Kawasaki Robotics

CL1 Series Collaborative Robots

User Manual

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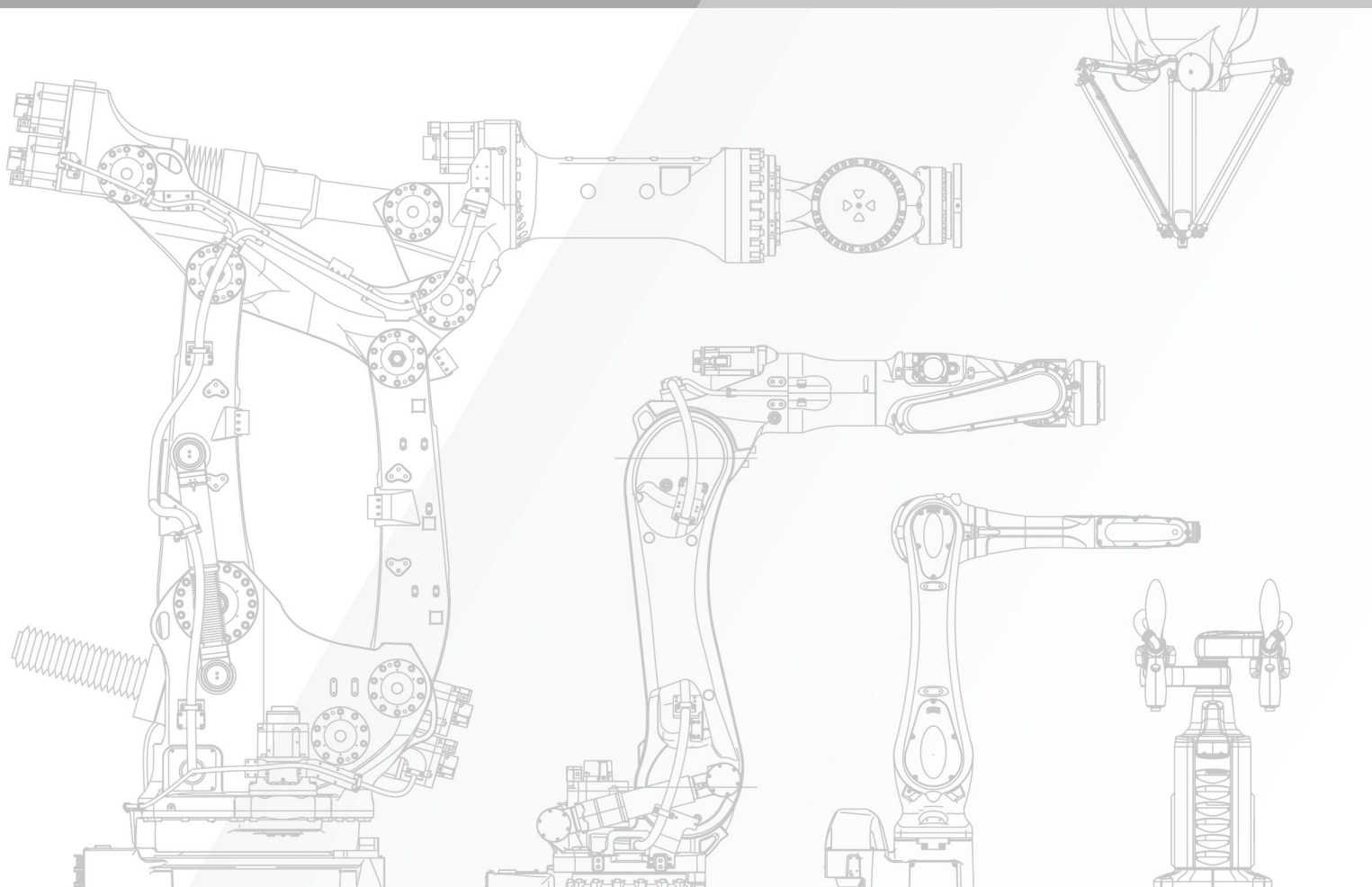

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1 ABOUT THIS DOCUMENT

1.1 How to use this Manual

This manual contains information that is necessary to use the robot. Read this manual and make sure that you understand the safety, assembly, maintenance, and operation of the CL1 robot series before attempting to use it.

Always keep this manual in a safe place where it will be available for reference during operation.

Read and understand the instructions chapter 2, General Safety Instructions on page 5. The user manual provides instructions for CL1 operators for the following aspects:

1.2 Safety: The operator shall keep all safety instructions in mind.

- Mechanical Installation: The operator shall follow the instructions when installing the robot.
- Electrical Ports: Open ports of CL1 are introduced to provide convenience for secondary development.
- Software Control: Is described in the CL1 software user manual. It can guide the operator to install software and run the robot.
- Security Configuration: It introduces the basic safety settings.

1.3 Related Documents

The CL1 robot system can be used both as stand-alone and as part of a plant. Also follow the related manuals and the instructions for the other system components. This includes:

- Quick Start Guide
- GUI & Software Manual
- Service Manual
- Kawasaki RoboticsPy Documentation
- Training Materials

1.4 Robot Models

This manual provides information for the following CL1 models.

- CL103
- CL105
- CL108
- CL110

When information varies between different robot models, details are provided. When information is common to all robot models, an illustration of a single robot model is typically shown.

1.5 Used Characters and Symbols

In this user manual, various elements are used to indicate special text meanings or especially important text passages.

Symbols and terms used in warnings:

The below table defines the common safety warnings, symbols and terms that may exist in the content of using robots:

⚠	The general danger symbol warns of risk of serious injury when used with the signal words **CAUTION**, **WARNING** and **DANGER**. Follow all the instructions in order to avoid injuries or death.
NOTICE	Indicates a hazardous situation which, if not avoided, results in damage to or destruction of the device.
CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

Structure of warnings:

⚠ SIGNAL WORD
Type and source of the danger **Consequences resulting from non-observance** ► Action for danger avoidance.

Symbols and marks:

🗐	**Prerequisite** Indicates a prerequisite that must be satisfied before one of the following actions is performed, e.g.: 🗐 You are in the measurement display.
►	**Action** Indicates a single action, e.g.: ► Switch on device.
➔	**Result** Indicates the result of an action, e.g.: ➔ The device starts a self-test.
Bold text	**Operating element or menu name** Indicates operating elements and menu names, e.g.: ► Press the **OK** button.
NOTE:	Important additional information or notes regarding exceptions and special cases.

1.6 Abbreviations

Abbreviation	Description
AC	Alternating Current
AI	Analog Input
ANSI	American National Standards Institute
AO	Analog Output
CB	Control cabinet
DC	Direct Current
DI	Digital Input
DIN	German Institute for Standardization
DO	Digital Output
EMC	Electromagnetic Compatibility
EN	European Standard
ESD	Electrostatic Discharge
GND	Ground
GUI	Graphical User Interface
HMI	Human Machine Interface
I/O	Input / Output
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
PLC	Programmable Logic Controller
PL d	Performance Level d
TCP	Tool Center Point
TP	Teach Pendant
USB	Universal Serial Bus

Table 1: Abbreviations

1.7 Technical Support

Kawasaki Robotics GmbH will provide you with long-term technical services. If you have any technical problems or other needs during use, visit our company website: www.kawasakirobotics.de, or directly contact our engineers.

Contact Information

Company Address:
Kawasaki Robotics GmbH,
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2 GENERAL SAFETY INSTRUCTIONS

⚠ IMPORTANT NOTE

Machine Safety

The product described in these operating instructions is an incomplete machine in terms of safety and is intended for installation in a system or with attached parts. This equipment must be completed in terms of safety and CE marked in accordance with the applicable regulations (i.e., Machinery Directive 2006/42/EC). Until this marking, commissioning of the product is prohibited by EU law. A special regulation applies to demonstration and prototype devices, which may be put into operation in consultation with CL1 Robotics GmbH under compliance with special conditions and associated training.

The CL1 Robot System has been manufactured according to the accepted rules of safety and current technology. However, there still is a danger of personal injury or damage to equipment if the following general safety instructions and warnings are not observed and implemented.

- Read these instructions completely before working with the CL1 Robot. The contents with warning signs need to be mastered and strictly followed.
- Always keep this manual in a safe place where it will be available for reference during operation.
- Always include the operating instructions when passing the CL1 Robot on to third parties.

This chapter introduces the safety principles and specifications that must be followed when operating the robot or robot system. Because the robot system is complex and dangerous, users need to fully understand the risks of operation and strictly abide by and implement the specifications and requirements in this manual. Operators and integrators need to have sufficient safety awareness and comply with the industrial robot safety standard ISO 10218.

CL1 robots are equipped with a variety of built-in safety functions and safety I/O, digital and analog control signals to and from the electrical interface, used to connect other machines and additional protection devices. Each safety function and I/O are constructed in accordance with EN ISO13849-1:2015. The performance level (PL d) of the three types of structures is used to understand the configuration of safety functions, inputs, and outputs in the user interface.

About the connection of safety equipment and I/O:

- The use and configuration of safety functions and interfaces must follow the risk assessment procedures of each robot application.
- If the robot finds a fault or violation in the safety system, the robot will immediately go into a safe stage and stop (for example, a line in the emergency stop circuit is cut off or a safety limit violation occurs).
- The stop time should be considered as part of the application risk assessment.
- The difference between the safety configuration parameters used and the risk assessment can lead to risks that cannot be reasonably eliminated or risks that cannot be sufficiently reduced.
- Make sure that the tool and jaws are properly connected to avoid danger if the power supply is interrupted.
- The end effector is not protected by the security system of Kawasaki Robotics GmbH. End effector and/or connection cable function is not monitored.

The following general safety precautions must be followed during all phases of operation, service, and repair of this robot.

⚠ IMPORTANT NOTE
Liability Kawasaki Robotics GmbH shall not be liable for failure, indirect, incidental, or consequential damages, loss of profits or production or commercial loss in any way connected with the CL1 safety standards.

2.1 General Instructions

In this chapter the general advices are shown how to properly use the robot and how the environment should around the robot should look like:

- Do not use the robot if it is damaged. Contact the technical support personnel of Kawasaki Robotics GmbH immediately.
- Observe the regulations for accident prevention and environmental protection for the country where the device is used and at the workplace.
- Only authorized and qualified personnel is permitted to work (assembly, installation, configuration, commissioning, operation, maintenance) on the robot.
- Disconnect the power supply and install the robot and all electrical equipment in accordance with the requirements and specifications in this manual. Follow the safety instructions and warning as per Chapter 6.3 Electrical Installation.
- Do not connect the safety device to the regular normal I/O interface. Only use the safety type I/O interface.
- Do not place any objects and any mechanical loads on the device under any circumstances.
- Ensure that the power supply is within the stipulated tolerance for the module.
- Kawasaki Robotics GmbH shall not be liable for any damage or personal injury caused to the robot due to errors in this script or improper operation of the robot.
- Take care of potential hazards leading to injuries and equipment damage when working with the robot system.

Examples for potential hazards:

- Fingers are caught between the robot foot and the base.
- Sharp edges and sharp points on the tool or tool connector pierce the skin.
- Sharp edges and sharp points on obstacles near the robot trajectory puncture the skin.
- Injured by a robot collision.
- Sprains or fractures due to the impact between the robot's payload and a solid surface.
- Consequences due to insecure bolts used to fix the robot arm or tool.
- Items fall from the tool, for example due to inadequate clamping or power failure.
- Operation errors due to different emergency stop buttons on different machines.

2.2 Operator qualifications

For the operation and maintenance of the robotic system, there are different levels of qualification needed. Please ask your Kawasaki representative to offer you the training that is needed to fulfil those tasks.

Phase of Robotic system life cycle	Task	Qualification of Operator *		
		Non-professional *	Trained *	Specialist *
Transport (original packaging)	Lifting, transportation, handling	x		
Transport (unpacked)	Unpacking, Lifting, transportation, handling		X	
Installation	Mounting		X	
	Assembly		X	
	Connection of original cables (plugs)		X	
	Connection of custom cables (GPIOs)			X
	Testing		X	
Teaching & Programming (initial/ changes)	Setting of parameters (e.g. speed, force, travelling limits)		X	
	Functional tests		X	
	Verification of final system			X
Operation	Normal operations		X	
	Starting/restarting system		X	
	Stopping system		X	
Maintenance	Cleaning		X	
	Resetting		X	
Service	Troubleshooting		X	
	Verification of repairs			X
	Rescue of trapped persons	X		
Decommissioning/ Disabling	Disconnecting from mains		X	
	Packing		X	

Table 2: Necessary operator qualifications in different phases of the robotic system life cycle

* **Operator:** A person or persons installing, operating, adjusting, maintaining, cleaning, repairing or moving machinery.
* **Non-professional:** A person or persons without specified training by Kawasaki robotics or authorized partner. These persons must be appropriately instructed to perform the assigned tasks.
* **Trained personnel:** A person or persons who have been instructed by Kawasaki Robotics or an authorized partner and trained in the duties with which they are entrusted and the risks which may arise from incorrect behavior. They also have been advised on the necessary protective devices and precautions.

* **Specialist:** A qualified person, which based on professional training, knowledge and experience is able to assess assigned duties and will be aware of possible risks. Furthermore, this person knows the relevant regulations.

2.3 Robot assembly and installation

- Make sure that there is enough space for robot arms to move freely.
- Make sure that the arms and tools of the robot are installed properly and safely.
- Make sure that installation settings (such as robot's installation angle, additional TCP load, TCP offset, safety configuration) are correct. Save the installation file and load it into the program (See Software Manual for instructions).
- Free drive function (impedance / reverse drive) can only be used in the installation process after passing the risk assessment. Tools and obstacles should not have sharp corners or twists. Ensure that the head and face of all people are beyond the reach of robot.
- If the software gives out a fatal error message, activate the emergency stop quickly, write down the situation that causes the error, find out the related error codes on the code page, refer page 71 Malfunctions and Failures, and contact us.
- Connecting different machines may pose risks or cause new danger. A comprehensive risk assessment on the whole installation process has always to be carried out. When different safety and emergency stop performance levels are required, the highest performance level has always to be selected. Always read and understand the user manual of all the devices used in the installation.
- When the robot is connected or work together with other machines that may damage the robot, it is strongly recommended that all functions of the robot and robot program shall be checked separately. It is recommended to use other temporary road points outside the mechanical workspace to detect the robot program.
- After the robot installation and construction are completed, a comprehensive risk assessment needs to be conducted again and the documentation kept.
- The security parameters are set and changed by authorized personnel, and passwords or isolation measures are used to prevent unauthorized personnel from changing or setting security parameters. After the safety factor is modified, the relevant safety functions need to be analyzed.

2.4 Commissioning

Before using the robot for the first time and putting it into production, preliminary testing and inspection of the robot and its protective system are required.

The user must check and ensure that all safety parameters and user programs are correct and that all safety functions are working properly. A person qualified to operate the robot is required to check each safety function. The robot can only be started after passing a comprehensive and careful safety test and reaching a safety level.

- Before starting the system and equipment for the first time, ensure that the equipment is complete, free from any damage for safe operation.
- During this inspection, it is necessary to observe whether it complies with the effective safety production regulations of the country or region, and all safety functions must be tested.
- Make sure that the robot's arms and tools are installed correctly and safely.
- Make sure that the robot arm has enough space to move freely.
- Make sure to set the correct installation settings (such as the installation angle of the robot body, the additional TCP load, TCP tool coordinates, safety configuration). Save and load the installation file into the program.

- Make sure that the installation settings (such as robot's installation angle, additional TCP load, TCP offset, safety configuration) are correct. Save the installation file and load it into the program.
- Tools and obstacles must not have sharp corners or twisted points. Make sure everyone's head and face are outside the reach of the robot.

2.5 Operation

When operating the robot system, you must first ensure the safety of the workers. The general precautions are listed below:

- Take appropriate measures to ensure the safety of the workers.
- Each operator using the robot system should receive training through the training course sponsored by Kawasaki Robotics GmbH or an authorized partner.
- The user needs to ensure that he fully masters the safe and standardized operation process and has the qualification for robot operation. For details of the training, inquire with our company, see the official website for contact information: www.kawasakirobotics.de.
- Pay attention to the movement of robot when using teach pendant.
- Do not enter the safety scope of the robot or touch the robot when the system is running.
- Do not wear loose clothes or jewels when operating the robot. Be sure to tie your long hairs up and keep them behind your head when operating the robot.
- During the operation of the equipment, even if the robot seems to have stopped, it may be because the robot is waiting for the start signal and might start to move any time. Even in this state, the robot should be regarded as being in motion.
- Make sure that safety measures (such as guardrails, ropes, or protective screens) are taken near the robot operation area to protect the operator and surrounding people. Locks should be set according to the needs, so that the person in charge of the operation cannot access the robot power supply.
- Lines should be drawn on the floor to mark the range of motion of the robot, so that the operator understands the range of motion of the robot including holding tools (manipulators, tools, etc.).
- Do not wear the gloves while working on the operation panel and the teach pendant. It may cause operational errors.
- Robot and electrical control cabinet will produce heat in the operating process.
  - Do not operate or touch the robot while working or just after stopping work.
  - Never put your fingers into the hot place of the control cabinet.
- Generally, the robot cools down in one hour after disconnecting the power.
- In the event of an accident or abnormal operation of the robot, you must press the emergency stop switch to stop the robot immediately. In rare cases, it may be necessary to move one or more robot joints in an emergency situation where the power supply of the robot fails or does not want to use the power supply (see section *8.4 Emergency Handling* on page *67*.)
- In an emergency or abnormal situation such as a person being caught or surrounded by a robot, push or pull the robot arm with force (at least 500 N) to force the joint to move.
- Manually moving the robot arm without electric drive is limited to emergency situations and may damage the joints.

2.6 Modification

Do not modify the robot. Any modification of the robot could cause unpredictable danger for the user. The authorized reconfiguration of robot should be in accordance with the latest edition of all related service manuals. Kawasaki Robotics GmbH shall not be liable for failure or consequential damages caused by any un-authorized modification of the robot.

2.7 Repair and Maintenance

Obey all safety instructions in this manual before carrying out any maintenance and repair work.

- Repair and maintenance work may only be carried out by qualified personnel.
- Remove the main input cable from the electrical control cabinet to ensure that it is completely powered off.
- Disconnect other energy sources connected to the robot arm or electrical control cabinet. Take necessary precautions to prevent others from reconnecting the system energy during maintenance.
- Check the ground connection before restarting the system.
- Observe ESD regulations when disassembling the robot arm or electrical control cabinet.
- Do not disassemble the power supply system of electrical control cabinet. The power supply system may retain high voltage (up to 600 V) after turning off the electrical control cabinet.
- Avoid water or dust entering the robot arm or electrical control cabinet.
- After maintenance and repair, a check must be carried out to ensure the safety level required by the service. When verifying, you must abide by effective national or local safety laws and regulations. Meanwhile, all safety functions should be checked.
- CL1 series robot joint modules are equipped with brakes to maintain the robot's posture when the power is turned off. Do not artificially break the power supply system frequently to avoid excessive wear of the brakes. It is recommended that the time interval for switching on and off each time should be greater than 10 s.

2.8 Environmental Conditions

- Only operate the device under ambient conditions as specified in the technical data in this manual (see *Technical Specifications* on page *98*).
- Prevent the robot from being exposed to permanent magnetic fields. A strong magnetic field can damage the robot.

2.9 Device Malfunctions

- Only operate the device under the conditions and for the purposes for which it was designed.
- Periodically inspect the device for damages. Please refer to chapter 10.3 for further details.
- Only have repairs performed by specialists.

2.10 Qualified Personnel

Assembly, disassembly, commissioning, and operation require basic electrical and mechanical knowledge, as well as knowledge of the appropriate technical terms. Assembly, disassembly, commissioning, and operation may therefore only be carried out by qualified electrical or mechanical personnel or an instructed person under the direction and supervision of qualified personnel.

Qualified personnel are those who can recognize possible hazards and institute the appropriate safety measures due to their professional training, knowledge, and experience as well as their understanding of the relevant conditions pertaining to the work to be done. Qualified personnel must observe the rules relevant to the subject area.

2.11 Robot Integrator

The integrator is a person who designs, provides, manufacturers or assembles an integrated manufacturing system and is responsible for the safety strategy, including protective measures, control interfaces and connections of the control system.

2.12 Risk Assessment

Risk assessment is one of the most important tasks that the integrator must complete. The robot itself is a partially completed machine, and the safety of the installed robot depends on how the robot is integrated (such as tool, obstacle, and other machinery).

It is recommended that the integrator should use at least the guidelines of ISO12100 and ISO10218-2 to carry out risk assessment.

The risk assessment needs to consider three situations: the risk of robot installation, robot demonstration and the risk of running robot.

For the non-collaborative installation of the robot (e.g., when using dangerous tools), risk assessment may infer that integrator need to connect additional security devices to protect themselves when programming the robot system.

Hazard Identification

The risk assessment should consider all potential contact between the operator and the robot during normal use and foreseeable misuse. The operator's neck, face and head should not be exposed to avoid touching. Using robots without using peripheral safety guards requires a risk assessment to determine whether the relevant hazards will constitute an unacceptable risk, such as:

- The use of sharp end effectors or tool connectors may be dangerous.
- It may be dangerous to handle toxic or other harmful substances.
- The operator's fingers may be caught by the robot base or joints.
- The danger of being collided by the robot.
- The danger that the robot or the tool connected to the end is not fixed in place.
- Danger caused by impact between the robot payload and a solid surface.

Integrators must measure such hazards and their associated risk levels through risk assessment and determine and implement appropriate measures to reduce the risk to an acceptable level. Please note that there may be other major hazards with certain robotic devices.

By combining the inherent safety design measures applied by CL1 robots with the safety specifications or risk assessments implemented by integrators and end users, the risks associated with the collaborative operation of CL1 series robots are reduced to a reasonable and feasible level as much as possible. This document can be used to communicate any remaining risks of the robot before installation to the integrator and end user. If the integrator’s risk assessment determines that there are hazards in its specific application that may cause unacceptable harm to the user. In that case, the integrator must take appropriate risk reduction measures to eliminate or minimize the hazards to an acceptable level. It is unsafe to use before taking appropriate risk reduction measures (if necessary).

If the robot is installed in a non-cooperative manner (for example, when using dangerous tools), the risk assessment may infer that the integrator needs to connect additional safety equipment (for example, safe start-up equipment) to ensure the safety of personnel and equipment during their programming.

2.13 Emergency Stop Mechanism

All the moving parts of robot will stop when the emergency-stop is activated. After releasing the emergency-stop, no action of the robot is started. The emergency-stop cannot be used as a risk reduction measure, but it can be used as a secondary protection device. If multiple emergency-stop buttons need to be connected, they should be included in the risk assessment of robot application.

2.14 Responsibilities and Specifications

The CL1 series of robots can be combined with other equipment to form a complete machine, which is not complete in itself. Therefore, the information in this manual does not include how to fully design, install, and operate a complete robot, nor does it include all the possibility of affecting the safety of the peripheral equipment of this complete system. The safety of a complete robot installation depends on how the robot is integrated.

NOTICE
► **Integrators** need to follow the laws and regulations of the host country and safety regulations and standards to conduct a risk assessment of the design and installation of the complete system.

Risk assessment is one of the most important tasks that integrators must complete.

Integrators can refer to the following standards to perform the risk assessment process.

- ISO 12100:2011-03 Safety of machinery-General design principles-Risk assessment and risk reduction.
- ISO 10218-2:2011 Robots and robotic equipment-Safety Requirements-Part 2: Industrial robot systems and integration.
- ISO/TS 15066:2016 Robots and robotic devices – Safety requirements for industrial robots – Collaborative operation.

The integrator of CL1 robot needs to perform but not limited to the following responsibilities:

- Comprehensive risk assessment of complete robot systems.
- Confirm that the design and installation of the entire system is accurate.
- Provide training to users and staff.
- Create a complete system of operating specifications and clearly explain the use process.
- Establish appropriate security measures.
- Use appropriate methods during final installation to eliminate hazards or minimize all hazards.
- Communicate residual risks to end users.
- Mark the integrator's logo and contact information on the robot.
- Archive related technical documents.

Contact Kawasaki Robotics for applicable standards and legal guidelines.

All safety information contained in this manual should not be regarded as a guarantee of Kawasaki Robotics GmbH even if all safety instructions are followed, personal injury or equipment damage caused by operators may still occur.

Kawasaki Robotics GmbH is committed to continuously improving the reliability and performance of the product, and therefore reserves the right to upgrade the product without prior notice. Kawasaki Robotics GmbH strives to ensure the accuracy and reliability of the contents of this manual but is not responsible for any errors or missing information.

2.15 Intended Use

The CL1 robot is only to be used as/for general industrial equipment, such as operating or fixing tools, equipment, processing or transferring parts, products. CL1 is only allowed to be used under specified environmental conditions. For specific information about the operating environment and operating conditions, refer to the appendix.

CL1 robot has a special safety level feature that can be used for collaborative operation, where the robot system operates without any safety protection devices, field induction devices and/or together with a human.

Collaborative operation is only intended for non-hazardous applications, where the complete application, including tool/end effector, work piece, obstacles, and other machines, is without any significant hazards according to the risk assessment of the specific application. Robot controllers and robots are limited to the use of general industrial equipment and cannot be used in applications that violate the intended use.

2.16 Non-intended Use

All applications that are not defined in the “Intended use” section are considered improper applications and are prohibited.

Kawasaki Robotics GmbH will not assume any liability for misuse. Misuse includes, but not limited to:

- Used in flammable and explosive hazardous environments.
- Device for moving or carrying people or other animals.
- Used in medical equipment and other devices related to human life.
- For devices that have a significant impact on sociality and publicity.
- Used in vibration environment of vehicles, ships, etc.
- Used for climbing tools.

2.17 Warranty

In the principle of no prejudice to any claim agreement that may be reached between users (customers) and distributors or retailers, the manufacturer shall give customers a product quality warranty according to the following terms: If any defect occurs due to defective manufacturing or materials within 12 months after initial use of equipment or components (not more than 15 months if transportation time is included), Kawasaki Robotics shall provide necessary spare components while users (customers) shall provide labor for replacement with spare components. Related components shall be maintained or replaced with another component embodying the up-to-date technological level. This product quality warranty is invalid if equipment defects are caused by improper handling or failure to observe related information described in the user manual. This product quality warranty does not apply to or extend to any maintenance performed by authorized distributors or customers such as installation and software downloading. Users (Customers) must provide a purchase receipt and purchase date as valid evidence of enjoying the product quality warranty.

