The heart of Robotics

Product specification

Controller IRC5 with FlexPendant

RobotWare-RW 5.11

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Controller IRC5 with FlexPendant

RobotWare RW 5.11

3HAC021785-001

Revision L

ABB AB
Robotics Products
SE-721 68 Västerås
Sweden

Overview

About this Product specification

It describes the performance of the industrial robot controller in terms of:

- The structure and dimensional prints
- The fulfilment of standards, safety and operating requirements
- Basic RobotWare functions
- I/O system
- Additional motors
- The specification of variants and options available

Users

It is intended for:

- Product managers and Product personnel
- Sales and Marketing personnel
- Order and Customer Service personnel

Contents

Please see Table of Contents on page 3.

Revisions

Revision	Description
Revision 5	-Changes due to new functions in RobotWare 5.07 -New hardware options like new I/O units and FlexPendant Hot Plug -Various text corrections
Revision F	- IRB 6400RF and new main computer information
Revision G	- Electronic Position Switch (new chapter) - Panel Mounted Controller (new chapter) - Introduction of Flange disconnect - Usage of optional cables with examples - New options for IRC5 Stand alone
Revision H	- EtherNet/IP - DeviceNet 4 channels - Moist dust filter - Interbus m/s removed
Revision J	- New PROFIBUS DP slave - New 24 V power supply - Enhanced illustrations in chapter 2
Revision K	- Remote Service enabled - SafeMove - Mass memory and analog I/O options removed
Revision L	- Update for RobotWare RW 5.11 - PROFINET introduced

Complementary documentation

Product specification	Description
Product specification	Motor units MU10, MU20, MU30, 3HEA800973-001
Product specification	Controller software IRC5 RobotWare, 3HAC022349-001

Reference manual	Description
RAPID reference manual	RAPID kernel, 3HAC16585-1
Technical reference manual	System parameters, 3HAC17076-1

Operating manual	Description
Operating manual	IRC5 with FlexPendant, 3HAC16590-1
Operating manual	RobotStudio, 3HAC032104-001

Application manual	Description
Application manual	Additional axes and stand alone controller, 3HAC021395-001
Application manual	DeviceNet, 3HAC020676-001

1 Description

1.1 Structure

1.1.1 Introduction

General

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

Dual cabinet controller

IRC5 is made up of the following modules:

- Drive module, containing the drive system
- Control module, containing the computer, operator's panel, the mains switch, communication interfaces, Flex Pendant connection, service ports and some space for customer equipment, for example ABB I/O boards. The controller also contains the system software, that is RobotWare-OS, which includes all basic functions for operation and programming.
  Furthermore, the computer offers 4 PCI slots for expansion boards.

Single cabinet controller

The content described above can also be mounted in one cabinet. The single cabinet offers a more compact solution suitable for most applications where there is less need for additional equipment inside.

Cabinets

Data	Weight
Single cabinet controller Dual cabinet controller	max 150 kg max 180 kg
Control module	50 kg
Drive module	100-130 kg
Empty cabinet small	35 kg
Empty cabinet large	42 kg

Data	Volume (H x W x D)
Single cabinet controller Empty cabinet large	970 x 725 x 710 mm
Dual cabinet controller	1370 x 725 x 710 mm
Drive module Empty cabinet small	720 x 725 x 710 mm

1.1.1 Introduction

Airborne noise level

Airborne noise level	Description
Sound pressure level outside	< 70 dB (A) Leq (acc. to the working space Machinery directive 98/37/EEC)

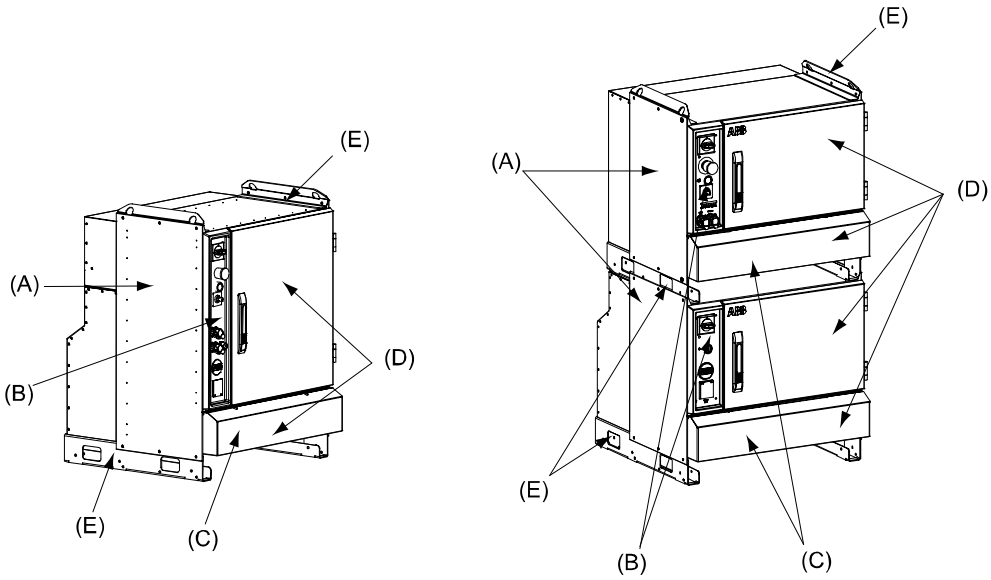


Figure 1 Single cabinet and dual cabinet (design 2006).

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

Single cabinet - different views

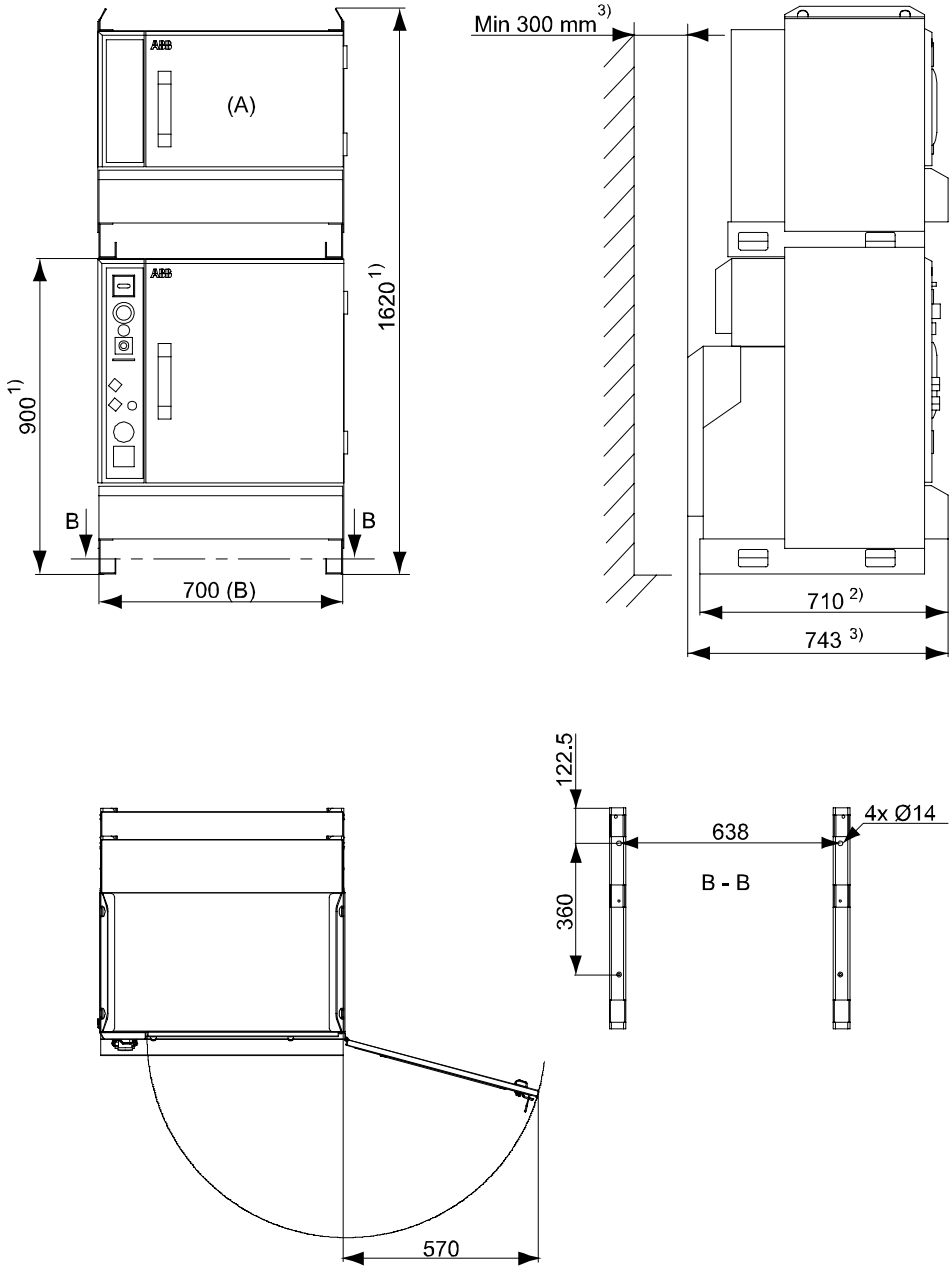


Figure 2 View of the Single cabinet from the front and from above (dimensions in mm).

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

Dual cabinet - different views

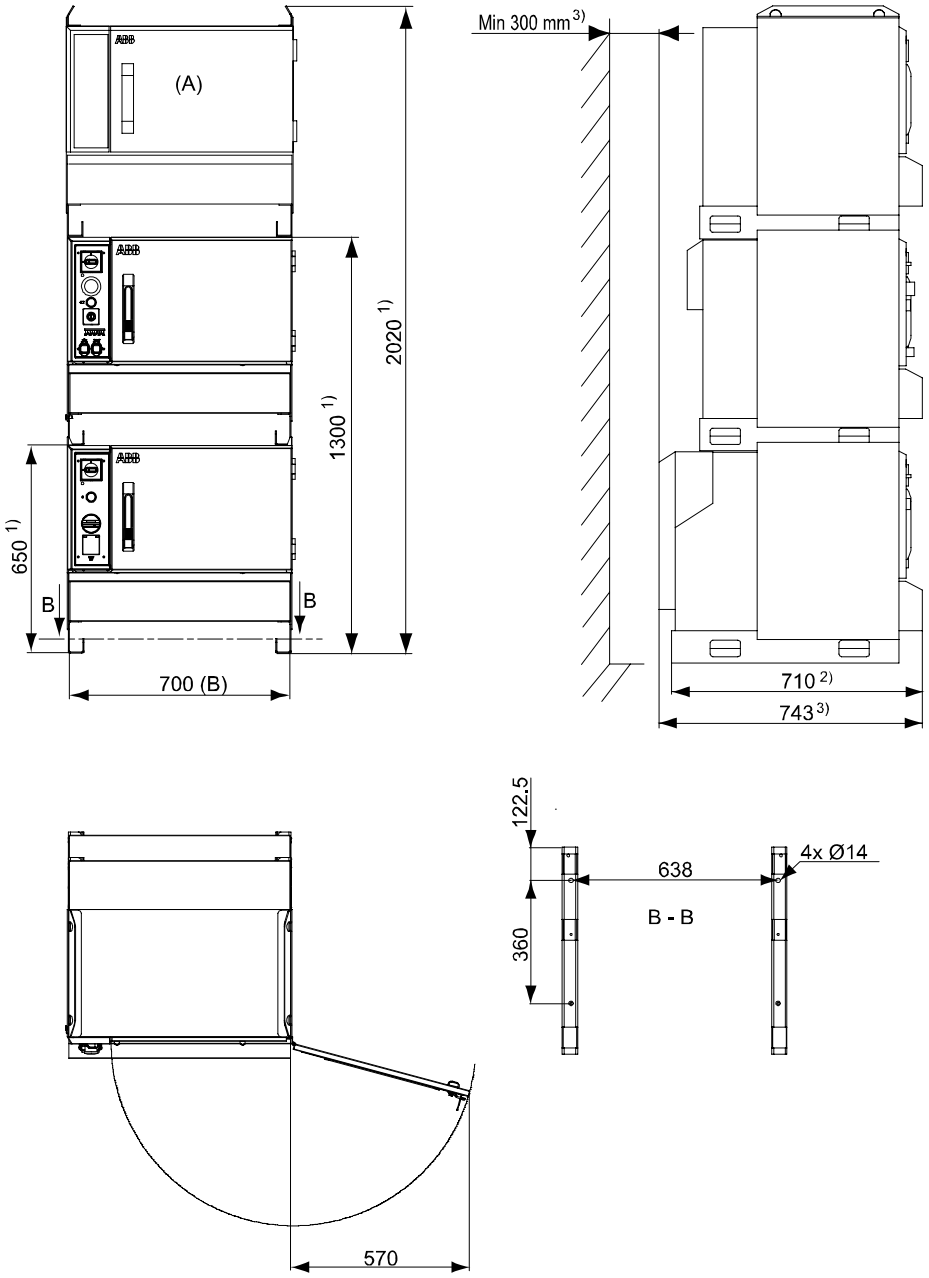


Figure 3 View of the Dual cabinet from the front and from above (dimensions in mm).

Pos	Description
A	Optional process module
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

1.1.2 Stacking of IRC5 modules

The mechanical structure allows IRC5 modules to be mounted in several combinations. For stability reasons the pile should, however be limited to approx 2 m in height. Optional wheels are permitted in all combinations as shown.

Basic combinations

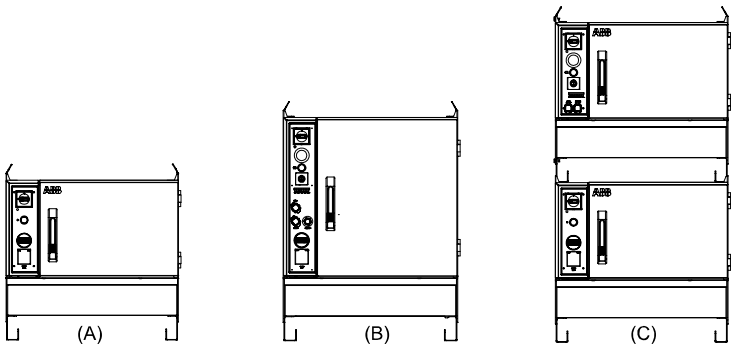


Figure 4 Basic combinations.

