MP113E

M-5x1 High-Precision Linear Stage

User Manual

Version: 2.0.1 Date: 2023-04-27

This document describes the following linear stages:

- M-5x1.DDx:
  with ActiveDrive DC motor, linear encoder
- M-5x1.DG1:
  with DC gear motor, rotary encoder
- M-5x1.EC:
  with brushless DC motor, rotary encoder
- M-5x1.PD1:
  with ActiveDrive DC motor, PWM, rotary encoder
- M-5x1.PG1:
  with DC gear motor, PWM, rotary encoder

x stands for travel range:
1 = 102 mm
2 = 204 mm
3 = 306 mm

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1 About this Document

1.1 Objective and Target Group of this User Manual

This user manual contains the information needed for using the M-511, M-521, and M-531 (hereafter also referred to as called M-5x1) as intended.

Basic knowledge of closed-loop systems, motion control concepts, and applicable safety measures is assumed.

The latest versions of the user manuals are available for download 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.

➢ Precautions to avoid the risk.

NOTICE

Dangerous situation

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

➢ Precautions to avoid the risk.

INFORMATION

Information for easier handling, tricks, tips, etc.

Symbol / Label	Meaning
1. 2.	Action consisting of several steps with strict sequential order
➢	Action consisting of one or more steps without relevant sequential order
▪	List item
p. 5	Cross-reference to page 5
RS-232	Label on the product indicating an operating element (example: RS-232 interface socket)
⚠	Warning sign on the product which refers to detailed information in this manual.

1.3 Definition of Terms

Term	Explanation
Load Capacity	Maximum load capacity in the vertical direction when the positioner is mounted horizontally. The contact point of the load is at the center of the motion platform.
Max. push/pull force	Maximum force in the direction of motion. Some positioners may apply higher forces, but this could limit their lifetimes. In the case of vertical mounting, the specified value (p. 49) for models without a gearhead and brake only applies when servo mode is switched on.
Incremental position sensor	Sensor (encoder) for detecting changes of position or changes of angle. Signals from the incremental position sensor are used for axis position feedback. After the controller is switched on, referencing must be done before absolute target positions can be commanded and reached.

1.4 Figures

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

1.5 Other Applicable Documents

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

Product	Document
C-863.12 DC Motor Controller	MS249 User Manual
C-663.12 Stepper Motor Controller	MS241 User Manual
C-884 DC Motor Controller	MS243 User Manual
C-885 PIMotionMaster	C885T0002 User Manual
C-863.12C885 for C-885 PIMotionMaster	C863T0004 User Manual
C-863.20C885 for C-885 PIMotionMaster	C863T0005 User Manual

The latest versions of the user manuals are available for download on our website.

1.6 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.physikinstrumente.com/en/.
2. Search the website for the product number (e.g., F-511).
3. Click the corresponding product to open the product detail page.
4. Click the ***Downloads*** tab.

   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

2.1 Intended Use

The M-5x1 is a laboratory device as defined by DIN EN 61010. It is intended for indoor use in an environment which is free of dirt, oil, and lubricants.

According to its design, the M-5x1 is intended for positioning, adjusting, and shifting loads in one axis at different velocities. The M-5x1 is **not** intended for applications in areas where failure would be a considerable risk for people or the environment.

The M5x1 is intended for horizontal or vertical mounting. For the load limits with vertical mounting, see "General Notes on Installation" (p. 17).

It is only possible to use the M-5x1 as intended when completely mounted and connected.

The M-5x1 must be operated with a suitable controller (p. 12). The controller is not included in the scope of delivery of the M-5x1.

2.2 General Safety Instructions

The M-5x1 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 M-5x1.

- ➢ Use the M-5x1 for its intended purpose only, and when it is in perfect technical condition.
- ➢ Read the user manual.
- ➢ Immediately eliminate any faults and malfunctions that may affect safety (p. 43).

The operator is responsible for installing and operating the M-5x1 correctly.

2.3 Organizational Measures

User manual

- Always keep this user manual together with the M-5x1.
  The latest versions of the user manuals are available for download on our website (p. 2).
- Add all information from the manufacturer such as supplements or technical notes to the user manual.
- If you give the M-5x1 to a third party, include this user manual as well as all other relevant information provided by the manufacturer.
- Only use the device on the basis of the complete user manual. Missing information due to an incomplete user manual can result in damage to equipment.
- Install and operate the M-5x1 only after you have read and understood this user manual.

