PZ234E

P-62x Positioners

User Manual

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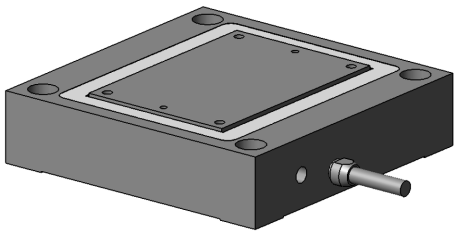

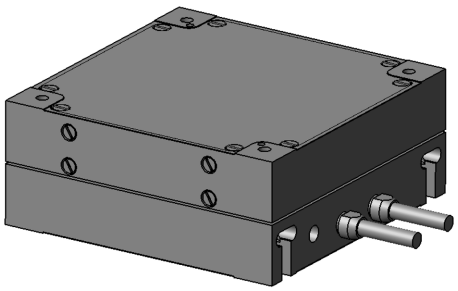

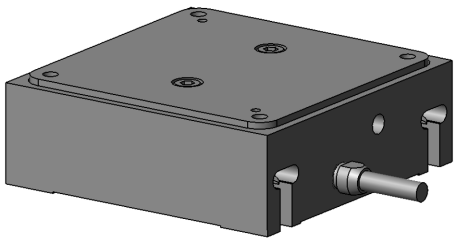

This document describes the following products:

- **P-620.1 – P-629.1**
  PIHera piezo linear stage
  P-620.1CD/.1CL/.10L
  P-621.1CD/.1CL/.10L/.1U
  P-622.1CD/.1CL/.10L/.1U
  P-625.1CD/.1CL/.10L/.1U
  P-628.1CD/.1CL/.10L
  P-629.1CD/.1CL/.10L

- **P-620.2 – P-629.2**
  PIHera piezo XY stage
  P-620.2CD/.2CL/.20L
  P-621.2CD/.2CL/.20L
  P-622.2CD/.2CL/.20L
  P-625.2CD/.2CL/.20L
  P-628.2CD/.2CL/.20L
  P-629.2CD/.2CL

- **P-620.Z - P-622.Z**
  PIHera precision Z stage
  P-620.ZCD/.ZCL/.Z0L
  P-621.ZCD/.ZCL/.Z0L
  P-622.ZCD/.ZCL/.Z0L

  .1CD/.2CD/.ZCD with D-sub connector 7W2
  .1U with D-sub connector 5W1 (f)
  .1CL/.2CL/.ZCL/.10L/.20L/.Z0L with LEMO connector(s)

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Contents

1 About this Document 1

1.1 Objective and Target Group of this User Manual 1
1.2 Symbols and Typographic Conventions 1
1.3 Definition of Terms 2
1.4 Figures 2
1.5 Other Applicable Documents 2
1.6 Downloading Manuals 3

2 Safety 5

2.1 Intended Use 5
2.2 General Safety Instructions 5
2.3 Organizational Measures 7

3 Product Description 9

3.1 Model Overview 9
3.2 Product View 12
3.3 Product Labeling 13
3.4 Scope of Delivery 14
3.5 Suitable Electronics 15
3.6 Accessories 15
3.7 Technical Features 16
3.7.1 PICMA® Piezo Actuators 16
3.7.2 Flexure Guides 16
3.7.3 Capacitive Sensors 17
3.7.4 ID Chip (Models with D-sub 7W2 Connector Only) 17

4 Unpacking 19

5 Installation 21

5.1 General Notes on Installing 21
5.2 Fixing the P-62x and the Load 22
5.3 Connecting the P-62x to the Protective Earth Conductor 25
5.4 Connecting the Vacuum Version to the Electronics 29

6 Starting and Operating 31

6.1 General Notes on Starting 31
6.2 Operating the P-62x 33
6.3 Discharging the P-62x 33

7 Maintenance 35

7.1 General Notes on Maintenance 35
7.2 Cleaning the P-62x 35

8 Troubleshooting 37

9 Customer Service 39

10 Technical Data 41

10.1 Specifications 41
10.1.1 P-62x.1 Data Table 41
10.1.2 P-62x.2 Data Table 44
10.1.3 P-62x.Z Data Table 48
10.1.4 P-62x.U Data Table 50
10.1.5 Materials Used for Vacuum-Compatible Models 52
10.1.6 Maximum Ratings 52
10.1.7 Ambient Conditions and Classifications 53
10.2 Dimensions 54
10.3 Torque for Stainless Steel Screws (A2-70) 58
10.4 Maximum Torque on the Platform 58
10.5 Pin Assignment 59

11 Old Equipment Disposal 61

12 European Declarations of Conformity 63

1 About this Document

In this Chapter

Objective and Target Group of this User Manual 1
Symbols and Typographic Conventions 1
Definition of Terms 2
Figures 2
Other Applicable Documents 2
Downloading Manuals 3

1.1 Objective and Target Group of this User Manual

This user manual contains the information required for using the P-62x as intended ("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
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. 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 attached to the product that refer to detailed information in this manual.

1.3 Definition of Terms

Term	Explanation
Positioner	Electrically driven mechanics (here: P-62x) 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.

Product	Document
E-503 Piezo Amplifier Module	PZ62E User Manual
E-505 Piezo Amplifier Module	
E-610 Piezo Amplifier / Servo Controller (OEM Module)	PZ70E User Manual PZ72E User Manual

Product	Document
E-621 Piezo Amplifier / Servo Controller Module	PZ160E User Manual
E-625 Piezo Servo Controller (Benchtop Device)	PZ166E User Manual
E-663 Piezo Amplifier	PZ69E User Manual
E-665 Piezo Amplifier / Servo Controller	PZ127E User Manual
E-709 Digital Piezo Controller	PZ222E User Manual
E-712 Digital Piezo Controller (Modular System)	PZ195E User Manual
E-727.x • E-727.xAP Digital Multi-Channel Piezo Controller	E727T0005 User Manual
E-727.xF Digital Multi-Channel Piezo Controller	
E-754 Digital Piezo Controller	E754T0001 User Manual
PIMikroMove	SM148E Software Manual
P-5xx / P-6xx / P-7xx Piezo Positioning Systems	PZ240EK Short Instructions

1.6 Downloading Manuals

INFORMATION

If a manual is missing or problems occur with downloading:

➢ Contact our customer service department (p. 39).

Downloading manuals

1. Open the website **www.pi.ws**.
2. Search the website for the product number (e.g., P-621) or the product family (e.g., PIHera).
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

Intended Use 5
General Safety Instructions 5
Organizational Measures 7

2.1 Intended Use

The P-62x 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.

According to its design, the P-62x is intended for fine positioning as well as moving small objects quickly and precisely. The specifications for the P-62x apply to horizontal mounting. Depending on the version, moving is done as follows:

Model	Motion	Axis
P-62x.1x(x)	In one axis horizontally	X
P-62x.2xx	In two axes horizontally	X, Y
P-62x.Zxx	In one axis vertically	Z

Vertical mounting is only possible under certain conditions.

The P-62x can only be used as intended in conjunction with suitable electronics (p. 15) available from PI. The electronics are not in the P-62x's scope of delivery.

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-62x 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-62x.

- Use the P-62x 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-62x.

The P-62x 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. Touching or short-circuiting the contacts in the P-62x's connector can lead to minor injuries from electric shock. The piezo actuators can be destroyed by an abrupt contraction.

- Do **not** open the P-62x.
- Discharge the positioner's piezo actuators before installing:
  Connect the positioner to the switched-off PI electronics equipped with an internal discharge resistor.
- Do **not** pull the plug connector out of the electronics during operation.

Positioners with D-sub plug connector:

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

- Do **not** touch the contacts in the plug connector.
- Use screws to secure the positioner's connector 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-62x in the case of malfunction or failure of the system. If there are touch voltages, touching the P-62x can result in minor injuries from electric shock.

- Connect the P-62x to a protective earth conductor (p. 25) 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-62x to the protective earth conductor before restarting.

Mechanical forces can damage or misalign the P-62x.

- Avoid impacts that affect the P-62x.
- Do **not** drop the P-62x.
- Do **not** exceed the maximum permissible stress and load capacities according to the specifications (p. 41).
- Do **not** touch any sensitive parts (e.g., platform) when handling the P-62x.

The P-62x 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-62x.

2.3 Organizational Measures

User manual

- Always keep this user manual together with the P-62x.
  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-62x 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-62x only after you have read and understood this user manual.

Personnel qualification

The P-62x may only be installed, started, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

3 Product Description

In this Chapter

Model Overview 9
Product View 12
Product Labeling 13
Scope of Delivery 14
Suitable Electronics 15
Accessories 15
Technical Features 16

3.1 Model Overview

The P-62x is available in the following versions:

PIHera piezo linear stage

Model	Description
P-620.1CD	PIHera precision linear nanopositioner, 50 µm, direct position measuring, capacitive sensor, D-sub connector
P-620.1CL	PIHera precision linear nanopositioner, 50 µm, direct position measuring, capacitive sensor, LEMO connectors
P-620.10L	PIHera precision linear nanopositioner, 60 µm, without sensor, LEMO connectors
P-621.1CD	PIHera precision linear nanopositioner, 100 µm, direct position measuring, capacitive sensor, D-sub connector
P-621.1CL	PIHera precision linear nanopositioner, 100 µm, direct position measuring, capacitive sensor, LEMO connectors
P-621.10L	PIHera precision linear nanopositioner, 120 µm, without sensor, LEMO connectors
P-622.1CD	PIHera precision linear nanopositioner, 250 µm, direct position measuring, capacitive sensor, D-sub connector
P-622.1CL	PIHera precision linear nanopositioner, 250 µm, direct position measuring, capacitive sensor, LEMO connectors
P-622.10L	PIHera precision linear nanopositioner, 300 µm, without sensor, LEMO connectors
P-625.1CD	PIHera precision linear nanopositioner, 500 µm, direct position measuring, capacitive sensor, D-sub connector
P-625.1CL	PIHera precision linear nanopositioner, 500 µm, direct position measuring, capacitive sensor, LEMO connectors

Model	Description
P-625.10L	PIHera precision linear nanopositioner, 600 µm, without sensor, LEMO connectors
P-628.1CD	PIHera precision linear nanopositioner, 800 µm, direct position measuring, capacitive sensor, D-sub connector
P-628.1CL	PIHera precision linear nanopositioner, 800 µm, direct position measuring, capacitive sensor, LEMO connectors
P-628.10L	PIHera precision linear nanopositioner, 950 µm, without sensor, LEMO connectors
P-629.1CD	PIHera precision linear nanopositioner, 1500 µm, direct position measuring, capacitive sensor, D-sub connector
P-629.1CL	PIHera precision linear nanopositioner, 1500 µm, direct position measuring, capacitive sensor, LEMO connectors
P-629.10L	PIHera precision linear nanopositioner, 1800 µm, without sensor, LEMO connectors

PIHera piezo linear stage (vacuum compatible to 10^{-9} hPa)

Model	Description
P-621.1U	PIHera precision linear nanopositioner, 100 µm, direct position measuring, capacitive sensor, D-sub connector, vacuum compatible to 10^{-9} hPa
P-622.1U	PIHera precision linear nanopositioner, 250 µm, direct position measuring, capacitive sensor, D-sub connector, vacuum compatible to 10^{-9} hPa
P-625.1U	PIHera precision linear nanopositioner, 500 µm, direct position measuring,capacitive sensor, D-sub connector, vacuum compatible to 10^{-9} hPa

PIHera piezo XY stage

Model	Description
P-620.2CD	PIHera precision XY nanopositioner, 50 µm × 50 µm, direct position measuring, capacitive sensors, D-sub connector
P-620.2CL	PIHera precision XY nanopositioner, 50 µm × 50 µm, direct position measuring, capacitive sensors, LEMO connectors
P-620.20L	PIHera precision XY nanopositioner, 60 µm × 60 µm, without sensors, LEMO connectors
P-621.2CD	PIHera precision XY nanopositioner, 100 µm × 100 µm, direct position measuring, capacitive sensors, D-sub connector
P-621.2CL	PIHera precision XY nanopositioner, 100 µm × 100 µm, direct position measuring, capacitive sensors, LEMO connectors
P-621.20L	PIHera precision XY nanopositioner, 120 µm × 120 µm, without sensors, LEMO connectors
P-622.2CD	PIHera precision XY nanopositioner, 250 µm × 250 µm, direct position measuring, capacitive sensors, D-sub connector

