

## MP149E L-220 Linear Actuators User Manual

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**This document describes the following high-resolution linear actuators:**

- L-220.10DG  
DC drive with gearhead,  
travel range 13 mm (0.5")
- L-220.10SG  
Stepper motor drive with gearhead,  
travel range 13 mm (0.5")
- L-220.20DG  
DC drive with gearhead,  
travel range 26 mm (1")
- L-220.20SG  
Stepper motor drive with gearhead,  
travel range 26 mm (1")
- L-220.50DG  
DC drive with gearhead,  
travel range 52 mm (2")
- L-220.50SG  
Stepper motor drive with gearhead,  
travel range 52 mm (2")
- L-220.70DG  
DC drive with gearhead,  
travel range 77mm (3")
- L-220.70SG  
Stepper motor drive with gearhead,  
travel range 77mm (3")



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Subject to change without notice. This manual is superseded by any new release. The latest release is available for download from our website (p. 3).

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# 1 About this Document

## In this Chapter

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## 1.1 Objective and Target Group of this User Manual

This user manual contains the necessary information on the intended use of the L-220. 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 (p. 3).

## 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.

- 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)

### 1.3 Definition of Terms

Term	Explanation
Load capacity	Maximum load capacity in the vertical direction when the linear actuator is mounted horizontally. The contact point of the load is at the center of the motion 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 (s. 31) for models without a gearhead and brake only applies when the servo mode is on.
Rotary encoder	The rotary encoder is a 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 Other Applicable Documents

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

Product	Document
L-220	MP159EK short instructions for L-2xx/MA-35/MP-20/MP-15 linear actuators
C-863.11 DC Motor Controller	MS205E user manual
C-663.11 stepper motor controller	MS208E User Manual
C-884 DC Motor Controller	MS213E user manual

## 1.5 Downloading Manuals

### INFORMATION

If a manual is missing or problems occur with downloading:

- Contact our customer service department (p. 29).

### INFORMATION

For products that are supplied with software (CD in the scope of delivery), access to the manuals is protected by a password. Protected manuals are only displayed on the website after entering the password.

The password is included on the CD of the product.

#### For products with CD: Identify the password

1. Insert the product CD into the PC drive.
2. Switch to the Manuals directory on the CD.
3. In the Manuals directory, open the Release News (file including *releasenews* in the file name).
4. Find the user name and the password in the section "User login for software download" in the Release News.

#### Downloading manuals

1. Open the website **www.pi.ws**.
2. If access to the manuals is protected by a password:
  - a) Click **Login**.
  - b) Log in with the user name and password.
3. Click **Search**.
4. Enter the product number up to the period (e.g., P-882) or the product family (e.g., PICMA® Bender) into the search field.
5. Click **Start search** or press the **Enter** key.
6. Open the corresponding product detail page in the list of search results:
  - c) If necessary: Scroll down the list.
  - d) If necessary: Click **Load more results** at the bottom of the list.
  - e) Click the corresponding product in the list.
7. Scroll down to the **Downloads** section on the product detail page.  
The manuals are shown under **Documentation**.
8. Click the desired manual and save it to the hard disk of your PC or to a data storage medium.





## 2 Safety

### In this Chapter

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### 2.1 Intended Use

The L-220 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-220 is intended for single-axis positioning, adjusting and shifting of loads at various velocities.

The intended use of the L-220 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-220.

### 2.2 General Safety Instructions

The L-220 is built according to state-of-the-art technology and recognized safety standards. Improper use of the L-220 may result in personal injury and/or damage to the L-220.

- Only use the L-220 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 the correct installation and operation of the L-220.

## 2.2.1 Organizational Measures

### User manual

- Always keep this user manual available when using the L-220. The latest versions of the user manuals are available on our website (p. 3) for download.
- Add all information from the manufacturer such as supplements or technical notes to the user manual.
- If you give the L-220 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-220 after you have read and understood this user manual.

### Personnel qualification

The L-220 may only be installed, started up, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

# 3 Product Description

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### 3.1 Model Overview

There are six standard versions of the L-220. All models are high-resolution linear actuators with a limit switch. They differ with respect to:

- Drive type
- Travel range

Model	Travel range			Drive type		
	13 mm	26 mm	52 mm	77 mm	DC gear motor	Step gear motor
L-220.10DG	+				+	
L-220.10SG	+					+
L-220.20DG		+			+	
L-220.20SG		+				+
L-220.50DG			+		+	
L-220.50SG			+			+
L-220.70DG				+	+	
L-220.70SG				+		+

### Detailed model overview

Order number	Product name
L-220.10DG	High-resolution linear actuator, DC gear motor, 13 mm (0.5") travel range, magnetic limit switches
L-220.10SG	High-resolution linear actuator, stepper motor with gearhead, 13 mm (0.5") travel range, magnetic limit switches
L-220.20DG	High-resolution linear actuator, DC gear motor, 26 mm (1") travel range, magnetic limit switches
L-220.20SG	High-resolution linear actuator, stepper motor with gearhead, 26 mm (1") travel range, magnetic limit switches
L-220.50DG	High-resolution linear actuator, DC gear motor, 52 mm (2") travel range, magnetic limit switches
L-220.50SG	High-resolution linear actuator, stepper motor with gearhead, 52 mm (2") travel range, magnetic limit switches
L-220.70DG	High-resolution linear actuator, DC gear motor, 77 mm (3") travel range, magnetic limit switches
L-220.70SG	High-resolution linear actuator, stepper motor with gearhead, 77 mm (3") travel range, magnetic limit switches

- For further technical data, see the specifications (p. 31).

