

MECADEMIC

INDUSTRIAL ROBOTICS



MECA500 (R3 & R4)

USER MANUAL

For Firmware Version 9.2.x

Document Revision: 1

November 2, 2022

The information contained herein is the property of Mecademic and shall not be reproduced in whole or in part without prior written approval of Mecademic. The information herein is subject to change without notice and should not be construed as a commitment by Mecademic. This manual will be periodically reviewed and revised.

While every effort has been made to ensure accuracy in this publication, no responsibility can be accepted for errors or omissions. Data may change, as well as legislation, and you are strongly advised to obtain copies of the most recently issued regulations, standards, and guidelines.

This document is not intended to form the basis of a contract.

© Copyright 2015–2022 Mecademic

CONTENTS

1. INTRODUCTION	1
1.1. Inside the box	1
2. SAFETY	2
2.1. Power supply and safety features	3
2.2. Disabling the robot brakes	5
2.3. Limitations of the brakes	5
3. TECHNICAL SPECIFICATIONS	6
4. INSTALLING THE MECA500	8
5. THE WEB INTERFACE	12
5.1. Updating the robot's firmware	12
5.2. Overview	13
5.3. The programming panel	13
5.3.1 The status control checkboxes	13
5.3.2 The program editor field	14
5.3.3 The Response Log field	15
5.3.4 The Request Log tab	15
5.4. The robot position panel	15
5.5. 3D view panel	16
5.6. The Quick Command panel	16
5.7. The jogging panel	16
5.7.1 The Joint Jog tab	16
5.7.2 The Cartesian Jog tab	16
5.7.3 The Joystick tab	17
5.7.4 Opening and closing Mecademic's grippers	19
6. OPERATING THE ROBOT	20
6.1. Power-up procedure	20
6.1.1 Powering the robot	20
6.1.2 Connecting to the robot	20
6.1.3 Activating the robot	20
6.1.4 Homing the robot	20
6.1.5 Moving the robot	20
6.2. Power-off procedure	22
6.2.1 Zeroing the robot joints (optional)	22
6.2.2 Deactivating the robot	22
6.2.3 Disconnecting the robot	22
6.2.4 Removing power	22
6.3. Offline mode	23
6.3.1 Saving the program via the web interface	23
6.3.2 Running an offline program	23
6.4. Robot control panel	24
6.4.1 LEDs	24




- 6.4.2 Buttons..... 24
- 7. OPERATING THE INTELLIGENT POWER SUPPLY26**
 - 7.1. Emergency and protective stops and resetting these..... 26
 - 7.2. LEDs..... 27
 - 7.3. External connections 28
- 8. INSTALLING AN END-EFFECTOR.....31**
- 9. EXAMPLES32**
 - 9.1. Draw a square..... 32
- 10. TROUBLESHOOTING33**

ABOUT THIS MANUAL

There are two manuals that come with the Meca500 industrial robot system (revision R3 or R4): this one and the [Programming Manual](#). This manual will guide you through the steps required for setting up your Meca500 and for using it in a safe manner. You must read this user manual thoroughly during the unpacking and first use of your Meca500.

Symbol definitions

The following table lists the symbols that may be used in Mecademic manuals to denote certain conditions. Particular attention must be paid to the warning messages in this manual.

SYMBOL	DEFINITION
	NOTICE. Identifies information that requires special consideration.
	CAUTION. Provides indications that must be respected in order to avoid equipment or work (data) on the system being damaged or lost.
	WARNING. Provides indications that must be respected in order to avoid a potentially hazardous situation, which could result in injury.

1. INTRODUCTION

The Meca500 is a six-axis industrial robot arm that is easy to use, robust and lightweight. However, the robot is a precision device with rapidly moving parts and should therefore be used only by technical personnel who have read and understood this user manual, to avoid damages to the robot, its end-effector, the workpiece and adjacent equipment, and, most importantly, to avoid injuries.

1.1. Inside the box

Remove all items carefully and do not discard your shipping box and packing foam.

Table 1 shows the items that come with a standard shipment of a Meca500 robot system. Your box may also contain the MEGP 25E or MEGP 25LS electric gripper, the MPM500 pneumatic module, or other small accessories. Do not open these additional packages immediately. You must read the grippers or pneumatic module user manuals prior to installing the end-of-arm-tooling (EOAT) on the robot.






Qty	SKU	Description	Photo
1	9100-001 OR 9100-002	Meca500 robot arm, revision R3 OR Meca500 robot arm, revision R4	
1	9201-001 OR 9200-003	24 V DC intelligent power supply, revision R3 OR 24 V DC intelligent power supply, revision R4	
1	9403-001	D-SUB 15-position dongle	
1	2003-005	Ethernet cable: 2-meter M12 D-Code to RJ45	
1	2003-006	DC power cable: M12 circular male to M12 circular female DC power cable	

Table 1: Standard parts list



Note, that you must provide your own AC power cord, with three-prong IEC C13 connector on one end, and your own country's power plug on the other. You must also provide M6 screws of proper length for fixing the robot's base and the power supply.

The box contains a sheet specifying the robot firmware version. If that version is not 9.2.x, go to <https://support.mecademic.com> and download the corresponding user manual.

2. SAFETY

The Meca500 weighs less than 5 kg, however, it can move fast and cause injuries, especially when certain end-effectors are attached to its flange (e.g., a sharp tool or a laser). The robot also has pinch points where robot joints can squeeze a finger (Figure 1).

It is imperative that you follow the guidelines of ISO 12100:2010 and ISO 10218-2:2011 and conduct a risk assessment of your complete robot cell, including the Meca500, its end-effector and all adjacent equipment.



In the shipping position, the robot can be temporarily deposited on its base. In other robot positions, the robot may tip and should not be placed on its base without fixing it. If the robot tips and falls from a height, it may cause an injury, and certainly get damaged.



- Handle the robot with care.
- The Meca500 is equipped with brakes on its first three joints (the ones close to the base). When the robot is not activated, these brakes are automatically applied.
Do not force the robot brakes, unless there is an emergency!
- Inspect the robot and power supply for damages. If either appears damaged, do not use them and contact us immediately.
- Do not modify or disassemble the robot arm or the power supply.
- Do not use or store the Meca500 in a humid environment.
- Do not operate the Meca500 at temperatures below 5°C or above 45°C.
- Use only the power supply provided with your system.
- Use only the Ethernet and DC-power cables provided. If longer cables are needed, contact us.



Figure 1: Pinch point example

2.1. Power supply and safety features

The Mecademic power supply integrates several safety features. Use only the intelligent power supply provided by us to power your Meca500 robot arm: it will not function with our older power supplies, or other third party 24 V DC power supplies.

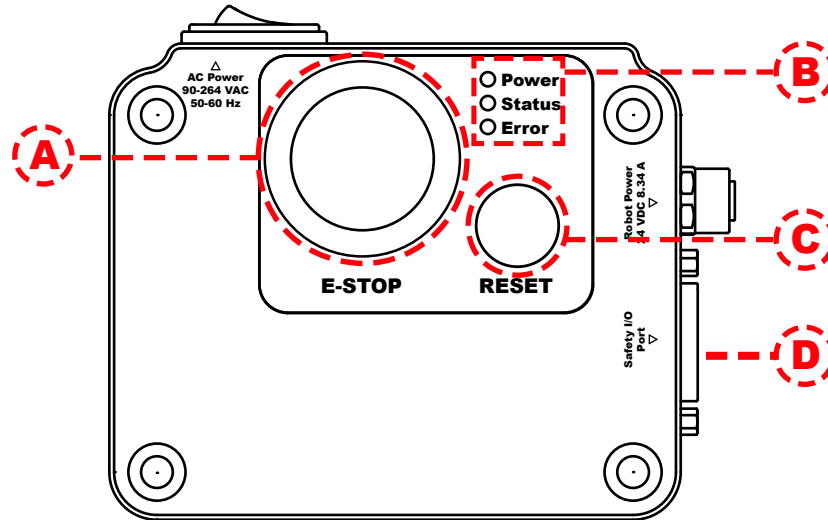


Figure 2: Power supply features



The latest, R4, revision of the Meca500 incorporates one major change compared to version R3: the E-Stop no longer cuts power to the complete robot, but only to the motor drives. Do not use the power supply of an R3 version with a Meca500 R4, and vice versa. The R4 robot arms and power supplies are clearly indicated as being R4.

Figure 2 and Figure 3 show the Meca500 power supply with safety module. Its main features are:

- A: Emergency stop button (Stop Category 1), designed as PL=d with Safety Category 3.
- B: Status LEDs.
- C: Reset button.
- D: D-SUB 15-position interface (see also Figure 3) for connecting safety I/O.

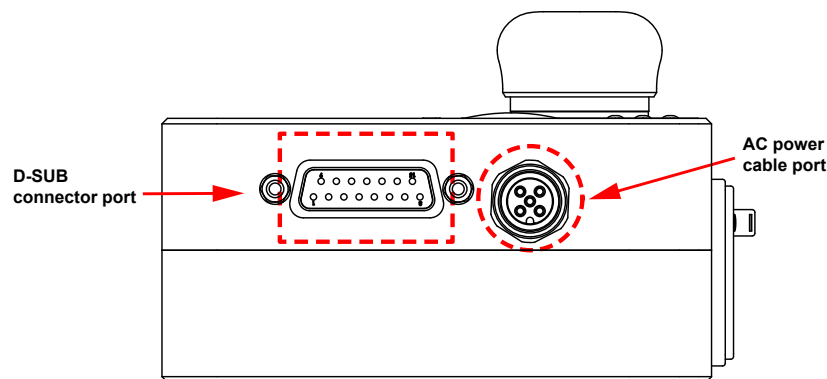


Figure 3: Power supply connectors



To start using your robot immediately, connect the D-SUB 15-position dongle to the power supply interface, while the power supply is still switched off.



The D-SUB connector is a bypass device to be used during setup and maintenance only. You must wire the appropriate external safety I/O connections when using the robot in production mode (see [Section 7](#)).



Stand away from the robot when it is activated, wear safety goggles and be attentive and alert. In case of an emergency, press the E-STOP button (on the power supply) immediately.

Connect the D-SUB bypass dongle to the power supply interface to get familiar with your robot. This would deactivate the external protective stops and emergency stop connections. Read [Section 7](#) to learn how to wire your external safety connections.

