User Manual

L-505.02A212F LINEAR STAGE WITH STEPPER MOTOR
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2 About this Document

2.1 Objective and Target Group

This user manual contains the information needed for the intended use of the L-505.02A212F. Basic knowledge of closed-loop systems, motion control concepts, and applicable safety measures is assumed.

2.2 Other Applicable Documents

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

<table>
<thead>
<tr>
<th>Document number</th>
<th>Document type</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP146EK</td>
<td>Short instructions</td>
<td>Positioners with electric motors</td>
</tr>
<tr>
<td>SM148E</td>
<td>Software Manual</td>
<td>PIMikroMove</td>
</tr>
<tr>
<td>MS208E</td>
<td>User Manual</td>
<td>C-663 Mercury Step Controller</td>
</tr>
<tr>
<td>MS241E</td>
<td>User Manual</td>
<td>C-663.12 Mercury Step Stepper Motor Controller</td>
</tr>
<tr>
<td>-</td>
<td>Hardware Manual</td>
<td>SMC Hydra Motion Controller</td>
</tr>
<tr>
<td>-</td>
<td>Hardware Manual</td>
<td>SMC Pollux Motion Controller</td>
</tr>
</tbody>
</table>

The latest versions of the user manuals can be downloaded (p. 6) at www.pi.ws.

2.3 Explanation of Symbols

This chapter explains the symbols and markings used by PI in this user manual.

2.3.1 Typographic Conventions

<table>
<thead>
<tr>
<th>Symbol / Label</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Action consisting of several steps whose sequential order must be ob-</td>
</tr>
<tr>
<td>2.</td>
<td>served</td>
</tr>
<tr>
<td>■</td>
<td>Lists</td>
</tr>
<tr>
<td>p. 5</td>
<td>Cross-reference to page 5</td>
</tr>
<tr>
<td>RS-232</td>
<td>Labeling of an operating element on the product (example: socket of the RS-232 interface)</td>
</tr>
<tr>
<td>Start &gt; Settings</td>
<td>Menu path in the PC software (example: to open the menu, the Start and Settings menus must be clicked successively)</td>
</tr>
<tr>
<td>POS?</td>
<td>Command line or a command from PI's General Command Set (GCS) (example: command to get the axis position)</td>
</tr>
<tr>
<td>Device S/N</td>
<td>Parameter name (example: parameter where the serial number is stored)</td>
</tr>
<tr>
<td>5</td>
<td>Value that must be entered or selected via the PC software</td>
</tr>
</tbody>
</table>
2.3.2 Symbols Used

<table>
<thead>
<tr>
<th>Symbol / Label</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>General hazard symbol</td>
</tr>
</tbody>
</table>

**DANGER**
Dangerous situation
Failure to observe can lead to death or serious injury.
► Measures for avoiding the risk.

**WARNING**
Dangerous situation
Failure to observe can lead to serious injury.
► Action to take to avoid the risk.

**CAUTION**
Dangerous situation
Failure to observe can lead to minor injury.
► Actions to take to avoid the risk.

**NOTICE**
Dangerous situation
Failure to observe can lead to material damage.
► Action to take to avoid the risk.

**Information**
Additional information on the L-505.02A212F that can affect your application.

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

2.5 Downloading Manuals
The latest versions of the user manuals can be downloaded (p. 6) at www.pi.ws.
For products that are supplied with software (CD in the scope of delivery), access to the manuals is protected by a password. Protected content is only displayed on the website after entering the login data. You need the product CD to get the login data.
If a manual is missing or problems occur with downloading, contact our customer service department (p. 30).

**Downloading Manuals**
1. Open the website www.pi.ws.
2. If the product was shipped with a CD: Log into the website:
   a) Click Login.
   b) Enter the login data.
The login data is in the \textit{[...].Releasenews[...].pdf} in the \textit{Manuals} directory on the product CD.

If necessary: Follow the link and register yourself to get the login data.

\begin{itemize}
\item[c)] Click \textit{Login} or press the \textit{Enter} key.
\end{itemize}

3. Search for the product:
\begin{itemize}
\item[a)] Click \textit{Search}.
\item[b)] Enter the product number up to the period (e.g., L-505) into the search field.
\item[c)] Click \textit{Start search} or press the \textit{Enter} key.
\item[d)] If necessary: Click \textit{Load more results} at the bottom of the list.
\end{itemize}

4. Click the corresponding product in the list of search results.

5. Click the \textit{Downloads} tab.

\textit{The manuals are shown under Documentation.}

6. Click the desired manual and save it.
3 Safety

3.1 Intended Use

The L-505.02A212F is a laboratory device as defined by DIN EN 61010-1. It is intended for indoor use and use in an environment that is free of dirt, oil, and lubricants.

In accordance with its design, the L-505.02A212F is intended for positioning, adjusting and shifting loads in one axis at various velocities. The L-505.02A212F is not intended for applications in areas, in which a failure would present severe risks to human beings or the environment.

The intended use of the L-505.02A212F is only possible when completely mounted and connected. The L-505.02A212F must be operated with suitable electronics (p. 11). The electronics are not in the scope of delivery of the L-505.02A212F.

