



Product specification

Articulated robot

IRB 1400
IRB 1400 - CR
IRB 1400 - H
M2004, M2000



Product specification

Articulated robot

3HAC 9376-1

Rev.E

IRB 1400

IRB 1400 - CR

IRB 1400 - H

M2004/M2000

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1 Description

1.1 Structure

1.1.1 Introduction

General

IRB 1400 is a 6-axis industrial robot, designed specifically for manufacturing industries that use flexible robot-based automation. The robot has an open structure that is specially adapted for flexible use, and can communicate extensively with external systems.

Clean Room robot

The Clean Room robot is classified for clean room class 100 according to US Federal Standard 209 or class 5 according to ISO 14644-1.

The robot is equipped with the IRC5 controller and robot control software, RobotWare for M2004 and with the S4Cplus controller and robot control software BaseWare OS for M2000. RobotWare and BaseWare OS supports every aspect of the robot system, such as motion control, development and execution of application programs, communication etc. See Product specification - Controller IRC5 with FlexPendant for M2004 and Product specification - Controller S4Cplus for M2000. Safety standards require a controller to be connected to the robot.

For additional functionality, the robot can be equipped with optional software for application support - for example gluing and arc welding, communication features - network communication - and advanced functions such as multitasking, sensor control etc. For a complete description of optional software, see the Product specification - Controller software/RobotWare Options.

Manipulator axes

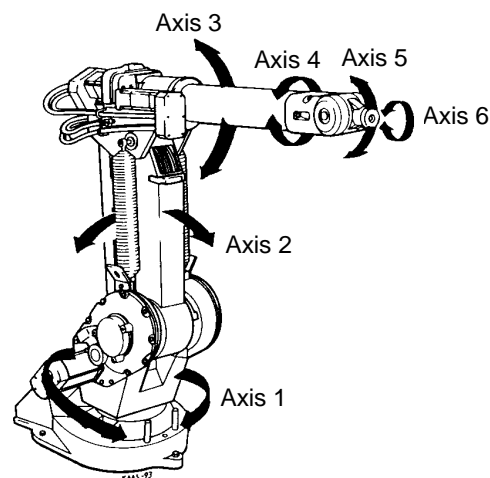


Figure 1 The IRB 1400 manipulator has 6 axes.

1 Description

1.1.2 Different robot versions

1.1.2 Different robot versions

The IRB 1400 is available in three different versions:

Robot version	Description
IRB 1400	for floor mounting
IRB 1400CR	for clean room installation
IRB 1400H	for inverted mounting

Weight

Robot	Weight
Manipulator	225 kg

Other technical data

Data	Description	Value
Airborne noise level	The sound pressure level outside the working space	< 70 dB (A) Leq (acc. to Machinery directive 89/392 EEC)

Power consumption

Path E1-E2-E3-E4 in the ISO Cube, maximum load.