According to the product quality warranty, any claim must be made within two months when the product quality warranty is not obviously fulfilled. Any equipment or components replaced or returned to Kawasaki Robotics shall be owned by Kawasaki Robotics. Any other claim arising from or in connection with equipment is not within the scope of this product quality warranty. Any terms of this product quality warranty do not try to limit or exclude customers' legal rights as well as the manufacturer's liability for any casualties due to its negligence. The duration of this product quality warranty shall not be extended due to any services provided according to the terms of this product quality warranty. Kawasaki Robotics reserves the right to collect replacement or maintenance costs to customers without violating the principles of this product quality warranty. The preceding regulations do not imply any change of burden of proof, harming the interests of customers.

If equipment shows any defect, Kawasaki Robotics shall not bear any resulting damage or loss, e.g., production loss or damage to other production equipment.

2.18 Disclaimer

Kawasaki Robotics reserves the right to upgrade products without prior notice because it devotes itself to continual improvement on product reliability and performance. Kawasaki Robotics does its best to ensure the accuracy and reliability of the contents of this manual but disclaims any liability for any error or missing information.

3 PRODUCT DESCRIPTION

The CL1, is a collaborative robot with six degrees of freedom that combines the agility of lightweight design with industrial performance in terms of speed, precision and protection, bridging the gap between the world of collaborative and industrial robots.

The CL1 can safely handle all types of delicate parts and assemble objects with consistent force, eliminating waste and preventing harming collisions. Combined with its powerful controller, it can work with high speeds and follow defined paths in the most precise manner.

Specially designed control systems allow the CL1 to be seamlessly integrated into any production line, while its intuitive user interface enables anyone to create programs for the CL1 with ease.

Thanks to its compact and robust design, the CL1 can be used in all kinds of harsh environments that may not be suitable for other collaborative robots.

3.1 Robot types and dimensions

This manual contains information for the following models of CL1:

- CL103 with 3 kg payload and 590 mm reach
- CL105 with 5 kg payload and 800 mm reach
- CL108 with 8 kg payload and 1300 mm reach
- CL110 with 10 kg payload and 1000 mm reach

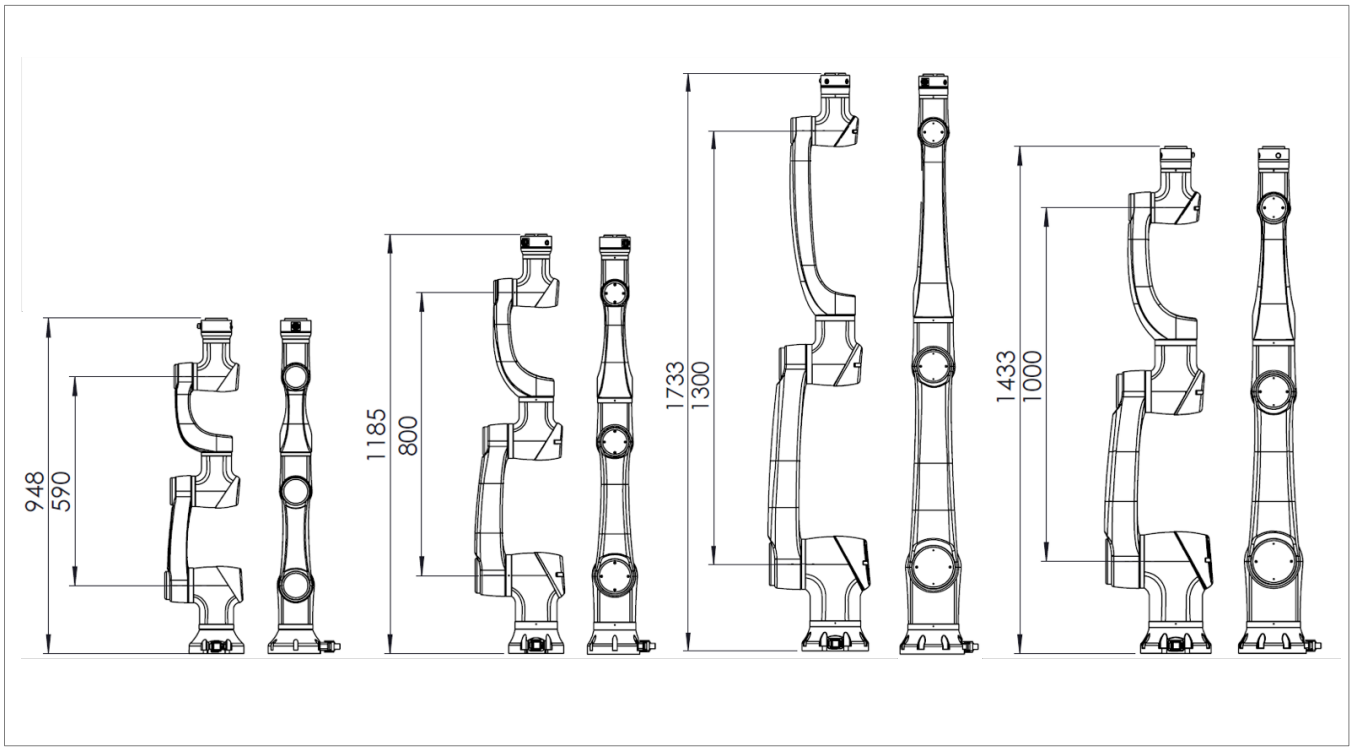
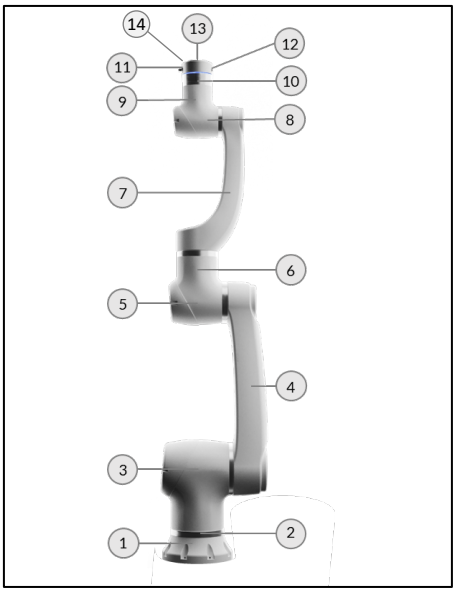


Fig. 1: Robot dimensions for different types CL1 03, 05, 08, 10

3.2 Robot Body

3.2.1 Overview



1 Robot base (Link 0)
2 Joint 1 (J1)
3 Joint 2 (J2)
4 Link 2/3
5 Joint 3 (J3)
6 Joint 4 (J4)
7 Link 4/5
8 Joint 5 (J5)
9 Axis module 5/6
10 Joint 6 (J6)
11 I/O End connector (12 pole)
12 TCP Buttons
13 Tool center point (TCP)
14 LED Ring

Fig. 2: Overview robotic arm (CL1)

1 Joint 5 (J5)
2 CL1 axis module 5/6
3 Joint 6 (J6)
4 Tool connector
5 TCP buttons
6 Connector flange
7 LED Ring

Fig. 3: Overview axis module 5/6 and TCP (CL1)

3.2.2 Tool Payload Range

Due to different distances between load center at the end of robot and the center of installed flange, the allowable payload of robot will change accordingly. The relationship between the centroid distance and allowable payload is shown below:

Item	Specification			
	CL103	**CL105**	**CL108**	**CL110**
Payload	3 kg	5 kg	8 kg	10 kg
Reach	590 mm	800 mm	1300 mm	1000 mm

Table 3: Payload, reach specifications

3.2.2.1 Configuring the mass of the tool

The mass of the tool must be configured properly to ensure the performance of the robot system. Also, the ZeroG mode is affected by the mass and could be drifting away if the mass is not set properly.

Detailed information about the integration of tools and the mass can be found in the CL1 Software User Manual.

3.2.2.2 Payload diagrams

This chapter explains the relationship between the tool mass and the distance of the center of mass from the tool center point.

Consider the following points to understand the payload diagrams:

- Shown is the maximum payload of the robot over the robot's workspace during full speed motion.
- The x-axis shows the position of the robot's TCP **Lz** in z-direction, e.g., the height above the robot's mounting position.
- The y-axis shows the distance from the robot's TCP to its base.
- With increasing height or distance from the robot's base, the maximum payload decreases.
- The maximum payload is an equivalent mass acting mounted to the robot's flange. Tools with a large lever arm will have a larger equivalent mass than its actual mass.
- The maximum payload is computed for full speed motions, meaning that the robot operates at maximum velocity and maximum acceleration. For slower motions, larger load might be feasible.
- If the maximum payload is exceeded, the robot will automatically slow down its motion.

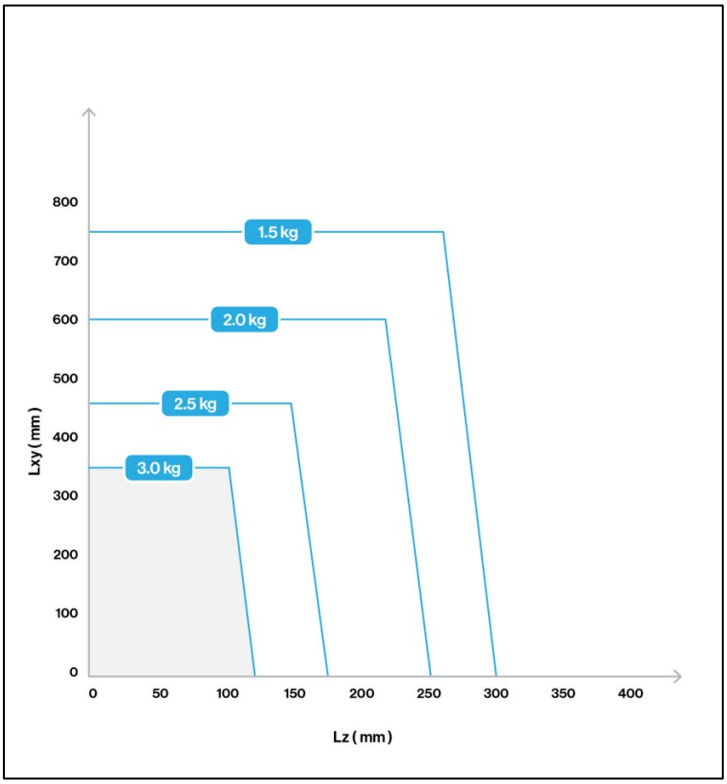


Fig. 4: Tool load to distance ratio diagram for CL103

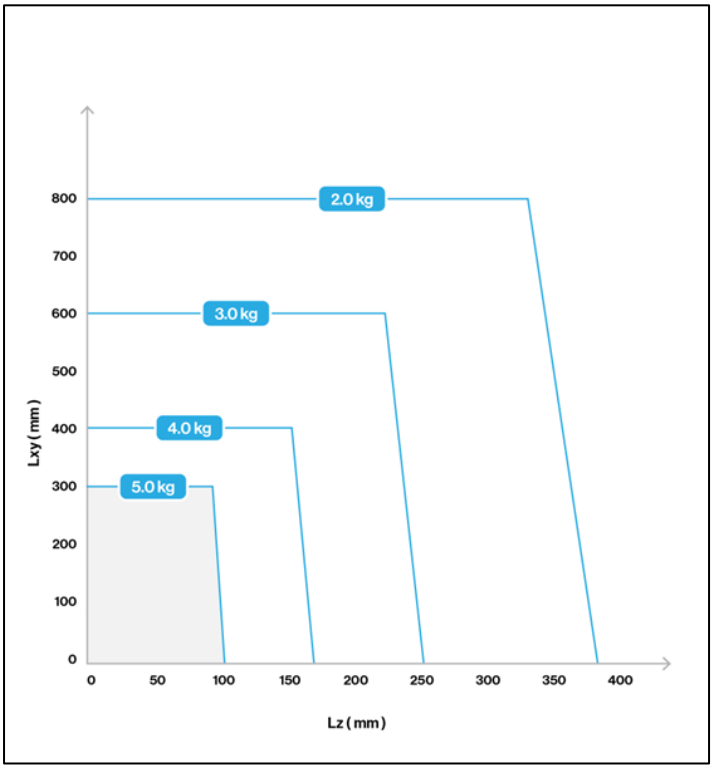


Fig. 5: Tool load to distance ratio diagram for CL105

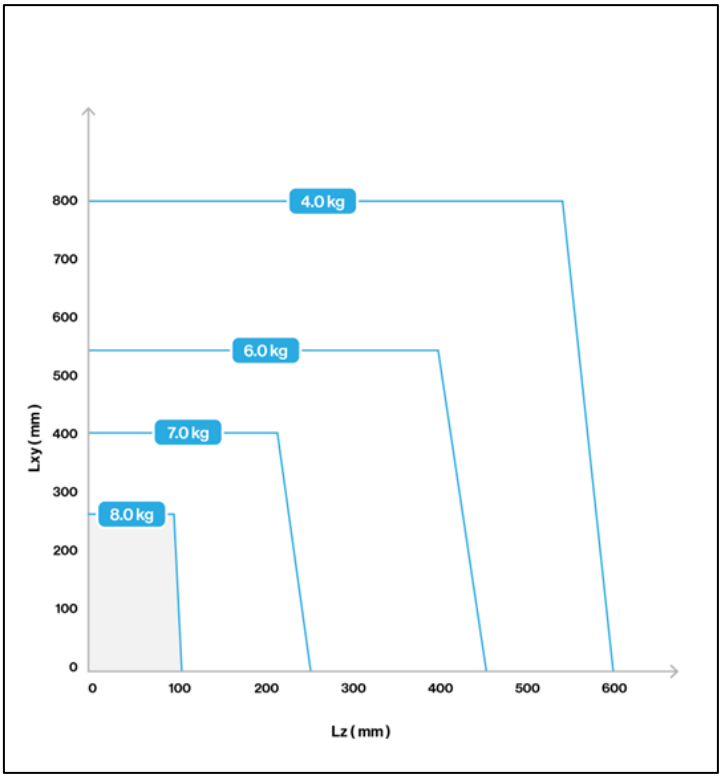


Fig. 6: Tool load to distance ratio diagram for CL108

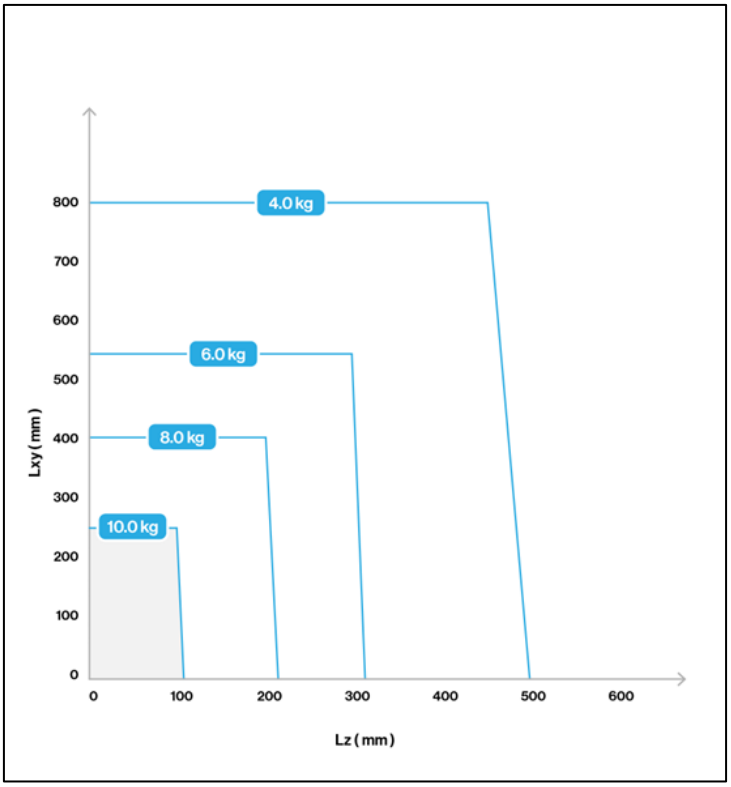


Fig. 7: Tool load to distance ratio diagram for CL110

3.3 Robot Velocities

Table 4 specifies maximum robot velocities. For those speeds to be reached, specific conditions must be met. For typical robot velocities, please refer to Table 5.

Note that not every programmed motion will reach the specified maximum speed, e.g. when the acceleration phase is not long enough or when the maximum axes loads would be exceeded. For higher payloads, acceleration and speeds should be reduced. E.g. for max. payload it is recommended to reduce acceleration and speed to 70% within the motion settings. For further information please contact your Kawasaki Robotics representative.

The max. acceleration of each joint is 90 $\frac{deg}{s^2}$.

For most scenarios of collaborative use, typical speeds are below 30 deg/s for axes and 250 mm/s for linear movements.

Table 4: Maximum velocities

Value	CL103N	CL105N	CL108N	CL110N
Max. axes speed[1]	200 deg/s	200 deg/s	200 deg/s	200 deg/s
Max. TCP speed[2]	2500 mm/s	3000 mm/s	4500 mm/s	3600 mm/s
Max. linear speeds	500 mm/s	1000 mm/s	1000 mm/s	1000 mm/s

[1] Only reachable with enough acceleration distance and prior to consent and adjustments by Kawasaki Robotics.
[2] Only reachable with a combination of motions (multiple axes). No linear/cartesian movement.

Table 5: Typical velocities

Value	CL103N	CL105N	CL108N	CL110N
Typical axes speeds	30 deg/s	30 deg/s	30 deg/s	30 deg/s
Typical TCP Speed	1000 mm/s	1200 mm/s	1800 mm/s	1440 mm/s
Typical linear speeds	250 mm/s	250 mm/s	250 mm/s	250 mm/s

3.4 Robot Control cabinet

3.4.1 Overview

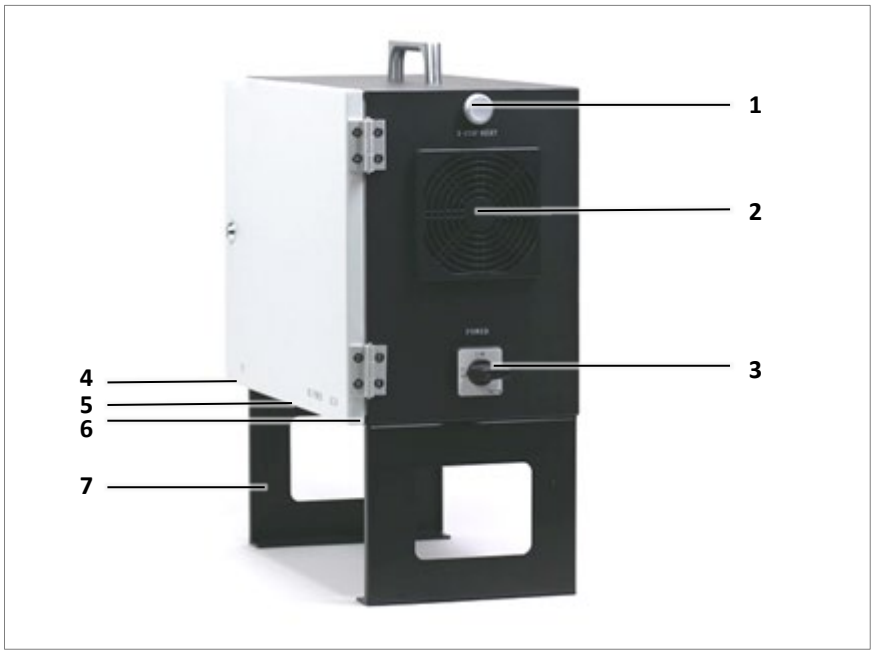


Fig. 8: Electrical control cabinet overview

1 E-stop reset button
2 Air outlet
3 Main Power switch
4 Teach Pendant connector
5 RC Power (48 V) + EtherCat
6 AC Input
7 Cabinet foot

3.4.2 Dimensions

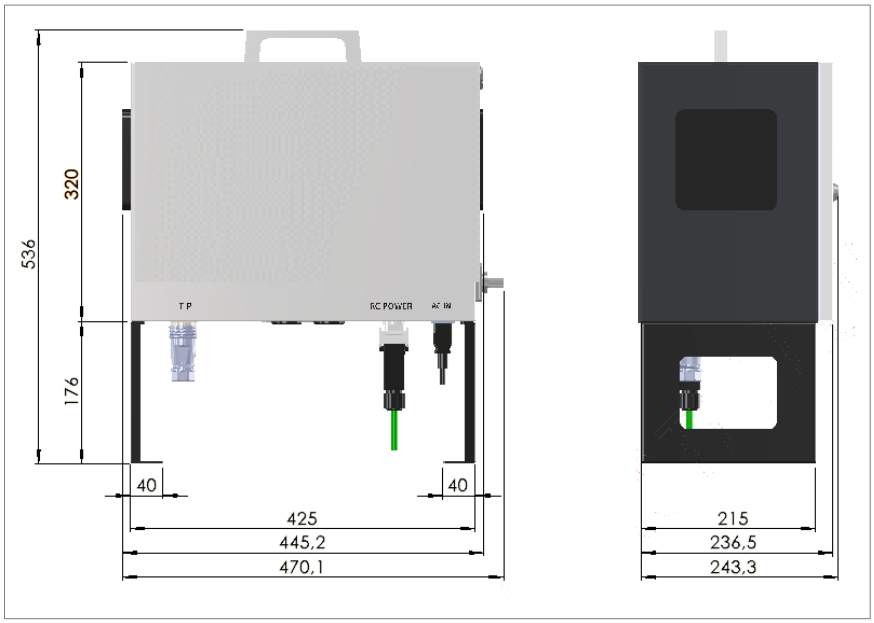


Fig. 9: Dimensions in mm - Electrical control cabinet

3.4.3 Specifications - Electrical control cabinet

Item	Specification
Weight	20 kg
Operating temperature	0 - 50 °C
Relative Humidity	10 - 80 % (without condensation)
IP classification	IP30
Electric cabinet size	536 mm x 470 mm x 243 mm
Paint color	Black / White
External power supply input	100–240 V AC, 50–60Hz, 1.5 kW

Table 6: Electrical control cabinet specifications

3.5 Robot Teach Pendant

3.5.1 Kawasaki Teach Pendant

The following picture shows the Teach Pendant.

Fig. 10: Overview Kawasaki Teach Pendant

3.5.1.1 Overview

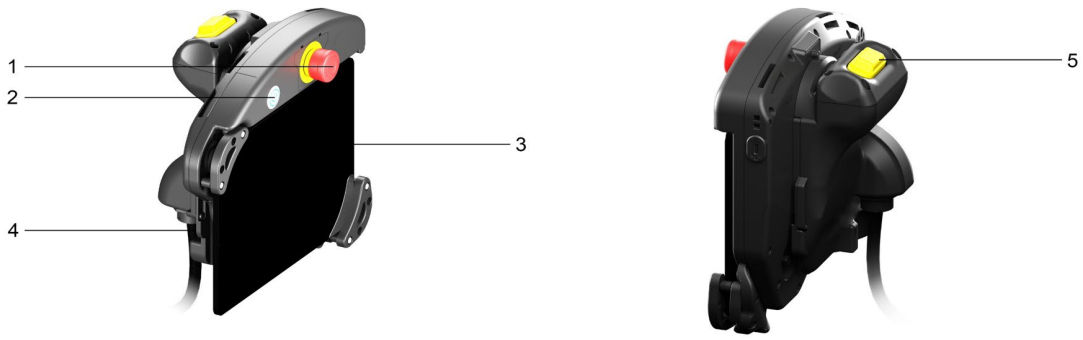


Fig. 11: Teach Pendant Overview

1 Emergency Stop Switch
2 Configurable button (future release)
3 Touch Screen Display
4 Connection Cable to Control cabinet
5 Dead Man Switch

3.5.1.2 Dimensions

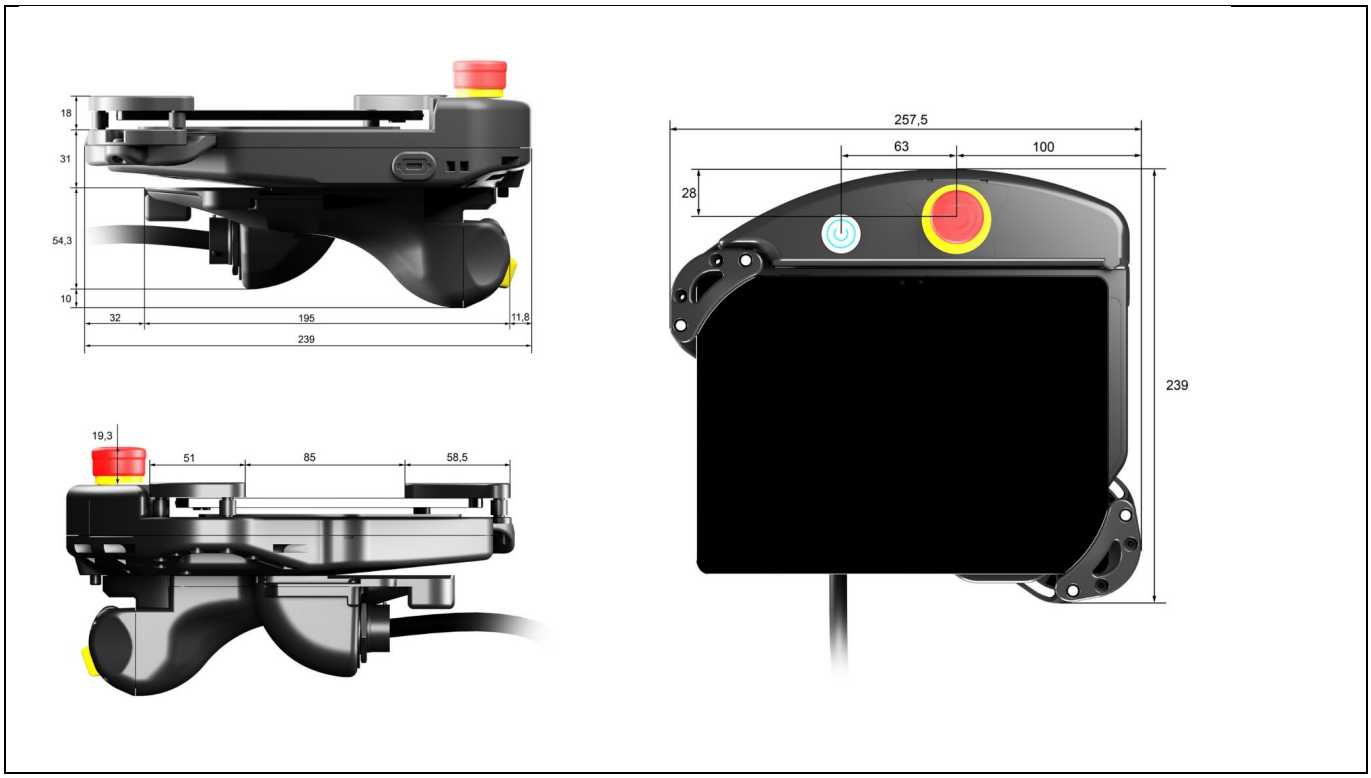


Fig. 12: Size and dimensions in mm - Teach Pendant

3.5.1.3 Specifications - Teach Pendant

Item	Specification
Dimensions	258 mm x 239 mm x 133 mm (length x width x height)
Resolution	2560 x 1600 px
Display	11” touchscreen
Weight	1.5 kg (without cable) 2.5 kg (incl. 5m cable)
Cable length	5 m

Table 7: Teach Pendant specifications

4 SCOPE OF DELIVERY

Ensure that all parts and materials have been delivered. The scope of delivery is shown below.