Personnel qualification

The M-5x1 may only be installed, started, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

3 Product Description

3.1 Model Overview

Classification of the positioners

The stages of the M-511, M-521 and M-531 series are summarized under the designation M-5x1 in this manual.

All models are microtranslation stages with a ball screw. They differ with respect to:

- Travel range
- Drive type
- Presence of a motor brake
- Encoder type

M-5x1	Travel range in mm	Travel range in inches
x = 1	102	4
x = 2	204	8
x = 3	306	12

Version	Drive type				Brake available	Encoder type	
	DC motor					Linear	Rotation
	Direct drive, PWM	Direct drive, brushless, PWM	Gearhead, analog	Gearhead, PWM			
.DD1	●					●	
.DD2	●				●	●	
.PD1	●						●
.EC		●					●
.DG1			●				●
.PG1				●			●

Detailed model overview

Product number	Product Description
M-511.DD1	Microtranslation stage, 102 mm, ActiveDrive DC motor, linear encoder
M-511.DD2	Microtranslation stage, 102 mm, ActiveDrive DC motor, linear encoder, motor brake
M-511.DG1	Microtranslation stage, 102 mm, DC gear motor, rotary encoder
M-511.EC	Microtranslation stage, 102 mm, brushless DC motor, rotary encoder
M-511.PD1	Microtranslation stage, 102 mm, ActiveDrive DC motor, rotary encoder
M-511.PG1	Microtranslation stage, 102 mm, ActiveDrive DC gear motor, rotary encoder
M-521.DD1	Microtranslation stage, 204 mm, ActiveDrive DC motor, linear encoder
M-521.DD2	Microtranslation stage, 204 mm, ActiveDrive DC motor, linear encoder, motor brake
M-521.DG1	Microtranslation stage, 204 mm, DC gear motor, rotary encoder
M-521.EC	Microtranslation stage, 204 mm, brushless DC motor, rotary encoder
M-521.PD1	Microtranslation stage, 204 mm, ActiveDrive DC motor, rotary encoder
M-521.PG1	Microtranslation stage, 204 mm, ActiveDrive DC gear motor, rotary encoder
M-531.DD1	Microtranslation stage, 306 mm, ActiveDrive DC motor, linear encoder
M-531.DD2	Microtranslation stage, 306 mm, ActiveDrive DC motor, linear encoder, motor brake
M-531.DG1	Microtranslation stage, 306 mm, DC gear motor, rotary encoder
M-531.EC	Microtranslation stage, 306 mm, brushless DC motor, rotary encoder
M-531.PD1	Microtranslation stage, 306 mm, ActiveDrive DC motor, rotary encoder
M-531.PG1	Microtranslation stage, 306 mm, ActiveDrive DC gear motor, rotary encoder

- Refer to the specifications for further technical data. (p. 49).

3.2 Product View

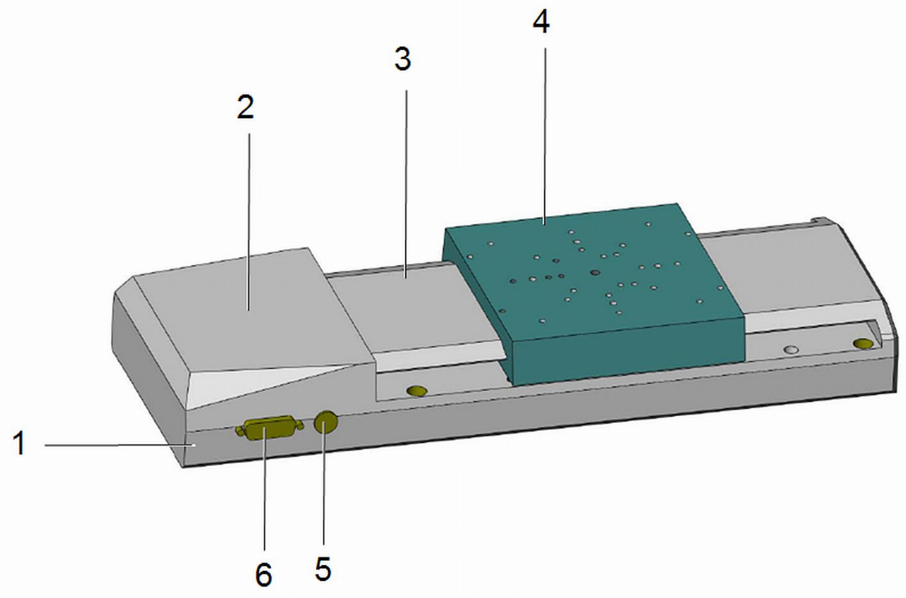


Figure 1: Positioner components (here: M-511)

