# 2. Your Robot

**Introduction**

Congratulations on the purchase of your new Universal Robots robot, which consists of the robot arm (manipulator), Control Box and the Teach Pendant.

Originally designed to mimic the range of motion of a human arm, the robot arm is composed of aluminium tubes, articulated by six joints, allowing for a high range of flexibility in your automation installation.
The Universal Robots patented programming interface, PolyScope, allows you to create, load and run your automation applications.

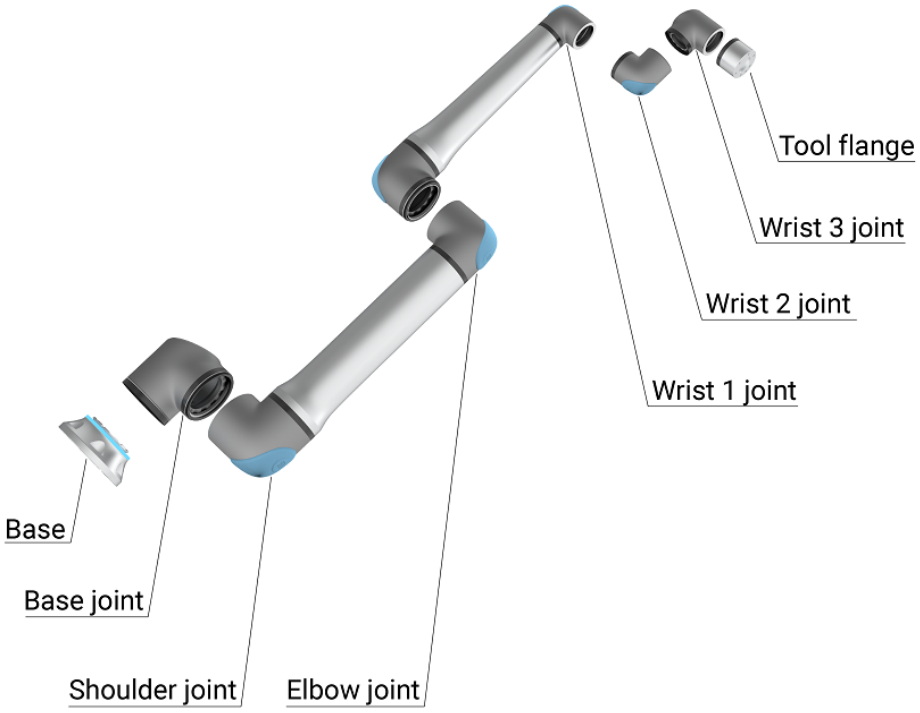
**In the boxes**

- Robot arm
- Control Box
- Teach Pendant or a 3PE Teach Pendant
- Mounting bracket for the Control Box
- Mounting bracket for the 3PE Teach Pendant
- Key for opening the Control Box
- Cable for connecting the robot arm and the Control Box (multiple options available depending on robot size)
- Mains cable or power cable compatible with your region
- Round sling or lifting sling (depending on robot size)
- Tool cable adapter (depending on robot version)
- This manual

**About the robot arm**

The Joints, Base and Tool Flange are the main components of the robot arm. The controller coordinates joint motion to move the robot arm.

Attaching an end effector (tool) to the Tool Flange at the end of the robot arm, allows the robot to manipulate a workpiece. Some tools have a specific purpose beyond manipulating a part, for example, QC inspection, applying adhesives and welding.




1.1: *The main components of the robot arm.*

- **Base**: where the robot arm is mounted.
- **Shoulder** and **Elbow**: make larger movements.
- **Wrist 1** and **Wrist 2**: make finer movements.
- **Wrist 3**: where the tool is attached to the Tool Flange.

The robot is partly completed machinery, as such a Declaration of Incorporation is provided. A risk assessment is required for each robot application.

**About the manual**

This manual contains safety information, guidelines for safe use, and instructions to mount the robot arm, Control Box and Teach Pendant. You can also find instructions for how to begin to install and how to start programming the robot.

Read and adhere to the intended uses. Perform a risk assessment. Install and use in accordance with the electrical and mechanical specifications provided in this user manual.