4.1 Inside the Box

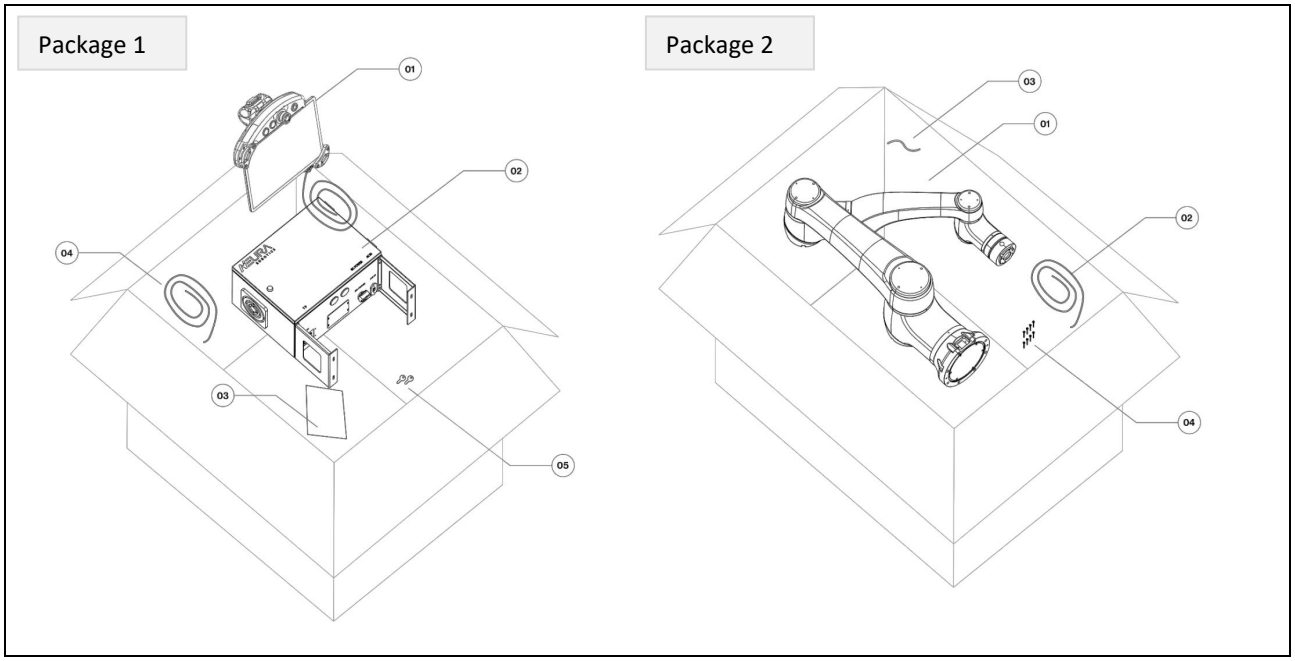


Fig. 13: Packaging overview: Scope of delivery Package 1&2

4.2 List of Parts

No.	Item	Quantity
Package 1		
01	Teach Pendant (incl. cable)	1
01	Electrical Control cabinet	1
03	Test Report	1
04	Power Supply Cable (5 meter)	1
05	Control cabinet Keys	2
Package 2		
01	CL1 Robot Arm	1
02	Robot & Controlbox connection cable (5 m)	
03	Tool I/O Cable (M12 connector)	1
04	M6 Screws + Washers CL103/CL105) M8 Screws + Washers (CL108/CL110)	6 8

Table 8: List of parts included in the packages (scope of delivery)

5 TRANSPORT AND STORAGE

⚠ WARNING

Heavy weight of the device

The robot system is, packed or unpacked, heavy. Improper handling may result in injury or damage to the device.

- ► Do not lift the Robot (packed or unpacked) unassisted.
- ► Ensure that the at least two people carry the robot together and hold firmly at the base while moving the robot.
- ► Obey all safety precautions while lifting the robot.
- ► Make sure not to overload your back or other body parts when lifting the equipment.
- ► Make sure that only certified personnel operate the lifting equipment.
- ► Use proper lifting equipment and ensure that the lifting equipment can withstand the weight of robot.
- ► Kawasaki Robotics cannot be held responsible for any damage caused by transportation of the equipment.

NOTICE

Condensation within the device

Condensation can damage the system electronics.

- ► Do not store, ship or use your module under conditions where temperature fluctuations could cause condensation within the device.
- ► If your device was shipped in cold weather, leave it in its box and allow it to warm slowly to room temperature to avoid condensation.

5.1 Transportation

The following measures must be observed when transporting the robot.

5.1.1 Handling of the Robot

- When lifting the robot, the moving parts should be fixed by appropriate measures to avoid unexpected movements during lifting and transportation, which may cause damage.
- Use proper lifting equipment. All regional and national guidelines for lifting shall be followed.
- Pay attention to your posture when moving the arm and control cabinet cartons to avoid back injury.
- Kawasaki Robotics GmbH is not responsible for any damage that occurs during transportation of the equipment.
- Before moving or transporting the robot, it must be moved to its ground position.
- During transportation, ensure that the robot is stable and remains in place.
- The controller box shall be lifted by the handle.
- After fixing, turn on the robot and use the robot's learning function to adjust the robot's posture to a suitable position.
- Make sure that you follow the safety precautions while transporting the robot.

5.1.2 Transportation Position (Park Position)

Angles CL103		
A1	**A2**	**A3**
90°	0°	-143°
A4	**A5**	**A6**
0°	0°	0°

Angles CL105		
A1	**A2**	**A3**
90°	0°	-143°
A4	**A5**	**A6**
0°	0°	0°

Angles CL108		
A1	**A2**	**A3**
90°	0°	-145°
A4	**A5**	**A6**
0°	-35°	0°

Angles CL110		
A1	**A2**	**A3**
90°	0°	-145°
A4	**A5**	**A6**
0°	-35°	0°

Table 9: Transportation position (angles in degrees) of the robotic arm

5.2 Storage Conditions

- This product must be shipped and stored in a temperature-controlled environment, within the range **-20°C to 60°C (-4°F to 140°F)**. The recommended **humidity should not exceed 75 %, non-condensing**. It should be shipped and stored in the supplied package, which is designed to prevent damage from normal shock and vibration. You should protect the package from excessive shock and vibration.
- The product must always be stored and shipped in an upright position in a clean, dry area that is free from condensation. Do not lay the package on its side or any other non-upright position: this could damage the product.
- Make sure that you follow the storage safety instructions.

5.3 Unpacking

The following measures must be observed when unpacking (procedure see *Unpacking the robot* on page *31*) the robot:

- The packed robot is placed at ground level near the installation site and has a stable position.
- Carefully remove the original packaging and keep it in a dry place in case you need to repack and transport the robot in the future.
- When moving the robot out of the packing material and into the installation position, hold the robot firmly until all screws of the robot base are tightened.
- Lift both tubes of the robot arm at the same time when moving it from the packaging to the installation place. Hold the robot in place until all mounting bolts are securely tightened at the base of the robot.

5.4 Packing

Precautions for packing:

- Before the robot can be packed it must be powered off.
- Before packing the robot, all connection cables must be disconnected.
- The robot must be in a stable position for packing and transport.
- The screws of the robot base must be loosened, and the robot must be secured against falling over.

The following measures must be observed when packing the robot:

- Hold the robot firmly while loosening the screws at the base of the robot so that it keeps in a stable position.
- When packing and transporting, the robot shall be packed in accordance with the applicable packaging guidelines and the required markings, applied to the outside of the box. In addition to all regional and national guidelines.
- Lift both tubes of the robot arm simultaneously when moving it from the installation location to the packaging location. Hold the robot in place until it is fixed in its packaging and cannot slide or fall over.
- Protective measures should be taken to protect robot against collisions, which many result in scratches on the robot's surface or damage to its internal structure.
- Use the original packaging for transport of the robot.

6 ASSEMBLY AND INSTALLATION

6.1 Site Requirements

6.1.1 Installation environment requirements

The robot and its Control Cabinet should be installed indoors. While the robot is compliant with IP66 (dust-tight and protected against water jets), for the Control Cabinet or the robot in regard to other environmental conditions not covered by the IP code, the following requirements must be met:

- Room temperature of 0–50 ºC (to prevent excessive temperature change).
- Relative humidity of 10–75 %, non-condensing.
- Keep it away from direct sunlight.
- Keep it away from dust, soot, salt, metal powder and water.
- Protect it against shock and vibration.
- Keep it away from flammable, explosive, and corrosive gas, solid materials, and liquids.
- Keep it away or isolate from electrical interference sources.
- For the details about the installation space scope of the robot, refer to the robot dimension chart and the specification table of electrical Control Cabinet.

6.1.2 Robot working space

The workspace or effective reach of the CL1 robot series goes from 590-1300 mm from the robot second joint to the fifth joint. When selecting the location to install robot, considerations should be given to the cylinder space above and below the robot base.

Try to keep the tool away from the cylindrical space as much as possible, otherwise it will cause the situation where the tool moves slowly and joints move too fast, which leads to the low efficiency of robot and brings difficulties in carrying out risk assessment.

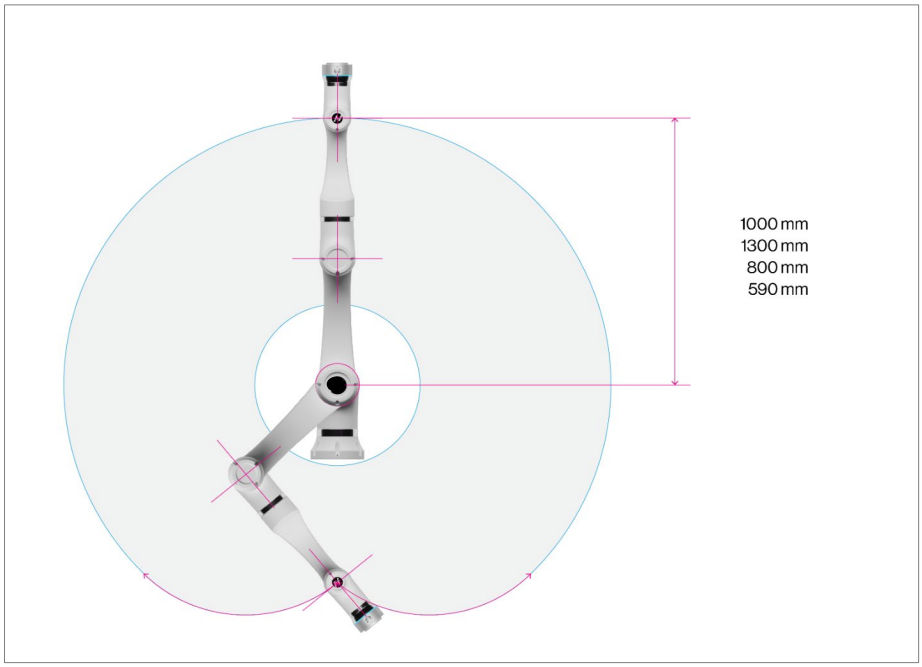


Fig. 14: Workspace of CL1 robot series

6.1.3 Working Angles:

This table shows the possible working areas of the CL1 Cobot.

Axis	Working angles
	CL1 03/05/08/10
A1	± 180°
A2	± 135°
A3	± 150°
A4	± 180°
A5	± 180°
A6	± 360° (opt.)

Table 10: Working angles in degrees of the robotic arm

6.1.4 Installation space

Make sure that the installation space according to the robot working space and the size and specification of the control cabinet.

⚠ WARNING

Not enough safety distance

Serious injuries can result if not enough safety distance to the robot is provided.

► Make sure that the safety distance is at least 100 mm longer than the maximum working space of the robot after installing the jig at the robot terminal.

NOTICE

Excessive bending of cables

Excessive bending of cables might lead to damage them.

► The minimum bending radius of the robot power cord is 90 mm. When installing the cable, make sure that there is enough space to install power supply signal line and other cables, to prevent the cable from over bending.

In addition to the space required for installing the robot and electrical control cabinet, ensure the minimum space required for the following conditions:

- Enough space to install robot terminal fixture and workspace.
- Enough space for robot teaching.
- Enough space for operator to implement installation, inspection, and repair activities.
- Enough space for pneumatic hoses attached to robot and base.

6.2 Mechanical Installation

⚠ WARNING

Heavy weight of the device

The robot system is heavy, in packed or unpacked state. Improper handling may result in injury or damage to the device.

- ► Do not lift the Robot (packed or unpacked) unassisted.
- ► Ensure that at least two people carry the robot together and hold firmly at the base while moving the robot.
- ► Obey all safety precautions while lifting the robot.
- ► Make sure not to overload your back or other body parts when lifting the equipment.
- ► Make sure that only certified personnel operate the lifting equipment.
- ► Use proper lifting equipment and ensure that the lifting equipment can withstand the weight of robot.
- ► Kawasaki Robotics cannot be held responsible for any damage caused by transportation of the equipment.

NOTICE

Condensation within the device

Condensation can damage the system electronics

- ► Do not store, ship, or use your module under conditions where temperature fluctuations could cause condensation within the device.
- ► If your device was shipped in cold weather, leave it in its box and allow it to warm slowly to room temperature to avoid condensation.

6.2.1 Unpacking the robot

NOTICE

Damage to the robot due to improper handling and transportation

Improper handling can lead to damage of the device.

- ► Do not use force to open the container.
- ► Prevent the robot surface from scratches or impact and collision when opening the carton.
- ► Open the carton in a dry and clean external environment.
- ► When taking the machine out of the carton, pay attention to protecting the appearance of the robot, and avoid collision and scratches.
- ► Observe the notes in section Transport and Storage on page *25*.
- ► For the matters needing attention in the transportation process, refer to

- ►
- ► Table **7: List of** parts **included in the packages (scope of delivery)**
- ► on page *24*.

Use the following procedure to unpack the robot from its shipping container.

It is recommended to have the mounting surface prepared so the robot can be fastened immediately after unpacking.

1. Open the shipping container and remove the top foam insert. Place the top foam insert in a safe location
2. Ensure that at least two people carry the robot together and hold firmly at the base while moving the robot.
3. Until the robot base is fastened with screws (M6 or M8) tightly, the robot arm should always be supported to avoid tipping.
4. Fasten the robot to the mounting surface. Refer to *Fastening the robot 6.2.2*.
5. Inspect the entire robot for damage before proceeding with further installation. If any damage is evident, contact Kawasaki Robotics GmbH.
6. Remove the middle form insert and place the insert in a safe location.
7. Remove the power cable, IO Cable, connecting cable, and teach pendant.
8. Remove the control cabinet (at least two people should remove the control cabinet from the carton box).

⚠ CAUTION
At this stage, do not connect the power cable of the control cabinet to any electrical outlet, or it may cause equipment damage.

9. After the robot is fastened to the mounting surface, the unpacking procedure is complete.

6.2.2 Fastening the robot

No installation platform is provided when you purchase the robot. The size and shape of the installation platform vary due to different robot systems, but the following basic requirements should be met:

- The installation platform should be at least 20 mm thick. It is recommended that a steel plate should be used to suppress the vibration.
- It is recommended that the surface roughness of the installation platform should not exceed Rz 25 µm.

⚠ CAUTION

Fastening the robot

Improper sequencing or torquing of the screws may result in damage

► Ensure that the screws are correctly tightened in a crosswise pattern with equal two torque steps (50% and 100%).

Fasten the CL103 and CL105 robots

- Use M6 screws (whose specifications meet ISO 898-1 performance level 10.9 or 12.9 mark) to fasten the CL103 and CL105 robots onto the mounting base with an allen key (see below Fig. 15:).
- Use the torque of 13.2 Nm to tighten screws.

Fasten the robot CL108 and CL110 robots

- Use M8 screws (whose specifications meet ISO 898-1 performance level 10.9 or 12.9 mark) to fasten the CL108 and CL110 robots onto the mounting base with an allen key (see below Fig. 15:).
- Use the torque of 32.08 Nm to tighten screws.

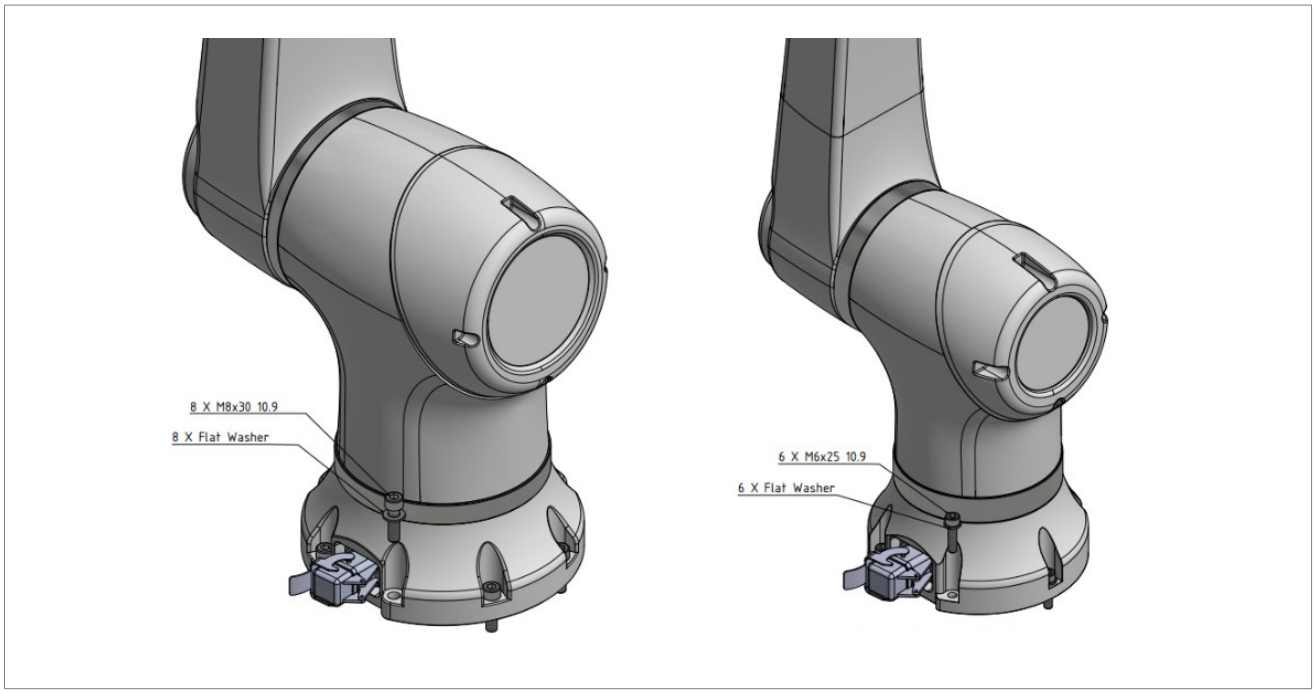


Fig. 15: Fixing points for CL1

6.2.3 Technical Drawings Base (Link0)

The installation dimensions of the robot base are shown in the following figures.

6.2.3.1 Base (Link0) V1

These are the Base (Link0) drawings of the robots that have been produced until September 2023. Please refer to your Kawasaki representative to get the information, what kind of Base (Link0) your cobot has.

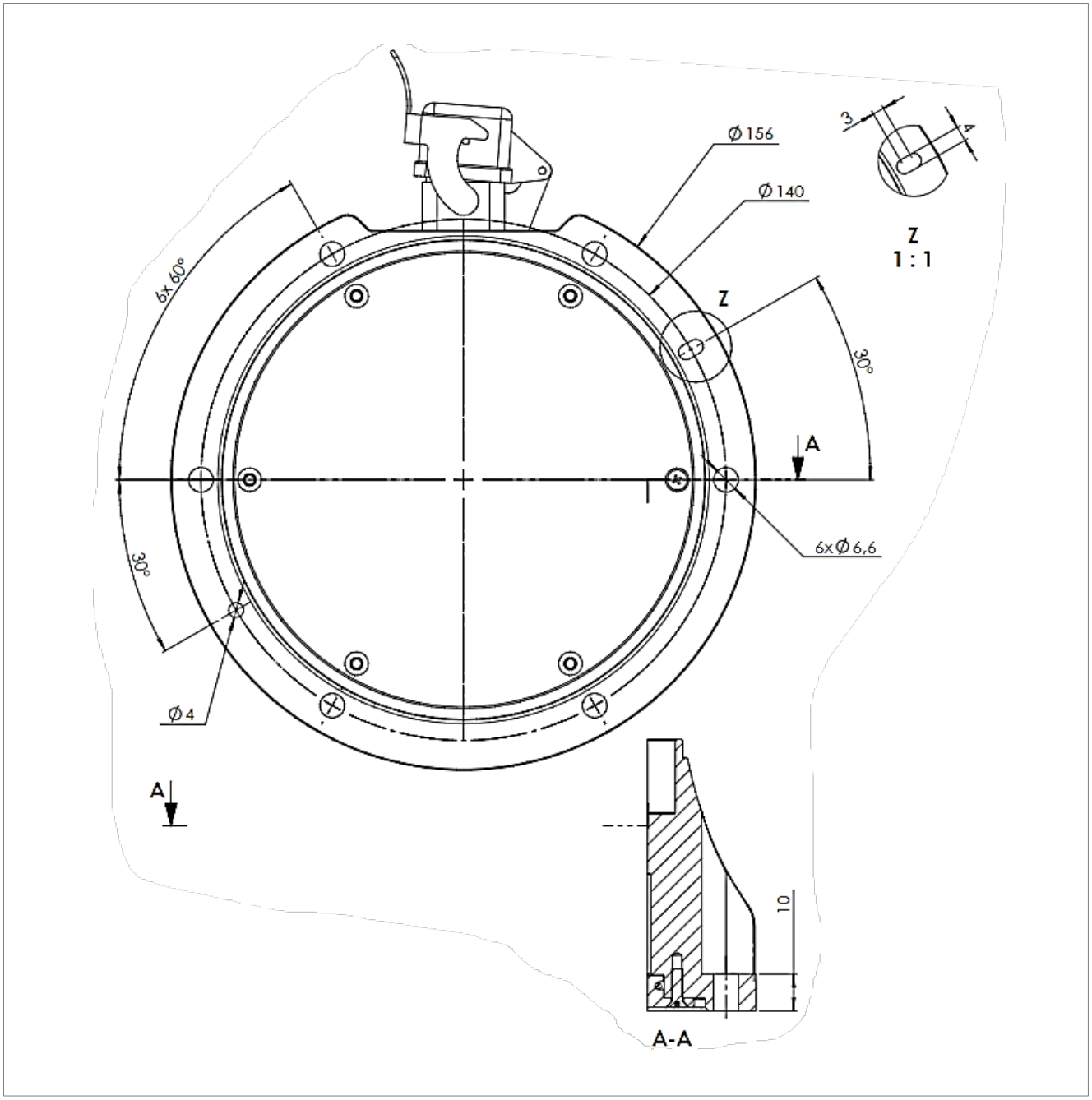


Fig. 16: Installation dimensions of robot base (V1 until Sept. 2023) – CL103/CL105

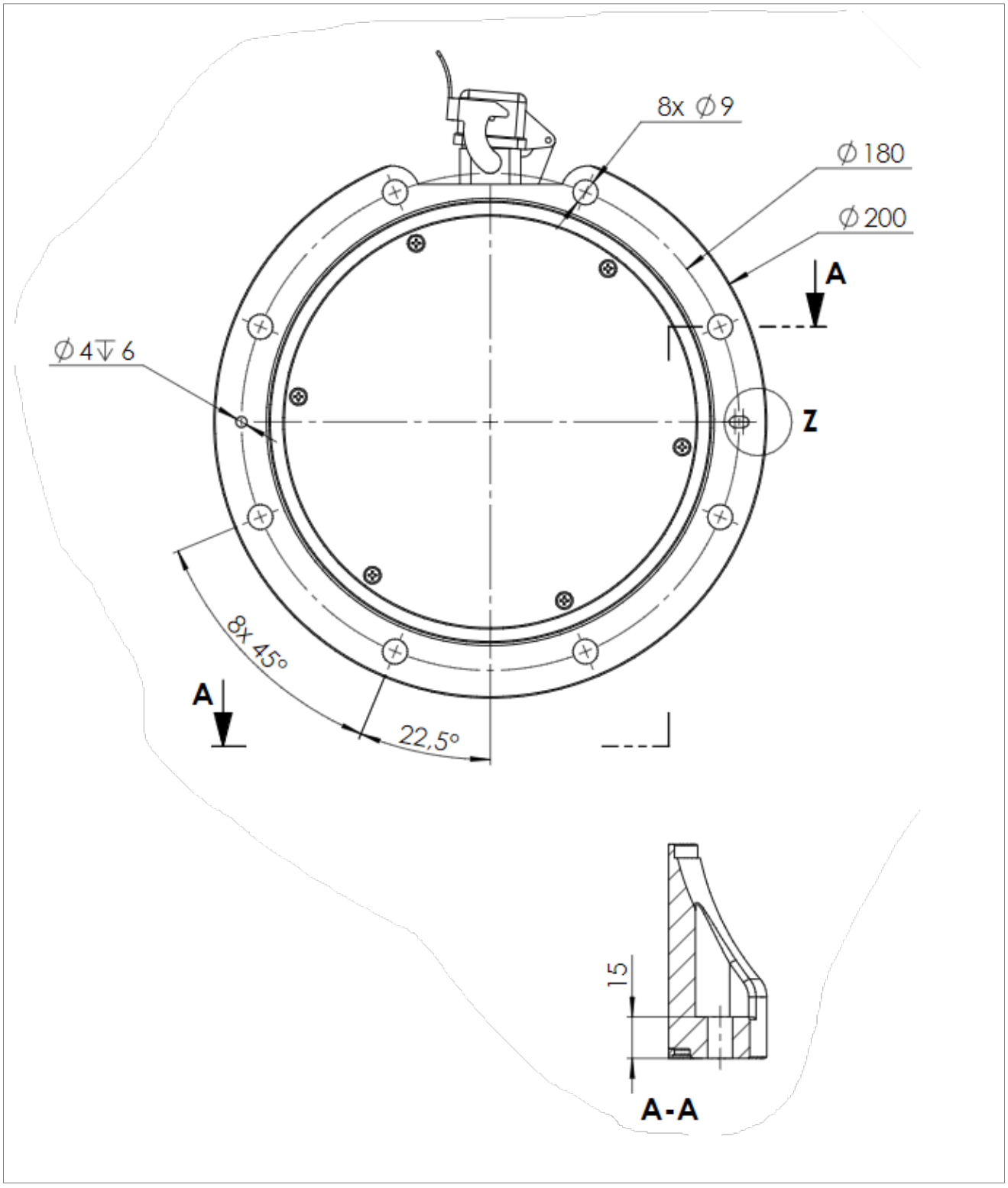


Fig. 17: Installation dimensions of robot base (V1 until Sept. 2023) – CL108/CL110

6.2.3.2 Base (Link0) V2

From October 2023 onwards there was a new improved release of the Base (Link0) announced. Please refer to your Kawasaki representative to get the information, what kind of Base (Link0) your cobot has.

