The heart of Robotics

# Product specification

## Articulated robot

IRB 640
M2000


ABB

# Product specification

Articulated robot
3HAC 9217-1
Rev.B
IRB 640
M2000

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## Table of Contents

# 1 Description

## 1.1 Structure

### 1.1.1 Introduction

**Industrial robot**

IRB 640 is a 4-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.

The IRB 640 is extremely powerful with a handling capacity of 160 kg, and thanks to optimised robot drive-trains and ABB's patented QuickMove™ functions, it is the quickest robot in its class.

**BaseWare OS**

The robot is equipped with the operating system BaseWare OS. BaseWare OS controls every aspect of the robot, like motion control, development and execution of application programs communication etc. See Product specification - Controller S4Cplus.

**Optional software**

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 - Controller software RobotWare Options.

1.1.2 Robot data

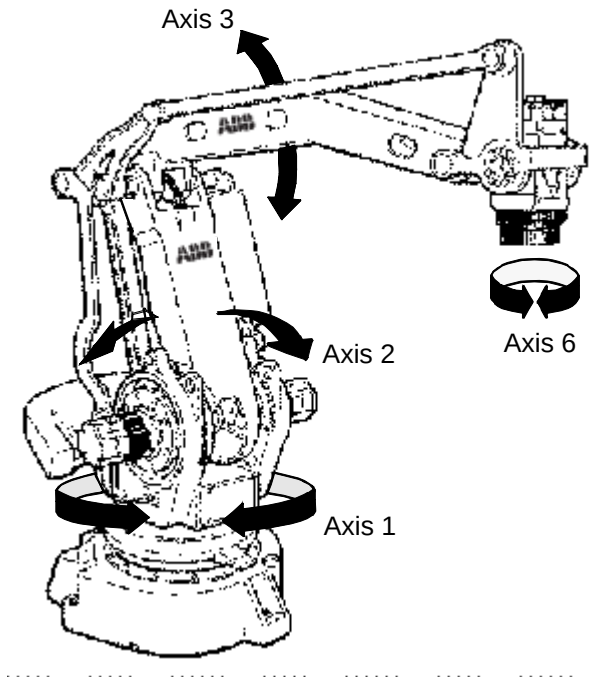


Figure 1 The IRB 640 manipulator has 4 axes.

## 1.1.2 Robot data

**General**

| | Description |
|---|---|
| Manipulator weight | 1950 kg |
| Airborne noise level | The sound pressure level outside < 70 dB (A) Leq (acc. to the working space Machinery directive 89/392 EEC). |

