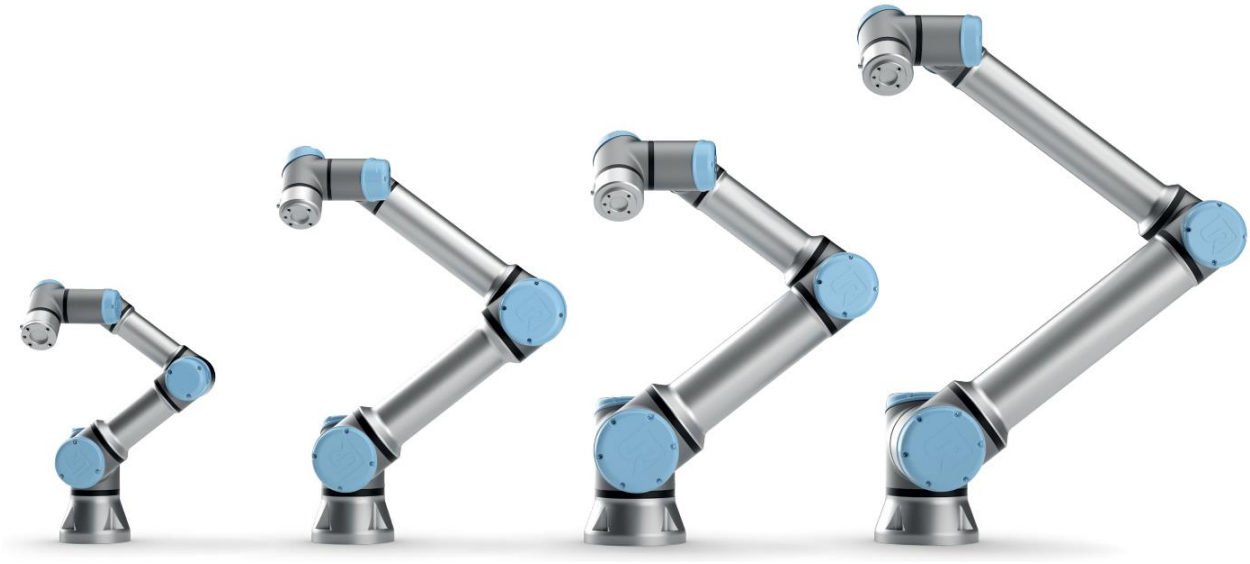

# Installation Guide

ORIGINAL INSTRUCTIONS (EN)

Version 1.3.3

**Robot:**
CB-Series: UR3, UR5, UR10
e-Series: UR3e, UR5e, UR10e, UR16e

**Control Box:**
CB-Series: Control Box, Control Box Merge
e-Series: Control Box, OEM AC, OEM DC

# Table of Contents

# 1. Purpose

This installation guide is intended for experienced personnel to review existing robot installations or design and review new robot integrations. It is very important that the robots are installed properly and with good programming practice. Therefore, this document is designed as a "checklist". Please always go through the complete guide to ensure that everything was checked and considered.

## 1.1 Disclaimer

This document does not replace Universal Robots documentation. This document does not guarantee completeness of all considerations for proper installation. The installation parameter values specified here are intended as starting points for installation and should not be interpreted as specifications or limits. These values can change with future versions by further findings. This approach is intended to simplify and structure the robot integrations and robot installation auditing.

## 1.2 Company details

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## 1.3 How to use this guide

Step 1: Check the condition of the first fields for relevance. "YES" means it should be checked for all applications.

Step 2: Read description and compare with installation. If differences are visible, correct them.

Step 3: If you need more information or details, go to the appendix.

Step 4: Put initials into checklist field.

