# User Manual

PZ301EN, applies to S-303

CBo, 03.02.2020

# S-303 Piezo Phase Shifter

## High Dynamics, Subnanometer-Precision Piezo Phase Shifter


Physik Instrumente (PI ) GmbH & Co. KG, Auf der Roemerstrasse 1, 76228 Karlsruhe, Germany
Phone +49 721 4846-0, Fax +49 721 4846-1019, Email info@pi.de, www.pi.ws

# User Manual

PZ301EN, applies to S-303

CBo, 03.02.2020

# Contents

# About this Document

This user manual contains the information necessary for using the S-303 (hereinafter referred to as "phase shifter" or "positioner) as intended. The letter "x" stands for various models.

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

## Typographic Conventions

| Symbol/ Label | Meaning |
|---|---|
| 1.<br>2. | Action consisting of several steps with strict sequential order |
| ➢ | Action consisting of one or more steps without relevant sequential order |
| ▪ | Lists |
| p. 5 | Cross-reference to page 5 |

## Symbols Used

***CAUTION***

**Dangerous situation**
If not avoided, the dangerous situation will result in minor injury or damage to the equipment.

➢ Measures for avoiding the risk.

***NOTICE***

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

➢ Measures for avoiding the risk.

***INFORMATION***

Additional information that can affect your application.

| Symbol/Label | Meaning |
|---|---|
|  | Warning sign fixed to the product that refers to detailed information in this manual. |
|  | Prohibition sign, screwdriver |

## 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 are not binding.

## Other Applicable Documents

| Product | Document |
|---|---|
| S-3xx piezo tip/tilt platforms | PZ277EK short instructions |

The latest versions of the user manuals are available on our website for download.

## Downloading Manuals

***INFORMATION***

If a manual is missing or problems occur with downloading:

➢ Contact our customer service department (p. 21).

**Downloading manuals**

1. Open the website **www.pi.ws**.
2. Search the website for the product number (e.g., S-303) or the product family (e.g., phase shifter).
3. Click the corresponding product to open the product detail page.
4. Click ***Downloads***.

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

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

# Safety

## Intended Use

The S-303 is a laboratory device as defined by DIN EN 61010-1. It is intended for indoor use and use in an environment which is free of dirt, oil, and lubricants.

In accordance with its design, the S-303 is intended for positioning and adjusting mirrors and optics with a diameter of up to 25 mm in one axis with a maximum load of 0.5 N.

The S-303 is not intended for applications in areas where failure would be a considerable risk for people or the environment.

The S-303 can be mounted in any orientation. The specifications refer to an S-303 with vertically aligned motion axis (upright, not upside down).

It is only possible to use the S-303 as intended when it is completely mounted and connected. The S-303 must be operated with suitable electronics (p. 9) offered by PI. The electronics are not included in the scope of delivery of the S-303.

The S-303 may only be installed, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

## Safety Precautions

***CAUTION***

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

The S-303 is driven by piezo actuators. Temperature changes and compressive stress can induce charges in piezo actuators. After disconnecting from the electronics, piezo actuators can remain charged for several hours. Touching or short-circuiting the contacts in the connector of the S-303 could lead to minor injuries. In addition, the piezo actuators can be destroyed by an abrupt contraction.

- Do **not** open the S-303.
- Do not put any objects into the gap between the motion platform and the base body.
- Discharge the S-303 before installing (p. 18).
- Do **not** pull the plug connector out of the electronics during operation.


For S-303 with D-sub connector:
Touching the contacts in the plug connector could lead to an electric shock (max. 120 V DC) and minor injuries.

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

***CAUTION***

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

If the protective earth conductor is missing or not properly connected, dangerous touch voltages can occur on the S-303 in the event of malfunction or failure of the system. If there are touch voltages, touching the S-303 can result in minor injury due to electric shock.

- Connect the S-303 to a protective earth conductor before startup (p. 11).
- Do **not** remove the protective earth conductor during operation.
- If the protective earth conductor has to be removed temporarily (e.g., for modification), reconnect the S-303 to the protective earth conductor before restarting.

**NOTICE**

**Excessively high or wrongly connected operating voltage!**

Excessively high or wrongly connected operating voltages can cause damage to the S-303.

- Operate the S-303 with controllers/drivers and original accessories from PI.
- Do not exceed the operating voltage range (p. 23) specified for the S-303.
- Operate the S-303 only when the operating voltage is connected properly; see "Pin Assignment" (p. 26).

**NOTICE**

**Unsuitable cables!**

Unsuitable cables can cause damage to the S-303 and the electronics.

- Only use cables from PI for connecting the S-303 to the electronics.

***INFORMATION***

Cable extensions can affect the performance of the S-303.

- Do not use extension cables. If you need longer cables, contact our customer service department (p. 21).

