MS203E

H-206 Hexapod

User Manual

Version: 2.1.0 Date: 04.12.2019

This document describes the following product:

- **H-206.F2**
  Hexapod microrobot for optical alignment, removable magnetic plate, DC motor, 1.5 kg load capacity, 8 mm/s velocity, including 3 m cable

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Contents

1 About this Document

In this Chapter

1.1 Objective and Target Audience of this User Manual

This manual contains information on using the H-206 as intended.

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:

NOTICE

Dangerous situation
Failure to comply could cause damage to equipment.

➢ Precautionary measures for avoiding the risk.

INFORMATION

Information for easier handling, tricks, tips, etc.

Symbol/Label	Meaning
1. 2.	Action consisting of several steps whose sequential order must be observed
➢	Action consisting of one or several steps whose sequential order is irrelevant

Symbol/Label	Meaning
▪	List item
p. 5	Cross-reference to page 5
RS-232	Labeling of an operating element on the product (example: socket of the RS-232 interface)
	Warning sign on the product which refers to detailed information in this manual.

1.3 Figures

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

1.4 Other Applicable Documents

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

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

1.5 Downloading Manuals

INFORMATION

If a manual is missing or problems occur with downloading:

➢ Contact our customer service department (p. 47).

Downloading manuals

1. Open the website **www.pi.ws**.
2. Search the website for the product number (e.g., P-882) or the product family (e.g., PICMA® bender).
3. Click the corresponding product to open the product detail page.
4. Click ***Downloads***.

   The manuals are shown under ***Documentation***.
5. Click the desired manual and fill out the inquiry form.

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

2 Safety

In this Chapter

2.1 Intended Use

The hexapod for 6-DOF alignment is a laboratory device as defined by DIN EN 61010-1. It is intended for indoor use in an environment that is free of dirt, oil, and lubricants.

In accordance with its design, the hexapod is intended for positioning, adjusting and shifting of optical components (hereafter referred to as "load") 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-206 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-206.

- Use the H-206 for its intended purpose only, and only when it is in perfect technical condition.
- Read the user manual.
- Eliminate any malfunctions that may affect safety immediately.

The operator is responsible for the correct installation and operation of the H-206.

2.3 Organizational Measures

User manual

- Always keep this user manual together with the H-206.
  The latest versions of the user manuals are available for download (p. 3) on our website.

- Add all information from the manufacturer to the user manual, for example supplements or technical notes.
- If you give the H-206 to a third party, include this user manual as well as other relevant information provided by the manufacturer.
- Do the work only if the user manual is complete. Missing information due to an incomplete user manual can result in minor injury and damage to equipment.
- Install and operate the H-206 only after you have read and understood this user manual.

Personnel qualification

The H-206 may only be installed, started, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

3 Product Description

In this Chapter

3.1 Features and Applications

The H-206 hexapod is ideally suited for applications concerning the fiber alignment of optical components. Flexures guarantee the highest precision.

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

Model	Designation
H-206.F2	Hexapod microrobot for optical alignment, removable magnetic plate, DC motor, 1.5 kg load capacity, 8 mm/s velocity, including 3 m cable

3.3 Suitable Controllers

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

➢ To order, contact our customer service department (p. 47).

3.4 Product View

Figure 1: Product view

1 Mounting plate for fast replacement of different assemblies
2 Motion platform
3 LEDs (arranged from top to bottom):
Limit switch status:
red = limit switch is activated
off = correct operation
Ready state:
green = hexapod is ready for operation
off = hexapod is not ready for operation
4 Panel plug for power supply cable
5 Panel plug for data transmission cable
6 Housing
7 Base plate
8 Angle bracket for fixing immovable components

INFORMATION

The mounting plate (1) is held on the motion platform (2) by two magnets. Adjustment elements guarantee accurate fitting of the mounting plate.

Additional mounting plates are available as optional accessories (p. 11). There, fast replacement of the load to be aligned is possible.

3.5 Scope of Delivery

Order number	Components
H-206	Hexapod according to your order (p. 7) The motion platform is removed and wrapped separately with the following parts: ▪ Mounting plate for fast mounting of loads to be aligned ▪ 12 M2.5x8 countersunk screws ISO 7046 A2 for mounting of the motion platform plus 4 spare screws ▪ Phillips-head screwdriver, size 1
Cable set, consisting of:	
K040B0241	Data transmission cable, HD Sub-D 78 f/m, 1:1, 3 m
K060B0112	Power supply cable, M12 f/m, 3 m
000015165	Steward snap-on ferrite
Packaging, consisting of:	
–	▪ Transport cover, installed on H-206 with 4 M3x5 screws ▪ Transport plate made of wood, mounted on H-206 with 4 M6 screws ▪ Inner box ▪ Cover and insert for inner box, made of corrugated cardboard ▪ Two pads for sliding onto the inner box ▪ Outer box ▪ Pallet
Documentation, consisting of:	
H206T0001	Technical note on unpacking the hexapod
MS247EK	Short instructions for hexapod systems
Screw sets:	
000034605	Mounting accessories: ▪ 6 socket head screws, M6x30 ISO 4762 ▪ 1 hex key 5.0 DIN 911
000036450	Accessories for connection 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

3.6 Accessories

Order number		
F-206.TMU	Mounting plate for fast replacement of different assemblies	
F-603.11	Objective holder	All holders are equipped with a 3 mm wide rib that fits into the respective groove of the motion platform of the hexapod H-206. M3 screws and miniature cleats are used to fasten these accessories quickly.
F-603.22	Ferrule holder	
F-603.60	Fiber holder with magnetic clamping	

To order, contact our customer service department (p. 47).

Order number	Description*		
C-887.5A03	Hexapod cable set **3 m**, consisting of:		
	Description	**Length**	**Item number**
	Data transmission cable, HD D-sub 78 f/m, 1:1	3 m	K040B0490
	Power supply cable, M12 m/f, 1:1	3 m	K060B0262
C-887.5B03	Hexapod cable set **3 m**, drag chain compatible, consisting of:		
	Designation	**Length**	**Item number**
	Data transmission cable, HD D-sub 78 f/m, 1:1	3 m	K040B0270
	Power supply cable, M12 m/f, 1:1	3 m	K060B0262
C-887.5A05	Hexapod cable set **5 m**, consisting of:		
	Designation	**Length**	**Item number**
	Data transmission cable, HD D-sub 78 f/m, 1:1	5 m	K040B0243
	Power supply cable, M12 m/f, 1:1	5 m	K060B0222
C-887.5B05	Hexapod cable set **5 m**, drag chain compatible, consisting of:		
	Designation	**Length**	**Item number**
	Data transmission cable, HD D-sub 78 f/m, 1:1	5 m	K040B0271
	Power supply cable, M12 m/f, 1:1	5 m	K060B0222
C-887.5A07	Hexapod cable set **7.5 m**, consisting of:		
	Designation	**Length**	**Item number**
	Data transmission cable, HD D-sub 78 f/m, 1:1	7.5 m	K040B0244
	Power supply cable, M12 m/f, 1:1	7.5 m	K060B0223
C-887.5B07	Hexapod cable set **7.5 m**, drag chain compatible, consisting of:		
	Designation	**Length**	**Item number**
	Data transmission cable, HD D-sub 78 f/m, 1:1	7.5 m	K040B0295
	Power supply cable, M12 m/f, 1:1	7.5 m	K060B0223

