional robots, MultiMove.

Up to three additional axes can be controlled by each drive module, and up to three additional drive modules can be connected. For more information see [MultiMove on page 32](#).



xx1500000255

Pos	Name	Description
A	Controller color	Aluzink
B	Operator's panel	
C	Connector covers	All cable connections at the front, optional covered
D	Controller color, door and connector covers	NCS 2502 B (light grey)
E	Controller color, feet and lifting eyes	Black

Cabinet data

Data	Weight
Drive module	100-130 kg
Empty cabinet small	35 kg
Data	Volume (H x W x D)
Drive module	720 x 725 x 710 mm
Empty cabinet small	

For information on ordering empty cabinets, see [Process module on page 116](#).

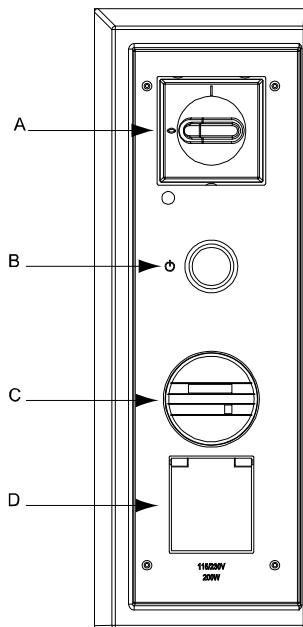
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1 Description of the IRC5 controller

1.1.2 Additional drive module

Continued

Operator's panel



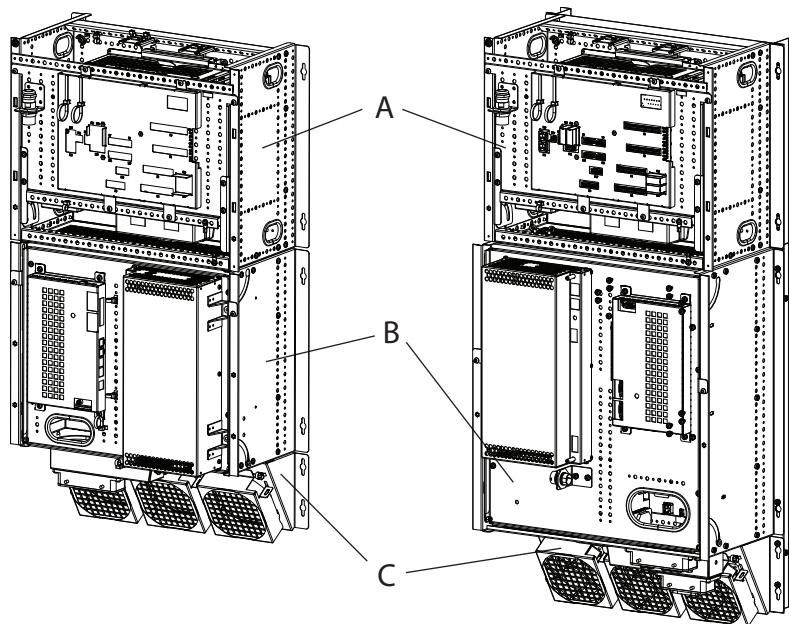
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Pos	Description
A	Mains isolator switch.
B	Stand by lamp indicates that electronic supply is switched on by the Control Module mains switch.
C	Duty Time Counter (option) accumulates the hours (up to 99999.99 h) when the motors are in operation and the brakes are released.
D	Service outlet 115/230V, 200W (option)

1.1.3 IRC5 Panel Mounted Controller

General

The IRC5 Panel Mounted Controller (PMC), is a concept where the controller can be mounted in a customer cabinet for example when there are special demands on size reduction or hygienic encapsulation. For MultiMove applications the robot can be ordered with only the drive module. Two versions of Panel Mounted Controller are available, depending on robot version and size, PMC Small and PMC Large. The difference is the size of drive units in the Drive module.



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Pos	Description
A	Control Module
B	Drive Module (different design for PMC small and PMC large)
C	Fan unit (for PMC large this is a part of the Drive Module)

The modules have to be encapsulated by the customer to at least protection class IP54 according to IEC 60529. The modules are delivered in class IP20. The supplied cabling between the modules is long enough to allow side-by-side mounting or back-to-back as an alternative to the vertical mounting as shown in the pictures. For MultiMove applications an additional robot's Drive module can be mounted below the main robot's Drive module. For further separation, customized solution is possible. The cabling consists of one standard shielded Ethernet cable and one safety interlocking cable. The required connector are of type Molex Micro-Fit 8 and 10 pole art. no. 43025, socket art. no. 43030.

Air channel for PMC large

For PMC large, there is an air channel that is mounted behind the controller modules. Make sure that the air can flow freely in the air channel behind the controller as well as through the controller.

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1 Description of the IRC5 controller

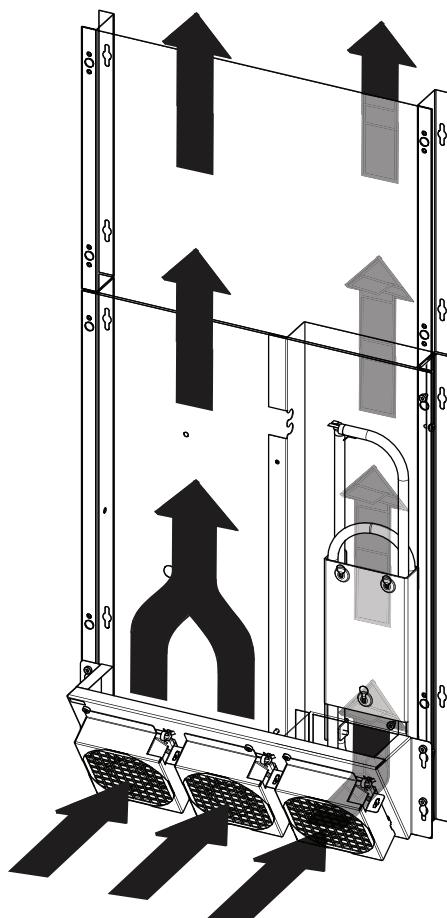
1.1.3 IRC5 Panel Mounted Controller

Continued

If the Control Module is mounted separately, it can be mounted without the air channel. If it is mounted on top of the Drive Module, it must be mounted on the air channel so it does not obstruct the air flow.

The air flow

The fan to the right creates an air flow through the air channel behind the controller, where the brake resistor bleeder is located. The two fans to the left creates an air flow through the controller modules.



Limitations

Following IRB robots are available with Panel Mounted Controller.

PMC Small available for:

- IRB 140
- IRB 260
- IRB 360
- IRB 1200
- IRB 1600

PMC Large available for:

- IRB 2400
- IRB 2600

Continues on next page

- IRB 4400
- IRB 4600
- IRB 66XX (except IRB 6660)
- IRB 6700
- IRB 7600
- IRB 460
- IRB 660
- IRB 760

Drive units for additional motors can not be installed.

Standards that concern electrical installation and encapsulation have to be addressed by the customer

Regarding the EU Machinery Directive, the Panel Mounted Controller is designed to fulfill the requirements when mounted in an integrator encapsulation.

The Panel Mounted Controller is UL Recognized as standard (UR labelled).

However, certain options have to be selected in a proper way. Examples are Safety lamp on the manipulator arm and 2-mode operation mode selector.

The motor cable is to be connected to industrial connector on the drive module.

The following options are not available with Panel Mounted Controller:

Option	Description
429-1	UL/CSA (the PMC is UL recognized)
129-1	Prepared for CE labelling (the mains filter is standard)
752-x	Mains connection type
742-x	Mains switch
743-1	Circuit breaker for rotary switch
744-1	Door interlock
708-x	Room temperature (customer internal cabinet air max. 45°C)
764-1	Air filter
741-x	Cabinet connector cover
707-1, 906-1	Ethernet on connector plate
714-1	RS232 to RS422 converter
716-726	Internal I/O and gateway units
727-x	24V 8/16A
730-1	DeviceNet™ on connector plate
731-2	Safety external connector (internal 731-1 included)
671-673	IMM interface
733-1	Operator's panel on cabinet
737-1	Status LEDs on front
907-1	Drives for additional axes
757	SMB for additional axes
761-x	Extension cables between modules

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1 Description of the IRC5 controller

1.1.3 IRC5 Panel Mounted Controller

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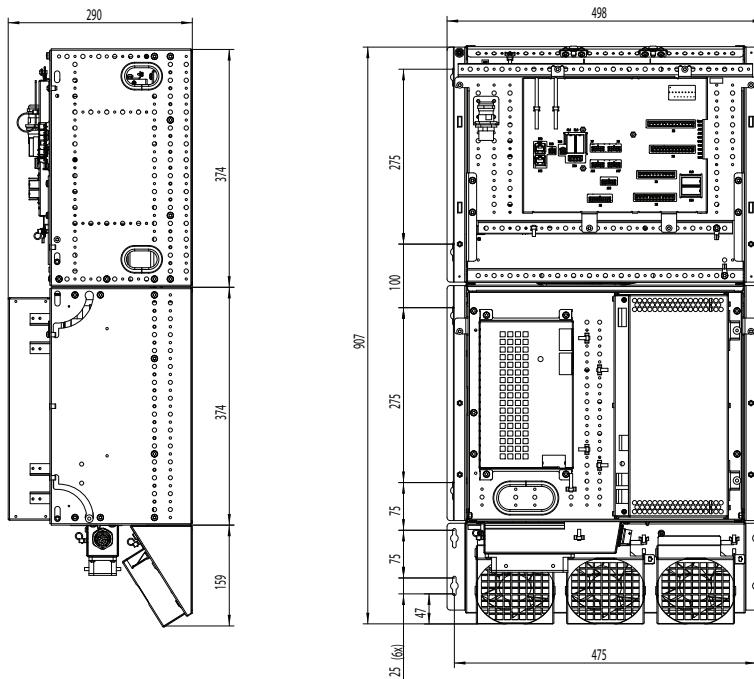
Option	Description
767-1	Duty Time Counter
758-1	Wheels
736-x	Service outlet
768-x	Empty cabinet
715-1	Installation kit
1341-1	Vision interface
922-1	Prepared for IRBP
946-1	Prepared for MU&GU
981-1	Prepared for IRBT

Furthermore, options intended for arc welding applications are not available together with Panel Mounted Controller.

Installation

Space requirement according to Figure 19. For detailed installation information see *Product manual - IRC5 Panel Mounted Controller*.

Dimensions for PMC small



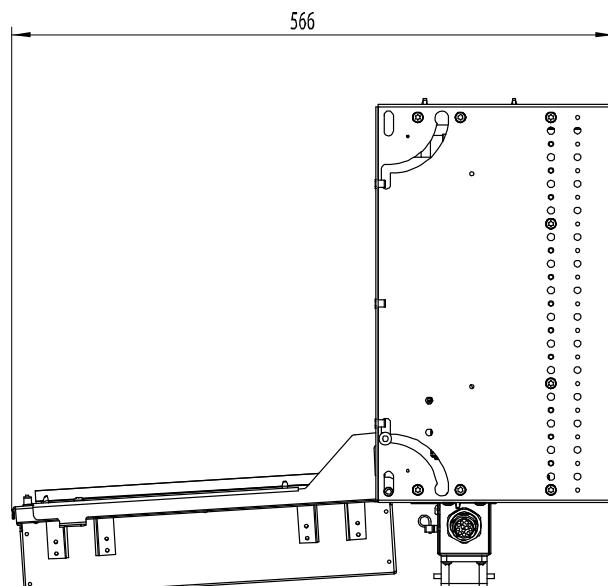
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1 Description of the IRC5 controller

1.1.3 IRC5 Panel Mounted Controller

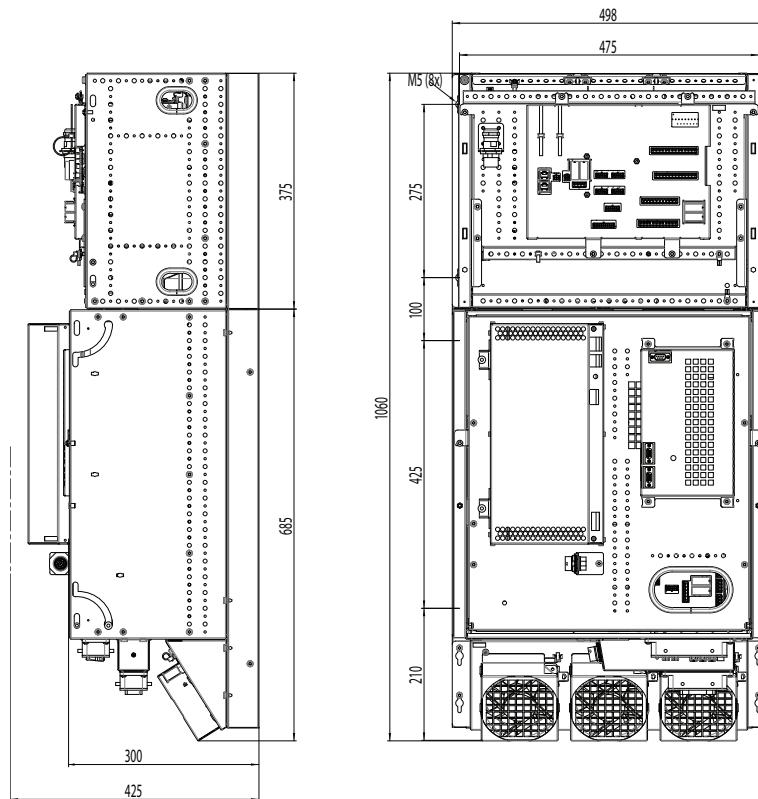
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Pos	Description
A	FlexPendant connection if no remote panel

Dimensions for PMC large



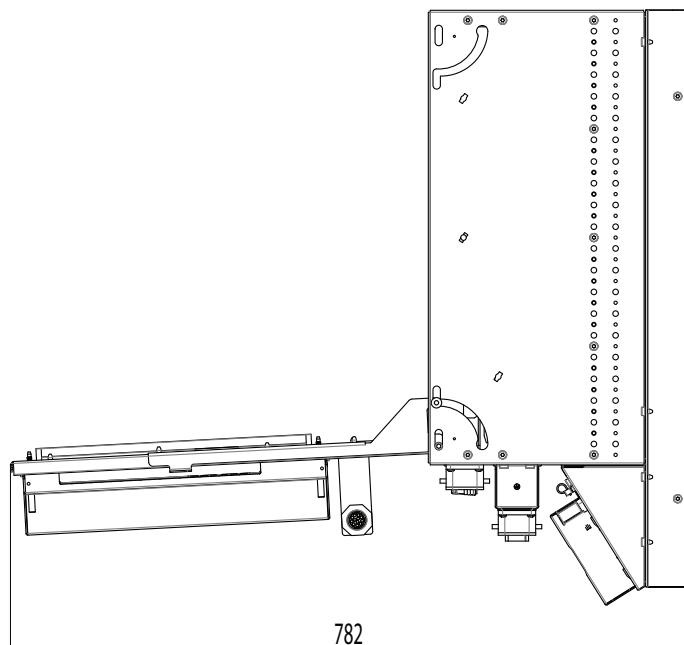
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1 Description of the IRC5 controller

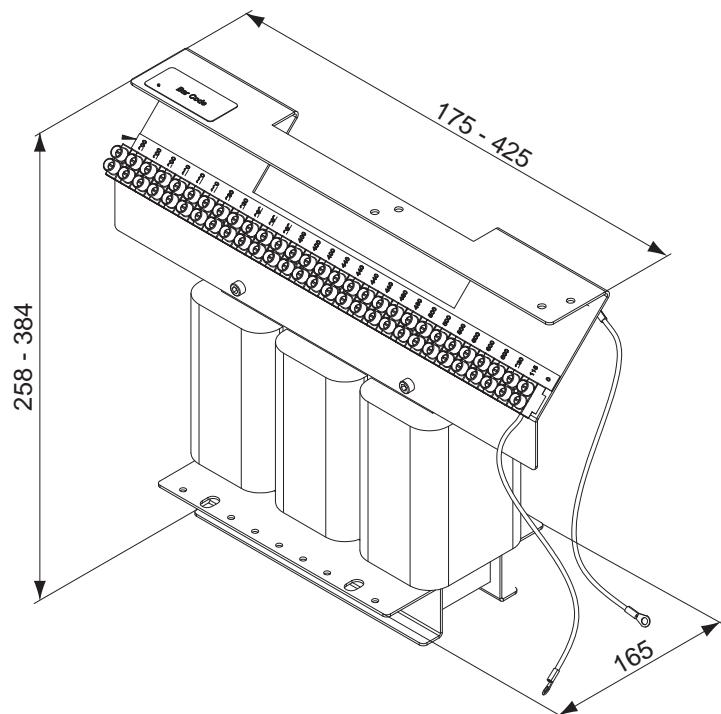
1.1.3 IRC5 Panel Mounted Controller

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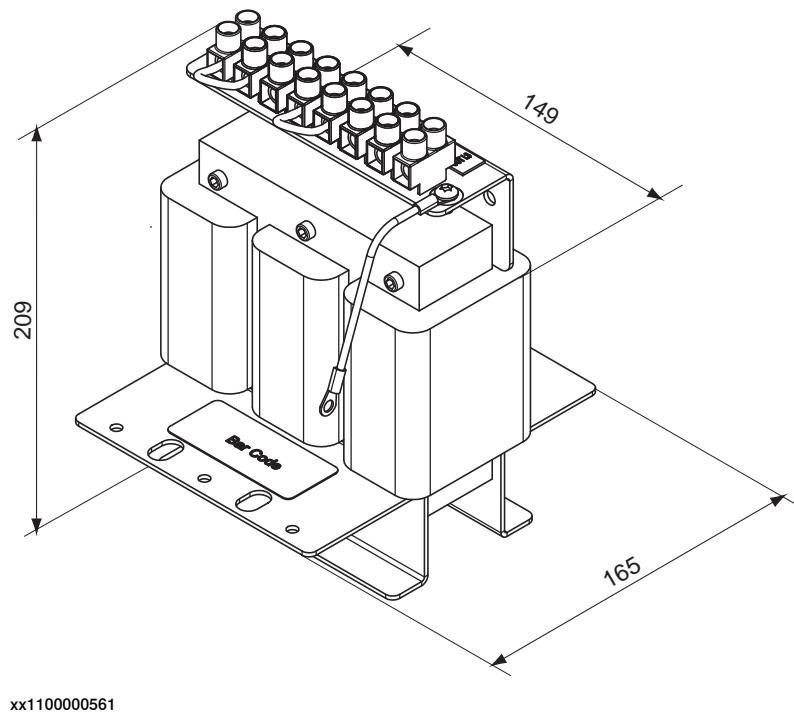
Dimensions for transformer



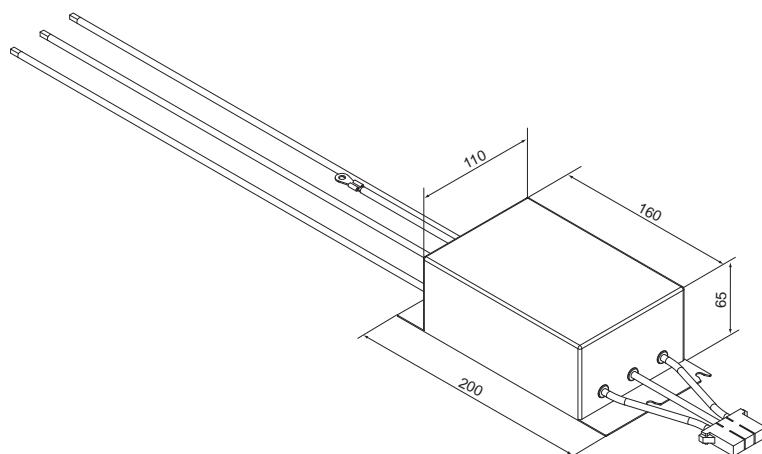
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Dimensions for inductor (only used with PMC Large)



Dimensions for line filter



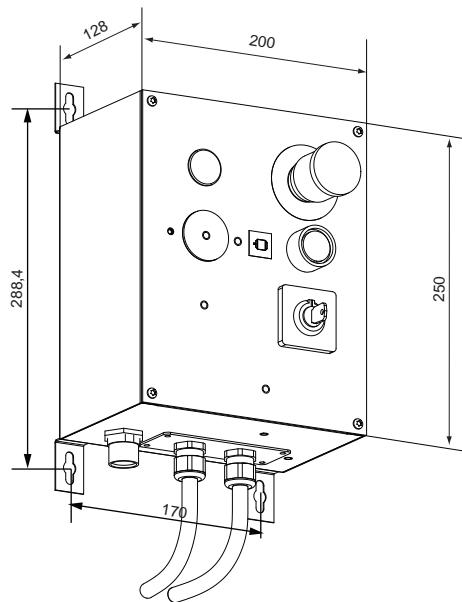
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1 Description of the IRC5 controller

1.1.3 IRC5 Panel Mounted Controller

Continued

Dimensions for external operator's panel



Weight

- Control module 12 kg
- Drive module Small 24 kg
- Drive module Large 40 kg
- Transformer 13-35 kg
- Fan unit 0.5 kg
- Inductor for Drive module large 5 kg
- External Operator panel 3 kg

Power and cooling

For PMC Small, a 4 kVA transformer is included. For PMC Large with 400-480 V, a single phase transformer is included. The transformer comes with rotary mains switch and secondary fuses.