# Product Description

## Model Overview

The S-303 is available in the following versions:

| Model | Description |
|---|---|
| S-303.0L | Piezo phase shifter, 3 µm, without sensor |
| S-303.CD | Piezo phase shifter, 3 µm, capacitive sensor |
| S-303.0LI | Piezo phase shifter, 3 µm, without sensor, Invar |
| S-303.CDI | Piezo phase shifter, 3 µm, capacitive sensor, Invar |

## Product View

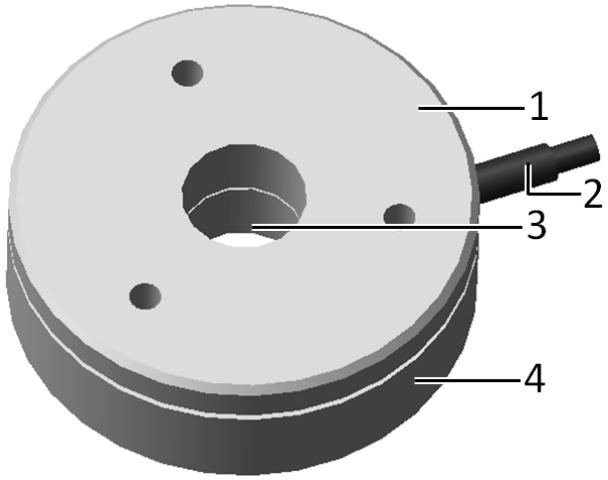


Fig. 1: S-303 piezo phase shifter (example view of the S-303.0L/.0LI)

1 Motion platform
2 Cable exit
3 Aperture (S-303.0L / .0LI only)
4 Base body

## Product Labeling

| Labeling | Description |
|---|---|
| S-303.CD | Product name (example), the characters after the period refer to the model |
| 123456789 | Serial number (example), individual for each S-303<br>Meaning of each position (from the left):<br>1 = internal information<br>2 and 3 = manufacturing year<br>4 to 9 = consecutive numbers |
| | Data matrix code (example; contains the serial number) |
| Country of origin: Germany | Country of origin |
| | Warning sign "Pay attention to the manual!" |
| | Old equipment disposal (p. 27) |
| WWW.PI.WS | Manufacturer's address (website) |
| CE | CE conformity mark |
| PI | Manufacturer's logo |

## Scope of Delivery

| Product no. | Description |
|---|---|
| S-303 | Piezo phase shifter according order (p. 7) |
| PZ277EK | Short instructions for S-3xx piezo tip/tilt platforms |

## Suitable Electronics

| Product no. | Description | Channels |
|---|---|---|
| E-503 | Piezo amplifier module (for E-500 piezo controller system) | 3 |
| E-505 | Piezo amplifier module (for E-500 piezo controller system) | 1 |
| E-610 | Piezo amplifier / servo controller, OEM module with optional position control | 1 |
| E-621 | Piezo amplifier / servo controller module | 1 |
| E-625 | Piezo amplifier / servo controller, benchtop device | 1 |
| E-663 | Piezo amplifier for open-loop piezo systems and actuators without position sensor, benchtop device | 3 |
| E-665 | Piezo Amplifier / Servo Controller | 1 |
| E-754 | Digital High-Speed Piezo Controller | 1 |

➢ To order, contact the customer service department (p. 21).

# Unpacking

***NOTICE***

**Mechanical overload due to incorrect handling!**

Impermissible mechanical overload of the S-303 can cause damage and lead to loss of accuracy.

➢ Avoid shocks and drops.

1. Unpack the S-303 with care.
2. Compare the contents with the scope of delivery according to the contract and the delivery note.
3. If any parts are damaged or missing, contact our customer service department immediately (p. 21).
4. Keep all packaging materials in case the product needs to be returned.

# Installation

## General Notes on Installation

***NOTICE***

**Damage caused by loosening the screw on the bottom of the S-303!**

There is a screw in the middle of the base body on the bottom of the S-303 (S-303.CD/.CDI models only) (seeFig. 3, P. 11). Loosening this screw leads to damage.

- Do **not** loosen the screw on the bottom of the base body.

***NOTICE***

**Unsuitable or wrongly mounted screws!**

Using unsuitable or wrongly inserted screws could cause damage to the S-303.

- Select the screw length according to the depth of the mounting holes.
- Do not allow screw heads to protrude.
- Only use the holes or threads intended for the purpose of fixing the the S-303 and loads.
- Pay attention to the torque range specified for the screws used during installation (p. 26).

***NOTICE***

**Damage due to jamming of the motion platform!**

There is a gap between the motion platform and the base body of the S-303. Clamping the gap or inserting objects into the gap causes damage to the S-303.

- Keep the gap between the motion platform and base body clear so that the motion platform can move freely.
- Do not put any objects into the gap between the motion platform and the base body.

***NOTICE***

**Reduced accuracy when the S-303 is warped!**

Mounting the S-303 onto an uneven surface and fixing loads with uneven contact surface could warp the S-303. Warping reduces the accuracy.

- Make sure that the surface for mounting the S-303 and the load's contact surface have the following characteristics:
  - Flatness ≤ 10 µm
  - Similar thermal expansion properties such as the S-303

## Connecting the S-303 to the Protective Earth Conductor

***INFORMATION***

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

***INFORMATION***

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

➢ If a ground loop occurs, contact our customer service department (p. 21).

