

**MP157E**  
**L-310 Precision Z Stage**  
**User manual**

Version: 1.4

Date: 2022-09-20



**This document describes the following precision Z stages with 26 mm travel range:**

- L-310.2xSD:  
with 2-phase stepper motor
- L-310.0232xx:  
with DC motor
- L-310.0252xx:  
with BLDC motor



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Subject to change. This manual is superseded by any new release. The latest release is available for download from our website.

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# 1 About this Document

## 1.1 Objective and Target Group of this User Manual

This user manual contains the information required for the intended use of the L-310.

Basic knowledge of closed-loop systems, motion control concepts, and applicable safety measures is assumed.

The latest versions of the user manuals are available for download on our website (page 2).

## 1.2 Symbols and Typographic Conventions

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

### NOTICE




#### Dangerous situation

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

- Measures for avoiding the risk.

### INFORMATION

Information for easier handling, tricks, tips, etc.

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

## 1.3 Definition of Terms

Term	Explanation
Max. push/pull force	Maximum force in the direction of motion. Some stages may have higher forces but with limited lifetimes. In the case of vertical mounting, the specified value only applies when the servo mode is switched on. (p. 33).
BLDC motor	Brushless direct current motor. Commutation is electronic.

## 1.4 Pictures

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 Further Applicable Documents

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

Product	Document
Stages with electric motors	MP146EK Short Instructions
C-663.12 Stepper Motor Controller	MS241E User Manual
C-863.12 DC Motor Controller	MS249E User Manual
C-884 DC Motor Controller	MS213E User Manual
C-885 PIMotionMaster	C885T0002 User Manual
C-663.12C885 for C-885 PIMotionMaster	C663T0004 User Manual
C-863.20C885 for C-885 PIMotionMaster	C863T0005 User Manual

## 1.6 Downloading Manuals

### INFORMATION

If a manual is missing or there are problems with downloading:

- Contact our customer service department (p. 31).

### Downloading manuals

1. Open the website [www.pi.ws](http://www.pi.ws).
2. Search the website for the product number (e.g., C-885).
3. Click the corresponding product to open the product detail page.
4. Click the ***Downloads*** tab.

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.





## 2 Safety

### 2.1 Intended Use

The L-310 is a laboratory device as defined by DIN EN 61010. 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 L-310 is intended for single-axis positioning, adjusting and shifting of loads at different velocities. The L-310 is **not** intended for applications in areas, in which a failure would represent severe risks to human beings or the environment.

The intended use of the L-310 is only possible when completely mounted and connected.

The L-310 must be operated with a suitable controller (p. 11). The controller is not in the scope of delivery of the L-310.

### 2.2 General Safety Instructions

The L-310 is built according to state-of-the-art technology and recognized safety standards. Improper use of the L-310 may result in personal injury and/or damage to the L-310.

- Only use the L-310 for its intended purpose, and only use it if it is in perfect condition.
- Read the user manual.
- Immediately eliminate any faults and malfunctions that are likely to affect safety (p. 29).

The operator is responsible for correct installation and operation of the L-310.

## 2.3 Organizational Measures

### User manual

- Always keep this user manual available when using the L-310.  
The latest versions of the user manuals are available on our website (p. 2) for download.
- Add all information from the manufacturer such as supplements or technical notes to the user manual.
- If you give the L-310 to other users, also include this user manual as well as all other relevant information provided by the manufacturer.
- Only use the device on the basis of the complete user manual. Missing information due to an incomplete user manual can result in damage to equipment.
- Only install and operate the L-310 after you have read and understood this user manual.

### Personnel qualification

The L-310 may only be installed, started, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

## 3 Product Description

### 3.1 Model Overview

#### Classification of the positioners

All models are electromotive precision Z stages with a travel range of 26 mm. They differ with respect to the drive type and encoder equipment.

L-310	Drive type			Encoder type		
	DC motor	BLDC motor	Stepper motor	Linear encoder sin/cos	Linear encoder A/B	Rotary encoder A/B
.20SD			+			
.2ASD*			+	+		
.023211*	+			+		
.023212	+				+	
.023232	+					+
.025212*		+			+	
.025232		+				+

\* Separate sensor connector

#### Detailed model overview

Product number	Product Description
L-310.20SD	Precision Z Stage, 26 mm, stepper motor
L-310.2ASD	Precision Z stage, 26 mm, stepper motor, linear encoder with sin/cos signal transmission
L-310.023211	Precision Z stage, 26 mm, DC motor, linear encoder with sin/cos signal transmission
L-310.023212	Precision Z stage, 26 mm, DC motor, linear encoder with A/B quadrature signal transmission
L-310.023232	Precision Z stage, 26 mm, DC motor, rotary encoder with A/B quadrature signal transmission
L-310.025212	Precision Z stage, 26 mm, BLDC motor, linear encoder with A/B quadrature signal transmission

Product number	Product Description
L-310.025232	Precision Z stage, 26 mm, BLDC motor, rotary encoder with A/B quadrature signal transmission

➤ For further technical data, see the specifications. (p. 33).