Also the PMC drive module only, option 700-6 intended for MultiMove, includes a transformer.

For PMC Large a fan unit for internal cooling is included in the controller delivery, the unit force cooling air through the drive module and bleeder resistor. For PMC Small the fan unit is optional.

For calculation of the enclosure temperature rise, the dissipated heat has to be known. Since most of the heat depends on the robot motion, the robot program again is dimensioning. With the above 50 % duty cycle, the generated heat is approximately:

Robot type	Heat
IRB 1200	300 W
IRB 140	250 W
IRB 1600	300 W

Continues on next page

1 Description of the IRC5 controller

1.1.3 IRC5 Panel Mounted Controller

Continued

Robot type	Heat
IRB 2400	500 W
IRB 260	350 W
IRB 2600	500 W
IRB 360	700W
IRB 4400	700 W
IRB 460	700 W
IRB 4600	700 W
IRB 660	1000 W
IRB 6620	1000 W
IRB 6640	1000 W
IRB 6700	1000 W
IRB 760	1000 W
IRB 7600	1500 W

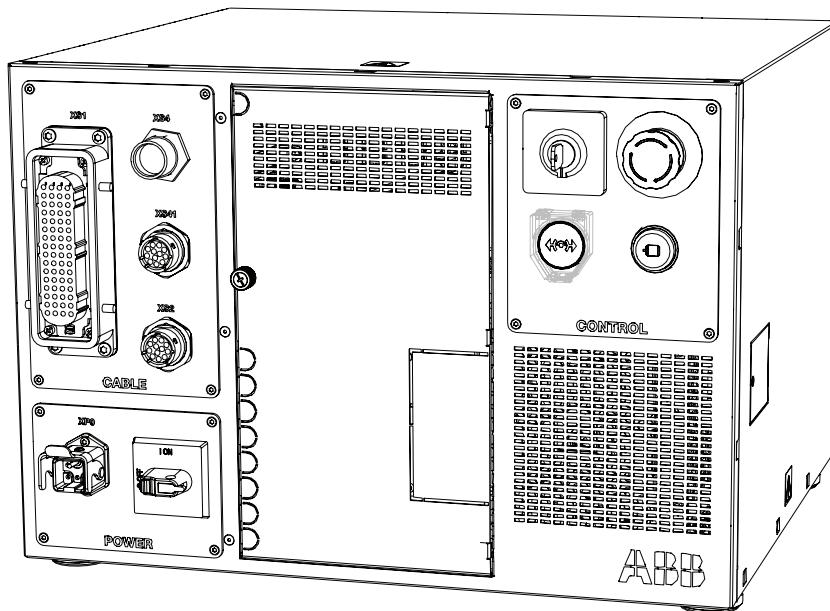
1 Description of the IRC5 controller

1.1.4 IRC5 Compact controller

1.1.4 IRC5 Compact controller

General

The IRC5 Compact controller is a desktop sized robot controller designed for segments such as 3C market. The compact controller protection degree is class IP20, according to IEC60529.



Limitations

The IRC5 Compact controller is available with the following IRBs:

- IRB 120
- IRB 140 ¹
- IRB 260 ¹
- IRB 360 ¹
- IRB 1200 ¹
- IRB 1410 ¹
- IRB 1600 ¹

¹ Max axis speed limited due to 1 phase 220/230 V. See the product specification for the respective robot.



Note

MultiMove is not possible.

In the IRC5 Compact controller there is only room to mount one I/O unit (DSQC 652 is included as standard) inside the cabinet.

Continues on next page

1 Description of the IRC5 controller

1.1.4 IRC5 Compact controller

Continued

The IRB 120 brake release button is located on the front panel of the controller, this means that an IRB 120 with IRC5 Single cabinet requires a customer solution for brake release.

The following options are not available with IRC5 Compact controller:

Option	Description
129-1	Prepared for CE labelling (the mains filter is standard)
604-X	MultiMove
671-673	IMM interface
702-2	Hot plug (for FlexPendant)
707-1, 906-1	Ethernet connector plate
708-2	Room temperature 52C (Max temp, 45C is std)
715-1	Installation kit
717-726	Internal I/O and gateway unit (16in/16out is std)
727-x	24V 4/8 16A (24V 4A for external mounting is available)
727-X	24V 4/8 16A (24V 4A for external mounting is available)
728-1	DeviceNet 24V 4Amps
730-1	DeviceNet™ on connector plate
731-X	Safety Connection
733-1	Panel on Cabinet
735-X	Key switch
736-X	Service outlet
737-1	Status LEDs on front
741-1	Cabinet connector cover
742-3	Flange disconnect (rotary switch is std)
743-1	Circuit breaker
744-1	Door interlock
752-x	Mains connection type
753-766	Drives for additional axes
757-x	SMB for additional axes
758-1	Wheels
761-x	Extension cables between modules
764-x	Cooling air filter
767-1	Duty Time Counter
768-X	empty cabinet
769-x	Mains voltage
810-1	Electronic Position Switches
810-2	SafeMove
881-2	PMC without transformer
882-x	Fans

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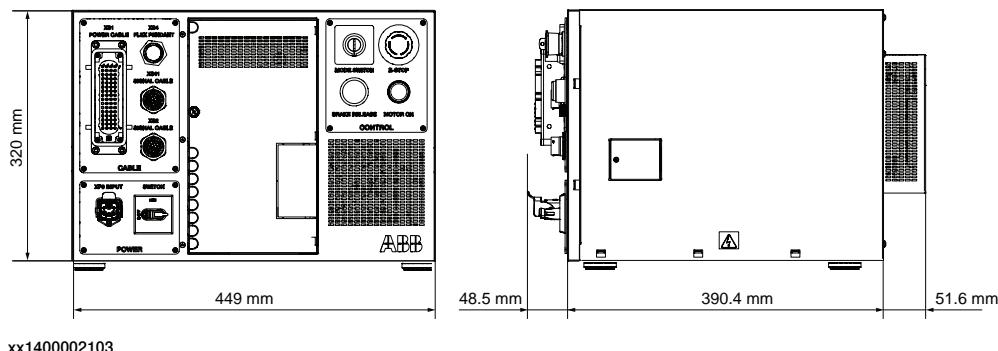
1 Description of the IRC5 controller

1.1.4 IRC5 Compact controller

Continued

Option	Description
890-3	Pre-wiring
901-1	Dispensepack support
902-1	Channel support
906-1	Ethernet connector plate
907-X	Additional drive
922-1	Prepared for IRBP
931-1	World transformer
941-1	Ethernet switch
946-1	Prepared for MU/GU 757-X SMB for additional axes
1003-1	Drive interface
	All Arc welding related hardware options

Dimensions



Weight 28.5 kg

Power and cooling

For calculation of the enclosure temperature rise, the dissipated heat has to be known. Since most of the heat depends on the robot motion, the robot program again is dimensioning. With the above 50 % duty cycle, the generated heat is approximately:

Robot type	Heat
IRB 120	250 W
IRB 140	250 W
IRB 1200	300 W
IRB 1600	300 W
IRB 260	350 W
IRB 360	700 W

1.1.5 IRC5 as stand alone controller

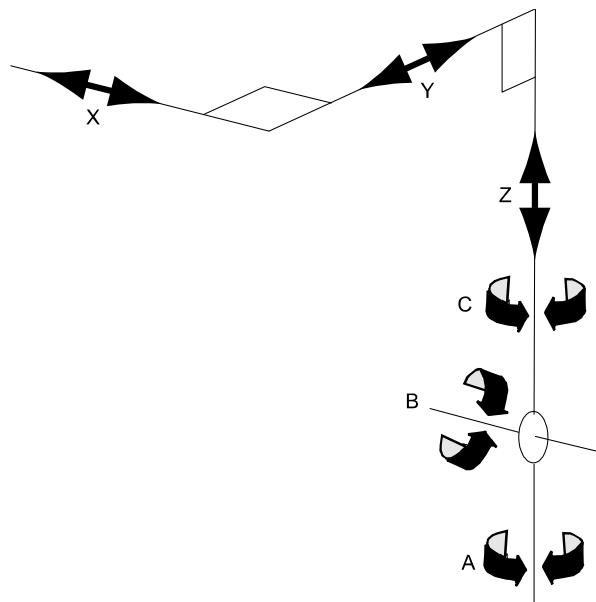
General

The IRC5 offers the capability to control a wide range of mechanical devices, additional axes and peripheral equipment. Thereby it is possible to gain from ABB motion technology (including MultiMove) plus an extensive range of other controller features, also for non-ABB manipulators.

Linear mechanical units

Linear mechanical devices, for example gantries, consist of up to three linear main axes and up to three rotating wrist axes. These configurations are supported by kinematic models.

The kinematic model describes the relation between motor rotations and the movement of the TCP (Tool Center Point), thus enabling geometric programming and interpolation, making programming easier and faster.



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Arbitrary mechanical units

For arbitrary types of mechanical units, such as loaders, conveyors etc., it is often useful and sufficient to apply joint level control (also when the unit consists of multiple axes). In this case, the benefits of a kinematic model are obviously not available.

ABB manipulators

It is possible to exchange earlier ABB controllers connected to ABB IRB manipulators, thus benefitting from the latest control system technology. The earlier manipulators covered by the 3 phase variants of IRC5 are:

- IRB 140 M2000
- IRB 1400 M98 and M2000

Continues on next page

1 Description of the IRC5 controller

1.1.5 IRC5 as stand alone controller

Continued

- IRB 2400 M98A and M2000
- IRB 4400 M98A and M2000
- IRB 340 M98 and M2000
- IRB 6600 M2000
- IRB 7600 M2000
- IRB 6400R M99 and M2000 (200/2.5 and 200/2.8)

Motor and drive system selection

The procedure for choosing a stand alone IRC5 drive system is similar to that used for additional motors, see [Additional motors on page 34](#).



Note

For more information on motors and measurement system, see *Product specification - Motor Units and Gear Units* and *Application manual - Additional axes and stand alone controller*.

Limitations

The number of axes and mechanical units are limited as follows.

For systems without MultiMove:

- One single motion task
- Maximum 12 axes (located in 1 or 2 drive modules)
- Maximum 1 TCP robot
- Maximum 6 additional axes (which can be grouped in an arbitrary number of mechanical units)

Note 1: A TCP robot is a robot equipped with a kinematic model, which is programmed in x, y, z coordinates of the TCP, plus tool orientation. An IRB manipulator is an example of a TCP robot.

Note 2: Without MultiMove, semi-independent programming of individual mechanical units/axes can be achieved through the option 610-1 Independent Axis. Normally, MultiMove is preferred when independent programming is desired.

For systems with MultiMove:

- Maximum 6 motion tasks
- All the non-MultiMove limitations above apply per task
- Maximum 4 TCP robots in total
- Maximum 4 drive modules (that is maximum 32-36 axes)

Continues on next page

Note: It is perfectly possible to mix control of IRB manipulators and non-ABB units in the same system.



Note

Since non-ABB manipulators are controlled without the support of a dynamic model, certain limitations apply, for example:

- Only limited QuickMove™ and TrueMove™
- No automatic adaption to vary load conditions
- No Load Identification
- No Collision Detection
- No Absolute Accuracy

1 Description of the IRC5 controller

1.1.6 MultiMove

1.1.6 MultiMove

General

It is possible to connect up to three additional Drive modules, each running one robot or a number of additional motors, to one Single cabinet controller or Control module. Each robot can control additional motors, see [Additional motors on page 34](#).

Module connections

The Drive modules are connected to the Single cabinet controller or Control module by an Ethernet cable and a safety signal cable with a maximum length of 75 m.



Note

Note that it is not necessary to have several Drive modules in order to run MultiMove, as long as the mechanical units are all connected to the same Drive module. One example is “manual jog”, where one additional axis is controlled from a separate task.

MultiMove system

With a MultiMove system, it is possible to operate the robots either individually (option 604-2 MultiMove Independant) or in a co-operative manner, (option 604-1 MultiMove Coordinated). Examples of the latter are:

- Dual robots welding on work objects rotated by an positioner
- Multiple robots together lifting a heavy object
- One robot holding a work piece while another robot is processing the work piece (typically welding)

Robot combinations

Arbitrary robot types can be combined in a MultiMove system. For IRB 360 the following limitations apply:

- With two IRB 360 in a MultiMove system, no more robots can be connected.
- The IRB 360 can not be coordinated with another robot (IRB 360 or other type).



Note

For further information, see *Application manual - MultiMove*.



Note

Note that when several robots are connected to one Single cabinet controller or Control module, the complete cell is regarded as one robot from the safety system point of view.

Continues on next page

Limitations

Note that screw terminals for signals from the additional robots (customer signals, position switches) may not be possible to fit in the main robot cabinet. Especially the limited space of the Single cabinet requires attentions. An Empty cabinet (option 768-1 or option 768-2) is recommended to give space also for I/O units or customer PLC.

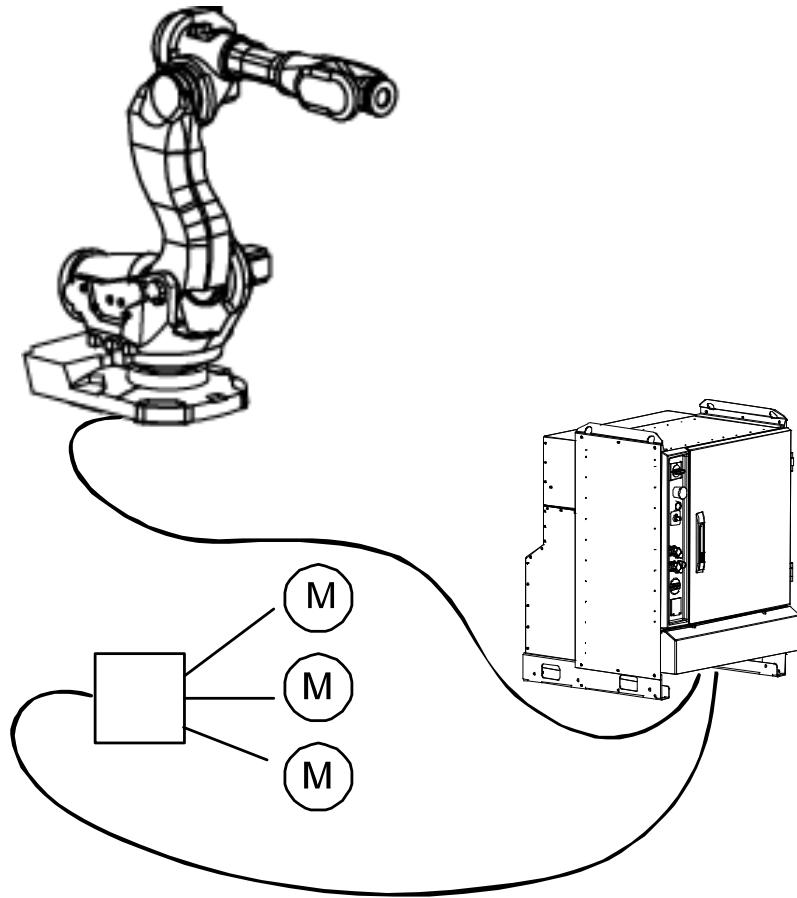
1 Description of the IRC5 controller

1.1.7 Additional motors

1.1.7 Additional motors

General

The IRC5 controller cabinet can be supplied with drive units for up to three additional motors. These motors are programmed and moved in the same way as the robot's motors. See figure below.



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Note

Ordering information and data for the individual drive units are found in chapter Drive unit data.

Additional Drive module connection

An IRC5 Drive module can be connected to the Single cabinet, independent of the robot type. An Ethernet switch plus cabling is the only additional hardware required. A Drive module is basically equipped with drives for 6 motors but can be supplied with drives for further 3 motors. The Drive module is complete with power distribution, transformer, dual MOTORS ON contactor circuits, cooling, power supply and axis computer.

Available drive system sizes corresponds to IRB 1600, IRB 2600 and IRB 66XX.

Continues on next page

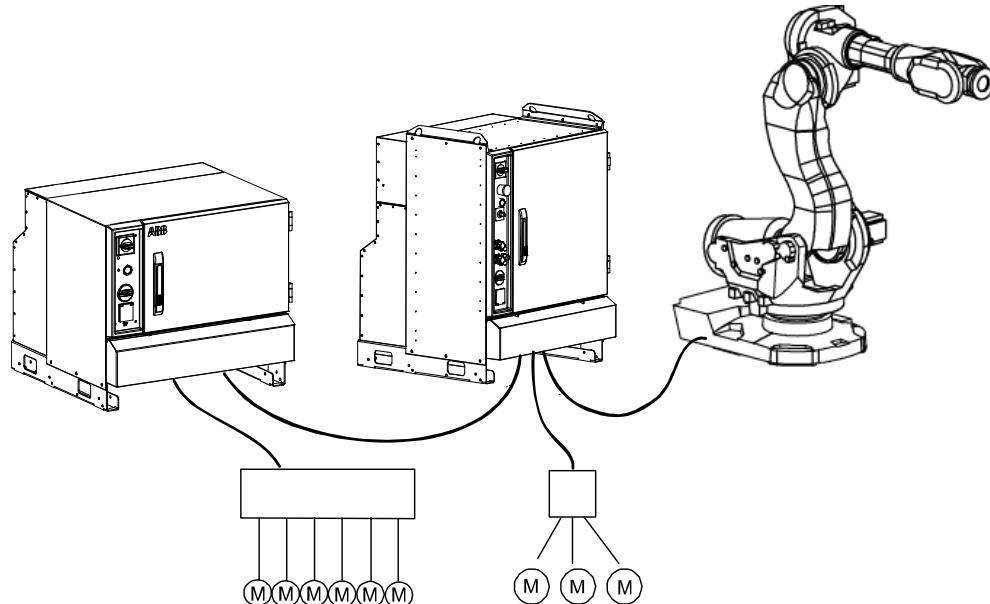
See chapter Drive unit data for the individual drive units. Ordering additional Drive module is done via the Specification form “IRC5 Controller”. Select the option 700-1 Drive module only and then option 751-x Drive system.

