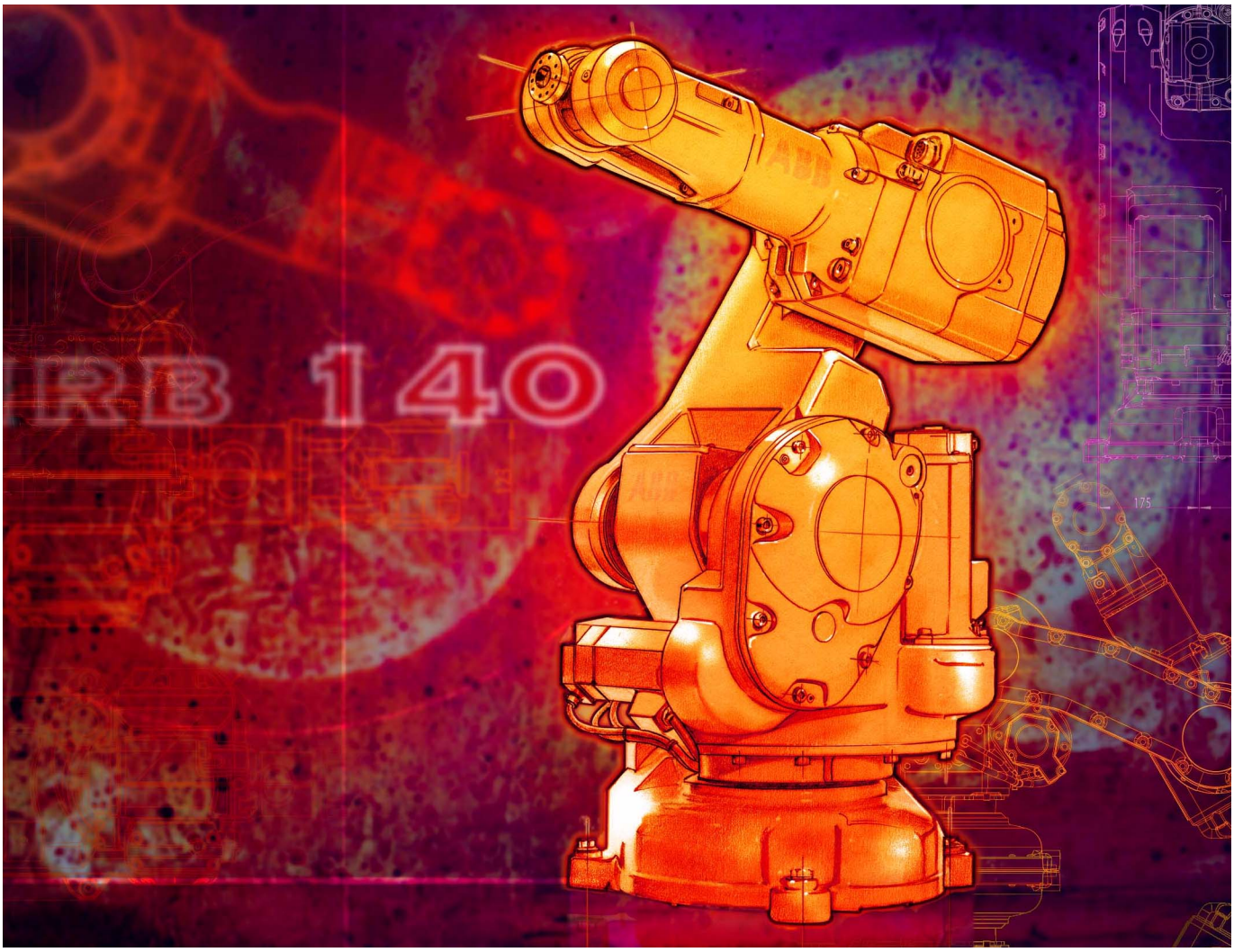
Product specification

Articulated robot

IRB 140
IRB 140 - F
IRB 140 - CW
IRB 140 - CR
M2004/M2000



Product specification

Articulated robot
3HAC 9041-1
Rev.6
IRB 140
IRB 140 - F
IRB 140 - CW
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M2004/M2000

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1 Description

1.1 Structure

1.1.1 Instruction

General

IRB 140 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.