To connect the power supply to the robot, use the DC power cable provided and never modify it.

When disconnecting the AC power, either by using the on/off switch on the power supply or by unplugging the AC cord, the brakes on joints 1, 2 and 3 will be immediately applied and the joints will be immobilized instantly. Therefore, to avoid premature use of the brakes, do not disconnect the AC power when the robot is moving.

When disconnecting the AC power, pressing the E-STOP button, or activating the external E-Stop or protective stop 1, the wrist joints of the robot become free. This minimizes the risks of pinning and pinching from the wrist and the end-effector. However, beware that the end-effector might slowly move downwards under the effects of gravity, as shown in [Figure 4](#). Depending on the type of end-effector used, this residual motion might lead to an injury.



Beware that the end-effector might slowly move downwards under the effects of gravity when you deactivate the robot (e.g., by pressing the E-STOP button).



Figure 4: When the robot is deactivated, the end-effector will slowly move downwards under the effects of gravity

2.2. Disabling the robot brakes

In case of a collision, you can disable the brakes of joints 1, 2 and 3. This can only be done if the robot is powered AND not activated. How to activate and deactivate the robot is explained later in this manual, but for now, it suffices to say that the robot is deactivated after pressing the E-STOP button. Thus, in case of a collision—though ideally prior to that—you must press the E-STOP button.

Then, to release the brakes of joints 1, 2 and 3, press one of the two 0G buttons on the base of the robot continuously while holding the robot with your other hand. After 3 seconds, you will hear the deactivation of the brakes. Continue holding the 0G button pressed and move the robot away from obstacles. Finally, release the 0G button, and move away from the robot. Note that there is a pair of commands to disable and re-enable the brakes. These are described in the [Programming Manual](#).

2.3. Limitations of the brakes

Remember that the robot has brakes on joints 1, 2 and 3 only. Therefore, when the robot is deactivated or powered off, the robot's end-effector will go down under the effects of gravity ([Figure 4](#)).

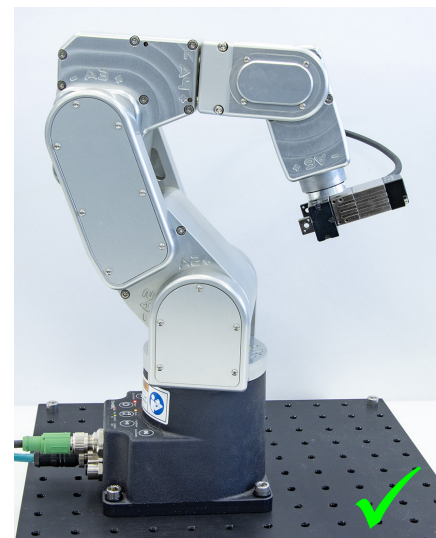
In addition, it is important to remember that the brakes used on joints 1, 2 and 3 are emergency brakes, not locking brakes. Therefore, if you leave the robot in a configuration where the robot's forearm is nearly horizontal, the robot will slowly fall down under the effects of gravity, especially if you have the maximum payload. For example, if you deactivate the robot in the configuration shown in [Figure 5a](#), the robot's gripper might eventually collide with the table.



Before leaving the robot deactivated or powered off for an extended period of time, bring it to a position that minimizes the static torques on joints 1, 2 and 3 (see [Figure 5](#)).



(a) DO NOT leave the robot deactivated like this



(b) DO leave it like this

Figure 5: Before leaving the robot deactivated for an extended period of time, move it to a position that minimizes the static joint torques

3. TECHNICAL SPECIFICATIONS

Table 2 lists the main technical specifications of the Meca500 robot arm. Note that the maximum tool-center point (TCP) speed is software limited to 1,000 mm/s when the robot executes Cartesian-space motion commands, regardless of the definition of the TCP with respect to the robot's flange. However, if the robot is fully stretched and all joints move at maximum speed, due to a joint-space command, the TCP speed can surpass 2,000 mm/s.



When the robot arm is fully-stretched, the robot's end-effector can move at 2,000 mm/s or even faster.

TECHNICAL SPECIFICATIONS	
Characteristic	Value
Position repeatability	0.005 mm
Rated payload	0.5 kg
Maximum payload	1.0 kg (under special conditions)
Weight of robot arm	4.6 kg
Range for joint 1	[−175°, 175°]
Range for joint 2	[−70°, 90°]
Range for joint 3	[−135°, 70°]
Range for joint 4	[−170°, 170°]
Range for joint 5	[−115°, 115°]
Range for joint 6	[−36,000°, 36,000°]
Maximum speed for joint 1	150°/s
Maximum speed for joint 2	150°/s
Maximum speed for joint 3	180°/s
Maximum speed for joint 4	300°/s
Maximum speed for joint 5	300°/s
Maximum speed for joint 6	500°/s
Maximum TCP speed	1,000 mm/s
Maximum power consumption	200 W
Input voltage	24 VDC
Operating ambient temperature range	[5°, 45°]
Operating ambient relative humidity range	[10%, 80%] (non-condensing)
IP rating	IP 40

Table 2: Technical specifications for the Meca500

Figure 6 shows all the link lengths and offsets of the Meca500, necessary for obtaining the so-called Denavit-Hartenberg parameters. Note that all joints are at zero degrees in the configuration drawn in black line. Also note that the gray zone is the area attainable by the center of the robot's wrist (the intersection point of the last three axes), for a fixed angle of joint 1. This area, or even the volume obtained by sweeping this area about the axis of joint 1 is NOT the workspace of the robot. The workspace of the robot is a six-dimensional entity depending on the definition of the tool reference frame. The workspace is the set of all attainable poses (positions and orientations) of the tool reference frame with respect to the robot's base. Even for a specific choice of a tool reference frame, it is impossible to represent this six-dimensional workspace (read [this tutorial](#) of ours).

The CAD files of the Meca500 (in STEP format) can be downloaded from our [web site](#). Alternatively, you can use one of several robot simulation and offline programming software packages that include a model of our Meca500, including Visual Components and RoboDK. Note that we also offer a [Mecademic-only version of RoboDK](#), for exclusive use with our robots.

Finally, as already mentioned, the power supply provided has an IEC C14 connector that accepts an AC power cord with three-prong IEC C13 connector on one end, and your own country's power plug on the other. You can connect this power cord to any AC source that supplies voltage between 90 V and 264 V at frequency between 50 Hz to 60 Hz.

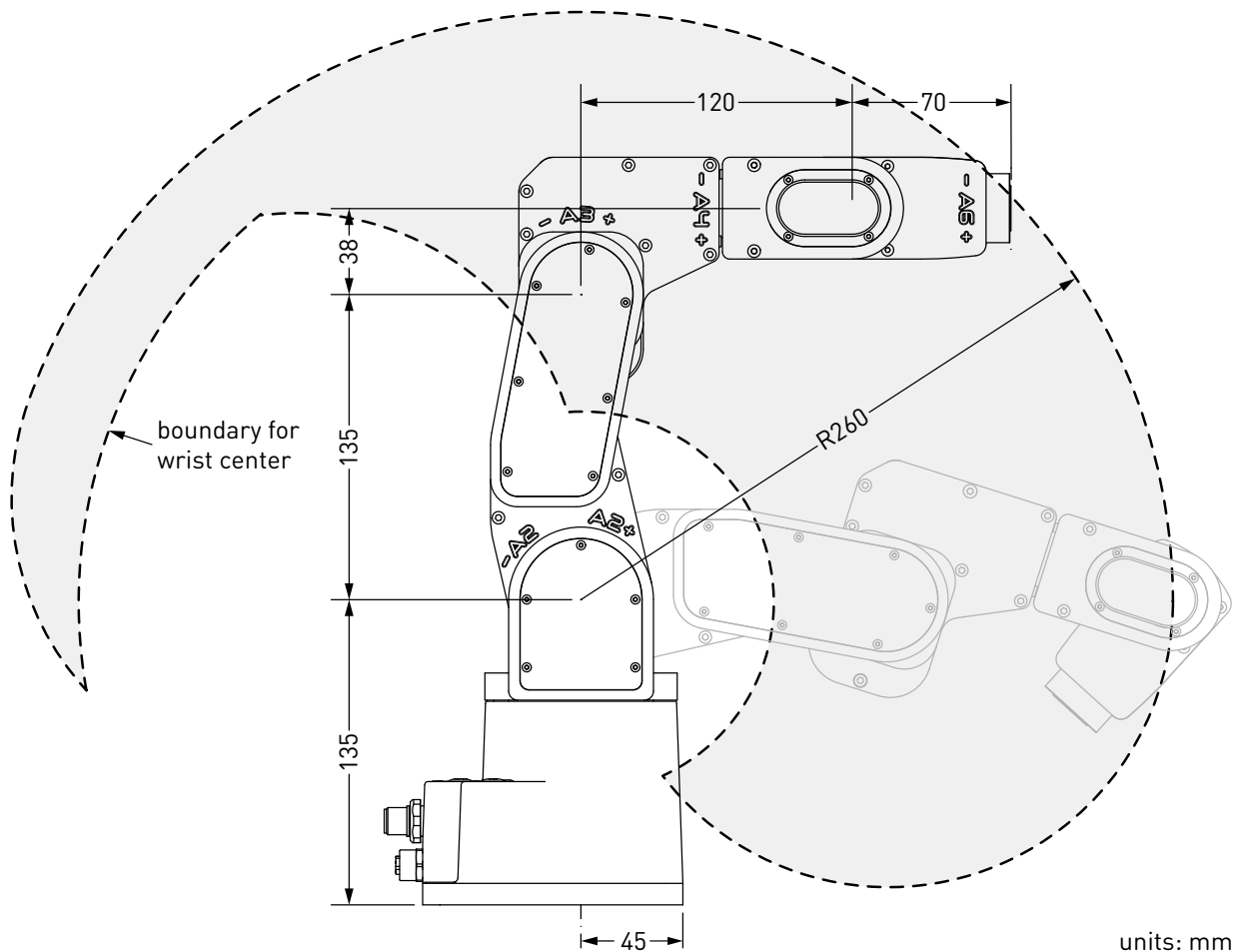


Figure 6: The dimensions of the Meca500

4. INSTALLING THE MECA500

You are surely eager to start using your Meca500. It is, however, imperative that you fix solidly the base of your robot arm with four M6 screws before activating the robot. We typically use metric breadboards such as those from Thorlabs, but you can also use our [adaptor plate](#), build your entire robot cell at Vention, or use the modular system made by Tessella Automation. We recommend that you use three kinematic positioners to constraint your base, so that you can always remove and then install it in the exact same location. Our adaptor plate, for example, uses three locating pins.