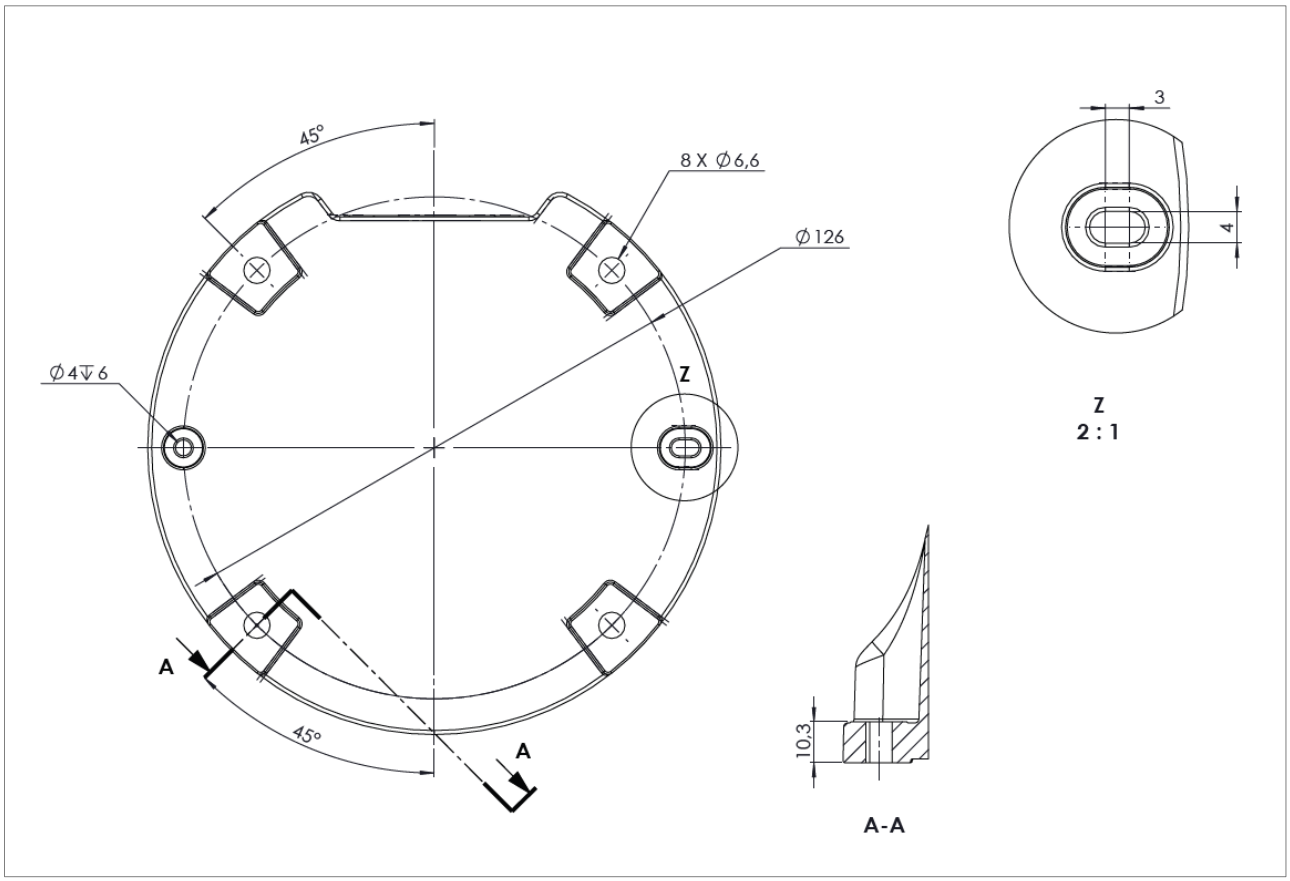


Fig. 18: Installation dimensions of robot base (V2 from Oct. 2023) – CL103

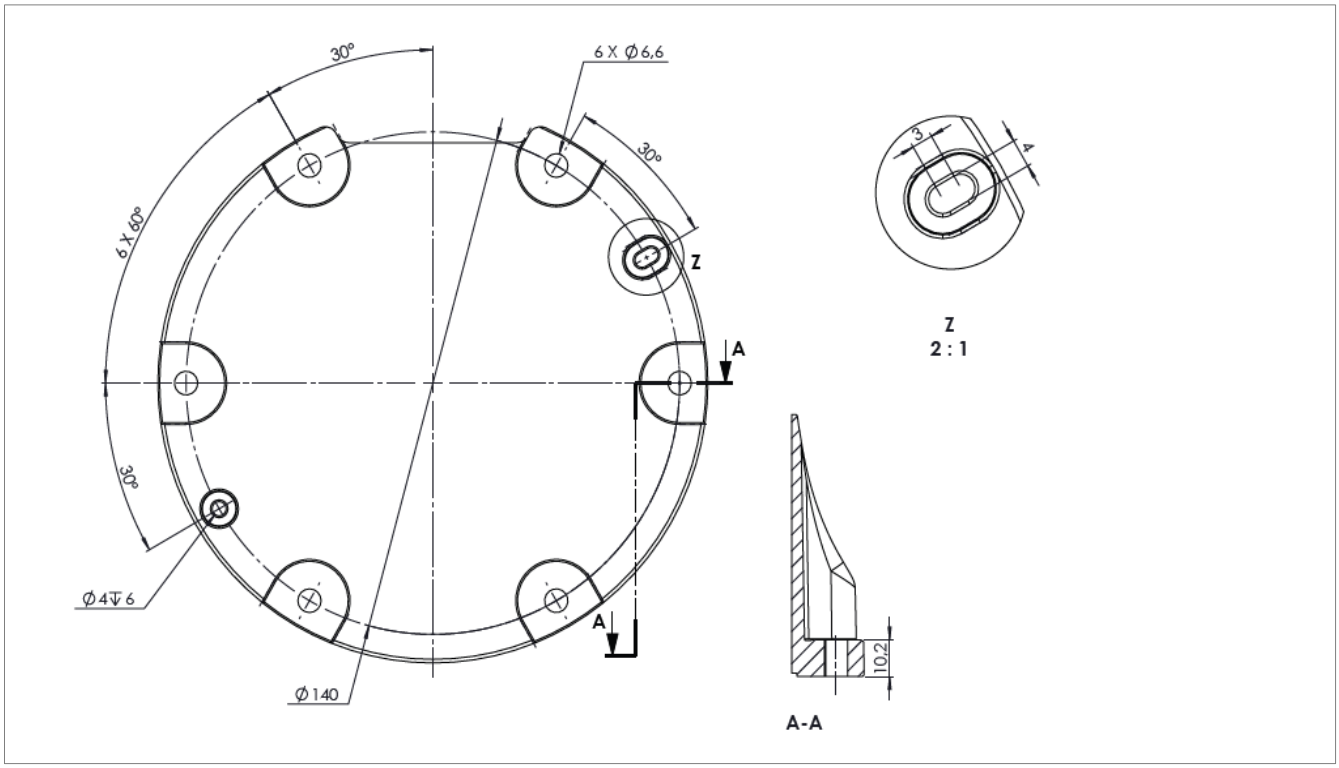


Fig. 19: Installation dimensions of robot base (V2 from Oct. 2023) – CL105

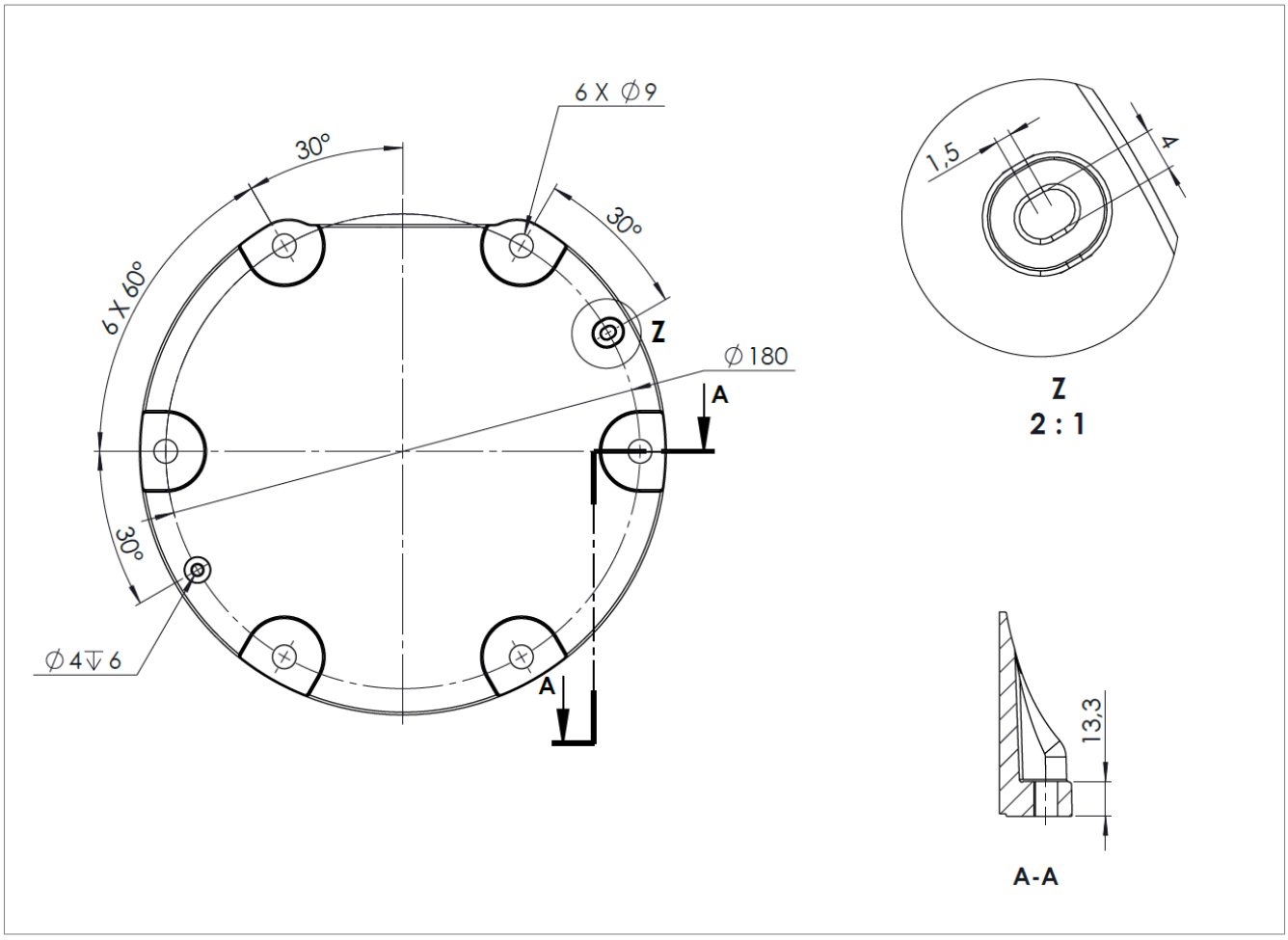


Fig. 20: Installation dimensions of robot base (V2 from Oct. 2023) – CL108/CL110

6.2.4 Installing tools to the robot flange

No end-effector or gripper is provided or included within the purchase of the robot.

The screw holes for the fixed tool at the robot ends are M6.

⚠ CAUTION

Installing tools to the robot flange

Improper sequencing or torquing of the screws may result in damage

▶ Ensure that the screws are correctly tightened in a crosswise pattern with equal two torque steps (50% and 100%).

Installing tools to the robot flange

- Use 4x M6 screws (whose specifications meet ISO 898-1 performance level 10.9 or 12.9 mark) to install tools to the robot flange.
- Use the torque of 9.92 Nm to tighten screws

The CL1 tool flange has the following dimensions as shown in Fig. 21:

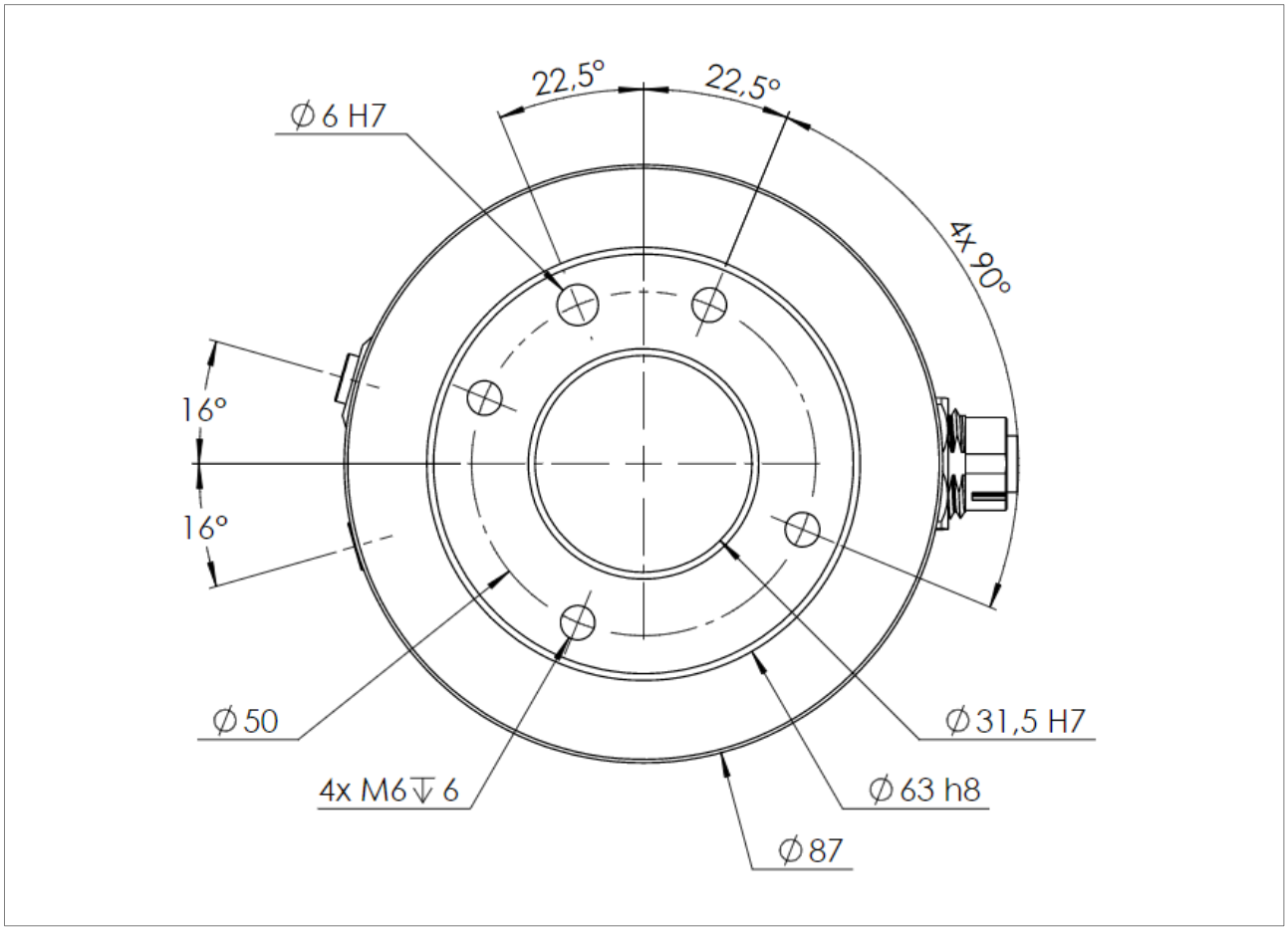


Fig. 21: CL1 tool flange (ISO-9409-1-50-4M6) dimensions (all dimensions in mm)

6.3 Electrical Installation

⚠ WARNING

Installation and handling

Improper installation and handling of the device can lead to serious injuries.

- ► Read and observe all safety instructions in this document.
- ► Read the CL1 Quick Start Installation Guideline before installing the electrical control cabinet.
- ► Do not disassemble the electrical control cabinet, otherwise it may cause electricity leakage and electric shock.
- ► Never use cables other than the ones supplied by Kawasaki Robotics GmbH to ensure that the proper functionality and compliance with safety or EMC regulations. If you need longer cables, contact Kawasaki Robotics GmbH.
- ► Ensure that the robot is properly grounded. If the grounding is not correct, it may cause a fire or electric shock.
- ► **Hot plugging of cables and connectors is not allowed.**
- ► **Ensure that all connections are properly established before turning ON the power.**

DANGER

Improper installation and handling of the device

Improper installation and handling of the device can lead to serious injuries.

- ► Do not disassemble the electrical control cabinet, otherwise it may cause electric shock

NOTICE

Unintended installation and handling of the device

Unintended installation and handling may lead to damage of the device.

- ► Read and observe all safety instructions in this document.
- ► Use the accessory nylon clip to fix the cable after connecting the cable.
- ► Do not apply excessive force when connecting the connector(s) to the control cabinet because that can cause damage to the connector(s).
- ► Do not bend the cables too much during connecting as that can cause damage to the cables.
- ► The electrical control cabinet is equipped with fans at the back end. Do not block the air outlet that can restrict the airflow.
- ► The location of the control cabinet and the distribution cable should be as far as possible from the noise or vibration sources. If they are too close to the noise or vibration sources, there may be a positional deviations or malfunctions

6.3.1 Electrical interfaces

The CL1 robot system features the following electrical interfaces:

- Main connections (see *6.3.2.1 Power supply cable* on page *40* and *6.3.3.1 Peripheral interface and connection instructions* on page *41*).
- Robot connection (see 6.3.2.2 Robot Connecting cable on page *40* and 6.3.3.1 *Peripheral interface and connection instructions* on page *41*).
- I/O connections for controlling the robot (see Peripheral interface and connection instructions on page 41 and *Safety guardrail* on page *52*).
- I/O connections for controlling the robot tool (see robot flange (TCP) communication port on page 54).

6.3.2 Cables

6.3.2.1 Power supply cable

The cable shown below is the power cord of the electrical control cabinet. The power cord has a length of 5 m.

The control cabinet must be connected to the power supply. This process must be completed using the corresponding IEC C13 wire connected to the standard IEC C14 plug at the bottom of the control cabinet. The other end of the power supply cable has a locking mechanism, and it is plugged in the power connection of the control cabinet.

Power supply

The power supply shall be equipped with at least the following accessories:

- Grounding
- Overcurrent circuit breaker
- Residual current circuit breaker

It is recommended that all the devices in the robot application should have a power supply switch, to lock and post a sign during repair and maintenance.

Fig. 22: Power supply cable (110-230 V)

6.3.2.2 Robot Connecting cable

The cable shown below is the connecting cable to connect the robot and the electrical control cabinet. The robot connection cable has a length of 5 m.

Connect the gray end connector to the robot base plug, and the black end connector to the electrical control cabinet's plug.

Fig. 23: Robot connection cable (5m)

6.3.3 Electrical control cabinet

6.3.3.1 Peripheral interface and connection instructions

Electrical control cabinet overview for switches, connectors, and socket, refer to *Overview* on page *16*.

Fig. 24: Electrical control cabinet overview switches and connectors

1 Reset button (Enable 48 V)
2 Power switch (110-230 V Supply)
3 HMI connector for Teach Pendant
4 RC power and comm. to robotic arm
5 AC IN (110-230 V power Socket)

Installing the control cabinet

Steps:

1. Place the control cabinet on a flat surface and make sure that the air vents are not blocked.
2. Connect the teach pendant to the control (**3**).
3. Connect the control cabinet to the robot (**4**).
4. Connect the control cabinet to the power supply (**5**).

6.3.3.2 General Information about connecting Input and Output ports

⚠ WARNING

Hot plugging of electrical and connections to I/O ports

Electrical failures can result during hot plugging to I/O ports

- ► Make sure that the robot is powered of and the control cabinet is turned off (Main Power Switch on “0”)
- ► Check and finish all electrical connections to the I/O ports before starting the system again.

6.3.3.3 Controller I/O Board Connector (V1.0)

The controller provides a series of external ports, which can connect controller I/O with various devices such as external relays, PLC, sensors, and emergency stop device.

The port layout of the controller panel I/O (V1.0) is shown below:

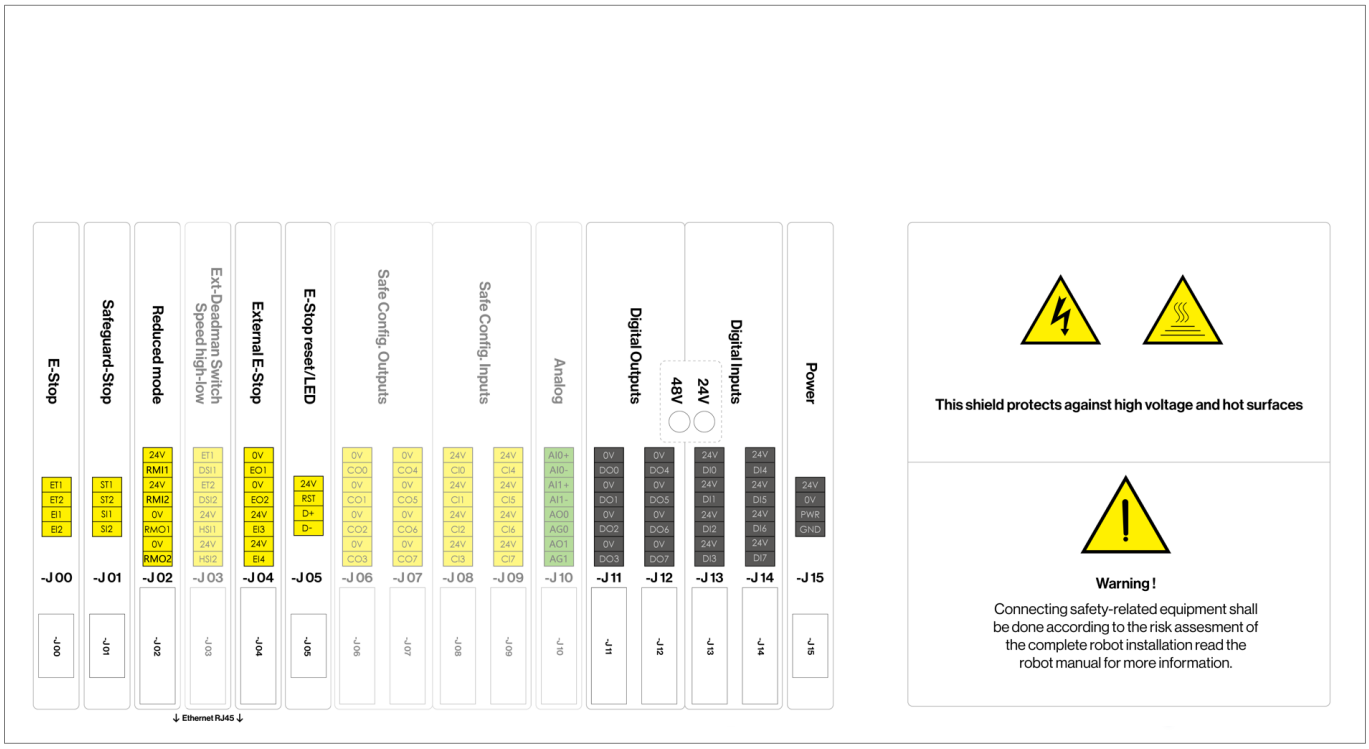


Fig. 25: Port layout of the controller I/O panel (V1.0)

E-Stop

Connector	Pin #	Type	Signal Name	Function
-J00	1	Safe Clock Signal T1	ET1	24 V safety clock signal T1 (Out)
ET1 ET2 EI1 EI2	2	Safe Clock Signal T2	ET2	24 V safety clock signal T2 (Out)
	3	Safe Input	EI1	E-Stop Input
	4	Safe Input	EI2	E-Stop Input

Safeguard Stop

Connector	Pin #	Type	Signal Name	Function
-J01	1	Safe Clock Signal T1	ST1	24 V safety clock signal T1
ST1 ST2 SI1 SI2	2	Safe Clock Signal T1	ST2	24 V safety clock signal T1
	3	Safe Input	SI1	Safe Guard Stop Input 1
	4	Safe Input	SI2	Safe Guard Stop Input 1

Reduced mode

Connector	Pin #	Type	Signal Name	Function
-J02	1	24 V	24 V	Supply: 24 V Output
24V RMI1 24V RMI2 0V RMO1 0V RMO2	2	Safe Input	RMI1	Reduced mode signal 1 active (signal low)
	3	24 V	24 V	Supply: 24 V Output
	4	Safe Input	RMI2	Reduced mode signal 2 active (signal low)
	5	GND	0 V	Ground
	6	Safe Output	RMO1	Feedback: Red. mode 1 is active (signal low)
	7	GND	0 V	Ground
	8	Safe Output	RMO2	Feedback: Red. mode 2 is active (signal low)

External Deadman Switch Speed high/low

Connector	Pin #	Type	Signal Name	Function
-J03	1	Safe Clock Signal 1	ET1	24 V safety clock signal T1 (Out)
ET1 DSI1 ET2 DSI2 24V HSI1 24V HSI2	2	Safe Input	DSI1	External Dead man switch input 1
	3	Safe Clock Signal 2	ET2	24 V safety clock signal T2 (Out)
	4	Safe Input	DSI2	External Dead man switch input 2
	5	24 V	24 V	Supply: 24 V Output
	6	Safe Input	HSI1	Enable Signal 1 for Highspeed (high)
	7	24 V	24 V	Supply: 24 V Output
	8	Safe Input	HSI2	Enable Signal 2 for Highspeed (high)

Reserved for future use.