Pos	Description
A	Drive module, H = 720
B	Single cabinet, H = 970
C	Dual cabinet, H = 1370

Examples of customer combinations

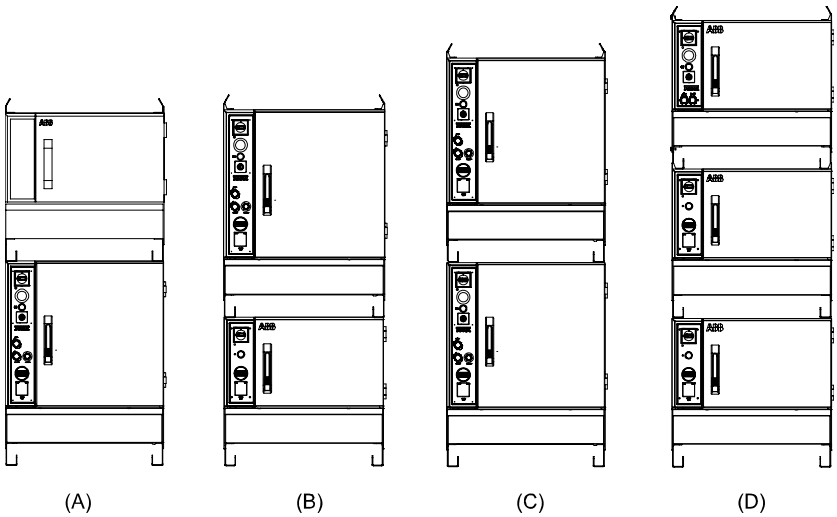


Figure 5 Examples of customer combinations.

Pos	Description
A	Single cabinet and empty cabinet small, H = 1620
B	Drive module and Single cabinet, H = 1620
C	Two Single cabinets, H = 1870 (or Single and empty cabinet large)
D	Drive module and Dual cabinet, H = 2020

1.2 Safety/Standards

1.2.1 Standards

The ABB robots controlled by the IRC5 conforms to the following standards:

Standard	Description
EN ISO 12100 -1	Safety of machinery, terminology
EN ISO 12100 -2	Safety of machinery, technical specifications
EN 954-1	Safety of machinery, safety related parts of control systems
EN ISO 13850:2006	Safety of machinery - Emergency stop - Principles for design
EN ISO 10218-1:2006	Robots for industrial environments - Safety requirements - Part 1 Robot
EN 61000-6-4 (option)	EMC, Generic emission
EN 61000-6-2	EMC, Generic immunity

Standard	Description
EN ISO 60204-1:2006	Safety of machinery - Electrical equipment of machines - Part 1 General requirements
IEC 60529	Degrees of protection provided by enclosures

Standard	Description
ISO 9787	Manipulating industrial robots, coordinate systems and motions

Standard	Description
ANSI/RIA 15.06/1999	Safety Requirements for Industrial Robots and Robot Systems
ANSI/UL 1740-1998 (option)	Safety Standard for Robots and Robotic Equipment
CAN/CSA Z 434-03 (option)	Industrial Robots and Robot Systems - General Safety Requirements

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 function	Description
Safety 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 category 3 of EN 954-1, 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, that is not by any external equipment.
Reduced speed	In manual mode, the speed is limited to a maximum of 250 mm/s (600 inch/min). The speed limitation applies not only to the TCP (Tool Center point), but to all parts of the robot. 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. An additional enabling device can be connected to the safety system, for two operator safety.
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.
Over-speed protection	The speed of the robot is monitored by two independent computers.
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.
Delayed protective stop	A delayed stop gives a smooth stop. The robot stops in 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 The movement of each axes can be restricted Hardware Limit switches can be connected to the robot´s safety chain circuit

1.2.1 Standards

Safety function	Description
Hold-to-run control	“Hold-to-run” means that you must depress a button continously 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 UL’s (Underwriters Laboratories) requirements 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 safety system points of view. When in manual mode all coordinated robots can be jogged simultaneously as well as only one robot or other mechanical unit at a time can be jogged, selected from the FlexPendant.

1.3 Operation

1.3.1 Operator’s panel, Single cabinet

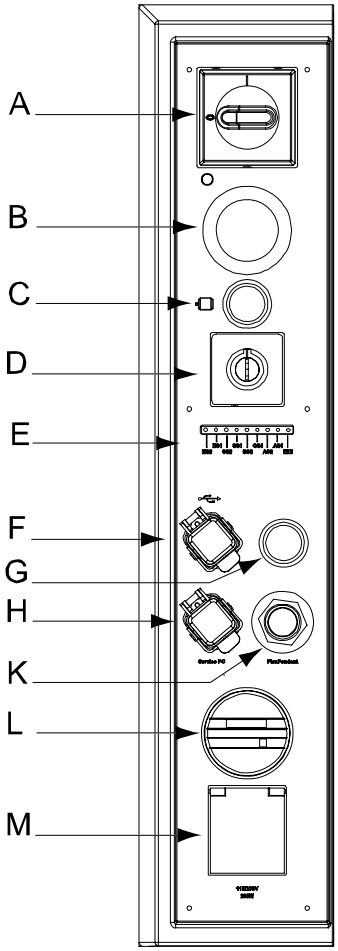


Figure 6 Operator’s panel for Single cabinet.

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)
F	USB connection
G	FlexPendant Hot Plug pushbutton (option)
H	Service PC connection
K	FlexPendant connection
L	Duty Time Counter (option)
M	Service outlet 115/230 V, 200 W (option)

1.3.2 Operator’s panel, Dual cabinet

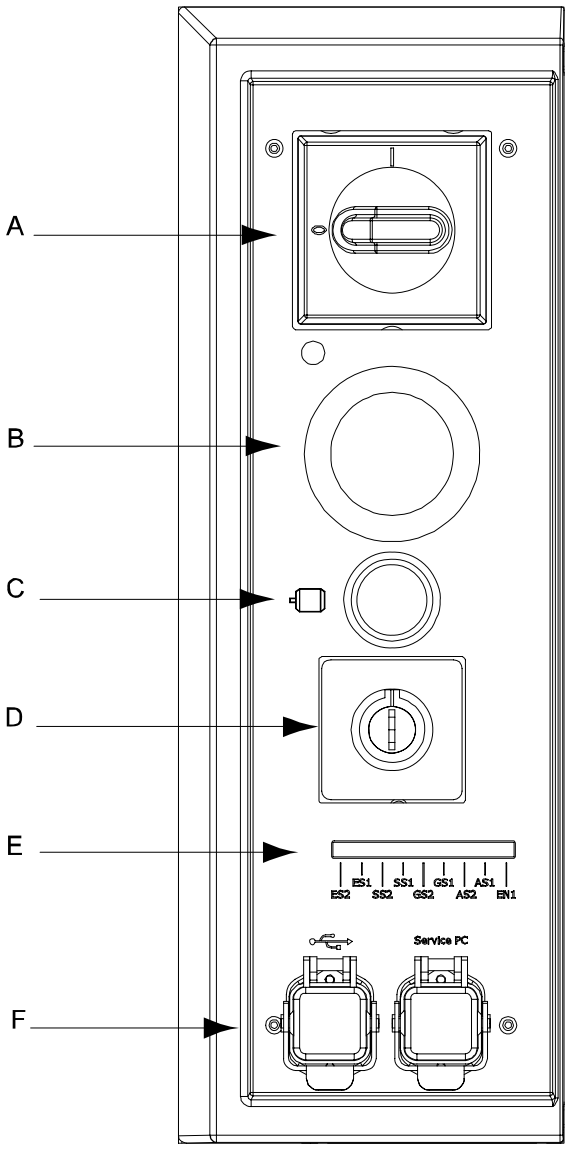


Figure 7 Control module.

Pos	Name
A	Mains switch and remote control of power to Drive Module(s)
B	Emergency stop - if pressed in, turn to release
C	MOTORS ON
D	Operating mode selector
E	Safety chain LEDs (option)
F	- USB connection - Service PC connection

Motors on

MOTORS ON	Operation	Note
Continuous light	Ready for program execution.	
Fast flashing light (4 Hz)	The robot is not calibrated or the revolution counters are not updated.	The motors have been switched on.
Slow flashing light (1 Hz)	One of the protective space stops is active.	The motors have been switched off.

Operating mode selector

Using a key switch, the robot can be locked in two or three different operating modes (depending on chosen mode selector).

Operating mode	Description	Signs
Automatic mode	Running production	
Manual mode at reduced speed	Programming and setup Max. speed 250 mm/s (600 inches/min.)	
Manual mode at full speed	Testing at full program speed Equipped with this mode, the robot is not approved according to ANSI/UL	

Remote Control

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
- USB connection

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

For more information on how to operate the robot, see the Operating manual IRC5 with FlexPendant and Operating manual RobotStudio. See 1.7.1 Testing program.

1.3.2 Operator’s panel, Dual cabinet

Drive module

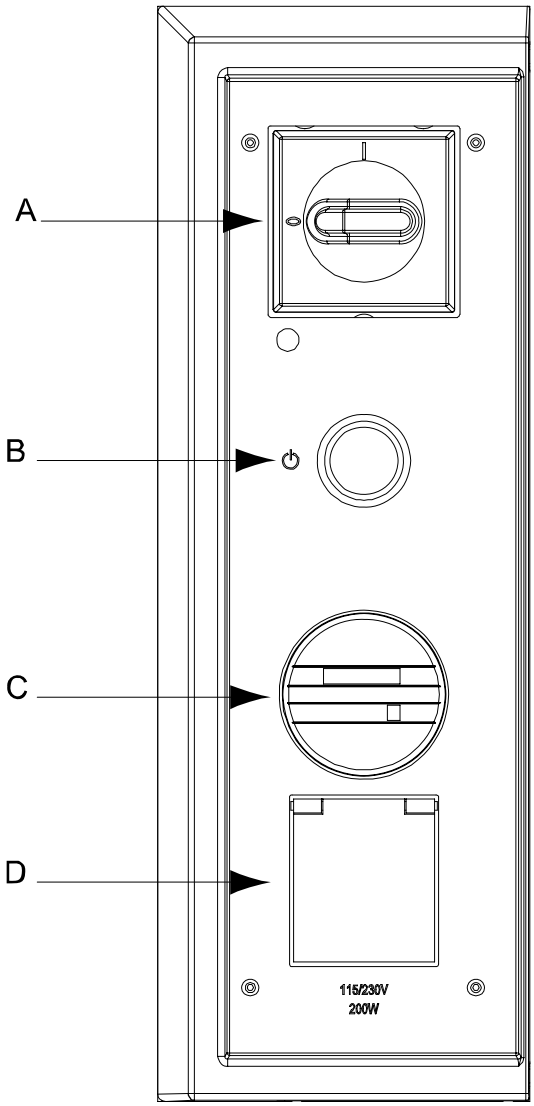


Figure 8 Drive module.

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 115/230 V, 200 W (option)

1.3.3 FlexPendant

All operations and programming can be carried out using the portable FlexPendant (see Figure 9), the operator’s panel (see Figure 7) and RobotStudio.

Figure 9 The FlexPendant is equipped with a large touch screen color display, which displays different kinds of system information, plain language messages, pictures/graphs and areas for user interaction through finger touch.

Pos	Description
A	Display
B	User defined keys
C	Emergency stop button
D	Joystick
E	Program execution keys

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 (available languages, see options in chapter 2.3 Control module under additional languages. The user can choose two alternative languages besides English without reloading RobotWare.

1.3.3 FlexPendant

Feature	Description
Display with touchscreen	A 7.5” color display which displays text as well as graphical information. User input is entered by pressing menu commands, push buttons etc. with the finger only on the display (no stylus required). 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.
User-defined 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.
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.

Example of FlexPendant window

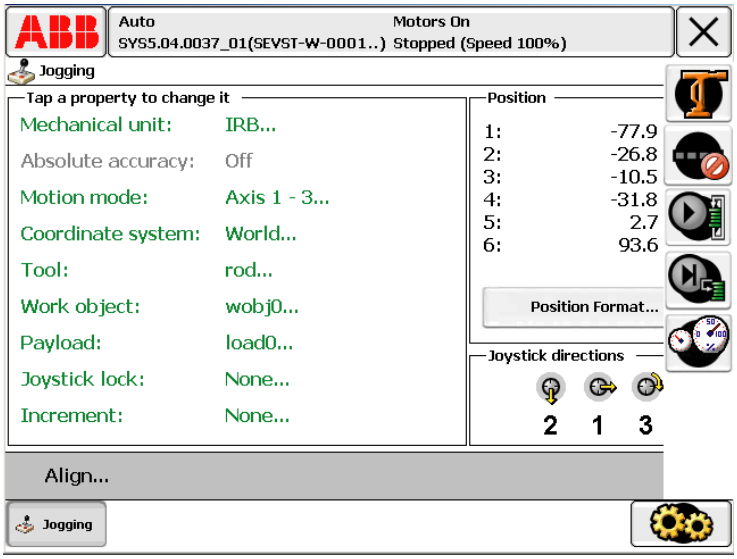


Figure 10 Example of a FlexPendant window; the jogging window with the quick bar menu open at the right side.

1.3.4 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.

1.3.4.1 Key features

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 system parameters on a running system.

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

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

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

1.4 MultiMove (optional)

1.4.1 Introduction

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, as described in chapter 1.14 Additional Motors.

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 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).

For further information, see Application manual - MultiMove

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.

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.

1.5 Memory

1.5.1 Introduction

Available memory

The controller has the following memory types:

Memory types	Size	Description
Fixed DRAM memory	256 MB	Working memory
Mass memory	≥ 256 MB	Compact flash[a]
Removable mass memory	Customer selected	USB flash memory interface[b]

a. Use only ABB validated (industrial type) article.
b. USB 1.1 and 2.0 full and high speed are supported. Filesystems FAT16 and FAT32 are supported.