With maximum three additional Drive modules it is possible to control up to 36 motors.



Note

Note that an additional Drive module for additional motors reduces the maximum number of additional robots to two. See [MultiMove on page 32](#) (optional).



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Simultaneous coordination

Up to 12 motors, including the robot, can be active at the same time in the same motion task. The robot motion can be simultaneously coordinated with for example, a linear robot carrier and a work piece positioner.

Mechanical units

The additional motors can be grouped into mechanical units to facilitate, for example, the handling of robot carriers, workpiece manipulators, etc. All motors within a mechanical unit must be connected to the same Drive module.

Activation/Deactivation of mechanical unit

A mechanical unit can be activated or deactivated to make it safe when, for example, manually loading a workpiece on the unit. In order to reduce investment costs, any motors that do not have to be active at the same time, can share the same drive unit.

Continues on next page

1 Description of the IRC5 controller

1.1.7 Additional motors

Continued

Motor selection

For motor selection, see *Product specification - Motor Units and Gear Units*.



Note

ABB can not guarantee complete functionality when using third party equipment. Use of ABB verified equipment for optimal performance is recommended.

Absolute position

Absolute position is accomplished by battery-backed resolver revolution counters in the serial measurement board (SMB). Encapsulated SMB units are also described in *Product specification - Motor Units and Gear Units*.



Note

For more information on how to install an additional motor, see *Application manual - Additional axes and stand alone controller*. This manual also specifies necessary resolver data, and how to create a simple dimensioning of the motor.

1.1.8 External panel

General

Both the operator's panel and the FlexPendant can be mounted externally, that is separated from the cabinet and the robot can then be controlled from there.

The optional remote panel contains:

- Emergency stop
- MOTORS ON
- Operating mode selector
- FlexPendant connector, inclusive optional Hot plug

Remaining on the Control cabinet:

- Mains switch
- Optional safety LEDs
- Service PC connection

The robot can also be controlled remotely from a computer, PLC or from a customer's panel, using serial communication (optional) or digital system signals.



Note

For more information on how to operate the robot, see *Operating manual - IRC5 with FlexPendant*, or *Operating manual - RobotStudio*.

1 Description of the IRC5 controller

1.2.1 Applicable safety standards

1.2 Safety

1.2.1 Applicable safety standards

Standards, EN ISO

The robot system is designed in accordance with the requirements of:

Standard	Description
EN ISO 12100	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN ISO 13849-1	Safety of machinery, safety related parts of control systems - Part 1: General principles for design
EN ISO 13850	Safety of machinery - Emergency stop - Principles for design
EN ISO 10218-1	Robots for industrial environments - Safety requirements -Part 1 Robot
EN ISO 9787	Robots and robotic devices -- Coordinate systems and motion nomenclatures
EN ISO 9283	Manipulating industrial robots, performance criteria, and related test methods
EN ISO 14644-1 ⁱ	Classification of air cleanliness
EN ISO 13732-1	Ergonomics of the thermal environment - Part 1
EN IEC 61000-6-4 (option 129-1)	EMC, Generic emission
EN IEC 61000-6-2	EMC, Generic immunity
EN IEC 60974-1 ⁱⁱ	Arc welding equipment - Part 1: Welding power sources
EN IEC 60974-10 ⁱⁱ	Arc welding equipment - Part 10: EMC requirements
EN IEC 60204-1	Safety of machinery - Electrical equipment of machines - Part 1 General requirements
IEC 60529	Degrees of protection provided by enclosures (IP code)

ⁱ Only robots with protection Clean Room.

ⁱⁱ Only valid for arc welding robots. Replaces EN IEC 61000-6-4 for arc welding robots.

European standards

Standard	Description
EN 614-1	Safety of machinery - Ergonomic design principles - Part 1: Terminology and general principles
EN 574	Safety of machinery - Two-hand control devices - Functional aspects - Principles for design
EN 953	Safety of machinery - General requirements for the design and construction of fixed and movable guards

Other standards

Standard	Description
ANSI/RIA R15.06	Safety requirements for industrial robots and robot systems

Continues on next page

1 Description of the IRC5 controller

1.2.1 Applicable safety standards

Continued

Standard	Description
ANSI/UL 1740 (option 429-1)	Safety standard for robots and robotic equipment
CAN/CSA Z 434-03 (option 429-1)	Industrial robots and robot Systems - General safety requirements

1 Description of the IRC5 controller

1.2.2 Safety functions

1.2.2 Safety functions

Safety

The robot controller is designed with absolute safety in mind. 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
Safety Performance Level d and category 3	Malfunction of a single component, such as a sticking relay, will be detected at the next MOTOR OFF/MOTOR ON operation. MOTOR ON is then prevented and the faulty section is indicated. The executing circuits are continuously monitored. This complies with Performance Level d and category 3 of EN ISO 13849-1, Safety of machinery - safety related parts of control systems - Part 1.
Selecting the operating mode	The robot can be operated either manually or automatically. In manual mode, the robot can only be operated via the FlexPendant or RobotStudio online, that is not by any other external equipment.
Reduced speed	In manual mode, the speed is limited to a maximum of 250 mm/s (600 inch/min.) and monitored by two independent computers. The speed limitation applies not only to the TCP (Tool Center Point), but also to the center of the mounting plate and the back of the upper arm. It is also possible to monitor the speed of equipment mounted on the robot.
Three position enabling device	The enabling device on the FlexPendant must be used to move the robot when in manual mode. The enabling device consists of a switch with three positions, meaning that all robot movements stop when either the enabling device is pushed fully in, or when it is released completely. This makes the robot safer to operate.
Safe manual movement	The robot is moved using a joystick instead of the operator having to look at the FlexPendant to find the right key.
Emergency stop	There is one emergency stop push button on the controller and another one on the FlexPendant. Additional emergency stop buttons can be connected to the robot's safety chain circuit.
Protective stop	The controller has a number of electrical inputs which can be used to connect external safety equipment, such as safety gates and light curtains. This allows the robot's safety functions to be activated both by peripheral equipment and by the robot itself. The stop can be uncontrolled (category 0) or controlled (category 1).
Controlled protective stop	A controlled stop gives a smooth stop. The robot stops the same way as at a normal program stop with no deviation from the programmed path. After approximately 1 second the power supplied to the motors is cut off.
Collision detection	In case of an unexpected mechanical disturbance like a collision, electrode sticking, etc., the robot will stop and then slightly back off from its stop position.
Restricting the working space	Software: <ul style="list-style-type: none">• The movement of each axes can be restricted Hardware: <ul style="list-style-type: none">• Moveable mechanical stops

Continues on next page

Safety functions	Description
Hold-to-run control	“Hold-to-run” means that you must depress a button continuously in order to move the robot. When the button is released the robot will stop. The hold-to-run function makes program testing safer. At reduced speed it can be activated/deactivated by a system parameter.
Fire safety	The control system complies with the requirement of UL (Underwriters Laboratories) for fire safety.
Safety lamp	As an option, a safety lamp mounted on the manipulator can be connected. The lamp is activated when the controller is in the MOTORS ON state.
MultiMove	When several robots are connected to one control module, all these robots are regarded as one robot from the point of view of the safety system. For example, all robots will be in the same operating mode and they will all be affected by an emergency stop or protective stop. When in manual mode one robot, or other mechanical unit, at a time can be jogged, selected from the FlexPendant. If in coordinated mode, all coordinated robots can be jogged simultaneously as well.

Minimum operating cycles for safety parts

The minimum expected cycles for safety parts is listed below.

Safety part	Minimum cycles
Enable device	100000
Emergency stop (FlexPendant)	500000
Emergency stop (operator panel)	500000
Mode switch (CAM Switch)	100000
Contactors K42, K43, K44	10000000
Automatic fuse F1	50000
Automatic fuse F2	20000
Automatic fuse F5	20000
Automatic fuse F6	50000

1 Description of the IRC5 controller

1.2.3 Safety data

1.2.3 Safety data

About this section

This chapter describes the necessary safety data required by standard ISO 13849-1:2008.

Prevailing directives and standards

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

- Machinery Directive 2006/42/EC
- ISO 10218-1:2011
- ISO 13849-1:2008

In addition to these standards covering general machinery safety, a number of more specialized standards (referred to as normative), must also be fulfilled. See ISO 10218-1 chapter 2, "Normative references".

An alternative standard is:

- IEC 62061

See [IEC 62061 and PFH values on page 43](#).

Performance level and category

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

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

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

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

Continues on next page

IEC 62061 and PFH values

The standard IEC 62061 as well as ISO 13849-1 specifies the requirements for the design and implementation of safety related control systems of machinery. Either of these standards can be used for the verification of required safety. In IEC 62061 the Safety Integrity Level (SIL) as a measure of safety level is used, resembling the PL in ISO 13849. Connected to the SIL is the value of Probability of Dangerous Failure per Hour (PFHd), see IEC 62061 Table 3.

Performance level for ABB IRB robots and IRC5 controller

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

The safety related parts of robot and controller are, for example, the following stop circuits:

- Enabling device on FlexPendant and T10
- Emergency stop on operator panel
- Emergency stop on FlexPendant and T10
- Limiting switch on contactor board connector X21, X22
- Protective stops (AS, GS, SS)
- SafeMove
- Electronic position switches (EPS)

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

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

Stop circuit	Calculated MTTFd [years]	DCavg
Enabling device on FlexPendant and T10	80	Medium
Emergency stop on operator panel	126	Medium
Emergency stop on FlexPendant and T10	117	Medium
Limiting switch on contactor board connector X21, X22 ⁱ	180	Medium
Protective stops (AS, GS, SS) ⁱ	134	Medium
SafeMove (option) ⁱ	58	Medium
Electronic position switches (option)	105	Medium

ⁱ MTTFd is calculated without customer connections

Continues on next page

1 Description of the IRC5 controller

1.2.3 Safety data

Continued

Safety Integrity level for ABB IRB robots and IRC5 controller

Based on the values from the previous table of MTTFd values, the corresponding PFHd can be calculated using the Annex K, table K1 of ISO13849-1:2008. These are shown in the following table.

Stop circuit	Calculated PFHd
Enabling device on Flexpendant and T10	6.62x10E-08
Emergency stop on operator panel	4.29x10E-08 ⁱ
Emergency stop on FlexPendant and T10	4.29x10E-08 ⁱ
Limiting switch on contactor board connector X21, X22 ⁱⁱ	4.29x10E-08 ⁱ
Protective stops (AS, GS, SS) ⁱⁱ	4.29x10E-08 ⁱ
SafeMove (option) ⁱⁱ	1.03x10E-07
Electronic position switches (option)	4.29x10E-08 ⁱ

ⁱ The MTTFd values used for the calculations of the PFHd values are limited to max 100 years.

ⁱⁱ Calculated without customer connections



Note

The values in this table correspond to SIL 3 for all circuits.

Conclusion

According to ISO 13849-1:2008

The IRC5 controller safety system has a safety category 3 with performance level PL d according to ISO 13849-1:2008 using the simplified method of chapter 4.5.4 of ISO 13849-1:2008 and thus fulfils the safety performance requirement of the robot safety standard ISO 10218-1:2011.

The detailed analysis gives the following results:

- The enable switch circuit, Emergency stop and protective stop circuit conforms to the performance level PL e according to ISO 13849-1, Annex K, table K1.
- For the overall design and structure, the category 3 has been verified and meets the requirements.
- The Diagnostic Coverage is medium ($90\% < DCavg < 99\%$).
- The Common Cause Failure (CCF) is met according to the standard requirements.

According to IEC 62061

The PFHd values (shown in [Safety Integrity level for ABB IRB robots and IRC5 controller on page 44](#)) correspond to SIL 3 for the enable switch circuit, emergency stop and protective stop circuits according to table K1 of ISO 13849-1:2008.

1.3 Installation and maintenance

1.3.1 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.

Operating requirements

Requirements	Description
Dust and water protection according to IEC 529	Controller electronics IP54, air cooling ducts IP33 Variant Panel Mounted IP20
Cabinet protection	NEMA class 13
Explosive environments	The controller must not be located or operated in an explosive environment according to ATEX 94/9/EC.
Ambient temperature during operation	+0°C (+32°F) to +45°C (+113°F) (with option 708-2: +52°C (+125°F))
Ambient temperature during transportation and storage	-25°C (-13°F) to +55°C (+131°F) for short periods (not exceeding 24 hours): up to +70°C (+158°F).
Relative humidity	Max. 95% at constant temperature
Vibration during transportation	Max. ca. 0.9 g = ca. 10m/s ²
Vibration during operation	Max. ca. 0.15g = ca. 1.5m/s ²
Bumps during transportation and operation	Max. 5 g = 50 m/s ² (11 ms)

Power supply

Mains	Values
Voltage	200-600 V, 3 phase or 220/230 V, 1 phase
Voltage tolerance	+10%, -15%
Frequency	48.5 to 61.8 Hz



Note

The use of Delta power voids warranty. If the facility has Delta of any kind, an isolation transformer that converts the power to Y center-ground-tap is required.

Continues on next page

1 Description of the IRC5 controller

1.3.1 Installation

Continued

Controller rated power

Robot	Rated power
IRB 120, 1200, 140, 1410, 1600, 2400, 2600, 260, 360, 4400	4 kVA
IRB 4600, 660, 460, 760, 66XX, 6700, 7600	13 kVA
Additional Drive module	4 or 13 kVA

Line fusing

Recommended line fusing, slow-blowing diazed or circuit breaker with trip characteristic K. Max. fuse 35A, with options 80A.

Robot	Voltage	Description
IRB 120, 1200, 140, 260, 360, 1410, 1600	at 220/230 V	1x10 A (Compact)
IRB 120, 1200, 140, 1410, 1600, 2400, 2600, 260, 360, 4400	at 400-660 V	3x16 A (Single cabinet)
IRB 120, 1200, 140, 1410, 1600, 2400, 2600, 260, 360, 4400	at 200-220 V	3x16 A (Single cabinet)
IRB 4600, 660, 460, 760, 66XX, 6700, 7600	at 400-600 V	3x25 A
IRB 4600, 660, 460, 760, 66XX, 6700, 7600	at 200-220 V	3x35 A

Power consumption

See product specification for respective IRB.

When a connected manipulator is in MOTORS OFF mode or MOTORS ON with the brakes engaged (stand still), the typical IRC5 power consumption is 200/250W, customer I/O load excluded.

UPS

Computer system backup capacity (UPS)	Value
At power interrupt	20 sec (maintenance free energy bank)

Configuration

The controller is very flexible and can, by using RobotStudio or the FlexPendant, easily be configured to suit the needs of each user:

Configuration	Description
Authorization	Password protection IRC5 includes an advanced user authorization system, UAS. It includes administration of users and access rights connected to user names and passwords. The same user can have different access rights for different parts of the robot system.
Most common I/O	User-defined lists of I/O signals.

Continues on next page

Configuration	Description
Instruction pick list	User-defined set of instructions.
Instruction builder	User-defined instructions.
Operator dialogs	Customized operator dialogs.
Language	All text on the FlexPendant can be displayed in several languages.
Date and time	Calendar support.
Power on sequence	Action taken when the power is switched on.
EM stop sequence	Action taken at an emergency stop.
Main start sequence	Action taken when the program is starting from the beginning.
Program start sequence	Action taken at program start.
Program stop sequence	Action taken at program stop.
Change program sequence	Action taken when a new program is loaded.
Working space	Working space limitations.
Additional axes	Number, type, common drive unit, mechanical units.
Brake delay time	Time before brakes are engaged.
I/O signals	Logical names of boards and signals, I/O mapping, cross connections, polarity, scaling, default value at start up, interrupts, group I/O etc., see I/O system on page 57 .
Serial communication (optional)	Configuration

For a detailed description of the installation procedure, see *Technical reference manual - System parameters*.

1 Description of the IRC5 controller

1.3.2 Maintenance

1.3.2 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.

Functions

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

Function	Detail
Online supervision	Internal hardware functions CPU temperature CPU power levels AC and DC voltage level Power Supply functions UPS capacitor status All internal communication channels (cables) CMOS battery Safety chains (two channel supervision) Safety chains (function test) Contactors and relays Operating mode switch Motor temperatures Drive system: communication cable, voltage levels, temperatures, motor current and cable, reference quality Measurement system: communication cable, resolver function including cables Field bus cable (communication and power) Field bus units (connection, status) Program execution and resource handling
Power on	Built-in self-test
Fault tracing support	Computer status LEDs and console (serial channel) optional
Error message	Displayed in plain 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, WebWareServer or any OPC client application.
Manual test	Commands and service programs in RAPID to test units and functions.

Continues on next page

Function	Detail
Properties	Detailed properties of hardware and software in the controller are available for viewing from pendant or RobotStudio.
Safety chain status LEDs	On the panel unit (std) On the operator's panel (optionally).

User program

Most errors detected by the user program can also be reported to and handled by the standard error system. Error messages and recovery procedures are displayed in plain language.

1 Description of the IRC5 controller

1.4.1 The IRC5 main computer

1.4 Computer system

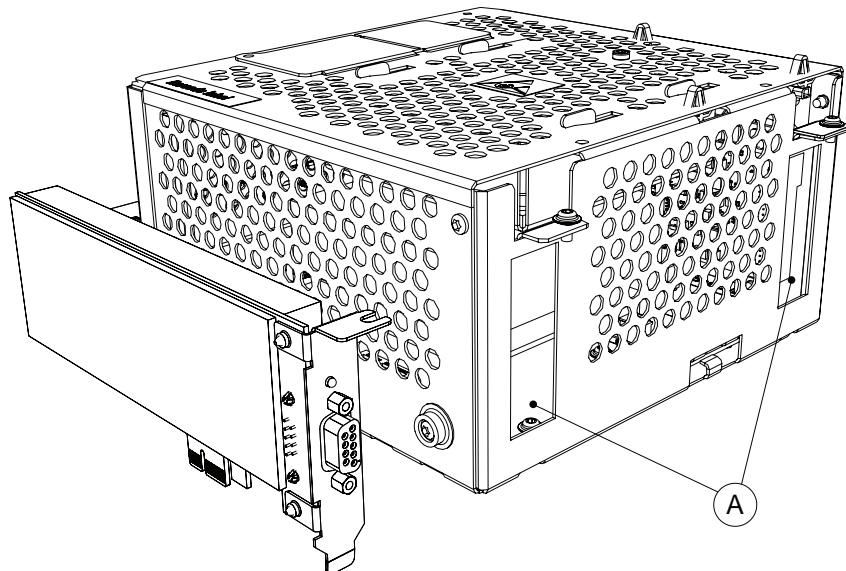
1.4.1 The IRC5 main computer

General

The IRC5 main computer is included in all types of controllers.

PCI options

Two slots are available for hardware extension.

