Product Specification

S4Cplus

3HAC 9039-1/Rev. 5
M2000/BaseWare OS 4.0



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1 Description

1.1 Structure

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

The controller also contains the system software, i.e. the BaseWare OS (operating system), which includes all basic functions for operation and programming.

Controller weight	250 kg
Controller volume:	950 x 800 x 620 mm

Airborne noise level:

The sound pressure level outside the working space	< 70 dB (A) Leq (acc. to Machinery directive 98/37/EEC)

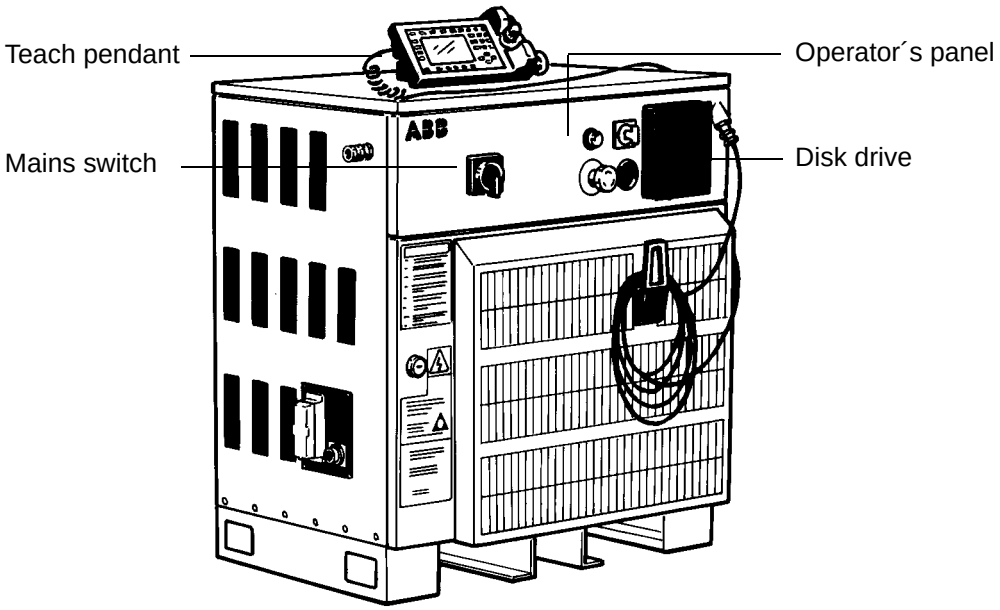


Figure 1 The controller is specifically designed to control robots, which means that optimal performance and functionality is achieved.

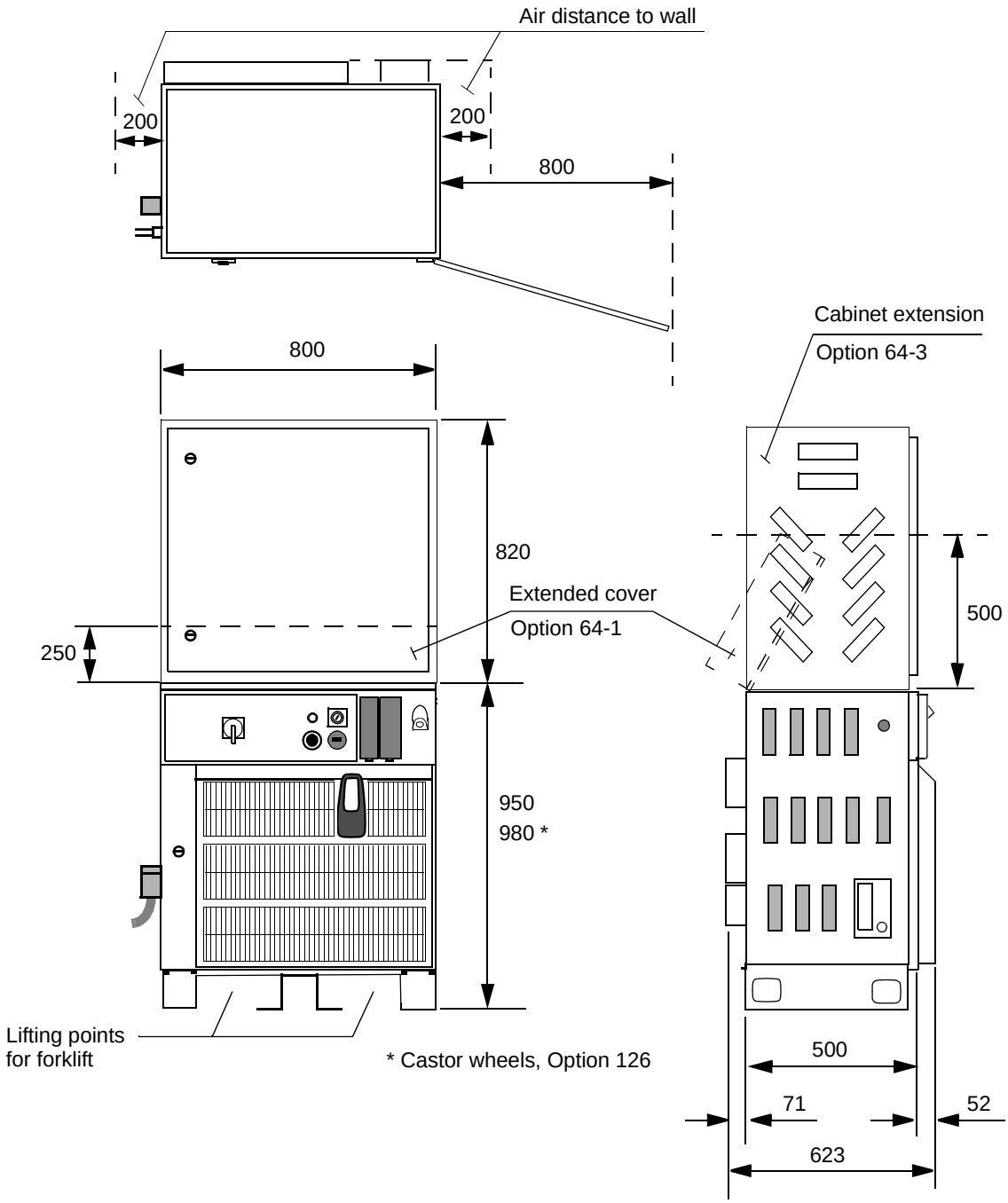


Figure 2 View of the controller from the front, from above and from the side (dimensions in mm).

1.2 Safety/Standards

The robot conforms to the following standards:

EN 292-1	Safety of machinery, terminology
EN 292-2	Safety of machinery, technical specifications
EN 954-1	Safety of machinery, safety related parts of control systems
EN 60204	Electrical equipment of industrial machines
IEC 204-1	Electrical equipment of industrial machines
ISO 10218, EN 775	Manipulating industrial robots, safety
ANSI/RIA 15.06/1999	Industrial robots, safety requirements
ISO 9787	Manipulating industrial robots, coordinate systems and motions
IEC 529	Degrees of protection provided by enclosures
EN 50081-2	EMC, Generic emission
EN 61000-6-2	EMC, Generic immunity
ANSI/UL 1740-1998 (option)	Standard for Industrial Robots and Robotic Equipment
CAN/CSA Z 434-94 (option)	Industrial Robots and Robot Systems - General Safety Requirements

The robot complies fully with the health and safety standards specified in the EEC's Machinery Directives.

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 shuts off and the brakes engage.

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. 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 teach pendant, i.e. 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 Centre 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 teach pendant must be used to move the robot when in manual mode. The enabling device consists of a switch with three positions, meaning that all robot movements stop when either the enabling device is pushed fully in, or when it is released completely. This makes the robot safer to operate.

Safe manual movement
The robot is moved using a joystick instead of the operator having to look at the teach pendant 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 on the teach pendant. Additional emergency stop buttons can be connected to the robot's safety chain circuit.

Safeguarded space 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 safeguarded space 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 approx. 1 second the power supplied to the motors shuts off.

Collision detection
In case an unexpected mechanical disturbance like a collision, electrode sticking, etc. occurs, the robot will stop and slightly back off from its stop position.

Restricting the working space
The movement of each axis can be restricted using software limits.
There are safeguarded space stops for connection of limit switches to restrict the working space.
For some robots the axes 1-3 can also be restricted by means of mechanical stops.

Hold-to-run control
"Hold-to-run" means that you must depress the start button in order to move the robot. When the button is released the robot will stop. The hold-to-run function makes program testing safer.

Fire safety
Both the manipulator and control system comply with UL's (Underwriters Laboratory) tough requirements for fire safety.

Safety lamp
As an option, the robot can be equipped with a safety lamp mounted on the manipulator. This is activated when the controller is in the MOTORS ON state.

1.3 Operation

All operations and programming can be carried out using the portable teach pendant (see Figure 3) and operator's panel (see Figure 5).

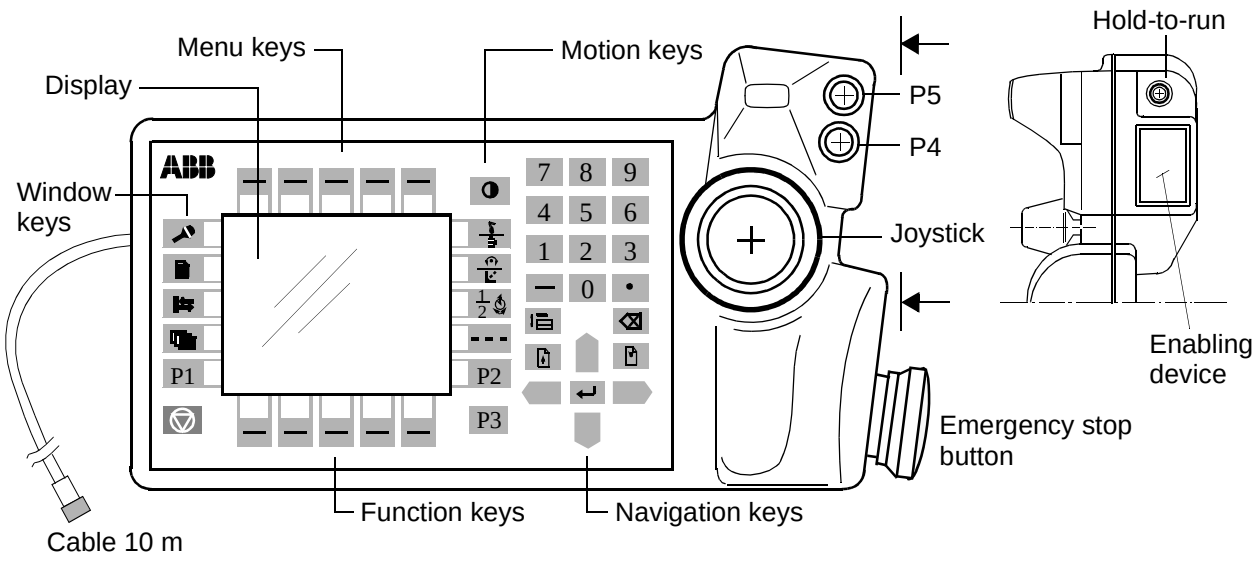


Figure 3 The teach pendant is equipped with a large display, which displays prompts, information, error messages and other information in plain English.

Information is presented on a display using windows, pull-down menus, dialogs and function keys. No previous programming or computer experience is required to learn how to operate the robot. All operations can be carried out from the teach pendant, which means that an additional keyboard is not required. All information, including the complete programming language, is in English or, if preferred, some other major language. (Available languages, see options on page 33).

Display
Displays all information during programming, to change programs, etc.
16 text lines with 40 characters per line.

Motion keys
Select the type of movement when jogging.

Navigation keys
Used to move the cursor within a window on the display and enter data.

Menu keys
Display pull-down menus, see Figure 4.

Function keys
Select the commands used most often.