Foundry and Wash robots

The robot versions Foundry and Wash are designed for harsh environments and have special surface treatment and paint for excellent corrosion protection. The connectors are designed for severe environment, and bearings, gears and other sensitive parts are high protected. The robots have the FoundryPlus protection which means that the whole manipulator is IP67 classified and steam washable.

Clean Room robots

The Clean Room robots are classified for clean room class 10 according to US Federal Standard 209 or class 4 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 och BaseWare OS supports every aspect of the robot system, such as motion control, development and execution of application programs, communication etc. See Product Specification IRC5 for M2004 and Product Specification 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 on optional software, see the Product Specification RobotWare Options.

1.1.1 Instruction

Manipulator axes

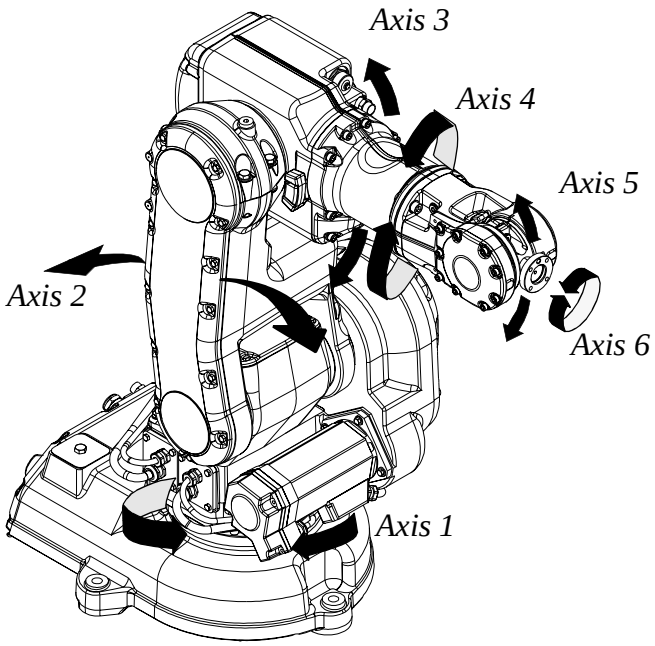


Figure 1 The IRB 140 manipulator has 6 axes.

1.1.2 Different robot versions

General

The IRB 140 is available in a number of different variants. They can all be mounted on floor, inverted or on wall in any angle. The high speed variant, IRB 140T, provides further reduced cycle time:

Environment adaption	Standard performance variants	High speed variants
Standard	IRB 140	IRB 140T
Foundry	IRB 140F	IRB 140TF
Wash	IRB 140CW	IRB 140TCW
Clean room	IRB 140CR	IRB 140TCR

Manipulator Weight

Data	Description
Manipulator	98 kg (excluding the cables to the controller)