Order number	Description*		
C-887.5A10	Hexapod cable set **10 m**, consisting of:		
	Designation	**Length**	**Item number**
	Data transmission cable, HD D-sub 78 f/m, 1:1	10 m	K040B0245
	Power supply cable, M12 m/f, 1:1	10 m	K060B0224
C-887.5B10	Hexapod cable set **10 m**, drag chain compatible, consisting of:		
	Designation	**Length**	**Item number**
	Data transmission cable, HD D-sub 78 f/m, 1:1	10 m	K040B0296
	Power supply cable, M12 m/f, 1:1	10 m	K060B0224
C-887.5A20	Hexapod cable set **20 m**, consisting of:		
	Designation	**Length**	**Item number**
	Data transmission cable, HD D-sub 78 f/m, 1:1	20 m	K040B0251
	Power supply cable, M12 m/f, 1:1	20 m	K060B0225
C-887.5B20	Hexapod cable set **20 m**, drag chain compatible, consisting of:		
	Designation	**Length**	**Item number**
	Data transmission cable, HD D-sub 78 f/m, 1:1	20 m	K040B0297
	Power supply cable, M12 m/f, 1:1	20 m	K060B0225
C-887.5A50	Hexapod cable set **50 m**, consisting of:		
	Designation	**Length**	**Item number**
	Line driver box for data transmission cable, controller-side	–	C887B0057
	Line driver box for data transmission cable, hexapod-side	–	C887B0058
	Short data transmission cable, HD D-sub 78 f/m, 1:1	3 m	K040B0241
	Long data transmission cable, HD D-sub 44 f/m, 1:1, three pieces	44 m	K040B0277
	Power supply cable for hexapod-side line driver box, with M12 connector (m)/M-12 connector (f)	47 m	K060B0228
	Power adapter for hexapod, with M12 connector (f) and power cord	1.5 m**	C-501.24180M12
	Snap-on ferrite, for hexapod power adapter	–	000012097

* See "Cable Set Specifications" (p. 50) for more information.

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

To order, contact our customer service department (p. 47).

3.7 Technical Features

3.7.1 Struts

The Hexapod has six struts with moveable base points. Each base point 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 preloaded and equipped with flexures. The motion of the base point is generated and monitored for each strut via the following components:

- DC motor
- Drive screw
- Precision guiding
- Incremental encoder
- Reference and limit switches

3.7.2 Reference Switch and Limit Switches

The reference switches of the struts function independently of each other.

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 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.

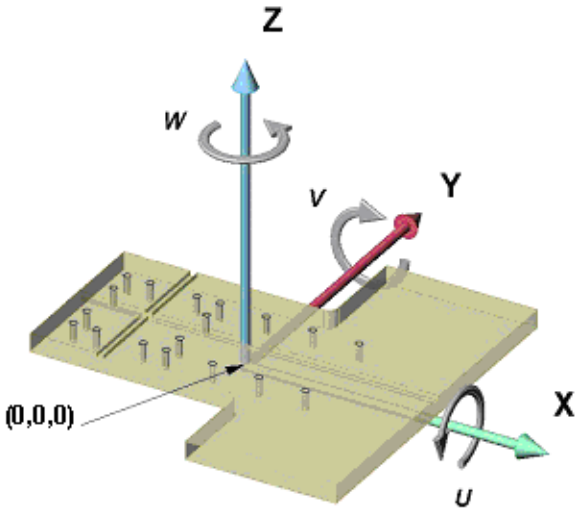


Figure 2: XYZ coordinate system with origin (0,0,0), rotations to the rotational coordinates U, V and W

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. 57).

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. 57).

INFORMATION

The dimensional drawing (p. 52) contains the following:

- Orientation of the default coordinate system
- Position of the center of rotation when the controller's factury settings are used and the motion platform is in its reference position.

Example: Consecutive rotations

INFORMATION

For a clearer view, the figures have been adapted as follows:

- 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 3.

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

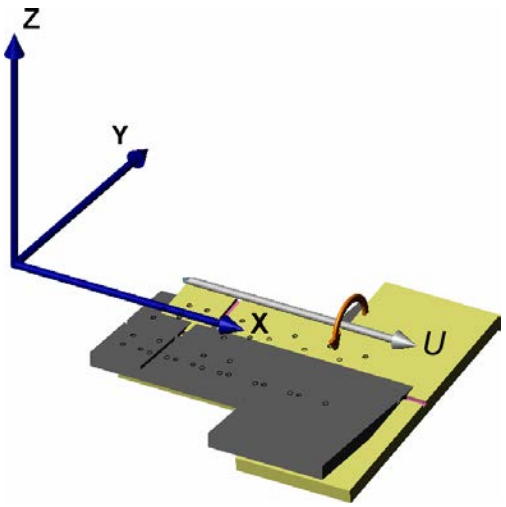


Figure 3: Rotation around the U axis

Platform in reference position

Platform position: U = 3 (U parallel to spatially fixed X axis)

2. The V axis is commanded to move to position –3.

   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.

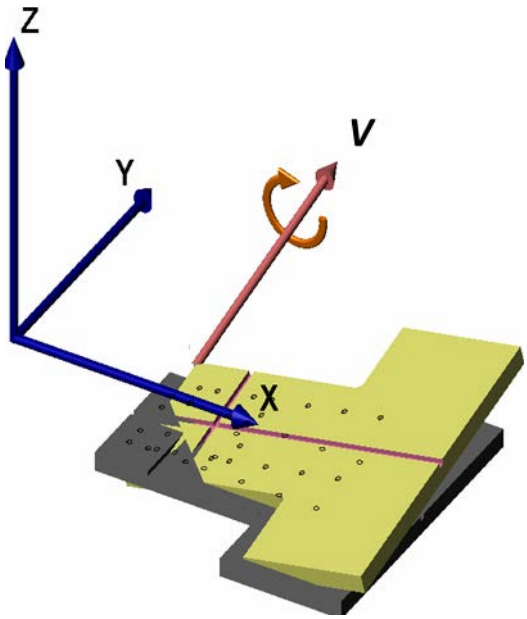


Figure 4: Rotation around the V axis

Platform in reference position

Platform position: U = 3, V = –3 (U and V parallel to the platform level)

3. The W axis is commanded to move to position 3.

   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.

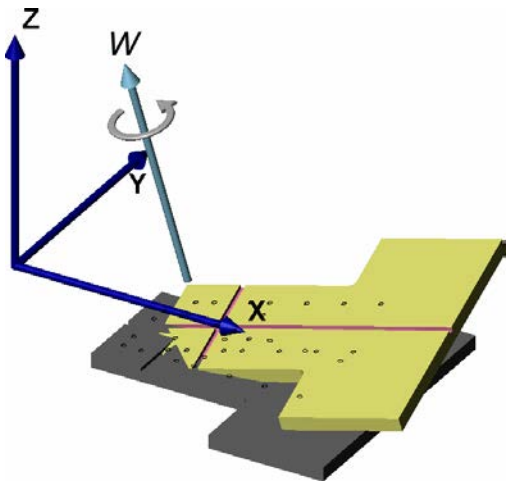


Figure 5: Rotation around the W axis

Platform in reference position

Platform position: U = 3, V = –3, W = 3 (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. 49).

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 installed transport cover and plate. The motion platform is removed. It is wrapped separately with the mounting plate and mounting accessories, see "Mounting the Motion Platform" (p. 25).

NOTICE

Impermissible mechanical load!
An impermissible mechanical load could damage the hexapod.

