

**Delta Robot
CR_UGD4_XXLH Series**

Delta Robot XXL

USER'S MANUAL

OMRON

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Safety Instructions

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1. Attention

Information in this document can change without prior notice.

OMRON EUROPE B.V. cannot be held responsible for any damage to the environment, to the machine or to the functioning of the machine occurred by errors or missing data in the illustrations, drawing or specifications.

No part of this manual and added documentation may be copied, reproduced or translated into another language without prior written approval.

Read and understand the material contained in this user's manual before you work on the CR_UGD4_XXLH robot for the first time. This user's manual is supposed to help you use the capabilities of the CR_UGD4_XXLH robot safely and properly.

2. Explanation of warnings and notes

This manual uses the following safety alert symbols and signal words to provide safety instructions that must be observed and to describe handling precautions, prohibited actions, and compulsory actions. Make sure you understand the meaning of each symbol and signal word and then read this manual.

**DANGER**

THIS INDICATES AN IMMEDIATELY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, WILL RESULT IN DEATH OR SERIOUS INJURY.

**WARNING**

THIS INDICATES A POTENTIALLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN DEATH OR SERIOUS INJURY.

**NOTE**

Explains the key point in the operation in a simple and clear manner.

3. Safety information

3.1 General

This '3. Safety information' subchapter contains information regarding working with the CR_UGD4_XXLH robot. Qualified personnel working with the CR_UGD4_XXLH robot must have read and understood the CR_UGD4_XXLH robot documentation, including the safety information chapter.

3.2 Qualified personnel

These are people who, due their specialist training, knowledge and experience, and their familiarization with the relevant standards, are able to assess the work to be carried out and detect any potential hazards.

3.3 Liability

The CR_UGD4_XXLH robot is build using state-of-the-art technology and in accordance with the recognized safety rules. Nevertheless, misuse of the CR_UGD4_XXLH robot may constitute a risk to life and limb or cause damage to the CR_UGD4_XXLH robot and to other material property.

3.4 Installation and operating conditions

You may only use the components in accordance with the installation and operating conditions described in the documentation. The operating conditions at the installation location must be checked and maintained in accordance with the required technical data. Within the meaning of the Machinery Directive the CR_UGD4_XXLH robot is an incomplete machine. Commissioning is prohibited until the usable machine or system in which the CR_UGD4_XXLH robot is installed meets all requirements of the Machine directive 2006/42/EC.

For the CR_UGD4_XXLH robot you have to observe the following standards, directives and regulations:

- EN ISO 10218-1:2011 Robots and robotic devices - Safety requirements for industrial robots - Part 1: Robots.
- EN ISO 10218-1:2011 Robots and robotic devices - Safety requirements for industrial robots - Part 2: Robot systems and integration.

3.5 Residual risks

Safety and health risks arising from the robot mechanics have been reduced by means of safety technology and design engineering. However a residual risk remains, since the robot mechanics will be move by an automated control system.

The following are typical warnings concerning residual risks which cannot be assigned to a specific action. The expression of safety labels is identical to the safety information.

3.5.1 Release device

The robot mechanics are not supplied with an release switch to control the brakes of the motors.



WARNING

- MOUNT A RELEASE SWITCH ON THE MACHINE SO THE ARMS (MOTOR) OF THE ROBOT COULD BE MANUALLY MOVED.
- MOVING AN AXIS WITH AN IMPROPERLY WORKING RELEASE SWITCH CAN DAMAGE THE MOTOR BRAKE. THIS CAN RESULT IN PERSONAL INJURY AND MATERIAL DAMAGE.
- BEFORE RELEASING THE BRAKE, YOU HAVE TO BE SURE THAT NO ONE IS IN THE HAZARD AREA OF THE ROBOT.

3.5.2 Transport

The prescribed transport position of the robot must be observed. Transportation must be carried out in accordance with the transportation instructions or assembly instructions of the robot.



WARNING

- ONLY USE AUTHORIZED HANDLING EQUIPMENT WITH A SUFFICIENT LOAD-BEARING CAPACITY TO TRANSPORT THE ROBOT.
- WEAR SUITABLE PROTECTIVE CLOTHING IF NECESSARY.

3.5.3 Assembly and start-up

Before starting up systems and devices for the first time, a check must be carried out to ensure that the system and devices are completed and operational, that they can be operated safely and that any damage is detected.

The valid national or regional work safety regulations must be observed for this check. The correct functioning of all safety circuits must also be tested.

The following tests must be carried out before start-up and recommissioning. It must be ensured that:

- The robot is correctly installed and fastened in accordance with the specifications in the assembly instructions.
- There are no foreign bodies or loose parts on the robot.
- All required safety equipment is correctly installed and operational.



WARNING

- A WRONG INSTALLED ROBOT MAY THROW OFF HIS ARMS.
- WEAR SUITABLE PROTECTIVE CLOTHING IF NECESSARY.

3.5.4 Maintenance and repair

After maintenance and repair work, checks must be carried out to ensure the required safety level. The valid national or regional work safety regulations must be observed for this check. The correct functioning of all safety circuits must also be tested.

The purpose of maintenance and repair work is to ensure that the system is kept original or, in the event of a fault, to return the system to an operational state. Repair work includes troubleshooting in addition to the actual repair itself.

The following safety measures must be carried out when working on the robot:

- Switch of the machine (system) where the robot is built-in (e.g. with a padlock) to prevent it from being switched on again
- Label the machine (system) with a sign indication that work is in progress. This sign must remain in place, even during temporary interruptions to the work.
- The emergency stop from the machine (system) must remain active. If safety functions or safeguards are deactivated during maintenance or repair work, they must be reactivated immediately after the work is completed.

3.5.5 System integrator

The robot is safely integrated into a complete system by the system integrator. The system integrator is responsible for the following tasks:

- Installing the robot
- Performing risk assessment
- Implementing the required safety functions and safeguards
- Issuing the declaration of conformity
- Attaching the CE mark
- Creating the operating instructions for the complete system

Chapter 1 Introduction

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1. Introduction

Congratulations with the purchase of your high speed Delta robot XXL. This is a high speed pick and place robot which uses state-of-the-art carbon composite materials and the latest servo drive technology to be put in use in the most demanding pick and place applications.

This manual should be read before the commissioning of the robot. By mechanical engineers in the design phase during the integration of the robot in the machine and by software engineers to check the performance envelope of the robot.

This manual describes the main versions of the CR_UGD4_XXLH robot, and all options. Where applicable check the appropriate data for your robot type, the type can be found on the identification tag of the robot.



1.1 Description of the robot

The CR_UGD4_XXLH Delta robot is a high speed pick and place robot which uses state-of-the-art carbon composite materials and the latest servo drive technology to be put in use in the most demanding pick and place applications. The robot is designed as a 3-axis (optional 4th rotational axis) Delta kinematic system.

