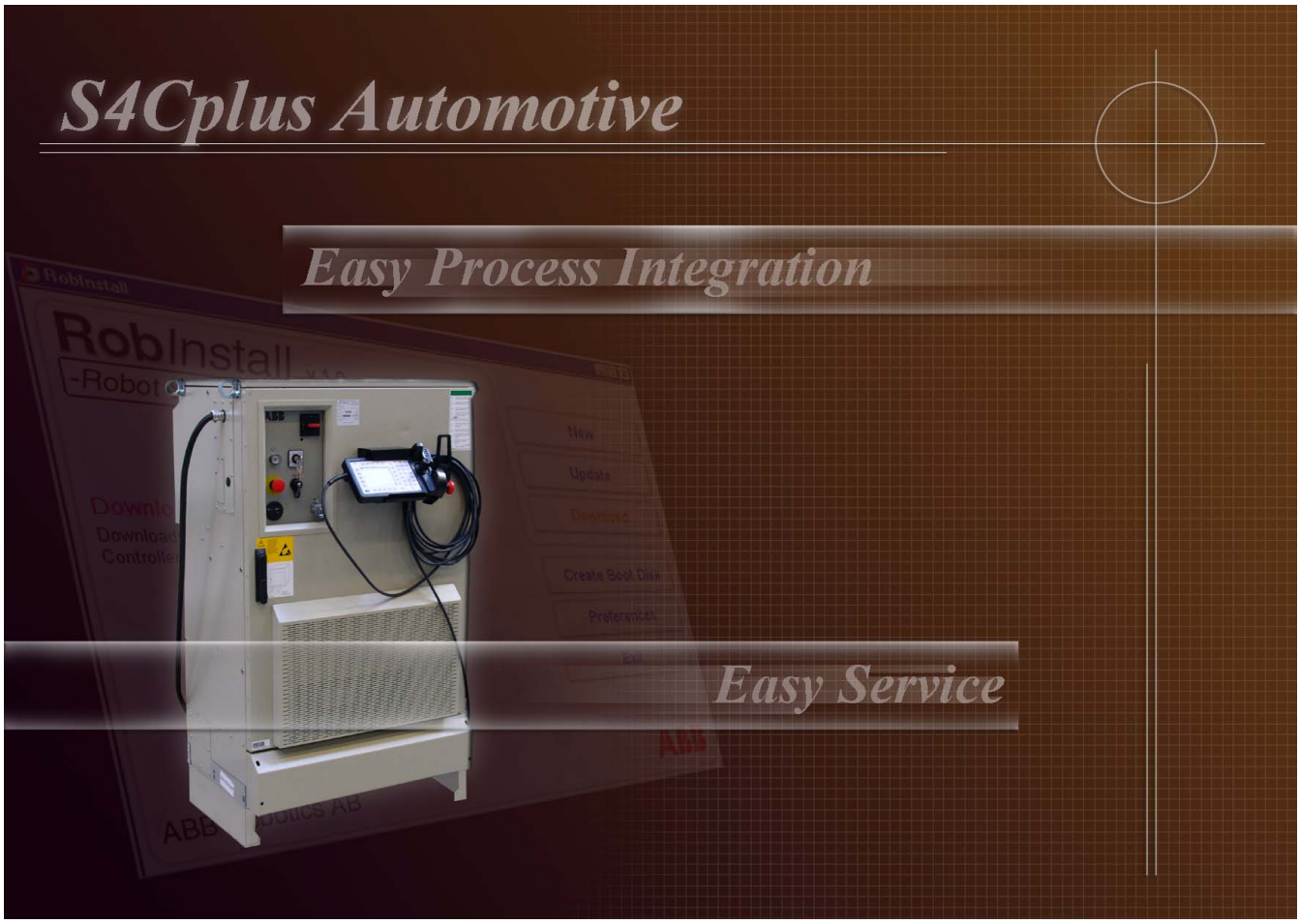
Product specification

Controller

S4Cplus Automotive

M2000A



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Robot Controller
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3HAC 17710-1
Revision 3

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ABB Automation Technologies AB
Robotics
SE-721 68 Västerås
Sweden

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1 Description

1.1 Structure

1.1.1 Introduction

General

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.

Data	Description
Controller weight	320 kg
Controller volume	1400 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)

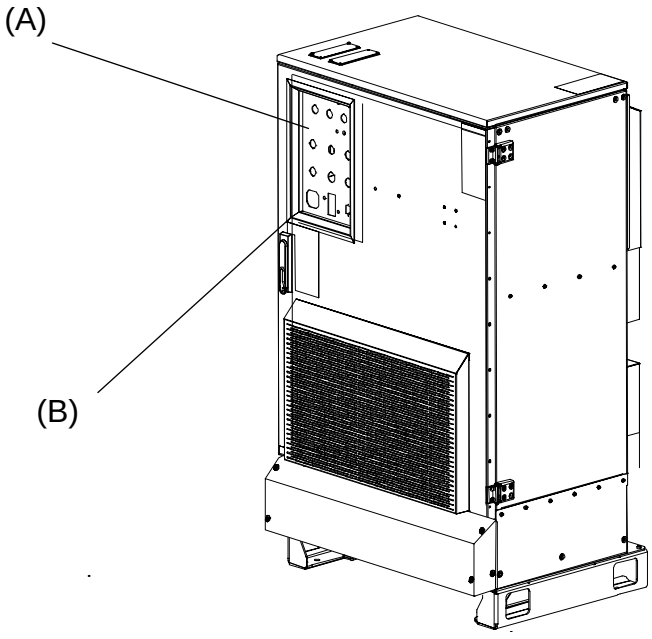

Figure 1 The controller is specifically designed to control robots, which means that optimal performance and functionality is achieved.

Pos	Description
A	Mains switch
B	Operator’s panel

1.1.1 Introduction

Illustration

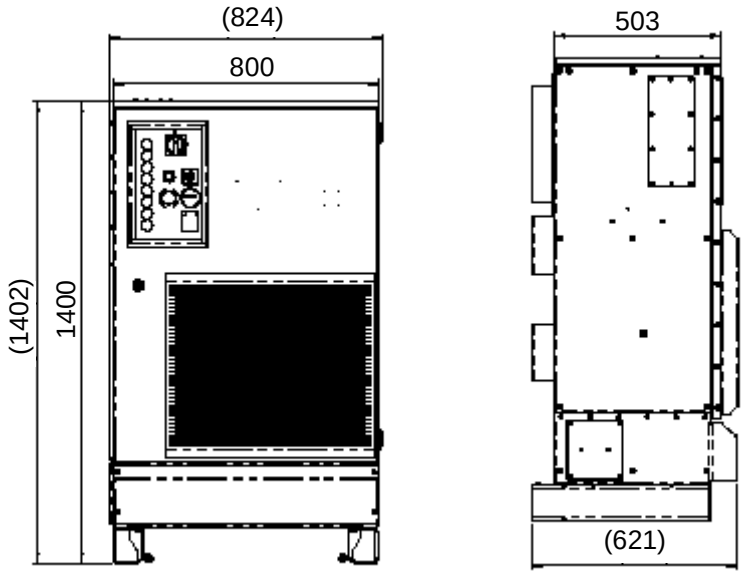

Figure 2 View of the controller from the front and from the side (dimensions in mm).