PI also produces custom versions upon request. Custom versions can differ from the described standard products in respect to dimensions, characteristics or other technical data.

- If necessary, contact our customer service department directly (p. 29).

### 3.2 Product View

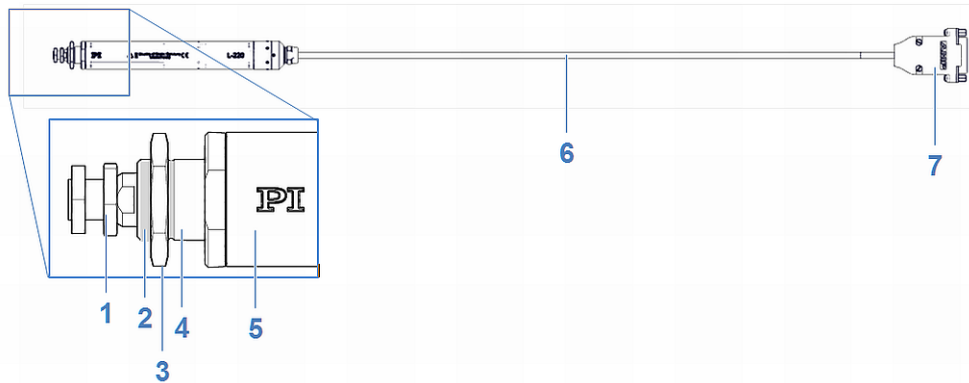


Figure 1: Parts of the L-220 (here with flat tip)

- 1 Tip, replaceable (here: Flat, mounted on pusher)
- 2 Thread for clamp connection
- 3 Mounting nut for clamp connection
- 4 Smooth cylinder surface, e.g., for mounting in a hole
- 5 Sleeve
- 6 Cable
- 7 Controller connection (HD Sub-D 26, male)

### 3.3 Direction of motion

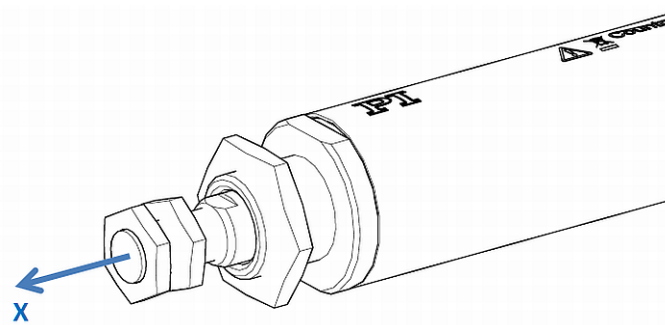


Figure 2: Direction of motion of the pusher (her with flat tip)

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

### 3.4 Product Labeling

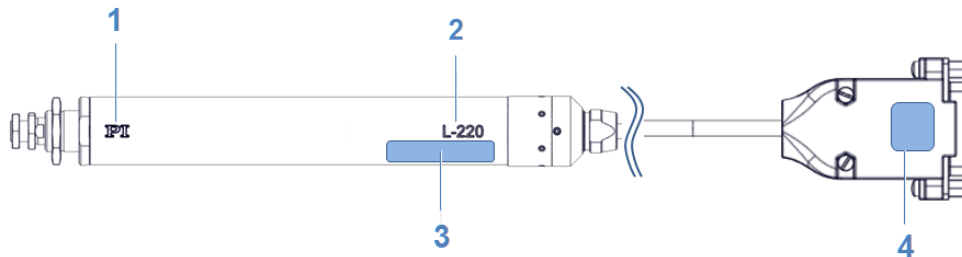


Figure 3: Product labeling

Position	Labeling	Description
1, 3		Manufacturer's logo
2	L-220	Product series
3	L-220.20SD00	Product name (example), the characters after the period refer to the model
3	415002159	Serial number (example), individual for each L-220 Meaning of the places (counting from left): 1 = internal information, 2 and 3 = year of manufacture, 4 to 9 = consecutive numbers
3		Warning sign "Observe manual!"
3	Country of origin: Germany	Country of origin
3		CE conformity mark
3	WWW.PI.WS	Manufacturer's address (website)
3		Old equipment disposal
4*		Warning sign "Electrostatic sensitive devices"