Model	Description
P-622.2CL	PIHera precision XY nanopositioner, 250 µm × 250 µm, direct position measuring, capacitive sensors, LEMO connectors
P-622.20L	PIHera precision XY nanopositioner, 300 µm × 300 µm, without sensors, LEMO connectors
P-625.2CD	PIHera precision XY nanopositioner, 500 µm × 500 µm, direct position measuring, capacitive sensors, D-sub connector
P-625.2CL	PIHera precision XY nanopositioner, 500 µm × 500 µm, direct position measuring, capacitive sensors, LEMO connectors
P-625.20L	PIHera precision XY nanopositioner, 600 µm × 600 µm, without sensors, LEMO connectors
P-628.2CD	PIHera precision XY nanopositioner, 800 µm × 800 µm, direct position measuring, capacitive sensors, D-sub connector
P-628.2CL	PIHera precision XY nanopositioner, 800 µm × 800 µm, direct position measuring, capacitive sensors, LEMO connectors
P-628.20L	PIHera precision XY nanopositioner, 1000 µm × 1000 µm, without sensors, LEMO connectors
P-629.2CD	PIHera precision XY nanopositioner, 1500 µm × 1500 µm, direct position measuring, capacitive sensors, D-sub connector
P-629.2CL	PIHera precision XY nanopositioner, 1500 µm × 1500 µm, direct position measuring, capacitive sensors, LEMO connectors

PIHera precision Z stage

Model	Description
P-620.ZCD	Precise PIHera vertical nanopositioning stage, 50 µm, direct position measuring, capacitive sensor, D-sub connector
P-620.ZCL	Precise PIHera vertical nanopositioning stage, 50 µm, direct position measuring, capacitive sensor, LEMO connectors
P-620.Z0L	Precise PIHera vertical nanopositioning stage, 65 µm, without sensor, LEMO connectors
P-621.ZCD	Precise PIHera vertical nanopositioning stage, 100 µm, direct position measuring, capacitive sensor, D-sub connector
P-621.ZCL	Precise PIHera vertical nanopositioning stage, 100 µm, direct position measuring, capacitive sensor, LEMO connectors
P-621.Z0L	Precise PIHera vertical nanopositioning stage, 140 µm, without sensor, LEMO connectors
P-622.ZCD	Precise PIHera vertical nanopositioning stage, 250 µm, direct position measuring, capacitive sensor, D-sub connector
P-622.ZCL	Precise PIHera vertical nanopositioning stage, 250 µm, direct position measuring, capacitive sensor, LEMO connectors
P-622.Z0L	Precise PIHera vertical nanopositioning stage, 350 µm, without sensor, LEMO connectors

3.2 Product View

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

➢ Pay attention to the symbols on your device.

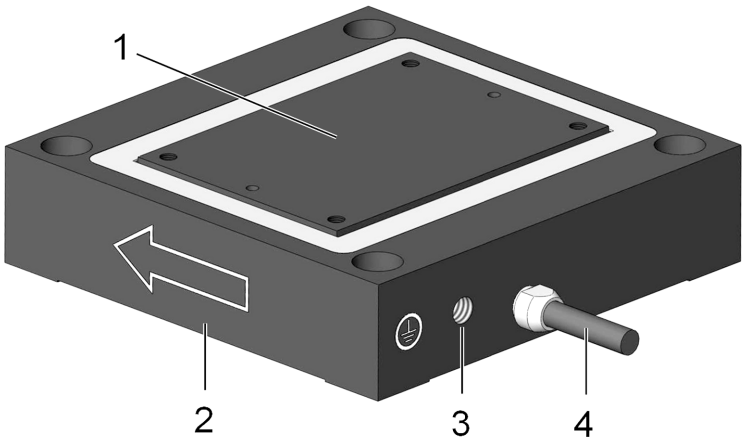


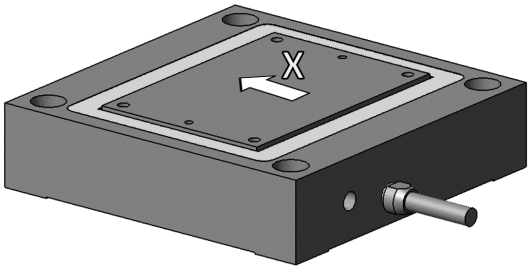
Figure 1: Example of product view

1 Platform
2 Base body
3 Threaded hole for connecting the protective earth conductor
4 Cable exit

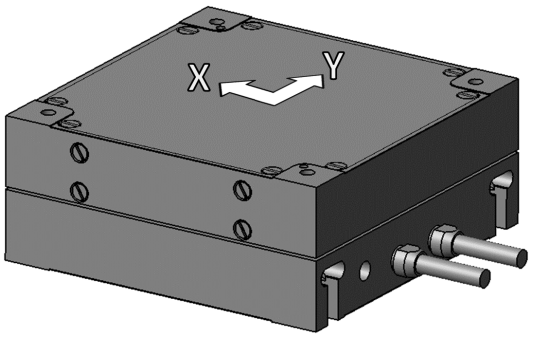
Direction of P-62x motion

The arrows indicate the positive direction of motion in each case.

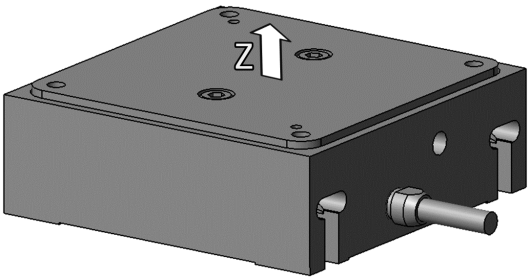
P-62x.1x(x)



P-62x.2xx



P-62x.Zxx



3.3 Product Labeling

Labeling	Description
P-621.1CD	Product number (example)
123456789	Serial number (example), individual for each P-62x Meaning of each position (from the left): 1 = internal information 2 and 3 = year of manufacture 4 to 9 = consecutive number
PIHera	Brand name
⚠	Warning sign "Pay attention to the manual!"
	Old equipment disposal (p. 61)
Country of origin: Germany	Country of origin
WWW.PI.WS	Manufacturer's address (website)
CE	CE conformity mark
PI	Manufacturer's logo
⏚	Symbol for the protective earth conductor (p. 25)

If applicable:

- The arrows indicate the positive direction of motion.
- The letter X, Y, and Z indicate the axis.

Figure 2: "Residual Voltage" warning sign on the connector of the P-62x

"Residual Voltage" warning: Risk of electric shock (p. 5) for models with D-sub plug connector

3.4 Scope of Delivery

Product number	Description	Model
P-62x	Positioner according to order (p. 9)	-
000036450	M4 screw set for protective earth, consisting of: ▪ 1 flat-head screw with cross recess, M4x8, ISO 7045 ▪ 2 lock washers ▪ 2 flat washers	All models except P-620 and P-621.2xx
000036451	M2 screw set for protective earth, consisting of: ▪ 4 socket head screws, M2x12, ISO 4762 ▪ 4 lock washers ▪ 4 dowel pins, Ø 1 m6 x 4, ISO 8734 ▪ 1 hex key	P-620
2491	Screw set, consisting of: ▪ 8 M3x10 socket head screws, DIN 7984 ▪ 4 dowel pins Ø 1.5 m6 x 4, ISO 8734 ▪ 1 hex key	P-621.2xx P-622.2xx P-625.2xx P-628.2xx
000017112	Screw set, consisting of: ▪ 4 socket head screws, M4x16, ISO 7984 ▪ 4 dowel pins Ø 1.5 m6 x 4, ISO 8734 ▪ 1 hex key	P-629.2xx
000011857	Screw set, consisting of: ▪ 4 M3x10 socket head screws, DIN 7984 ▪ 4 dowel pins Ø 1.5 m6 x 4, ISO 8734 ▪ 1 hex key	P-621.Zxx P-622.Zxx
PZ240EK	Short instructions for piezo positioning systems	All models

3.5 Suitable Electronics

To operate a P-62x, you need suitable electronics. Selection of the device depends on the application and the connectors available.

Electronics	Connector*	Channels**
E-505 piezo amplifier module	LEMO	1
E-610 piezo amplifier / servo controller (OEM module)	LEMO	1
E-503 piezo amplifier module	LEMO	3
E-663 piezo amplifier	LEMO	3
E-621 piezo amplifier / servo controller module	D-sub 7W2	1
E-625 piezo servo controller (benchtop device)	D-sub 7W2	1
E-665 piezo driver / servo controller (benchtop device)	D-sub 7W2	1
E-709 digital piezo controller	D-sub 7W2	1
E-754 digital piezo controller	D-sub 7W2	1
E-727.x • E-727.xAP digital multi-channel piezo controller	D-sub 25W3	3
E-727.xF digital multi-channel piezo controller	D-sub 25W3	3
E-712 digital piezo controller (modular system)	D-sub 25W3	3/6

* In some cases, adapter cables (p. 15) are necessary for connecting.
** When using single-channel electronics, each motion axis requires its own individual electronics.

3.6 Accessories

Adapter cables for models with D-sub plug connector(s)

Product number	Description
P-895.2D1DDC*	Adapter cable D-sub 25W3 (f) and D-sub 7W2 (f) to D-sub 25W3 (m) for piezo actuator nanopositioning systems with capacitive sensors, 3 channels, length: 0.3 m.
P-895.2DDC	Adapter cable 2× D-sub 7W2 (f) to D-sub 25W3 (m) for piezo actuator nanopositioning systems with capacitive sensors, 2 channels, length: 0.3 m.
P-895.3DDC	Adapter cable 3× D-sub 7W2 (f) to D-sub 25W3 (m) for piezo actuator nanopositioning systems with capacitive sensors, 3 channels, length: 0.3 m.

* 2 channels to D-sub 25W3 (f) and 1 channel to D-sub 7W2 (f) available.

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.
P-895.3LDC	Adapter cable LEMO to D-sub 25W3 (m) for piezo actuator nanopositioning systems with capacitive sensors, 3 channels, length: 0.3 m.

Accessories for vacuum-compatible models

Product number	Description
P-890.1CV	Vacuum feedthrough D-sub 5W1 (m/m), 1 channel, for a piezo voltage to 130 V and sensor signal (capacitive sensor), DN40CF flange, to 10^{-9} hPa, bakeout to 150 °C
P-890.2CV	Vacuum feedthrough D-sub 5W1 (m/m), 2 channels, for a piezo voltage to 130 V and sensor signal (capacitive sensor), DN63CF flange, to 10^{-9} hPa, bakeout to 150 °C
K030B0392	Adapter cable, D-sub 5W1 (f) to D-sub 7W2 (m), 1 channel, 2 m, for connecting to the P-890.1CV or P-890.2CV air side vacuum feedthrough

➢ To order, contact our customer service department (p. 39).

3.7 Technical Features

3.7.1 PICMA® Piezo Actuators

P-62x 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-62x 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

Except for the models P-62x.x0L, all P-62x are equipped with 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 7W2 Connector Only)

An ID chip is in the D-sub connector of the P-62x. When the P-62x 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-62x connected. A P-62x 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

NOTICE

Mechanical overload due to incorrect handling!

An impermissible mechanical load on the platform of the P-62x can cause damage to the piezo actuators, sensors, and flexures of the P-62x as well as loss of accuracy.

- Do **not** touch any sensitive parts (e.g., platform) when handling the P-62x.

INFORMATION

When handling the vacuum version of the positioner, attention must be paid to appropriate cleanliness. At PI, all parts are cleaned before assembly. Powder-free gloves are worn during assembly and measuring. In addition, the positioner is wipe cleaned afterwards and then shrink-wrapped twice in vacuum-compatible film.

- Touch the positioner only with powder-free gloves.
- If necessary, wipe the positioner clean after unpacking.

1. Unpack the P-62x 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. 39) immediately.
4. Keep all packaging materials in case the product needs to be returned.

5 Installation

In this Chapter

General Notes on Installing 21
Fixing the P-62x and the Load 22
Connecting the P-62x to the Protective Earth Conductor 25
Connecting the Vacuum Version to the Electronics 29

5.1 General Notes on Installing

CAUTION

Dangerous voltage and residual charge in piezo actuators!