1.2 Safety/Standards

1.2.1 Standards

The robot conforms to the following standards:

Standard	Description
EN ISO 12100-1	Safety of machinery, terminology
EN ISO 12100-2	Safety of machinery, technical specifications
EN 954-1	Safety of machinery, safety related parts of control systems
EN 775	Manipulating industrial robots, safety
EN 60204	Electrical equipment of industrial machines
EN 61000-6-4 (option)	EMC, Generic emission
EN 61000-6-2	EMC, Generic immunity

Standards	Description
IEC 204-1	Electrical equipment of industrial machines
IEC 529	Degrees of protection provided by enclosures

Standards	Description
ISO 10218	Manipulating industrial robots, safety
ISO 9787	Manipulating industrial robots, coordinate systems and motions

Standards	Description
ANSI/RIA 15.06/1999	Safety Requirements for Industrial robots and Robot Systems
ANSI/UL 1740-1998[1])	Safety Standard for Robots and Robotic Equipment
CAN/CSA Z 434-03[1])	Industrial Robots and Robot Systems - General Safety Requirements

1. Complies if certain options are avoided.

Health and safety standards

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

Safety system based on a two-channel circuit

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.

1.3 Operation

1.3.1 Introduction

General

All operations and programming can be carried out using the portable teach pendant (see Figure 3) and operator’s panel see Operating mode selector .

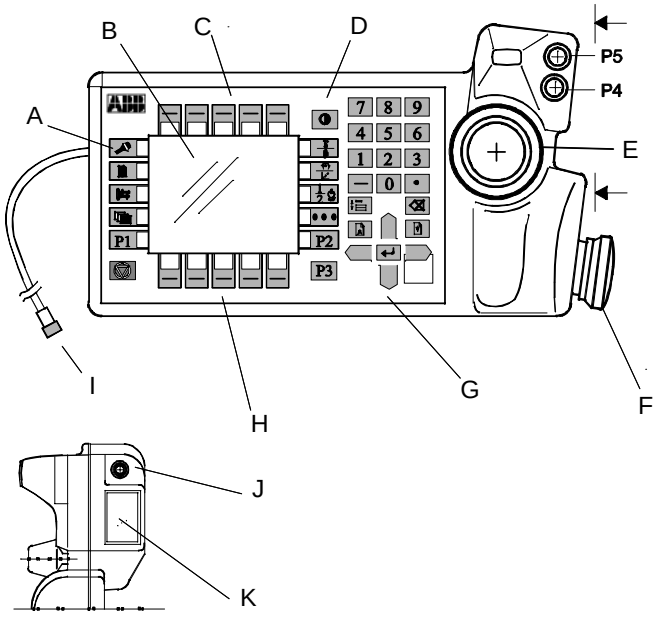

Figure 3 The teach pendant is equipped with a large display, which displays prompts, information, error messages and other information in plain English.

Pos	Description
A	Window keys
B	Display
C	Menu keys
D	Motion keys
E	Joystick
F	Emergency stop button
G	Navigation keys
H	Function keys
I	Cable 10m
J	Hold-to-run
K	Enabling device

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 for Teach Pendant Languages in Specification of Variants and Options

Portable teach pendant

Menu	Description
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 MOTORSON. 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.

1.3.1 Introduction

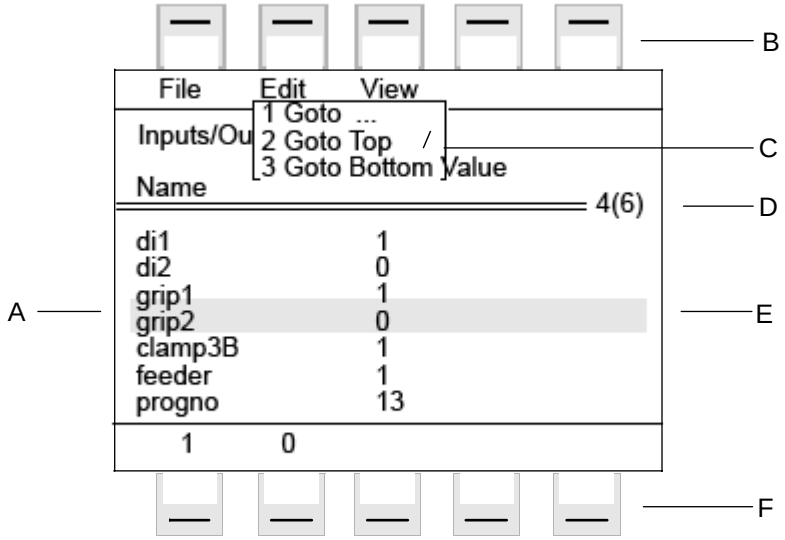

Figure 4 Window for manual operation of input and output signals.

Pos	Description
A	I/O list
B	Menu keys
C	Menu
D	Line indicato
E	Cursor
F	Function keys

Deflection of the joystick

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.

User tasks

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

- Production
- Programming
- System setup
- Service and installation

Operator's panel

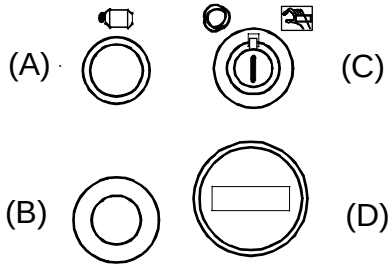

Figure 5 Operator's panel

Pos	Description
A	MOTORS ON button and indicating lamp.
B	Emergency stop: if pressed in, pull to release.
C	Operating mode selector.
D	Duty time counter: indicates the operation time for the manipulator (released brakes).

Motors on

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

Operating mode selector

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

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

As optional	Description	Signs
Manual mode at full speed	Testing at full program speed	100% 

Equipped with this mode, the robot is not approved according to ANSI/UL

The operating mode is selected using the operator‘s panel on the controller.

External mounting

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

Remote controll

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

Custom pushbuttons

The S4Cplus Automotive is prepared for up to 4 additional buttons in the right part of the operator’s panel.

1.4 Memory

1.4.1 Introduction

General

Available memory

The controller has two different memories:

Memory	Size	Usage
Fixed DRAM memory	32 MB	working memory
Flash disk memory	64 MB, standard	mass memory
Flash disk memory	128 MB, optional	mass memory

DRAM memory

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

DRAM memory	Size	Option
System software		
System software execution data		
User RAPID see Figure 6	5.5 MB 0.7 MB (at most)	when installing different options, the user program memory will decrease

Flash disk memory

The flash disk is divided into four main areas:

Main areas	Size	Description
Base area	5 MB	permanent code for booting
Release area	20 MB	the code for a specific release is stored
System specific data area	10 MB	the run time specific data including the user program for a system is stored at backup
User mass memory area		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.

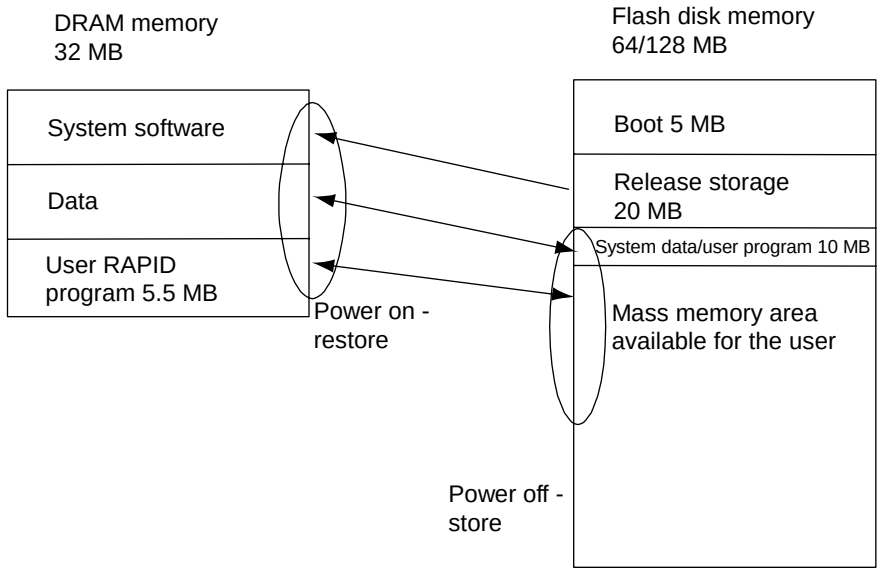

Figure 6 Available memory.