\* also on the opposite side of the connector

### 3.5 Scope of Delivery

Order number	Components	L-220.x0DG	L-220.x0SG
L-220	Linear actuator according to order (p. 7), with flat tip and spherical tip ( <b>not</b> mounted on delivery)	+	+
MP159DK	Short instructions for L-2xx/MA-35/MP-20/MP-15 linear actuators	+	+
C-815.LDM1	Motor cable for connection to C-863 and C-884 DC motor controller	+	
C-815.LSM1	Motor cable for connection to C-663 stepper motor controller		+

### 3.6 Suitable Controllers

The L-220 must be connected to a suitable controller. The following controllers from PI are suitable for the operation of the L-220:

Stage	Controller	Axes per controller	PC interface	Multiple controllers on the same PC
L-220.x0DG	C-863	1	USB, RS-232, daisy chain network	Yes, same interface
	C-884	1 to 4	USB, RS-232, TCP/IP	Yes
L-220.x0SG	C-663.11 C-663.12	1	USB, RS-232, daisy chain network	Yes, same interface

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-220 used.

## **3.7 Technical Features**

### **3.7.1 Rotary Encoder**

The models with DC motors are equipped with a rotary encoder. A rotary encoder, also called an incremental or incremental 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-220 is equipped with noncontact, Hall-effect limit switches.

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

See "Limit Switch Specifications" for more information (p. 33).

### **3.7.3 Reference Point Switch**

The L-220 is equipped with one direction-sensing reference point 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 point switch.

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

For more information, see "Reference Point Switch Specifications" (p. 33).



## 4 Unpacking

1. Unpack the L-220 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

### In this Chapter

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Installing the Linear Actuator in a Mechanical Mounting .....	17
Mounting a tip .....	18
Changing the tip.....	20

### 5.1 General Notes on Installation

#### NOTICE



#### Cable break!

A cable break leads to failure of the linear actuator.

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

#### NOTICE



#### Increased friction!

Lateral forces that act on the pusher of the linear actuator increase the friction of the internal drive components. Increased friction impairs the motion of the pusher and increases wear on the drive components.

- Avoid lateral forces on the tip and on the pusher of the L-220.

#### NOTICE



#### Heating up of the L-220 during operation!

The heat produced during operation of the L-220 can affect your application.

- Install the L-220 so that the application is not impaired by the dissipated heat.

#### INFORMATION

Models with DC gear motors are equipped with integrated signal drivers for cable lengths  $\leq 10\text{m}$  between the linear actuator and the motor controller

## 5.2 Providing a Suitable Mechanical Mounting and Installation Environment

A suitable mechanical mounting and installation environment are necessary for the proper use of the actuator.

- Make sure that the following conditions have been met:
  - Material and statics of the mounting are designed so that the static and dynamic forces that occur can be safely and continuously managed.
  - The dimensions of the mounting are adapted to the dimensions of the actuator (see above figures and dimensions (p. 34)).
  - The intended motions of the pusher and the load must not be inhibited by the dimensions of the installation environment.
- Take into account the following specifications as well when planning the application and installing the actuator:
  - Dimensions of the tip selected (see Dimensions (p. 34))
  - Travel range: (see data table (p. 31))
  - Space requirements for a kink-free and proper guiding of the connecting cable and additional motor cables
  - Length of the connection cable (approx. 0.5 m) and the motor cable (3 m)
- If the limit switches of the actuator cannot be reached with the planned minimum and maximum displacements: Make sure that the actuator and the load **only move within the planned range**. Suitable measures:
  - Corresponding programming of the controller
  - Emergency off switch
  - Automatic shutdown systems
- Avoid or label danger areas that result from the installation of the actuator and from use, in accordance with the legal regulations (e.g. risk of crushing in the case of heavy moving loads, fast actuator motions and/or high drive torques).

The complete dimensions of the actuator and relevant individual parts can be found in the figures in the section Dimensions (p. 34).

## 5.3 Installing the Linear Actuator in a Mechanical Mounting

### NOTICE



#### Incorrect tightening torque of the mounting nut!

The motion of the pusher can be hindered by a mounting nut that has been tightened too strongly. This reduces the positioning accuracy.

- Tighten the mounting nut to a maximum torque 10 Nm.

### INFORMATION

To achieve an optimum repeatability, the mounting shaft must not have any backlash. During mounting, make sure that there is a faultless connection between the actuator and the mechanical mounting.

