MP164E

L-402 Miniature Linear Stage

User Manual

Version: 1.2.0 Date: 2020-06-19

This document describes the following miniature linear stage with 13 mm (0.5") travel range:

- L-402.10DD
  with DC motor
- L-402.10SD
  with stepper 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 This manual is superseded by any new release.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 (p. **Fehler! Textmarke nicht definiert.**).

Contents

1 About this Document

1.1 Objective and Target Group of this User Manual

This user manual contains the required information on the intended use of the L-402.

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

1.2 Other Applicable Documents

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

Product	Document
L-402	MP146EK Short Instructions for Positioners with Electric Motors
C-884 DC Motor Controller	MS213E User Manual
C-663.12 Stepper Motor Controller	MS241E User Manual
C-863.12 DC Motor Controller	MS249E User Manual

The latest versions of the user manuals are available for download on our website (p. **Fehler! Textmarke nicht definiert.**).

1.3 Symbols and Typographic Conventions

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

CAUTION

Dangerous situation

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

➢ Actions to take to avoid the risk.

NOTICE

Dangerous situation

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

➢ Actions to take to avoid 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)

1.4 Figures

For better understandability, the colors, proportions and degree of detail in illustrations can deviate from the actual circumstances. Photographic illustrations may also differ and must not be seen as guaranteed properties.

1.5 Downloading Manuals

INFORMATION

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

➢ Contact our customer service department (p. **Fehler! Textmarke nicht definiert.**).

Downloading manuals

1. Open the website 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-402 is a laboratory device as defined by DIN EN 61010-1. It is intended for indoor use and use in an environment which is free of dirt, oil, and lubricants.

In accordance with its design, the L-402 is intended for single-axis positioning, adjusting and shifting of loads at different velocities.

The intended use of the L-402 is only possible when installed and in conjunction with a suitable controller. The controller is not included in the scope of delivery of the L-402.

2.2 General Safety Instructions

The L-402 is built according to state-of-the-art technology and recognized safety standards. Improper use of the L-402 may result in personal injury and/or damage to the L-402.

- Only use the L-402 for its intended purpose, and only use it if it is in good working order.
- Read the user manual.
- Immediately eliminate any faults and malfunctions that are likely to affect safety.

The operator is responsible for correct installation and operation of the L-402.

2.2.1 Organizational Measures

User Manual

- Always keep this user manual available when using the L-402.
  The latest versions of the user manuals are available on our website (p. **Fehler! Textmarke nicht definiert.**) for download.
- Add all information from the manufacturer such as supplements or technical notes to the user manual.
- If you give the L-402 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-402 after you have read and understood this user manual.

Personnel Qualification

The L-402 may only be installed, started up, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

3 Product Description

3.1 Model Overview

Order number	Product name
L-402.10SD	Miniature linear stage, 22 mm width, stepper motor, 13 mm travel range
L-402.10DD	Miniature linear stage, 22 mm width, DC motor, 13 mm travel range

3.2 Product View

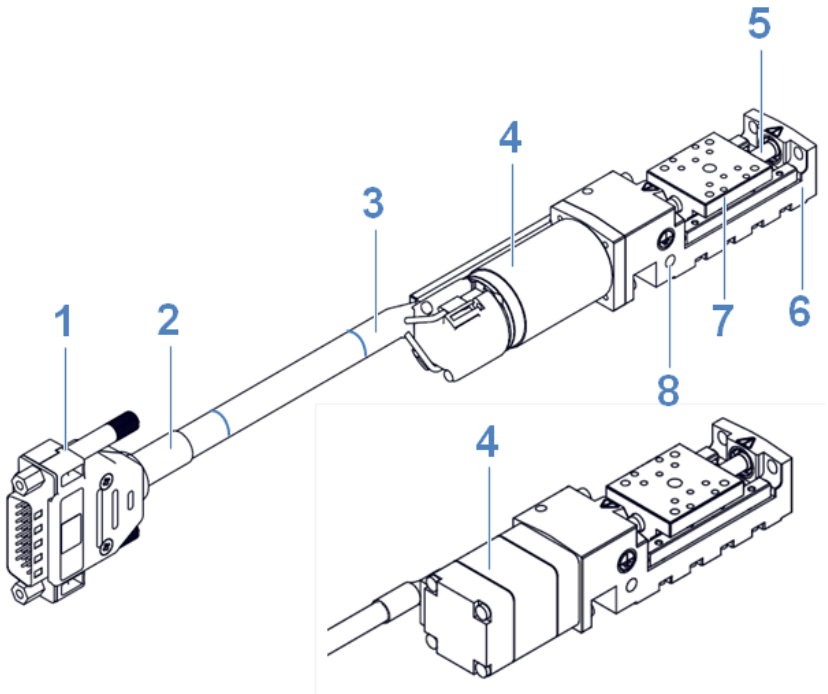


Figure 1: Parts of the L-402: above: L-402.10DD, below L-402.10SD (detail)

1 HD D-Sub 26 connector
2 Ferrite
3 Motor cable
4 Motor
5 Drive screw
6 Base body
7 Platform
8 Protective earth connection

