e.DO Robot

Rel. 00 - Versions
- 6 central axes
- 6 side axes
- 6 central axes, with Gripper
- 6 side axes, with Gripper

Service Manual

- Detailed technical characteristics of the Robot
- Robot configuration customization
- Robot maintenance
- Methods and procedures for contacting the Service Center
- Instructions for decommissioning and disposal of the Robot
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TO WHOM IS THIS HANDBOOK ADDRESSED?

This handbook is addressed to a trained personnel authorized to carry out maintenance, assembly/disassembly of components, and customization of e.DO configuration.
It contains technical information useful and necessary for the correct performance of the aforementioned operations.
This chapter contains:

- Documentation storage
- Limits on the handbook contents
- Symbols used in the handbook
- Modification History.
Documentation storage

All documents supplied with e.DO must be stored in the immediate vicinity of the area in which e.DO is in use and kept available to all persons operating on the machine.

The documentation must be kept intact for the entire operational life of e.DO.

In case of lost or damage of this handbook (also partial), request a new copy to the manufacturer.

Limits on the handbook contents

The images included in the instructions handbook have the purpose to represent the product and can differ from what is actually visible on the system.

Symbols used in the handbook

Below are indicated the symbols that represent: WARNING, CAUTION and NOTES and their meaning.

![Warning Symbol]

This symbol indicates operating procedures, technical information and precautions that if are not observed and/or correctly performed may cause injuries to the personnel.

![Caution Symbol]

This symbol indicates operating procedures, technical information and precautions that if are not observed and/or correctly performed may cause damage to the equipment.

![Note Symbol]

This symbol indicates operating procedures, technical information and precautions that must be underlined.

![WEEE Symbol]

The symbol draws the attention to materials disposal that is regulated by the WEEE Directive.
MODIFICATION HISTORY

The following table shows the history of the Handbook release, with related changes / improvements made.

<table>
<thead>
<tr>
<th>Date</th>
<th>Edition of the Handbook</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019/03</td>
<td>00/2019.03</td>
<td>First release of the handbook</td>
</tr>
<tr>
<td>2019/04</td>
<td>00/2019.04</td>
<td>Improvement of paragraphs related to “Control Switch” on Desk Simulator. Minor content improvements.</td>
</tr>
</tbody>
</table>
1. SAFETY REQUIREMENTS

Carefully read this document before carrying out any operation on the Robot. Comau will not be responsible for any damages or injuries caused by improper/unauthorized installations, uses or operations carried out on the Robot.

Before using or operating on the Robot, view the introductory video on safety aspects, available online.

The video is accessible by scanning the following QR code:

![QR Code]

During the use of the Robot, pay attention because a residual risk of pinching remains on the axes 2, 3 and 5, identified by specific warning labels:

![Warning Label]
2. DETAILED TECHNICAL FEATURES OF THE ROBOT

The following paragraphs contain the main detailed technical features of the Robot:

– Robot workspaces, calibration and transport position
– Robot wrist features
2.1 Robot workspaces, calibration and transport position

The drawings and tables below show the Robot workspace, in two available versions, and the relative calibration position:

- Robot workspaces in configuration of 6 axes - e.DO standard
- Robot workspaces in configuration of 6 axes - e.DO standard with e.DO Gripper
- Robot workspaces in configuration of 6 axes - e.DO Offset
- Robot workspaces in configuration of 6 axes - e.DO Offset with e.DO Gripper
- Calibration and transport position for Robot in configuration of 6 axes (central and side)

The workspaces shown in the figure are obtained with limit switch screws installed in this position allow minimum limitation useful to avoid pinching on axes 2 and 3.
Fig. 2.1 - Robot workspaces in configuration of 6 axes - e.DO standard

* = Calibration position
Dimensions in millimetres
Fig. 2.2 - Robot workspaces in configuration of 6 axes - e.DO standard with e.DO Gripper

Dimensions in millimetres
Fig. 2.3 - Robot workspaces in configuration of 6 axes - e.DO Offset

* = Calibration position
Dimensions in millimetres
Fig. 2.4 - Robot workspaces in configuration of 6 axes - e.DO Offset with e.DO Gripper

* = Calibration position
Dimensions in millimetres
Tab. 2.1 - Calibration and transport position for Robot in configuration of 6 axes (central and side)

<table>
<thead>
<tr>
<th>Joints in calibration position</th>
<th>Axis 1</th>
<th>Axis 2</th>
<th>Axis 3</th>
<th>Axis 4</th>
<th>Axis 5</th>
<th>Axis 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°</td>
<td>0°</td>
<td>0°</td>
<td>0°</td>
<td>0°</td>
<td>0°</td>
<td>0°</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Joints in transport position</th>
<th>Axis 1</th>
<th>Axis 2</th>
<th>Axis 3</th>
<th>Axis 4</th>
<th>Axis 5</th>
<th>Axis 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°</td>
<td>-60°</td>
<td>-20°</td>
<td>0°</td>
<td>-90°</td>
<td>0°</td>
<td></td>
</tr>
</tbody>
</table>
2.2 Robot wrist features

The following drawings and graphs show the main Robot technical features:

- Diagram of holes on Robot flange for tool fixing
- Wrist loads

2.2.1 Diagram of holes on Robot flange for tool fixing

Fig. 2.5 - Diagram of holes on Robot flange for tool fixing

Dimensions in mm
On the Robot flange there is also a special information label, showing data useful for correctly fixing the tool on the flange itself.
In particular, there is shown the maximum length of the screws to be used, depending on the thickness of the flange of the tool to be fixed.

