Product Specification

Industrial Controller

3HAC 13335-1/M2000/BaseWare OS 4.0/Rev. 0
IRC S4Cplus

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1 Description

1.1 Structure

The control system contains the electronics required to control a wide range of mechanical units, external axes and peripheral equipment. This means that it is possible for manufacturers of mechanical units to gain from ABB's superior motion control and extensive controller features. We refer to this system as IRC (Industrial Robot Controller).

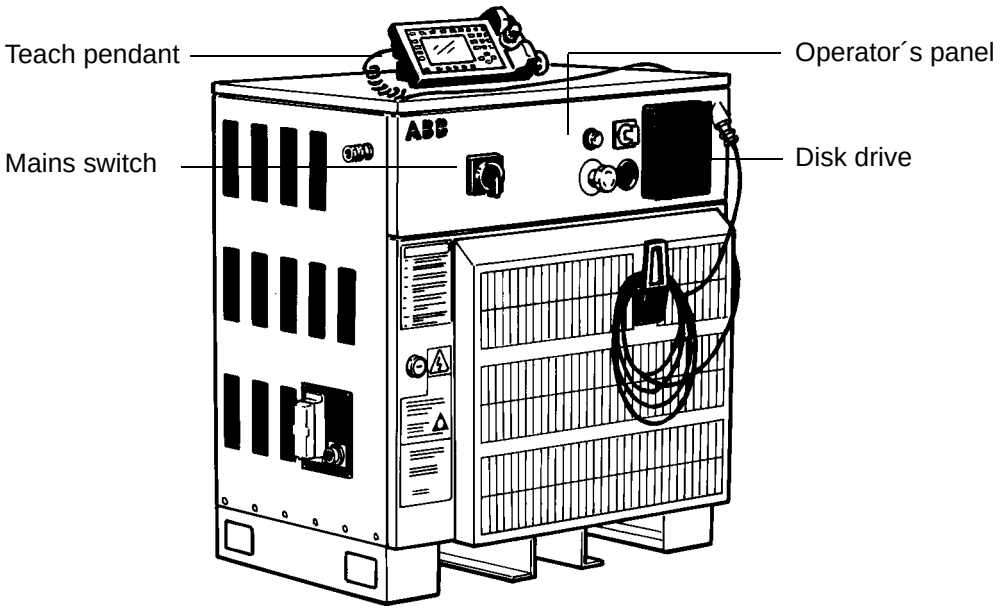


Figure 1 The control system is specifically designed to control mechanical units, which means that optimal performance and functionality is achieved.

Typical mechanical units that can be controlled are:

Linear mechanical units
For these units we support kinematic models which enable linear and circular interpolation (i.e. easy programming of the path). The units are typically linear, but there is also support for rotating axes (e.g. wrist axes).

Arbitrary mechanical units
For any type of mechanical unit, such as loaders, conveyors etc., it is efficient to do the programming axis per axis, referred to as Generic Position Control (i.e. joint programming). These units are typically one axis units. Several one axis units can be controlled by one control system. This method can also be used if the arm configuration is not represented with a kinematic model.

ABB manipulators
It is also possible to connect IRC to ABB manipulators (i.e. retrofit and refurbishment). By doing so, the customer will gain from a cost efficient way of accessing the latest control system technology and in some extent also decrease cycle time.

Description of a kinematic model:

The kinematic model describes the relation between several mechanical arms connected together. This relation must be known to be able to calculate and plan the path executed by the control system. The kinematic model enables definition of TCP (Tool Centre Point) which makes programming easier and faster. Each programming position is set relative to a coordinate system. This makes reuse of programs more efficient. The kinematic model also enables easy programming of linear and circular paths and reorientation around

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

Control system weight 250 kg

Control system 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)

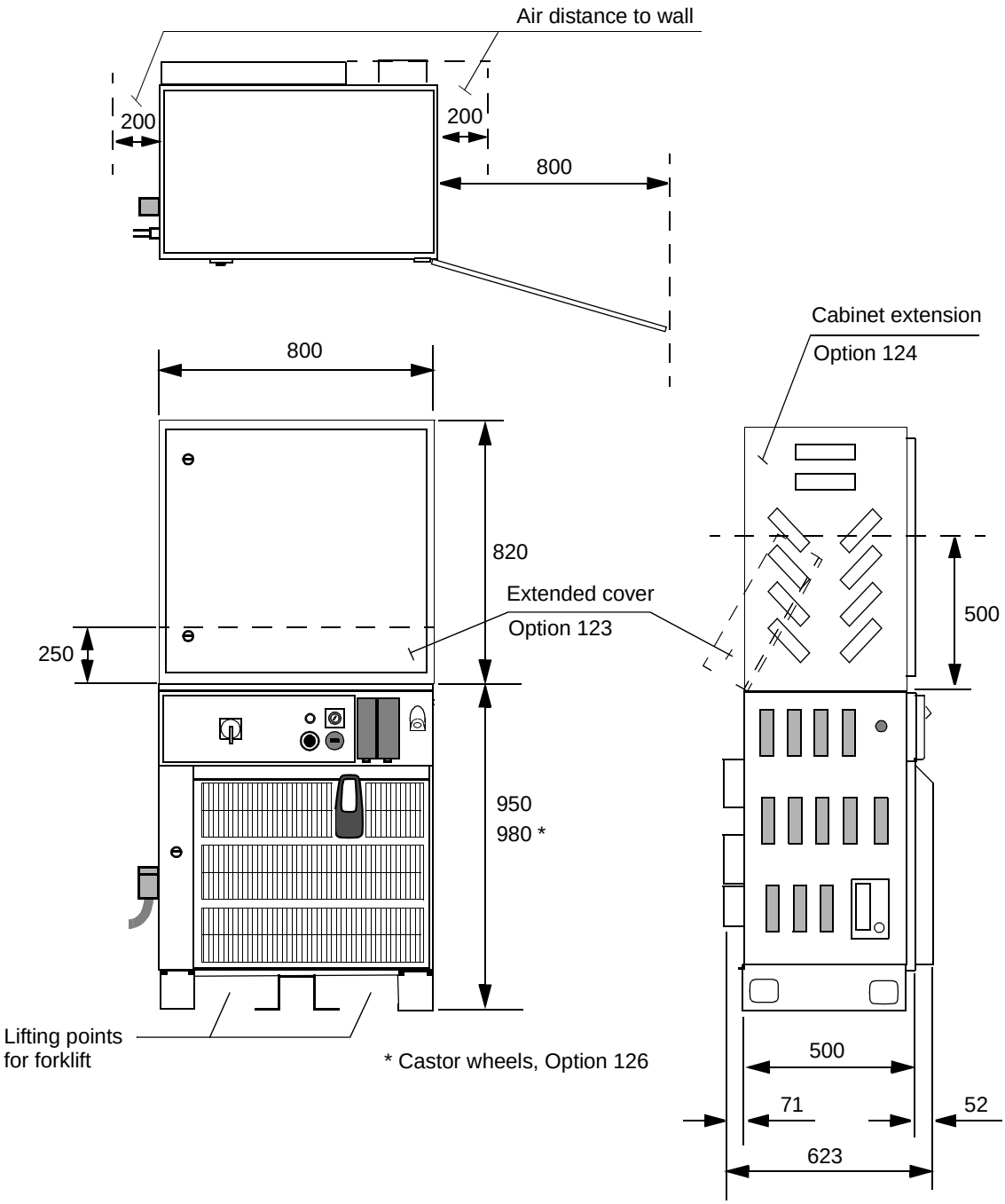


Figure 2 View of the control system from the front, from above and from the side (dimensions in mm).

1.2 Safety/Standards

The control system conforms to and enables mechanical units to comply with 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 mechanical units, safety
ANSI/RIA 15.06/1999	Industrial mechanical units, 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 1740-1996 (option)	Standard for Industrial Robots and Robotic Equipment
CAN/CSA Z 434-94 (option)	Industrial Robots and Robot Systems - General Safety Requirements

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

The control system 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 mechanical unit can be operated either manually or automatically. In manual mode, the mechanical unit 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 feature is only valid with kinematic model.

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

Safe manual movement
The mechanical unit 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 mechanical unit is monitored by two independent computers.

Emergency stop
There is one emergency stop push button on the control system and another on the teach pendant. Additional emergency stop buttons can be connected to the mechanical unit's safety chain circuit.

Safeguarded space stop
The control system 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 mechanical unit's safety functions to be activated both by peripheral equipment and by the mechanical unit itself.

Delayed safeguarded space stop
A delayed stop gives a smooth stop. The mechanical unit 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 (IRB manipulators only)
In case an unexpected mechanical disturbance like a collision, electrode sticking, etc. occurs, the mechanical unit 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.

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

Fire safety
The control system complies with UL's (Underwriters Laboratory) tough requirements for fire safety.

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).

