

# Product Specification

*IRB 1400*

3HAC 9376-1 / Rev 3  
M2000



S4Cplus



140



2400



1400



840



4400



340



6400S



640



6400PE



6400R

The information in this document is subject to change without notice and should not be construed as a commitment by ABB Automation Technologies, Robotics. ABB Automation Technologies, Robotics assumes no responsibility for any errors that may appear in this document.

In no event shall ABB Automation Technologies, Robotics be liable for incidental or consequential damages arising from use of this document or of the software and hardware described in this document.

This document and parts thereof must not be reproduced or copied without ABB Automation Technologies, Robotics' written permission, and contents thereof must not be imparted to a third party nor be used for any unauthorized purpose. Contravention will be prosecuted.

Additional copies of this document may be obtained from ABB Automation Technologies, Robotics at its then current charge.

© Copyright 2001 ABB. All rights reserved.

Article number: 3HAC 9376-1/Rev 3  
Issue: M2000

ABB Automation Technologies, Robotics  
S-721 68 Västerås  
Sweden

## CONTENTS

	Page
<b>1 Description .....</b>	<b>3</b>
1.1 Structure.....	3
Different robot versions .....	3
1.2 Safety/Standards .....	6
1.3 Installation .....	7
Operating requirements.....	8
Mounting the manipulator.....	8
Load diagram .....	10
Mounting of equipment.....	11
1.4 Maintenance and Troubleshooting .....	12
1.5 Robot Motion.....	13
Performance according to ISO 9283.....	15
Velocity .....	15
Resolution .....	15
1.6 Signals .....	15
<b>2 Specification of Variants and Options.....</b>	<b>17</b>
<b>3 Accessories .....</b>	<b>21</b>
<b>4 Index.....</b>	<b>23</b>



---



---

# 1 Description

---

## 1.1 Structure

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.

The Clean Room robot is classified for clean room class 100 according to US Federal Standard 209.

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 S4Cplus.

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.

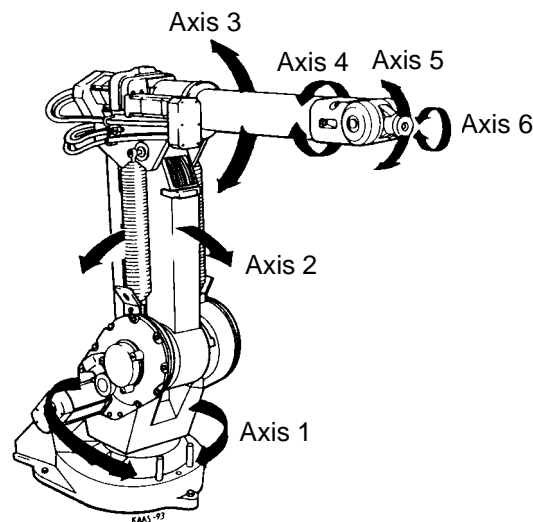


Figure 1 The IRB 1400 manipulator has 6 axes.

### Different robot versions

The IRB 1400 is available in three different versions:

- IRB 1400, for floor mounting
- IRB 1400CR, for clean room installation
- IRB 1400H, for inverted mounting.

Weight: Manipulator 225 kg

Airborne noise level:

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

*Description*

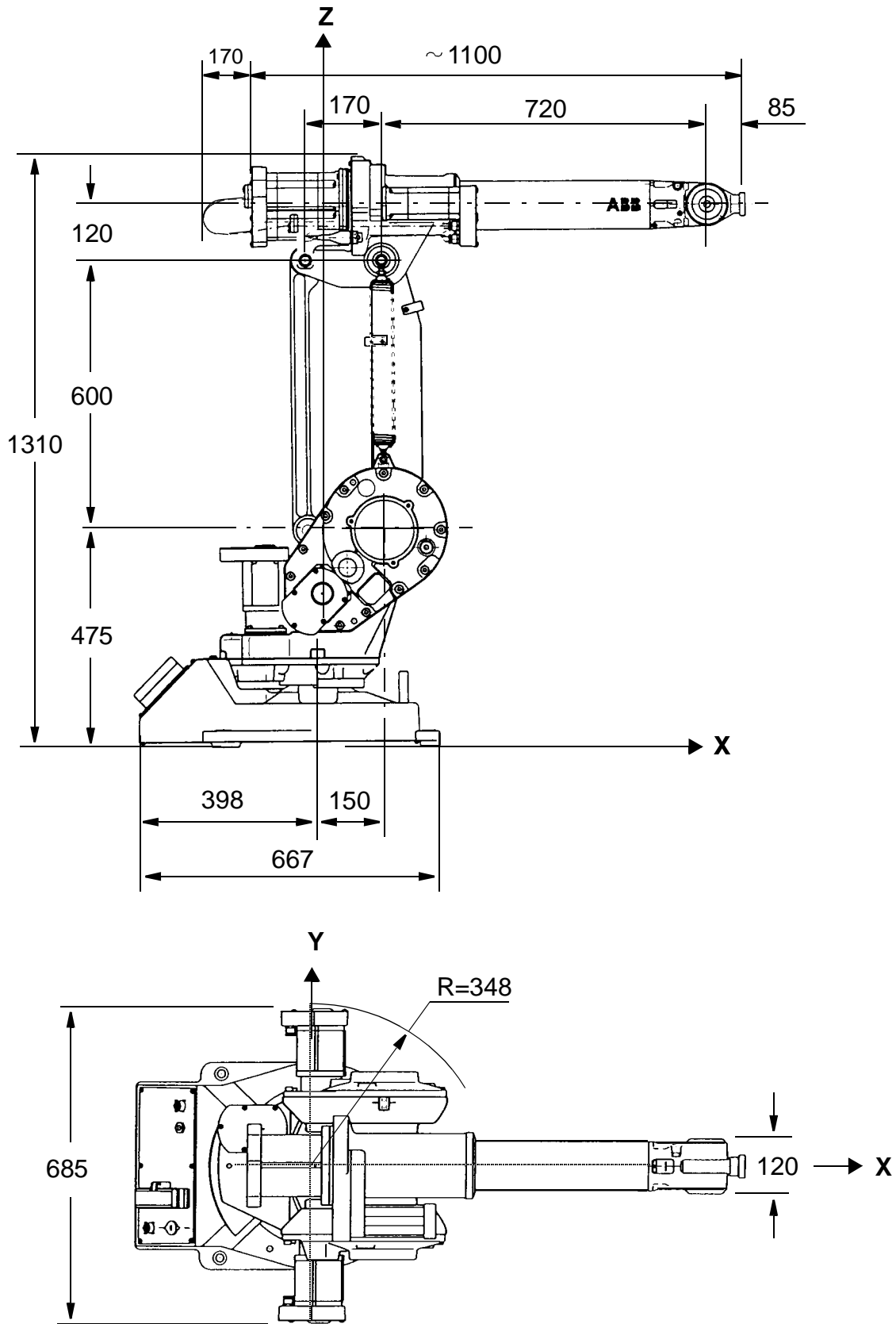


Figure 2 View of the manipulator (floor mounted version) from the side and above (dimensions in mm).

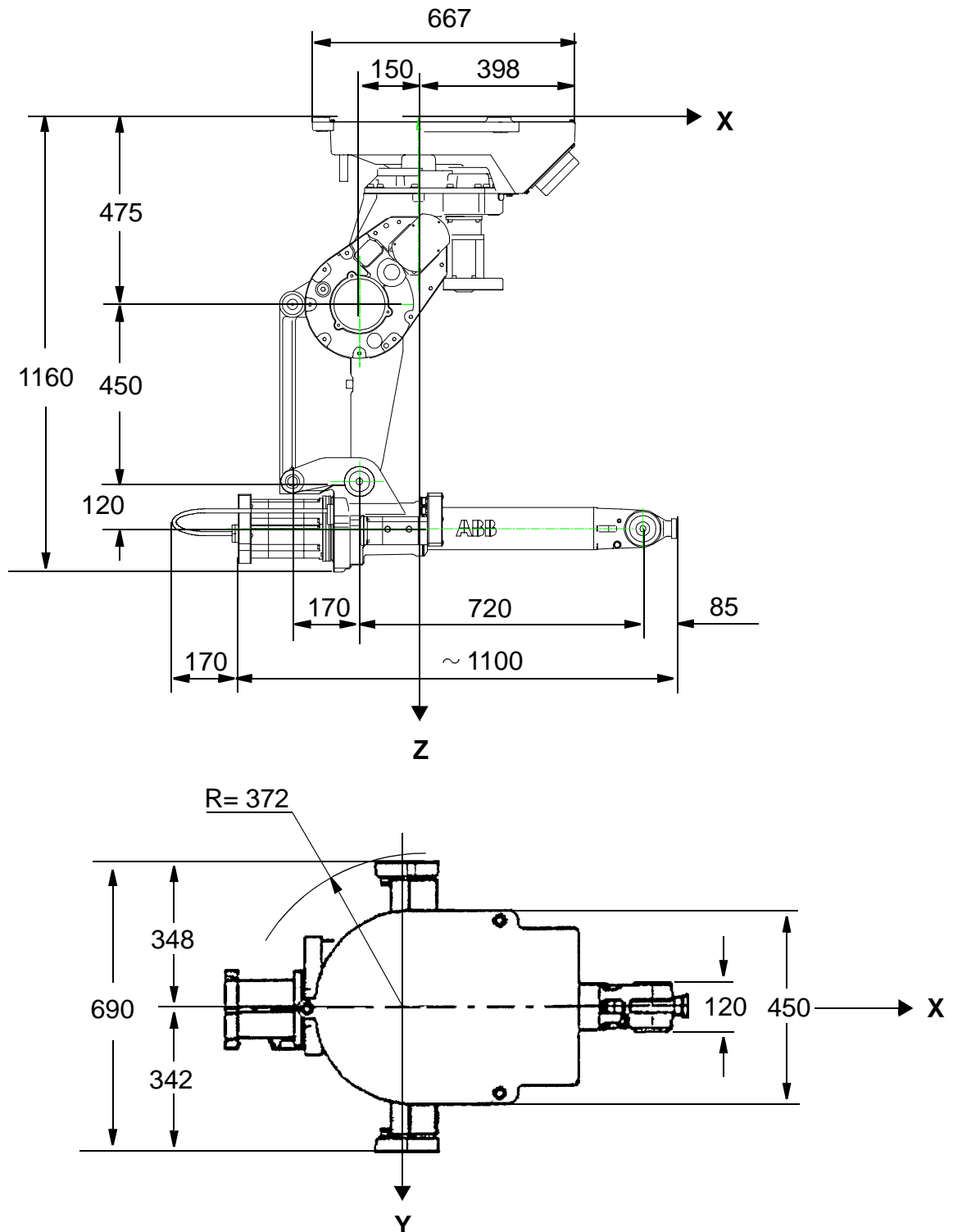


Figure 3 View of the manipulator (inverted mounted version) from the side and above (dimensions in mm).