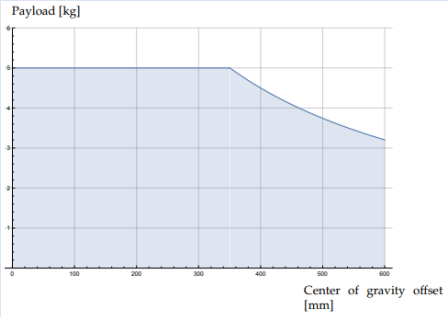
| Step 1 | Step 2 | Step 3 | Step 4 |
|---|---|---|---|

| Relevant | Description | Further Information | Checked |
|---|---|---|---|
| **YES** | Mount the robot on a sturdy surface strong enough to withstand at least ten times the full torque of the base joint and at least five times the weight of the robot arm. Furthermore, the surface shall be vibration free. | UR User Manual Chapter “Mounting”<br><br>UR Support Site Article “Max. joint torques” | |

# 2. Mechanical Set Up

| Relevant | Description | Further Information | Checked |
|---|---|---|---|
| **YES** | Mount the robot on a sturdy surface strong enough to withstand at least ten times the full torque of the base joint and at least five times the weight of the robot arm. Furthermore, the surface shall be vibration free. | UR User Manual Chapter “Mounting”<br><br>UR Support Site Article “Max. joint torques” | |
| **YES** | Is robot mount in an environment suited for the IP rating?<br><br>The robot must be operated in environments that fulfill the required IP ratings of Robot Arm, Teach Pendant and Control Box. | UR User Manual Chapter “Technical Specifications”<br><br>UR Support Site Article “IP (Ingress Protection) ratings report UR3, UR5 and UR10” | |
| **Linear Axis?**<br><br>**YES**<br><br>**NO** | If the robot is mounted on a linear axis or a moving platform then the acceleration of the moving mounting base shall be very low. A high acceleration might cause the robot to stop, thinking it bumped into something.<br><br>It is recommended to keep the robot joints stationary while the linear stage is in motion, especially during accelerating and decelerating. The validation that robot joints are stationary (steady) can be done by using script function “is_steady()”.<br><br>It also might be helpful to keep the robot in more of a folded-up pose versus extended (to avoid accidental protective stops). | UR User Manual Chapter “Mounting”<br><br>UR Support Site Article “7th Axis Gravity Settings”<br><br>UR Script Manual function “is_steady()” | |
| **YES** | Please go through inspection plan in Service Manual and follow all recommended inspections. By doing this you can eliminate many possible failures. | UR Service Manual Chapter “Preventive Maintenance” | |

# 3. Payload / Center of Gravity Offset

| Relevant | Description | Further Information | Checked |
|---|---|---|---|
| **YES** | Payload and Center of Gravity must be set correctly. The maximum allowed payload of the robot arm depends on the center of gravity offset. The center of gravity offset is defined as the distance between the center of the tool output flange and the center of gravity of the total payload (tool + workpiece).<br><br>Example for UR5 – CB3<br>  | UR User Manual Chapter “Maximum Payload” & “Payload” & “Center of Gravity”<br><br>UR Support Site Article “Setting payload and center of gravity when using multiple TCPs” | |
| **YES** | The Payload and Center of Gravity must be always adjusted when a workpiece is picked up or dropped off.<br><br>The script command from the Script Manual can be used for this purpose. "set_payload(m, cog)" | UR User Manual Chapter “Payload” & “Center of Gravity”<br><br>UR Script Manual function “set_payload()”<br><br>UR Support Site Article “Setting payload and center of gravity when using multiple TCPs” | |