Window keys
Display one of the robot's various windows.
These windows control a number of different functions:

- Jog (manual operation)
- Program, edit and test a program
- Manual input/output management

- File management
- System configuration
- Service and troubleshooting
- Automatic operation

User-defined keys (P1-P5)
Five user-defined keys that can be configured to set or reset an output (e.g. open/close gripper) or to activate a system input.

Hold-to-run
A push button which must be pressed when running the program in manual mode with full speed.

Enabling device
A push button which, 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 taken to the MOTORS OFF state.

Joystick
The joystick is used to jog (move) the robot manually; e.g. when programming the robot.

Emergency stop button
The robot stops immediately when the button is pressed in.

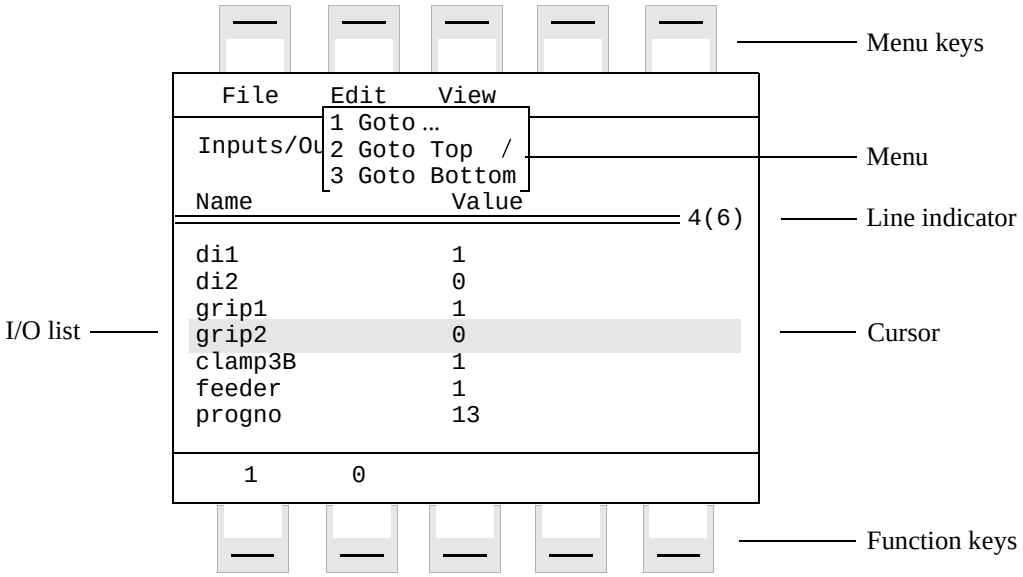


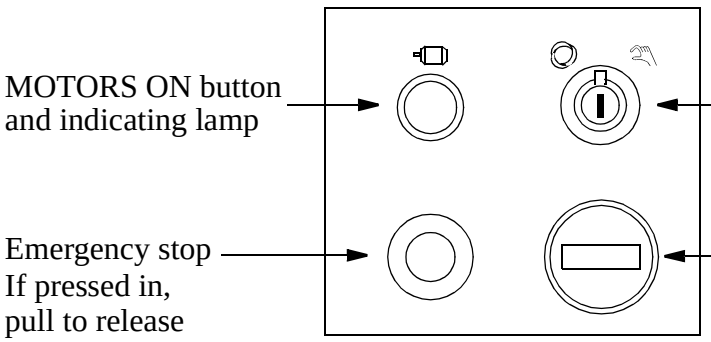
Figure 4 Window for manual operation of input and output signals.

Using the joystick, the robot can be manually jogged (moved). 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.

The robot supports different user tasks, with dedicated windows for:

- Production
- Programming
- System setup
- Service and installation

Operator’s panel



MOTORS ON

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

Automatic mode	=	Running production
Manual mode at reduced speed	=	Programming and setup Max. speed 250 mm/s (600 inches/min.)

Optional:

100% Manual mode at full speed Equipped with this mode, the robot is not approved according to ANSI/UL	=	Testing at full program speed

Figure 5 The operating mode is selected using the operator’s panel on the controller.

Both the operator’s panel and the teach pendant can be mounted externally, i.e. separated from the cabinet. The robot can then be controlled from there.

The robot can be remotely controlled 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 User’s Guide.

1.4 Memory

Available memory

The controller has two different memories:

- a fixed DRAM memory of size 32 MB, used as working memory
- a flash disk memory, standard 64 MB, used as mass memory. Optional 128 MB.

The DRAM memory is used for running the system software and the user programs and it is thus divided into three areas:

- system software
- system software execution data
- user RAPID programs, about 5.5 MB, see Figure 6 (when installing different options, the user program memory will decrease, at most by about 0.7 MB).

The flash disk is divided into four main areas:

- a base area of 5 MB, with permanent code for booting
- a release area of 20 MB, where all the code for a specific release is stored
- a system specific data area of 10 MB, where all the run time specific data including the user program for a system is stored at backup
- a user mass memory area which can be used for storing RAPID programs, data, logs etc.

The flash disk is used for backup, i.e. when a power failure occurs or at power off, all the system specific data including the user program, see Figure 6, will be stored on the flash disk and restored at power on. A backup power system (UPS) ensures the automatic storage function.

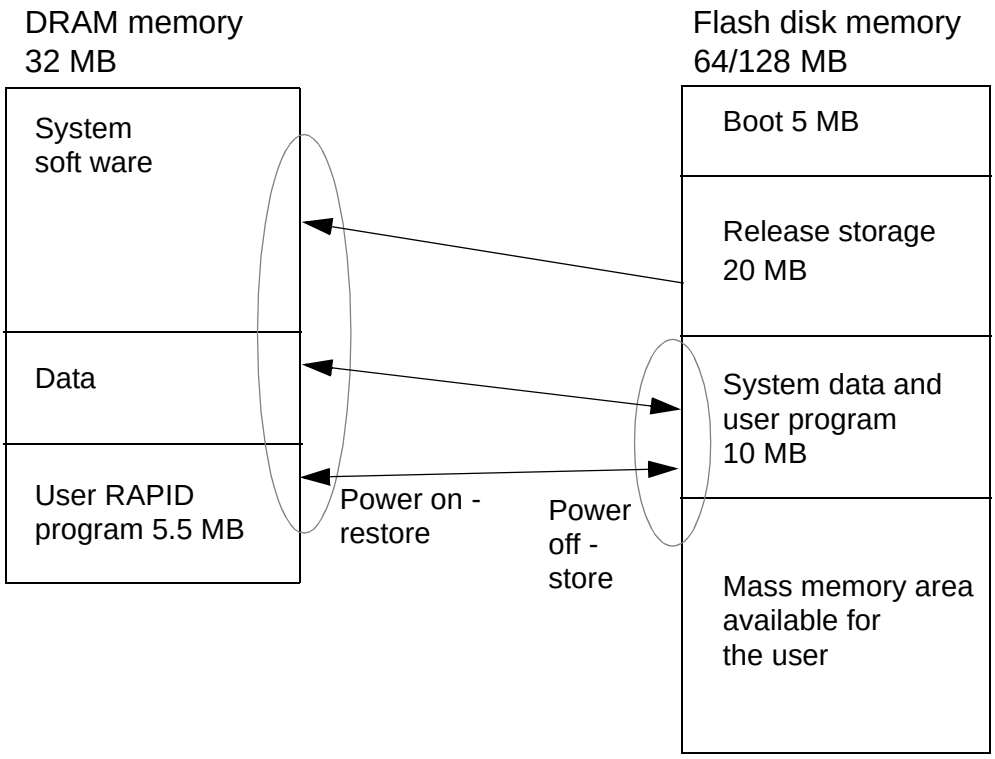


Figure 6 Available memory.

Several different systems, i.e. process applications, may be installed at the same time in the controller, of which one can be active. Each such application will occupy another 10 MB of the flash memory for system data. The release storage area will be in common as long as the process applications are based on the same release. If two different releases should be loaded, the release storage area must also be doubled.

For RAPID memory consumption, see RAPID Developer's Manual. As an example, a MoveL or MoveJ instruction consumes 236 bytes when the robtarget is stored in the instruction (marked with '*') and 168 bytes if a named robtarget is used. In the latter case, the CONST declaration of the named robtarget consumes an additional 280 bytes.

Additional software options will reduce the available user program memory, most of them however only marginally, i.e. the user program area will still be about 5.5 MB. Only the SpotWare option will reduce memory significantly, i.e. down to about 4.8 MB depending on the number of simultaneous welding guns.

1.5 Installation

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 teach pendant.

Operating requirements

Protection standards	IEC529
Controller electronics	IP54

Explosive environments
The controller must not be located or operated in an explosive environment.

Ambient temperature

Controller during operation	+5°C (41°F) to +45°C (113°F)
with option 85-2	+52°C (125°F)
Controller during transportation and storage, for short periods (not exceeding 24 hours)	-25°C (13°F) to +55°C (131°F) up to +70°C (158°F)

Relative humidity

Transportation, storage and operation	Max. 95% at constant temperature

Vibration

Controller during transportation and storage	10-55 Hz:	Max. ±0.15 mm
	55-150 Hz:	Max. 20 m/s^2

Bumps

Controller during transportation and storage	Max. 100 m/s^2 (4-7 ms)

Power supply

Mains voltage	200-600 V, 3p (3p + N for certain options
Mains voltage tolerance	+10%,-15%
Mains frequency	48.5 to 61.8 Hz

Rated power:

IRB 140, 1400, 2400	4.5 kVA (transformer size)
IRB 340, 140[1], 1400[1], 2400[1],4400, 640, 6400, 940	7.8 kVA (transformer size)
IRB 6600	6 kVA (ISO 9283)
IRB 7600	7.1 kVA (ISO 9283)
External axes cabinet	7.2 kVA (transformer size)

Recommended line fusing (if not included as optional circuit breker)

IRB 140-940	at 400-600V	3x16A slow-blowing
	at 200-220V	3x25A slow-blowing
IRB 6600-7600	at 400-600V	3x25A slow-blowing
	at 200-220V	3x50A slow-blowing

Computer system backup capacity at power interrupt	20 sec (rechargeable battery)

Configuration

The robot is very flexible and can, by using the teach pendant, easily be configured to suit the needs of each user:

Authorisation	Password protection for configuration and program window
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	Customised operator dialogs
Language	All text on the teach pendant 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
External axes	Number, type, common drive unit, mechanical units
Brake delay time	Time before brakes are engaged
I/O signal	Logical names of boards and signals, I/O mapping, cross connections, polarity, scaling, default value at start up, interrupts, group I/O
Serial communication	Configuration

For a detailed description of the installation procedure, see the Product Manual - Installation and Commissioning.

1. Enlarged transformer for external axes

1.6 Programming

Programming the robot involves choosing instructions and arguments from lists of appropriate alternatives. Users do not need to remember the format of instructions, since they are prompted in plain English. “See and pick” is used instead of “remember and type”.

The programming environment can be easily customized using the teach pendant.

- Shop floor language can be used to name programs, signals, counters, etc.
- New instructions can be easily written.
- 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.

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

The exact position can be defined (see Figure 7) as:

- a stop point, i.e. the robot reaches the programmed position

or

- a fly-by point, i.e. the robot passes close to the programmed position. The size of the deviation is defined independently for the TCP, the tool orientation and the external axes.

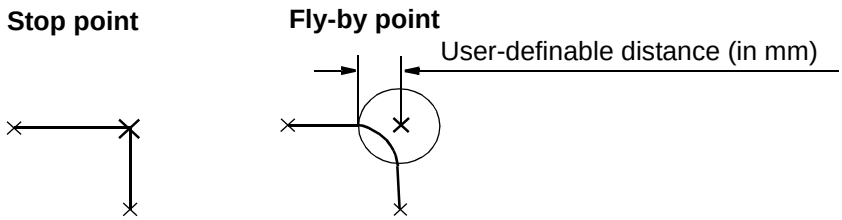


Figure 7 The fly-by point reduces the cycle time since the robot does not have to stop at the programmed point. The path is speed independent.