- Only hold the hexapod by the following components:
  - Three angle brackets for fixing immovable components
  - Base plate
  - Transport plate
- Avoid impacts that affect the hexapod.
- Do not drop the hexapod.
- Do not remove the transport cover until the hexapod has been mounted onto a surface at its place of application (p. 24).

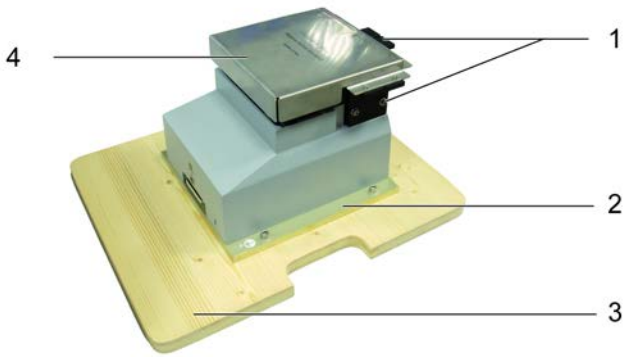


Figure 6: Hexapod with transport cover and transport plate

1 Angle bracket for fixing immovable components
2 Base plate
3 Wooden transport plate
4 Transport cover

Tools and Accessories

- Hex key 5.0 from the screw set supplied (p. 10)

Unpacking the hexapod

1. Open the outer box.
2. Lift the inner box with the side pads out of the outer box.
3. Remove the side pads.
4. Open the inner box.
5. Remove the foam cover.
6. Remove the motion platform (wrapped separately in foil).
7. Remove the corrugated cardboard cover.
8. Remove the corrugated cardboard insert.
9. Hold the hexapod by the wooden transport plate and take it out of the inner box.
10. Compare the contents with the items listed in the contract and the packing list. If parts are incorrectly supplied or missing, contact PI immediately.
11. Inspect the hexapod for signs of damage. If you notice signs of damage, contact PI immediately.
12. Remove the wooden transport plate:
    a) Use the 5.0 hex key to loosen the four M6 screws that attach the transport plate to the base plate of the H-206.
    b) Remove the 4 loosened screws and the corresponding plastic flat washers.
    c) Remove the H-206 from the transport plate.
    d) Slide a plastic washer onto each M6 screw.
    e) Screw the 4 M6 screws into the T-nuts in the wooden transport plate, in order to prevent losing the screws and washers.
13. **Do not** remove the transport cover yet.
14. Keep all packaging materials and the transport plate in case the product needs to be transported again later.

5 Installation

In this Chapter

5.1 General Notes on Installation

NOTICE

Impermissible mechanical load and collisions!

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

- Only install the hexapod in horizontal orientation, so that the load has a vertical effect on the motion platform.
- Avoid lateral forces on the motion platform of the hexapod.
- Only hold the hexapod by the three angle brackets for fixing unmovable components or by the base plate.
- Do not remove the transport cover until the hexapod has been mounted onto a surface at its place of application (p. 25).
- 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 apply only when the controller has the servo mode switched on for the axes of the motion platform.
- 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.
- Make sure that collisions are not possible between the hexapod, the load to be moved, and the surroundings in the workspace of the hexapod.

NOTICE

Damage when exceeding the permissible operating temperature!
Exceeding the specified operating temperature can damage the hexapod.

➢ Adhere to the values specified (p. 49) during and after installation of the hexapod.

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).

	Servo mode switched on for hexapod – max. load capacity		**Servo mode switched off for hexapod – max. holding force**
Fulfilling the specifications (p. 49)	Reduced accuracy for extreme target positions	Specified accuracy reached for all target positions	–
H-206.F2	1.5 kg	1.2 kg	10 N

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

➢ Contact our customer service department (p. 47).

5.3 Attaching the Snap-on Ferrite

Figure 7: 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. 10)
- 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).
   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. 10) and the M4 hole with an 8 mm depth marked with the ground connection symbol (p. 52).
2. Connect the motion platform to the grounding system:
   – Use one of the mounting holes in the motion platform (p. 52) 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

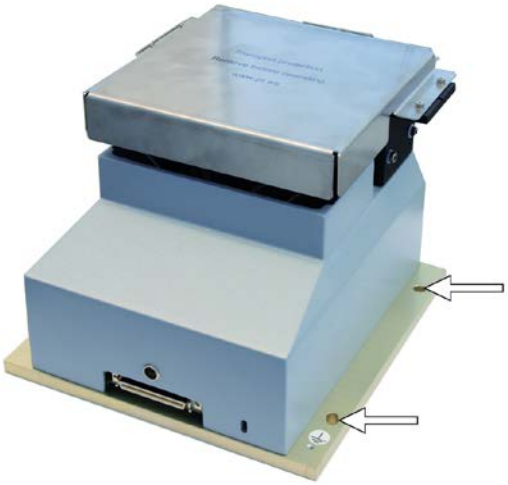


Figure 8: Mounting holes in the base plate, two of four holes visible

Requirements

- ✓ You have read and understood the general notes on installation (p. 21).
- ✓ You have removed the transport plate from the hexapod, see "Unpacking" (p. 19).

Tools and Accessories

- Hex key 5.0 and four of the supplied screws (p. 10)

Mounting the hexapod

1. Drill four M6 threaded holes into the surface for mounting with M6x30 screws.

   The arrangement of the four mounting holes can be found in the dimensional drawing (p. 52).

2. Mount the hexapod on the four mounting holes in the base plate using the included M6x30 screws.

5.6 Mounting the Motion Platform

The hexapod is delivered with an installed transport cover, refer to "Unpacking" (p. 19). The motion platform is removed and wrapped separately.

NOTICE

Impermissible mechanical load!

An impermissible mechanical load can damage the hexapod.

- ➢ Avoid high forces and torques while mounting the motion platform.
- ➢ Tighten the screws with a maximum torque of approx. 0.2 Nm when mounting the motion platform.

INFORMATION

The mounting plate (4) is held to the motion platform (3) by two magnets.

Figure 9: Motion platform, disassembled and wrapped separately, with mounting plate and mounting accessories

1 Phillips-head screwdriver, size 1
2 16 M2.5x8 countersunk screws, covered with a drying agent here
3 Motion platform
4 Mounting plate for fast mounting of loads to be aligned

INFORMATION

The motion platform has recesses on the bottom side for an exact fit on the carrier plate.

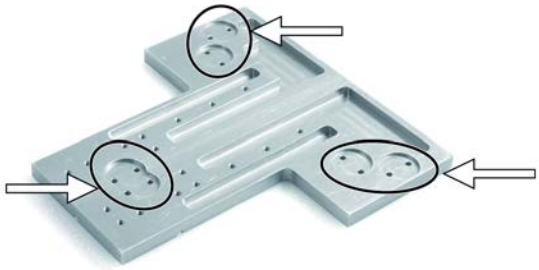


Figure 10: Bottom side of the motion platform, markings indicate the positions of the countersunk holes for fixing to the carrier plate

Requirements

- ✓ You have read and understood the general notes on installation (p. 21).
- ✓ You have mounted the hexapod at its place of application, see "Mounting the Hexapod onto a Surface" (p. 25).

Tools and Accessories

- Motion platform with the following mounting accessories in the scope of delivery (p. 10):
  - 12 A2 M2.5x8 countersunk screws
  - Phillips-head screwdriver, size 1
- Hex key 2.5

Mounting the Motion Platform

1. Remove the transport cover:
   a) Use the 2.5 hex key to loosen the four M3x5 screws that attach the transport lid to the side angle brackets of the H-206.
   b) Remove the 4 loosened screws and the corresponding metal flat washers.
   c) Remove the transport cover.

