This document describes the following products:

- **H-811.I2**
  Miniature Hexapod microrobot, brushless DC motor, 5 kg load capacity, 20 mm/s velocity, 0.5 m cable length, including 3 m cable set

- **H-811.I2V**
  Miniature Hexapod microrobot, brushless DC motor, vacuum compatible to $10^{-6}$ hPa, 5 kg load capacity, 10 mm/s velocity, 2 m cable length, including 3 m cable set and feedthrough

- **H-811.F2**
  Miniature Hexapod microrobot for optical alignment, removable magnetic plate, brushless DC motor, 5 kg load capacity, 20 mm/s velocity, 2 m cable length

- **H-811.S2**
  Miniature hexapod microrobot for high dynamics applications, direct drive, 25 mm/s, 1.5 kg load, 2 m cable
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PI®, NanoCube®, PICMA®, PILine®, NEXLINE®, PiezoWalk®, NEXACT®, Picoactuator®, PInano®, PI Mag®, Q-Motion®

The patents held by PI are found in our patent list: http://www.physikinstrumente.com/en/about-pi/patents

Notes on brand names and third-party trademarks:

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Original instructions
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Subject to change. This manual is superseded by any new release. The latest respective release is available for download (p. 3) on our website.
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1 About this Document

In this Chapter

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1.1 Objective and Target Audience of this User Manual

This manual contains information on the intended use of the H-811.
It assumes that the reader has a fundamental understanding of basic servo systems as well as
motion control concepts and applicable safety procedures.
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
Failure to comply could lead to minor injury.
➢ Precautionary measures for avoiding.

NOTICE

Dangerous situation
Failure to comply could cause damage to equipment.
➢ Precautionary measures for avoiding.

INFORMATION

Information for easier handling, tricks, tips, etc.
1 About this Document

1.3 Figures

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

1.4 Other Applicable Documents

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

<table>
<thead>
<tr>
<th>Device/program</th>
<th>Document no.</th>
<th>Document content</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-887.5xx controller</td>
<td>MS247EK</td>
<td>Short instructions for hexapod systems</td>
</tr>
<tr>
<td></td>
<td>MS244E</td>
<td>User manual</td>
</tr>
<tr>
<td></td>
<td>C887T0011</td>
<td>EtherCAT interface of the C-887.53 controller series</td>
</tr>
<tr>
<td></td>
<td>C887T0007</td>
<td>Coordinate Systems for Hexapod Microrobots</td>
</tr>
<tr>
<td></td>
<td>C887T0021</td>
<td>Motion of the Hexapod. Position and Orientation in Space, Center of Rotation</td>
</tr>
<tr>
<td>PI Hexapod Simulation Tool</td>
<td>A000T0068</td>
<td>Determining the workspace and the permissible load of the hexapod</td>
</tr>
<tr>
<td>PC software included in the controller's scope of delivery</td>
<td>Various</td>
<td>For details, see the user manual for the C-887.5xx controller.</td>
</tr>
</tbody>
</table>
1.5 Downloading Manuals

INFO
If a manual is missing or problems occur with downloading:
➢ Contact our customer service department (p. 51).

INFO
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 access data.
You need the product CD to get the access data.

For products with CD: Get access data
1. Insert the product CD into the PC drive.
2. Switch to the Manuals directory on the CD.
3. In the Manuals directory, open the Release News (file including releasenews in the file name).
4. Get the access data for downloading protected content in the "User login for software download" section of the Release News. Possible methods for getting the access data:
   - Link to a page for registering and requesting the access data
   - User name and password is specified
5. If the access data needs to be requested via a registration page:
   a) Follow the link in the Release News.
   b) Enter the required information in the browser window.
   c) Click Show login data in the browser window.
   d) Note the user name and password shown in the browser window.

Downloading manuals
If you have requested access data for protected contents via a registration page (see above):
➢ Click the links in the browser window to change to the content for your product and log in using the access data that you received.

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

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Measures for Handling Vacuum-Compatible Products ................................................................. 6

2.1 Intended Use

The hexapod microrobot (short "hexapod") is a laboratory device as defined by DIN EN 61010-1. It is built for indoor use and use in an environment which is free of dirt, oil, and lubricants. In accordance with its design, the hexapod is intended for positioning, adjusting, and shifting of loads on six axes at various velocities.

The intended use of the hexapod is only possible in conjunction with a suitable controller available from PI (p. 8), which coordinates all motion of the hexapod.

2.2 General Safety Instructions

The H-811 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 H-811.

- Use the H-811 for its intended purpose only, and only when it is in perfect technical condition.
- Read the user manual.
- Eliminate any faults and malfunctions likely to affect safety immediately.

The operator is responsible for the correct installation and operation of the H-811.

2.3 Organizational Measures

User manual

- Always keep this user manual available with the H-811. The latest versions of the user manuals are available for download (p. 3) on our website.
2 Safety

➢ Add all information from the manufacturer to the user manual, for example supplements or technical notes.
➢ If you give the H-811 to other users, also include this user manual as well as other relevant information provided by the manufacturer.
➢ Use the device only if the user manual is complete. Missing information due to an incomplete user manual can result in minor injury and damage to equipment.
➢ Install and operate the H-811 only after you have read and understood this user manual.

Personnel qualification

The H-811 may only be installed, started, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

2.4 Measures for Handling Vacuum-Compatible Products

When handling the vacuum version of the hexapod, 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 hexapod is cleaned once again by wiping and shrink-wrapped twice in vacuum-compatible film.

➢ Touch the hexapod only with powder-free gloves.
➢ If necessary, wipe the hexapod clean after unpacking.
3 Product Description

In this Chapter

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Model Overview ............................................................................................................................. 7
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Product View .................................................................................................................................. 9
Scope of Delivery ........................................................................................................................... 9
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3.1 Features and Applications

The various models (p. 7) of H-811 hexapod that are offered differ with respect to the maximum velocity, and load capacity as well as suitability for use in a vacuum.

The parallel-kinematic design offers the following advantages:

- Positioning operations in six independent axes (three translational axes, three rotational axes) with short settling times
- The center of rotation moves together with the motion platform
- High accuracy and step resolution in all axes
- No accumulation of errors of individual axes
- No friction and torques from moving cables

The hexapod is controlled with a controller that can be ordered separately from PI (p. 8). The position commands to the controller are entered as Cartesian coordinates.

3.2 Model Overview

<table>
<thead>
<tr>
<th>Model</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-811.I2</td>
<td>Miniature Hexapod microrobot, brushless DC motor, 5 kg load capacity, 20 mm/s velocity, 0.5 m cable length, including 3 m cable set</td>
</tr>
<tr>
<td>H-811.I2V</td>
<td>Miniature Hexapod microrobot, brushless DC motor, vacuum compatible to 10^{-6} hPa, 5 kg load capacity, 10 mm/s velocity, 2 m cable length, including 3 m cable set and feedthrough</td>
</tr>
</tbody>
</table>
3 Product Description

<table>
<thead>
<tr>
<th>Model</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-811.F2</td>
<td>Miniature Hexapod microrobot for optical alignment, removable magnetic plate, brushless DC motor, 5 kg load capacity, 20 mm/s velocity, 2 m cable length</td>
</tr>
<tr>
<td>H-811.S2</td>
<td>Miniature hexapod microrobot for high dynamics applications, direct drive, 25 mm/s, 1.5 kg load, 2 m cable</td>
</tr>
</tbody>
</table>

3.3 Suitable Controllers

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-887.52</td>
<td>6-axis controller for hexapods, TCP/IP, RS-232, benchtop device, incl. control of two additional axes</td>
</tr>
<tr>
<td>C-887.521</td>
<td>6-axis controller for hexapods, TCP/IP, RS-232, benchtop device, incl. control of two additional axes, analog inputs</td>
</tr>
<tr>
<td>C-887.522</td>
<td>6-axis controller for hexapods, TCP/IP, RS-232, benchtop device, incl. control of two additional axes, motion stop</td>
</tr>
<tr>
<td>C-887.523</td>
<td>6-axis controller for hexapods, TCP/IP, RS-232, benchtop device, incl. control of two additional axes, analog inputs</td>
</tr>
<tr>
<td>C-887.53</td>
<td>6-axis controller for hexapods, TCP/IP, RS-232, benchtop device, incl. control of two additional axes, EtherCAT interface</td>
</tr>
<tr>
<td>C-887.531</td>
<td>6-axis controller for hexapods, TCP/IP, RS-232, benchtop device, incl. control of two additional axes, EtherCAT interface, analog inputs</td>
</tr>
<tr>
<td>C-887.532</td>
<td>6-axis controller for hexapods, TCP/IP, RS-232, benchtop device, incl. control of two additional axes, EtherCAT interface, motion stop</td>
</tr>
<tr>
<td>C-887.533</td>
<td>6-axis controller for hexapods, TCP/IP, RS-232, benchtop device, incl. control of two additional axes, EtherCAT interface, motion stop, analog inputs</td>
</tr>
</tbody>
</table>

➢ To order, contact our customer service department (p. 51).
3.4 Product View

Figure 1: Product view, H-811.F2 left, H-811.I2 right (applies to H-811.I2V and H-811.S2 also)

1. Motion platform
2. Strut
3. Data transmission cable
4. Power supply cable
5. Base plate
6. Mounting plate, held by magnets