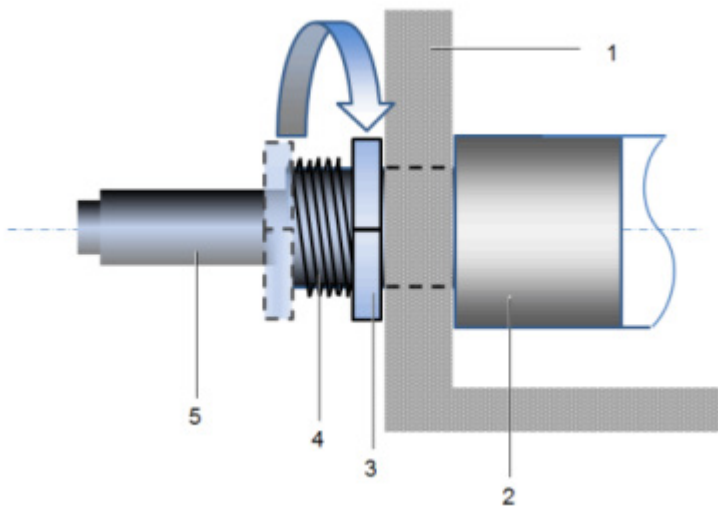


Figure 4: Clamp connection (schematic)

- 1 Mechanical mounting
- 2 Sleeve
- 3 Mounting nut
- 4 Mounting shaft with thread
- 5 Pusher

We recommend installing the actuator in the mechanical mounting with a clamp connection. The following instructions refer to this case.

#### Requirements

- ✓ You have read and understood the general notes on installation (p. 15).
- ✓ You have provided your application with a suitable mounting for the mounting shaft of the actuator.
- ✓ The tip is **not** mounted on the actuator.

### Tools and accessories

- Open-end wrench AF 17

### Installing the actuator

1. Loosen the mounting nut on the mounting shaft of the actuator.
2. Position the actuator in the mounting of your application.
3. If necessary, put a suitable flat washer or a suitable spring washer on the mounting shaft.
4. Manually screw the mounting nut into the thread of the mounting shaft with a few rotations.
5. To clamp the actuator in the mounting, tighten the mounting nut using the open-end wrench until you feel a resistance. The torque may **not** exceed 10 Nm!
6. Check that the actuator is affixed firmly in the mounting.

## 5.4 Mounting a Tip

### NOTICE



#### Damage of the mechanics from torques at the tip

- Avoid generation of torques when mounting or changing the tip.

### INFORMATION

The supplied tips make it possible to realize different mechanical connections to a load:

- A flat tip allows a wide-area connection to a load.
- A spherical tip allows a punctiform connection to a load.

To achieve optimum repeatability:

- Use a tip.

Make sure that the selected tip is completely screwed in and does not have any backlash.

The tip is used to establish contact with the load. On delivery, the tip is **not** preassembled.

The scope of delivery includes a tip with flat and hemispherical contact surfaces. An M6 inner thread is provided for mounting the tip in the pusher.

### Requirements

- ✓ You have read and understood the general notes on installation (p. 15).
- ✓ The pusher has been moved out so that you can easily reach the tip. In the delivery state, the pusher is moved out.

### Tools and accessories

- Supplied tip
- Optional:
  - Open-end wrench AF 7
  - Open-end wrench AF 8

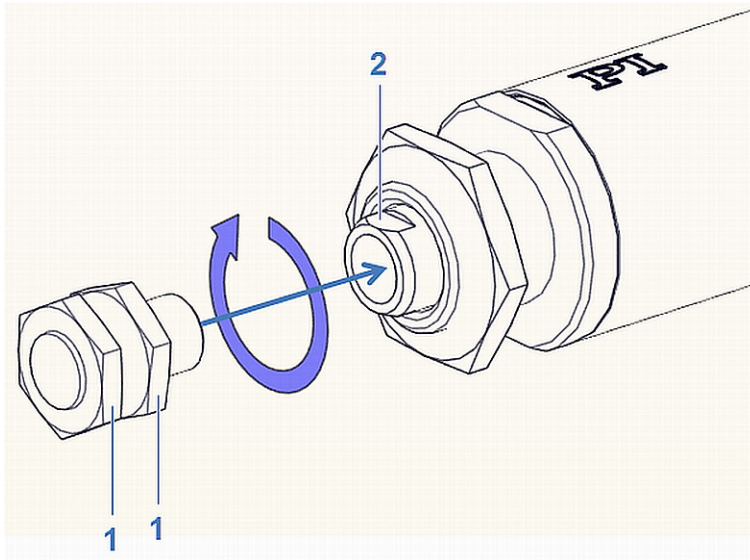


Figure 5: Mounting the tip, schematic

- 1 Wrench flat of the tip
- 2 Wrench flat of the linear actuator

### Mounting a tip

1. Screw the selected tip by hand into the inner thread of the pusher (see figure above).
2. If necessary: Tighten the tip further with a tightening torque of max. 2 Nm:
  - a) Position an AF 7 open-end wrench on the wrench flat of the linear actuator.
  - b) Position an AF 8 open-end wrench on the wrench flats of the tip.
  - c) Screw the tip further into the pusher with the AF 8 open-end wrench.
3. Make sure that the tip is affixed firmly.

## 5.5 Changing the Tip

### NOTICE



#### Damage of the mechanics from torques at the tip

- Avoid generation of torques when mounting or changing the tip.