---

### 1.2 Safety/Standards

The robot conforms to the following standards:

EN 292-1	Safety of machinery, terminology
EN 292-2	Safety of machinery, technical specifications
EN 954-1	Safety of machinery, safety related parts of control systems
EN 60204	Electrical equipment of industrial machines
IEC 204-1	Electrical equipment of industrial machines
ISO 10218, EN 775	Manipulating industrial robots, safety
ANSI/RIA 15.06/1999	Industrial robots, safety requirements
ISO 9787	Manipulating industrial robots, coordinate systems and motions
IEC 529	Degrees of protection provided by enclosures
EN 50081-2	EMC, Generic emission
EN 50082-2	EMC, Generic immunity
ANSI/UL 1740-1996 (option)	Standard for Industrial Robots and Robotic Equipment
CAN/CSA Z 434-94 (option)	Industrial Robots and Robot Systems - General Safety Requirements

The 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 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.

**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 Laboratory) 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**

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.

## Description

### Operating requirements

#### Protection standards

IEC529

#### Clean room standards

Clean room manipulaor US Federal Standard 209, class 100

#### Explosive environments

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

#### Ambient 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

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.

	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

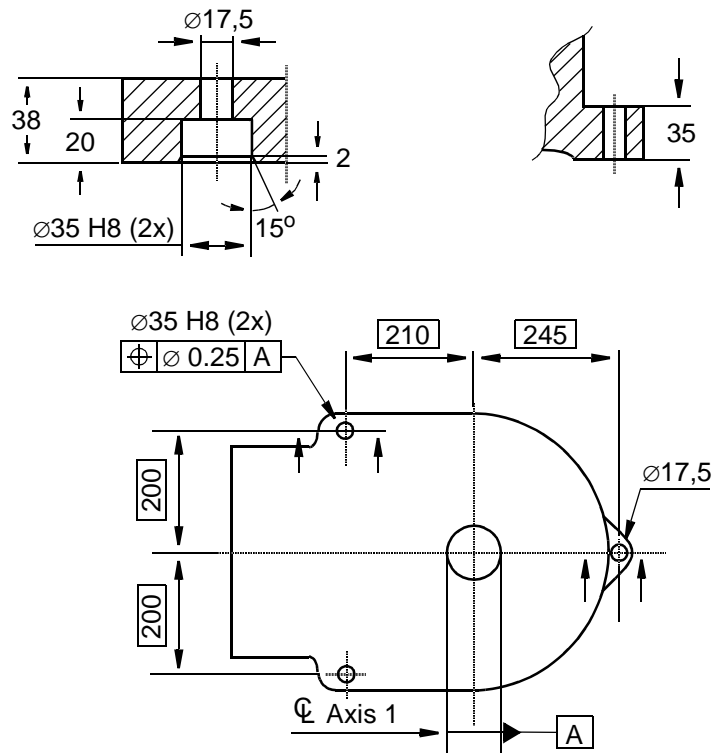
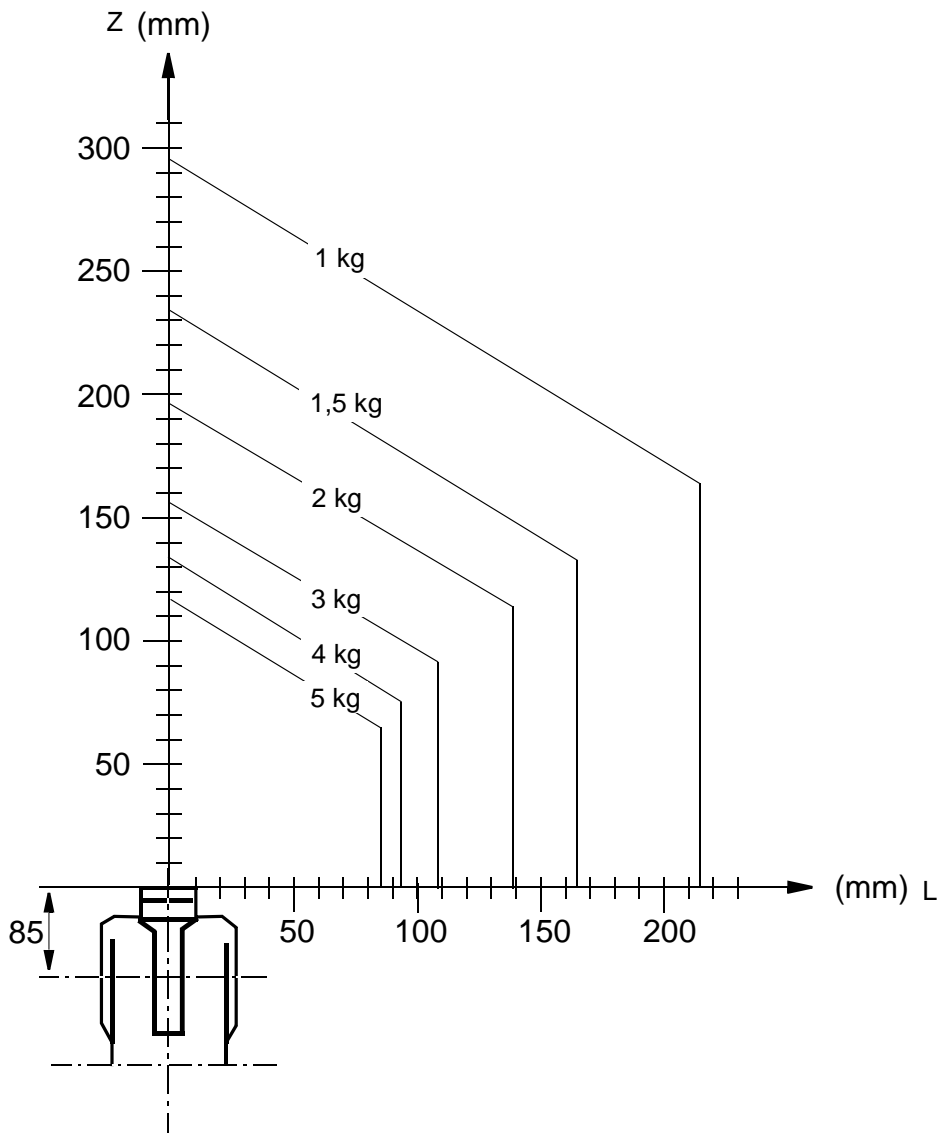