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 external 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. These 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 diskette.

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, i.e. “cut-and-paste”, copy, delete, find and change, undo etc. Individual arguments in an instruction can also be edited using these commands.

No reprogramming is necessary when processing left-hand and right-hand parts, since the program can be mirrored in any plane.

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)

or by

- entering or modifying numeric values.

To prevent unauthorised 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 forward/backward step-by-step
- simulate wait conditions
- temporarily reduce the speed
- change a position
- tune (displace) a position during program execution.

For more information, see the User’s Guide and RAPID Reference Manual.

1.7 Automatic Operation

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

The operation procedure can be customised to suit the robot installation by means of user-defined operating dialogs.

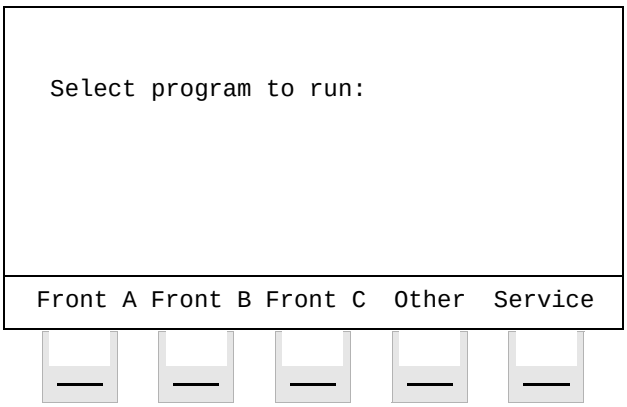


Figure 8 The operator dialogs can be easily customised.

A special input can be set to order the robot to go to a service position. After service, the robot is ordered to return to the programmed path and continue program execution.

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 customise each installation and to make sure that the robot is started up in a controlled way.

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.

1.8 The RAPID Language and Environment

The RAPID language is a well balanced combination of simplicity, flexibility and powerfulness. 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 (shop floor language) on variables, routines and I/O.
- Extensive program flow control.
- Arithmetic and logical expressions.
- Interrupt handling.
- Error handling (for exception handling in general, see *Exception handling*).

- 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, e.g mathematics and robot specific.
- Unlimited language (no max. number of variables etc., only memory limited).

Windows based man machine interface with built-in RAPID support (e.g. user defined pick lists).

1.9 Exception handling

Many advanced features are available to make fast error recovery possible. Characteristic is that the error recovery features are easy to adapt to a specific installation in order to minimise 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.

1.10 Maintenance and Troubleshooting

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 normal workshop environment.
- There is a supervision of temperature, fans and battery health.

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

- It performs a self-test when power on is set.
- Computer status LEDs and console (serial channel) for fault tracing support.
- Errors are indicated by a 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 read on the teach pendant display, stored in a file or printed on a printer.
- There are commands and service programs in RAPID to test units and functions.
- LEDs on the panel unit indicate status of the safeguarded switches.

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.

For detailed information on maintenance procedures, see Maintenance section in the Product Manual.

1.11 Robot Motion

Motion concepts

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, e.g. 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 an emergency stop, a safeguarded stop, a process stop, a program stop or a power failure.

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

Coordinate systems

BaseWare includes a very powerful concept of multiple coordinate systems that facilitates jogging, program adjustment, copying between robots, off-line programming, sensor based applications, external axes co-ordination etc. Full support for TCP (Tool Centre Point) attached to the robot or fixed in the cell (“Stationary TCP”).

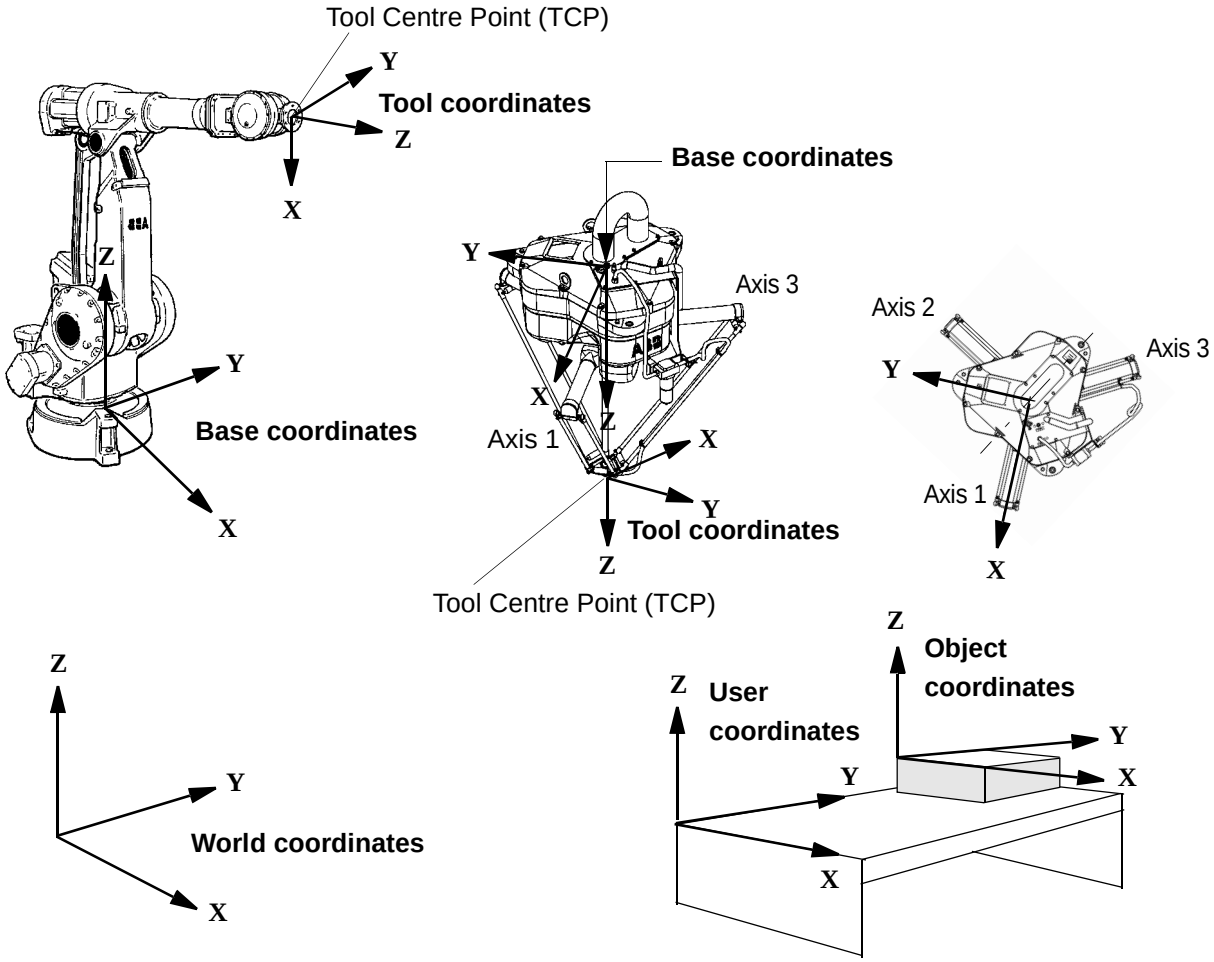


Figure 9 The coordinate systems, used to make jogging and off-line programming easier.

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.

The base coordinate system is attached to the base mounting surface of the robot.

The tool coordinate system specifies the tool's centre point and orientation.

The user coordinate system specifies the position of a fixture or workpiece manipulator.

The object coordinate system specifies how a workpiece is positioned in a fixture or workpiece manipulator.

The coordinate systems can be programmed by specifying numeric values or jogging the robot through a number of positions (the tool does not have to be removed).

Each position is specified in object coordinates with respect to the tool's position and orientation. This means that even if a tool is changed because it is damaged, the old program can still be used, unchanged, by making a new definition of the tool.
If a fixture or workpiece is moved, only the user or object coordinate system has to be redefined.

Stationary TCP

When the robot is holding a work object and working on a stationary tool, it is possible to define a TCP for that tool. When that tool is active, the programmed path and speed are related to the work object.

Program 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 - 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.

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.

Jogging

The robot can be manually operated in any one of the following ways:

- Axis-by-axis, i.e. one axis at a time.
- Linearly, i.e. 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 external axes can be displayed on the teach pendant.

Singularity handling

The robot can pass through singular points in a controlled way, i.e. points where two axes coincide.

Motion Supervision

The behaviour of the motion system is continuously monitored as regards 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 “Load Identification and Collision Detection”).

External axes

Very flexible possibilities to configure external axes. Includes for instance high performance coordination with robot movement and shared drive unit for several axes.

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 optimise the servo tuning to minimise load oscillation.

Soft Servo

Any axis (also external) can be switched to soft servo mode, which means that it will adopt a spring-like behaviour.

1.12 External Axes

The robot can control up to six external axes. These axes are programmed and moved using the teach pendant in the same way as the robot's axes.

The external axes can be grouped into mechanical units to facilitate, for example, the handling of robot carriers, workpiece manipulators, etc.

The robot motion can be simultaneously coordinated with for example, a linear robot carrier and a work piece positioner.

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

An external axis is an AC motor (IRB motor type or similar) controlled via a drive unit mounted in the robot cabinet or in a separate enclosure. See Specification of Variants and Options.

Resolver	Connected directly to motor shaft Transmitter type resolver Voltage ratio 2:1 (rotor: stator)
Resolver supply	5.0 V/4 kHz

Absolute position is accomplished by battery-backed resolver revolution counters in the serial measurement board (SMB). The SMB is located close to the motor(s) according to Figure 10.

For more information on how to install an external axis, see the User's Guide - External Axes.

External axes for robot types IRB 4400 and IRB 6400X:
When more than one external axis is used, the drive units for external axis 2 and upwards must be located in a separate cabinet as shown in Figure 10.

External axes for robot types IRB 140, IRB 1400, and IRB 2400:
When more than three external axes are used, the drive units for external axis 4 and upwards must be located in a separate cabinet as shown in Figure 10.

External axes for robot types IRB 6600 and IRB 7600:
The drive units for all external axes must be located in a separate cabinet as shown in Figure 10.