Other technical data

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

Power consumption

Path E-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

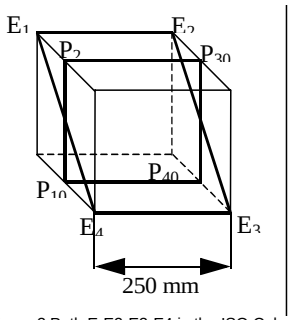


Figure 2 Path E-E2-E3-E4 in the ISO Cube, maximum load

Dimensions
IRB 140

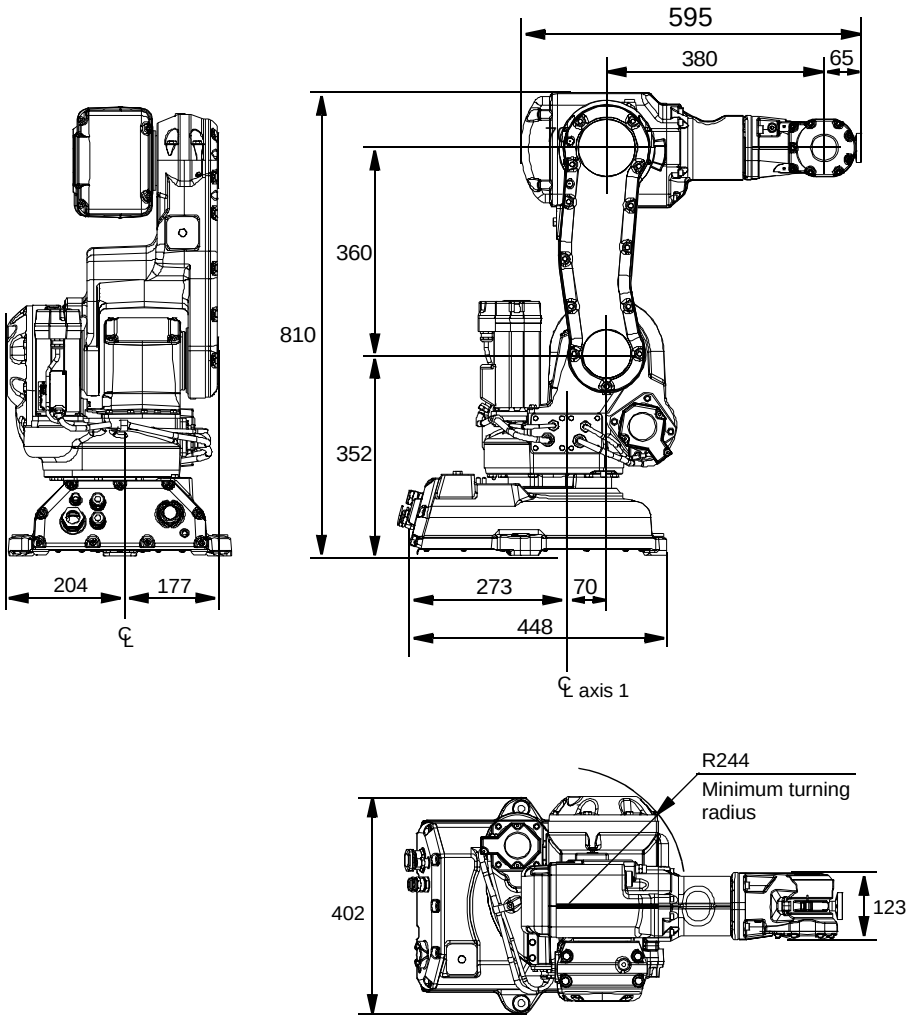


Figure 3 View of the manipulator from the back, side and above (dimensions in mm).

1.2 Safety/Standards

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 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

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

Standard	Description
ISO 10218	Manipulating industrial robots, safety
ISO 9787	Manipulating industrial robots, coordinate systems and motions
ISO 9409-1	Manipulating industrial robots, mechanical interface

Standard	Description
ANSI/RIA R15.06/1999 (option)	Safety Requirements for Industrial Robots and Robot Systems
ANSI/UL 1740-1998 (option)	Safety Standard for Industrial Robots and Robotic Equipment
CAN/CSA Z 43403 (option)	Industrial Robots and Robot Systems - General Safety Requirements
US Federal Standard 209	Clean room classification

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

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 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 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.

Collision detection (option)

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

Restricting the working space

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

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.

1.3 Installation

1.3.1 Introduction

General

IRB 140 is available in four different environmental adapted variants, one for normal industrial environment, one for foundry, one for other harsh environment, and one for clean room environment. 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 1,5 kg, can be mounted on the upper arm.

For more information about mounting of extra equipment, see Figure 7 .

1.3.2 Operating requirements

Robot version/ Protection standard	IEC529
All variants, manipulator	IP67

Steam washable

Foundry and Wash version

Clean room standards

Clean room manipulator US Federal Standard 209, class 10 or ISO 14644-1 class 4.