External E-Stop

Connector	Pin #	Type	Signal Name	Function
-J04	1	GND	0 V	Ground
0V EO1 0V EO2 24V EI3 24V EI4	2	Safe Output	EO1	Feedback: E-Stop state 1 (Out)
	3	GND	0 V	Ground
	4	Safe Output	EO2	Feedback: E-Stop state 2 (Out)
	5	24 V	24 V	Supply: 24 V Output
	6	Safe Input	EI3	Ext. E-Stop Input 1
	7	24 V	24 V	Supply: 24 V Output
	8	Safe Input	EI4	Ext. E-Stop Input 2

E-Stop reset/ LED

Connector	Pin #	Type	Signal Name	Function
-J05	1	24 V	24 V	Supply: 24 V Output
24V RST D+ D-	2	Safe Input	RST	External reset Safety Input
	3	Safe Output	D+	LED indication of 48 V supply active (+)
	4	GND	D-	Ground

Safe Configurable Outputs (Customizable)

Connector	Pin #	Type	Signal Name	Function
-J06	1	Ground	CO0	Common Ground (GND)
0V CO0 0V CO1 0V CO2 0V CO3	2	Safe Output	CO1	Customer defined output 24 V (TBD)
	3	Ground	CO2	Common Ground (GND)
	4	Safe Output	CO3	Customer defined output 24 V (TBD)
	5	Ground	CO4	Common Ground (GND)
	6	Safe Output	CO5	Customer defined output 24 V (TBD)
	7	Ground	CO 6	Common Ground (GND)
	8	Safe Output	*Reserved for future use.*	Customer defined output 24 V (TBD)
-J07	1	Ground	CO0	Common Ground (GND)
0V CO4 0V CO5 0V CO6 0V CO7	2	Safe Output	CO1	Customer defined output 24 V (TBD)
	3	Ground	CO2	Common Ground (GND)
	4	Safe Output	CO3	Customer defined output 24 V (TBD)
	5	Ground	CO4	Common Ground (GND)
	6	Safe Output	CO5	Customer defined output 24 V (TBD)
	7	Ground	CO 6	Common Ground (GND)
	8	Safe Output	CO 7	Customer defined output 24 V (TBD)

Safe Configurable Inputs (Customizable)

Connector	Pin #	Type	Signal Name	Function
-J08	1	24 V	CI0	Supply: 24 V Output
24V CI0 24V CI1 24V CI2 24V CI3	2	Safe Input	CI1	Customer defined Input function (TBD)
	3	24 V	CI2	Supply: 24 V Output
	4	Safe Input	CI3	Customer defined Input function (TBD)
	5	24 V	CI4	Supply: 24 V Output
	6	Safe Input	CI5	Customer defined Input function (TBD)
	7	24 V	CI6	Supply: 24 V Output
	8	Safe Input	CI7	Customer defined Input function (TBD)
-J09	1	24 V	CI0	Supply: 24 V Output
24V CI4 24V CI5 24V CI6 24V CI7	2	Safe Input	CI1	Customer defined Input function (TBD)
	3	24 V	CI2	Supply: 24 V Output
	4	Safe Input	CI3	Customer defined Input function (TBD)
	5	24 V	CI4	Supply: 24 V Output
	6	Safe Input	CI5	Customer defined Input function (TBD)
	7	24 V	CI6	Supply: 24 V Output
	8	Safe Input	CI7	Customer defined Input function (TBD)

Reserved for future use.

Analog

Connector	Pin #	Type	Signal Name	Function
-J10	1	AI	AI0+	Analogue input (+)
AI0+ AI0- AI1+ AI1- AO0 AG0 AO1 AG1	2	AI	AI0-	Analogue input (-)
	3	AI	AI1+	Analogue input (+)
	4	AI	AI1-	Analogue input (-)
	5	AO	AO0	Analogue output voltage
	6	GND	AG0	Ground
	7	AO	AO1	Analogue output voltage
	8	GND	AG1	Ground

Reserved for future use.

Digital Outputs

Connector	Pin #	Type	Signal Name	Function
-J11 	1	Ground	0 V	Common Ground (GND)
	2	Digital Output	DO0	General Non-Safe Output (24 V)
	3	Ground	0 V	Common Ground (GND)
	4	Digital Output	DO1	General Non-Safe Output (24 V)
	5	Ground	0 V	Common Ground (GND)
	6	Digital Output	DO2	General Non-Safe Output (24 V)
	7	Ground	0 V	Common Ground (GND)
	8	Digital Output	DO 3	General Non-Safe Output (24 V)
-J12 	1	Ground	0 V	Common Ground (GND)
	2	Digital Output	DO4	General Non-Safe Output (24 V)
	3	Ground	0 V	Common Ground (GND)
	4	Digital Output	DO5	General Non-Safe Output (24 V)
	5	Ground	0 V	Common Ground (GND)
	6	Digital Output	DO6	General Non-Safe Output (24 V)
	7	Ground	0 V	Common Ground (GND)
	8	Digital Output	DO 7	General Non-Safe Output (24 V)

Digital Inputs

Connector	Pin #	Type	Signal Name	Function
-J13 	1	24 V	24 V	24 V Output Supply
	2	Digital Input	DI0	General Non-Safe Dig. Input
	3	24 V	24 V	24 V Output Supply
	4	Digital Input	DI1	General Non-Safe Dig. Input
	5	24 V	24 V	24 V Output Supply
	6	Digital Input	DI2	General Non-Safe Dig. Input
	7	24 V	24 V	24 V Output Supply
	8	Digital Input	DI3	General Non-Safe Dig. Input
-J14 	1	24 V	24 V	24 V Output Supply
	2	Digital Input	DI4	General Non-Safe Dig. Input
	3	24 V	24 V	24 V Output Supply
	4	Digital Input	DI5	General Non-Safe Dig. Input
	5	24 V	24 V	24 V Output Supply
	6	Digital Input	DI6	General Non-Safe Dig. Input
	7	24 V	24 V	24 V Output Supply
	8	Digital Input	DI7	General Non-Safe Dig. Input

Power

Connector	Pin #	Type	Signal Name	Function
-J15 	1	24 V	24 V	Customer external 24 V supply connection
	2	GND	0 V	Common Ground
	3	Power	PWR	Customer external 24 V input connection
	4	GND	GND	Ground
	5	Safe Input	SI2	Safe Guard Stop Input 1

Table 11: Controller I/O Connector Board (V1.0)

6.3.4 Safety I/Os & Functions

⚠ DANGER

Failure of safety functions

False configuration or connection of safety signals may lead to casualty accidents caused by failure of safety functions

- ► Do not connect the safety signal with unsafe PLC. Be sure to separate safety signals from the ordinary I/O port signal.
- ► All the Safety I/O have redundant (two independent) channels. Keep two channels independent to ensure that the safety function will not fail when one channel fails.
- ► The robot's safety functions must be checked before operation, and safety functions must be tested on a regular basis.

This section introduces special safety input (red text font), follow the digital I/O general specification during use. The safety inputs also include **emergency stop** and **safety protection stop**.

Emergency stop input is used only for stopping equipment under emergency.

The safety protection stop input is used for all types of safety protection devices. Their functional differences are shown in the following table.

Functional differences between emergency stop and safety protection stop

Robot stops moving	Yes	Yes
Run program	Stop	Suspend
Robot power supply	Close	Open
Shutdown category (IEC 60204)	1	2
Performance level (ISO 13849-1)	PL d	PL d

Table 12: Safety I/O terminal information

6.3.4.1 Default safety configuration (I/O Board V1.0)

The robot has default safety configuration at delivery and is not connected with external safety devices.

Its configuration is as follows:

Fig. 26: Default Safety configuration and bridges / jumpers on the Main I/O Board

Bridge / Jumper the clocked Emergency stop (-J00)

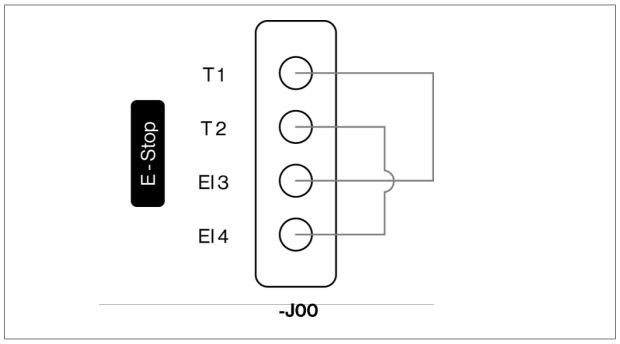


Fig. 27: Default safety configuration E-Stop

Bridge / Jumper the Safe guard - Stop (-J01)

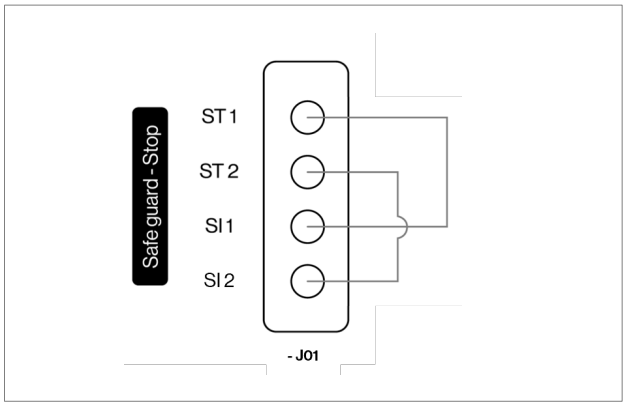


Fig. 28: Default safety configuration Safe Guard-Stop

Bridge / Jumper the Reduced Mode (off) (-J02)

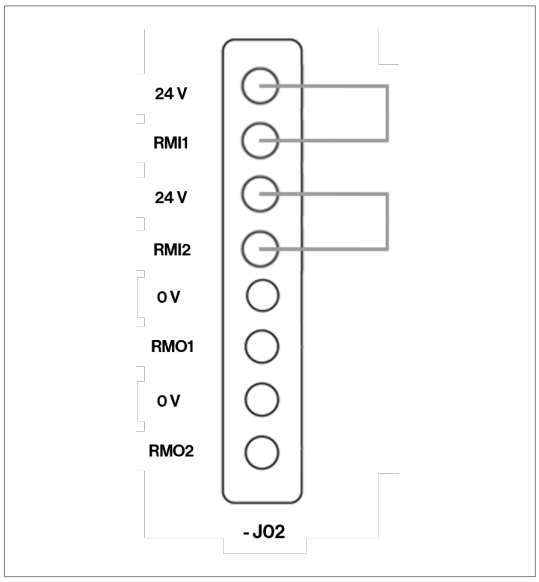


Fig. 29: Default safety configuration Reduced Mode (off)

Bridge / Jumper the High Speed Enable (-J03) (not used)

These Safe Inputs are for a future release.

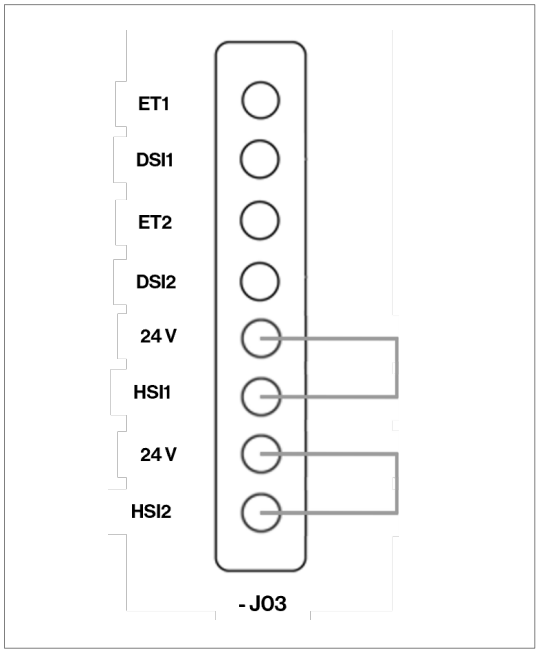


Fig. 30: Default safety configuration Highspeed Enable (always on)

Bridge / Jumper the External Emergency stop (-J04)

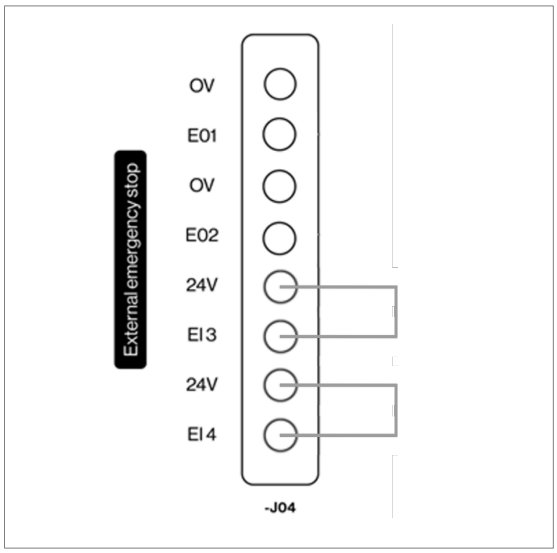


Fig. 31: Default safety configuration Ext. E-Stop

General Operation and Connections

Removing the bridges / jumpers will trigger the safety function. There are the following safety functions that can be used to integrate the Safety Equipment:

- Remove the bridges / jumpers of the E-Stop (-J00) and connect an E-Stop to it. For this E-Stop the internal clocked signal must be used (Pin 1&2).
- Remove the bridges / jumpers of the Safe Guard Stop (-J01) and connect it to e.g. a safety door switch. For reference see the following chapters.
- Remove the bridges / jumpers of the Reduced Mode (-J02) and connect it to e.g. a key switch, laser tracker or door switch. For reference see the following chapters.
- Remove the bridges/ jumpers for External E-Stop (-J04) and connect an E-Stop or Safety PLC to it with 2 Channel 24 V from the internal or an external source. For reference see the following chapters.

6.3.4.2 Connect the E-Stop button

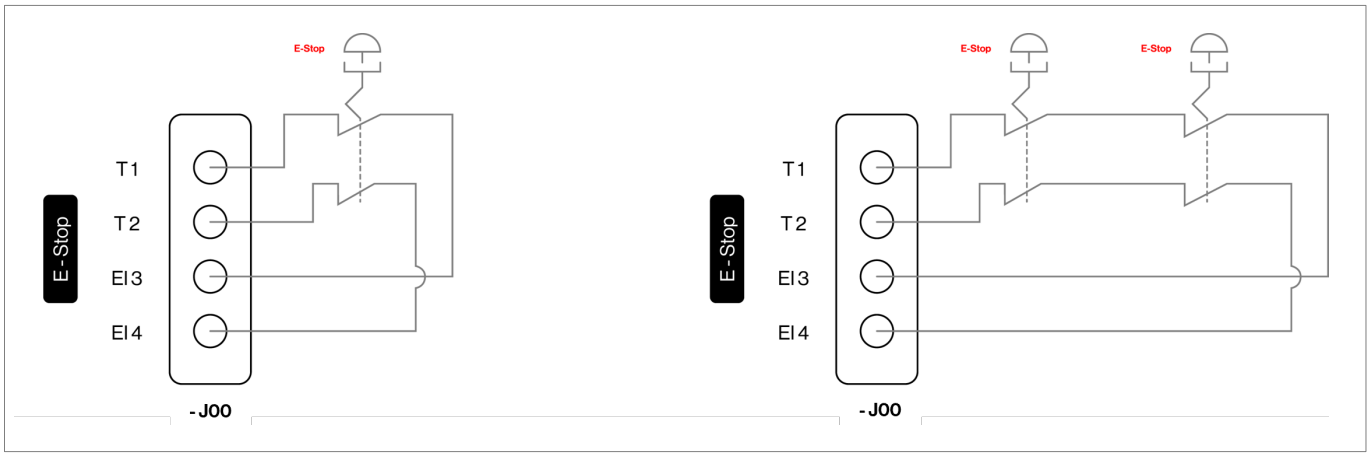


Fig. 32: Connect the E-Stop button configuration

Reset the emergency stop

Resetting the E-STOP is only possible from the E-STOP reset push button on the frontside of the control cabinet or with the external connection to the Reset Safe Input on the I/O-Board.

6.3.4.3 Share emergency stop with other machines / robots

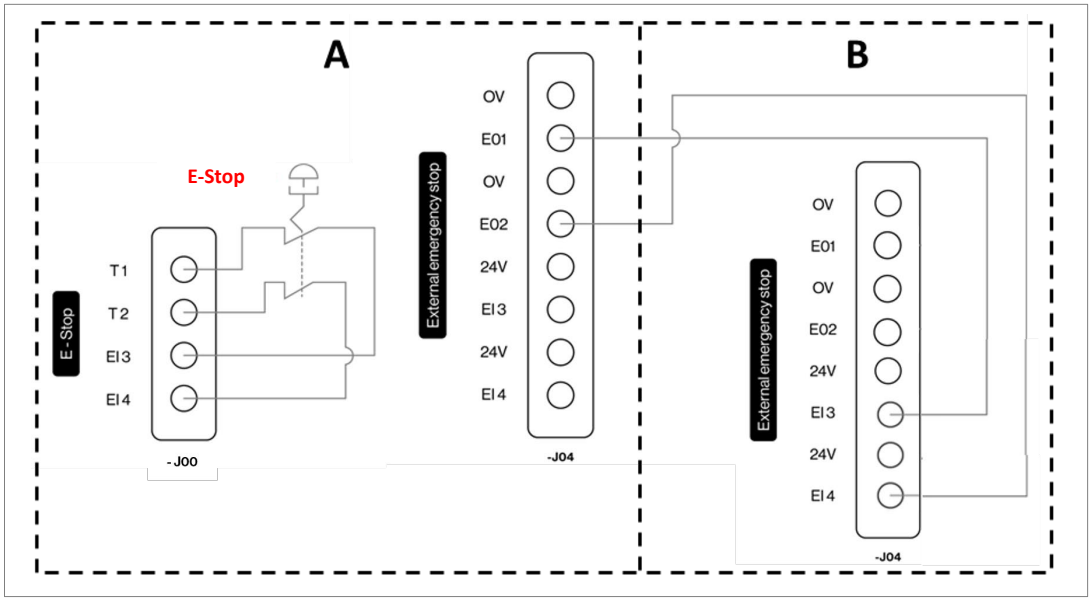


Fig. 33: Share emergency stop with other machines configuration

6.3.4.4 Bridge/Jumper of Safety protection stop (-J01)

Taking the door switch as an example, the following diagram introduces the construction of basic protection stop function, when the door is opened, robot stops. If the door is closed again, the robot will start and execute the motion again.

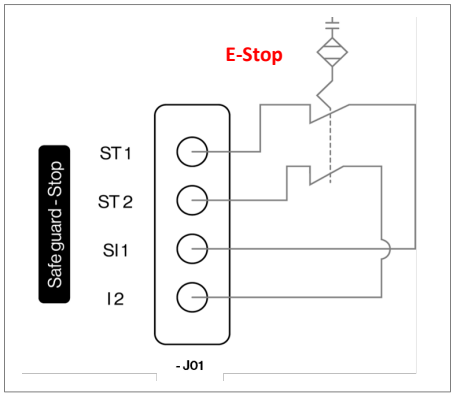


Fig. 34: Safety protection stop configuration

If the customer wants to teach the robot with an open door, the reduced mode must be on “low”. See next chapter. The ZeroG can always be operated even if the door is opened.

6.3.4.5 Reduced mode (-J02)

Taking the laser tracker as an example, the following diagram introduces the construction of reduced mode function, when something enters the safety area. If nobody is inside the yellow zone, the Reduced Mode Input (RMI1 and RMI2) must be high with 24V. As soon as someone enters the yellow area, the Reduced Mode Input (RMI1 and RMI2) goes on low 0V. The robot slows down to 15% of the speed that is used.

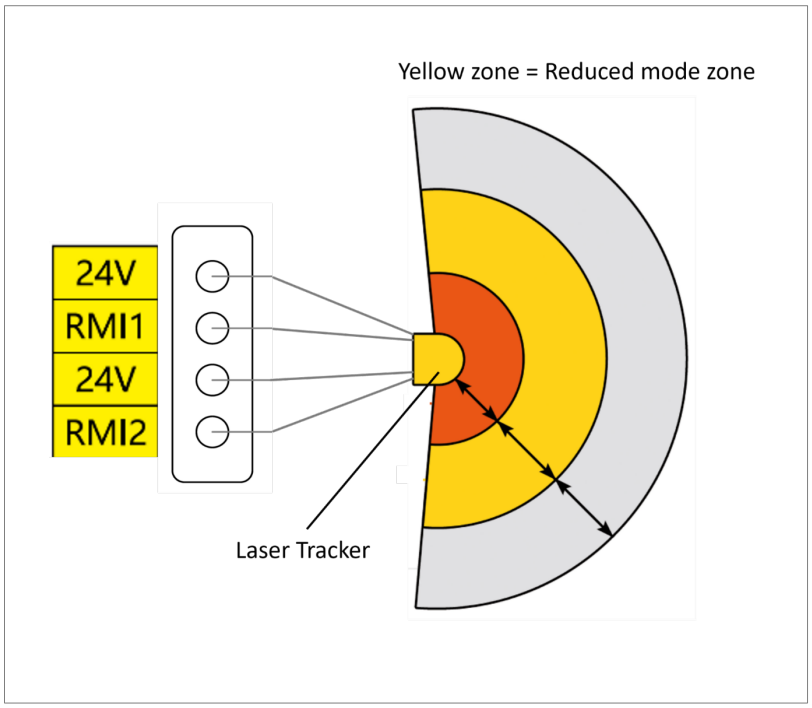


Fig. 35: Connection of reduced mode to laser tracker (safety zones)

6.3.4.6 Safety guardrail

Users should carry out risk assessment for specific robot applications to determine whether to install security guardrails in the actual operating environment. If a safety guardrail needs to be installed, you should carefully calculate the space of the safety guardrail.

⚠ WARNING

Safety area with guardrail is too small

If the safety area is too small, this can result in personal injury or damage to property during operation.

- ► The working area must be marked and secured/barricaded.
- ► Specification for the area to be barricaded:
  The circular radius of the guardrail > length of the mechanical arm + length of the end attachment of the mechanical arm.
- ► Place information and warning signs in a clearly visible position.
- ► Install emergency stop circuit for access door.

6.3.5 General digital I/O (non-safe)

The general digital I/O must follow the general configuration of digital I/O. The flexible I/O, which is not used for safety functions, can be used as general digital I/O. All Inputs and Outputs work with 24 V.

6.3.5.1 Connection of digital I/Os

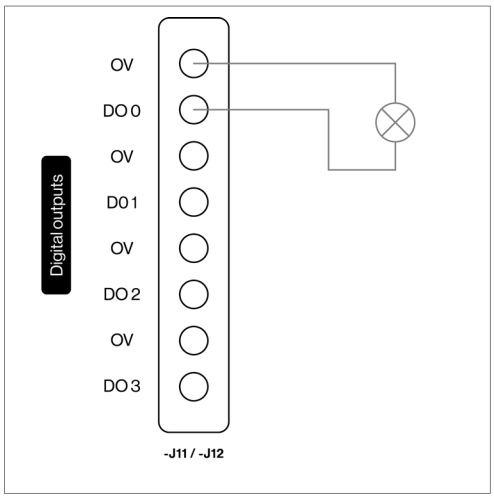


Fig. 36: Digital output singal - connection

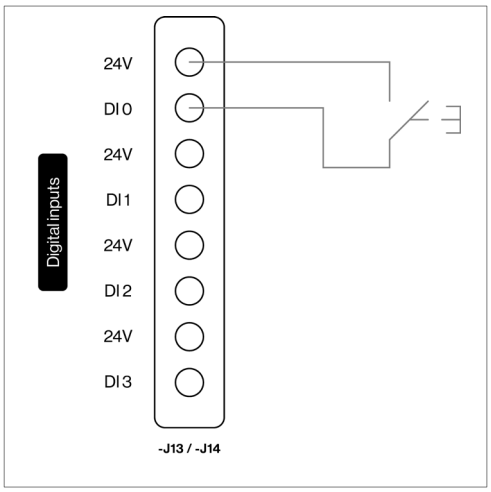


Fig. 37: Digital input singal – connection

6.3.5.2 Power supply configuration

No external power supply

If no external 24 V DC power supply is used terminals 1,2 and 3,4 should be bridged as shown below.

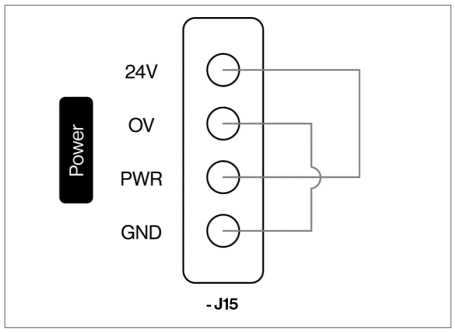


Fig. 38: Power supply configuration

with external power supply

If an external 24 V DC power supply is used V+ should be connected to -J15 PWR and V- should be connected to -J15 GND with max. 2,5 A

6.3.6 Robot flange (TCP) communication port

⚠ WARNING

Hot plugging of electrical and connections to I/O ports

Electrical failures can result due to hot plugging to I/O ports

- ► Make sure that the robot is powered of and the control cabinet is turned off (main power switch on “0”)
- ► Check and finish all electrical connections to the I/O ports before starting the system again.

6.3.6.1 TCP Flange connection pin-out

External flange connections pin-out (12 pole M12 connector/ IEC 61076-2-101)

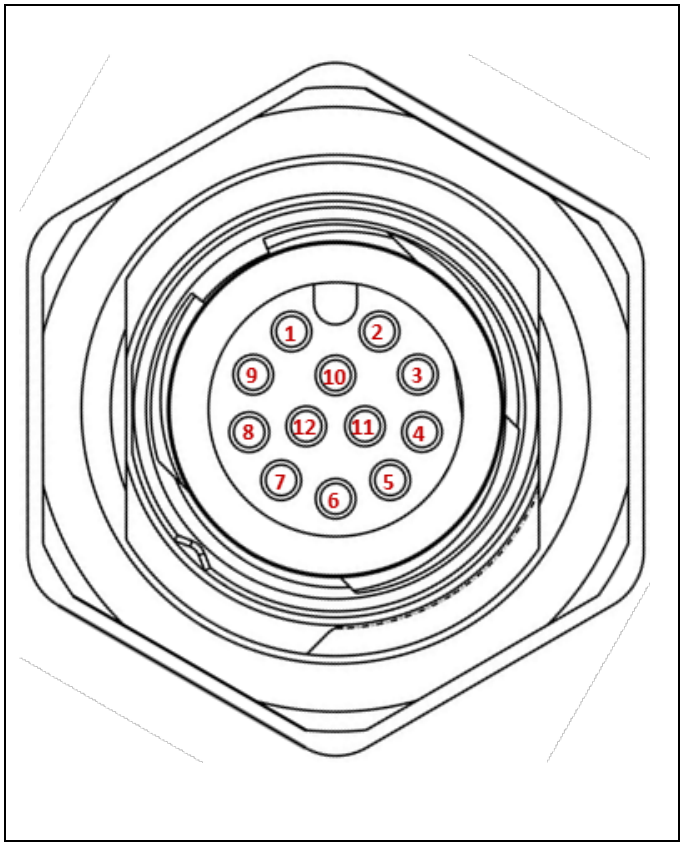


Fig. 39: IO ports, pin assignment of M12 connector (IEC 61076-2-101)

Pin-out of M12 connector for external connection is defined as follows:

Pin	Line	Cable color	Definition
1	Input_0	Brown	Digital input 0
2	Input_1	Blue	Digital input 1
3	Input_2	White	Digital input 2
4	Output_0	Green	Digital output 0
5	Output _1	Powder	Digital output 1
6	Output _2	Yellow	Digital output 2
7	RS485_A (TX+)	Black	RS484+ communication (Modbus RTU)
8	RS485_B (TX-)	Gray	RS484- communication (Modbus RTU)
9	AI 0	Red	Analog input 0
10	AI 1	Purple	Analog input 1
11	24 V	Ash powder (Grey/ Pink)	Power supply (24V)
12	GND	Red / Blue	Common Ground (0V)

Table 13: External wiring for M12 TCP Connector

6.3.6.2 Internal power supply

Parameter	Minimum-Value	Typical Value	Maximum-Value	Unit
24 V source voltage	-	24	-	V
24 V source current	-	0.6	1.5	A

Table 14: Internal power supply specifications

If the current exceeds its limit, the software will protect and turn off the output, and the internal control system will generate error messages and display them in the robot log.