Speed [mm/s]	Power consumption [kW]
Max.	0.44
1000	0.39
500	0.36
100	0.34

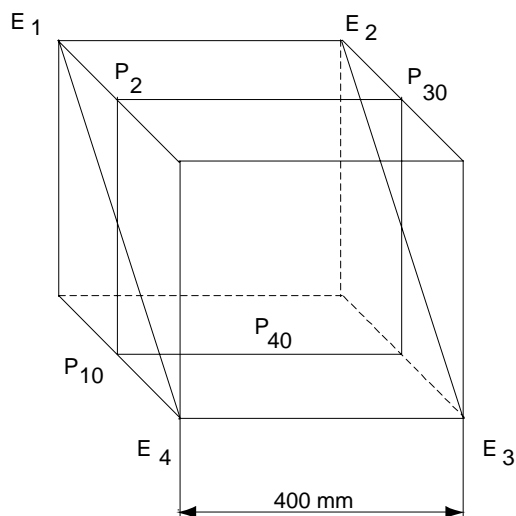


Figure 2 Path E1-E2-E3-E4 in the ISO Cube, maximum load

Dimensions IRB 1400, IRB 1400CR

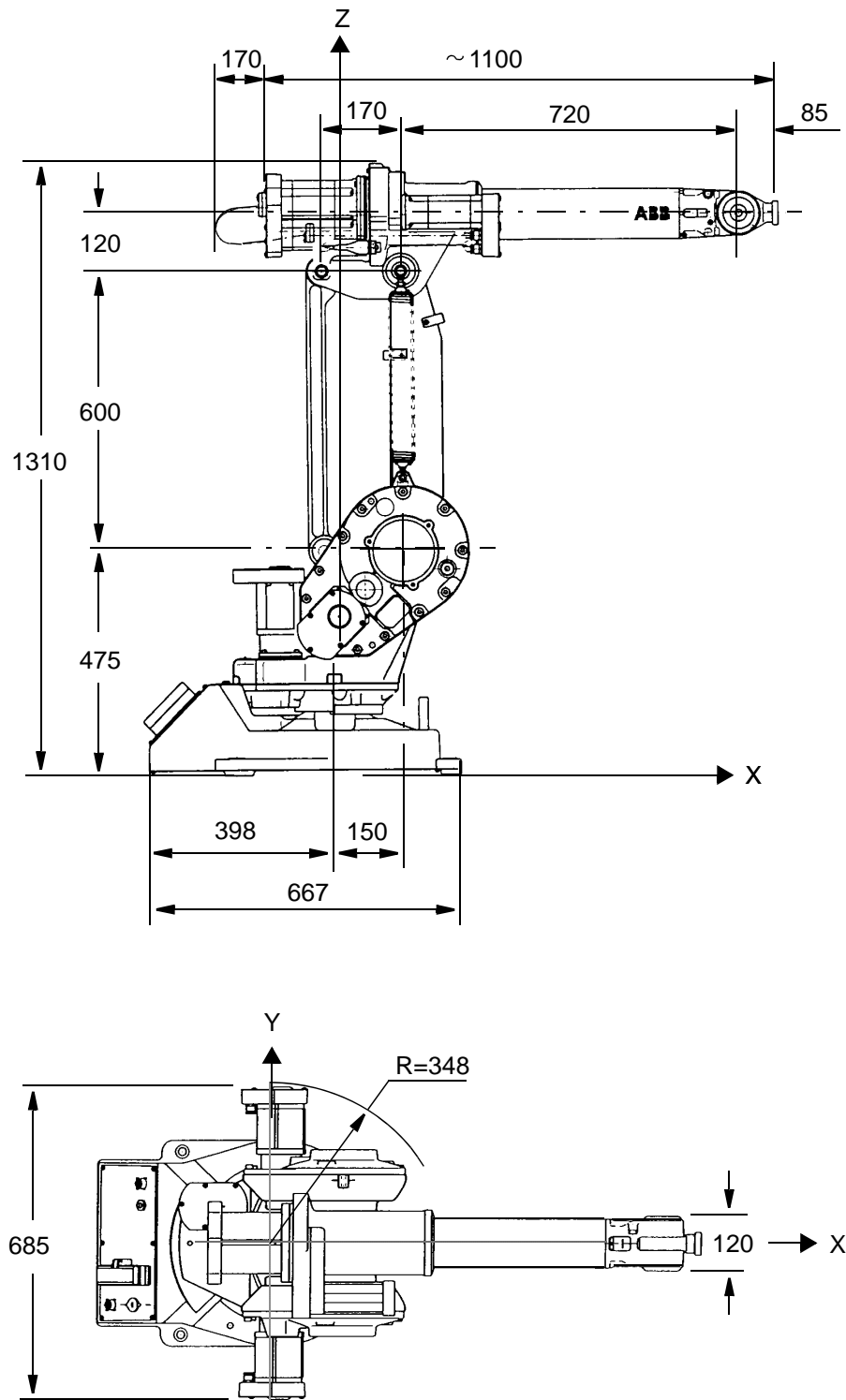


Figure 3 View of the manipulator (floor mounted version) from the side and above(dimensions in mm).

1 Description

1.1.2 Different robot versions

Dimensions IRB 1400H

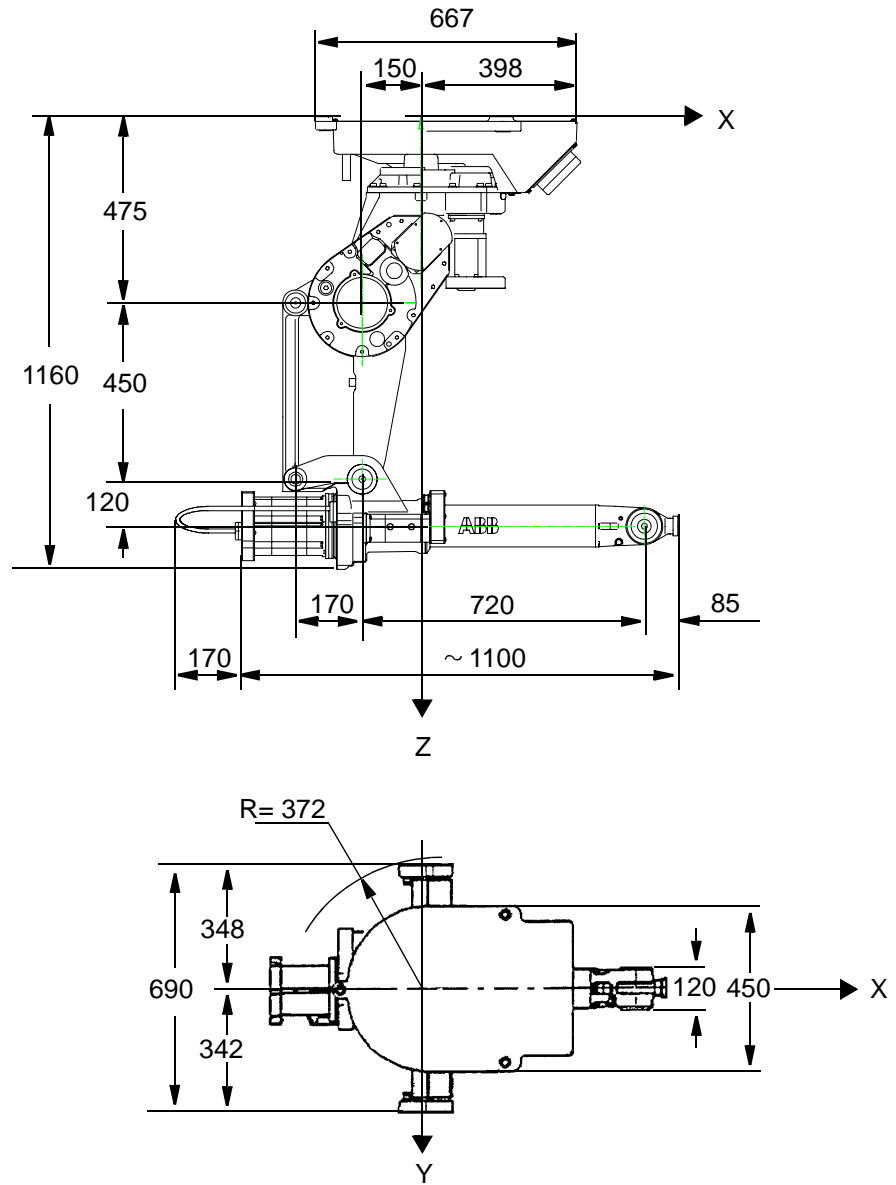


Figure 4 View of the manipulator (inverted mounted version) from the side and above (dimensions in mm).