Characteristics of the robot:

- Requires very low maintenance
- 3 + 1 (rotational axis optional) degrees of freedom
- Compact design for mounting in a machine
- Low noise level < 70 dB (A)

1.2 Type code explanation

CR_UGD4_XXLH_R: 3 + 1 axes (with rotational axis), 1600 mm working range, max. payload: 8 kg

CR_UGD4_XXLH_NR: 3 axes (without rotational axis), 1600 mm working range, max. payload: 8 kg

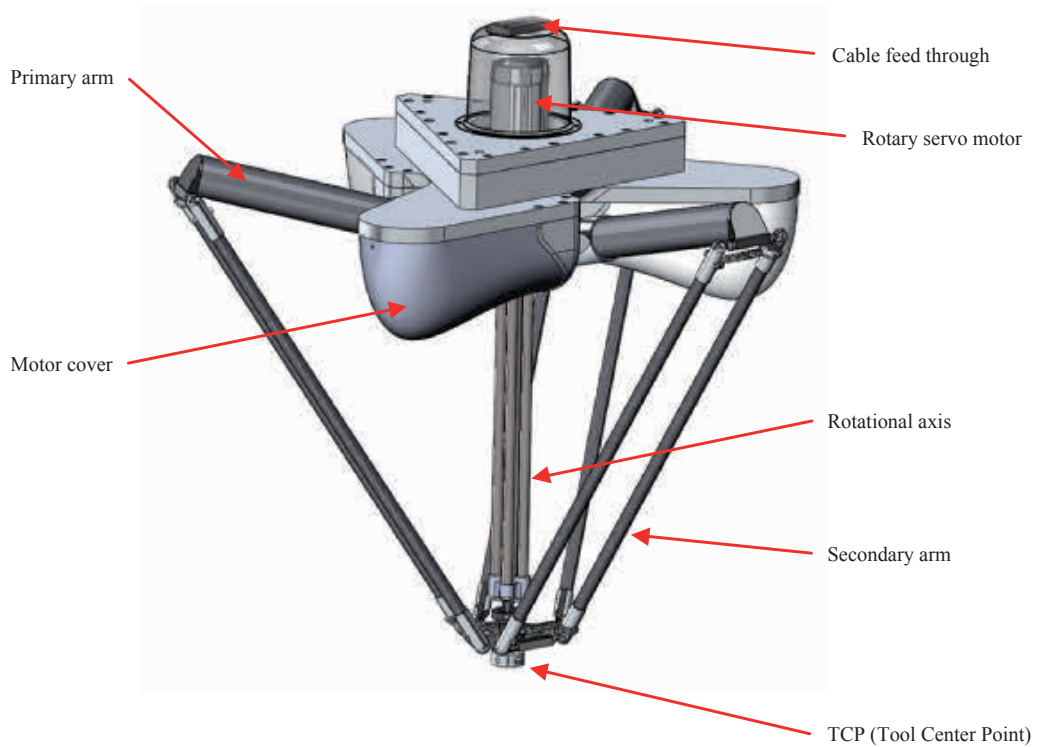
2. Identification

On the robot base plate an identification tag is mounted, important data on this plate:

- Robot type
- Total weight of the robot
- Year of production
- Serial number, important for ordering spareparts

3. Part names

CR_UGD4_XXLH



The CR_UGD4_XXLH robot consists of three radially placed axis which give the TCP freedom to move in three directions, X, Y and Z. An optional fourth axis can take care of the rotation, R_z , of the TCP.

The primary and secondary arms of the robot are constructed from anodized aluminum ends and carbon composite material; they are directly mounted on a double-stage gear box to guarantee high stiffness. The secondary arms are mounted with hardened stainless steel ball joint bearings to the primary arms and the TCP, this guarantees low wear and friction and is very easy to service.

Optionally the robot is equipped with an extra servo motor for the rotational axis, the sliding shaft is constructed of titanium to maintain the highly dynamic character of the robot.

Chapter 2 Model overview

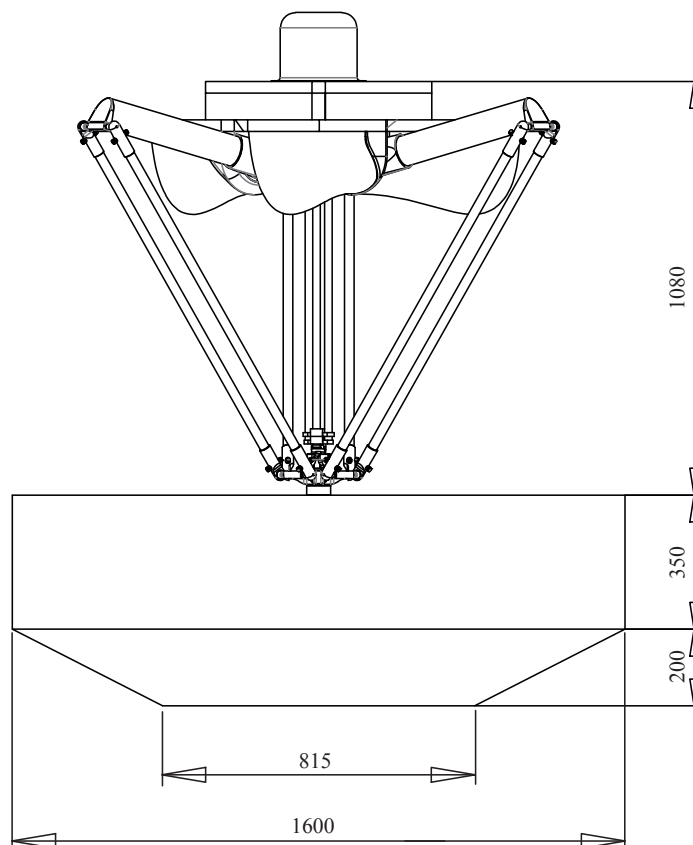
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1. Overview

The CR_UGD4_XXLH has a working range of 1600 mm. The specifications are given in the below figure, if specifications differ for models, for instance with- or without rotation axis, it is indicated in the specification list. The Delta robot is delivered standard with sanitary secondary arms, this means they are fully closed to prevent any contamination on the inside of the secondary arms.

CR_UGD4_XXLH (1600 mm)



NOTE

Note that the rotation servo motor, on the top of the robot, is optional.

2. Optional extensions

The CR_UGD4_XXLH robot can be delivered with several options:

- Rotational axis, an extra motor with gearbox is placed on top of the base plate, four titanium tubes, captured in two plastic parts, sliding over each other, are used to transfer a rotating motion to the TCP.



Chapter 3 Installation

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1. Unpacking

The robot is delivered in a special crate, the secondary arms are not mounted yet, it is advised to mount them when the robot is mounted in the machine frame.

The baseplate is fixed in a wooden frame. There are 2 lifting eyes on the baseplate, the baseplate can be lifted from the box with an lifting machine.

The secondary arms are stored in the smaller boxes delivered in the shipping crate.



WARNING

THE ROBOT IS TOO HEAVY TO LIFT MANUAL, USE PROPER TOOLS TO LIFT THE ROBOT OUT OF THE CRATE.

