PULSE
COLLABORATIVE ROBOT

HARDWARE INSTALLATION MANUAL

ROZUM
ROBOTICS

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INTRODUCTION

This manual describes the basic features and components of the PULSE robot and details its specifications. The instructions and recommendations in the document are intended to assist the integrator in installing and commissioning a system comprising a robot arm, an end effector, and a control box.

WARNING SIGNS AND THEIR MEANINGS

Below, we list the warning symbols used throughout the manual and explain their meanings.

The sign denotes important information that is not directly related to safety, but that the user should be aware of.

The sign indicates important safety precautions the user should follow.

1. PRODUCT OVERVIEW

1.1. Basic features and components

The PULSE collaborative robot is a lightweight arm designed for industrial use. Its possible applications include handling, pick-and-place, and various processing operations (e.g., welding, deburring, etc.).

The arm comes in combination with a control box that features an integrated PC running the PULSE DESK software. Using the software, you can program the arm to move along a desired trajectory and perform different kinds of operations with an end effector.

An end effector is a device or a tool connected to the end of the robot arm.

Possible end effectors range from grippers for pick-and-place operations, material removal tools for cutting, drilling, and deburring to welding torches.

Without an end effector mounted, the robot arm consists of the following parts (see Figure 1-1):

- a mounting base
- six interlinked segments
- a mounting flange for attaching an end effector

1	Mounting base
2	Axis 1
3	Axis 2
5	Axis 4
6	Axis 5
7	Axis 6
8	Mounting flange

Figure 1-1: Components of the PULSE collaborative robot

Each of the segments includes the following elements (see Figure 1-2):

- an aluminum alloy tube **(1)**
- a rotating joint comprising a proprietary servo motor **(2)** and fitting elements **(3)**

The modular design allows for assembling the segments into any custom configurations to increase the payload or degrees of freedom and to extend the reach (as compared to the basic specifications in Section 1.3).

Figure 1-2: The elements in a segment of the PULSE robot

The PULSE robots are designed for collaborative operation—without safety devices and/or together with a human. Collaborative operation, however, is only possible in non-hazardous applications, where all the components, including tools, work pieces, obstacles, and other machines, pose no threat according to the application's risk assessment.

You should also take into consideration the following use restrictions:

Failure to observe the restrictions shall constitute a misuse, making our warranty void.

- It is prohibited to install and operate the PULSE robot in an explosive environment.
- Always conduct a risk assessment before installing and operating the PULSE robot.
- Avoid using the PULSE robot outside the operating parameters (see Section 1.3).

1.2. Supply package

When you order a PULSE robot, you receive a package containing the following:

- an assembled robot arm
- a control box
- an emergency shutdown (ESD) button with a connection cable
- a 220V mains cable
- a hybrid cable to connect the robot arm and the control box
- an Ethernet cable
- mounting bolts
- user documentation

1.3. Robot arm specifications

The robot arm has the specifications as listed in Table 1-1 below.

Table 1-1: Technical specifications of PULSE robots

Specification	Value
Weight[1)]	8 kg
Payload[1)]	3 kg
Degrees of freedom[1)]	6 axes
Reach[1)]	700 mm
Repeatability	+/-0.1 mm
Non-stop lifetime cycle	20,000+ hours
Protection class	IP30
Noise level	less than 60 dB
Rated voltage	48 VDC
Average power	100 W
Maximum power	500 W
Nominal speed	30 RPM
Max tool center point (TCP) velocity	2 m/s
Max TCP acceleration	11 mm/s*s
Acceleration time 0-1 m/s	0.1 s

[1)] The specification values can vary, depending on the customer precise requirements. There is a possibility to extend the reach, increase the weight and the payload, and to add a seventh degree of freedom.

When operating the robot, make sure to comply with the following parameters:

- Ambient temperature: -10°C to +45°C

Figure 1-3 illustrates the working range of the robot with the specifications as indicated in Table 1-1 when extended to its full length. It is essential to consider the range when installing the robot to avoid any damage to people or equipment.

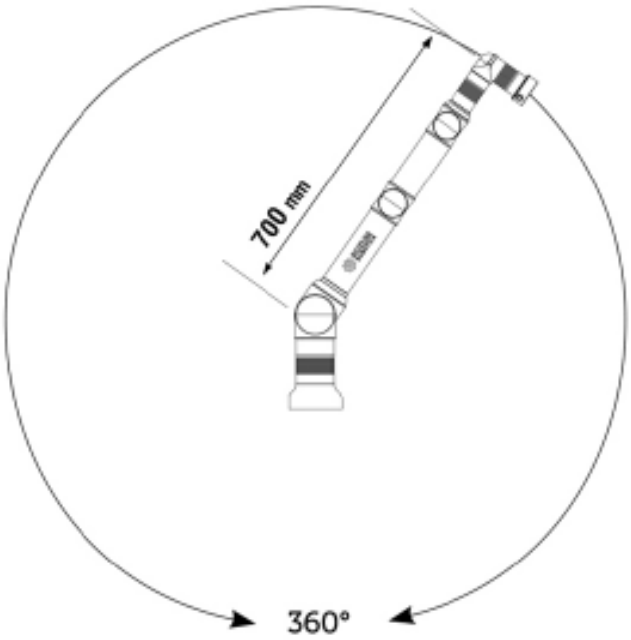

Figure 1-3: The working range of the PULSE robot

As mentioned in Section 1.1, the robot comprises six axes when supplied in its basic design. The axes have the lengths as shown in Figure 1-4.