3.5 Scope of Delivery

<table>
<thead>
<tr>
<th>Order number</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-811</td>
<td>Hexapod according to your order (p. 7). H-811.I2: Cables with a length of 0.5 m are installed permanently. H-811.I2V, .F2, .S2: Cables with a length of 2 m are installed permanently.</td>
</tr>
<tr>
<td>000015165</td>
<td>Steward snap-on ferrite</td>
</tr>
</tbody>
</table>
### Order number | Components
--- | ---
H-811.I2 / H-811.I2V models only:  
Cable set 3 m, drag chain compatible |  
- Data transmission cable, HD D-sub 78 f/m, 1:1, item number K040B0316 / K040B0328  
- Power supply cable, M12 m/f, 1:1, item number 000065069
H-811.I2V vacuum-compatible model only:  
4668 | Vacuum feedthrough for data transmission, HD D-sub 78 m/f
C887B0002 | Vacuum feedthrough for power supply, LEMO 2-pin (f) to M12 (m)
H-811.I2 model only:  
000067899 | Connector holder for fixing the data transmission cable
Packaging, consisting of:  
- Outer box  
- Inner box  
- Eight cushioned corners for inner box  
- Foam insert for inner box, with separate clamp  
- Pallet
Documentation, consisting of:  
H811T0001 | Technical note on unpacking the hexapod  
MS247EK | Short instructions for hexapod systems  
F712T0016 | H-811.F2 model only: Fast, multi-channel alignment in the Photonics
Screw sets:  
000020110 | Mounting kit:  
- 6 socket head screws, M4x25 ISO 4762  
- 1 hex key 3.0 DIN 911
000036450 | Accessories for connecting to the grounding system:  
- 1 flat-head screw with cross recess, M4x8 ISO 7045  
- 2 flat washers, form A-4.3 DIN 7090  
- 2 safety washers, Schnorr Ø 4 mm N0110
000070600 | H-811.I2 model only: Accessory for affixing the connector holder to the data transmission cable:  
- 2 M6×30 socket head screws ISO 4762  
- 1 hex key 5.0 DIN 911


### 3.6 Accessories

<table>
<thead>
<tr>
<th>Order number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-811.12PS</td>
<td>Separate 12 V wide input range power supply (60 W/5 A) for use with line voltages from 100 to 240 V AC and voltage frequencies of 50 or 60 Hz, with 4-pin M12 connector (f) Optional power supply for the hexapod. Replaces the power supply from the controller. Ideal for static applications that require increased position stability. For further information, see &quot;Optional: Operating the Hexapod with a Separate 12 V Power Adapter&quot; (p. 39).</td>
</tr>
<tr>
<td>F-206.TMU</td>
<td>H-811.F2 model only: Mounting plate for fast replacement of different assemblies</td>
</tr>
<tr>
<td>C-887.5B03</td>
<td>Hexapod cable set 3 m, drag chain compatible*, consisting of:</td>
</tr>
<tr>
<td></td>
<td>Description</td>
</tr>
<tr>
<td></td>
<td>Data transmission cable, HD D-sub 78 f/m, 1:1</td>
</tr>
<tr>
<td></td>
<td>Power supply cable, M12 m/f, 1:1</td>
</tr>
<tr>
<td>C-887.5B05</td>
<td>Hexapod cable set 5 m, drag chain compatible*, consisting of:</td>
</tr>
<tr>
<td></td>
<td>Description</td>
</tr>
<tr>
<td></td>
<td>Data transmission cable, HD D-sub 78 f/m, 1:1</td>
</tr>
<tr>
<td></td>
<td>Power supply cable, M12 m/f, 1:1</td>
</tr>
<tr>
<td>C-887.5B07</td>
<td>Hexapod cable set 7.5 m, drag chain compatible*, consisting of:</td>
</tr>
<tr>
<td></td>
<td>Description</td>
</tr>
<tr>
<td></td>
<td>Data transmission cable, HD D-sub 78 f/m, 1:1</td>
</tr>
<tr>
<td></td>
<td>Power supply cable, M12 m/f, 1:1</td>
</tr>
</tbody>
</table>

*Suitable for H-811.F2 and .S2 models. For specifications, see "Drag Chain Compatible Cables" (p. 59).

If you want to order or have any questions on further cable sets, contact the customer service department (p. 51).

### 3.7 Technical Features

#### 3.7.1 Struts

The hexapod has six adjustable-length struts. Each strut carries out linear motion. Each set of settings of the six struts defines a position of the motion platform in six degrees of freedom (three translational axes and three rotational axes).
Each strut is equipped with the following components:

- One actuator
- Reference and limit switches
- Joints for connecting to the base plate and motion platform

The actuator contains a brushless DC motor with an incremental rotary encoder and a drive screw.

### 3.7.2 Reference Point Switch and Limit Switches

The reference point switch of a strut functions independently of the angular positions of the strut ends and the lengths of the other struts.

When a limit switch is activated, the power source of the motor is switched off to protect the hexapod against damage from malfunctions.

### 3.7.3 Control

Der hexapod is intended for operation with a suitable controller from PI (p. 8). The controller makes it possible to command motion of individual axes, combinations of axes or all six axes at the same time in a single motion command.

The controller calculates the settings for the individual struts from the target positions given for the translational and rotational axes. The velocities and accelerations of the struts are calculated so that all struts start and stop at the same time.

Every time the controller of a hexapod equipped with incremental encoders is switched on or rebooted, the hexapod must complete a reference move, in which each strut moves to its reference point switch. After the reference move, the motion platform is in the reference position and can be commanded to move to absolute target positions.

For further information, see the user manual for the controller.

### 3.7.4 Motion

The platform moves along the translational axes X, Y, and Z and around the rotational axes U, V, and W.

Using the controller, custom coordinate systems can be defined and used instead of the default coordinate system.

Default and user-defined coordinate systems are always right-handed systems. It is not possible to convert a right-handed system to a left-handed system.
The following is a description of how the hexapod behaves with the default coordinate system. Work with user-defined coordinate systems is described in the C887T0007 technical note.

Figure 2: Coordinate system and rotations to the rotational coordinates U, V, and W. The coordinate system is depicted above the platform for better clarity.

Translation
Translations are described in the spatially-fixed coordinate system. The translational axes X, Y, and Z meet at the origin of the coordinate system (0,0,0). For further information, see the glossary (p. 69).

Rotation
Rotations take place around the rotational axes U, V, and W. The rotational axes meet at the center of rotation (also referred to as "pivot point"). The rotational axes and therefore also the center of rotation always move together with the platform of the hexapod (see also the example below for consecutive rotations).

A given rotation in space is calculated from the individual rotations in the order U -> V -> W. For further information on the center of rotation, see the glossary (p. 69).

INFORMATION
The dimensional drawing (p. 61) contains the following:
- Orientation of the default coordinate system
- Position of the default center of rotation
Example: Consecutive rotations

**INFORMATION**

For a clearer view, the figures have been adapted as follows:
- Round platform replaced by T-shaped platform
- Coordinate system shown shifted
- Center of rotation in the top left corner of the platform

1. The U axis is commanded to move to position 10.
   
The rotation around the U axis tilts the rotational axes V and W.

![Figure 3: Rotation around the U axis](image)

- Platform in reference position
- Platform position: \( U = 10 \) (U parallel to spatially-fixed X axis)
2. The V axis is commanded to move to position –10.
   The rotation takes place around rotational axis V, which was tilted during the previous rotation.
   The rotation around the V axis tilts the rotational axes U and W.

![Figure 4: Rotation around the V axis](image)

- Platform in reference position
- Platform position: U = 10, V = –10 (U and V parallel to the platform level)
3. The W axis is commanded to move to position 10.

The rotation takes place around the rotational axis W, which was tilted during the previous rotations. The W axis is always vertical to the platform level.

The rotation around the W axis tilts the rotational axes U and V.

For further data on the travel ranges, see the "Specifications" section (p. 53).

3.7.5 ID Chip

The hexapod has an ID chip that contains data on the type of hexapod, its serial number, and the date of manufacture. The data is loaded from the ID chip when the controller is switched on or rebooted. Depending on the data loaded, the controller keeps the current configuration or installs a new configuration.

For simple replacement, the configuration data for all standard hexapods is stored at the factory in every standard controller (e.g., geometry data and control parameters). The configuration data for customized hexapods is only stored on the controller if the hexapod and controller are delivered together, or if PI was correspondingly informed before delivery of the controller.

For further information and application notes, see the documentation of the controller used.
4 Unpacking

The Hexapod is delivered in a special packaging with adapted foam inserts.

**NOTICE**

Impermissible mechanical load!
Impermissible mechanical load can damage the hexapod.
- Only ship the hexapod in the original packaging.
- Only hold the hexapod by the base plate.

**INFORMATION**

When handling the vacuum version of the hexapod, attention must be paid to appropriate cleanliness. At PI, all parts are cleaned before assembly. Powder-free gloves are worn during assembly and measuring. In addition, the hexapod is wipe cleaned afterwards and then shrink-wrapped twice in vacuum-compatible film.
- Touch the hexapod only with powder-free gloves.
- If necessary, wipe the hexapod clean after unpacking.

**Keeping the packaging**
- Keep all packaging material in case the product needs to be transported later.

**Unpacking the hexapod**
1. Open the outer box.
2. Remove the four cushioned corners.
3. Open the inner box.
4. Take the foam insert together with the hexapod out of the inner box carefully.

5. Tip the foam insert with the hexapod 90° onto its longitudinal side and put it onto an underlying surface.
6. Remove the clamp from the underneath of the foam insert.

7. Remove the top half of the foam insert.
8. Grip the base plate of the hexapod and take it out of the lower half of the foam insert.

9. Remove the foil from the hexapod.

10. Compare the contents with the items listed in the contract and the packing list. If any of the parts are wrong or are missing, contact PI immediately.

11. Inspect the hexapod for signs of damage. If there is any sign of damage, contact PI immediately.
5 Installation

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5.1 General Notes on Installation

The hexapod can be mounted in any orientation.

