ROBOTICS

Product specification

IRB 14050

Trace back information:
Workspace 22B version a4
Checked in 2022-06-01
Skribenta version 5.5.019

Product specification
IRB 14050

Document ID: 3HAC064627-001
Revision: M

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Original instructions.

Table of contents

Overview of this specification

About this product specification

It describes the performance of the manipulator or a complete family of manipulators in terms of:

- The structure and dimensional prints
- The fulfilment of standards, safety and operating requirements
- The load diagrams, mounting of extra equipment, the motion and the robot reach
- The specification of variants and options available

The product specification also contains information for the controller.

Usage

Product specifications are used to find data and performance about the product, for example to decide which product to buy. How to handle the product is described in the product manual.

Users

It is intended for:

- Product managers and product personnel
- Sales and marketing personnel
- Order and customer service personnel

References

Document name	Document ID
Product manual, spare parts - IRB 14050	*3HAC064628-001*
Product specification - IRB 14050	*3HAC064627-001*
Product manual - Grippers for IRB 14050	*3HAC064626-001*
Circuit diagram - IRB 14050	*3HAC064375-009*
Safety manual for robot - Manipulator and IRC5 or OmniCore controller [i]	*3HAC031045-001*
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*
Product manual - OmniCore C30	*3HAC060860-001*
Technical reference manual - Event logs for RobotWare 7	*3HAC066553-001*
Technical reference manual - System parameters	*3HAC065041-001*
Application manual - Scalable I/O	*3HAC070208-001*
Application manual - Conveyor tracking	*3HAC066561-001*

[i] This manual contains all safety instructions from the product manuals for the manipulators and the controllers.

Revisions

Revision	Description
A	First edition.

Continues on next page

Continued

Revision	Description
B	Published in release 19C. The following updates are done in this revision: • Updated the section of Functional safety. See *Functional safety on page 22*.
C	Published in release 19D. The following updates are done in this revision: • Minor changes. • Added the section Unlisted options. See *Unlisted options on page 82*. • Updated dimension figure and base hole configuration figure. • Added the introduction of connection points.
D	Published in release 20A. The following updates are done in this revision: • The description of Type A added in robot description chapter. • Minor changes in section *Specification of variants and options*. • Updated robot arm dimension figure.
E	Published in release 20B. The following updates are done in this revision: • Corrected the quantity of washers for securing robot to the foundation. • Updated robot arm dimension.
F	Published in release 20C. The following updates are done in this revision: • Minor changes.
G	Published in release 20D. The following updates are done in this revision: • Added note about default configuration of emergency stop. • Warranty section updated.
H	Published in release 21A. The following updates are done in this revision: • Minor changes.
J	Published in release 21B. The following updates are done in this revision: • Clean room information added. • Typical production data regarding absolute accuracy calibration updated. • Removed Axis resolution.
K	Published in release 21C. The following updates are made in this revision: • Option [438-6] added.
L	Published in release 22A. The following updates are made in this revision: • Updated the table for Unlisted options.
M	Published in release 22B. The following updates are made in this revision: • Updated translations.

1 Description

1.1 Structure

1.1.1 Introduction to structure

General

The IRB 14050 is ABB Robotics first generation single arm robot with 7-axis, industrial robot, designed specifically for manufacturing industries that use flexible robot-based automation, e.g. 3C industry. The robot has an open structure that is especially adapted for flexible use, and can communicate extensively with external systems.

Continues on next page

1.1.1.1 Robot description

1.1.1.1.1 Robot type description

Type A of IRB 14050

The difference between IRB 14050 and IRB 14050 Type A is that the Type A has a reinforced design on the arm.

As a result of this, the following parts differ between types:

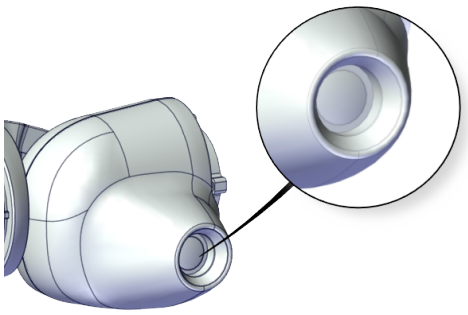
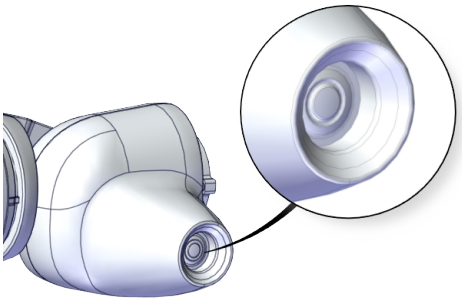
- Motor brake, axis 1 and axis 2
- Gearbox, axis 4 and axis 5
- Mechanical design, axis 4 and axis 5
- Cable harness design

Those robots in original design are simply named IRB 14050 (no-type-specified).

How to know which type the robot is?

The following characteristics can be used to figure out the robot type.

Axis 5 appearance

IRB 14050 (no-type-specified)	IRB 14050 Type A
 xx1900001956	 xx1900001957

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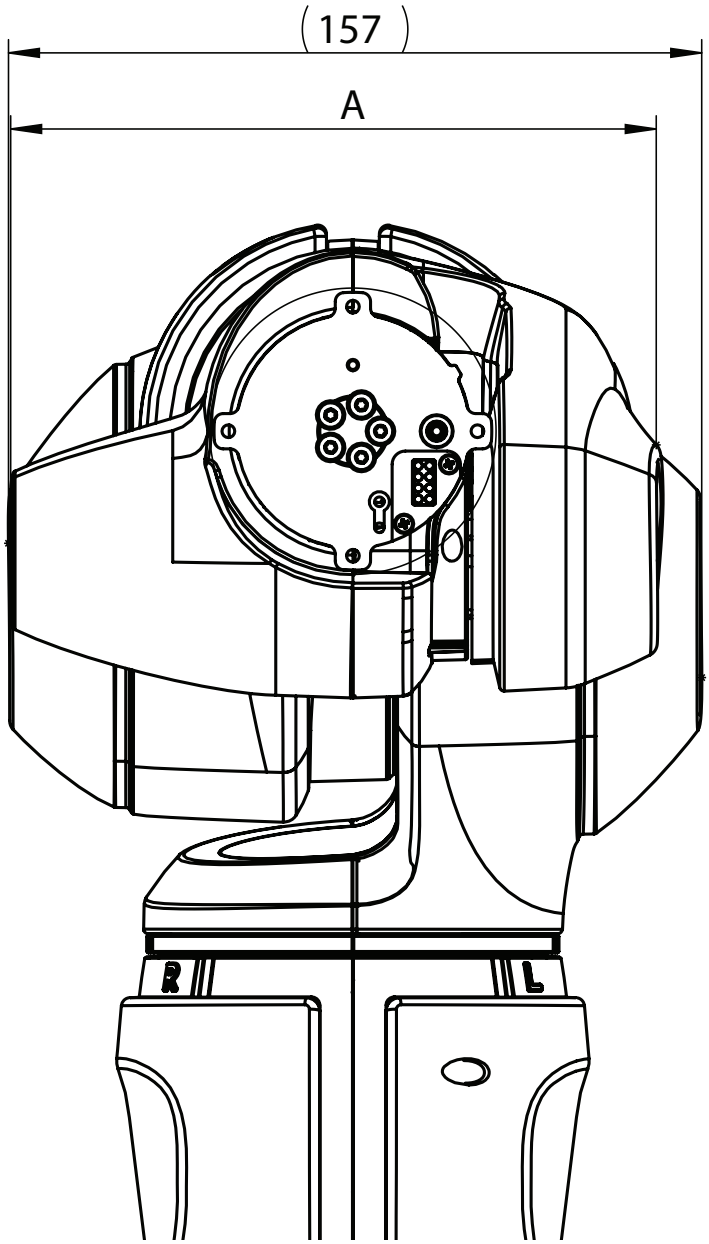
Robot dimension



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	IRB 14050 (no-type-specified)	IRB 14050 Type A
A	137 mm	146 mm

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1.1.1.1.1 Robot type description
Continued

Arm configuration during system installation

The robot type must be correctly selected when setting the arm configuration during system installation, otherwise, unexpected motion error or performance issues may occur.

Type A is available for selection as below only in RobotStudio 2019.5.3 or later and RobotWare 7.0.3 or later.

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Clean room classification

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Particle emission from the robot IRB 14050 fulfill Clean room class 6 standard according to DIN EN ISO 14644-1, -14.

According to IPA test result, the robot IRB 14050 is suitable for use in clean room environments.

Classification of airborne molecular contamination, see below:

Test environment parameters				
Cleanroom Air Cleanliness Class (According to ISO 14644-1)	Airflow velocity	Airflow pattern	Temperature	Relative humidity
ISO 1	0.45 m/s	vertical laminar flow	22°C ± 0.5°C	45% ± 0.5%

Test procedure parameters				
Capacity	Attached payload	Pressure of ultraclean air	Operation of each arm	Operation of each axis
50% and 100%	0.5 kg	N/A	N/A	separately

Test result/Classification:

When operated under the specified test conditions, the IRB 14050 is suitable for use in cleanrooms fulfilling the specifications of the following Air Cleanliness Classes according to ISO 14644-1.

Test parameter(s)	Air Cleanliness Class
Capacity=50%	6
Capacity=100%	6
Overall result	6

Protection

The robot has IP30 protection.

Operating system

The robot is controlled by the controller (separated) which is equipped with robot control software, RobotWare. RobotWare supports every aspect of the robot system, such as motion control, development and execution of application programs, communication etc. See *Operating manual - OmniCore*.

Safety

The safety standards are valid for the complete robot.

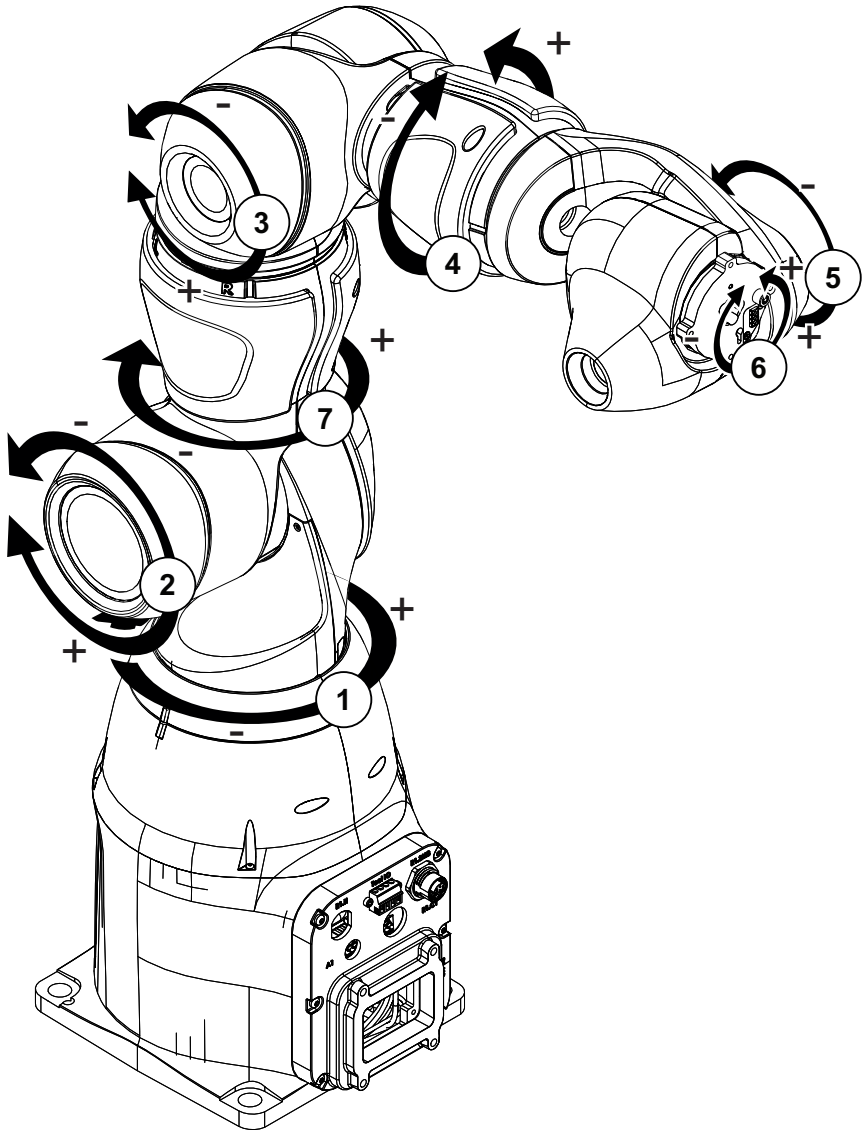
Additional functionality

For additional functionality, the robot can be equipped with optional software for application support, for example communication features, network communication, and advanced functions such as multitasking, sensor control etc.

For a complete description on optional software, see the *Product specification - OmniCore C line*.

1.1.1.1.1 Robot type description
Continued

Arm axes



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1.1.2 The Robot

General

The IRB 14050 can only be mounted on floor, wall and ceiling, no other mounting position is permitted.

Robot	Handling capacity (kg)	Reach (m)
IRB 14050	0.5 kg	0.559 m

Manipulator weight

Data	Weight
IRB 14050	9.48 kg (without gripper)

Other technical data

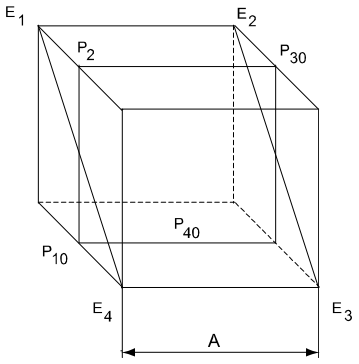
Data	Description	Note
Airborne noise level	The sound pressure level outside	< 70 dB (A) Leq (acc. to the working space Machinery directive 2006/42/EG)

Power consumption

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

Type of movement	Power consumption (kW)
Average power consumption	< 0.17 kW

Robot in 0 degree position	IRB 14050
Brakes engaged	0.09 kW
Brakes disengaged	0.14 kW



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Position	Description
A	250 mm

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1.1.2 The Robot
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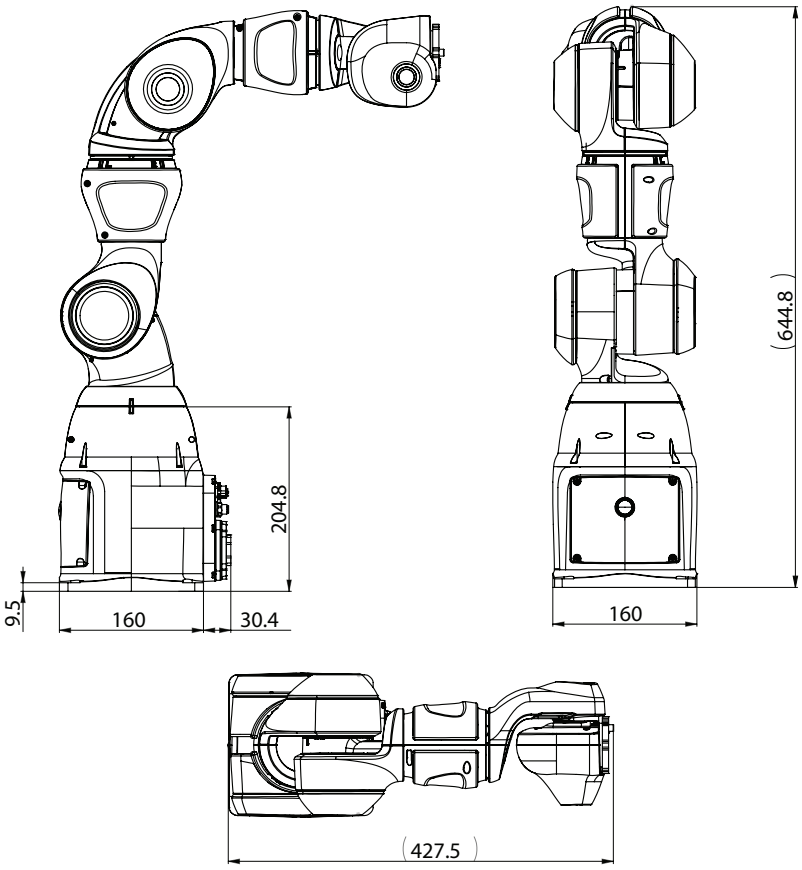
Dimensions