The L-505.02A212F may not be used for purposes other than those stated in this user manual. The L-505.02A212F may only be used in compliance with the technical specifications and instructions in this user manual.

3.2 General Safety Instructions

The L-505.02A212F is built according to state-of-the-art technology and recognized safety standards. Improper use of the L-505.02A212F may result in personal injury and/or damage to the L-505.02A212F.

► Use the L-505.02A212F only for its intended purpose and if it is in perfect condition.
► Read the user manual.
► Eliminate any faults and malfunctions that are likely to affect safety immediately.

The operator is responsible for correct installation and operation of the L-505.02A212F.

3.3 Organizational Measures

3.3.1 User Manual

► Always keep this user manual available with the L-505.02A212F. The latest versions of the user manuals can be downloaded (p. 6) at www.pi.ws.
► Add all information from the manufacturer such as supplements or technical notes to the user manual.
► If you give the L-505.02A212F to a third party, also include 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 damage to equipment.
► Only install and operate the L-505.02A212F after you have read and understood this user manual.

3.3.2 General Personnel Qualification

The L-505.02A212F may only be installed, started up, operated, maintained, and cleaned by authorized and appropriately qualified personnel.
4 Product Description

4.1 Product Labeling

Figure 1: Product label on the L-505.02A212F
1. Type plate
2. Warning symbol: Electrostatic sensitive device
3. Protective earth connector
4. Warning symbol: Risk of crushing

4.1.1 Type Plate

The type plate is on the plug connector of the L-505.02A212F.

Figure 2: Type plate of the L-505.02A212F
1. Product number (example)
2. Serial number (example), individual for each L-505.02A212F
   Meaning of the position (counting from the left):
   1 = internal information,
   2 and 3 = year of manufacture,
   4 to 9 = consecutive numbers
3. Warning and conformity symbols (Old equipment disposal (p. 36), CE mark (p. 41))
4.2 Scope of Delivery

<table>
<thead>
<tr>
<th>Product number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-505.02A212F</td>
<td>Linear stage according to order</td>
</tr>
<tr>
<td>L505B1000</td>
<td>Mounting kit for mounting the L-505.02A212F, consisting of:</td>
</tr>
<tr>
<td></td>
<td>■ 4 socket head screws, ISO 4762 M3x6</td>
</tr>
<tr>
<td></td>
<td>■ 2 dowel pins, ISO 8734, 2m6 x 8</td>
</tr>
<tr>
<td>000036450</td>
<td>M4 screw set for protective earth, consisting of:</td>
</tr>
<tr>
<td></td>
<td>■ 1 flat-head screw with cross recess, ISO 7045 M4x8</td>
</tr>
<tr>
<td></td>
<td>■ 2 safety washers</td>
</tr>
<tr>
<td></td>
<td>■ 2 flat washers</td>
</tr>
<tr>
<td>720090669-0300</td>
<td>Drive/encoder cable, stepper motor and encoder to SMC Hydra controller, HD Sub-D 26 (f) to Sub-D 15 (m) (motor) and HD Sub-D 15 (encoder), 3 m</td>
</tr>
<tr>
<td>7200900860-0300</td>
<td>Drive/encoder cable, stepper motor and encoder to C-663.11 Mercury Step stepper motor controller, HD Sub-D 26 (f) to Sub-D 15 (m), 3 m</td>
</tr>
<tr>
<td>C-815.00UP0100-0300</td>
<td>Drive/encoder cable, stepper motor and encoder to C-663.12 Mercury Step stepper motor controller, HD Sub-D 26 (f) to HD-Sub-D 26 (m), 3 m</td>
</tr>
<tr>
<td>MP146EK</td>
<td>Short instructions for positioners with electric motors</td>
</tr>
</tbody>
</table>

4.3 Overview

1. Legend

4.3.1 Base Body

The base body is the basis of the positioner. The L-505.02A212F is mounted onto a surface via the base body (p. 13).

The base body comprises the following subassembly or subassemblies:

Drive screw

The drive screw converts the rotary motion of the drive to linear motion of the motion platform.

Reference Point Switch

The reference point switch is a sensor whose fixed position serves as the reference point for incremental sensor signals.
Limit switches
The limit switches are sensors at each end of the travel range that enable the electronics to abort motion in order to prevent the motion platform from colliding with the mechanical hard stop.

Position sensor
The sensor measures the position of the motion platform incremental to a known reference point. Optical linear encoders measure the actual position directly (direct position measuring). Therefore, errors in the drive, such as nonlinearity, backlash or elastic deformations cannot influence the measurement of the position.

4.3.2 Drive Connection
The electrical connection to the electronics is established via the drive connection (p. 21). The drive connection transmits the supply voltage, the signals for the drive as well as the sensor signals of the L-505.02A212F.

The drive connection comprises the following subassembly or subassemblies:

ID chip
Information on the L-505.02A212F (e.g., type, serial number, date of manufacture, version of the hardware) is stored in parameters on the ID chip. Electronics that support the ID chip evaluate the data from the ID chip and can select the corresponding type of positioner automatically from the positioner database during startup.

For more information on ID chip recognition, see the manual for the electronics.