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)
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

Mounting the manipulator

Maximum load in relation to the base coordinate system. See Figure 4:

	Data	Endurance load in operation	Max. load at emergency stop
Force xy	floor suspended wall	± 1300N ± 1300N ± 2200N	± 3200N ± 3200N ± 3900N
Force z	floor suspended wall	-1000 ± 1000N +1000 ±1 000N ± 1000N	-1000 ± 2000N +1000 ± 2000N ± 2200N
Torque Mxy		± 1300Nm	± 2200Nm
Torque Mz		± 300Nm	± 750Nm

Illustration

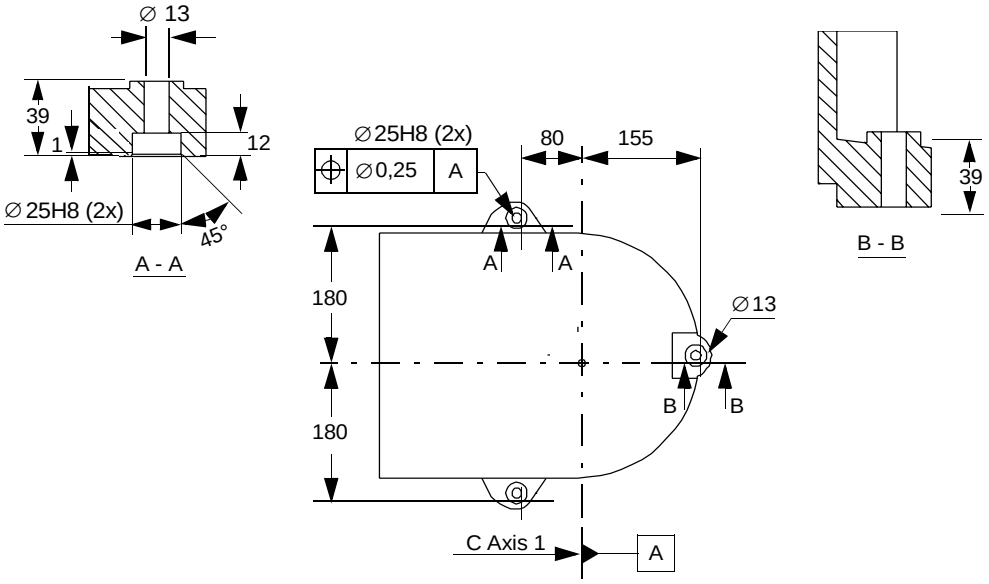
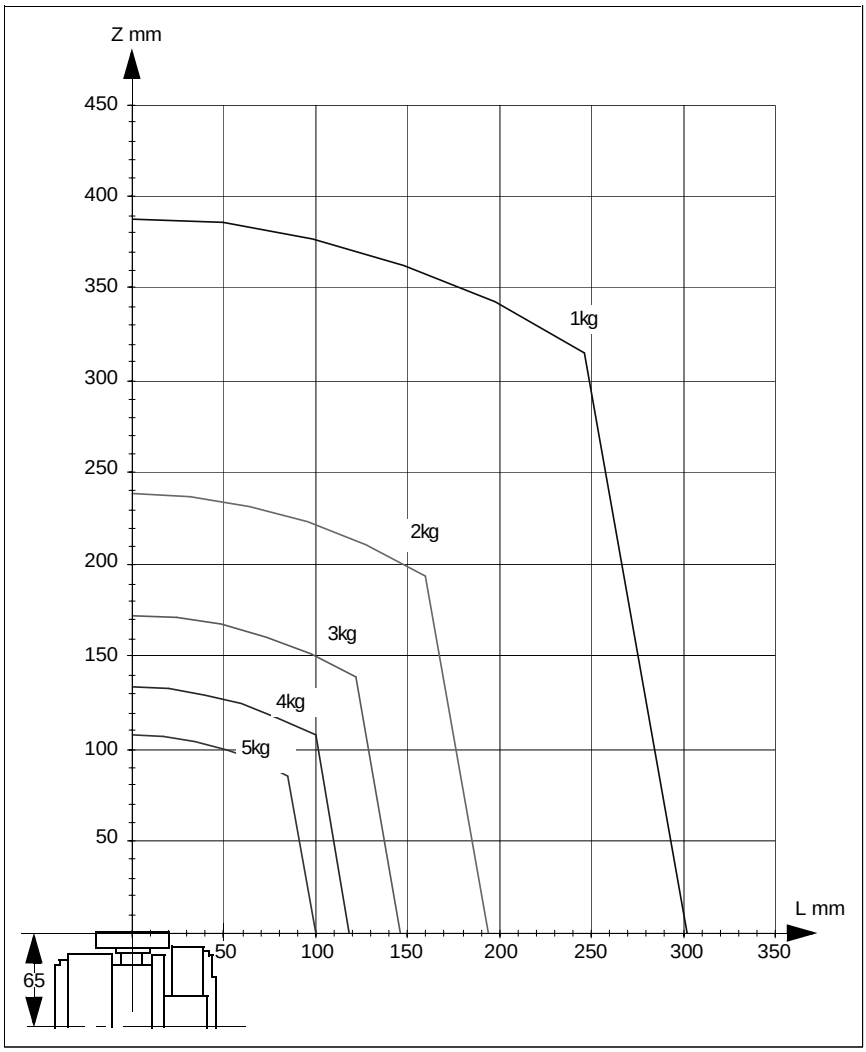