The dimensions of the base are shown in [Figure 7](#) and an example of installation is shown in [Figure 8](#). Note that you can install the robot base in any orientation. The robot will automatically detect the angle between the axis of joint 1 and the gravity vector (no need to manually specify this angle). Also, note that you can mount the robot's base on a mobile body (e.g., on the carriage of a linear guide), but only if you do not intend to move the robot's joints, while the robot's base is moving with respect to the ground.

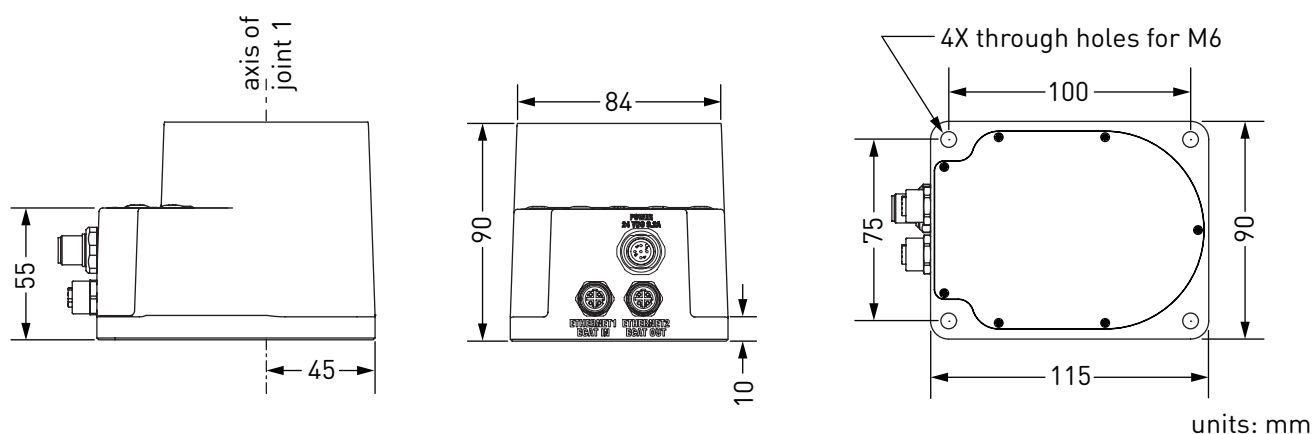


Figure 7: Dimensions of the robot base

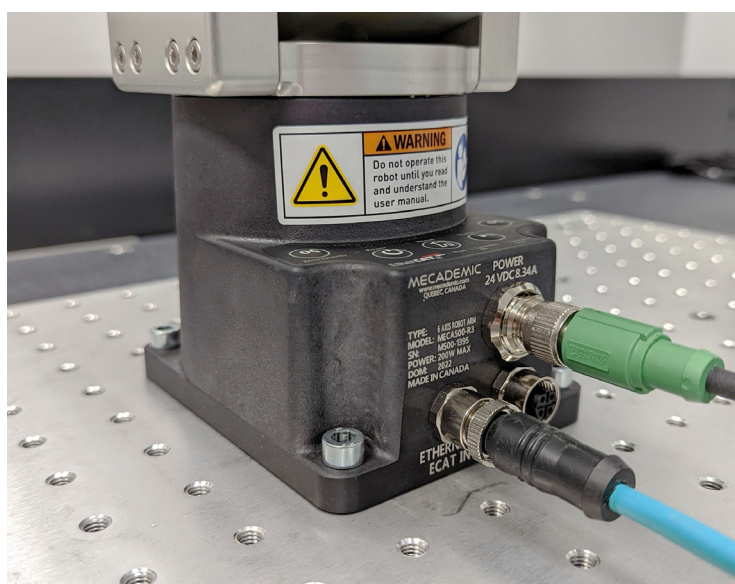


Figure 8: The robot base installed, with the connectors attached

Do not install any end-effector yet. We will cover this topic in [Section 8](#).

Next, you must solidly attach the power supply using four M6 screws ([Figure 9](#)), at a location sufficiently close to the robot's base to allow connection with the 2-meter DC cable provided. However, unless you are using an external emergency stop wired via the D-SUB connector, you must fix the power supply at a location that makes the integrated E-STOP button readily accessible by an operator and outside the working range of the robot.

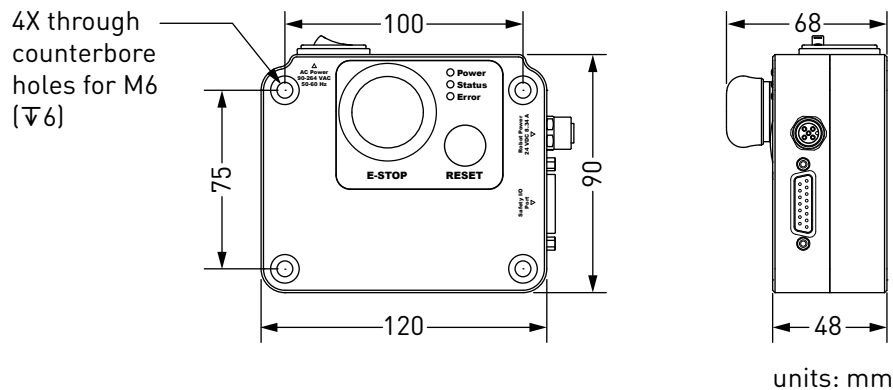
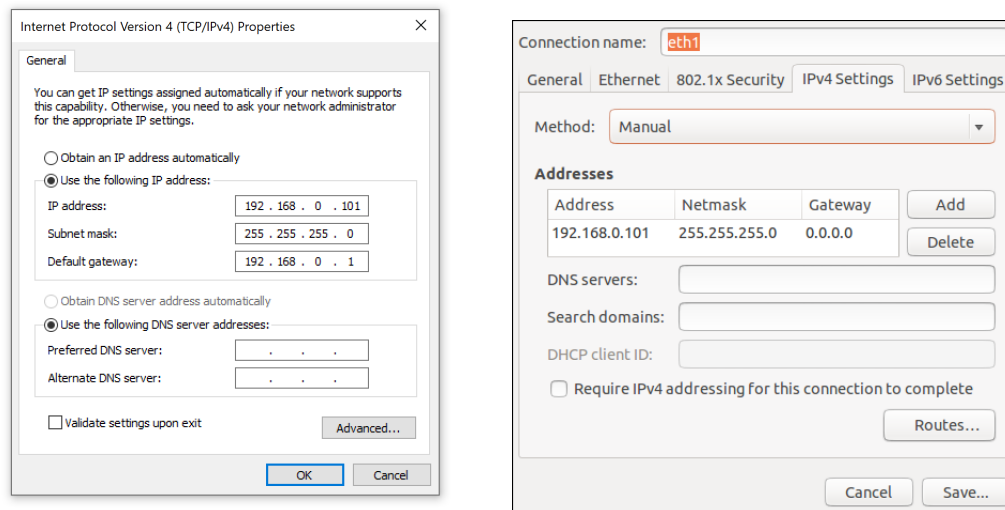


Figure 9: Dimensions of the Meca500 intelligent power supply

The following steps must then be executed before you can start using your Meca500:

1. Attach the circular connector of the Ethernet cable to the ETHERNET1 port on the robot's base and connect the RJ-45 jack to your computer or router ([Figure 8](#)). The two Ethernet ports on the robot's base act as a bridge, so you can daisy-chain several Meca500 robots, or connect an Ethernet I/O module on the ETHERNET2 port.
2. Use the DC power cable provided to connect the unpowered power supply to the robot's DC power connector ([Figure 8](#)). Make sure the connectors are completely screwed, or else you may damage the robot. Then, connect the power supply to your country-specific AC power cord (not provided). Only then, can you connect the AC power cord to an AC outlet, and switch the power supply on using its on/off button.
3. The green LED on the power supply (next to "Power") will be illuminated. Now, you must provide power to the robot by pressing the RESET button on the power supply.
4. You will hear a clicking sound coming from the power supply, and the robot's LEDs will start flashing for a few seconds while the robot's controller is booting. Once the controller ready, the red LED on the robot's base will start flashing intermittently.
5. Depending on which of the two Ethernet ports was used in step 1, the Link/Act IN (for ETHERNET1) or Link/Act OUT (for ETHERNET2) green LED will stop flashing and remain illuminated, but only once the robot has finished booting. If not, detach the Ethernet cable and repeat step 1.
6. Configure your computer with a static IP address, on the same subnet as the robot's default IP address, i.e., 192.168.0.x. The way to do this differs from one operating system to another. [Figure 10](#) shows how to do this in Windows and in Linux.
7. Open (preferably) the latest version of Google Chrome and type Meca500's default IP address 192.168.0.100 in the address bar.
8. Meca500's web interface should load instantaneously. If it doesn't, repeat the previous step with a different browser.



(a) Windows

(b) Linux

Figure 10: Two examples of how to configure the IP address of your computer



Always connect the DC power cable before connecting the power supply to an AC outlet. Always disconnect the power supply from the AC outlet before disconnecting the DC power cable.

It is also possible to change the robot's network configuration. This option is available through the robot's web interface, which will be described in detail in [Section 5](#). Here is the procedure for doing so:

1. Click on the Options dropdown menu and then on Settings ([Figure 11](#)).
2. Depending on your configuration, choose DHCP to automatically receive an address from your router or Static to force a specific IP. You don't need to reboot the robot; the new configuration will be applied as soon as you click on the Save button ([Figure 12](#)).