4.4 Suitable Electronics
The L-505.02A212F must be connected to suitable electronics that supply the necessary voltage for operating and if required, to evaluate the sensor and limit switch signals. The following electronics are suitable:

<table>
<thead>
<tr>
<th>Product number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-663.12</td>
<td>Mercury Step Stepper Motor Controller</td>
</tr>
<tr>
<td>SMC Hydra</td>
<td>Motion Controller</td>
</tr>
<tr>
<td>SMC Pollux</td>
<td>Motion Controller</td>
</tr>
</tbody>
</table>

To order, contact our customer service department (p. 30).

4.5 Accessories

<table>
<thead>
<tr>
<th>Product number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-505.AP1</td>
<td>Mounting adapter for vertical mounting of L-505 positioners</td>
</tr>
</tbody>
</table>

To order, contact our customer service department (p. 30).
Unpacking

Unpacking the L-505.02A212F

1. Unpack the L-505.02A212F with care.
2. When the L-505.02A212F was delivered with ESD protective caps on the connections: Do not remove the ESD protective caps.
3. Compare the contents with the scope of delivery according to the contract and the delivery note.
4. Inspect the contents for signs of damage. If any parts are damaged or missing, contact our customer service department (p. 30) immediately.
5. Keep all packaging materials in case the product needs to be returned.
6 Installation

6.1 Mounting the L-505.02A212F

Overview

Tools and Accessories

- Screw set for mounting the L-505.02A212F (p. 10)
- Suitable screwdriver

Requirements

✓ You have read and understood the general safety instructions (p. 8).
✓ You have provided a suitable surface with the holes necessary for the screws and if required, locating pins (p. 34).

- The flatness of the surface is \( \leq 10 \, \mu m \).
- For applications with large temperature changes: The surface should have the same or similar thermal expansion properties as the L-505.02A212F.
✓ You have accounted for the space required to route cables without bending and according to regulations.

⚠️ CAUTION

Risk of crushing by moving parts!

Risk of minor injuries from crushing between the moving parts of the L-505.02A212F or the load and a fixed part or obstacle.

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

**Damage due to collisions!**

Collisions can damage the L505.02A212F, the load to be moved, and the surroundings.

► Make sure that collisions are not possible between the L505.02A212F, the load to be moved, and the surroundings in the motion range of the L505.02A212F.

► Do not place any cables or other objects in areas where they could be caught by moving parts.

**NOTICE**

**Excessively long screws and locating pins**

Screws and locating pins that are inserted too deeply can damage the L505.02A212F.

► Pay attention to the depth of the mounting and locating holes (p. 35) in the L505.02A212F.

► Only use screws and locating pins of the correct length for the respective mounting holes.

---

**Mounting the L-505.02A212F on a Surface**

1. If necessary: Allow access to the mounting holes in the base body of the L505.02A212F. Possible measures:
   - Temporary startup of the positioner (p. 23) and command the platform to a suitable position
   - Move the motion platform by hand

2. Align the L-505.02A212F on the surface so that the corresponding mounting holes in the L505.02A212F and the surface overlap.

3. Insert the screws into all accessible mounting holes and tighten.

4. If necessary: Repeat steps 1 to 3 for all concealed mounting holes.

5. Check that the L-505.02A212F is affixed firmly to the surface.

---

**6.2 Connecting the L-505.02A212F to the Protective Earth Conductor**

It is only necessary to connect the L-505.02A212F to the protective earth conductor when both of the following conditions are met:

- The load on the motion platform must be connected to the protective earth conductor, but it is not possible to connect the protective earth conductor directly.
- The load and the motion platform are connected conductively to each other.

**Overview**

1. Connector for the protective earth conductor on the L-505.02A212F, indicated by the protective earth symbol
2. Safety washer
3. Flat washer
4. Protective earth conductor lug  
5. Screw, ISO 7045 M4×8

Tools and Accessories
- Suitable protective earth conductor:
  - Cable cross section ≥ 0.75 mm²  
  - Contact resistance <0.1 Ω at 25 A at all connection points relevant for attaching the protective earth conductor 
- M4 screw set for protective earth, in the scope of delivery of the L-505.02A212F (p. 10) 
- Suitable screwdriver

Requirements
✓ You have read and understood the general safety instructions (p. 8).

Information
- Observe the applicable standards for connecting the protective earth conductor.

Connecting the L-505.02A212F to the Protective Earth Conductor
1. If necessary, attach a suitable cable lug to the protective earth conductor.  
2. Attach the cable lug of the protective earth conductor to the protective earth connection as shown in the illustration of the L-505.02A212F. 
3. Tighten the screw with a torque of 1.2 Nm to 1.5 Nm.
4. Make sure that the contact resistance is <0.1 Ω at 25 A at all connection points relevant for attaching the protective earth conductor.