3.3 Direction of Motion

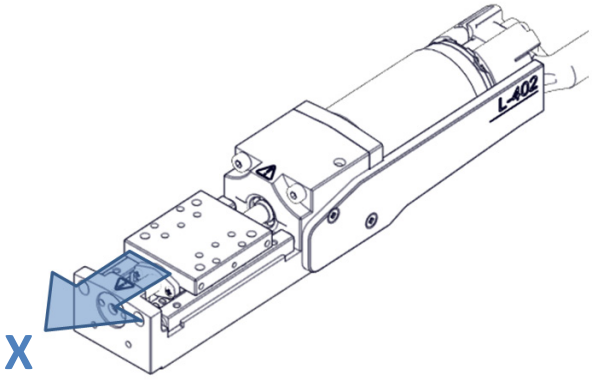


Figure 2: Direction of motion

X Direction of motion on positive command

3.4 Product Labeling

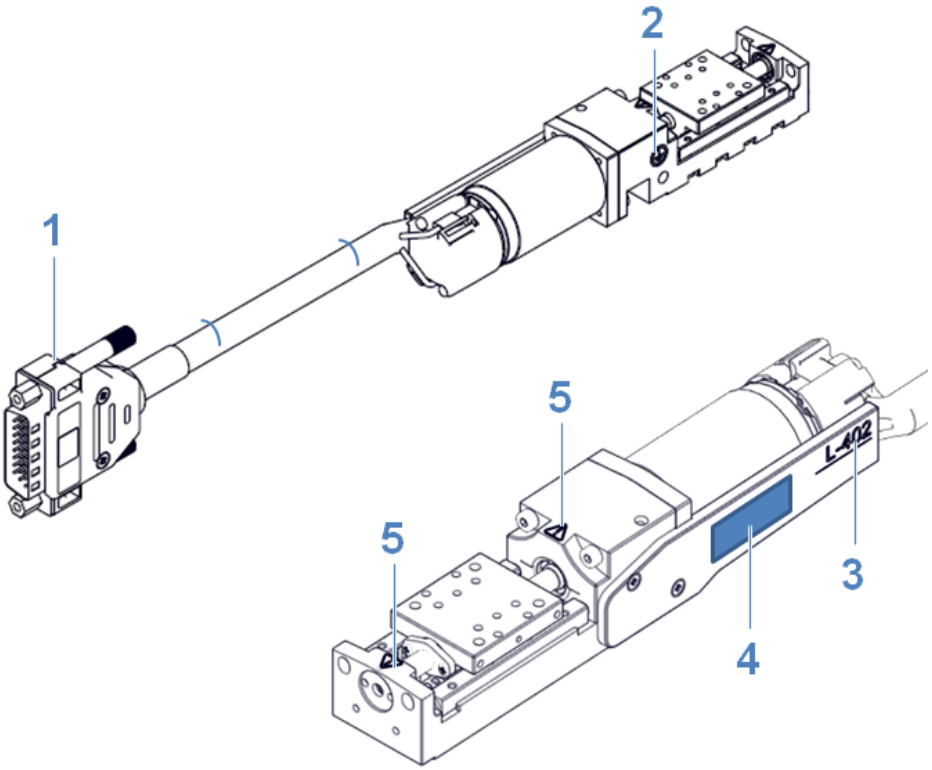


Figure 3: Product labeling

Position	Labeling	Description
1		Warning sign "ESD sensitive devices"
2		Protective earth connection
3.4	L-402	Product name
4		Old equipment disposal
4	Country of origin: Germany	Country of origin
4		Manufacturer's logo
4	415002159	Serial number (example), individual for each L-402 Meaning of the places (counting from the left): 1 = internal information, 2 and 3 = year of manufacturer, 4 to 9 = consecutive numbers
4		CE conformity mark
4	WWW.PI.WS	Manufacturer's address (website)
4, 5		Warning sign "Observe manual!"

3.5 Scope of Delivery

Item number	Component
	L-402 according to order (p. 5)
6214500022	Screw set for mounting the L-402: ▪ 2 socket head cap screws, ISO 14580 M2x6 ▪ 2 socket head cap screws, ISO 14580 M2.5x8 ▪ 2 dowel pins, DIN 7- 1.5m6 x 4
K3110154	UNC bolt for adaptation to a connector of an extension cable (2 units)
MP146EK	Short Instructions for Positioners with Electric Motors

3.6 Suitable Controllers

The L-402 must be connected to a suitable controller. The following controllers from PI are suitable for the operation of the L-402:

Stage	Controller
L-402.10DD	C-863.12 Mercury servo controller, for DC motors and PWM motor driver, 1 axis, HD D-sub 26, USB, RS-232, I/O, connector for analog joystick
	C-884.4DC / C-884.6DC Controller for DC motors, 4/6 axes , USB, RS-232, Ethernet, SPI, I/O, joystick connector
L-402.10SC	C-663.12 Compact Mercury Step stepper motor controller , 1 axis, closed-loop and open-loop operation, HD Sub-D 26, 48 V

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

The operating parameters must be adjusted depending on the version of the L-402 used.

If extension cables and/or adapter cables are required to connect the L-402 to the controller, they must be ordered separately.

To order, contact our customer service department (p. 25).

3.7 Technical Features

3.7.1 Rotary Encoder

The models with DC motors are equipped with a rotary encoder. A rotary encoder is implemented at a rotating point in the drivetrain, e.g., the motor shaft. To determine the relative position, the controller counts the encoder signals, the so-called impulses.

3.7.2 Limit Switches

The L-402 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 linear actuator runs into the hard stop.

See "Limit Switch Specifications" for more information (p. 29).

3.7.3 Reference Switch

The L-402 is equipped with one direction-sensing reference switch that is located at about the midpoint of the travel range. This sensor transmits a TTL signal that indicates whether the linear actuator is on the positive or negative side of the reference switch.

See the controller's user manual for the commands that make use of the reference signal.

For more information, see "Reference Switch Specifications" (p. 29).

4 Unpacking

1. Unpack the L-402 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

Unwanted changes in position with vertical mounting!

If the load exceeds the self-locking of the drive when the L-402 is mounted vertically, unintentional changes in the position of the motion platform will occur. Unwanted changes in the position of the motion platform can damage the drive, the load or the environment.

- ➢ When the L-402 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. 27)).

NOTICE

Electrostatic hazard

Touching the pins in the connections of the L-402 can damage electrostatic sensitive devices (ESD) of the L-402. For this reason, the L-402 is supplied with ESD protection on all connections.

- ➢ Do not remove the ESD protection from the connections until you connect the L-402 to the controller.

NOTICE

Cable break!

A cable break leads to failure of the L-402.

- ➢ Install the L-402 so that the cable is not bent too strongly or crushed.

NOTICE

Heating of the L-402 during operation!

The heat produced during operation of the L-402 can affect your application.

- ➢ Install the L-402 so that the application is not impaired by the dissipated 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 stage.