2. Connecting the motor cables

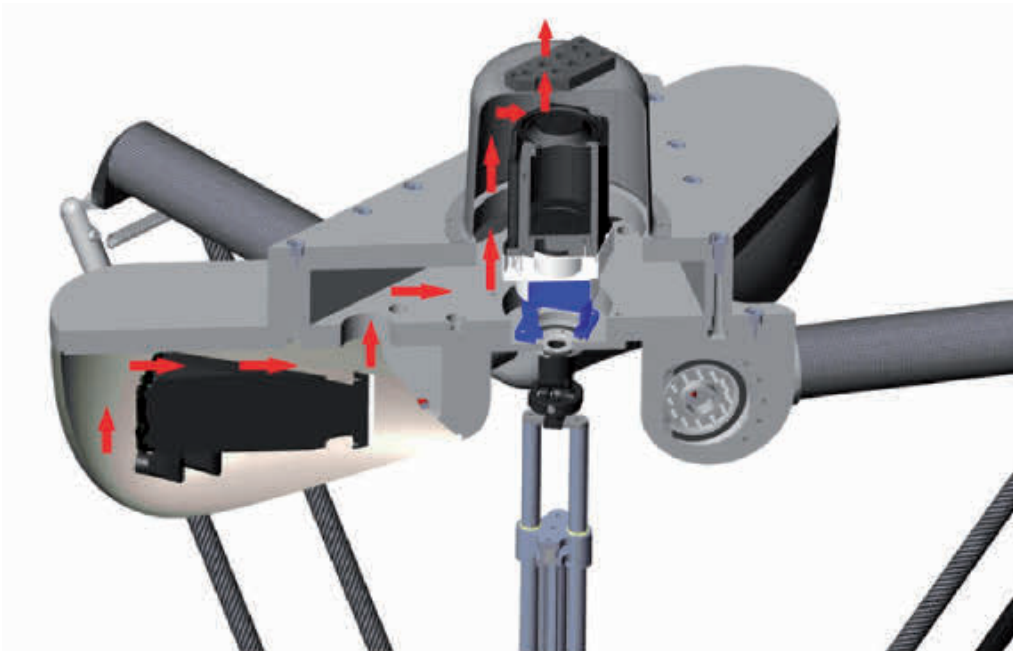
First remove the motor protection hoods from the robot after loosening the locking screw at the outside of the motor hoods.

Remove the motor cover for the rotational axis motor on top of the robot.

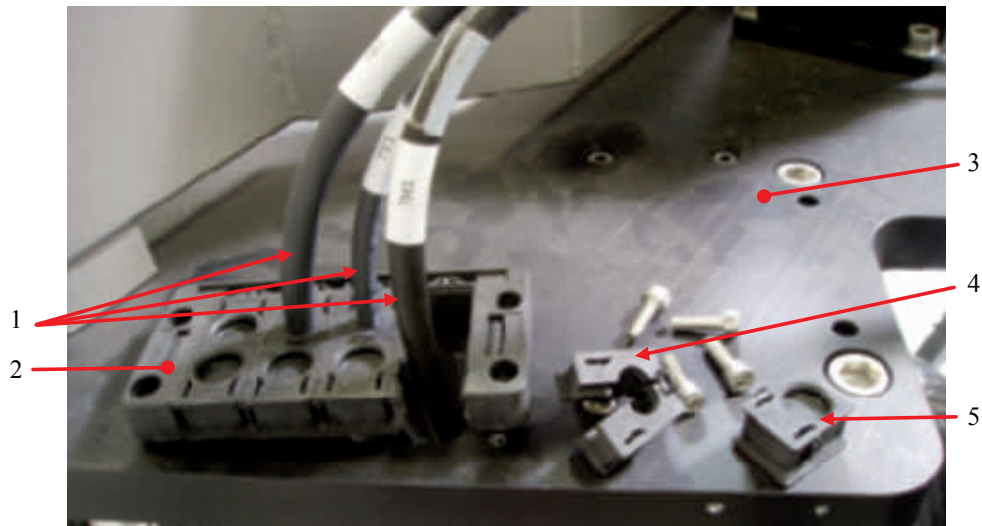
Unscrew the cable feed through block on top of motor cover for the rotational axis.

Feed the motor cables through the hole in the motor cover for the rotational axis and in the baseplate and connect them to the servomotor.

See route through base plate showed in the below figure.

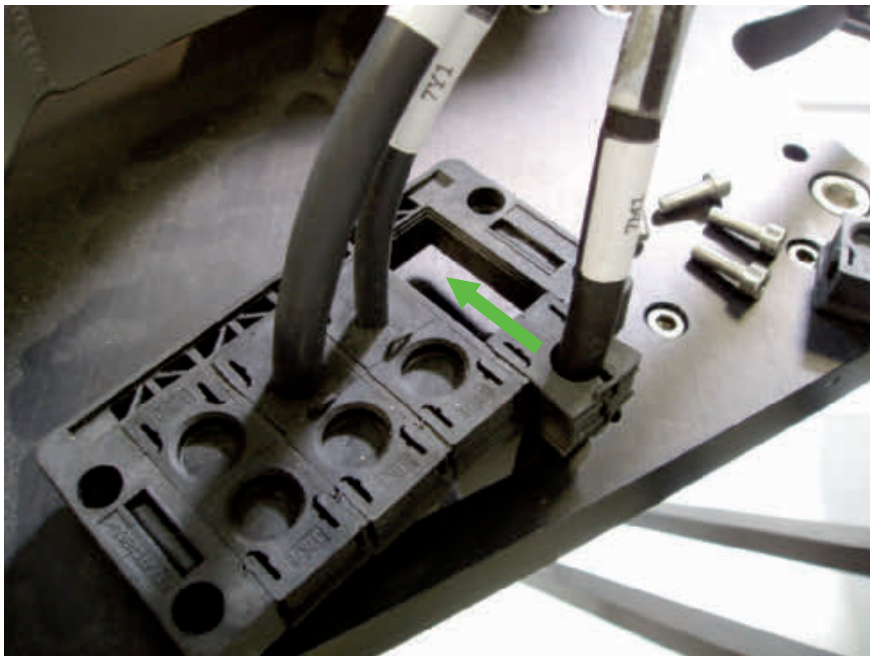


Now slide the feed through glands out of the cable feed through.



No.	Description
1	Cables to servomotor
2	Cable feed through
3	Baseplate
4	Feedthrough gland
5	Feedthrough gland blindstop

Clamp the feed through gland around the cable and slide it back into the cable feed through block. After sliding all glands and cables into the block and screw the feed through block back on the motor cover.



