

## MP116E N-422 Linear Drive User Manual

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Date: 26.03.2024



**This document describes the following product:**

- **N-422.50**  
Linear actuator with piezo motor; piezoelectric inertia drive; 35 mm travel range; 7 N feed force; 5 mm/s maximum velocity; 1.5 m cable length



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 This manual is superseded by any new release.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

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# 1 About this Document

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### 1.1 Objective and Target Group of this User Manual

This user manual contains the information necessary for using the N-422 as intended.

We assume that the user has basic knowledge of closed-loop systems, motion control concepts, and applicable safety measures.

### 1.2 Symbols and Typographic Conventions

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

#### CAUTION



**Dangerous situation**

Failure to comply could lead to minor injury.



- Precautionary measures for avoiding the risk.

#### NOTICE



**Dangerous situation**

Failure to comply could result in damage to the equipment.

- Precautions to avoid the risk.

#### INFORMATION

Information for easier handling, tricks, tips, etc.

Symbol/Label	Meaning
1.	Action consisting of several steps with strict sequential order
2.	
➤	Action consisting of one or more steps without relevant sequential order
▪	Bullet point
p. 5	Cross-reference to page 5
RS-232	Label on the product indicating an operating element (example: RS-232 interface socket)
	Warning sign on the product referring to detailed information in this manual.

### 1.3 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.

### 1.4 Other Applicable Documents

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

Product	Document
E-872.401 Q-Motion® piezo motor / PiezoMike drive electronics	PZ279 User Manual

## 1.5 Downloading Manuals

### ***INFORMATION***

If a manual is missing or problems occur with downloading:

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

### **Downloading manuals**

1. Open the website **www.pi.ws**.
2. Search the website for the product number (e.g., N-422).
3. In the search results, select the product to open the product detail page.
4. Select ***Downloads***.

The manuals are shown under ***Documentation***. Software manuals are shown under ***General Software Documentation***.

5. For the desired manual, select ***ADD TO LIST*** and then ***REQUEST***.
6. Fill out the request form and select ***SEND REQUEST***.

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



## 2 Safety

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### 2.1 Intended Use

The N-422 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.

The N-422 is a linear drive for integration in motion systems used for positioning, adjusting and displacing an object (load) on an axis. For integration purposes, the mechanics into which the N-422 is to be installed must have suitable guides. The N-422 can be mounted horizontally or vertically.

The N-422 linear drive uses the principle of inertia (stick-slip effect). The feed of the runner is produced by alternating static and sliding friction between the runner and a cyclically activated piezo actuator. The object (load) which is to be moved is coupled with the moving runner.

The drive is self-locking at rest, requires no current, and does not generate any heat. It holds the position with maximum force.

The N-422 is not intended for continuous operation. Refer to "Technical Data" (p. 31) for further information on the operating conditions of the N-422.

The intended use of the N-422 is only possible in conjunction with suitable drive electronics which have the necessary operating voltages. The drive electronics are not in the scope of delivery of the N-422. PI offers suitable drive electronics p. 9.

External position sensors and a position controller are required for the closed-loop operation of a motion system with N-422 drive and drive electronics.

## 2.2 General Safety Instructions

The N-422 is built according to state-of-the-art technology and recognized safety standards. Improper use of the N-422 may result in personal injury and/or damage to the N-422.

- Use the N-422 for its intended purpose only, and only when it is in perfect condition.
- Read the user manual.
- Immediately eliminate any faults and malfunctions that are likely to affect safety.

The operator is responsible for installing and operating the N-422 correctly.

If the protective earth conductor is not or not properly connected, dangerous touch voltages can occur on the N-422 in the event of a malfunction or failure of the system. If there are touch voltages, touching the N-422 can result in minor injuries from electric shock.

- Connect the N-422 to a protective earth conductor (p. 16) before starting.
- Do **not** remove the protective earth conductor during operation.
- If the protective earth conductor has to be removed temporarily (e.g., in the case of modifications), reconnect the N-422 to the protective earth conductor before restarting.

## 2.3 Organizational Measures

### User manual

- Always keep this user manual together with the N-422. The latest versions of the user manuals are available for download on our website (p. 3).
- Add all information from the manufacturer such as supplements or technical notes to the user manual.
- If you give the N-422 to other users, include this user manual as well as all other relevant information provided by the manufacturer.
- Do the work only if the user manual is complete. Missing information due to an incomplete user manual can result in minor injury and damage to equipment.
- Install and operate the N-422 only after you have read and understood this user manual.

