This document describes the following product:
- **H-820.D2**
  Hexapod microrobot, basis model, 20 mm/s, 20 kg load, Sub-D connector (m), cable set 3 m
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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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Document number: MS207E, BRo, Version 2.2.0

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 This manual is superseded by any new release.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-820.

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

Symbol/Label | Meaning
--- | ---
1. | Action consisting of several steps whose sequential order must be observed
2. | Action consisting of one or several steps whose sequential order is irrelevant
- | List item
p. 5 | Cross-reference to page 5
RS-232 | Labeling of an operating element on the product (example: socket of the RS-232 interface)

⚠️ Warning sign on the product which refers to detailed information in this manual.

1.3 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>
1.4 Downloading Manuals

**INFORMATION**

If a manual is missing or problems occur with downloading:

➢ Contact our customer service department (p. 37).

**INFORMATION**

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](http://www.pi.ws).
2. If access to the manuals is protected by a password:
1 About this Document

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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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-820 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-820.

➢ Use the H-820 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-820.

2.3 Organizational Measures

User manual

➢ Always keep this user manual available with the H-820.
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-820 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-820 only after you have read and understood this user manual.

Personnel qualification

The H-820 may only be installed, started, operated, maintained, and cleaned by authorized and appropriately qualified personnel.
3 Product Description

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- Model Overview ................................................................................. 7
- Suitable Controllers ......................................................................... 8
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- Accessories ..................................................................................... 10
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3.1 Features and Applications

The H-820 hexapod achieves a velocity of up to 20 mm/s. It can be loaded with a maximum of 20 kg in a vertical orientation and with a maximum of 10 kg in any other orientation.

The parallel-kinematic design offers the following advantages:

- Positioning operations on six independent axes (three translational axes, three rotational axes) with short settling times
- High accuracy and step resolution on 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 in Cartesian coordinates.

3.2 Model Overview

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-820.D2</td>
<td>Hexapod microrobot, basis model, 20 mm/s, 20 kg load, Sub-D connector (m), cable set 3 m</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, motion stop, 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. 37).
3.4 Product View

![Product View Image]

Figure 1: Product view

1. Motion Platform
2. Strut
3. Coordinate cube
4. Panel plug for power supply cable
5. Panel plug for data transmission cable
6. Base plate

3.5 Scope of Delivery

<table>
<thead>
<tr>
<th>Order number</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-820</td>
<td>Hexapod according to your order (p. 7)</td>
</tr>
<tr>
<td>K040B0241</td>
<td>Data transmission cable, HD D-sub 78 f/m, 1:1, 3 m</td>
</tr>
<tr>
<td>K060B0111</td>
<td>Power supply cable, M12m 180° to M12f 90°, 3 m</td>
</tr>
<tr>
<td>000015165</td>
<td>Steward snap-on ferrite</td>
</tr>
</tbody>
</table>
### Packaging, consisting of:
- Inner and outer box
- Foam and corrugated cardboard cushions
- Pallet

### Documentation, consisting of:
- H820T0001: Printed technical note on unpacking the hexapod
- MS247E: Short instructions for hexapod systems

### Screw sets:
- 000034605: Mounting kit:
  - 6 socket head screws, M6x30 ISO 4762
  - 1 hex key 5.0 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