6.3 Setting Up a Multi-Axis System
The L-505.02A212F can be used in XY systems.

Designations in these instructions:
- **Lower positioner:** Forms the basis of the multi-axis system, is attached to an underlying surface  
- **Upper positioner:** Forms the upper axis of the multi-axis system, is attached to the lower positioner rotated by 90°

Tools and Accessories
- Screws in the scope of delivery of the L-505.02A212F:  
  - 4 screws ISO 4762, M3x6, A2  
  - 2 locating pins ISO 8734, 2m6x8  
- Suitable screwdriver

Requirements
✓ You have read and understood the general safety instructions (p. 8).  
✓ The positioners are not connected to the electronics.  
✓ The lower positioner has been mounted onto the underlying surface properly (p. 13).  
✓ You have accounted for the space required to route cables without bending and according to regulations.
NOTICE

**Impermissibly high load on the positioners!**

In a multi-axis system, the stage used for the upper axis must also be moved. Impermissibly high loads impair the motion and can damage the positioners.

- Pay attention to the maximum permissible forces (p. 31) that may act on the motion platform.
- In the case of multi-axis systems, include the masses of the positioners to be moved when calculating the load.

NOTICE

**Excessively long screws and locating pins**

Screws and locating pins that are inserted too deeply can damage the L-505.02A212F.

- Pay attention to the depth of the mounting and locating holes (p. 35) in the L-505.02A212F.
- Only use screws and locating pins of the correct length for the respective mounting holes.

Building an XY Multi-Axis System

1. Mount the L-505.02A212F onto the lower L-505.
   a) Insert two locating pins 2 mm m6 × 8 mm into the motion platform of the lower L-505.
2. Align the L-505.02A212F to the lower L-505.
3. Insert the M3×6 screws into the holes in the upper L-505 and tighten them.
6.4 Building a Vertical Multi-Axis System

The L-505.02A212F can be used as Z axis. A mounting bracket is necessary, see Optional Accessories (p. 11).

Designations in these instructions:
- **Horizontal positioner**: Forms the horizontal axis of the multi-axis system
- **Vertical positioner**: Forms the vertical axis of the multi-axis system, is attached to the mounting bracket rotated around 90°
Z Mounting Overview

The mounting bracket for the L-505 can be attached in two different configurations.

Requirements
✓ You have read and understood the general safety instructions (p. 8).
✓ The positioners are not connected to the electronics.
✓ The lower positioner has been mounted onto the underlying surface properly (p. 13).
✓ You have accounted for the space required to route cables without bending and according to regulations.

NOTICE
Impermissibly high load on the positioners!
In a multi-axis system, the stage used for the upper axis must also be moved. Impermissibly high loads impair the motion and can damage the positioners.
► Pay attention to the maximum permissible forces (p. 31) that may act on the motion platform.
► In the case of multi-axis systems, include the masses of the positioners to be moved when calculating the load.

NOTICE
Unwanted changes in position with vertical mounting!
If the load exceeds the self-locking of the L-505.02A212F when the stage is mounted vertically, unwanted changes in the position of the motion platform will occur. Unwanted changes in the position of the motion platform can damage the drive, the load or the environment.
► If the L-505.02A212F is mounted vertically, make sure that the installed load is lower than the self-locking of the drive. (see Specifications (p. 31))

NOTICE
Excessively long screws and locating pins
Screws and locating pins that are inserted too deeply can damage the L-505.02A212F.
► Pay attention to the depth of the mounting and locating holes (p. 35) in the L-505.02A212F.
► Only use screws and locating pins of the correct length for the respective mounting holes.
Tools and Accessories

- Mounting bracket, see Optional Accessories (p. 11)
- Mounting hardware, in the scope of delivery of the L-505
  - 4 screws ISO 4762, M3×6, A2
  - 2 locating pins ISO 8734, 2m6×8
- Mounting hardware, scope of delivery of the mounting bracket
  - 4 screws ISO 4762, M3×10, A2
  - 2 locating pins ISO 8734, 2m6×8

Building a Vertical Multi-Axis System

1. Attach the mounting bracket to the lower L-505.
   a) Insert two locating pins 2 mm m6 × 8 mm into the motion platform of the lower L-505.
   b) Align the mounting bracket to the lower L-505.
   c) Insert the M3×10 screws into the holes in the mounting bracket and tighten them.

2. Attach the upper L-505 to the mounting bracket.
   a) Insert two 2 mm m6 × 8 mm locating pins into the mounting bracket.
   b) Align the L-505 to the mounting bracket.
   c) Insert the M3×6 screws into the holes in the upper L-505 and tighten them.
6.5 Mounting the Load onto the L-505.02A212F

Overview

Figure 3: Load mounting at the hole in the pusher of the L-505.02A212F
1. Screws
2. Load
3. Motion platform of the L-505.02A212F

Tools and Accessories
- At least 3 screws with suitable dimensions (p. 34)
- Suitable tools for tightening the screws
- Optional: 2 suitably dimensioned dowel pins as locating pins for aligning the load on the L-505.02A212F

Requirements
- You have read and understood the general safety instructions (p. 8).
- You have mounted the L-505.02A212F on the surface (p. 13) properly.
- The L-505.02A212F is not connected to the electronics.
✓ You have prepared the load so that it can be affixed to the mounting holes on the motion platform:
  ■ The distance between the center of gravity of the load and the center of the motion platform is as small as possible in all directions.
  ■ At least three points are provided for affixing the load on the motion platform.

**NOTICE**

**Impermissibly high load on the L-505.02A212F**

An impermissibly high load impairs the motion of the motion platform and can damage the L-505.02A212F.