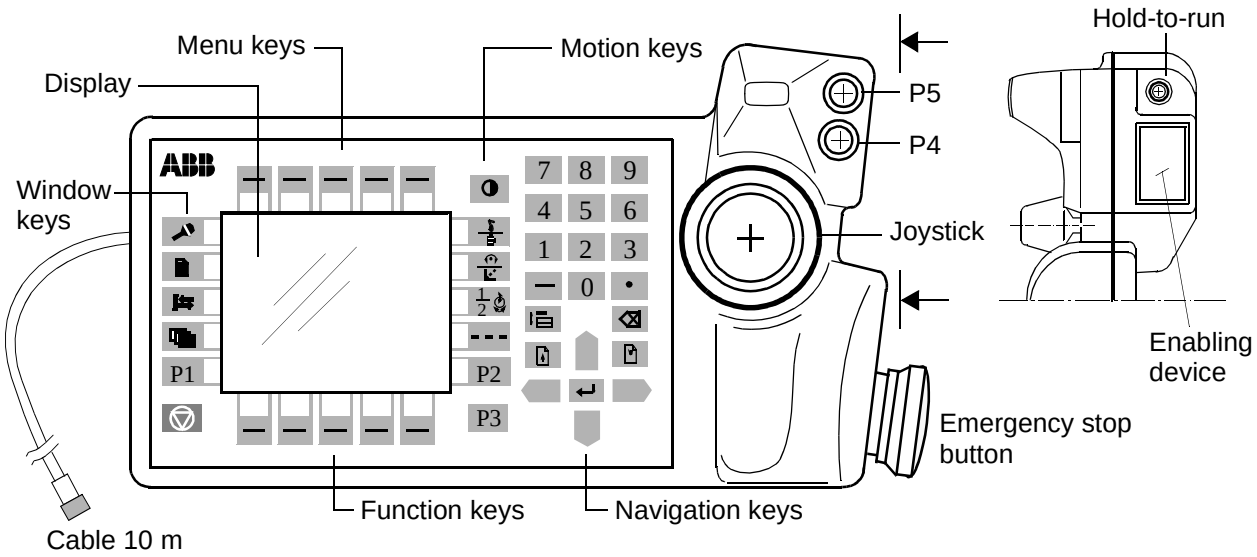


Figure 3 The teach pendant is equipped with a large display, which displays prompts, information, error messages and other information in plain English.

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 mechanical unit. 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 41).

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 mechanical unit'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 mechanical unit is taken to the MOTORS OFF state.

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

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

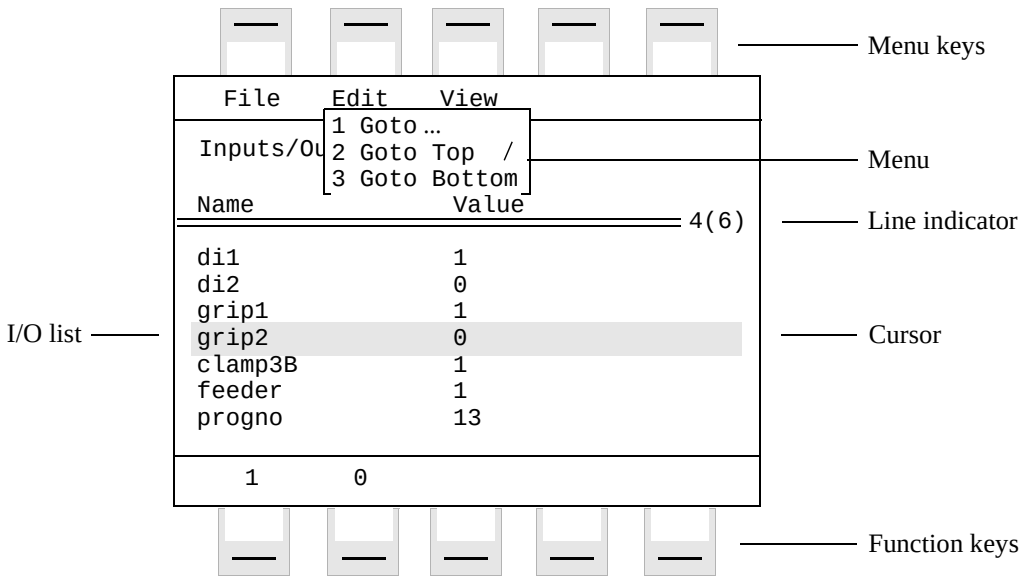


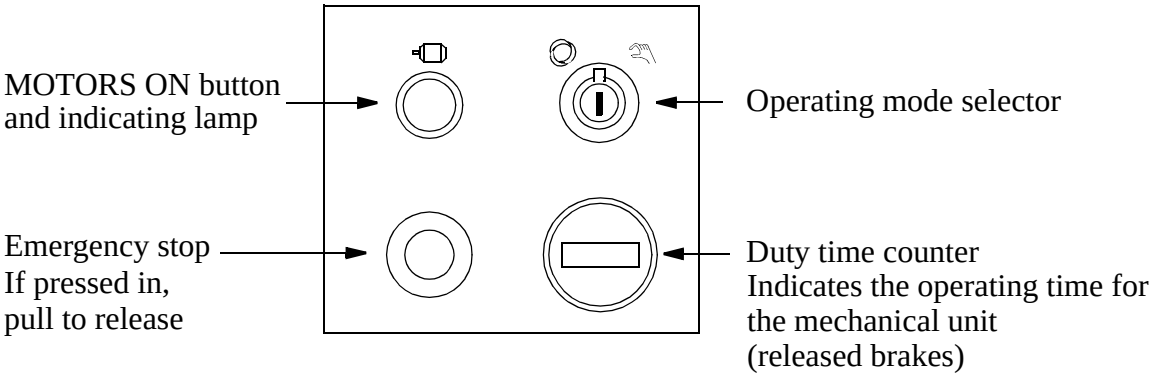
Figure 4 Window for manual operation of input and output signals.

Using the joystick, the mechanical unit can be manually jogged (moved). The user determines the speed of this movement; large deflections of the joystick will move the mechanical unit quickly, smaller deflections will move it more slowly.

The mechanical unit 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 mechanical unit 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 mechanical unit 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.)

As optional:

100% Manual mode at full speed Equipped with this mode, the mechanical unit 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 control system.

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

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

1.4 Memory

Available memory

The control system 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 with 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.

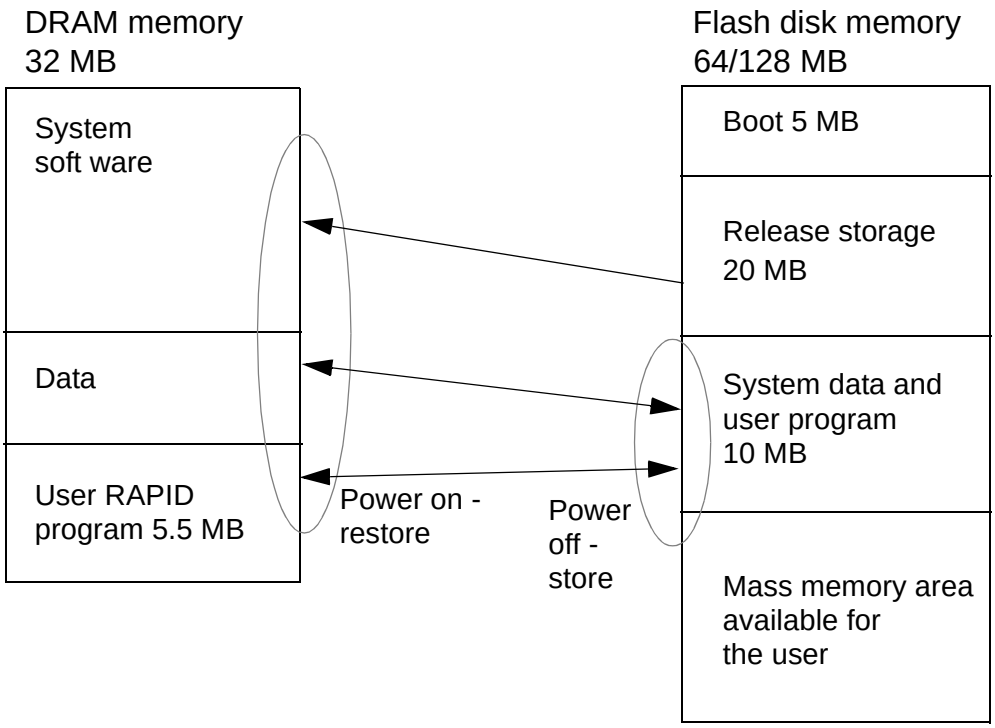


Figure 6 Available memory.

Several different systems, i.e. process applications, may be installed at the same time in the control system, 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 control system is delivered with a template configuration for a selected mechanical unit (i.e. kinematic model), and can be operated immediately after installation. The template needs to be adapted to the unique properties of each mechanical unit. If the control system is connected to an IRB manipulator, all configuration parameters are pre-defined. Its configuration is displayed in plain language and can easily be changed using the teach pendant.

Operating requirements

Protection standards	IEC529
Electronic	IP54
Air ducts	IP 30

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

Ambient temperature

Operation	+5°C (41°F) to +45°C (113°F)
with option 473	+52°C (125°F)
Transportation and storage, for short periods (not exceeding 24 hours)	-25°C (13°F) to +42°C (107°F) up to +70°C (158°F)

Relative humidity

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

Vibration

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

Bumps

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:	
DC1 system	4.5 kVA (transformer size)
DC2 and DC3 systems	7.8 kVA (transformer size)
DC5 system	17 kVA
External axes drives in separate cabinet	7.2 kVA (transformer size)
Computer system backup capacity at power interrupt	20 sec (rechargeable battery)

Configuration

The mechanical unit 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.