NOTICE

Impermissible mechanical load and collisions!
Impermissible mechanical load and collisions between the hexapod, the load to be moved, and the surroundings can damage the hexapod.

➢ Only hold the hexapod by the base plate.
➢ Before installing the load, determine the limit value for the load of the hexapod with a simulation program (p. 22).
  The limit values determined with the simulation program are only valid when the controller has the servo mode switched on for the axes of the motion platform of the connected hexapod.
➢ Before installing the load, determine the workspace of the hexapod with a simulation program (p. 22).
  The limits of the workspace vary according to the current position of the hexapod (translational and rotational coordinates) as well as the active coordinate system and the current coordinates of the center of rotation.
➢ Avoid high forces and torques on the motion platform during installation.
➢ To avoid unintentional deactivation of the hexapod system and resulting position changes of the hexapod system, make sure that the power supply is not interrupted.
➢ Make sure that no collisions between the hexapod, the load to be moved, and the surroundings are possible in the workspace of the hexapod.
NOTICE

Cable break due to excessively bent or crushed cable!
A cable break leads to failure of the hexapod.

- Ensure that your application fulfills the following requirements for the cables permanently installed at your hexapod:
  - The cables are not subject to tensile stress.
  - The cables are not being moved.
- Secure the cables in a suitable manner.
- H-811.I2: Affix the permanently installed data transmission cable with the supplied connector holder (p. 9) to the surface.

INFORMATION

The optionally available PIVeriMove hexapod software for collision checking makes it possible to check mathematically for possible collisions between the hexapod, load, and surroundings. The use of the software is recommended when the hexapod is located in a limited installation space and/or operated with a spatially limiting load. For details on activation and configuration of PIVeriMove, see the C887T0002 technical note (in the scope of delivery of the software).

5.2 Determining the Permissible Load and Workspace

Tools and Accessories

- PC with Windows operating system with the PI Hexapod Simulation Tool installed. For further information, see the A000T0068 technical note.

Determining the workspace and the permissible load of the hexapod

- Follow the instructions in the A000T0068 technical note to determine the workspace and the limit value for the load of the hexapod with the simulation program.

The limit values in the following table serve as a guide. They only apply when the center of mass is at the origin of the default coordinate system (0,0,0).
5 Installation

<table>
<thead>
<tr>
<th>Mounting position of the base plate</th>
<th>Servo mode switched on for hexapod – max. load capacity</th>
<th>Servo mode switched off for hexapod – max. holding force</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-811.I2, .I2V</td>
<td>5 kg 2.5 kg</td>
<td>15 N 2.5 N</td>
</tr>
<tr>
<td>H-811.F2</td>
<td>5 kg 2.5 kg</td>
<td>12 N 2 N</td>
</tr>
<tr>
<td>H-811.S2</td>
<td>1.5 kg 0.3 kg</td>
<td>15 N 2.5 N</td>
</tr>
</tbody>
</table>

If you need help on determining the limit value for the load or determining the workspace:

➢ Contact our customer service department (p. 51).

5.3 Attaching the Snap-on Ferrite

![Figure 6: Power supply cable of the hexapod with snap-on ferrite](image)

1  Power supply cable of the hexapod
2  000015165 snap-on ferrite
3  M12 connector (m) (for connection to the controller)

INFORMATION

The snap-on ferrite ensures the electromagnetic compatibility of the hexapod system.

000015165 snap-on ferrite: The 000015165 snap-on ferrite is included in the scope of delivery of the hexapod. The snap-on ferrite is intended for permanent attachment to the power supply cable of the hexapod.

000012097 snap-on ferrite: When a cable set with line driver boxes is used, the 000012097 snap-on ferrite is included in the scope of delivery of the cable set. The snap-on ferrite is intended for permanent attachment to the hexapod-side cable of the power supply.

➢ When attaching the snap-on ferrite, make sure that it is correctly positioned on the cable. The snap-on ferrite can only be removed with special tools (not included in the scope of delivery).

➢ 000015165 snap-on ferrite: Attach the snap-on ferrite to the power supply cable of the hexapod before you connect the hexapod to the controller for the first time.

➢ 000012097 snap-on ferrite: Attach the snap-on ferrite to the hexapod-side cable of the power supply before connecting the hexapod to the power supply for the first time.
Tools and accessories

- 000015165 snap-on ferrite, included in the scope of delivery of the hexapod (p. 9)
- 000012097 snap-on ferrite, included in the scope of delivery of a cable set with the line driver boxes (p. 11)

Permanently attaching the snap-on ferrite

1. 000015165 snap-on ferrite:
   Put the power supply cable of the hexapod into the open snap-on ferrite close to and behind the M12 connector (m) that is intended for connection to the controller (see figure).

2. 000012097 snap-on ferrite:
   Put the hexapod-side cable of the power supply into the open snap-on ferrite approx. 10 to 15 cm behind the power supply (without figure).

2. Close the snap-on ferrite:
   a) Align the cable so that it is not squeezed when the snap-on ferrite is closed.
   b) Carefully press the two halves of the snap-on ferrite around the cable until the lock engages.

5.4 Grounding the Hexapod

The hexapod is not grounded via the power supply cable. If a functional grounding is required for potential equalization:

1. Connect the base plate to the grounding system:
   - For connection, use the supplied accessories (p. 9) and the M4 hole with an 8 mm depth marked with the ground connection symbol (p. 61).

2. Connect the motion platform to the grounding system:
   - Use one of the mounting holes in the motion platform (p. 61) for connection.
   - If the motion platform and the load are connected conductively to each other, connect the load to the grounding system.
5.5 H-811.I2: Affixing the Data Transmission Cable with the Connector Holder

**NOTICE**

Impermissible mechanical load!
The data transmission cable that is permanently installed on the H-811.I2 hexapod (length 0.5 m) is **not** drag chain compatible. Impermissible forces can damage the cable or the hexapod.

- Ensure the following in your application for the permanently installed data transmission cable:
  - The cable is **not** subject to tensile stress.
  - The cable is **not** moved.
- Affix the permanently installed data transmission cable with the supplied connector holder (p. 9) to the surface.

![Figure 7: H-811.I2: Affix the connector holder onto the surface](image)

**Requirements**

- You have read and understood the general notes on installation (p. 21).

**Tools and accessories**

- Connector holder supplied including mounting accessories:
  - Two M6x30 screws
  - Hex key 5.0
Affixing the data transmission cable with connector holder

1. Attach the connector holder to the HD Sub-D 78 connector (m) of the data transmission cable that is permanently installed on the H-811.i2 hexapod:
   a) Remove both hexagonal nuts from the screws of the connector.
   b) Affix the connector to the connector holder with the screws.

2. Drill two M6 threaded holes into the surface for mounting with M6x30 screws:
   − Pay attention to the arrangement of the two mounting holes in the connector holder, see dimensional drawing (p. 61).
   − Put the connector holder on the surface so that the data transmission cable that is permanently installed on the hexapod, is **not** moved in your application and is **not** subject to tensile stress.

3. Affix the connector holder on the surface with the screws supplied.
   The free side of the connector holder is intended to connect the drag chain-compatible data transmission cable (included in the cable set of the H-811.i2). For further information, see "Connecting the Hexapod to the Controller" (p. 29).

5.6 Mounting the Hexapod on a Surface

**NOTICE**

**Impermissible mechanical load!**
An impermissible mechanical load can damage the hexapod.

➢ Only hold the hexapod by the base plate.

**NOTICE**

**Warping of the base plate!**
Incorrect mounting can warp the base plate. Warping of the base plate reduces the accuracy.

➢ Mount the hexapod on an even surface. The recommended flatness of the surface is 200 µm.

Requirements

✓ You have read and understood the general notes on installation (p. 21).

Tools and accessories

- Hex key 3.0 and six of the supplied M4x25 screws (p. 9)
- Optional: two locating pins for easy alignment of the hexapod, suitable for holes with Ø 3 mm F7, not included in the scope of delivery
Mounting the hexapod

1. Make the necessary holes in the surface:
   - Six M4 threaded holes for mounting with M4x25 screws
   - Optional: two locating holes with Ø 3 mm F7 for accommodating locating pins

   The arrangement of the six mounting holes as well as the two locating holes in the base plate of the hexapod can be found in the dimensional drawing (p. 61). The locating holes are in the bottom side of the base plate.

2. If you use locating pins to align the hexapod:
   a) Insert the locating pins into the locating holes in the hexapod or the surface.
   b) Place the hexapod on the surface so that the locating pins are inserted into the corresponding locating holes on the other side.

3. Mount the hexapod on the six mounting holes in the base plate using the included screws.

5.7 Affixing the Load to the Hexapod

NOTICE

Impermissible mechanical load and collisions!
Impermissible mechanical load and collisions between the hexapod, the load to be moved, and the surroundings can damage the hexapod.

- Make sure that the installed load observes the limit value resulting from the load test (p. 22).
- Avoid high forces and torques on the motion platform during installation.
- Make sure that no collisions between the hexapod, the load to be moved, and the surroundings are possible in the workspace of the hexapod.

NOTICE

Excessively long screws!
The hexapod can be damaged by screws that are inserted too deeply.

- When selecting the screw length, observe the thickness of the motion platform or the depth of the mounting holes (p. 61) together with the load to be mounted.
- Only use screws that do not project under the motion platform after being screwed in.
- Only mount the hexapod and the load on the mounting fixtures (holes) intended for this purpose.
INFORMATION
H-811.F2 model only:
The load to be aligned can be fixed to the mounting plate or directly to the motion platform. Fixing to the mounting plate is recommended.
The mounting plate is held on to the motion platform by two magnets. The following adjusting elements guarantee accurate fitting of the mounting plate:
- Three guides on the top of the motion platform
- Three balls on the bottom of the mounting plate
Additional mounting plates are available as optional accessories (p. 11). Therefore, it is possible to replace the load to be aligned quickly.

