**MP118E**

# LPS-24 Miniature Positioner

## User Manual

Version: 1.1.0 Date: 23.05.2014

**This document describes the following products:**

- **5862-9-1110**
  LPS-24 Miniature Linear Positioner, 15 mm, 150 nm Resolution
- **5862-9-1230**
  LPS-24 Miniature Nanopositioner, 15 mm, 0.5 nm Resolution
- **5862-V-1120**
  LPS-24 Miniature Linear Positioner, 15 mm, 20 nm Resolution, Vacuum-Compatible to $10^{-6}$ hPa
- **5862-V-1230**
  LPS-24 Miniature Nanopositioner, 15 mm, 0,5 nm Resolution, Vacuum-Compatible to $10^{-6}$ hPa



Physik Instrumente (PI) GmbH & Co. KG, Auf der Roemerstr. 1, 76228 Karlsruhe, Germany
Phone: +49 721 4846-0, Fax: +49 721 4846-1019, E-mail: info@pi.ws



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# Contents

# 1 About this Document

## In this Chapter



## 1.1 Goal and Target Audience of this User Manual

This user manual contains the information needed for the intended use of the LPS-24 (unless stated otherwise, "LPS-24" is used in this manual to refer to the 5862-9-1110, 5862-9-1230, 5862-V-1120 and 5862-V-1230 models, see "Model Overview" (p. 7)).

Basic knowledge of servo systems, motion control concepts and applicable safety measures is assumed.

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

## 1.2 Symbols and Typographic Conventions

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

***CAUTION***

**Dangerous situation**

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

➢ Actions to take to avoid the situation.

***NOTICE***

**Dangerous situation**

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

➢ Actions to take to avoid the situation.

***INFORMATION***

Information for easier handling, tricks, tips, etc.

| Symbol/ Label | Meaning |
|---|---|
| 1.<br>2. | Action consisting of several steps whose sequential order must be observed |
| ➢ | Action consisting of one or several steps whose sequential order is irrelevant |
| ▪ | List item |
| p. 5 | Cross-reference to page 5 |
| **RS-232** | Labeling of an operating element on the product (example: socket of the RS-232 interface) |
|  | Warning sign on the product which refers 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 which are mentioned in this documentation are described in their own manuals.

| Product | Document |
|---|---|
| E-861 NEXACT® Servo Controller | PZ205E User Manual |
| PIMikroMove | SM148E Software Manual |

## 1.5 Downloading Manuals

***INFORMATION***

If a manual is missing on our website or if there are problems in downloading:

➢ Contact our customer service department (p. 57).

The current versions of the manuals are found on our website. For some products (e.g. Hexapod systems and electronics that are delivered with a CD), access to the manuals is password-protected. The password is stored on the CD.

### Download freely accessible manuals

1. Open the website **http://www.pi-portal.ws**.
2. Click ***Downloads***.
3. Click the corresponding category (e.g. ***PImiCos***)
4. Click the corresponding product code (e.g. ***LPS-24***).
5. Click ***Documents***.

   The available manuals are displayed.
6. Click the desired manual and save it on the hard disk of your PC or on a data storage medium.

### Download password-protected manuals

1. Carry out steps 1 to 5 of the download process for freely accessible manuals.
2. Insert the product CD in the PC drive.
3. Switch to the ***Manuals*** directory on the CD.
4. In the ***Manuals*** directory, open the Release News (file including ***releasenews*** in the file name).
5. Find the user name and password in the ***User login for software download*** section in the Release News.
6. In the ***User login*** area on the left margin in the website, enter the user name and the password in the corresponding fields.
7. Click ***Login***.

   The available manuals are displayed.

8. Click the desired manual and save it on the hard disk of your PC or on a data storage medium.

# 2 Safety

## In this Chapter



## 2.1 Intended Use

The LPS-24 is a laboratory device as defined by DIN EN 61010-1. It is intended to be used in interior spaces and in an environment which is free of dirt, oil and lubricants.

Based on its design and realization, the LPS-24 is intended for single-axis positioning, adjusting and shifting of loads at different velocities.

The LPS-24 is a miniature positioner for nanopositioning technology. The feed is produced by NEXACT® piezo actuators coupled to a ceramic rail (PiezoWalk® principle). NEXACT® drives thus combine relatively long travel ranges with the nanometer precision of piezo actuators.

The LPS-24 is equipped with a linear encoder for direct position measurement.

The intended use of the LPS-24 is only possible when installed and in connection with a suitable controller (p. 13). The controller is not included in the scope of delivery of the LPS-24.

## 2.2 General Safety Instructions

The LPS-24 is built according to state-of-the-art technology and recognized safety standards. Improper use can result in personal injury and/or damage to the LPS-24.

- Only use the LPS-24 for its intended purpose, and only use it if it is in a 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 LPS-24.

## 2.2.1 Organizational Measures

### User manual

- Always keep this user manual available by the LPS-24.
  The latest versions of the user manuals are available for download (p. 3) on our website.
- Add all information given by the manufacturer to the user manual, for example supplements or Technical Notes.
- If you pass the LPS-24 on to other users, also turn over this user manual as well as 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 property damage.
- Only install and operate the LPS-24 after having read and understood this user manual.

### Personnel qualification

The LPS-24 may only be installed, started up, operated, maintained and cleaned by authorized and appropriately qualified personnel.

## 2.2.2 Measures for Handling Vacuum-Compatible Products

When handling the vacuum version of the miniature positioner, attention must be paid to appropriate cleanliness. At PI, all parts are cleaned before assembly. During assembly and measurement, powder-free gloves are worn. Afterwards, the miniature positioner is cleaned once again by wiping and shrink-wrapped twice in vacuum-compatible film.

- Only touch the miniature positioner with powder-free gloves.
- If necessary, wipe the miniature positioner clean after unpacking.

# 3 Product Description

## In this Chapter



## 3.1 Model Overview

Four standard versions of the LPS-24 miniature positioner are available. They differ in terms of the following features:

- Sensor resolution
- Dimensions
- Suitability for operation in vacuum

| Model | Sensor resolution | Dimensions | Vacuum suitability (to $10^{-6}$ hPa) |
|---|---|---|---|
| 5862-9-1110 | 150 nm | 24 mm × 33 mm × 20 mm | No |
| 5862-9-1230 | 0.5 nm | 24 mm × 63 mm × 20 mm | No |
| 5862-V-1120 | 20 nm | 24 mm × 33 mm × 20 mm | Yes |
| 5862-V-1230 | 0.5 nm | 24 mm × 63 mm × 20 mm | Yes |

➢ For further technical data, see the specifications (p. 59).

## 3.2 Product View

### 3.2.1 Overview

*Figure 1: Left: LPS-24 5862-9-1230 (appearance of the 5862-V-1230 model is identical); right: LPS-24 5862-9-1110 (appearance of the 5862-V-1120 model is identical)*

### 3.2.2 Product Details

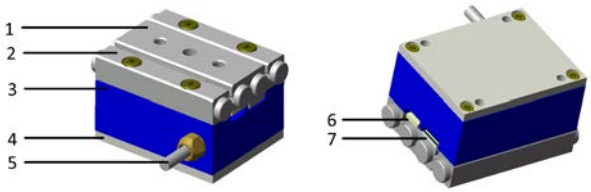



*Figure 2: Miniature positioner LPS-24 5862-9-1110 / 5862-V-1120 from top (left) and bottom (right)*

*1 Moving platform*
*2 Linear guiding*
*3 Base body*
*4 Cover of the base body*
*5 Cable exit for connection of drive and sensor*
*6 Ceramic rail of the NEXACT® drive*
*7 Ruler of the linear encoder*

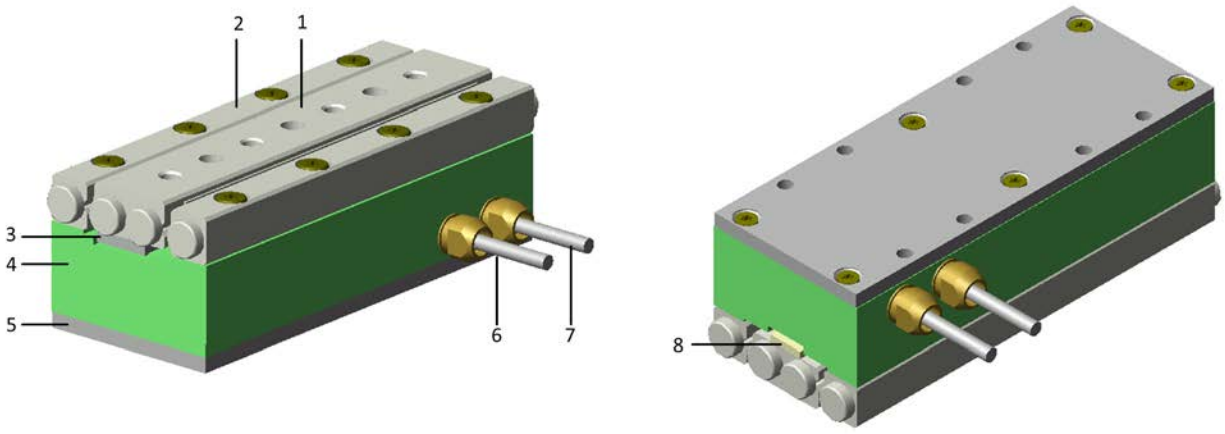



*Figure 3: Miniature positioner LPS-24 5862-9-1230 / 5862-V-1230 from top (left) and bottom (right)*

*1 Moving platform*
*2 Linear guiding*
*3 Ruler of the linear encoder*
*4 Base body*
*5 Cover of the base body*
*6 Cable exit for sensor connection*
*7 Cable exit for drive connection*
*8 Ceramic rail of the NEXACT® drive*

## 3.2.3 Product Labeling

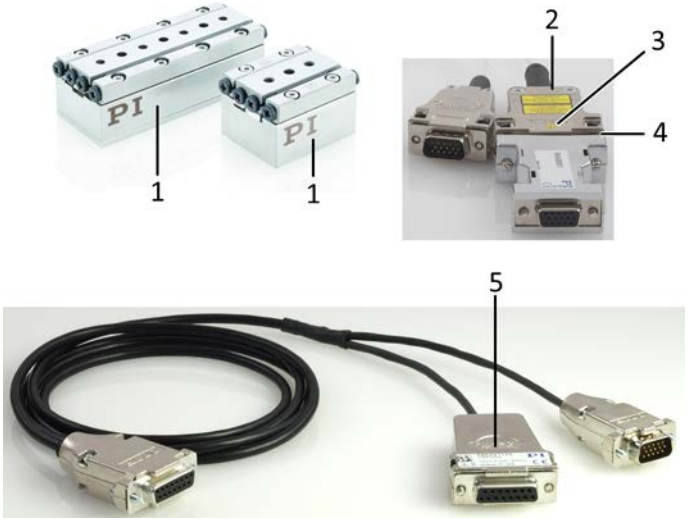
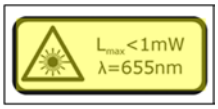



*Figure 4: Position of the product labels, explanation of the labeling, see table*

*1 Present with all models*
*2 Only with LPS-24 5862-9-1230 and 5862-V-1230*
*3 Only with LPS-24 5862-9-1230 and 5862-V-1230*
*4 Only with LPS-24 5862-9-1230 and 5862-V-1230*
*5 Only with LPS-24 5862-9-1120 and 5862-V-1230 (sensor cable on the air side)*

| Position | Labeling | Description |
|---|---|---|
| 1, 5 | PI | Manufacturer's logo |
| 1 | LPS-24 | Product name |
| 1, 5 | 586291230 | Model number (example) |
| 1, 5 | 114010244 | Serial number (example), individual for each LPS-24<br>Meaning of the places (counting from left): 1 = internal information, 2 and 3 = manufacturing year, 4 to 9 = consecutive numbers |
| 1, 5 | Country of origin: Germany | Country of origin |

| Position | Labeling | Description |
|---|---|---|
| 1, 5 |  | Old equipment disposal (p. 75) |
| 1, 5 |  | CE conformity mark |
| 1, 5 |  | Warning sign "Observe manual!" |
| 1, 5 | WWW.PI.WS | Manufacturer's address (website) |
| 2 |  | Notice of laser radiation (p. 53) (here: Top side of sensor connector) |
| 3 |  | Warning sign "Observe manual!" (here: Top side of sensor connector) |
| 4 |  | Warning sign and values for the laser (p. 53) (here: Bottom side of sensor connector) |
| 5 |  | Data matrix code (example; contains the serial number) |

## 3.3 Scope of Delivery

The LPS-24 is delivered with the following components.

| Order Number | Component |
|---|---|
| LPS-24<br>5862-9-1110,<br>5862-9-1230,<br>5862-V-1120<br>or<br>5862-V-1230 | Miniature positioner according to order |
| 000044133 | Screw set:<br>▪ 8 M2.5x6 screws ISO 4762<br>▪ 4 M3x6 screws ISO 4762 |
| MP118E | User manual (this document) in printed form |
| With LPS-24 5862-9-1230, 5862-V-1120 and 5862-V-1230: | |
| N664B0001 | Adapter Sub-D 15 (m) to HD Sub-D 15 (f) for sensor connection |
| Only with LPS-24 5862-V-1120: | |
| N661B0008 | Y cable for drive and sensor signals on the air side, Sub-D 15 (f) to Sub-D 15 (f) and HD Sub-D 15 (m), 2.1 m<br>A suitable vacuum feedthrough is available as an optional accessory (p. 13) |
| Only with LPS-24 5862-V-1230: | |
| 000015460 | Vacuum feedthrough for the drive, LEMO 6-pin, m/f |
| K030B0664 | Cable for the drive on the air side, LEMO 6-pin to HD Sub-D 15 (m), 1.6 m |
| 000025824 | Vacuum feedthrough for the sensor connection, LEMO 8-pin, m/f |
| E852B0072 | Cable for sensor signals on the air side, LEMO 8-pin to Sub-D 15 (f), 1.5 m |

## 3.4 Accessories

| Order Number | Description |
|---|---|
| N-662.AP1 | Adapter plate for setting up an XY system consisting of two LPS-24's, whereby a 5862-9-1110 or 5862-V-1120 model is used as the Y axis (upper miniature positioner). Material: Steel (1.4104); mass: 29.4 g; including:<br>▪ 4 M2.5x4 screws ISO 4762<br>▪ 2 M3x5 screws ISO 4762 |
| N-662.AP2 | Adapter plate for setting up an XY system consisting of two LPS-24's, whereby a 5862-9-1230 or 5862-V-1230 model is used as the Y axis (upper miniature positioner). Material: Steel (1.4104); mass: 52.5 g; including:<br>▪ 4 M2.5x4 screws ISO 4762<br>▪ 2 M3x5 screws ISO 4762 |
| N-662.APZ | Adapter bracket for the vertical mounting of LPS-24 miniature positioners. Material: Steel (1.4104); mass: 57.3 g; including:<br>▪ 4 M2.5x4 screws ISO 4762<br>▪ 2 M3x5 screws ISO 4762 |
| C-815.VF | Vacuum feedthrough for LPS-24 5862-V-1120 (drive and sensor signals), Sub-D 15 (m/f), including Technical Note C815T0003 |

To order, contact our customer service department (p. 57).