Fig. 2.6 - Information label on the Robot flange for tool fixing
2.2.2 Wrist loads

Max load \((Q_F)\) applicable to the flange is defined depending on the \(L_z\) and \(L_{xy}\) coordinates of the load barycentre \((P)\), represented in the following figure.

Fig. 2.7 - Barycentre coordinates of the load applied to the flange

Max load \((Q_F)\) applicable to the flange is defined using the wrist load graphs given below.

Fig. 2.8 - Graphs for determination of the maximum load applicable to the Robot flange.

\[
\begin{align*}
A) & \quad M = 0.4 \text{ kg} \\
B) & \quad M = 0.6 \text{ kg} \\
C) & \quad M = 0.8 \text{ kg} \\
D) & \quad M = 1 \text{ kg}
\end{align*}
\]

\(M=\) mass in kg of the load applied to the Robot wrist
3. ROBOT CONFIGURATION CUSTOMIZATION

- Use of connectors on Robot base
- Hardware customization
- Software customization
3.1 Use of connectors on Robot base

Fig. 3.1 - Identification of connectors on Robot base

- RJ45 connector (A)
- USB connector (B)
- 9-pin D-Sub connector (C)

3.1.1 RJ45 connector
The RJ45 connector on Robot base is internally connected to 10/100 Ethernet port (with DHCP) of Raspberry Pi 3 model B that manages the operation of the Robot. It can be used to make a wired Ethernet connection between an external device and the Robot Raspberry.

3.1.2 USB connector
The USB-A connector available on Robot base is internally connected to one of USB 2.0 ports of the Raspberry Pi 3 model B that manages the operation of the Robot. It can be used to connect USB peripherals to the Raspberry (compatibly with 100 mA current supplied by the USB port).

3.1.3 9-pin D-Sub connector
The 9-pole D-Sub female connector available on the connection cable of remote emergency push-button, can be used for Connection of any additional emergency push-buttons, Connection of any interlocking devices associated with guards or for Connecting e.DO to Desk Simulator and use through Teach Pendant TP5.

For details on the pinout and how to use the 9-pin D-Sub connector, refer to par. 3.2 Hardware customization on page 22.
3.2 Hardware customization

- Connection of any additional emergency push-buttons
- Connection of any interlocking devices associated with guards
- Simultaneous connection of additional emergency push-button and interlocking device associated with guards
- e.DO Gripper assembly
- e.DO Marker Holder assembly
- Connecting e.DO to Desk Simulator and use through Teach Pendant TP5

3.2.1 Connection of any additional emergency push-buttons

The Robot is equipped for connection of additional emergency devices, through “E-Stop” input on a specific connector (used also for Connecting e.DO to Desk Simulator and use through Teach Pendant TP5); depending on the application provided, evaluate the need to install additional emergency push-buttons. The emergency stop push-button must be of red mushroom head type with a yellow background, with mechanical latching and equipped with 2 normally closed contacts (with forced opening) in accordance with the requirements of the standard UNI EN ISO 13850. If not used, the “E-Stop” input must be closed again with a special cap connector.

Fig. 3.2 - “E-Stop” input connection diagram - central e.DO
Fig. 3.3 - “E-Stop” input connection diagram - side e.DO

Tab. 3.1 - Connector pinout (pins relative to the input for additional emergency push-buttons connection)

<table>
<thead>
<tr>
<th>PIN</th>
<th>Name / function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>V_Out_Safe (24 Vdc)</td>
</tr>
<tr>
<td>2</td>
<td>0V (V_Out_Safe)</td>
</tr>
<tr>
<td>3</td>
<td>E-Stop CH1 (Connection to Relay K1, inside hexagonal base)</td>
</tr>
<tr>
<td>4</td>
<td>E-Stop CH2 (Connection to input on Raspberry, inside hexagonal base)</td>
</tr>
</tbody>
</table>
3.2.2 Connection of any interlocking devices associated with guards

The Robot is arranged for connection to any interlocking devices (2 voltage-free contacts, normally closed) associated with guards through “Fence” input on a special connector. The “Fence” input opening makes the Robot to stop safely. If not used, the “Fence” input must be closed again with a special cap connector. The following figure shows the diagram of the “Fence” input connection.