1.6 Programming

Programming the mechanical unit 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 mechanical unit to move.

The end position of a movement is selected either by manually jogging the mechanical unit 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 mechanical unit reaches the programmed position

  or

- a fly-by point, i.e. the mechanical unit passes close to the programmed position. The size of the deviation is defined independently for the TCP, the tool orientation and the external axes (requires kinematic model).

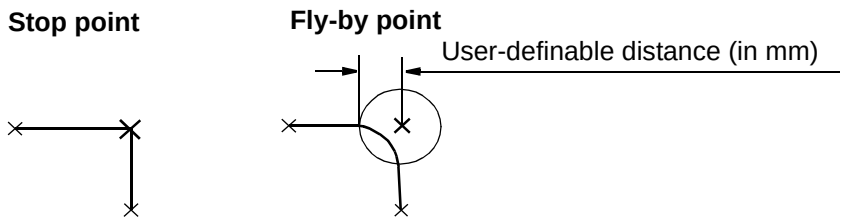


Figure 7 The fly-by point reduces the cycle time since the mechanical unit does not have to stop at the programmed point. The path is speed independent.

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 (requires kinematic model)

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 down loaded 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 mechanical unit position can easily be changed either by

- jogging the mechanical unit 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 (requires kinematic model).

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 mechanical unit installation by means of user-defined operating dialogs.

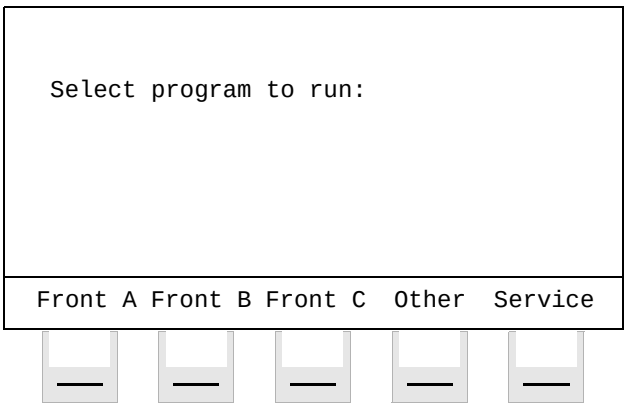


Figure 8 The operator dialogs can be easily customised.

A special input can be set to order the mechanical unit to go to a service position. After service, the mechanical unit 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 mechanical unit is started up in a controlled way.

The mechanical unit equipped with the ABB serial measurement board for absolute measurement, makes it possible to operate the mechanical unit directly when the power is switched on. For your convenience, the mechanical unit 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 mechanical unit 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 control system requires only a minimum of maintenance during operation. It has been designed to make it as easy to service as possible:

- The control system 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 control system 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 Mechanical unit motion

Motion concepts (IRB manipulators only)

QuickMove™

The QuickMove™ concept means that a self-optimizing motion control is used. The mechanical unit 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 (requires kinematic model)

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

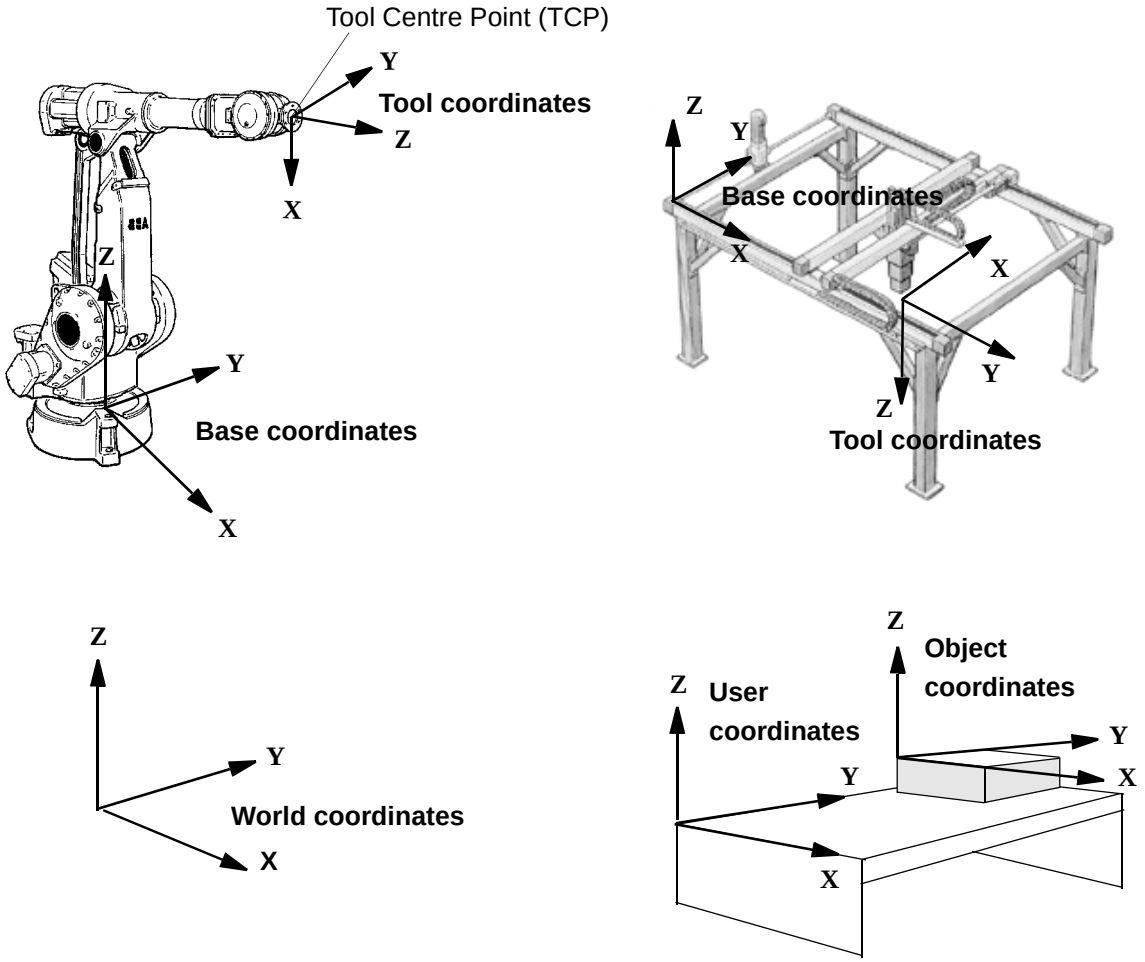


Figure 9 The coordinate systems, used to make jogging and off-line programming easier.

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 mechanical unit position to a fixed point in the workshop. The world coordinate system is also very useful when two mechanical units work together or when using a mechanical unit carrier.

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

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 mechanical unit 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 (requires kinematic model)

When the mechanical unit 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 mechanical unit 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 (requires kinematic model).
- Circle motion, the TCP moves in a circular path (requires kinematic model).

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 mechanical unit can find its position by means of a digital sensor. The mechanical unit program can then be modified in order to adjust the motion to the location of the part (requires kinematic model).

Jogging

The mechanical unit 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 (requires kinematic model).
- Reoriented around the TCP (requires kinematic model).

It is possible to select the step size for incremental jogging. Incremental jogging can be used to position the mechanical unit with high precision, since the mechanical unit moves a short distance each time the joystick is moved.

During manual operation, the current position of the mechanical unit and the external axes can be displayed on the teach pendant.

Singularity handling

The mechanical unit can pass through singular points in a controlled way, i.e. points where two axes coincide (only applicable for mechanical units with kinematic model).

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 mechanical unit if something is not OK. A further monitoring function, Collision Detection, is optional and only valid for IRB manipulators (see option “Load Identification and Collision Detection”).

External axes

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

Electronically linked motors

For linear mechanical units with longer arms (typically axis X or Y), a mechanical shaft is often required to drive the arm on each side. IRC offers a software function that can replace the mechanical shaft. This type of control is referred to as Electronically Linked Motors. The function is also useful in any application where one motors needs to be synchronized with another. For more information see Product Specification RobotWare Options.

Big Inertia (IRB manipulators only)

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 Motors

The motors connected to IRC are controlled by internal drive modules and must therefor be of same or similar type as the motors used in ABB manipulators. The motors are synchronous AC motors with permanent magnets. Each motor has a resolver which is connected to a serial measurement board (SMB) which transforms the analog signals into digital and transmits them to the control system via a serial communication. The SMB can handle 1- 6 resolvers.