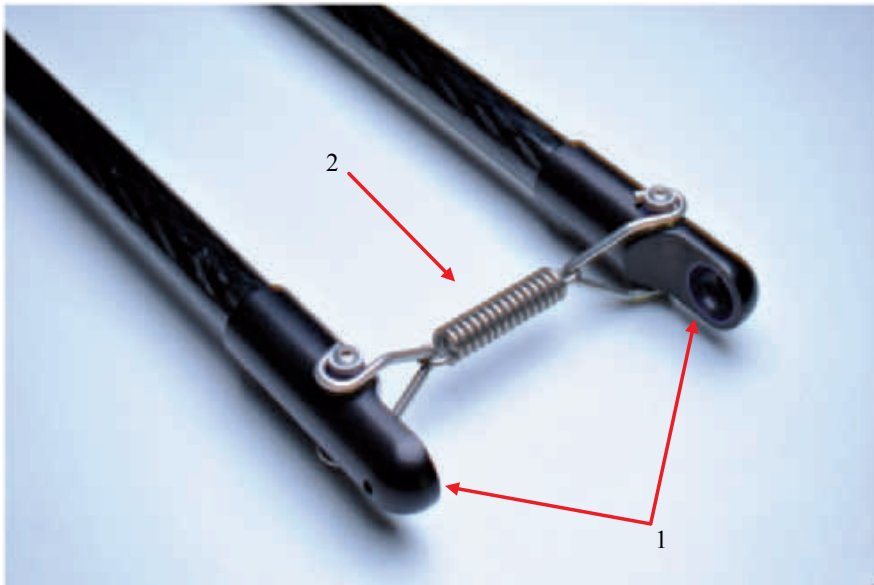
3. Assembling the secondary arms



WARNING

ASSEMBLING THE SECONDARY ARMS MUST BE DONE WITH THREE PERSONS.

Get two of the secondary arms and mount the assembled spring on the secondary arms.



No.	Description
1	Secondary arm
2	Spring package

Now put the two secondary arms on the primary arm by pulling the two secondary arms apart and fitting the ball cups of the secondary arms over the ball joints of the primary arms. This should be performed by a minimum of 3 people.



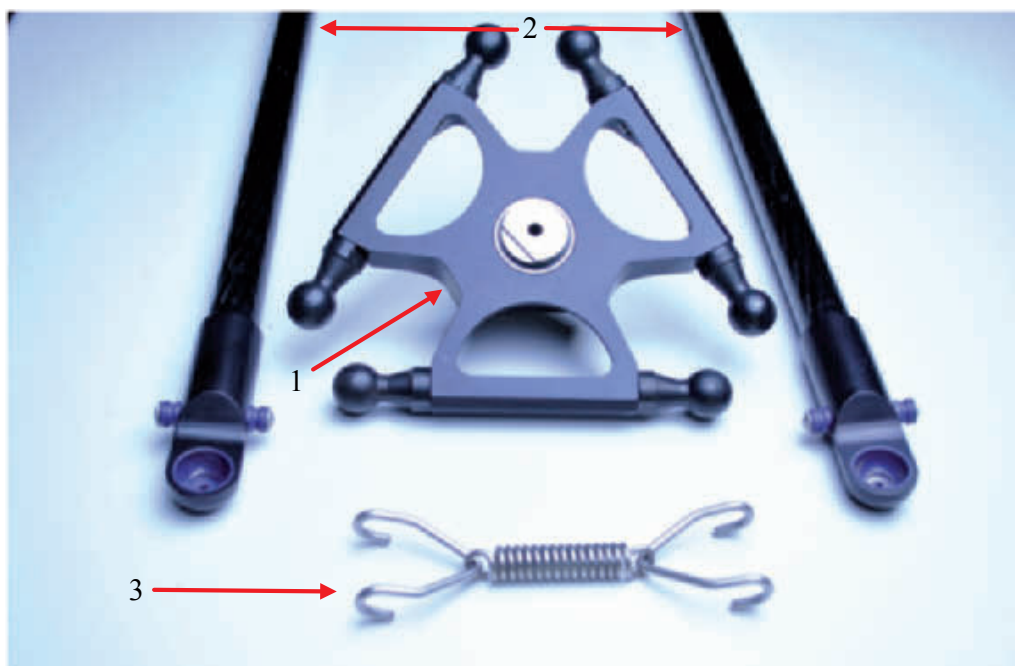
Repeat the procedure for mounting the TCP joint to the primary arms.



Repeat this procedure for the three arms. Tip! After mounting the first and second arm you can put the TCP joint to rest on a surface below the robot.

4. Mounting the rotational axis

In the shipping crate separate boxes are included which contain the parts for the rotational axis (option) and the secondary arms. First check if all components are available:



No.	Description
1	TCP - option rotation axis (1x)
2	Secondary arm (6x)
3	Spring package (6x)

If your robot is delivered with the optional rotational axis, shown below, it needs to be mounted separately.



Loose the two M5 bolts in the above cardan coupling and mount the cardan coupling on the motor shaft from the rotation motor (see below picture).



Tighten the locking screw of the cardan shaft with a 5 mm Allen key.

5. Calibration

Not every robot that is delivered is calibrated.

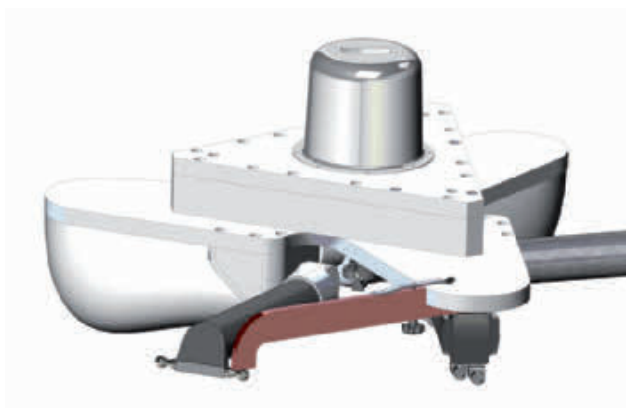
If you want to calibrate the robot by yourself, a calibration kit with a special tool is available (shown in the below picture).

The calibration set can be ordered as CR_ART.1098



No.	Description
1	Calibration tool

1. Slide the calibration tool on the base plate and tighten the star knob.
2. Release the brake of the motor and put the ball joint at the calibration tool. Now calibrate the motor in your software. Repeat this action for every arm



WARNING

- CALIBRATING THE ROBOT MUST BE CARRIED OUT BY QUALIFIED PROGRAMMING PERSONNEL ONLY, AS THIS REQUIRES AN EXCELLENT LEVEL OF KNOWLEDGE OF THE CONTROL SYSTEM.
- WHEN CARRYING OUT THE HOMING YOURSELF, THIS MUST BE CARRIED OUT EXACTLY IN THE WAY AND THE ORDER THAT THEY ARE DESCRIBED.

Chapter 4 Maintenance

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1. Periodic check, wear of springs

The wear of the springs cannot be checked, they must be replaced periodically. The exact period is dependent on factors like, environmental conditions, number of running hours per day and speed of movements. Under normal conditions the springs should last at least 3800 production hours.