- ➢ If possible, simulate the positioner motions 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 L-402 and the application, in accordance with the legal regulations.

5.2 Attaching the L-402 to a Surface

NOTICE

Warping of the L-402 due to mounting on uneven surfaces!

Mounting the L-402 on an uneven surface can warp the L-402. Warping reduces the accuracy.

- ➢ Mount the L-402 onto an even surface. The recommended flatness of the surface is ≤10 µm.
- ➢ For applications with large temperature changes:
  Only mount the L-402 on surfaces that have the same or similar thermal expansion properties as the L-402.

Requirements

- ✓ You have read and understood the general notes on installation (p. 11).
- ✓ 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. 30)):
  - For mounting on the bottom of the L-402: Two M2 threaded holes are provided.
  - For mounting on the front of the L-402: Two M2.5 threaded holes are provided.
  - If you use locating pins to align the L-402: Two 1.5 mm Ø locating holes are present.
  - The flatness of the surface is ≤10 µm.
  - For applications with large temperature changes: The surface should have the same or similar thermal expansion properties as the L-402 (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 accessories; scope of delivery (p 7)
  - 2 socket head screws, ISO 14580 M2x6 (when mounting in the bottom) or M2.5x8 (when mounting on the front)

  - Optional: 2 dowel pins, DIN 7 1.5 m6x4 for us as locating pins
- Torx screwdriver:
  - For M2 screws: T6
  - For M2.5 screws: T8

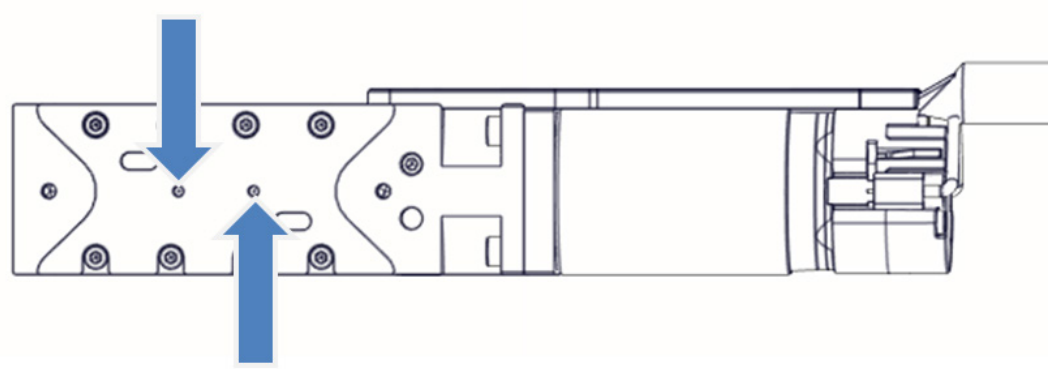


Figure 4: Position of the locating holes

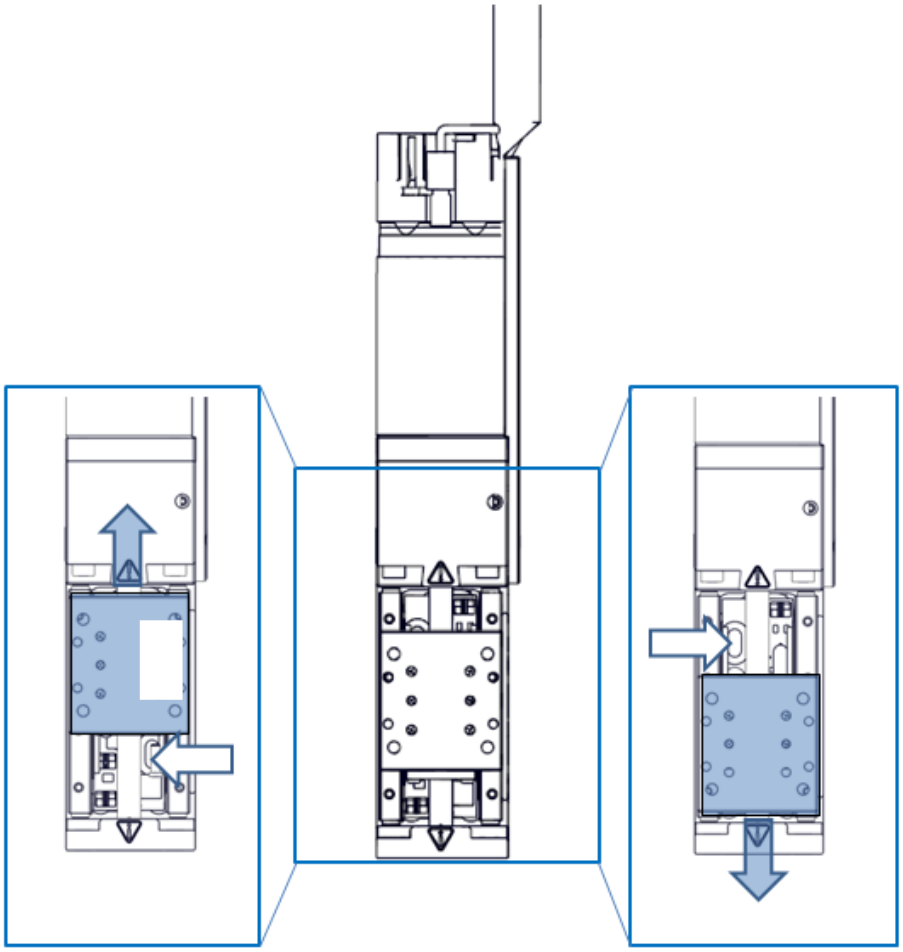


Figure 5: Position of the longitudinal holes for screw mounting and moving the platform

Mounting the L-402 onto a surface - mounting on the bottom

1. Align the L-402 on the surface so that the corresponding mounting holes in the stage and the surface overlap.
2. If you use locating pins to align the stage:
   a. Insert the locating pins into the respective holes in the surface.
   b. Place the L-402 on the surface so that the locating pins are inserted into the corresponding locating holes on the other side.
3. Allow access to the mounting holes in the base body of the L-402. Possible measures:
   – Temporary start-up of the stage and commanding the platform to a suitable position
   – Moving the platform manually (ü. **Fehler! Textmarke nicht definiert.**)
4. Completely screw in the screws into all mounting holes.
5. Repeat steps 2 to 4 for the concealed mounting hole.
6. Check that the L-402 is affixed firmly to the surface.