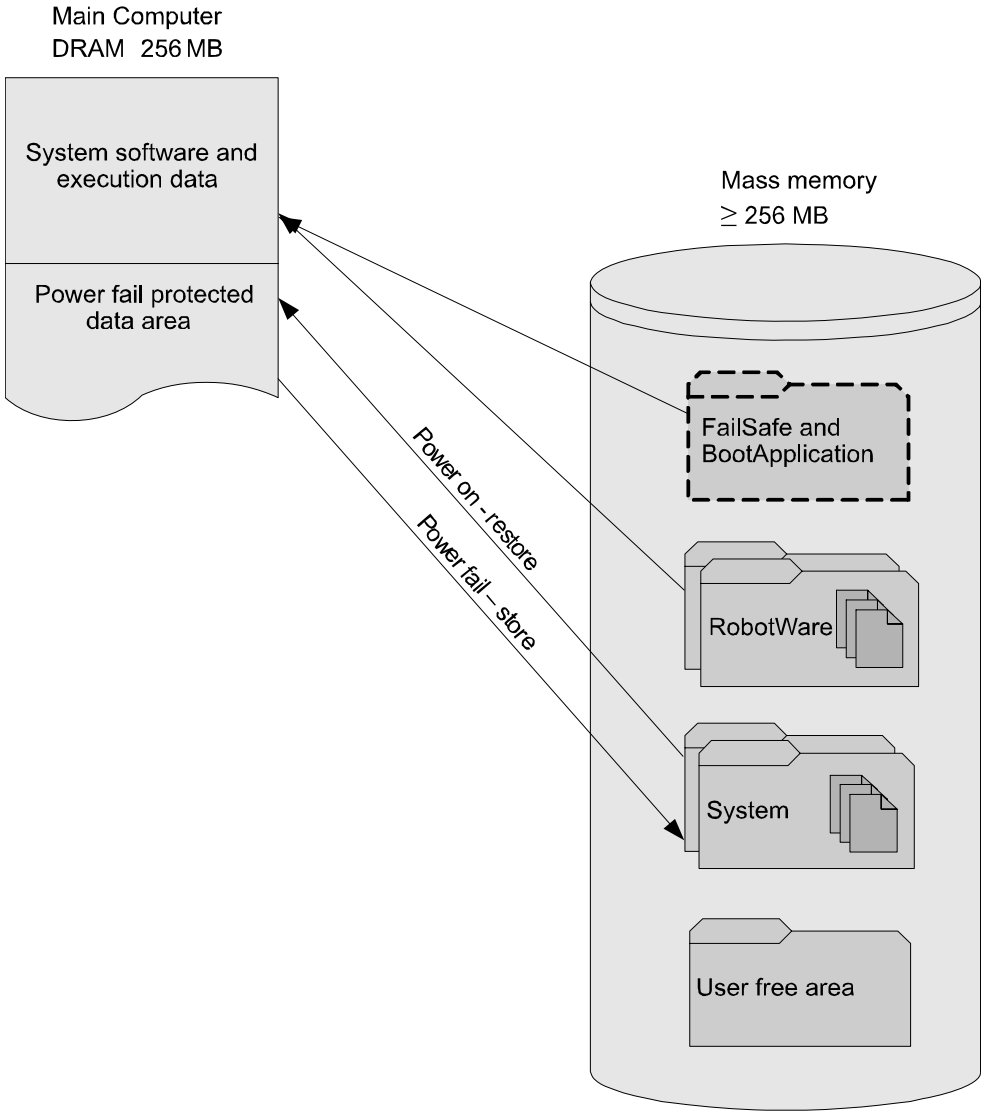


Figure 11 Available memory

DRAM memory

The DRAM memory is divided into two areas, see Figure 11.

Areas	Size	Description
System software and execution data	-	Operating system and RobotWare
Power fail protected data - RAPID memory - Configurations - Event logs - Text database	25 MB 20 MB 2.5 MB 400 KB 375 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 11.

Areas	Size	Description
Base area	20 MB ~32 MB	Fail Safe partition for troubleshooting BootApplication
Release area	~60 MB	All code 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 ~50 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	> 124 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.

Example of RAPID memory consumption

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

Instruction	Robtarget marked (‘*’)	Robtarget named
MoveL or MoveJ	312 bytes	552 bytes

1.6 Installation

1.6.1 Introduction

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.

For a MultiMove system it is normally necessary to reconfigure the system at installation, using the RobotStudio, in order to take the additional robots into account.

Operating requirements

Requirements	Description
Dust and water protection according to IEC 529	Controller electronics IP54 Air cooling ducts IP30
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.10 m/s^2
Vibration during operation	Max. ca. 0,15 g = ca.1,5 m/s^2
Bumps during transportation and operation	Max. 5 g = 50 m/s^2 (11ms)

Power supply

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

If the customer power supply system is of types Ungrounded or Cornergrounded Delta, ABB strongly recommends supply from an isolating transformer.

Controller rated power

Robot	Rated power
IRB 140, 1400, 1600, 2400, 260, 340/360, 4400, 6400RF	6 kVA (transformer size)
IRB 660, 66XX, 7600	13 kVA (transformer size)
Additional Drive module	6 or 13 kVA (transformer size)

Line fusing

Recommended line fusing, slow-blowing diazed or circuit breaker with trip characteristic K.

Robot	Voltage	Description
IRB 140, 1400, 1600, 2400, 260, 340/360, 4400, 6400RF	at 400-600 V	3x16 A
IRB 140, 1400, 1600, 2400, 260, 340/360, 4400, 6400RF	at 200-220 V	3x25 A
IRB 660, 66XX, 7600	at 400-600 V	3x25 A
IRB 660, 66XX, 7600	at 200-220 V	3x25 A

Power consumption

See Product specification for respective IRB.

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.
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 chapter 1.19 I/O System.).
Serial communication	Configuration.

For a detailed description of the installation procedure, see the Reference manual - System Parameters.

1.7 Programming

1.7.1 Introduction

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 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.

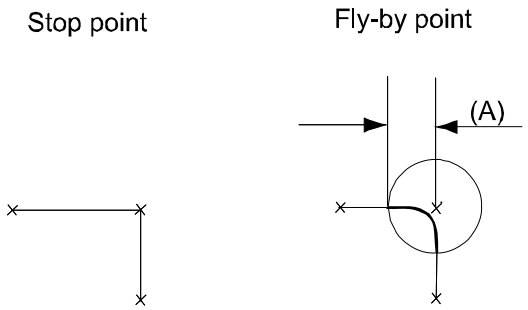


Figure 12 The fly-by point reduces the cycle time since the robot does not have to stop at the programmed point. The path is speed independent.

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 the Operating manual - IRC5 with FlexPendant and Operating manual - RobotStudio.

1.8 Automatic Operation

1.8.1 Introduction

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.

1.9 The RAPID Language and Environment

1.9.1 Introduction

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 chapter 1.10 Exception handling)
- 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

1.10 Exception handling

1.10.1 Introduction

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

1.11 Maintenance and Troubleshooting

1.11.1 Introduction

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
On-line 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)
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, WebWare Server or any OPC client application.
Manual test	Commands and service programs in RAPID to test units and functions.

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.

1.12 Remote Service

Service Remote box

The purpose of the Remote Service box is to act as a bridge between the robot controller and a romote server. The connection between the Servics 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 link:

http://www.abb.com/product/seitp327/80c57f2137140cc8c125711c004ce4c4.aspx_

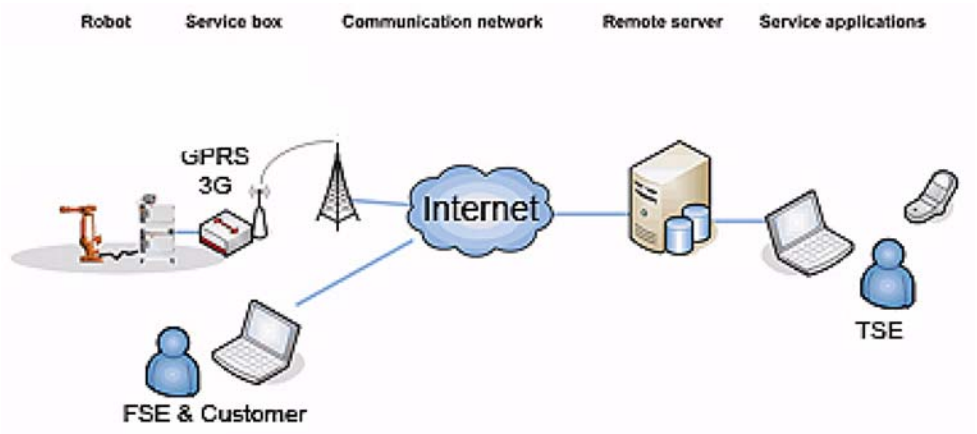


Figure 13 Remote Service.

1.13 Robot Motion

1.13.1 Introduction

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.

Coordinate systems

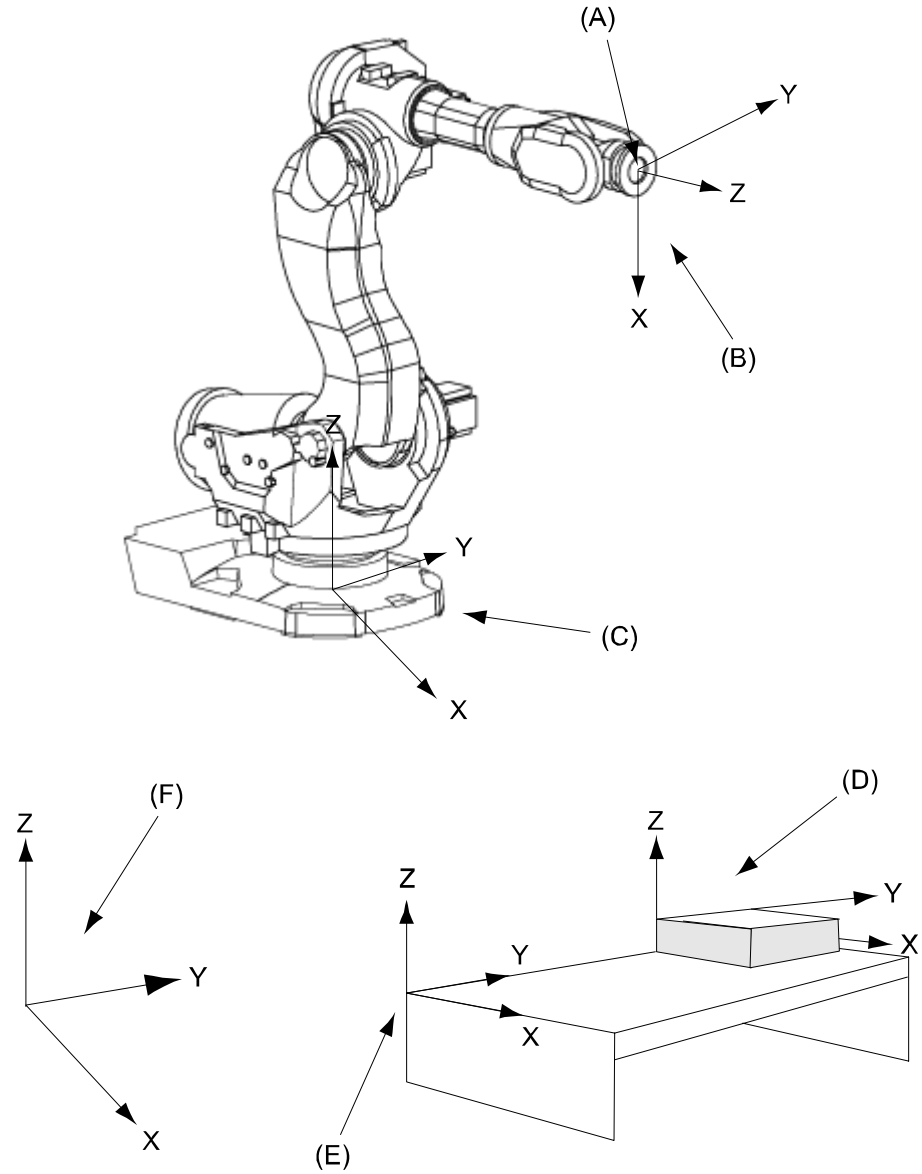


Figure 14 The coordinate system, used to make jogging and off-line programming easier.

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

1.13.1 Introduction

Coordinate systems

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

Additional features

System	Description
Program execution	The robot can move in any of the following ways: -Joint motion (all axes move individually and reach the programmed position at the same time). -Linear motion (the TCP moves in a linear path). -Circle motion (the TCP moves in a circular path).
Soft servo	Soft servo - allowing external forces to cause deviation from programmed position - can be used as an alternative to mechanical compliance in grippers, where imperfection in processed objects can occur. Any motors (also additional) can be switched to soft servo mode, which means that it will adopt a spring-like behaviour.
Jogging	The robot can be manually operated in any one of the following ways: -Axis-by-axis, that is one axis at a time. -Linearly, that is the TCP moves in a linear path (relative to one of the coordinate systems mentioned above). -Reoriented around the TCP. It is possible to select the step size for incremental jogging. Incremental jogging can be used to position the robot with high precision, since the robot moves a short distance each time the joystick is moved. During manual operation, the current position of the robot and the additional axes can be displayed on the FlexPendant.
Singularity handling	The robot can pass through singular points in a controlled way, that is points where two axes coincide.
Motion supervision	The behaviour 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 RobotWare-Collision Detection).
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 indentify 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 the robot families IRB 140, 1400, 1600, 2400 (not 260), 4400, 6400RF, 66XX (not 660) and 7600, as well as for positioners IRBP-L, -K, -R and -A.

1.14 Additional Motors

1.14.1 Introduction

General

The IRC5 controller cabinet can be supplied with drive units for up to three additional motors (two for IRB4400/6400RF/66XX/7600). These motors are programmed and moved in the same way as the robot's motors. See Figure 15.

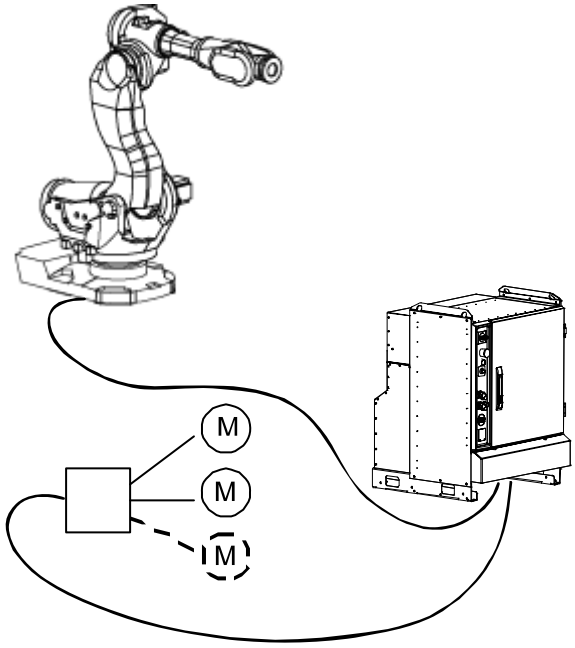


Figure 15 Standard controller.

