User Manual

U-523.25 PILINE® LINEAR STAGE
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1 Legal Information

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The patents held by PI can be found in our list at http://www.physikinstrumente.com/en/about-pi/patents.

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2  About this Document

2.1  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.

2.2  Other Applicable Documents

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

<table>
<thead>
<tr>
<th>Document number</th>
<th>Document type</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP121EK</td>
<td>Short instructions</td>
<td>PLine® Stages</td>
</tr>
<tr>
<td>SM148E</td>
<td>Software manual</td>
<td>PIMikroMove</td>
</tr>
<tr>
<td>MS223E</td>
<td>User manual</td>
<td>C-867.1U</td>
</tr>
<tr>
<td>MS231E</td>
<td>User manual</td>
<td>C-867.2U2</td>
</tr>
<tr>
<td>C867T0017</td>
<td>User Manual</td>
<td>C-867.10C885</td>
</tr>
</tbody>
</table>

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

2.3  Explanation of Symbols

This chapter explains the symbols and markings used by PI in this user manual.

2.3.1  Typographic Conventions

<table>
<thead>
<tr>
<th>Symbol / Label</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Action consisting of several steps whose sequential order must be observed</td>
</tr>
<tr>
<td>2.</td>
<td></td>
</tr>
<tr>
<td>■</td>
<td>Lists</td>
</tr>
<tr>
<td>p. 5</td>
<td>Cross-reference to page 5</td>
</tr>
<tr>
<td>RS-232</td>
<td>Labeling of an operating element on the product (example: socket of the RS-232 interface)</td>
</tr>
<tr>
<td>Start &gt; Settings</td>
<td>Menu path in the PC software (example: to open the menu, the Start and Settings menus must be clicked successively)</td>
</tr>
<tr>
<td>POS?</td>
<td>Command line or a command from PI's General Command Set (GCS) (example: command to get the axis position)</td>
</tr>
<tr>
<td>Device S/N</td>
<td>Parameter name (example: parameter where the serial number is stored)</td>
</tr>
<tr>
<td>5</td>
<td>Value that must be entered or selected via the PC software</td>
</tr>
</tbody>
</table>
2.3.2 Symbols Used

<table>
<thead>
<tr>
<th>Symbol / Label</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Warning of electrical voltage</td>
</tr>
<tr>
<td></td>
<td>General hazard symbol</td>
</tr>
</tbody>
</table>

⚠️ **DANGER**

Dangerous situation
Failure to observe can lead to death or serious injury.
► Measures for avoiding the risk.

⚠️ **WARNING**

Dangerous situation
Failure to observe can lead to serious injury.
► Action to take to avoid the risk.

⚠️ **CAUTION**

Dangerous situation
Failure to observe can lead to minor injury.
► Actions to take to avoid the risk.

⚠️ **NOTICE**

Dangerous situation
Failure to observe can lead to material damage.
► Action to take to avoid the risk.

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

2.4 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.

2.5 Downloading Manuals

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

For products that are supplied with software (CD in the scope of delivery), access to the manuals is protected by a password. Protected content is only displayed on the website after entering the login data. You need the product CD to get the login data.

If a manual is missing or problems occur with downloading, contact our customer service department (p. 23).

Downloading Manuals
1. Open the website www.pi.ws.
2. If the product was shipped with a CD: Log into the website:
   a) Click Login.
   b) Enter the login data.
      The login data is in the `[...]_Releasenews_[...]_.pdf` in the Manuals directory on the product CD.
      If necessary: Follow the link and register yourself to get the login data.
   c) Click Login or press the Enter key.
3. Search for the product:
   a) Click Search.
   b) Enter the product number up to the period (e.g., U-523) into the search field.
   c) Click Start search or press the Enter key.
   d) If necessary: Click Load more results at the bottom of the list.
4. Click the corresponding product in the list of search results.
5. Click the Downloads tab.
   ➔ The manuals are shown under Documentation.
6. Click the desired manual and save it.
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 (p. 12). 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

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 if it is in perfect condition.
► Read the user manual.
► Eliminate any faults and malfunctions that are likely to affect safety immediately.

The operator is responsible for correct installation and operation of the U-523.25.

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.
► 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.

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 label on the U-523.25
1. Type plate
2. Warning and conformity symbols (Old equipment disposal (p. 27), CE mark (p. 31))

Figure 2: Product label on 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
   Meaning of the position (counting from the left):
   1 = internal information,
   2 and 3 = year of manufacture,
   4 to 9 = consecutive numbers
3. Data matrix code (example; contains the serial number)
4. Revision number
4.2 Scope of Delivery

<table>
<thead>
<tr>
<th>Product number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-523.25</td>
<td>Linear stage according to order</td>
</tr>
<tr>
<td>000074746</td>
<td>Mounting kit for mounting the U-523.25, consisting of</td>
</tr>
<tr>
<td></td>
<td>■ 4 pan head screws M1,6x8-1.4301</td>
</tr>
<tr>
<td>MP121EK</td>
<td>Kurzanleitung für PILine® Positionierer</td>
</tr>
</tbody>
</table>

4.3 Overview

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

The arrow shows positive direction of motion of the axis.

4.3.1 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. 14).

The base body comprises the following subassembly or subassemblies:

- **Reference Point Switch**
  The reference point switch is a sensor whose fixed position serves as the reference point for incremental sensor signals.

- **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.

- **Displacement sensor**
  The sensor measures the position of the motion platform incremental to a known reference point. Optical linear encoders measure the actual position directly (direct metrology). Therefore, errors in the drive, such as nonlinearity, backlash or elastic deformations cannot influence the measurement of the position.
4.3.2 Drive Connection

The electrical connection to the electronics is established via the drive connection (p. 15). The drive connection transmits the supply voltage, the signals for the drive as well as the sensor signals of the U-523.25. The drive connection comprises the following subassembly or subassemblies:

ID chip

Information on the U-523.25 (e.g., type, serial number, date of manufacture, version of the hardware) is stored in parameters on the ID chip. Electronics that support the ID chip evaluate the data from the ID chip and can select the corresponding type of positioner automatically from the positioner database during startup. For more information on ID chip recognition, see the manual for the electronics used.

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:

<table>
<thead>
<tr>
<th>Product number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-867.10C885</td>
<td>Motion controller module for PILine® piezo motor systems, 1 axis, for PIMotionMaster</td>
</tr>
<tr>
<td>C-867.1U</td>
<td>PILine® controller, network capable, 1 axis, with USB and RS-232 interface</td>
</tr>
<tr>
<td>C-867.2U2</td>
<td>PILine® controller, network capable, 2 axes, with USB and RS-232 interface</td>
</tr>
</tbody>
</table>

To order, contact our customer service department (p. 23).
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 connection 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. When the U-523.25 was delivered with ESD protective caps on the connections: 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. 23) 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
- The surface that is connected to the protective earth conductor

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

Overview

Figure 4: Mounting holes in the motion platform of the U-523.25

Tools and Accessories
- Screw set for mounting the U-523.25 (p. 11)
- Suitable screwdriver

Requirements
✓ You have read and understood the general safety instructions (p. 8).
✓ You have provided a suitable surface with the holes necessary for the screws and if required, locating pins (p. 26).
- The flatness of the surface is \( \leq 10 \mu m \).
For applications with large temperature changes: The surface should have the same or similar thermal expansion properties as the U-523.25.

✓ 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, 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.
► 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.

**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.
► 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.

**Mounting the U-523.25 on a Surface**

1. If necessary: Allow access to the mounting holes in the base body of the U-523.25. Possible measures:
   - Temporary startup of the positioner (p. 17) and command the platform to a suitable position
   - Move the motion platform by hand
2. Align the U-523.25 on the surface so that the corresponding mounting holes in the U-523.25 and the surface overlap.
3. Insert the screws into all accessible mounting holes and tighten.
4. If necessary: Repeat steps 1 to 3 for all concealed mounting holes.
5. Check that the U-523.25 is affixed firmly to the surface.

**6.2 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. 8).
✓ 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 a wrong cable can damage the U-523.25 or the electronics.
- Connect the U-523.25 to suitable electronics (p. 12) from PI only.
- Use cables from PI only to connect the U-523.25 to the electronics.

Connecting the U-523.25
1. If necessary: Remove the ESD protective caps from the connections of the U-523.25.
2. Connect the drive plug of the U-523.25 to the drive socket on the electronics.
3. Secure the connector against unintentional removal.
7 Startup / Operation

7.1 Starting and operating the U-523.25

Tools and Accessories

- Electronics from PI (p. 12)

Requirements

✓ You have read and understood the general safety instructions (p. 8).
✓ For startup with a load or in a multi-axis system: You have installed the U-523.25 properly (p. 14).
✓ 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).

⚠️ CAUTION

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

⚠️ 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. 25), which is specified for the U-523.25.
► Pay attention to correct pin assignment (p. 29).

⚠️ NOTICE

Kurzschluss durch Kondenswasser!
Kondenswasser kann zu elektrischen Kurzschlüssen und zum Ausfall des U-523.25 führen.
► Lassen Sie den U-523.25 in folgenden Fällen für eine angemessene Zeit stehen, um ihn auf Raumtemperatur zu bringen:
  • Nach dem Auspacken bzw. vor der ersten Inbetriebnahme
  • Wenn der U-523.25 von einer kalten in eine warme Umgebung oder von einer warmen in eine kalte Umgebung gebracht wird
  • Halten Sie den U-523.25 frei von Kondenswasser.
**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.

---

**Starting and operating the U-523.25**

1. Start 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: In the PC software, select the entry in the positioner database that matches the U-523.25 exactly.
   ■ If you are using electronics from another manufacturer: Configure the electronics according to the parameter of the U-523.25 (p. 29).
3. Start a few motion cycles for testing purposes (see the user manual for the electronics).
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. 23).

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

**Performing 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 motion platform of the U-523.25 for the maintenance run.
2. Perform 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 motion platform again and mount the load back onto the U-523.25.

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. 23).

8.3 Cleaning

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

**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. 23).

**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.
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.
<table>
<thead>
<tr>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The positioner does not move, no operating noise can be heard</strong></td>
</tr>
<tr>
<td>There is a motion error.</td>
</tr>
<tr>
<td>Defective electronics</td>
</tr>
<tr>
<td>Electronics not connected correctly</td>
</tr>
<tr>
<td><strong>Reduced positioning accuracy</strong></td>
</tr>
<tr>
<td>When the U-523.25 is mounted vertically: Load exceeds the self-locking of the drive</td>
</tr>
<tr>
<td>Warped base body</td>
</tr>
<tr>
<td>Increased wear due to small motion over a long period of time</td>
</tr>
<tr>
<td><strong>Uncontrolled oscillation</strong></td>
</tr>
</tbody>
</table>
| 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. |
10 Transportation

Preparing the U-523.25 for Transportation

1. Pay attention to the ambient conditions and classifications (p. 25).
2. Pack the U-523.25 in the original packaging.
3. If the U-523.25 is to be sent, use a stable outer box.
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) GmbH & Co. KG
Auf der Roemerstrasse 1
76228 Karlsruhe
Germany
service@pi.de
www.pi.de
## 12 Technical Data

### 12.1 Specifications

<table>
<thead>
<tr>
<th>Motion</th>
<th>U-523.25</th>
<th>Unit</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active axes</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel range</td>
<td>22 mm × 22 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Velocity, closed-loop</td>
<td>200</td>
<td>mm/s</td>
<td>max.</td>
</tr>
<tr>
<td>Bidirectional repeatability</td>
<td>±0.2</td>
<td>µm</td>
<td></td>
</tr>
<tr>
<td>Pitch</td>
<td>±60</td>
<td>µrad</td>
<td>max.</td>
</tr>
<tr>
<td>Yaw</td>
<td>±300</td>
<td>µrad</td>
<td>max.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mechanical properties</th>
<th>U-523.25</th>
<th>Unit</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load capacity in z</td>
<td>5</td>
<td>N</td>
<td>max.</td>
</tr>
<tr>
<td>Mass without cable</td>
<td>70</td>
<td>g</td>
<td></td>
</tr>
<tr>
<td>Linear guide</td>
<td>Crossed roller bearing with anti-creep system</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drive properties</th>
<th>U-523.25</th>
<th>Unit</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive type</td>
<td>PILine® ultrasonic piezo motor, performance class 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal force</td>
<td>2</td>
<td>N</td>
<td>typ.</td>
</tr>
<tr>
<td>Holding force</td>
<td>2</td>
<td>N</td>
<td>typ.</td>
</tr>
</tbody>
</table>
### Positioning

<table>
<thead>
<tr>
<th></th>
<th>U-523.25</th>
<th>Unit</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated sensor</td>
<td>Optical, incremental sensor, sin/cos signal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensor resolution</td>
<td>10</td>
<td>nm</td>
<td></td>
</tr>
<tr>
<td>Minimum incremental motion</td>
<td>0.1</td>
<td>µm</td>
<td>typ.</td>
</tr>
<tr>
<td>Reference point switch</td>
<td>Direction-sensing optical reference point switch</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Miscellaneous

<table>
<thead>
<tr>
<th></th>
<th>U-523.25</th>
<th>Unit</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature range</td>
<td>0 to 40</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Humidity</td>
<td>20 – 90% rel., not condensing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>Aluminum, anodized</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor / sensor connection</td>
<td>Sub-D 15 (m)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cable length</td>
<td>1.5 m</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 12.2 Maximum Ratings

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

<table>
<thead>
<tr>
<th>Maximum operating voltage</th>
<th>Operating frequency</th>
<th>Maximum power consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>160 V&lt;sub&gt;pp&lt;/sub&gt; (57 V&lt;sub&gt;eff&lt;/sub&gt;)</td>
<td>210 to 225 kHz</td>
<td>10 W</td>
</tr>
</tbody>
</table>

### 12.3 Ambient Conditions and Classifications

The following ambient conditions and classifications for the U-523.25 must be observed:
### 12.4 Dimensions

![Dimensions Diagram](image)

Figure 5: Dimensions of the U-523.25

Dimensions in mm. Note that the decimal places are separated by a comma in the drawings.
13 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 fulfil 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) GmbH & Co. KG
Auf der Roemerstrasse 1
76228 Karlsruhe
Germany
info@pi.de
www.pi.de
**Linear Encoder**
The linear encoder is an incremental sensor for capturing changes in position. Signals from the sensor are used for axis position feedback. After the controller is switched on, a reference point definition must be performed 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.
14 Appendix

14.1 Pin Assignment

14.1.1 Drive connector

Figure 6: Sub-D 15 (m)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NC</td>
<td>Not connected</td>
</tr>
<tr>
<td>2</td>
<td>USM_P1</td>
<td>Input: Piezo, 71 VAC (RMS)</td>
</tr>
<tr>
<td>3</td>
<td>USM_P2</td>
<td>Input: Piezo, 71 VAC (RMS)</td>
</tr>
<tr>
<td>4</td>
<td>V_{DD}</td>
<td>Input: Power supply, +5 V</td>
</tr>
<tr>
<td>5</td>
<td>NC</td>
<td>Not connected</td>
</tr>
<tr>
<td>6</td>
<td>ID_CHIP</td>
<td>Bidirectional: Data line for ID chip</td>
</tr>
<tr>
<td>7</td>
<td>ENCA-</td>
<td>Output: Encoder channel A (inverted)</td>
</tr>
<tr>
<td>8</td>
<td>ENCB-</td>
<td>Output: Encoder channel B (inverted)</td>
</tr>
<tr>
<td>9</td>
<td>USM_P1</td>
<td>Input: Piezo, 71 VAC (RMS)</td>
</tr>
<tr>
<td>10</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>11</td>
<td>USM_P3</td>
<td>Input: Piezo, 71 VAC (RMS)</td>
</tr>
<tr>
<td>12</td>
<td>NC</td>
<td>Not connected</td>
</tr>
<tr>
<td>13</td>
<td>REF SWITCH</td>
<td>Output: Reference point switch</td>
</tr>
<tr>
<td>14</td>
<td>ENCA+</td>
<td>Output: Encoder channel A</td>
</tr>
<tr>
<td>15</td>
<td>ENCB+</td>
<td>Output: Encoder channel B</td>
</tr>
</tbody>
</table>

14.2 Drive Properties

14.2.1 Drive Performance and Operating Voltage

The following table shows the relationship between the control value, operating voltage, and drive performance 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.
The operating voltage is limited by the electronics with parameter 0x7C (Maximum Motor Output (V)). This maximum value may not be exceeded in order not to damage the drive.

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

### 14.2.2 Velocity and Dynamic Force

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

![Figure 7: Relation between velocity and force](image-url)
EU Declaration of Conformity

An EU Declaration of Conformity was issued for the U-523.25 in accordance with the following European directives:

- EMC Directive
- RoHS Directive

The applied standards certifying the conformity are listed below.

- EMC: EN 61326-1
- Safety: EN 61010-1
- RoHS: EN 50581