### Accessories

<table>
<thead>
<tr>
<th>Order number</th>
<th>Description</th>
<th>Description</th>
<th>Length</th>
<th>Item number</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-887.5B03</td>
<td>Hexapod cable set 3 m, drag chain compatible*, consisting of:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data transmission cable, HD D-sub 78 f/m, 1:1</td>
<td>3 m</td>
<td>K040B0270</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power supply cable, M12 m/f, 1:1</td>
<td>3 m</td>
<td>K060B0262</td>
<td></td>
</tr>
<tr>
<td>C-887.5B05</td>
<td>Hexapod cable set 5 m, drag chain compatible*, consisting of:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data transmission cable, HD D-sub 78 f/m, 1:1</td>
<td>5 m</td>
<td>K040B0271</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power supply cable, M12 m/f, 1:1</td>
<td>5 m</td>
<td>K060B0222</td>
<td></td>
</tr>
<tr>
<td>C-887.5B07</td>
<td>Hexapod cable set 7.5 m, drag chain compatible*, consisting of:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data transmission cable, HD D-sub 78 f/m, 1:1</td>
<td>7.5 m</td>
<td>K040B0295</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power supply cable, M12 m/f, 1:1</td>
<td>7.5 m</td>
<td>K060B0223</td>
<td></td>
</tr>
</tbody>
</table>
### Product Description

#### Order number | Description
--- | ---
C-887.5B10 | Hexapod cable set **10 m**, drag chain compatible*, consisting of:

<table>
<thead>
<tr>
<th>Description</th>
<th>Length</th>
<th>Item number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data transmission cable, HD D-sub 78 f/m, 1:1</td>
<td>10 m</td>
<td>K040B0296</td>
</tr>
<tr>
<td>Power supply cable, M12 m/f, 1:1</td>
<td>10 m</td>
<td>K060B0224</td>
</tr>
</tbody>
</table>

C-887.5B20 | Hexapod cable set **20 m**, drag chain compatible*, consisting of:

<table>
<thead>
<tr>
<th>Description</th>
<th>Length</th>
<th>Item number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data transmission cable, HD D-sub 78 f/m, 1:1</td>
<td>20 m</td>
<td>K040B0297</td>
</tr>
<tr>
<td>Power supply cable, M12 m/f, 1:1</td>
<td>20 m</td>
<td>K060B0225</td>
</tr>
</tbody>
</table>

C-887.5A50 | Hexapod cable set **50 m**, consisting of:

<table>
<thead>
<tr>
<th>Description</th>
<th>Length</th>
<th>Item number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line driver box for data transmission cable, controller-side</td>
<td>–</td>
<td>C887B0057</td>
</tr>
<tr>
<td>Line driver box for data transmission cable, hexapod-side</td>
<td>–</td>
<td>C887B0058</td>
</tr>
<tr>
<td>Short data transmission cable, HD D-sub 78 f/m, 1:1</td>
<td>3 m</td>
<td>K040B0034</td>
</tr>
<tr>
<td>Long data transmission cable, HD D-sub 44 f/m, 1:1, three pieces</td>
<td>44 m</td>
<td>K040B0277</td>
</tr>
<tr>
<td>Power supply cable for hexapod-side line driver box, with M12 connector (m)/M-12 connector (f)</td>
<td>47 m</td>
<td>K060B0228</td>
</tr>
<tr>
<td>Power supply for hexapod, with M12 connector (f) and power cord</td>
<td>1.5 m**</td>
<td>C-887.5PS</td>
</tr>
<tr>
<td>Würth snap-on ferrite, for hexapod power supply</td>
<td>–</td>
<td>000012097</td>
</tr>
</tbody>
</table>

*For specifications, see "Drag Chain Compatible Cables" (p. 41)

**The length refers to the cable between the power supply and the hexapod.

To order, contact our customer service department (p. 37).

### 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. 47).

**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. 47).

**INFORMATION**

The dimensional drawing (p. 42) 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]

- 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.

![Diagram of rotation around the W axis](image)

**Figure 5:** Rotation around the W axis

- Platform in reference position
- Platform position: \( U = 10, V = -10, W = 10 \) (U and V parallel to the platform level, W vertical to the platform level)

For further data on the travel ranges, see the "Specifications" section (p. 39).

### 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.

**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 foam cushion.
3. Open the inner box.
4. Remove the corrugated cardboard insert and the foam cushion
5. Grip the hexapod's base plate and take it out of the foam insert.
6. Remove the foil from the hexapod.
7. 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.
8. 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. 20).
  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. 20).
  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.
5 Installation

**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 are for orientation. They only apply when the center of mass is at the origin of the default coordinate system (0,0,0).