The P-62x 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. Touching or short-circuiting the contacts in the P-62x's connector can lead to minor injuries from electric shock. The piezo actuators can be destroyed by an abrupt contraction.

- Do **not** open the P-62x.
- Discharge the positioner's piezo actuators before installing:
  Connect the positioner to the switched-off PI electronics equipped with an internal discharge resistor.
- Do **not** pull the plug connector out of the electronics during operation.

Positioners with D-sub plug connector:

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

- Do **not** touch the contacts in the plug connector.
- Use screws to secure the positioner's connector against being pulled out of the electronics.

NOTICE

Damage due to unsuitable cables!

Unsuitable cables can damage the P-62x and the electronics.

- Use cables provided by PI only to connect the P-62x to the electronics.

INFORMATION

Extension cables can reduce the positioning accuracy of the P-62x or affect sensor processing by the electronics.

- Do **not** use extension cables. If you need longer cables, contact our customer service department (p. 39).

5.2 Fixing the P-62x and the Load

NOTICE

Mechanical overload of the platform!

High torques and high loads can overload the platform of the P-62x when fixing the load. Mechanical overload can cause damage to the piezo actuators, sensors, and flexures of the P-62x and lead to loss of accuracy.

- Do **not** exceed the maximum permissible torque on the platform (p. 58) when fixing the load.
- Do **not** exceed the maximum permissible loads according to the specifications (p. 41).
- Hold the load when tightening (or loosening) the screws.

NOTICE

Protruding screw heads!

Protruding screw heads can damage the P-62x.

- Ensure that the screw heads do not protrude from countersunk holes so that they do not interfere with the motion.

NOTICE

Excessively long screws!

The P-62x could be damaged by screws inserted too deeply.

- Pay attention to the depth of the mounting holes in the platform (p. 54).
- Use screws of the correct length for the respective mounting holes only.

NOTICE

Damage due to incorrectly tightened screws!

Incorrectly tightened screws can cause damage.

- Pay attention to the torque range (p. 58) specified for the screws used during installation.

NOTICE

Warping the P-62x when mounting onto uneven surfaces!
Fixing the P-62x onto an uneven surface can warp the P-62x. Warping reduces the accuracy.

- ➢ Fix the P-62x onto a flat surface. The recommended flatness of the surface is ≤20 µm.
- ➢ For applications with large temperature fluctuations:
  Only fix the P-62x onto surfaces that have the same or similar thermal expansion properties as the P-62x (e.g., surfaces made of aluminum).

NOTICE

Tensile stress on piezo actuator due to mounting in wrong orientation!
The P-62x is intended for mounting in horizontal orientation (standing on a surface, not suspended). Mounting in other orientations can cause tensile stress that reduces the preload and destroys the piezo actuator.

- ➢ If you want to mount the P-62x in a different orientation to that intended (e.g., vertically or upside down), contact our customer service department (p. 39).

INFORMATION

In order to facilitate mounting with screws, you can fix the P-62x or loads using dowel pins. The P-62x has two holes each on the bottom of the base body and on the platform to accommodate dowel pins.

INFORMATION

The P-62x's direction of motion is indicated in the product view (p. 12).

Center of load at the optimal position:

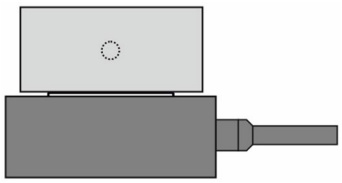


Figure 3: Example of an optimally placed load

Center of load at an unsuitable position:

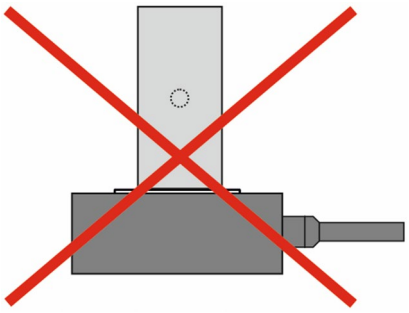


Figure 4: Tall load and center of load too far above the platform

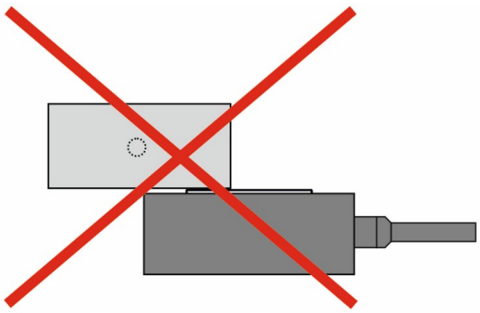


Figure 5: Unwanted lever effect and center of load on the side of the platform

Requirements

- ✓ You have read and understood the general notes on installation (p. 21).
- ✓ The P-62x is **not** connected to the controller.

Tools and accessories

- If a screw set for fixing the positioner onto an underlying surface is **not** included in the scope of delivery (p. 14):
  - Screws of suitable size and length (p. 54)
  - Optional: Dowel pins of suitable size and length (p. 54)
- If a screw set for fixing the positioner onto a surface is included in the scope of delivery (p. 14):
  - Screws supplied for fixing the positioner onto a surface
  - Optional: Dowel pins supplied for aligning the positioner or loads
- Suitable tools

Fixing the P-62x and the load

1. Alignment:
   - Align the positioner so that the corresponding mounting holes in the positioner and underlying surface are in line. Optional: Use the locating holes (p. 54) in the positioner's base body as well as suitable dowel pins for alignment.
   - Align the load on the positioner so that the mounting holes in the load and the holes in the platform are in line. Optional: Use the locating holes (p. 54) in the positioner's platform as well as suitable dowel pins for alignment.
2. Fixing:
   - Fix the positioner only by tightening the screws in the mounting holes (p. 54) provided. If the positioner is not equipped with a separate protective earth connector, follow the instructions for connecting the protective earth conductor via the mounting holes (p. 25) when mounting the positioner.
   - Fix loads only by tightening the screws in the threaded holes (p. 54) provided.

5.3 Connecting the P-62x 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 liquid adhesive) to prevent it from unscrewing by itself.

INFORMATION

In the case of P-62x 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. 39).

The connection of the P-62x to the protective earth conductor depends on the model:

- Models **with** separate protective earth connector (all except P-620 and P-621.2xx)
- Models **without** separate protective earth connector (P-620 and P-621.2xx only)

Separate protective earth connector available

If a separate protective earth connector is available, it must be used.

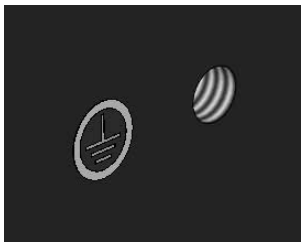


Figure 6: Threaded hole for protective earth connection

Separate protective earth connector not available

If a separate protective earth connector is not available, **all** mounting holes marked with the protective earth conductor symbol ⏚ must be used to ensure proper connection of the protective earth conductor.

Figure 7: Mounting hole with symbol for the protective earth conductor

Tools and accessories

- Suitable protective earth conductor: Cable cross section ≥ 0.75 mm²
- Suitable screwdriver
- All models except P-620 and P-621.2xx: M4 protective earth conductor screw set (p. 14) for connecting the protective earth conductor
- When mounting a P-620 and P-621.2xx:
  - Screw set (p. 14) for mounting the positioner onto an underlying surface
  - Suitable underlying surface: The underlying for mounting the positioner must be connected to a suitable protective earth conductor. The surfaces that make contact with the positioner, usually the holes for accommodating the mounting screws, must be sufficiently conductive.

Requirements

- ✓ You have read and understood the general notes on installation (p. 21).
- ✓ The P-62x is **not** connected to the controller.

Connecting the protective earth conductor to the separate protective earth connector (all models except P-620 and P-621.2xx)

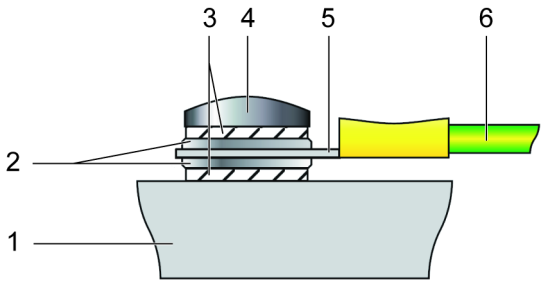


Figure 8: Connecting the protective earth conductor (profile view)

1 Base body of the P-62x
2 Flat washer
3 Lock washer
4 Screw
5 Cable lug
6 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-62x 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.

Connecting the protective earth conductor via the mounting holes (P-620 and P-621.2xx only)

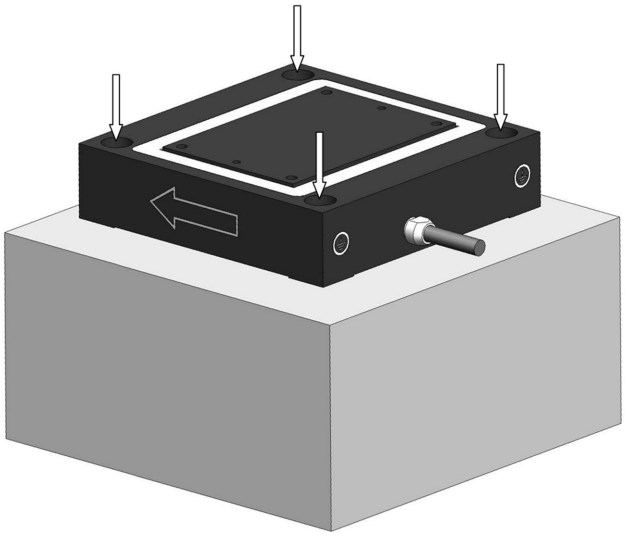


Figure 9: Positioner on a surface that must be connected to a protective earth conductor; for mounting holes, see arrows.

1. Align the positioner so that the corresponding mounting holes in the positioner and underlying surface are in line. Optional: Use the locating holes (p. 54) in the positioner's base body as well as the supplied dowel pins for alignment.
2. Mount the positioner onto an electrically conductive underlying surface connected to a suitable protective earth conductor:
   a) If the screw set includes lock washers, place a lock washer onto each screw.
   b) Insert a screw into each of the four mounting holes (see figure). If lock washers are intended, insert each screw together with the lock washer.
   The mounting holes are marked respectively with the protective earth conductor symbol ⏚.
   c) Tighten each of the four screws with at least four turns to the torque (p. 58) specified for the screws.
3. Make sure that the contact resistance is <0.1 Ω at 25 A at all points relevant for attaching the protective earth conductor.

5.4 Connecting the Vacuum Version to the Electronics

INFORMATION

This section describes connection of the vacuum version of the P-62x to electronics with D-sub 7W2 socket. For connecting electronics with D-sub 25W3 socket, you also need a suitable P-895 adapter cable (p. 15) connected to the D-sub 25W3 socket of the electronics.

Requirements

- ✓ You have read and understood the general notes on installation (p. 21).
- ✓ The electronics are switched off, i.e., **not** connected to the power supply.
- ✓ You have connected the P-62x to the protective earth conductor (p. 25).
- ✓ You have installed the P-890 vacuum feedthrough (p. 15) into your vacuum chamber.

Tools and accessories

- K030B0392 adapter cable (p. 15)

Connecting the vacuum version to the electronics

➢ Connect the P-62x ("positioner"), vacuum feedthrough, and electronics as shown in the connection diagram below.

– Pay attention to the assignment specified on the labeling of the sockets, plug connectors, and cables.