## 3.2 Product View

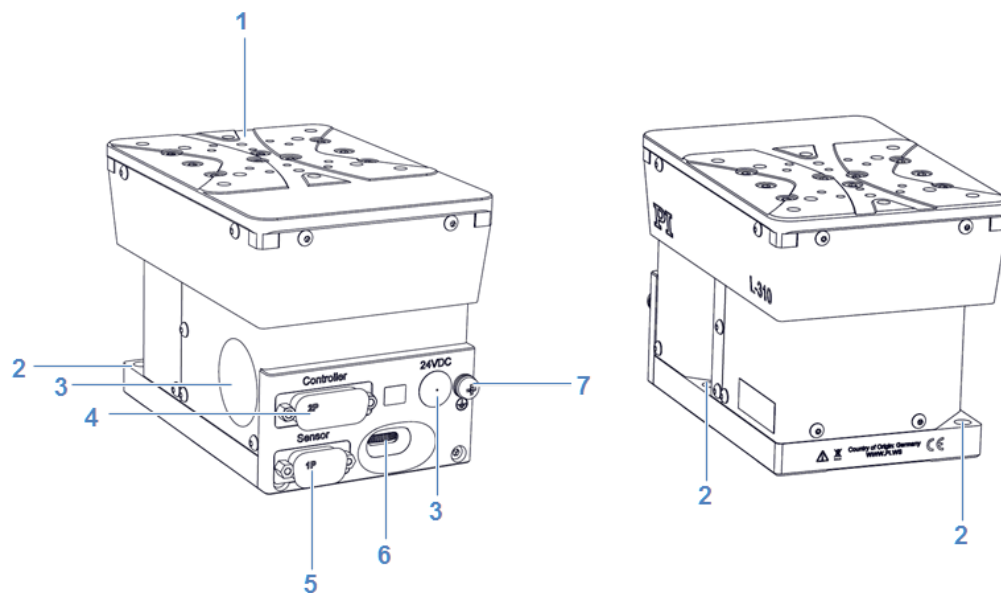


Figure 1: Parts of the L-310

- 1 Platform
- 2 Mounting hole
- 3 Voltage connector (not used)
- 4 Controller connector (shown with a protective cap)
- 5 Sensor connector (L-310.2ASD / .023211 / .025212 models only, shown with a protective cap)
- 6 Thumbwheel (for unblocking, see p. 30)
- 7 Protective earth connection

### 3.3 Direction of Motion

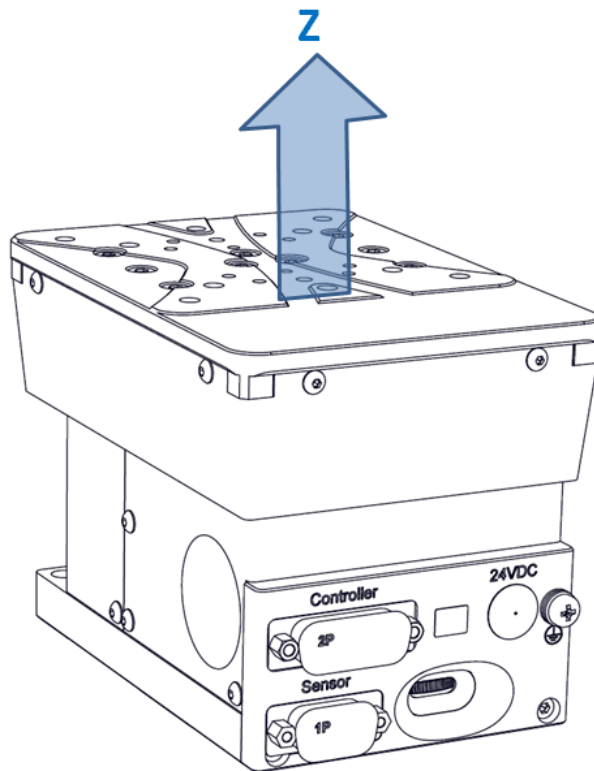


Figure 2: Direction of motion of the platform

Z (arrow direction :) Direction of motion on positive commanding

### 3.4 Product Labeling

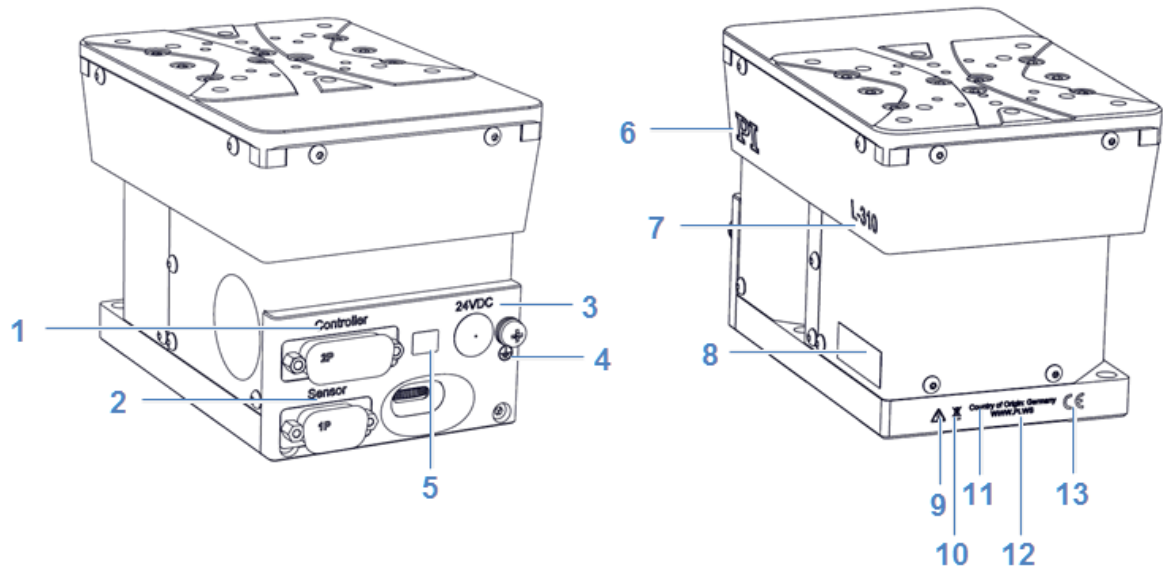








Figure 3: Product labeling

Position	Labeling	Description
1	Controller	Motor connector
2	Sensor	Encoder connector (L-310.2ASD / .023211 / .025212 models only)
3	24 V DC	Power adapter connector (not used)
4		Protective earth conductor connection (p. 18)
5		Warning sign "Electrostatic sensitive devices"
6, 8		Manufacturer's logo
7, 8	L-310	Product series
8	415002159	Serial number (example), individual for each L-310 Meaning of the places (counting from left): 1 = internal information, 2 and 3 = year of manufacture, 4 to 9 = consecutive numbers
8, 9		Warning sign "Observe manual!"
8, 10		Old equipment disposal
8, 11	Country of origin: Germany	Country of origin
8, 12	WWW.PI.WS	Manufacturer's address (website)

Position	Labeling	Description
8, 13		CE conformity mark

### 3.5 Scope of Delivery

Item number	Component
L-310	Stage according to order (p. 7)
MP146EK	Short instructions for stages with electric motors
66115027	Mounting kit: <ul style="list-style-type: none"> <li>• 2 socket head screw, ISO 4762 M6x20</li> <li>• 2 dowel pins, ISO 2338 - 4 h8 x 10</li> </ul>

### 3.6 Suitable Controllers

	C-663.12	C-863.12	C-884	C-885 with C-663.12C8 85	C-885 with C-863.20C8 85	ACS modular controller
L-310.20SD	+			+		+
L-310.2ASD	+			+		+
L-310.023211		+	+		+	+
L-310.023212		+	+		+	+
L-310.023232		+	+		+	+
L-310.025212						+
L-310.025232						+

PC software is in the scope of delivery of the controllers from PI. The operation of the controllers is described in the corresponding user manuals.