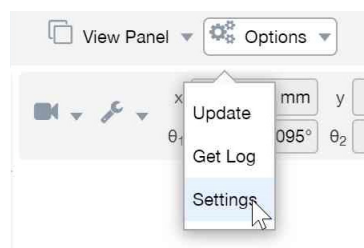


Figure 11: Options dropdown menu

Settings

DHCP

IP

192.168.0.100

Netmask

255.255.255.0

Gateway

192.168.0.1

Save

(a) DHCP

Settings

Static

IP

192.168.0.100

Netmask

255.255.255.0

Gateway

192.168.0.1

Save

(b) Static

Figure 12: Two ways to change the robot’s network configuration

5. THE WEB INTERFACE


Meca500's web interface is more or less the equivalent of the teach pendant's interface of a traditional industrial robot. The interface is essentially an HTML 5 web page with JavaScript and WebGL scripts. All of these files reside in the robot's controller, so you do not need to install anything on your computer, but Google Chrome.

The interface basically translates your mouse clicks, joystick movements and keyboard entries into proprietary commands that are sent to the robot's controller. These are the same commands described in the Programming Manual that you will eventually start sending from your own application, written in C++, Java, Python or any other modern programming language. In addition, the web interface displays the feedback messages received from the robot and the 3D model of the actual robot.

The web interface is intended mainly for testing and writing simple programs. You must create your own software application or program if you intend to use the robot for complex tasks, such as interacting with inputs and outputs (in which case you also need a third-party I/O module).

The web interface is also used for updating the firmware of your robot.

5.1. Updating the robot's firmware

Before you continue to read any further, make sure that you have the latest firmware installed on the robot and that you read the manuals corresponding to that firmware. Go to the [Downloads](#) section of our web site and download the latest firmware (a zip file). Unzip it. Then, once you have followed the procedures of [Section 4](#), and before activating the WebSocket/TCP connection on port 10,000 (i.e., before selecting the  checkbox) and activating the robot, click on Update in the Options menu in the web interface ([Figure 11](#)). A new interface will load in the same browser tab. Click on Choose File and select the file Meca500*.update that you just extracted. Then click on the Upload button. Wait a couple of minutes for the update to be completed. Once completed, the robot will reboot and the new web interface will reload.

Now that you have installed the latest robot firmware, make sure to download the latest user and programming manuals from the [Downloads](#) section of our web site and keep these manuals until you update again your firmware.

Next time you update your robot's firmware, you must also read the PDF file that is in the zip package (i.e., the Release Notes). That document lists of all the recent firmware changes.



If you have the MEGP 25E or MEGP 25LS electric gripper or the MPM500 pneumatic module installed on your Meca500 during the robot's firmware update, the firmware of your end-of-arm-tooling (EOAT) will also be updated. Otherwise, you can update the firmware of your EOAT later, by following the same procedure but selecting the m500_exttools*.update file.

5.2. Overview

Figure 13 shows the main elements of the web interface. These are:

- The menu bar
- The programming panel
- The quick command panel
- The jogging panel
- The current robot position panel
- The 3D view window

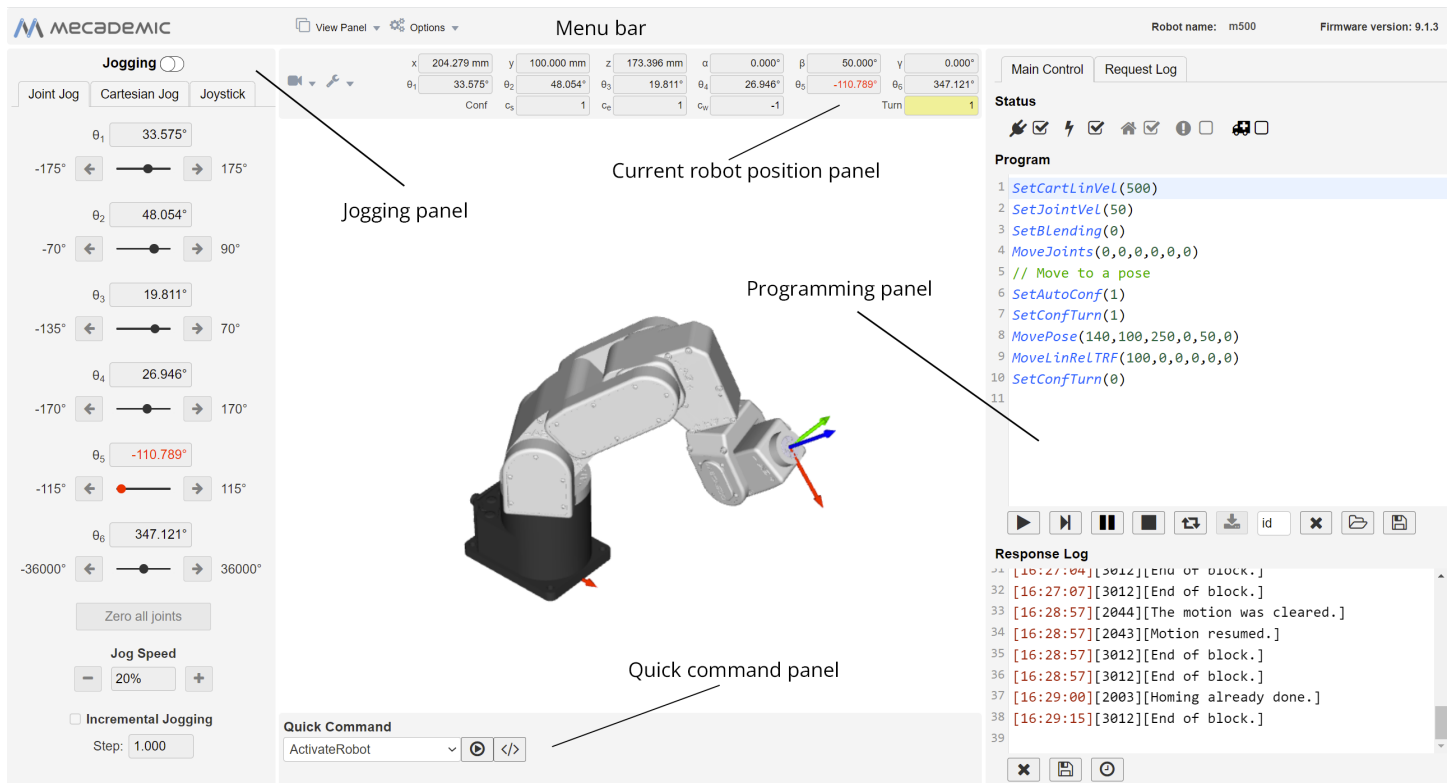



Figure 13: Overview of Meca500's web interface

You can hide the programming panel, the jogging panel and the quick command panel from the View Panel drop-down menu in the menu toolbar.

5.3. The programming panel

The programming panel has two tabs: the Main Control and the Request Log tabs.

5.3.1 The status control checkboxes

Once the web user interface is loaded, the first step is to connect it to the robot. So far, you have only established an HTTP connection with the robot, but not activated the socket messaging which is the only communication channel for controlling the robot via the web interface. To connect to the robot, select the  checkbox.

A pop-up window will be displayed with two radio buttons. For now, leave the Control radio button selected. The Monitoring option can be used to see in real-time the motion of the robot when another client (other than the web interface, e.g., Matlab running on the same PC) is controlling the actual robot.

Next, you need to activate the robot by selecting the ⚡ checkbox. Once, the robot is activated, which takes approximately 10 seconds, you need to home it by selecting the 🏠 checkbox. During homing, all joints rotate slightly for approximately 4 seconds. Make sure the robot is not near an obstacle.

Finally, whenever you have a motion error, the ⚠ checkbox will become selected and red. To reset the error, you need to clear the checkbox (or press the ▶ below the Program field, as we will explain later).

5.3.2 The program editor field

The program editor is used mainly for writing and executing very simple programs, i.e., for testing. These programs are sequences of the proprietary commands described in the Programming Manual. The robot's command interface does not support conditionals, loops, or other flow control statements, nor variables. The robot only accepts request commands (to get information from the robot) and motion commands (to tell the robot to perform an action). The editor also supports comments in C/C++ style (e.g., // and /* */).

For complex tasks, you must write a program outside the web interface (e.g., in your preferred integrated development environment) that parses the robot's feedback, controls the robot, and handles all flow control logic. For this, you can use any language that supports communication over TCP/IP (e.g., C/C++, C#, Python, Java or even Structured Text, in the case of a PLC). Note that we offer a Python API on our [GitHub](#) account.

The control buttons below the editor field have the following functionality:

- ▶ Execute the complete program.
- ⏮ Execute the command where the cursor is, and move the cursor to the next line. You can also use the keyboard shortcut **Ctrl+Enter** for that.
- ⏸ Hold motion (pauses the robot and keeps the current program; motion is restarted with the same button, when it becomes red).
- Clear motion (stops the motion and clears the command queue).
- ↺ Loop the program.
- 💾 Save the program in the robot for offline execution (see [Section 6.3.1](#)), with the id number defined in the number field on the right of this button, only when the robot is deactivated.
- ✕ Delete all entries in the program editor field.
- 📂 Open an existing program.
- 📄 Save the contents of the program editor field to a file.

In the event of a motion error, the ▶ button changes to ⚠ and all other buttons on the same row are disabled. Pressing ⚠ resets the error.

Finally, an important feature of the programming editor is the context menu called by pressing the right mouse button when the mouse cursor is over the programming editor ([Figure 14](#)). Essentially, this gives you access to insert most available commands at the current position of the cursor in the programming editor. This functionality is quite similar to the quick command menu, with a few differences. The only major difference is the possibility to insert the commands *MoveJoints*, *MoveLin*, and *MovePose* with the

current joint set or end-effector pose, as well as the commands *SetConf* and *SetConfTurn*, with the current inverse kinematic parameters.

To cancel the context menu without inserting a command, press **Esc** or click away.

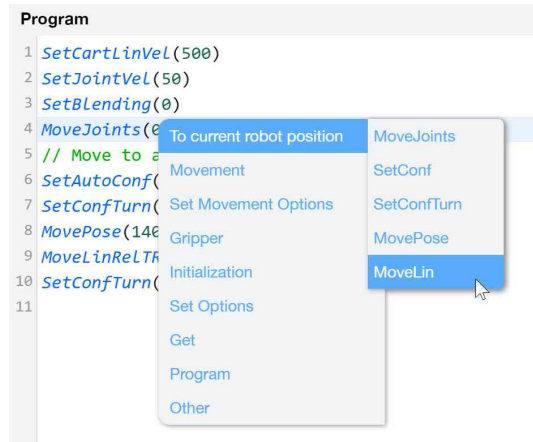


Figure 14: Context menu in the programming editor

5.3.3 The Response Log field

The log field displays all the messages that are sent by the robot. The control buttons associated with this field are self explanatory:

- ✕ Clear the response log.
- 💾 Save the response log to your computer.
- 🕒 Show/hide timestamp in the response log.