<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-820.D2</td>
<td>Mounted horizontally / 20 kg</td>
<td>Mounted horizontally / 200 N</td>
</tr>
<tr>
<td></td>
<td>Mounted as desired / 10 kg</td>
<td>Mounted as desired / 100 N</td>
</tr>
</tbody>
</table>

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

- Contact our customer service department (p. 37).
5.3 Attaching the Snap-on Ferrite

Figure 6: Power supply cable of the hexapod with snap-on ferrite

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. 10)
5 Installation

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. 00012097 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 marked with the ground connection symbol (p. 42).
2. Connect the motion platform to the grounding system:
   – Use one of the mounting holes in the motion platform (p. 42) for connection. or
   – If the motion platform and the load are connected conductively to each other, connect the load to the grounding system.

5.5 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 300 µm.

Requirements

✓ You have read and understood the general notes on installation (p. 19).

Tools and accessories

- Hex key 5.0 and three of the supplied screws (p. 9).

Mounting the hexapod

1. Provide three M6 threaded holes in the support for mounting with M6x30 screws. The arrangement of the mounting holes in the base plate of the hexapod can be found in the dimensional drawing (p. 42) as well as in the corresponding figure.

2. Mount the hexapod on the three mounting holes in the base plate using the M6x30 screws supplied.
5.6 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. 20).
- 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. 42) 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.

---

Figure 8: M6 mounting holes in the motion platform
5 Installation

Requirements
✓ You have read and understood the general notes on installation (p. 19).
✓ You have determined the permissible load and the workspace of the hexapod (p. 20).
✓ You have designed the load and the surroundings of the hexapod so that the permissible load of the hexapod is observed and no collisions can occur.

Tools and accessories
- At least three M6 screws with suitable length
- Suitable tool for tightening the screws

Affixing the load
1. Align the load so that at least three mounting holes in the motion platform can be used to affix the load.
   The arrangement of the mounting holes in the motion platform of the hexapod can be found in the dimensional drawing (p. 42) as well as in the corresponding figure.
2. Use the screws to affix the load to the selected mounting holes in the motion platform.

5.7 Optional: Removing the Coordinate Cube

You can remove the coordinate cube from the base plate of the hexapod.

Tools and accessories
- Hex key AF 2.0

Removing the coordinate cube

![Coordinate Cube Diagram](image)

Figure 9: Removing the Coordinate Cube

1. Loosen the threaded pin M4x8.
2. Pull the coordinate cube upwards away from the base plate.
5.8 Connecting the Hexapod to the Controller

A cable set with a length of 3 m is included in the scope of delivery of the hexapod (p. 9). Longer cable sets are available as optional accessory (p. 10). Cable sets with a length >20 m include line driver boxes (e.g., C-887.5A50 cable set with a length of 50 m).

**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. 21) 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 0.

**Tools and accessories**

- Cable set from the scope of delivery of the hexapod (p. 9).
- Alternative: Longer cable set available as optional accessory (p. 10).

**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)

Panel plug / connector, male
Socket / connector, female
Controller See "Suitable controllers" (p. 8)
Hexapod H-820.D2
A C-887.5PS power supply, from the scope of delivery of the controller, output 24 V DC

<table>
<thead>
<tr>
<th>Cable Set</th>
<th>Scope of delivery / C-887.5B03</th>
<th>C-887.5B05</th>
<th>C-887.5B07</th>
<th>C-887.5B10</th>
<th>C-887.5B20</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Data transmission cable 3 m K040B0241 / K040B0270</td>
<td>5 m K040B0271</td>
<td>7.5 m K040B0295</td>
<td>10 m K040B0296</td>
<td>20 m K040B0297</td>
</tr>
<tr>
<td>2</td>
<td>Power supply cable for the hexapod 3 m K060B0111 / K060B0262</td>
<td>5 m K060B0222</td>
<td>7.5 m K060B0223</td>
<td>10 m K060B0224</td>
<td>20 m K060B0225</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-820.D2