### Personnel qualification

The N-422 may only be installed, started, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

### 3 Product Description

#### In this Chapter

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#### 3.1 Product View

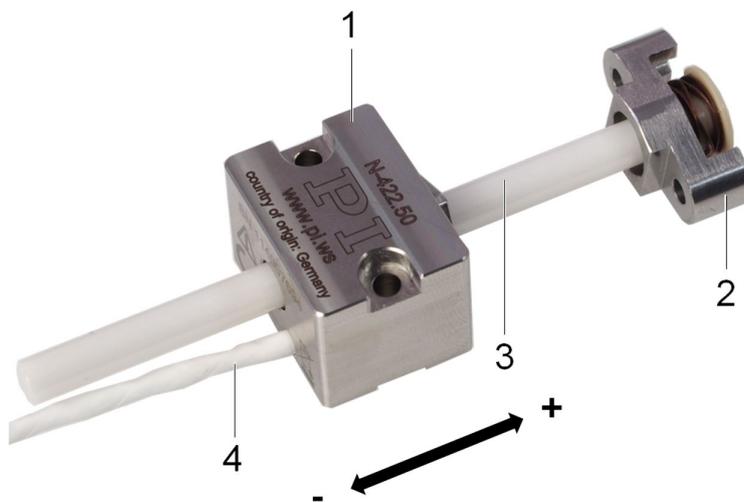


Figure 1: N-422: Product view

- 1 Base body
- 2 Coupling element (consisting of clamp, spring and tip) for fixing the object which is to be moved
- 3 Moving runner
- 4 Connecting cable

The arrow indicates the polarity of the direction of motion when the base body of the N-422 is on the fixed part of the mechanics and the runner is coupled to the moving part.

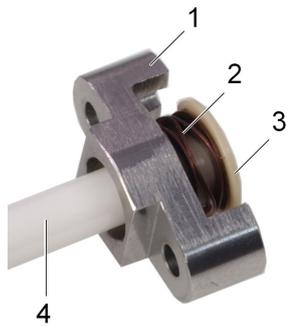


Figure 2: N-422: Detailed view of the coupling element

- 1 Clamp
- 2 Spring
- 3 Tip
- 4 Moving runner

### 3.2 Product Labeling

Labeling	Description
N-422.50	Product name
	Manufacturer's logo
WWW.PI.WS	Manufacturer's address (website)
Country of origin: Germany	Country of origin
123456789	Serial number (example), individual for each N-422 Meaning of each position (from the left): 1 = internal information, 2 and 3 = year of manufacture, 4 to 9 = consecutive number
	Warning sign "Pay attention to the manual!"
	CE conformity mark
	Old equipment disposal (p. 37)
	Symbol for the protective earth conductor (p. 16)

### 3.3 Scope of Delivery

Product number	Description
N-422.50	Linear actuator with piezo motor; piezoelectric inertia drive; 35 mm travel range; 7 N feed force; 5 mm/s maximum velocity; 1.5 m cable length
000044159	Screw set, consisting of: <ul style="list-style-type: none"> <li>▪ 3 socket head screws M2x8-A2-50, ISO 4762</li> <li>▪ 3 flat head screws M2x16-A2-050, ISO 14583</li> <li>▪ 3 Schnorr S2-A2 lock washers</li> <li>▪ T6 Torx keys for screws M2x16-A2</li> <li>▪ AF 1.5 Hex key with spherical head for M2x8-A2 screws</li> </ul>
MP116E	User manual (this document) in printed form

### 3.4 Suitable Drive Electronics

To operate the N-422, you need suitable drive electronics (not in the scope of delivery). The following drive electronics are available:

Product number	Description
E-872.401	Q-Motion® piezo motor / PiezoMike drive electronics, benchtop device, drives up to 4 linear actuators via one amplifier channel, TCP/IP, USB, USB for joystick, Digital-I/O

- To order, contact the customer service department (p. 29).

### 3.5 Optional Accessories

Product number	Description
N-400.A02	Extension cable, 3-pole LEMO connector to 3-pole LEMO connector, 2 m
N-400.A05	Extension cable, 3-pole LEMO connector to 3-pole LEMO connector, 5 m
N-400.A08	Extension cable, 3-pole LEMO connector to 3-pole LEMO connector, 8 m
N-400.ALM	Adapter, 3-pole LEMO to 4-pole Mini-DIN, 5 cm PiezoMike adapter for connecting PiezoMike linear actuators to older electronics from the E-870 series with Mini-DIN sockets
N-400.AML	Adapter, 4-pole Mini-DIN to 3-pole LEMO, 5 cm PiezoMike adapter for connecting older PiezoMike linear actuators with Mini-DIN connectors to E-872 electronics

- To order, contact the customer service department (p. 29).