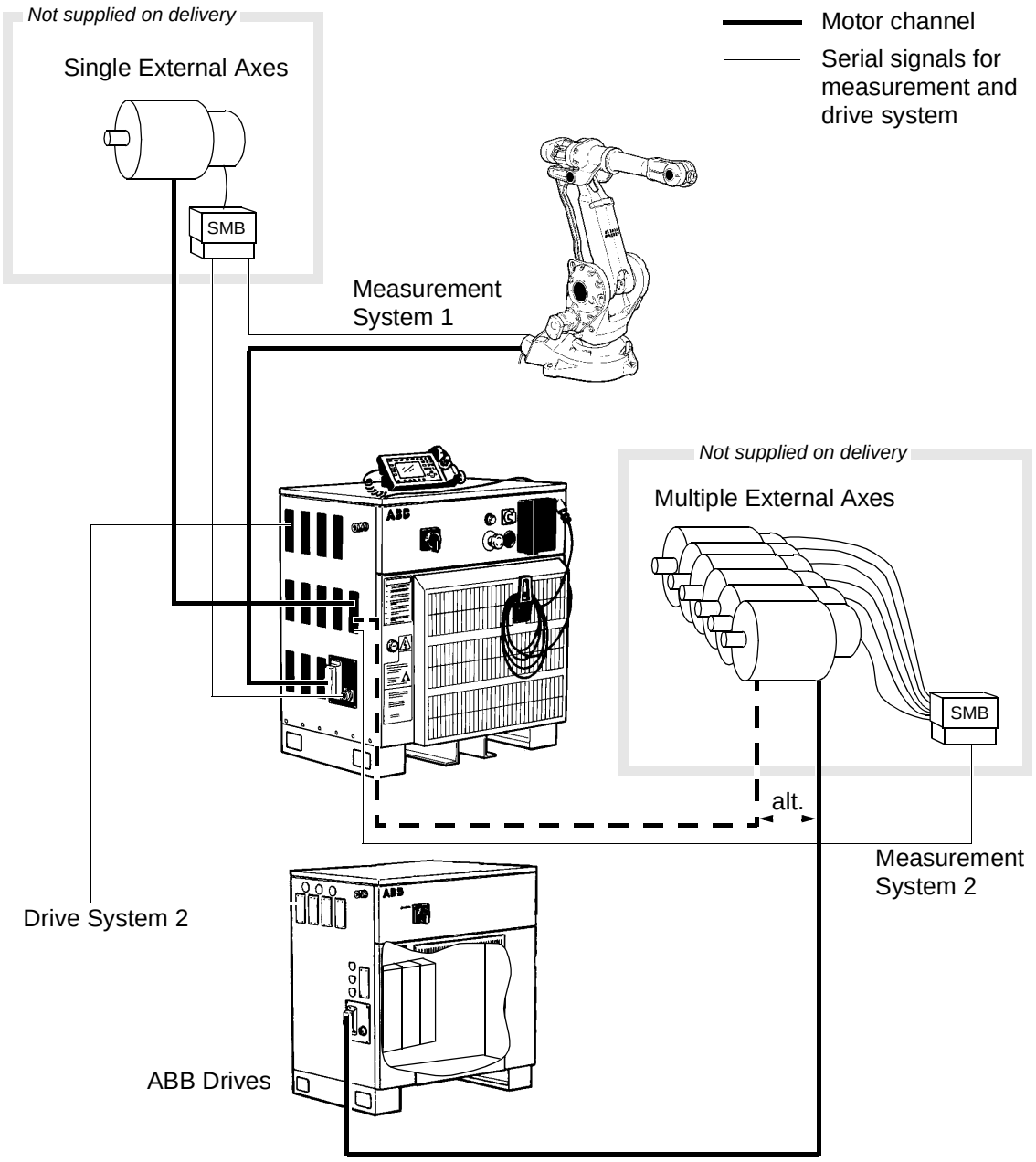


Figure 10 Outline diagram, external axes.

1.13 I/O System

A distributed I/O system is used, based on the fieldbus standard CAN/DeviceNet. This makes it possible to mount the I/O units either inside the cabinet or outside the cabinet with a cable connecting the I/O unit to the cabinet.

Two independent CAN/DeviceNet buses allow various conditions of I/O handling. Both channels can be operating as master or slave. One bus, CAN1, is operating with fixed data rate, and the other, CAN2 (accessible by the software option I/O Plus), with different data rates.

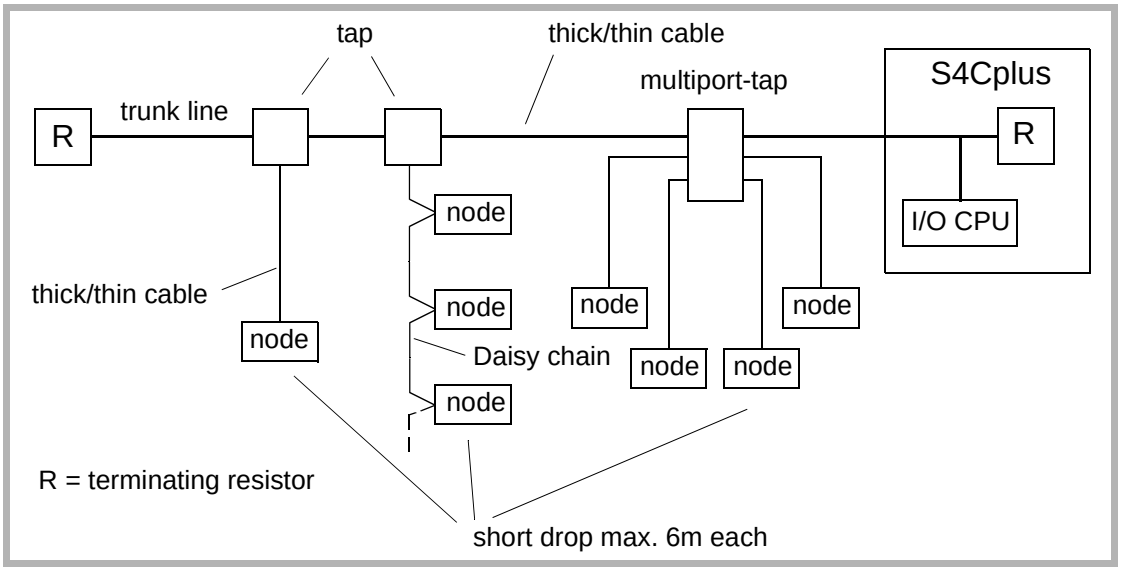


Figure 11 Example of a general DeviceNet bus.

A number of different input and output units can be installed:

- Digital inputs and outputs.
- Analog inputs and outputs.
- Gateway (slave) for Allen-Bradley Remote I/O.
- Gateway (slave) for Interbus Slave.
- Gateway (slave) for Profibus DP Slave.

S4Cplus with the option I/O Plus can be configured for fieldbus units from other suppliers. For more details see the Product Specification RobotWare Options.

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

- Each signal and unit can be given a name, e.g. gripper, feeder.
- I/O mapping (i.e. 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 if they were a single signal when, for example, entering a bar code.
- Sophisticated error handling.
- Selectable “trust level” (i.e. what action to take when a unit is “lost”).

- Program controlled enabling/disabling of I/O units.
- Scaling of analog signals.
- Filtering.
- Polarity definition.
- Pulsing.
- TCP-proportional analog signal.
- Programmable delays.
- Simulated I/O (for forming cross connections or logical conditions without need the for physical hardware).
- Accurate coordination with motion.

Signals can be assigned to special system functions, such as program start, so as to be able to control the robot from an external panel or 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, i.e. if a limited 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. Requires Multitasking option, see Product Specification RobotWare.

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.
- Print signal information on a printer.

I/O signals can for some robots also be routed parallel or serial to connectors on the upper arm of the robot.

Types of connection

The following types of connection are available:

- “Screw terminals” on the I/O units
- Industrial connectors on cabinet wall
- Distributed I/O-connections inside or on cabinet wall

For more detailed information, see Chapter 2, *Specification of Variants and Options*.

ABB I/O units (node types)

Several I/O units can be used. The following table shows the maximum number of physical signals that can be used on each unit. Data rate is fixed at 500 Kbit/s.

Type of unit	DSQC	Option no.	Digital		Analog			Power supply
			In	Out	Voltage inputs	Voltage output	Current output	
Digital I/O 24 VDC	328	61-1	16	16				Internal/External[1]
Digital I/O 120 VAC	320	60-1	16	16				Internal/External
Analog I/O	355	54-1			4	3	1	Internal
AD Combi I/O	327	58-1	16	16		2		Internal/External[1]
Relay I/O	332	63-1	16	16				Internal/External[1]
Allen-Bradley Remote I/O Slave	350	13-1	128[2]	128				
Interbus Slave	351	178-1	64[2]	64				
Profibus DP Slave	352	251-1	128[2]	128				
Simulated I/O[3]			100	100	30	30		
Encoder interface unit[4] Encoder interface unit[5]	354 377	79-1 80-1	1					

1. The digital signals are supplied in groups, each group having 8 inputs or outputs.
2. To calculate the number of logical signals, add 2 status signals for Allen-Bradley Remote I/O unit and 1 for Interbus and Profibus DP.
3. A non physical I/O unit can be used to form cross connections and logical conditions without physical wiring. No. of signals are to be configured. Some ProcessWares include SIM unit.
4. Dedicated for conveyor tracking only.
5. Only for PickMaster 4.0

Distributed I/O

The maximum number of logical signals is 1024 in total for the CAN/DeviceNet buses (inputs or outputs, group I/O, analog and digital including field buses)

	CAN1	CAN2 (option)
Max. total no of units*	20 (including SIM units)	20
Data rate (fixed)	500 Kbit/s	125/250/500 Kbit/s.
Max. total cable length	100 m trunk + 39m drop	up to 500m
Cable type (not included)	According to DeviceNet specification release 1.2	

* Max. four units can be mounted inside the cabinet.

Signal data

Permitted customer 24 V DC load			max. 7,5 A
Digital inputs 24 V DC	(option 61-1/58-1)		
	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		5–15 ms
	software		≤ 3 ms
	Time variations:		± 2 ms
Digital outputs 24 V DC	(option 61-1/58-1)		
	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
	Potential difference:	max.	500 V
	Time delays: hardware		≤ 1 ms
	software		≤ 2 ms
	Time variations:		± 2 ms
Relay outputs	(option 63-1)		
	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
	Potential difference:	max.	500V
	Time intervals: hardware (set signal)		typical 13 ms
	hardware (reset signal)		typical 8 ms
	software		≤ 4 ms
Digital inputs 120 V AC	(option 60-1)		
	Optically isolated		
	Rated voltage		120 V AC
	Input voltage range:	“1”	90 to 140 V AC
	Input voltage range:	“0”	0 to 45 V AC
	Input current (typical):		7.5 mA
	Time intervals: hardware		≤ 20 ms
	software		≤ 4 ms

Digital outputs			
120 V AC	(option 60-1)		
	Optically isolated, voltage spike protection		
	Rated voltage		120 V AC
	Output current:	max.	1A/channel, 12 A 16 channels or
		max.	2A/channel, 10 A 16 channels (56 A in 20 ms)
		min.	30mA
	Voltage range:		24 to 140 V AC
	Potential difference:	max.	500 V
	Off state leakage current:	max.	2mA rms
	On state voltage drop:	max.	1.5 V
	Time intervals: hardware		≤ 12 ms
	software		≤ 4 ms
Analog inputs	(option 54-1)		
	Voltage Input voltage:		±10 V
	Input impedance:		>1 Mohm
	Resolution:		0.61 mV (14 bits)
	Accuracy:		±0.2% of input signal
Analog outputs	(option 54-1)		
	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 58-1)		
	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		≤ 2.0 ms
	software		≤ 4 ms

System signals

Signals can be assigned to special system functions. Several signals can be given the same functionality.

Digital outputs	Motors on/off
	Executes program
	Error
	Automatic mode
	Emergency stop
	Restart not possible
	Run chain closed

Digital inputs	Motors on/off Starts program from where it is Motors on and program start Starts program from the beginning Stops program Stops program when the program cycle is ready Stops program after current instruction Executes “trap routine” without affecting status of stopped regular program[1] Loads and starts program from the beginning[1] Resets error Resets emergency stop System reset
Analog output	TCP speed signal

1. Program can be decided when configuring the robot.

For more information on system signals, see User’s Guide - System Parameters.

1.14 Communication

The controller has three serial channels for permanent use - two RS232 and one RS422 Full duplex - which can be used for communication point to point with printers, terminals, computers and other equipment. For temporary use, like service, there are two more RS 232 channels.

The serial channels can be used at speeds up to 19,200 bit/s (max. 1 channel with speed 19,200 bit/s).