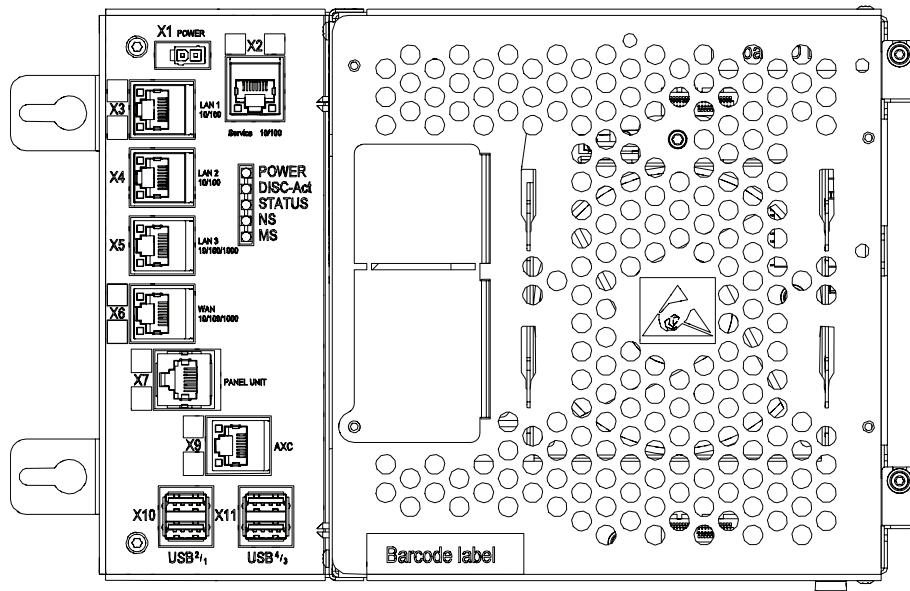


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Pos	Description
A	Slot for PCIe cards

Continues on next page

Ethernet connections



X1	Power supply
X2 (yellow)	Service (connection of PC)
X3 (green)	LAN1 (connection of FlexPendant)
X4	LAN2 (connection of Ethernet based options, 888-X, 841-1, 941-1)
X5	LAN3 Connection of Ethernet based options, 888-X, 849-1, 941-1)
X6	WAN (connection to factory WAN, options 707-1 or 906-1)
X7 (blue)	Panel unit
X9 (red)	Axis computer
X10, X11	USB ports (4 ports)

Priority for Ethernet ports vs. options

Prio	Option	LAN2	LAN3	WAN
1	941-1 Ethernet switch		X	
3	707-1 Ethernet RJ45 on front			X
4	906-1 Ethernet M12 on front			X
5	841-1 Ethernet IP	X	X	
6	888-X Profinet SW	X	X	

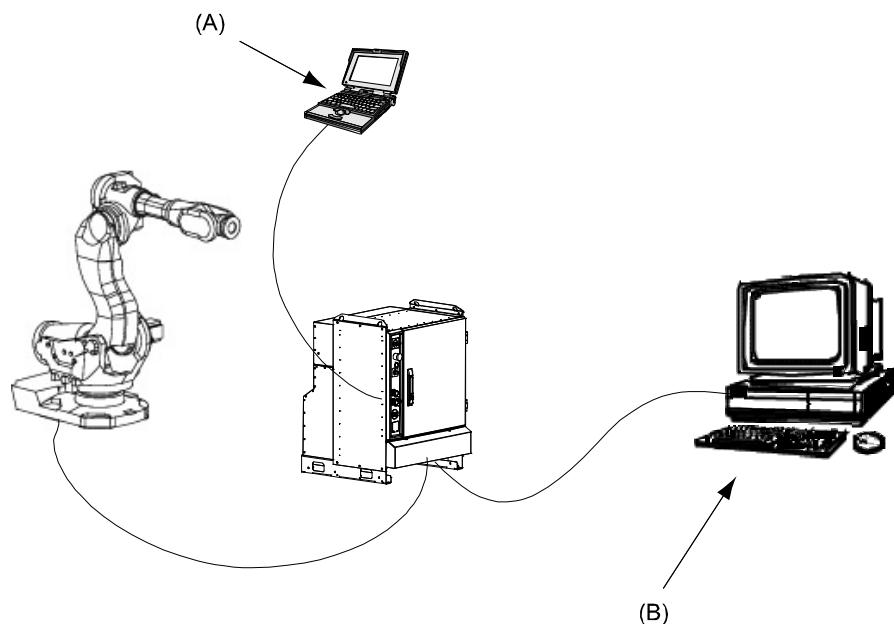
1 Description of the IRC5 controller

1.4.2 Communication

1.4.2 Communication

Ethernet

The controller has several Ethernet channels which can be used at 10 Mbit/s or 100Mbit/s. The communication speed is set automatically.



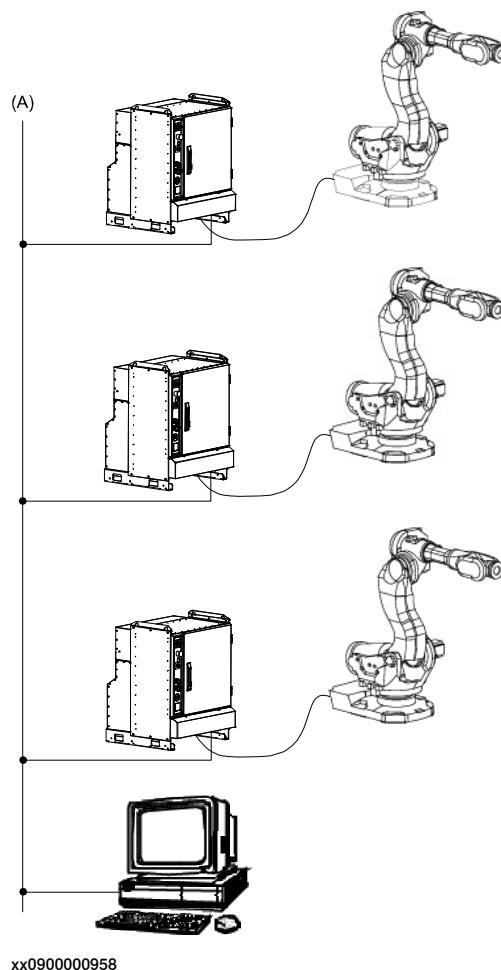
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Pos	Description
A	Temporary Ethernet for service, not for network
B	Permanent Ethernet

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

- DNS, DHCP etc. (including multiple gateway)
- Network file system access using FTP/NFS client and FTP server
- Control and/or monitoring of controllers over OPC or by Windows applications built with PC SDK
- Boot/upgrading of controller software via the network or a portable PC
- Communication with RobotStudio

Continues on next page



Pos	Description
A	Factory network

Serial channel

The controller has one optional serial channel (option 970-1) RS232 for permanent use which can be used for communication point to point with printers, terminals, computers and other equipment.

The serial channel can be used at speeds up to 38.4 Kbit/s.

The RS232 channel can be converted to RS422 or RS485 with an adapter. The following modes of operation are supported:

- RS422
- RS485 4-wire (full duplex, Master)



Note

Synchronous (clocked) mode is NOT supported.

1 Description of the IRC5 controller

1.4.3 Memory

1.4.3 Memory

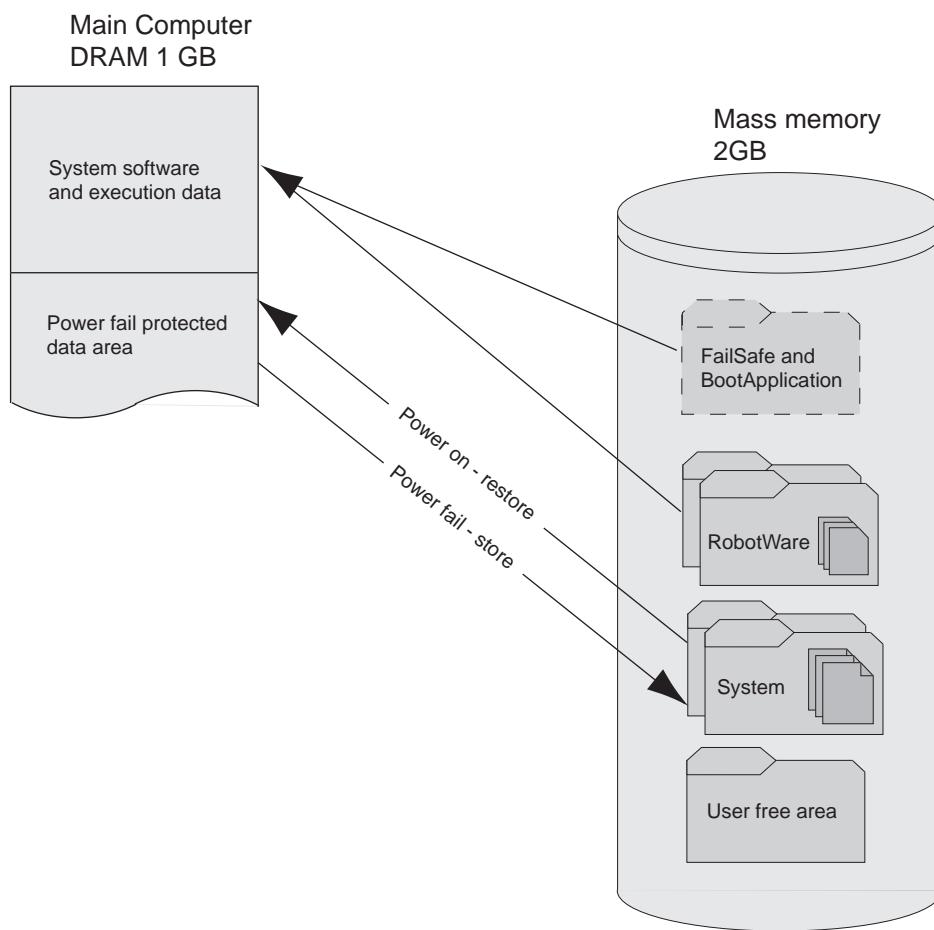
Available memory

The controller has the following memory types:

Memory types	Size	Description
Fixed DRAM memory	1 GB	Working memory
Mass memory	2 GB	SD
Removable mass memory	Customer selected	USB flash memory interface ⁱ

ⁱ USB 1.1 and 2.0 full and high speed are supported.

Filesystem FAT32 is supported.



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Continues on next page

DRAM memory

The DRAM memory is divided into two areas, see Figure above.

Areas	Size	Description
System software and execution data	-	Operating system and RobotWare
Power fail protection data <ul style="list-style-type: none"> • RAPID memory • Configurations • Event logs • Text database 	32 MB <ul style="list-style-type: none"> • 24 MB • 5 MB • 400 KB • 395 KB 	The power fail protected data is saved, as a compressed image, on the mass memory when power failure occurs or at power off. A backup power system (UPS) ensures the automatic storage function. The size of the power fail protected data is limited by the capacity of the backup energy bank.

Mass memory

The mass memory is divided into four main areas, see Figure above

Areas	Size	Description
Base area	20 MB ~32 MB	Fail Safe partition for troubleshooting Boot Application
Release area	~90 MB	All codes and binaries for a specific RobotWare release. The RobotWare storage area will be common as long as all installed systems are based on the same RobotWare. If two or more different RobotWare releases are installed, each release will occupy ~90 MB
System specific data area	20 MB	All the run time specific data including the compressed image stored at power off. Several different systems may be installed at the same time in the controller, of which one system is the active one.
User free area	>750 MB	Can be used for storing RAPID programs, data backups, logs, additional RobotWare releases etc.

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 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 below.

**Note**

RAPID tasks in a Multitasking and MultiMove system share the same memory.

Continues on next page

1 Description of the IRC5 controller

1.4.3 Memory

Continued

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

1.4.4 I/O system

Fieldbus master/slave

There is a choice of different fieldbus types (option):

Option	Description	Number of I/O units
DeviceNet™	PCIe card certified by ABB included	20
PROFIBUS DP Master	PCIe card certified by ABB included	20
PROFINET IO SW	Software based	50
EtherNet/IP™	Software based	20 units (4049 signals/unit)

This makes it possible to mount the I/O units either inside the cabinet or outside the cabinet with a bus cable connecting the I/O unit to the cabinet.

Multiple fieldbuses can be installed in parallel with both master and slave functionality. Maximum total number of I/O units is 40.

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

For DeviceNet™, a number of different I/O units are available from ABB, see [ABB DeviceNet™ I/O units \(node types\) on page 59](#), and [Internal DeviceNet IO on page 98](#).

Fieldbus adapter (slave)

The adapter is docked directly into the main computer. The adapter consists of a slave unit which enables communication with a master, either of:

- EthernetNet/IP™
- PROFIBUS DP
- PROFINET IO
- DEVICNET

Fieldbus gateway (slave)

A gateway unit acts as a translator between IRC5 DeviceNet™ and the customer fieldbus master:

- CC-Link

Number of logical signals

The maximum number of logical signals is 12000 in total for all installed fieldbuses (inputs or outputs, group I/O, analog and digital).

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.

Digital inputs	Digital outputs	Analog outputs
Backup	Auto on	TCP Speed

Continues on next page

1 Description of the IRC5 controller

1.4.4 I/O system

Continued

Digital inputs	Digital outputs	Analog outputs
Disable backup	Backup Error	TCP Speed Reference
Enable Energy Saving	Enable Energy Saving	
Interrupt	Backup in progress	
Limit Speed	Limit Speed	
Load	Cycle On	
Load and Start	Emergency Stop	
Motors Off	Execution Error	
Motors On	Mechanical Unit Active	
Motors On and Start	Mechanical Unit Not Moving	
Reset Emergency Stop	Motion Supervision On	
Reset Execution Error signal	Motion Supervision Triggered	
SimMode	Motors Off	
Soft Stop	Motors Off State	
Start	Motors On	
Start at main	Motors On State	
Stop	Path Return Region Error	
Stop at end of Cycle	Power Fail Error	
Stop at end of Instruction	Production Execution Error	
System Restart	Run Chain OK	
Quick Stop	SimMode	
	Simulated I/O	
	Task Execution	
Write Access	Write Access	



Note

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

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, 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

Continues on next page

- 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

PLC

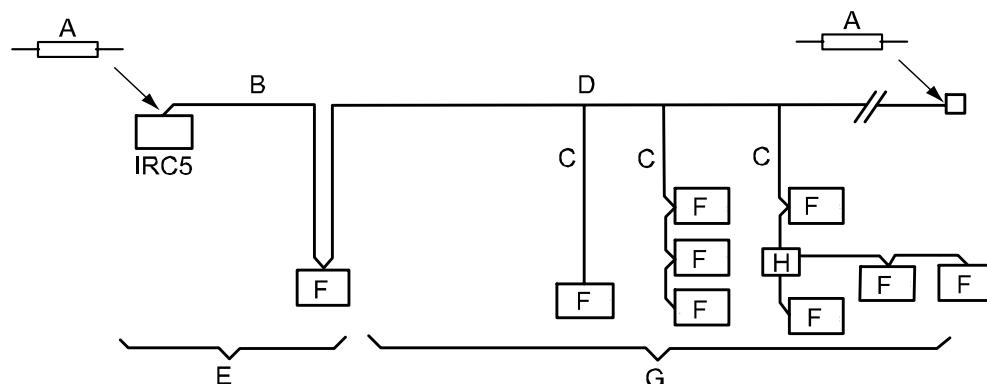
The robot can function as a PLC by monitoring and controlling I/O signals:

- I/O instructions are executed concurrent to the robot motion.
- Inputs can be connected to trap routines. When such an input is set, the trap routine starts executing. Following this, normal program execution resumes. In most cases, this will not have any visible effect on the robot motion, as long as a reasonable number of instructions are executed in the trap routine.
- Background programs (for monitoring signals, for example) can be run in parallel with the actual robot program. This requires the option Multitasking, see *Product specification - Controller software IRC5*.

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

ABB DeviceNet™ I/O units (node types)

Pos	Description	Remark
A	Terminator	
B	Trunk line	
C	Drop line	
D	Tap	

Continues on next page

1 Description of the IRC5 controller

1.4.4 I/O system

Continued

Pos	Description	Remark
E	Zero drop	
F	I/O unit	
G	Short drop	
H	T-connector	

The table shows the maximum number of physical signals that can be handled by each unit.

Type of unit	DSQC	Option No.	In	Out	Voltage output	Power supply	Bus speed
Digital I/O 24 VDC	652	716-1	16	16		Internal/External	Auto detect
AD Combi I/O	651	717-2	8	8	2	Internal/External	Auto detect
Relay I/O	653	718-2	8	8		Internal/External	Auto detect
CC-Link gateway	378B	723-1	176	176			500 kB/s
Encoder interface unit	377B	726-1	1				500 kB/s

Maximum four ABB DeviceNet™ I/O or three gateway units can be mounted in the Single cabinet controller (inside of door).

Power supply

In the Single Cabinet, there is always 24 V DC available at door terminals. The rated current depends on robot size and if additional motors are supplied from the cabinet.

Robot type	24 V I/O
IRB 120 - 4400	8 A
IRB 140 - 4400 with 3 X MU	8 A
IRB 4600 - 7600	8 A
IRB 4600 - 7600 with 3 x MU	5 A

The DSQC609 is possible to order with the Single Cabinet (max 2 units).

Type	Name	Data
Single Cabinet basic	24 V I/O	<p>Output voltage 24 V DC - 2% + 10%. 0 V directly grounded to chassis.</p> <p>Rated continuous load see table above</p> <p>Output over current protection < 8 A, short circuit protected</p> <p>Output over voltage protection < 31.2 V</p> <p>Output hold-up > 20 ms</p> <p>Output noise/ripple < 200 mV p-p</p>

Continues on next page

Type	Name	Data
Option 727-x, 886-1 DSQC609	Customer I/O Power supply	Input 230 V AC Output voltage 24 V DC - 1% + 10%. 0 V directly grounded to chassis. Rated continuous load 4 A Output over current protection < 4.16 A, short circuit protected Output over voltage protection < 31.2 V Output hold-up > 20 ms Output noise/ripple < 200 mV p-p
Option 728-1	DeviceNet™ Power supply	Input 230 V AC Output voltage 24 V DC - 1% + 5%, galvanically isolated from chassis. Rated continuous load 3.9 A Output over load protection < 100 VA Output over voltage protection < 36 V Output hold-up > 20 ms Output noise/ripple < 200 mV p-p Fulfils Limited Power Source NEC Class 2 requirement

The DeviceNet unit isolated outputs minimize the risk for ground loops due to potential differences that can occur if a distributed bus has several 0 V groundings.

Signal data

Digital inputs (options 716-1, 717-2, 718-2)	Values
24 V DC Optically isolated	
Rated voltage	24 V DC
Logical voltage levels	"1" 15 to 35 V "0" - 35 to 5 V
Input current at rated input voltage	6 mA
Potential difference	max. 500 V
Time delays	hardware filter = 5 ms (\pm 0.5 ms) software delay \leq 0.5 ms ⁱ
Time variations	-1 ms +2 ms

ⁱ Software delay time is depending on connection type. The time presented here is for default settings, Change-Of-State with production inhibit time 10 ms.

Digital outputs (options 716-1, 717-2)	Values
24 V DC Optically isolated	short-circuit protected, supply polarity protection
Voltage supply	19 to 35 V
Rated voltage	24 V DC
Logical voltage levels	"1" 18 to 34 V "0" < 7 V
Output current	max. 0.5 A/channel
Potential difference	max. 500 V

Continues on next page

1 Description of the IRC5 controller

1.4.4 I/O system

Continued

Digital outputs (options 716-1, 717-2)	Values
Time delays	hardware \leq 0.5 ms software \leq 1 ms
Time variations	-1ms + 2 ms
Relay outputs (option 718-2)	Values
Single pole relays with one make contact (normally open)	
Rated voltage	24 V DC, 120 VAC
Voltage range	19 to 35 V DC 24 to 140 V AC
Output current	max. 2 A/channel
Potential difference	max. 500V
Time intervals	hardware (set signal) typical 13 ms hardware (reset signal) typical 4 ms software \leq 4 ms
Analog outputs (option 717-2)	Values
Output voltage (galvanically isolated)	0 to + 10 V
Load impedance	min. 2 kohm
Resolution	2.44 mV (12 bits)
Accuracy	\pm 25 mV \pm 0.5% of output voltage
Potential difference	max. 500 V
Time intervals	hardware \leq 2.2 ms software \leq 4 ms

1.5 Operator's interface

1.5.1 FlexPendant

General

All operations and programming can be carried out using the portable FlexPendant (see Figure below), the operator panel, and RobotStudio.