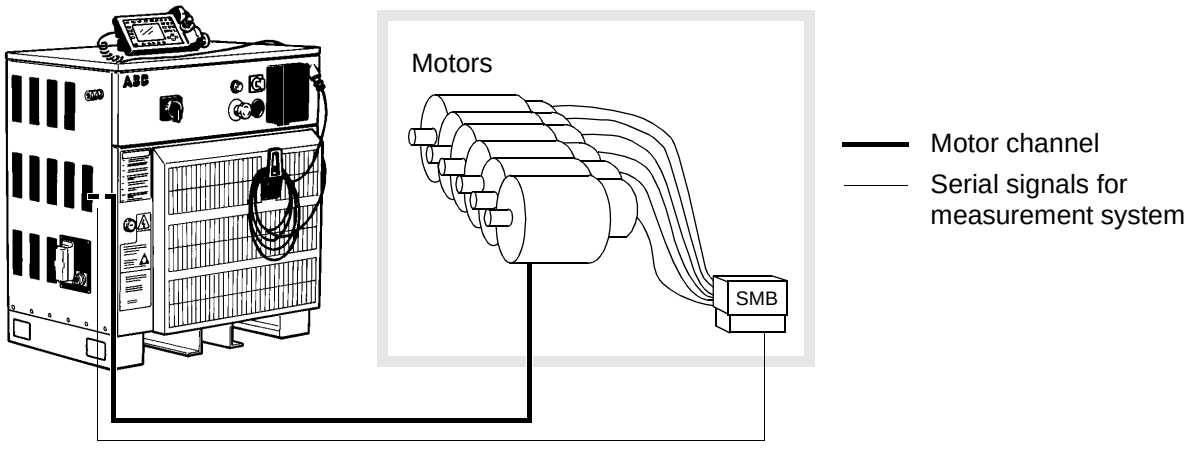


Figure 10 Overview of motor connectivity.

Absolute position is accomplished by battery-backed resolver revolution counters in the SMB.

A maximum number of 12 motors can be controlled by IRC at the same time. If no kinematic model is selected (i.e. Generic Position Control is selected), the total number is limited to 6 motors.

To simplify motor selection, there is a range of motor units offered by ABB. These motors are also provided as external motors to the IRB manipulators. Together with the motor units, there is a box containing a SMB. This box also serves as a junction point for all connections. In addition there are cables and configuration parameters available.

Available motor units:

Name	Maximum torque (Nm)	Rated torque (Nm)	Rated speed (rpm)
Small	5.7	1.7	4500
Medium	13.5	5	4500
Large[1]	26 or 37	12	3083 or 4200
X-large	52	23	3400

1. Maximum torque 26 Nm with drive unit type T at 3083 rpm.
   Maximum torque 37 Nm with drive unit type U at 4200 rpm (requires DC3 system).

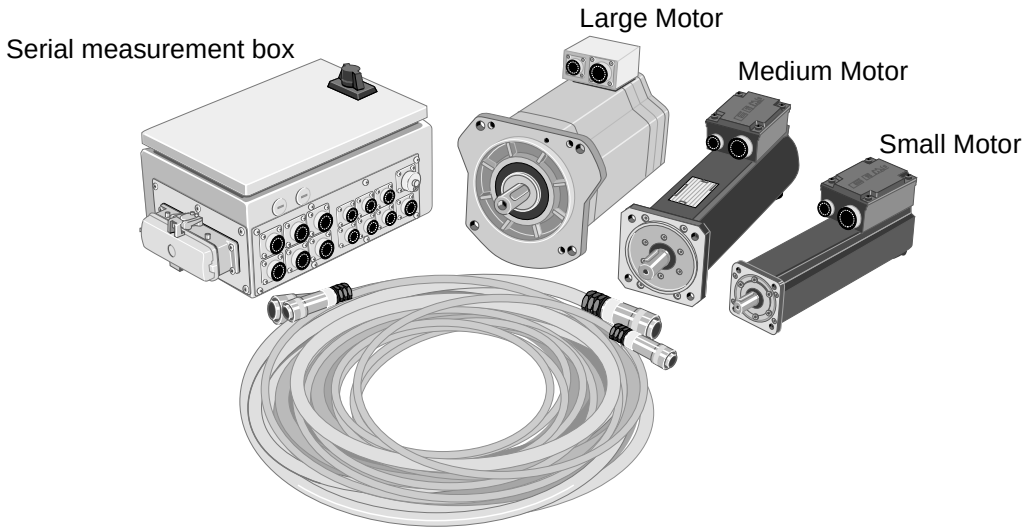


Figure 11 ABB motor units

For more information, see Product Specification Motor Units.

It is also possible to select other motors. However, in this case it is important to make a selection that matches the drive and measurement system interface in IRC.

General motor demands:

- Permanent magnet servo-motor of synchronous type intended for three-phase sinusoidal AC voltage, coupled in star (Y) connection
- Winded as class F according to IEC 85
- Dielectric strength minimum 1600 V
- PTC resistor temperature sensor
  - High temperature > 3500 Ω
  - Low temperature < 3000 Ω
  - Example:
    For F class winding with maximum temperature of 155 C,
    Siemens B59135-M155_A70 can be used.
- Brake
  - Select a brake with minimum brake torque, sufficient large to handle emergency stop when axis moving downwards with maximum gravity. Check that maximum brake torque don't exceed allowed mechanical stress levels.
  - Brake release voltage: 24 VDC +/- 10%.
  - Check brake release voltage at maximum brake (motor) temperature and maximum allowed wear out for the brake.
- The speed and torque depends of motor parameters and drive system limitations. How to calculate necessary motor is described in the document User´s Guide External Axes.

General resolver demands:

- Integrated in motor of IRB type or art. no. 5766 388-5, size 11
- Resolver must be approved by ABB for reliable operation
- Approved resolvers: LTN RE-21-1-V02 (Dec. 1999)
- Motor to resolver gear ratio 1:1 (single speed resolver)
- Resolver cable length: Max 30 m (X, Y for each resolver)
  However, the SMB shall be located as close to the motors as possible.
- Cable: AWG 24, Max 55 pF/m, with shield
- Measurement signal cables must be separated from power cables and cables from temperature sensor and brake.

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.

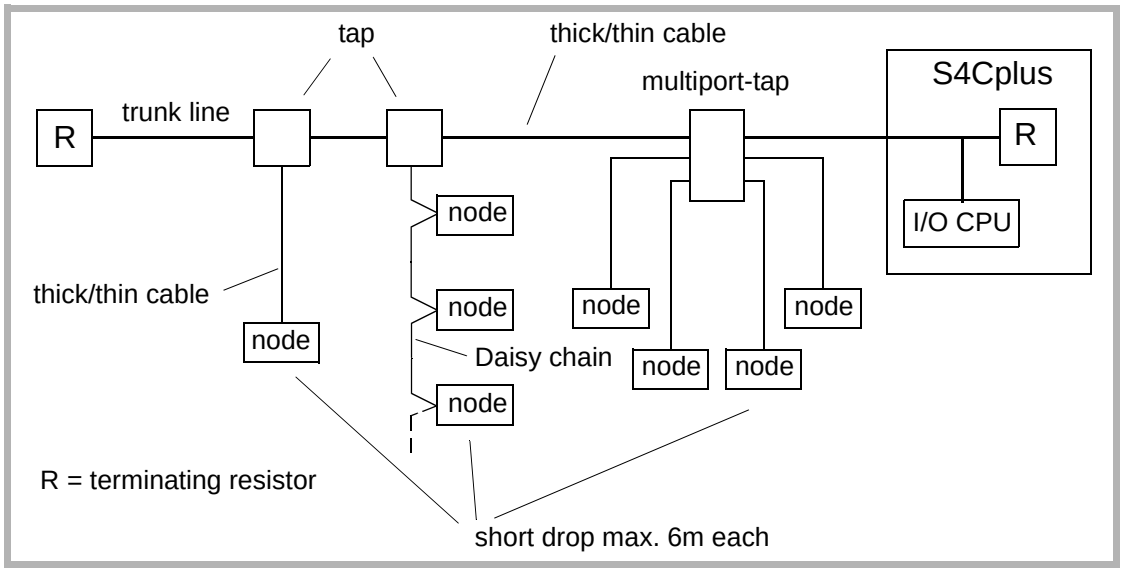


Figure 12 Example of a general DeviceNet bus.

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 mechanical unit from an external panel or PLC.

The mechanical unit can work as a PLC by monitoring and controlling I/O signals:

- I/O instructions can be executed concurrent to the mechanical unit 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 mechanical unit 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 mechanical unit 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 mechanical units also be routed parallel or serial to connectors on the upper arm of the mechanical unit.

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	Option no.	Digital		Analog			Power supply
		In	Out	Voltage inputs	Voltage output	Current output	
Digital I/O 24 VDC	20x	16	16				Internal/External[1]
Digital I/O 120 VAC	25x	16	16				Internal/External
Analog I/O	22x			4	3	1	Internal
AD Combi I/O	23x	16	16		2		Internal/External[1]
Relay I/O	26x	16	16				Internal/External[1]
Allen-Bradley Remote I/O Slave	241	128[2]	128				
Interbus Slave	242-285	64[2]	64				
Profibus DP Slave	243-287	128[2]	128				
Simulated I/O[3]		100	100	30	30		
Encoder interface unit[4] Encoder interface unit[5]	244 249	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 201/203)			
	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 201/203)			
	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 205)			
	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 204)			
	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 204)		
	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 202)		
	Voltage Input voltage:		±10 V
	Input impedance:		>1 Mohm
	Resolution:		0.61 mV (14 bits)
	Accuracy:		±0.2% of input signal
Analog outputs	(option 202)		
	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 203)		
	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 mechanical unit.