1	Base body
2	Motor cover
3	Spindle cover
4	Motion platform
5	Power adapter connector (M8 panel plug; not .DG1 models)
6	Controller connector (D-sub 15 panel plug)

3.3 Product Labeling

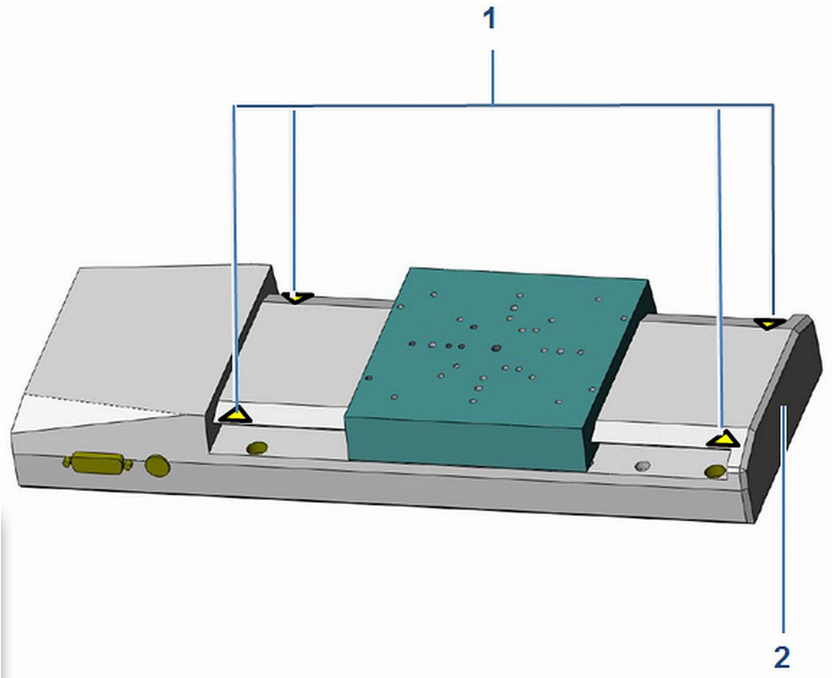


Figure 2: Product labeling

Position	Labeling	Description
1		"Risk of crushing" warning sign
2	PI	Manufacturer's logo
2	WWW.PI.WS	Manufacturer's address (website)
2	M-511.DD1	Product name (example), the characters following the period refer to the model
2	SN: A16045786	Serial number (example), individual for each M-5x1 Meaning of each position (from the left): 1 = internal information, 2 and 3 = year of manufacture, 4 to 9 = consecutive number
2	Country of Origin: Germany	Country of origin
2	⚠	Warning sign "Pay attention to the manual!"
2		Old equipment disposal (p. 61)
2	CE	CE conformity mark

3.4 Scope of Delivery

Product number	Description
M-5x1.xxx	Positioner according to the order (p. 7)
2504	Screw set for attaching the stage, load and mounting adapters ▪ 4 socket head screws, A2 M4×16 ISO 4762 ▪ 4 socket head screws, A2 M4x30 ISO 4762 ▪ 4 socket head screws, A2 M6×30 ISO 4762 ▪ Hex key AF 3 DIN 911 ▪ Hex key AF 5 DIN 911
MP119EK	Short instructions for positioners with electric motors
For the models M-5x1.DD1, .DD2, .EC, .PG1, .PD1 additionally:	
C-501.24050H	Wide input range power supply 24 V DC / 50 W
3763	Power cord
K050B0003	Adapter for the power adapter connection; barrel connector to M8 4-pole connector (f)

3.5 Optional Accessories

Product number	Description
C-815.83	Motor cable, 10 m, D-sub, 15-pin/pole (m/f)
M-500.206	Adapter plate for mounting H-206 Hexapods on M-511, M-521 and M-531 stages. Material: Al
M-590.00	Three-point support for mounting M-505, M-510, M-511, M-521 and M-531 stages on honeycomb tables etc. (metric and inches). Material: Al; mass: 0.4 kg Consisting of: ▪ Adapter plate, wide (M59000001) Adapter plate, narrow (M59000002)
M-592.10	Adapter bracket for mounting M-511, M-521, and M-531 stages vertically. Material: Al; mass: 0.2 kg

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

3.6 Suitable Controllers

Product number	Description
C-863.12	Mercury servo controller, for DC motors and PWM motor drivers
C-863.20C885	Motion controller module for DC motors, for C-885 PIMotionMaster
C-884	Controller for DC motors

PC software is included in the scope of delivery of the controllers from PI. The operation of the controllers is described in the corresponding user manuals.