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Pos	Description
A	Display
B	Programmable keys
C	Emergency stop button
D	Joystick
E	Program execution keys
F	USB Memory stick connection
G	Stylus pocket

Information is presented on the display in an intuitive way. No previous programming or computer experience is required to learn how to use the FlexPendant. All information is in English or, if preferred, some other language (for available languages, see *Product specification - Controller software IRC5*). Two

Continues on next page

1 Description of the IRC5 controller

1.5.1 FlexPendant

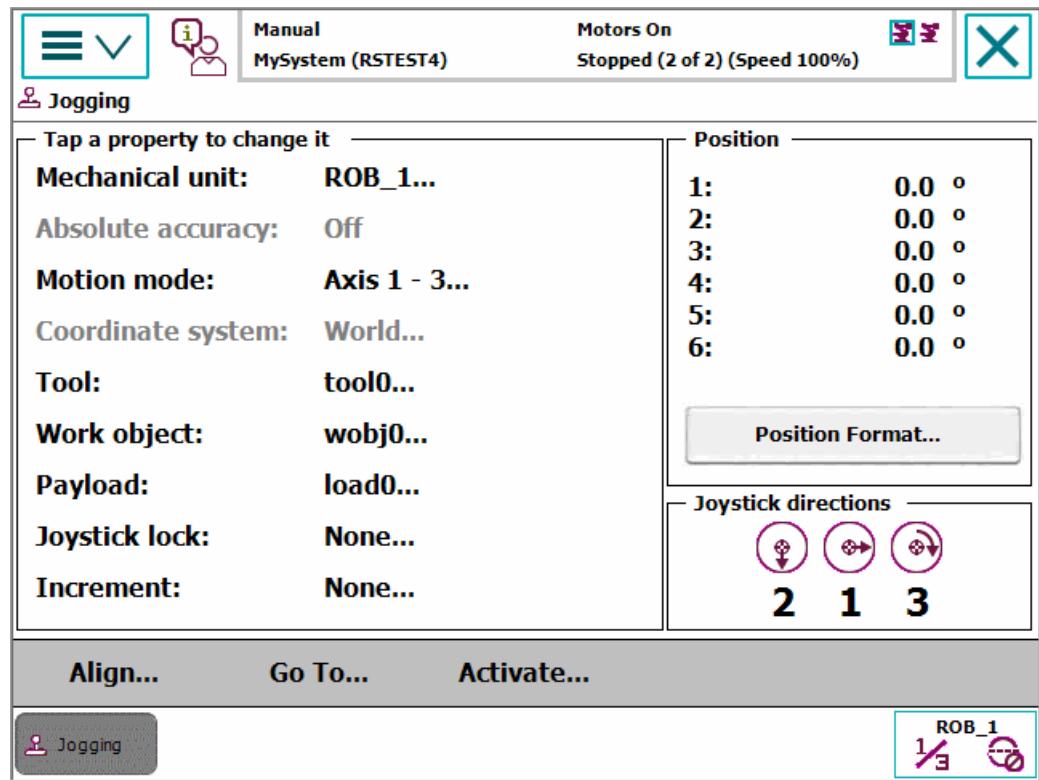
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alternative languages, besides English, can be installed without reloading RobotWare.

Features	Description
Display with touchscreen	A 6.5" 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. Several windows can be open simultaneously. Zoom in and out is available in many views. Many properties of the display can be set by the user for a personalized look and feel. It is possible to invert the display and joystick directions to make the FlexPendant suitable for left handed users. The FlexPendant can house powerful user applications built on Microsoft.NET technology.
Program execution keys	Keys for program start/stop and stepwise execution forward/backward.
Hold-to-run	One of the program execution keys must be pressed continuously when running the program in manual mode with full speed.
Programmable keys	Four user-defined keys that can be configured to set or reset an output (for example open/close gripper) or to activate a system input.
Jogging keys	Four action keys for jogging.
Enabling device	A push button which, in manual mode, when pressed halfway in, takes the system to MOTORS ON. When the enabling device is released or pushed all the way in, the robot is brought to the MOTOR OFF state.
Joystick	The 3D joystick is used to jog (move) the robot manually; for example when programming the robot. The user determines the speed of this movement, 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.

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Example of FlexPendant window



1 Description of the IRC5 controller

1.5.2 T10

1.5.2 T10

General



Note

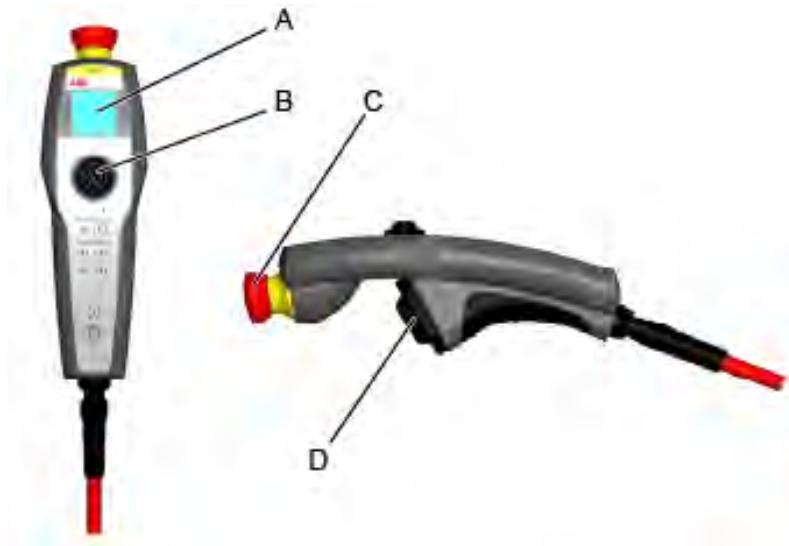
Only available with RobotWare 6

Handheld device used for:

- Jogging robot by pointing and moving the device
- creating and modifying robot path
- starting & stopping robot program

Device features:

- Advanced acceleration & gyroscope sensors
- Dual channel 3 position enabling control device
- Protection class IP 65



xx1400002068

Pos	Description
A	128 x 128 pixel Display
B	Two axis joystick
C	Emergency stop button
D	Enabling control device

1.5.3 RobotStudio

Overview

RobotStudio is a PC application for working efficiently with IRC5 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, a new 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, on-line 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 PC Interface, over a network connection.

A safe mastership handling system ensures that RobotStudio can only take control of a robot if this is acknowledged from the FlexPendant.

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 System Builder 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
- 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.

System Builder

The System Builder is your tool for creating, modifying and maintaining systems. You also use the System Builder to download systems from the PC to the controller.

Configuration Editor

Use the Configuration Editor to make easy and controlled changes of systemparameters 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.

Continues on next page

1 Description of the IRC5 controller

1.5.3 RobotStudio

Continued

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:

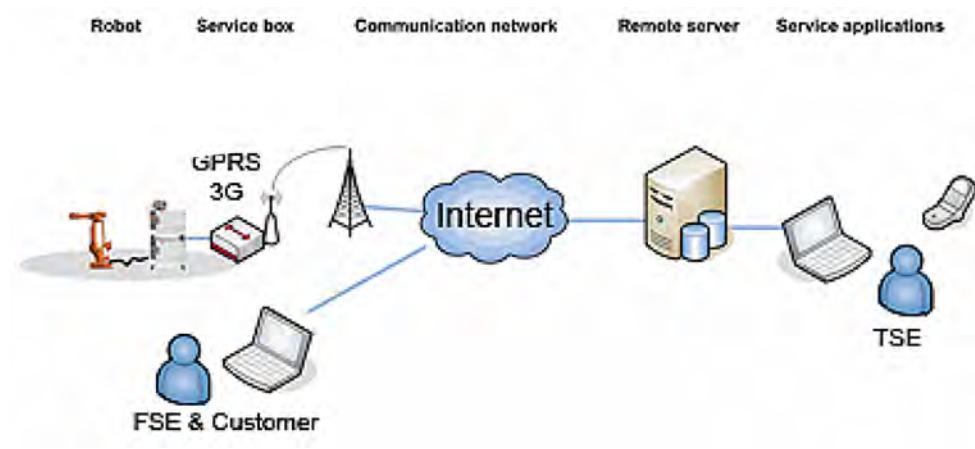
- Backing up and restoring systems
- Administration tool for User Authorization
- And other tools for viewing and handling controller and system properties.
for example monitoring of I/O signals

1.5.4 Remote Service

Remote Service box

The purpose of the Remote Service box is to act as a bridge between the robot controller and a remote server. The connection between the service box and the remote server is made by using a wireless GPRS technology and the Internet. Through the console port and the Ethernet port the information from the robot is buffered, parsed and filtered to obtain valuable service information in the Remote Service application.

The picture below gives a brief overview of the solution. For further details, see *Application manual - Remote Service*.



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1 Description of the IRC5 controller

1.6.1 Programming

1.6 Programming

1.6.1 Programming

General

Programming the robot can be done both from the FlexPendant or RobotStudio. On the FlexPendant, instructions and arguments are picked from lists of appropriate alternatives. In RobotStudio, programs are typed in a free text format and checked for errors when “Apply Changes” is clicked (if no errors, the changes immediately take effect in the robot memory).

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

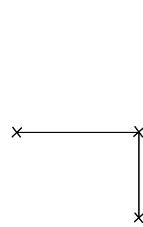
The end position of a movement is selected either by manually jogging the robot to the desired position with the joystick, by referring to a previously defined position or by defining numeric values.

Position types

A position can be defined either as:

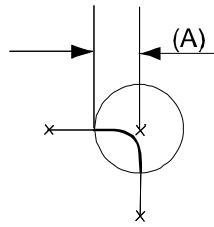
- a stop point, that is the robot reaches the programmed position.
- or a fly-by point, that is the robot passes close to the programmed position. The size of the deviation is defined independently for the TCP, the tool orientation and the additional axes.

Stop point



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Fly-by point



Continues on next page

Pos	Description
A	User definable distance (in mm).

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

For convenience, the programs can be named and stored in different directories.

The mass memory can also be used for program storage. Programs can then be automatically downloaded using a program instruction. The complete program or parts of programs can be transferred to/from the network or a portable flash memory connected to a USB port.

The program is stored as a normal PC text file, which means that it 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 with the joystick to a new position and then pressing the “ModPos” key (this registers the new position)
- entering or modifying numeric values

To prevent unauthorized personnel from making program changes, passwords 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 - IRC5 with FlexPendant* and *Operating manual - RobotStudio*.

1 Description of the IRC5 controller

1.6.2 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.

Absolute measurement

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 the power failure if this behavior has been selected.

1.6.3 RAPID Language and 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 [Exception handling on page 74](#))
- 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 max. number of variables etc., only memory limited). Built-in RAPID support in user interfaces, for example user defined pick lists, facilitate working with RAPID

1 Description of the IRC5 controller

1.6.4 Exception handling

1.6.4 Exception 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 down time.

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

1.6.5 Robot Motion

QuickMove™

The QuickMove™ concept means that a self-optimizing motion control is used. The robot automatically optimizes the servo 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.

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

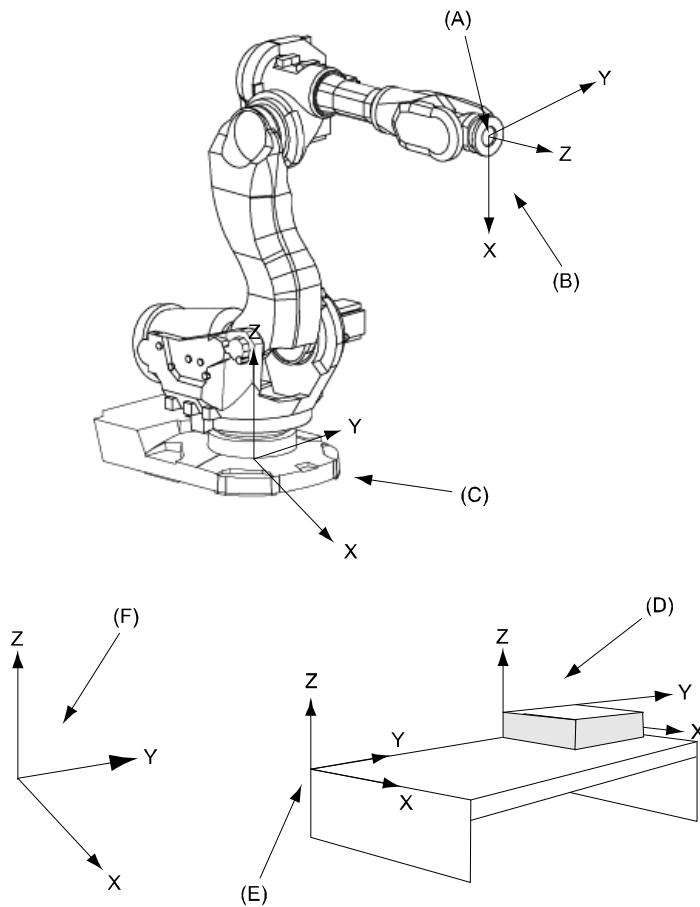
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1 Description of the IRC5 controller

1.6.5 Robot Motion

Continued

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 coordinate 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.

Continues on next page

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	<p>The object coordinate system specifies how a workpiece is positioned in a fixture or workpiece manipulator.</p> <p>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).</p> <p>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.</p> <p>If a fixture or workpiece is moved, only the user or object coordinate system has to be redefined.</p>
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	<p>The robot can move in any of the following ways:</p> <ul style="list-style-type: none"> • 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	<p>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.</p> <p>Any motors (also additional) can be switched to soft servo mode, which means that it will adopt a spring-like behavior.</p>
Jogging	<p>The robot can be manually operated in any one of the following ways:</p> <ul style="list-style-type: none"> • 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. <p>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.</p> <p>During manual operation, the current position of the robot and the additional axes can be displayed on the FlexPendant.</p>

Continues on next page

1 Description of the IRC5 controller

1.6.5 Robot Motion

Continued

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 <i>Collision Detection</i> , described in <i>Product specification - Controller software IRC5</i>).
Additional motors	Very flexible possibilities to configure additional motors. Includes for instance high performance coordination with robot movement and shared drive unit for several motors.
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 all six axes robots and four axes robots, except for IRB 360, as well as for positioners IRBP-L, -K, -R and -A.

1.7 Additional safety options

1.7.1 Electronic Position Switches

General

Electronic Position Switches (EPS) is an additional safety computer in the controller, with the purpose of providing safe output signals representing the position of robot axes. The output signals are typically connected to cell safety circuitry and/or a safety PLC which takes care of interlocking the robot cell, for example in order to prevent robot and operator to enter a common area simultaneously.

Features

- Safety classification according to EN 954-1: Category 3
- Supervision of all robot axes.
- No installation on manipulator.
- 5 safe outputs, representing status for signal axis or a combination of axes.
- Safe input from a synchronization switch for repeated checks during production
- Access to status of safe outputs from RAPID, without any wiring
- EPS replaces mechanical position switches

Option content

The following is included with the option delivery

- The safety computer unit, installed close to the axis computer
- A 14 pole connector plug for I/O connection.
- EPS Configuration Wizard, add-in software to RobotStudio. With EPS Configuration Wizard you can:
 - Set up supervision of all robot axes
 - Quickly modify the supervision settings (password protected)
 - Print a safety certificate

Limitations

- Additional axis, including track motion, positioners etc. connected to measurement link 2 can not be supervised.
- Continuous rotation axes cannot be supervised.
- Drive unit cannot be shared for supervised axes, for example between tools.
- Not available for IRB 120 and IRB 360.
- Not available for non IRB mechanical units.

1 Description of the IRC5 controller

1.7.2 SafeMove

1.7.2 SafeMove

Purpose

SafeMove is a safety controller in the robot system. The purpose of the safety controller is to ensure a high safety level in the robot system using supervision functions that can stop the robot and monitoring functions that can set safe digital output signals.

The supervision functions are activated by safe digital input signals. Both input and output signals can be connected to, for instance, a safety PLC that can control which behavior is allowed for the robot at different times.

The safety controller also sends status signals to the main computer, that is the standard IRC5 robot controller.

Note that SafeMove is one component in a cell safety system, normally complemented by other equipment, e.g. light barriers, for detecting the whereabouts of the operator.

Some examples of applications:

- Manual loading of gripper
- Manual inspection in robot cell during operation
- Optimization of cell size
- Protection of sensitive equipment
- Ensuring safe orientation of emitting processes

What is included

The following is included with the option SafeMove [810-2]:

- Safety controller, DSQC 647 (3HAC026272-001)
- Two 12 pole plug contacts and two 10 pole plug contacts for I/O connections.

The option SafeMove gives you access to SafeMove Configurator functionality in RobotStudio.

With SafeMove Configurator you can:

- configure supervision functions (active supervision that can stop the robot)
- configure activation signals for the supervision functions
- configure monitoring functions (passive monitoring, only sets output signals)
- configure output signals for the monitoring functions
- easily modify the configuration.

Supported robots

The following robot families are supported by SafeMove:

- IRB 140
- IRB 260
- IRB 460
- IRB 660
- IRB 760
- IRB 1600

Continues on next page

- IRB 2400
- IRB 2600
- IRB 4400
- IRB 4600
- IRB 6620
- IRB 6640
- IRB 6660
- IRB 6650S
- IRB 6700
- IRB 7600
- IRB 8700

Other robot models are not supported.

SafeMove cannot be used for parallel arm robots, such as IRB 360.

Supported additional axes

Basically the SafeMove option only supports ABB track motion units. Non ABB track motion units and non ABB positioners may be supported by the SafeMove option if the customer configures the appropriate parameters. The SafeMove option only supports additional axes that are single axis mechanical units. For example, two axes positioners cannot be supported.

Further, there are always the following upper and lower work area limitations:

- Track unit length (arm side) max \pm 100 m
- Rotating axis (arm side) max \pm 25 700 degrees or \pm 448 radians

On the motor side there is also a limitation of \pm 10 000 revolutions.

Stand alone controller

Stand alone controller or drive module without TCP robot, are not supported by SafeMove.

Servo welding gun

SafeMove does not support supervision of servo welding guns.

Tool changer

SafeMove supports up to 4 different tools. All included tools must have their appropriate settings in the configuration file. Selection of tool to be supervised is done by 2 binary coded safe inputs on SafeMove.

Robot mounted on rotational axis

SafeMove does not support supervision or monitoring of a robot mounted on a rotational axis.

No deactivation

All supervised and monitored axes must be active all the time. SafeMove does not support activation/deactivation of additional axis.

Continues on next page

1 Description of the IRC5 controller

1.7.2 SafeMove

Continued

The ABB positioners normally use the activation/deactivation feature and therefore they are not supported by SafeMove.

Independent joint

SafeMove does not support a robot system comprising supervision or monitoring of continuously rotating axes (independent joints).

Shared drive modules

Drive units of supervised and monitored axes cannot be shared, for instance between positioner axes.