Figure 4 Hole configuration (dimensions in mm).

# Description

## 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 centre of gravity

J= max. 0.012 kgm<sup>2</sup>

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

Figure 5 Maximum allowed weight for tool mounted on the mounting flange at different positions (centres of gravity).

Mounting of equipment

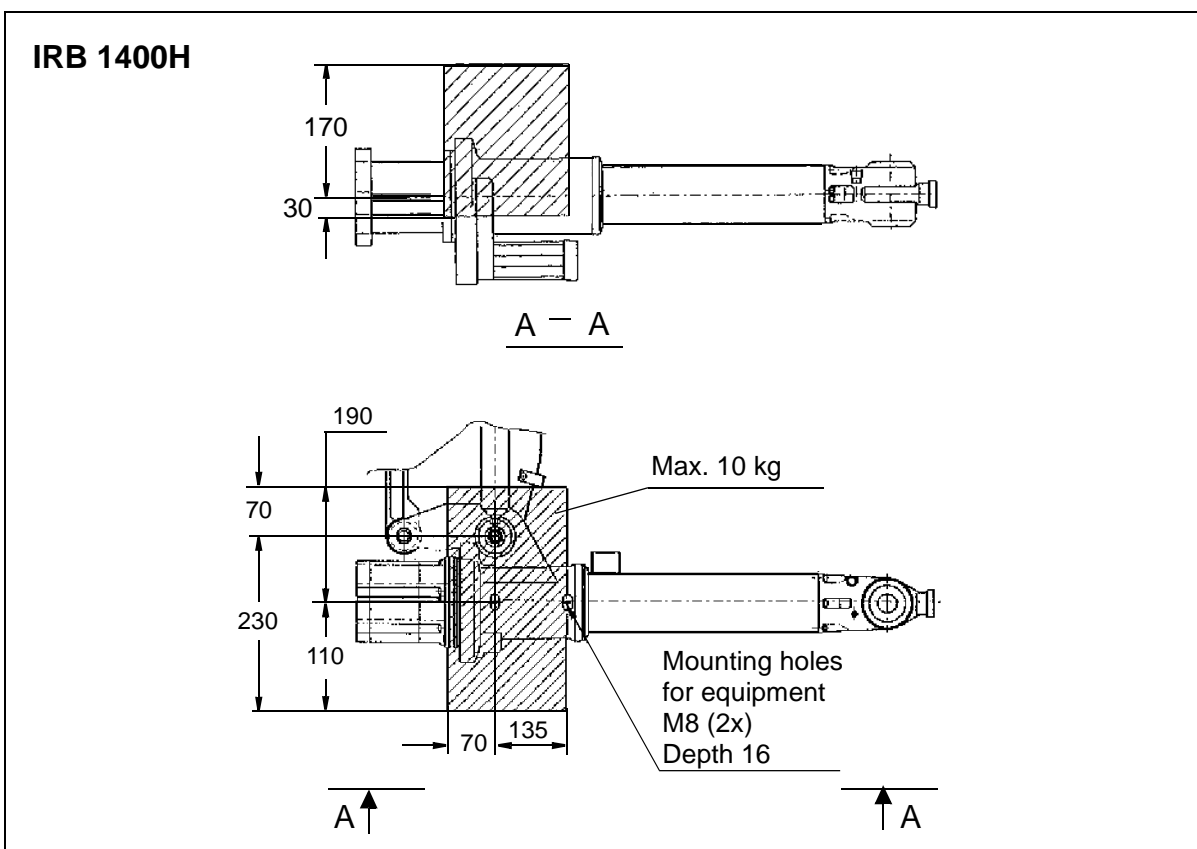
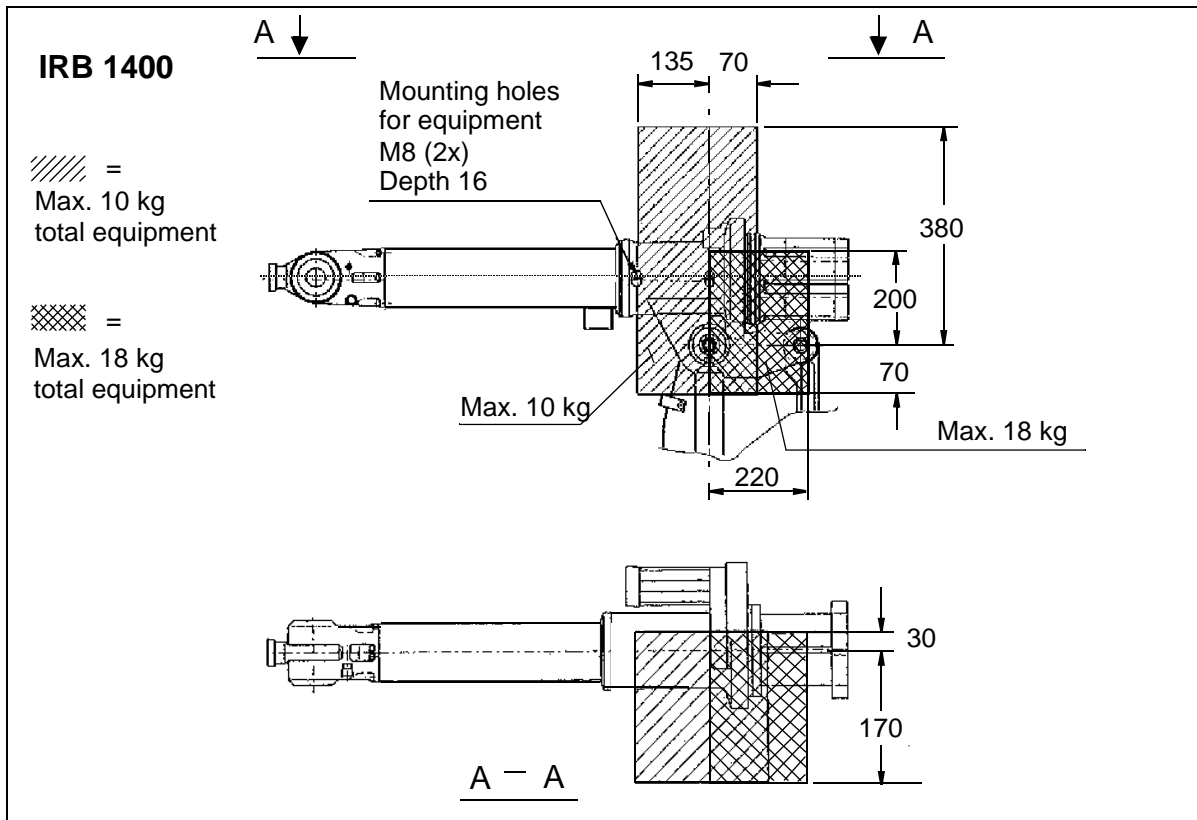