Manipulator with rear connector interface



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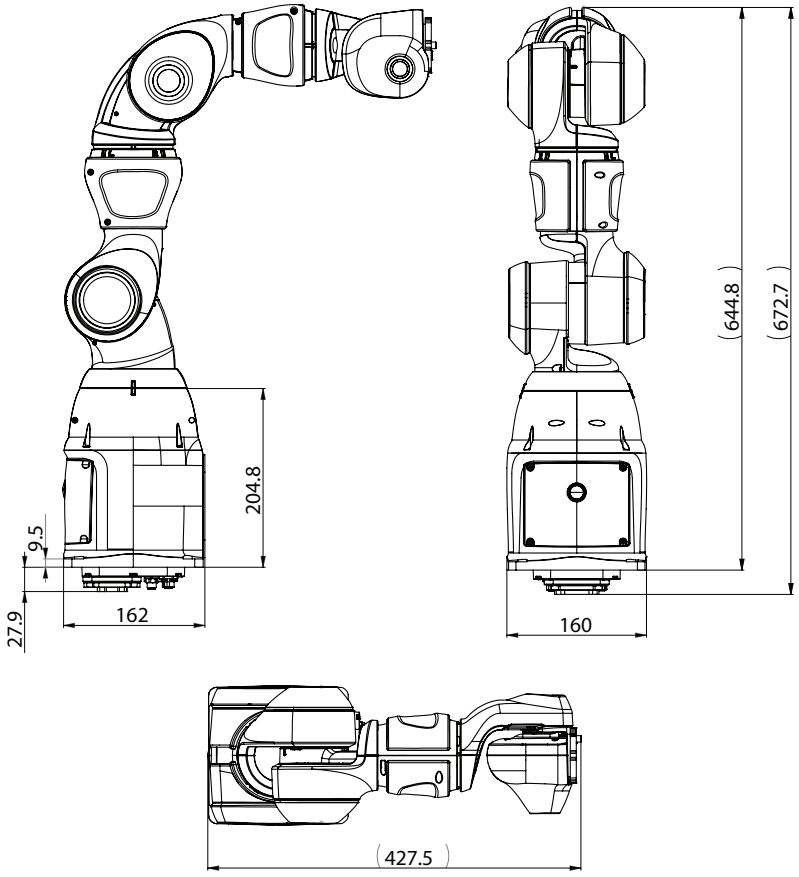
Manipulator with bottom connector interface (option 3309-1)



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1.1.2 The Robot
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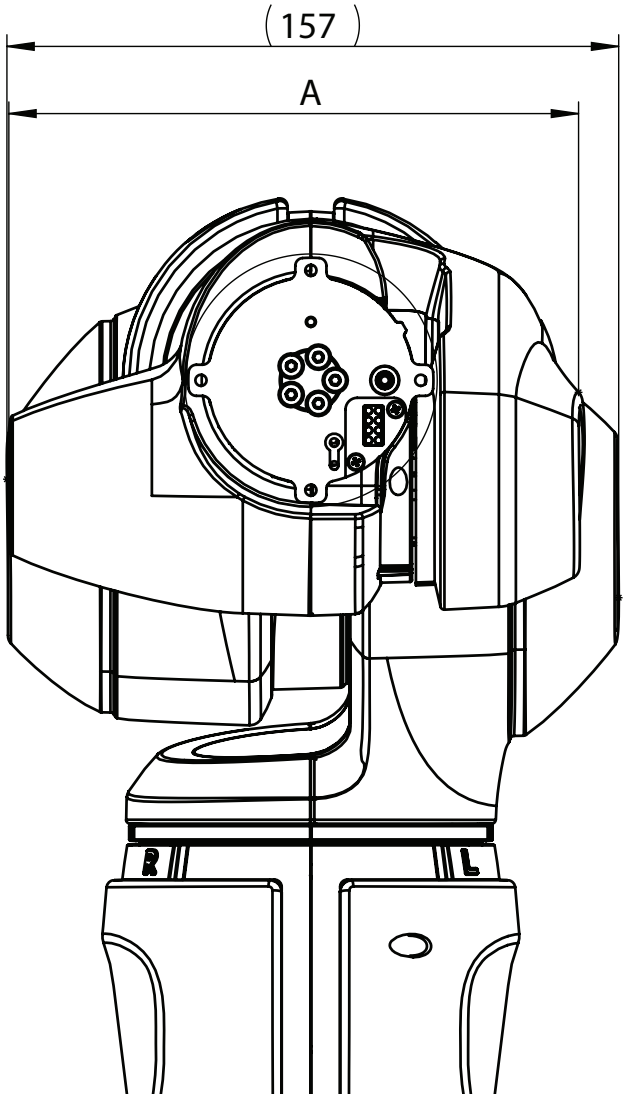
Robot arms



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	IRB 14050 (no-type-specified)	IRB 14050 Type A
A	137 mm	146 mm

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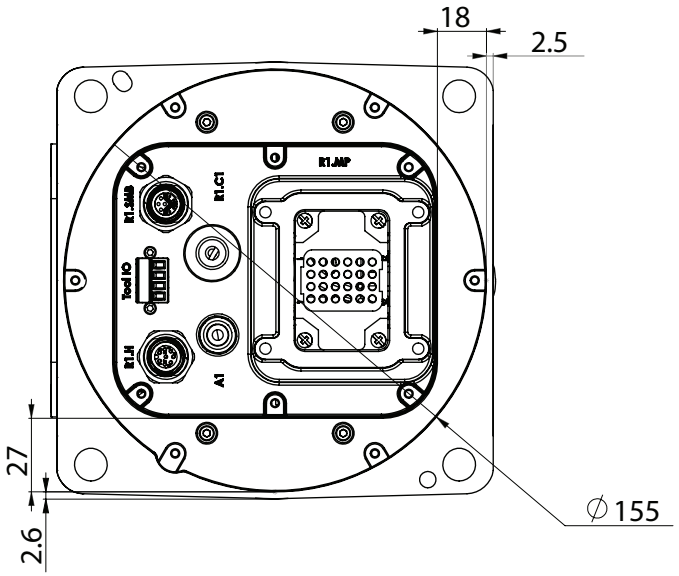
Robot base



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1.2 Safety

1.2.1 Applicable standards

General

The product is compliant with ISO 10218-1:2011, *Robots for industrial environments - Safety requirements - Part 1 Robots*, and applicable parts in the normative references, as referred to from ISO 10218-1:2011. In case of deviation from ISO 10218-1:2011, these are listed in the declaration of incorporation. The declaration of incorporation is part of the delivery.

Robot standards

Standard	Description
ISO 9283	Manipulating industrial robots – Performance criteria and related test methods
ISO 9787	Robots and robotic devices – Coordinate systems and motion nomenclatures
ISO 9946	Manipulating industrial robots – Presentation of characteristics

Other standards used in design

Standard	Description
IEC 60204	Safety of machinery - Electrical equipment of machines - Part 1: General requirements, normative reference from ISO 10218-1
IEC 61000-6-2	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments
IEC 61000-6-4	Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments
ISO 13849-1:2006	Safety of machinery - Safety related parts of control systems - Part 1: General principles for design, normative reference from ISO 10218-1
IEC 61340-5-1	Protection of electronic devices from electrostatic phenomena - General requirements
ISO/TS 15066	Robots and robotic devices - Collaborative robots This Technical Specification specifies safety requirements for collaborative industrial robot systems and the work environment, and supplements the requirements and guidance on collaborative industrial robot operation given in ISO 10218-1 and ISO 10218-2.

Region specific standards and regulations

Standard	Description
ANSI/RIA R15.06	Safety requirements for industrial robots and robot systems
ANSI/UL 1740	Safety standard for robots and robotic equipment
CAN/CSA Z 434-03	Industrial robots and robot Systems - General safety requirements

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Standard	Description
ANSI/ESD S20.20	Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)
EN ISO 10218-1	Robots and robotic devices — Safety requirements for industrial robots — Part 1: Robots

Deviations

Deviations from ISO 10218-1:2011 for IRB 14050

The IRB 14050 is by default always in collaborative operation.

Requirement	Deviation for IRB 14050	Motivation
§5.7.3 & §5.8.3 Enabling device	The enabling device on FlexPendant is only active, when a SafeMove configuration is active.	The IRB 14050 robot is intended for collaborative applications where contact between robot and the operator is harmless. An enabling device does not further contribute to a risk reduction.

1.2.2 Safety functions

Emergency stops

The configuration of emergency stops is stop category 1 and cannot be changed when using RobotWare 7.1 or later.

The axes 4-5-6 can drop when a robot stopping function triggers motors OFF status, because there are no holding brakes on these motors.

Note

The robot application shall be designed so that when the robot is in Motors OFF state, changing the position in axes 4, 5, or 6 will not cause any additional hazards.

The robot stopping functions can trigger Motors OFF state.

Functional safety

The following safety functions are inherent design measures in the control system, contributing to power and force limiting. They are category B, performance level b, according to EN ISO 13849-1.

Safety functions	Description
Cartesian speed supervision	The Cartesian speed of the elbow (arm check point, ACP) and the wrist (wrist center point, WCP) are supervised. If a limit is exceeded, the robot motion is stopped and a message displayed to the user. The default speed limit can be modified based on the risk assessment of the robot installation. The function is active in both manual and automatic mode. The speed limits are set by system parameters. See *Technical reference manual - System parameters*.

Additional safety features in the control system

Safety functions	Description
Three-position enabling device	The FlexPendant is always equipped with a three-position enabling device, but for the IRB 14050 system the enabling device is not used. Therefore the enabling device is disabled and inactive when the FlexPendant is connected to an IRB 14050 system, but it is enabled and active when connected to another robot.
Collision detection	In case of an unexpected mechanical disturbance, like a collision, the robot will stop and then slightly back off from its stop position.
Fire safety	The robot system complies with the requirements of UL (Underwriters Laboratories) for fire safety.
Electrical safety	The robot system complies with the requirements of UL for electrical safety.

1.3 Installation

Introduction to installation

IRB 14050 is intended for use in industrial environment.

An arm can handle a maximum payload of 0.5 kg.

Continues on next page

1.3.1 Operating requirements

Protection standard

Robot variant	Protection standard IEC529
Manipulator + controller	IP30

Explosive environments

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

Working range limitations

EPS will not be selectable and no mechanical limitations available.

Ambient temperature

Description	Standard/Option	Temperature
Manipulator + controller during operation	Standard	+ 5°C [i] (41°F) to + 40°C (104°F)
Complete robot during transportation and storage	Standard	- 10°C (14°F) to + 55°C (131°F)

[i] At low environmental temperature < 10ºC is, as with any other machine, a warm-up phase recommended to be run with the robot. Otherwise there is a risk that the robot stops or run with lower performance due to temperature dependent oil and grease viscosity.

Relative humidity

Description	Relative humidity
Complete robot during operation, transportation and storage	Max. 85% at constant temperature

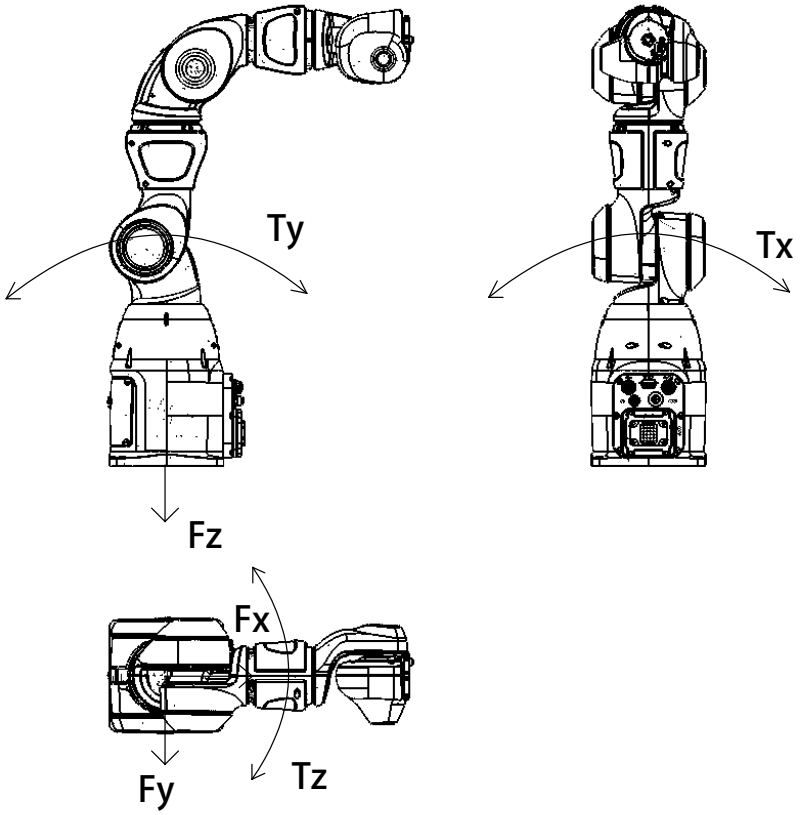
1.3.2 Mounting the manipulator

Maximum load

Maximum load in to the base coordination system. See Figure below.

Table mounted

Force	Endurance load (in operation)	Max. load (emergency stop)
Force x	±42.7 N	±158.6 N
Force y	±42.03 N	±153.19 N
Force z	75.65±36 N	75.65±87.34 N
Torque x	±30.52 Nm	±91.47 Nm
Torque y	±30 Nm	±95.07 Nm
Torque z	±12.32 Nm	±14.83 Nm



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F_x	Force in the X plane
F_y	Force in the Y plane
F_z	Force in the Z plane

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1.3.2 Mounting the manipulator
Continued

T_x	Bending torque in the X plane
T_y	Bending torque in the Y plane
T_z	Bending torque in the Z plane

The table shows the various forces and torques working on the robot during different kinds of operation.

Note

These forces and torques are extreme values that are rarely encountered during operation. The values also never reach their maximum at the same time!

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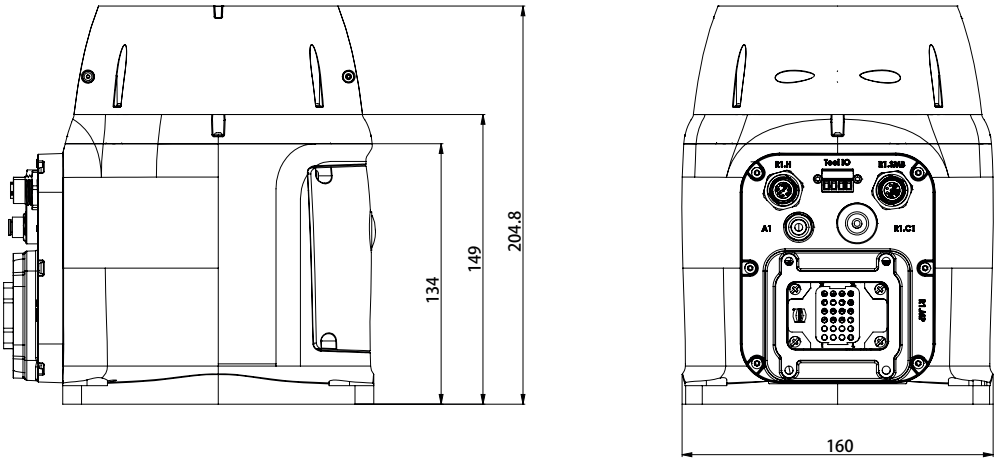
Fastening holes robot base

The illustration shows the hole configuration used when securing the robot.