5.3.4 The Request Log tab

The request log is the log of all commands sent to the robot, by using the programming panel, the quick command panel, or the jogging panel. The only commands that are not logged are the velocity-mode motion commands sent while jogging the robot.

5.4. The robot position panel



Once the robot is activated and homed, you will be able to see its current joint values as well as the current pose of the *TRF* (*Tool Reference Frame*) with respect to the *WRF* (*World Reference Frame*). You can also see the current inverse kinematics configuration parameters. When not in jogging mode, each of these four parameters will be highlighted in yellow (as illustrated in [Figure 13](#)) if the desired value for that parameter (set by the commands *SetConf* or *SetConfTurn*) is different from the current value. Similarly, each of the joint angle values turns red, when too close to one of its limits (the default limits can be further restrained).

The robot position panel also hosts two drop-down menus. From 🗖 you can show or hide the TRF and WRF displayed in the 3D view window. Note that the x axes are in red, the y axes are in green, and the z axes are in blue. From 📺, you can choose between several preset views for the 3D view window.

5.5. 3D view panel

The 3D view window shows an orthographic projection of the robot in its current position and the current WRF and TRF. To zoom in and out, place your mouse cursor over the 3D view window and use your mouse wheel. To change the view angle, press the left mouse button inside the 3D view window, hold it down and drag the mouse. To change the view angle along a different choice of two axes, press the right mouse buttons inside the 3D view window, hold it down and drag the mouse. Finally, to pan, press the mouse wheel inside the 3D view window, hold it down and drag the mouse.

5.6. The Quick Command panel

The drop-down list in the quick command panel has most proprietary commands supported by the Meca500. If a command selected has arguments, additional numerical fields will appear. Once these fields are filled in correctly, you can either execute the command by pressing the  button or insert it in the programming editor at the last cursor position by pressing the  button.



5.7. The jogging panel

The jogging panel is used to jog (move) the robot in several different ways. Once a desired robot joint arrangement is reached, you can use the context menu in the program editor field to insert a motion command with current joint set or TRF pose.

The Jogging toggle switch is used to activate or deactivate the jogging functions. It is important to understand that activating the jogging deactivates the execution of commands from the quick command panel and the programming editor, and vice versa, for safety reasons. Furthermore, when jogging is activated, the robot speed is reduced to 50%, again for safety reasons. You can also activate/deactivate jogging with the shortcut **Alt+T**.

The jogging panel has three tabs that will be described in the following sections.

5.7.1 The Joint Jog tab

In the Joint Jog tab ([Figure 13](#)), you can rotate each joint separately using the arrow buttons ( or ) or you can enter a joint value directly. When a joint value is too close to its limit, the corresponding slider as well as the joint value in both the joint jog tab and the robot posture panel becomes red. For convenience, a "Zero all joints" button is provided that sets all joint angles to zero.

You can also select the jog speed from a list of preset percentage values using the "+" and "-" buttons, or positioning your mouse over the jog speed text field and using your mouse wheel. The jog speed can also be selected in the Cartesian Jog tab (there is an identical jog speed selector). The jog speed selected has effect even when the Joystick tab is active.

Finally, selecting the Incremental Jogging checkbox allows you to inch with predefined angular steps (from 0.001° to 5.000°). However, in incremental jogging, if a joint reaches a limit, a motion error is generated. For convenience, this error is reset automatically, so you can immediately start jogging the joint in the opposite direction.

5.7.2 The Cartesian Jog tab

In the Cartesian Jog tab ([Figure 15a](#)), you can move the robot along (by pressing the X, Y, or Z arrow buttons) or about (by pressing the Rx, Ry, or Rz arrow buttons) the axes of the TRF (if the TRF radio

button is selected) or along or about the axes of a reference frame having the same orientation as the WRF but with origin at the TCP (if WRF is selected).

As in the Joint Jog tab, you can select the jog speed and choose to jog both continuously and incrementally. For the incremental jogging, you can choose both a linear step (from 0.001 mm to 5.000 mm) and an angular step (from 0.001° to 5.000°). As with the joint incremental jogging, in Cartesian incremental jogging, if a joint reaches a limit, a motion error is generated, but this error is reset automatically, so you can immediately start jogging in a different direction.



In Cartesian jog, when reorienting the end-effector using the Rx, Ry and Rz arrow buttons, you do not modify independently each Euler angle, but rather rotate the TRF about axes passing through its origin (the TCP) and coincident with its x, y or z axes, if the TRF option is chosen, or parallel to the x, y or z axes of the WRF, if the WRF option is chosen.

(a) Cartesian jog tab

Axis	Robot	Reverse	Disable
x	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
y	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
z	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rx	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rz	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(b) Joystick tab (in case of 3DConnexion's SpaceMouse)

Axis	Robot	Reverse	Disable
x	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
y	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
z	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rx	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rz	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(c) Joystick tab (in case of Mecademic's MJ3 joystick)

Figure 15: The Cartesian jog and joystick tabs

5.7.3 The Joystick tab

Instead of using your mouse to jog the Meca500, you can use the SpaceMouse 6-axis mouse from 3Dconnexion (Figure 16a) or our MJ3 3-axis USB precision joystick (Figure 16a). To use the SpaceMouse or the MJ3, you need to have the jogging enabled and the Joystick tab selected. For the web interface to detect the SpaceMouse or the MJ3, you will need to press one of the device's buttons or, occasionally, unplug and replug the device. Once the SpaceMouse or the MJ3 is detected, you will see the table of menus shown in Figure 15b or Figure 15c.



(a) SpaceMouse® (wireless model)



(b) MJ3

Figure 16: The SpaceMouse wireless 6-axis mouse from 3Dconnexion and the MJ3 3-axis USB precision joystick from Mecademic



Do not install the driver and the software that come with the SpaceMouse as these will interfere with the desired functioning of the device in the Mecademic web interface. Also, if you opt for the wireless model, keep the device close to the universal USB receiver and remember to recharge the device regularly. Finally, note that if the web interface detects both a SpaceMouse and an MJ3, it will select the MJ3.



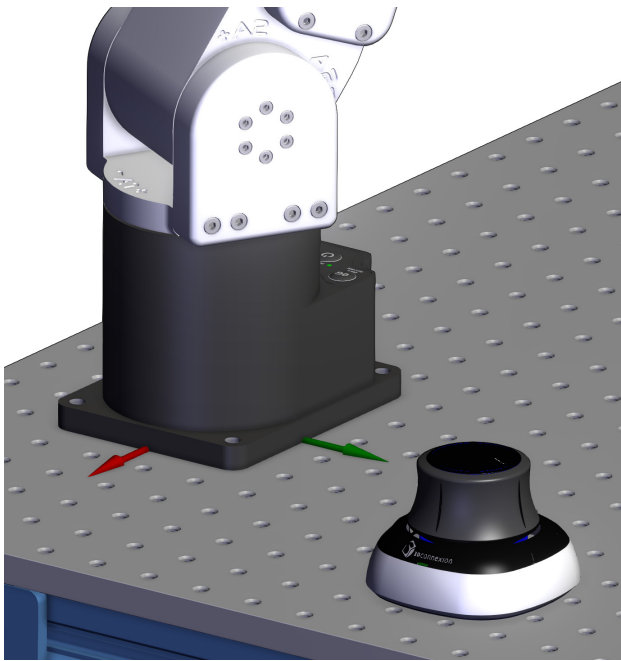
The MJ3 joystick must be used with the cable on the left, or else the directions shown in the icons of the Joystick tab ([Figure 15c](#)) will be wrong.

To select between joint jog, Cartesian jog with respect to the TRF or Cartesian jog with respect to the WRF, you can either use your mouse or press (up to two times if necessary) the right button of the SpaceMouse or of the MJ3 until the desired selection is obtained. Note that the choice of jogging mode is shared among the three jogging tabs. For example, if you choose Cartesian jog with respect to the TRF in the Joystick tab and then switch to the Cartesian Jog tab, the TRF radio button will be automatically selected, and vice versa.

It takes some practice to become comfortable with using all six axes of the SpaceMouse at once. Until then, you should better use only three axes at a time (either translations or rotations). To select between all six axes (by default), translations only or rotations only, press (up to two times if necessary) the left button of the SpaceMouse until the desired selection is obtained. Alternatively, you can disable any of the device axes directly from the joystick menu (by selecting the checkboxes under Disable).

For much more precise jogging, we strongly recommend the use of the MJ3. In the case of the MJ3, the left button of the joystick toggles the assignments for the three axes.

Finally, for a particular installation of your Meca500 and a particular choice of TRF and WRF, you might feel more comfortable reassigning the mapping between the axes of the SpaceMouse or of the MJ3 and the robot degrees of freedom (instead of physically reorienting your joystick). An example in the case of the SpaceMouse is shown in [Figure 17](#).



(a) Particular installation and WRF choice

☐ Joint jog

☒ Cartesian jog, WRF

☐ Cartesian jog, TRF

Axis	Robot	Reverse	Disable
	y ▾	<input type="checkbox"/>	<input type="checkbox"/>
	x ▾	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	z ▾	<input type="checkbox"/>	<input type="checkbox"/>
	Ry ▾	<input type="checkbox"/>	<input type="checkbox"/>
	Rx ▾	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	Rz ▾	<input type="checkbox"/>	<input type="checkbox"/>

Hold Ctrl key to use the joystick.

(b) Joystick tab with new mapping

Figure 17: Changing the mapping for the joystick axes

5.7.4 Opening and closing Mecademic’s grippers

If you have installed our [MEGP 25E](#) or [MEGP 25LS](#) electric gripper, you can open and close it with the shortcut **Alt+G**, as long as the robot is homed and the web interface connected to the robot.

6. OPERATING THE ROBOT


6.1. Power-up procedure

If you have read [Section 4](#) and [Section 5](#) carefully and followed the steps, your robot is already powered up, updated and ready to move. Nevertheless, here is a quick summary of the steps that you need to follow in order to power up your robot, as described before, as well as alternative methods.