Installation of different systems in the controller

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.

RAPID memory consumption

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

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

1.5.1 Introduction

Configuration for the corresponding manipulator

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

Requirements	Description
Protection standards IEC529	Controller electronics IP54
Explosive environments	The controller must not be located or operated in an explosive environment
Ambient temperature during operation	option 85-1: +5°C (+41°F) to +45°C (+113°F) option 85-2: +52°C (+125°F)
Ambient temperature during transportation and storage	-25°C (-13°F) to +55°C (+131°F) for short periods (not exceeding 24 hours) up to +70°C (+158°F)
Relative humidity, Transportation, storage and operation	Max. 95% at constant temperature
Vibration during transportation and storage	0-55 Hz: Max. ±0.15 mm 55-150 Hz: Max. 20 m/s^2
Bumps during transportation and storage	Max. 100 m/s^2 (4-7 ms)

Power supply

Description	Value
Mains voltage	400-600 V, 3ph (3ph + N for certain options)
Mains voltage tolerance	+10%, -15%
Mains frequency	48.5 to 61.8 Hz

Rated power

Robot	Values
IRB 140, 1400, 2400	4.5 kVA (transformer size)
IRB 4400, 6400	7.8 kVA (transformer size)
IRB 6600-225/2.55	6 kVA (ISO 9283)
IRB 7600-400/2.55	7.1 kVA (ISO 9283)

Computer system

Description	Value
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:

User needs	Description
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

1.6.1 Introduction

General

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”.

Programming environment

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
- 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.

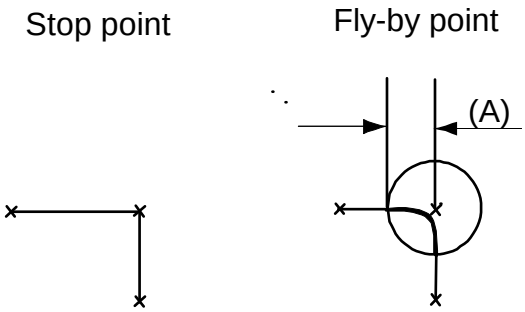

Figure 7 The fly-by point reduces the cycle time since the robot does not have to stop at the programmed point. The path is speed independent.

Pos	Description
A	User-definable distance (in mm).

The velocity

The velocity may be specified in the following units:

Units	Velocity
mm/s	
seconds	The 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.

Change of robot position

A robot position can easily be changed either by:

- Jogging the robot with the joystick to a new position and then pressing the “ModPos” key (this registers the new position).
- Entering or modifying numeric values.

To prevent 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

1.7.1 Introduction

General

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.

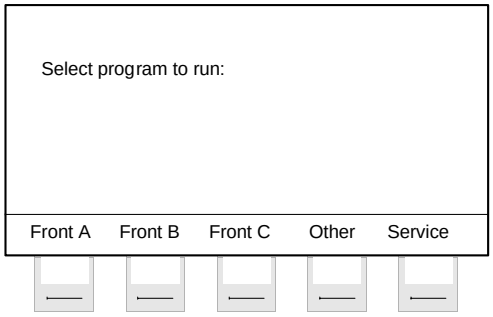

Figure 8 The operator dialogs can be easily customised.

Service position

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.

Special routines

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

Absolute measurement

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

1.8 The RAPID Language and Environment

1.8.1 Introduction

General

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

1.9.1 Introduction

General

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

1.10.1 Introduction

Easy to service

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

Error detection

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

1.11.1 Introduction

QuickMove™

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

- No parameters have to be adjusted to achieve correct path, orientation and velocity.
- Maximum acceleration is always obtained (acceleration can be reduced, 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”).

1.11.1 Introduction

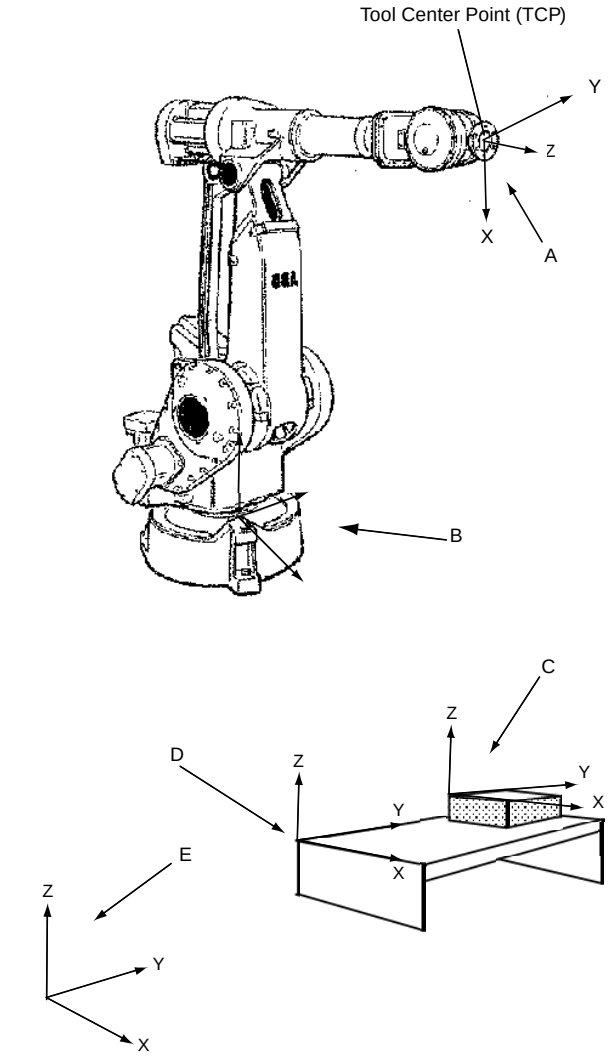

Figure 9 The coordinate systems, used to make jogging and off-line programming easier.

Pos	Description
A	Tool coordinates
B	Base coordinates
C	Object coordinates
D	User coordinates
E	World coordinates

Coordinate systems

Systems	Description
World coordinate system	The world coordinate system defines a reference to the floor, which is the starting point for the other coordinate systems. Using this coordinate system, it is possible to relate the robot position to a fixed point in the workshop. The world coordinate system is also very useful when two robots work together or when using a robot carrier.
Base coordinate system	The base coordinate system is attached to the base mounting surface of the robot.
Tool coordinate system	The tool coordinate system specifies the tool's centre point and orientation.
User coordinate system	The user coordinate system specifies the position of a fixture or workpiece manipulator.
Object coordinate system	The object coordinate system specifies how a workpiece is positioned in a fixture or workpiece manipulator
Programming of the coordinate systems	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).
Position specification	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	Soft servo - allowing external forces to cause deviation from programmed position - can be used as an alternative to mechanical compliance in grippers, where imperfection in processed objects can occur. Any axis (also external) can be switched to soft servo mode, which means that it will adopt a spring-like behaviour
Location	If the location of a workpiece varies from time to time, the robot can find its position by means of a digital sensor. The robot program can then be modified in order to adjust the motion to the location of the part.