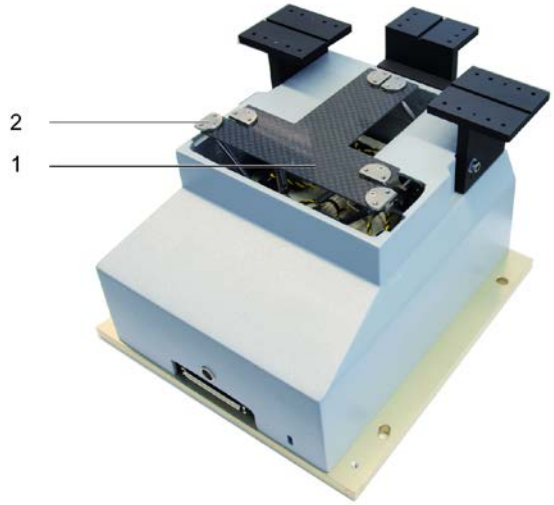


Figure 11: H-206 after the transport cover has been removed

1 Carrier plate for motion platform, made of carbon
2 Holding fixture for mounting screws, 6 pieces provided

The carrier plate for the motion platform is accessible.

2. Mount the motion platform:

   a) Remove the motion platform and the mounting accessories from the wrapping.

   b) Remove the mounting plate from the motion platform.

   c) Carefully place the motion platform on the carrier plate (1) so that the six holding fixtures for the mounting screws (2) fit in the respective recesses in the bottom side of the motion platform.

   d) Fasten the motion platform to the carrier plate with 12 M2.5x8 screws with a maximum torque of 0.2 Nm each. The positions of the countersunk holes for mounting can be found in the figure showing the bottom side of the motion platform.

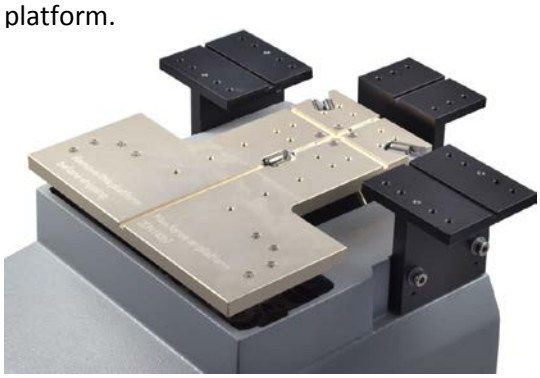


Figure 12: Motion platform mounted on the H-206

3. Keep the transport lid, the corresponding screws and washers in case the hexapod needs to be transported again later.

5.7 Fixing 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).
- Install the load so that it applies a vertical force to the motion platform.
- 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 mounting plate or of the motion platform, or the depth of the mounting holes (p. 52) together with the load to be mounted.
- Only use screws that do not project under the mounting plate or motion platform after being screwed in.
- Only mount the hexapod and the load on the mounting fixtures (holes) intended for this purpose.

INFORMATION

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 to the motion platform by two magnets. The following adjustment elements guarantee accurate fitting of the mounting plate:

- Three guidings on the top side of the motion platform
- Three balls on the bottom side of the mounting plate

Additional mounting plates are available as optional accessories (p. 11). Thus, fast replacement of the load to be aligned is possible.

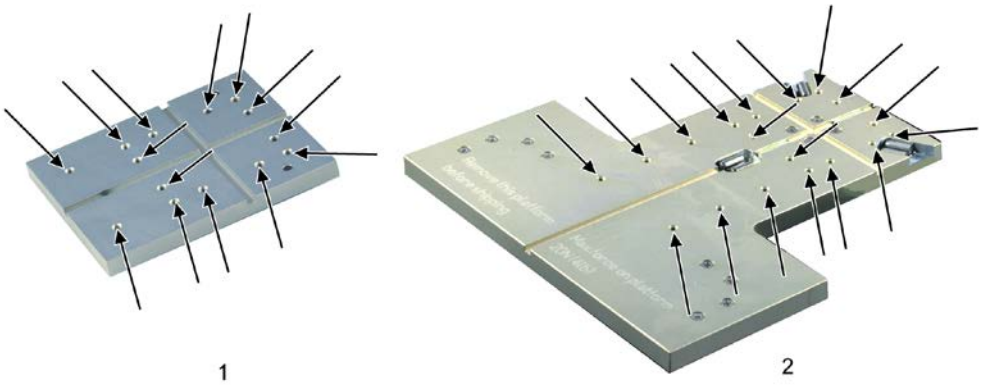


Figure 13: M3 mounting holes with 6 mm depth for fixing the load

1 Mounting plate
2 Motion platform

Requirements

- ✓ You have read and understood the general notes on installation (p. 21).
- ✓ You have determined the permissible load and the workspace of 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.
- ✓ You have mounted the motion platform (p. 25).

Tools and Accessories

- M3 screws with suitable length
- Suitable tool for tightening the screws
- If you want to fix multiple loads to be aligned in quick succession: One additional mounting plate each per assembly, available as optional accessories (p. 11).

Fixing the load

1. If necessary, remove the mounting plate from the motion platform.
2. Align the load so that the selected mounting holes in the top side of the mounting plate or in the motion platform can be used to fix it. The arrangement of the mounting holes in the mounting plate and in the motion platform of the hexapod can be found in the dimensional drawing (p. 52) as well as in the corresponding figure.
3. Use the screws to fix the load to the mounting holes selected in the top side of the mounting plate or in the motion platform.
4. When you have fixed the load to the mounting plate:
   - Carefully place the mounting plate on the motion platform so that the three balls on the bottom side of the mounting plate are in the guidings on the top side of the motion platform.

5.8 Fixing an Immovable Component to the Hexapod

The hexapod has three angle brackets for fixing immovable components on the sides and rear panel of the case. These angle brackets can be used for example, to attach optical components to align the load with.

Figure 14: Angle brackets for immovable components on the H-206 hexapod

1 Side angle brackets for fixing immovable components
2 Angle bracket on the rear panel for fixing immovable components

Prerequisites

- ✓ You have read and understood the general notes on installation (p. 21).
- ✓ You have designed the immovable component so that collisions are not possible.

Tools and accessories

- M3 screws with suitable length
- Suitable tools for fastening the screws

Fixing an immovable component to the hexapod

1. Align the component to be fixed so that the mounting holes of the selected angle bracket can be used. The layout of the mounting holes in the three angle brackets can be found in the dimensional drawing (p. 52).
2. Fix the component to the mounting holes in the angle bracket using the M3 screws.

5.9 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. 10). 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).

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 ○.