# 4. Motion Control

| Relevant | Description | Further Information | Checked |
|---|---|---|---|
| **YES** | Program the trajectories of the robot smoothly and continuously to avoid disruptive movements.<br><br>Blends should be programmed with at least 15 mm if there is no special requirement by application (e.g. Gluing). | UR User Manual Chapter “Command: Fixed Waypoint” | |
| **MoveP used?**<br><br>**YES**<br>**NO** | While the robot is moving through the waypoints with constant speed, the robot cannot wait for either an I/O operation or an operator action. Some smart gripper commands will also impose a wait on the program execution, so this is something to also be aware of.<br><br>Doing so might stop the robot motion or cause a protective stop.<br>If a wait is necessary, stop robot with script command "stopl()". | UR Support Site Article “Circular path using MoveP/MoveC”<br><br>UR Script Manual function “stopl()” | |
| **Skipped Waypoint entries in the log file?**<br><br>**YES**<br>**NO** | Waypoints in the program that are too close to each other or whose blend is too large are skipped during program execution. This is logged as a warning message in the Log File.<br><br>e.g. warning message:<br>“Overlapping Blends in a MoveL, a waypoint was skipped”<br><br>Adjust blend configuration in specific waypoints. | UR Support Site Article “Circular path using MoveP/MoveC” | |
| **Loops or If command where *"Check expression continuously"* is selected?**<br><br>**YES**<br>**NO** | The robot should not be stopped abruptly. This can occur due to a jump out of the program section where “check expression continuously” is enabled.<br><br>Realize the continuous expression check without interrupting the movement. If interrupt is necessary script commands “stopl()/stopj()” can be used. | UR Script Manual function “stopl()/stopj()” | |

### 4.1 Acceleration

| Relevant | Description | Further Information | Checked |
|---|---|---|---|
| **YES** | It is generally advised to avoid the use of accelerations higher than needed for a given application. High accelerations, especially in combination with high loads, can lead to reduced lifetime of the robot.<br><br>Acceleration values are advised to be below 800 °/s² or below 2500 mm/s².<br><br>It is good practice to choose a reasonable ratio between speed and acceleration depending on the distance of the waypoints. | UR User Manual Chapter “Product warranty” | |

### 4.2 Speed

| Relevant | Description | Further Information | Checked |
|---|---|---|---|
| **YES** | For applications with short cycle times and high requirements on speed, it is generally advised to use blends as much as possible to ensure smooth trajectories without the need for high accelerations.<br><br>It is recommended to use large radii when high speed is used and good practice to choose a reasonable ratio between speed and acceleration depending on the distance of the waypoints. | UR User Manual Chapter “Product warranty” | |

# 5. I/O Ports

## 5.1 Inputs and Outputs

| Relevant | Description | Further Information | Checked |
|---|---|---|---|
| **YES** | Check all terminals for proper connection. Terminals should not be loose. You should also take caution that the shield of the wire (if present) is not contacting any terminal connections.<br><br>Incorrect or loose connection of these terminals can result in problems with the signals. | UR User Manual Chapter “Controller I/O” | |
| **Controller I/O used?**<br><br>**YES**<br>**NO** | Be sure that the current per single I/O is not above the maximum allowed value.<br><br>Be sure that the total current used by all I/O is not above the maximum allowed.<br><br>If there is a need for larger current supplying capacity than can be supplied by internal power supply unit use an external power supply unit and make sure the 24 V jumper is properly configured and that the internal 24 V supply of the robot is not tied to the external 24 V supply. It is not good practice to have the outputs of two different 24 V power supplies connected together. | UR User Manual Chapter “Controller I/O”<br><br>UR Support Website Article “Connecting internal inputs and outputs (I/O) on the robot’s controller” | |
| **Tool I/O used?**<br><br>**YES**<br>**NO** | Be sure that the current per single I/O is not above the maximum allowed value.<br><br>Be sure that the total current used by all I/O is not above the maximum allowed value. | UR User Manual Chapter “Tool I/O” | |
| **Safety devices connected?**<br><br>**YES**<br>**NO** | Check mismatch time settings on safety signals on external safety devices. Note that dual channel safety outputs are switched with a maximum delay of 8 ms within the UR robots safety IO and an internal error message is triggered after 48 ms. A value of 20 ms is recommended for setting the mismatch on safety inputs on external devices (like Safety PLCs). | UR Support Website Article “Scan time for CB3 and e-Series controller I/O” | |