1.11.1 Introduction

Systems	Description
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.

1.12 External Axes

1.12.1 Introduction

General

The S4Cplus control system 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 S4Cplus Automotive control system is limited to handle up to two external axes.

	Description
Mechanical units	The external axes can be grouped into mechanical units to facilitate, for example, the handling of robot carriers, workpiece manipulators, etc.
Coordination	The robot motion can be simultaneously coordinated with for example, a linear robot carrier and a work piece positioner.
Activate/Deactivate	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.

AC motor

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

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

Absolute position

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

1.12.1 Introduction

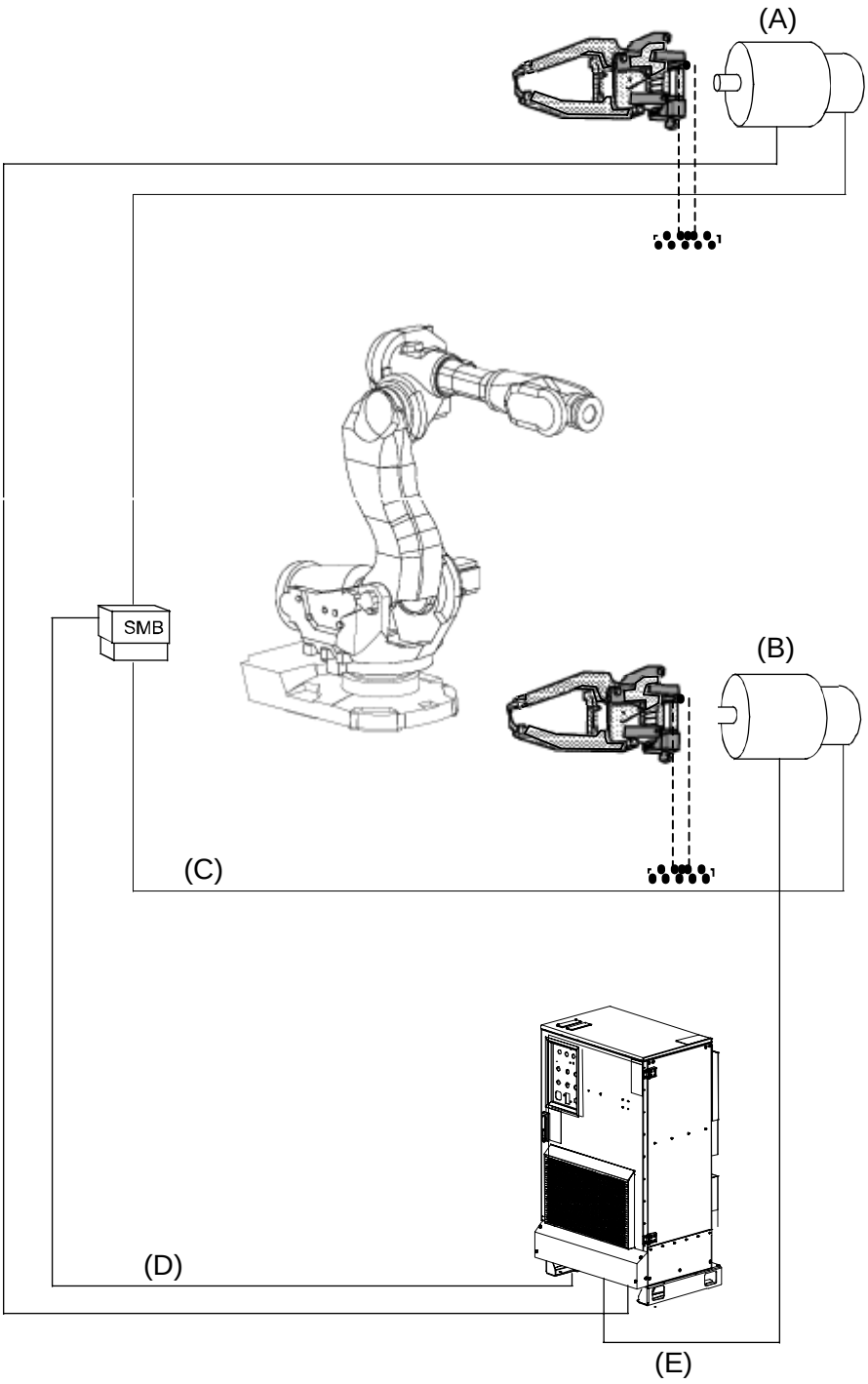

Figure 10 Example. Twin stationary Servo Guns controlled as external axes.

Pos	Description
A	Motor 7
B	Motor 8
C	Resolver signals
D	To axes computer 2
E	Motor current

1.13 I/O System

1.13.1 Introduction

General

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.

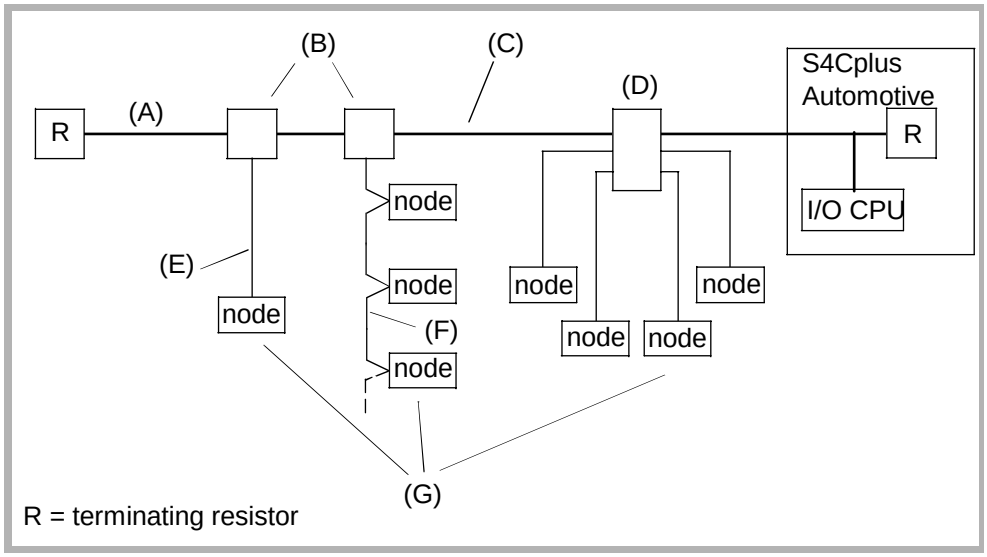

Figure 11 Example of a general DeviceNet bus.

Pos	Description
A	Trunk line
B	Tap
C	Thick/thin cable
D	Multiport-tap
E	Thick/thin cable
F	Daisy chain
G	Short drop max. 6 m each

1.13.1 Introduction

Input and output units

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.

I/O Plus

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

Configuration of inputs and outputs

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.

PLC

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 work as a PLC by monitoring and controlling I/O signals:

- I/O instructions can be 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.

Available manual functions

- 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

- “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]	244	79-1	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.