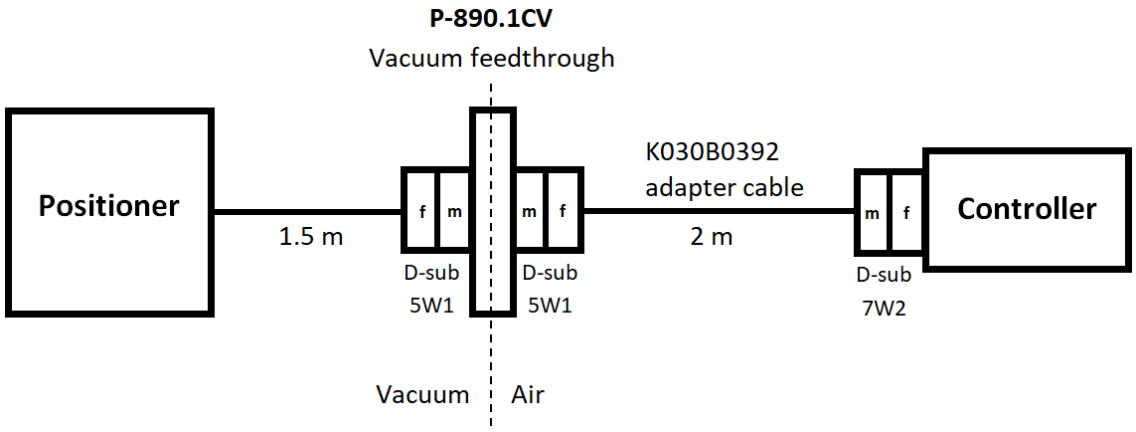


Figure 10: Connection of the .1U vacuum version to the electronics with P-890.1CV vacuum feedthrough

6 Starting and Operating

In this Chapter

General Notes on Starting 31
Operating the P-62x 33
Discharging the P-62x 33

6.1 General Notes on Starting

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-62x in the case of malfunction or failure of the system. If there are touch voltages, touching the P-62x can result in minor injuries from electric shock.

- Connect the P-62x to a protective earth conductor (p. 25) 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-62x to the protective earth conductor before restarting.

NOTICE

Destruction of the piezo actuator due to electric flashovers!

Using the P-62x 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-62x in environments that can increase the electrical conductivity.
- Only operate the P-62x within the permissible ambient conditions and classifications (p. 53).
- When using in a vacuum under 0.1 hPa:
  Do **not** operate the P-62x during evacuation or ventilation.

NOTICE

Decreased lifetime due to permanently high voltage!

Applying a continuous high static voltage to piezo actuators reduces the lifetime of the piezo ceramic.

- ➢ When the P-62x is not used but the electronics remain switched on to ensure temperature stability, discharge the P-62x (p. 33).

NOTICE

Shortened lifetime of the flexure guides in dynamic operation!

Dynamic operation and scanning applications can shorten the lifetime of flexure guides significantly when using the maximum travel range in open-loop operation.

- ➢ Avoid full load in open loop during dynamic operation and in scan applications. If your application requires a corresponding operating mode, contact our customer service department (p. 39).

NOTICE

Uncontrolled oscillation!

Oscillation can cause irreparable damage to the P-62x. 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-62x is operated near to its resonant frequency.

If you notice oscillation:

- ➢ In closed-loop operation, switch off the servo mode immediately.
- ➢ In open-loop operation, stop the P-62x immediately.

INFORMATION

The P-62x's direction of motion is indicated in the product view (p. 12).

INFORMATION

Systems are calibrated at the factory to achieve optimum positioning accuracy. Replacing the system components can lead to a reduction of position accuracy when positioners are used with an ID-chip that does not contain calibration data or when LEMO plug connectors are used.

- ➢ When connecting the positioner, pay attention to the assignment of the motion axes to the controller channels, which is specified on the calibration label of the controller.

If position accuracy is reduced after replacing the P-62x or the controller:

- ➢ Recalibrate the axis displacement (refer to the controller manual) or contact our customer service department (p. 39).

INFORMATION

Sound and vibration (e.g., footfall, knocks) can be transmitted to the P-62x and can affect its performance with regard to position stability.

➢ Avoid sound and vibration while the P-62x is being operated.

INFORMATION

The expansion of the piezo actuators depends on the ambient temperature and can vary by up to 20 % in the given temperature ranges.

6.2 Operating the P-62x

➢ Follow the instructions in the manual for the electronics (p. 15) used for starting and operating the P-62x.

6.3 Discharging the P-62x

The P-62x must be discharged in the following cases:

- Before Installation
- When the P-62x is not used but the electronics remain switched on to ensure temperature stability
- Before demounting (e.g., before cleaning and transporting the P-62x and for modifications)

The P-62x 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

General Notes on Maintenance 35
Cleaning the P-62x 35

7.1 General Notes on Maintenance

NOTICE

Misalignment from loosening screws!
The P-62x 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 any screws only when instructed in this manual.
- ➢ Do **not** open the P-62x.

7.2 Cleaning the P-62x

NOTICE

Damage from ultrasonic cleaning!
Ultrasonic cleaning can damage the P-62x.

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

Requirements

- ✓ You have discharged the piezo actuators of the P-62x (p. 33).
- ✓ You have disconnected the P-62x from the controller.

Cleaning the P-62x

Only when the positioner is **not** used in vacuum:

- ➢ Clean the surfaces of the P-62x with a cloth dampened with a mild cleanser or disinfectant (e.g., isopropyl alcohol).

Only when the positioner is used in vacuum:

- ➢ Touch the positioner only when wearing powder-free gloves.
- ➢ If necessary, wipe the positioner clean.

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. 41).
	Zero shift of the sensor for the following reasons: ▪ Load in direction of motion ▪ 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 platform is warped	➢ Mount the P-62x onto surfaces with the following characteristics only: – Flatness of at least 20 µm – The thermal expansion properties are similar to those of the P-62x (e.g., surfaces made of aluminum). ➢ Mount loads onto the P-62x with the following characteristics only: – The contact surface of the load has a flatness of at least 20 µm. – The thermal expansion properties are similar to those of the P-62x (e.g., loads made of aluminum).
	P-62x or controller has been replaced	When using positioners where the ID chip does not contain any calibration data, or LEMO plug connectors, axis displacement has to be recalibrated after the P-62x or the controller has been replaced. ➢ Recalibrate the axis displacement (see controller manual) or contact our customer service department (p. 39).

Problem	Possible causes	Solution
	Axes were mixed up during connection	➢ 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 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. 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, operate the positioner only 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. 39).

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

Specifications 41
Dimensions 54
Torque for Stainless Steel Screws (A2-70) 58
Maximum Torque on the Platform 58
Pin Assignment 59

10.1 Specifications

10.1.1 P-62x.1 Data Table

Motion	P-620.1CD	P-621.1CD	P-622.1CD	P-625.1CD	P-628.1CD	P-629.1CD	Tolerance
Active axes	X	X	X	X	X	X	
Travel range in X	50 µm	100 µm	250 µm	500 µm	800 µm	1500 µm	
Travel range in X, open loop	60 µm	120 µm	300 µm	600 µm	950 µm	1800 µm	±20%
Linearity error in X	0.02 %	0.02 %	0.02 %	0.03 %	0.03 %	0.03 %	typ.
Pitch (Rotational crosstalk in θY with motion in X)	± 3 µrad	± 3 µrad	± 3 µrad	± 6 µrad	± 6 µrad	± 30 µrad	typ.
Yaw (Rotational crosstalk in θZ with motion in X)	± 3 µrad	± 3 µrad	± 3 µrad	± 6 µrad	± 6 µrad	± 10 µrad	typ.
Positioning	**P-620.1CD**	**P-621.1CD**	**P-622.1CD**	**P-625.1CD**	**P-628.1CD**	**P-629.1CD**	**Tolerance**
Integrated sensor	Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring	
System resolution in X	0.2 nm	0.4 nm	0.7 nm	1.4 nm	1.8 nm	3 nm	
Resolution in X, open loop	0.1 nm	0.2 nm	0.4 nm	0.5 nm	0.5 nm	2 nm	typ.
Bidirectional repeatability in X	± 1 nm	± 1 nm	± 1 nm	± 5 nm	± 10 nm	± 14 nm	typ.
Drive properties	**P-620.1CD**	**P-621.1CD**	**P-622.1CD**	**P-625.1CD**	**P-628.1CD**	**P-629.1CD**	**Tolerance**
Drive type	PICMA®	PICMA®	PICMA®	PICMA®	PICMA®	PICMA®	
Electrical capacitance in X	0.35 µF	1.5 µF	3.1 µF	6.2 µF	19 µF	52 µF	±20%

Mechanical properties	P-620.1CD	P-621.1CD	P-622.1CD	P-625.1CD	P-628.1CD	P-629.1CD	Tolerance
Guide	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	
Stiffness in X	0.42 N/µm	0.35 N/µm	0.2 N/µm	0.1 N/µm	0.12 N/µm	0.13 N/µm	±20 %
Resonant frequency in X, under load with 120 g	260 Hz	240 Hz	185 Hz	110 Hz	90 Hz	110 Hz	±20%
Resonant frequency in X, under load with 20 g	550 Hz	520 Hz	340 Hz	180 Hz	115 Hz	120 Hz	±20%
Resonant frequency in X, unloaded	1100 Hz	800 Hz	400 Hz	215 Hz	125 Hz	125 Hz	±20%
Permissible push force in X	10 N	10 N	10 N	10 N	10 N	10 N	max.
Permissible push force in Y	10 N	10 N	10 N	10 N	10 N	8 N	max.
Permissible push force in Z	10 N	10 N	10 N	10 N	10 N	10 N	max.
Permissible pull force in X	10 N	10 N	10 N	10 N	10 N	10 N	max.
Overall mass	110 g	160 g	200 g	240 g	380 g	720 g	
Material	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	
Miscellaneous	**P-620.1CD**	**P-621.1CD**	**P-622.1CD**	**P-625.1CD**	**P-628.1CD**	**P-629.1CD**	**Tolerance**
Connector	D-sub 7W2 (m)	D-sub 7W2 (m)	D-sub 7W2 (m)	D-sub 7W2 (m)	D-sub 7W2 (m)	D-sub 7W2 (m)	
Recommended controllers / drivers	E-503, E-505, E-610, E-621, E-625, E-709.1C1L, E-754	E-503, E-505, E-610, E-621, E-625, E-709.1C1L, E-754	E-503, E-505, E-610, E-621, E-625, E-709.1C1L, E-754	E-503, E-505, E-610, E-621, E-625, E-709.1C1L, E-754	E-503, E-505, E-610, E-621, E-625, E-709.1C1L, E-754	E-503, E-505, E-610, E-621, E-625, E-709.1C1L, E-754	
Cable length	1.5 m	1.5 m	1.5 m	1.5 m	1.5 m	1.5 m	
Operating temperature range	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	

P-628.1CD: Linearity error in X (typ.) 0.03 % with digital controller. With analog controllers 0.05 %.
P-629.1CD: Linearity error in X (typ.) 0.03 % with digital controller. With analog controllers 0.08 %.
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.
All specifications based on room temperature (22 °C ±3 °C).

Motion	P-620.1CL	P-621.1CL	P-622.1CL	P-625.1CL	P-628.1CL	P-629.1CL	Tolerance
Active axes	X	X	X	X	X	X	
Travel range in X	50 µm	100 µm	250 µm	500 µm	800 µm	1500 µm	
Travel range in X, open loop	60 µm	120 µm	300 µm	600 µm	950 µm	1800 µm	±20%
Linearity error in X	0.02 %	0.02 %	0.02 %	0.03 %	0.03 %	0.03 %	typ.
Pitch (Rotational crosstalk in θY with motion in X)	± 3 µrad	± 3 µrad	± 3 µrad	± 6 µrad	± 6 µrad	± 30 µrad	typ.
Yaw (Rotational crosstalk in θZ with motion in X)	± 3 µrad	± 3 µrad	± 3 µrad	± 6 µrad	± 6 µrad	± 10 µrad	typ.
Positioning	**P-620.1CL**	**P-621.1CL**	**P-622.1CL**	**P-625.1CL**	**P-628.1CL**	**P-629.1CL**	**Tolerance**
Integrated sensor	Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring	
System resolution in X	0.2 nm	0.4 nm	0.7 nm	1.4 nm	1.8 nm	3 nm	
Resolution in X, open loop	0.1 nm	0.2 nm	0.4 nm	0.5 nm	0.5 nm	2 nm	typ.
Bidirectional repeatability in X	± 1 nm	± 1 nm	± 1 nm	± 5 nm	± 10 nm	± 14 nm	typ.