## **3.7 Technical Features**

### **3.7.1 Encoder**

The L-310.2ASD / .023211 / .023212 / .025212 models are equipped with an optical linear encoder. This measures the actual position directly (direct metrology). Errors occurring in the drive, such as nonlinearity, backlash or elastic deformations cannot influence measuring of the position.

The L-310.023232 / .025232 models are equipped with an optical rotary encoder. A rotary encoder, also called an incremental rotary encoder, is implemented at a rotating point in the drivetrain, e.g., the motor shaft.

Refer to the table in the "Specifications" section for the encoder resolution (p. 33).

The L-310.20SD model does not have an encoder.

### **3.7.2 Limit Switches**

The stage is equipped with noncontact, magnetic (Hall effect) limit switches.

Each limit switch sends its signal to the controller on a dedicated line. The controller then stops the motion. If the controller does not stop the motion in time, the stage runs into the hard stop.

See "Limit Switch Specifications" for more information (p. 37).

### **3.7.3 Reference Switch**

The stage is equipped with a direction-sensing reference switch (see "Reference Switch Specifications" (p. 37)).

The commands that use the reference signal are described in the user manual for the controller and/or in the corresponding software manuals.



## **4 Unpacking**

1. Unpack the L-310 with care.
2. Compare the contents with the items listed in the contract and the packing list.
3. Inspect the contents for signs of damage. If there is any sign of damage or missing parts, contact PI immediately.
4. Keep all packaging materials in case the product needs to be returned.



## 5 Installation

### 5.1 General Notes on Installation

#### NOTICE

**Cable break!**

A cable break leads to failure of the positioner.

- Install the stage so that the cable is not bent too strongly or crushed.

#### NOTICE

**Heating of the L-310 during operation!**

The heat produced during operation of the L-310 can affect your application.

- Install the L-310 so that the application is not impaired by dissipating heat.

#### NOTICE

**Damage due to removed caps or screws!**

Removing caps and screws can lead to contamination and failure of the L-310.

- Do not loosen **any** screws on the stage.
- Do not remove **any** other caps except the protective caps.
- Remove the protective caps only when connecting to the controller.

#### INFORMATION

For optimal repeatability, all components must be connected firmly together.

- If possible, simulate the platform motion with a mounted load or make suitable calculations to detect collisions or unfavorable center of gravity constellations.
- If necessary, take suitable constructive measures to avoid collisions and instability in the overall system.
- Avoid or mark danger zones that result from the installation of the positioner and the application, in accordance with the legal regulations.

## 5.2 Attaching the L-310 to a Surface

### NOTICE



#### Warping of the L-310 due to mounting on uneven surfaces!

Mounting the L-310 on an uneven surface can warp the L-310. Warping reduces the accuracy.

- Mount the L-310 onto a flat surface. The recommended flatness of the surface is  $\leq 5 \mu\text{m}$ .
- For applications with large temperature changes:  
Only mount the L-310 on surfaces that have the same or similar thermal expansion properties as the L-310.

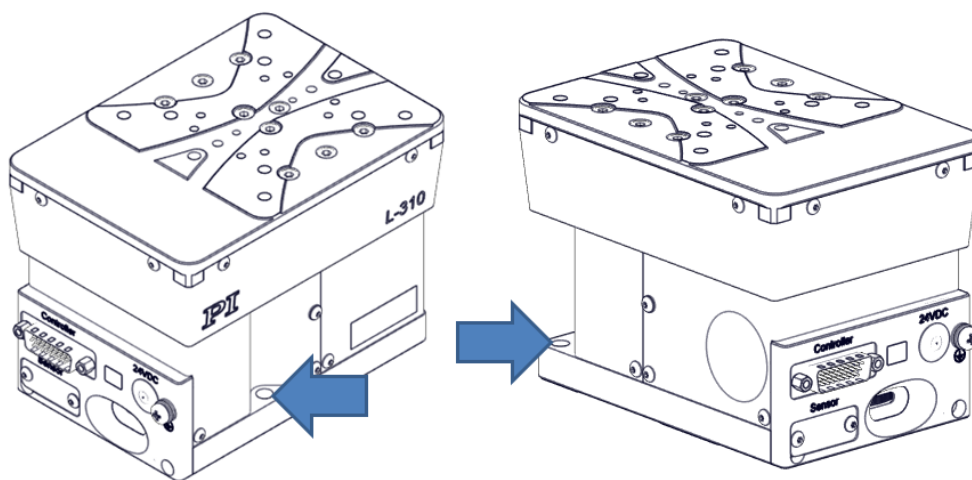


Figure 4: Position of the through-holes for mounting the positioner from above

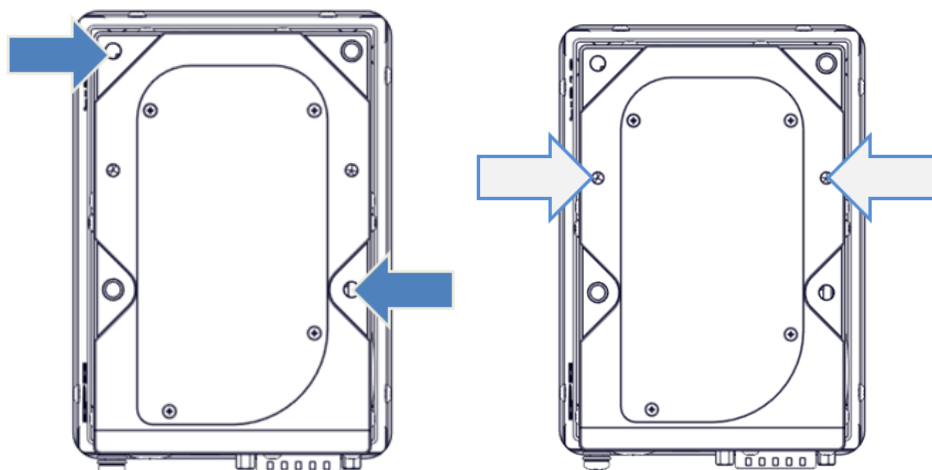


Figure 5: Underside view: Position of the threaded hole for mounting the positioner from below (left); position of the holes for locating pins (right)