6.3.6.3 Digital output end

At the digital output terminal, the current can only be irrigated into the GND (0V), rather than adopting pull current. After the digital output terminal is activated, the corresponding joint will be driven to connect GND; after digital output is disabled, the corresponding joint will be in the open circuit (open set/open drain).

Terminal	Parameter	Minimum-Value	Typical Value	Maximum-Value	Unit
DO 0/1/2	Voltage drop	0	0/24	24	V
DO 0/1/2	Current	0	-	0.4	A
DO 0/1/2	Leakage current	0	-	0.5	mA
DO 0/1/2	Features	-	PNP	-	Types

Table 15: Digital output specifications

NOTICE

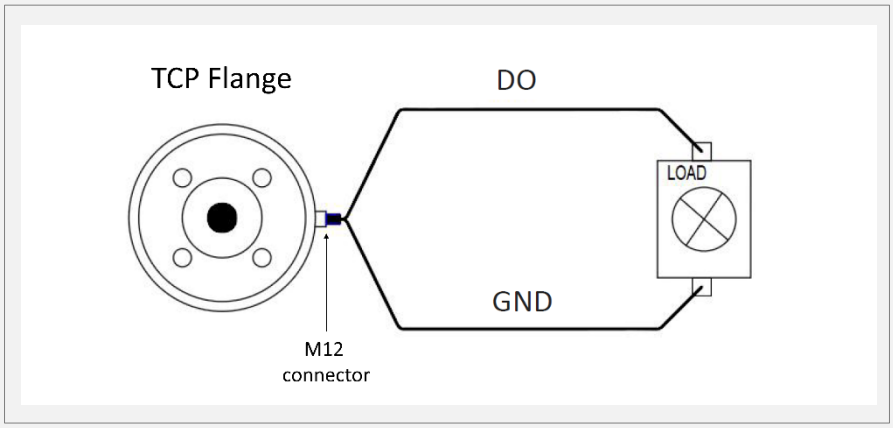
Exceeding current

There is no current restriction in the digital output terminal of tools, permanent damage may occur if it exceeds the specified data.

► Do not exceed specified current values.

Example of using digital output terminal

In this diagram, the IO board provides power for the external equipment. If the external system uses its own power supply, grounding treatment is required.



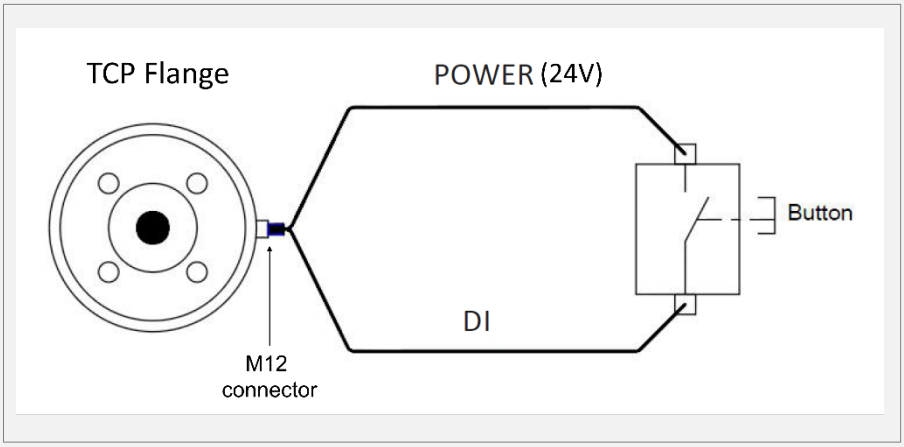
6.3.6.4 Digital input terminal

Terminal	Parameter	Minimum-Value	Typical Value	Maximum-Value	Unit
DI 0/1/2	Voltage	0	24	24	V
DI 0/1/2	OFF area	0	0	5	V
DI 0/1/2	ON area	11	24	24	V
DI 0/1/2	Current	2	-	15	mA
DI 0/1/2	Features	-	PNP	-	Types

Table 16: Specifications of the digital input terminal

Example of using digital input terminal

The diagram shows how to connect simple buttons or switches. In this diagram, the IO board provides power for the external equipment. If the external system uses its own power supply, grounding treatment is required.



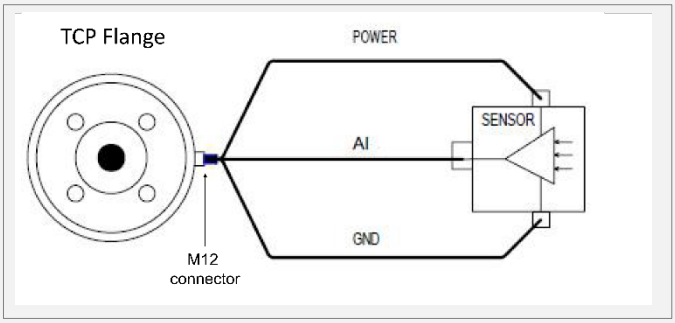
6.3.6.5 Analog input

Parameter	Minimum-Value	Typical Value	Maximum-Value	Unit
Input voltage in voltage mode	0	-	10	V
Input current in current mode	4	-	20	mA
Input resistance from 0 V–10 V	-	15	-	kΩ
Input resistance within 4 mA–20 mA current range	-	500	-	Ω
DI 0/1/2 Features	-	PNP	-	Types

Table 17: Specifications of the analogue input terminal

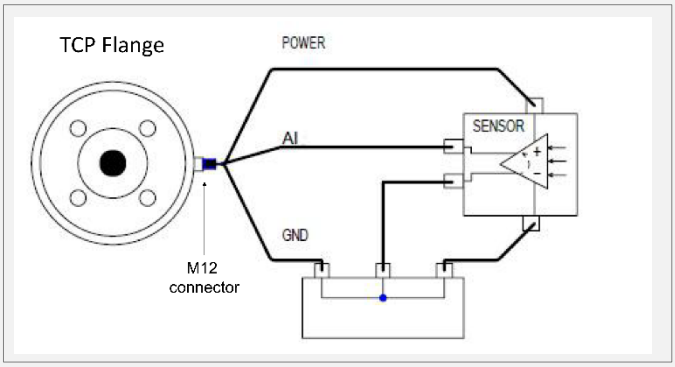
First, the input mode of the analog input must be the same as the setting in the communication card of the host computer. The output end of the sensor can be set to the current mode or the voltage mode. Check to make sure that the sensor with voltage output can drive the internal resistance of this board, otherwise the measured value may be invalid.

Example of using analog input, here are two simple examples:



Examples

Wiring diagram of analog input voltage mode and current three-wire mode.



The analog input is the current two-wire mode wiring diagram.

6.3.6.6 RS485 serial port line (Modbus RTU)

Type	Function	Description
TXD	send data	RS485 data communications for grippers in the KAWASAKI ROBOTICS library.
RXD	receive data	
GND	ground signal	

Parameter	Value	Unit
Baud rate	115.200 (1 million baud in future release)	B/s
Data bits	8	Bit
Stop bit	1	Bit

Table 18: Specifications of the RS485 serial port line (Modbus RTU)

6.4 Software Installation and Updates

For Backing up robot data or installing software updates, a USB flash drive with a specific name (**Kawasaki RoboticsUSB**) and file format (**exFAT**) is required.

For detailed instructions on how to prepare the USB flash drive, please refer to the **CL1 Software Manual**.

6.4.1 Back up und Restore

The robot data can be backed up or restored via the CL1 GUI.

For detailed instructions on how to backup/restore data, please refer to the **CL1 Software Manual**.

6.4.2 Software Update

The robot software can be updated via the CL1 GUI.

For detailed instructions on how to perform a robot software update, please refer to the **CL1 Software Manual**.

7 OPERATING ELEMENTS AND DISPLAYS

7.1 Power Buttons / Switches

7.1.1 Turning on/off Robot with Teach Pendant V2

The CL1 robot system provides one main power switch and one reset button on the control cabinet.

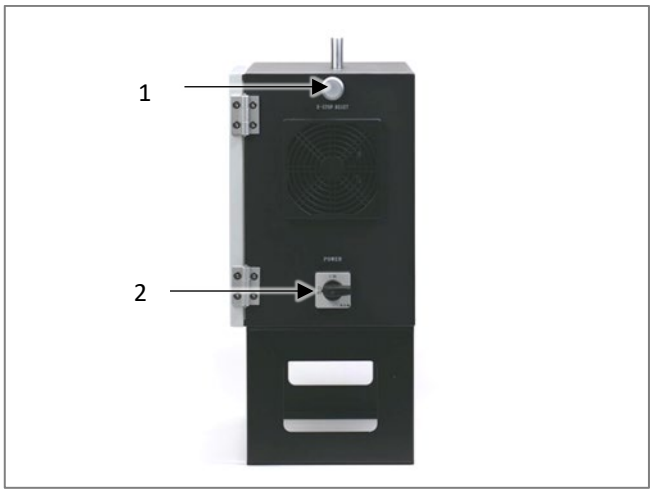


Fig. 40: Power switch (2) and E-stop reset button (1) at control cabinet

Power on the robot:

- Power switch (2) at the control cabinet turns on 230 V power supply to the control cabinet.
- E-stop reset button (1) needs to be pressed once, to enable the 48 V power supply to robot.
  The button turns white (LED) after 48V power to the robot is active.
- The Main PC starts automatically.
- Long press the tablets “On/Off” button to turn on the tablet (similar how you turn on an Android Smartphone)

Power off the robot:

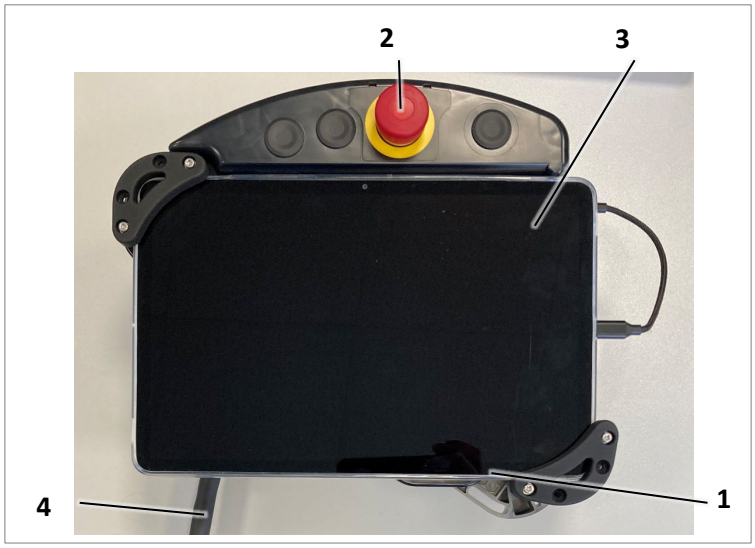
The same switches and the GUI are necessary to turn the device off properly.

- First use the GUI for turning off the Industrial PC
- Then use the main switch (2) to power off the control cabinet. (see Electrical installation and booting process on page 65).
- Turn off the Tablet by long press the off button (similar how you turn off an Android Smartphone)

7.2 Teach Pendant

7.2.1 Kawasaki Teach Pendant V2

The CL1 teach pendant Version V2 (since March 2023) is an easy programming user interface for teaching, programming and operating the robot system.



1 Power button
2 Emergency stop button
3 Display (touch screen) incl. GUI
4 Connecting cable to the control cabinet

Fig. 41: Teach pendant V2 with its main operating and display features

7.3 TCP Buttons (HMI Buttons)

The robot has two programmable buttons on the TCP, the **Point** and the **Free** button (see Fig. 48: (1)).

The **Point** button can be configured to perform different actions from within the GUI:

- No Action
- ZeroG On
- ZeroG Off
- Save Point
- Delete Point

The **Free** button can only be used for:

- No Action (deactivated)
- ZeroG On

Keeping the **Free** button pressed will switch ZeroG mode from stiff to soft. This behavior cannot be changed.

Fig. 42: Robot TCP flange with TCP (HMI) buttons

7.4 LED-Ring

The robot has an LED-Ring on the TCP (see Fig. 48: (2)) used to indicate its current status.

	Blue blinking Blue solid	Idle: after robot startup or emergency stop reset Idle: robot not moving
	Green solid	Active: robot moving
	Yellow blinking	Collision: collision detected
	Red solid	Emergency stop: if the robot initiated an emergency stop on its own (not pressing the emergency stop switch, see note below). E.g. if state of physical robot and robot state in Gui don't match.

NOTICE If the emergency stop switch is pressed, power to the robot is cut, hence there is no color indication for an emergency stop.

7.5 GUI Interface

The CL1 software NEURON OS offers an easy-to-use Graphical User Interface with various programming functions.

7.5.1 Programming Features

Programming Features	
Smart GUI	NEURON OS Easy Programming Interface
Fast programming	Shortcut Buttons, Dynamic Path and Force Recording
Human-Robot-Interaction	Visual Touch, Drag & Drop, Python Editor
Environment Visualization	3D CAD Data & Saved Points

Table 19: Overview programming features

7.5.2 GUI Interface Main Page

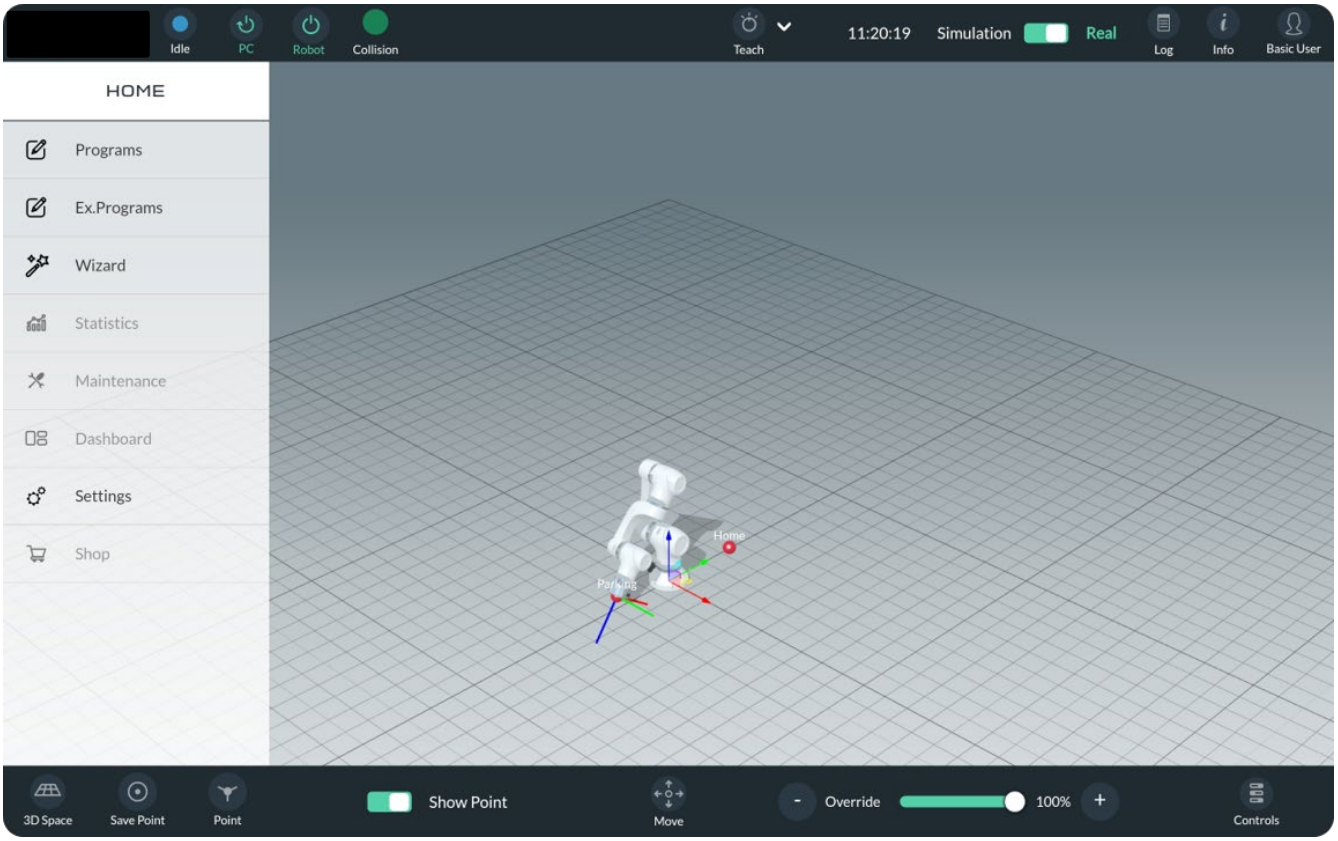


Fig. 43: CL1 Smart GUI interface, main page

Detailed information about the software operation can be found in the CL1 Software User Manual.

7.6 Python API

The Python API can be used to send commands to the robot and perform certain actions from an external PC.

Detailed information about the Python API can be found in the CL1 Software User Manual.
There is a separate document that shows how to install and use the python API on a Windows or Linux PC.

8 COMMISSIONING AND OPERATION

⚠ DANGER

Improper installing and using of the system

Improper installing and using of the robot system can lead to serious injuries or death.

- ► Before switching on the robot, check the correct installation of the system (see *Assembly and Installation* on page *28*).
- ► All security measures (see *General Safety Instructions* on page *4*) have been implemented and their functionality has been checked.
- ► Observe all general safety instructions in this user manual.

8.1 Commissioning of the Robot

In principle, the following steps are carried out during commissioning:

1. Powering on the system (Electrical installation and booting Process)
2. Configuring the system (teach pendant or manually)
3. Starting the specified process (GUI Buttons)

For information about configuring the robot system refer to the CL1 Software User Manual.

8.2 Electrical installation and booting process

Connecting and booting the robot system

In the following figure it shows the different connectors of the control cabinet.

Fig. 44: Connections of Controlbox (botton view)

1. Connect the interface of the teach pendant to the HMI connector of the control cabinet as shown below.

2. Connect the control cabinet with the robot via the robot cable connector using the connecting cable (see *Robot* Connecting cable on page *40*).

3. Connect the control cabinet with the 230 V power supply using the power cord (see *Power supply cable* on page *40*) of the control cabinet as shown below.

4. Turn the power switch button from 0 /OFF → 1/ON on the electric cabinet.

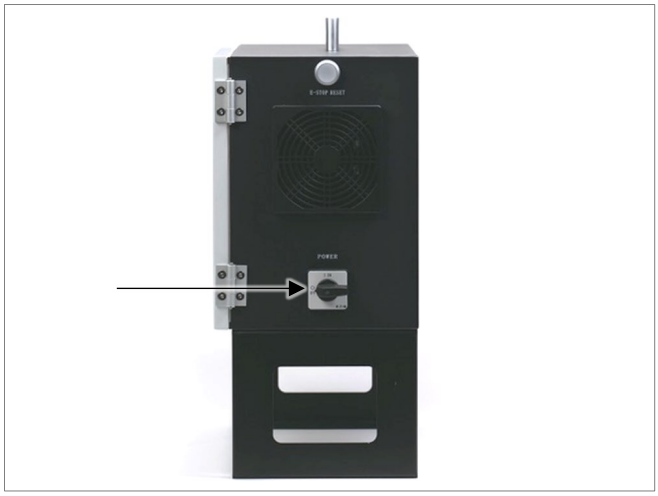


Fig. 45: Right side of the Control cabinet

5. Wait for about 15 seconds and press the white E-stop reset button on the control cabinet, when it lights up.
The robot is ready for motion and the NEURON OS Software starts automatically.

Fig. 46: Right side of the Control cabinet

8.3 Dynamic Parameter Identification (DPI)

The Dynamic Parameter Identification can be used to improve the behaviour of the **ZeroG mode,** increase the robustness of the **Collision Detection** or to identify **dynamic tool parameters**. It can be performed via the specific wizard in the GUI. Please refer to the CL1 Software Manual for detailed instructions.

If changes have been applied to the robot or its tool, DPI must be performed.
DPI can be verified if the robot does not drift when activating ZeroG.

8.4 Kawasaki Robotics Software Operation

The NEURON OS software for the teach pendant is an interface operation software for manual robot operation, programming, parameter configuration and user monitoring.

The user can control the robot to move according to the path specified by the user through the operation interface function button, so that the robot can complete the expected action.

It can be said that the teach pendant is the steering wheel for controlling the movement of the robot.
The teach pendant is divided into the following modules:

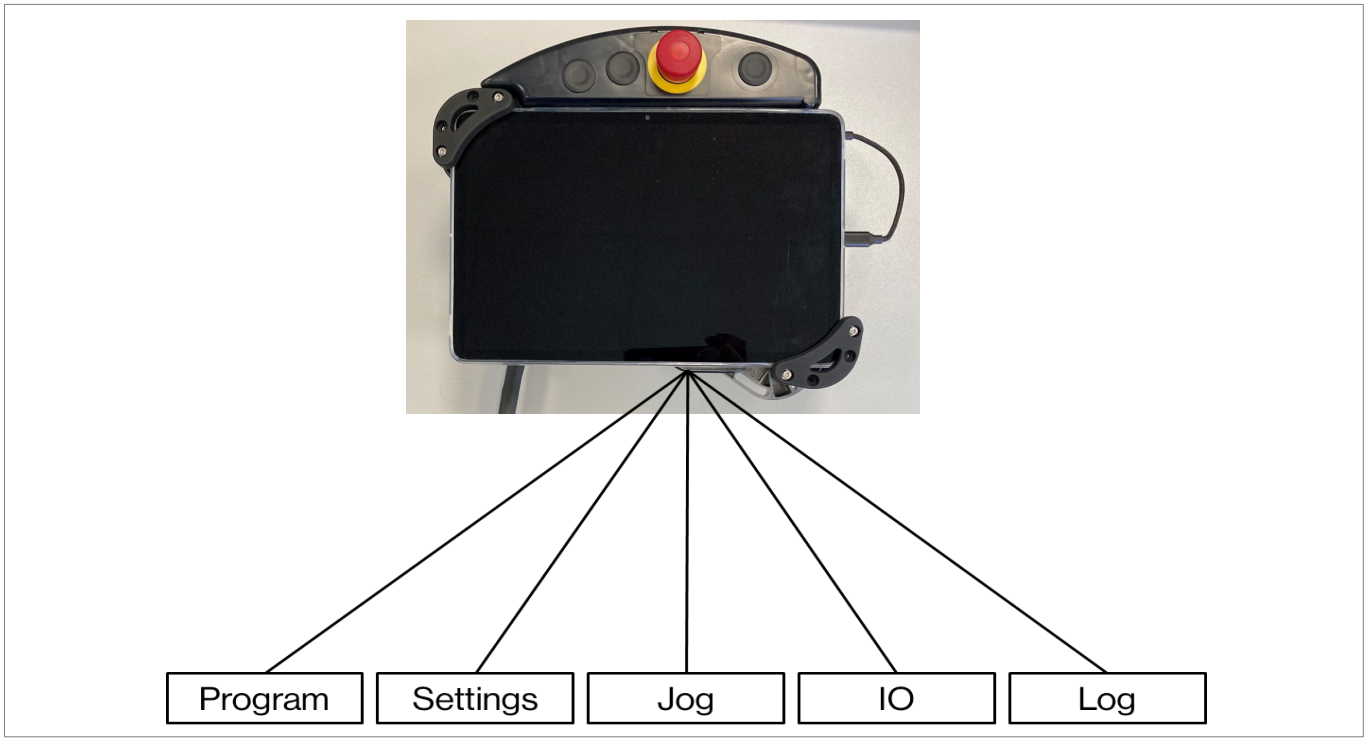


Fig. 47: Modules of the teach pendant

For more information about the Software refer to the CL1 Software User Manual.

8.5 Safety Logic

Detailed information about the robots Safety Logic and the configurable safety options are described in the CL Safety Specification Document. Please always refer to the document in its version corresponding to your robots' safety logic. For further assistance, please contact your Kawasaki Robotics representative.

8.6 Emergency Handling

8.6.1 Emergency stop device

⚠ DANGER

Not integrated tools to emergency stop device

Failure to observe this warning may result in death, serious personal injury, or significant property damage.

► Tools or equipment connected to the terminal must be integrated into the emergency stop circuit of the system if they pose a potential threat.

CL1 series robots are equipped with an emergency stop button on the teach pendant and offer multiple connections at the Main IO Board inside the control cabinet.

This button must be pressed in a dangerous or emergency situation.
Pressing the emergency stop button will stop all movement of the robot.

The control cabinet is equipped with an external emergency stop button port on the Main IO Board, which can be used by integrators or customers.

Fig. 48: Emergency stop button on Teach Pendant V2

- Emergency shutdown cannot be used as a risk mitigation measure, but it can be used as a secondary protection device.
- If multiple emergencies stop buttons must be connected, they must be included in the risk assessment of the robot application.
- The emergency stop button meets the requirements of IEC 60947-5-5.

8.6.2 Execute emergency stop

► Press emergency stop button on the teach pendant.
► All movement of the robot stops, 48 V robot power will be cut off.

8.6.3 Force emergency movement of joint

In rare cases, it may be necessary to move one or more robot joints in an emergency situation where the power supply of the robot fails or does not want to use the power supply.

This can be forced by the following methods:

8.6.3.1 Brake release function

This page function enables the operator to open the brakes of individual axes. This can be required after changing an axis or to recover from a collision. The robot axis must be turned off before opening the brakes.

► Pressing the red button for an axis will open the brake of that axis and allows the operator to move the axis.

► Opening the brake is only possible when the robot is turned off.

► Using the **Set to Zero** button will set the current joint configuration as the new Zero position of the axis.
This is only recommended after changing an axis.

The brake features are password protected and should only be performed by trained personnel.
The consequences of changing the Zero position of an axis are the responsibility of the operator.