Risk assessment requires an understanding of the hazards, risks and risk reduction measures for the robot application. Robot integration can require a basic level of mechanical and electrical training.

**Content disclaimer**

Universal Robots A/S continues to improve the reliability and performance of its products, and as such reserves the right to upgrade products, and product documentation, without prior warning. Universal Robots A/S takes every care to ensure the content of the User Manual/s is precise and correct, but takes no responsibility for any errors or missing information.

This manual does not contain warranty information.

**myUR**

The myUR portal allows you to register all your robots, keep track of service cases and answer general support questions.

Sign into myur.universal-robots.com to access the portal.

In the myUR portal, your cases are handled either by your preferred distributor, or escalated to Universal Robots Customer Service teams.
You can also subscribe to robot monitoring and manage additional user accounts in your company.

**Support**

The support site www.universal-robots.com/support contains other language versions of this manual

**UR+**

The online showroom UR+www.universal-robots.com/plus provides cutting-edge products to customize your UR robot application. You can find everything you need in one place – from tools and accessories to software.

UR+ products connect to and work with UR robots to ensure simple set-up and an overall smooth user experience. All UR+ products are tested by UR.

You can also access the UR+ Partner Program via our software platform plus.universal-robots.com to design more user-friendly products for UR robots.

**UR forums**

The UR Forum forum.universal-robots.com allows robot enthusiasts of all skill levels to connect to UR and each other, to ask questions and to exchange information. While the UR Forum was created by UR+ and our admins are UR employees, the majority of the content is created by you, the UR Forum user.

**Academy**

The UR Academy site academy.universal-robots.com offers a variety of training opportunities.

**Developer suite**

The UR Developer Suite universal-robots.com/products/ur-developer-suite is a collection of all the tools needed to build an entire solution, including developing URCaps, adapting end-effectors, and integrating hardware.

**Online manuals**

Manuals, guides and handbooks can be read online. We have gathered a large number of documents at https://www.universal-robots.com/manuals

- PolyScope Software Handbook with descriptions and instructions for the software
- The Service Handbook with instructions for troubleshooting, maintenance and repair
- The Script Directory with scripting for in depth programming

# 2.1. Technical Specifications UR5e

| | |
|---|---|
| Robot type | UR5e |
| Robot weight | 20.7 kg / 45.7 lb |
| Maximum payload | 5 kg / 11 lb |
| Reach | 850 mm / 33.5 in |
| Joint ranges | Unlimited rotation of tool flange, ± 360 ° for all other joints<br>± 360 ° for all joints |
| Speed | Joints: Max 180 °/s .<br>Tool: Approx. 1 m/s / Approx. 39.4 in/s. |
| System update frequency | 500 Hz |
| Force Torque sensor accuracy | 4 N |
| Pose repeatability | ± 0.03 mm / ± 0.0011 in (1.1 mils)per ISO 9283 |
| Footprint | Ø149 mm / 5.9 in |
| Degrees of freedom | 6 rotating joints |
| Control Box size (W × H × D) | 460 mm × 449 mm × 254 mm / 18.2 in × 17.6 in × 10 in |
| Control Box I/O ports | 16 digital in, 16 digital out, 2 analog in, 2 analog out |
| Tool I/O ports | 2 digital in, 2 digital out, 2 analog in |
| Tool Communication | RS |
| Tool I/O power supply & voltage | 12 V/24 V 1.5 A (Dual pin) 1 A (Single pin) |
| Control Box I/O power supply | 24 V 2 A in Control Box |
| Communication | TCP/IP 1000 Mbit: IEEE 802.3ab, 1000BASE-T Ethernet socket, MODBUS TCP & EtherNet/IP Adapter, Profinet |
| Programming | PolyScope graphical user interface on 12" touchscreen |
| Noise | Robot Arm: Less than 60dB(A) Control Box: Less than 50dB(A)<br>Robot Arm: Less than 65dB(A) Control Box: Less than 50dB(A) |
| IP classification | IP54 |
| Cleanroom classification | Robot Arm: ISO Class 5, Control Box: ISO Class 6 |
| Power consumption (average) | 570 W |
| Power consumption | Approx. 250 W using a typical program |
| Short-Circuit Current Rating (SCCR) | 200A |
| Collaboration operation | 17 advanced safety functions. In compliance with: EN ISO 13849-1, PLd, Cat.3 and EN ISO 10218-1 |
| Materials | Aluminium, PC/ASA plastic |
| Ambient temperature range | 0-50 °C. At ambient temperatures above 35°C, the robot may operate at reduced speed and performance. |
| Control Box power source | 100-240 VAC, 47-440 Hz |
| TP cable: Teach Pendant to Control Box | 4.5 m / 177 in |
| Robot Cable: Robot Arm to Control Box (options) | Standard (PVC) 6 m/236 in x 13.4 mm<br>Standard (PVC) 12 m/472.4 in x 13.4 mm<br>Hiflex (PUR) 6 m/236 in x 12.1 mm<br>Hiflex (PUR) 12 m/472.4 in x 12.1 mm |