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)

Units	CAN1	CAN2 (option)
Max. total no of units[1]	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	According to DeviceNet specification release 1.2

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

Permitted customer

Load	Value
24 V DC load	max.7,5 A

Digital inputs 24V DC Option 61-1/58-1

Parameter	Value
Optically-isolated	
Rated voltage	24 V DC
Logical voltage levels “1”	15 to 35 V
Logical voltage levels “0”	-35 to 5 V
Input current at rated input voltage	6 mA
Potential difference	max.500 V
Time delays, hardware	5 - 15 ms
Time delays, software	≤ 3 ms
Time variations	± 2 ms

Digital outputs 24V DC Option 61-1/58-1

Parameter	Value
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

Parameter	Value
Logical voltage levels: “0”	< 7 V
Output current	max. 0.5 A
Potential difference	max. 500 V
Time delays: hardware	≤ 1ms
Time delays: software	≤2 ms
Time variations	± 2 ms

Analog inputs option 54-1

Parameter	Description	Values
Voltage	Input voltage	±10 V
Voltage	Input impedance	>1 Mohm
Voltage	Resolution	0.61 mV (14 bits)
Accuracy		±0.2% of input signal

Analog outputs option 54-1

Parameter	Description	Values
Voltage	Output voltage	±10 V
Voltage	Load impedance	min. 2 kohm
Voltage	Resolution	2.44 mV (12 bits)
Current	Output current	4-20 mA
Current	Load impedance	min. 800 ohm
Current	Resolution	4.88 µA (12 bits)
Accuracy		±0.2% of output signal

Analog outputs option 58-1

Parameter	Values
Output voltage galvanically isolated	0 to +10 V
Load impedance	min. 2 kohm
Resolution	2.44 mV (12 bits)
Accuracy	±25 mV ±0.5% of output voltage
Potential difference	max. 500 V
Time intervals: hardware	≤ 2.0 ms
Time intervals: software	≤ 4 ms

System signals

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

Digital outputs	Digital inputs	Analog output
Motors on/off	Motors on/off	TCP speed signal
Executes program	Starts program from where it is	
Error	Motors on and program start	
Automatic mode	Starts program from the beginning	
Emergency stop	Stops program	
Restart not possible	Stops program when the program cycle is ready	
Run chain closed	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	

1. Program can be decided when configuring the robot.

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

1.14 Communication

1.14.1 Introduction

General

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.

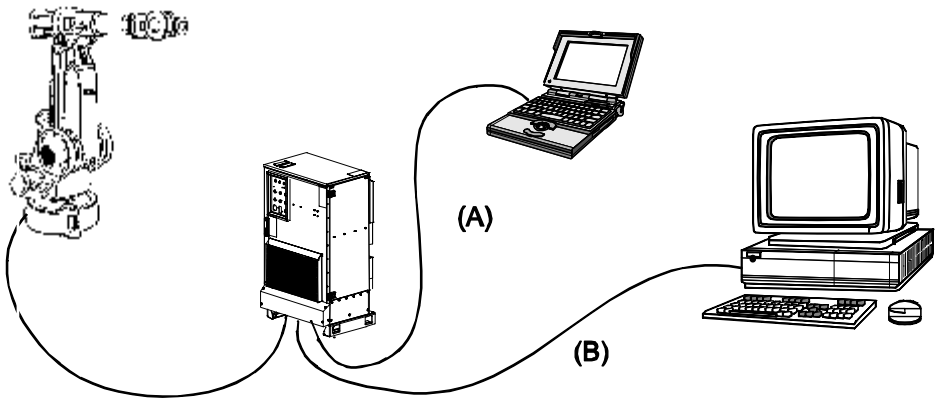

Figure 12 Point-to-point communication.

Pos	Description
A	Temporary Main CPU console Ethernet 10 Mbit/s.
B	Permanent Ethernet or serial.

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

Configuration	Description
DNS, DHCP etc.	Inclusion of multiple gateway
Network file system	Accesses using FTP/NFS client and FTP server
Control and/or monitoring of controllers with RAP protocol	Possibility to use OPC, ActiveX, and other APIs for integration with Window applications
Boot/upgrading of controller software	Via the network or a portable PC

1.14.1 Introduction

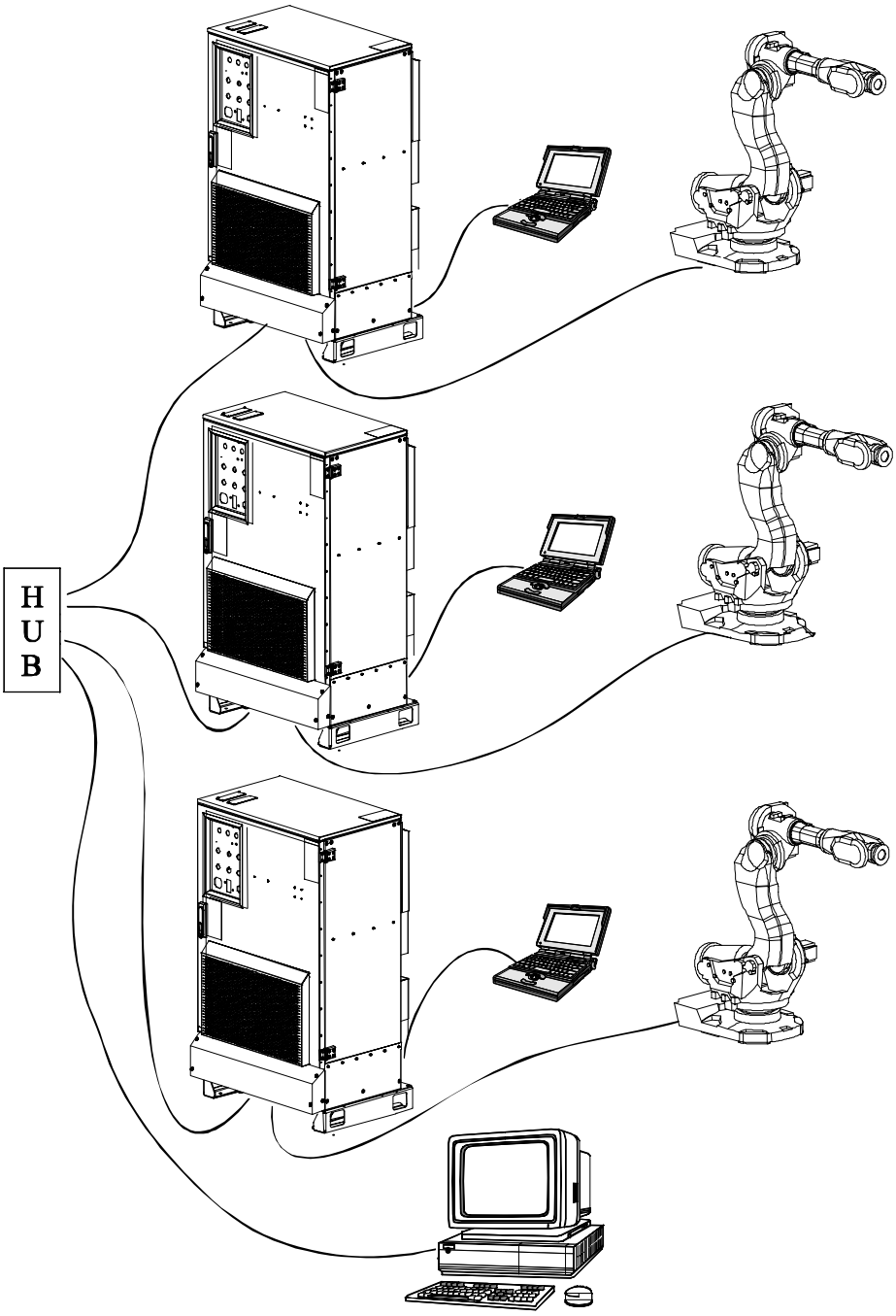

Figure 13 Network (LAN) communication.