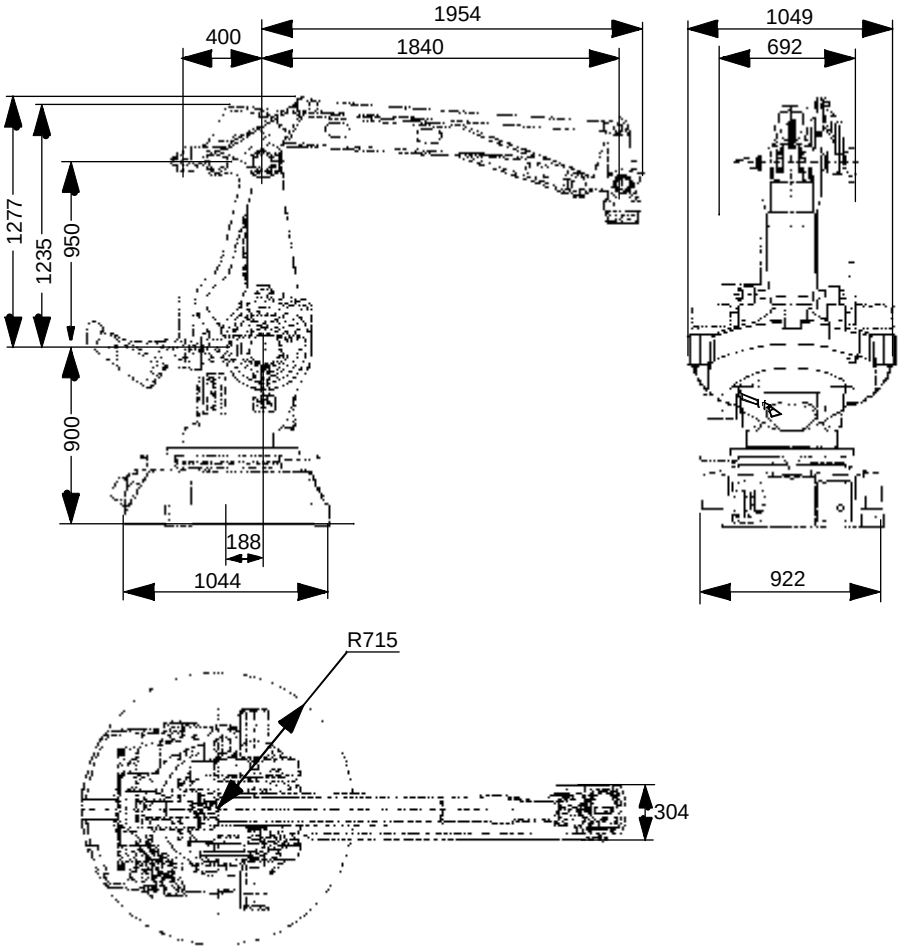


Figure 2 View of the manipulator from the side, rear and above (dimensions in mm).

# 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 60204 | Electrical equipment of industrial machines |
| EN 775 | Electrical equipment of industrial machines |
| EN 61000-6-4 (option) | EMC, Generic emission |
| EN 61000-6-2 | EMC, Generic immunity |

| Standard | Description |
|---|---|
| IEC 60204-1 | Electrical equipment of industrial machines |
| IEC 60529 | Degrees of protection provided by enclosures |

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

| Standard | Description |
|---|---|
| ANSI/RIA 15.06/1999 | 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.

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 inch/min.).The 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 a normal program stop with no deviation from the programmed path. After approx. 1 second the power supplied to the motors shuts off.

**Restricting the working space**

The movement of each axis can be restricted using software limits.
Axes 1-3 can also be restricted by means of mechanical stops (option).

**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 Laboratories) tough requirements for fire safety.

**Safety lamp (option)**

As an 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**

The IRB 640 is designed for floor mounting. An end effector of max. weight 160 kg, including payload, can be mounted on the mounting flange (axis 6). Load diagram, see 1.3.4 Load diagram.

Extra loads (valve packages) can be mounted on the upper arm. An extra load can also be mounted on the frame of axis 1.

Holes for mounting extra equipment see 1.3.5 Mounting equipment..

The working range of axes 1-3 can be limited by mechanical stops. Position switches can be supplied on axis 1 and axis 2 for position indication of the manipulator.

## 1.3.2 Operating requirements

**Protection standards**

| Description | Protection standard IEC529 |
|---|---|
| Manipulator | IP54 |
| Wrist | IP55 |

**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 |

## 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 | ± 12000 N | ± 18000 N |
| Force z | 21000 ± 5500 N | - 21000 ± 10000 N |
| Torque xy | ± 32000 Nm | ± 39000 Nm |
| Torque z | ± 6000 Nm | ± 13000 Nm |

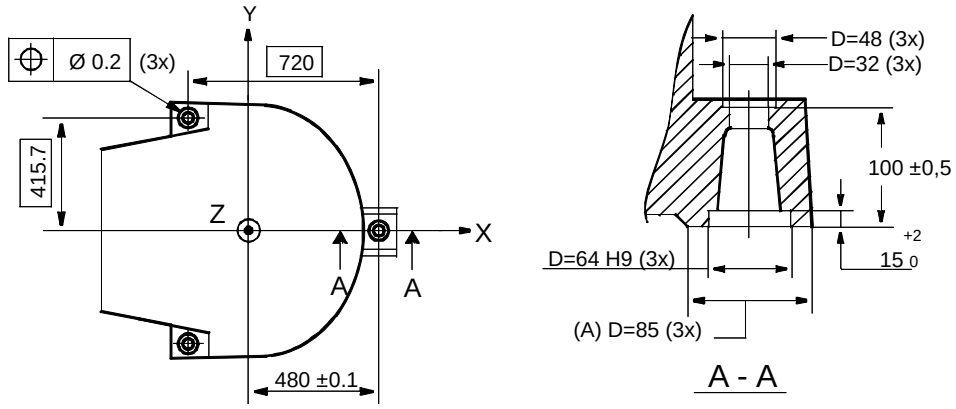


Figure 3 Hole configuration (dimensions in mm).