## 3.5 Suitable Controllers

| Controller | Description |
|---|---|
| E-861.1A1 | Digital NEXACT® Controller |

➢ To order, contact our customer service department (p. 57).

# 3.6 Technical Features

## 3.6.1 Linear Encoder (Sensor)

The miniature positioner is equipped with an optical linear encoder. For the encoder resolution, refer to the table in the "Specifications" section (p. 59).

Optical linear encoders measure the actual position directly (direct metrology). Therefore, errors occurring in the drivetrain, such as nonlinearity, backlash or elastic deformation, cannot influence the measurement of the position.

## 3.6.2 Reference Point Switch

The miniature positioner is equipped with a direction-sensing reference point switch that is located approximately in the middle of the travel range. This sensor transmits a TTL signal that indicates whether the miniature positioner is on the positive or negative side of the reference point switch.

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

***INFORMATION***

The LPS-24 5862-V-1120 model does not have a reference point switch.

# 4 Unpacking

***INFORMATION***

When handling the vacuum version of the miniature positioner, attention must be paid to appropriate cleanliness. At PI, all parts are cleaned before assembly. During assembly and measurement, powder-free gloves are worn. Afterwards, the miniature positioner is cleaned once again by wiping and shrink-wrapped twice in vacuum-compatible film.

- Only touch the miniature positioner with powder-free gloves.
- If necessary, wipe the miniature positioner clean after unpacking.

1. Unpack the LPS-24 with care.
2. Compare the contents against the items covered by the contract and against the packing list.
3. Inspect the contents for signs of damage. If parts are missing or you notice signs of damage, contact PI immediately.
4. Keep all packaging materials in case the product needs to be returned.

# 5 Installation

## In this Chapter



## 5.1 General Notes on Installation

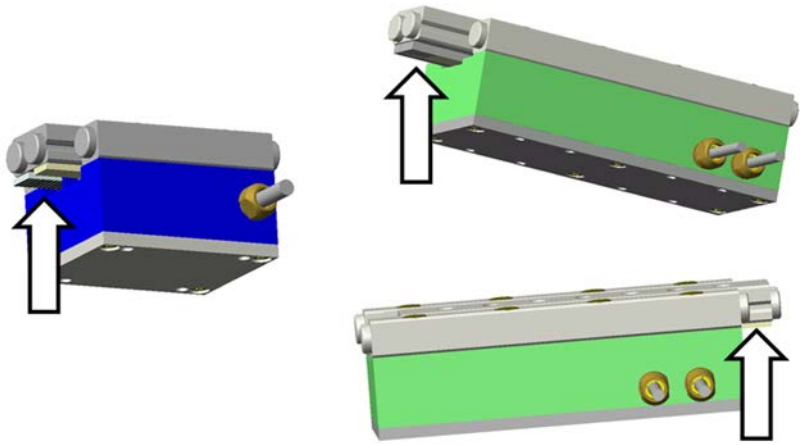


*Figure 5: Accessible when the moving platform is driven out: Ruler of the linear encoder and ceramic rail of the NEXACT® drive, left LPS-24 5862-9-1110 / 5862-V-1120, right LPS-24 5862-9-1230 / 5862-V-1230*

**NOTICE**

**Damage to the piezo actuators!**

If the moving platform of the miniature positioner is displaced by applying external forces, the piezo actuators of the NEXACT® drive may be damaged irreparably.

- ➢ Initiate all motions by sending motion commands to the controller. Do **not** displace the moving platform manually.
- ➢ Make sure that forces acting on the moving platform in the direction of motion **do not** exceed (p. 59) the passive holding force and the feed force of the drive.

**NOTICE**

**Damage from mechanical actions!**

The ruler of the linear encoder is scratch-sensitive and can be damaged by mechanical actions, e.g. from pointed objects.

- ➢ Treat the ruler with extreme care.

**NOTICE**

**Malfunction due to soiling!**

Any type of soiling, e.g. dust, oil, grease or condensation, will render the LPS-24 inoperable.

- ➢ Keep the LPS-24 free from dirt and condensation.
- ➢ Avoid touching the ceramic rail of the NEXACT® drive and the ruler of the linear encoder.

**NOTICE**

**Malfunction due to radiation!**

Radiation (e.g. X-rays) will render the LPS-24 inoperable.

- ➢ Protect the LPS-24 from radiation.

**NOTICE**

**Damage from incorrect mounting!**

Incorrect mounting of the LPS-24 or incorrectly mounted parts can damage the LPS-24.

- ➢ Only mount the LPS-24 and the loads on the mounting fixtures (holes) intended for this purpose.

**NOTICE**

**Warping of the LPS-24 due to mounting on uneven surfaces!**

Mounting the LPS-24 on an uneven surface can warp the LPS-24. Warping reduces the accuracy.

- ➢ Mount the LPS-24 on an even surface. The recommended evenness of the surface is ≤10 µm.
- ➢ For applications with great temperature changes:
  Only mount the LPS-24 on surfaces that have the same or similar thermal expansion properties as the LPS-24.

**NOTICE**

**Damage from unsuitable cables!**

Unsuitable cables can damage the miniature positioner and the electronics.

- ➢ Only use cables provided by PI for connecting the LPS-24 to the electronics.

**INFORMATION**

The air-side cables E852B0072 and N661B0008 for the sensor connections of the vacuum-compatible miniature positioners contain the electronics for the respectively connected sensors. The electronics in the cables and the sensors in the miniature positioners are adapted to each other.

- ➢ Make sure that the serial number of the connected miniature positioner matches the serial number on the connector shell of the cable, see p. 10.
- ➢ If the cable or the miniature positioner has to be replaced, contact our customer service department (p. 57).

**INFORMATION**

For the reproducibility of the positioning to be optimal, all components must be affixed with zero-backlash.

- ➢ Make sure that miniature positioner and load are affixed with zero-backlash.

***INFORMATION***

When handling the vacuum version of the miniature positioner, appropriate cleanliness must be ensured.

- ➢ Only touch the miniature positioner with powder-free gloves.
- ➢ If necessary, wipe the miniature positioner clean.

## 5.2 Mounting the LPS-24

***NOTICE***

**Screws that are too long!**

The LPS-24 can be damaged by screws that are screwed in too deeply.

- ➢ Observe the depth of the mounting holes (p. 63).
- ➢ Only use screws of the correct length for the respective mounting holes.

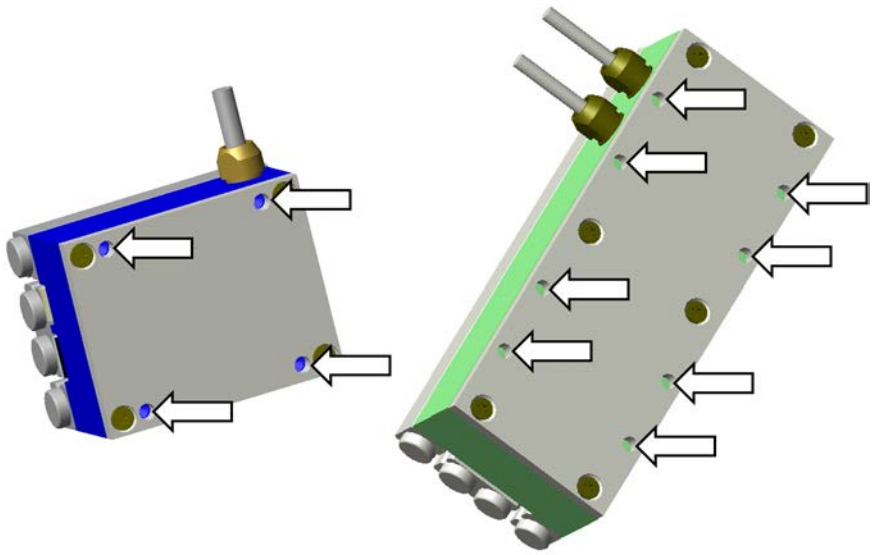


*Figure 6: Position of the mounting holes in the cover of the base body, LPS-24 5862-9-1110 / 5862-V-1120 (left) and LPS-24 5862-9-1230 / 5862-V-1230 (right)*

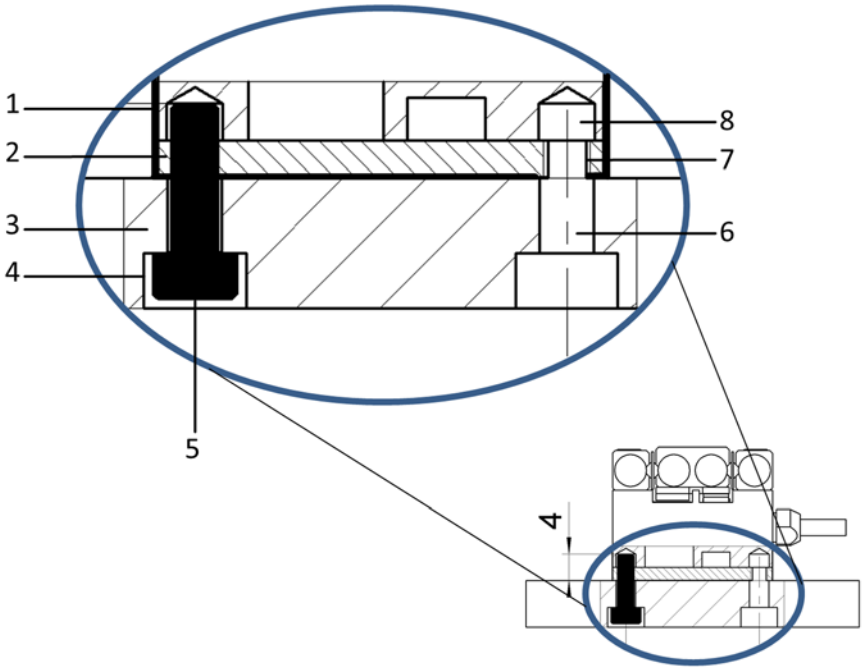



*Figure 7: LPS-24 5862-9-1110 or 5862-V-1120: 4 mm maximum screw-in depth for mounting on a surface*

1 *Base body of the LPS-24*
2 *Cover of the base body of the LPS-24*
3 *Surface on which the LPS-24 is mounted*
4 *Counterbore in the surface*
5 *M2.5 hex-head cap screw, ISO 4762, ISO 1206*
6 *Through hole in the surface for M2.5 screw*
7 *M2.5 threaded hole, depth 2 mm in the cover of the base body*
8 *Recess in the base body, depth 2 mm*

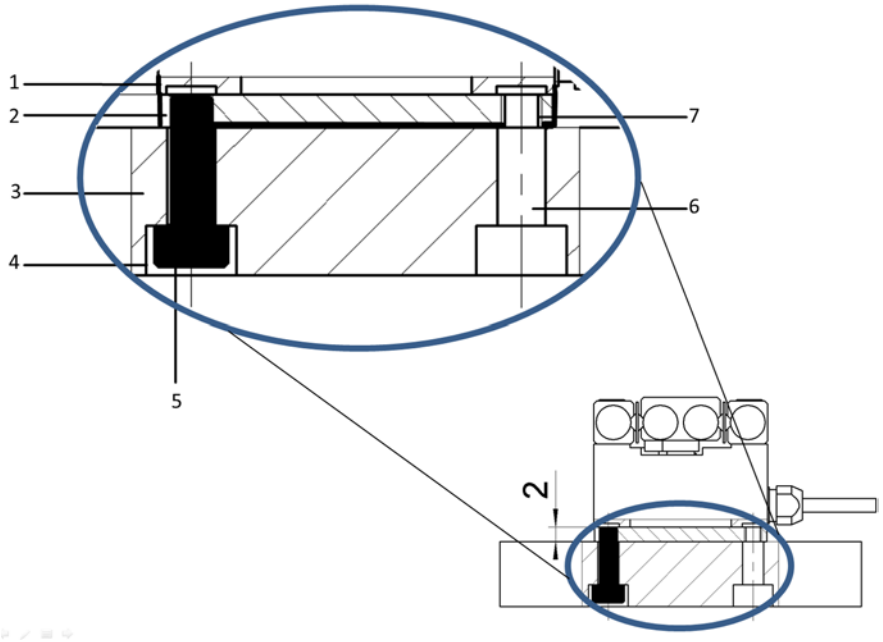



*Figure 8: LPS-24 5862-9-1230 or 5862-V-1230: 2 mm maximum screw-in depth for mounting on a surface*

1 *Base body of the LPS-24*
2 *Cover of the base body of the LPS-24*
3 *Surface on which the LPS-24 is mounted*
4 *Counterbore in the surface*
5 *M2.5 hex-head cap screw, ISO 4762, ISO 1206*
6 *Through hole in the surface for M2.5 screws*
7 *M2.5 threaded hole, depth 2 mm in the cover of the base body*

## Prerequisites

- ✓ You have read and understood the general notes on installation (p. 17).
- ✓ You have provided a suitable surface:
  - Four mounting holes are present. For the required position of the holes, see "Dimensions" (p. 63).
  - The thickness of the surface and the depth of the mounting holes and counterbores are matched for compliance with the maximum screw-in depth in the LPS-24, see figures above.
  - The evenness of the surface is ≤10 µm.