1.2 Safety/Standards

1.2.1 Standards

The robot conforms to the following standards:

Standards	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 60204	Electrical equipment of industrial machines
EN 61000-6-4 (option)	EMC, Generic emission
EN 61000-6-2	EMC, Generic immunity
EN 775	Manipulating industrial robots, safety

Standards	Description
IEC 60204-1	Electrical equipment of industrial machines
IEC 60529	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 R15.06/ 1999 (option)	Safety requirements for industrial robots and Robot Systems
ANSI/UL 1740-1998 (option)	Safety Standard for Robots and Robotic Equipment
CAN/CSA Z 434-03 (option)	Industrial Robots and Robot Systems - General Safety Requirements

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

1 Description

1.2.2 Safety

1.2.2 Safety

The robot 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 inches/min.). A speed limitation applies not only to the TCP (Tool Center Point), but to all parts of the robot. It is also possible to monitor the speed of equipment mounted on the robot.

Three position enabling device

The enabling device on the 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 robot 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 normal program stop with no deviation from the programmed path. After approx. one second the power supplied to the motors shuts off.

Restricting the working space

The movement of each of the axes can be restricted using software limits.

Axes 1, 2 and 3 can also be restricted by means of an adjustable mechanical stop (option).

Hold-to-run control

“Hold-to-run” means that you must depress the start button in order to move the robot. When the key 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 Laboratories) tough requirements for fire safety.

Safety lamp (option)

The robot can be equipped with a safety lamp mounted on the manipulator. This is activated when the motors are in the MOTORS ON state.

1 Description

1.3.1 Introduction

1.3 Installation

1.3.1 Introduction

General

There are two versions of IRB 1400, one for floor mounting and one for inverted mounting. An end effector, weighing a maximum of 5 kg, including payload, can be mounted on the robot's mounting flange (axis 6). Other equipment, weighing a maximum of 18 kg, can be mounted on the rear of the upper arm.

1.3.2 Operating requirements

Protection standards

IEC529

Clean room standards

Clean room manipulaor: US Federal Standard 209, class 100 and ISO14644-1. class 5

Explosive environments

The robot must not be located or operated in an explosive environment.

Ambient temperature

Description	Temperature
Manipulator during operation	+5°C (+41°F) to +45°C (+113°F)
Complete robot during transportation and storage	-25°C (-13°F) to +55°C (+131°F)
Complete robot during transportation and storage, for short periods (not exceeding 24 hours)	up to +70°C (+158°F)

Relative humidity

Description	Relative humidity
Complete robot during transportation and storage	Max. 95% at constant temperature
Complete robot during operation	Max. 95% at constant temperature

1.3.3 Mounting the manipulator

Maximum load in relation to the base coordinate system.

	Endurance load in operation	Max. load at emergency stop
Force xy	± 1500 N	± 2000 N
Force z (floor mounting)	+2800 ± 500 N	+2800 ± 700 N
Force z (inverted mounting)	- 2800 ± 800 N	-2800 ± 1000 N
Torque xy	± 1800 Nm	± 2000 Nm
Torque z	± 400 Nm	± 500 Nm

Illustration

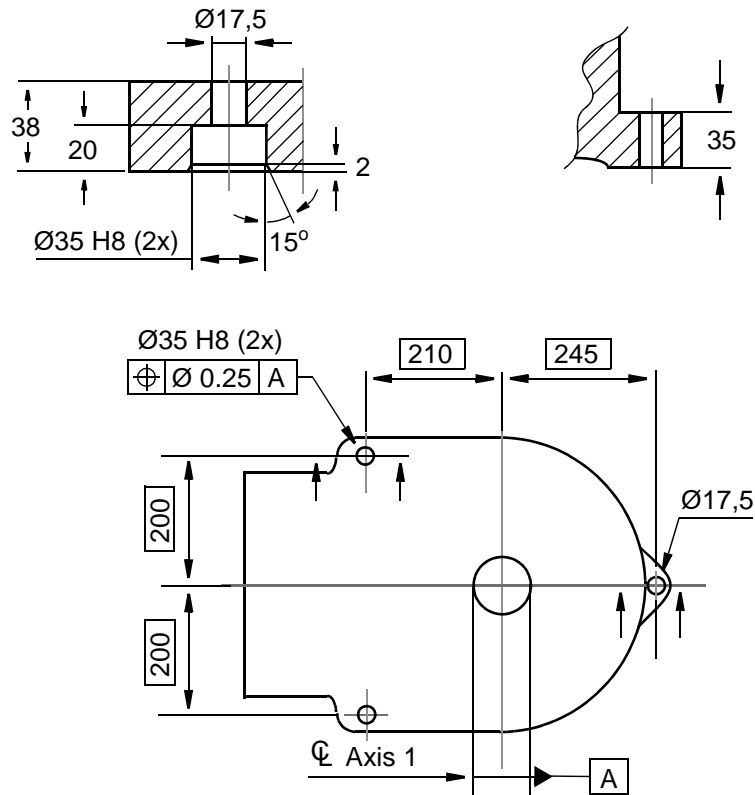
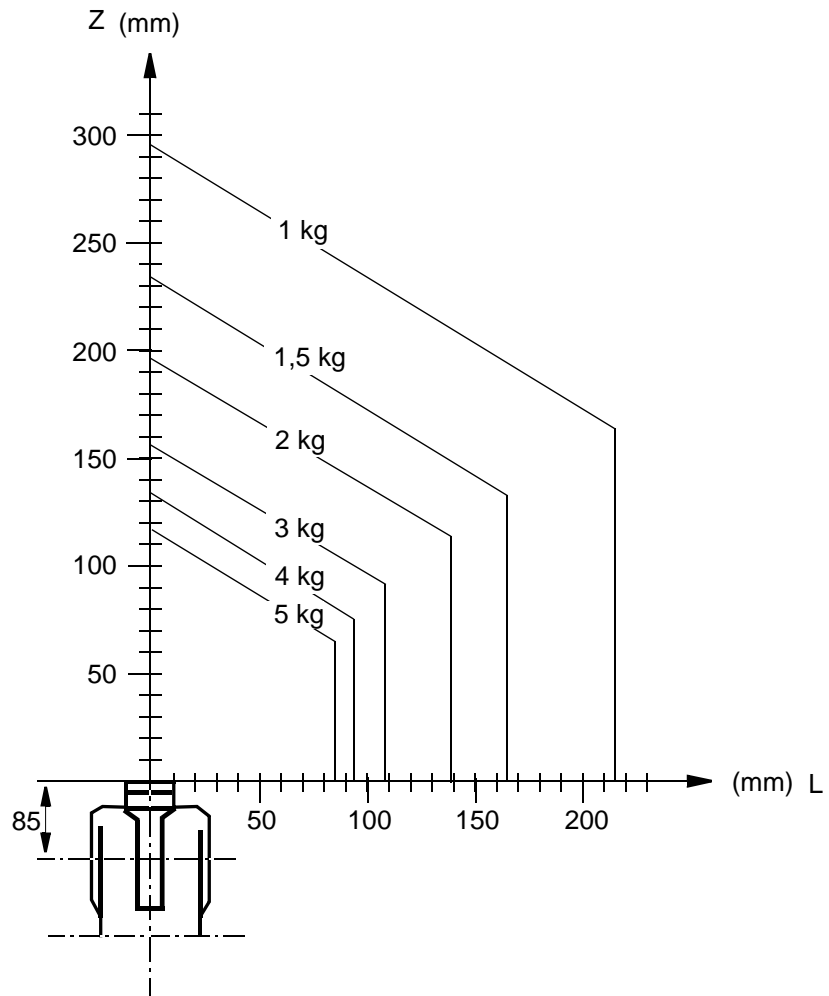


