

MP140E

L-511 Linear Stage

User Manual

Version: 1.7.0

Date: 2022-11-14



This document describes the following linear stages:

- L-511.x0SD00:
with 2-phase stepper motor, without encoder
with sin/cos signal transmission
- L-511.xASD00:
with 2-phase stepper motor and linear encoder
with sin/cos signal transmission
- L-511.x0DG10:
with DC gear motor and rotary encoder
with A/B quadrature signal transmission
- L-511.x0AD10:
with ActiveDrive DC motor and rotary encoder
with A/B quadrature signal transmission
- L-511.x4AD00:
with ActiveDrive DC motor and linear encoder
with A/B quadrature transmission
- L-511.0y3111:
with DC motor and linear encoder
with sin/cos signal transmission
- L-511.0y3132:
with DC motor and rotary encoder
with A/B quadrature signal transmission
- L-511.0y5111:
with BLDC motor and linear encoder
with sin/cos signal transmission
- L-511.0y5132:
with BLDC motor and rotary encoder
with A/B quadrature signal transmission



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Original instructions

Version:: 2022-11-14

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Subject to change. This manual is superseded by any new release. The latest respective release is available for download on our website (<http://www.pi.ws>).

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	Pictures	2
1.5	Downloading Manuals.....	3
2	Safety	5
2.1	Intended Use	5
2.2	General Safety Instructions	5
2.3	Organizational Measures.....	5
3	Product Description	7
3.1	Model Overview	7
3.2	Product View	11
3.3	Direction of Motion.....	11
3.4	Product Labeling.....	12
3.5	Scope of Delivery.....	13
3.6	Accessories	14
3.7	Suitable Controllers.....	14
3.8	Technical Features.....	15
3.8.1	Encoder	15
3.8.2	Limit Switches.....	15
3.8.3	Reference Point Switch.....	15
3.8.4	Integrated PWM Amplifier	15
4	Unpacking	17
5	Installation	19
5.1	General Notes on Installation.....	19
5.2	Attaching the L-511 to a Surface	20
5.3	Connecting the L-511 to the Protective Earth Conductor.....	22
5.4	Affixing the Load to the L-511	24
5.5	Building a Multi-Axis System	26
5.5.1	General Notes on Building a Multi-Axis System	26
5.5.2	Building an XY System.....	27
5.5.3	Building a Z System.....	29
5.6	Connecting the L-511 to a Controller	33
5.7	Connecting the Power Adapter to the L-511.xxADx0.....	34

6	Startup	35
6.1	General Notes on Startup.....	35
6.2	Starting and Operating the Positioner	37
7	Maintenance	39
7.1	General Notes on Maintenance	39
7.2	Performing a Maintenance Measures.....	39
7.3	Cleaning the L-511.....	40
8	Troubleshooting	41
8.1	Possible Causes and Remedies.....	41
8.2	Moving the Platform by Hand	43
9	Customer Service Department	45
10	Technical Data	47
10.1	Specifications.....	47
10.1.1	Data Table.....	47
10.1.2	Maximum Ratings	56
10.1.3	Ambient Conditions and Classifications	56
10.1.4	Limit Switch Specifications	56
10.1.5	Reference Point Switch Specifications	57
10.2	Dimensions	58
10.2.1	L-511 Positioners	58
10.2.2	Hole Pattern of the Platform	63
10.2.3	L-500.AV1 Adapter Bracket	64
10.3	Pin Assignment	65
10.3.1	HD D-Sub 26 (m)	65
10.3.2	D-Sub 15 (m).....	68
10.3.3	D-Sub 9 (m).....	69
10.3.4	M8 4-pin (m).....	70
10.4	Tightening Torque for Screws, ISO 4762 - A2.....	70
11	Old Equipment Disposal	71
12	EU Declaration of Conformity	73

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-511.

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.

1.2 Symbols and Typographic Conventions

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

CAUTION



Dangerous situation

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

- 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

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
Load capacity	Maximum load capacity in the vertical direction when the stage is mounted horizontally. The contact point of the load is in the center of the platform.
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 (see 47) for models without a gearhead and brake only applies when the servo mode is on.
Linear encoder	The linear encoder is an incremental sensor for capturing changes in position. Signals from the sensor are used for axis position feedback. After the controller is switched on, a reference point definition must be performed before absolute target positions can be commanded and reached.

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 Downloading Manuals

INFORMATION

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

- Contact our customer service department (p. 45).

Downloading manuals

1. Open the website www.pi.ws.
2. Search the website for the product number (e.g., L-511).
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-511 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-511 is intended for single-axis positioning, adjusting and shifting of loads at different velocities. The L-511 is **not** intended for applications in areas, in which a failure would represent severe risks to human beings or the environment.

The L-511 is intended for horizontal or vertical mounting. For the load limits with vertical mounting, see "General Notes on Installation". (p. 19).

The intended use of the L-511 is only possible when completely mounted and connected.

The L-511 must be operated with a suitable controller (p. 14). The controller is not in the scope of delivery of the L-511.

2.2 General Safety Instructions

The L-511 is built according to state-of-the-art technology and recognized safety standards. Improper use of the L-511 may result in personal injury and/or damage to the L-511.

- Only use the L-511 for its intended purpose, and only use it if it is in perfect condition.
- Read the user manual.
- Eliminate any faults and malfunctions that are likely to affect safety immediately.

The operator is responsible for correct installation and operation of the L-511.

2.3 Organizational Measures

User manual

- Always keep this user manual available when using the L-511. The latest versions of the user manuals are available on our website (p. 5) for download.
- Add all information from the manufacturer such as supplements or technical notes to the user manual.
- If you give the L-511 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 minor injury and damage to equipment.
- Only install and operate the L-511 after you have read and understood this user manual.

Personnel qualification

The L-511 may only be installed, started, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

3 Product Description

INFORMATION

Meaning of the variable x and y in combined model designations

- The following applies to the L-511.x0AD10, L-511.x4AD00, L-511.x0DG10, L-511.x0SD00, L-511.xASD00 models:
x at the first position after the period indicates the travel range
(2: 52 mm, 4: 102 mm, 6: 155 mm)
- The following applies to the L-511.0y3111, L-511.0y3132, L-511.0y5111 models:
y at the second position after the period indicates the travel range
(3: 52 mm, 5: 102 mm, 7: 155 mm)

3.1 Model Overview

Classification of positioners

All L-511 models are electromotive linear positioning stages with precision ball screw. They differ with respect to:

- Travel range
- Drive type
- Encoder equipment

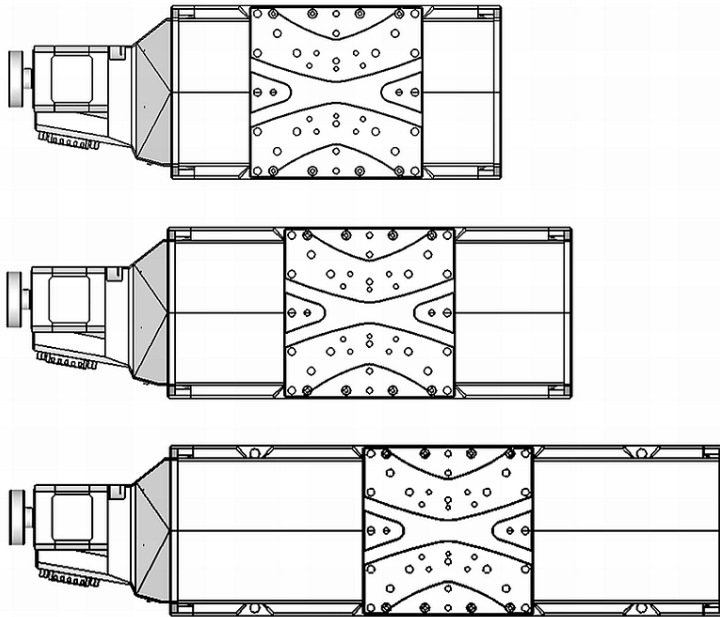
Travel range

Figure 1: Models with different travel ranges, example L-511.20SD00, L-511.40SD00, L-511.60SD00 (from top to bottom)

Models	Travel range in mm	Travel range in inches (approx.)
L-511.2xxxx0 / L-511.03xxxx	52	2
L-511.4xxxx0 / L-511.05xxxx	102	4
L-511.6xxxx0 / L-511.07xxxx	155	6

Drive type / Encoder equipment

L-511	Drive type					Encoder type	
	BLDC	DC motor	ActiveDrive	DC gearhead motor	Stepper motor	Linear encoder	Rotation encoder
.x0AD10*			+				+
.x4AD00*			+			+	
.x0DG10				+			+
.x0SD00					+		
.xASD00**					+	+	
.0y3111**		+				+	
.0y3132		+					+

L-511	Drive type					Encoder type	
	BLDC	DC motor	ActiveDrive	DC gearhead motor	Stepper motor	Linear encoder	Rotation encoder
.0y5111**	+					+	
.0y5132	+						+

* Separate power adapter connector

** Separate sensor connector

Detailed model overview

Order number	Product name
L-511.033111	Precision linear stage, 110 mm width, 52 mm travel range, DC motor, linear encoder with sin/cos signal transmission
L-511.033132	Precision linear stage, 110 mm width, 52 mm travel range, DC motor
L-511.035111	Precision linear stage, 110 mm width, 52 mm travel range, BLDC motor, linear encoder with sin/cos signal transmission
L-511.035132	Precision linear stage, 110 mm width, 52 mm travel range, BLDC
L-511.053111	Precision linear stage, 110 mm width, 102 mm travel range, DC motor, linear encoder with sin/cos signal transmission
L-511.053132	Precision linear stage, 110 mm width, 102 mm travel range, DC motor
L-511.055111	Precision linear stage, 110 mm width, 102 mm travel range, BLDC, linear encoder with sin/cos signal transmission
L-511.055132	Precision linear stage, 110 mm width, 102 mm travel range, BLDC
L-511.073111	Precision linear stage, 110 mm width, 155 mm travel range, DC motor, linear encoder with sin/cos signal transmission
L-511.073132	Precision linear stage, 110 mm width, 155 mm travel range, DC motor
L-511.075111	Precision linear stage, 110 mm width, 155 mm travel range, BLDC, linear encoder with sin/cos signal transmission
L-511.075132	Precision linear stage, 110 mm width, 155 mm travel range, BLDC
L-511.20AD10	Precision linear stage, 110 mm width, ActiveDrive DC motor, 52 mm (2") travel range, optical limit switches
L-511.20DG10	Precision linear stage, 110 mm width, DC gear motor, 52 mm (2") travel range, optical limit switches
L-511.20SD00	Precision linear stage, 110 mm width, 2-phase stepper motor, 52 mm (2") travel range, optical limit switches
L-511.24AD00	Precision linear stage, 110 mm width, ActiveDrive DC motor, 52 mm (2") travel range, linear encoder with A/B quadrature signal transmission, optical limit switches

Order number	Product name
L-511.2ASD00	Precision linear stage, 110 mm width, 2-phase stepper motor, 52 mm (2") travel range, linear encoder with sin/cos signal transmission, optical limit switches
L-511.40AD10	Precision linear stage, 110 mm width, ActiveDrive DC motor, 102 mm (4") travel range, optical limit switches
L-511.40DG10	Precision linear stage, 110 mm width, DC gear motor, 102 mm (4") travel range, optical limit switches
L-511.40SD00	Precision linear stage, 110 mm width, 2-phase stepper motor, 102 mm (4") travel range, optical limit switches
L-511.44AD00	Precision linear stage, 110 mm width, ActiveDrive DC motor, 102 mm (4") travel range, linear encoder with A/B quadrature signal transmission, optical limit switches
L-511.4ASD00	Precision linear stage, 110 mm width, 2-phase stepper motor, 102 mm (4") travel range, linear encoder with sin/cos signal transmission, optical limit switches
L-511.60AD10	Precision linear stage, 110 mm width, ActiveDrive DC motor, 155 mm (6") travel range, optical limit switches
L-511.60DG10	Precision linear stage, 110 mm width, DC gear motor, 155 mm (6") travel range, optical limit switches
L-511.60SD00	Precision linear stage, 110 mm width, 2-phase stepper motor, 155 mm (6") travel range, optical limit switches
L-511.64AD00	Precision linear stage, 110 mm width, ActiveDrive DC motor, 155 mm (6") travel range, linear encoder with A/B quadrature signal transmission, optical limit switches
L-511.6ASD00	Precision linear stage, 110 mm width, 2-phase stepper motor, 155 mm (6") travel range, linear encoder with sin/cos signal transmission, optical limit switches