| Pos | Description |
|---|---|
| A | Support surface |

## 1.3.4 Load diagram

**Illustration**

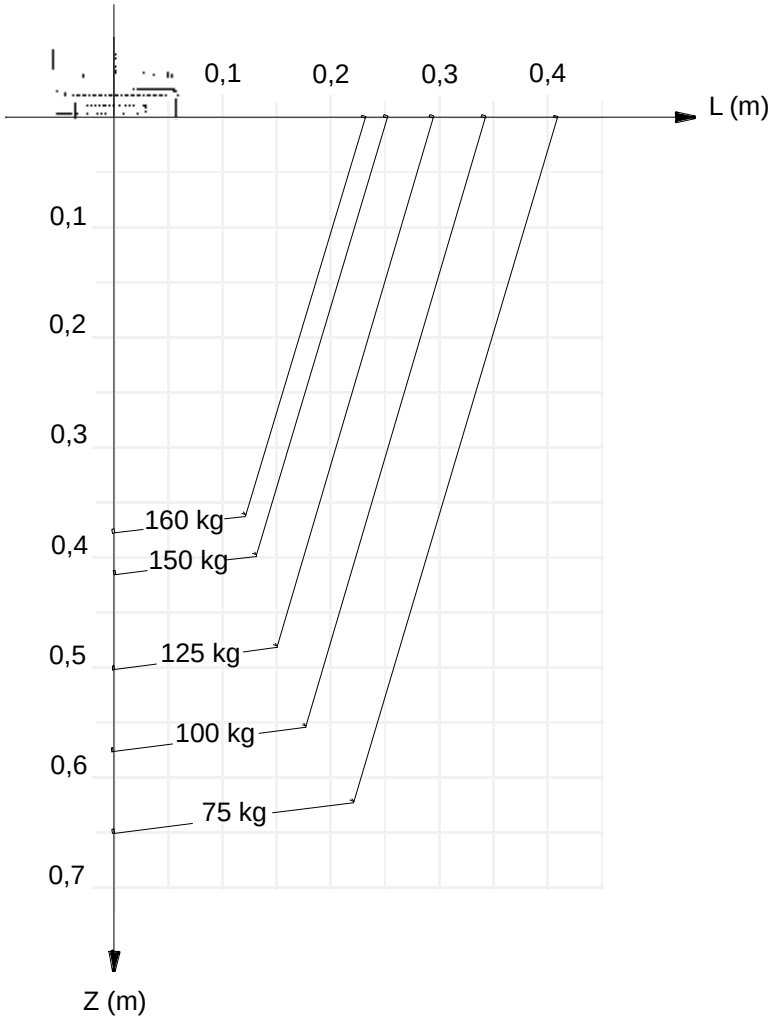


Figure 4 Maximum weight permitted for load mounted on the mounting flange at different positions (center of gravity).

| | Description |
|---|---|
| The load diagram is valid for $J_0$ <100 kgm$^2$. | $J_0$ = the maximum component ($J_{X0}$, $J_{Y0}$, $J_{Z0}$) of the moment of inertia of the handling weight at its center of gravity. |

## 1.3.5 Mounting equipment

Extra loads can be mounted on the upper arm and the frame. Definitions of distances and masses are shown in Figure 5 (upper arm) and in Figure 6 (frame).
The robot is supplied with holes for mounting extra equipment (see Figure 7).

### Upper arm

Permitted extra load on upper arm plus the maximum handling weight. See Figure 5.

| | Description |
|---|---|
| M1 ≤ 35 kg with distance a ≤ 500 mm | Center of gravity in axis 3 extension. |
| M2 ≤ 35 kg with distance b ≤ 400 mm | |

If the handling weight is lower than the maximum weight, the upper arm load can be increased.

For example, if the handling weight is only 120 kg, which is 40 kg less than max. handling capacity, you can put additional 40 kg on top of M1 or M2 on the upper arm. These “additional 40 kg” can be mounted in any of the holes for extra equipment.

The upper arm load should then be defined in the software as one mass.
It is important that this is done correctly to ensure that the robot’s motions remain perfect.