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

1.14 Communication

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

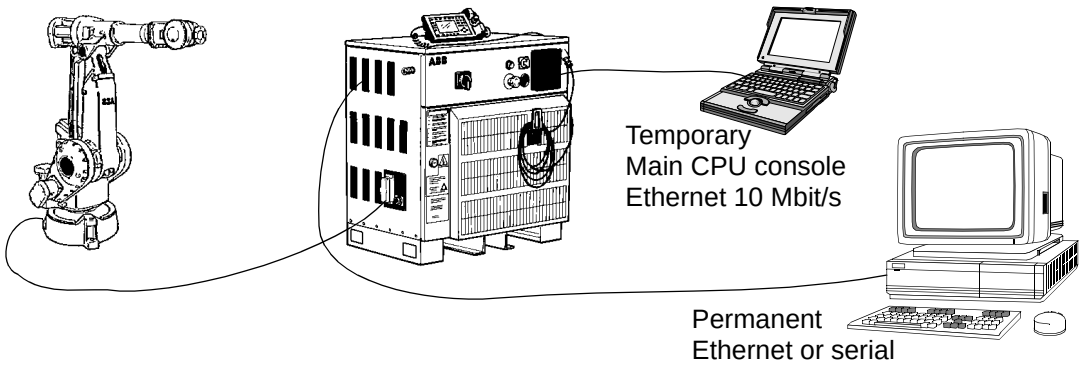


Figure 13 Point-to-point communication.

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 control systems with RAP protocol makes it possible to use OPC, ActiveX, and other APIs for integration with Window applications
- Boot/upgrading of control system software via the network or a portable PC.

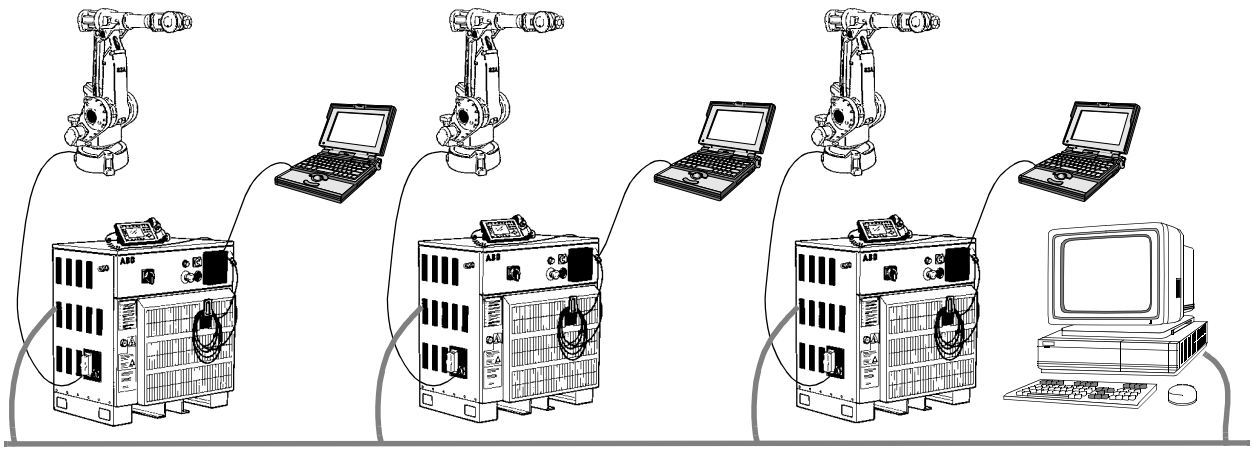


Figure 14 Network (LAN) communication.

2 Specification of Variants and Options

The different variants and options for the control system are described below.
The same numbers are used here as in the Specification Form.
When ordering IRC, the first decision is to determine whether the control system shall be used together with an IRB manipulator (option 456) or with another type of mechanical unit (option 455). If an IRB manipulator is selected, any option in range of 3xxx is to be defined. Then the correct drive system and kinematic model are automatically specified.
For description of the manipulator options, see Product Specification respectively.
For description of software options, see Product Specification RobotWare Options.

1 DRIVE SYSTEM (for option 455)

To select the suitable drive unit for a certain motor, the table below gives relations between drive unit identity and corresponding motor current range.

For a more detailed information on how to match motors and drive units, see User´s Guide External Axes.

Drive unit identity	Motor max current A_{rms}	Drive unit rated current A_{rms}	Suitable motor type[1]
W	11.5-57	30	XL
V	5.5-26	14.5	XL
U	11-55	24	M, L, XL
T	7.5-37	20	S, M, L, XL
G	6-30	16	S, M, L
E	4-19	8.4	S, M
C	2.5-11	5	S
B	1.5-7	4	(S)

1. See Chapter 1.12

Figure 15 Motor selecting table

There are four drive systems named after the DC-link they are built around. Each drive system has a certain maximum power output. The drive power definition (kW_{max}/ kW_{rated}) is based on DC-link data at the minimum operational 85% line voltage. At nominal line voltage the power is approximately 17% higher

DC1 system
275-407 VDC, 6.6 kW max / 1.7 kW rated.

481 DC1 + ECB

482 DC1 + ECB + ECB

DC2 system
275-407 VDC, 22 kW max / 4.0 kW rated.

483 DC2 + GT

484 DC2 + GT + GT

483 DC2 + GT + GT + GT

DC3 system
DC voltage 370 V (independent of line voltage variations), 25.9 kW max / 6.1 kW rated.

486 DC3 + GT

487 DC3 + GT + GT

488 DC3 + GT + GT + GT

489 DC3 + GU +GT

490 DC3 + GU + GT + GT

491 DC3 + GU + GU + GT

492 DC3 + GU

493 DC3 + GU + GU

494 DC3 + GU + GU + GU

DC5 system
DC voltage 480-730 V, 44 kW max / 13 kW rated.
Note that this drive system is intended for direct connection to line voltage 400-475 V without transformer. Other line voltage is not possible to choose.

477 DC5 + VW

478 DC5 + VW + VW

479 DC5 + VW + VW + VW

2 KINEMATIC MODELS

741 Generic Position Control
Joint interpolation principle is valid for all axes. If several axes are involved in the same motion instruction, they will all reach the destination point at the same time.
No linear or circular interpolation is possible.

Kinematic models for linear mechanical units
Definition of the axes are described in the figure below. Linear and circular interpolation is possible.

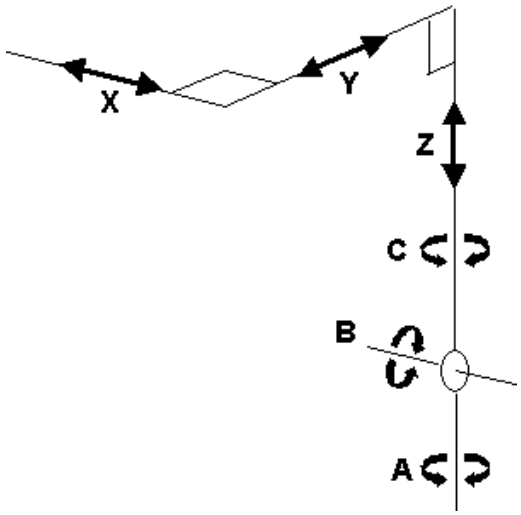


Figure 16 Definition of linear mechanical unit axes.

742 XYZ
Axis X linear, axis Y linear, axis Z linear.

743 XYZC
Axis X linear, axis Y linear, axis Z linear, axis C rotating around Z axis.

744 XYZB(X)
Axis X linear, axis Y linear, axis Z linear, axis B rotating around X axis.

745 XYZB(Y)
Axis X linear, axis Y linear, axis Z linear, axis B rotating around Y axis.

746 XYZB(X)A
Axis X linear, axis Y linear, axis Z linear, axis B rotating around X axis, axis A rotating.

747 XYZB(Y)A
Axis X linear, axis Y linear, axis Z linear, axis B rotating around Y axis, axis A rotating.

748 XYZCBA
Axis X linear, axis Y linear, axis Z linear, axis C rotating around Z axis, axis B rotating, axis A rotating.

749 YZ
Axis Y linear, axis Z linear.

750 YZC
Axis Y linear, axis Z linear, axis C rotating around Z axis.

751 YZB(X)
Axis Y linear, axis Z linear, axis B rotating around X axis.

752 YZB(Y)
Axis Y linear, axis Z linear, axis B rotating around Y axis.

753 YZB(X)A
Axis Y linear, axis Z linear, axis B rotating around X axis, axis A rotating.

754 YZB(Y)A
Axis Y linear, axis Z linear, axis B rotating around Y axis, axis A rotating.

755 YZCBA
Axis Y linear, axis Z linear, axis C rotating around Z axis, axis B rotating, axis A rotating.

Special kinematic models

756 ABB Doppin 2 axes

757 ABB Doppin 3 axes

758 Toploader

076/069/078-081 Position switch cabling
This option consists of screw terminals inside the cabinet (076) with cabling to the cabinet wall and connection cable in different lengths (078-081) to the mechanical unit. It is possible to select cabling for one (069) or two (071) switches.
For more information, please see Product Specification IRB 6400R.