The S-303 does not have a separate protective earth connector and must be mounted onto an electrically conductive surface that is connected to a protective earth conductor.

### Connecting the S-303 to a Protective Earth Conductor

➢ Follow the instructions in the "Mounting the S-303" section (p. 11).

## Mounting the S-303

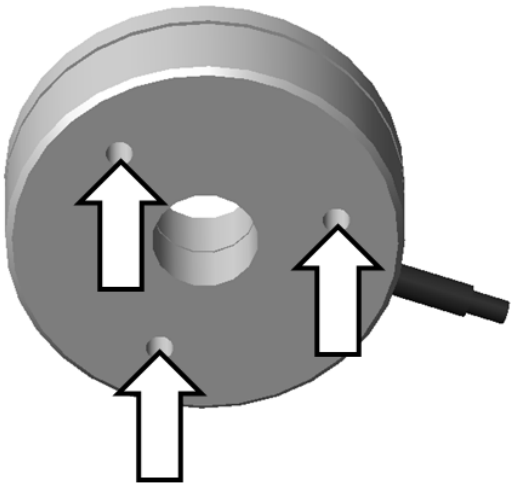

Fig. 2: Mounting holes in the base body of the S-303.0L/.0LI

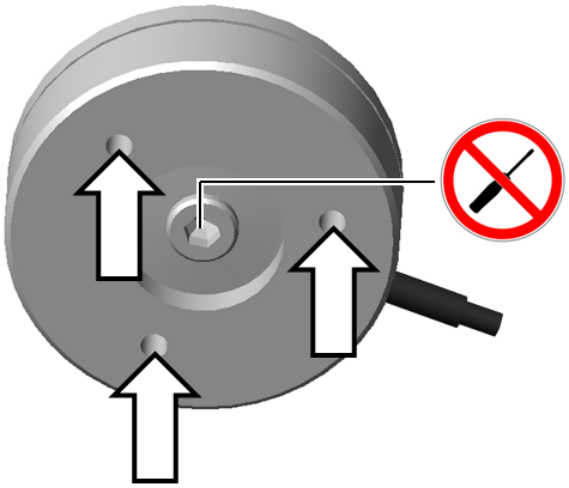

Fig. 3: Mounting holes in the base body of the S-303.CD/.CDI

**Attention: Do not loosen the screw!**
Loosening the screw leads to damage.

### Requirements

- ✓ You have read and understood the safety precautions (p. 6).
- ✓ You have read and understood the general notes on installation (p. 10).
- ✓ The S-303 is **not** connected to the electronics.
- ✓ All mounting materials (e.g., screws) are electrically conductive.

✓ You have provided a suitable surface for fixing the S-303:
- The surface is electrically conductive and connected to a protective earth conductor with a cross section of ≥ 0.75 mm².
- The surface has three through-holes for M2.5 screws. Refer to "Dimensions" for the required position and depth of the holes (p. 24).
- The surface flatness is ≤ 10 µm.
- For applications with great temperature fluctuations: The surface should have the same or similar thermal expansion properties as the S-303.

✓ You have accounted for the space required to route cables according to regulations and without bending them.

### Tools and accessories

- Three electrically conductive M2.5 screws of appropriate length (p. 24)
- Suitable screwdriver

### Mounting the S-303

1. Align the S-303 so that the mounting holes in the base body (see Fig. 2 respectively Fig. 3) are in line with the corresponding holes in the surface.
2. Fix the S-303 using the screws:
   a) Insert a screw into each hole.
   b) Tighten the screws. Pay attention to the specified torque range (p. 26).
3. Make sure that the contact resistance is <0.1 Ω at 25 A at all points relevant for attaching the protective earth conductor.
4. Check that the S-303 is sitting firmly on the surface.

# Mounting the Load

## Avoiding Mounting Errors

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

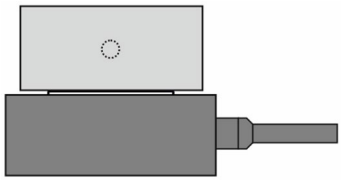

Fig. 4: Example of an optimally placed load

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

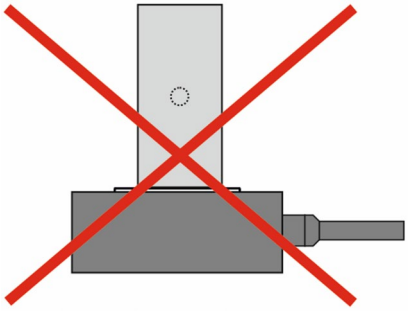

Fig. 5: Tall setup and center of load too far above the motion platform

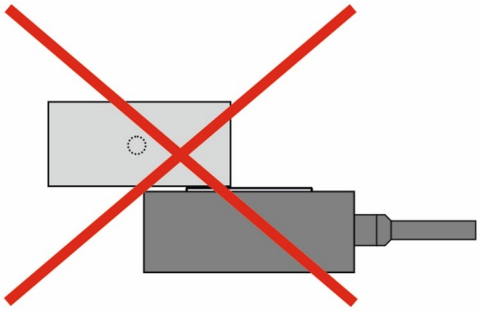

Fig. 6: Long lever and center of load on the side of the motion platform

## Fixing the Load

***NOTICE***

**Mechanical overload due to high torques and loads!**

High torques and heavy loads can overload the platform of the S-303 during mounting. Mechanical overload can cause damage to the piezo actuators and sensors of the S-303 as well as loss of accuracy.