## 4 Unpacking

1. Unpack the N-422 with care.
2. Compare the contents with the scope of delivery according to the contract and the delivery note.
3. Inspect the contents for signs of damage. If any parts are damaged or missing, contact our customer service department immediately (p. 29).
4. Keep all packaging materials in case the product needs to be returned.



## 5 Installing

### In this Chapter

General Notes on Installation .....	13
Integrating the N-422 in the Mechanics and Connecting It to the Protective Earth Conductor.	16

### 5.1 General Notes on Installation

#### NOTICE



#### Increased friction due to lateral forces on the runner!

Lateral forces that act on the runner of the linear drive increase the friction between the runner and other components of the drive. Increased friction impairs the motion of the runner and increases wear on the drive components.

- Avoid lateral forces on the runner of the linear drive.
- Precisely align the base body, runner and guide with each other across the entire travel range.
- If possible, use high-quality linear guides that have been specially designed for high-precision applications (e.g., crossed roller bearings or roller bearings).
- Avoid manually moving the runner of the N-422.

#### NOTICE



#### Damage from pulling out or moving the runner!

Completely pulling out or moving the runner from the base body will destroy the N-422.

- Do **not** pull out or move the runner from the base body of the N-422.
- Design the positioning system so that the free end of the runner still protrudes from the base body of the N-422 even when the travel range is used completely.
- Limit the travel range appropriately, e.g., with a mechanical hard stop in the positioning system.

#### NOTICE



#### Damage from collision of the coupling element with the base body!

If the coupling element collides with the base body of the N-422, damage or considerable wear to the N-422 is possible.

- Design the positioning system so that there is no contact between the coupling element and the base body of the N-422.

**NOTICE****Damage from opening the base body!**

Opening the base body destroys the N-422.

- Do **not** open the N-422.

**NOTICE****Warping of the base body!**

Unsuitable mounting could warp the base body and therefore the linear drive. Warping of the base body reduces the feed force.

- Mount the N-422 onto an even surface. The recommended flatness of the surface is 50 µm.
- For applications with large temperature fluctuations:  
Only mount the N-422 onto surfaces which have the same or similar thermal expansion properties as the N-422 (e.g., surfaces made of stainless steel).

**NOTICE****The N-422 heats up during operation!**

During operation, the N-422 emits up to 15 watts of heat which can affect your application.

- Install the N-422 so that your application is not impaired by dissipating heat.
- Ensure sufficient ventilation at the place of application.
- Make sure that the complete lower side of the N-422 is in contact with the surface on which the N-422 is mounted.
- If possible: Pay attention to the optimal operating conditions (duty cycle, ambient temperature), see "Lifetime" (p. 33).

**NOTICE****Damage from unsuitable cables!**

Unsuitable cables can damage the electronics.

- Only use the cables provided by PI for connecting the N-422 to the electronics.

**INFORMATION**

If the N-422 becomes contaminated with dirt, oil, lubricant or condensation, the dynamic force and the velocity of the drive will decrease.

- If necessary, install the entire system in a housing to protect it from contamination.
- Prevent the N-422 from condensing. If condensation has formed on the N-422, let the drive dry before startup.

### INFORMATION

When the N-422 is installed in mechanics which are to be operated in closed-loop mode, you will need an external position sensor such as a linear encoder (not in the scope of delivery). Furthermore, the electronics must be able to read out and process the signals of the external position sensor.

- Pay attention to the installation instructions of the manufacturer when installing the position sensor.
- Mount the position sensor as closely as possible to the intended motion.
- Pay attention to the input and output signals of the electronics used to operate the N-422.

### INFORMATION

The object which is to be moved is fastened to the coupling element of the N-422.

### Directions of motion

When the base body of the N-422 is on the fixed part of the mechanics and the runner is coupled to the moving part, the polarity of the direction of motion corresponds to that shown in the following figure.



Figure 3: Directions of motion of the N-422

For further information on the operating conditions, refer to the "Technical Data" section (p. 31).

## 5.2 Integrating the N-422 in the Mechanics and Connecting It to the Protective Earth Conductor

### **INFORMATION**

The N-422 makes contact with the protective earth conductor as follows:

- Two mounting holes in the base body of the N-422
- Suitable conductive screws (p. 9)
- Protective earth conductor connected to the surface that the N-422 is mounted on

### **INFORMATION**

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

### **INFORMATION**

- If there is any vibration in your application, secure the screw connection for the protective earth conductor in a suitable manner to prevent it from unscrewing by itself. If this is not possible, check the screw connection at regular intervals and retighten the screws if necessary.