**Requirements**

- ✓ You have read and understood the general notes on installation (p. 15).
- ✓ You have provided a suitable surface (for the required position and depth of the holes for accommodating the screws and locating pins, see "Dimensions" (p. 38)):
  - For mounting from above: 2 threaded holes M6 are provided.
  - For mounting from below: 2 through-holes,  $\varnothing$  6.6 mm are provided.
  - If you use locating pins to align the stage: Two 4 mm  $\varnothing$  locating holes are present.
  - The surface flatness is  $\leq 5 \mu\text{m}$ .
  - For applications with large temperature changes: The surface should have the same or similar thermal expansion properties as the L-310 (e.g., surface made of aluminum).
- ✓ You have accounted for the space required to route cables without bending and according to regulations.

**Tools and accessories**

- Mounting kit; in the scope of delivery (p. 11)
  - 2 socket head screws, ISO 4762 M6x20
  - 2 dowel pins, ISO 2338 - 4 h8  $\times$  10, for use as locating pins
- Hex key, AF 5

**Mounting the positioner onto a surface**

1. Place the positioner on the surface so that the corresponding mounting holes in the positioner and the surface are in line.  
  
If you use locating pins to align the stage:
  - a) Insert the locating pins into the respective holes in the surface.
  - b) Place the stage on the surface so that the locating pins are inserted into the corresponding locating holes on the other side.
2. Tighten all screws in the mounting holes selected. Pay attention to the permissible tightening torques (p. 43)
3. Check that the positioner is affixed firmly to the surface.

### 5.3 Connecting the L-310 to the Protective Earth Conductor

#### INFORMATION

It is only necessary to connect the L-310 to the protective earth conductor when both of the following conditions are met:

- The load on the motion platform of the L-310 must be connected to the protective earth conductor, but it is not possible to connect the protective earth conductor directly to the load.
- The load and the platform are connected conductively to each other.

#### INFORMATION

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

A protective earth connection is located on front side of the L-310.

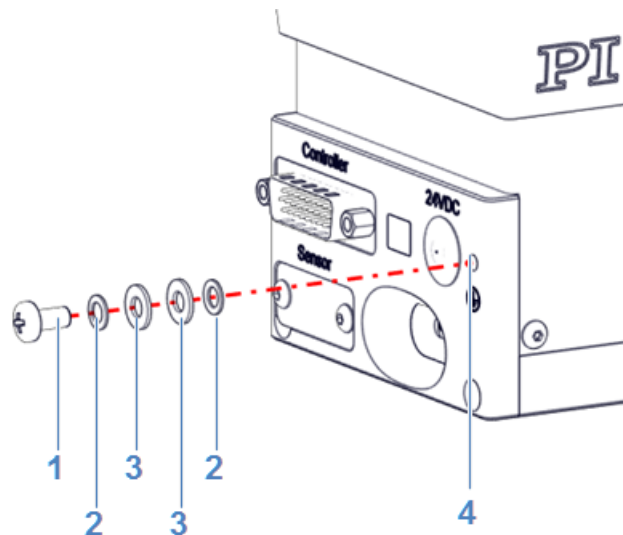


Figure 6: Protective earth connection setup (exploded view)

- 1 Screw, M4x8, ISO 7045
- 2 Flat washer
- 3 Safety washer
- 10 M4 mounting hole

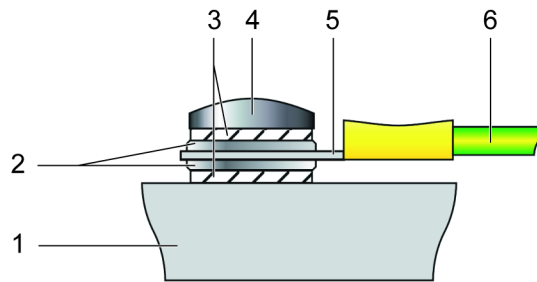


Figure 7: Mounting of the protective earth conductor (profile view)

- 1 Base body of the L-310 (front side)
- 2 Flat washer
- 3 Safety washer
- 4 Screw, M4x8, ISO 7045
- 5 Cable lug
- 6 Protective earth conductor

### Requirements

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

### Tools and accessories

- Suitable protective earth conductor: Cable cross section  $\geq 0.75 \text{ mm}^2$
- PH1 screwdriver or similar tool

### Connecting the L-310 to the protective earth conductor

1. If necessary, attach a suitable cable lug to the protective earth conductor.
2. Remove the screw and the safety and flat washers of the protective earth connection (p. Figure 6).
3. Tighten the screw (together with the safety and flat washers) to affix the cable lug of the protective earth conductor to the protective earth connection (p. Figure 7)
4. Tighten the screw with a torque of 1.2 Nm to 1.5 Nm.
5. Make sure that the contact resistance is  $< 0.1 \Omega$  at 25 A at all connection points relevant for attaching the protective earth conductor.

## 5.4 Affixing the Load to the L-310

### NOTICE



#### Impermissibly high load on the stage!

An impermissible high load impairs the motion of the platform and can damage the positioner.

- When considering the mass and mounting method of the load, pay attention to the specified maximum permissible forces that may act on the platform (p. 33).

### Requirements

- ✓ You have read and understood the general notes on installation (p. 15).
- ✓ You have mounted the stage onto a surface properly (p. 16).
- ✓ The stage is **not** connected to the controller.
- ✓ You have prepared the load so that it can be affixed to the mounting holes on the upper platform (p. 39):
  - The distance between the center of gravity of the load and the center of the platform is as small as possible in all directions.
  - At least two points are provided for mounting the load on the platform (ideally: three attachment points).

### Tools and accessories

- At least 2 screws of suitable length. Options:
  - M6 screws
  - M4 screws
- Suitable tool for tightening the screws

### Affixing the load

1. Align the load so that the selected mounting holes in the platform can be used to affix it.
2. Use the screws to affix the load on the selected mounting holes in the platform.
3. Check that the load is affixed firmly to the platform of the positioner.