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 or Dual cabinet, independent of the robot type. An Ethernet board (option 710-1) plus cabling is the only additional hardware required. A Drive module is basically equipped with drives for 4-6 motors but can be supplied with drives for further 2-3 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 are IRB 2400, IRB 340/IRB 360, IRB 4400, IRB 6400RF and IRB 66XX.

See chapter Drive unit data for the individual drive units. Ordering additional Drive module is done via the Specification form “IRC5 Controller CONTROLLER OFFER”. 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. See Figure 16.

Note that an additional Drive module for additional motors reduces the maximum number of additional robots to two. See chapter 1.4 MultiMove (optional).

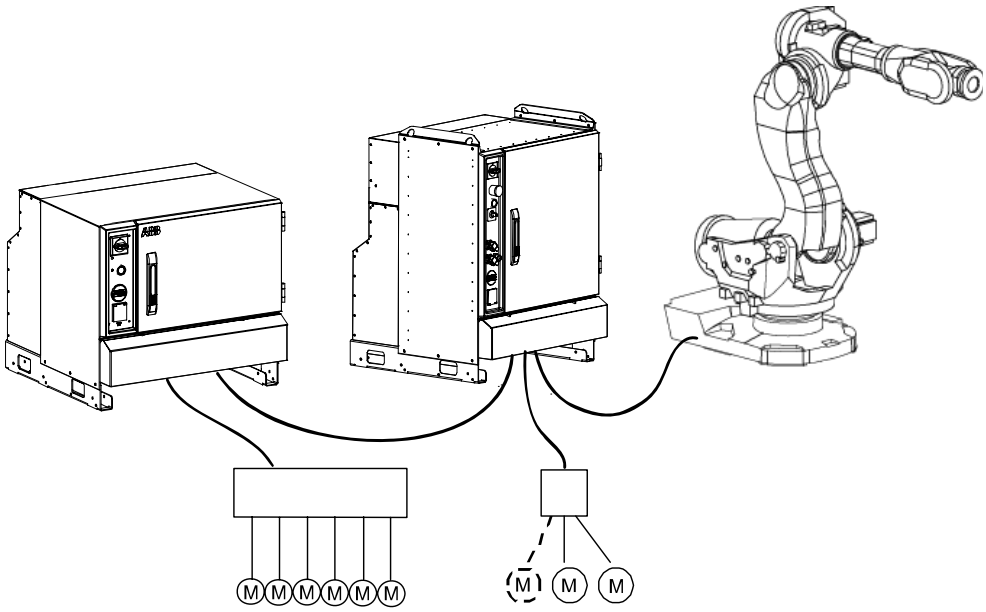


Figure 16 Additional Drive module.

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.

Motor selection

For motor selection, see the Product specification - Motor unit MU10, MU20, MU30.

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 the Product specification - Motor Units.

For more information on how to install an additional motor, see the Application manual – additional axes and stand alone controller. This manual also specifies necessary resolver data.

Motor dimensioning guide-line according to 3HAC 023209-001, is available on ABB Library.

1.15 Electronic Position Switches

1.15.1 Introduction

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 in 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 a single 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.

1.15.2 Option content

The following is included with the option on 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.

1.15.3 Limitations

- Additional axes can be supervised, provided that all axes are connected to measurement link 1.
- Continuously rotating axes cannot be supervised.
- Drive units cannot be shared for supervised axes, for instance between tools.
- Not available for IRB 340/IRB 360.
- Not available for non IRB mechanical units.

1.16 IRC5 as stand alone controller

1.16.1 Introduction

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.

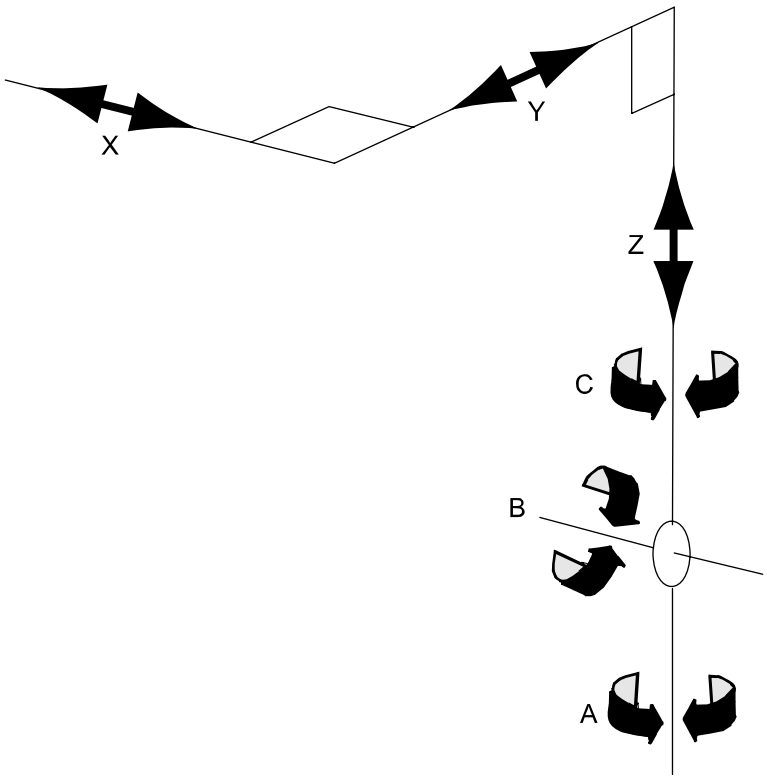


Figure 17 Definition of linear mechanical unit axes.

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 IRC5 are:

- IRB 140 M2000
- IRB 1400 M98 and M2000
- 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 chapter 1.14 Additional Motors.

Example: Assume large motors MU30 are required and the desired torque corresponds to W drive unit current capacity - select a IRB 66XX Drive system. The basic configuration is 3 W drives and 3 V drives. Two further W drives are possible to install. These and other options are described in chapter 2.4 Drive module.

To assure right combination of Motors, SMB boxes and cables, please ask for a quotation.

The stand alone concept is available for drive system sizes IRB 2400, IRB 340, IRB 4400, IRB 6400RF and IRB 66XX.

For more information on motors and measurement system, see the Product specification - Motor unit and the Application manual - addtional axes and stand alone controller.

Limitations

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

Non-MultiMove system

- 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)

rem 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.

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

MultiMove system

- 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)

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

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 adaptation to varying load conditions
- No Load Identification
- No Collision Detection
- No Absolute Accuracy

1.17 SafeMove

1.17.1 Introduction

General

SafeMove is a safety controller in the robot. The purpose of the safety controller is to ensure a high safety level 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 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.

Note that SafeMove is one component in a cell safety system, normally complemented by other equipment, for example 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

1.17.2 Option content

The following is included with the option on delivery:

- Safety controller, installed close to the axis computer
- Two 12 pole plug contacts and two 10 pole plug contacts for I/O connections.

The option SafeMove gives you access to SafeMove Configurator, an add-in software to 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.

1.17.3 Limitations

Supported robots

The following robot families are supported:

- IRB 6640
- IRB 6620
- IRB 660
- IRB 7600
- IRB 6660
- IRB 6650S
- IRB 4400
- IRB 2400
- IRB 260
- IRB 1600
- IRB 140

Other robot models are not supported.

SafeMove cannot be used for parallel 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.

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

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

On the motor side there is also a limitation of ± 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.

Servo tool changer

SafeMove does not support more than one tool. If a robot is equipped with a tool changer it is recommended to configure the robot for tool 0. Note that there must be enough margin to allow for the largest tool that is being used.

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.

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

Independent joint

SafeMove does not support 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 interface board).

RAPID non motion execution

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

Borderline positions

If the robot is stopped in a position on the border of the defined range, after approximately 50 minutes all SafeMove outputs may go low, the robot may stop, and the synchronization may be lost. There will be a warning 10 minutes before this happens (elog 20473). This is due to the redundancy check that is done between the two CPUs in SafeMove.

Tip! Never leave the robot for a longer period in a position near the borders of Monitor Axis Range.

1.18 Panel Mounted Controller

1.18.1 Introduction

General

The IRC5 controller can be mounted in a customer cabinet for example when there are special demands on size reduction or hygienic encapsulation. The main parts are assembled in racks with the same functional split as in the Dual cabinet. For MultiMove applications the robots can be ordered with only the drive module.

Figure 18 Example of modules mounting.

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 connectors are of type Molex Micro-Fit 8 and 10 pole art. no. 43025, socket art. no. 43030.

1.18.2 Limitations

Following IRB robots are available with Panel Mounted Controller:

- IRB 140
- IRB 1600
- IRB 2400
- IRB 340/IRB 360
- IRB 260

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 document “Declaration by the manufacturer”, which normally is enclosed with an ABB cabinet equipped with a line filter, is not enclosed with the Panel Mounted Controller because protection degree IP 40 is not fulfilled.

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 operating mode selector.

The motor cable is to be connected to terminals on the drive module. For IRB 140 and IRB 340/IRB 360 the 7 m cable is prepared, for other robots and cable lengths the integrator must remove the industrial connector.

The following options are not available with Panel Mounted Controller:

Option	Description
16-1[a]	Customer signals connection in cabinet (floor cable available)
271-1[a]	Position switch connection in cabinet (floor cable available)
429-1	UL/CSA (the PMC is UL recognized)
129-1	EU EMC (the mains filter comes always with the drive module)
769-x	Mains voltage (multi tap transformer available as option 881-1)
752-x	Mains connection type
742-x	Mains switch (rotary switch included with transformer option 881-1)
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
829-1	Protection bar
707-1	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

Option	Description
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
753-766	Drives for additional axes
757	SMB for additional axes
761-x	Extension cables between modules
767-1	Duty Time Counter
758-1	Wheels
736-x	Service outlet
810-1	Electronic Position Switches
810-2	SafeMove
768-x	Empty cabinet
715-1	Installation kit

a. Option 16-1 respective 271-1 must be selected when floor cables are required.

Furthermore, options in IRB 1600 and IRB 2400 intended for arc welding applications are not available together with Panel Mounted Controller.

Note! The line filter always included is rated max 3x520V.

1.18.3 Installation

Space requirement according to Figure 19. For detailed installation information see Product manual, Panel Mounted Controller IRC5, 3HAC027707-001.

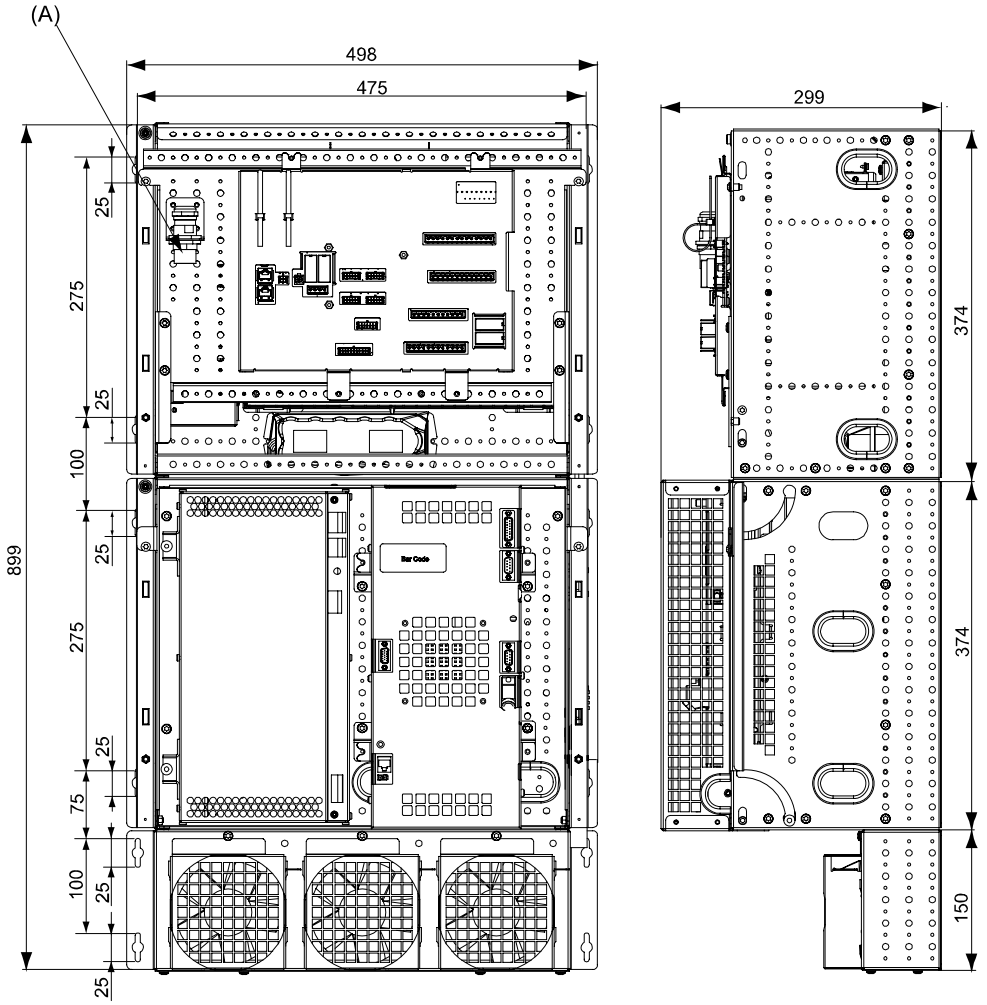


Figure 19 Dimensions for Panel Mounted Controller (xx0600003314).

Pos	Description
A	FlexPendant connection if no remote panel.