Note: changing the Zero position will affect the positioning of the robot.
Afterwards, the robot needs to be recalibrated to achieve high absolute accuracy.

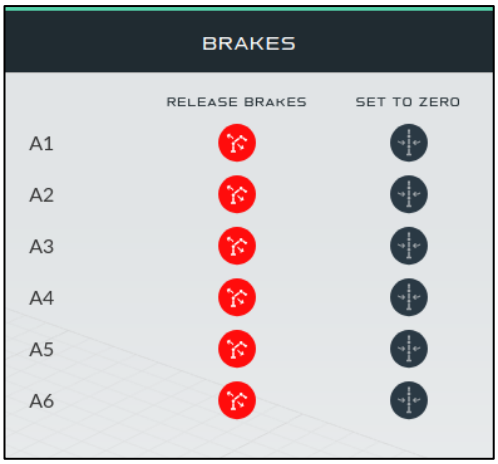


Fig. 49: Brake release function inside the GUI

WARNING	Manually setting the zero position of the axis overwrites the calibrated zero positions. Setting wrong zero positions can damage the system and lead to unexpected behavior of the robot system.

8.6.4 Forced reverse drive

► Push or pull the robot arm to force the joint to move (force at least 500N).

8.6.4.1 Forced manual movement

NOTICE
Forced manual move of robot arm

Joints may be damaged.

- ► Only perform in emergency situations.
- ► Move the robot arm by hand.

8.6.5 Robot safety protection (Torque limit protection)

The robot constantly observes its proprioceptive sensors to detect possible error states, e.g., due to a contact with the environment. This is done through several redundant layers on both hardware and software levels. If the Torque Limit protection is exceeded, the robot enters an error state and reacts accordingly. In case of a collision with the operator or another object in its workspace, the robot goes into collision state. When choosing the Reflex option, the robot will move away from the collision location, thereby resulting in reduced clamping forces. For the evaluation of the safe operation of the robot, a risk assessment needs to be made by the integrator.

8.6.6 Recovery from emergency

All emergency-stop devices in the form of keys have a mechanical safety lock function. This "lock" must be opened to end the emergency stop state of the device.

Recovering from the emergency stop state is a simple but very important step, this step can only be operated after ensuring that the danger of the robot system is eliminated.

Open the emergency lock

- ► Turn the emergency stop button to open the "lock"
- ► Reset the 48 V with pressing the white button on the control cabinet
- ► Reset Emergency Stop from Teach Pendant
- ► Enable the Robot for continuing the motion

9 MALFUNCTIONS AND FAILURES

9.1 Troubleshooting

If there are any problems or malfunctions which are not mentioned in the following error tables, contact service partner or integrator. Kawasaki Robotics recommends to attend the CL1 courses for the Basic, Advanced and Service training to perform a proper troubleshooting of the robots.

9.2 Error Codes

9.2.1 CL1 function return error code table

Error Code	State Description	Solution
General error messages		
1002	Warning: Point not reachable: Position out of Workspace	Change the position to be inside the workspace or change the workspace settings.
1003	Warning: Invalid Input Value	Change to a valid input value and try again.
1004	Warning: Invalid Input Type	Change to a valid input type and try again.
1005	Warning: Invalid unit	Change to a valid unit and try again.
1007	Warning: Wrong number of Joints	Configuration file needs to be checked. Contact KAWASAKI ROBOTICS for details.
1008	Warning: Invalid Joint Position	Joint value is not valid. Check the Position.
1009	Error: Joint Velocity to high	(1) Restart the robot control with **PC->Reset Control** from GUI. (2) Change commanded joint velocity range according to operation guide.
1010	Warning: Joint Velocity to low	Check the velocity set point.
1011	Warning: Invalid Joint Acceleration	Check the acceleration limits and set points
1012	Warning: Invalid end effector Position	TCP position should be changed by jogging
1013	Error: End effector Velocity to high	(1) Restart the robot control with **PC->Reset Control** from GUI. (2) Change commanded end effector Velocity range according to operation guide.
1014	Warning: End effector Velocity to low	Check the velocity set point.
1015	Error: Invalid end effector Acceleration	(1) Restart robot control with **PC->Reset Control** from GUI. (2) Change commanded end effector acceleration range according to operation guide.
1016	Warning: Cannot move in desired direction from current configuration	Change the desired direction of movement.

Error Code	State Description	Solution
1017	Warning: Desired Position cannot be reached, out of workspace	Change the position to be inside the workspace.
1018	Warning: Wrong input vector size. Size must be a multiple of 6	Change the input vector size to be a multiple of 6.
1019	Error: Generation of circular path failed	Restart robot control with **PC->Reset Control** from GUI.
1020	Error: Wrong input vector size. Size must be 18 for a MoveCircular	(1) Create a program with 3 different target points. (2) Restart robot control with **PC->Reset Control** from GUI.
1021	Error: Given points for move circular create to big radius	Restart robot control with **PC->Reset Control** from GUI.
1022	Error: Generation of Linear path failed	Restart the robot control with **PC->Reset Control** from GUI.
1023	Error: Cannot generate the required Blending path	Restart the robot control with **PC->Reset Control** from GUI.
1024	Warning: Invalid Position requested, recheck the input values	Check the input values.
1025	Warning: Cannot active ZeroG, Close to the joint limit	Move the robot via jogging mode out of software limits and turn on ZeroG again.
1026	Error: Cannot move in desired direction from current configuration	Restart robot control with **PC->Reset Control** from GUI.
1027	Warning: Axis 1 at limits	(1) Use the jogging slider at (**Move->Joint->A1 to A7**) to bring back the axis at a limit within the permissible operating range. (2) It's possible to change the joint limit operation range. Check **settings->Robot->Joint->Limits**. For maximum and minimum joint limits refer to the operation guide.
1028	Warning: Axis 2 at limits	(1) Use the jogging slider at (**Move->Joint->A1 to A7**) to bring back the axis at a limit within the permissible operating range. (2) It's possible to change the joint limit operation range. Check **settings->Robot->Joint->Limits**. For maximum and minimum joint limits refer to the operation guide.
1029	Warning: Axis 3 at limits	(1) Use the jogging slider at (**Move->Joint->A1 to A7**) to bring back the axis at a limit within the permissible operating range. (2) It's possible to change the joint limit operation range. Check **settings->Robot->Joint->Limits**. For maximum and minimum joint limits refer to the operation guide.
1030	Warning: Axis 4 at limits	(1) Use the jogging slider at (**Move->Joint->A1 to A7**) to bring back the axis at a limit within the permissible operating range. (2) It's possible to change the joint limit operation range. Check **settings->Robot->Joint->Limits**. For maximum and minimum joint limits refer to the operation guide.

Error Code	State Description	Solution
1031	Warning: Axis 5 at limits	(1) Use the jogging slider at (**Move->Joint->A1 to A7**) to bring back the axis at a limit within the permissible operating range. (2) It's possible to change the joint limit operation range. Check **settings->Robot->Joint->Limits**. For maximum and minimum joint limits refer to the operation guide.
1032	Warning: Axis 6 at limits	(1) Use the jogging slider at (**Move->Joint->A1 to A7**) to bring back the axis at a limit within the permissible operating range. (2) It's possible to change the joint limit operation range. Check **settings->Robot->Joint->Limits**. For maximum and minimum joint limits refer to the operation guide.
1034	Warning: X-Axis at limits	(1) Use the cartesian jogging slider at (**Move->Cartesian->X, Y and Z**) to bring back the axis at a limit within the permissible operating range. (2) It's possible to change the cartesian limit operation range. Check **settings->Robot->Cartesian->Limits**. For maximum and minimum cartesian limits refer to the operation guide.
1035	Warning: Y-Axis at limits	(1) Use the cartesian jogging slider at (**Move->Cartesian->X, Y and Z**) to bring back the axis at a limit within the permissible operating range. (2) It's possible to change the cartesian limit operation range. Check **settings->Robot->Cartesian->Limits**. For maximum and minimum cartesian limits refer to the operation guide.
1036	Warning: Z-Axis at limits	(1) Use the cartesian jogging slider at (**Move->Cartesian->X, Y and Z**) to bring back the axis at a limit within the permissible operating range. (2) It's possible to change the cartesian limit operation range. Check **settings->Robot->Cartesian->Limits**. For maximum and minimum cartesian limits refer to the operation guide.
1037	Warning: Desired value of Axis 1 at limits. The motion in the direction is not possible.	(1) Check Current operation range of joint limits. Make sure the desired position is within permissible operation range. (2) It's possible to change the joint limit operation range. Check **settings->Robot->Joint->Limits**. For maximum and minimum joint limits refer to the operation guide.
1038	Warning: Desired value of Axis 2 at limits. The motion in the direction is not possible.	(1) Check Current operation range of joint limits. Make sure the desired position is within permissible operation range. (2) It's possible to change the joint limit operation range. Check **settings->Robot->Joint->Limits**. For maximum and minimum joint limits refer to the operation guide.
1039	Warning: Desired value of Axis 3 at limits. The motion in the direction is not possible.	(1) Check Current operation range of joint limits. Make sure the desired position is within permissible operation range. (2) It's possible to change the joint limit operation range. Check **settings->Robot->Joint->Limits**. For maximum and minimum joint limits refer to the operation guide.

Error Code	State Description	Solution
1040	Warning: Desired value of Axis 4 at limits. The motion in the direction is not possible.	(1) Check Current operation range of joint limits. Make sure the desired position is within permissible operation range. (2) It's possible to change the joint limit operation range. Check **settings->Robot->Joint->Limits**. For maximum and minimum joint limits refer to the operation guide.
1041	Warning: Desired value of Axis 5 at limits. The motion in the direction is not possible.	(1) Check Current operation range of joint limits. Make sure the desired position is within permissible operation range. (2) It's possible to change the joint limit operation range. Check **settings->Robot->Joint->Limits**. For maximum and minimum joint limits refer to the operation guide.
1042	Warning: Desired value of Axis 6 at limits. The motion in the direction is not possible.	(1) Check Current operation range of joint limits. Make sure the desired position is within permissible operation range. (2) It's possible to change the joint limit operation range. Check **settings->Robot->Joint->Limits**. For maximum and minimum joint limits refer to the operation guide.
1044	Warning: invalid joint velocity	Check the joint velocity parameter. Values below 0 are not allowed.
1045	Warning: Desired value of Axis 1 near limits. The motion in the direction will be slowed down.	Move this specific axis into the opposite direction to not reach the limitation of the axis.
1046	Warning: Desired value of Axis 2 near limits. The motion in the direction will be slowed down.	Move this specific axis into the opposite direction to not reach the limitation of the axis.
1047	Warning: Desired value of Axis 3 near limits. The motion in the direction will be slowed down.	Move this specific axis into the opposite direction to not reach the limitation of the axis.
1048	Warning: Desired value of Axis 4 near limits. The motion in the direction will be slowed down.	Move this specific axis into the opposite direction to not reach the limitation of the axis.
1049	Warning: Desired value of Axis 5 near limits. The motion in the direction will be slowed down.	Move this specific axis into the opposite direction to not reach the limitation of the axis.
1050	Warning: Desired value of Axis 6 near limits. The motion in the direction will be slowed down.	Move this specific axis into the opposite direction to not reach the limitation of the axis.
1052	Warning: Robot TCP is at cartesian workspace limits in X-direction. The motion in this direction is not possible.	Move the robot the opposite X-direction to move the robot out of the limitation.
1053	Warning: Robot TCP is at cartesian workspace limits in Y-direction. The motion in this direction is not possible.	Move the robot the opposite Y-direction to move the robot out of the limitation.
1054	Warning: Robot TCP is at cartesian workspace limits in Z-direction. The motion in this direction is not possible.	Move the robot the opposite Z-direction to move the robot out of the limitation.

Error Code	State Description	Solution
1055	Warning: Robot TCP is near cartesian workspace limits in X-direction. The motion in the direction will be slowed down.	Move the robot the opposite X-direction to move the robot away from the limits.
1056	Warning: Robot TCP is near cartesian workspace limits in Y-direction. The motion in the direction will be slowed down.	Move the robot the opposite Y-direction to move the robot away from the limits.
1057	Warning: Robot TCP is near cartesian workspace limits in Z-direction. The motion in the direction will be slowed down.	Move the robot the opposite Z-direction to move the robot away from the limits.
1058	Warning: Modifier configurated without path.	Please contact your Kawasaki Robotics representative or distributor for further assistance with troubleshooting.
1059	Warning: Weaving configurated with invalid weaving pattern.	The specified parameters for the weaving pattern are invalid and need to be adapted. Please refer to the Software Manual for the details on how to define them.
1060	Warning: Weaving configurated with invalid amplitude.	The amplitude for the weaving pattern is invalid and needs to be adapted. Please refer to the Software Manual for the details on how to define them.
1061	Warning: Weaving configurated with invalid frequency.	The frequency of the weaving pattern is invalid and needs to be adapted. Please refer to the Software Manual for the details on how to define them.
1062	Warning: Weaving configurated with invalid velocity, velocity value exceeds 16.67 mm/s. Please reduce velocity.	The specified parameters for the weaving pattern are invalid and need to be adapted. Please refer to the Software Manual for the details on how to define them.
1063	Warning: Weaving configurated with invalid dwell time. Dwell time exceeds time given by frequency.	The specified parameters for the weaving pattern are invalid and need to be adapted. Please refer to the Software Manual for the details on how to define them. The dwell time exceeds the period duration specified by the weaving frequency.
1064	Warning: Collision detection stopped. Unable to read collision parameters from the json file.	Please contact your Kawasaki Robotics representative or distributor for further assistance with troubleshooting.
1065	Warning: Setting new joint limits is not possible. The current robot configuration violates the new limits. Please move the robot into the new limits.	Please move the robot into the new limits.
1070	Warning: Tool mass is not valid. Please check the tool parameters and try again.	Please check the tool parameters and try again.
1071	Warning: Desired motion violates X-Axis limits. The motion is not possible.	Please move other X-direction.
1072	Warning: Desired motion violates Y-Axis limits. The motion is not possible.	Please move other Y-direction.

Error Code	State Description	Solution
1073	Warning: Desired motion violates Z-Axis limits. The motion is not possible.	Please move other Z-direction.
1080	Warning: Axis 1 beyond limits. The motion in the desired direction is not possible. Please move the robot back into the limits.	Please move the robot back into the limits.
1081	Warning: Axis 2 beyond limits. The motion in the desired direction is not possible. Please move the robot back into the limits.	Please move the robot back into the limits.
1082	Warning: Axis 3 beyond limits. The motion in the desired direction is not possible. Please move the robot back into the limits.	Please move the robot back into the limits.
1083	Warning: Axis 4 beyond limits. The motion in the desired direction is not possible. Please move the robot back into the limits.	Please move the robot back into the limits.
1084	Warning: Axis 5 beyond limits. The motion in the desired direction is not possible. Please move the robot back into the limits.	Please move the robot back into the limits.
1085	Warning: Axis 6 beyond limits. The motion in the desired direction is not possible. Please move the robot back into the limits.	Please move the robot back into the limits.
1086	Warning: Axis 7 beyond limits. The motion in the desired direction is not possible. Please move the robot back into the limits.	Please move the robot back into the limits.
Collision error messages		
2001	Warning: Obstacle in trajectory detected	Remove the obstacle from the trajectory path.
2002	Warning: Collision occurred	(1) Remove the object that caused the collision from the robot workspace. (2) Reset the collision to continue the motion.
2003	Warning: Movement blocked by something	Remove the object that caused blocking from the robot workspace.
2004	Warning: Object to grasp not reachable	Make sure that the grasp location is within the robot workspace.
2005	Warning: Object to grasp not reachable	Make sure that the grasp location is within the robot workspace. The object shape should be compatible with the current tool. Refer to the operation guide for more information about the robot workspace and tools.
2006	Warning: Could not find/detect object	Make sure the object is positioned correctly with appropriate lighting. Refer to the operation guide for more information about object detection.

Error Code	State Description	Solution
EtherCAT communication error messages		
3001	Error: Communication Problem with Host IP	(1) Check the cable with the host pc for damage. Replace it if is necessary. (2) Restart robot control with **PC->Reset Control** from GUI.
3002	Error: Communication Problem with a Joint	Restart robot control with **PC->Reset Control** from GUI.
3004	Error: Queue overload, data loss	Restart robot control with **PC->Reset Control** from GUI.
3005	Warning: Communication Problem with Host PC	Check connection to Host PC
3006	Warning: Communication Problem with GUI server! Jog Motion was stopped. Check the connection to the Teach Pendant!	Check the connection to the Teach Pendant!
Robot status error messages		
4001	Error: Current too High	(1) Shutdown both pc with **PC->Power Off** from GUI. (2) Power off the Control Cabinet by switching off the power switch. (3) Wait until all the colling fans in the Control Cabinet is at a complete standstill. (4) Make sure the power supply ratings are as per the operation guide. (5) Power on the Control Cabinet again. Release all the emergencies and press the white E-Stop reset button. (6) Make sure the mounted tool does not exceed the maximum payload of the robot.
4002	Error: Current too Low	(1) Shutdown both pc with **PC->Power Off** from GUI. (2) Power off the Control Cabinet by switching off the power switch. (3) Wait until all the cooling fans in the Control Cabinet is at a complete standstill. (4) Make sure the power supply ratings are as per the operation guide. (5) Power on the Control Cabinet again. Release all the emergencies and press the white E-stop reset button.
4003	Error: Voltage too High	(1) Shutdown both pc with **PC->Power Off** from GUI. (2) Power off the Control Cabinet by switching off the power switch. (3) Wait until all the colling fans in the Control Cabinet is at a complete standstill. (4) Make sure the power supply ratings are as per the operation guide. (5) Power on the Control Cabinet again. Release all the emergencies and press the white E-stop reset button. (6) Make sure the mounted tool does not exceed the maximum payload of the robot.
4004	Error: Voltage too Low	(1) Shutdown both pc with **PC->Power Off** from GUI. (2) Power off the Control Cabinet by switching off the power switch.

Error Code	State Description	Solution
		(3) Wait until all the colling fans in the Control Cabinet is at a complete standstill. (4) Make sure the power supply ratings are as per the operation guide. (5) Power on the Control Cabinet again. Release all the emergencies and press the white E-stop reset button.
4005	Warning: Temperature	(1) Shutdown PC with **PC->Power Off** from GUI. (2) Power off the Control Cabinet by switching off the power switch. (3) Before powering on the robot, make sure the operating temperature range of the robot is as per the operation guide. (4) Check if all fans are working
4006	Error: Cycle could not achieve real time, high CPU	Restart robot control with **PC->Reset Control** from GUI.
4007	Warning: Calibration failed	Restart robot control with **PC->Reset Control** from GUI.
4008	Error: Emergency Stop Pressed	(1) Release the emergency stop. (2) Press the white E-stop reset button in the Control Cabinet of the robot. (3) Restart robot control with **PC->Reset Control** from GUI.
4009	Error: Communication with some EtherCAT clients not completing within allotted time	(1) Restart robot control with **PC->Reset Control** from GUI (2) If Point (1) doesn't solve the issue → Power cycle the robot.
4010	Error: Transmitting data to EtherCAT clients	(1) Restart robot control with **PC->Reset Control** from GUI (2) If Point (1) doesn't solve the issue → Power cycle the robot.
4011	Error: Receiving Data from EtherCAT clients failed completely. click on PC button and reset control	(1) Restart robot control with **PC->Reset Control** from GUI (2) If Point (1) doesn't solve the issue → Power cycle the robot.
4012	Error: Communication with High Level timed out	(1) Restart robot control with **PC->Reset Control** from GUI (2) If Point (1) doesn't solve the issue → Power cycle the robot.
4013	Error: Robot did not transition to ready to power on within 78 lotted time. Click on PC button and reset control. If the error reappears, power off and power cycle the Control Cabinet	(1) Restart robot control with **PC->Reset Control** from GUI (2) If Point (1) doesn't solve the issue → Power cycle the robot.
4014	Error: Robot did not transition to operation enable i.e. robot did not power on within 78 lotted time. Click on PC button and reset control. If the error reappears, power off and power cycle the Control Cabinet	(1) Restart robot control with **PC->Reset Control** from GUI (2) If Point (1) doesn't solve the issue → Power cycle the robot.

Error Code	State Description	Solution
4015	Error: Robot did not power off within 79 lotted time. Click on PC button and reset control. If the error reappears, power off and power cycle the Control Cabinet	(1) Restart robot control with **PC->Reset Control** from GUI (2) If Point (1) doesn't solve the issue → Power cycle the robot.
4016	Error: Some axes are powered on while others are powered off after 79 lotted time	(1) Restart robot control with **PC->Reset Control** from GUI (2) If Point (1) doesn't solve the issue → Power cycle the robot.
4017	Error: Axes are in fault state according to DS402 profile. Check if some drives are in fault	(1) Restart robot control with **PC->Reset Control** from GUI (2) If Point (1) doesn't solve the issue → Power cycle the robot.
4018	Error: Emergency Pressed or not reset. Release all Emergency PB and press illuminated white PB on Control Cabinet. It should glow white. Then press reset on HMI	(1) Release all the emergency stops. (2) Press the white E-stop reset button in the Control Cabinet of the robot. (3) Restart robot control with **PC->Reset Control** from GUI (4) If Point (3) doesn't solve the issue → Power cycle the robot.
4019	Error: Robot Switched Off During Execution	(1) Restart robot control with **PC->Reset Control** from GUI (2) If Point (1) doesn't solve the issue → Power cycle the robot.
4020	Warning: Did not receive data from EtherCAT clients for one cycle	(1) Restart robot control with **PC->Reset Control** from GUI (2) If Point (1) doesn't solve the issue → Power cycle the robot.
4021	Error: Jump in Position Command in Axis 1	(1) Restart robot control with **PC->Reset Control** from GUI (2) If Point (1) doesn't solve the issue → Power cycle the robot.
4022	Error: Jump in Position Command in Axis 2	(1) Restart robot control with **PC->Reset Control** from GUI (2) If Point (1) doesn't solve the issue → Power cycle the robot.
4023	Error: Jump in Position Command in Axis 3	(1) Restart robot control with **PC->Reset Control** from GUI (2) If Point (1) doesn't solve the issue → Power cycle the robot.
4024	Error: Jump in Position Command in Axis 4	(1) Restart robot control with **PC->Reset Control** from GUI (2) If Point (1) doesn't solve the issue → Power cycle the robot.
4025	Error: Jump in Position Command in Axis 5	(1) Restart robot control with **PC->Reset Control** from GUI (2) If Point (1) doesn't solve the issue → Power cycle the robot.

Error Code	State Description	Solution
4026	Error: Jump in Position Command in Axis 6	(1) Restart robot control with **PC->Reset Control** from GUI (2) If Point (1) doesn't solve the issue → Power cycle the robot.
4028	Warning: End effector board not initialised	(1) Restart robot control with **PC->Reset Control** from GUI (2) If Point (1) doesn't solve the issue → Power cycle the robot.
4029	Error: Axis is not ready to take command	(1) Restart robot control with **PC->Reset Control** from GUI (2) If Point (1) doesn't solve the issue → Power cycle the robot.
4030	Error: EtherCAT Robot slave lost	(1) Restart robot control with **PC->Reset Control** from GUI (2) If Point (1) doesn't solve the issue → Power cycle the robot.
4031	Warning: Turning On collision detection as per the safety logic	Informational warning.
4032	Warning: Turning Off collision detection as per the safety logic	Informational warning.
Robot calibration error messages		
5001	Warning: Joint not calibrated	Joint needs to be calibrated according to the calibration documentation.
5002	Warning: Axis not calibrated	Axis module needs to be calibrated according to the calibration documentation.
5003	Warning: Sensor not calibrated	Sensor needs to be calibrated according to the calibration documentation of manufacturer.
5004	Warning: Permissible load capacity exceeded	Lower the payload on the robot.
Motion planning error messages		
6001	Warning: Could not generate path	(1) Check the robot for points that are out of reach. (2) Check the path and points for axes singularities. (3) Check the software / hardware limits are not exceeded
6002	Warning: Inverse Kinematic could not find a solution	(1) Check the robot for points that are out of reach. (2) Check the path and points for axes singularities. (3) Check the software / hardware limits are not exceeded
6003	Warning: desired trajectory leads to a Singularity	Check the path and points for axes singularities.
6004	Error: Could not generate spline	(1) Check the robot for points that are out of reach. (2) Check the path and points for axes singularities. (3) Check the software / hardware limits are not exceeded (4) Restart robot control with **PC->Reset Control** from GUI

Error Code	State Description	Solution
6005	Error: Two points in the blending motion are the same	Separate or delete the points that are too close to each other.
6006	Error: Two points in the blending motion are too close to each other (for given blend radius)	Restart robot control with **PC->Reset Control** from GUI
6007	Error: Angle between two path segments is 180°	Restart robot control with **PC->Reset Control** from GUI
6008	Error: Could not Transfer Spline	Restart robot control with **PC->Reset Control** from GUI
6009	Error: Generated Spline dimension is invalid	Restart robot control with **PC->Reset Control** from GUI
6010	Warning: Could not generate spline	(1) Check the robot for points that are out of reach. (2) Check the path and points for axes singularities. (3) Check the software / hardware limits are not exceeded (4) Restart robot control with **PC->Reset Control** from GUI
6011	Warning: Could not reset with the current configuration	Check the configuration settings
6012	Warning: Could not pause, the robot is not running	Use the Pause function when the robot is running.
6013	Warning: Could not stop, the robot is not running	Use the Stop function when the robot is running.
6014	Warning: Operation finished in an invalid state	Check the last movement or function at the end of the Program
6015	Warning: Command failed reached timeout	Check the commanding cycle. Too many commands in short time can lead to this error.
6016	Warning: Trajectory Generator in Error	Restart robot control with **PC->Reset Control** from GUI
6017	Error: Generated Spline total time is zero.	Restart robot control with **PC->Reset Control** from GUI
6018	Warning: MoveJointComposite cannot be generated. Two points are similar in the path	Create a program with 3 different target points. Re-teach the points accordingly.
6019	Warning: MoveJointComposite cannot be generated. Waypoints are less than 3	Create a program with a minimum of 3 target points.
6020	Warning: MoveJoint cannot interpolate to starting point.	Use the jogging slider at (**Move->Joint->A1 to A7**) to move the robot near the starting point.
6021	Warning: MoveCircular Could not generated cartesian trajectory	(1) Check the robot for points that are out of reach. (2) Check the path and points for axes singularities. (3) Check the software / hardware limits are not exceeded (4) Restart robot control with **PC->Reset Control** from GUI
6022	Warning: MoveJoint Input of waypoints is not correct	Check the program for correct values of MoveJoint