Figure 5 Hole configuration (dimensions in mm).

1 Description

1.3.4 Load diagram

1.3.4 Load diagram



Z= see the above diagram and the coordinate system in Product Specification S4Cplus

L= distance in X- Y plane from Z-axis to the center of gravity

J= max. 0.012 kgm²

J= own moment of inertia, of the total handling weight

Figure 6 Maximum allowed weight for tool mounted on the mounting flange at different positions (center of gravity).

1.3.5 Mounting of equipment

IRB 1400

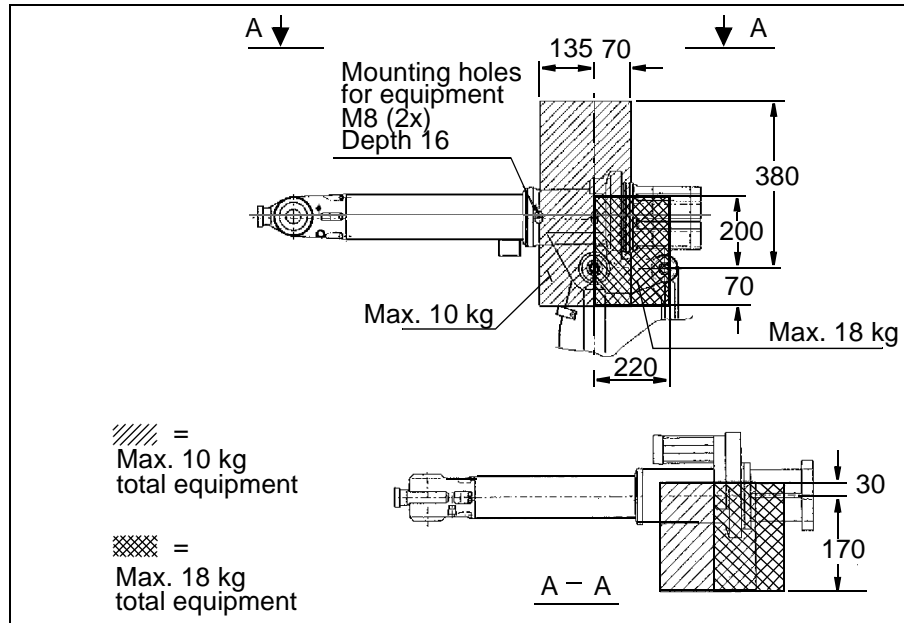


Figure 7 The shaded area indicates the permitted position (center of gravity) for any extra equipment mounted on the upper arm (dimensions in mm).