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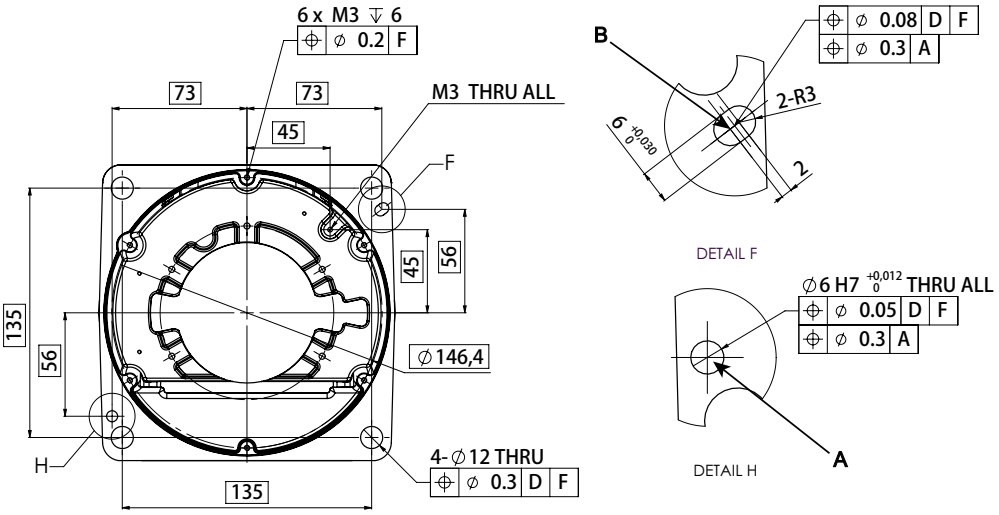

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A	Master hole (round)
B	Alignment hole (slot)

Attachment bolts, specification

The table specifies the type of securing screws and washers to be used to secure the robot directly to the foundation. It also specifies the type of pins to be used.

Suitable screws	M10x25
Suitable washers	10.5x20x2
Quantity	4 pcs
Quality	8.8
Guide pins	2 pcs, article number 3HNP00449-1
Tightening torque	40 Nm

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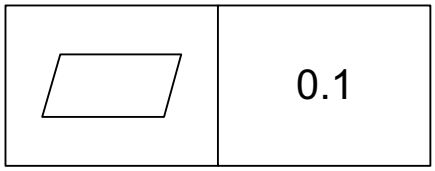
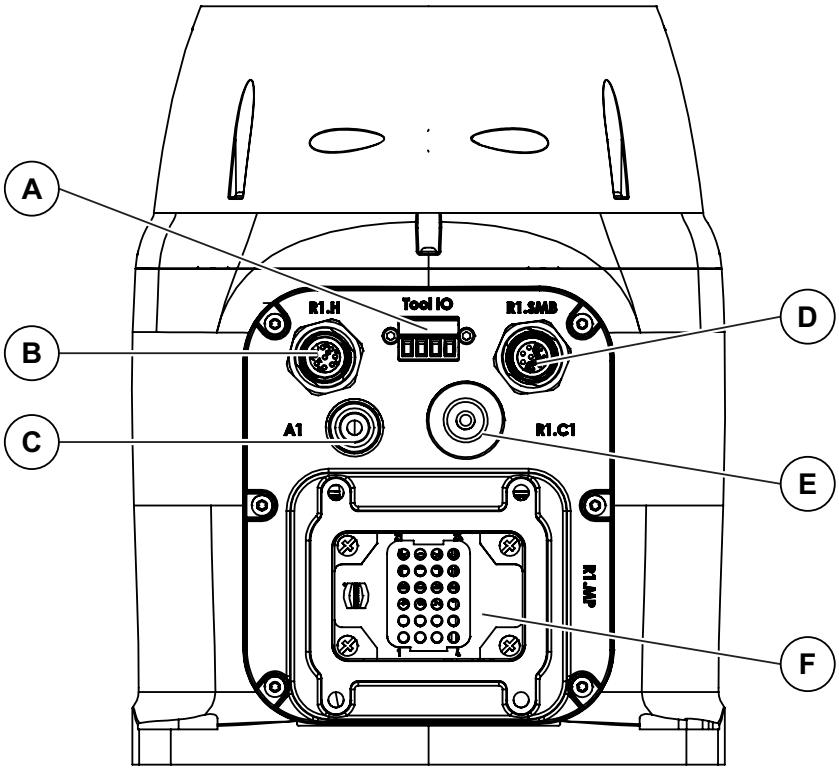
1.3.2 Mounting the manipulator
Continued

Level surface requirement	 xx1500000627

Connection points

These figures show the location of the connection points.



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	Name	Note
A	Tool I/O	4x digital I/O signals to the tool flanges, to be cross connected with M12.X3. This is alternative to Ethernet on the tool flange.
B	R1.H	Hybrid connector to provide Ethernet and 24VDC power to Ethernet I/O module, hall sensor and gripper.
C	A1	OD 4 mm air hose, 0.5 MPa air pressure.
D	R1.SMB	Transfers resolver data from and power supply to the serial measurement board.
E	R1.C1	Cable inlet reserved for customer signals which is connected from the I/O module inside base.
F	R1.MP	Transfers drive power from the drive units in the control cabinet to the robot motors.

1.4 Load diagram

1.4.1 Introduction to load diagram

Information

WARNING

It is very important to always define correct actual load data and correct payload of the robot. Incorrect definitions of load data can result in overloading of the robot.

If incorrect load data is used, and/or if loads outside the load diagram are used, the following parts can be damaged due to overload:

- motors
- gearboxes
- mechanical structure

WARNING

In RobotWare, the service routine LoadIdentify can be used to determine correct load parameters. The routine automatically defines the tool and the load.

See *Operating manual - OmniCore*, for detailed information.

WARNING

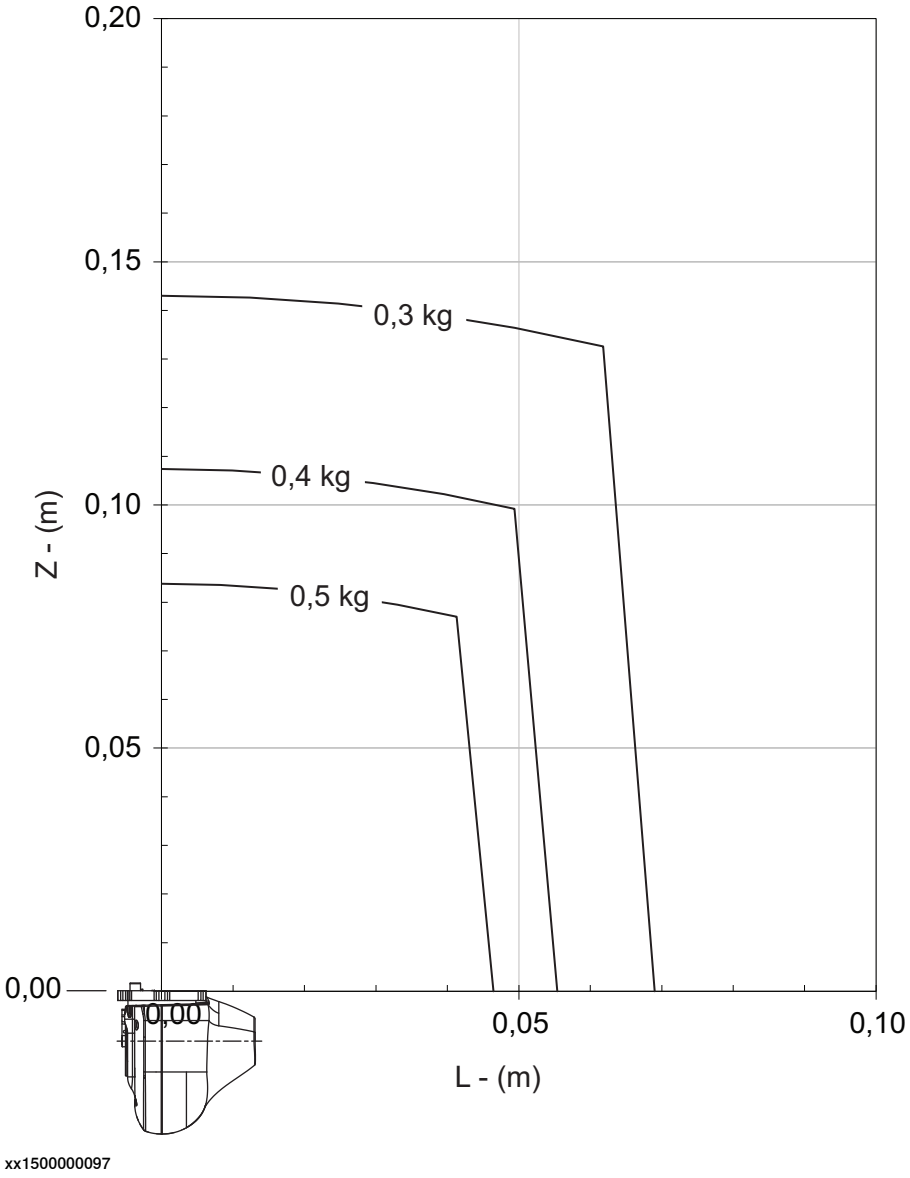
Robots running with incorrect load data and/or with loads outside the load diagram, will not be covered by robot warranty.

General

The load diagram includes a nominal pay load inertia, J_0 of 0.001 kgm^2. At different moment of inertia the load diagram will be changed. For robots that are allowed tilted, wall or inverted mounted, the load diagrams as given are valid and thus it is also possible to use RobotLoad within those tilt and axis limits.

1.4.2 Load diagram

IRB 14050 - 0.5/0.5 (without gripper)



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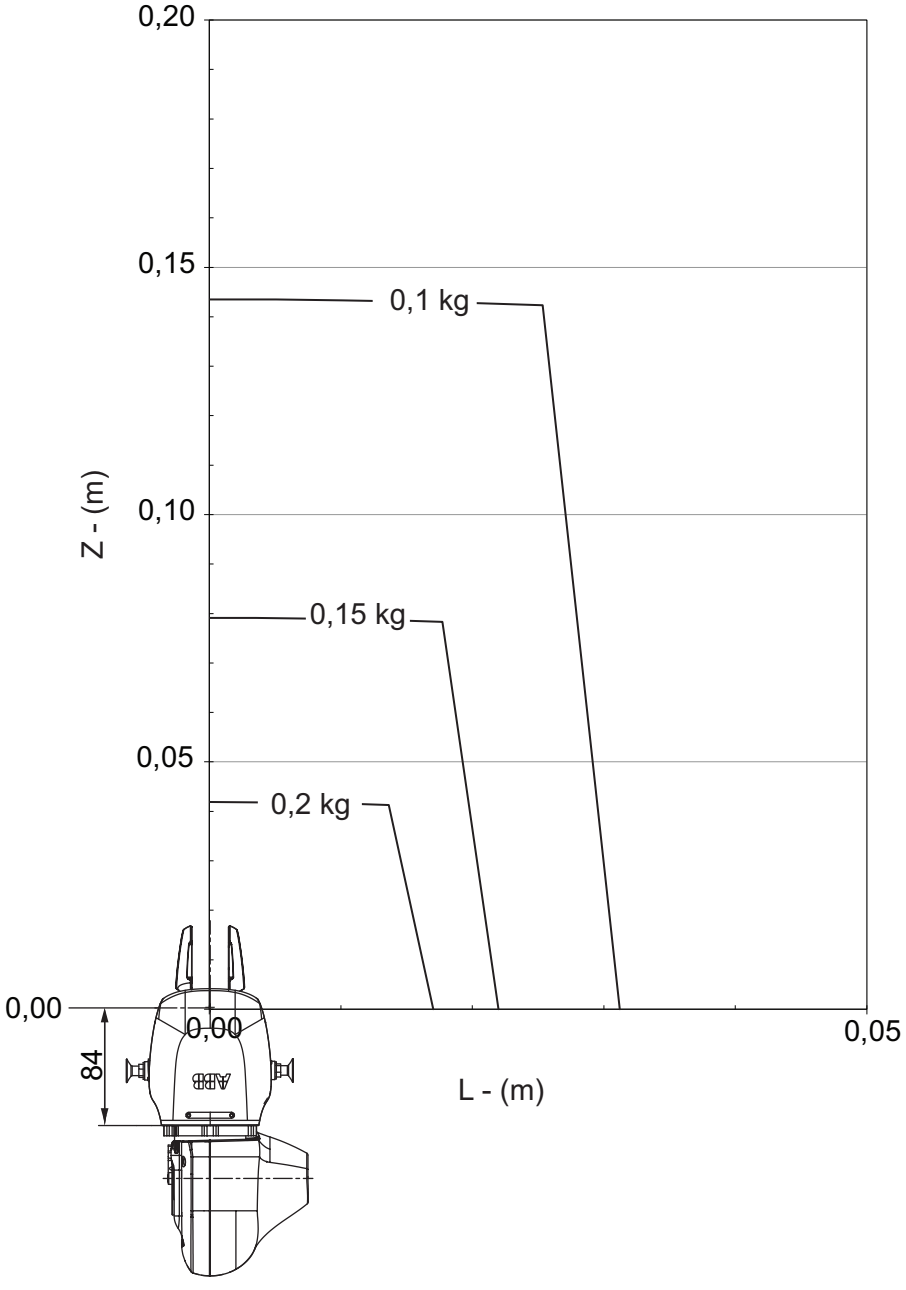
IRB 14050 - 0.5/0.5(with gripper)

Hand CoG, see table below.



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Mass	Z	L
280 g	47.3 mm	13.9 mm

The load diagram with gripper is an example, given for the heaviest combination of IRB 14050 Gripper options (servo + 2 vacuum modules), including fingers and suction tools. Actual load capacity should be determined from the robot load diagram and the mass data of the actual gripper and end effectors.

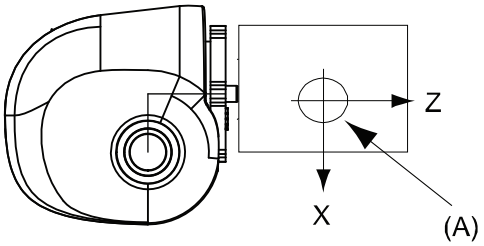
1.4.3 Maximum load and moment of inertia

General

Total load given as: Mass in kg, center of gravity (Z and L) in m and moment of inertia (J_{0x}, J_{0y}, J_{0z}) in kgm^2. $L = \sqrt{(X^2 + Y^2)}$.

Full movement

Axis	Robot variant	Max. value
5	IRB 14050 - 0.5/0.5	J_5 = Mass x $((Z + 0.045)^2 + L^2)$ + max (J_{0x}, J_{0y}) ≤ 0.012 kgm^2
6	IRB 14050 - 0.5/0.5	J_6 = Mass x L^2 + J_{0Z} ≤ 0.009 kgm^2



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Position	Description
A	Center of gravity
J_{0x}, J_{0y}, J_{0z}	Max. moment of inertia around the X, Y and Z axes at center of gravity.

Wrist torque

The table below shows the maximum permissible torque due to payload.

Note

The values are for reference only, and should not be used for calculating permitted load offset (position of center of gravity) within the load diagram, since those also are limited by main axes torques as well as dynamic loads. Also arm loads will influence the permitted load diagram, contact your local ABB organization.

Robot variant	Max wrist torque axes 4 and 5	Max wrist torque axis 6	Max torque valid at load
IRB 14050	0.64 Nm	0.23 Nm	0.5 kg

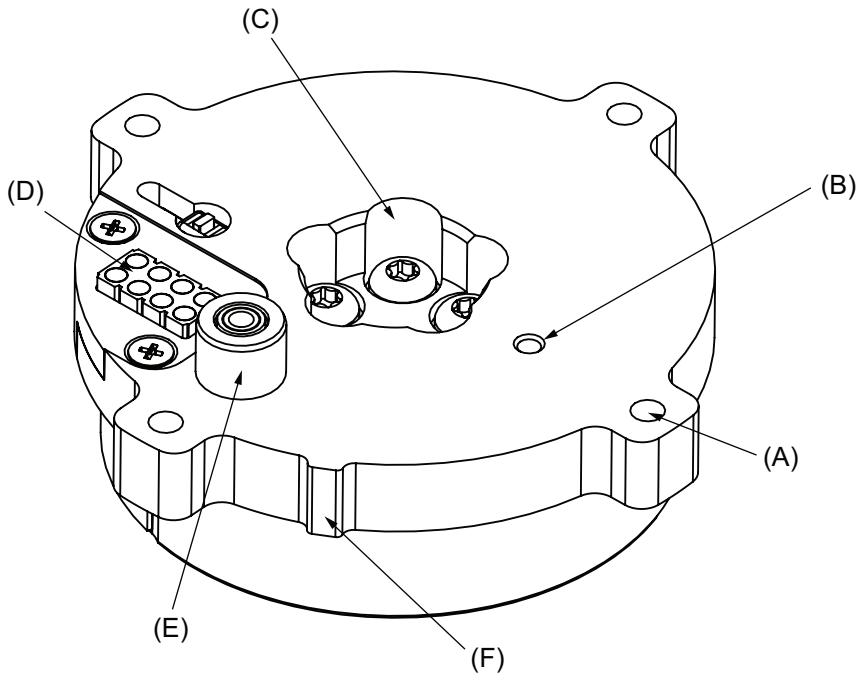
1.5 Mounting of equipment

1.5.1 General

Each arm ends with a tool flange, for mounting of available grippers, see *Grippers on page 49* or for customer specific equipment and on robot.