1.18.3 Installation

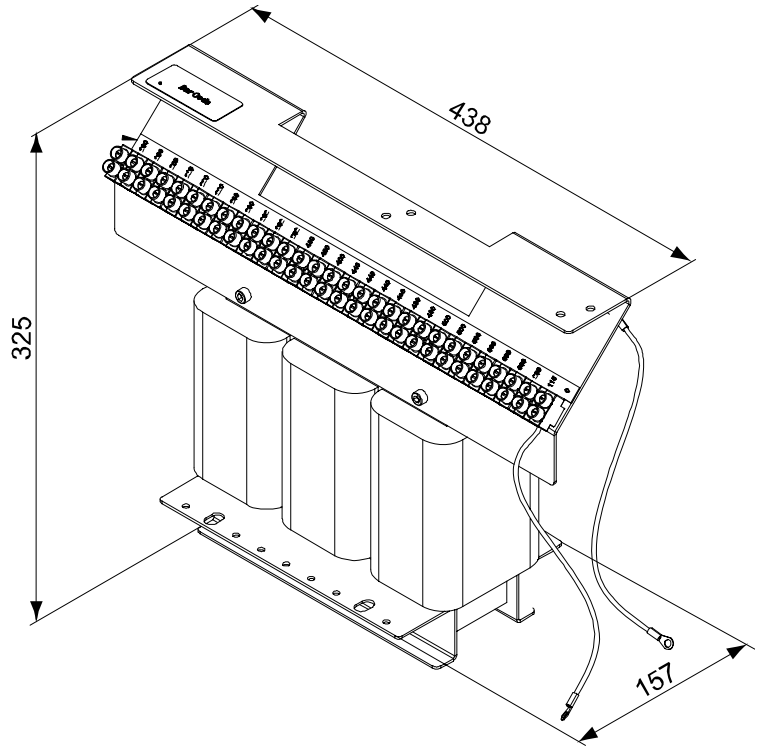


Figure 20 Transformer unit.

Weight

- Control module 12 kg
- Drive module 24 kg
- Transformer 35 kg
- Fan unit 390 g

1.18.4 Power and cooling

As option the 6 kVA transformer that normally is delivered with the Single and Dual cabinet can be ordered. The option includes also rotary mains switch and secondary fuses. The transformer is not intended for other loads than the IRC5 Panel Mounted Controller.

If the integrator supplies the transformer, the following power is required:

Robot type	Power
IRB 140 and IRB 1600	3x 262 V 6 Amps
IRB 340/IRB 360, IRB 260 and IRB 2400	3 x 262 V 8 Amps
All	1 x 230 V 8.5 Amps

The need for the additional fan unit is very much related to the robot duty cycle and temperature. As a rule of thumb horizontal mounting of the modules requires fans. Vertical mounting and a temperature not exceeding 30 C allows a duty cycle of 50 % (motion 50 % and idle 50 %) without fans.

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 140	250 W
IRB 1600	300 W
IRB 340/IRB 360	700 W
IRB 260	350 W
IRB 2400	350 W

1.19 I/O System

1.19.1 Introduction

Fieldbus master/slave

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

Option	Description
DeviceNet	PCI card certified by ABB included
PROFIBUS DP	PCI card certified by ABB included
PROFINET IO	On request. PCI card certified by ABB included

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.

For all bus types, commercially available third party slave boards can be used.

For DeviceNet, a number of different input and output units are available from ABB, see table below Figure 21 on page 61 and chapter 2 Specification of Variants and Options.

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:

- Ethernet/IP
- PROFIBUS DP
- PROFINET IO

Fieldbus gateway (slave)

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

- Allen-Bradley RIO
- Interbus

Number of logical signals

The maximum number of logical signals is 2048 (8192 if PROFINET IO) in total for all installed field buses (inputs or outputs, group I/O, analog and digital).

Number of nodes

A maximum of 20 I/O units (nodes) (30 if PROFINET IO) may be connected to each field bus and a maximum of 40 units (nodes) may be connected in the system totally.

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
Motors On	Auto on	TCP Speed
Motors On and Start	Simulated I/O	TCP Speed Reference
Motors Off	Cycle On	
Load and Start	Emergency Stop	
Interrupt	Execution Error	
Start	Motors Off State	
Start at main	Motors On State	
Stop	Motors Off	
Quick Stop	Motors On	
Soft Stop	Motion Supervision On	
Stop at end of Cycle	Motion Supervision Triggered	
Stop at end of Instruction	Power Fail Error	
Reset Execution Error signal	Path Return Region Error	
Reset Emergency Stop	Runchain Ok	
System Restart	Mechanical Unit Active	
Load	TaskExecuting	

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

1.19.1 Introduction

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 16 digital signals can be grouped together and used as a single signal when, for example, entering a bar code
- Sophisticated error handling
- Selectable “trust level” (that is what action to take when a unit is “lost”)
- Program controlled enabling/disabling of I/O units
- Scaling of analog signals
- Filtering
- Pulsing
- TCP-proportional analog signal
- Programmable delays
- Virtual I/O (for forming cross connections or logical conditions without need for the physical hardware)
- Accurate coordination with motion

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 Multitasking option, see Product specification - Controller software IRC5, RobotWare Options.

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)

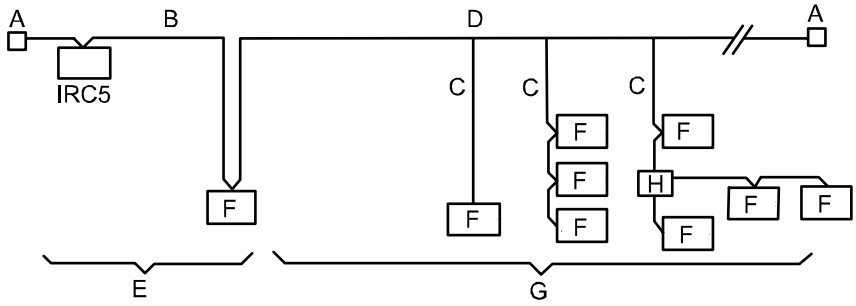


Figure 21 Example of a DeviceNet bus.

Pos	Description
A	Terminator
B	Trunk line
C	Drop line
D	Tap
E	Zero drop
F	Node
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
Allen-Bradley Remote I/O gateway	350B	721-1	128[a]	128			500 kB/s
Interbus gateway	351B	722-1	64[a]	64			500 kB/s
Encoder interface unit	377B	726-1	1				500 kB/s

a. To calculate the number of logical signals, add 2 status signals.

Maximum four ABB DeviceNet I/O or three gateway units can be mounted in the Single cabinet controller (inside of door).
The Dual cabinet controller can take six I/O units inside the Control module.

Power supply

In the Single Cabinet, delivered after November 2007, 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. The current limit for the combined 24 V I/O and 24 V Brake is 13 A, which allows customer load according to below table.

Robot type	24 V I/O
IRB 140 - 2400	8 A[a]
IRB 140 - 2400 with 3 additional MU30	6.4 A
IRB 4400	8 A[a]
IRB 4400 with 2 additional MU30	6 A
IRB 6400RF	6 A
IRB 6400RF with 2 additional MU30	3.5 A
IRB 660	8 A[a]
IRB 660 with 2 additional MU30	5.8 A
IRB 66XX	5.5 A
IRB 66XX with 2 additional MU30	3 A
IRB 7600	5.2 A
IRB 7600 with 2 additional MU30	2.8 A

a. 24 V I/O current limit is 8 A. A short circuit in the 24 V I/O will not influence the 24 V BRAKE.

In the Dual cabinet optional 24 V 4 A units DSQC609 have to be ordered, 1, 2 or 4 units. The DSQC609 is also possible to order with the Single Cabinet (max. 2 units).

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

Type	Name	Data
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 $_{p-p}$ Fullfils Limited Power Source NEC Class 2 requirement

The DeviceNet unit isolated outputs minmize 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 (option 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 (± 0.5 ms) software delay ≤ 0.5 ms[a]
Time variations	-1 ms +2 ms

a. 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.

1.19.1 Introduction

Digital outputs (option 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
Time delays	hardware ≤ 0.5 ms software ≤ 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 8 ms software ≤ 4 ms

Analog inputs (option 719-1)	Values
Voltage Input voltage	± 10 V
Input impedance	> 1 Mohm
Resolution	0.61 mV (14 bits)
Accuracy	± 0.2% of input signal

Analog outputs (option 719-1)	Values
VoltageOutput voltage	± 10 V
Load impedance	min. 2 kohm
Resolution	2.44 mV (12 bits)
CurrentOutput current	4 - 20 mA
Load impedance	min. 800 ohm
Resolution	4.88 µA (12 bits)
Accuracy	± 0.2% of output signal

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	± 25 mV ± 0.5% of output voltage
Potential difference	max. 500 V
Time intervals	hardware ≤ 2.2 ms software ≤ 4 ms

1.20 Communication

1.20.1 Introduction

Ethernet

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

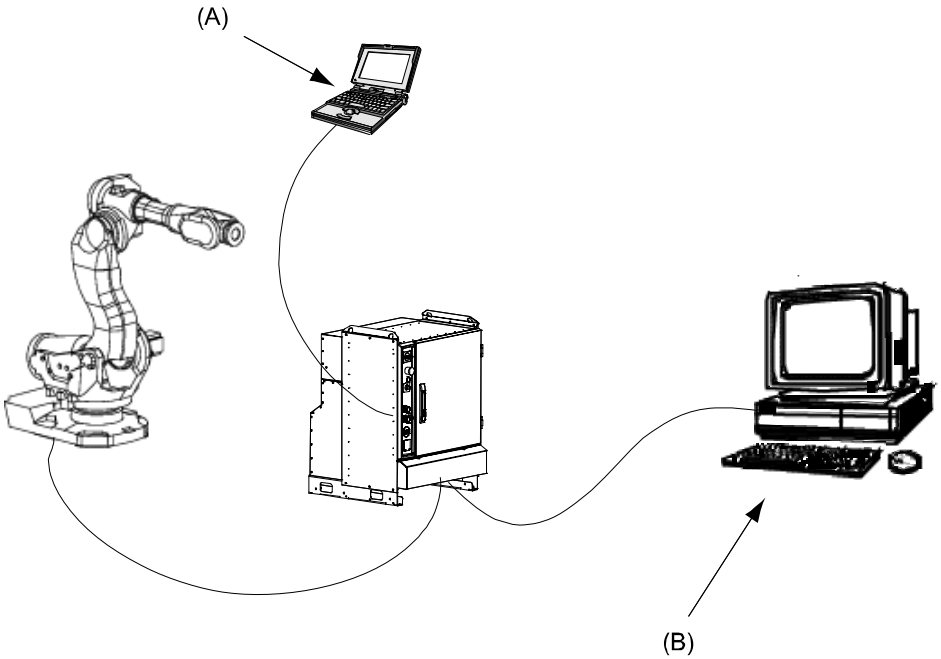


Figure 22 Point-to-point communication.

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 (part of Robot Application Builder)
- Boot/upgrading of controller software via the network or a portable PC
- Communication with RobotStudio

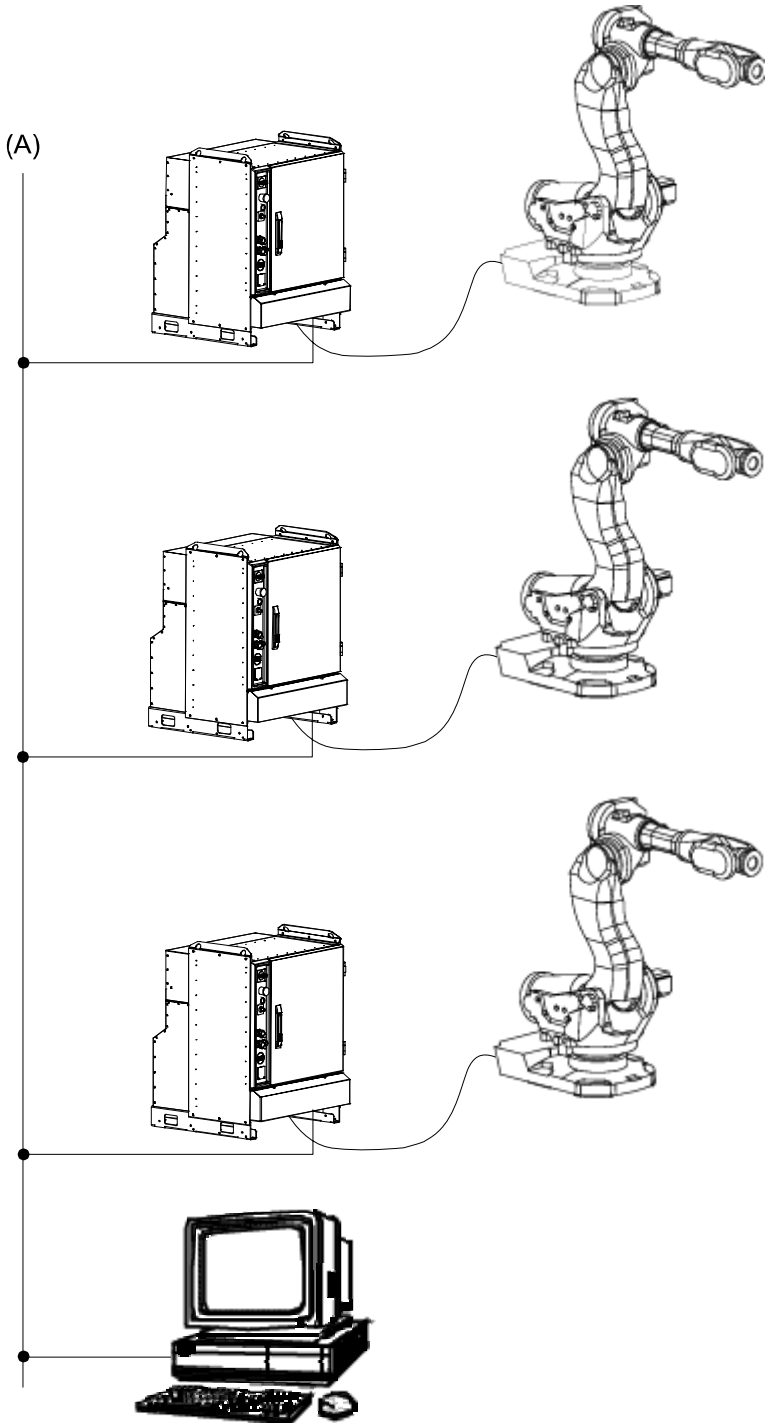


Figure 23 Network (LAN) communication.

Pos	Description
A	Factory network

Serial channel

The controller has one serial channel 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 optional adapter. The following modes of operation are supported:

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

Note: Synchronous (clocked) mode is NOT supported.

2 Specification of Variants and Options

2.1 Structure

2.1.1 Introduction

General

The different variants and options for the controller are described below.

The same option numbers are used here as in the respective Specification form for any IRB.

For details about manipulator options, see Product specification for the respective IRB. For software options, see Product specification - Controller software IRC5, RobotWare Options.

2.1.2 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 chapter 1.16 IRC5 as stand alone controller.

For more information, like available kinematic models, see Application manual - Additional axes and stand alone controller.