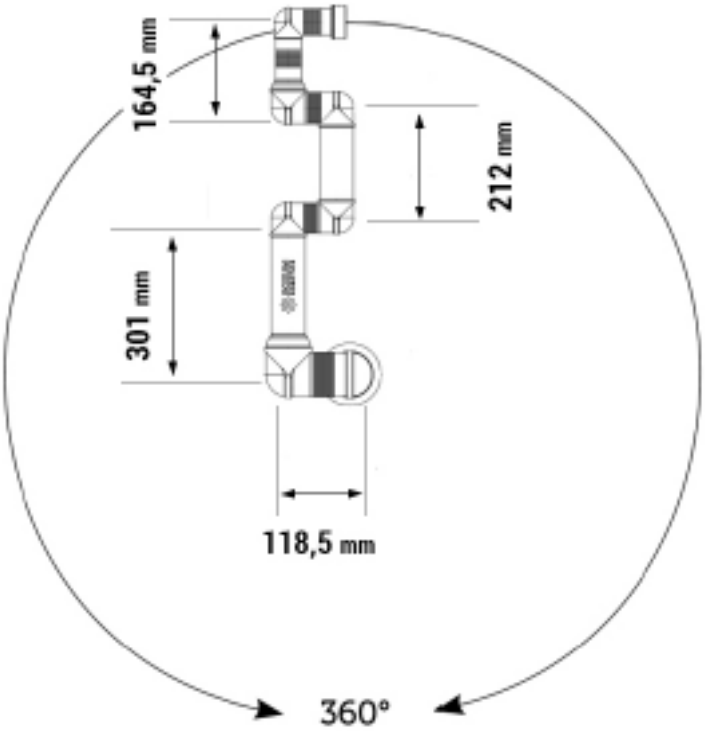

Figure 1-4: The lengths of the robot axes

The axes also have different motion ranges (see Table 1-2).

For location of the axes, see Figure 1-1.

Table 1-2: The motion ranges and maximum speeds of the robot axes

Axis	Motion range	Maximum speed
Axis 1 (base)	-360° to 360°	240°/s
Axis 2	-360° to 360°	240°/s
Axis 3	-160° to 160°	270°/s
Axis 4	-170° to 170°	270°/s
Axis 5	-360° to 360°	330°/s
Axis 6	-360° to 360°	330°/s

1.4. Control box

Supplied together with the PULSE robot, the control box controls and monitors the robot's operation, providing an interface for communication between the hardware and software components of the system. In addition, it features integrated safety functions that allow for secure human-robot collaboration.

Although the PULSE robot is designed for collaborative operation, the integrator should conduct a risk assessment to evaluate the need for additional safety devices (e.g., fencing, caging, etc.) at a specific robot installation.

The control box is a case of the dimensions as indicated in Table 1-3. It comprises a personal computer (PC) with pre-installed control software (PULSE DESK), as well as other modules required to provide communication, safety, and other essential functions.

The robot arm and the control box communicate with each other by means of a CAN connection. The control box transmits CANOpen messages with commands, while receiving and processing execution reports and telemetry from the robot arm components (e.g., servo drives, sensors, etc.).

The control box supplied with the PULSE robot of basic design (see Section 1.1) has the specifications as detailed in Table 1-3 below.

Table 1-3: The specifications of the control box for PULSE robots

Specification	Value
Weight	9 kg
Dimensions (D x W x H)	260 x 483 x 88 mm
Noise level	Less than 60 dB
Protection rating	IP20
API implementation options	C+/C++/C#/Python/ROS

1.5. ESD button

For the PULSE robot, the ESD button (see Figure 1-5) is supplied as a standalone device assembled with a connection cable. Use the button to immediately stop all robot motion in an emergency, when other protective measures have proved to be impracticable or inefficient. The button is designed as a Category 1 Stop function in accordance with ISO 10218-1, which implies a controlled stop with power supplied to the motors until full stop is achieved.

Figure 1-5: The ESD button for the PULSE robot

The actual appearance of the ESD button can differ from that shown in Figure 1-5.

Each robot installation should have its own ESD button. You can place the button at any location within the reach of the person operating a specific PULSE robot.