2. Cleaning the robot

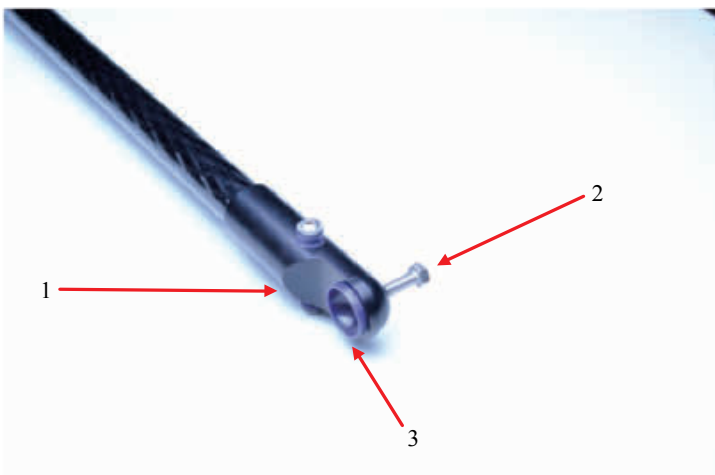
Clean the robot by washing with soft cloth or sponge. Use soap or mild detergent and warm water followed by clear water rinse.

For oil and grease stains use alcohol with soft cloth.

Do not use a high pressure water cleaner, or any other high pressure cleaning device.

3. Replacement of cups

The cup holder have a threaded hole in the back of them, this is used to press the cups out of the cup holder, as is shown in the below picture:



No.	Description
1	Cup
2	M5 bolt
3	Cup holder

4. Spare parts

Description	OMRON Part No.
Calibration tool	CR_ART.1098
Primary arm set	CR_ART.1121
Secondary arm set	CR_ART.1122
Spring package	CR_ART.1123
Ball bearing cups	CR_ART.1124
Spline part rotational axis	CR_ART.1125
Cardan coupling	CR_ART.1126
Hinge rollers (24 pieces)	CR_ART.1127
Plain bearing	CR_ART.1128
Gearbox for the primary arm	CR_ART.1143
Gearbox for the rotational axis	CR_ART.1154

Chapter 5 Robot settings

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1. Kinematics

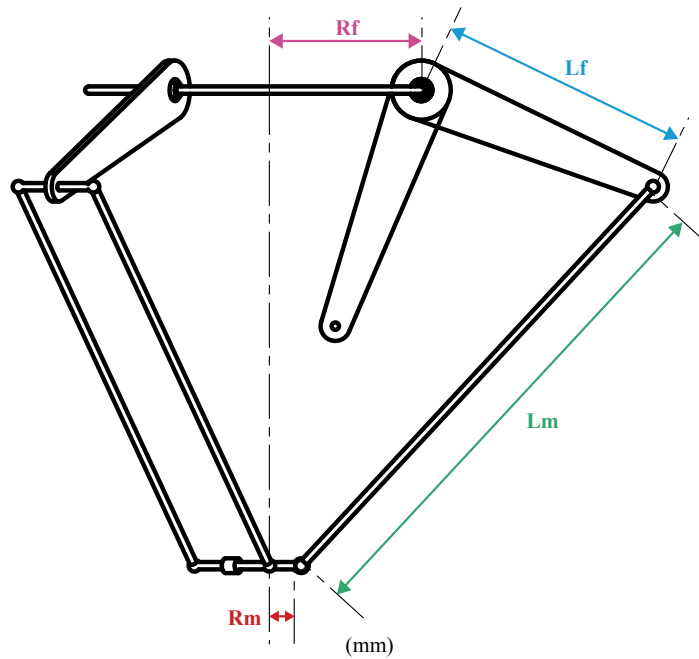
The kinematics parameters for the CR_UGD4_XXLH robot are shown below. Set these parameters corresponding to the controller settings.



WARNING

IF THE KINEMATICS PARAMETERS ARE NOT SET PROPERLY, THIS MAY CAUSE THE ROBOT TO MALFUNCTION. SO, BE SURE TO SET THESE PARAMETERS CORRECTLY.

Kinematics parameters



Rf:	147.5 mm Distance (radius) from the center of the fixed frame to the motor of the axis
Rm:	70 mm Distance (radius) from the center of the moving frame to the connection point of Link 2
Lf:	525 mm Length of Link 1
Lm:	1085 mm Length of Link 2

2. Workspace

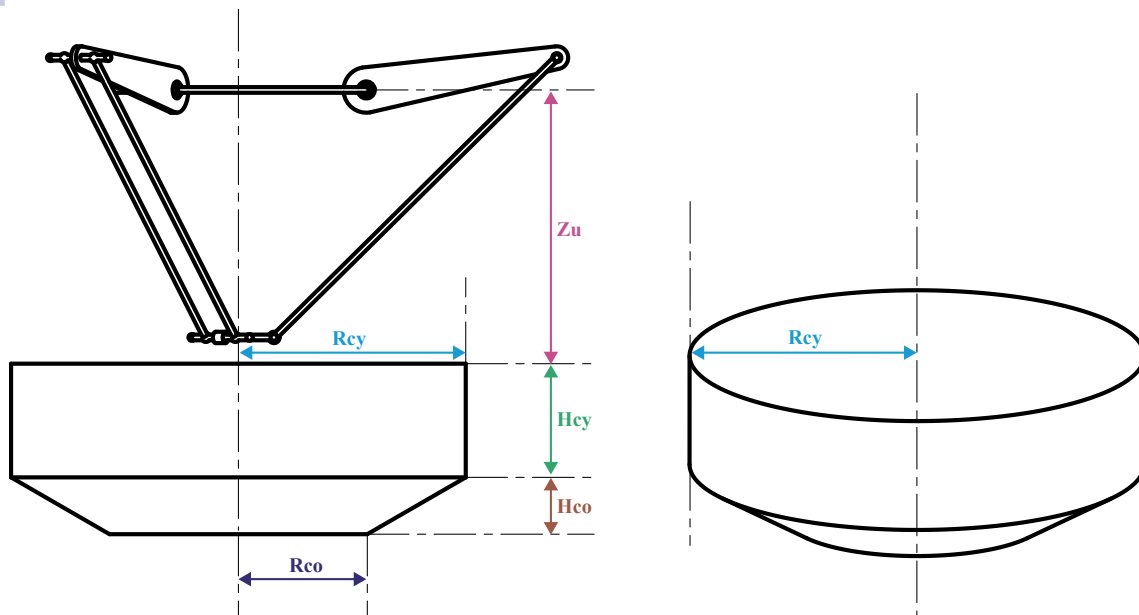
The workspace parameters for the CR_UGD4_XXLH robot are shown below. Set these parameters corresponding to the controller settings.



WARNING

IF THE WORKSPACE PARAMETERS ARE NOT SET PROPERLY, THIS MAY CAUSE THE ROBOT TO MALFUNCTION. SO, BE SURE TO SET THESE PARAMETERS CORRECTLY.