Fig. 3.4 - “Fence” input connection diagram - central e.DO
Fig. 3.5 - “Fence” input connection diagram - side e.DO

Tab. 3.2 - Connector pinout (pins relative to the input for guard interlocking devices connection)

<table>
<thead>
<tr>
<th>PIN</th>
<th>Name / function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>V_Out_Safe (24 Vdc)</td>
</tr>
<tr>
<td>2</td>
<td>0V (V_Out_Safe)</td>
</tr>
<tr>
<td>5</td>
<td>Fence CH1 (Connection to Relay K2, inside hexagonal base)</td>
</tr>
<tr>
<td>6</td>
<td>Fence CH2 (Connection to input on Raspberry, inside hexagonal base)</td>
</tr>
</tbody>
</table>
3.2.3 Simultaneous connection of additional emergency push-button and interlocking device associated with guards

The simultaneous connection of the additional emergency push-button and interlocking device associated with guards can be carried out by wiring both devices on the 9-pole D-Sub connector as shown in the previous par. 3.2.1 and par. 3.2.2.

The connection diagram is shown below.

Fig. 3.6 - “E-Stop” input and “Fence” input simultaneous connection diagram
3.2.4 e.DO Gripper assembly

- Packaging removal and preliminary checks
- e.DO Gripper diagrams and drawings
- e.DO Gripper connection electrical circuit diagram
- Equipment and material required
- e.DO Gripper installation procedure
- Check of the correct functioning after the installation
- Arrangement for integration of perimeter guards for use of the e.DO Gripper
### 3.2.4.1 Packaging removal and preliminary checks

The e.DO Gripper packaging contains:
- q.ty 1 e.DO Gripper
- q.ty 1 CAN network connection cable
- q.ty 1 e.DO Gripper power supply cable
- q.ty 2 socket hex head screws M3x10 for fixing the guard from the electronic board side (already screwed on the guard)
- q.ty 1 socket hex head screw M3x8 for fixing the guard from the motor side (already screwed on the guard)
- q.ty 2 socket hex head screws M3x10 for fixing of the e.DO Gripper to the Robot (captive, already screwed on the e.DO Gripper)
- q.ty 2 hex spacers M3 l=12 for fixing of the e.DO Gripper to the Robot (unmissable, already screwed on the e.DO Gripper)

**Fig. 3.7 - Content within the e.DO Gripper packaging**

<table>
<thead>
<tr>
<th>View</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>e.DO Gripper</td>
</tr>
<tr>
<td>B</td>
<td>Socket hex head screws M3x10; (q.ty 4)</td>
</tr>
<tr>
<td>C</td>
<td>Socket hex head screws M3x8 (q.ty 1)</td>
</tr>
<tr>
<td>D</td>
<td>Hex spacers M3 l=12 (q.ty 2)</td>
</tr>
<tr>
<td>E</td>
<td>CAN network connection cable</td>
</tr>
<tr>
<td>F</td>
<td>e.DO Gripper power supply cable</td>
</tr>
</tbody>
</table>
Remove the e.DO Gripper from the related packaging, proceeding as indicated below:

– The e.DO Gripper is packed in a normal cardboard box with pressure lock; no special tools are required to remove the packaging;
– remove the packaging paying particular attention not to damage the contents;
– make sure that all the components indicated in the previous Fig. 3.7 are present inside the package;
– after removing the packaging, make sure the e.DO Gripper does not show signs of damage during transport; if it does, do not install the e.DO Gripper and contact the Comau Service Centre (see Chap.5. - How to contact the Comau Service Center on page 59);
– the packaging materials must be kept out of reach of children, as they are potential sources of danger.
### 3.2.4.2 e.DO Gripper diagrams and drawings

In the following chapter are described:

- e.DO Gripper mechanical drawings (dimensions, workspaces)
- Flange hole diagram for e.DO Gripper fixing

### 3.2.4.2.1 e.DO Gripper mechanical drawings (dimensions, workspaces)

The following drawings show the dimensions of the e.DO Gripper (dimensions in mm):

- Dimensions of open e.DO Gripper
- Dimensions of closed e.DO Gripper

**Fig. 3.8 - Dimensions of open e.DO Gripper**
Fig. 3.9 - Dimensions of closed e.DO Gripper
### Flange hole diagram for e.DO Gripper fixing

The following drawing shows the diagram of holes present on the e.DO Gripper flange to be used for the e.DO Gripper fixing to the e.DO Robot (dimensions in mm).

**Fig. 3.10 - Flange hole diagram for e.DO Gripper**
### 3.2.4.3 e.DO Gripper connection electrical circuit diagram

In the following diagram there are given the electrical connections necessary to be performed on the e.DO Gripper electronic board (PCB), in order to allow its correct operation.