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

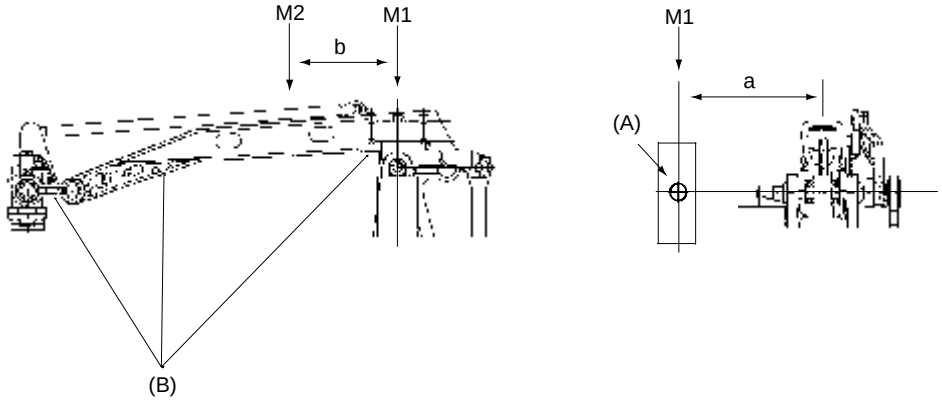


Figure 5 Permitted extra load on upper arm.

| Pos | Description |
|---|---|
| A | Holes for extra equipment. Measurement see Figure 7. |

## Frame (Hip Load)

| | |
|---|---|
| Permitted extra load on frame | $J_H$ = 120 kgm$^2$. |
| Recommended position see Figure 6 | $J_H = J_{H0} + M4 \times R^2$<br>where:<br>$J_{H0}$ is the moment of inertia of the equipment.<br>R is the radius (m) from the center of axis 1.<br>M4 is the total mass (kg) of the equipment including bracket and harness (≤ 320 kg). |

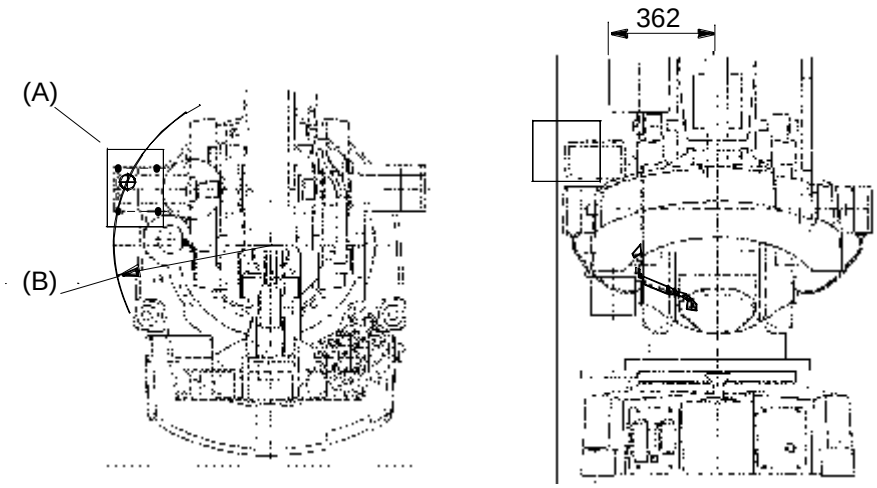


Figure 6 Extra load on frame of IRB 640 (dimensions in mm).

| Pos | Description |
|---|---|
| A | M4 $J_{H0}$ |
| B | R around axis 1 |

Note! Hip load can only be mounted on the robot's left side.
Forklift device on the right side must be dismounted before using the robot.

1.3.5 Mounting equipment

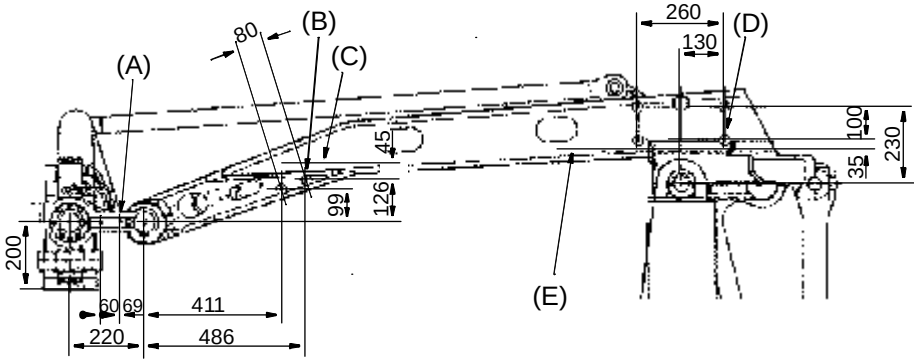


Figure 7 Holes for mounting extra equipment (dimensions in mm).