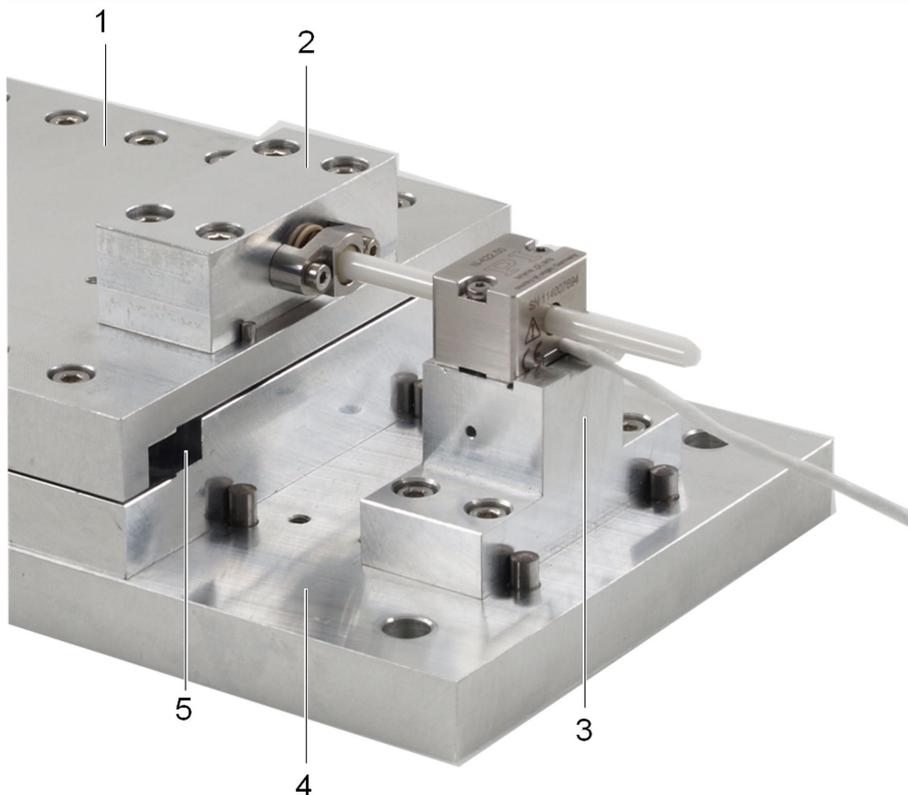


Figure 4: Example of integration of the N-422 in the mechanics

- 1 Moving sled
- 2 Mounting fixture for the coupling element of the N-422
- 3 Mounting fixture for the base body of the N-422
- 4 Base body of the mechanics
- 5 Guide