Figure 6 The shaded area indicates the permitted position (centre of gravity) for any extra equipment mounted on the upper arm (dimensions in mm).

## Description

Mounting holes  
for equipment, both sides  
M8 (3x), R=75  
Depth 16

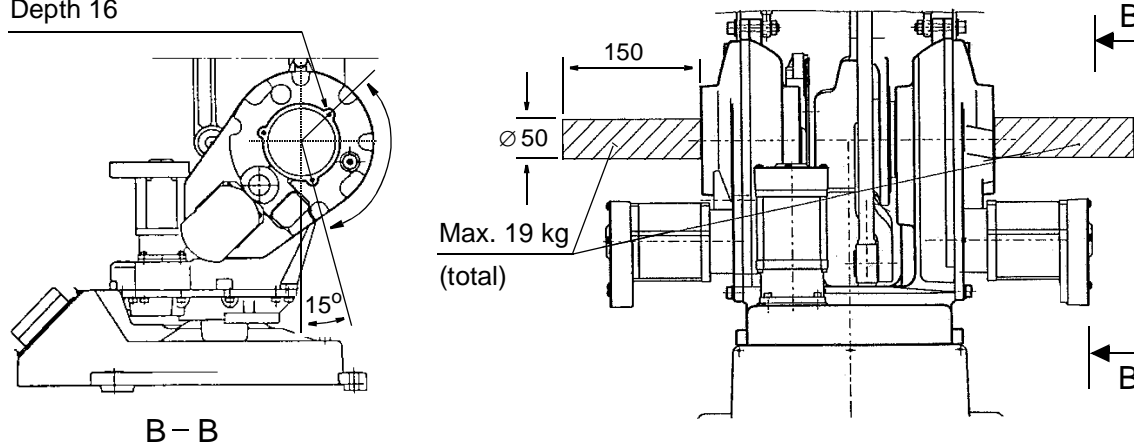


Figure 7 The shaded area indicates the permitted position (centre of gravity) for any extra equipment mounted on the frame (dimensions in mm).