IRB 1400H

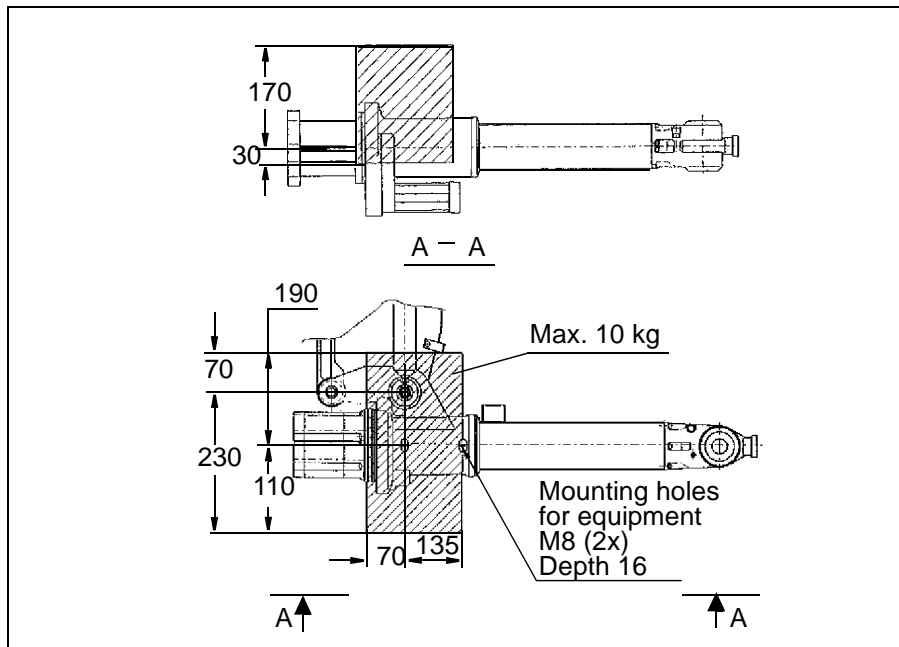


Figure 8 The shaded area indicates the permitted position (center of gravity) for any extra equipment mounted on the upper arm (dimensions in mm).

1 Description

1.3.5 Mounting of equipment

Mounting holes for equipment

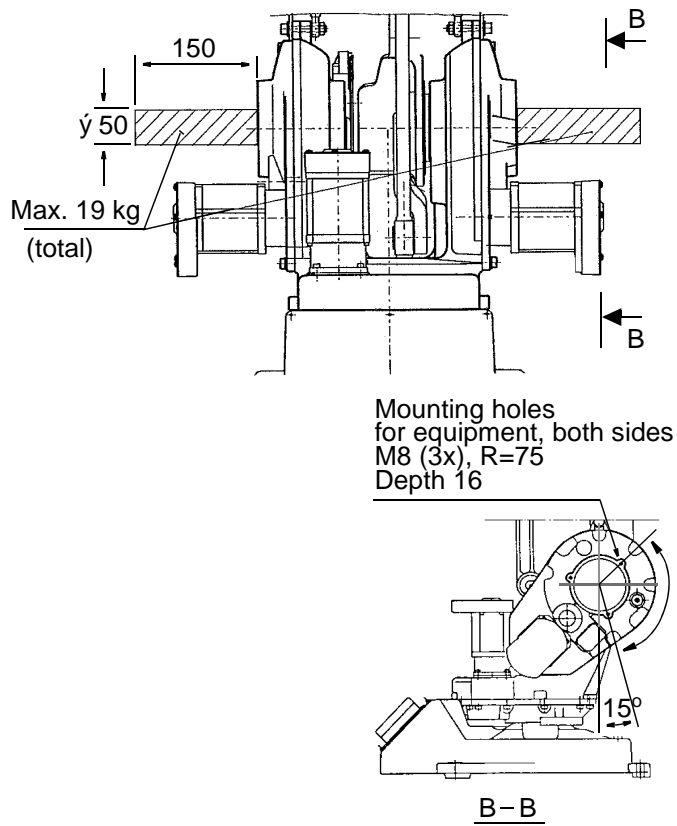


Figure 9 The shaded area indicates the permitted position (center of gravity) for any extra equipment mounted on the frame (dimensions in mm).

Tool flange

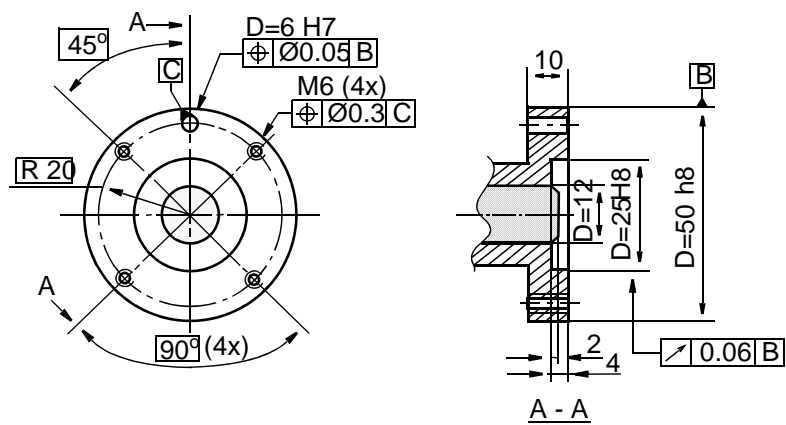


Figure 10 The mechanical interface, mounting flange (dimensions in mm).

1.4 Maintenance and Troubleshooting

1.4.1 Introduction

General

The robot requires only a minimum of maintenance during operation. It has been designed to make it as easy to service as possible:

- Maintenance-free AC motors are used.
- Oil and grease are used for the gear boxes.
- The cabling is routed for longevity, and in the unlikely event of a failure, its modular design makes it easy to change.

Maintenance

The following maintenance is required:

- Lubricating spring brackets every six months.
- Changing filter for the transformer/drive unit cooling every year.
- Greasing axes 5 and 6 every year.
- Changing batteries every third year.

The maintenance intervals depend on the use of the robot. For detailed information on maintenance procedures, see Maintenance section in the Product manual.