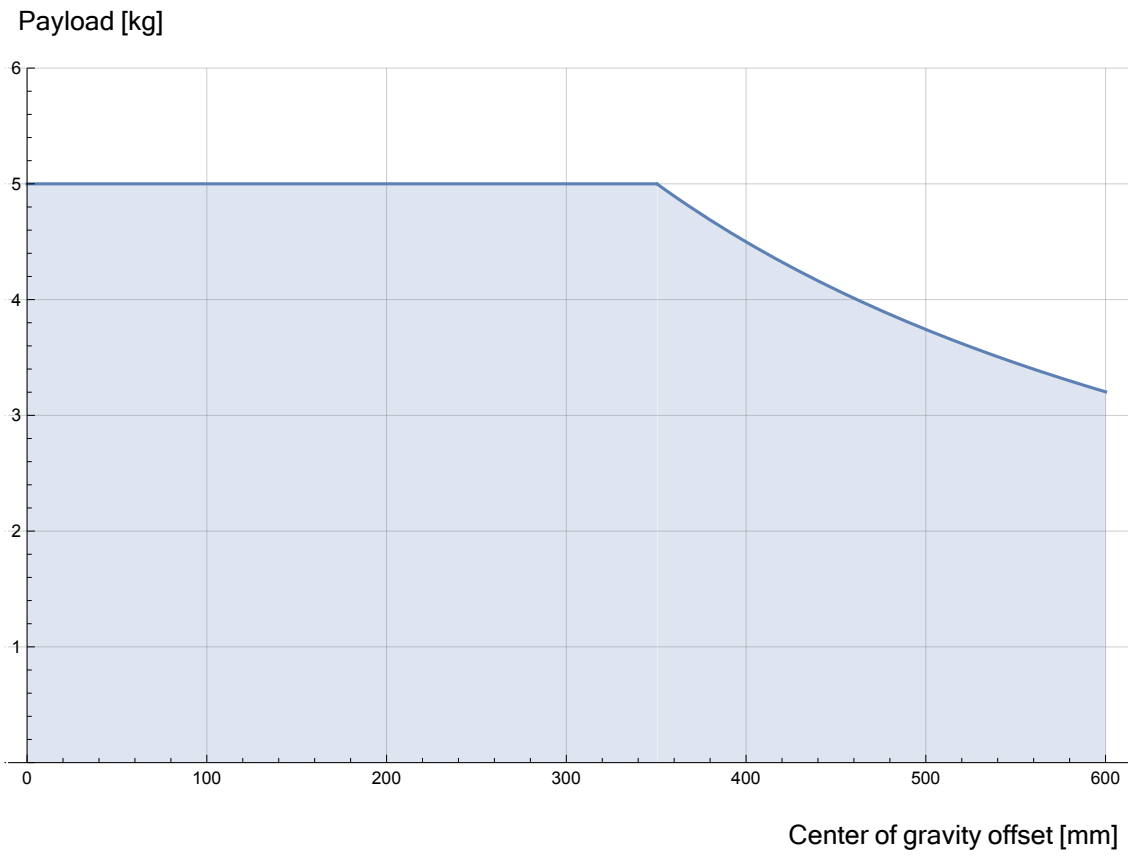
# 2.2. Maximum Payload

**Description**

The rated robot arm payload depends on the center of gravity (CoG) offset of the payload, as shown below. The CoG offset is defined as the distance from the center of the tool flange to the center of gravity of the attached payload.