Mounting the L-402 onto a surface - mounting on the front

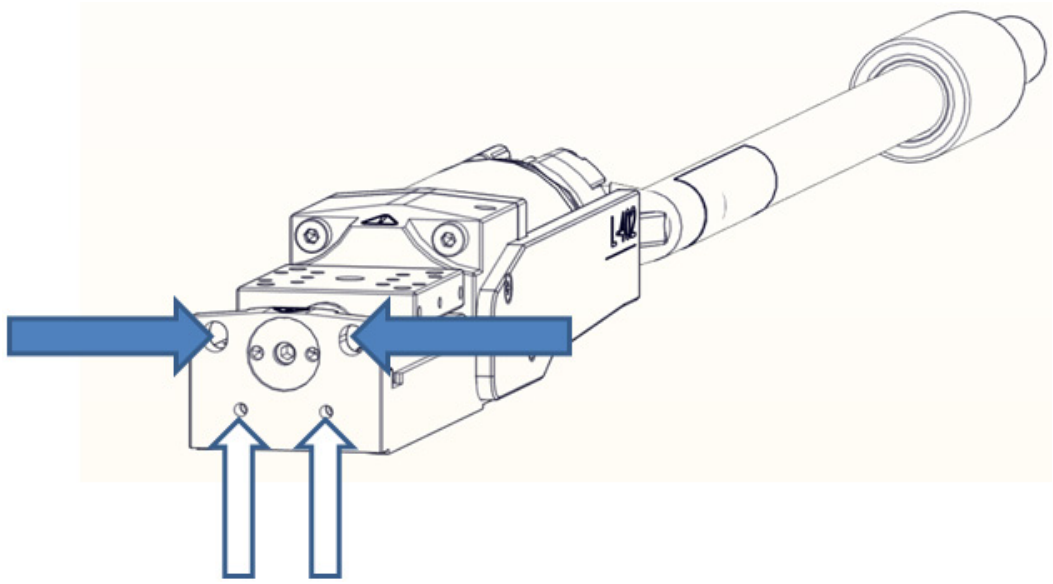


Figure 6: Position of the locating holes (bright/white arrows) and the mounting holes (dark/blue arrows) on the front

1. If necessary: Move the platform just enough to allow the screws or nuts to be mounted in the mounting holes (see figure) with the corresponding tool. Possible measures:
   – Temporary start-up of the stage and commanding the platform to a suitable position
   – Moving the platform manually (p. **Fehler! Textmarke nicht definiert.**)
2. Align the L-402 on the surface so that the corresponding mounting holes in the stage and the surface overlap.
3. If you use locating pins to align the L-402:
   a. Insert the locating pins into the respective holes in the surface.

b. Place the L-402 on the surface so that the locating pins are inserted into the corresponding locating holes on the other side.

4. Completely screw in the screws into all mounting holes.
5. Check that the L-402 is affixed firmly to the surface.

5.3 Connecting the L-402 to the Protective Earth Conductor

INFORMATION

It is only necessary to connect the L-402 to the protective earth conductor when both of the following conditions are met:

- The load on the motion platform of the L-402 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 motion platform are connected conductively to each other.

INFORMATION

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

On the side of the L-402, there is an M4 hole for connecting the protective earth conductor. In the following figure, this hole is marked with an arrow.

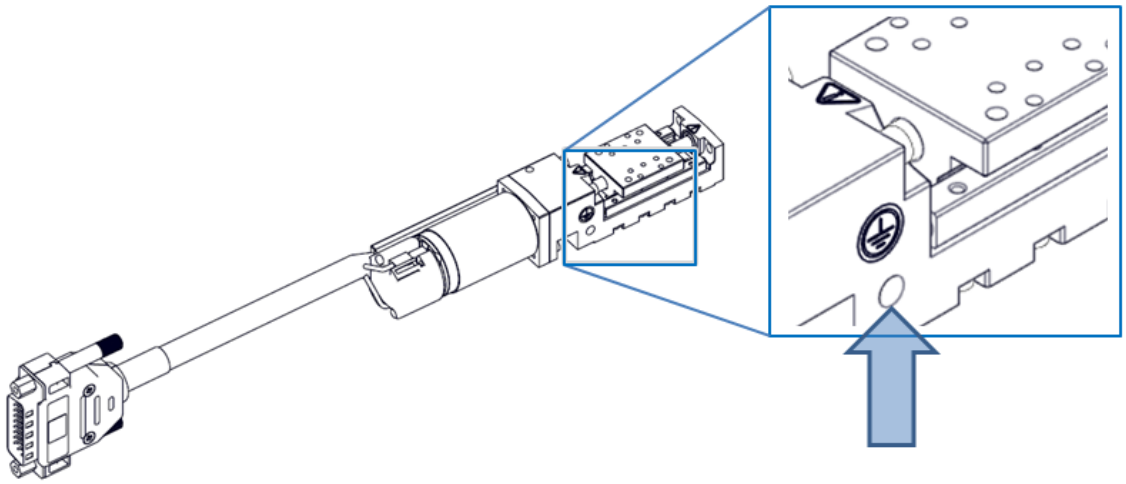


Figure 7: Position of the hole for the protective earth connection

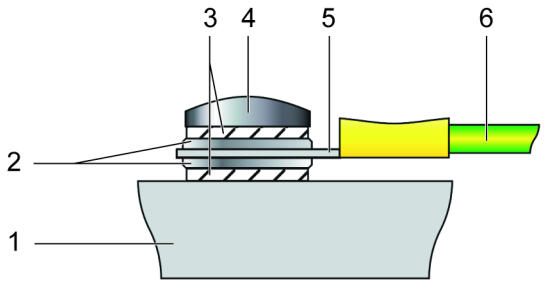


Figure 8: Mounting of the protective earth conductor (profile view)

1 Base body of the L-402
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. 11).

Tools and accessories

- Suitable protective earth conductor: Cable cross section ≥ 0.75 mm^2
- Screw, M4x8, ISO 7045
- 2 washers, ISO 7089-4
- 2 safety washers, S4
- Suitable screwdriver

Connecting the L-402 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-402 as shown in the profile view.
3. Tighten the M4 screw with a torque of 1.2 Nm to 1.5 Nm.
4. Make sure that the contact resistance at all connection points relevant for mounting the protective earth conductor is <0.1 Ω at 25 A.