Figure 4 Hole configuration (dimensions in mm).

1.3.3 Load diagram

IRB 140

The robot is optimized for the rated load according to the load diagram and rated moment of inertia. These have been used in the performance tests. The maximum allowed load and moment of inertia are received from the formulas in Figure 6.



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

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

J_0 = rated own moment of inertia on the total handle weight = 0.012kgm^2

Figure 5 Rated weight for tool mounted on the mounting flange at different positions (center of gravity).

Definitions

Mass	kg
Length (Z, L)	m
T	Nm
J	kgm^2

Mass ≤ 5 Kg

Axis 5

Load	Description
Maximum static load	$T5 = 9.81 \bullet Mass \bullet \sqrt{(Z+0.065)^2 + L^2} \leq 8.5$ Nm
	$T5i = 9.81 \bullet Mass \bullet (Z + 0.065 + L/1.04) \leq 11.4$ Nm
Maximum dynamic load	$J5 = Mass \bullet ((Z+0.065)^2 + L^2) + \max(J_{0L}) \leq 0.35$ kgm^2

Axis 6

Load	Description
Maximum static load	$T6 = 9.81 \bullet Mass \bullet L \leq 4.9$ Nm
Maximum dynamic load	$J6 = Mass \bullet L^2 + J_{0Z} \leq 0.24$ kgm^2

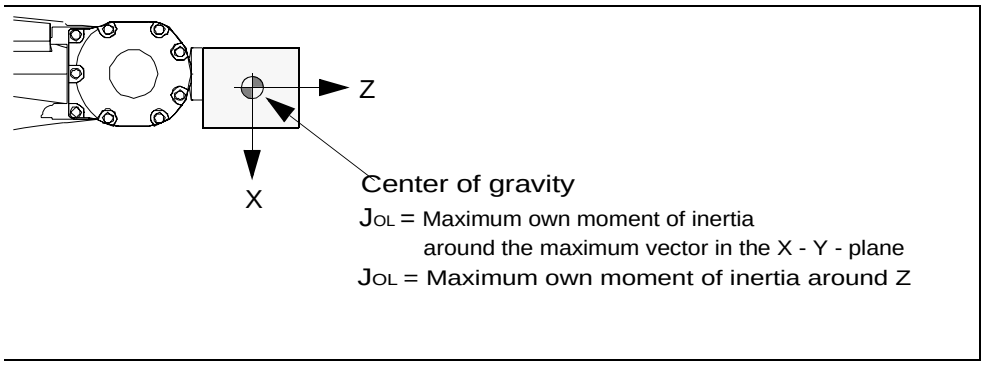


Figure 6 Own moment of inertia.