The robot arm can accommodate a long center of gravity offset, if the payload is placed below the tool flange. For example when computing the payload mass in a pick and place application, consider both the gripper and the workpiece.

The robot's capacity to accelerate can be reduced if the payload CoG exceeds the robot's reach and payload. You can verify the reach and payload of your robot in the Technical Specifications.




*The relationship between the rated payload and the center of gravity offset.*

**Payload inertia**

You can configure payloads with high inertia, if the payload is set correctly.
The controller software automatically adjusts accelerations when the following parameters are correclty configured:

- Payload mass
- Center of gravity
- Inertia

You can use the URSim to evaluate the accelerations and cycle times of the robot motions with a specific payload.

# 2.3. Stopping Time and Stopping Distance

**Description**

**NOTICE**

You can set user-defined safety rated maximum stopping time and distance.
If user-defined settings are used, the program speed is dynamically adjusted to always comply with the selected limits.

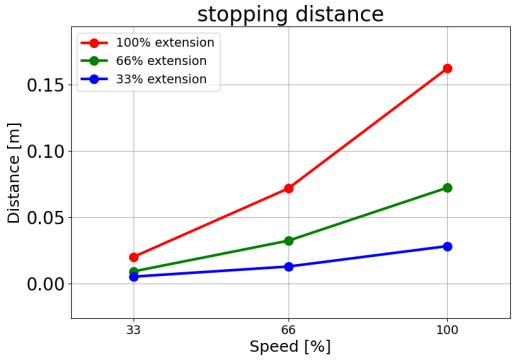
The graphical data provided for **Joint 0 (base)**, **Joint 1 (shoulder)** and **Joint 2 (elbow)** is valid for stopping distance and stopping time:

- Category 0
- Category 1
- Category 2

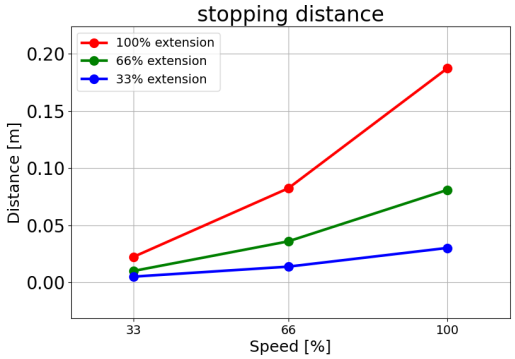
The **Joint 0** test was carried out using a horizontal movement, where the rotational axis was perpendicular to the ground. For the **Joint 1** and **Joint 2** tests, the robot followed a vertical trajectory, where the rotational axes were parallel to the ground, and the stop was done while the robot was moving downward.
The Y-axis is the distance from where the stop is initiated to the final position.
The payload CoG is at the tool flange.

**Joint 0 (BASE)**

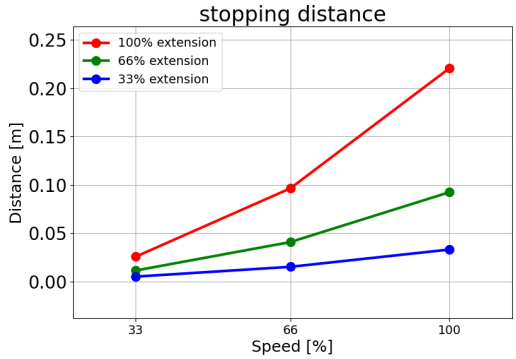
Stopping distance in meters for 33% of 5kg