3.2 Product View

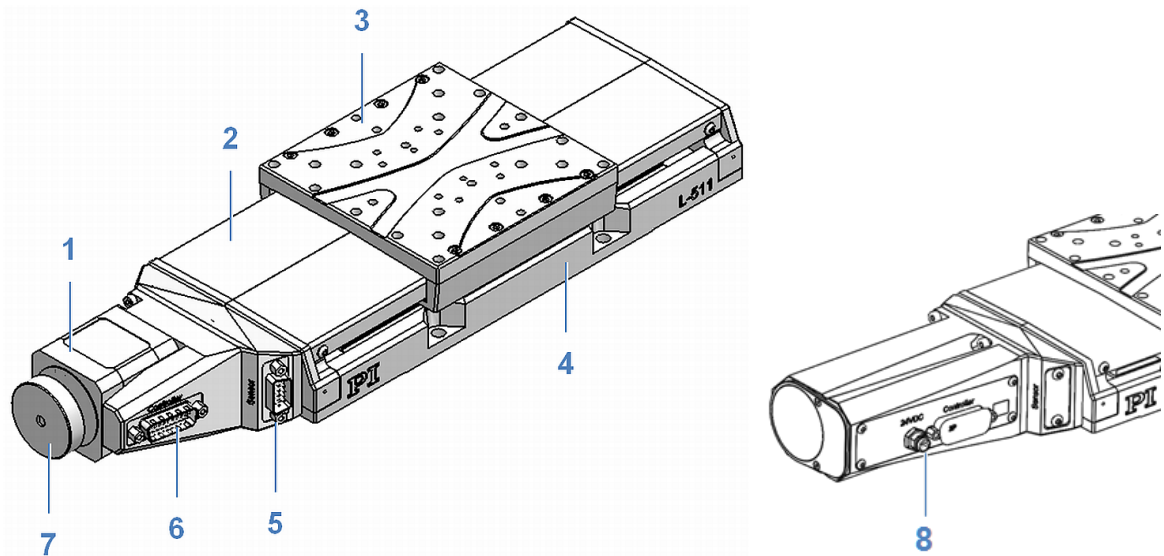


Figure 2: Parts of the L-511

- 1 Motor module (shape depending on model type)
- 2 Protective cover
- 3 Platform
- 4 Base body
- 5 Linear encoder connector (D-Sub 9 panel plug; L-511.xASD00, L-511.x0AD10, L-511.0y3111, and L-511.0y5111 models only)
- 6 Motor connector (HD D-Sub 26 panel plug; for L-511.xxADx0 models: D-Sub 15)
- 7 Vibration absorption (L-511.xxSD00 models only)
- 8 Power adapter connector (L-511.xxAD00 models only)

3.3 Direction of Motion

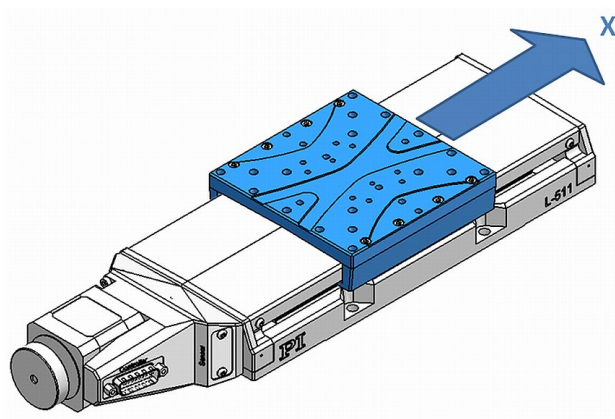


Figure 3: Direction of motion of the platform

X (arrow direction:) Direction of motion on positive command

3.4 Product Labeling

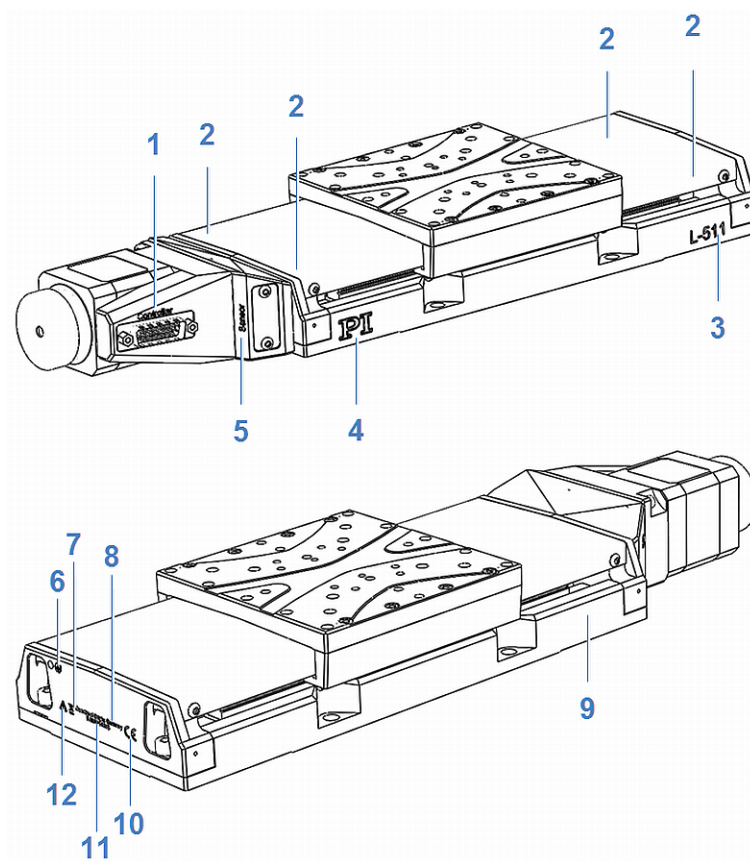








Figure 4: Product labeling

Position	Labeling	Description
1	Controller	Motor connector
2		Warning sign "Risk of crushing": Reference to dangerous forces (p. 35)
3	L-511	Product series
4		Manufacturer's logo
5	Sensor	Linear encoder connector (L-511.xASD00; L-511.0y5111 models only)
6		Protective earth symbol, marks the protective earth connection of the L-511 (p. 22)
7, 9		Old equipment disposal
8, 9	Country of origin: Germany	Country of origin
9	L-511.20SD00	Product name (example), the characters after the period refer to the model

Position	Labeling	Description
9	415002159	Serial number (example), individual for each L-511 Meaning of the places (counting from left): 1 = internal information, 2 and 3 = year of manufacture, 4 to 9 = consecutive numbers
9, 10		CE conformity mark
9, 11	WWW.PI.WS	Manufacturer's address (website)
9, 12		Warning sign "Observe manual!"

3.5 Scope of Delivery

Item number	Component	Delivered with L-511	
L-511.xxxxxx	Stage according to the order (p. 7)	.x0SD00 .xASD00 .x0DG10 .0y3111 .0y3132 .0y5111 .0y5132	.x0AD10 .x4AD00
62365200 (for L-511.2xxxxx, L-511.4xxxxx, L-511.03yyyy, L-511.05yyyy) or 62365201 (for L-511.6xxxxx, L-511.07yyyy)	Screw set for mounting the positioner Socket head screws ISO 4762 M6x12 62365200: 4 screws, 62365201: 8 screws 2 dowel pins, ISO 2883 4h8 x 10 Washers DIN 433-6 62365200: 4 washers 62365201: 8 washers	+	+
MP146EK	Short instructions for stages with electric motors	+	+
7300900006-0180	ActiveDrive supply cable set: <ul style="list-style-type: none"> Wide-range power adapter secondary, 24V DC / 120 W Power cord, 1.80 m Adapter, barrel connector to M8 socket 		+

3.6 Accessories

Order number	Description
L-500.AV1	Adapter bracket for vertical mounting of L-511 positioners, included <ul style="list-style-type: none"> 10 socket head screws ISO 4762 M6x10 2 dowel pins, ISO 2338 - 4h8 x 8

➤ To order, contact the customer service department (p. 45).

3.7 Suitable Controllers

	C-663.12	C-863	C-891	C-884	C-885 with C-663. 12C885	C-885 with C-891. 11C885	C-885 with C-863. 20C885	Modular ACS controller
Motion axes per controller (max.)	1	1	1	6	20	20	40	
PC interfaces	USB, RS-232, daisy chain network	USB, RS-232, LAN	RS-232, LAN	RS-232, LAN	USB, LAN	USB, LAN	USB, LAN	USB, LAN
Multiple controllers on the same PC	+	+	+	+	+	+	+	+
L-511.x0SD00	+				+			+
L 511.xASD00	+				+			+
L 511.x0DG10		+		+			+	+
L 511.x4AD00		+		+			+	
L 511.x0AD10		+		+			+	
L 511.0y3111		+		+			+	+
L-511.0y3132		+		+			+	+
L-511.0y5111								+
L-511.0y5132			+			+		+

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.

3.8 Technical Features

3.8.1 Encoder

The L-511.x0SD00 models do not have an encoder.

Linear encoder

The L-511.0y3111, L-511.0y5111, L-511.xASD0, and L-511.x4AD00 models are equipped with an optical linear encoder. For the encoder resolution, refer to the table in the "Specifications" section (p. 47).

Optical linear encoders measure the actual position directly (direct metrology). Errors occurring in the drive, such as nonlinearity, backlash or elastic deformations cannot influence measuring of the position.

Rotary encoder

The L-511.0y3132, L-511.0y5132, L-511.x0DG10, and L-511.x0AD10 models are equipped with an incremental 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.

For the encoder resolution, refer to the table in the "Specifications" section (p. 47).

3.8.2 Limit Switches

The L-511 is equipped with optical 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. 56).

3.8.3 Reference Point Switch

The stage is equipped with one direction-sensing reference point switch that is located at about the midpoint of the travel range. This sensor provides a TTL signal indicating whether the stage is on the positive or negative side of the reference point switch.

See the controller user manual and/or associated software manuals for the commands that make use of the reference point signal.

3.8.4 Integrated PWM Amplifier

The L-511.x4AD00 and L-511.x0AD10 models are equipped with a PWM amplifier ("ActiveDrive Concept"). The motor and PWM amplifier are installed in a common housing and therefore optimally integrated and shielded. The PWM amplifier only receives the control signals from the controller, whereas the supply voltage is provided via an external power adapter. The ActiveDrive concept allows high motor power and dynamics at low power loss.

4 Unpacking

NOTICE



Electrostatic hazard

Touching the pins in the connectors of the L-511 can damage the electrostatic sensitive devices (ESD) of the L-511. For this reason, the L-511 is supplied with ESD protection on all connections.

- Do not remove the ESD protection from the connections until you connect the L-511 to the controller.

1. Unpack the L-511 with care.
2. Do **not** remove the ESD protection from any of the L-511 connectors.
3. Compare the contents with the items listed in the contract and the packing list.
4. Inspect the contents for signs of damage. If there is any sign of damage or missing parts, contact PI immediately.
5. Keep all packaging materials and the ESD protection in case the product needs to be returned.

5 Installation

5.1 General Notes on Installation

NOTICE

**Unwanted changes in position with vertical mounting!**

If the load exceeds the self-locking of the drive when the positioner is mounted vertically, unwanted changes in the position of the platform occur. Unintentional changes in the position of the platform can damage the drive, the load or the environment.

- When a positioner is mounted vertically, make sure that the installed load is lower than the self-locking of the drive (see specification of the holding force in "Data table" (p. 47)).

NOTICE

**Electrostatic hazard**

Touching the pins in the connectors of the L-511 can damage the electrostatic sensitive devices (ESD) of the L-511. For this reason, the L-511 is supplied with ESD protection on all connections.

- Do not remove the ESD protection from the connections until you connect the L-511 to the controller.

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.

**Heating of the L-511 during operation!**

The heat produced during operation of the L-511 can affect your application.

- Install the L-511 so that the application is not impaired by dissipating heat.

INFORMATION

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

INFORMATION

The use of locating pins during mounting reduces deviations from the ideal alignment of the positioner.

- If possible, simulate the motion of the positioner 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-511 to a Surface

NOTICE**Warping of the L-511 due to mounting on uneven surfaces!**

Mounting the L-511 on an uneven surface can warp the L-511. Warping reduces the accuracy.