Tools and accessories

- Cable set from the scope of delivery of the hexapod (p. 10)
- Optional: Additional cable set, available as accessory (p. 11)

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)

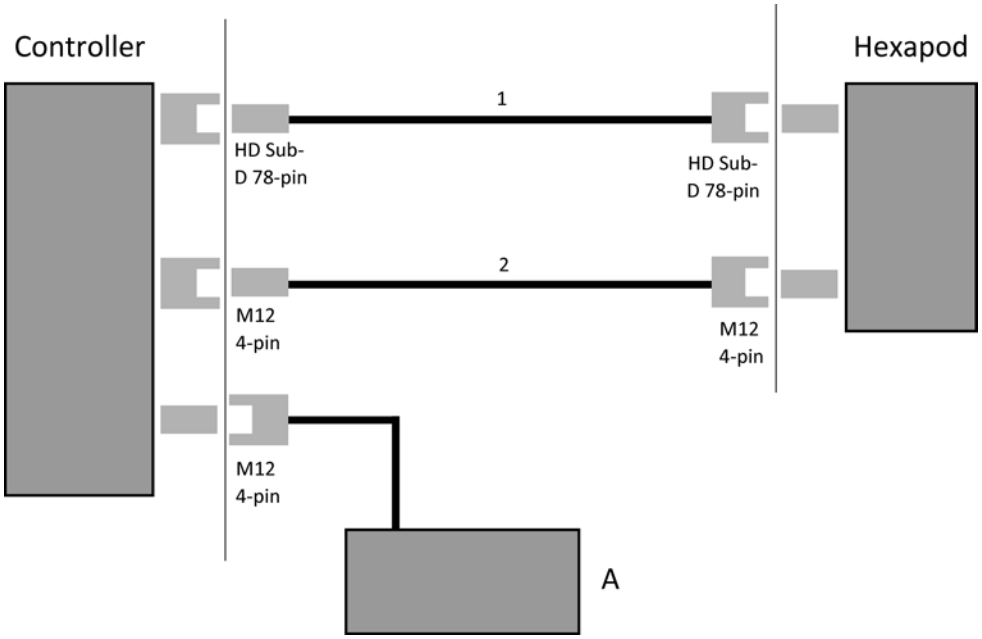


Figure 15: Connection diagram of cable set without line driver boxes

	Panel plug / connector, male
	Socket / connector, female
Controller	Refer to "Suitable Controllers" (p. 8)
Hexapod	H-206
A	Power adapter, from the scope of delivery of the controller, 24 V DC output
1	Data transmission cable*
2	Power supply cable*

* From the scope of delivery of the hexapod (p. 10) or of an optionally available cable set (p. 11).

Cabling with line driver boxes (no vacuum)

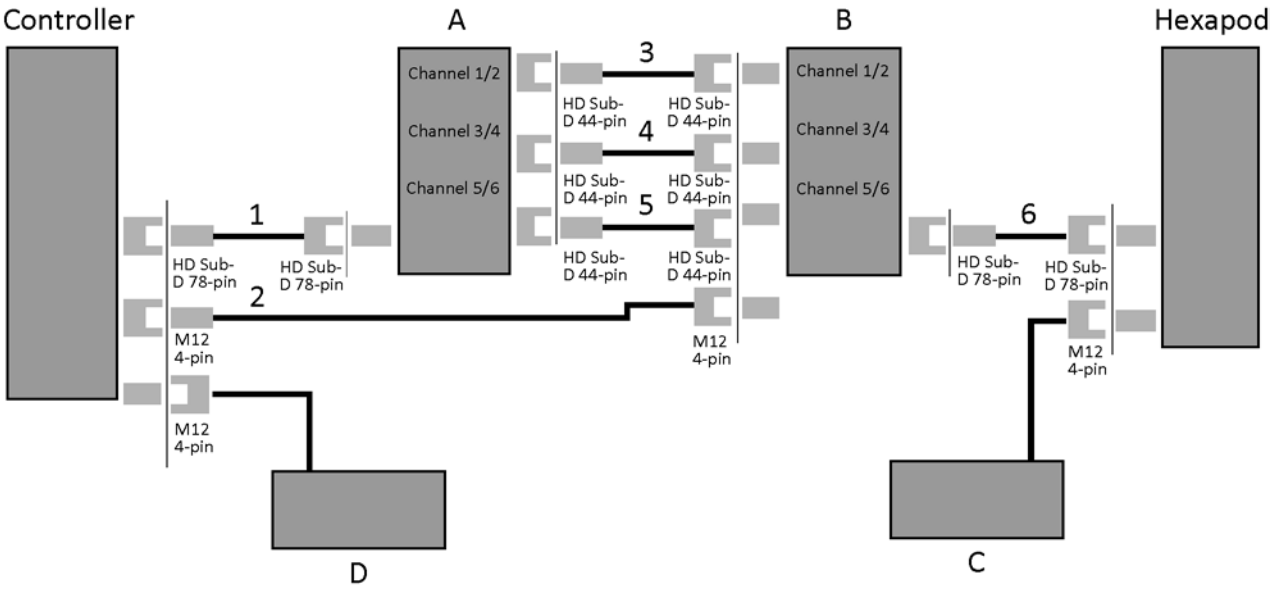


Figure 16: Connection diagram of cable set with line driver boxes

	Panel plug / connector, male
	Socket / connector, female
Controller	Refer to "Suitable Controllers" (p. 8)
Hexapod	H-206
A	Controller-side line driver box*
B	Hexapod-side line driver box*
C	Power adapter, 24 V DC output*
D	Power adapter, from the scope of delivery of the controller, 24 V DC output
1	Data transmission cable, 3 m*
2	Power supply cable for the hexapod-side line driver box, 47 m*
3, 4, 5	Data transmission cable 44 m* **Maintain channel assignment!**
6	Data transmission cable 3 m**

* From the scope of delivery of the cable set (p. 11).

** From the scope of delivery of the hexapod (p. 10).

6 Startup

In this Chapter

6.1 General Notes on Startup

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.

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.

INFORMATION

In rare cases, the limit switches of the hexapod struts can be activated, in particular if the hexapod is exposed to strong vibrations during transport. If at least one limit switch is activated, the red LED for the limit switch status in the front panel of the hexapod housing lights up when the controller is switched on. In order to deactivate the limit switches, a successful reference move of the hexapod is required.

- ➢ Start up the hexapod system. Startup also includes a reference move (see user manual for the controller).
- ➢ If the red LED stays on and/or the reference move is not successfully performed: Contact our customer service department (p. 47).

6.2 Starting Up the Hexapod System

Requirements

- ✓ You have read and understood the general notes on startup (p. 35).
- ✓ You have correctly installed the hexapod, i.e., you have mounted the hexapod onto a surface, fixed 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.

Accessories

- PC with suitable software (refer to the user manual of the controller)

Starting up the hexapod system

1. Start up the controller (refer to the user manual of the controller).
2. Run a few motion cycles for test purposes (refer to the user manual of the controller).

7 Maintenance

In this Chapter

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. 49).

- 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!

An impermissible mechanical load could damage the hexapod.

- Avoid high forces and torques when removing the motion platform.
- Only transport the hexapod when the motion platform has been removed from the hexapod and the transport cover has been fixed to the hexapod.
- Ship the hexapod in the original packaging only.
- Only hold the hexapod by the following components:
  - Three angle brackets for fixing immovable components
  - Base plate
  - Transport plate
- Avoid impacts that affect the hexapod.
- Do not drop the hexapod.

Accessories

- Original packaging (p. 10)
- Hex key 5.0 from the supplied screw set (p. 10)
- Phillips-head screw driver, size 1, included (p. 10)
- Hex key 2.5

Packing the hexapod

1. Switch the controller off.
2. Remove the data transmission cable and the power supply cable from the controller and the hexapod.