Stopping distance in meters for 66% of 5kg

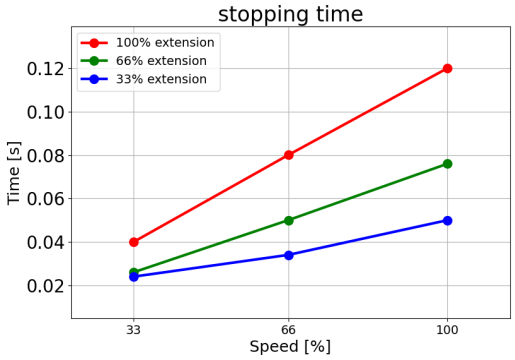



Stopping distance in meters for maximum payload of 5kg

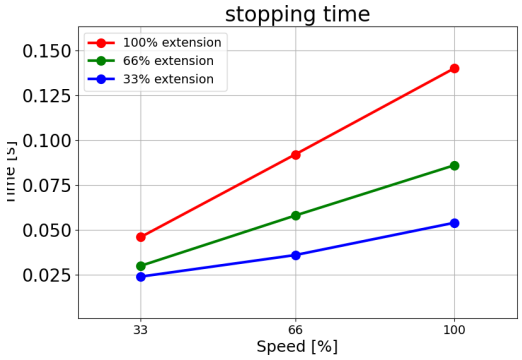



**Joint 0 (BASE)**

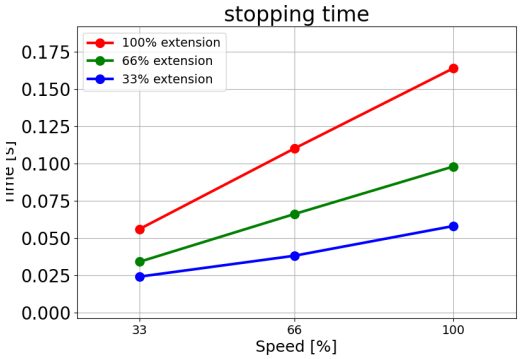
Stopping time in seconds for 33% of 5kg




Stopping time in seconds for 66% of 5kg

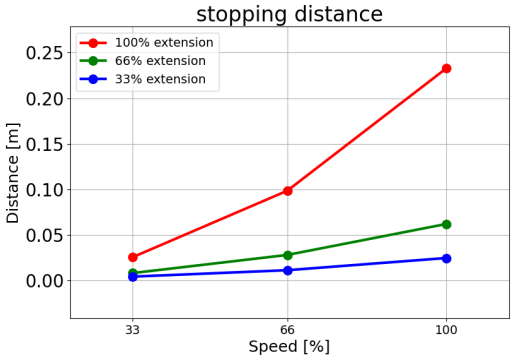


Stopping time in seconds for maximum payload of 5kg

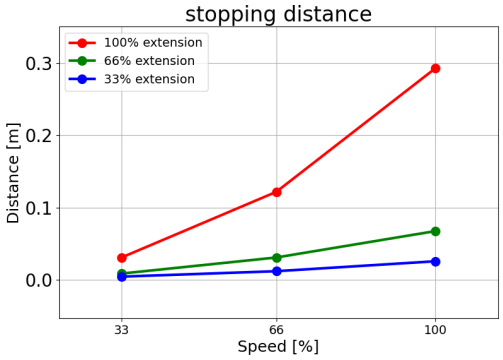



**Joint 1 (SHOULDER)**

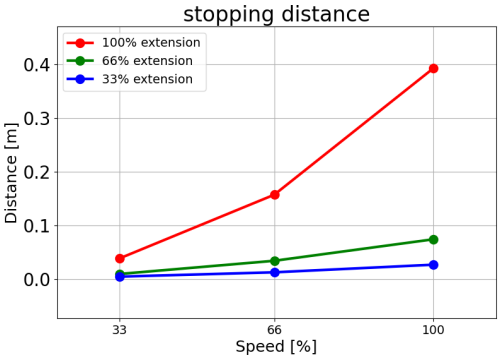
Stopping distance in meters for 33% of 5kg