| Pos | Description |
|---|---|
| A | M10 (2x) depth 25 |
| B | M10 (2x) through |
| C | Limit for M10 surfaces |
| D | M10 (4x) through |
| E | Limit for M10 surfaces |

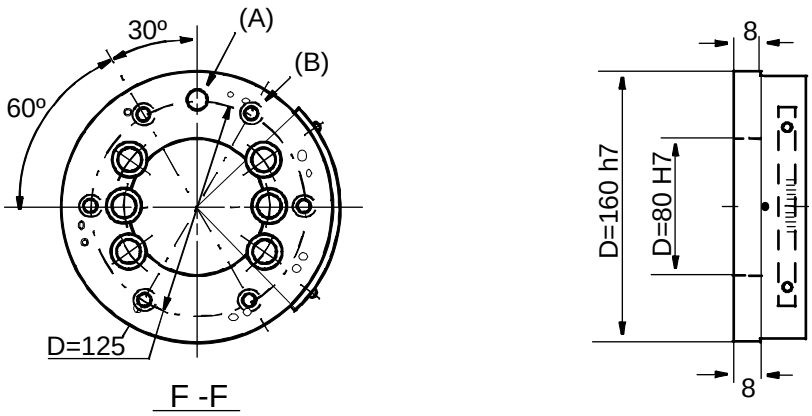


Figure 8 The mechanical interface (mounting flange) ISO 9409-1-A125 (dimensions in mm).

| Pos | Description |
|---|---|
| A | D=10 H7 depth 10 |
| B | M10 (6x) depth 18 |

# 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.
- Liquid grease or oil is 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.

The following maintenance is required:

- Changing grease and oil every third year.
- Changing batteries every third year.
- Some additional checks every 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

**General**

| Type of motion | Range of movement |
|---|---|
| Axis 1 Rotation motion | +180° to -180° |
| Axis 2 Arm motion | +70° to -70° |
| Axis 3 Arm motion | +85° to -28° |
| Axis 6 Turn motion | +300° to -300° |