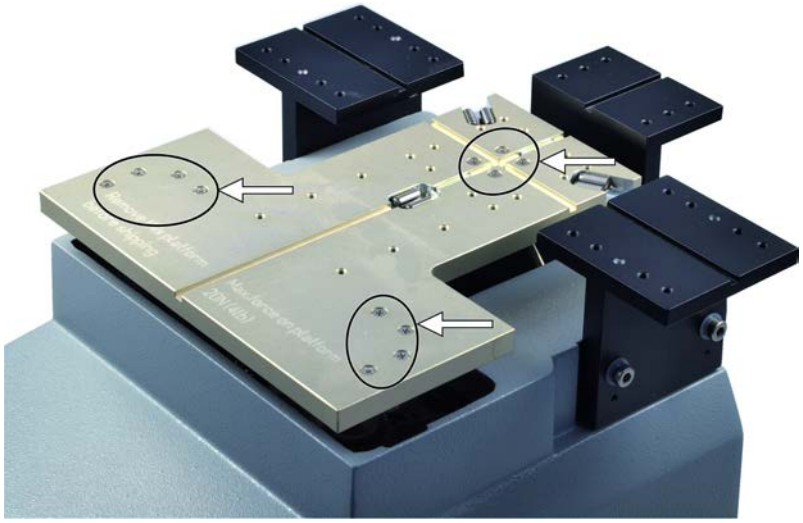


Figure 17: Motion platform, markings indicate the positions of the 12 screws with which the motion platform is fastened to the carrier plate

3. Remove the motion platform:
   a) Remove the mounting plate with the load from the motion platform.
   b) If the load is fixed directly to the motion platform, remove the load.
   c) Use the Phillips-head screwdriver to completely loosen the 12 M2.5x8 screws with which the motion platform is fixed to the carrier plate.
   d) Remove the motion platform, including the 12 screws, from the hexapod.
   e) Wrap the motion platform, the 12 screws and if necessary, the mounting plate in foil.

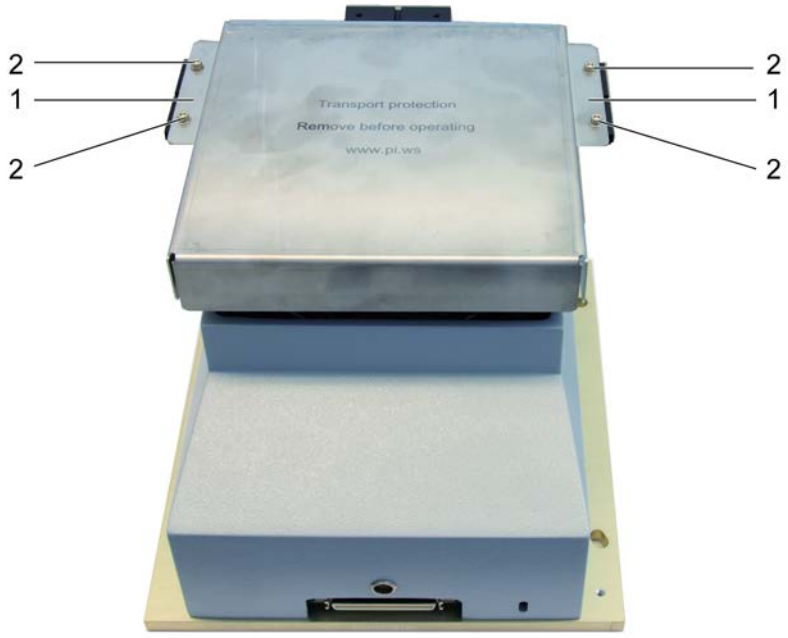


Figure 18: Hexapod with transport cover

1 Side mounting flange of the transport cover
2 M3x5 screw with metal washer

4. Fix the transport cover to the hexapod:

   a) Put the transport cover onto the hexapod so that the three mounting flanges of the cover lie on the three angle brackets for fixing immovable components.

   b) Align the transport cover so that the four holes in both side mounting flanges lie exactly above the corresponding holes in the side angle brackets.

   c) Fasten four M3x5 screws, including the corresponding washers, to the aligned holes using the 2.5 hex key.

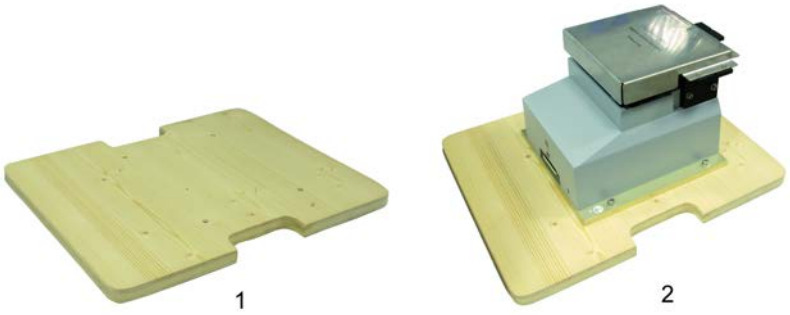


Figure 19: Wooden transport plate and transport plate with Hexapod

1 Wooden transport plate
2 Hexapod on transport plate

5. Fix the hexapod to the wooden transport plate:
   a) Loosen the four M6x30 screws used to mount the hexapod on the surface.
   b) Remove the 4 M6x30 screws.
   c) Make sure that the flanges of the four T-nuts in the wooden transport plate are facing downwards.
   d) Place the hexapod on the transport plate so that the four holes in its base plate lie above the T-nuts in the transport plate.
   e) Fix the hexapod with the 4 M6x30 screws and the corresponding washers to the T-nuts.
6. Open the outer box.
7. Lift the inner box with the side pads out of the outer box.
8. Remove the side pads from the inner box.
9. Open the inner box.
10. Remove the foam cover.
11. Remove the cover and insert made of corrugated cardboard.
12. Hold the hexapod by the wooden transport plate and put it into the inner box.

Figure 20: Hexapod in inner box with corrugated cardboard insert

13. Put the corrugated cardboard insert into the inner box.

Figure 21: Inner box with corrugated cardboard cover

14. Put the corrugated cardboard cover into the inner box.

Figure 22: Inner box with cover and wrapped mounting plate

15. Put the motion platform which is wrapped separately in foil on the corrugated cardboard cover.
16. Insert the foam cover into the inner box.
17. Close the inner box.

18. Slide the side pads onto the inner box.

Figure 23: Inner box with side pads

19. Put the inner box with the side pads into the outer box.

Figure 24: Inner box with side pads in outer box

20. Close the outer box.
21. Secure the box on the pallet.

7.3 Cleaning the Hexapod

Requirements

✓ You have disconnected the hexapod from the controller.

Cleaning the hexapod

➢ When necessary, clean the surface of the hexapod with a cloth dampened lightly with a mild cleanser or disinfectant.

8 Troubleshooting

Problem	Possible causes	Solution
Unexpected hexapod behavior.	▪ Cable broken ▪ 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. 47).
The hexapod does not achieve the specified accuracy.	▪ Increased wear due to small motion over a long period of time	➢ Perform a maintenance run over the entire travel range (p. 37).
The hexapod does not move.	▪ Foreign body has entered the drive of a strut ▪ Faulty motor ▪ 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. 47).
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 with "Make contact" (for details, see user manual for the controller). If you use the C-887.MSB motion-stop-box from PI: Press the

Problem	Possible causes	Solution
		mushroom button first to unlock it, then press the green pushbutton. 3. Switch the servo mode on for the hexapod axes. Use the SVO command or the corresponding operating elements in the PC software. Note: A new reference move is not necessary
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. 47) in order to receive valid configuration data.
The red LED signaling the limit switch status is active.	▪ At least one limit switch is activated.	➢ Perform a reference move (part of startup of hexapod system (p. 35), see also user manual for the controller). ➢ If the red LED stays on and/or the reference move is not successfully performed: Contact our customer service department (p. 47).