Below is an overview of the robot and tool flange, see *Tool flange on page 34* for details.

1.5.2 Tool flange



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Pos	Description
A	4 x 2.9 thru holes for M2.5 screws
B	2E8 pin hole for alignment
C	15H7 for alignment, max depth 5 mm
D	Mill-Max (430-10-208-00-240000), spring-loaded header, double row 8 pad connector for 24V and Ethernet or IO
E	Outer diam. 7.5e8 and inner diam. 4.4F10 for air hose
F	Calibration mark for axis 6

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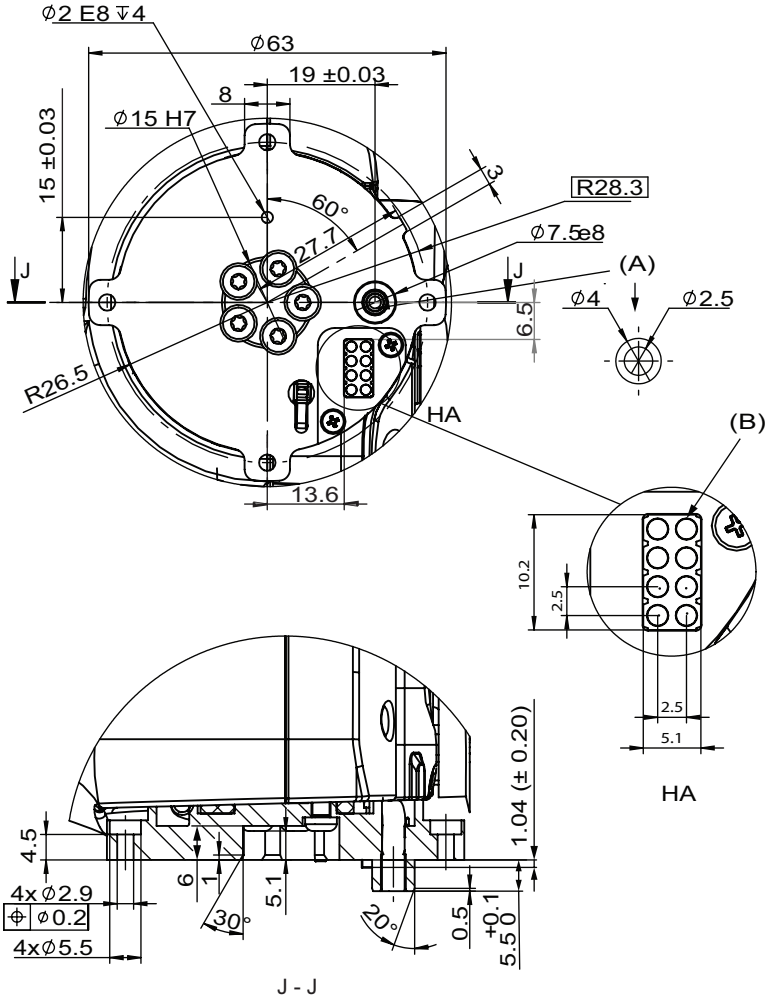

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Pos	Description
A	Dimensions air hose
B	Mill-Max (430-10-208-00-240000), spring-loaded header, double row 8 pad connector

1.6 Calibration

1.6.1 Calibration methods

Overview

This section specifies the different types of calibration and the calibration methods that are supplied by ABB.

More information is available in the product manual.

Types of calibration

Type of calibration	Description	Calibration method
Standard calibration	The calibrated robot is positioned at calibration position. Standard calibration data is found on the SMB (serial measurement board) or EIB in the robot.	
Absolute accuracy calibration (optional)	Based on standard calibration, and besides positioning the robot at synchronization position, the Absolute accuracy calibration also compensates for: • Mechanical tolerances in the robot structure • Deflection due to load Absolute accuracy calibration focuses on positioning accuracy in the Cartesian coordinate system for the robot. Absolute accuracy calibration data is found on the SMB (serial measurement board) in the robot. A robot calibrated with Absolute accuracy has the option information printed on its name plate. To regain 100% Absolute accuracy performance, the robot must be recalibrated for absolute accuracy after repair or maintenance that affects the mechanical structure.	CalibWare

Brief description of calibration methods

CalibWare - Absolute Accuracy calibration

The CalibWare tool guides through the calibration process and calculates new compensation parameters. This is further detailed in the *Application manual - CalibWare Field*.

If a service operation is done to a robot with the option Absolute Accuracy, a new absolute accuracy calibration is required in order to establish full performance. For most cases after replacements that do not include taking apart the robot structure, standard calibration is sufficient.

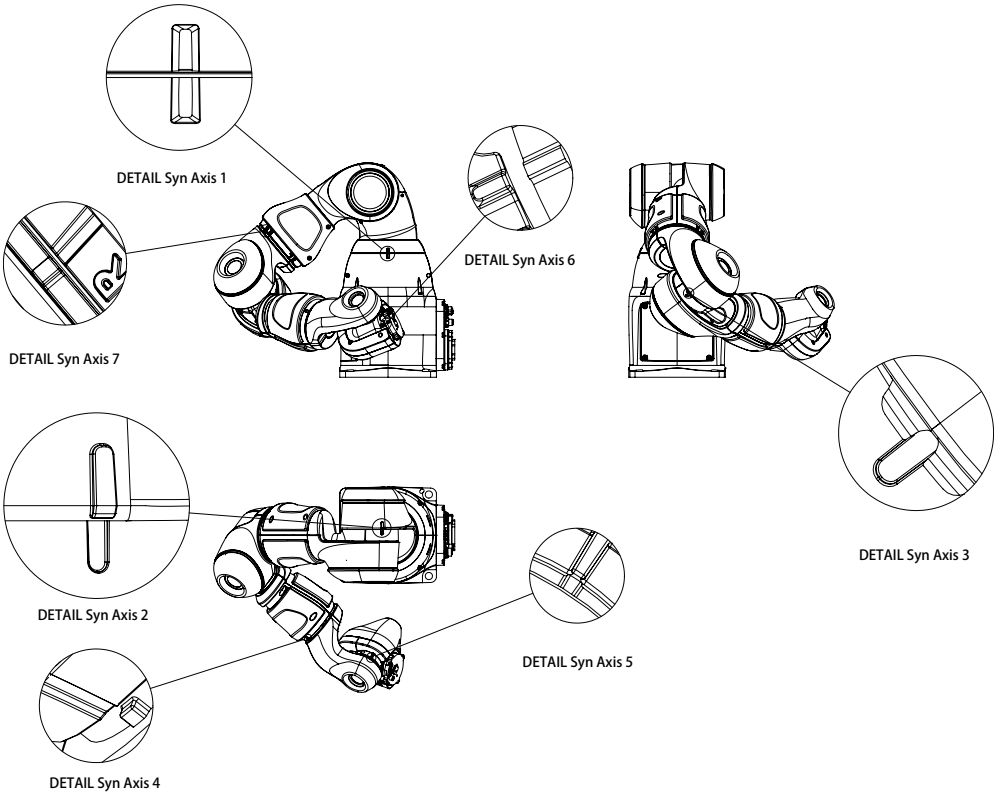
The Absolute Accuracy option varies according to the robot mounting position. This is printed on the robot name plate for each robot. The robot must be in the correct mounting position when it is recalibrated for absolute accuracy.

1.6.2 Fine calibration

General

Fine calibration is made by moving the axes so that the synchronization mark on each joint is aligned, and running the CalHall routine.

For detailed information on calibration of the robot see *Product manual - IRB 14050*.



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1.6.3 Absolute Accuracy calibration

Purpose

Absolute Accuracy is a calibration concept that improves TCP accuracy. The difference between an ideal robot and a real robot can be several millimeters, resulting from mechanical tolerances and deflection in the robot structure. *Absolute Accuracy* compensates for these differences.

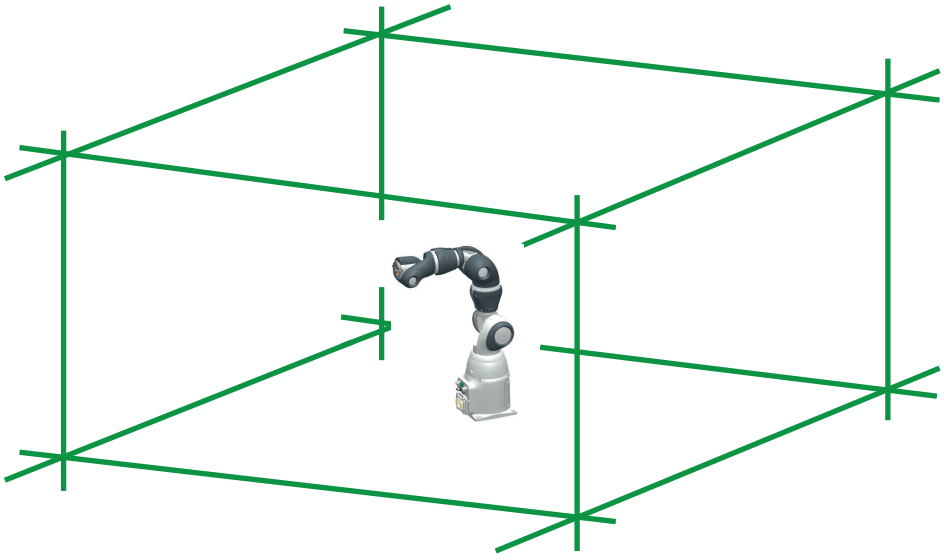
Here are some examples of when this accuracy is important:

- Exchangeability of robots
- Offline programming with no or minimum touch-up
- Online programming with accurate movement and reorientation of tool
- Programming with accurate offset movement in relation to eg. vision system or offset programming
- Re-use of programs between applications

The option *Absolute Accuracy* is integrated in the controller algorithms and does not need external equipment or calculation.

Note

The performance data is applicable to the corresponding RobotWare version of the individual robot.



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What is included

Every *Absolute Accuracy* robot is delivered with:

- compensation parameters saved on the robot's serial measurement board
- a birth certificate representing the *Absolute Accuracy* measurement protocol for the calibration and verification sequence.

A robot with *Absolute Accuracy* calibration has a label with this information on the manipulator.

Continues on next page

Absolute Accuracy supports floor mounted, wall mounted and ceiling mounted installations. Compensation parameters saved in the robot's serial measurement board differ depending on which Absolute Accuracy option is selected.

When is *Absolute Accuracy* being used

Absolute Accuracy works on a robot target in Cartesian coordinates, not on the individual joints. Therefore, joint based movements (e.g. `MoveAbsJ`) will not be affected.

If the robot is inverted, the Absolute Accuracy calibration must be performed when the robot is inverted.

Absolute Accuracy active

Absolute Accuracy will be active in the following cases:

- Any motion function based on robtargets (e.g. `MoveL`) and ModPos on robtargets
- Reorientation jogging
- Linear jogging
- Tool definition (4, 5, 6 point tool definition, room fixed TCP, stationary tool)
- Work object definition

Absolute Accuracy not active

The following are examples of when Absolute Accuracy is not active:

- Any motion function based on a jointtarget (`MoveAbsJ`)
- Independent joint
- Joint based jogging

RAPID instructions

There are no RAPID instructions included in this option.

Precision and tolerances

Typical production data regarding absolute accuracy calibration are:

Robot	Global absolute accuracy (mm)		
	Average	Max	% Within 1 mm
IRB 14050 - 0.5/0.5	0.25	0.45	100

1.7 Maintenance and troubleshooting

1.7.1 Introduction to maintenance and trouble shooting

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.
- Grease used for all gear boxes.
- The cabling is routed for longevity.
- It has a program memory “battery low” alarm.

Maintenance

The maintenance intervals depend on the use of the robot, the required maintenance activities also depends on selected options. For detailed information on maintenance procedures, see Maintenance section in the Product Manual.

1.8 Robot motion

1.8.1 Working range and type of motion

Robot motion

Axis	Type of motion	Degree of motion
Axis 1	Arm - Rotation motion	-168.5° to +168.5°
Axis 2	Arm - Bend motion	-143.5° to +43.5°
Axis 7	Arm - Rotation motion	-168.5° to +168.5°
Axis 3	Arm - Bend motion	-123.5° to +80°
Axis 4	Wrist - Rotation motion	-290° to +290°
Axis 5	Wrist - Bend motion	-88° to +138°
Axis 6	Flange - Rotation motion	-229° to +229°

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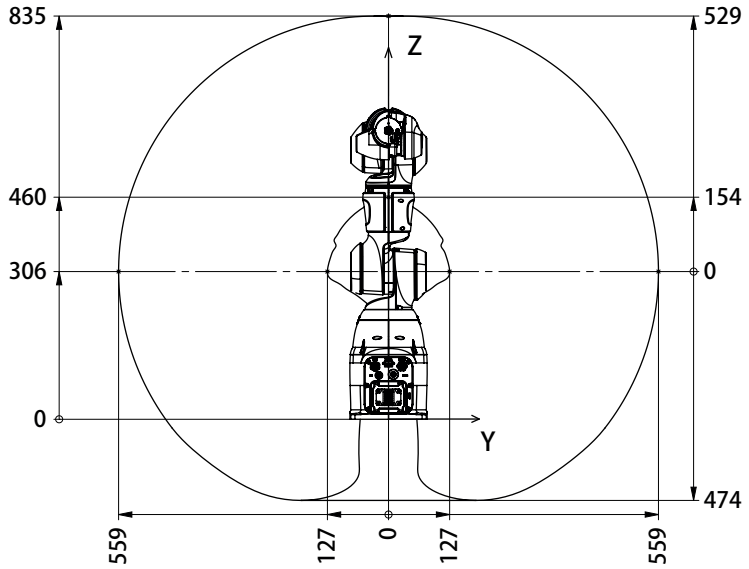
1.8.1 Working range and type of motion
Continued

Illustration, working range IRB 14050

The illustrations show the unrestricted working range of the robot.