6.1.1 Powering the robot

- Turn the power supply on.
- Make sure that the E-STOP button on the power supply is released (by twisting it clockwise) and press the RESET button, next to it.
- Wait approximately one minute.


6.1.2 Connecting to the robot

- Connect to the robot's web interface.
- Click the  checkbox in the Main Control tab.
- Select the Control option and click Connect.
- As soon as the robot is connected, you will get the following welcome message in the log panel: [3000][Connected to Meca500 R4 v.9.2.x].

6.1.3 Activating the robot

- Select the  checkbox, in the Main Control tab OR type in the programming text field ActivateRobot and click the ► button. You will hear a distinctive clicking sound.

6.1.4 Homing the robot

- Select the  checkbox in the Main Control tab or erase ActivateRobot, type Home and click the ► button in the programming panel.



The robot will move slightly during homing. Before homing it, make sure that there is no risk for mechanical interference.

6.1.5 Moving the robot

A six-axis robot arm is a complex mechanism and no matter how intuitive its programming interface is, the robot will still have limits. These limitations are not always obvious. For example, in any six-axis robot arm, there are often paths that the robot cannot follow, even though they seem to be inside the robot's workspace. Never forget that the workspace of a general six-axis robot is a very intricate six-dimensional entity, not just a sphere.



If you know nothing about orientation representations and robot singularities, we strongly advise you to read some introductory notes on robotics and our tutorials on [Euler angles](#) and on [robot singularities](#).

After homing, click the Zero All Joints button in the Joints Jog tab on the left. The robot will move all of its joints to their 0° positions. In this robot joint set (shown in [Figure 6](#)), the robot is in a so-called wrist singularity. Most industrial robots cannot move in Cartesian mode from such a singularity. In order to simplify the use of the Meca500, as of firmware 9, we have implemented an algorithm that allows the robot to move through such a singularity.



The Cartesian coordinates displayed above the robot in the web interface are those of the Tool Reference Frame (TRF) with respect to the World Reference Frame (WRF). Both frames are displayed in the web interface. By default, the TRF is located at the flange of the robot and the WRF at the bottom of the robot's base (as in [Figure 18](#)). The origin of the TRF is called the TCP (Tool Center Point).



We use Euler angles (α , β , γ) to define the orientation of a second reference frame with respect to a first one. More specifically, if we consider both frames initially coincident, we rotate the second frame about its x axis at α degrees, then about its y axis at β degrees, and finally about its z axis at γ degrees. This Euler-angle convention is sometimes referred to as z - y '- x ".

Thus, for example, you can simply enable jogging, go to the Cartesian tab, and with the TRF option selected, press the +X arrow button. Alternatively, you can perform the same kind of linear motion by following any of these steps:

- Clear the programming text field, type `MoveLin(250,0,150,0,90,0)`, and press ►.

OR

- In the quick command panel, select MovePose, fill in the arguments with the values 250, 0, 150, 0, 90, and 0, and click on ►.

OR

- Clear the programming text field, type `MoveLinRelTRF(58,0,0,0,0,0)`, and press ►.

[Figure 18](#) shows the resulting robot position.

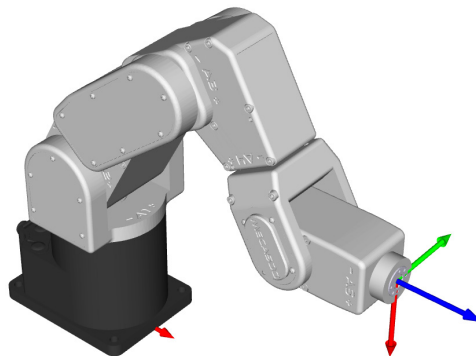


Figure 18: Robot position when its TRF is at $x = 250$ mm, $y = 0$ mm, $z = 150$ mm, $\alpha = 0^\circ$, $\beta = 90^\circ$, $\gamma = 0^\circ$ with respect to its WRF

6.2. Power-off procedure

6.2.1 Zeroing the robot joints (optional)

It might be a good idea to always bring the robot joints to their zero positions before turning the robot off. This can be done in two ways:

- send a *MoveJoints* command with all arguments equal to 0

OR

- click on the Zero All Joints button in the Joints Jog panel.

6.2.2 Deactivating the robot

To deactivate the robot

- clear the ⚡ checkbox

OR

- send the *DeactivateRobot* command via the programming editor or via the quick command panel.



Recall that there are no brakes on joints 4, 5 and 6. As soon as you deactivate the robot, the end-effector will slowly tilt down under the effects of gravity.



If you accidentally close your web interface before deactivating the robot, the robot will stop (in case it was moving) but will remain activated.

6.2.3 Disconnecting the robot

To disconnect the web interface from the robot, clear the 🖱️ checkbox.



If you disconnect the web interface from the robot before deactivating the robot, the robot will stop moving.

6.2.4 Removing power

Finally, unplug the power supply from the AC outlet or switch the power supply off.



Never detach the DC power connector from the robot's base, before unplugging the power supply's AC power cord from the AC outlet or switching the power supply off.

6.3. Offline mode

You can store an offline program in the robot and execute it without an external computer. This program is kept, even after power off, until replaced by another one. You can save up to 500 programs, but only the first one can be executed from the robot control panel.

6.3.1 Saving the program via the web interface

- To save a program via the buttons on the web interface, the robot must be deactivated, i.e., the ⚡ checkbox must be cleared.
- Write the program in the programming editor.
- To run the program on infinite loop, insert the command *SetOffLineProgramLoop(1)*. (The ↺ checkbox has no effect on the execution of the offline program.)
- Enter 1 as the program ID number in the entry field next to the ⬇ button.
- Click on the ⬇ button.

6.3.2 Running an offline program

To execute the offline program 1, make sure there is no user connected to the robot and press the Start/Pause button on the robot base. The Start/Pause LED will flash rapidly for three seconds, after which the robot will start executing the program.



Immediately after pressing the Start/Pause button on the robot's base, move away your hand and stay outside the robot's reach.



Figure 19: Robot control panel

6.4. Robot control panel

The set of buttons and LEDs on the robot's base is called the robot's control panel ([Figure 19](#)). The meanings of the LEDs and the functionalities of the buttons will be summarized in what follows.

6.4.1 LEDs

After a power up, the Power, Home and Start/Pause LEDs will flash fast simultaneously during a couple of seconds. After that, the LEDs will be lit as described below.

Power LED

The Power LED is red and indicates the activation state of the robot:

- The LED will flash slowly when the robot is deactivated.
- The LED will flash fast when the robot is being activated.
- The LED will be lit continuously when the robot is activated.

Home LED

The Home LED is yellow and indicates the homing state of the robot:

- The LED will be off when the robot is not homed.
- The LED will flash slowly when the robot is being homed.
- The LED will be lit continuously when the robot is homed.

Start/Pause LED

The Start/Pause LED is yellow and indicates the motion state of the robot:

- The LED will flash fast when the Start/Pause button was pressed and the program saved in the robot is about to start.
- The LED will be off when the robot is not moving.
- The LED will be lit continuously when the robot is moving.

Link/Act IN and Link/Act Out LEDs

Both LEDs are green and flash when there is network activity in the corresponding Ethernet port. The LEDs function in the same manner as on a normal Ethernet RJ-45 port.

Run LED

Used only when the robot is controlled via EtherCAT (see the [Programming Manual](#)).

Finally, when the robot is in error mode, the Power, Home and Start/Pause LEDs flash fast simultaneously. Also, if you keep the Power button pressed continuously during power-up, which provokes a network reset of the robot, the Power, Home and Play LEDs, will first flash simultaneously eleven times, and then blink several times sequentially.

6.4.2 Buttons

The buttons on the control panel are active only when no user is connected to the robot, except for the 0G button, which is always active. In what follows, you must refer to the detailed descriptions of the commands associated with each button.



When pressing the buttons on the robot's control panel, keep your fingers away from the pinch points of the robot, and move away from the robot as soon as a button is released.

Power button

The Power button acts as the *ActivateRobot* and *DeactivateRobot* commands:

- when the robot is deactivated, pressing Power will send the *ActivateRobot* command.
- when the robot is activated, pressing Power will send the *DeactivateRobot* command.
- when the robot is in error mode, pressing and holding Power for five seconds will send the *DeactivateRobot* command.

Pressing and holding Power during power-up will reset the robot network configuration.

Home button

The Home button acts as the *Home* and *ResetError* commands:

- when the robot is deactivated, pressing Home has no effect.
- when the robot is activated, pressing Home sends the *Home* command.
- when the robot is homed, pressing Home has no effect.
- when the robot is in error mode, pressing and holding Home for five seconds will send the *ResetError* command.

Start/Pause button

The Start/Pause button on the robot control panel acts as the *StartProgram*, *PauseMotion*, *ResumeMotion*, and *ClearMotion* commands:

- when the robot is activated, homed and not executing a program, pressing Start/Pause will send the *StartProgram*(1) command three seconds after being pressed.
- when the robot is activated and homed, pressing Start/Pause will send the *ClearMotion* command, whether the robot is moving or not.
- when the robot is activated, homed and moving, pressing Start/Pause will send the *PauseMotion* command.
- when the robot is activated, homed and stopped (by the *PauseMotion* command), pressing Start/Pause will send the *ResumeMotion* command.

0G button

Pressing and holding the 0G button for three seconds, but only if the robot is deactivated, will release the brakes. While keeping 0G pressed with one hand, you can manually move the robot with your other hand. The brakes will re-engage as soon as the 0G button is released.



Once the robot is deactivated, hold the robot with one hand, before pressing the 0G button. Otherwise, the robot may fall down under the effect of gravity.

7. OPERATING THE INTELLIGENT POWER SUPPLY

The R4 version of Mecademic's intelligent power supply is shown in [Figure 20](#). The R3 version is visually identical to the R4 version, except for some of the engravings. However, there are some hardware differences. Therefore, never use an R3 power supply with a Meca500 R4 or an R4 power supply with a Meca500 R3. The D-SUB dongle is, however, identical in both versions.