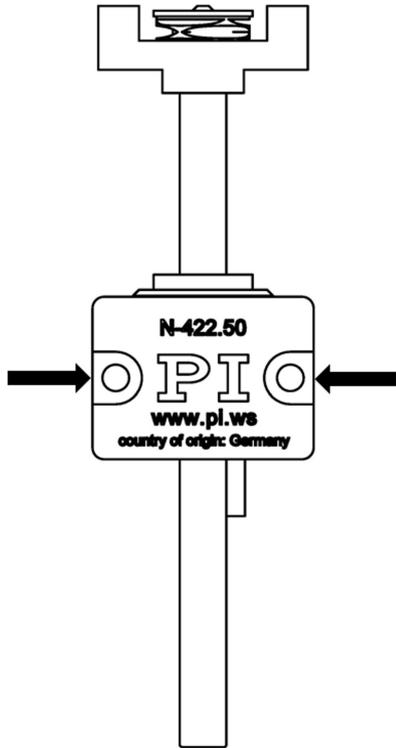


Figure 5: Mounting holes in the base body of the N-422



Figure 6: Mounting holes in the coupling element of the N-422

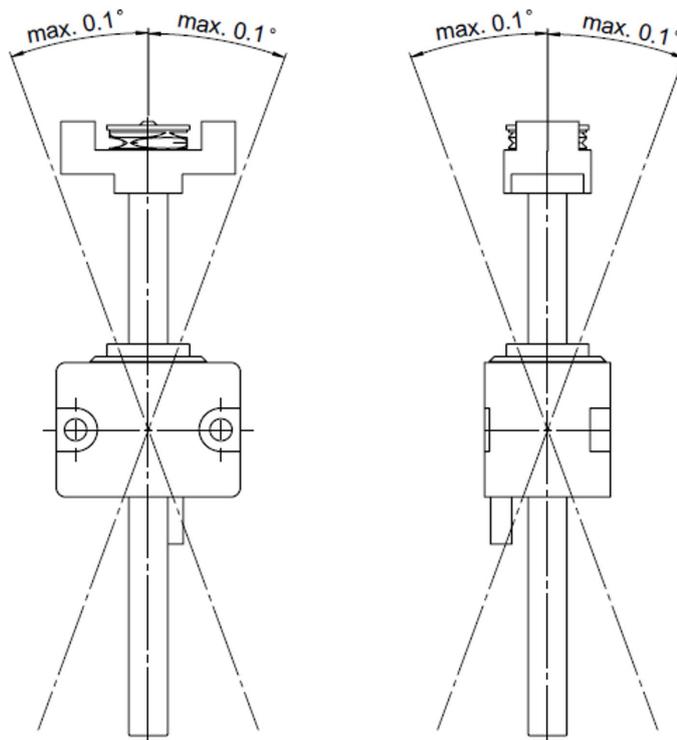


Figure 7: N-422: Maximum permissible angular misalignment between the mounting fixtures for the base body and coupling element (figure not true to scale)

### Requirements

- ✓ You have read and understood the General Notes on Installation (p. 13).
- ✓ The N-422 is **not** connected to the drive electronics.
- ✓ You have provided a suitable mechanics:
  - The angular misalignment between the mounting fixtures for the base body and coupling element is within the tolerance limits (see above figure).
  - There are M2 mounting holes with a suitable depth in the surface and the object to be moved.
  - The mechanics is connected to a suitable protective earth conductor: Cable cross section  $\geq 0.75 \text{ mm}^2$
  - The holes for the screws are sufficiently conductive to ensure that the protective earth conductor functions properly.

Refer to the dimensional drawing (p. 34) to find out the position of the mounting holes in the base body and in the coupling element of the N-422.

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

**Tools and accessories**

- Mounting kit (included in the scope of delivery)
  - 2 M2x16-A2 screws
  - 2 M2x8-A2 screws
  - 2 S2-A2 lock washers
  - T6 Torx screwdriver for M2x16-A2 screws
  - Hex key AF 1.5 with spherical head for M2x8-A2 screws

**Integrating the N-422 in the mechanics and connecting it to the protective earth conductor**

1. Align the N-422 on the surface so that the mounting holes in the base body of the N-422 are in line with the mounting holes in the surface.
2. Screw the base body onto the surface with the M2x16-A2 screws and the S2-A2 lock washers.
  - Tighten the screws only slightly.
3. Screw the clamp of the coupling element with the M2x8-A2 screws onto the object to be moved.
  - Tighten the two screws with the same torque so that both contact surfaces of the clamp lie on the object to be moved and the spring is equally loaded.
4. Tighten the M2x16-A2 screws for fixing the base body with a torque of 50 Ncm.
5. Make sure that the contact resistance at all points relevant for attaching the protective earth conductor is  $<0.1 \Omega$  at 25 A.



## 6 Starting and Operating

### In this Chapter

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Starting and Operating the N-422 with E-872.401 Drive Electronics .....	23
Operating Parameters of the N-422 .....	23

### 6.1 General Notes on Starting and Operating

#### CAUTION



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

If the protective earth conductor is not or not properly connected, dangerous touch voltages can occur on the N-422 in the event of a malfunction or failure of the system. If there are touch voltages, touching the N-422 can result in minor injuries from electric shock.

- Connect the N-422 to a protective earth conductor (p. 16) before starting.
- Do **not** remove the protective earth conductor during operation.
- If the protective earth conductor has to be removed temporarily (e.g., in the case of modifications), reconnect the N-422 to the protective earth conductor before restarting.

#### CAUTION



#### Risk of crushing by moving parts!

Risk of minor injuries from crushing between the moving parts of the linear drive and a stationary part or obstacle.

- Keep your fingers away from areas where they could be caught by moving parts.

#### NOTICE



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

Excessively high or wrongly connected operating voltages can damage the N-422.

- Operate the N-422 with controllers/drivers and original accessories from PI.
- Do **not** exceed the operating voltage range (p. 32) specified for the N-422.
- Operate the N-422 only when the operating voltage is properly connected; see "Pin Assignment" (p. 35).

**NOTICE****Operating frequency too high!**

An excessively high operating frequency can damage the N-422.

- Operate the N-422 with controllers/drivers and original accessories from PI.
- Do **not** exceed the operating frequency range (p. 32) specified for the N-422.

**NOTICE****Damage from pulling out or moving the runner!**

Completely pulling out or moving the runner from the base body will destroy the N-422.

- Do **not** pull out or move the runner from the base body of the N-422.
- Only put the N-422 into operation when it has been installed and completely assembled in a positioning system with a limited travel range.