3.7 Technical Features

3.7.1 Encoder

Linear encoder

The M-5x1.DD1 and .DD2 models are equipped with an optical linear encoder. This measures the actual position directly (direct metrology). Errors in the drive, such as nonlinearity, backlash or elastic deformations cannot influence measuring of the position.

For the encoder resolution, refer to the table in the "Specifications" section (p. 49).

Rotary encoder

The M-5x1.PD1, .PG1, .DG1, and .EC models are equipped with an incremental rotary encoder.

A rotary encoder, also called an incremental rotary encoder, is implemented at a rotating point in the drivetrain, e.g., the motor shaft.

3.7.2 Limit Switches

The positioner is equipped with noncontact, magnetic (Hall effect) limit switches.

Each limit switch sends its signal to the controller on a dedicated line. If reached, the controller stops the motion. If the controller does not stop the motion in time, the positioner runs into the hard stop.

For further information, refer to "Limit Switch Specifications" (p. 51).

Limit switch*	Availability of the signal	Function
"Inner" limit switches N1 and P1	Output to the controller on the D-sub 15 panel plug (p. 54) Also refer to the "Limit Switch Specifications" (p.49).	When triggering takes place, the controller switches off the servo mode for the affected axis and thereby stops the motion. The motion platform can be moved away from the limit switch by command, see "Troubleshooting" (p. 43).
"Outer" limit switches N2 and	No connection to the controller	The triggering interrupts the power supply to the drive via a relay. The motion platform

Limit switch*	Availability of the signal	Function
P2		cannot be moved away from the limit switch by command but must be moved manually (p. 45).

*N = negative limit switch, P = positive limit switch

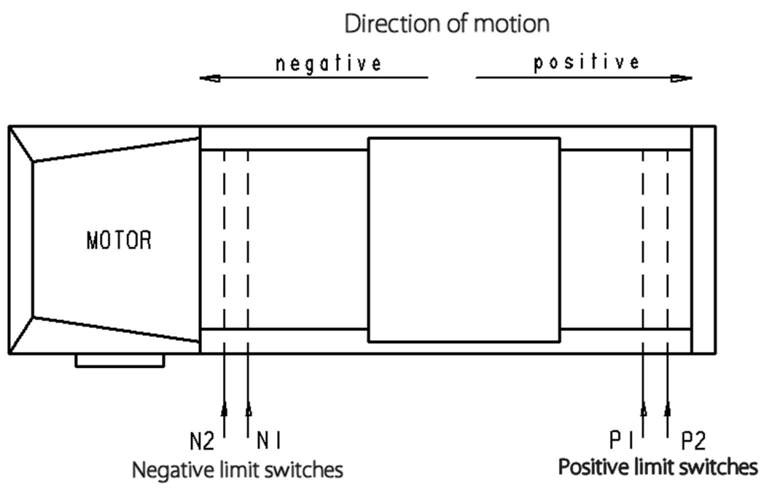


Figure 3: Limit switch arrangement with M-5x1

The gap between N1 and N2 or P1 and P2 is approx. 5.3 mm in each case.

INFORMATION

In the case of controllers from PI, the permissible travel range of the positioner is represented via parameters in the controller. Suitable parameter values can be loaded from a positioner database in the supplied PC software; see also "M-5x1 Entries in the PI Positioner Database" (p. 39). With the values loaded from the positioner database for the lower and upper limit of the travel range, the limit switches cannot be approached with motion commands. The controller furthermore calculates the dynamics profile during motion so that the positioner decelerates in time before the end of the permissible travel range. The positioner can only reach the limit switch in exceptional cases, e.g., with a very high velocity and/or under high load.

Refer to the user manual for the controller for details.

3.7.3 Reference Switch

The positioner is equipped with a direction-sensing reference switch, which is located at about the midpoint of the travel range (see "Reference Switch Specifications" (p. 52)).

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

3.7.4 Motor Brake

The M-5x1.DD2 models are equipped with a motor brake. Positioners with a motor brake are especially suited for vertical mounting.

The motor brake is activated and deactivated via the connected controller. Controllers from PI activate the brake automatically when servo mode is switched off. Refer to the user manual for the controller for details.