Workspace parameters



Zu:	-811 mm	Distance from the Z-axis origin position
Rcy:	800 mm	Radius of the cylinder
Hey:	350 mm	Height of the cylinder
Rco:	407 mm	Radius of the frustum cone of underside
Hco:	200 mm	Height of the frustum cone

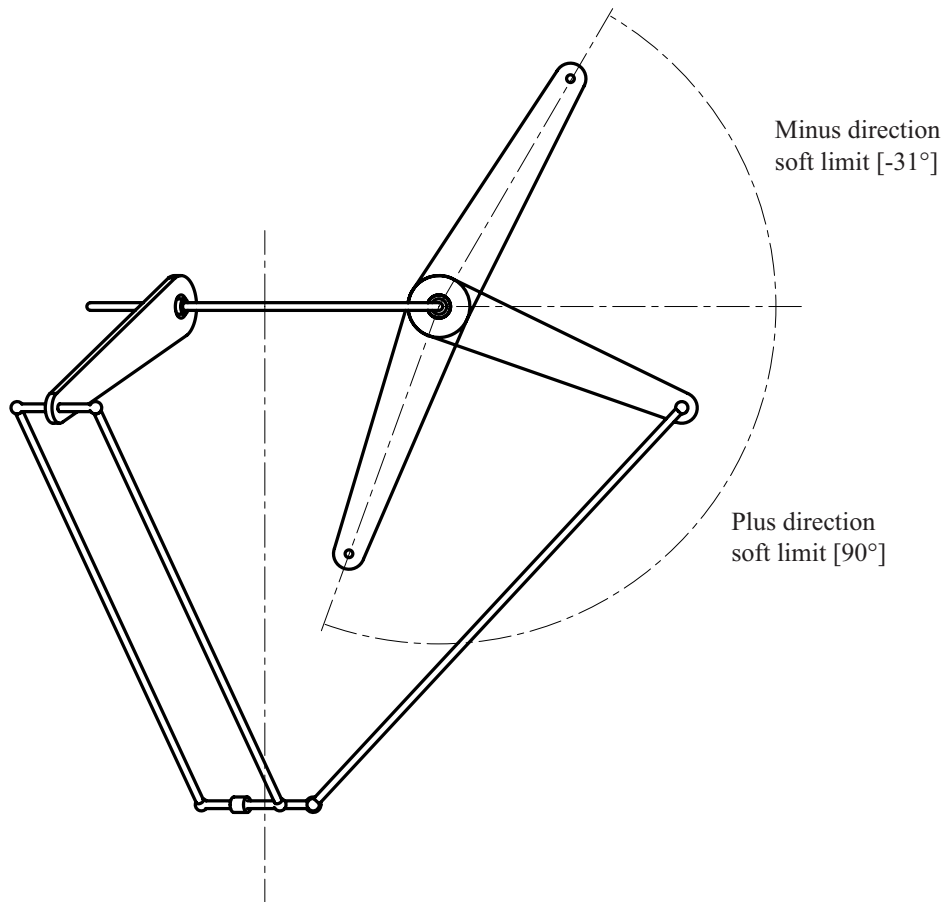
3. Software limits

The software limits for the CR_UGD4_XXLH robot are shown below.



WARNING

IF THE α -, β - OR γ - AXIS SOFT LIMIT IS SET INCORRECTLY, THE ARM MAY COLLIDE WITH THE ROBOT BASE OR BASE PREPARED BY THE USER, CAUSING BREAKAGE. SO, BE SURE TO SET THE SOFT LIMITS CORRECTLY.



Chapter 6 Specifications

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1. Basic specifications

Robot model			CR_UDG4_XXLH_R	CR_UDG4_XXLH_NR
Working volume	X, Y axis	Stroke	Ø1600mm	
	Z axis	Stroke	350mm (max. Ø1600mm)/550mm (center Ø815mm)	
	θ axis	Rotation range	±180° (default setting, it can be changed)	
Servo motor		Arm 1, 2, 3	3000W	
		Rotational axis 4	1000W	
Repeatability *1		X, Y, Z axis	±1mm	
		θ axis	±0.3°	
Maximum through-put *2			80 CPM*4	
Maximum payload			8kg	
θ axis tolerable moment of inertia *3			According to the servo motor	
User tubing (outer diameter)			Ø8*5	
Travel limit			Soft limit	
Noise level			< 70 dB (A)	
Ambient temperature			5°C to 45°C	
Relative humidity			Max. 90%	
Protection class			IP65	
Weight			115kg	

*1: This is the value at a constant ambient temperature.

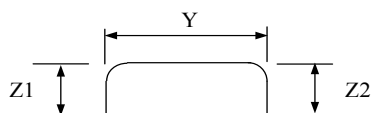
*2: With 0.1kg payload. When reciprocating 305mm in horizontal and 25mm in vertical directions.

*3: There are limits to acceleration coefficient settings.

*4: CPM: Cycle per minutes. Check the note 2 for the cycle definition.

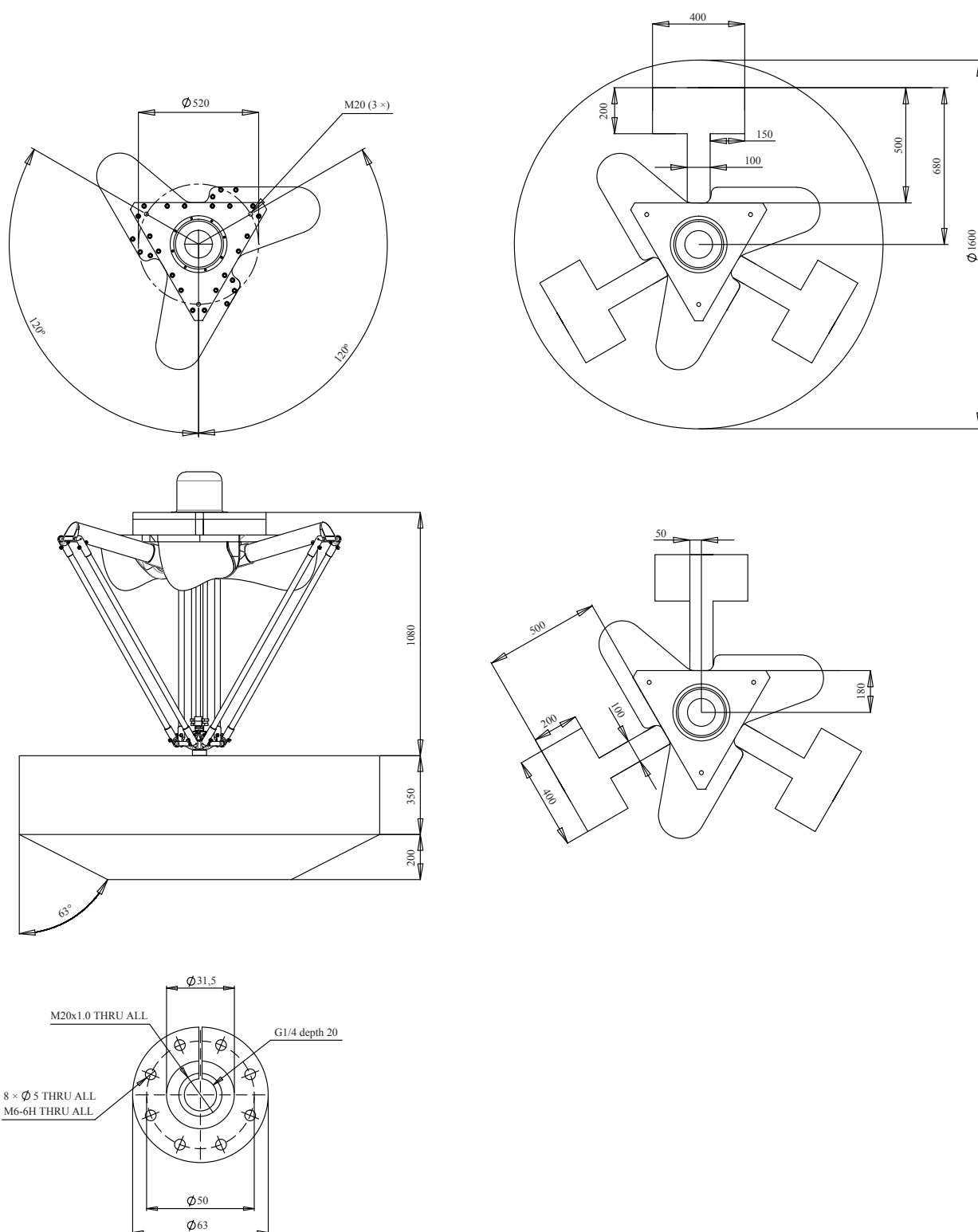
*5: Only for the air suctioning. The air injection is not allowed.