Drive properties	P-620.1CL	P-621.1CL	P-622.1CL	P-625.1CL	P-628.1CL	P-629.1CL	Tolerance
Drive type	PICMA®	PICMA®	PICMA®	PICMA®	PICMA®	PICMA®	
Electrical capacitance in X	0.35 µF	1.5 µF	3.1 µF	6.2 µF	19 µF	52 µF	±20%
Mechanical properties	**P-620.1CL**	**P-621.1CL**	**P-622.1CL**	**P-625.1CL**	**P-628.1CL**	**P-629.1CL**	**Tolerance**
Guide	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	
Stiffness in X	0.42 N/µm	0.35 N/µm	0.2 N/µm	0.1 N/µm	0.12 N/µm	0.13 N/µm	±20 %
Resonant frequency in X, under load with 120 g	260 Hz	240 Hz	185 Hz	110 Hz	90 Hz	110 Hz	±20%
Resonant frequency in X, under load with 20 g	550 Hz	520 Hz	340 Hz	180 Hz	115 Hz	120 Hz	±20%
Resonant frequency in X, unloaded	1100 Hz	800 Hz	400 Hz	215 Hz	125 Hz	125 Hz	±20%
Permissible push force in X	10 N	10 N	10 N	10 N	10 N	10 N	max.
Permissible push force in Y	10 N	10 N	10 N	10 N	10 N	8 N	max.
Permissible push force in Z	10 N	10 N	10 N	10 N	10 N	10 N	max.
Permissible pull force in X	10 N	10 N	10 N	10 N	10 N	10 N	max.
Overall mass	110 g	160 g	200 g	240 g	380 g	720 g	
Material	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	
Miscellaneous	**P-620.1CL**	**P-621.1CL**	**P-622.1CL**	**P-625.1CL**	**P-628.1CL**	**P-629.1CL**	**Tolerance**
Connector	LEMO LVPZT	LEMO LVPZT	LEMO LVPZT	LEMO LVPZT	LEMO LVPZT	LEMO LVPZT	
Recommended controllers / drivers	E-503, E-505, E-610, E-621, E-625, E-709.1C1L, E-754	E-503, E-505, E-610, E-621, E-625, E-709.1C1L, E-754	E-503, E-505, E-610, E-621, E-625, E-709.1C1L, E-754	E-503, E-505, E-610, E-621, E-625, E-709.1C1L, E-754	E-503, E-505, E-610, E-621, E-625, E-709.1C1L, E-754	E-503, E-505, E-610, E-621, E-625, E-709.1C1L, E-754	
Cable length	1.5 m	1.5 m	1.5 m	1.5 m	1.5 m	1.5 m	
Operating temperature range	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	
Sensor connector	LEMO for capacitive sensors	LEMO for capacitive sensors	LEMO for capacitive sensors	LEMO for capacitive sensors	LEMO for capacitive sensors	LEMO for capacitive sensors	

P-628.1CL: Linearity error in X (typ.) 0.03 % with digital controller. With analog controllers 0.05 %.
P-629.1CL: Linearity error in X (typ.) 0.03 % with digital controller. With analog controllers 0.08 %.
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.
All specifications based on room temperature (22 °C ±3 °C).

Motion	P-620.10L	P-621.10L	P-622.10L	P-625.10L	P-628.10L	P-629.10L	Tolerance
Active axes	X	X	X	X	X	X	
Travel range in X, open loop	60 µm	120 µm	300 µm	600 µm	950 µm	1800 µm	±20%
Pitch (Rotational crosstalk in θY with motion in X)	± 3 µrad	± 3 µrad	± 3 µrad	± 6 µrad	± 6 µrad	± 30 µrad	typ.
Yaw (Rotational crosstalk in θZ with motion in X)	± 3 µrad	± 3 µrad	± 3 µrad	± 6 µrad	± 6 µrad	± 10 µrad	typ.
Positioning	**P-620.10L**	**P-621.10L**	**P-622.10L**	**P-625.10L**	**P-628.10L**	**P-629.10L**	**Tolerance**
Resolution in X, open loop	0.1 nm	0.2 nm	0.4 nm	0.5 nm	0.5 nm	2 nm	typ.
Drive properties	**P-620.10L**	**P-621.10L**	**P-622.10L**	**P-625.10L**	**P-628.10L**	**P-629.10L**	**Tolerance**
Drive type	PICMA®	PICMA®	PICMA®	PICMA®	PICMA®	PICMA®	
Electrical capacitance in X	0.35 µF	1.5 µF	3.1 µF	6.2 µF	19 µF	52 µF	±20%

Mechanical properties	P-620.10L	P-621.10L	P-622.10L	P-625.10L	P-628.10L	P-629.10L	Tolerance
Guide	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	
Stiffness in X	0.42 N/µm	0.35 N/µm	0.2 N/µm	0.1 N/µm	0.12 N/µm	0.13 N/µm	±20 %
Resonant frequency in X, under load with 120 g	260 Hz	240 Hz	185 Hz	110 Hz	90 Hz	110 Hz	±20%
Resonant frequency in X, under load with 20 g	550 Hz	520 Hz	340 Hz	180 Hz	115 Hz	120 Hz	±20%
Resonant frequency in X, unloaded	1100 Hz	800 Hz	400 Hz	215 Hz	125 Hz	125 Hz	±20%
Permissible push force in X	10 N	10 N	10 N	10 N	10 N	10 N	max.
Permissible push force in Y	10 N	10 N	10 N	10 N	10 N	8 N	max.
Permissible push force in Z	10 N	10 N	10 N	10 N	10 N	10 N	max.
Permissible pull force in X	10 N	10 N	10 N	10 N	10 N	10 N	max.
Overall mass	110 g	160 g	200 g	240 g	380 g	720 g	
Material	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	
Miscellaneous	**P-620.10L**	**P-621.10L**	**P-622.10L**	**P-625.10L**	**P-628.10L**	**P-629.10L**	**Tolerance**
Connector	LEMO LVPZT	LEMO LVPZT	LEMO LVPZT	LEMO LVPZT	LEMO LVPZT	LEMO LVPZT	
Recommended controllers / drivers	E-503, E-505, E-610, E-665	E-503, E-505, E-610, E-665	E-503, E-505, E-610, E-665	E-503, E-505, E-610, E-665	E-503, E-505, E-610, E-665	E-503, E-505, E-610, E-665	
Cable length	1.5 m	1.5 m	1.5 m	1.5 m	1.5 m	1.5 m	
Operating temperature range	-20 to 150 °C	-20 to 150 °C	-20 to 150 °C	-20 to 150 °C	-20 to 150 °C	-20 to 150 °C	

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.
All specifications based on room temperature (22 °C ±3 °C).

10.1.2 P-62x.2 Data Table

Motion	P-620.2CD	P-621.2CD	P-622.2CD	P-625.2CD	P-628.2CD	P-629.2CD	Tolerance
Active axes	X Y	X Y	X Y	X Y	X Y	X Y	
Travel range in X	50 µm	100 µm	250 µm	500 µm	800 µm	1500 µm	
Travel range in Y	50 µm	100 µm	250 µm	500 µm	800 µm	1500 µm	
Travel range in X, open loop	60 µm	120 µm	300 µm	600 µm	1000 µm	1800 µm	±20%
Travel range in Y, open loop	60 µm	120 µm	300 µm	600 µm	1000 µm	1800 µm	±20%
Linearity error in X	0.02 %	0.02 %	0.02 %	0.03 %	0.03 %	0.03 %	typ.
Linearity error in Y	0.02 %	0.02 %	0.02 %	0.03 %	0.03 %	0.03 %	typ.
Pitch (Rotational crosstalk in θX with motion in Y)	± 3 µrad	± 3 µrad	± 3 µrad	± 3 µrad	± 20 µrad	± 30 µrad	typ.
Pitch (Rotational crosstalk in θY with motion in X)	± 3 µrad	± 3 µrad	± 3 µrad	± 3 µrad	± 20 µrad	± 30 µrad	typ.
Yaw (Rotational crosstalk in θZ with motion in X)	± 3 µrad	± 3 µrad	± 3 µrad	± 5 µrad	± 5 µrad	± 5 µrad	typ.
Yaw (Rotational crosstalk in θZ with motion in Y)	± 3 µrad	± 3 µrad	± 3 µrad	± 5 µrad	± 5 µrad	± 5 µrad	typ.
Positioning	**P-620.2CD**	**P-621.2CD**	**P-622.2CD**	**P-625.2CD**	**P-628.2CD**	**P-629.2CD**	**Tolerance**
Integrated sensor	Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring	
System resolution in X	0.2 nm	0.4 nm	0.7 nm	1.4 nm	3.5 nm	3.5 nm	

System resolution in Y	0.2 nm	0.4 nm	0.7 nm	1.4 nm	3.5 nm	3.5 nm	
Resolution in X, open loop	0.1 nm	0.2 nm	0.4 nm	0.5 nm	0.5 nm	2 nm	typ.
Resolution in Y, open loop	0.1 nm	0.2 nm	0.4 nm	0.5 nm	0.5 nm	2 nm	typ.
Bidirectional repeatability in X	± 2 nm	± 2 nm	± 2 nm	± 5 nm	± 10 nm	± 14 nm	typ.
Bidirectional repeatability in Y	± 2 nm	± 2 nm	± 2 nm	± 5 nm	± 10 nm	± 14 nm	typ.
Drive properties	**P-620.2CD**	**P-621.2CD**	**P-622.2CD**	**P-625.2CD**	**P-628.2CD**	**P-629.2CD**	**Tolerance**
Drive type	PICMA®	PICMA®	PICMA®	PICMA®	PICMA®	PICMA®	
Electrical capacitance in X	0.35 µF	1.5 µF	3.1 µF	6.2 µF	19 µF	52 µF	±20%
Electrical capacitance in Y	0.35 µF	1.5 µF	3.1 µF	6.2 µF	19 µF	52 µF	±20%
Mechanical properties	**P-620.2CD**	**P-621.2CD**	**P-622.2CD**	**P-625.2CD**	**P-628.2CD**	**P-629.2CD**	**Tolerance**
Guide	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	
Stiffness in X	0.22 N/µm	0.25 N/µm	0.2 N/µm	0.1 N/µm	0.05 N/µm	0.1 N/µm	±20 %
Stiffness in Y	0.22 N/µm	0.25 N/µm	0.2 N/µm	0.1 N/µm	0.05 N/µm	0.1 N/µm	±20 %
Resonant frequency in X, under load with 100 g	270 Hz	220 Hz	160 Hz	105 Hz	55 Hz	50 Hz	±20%
Resonant frequency in X, under load with 50 g	285 Hz	285 Hz	180 Hz	120 Hz	60 Hz	55 Hz	±20%
Resonant frequency in X, unloaded	575 Hz	420 Hz	225 Hz	135 Hz	75 Hz	60 Hz	±20%
Resonant frequency in Y, under load with 100 g	300 Hz	285 Hz	175 Hz	125 Hz	75 Hz	80 Hz	±20%
Resonant frequency in Y, under load with 50 g	395 Hz	365 Hz	215 Hz	150 Hz	85 Hz	85 Hz	±20%
Resonant frequency in Y, unloaded	800 Hz	535 Hz	300 Hz	195 Hz	105 Hz	100 Hz	±20%
Permissible push force in X	10 N	10 N	10 N	10 N	10 N	10 N	max.
Permissible push force in Y	10 N	10 N	10 N	10 N	10 N	10 N	max.
Permissible push force in Z	10 N	10 N	10 N	10 N	10 N	10 N	max.
Permissible pull force in X	5 N	8 N	8 N	8 N	8 N	8 N	max.
Permissible pull force in Y	5 N	8 N	8 N	8 N	8 N	8 N	max.
Permissible pull force in Z	10 N	10 N	10 N	10 N	10 N	10 N	max.
Overall mass	195 g	295 g	348 g	430 g	700 g	1370 g	
Material	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	
Miscellaneous	**P-620.2CD**	**P-621.2CD**	**P-622.2CD**	**P-625.2CD**	**P-628.2CD**	**P-629.2CD**	**Tolerance**
Connector	2 × D-sub 7W2 (m)	2 × D-sub 7W2 (m)	2 × D-sub 7W2 (m)	2 × D-sub 7W2 (m)	2 × D-sub 7W2 (m)	2 × D-sub 7W2 (m)	
Recommended controllers / drivers	E-503, E-505, E-621, E-712, E-727	E-503, E-505, E-621, E-712, E-727	E-503, E-505, E-621, E-712, E-727	E-503, E-505, E-621, E-712, E-727	E-503, E-505, E-621, E-712, E-727	E-503, E-505, E-621, E-712, E-727	
Cable length	1.5 m	1.5 m	1.5 m	1.5 m	1.5 m	1.5 m	
Operating temperature range	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	

P-628.2CD: Linearity error in X, Y (typ.) 0.03 % with digital controller. With analog controllers 0.05 %.
P-629.2CD: Linearity error in X, Y (typ.) 0.03 % with digital controller. With analog controllers 0.08 %.
X: lower axis; Y: upper axis.
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.
All specifications based on room temperature (22 °C ±3 °C).