3.7.5 Brushless Motor

The M-5x1.EC models are equipped with a brushless DC motor. The motor is electronically commuted and therefore very low wear.

3.7.6 Integrated PWM Amplifier

The M-5x1.DD1, .DD2, .PD1 und .EC models with direct drive are equipped with a PWM amplifier ("ActiveDrive concept"). The motor and PWM amplifier are installed in a joint housing and therefore optimally integrated and shielded. The PWM amplifier only receives the control signals from the controller, whereas the supply voltage is provided via an external power adapter. The ActiveDrive concept allows high motor power and dynamics at low power loss.

The M-5x1.PG1 models with DC gear motor are only equipped with a PWM amplifier for compatibility reasons.

4 Unpacking

1. Unpack the M-5x1 with care.
2. Compare the contents with the scope of delivery according to the contract and the delivery note.
3. Inspect the contents for signs of damage. If any parts are damaged or missing, contact our customer service department immediately.
4. Keep all packaging materials in case the product needs to be returned.

5 Installing

5.1 General Notes on Installing

NOTICE

Unwanted changes in position when mounted vertically!

If the load exceeds the self-locking of the drive when the stage is mounted vertically, unwanted changes in the position of the platform occur. Unwanted changes in the position of the platform can damage the drive, the load, or the surroundings.

- If the positioner is mounted vertically, make sure that the installed load is lower than the holding force of the drive:
  - Stage with gearhead: max. 80 N
  - Stage with motor brake: max. 80 N
- In the case of vertical mounting, use a stage with a motor brake (.DD2) or with a gearhead (.DG1, .PG1).
- **Note that in the switched-off state, the holding force is absent.**

NOTICE

- Protruding screw heads! Protruding screw heads can damage the M-5x1. Make sure that the screw heads are fully countersunk in the mounting holes and cannot interfere with the motion.

NOTICE

Cable break!

A cable break leads to failure of the positioner.

- Install the positioner so that the cable is not bent too strongly or squashed.

NOTICE

Heating up of the M-5x1 during operation!

The heat produced while operating the M-5x1 may affect your application.

- Install the M-5x1 so that your application is not impaired by the dissipating heat.

INFORMATION

For optimal repeatability, all components must be connected firmly together.

- ➢ If possible, simulate the platform motion with a mounted load or make suitable calculations to detect collisions or unfavorable center of gravity constellations.
- ➢ If necessary, take suitable constructive measures to avoid collisions and instability in the overall system.
- ➢ In accordance with the legal regulations, avoid or mark danger zones that result from the installation of the positioner and the application.

INFORMATION

The holes in the motion platform of the M-5x1 are arranged in the PI standard hole pattern. The PI standard hole pattern is used with many micropositioning stages from PI and allows a simple combination of linear and rotation stages with minimum effort.

5.2 Attaching the M-5x1 to an Underlying Surface

NOTICE

Warping of the M-5x1 when mounted on uneven surfaces!

The M-5x1 can warp if mounted on an uneven surface. Warping reduces the accuracy.

- ➢ Mount the M-5x1 on an even surface. The recommended flatness of the surface is ≤10 µm.
- ➢ For applications with large temperature fluctuations:
  Mount the M-5x1 only on surfaces that have the same or similar thermal expansion properties as the M-5x1.

INFORMATION

The positive direction of motion is in the opposite direction of the cable exit.

5.2.1 Using a Surface with the Hole Pattern of the M-5x1 Base Body

NOTICE

Wear from moving the platform by hand!

Moving the platform by hand increases wear in the case of positioners with a gearhead.

- ➢ In the case of the M-5x1.DG1 und .PG1 models, move the platform by hand only if they cannot be moved in any other way.

INFORMATION

The M-5x1 can be fixed to an underlying surface with M6 or M4 screws. Advantages when the positioner is installed with M6 screws:

- The holes for M6 screws are freely accessible in the delivery state.
- M6 screws can absorb greater forces than M4 screws.