Track motion coordinates

When a robot is mounted on a track motion, the following limitations apply:

- It is only possible to define a rotation (no translation) of the robot base frame relative the track motion base frame.
- It is only possible to define a translation (no rotation) of the track motion base frame relative the world frame.

Limit switch override cannot be used

If the option SafeMove is used, it is not allowed to connect any signal to the limit switch override (X23 on the contactor board).

RAPID non motion execution

This test feature cannot fully be used together with the SafeMove option.

Borderline positions

In very rare cases an error message, elog 20473, might be presented if the robot is stopped for a time longer than 40 min in a position exactly on the border of the defined range. This is because of the internal safe design of the SafeMove controller, using a safe two channel microprocessor solution.



Tip

To avoid this, never leave the robot for a longer period in a position near the borders of Monitor Axis Range.

Alternative calibration position

The alternative calibration position, which can be used for robots and external axes, is not supported by SafeMove. The calibration position shall be defined to zero position.



Note

Alternative calibration position can be set in the system parameter *Calibration Position*, which is found under topic *Motion* and type *Arm*.

Continues on next page

MultiMove

It is not supported to use a mixture of EPS (Electronic Position Switches) and SafeMove in a MultiMove installation. However, robots can be used with or without SafeMove in a mixed setup.

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2 Specification of variants and options

2.1 Introduction to variants and options

General

The different variants and options for the controller are described below. The same option numbers and structure are used here as in the specification form.

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

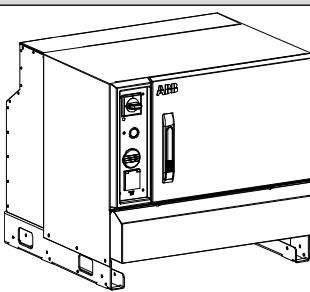
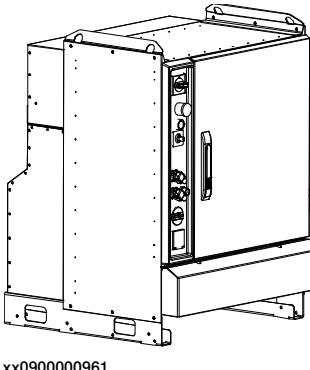
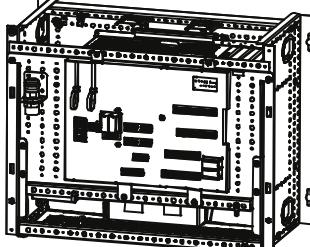
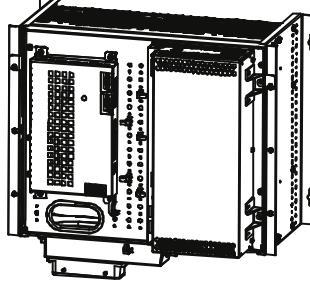
For software options, see *Product specification - Controller software IRC5*.

2 Specification of variants and options

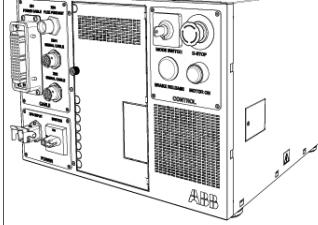
2.2 Basic

2.2 Basic

Controller variants

Option	Description	Illustration
700-1	Drive module only This option is intended for: <ul style="list-style-type: none">• additional robots in a MultiMove configuration.• extended use of additional motors. In this case, the IRC5 stand alone specification form is used. For more information, see Additional drive module on page 15 .	 xx0900000959
700-3	Single cabinet This option is the normal selection for all robots, also for a MultiMove main robot. For more information, see Single cabinet controller on page 9 .	 xx0900000961
700-5	Panel Mounted Controller This controller is intended for integration in customer equipment and consists of two separate modules. <ul style="list-style-type: none">• Control module.• Drive module (small or large, depending on robot version). For more information, see IRC5 Panel Mounted Controller on page 17 .	  xx0900000962
700-6	Panel mounted drive only Additional drive module for Panel Mounted Controller, small or large. This controller is intended for integration in customer equipment.	

Continues on next page

Option	Description	Illustration
700-8	<p>Compact 2nd generation</p> <p>The Compact controller is the standard controller for IRB 120. Available also for IRB 140, 1200, 1410, 1600, 260 and 360.</p> <p>Dimensions 310 x 449 x 442 (HxWxD).</p> <p>For more information, see IRC5 Compact controller on page 26.</p>	 xx0900000316

For empty cabinets and installation kits, see [Process module on page 116](#).

IRC5C controller mounting kit

Option	Description
984-1	Mounting kit Mounting kit for the Compact controller.

Underwriters Laboratory

Option	Description
429-1	<p>UL/CSA</p> <p>The robot and the control system are certified by Underwriters Laboratories to comply with the Safety Standard ANSI/UL 1740-1998 <i>Industrial Robots and Robotic Equipment</i> and CAN/CSA Z 434-94. Law for UL/CSA certification is required in some US states and Canada.</p> <p>UL (UL listed) means certification of the complete robot product.</p> <p>The option is visualized by a "UL" label attached to the cabinet.</p> <p>Note that the variant Panel Mounted Controller is labelled UR (UL recognized) as standard</p>

EC Machinery Directive

Option	Description
129-1	<p>Prepared for CE labelling</p> <p>The robot and the control system comply with the European Union Directive <i>Electromagnetic Compatibility 89/336/EEC</i>. This directive is mandatory for robots operated within EU countries.</p> <p>The option consists of filter located in the Drive module.</p> <p>For the variants Panel Mounted Controller and Compact the filter is always included.</p> <p>Not available for Single cabinets connected to 500 V (IRB 120 -1600), 600 V (IRB 2600-7600) since the filter rating is 525 V.</p>

Transformer for Panel Mounted

Option	Description
881-2	PMC without transformer.

Continues on next page

2 Specification of variants and options

2.2 Basic

Continued

Mains voltage

The IRC5 controller can be connected to a rated voltage of between 200 V and 600 V, 3-phase and protective earthing.

The options below indicate the connection and labelling at delivery.

Option	Voltage labelling	Servo transformer included		
		IRB 120 - 4400	IRB 4600, 660, 66XX, 6700	IRB 7600
769-7	200 V	Yes, Size 1	Yes, Size 5	Yes, Size 5
769-1	220 V	Yes, Size 1	Yes, Size 5	Yes, Size 5
769-2	400 V	Yes, Size 2	-	Yes, Size 5
769-3	440 V	Yes, Size 3	-	Yes, Size 5
769-4	480 V	Yes, Size 3	-	-
769-5	500 V	Yes, Size 3	Yes, Size 5	Yes, Size 5
769-6	600 V	Yes, Size 3	Yes, Size 5	Yes, Size 5

Multi voltage transformer

Option	Description
931-1	World transformer 6 kVA transformer for robots IRB 120-4400. Voltage range 200-600 V

Mains connection type

The power is connected either directly to the mains switch inside the cabinet or to an external connector.

The cable is not supplied.

Option	Description
752-1	Cable gland Cable gland for inside connection. Diameter of cable: 10-20 mm.
752-2	6HSB 6p+PE Connection via an industrial Harting 6HSB connector in accordance with DIN 41640. 35 A, 600V, 6p + PE. The cable counterpart is included.

Mains switch

For Single cabinet there is only one switch. For MultiMove with several Drive modules the total power on/off is controlled from the main robot.

Option	Description
742-1	Rotary switch Rotary switch with padlocking possibility. Customer fuses at the distribution panel are required for short circuit protection of Drive module cabling, see Installation on page 45 .

Continues on next page

Circuit breaker

For Single cabinet there is only one switch. For MultiMove with several Drive modules the total power on/off is controlled from the main robot.

Option	Description
743-1	Circuit breaker Circuit breaker for the rotary switch. The circuit breaker acts as overload protection of Drive module cabling for the case when customer fuses are >3x32A. For fuse selection see interrupt capacity table below. Max. customer fuse 3x80A

Mains voltage	Interrupt capacity for option 743-1
200 V	100 kA
220 V	100 kA
400 V	50 kA
440 V	30 kA
480 V	22 kA
500 V	20 kA
600 V	10 kA

Door interlock

Option	Description
744-1	Door interlock Door interlock for rotary switch. A mechanical lock prevents door opening when the switch is in ON-position.

Room temperature

Option	Temperature	Description
708-1	Max 45 C Room temperature up to + 45°C (+ 113°F).	Standard design.
708-2	Max 52 C Room temperature up to + 52°C (+ 125°F).	Forced air circulation inside cabinet, increased fan capacity in the IRB 66XX/IRB 7600 Drive system.

Temperature sensor fans

Option	Temperature	Description
1170-1	Temperature sensor fans	The drive unit fans are dynamically controlled. The rotation speed of the fans will vary individually with ambient temperature and drive unit load. This reduces power consumption and sound pressure.

Fans for Panel Mounted Controller

Option	Description
882-1	Fans Fan unit including 3 fans (Included in PMC Large).

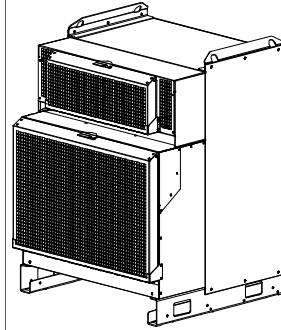
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2 Specification of variants and options

2.2 Basic

Continued

Cooling air filter

Option	Description	Illustration
764-1	Moist particle filter Metal mesh stops particles >0.5 mm from entering the cooling ducts.	
764-2	Moist dust filter Synthetic filter prevents sticky dust from clogging the cooling fans and heat sinks.	 xx0900001028

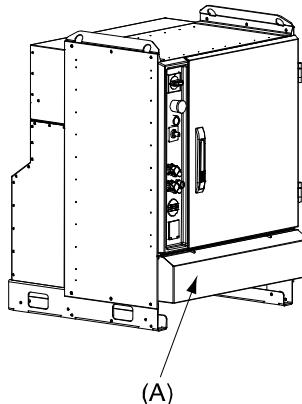


Note

Avoid these options if the cabinet rear can be exposed to weld spatter. Clean filters are fire resistant but dirty filters are not.

Cabinet connector protection

Option	Description
741-1	Connector cover Each module in the order will be equipped with an connector cover. For information about the cabinet connectors, see Cabinet connectors on page 13 .



xx0900000963

A	Connector cover
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Continues on next page

Warranty

Option	Type	Description
438-1	Standard warranty	Standard warranty is 12 months from <i>Customer Delivery Date</i> or latest 18 months after <i>Factory Shipment Date</i> , 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 <i>Factory Shipment Date</i> or from activation date of standard warranty in WebConfig.  Note Special conditions are applicable, see <i>Robotics Warranty Directives</i> .

Remote Service enabled

The Service box is located in the Control module or Single cabinet floor. An antenna with magnetic foot (included) is to be connected to the connector plate.

Option	Description
890-1	GPRS/Internet Remote Service enabling kit for both wireless (GPRS) and Internet usage. The Remote Service need to be activated by local ABB as part of a Service Level Agreement. The cost for mobile and internet communication is included until last day of standard warranty period as registered in WebConfig.
890-2	Pre-wiring Remote Service enabling kit for Internet usage only. The Remote Service need to be activated by local ABB as part of a Service Level Agreement. The cost for mobile and internet communication is included until last day of standard warranty period as registered in WebConfig.

2 Specification of variants and options

2.3 Floor cables

2.3 Floor cables

Manipulator cable - length

The manipulator cables consists of two cables.

Cable Type	Description
Motor cable	Industrial connector type in both ends except for IRB 140 and IRB 360 where the manipulator end has internal connection.
Measurement cable	Circular connector type in both ends except for IRB 140 and IRB 360 where the manipulator end has internal connection.

Option	Description	Remarks
210-1	3 m	IRB 120, IRB 140, and IRB 360.
210-2	7 m	
210-3	15 m	
210-4	22 m	211-2 for IRB 140
210-5	30 m	211-3 for IRB 140

Connection of parallel communication

Option	Description
94-1	7 m
94-2	15 m
94-4	30 m

2.4 Control module

FlexPendant

Color graphic pendant with touch screen. For more information, see [FlexPendant on page 63](#).

Option	Description
701-1	FlexPendant 10 m
701-3	FlexPendant 30 m With this option the FlexPendant is delivered with a 10 m cable and comes with a separate 30 m cable. The cable replacement is an easy operation.



xx1400002067

A	Display
B	Emergency stop button
C	Enabling control device
D	Joystick

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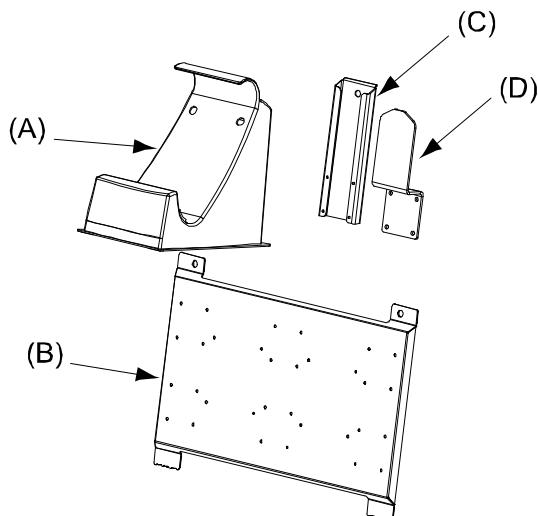
2 Specification of variants and options

2.4 Control module

Continued

FlexPendant mounting

Various articles for mounting are included, see figure below.



xx0900000981

A	Display
B	Mounting plate (mounting holes Ø 8.5 mm (2x), distance 340 mm)
C	Cable bracket holder
D	Cable bracket

FlexPendant removal

Option	Description
702-1	Connector plug The option consists of a jumper connector to close the safety chains. This is mandatory if a FlexPendant is not connected.
702-2	Hot plug The FlexPendant can be disconnected and reconnected without breaking the safety chain and affecting the program execution. Connector plug included. Available also for remote panel.

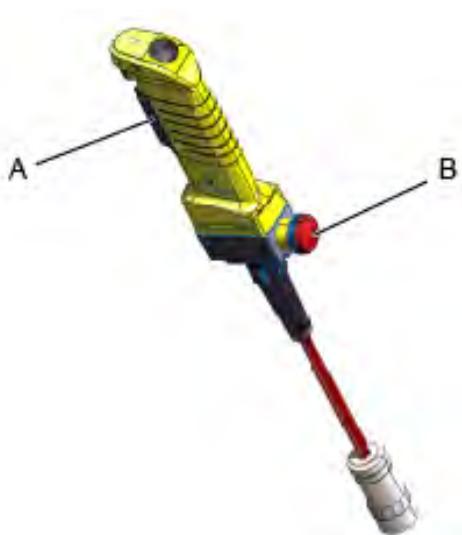
T10 Jogging device

Option	Description
976-1	T10 Jogging device The T10 is a jogging device used to jog manipulators and mechanical units in an intuitive way by pointing the device in the direction of movement. For more information, see T10 on page 66 .

Jokab enabling device

Option	Description
983-1	Enabling device The Jokab enabling device is a handheld safety device used for enabling robot movements for testing, and provides full control of robot stop.

Continues on next page



xx1400002069

A	3 pos enabling button
B	Emergency stop button

FlexPendant language

The basic language is always English. The following languages are available:

Description
French
German
Spanish
Italian
Chinese
Portuguese
Dutch
Swedish
Danish
Czech
Finnish
Korean
Japanese
Russian
Polish
Turkish
Hungarian
Romanian
Slovenian

Continues on next page

2 Specification of variants and options

2.4 Control module

Continued

RS232 serial port

Option	Description
970-1	RS232 Serial Channel One RS232 serial channel for permanent use which can be used for communication point to point with printers, terminals, computers, and other equipment.

The fieldbus adapter and the RS232 serial channel is located on the fieldbus adapter expansion board. Therefore the option 970-1 is required when using a fieldbus adapter, see [Fieldbus adapters on page 97](#).

DeviceNet™ m/s

Option	Description
709-1	Single channel

PROFIBUS DP

Option	Description
969-1	PROFIBUS DP

PROFIBUS DP m/s CFG tool

Option	Description
285-1	PROFIBUS DP m/s CFG tool

PROFINET IO

Option	Description
888-2	PROFINET IO m/s SW Occupies one Ethernet port.
888-3	PROFINET IO slave SW Occupies one Ethernet port.

EtherNet/IP™

Option	Description
841-1	EtherNet/IP™ m/s Occupies one Ethernet port.

Ethernet switch

Option	Description
941-1	Ethernet switch Occupies one EtherNet port.

PROFIENERGY

Option	Description
963-1	PROFIENERGY, for details see <i>Application manual - PROFIenergy Device</i>

Continues on next page

Connectors on front plate

Option	Description
730-1	DeviceNet™ on front One external DeviceNet™ connector. Corresponding customer part is not included. Brad Harrison type 1A5006-34 or ABB part number 3HAC 7811-1 is recommended.
707-1	Ethernet RJ45 Internally connected to the computer LAN port.
906-1	Ethernet M12 Internally connected to either the EtherNet/IP™ port or the PROFINET IO port.

For more information about the Ethernet connectors on the main computer, see [Ethernet connections on page 51](#).

Fieldbus adapters

Option	Description
840-1	EtherNet/IP™ Up to 1024 digital inputs and 1024 digital outputs can be transferred serially to a master equipped with an EtherNet/IP™ interface. The bus cable is connected directly to the adapter RJ45 connector.
840-2	PROFIBUS DP Up to 512 digital inputs and 512 digital outputs can be transferred serially to a master equipped with a PROFIBUS DP interface. The bus cable is connected to the adapter D-sub connector.
840-3	PROFINET IO Up to 1024 digital inputs and 1024 digital outputs can be transferred serially to a master equipped with a PROFINET IO interface. The bus cable is connected to the adapter RJ45 connector.
840-4	DeviceNet IO Max 512 bytes of I/O data. Baudrate 125-500 kbit autodetect.

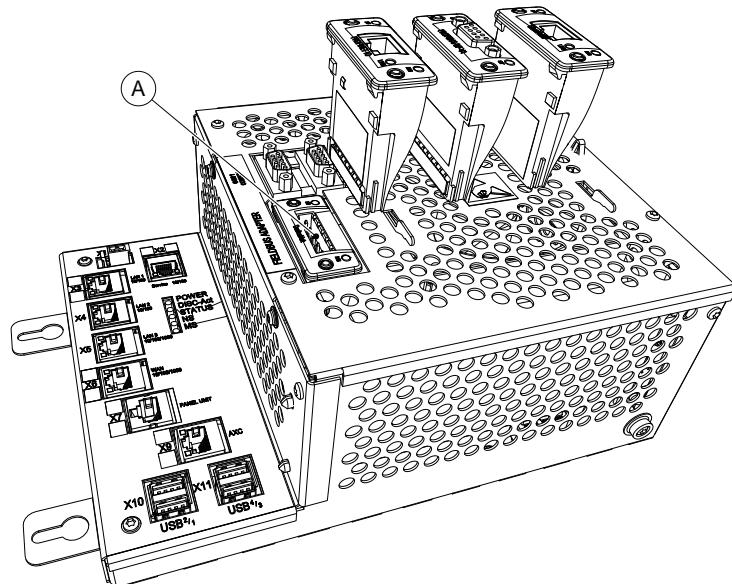
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2 Specification of variants and options

2.4 Control module

Continued

The fieldbus adapter and the RS232 serial channel is located on the fieldbus adapter expansion board. Therefore the option 970-1 is required when using a fieldbus adapter, see [RS232 serial port on page 96](#).