Error Code	State Description	Solution
6023	Warning: MoveJointComposite joint list generation failed	(1) Check the robot for points that are out of reach. (2) Check the path and points for axes singularities. (3) Check the software / hardware limits are not exceeded (4) Restart robot control with **PC->Reset Control** from GUI
6024	Warning: MoveLinear Spline cannot be generated. Number of trials has been exceeded !!	(1) Check the robot for points that are out of reach. (2) Check the path and points for axes singularities. (3) Check the software / hardware limits are not exceeded (4) Restart robot control with **PC->Reset Control** from GUI
6025	Error: MoveLinear Spline cannot be generated. Transitioning to ERROR	Restart robot control with **PC->Reset Control** from GUI
6026	Warning: MoveCircularComposite Trajectory Duration invalid, aborting	Check the MoveCircular values and used points
6027	Warning: MoveCircularComposite Circular Trajectory Cyclic is NULL	Check the MoveCircular values and used points
6028	Warning: MoveCircularComposite Circular Trajectory Base is NULL	Check the MoveCircular values and used points
6029	Warning: MoveLinear Trajectory Duration invalid, aborting	Check the MoveLinear values and used points
6030	Warning: MoveLinear Input of waypoints is not correct	Check the MoveLinear values and used points
6031	Warning: MoveJoint jump in position and velocities	► Check the parameters of the motion command. ➢ Restart robot control with **PC->Reset Control** from GUI
6032	Warning: Radius is too small	Check the points for MoveCircular, the total diameter of the circle needs to be re-defined.
6033	Warning: Radius is too big	Check the points for MoveCircular, the total diameter of the circle is too big.
6034	Warning: MoveCircular tilt angle is too big	Check the points for MoveCircular, the angle cannot be solved.
6035	Warning: Starting point of trajectory is far from current point	Check the programmed points and bring the starting point closer to the current point.
6036	Warning: Not enough target points	Add the minimum of points.
6037	Warning: MoveRecordedPath - Cannot read from file	File not saved properly. Re-teach the recorded path and save it again. If it does not work: ➢ Restart robot control with **PC->Reset Control** from GUI
6038	Warning: Error during allocating/deallocating memory	➢ Restart robot control with **PC->Reset Control** from GUI

Error Code	State Description	Solution
		➢ If needed, Power Cycle the robot
6039	Warning: MoveLinear cartesian limit violated	Change the points closer inside the cartesian space
6040	Warning: MoveCircular Too Many Points in Target	Change the points for circular motion to the correct amount.
6041	Warning: Wrong Angle Input for MoveCircular. use angle = 0.0	Use angle = 0.0
6042	Warning: Collision with Bounding Box detected.	Informational warning that Bounding Box limits were violated.
6043	Warning: MoveCircular circle plane is undefined.	Verify the taught points. If necessary, reteach some or all circular points.
6044	Warning: Runtime error occured while planning a motion.	Verify the taught points. If necessary, reteach some or all circular points.
6045	Warning: MoveComposite Motion Command does not start where last Motion Command ended.	Please start MoveComposite from where the last motion command ended.
Controller cabinet status error messages		
7001	Error: Unable to open file	(1) Check if the file exists. (2) Check if the file has the correct file type (3) Restart robot control with **PC->Reset** Control from GUI.
7002	Error: Unable to read from file	(1) Check the contents of the file as described in the operation guide. (2) Restart robot control with **PC->Reset Control** from GUI.
7003	Error: Unable to write to file	(1) Check if the file exists (2) Restart robot control with **PC->Reset Control** from GUI
7004	Error: Undefined Input	(1) Check the number of joints in the file matches with actual joints of the robot. (2) Restart robot control with **PC->Reset Control** from GUI.
7006	Error: Motor is Stuck	(1) Power off the robot with **PC->Power Off** from GUI. (2) Power off the Control Cabinet by switching off the power switch. (3) Wait until all the cooling fans in the Control Cabinet are at a complete standstill. (4) Power on the Control Cabinet again. Release all the emergencies and press the white E-stop reset button.
7007	Warning: ENI configuration file not found!	(1) Power off the robot with **PC->Power Off** from GUI. (2) Power off the Control Cabinet by switching off the power switch. (3) Wait until all the cooling fans in the Control Cabinet are at a complete standstill. (4) Power on the Control Cabinet again. Release all the emergencies and press the white E-stop reset button.

Error Code	State Description	Solution
		If this error comes up repeatedly, please contact your robot supplier.
7008	Warning: Wrong ENI file with different number of slaves	(1) Power off the robot with **PC->Power Off** from GUI. (2) Power off the Control Cabinet by switching off the power switch. (3) Wait until all the cooling fans in the Control Cabinet are at a complete standstill. (4) Power on the Control Cabinet again. Release all the emergencies and press the white E-stop reset button. If this error comes up repeatedly, please contact your robot supplier.
Robot axis status error messages		
8001	Error: Robot configuration is in an Invalid State	Restart robot control with **PC->Reset Control** from GUI
8002	Error: Invalid Transition	Restart robot control with **PC->Reset Control** from GUI
8003	Error: Speed Tracking	Restart robot control with **PC->Reset Control** from GUI
8004	Error: Position Tracking	Restart robot control with **PC->Reset Control** from GUI
8005	Error: Communication with EtherCAT failed!	Restart robot control with **PC->Reset Control** from GUI
Robot configuration status error messages		
9001	Warning: Close to a singularity	Change the robot position to avoid the singularity
9002	Warning: Torque too high could cause damage	Check the payload, equipment or external forces not exceeding the limits of the robot.
9003	Warning: Robot is not available during Emergency	Reset the E-Stop before enabling the robot.
9004	Error: External Torques detected, check the Tool Configuration	(1) Check the tool settings at **settings->Tools**. Make sure that the **Tool Description, Inertia and Settings** are correct. Save the configuration. (2) Restart robot control with **PC->Reset Control**
9005	Warning: Maximum Static torque is exceeded. Reduce the mass	Check if the mass is set up in the tool parameter correctly. Check if the mass does not exceed the maximum of the robot capabilities (Check the manual for the allowed payload on your robot) Run DPI again or reduce the mounted payload.
9006	Warning: Approaching a singularity limit. The motion in the direction will be slowed down.	No action required. The user is informed that the motion is slowed down.
9007	Warning: At a singularity limit. The motion in desired direction is not possible.	The desired motion is not feasible due to singularities.
9009	Warning: In zeroG safe speed limit exceeded. Please restart zeroG again.	The maximum speed in ZeroG is exceeded. This can be due to too fast movement by the operator. Then, simply restart ZeroG.

Error Code	State Description	Solution
		If this error occurs without operator input, check the correct tool parameter setting, the correct gravity vector setting, the tuning parameters of ZeroG mode. Eventually, run the DPI wizard.
9010	Warning: In zeroG joint limit exceeded. Please check the limit in gui.	The robot was forcefully moved over its axis limit. Try leaving the limit via joint jogging. Else, if it is not possible to power on the robot, moving the axis out of its limit can be achieved via the brake release feature.
9011	Warning: Collision Detected. Check the workspace and reset collision error.	Check the workspace and reset collision error to continue the robot motion. If a false positive collision occurs, tuning the collision sensitivity is possible via the robot settings.
9012	Warning: Reduced mode activated.	Information that reduced mode is activated. The robot will only move at a slow speed.
9013	Warning: Protective stop activated.	Information that protective mode is activated.
9014	Warning: Enabling external freedrive mode.	Information that zeroG mode is activated via the external mode.
9015	Warning: In ZeroG jump in locked axis position. Please restart zeroG again.	The robot was forcefully moved out of its locked axis configuration. Deactivate axis lock and check the normal ZeroG mode behaviour. Check the tool parameter setting, the gravity vector settings and the ZeroG settings. Reduce the load mounted on the robot.
9016	Warning: In ZeroG jump in locked axis velocity. Please restart ZeroG again.	The robot was forcefully moved out of its locked axis configuration. Deactivate axis lock and check the normal ZeroG mode behaviour. Check the tool parameter setting, the gravity vector settings and the ZeroG settings. Reduce the load mounted on the robot.
9031	Warning: HMI button pressed in non-Teach mode.	Please enable Teach mode and try again.
9032	Warning: In ZeroG axis lock is enabled.	Please disable axis lock and try again.
9033	Warning: Cannot initialize the robot, please press the white reset button and try again, switching to simulation mode.	Please try to reset control.
9034	Warning: Collision detected due to large dynamical model error. Please check tool settings, gravity vector settings or do DPI again.	Please check tool settings, gravity vector settings or do DPI again.
9035	Error: After collision in reflex mode large TCP movement detected. Please check tool settings, gravity vector settings or do DPI again.	Please check tool settings, gravity vector settings or do DPI again.
9036	Warning: The gravity vector is changed. Please move away from the robot, turn off reflex mode and then turn on ZeroG mode at 5 random positions to ensure its correctness.	Please move away from the robot, turn off reflex mode and then turn on ZeroG mode at 5 random positions to ensure its correctness.

Error Code	State Description	Solution
9037	Warning: Optimization of Cartesian motion failed. Could not find solution for given parameters.	Please change the setting parameters, i.e. velocity, acceleration, blending radius (for static blending) for the failed motion segment or adjust the desired pose of targets.
9038	Warning: Cartesian motion was not able to find segment type.	Please change the setting parameters, i.e. velocity, acceleration, blending radius (for static blending) for the failed motion segment or adjust the desired pose of targets.
9039	Warning: Rotational Velocity was not correctly initialized, less than 0.0.	Please change parameter setting to be > 0.
9040	Warning: ZeroG was turned off automatically due to inactivity for 10 minutes.	Please turn ZeroG back on again if desired.
Robot EtherCAT-Stack status error messages		
10001	Error FATAL error in EtherCAT stack	➢ Restart robot control with **PC->Reset Control** ➢ If needed, Power Cycle the robot ➢ If the error persists, contact your robot supplier
10002	Error non-fatal error in EtherCAT stack	➢ Restart robot control with **PC->Reset Control** ➢ If needed, Power Cycle the robot ➢ If the error persists, contact your robot supplier

Table 20: CL1 function return error codes

9.2.2 CL1 controller error processing

Description	Error Display	Solution
Normal	Normal	
Short circuit error	Error: Short circuit error!	
Overvoltage error	Error: Over voltage limit error!	
Undervoltage error	Error: Under voltage limit error!	
Overspeed error	Error: Over velocity limit error!	
Execution error	Error: Execute error!	
RMS overcurrent error	Error: Over current error!	
Encoder error	Error: Encoder error!	Click **Reset** to perform resetting and clearing. Click the **Servo On** button to enable the robot
Position following error	Error: Following position error!	
Speed following error	Error: Following velocity error!	
Negative limit error	Error: Negative limit error!	
Positive limit error	Error: Positive limit error!	
Servo overtemperature error	Error: Server over heating error!	
Peak current error	Error: Max current error!	
Hardware braking error	Error: Emergency stop error!	
UDM error	Error: UDM error!	
Servo parameter error	Error: Server parameter error!	
Enablement timeout	Error: Robot enable time out!	Check whether the robot body drive UDM operates normally. Click the **Servo On** button to re-enable the robot.
SDK collision detection	Error: Robot Collide with body!	(1) Manually open the brake using the demonstrator. (2) Manually drag the robot so that it leaves the self-collision posture. (3) Close the brake and perform clearing and enablement.
Joint limit	Error: Over joint limit error!	(1) In enabled state, let the axis move back to safe space in the reverse direction of the axis that exceeds safe space due to long jog movement. Click **Reset** to perform resetting and clearing. (2) In disabled state, Click Reset to perform clearing. Click **Servo On**. Let the axis move back to safe space in the reverse direction of the axis that exceeds safe space due to long jog movement.
Singularity	Error: Singularity error	Click **Reset** to perform clearing. Click **Servo On** to enable the robot.

Description	Error Display	Solution
Abnormal stop	Error: General stopping criterion	Click **Reset** to perform clearing.
SDK calculation error	Error: calculate failed	Click **Reset** to perform clearing.
UDM state error	Error: UDM Status Error!	Shut down the master; Start the master.
Slave error	Error: Init slave Error!	Click **Reset** to perform clearing.
HomeStep2 error	Error: Home Step2Error!	Click **Reset** to perform clearing.

Table 21: CL1 controller error processing

9.2.3 Further CL1 error messages

Error Code HEX	Error Display	Solution
0x3130	AC fail: loss of phase	Check the Control Cabinet connection for AC. Replace the cable if necessary.
0x7381	Hall sensor speed is too high or disconnected	Check the connection.
0x8480	Speed tracking error	During robot motion there was a difference between speed set point and feedback detected.
0x8611	Position tracking error	During robot motion there was a difference between position set point and feedback detected.
0x5280	Gantry Yaw error limit exceeded	Check the Yaw-Value of gantry system
0x8130	Communication failed, loss of synchronization or frame loss was detected	Communication between EtherCat slaves interrupted or bad quality. Try to find the last available slaves and check the to the lost slave.
0x3120	Under voltage	Check supply voltage for 24V and 48V PSU. Inform KAWASAKI ROBOTICS / Distributor for solution
0x3310	Over voltage	Check supply voltage for 24V and 48V PSU. Also check possible short cuts on cabling inside the robot or control cabinet. Inform KAWASAKI ROBOTICS / Distributor for solution
0xFF20	Safe Torque Off	Torque limit exceeded; Collision might be causing the problem
0x2340	Short circuit	Electrical investigation necessary
0x4210	Motor over temperature	Reduce Speed, Payload, or duty cycle. Motor might need to be exchanged. Inform KAWASAKI ROBOTICS / Distributor for solution
0x8481	Over speed protection	Reduce commanded speed for robot.

Error Code HEX	Error Display	Solution
0x6180	SLT fault reaction	-
0x7121	Motor stuck	Motor or phase cables might be damaged. Replacement of Axis needed. Inform KAWASAKI ROBOTICS / Distributor for solution
0x8680	Position Limit Exceeded	Inform KAWASAKI ROBOTICS / Distributor for solution
0xFF40	Gantry slave disabled	Inform KAWASAKI ROBOTICS / Distributor for solution
0x5442	Motor disabled. Additional abort input is active	Inform KAWASAKI ROBOTICS / Distributor for solution
0x4310	Drive over-temperature	Servo Drive might be damaged. Replacement needed. Inform KAWASAKI ROBOTICS / Distributor for solution
0xFF50	Attached slave drive fault	Inform KAWASAKI ROBOTICS / Distributor for solution
0xFF10	Failed to enable the motor	Servo Drive might be damaged. Replacement needed. Inform KAWASAKI ROBOTICS / Distributor for solution
0xFF30	Motor disabled local	Servo Drive might be damaged. Replacement needed. Inform KAWASAKI ROBOTICS / Distributor for solution
0x5441	Motor disabled by INHIBIT or ABORT	Servo Drive might be damaged. Replacement needed. Inform KAWASAKI ROBOTICS / Distributor for solution
0x6300	RPDO failed	Inform KAWASAKI ROBOTICS / Distributor for solution
0x7300	Feedback error	Inform KAWASAKI ROBOTICS / Distributor for solution
0x7382	Commutation process fail during motor on	Servo Drive might be damaged. Replacement needed. Inform KAWASAKI ROBOTICS / Distributor for solution
0x8110	CAN Message lost (corrupted or overrun)	Servo Drive might be damaged. Replacement needed. Inform KAWASAKI ROBOTICS / Distributor for solution
0x8140	Recovered from bus off	Servo Drive might be damaged. Replacement needed. Inform KAWASAKI ROBOTICS / Distributor for solution

Error Code HEX	Error Display	Solution
0x8210	Attempt to access a non-configured RPDO	Inform KAWASAKI ROBOTICS / Distributor for solution
0xFF01	Request by user program EMCY(N) function	Inform KAWASAKI ROBOTICS / Distributor for solution

Table 22: Further CL1 error messages

9.2.4 Cl1 controller error processing

Description	Error Display	Solution
Normal	Normal	
Short circuit error	Error: Short circuit error!	
Overvoltage error	Error: Over voltage limit error!	
Undervoltage error	Error: Under voltage limit error!	
Overspeed error	Error: Over velocity limit error!	
Execution error	Error: Execute error!	
RMS overcurrent error	Error: Over current error!	
Encoder error	Error: Encoder error!	Click **Reset** to perform resetting and clearing. Click the **Servo On** button to enable the robot
Position following error	Error: Following position error!	
Speed following error	Error: Following velocity error!	
Negative limit error	Error: Negative limit error!	
Positive limit error	Error: Positive limit error!	
Servo overtemperature error	Error: Server over heating error!	
Peak current error	Error: Max current error!	
Hardware braking error	Error: Emergency stop error!	
UDM error	Error: UDM error!	
Servo parameter error	Error: Server parameter error!	
Enablement timeout	Error: Robot enable time out!	Check whether the robot body drive UDM operates normally. Click the **Servo On** button to re-enable the robot.
SDK collision detection	Error: Robot Collide with body!	(1) Manually open the brake using the demonstrator. (2) Manually drag the robot so that it leaves the self-collision posture. (3) Close the brake and perform clearing and enablement.
Joint limit	Error: Over joint limit error!	(1) In enabled state, let the axis move back to safe space in the reverse direction of the axis that exceeds safe space due to long jog movement. Click

Description	Error Display	Solution
		Reset to perform resetting and clearing. (2) In disabled state, Click Reset to perform clearing. Click **Servo On**. Let the axis move back to safe space in the reverse direction of the axis that exceeds safe space due to long jog movement.
Singularity	Error: Singularity error	Click **Reset** to perform clearing. Click **Servo On** to enable the robot.
Abnormal stop	Error: General stopping criterion	Click **Reset** to perform clearing.
SDK calculation error	Error: calculate failed	Click **Reset** to perform clearing.
UDM state error	Error: UDM Status Error!	Shut down the master; Start the master.
Slave error	Error: Init slave Error!	Click **Reset** to perform clearing.
HomeStep2 error	Error: Home Step2Error!	Click **Reset** to perform clearing.

Table 23: CL1 controller error processing

9.2.5 Further CL1 error messages

Error Code HEX	Error Display	Solution
0x3130	AC fail: loss of phase	Check the control cabinet connection for AC. Replace the cable if necessary.
0x7381	Hall sensor speed is too high or disconnected	Check the connection.
0x8480	Speed tracking error	During robot motion there was a difference between speed set point and feedback detected.
0x8611	Position tracking error	During robot motion there was a difference between position set point and feedback detected.
0x5280	Gantry Yaw error limit exceeded	Check the Yaw-Value of gantry system
0x8130	Communication failed, loss of synchronization or frame loss was detected	Communication between EtherCat slaves interrupted or bad quality. Try to find the last available slaves and check the to the lost slave.
0x3120	Under voltage	Check supply voltage for 24V and 48V PSU. Inform KAWASAKI ROBOTICS / Distributor for solution
0x3310	Over voltage	Check supply voltage for 24V and 48V PSU. Also check possible short cuts on cabling inside the robot or control cabinet. Inform KAWASAKI ROBOTICS / Distributor for solution

Error Code HEX	Error Display	Solution
0xFF20	Safe Torque Off	Torque limit exceeded; Collision might be causing the problem
0x2340	Short circuit	Electrical investigation necessary
0x4210	Motor over temperature	Reduce Speed, Payload, or duty cycle. Motor might need to be exchanged. Inform KAWASAKI ROBOTICS / Distributor for solution
0x8481	Over speed protection	Reduce commanded speed for robot.
0x6180	SLT fault reaction	-
0x7121	Motor stuck	Motor or phase cables might be damaged. Replacement of Axis needed. Inform KAWASAKI ROBOTICS / Distributor for solution
0x8680	Position Limit Exceeded	Inform KAWASAKI ROBOTICS / Distributor for solution
0xFF40	Gantry slave disabled	Inform KAWASAKI ROBOTICS / Distributor for solution
0x5442	Motor disabled. Additional abort input is active	Inform KAWASAKI ROBOTICS / Distributor for solution
0x4310	Drive over-temperature	Servo Drive might be damaged. Replacement needed. Inform KAWASAKI ROBOTICS / Distributor for solution
0xFF50	Attached slave drive fault	Inform KAWASAKI ROBOTICS / Distributor for solution
0xFF10	Failed to enable the motor	Servo Drive might be damaged. Replacement needed. Inform KAWASAKI ROBOTICS / Distributor for solution
0xFF30	Motor disabled local	Servo Drive might be damaged. Replacement needed. Inform KAWASAKI ROBOTICS / Distributor for solution
0x5441	Motor disabled by INHIBIT or ABORT	Servo Drive might be damaged. Replacement needed. Inform KAWASAKI ROBOTICS / Distributor for solution
0x6300	RPDO failed	Inform KAWASAKI ROBOTICS / Distributor for solution
0x7300	Feedback error	Inform KAWASAKI ROBOTICS / Distributor for solution
0x7382	Commutation process fail during motor on	Servo Drive might be damaged. Replacement needed. Inform KAWASAKI ROBOTICS / Distributor for solution

Error Code HEX	Error Display	Solution
0x8110	CAN Message lost (corrupted or overrun)	Servo Drive might be damaged. Replacement needed. Inform KAWASAKI ROBOTICS / Distributor for solution
0x8140	Recovered from bus off	Servo Drive might be damaged. Replacement needed. Inform KAWASAKI ROBOTICS / Distributor for solution
0x8210	Attempt to access a non-configured RPDO	Inform KAWASAKI ROBOTICS / Distributor for solution
0xFF01	Request by user program EMCY(N) function	Inform KAWASAKI ROBOTICS / Distributor for solution

Table 24: Further CL1 error messages

10 MAINTENANCE, SERVICE AND REPAIR

10.1 Maintenance and Repair

- Only authorized system integrators, or Kawasaki Robotics, shall perform maintenance and service/repairs.
- All parts returned to Kawasaki Robotics shall be returned according to the service manual.
- You must perform maintenance and repair work in compliance with all safety instructions in this manual (see *General Safety Instructions* on page *4*)

10.2 Safety Instructions

- After maintenance and repair work, checks must be done to ensure the required safety level.
- Checks must adhere to valid national or regional work safety regulations. The correct functioning of all safety functions shall also be tested.
- The purpose of maintenance and repair work is to ensure that the system is kept operational 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.

When working on the robot arm or control cabinet, you must observe the following procedures and warnings:

1. Do not change anything in the safety configuration of the software (e.g., the force limit). The safety configuration is described in the Software User Manual. If any safety parameter is changed, the complete robot system shall be considered new, meaning that the overall safety approval process, including risk assessment, shall be updated accordingly.
2. Replace faulty components using new components with the same article numbers or equivalent components approved by Kawasaki Robotics for this purpose.
3. Reactivate any deactivated safety measures immediately after the work is completed.
4. Document all repairs and save this documentation in the technical file associated with the complete robot system.

10.3 Maintenance Intervals

10.3.1 Routine Inspection

Make sure that the following activities are checked daily to ensure the robot system function and safety.

Item	Operating state	Inspection point	Solution
Cables	OFF	▶ Check the cables for any cracks or damages or loose	▶ If the cables are damaged or cracked, replace them immediately
White covers and robot arm covers	OFF	▶ Check the cables for any cracks or damages or loose	▶ Replace them timely
Bolt, screw	OFF	▶ Check the bolts on the installation platform are loose	▶ If the blots and screws are loose, torque tighten them

		▶ Check the screws of the covers are loose	
Emergency stop switch and LED indicators and buttons	ON	▶ Check the whether the LED indicators are displayed normally, and emergency stop switch is working regularly	▶ If that happens, replace the corresponding components timely

Table 25: Routine inspection descriptions

10.3.2 Periodic Inspection

To ensure the function and safety of the robot system, perform the following checks periodically.

Item	Period	Remark
Warning, Safety labels	1 week	▶ Ensure labels are present and legible ▶ Replace them if necessary
Check the control cabinet filters	1 month	▶ Replace at least every 3 months
Check emergency switch	1 week	▶ Press the emergency switch and the IO E-Stop in open-loop status. ▶ Verify that each shuts off power
Check robot mounting screws	3 months	▶ Follow the robot installation process

Table 26: Periodic inspection time

11 DISASSEMBLY AND MODIFICATION

Only authorized system integrators or Kawasaki Robotics are allowed to perform disassembly and modifications of the CL1 robot system. An official Training from Kawasaki Robotics is necessary.

The same safety requirements apply as for maintenance and repair work.

12 ENVIRONMENT AND DISPOSAL

CL1 robot is a high-quality device that can be expected to function for a long time. Nevertheless, this device will eventually reach the end of its service lifetime. At that time, be aware that electrical devices must be properly disposed.

Dispose of the device, device parts and consumables in accordance with the applicable guidelines and laws of the country in which the device is installed and operated.

Kawasaki Robots are produced with restricted use of hazardous substances to protect the environment as defined by the European RoHS directive 2011/65/EU. These substances include cameras, mercury, cadmium, lead, chromium VI, polybrominated biphenyls and polybrominated diphenyl ethers.

The below symbol on the robot indicates that the appliance must not be disposed of with unsorted common municipal waste. As the end-user, it is your responsibility to dispose of the end-of-life appliance in an environmentally sensitive manner by returning to Kawasaki Robotics GmbH or depositing it in a designated collection point.

Importers in countries covered by the European WEEE Directive 2012/19/EU must make their own registration to the national WEEE register of their country.

The following symbols are affixed on the robot to indicate conformity with the above legislations:

Disposing of Batteries

During normal use, no environmental damage is caused by the batteries. Both rechargeable and non-rechargeable batteries are, however, special waste and must be disposed of separately after use as they contain hazardous chemicals. Both types of batteries must only be disposed of through an approved takeback system. Under no circumstances may batteries be disposed of with household waste.

13 APPENDIX

13.1 Technical Specifications

Type	Specification			
	CL103	CL105	CL108	CL110
Weight	18 kg	26 kg	48 kg	45 kg
Payload	3 kg	5 kg	8 kg	10 kg
Reach	590 mm	800 mm	1300 mm	1000 mm
Joint range	Reference in Data Sheet			
Joint speed	Reference in Data Sheet			
Repeatability	± 0.02 mm	± 0.02 mm	± 0.02 mm	± 0.02 mm
Footprint base	Ø 156 mm	Ø 156 mm	Ø 200 mm	Ø 200 mm
Degrees of freedom	6			
Tool flange connection	Digital inputs: 3 Digital outputs: 3 Analog inputs: 2 Modbus RTU (RS485)			
I/O port	M12 12-pin-A-M / IEC 61076-2-101			
I/O power supply	24 V, max. 1000mA			
Programming	On-screen manipulation, Tree Editor; remote access (API)			
Robot IP class	IP66			
Robot Power	48 V /21 A			
Main material	Aluminum casting			
Operating temperature	0 - 50 °C			
External power input	100-240 VAC, 50-60 Hz			
Cables	5 m			
Resolution	Touch Screen Tablet 2560 x 1600 px			

Table 27: Technical Specifications of the CL1 models

13.2 List of Figures

13.3 List of Tables

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