 ► Pay attention to the maximum permissible forces (p. 31) that may act on the motion platform.
 ► In the case of multi-axis systems, include the masses of the positioners to be moved when calculating the load.

**NOTICE**

**Excessively long screws and locating pins**

Screws and locating pins that are inserted too deeply can damage the L-505.02A212F.

 ► Pay attention to the depth of the mounting and locating holes (p. 34).
 ► Only use screws and locating pins of the correct length for the respective mounting holes.

**Affixing the Load**

1. If necessary: Insert the locating pins into the corresponding holes in the motion platform.
2. Align the load on the motion platform so that the mounting holes selected in the motion platform can be used for mounting the load.
3. Place the load onto the motion platform so that the locating pins are inserted into the corresponding locating holes in the load.
4. Tighten the screws in all mounting holes.
5. Check that the load is affixed firmly to the motion platform.

**6.6 Connecting the L-505.02A212F**

**Tools and Accessories**

 ■ Wenn nötig: Suitable cable set
 ■ If necessary: Suitable screwdriver for the locking screws of the connectors.

**Requirements**

 ✓ You have read and understood the general safety instructions (p. 8).
 ✓ You have read and understood the user manual for the electronics used.
 ✓ You have installed the electronics properly.
 ✓ The electronics are switched off.

**NOTICE**

**Damage due to incorrect connection of the L-505.02A212F!**

Connecting unsuitable electronics or a wrong cable can damage the L-505.02A212F or the electronics.

 ► Connect the L-505.02A212F to suitable electronics (p. 11) from PI miCos only.
 ► Use cables from PI miCos only to connect the L-505.02A212F to the electronics.
Connecting the L-505.02A212F

1. If necessary: Remove the ESD protective caps from the connections of the L-505.02A212F.
2. Connect the drive plug of the L-505.02A212F to the drive socket on the electronics.
3. Secure the connector against unintentional removal.
7 Startup / Operation

7.1 Starting and operating the L-505.02A212F

Tools and Accessories

- Electronics from PI (p. 11)

Requirements

✓ You have read and understood the general safety instructions (p. 8).
✓ For startup with a load or in a multi-axis system: You have installed the L-505.02A212F properly (p. 13).
✓ You have read and understood the user manual for the electronics used.
✓ If a digital controller is used: You have read and understood the manual for the PC software used.
✓ The electronics and if required, the PC software, have been installed (see the user manual for the electronics).

**CAUTION**

Risk of crushing by moving parts!
Risk of minor injuries from crushing between the moving parts of the L-505.02A212F or the load and a fixed part or obstacle.

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

**NOTICE**

Operating voltage excessively high or incorrectly connected!
Operating voltages that are too high or incorrectly connected can cause damage to the L-505.02A212F.

► Pay attention to the operating voltage range (p. 33), which is specified for the L-505.02A212F.
► Pay attention to correct pin assignment (p. 38).

**NOTICE**

Damage due to the high acceleration!
High acceleration can cause considerable wear and damage the L-505.02A212F.

► Stop motion immediately if a malfunction occurs.
► Avoid collisions with objects in the workspace or the end of the travel range.
► Approach the end of the travel range always at a low velocity.

**NOTICE**

Uncontrolled oscillation!
Oscillation can cause irreparable damage to the L-505.02A212F. Oscillation is indicated by a humming noise and can result from the following causes:

- The load and/or dynamics during operation differ considerably to the calibration settings.
- The L-505.02A212F is operated near to its resonant frequency.
► If you notice oscillation, stop the L-505.02A212F immediately.
Starting and operating the L-505.02A212F

1. Start up the electronics (see the user manual for the electronics).

2. Configure the electronics for the L-505.02A212F during startup:
   - If you are using a digital controller from PI: In the PC software, select the entry in the positioner database that matches the L-505.02A212F exactly.
   - If you are using electronics from another manufacturer: Configure the electronics according to the parameter of the L-505.02A212F (p. 39).

3. Start a few motion cycles for testing purposes (see the user manual for the electronics).
8  Maintenance

NOTICE

Damage due to improper maintenance!
Improper maintenance can lead to misalignment and failure of the L-505.02A212F.
► Loosen screws only according to the instructions in this manual or the instructions of our customer service department (p. 30).

8.1  Maintenance Run

The maintenance run serves to distribute the existing lubricant.
The following intervals for the maintenance run depend on the operating conditions and the period of use:
■ After 500 operating hours or at least after one 1 year
■ If the L-505.02A212F is moved over a small travel range (<20 % of the entire travel range) during industrial operation: After every 2000 motion cycles

Performing a Maintenance Run

1. Make sure that collisions between the L-505.02A212F, the load to be moved, and the surroundings are not possible over the entire travel range of the L-505.02A212F. If necessary, remove the load from the motion platform of the L-505.02A212F for the maintenance run.
2. Perform a maintenance run over the entire travel range:
   a) Command the L-505.02A212F to the end of a travel range and from there to the opposite end of the travel range (see manual for the electronics).
   b) If necessary: Command the L-505.02A212F to a position, where the load can be mounted onto the motion platform again and mount the load back onto the L-505.02A212F (p. 20).