## 5.5 Connecting the L-310 to a Controller

### NOTICE

**Damage if an incorrect controller or motor cable is connected!**

Connecting a stage to an unsuitable controller or using an unsuitable motor cable can cause damage to the stage or controller.

- Only connect the stage to a suitable controller (p. 11).
- To connect the positioner to the controller, only use a motor cable that is suitable for the controller.

### Requirements

- ✓ You have read and understood the general notes on installation (p. 15).
- ✓ You have installed the controller.
- ✓ You have read and understood the user manual for the controller.
- ✓ The controller is switched off.

### Tools and accessories

- Suitable cable(s) according to your order
- Suitable tools for tightening the screws to the connections

### Connecting the L-310 to a controller

1. Remove the protective caps from all connections of the L-310.
2. Connect the L-310 and the controller to each other:
3. Use the integrated screws to secure the connections against accidental disconnection.



## 6 Startup

### 6.1 General Notes on Startup

#### NOTICE

**Damage due to collisions!**

Collisions can damage the positioner, the load to be moved, and the surroundings.

- Make sure that no collisions are possible between the positioner, the load to be moved, and the surroundings in the motion range of the positioner.
- Do not place any objects in areas where they can be caught by moving parts.
- Stop the motion immediately if a controller malfunction occurs.
- If possible, adapt the travel range limits of your mechanical system in the software that you use for commanding the motion.

#### NOTICE

**Damage if an incorrect controller or motor cable is connected!**

Connecting a stage to an unsuitable controller or using an unsuitable motor cable can cause damage to the stage or controller.

- Only connect a stage to a suitable controller (p. 11).
- To connect the positioner to the controller, only use a motor cable that is suitable for the controller.

#### NOTICE

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

Operating voltages that are excessively high or incorrectly connected can cause damage to the L-310.

- Do **not** exceed the operating voltage range (p. 36) specified for the L-310.
- Operate the L-310 only when the operating voltage is properly connected; see "Pin Assignment" (p. 39)

**NOTICE****Damage or considerable wear due to high accelerations!**

High accelerations can cause damage to or considerable wear on the mechanics.

- Stop the motion immediately if a controller malfunction occurs.
- Ensure that the end of the travel range is approached at low velocity.
- Determine the maximum velocity for your application.

**NOTICE****Unintentional motion!**

Unintentional motion of the L-310 is possible when it is connected to the controller. Defective or incorrect operation of the software can also result in unintentional motion.

- Do not place any objects in areas where they can be caught by moving parts.
- Before connecting the L-310, check whether a macro is defined as the startup macro in the controller, and cancel the selection of the startup macro if necessary.

**INFORMATION**

The maximum velocity for a L-310.20SD or L-310.2ASD should be determined in the application. If the commanded velocity is too high, the stepper motor might stop without the controller detecting this state.

**INFORMATION**

The repeatability of the positioning is only ensured when the reference switch is always approached from the same side. Controllers from PI fulfill this requirement as a result of the automatic direction sensing for reference moves to the reference switch.

## 6.2 Starting and Operating the Positioner

### Requirements

- ✓ You have read and understood the general notes on startup (p. 23).
- ✓ When starting and operating with a load or in a multi-axis system: You have installed the stage properly (p. 15).
- ✓ You have read and understood the user manual for the controller used.
- ✓ You have read and understood the manual for the PC software used.
- ✓ The controller and the required PC software have been installed. All connections on the controller have been set up (see "Connecting the L-310 to the Controller" (p. 21) and the user manual for the controller).

### Starting and Operating the Positioner

1. Start and operate the controller (see user manual for the controller).

Configure the controller during startup using the PC software for the stage used (see user manual for the controller and the PC software): Select the entry in the stage database that exactly matches the stage model used.

2. Start a few motion cycles for testing purposes (see user manual for the controller).

### 6.2.1 L-310 Entries in the PI Positioner Database

For PI controllers, you can select the connected stage from a stage database in the corresponding PC software. The appropriate operating parameters are therefore loaded to the controller. You can find a detailed description in the user manual for the controller or in the manual for the PC software used.



## 7 Maintenance

### 7.1 General Notes on Maintenance

#### NOTICE

**Damage due to improper maintenance!**

Removing caps and screws can lead to contamination and failure of the L-310.

- Do not loosen **any** screws on the stage.
- Do not remove **any** other caps except the protective caps.

### 7.2 Performing Maintenance Work

Depending on the operating conditions and the period of use of the L-310, the following maintenance measures are required:

**Maintenance run**

The maintenance run serves the purpose of distributing the existing lubricant.

- After 500 operating hours or at least after 1 year, perform a maintenance run over the entire travel range, in order for the existing lubricant to be distributed evenly.
- If the L-310 is to be operated continuously in an industrial environment over a small travel range (<20 % of the entire travel range), perform a maintenance run across the entire travel range every 5000 motion cycles.

**Relubricating**

Under laboratory conditions, the positioner needs extra lubrication in exceptional cases only. For continuous industrial use, the lubrication intervals must be defined individually.

- If you have any questions on relubricating, contact our customer service department (p. 31).

### 7.3 Cleaning the L-310

**Requirements**

- ✓ You have disconnected the stage from the controller.

**Cleaning the positioner**

- If necessary, clean the surfaces of the positioner with a cloth that is dampened with a mild cleanser or disinfectant.





## 8 Troubleshooting

### 8.1 Possible Causes and Remedies

Problem	Possible causes	Solution
Reduced positioning accuracy	Warped base body	➤ Mount the L-310 onto a flat surface. The recommended flatness of the surface is $\leq 5 \mu\text{m}$ .
	Increased wear due to small motion over a long period of time	➤ Perform a maintenance run over the entire travel range.
Impairment of the function after system modification	<ul style="list-style-type: none"> <li>▪ Controller was replaced.</li> <li>▪ The LS310 was replaced by another model.</li> </ul>	➤ Load the parameters from the positioner database that correspond to the combination of controller and the L-310 model.
Mechanical system does not move; no operating noise can be heard.	Controller not correctly connected or defective.	<ul style="list-style-type: none"> <li>➤ Check all connecting cables.</li> <li>➤ Check the controller.</li> <li>➤ If necessary, check the power adapter of the stage.</li> </ul>
For L-310.20SD and L-310.2ASD models: Actual position deviates from the displayed position.	The motor is overloaded by an external load torque or the mass to be driven in the case of strong acceleration or deceleration.	<p>The motor skips steps. The information on the current position is lost without the controller detecting the state.</p> <ul style="list-style-type: none"> <li>➤ Use a stepper motor in the application to determine the maximum velocity for a stage.</li> <li>➤ Start a new reference move.</li> </ul>

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. 31).