**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

<table>
<thead>
<tr>
<th>1</th>
<th>Data transmission cable 3 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Power supply cable for the hexapod-side line driver box, 47 m</td>
</tr>
<tr>
<td>3, 4, 5</td>
<td>Data transmission cable 44 m</td>
</tr>
<tr>
<td>6</td>
<td>Data transmission cable 3 m</td>
</tr>
</tbody>
</table>

* Observe channel assignment!
* Cable set used: C-887.5A50.
6 Startup

In this Chapter

General Notes on Startup ............................................................................................................ 29
Starting Up the Hexapod System .................................................................................................. 30

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 `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.
6.2 Starting Up the Hexapod System

Requirements

✓ You have read and understood the general notes on startup (p. 29).
✓ 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. 19).
✓ You have read and understood the user manual of the controller.

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).
7 Maintenance

In this Chapter

Performing a Maintenance Run ................................................................. 31
Packing the Hexapod for Transport ............................................................ 31
Cleaning the Hexapod ...................................................................... 34

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. 39).

- 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.
Accessories

- Original packaging (p. 9)
- Electrostatic dissipative film
- Strapping band
- Stretch film

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 and the hexapod.
   d) Loosen the three M6x30 screws used to fix the hexapod on the underlying surface.
   e) Remove the three M6x30 screws.
3. Pack the hexapod in electrostatic dissipative film to protect against dirt.
4. If necessary, prepare the original packaging, see figures:
   a) Put the outer box onto the pallet.
   b) Lay a 740 x 740 x 130 mm foam cushion into the outer box. Make sure that the recess for the inner box points upwards, while the "feet" point downwards.
   c) Insert the inner box into the outer box.
   d) Place the foam insert for the hexapod's base plate into the inner box. Pay attention to the appropriate orientation of the insert.
5. Grip the hexapod's base plate and put it into the foam insert of the inner box.
6. Put the foam cover onto the hexapod, see figure. Pay attention to the appropriate orientation of the cover.
7. Place the cushion made of folded corrugated cardboard onto the foam cover, see figure.
8. Close the inner box.
9. Put a 740 x 740 x 130 mm foam cushion onto the inner box, see figure.
10. Put the cover onto the outer box, see figure.
11. Secure the outer box on the pallet with two parallel strapping bands.
12. Wrap the box and pallet with stretch film.
7 Maintenance

Step 4 a

Step 4 b

Step 4 d
Right: Appropriate orientation of the foam insert, view from above

Step 6
Right: Appropriate orientation of the foam cover, view from above

Step 7
7.3 Cleaning the Hexapod

Requirements

- You have removed the cables for data transmission and the power supply from the hexapod.

Cleaning the hexapod

- If necessary, clean the surfaces of the hexapod with a cloth that is lightly dampened with a mild cleanser or disinfectant.
## 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. 37). |
| The hexapod does not achieve the specified accuracy. | - Warped base plate | ➢ Mount the hexapod onto an even surface (p. 22). The recommended flatness of the surface is 300 µm.  
- Increased wear due to small motion over a long period of time | ➢ Perform a maintenance run over the entire travel range (p. 31). |
| 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. 37). |
| The hexapod does not move. | Controller with **E-Stop** socket:  
- Nothing connected to **E-Stop**  
- "Break contact" is active on **E-Stop**  
In both cases, the **24 V Out 7 A** output of the controller is disabled. | 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

### Problem

<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. 37) 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. 37).
9 Customer Service

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 ...................................................................................................................................... 39
Ambient Conditions and Classifications ....................................................................................... 41
Dimensions ...................................................................................................................................... 42
Pin Assignment ............................................................................................................................... 42