Figure 8: H-811.F2 model only: Mounting plate

Bright arrow Lift the mounting plate to remove it
Dark arrow Put the mounting plate onto the motion platform carefully to attach it

Requirements
✓ You have read and understood the general notes on installation (p. 21).
✓ You have determined the permissible load and the workspace for the hexapod (p. 22).
✓ You have designed the load and the surroundings of the hexapod so that the permissible load of the hexapod is adhered to and no collisions can occur.
5 Installation

Tools and accessories

- 3 M4 screws of suitable length
- Suitable tool for tightening the screws
- Optional: Two locating pins for easy alignment of the load on the hexapod, suitable for holes with Ø 3 mm F7, not in the scope of delivery
- H-811.F2 model only: If want to fix several loads to be aligned in quick succession: One additional mounting plate each per assembly, available as optional accessory (p. 11).

Affixing the load

1. H-811.F2 model only: If necessary, remove the mounting plate from the motion platform (see figure).
2. Align the load so that the selected mounting holes can be used to fix it.
   If you use locating pins to align the load:
   a) Drill two locating holes with Ø 3 mm F7 into the load to accommodate the locating pins.
   b) Insert the locating pins into the locating holes in the motion platform or in the load.
   c) Place the load on the motion platform so that the locating pins are inserted into the corresponding locating holes on the other side.
   The layout for the holes in the motion platform of the hexapod and the mounting plate can be found in the dimensional drawing (p. 61).
3. To fix the load, tighten the screws in the selected mounting holes of the motion platform or the mounting plate.
4. H-811.F2 model only:
   - If necessary, put the mounting plate carefully onto the motion platform so that the three balls on the bottom of the mounting plate are in the guidings on the top of the motion platform (see figure).

5.8 Connecting the Hexapod to the Controller

Cables with a length of 0.5 m (H-811.I2) or 2 m (H-811.I2V, .F2, .S2) are installed on the hexapod permanently. In addition, a cable set with a length of 3 m is included in the scope of delivery of the H-811.I2 and H-811.I2V (p. 9) models.

Additional cable sets are available as optional accessory (p. 11).

Cable sets with a length >20 m include line driver boxes (e.g., C-887.5A50 cable set with a length of 50 m).

Vacuum feedthroughs are also included in the scope of delivery of a vacuum-compatible hexapod (p. 9).
**NOTICE**

Cable break due to excessively bent or crushed cable!
A cable break leads to failure of the hexapod.

- Ensure that your application fulfills the following requirements for the cables permanently installed at your hexapod:
  - The cables are **not** subject to tensile stress.
  - The cables are **not** being moved.
- Secure the cables in a suitable manner.
- H-811.I2: Affix the permanently installed data transmission cable with the supplied connector holder (p. 9) to the surface.

**NOTICE**

Incorrect wiring!
When a cable set with line driver boxes is used:
Interchanging the cables between the channels of the line drive boxes causes the hexapod not to move or move uncontrollably. Uncontrolled motion of the hexapod can cause collision that can damage the hexapod, the load to be moved or the surroundings.
- When connecting the line driver boxes, observe the channel assignment that is specified on the labeling of the sockets and connectors.

**INFORMATION**

When a cable set with line driver boxes is used:
The **24 V Out 7 A** connection on the controller is not available for the hexapod because this connection is required for the power supply of the hexapod-side line driver box. A C-887.5PS power supply for the hexapod and a snap-on ferrite (000012097) are therefore included in the scope of delivery of the cable set.
- Attach the snap-on ferrite to the hexapod-side cable of the power supply (p. 23) before connecting the hexapod to the power supply for the first time.

**Requirements**

- The controller is switched **off**, i.e., the on/off switch is in the position 📋.
- H-811.I2 hexapod: You have fixed the permanently installed data transmission cable to the underlying surface with the connector holder supplied (p. 25).

**Tools and accessories**

- Cable set from the scope of delivery of the hexapod (p. 9)
- Optional: Additional cable set, available as accessory (p. 11) on request (p. 51)
- If you want to operate a vacuum-compatible hexapod in a vacuum chamber: Suitable tools for installing the vacuum feedthrough
If necessary: Installing vacuum feedthroughs

Figure 9: Vacuum feedthrough for data transmission (4668), dimensions in mm

- B 4 holes, Ø6 x 45° for M3 countersunk screw

- Install the vacuum feedthrough for data transmission (4668) so that the HD Sub-D 78 socket (f) is in the vacuum chamber.
5 Installation

Figure 10: Vacuum feedthrough for the power supply of the hexapod (C887B0002), dimensions in mm

- Install the vacuum feedthrough for the power supply (C887B0002) so that the 2-pin LEMO connection is in the vacuum chamber.

Connecting the hexapod to the controller

- Connect the hexapod and the controller to each other:
  - Observe the connection diagram that matches your cable set (see below).
  - Observe the assignment that is given by the labeling on the sockets, connectors and cables.
  - Observe the mechanical coding of connectors and sockets.
  - Do not use force.
  - Use the integrated screws to secure the connections against accidental disconnection.
### Standard cabling (no vacuum, without line driver boxes)

![Connection diagram of cable set without line driver boxes](image)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Controller</strong></td>
<td>Panel plug / connector, male</td>
</tr>
<tr>
<td></td>
<td>Socket / connector, female</td>
</tr>
<tr>
<td><strong>Hexapod</strong></td>
<td>See &quot;Suitable Controllers&quot; (p. 8)</td>
</tr>
<tr>
<td>H-811.I2</td>
<td>Cables with a length of 0.5 m are installed permanently.</td>
</tr>
<tr>
<td>H-811.F2, .S2</td>
<td>Cables with a length of 2 m are installed permanently.</td>
</tr>
<tr>
<td>A</td>
<td>C-887.5PS power adapter, from the scope of delivery of the controller, output 24 V DC</td>
</tr>
<tr>
<td>1</td>
<td>Data transmission cable, 3 m, from the scope of delivery of the hexapod (p. 9) or another suitable data transmission cable (available on request (p. 51))</td>
</tr>
<tr>
<td></td>
<td>H-811.F2 and .S2 can also be connected directly to the controller.</td>
</tr>
<tr>
<td>2</td>
<td>Power supply cable, 3 m, from the scope of delivery of the hexapod (p. 9) or another suitable power supply cable (available on request (p. 51))</td>
</tr>
<tr>
<td></td>
<td>H-811.F2 and .S2 can also be connected directly to the controller.</td>
</tr>
</tbody>
</table>
Cabling with line driver boxes (no vacuum)

Controller

Panel plug / connector, male

Socket / connector, female

See "Suitable Controllers" (p. 8)

Hexapod

H-811.I2: Cables with a length of 0.5 m are installed permanently.
H-811.F2, .S2: Cables with a length of 2 m are installed permanently.

A  
C887B0057 controller-side line driver box, from the scope of delivery of the cable set*

B  
C887B0058 hexapod-side line driver box, from the scope of delivery of the cable set*

C  
C-887.5PS power adapter, from the scope of delivery of the cable set*, output 24 V DC

D  
C-887.5PS power adapter, from the scope of delivery of the controller, output 24 V DC

1  
Data transmission cable 3 m  
K040B0241, from the scope of delivery of the cable set*

2  
Power supply cable for the hexapod-side line driver box, 47 m  
K060B0228, from the scope of delivery of the cable set*

3, 4, 5  
Data transmission cable 44 m  
K040B0277, from the scope of delivery of the cable set*  
Maintain channel assignment!

6  
H-811.I2: Data transmission cable, 3 m, (K040B0316), from the scope of delivery of the hexapod  
H-811.F2, .S2: The hexapod is connected to the line driver box by its permanently installed data transmission cable.

* Cable set used: C-887.5A50.
Cabling for vacuum (without line driver boxes)

![Connection diagram of the cable set for the vacuum-compatible hexapod](image)

Figure 13: Connection diagram of the cable set for the vacuum-compatible hexapod

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Panel plug / connector, male</td>
</tr>
<tr>
<td>2</td>
<td>Socket / connector, female</td>
</tr>
<tr>
<td>3</td>
<td>Controller See &quot;Suitable Controllers&quot; (p. 8)</td>
</tr>
<tr>
<td>4</td>
<td>Hexapod H-811.I2V. Cables with a length of 2 m are installed permanently.</td>
</tr>
<tr>
<td>5</td>
<td>A C-887.5PS power supply, from the scope of delivery of the controller, output 24 V DC</td>
</tr>
<tr>
<td></td>
<td>1 Vacuum chamber</td>
</tr>
<tr>
<td></td>
<td>2 Data transmission cable 3 m from the scope of delivery of the hexapod (p. 9). Longer cables on request (p. 51).</td>
</tr>
<tr>
<td></td>
<td>3 Power supply cable 3 m for hexapod, from the scope of delivery of the hexapod (p. 9). Longer cables on request (p. 51).</td>
</tr>
<tr>
<td></td>
<td>4 4668 vacuum feedthrough for data transmission, HD Sub-D 78m/f</td>
</tr>
<tr>
<td></td>
<td>5 C88780002 vacuum feedthrough for the power supply, LEMO 2-pin (f) to M12 (m)</td>
</tr>
</tbody>
</table>

Cabling for vacuum, with line driver boxes

- For the cabling inside the vacuum chamber, see "Cabling for vacuum (without line driver boxes)".
- For the cabling on the air side, see "Cabling with line driver boxes (no vacuum)".
6 Startup

In this Chapter

General Notes on Startup ............................................................................................................ 37
Starting Up the Hexapod System ................................................................................................. 38
Optional: Operating the Hexapod with a Separate 12 V Power Adapter ................................. 39

6.1 General Notes on Startup

CAUTION

Risk of crushing by moving parts!
There is a risk of minor injuries from crushing between the moving parts of the hexapod and a stationary part or obstacle.
➢ Keep your fingers away from areas where they can get caught by moving parts.

