



User Manual

U-523.25 PILINE® LINEAR STAGE

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1 Legal Information



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2 Introduction

2.1 About this Document

2.1.1 Objective and Target Group

This user manual contains the information needed for the intended use of the U-523.25. Basic knowledge of closed-loop systems, motion control concepts, and applicable safety measures is assumed.



2.1.2 Explanation of Symbols

This chapter explains the symbols and markings used by PI in their user manuals.

Typographic Conventions

Symbol / label	Meaning
1. 2.	Action consisting of one or several steps with strict sequential order
►	Action consisting of one or more steps without relevant sequential order
■	Lists
p. 5	Cross-reference to page 5
RS-232	Label on the product indicating an operating element (example: RS-232 interface socket)

Symbols Used

Symbol / Label	Meaning
	Warning of electrical voltage
	General hazard symbol



DANGER

Dangerous situation

Failure to comply could lead to death or serious injury.

► Precautionary measures for avoiding the risk.



WARNING

Dangerous situation

Failure to comply could lead to serious injury.

► Precautionary measures for avoiding the risk.

**CAUTION****Dangerous situation**

Failure to comply could lead to minor injury.

- Precautionary measures for avoiding the risk.

NOTICE**Dangerous situation**

Failure to comply could lead to material damage.

- Precautionary measures for avoiding the risk.

Information

Additional information on the U-523.25 that can affect your application.

2.1.3 Figures

For better understandability, the colors, proportions and degree of detail in illustrations can deviate from the actual circumstances. Photographic illustrations may also differ and must not be seen as guaranteed properties.

2.1.4 Other Applicable Documents

The devices and software tools that are mentioned in this documentation are described in separate manuals.

Document number	Document type	Product
MP121EK	Short instructions	PILine® positioners
SM148E	Software manual	PIMikroMove
MS223E	User manual	C-867.1U
MS231E	User manual	C-867.2U2
C867T0017	User Manual	C-867.10C885

The latest versions of the user manuals can be [downloaded \(p. 6\)](#) at www.pi.ws.

2.1.5 Downloading Manuals**Information**

If a manual is missing or problems occur with downloading:

- Contact our [customer service department \(p. 7\)](#).

Downloading Manuals

1. Open the website www.pi.ws.
2. Search the website for the product number (e.g., U-523).
3. In the search results, select the product to open the product detail page.
4. Select **Downloads**.
→ The manuals are shown under **Documentation**. Software manuals are shown under **General Software Documentation**.
5. For the desired manual, select **ADD TO LIST** and then **REQUEST**.
6. Fill out the request form and select **SEND REQUEST**.
→ The download link will be sent to the email address entered in the form.

2.2 European Declarations of Conformity

For the U-523.25, declarations of conformity were issued according to the following European statutory requirements:

- Low Voltage Directive
- EMC Directive
- RoHS Directive

The standards applied for certifying conformity are listed below.

- Safety (Low Voltage Directive): EN 61010-1
- EMC: EN 61326-1
- RoHS: EN IEC 63000

2.3 Customer Service Department

For enquiries and orders, contact your PI representative or send us an [email](#).

If you have any questions concerning your system, provide the following information:

- Product and serial numbers of all products in the system
- Firmware version of the controller (if applicable)
- Version of the driver or the software (if applicable)
- Operating system on the PC (if applicable)

If possible: Take photographs or make videos of your system that can be sent to our customer service department if requested.

Customer service address:

Physik Instrumente (PI) SE & Co. KG
Auf der Römerstraße 1
76228 Karlsruhe
Germany

service@pi.de
www.pi.de

2.4 Old Equipment Disposal

In accordance with EU law, electrical and electronic equipment may not be disposed of in EU member states via the municipal residual waste.

Dispose of your old equipment according to international, national, and local rules and regulations.

In order to fulfill the responsibility as the product manufacturer, PI undertakes environmentally correct disposal of all PI equipment free of charge, if it was made available to the market after August 13, 2005.

Any old PI equipment can be sent free of charge to the following address:

Physik Instrumente (PI) SE & Co. KG
Auf der Römerstraße 1
76228 Karlsruhe
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www.pi.de



3 Safety

3.1 Intended Use

The U-523.25 is a laboratory device as defined by DIN EN 61010-1. It is intended for indoor use and use in an environment that is free of dirt, oil, and lubricants.

In accordance with its design, the U-523.25 is intended for positioning, adjusting and shifting loads in one axis at various velocities. The U-523.25 is **not** intended for applications in areas, in which a failure would present severe risks to human beings or the environment.

The intended use of the U-523.25 is only possible when completely mounted and connected. The U-523.25 must be operated with suitable electronics. The electronics are not in the scope of delivery of the U-523.25.

The U-523.25 may not be used for purposes other than those stated in this user manual. The U-523.25 may only be used in compliance with the technical specifications and instructions in this user manual.

3.2 General Safety Instructions

Piezomotors are driven by piezo actuators. After disconnection from the electronics, piezo actuators can remain electrically charged for several hours. Temperature changes can also induce charges in piezo actuators. Touching charged parts can result in minor injuries from electric shock.

- ▶ Do **not** open the U-523.25.
- ▶ Do not touch the contacts in the connector of the U-523.25.

If the protective earth conductor is missing or not properly connected, risk of dangerous touch voltages on the U-523.25 in the event of malfunction or failure of the system. If touch voltages exist, touching the U-523.25 can lead to minor injury from electric shock.

- ▶ [Connect the U-523.25 to a protective earth conductor before startup \(p. 15\).](#)
- ▶ Do **not** remove the protective earth conductor during operation.
- ▶ If the protective earth conductor has to be temporarily removed (e.g., for modifications), reconnect the U-523.25 to the protective earth conductor before restarting.

Mechanical forces can destroy the U-523.25.

- ▶ Avoid impacts that affect the U-523.25.
- ▶ Do not drop the U-523.25.

Unsuitable cables can cause damage to the electronics or the U-523.25 and affect the performance.