# 6. Programming

## 6.1 Processing

| Relevant | Description | Further Information | Checked |
|---|---|---|---|
| **Threads or Events used in the program?**<br><br>**YES**<br>**NO** | Many parallel or computationally-intensive processes can put additional strain on the robots control software. The use of threads should be carefully considered, and overuse might cause the PolyScope GUI to seem slow and unresponsive. Efficient programming is important. | UR User Manual Chapter ”Event” & ”Thread” | |
| **Switch/case Used?**<br><br>**YES**<br>**NO** | Verify that switch case statements are used in a non-stressful way on robot.<br><br>Do not use blend in last or first waypoints in cases. It could cause problems when jumping through cases. | UR User Manual Chapter “Switch“ | |
| **Does robot show “runtime error / infinite loop”?**<br><br>**YES**<br>**NO** | This error happens due to the fact, that all operations do not necessarily use physical time code segments that execute only one command repeatedly might cause the runtime interpreter to view this command sequence as an infinite loop.<br><br>Use wait command or sync() function for avoiding runtime errors. | UR Script Manual function “sync()”<br><br>UR Support Site Article “Runtime error/Infinite loop” | |

### 6.2 Protective Stop

| Relevant | Description | Further Information | Checked |
|---|---|---|---|
| **"C153 Protective Stop" in Log File?**<br><br>**YES**<br>**NO** | 1. Check installation settings and make sure the following settings are configured correctly:<br><br>- Payload<br>- Tool Center Point<br>- Center of Gravity<br>- Mounting<br>- Accelerations<br><br>2. Verify that the robot does not push excessively in pick-up place positions, thereby creating unwanted forces that can cause protective stops. Re-teach relevant waypoints for higher precision.<br><br>3. Is Smooth Transition set to "Hard" and the accelerations and/or speed is high, its recommended to use "Soft" options when possible. | UR Support Site Article "Preventive actions for error code "C153 Protective Stop: joint positions deviates from path"" | |

### 6.3 UR+/URCaps

| Relevant | Description | Further Information | Checked |
|---|---|---|---|
| **URCaps installed?**<br><br>**YES**<br>**NO** | Unnecessary URCaps software delay the program start and require additional performance.<br><br>If many URCaps have been installed and uninstalled again, generating new image using Win32DiskImager (free-ware SW tool) and downloaded Robot Image Software from UR Support Site is a good practice.<br><br>It is important to backup programs and calibration data and transfer to new image. | UR Service Manual Chapter "Backup of data"<br><br>UR Support Site Article "How to replace flashcard in CB3 robots" | |

### 6.4 Interfaces

| Relevant | Description | Further Information | Checked |
|---|---|---|---|
| **Interfaces used?**<br><br>**YES**<br>**NO** | Please note that communication with dashboard server or external devices is not opened and closed unnecessarily often. This is CPU intensive operation and may delay the program execution. | | |

6.5 Safety

| Relevant | Description | Further Information | Checked |
|---|---|---|---|
| **Using standard safety settings?**<br><br>**YES**<br>**NO** | Is Safety Checksum on Default “CCCC” or Safety password not set?<br><br>Please verify that a proper risk assessment is done with the system that the robot is part of. The safe use of UR robots includes considering the gripper, the part and any external automation that the robot interacts with that might get the operator involved. | UR User Manual Chapter “Safety Configuration”<br><br>UR Support Site Article “Safety standards” | |
| **Speed Slider limits during program run?**<br><br>**YES**<br>**NO** | Check that the safe velocities are set correctly and do not restrict the productivity of the robot. | UR User Manual Chapter “General Limits” | |
| **Safety Scanner?**<br><br>**YES**<br>**NO** | Is a safety scanner part of the setup, ensure it’s not unnecessary activated.<br><br>If Smooth Transition is set to “Hard” and the accelerations and/or speed is high, it is recommended to use “Soft” options when possible. | | |

**NOTICE**

If you have no success with above guidelines, please contact the Distributor from where the robot has been purchased in order to get additional support.

If you have any questions about this document, please contact your local Distributor or local representative of Universal Robots.

https://www.universal-robots.com/distributors/