2 Specification of Variants and Options

2.1 Introduction

2.1.1 General

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.

2.2 Safety standards

2.2.1 Introduction

EU - Electromagnetic Compatibility

Option	Description
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. Not available for controllers connected to 600 V.

2.3 Control system

2.3.1 Introduction

Cabinet

Variants

Option	Cabinet	Description
66-2	Standard cabinet	The S4Cplus Automotive cabinet is provided with covered openings for additional customer equipment on the top or on the left side (see previous figures). All connections are made to connectors located in the cabinet foot, behind a protective cover.
64-2	Cabinet on foot	The foot is made for fork lift transport.
67-1	Cabinet on wheels	Increase height by 30 mm.

Operator´s panel

The operator’s panel and teach pendant holder can be installed in different ways:

Option	Panel	Description
242-6	Standard	i.e. on the front of the cabinet
242-1	External	i.e. in a separate operator’s unit. (See Figure 14 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 box. (See Figure 15)

2.3.1 Introduction

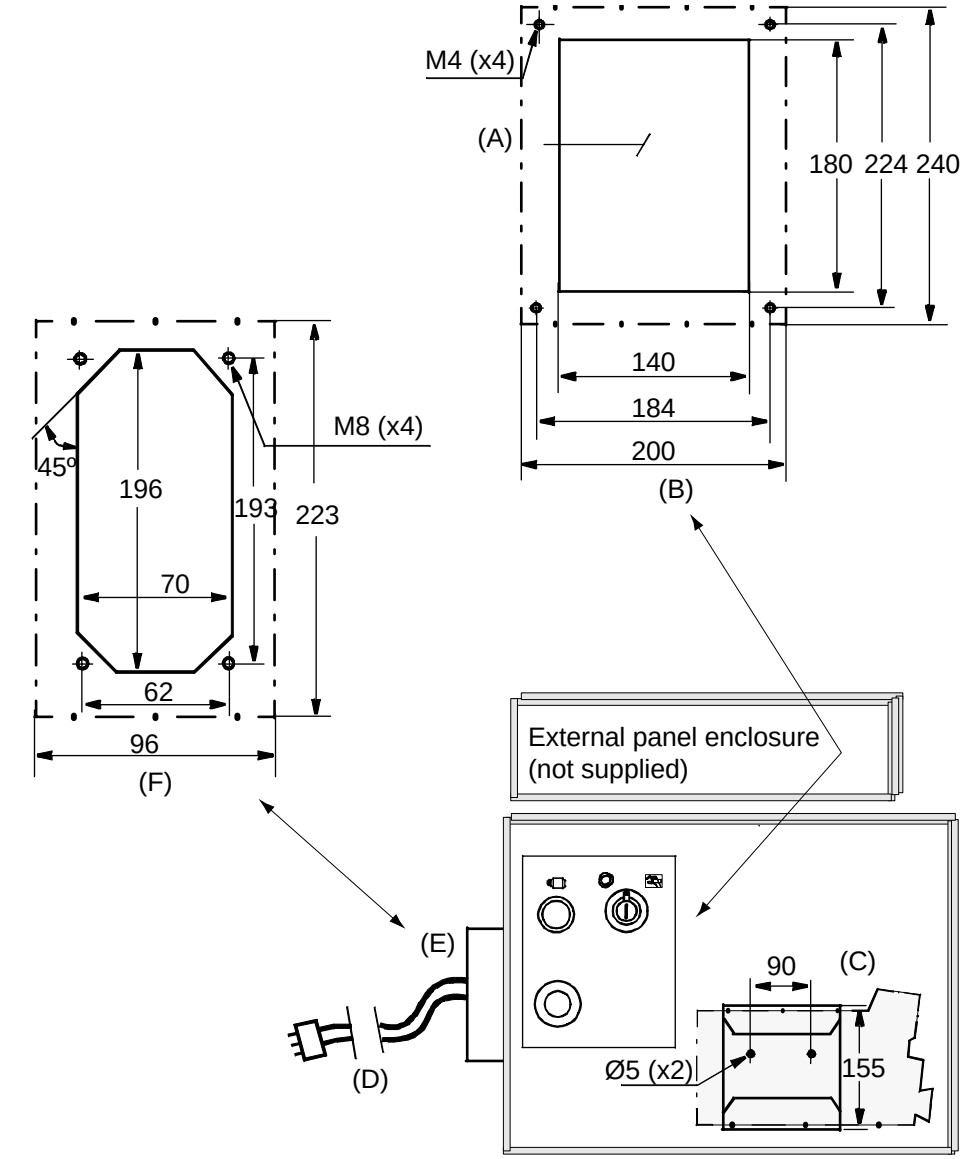

Figure 14 Required preparation of external panel enclosure (all dimensions in mm).

Pos	Description
A	Required depth 200 mm
B	Holes for operator’s panel
C	Holes for teach pendant holder
D	Connection to the controller
E	Teach pendant connection
F	Holes for flange

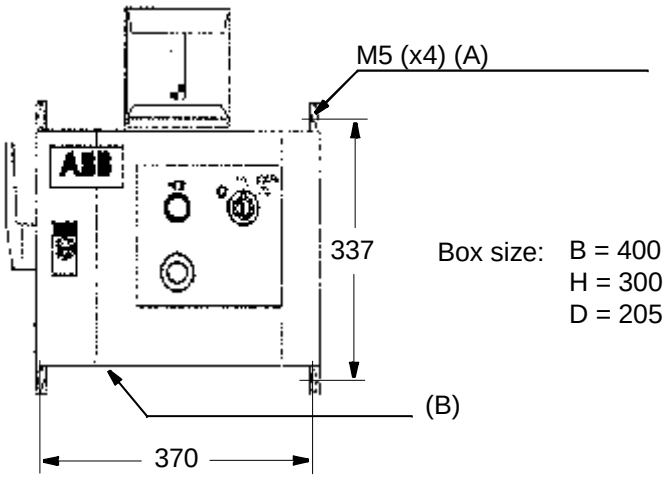

Figure 15 Operator's panel mounted in a box (all dimensions in mm).

Pos	Description
A	For fastening of box
B	Connection flange

Operator´s panel cable

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

Door keys

Option	Door Keys
65-6	Standard
65-1	Doppelbart
65-5	Square outside 7 mm
65-2	EMKA DB
65-7	Triangular 6,5 mm outside

Operating mode selector

Option	Description
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

The S4Cplus Automotive controller has no dust filter in the door. It is possible to clean the air duct from behind. To prevent dust from penetrating the computer unit, the ambient air does not flow around the unit. It is directed only through the cooling device at the rear of the unit.

Option	Description
85-1	Ambient temperature up to 45° C (113°F). 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).
483-1	Dust filter for harsh (oily air) environment, e.g. machine shop.