NOTICE

Incorrect configuration of the controller!
The configuration data used by the controller (e.g., geometrical data and servo control parameters) must be adapted to the hexapod. If incorrect configuration data is used, the hexapod can be damaged by uncontrolled motion or collisions.

When the controller is switched on or rebooted, the configuration data is adapted using the data that is loaded from the ID chip.
➢ Once you have established communication via TCP/IP or RS-232, send the \texttt{CST?} command. The response shows the hexapod, to which the controller is adapted.
➢ Only operate the hexapod with a controller whose configuration data is adapted to the hexapod.
**NOTICE**

**Damage due to collisions!**
Collisions can damage the hexapod, the load to be moved, and the surroundings.
- Make sure that no collisions are possible between the hexapod, the load to be moved, and the surroundings in the workspace of the hexapod.
- Do not place any objects in areas where they can be caught by moving parts.
- Stop the motion immediately if a controller malfunction occurs.

**NOTICE**

**Damage from unintentional position changes!**
The self-locking of the hexapod struts is very low. Although the installed load complies with the limit value resulting from the load test (p. 22), it can trigger an unintentional change in the position of the hexapod if the servo mode or the controller is switched off and in addition, one of the following conditions is met:
- The hexapod is not mounted with a horizontally oriented base plate but in any other orientation.
- The hexapod is mounted with a horizontally oriented base plate and is not in the reference position.

As a result of unintentional position changes, the actuators in the hexapod struts can be damaged, and collisions between the hexapod, the load to be moved and the surroundings are possible. Collisions can damage the hexapod, the load to be moved or the surroundings.
- Support the motion platform or the load appropriately when the servo mode or the controller is switched off.

**NOTICE**

**Heating up of the hexapod in the vacuum!**
The hexapod heats up during operation in the vacuum.
- Allow the heat to dissipate accordingly.

### 6.2 Starting Up the Hexapod System

**Requirements**
- ✓ You have read and understood the general notes on startup (p. 37).
- ✓ You have correctly installed the hexapod, i.e., you have mounted the hexapod onto a surface, affixed the load to the hexapod and connected the hexapod to the controller according to the instructions in "Installation" (p. 21).
- ✓ You have read and understood the user manual of the controller.
6 Startup

Accessories
- PC with suitable software (see user manual of the controller)

Starting up the hexapod system
1. Start up the controller (see user manual of the controller).
2. Perform a few motion cycles for testing purposes (see user manual of the controller).

6.3 Optional: Operating the Hexapod with a Separate 12 V Power Adapter

The hexapod can be supplied via a separate 12 V power adapter in static applications that require increased position stability.

INFORMATION
If your controller has an **E-Stop** socket (C-887.522, .523, .532 and .533 models):
Deactivating the 24 V output on the controller via the **E-Stop** socket remains ineffective when the hexapod is supplied via a separate power adapter.
- If you want to actively use the **E-Stop** socket, connect the hexapod's power adapter accordingly. For further information, see "Using the E-Stop Socket" in the user manual for the C-887.5xx controller (MS244).

Requirements
- You have read and understood the general notes on startup (p. 37).
- You have read and understood the user manual for the controller.
- You have fixed the hexapod to an underlying surface according to the instructions in "Installation" (p. 21) and also fixed the load onto the hexapod.
- The 12 V power adapter is **not** connected to the power socket via the power cord.
- The controller is switched off, i.e., the on/off switch is in the ○ position.

Accessories
- C-501.12060M12 12 V wide input range power supply (60 W / 5 A), included with the H-811.12PS option, which is available as optional accessory (p. 11).
- PC where PI Terminal is installed (see user manual for the controller)

Hexapod operated with separate 12 V power adapter
1. If you did **not** order the 12 V power adapter together with your hexapod system and have **not** yet adapted the controller’s settings to the 12 V power adapter:
6 Startup

a) Connect the C-887.5xx controller to the power supply (24 V) and the PC. Follow the instructions in the user manual for the controller (MS244).

b) Switch the controller on.

c) Use PITerminal to establish communication between the controller and the PC via the TCP/IP interface or the RS-232 interface.

d) Send the following commands to adapt the controller’s settings permanently to the 12 V power adapter of the hexapod and to reboot the controller:

   SVO X 0
   CCL 1 advanced
   SPA 1 0x19004000 0
   WPA 101 1 0x19004000
   SPA 1 0x5a 50000 2 0x5a 50000 3 0x5a 50000 4 0x5a 50000 5 0x5a 50000 6 0x5a 50000
   WPA 101 1 0x5a 2 0x5a 3 0x5a 4 0x5a 5 0x5a 6 0x5a
   RBT

e) Close PITerminal.

f) Switch the controller off.

2. Connect the hexapod to the controller and the 12-V power adapter.
   − Follow the instructions in "Connecting the Hexapod to the Controller" (p. 29), however, do not connect the hexapod’s power supply cable to the 24 V output of the controller but instead, to the 12 V power adapter. See figure for an example.

3. Plug the power cord of the 12 V power adapter into the power socket.

4. Start and operate the controller (see user manual for the controller).

5. Start a few motion cycles for testing purposes (see user manual for the controller).
Reset to 24 V operation

If the hexapod is to be supplied by the controller's 24 V output again, proceed as follows:

1. Switch the controller off.
2. Disconnect the hexapod from the C-501.12060M12 power adapter.
3. Switch the controller on.
4. Use PIterminal to establish communication between the controller and the PC via the TCP/IP interface or the RS-232 interface.
5. Send the following commands to adapt the controller's settings permanently to the hexapod's 24 V supply:
   
   SVO X 0
   
   CCL 1 advanced
   
   SPA 1 0x19004000 1
   
   WPA 101 1 0x19004000
   
   SPA 1 0x5a 80000 2 0x5a 80000 3 0x5a 80000 4 0x5a 80000 5 0x5a 80000 6 0x5a 80000
   
   WPA 101 1 0x5a 2 0x5a 3 0x5a 4 0x5a 5 0x5a 6 0x5a
   
6. Close PIterminal.
7. Switch the controller off.
8. If there is an M12 screw plug, remove it from the controller's 24 V output (24 V Out 7 A).
9. Connect the hexapod to the 24 V output of the controller. For further information, see "Connecting the Hexapod to the Controller" (p. 29).
7 Maintenance

In this Chapter

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Cleaning the Hexapod .............................................................................. 47

NOTICE

Damage due to improper maintenance!
The hexapod can become misaligned as a result of improper maintenance. The specifications can change as a result (p. 53).

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

Depending on the operational conditions and the period of use of the hexapod, the following maintenance measures are required.

7.1 Performing a Maintenance Run

Frequent motion over a limited travel range can cause the lubricant to be distributed unevenly on the drive screw.

➢ Perform a maintenance run over the entire travel range at regular intervals (see user manual of the controller). The more often motion is performed over a limited travel range, the shorter the time has to be between the maintenance runs.

7.2 Packing the Hexapod for Transport

NOTICE

Impermissible mechanical load!
Impermissible mechanical load can damage the hexapod.

➢ Only ship the hexapod in the original packaging.
➢ Only hold the hexapod by the base plate.

NOTICE

Damage from applying high forces!
Hexapod struts with direct drive can be carefully moved by hand in the case of an error. Blocked struts can be damaged by the use of force.

➢ If one or more struts of the hexapod are blocked, do not move the hexapod by hand.
➢ If you move the hexapod by hand, do not use high forces.
**NOTICE**

**Cable break due to excessively bent or crushed cable!**
A cable break leads to failure of the hexapod.
 Pack the hexapod so that the cables are not bent or crushed too much.

**Accessories**
- Original packaging (p. 9)

**Packing the hexapod**
1. Command motion of the hexapod to the transport position:
   \[ X = Y = Z = U = V = W = 0 \]
2. Uninstall the hexapod system:
   a) Remove the load from the motion platform of the hexapod.
   b) Switch the controller off.
   c) Remove the data transmission cable and the power supply cable from the controller.
   d) Disengage all connections between the cables attached permanently to the hexapod and the cable set used, and remove the cables from all attachments (e.g., connector holder of the H-811.I2).
   e) Remove the hexapod from the surface.
3. Pack each connector of the hexapod separately in electrostatic dissipative film.
4. Pack the hexapod in electrostatic dissipative film to protect against dirt.
5. Grip the base plate of the hexapod and lay it sideways into one half of the foam insert. Make sure that the hexapod is correctly aligned to the recesses in the insert.
6. Align the second half of the foam insert and put it onto the hexapod.

7. Push the clamp onto the foam insert to hold both halves together.
8. Make sure that the inner box is sitting on four cushioned corners in the outer box.

9. Put the hexapod into the inner box:
   a) Align the foam insert so that the clamp and therefore the hexapod’s base plate are pointing **downwards**.
   b) Lay the cables onto the top of the foam insert. Avoid bending the cables.
   c) Lower the foam insert with the hexapod into the inner box carefully.

10. Close the inner box.
11. Put four cushioned corners onto the inner box.

12. Close the outer box.

13. Secure the box on the pallet.

7.3 Cleaning the Hexapod

Requirements

✓ You have disconnected the hexapod from the controller.

Cleaning the hexapod

Only when the hexapod is not used in vacuum:

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

Only when the hexapod is used in vacuum:

➢ Touch the hexapod only with powder-free gloves.