1.3.3 Load diagram

Mounting of equipment

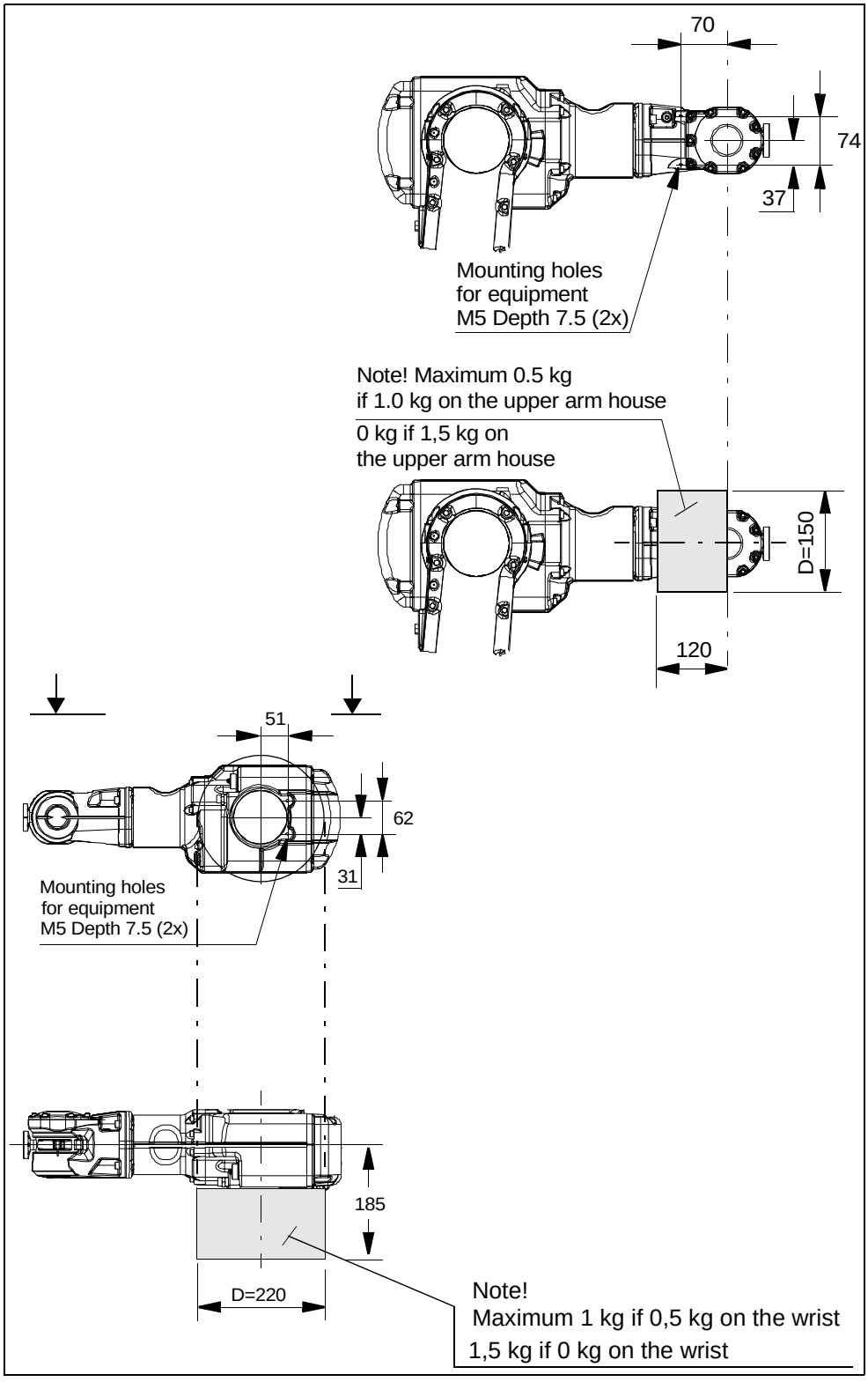


Figure 7 The shaded area indicates the permitted position of the center of gravity for any extra equipment mounted (dimensions in mm).