**NOTICE****Increased friction due to lateral forces on the runner!**

Lateral forces which, due to manual movement act on the linear drive's runner increase the wear on the drive's components.

- Avoid manually moving the runner of the N-422.

**NOTICE****Damage from collision of the N-422 with the hard stop!**

If the hard stop of the positioning system has been reached, or the drive is blocked and is still being controlled, there can be damage or considerable wear to the N-422.

- Do **not** place any objects in areas where they could be caught by moving parts.
- Do **not** continue to control the N-422 at the end of the travel range.

**INFORMATION**

The drive electronics are adapted via parameters to the N-422. Changing parameter values can cause undesirable results.

- Only operate the N-422 when the drive electronics' parameters have been set correctly, see "Operating Parameters of the N-422" (p. 23).

For more information on the operating conditions, see the "Technical Data" section (p. 31).

The startup of the N-422 is done with the E-872.401 (p. 9) drive electronics from PI.

## 6.2 Starting and Operating the N-422 with E-872.401 Drive Electronics

### Requirements

- ✓ You have read and understood the general notes on starting and operating (p. 21).
- ✓ The N-422 has been installed properly (p. 13).
- ✓ The E-872.401 drive electronics were installed properly, and all connectors were connected to E-872.401 (see PZ279 User Manual).

### Starting and operating the N-422 with E-872.401 drive electronics

1. Make sure that the drive electronics' parameters have been set correctly, see "Operating Parameters of the N-422" (p. 23).
2. Provide the control signal required for operating the system. Refer to the PZ279 User Manual for more details.

## 6.3 Operating Parameters of the N-422

### INFORMATION

When starting and operating with the N-400.A05 or N-400.A08 extension cables, an adapted parameter set from the positioner database must be loaded into the drive electronics.

When using the N-400.A05 extension cable:

- Load the "N-422.50:N4XA05" parameter set to the drive electronics (see the PZ279 User Manual).

When using the N-400.A08 extension cable:

- Load the "N-422.50:N4XA08" parameter set to the drive electronics (see the PZ279 User Manual).

The following table lists the settings for the parameters of the drive electronics.

Parameter	Parameter in E-872.401 drive electronics	Value*	Unit
Maximum control value	<b>Maximum Motor Output</b> ID 0x9	20000	-
Query if the positioner is a rotation stage	<b>Is Rotary Stage?</b> ID 0x13	0	-
Positioner name	<b>Stage Name</b> ID 0x3c	N-422.50	-
Invert the direction of motion for HID-controlled axes	<b>Invert Direction Of Motion For Joystick-Controlled Axis?</b> ID 0x61	0	-

Parameter	Parameter in E-872.401 drive electronics	Value*	Unit
Operating frequency in step mode	<b>PIShift Frequency</b> ID 0x1F000400	25000	Hz
Operating voltage, lower limit	<b>PIShift Lower Supply Voltage</b> ID 0x1F000100	0	V
Operating voltage, upper limit	<b>PIShift Upper Supply Voltage</b> ID 0x1F000000	48	V
Charging current during forward motion	<b>PIShift Forward Current</b> ID 0x1F000200	0.6	A
Charging current during backward motion	<b>PIShift Backward Current</b> ID 0x1F000300	-0.6	A
Duty cycle of the current source during the output of one period of the modified sawtooth signal in step mode	<b>PIShift Charge Cycle</b> ID 0x1F000500	1	-

\* When using the N-400.A05 or N-400.A08 extension cable, the following deviating values apply:

N-400.A05 extension cable:

- Parameter ID 0x3c (**Stage Name**): N-422.50:N4XA05
- Parameter ID 0x1F000000 (**PIShift Upper Supply Voltage**): 60

N-400.A08 extension cable:

- Parameter ID 0x3c (**Stage Name**): N-422.50:N4XA08
- Parameter ID 0x1F000000 (**PIShift Upper Supply Voltage**): 60

## 7 Maintenance

If the N-422 is operated in a clean environment, no maintenance is required.

If you would like your device to be serviced, please contact our customer service department (p. 29).