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

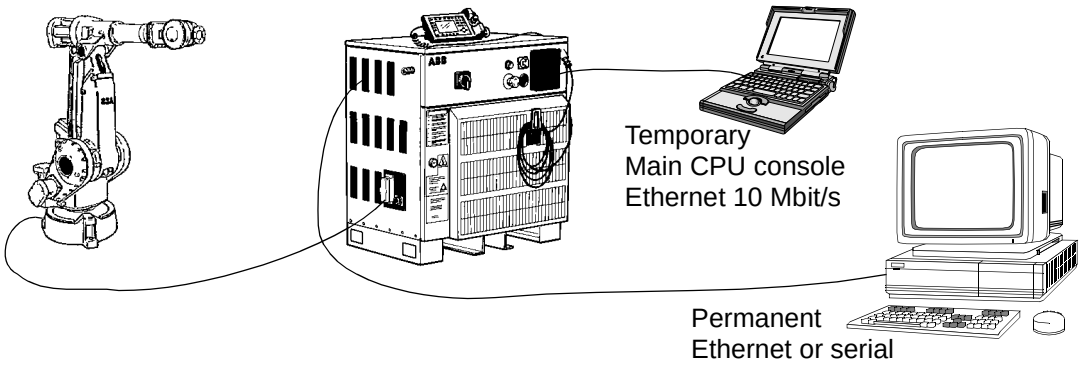


Figure 12 Point-to-point communication.

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

- DNS, DHCP etc. (including multiple gateway)
- Network file system accesses using FTP/NFS client and FTP server
- Control and/or monitoring of controllers with RAP protocol makes it possible to use OPC, ActiveX, and other APIs for integration with Window applications
- Boot/upgrading of controller software via the network or a portable PC.

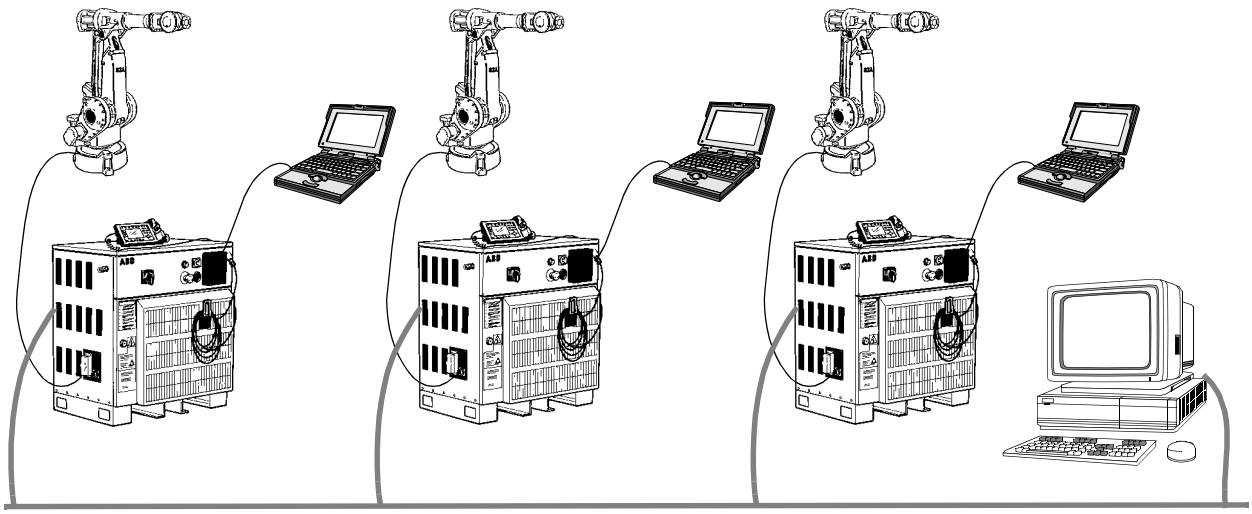


Figure 13 Network (LAN) communication.

2 Specification of Variants and Options

The different variants and options for the controller are described below.
The same numbers are used here as in the Specification form.
For manipulator options, see Product Specification respectively, and for software options, see Product Specification RobotWare Options.

1 SAFETY STANDARDS

EU - Electromagnetic Compatibility

129-1 The controller complies with the European Union Directive “Electromagnetic Compatibility” 89/336/EEC. This option is required by law for end users in the European Union.

UNDERWRITERS LABORATORY

429-1 UL/CSA
The robot is certified by Underwriters Laboratory to comply with the Safety Standard ANSI/UL 1740-1996 “Industrial Robots and Robotic Equipment” and CAN/CSA Z 434-94.
UL/UR certification is required by law in some US states and Canada.
UL (UL/CSA) means certification of complete product and UR (UL recognized Component) means certification of component or not complete product.
Safety lamp (213-1) Door interlock (188-1 or 207-1) Operating mode selector standard 2 modes (241-1) are mandatory.
Not with Cabinet height 950 mm no cover (64-5), Cabinet height 1200 mm (64-1), Cabinet height 1750 mm (64-3), Cabinet variant Prepared for Arcitec (66-1), Mains connection type CEE17 connector (206-3, 206-2), Service outlet type 230V Europe (328-1).

429-2 UR (UL Recognized)
The robot is certified by Underwriters Laboratory to comply with the Safety Standard UL 1740 “Industrial Robots and Robotic Equipment”. UL/UR certification is required by law in some US states and Canada. UL (UL listed) means certification of complete product and UR (UL Recognized Component) means certification of component or not complete product.
Safety lamp (213-1), Door interlock (188-1 or 207-1), Operating mode selector standard 2 modes (241-1) are mandatory.
Not with Cabinet variant Prepared for Arcitec (66-1), Mains connection type CEE17 connector (206-3, 206-2), Service outlet type 230V Europe (328-1).

2 CONTROL SYSTEM

CABINET

Variant

66-2 Standard cabinet with upper cover.

66-1 Prepared for Arcitec
Rotary switch 80A (207-5) and Circuit breaker standard (70-2) and Arcitec 4.0 (18-1) are mandatory.
Not with Wheels (67-1) or Mains connection type CEE17 connector (206-3, 206-2) or 6HSB (206-4) or Mains switch Flange disconnector (207-1) or Servo disconnector (320-1) or UL (429-1) or UR (429-2).

Cabinet Height (wheels not included in height)

64-4 Standard cabinet 950 mm with upper cover.

64-5 Standard cabinet 950 mm without upper cover. To be used when cabinet extension is mounted on top of the cabinet after delivery.
Not with Door interlock (188-1) or UL (429-1) or UR (429-2).

64-1 Standard cabinet with 250 mm extension. The height of the cover increases the available space for external equipment that can be mounted inside the cabinet.
Not with UL (429-1).

64-3 Standard cabinet with 800 mm extension. The extension is mounted on top of the standard cabinet. There is a mounting plate inside. (See Figure 14).
The cabinet extension is opened via a front door and it has no floor. The upper part of the standard cabinet is therefore accessible.
Not with UL (429-1).

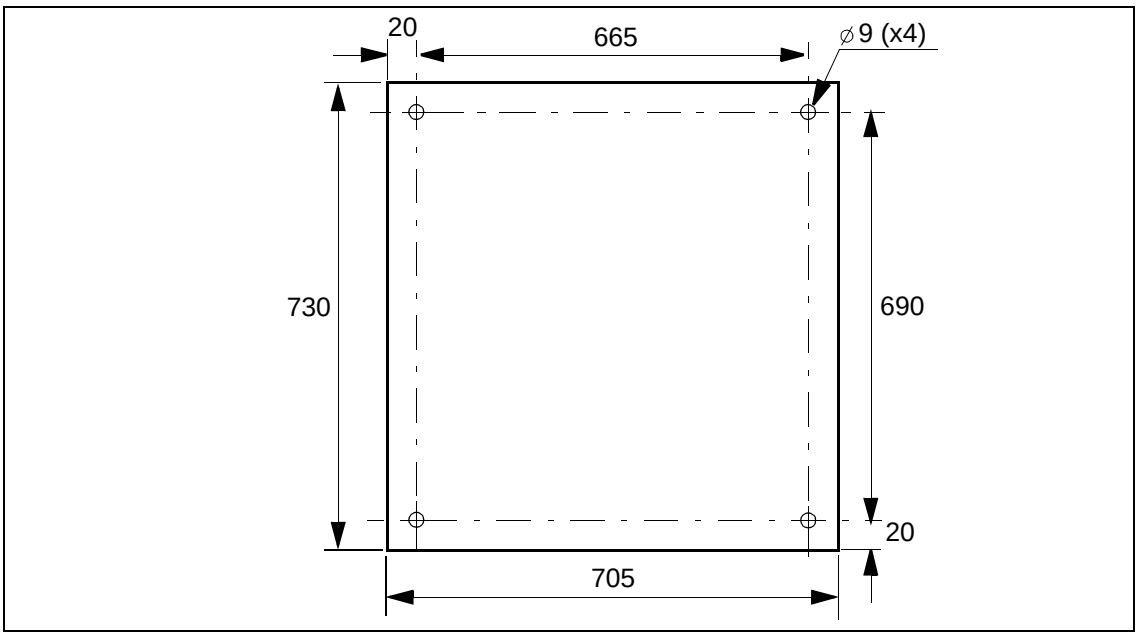


Figure 14 Mounting plate for mounting of equipment (dimensions in mm)

67-1 Cabinet on wheels. Increase the height by 30 mm.
Not with Prepared for Arcitec (66-1).

OPERATOR'S PANEL

The operator's panel and teach pendant holder can be installed in different ways.

242-6 Standard, i.e. on the front of the cabinet.

242-1 External, i.e. in a separate operator's unit. (See Figure 15 for required preparation)
All necessary cabling, including flange, connectors, sealing strips, screws, etc., is supplied.
External enclosure is not supplied.

242-4 External, mounted in a box. (See Figure 16)

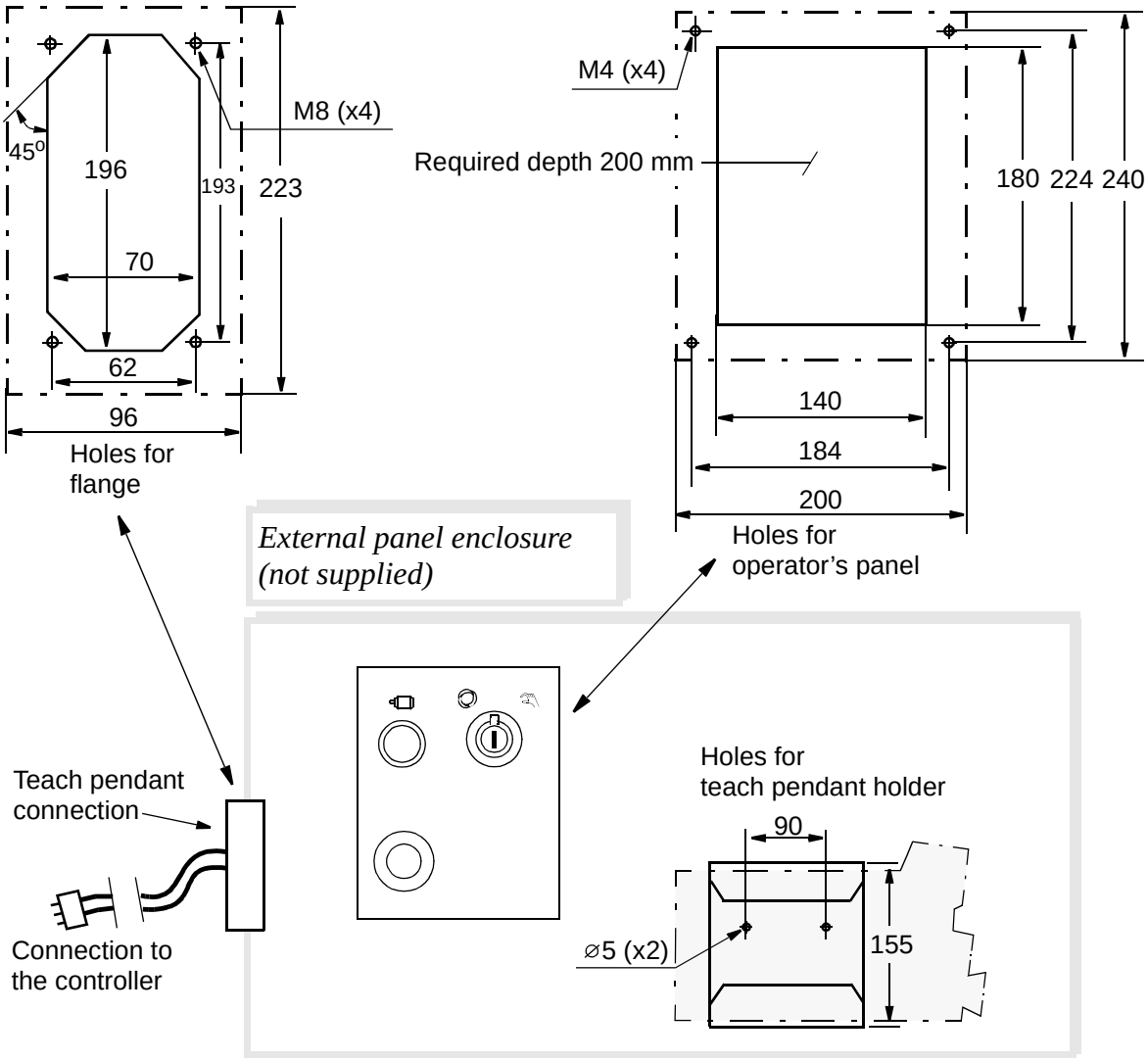


Figure 15 Required preparation of external panel enclosure (all dimensions in mm).