10.1 Specifications

10.1.1 Data Table

<table>
<thead>
<tr>
<th>Motion and positioning</th>
<th>H-820.D2</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* X, Y</td>
<td>±50 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel range* Z</td>
<td>±25 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel range* θx, θy</td>
<td>±15 °</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel range* θz</td>
<td>±30 °</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actuator drive</td>
<td>Torque motor, brushless (BLDC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actuator design resolution</td>
<td>0.2 µm</td>
<td>µm</td>
<td>typ.</td>
</tr>
<tr>
<td>Minimum incremental motion X, Y, Z</td>
<td>5 µm</td>
<td>µm</td>
<td>typ.</td>
</tr>
<tr>
<td>Minimum incremental motion θx, θy, θz</td>
<td>12.5 µrad</td>
<td>µrad</td>
<td>typ.</td>
</tr>
<tr>
<td>Repeatability X, Y</td>
<td>±1.5 µm</td>
<td>µm</td>
<td>typ.</td>
</tr>
<tr>
<td>Repeatability Z</td>
<td>±0.5 µm</td>
<td>µm</td>
<td>typ.</td>
</tr>
<tr>
<td>Repeatability θx, θy</td>
<td>±8 µrad</td>
<td>µrad</td>
<td>typ.</td>
</tr>
<tr>
<td>Repeatability θz</td>
<td>±25 µrad</td>
<td>µrad</td>
<td>typ.</td>
</tr>
<tr>
<td>Backlash X, Y</td>
<td>30 µm</td>
<td>µm</td>
<td>typ.</td>
</tr>
<tr>
<td>Backlash Z</td>
<td>3 µm</td>
<td>µm</td>
<td>typ.</td>
</tr>
<tr>
<td>Backlash θx, θy</td>
<td>30 µrad</td>
<td>µrad</td>
<td>typ.</td>
</tr>
<tr>
<td>Backlash θz</td>
<td>300 µrad</td>
<td>µrad</td>
<td>typ.</td>
</tr>
<tr>
<td>Max. velocity X, Y, Z</td>
<td>20 mm/s</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**10 Technical Data**

<table>
<thead>
<tr>
<th>Motion and positioning</th>
<th>H-820.D2</th>
<th>Unit</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. velocity $\theta_x$, $\theta_y$, $\theta_z$</td>
<td>200</td>
<td>mrad/s</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mechanical properties</th>
<th>H-820.D2</th>
<th>Unit</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load capacity (horizontal base plate)</td>
<td>20</td>
<td>kg</td>
<td>max.</td>
</tr>
<tr>
<td>Load capacity (base plate in any orientation)</td>
<td>10</td>
<td>kg</td>
<td>max.</td>
</tr>
<tr>
<td>Holding force (horizontal base plate)</td>
<td>200</td>
<td>N</td>
<td>max.</td>
</tr>
<tr>
<td>Holding force (base plate in any orientation)</td>
<td>100</td>
<td>N</td>
<td>max.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Miscellaneous</th>
<th>H-820.D2</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>Aluminum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>15</td>
<td>kg</td>
<td>±5 %</td>
</tr>
<tr>
<td>Cable length</td>
<td>3</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, $\theta_x$, $\theta_y$, $\theta_z$) 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.

**10.1.2 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>
## 10.1.3 Drag Chain Compatible Cables

<table>
<thead>
<tr>
<th>Drag chain compatible cable set, for components, see &quot;Optional Accessories&quot; (p. 10)</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cable length</strong></td>
<td><strong>3 / 5 / 7.5 / 10 / 20 m</strong></td>
</tr>
<tr>
<td><strong>Maximum velocity</strong></td>
<td><strong>3 m/s</strong></td>
</tr>
<tr>
<td><strong>Maximum acceleration</strong></td>
<td><strong>7.5 m/s²</strong></td>
</tr>
<tr>
<td><strong>Maximum number of bending cycles</strong></td>
<td><strong>1 million</strong></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