1 Description

1.5.1 Introduction

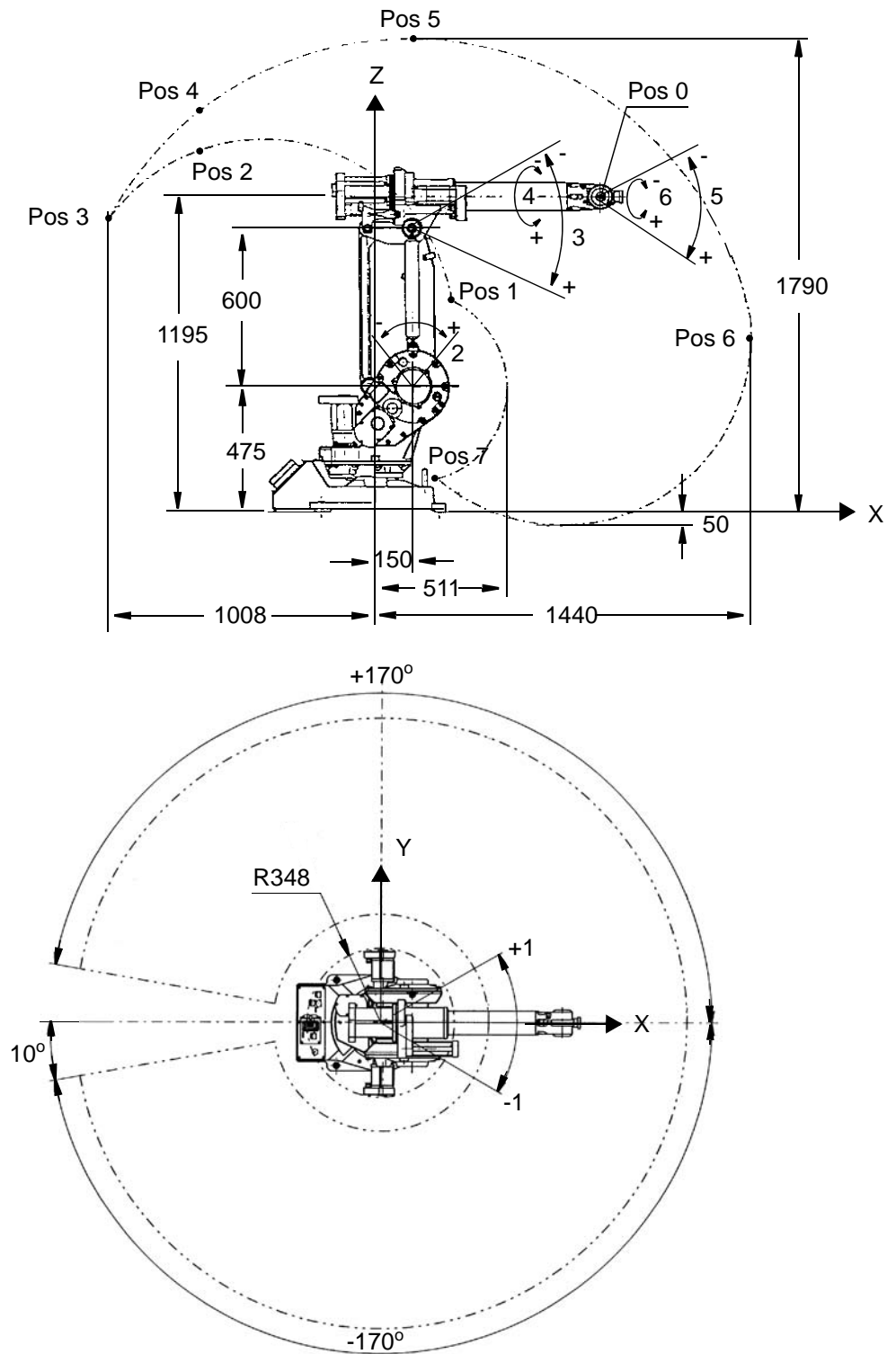
1.5 Robot Motion

1.5.1 Introduction

IRB 1400

Extreme positions of the robot arm.

Type of motion	Range of movement
Axis 1 Rotation motion	+170° to -170°
Axis 2 Arm motion	+70° to -70°
Axis 3 Arm motion	+70° to -65°
Axis 4 Wrist motion	+150°to -150°
Axis 5 Bend motion	+115° to -115°
Axis 6 Turn motion	+300° to -300°



For Positions at wrist center and Angle see the table on the next page.

Figure 11 The extreme positions of the robot arm.

1 Description

1.5.1 Introduction

Positions at wrist center (mm) and Angle (degrees) Positions 0 to 7:

Position no (see Figure 11)	Position (mm) X	Position (mm) Z	Angle (degrees) Axis 2	Angle (degrees) Axis 3
0	870	1195	0	0
1	306	800	-70	+70
2	-716	1345	-70	-35
3	-1008	1104	-70	-65
4	-596	1561	-43	-65
5	208	1792	-6	-65
6	1442	737	+70	-65
7	239	125	+70	+70

IRB 1400H

Extreme positions of the robot arm, inverted version.

Type of motion	Range of movement
Axis 1 Rotation motion	+170° to -170°
Axis 2 Arm motion	+20° to -100°
Axis 3 Arm motion	+70° to -65°
Axis 4 Wrist motion	+150° to -150°
Axis 5 Bend motion	+115° to -115°
Axis 6 Turn motion	+300° to -300°