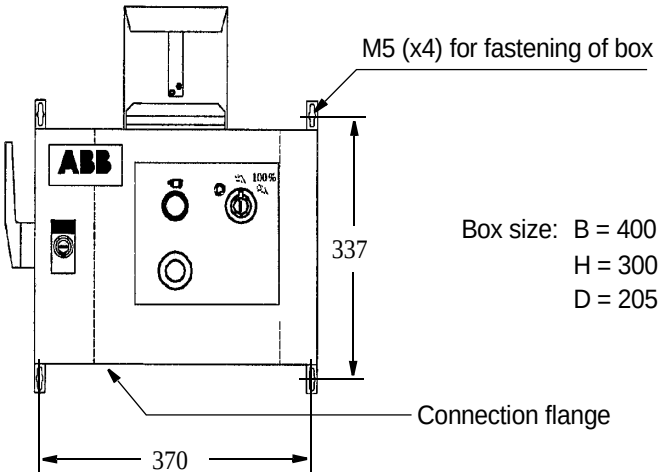


Figure 16 Operator's panel mounted in a box (all dimensions in mm).

OPERATOR'S PANEL CABLE

240-1 15 m
240-2 22 m
240-3 30 m

DOOR KEYS

65-6 Standard
65-1 Doppelbart
65-5 Square outside 7 mm
65-2 EMKA DB
65-4 Locking cylinder 3524

OPERATING MODE SELECTOR

241-1 Standard, 2 modes: manual and automatic.
241-2 Standard, 3 modes: manual, manual full speed and automatic.
Does not comply with UL and UR safety standards.

CONTROLLER COOLING

85-1 Ambient temperature up to 45°C (113°F)
Standard design. The computer unit is provided with a passive heat exchanger (cooling fins on the rear part of the box).
85-2 Ambient temperature up to 52°C (125°F)
The computer unit is provided with an active Peltier cooling equipment (replaces the cooling fins from option 85-1).

TEACH PENDANT

370-1 Teach pendant with back lighting, connection cable 10 m.

Teach pendant language

413-1 English
419-1 Swedish
416-1 German
415-1 French
420-1 Spanish
449-1 Portuguese
411-1 Danish
417-1 Italian
412-1 Dutch
418-1 Japanese
410-1 Czech
414-1 Finnish

Extension cable for the teach pendant:

373-1 10 m
An extension cable can be connected between the controller and the teach pendant. The total length of cable between the controller and the teach pendant should not exceed 40 m.
Note that the length of the optional operator's panel cable must be included in the limitation.

373-2 20 m

MAINS VOLTAGE

The control system can be connected to a rated voltage of between 200 V and 600 V, 3-phase and protective earthing. A voltage fluctuation of +10% to -15% is permissible.

208-1 200V
208-2 220V
208-3 400V
208-4 440V
208-5 475V
208-7 500V
208-8 525V
208-9 600V

For all robots except for IRB 6600/7600 the voltage range must be specified. This gives the possibility to select between three different transformers.

442-1 Voltage range 200, 220, 400, 440V
442-2 Voltage range 400, 440, 475, 500V
442-3 Voltage range 475, 500, 525, 600V

The robots IRB 7600 and 6600 are delivered with an external transformer, see Figure 17, with some exceptions:

- not IRB 7600 and IRB 6650-125/3.2 when mains voltage is 475V (option 208-5)
- not other IRB 66x0 when mains voltage is 400-475V (option 208-3, -4, -5).

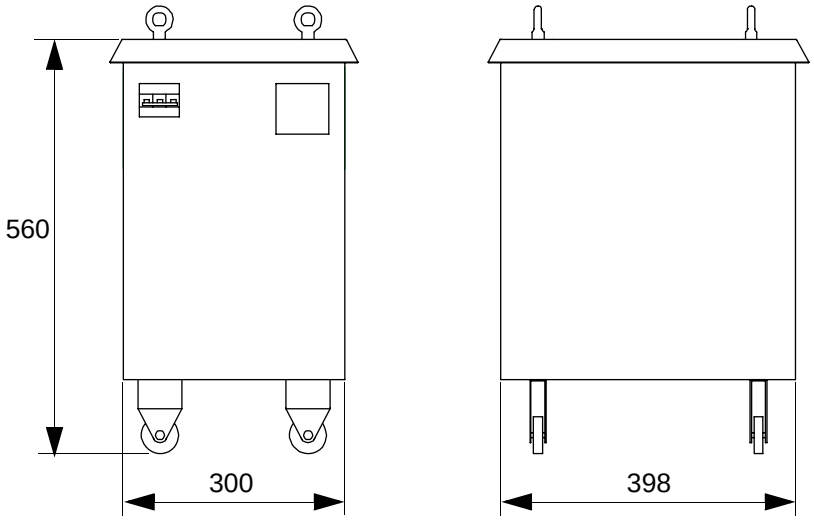


Figure 17 Transformer unit (dimensions in mm).

MAINS CONNECTION TYPE

The power is connected either inside the cabinet or to a connector on the cabinet's left-hand side. The cable is not supplied. If option 206-2--4 is chosen, the female connector (cable part) is included.

206-1 Cable gland for inside connection. Diameter of cable: 11-12 mm.

206-3 CEE17-connector 32 A, 380-415 V, 3p + PE (see Figure 18). Not with Flange disconnector (207-1) or UL/UR (429-1/429-2) or Service outlet power supply (331-2). Not available for IRB 6600/7600.

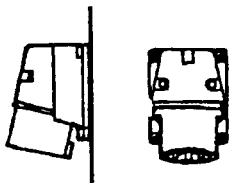


Figure 18 CEE male connector.

206-2 32 A, 380-415 V, 3p + N + PE (see Figure 18). Not with Flange disconnector (207-1) or UL/UR (429-1/429-2). Not available for IRB 6600/7600.

206-4 Connection via an industrial Harting 6HSB connector in accordance with DIN 41640. 35 A, 600 V, 6p + PE (see Figure 19). Cannot be combined with Flange disconnector (207-1).

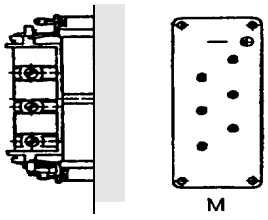


Figure 19 DIN male connector.

MAINS SWITCH

207-4 Rotary switch 40 A in accordance with the standard in section 1.2 and IEC 337-1, VDE 0113. Customer fuses for cable protection required.

207-1 Flange disconnector in accordance with the standard in section 1.2. Includes door interlock for flange disconnector and a 20A circuit breaker with interrupt capacity 14 kA.

207-8 Flange disconnector in accordance with the standard in section 1.2. Includes door interlock for flange disconnector and a 20A circuit breaker with interrupt capacity 65 kA at 400V, 25 kA at 600V.

207-5 Rotary switch 80 A. Customer fuses for cable protection required.
Included in the option Prepared for Arcitec (66-1).

320-1 Servo disconnector.
This option adds a rotary switch 40 A to the two contactors in the AC power supply for the drive system. The handle can be locked by a padlock, e.g. in an off position.

188-1 Door interlock for rotary switch.
Included in the options UL/CSA/UR (429-1, 429-2) and Servo disconnector (320-1).

70-2 Circuit breaker for rotary switch. Rated current 16A (option 442-2, -3) or 25A (option 442-2) circuit breaker for short circuit protection of mains cables in the cabinet. Circuit breaker approved in accordance with IEC 898, VDE 0660. Interrupt capacity 30 kA at 400V.

For IRB 7600 and IRB 6600 the cabinet circuit breaker is always rated 25A. When an external transformer is supplied, the circuit breaker is located in the transformer.

I/O INTERFACES

The standard cabinet can be equipped with up to four I/O units. For more details, see page 22.

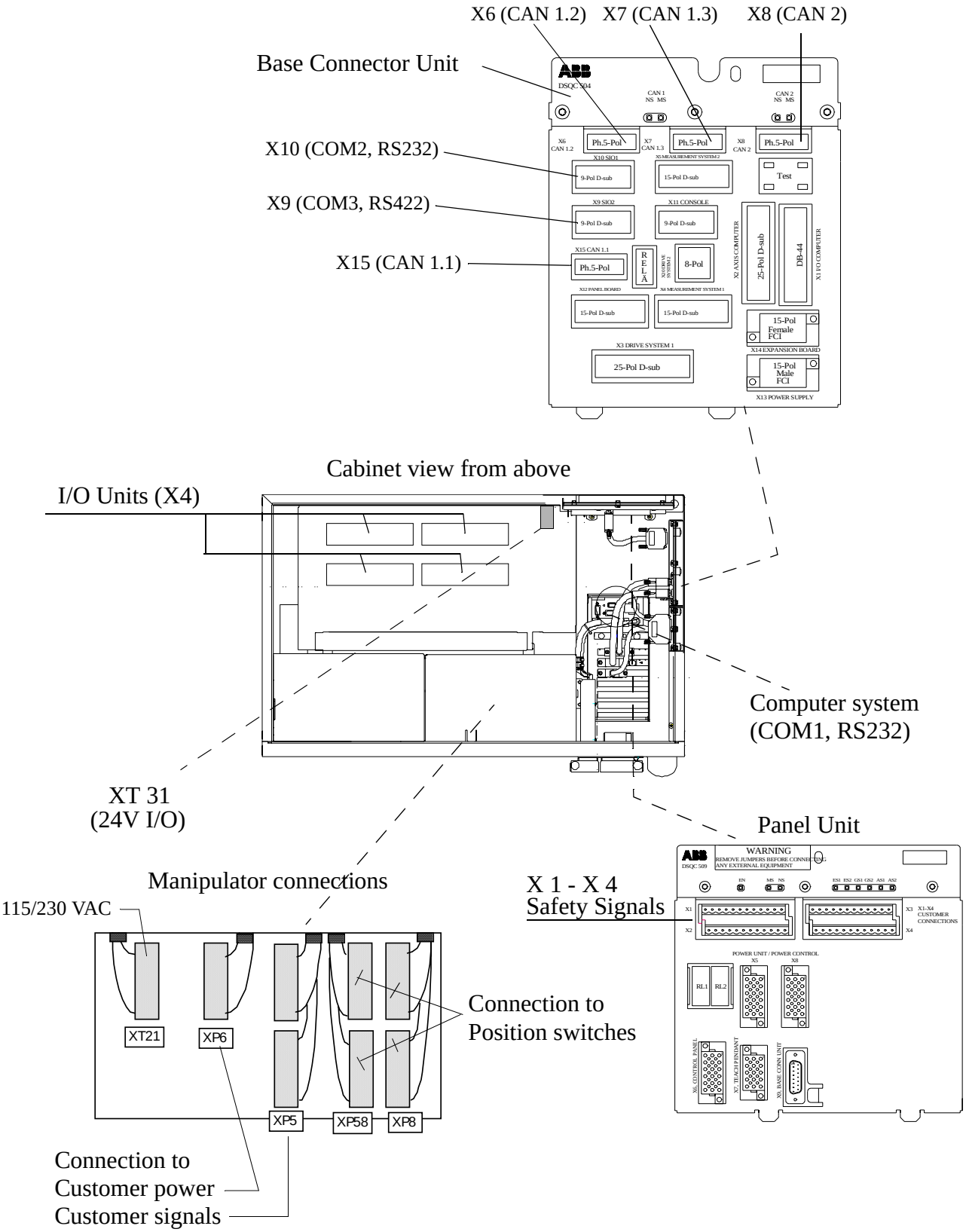


Figure 20 I/O unit and screw terminal locations.