8.2  Relubricating

Overview

1. Guides
2. Drive screw

**Auxiliary Materials Required**
- Lubricant for the drive screw: Isoflex Topas 30
- Lubricant for the guides: Klüberquiet BQ 72-72

**Relubricating**
Under laboratory conditions, it is only necessary to relubricate the L-505.02A212F in exceptional cases. For continuous industrial use, the lubrication intervals must be defined individually.
If you have any questions on relubricating, contact our customer service department (p. 30).

### 8.3 Moving the Motion Platform by Hand

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

**Requirements**
- ✔ You have disconnected the L-505.02A212F from the electronics.

**Moving the Motion Platform by Hand**
1. Insert a TX 6 hex key into face of the drive screw.

2. Turn the hex key as far as necessary.
   a) Turn the screwdriver clockwise to move the motion platform in the direction of the screw hole.
   b) Turn the screwdriver counterclockwise to move the motion platform away from the screw hole.

> The rotary motion is transferred directly to the drive screw.

### 8.4 Cleaning

**Requirements**
- ✔ You have disconnected the L-505.02A212F from the electronics.

**Auxiliary Materials Required**
- Soft, lint-free cloth
- Mild cleaning agent or disinfectant
If you have any questions on the auxiliary materials recommended for the L-505.02A212F, contact our customer service department (p. 30).

**NOTICE**

Damage due to unsuitable cleaning agents!
Some cleaning agents can cause rusting on the L-505.02A212F or dissolve plastics, paints or adhesives.

► Do **not** clean with water or acetone.

Cleaning the L-505.02A212F

1. Dampen the cloth with the cleaning agent or disinfectant.
2. Carefully wipe the surfaces of the L-505.02A212F.
## Troubleshooting

<table>
<thead>
<tr>
<th>Issue</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>The positioner does not move, no operating noise can be heard</td>
<td>- Reset the motion error.</td>
</tr>
<tr>
<td>There is a motion error.</td>
<td></td>
</tr>
<tr>
<td>Defective electronics</td>
<td>- Check the electronics.</td>
</tr>
<tr>
<td>Electronics not connected correctly</td>
<td>- Check all connecting cables (p. 21).</td>
</tr>
<tr>
<td>Reduced positioning accuracy</td>
<td>- Make sure that the self-locking of the drive (p. 31) is not exceeded.</td>
</tr>
<tr>
<td>When the L-505.02A212F is mounted vertically: Load exceeds the self-locking of the drive</td>
<td></td>
</tr>
<tr>
<td>Warped base body</td>
<td>- Mount the L-505.02A212F onto an even surface (p. 13).</td>
</tr>
<tr>
<td>Increased wear due to small motion over a long period of time</td>
<td>- Perform a maintenance run (p. 25).</td>
</tr>
<tr>
<td>Actual position deviates from the displayed position</td>
<td>- Determine the maximum velocity and acceleration in the application that do not lead to step loss.</td>
</tr>
<tr>
<td>The drive is overloaded as a result of excessive mass on or excessive acceleration of the motion platform</td>
<td></td>
</tr>
<tr>
<td>Uncontrolled oscillation</td>
<td>- Switch off the servo control system or the controller immediately.</td>
</tr>
<tr>
<td>Large changes to the load or the alignment of the L-505.02A212F</td>
<td>- Check whether the servo control parameter settings correspond to the selected closed-loop control mode; see user manual for the controller.</td>
</tr>
<tr>
<td></td>
<td>- If necessary, correct the settings of the servo control parameters.</td>
</tr>
</tbody>
</table>
10 Transportation

Preparing the L-505.02A212F for Transportation

1. Pay attention to the ambient conditions and classifications (p. 33).
2. Pack the L-505.02A212F in the original packaging.
3. If the L-505.02A212F is to be sent, use a stable outer box.
11 Customer Service Department

For enquiries and orders, contact your PI miCos representative or send us an email.

If you have any 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)
- Operating system on the PC (if applicable)

If possible: Take photographs or make videos of your system that can be sent to our customer service department if requested.

Customer service address:
Physik Instrumente (PI) GmbH & Co. KG
Auf der Roemerstrasse 1
76228 Karlsruhe
Germany