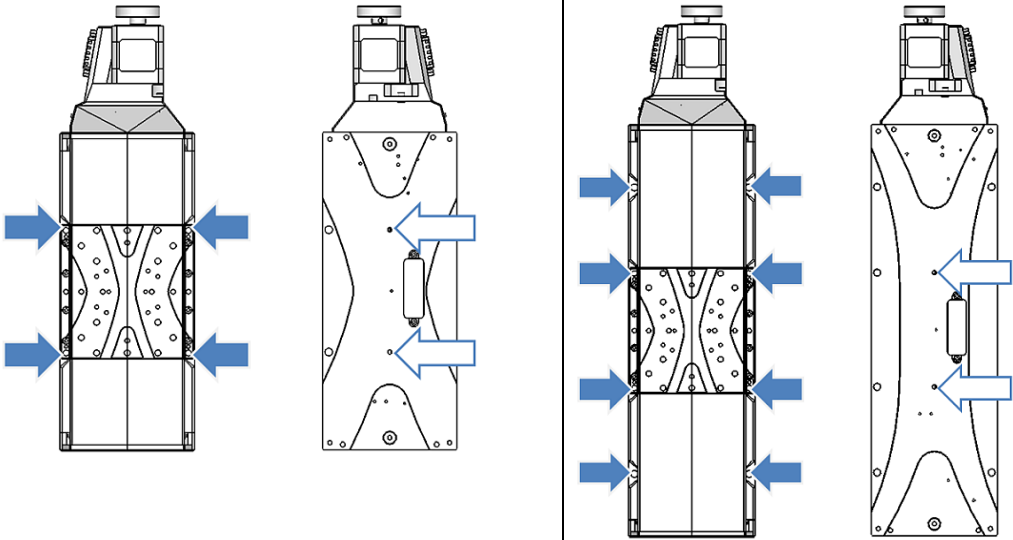
- Mount the L-511 onto a flat surface. The recommended flatness of the surface is $\leq 2 \mu\text{m}$.
- For applications with large temperature changes:
Only mount the L-511 on surfaces that have the same or similar thermal expansion properties as the L-511.

INFORMATION

For mounting onto a surface, the L-511 has mounting holes for M6 screws in its base body. The number depends on the model:

- L-511.2xSD00, L-511.4xSD00, L-511.03xxxx, L-511.05xxxx: **4** mounting holes
- L-511.6xSD00, L-511.07xxxx: **8** mounting holes

The correct number of screws and washers is in the scope of delivery of the L-511.

Position of the holes for alignment and mounting of the positioner	
Top (left) and bottom (right) respectively; dark arrows: mounting holes, light arrows: locating holes)	
	
L-511.03yyyy, L-511.05yyyy, L-511.2xxxxx and L-511.4xxxxx models (example L-511.40SD00)	L-511.07yyyy L-511.6xxxxx models (example L-511.60SD00)

Requirements

- ✓ You have read and understood the general notes on installation (p. 19).
- ✓ 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. 58)):
 - Four or eight M6 threaded holes are present (depends on the model).
 - If you use locating pins to align the stage: Two 4 mm \varnothing locating holes are present.
 - The surface flatness is $\leq 2 \mu\text{m}$.
 - For applications with large temperature changes: The surface should have the same or similar thermal expansion properties as the L-511 (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. 13)
 - 4 or 8 socket head screws, ISO 4762 M6x12
 - 4 or 8 washers DIN 433-6
 - 2 dowel pins, ISO 2338 4h8 \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. Allow access to the mounting holes in the base body of the positioner. Possible measures:
 - Temporary startup of the positioner (p. 35) and commanding the platform to a suitable position
 - Moving the platform by hand (page 43)
 3. Place washers on all accessible mounting holes.
 4. Insert the screws into all accessible mounting holes and tighten.
 5. Repeat steps 2 to 4 for all concealed mounting holes.
 6. Check that the positioner is affixed firmly to the surface.

5.3 Connecting the L-511 to the Protective Earth Conductor**INFORMATION**

It is only necessary to connect the L-511 to the protective earth conductor when both of the following conditions are met:

- The load on the motion platform of the L-511 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.

There is an M4 hole on the front of the L-511 for connecting the protective earth conductor. In the following figure, this hole is marked with an arrow.

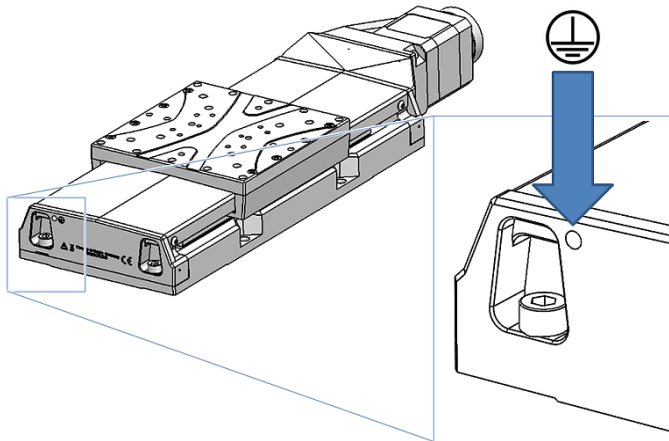


Figure 5: Position of the hole for the protective earth connection

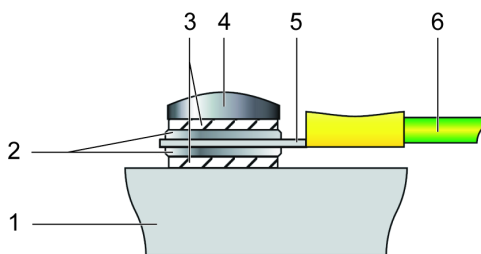


Figure 6: Mounting of the protective earth conductor (profile view)

- 1 Base body of the L-511
- 2 Flat washer
- 3 Safety washer
- 4 Screw
- 5 Cable lug
- 6 Protective earth conductor

Requirements

- ✓ You have read and understood the general notes on installation (p. 19).

Tools and accessories

- Suitable protective earth conductor: Cable cross section $\geq 0.75 \text{ mm}^2$
- Screw, M4x8, ISO 7045
- 2 washers ISO 7089-4
- 2 safety washers S4
- Suitable screwdriver

Connecting the L-511 to the protective earth conductor

1. If necessary, attach a suitable cable lug to the protective earth conductor.
2. Affix the cable lug of the protective earth conductor using the M4 screw on the protective earth connection of the L-511 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 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-511

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. 47).

NOTICE



Excessively long screws!

Screws and locating pins that are inserted too deeply can damage the lower stage.

- Pay attention the depth of the mounting holes in the platform of the lower positioner (p. 58).
- Only use screws and locating pins of the correct length for the respective mounting holes.

Requirements

- ✓ You have read and understood the general notes on installation (p. 19).
- ✓ You have mounted the stage onto a surface properly (p. 20).
- ✓ 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. 60):
 - 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 or four attachment points).
 - If you use locating pins for aligning the load: Make sure that there are locating holes of $\varnothing 3 \text{ mm H7}$ or $\varnothing 4 \text{ mm H7}$ in the load for accommodating locating pins.

Tools and accessories

- At least 2 screws of suitable length. Options:
 - M3 screws
 - M4 screws
- Suitable tool for tightening the screws
- Optional: At least 2 locating pins of a suitable length for aligning the load on the L511. Options:
 - Dowel pins, ISO 2338 3h8
 - Dowel pins, ISO 2338 4h8

Affixing the load

1. Align the load so that the selected mounting holes in the platform can be used to affix it (p. 60).
If you use locating pins to align the load:
 - a) Insert the locating pins into the locating holes in the platform.
 - b) Place the load on the platform so that the locating pins are inserted into the corresponding locating holes on the other side.
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 Building a Multi-Axis System

The L-511 can be used in multi-axis systems.

Typical combinations:

- XY system (p. 27)
- Z system (XZ or XYZ combination) (p. 29)
- For possible combinations with other positioners, contact our customer service department. (p. 45).

5.5.1 General Notes on Building a Multi-Axis System

NOTICE



Impermissibly high load on the positioners!

In a multi-axis system, the stage used for the Y and/or Z axis must also be moved. Impermissibly high loads impair the motion and can damage the stages.

- Include the masses of the positioner and the mounting adapters (p. 13) in the calculation of the load to be moved.
- For all stages in a multi-axis system: Do **not** exceed the maximum permissible load.
- When the positioner is mounted vertically, make sure that the installed load is lower than the self-locking of the drive.

-
- Only install and operate the multi-axis system after you have read and understood the user manuals for all components of the multi-axis system.
 - If you need special mounting adapters, contact our customer service department (p. 45).

5.5.2 Building an XY System

NOTICE

**Excessively long screws!**

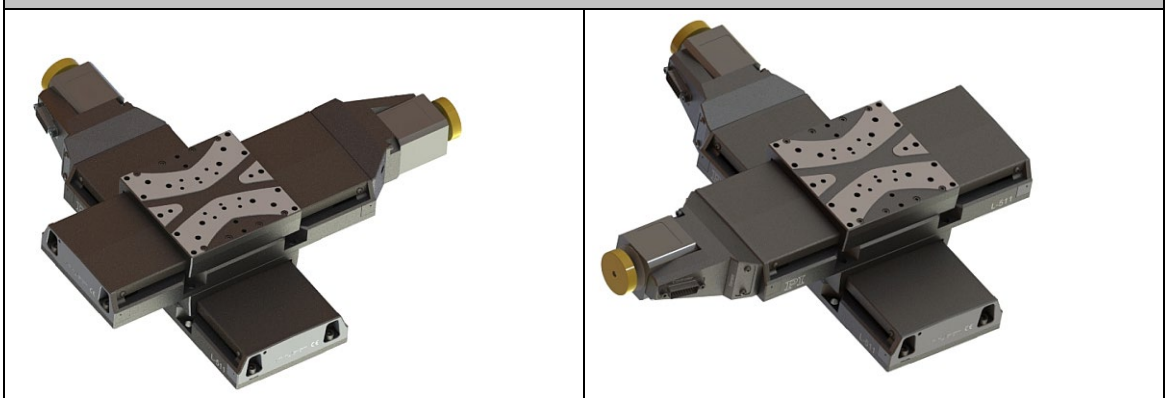
Screws and locating pins that are inserted too deeply can damage the lower stage.

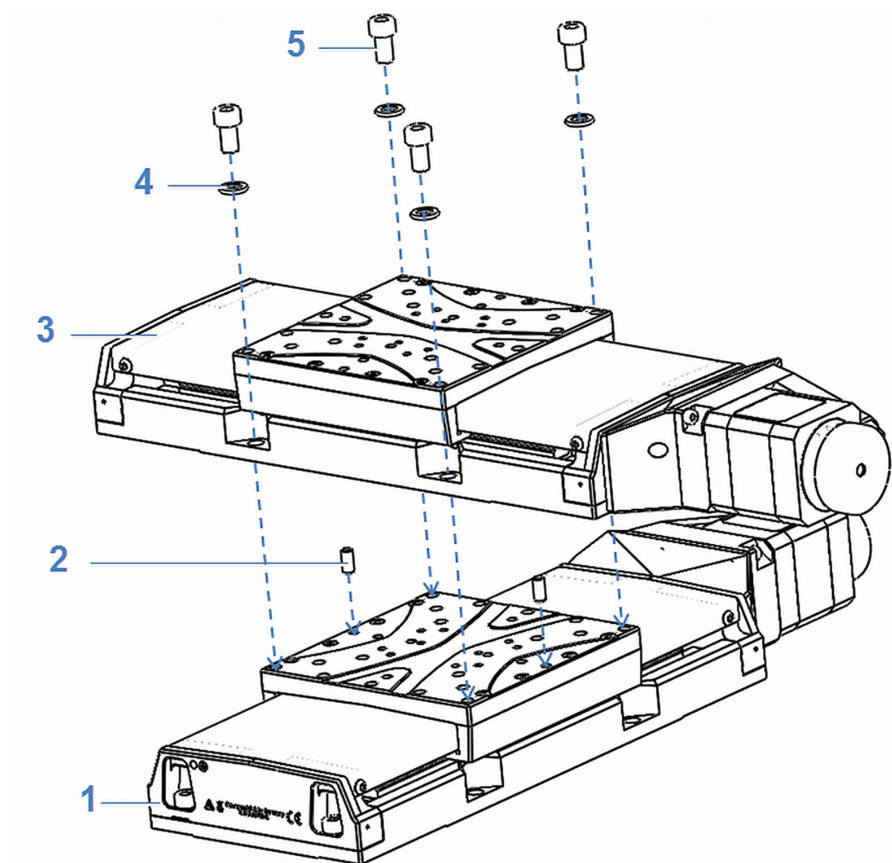
- Pay attention the depth of the mounting holes in the platform of the lower positioner (p. 58).
- Only use screws and locating pins of the correct length for the respective mounting holes.