## 8 Troubleshooting

Problem	Possible causes	Solution
Reduced performance and increased wear	Warped base body	➤ Mount the N-422 horizontally on a flat surface. The recommended flatness of the surface is 50 µm.
	Increased friction due to lateral forces on the runner	<ul style="list-style-type: none"> <li>➤ Avoid lateral forces on the runner of the N-422.</li> <li>➤ Precisely align the base body, runner and guide with each other across the entire travel range.</li> <li>➤ If possible, use high-quality linear guides (e.g., crossed roller bearings or roller bearings).</li> </ul>
No or limited motion	<ul style="list-style-type: none"> <li>▪ Excessive load</li> <li>▪ Excessive counterforces in the direction of motion</li> <li>▪ Parameters of the drive electronics incorrectly set</li> </ul>	<ul style="list-style-type: none"> <li>➤ Reduce the load. Pay attention to the information in the "Drive Performance" section (p. 33).</li> <li>➤ In the case of vertical mounting, ensure gravity compensation so that the maximum load (p. 31) is not exceeded. In this case, contact our customer service department (p. 29).</li> <li>➤ Check the settings for the drive electronics' parameters (for details, see "Operating Parameters of the N-422" (p. 23) and the PZ279 User Manual).</li> </ul>

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



## 9 Customer Service Department

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

- If you have questions concerning your system, provide the following information:
  - Product and serial numbers of all products in the system
  - Firmware version of the controller (if applicable)
  - Version of the driver or the software (if applicable)
  - PC operating system (if applicable)
- If possible: Take photographs or make videos of your system that can be sent to our customer service department if requested.

The latest versions of the user manuals are available for download on our website (p. 3).



## 10 Technical Data

Subject to change. You can find the latest product specifications on the product web page at [www.pi.ws](https://www.pi.ws) (<https://www.pi.ws>).

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### 10.1 Specifications

#### 10.1.1 Data Table

##### Specifications

Motion	N-422.50	Tolerance
Active axes	X	
Travel range in X	35 mm	
Maximum velocity in X, unloaded	5 mm/s	Min.
Maximum step frequency	20 kHz	Max.
Positioning	N-422.50	Tolerance
Step size in full-step mode	300 nm	Typ.
Drive Properties	N-422.50	Tolerance
Drive type	Piezoelectric inertia drive	
Operating voltage	48 V <sub>pp</sub>	Max.
Maximum power consumption	15 (actuator), 30 (driver input) W	nominal
Drive force in X	7 N	Max.
Mechanical Properties	N-422.50	Tolerance
Stiffness in X	>4 N/μm	±20 %
Holding force in X, passive	10 N	Min.
Overall mass	25 g	±5 %
Material	Stainless steel; ceramic (runner)	

Miscellaneous	N-422.50	Tolerance
Operating temperature range	0 to 50 °C	
Connector	LEMO FFA.0S.303.CLAC27	
Cable length	2 m	+30 / -0 mm
Recommended controllers / drivers	E-872.401	

The maximum step frequency and maximum velocity depend on the drive electronics.

### 10.1.2 Maximum Ratings

N-422 linear drives are designed for the following operating data:

Maximum operating voltage	Maximum operating frequency	Maximum power consumption
		
48 V <sub>pp</sub>	23 kHz	15 W

### 10.1.3 Ambient Conditions and Classifications

Pay attention to the following ambient conditions and classifications for the N-422:

Area of application	For indoor use only
Maximum altitude	2000 m
Air pressure	1100 to 0.1 hPa
Relative humidity	Highest relative humidity 80 % for temperatures up to 31 °C Decreasing linearly to 50 % relative humidity at 40 °C
Operating temperature	0 to 50 °C
Storage temperature	-20 to 75 °C
Transport temperature	-20 to 75 °C
Overvoltage category	II
Protection class	I
Degree of pollution	1
Degree of protection according to IEC 60529	IP30

## 10.2 Drive Performance

### Velocity and dynamic force

The following graph can be used to estimate the dynamic force (push/pull force, force in N) of the N-422 at different velocities.

#### N-422.50



Figure 8: Relation between the velocity and the push/pull force of the N-422

## 10.3 Lifetime

The N-422 can achieve a lifetime of 2000 m under optimal operating conditions and with full use of the travel range.

Optimal operating conditions of the N-422:

- Duty cycle: Maximum 50 %
- Running time: Maximum 10 seconds
- Ambient temperature: Room temperature
- Air pressure: Normal pressure
- Proper installation of the N-422 (p. 13)
- Proper settings for the drive electronics, see "Operating Parameters of the N-422" (p. 23)