- Avoid torques > 0.1 Nm on the motion platform. Hold the load in position when tightening the screws to avoid exceeding the maximum torque.
- Do **not** exceed the maximum permissible load capacities according to the specifications (p. 22).
- Pay attention to the torque range specified for the screws used during installation (p. 26).

***NOTICE***

**Center of load at unsuitable position!**

If the center of load is located too far away from the center of the motion platform (e.g., tall load and unwanted lever effect), the S-303 will be damaged, especially in dynamic operation, by high loads (e.g., high torques and resonant vibrations).

- If the center of the load to be fixed is too high or to the side of the motion platform, adjust the controller settings before starting and operating or contact our customer service department (p. 21).

***NOTICE***

**Warping due to unsuitable adhesion of the load!**

The load or motion platform of the S-303 can warp when the adhesive is used on the entire contact surface or hardened thermally. Warping reduces the accuracy.

- Apply several spots of adhesive and avoid spreading the adhesive over the entire surface.
- If possible, use adhesives that harden at room temperature.
- Make sure that the load and the S-303 have similar thermal expansion properties.

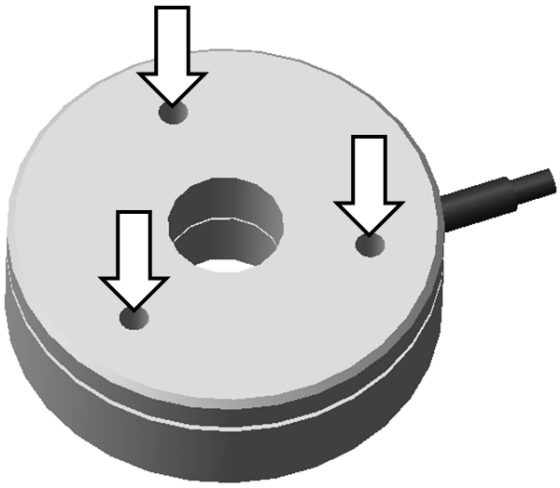

Fig. 7: Mounting holes in the motion platform of the S-303.0L/.0LI

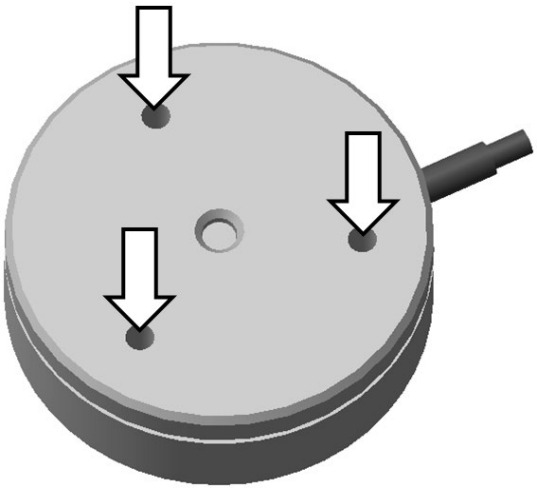

Fig. 8: Mounting holes in the motion platform of the S-303.CD/CDI

### Requirements

- ✓ You have read and understood the safety precautions (p. 6).
- ✓ You have read and understood the general notes on installation (p. 10).
- ✓ You have read and understood the section "Avoiding Mounting Errors" (p. 12).
- ✓ The S-303 is **not** connected to the electronics.

When the load is glued on:

- ✓ You have read and understood the instructions from the adhesive manufacturer.
- ✓ The gluing surfaces are dry, free of dust and grease.

### Tools and accessories

When the load is screwed on:

- Three M2.5 screws of suitable length (p. 24)
- Suitable screwdriver

When the load is glued on:

- Suitable adhesive

### Screwing the Load

1. Align the load on the S-303 so that the mounting holes in the load and the holes in the motion platform are in line.
2. Fix the load using the screws. Hold the load so that it cannot move while tightening the screws and do not exceed the maximum torques:
   - Maximum torque on the motion platform: 0.1 Nm
   - Torque range (p. 26) for the screws
3. Check carefully that the load is sitting firmly on the motion platform.

### Gluing the Load

1. Apply several spots of adhesive (do **not** apply the adhesive to the whole surface).
2. Glue the load to the motion platform's contact surface.
3. If possible, allow the adhesive to harden at room temperature.