Designations in these instructions:

- **Lower stage:** Forms the basis of the multi-axis system (X axis), is attached to a surface
- **Upper stage:** Forms the Y axis of the multi-axis system, is attached to the lower stage rotated by 90°

Examples of XY systems consisting of two L-511s





- 1 Lower positioner
- 2 Locating pin 4 m6 × 10
- 3 Upper positioner
- 4 Washer
- 5 M6x12 screw

Requirements

- ✓ You have read and understood the general notes on installation (p. 19).
- ✓ You have read and understood the general notes on building a multi-axis system (p. 26).
- ✓ You have accounted for the space required to route cables without bending and according to regulations.
- ✓ You have mounted the lower stage onto a surface properly. (p. 20).

Tools and accessories

- Mounting kit from the scope of delivery of the upper positioner
 - 4 screws, ISO 4762 M6x12
 - 4 washers DIN 433-6
 - 2 dowel pins, ISO 2338 4h8 × 10, for use as locating pins
- Hex key, AF 5

Building an XY System

1. Insert the two locating pins into the locating holes in the platform of the lower L-511 (see figure above).
2. Place the upper L-511 on the lower L-511 so that the locating pins are inserted into the corresponding locating holes on the other side.
3. Allow access to two of the required mounting holes in the base body of the positioner. Possible measures:
 - Temporary startup of the upper positioner (p. 35) and commanding the platform to a suitable position
 - Moving the platform by hand (p. 43)
4. Mount the upper L-511 on the two accessible mounting holes on the lower L-511:
 - a) Place washers on the mounting holes.
 - b) Tighten all screws in the mounting holes.
5. Repeat steps 3 and 4 for the two other required mounting holes in the base body of the upper positioner.
6. Check that the upper positioner is affixed firmly.

5.5.3 Building a Z System

NOTICE



Excessively long screws!

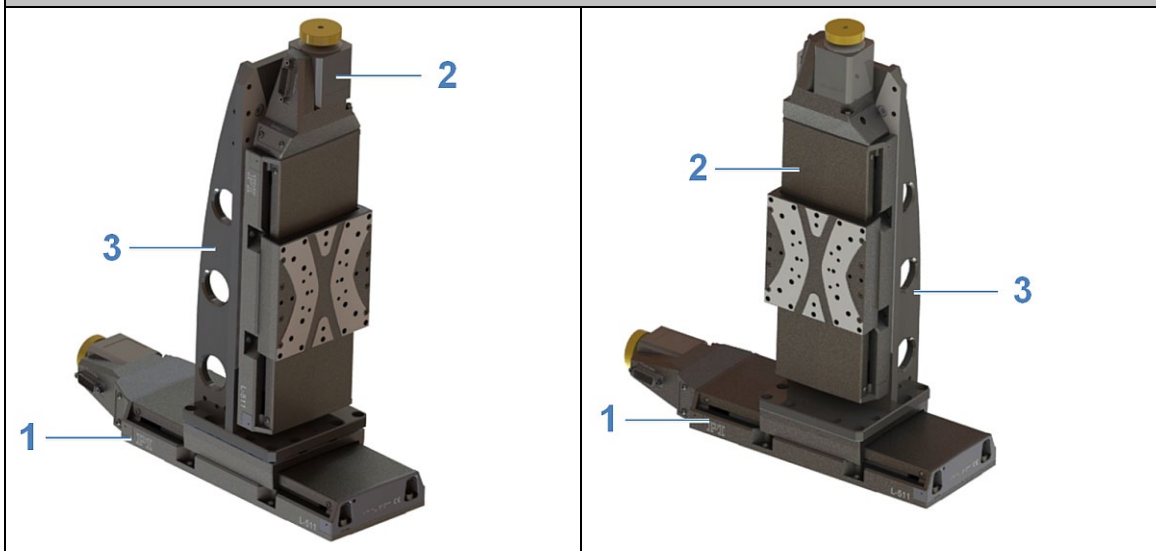
Screws and locating pins that are inserted too deeply can damage the lower stage.

- Pay attention the depth of the mounting holes in the platform of the lower positioner (p. 58).
- Only use screws and locating pins of the correct length for the respective mounting holes.

Designations in these instructions:

- **Lower stage:** X axis in an XZ combination; Y axis in an XYZ combination. The stage on which the upper stage is mounted using an adapter bracket.
- **Upper stage:** Forms the Z axis of the multi-axis system, is mounted in a vertical alignment to the lower stage with an adapter bracket.

Examples of XZ systems consisting of two L-511 and an adapter bracket



- 1 Lower positioner
- 2 Upper positioner
- 3 Adapter bracket

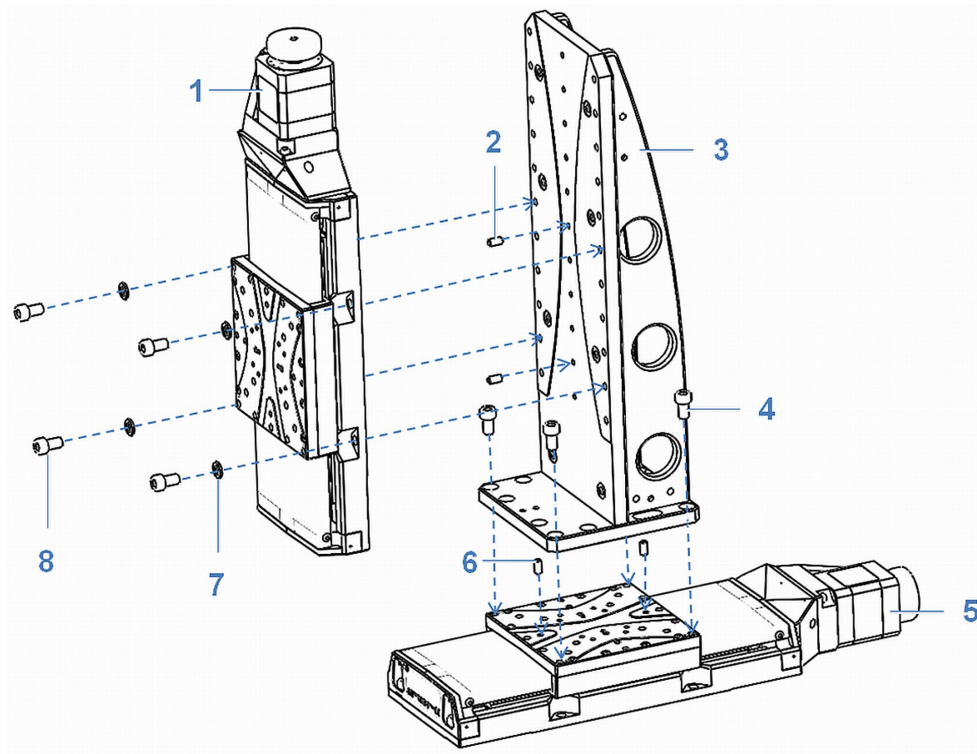
Requirements

- ✓ You have read and understood the general notes on installation (p. 19).
- ✓ You have read and understood the general notes on building a multi-axis system (p. 26).
- ✓ You have accounted for the space required to route cables without bending and according to regulations.
- ✓ If you build an XZ combination: You have mounted the lower positioner onto a surface properly (p. 20).
- ✓ If you build an XYZ combination: You have attached the stages for the X and Y axis properly (p. 27).

Tools and accessories

- L-500.AV1 adapter bracket, available as optional accessory (p. 13):
- Mounting kit from the scope of delivery of the upper positioner:
 - 4 or 8 socket head screws, ISO 4762 M6x12
 - 2 dowel pins, ISO 2338 4h8 x 10, for use as locating pins
- Mounting kit from the scope of delivery of the adapter bracket:
 - 4 socket head screws, ISO 4762 M6x10
 - 2 dowel pins, ISO 2338 4h8 x 8, for use as locating pins
- Hex key, AF 5

Building a Z system



- 1 Upper positioner
- 2 Locating pin 4 m6 × 10
- 3 Adapter bracket
- 4 M6x10 screw
- 5 Lower positioner
- 6 Locating pin 4 m6 × 8
- 7 Washer
- 8 M6x12 screw

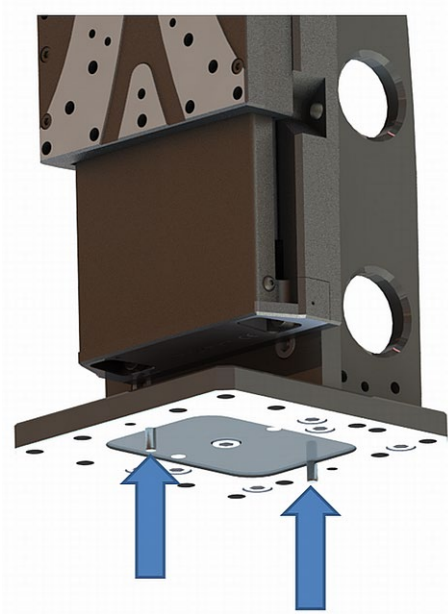


Figure 7: Inserting the locating pins

1. Mount the short side of the adapter bracket onto the motion platform of the lower positioner:
 - a) (Optional:) Insert the locating pins 4 m6 × 8 into the locating holes in the short side of the adapter bracket from below and up to approx. 2/3 of their length (see figure above).
 - b) Place the short side of the adapter bracket on the platform of the lower positioner so that the locating pins are inserted into the corresponding locating holes in the platform.
 - c) Insert four M6x10 screws into the mounting holes of the adapter bracket.
 - d) Insert the four screws and tighten.
2. Check that the adapter bracket and the lower stage are affixed firmly.
3. Mount the upper stage to the long side of the adapter bracket:
 - a) Align the upper stage so that the motor module points away from the origin of the sides of the adapter bracket; i.e., upwards in the Z system.
 - b) (Optional:) Insert the locating pins 4 m6 × 10 into the locating holes in the long side of the adapter bracket.
 - c) Place the stage on the long side of the adapter bracket so that the locating pins are inserted into the corresponding locating holes on the other side.
 - d) Mount the stage with four or eight M6x12 screws by performing steps 3 to 6 in the instructions "Setting up an XY System" for all mounting holes. (p. 27).
4. Check that the adapter bracket and the upper stage are affixed firmly.

5.6 Connecting the L-511 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. 14).
- Use the cables that were supplied with your order and your specific positioner/controller combination to connect the positioner to the controller.

Requirements

- ✓ You have read and understood the general notes on installation (p. 19).
- ✓ You have installed the controller.
- ✓ You have read and understood the user manual for the controller.
- ✓ The controller is switched off.

Tools and accessories

- Cable from the scope of delivery of the positioner (p. 13)
- Suitable tools for tightening the screws to the connections

Connecting the L-511 to a controller

1. Remove the ESD protection from all connections of the L-511.
2. Connect the L-511 and the controller to each other.
3. Use the integrated screws to secure the connections against accidental disconnection.

5.7 Connecting the Power Adapter to the L-511.xxADx0

Connecting a power adapter is only necessary for the L-511.x0AD10 and L-511.x4AD00 models.

Requirements

- ✓ The power cord is **not** connected to the power socket.

Tools and accessories

- Supplied components:
 - 24 V wide input range power supply
 - Adapter for the power adapter connection; barrel connector, 5.5 mm x 2.1 mm to M8 4-pin (f)
 - Power cord
- If one of the components supplied for connecting to the power supply has to be replaced: Use a sufficiently measured and certified replacement component. Details:
 - Power adapter: Output 24 V DC, maximum output current 5 A
 - Power cord: Three wires, cable cross section at least $3 \times 0.75 \text{ mm}^2$ ($3 \times \text{AWG18}$), maximum length 2 m

Connecting the power adapter to the L-511

- Connect the M8 connector (f) of the adapter to the M8 panel plug of the L511.
- Connect the barrel connector of the adapter to the barrel connector socket of the power adapter.
- Connect the power cord to the power adapter.

6 Startup

6.1 General Notes on Startup

CAUTION

**Risk of crushing by moving parts!**

Risk of minor injury from crushing between the parts of the positioner or the load and a fixed part or obstacle.