Stopping distance in meters for 66% of 5kg

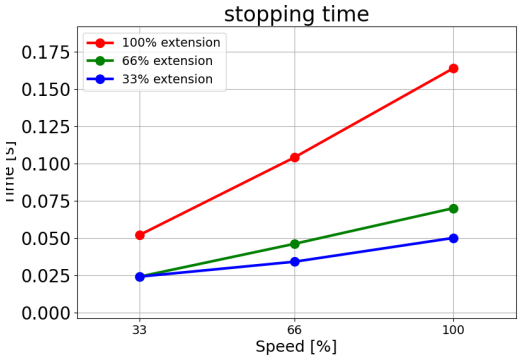



Stopping distance in meters for maximum payload of 5kg

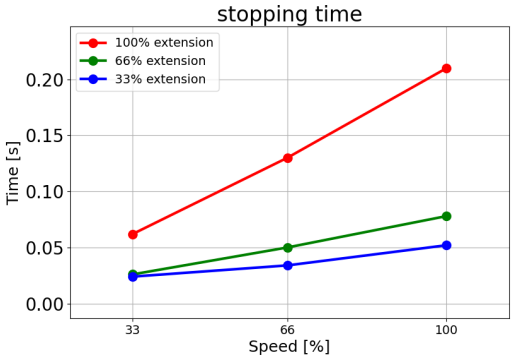


**Joint 1 (SHOULDER)**

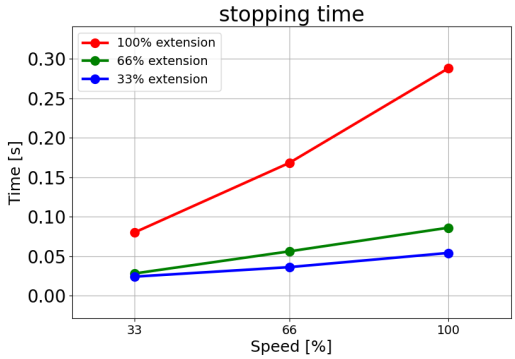
Stopping time in seconds for 33% of 5kg




Stopping time in seconds for 66% of 5kg

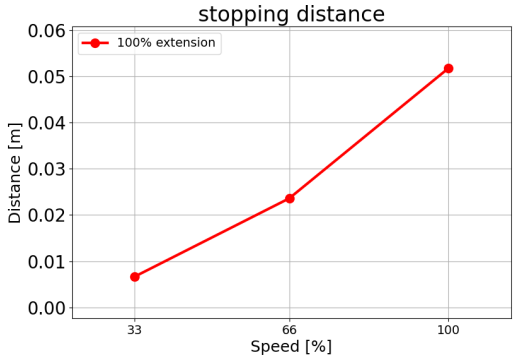



Stopping time in seconds for maximum payload of 5kg

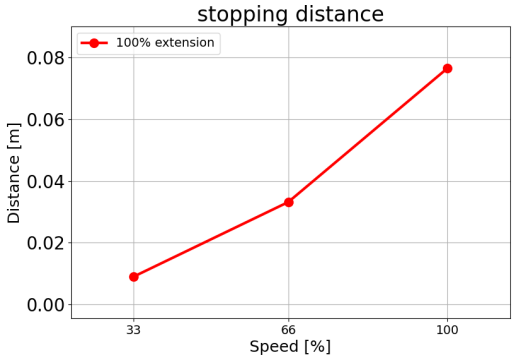



**Joint 2 (ELBOW)**

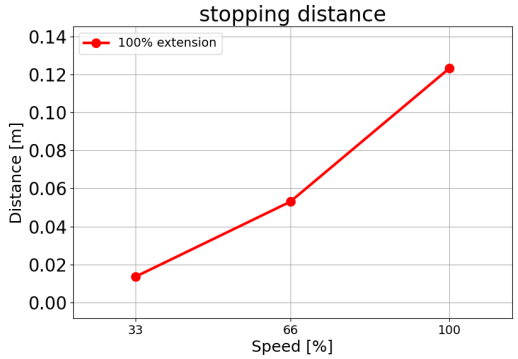
Stopping distance in meters for 33% of 5kg