#### Requirements

- ✓ You have read and understood the general notes on installation (p. 15).
- ✓ You have made the L-220 accessible for changing the tip.
- ✓ The pusher has been moved out so that you can easily reach the tip.  
In the delivery state, the pusher is moved out.

#### Tools and accessories

- Supplied tip
- Open-end wrench AF 7
- Open-end wrench AF 8

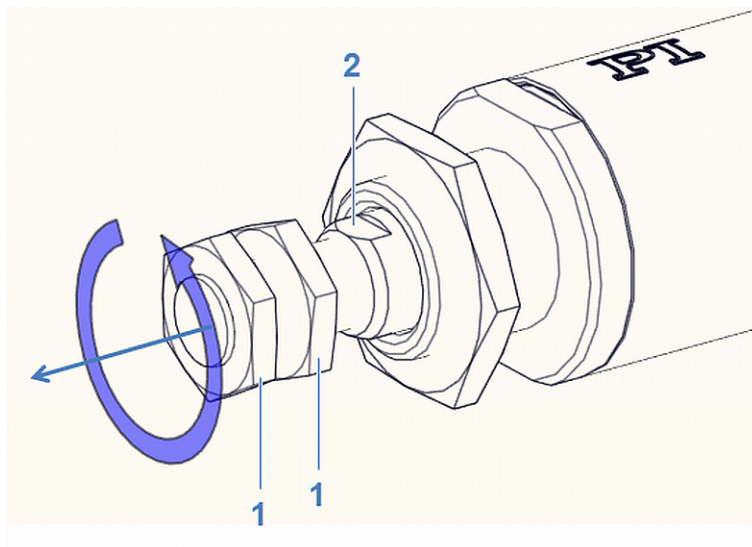


Figure 6: Removing the tip

- 1 Wrench flat of the tip
- 2 Wrench flat of the linear actuator

#### Removing and changing the tip

1. Position an AF 7 open-end wrench on the wrench flat of the linear actuator.
2. Position an AF 8 open-end wrench on the wrench flats of the tightened tip.
3. Screw the tip out of pusher with the AF 8 open-end wrench.
4. Mounting the selected tip (p. 18).



## 6 Start-Up

### In this Chapter

General Notes on Start-Up .....	21
Starting up the Linear Actuator .....	23

### 6.1 General Notes on Start-Up

#### CAUTION



#### Unintentional motion of the linear actuator while connecting it to the controller!

- Do not place any objects in areas where they can be caught by moving parts.
- Keep your fingers at a safe distance from the motion range of the linear actuator.

#### NOTICE



#### Damage if a wrong motor controller is connected!

Connecting a linear actuator to an unsuitable controller can cause damage to the linear actuator or controller.

- Connect a linear actuator with DC motor to a DC motor controller only.
- Connect a linear actuator with stepper motor to a stepper motor controller only.

#### NOTICE



#### Damage due to the pusher crashing into the hard stop!

When the limit switches are deactivated, the motion of the pusher is aborted by the hard stop and the L-220 can be damaged.

- Do **not** deactivate the limit switches in the software.
- Test limit switch operation at low velocities only.

**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.
- Set the control signal so that the moving part does not stop abruptly or try to continue motion at the end of the travel range.
- Determine the maximum velocity for your application.

**NOTICE****Damage from unsuitable controllers and PC software!**

Unsuitable controllers and PC software can cause damage to the actuator.

- If you use controllers and software from other manufacturers, **before** starting up the actuator, check the technical data to make sure that they are suitable!

**INFORMATION**

The maximum velocity for a linear actuator with a stepper motor 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**

For models with DC motors:

Improper setting of the servo-control parameters can impair the performance of the L-220. This can have the following consequences:

- Oscillation
- Imprecise approach of the position
- Settling time is too long
- If the performance of the L-220 is not satisfactory, check the settings for the servo-control parameters of your controller.

**INFORMATION**

Moving the pusher outwards corresponds to the positive direction of motion.

## 6.2 Starting up the Linear Actuator

### NOTICE



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

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

- Only connect a stage to a suitable controller.
- To connect the stage to the controller, only use a motor cable that is suitable for the controller:
  - **C-663** controller: **C-815.LSM1** motor cable
  - **C-863** or **C-884** controller: **C-815.LDM1** motor cable

#### Requirements

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

#### Tools and accessories

- Cable from the scope of delivery of the stage (p. 11)
- Suitable tools for tightening the screws to the connections

#### Connecting the L-220 to a controller

1. Remove the ESD protection from the motor connection of the L-220.
2. Connect the L-220, cable, and controller with each other as shown in the corresponding connection diagram (see above).
3. Use the integrated screws to secure the connections against accidental disconnection.

### 6.2.1 L-220 Entries in the Stage Database of PI

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

## 6.2.2 Operating Parameters of the Models with DC Motor

If you use a DC motor controller from a third-party supplier, it may be necessary to enter operating parameters to adapt it to the linear actuator used.