➢ If necessary, wipe the hexapod clean.
## 8 Troubleshooting

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible causes</th>
<th>Solution</th>
</tr>
</thead>
</table>
| Unexpected hexapod behavior. | • Cable defective  
• Connector or soldered joints loosened | ➢ Check the data transmission and power supply cables.  
➢ Replace the cables by cables of the same type and test the function of the hexapod.  
➢ Contact our customer service department (p. 51). |
| The hexapod does not achieve the specified accuracy. | • Warped base plate  
• Increased wear due to small motion over a long period of time | ➢ Mount the hexapod onto an even surface (p. 26). The recommended flatness of the surface is 200 µm.  
➢ Perform a maintenance run over the entire travel range (p. 43). |
| The hexapod does not move. | • Worn drive screw  
• Foreign body has entered the drive screw  
• Faulty motor  
• Blocked or broken joint  
• Dirty encoder | ➢ Carry out a strut test (see user manual for the controller). The strut test should be carried out in the reference position, unless the malfunction occurs with maximum or minimum displacement of the platform in Z.  
➢ Contact our customer service department (p. 51). |
| The hexapod does not move. | Controller with **E-Stop** socket:  
• Nothing connected to **E-Stop**  
• "Break contact" is active on **E-Stop** | Controllers with the **E-Stop** socket support the "Motion Stop" functionality, with which the motion of the hexapod can be stopped with external devices (pushbuttons, switches). If you do not use the "Motion Stop" functionality:  
➢ Make sure that the C887B0038 shorting plug from the scope of delivery of the controller is inserted in the **E-Stop** socket. If you use the "Motion Stop" functionality:  
1. Check your system and make sure that the hexapod can be moved safely.  
2. Activate the **24 V Out 7 A** output |
### Troubleshooting

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible causes</th>
<th>Solution</th>
</tr>
</thead>
</table>
| The hexapod does not move. | Incorrect or missing configuration data | ✓ Send the `CST?` command. The response shows the hexapod, to which the controller is adapted.  
✓ Send the `ERR?` command. Error code "233" in the answer indicates that the configuration data for the hexapod is missing on the controller. Contact our customer service department (p. 51) in order to receive valid configuration data. |

If the problem with your hexapod is not listed in the table or cannot be solved as described, contact our customer service department (p. 51).
For inquiries and orders, contact your PI sales engineer or send us an email (mailto:service@pi.de).

- 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.

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

In this Chapter
Specifications ........................................................................................................................................ 53
Drag Chain Compatible Cables ........................................................................................................ 59
Ambient Conditions and Classifications .......................................................................................... 60
Dimensions ..................................................................................................................................... 61
Pin Assignment ............................................................................................................................. 63

10.1 Specifications

10.1.1 Data Table

<table>
<thead>
<tr>
<th>Motion and positioning</th>
<th>H-811.I2 / .I2V**</th>
<th>Unit</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active axes</td>
<td>X, Y, Z, θx, θy, θz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel range* in X, Y</td>
<td>±17, ±16</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>Travel range* in Z</td>
<td>±6.5</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>Travel range* in θx, θy</td>
<td>±10, ±10</td>
<td>°</td>
<td></td>
</tr>
<tr>
<td>Travel range* in θz</td>
<td>±21</td>
<td>°</td>
<td></td>
</tr>
<tr>
<td>Actuator design resolution</td>
<td>5</td>
<td>nm</td>
<td></td>
</tr>
<tr>
<td>Minimum incremental motion X, Y</td>
<td>0.2</td>
<td>μm</td>
<td>typ.</td>
</tr>
<tr>
<td>Minimum incremental motion Z</td>
<td>0.08</td>
<td>μm</td>
<td>typ.</td>
</tr>
<tr>
<td>Minimum incremental motion θx, θy</td>
<td>2.5</td>
<td>μrad</td>
<td>typ.</td>
</tr>
<tr>
<td>Minimum incremental motion θz</td>
<td>5</td>
<td>μrad</td>
<td>typ.</td>
</tr>
<tr>
<td>Backlash X, Y</td>
<td>0.2</td>
<td>μm</td>
<td>typ.</td>
</tr>
<tr>
<td>Backlash Z</td>
<td>0.06</td>
<td>μm</td>
<td>typ.</td>
</tr>
<tr>
<td>Backlash θx, θy</td>
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<td>μrad</td>
<td>typ.</td>
</tr>
<tr>
<td>Backlash θz</td>
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<td>μrad</td>
<td>typ.</td>
</tr>
<tr>
<td>Repeatability X, Y</td>
<td>±0.15</td>
<td>μm</td>
<td>typ.</td>
</tr>
<tr>
<td>Repeatability Z</td>
<td>±0.06</td>
<td>μm</td>
<td>typ.</td>
</tr>
</tbody>
</table>
## Repeatability

<table>
<thead>
<tr>
<th>Axis</th>
<th>Repeatability</th>
<th>Unit</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>θ_x, θ_y</td>
<td>±2</td>
<td>µrad</td>
<td>typ.</td>
</tr>
<tr>
<td>θ_z</td>
<td>±3</td>
<td>µrad</td>
<td>typ.</td>
</tr>
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</table>

## Max. Velocity

<table>
<thead>
<tr>
<th>Axis</th>
<th>Max. Velocity</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>X, Y, Z</td>
<td>20 / 10</td>
<td>mm/s</td>
</tr>
<tr>
<td>θ_x, θ_y, θ_z</td>
<td>500 / 250</td>
<td>mrad/s</td>
</tr>
</tbody>
</table>

## Typ. Velocity

<table>
<thead>
<tr>
<th>Axis</th>
<th>Typ. Velocity</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>X, Y, Z</td>
<td>10 / 5</td>
<td>mm/s</td>
</tr>
<tr>
<td>θ_x, θ_y, θ_z</td>
<td>240 / 120</td>
<td>mrad/s</td>
</tr>
</tbody>
</table>

## Mechanical Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>H-811.I2 / .I2V**</th>
<th>Unit</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stiffness X / Y</td>
<td>0.7</td>
<td>N/µm</td>
<td></td>
</tr>
<tr>
<td>Stiffness Z</td>
<td>8</td>
<td>N/µm</td>
<td></td>
</tr>
<tr>
<td>Load capacity, horizontal base plate</td>
<td>5</td>
<td>kg</td>
<td>max.</td>
</tr>
<tr>
<td>Load capacity, base plate in any orientation</td>
<td>2.5</td>
<td>kg</td>
<td>max.</td>
</tr>
<tr>
<td>Holding force, power off, horizontal base plate</td>
<td>15</td>
<td>N</td>
<td>max.</td>
</tr>
<tr>
<td>Holding force, power off, base plate in any orientation</td>
<td>2.5</td>
<td>N</td>
<td>max.</td>
</tr>
<tr>
<td>Motor type</td>
<td>BLDC motor</td>
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## Miscellaneous

<table>
<thead>
<tr>
<th>Property</th>
<th>H-811.I2 / .I2V**</th>
<th>Unit</th>
<th>Tolerance</th>
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</thead>
<tbody>
<tr>
<td>Operating temperature range</td>
<td>0 to 50</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>Stainless steel, aluminum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>2.2</td>
<td>kg</td>
<td>±5 %</td>
</tr>
<tr>
<td>Cable length</td>
<td>0.5 + 3 / 3 (air) + 2 (vacuum)</td>
<td>m</td>
<td>±10 mm</td>
</tr>
<tr>
<td>Recommended controller</td>
<td>C-887.5x</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Technical data specified at 20±3 °C.

* The travel ranges of the individual coordinates (X, Y, Z, θ_x, θ_y, θ_z) are interdependent. The data for each axis in this table shows its maximum travel range, where all other axes and the pivot point are at the reference position.

** For continuous operation in a vacuum, restrictions on operating parameters may be necessary due to heat generation.
## Technical Data

<table>
<thead>
<tr>
<th><strong>Motion and positioning</strong></th>
<th><strong>H-811.F2</strong></th>
<th>Unit</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active axes</td>
<td>X, Y, Z, θx, θy, θz</td>
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<td></td>
</tr>
<tr>
<td>Travel range* in X, Y</td>
<td>±17, ±16</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>Travel range* in Z</td>
<td>±6.5</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>Travel range* in θx, θy</td>
<td>±10, ±10</td>
<td>°</td>
<td></td>
</tr>
<tr>
<td>Travel range* in θz</td>
<td>±21</td>
<td>°</td>
<td></td>
</tr>
<tr>
<td>Actuator design resolution</td>
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<td>nm</td>
<td></td>
</tr>
<tr>
<td>Min. incremental motion X, Y</td>
<td>0.2</td>
<td>µm</td>
<td>typ.</td>
</tr>
<tr>
<td>Min. incremental motion Z</td>
<td>0.08</td>
<td>µm</td>
<td>typ.</td>
</tr>
<tr>
<td>Minimum incremental motion θx, θy</td>
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<td>µrad</td>
<td>typ.</td>
</tr>
<tr>
<td>Minimum incremental motion θz</td>
<td>3</td>
<td>µrad</td>
<td>typ.</td>
</tr>
<tr>
<td>Backlash X, Y</td>
<td>0.2</td>
<td>µm</td>
<td>typ.</td>
</tr>
<tr>
<td>Backlash Z</td>
<td>0.06</td>
<td>µm</td>
<td>typ.</td>
</tr>
<tr>
<td>Backlash θx, θy</td>
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<td>µrad</td>
<td>typ.</td>
</tr>
<tr>
<td>Backlash θz</td>
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<td>µrad</td>
<td>typ.</td>
</tr>
<tr>
<td>Repeatability X, Y</td>
<td>±0.15</td>
<td>µm</td>
<td>typ.</td>
</tr>
<tr>
<td>Repeatability Z</td>
<td>±0.06</td>
<td>µm</td>
<td>typ.</td>
</tr>
<tr>
<td>Repeatability θx, θy</td>
<td>±2</td>
<td>µrad</td>
<td>typ.</td>
</tr>
<tr>
<td>Repeatability θz</td>
<td>±3</td>
<td>µrad</td>
<td>typ.</td>
</tr>
<tr>
<td>Max. velocity X, Y, Z</td>
<td>20</td>
<td>mm/s</td>
<td></td>
</tr>
<tr>
<td>Max. velocity θx, θy, θz</td>
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<td>mrad/s</td>
<td></td>
</tr>
<tr>
<td>Typ. Velocity X, Y, Z</td>
<td>10</td>
<td>mm/s</td>
<td></td>
</tr>
<tr>
<td>Typ. Velocity θx, θy, θz</td>
<td>240</td>
<td>mrad/s</td>
<td></td>
</tr>
</tbody>
</table>