61-1 Digital 24 VDC I/O: 16 inputs/16 outputs.

54-1 Analog I/O: 4 inputs/4 outputs.

58-1 AD Combi I/O: 16 digital inputs/16 digital outputs and 2 analog outputs (0-10V).

60-1 Digital 120 VAC I/O 16 inputs/16 outputs.

63-1 Digital I/O with relay outputs: 16 inputs/16 outputs.
Relay outputs to be used when more current or voltage is required from the digital outputs. The inputs are not separated by relays.

Connection of I/O

191-3 Internal connection (options 61-1, 54-1, 58-1, 60-1, 63-1). The signals are connected directly to screw terminals on the I/O units in the upper part of the cabinet (see Figure 20).

191-2 External connection
The signals are connected via 64-pole standard industrial connector in accordance with DIN 43652. The connector is located on the left-hand side of the controller. Corresponding customer part is included.

225-1 Prepared for 4 I/O units
The internal CAN/Devicenet cabling to the I/O units exists in two versions, one for up to two I/O units and one for up to four I/O units. The versions are selected to match the number of ordered I/O units. By this option it is possible to get the four unit version even if one or two I/O units are ordered.

SAFETY SIGNALS

309-3 Internal connection
The signals are connected directly to screw terminals in the upper part of the cabinet (see Figure 20).

309-2 External connection
The signals are connected via 64-pole standard industrial connector in accordance with DIN 43652. The connector is located on the left-hand side of the controller. Corresponding customer part is included.

FIELD BUS AND COMMUNICATION

108-1 CAN/DeviceNet
Connection on the left side to two 5-pole female connectors in accordance with ANSI. (Male connectors are supplied).

126-1 LAN/Ethernet
RJ45 connector to be used for LAN connector.
(When the connector is not used, a protective hood covers it).

250-1 Profibus DP Master/Slave
The hardware of the Profibus-DP field bus consists of a master/slave unit, DSQC 510, and distributed I/O units, called slave units. The DSQC 510 unit is mounted in the S4Cplus computer system where it is connected to the PCI bus while the slave units are attached to the field bus network.

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 510 unit.

The slave part of the DSQC 510 is normally controlled by an external master on a separate Profibus-DP network. This network is a different one than the network holding the slave units for the master part of the board. The slave part is a digital input and output I/O unit with up to 512 digital input and 512 digital output signals.

The signals are connected to the board front (two 9-pole D-sub).
Profibus DP M/S CFG Tool (option 285-1) is required when setting up the master part or when changing the number of signals for the slave part. For more information see Product Specification RobotWare Options.

177-3/177-1

Interbus Master/Slave
The hardware of the Interbus field bus consists of a Master/Slave unit (DSQC512/529) and distributed I/O units. The master and the slave units are two separate boards connected by a flat cable. The DSQC512/529 unit is connected to the S4Cplus robot controller PCI bus while the I/O units are attached to the field bus net.

The I/O units may be digital or analog modules. They are all controlled by the master part of the DSQC512/529 unit.

The slave part of the DSQC512/529 unit is normally controlled by an external master on a separate Interbus network. This network is a different one than the network hold ing the I/O units for the master part of the board. The slave part is a digital in- and out put I/O unit with up to 160 digital in- and 160 digital out signals.

Two variants are available:
177-3 for optical fibre connection (DSQC512)
177-1 for copper wire connection (DSQC529)

Interbus M/S CFG Tool (option 185-1) is required when setting up the master part or when changing the number of signals for the slave part. For more information see Product Specification RobotWare Options.

GATEWAY UNITS

For more details, see I/O System on page 22.

13-1 Allen-Bradley Remote I/O
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 unit reduces the number of I/O units that can be mounted in cabinet by one. The field bus cables are connected directly to the A-B Remote I/O unit in the upper part of the cabinet (see Figure 20). Connectors Phoenix MSTB 2.5/xx-ST-5.08 or equivalent are included.

178-1 Interbus Slave
Up to 64 digital inputs and 64 digital outputs can be transferred serially to a PLC equipped with an InterBus interface. The unit reduces the number of I/O units that can be mounted in the cabinet by one. The signals are connected directly to the InterBus slave unit (two 9-pole D-sub) in the upper part of the cabinet.

251-1 Profibus DP Slave
Up to 128 digital inputs and 128 digital outputs can be transferred serially to a PLC equipped with a Profibus DP interface. The unit reduces the number of I/O units that can be mounted in the cabinet by one. The signals are connected directly to the Profibus DP slave unit (one 9-pole D-sub) in the upper part of the cabinet.

79-1 Encoder interface unit for conveyor tracking (DSQC 354)
Conveyor Tracking, RobotWare option 83-1, is the function whereby the robot follows a work object which is mounted on a moving conveyor. The customer encoder and synchronization switch cables are connected directly to the encoder unit in the upper part of the cabinet (see Figure 20). Screw connector is included.
This option is also required for the function Sensor Synch, RobotWare option 316-1.

80-1 Encoder interface unit for conveyor tracking (DSQC 377)
The option adds functions required for PickMaster 4.0.
Physically similar to DSQC 354.

EXTERNAL I/O UNITS

I/O units can be delivered separately. The units can then be mounted outside the cabinet or in the cabinet extension. These are connected in a chain to a connector (CAN 3 or CAN 2, see Figure 20) in the upper part of the cabinet. Connectors to the I/O units and a connector to the cabinet (Phoenix MSTB 2.5/xx-ST-5.08), but no cabling, is included. Dimensions according to Figure 21 and Figure 22.
For more details, see I/O System on page 22.

137-1 Digital I/O 24 V DC: 16 inputs/16 outputs.

132-1 Analog I/O.

130-1 AD Combi I/O: 16 digital inputs/16 digital outputs and 2 analog outputs (0-10V).

136-1 Digital I/O 120 V AC: 16 inputs/16 outputs.

138-1 Digital I/O with relay outputs: 16 inputs/16 outputs.

EXTERNAL GATEWAY UNITS

131-1 Allen Bradley Remote I/O

142-1 Interbus Slave

144-1 Profibus DP Slave

134-1 Encoder interface unit DSQC 354

135-1 Encoder interface unit DSQC 377

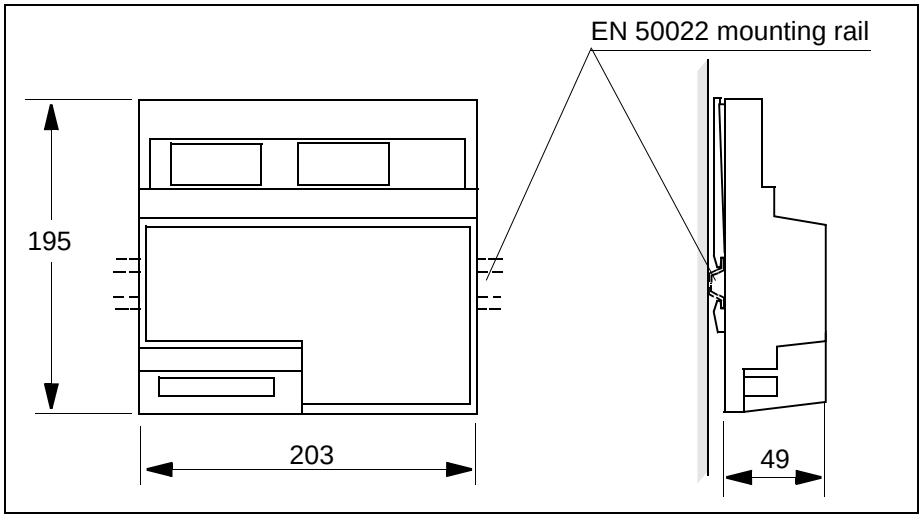


Figure 21 Dimensions for units 137-1, 132-1, 130-1, 136-1, 138-1.

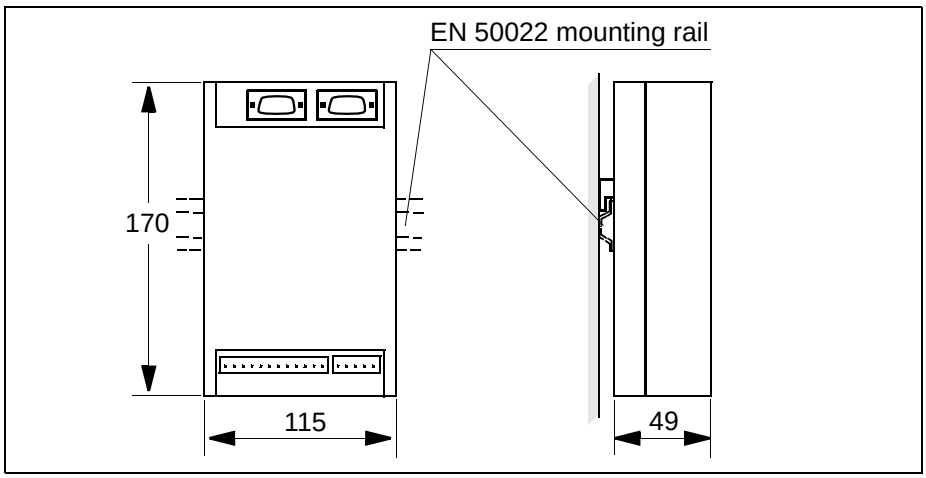


Figure 22 Dimension for units 131-1, 142-1, 144-1, 134-1, 135-1.

EXTERNAL AXES IN ROBOT CABINET
(not available for IRB 340, IRB 6400PE, IRB 6600, IRB 7600)

It is possible to equip the controller with drives for external axes. The motors are connected to a standard industrial 64-pin female connector, in accordance with DIN 43652, on the left-hand side of the cabinet. (Male connector is also supplied.)

52-1 Drive unit C
The drive unit is part of the DC-link. Recommended motor type see Figure 23.
Not available for IRB 640.

52-7 Drive unit T
The drive unit is part of the DC-link. Recommended motor type see Figure 23.
Not available for IRB 640, 6400R.

52-9 Drive unit U
The drive unit is part of the DC-link. Recommended motor types see Figure 23.
Not available for IRB 4400, 6400S, 6400PE, 640.
For IRB 140, 1400 and 2400 the option consists of a larger transformer, DC link DC4U with integrated U drive unit and one extra axis computer with its connection board.

No cabling from the drive unit U to cabinet wall is included.
For IRB 6400R the option consists of a DC link DC4U with integrated U drive unit with cabling to the cabinet wall.

52-3 Drive unit GT
A separate drive unit including two drives. Recommended motor type see Figure 23.
Not available for IRB 4400, 6400R, 6400S

52-4 Prepared for drives GT
The same as 52-3 but without the GT drive module. The preparation includes; larger transformer, larger DC link DC2, and one additional axis computer with its connection board.
Not available for IRB 4400, 640, 6400R, 6400S

52-6 Prepared for drives GT
The same as 52-4 but without additional axes computer and connection board.