- ▶ Only use genuine original parts from PI to connect the U-523.25.

The U-523.25 is built according to state-of-the-art technology and recognized safety standards. Improper use of the U-523.25 may result in personal injury and/or damage to the U-523.25.

- ▶ Use the U-523.25 only for its intended purpose and when it is in perfect condition.
- ▶ Read the user manual.
- ▶ Eliminate any malfunctions that may affect safety immediately.

The operator is responsible for installing and operating the U-523.25 correctly.

3.3 Organizational Measures

3.3.1 User Manual

- ▶ Always keep this user manual available with the U-523.25. The latest versions of the user manuals can be [downloaded \(p. 6\)](#) at www.pi.ws.
- ▶ Add all information from the manufacturer such as supplements or technical notes to the user manual.
- ▶ If you give the U-523.25 to a third party, also include this user manual as well as other relevant information provided by the manufacturer.
- ▶ Only use the device on the basis of the complete user manual. Missing information due to an incomplete user manual can result in minor injury and damage to equipment.
- ▶ Only install and operate the U-523.25 after you have read and understood this user manual.

3.3.2 General Personnel Qualification

The U-523.25 may only be installed, started up, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

4 Product Description

4.1 Product Labeling

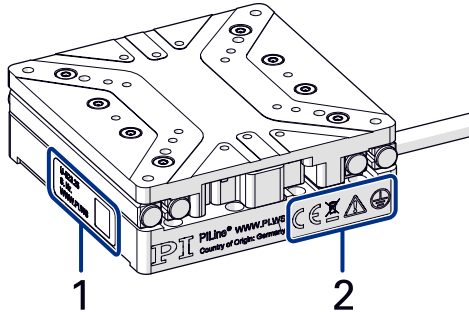


Figure 1: Product labeling on the U-523.25

1. Type plate
2. Warning and conformity symbols ([old equipment disposal \(p. 7\)](#), [CE mark \(p. 7\)](#))

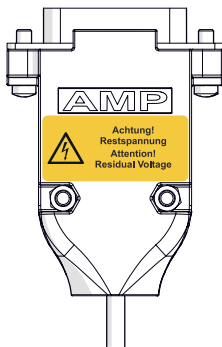


Figure 2: Product labeling on the drive connector of the U-523.25: Warning of electrical voltage

4.1.1 Type Plate

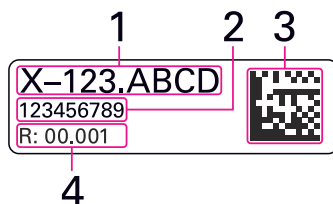
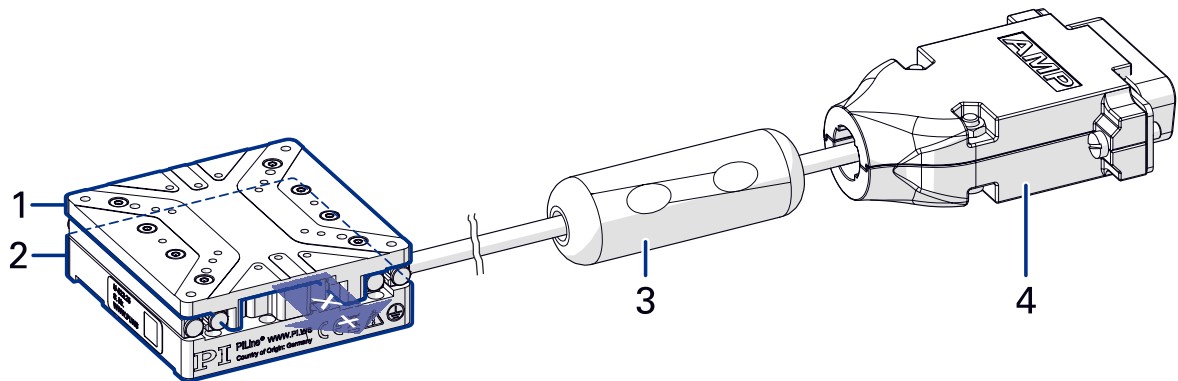


Figure 3: Type plate of the U-523.25

1. Product number (example)
2. Serial number (example), individual for each U-523.25
3. Data matrix code (example; contains the serial number)
4. Revision number

4.2 Overview



1. Motion platform
2. Base body
3. Snap-on ferrite
4. Drive connector

The arrow shows positive direction of motion of the axis.

4.2.1 Base Body

The base body is the basis of the positioner. The U-523.25 [is mounted onto a surface via the base body \(p. 15\)](#).

The base body comprises the following subassembly (subassemblies):

Reference switch

The reference switch is a sensor whose fixed position serves as the reference point for incremental sensor signals.

Position sensor

The position sensor is an incremental sensor: It measures the position of the motion platform relative to a known reference point.

4.2.2 Drive

Drive

The drive generates the force that is required for the dynamics of the motion platform. The drive force acts directly on the friction rail that is connected to the motion platform.

4.2.3 Drive Connector

The electrical connection to the electronics is established via the drive [connector \(p. 19\)](#). The drive connector transmits the signals for the drive as well as the sensor signals of the U-523.25.

The drive connector comprises the following subassembly or subassemblies:

ID chip

Information on the U-523.25 (e.g., type, serial number, date of manufacture, hardware version) is stored in parameters on the ID chip. Electronics that support the ID chip evaluate the data from the ID chip and offer the corresponding positioner type from the positioner database automatically for selection when starting with the PC software from PI.

For more information on ID chip recognition, see the manual for the electronics.

4.3 Scope of Delivery

Product number	Description
U-523.25	Linear stage according to the order
000074746	Mounting kit for mounting the U-523.25, consisting of <ul style="list-style-type: none"> ■ 4 pan head screws M1.6x8-1.4301
MP121EK	Short instructions for PLine® positioners

4.4 Suitable Electronics

The U-523.25 must be connected to suitable electronics that supply the necessary voltage for operating and if required, to evaluate the sensor and limit switch signals. The following electronics are suitable:

Product number	Description
C-867.10C885	Motion controller module for PLine® piezo motor systems, 1 axis, for PIMotionMaster
C-867.1U	PLine® controller, network capable, 1 axis, with USB and RS-232 interface
C-867.2U2	PLine® controller, network capable, 2 axes, with USB and RS-232 interface

To order, contact our [customer service department \(p. 7\)](#).

5 Unpacking



CAUTION



Dangerous voltage and residual charge in piezo actuators!

Temperature changes and compressive load can induce charges in piezo actuators. The U-523.25 can remain charged for several hours after it is disconnected from the electronics. Touching live parts of the U-523.25 can result in minor injury from electric shock.

- ▶ Do **not** touch the drive connector of the U-523.25.
- ▶ Do **not** disconnect the electronics during operation of the U-523.25.
- ▶ Do **not** disassemble the U-523.25.

Unpacking the U-523.25

1. Unpack the U-523.25 with care.
2. If the U-523.25 was supplied with ESD protective caps on the connectors: Do **not** remove the ESD protective caps.
3. Compare the contents with the scope of delivery according to the contract and the delivery note.
4. Inspect the contents for signs of damage. If any parts are damaged or missing, contact our [customer service department \(p. 7\)](#) immediately.
5. Keep all packaging materials in case the product needs to be returned.

6 Installation

6.1 Mounting the U-523.25 and Connecting to a Protective Earth Conductor

The protective earth connection of the U-523.25 is established as follows:

- Mounting holes in the base body of the U-523.25
- Suitable, conductive screws
- Surface connected to the protective earth conductor

Overview

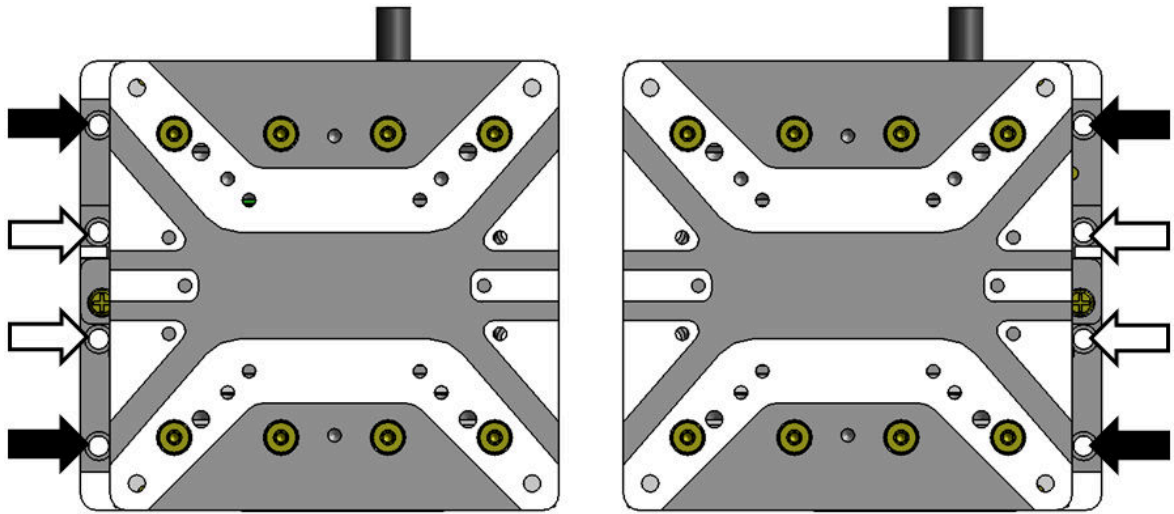


Figure 4: Mounting holes in the base body of the U-523.25 for M1.6 screws

We recommend using the holes marked by the black arrows. Refer to ["Dimensions" \(p. 30\)](#) for the exact position and depth of the holes.

Tools and Accessories

- [Screw set for mounting the U-523.25 \(p. 13\)](#)
- Suitable screwdriver

Requirements

- ✓ You have read and understood the [general safety instructions \(p. 9\)](#).
- ✓ The U-523.25 is not connected to the electronics.
- ✓ You have provided a suitable underlying surface with the holes necessary for the [screws and if required, locating pins \(p. 30\)](#).
 - The surface flatness is $\leq 10 \mu\text{m}$.
 - For applications with large temperature fluctuations: The surface should have the same or similar thermal expansion properties as the U-523.25.
 - The threaded holes are sufficiently conductive.
- ✓ The underlying surface is connected to a protective earth conductor. The cross section of the protective earth conductor is at least 0.75 mm^2 .
- ✓ You have accounted for the space required to route cables without bending and according to regulations.

**CAUTION****Risk of electric shock if the protective earth conductor is not connected!**

If the protective earth conductor is missing or not properly connected, dangerous touch voltages can occur on the U-523.25 in the event of malfunction or failure of the system. If there are touch voltages, touching the U-523.25 can lead to minor injury due to electric shock.

- ▶ Connect the U-523.25 to a [protective earth conductor \(p. 15\)](#) before startup.
- ▶ Do **not** remove the protective earth conductor during operation.
- ▶ If the protective earth conductor has to be removed temporarily (e.g., for modification), reconnect the U-523.25 to the protective earth conductor before restarting.

NOTICE**Damage due to collisions!**

Collisions can damage the U-523.25, the load to be moved, and the surroundings.

- ▶ Make sure that collisions are not possible between the U-523.25, the load to be moved, and the surroundings in the motion range of the U-523.25.
- ▶ Do not place any cables or other objects in areas where they could be caught by moving parts.

NOTICE**Excessively long screws**

Screws inserted too deeply can damage the U-523.25.

- ▶ Pay attention to the depth of the mounting holes in the base body and the motion platform of the [U-523.25 \(p. 30\)](#).
- ▶ Only use screws with the correct length for the respective mounting holes.

Information

The U-523.25 can heat up during operation. The heat produced during operation can affect your application.

Information

- ▶ Pay attention to the applicable standards for connecting the protective earth conductor.

Mounting the U-523.25 onto an Underlying Surface

1. If necessary: Give access to the mounting holes in the base body of the U-523.25. Possible measures:
 - [Starting and operating the positioner \(p. 21\)](#) temporarily and commanding the platform to a suitable position
 - Moving the platform by hand
2. Align the U-523.25 on the underlying surface so that the corresponding mounting holes in the U-523.25 and underlying surface are in line.
3. Tighten the screws in all accessible mounting holes completely.
4. If necessary: Repeat steps 1 to 3 for all concealed mounting holes.
5. Check that the U-523.25 is sitting firmly on the underlying surface.
6. Make sure that the contact resistance is $<0.1 \Omega$ at 25 A at all points relevant for attaching the protective earth conductor.

6.2 Mounting a Rotation Stage on the U-523.25

The following rotation stages can be mounted on the U-523.25:

- U-622.03
- U-624.03

Overview

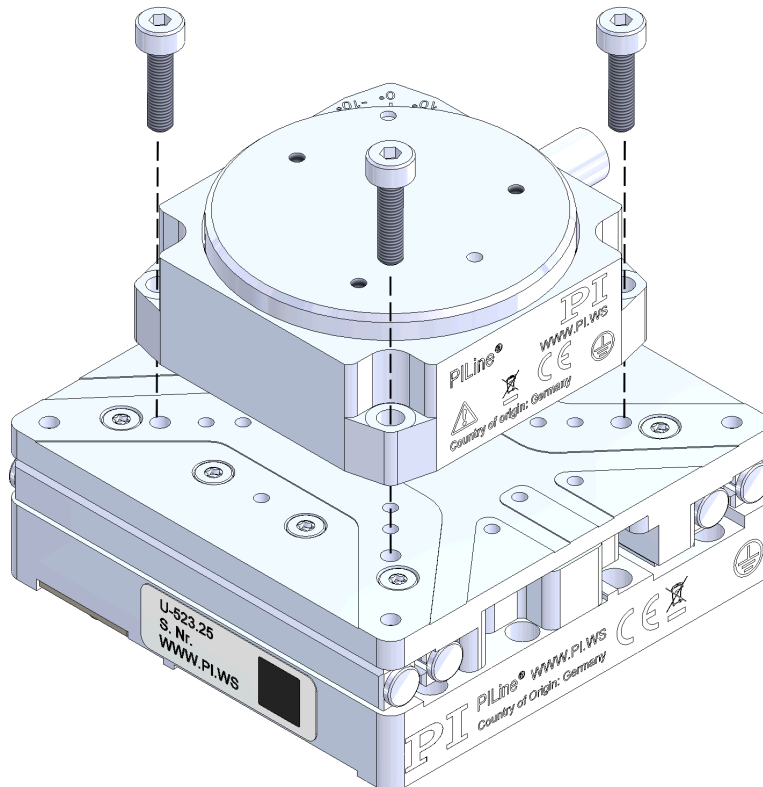


Figure 5: Example of mounting a U-624.03 on the U-523.25

Tools and Accessories

- Suitable screws:
 - When mounting a U-622.03: 2 M1.6x7 mm screws (not included in the scope of delivery)
 - When mounting a U-624.03: 3 M2x8 mm screws (not included in the scope of delivery)
- Suitable screwdriver

Requirements

- ✓ You have read and understood the [general safety instructions \(p. 9\)](#).
- ✓ The positioners are **not** connected to the electronics.
- ✓ The lower positioner has been [mounted onto the underlying surface properly \(p. 15\)](#).
- ✓ You have accounted for the space required to route cables without bending and according to regulations.

NOTICE**Mechanical overload of the motion platform!**

High torques and high loads can overload the motion platform of the U-523.25 when fixing the load. Mechanical overloading damages the U-523.25.

- ▶ Avoid torques on the motion platform.
- ▶ Do **not** exceed the maximum permissible loads according to the [specifications \(p. 27\)](#).
- ▶ Hold the load and adhere to the specified torque range when tightening (or loosening) the [screws \(p. 35\)](#).
- ▶ When calculating the load the calculations must also include the masses of positioners moved in multi-axis systems.

NOTICE**Excessively long screws**

Screws inserted too deeply can damage the U-523.25.

- ▶ Pay attention to the [depth of the mounting holes \(p. 30\)](#).
- ▶ Only use screws with the correct length for the respective mounting holes.

Mounting a Rotation Stage on the U-523.25

1. Put the upper positioner on the lower positioner so that the corresponding mounting holes in the upper and lower positioners are in line.
2. Hold the upper positioner so that it cannot move while tightening the screws.
3. Tighten the screws loosely in all mounting holes to avoid tension.
4. Tighten the screws. Avoid applying torque to the motion platform when tightening the screws, and adhere to the [torque range \(p. 35\)](#) specified for the screws.
5. Check that the upper positioner is firmly seated.

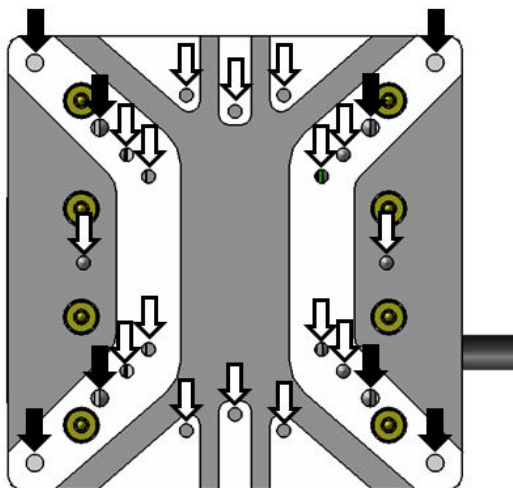
6.3 Mounting the Load onto the U-523.25**Overview**

Figure 6: Mounting holes in the motion platform of the U-523.25

Black arrows: M2 holes

White arrows: M1.6 holes

Refer to "[Dimensions](#)" ([p. 30](#)) for the exact position and depth of the holes.

Tools and Accessories

- At least 3 screws with suitable [dimensions \(p. 30\)](#)
- Suitable tool for tightening the screws

Requirements

- ✓ You have read and understood the [general safety instructions \(p. 9\)](#).
- ✓ The U-523.25 is not connected to the electronics.
- ✓ You have mounted the U-523.25 [onto the surface \(p. 15\)](#) properly.
- ✓ You have prepared the load so that it can be fixed to the mounting holes in the motion platform:
 - The gap between the center of gravity of the load and the center of the motion platform is as small as possible in all directions.
 - At least three points are provided for fixing the load on the motion platform.

NOTICE**Mechanical overload of the motion platform!**

High torques and high loads can overload the motion platform of the U-523.25 when fixing the load. Mechanical overloading damages the U-523.25.

- ▶ Avoid torques on the motion platform.
- ▶ Do **not** exceed the maximum permissible loads according to the [specifications \(p. 27\)](#).
- ▶ Hold the load and adhere to the specified torque range when tightening (or loosening) the [screws \(p. 35\)](#).
- ▶ When calculating the load the calculations must also include the masses of positioners moved in multi-axis systems.

NOTICE**Excessively long screws**

Screws inserted too deeply can damage the U-523.25.

- ▶ Pay attention to the [depth of the mounting holes \(p. 30\)](#).
- ▶ Only use screws with the correct length for the respective mounting holes.

Fixing the Load

1. Align the load on the platform so that the mounting holes selected in the platform can be used to mount the load.
2. Hold the load so that it cannot move while tightening the screws.
3. Tighten the screws loosely in all mounting holes to avoid tension.
4. Tighten the screws. Avoid applying torque to the motion platform when tightening the screws, and adhere to the [torque range \(p. 35\)](#) specified for the screws.
5. Check that the load is sitting firmly on the platform.

6.4 Connecting the U-523.25

Tools and Accessories

- If necessary: Suitable screwdriver for the locking screws of the connectors.

Requirements

- ✓ You have read and understood the [general safety instructions \(p. 9\)](#).
- ✓ You have read and understood the user manual for the electronics used.
- ✓ You have installed the electronics properly.

- ✓ The electronics are switched off.

NOTICE



Damage due to incorrect connection of the U-523.25!

Connecting unsuitable electronics or the wrong cable can lead to damage to the U-523.25 or the electronics.

- ▶ Make sure that the electronics support the drive type of the U-523.25 and have been configured accordingly.
- ▶ Use cables from PI only to connect the U-523.25 to the electronics.
- ▶ Pay attention to correct [pin assignment \(p. 34\)](#).

Connecting the U-523.25

1. If necessary: Remove the ESD protective caps from the connectors of the U-523.25.
2. Connect the U-523.25's drive connector to the drive connector on the electronics.
3. If necessary: Secure the connection against unintentional loosening.

7 Startup and Operation

7.1 Starting and Operating the U-523.25



CAUTION



Risk of electric shock if the protective earth conductor is not connected!

If the protective earth conductor is missing or not properly connected, dangerous touch voltages can occur on the U-523.25 in the event of malfunction or failure of the system. If there are touch voltages, touching the U-523.25 can lead to minor injury due to electric shock.

- ▶ Connect the U-523.25 to a [protective earth conductor \(p. 15\)](#) before startup.
- ▶ Do **not** remove the protective earth conductor during operation.
- ▶ If the protective earth conductor has to be removed temporarily (e.g., for modification), reconnect the U-523.25 to the protective earth conductor before restarting.

NOTICE



Operating voltage excessively high or incorrectly connected!

Operating voltages that are too high or incorrectly connected can cause damage to the U-523.25.

- ▶ Pay attention to the [operating voltage range \(p. 28\)](#), which is specified for the U-523.25.
- ▶ Pay attention to correct [pin assignment \(p. 34\)](#).

NOTICE



Short circuit due to condensation!

Condensation can lead to short-circuiting and failure of the U-523.25.

- ▶ Leave the U-523.25 to stand for a reasonable time to allow it to reach room temperature in the following cases:
 - After unpacking or before starting and operating for the first time
 - When the U-523.25 is brought from a cold to a warm environment or a warm to a cold environment
- ▶ Keep the U-523.25 free of condensation.

NOTICE



Damage due to the high acceleration!

High acceleration can cause considerable wear and damage the U-523.25.

- ▶ Stop motion immediately if a malfunction occurs.
- ▶ Avoid collisions with objects in the workspace or the end of the travel range.
- ▶ Approach the end of the travel range always at a low velocity.

NOTICE



Uncontrolled oscillation!

Oscillation can cause irreparable damage to the U-523.25. Oscillation is indicated by a humming noise and can result from the following causes:

- The load and/or dynamics during operation differ considerably to the calibration settings.
- The U-523.25 is operated near to its resonant frequency.
- ▶ If you notice oscillation, stop the U-523.25 immediately.

Requirements

- ✓ You have read and understood the [general safety instructions \(p. 9\)](#).

- ✓ You have [installed \(p. 15\)](#) the U-523.25 correctly.
- ✓ The U-523.25 is connected to the [protective earth conductor \(p. 15\)](#).
- ✓ You have read and understood the user manual for the electronics used.
- ✓ If a digital controller is used: You have read and understood the manual for the PC software used.
- ✓ The electronics and if required, the PC software, have been installed (see the user manual for the electronics).

Starting and Operating the U-523.25

1. Start up the electronics (see the user manual for the electronics).
2. Configure the electronics for the U-523.25 during startup. If you are using a digital controller from PI, run the PC software and select the entry in the positioner database that matches the U-523.25 exactly.
3. Start a few motion cycles for testing purposes (see the user manual for the electronics).

7.2 Adjusting Parameter Values when Using Extension Cables

Information

It may be necessary to optimize the motor performance when using extension cables. The parameter values in the controller must be adjusted if the total cable length exceeds 3 m (between positioner and controller).

- If the total cable length between the positioner and the controller exceeds 6.5 m, contact our [customer service department \(p. 7\)](#).

Adjusting parameter values when using extension cables

1. Adjust the value of the **Frequency Shift** parameter (ID 0x64) in the controller. Possible values: 20, 15, 10, 5, 0, -5, -10, -15, -20.
2. Repeat step 1 until the U-523.25 has reached optimal motor power.
3. Save the new parameter values to a positioner database on the PC or the nonvolatile memory of the controller for future use (refer to the controller manual and the PIMikroMove manual).

8 Maintenance

NOTICE



Damage due to improper maintenance!

Improper maintenance can lead to misalignment and failure of the U-523.25.

- ▶ Loosen screws only according to the instructions in this manual or the instructions of our [customer service department \(p. 7\)](#).

8.1 Maintenance Run

The maintenance run serves to distribute the existing lubricant.

The following intervals for the maintenance run depend on the operating conditions and the period of use:

- After 500 operating hours or at least after one 1 year
- If the U-523.25 is moved over a small travel range (<20 % of the entire travel range) during industrial operation: After every 2000 motion cycles

Doing a Maintenance Run

1. Make sure that collisions between the U-523.25, the load to be moved, and the surroundings are not possible over the entire travel range of the U-523.25. If necessary, remove the load from the U-523.25 for the maintenance run.
2. Do a maintenance run over the entire travel range:
 - a) Command the U-523.25 to the end of a travel range and from there to the opposite end of the travel range (see manual for the electronics).
 - b) If necessary: Command the U-523.25 to a position where the load can be mounted onto the U-523.25 again, and [mount the load back onto the U-523.25 \(p. 18\)](#).

8.2 Relubricating

Under laboratory conditions, it is only necessary to relubricate the U-523.25 in exceptional cases. For continuous industrial use, the lubrication intervals must be defined individually.

If you have any questions on relubricating, contact our [customer service department \(p. 7\)](#).

8.3 Cleaning

NOTICE



Damage due to unsuitable cleaning agents!

Some cleaning agents can cause rusting on the U-523.25 or dissolve plastics, paints or adhesives.

- ▶ Do **not** clean with water or acetone.

Auxiliary Materials Required

- Soft, lint-free cloth
- Mild cleaning agent or disinfectant

If you have any questions on the auxiliary materials recommended for the U-523.25, contact our [customer service department \(p. 7\)](#).

Requirements

- ✓ You have disconnected the U-523.25 from the electronics.

Cleaning the U-523.25

1. Dampen the cloth with the cleaning agent or disinfectant.
2. Carefully wipe the surfaces of the U-523.25.

9 Troubleshooting

The positioner does not move	
Cable not connected correctly	► Check the cable connections.
The electronics or mechanics were replaced	► Run the startup (p. 21) once again.
Electronics not connected correctly	► Check all connecting cables (p. 19) .
Defective electronics	► Check the electronics.
The positioner was connected to the switched-on electronics	► Switch the electronics off and on again or restart them with the RBT command or with the corresponding PC software function.
Incorrect configuration	► Check the U-523.25's parameter settings in the electronics connected and make the appropriate corrections.
Incorrect command or incorrect syntax	► Send the ERR? command in the PI electronics and check the error code .
Incorrect axis or channel commanded	► Make sure that the electronics use the correct axis respectively channel identifier.
Commanded axis is not referenced	► Do a reference move for the axis as described in the user manual for the controller.
Reduced positioning accuracy	
When the U-523.25 is mounted vertically: Load exceeds the holding force of the drive	► Make sure that the holding force of the drive (p. 27) is not exceeded.
Warped base body	► Mount the U-523.25 onto an even surface (p. 15) .
Increased wear due to small motion over a long period of time	► Perform a maintenance run (p. 23) .
Uncontrolled oscillation	
Large changes to the load or the alignment of the U-523.25	► Switch off the servo control system or the controller immediately. ► Check whether the servo control parameter settings correspond to the selected closed-loop control mode; see user manual for the controller. ► If necessary, correct the settings of the servo control parameters.

If the problem is not listed in the table or cannot be solved as described, contact our [customer service department \(p. 7\)](#).

10 Transportation

Pay attention to the [ambient conditions and classifications \(p. 29\)](#) when transporting the U-523.25.

10.1 Packing the U-523.25

1. Pack the U-523.25 in the original packaging.
2. If the U-523.25 is to be sent, use a stable outer box.

11 Technical Data

Subject to change. You can find the latest product specifications on the product web page at www.pi.ws.

11.1 Specifications

Motion	U-523.25	Unit	Tolerance
Active axes	X		
Travel range in X	22	mm	
Maximum velocity in X	200	mm/s	
Angular error around Y (pitch)	±750	μrad	Typ.
Angular error around Z (yaw)	±150	μrad	Typ.

Positioning	U-523.25	Unit	Tolerance
Minimum incremental motion in X	0.1	μm	Typ.
Reference switch	Optical		
Integrated sensor	Incremental linear encoder		
Sensor resolution	10	nm	

Drive Properties	U-523.25	Unit	Tolerance
Drive type	PILine® piezo motor, performance class 1		
Drive force in X	2	N	Typ.

Mechanical Properties	U-523.25	Unit	Tolerance
Permissible push force in Z	5	N	Max.
Holding force in X, passive	2	N	Min.
Guide	Crossed roller guide		
Overall mass	140	g	
Mass without cable	70	g	
Material	Aluminum, anodized		

Miscellaneous	U-523.25	Unit	Tolerance
Operating temperature range	0 to 40	°C	
Connector	D-sub 15 (m)		
Cable length	1.5	m	
Recommended controllers / drivers	C-867.1U, C-867.10C885, C-867.2U2		


Specifications determined with the C-867.1U controller.

Ask about customized versions.

At PI, technical data is specified at 22 ± 3 °C. Unless otherwise stated, the values are for unloaded conditions. Some properties are interdependent. The designation "typ." indicates a statistical average for a property; it does not indicate a guaranteed value for every product supplied. During the final inspection of a product, only selected properties are analyzed, not all. Please note that some product characteristics may deteriorate with increasing operating time.

11.2 Maximum Ratings

The U-523.25 is designed for the following operating data:

Maximum operating voltage	Operating frequency	Maximum power consumption
		
160 V _{pp} (57 V _{eff})	210 to 225 kHz	10 W

11.3 Ambient Conditions and Classifications

Pay attention to the following ambient conditions and classifications for the U-523.25:

Area of application	For indoor use only
Maximum altitude	2000 m above msl
Relative humidity	Max. 80 % for temperatures to 31 °C, linearly decreasing to 50 % at 40 °C
Operating temperature	0 °C to 40 °C
Storage temperature	-20 °C to 75 °C
Transport temperature	-20 °C to 75 °C
Overvoltage category	II
Protection class	I
Degree of pollution	1
Degree of protection according to IEC 60529	IP20

11.5 Drive Properties

11.5.1 Motor Power and Operating Voltage

The following table shows the relationship between the control value, operating voltage, and motor power of the U-523.25. The operating voltage is output by the controller and depends on the actual control value. The polarity sign of the control value determines the direction of motion.

Motor power	Control value (positive or negative)	Corresponding operating voltage (rounded)
0%	0	0 V _{eff}
25%	8192	14 V _{eff}
50%	16384	29 V _{eff}
75%	24575	43 V _{eff}
100%	32767	57 V _{eff}

The operating voltage is limited by the controller with parameter 0x7C (**Maximum Motor Output (V)**). When you load the operating parameters of the U-523.25 from the positioner database, this parameter is set to the maximum permissible value. This maximum value may not be exceeded in order not to damage the motor.

The control value is specified by the servo algorithm of the electronics or the SMO command.

11.5.2 Velocity and Dynamic Force

The following figure shows approximately the relationship between the velocity and force of the U-523.25 with different motor powers. Motion is possible from a motor power of approx. 30 %.

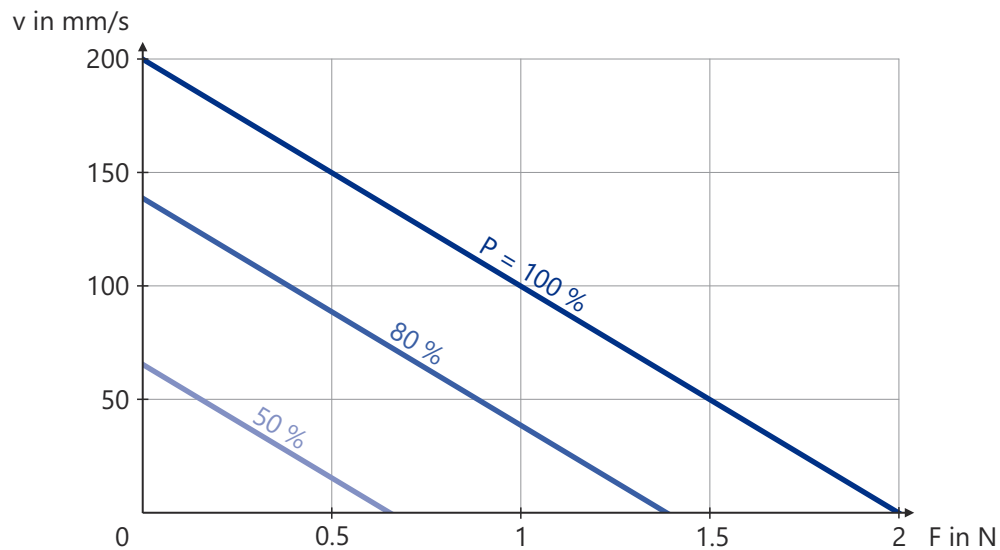


Figure 8: Relation between velocity and force

11.5.3 Motor Power and Lifetime

Motor power, duty cycle and ambient temperature influence the lifetime of the positioner. In order to prevent overheating and high wear, the motor power and the duty cycle should not exceed the limits given in the following graph. A load cycle corresponds to a positioning run and includes the acceleration, motion, deceleration as well as downtime (break). The motor should only sporadically be operated at peak power; the peak power serves as a control reserve.

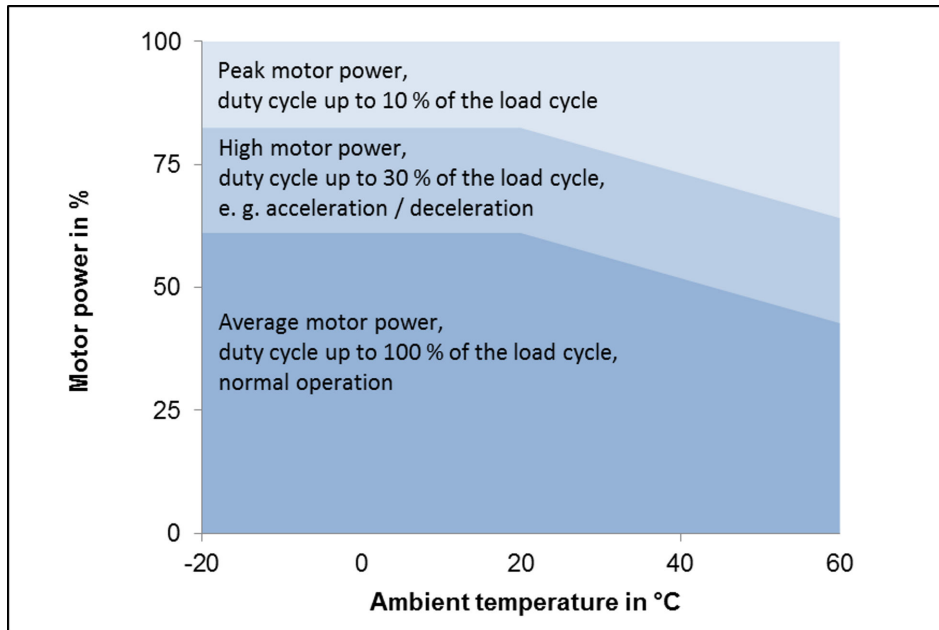


Figure 9: U-523.25: Recommended duty cycle and motor power depending on the ambient temperature