- Use safeguards to protect limbs in areas where they could be caught by parts.
- Observe the safety distances in accordance with DIN EN ISO 13857 when installing protective structures.

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 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 the stage to a suitable controller (p. 14).
- Use the cables that were supplied with your order and your specific positioner/controller combination to connect the positioner to 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-511.

- Do **not** exceed the operating voltage range (p. 56) that is specified for the L-511.
- Operate the L-511 only when the operating voltage is properly connected; see "Pin Assignment" (p. 65).

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-511 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 parts.
- Before connecting the L-511, 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 an L-511.x0SD00 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 point 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 point switch.

For L-511.xASD00 models:

INFORMATION

Improper setting of the servo control parameters can impair the performance of the L-511. This can have the following consequences:

- Oscillation
- Imprecise approach of the position
- Settling time is too long

If the performance of the L-511 is not satisfactory, check the settings for the servo control parameters of your controller.

6.2 Starting and Operating the Positioner

Requirements

- ✓ You have read and understood the general notes on startup (p. 35).
- ✓ When starting and operating with a load or in a multi-axis system: You have installed the stage properly (p. 26).
- ✓ 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-511 to the Controller" (p. 33) 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):
 - If you use a controller from PI: Select the entry in the positioner database that exactly fits the positioner model used (p. 37).
 - If you use a controller from another manufacturer: Enter the parameters in the corresponding PC software that exactly fit the positioner model.
2. Start a few motion cycles for testing purposes (see user manual for the controller).

7 Maintenance

7.1 General Notes on Maintenance

NOTICE

**Damage due to improper maintenance!**

Improper maintenance can result in misalignment and failure of the L-511.

- Only loosen screws according to the instructions in this manual.

7.2 Performing a Maintenance Measures

Depending on the operating conditions and the period of use of the L-511, 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 you operate your stage continuously over only a short travel range (<20% of the entire travel range), perform a run across the entire travel range approximately every 2000 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. 45).

7.3 Cleaning the L-511

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-511 onto a flat surface. The recommended flatness of the surface is $\leq 2 \mu\text{m}$.
	When the L-511 is mounted vertically: The load exceeds the self-locking of the drive.	➤ Reduce the load. Make sure that the self-locking (see specification of the holding force in the data table) of the drive is not exceeded (p. 47)).
	Increased wear due to small motion over a long period of time	➤ Perform a maintenance run over the entire travel range (p. 39).
Impairment of the function after system modification	<ul style="list-style-type: none"> ▪ Controller was replaced. ▪ The LS511 was replaced by another model. 	<p>Controller from PI:</p> <ul style="list-style-type: none"> ➤ Load the parameters from the positioner database that correspond to the combination of controller and the L-511 model. <p>Controller from a third-party supplier:</p> <ul style="list-style-type: none"> ➤ Check the operating parameters.

Problem	Possible causes	Solution
Mechanical system does not move; no operating noise can be heard.	Controller not correctly connected or defective.	<ul style="list-style-type: none"> ➤ Check all connecting cables. ➤ Check the controller.
	When a PI controller is used: Axis motion error.	<p>Motion error = The difference between the current position and the commanded position exceeds the specified maximum value in closed-loop operation. Motion errors can be caused for example, by malfunctions of the drive or the position sensor of the stage.</p> <ol style="list-style-type: none"> 1. Read out the error code of the controller in the PC software. If there is a motion error, error code -1024 is output. 2. Check your system and make sure that all axes can be moved safely. 3. Switch on the servo mode for the affected axis in the PC Software. <p>For details, see the user manual for the controller.</p>
	Platform has triggered the limit switch.	<p>If you use a controller from PI:</p> <ol style="list-style-type: none"> 1. Switch on the servo mode for the affected axis again in the PC software. 2. Command an axis motion away from the limit switch in the PC software.
For L-511.x0SD00 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"> ➤ Use a stepper motor in the application to determine the maximum velocity for a stage. ➤ Start a new reference move.

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. 45).

8.2 Moving the Platform by Hand

It is **only** possible to move the L-511.xxSD00 models by hand.

INFORMATION

It can be necessary to move the platform by hand to provide access to mounting holes for mounting screws in the base body of the positioner.

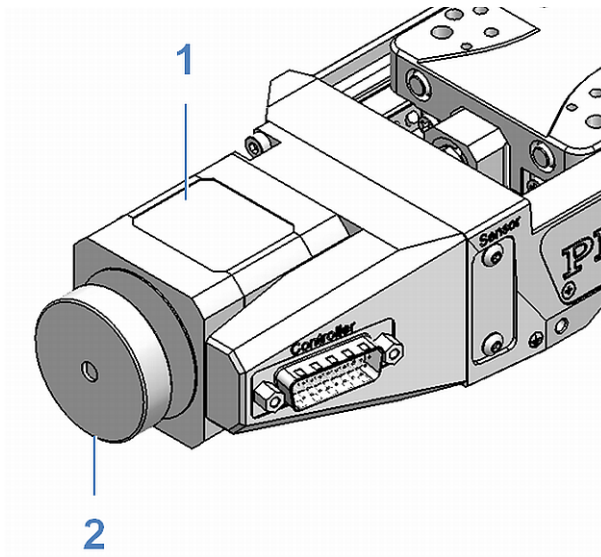


Figure 8: Position of the vibration absorber

- 1 Motor
- 2 Vibration absorber

Requirements

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

Moving the platform by hand

- Turn the vibration absorber as far as necessary:
 - Clockwise rotation: Platform moves away from the motor
 - Counterclockwise rotation: Platform moves in the direction of the motor

The rotary motion is transferred directly to the drive screw.

9 Customer Service Department

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 codes 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.

10 Technical Data

10.1 Specifications

10.1.1 Data Table

General specifications	L-511	Unit	Tolerance
Active axes	X		
Drive screw type	Ball screw		
Drive screw pitch	2	mm	
Guide type	Recirculating ball bearing guide		
Load capacity	500	N	Max.
Permissible lateral force	250	N	Max.
Permissible torque M_x in θX	60	Nm	Max.
Permissible torque M_y in θY	30	Nm	Max.
Permissible torque M_z in θZ	30	Nm	Max.
Reference and limit switches	Optical		
Material	Aluminum, stainless steel		
Operating temperature range	5 to 40	°C	

Travel range-dependent specifications	L-511.2 / L-511.03	L-511.4 / L-511.05	L-511.6 / L-511.07	Unit	Tolerance
Travel range	52	102	155	mm	
Pitch / yaw	±40	±60	±70	μrad	typ.
Straightness / flatness	±1.5	±2.5	±3.0	μm	typ.
Moved mass, unloaded	0.6	0.6	0.65	kg	±5%
Mass					
DC gear motor	2.5	2.7	2.9	kg	±5%
Active Drive DC motor with rotary encoder	2.5	2.8	3.3	kg	±5%
Active Drive DC motor with linear encoder	2.5	2.7	3.5	kg	±5%
BLDC motor / BLDC motor with linear encoder	2.4	2.7	3.0	kg	±5%
Stepper motor / stepper motor with linear encoder	2.4	2.6	3.1	kg	±5%

DC motor and encoder options	DC gear motor with rotary encoder L-511.x0DG10	ActiveDrive DC motor with rotary encoder L-511.x0AD10	ActiveDrive DC motor with linear encoder L-511.x4AD00	Unit	Tolerance
System resolution	17	122	50	nm	
Unidirectional repeatability	0.2	0.488	0.1	μm	Typ.
Bidirectional repeatability	±2	±1.250	±0.2	μm	Typ.
Minimum incremental motion	0.1	0.488	0.1	μm	Typ.
Maximum velocity	6	90	90	mm/s	
Drive force	100	100	100	N	Max.
Holding force (passive)	50	—	—	N	Typ.
Limit switch	Forked photoelectric sensor, N/C contact, 5V, NPN	Forked photoelectric sensor, N/C contact, 5V, TTL	Forked photoelectric sensor, N/C contact, 5V, TTL		
Gear ratio	2401:81	—	—		
Motor encoder	Incremental rotary encoder	Incremental rotary encoder	—		
Motor encoder: Sensor resolution	4096	16384	—	Cts./rev	
Motor encoder: Sensor signal	A/B quadrature, TTL	A/B quadrature, TTL	A/B quadrature, TTL		
Linear encoder	—	—	Incremental linear encoder		
Sensor resolution linear encoder	—	—	50	nm	
Sensor signal linear encoder	—	—	A/B quadrature, TTL		
Motor type	DC gear motor	ActiveDrive DC motor (PWM)	ActiveDrive DC motor (PWM)		
Operating voltage, nominal	12	24	24	V	Nom.
Operating voltage, max.	24	48	48	V	Max.
Resistance**	4.09	1.63	1.63	Ω	Typ.
Inductance**	0.18	0.27	0.27	mH	Typ.
Back EMF	1.68	3.95	3.95	V/kRPM	Max.
Number of pole pairs	—	—	—		

DC motor and encoder options	DC gear motor with rotary encoder L-511.x0DG10	ActiveDrive DC motor with rotary encoder L-511.x0AD10	ActiveDrive DC motor with linear encoder L-511.x4AD00	Unit	Tolerance
Motor resolution	—	—	—	Full steps/r ev.	
Connector	HD D-sub 26 (m)	D-sub 15 (m)	D-sub 15 (m) (motor/sensor)		
Connector: Linear encoder	—	—	—		
Connector: Supply voltage	—	M8 4-pin (m)	M8 4-pin (m)		
Recommended controllers/drivers	C-863 C-884 C-885 with C-863.20C885 ACS modular controller	C-863 C-884 C-885 with C-863.20C885	C-863 C-884 C-885 with C-863.20C885		

BLDC motor and encoder option	BLDC motor with rotary encoder L-511.xx5132	BLDC motor with rotary encoder and linear encoder L-511.xx5111	Unit	Tolerance
System resolution	100	50	nm	
Unidirectional repeatability	0.2	0.1	μm	Typ.
Bidirectional repeatability	±1.25	±0.1	μm	Typ.
Minimum incremental motion	0.2	0.1	μm	Typ.
Maximum velocity	90	90	mm/s	
Drive force	100	100	N	Max.
Holding force (passive)	—	—	N	Typ.
Limit switch	Forked photoelectric sensor, N/C contact, 5V, NPN	Forked photoelectric sensor, N/C contact, 5V, NPN		
Gear ratio	—	—		
Motor encoder	Incremental rotary encoder	Incremental rotary encoder		
Motor encoder: Sensor resolution	20000	20000	Cts./rev	
Motor encoder: Sensor	A/B quadrature, TTL	A/B quadrature, TTL		

BLDC motor and encoder option	BLDC motor with rotary encoder L-511.xx5132	BLDC motor with rotary encoder and linear encoder L-511.xx5111	Unit	Tolerance
signal				
Linear encoder	–	Incremental linear encoder		
Sensor resolution linear encoder	100	50	nm	
Sensor signal linear encoder	–	Sin/cos, 1 V peak-peak, 20 µm signal period		
Motor type	Brushless DC motor, 3-phase	Brushless DC motor, 3-phase		
Operating voltage, nominal	36	36	V	Nom.
Operating voltage, max.	48	48	V	Max.
Resistance*	0.807	0.807	Ω	Typ.
Inductance*	0.644	0.644	mH	Typ.
Back EMF	3.3	3.3	V/kRPM	Max.
Number of pole pairs	7	7		
Motor resolution	–	–	Full steps/r ev.	
Connector	HD D-sub 26 (m)	HD D-sub 26 (m)		
Connector: Linear encoder	–	D-sub 9 (m)		
Connector: Supply voltage	–	–		
Recommended controllers/drivers	C-891 C-885 with C-891.11C885 ACS modular controller	ACS modular controller		

Stepper motor and encoder options	2-phase stepper motor L-511.x0SD00	2-phase stepper motor with linear encoder L-511.xASD00	Unit	Tolerance
System resolution	10000	5	nm	
Unidirectional repeatability	0.2	0.1	µm	Typ.
Bidirectional repeatability	±2	±0.2	µm	Typ.