Stopping distance in meters for 66% of 5kg

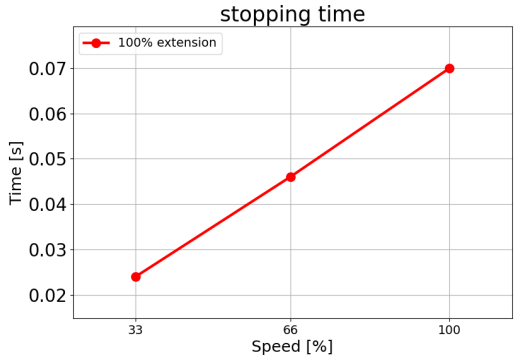



Stopping distance in meters maximum payload of 5kg

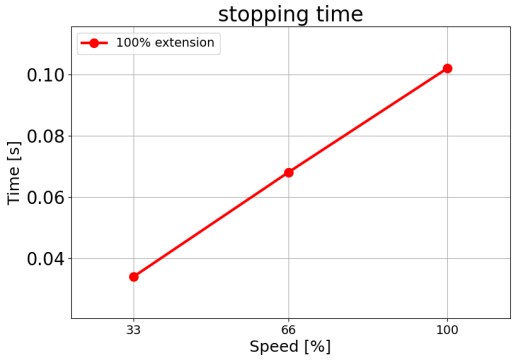



**Joint 2 (ELBOW)**

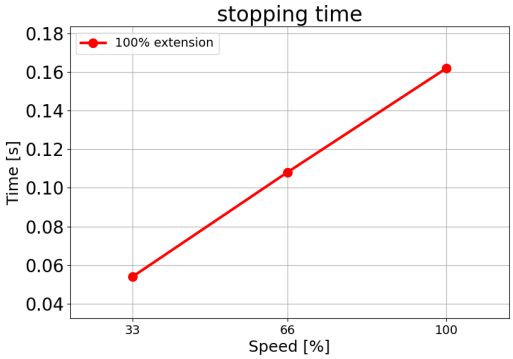
Stopping time in seconds for 33% of 5kg




Stopping time in seconds for 66% of 5kg



Stopping time in seconds for maximum payload of 5kg

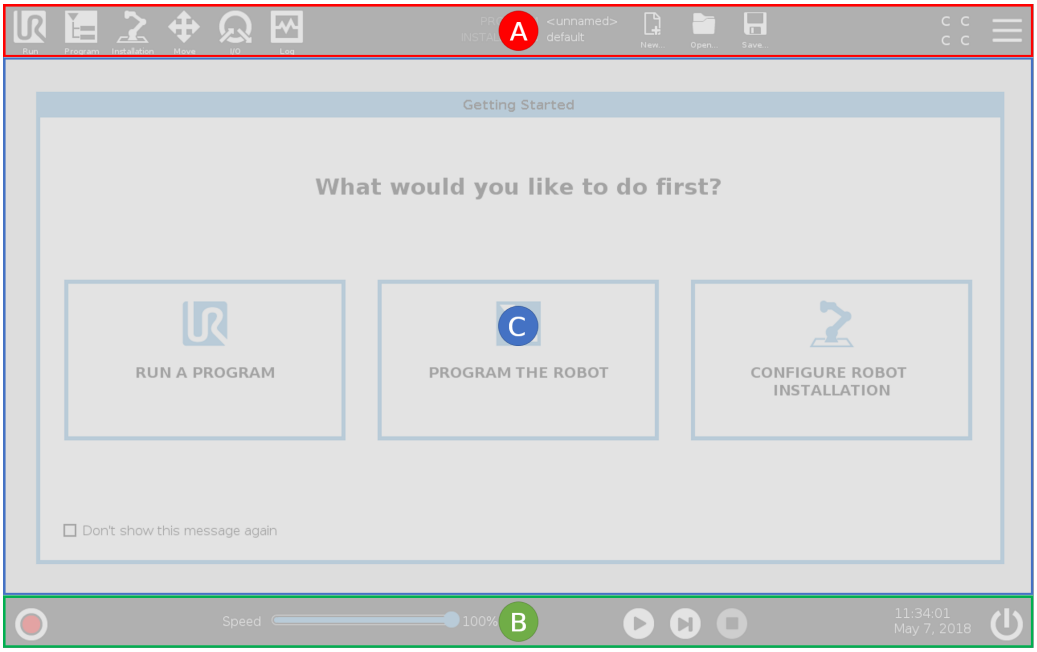


# 2.4. PolyScope Overview

**Description**

PolyScope is the Graphical User Interface (GUI) on the **Teach Pendant** that operates the robot arm via a touch screen. You create, load and execute programs for the robot in PolyScope. The PolyScope interface is divided as shown in the following illustration:

- A: **Header** with icons/tabs that make interactive screens available to you.
- B: **Footer** with buttons that control your loaded program/s.
- C: **Screen** with fields and options to manage and monitor robot actions.




**Using the Touch Screen**

The touch sensitivity is designed to avoid false selections on PolyScope, and to prevent unexpected motion of the robot.

The Teach Pendant touch screen is optimized for use in industrial environments. Unlike consumer electronics, Teach Pendant touch screen sensitivity is, by design, more resistant to environmental factors such as:

- water droplets and/or machine coolant droplets
- radio wave emissions
- other conducted noise from the operating environment.

For best results, use the tip of your finger to make a selection on the screen.
In this manual, this is referred to as a "tap".
A commercially available stylus may be used to make selections on the screen if desired.

## 2.4.1. Icons/Tabs On PolyScope

**Description**

The following section lists and defines the icons/tabs and buttons in the PolyScope interface.

**Header Icons / Functions**


**Run** is a simple means of operating the robot using pre-written programs.

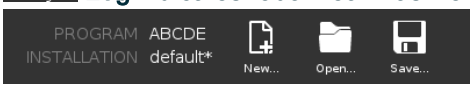

**Program** creates and/or modifies robot programs.


**Installation** configures robot arm settings and external equipment e.g. mounting and safety.


**Move** controls and/or regulates robot movement.


**I/O** monitors and sets live Input/Output signals to and from robot control box.


**Log** indicates robot health as well as any warning or error messages.




**Program and Installation Manager** selects and displays active program and installation. The Program and Installation Manager includes: File Path, New, Open and Save.


**New...** creates a new Program or Installation.


**Open...** opens a previously created and saved Program or Installation.


**Save...** saves a Program, Installation or both at the same time.

**Operational modes**


**Automatic** indicates the operational mode of the robot is set to Automatic. Tap it to switch to the Manual operational mode.


**Manual** indicates the operational mode of the robot is set to Manual. Tap it to switch to the Automatic operational mode.

**Remote Control**

The Local mode and Remote mode icons only become accessible if you enable Remote Control.

**Local** indicates the robot can be controlled locally. Tap it to switch to Remote control.

**Remote** indicates the robot can be controlled from a remote location. Tap it to switch to Local control.

**Safety Checksum** displays the active safety configuration.


**Hamburger Menu** accesses PolyScope Help, About and Settings.

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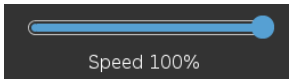
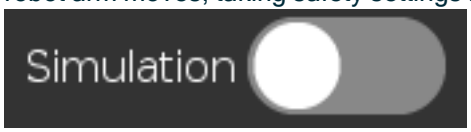
**Footer Icons / Functions**


**Initialize** manages robot state. When RED, press it to make the robot operational.



**Speed Slider** shows in real time the relative speed at which the robot arm moves, taking safety settings into account.



**Simulation** button toggles a program execution between Simulation Mode and the Real Robot. When running in Simulation Mode, the Robot Arm does not move. Therefore, the robot cannot damage itself or nearby equipment in a collision. If you are unsure what the Robot Arm will do, use Simulation Mode to test programs.


**Play** starts current loaded robot Program.


**Step** allows a Program to be run single-stepped.


**Stop** halts current loaded robot Program.

**High Speed Manual Mode**

High Speed Manual Mode is a hold-to-run function, only available in Manual mode when a Three-Position Enabling Device is configured.

**High Speed Manual Mode**allows both tool speed and elbow speed to temporarily exceed 250mm/s.

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