Front view



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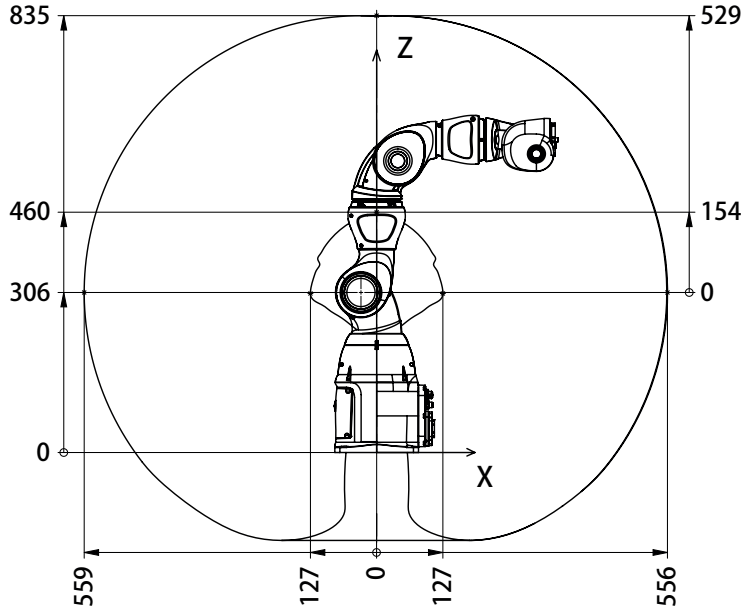
Side view



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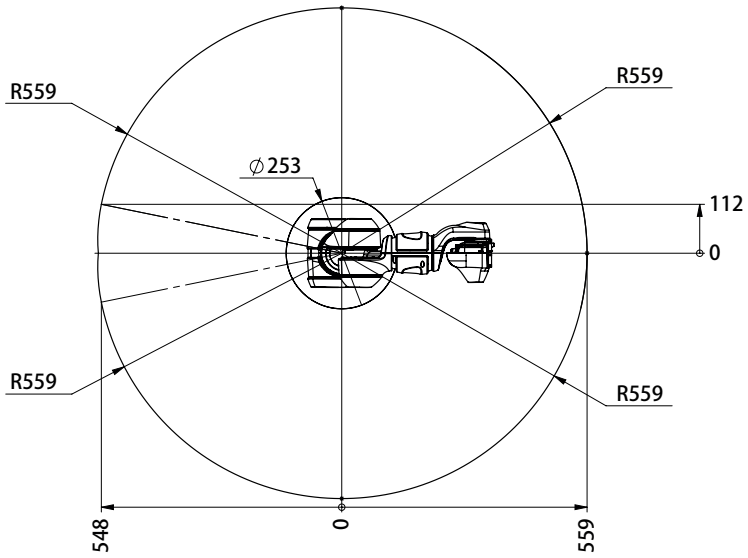
Top view



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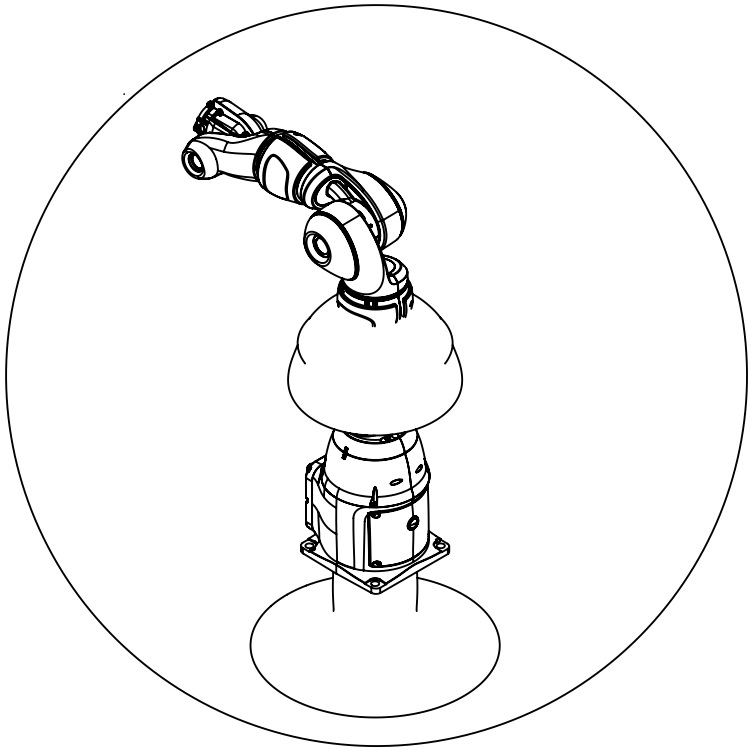
Isometric view



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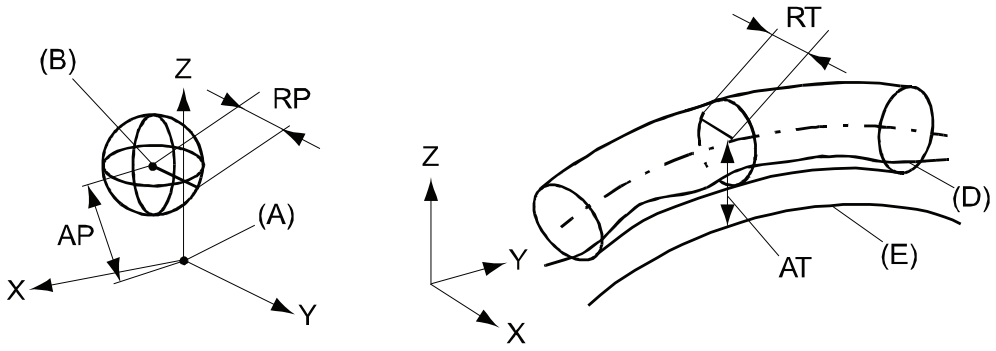
1.8.2 Performance according to ISO 9283

General

At rated maximum load, maximum offset and 1.5 m/s velocity on the inclined ISO test plane, with all six axes in motion. Values in the table below are the average result of measurements on a small number of robots. The result may differ depending on where in the working range the robot is positioning, velocity, arm configuration, from which direction the position is approached, the load direction of the arm system. Backlashes in gearboxes also affect the result.

The figures for AP, RP, AT and RT are measured according to figure below.



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Position	Description	Position	Description
A	Programmed position	E	Programmed path
B	Mean position at program execution	D	Actual path at program execution
AP	Mean distance from programmed position	AT	Max deviation from E to average path
RP	Tolerance of position B at repeated positioning	RT	Tolerance of the path at repeated program execution

Description	Values
	IRB 14050
Pose repeatability, RP (mm)	0.02
Pose accuracy, AP (mm)	0.02
Linear path repeatability, RT (mm)	0.10
Linear path accuracy, AT (mm)	1.36
Pose stabilization time, Pst (s) within 0.1 mm of the position	0.37

1.8.3 Velocity

General

Robot variant	Axis 1	Axis 2	Axis 7	Axis 3	Axis 4	Axis 5	Axis 6
IRB 14050	180 °/s	180 °/s	180 °/s	180 °/s	400 °/s	400 °/s	400 °/s

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

1.8.4 Stopping distance / time

General

Stopping distance/time for emergency stop (category 0) at max speed, max stretched out and max load, categories according to EN 60204-1. All results are from tests on one moving axis. All stop distances are valid for floor mounted robot, without any tilting.

Category 0 stop

Robot variant	Axis	Stopping distance in degrees	Stop time (s)
IRB 14050	1	23	0.37
	2	23	0.37
	7	26	0.40
	3	26	0.40

Note

Axes 4, 5, and 6 may have small residual movements after the stop due to the influence of gravity and inertia.

1.9 Customer connections

Introduction to customer connections

Customer connection, the cables are integrated in the robot and the connectors are placed on the left side at the base and in the tool flange.

The tool flange is equipped with an 8-pole pad-type connector for signal and power. Positions E-H are for power (24V) and PE. Positions A-D are for signal, and can be either Ethernet or IO signals.

Upon delivery, the robot has Ethernet on the flange positions A-D. The Ethernet connection from each arm is routed to the LAN2 port on the main computer via an internal Ethernet switch in the controller. The user can reconnect inside the controller to instead get IO signals on the flanges. There is a female Ethernet connector waiting next to the Ethernet switch inside of the controller, by which flange positions A-D can instead be routed to XP12 on the left side panel of the controller. There, cross connections to DI and DO connectors XS8 and XS7 can easily be made.

On each flange, only one of Ethernet and IO signals can be used at the same time. When selecting the IRB 14050 SmartGrippers, Ethernet will be used, and the Tool IO signals on XP12 are not available on the flange. The Tool IO signals, on the other hand, can be used when integrating a basic pneumatic or electric gripper that is controlled by a small number of IO signals, and that is not Ethernet-based.

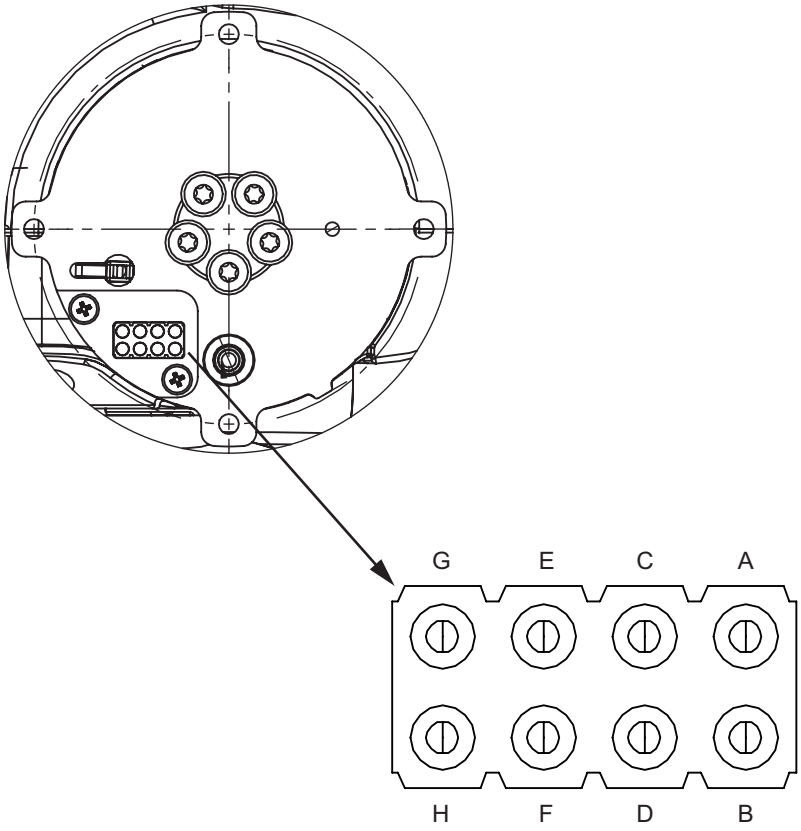
Continues on next page

1.9 Customer connections
Continued

Tool flange

Note

Customer signals (each arm) at tool flange is only available when no grippers are selected. Tool connector type, Spring-loaded Header Double row, Mill-Max (430-10-208-00-240000).



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Pin	Description
A	EtherNet RD-
B	EtherNet TD-
C	EtherNet RD+ (Max current = 2A, when not used as Ethernet signals)
D	EtherNet TD+ (Max current = 2A, when not used as Ethernet signals)
E	PE
F	Spare
G	0V, IO
H	24V, IO (Max current = 1 A/arm)

2 Grippers

2.1 Structure

2.1.1 Introduction

General

The IRB 14050 gripper is a smart, multifunctional gripper for part handling and assembly. The gripper has one basic servo module and two optional functional modules, vacuum and vision. The three modules can be combined to provide five different combinations for users in different applications.

A pair of getting-started fingers are provided together with the gripper for demo and test purposes. These fingers should be replaced with fingers designed for the actual application by the system integrator.

If the vacuum module option is selected, a first set of suction cups and filters are provided together with the gripper.

Note

It is the same gripper as for IRB 14000.

Protection

The IRB 14050 gripper has IP30 protection.

Communication

The IRB 14050 gripper communicates with the IRB 14050 controller over an Ethernet IP fieldbus. A RobotWare add-in, SmartGripper, is provided to facilitate the operation and programming of the gripper. The add-in contains RAPID driver, FlexPendant interface and configuration files.

Safety

The IRB 14050 gripper has a patented floating shell structure that helps absorb impacts during collisions. End effectors such as fingers and suction tools need to be designed for the actual application and included in the risk assessment by the system integrator.

2.1.2 Function modules

General

The functions of the three gripper modules are described as follows.

	Function module	Description
1	Servo	The servo module is the basic part of the gripper. It gives the function of gripping objects. Fingers are installed on the base of the servo module, and finger movement and force can be controlled and supervised.
2	Vacuum	The vacuum module contains the vacuum generator, vacuum pressure sensor and blow-off actuator. When the suction tools are mounted, the gripper can pick up objects by the suction function and place the objects by the blow-off function.
3	Vision	The vision module contains a Cognex AE3 In-Sight camera, supporting all functions of ABB Integrated Vision.

The three function modules can be combined into five different possibilities as listed in the following table.

	Combination	Includes...
1	Servo	One servo module
2	Servo + Vacuum	One servo module and one vacuum module
3	Servo + Vacuum 1 + Vacuum 2	One servo module and two vacuum modules
4	Servo + Vision	One servo module and one vision module
5	Servo + Vision + Vacuum	One servo module, one vision module, and one vacuum module

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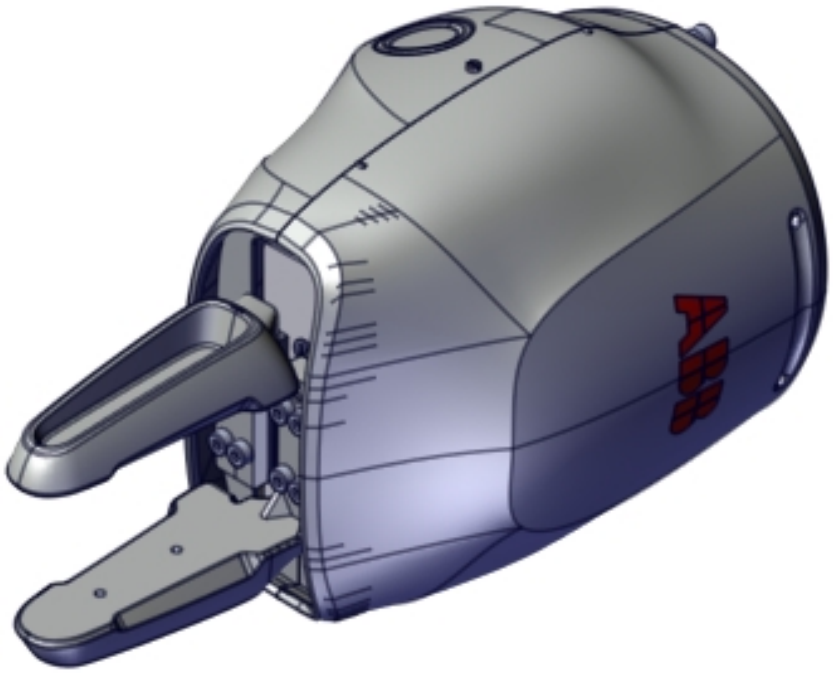
Combination views

Servo

The following figure illustrates the gripper with one servo module.



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2.1.2 Function modules
Continued

Servo + Vacuum

The following figure illustrates the gripper with one servo module and one vacuum module.

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Servo + Vacuum 1 + Vacuum 2

The following figure illustrates the gripper with one servo module and two vacuum modules.

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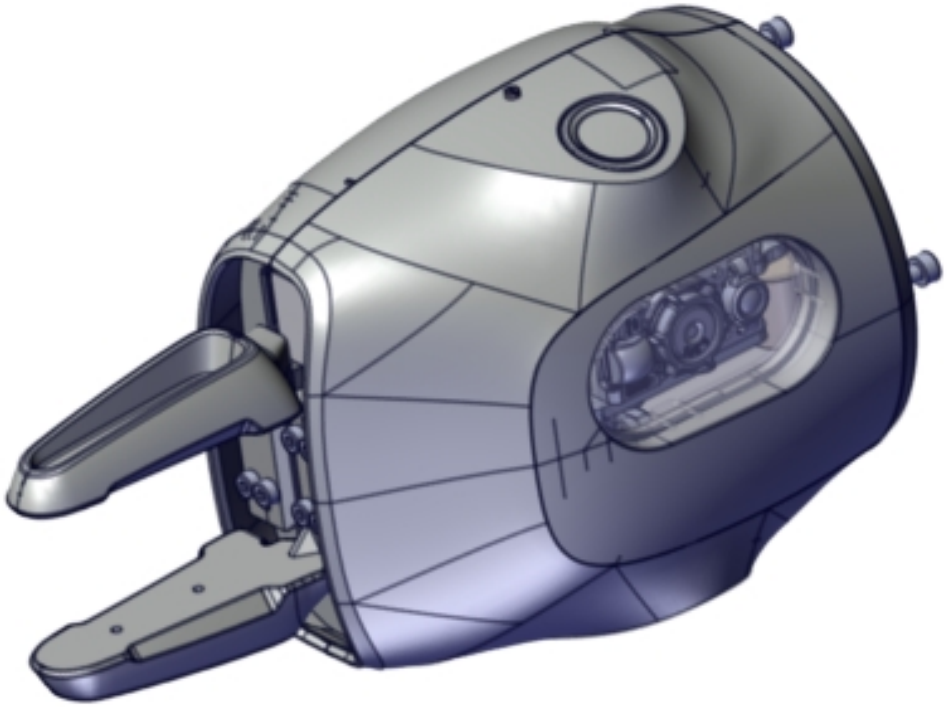
2.1.2 Function modules
Continued

Servo + Vision

The following figure illustrates the gripper with one servo module and one vision module.