## 8.2 Moving the Platform by Hand

### INFORMATION

It is necessary to repeat the reference move after moving manually and connecting to the controller.

The thumbwheel can be used to move the platform without damaging the drive. This can be necessary when the platform is stuck at the beginning or the end of the travel range (has reached the hard stop).

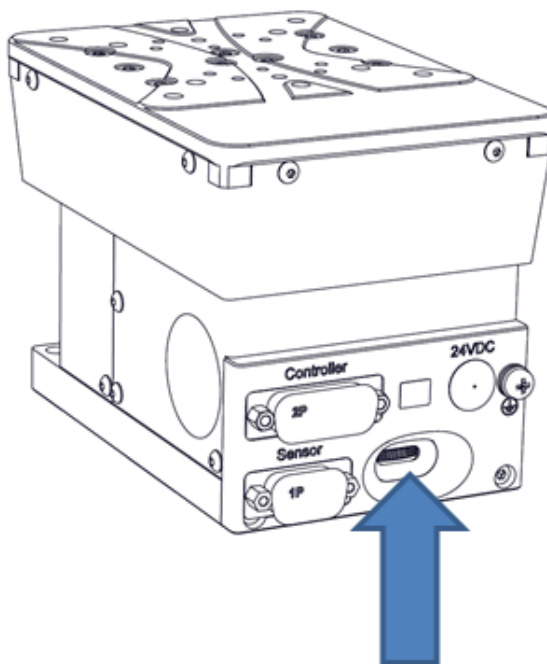


Figure 8: Position of the thumbwheel

### Requirements

The stage is **not** connected to the controller.

### Moving the platform by hand

- Turn the thumbwheel as far as necessary:
  - Turn to the left: The platform moves in a positive direction (upwards).
  - Turn to the right: The platform moves in a negative direction (downwards).

## 9 Customer Service

For inquiries and orders, contact your PI sales engineer or send us an email (<mailto:info@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 on our website (p. 2) for download.



## 10 Technical Data

### 10.1 Specifications

#### 10.1.1 Data Table

Motion	L-310.2xSD	L-310.023xxx	L-310.025xxx	Unit	Tolerance
Active axis	Z	Z	Z		
Travel range	26	26	26	mm	
Pitch / yaw	±150	±150	±150	μrad	Typ.
Straightness / flatness	±3	±3	±3	μm	Typ.
Velocity	15	50	50	mm/s	Max.

Positioning: L-310.xxxD	L-310.20SD	L-310.2ASD	Unit	Tolerance
Integrated sensor	–	Incremental linear encoder		
Sensor signal	–	sin/cos, 20 μm signal period		
Sensor resolution rotary encoder	–	–	cts./rev	
Sensor resolution linear encoder	–	–	μm	
Minimum incremental motion	0.3	0.05	μm	Typ.
Unidirectional repeatability	0.3	0.1	μm	Typ.
Bidirectional repeatability	±2	±0.2	μm	Typ.
Limit switches	Hall effect, N/C contact, 5V, NPN	Hall effect, N/C contact, 5V, NPN		
Reference switch repeatability	2	2	μm	Typ.

Positioning: L-310.02x2xx	L-310.023211	L-310.023212	L-310.023232	L-310.025212	L-310.025232	Unit	Tolerance
Integrated sensor	Incremental linear encoder	Incremental linear encoder	Rotary encoder	Incremental linear encoder, rotary encoder	Rotary encoder		
Sensor signal	sin/cos, 20 µm signal period	A/B quadrature, TTL	A/B quadrature, TTL	A/B quadrature, TTL	A/B quadrature, TTL		
Sensor resolution rotary encoder	–	–	16384	20000	20000	cts./rev	
Sensor resolution linear encoder	–	0.05	–	0.05	–	µm	
Minimum incremental motion	0.2	0.2	0.3	0.2	0.3	µm	Typ.
Unidirectional repeatability	0.2	0.2	0.3	0.2	0.3	µm	Typ.
Bidirectional repeatability	±0.2	±0.2	±2	±0.2	±2	µm	Typ.
Limit switches	Hall effect, N/C contact, 5V, NPN	Hall effect, N/C contact, 5V, NPN	Hall effect, N/C contact, 5V, NPN	Hall effect, N/C contact, 5V, NPN	Hall effect, N/C contact, 5V, NPN		
Reference switch repeatability	2	2	2	2	2	µm	Typ.




Mechanical properties	L-310.2xSD	L-310.023xxx	L-310.025xxx	Unit	Tolerance
Drive screw	Ball screw	Ball screw	Ball screw		
Drive screw pitch	1	1	1	mm	
Guide	Crossed roller guides with anti-creep system	Crossed roller guides with anti-creep system	Crossed roller guides with anti-creep system		
Holding force, power off	50	30	30	N	Max.
Permissible lateral force, F <sub>x</sub>	100	100	100	N	Max.
Permissible lateral force, F <sub>y</sub>	50	50	50	N	Max.
Load capacity (push/pull force)	55	100	100	N	Max.
Permissible torque in $\theta_x$ (M <sub>x</sub> )	40	40	40	Nm	Max.
Permissible torque in $\theta_y$ (M <sub>y</sub> )	80	80	80	Nm	Max.
Permissible torque in $\theta_z$ (M <sub>z</sub> )	80	80	80	Nm	Max.

Drive properties	L-310.2xSD	L-310.023xxx	L-310.025xxx	Unit	Tolerance
Motor type	2-phase stepper motor	DC motor	BLDC motor		
Operating voltage, nominal	24	24	24	V	
Operating voltage, max.	48	48	48	V	
Step resolution	200	—	—	full steps/rev.	