2.1.3 IRC5 as retrofit

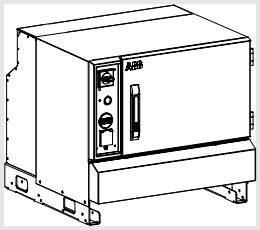
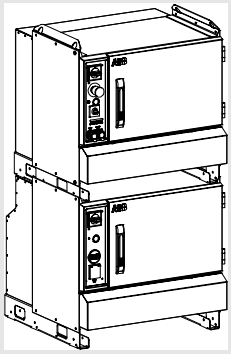
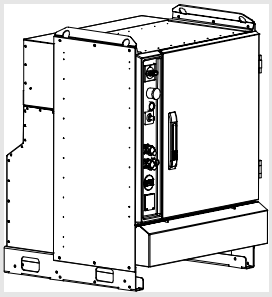
Specification form for IRC5 Controller is to be used.

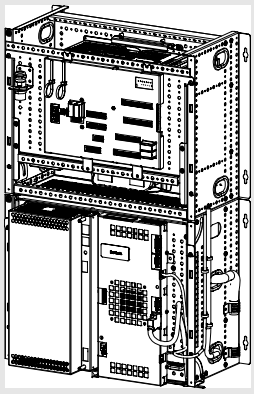
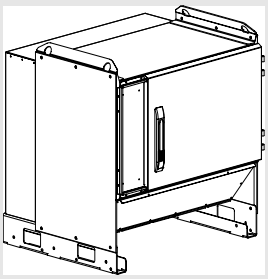
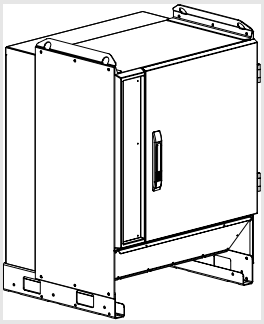
When the controller is to be connected to an existing IRB manipulator it is essential to select the appropriate variant in order to facilitate commissioning. Available variants are listed in the specification form.

2.2 Basic

2.2.1 Introduction

Controller variants

Option	Description	
700-1 Drive module only	This option is intended for: 1. additional robots in a MultiMove configuration 2. extended use of additional motors. In this case, the IRC5 stand alone specification form is used. For cabinet dimensions see page 7.	
700-2 Dual cabinet	This option is selected when more option space is needed or when distribution of modules is preferred. The two modules can be separated for lower height or placed at different locations. Max. distance between the modules is 75 m. For cabinet dimensions see page 7.	
700-3 Single cabinet	This option is the normal selection for all robots, also for a MultiMove main robot. For cabinet dimensions see page 7.	

Option	Description	
700-5 Panel mounted controller - control module - drive module	Options intended for integration in customer equipment. See chapter 1.18 Panel Mounted Controller for further information.	
700-6 Additional Drive module for Panel mounted controller	Options intended for integration in customer equipment.	
768-1 Empty cabinet small (based on Dual cabinet Control Module)	This option is intended for customer equipment or extended use of I/O units. Mounting plate dimensions (HxW): 511 x 660 mm. Mounting depth (D): 250-325 mm For cabinet dimensions see page 7.	
768-2 Empty cabinet large (based on single cabinet)	This option is intended for customer equipment or extended use of I/O units. Mounting plate dimensions (HxW): 711 x 660 mm. Mounting depth (D): 250-325 mm For cabinet dimensions see page 7.	
715-1 Installation kit	Mounting bars, EMC multi cable gland, door cable router, terminal mounting plate	

Prepared for IRBT

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

2.2.1 Introduction

Safety compliance

Option	Description
429-1 UL/CSA	The robot and the control system are certified by Underwriters Laboratories to comply with the Safety Standard ANSI/UL 1740-1998 “Industrial Robots and Robotic Equipment” and CAN/CSA Z 434-94. Law for UL/CSA certification is required in some US states and Canada. UL (UL listed) means certification of the complete robot product. The option is visualized by a “UL” label attached to the cabinet.
129-1 EU - Electromagnetic Compatibility	The robot and the control system comply with the European Union Directive “Electromagnetic Compatibility” 89/336/EEC. This directive is mandatory for robots operated within EU countries. The option consists of an additional line filter located in the Drive module. A certifying document “Declaration by the manufacturer” is also supplied which tells the machine integrator that the robot is prepared for CE marking. Not available for controllers connected to 600 V.

Mains voltage

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

When Dual cabinets, the Control module is supplied with 230 V from the Drive module.

The options below indicate the connection and labelling at delivery. All robots with options including servo transformer can be re-connected for another mains voltage if for example a line builder uses a different voltage than the end customer. An IRB 660 or IRB 66XX specified for 400 - 480 V can be re-connected within this range.

Option	Voltage	Servo transformer included					
		IRB 140, 1400	IRB 1600, 2400, 260	IRB 4400, 6400RF	IRB 340/ IRB 360	IRB 660, 66XX	IRB 7600
769-7	200 V	Yes	Yes	Yes	Yes	Yes	Yes
769-1	220 V	Yes	Yes	Yes	Yes	Yes	Yes
769-2	400 V	Yes	Yes	Yes	Yes	-	Yes
769-3	440 V	Yes	Yes	Yes	Yes	-	Yes
769-4	480 V	Yes	Yes	Yes	Yes	-	-
769-5	500 V	Yes	Yes	Yes	Yes	Yes	Yes
769-6	600 V	Yes	Yes	Yes	Yes	Yes	Yes

Transformer for Panel Mounted Controller

Option	Description
881-1	6 KVA, the same as for robots IRB 140 - 6400RF

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. If option 752-2 is chosen, the cable counterpart is included.

Option	Description
752-1	Cable gland for inside connection. Diameter of cable: 10-20 mm.
752-2	Connection via an industrial Harting 6HSB connector in accordance with DIN 41640. 35 A, 600 V, 6p + PE (see Figure 24).

Mains switch

For Single cabinet there is only one switch. For Dual cabinet the power is controlled from the Control module switch while the Drive module switch acts as an isolator. For MultiMove with several Drive modules the total power on/off is controlled from the main robot.

Option	Description
742-1	Rotary switch with padlocking possibility. Customer fuses (see chapter 1.6 Installation) at the distribution panel are required for short circuit protection of Drive module cabling.
743-1	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
742-3	Flange disconnector with integrated door interlock. A 20A circuit breaker is included. Max. customer fuse 3x80A. The option is available for Single cabinet only.

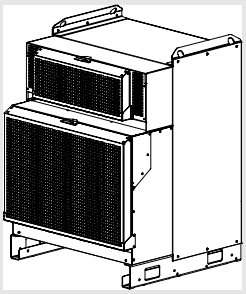
Mains voltage	Interrupt capacity	
	for option 743-1	for option 742-3
200 V	100 kA	100 kA
220 V	100 kA	100 kA
400 V	50 kA	70 kA
440 V	30 kA	65 kA
480 V	22 kA	65 kA
500 V	20 kA	25 kA
600 V	10 kA	25 kA

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

Room temperature for the controller

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

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.	

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

Fans for Panel Mounted Controller

Option	Description
882-1	Fan unit including 3 fans.

Cabinet connectors

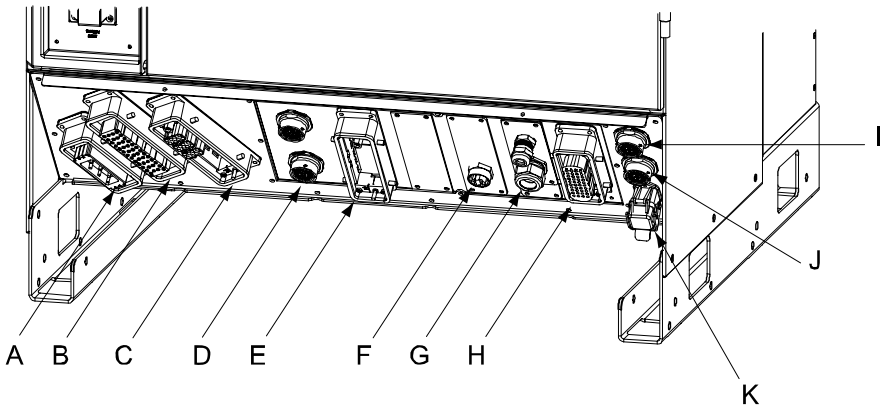


Figure 24 IRC5 Single cabinet connector plate.

Pos	Description
A	Power inlet, option 752-2
B	Manipulator motor cable (Horizontal orientation for large robots)
C	Power to additional motors, XS7 (Horizontal orientation for large robots)
D	Floor cables for manipulator position switches
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 on connector plate, option 707-1

For the Dual cabinet version, the Positions A,B,C, I and J are located on the Drive module connector plate. The other connectors are located on the Control module.

Cabinet connector protection

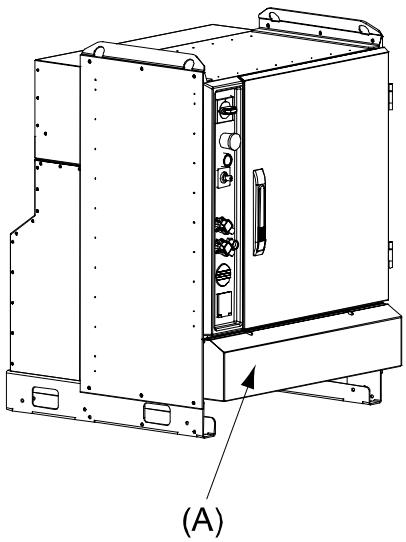


Figure 25 Cabinet connector protection.

Pos	Description
A	Connector cover

Option	Description
741-1	Each module in the order will be equipped with a connector cover.

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, see Figure 24.

Option	Description
890-1	GPRS electronic device. Service agreement subscription with local ABB is required. Communication fee for the first 18 months after delivery is included.

Manipulator cables

The manipulator cables consists of two cables.

Cable Type	Description
Motor cable	Industrial connector type in both ends exept for IRB 140 and IRB 340/ IRB 360 where the manipulator end has internal connection.
Measurement cable	Circular connector type in both ends exept for IRB 140 and IRB 340/ IRB 360 where the manipulator end has internal connection.

Option	Description	Remarks
210-1	3 m	IRB 140 and IRB 340/IRB 360
210-2	7 m	[a]
210-3	15 m	
210-4	22 m	211-2 for IRB 140
210-5	30 m	211-3 for IRB 140

a. Together with Panel Mounted Controller the 7 m cables for IRB 140 and IRB 340/ IRB 360 are prepared for internal connection also in cabinet end.

2.3 Control module

2.3.1 Introduction

FlexPendant

Color graphic pendant with touch screen. Various articles for mounting are included, see Figure 26.

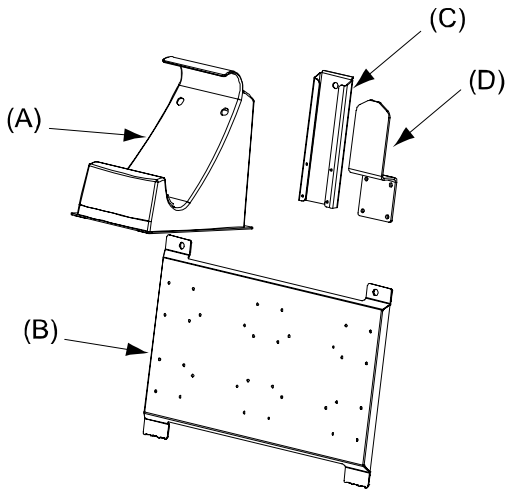


Figure 26 Items included in assembly kit.

Pos	Description
A	FlexPendant-holder
B	Mounting plate (Mounting holes Ø 8.5 mm (2x), distance 340 mm)
C	Cable bracket holder
D	Cable bracket

Option	Description	
701-1	With 10 m cable	
701-3	With 30 m cable	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.
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.
829-1	Protection bar	Side bar to protect key switch and FlexPendant connector.

FlexPendant language

Three user interface languages can be stored in the pendant. English is always available, the first and second additional language can be selected. The user can switch between the languages with a restart of the FlexPendant.

Additional languages

Option	First aditional language	Option	Second additional language
644-1	French	645-1	French
644-2	German	645-2	German
644-3	Spanish	645-3	Spanish
644-4	Italian	645-4	Italian
644-5	Chinese	645-5	Chinese
644-6	Portuguese	645-6	Portuguese
644-7	Dutch	645-7	Dutch
644-8	Swedish	645-8	Swedish
644-9	Danish	645-9	Danish
644-10	Czech	645-10	Czech
644-11	Finnish	645-11	Finnish
644-12	Korean	645-12	Korean
644-13	Japanese	645-13	Japanese
644-14	Russian	645-14	Russian

Network connection, LAN

Option	Description	
707-1	Ethernet on connector plate	As an addition to the connector on the computer front (see below), there is an optional RJ45 connector (IP 54 protected) on the connector plate, see Figure 24. Corresponding customer part is not included. Harting type 09 45 115 1100 00 (complete kit) is recommended.

Optional PCI cards

Four slots are available for different usage.

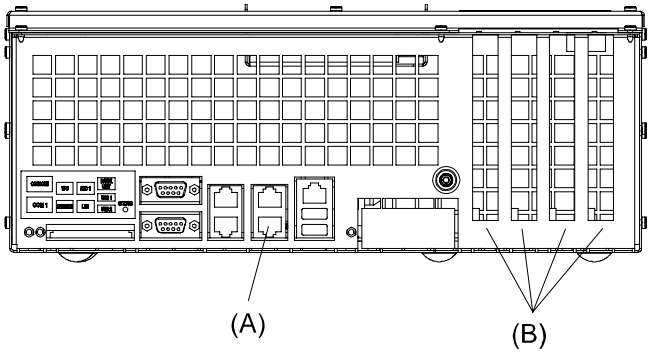


Figure 27 LAN port and PCI slots on the computer unit. xx0600002889.

Pos	Description
A	LAN port
B	PCI slots

Option	Description	
709-1	DeviceNet m/s single channel	Required when ABB I/O and gateway units are to be used as well as 3rd party DeviceNet units. The hardware consists of a PCI board with a 5-pole open DeviceNet connector at the front. The DeviceNet bus can be configured for 125/250/500 Kbit/s. The highest speed, which has to be used for ABB units, maximize the trunk cable length to 100 m. For more information, see Application manual - DeviceNet. Occupies one PCI slot. The option is delivered with bus cable harness for two (Single cabinet) or four (Dual cabinet) I/O or gateway units.
709-2	DeviceNet m/s dual channels	Same as 709-1 but with two 5-pole connectors. Occupies one PCI slot. The option is delivered with bus cable harness from channel 1 for two (Single cabinet) or four (Dual cabinet) I/O or gateway units.