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A	Slot for AnybusCC fieldbus adapters
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Internal DeviceNet IO

Option	Description
716-1	Digital 24V 16In/16Out Digital 24 VDC I/O (DSQC 652). 16 inputs/16 outputs. Also available for external mounting, see External DeviceNet I/O on page 99 .
717-2	Combi 8DIn/8DOut 2AnOut AD Combi I/O (DSQC 651). 8 digital inputs/8 digital outputs and 2 analog outputs (0-10 V).
718-2	Digital in/8 Relay Out Digital I/O with relay outputs (DSQC 653). 8 inputs/8 outputs. Relay outputs to be used when more current or voltage is required from the digital outputs. The inputs are ordinary digital 24 V.

Maximum four ABB DeviceNet™ I/O or three gateway units can be mounted in the Single cabinet controller (inside of door).

The Compact controller includes 1 internal I/O unit (716-1). Further internal units are not possible. The signals are accessed at the Compact front on terminal connectors behind a cover.

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Internal DeviceNet gateway

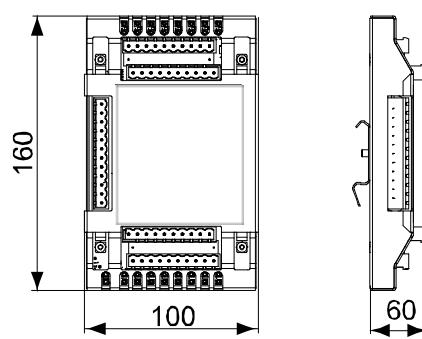
Option	Description
723-1	<p>CC-Link slave CC-Link (DSQC 378B).</p> <p>Up to 176 digital inputs and 176 digital outputs can be transferred serially to a PLC equipped with an CC-Link interface. The bus cables are connected directly to the DSQC 378B (one 6-pole Phoenix connector included).</p> <p>Also available for external mounting, see External DeviceNet gateway on page 100.</p>
726-1	<p>Encoder interface unit Encoder interface unit for conveyor tracking (DSQC 377B).</p> <p>This option is required for:</p> <ul style="list-style-type: none"> • <i>Conveyor Tracking</i> (RW option 606-1) which makes the robot follow a work object on a moving conveyor. • <i>Sensor Synchronization</i> (RW option 607-1) adjusts the robot speed to an external moving device (for example a press or conveyor) with the help of a sensor. • <i>PickMaster</i> conveyor tracking applications. <p>The customer encoder and synchronization switch cables are connected directly to the DSQC 377B (one 16-pole Phoenix connector included). The encoder must be of 2 phase type for quadrature pulses, to enable registration of reverse conveyor motion, and to avoid false counts due to vibration etc. when the conveyor is not moving.</p> <p>Output signal: Open collector PNP output.</p> <p>Voltage: 10-30 V (normally supplied by 24 VDC from DSQC 377B).</p> <p>Current: 50-100 mA.</p> <p>Phase: 2 phase with 90 degree phase shift.</p> <p>Duty cycle: 50%.</p> <p>Following encoder is verified: Lenord & Bauer GEL 262.</p>

External DeviceNet I/O

Option	Description
816-1	<p>Digital 24V 16In/16Out Digital 24 VDC I/O (DSQC 652).</p> <p>16 inputs/16 outputs.</p> <p>Also available for internal mounting, see Internal DeviceNet IO on page 98.</p>

ABB I/O and gateway units may be located elsewhere in an encapsulation. The units are prepared for DIN rail mounting. Protection degree is IP 20 and max. operating temperature is +65°C (+149°F).

Bus connectors, address key and termination resistor are included.



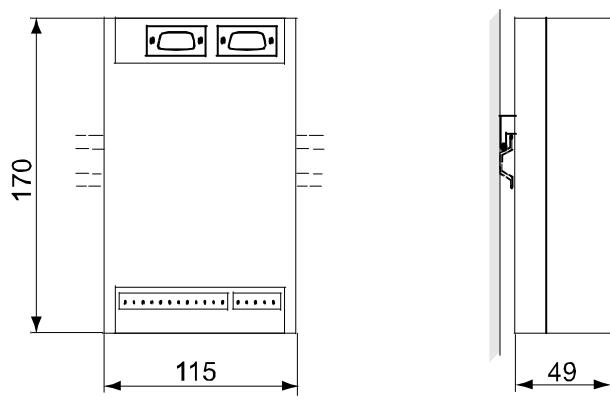
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2 Specification of variants and options

2.4 Control module

Continued



Bus connection to the controller is performed by:

- directly to PCIe master (709-x), if no internal DeviceNet™ units are installed
- to 5 pole connector (A35.X1) in internal cable harness, if other DeviceNet™ units are installed
- to external connector (XS17) on cabinet connector plate, if option 730-1, see below is selected.

External DeviceNet gateway

Option	Description
723-1	CC-Link slave External CC-Link (DSQC 378B). Corresponding to the option 723-1, see Internal DeviceNet gateway on page 99 .

Power supply

Option	Description
727-1	24V 8Amps 24 V 8 Amps for bus and process supply.
727-3	24V 4Amps 24 V 4 Amps for bus and process supply.
728-1	Devicenet 24V 4Amps 24 V 4 Amps for bus supply. Galvanically isolated from ground. In the normal case the Single cabinet integrated 24 V I/O supply can be used for both bus and customer I/O. The bus is then grounded at the cabinet chassis. Single point grounding is required by ODVA (Open DeviceNet™ Vendor Association). If there is a risk for multiple grounds, for example when the bus is distributed to several places, the option 728-1 is recommended. Then the 24 V supply is isolated from ground and the bus can be single point grounded at any customer selected place. Another reason for selecting option 728-1 is the < 100 W output, thereby fulfilling requirements for Limited Power Source class 2 from NEC. This requirement is also met by separating the outputs for the 4 A units 727-x.
886-1	24V 4A 24 V 4 Amps for customer DIN rail mounting.

The total 24 V customer load may not exceed 20 A when powered from the IRC5 transformer 230 V.

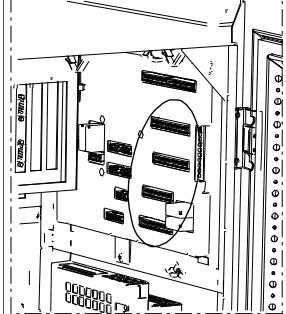
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In combination with DeviceNet™ m/s single channel (option 709-1) and any DeviceNet™ node (for example option 716-1), the customer power supply is pre-wired in the following ways:

Single cabinet

- As standard 24 V I/O supplies the DeviceNet™ bus and is also available for general usage on door terminals XT31. Available current 1.6 - 8 A, see [I/O system on page 57](#).
- Option 727-3. 4 A is available for general usage on door terminals X31 in addition to and separated from above.
- Option 727-1. 2 x 4 A is available for general usage on door terminals XT31 in addition to and separated from above. The two outputs are parallel connected at delivery.
- Option 728-1. The 4 A DeviceNet™ unit supplies the DeviceNet™ bus.

Safety interface

Option	Description	Illustration
731-1	<p>Safety internal connection</p> <p>The signals are connected directly to screw terminals at the panel board inside the cabinet.</p>	 xx0900000983
731-2	<p>Safety external connection</p> <p>The signals are connected via a 40-pole standard industrial connector in accordance with DIN 43652. The connector is located at the foot of the module. Corresponding customer part is included.</p>	

IMM interface

IMM (Injection Mould Machines) interface. The Euromap (European Committee of Machinery Manufacturers for the Plastics and Rubber Industries) and SPI (Society of Plastics Industry) options are the injection moulding machine – robot signal interface.

The two different options are based on the European and the American standards.

Connection

Option	Description
671-1	<p>Euromap 12 and SPI AN116</p> <p>This is used for injection moulding machines which offer only single channel security. To adapt to the robot controller using Euromap 67, a converter box is plugged on the Euromap 67 connector outside the cabinet. Includes option 671-2.</p>

Continues on next page

2 Specification of variants and options

2.4 Control module

Continued

Option	Description
671-2	Euromap 67 and SPI AN146 This is the standard in Europe, which offers double channel security from the injection moulding machine. The robot interface for Europe 67 is implemented in the standard IRC5 cabinet with a Euromap connector mounted on the connector plate.

Cable

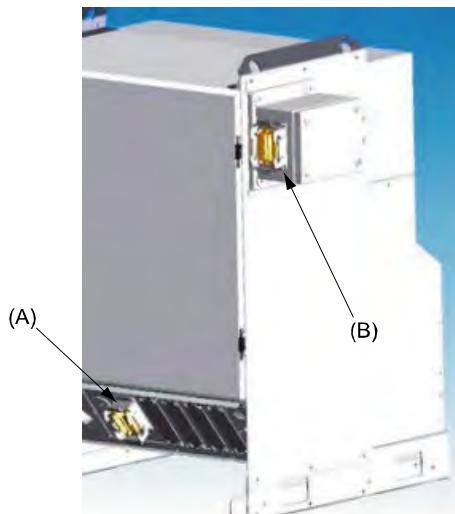
Option	Description
673-1	Cable 10m
673-2	Cable 15m

Further options

The Euromap/SPI options require the following options to be ordered with the robot:

- 1 digital I/O DeviceNet™ board [716-1 or 716-2 or 718-2 (SPI)] (for additional devices such as gripper, conveyor, additional boards are needed)
- 1 PCI interface board required for the DeviceNet™ bus [709-1]

To control the Euromap/SPI signal "Mould area free", the option Electronic Position Switches is recommended. With a position switch function on axis 1, the signal "Mould area free" is set when the robot turns out of the range defined by axis 1. Position switch functions on axis 1 and 2 can be combined to set the signal "Mould area free" earlier and thereby close the machine earlier. The option Electronic Position Switches, 810-1, is ordered separately. To configure the Euromap/SPI input and output signals in the RobotWare, I/O-configuration files are available on the RobotWare DVD in the folder *Utility*. In robot test mode, when the machine is disconnected, the controller jumper plug can be used. The Euromap/SPI options are compatible with application software RobotWare Plastics Mould, [675-1].



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A	Option 671-2, Euromap 67
B	Option 671-1, Euromap 12

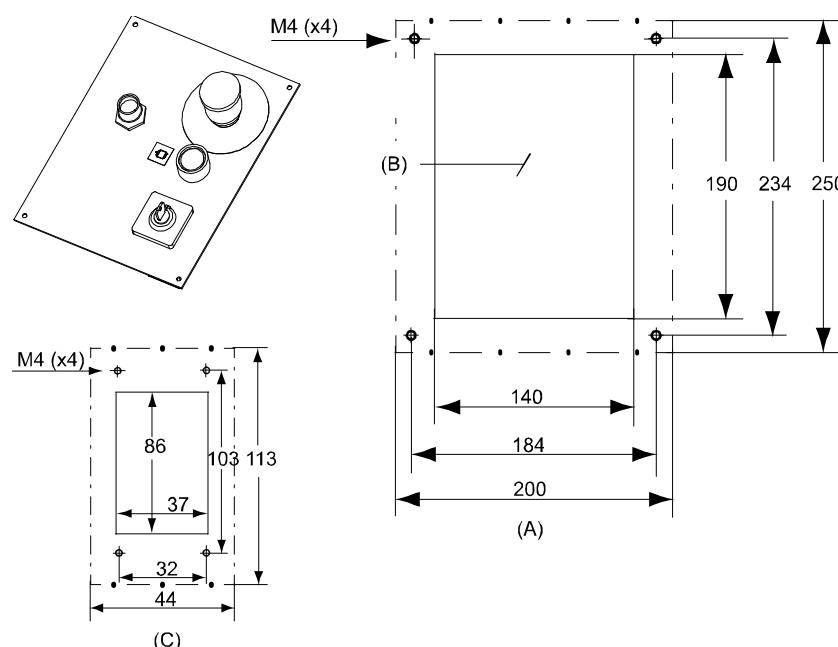
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Operator's panel

The operator panel can be installed in different ways.

Option	Description
733-1	Panel on cabinet (standard) On the front of the cabinet.
733-3	External panel To be mounted in a separate operator's unit (enclosure not supplied). See installation requirements in the figure below.
733-4	External panel small box Mounted in a box. See figure below

External panel installation requirements



xx0900000984

A	Holes for operator panel
B	Required depth 130 mm
C	Holes for cable flange

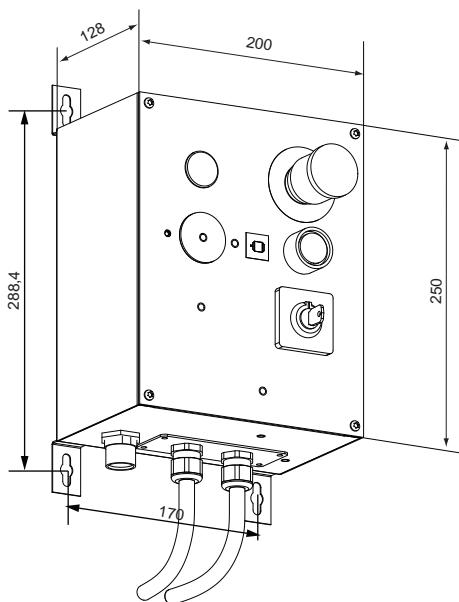
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2 Specification of variants and options

2.4 Control module

Continued

External panel small box



xx1100000562

A	Use M5 for fastening
B	Color NCS 2502B (light grey)

Operator's panel cable

Option	Description
734-1	Panel cable - 15 m
734-3	Panel cable - 30 m
734-5	Panel cable - 7 m

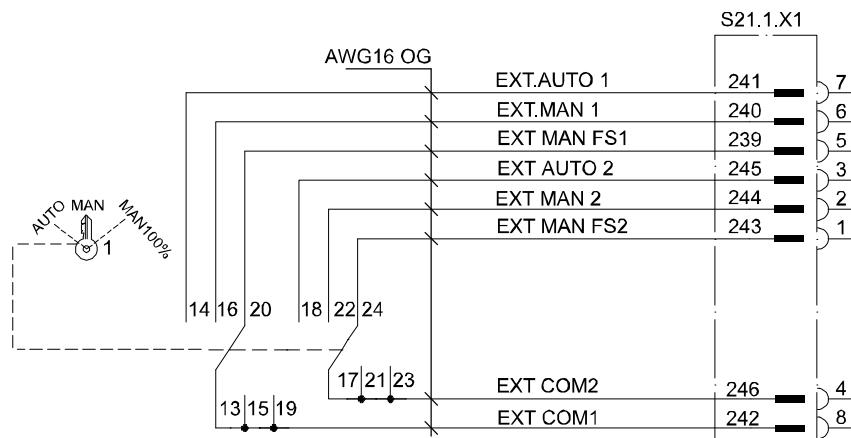
Operating mode selector (key switch)

Option	Standard	Description
735-1	Standard	Three modes: manual, manual full speed and automatic.
735-2	Standard	Two modes: manual and automatic.
735-3	Additional contact	Three modes manual, manual full speed and automatic.
735-4	Additional contact	Two modes: manual and automatic.

The three mode types do not comply with UL safety standards, since manual full speed is not permitted. The option additional contact means contacts (dual

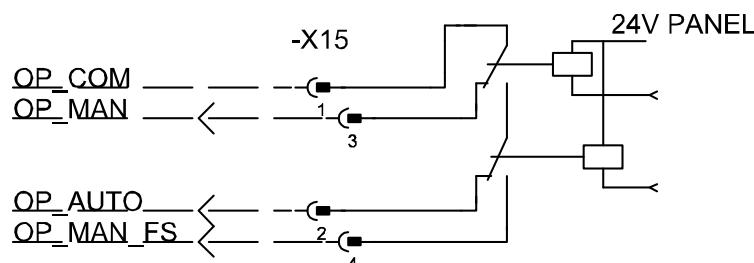
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channels) for customer usage, see Figure below. The connector S21.1.X1 is found in the cable harness. Customer part is included.



xx0900001033

As standard the mode selector position can be indicated by relay contacts (single channel), see figure below. The connector X15 is located at the panel board (see option 731-1). Customer part is not included. Recommended type ABB CEWE Control, article number 1SSA 445024 R0100.



xx0900000982

Status LEDs at front

External status indication of the safety signals in addition to the internal LEDs at the panel board. The LEDs are located at the cabinet operator panel (not available on the remote operator panel).

Option	Description
737-1	Status LEDs at front

2 Specification of variants and options

2.5 Drive module

2.5 Drive module

Single drive unit

Options	Description
907-1	Single drive unit (maximum three) Drive unit ADU-790A

Single drive unit data

Drive unit type	Rated current (Amp rms)	Max current (Amp rms)	Voltage to motor (V rms)
ADU-790A	30	55	377-430 ⁱ , 234

ⁱ Depending on line voltage, when used in IRB 66XX/7600

Prepared for positioner, motor unit, or gear unit

Option	Description
922-1	Prepared for IRBP
946-1	Prepared for MU/GU

Cabinet prepared for mounting of motor selector unit. The option is also used in ordering system to link IRB order with IRBP/MU/GU order.

For more than three additional motors a separate drive module is ordered from the stand alone controller specification form. For more information, see [IRC5 as stand alone controller on page 29](#) and [Drive system selection, stand alone controller on page 118](#).

SMB for additional motors

The normal way for additional motors is to use the encapsulated SMB (Serial Measurement Board) units with floor cable offered by the IRBP Function Package specification form.

The floor cable is connected to measurement link 2. A connector XS41 is provided on the connector plate as soon as a single drive unit is selected, see [Cabinet connectors on page 13](#). For users who want to put the board in own encapsulation (at least IP54), the following options are available. Floor cable to XS41 has to be provided by the user.

Option	Description
757-1	Ext SMB unit Serial measurement board as separate unit with battery for mounting in an external cabinet encapsulation.
757-2	Ext SMB unit w. cables Serial measurement board as separate unit with battery and cables for mounting in an external encapsulation. One 700 mm cable with connector fitting the measurement link and one 1400 mm cable with a 64-pole industrial female connector for resolver connection.

Continues on next page



Note

Note that when a drive unit for axis 7 (option 907-1) is ordered, the measurement board in the manipulator can be used for resolver feedback.

The following manipulators are prepared for resolver 7 connection to the robot SMB. A separate option, 864-1, is required.

Manipulator	Description	Comment
IRB 360	Connector at base box, R3 FB7	
IRB 1600	Connector at base, R3 FB7	
IRB 2600	Connector at base, R3 FB7	
IRB 4600	Connector at base, R3 FB7	
IRB 660	Connector at base, R3 FB7	
IRB 760	Connector at base, R3 FB7	
IRB 6600	Connector at base, R3 FB7	
IRB 6620	Connector at base, R3 FB7	
IRB 6640	Connector at base, R3 FB7	Not for Foundry Prime.
IRB 6660	Connector at SMB cover, R2 FB7	
IRB 7600	Connector at base, R3 FB7	

Additional cables

These options are intended for distributed drive modules, see examples below.

Option	Description
761-1	Drive module cables 4m
761-3	Drive module cables 30m

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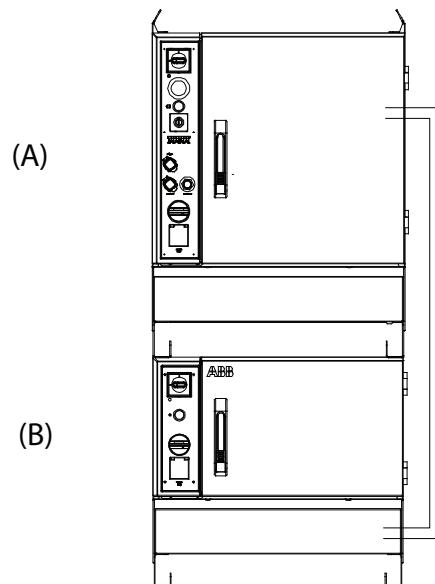
2 Specification of variants and options

2.5 Drive module

Continued

Example with option 761-1

Drive module only (700-1) with 4 m cable. The combination is intended for stacking with single cabinet. The option consists of Ethernet and safety cables (2 pcs). One cable duct is included but not mounted.