**Important**: Refer to the adhesive manufacturer's instructions on adhesive processing and hardening time.

## Connecting the S-303 to the Electronics

### Requirements

- ✓ You have read and understood the safety precautions (p. 6).
- ✓ You have read and understood the user manual for the electronics (p. 9).
- ✓ The electronics are switched off, i.e., **not** connected to the power supply.

### Connecting the S-303 to the Electronics

- ➢ Connect the plug of the S-303 to the corresponding socket on the electronics (refer to the user manual for the electronics).

# Starting and Operating

## General Notes on Starting and Operating

***CAUTION***

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

If the protective earth conductor is missing or not properly connected, dangerous touch voltages can occur on the S-303 in the event of malfunction or failure of the system. If there are touch voltages, touching the S-303 can result in minor injury due to electric shock.

- Connect the S-303 to a protective earth conductor before startup (p. 11).
- Do **not** remove the protective earth conductor during operation.
- If the protective earth conductor has to be removed temporarily (e.g., for modification), reconnect the S-303 to the protective earth conductor before restarting.

***NOTICE***

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

Using the S-303 in environments that increase the electrical conductivity could 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 S-303 in environments that can increase the electric conductivity.
- Operate the P303 only under permissible ambient conditions and classifications (p. 23).

***NOTICE***

**Destruction of the piezo actuator due to continuously high voltage!**

The constant application of high voltage to piezo actuators can lead to leakage currents and flashovers that will destroy the ceramic.

- If the S-303 is not used but the controller is to remain switched on to ensure temperature stability, discharge the S-303 (p. 18).

***NOTICE***

**Uncontrolled oscillation!**

Oscillation can cause irreparable damage to the S-303. Oscillation is indicated by a humming noise and can be caused by the following:

- A change in the load and/or dynamics requires the operating or servo control parameters to be adjusted.
- The S-303 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 S-303 immediately.

***INFORMATION***

Systems are calibrated at the factory to achieve optimal positioning accuracy. Replacing the system components could lead to a reduction of position accuracy when positioners are used that have ID chips without 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 that is specified by the calibration label on the controller.

If position accuracy is reduced after replacing the S-303 or the controller:

➢ Recalibrate the axis displacement (see controller manual) or contact our customer service department (p. 21).

## Starting and Operating the S-303

***INFORMATION***

S-303.CD/.CDI models only: Temperature changes or mechanical load can shift the sensor's zero point so that the S-303 is not able to reach its full travel range.

➢ If necessary, adjust the zero-point of the sensor (see controller manual). To prevent the sensor zero point from shifting again, the zero point should be adjusted only after the S-303 has been fully installed.

### Requirements

✓ You have read and understood the safety precautions (p. 6).
✓ You have read and understood the instructions on starting and operating (p. 16).
✓ You have installed the S-303 correctly (p. 10) and connected it to the electronics (p. 15).
✓ You have read and understood the user manual for the electronics (p. 9).

### Starting and Operating the S-303

➢ Follow the instructions on starting and operating the S-303 in the user manual for the electronics.

## Discharging the S-303

The S-303 must be discharged in the following cases:

- When the S-303 is not used but the electronics remain switched on to ensure temperature stability
- Before demounting (e.g., before cleaning and transporting the S-303) and for modifications
- If the connecting cable of the S-303 is accidentally pulled out of the electronics during operation

**Requirements**

✓ You have read and understood the safety precautions (p. 6).

**Discharging an S-303 Connected to the Electronics**

In closed-loop operation:

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

In open-loop operation:

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

**Discharging an S-303 not Connected to the Electronics**

➢ Connect the S-303's voltage plug to the **switched-off** electronics from PI for 10 seconds.

# Maintenance

***NOTICE***

**Misalignment from loosening screws!**
The S-303 is maintenance-free and precision adjusted.

➢ Loosen screws only when instructed in this user manual.
➢ Do **not** open the S-303.

# Cleaning the S-303

**NOTICE**

**Short-circuiting due to cleaning fluid penetrating the housing!**
Liquid intruding into the housing of the S-303 could lead to the destruction of the piezo actuator by electric flashovers.

- ➢ Discharge the S-303 (p. 18) before cleaning.
- ➢ Disconnect the S-303 from the electronics before cleaning.
- ➢ Prevent cleaning fluid from penetrating the housing of the S-303.

**NOTICE**

**Damage from ultrasonic cleaning!**
Ultrasonic cleaning can damage the S-303.

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

**NOTICE**

**Damage due to use of unsuitable cleaning agents!**
Strong alkaline detergents could damage the S-303.

- ➢ Use mild cleaning agents only (e.g., isopropyl alcohol or ethanol).

### Requirements

- ✓ You have discharged the S-303 (p. 18).
- ✓ You have disconnected the S-303 from the electronics.