Stepper motor and encoder options	2-phase stepper motor L-511.x0SD00	2-phase stepper motor with linear encoder L-511.xASD00	Unit	Tolerance
Minimum incremental motion	0.2	0.02	μm	Typ.
Maximum velocity	45	45	mm/s	
Drive force	100	100	N	Max.
Holding force (passive)	50	50	N	Typ.
Limit switch	Forked photoelectric sensor, N/C contactor, 5V, NPN	Forked photoelectric sensor, N/C contactor, 5V, NPN		
Gear ratio	—	—		
Motor encoder	—	—		
Motor encoder: Sensor resolution	—	—	Cts./rev	
Motor encoder: Sensor signal	—	—		
Linear encoder	—	Incremental linear encoder		
Sensor resolution linear encoder	—	5	nm	
Sensor signal linear encoder	—	Sin/cos, 1 V peak-peak, 20 μm signal period		
Motor type	2-phase stepper motor	2-phase stepper motor		
Operating voltage, nominal	24	24	V	Nom.
Operating voltage, max.	48	48	V	Max.
Resistance*	3.3	3.3	Ω	Typ.
Inductance*	2.8	2.8	mH	Typ.
Back EMF	—	—	V/kRM	Max.
Number of pole pairs	—	—		
Motor resolution	200	200	Full steps/rev.	
Connector	HD D-sub 26 (m)	HD D-sub 26 (m)		
Connector: Linear encoder	—	D-sub 9 (m)		
Connector: Supply voltage	—	—		
Recommended	C-663.12	C-663.12		

Stepper motor and encoder options	2-phase stepper motor L-511.x0SD00	2-phase stepper motor with linear encoder L-511.xASD00	Unit	Tolerance
controllers/drivers	C-885 with C-663.12C885 ACS modular controller	C-885 with C-663.12C885 ACS modular controller		

Stepper motor and encoder options	2-phase stepper motor L-511.x0SD00	2-phase stepper motor with linear encoder L-511.xASD00	Unit	Tolerance
System resolution	100	50	nm	
Unidirectional repeatability	0.2	0.1	μm	typ.
Bidirectional repeatability	±1.25	±0.1	μm	typ.
Minimum incremental motion	0.2	0.1	μm	typ.
Maximum velocity	90	90	mm/s	
Drive force	100	100	N	Max.
Holding force (passive)	–	–	N	typ.
Limit switch	Forked photoelectric sensor, N/C contactor, 5V, NPN	Forked photoelectric sensor, N/C contactor, 5V, NPN		
Gear ratio	–	–		
Motor encoder	Incremental rotary encoder	Incremental rotary encoder		
Motor encoder: Sensor resolution	20000	20000	Cts./rev	
Motor encoder: Sensor signal	A/B quadrature, TTL	A/B quadrature, TTL		
Linear encoder	–	Incremental linear encoder		
Sensor resolution linear encoder	100	50	nm	
Sensor signal linear encoder	–	sin/cos, 1 V peak-peak, 20 μm signal period		
Motor type	Brushless DC motor, 3-phase	Brushless DC motor, 3-phase		
Nominal voltage	36	36	V	
Peak voltage	48	48	V	
Resistance**	0.807	0.807	Ω	typ.
Inductance**	0.644	0.644	mH	typ.
Back EMF	3.3	3.3	V/kRM	Max.
Number of pole pairs	7	7		

Stepper motor and encoder options	2-phase stepper motor L-511.x0SD00	2-phase stepper motor with linear encoder L-511.xASD00	Unit	Tolerance
Motor resolution	—	—	Full steps/rev.	
Connector	HD D-Sub 26 (m)	HD D-Sub 26 (m)		
Connector: Linear encoder	—	D-Sub 9 (m)		
Connector: Supply voltage	—	—		
Recommended controllers/drivers	C-891 C-885 with C-891.11C885 ACS modular controller	C-891 C-885 with C-891.11C885 ACS modular controller		

Stepper motor and encoder options	2-phase stepper motor L-511.x0SD00	2-phase stepper motor with linear encoder L-511.xASD00	Unit	Tolerance
System resolution	10000	5	nm	
Unidirectional repeatability	0.2	0.1	μm	typ.
Bidirectional repeatability	±2	±0.2	μm	typ.
Minimum incremental motion	0.2	0.02	μm	typ.
Maximum velocity	45	45	mm/s	
Drive force	100	100	N	Max.
Holding force (passive)	50	50	N	typ.
Limit switch	Forked photoelectric sensor, N/C contactor, 5V, NPN	Forked photoelectric sensor, N/C contactor, 5V, NPN		
Gear ratio	—	—		
Motor encoder	—	—		
Motor encoder: Sensor resolution	—	—	Cts./rev	
Motor encoder: Sensor signal	—	—		
Linear encoder	—	Incremental linear encoder		
Sensor resolution linear encoder	—	5	nm	




Stepper motor and encoder options	2-phase stepper motor L-511.x0SD00	2-phase stepper motor with linear encoder L-511.xASD00	Unit	Tolerance
Sensor signal linear encoder	–	sin/cos, 1 V peak-peak, 20 μ m signal period		
Motor type	2-phase stepper motor	2-phase stepper motor		
Nominal voltage	24	24	V	
Peak voltage	48	48	V	
Resistance*	3.3	3.3	Ω	typ.
Inductance*	2.8	2.8	mH	typ.
Back EMF	–	–	V/kRM	Max.
Number of pole pairs	–	–		
Motor resolution	200	200	Full steps/r ev.	
Connector	HD D-Sub 26 (m)	HD D-Sub 26 (m)		
Connector: Linear encoder	–	D-Sub 9 (m)		
Connector: Supply voltage	–	–		
Recommended controllers/drivers	C-663.12 C-885 with C-663.12C885 ACS modular controller	C-663.12 C-885 with C-663.12C885 ACS modular controller		

* Resistance/inductance per phase

** Terminal resistance/inductance

10.1.2 Maximum Ratings

L-511 stages are designed for the following operating data:

Device	Maximum operating voltage 	Operating frequency 	Maximum power consumption 
L-511.x0SD00 L-511.xASD00	48 V	0 Hz	10 W
L-511.x0DG10	24 V	0 Hz	8.5 W
L-511.x0AD10 L-511.x4AD00	48 V	0 Hz	
L 511.0y3111 L-511.0y3132	48 V	0 Hz	
L-511.0y5111 L-511.0y5132	48 V	0 Hz	

10.1.3 Ambient Conditions and Classifications

The following ambient conditions and classifications must be observed for the L-511:

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. ± 10 % of the nominal voltage
Degree of pollution	2
Degree of protection according to IEC 60529	IP00

10.1.4 Limit Switch Specifications

Type	Optical sensor
Supply voltage	+5 V / ground
Signal output	Open collector

Signal logic	<p>The signal level changes when passing the limit switch. The signal logic is active high. That means:</p> <ul style="list-style-type: none"> ▪ Normal motor operation: low (0 V) ▪ Limit switch reached: high (+5 V)
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10.1.5 Reference Point Switch Specifications

Type	Optical sensor
Supply voltage	+5 V/GND, supplied via 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 point switch: The signal level changes from 0 to +5 V when the reference point switch is passed.

10.2 Dimensions

10.2.1 L-511 Positioners

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

For a detailed view (X) of the platform, see "Hole Patterns of the Platform" (p. 60).