5.4 Affixing the Load to the L-402

NOTICE

Impermissibly high load on the L-402!

An impermissible high load impairs the motion of the motion platform and can damage the L-402.

➢ When considering the mass and mounting method of the load, pay attention to the specified maximum permissible forces, that are permitted to act on the motion platform (p. 27).

Requirements

- ✓ You have read and understood the general notes on installation (p. 11).
- ✓ You have mounted the L-402 properly onto a surface (p. 12).
- ✓ The L-402 is **not** connected to the controller.
- ✓ You have prepared the load so that it can be affixed to the mounting holes on the motion platform (p.30):
  - The distance between the center of gravity of the load and the center of the motion platform is as small as possible in all directions.
  - At least two points are provided for affixing the load to the motion platform (ideally: three attachment points).

Tools and accessories

- At least 2 screws of suitable length. Options:
  - M2 screws
  - M2.5 screws
- Suitable tool for tightening the screws

Affixing the load

1. Align the load so that the selected mounting holes in the motion platform can be used to affix it.
2. Use the screws to affix the load to the selected mounting holes in the motion platform.
3. Check that the load is affixed firmly to the motion platform of the L-402.

5.5 Connecting the L-402 to a Controller

NOTICE

Damage if an incorrect controller or motor cable is connected!

Connecting the L-402 to an unsuitable controller or using an unsuitable motor cable can cause damage to the L-402 or controller.

- ➢ Only connect the L-402 to a suitable controller (p. 7).
- ➢ To connect the L-402 to the controller, only use a motor cable that is suitable for the controller.

Requirements

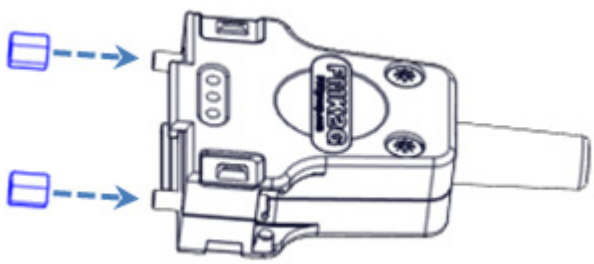
- ✓ You have read and understood the general notes on installation (p. 11).
- ✓ You have installed the controller.
- ✓ You have read and understood the user manual of the controller.
- ✓ The controller is switched off.

Tools and accessories

- If necessary:
  - Drive/encoder cable to be used as extension cable and/or adapter cable, suitable for the controller used (p. 7)
  - Four spacer bolts, part of the mounting hardware (incl. in scope of delivery (p. 7))
- Suitable screwdriver for the locking screws of the connectors.

Connecting the L-402 to a Controller

1. Remove the ESD protection from all connectors of the L-402.
2. Connect the L-402 to the controller.
   For connecting an extension/adapter cable, it might be required to affix the provided UNC bolts to the corresponding connector; using a hex key AF 5mm or a compliant tool (see schematic illustration below). Note that the tightening torque must **not** exceed **2.5 Nm**.



3. Use the integrated screws to secure the connections against accidental disconnection.

6 Start-Up

6.1 General Notes on Start-Up

CAUTION

Risk of crushing by moving parts!

There is a risk of minor injury from crushing between the moving parts of the L-402 or the load and a fixed part or obstacle.

- ➢ Use protective structures to keep limbs away from areas in which they could be caught by moving 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 L-402, the load to be moved, and the surroundings.

- ➢ Make sure that no collisions are possible between the L-402, the load to be moved, and the surroundings in the motion range of the stage.
- ➢ 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 is connected!

Connecting the L-402 to an unsuitable controller can cause damage to the stage or controller.

- ➢ Only connect the L-402 to a controller of the recommended type (p. 7).

NOTICE

Operating voltage excessively high or incorrectly connected!

Operating voltages that are excessively high or incorrectly connected can cause damage to the L-402.

- ➢ Do **not** exceed the operating voltage range (p. 28) that is specified for the L-402.
- ➢ Only operate the L-402 when the operating voltage is properly connected; see "Pin Assignment" (p. 33).

NOTICE

Damage or considerable wear due to high accelerations!

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

- ➢ 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 motions!

Unintentional motion of the L-402 is possible when it is connected to the controller. Defective software 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-402, check whether a macro is defined as the start-up macro in the controller, and cancel the selection of the start-up macro if necessary.

6.2 Starting up the L-402

Requirements

You have read and understood the general notes on start-up (p. 19).

- ✓ For starting up with a load or in a multi-axis system: You have properly installed the L-402 (p. 12).
- ✓ The L-402 has been properly connected to the controller (p. 18).
- ✓ You have read and understood the user manual of the controller used.
- ✓ The required PC software has been installed.
- ✓ You have read and understood the manual of the PC software used.

Starting up the L-402

1. Start up the controller (see user manual of the controller).

   Configure the controller(s) during start-up using the PC software for the L-402 used (see user manual of the controller, and the PC software): Select the entry in the stage database that exactly matches the L-402 model used. (p. 5).
2. Start a few motion cycles for testing purposes (see user manual of 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-402.

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

7.2 Performing a Maintenance Run

Depending on the operating conditions and the period of use of the L-402, the following maintenance measures are required:

Maintenance run

The maintenance run serves to distribute 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 lubricant present to be evenly distributed.
- If you operate your L-402 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.