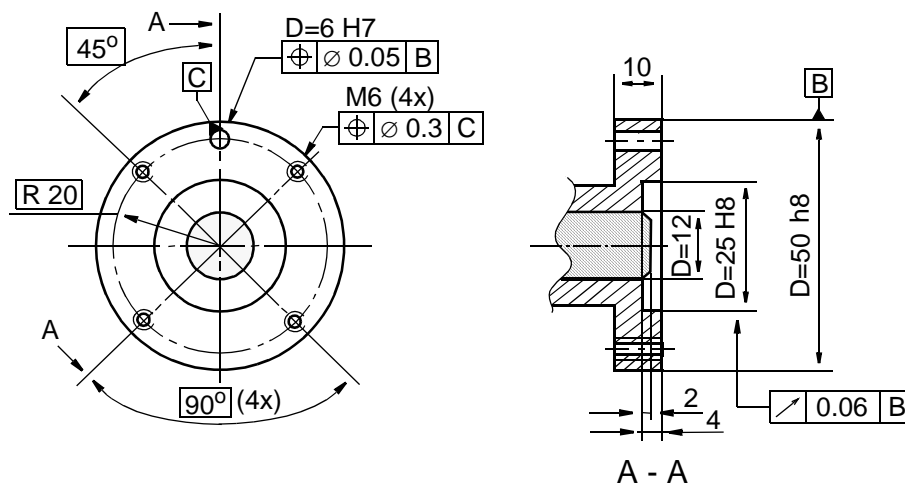


Figure 8 The mechanical interface, mounting flange (dimensions in mm).

## 1.4 Maintenance and Troubleshooting

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

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

## 1.5 Robot Motion

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

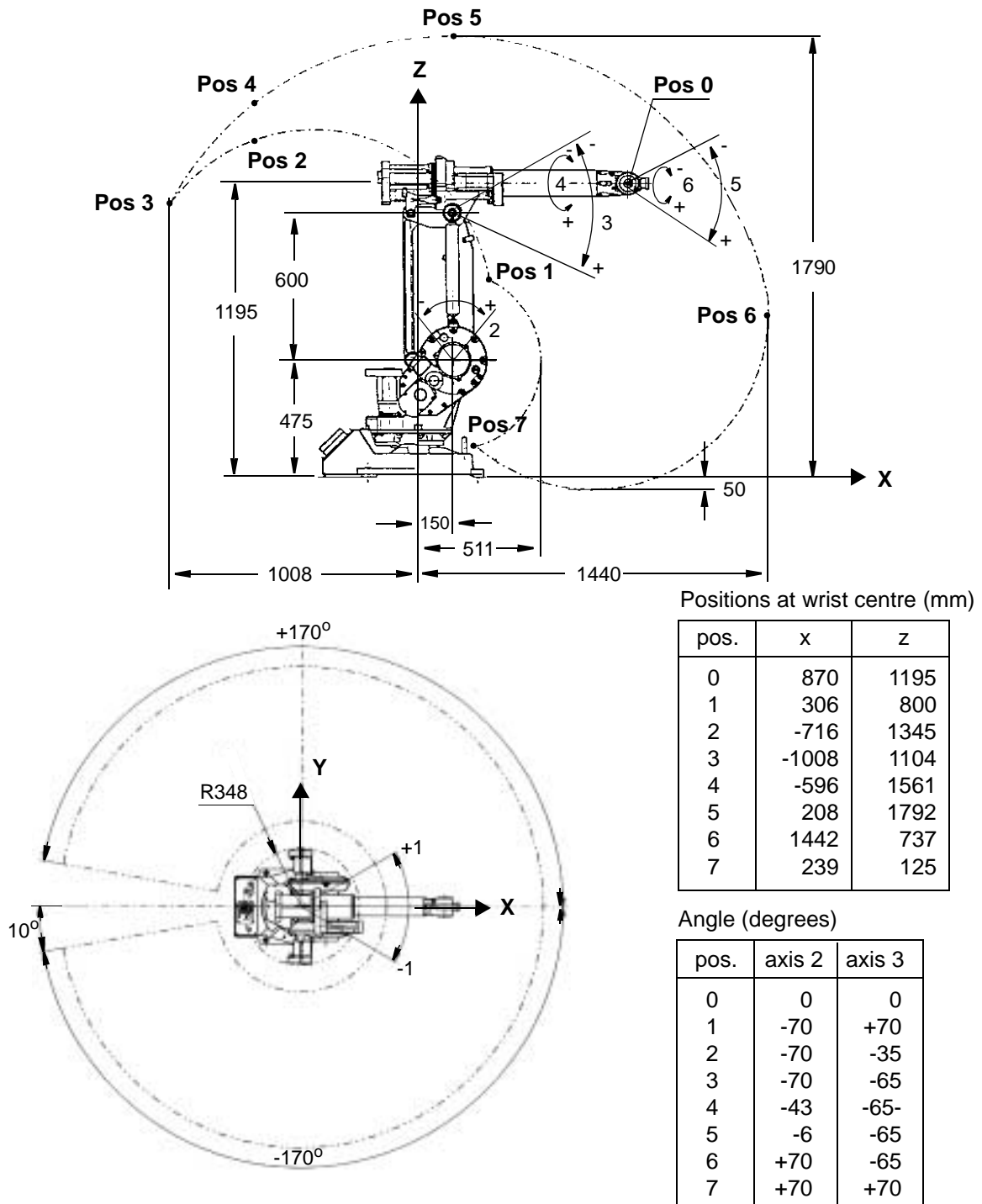
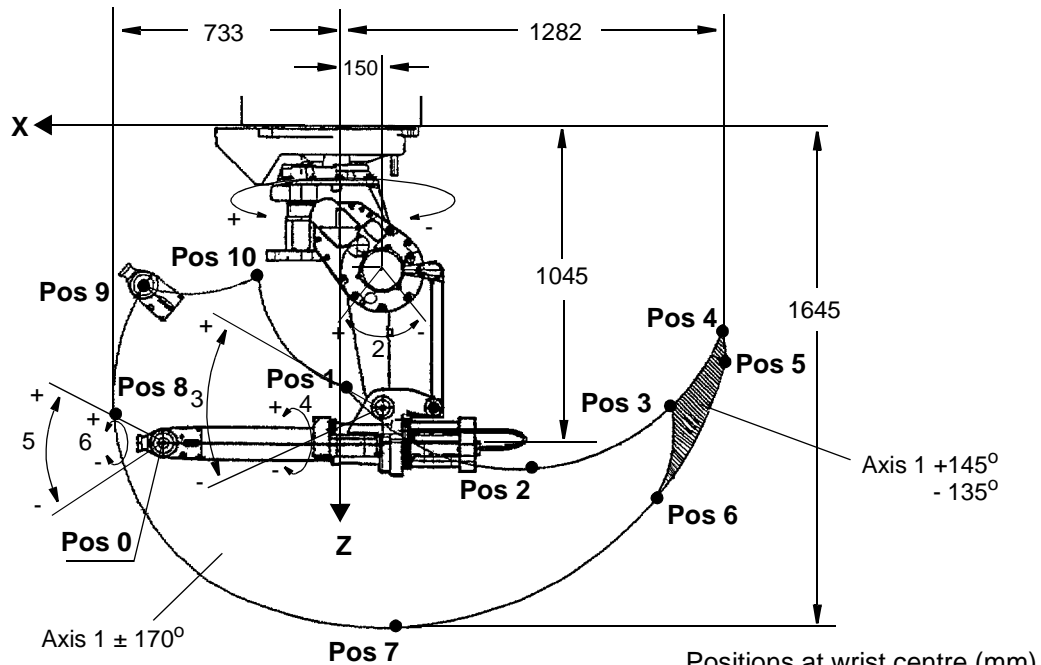