3 SAFETY STANDARDS

EU - Electromagnetic Compatibility

693 The control system complies with the European Union Directive “Electromagnetic Compatibility” 89/336/EEC. This option is required by law for end users in the European Union. The option consists of a transient filter towards the line voltage.

Underwriters Laboratory

695 UL/CSA
The control system 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.
Not with Cabinet height 950 mm no cover (122), Cabinet height 1200 mm (123), Cabinet height 1750 mm (124), Cabinet variant Prepared for Arcitec (112), Mains connection type CEE17 connector (132, 133), Service outlet type 230V Europe (412). Door interlock (145 or 142), Operating mode selector standard 2 modes (193) are mandatory.
Note that UL certification requires a Safety lamp on the mechanical unit.

696 UR (UL Recognized)
The control system 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.
Not with Cabinet variant Prepared for Arcitec (112), Mains connection type CEE17 connector (132, 133), Service outlet type 230V Europe (412).
Door interlock (145 or 142), Operating mode selector standard 2 modes (193) are mandatory. Note that UL certification requires a Safety lamp on the mechanical unit.

4 CONTROL SYSTEM

CABINET

Variant

111 Standard cabinet with upper cover.

112 Prepared for Arcitec
Rotary switch 80A (143) and Circuit breaker standard (147) and Arcitec 4.0 (556) are mandatory.
Not with Wheels (126) or Mains connection type CEE17 connector (132, 133) or 6HSB (134) or Mains switch Flange disconnector (142) or Servo disconnector (144) or UL (695) or UR (696).

Cabinet Height (wheels not included in height)

121 Standard cabinet 950 mm with upper cover.

122 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 (145) or UL (695) or UR (696).

123 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 (695).

124 Standard cabinet with 800 mm extension. The extension is mounted on top of the standard cabinet. There is a mounting plate inside. (See Figure 17).
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 (695) and Servo disconnector (144).

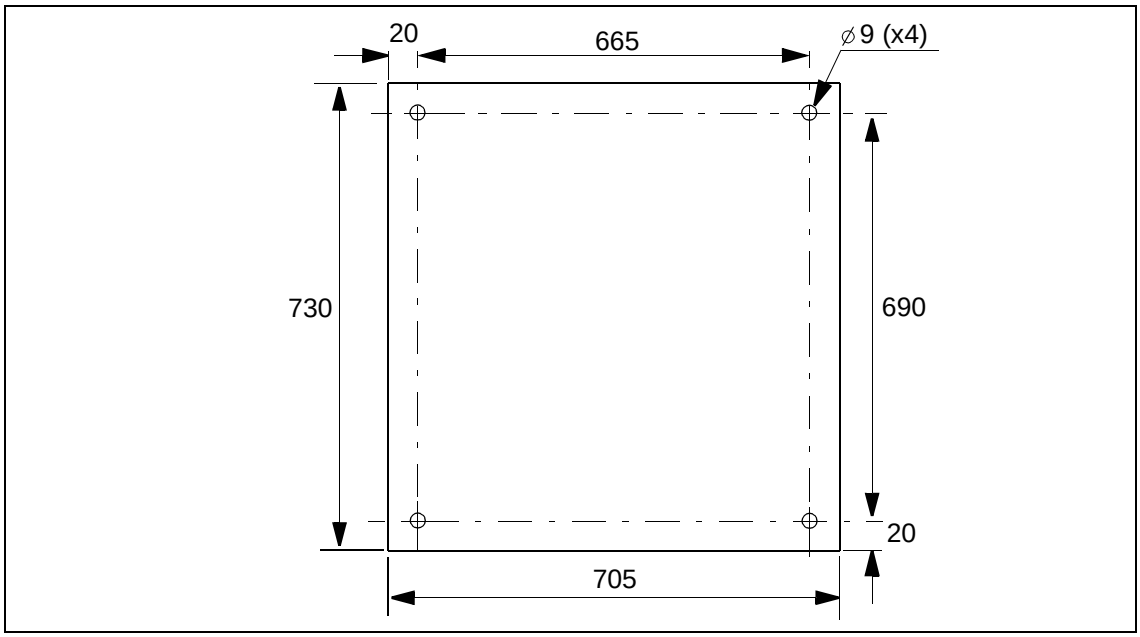


Figure 17 Mounting plate for mounting of equipment (dimensions in mm)

126 Cabinet on wheels. Increase the height by 30 mm.
Not with Prepared for Arcitec (112).

OPERATOR'S PANEL

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

181 Standard, i.e. on the front of the cabinet.

182 External, i.e. in a separate operator's unit. (See Figure 18 for required preparation)
All necessary cabling, including flange, connectors, sealing strips, screws, etc., is supplied.
External enclosure is not supplied.

183 External, mounted in a box. (See Figure 19)

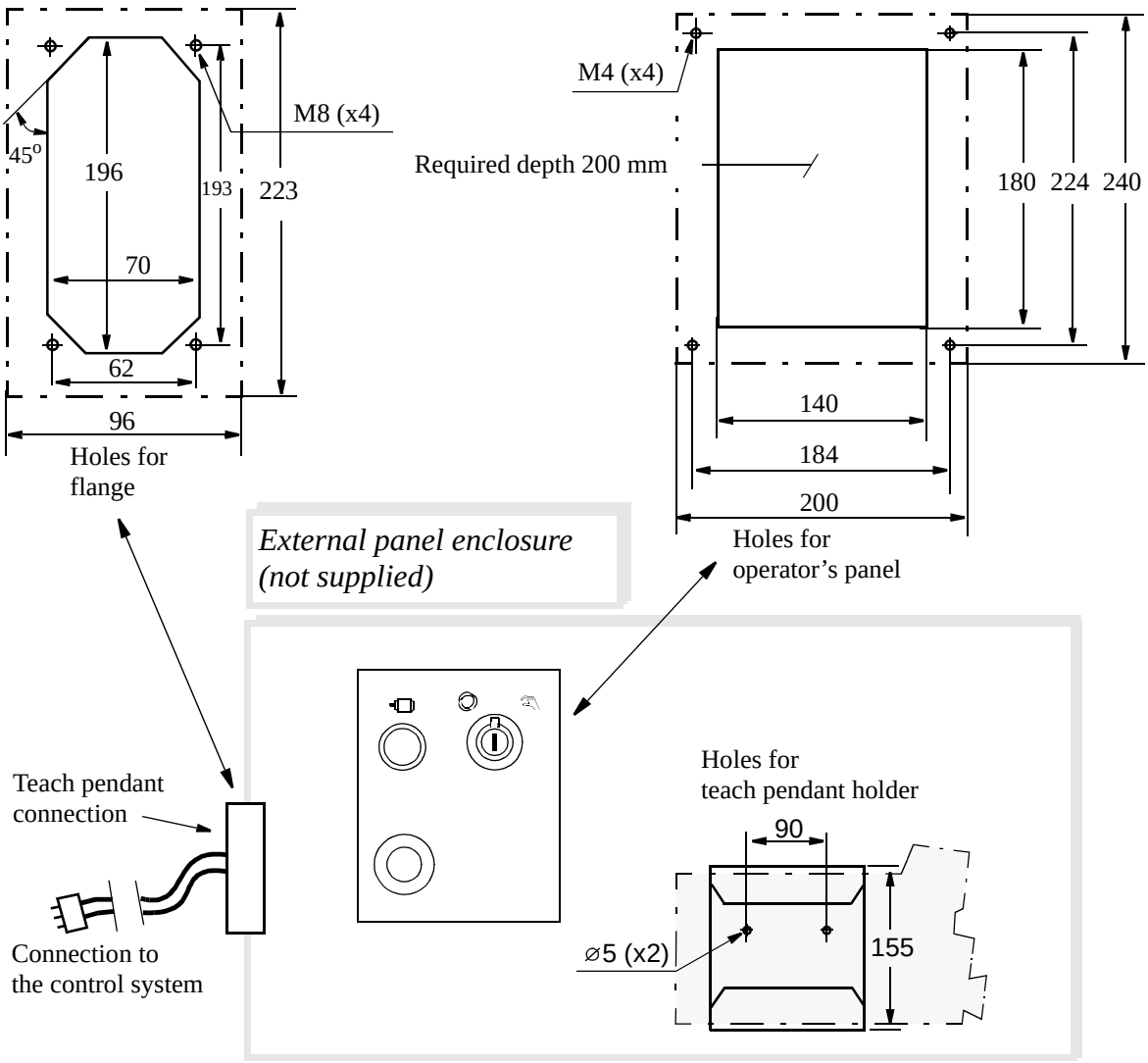


Figure 18 Required preparation of external panel enclosure (all dimensions in mm).