**Fig. 3.11 - Electrical diagram of e.DO Gripper connection**

<table>
<thead>
<tr>
<th>View</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>“BUS OUT” connector</td>
</tr>
<tr>
<td>B</td>
<td>“BUS IN” connectors</td>
</tr>
<tr>
<td>C</td>
<td>“SUPPLY” connector</td>
</tr>
<tr>
<td>D</td>
<td>“SERVO” connector</td>
</tr>
<tr>
<td>E</td>
<td>Connector not used</td>
</tr>
<tr>
<td>F</td>
<td>Connections coming from the electronic board (PCB) of the last Robot joint</td>
</tr>
<tr>
<td>R</td>
<td>Terminating resistor in the CAN network</td>
</tr>
</tbody>
</table>
3.2.4.4 Equipment and material required

For e.DO Gripper installation the following equipment is necessary:

- e.DO Gripper
- q.ty 2 hex spacers M3 l=12 (included and already screwed on the e.DO Gripper)
- q.ty 2 socket hex head screws M3x10 (included and already screwed on the e.DO Gripper)
- q.ty 1 CAN network connection cable (included with the e.DO Gripper)
- q.ty e.DO Gripper power supply cable (included with the e.DO Gripper)
- ratcheting torque wrench with 2.5 mm Allen bit (tightening torque of the screws 0.5 Nm).
### 3.2.4.5 e.DO Gripper installation procedure

The installation procedure of the e.DO Gripper on the e.DO Robot is given below.

#### Operating procedure

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Through the app, move the e.DO Robot to calibration position.</td>
</tr>
<tr>
<td>b.</td>
<td>Using a 2.5 mm Allen wrench, unscrew the two fixing socket hex head screws (A) M3x8 of the plastic protective cover (B) of the last Robot joint.</td>
</tr>
<tr>
<td>c.</td>
<td>Remove the plastic protective cover (B) of the last Robot joint.</td>
</tr>
</tbody>
</table>

At the end of the movement, shut down the e.DO, position the main switch in the open position (0 - OFF) then remove the plug from the power supply socket.
Operating procedure (Continued)

d. Using the 2.5 mm Allen wrench, unscrew completely but without removing (captive screws) the 2 fixing socket hex head screws M3x10 and remove the plastic protective cover of the e.DO Gripper electronic board (PCB).

e. Disconnect the CAN network terminating resistor from the electronic board (PCB) of the last Robot joint.

f. Insert the end with 2 connectors (D) (CAN SUPP and CAN SIGN) of the CAN network connection cable and power supply cable (E) (included with e.DO Gripper) inside the hole of the last Robot joint, as indicated by the arrow in the figure.

g. Remove the two connectors from the hole of the last Robot joint.
Operating procedure (Continued)

h. Connect the other end of the CAN network connection cable and power supply cable (E) to the connector (F) of the last Robot joint electronic board (PCB) (the same connector from which at step e. the terminating resistor was removed).

i. Insert the end with 2 connectors (D) (CAN SUPP and CAN SIGN) of the CAN network connection cable in the hole (G) present at the e.DO Gripper base.

j. Unscrew the four screws (H) (2 socket hex head screws M3x10 on the motor side and 2 hex spacers M3 on the electronic board) until they are flush with the e.DO Gripper flange.
### Operating procedure (Continued)

**k.** Using the 2.5 mm Allen wrench, unscrew completely but without removing (captive screw) the fixing socket hex head screw (J) M3x8 and remove the plastic protective cover of the e.DO Gripper rear side.

**l.** Using a 2.5 mm Allen wrench, fix the e.DO Gripper to the flange of the last Robot joint using 2 screws (K) M3x10 (side opposite to the electronic PCB board).

**m.** Using a 5.5 mm open-end wrench, fix the e.DO Gripper to the flange of the last Robot joint using 2 hex spacers (L) M3 l=12 (electronic PCB board side).

**n.** Tighten all the fixing screws to the torque of 0.5 Nm.

**o.** To avoid possible damage, do not overtighten the screws.

Representative figure
### Operating procedure (Continued)

**p.** Connect the 2 connectors (M) (CAN SUPP) and (N) (CAN SIGN) of the CAN network connection cable and power supply cable (included with e.DO Gripper), coming from the last Robot joint, to the corresponding connectors present on the e.DO Gripper electronic board (PCB), as shown in the figure.

**q.** Connect the 2 connectors (P) (2 PIN) and (Q) (4 PIN) of the power supply cable and terminating resistor (R) respectively to the connectors (S) and (T) of the e.DO Gripper electronic board (PCB), as shown in the figure.
Operating procedure (Continued)

r. Check the correct connection of all connectors on the e.DO Gripper electronic board (PCB), as shown in the figure.

s. Reposition the plastic protective cover of the e.DO Gripper electronic board (PCB) fixing it with the 2 socket hex head screws M3x10.

t. Reposition the plastic protective cover of the e.DO Gripper rear area, fixing it with the socket hex head screw (J) M3x8.

During the repositioning of the plastic protective cover, pay particular attention not to pinch the cables. Also verify that all cables are properly covered by the plastic protective cover.
Operating procedure (Continued)

u. Reposition the plastic protective cover (V) on the last Robot joint.

v. By means of a 2.5 mm Allen wrench, fix again the plastic protective cover (V) of the last Robot joint by using two socket hex head screws (W) M3x8. Tighten the screws to a 0.5 Nm torque.