1.1 Cycle time



P&P path	Payload	Cycle time
25 x 300 x 25 mm (Z1 x Y x Z2)	8 kg	1.00 s
200 x 500 x 200 mm (Z1 x Y x Z2)		1.50 s
200 x 1000 x 200 mm (Z1 x Y x Z2)		1.65 s
200 x 1500 x 200 mm (Z1 x Y x Z2)		1.77 s

2. External view and dimensions



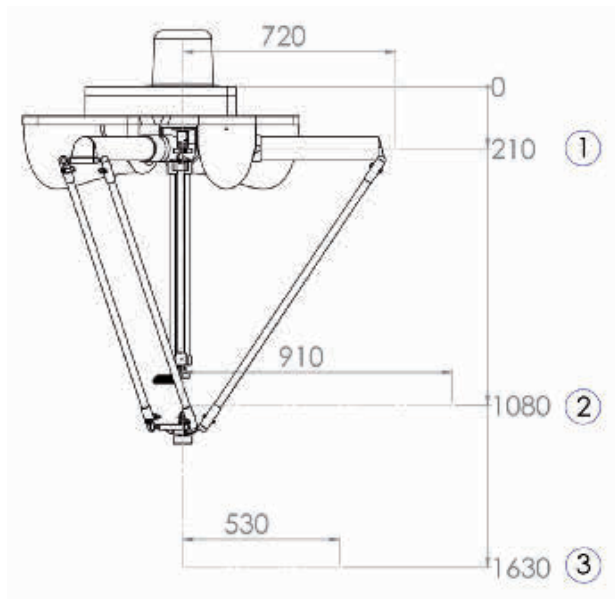
3. Design specifications

3.1 Occupation area of robot

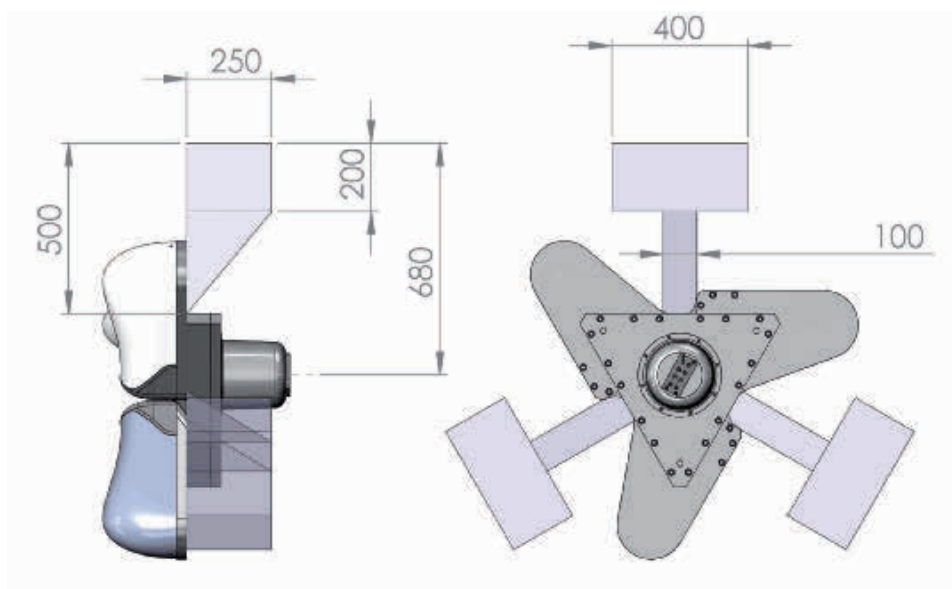
If the robot is integrated into the machine it must be considered what the reach is of all robot parts to prevent collision with other parts in the machine.

Maximum reach of robot arms for a CR_UGD4_XXLH robot without rotation axis are:

- The maximum reach of the primary arms when they are in their horizontal position.
- The maximum reach of the secondary arms when the arms are in their outer position.
- The lowest reach position of the TCP.



When the TCP moves to its outer positions, the primary and secondary arms can rise above the baseplate, take care that no mechanical obstructions are in the areas indicated in the below picture.



WARNING

IF MECHANICAL OBSTRUCTIONS ARE IN THE INDICATED AREA, THE ROBOT OR THE OTHER MACHINE PARTS COULD BE DAMAGED.

3.2 Mounting the robot to its frame

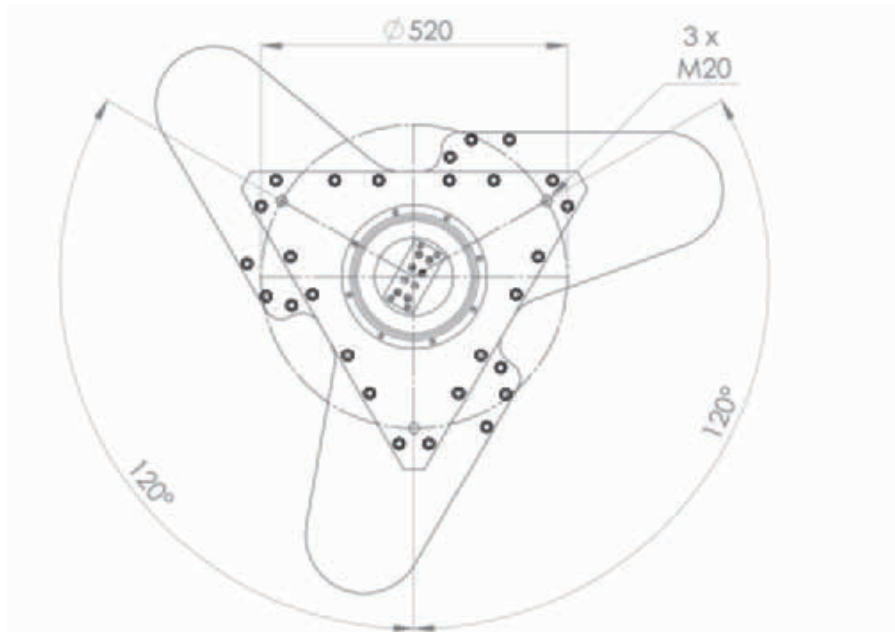
Three M20 6.8 bolts are needed to fasten the robot to the frame, exact bolt length depends on frame layout. The tightening torque of a M20 6.8 bolt is 250Nm.