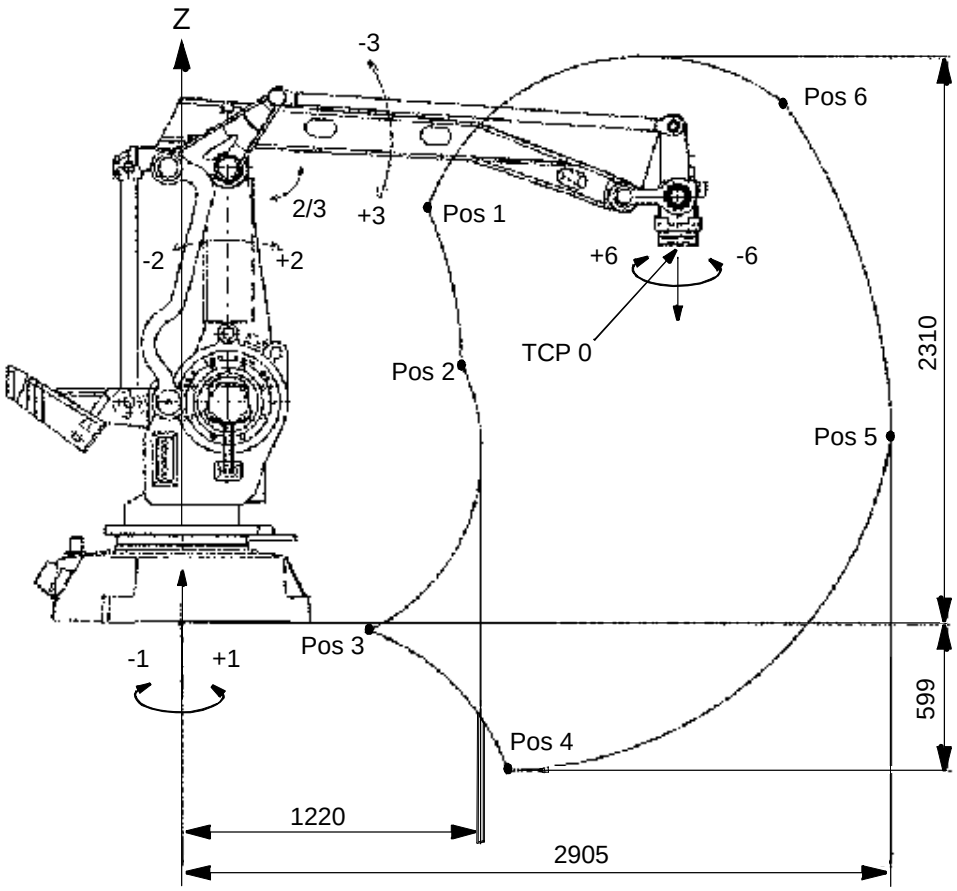


Figure 9 The extreme positions of the robot arm.

| Pos no. | Positions at TCP 0 (mm) X | Positions at TCP 0 (mm) Z | axis 2 (φ 2) | axis 3 (φ 3) |
|---|---|---|---|---|
| 0 | 2028 | 1536 | 0° | 0° |
| 1 | 999 | 1685 | -70° | -28° |
| 2 | 1139 | 1053 | -70° | -5° |
| 3 | 761 | -31 | 40° | 85° |
| 4 | 1328 | -599 | 70° | 85° |
| 5 | 2905 | 770 | 70° | 5° |
| 6 | 2464 | 2119 | 37° | -28° |

| | Description |
|---|---|
| Angle 2/3 (φ 2/φ3) | Min. 25º<br>Max. 155º<br>90° at pos. 0 |

## 1.5.2 Velocity

| Axis no. | Values |
|---|---|
| 1 | 125º/s |
| 2 | 125º/s |
| 3 | 125º/s |
| 6 | 275º/s |

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

**Resolution**

Approx. 0.01º on each axis.

# 1.6 Signals

More information of signals on upper arm see 1.6.1 Signal connections on robot arm.

## 1.6.1 Signal connections on robot arm

| Signals | | Description |
|---|---|---|
| Signals | 23 | 50 V, 250 mA |
| Power | 10 | 250 V, 2 A |
| Air | 1 | Max. 10 bar, inner hose diameter 11 mm |

| DeviceNet | | Description |
|---|---|---|
| Signals | 12 | 50 V, 250 mA |
| Power | 5 | 250 V, 2 A |
| Air | 1 | Max. 10 bar, inner hose diameter 11 mm |

| Customer Power Vacuum (option 96-1) | | Description |
|---|---|---|
| Power | 6 | 400 V, 4 A |
| Protective earth | 2 | |

# 2 Specification of Variants and Options

## 2.1 Introduction

### 2.1.1 General

The different variants and options for the IRB 640 are described below.
The same numbers are used here as in the Specification form. For controller options, see Product specification - Controller S4Cplus, and for software options, see Product specification - Controller software RobotWare Options.

### 2.1.2 Manipulator

**Variant**

| Option | Description |
|---|---|
| 435-39 | IRB 640 |

**Manipulator color**

| Option | Description |
|---|---|
| 209-1 | The manipulator is painted with ABB orange. |
| 209-4-192 | Colors according to RAL-codes. |
| 209-3 | ABB white Flex Palletizer. |

**Application interface**

Air supply and signals for extra equipment to upper arm.

| Option | Description |
|---|---|
| 051 Standard | Integrated hose for compressed air. There is an inlet at the base (see Figure 10) and an outlet on the tilthouse (see ). Connections: R1/2”. |

For connection of extra equipment on the manipulator, there are cables integrated into the manipulator’s cabling and two connectors:

- one Burndy 23-pin UTG 018-23S
- one Burndy 12-pin UTG 014-12S

| Option | Description |
|---|---|
| 17-1 DeviceNet | Integrated hose for compressed air. There is an inlet at the base (see Figure 10) and an outlet on the tilthouse (see ). Connections: R1/2”. |

For connection of extra equipment on the manipulator there is a CAN cable (length from the hole on the upper arm: 645 mm) integrated into the manipulator’s cabling. The connectors are:

- one Burndy 23-pin (12 available) UTG 018-23S
- one Burndy 12-pin (5 available) UTG 014-12S
- one CAN DeviceNet 5-pole female connector (Ø 1”)