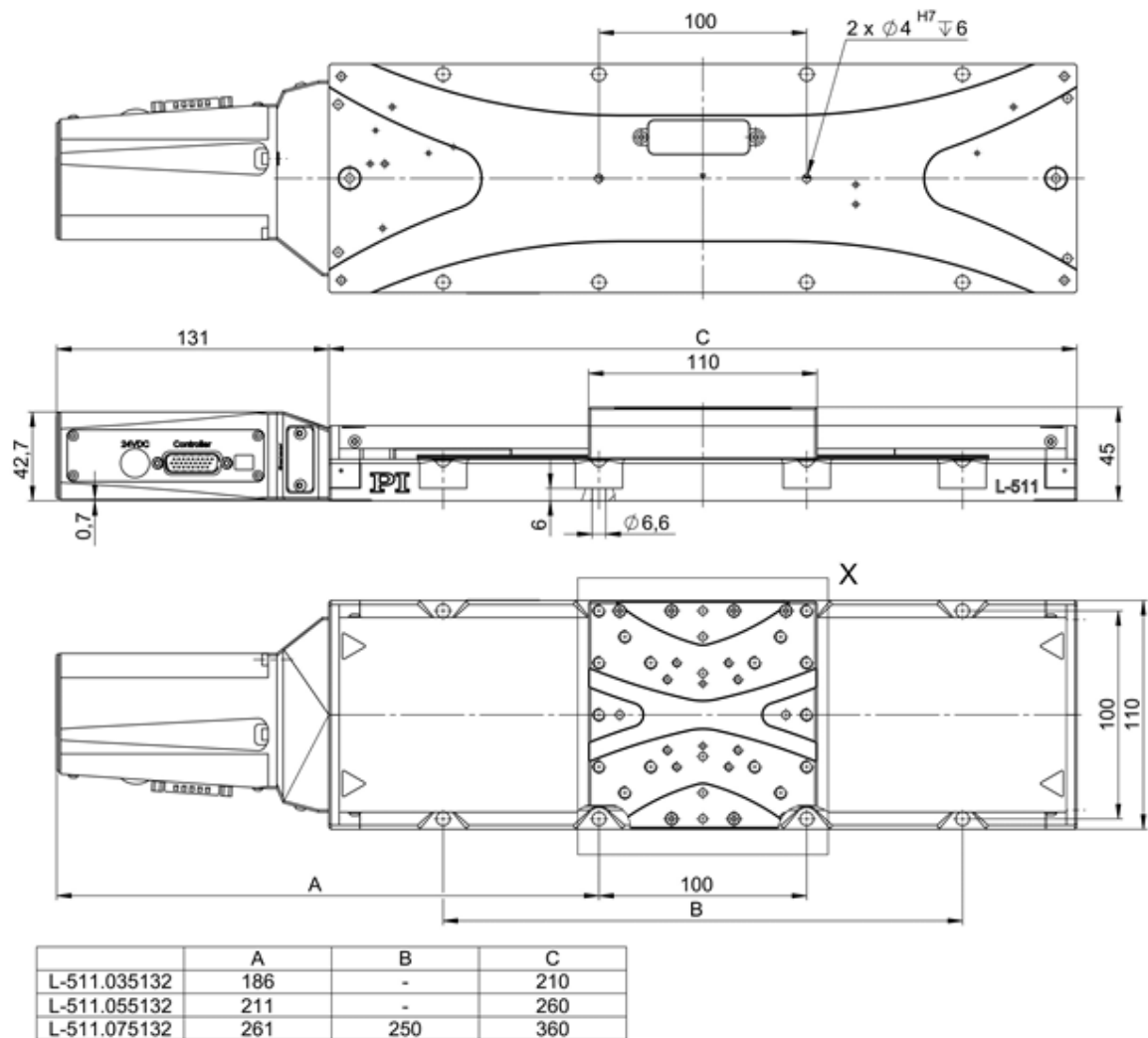


Figure 9: L-511 versions with BLDC motor and rotary encoder, dimensions in mm

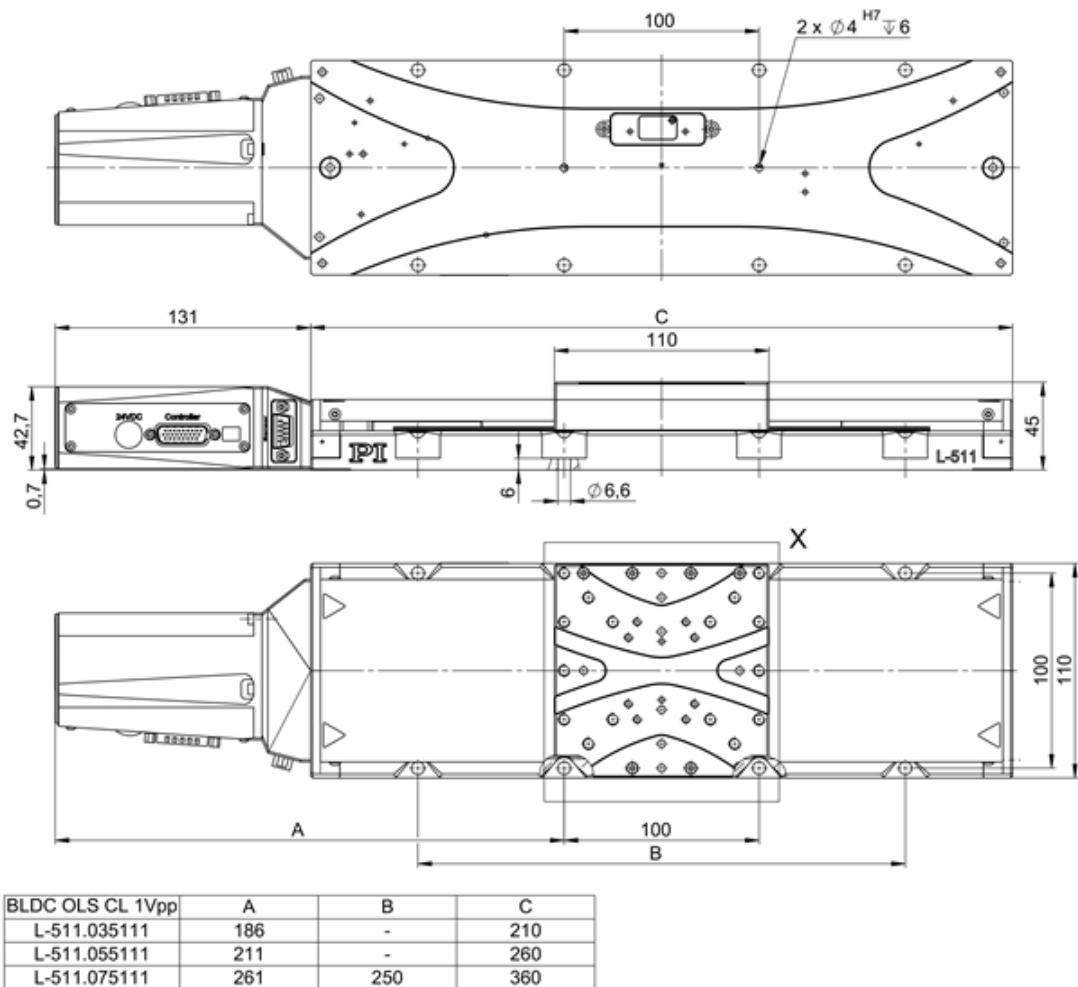


Figure 10: L-511 versions with BLDC motor and linear encoder, dimensions in mm

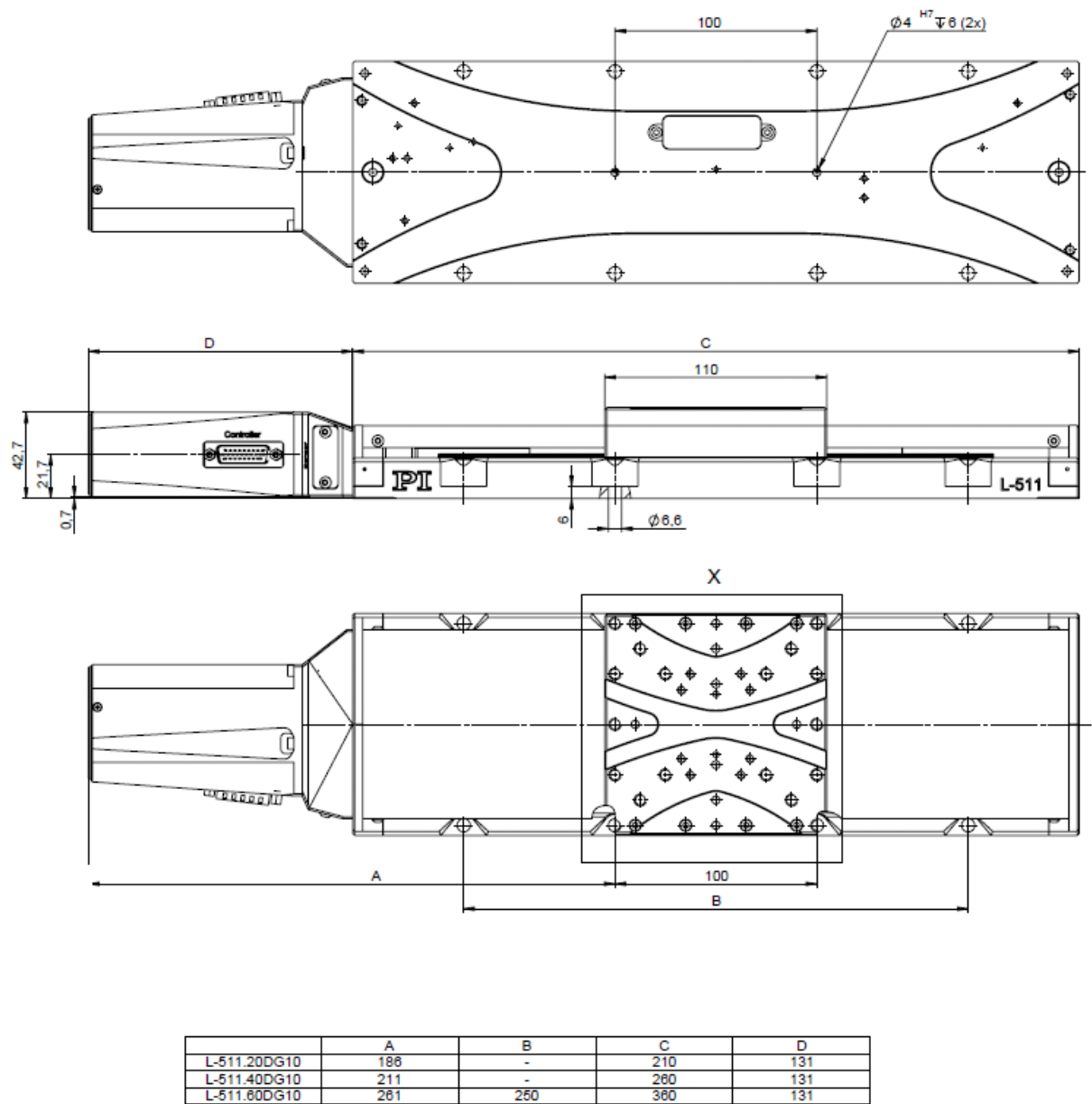


Figure 11: L-511 versions with DC gear motor, dimensions in mm

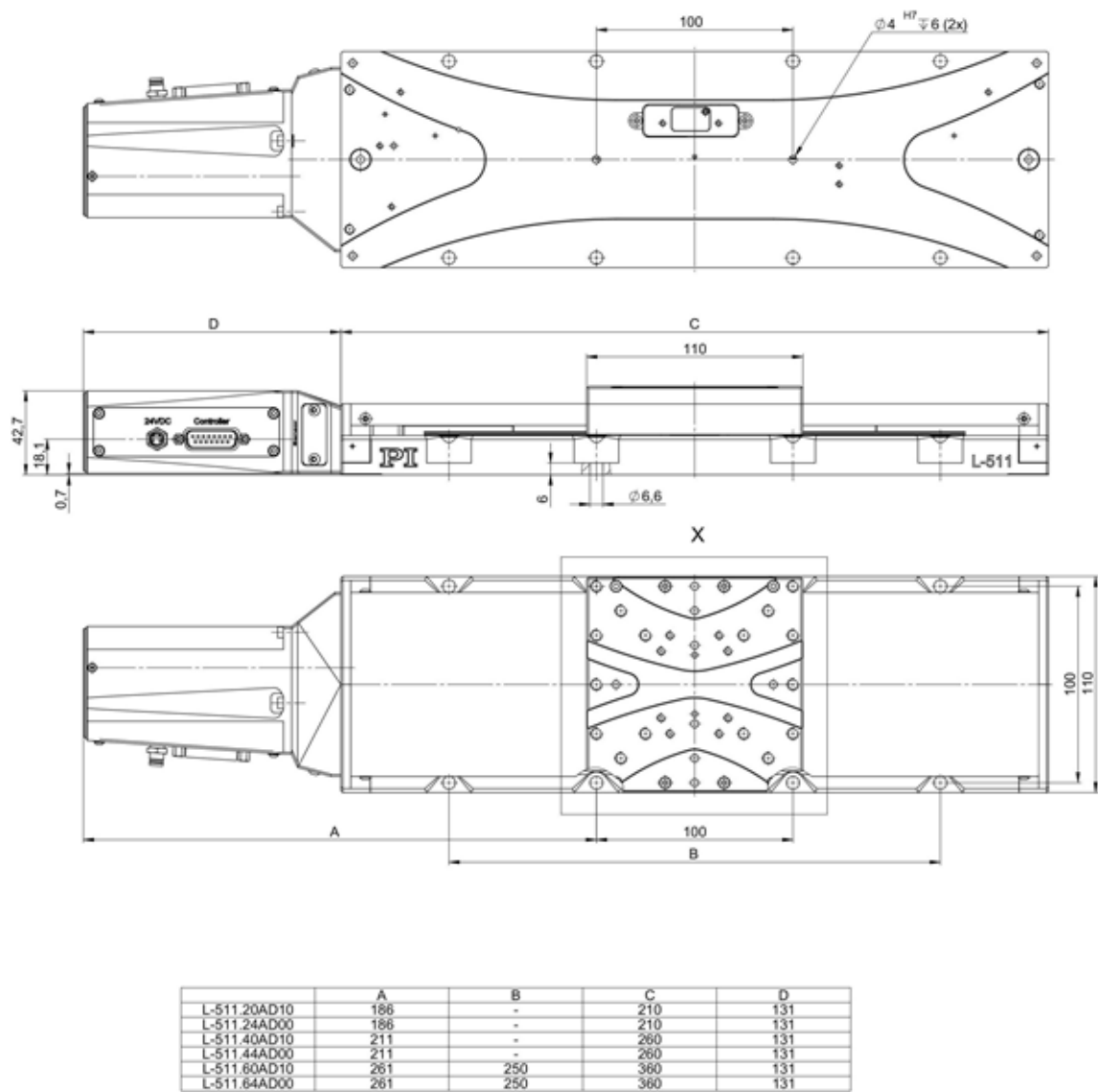


Figure 12: L-511 versions with ActiveDrive DC motor, dimensions in mm

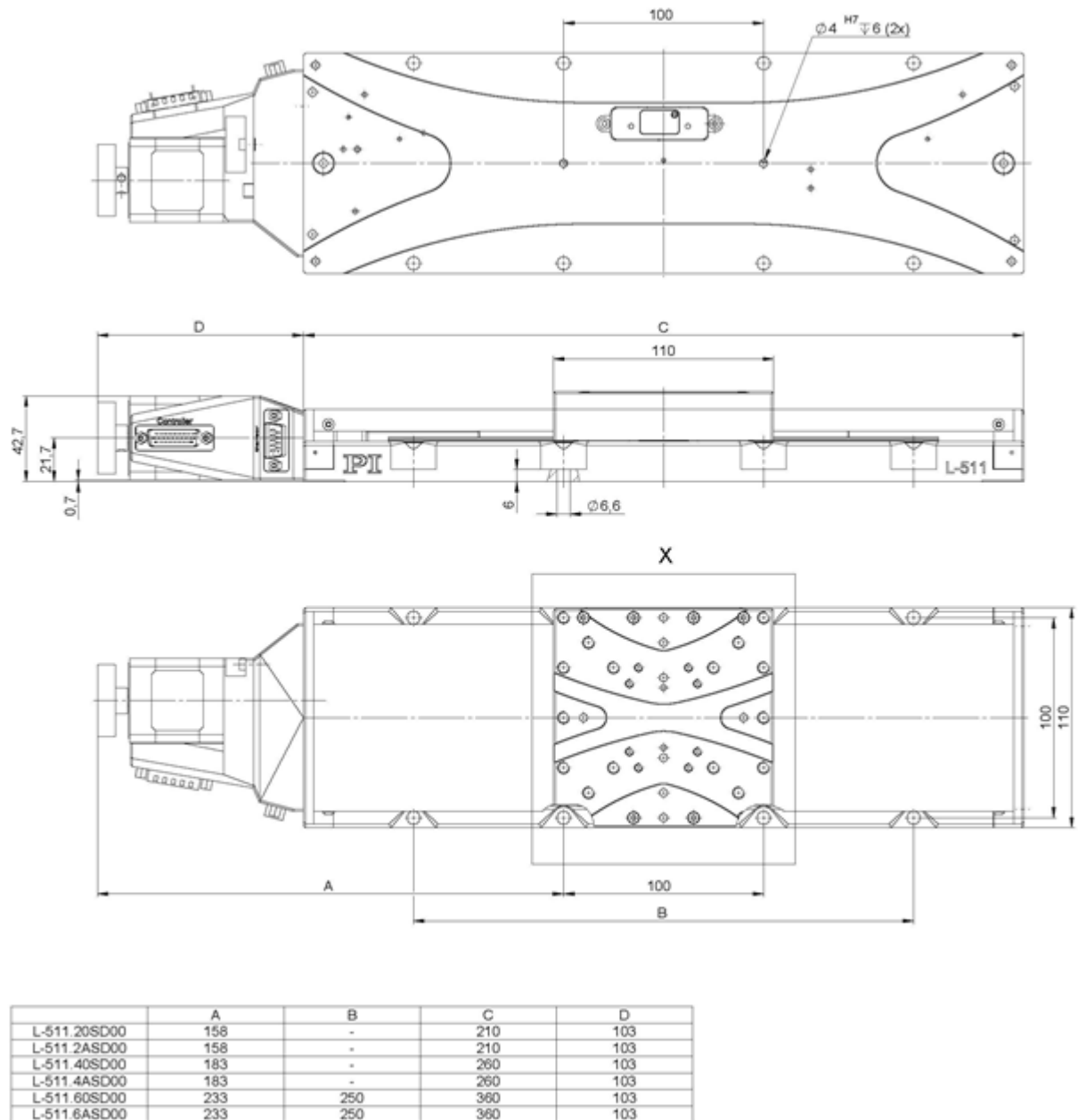


Figure 13: L-511 versions with stepper motor, dimensions in mm

10.2.2 Hole Pattern of the Platform

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

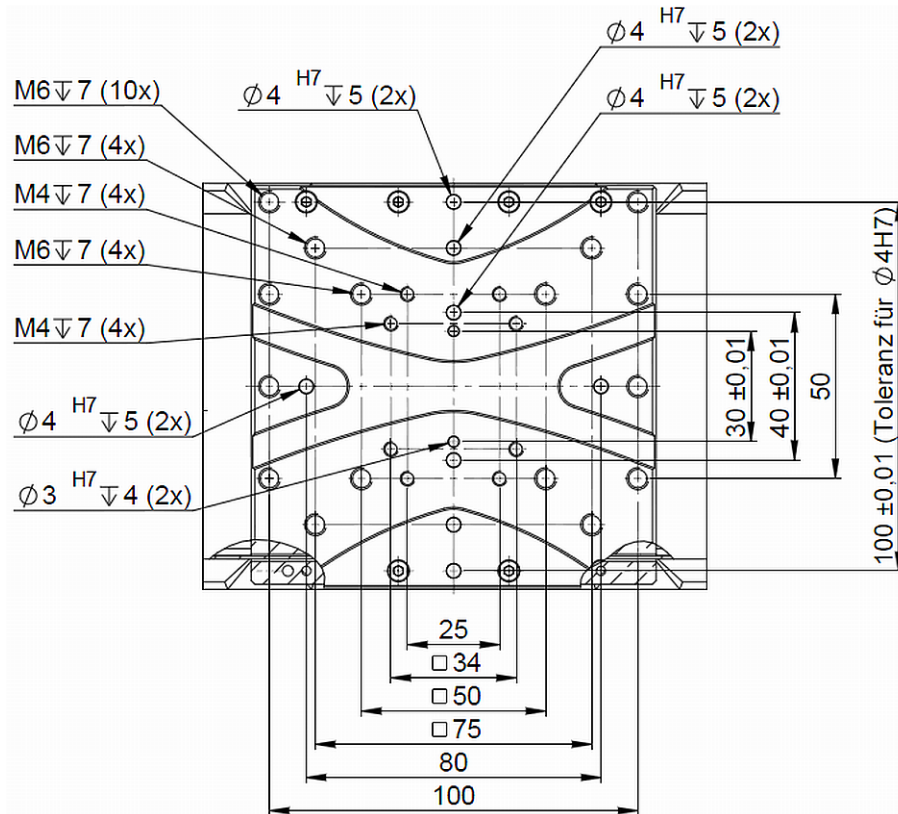


Figure 14: Hole pattern of the platform

10.2.3 L-500.AV1 Adapter Bracket

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

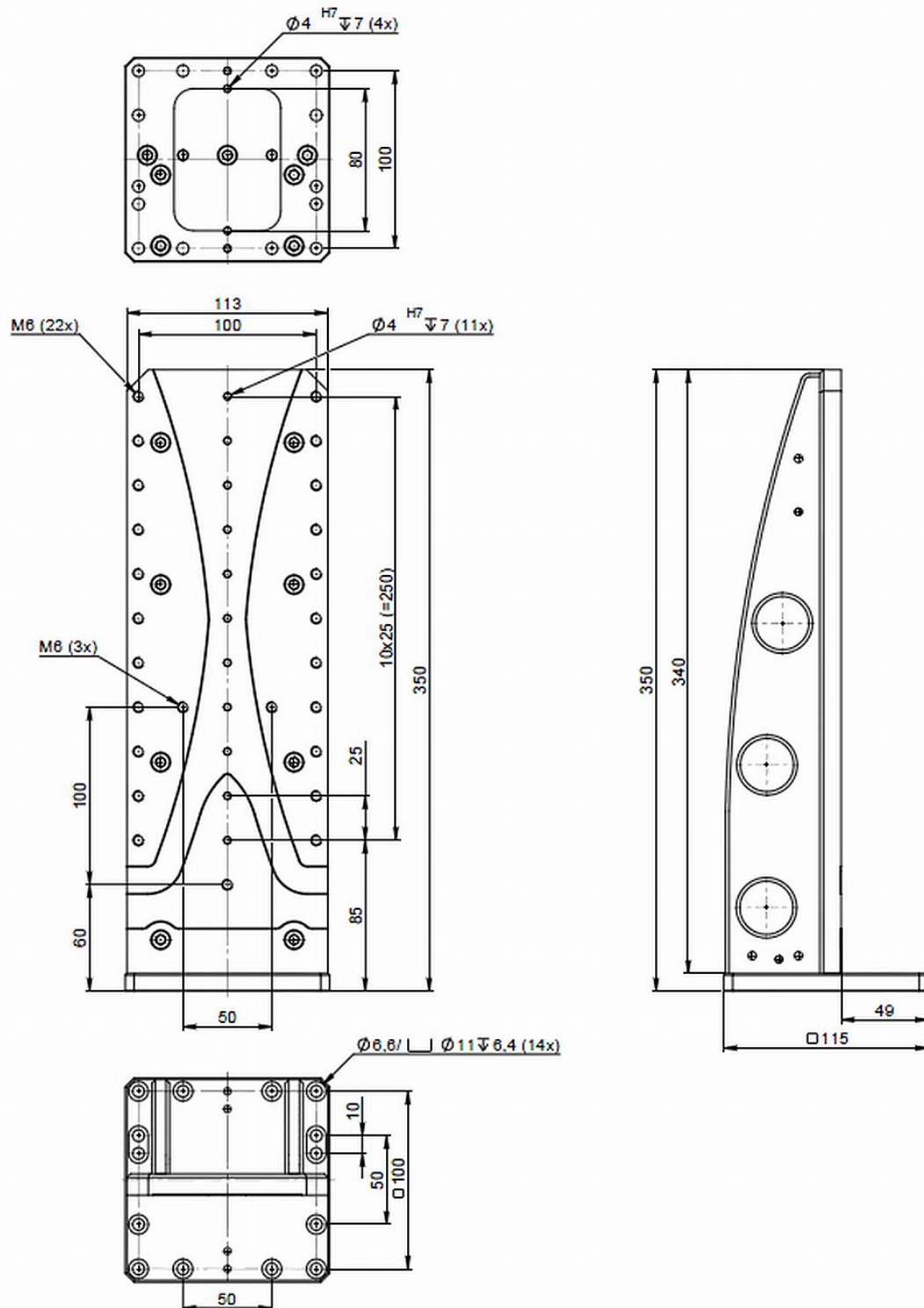


Figure 15: L-500.AV1 adapter bracket

10.3 Pin Assignment

10.3.1 HD D-Sub 26 (m)

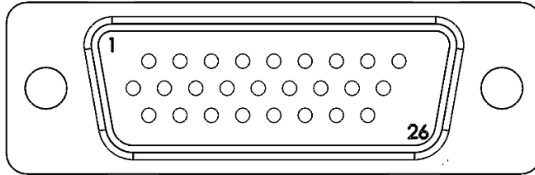


Figure 16: HD D-Sub 26 panel plug

L-511.xxSD00 models

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	PE (case GND)	GND
10	REF	Output
11	Limit E1 (neg.)	Output
12	Limit E2 (pos.)	Output
13	-	-
14	-	-
15	-	-
16	-	-
17	ID I/O	Bidirectional
18	Limit Power (5 V)	Input
19	-	-
20	-	-
21	-	-
22	-	-
23	-	-
24	-	-
25	GND (limit)	GND
26	-	-

L-511.xxDG10 / L 511.0y3111 / L-511.0y3132 models

Pin	Signal	Direction
1	Motor +	Input
2	Motor +	Input
3	Motor -	Input
4	Motor -	Input
5	-	-
6	-	-
7	-	-
8	-	-
9	PE (case GND)	-
10	REF	Output
11	Limit E1 (neg.)	Output
12	Limit E2 (pos.)	Output
13	-	-
14	-	-
15	-	-
16	-	-
17	ID I/O	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 C+	Output
24	Encoder C-	Output
25	GND (limit, encoder)	-
26	Encoder power (5 V)	Input

L-511.0y5111 / L-511.0y5132 models

Pin		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 neg.	Output
12	Limit pos.	Output
13	Hall 1	Output
14	Hall 2	Output
15	Hall 3	Output
16	-	-
17	ID	Output
18	Limit Power (+5 V)	Output