### Other materials required

- Soft, lint-free cloth
- Mild cleaning agent or disinfectant (e.g., isopropyl alcohol or ethanol)

### Cleaning the S-303

1. Dampen the cloth with the cleaning agent or disinfectant.
2. Wipe the surfaces of the S-303 carefully.

# 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 load according to the specifications (p. 22). |
| | Zero shifting of the sensor for the following reasons:<br>▪ Load in direction of motion<br>▪ The ambient/operating temperature of the positioner lies far above or below the calibration temperature (21 °C to 24 °C) | ➢ Adjust the zero point of the sensor (see controller manual). |
| Reduced accuracy | The base body or the motion platform is warped | ➢ Mount the S-303 onto surfaces with the following characteristics only:<br>– Flatness ≤ 10 µm<br>– The thermal expansion properties are similar to those of the S-303.<br>➢ Mount loads onto the S-303 with the following characteristics only:<br>– The contact surface of the load has a flatness of ≤ 10 µm.<br>– The thermal expansion properties are similar to those of the S-303. |
| Reduced accuracy | The positioner or controller was replaced | When using positioners, whose ID chip does not contain any calibration data, or LEMO plug connectors, axis displacement has to be recalibrated after the positioner or the controller has been replaced.<br>➢ Recalibrate the axis displacement (see controller manual) or contact our customer service department (p. 21). |
| | Axes were mixed up during connection | ➢ Pay attention to the assignment of the axes when connecting the positioner to a multi-channel controller. This assignment is indicated by labels on the devices. |

| Problem | Possible causes | Solution |
|---|---|---|
| The stage starts oscillating or positions inaccurately | Servo control parameters set incorrectly because for example, the load was changed | 1. Switch servo mode off for the corresponding motion axis/axes immediately.<br>2. Check the servo control parameter settings on the controller.<br>3. Adjust the servo control parameters on the controller according to the load change. |
| | Open-loop operation near to the resonant frequency | ➢ In open-loop operation, operate the stage only at a frequency below the resonant frequency. |

If the problem with your system is not listed in the table above or cannot be solved as described, contact our customer service department (p. 21).

# Customer Service Department

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

- ➢ If you have 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)
  - PC operating system (if applicable)
- ➢ If possible: Take photographs or make videos of your system that can be sent to our customer service department if requested.

The current versions of the user manuals can be downloaded at www.pi.ws (p. 5).

# Technical Data

## Specifications

| | S-303.CD / S-303.CDI | S-303.0L / S-303.0LI | Unit | Tolerance |
|---|---|---|---|---|
| Active axis | Z | Z | | |
| **Motion and positioning** | | | | |
| Integrated position sensor | Capacitive | – | | |
| Travel range at -20 to 120 V, open loop | 3 | 3 | µm | ±20 % |
| Travel range, closed loop | 2 | – | µm | |
| Resolution, closed loop* | 0.03 | – | nm | |
| Resolution, open loop* | 0.03 | 0.03 | nm | |
| Linearity error, closed loop** | 1 | – | % | Typ. |
| Repeatability | 0.7 | – | nm | Typ. |
| **Mechanical properties** | | | | |
| Stiffness | >400 | >400 | N/µm | |
| Push/pull force capacity | 0.5 | 0.5 | N | Max. |
| Resonant frequency, unloaded | 25 | 25 | kHz | ±20 % |
| **Drive properties** | | | | |
| Electrical capacitance | 0.9 | 0.9 | µF | ±20 % |
| **Miscellaneous** | | | | |
| Operating temperature range | -20 to 80 | -20 to 80 | °C | |
| Voltage connector | D-sub 7W2 (m) | LEMO | | |
| Sensor connector | D-sub 7W2 (m) | – | | |
| Mass | 100 | 30 | g | ±5 % |
| Housing material | CD version: Al<br>CDI version: Invar | 0L version: Al<br>0LI version: Invar | | |
| Recommended electronics | E-503, E-505, E610, E-621, E625, E-663, E665, E-754 | E-503, E-505, E610, E-621, E625, E-663, E665, E-754 | | |

* The resolution of the system is limited only by the noise of the amplifier and the measuring technology because PI piezo nanopositioning systems are free of friction.
** With digital controller, analog controllers provide a typical linearity of approx. 1 nm.
All specifications based on room temperature (22 °C ±3 °C).

## Maximum Ratings

S-303 piezo phase shifters are designed for the following operating data:

| Maximum operating voltage | Maximum operating frequency[1] (unloaded) | Maximum power consumption[2] |
|---|---|---|
| -20 to 120 V | 1 kHz | 1.5 W |

1 Due to the self-heating of the piezoceramic, higher operating frequencies are only possible in the small-signal range (≤ 10 % of the maximum operating voltage). If you want to operate the S-303 at higher operating frequencies, please contact our customer service department (p. 21).