### Alignment

| **Scanning time of spiraled area scan 500 µm Ø** | <2 | s |
| **Scanning time of spiraled area scan 100 µm Ø** | <0.5 | s |
| **Scanning time of spiraled area scan 10 µm Ø** | <0.2 | s |
## Mechanical properties

<table>
<thead>
<tr>
<th></th>
<th>H-811.F2</th>
<th>Unit</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stiffness X / Y</td>
<td>0.7</td>
<td>N/µm</td>
<td></td>
</tr>
<tr>
<td>Stiffness Z</td>
<td>8</td>
<td>N/µm</td>
<td></td>
</tr>
<tr>
<td>Load capacity (horizontal base plate / any orientation)</td>
<td>5 / 2.5</td>
<td>kg</td>
<td>max.</td>
</tr>
<tr>
<td>Holding force, power off (horizontal base plate / any orientation)</td>
<td>12 / 2</td>
<td>N</td>
<td>max.</td>
</tr>
<tr>
<td>Motor type</td>
<td>BLDC motor</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Miscellaneous

<table>
<thead>
<tr>
<th></th>
<th>H-811.F2</th>
<th>Unit</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature range</td>
<td>0 to 50</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>Stainless steel, aluminum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>2.2</td>
<td>kg</td>
<td>±5 %</td>
</tr>
<tr>
<td>Cable length</td>
<td>2</td>
<td>m</td>
<td>±10 mm</td>
</tr>
<tr>
<td>Recommended controller</td>
<td>C-887.5x</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Technical data specified at 20±3 °C.

* The travel ranges of the individual coordinates (X, Y, Z, θX, θY, θZ) are interdependent. The data for each axis in this table shows its maximum travel range, where all other axes and the pivot point are at the reference position.

** Typical time period to scan the full area and move to the maximum intensity

## Motion and positioning

<table>
<thead>
<tr>
<th></th>
<th>H-811.S2</th>
<th>Unit</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active axes</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Travel range* X, Y, Z</td>
<td>±17, ±16, ±6.5</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>Travel range* θX, θY, θZ</td>
<td>±10, ±10, ±21</td>
<td>°</td>
<td></td>
</tr>
<tr>
<td>Actuator design resolution</td>
<td>5</td>
<td>nm</td>
<td></td>
</tr>
<tr>
<td>Min. incremental motion X, Y</td>
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<td>µm</td>
<td>typ.</td>
</tr>
<tr>
<td>Min. incremental motion Z</td>
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<td>typ.</td>
</tr>
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<td>Minimum incremental motion θX, θY, θZ</td>
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<tr>
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<td>typ.</td>
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<tr>
<td>Backlash X, Y</td>
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<td>typ.</td>
</tr>
</tbody>
</table>
### Motion and positioning

<table>
<thead>
<tr>
<th>Parameter</th>
<th>H-811.S2</th>
<th>Unit</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
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<td>Backlash Z</td>
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<td>typ.</td>
</tr>
<tr>
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<td>µrad</td>
<td>typ.</td>
</tr>
<tr>
<td>Repeatability X, Y</td>
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<td>µm</td>
<td>typ.</td>
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<td>Repeatability Z</td>
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<td>typ.</td>
</tr>
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<td>Repeatability θ&lt;sub&gt;X&lt;/sub&gt;, θ&lt;sub&gt;Y&lt;/sub&gt;</td>
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<tr>
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<tr>
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<td></td>
</tr>
<tr>
<td>Typ. Velocity θ&lt;sub&gt;X&lt;/sub&gt;, θ&lt;sub&gt;Y&lt;/sub&gt;, θ&lt;sub&gt;Z&lt;/sub&gt;</td>
<td>240</td>
<td>mrad/s</td>
<td></td>
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</tbody>
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### Mechanical properties

<table>
<thead>
<tr>
<th>Parameter</th>
<th>H-811.S2</th>
<th>Unit</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stiffness X, Y</td>
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<td>N/µm</td>
<td></td>
</tr>
<tr>
<td>Stiffness Z</td>
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<td>N/µm</td>
<td></td>
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<td>Load capacity (horizontal base plate / any orientation)</td>
<td>1.5 / 0.3</td>
<td>kg</td>
<td>max.</td>
</tr>
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<td>Holding force, power off (horizontal base plate / any orientation)</td>
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### Miscellaneous

<table>
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<tr>
<th>Parameter</th>
<th>H-811.S2</th>
<th>Unit</th>
<th>Tolerance</th>
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<tbody>
<tr>
<td>Operating temperature range</td>
<td>0 to 50</td>
<td>°C</td>
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<tr>
<td>Material</td>
<td>Stainless steel, aluminum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>2.2</td>
<td>kg</td>
<td>±5 %</td>
</tr>
<tr>
<td>Cable length</td>
<td>2</td>
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<td>±10 mm</td>
</tr>
<tr>
<td>Recommended controller</td>
<td>C-887.5x</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Technical data specified at 20±3 °C.

* The travel ranges of the individual coordinates (X, Y, Z, θ<sub>X</sub>, θ<sub>Y</sub>, θ<sub>Z</sub>) are interdependent. The data for each axis in this table shows its maximum travel range, where all other axes and the pivot point are at the reference position.
## 10.1.2 Specifications for Vacuum-Compatible Versions

<table>
<thead>
<tr>
<th>Drive and sensor</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor</td>
<td>Brushless, three-phase torque motor</td>
</tr>
<tr>
<td></td>
<td>vacuum-compatible version with gold-plated pin contacts</td>
</tr>
<tr>
<td>Gearhead</td>
<td>Direct drive</td>
</tr>
<tr>
<td>Encoder</td>
<td>Optical encoder, vacuum-compatible</td>
</tr>
<tr>
<td>Reference point switch</td>
<td>Optical, vacuum-compatible</td>
</tr>
<tr>
<td>Limit switches</td>
<td>Optical, vacuum-compatible</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Materials used</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine-made parts</td>
<td>&gt;95 % of the machine-made parts, i.e., base plate, struts, motion platform: AlMgSi (3.2315) and AlMg4.5Mn (3.3547) chemically nickel-plated, stainless steel type 303 (1.4305) Remaining parts, e.g. coupling elements: Various vacuum-compatible materials</td>
</tr>
<tr>
<td>Bearing</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>Drivetrain elements</td>
<td>Stainless steel (drive screw)</td>
</tr>
<tr>
<td>Electrical components</td>
<td>Cable insulation: PTFE, FEP</td>
</tr>
<tr>
<td></td>
<td>Shrink tubing: Kynar</td>
</tr>
<tr>
<td></td>
<td>Solder: Sn95.5Ag3.8Cu0.7</td>
</tr>
<tr>
<td></td>
<td>PCB (main board)</td>
</tr>
<tr>
<td></td>
<td>Flexible printed circuit board (limit switch, pulse width modulation)</td>
</tr>
<tr>
<td></td>
<td>Aramid insulating paper</td>
</tr>
<tr>
<td></td>
<td>Polyimide film strip</td>
</tr>
<tr>
<td></td>
<td>Connector: DD78 (Positronic), type FFA (LEMO)</td>
</tr>
<tr>
<td>Grease</td>
<td>Brayco 815Z (Micronic)</td>
</tr>
<tr>
<td>Sealing compound and adhesive</td>
<td>Loctite 243, Loctite 603, Loctite 3321, Araldite 2014-1 (Huntsmann)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakeout temperature</td>
<td>80 °C (176 °F)</td>
</tr>
</tbody>
</table>
10.1.3 Maximum Ratings

The hexapod is designed for the following operating data:

<table>
<thead>
<tr>
<th>Maximum operating voltage</th>
<th>Maximum operating frequency (unloaded)</th>
<th>Maximum current consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 V DC</td>
<td>---</td>
<td>5 A</td>
</tr>
</tbody>
</table>

10.2 Drag Chain Compatible Cables

<table>
<thead>
<tr>
<th>Drag chain compatible cable sets</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable length</td>
<td>m</td>
</tr>
<tr>
<td>H-811.I2 and .I2V models: 3 m; in the scope of delivery (p. 9)</td>
<td></td>
</tr>
<tr>
<td>See &quot;Optional Accessories&quot; (p. 11) for further cable sets.</td>
<td></td>
</tr>
<tr>
<td>Maximum velocity</td>
<td>m/s</td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Maximum acceleration</td>
<td>m/s²</td>
</tr>
<tr>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>Maximum number of bending cycles</td>
<td></td>
</tr>
<tr>
<td>1 million</td>
<td></td>
</tr>
</tbody>
</table>