– For applications with great temperature changes:
The surface has the same or similar thermal expansion properties as the LPS-24.

✓ You accounted for the space required for cable routing free of kinks and in accordance with regulations.

✓ The miniature positioner is **not** connected to the controller.

### Tools and accessories

- For LPS-24 5862-9-1110 and 5862-V-1120: Four M2.5 hex-head cap screws of suitable length
- For LPS-24 5862-9-1230 and 5862-V-1230: Four to eight M2.5 hex-head cap screws of suitable length
- Suitable tools for fastening the screws

### Mounting the LPS-24

1. Align the miniature positioner on the surface so that the corresponding mounting holes in miniature positioner and surface overlap.
2. Screw the screws into the mounting holes on the bottom side of the surface.

   Maximum screw-in depth:

   – In LPS-24 5862-9-1110 and 5862-V-1120 4 mm

   – In LPS-24 5862-9-1230 and 5862-V-1230 2 mm

   Maximum torque: 50 Ncm
3. Check that the LPS-24 fits on the surface without backlash.

## 5.3 Affixing the Load to the LPS-24

***NOTICE***

**Screws and locating pins are too long!**

Screws and locating pins that are inserted too deeply damage the LPS-24.

➢ Observe the depth of the mounting holes (p. 63) in the moving platform.

➢ Observe the maximum depth of **4 mm** for the insertion of locating pins into the moving platform.

➢ Make sure to exclusively use screws and locating pins of the correct length for the respective holes.

***NOTICE***

**Impermissibly high load on the miniature positioner!**

An impermissibly high load interferes with the motion of the moving platform and can damage the miniature positioner.

➢ In respect to the mass and mounting type of the load, observe the maximum permissible forces that are allowed to act on the moving platform according to the specification (p. 59).

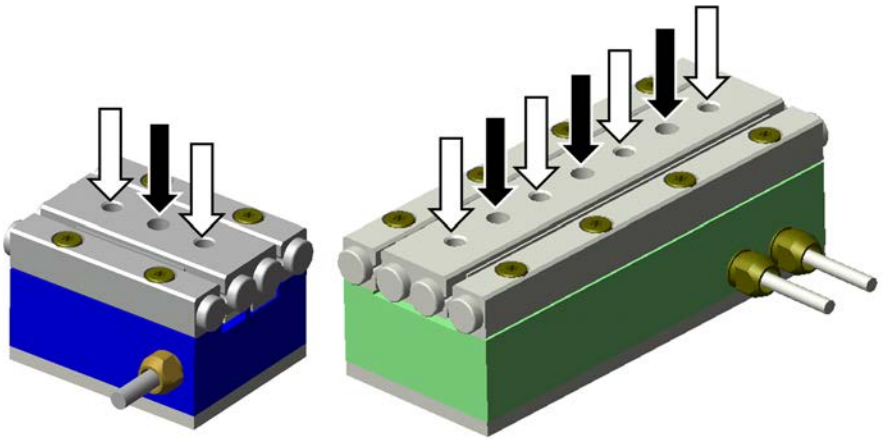


*Figure 9: Black arrows denote locating holes for alignment of the load, whereas white arrows denote threaded holes for affixing the load*

## Prerequisites

✓ You have read and understood the general notes on installation (p. 17).

✓ You have properly mounted the miniature positioner (p. 20).

✓ The miniature positioner is **not** connected to the controller.

✓ You have prepared the load so that it can be affixed to the mounting holes on the moving platform:

- The distance between the center of gravity of the load and the center of the moving platform is as small as possible in all directions.
- At least two points are provided for affixing the load on the moving platform.
- If you use locating pins for aligning the load: You made one or two locating holes of Ø 3 mm H7 for accommodation of locating pins.

### Tools and accessories

- M3 screws of suitable length. Quantity:
  - LPS-24 5862-9-1110 or 5862-V-1120: 2 screws
  - LPS-24 5862-9-1230 or 5862-V-1230: 2 to 4 screws
- Suitable tools for fastening the screws
- Optional: Locating pins for easy alignment of the load on the LPS-24, suitable for holes of Ø 3 mm H7 and 4 mm depth. Quantity:
  - LPS-24 5862-9-1110 or 5862-V-1120: 1 locating pin
  - LPS-24 5862-9-1230 or 5862-V-1230: 2 locating pins

### Affixing the load to the LPS-24

1. Align the load so that the selected mounting holes in the moving platform can be used for affixing it.

   If you use locating pins to align the load:

   - Observe the maximum depth of 4 mm for the insertion of locating pins into the moving platform.

   a) Insert the locating pins into the locating holes in the moving platform or the load.
   b) Place the load on the moving platform in such a way that the locating pins are inserted into the corresponding locating holes on the other side.
2. Affix the load to the selected mounting holes in the moving platform using the screws.

   Maximum screw-in depth in the moving platform of the LPS-24: 4 mm

   Maximum torque: 80 Ncm
3. Check that the load fits on the moving platform of the miniature positioner without backlash.

## 5.4 Setting Up a Multi-Axis System

The LPS-24 can be used in multi-axis systems.

Typical combinations:

- XY system (p. 27)
- Z system (p. 33) (XZ or XYZ combination)

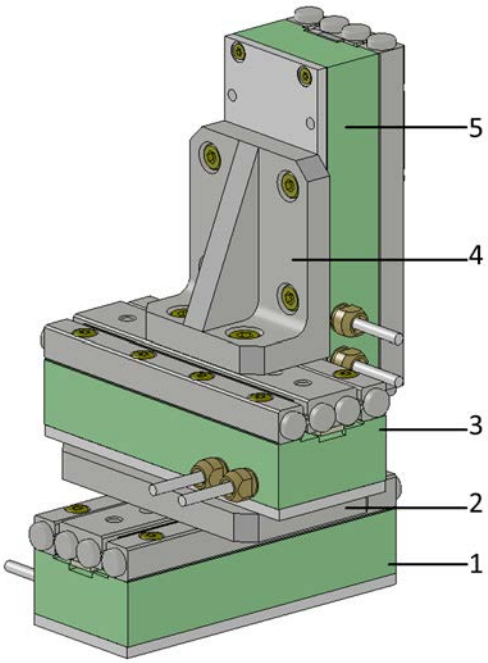



*Figure 10: Example of an XYZ system: Three LPS-24 5862-9-1230 mounted using an adapter plate and adapter bracket*

*1 Lower miniature positioner (here: LPS-24 5862-9-1230)*
*2 N-662.AP2 adapter plate*
*3 Middle miniature positioner (here: LPS-24 5862-9-1230)*
*4 N-662.APZ adapter bracket*
*5 Upper miniature positioner (here: LPS-24 5862-9-1230)*

### 5.4.1 General Information on Setting Up a Multi-Axis System

***NOTICE***

**Impermissibly high load on the miniature positioners!**

In a multi-axis system, also the miniature positioner used for the Y and/or Z axis must be moved. Impermissibly high loads interfere with the motion and can damage the miniature positioners.

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

- ➢ Only install and operate the multi-axis system after you have read and understood the user manuals of all components of the multi-axis system.
- ➢ If you require special mounting adapters, contact our customer service department (p. 57).

### 5.4.2 Setting Up an XY System

***NOTICE***

**Screws that are too long!**

The lower miniature positioner can be damaged by screws that are inserted too deeply.

- ➢ Observe the depth of the mounting holes in the moving platform of the lower miniature positioner.
- ➢ Only use screws of the correct length for the respective mounting holes.

***NOTICE***

**Damage to the piezo actuators!**

If the moving platform of the miniature positioner is displaced manually, the piezo actuators of the NEXACT® drive can be damaged irreparably.

- ➢ Initiate all motions by sending motion commands to the controller. Do **not** displace the moving platform manually.

***INFORMATION***

Currently, no standard adapter plate is offered for affixing an LPS-24 5862-9-1110 or 5862-V-1120 model to a 5862-9-1230 or 5862-V-1230 model.

- ➢ If you want to set up such an XY system, please contact our customer service department (p. 57).

Designations in these instructions:

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

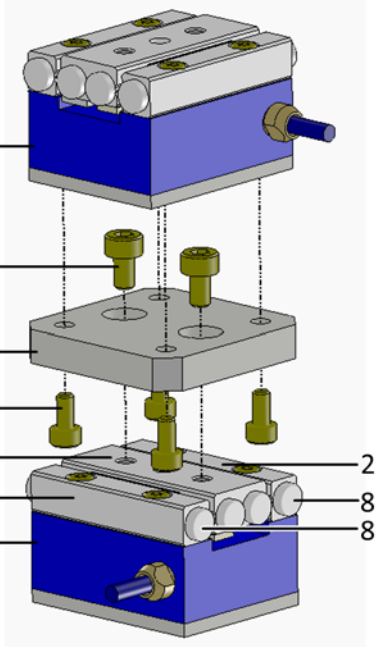



*Figure 11: Example: Setting up an XY system consisting of two LPS-24 5862-9-1110 and the N-662.AP1 adapter plate*

*1 Lower miniature positioner*
*2 Linear guiding*
*3 Moving platform*
*4 4 M2.5x4 screws for affixing the upper miniature positioner to the adapter plate*
*5 N-662.AP1 adapter plate*
*6 2 M3x5 screws for affixing the adapter plate to the lower miniature positioner*
*7 Upper miniature positioner*
*8 Cross-head screw on the front side of the linear guiding*

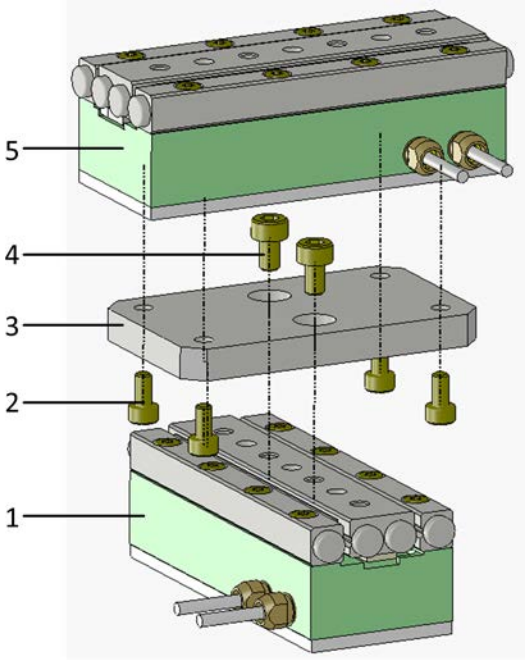



*Figure 12: Example: Setting up an XY system consisting of two LPS-24 5862-9-1230 and the N-662.AP2 adapter plate*

*1 Lower miniature positioner*
*2 4 M2.5x4 screws for affixing the upper miniature positioner to the adapter plate*
*3 N-662.AP2 adapter plate*
*4 2 M3x5 screws for affixing the adapter plate to the lower miniature positioner*
*5 Upper miniature positioner*

## Prerequisites

- ✓ You have read and understood the general notes on installation (p. 17).
- ✓ You have read and understood the general notes on setting up a multi-axis system (p. 27).
- ✓ You accounted for the space required for cable routing free of kinks and in accordance with regulations.
- ✓ You have properly mounted the lower miniature positioner (p. 20).

✓ If a 5862-9-1110 or 5862-V-1120 model is to be affixed to a 5862-9-1110 or 5862-V-1120 model:

- You have connected the lower miniature positioner to the controller (p. 37)
- You have put the lower miniature positioner into operation (p. 45) and the system is still ready for operation.

## Tools and accessories

- Suitable adapter plate, available as an optional accessory (p. 13):
  - If a 5862-9-1110 or 5862-V-1120 model is to be affixed to a 5862-9-1110 or 5862-V-1120 model: N-662.AP1
  - If a 5862-9-1230 or 5862-V-1230 model is to be affixed to any LPS-24 model: N-662.AP2

  For diameter and position of the holes in the adapter plates, see "Dimensions" (p. 63)
- 2 M3x5 screws from the scope of delivery of the adapter plate
- 4 M2.5x4 screws from the scope of delivery of the adapter plate
- Allen wrench AF 2
- Allen wrench AF 2.5
- If a 5862-9-1110 or 5862-V-1120 model is to be affixed to a 5862-9-1110 or 5862-V-1120 model: Suitable Phillips-head screwdriver

## Setting up an XY system

1. Position the adapter plate on the lower miniature positioner as in the figures above:
   - The counterbores of the two larger holes located in the middle of the adapter plate point upwards.
   - The two larger counter-sunk holes in the adapter plate and two holes in the moving platform of the lower miniature positioner overlap.
   - If the lower miniature positioner is an LPS-24 5862-9-1230 or 5862-V-1230: The adapter plate ideally sits over the middle of the moving platform.
2. Affix the adapter plate to the lower miniature positioner:
   a) Introduce two M3x5 screws into the two counter-sunk holes in the middle of the adapter plate from above.
   b) Tighten the two screws with a maximum torque of 80 Ncm each.
   c) Ensure that the screw heads do not protrude from the counter-sunk holes.

d) Check that the adapter plate fits without backlash.

3. Position the upper miniature positioner on the adapter plate as in the figures above, i.e. rotated by 90° in relation to the lower miniature positioner.
4. Affix the upper miniature positioner to the adapter plate:

   If the upper miniature positioner is an LPS-24 5862-9-1230 5862-V-1230:

   a) Align the upper miniature positioner:
      - The center of the upper miniature positioner is located over the center of the adapter plate.
      - Four mounting holes on the bottom side of the upper miniature positioner overlap with the counter-sunk holes in the corners of the adapter plate.
   b) Introduce four M2.5x4 screws into the counter-sunk holes of the adapter plate from below.
   c) Tighten the four screws with a maximum torque of 50 Ncm each.
   d) Ensure that the screw heads do not protrude from the counter-sunk holes.

   If the upper miniature positioner is an LPS-24 5862-9-1110 or 5862-V-1120:

   a) Make two of the four counter-sunk holes in the corners of the adapter plate accessible by commanding the moving platform of the lower miniature positioner to one end of the travel range.
   b) Align the upper miniature positioner so that the two corresponding mounting holes on its bottom side overlap with the two counter-sunk holes of the adapter plate that have been made accessible.
   c) If the two cross-head screws on the front sides of the linear guidings prevent access to the two counter-sunk holes in the adapter plate: Remove the two cross-head screws from the guidings.
   d) Introduce two M2.5x4 screws into the two counter-sunk holes of the adapter plate from below.
   e) Tighten the two screws with a maximum torque of 50 Ncm each.
   f) Ensure that the screw heads do not protrude from the counter-sunk holes.
   g) If you have removed the two cross-head screws from the linear guidings in step c): Screw the two cross-head screws into the linear guidings.
   h) Make the other two counter-sunk holes in the corners of the adapter plate accessible by commanding the moving platform of the lower miniature positioner to the opposite end of the travel range.
   i) Perform steps c) to g) for the two counter-sunk holes in the adapter plate that have been made accessible.
5. Check that the upper miniature positioner fits without backlash.

### 5.4.3 Setting Up a Z System with an Adapter Bracket

**NOTICE**

**Screws that are too long!**

The lower miniature positioner can be damaged by screws that are inserted too deeply.

- ➢ Observe the depth of the mounting holes in the moving platform of the lower miniature positioner.
- ➢ Only use screws of the correct length for the respective mounting holes.

Designations in these instructions:

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

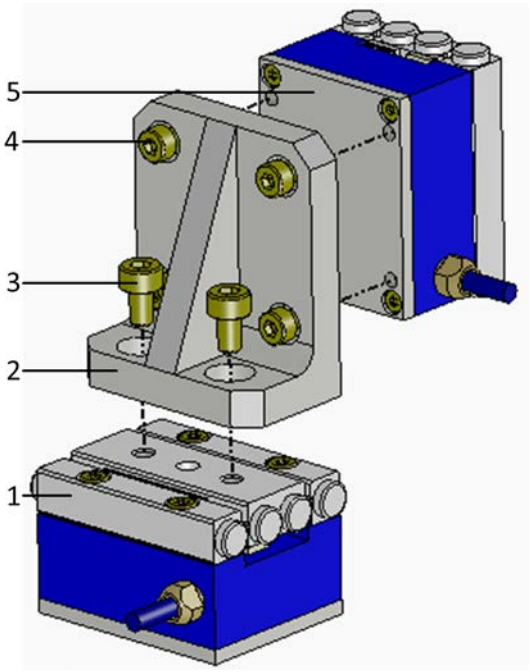



*Figure 13: Example: Setting up an XZ system consisting of two LPS-24 5862-9-1110 and the N-662.APZ adapter bracket*

*1 Lower miniature positioner*

*2 N-662.APZ adapter bracket*

*3 2 M3x5 screws for affixing the adapter bracket to the lower miniature positioner*

*4 4 M2.5x4 screws for affixing the upper miniature positioner to the adapter bracket*

*5 Upper miniature positioner*

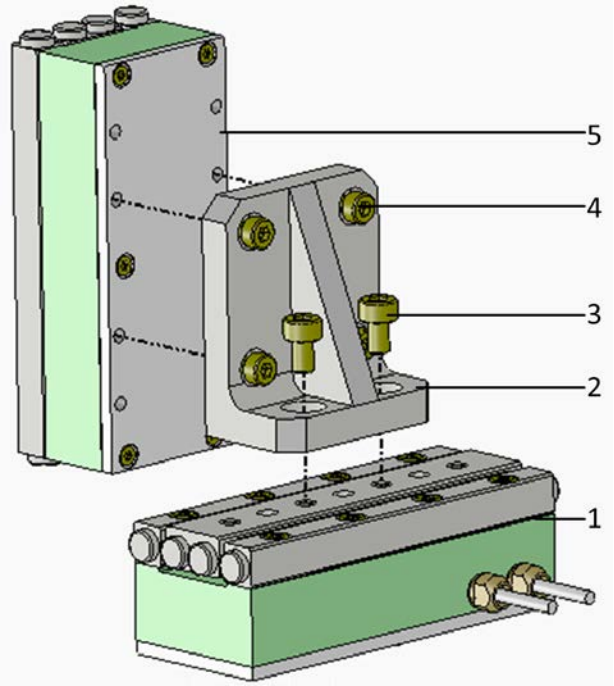



*Figure 14: Example: Setting up an XZ system consisting of two LPS-24 5862-9-1230 and the N-662.APZ adapter bracket*

*1 Lower miniature positioner*
*2 N-662.APZ adapter bracket*
*3 2 M3x5 screws for affixing the adapter bracket to the lower miniature positioner*
*4 4 M2.5x4 screws for affixing the upper miniature positioner to the adapter bracket*
*5 Upper miniature positioner*

## Prerequisites

- ✓ You have read and understood the general notes on installation (p. 17).
- ✓ You have read and understood the general notes on setting up a multi-axis system (p. 27).
- ✓ You accounted for the space required for cable routing free of kinks and in accordance with regulations.
- ✓ If you set up an XZ combination: You have properly mounted the lower miniature positioner on a surface (p. 20).

✓ If you set up an XYZ combination: You have properly mounted the miniature positioners for the X and Y axis (p. 27).

## Tools and accessories

- N-662.APZ adapter bracket, available as an optional accessory (p. 13). For the diameter and position of the holes in the adapter bracket, see "Dimensions" (p. 63).
- Mounting accessories in the scope of delivery of the adapter bracket:
  - 4 M2.5x4 screws
  - 2 M3x5 screws
- Allen wrench AF 2
- Allen wrench AF 2.5

## Setting up a Z system

1. Affix the upper miniature positioner to the adapter bracket:
   a) Align the upper miniature positioner (see figures):
      - The cable exit points to the bending edge of the adapter bracket, i.e. downwards in the Z system.
      - Four mounting holes on the bottom side of the upper miniature positioner overlap with the counter-sunk holes in the long side of the adapter bracket.
   b) Introduce four M2.5x4 screws into the counter-sunk holes of the adapter bracket.
   c) Tighten the four screws with a maximum torque of 50 Ncm each.
2. Affix the adapter bracket to the lower miniature positioner.
   a) Position the adapter bracket to which the upper miniature positioner is affixed on the moving platform of the lower miniature positioner as in the figures.
      - The upper miniature positioner is **not** located over the cable exit of the lower miniature positioner but on the opposite side.
      - The two counter-sunk holes in the adapter bracket and two holes in the moving platform of the lower miniature positioner overlap.
      - If the lower miniature positioner is an LPS-24 5862-9-1230 or 5862-V-1230: The adapter bracket ideally sits over the middle of the moving platform.

b) Introduce two M3x5 screws into the counter-sunk holes of the adapter bracket.
c) Tighten the two screws with a maximum torque of 80 Ncm each.

3. Check that the adapter bracket and the upper miniature positioner fit without backlash.

## 5.5 Connecting the LPS-24 to the Controller

### 5.5.1 Connecting the LPS-24 5862-9-1110

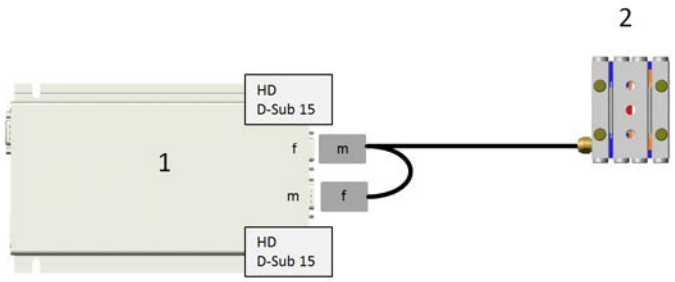



*Figure 15: Cable diagram for LPS-24 5862-9-1110 with controller*

*1 Controller (here E-861.1A1)*
*2 LPS-24 5862-9-1110*

#### Prerequisites

- ✓ You have read and understood the general notes on installation (p. 17).
- ✓ You have installed a suitable controller (p. 13).
- ✓ You have read and understood the user manual of the controller.
- ✓ The controller is switched off.

#### Connecting the LPS-24 5862-9-1110 to the E-861.1A1 controller

1. Connect the drive connector of the miniature positioner to the corresponding controller socket (see user manual of the controller).
2. Connect the sensor connector (HD Sub-D 15 (f)) of the miniature positioner to the panel plug of the controller (see user manual of the controller).
3. Secure the connections in question with the integrated screws against being accidently pulled out.

## 5.5.2 Connecting the LPS-24 5862-9-1230

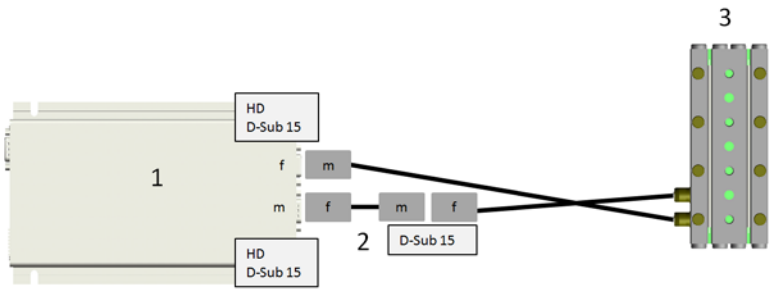



*Figure 16: Cable diagram for LPS-24 5862-9-1230 with controller*

*1 Controller (here E-861.1A1)*
*2 N664B0001 adapter for the sensor connection*
*3 LPS-24 5862-9-1230*

### Prerequisites

- ✓ You have read and understood the general notes on installation (p. 17).
- ✓ You have installed a suitable controller (p. 13).
- ✓ You have read and understood the user manual of the controller.
- ✓ The controller is switched off.

### Tools and accessories

- N664B0001 adapter, in the scope of delivery (p. 12)

### Connecting LPS-24 5862-9-1230 to the E-861.1A1 controller

1. Connect the drive connector of the miniature positioner to the corresponding controller socket (see user manual of the controller).
2. Connect the sensor connector (f) of the miniature positioner to the controller:
   a) Connect the sensor connector of the miniature positioner to the plug side of the adapter (Sub-D 15(m)).
   b) Connect the female side of the adapter (HD Sub-D 15 (f)) to the panel plug of the controller (see user manual of the controller).
3. Secure the connections in question with the integrated screws against being accidently pulled out.

### 5.5.3 Connecting the LPS-24 5862-V-1120 via Vacuum Feedthrough

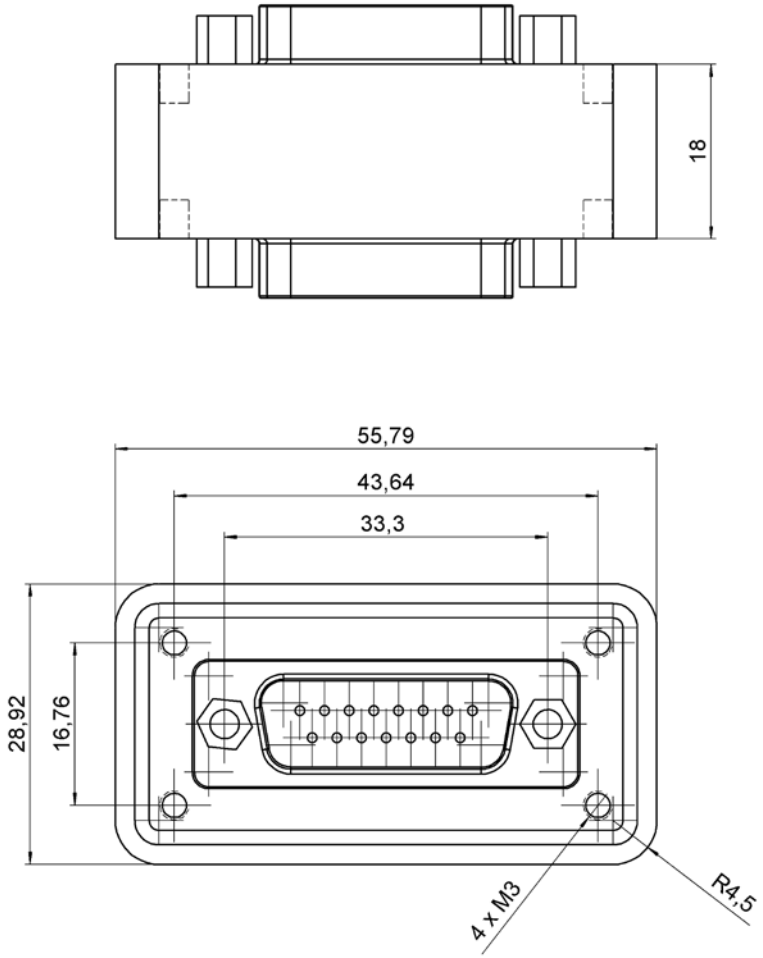



*Figure 17: Sub-D 15 (m/f) vacuum feedthrough for LPS-24 5862-V-1120*

#### Prerequisites

- ✓ You have read and understood the general notes on installation (p. 17).
- ✓ You have installed a suitable controller (p. 13).
- ✓ You have read and understood the user manual of the controller.
- ✓ The controller is switched off.

## Tools and accessories

- N661B0008 Y cable, the electronics of which has been adapted to the miniature positioner by PI (see serial number of the miniature positioner on the connector shell); in the scope of delivery (p. 12)
- N664B0001 adapter, in the scope of delivery (p. 12)
- C-815.VF vacuum feedthrough for drive and sensor signals, available as an optional accessory (p. 13)
- Suitable tools for installing the vacuum feedthrough

## Installing the vacuum feedthrough

1. See the above figure for the dimensions of the vacuum feedthrough.
2. Provide the vacuum chamber with a suitable opening.
3. Install the vacuum feedthrough so that the Sub-D 15 (f) socket is in the vacuum chamber.

## Connecting the LPS-24 5862-V-1120 to the E-861.1A1 controller

➢ Connect the miniature positioner, vacuum feedthrough, Y cable, adapter and controller with each other as shown in the connection diagram below.

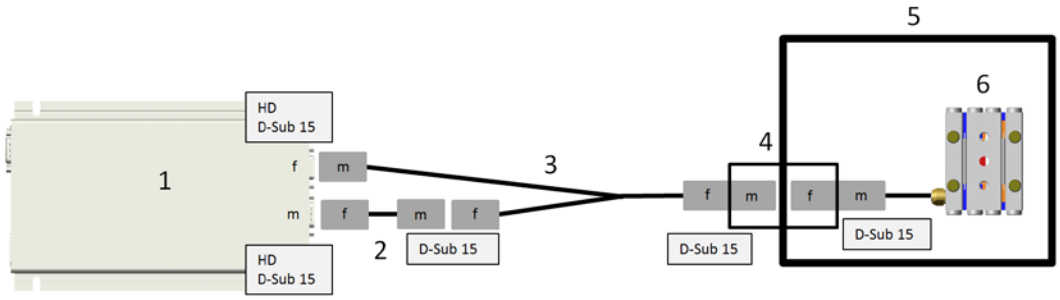



*Figure 18: Cable diagram for LPS-24 5862-V-1120 with vacuum feedthrough and controller*

*1 Controller (here E-861.1A1)*
*2 N664B0001 adapter for the sensor connection*
*3 N661B0008 Y cable for drive and sensor signals*
*4 C-815.VF vacuum feedthrough*
*5 Vacuum chamber*
*6 LPS-24 5862-V-1120 miniature positioner*

### 5.5.4 Connecting the LPS-24 5862-V-1230 via Vacuum Feedthrough

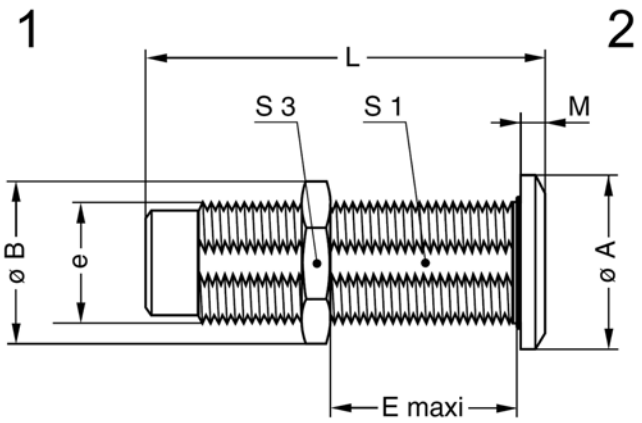



*Figure 19: Dimensions of the LEMO vacuum feedthroughs for LPS-24 5862-V-1230*

Vacuum feedthrough for the drive (item number 000015460):

LEMO SGJ.1B.306.CLLSV (component of the LPS-24 5862-V-1230)

| 1 | 2 | A | B | e | E maxi | L | M | S1 | S3 |
|---|---|---|---|---|---|---|---|---|---|
| Vacuum side | Air side | 17 mm | 15.8 mm | M12x1.00 | 28 mm | 39 mm | 2.5 mm | 10.5 mm | 14 mm |

Vacuum feedthrough for the sensor (item number 000025824):

LEMO SGJ.2B.308.CLLSV (component of the LPS-24 5862-V-1230)

| 1 | 2 | A | B | e | E maxi | L | M | S1 | S3 |
|---|---|---|---|---|---|---|---|---|---|
| Vacuum side | Air side | 20 mm | 21.5 mm | M16x1.00 | 25 mm | 44 mm | 4.0 mm | 15.0 mm | 19 mm |

#### Prerequisites

- ✓ You have read and understood the general notes on installation (p. 17).
- ✓ You have installed a suitable controller (p. 13).
- ✓ You have read and understood the user manual of the controller.
- ✓ The controller is switched off.

## Tools and accessories

- Included in the scope of delivery (p. 12):
  - 000015460 vacuum feedthrough for the drive
  - 000025824 vacuum feedthrough for the sensor connection
  - K030B0664 cable on the air side for the drive
  - E852B0072 cable on the air side for sensor signals, the electronics of which has been adapted to the miniature positioner by PI (see serial number of the miniature positioner on the connector shell)
  - N664B0001 adapter
- Suitable tools for installing the vacuum feedthrough

## Installing the vacuum feedthrough

1. Install the vacuum feedthrough for the drive (000015460):
   a) See the above table for the dimensions of the vacuum feedthrough.
   b) Provide the vacuum chamber with a suitable opening.
   c) Install the vacuum feedthrough so that the plug side of the vacuum feedthrough (LEMO 6-pin) is in the vacuum chamber.
2. Install the vacuum feedthrough for the sensor signals (000025824):
   a) See the above table for the dimensions of the vacuum feedthrough.
   b) Provide the vacuum chamber with a suitable opening.
   c) Install the vacuum feedthrough so that the plug side of the vacuum feedthrough (LEMO 8-pin) is in the vacuum chamber.

## Connecting the LPS-24 5862-V-1230 to the E-861.1A1 controller

➢ Connect the miniature positioner, vacuum feedthroughs, cable, adapter and controller with each other as shown in the connection diagram below.

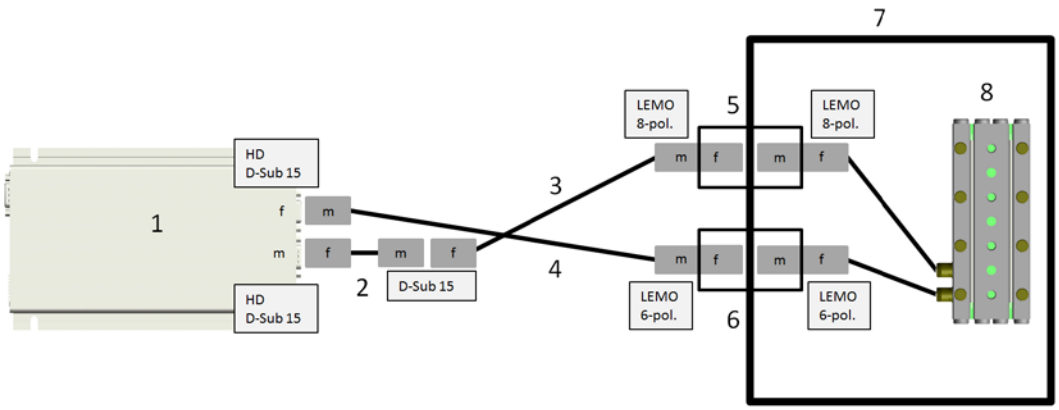



*Figure 20: Cable diagram for LPS-24 5862-V-1230 with vacuum feedthroughs and controller*

*1 Controller (here E-861.1A1)*
*2 N664B0001 adapter for the sensor connection*
*3 E852B0072 cable for sensor signals, on the air side*
*4 K030B0664 cable for the drive, on the air side*
*5 000025824 vacuum feedthrough for the sensor connection*
*6 000015460 vacuum feedthrough for the drive*
*7 Vacuum chamber*
*8 LPS-24 5862-V-1230 miniature positioner*

# 6 Start-Up and Operation

## In this Chapter



## 6.1 General Notes on Start-Up and Operation

***NOTICE***

**Damage from collisions!**

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

- ➢ Make sure that no collisions are possible between the miniature positioner, the load to be moved and the environment in the motion range of the miniature positioner.
- ➢ Do not place any objects in areas where they can get 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 to the piezo actuators!**

If the moving platform of the miniature positioner is displaced by applying external forces, the piezo actuators of the NEXACT® drive may be damaged irreparably.

- ➢ Initiate all motions by sending motion commands to the controller. Do **not** displace the moving platform manually.
- ➢ Make sure that forces acting on the moving platform in the direction of motion **do not** exceed (p. 59) the passive holding force and the feed force of the drive.

***NOTICE***

**Uncontrolled oscillation!**

Your application and the LPS-24 can be damaged by uncontrolled oscillations. Uncontrolled oscillations can be identified by the fact that the miniature positioner approaches the target position too slowly or too fast or does not keep it stable (servo jitter).

If uncontrolled oscillations occur during the operation of the LPS-24:

- ➢ Immediately switch off the servo-control system of the affected axis.
- ➢ Check the settings of the servo-control parameters.

***NOTICE***

**Destruction of the piezo actuators by electric flashovers!**

Using the LPS-24 in environments that increase the electrical conductivity can lead to the destruction of the piezo actuators of the NEXACT® drive by electric flashovers. Electric flashovers can be caused by moisture, high humidity, liquids and conductive materials (e.g. metal dust). In addition, electric flashovers can also occur in certain air pressure ranges due to the increased conductivity of the air.

- ➢ Avoid operating the LPS-24 in environments that can increase the electric conductivity.
- ➢ Only operate the LPS-24 within the permissible ambient conditions and classifications (p. 61).
- ➢ For operation in vacuum below 0.1 hPa:
  Do **not** operate the LPS-24 during evacuation.

***INFORMATION***

Shock-like impacts can cause encoder malfunction.

- ➢ Protect the miniature positioner from shock-like impacts.
- ➢ Carry out a reference move (see user manual of the controller).

***INFORMATION***

The positive direction of motion is away from the cable exit side.

***INFORMATION***

The repeatability of the positioning is only ensured when the reference point switch is always approached from the same side. Recommended controllers from PI fulfill this requirement with their automatic direction detection for reference moves to the reference point switch.

## 6.2 Operating Parameters

If you use the software enclosed with the E-861.1A1 controller, the operating parameters can be loaded from the *PIStages2.dat* stage database.

- ➢ Download the PI Update Finder from the PI website (http://www.update.pi-portal.ws) and use it to update the *PIStages2.dat* stage database on your PC.

For more information about the *PIStages2.dat* stage database, see user manual of the E-861.1A1 controller.

## 6.3 Operating the LPS-24

### Prerequisites

- ✓ You have read and understood the General Notes on Start-Up and Operation (p. 45).
- ✓ You have read and understood the user manual of the controller.
- ✓ You have read and understood the user manual of the PC software.
- ✓ You have properly installed the miniature positioner (p. 17).
- ✓ The controller and the required PC software have been installed. All connections with the controller have been established (see user manual of the controller).

### Operating the LPS-24

- ➢ LPS-24 5862-9-1110, 5862-9-1230 and 5862-V-1230 models: Follow the instructions in the manual of the used controller for start-up and operation of the LPS-24.
- ➢ LPS-24 5862-V-1120 model: For the start-up and operation of the LPS-24, follow the instructions in the manual of the used controller, but perform the reference point definition according to the instructions in "Performing the Reference Point Definition for LPS-24 5862-V-1120" (see below, (p. 48)).

## 6.4 Performing the Reference Point Definition for LPS-24 5862-V-1120

***INFORMATION***

The LPS-24 5862-V-1120 miniature positioner has neither a reference point switch nor limit switches and therefore cannot perform a standard reference move. The reference point is defined with the following procedure:

1. In open-loop operation (servo mode switched off), a motion is carried out to the negative hard stop.
2. The mode of reference point definition is set to the value zero. In this mode, an absolute position value can be assigned for the reference point definition of the axis.
3. The current position is set to the value -7.75 mm.
4. The miniature positioner is moved away from the hard stop in open-loop operation.
5. The servo mode is switched on.

It is recommended to use PIMikroMove to execute this procedure. PIMikroMove takes care of switching the mode to reference point definition, for example, so that you do not have to deal with the corresponding commands.

### Prerequisites

- ✓ You have established communication between the controller and the PC with PIMikroMove
- ✓ In PIMikroMove, you have selected the stage type LPS-24_5862V1120 in the ***Select connected stages*** step.

### Performing the reference point definition for LPS-24 5862-V-1120 with PIMikroMove

1. Close the ***Start up controller*** window, which shows the ***Start up axes*** step, by clicking ***Close***.

   The main window of PIMikroMove opens.

2. In the main window of PIMikroMove, open the single axis window for the LPS-24 5862-V-1120 by selecting the miniature positioner in the ***View > Single Axis Window*** menu.

The single axis window shows the current position of the miniature positioner in the ***Position [mm]*** field.

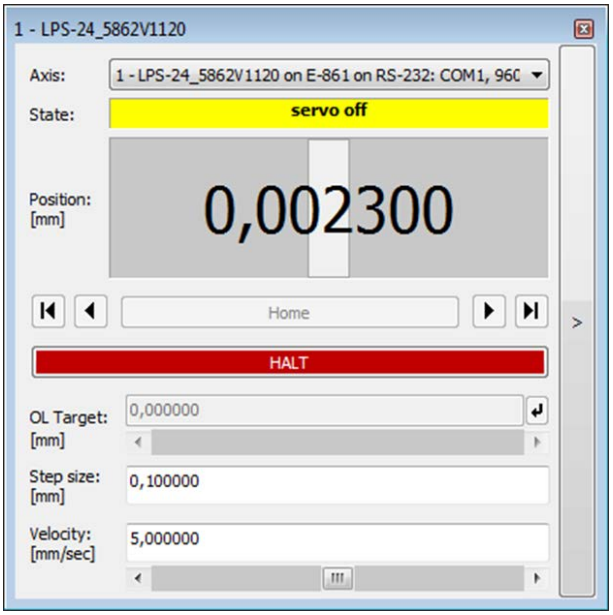



*Figure 21: PIMikroMove: Single axis window*

3. In the single axis window, make sure that the servo mode is switched off for the axis.

   a) Expand the view of the single axis window by clicking on the **>** button at the right edge of the window.
   b) If necessary, remove the check in the ***Servo*** check box that is located at the top center of the single axis window.

4. Start the motion of the miniature positioner to the negative hard stop:

   a) In the main window of PIMikroMove, go to the ***PiezoWalk® channels*** card by clicking the corresponding tab.
   b) On the ***PiezoWalk® channels*** card, enter e.g. the value 100 in the ***Open-Loop Number of Steps*** column.
   c) On the ***PiezoWalk® channels*** card, click the **<** arrow key repeatedly until the position display in the single axis window no longer changes.

| | Step Amplitude | Open-Loop Analog Driving | Open-Loop Velocity | < | Open-Loop Number of Steps | > | Open-Loop Remaining Steps | HALT | Relax |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 55,000000 | 0,000000 | 200,000000 | < | 100,000000 | > | | HALT | Relax |

*Figure 22: PIMikroMove: Excerpt from the PiezoWalk® channels card in the main window*

5. Set the current position to the value -7.75 mm:

a) In the main window of PIMikroMove, use the ***E-861 > Start up axes…*** menu item to open the ***Start up controller*** window again in the ***Start up axes*** step.

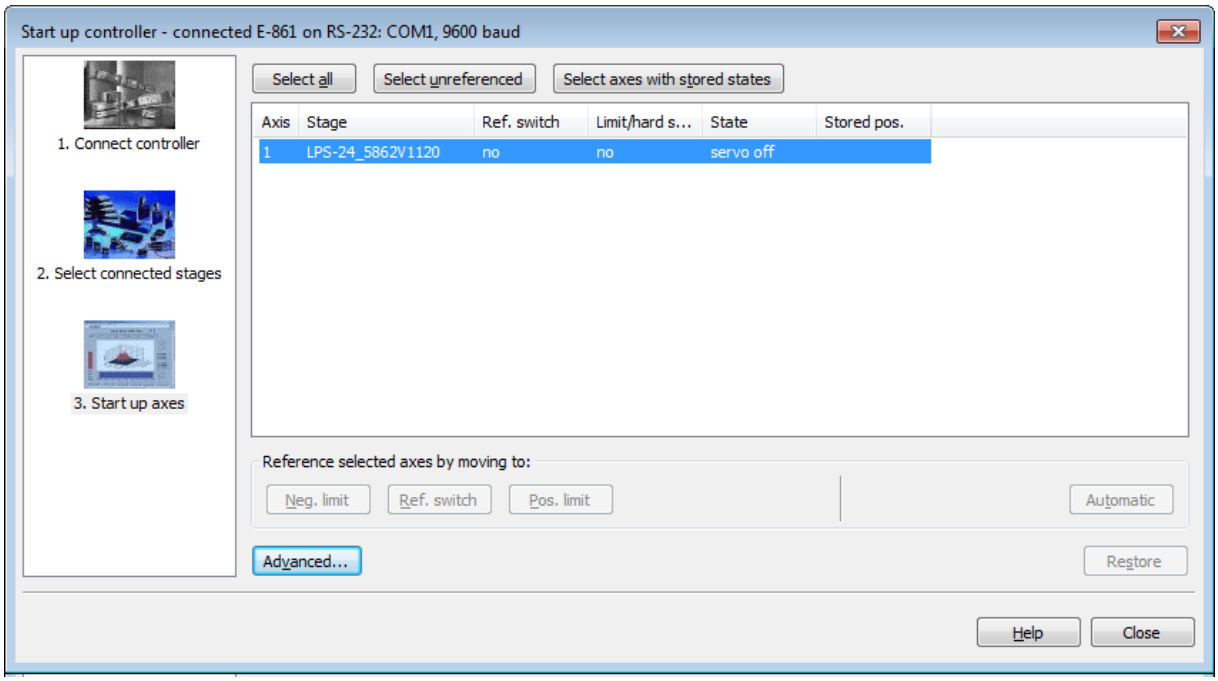



*Figure 23: Start up controller – Start up axes*

b) In the ***Start up controller*** window, click ***Advanced***.

The ***Advanced startup dialog*** window opens.

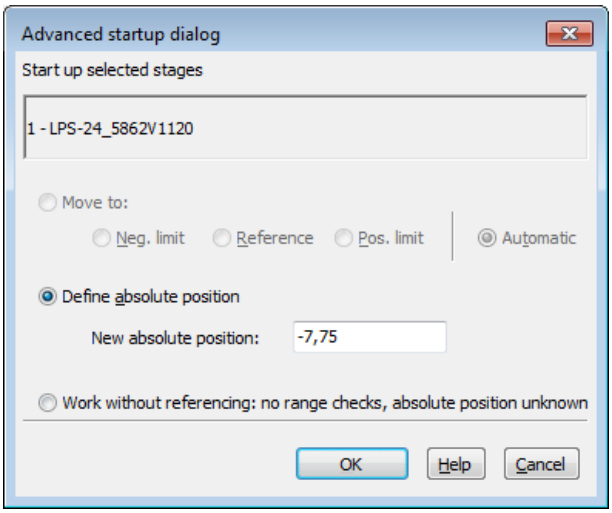



*Figure 24: Advanced startup dialog*

In the ***Advanced startup dialog*** window, set the value for the current position:

c) Select ***Define absolute position***. PIMikroMove automatically sets the appropriate mode of reference point definition.
d) In the ***New absolute position*** field, enter the value -7.75 as the new current position.
e) Click ***OK*** to set the position value.

The ***Warning*** window opens.

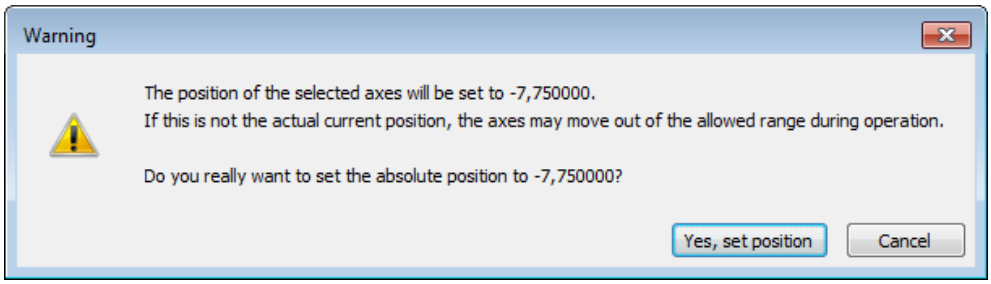



*Figure 25: Window for applying the set position value*

f) Click ***Yes, set position*** to apply the set position value.

The ***Warning*** and ***Advanced startup dialog*** windows close.

g) In the ***Start up controller*** window, click ***Close*** to close the window.

6. On the ***PiezoWalk® channels*** card in the main window of PIMikroMove, move the miniature positioner 100 steps in the positive direction by clicking the **>** arrow key.
7. In the single axis window, switch on the servo mode for the axis by marking the ***Servo*** check box.

## 6.5 Discharging the Piezo Actuators of the Drive

### Discharging the piezo actuators of the drive

If you want to pull out the connector of the drive from the controller:

1. If you are working in closed-loop operation: Switch off the servo mode on the controller.
2. Set the piezo voltage on the controller to 0 V by sending an `RNP` command (see user manual of the controller).
3. If possible: Switch off the controller.
4. Wait at least 10 seconds before disconnecting the controller.

# 7 Maintenance

## In this Chapter



## 7.1 General Notes on Maintenance

***NOTICE***

**Damage due to improper maintenance!**

The miniature positioner can become misaligned as a result of improper maintenance. The specifications can change as a result (p. 59).

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

For the 5862-9-1230 and 5862-V-1230 LPS-24 models, the following applies:

***CAUTION***

**Risk of glare and irritation!**

The linear encoder of the LPS-24 uses a class 2 laser according to DIN EN60825-1:2007. Technical data of the laser: $L_{max} \leq 1$ mW, $\lambda$=655 nm.

On delivery and if used according to the intended use of the LPS-24, the laser is fully shielded. Laser radiation can exit from the laser only if LPS-24 is opened. The laser beam can cause glare and irritation.

- ➢ Do **not** open or disassemble the LPS-24.
- ➢ Contact our customer service department if there is any malfunction of the LPS-24.

## 7.2 Cleaning the LPS-24

### Prerequisites

- ✓ You have discharged the piezo actuators of the LPS-24.
- ✓ You have disconnected the LPS-24 from the controller.

### Cleaning the LPS-24

- ➢ Do **not** do any ultrasonic cleaning.

Only when the miniature positioner is **not** used in vacuum:

- ➢ Clean the surfaces of the LPS-24 with a cloth that is slightly dampened with a mild cleanser or disinfectant (e.g. ethanol or isopropanol).

When the miniature positioner is used in a vacuum:

- ➢ Only touch the miniature positioner with powder-free gloves.
- ➢ If necessary, wipe the miniature positioner clean.

# 8 Troubleshooting

| Problem | Possible Causes | Solution |
|---|---|---|
| Target position is approached too slowly or with overshoot | ▪ Servo-control parameters are not optimally set<br>▪ Large changes in the load | 1. Switch off the servo-control system immediately.<br>2. Check the settings of the servo-control parameters.<br>3. If necessary, correct the settings of the servo-control parameters. |
| Target position is not kept stable | | |
| Uncontrolled oscillations of the LPS-24 | | |
| Reduced holding force and feed force | ▪ Ceramic rail of the NEXACT® drive is soiled, e.g. from being touched | ➢ Contact our customer service department (p. 57). |
| No or limited motion | ▪ Excessive load<br>▪ Excessive counterforces in the direction of motion | ➢ Reduce the load (see "Data Table" (p. 59)).<br>In the case of vertical mounting:<br>➢ Ensure gravity compensation so that the maximum load (p. 59) is not exceeded. |
| | ▪ Ruler of the encoder is soiled, e.g. from being touched | ➢ Contact our customer service department (p. 57). |
| | ▪ Encoder malfunction due to shock impact | ➢ Carry out a reference move (see user manual of the controller) |

| Problem | Possible Causes | Solution |
|---|---|---|
| Only LPS-24 5862-V-1120 / 5862-V-1230:<br>Reduced accuracy | ▪ Sensor cable or miniature positioner has been replaced | After a sensor cable or a miniature positioner has been replaced, it is necessary to adapt the sensor electronics to the sensor in the miniature positioner again.<br>➢ Contact our customer service department (p. 57). |

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. 57).

# 9 Customer Service

For inquiries and orders, contact your PI sales engineer or send us an e-mail (mailto:info@pi.ws).

If you have questions concerning your system, have the following information ready:

- Product codes 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)

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

# 10 Technical Data

## In this Chapter



## 10.1 Specifications

### 10.1.1 Data Table

| | **LPS-24 5862-9-1110** | **LPS-24 Vacuum to $10^{-6}$ hPa 5862-V-1120** | **LPS-24 5862-9-1230** | **LPS-24 Vacuum to $10^{-6}$ hPa 5862-V-1230** | **Unit** | **Tolerance** |
|---|---|---|---|---|---|---|
| Active axes | X | X | X | X | | |
| **Motion and positioning** | | | | | | |
| Travel range | 15 | 15 | 15 | 15 | mm | |
| Integrated sensor | Optical linear encoder | Optical linear encoder | Optical linear encoder PIOne | Optical linear encoder PIOne | | |
| Sensor resolution | 150 | 20 | 0.5 | 0.5 | nm | |
| Open-loop resolution | 0.03 | 0.03 | 0.03 | 0.03 | nm | typ. |
| Min. incremental motion | 150 | 40 | 1 | 1 | nm | |
| Velocity, closed-loop | 10 | 10 | 10 | 10 | mm/s | max. |
| Unidirectional repeatability | ±50 | ±20 | ±20 | ±20 | nm | typ. |

| | LPS-24<br>5862-9-1110 | LPS-24<br>Vacuum to<br>$10^{-6}$ hPa<br>5862-V-1120 | LPS-24<br>5862-9-1230 | LPS-24<br>Vacuum to<br>$10^{-6}$ hPa<br>5862-V-1230 | Unit | Tolerance |
|---|---|---|---|---|---|---|
| Crosstalk, angular error (15 mm travel) | ±100 | ±100 | ±100 | ±100 | µrad | typ. |
| Crosstalk, angular error (1 mm travel) | ±10 | ±10 | ±10 | ±10 | µrad | typ. |
| **Mechanical properties** | | | | | | |
| Stiffness in motion direction | 1 | 1 | 1 | 1 | N/µm | ±20 % |
| Load capacity | 10 | 10 | 10 | 10 | N | max. |
| Feed force (active) | 5 | 5 | 5 | 5 | N | max. |
| Holding force (passive) | 5 | 5 | 5 | 5 | N | min. |
| **Drive properties** | | | | | | |
| Motor type | NEXACT® linear drive | NEXACT® linear drive | NEXACT® linear drive | NEXACT® linear drive | | |
| Operating voltage | -10 to 45 | -10 to 45 | -10 to 45 | -10 to 45 | V | |
| **Miscellaneous** | | | | | | |
| Operating temperature range | 10 to 50 | 10 to 50 | 10 to 50 | 10 to 50 | °C | |
| Material | Steel | Steel | Steel | Steel | | |
| Mass | 160 | 160 | 250 | 250 | g | ±5 % |
| Dimensions | 24 mm × 33 mm × 20 mm | 24 mm × 33 mm × 20 mm | 24 mm × 63 mm × 20 mm | 24 mm × 63 mm × 20 mm | | |

| | **LPS-24 5862-9-1110** | **LPS-24 Vacuum to $10^{-6}$ hPa 5862-V-1120** | **LPS-24 5862-9-1230** | **LPS-24 Vacuum to $10^{-6}$ hPa 5862-V-1230** | **Unit** | **Tolerance** |
|---|---|---|---|---|---|---|
| Cable length | 1.5 m | 1.5 m on the vacuum side, 2 m on the air side | 1.5 m | 1.5 m on the vacuum side, 1.5 m on the air side | | ±10 mm |
| Connector | HD Sub-D (m) 15-pin (motor) HD Sub-D (f) 15-pin (sensor) | Sub-D 15 (motor and sensor) in vacuum; Sub-D 15 to HD Sub-D (m) 15-pin (motor) HD Sub-D (f) 15-pin (sensor) | HD Sub-D (m) 15-pin (motor) Sub-D (f) 15-pin (sensor) | LEMO FGJ.1B.306.CLLM27 (motor), LEMO FGJ.2B.308.CLLM21 (sensor) in vacuum; LEMO to HD Sub-D (m) 15-pin (motor) Sub-D (f) 15-pin (sensor) | | |
| Recommended controller/driver | E-861.1A1 | E-861.1A1 | E-861.1A1 | E-861.1A1 | | |

Ask about custom designs!

## 10.1.2 Ambient Conditions and Classifications

The following ambient conditions and classifications must be observed for the LPS-24:

| | |
|---|---|
| Area of application | For indoor use only |
| Maximum altitude | 2000 m |
| Air pressure | 1100 hPa to $10^{-6}$ hPa |
| Relative humidity | Highest relative humidity 80 % for temperatures to 31 °C, non-condensing<br>Decreasing linearly to 50 % relative humidity at 40 °C, non-condensing |
| Storage temperature | LPS-24 5862-9-1110: -40 °C to 85 °C |
| | LPS-24 5862-V-1120: -20 °C to 70 °C |
| | LPS-24 5862-9-1230 and LPS-24 5862-V-1230: -20 °C to 60 °C |

| | |
|---|---|
| Transport temperature | LPS-24 5862-9-1110: -40 °C to 85 °C |
| | LPS-24 5862-V-1120: -20 °C to 70 °C |
| | LPS-24 5862-9-1230 and LPS-24 5862-V-1230: -20 °C to 60 °C |
| Maximum bakeout temperature for vacuum-compatible products | LPS-24 5862-V-1120: 130 °C |
| | Sub-D 15 (m/f) vacuum feedthrough (see "Accessories" (p. 13)): 125 °C |
| | LPS-24 5862-V-1230: 50 °C |
| | LEMO vacuum feedthroughs (see "Scope of Delivery" (p. 12)): 80 °C |
| Overvoltage category (in acc. with EN 60664-1:2007 / VDE 0110-1) | II |
| Protection class (acc. to EN 61140 / VDE 0140-1) | I |
| Degree of pollution (acc. to EN 60664-1:2007 / VDE 0110-1) | 1 |
| Degree of protection (acc. to IEC 60529) | IP20 |

### 10.1.3 Maximum Ratings

The miniature positioner is designed for the following operating data:

| **Maximum Operating Voltage** | **Maximum Operating Frequency** | **Maximum Power Consumption** |
|---|---|---|
|  |  |  |
| 45 V | 1500 Hz | 20 W |

# 10.2 Dimensions

## 10.2.1 LPS-24 5862-9-1110 / 5862-V-1120

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

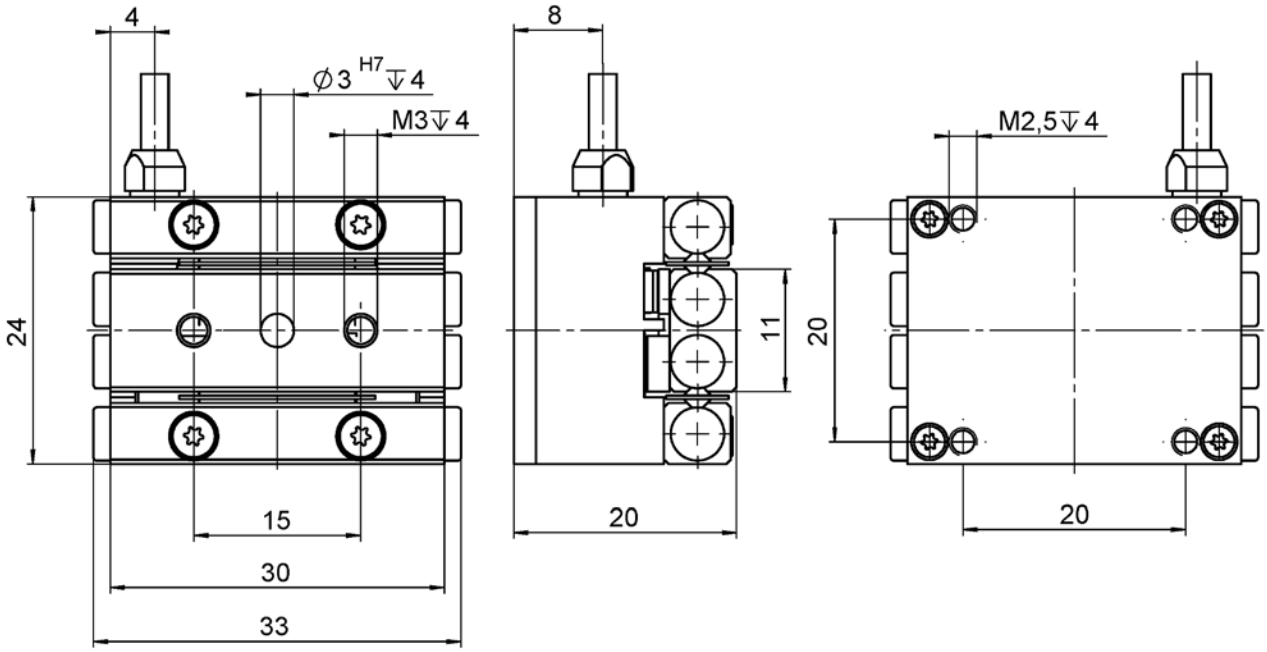



*Figure 26: Dimensions of the LPS-24 5862-9-1110 and 5862-V-1120, moving platform in reference position*

## 10.2.2 LPS-24 5862-9-1230 / 5862-V-1230

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

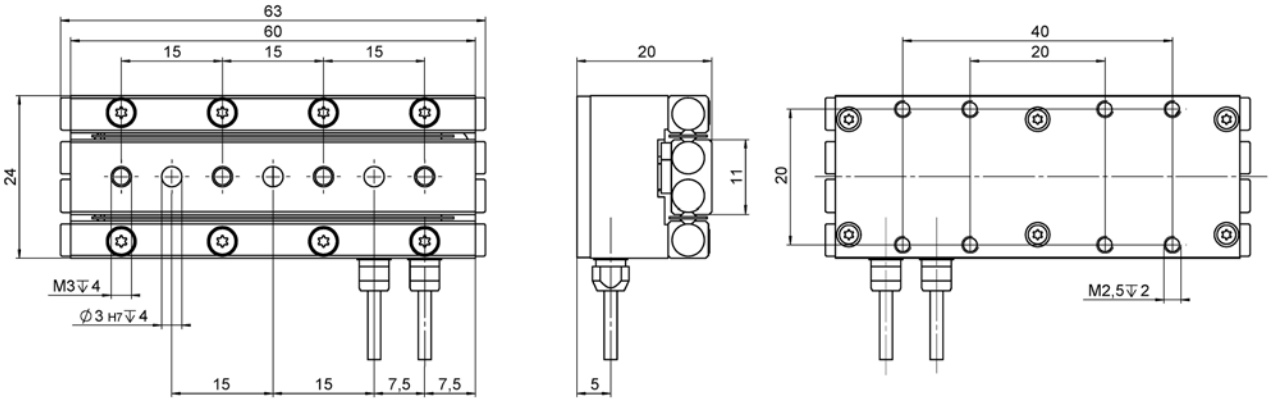



*Figure 27: Dimensions of the LPS-24 5862-9-1230 and 5862-V-1230, moving platform in reference position*