service@pi.de
www.pi.de
## 12 Technical Data

### 12.1 Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Unit</th>
<th>Tolerance</th>
<th>L-505.02A212F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active axes</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel range</td>
<td>mm</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>Integrated sensor</td>
<td></td>
<td>Incremental linear encoder</td>
<td></td>
</tr>
<tr>
<td>Sensor signal</td>
<td></td>
<td>A/B quadrature, differential, TTL</td>
<td></td>
</tr>
<tr>
<td>Sensor resolution</td>
<td>nm</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>System resolution</td>
<td>nm</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Minimum incremental motion</td>
<td>µm</td>
<td>typ.</td>
<td>0.05</td>
</tr>
<tr>
<td>Unidirectional repeatability</td>
<td>µm</td>
<td>typ.</td>
<td>0.1</td>
</tr>
<tr>
<td>Bidirectional repeatability</td>
<td>µm</td>
<td>typ.</td>
<td>±0.15</td>
</tr>
<tr>
<td>Maximum velocity</td>
<td>mm/s</td>
<td>max.</td>
<td>0.75</td>
</tr>
<tr>
<td>Reference point switch</td>
<td></td>
<td>Hall effect</td>
<td></td>
</tr>
<tr>
<td>Reference point switch repeatability</td>
<td>µm</td>
<td>typ.</td>
<td>&lt;4</td>
</tr>
<tr>
<td>Limit switch</td>
<td></td>
<td>Hall effect</td>
<td></td>
</tr>
<tr>
<td>Linear crosstalk in Y with motion in X</td>
<td>µm</td>
<td>typ.</td>
<td>±1</td>
</tr>
<tr>
<td>Linear crosstalk in Z with motion in X</td>
<td>µm</td>
<td>typ.</td>
<td>±1</td>
</tr>
<tr>
<td>Rotational crosstalk in θY with motion in X</td>
<td>µrad</td>
<td>typ.</td>
<td>±75</td>
</tr>
<tr>
<td>Rotational crosstalk in θZ with motion in X</td>
<td>µrad</td>
<td>typ.</td>
<td>±75</td>
</tr>
<tr>
<td>Drive screw type</td>
<td></td>
<td>Leadscrew</td>
<td></td>
</tr>
<tr>
<td>Drive screw pitch</td>
<td>mm</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Gear ratio</td>
<td></td>
<td>256/9</td>
<td></td>
</tr>
<tr>
<td>Parameter</td>
<td>Unit</td>
<td>Tolerance</td>
<td>L-505.02A212F</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>----------</td>
<td>-----------</td>
<td>---------------</td>
</tr>
<tr>
<td>Guide type</td>
<td></td>
<td>Ball bearings</td>
<td></td>
</tr>
<tr>
<td>Drive force</td>
<td>N</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Holding force (passive)</td>
<td>N</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Permissible lateral force</td>
<td>N</td>
<td>max. 30</td>
<td></td>
</tr>
<tr>
<td>Load capacity</td>
<td>N</td>
<td>max. 30</td>
<td></td>
</tr>
<tr>
<td>Permissible torque in $\theta_x$</td>
<td>N·m</td>
<td>max. 9</td>
<td></td>
</tr>
<tr>
<td>Permissible torque in $\theta_Y$</td>
<td>N·m</td>
<td>max. 8</td>
<td></td>
</tr>
<tr>
<td>Permissible torque in $\theta_Z$</td>
<td>N·m</td>
<td>max. 8</td>
<td></td>
</tr>
<tr>
<td>Overall mass</td>
<td>kg</td>
<td>±5 % 0.4</td>
<td></td>
</tr>
<tr>
<td>Moved mass, unloaded</td>
<td>g</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>Motor type</td>
<td></td>
<td>Stepper motor with gearhead</td>
<td></td>
</tr>
<tr>
<td>Nominal voltage</td>
<td>V</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Nominal current, RMS</td>
<td>A</td>
<td>max. 0.25</td>
<td></td>
</tr>
<tr>
<td>Resistance</td>
<td>$\Omega$</td>
<td>12.5</td>
<td></td>
</tr>
<tr>
<td>Inductance</td>
<td>mH</td>
<td>6.3</td>
<td></td>
</tr>
<tr>
<td>Motor resolution</td>
<td></td>
<td>Full steps/rev. 24</td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td></td>
<td>anodized aluminum, stainless steel</td>
<td></td>
</tr>
<tr>
<td>Cable length</td>
<td>m</td>
<td>±10 mm</td>
<td>0.5</td>
</tr>
<tr>
<td>Connector</td>
<td></td>
<td>HD Sub-D 26 (m)</td>
<td></td>
</tr>
</tbody>
</table>
### Unit Tolerance L-505.02A212F

**Recommended controllers/drivers**
- C-663.12 (single axis)
- SMC Hydra (double axis)
- C-885 with C-663.12C885 (up to 20 axes)
- ACS modular controller

**Operating temperature range**
- °C 5 to 40

### 12.2 Maximum Ratings

The L-505.02A212F is designed for the following operating data:

<table>
<thead>
<tr>
<th>Maximum operating voltage</th>
<th>Maximum Operating Frequency</th>
<th>Maximum power consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>48 V</td>
<td>-</td>
<td>2 W</td>
</tr>
</tbody>
</table>

### 12.3 Ambient Conditions and Classifications

The following ambient conditions and classifications for the L-505.02A212F must be observed:

<table>
<thead>
<tr>
<th>Area of application</th>
<th>Maximum altitude</th>
<th>Relative humidity</th>
<th>Storage temperature</th>
<th>Transport temperature</th>
<th>Supply voltage fluctuations</th>
<th>Degree of pollution</th>
<th>Degree of protection according to IEC 60529</th>
</tr>
</thead>
<tbody>
<tr>
<td>For indoor use only</td>
<td>2000 m above msl</td>
<td>20 to 80%, not condensing</td>
<td>-20 °C to +70 °C</td>
<td>-20 °C to +70 °C</td>
<td>Max. ±10 % of the nominal voltage</td>
<td>2</td>
<td>IP00</td>
</tr>
</tbody>
</table>

12.4 Dimensions

Figure 4: Dimensions of the L505.02A212F

Dimensions in mm. Note that the decimal places are separated by a comma in the drawings.
Figure 5: Mounting holes in the L-505.02A212F’s motion platform
Dimensions in mm. Note that the decimal places are separated by a comma in the drawings.
13 Old Equipment Disposal

In accordance with EU law, electrical and electronic equipment may not be disposed of in EU member states via the municipal residual waste.