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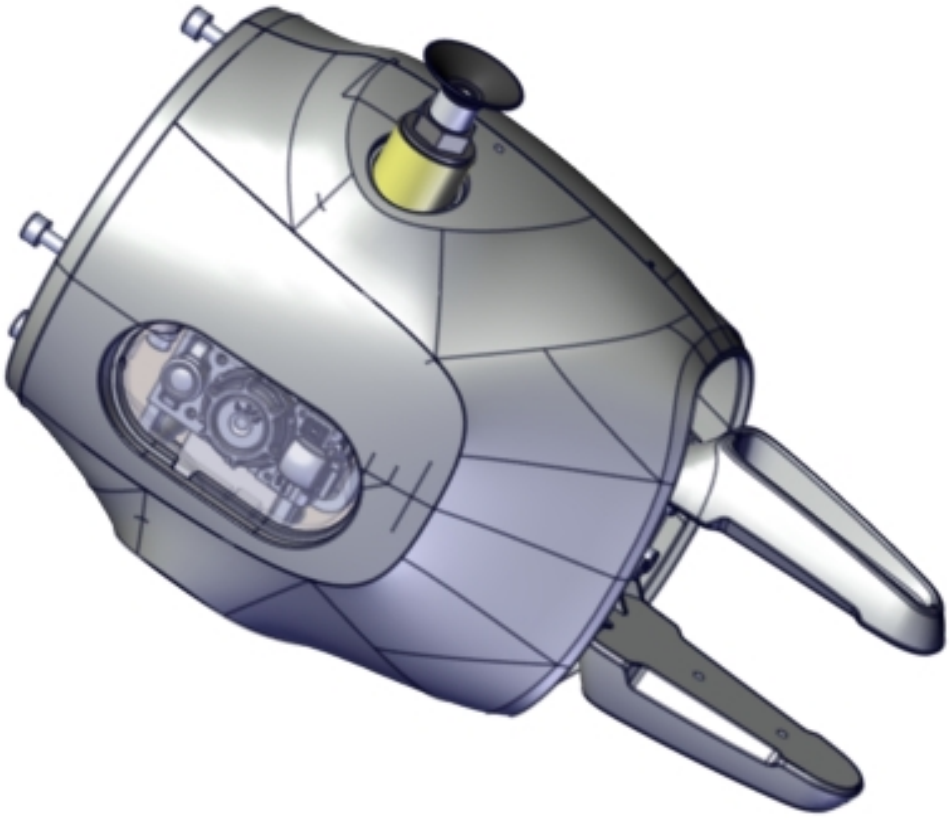
Servo + Vision + Vacuum

The following figure illustrates the gripper with one servo module, one vacuum module and one vision module.



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2.2 Technical data

2.2.1 General

Weight and load capacity

Combination	Weight (g) without fingers, suction cup(s), and filter(s)[i]	Weight (g) of the whole gripper	Max. load capacity (g) without fingers, suction cup(s), and filter(s)[ii]	Max. load capacity (g) of the whole gripper[ii]
Servo	215	230	285	270
Servo + Vacuum 1	225.5	248	274.5	252
Servo + Vacuum 1 + Vacuum 2	250	280	250	220
Servo + Vision	229	244	271	256
Servo + Vision + Vacuum 1	239.5	262	260.5	238

i The getting-started fingers weights 15 g, and the standard suction cups and filters weight 7.5 g per set.

ii Load capacity = 500 - Weight
Center of gravity (CoG) limitations applied. See the robot load diagram.

Detailed mass data - Center of Gravity

Combination	CoG (mm) without fingers, suction cup(s), and filter(s)			CoG (mm) of the whole gripper		
	x	y	z	x	y	z
Servo	8.7	12.3	49.2	8.2	11.7	52
Servo + Vacuum 1	8.9	12.3	48.7	8.6	11.7	52.7
Servo + Vacuum 1 + Vacuum 2	7.4	12.4	44.8	7.1	11.9	47.3
Servo + Vision	7.9	12.4	48.7	7.5	11.8	52.7
Servo + Vision + Vacuum 1	8.2	12.5	48.1	7.8	11.9	50.7

Detailed mass data - Inertia

Combination	Inertia (kgm^2) without fingers, suction cup(s), and filter(s)			Inertia (kgm^2) of the whole gripper		
	Ixx	Iyy	Izz	Ixx	Iyy	Izz
Servo	0.00017	0.00020	0.00008	0.00021	0.00024	0.00009
Servo + Vacuum	0.00017	0.00020	0.00008	0.00021	0.00024	0.00009
Servo + Vacuum 1 + Vacuum 2	0.00020	0.00024	0.00011	0.00025	0.00029	0.00012
Servo + Vision	0.00017	0.00019	0.00008	0.00021	0.00023	0.00008

Continues on next page

Combination	Inertia (kgm^2) without fingers, suction cup(s), and filter(s)			Inertia (kgm^2) of the whole gripper		
	Ixx	Iyy	Izz	Ixx	Iyy	Izz
Servo + Vision + Vacuum	0.00018	0.00020	0.00009	0.00022	0.00024	0.00009

Tooldata definitions without fingers, suction cup(s), and filter(s)

Combination	Tooldata
Servo	[TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [0.215, [8.7, 12.3, 49.2], [1, 0, 0, 0], 0.00017, 0.00020, 0.00008]]
Servo + Vacuum	[TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [0.226, [8.9, 12.3, 48.7], [1, 0, 0, 0], 0.00017, 0.00020, 0.00008]]
Servo + Vacuum 1 + Vacuum 2	[TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [0.250, [7.4, 12.4, 44.8], [1, 0, 0, 0], 0.00020, 0.00024, 0.00011]]
Servo + Vision	[TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [0.229, [7.9, 12.4, 48.7], [1, 0, 0, 0], 0.00017, 0.00019, 0.00008]]
Servo + Vision + Vacuum	[TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [0.240, [8.2, 12.5, 48.1], [1, 0, 0, 0], 0.00018, 0.00020, 0.00009]]

Tooldata definitions with fingers, suction cup(s), and filter(s)

Combination	Tooldata
Servo	[TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [0.230, [8.2, 11.7, 52.0], [1, 0, 0, 0], 0.00021, 0.00024, 0.00009]]
Servo + Vacuum	[TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [0.248, [8.6, 11.7, 52.7], [1, 0, 0, 0], 0.00021, 0.00024, 0.00009]]
Servo + Vacuum 1 + Vacuum 2	[TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [0.280, [7.1, 11.9, 47.3], [1, 0, 0, 0], 0.00025, 0.00029, 0.00012]]
Servo + Vision	[TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [0.244, [7.5, 11.8, 52.7], [1, 0, 0, 0], 0.00021, 0.00023, 0.00008]]
Servo + Vision + Vacuum	[TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [0.262, [7.8, 11.9, 50.7], [1, 0, 0, 0], 0.00022, 0.00024, 0.00009]]

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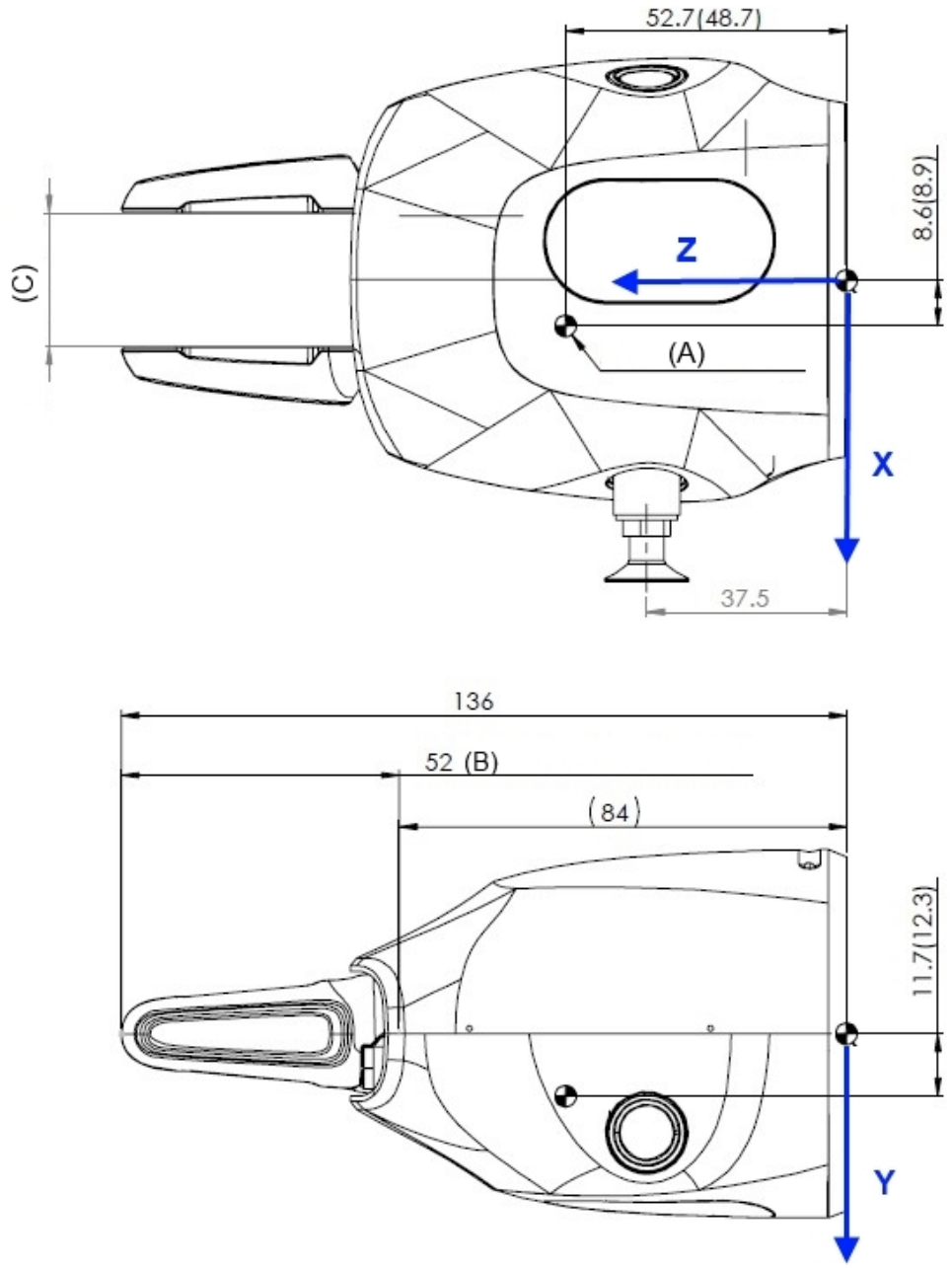
2.2.1 General
Continued

Mass data, illustration

The following figure shows the mass data of the gripper with one servo module and one vacuum module as an example.



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A	CoG Note: Dimensions of CoG in the brackets are without the fingers and suction tools
B	Getting-started finger length
C	Travel length: 0-50 mm

Continues on next page

Airborne noise level

Description	Note
The sound pressure level outside	< 55 dB, measured at a location 0.5 m away from the gripper.

Power consumption

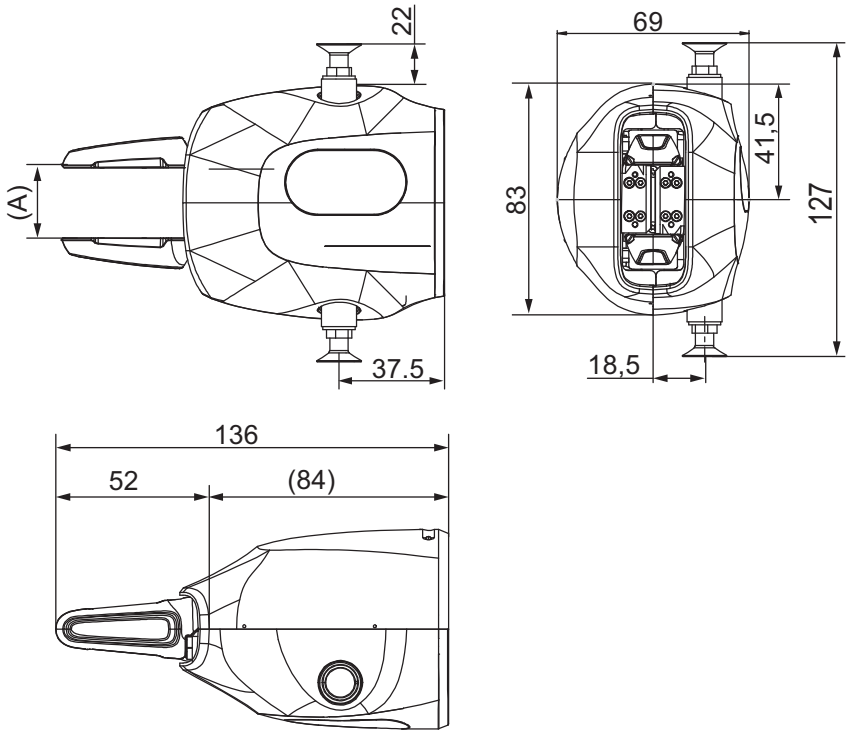
The gripper is powered by 24 V DC and the maximum power consumption of the whole gripper is 9 W.

Continues on next page

2.2.1 General
Continued

Dimensions

The following figure shows the dimension of the gripper with one servo module and two vacuum modules. The dimensions of other gripper options can be obtained by simply removing the dimension data of the suction cups and filters. For the specific dimension of the camera used in the gripper with a vision module, see *Camera, dimensions on page 65*.



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Pos	Description
A	Travel length = 0 - 50 mm

2.2.2 Servo module

Travel length

Description	Data
Travel length	0-50 mm (max. 25 mm per finger)

Maximum speed

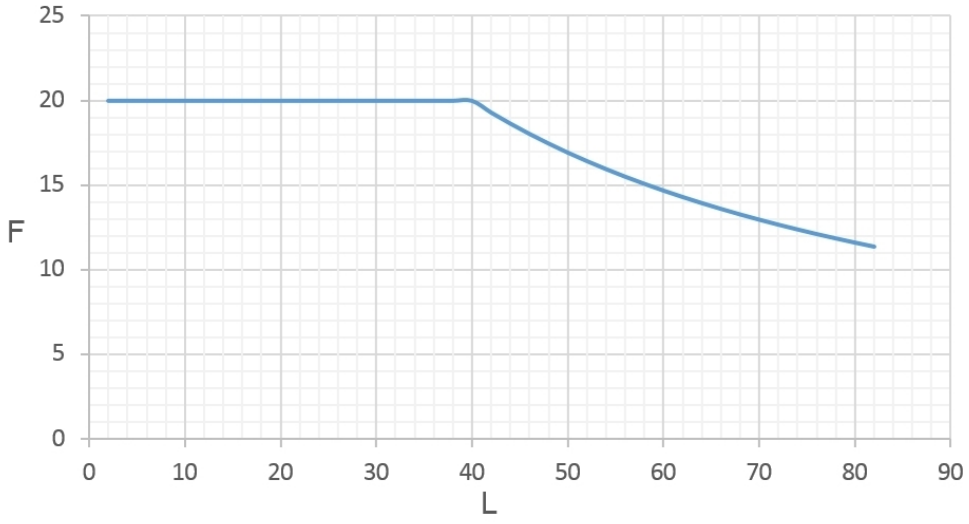
Description	Data
Speed	25 mm/s
Repeatability	±0.05 mm

Gripping force

Description	Data
Gripping direction	Inward or outward
Maximum gripping force	20 N (at the gripping point of 40 mm)
External force (not in gripping directions)	15 N (at the gripping point of 40 mm)
Force control accuracy	±3 N

Load diagram

The following figures show the relationship between the maximum allowed gripping force and gripping point to the finger flange.