WARNING

IT IS ADVISABLE TO PUT ONE MOTOR OF THE ROBOT IN LINE WITH THE DIRECTION OF THE TRANSPORT BELT TO MAKE PROGRAMMING EASIER.

The CR_UGD4_XXLH has a circle bolt pattern for mounting the robot to its frame.



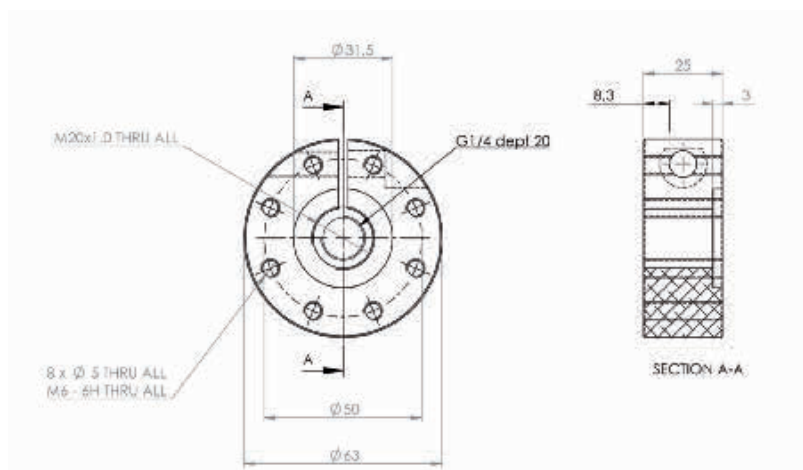
Keep free a minimum of 200mm space area above the plastic motor cover for the rotational axis. For service access this area might be needed to be able to remove the motor cover.

3.3 Arm load

The arms can be used to connect pneumatic hoses or small parts to, however this has a negative influence on robot performance. Note that the influence is lower when the parts are connected higher up on the arms.

3.4 Gripper interface

In the below picture is shown the flange connection of the robot according to ISO 9409-1-A50.



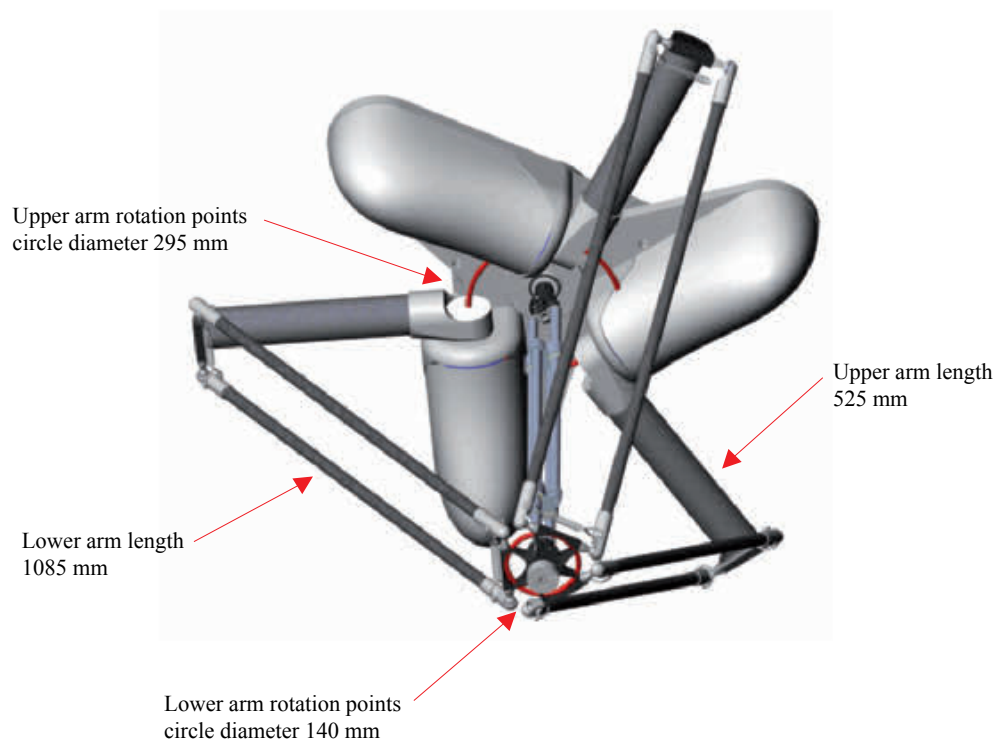
3.5 Software design



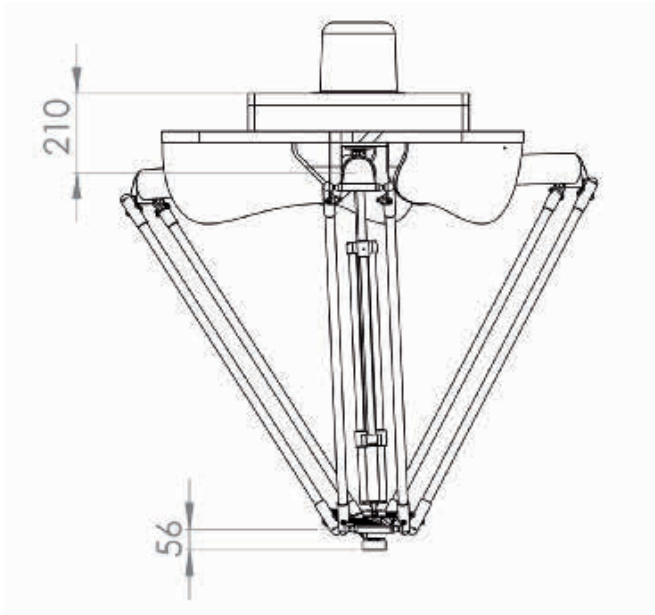
WARNING

THE INPUT TORQUE OF THE ROBOT GEARBOX IS LIMITED TO 10 N·M, LIMIT THE MOTOR TORQUE IN THE SOFTWARE TO PREVENT DAMAGE TO THE GEARBOX.

The arm lengths and pitch circles of the rotation points are shown in the below picture.



Offsets from rotation points to mounting points are shown in the below picture.



Revision history

A manual revision code appears as a suffix to the catalog number on the front cover manual.

Cat. No. I197E-EN-01



The following table outlines the changes made to the manual during each revision.

Revision code	Date	Description
01	May 2015	Original production



Authorized Distributor: