PZ254E

P-753 Positioning Systems

User Manual

Version: 1.0.0 Date: 13.10.2014

This document describes the following products:

- **P-753.11C / P-753.1CD**
  LISA High-Dynamics Piezo Nanopositioning System, 12 µm, Direct Metrology, Capacitive Sensor
- **P-753.21C / P-753.2CD**
  LISA High-Dynamics Piezo Nanopositioning System, 25 µm, Direct Metrology, Capacitive Sensor
- **P-753.31C / P-753.3CD**
  LISA High-Dynamics Piezo Nanopositioning System, 38 µm, Direct Metrology, Capacitive Sensor

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

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The products described in this document are in part protected by the following patents:

German patent no. 10021919C2

German patent no. 10234787C1

German patent no. 10348836B3

German patent no. 102005015405B3

German patent no. 102007011652B4

US patent no. 7,449,077

Japanese patent no. 4667863

Chinese patent no. ZL03813218.4

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Subject to change without notice. This manual is superseded by any new release. The latest release is available for download (p. 3) on our website.

Contents

1 About this Document

In this Chapter

1.1 Goal and Target Audience of this User Manual

This user manual contains the necessary information for the intended use of the P-753 (x stands for the different 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

If not avoided, the dangerous situation will result in minor injury.

➢ Actions to take to avoid the situation.

NOTICE

Dangerous situation

If not avoided, the dangerous situation will result in damage to the equipment.

➢ Actions to take to avoid the situation.

INFORMATION

Information for easier handling, tricks, tips, etc.

Symbol/ Label	Meaning
1. 2.	Action consisting of several steps whose sequential order must be observed
➢	Action consisting of one or several steps whose sequential order is irrelevant
▪	List item
p. 5	Cross-reference to page 5
RS-232	Labeling of an operating element on the product (example: socket of the RS-232 interface)
	Warning signs affixed to the product that refer to detailed information in this manual.

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.

1.4 Other Applicable Documents

The devices and software tools which are mentioned in this documentation are described in their own manuals.

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

Device	Document
E-501 modular piezo controller	PZ62E User Manual
E-505 piezo amplifier module	PZ62E User Manual
E-509 sensor / servo controller module	PZ77E User Manual
E-515 display module	PZ62E User Manual
E-517 interface and display module	PZ214E User Manual
E-610.C0 piezo amplifier / servo controller	PZ72E User Manual
E-625.CR piezo servo controller	PZ166E User Manual
E-665.CR piezo servo controller	PZ127E User Manual
E-753 digital piezo controller	PZ193E User Manual
PIMikroMove	SM148E Software Manual
P-5xx / P-6xx / P-7xx piezo positioning systems	PZ240EK Short Instructions

1.5 Downloading Manuals

INFORMATION

If a manual is missing or problems occur with downloading:

➢ Contact our customer service department (p. 35).

INFORMATION

For some products (e.g. Hexapod systems and electronics that are delivered with a CD), access to the manuals is password-protected. The password is stored on the CD. Availability of the manuals:

- Password-protected manuals: FTP download directory
- Freely available manuals: PI website

➢ Follow the corresponding instructions for downloading.

Download freely accessible manuals

1. Open the website **http://www.pi-portal.ws**.
2. Click ***Downloads***.
3. Click the corresponding product category.
4. Go to the corresponding product code.

   The available manuals are displayed.
5. Click the desired manual and save it on the hard disk of your PC or on a data storage medium.

Download password-protected manuals

1. Insert the product CD in the PC drive.
2. Switch to the Manuals directory on the CD.
3. In the Manuals directory, open the Release News (file including ***releasenews*** in the file name).
4. Find the user name and the password in the section "User login for software download" in the Release News.
5. Open the FTP download directory (ftp://pi-ftp.ws).
   - Windows operating systems: Open the FTP download directory in Windows Explorer.
6. Log in with the user name and the password from the Release News.
7. In the directory of the corresponding product, go to the Manuals sub-directory.
8. Copy the desired manual to the hard disk of your PC or to a data storage medium.

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.

Based on its design and realization, 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. 21).

The intended use of the P-753 is only possible in combination with suitable electronics (p. 12) that is available from PI. The electronics is 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.

- Only use the P-753 for its intended purpose, and only use it if it is in a good working order.
- Read the user manual.
- Immediately eliminate any faults and malfunctions that are likely to affect safety.

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 stresses can induce charges in piezo actuators. After being disconnected from the electronics, piezo actuators can also stay charged for several hours. Touching or short-circuiting the contacts in the connector of the P-753 can lead to minor injuries. In addition, the piezo actuators can be destroyed by an abrupt contraction.

- Do **not** open the P-753.
- Discharge the piezo actuators of the stage before installation:
  Connect the stage to the switched-off PI controller, which is equipped with an internal discharge resistor.
- Do **not** pull out the connector from the electronics during operation.

For stages with Sub-D connector:

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

- Do **not** touch the contacts in the connector.
- Secure the connector of the stage with screws against being pulled out of the controller.

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 touch voltages exist, touching the P-753 can result in minor injuries from electric shock.

- Connect the P-753 to a protective earth conductor (p. 19) before start-up.
- 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 starting it up again.

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. 37).
- Only hold the P-753 externally by the base body.

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

- Only loosen screws according to the instructions in this manual.
- Do **not** open the P-753.

2.3 Organizational Measures

User manual

- Always keep this user manual available by the P-753.
  The latest versions of the user manuals are available for download (p. 3) on our website.
- Add all information given by the manufacturer to the user manual, for example supplements or Technical Notes.
- If you pass the P-753 on to other users, also turn over 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 property damage.
- Only install and operate the P-753 after having read and understood this user manual.

Personnel qualification

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

3 Product Description

In this Chapter

3.1 Model Overview

The following standard versions of the P-753 are available:

Model	Description
P-753.11C	LISA high-dynamics piezo nanopositioning system, 12 µm, direct metrology, capacitive sensor, LEMO connector(s)
P-753.1CD	LISA high-dynamics piezo nanopositioning system, 12 µm, direct metrology, capacitive sensor, Sub-D connector(s)
P-753.21C	LISA high-dynamics piezo nanopositioning system, 25 µm, direct metrology, capacitive sensor, LEMO connector(s)
P-753.2CD	LISA high-dynamics piezo nanopositioning system, 25 µm, direct metrology, capacitive sensor, Sub-D connector(s)
P-753.31C	LISA high-dynamics piezo nanopositioning system, 38 µm, direct metrology, capacitive sensor, LEMO connector(s)
P-753.3CD	LISA high-dynamics piezo nanopositioning system, 38 µm, direct metrology, capacitive sensor, Sub-D connector(s)

3.2 Product View

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

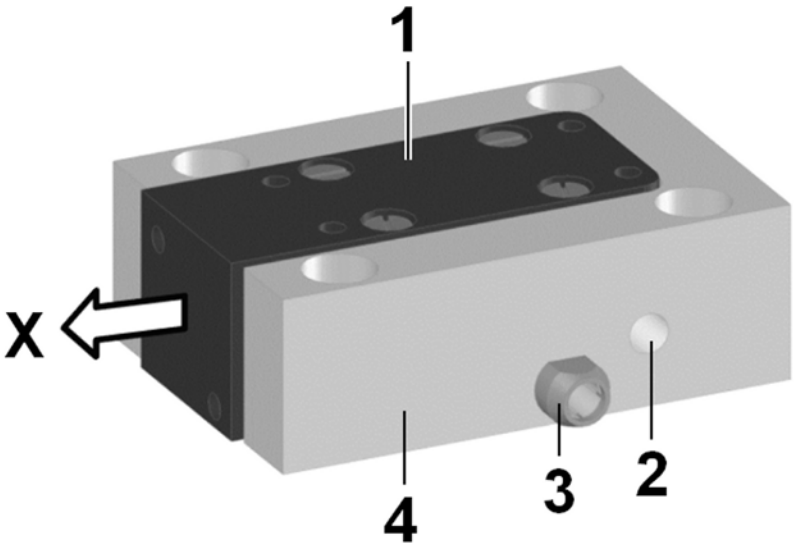


Figure 1: Example of product view

1 Moving platform
2 Protective earth connection
3 Cable exit
4 Base body
X Positive direction of motion of the stage

3.3 Product Labeling

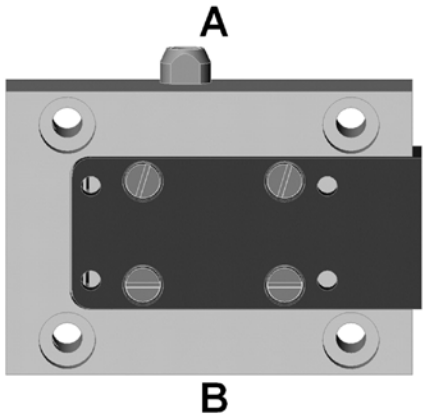


Figure 2: P-753: Position of the product labeling (example of a view from above)

Position	Labeling	Description
B	P-753.1CD	Product name (example), the places after the point refer to the model
B	114039262	Serial number (example), individual for each P-753 Meaning of the places (counting from left): 1 = internal information 2 and 3 = manufacturing year 4 to 9 = consecutive numbers
B	LISA	Brand name
B	PI	Manufacturer's logo
B	⚠	Warning sign "Observe manual!"
B		Old equipment disposal (p. 45)
B	Country of origin: Germany	Country of origin
B	WWW.PI.WS	Manufacturer's address (website)
B	CE	CE conformity mark
A	⏚	Symbol for the protective earth conductor, marks the protective earth connection of the P-753

Figure 3: P-753: "Residual voltage" warning sign on connector

Warning sign "Residual voltage": Notice of risk of electric shock (p. 5)

3.4 Scope of Delivery

Item ID	Components
P-753	Stage according to order (p. 9)
000036450	M4 screw set for protective earth, consisting of: ▪ 1 M4x8 flat-head screw with cross recess, ISO 7045 ▪ 2 safety washers ▪ 2 flat washers
PZ240EK	Short instructions for piezo positioning systems

3.5 Suitable Electronics

To operate a P-753, you need suitable electronics. Devices are selected depending on the type of application. The following table lists suitable devices (x = suitable).

Electronics	Chan-nels	P-753 Model					
		.11C	.21C	.31C	.1CD	.2CD	.3CD
E-610 piezo amplifier / servo controller, OEM module	1	x	x	x			
E-625 piezo servo controller (bench-top)	1				x	x	x
E-665 servo controller (bench-top)	1				x	x	x
E-753 digital piezo controller	1				x	x	x
E-501 modular piezo controller, consisting of: ▪ E-505 piezo amplifier module ▪ E-509 sensor / servo controller module Optional: E-517 interface and display module or E-515 display module	1	x	x	x			

3.6 Technical Features

3.6.1 PICMA® Piezo Actuators

P-753 stages are driven by PICMA® piezo actuators. PICMA® actuators have all-ceramic insulation and are therefore far superior to conventional actuators in respect to performance and lifetime. The monolithic piezoceramic block is protected against humidity and failure due to increased leakage current by a ceramic insulation layer. 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 backlash-, maintenance- and wear-free.

3.6.2 Flexure Guides

P-753 stages have flexure guides (flexures) for frictionless motion and high guiding accuracies.

A flexure guide is an element which is free from 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.

3.6.3 Capacitive Sensors

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

3.6.4 ID Chip (Only Models With Sub-D Connector)

An ID chip is located in the Sub-D connector of the stage. When the stage is calibrated at the factory with digital electronics, the calibration data is saved together with specific product information on the ID chip. When switched on, digital electronics read the data from the ID chip of the connected stage. Stages whose ID chip contains the calibration data can therefore be connected to any suitable digital electronics without a new calibration.

For more information on the ID chip, see the manual of the controller used.

4 Unpacking

1. Unpack the P-753 with care.
2. Compare the contents against the items covered by the contract and against the packing list.
3. Inspect the contents for signs of damage. If parts are missing or you notice signs of damage, contact PI immediately.
4. Keep all packaging materials in case the product needs to be returned.

5 Installation

In this Chapter

5.1 General Notes on Installation

CAUTION

Dangerous voltage and residual charge on piezo actuators!

The P-753 is driven by piezo actuators. Temperature changes and compressive stresses can induce charges in piezo actuators. After being disconnected from the electronics, piezo actuators can also stay charged for several hours. Touching or short-circuiting the contacts in the connector of the P-753 can lead to minor injuries. In addition, the piezo actuators can be destroyed by an abrupt contraction.

- Do **not** open the P-753.
- Discharge the piezo actuators of the stage before installation:
  Connect the stage to the switched-off PI controller, which is equipped with an internal discharge resistor.
- Do **not** pull out the connector from the electronics during operation.

For stages with Sub-D connector:

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

- Do **not** touch the contacts in the connector.
- Secure the connector of the stage with screws against being pulled out of the controller.

NOTICE

Mechanical overload from incorrect handling!

An impermissible mechanical overload of the moving platform of the P-753 can cause damage to the piezo actuators, sensors and flexure joints of the P-753 as well as losses of accuracy.

➢ Only hold the P-753 externally by the base body.

NOTICE

Damage from unsuitable cables!

Unsuitable cables can damage the stage and the electronics.

➢ Only use cables provided by PI for connecting the P-753 to the electronics.

NOTICE

Damage from incorrect mounting!

Incorrect mounting of the P-753 or incorrectly mounted parts can damage the P-753.

➢ Only mount the P-753 and the loads on the mounting fixtures (holes) intended for this purpose.

NOTICE

Damage due to incorrectly tightened screws!

Incorrectly tightened screws can cause damage.

➢ Observe the torque range (p. 43) given for the screws used during installation.

INFORMATION

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

➢ Do **not** use cable extensions. If you need longer cables, contact our customer service department (p. 35).

5.2 Connecting the P-753 to the Protective Earth Conductor

INFORMATION

In the case of P-753 stages with Sub-D connectors, ground loops can occur when the stage is grounded via its protective earth connector as well as by the shield of the connection cable for the electronics.

➢ If a ground loop occurs, contact our customer service department (p. 35).

INFORMATION

➢ Observe the applicable standards for mounting the protective earth conductor.

The P-753 is equipped with an M4 hole for fastening the protective earth conductor. This hole is located next to the cable exit and is marked with the protective earth conductor symbol ⏚ (see "Dimensions", p. 40).

Prerequisite

✓ You have read and understood the general notes on installation (p. 17).

✓ The stage is **not** connected to the electronics.

Tools and accessories

- Suitable protective earth conductor: Cross-sectional area of the cable ≥0.75 mm^2
- Supplied M4 protective earth screw set (p. 12) for connecting the protective earth conductor
- Suitable screwdriver

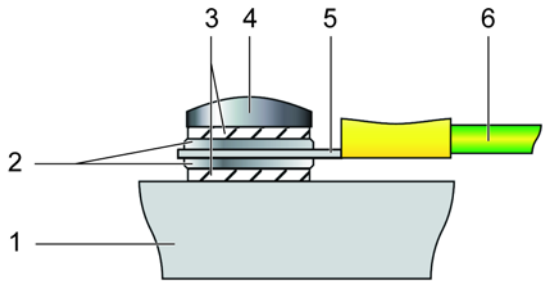


Figure 4: Mounting of the protective earth conductor (profile view)

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

Connecting the P-753 to the protective earth conductor

1. If necessary, fasten a suitable cable lug to the protective earth conductor.
2. Fasten the cable lug of the protective earth conductor using the M4 screw on the protective earth connection of 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 mounting the protective earth conductor is <0.1 Ω at 25 A.

5.3 Mounting the P-753

NOTICE

Warping of the P-753 due to mounting on uneven surfaces!

Mounting the P-753 on an uneven surface can warp the P-753. Warping reduces the accuracy.

- ➢ Mount the P-753 on an even surface. The recommended evenness of the surface is ≤10 µm.
- ➢ For applications with great temperature changes:
  Only mount the P-753 on 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 stage 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. 37).

NOTICE

Protruding screw heads!

Protruding screw heads can damage the P-753.

- ➢ Ensure that the screw heads do not protrude from counter-sunk holes so that they do not interfere with the stage motion.

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

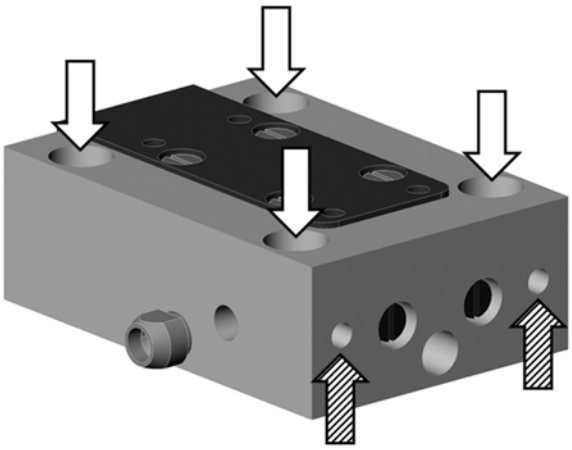


Figure 5: P-753: Four counter-sunk holes for mounting from above (white arrows) and two threaded holes for mounting from below (hatched arrows)

Prerequisite

- ✓ You have read and understood the general notes on installation (p. 17).
- ✓ You have provided a suitable surface. For the required position of the holes, see "Dimensions" (p. 40).
  - For mounting from above with M3 screws: Four M3 holes with a depth of at least 3 mm are present.
  - For mounting from below with M3 screws: Two through holes for M3 screws are present. The thickness of the surface and the depth of the counterbores at the through-holes in the surface are matched for compliance with the maximum screw-in depth of 5 mm in the P-753.
  - The evenness of the surface is ≤10 µm.
  - For applications with great temperature changes: 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 for a cable routing free of kinks and in accordance with regulations.
- ✓ The P-753 is **not** connected to the controller.

Tools and accessories

- For mounting from above: Four M3 screws of suitable length (p. 40)
- For mounting from below: Two M3 screws of suitable length (p. 40)
- Suitable screwdriver

Mounting the stage on a surface

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

   Mounting from above with four M3 screws:

   a) Introduce four screws into the counter-sunk holes in the base body of the P-753 from above.

   b) Tighten the four screws. Observe the specified torque range (p. 43) while doing so.

   Mounting from below with two M3 screws:

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

   b) Tighten the two screws. Observe the specified torque range (p. 43) while doing so.
3. Make sure that no screw heads protrude from the counter-sunk holes.
4. Check that the P-753 fits on the surface without backlash.
5. If necessary, secure the screws with a thread-locking adhesive.

5.4 Affixing the Load

NOTICE

Mechanical overload due to high torques and high loads!

When affixing the load, high torques and high loads can overload the moving platform of the P-753. Mechanical overload can cause damage to the piezo actuators, sensors and flexure joints of the P-753 and lead to losses in accuracy.

- Observe the torque range (p. 43) given for the screws used during installation.
- Avoid torques >0.3 Nm on the moving platform.
- Do **not** exceed the maximum permissible stress and load capacities according to the specifications (p. 37).

NOTICE

Warping of the P-753 due to affixing of loads with uneven contact surface!

Affixing loads with an uneven contact surface can warp the P-753. Warping reduces the accuracy.

- Only affix loads on the P-753 whose contact surface with the moving platform of the stage has an evenness of at least 10 µm.
- For applications with great temperature changes:
  Only affix loads on the P-753 that 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 far outside of the moving platform (e. g. high set-ups and long levers), the P-753 can be damaged from high strain on the flexure guides, high torques and oscillations, especially when operated dynamically.

- If the center of the load to be affixed is far above or to the side of the moving platform, adjust the controller settings before start-up or contact our customer service department (p. 35).

NOTICE

Screws that are too long!

The P-753 can be damaged by screws that are too long.

- ➢ Note the depth of the mounting holes in the moving platform (p. 40).
- ➢ Only use screws of the correct length for the respective mounting holes.

INFORMATION

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

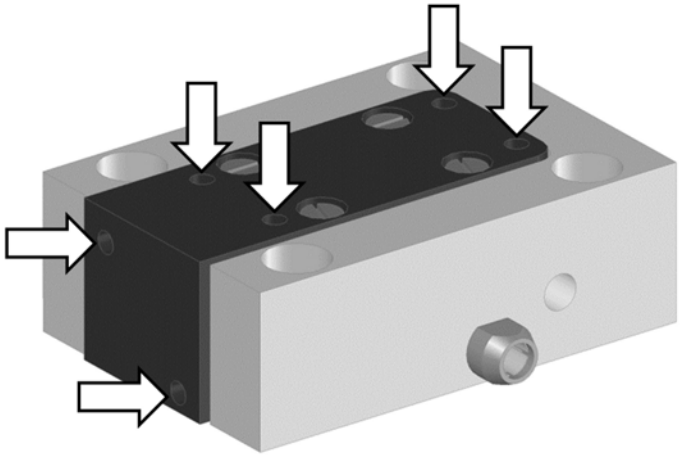


Figure 6: P-753: M2.5 holes in the moving platform for affixing loads

Center of load at the optimum position:

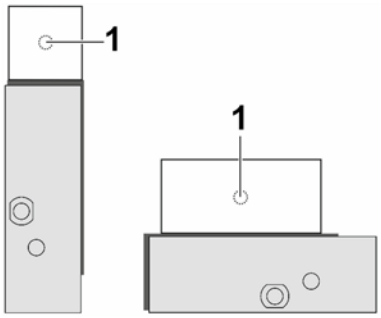


Figure 7: Example of an optimally placed load (1: center of load)

Center of load at an unsuitable position:

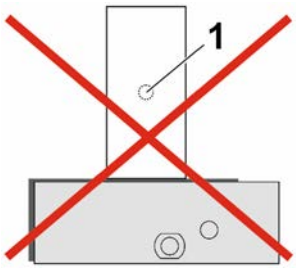


Figure 8: High set-up and center of load (1) far above the moving platform

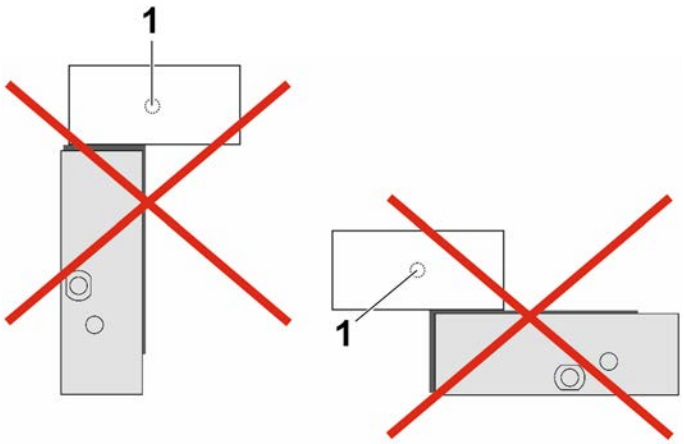


Figure 9: Long lever and center of load (1) on the side of the moving platform

Prerequisite

✓ You have read and understood the general notes on installation (p. 17).

Tools and accessories

- M2.5 screws of suitable length (p. 40)
- Suitable tools

Affixing the Load

➢ Only affix loads to the threaded holes (p. 40) intended for this purpose and with suitable screws. While doing so, observe the torque range (p. 43) specified for the screws, and avoid torques >0.3 Nm on the moving platform.

➢ Affix the load so that it is centered and that the center of load is on the moving platform.

6 Start-Up and Operation

In this Chapter

6.1 General Notes on Start-Up and Operation

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 touch voltages exist, touching the P-753 can result in minor injuries from electric shock.

- Connect the P-753 to a protective earth conductor (p. 19) before start-up.
- 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 starting it up again.

NOTICE

Destruction of the piezo actuator by electric flashovers!

The use of 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 such as 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.
- Only operate the P-753 within the permissible ambient conditions and classifications (p. 39).

NOTICE

Reduced lifetime of the piezo actuator due to permanently high voltage!

The permanent application of a high static voltage to piezo actuators leads to a considerable reduction in the lifetime of the piezo ceramic of the actuator.

- ➢ When the P-753 is not used but the controller remains switched on to ensure temperature stability, discharge the P-753 (p. 29).

NOTICE

Operating voltage too high or incorrectly connected!

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

- ➢ Only operate the P-753 with controllers/drivers and original accessories from PI.
- ➢ Do **not** exceed the operating voltage range (p. 38) for which the P-753 is specified.
- ➢ Only operate the P-753 when the operating voltage is properly connected; see "Pin Assignment" (p. 43).

NOTICE

Uncontrolled oscillation!

Oscillations can cause irreparable damage to the stage. Oscillations are indicated by a humming and can result from the following causes:

- A change in the load and/or dynamics requires the servo-control parameters to be adjusted.
- The stage is operated near its resonant frequency.

If you notice oscillations:

- ➢ In closed-loop operation, immediately switch off the servo mode.
- ➢ In open-loop operation, immediately stop the stage.

INFORMATION

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

INFORMATION

Sound and vibration (e.g. footfall, impacts) can be transmitted to the stage and can affect its performance with regard to position stability.

- ➢ Avoid transmitting sound and vibration while the stage is being operated.

6.2 Operating the P-753

➢ Follow the instructions in the manual of the controller used for start-up and operation of the P-753.

6.3 Discharging the P-753

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

- Before installation
- If the P-753 is not used but the controller remains 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 through the internal discharge resistor of the controller from PI.

Discharging a P-753 that is connected to the controller

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 controller.

Discharging a P-753 that is not connected to the controller

➢ Connect the stage to the switched-off controller 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

Prerequisites

✓ You have discharged the piezo actuators of the P-753 (p. 29).

✓ You have disconnected the P-753 from the controller.

Cleaning the P-753

➢ Clean the surfaces of the P-753 with a cloth that is slightly dampened with a mild cleanser or disinfectant (e.g. ethanol or isopropanol).

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

8 Troubleshooting

Problem	Possible Causes	Solution
No or limited motion	The cable is not connected correctly	➢ Check the cable connections.
	Excessive load	➢ Do **not** exceed the maximum permissible stress and load capacities according to the specifications (p. 37).
	Zero shift of the sensor for the following reasons: ▪ Load applied in direction of motion ▪ Ambient/operating temperature of the stage far above or below calibration temperature (21°C to 24°C)	➢ Perform a zero-point adjustment of the sensor (see controller manual).
Reduced accuracy	Warping of the base body or the moving platform	➢ Only mount the P-753 on surfaces with the following characteristics: – Evenness of at least 10 µm – The thermal expansion properties are similar to those of the P-753 (e. g. surfaces made of aluminum). ➢ Only affix loads with the following characteristics on the P-753: – The contact surface of the load has an evenness of at least 10 µm. – The thermal expansion properties are similar to those of the P-753 (e. g. loads made of aluminum).

Problem	Possible Causes	Solution
	P-753 or controller has been replaced	When stages, whose ID chip (p. 13) does not contain any calibration data, or LEMO connectors are used, the axis displacement has to be recalibrated after the P-753 or the controller has been replaced. ➢ Perform a recalibration of the axis displacement (see controller manual) or contact our customer service department (p. 35).
	Axes were mixed up during connection (only with LEMO connectors)	➢ Observe the assignment of the axes when connecting the stage to the controller. This assignment is indicated by labels on the devices.
	The stage is not connected to the corresponding controller (only with several systems)	➢ Observe 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 stage to be connected.
The stage starts oscillating or positions inaccurately	Servo-control parameters incorrectly set because e. g. the load was changed	1. Immediately switch off the servo mode of the corresponding stage axes. 2. Check the settings of the servo-control parameters on the controller. 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, only operate the stage with a frequency that is below the resonant frequency.

If the problem that occurred with your system is not listed in the table above or cannot be solved as described, contact our customer service department (p. 35).

9 Customer Service

For inquiries and orders, contact your PI sales engineer or send us an e-mail (info@pi.ws).

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

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

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

10 Technical Data

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		
Closed-loop travel	12	25	38	µm	
Closed-loop / open-loop resolution	0.05	0.1	0.2	nm	typ., full travel
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 %
Unloaded resonant frequency	5.6	3.7	2.9	kHz	±20 %
Resonant frequency @ 200 g	2.5	1.7	1.4	kHz	±20 %
Push / pull force capacity in motion direction	100 / 20	100 / 20	100 / 20	N	max.
Load capacity (vertical / horizontal mounting)	10 / 2	10 / 2	10 / 2	kg	max.
Drive properties					
Ceramic type	PICMA® P-885	PICMA® P-885	PICMA® P-885		
Electrical capacitance	1.5	3.1	4.6	µF	±20 %
Dynamic operating current coefficient	12	15	15	µA / (Hz × µm)	±20 %
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	44 mm × 30 mm × 62 mm	44 mm × 30 mm × 80 mm		
Mass	0.16	0.215	0.26	kg	±5 %
Cable length	1.5	1.5	1.5	m	±10 mm
Sensor / voltage connection	Sub-D Special	Sub-D Special	Sub-D Special		

The resolution of PI piezo nanopositioning systems is not limited by friction or stiction. Value given is noise-equivalent motion with the E-503 piezo amplifier module

Versions with LEMO connector available as P-753.x1C.
Vacuum-compatible versions to 10^{-9} hPa available as P-753.xUD.
Non-magnetic versions available as P-753.xND.

10.1.2 Maximum Ratings

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

Stage	Maximum Operating Voltage 	Maximum Operating Frequency (without Load)* 	Maximum Power Consumption** 
P-753.11C P-753.1CD	-20 to +120 V	1.9 kHz	5.4 W
P-753.21C P-753.2CD	-20 to +120 V	1.25 kHz	10.8 W
P-753.31C P-753.3CD	-20 to +120 V	1 kHz	16.2 W

* To prevent damage, it is recommended to operate the stage with maximally one third of the resonant frequency. If the stage is operated with a load, the values are lower.

** Corresponds to the power provided by the amplifier, which results in heating of the piezo actuator to approximately 80 °C.

10.1.3 Ambient Conditions and Classifications

The following ambient conditions and classifications must be observed for the P-753:

Area of application	For indoor use only
Maximum altitude	2000 m
Air pressure	1100 hPa to 0.1 hPa (corresponds to roughly 825 Torr to 0.075 Torr)
Relative humidity	Highest relative humidity 80 % for temperatures up to 31 °C 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

Dimensions in mm. Note that the decimal places are separated by a comma in the drawings.

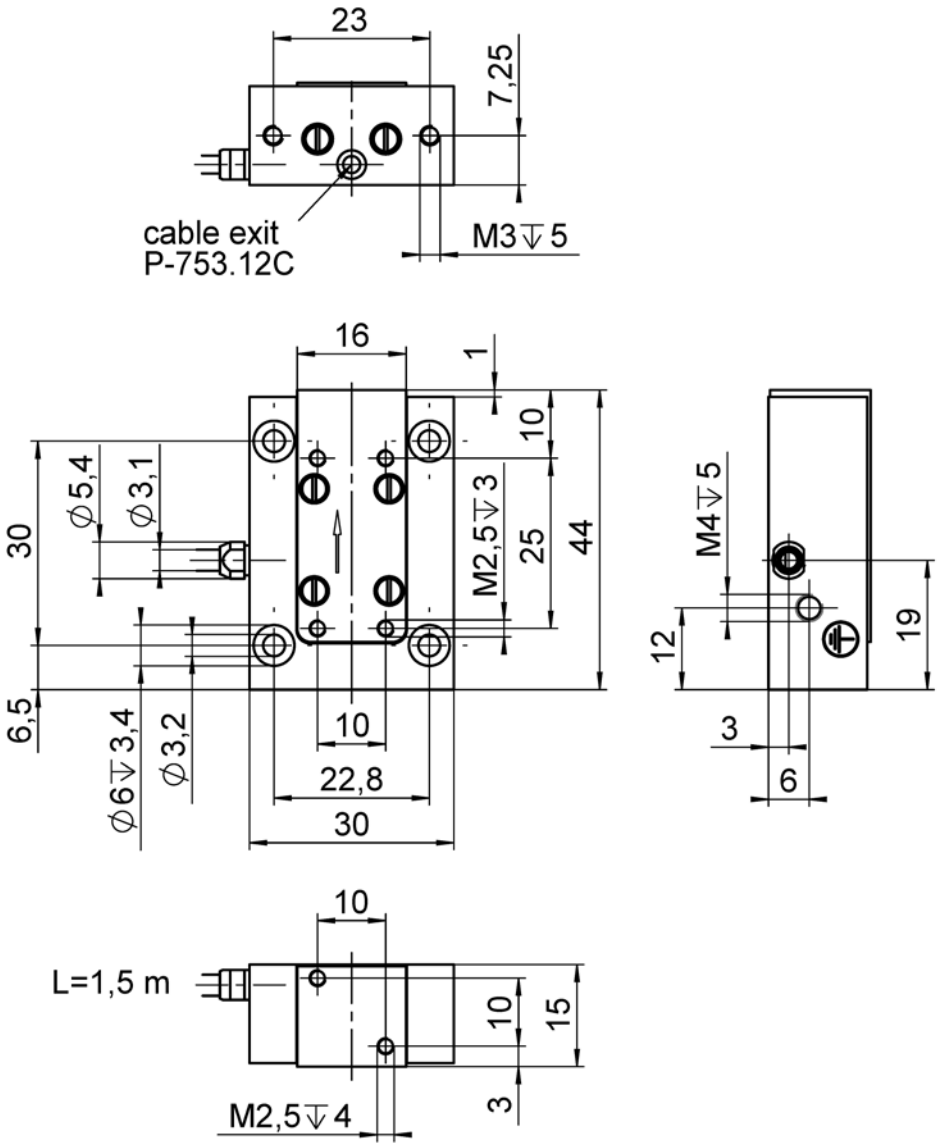


Figure 10: P-753.11C / P-753.1CD

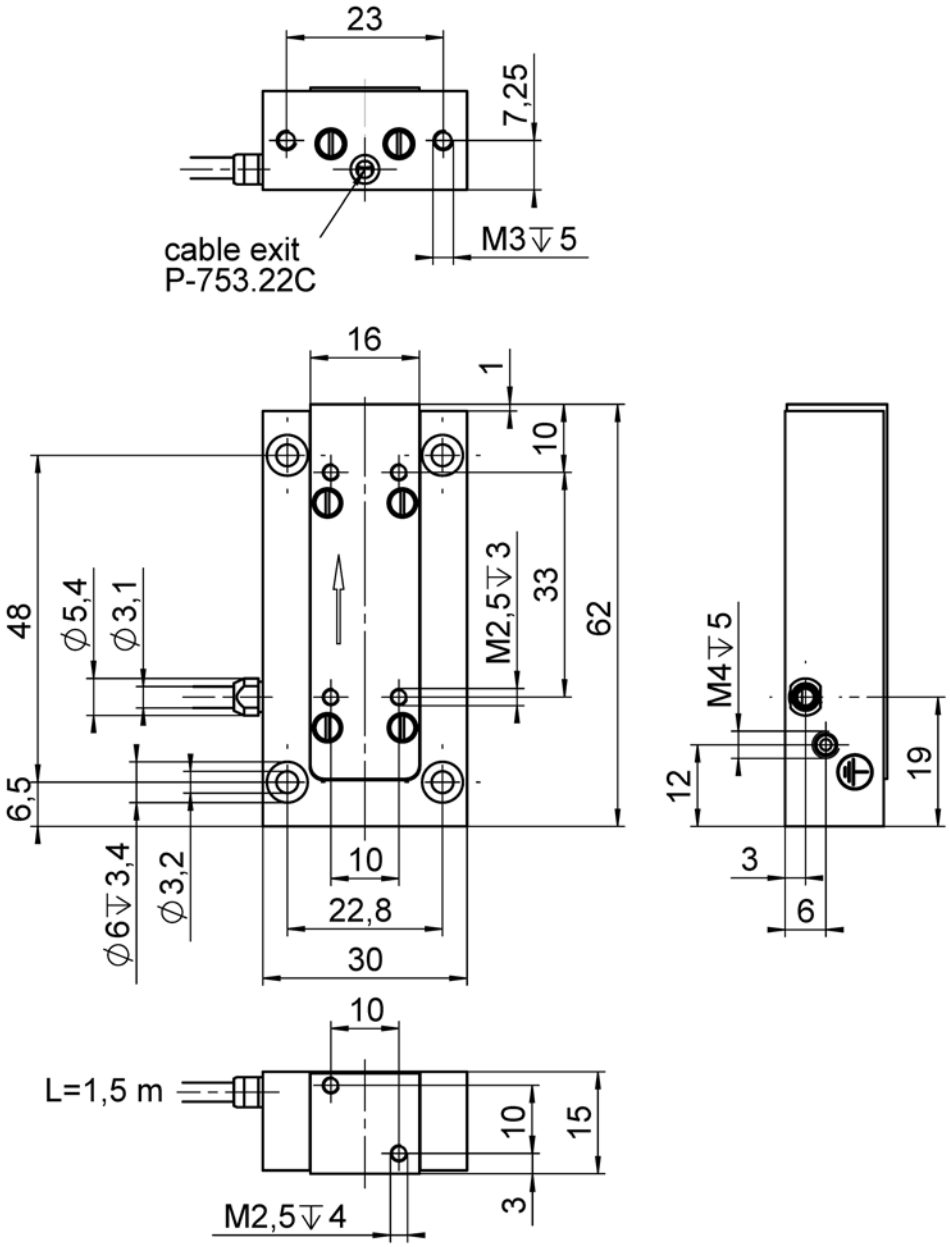


Figure 11: P-753.21C / P-753.2CD

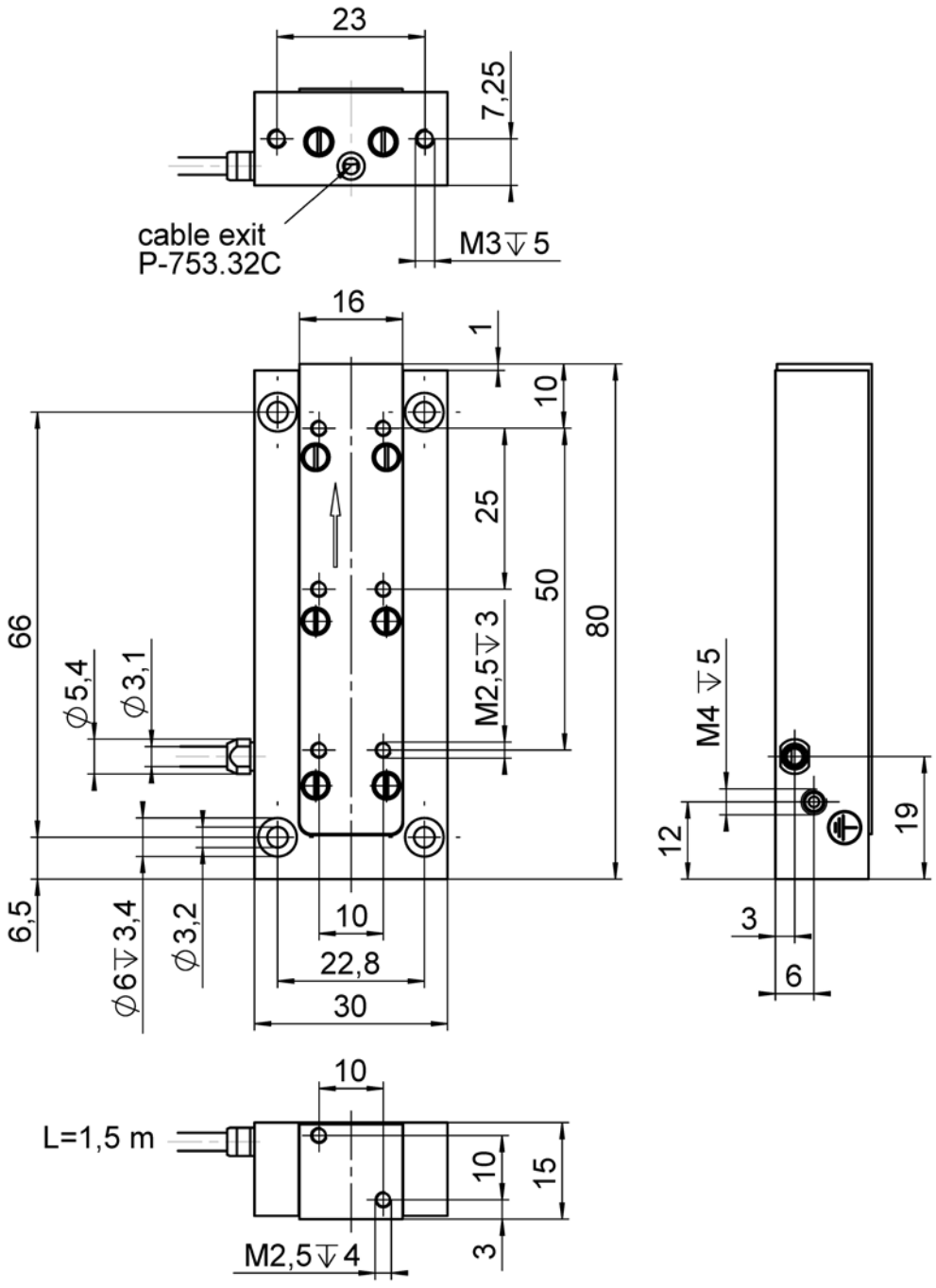


Figure 12: P-753.31C / P-753.3CD

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

10.4 Pin Assignment

7W2 Sub-D mix connector

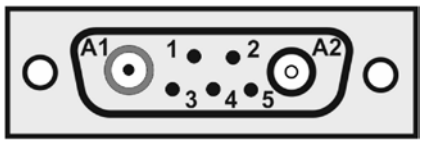


Figure 13: Sub-D Mix connector 7W2: Front side with connections

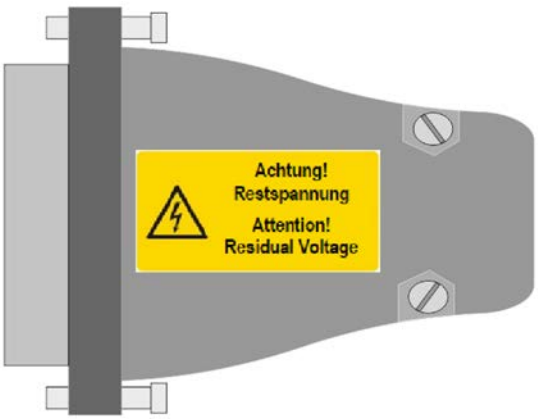


Figure 14: Sub-D mix connector: Exemplary top view

Pin	Signal	Function
A1	PZT	Piezo voltage
A2	Probe	Probe sensor signal (moving part of the capacitive sensor)
1	Data ID chip	Data cable for ID chip
2	GND target and ID chip	Ground of target and ID chip
3	GND PZT	Ground of piezo voltage
4	Free	-
5	Target	Target sensor signal (non-moving part of the capacitive sensor)
Case	-	Shield

LEMO coaxial connectors

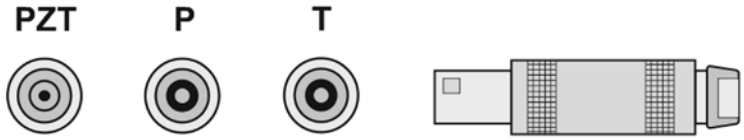


Figure 15: LEMO connectors: PZT, P and T

Connector	Signal	Function	Connector shell
P	Probe	Probe sensor signal (moving part of the capacitive sensor)	Cable shield
T	Target	Target sensor signal (non-moving part of the capacitive sensor)	Cable shield
PZT	PZT	Piezo voltage	Ground of piezo voltage on cable shield

11 Old Equipment Disposal

In accordance with the applicable EU law, electrical and electronic equipment may not be disposed of with unsorted municipal wastes in the member states of the EU.

When disposing of your old equipment, observe the international, national and local rules and regulations.

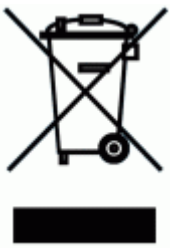
To meet the manufacturer's product responsibility with regard to this product, Physik Instrumente (PI) GmbH & Co. KG ensures environmentally correct disposal of old PI equipment that was first put into circulation after 13 August 2005, free of charge.

If you have old PI equipment, you can send it postage-free to the following address:

Physik Instrumente (PI) GmbH & Co. KG

Auf der Römerstr. 1

D-76228 Karlsruhe, Germany



12 EC Declaration of Conformity

For the P-753, an EC Declaration of Conformity has been issued in accordance with the following European directives:

2006/95/EC, Low Voltage Directive

2004/108/EC, EMC Directive

2011/65/EU, RoHS Directive

The applied standards certifying the conformity are listed below.

Safety (Low Voltage Directive): EN 61010-1:2010

EMC: EN 61326-1:2013

RoHS: EN 50581:2012