Motion	P-620.2CL	P-621.2CL	P-622.2CL	P-625.2CL	P-628.2CL	P-629.2CL	Tolerance
Active axes	X Y	X Y	X Y	X Y	X Y	X Y	
Travel range in X	50 µm	100 µm	250 µm	500 µm	800 µm	1500 µm	
Travel range in Y	50 µm	100 µm	250 µm	500 µm	800 µm	1500 µm	
Travel range in X, open loop	60 µm	120 µm	300 µm	600 µm	1000 µm	1800 µm	±20%
Travel range in Y, open loop	60 µm	120 µm	300 µm	600 µm	1000 µm	1800 µm	±20%
Linearity error in X	0.02 %	0.02 %	0.02 %	0.03 %	0.03 %	0.03 %	typ.
Linearity error in Y	0.02 %	0.02 %	0.02 %	0.03 %	0.03 %	0.03 %	typ.
Pitch (Rotational crosstalk in θX with motion in Y)	± 3 µrad	± 3 µrad	± 3 µrad	± 3 µrad	± 20 µrad	± 30 µrad	typ.
Pitch (Rotational crosstalk in θY with motion in X)	± 3 µrad	± 3 µrad	± 3 µrad	± 3 µrad	± 20 µrad	± 30 µrad	typ.
Yaw (Rotational crosstalk in θZ with motion in X)	± 3 µrad	± 3 µrad	± 3 µrad	± 5 µrad	± 5 µrad	± 5 µrad	typ.
Yaw (Rotational crosstalk in θZ with motion in Y)	± 3 µrad	± 3 µrad	± 3 µrad	± 5 µrad	± 5 µrad	± 5 µrad	typ.
Positioning	**P-620.2CL**	**P-621.2CL**	**P-622.2CL**	**P-625.2CL**	**P-628.2CL**	**P-629.2CL**	**Tolerance**
Integrated sensor	Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring	
System resolution in X	0.2 nm	0.4 nm	0.7 nm	1.4 nm	3.5 nm	3.5 nm	
System resolution in Y	0.2 nm	0.4 nm	0.7 nm	1.4 nm	3.5 nm	3.5 nm	
Resolution in X, open loop	0.1 nm	0.2 nm	0.4 nm	0.5 nm	0.5 nm	2 nm	typ.
Resolution in Y, open loop	0.1 nm	0.2 nm	0.4 nm	0.5 nm	0.5 nm	2 nm	typ.
Bidirectional repeatability in X	± 2 nm	± 2 nm	± 2 nm	± 5 nm	± 10 nm	± 14 nm	typ.
Bidirectional repeatability in Y	± 2 nm	± 2 nm	± 2 nm	± 5 nm	± 10 nm	± 14 nm	typ.
Drive properties	**P-620.2CL**	**P-621.2CL**	**P-622.2CL**	**P-625.2CL**	**P-628.2CL**	**P-629.2CL**	**Tolerance**
Drive type	PICMA®	PICMA®	PICMA®	PICMA®	PICMA®	PICMA®	
Electrical capacitance in X	0.35 µF	1.5 µF	3.1 µF	6.2 µF	19 µF	52 µF	±20%
Electrical capacitance in Y	0.35 µF	1.5 µF	3.1 µF	6.2 µF	19 µF	52 µF	±20%
Mechanical properties	**P-620.2CL**	**P-621.2CL**	**P-622.2CL**	**P-625.2CL**	**P-628.2CL**	**P-629.2CL**	**Tolerance**
Guide	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	
Stiffness in X	0.22 N/µm	0.25 N/µm	0.2 N/µm	0.1 N/µm	0.05 N/µm	0.1 N/µm	±20 %
Stiffness in Y	0.22 N/µm	0.25 N/µm	0.2 N/µm	0.1 N/µm	0.05 N/µm	0.1 N/µm	±20 %
Resonant frequency in X, under load with 100 g	270 Hz	220 Hz	160 Hz	105 Hz	55 Hz	50 Hz	±20%
Resonant frequency in X, under load with 50 g	285 Hz	285 Hz	180 Hz	120 Hz	60 Hz	55 Hz	±20%
Resonant frequency in X, unloaded	575 Hz	420 Hz	225 Hz	135 Hz	75 Hz	60 Hz	±20%
Resonant frequency in Y, under load with 100 g	300 Hz	285 Hz	175 Hz	125 Hz	75 Hz	80 Hz	±20%
Resonant frequency in Y, under load with 50 g	395 Hz	365 Hz	215 Hz	150 Hz	85 Hz	85 Hz	±20%
Resonant frequency in Y, unloaded	800 Hz	535 Hz	300 Hz	195 Hz	105 Hz	100 Hz	±20%
Permissible push force in X	10 N	10 N	10 N	10 N	10 N	10 N	max.

Permissible push force in Y	10 N	10 N	10 N	10 N	10 N	10 N	max.
Permissible push force in Z	10 N	10 N	10 N	10 N	10 N	10 N	max.
Permissible pull force in X	5 N	8 N	8 N	8 N	8 N	8 N	max.
Permissible pull force in Y	5 N	8 N	8 N	8 N	8 N	8 N	max.
Permissible pull force in Z	10 N	10 N	10 N	10 N	10 N	10 N	max.
Overall mass	195 g	295 g	348 g	430 g	700 g	1370 g	
Material	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	
Miscellaneous	**P-620.2CL**	**P-621.2CL**	**P-622.2CL**	**P-625.2CL**	**P-628.2CL**	**P-629.2CL**	**Tolerance**
Connector	LEMO LVPZT	LEMO LVPZT	LEMO LVPZT	LEMO LVPZT	LEMO LVPZT	LEMO LVPZT	
Recommended controllers / drivers	E-503, E-505, E-621, E-712, E-727	E-503, E-505, E-621, E-712, E-727	E-503, E-505, E-621, E-712, E-727	E-503, E-505, E-621, E-712, E-727	E-503, E-505, E-621, E-712, E-727	E-503, E-505, E-621, E-712, E-727	
Cable length	1.5 m	1.5 m	1.5 m	1.5 m	1.5 m	1.5 m	
Operating temperature range	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	
Sensor connector	LEMO for capacitive sensors	LEMO for capacitive sensors	LEMO for capacitive sensors	LEMO for capacitive sensors	LEMO for capacitive sensors	LEMO for capacitive sensors	

P-628.2CL: Linearity error in X, Y (typ.) 0.03 % with digital controller. With analog controllers 0.05 %.
P-629.2CL: Linearity error in X, Y (typ.) 0.03 % with digital controller. With analog controllers 0.08 %.
X: lower axis; Y: upper axis.
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.
All specifications based on room temperature (22 °C ±3 °C).

Motion	**P-620.20L**	**P-621.20L**	**P-622.20L**	**P-625.20L**	**P-628.20L**	**Tolerance**
Active axes	X Y	X Y	X Y	X Y	X Y	
Travel range in X, open loop	60 µm	120 µm	300 µm	600 µm	1000 µm	±20%
Travel range in Y, open loop	60 µm	120 µm	300 µm	600 µm	1000 µm	±20%
Pitch (Rotational crosstalk in θX with motion in Y)	± 3 µrad	± 3 µrad	± 3 µrad	± 3 µrad	± 20 µrad	typ.
Pitch (Rotational crosstalk in θY with motion in X)	± 3 µrad	± 3 µrad	± 3 µrad	± 3 µrad	± 20 µrad	typ.
Yaw (Rotational crosstalk in θZ with motion in X)	± 3 µrad	± 3 µrad	± 3 µrad	± 5 µrad	± 5 µrad	typ.
Yaw (Rotational crosstalk in θZ with motion in Y)	± 3 µrad	± 3 µrad	± 3 µrad	± 5 µrad	± 5 µrad	typ.
Positioning	**P-620.20L**	**P-621.20L**	**P-622.20L**	**P-625.20L**	**P-628.20L**	**Tolerance**
Resolution in X, open loop	0.1 nm	0.2 nm	0.4 nm	0.5 nm	0.5 nm	typ.
Resolution in Y, open loop	0.1 nm	0.2 nm	0.4 nm	0.5 nm	0.5 nm	typ.
Drive properties	**P-620.20L**	**P-621.20L**	**P-622.20L**	**P-625.20L**	**P-628.20L**	**Tolerance**
Drive type	PICMA®	PICMA®	PICMA®	PICMA®	PICMA®	
Electrical capacitance in X	0.35 µF	1.5 µF	3.1 µF	6.2 µF	19 µF	±20%
Electrical capacitance in Y	0.35 µF	1.5 µF	3.1 µF	6.2 µF	19 µF	±20%
Mechanical properties	**P-620.20L**	**P-621.20L**	**P-622.20L**	**P-625.20L**	**P-628.20L**	**Tolerance**
Guide	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	
Stiffness in X	0.22 N/µm	0.25 N/µm	0.2 N/µm	0.1 N/µm	0.05 N/µm	±20 %
Stiffness in Y	0.22 N/µm	0.25 N/µm	0.2 N/µm	0.1 N/µm	0.05 N/µm	±20 %
Resonant frequency in X, under load with 100 g	270 Hz	220 Hz	160 Hz	105 Hz	55 Hz	±20%
Resonant frequency in X, under load with 50 g	285 Hz	285 Hz	180 Hz	120 Hz	60 Hz	±20%

Resonant frequency in X, unloaded	575 Hz	420 Hz	225 Hz	135 Hz	75 Hz	±20%
Resonant frequency in Y, under load with 100 g	300 Hz	285 Hz	175 Hz	125 Hz	75 Hz	±20%
Resonant frequency in Y, under load with 50 g	395 Hz	365 Hz	215 Hz	150 Hz	85 Hz	±20%
Resonant frequency in Y, unloaded	800 Hz	535 Hz	300 Hz	195 Hz	105 Hz	±20%
Permissible push force in X	10 N	10 N	10 N	10 N	10 N	max.
Permissible push force in Y	10 N	10 N	10 N	10 N	10 N	max.
Permissible push force in Z	10 N	10 N	10 N	10 N	10 N	max.
Permissible pull force in X	5 N	8 N	8 N	8 N	8 N	max.
Permissible pull force in Y	5 N	8 N	8 N	8 N	8 N	max.
Permissible pull force in Z	10 N	10 N	10 N	10 N	10 N	max.
Overall mass	195 g	295 g	348 g	430 g	700 g	
Material	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	
Miscellaneous	**P-620.20L**	**P-621.20L**	**P-622.20L**	**P-625.20L**	**P-628.20L**	**Tolerance**
Connector	LEMO LVPZT	LEMO LVPZT	LEMO LVPZT	LEMO LVPZT	LEMO LVPZT	
Recommended controllers / drivers	E-503, E-505, E-663	E-503, E-505, E-663	E-503, E-505, E-663	E-503, E-505, E-663	E-503, E-505, E-663	
Cable length	1.5 m	1.5 m	1.5 m	1.5 m	1.5 m	
Operating temperature range	-20 to 150 °C	-20 to 150 °C	-20 to 150 °C	-20 to 150 °C	-20 to 150 °C	

X: lower axis; Y: upper axis.
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.
All specifications based on room temperature (22 °C ±3 °C).