**Connection of signals to**

| Option | Description |
|---|---|
| 16-2 Manipulator | The signals are connected directly to the robot base to one Harting 40-pin connector. The cables from the manipulator base are not supplied. |
| 16-1 Cabinet | The signals are connected to 12-pole screw terminals, Phoenix MSTB 2.5/12-ST-5.08, in the controller. The cable between R1.CP/CS and the controller is supplied. |

**Connectors type**

Type of fieldbus connectors on the upper arm:

| Option | Description |
|---|---|
| 17-1 DeviceNet | 5-pin “Mini” style female contact with 7/8-16 UN-2A THD female connection thread.<br>Meets ANSI/B93.55M-1981 design and intermateability requirements |

**Connection to cabinet (cable length)**

Standard:

| Option | Description |
|---|---|
| 94-1 | 7 m |
| 94-2 | 15 m |
| 94-3 | 22 m |
| 94-4 | 30 m |

DeviceNet:

| Option | Description |
|---|---|
| 90-2 | 7 m |
| 90-3 | 15 m |
| 90-4 | 22 m |
| 90-5 | 30 m |

## Customer power vacuum

| Option | Description |
|---|---|
| 96-1 | Cabling from the manipulator's base to the left side of the frame (for connection with a vacuum pump, see Figure 10).<br>On the base one Burndy 23 pin UTG 018-23S. On the left side of the manipulator's frame the cable ends with six wires + two protective earth. |

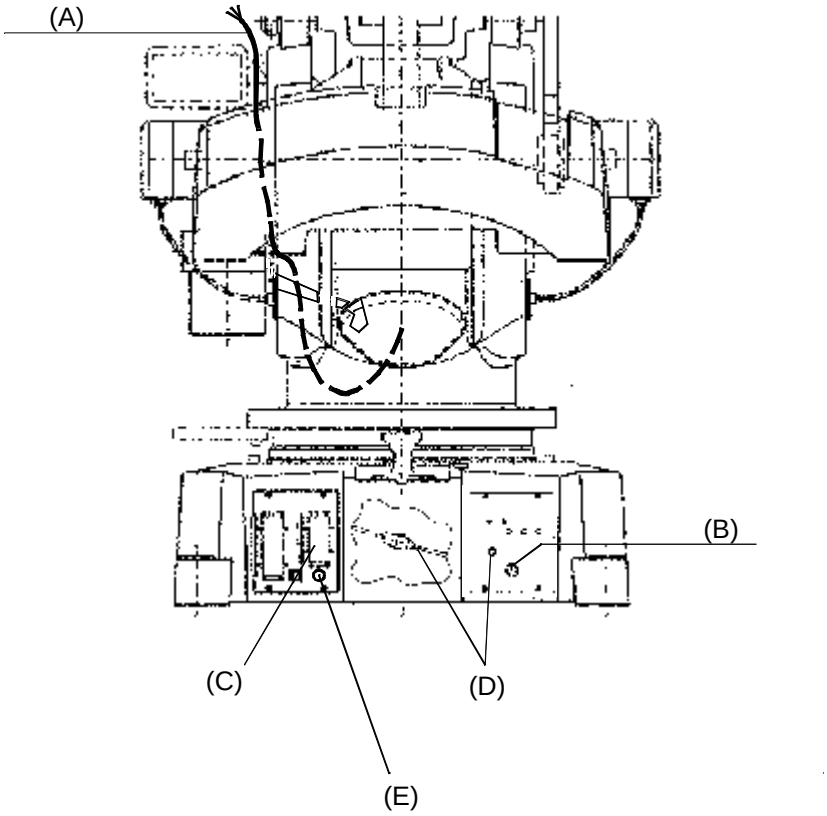


Figure 10 Connections at the manipulator base.

| Pos | Description |
|---|---|
| A | Option 96-1 R1.CPV |
| B | Air R1/2" |
| C | Option 17-5 R1.CP/CS |
| D | Option 96-1 R1.CPV |
| E | DeviceNet connection (option 17-1) R1.CB |