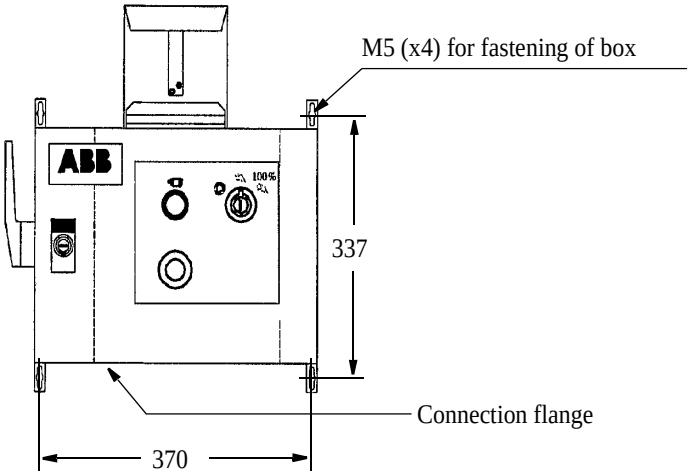


Figure 19 Operator's panel mounted in a box (all dimensions in mm).

OPERATOR'S PANEL CABLE

185 15 m

186 22 m

187 30 m

DOOR KEYS

461 Standard

462 Doppelbart

463 Square outside 7 mm

464 EMKA DB

466 Locking cylinder 3524

OPERATING MODE SELECTOR

193 Standard, 2 modes: manual and automatic.

191 Standard, 3 modes: manual, manual full speed and automatic.
Does not comply with UL and UR safety standards.

CONTROL SYSTEM COOLING

472 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).

473 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 472. Not available for IRB 7600.

TEACH PENDANT

601 Teach pendant with back lighting

Teach pendant language:

611 English
612 Swedish
613 German
614 French
615 Spanish
616 Portuguese
617 Danish
618 Italian
619 Dutch
620 Japanese
621 Czech
622 Finnish

Extension cable for the teach pendant:

606 10 m
This can be connected between the control system and the connector on the teach pendant's cable.
Not with Operator's panel extension cable 22 m (186) or 30 m (187).

A maximum of two extension cables may be used; i.e. the total length of cable between the control system and the teach pendant should not exceed 30 m.

607 20 m
Not with Operator's panel external (182) or External in a box (183)

MAINS VOLTAGE

The mechanical unit 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 in each connection.

151--163	Voltage	Voltage	Voltage
	200 V		
	220 V		
	400 V	400 V	
	440 V	440 V	
		475 V	475 V
		500 V	500 V
			525 V
			600 V

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 133-136 is chosen, the female connector (cable part) is included.

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

132 CEE17-connector 32 A, 380-415 V, 3p + PE (see Figure 20).
Not with Flange disconnector (142) or UL/UR (695/696) or Service outlet power supply (432).
Not available for IRB 7600.

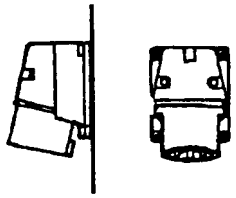


Figure 20 CEE male connector.

133 32 A, 380-415 V, 3p + N + PE (see Figure 20).
Not with Flange disconnector (142) or UL/UR (695/696).
Not available for IRB 7600.

134 Connection via an industrial Harting 6HSB connector in accordance with DIN 41640. 35 A, 600 V, 6p + PE (see Figure 21). Cannot be combined with Flange disconnector (142).

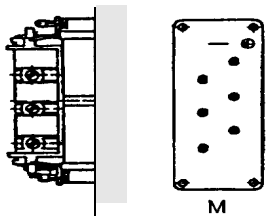


Figure 21 DIN male connector.

MAINS SWITCH

141 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.

142 Flange disconnector in accordance with the standard in section 1.2.
Includes door interlock for flange disconnector. Interrupt capacity 14 kA.

143 Rotary switch 80 A. Customer fuses for cable protection required.
Included in the option Prepared for Arcitec (112).

144 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.

145 Door interlock for rotary switch.
Included in the options UL/CSA/UR (695, 696) and Servo disconnector (144).

147 Circuit breaker for rotary switch. A 16 A (transformer 2 and 3) or 25 A (transformer 1) circuit breaker for short circuit protection of mains cables in the cabinet. Circuit breaker approved in accordance with IEC 898, VDE 0660. Interrupt capacity 6 kA.

148 Fuses (3x15 A) for the rotary switch for short circuit protection of mains cables in the cabinet. Interrupt capacity 50 kA.

I/O INTERFACES

The standard cabinet can be equipped with up to four I/O units. For more details, see page 25.

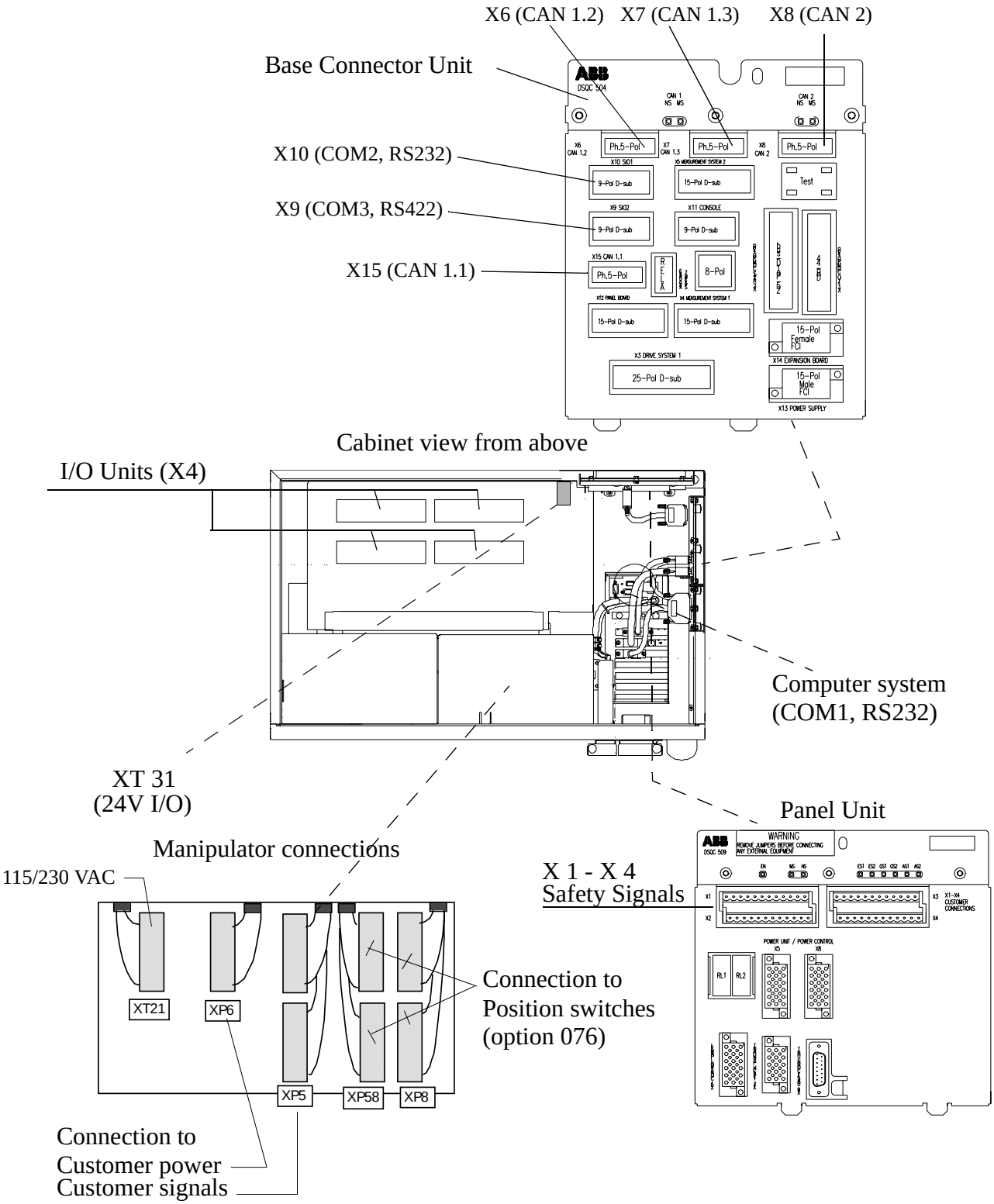


Figure 22 I/O unit and screw terminal locations.

201 Digital 24 VDC I/O: 16 inputs/16 outputs.

202 Analog I/O: 4 inputs/4 outputs.

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

204 Digital 120 VAC I/O 16 inputs/16 outputs.

205 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

251 **Internal connection** (options 201-204, 221-224, 231-234, 251-254, 261-264)
The signals are connected directly to screw terminals on the I/O units in the upper part of the cabinet (see Figure 22).

252 **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 control system. Corresponding customer part is included.

208 **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 less than three I/O units are ordered.

SAFETY SIGNALS

206 **Internal connection**
The signals are connected directly to screw terminals in the upper part of the cabinet (see Figure 22).

207 **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 control system. Corresponding customer part is included.

FIELD BUS AND COMMUNICATION ON LEFT WALL

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

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

246 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). 19 units (internal or external) can be connected to the cabinet. Profibus DP M/S CFG Tool (option 270) is required when setting up the master part or when changing the number of signals for the slave part.