10.1.3 P-62x.Z Data Table

Motion	**P-620.ZCD**	**P-620.ZCL**	**P-621.ZCD**	**P-621.ZCL**	**P-622.ZCD**	**P-622.ZCL**	**Tolerance**
Active axes	Z	Z	Z	Z	Z	Z	
Travel range in Z	50 µm	50 µm	100 µm	100 µm	250 µm	250 µm	
Travel range in Z, open loop	65 µm	65 µm	140 µm	140 µm	350 µm	350 µm	±20%
Linearity error in Z	0.02 %	0.02 %	0.02 %	0.02 %	0.02 %	0.02 %	typ.
Yaw (Rotational crosstalk in θX with motion in Z)	± 80 µrad	± 80 µrad	± 100 µrad	± 100 µrad	± 200 µrad	± 200 µrad	typ.
Pitch (Rotational crosstalk in θY with motion in Z)	± 80 µrad	± 80 µrad	± 100 µrad	± 100 µrad	± 200 µrad	± 200 µrad	typ.
Positioning	**P-620.ZCD**	**P-620.ZCL**	**P-621.ZCD**	**P-621.ZCL**	**P-622.ZCD**	**P-622.ZCL**	**Tolerance**
Integrated sensor	Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring	
System resolution in Z	0.2 nm	0.2 nm	0.3 nm	0.3 nm	1 nm	1 nm	
Resolution in Z, open loop	0.1 nm	0.1 nm	0.2 nm	0.2 nm	0.5 nm	0.5 nm	typ.
Bidirectional repeatability in Z	± 1 nm	± 1 nm	± 1 nm	± 1 nm	± 1 nm	± 1 nm	typ.
Drive properties	**P-620.ZCD**	**P-620.ZCL**	**P-621.ZCD**	**P-621.ZCL**	**P-622.ZCD**	**P-622.ZCL**	**Tolerance**
Drive type	PICMA®	PICMA®	PICMA®	PICMA®	PICMA®	PICMA®	
Electrical capacitance in Z	0.7 µF	0.7 µF	3 µF	3 µF	6.2 µF	6.2 µF	±20%

Mechanical properties	P-620.ZCD	P-620.ZCL	P-621.ZCD	P-621.ZCL	P-622.ZCD	P-622.ZCL	Tolerance
Guide	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	
Stiffness in Z	0.5 N/µm	0.5 N/µm	0.6 N/µm	0.6 N/µm	0.24 N/µm	0.24 N/µm	±20 %
Resonant frequency in Z, under load with 30 g	690 Hz	690 Hz	500 Hz	500 Hz	270 Hz	270 Hz	±20%
Resonant frequency in Z, unloaded	1000 Hz	1000 Hz	790 Hz	790 Hz	360 Hz	360 Hz	±20%
Permissible push force in Y	10 N	10 N	10 N	10 N	10 N	10 N	max.
Permissible push force in Z	10 N	10 N	10 N	10 N	10 N	10 N	max.
Permissible pull force in Z	5 N	5 N	8 N	8 N	8 N	8 N	max.
Overall mass	120 g	120 g	170 g	170 g	240 g	240 g	
Material	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	
Miscellaneous	**P-620.ZCD**	**P-620.ZCL**	**P-621.ZCD**	**P-621.ZCL**	**P-622.ZCD**	**P-622.ZCL**	**Tolerance**
Connector	D-sub 7W2 (m)	LEMO FFS.00.250.CTC E24	D-sub 7W2 (m)	LEMO FFS.00.250.CTC E24	D-sub 7W2 (m)	LEMO FFS.00.250.CTC E24	
Sensor connector	D-sub 7W2 (m)	LEMO for capacitive sensors	D-sub 7W2 (m)	LEMO for capacitive sensors	D-sub 7W2 (m)	LEMO for capacitive sensors	
Recommended controllers / drivers	E-503, E-505, E-610, E-621, E-625, E-709.1C1L, E-754	E-503, E-505, E-610, E-621, E-625, E-709.1C1L, E-754	E-503, E-505, E-610, E-621, E-625, E-709.1C1L, E-754	E-503, E-505, E-610, E-621, E-625, E-709.1C1L, E-754	E-503, E-505, E-610, E-621, E-625, E-709.1C1L, E-754	E-503, E-505, E-610, E-621, E-625, E-709.1C1L, E-754	
Cable length	1.5 m	1.5 m	1.5 m	1.5 m	1.5 m	1.5 m	
Operating temperature range	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	

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.
All specifications based on room temperature (22 °C ±3 °C).

Motion	P-620.Z0L	P-621.Z0L	P-622.Z0L	Tolerance
Active axes	Z	Z	Z	
Travel range in Z, open loop	65 µm	140 µm	350 µm	±20%
Yaw (Rotational crosstalk in θX with motion in Z)	± 80 µrad	± 100 µrad	± 200 µrad	typ.
Pitch (Rotational crosstalk in θY with motion in Z)	± 80 µrad	± 100 µrad	± 200 µrad	typ.
Positioning	**P-620.Z0L**	**P-621.Z0L**	**P-622.Z0L**	**Tolerance**
Resolution in Z, open loop	0.1 nm	0.2 nm	0.5 nm	typ.
Drive properties	**P-620.Z0L**	**P-621.Z0L**	**P-622.Z0L**	**Tolerance**
Drive type	PICMA®	PICMA®	PICMA®	
Electrical capacitance in Z	0.7 µF	3 µF	6.2 µF	±20%
Mechanical properties	**P-620.Z0L**	**P-621.Z0L**	**P-622.Z0L**	**Tolerance**
Guide	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	
Stiffness in Z	0.5 N/µm	0.6 N/µm	0.24 N/µm	±20 %
Resonant frequency in Z, under load with 30 g	690 Hz	500 Hz	270 Hz	±20%
Resonant frequency in Z, unloaded	1000 Hz	790 Hz	360 Hz	±20%
Permissible push force in Y	10 N	10 N	10 N	max.
Permissible push force in Z	10 N	10 N	10 N	max.

Permissible pull force in Z	5 N	8 N	8 N	max.
Overall mass	120 g	170 g	240 g	
Material	Aluminum	Aluminum	Aluminum	
Miscellaneous	**P-620.Z0L**	**P-621.Z0L**	**P-622.Z0L**	**Tolerance**
Connector	LEMO FFS.00.250.CTCE24	LEMO FFS.00.250.CTCE24	LEMO FFS.00.250.CTCE24	
Sensor connector				
Recommended controllers / drivers	E-503, E-505, E-610	E-503, E-505, E-610	E-503, E-505, E-610	
Cable length	1.5 m	1.5 m	1.5 m	
Operating temperature range	-20 to 150 °C	-20 to 150 °C	-20 to 150 °C	

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.
All specifications based on room temperature (22 °C ±3 °C).

10.1.4 P-62x.U Data Table

Motion	**P-621.1U**	**P-622.1U**	**P-625.1U**	**Tolerance**
Active axes	X	X	X	
Travel range in X	100 µm	250 µm	500 µm	
Travel range in X, open loop	120 µm	300 µm	600 µm	±20%
Linearity error in X	0.02 %	0.02 %	0.03 %	typ.
Pitch (Rotational crosstalk in θY with motion in X)	± 3 µrad	± 3 µrad	± 6 µrad	typ.
Yaw (Rotational crosstalk in θZ with motion in X)	± 3 µrad	± 3 µrad	± 6 µrad	typ.
Positioning	**P-621.1U**	**P-622.1U**	**P-625.1U**	**Tolerance**
Integrated sensor	Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring	
System resolution in X	0.4 nm	0.7 nm	1.4 nm	
Resolution in X, open loop	0.2 nm	0.4 nm	0.5 nm	typ.
Bidirectional repeatability in X	± 1 nm	± 1 nm	± 5 nm	typ.
Drive properties	**P-621.1U**	**P-622.1U**	**P-625.1U**	**Tolerance**
Drive type	PICMA®	PICMA®	PICMA®	
Electrical capacitance in X	1.5 µF	3.1 µF	6.2 µF	±20%
Mechanical properties	**P-621.1U**	**P-622.1U**	**P-625.1U**	**Tolerance**
Guide	Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification	
Stiffness in X	0.35 N/µm	0.2 N/µm	0.1 N/µm	±20 %
Resonant frequency in X, under load with 120 g	240 Hz	185 Hz	110 Hz	±20%
Resonant frequency in X, under load with 20 g	520 Hz	340 Hz	180 Hz	±20%
Resonant frequency in X, unloaded	800 Hz	400 Hz	215 Hz	±20%
Permissible push force in X	10 N	10 N	10 N	max.
Permissible push force in Y	10 N	10 N	10 N	max.
Permissible push force in Z	10 N	10 N	10 N	max.
Permissible pull force in X	10 N	10 N	10 N	max.
Overall mass	160 g	200 g	240 g	
Material	Aluminum	Aluminum	Aluminum	

Miscellaneous	P-621.1U	P-622.1U	P-625.1U	Tolerance
Connector	D-sub 5W1 (f)	D-sub 5W1 (f)	D-sub 5W1 (f)	
Vacuum class	10E-9 hPa	10E-9 hPa	10E-9 hPa	
Recommended controllers / drivers	E-503, E-505, E-610, E-621, E-625, E-665, E-709, E-754	E-503, E-505, E-610, E-621, E-625, E-665, E-709, E-754	E-503, E-505, E-610, E-621, E-625, E-665, E-709, E-754	
Cable length	1.5 m	1.5 m	1.5 m	
Operating temperature range	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	

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.
All specifications based on room temperature (22 °C ±3 °C).

10.1.5 Materials Used for Vacuum-Compatible Models

The following vacuum-compatible materials were used for the .1U vacuum versions of the P-62x:

Stainless steel, aluminum, Al_2O_3, titanium, piezoceramic, FEP, PEEK

Bakeout temperature: 130 °C

➢ For more information, contact our customer service department (p. 39).

10.1.6 Maximum Ratings

P-62x positioners are designed for the following operating data:

Positioner	Maximum operating voltage ⚠	Maximum operating frequency (unloaded)[1] ⚠	Maximum power consumption[2] ⚠
P-620.1xx	-20 to +120 V	367 Hz	3 W
P-621.1x(x)	-20 to +120 V	267 Hz	9 W
P-622.1x(x)	-20 to +120 V	133 Hz	9 W
P-625.1x(x)	-20 to +120 V	72 Hz	10 W
P-628.1xx	-20 to +120 V	42 Hz	18 W
P-629.1xx	-20 to +120 V	42 Hz	49 W
P-620.2xx	-20 to +120 V	267 Hz (in X and Y respectively)	4 W (2 W per axis)
P-621.2xx	-20 to +120 V	178 Hz (in X and Y respectively)	12 W (6 W per axis)
P-622.2xx	-20 to +120 V	100 Hz (in X and Y respectively)	14 W (7 W per axis)
P-625.2xx	-20 to +120 V	65 Hz (in X and Y respectively)	18 W (9 W per axis)
P-628.2xx	-20 to +120 V	35 Hz (in X and Y respectively)	30 W (15 W per axis)
P-629.2xx	-20 to +120 V	33 Hz (in X and Y respectively)	76 W (38 W per axis)
P-620.Zxx	-20 to +120 V	333 Hz	5 W
P-621.Zxx	-20 to +120 V	263 Hz	18 W
P-622.Zxx	-20 to +120 V	120 Hz	17 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/

10.1.7 Ambient Conditions and Classifications

Pay attention to the following ambient conditions and classifications for the P-62x:

Area of application	For indoor use only	
Maximum altitude	2000 m	
Air pressure	All models except vacuum-compatible models: 1100 hPa to 0.1 hPa	Vacuum-compatible models: 1100 hPa to 10^{-9} hPa
Relative humidity	Highest relative air humidity 80 % for temperatures to 31 °C Decreasing linearly to 50 % relative air humidity at 40 °C	
Operating temperature	-20 °C to 80 °C For models without sensor (P-62x.x0L): -20 °C to 150 °C	
Storage temperature	-20 °C to 80 °C	
Transport temperature	-25 °C to 85 °C	
Maximum bakeout temperature (vacuum-compatible models only)	130 °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 a comma is used in the drawings instead of a decimal point.