After the mechanical installation of the e.DO Gripper, it is necessary to perform some identification and setup operations via dedicated app (see par. 4.5 e.DO configuration on page 30).
3.2.4.6 Check of the correct functioning after the installation

Before proceeding with the use of e.DO equipped with the e.DO Gripper, it is necessary to check the correct functioning:

– connect e.DO to the power supply mains and perform the power-up;
– access the related app and perform the connection via Wi-Fi network;
– through appropriate pop-up windows:
  • select the Robot configuration;
  • confirm the presence of e.DO Gripper;
– perform the calibration of the joints following the steps proposed by the app;
– manually perform some opening / closing cycles of the e.DO Gripper in order to check its proper functioning.
3.2.4.7 **Arrangement for integration of perimeter guards for use of the e.DO Gripper**

The e.DO Gripper can be used for the execution of programs including small operations for handling small and non-dangerous objects, compatibly with [e.DO Gripper technical features](#) and [General technical features of the e.DO Robot](#).

The Robot is equipped for the connection of any guard interlocking devices, the installation of which may be necessary:
- for demonstration / simulation purposes only
- in case of use of e.DO equipped with e.DO Gripper for any special applications.

The normal use of e.DO and the e.DO Gripper in compliance with the [e.DO Gripper technical features](#) and areas of use envisaged does not require the installation of additional perimeter guards.

The following is an example of dimensioning, installation and connection of perimeter protective guards for the execution of special applications (e.g. potentially dangerous handling operations) with e.DO Gripper. For a correct dimensioning of the perimeter protective guards consult also:
- the [e.DO Gripper diagrams and drawings](#);
- Fig. 2.1 - Robot workspaces in configuration of 6 axes - e.DO standard on page 12;
- Fig. 2.2 - Robot workspaces in configuration of 6 axes - e.DO standard with e.DO Gripper on page 13;
- Fig. 2.3 - Robot workspaces in configuration of 6 axes - e.DO Offset on page 14;
- Fig. 2.4 - Robot workspaces in configuration of 6 axes - e.DO Offset with e.DO Gripper on page 15.

In case of installation of perimeter guards, the remote emergency push-button must be positioned outside the guards themselves.

For details regarding the pinout of the connectors and related connection diagrams, see the [par. 3.1 Use of connectors on Robot base on page 21](#).
Fig. 3.12 - Example of perimeter protective guards installation

Minimum dimensions of perimeter protective guards; dimensions in mm

- **A**: Perimeter protective guards (to be carried out by the User)
- **B**: Safety limit switch to control the correct positioning of the guard (to be installed by the User)
- **C**: Remote emergency push-button (present as standard with the Robot)
- **D**: Connector on which to connect the safety limit switch for positioning control of the guard (“Fence” input).
3.2.5 e.DO Marker Holder assembly

- Packaging removal and preliminary checks
- Equipment and material required
- e.DO Marker Holder installation procedure

3.2.5.1 Packaging removal and preliminary checks

The e.DO Marker Holder packaging contains:

- q.ty 1 e.DO Marker Holder (pre-assembled) composed of:
  - q.ty 1 base flange (CR82435501)
  - q.ty 1 marker holder (CR82435502)
- q.ty 4 socket hex head screws M3x8 (with as many washers) for fixing the e.DO Marker Holder directly to the e.DO flange

Fig. 3.13 - Content within the e.DO Marker Holder packaging

Remove the e.DO Marker Holder from the related packaging, proceeding as indicated below:

- The e.DO Marker Holder is packed in a normal cardboard box with pressure lock; no special tools are required to remove the packaging;
- remove the packaging paying particular attention not to damage the contents;
- make sure that all the components indicated in the previous Fig. 3.7 are present inside the package;
– after removing the packaging, make sure the e.DO Marker Holder does not show signs of damage during transport; if it does, do not install the e.DO Marker Holder and contact the Comau Service Centre (see Chap.5. - How to contact the Comau Service Center on page 59);
– the packaging materials must be kept out of reach of children, as they are potential sources of danger.

3.2.5.2 Equipment and material required

The installation of the e.DO Marker Holder can be carried out:

– on an e.DO Robot already equipped with e.DO Gripper; in this case it is sufficient to:
  • position the e.DO Marker Holder on the e.DO Gripper
  • tighten the gripping fingers of the e.DO Gripper until the e.DO Marker Holder is fixed, as indicated in the following Fig. 3.14
  • no additional equipment is required;

**Fig. 3.14 - e.DO Marker Holder - Mounting on the e.DO Gripper**

– on an e.DO Robot without e.DO Gripper, with e.DO Marker Holder fixing directly to the Robot flange; in this case the following equipment will be required:
  • q.ty 4 socket hex head screws M3x8 and as many washers (included with the e.DO Marker Holder)
  • ratcheting torque wrench with 2.5 mm Allen bit (tightening torque of the screws 0.5 Nm).
3.2.5.3 e.DO Marker Holder installation procedure

This procedure is valid only for the installation of the e.DO Marker Holder on a Robot without e.DO Gripper.

The installation procedure of the e.DO Marker Holder on an e.DO Robot without e.DO Gripper is given below.