Figure 20: Mecademic's R4 intelligent power supply

7.1. Emergency and protective stops and resetting these

The power supply is equipped with

- one E-STOP button (Stop Category 1), designed as PL=d with Safety Category 3,
- one RESET button,

and safety I/O connections for

- one external E-Stop (Stop Category 1),
- one external protective stop (Stop Category 1) that will be referred to as P-Stop 1,
- one external software protective stop that will be referred to as P-Stop 2 (not safety-rated),
- one external Reset,
- one motor power status indicator.

The E-STOP button, the external E-Stop, and P-Stop 1 are inter-related in an OR logic. In other words, pressing any of the two emergency buttons or removing power to the P-Stop 1 has the same effect: removing power from the motors of the robot and its EOAT (if R4) or in the complete robot (if R3). To give power to the motors, both emergency stops must be released and power to the P-Stop 1 must be applied. Therefore, for simplicity, in the rest of this subsection, we will only refer to the E-STOP button on the power supply.

Similarly, the RESET button on the power supply and the external Reset are inter-related in an OR logic. Pressing either of these yields the same action, as long as the other button is released. Therefore, for simplicity, in the rest of this subsection, we will only refer to the RESET button on the power supply.

Once you power up the robot, you must make sure the E-STOP button is released. Then, pressing the RESET button sends power to the robot motors are to the EOAT (if R4) or to the complete robot (if R3).

Once the robot is activated and homed, pressing the E-STOP button at any time instantly sends a signal to the robot to rapidly decelerate and come to a complete stop. The power supply then waits for a signal from the robot indicating that the robot is completely stopped, and as soon as that signal is received, but no later than in 500 ms, the power supply completely cuts power to the robot, in the case of R3 version, or only to the robot motors and Mecademic' EOAT, in the case of R4 version. In both cases, the robot brakes are then automatically applied to joints 1, 2 and 3.

To use the robot again, you must release the E-STOP button, and press the RESET button, then activate and home the robot.

Of course, you will also need to manage the stream of commands being sent to the robot. For example, if a PLC sends commands to the robot, while the robot is powered off, the program that runs on your PLC will need to be able to detect and manage this situation. To do so, you can get a signal from the intelligent power supply that an E-STOP has been pressed by connecting your PLC to the D-SUB connected, as will be explained in the following pages. In the case of the R4 version, the event is also reported by the robot controller.

7.2. LEDs

The power supply is equipped with three LEDs. As long as the power supply is switched on (using the on/off button shown in [Figure 20b](#)) and connected to an AC source that supplies voltage at 90–264 V at frequency of 50–60 Hz, the green LED next to "Power" stays illuminated. Supplying AC voltage outside this range may damage the power supply.

Once the power supply is switched on, the yellow Status LED indicates the status of the power supply. If the yellow LED is off, you need to press the RESET button, which sends power to the robot. If the proper Meca500 is correctly connected to the power supply, the yellow LED will turn on and stay lit.

If, in any situation, the yellow LED blinks regularly, this means that an emergency stop (either the one on the power supply or the external one) or the external P-Stop 2 is activated. You need to release the emergency stop or remove the cause for the P-Stop 2 and then press the RESET button.

If the yellow LED illuminates in sets of two flashes, this means that the integrated or external RESET button has been pressed too long. Make sure they are not pressed and then press any of them, in a quick fashion.

Finally, the red Error LED indicates if there is a problem with the power supply or with some of the connections to the D-SUB interface. If the red LED flashes (0.1 s on, 0.9 s off), either there is no robot connected to the power supply or the robot connected is an old version that is not supported by this power supply. If the red LED illuminates in sets of two quick flashes, the robot has detected a problem and sent a request to the power supply to be shut down. If this happens, contact us. If the red LED blinks in regular intervals (0.5 s on, 0.5 s off), this means that there is either a problem in your external emergency stop or Stop Category 1 connections or in our power supply. If you don't see any problem in your connections, contact us. Finally, if the red LED is constantly lit, there is a problem with the power supply. Switch off the power supply and contact us.

[Table 3](#) summarizes the different states of the three LEDs as well as their meanings.

POWER SUPPLY LEDS			
LED	Name	LED state	Explanation
Green	Power	Off	The power supply is turned on
		On	The power supply is turned off
Yellow	Status	Off	Robot is not powered. Press RESET.
		Blinking	Robot is not powered and a Stop Category 1 stop is pressed or the dongle is not plugged in. Remedy the situation and press RESET.
		Two flashes	Robot is not powered because a RESET button has been pressed for too long. Press RESET again.
		On	Robot is powered.
Red	Error	Off	There is no error.
		Flashes	No proper robot connected.
		Two flashes	Robot has detected a problem and requested that power be shut down. Contact Mecademic.
		Blinking	Problem with Stop Category 1 stops detected. Check external stop connections and contact Mecademic if no solution found.

Table 3: The various states of the LEDs on the power supply

7.3. External connections

The D-SUB dongle is a temporary bypass device. After performing a risk assessment for your installation, you must design and connect the appropriate safety circuit to the D-SUB connector. [Figure 21](#) shows the pinout of that connector and provides examples. As already mentioned, you can connect:

- one Stop Category 1 emergency stop (pins E-Stop – A1, E-Stop – B1, E-Stop – A2, E-Stop – B2);
- one Stop Category 1 protective stop (pins P-Stop 1 – A1, P-Stop 1 – K1, P-Stop 1 – A2, P-Stop 1 – K2);
- one reset button (pins Reset – A, Reset – K);
- one power status indicator (pins Power Status – A, Power Status – B);
- one software protective stop (pins P-Stop 2 – A, P-Stop 2 – B).



The software protective stop marked P-Stop 2 is not a safety-rated Category 2 protective stop.

Note that the external circuits shown in [Figure 21](#) are only suggestions. You may, for example, connect several external E-Stops in series, or instead of sending a signal to a PLC when the power to the robot is cut, you may connect a LED between the resistor and the Power Status – A line. [Figure 22](#) shows several other examples. Specifically, [Figure 22a](#) shows how to control the protective stop 1 from a PLC by supplying a 24 V DC signal. [Figure 22b](#) shows how to reset the power supply from a PLC. [Figure 22c](#) shows that you can supply a 24 mA continuous forward current to pins 4 and 5 if you do not want to use the protective stop 1. Lastly, [Figure 22d](#) shows that you need to short-circuit pins 1 and 9, and pins 2 and 10, if you do not intend to use an external E-Stop. In all cases, the resistances are mandatory for Meca500 R3, but optional for Meca500 R4.

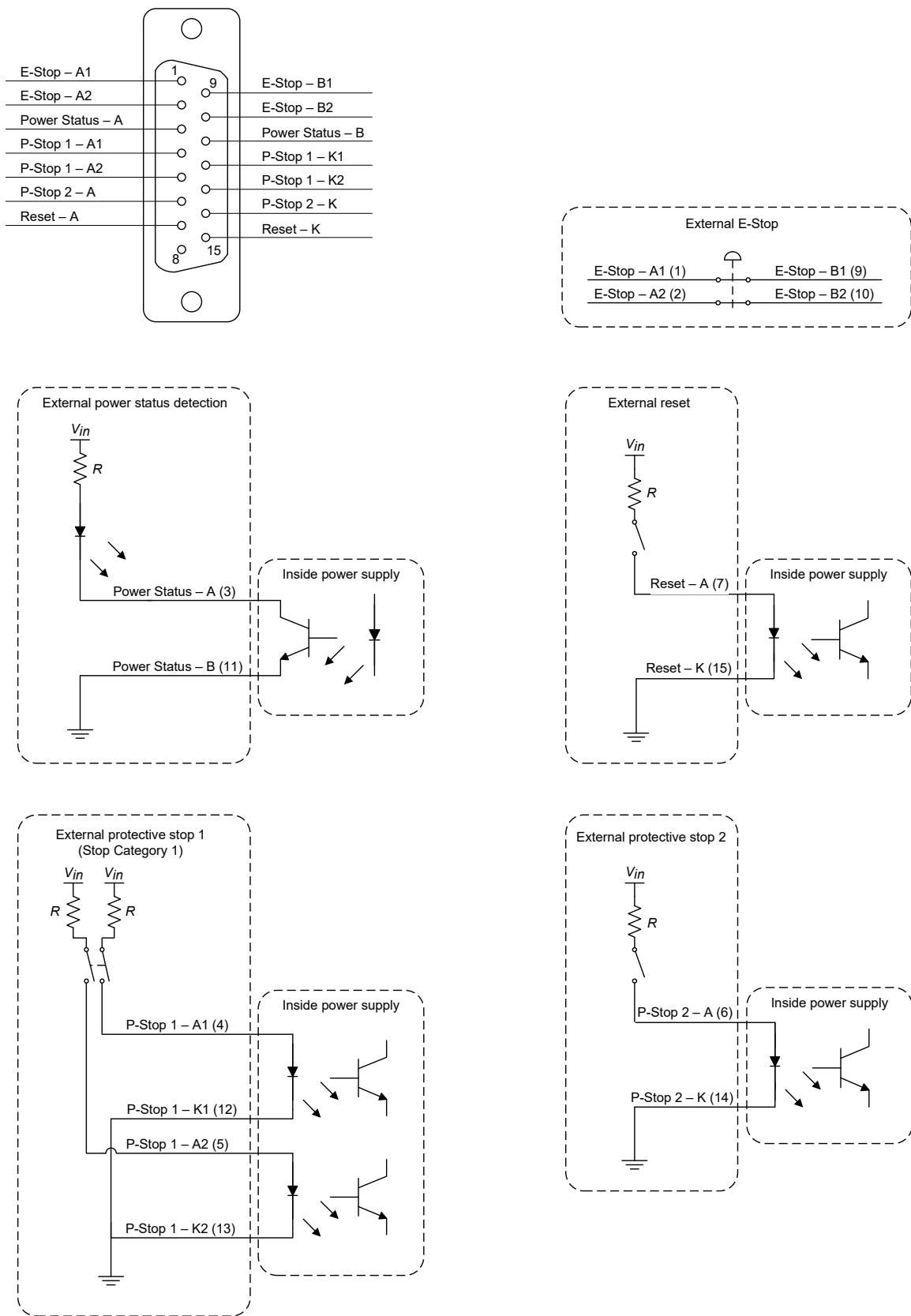


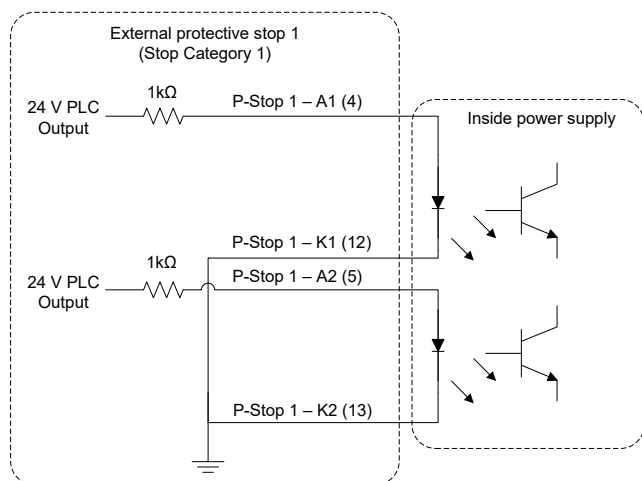
Figure 21: Electric diagram of suggested connections to the D-SUB connector (resistances are mandatory in R3)