### 10.2.3 N-662.AP1 Adapter Plate

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

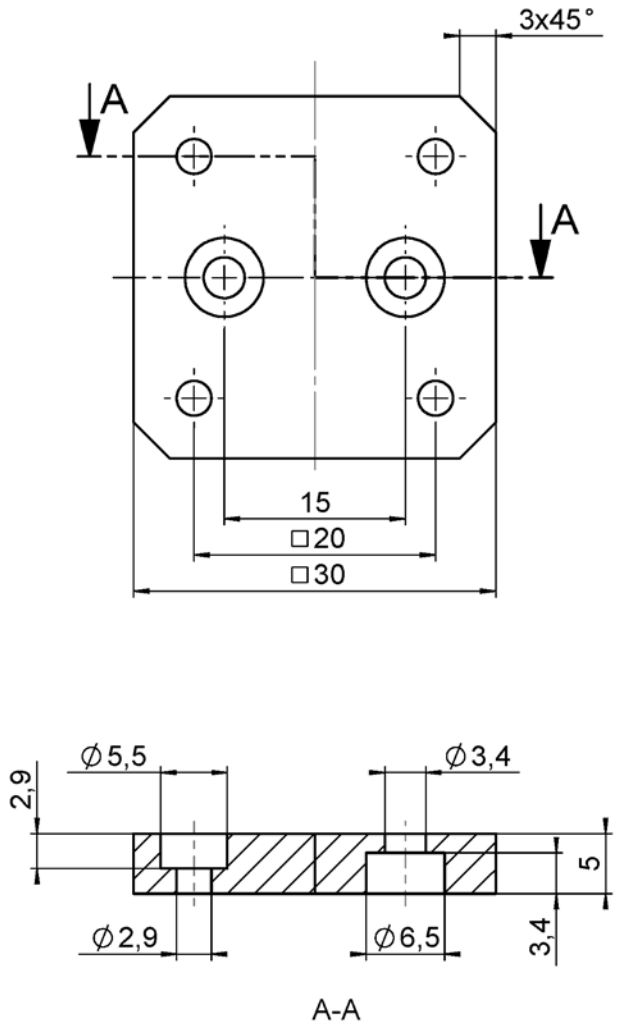



*Figure 28: N-662.AP1 adapter plate*

## 10.2.4 N-662.AP2 Adapter Plate

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

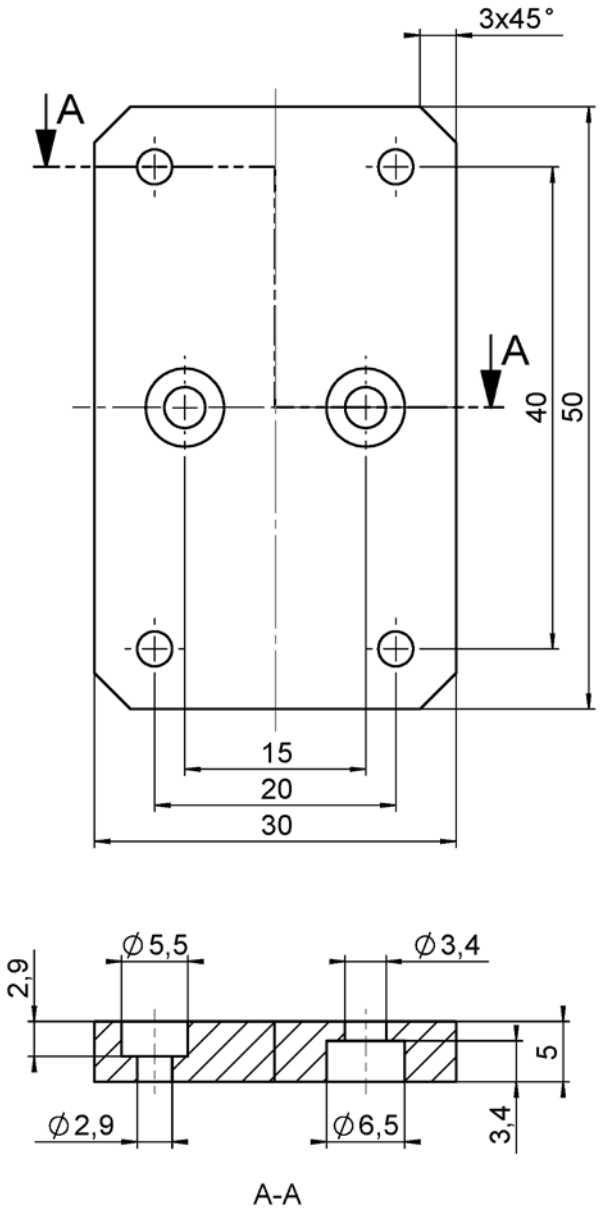



*Figure 29: N-662.AP2 adapter plate*

## 10.2.5 N-662.APZ Adapter Bracket

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

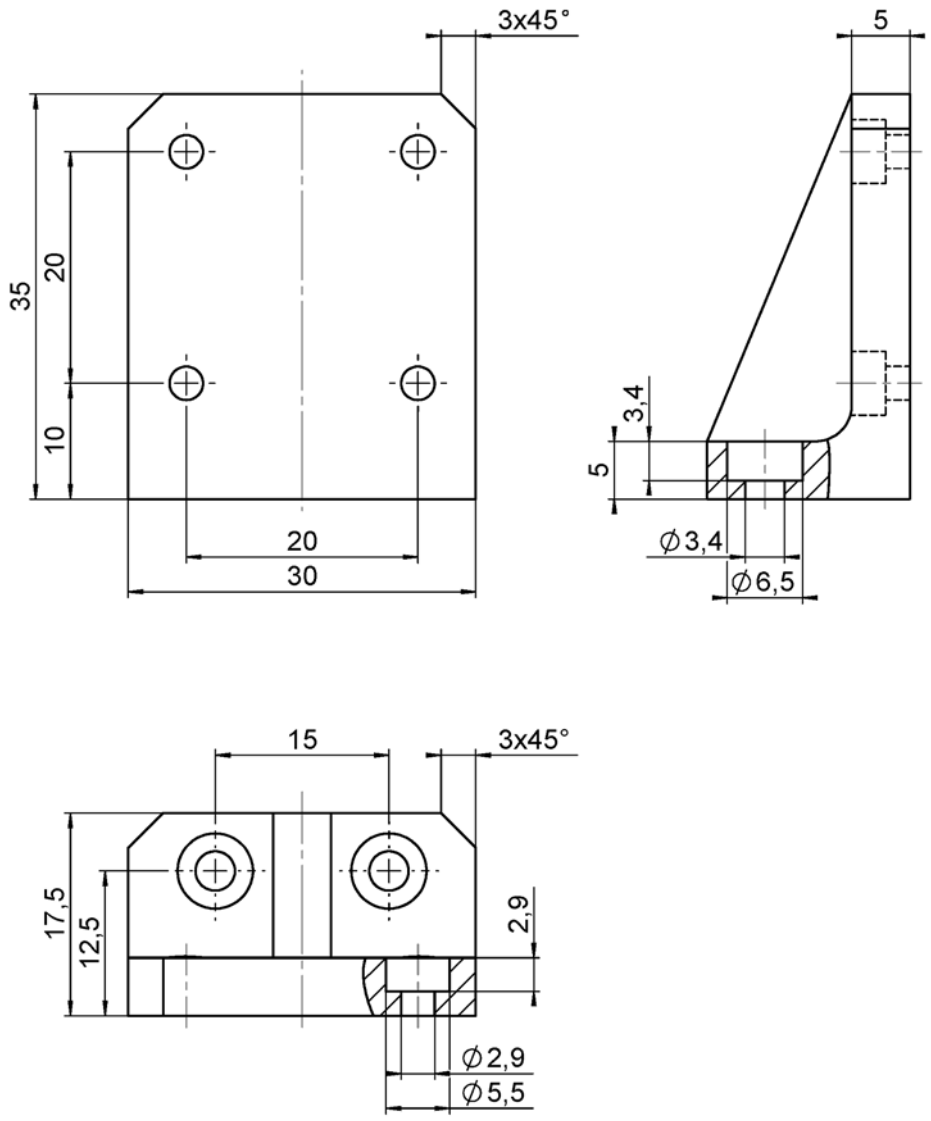



*Figure 30: N-662.APZ adapter bracket*

## 10.3 Pin Assignment

### 10.3.1 Drive Connection for LPS-24 5862-9-1110 and 5862-9-1230

The HD Sub-D 15 (m) connector transmits the signals to control the drive.

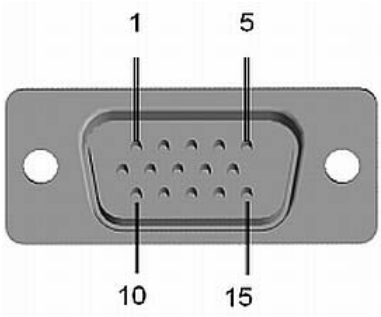



*Figure 31: HD Sub-D 15 connector (m) for the drive, mating side*

| Pin | Function[1] | Direction |
|---|---|---|
| 1 | Piezo 1 | Input |
| 2 | Piezo 3 | Input |
| 3 | - | - |
| 4 | - | - |
| 5 | - | - |
| 6 | Piezo 0 | Input |
| 7 | Piezo 2 | Input |
| 8 | AMP (amplifier enable)[2] | Output |
| 9 | - | - |
| 10 | - | - |
| 11 | Piezo GND | AGND |
| 12 | Piezo GND[3] | AGND |
| 13 | - | - |
| 14 | - | - |
| 15 | GND | Digital GND |

[1]) The "-" sign indicates that the corresponding pin has not been assigned.

[2]) This pin is connected to the GND in the connector shell. In the E-861.1A1 controller, this pin is used to activate the amplifiers.

[3]) This pin is only assigned in the LPS-24 5862-9-1230.

## 10.3.2 Sensor Connection for LPS-24 5862-9-1110

The HD Sub-D 15 (f) connector transmits the signals to and from the integrated linear encoder and the reference point switch.

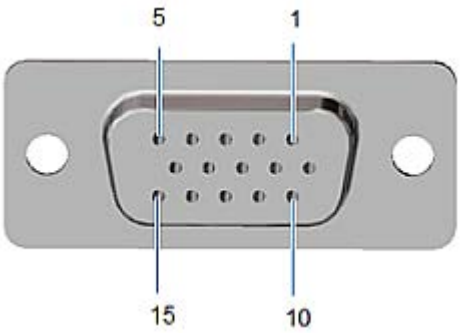



*Figure 32: HD Sub-D 15 (f) connector for sensor, mating side*

| Pin | Signal* | Function | Direction |
|---|---|---|---|
| 1 | REF | Reference point switch | Output |
| 2 | $V_{DD}$ | Supply voltage (+5 V) | Input |
| 3 | - | - | - |
| 4 | COS + | Encoder signal 2 (cosine) | Output |
| 5 | SIN + | Encoder signal 1 (sine) | Output |
| 6 | - | - | - |
| 7 | - | - | - |
| 8 | - | - | - |
| 9 | COS - | Encoder signal 2 (cosine, inverted) | Output |
| 10 | SIN - | Encoder signal 1 (sine, inverted) | Output |
| 11 | - | - | - |
| 12 | - | - | - |
| 13 | - | - | - |
| 14 | GND | GND | GND |
| 15 | - | - | - |

* The "-" sign indicates that the corresponding pin has not been assigned.

### 10.3.3 Sensor Connection for LPS-24 5862-9-1230

The Sub-D 15 (f) connector transmits the signals to and from the integrated linear encoder and the reference point switch.

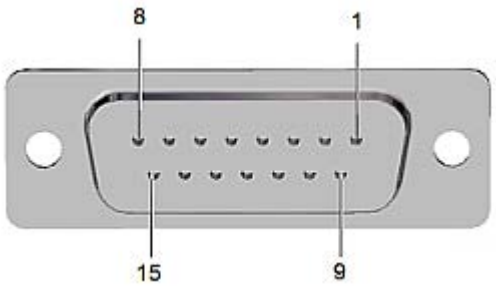



*Figure 33: Sub-D 15 connector (f) for sensor, mating side*

| Pin | Signal* | Function | Direction |
|---|---|---|---|
| 1 | $V_{DD}$ | Supply voltage (+5 V) | Input |
| 2 | GND | GND | |
| 3 | COS + | Encoder signal 1 (cosine) | Output |
| 4 | COS - | Encoder signal 1 (cosine, inverted) | Output |
| 5 | - | | |
| 6 | SIN + | Encoder signal 2 (sine) | Output |
| 7 | SIN - | Encoder signal 2 (sine, inverted) | Output |
| 8 | - | | |
| 9 | - | | |
| 10 | REF + | Reference point switch | Output |
| 11 | - | | |
| 12 | - | | |
| 13 | - | | |
| 14 | - | | |
| 15 | - | | |

* The character "-" indicates that the pin connection is not connected.

### 10.3.4 Connection for Drive and Sensor for LPS-24 5862-V-1120

The Sub-D 15 (m) connector transmits the signals from and to the integrated linear encoder and the signals for controlling the drive.

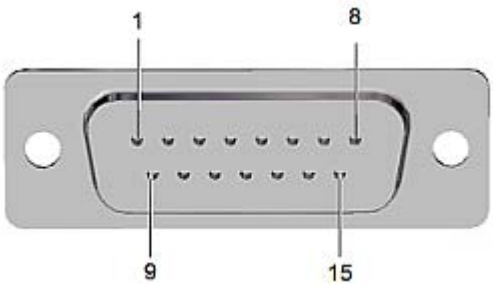


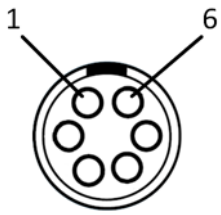

*Figure 34: Sub-D 15 (m) connector*

| | Pin | Function* | Direction |
|---|---|---|---|
| Drive | 1 | Piezo 1 | Input |
| | 2 | Piezo 3 | Input |
| | 3 | - | |
| | 4 | - | |
| | 5 | - | |
| | 6 | Piezo 0 | Input |
| | 7 | Piezo 2 | Input |
| | 8 | GND | |
| Sensor | 9 | - | |
| | 10 | $V_{DD}$ (+5 V) | Input |
| | 11 | SIN + | Output |
| | 12 | COS + | Output |
| | 13 | SIN - | Output |
| | 14 | COS - | Output |
| | 15 | GND | |

* The "-" sign indicates that the corresponding pin has not been assigned.

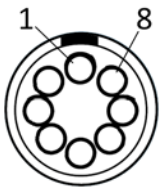
## 10.3.5 Drive Connection for LPS-24 5862-V-1230

LEMO SGJ.1B.306.CLLSV

| Contact side of the connector (f) | Pin | Function | Direction |
|---|---|---|---|
|  | 1 | Piezo 3 | Input |
| | 2 | Piezo 2 | Input |
| | 3 | GND | GND |
| | 4 | GND | GND |
| | 5 | Piezo 1 | Input |
| | 6 | Piezo 0 | Input |

## 10.3.6 Sensor Connection for LPS-24 5862-V-1230

LEMO SGJ.2B.308.CLLSV

| Contact side of the connector (f) | Pin | Function* | Direction |
|---|---|---|---|
|  | 1 | Supply voltage for laser diode 3.3 V | Input |
| | 2 | Supply voltage 5 V | Input |
| | 3 | GND | GND |
| | 4 | Reference point switch | Output |
| | 5 | C | Output |
| | 6 | B | Output |
| | 7 | A | Output |
| | 8 | - | - |

* The "-" sign indicates that the corresponding pin has not been assigned.

The signals at the sensor connection of the LPS-24 5862-V-1230 are not transmitted directly to the controller but are prepared for the sensor connection of the controller by the electronics in the sensor cable on the air side.

### 10.3.7 N664B0001 Adapter for the Sensor Connection

The pin assignments of the N664B0001 adapter, which is included in the scope of delivery of LPS-24 5862-9-1230, 5862-V-1120 and 5862-V-1230, are as follows:

- Sub-D 15 (m) connector: See "Sensor Connection for LPS-24 5862-9-1230" (p. 70)
- HD Sub-D 15 (f) connector: See "Sensor Connection for LPS-24 5862-9-1110" (p. 69)

# 11 Old Equipment Disposal

In accordance with the applicable EU law, electrical and electronic equipment may not be disposed of with unsorted municipal wastes in the member states of the EU.

When disposing of your old equipment, observe the international, national and local rules and regulations.

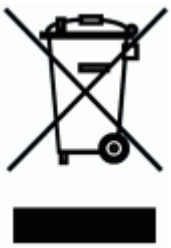
To meet the manufacturer's product responsibility with regard to this product, Physik Instrumente (PI) GmbH & Co. KG ensures environmentally correct disposal of old PI equipment that was first put into circulation after 13 August 2005, free of charge.

If you have old PI equipment, you can send it postage-free to the following address:

Physik Instrumente (PI) GmbH & Co. KG

Auf der Römerstr. 1

D-76228 Karlsruhe, Germany



# 12 EC Declaration of Conformity

For the LPS-24, an EC Declaration of Conformity has been issued in accordance with the following European directives:

2004/108/EC, EMC Directive

2011/65/EU, RoHS Directive

The applied standards certifying the conformity are listed below.

Electromagnetic Emission: EN 61000-6-3:2007, EN 55011:2009

Electromagnetic Immunity: EN 61000-6-1:2007