**Operating procedure**

a. Through the app, move the e.DO Robot to calibration position.

![Representative figure illustrating e.DO Robot in calibration position.](image)

At the end of the movement, shut down the e.DO, position the main switch in the open position (0 - OFF) then remove the plug from the power supply socket.

b. Position the base flange (A) of the e.DO Marker Holder on the e.DO flange (B), matching the fixing holes (C) and (D).
<table>
<thead>
<tr>
<th>Operating procedure (Continued)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. Fix the base flange (A) of the e.DO Marker Holder on the e.DO flange (B), using 4 socket hex head screws (E) M3x8 and interposing the corresponding washers, supplied with the e.DO Marker Holder.</td>
</tr>
<tr>
<td>d. Tighten the fixing screws to the torque of 0.5 Nm.</td>
</tr>
<tr>
<td>e. Fix the marker and the marker holder as indicated in the procedure on How to fix the marker on the e.DO Marker Holder (see par. 6.2.5 on page 57) in the User Manual.</td>
</tr>
</tbody>
</table>
3.2.6 Connecting e.DO to Desk Simulator and use through Teach Pendant TP5

- Equipment and material required
- Procedure for connecting e.DO to the Desk Simulator

3.2.6.1 Equipment and material required

For the connection of e.DO to the Desk Simulator, the following equipment / material is required:

- Desk Simulator for e.DO
- Teach Pendant TP5
- Y cable for connecting the Teach Pendant, Desk Simulator, e.DO
- Ethernet cable with RJ45 connectors at the ends, for connection between the Desk Simulator and e.DO.

3.2.6.2 Procedure for connecting e.DO to the Desk Simulator

Below is the procedure for connecting e.DO to the Desk Simulator in order to make it possible to control it through the Teach Pendant TP5.

<table>
<thead>
<tr>
<th>Operating procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Make sure that e.DO and the Desk Simulator are powered off.</td>
</tr>
<tr>
<td>b. Connect e.DO to the Desk Simulator and the Teach Pendant TP5 using the Y cable (A), as shown in the figure:</td>
</tr>
<tr>
<td>- remove the closure cap and connect the D-Sub connector, called X124/EXT, of the Y cable to the D-Sub connector (B) available on e.DO (on the remote emergency push-button cable);</td>
</tr>
<tr>
<td>- connect the connector named X124/DSK to the X124NEW connector (C) available on the Desk Simulator;</td>
</tr>
<tr>
<td>- connect the X124/TP5 connector to the relevant connector (D) of the Teach Pendant TP5.</td>
</tr>
</tbody>
</table>

![Diagram of equipment connections](image)
Operating procedure (Continued)

c. Power up e.DO as indicated in the par. 3.5 First power-up of the Robot on page 23 of the User Manual.

d. Perform Configuration and connection of the command interface (tablet) (connection to the Wi-Fi network, select the e.DO configuration) as indicated in the User Manual.

e. Perform e.DO calibration as indicated in the User Manual.

f. Power off the Desk Simulator by bringing the relative switch (E) to closed position (I - ON).

g. Wait for the completion of the Desk Simulator start-up process; at the end the main page “Desktop page” will be displayed on the Teach Pendant.
Operating procedure (Continued)

h. Perform the calibration of the virtual machine as indicated below; the following steps will allow you to align the position of e.DO virtual model present in the Simulated Desk to the actual position of the previously calibrated “physical” Robot.

! Failure to carry out the calibration procedure could generate untimely movements of the Robot (movement at maximum speed, until reaching the position set on the Teach Pendant) at the time of the switch from the tablet to the Teach Pendant.

i. Select, in order, the items “Service”, “System”, “Execute”.

j. Inside the “Execute” environment, write the instruction “MOVE ARM[1] TI $CAL_SYS” or select it from the instruction library, as follows:
   • select “Statement” on the lower left side of the window;
   • select “MOVE” folder
   • select “TO_CAL_SYS” instruction.
Operating procedure (Continued)

k. Confirm with “OK”.

l. The MOVE instruction for moving to $CAL_SYS$ position is indicated in the “Execute” field.

m. Confirm the execution of the instruction by pressing “Exec” on the lower left side of the window.

n. During the execution of the instruction, the screenshot shown in the figure alongside will appear.

The MOVE TO_CAL_SYS instruction will move the virtual model of the Robot to the calibration position (Axis 1, Axis 2, Axis 3, Axis 4, Axis 5, Axis 6 in position 0°).

o. To give consent to the movement it is necessary to provide the “DRIVE ON” by pressing, in an intermediate position, one of the enabling push-buttons on the rear side of the Teach Pendant.

p. The DRIVE ON status is indicated by lighting of the relative LED on the Teach Pendant.

q. To carry out the movement it is necessary to press and hold (until the end of the movement) a green “START” push-button on the Teach Pendant.

r. At the end of the movement, the virtual model of the Robot will be in the calibration position.
Operating procedure (Continued)

s. Connect the network cable (F) between e.DO (RJ45 connector on Robot base) and Desk Simulator (RJ45 connector identified with the abbreviation ETH).