52-5 Prepared for drives GU
The same as 52-4 but intended for a GU drive module. The preparation includes: larger transformer, larger DC link DC4, and one additional axis computer with its connection board.
Not available for IRB 4400, 640, 6400R, 6400S.

52-8 Drive unit T+GT
A combination of 52-7 and 52-3.
Not available for IRB 4400, 640, 6400R, 6400S

52-2 Drive unit C+GT
A combination of 52-1 and 52-3
Not available for IRB 4400, 640, 6400R, 6400S

422-1 Trackmotion
A special wiring for the three motor combination 52-8 (IRB 140, 1400, 2400 only) to be used when axis 7 is intended for an ABB Trackmotion. The drive unit in the DC link and the Trackmotion measurement board is then connected to the robot axes computer 1 while the drive unit and the measurement board for motor 8 and 9 is connected to axes computer 2. All motor power wiring is routed to one common connector, XS7.

323-1--6 Servo gun interfacing (IRB 6400R, IRB 6600 and 7600)

For further information see the Product Specification IRB 6400R chapter Servo Gun or IRB 6600 chapter Servo Gun (overview), and the Product Specification RobotWare Options (function description).

323-5 Stationary gun (SG) or one external axis for general use

IRB 6400R
The option consists of an encapsulated Serial Measurement Board (SMB) and cabling inside the controller.
The cabling between SMB and the controller is selected in the option range 95-1--4.
Drive unit 52-9 is required.

IRB 6600/7600
The option adds a resolver cable to the manipulator cable option 476-1 (or 467-1), and a 7m resolver cable between the manipulator and the welding gun pedestal. The customer connector to this cable should be an 8-pin Burndy, wired according to Motor Unit specification.

The cable between the controller DDU and the welding gun pedestal is selected in the option range 95-1, -2, -4(different lengths). The customer connector to this cable should be of Industrial Multi-connector type, corresponding to the manipulator CP/CS (see Product Specification IRB 6600/7600). Besides the necessary motor wiring, it also contains 12 wires for gun I/O, accessible on screw terminals in the cabinet.
Drive unit 53-2 or 53-3 (DDU-V or -W) must be selected.

323-1 Robot Gun (RG)

IRB 6400R
The option consists of an encapsulated SMB and cabling inside the controller.
It also includes bracket for 6400R foot mounting of the SMB box, and cabling between the SMB box and the manipulator.
The cabling between SMB and the controller is selected in th option range 93-1--4.
Drive unit option 52-9 is required.

IRB 6600/7600
The option adds resolver cables to the manipulator cable option 476-1. The cable between the controller and the manipulator is selected in the option range 450-1, -2, -4. Besides the necessary motor wiring the cable also contains 22 wires for gun I/O and CAN/DeviceNet fieldbus. The I/O wiring is accessible on screw terminals in the cabinet.
Drive unit 53-2 (DDU-V) must be selected.

323-3 One SG and one RG

IRB 6400R
The option is a combination of 523-5 and 523-1. A distributed drive unit (DDU) controls the SG motor.
The cabling between the SG SMB and the controller is selected in the option range 95-1--4, and the cabling between the RG SMB and the controller is selected in the option range 93-1--4.
Drive unit options 52-9 (for the RG) and 53-1 (for the SG) are required.

IRB 6600/7600
The option adds a resolver cable to the manipulator cable option 476-1. The cable between the controller and the welding gun pedestal is selected in the option range 95-1--4. The customer connector to this cable should be of Industrial Multi-connector type, corresponding to the manipulator CP/CS (see Product Specification IRB 6600/7600). Besides the necessary motor wiring it also contains 12 wires for gun I/O, accessible on screw terminals in the cabinet.

The cable between the controller and the manipulator (for RG) is selected in the option range 450-1, -2, -4. Besides the necessary motor wiring the cable also contains 22 wires for gun I/O and CAN/DeviceNet fieldbus.

The option also consists of an SMB box for two resolvers, a serial cable between the box and the controller (the same length as 210-2--5), and two resolver cables, one 1.5m for the RG and one 7m for the SG. The customer connector to the SG cable should be an 8-pin Burndy, wired according to the Motor Unit specification. The SMB box should be mounted close to the manipulator foot. Dimensions and mounting information can be found in the Product Specification Motor Unit.
Drive unit 53-4 (DDU-VW) must be selected.

323-6 Twin SG

IRB 6400R
The option is a combination of two options 323-5. A distributed drive unit controls the second SG motor.
The cabling between the SG SMBs and the controller is selected in the option range 95-1--4.
Drive unit options 52-9 (for one SG) and 53-1 (for the second SG) are required.

IRB 6600/7600
The option consists of an SMB box for two resolvers, a serial cable between the box and the controller (the same length as 686-689), and two 7m resolver cables. The customer connector to the SG cable should be an 8-pin Burndy, wired according to the Motor Unit specification.The SMB box should be mounted close to the manipulator foot. Dimensions and mounting information can be found in the product Specification Motor Unit.

The two cables between the controller and the pedestals are selected in the option range 95-1--2.
Customer connectors to the cables should be of Industrial Multi-connector type, corresponding to the manipulator CP/CS (see Product Specification IRB 6600/7600). Besides the necessary motor wiring, the cables also contain 12 wires for gun I/O, accessible on screw terminals in the cabinet (SG axis 7), or on the Multi connector inside (SG axis 8) the DDU.

Drive unit 53-4 (DDU-VW) must be selected.

323-4 SG and Track Motion (T)

IRB 6400R
The option is a combination of 323-5 and a track motion IRBT 6002S controlled by a distributed drive unit.
The cabling between the SG SMB and the controller is selected in the option range 95-1--4.
Drive unit options 52-9 (for the SG) and 53-1 (for the T) are required.

IRB 6600/7600
A 7m resolver cable for the SG is included in the option.
The customer connector to the cable should be an 8-pin Burndy, wired according to the Motor Unit specification.
The cable between the controller and the welding gun pedestal is selected in the option range 95-1--2.
The customer connector to the cable should be of Industrial Multi-connector type, corresponding to the manipulator CP/CS (see Product Specification IRB 6600/7600). Besides the necessary motor wiring the cable also contains 12 wires for gun I/O, accessible on screw terminals in the cabinet.

The SMB box and the power cable between the controller and the Track Motion are included in the Track Motion delivery. The serial measurement cable between the controller and the Track Motion are included in option 323-4 (length according to 210-2, -3).

Drive unit 53-4 (DDU-VW) must be selected.

323-2 RG and T

IRB 6400R
The option is a combination of 323-1 and a track motion IRBT 6002S controlled by a distributed drive unit.
The cabling between the RG SMB and the controller is selected in the option range 93-1--4.
Drive unit options 52-9 (for the SG) and 53-1 (for the T) are required.

IRB 6600/7600
The option adds a resolver cable to the manipulator cable option 2200. The RG cable between the controller and Track Motion is selected in the option range 450-1, -2, -4 except for the track motor cable which is included in the Track Motion delivery.
Besides the necessary motor wiring, the RG cable also contains 22 wires for gun I/O and CAN/DeviceNet fieldbus.
The option also consists of a 1.5m resolver cable for the RG to be connected to the Track Motion mounted SMB box.

Drive unit 53-4 (DDU-VW) must be selected.

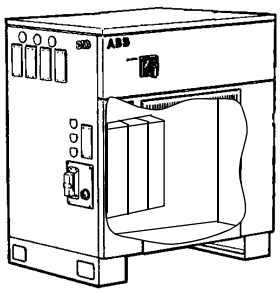
EXTERNAL AXES MEASUREMENT BOARD
(not available for IRB 340, IRB 6400PE)

The resolvers can be connected to a serial measurement board outside the controller.

312-2 Serial measurement board as separate unit

EXTERNAL AXES - SEPARATE CABINET (Low voltage)
(not available for IRB 340, IRB 6400PE)

An external cabinet can be supplied when there is not space enough in the standard cabinet. The external cabinet is connected to one Harting connector (cable length 7 m) on the left-hand side of the robot controller. Door interlock, mains connection, mains voltage and mains filter according to the robot controller. One transformer and one mains switch are included.



53-7/53-9 Drive unit GT, for 4 or 6 motors. Recommended motor types see Figure 23.

53-5 Drive unit ECB, for 3 or 6 motors. Recommended motor types see Figure 23.

53-6 Drive unit GT + ECB

53-8 Drive unit GT + GT + ECB

Drive voltage	Drive unit identity	Motor max current A_{rms}	Drive unit rated current A_{rms}	Suitable motor type
High	W	11.5-57	30	L (HV)
High	V	5.5-26	14.5	M (HV)
Low	U	11 - 55	24	M, L, XL
Low	T	7.5-37	20	S, M, L, XL
Low	G	6-30	16	S, M, L
Low	E	4 - 19	8,4	S, M
Low	C	2,5 - 11	5	S
Low	B	1,5 - 7	4	S

Figure 23 Motor selection table. Motor types according to external axes Motor Unit.

53-1 Drive unit DDU-U (low voltage)



A separate box (H=500mm W=300mm D=250mm) including a DC link DC4 and a drive unit GU where the U part is used (the G part is not connected).
The DDU-U is operated from an additional axis computor, included in the option.
DDU-U is mainly intended for Servo Gun solutions according to options 323-3, -4, -6 and is available for IRB 4400 and 6400R.

53-2 Drive unit DDU-V (IRB 6600/7600)
53-4 Drive unit DDU-VW (IRB 6600/7600)
53-3 Drive unit DDU-W (IRB 6600/7600)

A separate box (H=500mm, W=300mm, D=250mm) including a DC link DC5 and a drive unit VW.
The box has 4 keyholes on the back of the encapsulation for fastening on a wall or a fence with the connections pointing downwards.
Connection cabling (length 5m) to the controller is included.

The DDU-VW is operated from an additional axis computer included in the option, while the DDU-V and -W are operated from the basic robot axes computer.
The options also include appropriate cabling inside the manipulator for different resolver configurations, see Product Specification IRB 6600, chapter Servo Gun.
E.g. 7 axes applications utilise the built in 7 resolver SMB.



The DDU-V and VW are mainly intended for Servo Gun solutions according to options 323-1--6.
The DDU-W is intended for a Track Motion without ServoGun.

For general use of one external axis in IRB 6600 or IRB 7600, select options 323-5 and 467-1 for cabling to the built in 7 resolver SMB.

EQUIPMENT

Manipulator cable

212-2 Standard

Cable length

210-2 7m
210-3 15 m, not available for IRB 140
210-4 22 m, not available for IRB 140
210-5 30 m, not available for IRB 140
210-1 3 m, only available for IRB 140

Protection for manipulator cable (not availble for IRB 6600/7600)

288-1 Each unit length is 2 m. Totally 40 m protection can be specified.

SERVICE OUTLET

Any of the following standard outlets with protective earthing can be chosen for maintenance purposes.
The maximum load permitted is 500 VA (max. 100 W can be installed inside the cabinet).

328-6 120 V in accordance with American standard; single socket, Harvey Hubble.

328-1 230 V mains outlet in accordance with DIN VDE 0620; single socket suitable for EU countries.

POWER SUPPLY (to the service outlet)

331-3 Connection from the main transformer.
The voltage is switched on/off by the mains switch on the front of the cabinet.

331-2 Connection before mains switch without transformer which means that the voltage is always available.
Note this only applies when the mains voltage is 400 V, three-phase with neutral connection and a 230 V service socket.
Note! Connection before mains switch is not in compliance with some national standards, NFPL 79 for example.

MEMORY

Removable mass memory

215-1 Floppy drive
The disk drive normally works well at temperatures up to 40ºC (104ºF). The disk drive will not deteriorate at higher temperatures but there will be an increase in the number of reading/writing problems as the temperature increases.

Extended mass memory

140-1 Flash disc 128 Mb. Standard is 64 Mb

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