11.5.4 Influence of Downtimes on the Static Holding Force

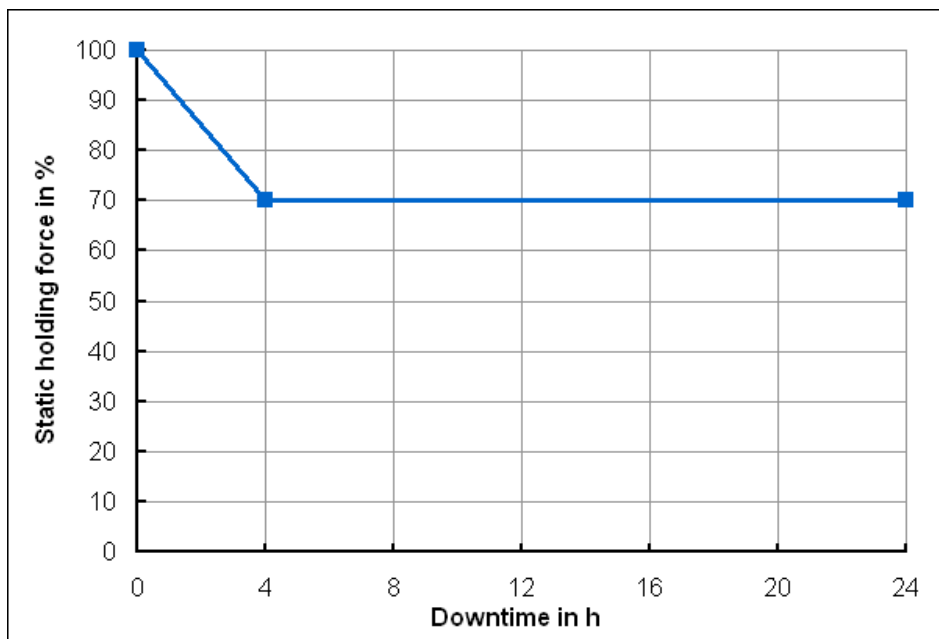


Figure 10: Static holding force of the U-523.25 depending on the downtime of the motor

12 Appendix

12.1 Pin Assignment

12.1.1 Drive Connector

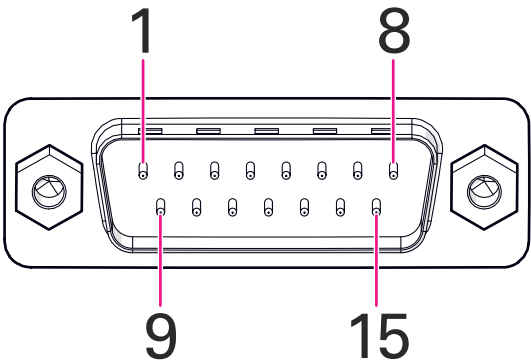


Figure 11: D-sub 15 (m)

Pin	Signal	Function
1	NC	Not connected
2	USM_P1	Input: Motor voltage ground
3	USM_P2	Input: Piezo, 57 VAC (RMS)
4	V _{DD}	Input: Power supply, +5 V
5	NC	Not connected
6	ID_CHIP	Bidirectional: Data line for ID chip
7	ENCA-	Output: Encoder channel A (inverted), RS-422
8	ENCB-	Output: Encoder channel B (inverted), RS-422
9	USM_P1	Input: Motor voltage ground
10	GND	Ground
11	USM_P3	Input: Piezo, 57 VAC (RMS)
12	NC	Not connected
13	REFSWITCH	Output: Reference switch
14	ENCA+	Output: Encoder channel A, RS-422
15	ENCB+	Output: Encoder channel B, RS-422

12.2 Torque for Stainless Steel Screws (A2-70)

Screw size	Minimum torque	Maximum torque
M6	4 Nm	6 Nm
M5	2.5 Nm	3.5 Nm
M4	1.5 Nm	2.5 Nm
M3	0.8 Nm	1.1 Nm
M2.5	0.3 Nm	0.4 Nm
M2	0.15 Nm	0.2 Nm
M1.6	0.06 Nm	0.12 Nm

Pay attention to the screw-in depth required for the respective material in accordance with VDI directive 2230.

Glossary

Lateral Force

Also: Lateral load capacity

Maximum permissible force orthogonally to the positioning direction. This value is directly valid for the motion platform or the slider with mounting rails at the product. The value is reduced when the force acts above the platform/slider.

Linear Encoder

The linear encoder is an incremental sensor for detecting changes in position. Signals from the sensor are used for axis position feedback. After the controller is switched on, referencing must be done before absolute target positions can be commanded and reached.

Load Capacity

Maximum load in the vertical direction when the U-523.25 is mounted horizontally. The contact point of the load is at the center of the motion platform.

Reference Switch

Many of the positioners are equipped with a direction sensing reference switch positioned approx. in the middle of the travel range. It is recommended to approach the reference switch always from the same direction to obtain best position repeatability.

Function: Optical, magnetic

Sensor Resolution

The sensor can be the critical element of position resolution so it may be necessary to specify the sensor resolution separately. Rotary encoder: Impulses per screw rotation. Linear encoder: Smallest motion still detected by the sensor system.

Specifications

The performance specifications are checked before dispatch. The performance specifications apply to room temperature (22 ± 3 °C), systems in closed-loop operation are calibrated at this temperature. It may be necessary to reset the operating parameters when operating at considerably lower or higher temperatures.