Parameter	L-220.x0DG	Unit
P term	400	-
I term	600	-
D term	400	-
I limit	1000	-
Maximum acceleration	35	mm/s <sup>2</sup>
Maximum velocity	3.5	mm/s
Maximum velocity	157936	counts/s
Gear ratio	29.6:1 (12493:567)	-
Encoder resolution	2048	counts/rev.
Limit switch polarity	Active high	-

## 6.2.3 Operating Parameters of the Models with Stepper Motor

If you use a stepper motor controller from a third-party supplier, it may be necessary to enter operating parameters to adapt it to the linear actuator used.

Parameter	L-220.x0SG	Unit
<b>Recommended Start Values</b>		
Holding current	127	mA
Operating current	245	mA
Holding current delay	500	ms
Maximum motor current	250	mA
Maximum acceleration	1579362	steps/s <sup>2</sup>
Maximum velocity	0.8	mm/s
Maximum velocity	2048	steps/s
<b>Hardware Properties</b>		
Gear ratio	76:1 (387283:5103)	-
Limit switch polarity	Active high	-
Full steps	24	steps/revolution
Phase resistance	12.5	ohm
Maximum phase current, bipolar	250	mA

## 7 Maintenance

### In this Chapter

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#### NOTICE



#### Damage due to improper maintenance!

The L-220 can become misaligned as a result of improper maintenance.

- Do not loosen any sealed screws.

### 7.1 Performing a Maintenance Run

Depending on the operating conditions and the period of use of the L-220, 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 equally distributed.
- 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.

#### Lubrication

Under laboratory conditions, the stage 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. 29).

## 7.2 Cleaning the L-220

### Requirements

- ✓ You have disconnected the linear actuator from the controller.

### Cleaning the linear actuator

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

## 8 Troubleshooting

Problem	Possible causes	Solution
Reduced positioning accuracy	Mounting nut is fastened too tight	<ul style="list-style-type: none"> <li>➤ Tighten the mounting nut to a maximum torque 10 Nm.</li> </ul>
Functional impairment after system modification	<ul style="list-style-type: none"> <li>▪ Motor controller has been replaced</li> <li>▪ L-220 was replaced by another model.</li> </ul>	<p>Motor controller from PI:</p> <ul style="list-style-type: none"> <li>➤ Load the parameters from the stage database that correspond to the combination of motor controller and L-220 model.</li> </ul> <p>Motor controller from a third-party supplier:</p> <ul style="list-style-type: none"> <li>➤ Check the operating parameters.</li> </ul>
The mechanics do not move.	Cable not connected correctly or defective	<ul style="list-style-type: none"> <li>➤ Check the connecting cable.</li> </ul>
	Lateral forces are affecting the pusher	<p>Lateral forces increase the friction on the internal drive components.</p> <ul style="list-style-type: none"> <li>➤ Avoid lateral forces on the tip and on the pusher of the L-220.</li> </ul>
The mechanics do not move, but generate operating noise.	Values for the velocity, acceleration and/or load are too high	<ul style="list-style-type: none"> <li>➤ Reduce the velocity.</li> <li>➤ Reduce the acceleration.</li> <li>➤ Reduce the load on the mechanical system.</li> </ul>
The mechanical system did not stop in time and ran into the limit stop	<ul style="list-style-type: none"> <li>▪ Velocity is too high (see chapter Limit Switches p. 12)</li> <li>▪ Limit switch is defective</li> <li>▪ Motor controller ignores the limit switch signal</li> </ul>	<ol style="list-style-type: none"> <li>1. Stop the motor.</li> <li>2. Command the mechanical system away from the hard stop.</li> <li>3. Check the settings of the motor controller for the limit switch processing.</li> </ol>
For L-220.x0SD models: Actual position deviates from the displayed position.	The motor is overloaded by an external load torque or the mass to be driven in the case of strong acceleration or deceleration.	<p>The motor skips steps. The information on the current position is lost without the controller detecting the state.</p> <ul style="list-style-type: none"> <li>➤ Determine the maximum velocity for a stage with a stepper motor in the application.</li> <li>➤ Start a new reference move.</li> </ul>

If the problem that occurred with your system is not listed in the table above or cannot be solved as described, contact our customer service department (p. 29).





## 9 Customer Service

For inquiries and orders, contact your PI sales engineer or send us an email (<mailto:info@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. 3) for download.