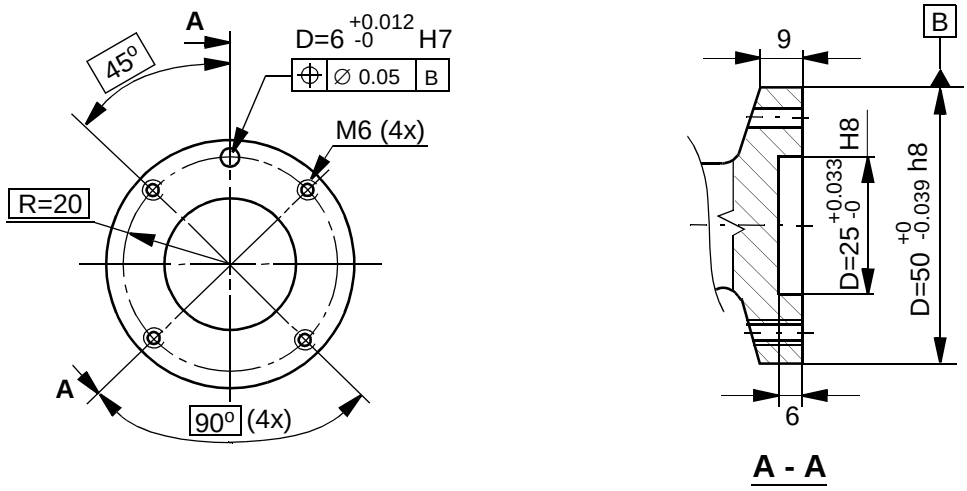


Figure 8 The mechanical interface, mounting flange (dimensions in mm).

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 is used for all gear boxes.
- The cabling is routed for longevity, and in the unlikely event of a failure, its modular design makes it easy to change.
- It has a program memory “battery low” alarm.

Maintenance

The following maintenance is required:

- Changing batteries every third year.

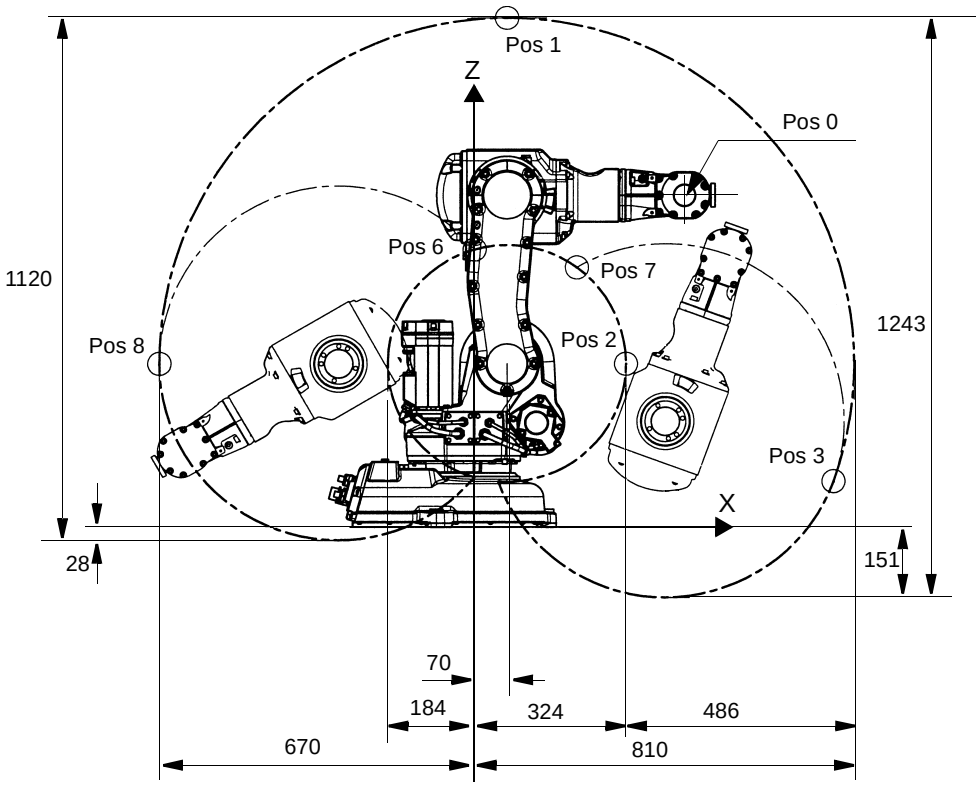
The maintenance intervals depends on the use of the robot. For detailed information on maintenance procedures, see Maintenance section in the Product Manual.