![Diagram showing network cable connection between e.DO and Desk Simulator]

F

- On “Home Page” of the Teach Pendant, press on the RJ45 connector icon with the IP address next to it.

- On the following page, check that the following parameters are set:
  - IP address = 10.42.0.40
  - Subnet Mask = 255.255.255.0
  - Gateway = 10.42.0.40
  - that correspond to the default parameters assigned by Comau.

- If necessary, manually change the parameters by entering the above.
The following parameters are assigned by default:
- on e.DO:
  - IP address 10.42.0.49
  - Subnet Mask 255.255.255.0
- on Desk Simulator:
  - IP address 10.42.0.40
  - Subnet Mask 255.255.255.0
  - Gateway 10.42.0.40

In case of changes to IP addresses, take into consideration the following:
- the IP addresses of e.DO and the Desk Simulator must be different, but belonging to the same subnet;
- DHCP is not present;
- in the previous steps t. t. and v. of the procedure it will be necessary to enter in the “IP address” and “Gateway” fields the IP address of the Desk Simulator corresponding to what has been set/changed.

Example of configuration with address modification:
- on e.DO:
  - IP address 192.168.0.100
  - Subnet Mask 255.255.255.0
- on Desk Simulator:
  - IP address 192.168.0.101 (or any IP address belonging to the subnet, except for 192.168.0.100 already used on e.DO)
  - Subnet Mask 255.255.255.0
  - Gateway 192.168.0.101

w. From the tablet, enable the Robot control through the Teach Pendant by accessing the “Settings” Menu, then the Control switch page and selecting “Enable” item, as described in the User Manual.
Operating procedure (Continued)

x. It will now be possible to carry out e.DO movement through the Teach Pendant TP5.

y. Check the Robot proper functioning:
   • provide the “DRIVE ON” to the Robot by holding one of the two enabling push-buttons on the rear side of the Teach Pendant in an intermediate position;
   • the DRIVE ON status is indicated by the lighting of the relative LED on the Teach Pendant;
   • using JOG keys, move one axis at a time and check its correct functioning.

z. Perform the needed movements / activities by means of the Teach Pendant.

At the end of use, before powering off e.DO, move it to calibration position as indicated from the step h. to the step q. of this procedure.
3.3 Software customization

e.DO is equipped with Open Source Software which can then be modified and customized by the user.
The user has the right to customize the following 2 software “macro blocks”, in accordance with the authorizations established by the relevant user licenses:

- Software on Raspberry
  - GPL v3 Open Source license

- Software on axis boards (joints + e.DO Gripper)
  - BSD 3-clause Open Source license
4. ROBOT MAINTENANCE

- Signalling LEDs meanings
- List of allowed and not-allowed operations, in order to preserve the warranty

4.1 Signalling LEDs meanings

On the electronic control board of each e.DO joint there are signalling LEDs, whose lighting can be used to identify any anomalies or faults on the board itself.

To access the electronic board, it is necessary to remove the perforated plastic cover installed on each joint.

The meaning of various signalling LEDs is given below:

- Orange LED
  - blinking, frequency 1 Hz = joints board correctly functioning, correctly communicates with the Raspberry;
  - blinking, frequency > 1 Hz = no communication;
  - off = board not powered or not functioning

- Red LED
  - off = OK board, no malfunction or error (Fault);
  - on = presence of an error (Fault) due to intervention of collision detection system (“Collision Detection”) or “Following Error”.


4.2 List of allowed and not-allowed operations, in order to preserve the warranty

Below is the list of operations / disassembly / customizations that can be carried out by the user without voiding the warranty of e.DO. Unauthorized operations are also indicated.

The execution of any operation / modification to the Robot not indicated in this paragraph or not authorized in writing by Comau, entails the forfeiture of the warranty.

The operations indicated below refer to the main elements that make up the e.DO Robot:
- big joint (Part No. CR82428100);
- small joint (Part No. CR82428300);
- Robot internal wiring (Part No. CR18915280);
- e.DO cabinet (Robot base and related electronic components, Part No. CR17932980).

Operations allowed

The following operations can be performed by the User, without voiding the Robot warranty.

- access the axis electronic control board, installed on the joint (big joint and small joint);
- access the cables of the Robot internal wiring and move them;
- access the SD card in the Raspberry installed inside the e.DO cabinet, with access through the side cap of the Robot base;
- change the position of the caps on the Robot base;
- changes to the software guaranteed by the accessibility to the SD card inside the e.DO cabinet.

Operations not allowed

The following operations cannot be performed by the User. If performed, the Robot warranty will be void.