Miscellaneous	L-310.2xSD	L-310.023xxx	L-310.025xxx	Unit	Tolerance
Operating temperature range	5 to 40	5 to 40	5 to 40	°C	
Material	Anodized aluminum	Anodized aluminum	Anodized aluminum		
MTBF	—	—	10000	h	
Mass	L-310.20SD: 2.7 L-310.2ASD: 2.8	2.7	2.7	kg	±5 %
Moved mass, unloaded	0.9	0.9	0.9	kg	±5 %
Connector	HD D-sub 26 (m) L-310.2ASD: HD D-sub 26 (m) (motor), D-sub 9 (m) (sensor)	L-310.023232: HD D-sub 26 (m) L-310.02321x: HD D-sub 26 (m) (motor), D-sub 9 (m) (sensor)	HD D-sub 26 (m)		
Recommended controllers/drivers	C-663.12 (single axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	ACS modular controller		

### 10.1.2 Maximum Ratings

The L-310 positioners are designed for the following operating data. They are **not** suitable for continuous operation.

Model	Maximum operating voltage 	Operating frequency 	Maximum power consumption 
L-310.20SD L-310.2ASD	48 V	-	12 W
L-310.023211 L-310.023212 L-310.023232	48 V	-	20 W
L-310.025212 L-310.025232	48 V	-	70 W

### 10.1.3 Ambient Conditions and Classifications

The following ambient conditions and classifications must be observed for the L-310:

Area of application	For indoor use only
Maximum altitude	2000 m
Relative humidity	Max. 80 % for temperatures up to 31 °C Linearly decreasing to 50 % at 40 °C
Storage temperature	0 °C to 70 °C
Transport temperature	0 °C to 70 °C
Supply fluctuations	Max. $\pm 10$ % of the nominal voltage
Degree of pollution	2
Degree of protection according to IEC 60529	IP00



#### 10.1.4 Limit Switch Specifications

Type	Magnetic (Hall effect) sensor
Supply voltage	+5 V/GND, supplied via the motor connector
Signal output	Open collector
Signal logic	The signal level changes when passing the limit switch. The signal logic is active high. That means: <ul style="list-style-type: none"><li>▪ Normal motor operation: low (0 V)</li><li>▪ Limit switch reached: high (+5 V)</li></ul>

#### 10.1.5 Reference Switch Specifications

Type	Magnetic (Hall effect) sensor
Supply voltage	+5 V/GND, supplied by the motor controller through the motor connector.
Signal output	Open collector
Signal logic	Direction sensing by means of different signal levels on the left and right side of the reference switch: The signal level changes from 0 to +5 V when the reference switch is passed.
Hysteresis	0.2 to 0.4 mm (when arriving from the positive or negative direction)

## 10.2 Dimensions

### 10.2.1 L-310 Positioner

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

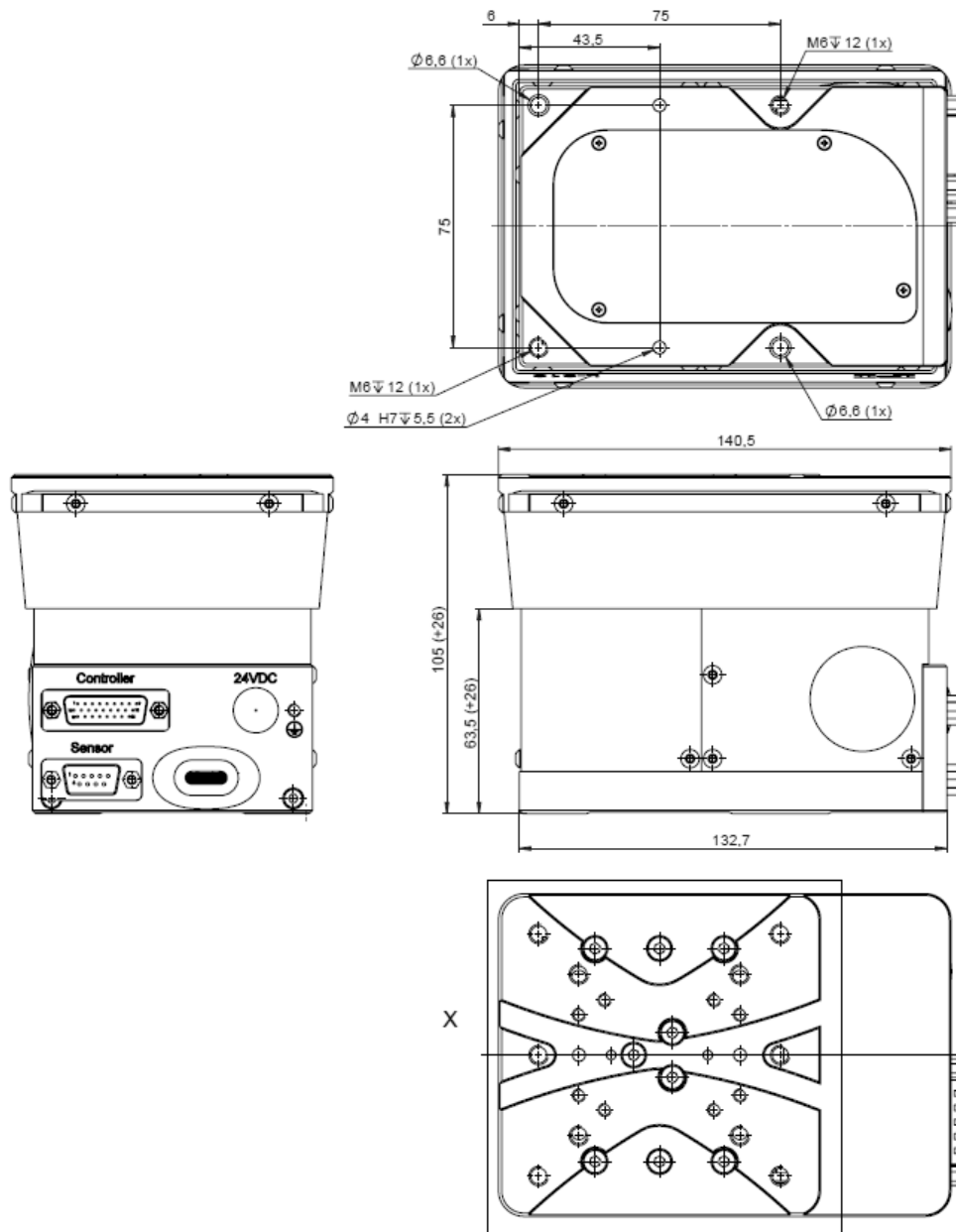
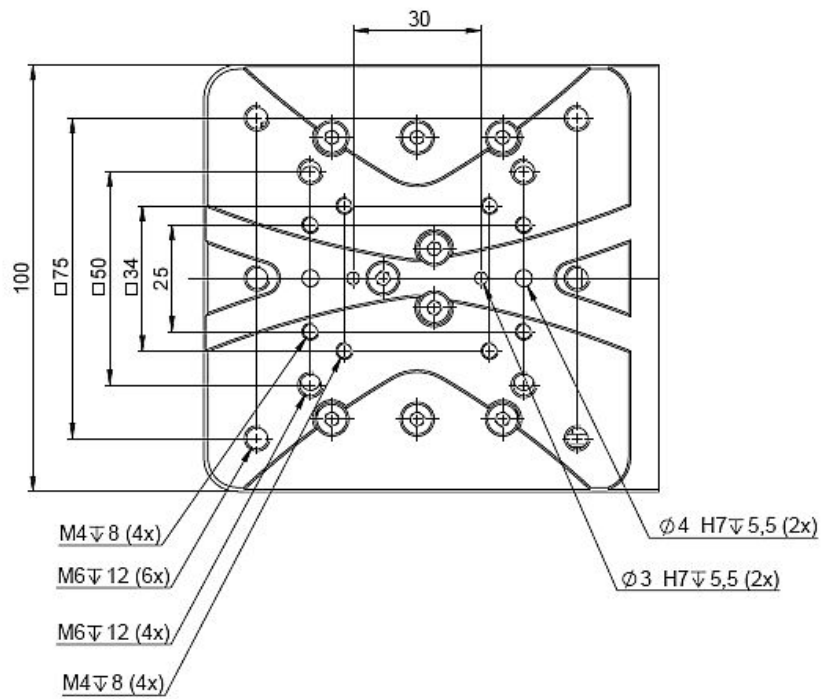