### 10.4 Dimensions

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

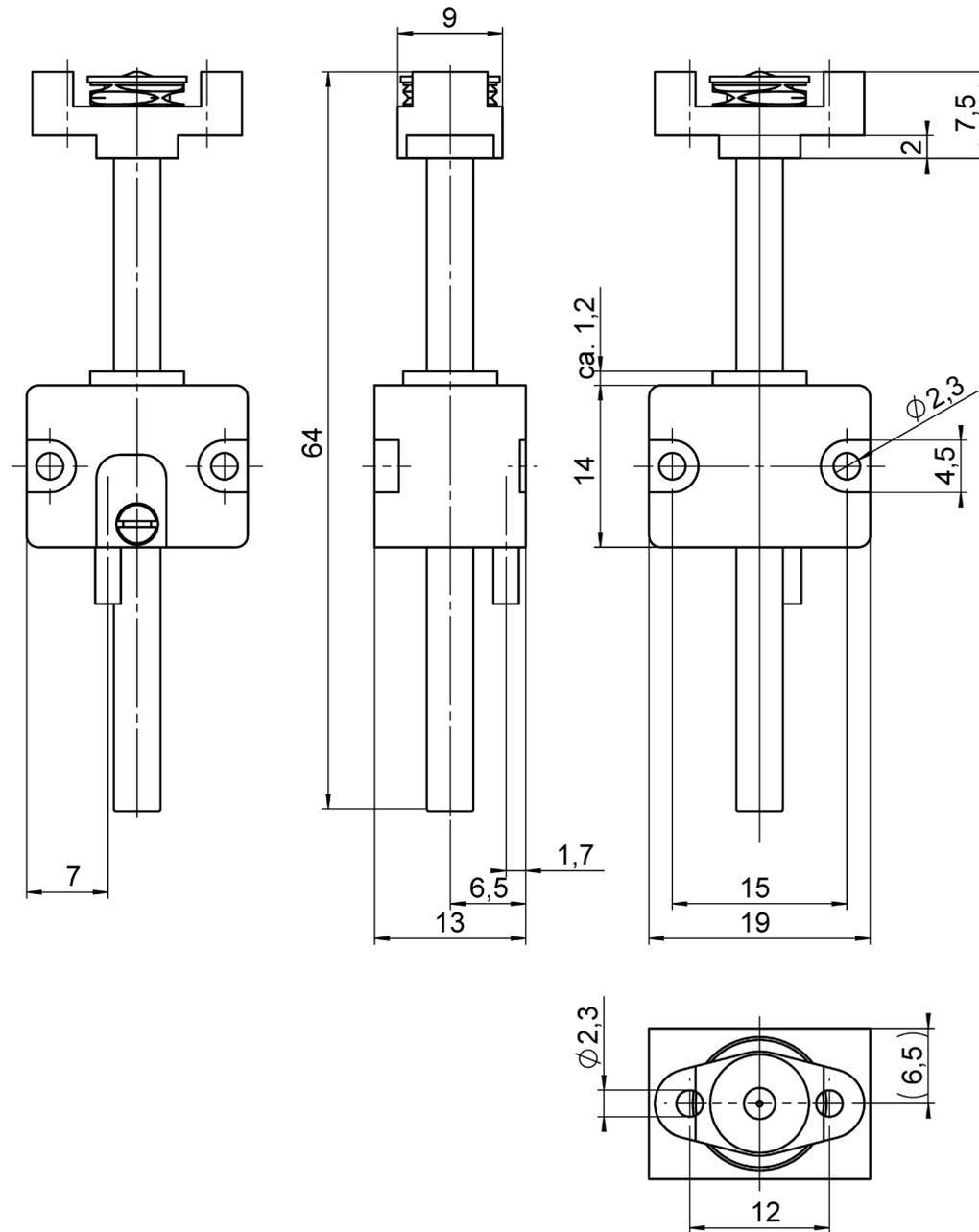


Figure 9: Dimensions of the N-422, position of the clamp when installed, spring loaded

## 10.5 Pin Assignment

LEMO connector, 3-pole (FFA.0S.303.CLAC27)

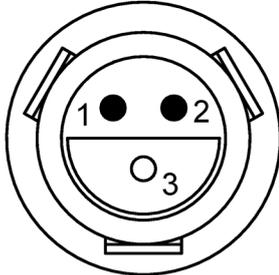


Figure 10: LEMO connector, 3-pole

Pin	Signal	Function
1	M+	Output: Motor voltage +
2	M-	Output: Motor voltage -
3		Not connected

The cable shield is connected to the connector shell.



## 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.

To fulfill the responsibility as the product manufacturer, Physik Instrumente (PI) GmbH & Co. KG undertakes environmentally correct disposal of all old PI equipment made available on the market after 13 August 2005 without charge.

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

Physik Instrumente (PI) GmbH & Co. KG  
Auf der Römerstraße 1  
76228 Karlsruhe, Germany





## 12 European Declarations of Conformity

For the N-422, declarations of conformity were issued according to the following European statutory requirements:

Low Voltage Directive

EMC Directive

RoHS Directive

The standards applied for certifying conformity are listed below.

Safety (Low Voltage Directive): EN 61010-1

EMC: EN 61326-1

RoHS: EN IEC 63000