## 10.2 Ambient Conditions and Classifications

| Degree of pollution | 2 |
| Air pressure | 1100 hPa to 780 hPa |
| Transport temperature | -25 °C to +85 °C |
| Storage temperature | 0 °C to 70 °C |
| Humidity | Highest relative humidity of 80% at temperatures of up to 31°C, decreasing linearly to a relative humidity of 50% at 40°C |
| Degree of protection according to IEC 60529: | IP20 |
| Area of application: | For indoor use only |
| Maximum altitude: | 2000 m |
10.3 Dimensions

The figure shows the hexapod in the reference position. Dimensions in mm. Note that the decimal points are separated by a comma in the drawings.

Figure 12: H-820.D2 Hexapod

The (0,0,0) coordinates refer to 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, the center of rotation is located at the origin of the coordinate system.

10.4 Pin Assignment

10.4.1 Power Supply Connection

Power supply via 4-pin M12 Panel plug

<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>
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### 10.4.2 Data Transmission Connection

Data transmission between hexapod and controller

Panel plug HD Sub-D 78 m

<table>
<thead>
<tr>
<th>Pin</th>
<th>Pin</th>
<th>Signal</th>
<th>Pin</th>
<th>Pin</th>
<th>Signal</th>
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<tr>
<td>1</td>
<td>21</td>
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</tr>
<tr>
<td>2</td>
<td></td>
<td>CH1 Ref OUT</td>
<td>41</td>
<td></td>
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</tr>
<tr>
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<td>22</td>
<td>CH1 LimN OUT</td>
<td>41</td>
<td>61</td>
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<tr>
<td></td>
<td>23</td>
<td>CH1 A+ OUT</td>
<td>42</td>
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</tr>
<tr>
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<td></td>
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<td>43</td>
<td></td>
<td>CH1 B- OUT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CH1 B+ OUT</td>
<td></td>
<td></td>
<td>CH1 B- OUT</td>
</tr>
<tr>
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<td></td>
<td>CH1 B+ OUT</td>
<td></td>
<td>45</td>
<td>CH2 B+ OUT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CH1 B- OUT</td>
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<td>CH2 MAGN IN</td>
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<td>47</td>
<td></td>
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</tr>
<tr>
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</tr>
<tr>
<td></td>
<td></td>
<td>CH2 LimP OUT</td>
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<td>CH3 B+ OUT</td>
</tr>
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<td></td>
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<td>49</td>
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<td>CH3 B- OUT</td>
</tr>
<tr>
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<td>CH4 MAGN IN</td>
</tr>
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<td>68</td>
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<td></td>
<td>CH4 LimP OUT</td>
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<td></td>
<td></td>
<td>CH4 LimN OUT</td>
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<tr>
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<td>CH3 A+ OUT</td>
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</tr>
<tr>
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</tr>
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<td>31</td>
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All signals: TTL
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<th>Pin</th>
<th>Signal</th>
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<td>CH6 Sign IN</td>
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<td>GND</td>
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<tr>
<td>33</td>
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<tr>
<td>34</td>
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<td>CH5 A+ OUT</td>
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<td>51</td>
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<td>CH5 LimP OUT</td>
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<td>57</td>
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</tr>
<tr>
<td>58</td>
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<td>CH6 B+ OUT</td>
</tr>
<tr>
<td>59</td>
<td></td>
<td>Brake/Enable drive</td>
</tr>
<tr>
<td>60</td>
<td></td>
<td>GND</td>
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<td>Brake/Enable drive</td>
</tr>
<tr>
<td>62</td>
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<td>GND</td>
</tr>
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<td>63</td>
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<td>Power Good 24 V output</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
**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. 42).

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 13: H-810 hexapod in the reference position.

1 Cable exit
Figure 14: 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 ....................................................................................... 53

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 figure shows the test setup used.

Figure 15: Test setup for measuring the X or Y axis.

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-820, 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