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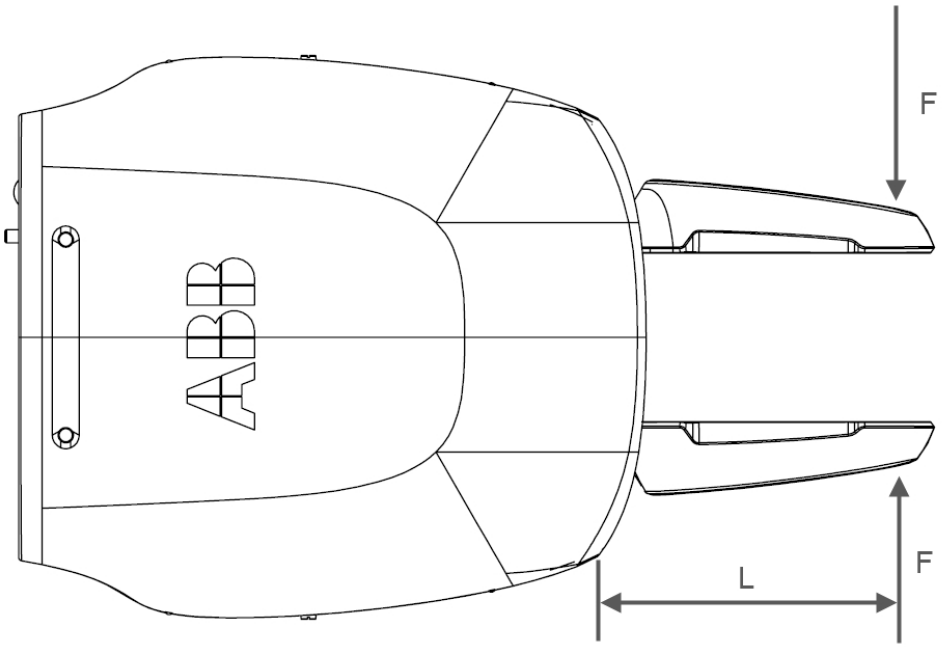
2.2.2 Servo module
Continued



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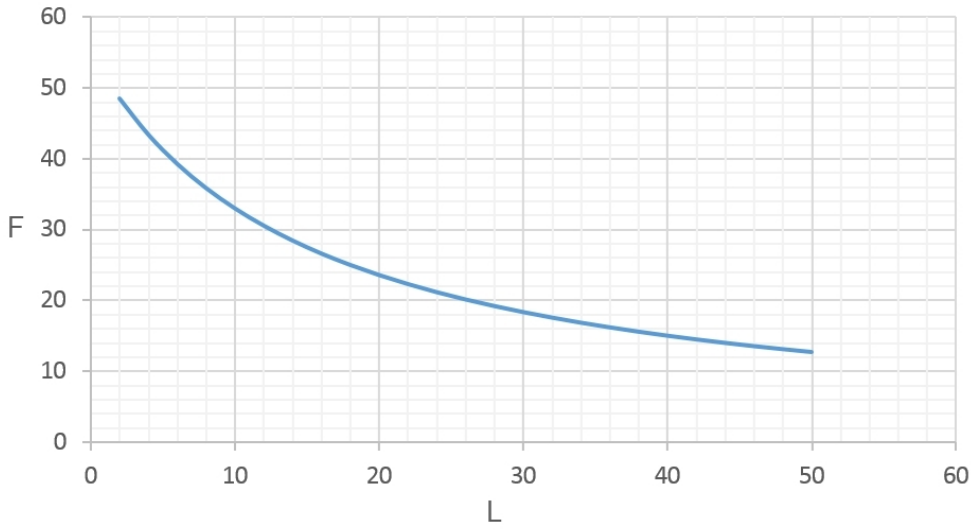
Pos	Description
F	Gripping force, in unit of N
L	Length from the gripping point to the finger flange, in unit of mm

The following figures show the relationship between the maximum allowed external force and gripping point to the finger flange.



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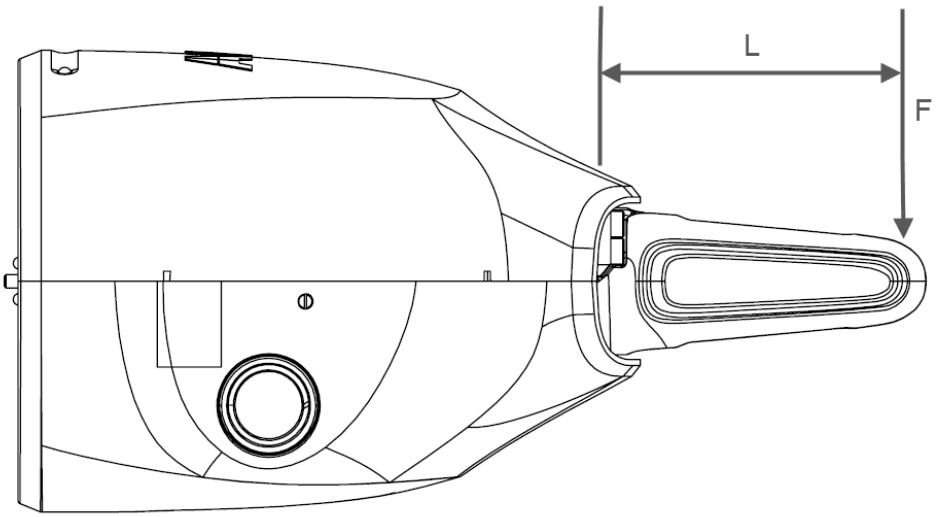

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Pos	Description
F	External force, in unit of N
L	Length from the gripping point to the finger flange, in unit of mm

Position control and calibration

The servo module has integrated position control with the repeatability of ±0.05 mm. The servo module is calibrated by RAPID instructions or using the FlexPendant interface.

For details, see the section *IRB 14050 gripper FlexPendant application* and chapter *RAPID references* in *Product manual - Grippers for IRB 14000*.

2.2.3 Vacuum module

Vacuum generator

The vacuum module has an integrated vacuum generator that is designed with a maximum payload of 150 g. The actual payload capacity depends on the following factors:

- Suction tool design and the choice of suction cups
- The surface structure of the object being picked
- The pickup point and the CoG of the object being picked
- Robot motion while the object is picked
- Air pressure input to the robot

Vacuum pressure sensor

The air pressure of the vacuum module can be monitored in real time using an in-built vacuum sensor. This makes it possible to detect whether the object is correctly picked up by the suction tool.

Blow-off actuator

To minimize cycle time and ensure accurate drop-off of the picked objects, a blow-off actuator is integrated in the vacuum module.

2.2.4 Vision module

General

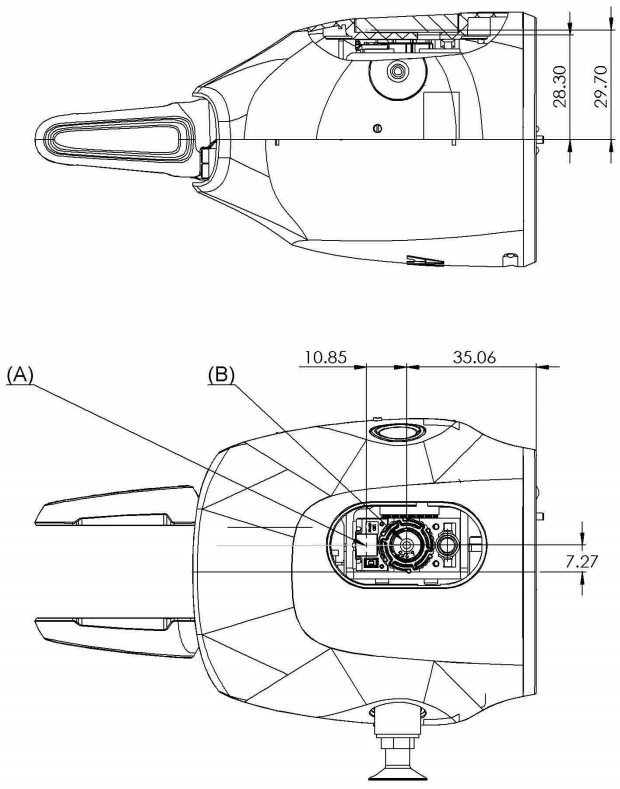
The vision module includes a Cognex AE3 camera and provides powerful and reliable vision and identification tools.

Camera, specification

Description	Data
Resolution	1.3 Megapixel
Lens	6.2mm f/5
Illumination	Integrated LED with programmable intensity
Software engine	Powered by Cognex In-Sight
Application programming software	ABB Integrated vision or Cognex In-Sight Explorer

Camera, dimensions

The following figure shows the dimension of the Cognex AE3 camera.



xx1500001395

Pos	Description
A	Internal illumination

Continues on next page

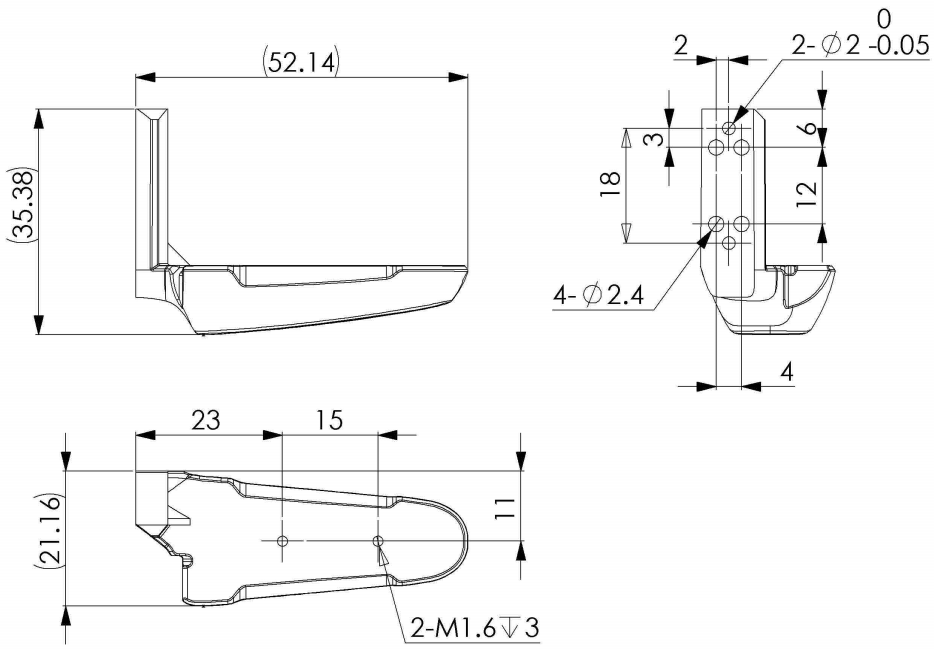
2.2.4 Vision module
Continued

Pos	Description
B	Lens

2.2.5 Fingers

Getting-started finger, dimensions

The following figure shows the dimension of the getting-started finger.



xx1500001606

Design requirements for customized fingers

Except for the two getting-started fingers delivered together with the IRB 14050 gripper, it is also possible for users to customize fingers based on actual requirements. When designing fingers, the following requirements should be met:

- To enhance the stiffness for gripping and extend lifetime of the fingers, it is recommended metal be used as the finger materials.
- The finger size must be designed properly to prevent any collision with the gripper shell during the finger movement or gripping.
- The length of the screws that are used for fastening the fingers to the finger flange must be proper and less than the maximum hole depth on the flange. For details about the maximum hole depth, see *Hole configuration, finger flange on page 73*.
- Installation direction and position of the fingers should follow those of the getting-started fingers. For details, see *Getting-started finger, dimensions on page 67*.

2.3 Installation

2.3.1 Operating requirements

Protection standard

Option combination	Protection standard IEC529
All gripper combinations	IP30

Ambient temperature

Description	Standard/Option	Temperature
Gripper during operation	Standard	+ 5°C (41°F) to + 40°C (104°F)
Gripper during transportation and storage	Standard	- 10°C (14°F) to + 55°C (131°F)

Air input

The nominal operating pressure is 6 bar. Considering the working pressure of air tube in arm, in normal operation the gripper is recommended to be supplied with 5-6 bar air input. Before the air input, ensure that the input air is filtered and clean.

Relative humidity

Description	Relative humidity
Complete gripper during operation, transportation and storage	85% at constant temperature (gaseous only)

2.3.2 Recommended standard tightening torque

Standard tightening torque

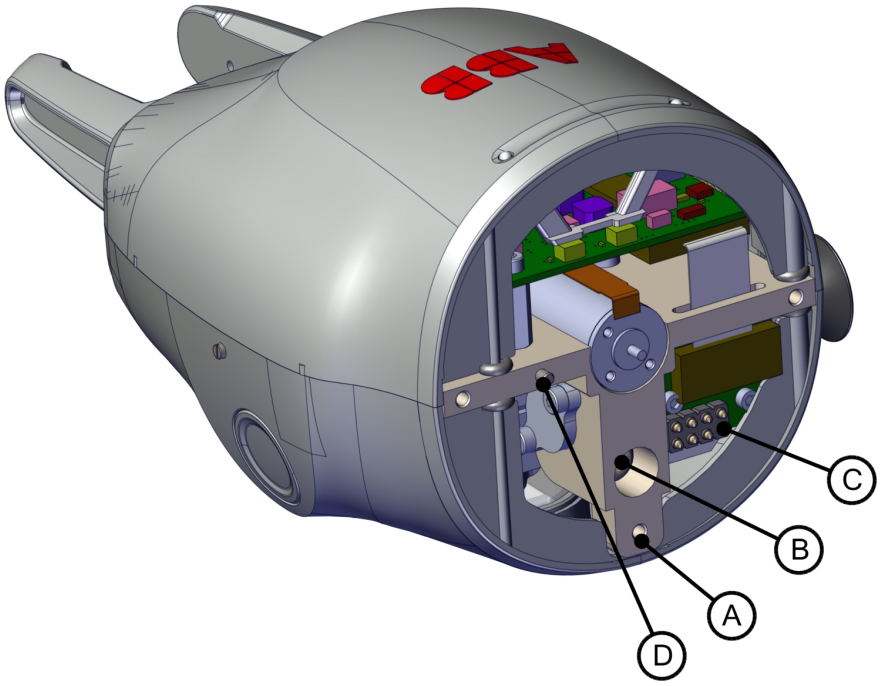
The table below specifies the recommended standard tightening torque for the screws.

Screw type	Tightening torque (Nm) on metal	Tightening torque (Nm) on plastic
M1.2	N/A	0.05
M1.6 (12.9 class carbon steel screw)	0.25	N/A
M1.6 (stainless steel screw)	N/A	0.05
M2	0.25	0.1
M2.5	0.45	0.45

2.3.3 Mounting the gripper

Mounting flange

Three M2.5 holes and one guide pin are used to assemble the gripper to the arm tool flange.

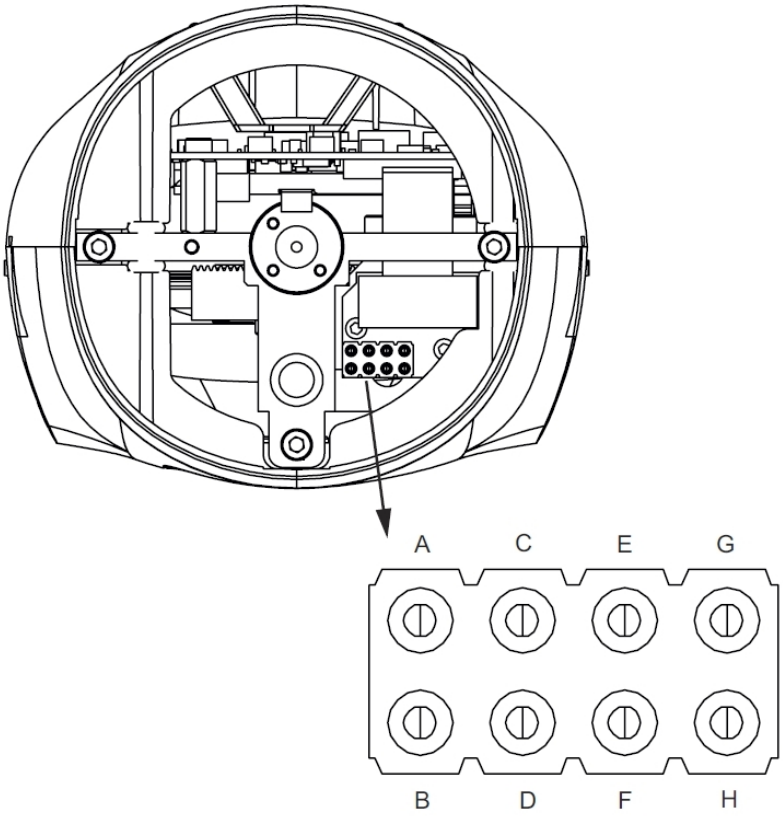


xx1500000126

Pos	Description
A	Recommended screws, three M2.5 x 8
B	Air hose
C	8-pin connector (spring-loaded)
D	Guide pin

Continues on next page

The pins of the connector (shown as C in the preceding figure) are defined as follows.