Lubrication

Under laboratory conditions, the L-402 needs extra lubrication in exceptional cases only. For continuous industrial use, the lubrication intervals must be defined individually.

- If you have any questions, contact our customer service department (p. 25).

7.3 Cleaning the L-402

Requirements

- ✓ You have disconnected the L-402 from the controller.

Cleaning the L-402

➢ If necessary, clean the surfaces of the L-402 with a cloth that is dampened with a mild cleanser or disinfectant.

7.4 Manually Moving the Motion Platform

INFORMATION

It can be necessary to move the motion platform manually to provide access to mounting holes for mounting screws in the base body of the L-402.

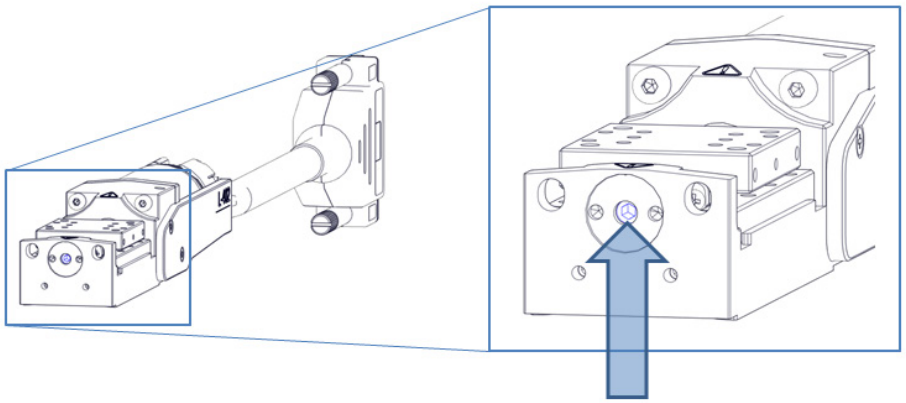


Figure 9: Position of the drive screw access

Requirements

✓ The L-402 is **not** connected to the controller.

Tools and accessories

- Hex key, AF 1.5

Manually moving the platform

1. Insert the hex key into the drive screw access until you sense resistance.
2. Turn the hex key as far as necessary:
   - Clockwise rotation: Platform moves away from the motor
   - Counterclockwise rotation: Platform moves in the direction of the motor

8 Troubleshooting

Problem	Possible causes	Solution
Reduced positioning accuracy	Warped base body	➢ Mount the L-402 onto an even surface. The recommended flatness of the surface is ≤ 10 µm.
	When the L-402 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. 27)).
	Increased wear due to small motions over a long period of time	➢ Perform a maintenance run over the entire travel range (p. 21).
Functional impairment after system modification	▪ Controller was replaced. ▪ The LS402 was replaced by another model.	Controller from PI: ➢ Load the parameters from the stage database that correspond to the combination of controller and the L-310 model. Controller from a third-party supplier: ➢ 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.	➢ Check all connecting cables. ➢ Check the controller.
	Axis motion error.	Motion error = The difference between the current position and the commanded position exceeds the specified maximum value in closed-loop operation. For example, motion errors can be caused by malfunctions of the drive or the position sensor of the positioner. 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. For details, see the user manual of the controller.
	Motion platform has triggered the limit switch.	If you use a controller from PI: 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-402.10SD 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.	The motor skips steps. The information on the current position is lost without the controller detecting the state. ➢ Determine the maximum velocity for a positioner with a stepper motor in the application. ➢ 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. 25).

9 Customer Service

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

- If you have questions concerning your system, have the following information ready:
  - Product and serial numbers of all products in the system
  - Firmware version of the controller (if present)
  - Version of the driver or the software (if present)
  - Operating system on the PC (if present)
- 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. **Fehler! Textmarke nicht definiert.**) for download.

10 Technical Data

10.1 Specifications

10.1.1 Data Table

	L-402.10DD	L-402.10SD	Unit	Tolerance
Motion and positioning				
Travel range	13	13	mm	
Integrated sensor	Rotary encoder with A/B quadrature signal transmission	–		
Design resolution	0.122	2.5 (full step)	µm	
Sensor resolution rotary encoder	4096	–	Cts./rev.	
Minimum incremental motion	1	0.5	µm	Typ.
Unidirectional repeatability	1	0.5	µm	Typ.
Bidirectional repeatability	±5	±5	µm	Typ.
Pitch	±175	±175	µrad	Typ.
Yaw	±125	±125	µrad	Typ.
Straightness	±3	±3	µm	Typ.
Flatness	±3	±3	µm	Typ.
Velocity	5	5	mm/s	Max.
Reference and limit switches	Forked photoelectric sensor, N/C contact, 5V, NPN	Forked photoelectric sensor, N/C contact, 5V, NPN		
Mechanical properties				
Drive screw	Leadscrew	Leadscrew		
Drive screw pitch	0.5	0.5	mm	
Load capacity	10	10	N	Max.
Push/pull force	10	10	N	Max.
Self-locking	10	10	N	Max.
Permissible lateral force	5	5	N	Max.
Permissible torque in θX, θY, θZ	1	1	N·m	Max.