## 10 Technical Data

### In this Chapter

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### 10.1 Specifications

#### 10.1.1 Data Table

	L-220.x0DG	L-220.x0SG	Unit	Tolerance
Motion axes	X	X		
<b>Motion and positioning</b>				
Travel range*	13 / 26 / 52 / 77	13 / 26 / 52 / 77	mm	
Integrated sensor	Rotary encoder	–		
Sensor resolution	2048	–	Cts./rev.	
Design resolution	0.022	0.55 (full step)* 0.034 (with C-663.11)		
Minimum incremental motion	0.1	0.1	μm	typ.
Backlash	1.5	1.5	μm	typ.
Unidirectional repeatability	1	1	μm	typ.
Velocity	3.5	0.8	mm/s	max.
<b>Mechanical properties</b>				
Thread pitch				
Ball screw	1	1	mm	
Gear ratio	22:1	76:1		approx.
Motor resolution	–	384 (29184)*	steps/rev.	
Push/pull force	125	125	N	max.
Permissible lateral force	1	1	N	max.

	L-220.x0DG	L-220.x0SG	Unit	Tolerance
<b>Drive properties</b>				
Motor Type	DC motor with gearhead	2-phase stepper motor* with gearhead		
Operating voltage	±12		V	
Limit and reference point switches	Hall effect	Hall effect		
<b>Miscellaneous</b>				
Operating temperature range	-20 to 65	-20 to 65	°C	
Material	Stainless steel, red brass	Stainless steel, red brass		
Mass	0.21 / 0.22 / 0.26 / 0.29	0.21 / 0.22 / 0.26 / 0.29	kg	±5 %
Cable length	0.5	0.5	m	±10 mm
Connector	HD Sub-D 26 (motor and rotary encoder) to Sub-D 15, 0.5 m cable	HD Sub-D 26 (motor) to Sub-D 15, 0.5 m cable		
Recommended controllers/drivers	C-863 (single axis) C-884 (up to 4 axes)	C-663 (single axis)		

\* 24 full steps/rev., max. 0.32 A/phase

3 m extension cable included.

Ask about custom designs!

### 10.1.2 Maximum Ratings

L-220 stages are designed for the following operating data:

Device	Maximum operating voltage	Operating frequency	Maximum power consumption
L-220.0DG	12 V	-	4 W
L-220.0SG	24 V	-	-

### 10.1.3 Ambient Conditions and Classifications

The following ambient conditions and classifications must be observed for the L-220:

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	-25 °C to 85 °C
Transport temperature	-25 °C to 85 °C
Supply fluctuations	Max. $\pm 10$ % of the nominal voltage
Degree of pollution	2
Degree of protection according to IEC 60529	IP40

### 10.1.4 Limit Switch Specifications

Type	Magnetic (Hall effect) sensor
Supply voltage	+5 V / ground
Signal output	Open collector (wiring 5 V to 24 V / max. 50 mA)
Signal logic	The signal level changes when passing the limit switch. The signal logic is active high. That means: <ul style="list-style-type: none"> <li>▪ Proper operation of the motor: Collector switches through.</li> <li>▪ Limit switch reached: Collector blocks</li> </ul>

### 10.1.5 Reference Point Switch Specifications

Type	Magnetic (Hall effect) sensor
Supply voltage	+5 V / GND
Signal output	Open collector (wiring 5 V to 24 V / max. 50 mA)
Signal logic	Blocking or switching through of the collector after passing the reference point switch, depending on the direction.