247/248 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 control system 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 holding the I/O units for the master part of the board. The slave part is a digital in- and output I/O unit with up to 160 digital in- and 160 digital out signals.

Two variants are available:
247 for optical fibre connection (DSQC512)
248 for copper wire connection (DSQC529)

Interbus M/S CFG Tool (option 271) is required when setting up the master part or when changing the number of signals for the slave part.

GATEWAY UNITS

For more details, see I/O System on page 25.

241 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 22). Connectors Phoenix MSTB 2.5/xx-ST-5.08 or equivalent are included.

242 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.

243 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.

244 Encoder interface unit for conveyor tracking (DSQC 354)
Conveyor Tracking, RobotWare option 540, is the function whereby the mechanical unit follows a work object which is mounted on a moving conveyor. The encoder and synchronization switch cables are connected directly to the encoder unit in the upper part of the cabinet (see Figure 22). Screw connector is included.
This unit is also required for the function Sensor Synch, RobotWare option 547.

249 Encoder interface unit for conveyor tracking (DSQC 377)
Only available for IRB 340, required for PickMaster 4.0.

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 22) 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 23 and Figure 24.
For more details, see I/O System on page 25.

221 Digital I/O 24 V DC: 16 inputs/16 outputs.

222 Analog I/O.

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

224 Digital I/O 120 V AC: 16 inputs/16 outputs.

225 Digital I/O with relay outputs: 16 inputs/16 outputs.

EXTERNAL GATEWAY UNITS

231 Allen Bradley Remote I/O

232 Interbus Slave

233 Profibus DP Slave

234 Encoder interface unit DSQC 354 for conveyor tracking

235 Encoder interface unit DSQC 377 for conveyor tracking

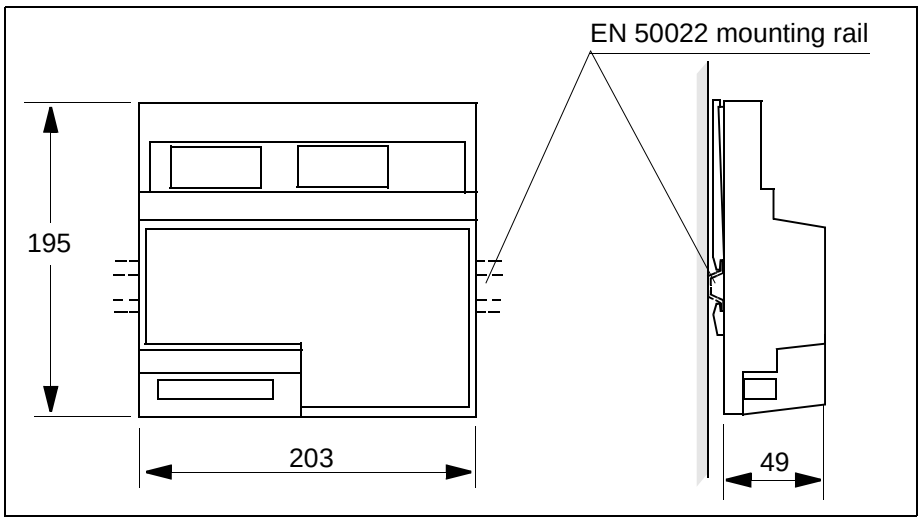


Figure 23 Dimensions for units 221-225.

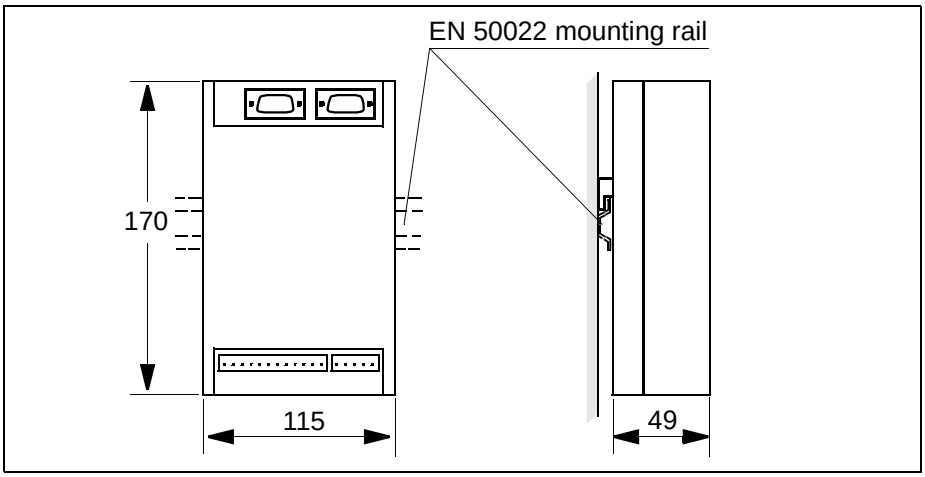


Figure 24 Dimension for units 231-234.

EXTERNAL AXES IN CONTROL SYSTEM CABINET

(not available for manipulators IRB 340, IRB 6400PE and not available for IRC together with non ABB manipulators)

It is possible to equip the control system 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.)

391 Drive unit C
The drive unit is part of the DC-link. Recommended motor type see Figure 15.
Not available for IRB 640.

392 Drive unit T
The drive unit is part of the DC-link. Recommended motor type see Figure 15.
Not available for IRB 640, 6400R.

397 Drive unit U
The drive unit is part of the DC-link. Recommended motor types see Figure 15.
Not available for IRB 140, 1400, 2400, 4400, 640

393 Drive unit GT
A separate drive unit including two drives. Recommended motor type see Figure 15.
Not available for IRB 4400, 6400R, 6400S

396 Prepared for drives GT
The same as 393 but without the GT drive module. The preparation includes; larger transformer, larger DC link DC2, and one additional axis computer with its connection.
Not available for IRB 4400, 640, 6400R, 6400S

398 Prepared for drives GT
The same as 396 but without additional axes computer and connection board.

394 Drive unit T+GT
A combination of 392 and 393.
Not available for IRB 4400, 640, 6400R, 6400S

395 Drive unit C+GT
A combination of 391 and 393
Not available for IRB 4400, 640, 6400R, 6400S

365 Trackmotion
A special option for the three motor combination 394 (IRB 140, 1400, 2400 only) to be used when axis 7 is intended for a SEFAX Trackmotion. The drive unit in the DC link and the Trackmotion measurement board is then connected to the mechanical unit 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.

701/702 Servo spot weld gun interface (IRB 6400R only)

The option consists of an encapsulated Serial Measurement Board and cabling inside the control system. Option 702 also includes bracket for 6400R foot mounting and cabling between the SMB and the manipulator.
In both cases the cabling between SMB and the control system is selected in the option range 686-689 (option 701) respective 681-684 (option 702). Drive unit option 397 is required for both the options.
See also Product Specification IRB 6400R chapter 1.8 for overview and Product Specification RobotWare Options for function description.

701 Stationary gun
702 Robot gun

EXTERNAL AXES MEASUREMENT BOARD

The resolvers can be connected to a serial measurement board outside the control system. Note that Motor Units includes an encapsulated SMB board and necessary cables between SMB and motor.

387 Serial measurement board as separate unit

388 Serial measurement board as separate unit
This option also includes cabling to be used when the SMB board is mounted in an encapsulation. The serial communication cable length is 700 mm ends with a connector fitting to the measurement cable. The resolver connection cable length is 1400 mm and ends with an industrial 64-pin female connector.

EXTERNAL AXES - SEPARATE CABINET

Drive units for external axes (exceeding the six drive units in the main cabinet) can be supplied in a similar cabinet (a simplified S4C M97 without computer unit and I/O system). The two cabinets are interconnected via a 7 m cable with 64-pole industrial connectors.

One 64-pole industrial connector is common for all motors (Note! Not identical interface as for the main cabinet) and one circular 8-pole connector is interface to the SMB circuit.

Door interlock, mains connection, mains voltage and mains filter are provided according to the selections for the main controller.

Note. External axes in separate cabinet is not applicable when option 741 Generic Position Control is selected.

371/372 Drive unit GT, for 4 or 6 motors.

373 Drive unit ECB, for 3 or 6 motors.

374 Drive unit GT + ECB

375 Drive unit GT + GT + ECB

Regarding drive unit data, see previous section Drive system. System power data is the same as DC2 system in the main cabinet.

EQUIPMENT

Manipulator cable, external connectors

653 Standard

654 Metal braided
Only together with cable length 7 m or 15 m (641 or 642).
Not available for IRB 340 and protection foundry.

Cable length

641 7m

642 15 m, not available for IRB 140

643 22 m, not available for IRB 140

644 30 m, not available for IRB 140

649 3 m, only available for IRB 140

Manipulator connection (only available for IRB 340)

657 External (not for the SA-version i.e. WashDown)

658 Internal

Protection for manipulator cable

845 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).

411 120 V in accordance with American standard; single socket, Harvey Hubble.

412 230 V mains outlet in accordance with DIN VDE 0620; single socket suitable for EU countries.

POWER SUPPLY (to the service outlet)

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

432 Connection before mains switch without transformer.
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

320 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

310 Flash disc 128 Mb. Standard is 64 Mb

3 Index