Option	Description	
709-4	DeviceNet m/s four channels	Two cards equal to 709-2. Occupies two PCI slots. The option is delivered with bus cable harness from channel 1 for two (Single cabinet) or four (Dual cabinet) I/O or gateway units.
710-1	Multiple Ethernet ports	Communication (3 Ethernet channels) card to other robot(s) in a Multi Move application or to additional motor drive units in separate Drive module. Occupies one PCI slot.
884-1	MMS with internal drives	Used in a single robot running a positioner in MultiMove. Neutralizes the MultiMove demand for 710-1.
711-1	PROFIBUS DP m/s	The hardware of the PROFIBUS DP field bus consists of a master/slave unit, DSQC 637. The signals are connected to the board front (two 9-pole D-sub). Occupies one PCI slot. The slave units can be I/O units with digital and/or analogue signals. They are all controlled via the master part of the DSQC 637 unit. The slave part of the DSQC 637 is normally controlled by an external master on a separate PROFIBUS DP network. The slave part is a digital input and output I/O unit with up to 512 digital input and 512 digital output signals.
285-1	PROFIBUS DP M/S CFG Tool	The tool consists of software for a standard PC. The tool creates a bus configuration, which is used in the robot controller. Note: This tool is NOT needed for configuration and use of other channels than the DSQC 637 master channel.
888-1	PROFINET IO m/s (On request)	The hardware of the PROFINET IO field bus consists of a master/slave unit, DSQC 678. The signals are connected to the board front (four RJ45). Occupies one PCI slot. With this option the LAN port is moved from the computer mother board (see Figure 27) to one of the four RJ45 The slave units can be I/O units with digital and/or analogue signals. They are all controlled via the master part of the DSQC 678 unit. To configure the master, use the PC tool Simatic Step 7 from Siemens. The slave part of the DSQC 678 is normally controlled by an external master on a separate PROFINET IO network. The slave part is a digital input and output I/O unit with up to 512 digital input and 512 digital output signals.

2.3.1 Introduction

Fieldbus adapters

Option	Description	
840-1	Ethernet/IP slave	Up to 512 digital inputs and 512 digital outputs can be tranferred 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 slave	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 slave	Up to 512 digital inputs and 512 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.

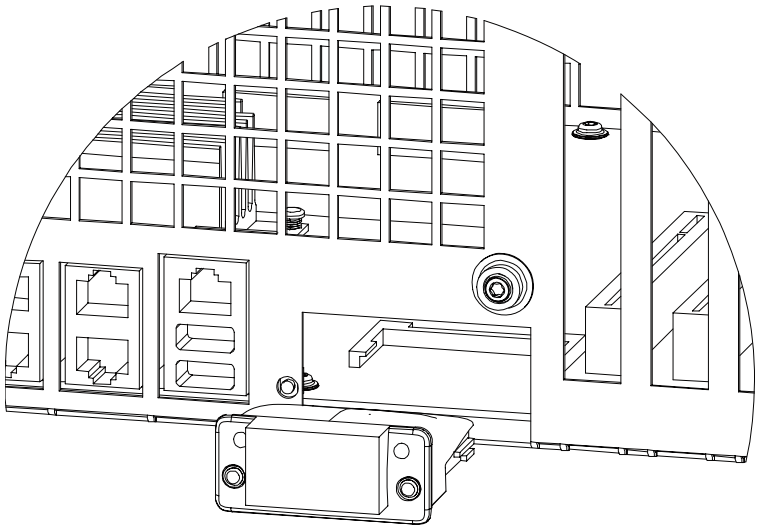


Figure 28 xx0700000195

RS 422/485

Option	Description	
714-1	RS232 to RS422/485 converter	An adapter plug added to the serial port COM1 via a short cable. The RS422/485 enables a more reliable point to point communication (differential) over longer distance, from RS232 = 15 m to RS422/485 = 120 m.

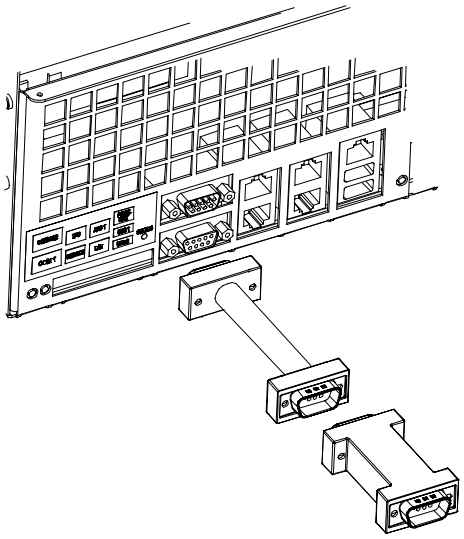


Figure 29 xx0600003075

Internal DeviceNet I/O units

Maximum four ABB DeviceNet I/O or three gateway units can be mounted in the Single cabinet controller (inside of door). The Dual cabinet controller can take six I/O units inside the Control module.

The customer cables are connected directly to spring load or screw terminals on the I/O units.

Option	Description	
716-1	Digital 24 VDC I/O (DSQC 652)	16 inputs/16 outputs
717-2	AD Combi I/O (DSQC 651)	8 digital inputs/8 digital outputs and 2 analog outputs (0-10 V)
718-2	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.

Internal DeviceNet gateway units

Option	Description	
721-1	Allen-Bradley Remote I/O (DSQC 350B)	Up to 128 digital inputs and outputs, in groups of 32, can be transferred serially to a PLC equipped with an Allen Bradley 1771 RIO node adapter. The bus cable is connected directly to the DSQC 350B (two 4-pole Phoenix connectors included).
722-1	Interbus (DSQC 351B)	Up to 64 digital inputs and 64 digital outputs can be transferred serially to a PLC equipped with an InterBus interface. The bus cables are connected directly to the DSQC 351B (two 9-pole D-sub).
726-1	Encoder interface unit for conveyor tracking (DSQC 377B)	This option is required for: • Conveyor Tracking (RW option 606-1) which makes the robot follow a work object on a moving conveyor. • Sensor Synchronization (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. • PickMaster conveyor tracking applications. 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 quadrate pulses, to enable registration of reverse conveyor motion, and to avoid false counts due to vibration etc. when the conveyor is not moving. **Output signal:** Open collector PNP output **Voltage:** 10 - 30 V (normally supplied by 24 VDC from DSQC 377B) **Current:** 50 - 100 mA **Phase:** 2 phase with 90 drgree phase shift **Duty cycle:** 50% **Following encoder is verified:** Lenord & Bauer GEL 262

External DeviceNet units

ABB I/O and gasteway 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, adress key and termination resistor are included.

Option	Description
816-826	Corresponds to internal units 716-726

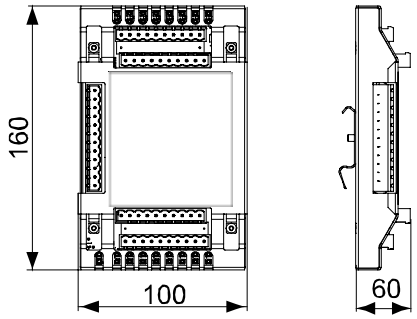


Figure 30 Dimensions for I/O units DSQC 651, 652, 653.

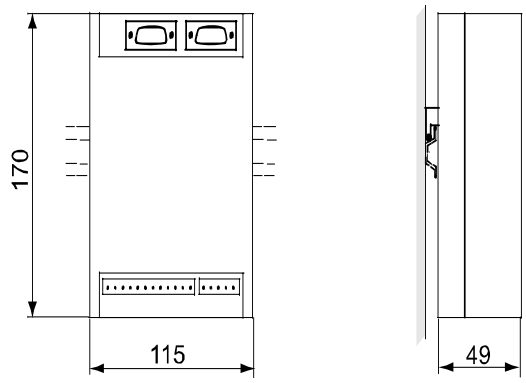


Figure 31 Dimension for gateway units.

Bus connection to the controller is performed by:

- directly to PCI 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.

Option	Description	
730-1	DeviceNet on front	One 5-pole female connector for option 709-1 in accordance with ANSI. See Figure 24. Corresponding customer part is not included. Brad Harrison type 1A5006-34 or ABB part number 3HAC 7811-1 is recommended.

Power supply (for customer I/O)

Option	Description
727-3	24 V 4 Amps for bus and process supply.
727-1	24 V 8 Amps for bus and process supply.
727-2	24 V 16 Amps for bus and process supply. Only available in Dual cabinet.
728-1	24 V 4 Amps for bus supply. Galvanically isolated from ground.
886-1	24 V 4 Amps for customer DIN rail mounting[a].

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

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 2.8 - 8 A, see chapter 1.19.1 Introduction.
- 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 ADeviceNet unit supplies the DeviceNet bus.

Dual cabinet

- Option 727-3. The 4 A unit supplies the DeviceNet bus and is also available for general usage on door terminals XT31.
- Option 727-1. 2 x 4 A supplies the DeviceNet bus and is also availble for general usage on floor terminals XT31. The two outputs are parallel connected at delivery.
- Option 727-2. 4 x 4 A supplies the DeviceNet bus and is also availble for general usage on floor terminals XT31. The outputs are parallel connected in two groups, each 2 x 4 A, at delivery.
- Option 728-1. The 4 A DeviceNet unit supplies the DeviceNet bus.

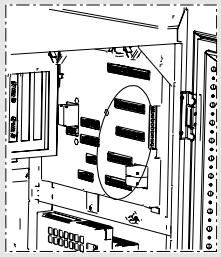
DeviceNet bus supply and grounding

In the normal case the Single cabinet integrated 24 V I/O supply can be used for both bus and customer I/O. For the Dual cabinet any of the options 727-x serve the same purpose. 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.

Safety signals interface

Option	Connection	Description
731-1	Internal connetion	The signals are connected directly to screw terminals at the panel board inside the cabinet. 
731-2	External connection	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. See Figure 24. Corresponding customer part is included.

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.

There are two different options based on European and American standards.

Option	Type	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.
671-1	Euromap 12 and SPI AN116	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. See Figure 32.
671-4	Euromap 67 kit for two IMM	Cable kit to allow two IMMs to be safely interfaced to one controller. The integrator installs the cable harness together with a safety relay (not included). Interface 671-2 to one IMM is included.

Cables to the Injection Mould Machine

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

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 Electronc Position Switches, 810-1, is ordered separately.

To configure the Euromap/SPI input and output signals in the RobotWare, IO-configuration files are available on the RobotWare CD 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].

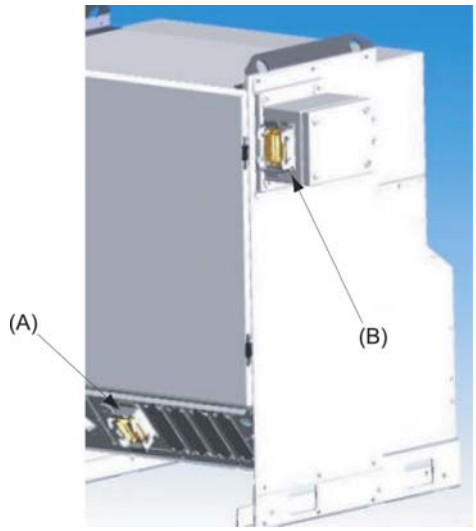


Figure 32 Additional converter box outside the cabinet plugged on the Euromap 67 connector.

Pos	Description
A	Option 671-2, Euromap 67, dual connectors for 671-4
B	Option 671-1, Euromap 12

Operator’s interface

The operator‘s panel can be installed in different ways.

Option	Description	
733-1	Standard	On the front of the cabinet.
733-2	External	Mounted in a box. See Figure 33.
733-3	External	To be mounted in a separate operator’s unit (enclosure not supplied). See Figure 34 for preparation.

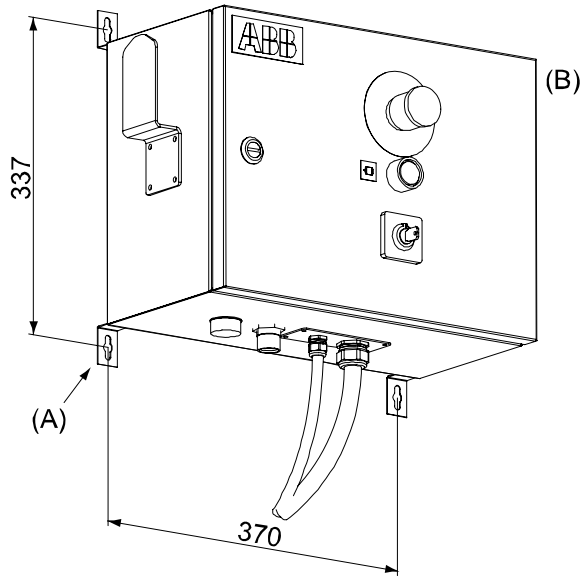


Figure 33 External control panel mounted in a box.

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

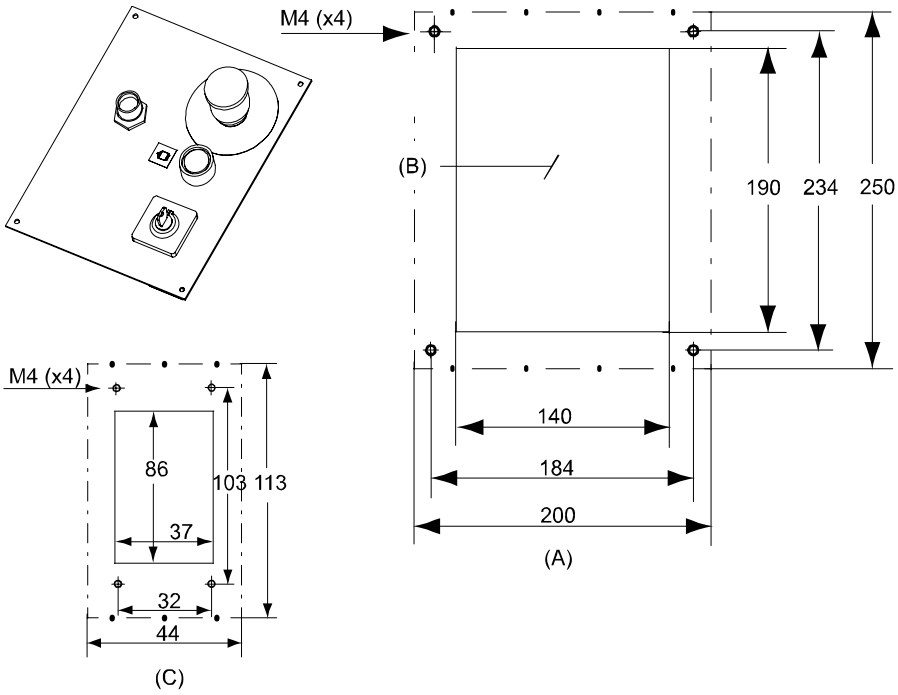


Figure 34 Required preparation of external panel enclosure (all dimensions in mm).