Dispose of your old equipment according to international, national, and local rules and regulations.

In order to fulfill the responsibility as the product manufacturer, PI miCos undertakes environmentally correct disposal of all PI miCos equipment free of charge, if it was made available to the market after August 13, 2005.

Any old PI miCos equipment can be sent free of charge to the following address:
PI miCos GmbH
Freiburger Strasse 30
79427 Eschbach
Germany
info@pimicos.de
www.pi.de
Glossar

Druck-/Zugkraft max.
Maximale Kraft in Bewegungsrichtung. Der L-505.02A212F kann eventuell höhere Kräfte aufbringen, jedoch mit beeinträchtigter Lebensdauer.

Linear Encoder
The linear encoder is an incremental sensor for capturing changes in position. Signals from the sensor are used for axis position feedback. After the controller is switched on, a reference point definition must be performed before absolute target positions can be commanded and reached.

Load Capacity
Maximum load in the vertical direction when the L-505.02A212F is mounted horizontally. The contact point of the load is at the center of the motion platform.
14 Appendix

14.1 Pin Assignment

14.1.1 Motor and position sensor connector

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Input: Motor voltage, phase A, +</td>
</tr>
<tr>
<td>2</td>
<td>Not connected</td>
</tr>
<tr>
<td>3</td>
<td>Input: Motor voltage, phase A, -</td>
</tr>
<tr>
<td>4</td>
<td>Not connected</td>
</tr>
<tr>
<td>5</td>
<td>Input: Motor voltage, phase B, +</td>
</tr>
<tr>
<td>6</td>
<td>Not connected</td>
</tr>
<tr>
<td>7</td>
<td>Input: Motor voltage, phase B, -</td>
</tr>
<tr>
<td>8</td>
<td>Not connected</td>
</tr>
<tr>
<td>9</td>
<td>Not connected</td>
</tr>
<tr>
<td>10</td>
<td>Output: Reference point switch</td>
</tr>
<tr>
<td>11</td>
<td>Output: Limit switch negative</td>
</tr>
<tr>
<td>12</td>
<td>Output: Limit switch positive</td>
</tr>
<tr>
<td>13</td>
<td>Not connected</td>
</tr>
<tr>
<td>14</td>
<td>Not connected</td>
</tr>
<tr>
<td>15</td>
<td>Not connected</td>
</tr>
<tr>
<td>16</td>
<td>Not connected</td>
</tr>
<tr>
<td>17</td>
<td>Bidirectional: Data line for ID chip</td>
</tr>
<tr>
<td>18</td>
<td>Input: Limit switch power supply</td>
</tr>
<tr>
<td>19</td>
<td>Output: Encoder channel A</td>
</tr>
<tr>
<td>20</td>
<td>Output: Encoder channel A (inverted)</td>
</tr>
<tr>
<td>21</td>
<td>Output: Encoder channel B</td>
</tr>
<tr>
<td>22</td>
<td>Output: Encoder channel B (inverted)</td>
</tr>
</tbody>
</table>

Figure 6: HD Sub-D 26 (m)
<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>Not connected</td>
</tr>
<tr>
<td>24</td>
<td>Not connected</td>
</tr>
<tr>
<td>25</td>
<td>Ground</td>
</tr>
<tr>
<td>26</td>
<td>Input: Encoder power supply</td>
</tr>
</tbody>
</table>

14.2 Drive properties

If you use third-party control electronics, it may be necessary to adapt the following operating parameters in the L-505.02A212F.

14.3 Reference point switch specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>Hall sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>+5 V</td>
</tr>
<tr>
<td>Signal output</td>
<td>Open collector</td>
</tr>
<tr>
<td>Signal logic</td>
<td>Direction sensing via different signal levels on the left and right of the reference point switch.</td>
</tr>
</tbody>
</table>

14.4 Limit switch specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>Hall sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>+5 V</td>
</tr>
<tr>
<td>Signal output</td>
<td>Open collector</td>
</tr>
<tr>
<td>Signal logic</td>
<td>N/C contact:</td>
</tr>
<tr>
<td></td>
<td>Limit switch inactive: Low resistance (0 V)</td>
</tr>
<tr>
<td></td>
<td>Limit switch active: High resistance (+5 V)</td>
</tr>
</tbody>
</table>
Figure 7: L-505 at the negative limit switch.

Figure 8: L-505 at the positive limit switch.
EU Declaration of Conformity

An EU Declaration of Conformity was issued for the L-505.02A212F in accordance with the following European directives:

- EMC Directive
- RoHS Directive

The applied standards certifying the conformity are listed below.

- EMC: EN 61326-1
- Safety: EN 61010-1
- RoHS: EN 50581