**PZ254E**

# P-753 Positioners

## User Manual

Version: 1.1.0 Date: 11.05.2022


**This document describes the following products:**

- **P-753.11C / P-753.1CD**
  LISA high dynamics piezo nanopositioner, 15 µm, direct position measuring, capacitive sensor
- **P-753.21C / P-753.2CD**
  LISA high dynamics piezo nanopositioner, 30 µm, direct position measuring, capacitive sensor
- **P-753.31C / P-753.3CD**
  LISA high dynamics piezo nanopositioner, 38 µm, direct position measuring, capacitive sensor

Models:
.11C/.21C/.31C = with LEMO connectors
.1CD/.2CD/.3CD = with D-sub connector

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Original instructions
First printing: 11.05.2022
Document number: PZ254E, CBo, Version 1.1.0

# Contents

# 1 About this Document

## In this Chapter



## 1.1 Objective and Target Group of this User Manual

This user manual contains the information required for the intended use of the P-753 (hereinafter referred to as "positioner"). The letter x in the product number stands for the various models (p. 9).

Basic knowledge of control technology, drive technologies and suitable safety measures is assumed.

The latest versions of the user manuals are available for download (p. 3) on our website.

## 1.2 Symbols and Typographic Conventions

The following symbols and typographic conventions are used in this user manual:

***CAUTION***

**Dangerous situation**
Failure to comply could lead to minor injury.

➢ Precautionary measures for avoiding the risk.

***NOTICE***

**Dangerous situation**
Failure to comply could cause damage to equipment.

➢ Precautionary measures for avoiding the risk.

***INFORMATION***

Information for easier handling, tricks, tips, etc.

| Symbol/Label | Meaning |
|---|---|
| 1.<br>2. | Action consisting of several steps with strict sequential order |
| ➢ | Action consisting of one or more steps without relevant sequential order. |
| ▪ | Bullet |
| p. 5 | Cross-reference to page 5 |
| **RS-232** | Label on the product indicating an operating element (example: RS-232 interface socket) |
|  | Warning signs on the product that refer to detailed information in this manual. |

## 1.3 Definition of Terms

| Term | Explanation |
|---|---|
| Positioner | Electrically driven mechanics (here: P-753) with one or more motion axes |
| Electronics | Piezo amplifier or piezo controller that supplies the operating voltage for positioners or piezo actuators |
| Piezo amplifier | Electronics without sensor evaluation for open-loop operation of positioners and piezo actuators |
| Piezo controller | Electronics with sensor evaluation for closed-loop operation of positioners and piezo actuators |

## 1.4 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.

## 1.5 Other Applicable Documents

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

The latest versions of the user manuals are available for download (p. 3) on our website.

| Product | Document |
|---|---|
| E-625.CR Piezo Servo Controller | PZ166 User Manual |
| E-709.1C1L Digital Piezo Controller | PZ305 User Manual |
| E-754 Digital Piezo Controller | E754T0001 User Manual |
| PIMikroMove | SM148E Software Manual |
| P-5xx / P-6xx / P-7xx Piezo Positioners | PZ240EK Short Instructions |

## 1.6 Downloading Manuals

***INFORMATION***

If a manual is missing or problems occur with downloading:

➢ Contact our customer service department (p. 33).

**Downloading Manuals**

1. Open the website **www.pi.ws**.
2. Search the website for the product number (e.g., P-753) or the product family (e.g., LISA).
3. Click the corresponding product to open the product detail page.
4. Click the ***Downloads*** tab.

   The manuals are shown under ***Documentation***. Software manuals are shown under ***General Software Documentation***.
5. Click the desired manual and fill out the inquiry form.

   The download link will then be sent to the email address entered.

# 2 Safety

## In this Chapter



## 2.1 Intended Use

The P-753 is a laboratory device as defined by DIN EN 61010-1. It is intended to be used in interior spaces and in an environment which is free of dirt, oil, and lubricants.

According to its design, the P-753 is intended for fine positioning as well as the fast and precise motion of small objects. The motion takes place linearly in one axis.

The P-753 can be mounted with a horizontally or vertically oriented motion axis. Vertical mounting is only possible under certain conditions (p. 18).

The P-753 can only be used as intended in conjunction with suitable electronics (p. 11) that are available from PI. The electronics are not included in the scope of delivery of the P-753.

The electronics must provide the required operating voltages. To ensure proper performance of the servo control system, the electronics must be able to read out and process the signals from the capacitive sensors.

## 2.2 General Safety Instructions

The P-753 is built according to state-of-the-art technology and recognized safety standards. Improper use can result in personal injury and/or damage to the P-753.

- Use the P-753 for its intended purpose only, and only when it is in perfect technical condition.
- Read the user manual.
- Eliminate any malfunctions that may affect safety immediately.

The operator is responsible for the correct installation and operation of the P-753.

The P-753 is driven by piezo actuators. Temperature changes and compressive stress can induce charges in piezo actuators. Piezo actuators can remain charged for several hours after disconnecting the electronics. If the P-753's connector has contacts that can be touched, or if other parts with touchable contacts (e.g., adapter cables) are connected to the connector, touching or short circuiting these contacts can lead to minor injuries from electric shock. The piezo actuators can be destroyed by an abrupt contraction.

- Do **not** open the P-753.
- Discharge the piezo actuators before installing the P-753 (p. 27).
- Do **not** pull the plug connector out of the electronics during operation.
- Do **not** touch the contacts in the connector of the P-753 or in the parts connected to it (e.g., adapter cables).
- If possible, use screws to secure the connectors against being pulled out of the electronics.

If a protective earth conductor is not or not properly connected, dangerous touch voltages can occur on the P-753 in the case of malfunction or failure of the system. If there are touch voltages, touching the P-753 can result in minor injuries from electric shock.

- Connect the P-753 to a protective earth conductor (p. 16) before starting.
- Do **not** remove the protective earth conductor during operation.
- If the protective earth conductor has to be removed temporarily (e.g., in the case of modifications), reconnect the P-753 to the protective earth conductor before restarting.

Mechanical forces can damage or misalign the P-753.

- Avoid impacts that affect the P-753.
- Do **not** drop the P-753.
- Do **not** exceed the maximum permissible stress and load capacities according to the specifications (p. 35).
- Do **not** touch any sensitive parts (e.g., motion platform) when handling the P-753.

The P-753 is maintenance-free and achieves its positioning accuracy as a result of the optimal alignment of mechanical components and piezo actuators. Loosened screws cause a loss in positioning accuracy.

- Loosen screws only when instructed in this manual.
- Do **not** open the P-753.

## 2.3 Organizational Measures

### User manual

- Always keep this user manual together with the P-753.
  The latest versions of the user manuals are available for download (p. 3) on our website.
- Add all information from the manufacturer to the user manual, for example supplements or technical notes.
- If you give the P-753 to a third party, include this user manual as well as other relevant information provided by the manufacturer.
- Do the work only if the user manual is complete. Missing information due to an incomplete user manual can result in minor injury and damage to equipment.
- Install and operate the P-753 only after you have read and understood this user manual.

### Personnel qualification

The P-753 may only be installed, started, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

# 3 Product Description

## In this Chapter



## 3.1 Model Overview

The P-753 is available in the following versions:

**LISA high dynamics piezo nanopositioner**

| Model | Description |
|---|---|
| P-753.11C | LISA high dynamics piezo nanopositioner, 15 µm, direct position measuring, capacitive sensor, LEMO connectors |
| P-753.1CD | LISA high dynamics piezo nanopositioner, 15 µm, direct position measuring, capacitive sensor, D-sub connector |
| P-753.21C | LISA high dynamics piezo nanopositioner, 30 µm, direct position measuring, capacitive sensor, LEMO connectors |
| P-753.2CD | LISA high dynamics piezo nanopositioner, 30 µm, direct position measuring, capacitive sensor, D-sub connector |
| P-753.31C | LISA high dynamics piezo nanopositioner, 38 µm, direct position measuring, capacitive sensor, LEMO connectors |
| P-753.3CD | LISA high dynamics piezo nanopositioner, 38 µm, direct position measuring, capacitive sensor, D-sub connector |

## 3.2 Product View

The figure serves as an example and can differ from your positioner model.

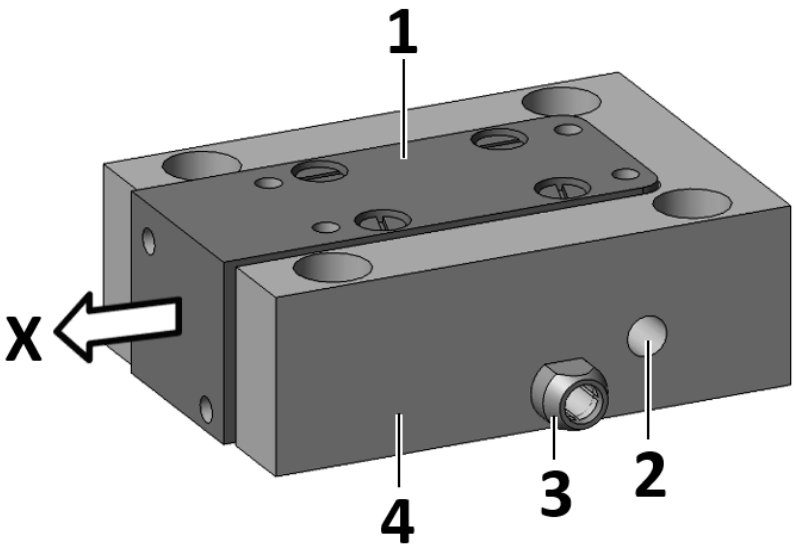


Figure 1: Example of product view

1 Motion platform
2 M4 hole for connecting the protective earth conductor
3 Cable exit
4 Base body
X Positive direction of motion of the positioner

## 3.3 Product Labeling

| Labeling | Description |
|---|---|
| P-753.1CD | Product name (example), the characters following the period refer to the model |
| 123456789 | Serial number (example), individual for each P-753<br>Meaning of each position (from the left):<br>1 = internal information<br>2 and 3 = year of manufacture<br>4 to 9 = consecutive number |
| LISA | Brand name |
| PI | Manufacturer's logo |
| ⚠ | Warning sign "Pay attention to the manual!" |
| | Old equipment disposal (p. 43) |
| Country of origin: Germany | Country of origin |
| WWW.PI.WS | Manufacturer's address (website) |
| CE | CE conformity mark |

| Labeling | Description |
|---|---|
| ⏚ | Symbol for the protective earth conductor, marks the protective earth connector of the P-753 (p. 16) |


Figure 2: "Residual Voltage" warning sign on the connector of the P-753
Notice of risk of electric shock (p. *5*) for models with D-sub plug connector

## 3.4 Scope of Delivery

| Product number | Description |
|---|---|
| P-753 | Positioner according to order (p. 9) |
| 000036450 | M4 screw set for protective earth, consisting of:<br>▪ One flat-head screw with cross recess, M4x8, ISO 7045<br>▪ 2 lock washers<br>▪ 2 flat washers |
| PZ240EK | Short instructions for P-5xx / P-6xx / P-7xx piezo positioners |

## 3.5 Suitable Electronics

You need suitable electronics to operate a P-753. Selecting the device depends on the application and the connectors available.

| Product number | Description |
|---|---|
| E-625.CR | Piezo amplifier / servo controller, 1 channel, -30 to 130 V, capacitive sensor, USB, RS-232 |
| E-709.1C1L | Digital piezo controller, 1 axis, -30 to 130 V, capacitive sensor, monitoring functionality, benchtop device |
| E-754.1CD | Single-channel, digital high-speed piezo controller for capacitive sensors, with TCP/IP, USB, and RS-232 interface |

➢ To order, contact our customer service department (p. 33).

## 3.6 Accessories

**Adapter cables for models with LEMO plug connectors**

| Product number | Description |
|---|---|
| P-895.1LDC | Adapter cable LEMO to D-sub 7W2 (m) for piezo actuator nanopositioning systems with capacitive sensors, 1 channel, length: 0.3 m. |

➢ To order, contact our customer service department (p. 33).

## 3.7 Technical Features

### 3.7.1 PICMA® Piezo Actuators

P-753 positioners are driven by PICMA® piezo actuators. PICMA® actuators have all-ceramic insulation and their performance and lifetime are therefore far superior to conventional actuators. The ceramic insulation layer protects the monolithic piezoceramic block against humidity and failure due to increased leakage current. In this way, an especially high reliability is achieved even under extreme ambient conditions. In contrast to motorized drives, there are no rotating parts or friction. The piezo actuators are therefore free of backlash, maintenance, and wear.

### 3.7.2 Flexure Guides

P-753 positioners have flexure guides for friction-free motion and high guiding accuracy.

A flexure guide is an element that is free of static and sliding friction. It is based on the elastic deformation (bending) of a solid (e.g., steel) and does not have any rolling or sliding parts. Flexure elements have a high stiffness and load capacity. Flexure guides are maintenance and wear free. They are 100% vacuum compatible, function in a wide temperature range and do not require any lubricants.

### 3.7.3 Capacitive Sensors

Capacitive sensors measure the position directly on the platform (direct metrology) and work without contact. Neither friction nor hysteresis interferes with the motion, which allows excellent linearity values to be achieved together with the high position resolution. In conjunction with suitable electronics, capacitive sensors achieve the best resolution, stability, and bandwidth.

### 3.7.4 ID Chip (Models with D-sub Connector Only)

An ID chip is in the D-sub connector of the P-753. When the P-753 is calibrated at the factory with digital electronics, the calibration data is saved on the ID chip together with specific product information. After switching on, the digital electronics read the data from the ID chip of the P-753 connected. A P-753 with an ID chip containing calibration data can therefore be connected to any suitable digital electronics without renewed calibration.

Refer to the manual for the controller for more information on the ID chip.

# 4 Unpacking

1. Unpack the P-753 with care.
2. Compare the contents with the scope of delivery according to the contract and the delivery note.
3. Inspect the contents for signs of damage. If any parts are damaged or missing, contact our customer service department (p. 33) immediately.
4. Keep all packaging materials in case the product needs to be returned.

# 5 Installation

## In this Chapter



## 5.1 General Notes on Installing

***CAUTION***

**Dangerous voltage and residual charge in piezo actuators!**

The P-753 is driven by piezo actuators. Temperature changes and compressive stress can induce charges in piezo actuators. Piezo actuators can remain charged for several hours after disconnecting the electronics. If the P-753's connector has contacts that can be touched, or if other parts with touchable contacts (e.g., adapter cables) are connected to the connector, touching or short circuiting these contacts can lead to minor injuries from electric shock. The piezo actuators can be destroyed by an abrupt contraction.

- Do **not** open the P-753.
- Discharge the piezo actuators before installing the P-753 (p. 27).
- Do **not** pull the plug connector out of the electronics during operation.


Touching the contacts in the connectors can lead to an electric shock (max. 130 V DC) and minor injuries.

- Do **not** touch the contacts in the connector of the P-753 or in the parts connected to it (e.g., adapter cables).
- If possible, use screws to secure the connectors against being pulled out of the electronics.

***NOTICE***

**Mechanical overload due to incorrect handling!**

An impermissible mechanical load on the motion platform of the P-753 can cause damage to the piezo actuators, sensors, and flexures of the P-753 as well as loss of accuracy.

- Do **not** touch any sensitive parts (e.g., motion platform) when handling the P-753.

**NOTICE**

**Damage due to unsuitable cables!**
Unsuitable cables can damage the P-753 and the electronics.

- Use cables provided by PI only to connect the P-753 to the electronics.

**NOTICE**

**Damage due to improper mounting!**
Improper mounting of the P-753 or incorrectly mounted parts can damage the P-753.

- Only use the holes or threads intended for the purpose of fixing the P-753 and loads.
- Install the P-753 so that the platform and all parts attached to it can move freely within the entire travel range.

**NOTICE**

**Damage due to incorrectly tightened screws!**
Incorrectly tightened screws can cause damage.

- Pay attention to the torque range (p. 41) specified for the screws used during installation.

**INFORMATION**

Extension cables can reduce the positioning accuracy of the P-753 or affect sensor processing by the electronics.

- Do **not** use extension cables. If you need longer cables, contact our customer service department (p. 33).

## 5.2 Connecting the P-753 to the Protective Earth Conductor

**INFORMATION**

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

**INFORMATION**

- If there is any vibration in your application, secure the screw connection for the protective earth conductor in a suitable manner (e.g., with conductive liquid adhesive) to prevent it from unscrewing by itself. If this is not possible, check the screw connection at regular intervals and retighten the screw if necessary.

***INFORMATION***

In the case of P-753 positioners with D-sub connectors, ground loops can occur when the positioner is grounded via its protective earth connector as well as via the connecting cable's shielding for the electronics.

➢ If a ground loop occurs, contact our customer service department (p. 33).

The P-753 has an M4 hole for attaching the protective earth conductor. This hole is marked with the symbol for the protective earth conductor ⏚. Refer to "Dimensions" (p. 38) for the exact position of the hole.

### Requirements

✓ You have read and understood the general notes on installing (p. 15).

✓ The P-753 is **not** connected to the electronics.

### Tools and accessories

- Suitable protective earth conductor: Cable cross section ≥0.75 mm²
- M4 protective earth screw set (p. 11) supplied for connecting the protective earth conductor
- Suitable screwdriver

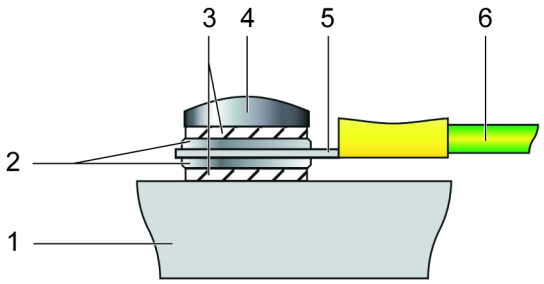


Figure 3: Connecting the protective earth conductor (profile view)

1 Base body of the P-753
2 Flat washer
3 Lock washer
4 Screw
5 Cable lug
6 Protective earth conductor

### Connecting the P-753 to the protective earth conductor

1. If necessary, attach a suitable cable lug to the protective earth conductor.
2. Use the M4 screw (together with the flat and lock washers) to attach the cable lug of the protective earth conductor to the threaded hole in the P-753 as shown in the profile view.
3. Tighten the M4 screw with a torque of 1.2 Nm to 1.5 Nm.
4. Make sure that the contact resistance at all connection points relevant for connecting the protective earth conductor is <0.1 Ω at 25 A.

## 5.3 Mounting the P-753

**NOTICE**

**Warping the P-753 when mounting onto uneven surfaces!**
The P-753 could warp if mounted on an uneven surface. Warping reduces the accuracy.

- Mount the P-753 onto a flat surface. The recommended flatness of the surface is ≤10 µm.
- For applications with large temperature fluctuations:
  Mount the P-753 only onto surfaces that have the same or similar thermal expansion properties as the P-753.

**NOTICE**

**Tensile stress on piezo actuator with vertical mounting!**
If the P-753 is mounted vertically and the direction of motion of the X axis is downward, this will result in a tensile stress which reduces the internal preload of the piezo actuator. Operation with reduced preload can destroy the piezo actuator.

- Do **not** exceed the maximum permissible stress and load capacities according to the specifications (p. 35).

**NOTICE**

**Unsuitable or wrongly mounted screws!**
Using unsuitable or wrongly inserted screws can cause damage to the P-753.

- Select the screw length according to the depth of the mounting holes (p. 38).
- Do **not** allow screw heads to protrude.
- Only use the holes or threads intended for the purpose of fixing the P-753 and loads.
- Pay attention to the torque range (p. 41) specified for the screws used during installation.

The following figure serves as an example and can differ from your positioner model.

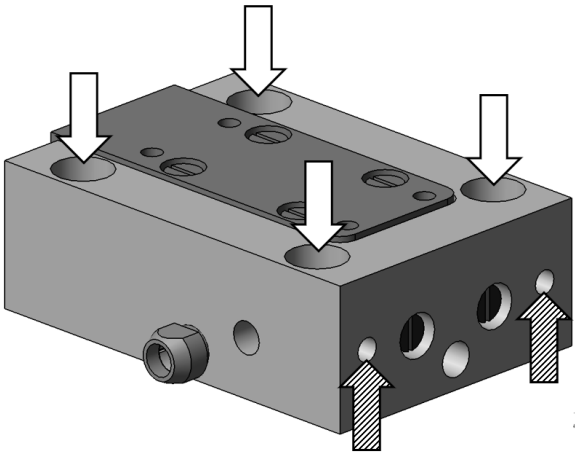

Figure 4: P-753: Four countersunk holes for mounting from above (white arrows) and two threaded holes for mounting from below (hatched arrows)

### Requirements

- ✓ You have read and understood the general notes on installing (p. 15).
- ✓ You have provided a suitable surface. For the required position of the holes, refer to "Dimensions" (p. 38).
  - For mounting from above with M3 screws: Four M3 holes are provided with a depth of at least 3 mm.
  - For mounting from below with M3 screws: Two through holes are provided for M3 screws. The thickness of the surface and the depth of the counterbores for the through-holes in the surface are matched so that a maximum screw-in depth of 5 mm in the P-753 is adhered to.
  - The surface flatness is ≤10 µm.
  - For applications with large temperature fluctuations: The surface should have the same thermal expansion properties as the P-753 (e.g., surface made of aluminum).
- ✓ You have accounted for the space required to route cables according to regulations and without bending them.
- ✓ The P-753 is **not** connected to the electronics.

### Tools and accessories

- For mounting from above: Four M3 screws of suitable length (p. 38)
- For mounting from below: Two M3 screws of suitable length (p. 38)
- Suitable screwdriver

### Mounting the P-753

1. Align the P-753 on the surface so that the corresponding holes in the P-753 and surface are in line.
2. Mount the P-753 onto the surface from above **or** from below:

   Mounting from above with four M3 screws:

   a) Insert the screws from above through the countersunk holes in the base body of the P-753 into the holes in the surface.

   b) Tighten the screws crosswise. Pay attention to the specified torque range (p. 41) while doing so.

   Mounting from below with two M3 screws:

   a) Insert the screws from below through the holes in the surface into the base body of the P-753.

   b) Tighten the screws. Pay attention to the specified torque range (p. 41) while doing so.
3. Make sure that the screw heads are fully sunken.
4. Check that the P-753 is sitting firmly on the surface.
5. If necessary, secure the screws with a thread-locking adhesive.

## 5.4 Fixing the Load

***NOTICE***

**Mechanical overload of the motion platform!**
High torques during fastening of the load as well as heavy loads can overload the motion platform of the P-753. Mechanical overload can cause damage to the piezo actuators, sensors, and flexures of the P-753 and lead to loss of accuracy.

- Avoid torques >0.3 Nm on the motion platform.
- Do **not** exceed the maximum permissible loads according to the specifications (p. 35).
- Hold the load and adhere to the specified torque range (p. 41) when tightening (or loosening) the screws.

***NOTICE***

**Warping the P-753 when fixing loads with an uneven contact surface!**
Fixing loads with an uneven contact surface could warp the P-753. Warping reduces the accuracy.

- Fix loads on the P-753 only when the surface contacting the P-753's motion platform has a flatness of at least 10 µm.
- For applications with large temperature fluctuations:
  Fix loads to the P-753 only when they have the same or similar thermal expansion properties as the P-753.

**NOTICE**

**Center of load at unsuitable position!**

If the center of load is located too far away from the center of the motion platform (e.g., tall load and unwanted lever effect), the P-753 can be damaged, especially in dynamic operation, by high strain on the flexure guides, high torques, and oscillations.

- ➢ If the center of the load to be fixed is too high or to the side of the motion platform, adjust the controller settings before starting and operating or or contact our customer service department (p. 33).

**NOTICE**

**Excessively long screws!**

The P-753 could be damaged by screws inserted too deeply.

- ➢ Pay attention to the depth of the mounting holes in the motion platform (p. 38).
- ➢ Use screws of the correct length for the respective mounting holes only.

***INFORMATION***

The positive direction of motion of the axis is specified in the product view (p. 10).

**Center of load at the optimal position:**

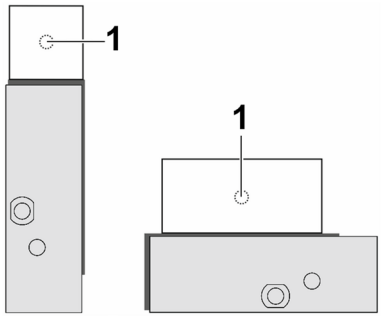


Figure 5: Example of an optimally placed load (1: center of load)

**Center of load at an unsuitable position:**

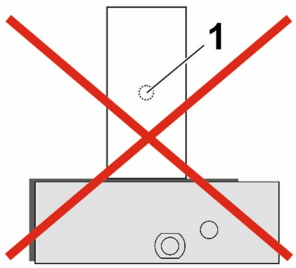


Figure 6: Tall setup and center of load (1) too far above the motion platform

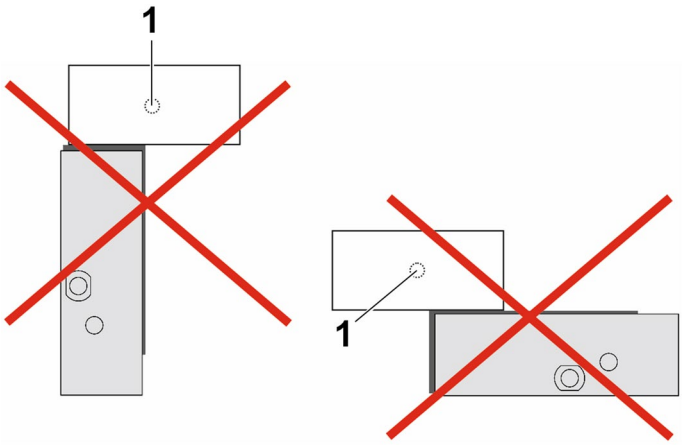


Figure 7: Long lever and center of load (1) on the side of the motion platform

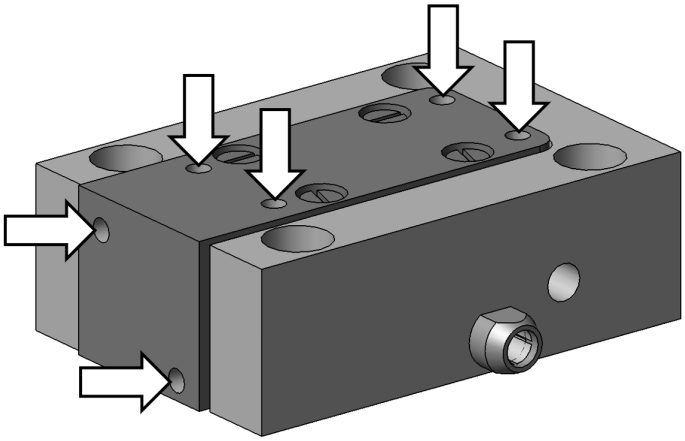

Figure 8: P-753: M2.5 holes in the motion platform for fixing loads

### Requirements

- ✓ You have read and understood the general notes on installing (p. 15).
- ✓ The P-753 is **not** connected to the electronics.

### Tools and accessories

- M2.5 screws of suitable length (p. 38)
- Suitable tools

### Fixing the load

- ➢ Fix loads only by inserting suitable screws into the threaded holes (p. 38) provided.
- ➢ Hold the load when tightening the screws, and pay attention to the torque range (p. 41) specified for the screws. Avoid torques >0.3 Nm on the motion platform.
- ➢ Fix the load so that its load center is in the middle of the motion platform.

## 5.5 Connecting the P-753 to the Electronics

***INFORMATION***

➢ When connecting, pay attention to the assignment specified on the labeling of the sockets, plug connectors, and cables.

### Requirements

- ✓ You have read and understood the general notes on installing (p. 15).
- ✓ You have installed suitable electronics (p. 11).
- ✓ The electronics are switched off, i.e., **not** connected to the power supply.
- ✓ You have read and understood the user manual for the electronics.
- ✓ You have connected the P-753 to the protective earth conductor (p. 16).

### Tools and accessories

- If intended for your system: Adapter cable (p. 12)

### Connecting the P-753 to the electronics

1. If adapter cables are intended, connect the adapter cable to the P-753.
2. Insert all of the P-753's connectors (or those on the adapter cable) to the corresponding socket on the electronics (refer to the user manual for the electronics).
3. If possible, secure the connector(s) against accidental disconnection.

# 6 Starting and Operating

## In this Chapter



## 6.1 General Notes on Starting and Operating

***CAUTION***

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

If a protective earth conductor is not or not properly connected, dangerous touch voltages can occur on the P-753 in the case of malfunction or failure of the system. If there are touch voltages, touching the P-753 can result in minor injuries from electric shock.

- Connect the P-753 to a protective earth conductor (p. 16) before starting.
- Do **not** remove the protective earth conductor during operation.
- If the protective earth conductor has to be removed temporarily (e.g., in the case of modifications), reconnect the P-753 to the protective earth conductor before restarting.

***NOTICE***

**Destruction of the piezo actuator due to electric flashovers!**

Using the P-753 in environments that increase the electrical conductivity can lead to the destruction of the piezo actuator by electric flashovers. Electric flashovers can be caused by moisture, high humidity, liquids, and conductive materials (e.g., metal dust). In addition, electric flashovers can also occur in certain air pressure ranges due to the increased conductivity of the air.

- Avoid operating the P-753 in environments that can increase the electric conductivity.
- Operate the P-753 only within the permissible ambient conditions and classifications (p. 37).

***NOTICE***

**Decreased lifetime due to permanently high voltage!**

Applying a continuous high static voltage to piezo actuators leads to a considerable reduction in the lifetime of the piezo ceramic.

- When the P-753 is not used but the electronics remain switched on to ensure temperature stability, discharge the P-753 (p. 27).

**NOTICE**

**Operating voltage too high or incorrectly connected!**

Operating voltages that are too high or incorrectly connected can cause damage to the P-753.

- Operate the P-753 only with controllers/drivers and original accessories from PI.
- Do **not** exceed the operating voltage range (p. 36) specified for the P-753.
- Operate the P-753 only when the operating voltage is properly connected; refer to "Pin Assignment" (p. 41).

**NOTICE**

**Uncontrolled oscillation!**

Oscillation can cause irreparable damage to the P-753. Oscillation is indicated by a humming noise and can be caused by the following:

- A change in the load and/or dynamics requires the servo control parameters to be adjusted.
- The P-753 is operated close to its resonant frequency, or with too high operating frequency.

If you notice oscillation:

- In closed-loop operation, switch off the servo mode immediately.
- In open-loop operation, stop the P-753 immediately.

**INFORMATION**

The positive direction of motion of the axis is specified in the product view (p. 10).

**INFORMATION**

Sound and vibration (e.g., footfall, knocks) can be transmitted to the P-753 and can affect its performance with regard to position stability.

- Avoid sound and vibration while the P-753 is being operated.

## 6.2 Operating the P-753

### Requirements

- ✓ You have read and understood the general notes on starting and operating.
- ✓ You have read and understood the user manual for the electronics.
- ✓ You have read and understood the user manual for the PC software.
- ✓ You have correctly installed (p. 15) the P-753, and connected it to the protective earth conductor (p. 16).
- ✓ The electronics and the required PC software were installed. All connections to the electronics were made (refer to the user manual for the electronics).

### Operating the P-753

- ➢ Follow the instructions for starting and operating the P-753 in the manual for the electronics (p. 11) used.

## 6.3 Discharging the P-753

The P-753 must be discharged in the following cases:

- Before Installation
- When the P-753 is not used but the electronics remain switched on to ensure temperature stability
- Before demounting (e.g., before cleaning and transporting the P-753 and for modifications)

The P-753 is discharged via the discharge resistor inside the electronics from PI.

### Discharging a positioner connected to the electronics

In closed-loop operation:

1. Switch off the servo mode on the controller.
2. Set the piezo voltage to 0 V on the controller.

In open-loop operation:

- ➢ Set the piezo voltage to 0 V on the electronics.

### Discharging a positioner not connected to the electronics

- ➢ Connect the positioner to the switched-off electronics from PI.

# 7 Maintenance

## In this Chapter



## 7.1 General Notes on Maintenance

***NOTICE***

**Misalignment from loosening screws on the base body!**
The P-753 is maintenance-free and precisely aligned. Loosened screws on the base body cause a loss in positioning accuracy.

- ➢ Do not loosen any screws on the base body.

## 7.2 Cleaning the P-753

***NOTICE***

**Damage from ultrasonic cleaning!**
Ultrasonic cleaning can damage the P-753.

- ➢ Do **not** do any ultrasonic cleaning.

***NOTICE***

**Damage due to dirt or liquids penetrating the housing!**
The P-753's housing is not air- or waterproof. Any dirt or liquids penetrating the housing can damage the P-753 and lead to electric short circuiting.

- ➢ Disconnect the P-753 from the electronics before cleaning.
- ➢ Prevent any dirt or liquids penetrating the P-753's housing.
- ➢ Do not use compressed air for cleaning.

**Requirements**

- ✓ You have discharged the piezo actuators of the P-753 (p. 27).
- ✓ You have disconnected the P-753 from the electronics.

### Cleaning the P-753

- Clean the surfaces of the P-753 with a cloth dampened with a mild cleanser or disinfectant (e.g., isopropyl alcohol).

# 8 Troubleshooting

| Problem | Possible causes | Solution |
|---|---|---|
| No or limited motion | Cable not connected correctly | ➢ Check the cable connections. |
| | Excessive load | ➢ Do **not** exceed the maximum permissible stress and load capacities according to the specifications (p. 35). |
| | Zero shift of the sensor for the following reasons:<br>▪ Load in direction of motion<br>▪ Ambient/operating temperature of the positioner is far above or below the calibration temperature (21 °C to 24 °C) | ➢ Adjust the zero-point of the sensor (refer to the controller manual). |
| Reduced accuracy | The base body or the motion platform is warped | ➢ Mount the P-753 onto surfaces with the following characteristics only:<br>– Flatness of at least 10 µm<br>– The thermal expansion properties are similar to those of the P-753 (e.g., surfaces made of aluminum).<br>➢ Fix loads to the P-753 with the following characteristics only:<br>– The contact surface of the load has a flatness of at least 10 µm.<br>– The thermal expansion properties are similar to those of the P-753 (e.g., loads made of aluminum). |
| | P-753 or controller has been replaced | When using positioners, whose ID chip (p. 12) does not contain any calibration data, or with LEMO plug connectors, axis displacement has to be recalibrated after the P-753 or the controller has been replaced.<br>➢ Perform a recalibration of the axis displacement (see controller manual) or contact our customer service department (p. 33). |

| Problem | Possible causes | Solution |
|---|---|---|
| | Axes were mixed up during connection (only with LEMO connectors) | ➢ Pay attention to the assignment of the axes when connecting the positioner to the controller. This assignment is indicated by labels on the devices. |
| | The positioner is not connected to the corresponding controller (only with several systems) | ➢ Pay attention to the assignment of the devices when several systems are connected. The assignment is indicated on the calibration label of the controller (see rear panel or bottom side), which contains the serial number of the positioner to be connected. |
| The positioner starts oscillating or positions inaccurately | Servo control parameters incorrectly set because for example, the load was changed | 1. Switch off the servo mode of the corresponding motion axes immediately.<br>2. Check the settings of the servo control parameters on the controller.<br>3. Adjust the servo control parameters on the controller according to the load change. |
| | Open-loop operation near the resonant frequency | ➢ In open-loop operation, operate the positioner only with a frequency that is below the resonant frequency. |

If the problem with your system is not listed in the table above or cannot be solved as described, contact our customer service department (p. 33).

# 9 Customer Service

For inquiries and orders, contact your PI sales engineer or send us an email (service@pi.de).

- 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.

The latest versions of the user manuals are available for download (p. 3) on our website.

# 10 Technical Data

Subject to change. You can find the latest product specifications on the product web page at www.pi.ws (https://www.pi.ws).

## In this Chapter



## 10.1 Specifications

### 10.1.1 Data Table

| | P-753.1CD | P-753.2CD | P-753.3CD | Unit | Tolerance |
|---|---|---|---|---|---|
| Active axes | X | X | X | | |
| **Motion and positioning** | | | | | |
| Integrated sensor | Capacitive | Capacitive | Capacitive | | |
| Travel range, closed loop | 15 | 30 | 38 | µm | |
| Resolution, closed loop | 0.1 | 0.2 | 0.25 | nm | Typ. |
| Linearity error, closed loop | 0.03 | 0.03 | 0.03 | % | Typ. |
| Repeatability | ±1 | ±2 | ±3 | nm | Typ. |
| Pitch / yaw | ±5 | ±7 | ±10 | µrad | Typ. |
| **Mechanical properties** | | | | | |
| Stiffness in motion direction | 45 | 24 | 16 | N/µm | ±20 % |
| Resonant frequency, unloaded | 5.6 | 3.7 | 2.9 | kHz | ±20 % |
| Resonant frequency, under load, 200 g | 2.5 | 1.7 | 1.4 | kHz | ±20 % |
| Push/pull force capacity in positioning direction | 100 / 20 | 100 / 20 | 100 / 20 | N | Max. |
| **Drive properties** | | | | | |
| Ceramic type | PICMA® P-885 | PICMA® P-885 | PICMA® P-885 | | |
| Electrical capacitance | 1.5 | 3.1 | 4.6 | µF | ±20 % |

| | P-753.1CD | P-753.2CD | P-753.3CD | Unit | Tolerance |
|---|---|---|---|---|---|
| **Miscellaneous** | | | | | |
| Operating temperature range | -20 to 80 | -20 to 80 | -20 to 80 | °C | |
| Material | Steel | Steel | Steel | | |
| Dimensions | 44 mm × 30 mm × 15 mm | 62 mm × 30 mm × 15 mm | 80 mm × 30 mm × 15 mm | | |
| Mass | 0.16 | 0.215 | 0.26 | kg | ±5 % |
| Cable length | 1.5 | 1.5 | 1.5 | m | ±10 mm |
| Sensor/voltage connector | D-sub 7W2 (m) | D-sub 7W2 (m) | D-sub 7W2 (m) | | |
| Recommended electronics | E-625, E-709.1C1L, E-754 | E-625, E-709.1C1L, E-754 | E-625, E-709.1C1L, E-754 | | |

The resolution of the system is limited only by the noise of the amplifier and the measuring technology because PI piezo nanopositioning systems are free of friction.

Versions with LEMO connector available as P-753.x1C.

### 10.1.2 Maximum Ratings

P-753 positioners are designed for the following operating data in continuous operation:

| Model | Maximum operating voltage | Maximum operating frequency (unloaded)[1] | Maximum power consumption[2] |
|---|---|---|---|
| P-753.11C<br>P-753.1CD | -20 to +120 V | 1.9 kHz | 5.4 W |
| P-753.21C<br>P-753.2CD | -20 to +120 V | 1.25 kHz | 10.8 W |
| P-753.31C<br>P-753.3CD | -20 to +120 V | 1 kHz | 16.2 W |

[1] To ensure stable operation, the maximum operating frequency has been defined as around one third of the mechanical resonant frequency.

[2] The heat that is generated by the piezo actuator during dynamic operation limits the value for maximum power consumption.

Details can be found at the following website:
https://www.physikinstrumente.com/en/technology/piezo-technology/properties-piezo-actuators/electrical-operation/

### 10.1.3 Ambient Conditions and Classifications

Pay attention to the following ambient conditions and classifications for the P-753:

| | |
|---|---|
| Area of application | For indoor use only |
| Maximum altitude | 2000 m |
| Air pressure | 1100 hPa to 0.1 hPa |
| Relative humidity | Highest relative humidity 80% for temperatures up to 31 °C<br>Decreasing linearly to 50% relative humidity at 40 °C |
| Operating temperature | -20 °C to 80 °C |
| Storage temperature | -20 °C to 80 °C |
| Transport temperature | -25 °C to 85 °C |
| Overvoltage category | II |
| Protection class | I |
| Degree of pollution | 1 |
| Degree of protection according to IEC 60529 | IP20 |

## 10.2 Dimensions

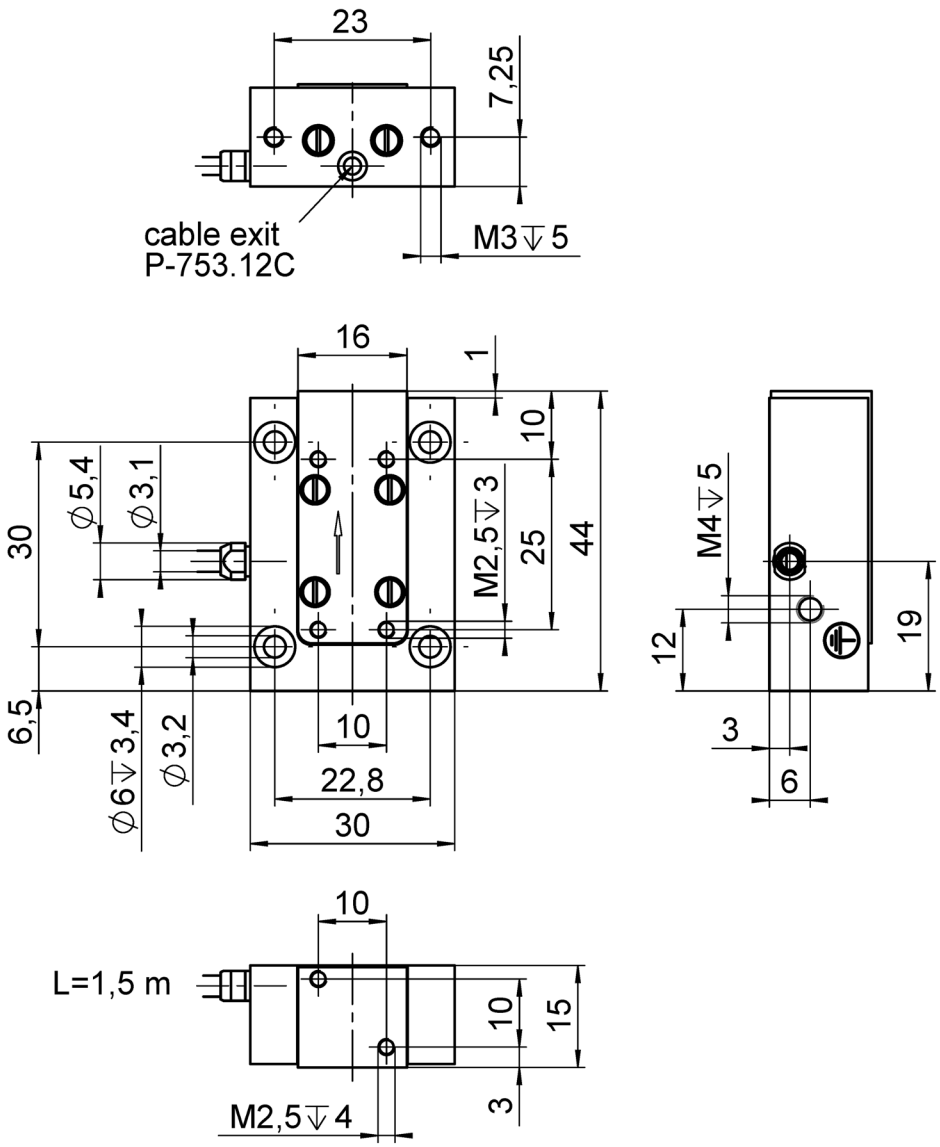


Figure 9: P-753.11C / P-753.1CD, dimensions in mm. Note that a comma is used in the drawings instead of a decimal point.

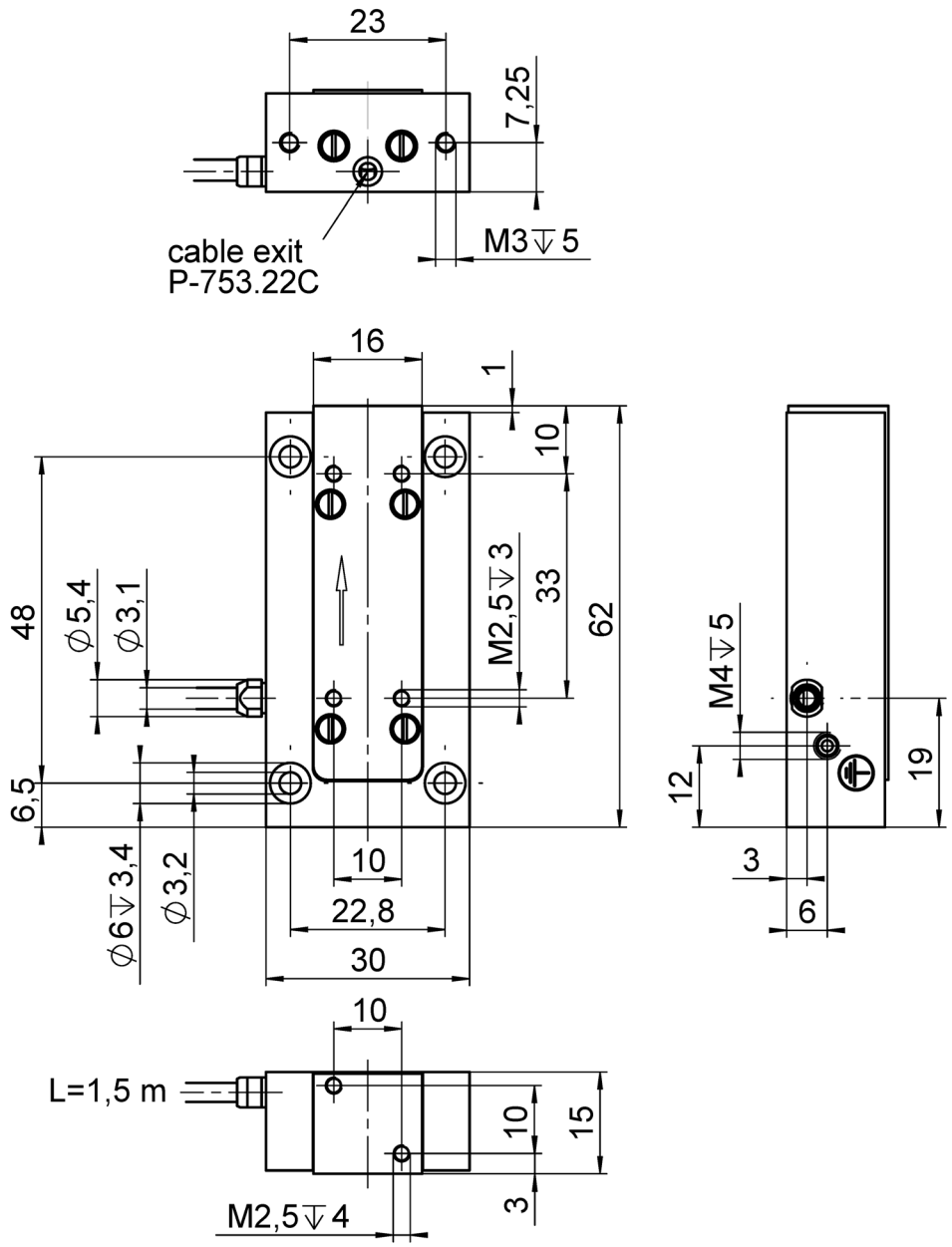


Figure 10: P-753.21C / P-753.2CD, dimensions in mm. Note that a comma is used in the drawings instead of a decimal point.

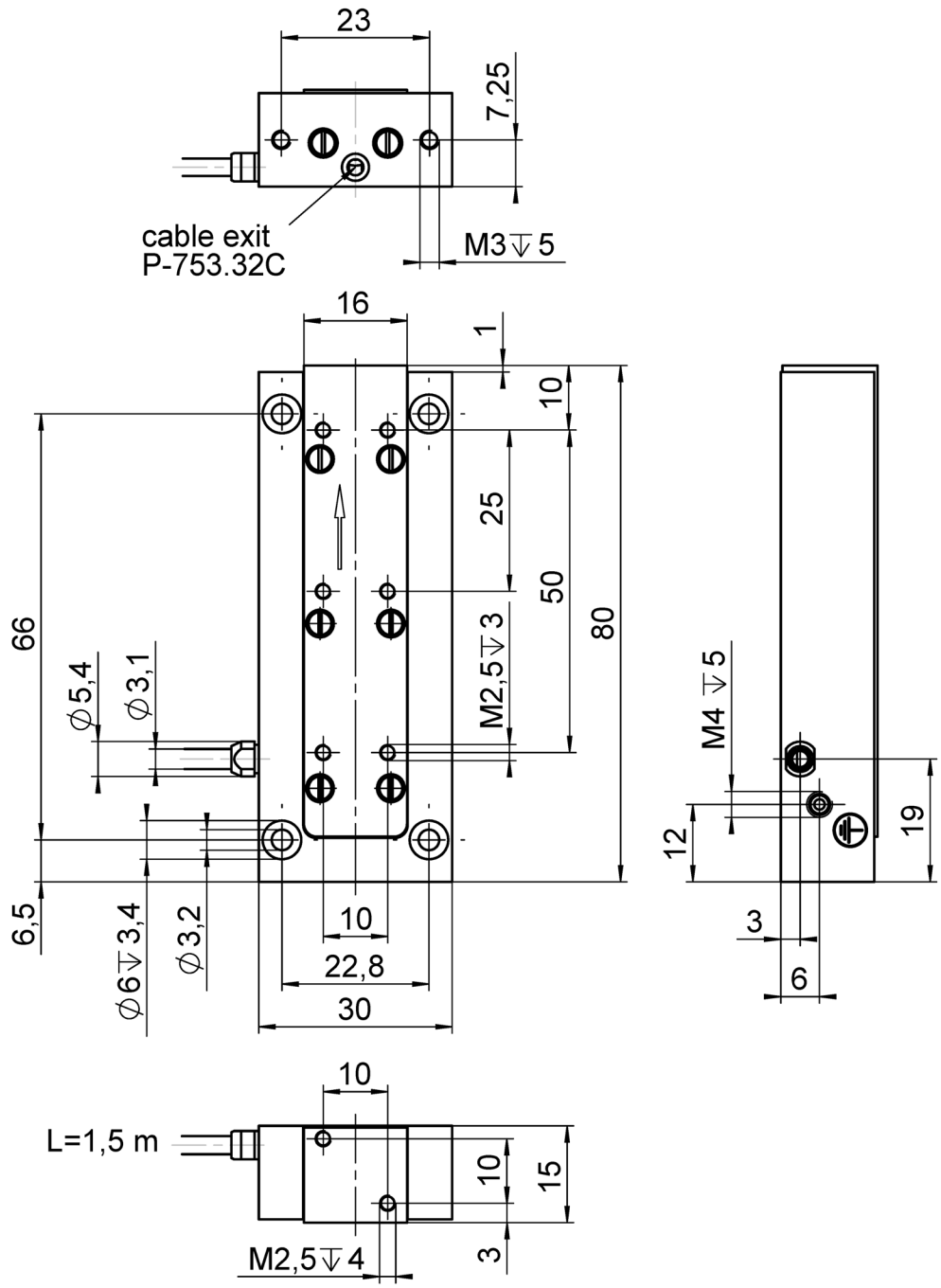


Figure 11: P-753.31C / P-753.3CD, dimensions in mm. Note that a comma is used in the drawings instead of a decimal point.

## 10.3 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 according to the VDI directive 2230.

## 10.4 Pin Assignment

### D-sub 7W2 (m) connector

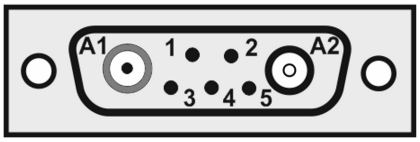


Figure 12: D-sub 7W2 (m) connector: Front with connections

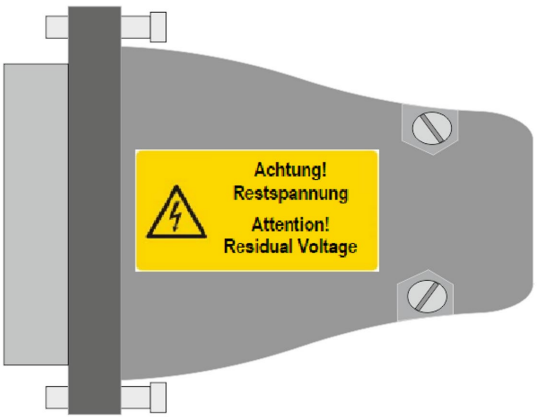


Figure 13: D-sub connector: Example top view

| Pin | Signal | Function |
|---|---|---|
| A1 | PZT | Piezo voltage |
| A2 | Probe | Probe sensor signal (immovable part of the capacitive sensor) |
| 1 | Data ID chip | Data line for ID chip |
| 2 | GND Target and ID chip | Target and ID chip ground |
| 3 | GND PZT | Piezo voltage ground |
| 4 | --- | (not connected) |
| 5 | Target | Target sensor signal (movable part of the capacitive sensor) |
| Housing | --- | Shield |

### LEMO coaxial connectors

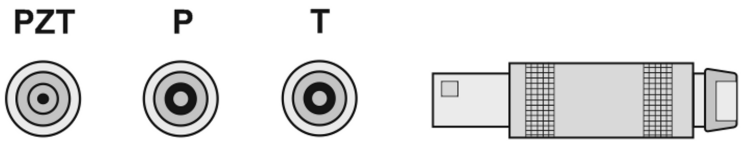


Figure 14: LEMO connectors: PZT, P and T

| Connector | Signal | Function | Connector shell |
|---|---|---|---|
| P | Probe | Probe sensor signal (immovable part of the capacitive sensor) | Cable shield |
| T | Target | Target sensor signal (movable part of the capacitive sensor) | Cable shield |
| PZT | PZT | Piezo voltage | Piezo voltage ground on cable shield |

# 11 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 its responsibility as the product manufacturer, Physik Instrumente (PI) GmbH & Co. KG undertakes environmentally correct disposal of all old PI equipment made available on the market after 13 August 2005 without charge.

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

Physik Instrumente (PI) GmbH & Co. KG

Auf der Roemerstr. 1

D-76228 Karlsruhe, Germany

# 12 European Declarations of Conformity

For the P-753, 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