Figure 9: Dimensions of the L-310

### 10.2.2 Hole Pattern of the Platform



## 10.3 Pin Assignment

### 10.3.1 HD D-Sub 26 (Male)

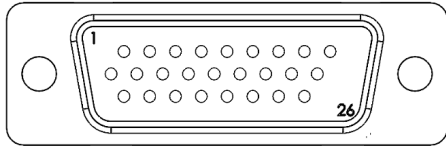


Figure 10: HD D-Sub 26 panel plug

#### L-310.20SD / L-310.2ASD

Pin	Signal	Direction
1	Motor A+	Input
2	Motor A+	Input
3	Motor A-	Input
4	Motor A-	Input
5	Motor B+	Input
6	Motor B+	Input
7	Motor B-	Input
8	Motor B-	Input
9	GND	-
10	REF	Output
11	Limit LE1 (neg.)	Output
12	Limit LE2 (pos.)	Output
13	-	-
14	-	-
15	-	-
16	-	-
17	ID	Output
18	Limit Power (+5 V)	Input
19	-	-
20	-	-
21	-	-
22	-	-
23	-	-
24	-	-

Pin	Signal	Direction
25	GND	-
26	-	-

**L-310.023211 / L-310.023212 / L-310.023232**

Pin	Signal	Direction
1	Motor +	Input
2	Motor +	Input
3	Motor -	Input
4	Motor -	Input
5	-	-
6	-	-
7	-	-
8	-	-
9	-	-
10	REF	Output
11	Limit LE1 (neg.)	Output
12	Limit LE2 (pos.)	Output
13	-	-
14	-	-
15	-	-
16	-	-
17	ID	Output
18	Limit Power (5 V)	Input
19	Encoder A+	Output
20	Encoder A-	Output
21	Encoder B+	Output
22	Encoder B-	Output
23	Encoder I+	Output
24	Encoder I-	Output
25	GND	-
26	Encoder Power (5 V)	Input

**L-310.025212 / L-310.025232**

Pin	Signal	Direction
1	Phase 1	Input
2	Phase 1	Input
3	Phase 2	Input
4	Phase 2	Input
5	Phase 3	Input
6	Phase 3	Input
7	-	-
8	-	-
9	-	-
10	REF	Output
11	Limit LE1 (neg.)	Output
12	Limit LE2 (pos.)	Output
13	Hall 1	Output
14	Hall 2	Output
15	Hall 3	Output
16	-	-
17	ID	Output
18	Limit Power (5 V)	Input
19	Encoder A+	Output
20	Encoder A-	Output
21	Encoder B+	Output
22	Encoder B-	Output
23	Encoder I+	Output
24	Encoder I-	Output
25	GND	-
26	Encoder Power (5 V)	Input

### 10.3.2 D-Sub 9 (Male)

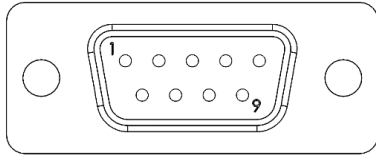


Figure 11: D-Sub 9 panel plug (L-310.2ASD / L-310.023211 / L-310 .025212 only)

Pin	Signal	Direction
1	Encoder A+	Output
2	Encoder B+	Output
3	Encoder C+	Output
4	Encoder GND	-
5	Encoder Power (+ 5V)	Input
6	Encoder A-	Output
7	Encoder B-	Output
8	Encoder C-	Output
9	-	-

## 10.4 Tightening Torque for Screws, ISO 4762 - A2

The following tightening torques for screws according to ISO4762 (corresponds to DIN 912) - A2 may not be exceeded.

Value	Maximum tightening torque
M3	1.5 Nm
M4	2 Nm
M5	2.5 Nm
M6	3 Nm





## 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 the responsibility as the product manufacturer, PI miCos GmbH undertakes environmentally correct disposal of all old PI miCos equipment made available on the market after 13 August, 2005 without charge.

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

PI miCos GmbH  
Freiburger Strasse 30  
79427 Eschbach, Germany





## **12 European Declarations of Conformity**

For the L-310, declarations of conformity were issued according to the following European statutory requirements:

- EMC Directive
- RoHS Directive

The standards applied for certifying the conformity are listed below.

- EMC: EN 61326-1
- Safety: EN 61010-1
- RoHS: EN IEC 63000