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

Details can be found online:
https://www.physikinstrumente.com/en/technology/piezo-technology/properties-piezo-actuators/electrical-operation/

## Ambient Conditions and Classifications

Pay attention to the following ambient conditions and classifications for the S-303:

| | |
|---|---|
| Area of application | For indoor use only |
| Maximum altitude | 2000 m above msl |
| Air pressure | 1100 hPa to 0.1 hPa |
| Relative humidity | Highest relative humidity 80 % for temperatures up to 31 °C<br>Decreasing linearly to 50 % relative humidity at 40 °C |
| Operating temperature | -20 °C to 80 °C |
| Storage temperature | -25 °C to 85 °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 |

## Dimensions

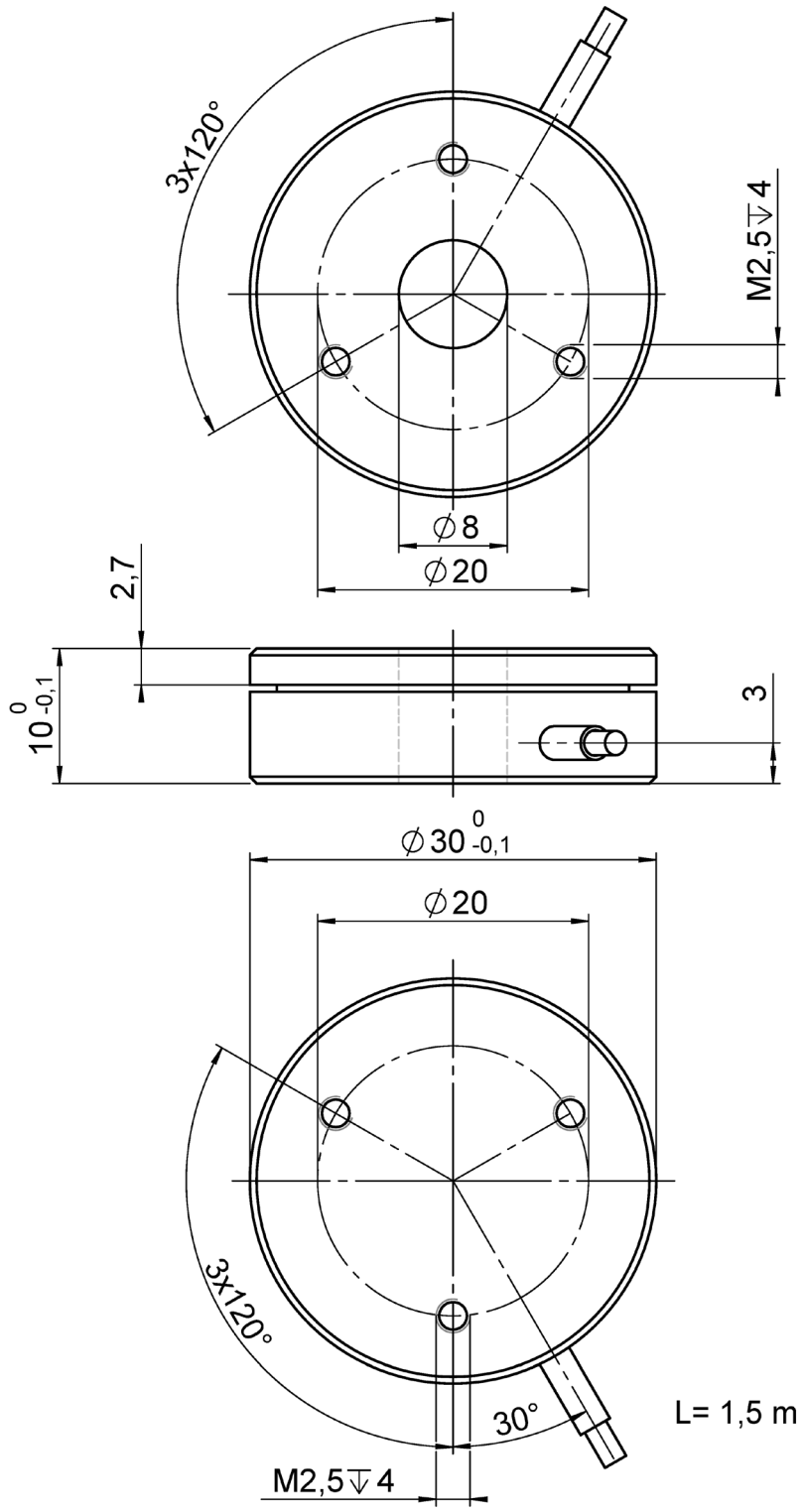


Fig. 9: S-303.0L/.0LI, dimensions in mm, note that the decimal places are separated by a comma in the drawings