## 10.2 Dimensions

### 10.2.1 Linear Stage

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

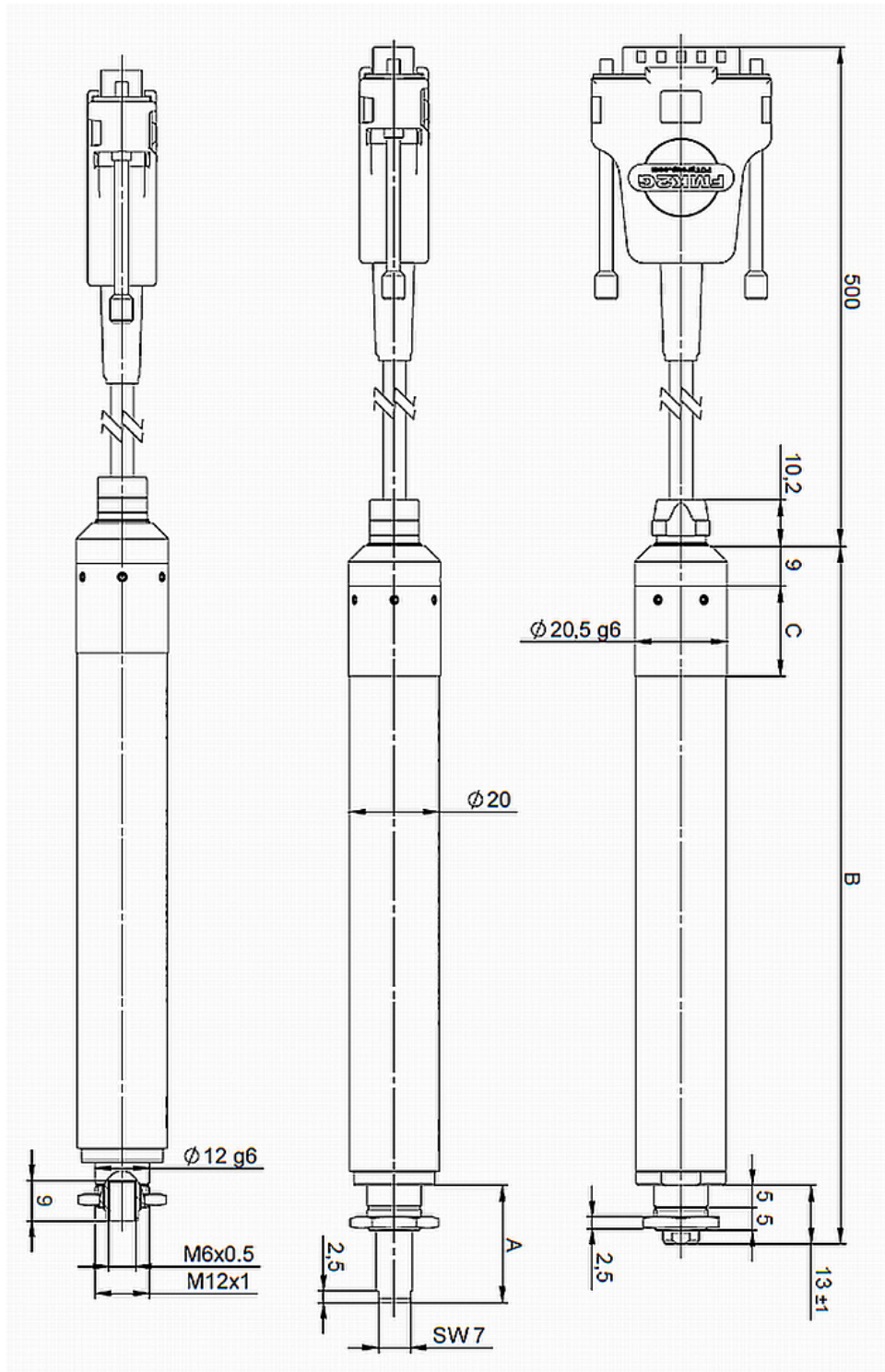


Figure 7: Dimensions of the stage

	Travel range	A	B	C
L-220.10SG	13	26	148.3	13
L-220.10DG	13	26	155.2	19.9
L-220.20SG	26	39	161.5	13
L-220.20DG	26	39	168.4	19.9
L-220.50SG	52	65	186.6	13
L-220.50DG	52	65	193.5	19.9
L-220.70SG	77	90	211.6	13
L-220.70DG	77	90	218.5	19.9

### 10.2.2 Tips

#### Flat tip

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

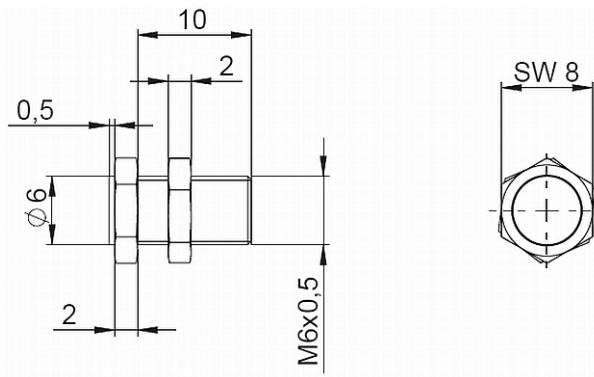


Figure 8: Dimensions of the flat tip

#### Round tip

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

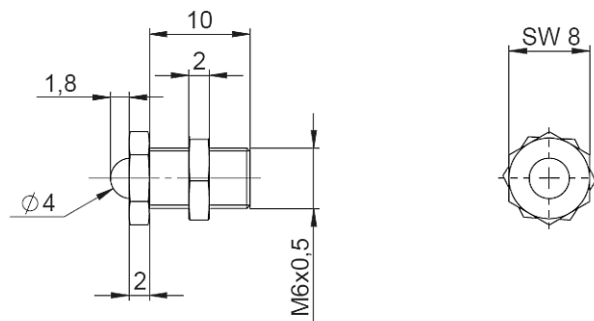


Figure 9: Dimensions of the round tip

## 10.3 Pin Assignment

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

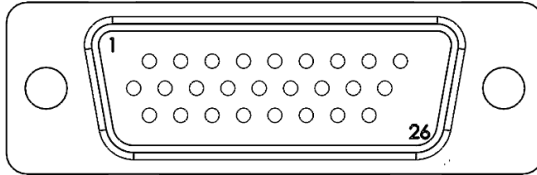


Figure 10: HD D-Sub 26 connector

#### Pin assignment for the L-220.x0SG 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	-	-
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 the L-220.x0DG models

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

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

PI miCos GmbH  
Freiburger Strasse 30  
79427 Eschbach, Germany





## 12 EU Declaration of Conformity

An EU Declaration of Conformity has been issued for the L-220 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