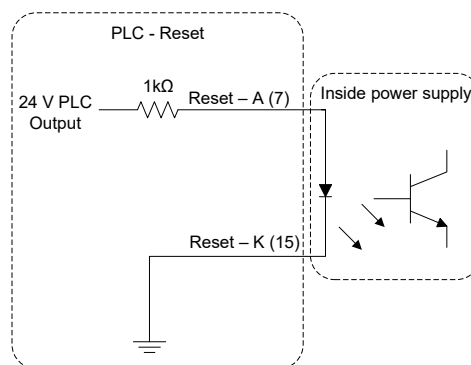
- The E-Stop and the P-Stop 1 are normally closed.
- The P-Stop 2 is normally open.



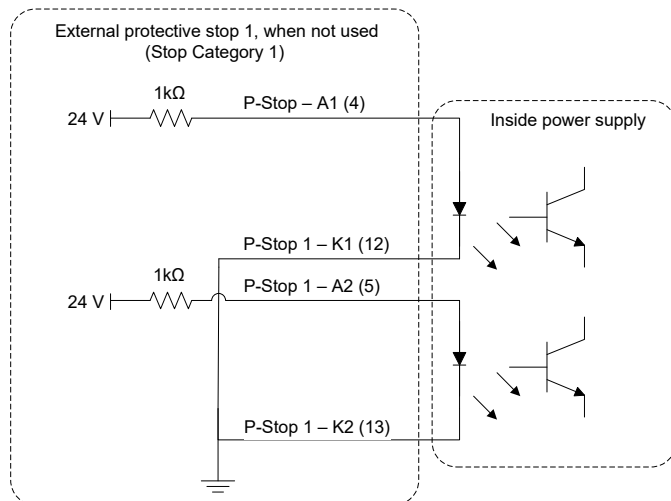
In R4, you may choose to not place the resistances shown in [Figure 21](#) and [Figure 22](#). However, THESE RESISTANCIES ARE MANDATORY in R3.



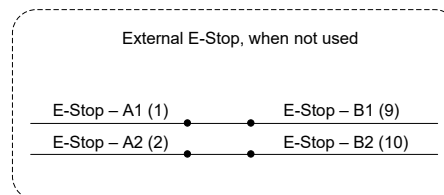
(a) external protective stop from a PLC



(b) reset from a PLC



(c) external protective stop 1 not used



(d) external E-Stop not used

Figure 22: Additional examples of connections to D-SUB connector (resistances are mandatory in R3)

8. INSTALLING AN END-EFFECTOR

The Meca500 comes with a proprietary tool I/O (input/output) port located at the robot extremity ([Figure 23a](#)). However, this tool port is reserved uniquely for our end-of-arm-tooling (EOAT), i.e., our electric grippers MEGP 25E and MEGP 25LS, and our pneumatic module MPM500. We do not share the pinout of this port or its custom-made communication protocol. To install our grippers or pneumatic module, refer to their user manuals.

If you want to use any other end-effector with the Meca500, you will need to control it independently from the Meca500. You can attach the cabling of your end-effector along the robot arm using adhesive-backed tie mounts. Finally, you must fix the end-effector to the robot's flange ([Figure 23b](#)) using four M3 screws and, optionally, one $\varnothing 3$ locating pin, all of properly selected length.

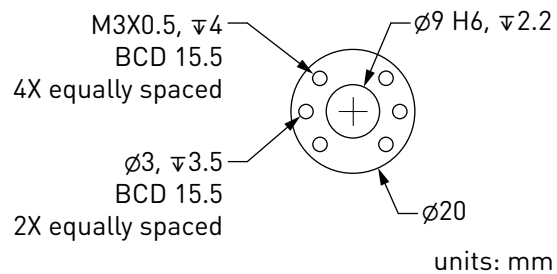


- Keep the robot un-powered while installing/removing a tool to its flange.
- Do not exceed the robot payload (0.5 kg).
- Securely fasten the tool to the robot flange.

Note that since joint 6 is multi-turn, there is no way of knowing the angle of joint 6 (even approximately), unless the robot is activated and homed. Therefore, prior to mounting an end-effector, it is important that you activate and home your robot, rotate joint 6 to its zero position, and finally unpower the robot. However, if the screw on the flange of the robot is not as in [Figure 23a](#) when $\theta_6 = 0^\circ$, then you need to follow the procedure described in Section Homing of the [Programming Manual](#).



(a) closeup



(b) dimensions

Figure 23: The mechanical interface (flange) of the Meca500. The flange is the $\varnothing 20$ disk, inside the black isolation ring, and is the only one to rotate when joint 6 rotates.



- Make sure that joint 6 is approximately at 0° before attaching an end-effector.
- Do not over-tighten the M3 screws.
- Attach the tool cabling in such a manner that it obstructs as little as possible the motions of the robot.
- Unless you plug the connector of one of our own EOAT, keep the cover (screw cap, not shown in [Figure 23a](#)) of the tool I/O port in place at all times.

9. EXAMPLES

9.1. Draw a square

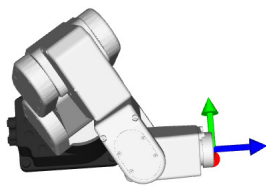
Here is an example of a very simple program that makes the robot's TCP follow a square path, using the *MoveLin* command :

```

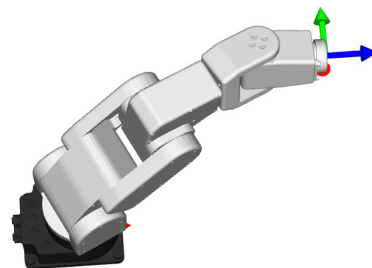
ActivateRobot
Home
MoveJoints(0, 0, 0, 0, 0, 0)
MovePose(140, -100, 250, 0, 90, 0)
MoveLin(140, 100, 250, 0, 90, 0)
MoveLin(270, 100, 250, 0, 90, 0)
MoveLin(270, -100, 250, 0, 90, 0)
MoveLin(140, -100, 250, 0, 90, 0)
MoveJoints(0, 0, 0, 0, 0, 0)

```

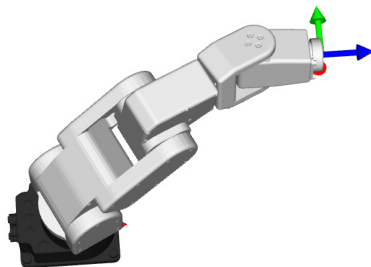
Figure 24 shows the result of four of the motion commands.



(a) *MovePose*(140, -100, 250, 0, 90, 0)



(b) *MoveLin*(270, 100, 250, 0, 90, 0)



(c) *MoveLin*(270, -100, 250, 0, 90, 0)



(d) *MoveLin*(140, -100, 250, 0, 90, 0)

Figure 24: The four separate robot positions that define the motion sequence

10. TROUBLESHOOTING

No LEDs are on upon power up

- Make sure all connectors are properly attached.
- Make sure the AC outlet works (the green LED on the power supply should be on).

No connection to the robot's web interface

- Make sure EtherCAT mode has not been enabled. To switch the robot back to Ethernet TCP/IP mode, the simplest way is to do a network configuration reset. This can be done by unplugging the power supply from the AC side, and then replugging it while holding the Power button on the robot's base for about ten seconds.
- Make sure the Ethernet cable is properly connected. The green Ethernet LED should pulse like on an RJ-45 connector. If the green LED is not illuminated, detach and reconnect the Ethernet cable.
- Make sure the router/switch works by checking the LEDs of the connection socket.
- Make sure you are connected to the same network as the robot.
- If you are using static IP addresses, make sure that the robot's IP default address (192.168.0.100) does not conflict with any other device on the network. For example:

Robot: IP = 192.168.0.100, netmask = 255.255.255.0, gateway = 192.168.0.1

Computer: IP = 192.168.0.101, netmask = 255.255.255.0, gateway = 192.168.0.1

- If you are using DHCP, make sure to verify the robot's IP address via your router's web interface.

Robot fails to boot

- Disconnect the power supply from the AC outlet and wait for the green LED of the power supply to turn off. Then reconnect the power supply and boot the robot.

Robot's IP address forgotten

- You can reset the robot's Ethernet configuration (i.e., set the robot's IP address to 192.168.0.100 and the communications mode to TCP/IP) using the following sequence:
 - Power off the robot;
 - Press the Power button on the robot base while powering on the robot (i.e., pressing the RESET button on the power supply) and keep the Power button pressed for about ten seconds until the red LED and the yellow LEDs on the robot base start to blink sequentially.

Storing the robot in its shipping box

To put the Meca500 back into the foam insert of its original shipping box, send the command `MoveJoints(0,-60,60,0,0,0)`. Recall that you must never force the brakes on joints 1, 2 and 3, unless there is an emergency.



Never disassemble the robot. The robot requires no maintenance, and if you think it is damaged, stop using it immediately and contact us.



If you are unable to solve your technical problem, do not hesitate to contact our technical support team by creating a ticket at <https://support.mecademic.com>.

Contact Us

Mecademic
1300 St-Patrick Street
Montreal (Quebec) H3K 1A4
Canada

1-514-360-2205
1-833-557-6268 (toll-free in North America)

<https://support.mecademic.com>

MECADEMIC
INDUSTRIAL ROBOTICS

© Copyright 2015–2022 Mecademic