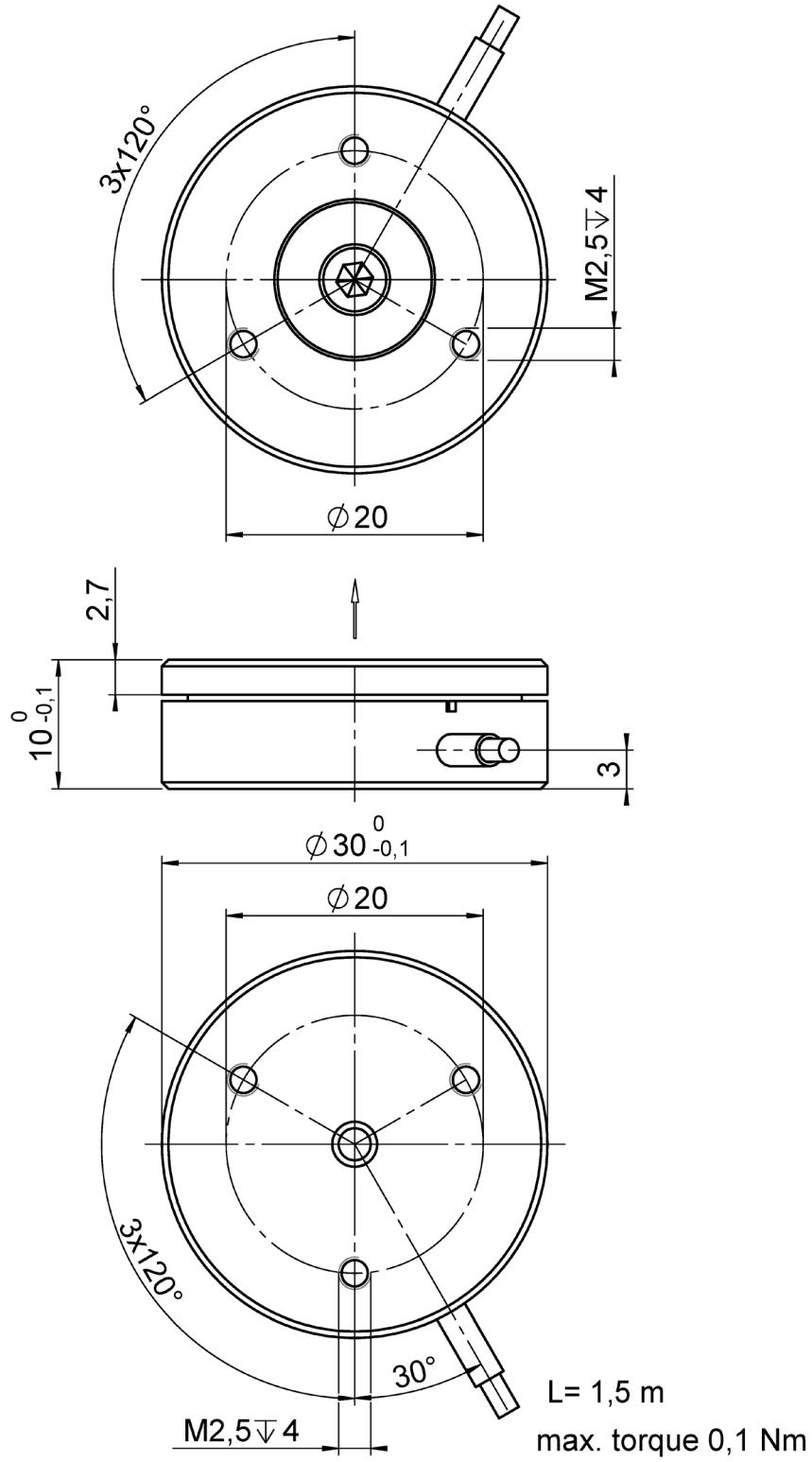


Fig. 10: S-303.CD/.CDI, dimensions in mm, note that the decimal places are separated by a comma in the drawings

## 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 |

## Pin Assignment

### S-303.0Lx

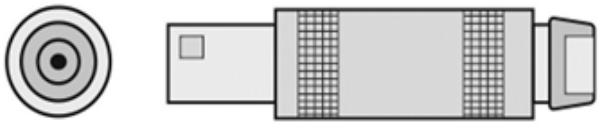

Fig. 11: LEMO coaxial connector for piezo voltage

| Pin | Function |
|---|---|
| Inner contact | PZT + (-20 to 120 V) |
| Connector shell | PZT - (GND) |

### S-303.CDx

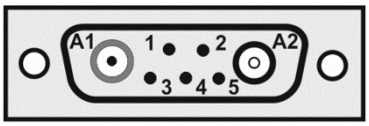


Fig. 12: D-sub 7W2 (m) plug connector (front view)

| Pin | Signal | Function |
|---|---|---|
| A1 inner conductor | Input | Piezo voltage + |
| A2 inner conductor | Output | Probe sensor signal<br>(immovable part of the capacitive sensor) |
| A2 outer conductor | GND | Shield |

| Pin | Signal | Function |
|---|---|---|
| 1 | Bidirectional | Data line for ID chip |
| 2 | GND | Shield of Target<br>Ground of ID chip when switched on |
| 3 | Input | Piezo voltage - |
| 4 | (no signal) | (not connected) |
| 5 | Input | Target sensor signal<br>(movable part of the capacitive sensor) |

The connector shell is connected to the cable shield.

# Old Equipment Disposal

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

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

In order to fulfill the responsibility as the product manufacturer, 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 Roemerstrasse 1
76228 Karlsruhe, Germany