	L-402.10DD	L-402.10SD	Unit	Tolerance
Drive properties				
Motor type	DC motor	2-phase stepper motor		
Step resolution	–	200	Full steps/rev.	
Operating voltage, nominal	24	24	V	Nom.
Operating voltage, max.	48	48	V	Max.
Miscellaneous				
Operating temperature range	5 to 40	5 to 40	°C	
Material	Aluminum, anodized, stainless steel	Aluminum, anodized, stainless steel		
Mass	0.16	0.15	kg	
Cable length	0.135	0.25	m	±10 mm
Connector	HD D-sub 26 (m)	HD D-sub 26 (m)		
Recommended controllers	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

10.1.2 Maximum Ratings

The L-402 are designed for the following operating data:

Device	Maximum operating voltage	Operating frequency	Maximum power consumption
L-402.10DD	12 V	-	8.5 W
L-402.10SD	24 V	-	5 W

10.1.3 Ambient Conditions and Classifications

The following ambient conditions and classifications must be observed for the L-402:

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	-20 °C to 65 °C
Transport temperature	-20 °C to 65 °C
Supply fluctuations	Max. ±10 % of the nominal voltage
Degree of pollution	2
Degree of protection according to IEC 60529	IP40

10.1.4 Limit Switch Specifications

Type	Optical sensor
Supply voltage	+5 V / ground
Signal output	Open collector
Signal logic	The signal level changes when passing the limit switch. The signal logic is active high. That means: ▪ Normal motor operation: low (0 V) ▪ Limit switch reached: high (+5 V)

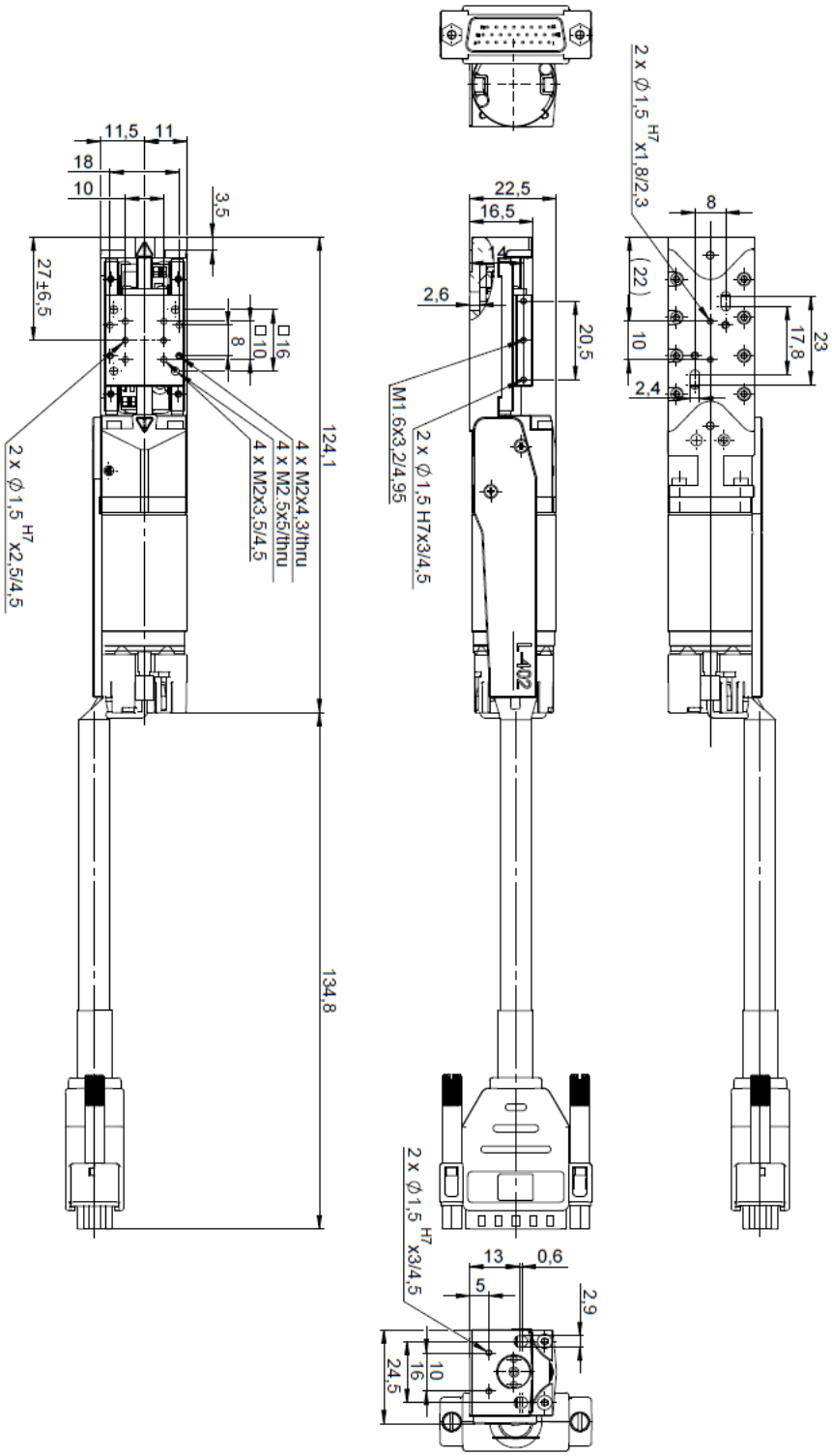
10.1.5 Reference Switch Specifications

Type	Optical sensor
Supply voltage	+5 V / ground
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.