xx1500000796

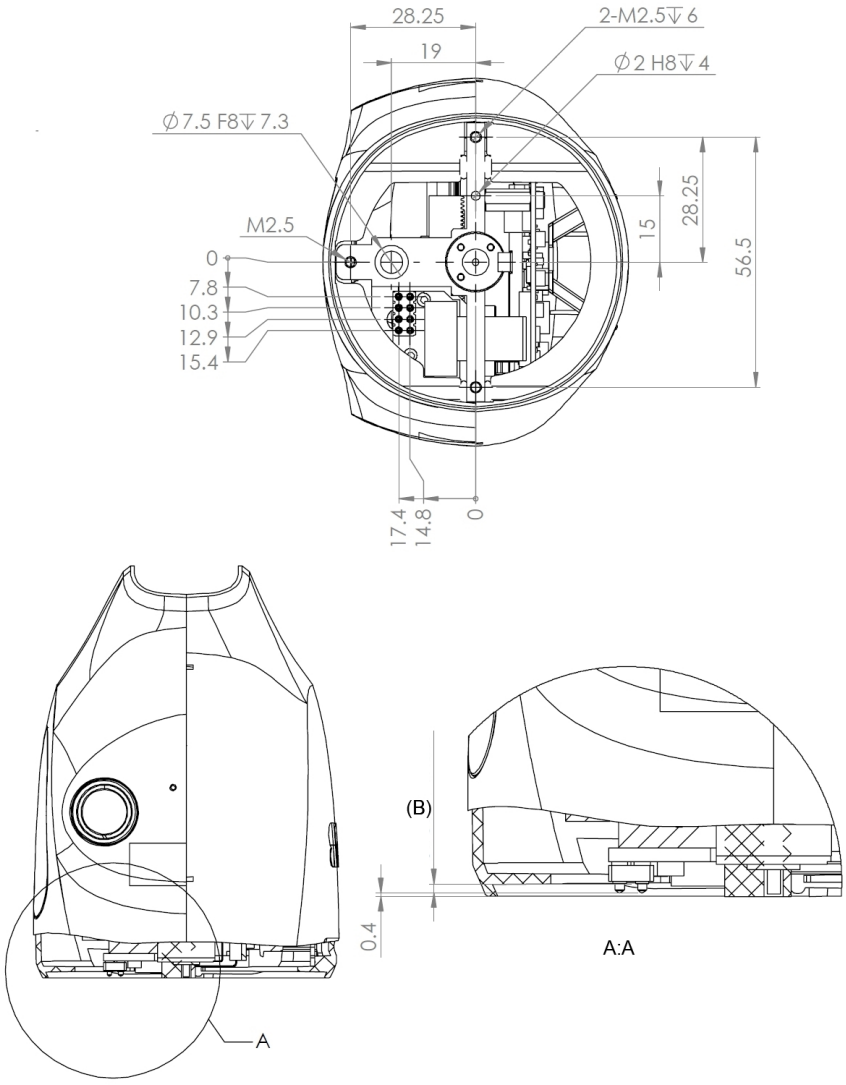
Pin	Description
A	EtherNet RD-
B	EtherNet TD-
C	EtherNet RD+
D	EtherNet TD+
E	PE
F	Spare
G	0V, IO
H	24V, IO

Continues on next page

2.3.3 Mounting the gripper
Continued

Hole configuration, mounting base

The following figure shows the hole configuration when assembling the gripper to the arm tool flange.



xx1500000793

Pos	Description
B	Stroke = 1 mm

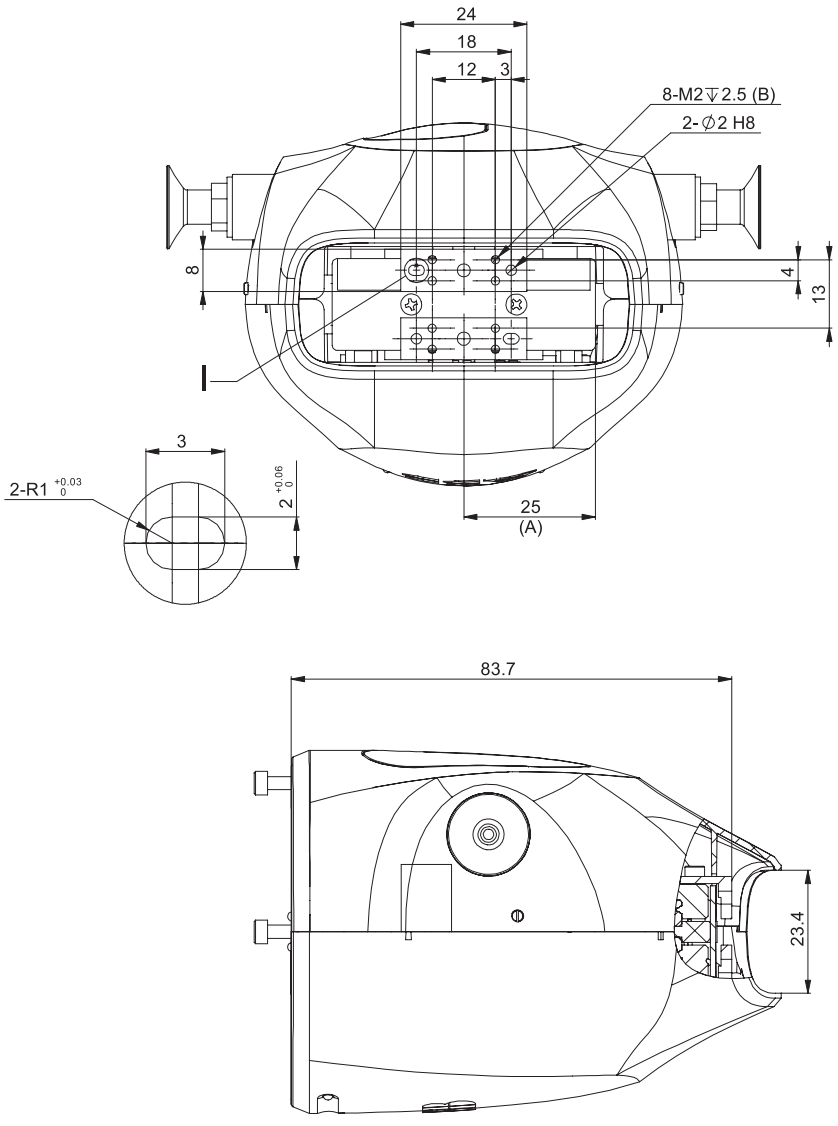
2.3.4 Mounting the fingers

General

A pair of getting-started fingers are provided together with the gripper for demo and test purposes. These fingers should be replaced with fingers designed for the actual application by the system integrator and must be included in the final risk assessment done by the system integrator.

Hole configuration, finger flange

The following figures show the hole configuration and main dimensions of the finger flanges.



xx1500000794

Pos	Description
A	Position of the maximum displacement
B	Maximum hole depth

2.3.5 Mounting tools to the vacuum module

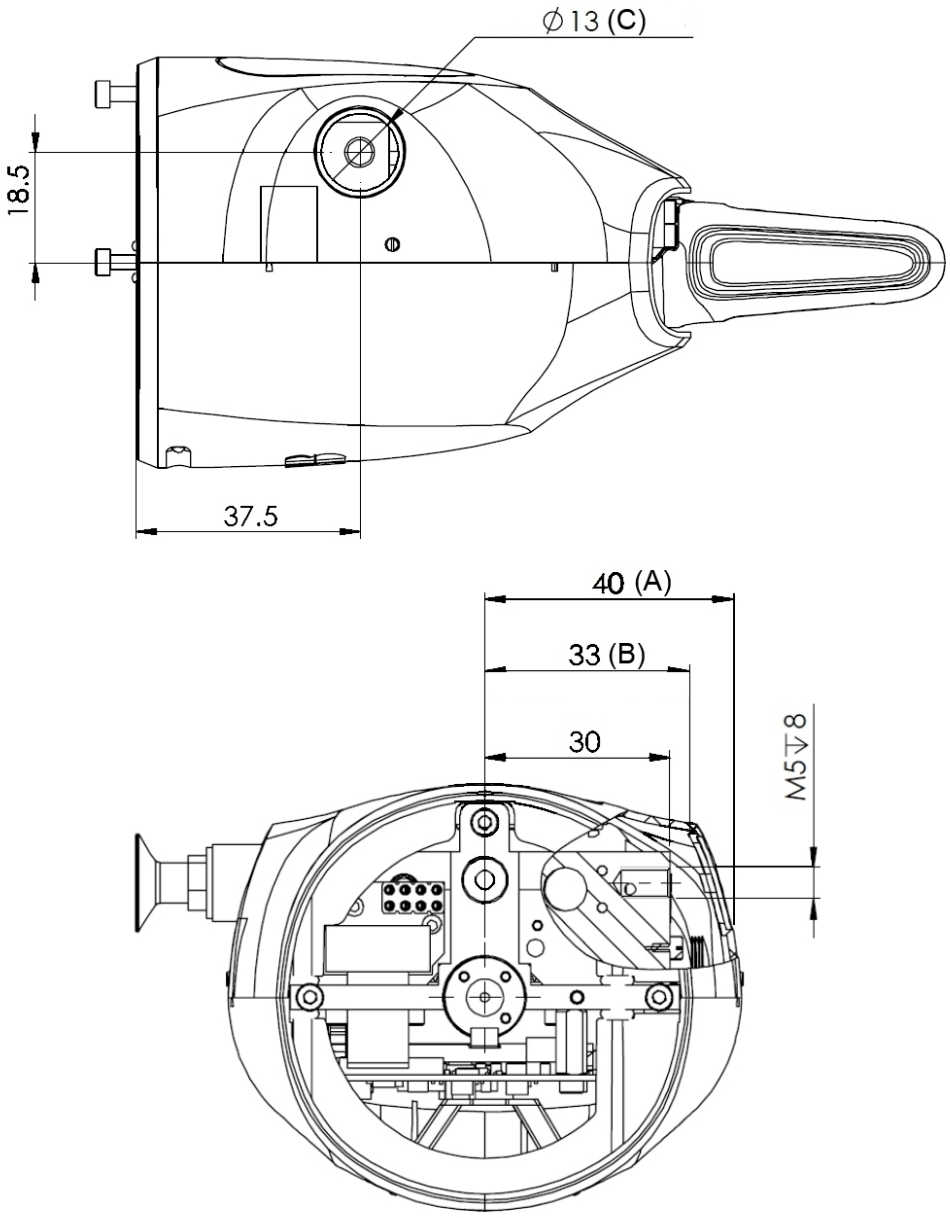
General

The vacuum module is delivered with a first set of suction cups and filters for demo and test purposes. Application-specific suction tools should be designed and chosen by the system integrator. Air filters are required in the suction tools to ensure the long-term performance of the vacuum module. If the vacuum function is not required, passive assembly tools, such as press tools, can also be mounted to the suction tool interface. Any tools mounted to the gripper must be included in the final risk assessment by the system integrator.

Continues on next page

Hole configuration, vacuum tools

The following figure shows the hole configuration and tool interface of the vacuum module.



xx1500000795

Pos	Description
A	Length from the center to the outer shell surface
B	Length from the center to the inner shell surface
C	Shell hole diameter

2.4 Maintenance and trouble shooting

2.4.1 Introduction

General

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

Maintenance

The maintenance intervals depend on the use of the gripper, and the required maintenance activities also depend on the selected options.

For detailed about the maintenance procedures, see the *Maintenance* chapter in the *Product manual - Product.ProductName*.

3 Specification of variants and options

3.1 Introduction to variants and options

General

The different variants and options for the IRB 14050 are described in the following sections. The same option numbers are used here as in the specification form.

The variants and options related to the robot controller are described in the product specification for the controller.

3.2 Manipulator

Manipulator variants

Option	IRB Type	Handling capacity (kg)	Reach (m)
3300-5	IRB 14050	0.5	0.559

Manipulator protection

Option	Description
3350-300	Base 30

Grippers

Below are the gripper options.

First gripper Servo

Option	Type	Description
1512-1	Servo	

First gripper Vacuum 1

Option	Type	Description
1513-1	Vacuum 1	Requires: Servo [1512-1]

First gripper Vacuum 2

Option	Type	Description
1514-1	Vacuum 2	Requires: Servo [1512-1] and Vacuum 1 [1513-1], Not together with: Vision [1515-1]

First gripper Vision

Option	Type	Description
1515-1	Vision	Requires: Servo [1512-1], integrated vision support [3127-1]

Second gripper Servo

Option	Type	Description
1516-1	Servo	

Second gripper Vacuum 1

Option	Type	Description
1517-1	Vacuum 1	Requires: Servo [1516-1]

Second gripper Vacuum 2

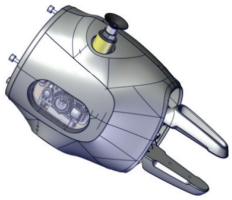
Option	Type	Description
1518-1	Vacuum 2	Requires: Servo [1516-1] and Vacuum 1 [1517-1], Not together with: Vision [1519-1]

Continues on next page

Second gripper Vision

Option	Type	Description
1519-1	Vision	Requires: Servo [1516-1], integrated vision support [3127-1]

Grippers

Option	Type	Description
1512(6)-1		Servo
1512(6)-1 + 1513(7)-1		Vacuum 1 Servo + one vacuum unit
1512(6)-1+1513(7)-1+1514(8)-1		Vacuum 2 Servo + two vacuum units
1512(6)-1+1515(9)-1		Vision Servo + integrated vision camera
1512(6)-1+1513(7)-1+1515(9)-1		Vision Servo + integrated vision camera + one vacuum unit

Robot cabling routing

Option	Description
3309-1	Under the base
3309-2	From side of base

Continues on next page

Warranty

For the selected period of time, ABB will provide spare parts and labour to repair or replace the non-conforming portion of the equipment without additional charges. During that period, it is required to have a yearly Preventative Maintenance according to ABB manuals to be performed by ABB. If due to customer restrains no data can be analyzed in the ABB Ability service *Condition Monitoring & Diagnostics* for robots with OmniCore controllers, and ABB has to travel to site, travel expenses are not covered. The Extended Warranty period always starts on the day of warranty expiration. Warranty Conditions apply as defined in the Terms & Conditions.

Note

This description above is not applicable for option *Stock warranty* [438-8]

Option	Type	Description
438-1	Standard warranty	Standard warranty is 12 months from *Customer Delivery Date* or latest 18 months after *Factory Shipment Date*, whichever occurs first. Warranty terms and conditions apply.
438-6	Standard warranty + 6 months	Standard warranty extended with 6 months from end date of the standard warranty. Warranty terms and conditions apply.
438-8	Stock warranty	Maximum 6 months postponed start of standard warranty, starting from factory shipment date. Note that no claims will be accepted for warranties that occurred before the end of stock warranty. Standard warranty commences automatically after 6 months from *Factory Shipment Date* or from activation date of standard warranty in WebConfig. **Note** Special conditions are applicable, see *Robotics Warranty Directives*.

3.3 Floor cables

Manipulator cable length

Option	Description
3200-1	3 m
3200-2	7 m

Mains cable

Option	Type	Description
3203-1	EU mains cable, 3 m	Cable assembly with CEE7/VII line-side plug.
3203-2	UK mains cable, 3 m	Cable assembly with BS1363 line-side plug, 5A fused.
3203-3	US mains cable, 9 ft	Cable assembly with NEMA5-15 line-side plug.
3203-4	JP mains cable, 3 m	Cable assembly with JI8303 line-side plug.
3203-5	CN mains cable, 3 m	Cable assembly with CPCS-CCC line-side plug.
3203-6	AU mains cable, 3 m	Cable assembly with AS/NZS 3112 line-side plug.

3.4 Unlisted options

Included by default, not listed in the specification form

Option	Name	Option	Name
3105-1	Motion Sup. Bundle	3113-1	Path Recovery
3107-1	Collision Detection	3127-1	Vision interface
3106-1	World Zones	3121-1	RW Add-In Prepared
3150-1	Collision Avoidance	3119-1	RobotStudio Connect
3112-1	Program Feature Bundle	3108-1	SoftMove
3114-1	Multitasking	3044-1	3 Modes Keyless

Not currently supported, not listed in the specification form

Option	Name	Option	Name
3015-1	24V 8Amps	3043-1	SafeMove Base
3017-1	FlexPend Ext Cable 15m	3111-1	Independent Axis
3017-2	FlexPend Ext Cable 22m	3123-1	Path Corrections
3017-3	FlexPend Ext Cable 30m	3100-1	Advanced robot motion
3038-1	Force Control Interface		

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3HAC064627-001, Rev M, en