Teach Pendant

Option	Description
370-1	Teach pendant with back lighting

Option	Teach Pendant Language
413-1	English
419-1	Swedish
416-1	German
415-1	French
420-1	Spanish
411-1	Danish
417-1	Italian
412-1	Dutch
410-1	Czech
414-1	Finish

Extension cable for the teach pendant

Option	Length	Description
373-1	10 m	This can be connected between the controller and the connector on the teach pendant's cable. Not with Operator's panel extension cable 15 m (240-1) or 30 m (240-3). A maximum of two extension cables may be used; i.e. the total length of cable between the controller and the teach pendant should not exceed 30 m.
373-2	20 m	Not with Operator's panel external (242-1).

Mains voltage

The robot can be connected to a rated voltage of between 400 V and 600 V, 3-phase and protective earthing. A voltage fluctuation of +10% to -15% is permissible in each connection.

Option	Mains Voltage
208-3	400 V
208-4	440 V
208-5	475 V
208-7	500 V
208-8	525 V
208-9	600 V

In addition to above selection, the voltage range has to be specified for IRB 140, 1400, 2400 and 4400 . This gives the possibility to select between two different transformers.

Option	Voltage range	Market
442-2	Voltage range 400, 440, 475, 500V	Intended for the European market
442-3	Voltage range 475, 500, 525, 600V	Intended for the North American market

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 option206-4 is chosen, the female connector (cable part) is included.

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

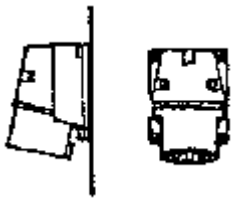

Figure 16 CEE male connector.

Option	Description
206-3	CEE17-connector 32 A, 380-415 V, 3p + PE (see Figure 16). 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

Option	Description
206-2	32 A, 380-415 V, 3p + N + PE (see Figure 16). Not available for IRB 6600/7600. Not with Service Outlet Power Supply (331-2).

Option	Description
206-4	Connection via an industrial Harting 6HSB connector in accordance with DIN 41640. 35 A, 600 V, 6p + PE (see Figure 17). Cannot be combined with Flange disconnector (207-1).

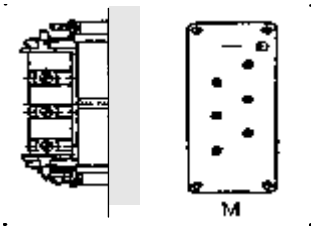

Figure 17 DIN male connector.

Mains switch

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. Interrupt rating 10kA.

Option	Description
70-2	Circuit breaker for rotary switch. A 16 A 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.
188-1	Door interlock for rotary switch.

I/O Interfaces

The cabinet can be equipped with up to four I/O units. For more details, See “I/O System” on page 33.

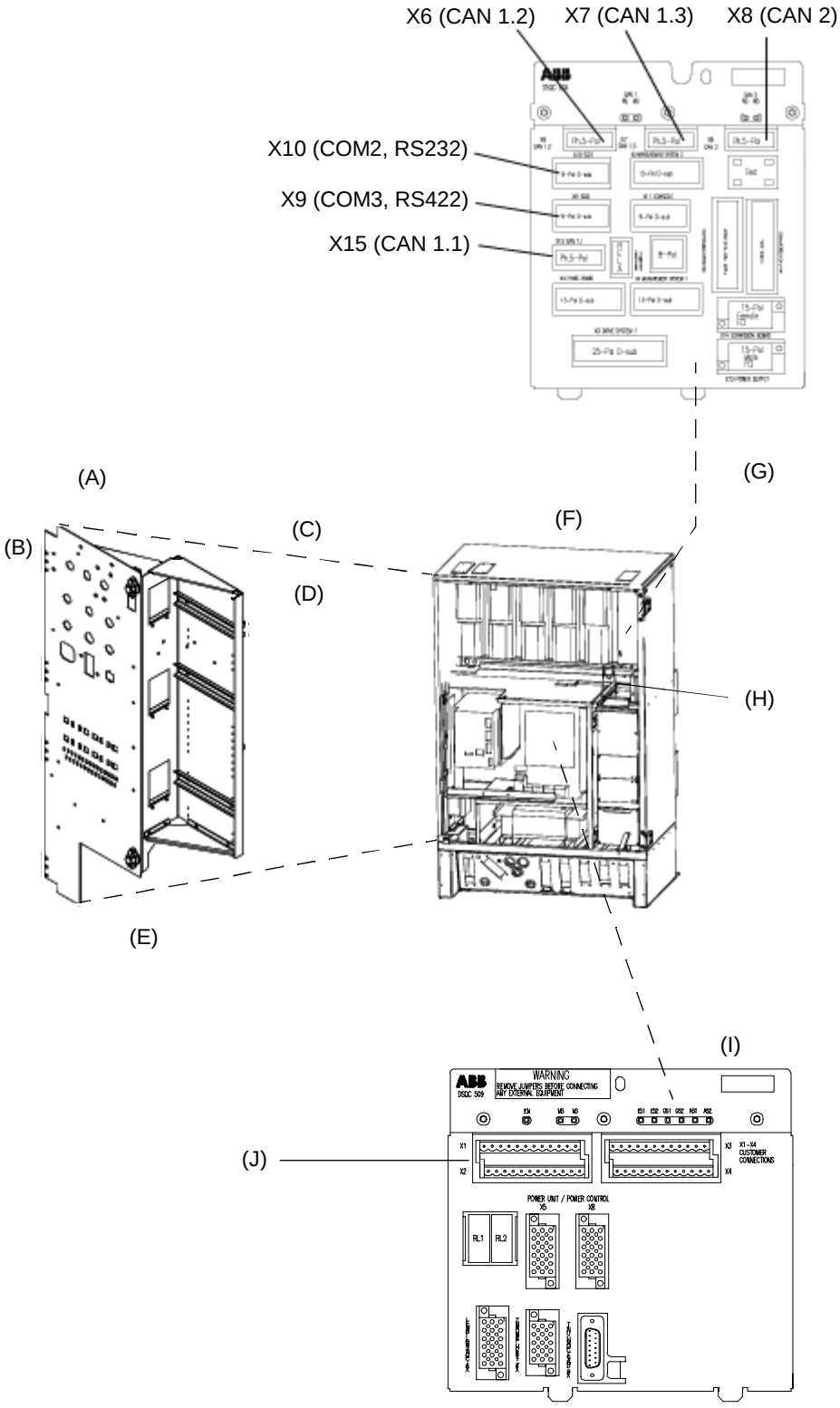

Figure 18 Location of I/O units and terminals

2.3.1 Introduction

Pos	Description
A	Internal swing-out door.
B	Service outlet.
C	I/O unit 4 and I/O unit 3.
D	I/O unit 1 and I/O unit 2.
E	Cable customer connections inside swing-out door X5, X6 and X8.
F	Cabinet inside view (door removed).
G	Base Connector unit A82 inside right wall.
H	Computer system COM1, RS232.
I	Panel unit.
J	X1 - X4 Safety system.

Inputs/outputs

Option	Feature	Inputs/outputs
61-1	Digital 24 VDC I/O	16 inputs/16 outputs
54-1	Analog I/O	4 inputs/4outputs
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

Option	Connection	Description
191-3	Internal connection	(option 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 of the cabinet (see).

Safety signals

Option	Connection	Description
309-3	Internal connection	The signals are connected directly to screw terminals (see Figure 19)
309-2	External connection	The signals are connected via a 12-pole Jaeger connector at the lower part of the cabinet. (Requires option 126-1)

Option	Connection	Description
309-4	External industrial connector	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

Option	Feature
126-1	LAN/Ethernet An industrial RJ45 connector to be used for Local Area Network.
250-1	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.