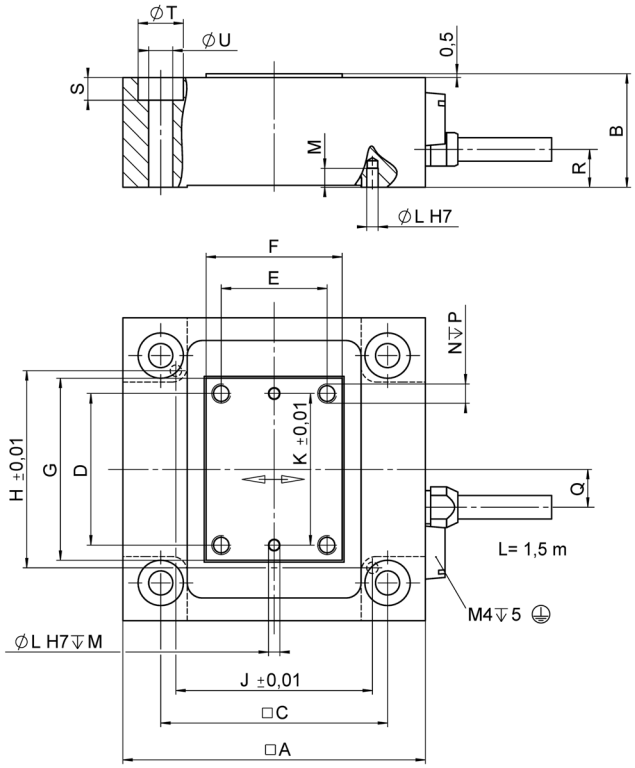
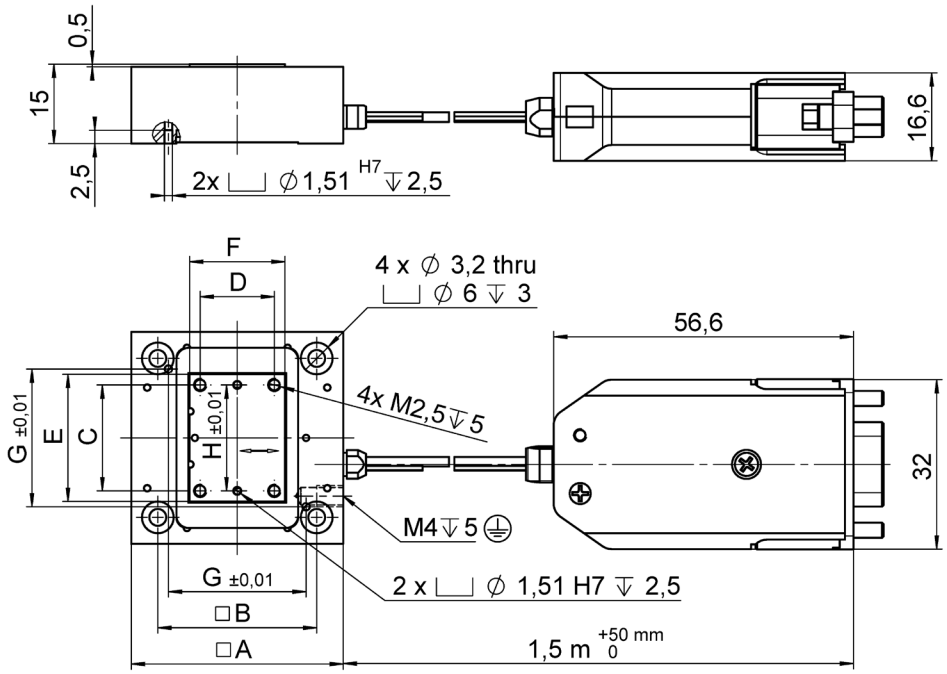


Figure 11: P-62x.1CD / .1CL / .10L

⏚ The P-620 does not have a separate protective earth connector.

	A	B	C	D	E	F	G	H	J	K
P-620.1xx	30	12	24	15	12	15	18	19	24	15
P-621.1x(x)	40	15	30	20	14	18	24	26	26	20
P-622.1x(x)	50	15	40	24	20	25	30	35	35	24
P-625.1x(x)	60	15	50	40	27	32	44.5	46	46	40
P-628.1xx	80	17	70	58	41	45	63	66	66	58
P-629.1xx	100	22.5	90	60	40	60	84	82	82	60

	Ø L	M	N	P	Q	R	S	Ø T	Ø U
P-620.1xx	1.01	1.5	M2	4	4.5	6	2	4.4	2.2
P-621.1x(x)	1.51	2.5	M2.5	5	5	5	3	6	3.2
P-622.1x(x)	1.51	2.5	M2.5	5	5.5	5	3	6	3.2
P-625.1x(x)	1.51	2.5	M2.5	5	5.5	5	3	6	3.2
P-628.1xx	1.51	2.5	M2.5	5	5.5	5	3	6	3.2
P-629.1xx	2.01	3.5	M2.5	3	10	7.5	4	8	4.3



	A	B	C	D	E	F	G	H
P-621.1U	40	30	20	14	24	18	26	20
P-622.1U	50	40	24	20	30	25	35	24
P-625.1U	60	50	40	45	32	46	50	40

Figure 12: P-62x.1U

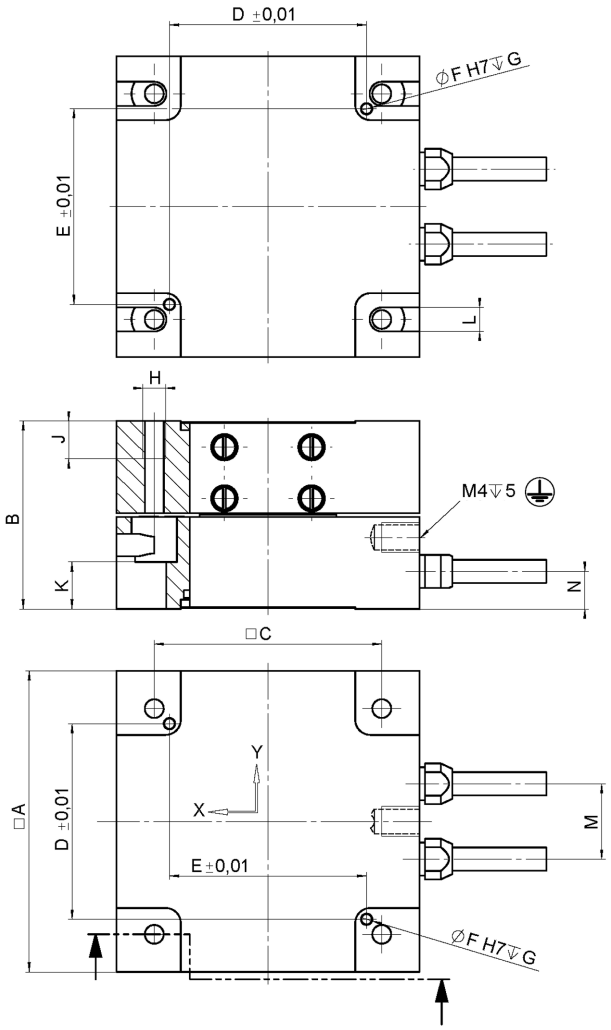


Figure 13: P-62x.2CD / .2CL / .20L

⏚ The P-620 and P-621.2xx do not have a separate protective earth connector.

	A	B	C	D	E	Ø F	G	H	J	K	L	M	N
P-620.2xx	30	21.5	24	24	19	1.01	1.5	M2	3.5	5.1	2.2	9	6
P-621.2xx	40	25	30	26	26	1.51	2.5	M3	5	6.25	3.2	10	5
P-622.2xx	50	25	40	35	35	1.51	2.5	M3	5	6.25	3.2	11	5
P-625.2xx	60	25	50	46	46	1.51	2.5	M3	6	6.25	3.2	11	5
P-628.2xx	80	30	70	66	66	1.51	2.5	M3	6	6.75	3.2	11	5
P-629.2xx	100	40	90	82	82	2.01	3.5	M4	7	9.75	4.3	16	7.5

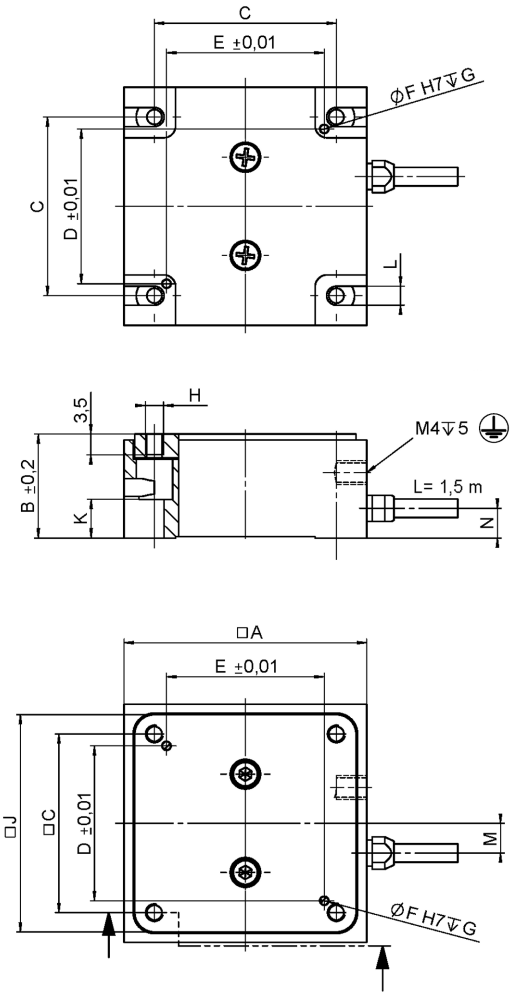


Figure 14: P-62x.ZCD / .ZCL / .Z0L

⏚ The P-620 does not have a separate protective earth connector.

	A	B	C	D	E	Ø F	G	H	J	K	L	M	N
P-620.Zxx	30	15	24	19	24	1.01	2	M2	28	5	2.2	4.5	6
P-621.Zxx	40	17.5	30	26	26	1.51	2.5	M3	36.5	6.5	3.2	5	5
P-622.Zxx	50	17.5	40	35	35	1.51	2.5	M3	46.5	6.5	3.2	5	5

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 Maximum Torque on the Platform

The following torque may not be exceeded when mounting a load:

Model	Maximum torque on the platform
P-620.Zxx	0.25 Nm
P-621.Zxx	0.5 Nm
P-622.Zxx	0.5 Nm
All models except the P-62x.Zxx	The maximum torque on the platform is equivalent to the maximum torque of the screws used (refer to "Torque for Stainless Steel Screws (A2-70)" (p. 58)).

10.5 Pin Assignment

D-sub 7W2 connector (m)

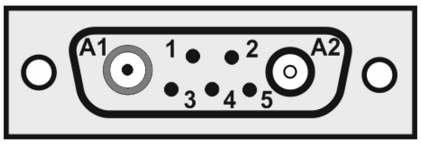


Figure 15: D-sub 7W2 connector (m): Front with connections

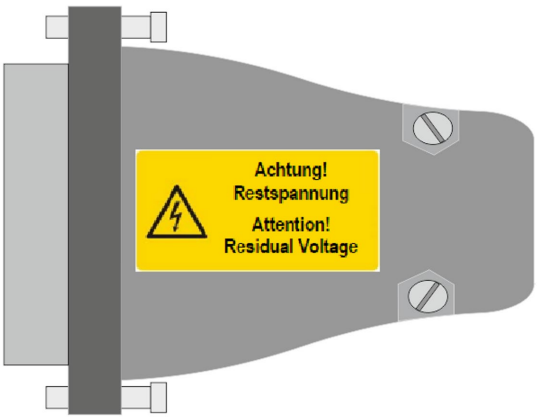


Figure 16: D-sub connector: Example top view

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

D-sub connector 5W1 (f)

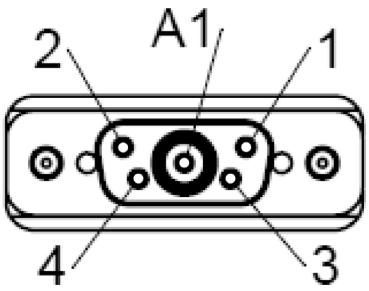


Figure 17: D-sub connector 5W1 (f): Front with connections

Pin	Signal	Function
A1 inner conductor	Probe	Probe sensor signal (immovable part of the capacitive sensor)
A1 outer conductor	GND probe	Probe sensor signal shield
1	Target	Target sensor signal (movable part of the capacitive sensor)
2	PZT+	Piezo voltage+
3	GND Target	Target sensor signal shield
4	PZT–	Piezo voltage–

LEMO coaxial connectors

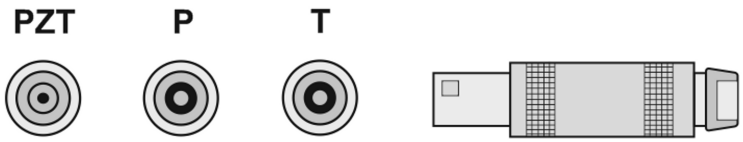


Figure 18: LEMO connectors: PZT, P and T

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 fulfil 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-62x, 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