Figure 9 The extreme positions of the robot arm.

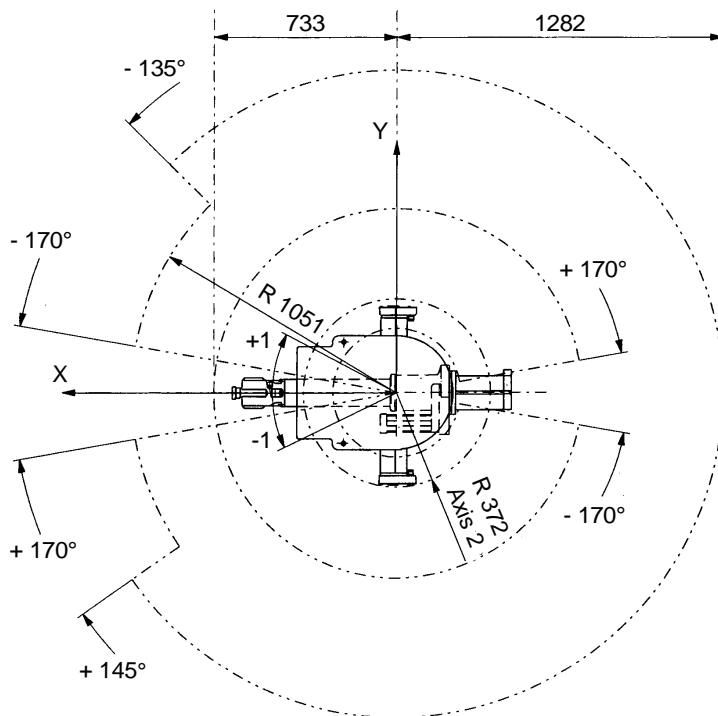
# Description

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



Positions at wrist centre (mm)

pos.	x	z
0	570	1045
1	-30	861
2	-586	1127
3	-1104	918
4	-1277	653
5	-1282	770
6	-1051	1221
7	-158	1645
8	734	891
9	633	527
10	254	494



Angle (degrees)

pos.	axis 2	axis 3
0	0	0
1	-100	+70
2	-100	+20
3	-100	-25
4	-100	-50
5	-85	-65
6	-60	-65
7	-10	-65
8	+20	-10
9	+20	+20
10	-30	+70

Figure 10 The extreme positions of the robot arm, inverted version (dimensions in mm). Manipulator seen from the side and above.



**Performance according to ISO 9283**

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. If guaranteed values are required, please contact your nearest ABB Flexible Automation Centre.

**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

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

**Resolution**

Approx. 0.01° on each axis.