➢ If the problem with your hexapod is not listed in the table or cannot be solved as described, contact our customer service department (p. 47).

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

10.1 Specifications

10.1.1 Data Table

Motion and positioning	H-206.F2	Unit	Tole-rance
Active axes	X, Y, Z, θ_X, θ_Y, θ_Z		
Travel range* X	-8 to 5.7	mm	
Travel range* Y	±5.7	mm	
Travel range* Z	±6.7	mm	
Travel range* θ_X	±5.7	°	
Travel range* θ_Y	±6.6	°	
Travel range* θ_Z	±5.5	°	
Actuator design resolution	33	nm	
Minimum incremental motion X, Y, Z	0.5	µm	typ.
Minimum incremental motion θ_X, θ_Y, θ_Z	2 (0.4")	µrad	typ.
Repeatability X, Y, Z	0.3	µm	typ.
Repeatability θ_X, θ_Y, θ_Z	6	µrad	typ.
Velocity X, Y, Z	8	mm/s	max.
Velocity X, Y, Z	2	mm/s	typ.
Load capacity (horizontal base plate)	1.5	kg	max.

Miscellaneous	H-206.F2	Unit	Tole-rance
Operating temperature range	5 to 35	°C	
Material	Aluminum		
Mass	5.8	kg	±5 %
Cable length	3	m	±10 mm
Recommended controller	C-887.5x		

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.

10.1.2 Maximum Ratings

The hexapod is designed for the following operating data:

Maximum operating voltage	Maximum operating frequency (unloaded)	Maximum current consumption
24 V DC	⎓	5 A

10.1.3 Cable Set Specifications

The following table lists the technical data of all optionally available cable sets, irrespective of whether they are suitable for the H-206 hexapods. Refer to "Optional Accessories" (p. 11)for a selection of suitable cable sets.

	Standard cable sets C-887.5A01 / C-887.5A02 / C-887.5A03 / C-887.5A05 / C-887.5A07 / C-887.5A10 / C-887.5A20 / C-887.5A50	Drag chain compatible cable sets C-887.5B01 / C-887.5B02 / C-887.5B03 / C-887.5B05 / C-887.5B07 / C-887.5B10 / C-887.5B20	Vacuum-compatible cable set C-887.5V02	
General				**Unit**
Cable length L	1 / 2 / 3 / 5 / 7.5 / 10 / 20 / 50	1 / 2 / 3 / 5 / 7.5 / 10 / 20	Vacuum side: 2 Air side: 3	m
Maximum velocity	-	3	-	m/s
Maximum acceleration	-	5	-	m/s^2
Maximum number of bending cycles	-	1 million	-	
Operating temperature range	-10 to +70	-10 to +70	-10 to +70	°C

	Standard cable sets C-887.5A01 / C-887.5A02 / C-887.5A03 / C-887.5A05 / C-887.5A07 / C-887.5A10 / C-887.5A20 / C-887.5A50	Drag chain compatible cable sets C-887.5B01 / C-887.5B02 / C-887.5B03 / C-887.5B05 / C-887.5B07 / C-887.5B10 / C-887.5B20	Vacuum-compatible cable set C-887.5V02	
Power supply cable				**Unit**
Minimum bending radius in a drag chain	-	94	-	mm
Minimum bending radius with the fixed installation	57	57	Vacuum side: 21 Air side: 57	mm
Outer diameter	7.5	5.9 to 7.5	Vacuum side: 4.1 Air side: 7.5	mm
Connector	M12 m/f	M12 m/f	M12 m/f	
Data transmission cable				**Unit**
Minimum bending radius in a drag chain	-	112	-	mm
Minimum bending radius with the fixed installation	70	84	Vacuum side: 70 Air side: 84	mm
Outer diameter	9.3	10.1 to 11.2	Vacuum side: 9.3 Air side: 10.1 to 11.2	mm
Connector	HD D-sub 78 m/f	HD D-sub 78 m/f	HD D-sub 78 m/f	

10.2 Ambient Conditions and Classifications

Degree of pollution:	2
Air pressure	1100 hPa to 780 hPa
Transport temperature:	–15 °C to +55 °C
Storage temperature:	–15 °C to +55 °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

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

The figure shows the hexapod in the reference position.

The (0,0,0) coordinates indicate 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.

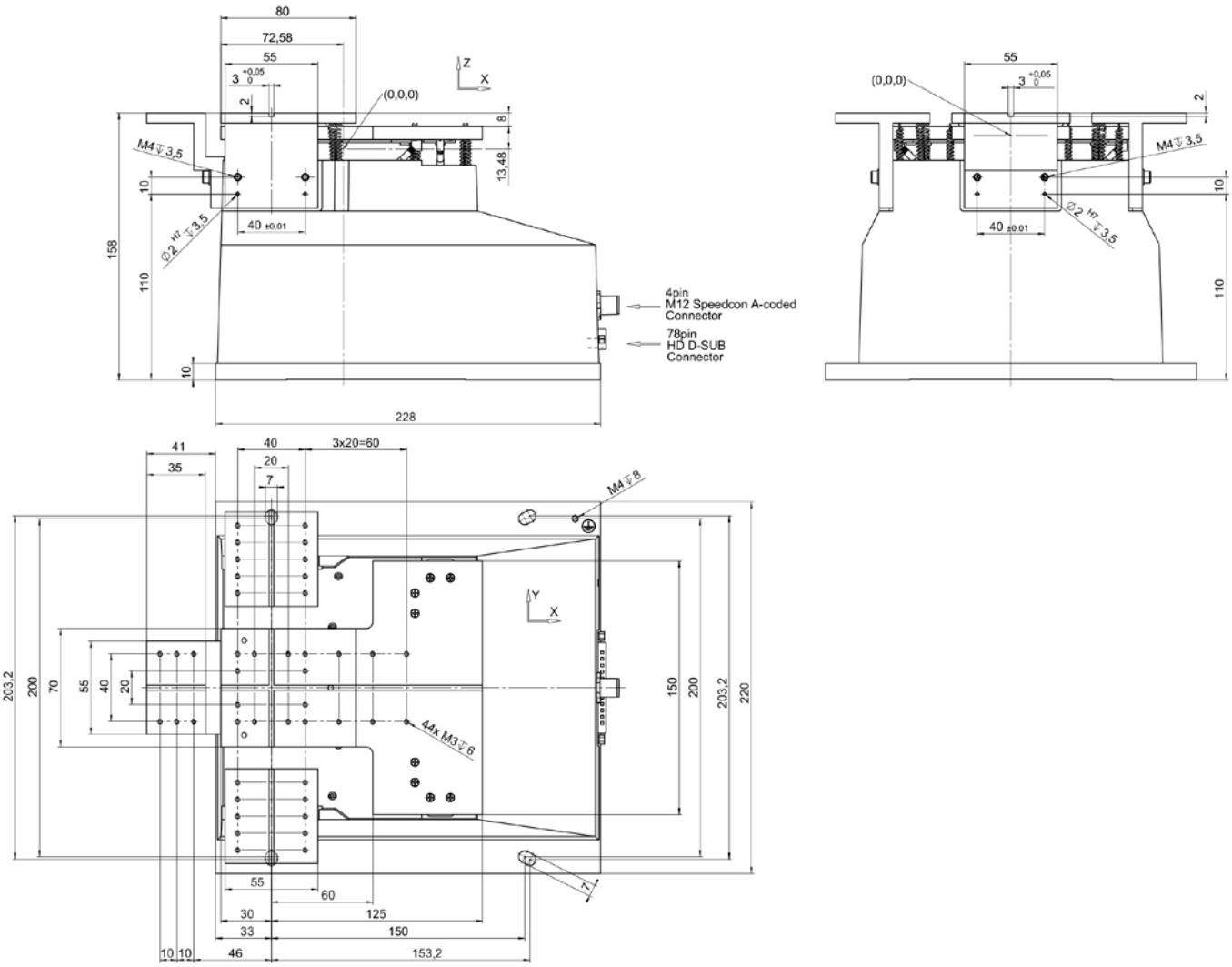


Figure 25: H-206 Hexapod (dimensions in mm)