19	Encoder A+	Output
20	Encoder A-	Output
21	Encoder B+	Output
22	Encoder B-	Output
23	Encoder C+	Output
24	Encoder C-	Output
25	GND	-
26	Encoder Power (5 V DC)	Input

10.3.2 D-Sub 15 (m)

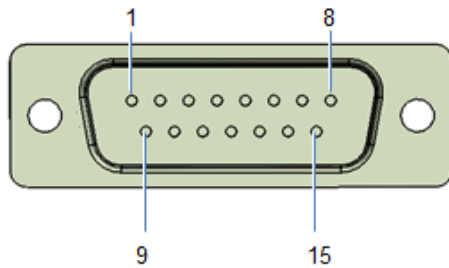


Figure 17: D-Sub 15 panel plug (L-511.x4AD00 / L-511.x0AD10 models only)

Pin	Signal	Direction
1	Motor brake	Input
2	Motor +	Input
3	MAGN	Input
4	Power 5 V DC	Input
5	Limit E2 (pos.)	Output
6	ID	Output
7	Encoder A-	Output
8	Encoder B-	Output
9	Motor -	Input
10	GND	-
11	SIGN	Input
12	Limit E1 (neg.)	Output
13	REF	Output
14	Encoder A+	Output
15	Encoder B+	Output

10.3.3 D-Sub 9 (m)

The D-Sub 9 panel plug is only on the L-511.xASD00, L-511.0y3111, and L-511.0y5111 models.

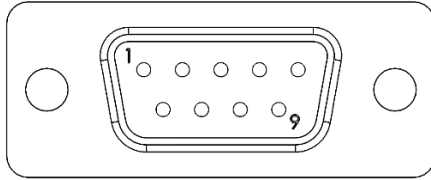


Figure 18: D-Sub 9 panel plug

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

10.3.4 M8 4-pin (m)

Connecting a power adapter is only necessary with the L-511.x0AD10 and L-511.x4AD00 models.

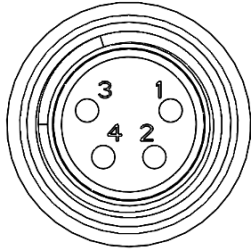


Figure 19: Power adapter connector M8, 4-pin

Pin	Signal	Direction
1	GND	GND
2	GND	GND
3	24 V DC supply voltage	Input
4	24 V DC supply voltage	Input

10.4 Tightening Torque for Screws, ISO 4762 - A2

The following tightening torques for screws according to ISO4762 (corresponds to DIN 912) - A2 must 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

Within the EU, electrical and electronic equipment must not be disposed of with the municipal residual waste.

Dispose of your old equipment according to the local regulations or return it free of charge to the following address:

PI miCos GmbH

Freiburger Strasse 30

79427 Eschbach, Germany



12 EU Declaration of Conformity

An EU Declaration of Conformity has been issued for the L-511 in accordance with the following European directives:

- EMC Directive
- RoHS Directive

The standards applied for certifying the conformity are listed below.

- EMC: EN 61326-1
- Safety: EN IEC 61010-1:2020
- RoHS: EN IEC 63000:2018