2. INSTALLATION

2.1. General requirements

The PULSE robot is partly completed machinery, which means its safe operation largely depends on its operating environment. Therefore, it is a common practice to conduct a risk assessment for each robot installation. The risk assessment is the responsibility of the integrator.

If the robot is operated in a non-collaborative installation (e.g., when using a hazardous tool), the risk assessment might conclude that the integrator needs additional safety devices to protect the operator while they work with the robot.

Before starting the installation, unpack the robot arm and the other components (as listed in Section 1.2) and get them ready for the mounting works.

When unpacking and installing the arm, make sure not to move or rotate the robot joints manually because it can cause irreparable damage.

Installation of the PULSE robot involves the following two steps:

1. Mechanical integration
2. Electrical integration

2.2. Mechanical integration

Pinching hazard! When performing the mounting works, try to keep your fingers away from the joints to avoid entrapment. Do not wear loose clothing or jewelry. Make sure long hair is tied back.

2.2.1. Mounting the robot arm

With only a 120-mm footprint (see Figure 2-1), the robot arm offers good space-saving opportunities. However, when choosing a mounting location, you need to account for the robot's full working range (see Figure 1-3) to exclude collisions with other equipment or objects.

To install the robot arm, follow the instructions below:

1. Unpack the robot arm and position it vertically relative to the mounting surface. The mounting surface should be flat, solid, and stable.

2. Holding the arm tight, fix it on the base with the twelve M4 mounting bolts from the supply package as shown in Figure 2-1.

   To improve the installation accuracy, you can also use two 5-mm dia pins.

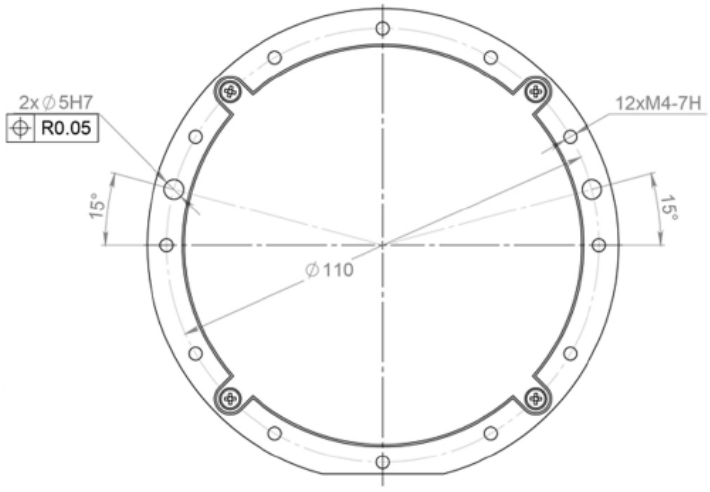

Figure 2-1: The footprint of the PULSE robot arm

Possible locations for mounting the PULSE robot arm include a horizontal surface (e.g., a table, flooring, and ceiling), a wall, or a moving platform.

Alternatively, the mounting kit of the robot arm can include a mounting plate. With the mounting plate, the installation procedure will include the following steps:

1. Position the robot arm vertically and, holding it tight, fix its base to the mounting plate. Use the twelve M4 mounting bolts from the supply package as shown in Figure 2-1.

For better installation accuracy, you can also use two 5-mm dia pins.

2. Fix the mounting plate assembled with the robot arm to a solid flat mounting surface.

2.2.2. Mounting an end effector

The supply package for the robot arm includes a special flange for mounting an end effector (Figure 2-2).

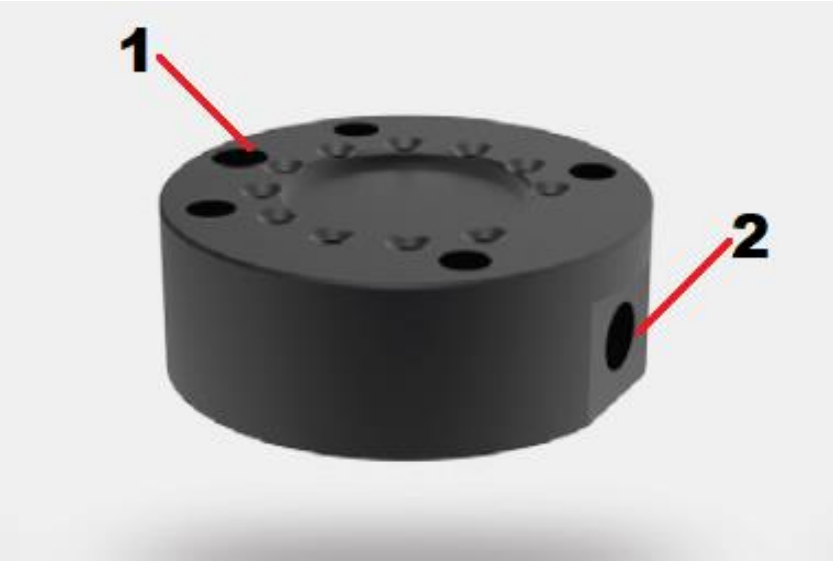

Figure 2-2: The mounting flange to attach an end effector

The mounting flange features **a standard ISO 9409-1-50-4-M6 mechanical interface (1)** and **a cable output (2)** for connecting the end effector electrically.