2.1.2 Manipulator

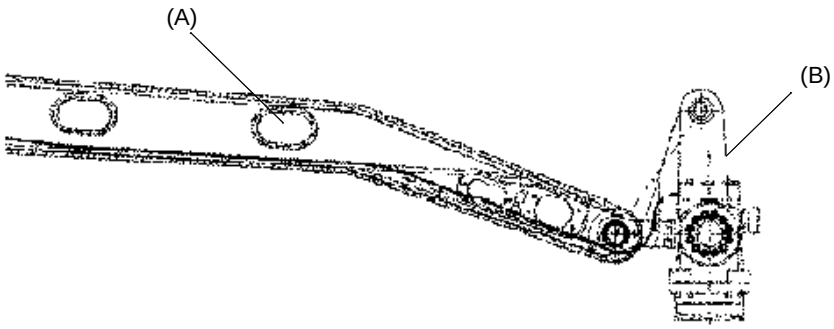


Figure 11 Connection of signals on the upper arm.

| Pos | Description |
|---|---|
| A | DeviceNet connection (option 17-1) |
| B | CP/CS (option 17-5) |

## Equipment

| Option | Description |
|---|---|
| 213-1<br>Safety lamp | A safety lamp with an orange fixed light can be mounted on the manipulator.<br>The lamp is active in MOTORS ON mode.<br>The safety lamp is required on a UL/UR approved robot. |
| 159-1<br>Fork lift device | Lifting device on the manipulator for fork-lift handling is mounted at delivery.<br>Lifting eyes for use with an overhead crane are integrated as standard. |
| 50-1<br>Brake release cover | Protective cover over push-buttons on brake release unit. |

## Position switch

Position switches indicating the position of one or two of the main axes. Rails with separate adjustable cams are attached to the manipulator. The cams, which have to be adapted to the switch function by the user, can be mounted in any position in the working range for each switch.

The position switch device is delivered as a kit to be assembled when installing the robot. Assembly instruction is included.

**Note!** This option may require external safety arrangements, e.g. light curtains, photocells or contact mats.

**Note!** The switches are not recommended to be used in severe environment with sand or chips.

1, 2 or 3 switches indicating the position of axis 1.

| Type | Description |
|---|---|
| Switch type | Telemecanique XCK-M1/ZCK-D16, 2 pole N/C + N/O, according to IEC 947-5-1. |

| Option | Description |
|---|---|
| 25-2 | 1 switch, axis 1 |
| 25-4 | 2 switches, axis 1 |
| 25-3 | 3 switches, axis 1 |
| 30-1 | 1 switch, axis 2 |

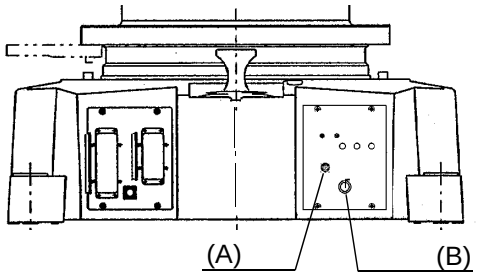


Figure 12 Connection of position switch cable to the base.

| Pos | Description |
|---|---|
| A | R1.SW |
| B | Air R 1/2” |

## Connection to

| Option | Description | |
|---|---|---|
| 271-2 | Manipulator | Connection on the manipulator base with one FCI 23-pin connector. |
| 271-1 | Cabinet | The signals are connected to 12-pole screw terminals, Phoenix MSTB 2.5/12-ST-5.08, in the controller. The cable between the manipulator base R1.SW and the controller, is included. |

## Connection of signals (Cable lengths)

| Option | Description |
|---|---|
| 273-1 | 7 m |
| 273-2 | 15 m |
| 273-3 | 22 m |
| 273-4 | 30 m |

### Working range limit

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

| Option | Description | |
|---|---|---|
| 28-1 | Axis 1 | 2 stops which allow the working range to be restricted in any increment of 20°. |
| 32-1 | Axis 2 | 6 stops which allow the working range to be restricted in increments of 20°. Each stop decreases the motion by 20°. This means that the motion can be decreased by 6 x 20° from the maximum axis motion. |
| 34-1 | Axis 3 | 6 stops which allow the working range to be restricted in increments of 20°. Each stop decreases the motion by 20°. This means that the motion can be decreased by 6 x 20° from the maximum axis motion. |

# 3 Accessories

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 S4Cplus, and Product specification - Controller software RobotWare Options.

## Robot Peripherals

- Track Motion
- Tool System
- Motor Units

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