1.5 Robot Motion

1.5.1 Introduction

Type of motion	Range of movement
Axis 1: Rotation motion	+180° to - 80°
Axis 2: Arm motion	+110° to -90°
Axis 3: Arm motion	+50° to -230°
Axis 4: Wrist motion	+200° to +200° Default +165 revolutions to -165 revolutions Max**)
Axis 5: Bend motion	+120° to -120°
Axis 6: Turn motion	+400° to -400° Default +163 revolutions to -163 revolutions Max**)

**)Option. The default working range for axis 4 and axis 6 can be extended by changing parameter values in the software



Positions at wrist center (mm) and Angle (degrees)
see the table on the next page

Figure 9 The extreme positions of the robot arm.

Positions at wrist center (mm) and Angle (degrees) for IRB 140:

Position no (see Figure 9)	Position (mm) X	Position (mm) Z	Angle (degrees) Axis 2	Angle (degrees) Axis 3
0	450	712	0	0
1	70	1092	0	-90
2	314	421	0	+50
3	765	99	110	-90
6	1	596	-90	+50
7	218	558	110	-230
8	-670	352	-90	-90

1.6 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.

Description	Values
Unidirectional pose repeatability	RP = 0.03 mm
Linear path accuracy	AT = 1.0 mm
Linear path repeatability	RT = 0.15 mm
Minimum positioning time, to within 0.5 mm of the position	0.2 sec. (on 35 mm linear path)

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

1.7 Velocity

Axis no.	IRB 140	IRB 140T
1	200°/s	250°/s
2	200°/s	250°/s
3	260°/s	260°/s
4	360°/s	360°/s
5	360°/s	360°/s
6	450°/s	450°/s

There is a supervision to prevent overheating in applications with intensive and frequent movements.

1.8 Resolution

Approx. 0.01° on each axis.

1.9 Signals

Signal connections on robot arm

For connection of extra equipment on the manipulator, there are cables integrated into the manipulator's cabling from the controller to the upper arm housing.

In the controller, the signals are connected to 12-pole terminals, Phoenix MSTB 2.5/ 12-ST-5.08, and on the upper arm housing to FCI UT07 14 12SH44N.

Hose for compressed air is also integrated into the manipulator. There is an inlet (R 1 / 4") at the base and an outlet (R1/4") on the upper arm housing.

Description	Number	Values
Signals	12	49V, 500 mA
Air	1	Max. 8 bar, inner hose diameter 6.5 mm

1.5.1 Introduction

2 Specification of Variants and Options

2.1 Introduction

General

The different variants and options for the IRB 140 are described below.

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

For controller options, see Product Specification for the controller, and for software options, see Product Specification RobotWare Options.

2.2 Manipulator

Variants

Option	Variant	Robots
435-2	Standard performance variants	IRB 140 / IRB 140F / IRB 140CW / IRB 140CR
435-44	High speed variants:	IRB 140T / IRB 140TF / IRB 140TCW / IRB 140TCR

Manipulator colour

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

Protection

Option	Description
287-4	Standard manipulator
287-3	Foundry Robot adapted for foundry or other harsh environments. The robot has the FoundryPlus protection which means that the whole manipulator is IP67 classified and steam washable. An excellent corrosion protection is obtained by a special coating. The connectors are designed for severe environments, and bearings, gears and other sensitive parts are high protected. The robot is labeled with “Foundry Plus”.
287-1	Clean Room Robot with clean room class 10 according to US Federal Standard 209 and with the same protection as in option 287-4. The robot is labeled with “Clean Room”.
287-5	Wash Robot with the same protection as in option 287-3.

Connector kit

Option	Description
431-1	Detached connectors, suitable to the connectors on the upper arm. The kit consists of connectors, pins and sockets.

Safety lamp

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

3 Accessories

Basic software and software options for robot and PC

For more information, see Product Specification IRC5 for M2004 and S4Cplus for M2000, and Product Specification RobotWare Options.

Robot Peripherals

- Motor Units

3HAC 9041-1, Revision 6, en

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