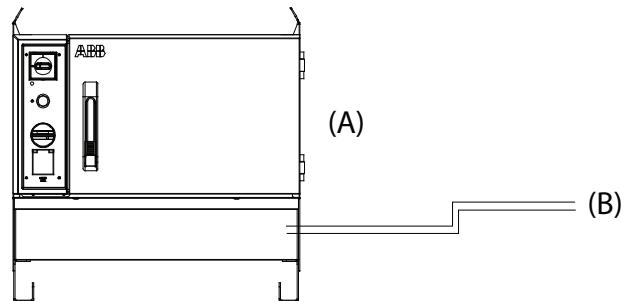


xx1300000794

A	Single cabinet
B	Drive module

Example with option 761-3

Drive module only (700-1) with 30 m cable for distributed layout. The option consists of Ethernet and safety cables (2 pcs). Cable duct is not included.



xx1300000795

A	Drive module
B	To single cabinet

Duty time counter

Option	Description
767-1	Duty time counter Indicates the operating time for the manipulator (released brakes)

Continues on next page

In addition to the optional hardware duty time counter (DTC) there is also a software DTC included in SIS (*Service Information System*). This function displays the operating time on the FlexPendant. To read the software DTC tap *ABB menu/System Info/Hardware devices/Mechanical units/ROB_1/General SIS data*.

For more information, see *Operating manual - Service Information System*.

Wheels

The cabinet foot can be equipped with wheels. Three wheels on each side with the middle wheel raised 5 mm. By balancing on the middle wheels the cabinet can easily be maneuvered. The cabinet resting position is on the front and middle wheels.

Option	Description
758-1	Wheels Wheels mounted in the cabinet foot

Service outlet

Any of the following standard outlets with earth fault protection can be chosen for service purposes. Max load is 200 W. The outlet is located at the front.

Option	Outlet
736-1	Service outlet 230V 230 V outlet in accordance with DIN VDE 0620. Single socket suitable for EU countries.
736-2	Service outlet 120V 120 V outlet in accordance with American standard. Single socket, Harvey Hubble.

Prepared for Force Control

For robots which will be equipped with a force sensor by the integrator. A voltage measurement board, is encapsulated in a box to be mounted close to the manipulator.

The box is connected to the axis computer measurement link 2 with a cable of same length as option 210-x.

Option	Description
738-1	Prep. for Force Control

The option *Force control package 636-x* contains all required hardware and software to run the robot in force control mode, see [Force control package on page 111](#).

EPS and SafeMove

A safety enabled separate computer located behind the axis computer.

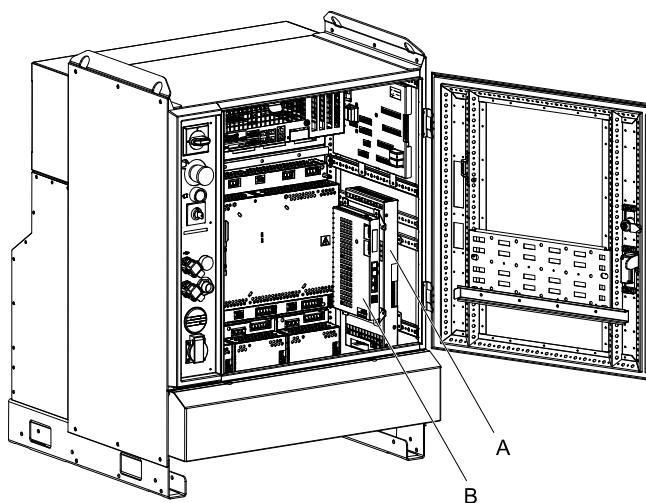
Option	Description
810-1	Electronic Position Switches
810-2	SafeMove

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2 Specification of variants and options

2.5 Drive module

Continued



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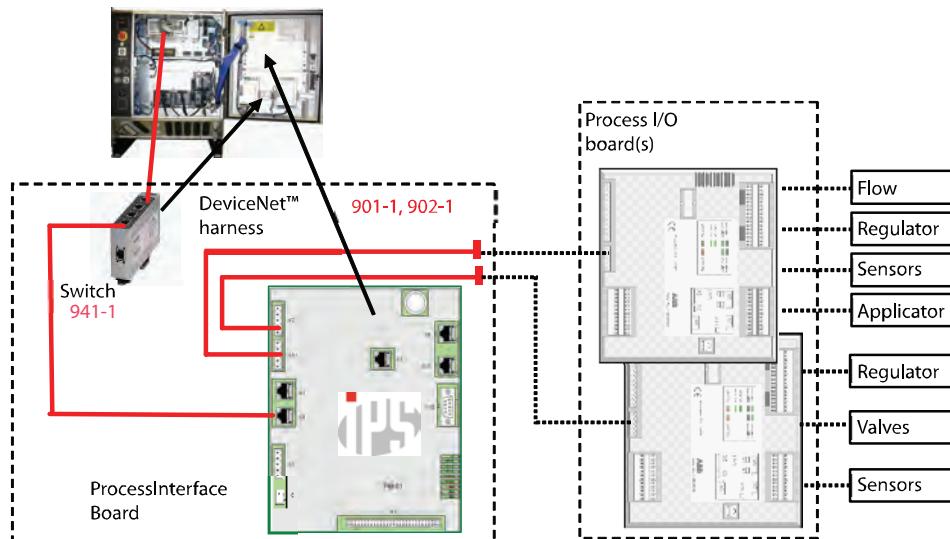
A	EPS or SafeMove board
B	Axis computer

2.6 RobotWare

DispensePac support

With DispensePac support hardware and software functions can be ordered as options when buying the robot. The intention of the DispensePac support is to supply building blocks supporting the complete Dispense Package that is offered via the ABB Global Lead center. For further information on DispensePac support, see *Application manual - Dispense*.

Option	Name	Description
901-1	DispensePac support	Process Interface board (PIB) with IPS software. Ethernet Communication cables. Ethernet switch. Power supply of PIB and switch. Two DeviceNet™ cables from PIB to cabinet floor. PIB communication software. RW Dispense adaptations for DispensePac support. Paint Medium package options including Production management is available in System Builder (RobotStudio).
902-1	Channel support	Defines number of control loops (1 - 5 to specify)



xx0900000965

Force control package

The force control package contains all required hardware and software to run the robot in force control mode.

It contains the following components:

- Option 738-1 *Prepared for Force Control*, see [Prepared for Force Control on page 109](#).
- Option 661-2 *Force Control Base*
- Force sensor, adapter plate and cabling as described below.

Option	Description
636-1	Force Control Package 165
636-2	Force Control Package 660

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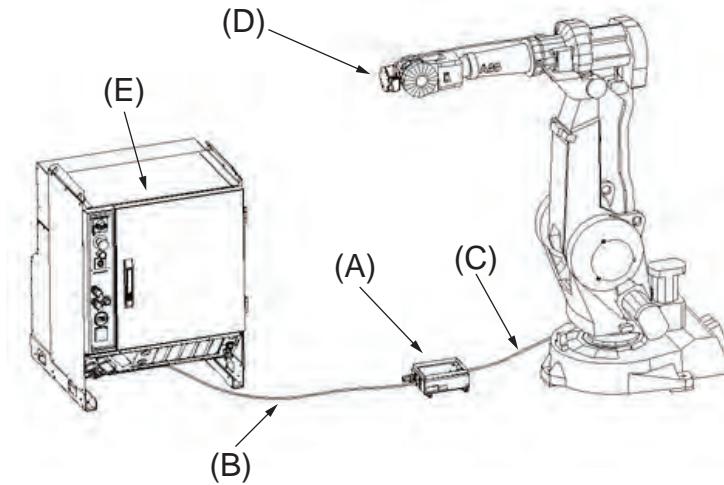
2 Specification of variants and options

2.6 RobotWare

Continued

Option	Description
636-3	Force Control Package 2500

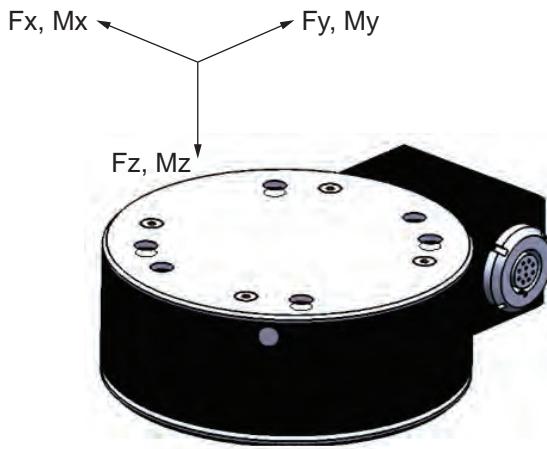
The integrated force sensor can be mounted on the robot flange using an adaptor plate. The force sensor can also be stationary mounted. A cable is supplied to connect the force sensor to the voltage measurement board. Cable management must be arranged by the user.



xx1300000204

A	Voltage measurement board (option 738-1, Prepared for Force Control)
B	Cable between robot controller and voltage measurement board
C	Cable between force sensor and voltage measurement board
D	Force sensor, including adaptor plate and calibration information
E	Force Control software (option 661-2 Force Control Base)

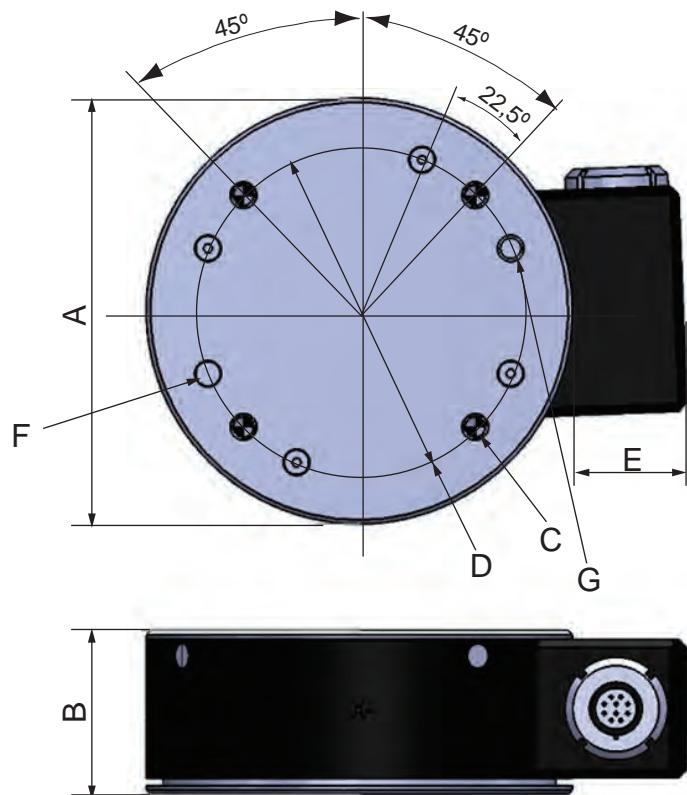
The force sensor measures all six components of force (F_x , F_y and F_z) and torque (M_x , M_y and M_z).



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Continues on next page

Force sensor dimensions



xx1300000206

	Sensor package 165 and 660	Sensor package 2500
A	Diam. Ø 104 mm	Diam. Ø 168 mm
B	Height 40 mm	Height 62 mm
C	4 x M6 Min. thread length is 7.6 mm (on both sides)	4 x M10 Min. thread length is 15 mm (on both sides)
D	Diam. Ø 80 mm	Diam. Ø 124 mm
E	27 mm	27 mm
F	Ø 6.02 ^{+0.02} , depth min. 7 mm (on both sides)	Ø 8.02 ^{+0.02} , depth min. 9 mm (on both sides)
G	Ø 5.02 ^{+0.02} , depth min. 7 mm (on both sides)	Ø 10.02 ^{+0.02} , depth min. 9 mm (on both sides)

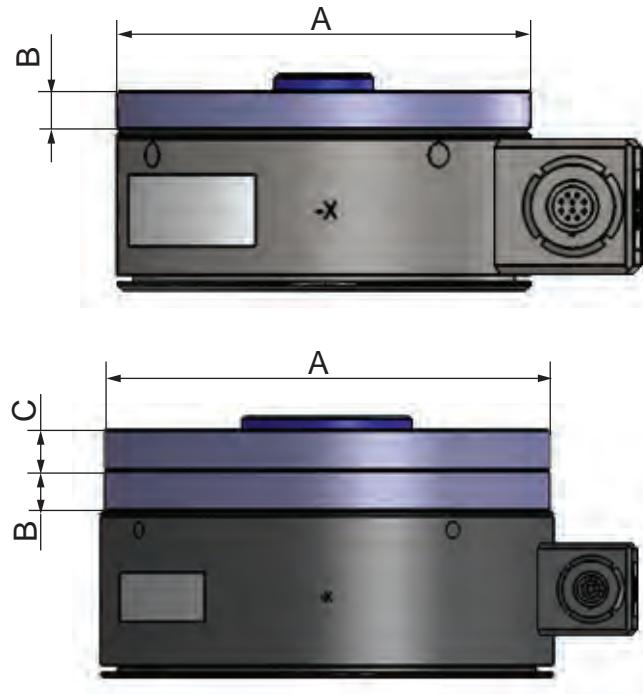
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2 Specification of variants and options

2.6 RobotWare

Continued

Adaptor plate dimensions



xx1300000207

	Sensor package 165		Sensor package 660		Sensor package 2500	
A	Ø 104 mm	Ø 104 mm	Ø 140 mm	Ø 165 mm	Ø 210 mm	
B	10 mm	10 mm	10 mm	15 mm	15 mm	
C	-	-	15 mm	15 mm	20 mm	
Type	Single adapter	Single adapter	Double adapters	Double adapters		
Weight (B + C)	0.6 kg	0.6 kg	1.1 + 1.7 kg	2.3 + 2.5 kg	3.8 + 5.3 kg	
Suitable robots	IRB 140, IRB 1200, IRB 1600, IRB 2400, IRB 2600	IRB 2400, IRB 2600	IRB 4400, IRB 4600	IRB 4400, IRB 4600	IRB 6620, IRB 6640, IRB 6650S, IRB 6660, IRB 6700	



Note

Note that the adaptor plate and force sensor will generate an offset and additional weight on the tool flange, and hence affect the available payload of the robot. Please refer to the robot load diagram for respective robot.

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Force sensor specification

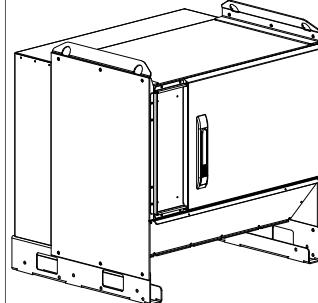
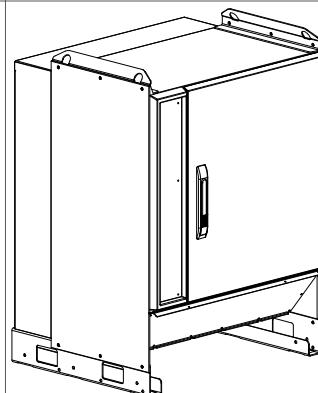
	Sensor package 165	Sensor package 660	Sensor package 2500
Capacity:			
Fx, Fy	165 N	660 N	2500 N
Fz	495 N	1980 N	6250 N
Mx, My, Mz	15 Nm	60 Nm	400 Nm
Overload capacity:			
Fx, Fy	1650 N	6600 N	25000 N
Fz	4950 N	19800 N	62500 N
Mx, My, Mz	150 Nm	600 Nm	4000 Nm
Operating temperature	-40 to +100 °C	-40 to +100 °C	-40 to +100 °C
IP rating	IP65	IP65	IP65
Sensor weight	1.25 kg	1.25 kg	5 kg

2 Specification of variants and options

2.7 Process

2.7 Process

Process module

Option	Description	Illustration
768-1	<p>Empty cabinet small</p> <p>This option is intended for customer equipment or extended use of I/O units.</p> <p>Mounting plate dimensions (HxW): 511 x 660 mm.</p> <p>Mounting depth (D): 250-325 mm</p> <p>For cabinet dimensions see Cabinet data on page 15.</p>	 xx0900000977
768-2	<p>Empty cabinet large (Based on single cabinet).</p> <p>This option is intended for customer equipment or extended use of I/O units.</p> <p>Mounting plate dimensions (HxW): 711 x 660 mm.</p> <p>Mounting depth (D): 250-325 mm</p> <p>For cabinet dimensions see Cabinet data on page 10.</p>	 xx0900000976

Installation kit

Option	Description
715-1	<p>Installation kit</p> <p>Mounting bars, EMC multi cable gland, door cable router, terminal mounting plate.</p>

2.8 Documentation

User documentation

Option	Description
808-1	Documentation on DVD The user documentation describes the manipulator system in detail, including service and safety instructions. All documents are available on the documentation DVD.

For more information, see *Product specification - Robot user documentation, IRC5 with RobotWare 6*.

2 Specification of variants and options

2.9 Other options

2.9 Other options

Stand alone IRC5

Specification form for IRC5 Controller is to be used.

Option	Description
435-99	Selected when the controller is to be connected to another mechanical structure than an IRB, see IRC5 as stand alone controller on page 29 .



Note

For more information, like available models, see [Application manual - Additional axes and stand alone controller](#).

Drive system selection, stand alone controller

For more than three additional motors a separate drive module is ordered from the stand alone controller specification form. Stand alone controller is also used for customer designed mechanical units like gantry robots. For more information, see [IRC5 as stand alone controller on page 29](#)

Option	Drive unit	Corresponding manipulator size
751-1	58 A 262 V (3x6, 3x14) ⁱ	IRB 140, IRB 360, IRB 1600
751-3	144 A 262 V (3x17, 3x31) ⁱⁱ	IRB 2400, IRB 2600, IRB 4400
751-5	144 A 400-480 V (3x17, 3x31) ⁱⁱ	IRB 66XX, IRB 4600
751-6	144 A 480 V (3x17, 3x31) ⁱⁱ	IRB 7600

ⁱ Drive unit with nominal 3x6 A (peak 3x8 A), nominal 3x14 A (peak 3x26 A)

ⁱⁱ Drive unit with nominal 3x17 A (peak 3x20 A), nominal 3x31 A (peak 3x54 A)

Only 4 active drives

For cabinets ordered as stand alone controllers it is possible to block two of the small drive units. The hardware remains the same (main drive unit, cabling a.s.o.).

Option	Description
823-1	Two small drive units disabled

IRC5 as retrofit

Specification form for IRC5 Controller is to be used.

When the controller is to be connected to an existing IRB manipulator it is essential to select the appropriate variant in the order to facilitate commissioning. Available variants are listed in the specification form.

Prepared for IRBT

Option	Description
1070-1	Internal cabling to 24V power supply Central lubrication

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Contact us

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

ABB AS, Robotics
Discrete Automation and Motion
Nordlysvegen 7, N-4340 BRYNE, Norway
Box 265, N-4349 BRYNE, Norway
Telephone: +47 51489000

ABB Engineering (Shanghai) Ltd.
No. 4528 Kangxin Hingway
PuDong District
SHANGHAI 201319, China
Telephone: +86 21 6105 6666

www.abb.com/robotics