**Power supply cable**

- Operating temperature range
  - -10 to +70 °C
- Minimum bending radius in a drag chain
  - 94 mm
- Minimum bending radius with the fixed installation
  - 57 mm
- Outer diameter
  - 7.5 mm

**Data transmission cable**

- Operating temperature range
  - -20 to +80 °C
- Minimum bending radius in a drag chain
  - 67 mm
- Minimum bending radius with the fixed installation
  - 102 mm
- Outer diameter
  - 10.2 mm
## 10.3 Ambient Conditions and Classifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree of pollution</td>
<td>2</td>
</tr>
<tr>
<td>Air pressure</td>
<td>1100 hPa to 780 hPa&lt;br&gt;Vacuum-compatible models: 1100 hPa to $10^{-6}$ hPa</td>
</tr>
<tr>
<td>Transport temperature</td>
<td>$-25 , ^\circ\text{C}$ to $+85 , ^\circ\text{C}$</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>$0 , ^\circ\text{C}$ to $70 , ^\circ\text{C}$</td>
</tr>
<tr>
<td>Bakeout temperature</td>
<td>Vacuum-compatible models only: $80 , ^\circ\text{C}$ (176 °F)</td>
</tr>
<tr>
<td>Humidity</td>
<td>Highest relative humidity of 80% at temperatures of up to $31, ^\circ\text{C}$, decreasing linearly to a relative humidity of 50% at $40, ^\circ\text{C}$</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP20</td>
</tr>
<tr>
<td>Area of application</td>
<td>For indoor use only</td>
</tr>
<tr>
<td>Maximum altitude</td>
<td>2000 m</td>
</tr>
</tbody>
</table>
10.4 Dimensions

10.4.1 H-811 Hexapod

Dimensions in mm. Note that a comma is used instead of a decimal point in the drawings.

The figure shows the hexapod in the reference position.

The (0,0,0) coordinates indicate the origin of the coordinate system. The center of rotation is at the origin of the coordinate system when the default settings for the coordinate system and center of rotation are used, and the hexapod is at the reference position.

Figure 14: H-811 hexapod, J2, J2V, S2 models
Figure 15: H-811 hexapod, F2 model
10.4.2  000067899 Connector Holder

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

Figure 16:  000067899 connector holder for strain relief

10.5  Pin Assignment

10.5.1  Power Supply Connection

Not for vacuum versions:
Power supply via 4-pin M12 Connector

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
</tr>
<tr>
<td>3</td>
<td>24 V DC</td>
</tr>
<tr>
<td>4</td>
<td>24 V DC</td>
</tr>
</tbody>
</table>

Only for vacuum versions:
power supply via 2-pin LEMO panel plug, male, type ECJ.1B.302.CLD

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
</tr>
<tr>
<td>2</td>
<td>24 V DC</td>
</tr>
</tbody>
</table>
10.5.2 Data Transmission Connection

Data transmission between hexapod and controller

Connector HD Sub-D 78 m

<table>
<thead>
<tr>
<th>Function</th>
<th>All signals: TTL</th>
</tr>
</thead>
</table>

### Pin Assignment

<table>
<thead>
<tr>
<th>Pin</th>
<th>Pin</th>
<th>Signal</th>
<th>Pin</th>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>21</td>
<td>CH1 Sign IN</td>
<td>40</td>
<td>60</td>
<td>CH1 MAGN IN</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>nc</td>
<td>41</td>
<td></td>
<td>CH1 LimP OUT</td>
</tr>
<tr>
<td>3</td>
<td>22</td>
<td>CH1 Ref OUT</td>
<td>42</td>
<td>61</td>
<td>CH1 LimN OUT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CH1 A+ OUT</td>
<td></td>
<td>62</td>
<td>CH1 B+ OUT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CH1 A- OUT</td>
<td></td>
<td></td>
<td>CH1 B- OUT</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>GND</td>
<td></td>
<td>63</td>
<td>CH2 MAGN IN</td>
</tr>
<tr>
<td>4</td>
<td>24</td>
<td>CH2 Sign IN</td>
<td>43</td>
<td></td>
<td>CH2 LimP OUT</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>nc</td>
<td>44</td>
<td>64</td>
<td>CH2 LimN OUT</td>
</tr>
<tr>
<td>6</td>
<td>25</td>
<td>CH2 Ref OUT</td>
<td>45</td>
<td></td>
<td>CH2 B+ OUT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CH2 A+ OUT</td>
<td></td>
<td>65</td>
<td>CH2 B- OUT</td>
</tr>
<tr>
<td></td>
<td>26</td>
<td>GND</td>
<td></td>
<td></td>
<td>GND</td>
</tr>
<tr>
<td>7</td>
<td>27</td>
<td>CH3 Sign IN</td>
<td>46</td>
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<td>CH3 MAGN IN</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>nc</td>
<td>47</td>
<td>66</td>
<td>CH3 LimP OUT</td>
</tr>
<tr>
<td>9</td>
<td>28</td>
<td>CH3 Ref OUT</td>
<td>48</td>
<td></td>
<td>CH3 LimN OUT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CH3 A+ OUT</td>
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<td>67</td>
<td>CH3 B+ OUT</td>
</tr>
<tr>
<td></td>
<td>29</td>
<td>GND</td>
<td></td>
<td>68</td>
<td>CH3 B- OUT</td>
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<tr>
<td>10</td>
<td>30</td>
<td>CH4 Sign IN</td>
<td>49</td>
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<td>GND</td>
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<tr>
<td>11</td>
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<td>nc</td>
<td>50</td>
<td>69</td>
<td>CH4 MAGN IN</td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>CH4 Ref OUT</td>
<td></td>
<td></td>
<td>CH4 LimP OUT</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>70</td>
<td>CH4 LimN OUT</td>
</tr>
<tr>
<td>Pin</td>
<td>Pin</td>
<td>Signal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>-----</td>
<td>----------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>31</td>
<td>CH4 A+ OUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>32</td>
<td>GND</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>33</td>
<td>CH5 Sign IN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>34</td>
<td>CH5 A+ OUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>35</td>
<td>CH5 A- OUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>36</td>
<td>CH6 Sign IN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>37</td>
<td>CH6 A+ OUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>38</td>
<td>CH6 A- OUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>39</td>
<td>GND</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>24 V input</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70</td>
<td></td>
<td>CH4 B+ OUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>51</td>
<td></td>
<td>CH4 B- OUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71</td>
<td></td>
<td>GND</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>52</td>
<td></td>
<td>CH5 MAGN IN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>72</td>
<td></td>
<td>CH5 LimP OUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>53</td>
<td></td>
<td>CH5 LimN OUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>73</td>
<td></td>
<td>CH5 B+ OUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>54</td>
<td></td>
<td>CH5 B- OUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>74</td>
<td></td>
<td>GND</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>55</td>
<td></td>
<td>CH6 MAGN IN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>75</td>
<td></td>
<td>CH6 LimP OUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>56</td>
<td></td>
<td>CH6 LimN OUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>76</td>
<td></td>
<td>CH6 B+ OUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>57</td>
<td></td>
<td>CH6 B- OUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td></td>
<td>GND</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>58</td>
<td></td>
<td>Brake/Enable drive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>59</td>
<td></td>
<td>Power Good 24 V output</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
11 Old Equipment Disposal

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

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

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

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

Physik Instrumente (PI) GmbH & Co. KG
Auf der Roemerstr. 1
D-76228 Karlsruhe, Germany
12 Glossary

User-defined coordinate system
Using the controller, custom coordinate systems can be defined and used instead of the default coordinate systems.

Work with user-defined coordinate systems and the work-and-tool concept is described in the C887T0007 technical note.

Workspace
The entirety of all combinations of translations and rotations that the hexapod can approach from the current position is referred to as the workspace.

The workspace can be limited by the following external factors:
- Installation space
- Dimensions and position of the load

Center of rotation
The center of rotation describes the intersection of the rotational axes U, V, and W. When the default settings for the coordinate system and the center of rotation are used, the center of rotation after a reference move is located at the origin of the coordinate system (0,0,0), see the dimensional drawing of the hexapod (p. 61).

The center of rotation always moves together with the platform.

Depending on the active operating coordinate system, the center of rotation can be moved from the origin of the coordinate system in the X and/or Y and/or Z direction with the SPI command. The center of rotation that can be moved using the SPI command is also referred to as "pivot point".

Hexapod system
The combination of hexapod, controller, cable set, and power supply is referred to as "hexapod system" in this manual.

Default coordinate system
The X, Y, and Z axes of the Cartesian coordinate system are always spatially fixed, i.e., the coordinate system does not move when the platform of the hexapod moves. The X, Y and Z axes are also referred to as translational axes.

The intersection of the axes X, Y, and Z of the spatially fixed Cartesian coordinate system (0,0,0) is referred to as the origin.
The Z axis is perpendicular to the base plate of the hexapod.
The following example figures of the H-810 hexapod show that the coordinate system does not move along with motion of the platform.

Figure 17: H-810 hexapod in the reference position.

1 Cable exit
Figure 18: H-810 hexapod, the platform of which has been moved in X.

1 Cable exit
13 Appendix

In this Chapter

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EU Declaration of Conformity ......................................................................................... 75

13.1 Explanations of the Performance Test Sheet

The hexapod is tested for the positioning accuracy of the translational axes before delivery. The performance test sheet is included in the scope of delivery.

The following test setup is used:

![Test setup for measuring the X or Y axis.](image)

1 Laser interferometer
2 Mirror
3 Bench

The following test cycles are performed:

- Motion over the entire travel range with at least 20 measuring points, in at least five cycles.
- Motion over partial sections, e.g., ±1 mm in increments of for example, 10 µm
13.2 EU Declaration of Conformity

For the H-811, an EU Declaration of Conformity has been issued 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