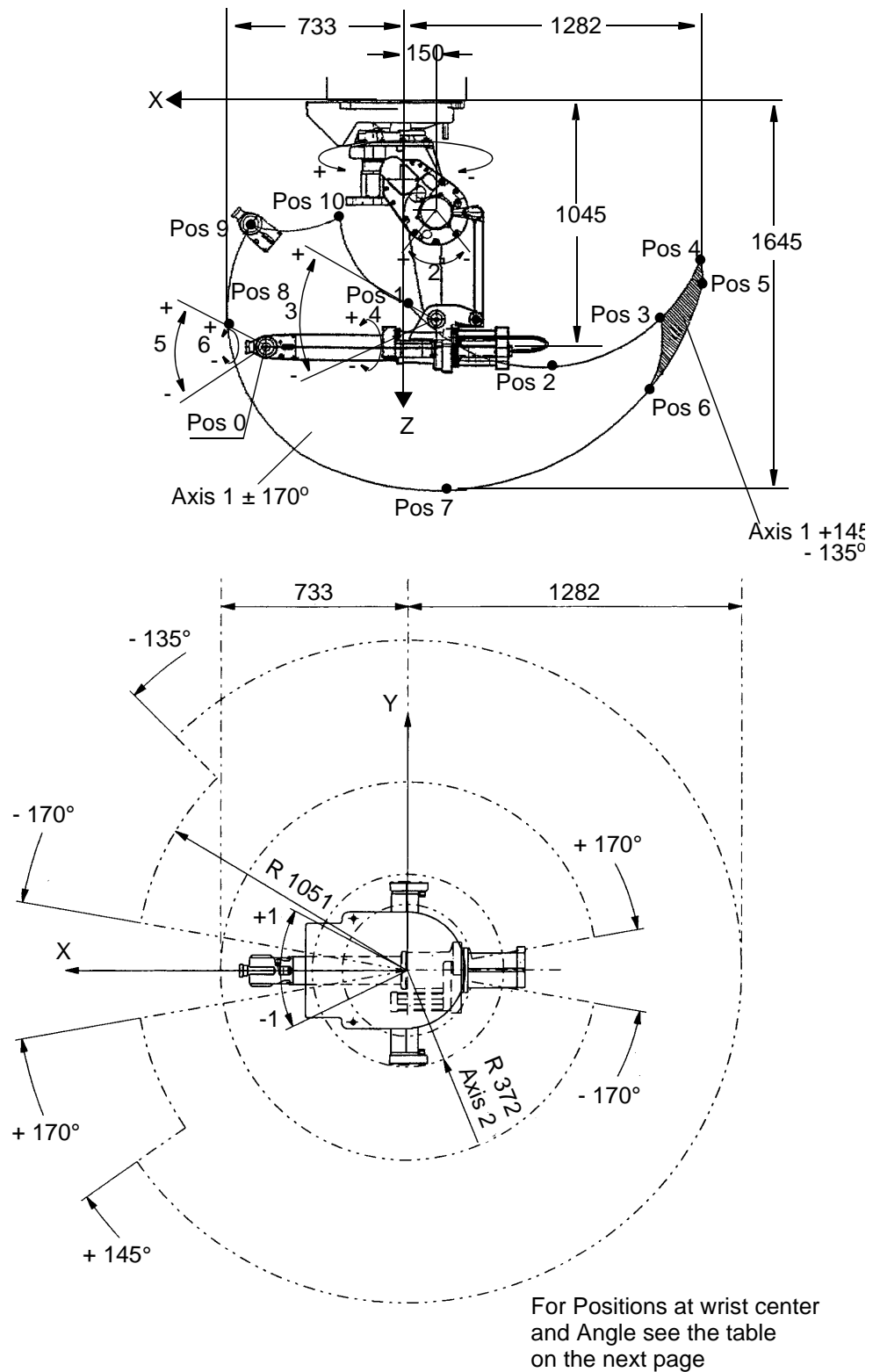


Figure 12 The extreme positions of the robot arm, inverted version (dimensions in mm). Manipulator seen from the side and above.

1 Description

1.5.1 Introduction

Positions at wrist center (mm) and Angle (degrees) Positions 0 to 10.

Position no (see Figure 12)	Position (mm) X	Position (mm) Z	Angle (degrees) Axis 2	Angle (degrees) Axis 3
0	570	1045	0	0
1	-30	861	-100	+70
2	-586	1127	-100	+20
3	-1104	918	-100	-25
4	-1277	653	-100	-50
5	-1282	770	-85	-65
6	-1051	1221	-60	-65
7	-158	1645	-10	-65
8	734	891	+20	-10
9	633	527	+20	+20
10	254	494	-30	+70

1.5.2 Performance according to ISO 9283

General

At rated load and 1 m/s velocity on the inclined ISO test plane with all six robot axes in motion.

Unidirectional pose repeatability	RP = 0.05 mm
Linear path accuracy	AT = 0.45 - 1.0 mm
Linear path repeatability	RT = 0.14 - 0.25 mm
Minimum positioning time, to within 0.2 mm of the position	0.2 - 0.35 sec. (on 35 mm linear path) 0.45 - 0.6 sec. (on 350 mm linear path)

The above values are the range of average test-results from a number of robots.

1.5.3 Velocity

Axis no.	IRB 1400	IRB 1400H
1	120°/s	130°/s
2	120°/s	130°/s
3	120°/s	120°/s
4	280°/s	280°/s
5	280°/s	280°/s
6	280°/s	280°/s

Supervision is required to prevent overheating in applications with intensive and frequent movements.

Resolution

Approx. 0.01° on each axis.

1.5.4 Signals



For more information of air and signals for extra equipment to upper arm, see Application Interface in Chapter 2 Specification of Variants and Options .

1 Description

1.5.4 Signals

2 Specification of Variants and Options

2.1 Introduction

2.1.1 General

The different variants and options for the IRB 1400 are described below.

The same numbers are used here as in the Specification form.

For controller options, see Product specification - Controller IRC5 with FlexPendant for M2004 and Product specification - Controller S4Cplus for M2000, and for software options, see Product specification - Controller software/RobotWare Options.

2.1.2 Manipulator

Variants

Option	Robot type
435-3	IRB 1400
435-4	IRB 1400H

Mounting position

Option	Description
224-1	Floor mounted
224-2	Hanging

Manipulator color

Option	Description
209-1	The robot is painted in color ABB Orange.
209-2	The robot is painted in white color.
209-4-192	The manipulator is painted with the chosen RAL-color.