Option	Variants of Interbus Master/Slave
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.

Buscable bushing

Option	Description
482-1	The buscable bushing is needed for internal cabling (i.e. option 177-4)

Gateway units

For more details see *I/O System* on page 33.

Option		Description
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 19). 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 540, is the function whereby the robot 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 19). A screw connector is included. This option is also required for the function Sensor Synch, RobotWare option 547.
152-1	FIP I/O	This option means that I/O position I/O 1 is reserved for a customer supplied FIP unit.

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 18 and Figure 19) 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 19 and Figure 20.

For more details, see *I/O System* on page 33.

Option	Description
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 V DC: 16 inputs/ 16 outputs
138-1	Digital I/O with relay outputs: 16 inputs/ 16 outputs

External gateway units

Option	Description
131-1	Allen Bradley Remote I/O
142-1	Interbus Slave
144-1	Profibus DP Slave
134-1	Encoder interface unit DSQC 354 for conveyor tracking

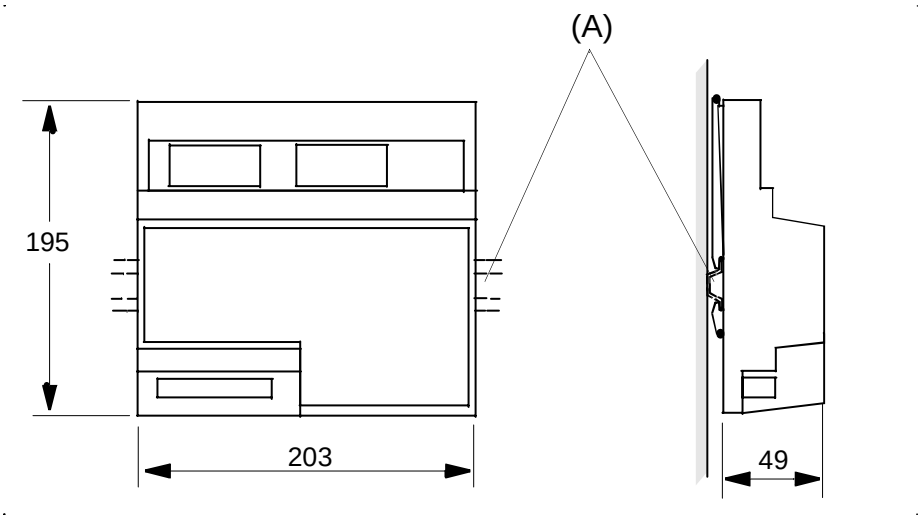

Figure 19 Dimensions for units 221-223.

Pos	Description
A	EN 50022 mounting rail.

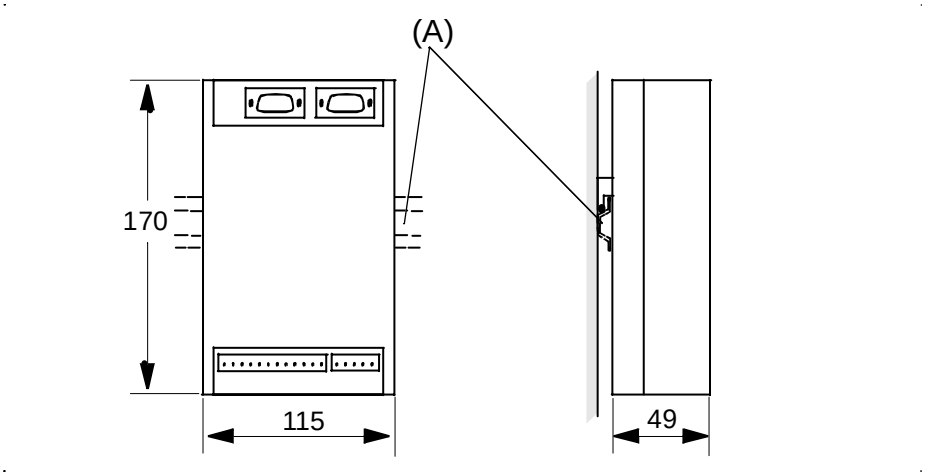

Figure 20 Dimension for units 231-234.

Pos	Description
A	EN 50022 mounting rail.

External axes in robot cabinet

It is possible to equip the controller with one drive module for external axes. The motors are connected to industrial modular connectors in the lower part of the cabinet.

For 7 axes systems (one external), the basic axis computer will handle all axes.
For 8 axes systems (two external), one additional axis computer is supplied.

Available combinations

The following combinations are available (one letter = 7 axes system).

Option	Combination	Robot
52-13	Drive unit V	IRB 6600/7600
52-14	Drive unit VW	IRB 6600/7600
52-12	Drive unit W	IRB 6600/7600
52-11	Drive unit T	IRB 140/1400/2400/4400
52-10	Drive unit GT	IRB 140/1400/2400/4400
52-9	Drive unit U	140/1400/2400
52-5	Prepared for Drive unit GU	140/1400/2400

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

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

Motor selection table

Motor types according to Product Specification Motor Unit.

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	MU 30
High	V	5.5-26	14.5	MU 20
Low	U	11-55	24	MU 30
Low	T	7.5-37	20	MU 30
Low	G	6-30	16	MU 20

Servo gun interface

323-1--6: For IRB 6600 and IRB 7600 only.

For further information see the Product Specification IRB 6600, Servo Gun (option) or IRB 7600, Servo Gun (option) overview and the Product specification RobotWare Options (function description).

Option	Description
323-5 Stationary Gun (SG)	The option adds a resolver cable to the manipulator cable option 476-1 (or 467-1) and a 7 m 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.
323-5 Stationary Gun (SG)	The cable between the controller DU 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 52-13 has to be selected.
323-1 Robot Gun (RG)	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 neccessary 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 52-13 (V) must be selected.

2.3.1 Introduction

Option	Description
323-3 One SG and one RG	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 52-14 (VW) must be selected.
323-6 Twin SG	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 52-14 (VW) must be selected.
323-4 SG and Track Motion (T)	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 52-14 (VW) must be selected.

Option	Description
323-2 RG and T	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 52-14 (VW) has to be selected.

External axes measurement board

The resolvers can be connected to a serial measurement board outside the controller (not together with Servo Gun options).

Option	Description
317-2	Serial measurement board as separate unit

Equipment

Option	Version	Description
212-2	Standard	Manipulator cable, external connectors

Option	Cable length
210-2	7m
210-3	15 m
210-4	22 m
210-5	30 m

Service outlet

A standard outlet 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).

Option	Description
328-1	230 V mains outlet in accordance with DIN VDE 0620; single socket suitable for EU countries. Does not comply with UL and UR safety standards.

2.3.1 Introduction

Power supply

Option	Description
331-3	Power supply to the service outlet. Connection from the main transformer. The voltage is switched on/off by the mains switch on the front of the cabinet

Removable mass memory

Option	Description
215-1 Floppy drive	The disk drive normally works well at temperatures up to 40^{o}C (104^{o}F). 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.
581-1 USB Flash Disc Interface	An external connector located together with the standard Ethernet service port. Following USB Flash Disk types are verified: SanDisk 512Mb Iomega 128 Mb Kingston 256 Mb Pen Drive 256 Mb

Extended mass memory

Option	Description
140-1	Flash disc 128 Mb. The standard unit is 64 Mb.

3HAC 17710-1, Revision 3, en

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