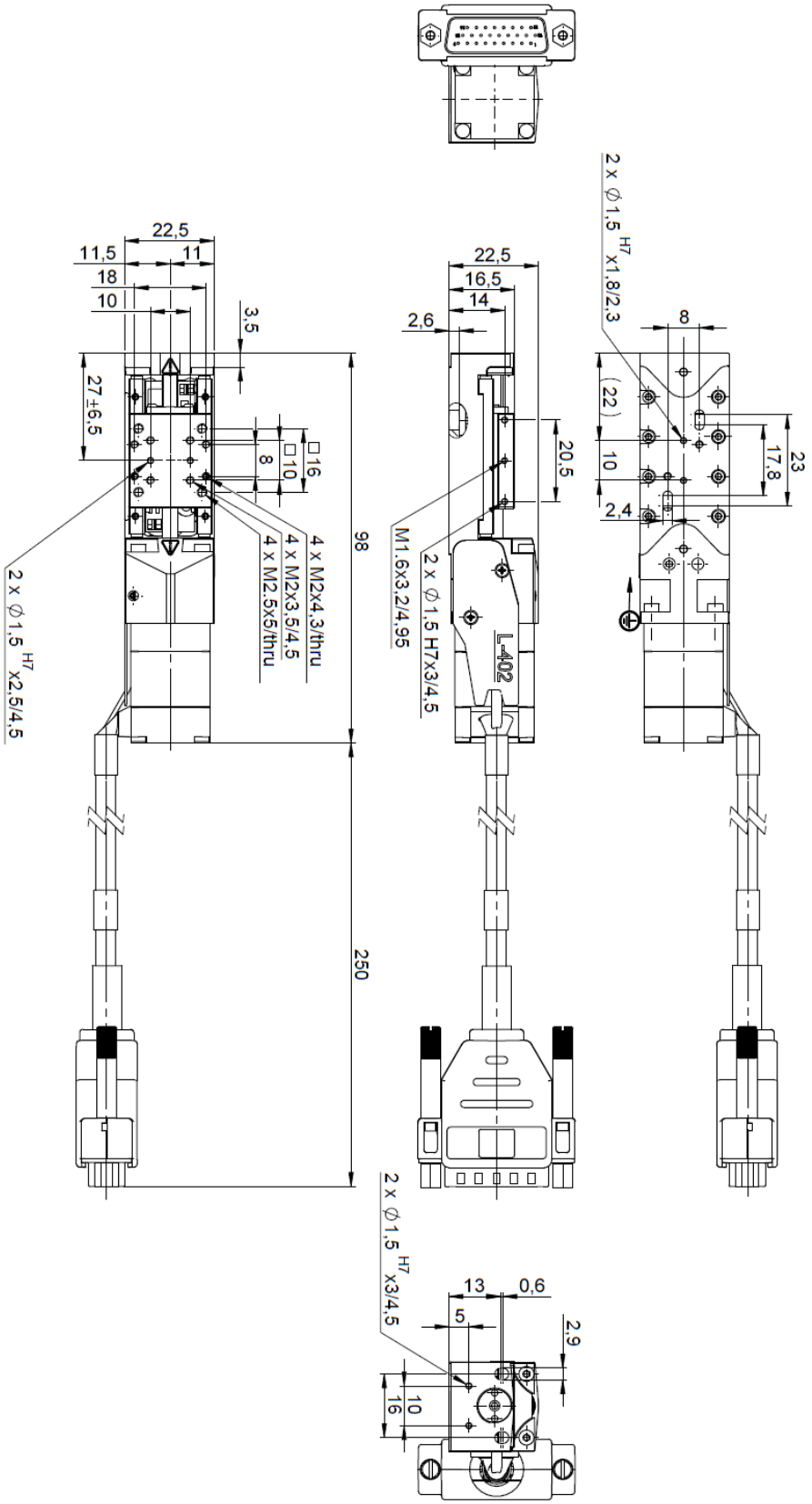
10.2 Dimensions

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

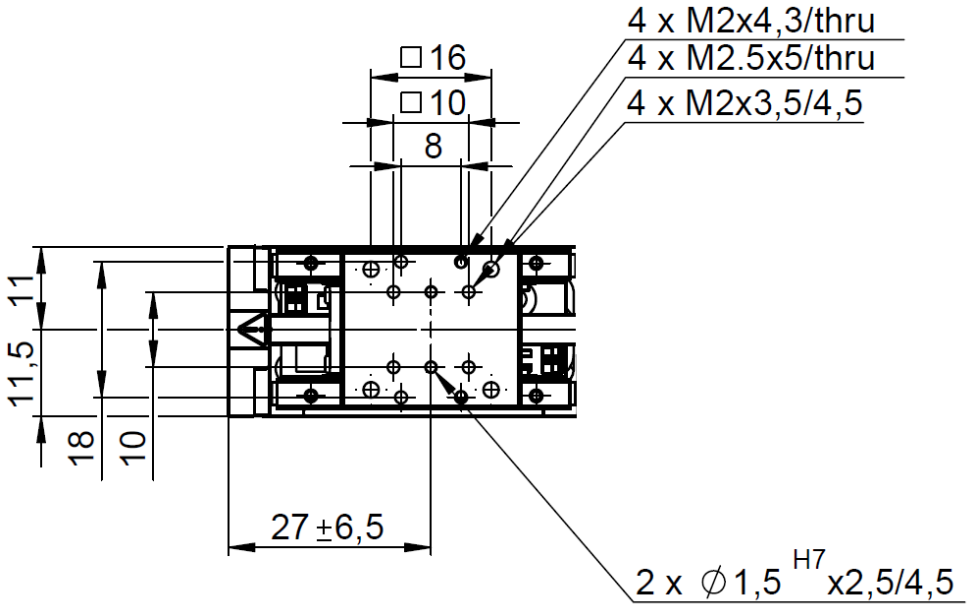
10.2.1 L-402.10DD



10.2.2 L-402.10SD



10.2.3 Hole Pattern of the Motion Platform



10.3 Pin Assignment

10.3.1 HD D-Sub 26 (m)

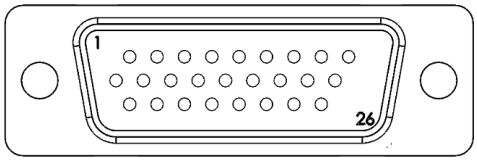


Figure 10: HD D-Sub 26 connector

Pin assignment for L-402.10SD

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	-	-
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	-	-

Pin assignment for L-402.10DD

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 E1 (neg)	Output
12	Limit E2 (pos)	Output
13	-	-
14	-	-
15	-	-
16	-	-
17	ID I/O	Bidirectional
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)	GND
26	Encoder power (+5 V)	Input

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 undertakes environmentally correct disposal of all PI miCos equipment free of charge, if it was made available to the market after August 13, 2005.

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

PI miCos GmbH

Freiburger Strasse 30

79427 Eschbach

Germany

info@pimicos.de

www.pi.de

12 EU Declaration of Conformity

An EU Declaration of Conformity has been issued for the L-402 in accordance with the following European directives:

EMC Directive

RoHS Directive

The applied standards certifying the conformity are listed below.

EMC: EN 61326-1

Safety: EN 61010-1

RoHS: EN 50581 or EN IEC 63000