- open the joint unit (big and/or small) by accessing the internal mechanism;
- modify the electrical connectors of the internal wiring;
- change the configuration of the internal wiring cables;
- open the Robot base, disassembling two semi-bases;
- access the internal electronic components of the e.DO cabinet, changing its functionality and/or connections.
5. HOW TO CONTACT THE COMAU SERVICE CENTER

- Main steps to be followed in the event of Robot malfunctioning or anomaly
- Assistance and maintenance interventions during warranty period
- Assistance and maintenance interventions outside warranty period
- Robot repackaging procedure and shipping to Comau for technical assistance

5.1 Main steps to be followed in the event of Robot malfunctioning or anomaly

In case of Robot malfunctioning or anomaly, it is necessary to follow the following steps in order:

- access the website https://edo.cloud/ and consult FAQs in the related section (https://edo.cloud/faqs/);
- in the event that it has not been possible to solve the anomaly through the directions in the FAQs:
  - see par. 4.1 Signalling LEDs meanings on page 57 of this handbook;
  - lastly, if the anomaly could not be resolved, a physical inspection on the Robot will be necessary, to be carried out by the Comau technicians at a Comau Centre
5.2 Assistance and maintenance interventions during warranty period

In the case of Robot under the warranty, following analysis of the diagnostic data (as indicated in the previous par. 5.1) by the Comau Technicians:

- in the event that the damage or malfunction is attributable to a manufacturing defect or lack of conformity
  - the damaged component will be fully replaced

- in case further inspections are necessary to establish the extent and cause of the damage or malfunction
  - the damaged component must be sent to a Comau Centre for necessary checks and inspections (see Robot repackaging procedure and shipping to Comau for technical assistance)
  - the shipping and transport of the component are to be paid by the Customer

- in the event that the damage or malfunction cannot be attributable to a manufacturing defect or lack of conformity (e.g. because of improper use, damages, etc.)
  - Comau will inform the Customer and propose an offer to repair or replace the component.

5.3 Assistance and maintenance interventions outside warranty period

In the case of Robot outside the warranty period, following analysis of the diagnostic data (as indicated in the previous par. 5.1) by its Technicians, Comau may propose:

- a repair or replacement offer, or

- to send a part or the whole S/N to a Comau Centre for further information.

Shipping costs are charged to the Customer.
5.4 Robot repackaging procedure and shipping to Comau for technical assistance

- Equipment and material required
- Robot disassembly and repackaging procedure

The procedure described in the following paragraphs describes the correct positioning inside the original packaging (for shipment to Comau for assistance) and the operations to be carried out if the Robot presents damage such as to prevent its movement in transport position.

5.4.1 Equipment and material required

For the disassembly and repositioning of e.DO inside the original packaging, the following equipment is required:

- 2.5 mm Allen wrench
- e.DO original box and packaging
- additional packaging material (e.g. bubble wrap sheets) for Robot protection
- packaging adhesive tape.
5.4.2 Robot disassembly and repackaging procedure

This procedure requires the reuse of the e.DO original box and packaging.

Operating procedure

Before proceeding with the disassembly, make sure that you have:
- powered off the Robot
- pressed the emergency push-button
- disconnected and removed the power cable from the e.DO base
- removed the e.DO Gripper (if present) by carrying out backwards the steps indicated in the e.DO Gripper installation procedure.

a. Working in 2 persons, adequately support the e.DO arm then unscrew the 4 screws (A) M3 that fix the e.DO arm to the relative base.

b. Once all the screws have been removed, lay the e.DO arm on a support table, paying attention not to pull the cables and connectors located under the axis 1.
### Operating procedure (Continued)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>c.</strong></td>
<td>Disconnect the connectors <strong>(B)</strong> “BRAKE”, “P. SUPPLY” and “CAN BUS” from the e.DO arm.</td>
</tr>
<tr>
<td><strong>d.</strong></td>
<td>Position the base of e.DO inside the appropriate housing in the original packaging.</td>
</tr>
</tbody>
</table>
### Operating procedure (Continued)

<table>
<thead>
<tr>
<th>Step</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.</td>
<td>Position a suitable protective packaging over the base (e.g. bubble wrap sheet) then position the e.DO arm inside the box, protecting it with the packaging, as shown in the figure.</td>
</tr>
<tr>
<td>f.</td>
<td>At the end, close the box with special packaging tape.</td>
</tr>
</tbody>
</table>
6. DECOMMISSIONING AND DISPOSAL

The disposal operations must be carried out in compliance with the law in force in the country where the machine is installed: dispose of the batteries, electronic boards and various components in an environmentally correct way and in accordance with the regulations in force transferring them to the appropriate collection facilities.

Minimum safety requirements to be followed during the Robot decommissioning and disposal are given below:

- disconnect the Robot from the power supply mains;
- disassemble the Robot following the instructions for disassembling the single joints, indicated in the relevant replacement sheets;
- perform the disposal of the Robot and various components in accordance with the law in force in the country where the Robot is installed;
- inside the Robot there are present batteries and electronic boards that must be disposed of according to the law in force in the country where the Robot is installed, transferring them to appropriate waste collection centres.
  - Lithium manganese oxide battery (button cell battery of CR1220 type) on the main electronic board (Raspberry)
  - Electronic boards
    - on Robot base (Raspberry)
    - on Robot joints
    - on e.DO Gripper