In case an installation requires a mechanical interface different from the standard ISO 9409-1-50-4-M6 one, we can modify the design of the mounting flange in accordance with your requirements.

2.2.3. Mounting the control box

There are three mounting options available for the control box:

- horizontal positioning on a flat solid surface (e.g., a table)
- vertical positioning using a specially designed stand
- rack mounting (DIN 19")

The choice of the mounting method will depend on the operating environment of the PULSE robot and your requirements.

When mounting the control box, provide an air clearance of 50 mm from its front and back panels.

2.3 Electrical integration

Before proceeding to any electrical integration works, make sure no power is supplied to the robot arm or the control box.

2.3.1. Continuous power supply requirement

For safety reasons, the integrator shall be obliged to provide continuous power supply to the robot arm (e.g., installing an uninterruptible power supply, a redundancy circuit, etc.). Otherwise, we cannot guarantee that the robot arm will maintain its position in case of a power outage, which may result in serious damage to its components.

2.3.2. Robot arm connections

The robot arm features the following connections:

- 4 digital I/O sockets
- 2 analog input sockets
- 1 power supply socket (48 V)

Power is supplied to the arm via the cable connecting it with the control box. It is a hybrid cable with two shielded data pairs and three power cores. For the cable specifications, see Table 2-1.

Never disconnect the cable when the robot arm is on.

Table 2-1: The hybrid cable specifications

Outer diameter (O.D.)	12.50 mm (approx.)
Conductor	bare stranded copper wire
Conductor size	0.22 qmm (control pairs) 2.50 qmm (power cores)
Characteristic impedance	110 Ohm+-10% (control pairs)
Temperature range	-25°C to +70°C (static) -15°C to +70°C (dynamic)
Bending radius	>12 x O. D.

2.3.3. Control box connections

The control box comprises all major connections required to provide power supply of the robot system, as well as communication within it and with external devices. The connections are located on both the front and the back panels of the device.

Back-panel connections

On the back panel, you can find the following connections (see Figure 2-3):

- 8 configurable digital I/O sockets for receiving/ transmitting digital signals **(1)**
- 1 USB 3.0 port (not shown in the figure)
- 1 Ethernet port—for integrating the system into an enterprise network (not shown in the figure)
- a power supply socket for connecting a 220V power cable **(2)**
- a mains fuse **(3)**
- a power switch to turn on/off the mains power supply **(4)**

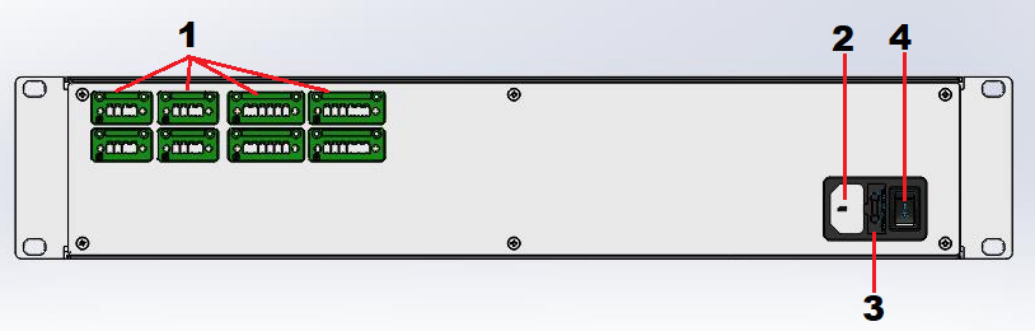

Figure 2-3: The back panel of the control box

Mains connection

The power connection of the control box is in accordance with the IEC 60320-1 C14 standard. The electrical specifications are as indicated in Table 2-2.

Table 2-2: Electrical specifications of a mains connection

Parameter	Min	Max	Unit
Input voltage	100	264	VAC
Mains frequency	47	63	Hz
Standby power	-	10	W
Nominal operating power	-	500	W

Additionally, it is recommended to install an external mains switch with a fuse to power all the equipment in the robot application.

Front-panel connections

The connections on the front panel of the control box include (see Figure 2-4):

- a socket for the cable connecting the control box and the robot **(1)** (for the cable specifications, see Table 2-1)
- a socket for connecting the ESD button **(2)** (for details about the ESD button, see Section 1.5)

Figure 2-4: The front panel of the control box