Pos	Description
A	Holes for operator’s panel
B	Required depth 200 mm
C	Holes for cable flange

Operator’s external panel cables

Option	Length
734-1	15 m
734-2	22 m
734-3	30 m

Operating mode selector (key switch)

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

The three modes types do not comply with UL safety standards, since manual full speed is not permitted.

The option additional contact means contacts (dual channels) for customer usage, see Figure 35. The connector S21.1.X1 is found in the cable harness. Customer part is included.

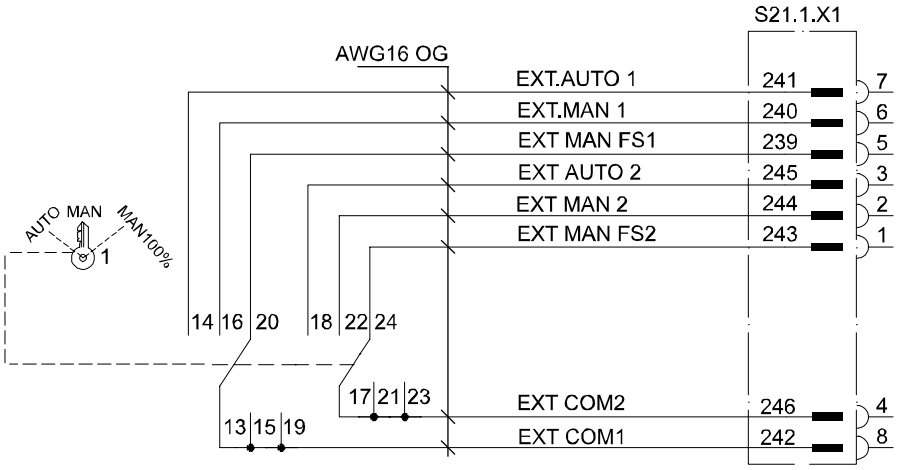


Figure 35 Mode selector dual contacts for customer usage.

As standard the mode selector position can be indicated by relay contacts (single channel), see Figure 36. 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.

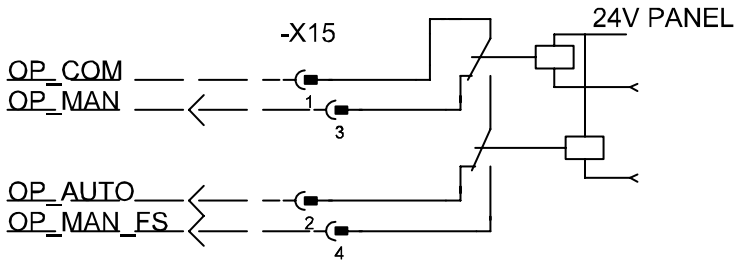


Figure 36 Mode selector indication.

Indication lamps

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’s panel (not available on the remote operator’s panel).

Option	Description
737-1	LEDs in front

2.4 Drive module

2.4.1 Introduction

Additional motors

The controller includes, in addition to drive system for a 4-6 axes robot, equipment to control additional motors, up to two single drive units for large robots, and up to three single drive units for small robots.

The connection to additional motors is collected in one (XS7, see Figure 24) industrial connector type Harting Han-Modular®. Corresponding cable connector is not supported (for part numbers see table below).

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

When ABB motors or positioners are ordered, the connector is included with the cabling.

When a complete drive module is selected for additional motors, the connector (XS1, see Figure 24) is identical to the corresponding robot. A robot floor cable from the controller to a customer split box can thus be selected.

Single Drive units for IRB 140, IRB 1410, IRB 1600, IRB 2400, IRB 260, IRB 340/360 (maximum three)

Options	Description
753-1, 754-1, 755-1	Drive unit C
753-2, 754-2, 755-2	Drive unit T
753-3, 754-3, 755-3	Drive unit U

Single Drive units for IRB 4400 (maximum two)

Options	Description
770-1, 771-1	Drive unit C
770-2, 771-2	Drive unit T
770-3, 771-3	Drive unit U

Single Drive units for IRB 660, IRB 6400RF, IRB 66XX, IRB 7600 (maximum two)

Options	Description
770-4, 771-4	Drive unit W

Larger rectifier for IRB 140, IRB 1410, IRB 1600, IRB 2400

Option	Description
766-1	Prepared for additional drive units

The rectifier capacity is increased so that additional drive units can be handled.

This option will thus minimize the effort of retrofitting additional motors for small robots. Large robots are prepared as standard.

Note! The option is not required if any of the options 753-771 is selected.

Drive system selection

The options are selected from the stand alone controller specification form. The purpose is either to run a customer designed mechanical unit or to control additional motors.

Option	Drive unit	Corresponding robot size
751-2	2 x E, 2 x C, 2 x B	IRB 1600, IRB 2400
751-4	3 x E, 1 x C	IRB 340/IRB 360
751-3	3 x G, 3 x T	IRB 4400
751-5	3 x V, 3 x W, 400-480V	IRB 66XX
751-6	3 x V, 3 x W, 480V	IRB 7600
751-8	3 x V, 3 x W, 262V	IRB 6400RF

Drive unit data

Drive unit type	Rated current (Amp rms)	Max current (Amp rms)	Voltage to motor (V rms)
W	30	55	377-430[a], 234[b]
V	14.5	25	377-430[a], 234[b]
U	36	55	234
T	25	38	234
G	16.5	26	234
E	12	19	234
C	9	12	234
B	5.5	6.7	234

a. Depending on line voltage, when used in IRB 66XX/7600.
b. Low voltage when used in IRB 6400RF.

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). This price reduction option is available for drive system 751-3, 751-5 and 751-8 corresponding to IRB 4400, 66XX and 6400RF size respectively.

Option	Description
823-1	Drive units 4 and 6 disabled

Additional motors measurement board

The normal way for additional motors is to use the encapulated SMB units with floor cable offered by the Motor Unit specification form. The floor cable is connected to measurement link 2. A connector XS41 (see Figure 24) is provided on the connector plate as soon as a single drive unit is selected.

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	Serial measurement board as separate unit with battery for mounting in an external cabinet encapsulation.
757-2	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.

Note that when a drive unit for axis 7 “first additional drive” is ordered, the measurement board in the robot can be used for resolver feedback. Following robots are prepared for resolver 7 connection to the robot SMB:

IRB	Description	Remark
1600	Short cable at base	
660	Connector at base, R3.FB7	Not Foundry Prime
6600	Connector at base, R3.FB7	Not Foundry Prime
6620	Connector at base, R3.FB7	
6640	Connector at base, R3.FB7	Not Foundry Prime
6660	Connector at SMB cover, R2.FB7	
7600	Connector at base, R3.FB7	Not Foundry Prime

Drive module cables

These options are intended for distributed Drive modules. Example of using, see Figure 38 to Figure 40.

Option	Description
761-1	Cable length 4 m
761-3	Cable length 30 m

“Normal” Dual cabinet (700-2)

"Normal" Dual cabinet (700-2), Interconnection cabling (approx 1m) consists of Ethernet, safety (right side cable duct) and 230V cables (left side cable duct). No optional cables needed

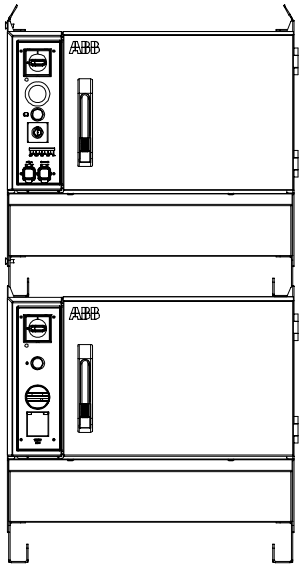


Figure 37

Example 1 with 761-1 or 761-3

Dual cabinet (700-2) with 4 or 30 m cable. The combination is intended for distributed layout (30 m) or side by side height reduction (4 m). The option consists of Ethernet, safety and 230V cables (3 pcs). The dual cabinet is delivered as one assembled unit with the 4 or 30 m cable connected in drive module end. Cable ducts are not included.

Figure 38

Example 2 with 761-1

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

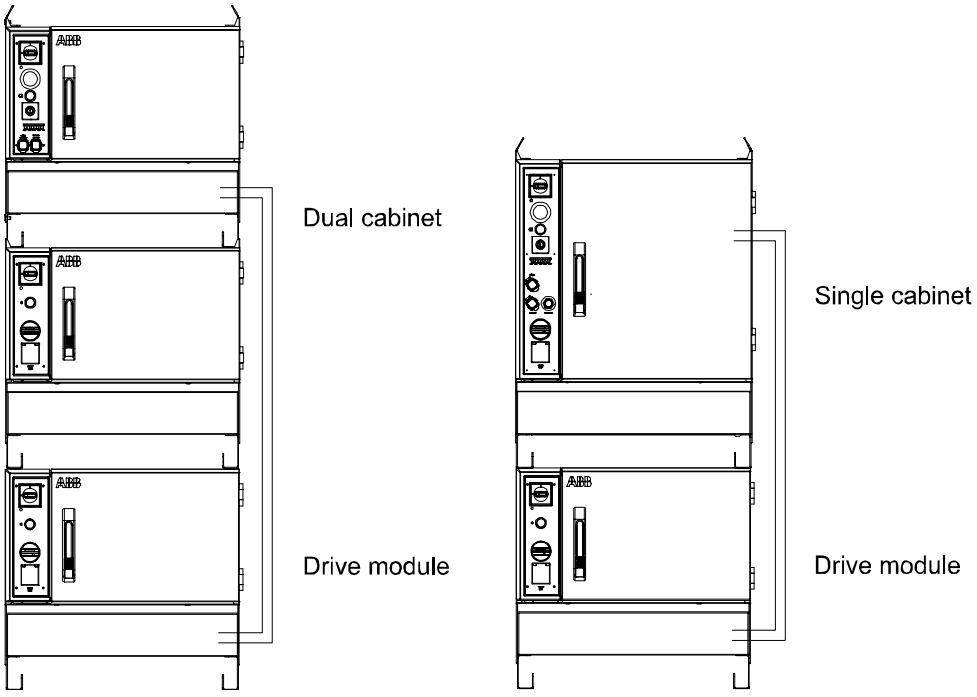


Figure 39

Example 3 with 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.

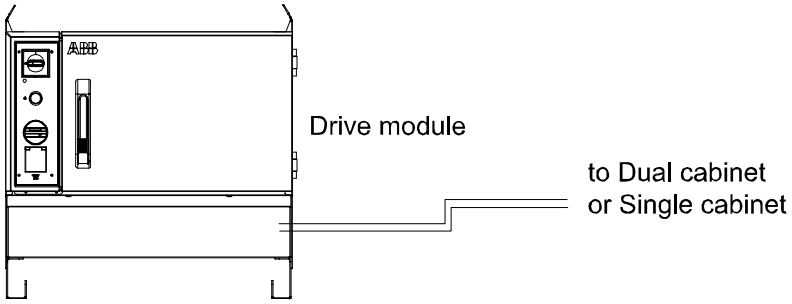


Figure 40

Duty time counter (DTC)

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

In addition to the optional hardware DTC there is also a software DTC (see SIS). This function displays the operating time on the FlexPendant. To read the software DTC press ABB/System Info/Hardware devices/Mechanical units/ROB_1/General SIS data.

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 manouvered. The cabinet resting position is on the front and middle wheels.

Option	Description
758-1	Wheels mounted in 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	Description
736-1	230 V outlet in accordance with DIN VDE 0620	Single socket suitable for EU countries.
736-2	120 V outlet in accordance with American standard	Single socket, Harvey Hubble.

Axis computer plus

For robots which will be equipped with a force sensor, an alternative axis computer is necessary. The standard DSQC601 is replaced by DSQC635, prepared for an additional sensor adapter card.

Option	Description
738-1	High performance axis computer, prepared for PMC card.

Position supervision computer

A safety enabled separate computer located behind the axis computer.

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

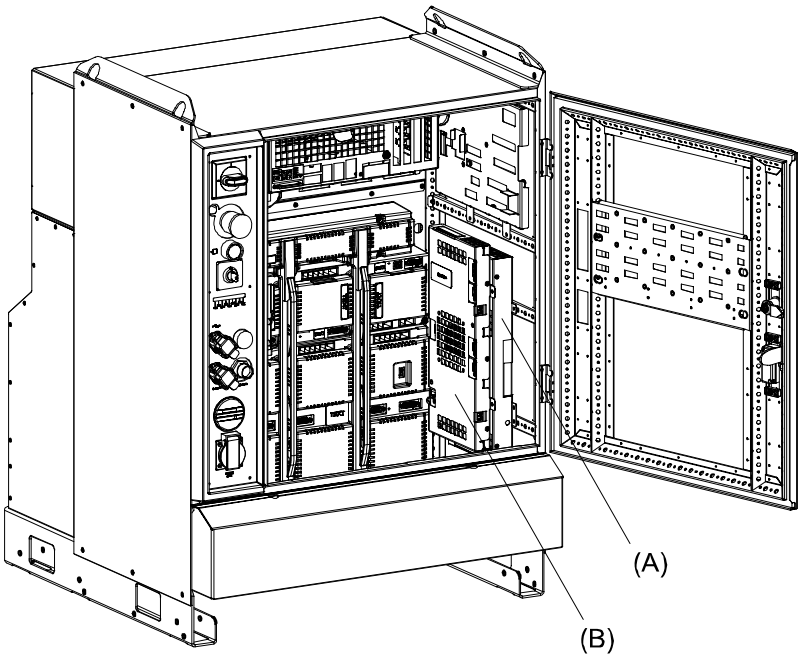


Figure 41 xx0600003203

A	EPS or SafeMove board
B	Axis computer

2.4.1 Introduction

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ABB AB
Robotics Products
S-721 68 VÄSTERÅS
SWEDEN
Telephone: +46 (0) 21 344000
Telefax: +46 (0) 21 132592