10.4 Pin Assignment

10.4.1 Power Supply Connection

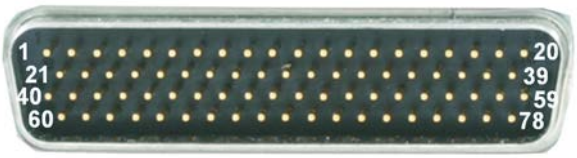
Power supply via 4-pin M12 Panel plug

Pin	Function	
1	GND	
2	GND	
3	24 V DC	
4	24 V DC	

10.4.2 Data Transmission Connection

Data transmission between hexapod and controller

Panel plug HD Sub-D 78 m

Function	
All signals: TTL	

Pin Assignment

Pin	Pin	Signal
1		CH1 Sign IN
	21	CH1 Ref OUT
2		nc
	22	CH1 A+ OUT
3		CH1 A- OUT
	23	GND
4		CH2 Sign IN
	24	CH2 Ref OUT
5		nc
	25	CH2 A+ OUT
6		CH2 A- OUT

Pin	Pin	Signal
40		CH1 MAGN IN
	60	CH1 LimP OUT
41		CH1 LimN OUT
	61	CH1 B+ OUT
42		CH1 B- OUT
	62	GND
43		CH2 MAGN IN
	63	CH2 LimP OUT
44		CH2 LimN OUT
	64	CH2 B+ OUT
45		CH2 B- OUT

Pin	Pin	Signal
	26	GND
7		CH3 Sign IN
	27	CH3 Ref OUT
8		nc
	28	CH3 A+ OUT
9		CH3 A- OUT
	29	GND
10		CH4 Sign IN
	30	CH4 Ref OUT
11		nc
	31	CH4 A+ OUT
12		CH4 A- OUT
	32	GND
13		CH5 Sign IN
	33	CH5 Ref OUT
14		nc
	34	CH5 A+ OUT
15		CH5 A- OUT
	35	GND
16		CH6 Sign IN
	36	CH6 Ref OUT
17		nc
	37	CH6 A+ OUT
18		CH6 A- OUT
	38	GND
19		ID Chip
	39	GND
20		24 V input

Pin	Pin	Signal
	65	GND
46		CH3 MAGN IN
	66	CH3 LimP OUT
47		CH3 LimN OUT
	67	CH3 B+ OUT
48		CH3 B- OUT
	68	GND
49		CH4 MAGN IN
	69	CH4 LimP OUT
50		CH4 LimN OUT
	70	CH4 B+ OUT
51		CH4 B- OUT
	71	GND
52		CH5 MAGN IN
	72	CH5 LimP OUT
53		CH5 LimN OUT
	73	CH5 B+ OUT
54		CH5 B- OUT
	74	GND
55		CH6 MAGN IN
	75	CH6 LimP OUT
56		CH6 LimN OUT
	76	CH6 B+ OUT
57		CH6 B- OUT
	77	GND
58		Brake/Enable drive
	78	GND
59		Power Good 24 V output

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. 52).

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.

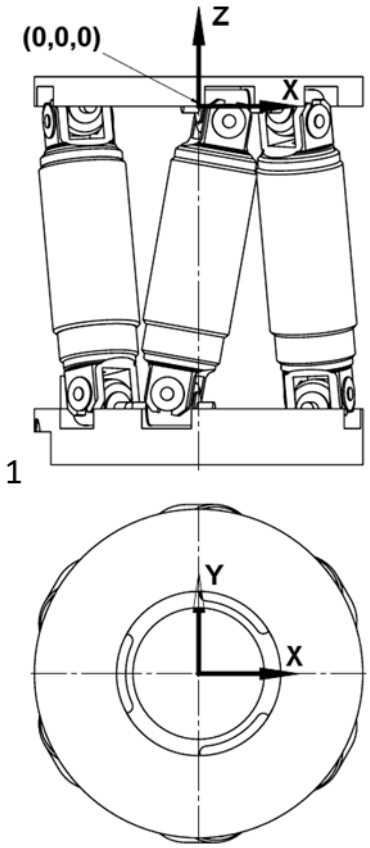


Figure 26: H-810 hexapod in the reference position.

1 Cable exit

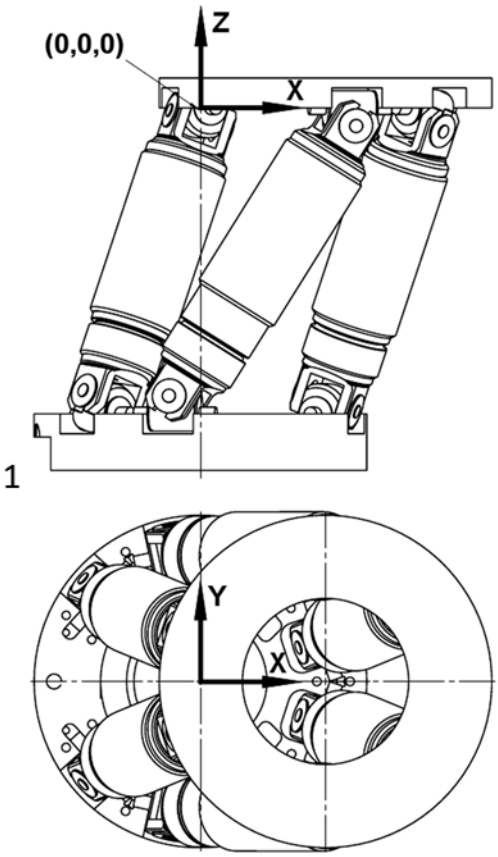


Figure 27: H-810 hexapod, the platform of which has been moved in X.

1 Cable exit

13 Appendix

In this Chapter

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.

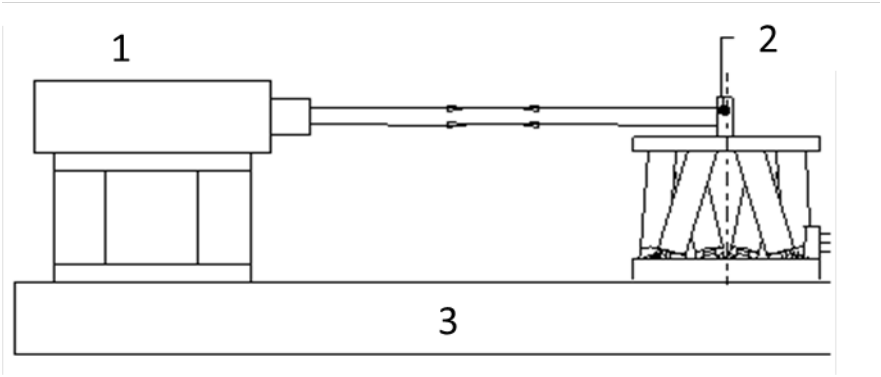


Figure 28: Test setup for measuring the X or Y axis.

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-206, 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