Protection

Option	Description
287-1	Clean Room Robot with clean room class 100 according to US Federal Standard 209. The robot is labeled with "Clean Room".

2 Specification of Variants and Options

2.1.3 Application interface

2.1.3 Application interface

Air supply and signals for extra equipment to upper arm

Option	Description
218-8	<p>Hose for compressed air is integrated into the manipulator. There is an inlet at the base and an outlet on the upper arm housing.</p> <p>Connections: R1/4" in the upper arm housing and at the base. Max. 8 bar.</p> <p>Inner hose diameter: 6.5 mm.</p> <p>For connection of extra equipment on the manipulator, there are cables integrated into the manipulator's cabling.</p> <p>Number of signals: 12 signals 49 V, 500 mA</p> <p>Connector on upper arm: FCI 12-pin UT0014-12SHT</p> <p>Connector on robot base: FCI 12-pin UT0014-12PHT</p>
218-3	<p>Control cabling to arc welding wire-feeder is integrated into the manipulator's cabling.</p> <p>Control signals:</p> <p>16 signals, 49 V, 500 mA</p> <p>Connector on upper arm housing: FCI 23-pin UTG 618-23PN</p> <p>Connector on robot base: FCI 23-pin socket UT001823SHT</p> <p><u>Power signals:</u></p> <p>12 signals, 300 V, 4 A</p> <p>Connector on upper arm housing: Burndy 12-pin socket UTG 614-12SN</p> <p>Connector on robot base: Burndy 12-pin UT001412PHT</p> <p>This option is not available for IRB 1400H and not together with 67A-D/671-674.</p>

Connection to manipulator or cabinet

Option	Description
16-2	<p>Manipulator</p> <p>The signals are connected directly to the manipulator base to one 12-pin Burndy connector, see option 041.</p>
16-1 ^a	<p>Cabinet</p> <p>The signals are connected to 12-pole screw terminals, Phoenix MSTB 2.5/12-ST-5.08, to the the controller.</p>

a. Note! In a M2004 MultiMove application additional robots have no Control Module. The screw terminals with internal cabling are then delivered separately to be mounted in the main robot Control Module or in another encapsulation, e.g. a PLC cabinet.

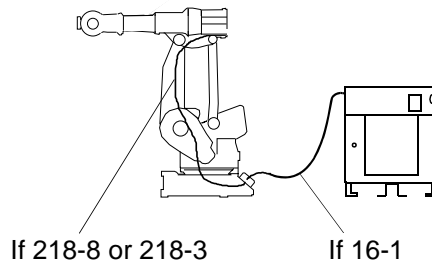


Figure 13

Connection to cabinet (cable length)

Option	Cable lengths
94-1	7m
94-2	15m
94-3	22m
94-4	30m

Safety lamp

Option	Description
213-1	<p>Safety lamp</p> <p>A safety lamp with an orange fixed light can be mounted on the manipulator.</p> <p>The lamp is active in MOTORS ON mode.</p> <p>The safety lamp is required on a UL/UR approved robot.</p>

Position switch

Switches indicating the position of axis 1. A design with two stationary switches is available. The switches are manufactured by Telemecanique and of type forced disconnect.

The two switches divide the working area of axis 1 into two fixed working zones, approx. 175° each. Together with external safety arrangement, this option allows access to one working zone at the same time as the robot is working in the other one.

Note that the switches are not recommended to be used in severe environments with sand or chips.



Option	Description
27-1	Two switches, axis 1 stationary

2 Specification of Variants and Options

2.1.3 Application interface

Connection to

Option	Description
271-2	Manipulator Connection on the manipulator base with one FCI 23-pin connector.
271-1	Cabinet Connection on the cabinet wall. Position switch cables are included. The signals are connected to 12-pole screw terminals, Phoenix MSTB 2.5/12-ST-5.08.

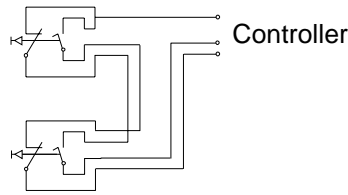


Figure 14 Connections of the signals

Cable lengths

Only together with option 271-1, connection to cabinet.

Option	Cable lengths
273-1	7m
273-2	15m
273-3	22m
273-4	30m

Connector kit

Detached connectors, suitable to the connectors for the application interface and position switches.

The kit consists of connectors, pins and sockets.

Option	Description
431-1	For the connectors on the upper arm of application interface, option 218-8.
239-1	For the connectors on the foot of connection to manipulator, option 16-2.
426-1	For connection to position switches and connection to manipulator, option 27-1 and option 271-2.

Working range limit

To increase the safety of the robot, the working range of axes 1, 2 and 3 can be restricted.

Option	Description
28-1	Axis 1 The working range of axis 1 can be limited. Using restriction stops, the working range can be limited from +150°/-150° to the smallest working range which is $\pm 50^\circ$. The restriction between 50° and 150° can be performed at any position by machining M10 holes and mounting the stops. The kit contains stops, screws and instructions.
32-1	Axis 2 By adding stop lugs, the working range of axis 2 can be restricted to +50° / -30° (for floor mounted version), -20° / -60° (for inverted mounted version).
34-1	Axis 3, Floor mounted (not 1400H) Axis 3 can be restricted so that it cannot move above the horizontal line, alternatively it can move a maximum of 10° above the horizontal line.

2 Specification of Variants and Options

2.1.3 Application interface

3 Accessories

General

There is a range of tools and equipment available, specially designed for the robot.

Basic software and software options for robot and PC

For more information, see Product specification - Controller IRC5 with FlexPendant for M2004 and Product specification - Controller S4Cplus for M2000, and Product specification - Controller software/RobotWare Options.

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