---

**1.6 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.

## *Description*

---

---

## **2 Specification of Variants and Options**

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 S4Cplus, and for software options, see Product Specification RobotWare Options.

### **1 MANIPULATOR**

#### **VARIANTS**

- 435-3** IRB 1400
- 435-4** IRB 1400H

#### **Mounting position**

- 224-1** Floor mounted
- 224-2** Hanging

#### **Manipulator colour**

- 209-1** Protection Standard has colour ABB Orange and protection Clean Room has colour white
- 209-4-192** The manipulator is painted with the chosen RAL-colour.

#### **Protection**

- 287-1 Clean Room**  
Robot with clean room class 100 according to US Federal Standard 209.  
Standard colour is white.  
The robot is labeled with “Clean Room”.

### **APPLICATION INTERFACE**

#### **Air supply and signals for extra equipment to upper arm**

- 218-8** Hose for compressed air is integrated into the manipulator. There is an inlet at the base and an outlet on the upper arm housing.  
  
Connections: R1/4” in the upper arm housing and at the base. Max. 8 bar.  
Inner hose diameter: 6.5 mm.  
  
For connection of extra equipment on the manipulator, there are cables integrated into the manipulator’s cabling.  
  
Number of signals: 12 signals 49 V, 500 mA.  
Connector on upper arm: FCI 12-pin UT0014-12SHT  
Connector on robot base: FCI 12-pin UT0014-12PHT
- 218-3** Control cabling to arc welding wire-feeder is integrated into the manipulator’s cabling.

## Specification of Variants and Options

### Control signals:

16 signals, 49 V, 500 mA

Connector on upper arm housing: FCI 23-pin UTG 618-23PN

Connector on robot base: FCI 23-pin socket UT001823SHT

### Power signals:

12 signals, 300 V, 4 A

Connector on upper arm housing: Burndy 12-pin socket UTG 614-12SN

Connector on robot base: Burndy 12-pin UT001412PHT

This option is not available for IRB 1400H and not together with 67A-D/671-674

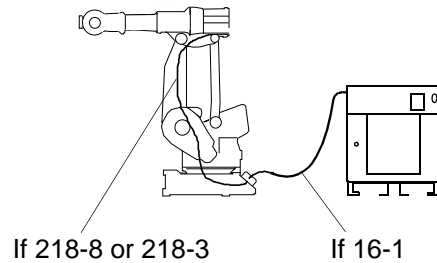
### Connection to

#### 16-2 Manipulator

The signals are connected directly to the manipulator base to one 12-pin Burndy connector, see option 041.

#### 16-1 Cabinet

The signals are connected to 12-pole screw terminals, Phoenix MSTB 2.5/12-ST-5.08, to the the controller.



### Connection to cabinet (Cable lengths)

94-1	7m
94-2	15m
94-3	22m
94-4	30m

## EQUIPMENT

#### 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.

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

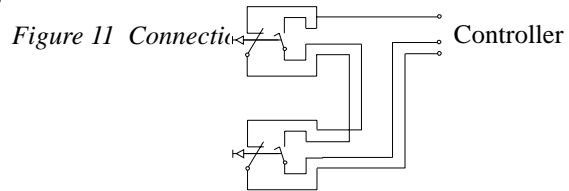
#### 27-1 Two switches, axis 1 stationary.

### Connection to

#### 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



### 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.

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

## WORKING RANGE LIMIT

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

- 28-1** **Axis 1**  
The working range of axis 1 can be limited. Using restriction stops, the working range can be limited from  $+150^{\circ}/-150^{\circ}$  to the smallest working range which is  $\pm 50^{\circ}$ . The restriction between  $50^{\circ}$  and  $150^{\circ}$  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  $+50^{\circ} / -30^{\circ}$  (for floor mounted version),  $-20^{\circ} / -60^{\circ}$  (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 can move a maximum of  $10^{\circ}$  above the horizontal line.

*Specification of Variants and Options*

---

---

## **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 S4Cplus, and Product Specification RobotWare Options.

### **Robot Peripherals**

- Track Motion
- Tool System
- Motor Units

## *Accessories*



---

---

## 4 Index

### A

accessories 21  
air supply 17

### C

connector kit 19  
cooling device 3

### D

dressing 18

### E

emergency stop 7  
enabling device 6  
equipment  
    mounting 11  
    permitted extra load 11  
extra equipment  
    connections 17

### F

fire safety 7

### H

hold-to-run control 7  
humidity 8

### I

installation 7

### L

load 7, 8  
load diagrams 10

### M

maintenance 12  
manipulator colours 17  
mechanical interface 12  
motion 13  
mounting

    extra equipment 11  
    robot 8  
mounting flange 12

### N

noise level 3

### O

operating requirements 8  
options 17  
overspeed protection 7

### P

payload 7  
performance 15  
position switch 18  
protection standards 8

### R

range of movement  
    working space 13  
reduced speed 6  
repeatability 15  
Robot Peripherals 21  
robot versions 3, 17

### S

safeguarded space stop 7  
    delayed 7  
safety 6  
safety lamp 7, 18  
service 12  
service position indicator 18  
signal connections 17  
space requirements 3  
standards 6  
structure 3

### T

temperature 8  
troubleshooting 12

## *Index*

### **U**

UL approved 6

### **V**

variants 17

### **W**

weight 3

working space  
restricting 7, 19