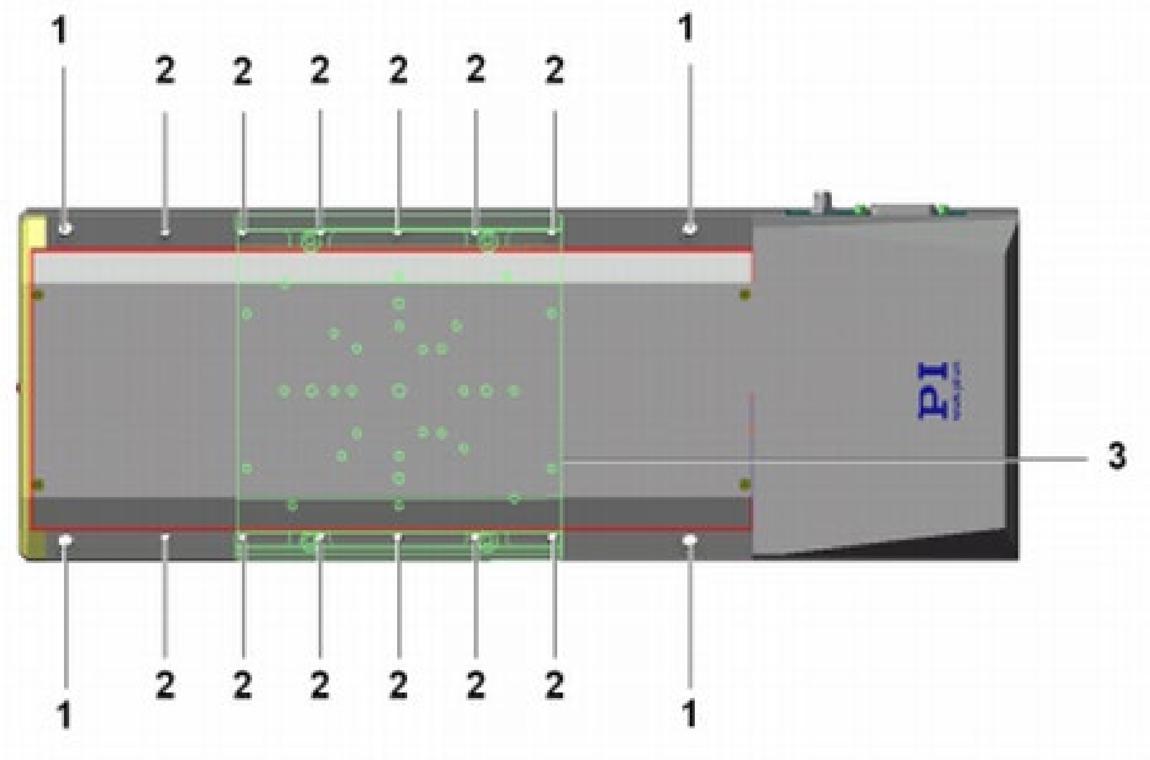


Figure 4: Mounting holes in the positioner's base body

1 *Mounting hole with counterbore for M6 socket head screw*

2 *Mounting hole with counterbore for M4 socket head screw*

3 *Motion platform in delivery state (implied)*

Requirements

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

✓ You have provided a suitable underlying surface (see "Dimensions" (p. 53)) for the required position and depth of the holes for the screws and locating pins:

– Four mounting holes are present. Optimum: M6 holes, alternatively: M4 holes

– The surface flatness is ≤10 µm.

– For applications with large temperature fluctuations: The surface should have the same or similar thermal expansion properties as the M-5x1 (e.g., underlying surface made of aluminum).

✓ You have accounted for the space required to route cables according to regulations and without bending them.

✓ If you want to make the mounting holes in the base body of the M-5x1 accessible by moving the platform by hand: The positioner is not connected to the power adapter and the controller.

Tools and accessories

- Screws, included in the scope of delivery:
  - 4 × M6x30

  or

  - 4 × M4x30
- Suitable screwdriver, included in the scope of delivery:
  - For M6 screws: hex key, AF 5
  - For M4 screws: hex key, AF 3

Attaching the positioner to a surface

1. Put the stage on the underlying surface so that the corresponding mounting holes in the stage and underlying surface are in line.

   If you use M4 screws, allow access to the mounting holes in the base body of the positioner. Possible measures:

   - Temporary startup of the positioner (p. 37) and commanding the platform to a suitable position
   - Moving the motion platform by hand (p. 45)
2. Tighten all screws in the mounting holes selected.
3. Check that the positioner is firmly mounted onto the underlying surface.

5.2.2 Using Adapters for the 25 mm × 25 mm Hole Pattern

INFORMATION

An adapter is necessary to attach the M-5x1 to a commercially available honeycomb plate with a hole pattern of 25 mm × 25 mm and M6 screws. PI offers the M-590.00 two-part three-point support as an adapter, see "Accessories" (p. 11).

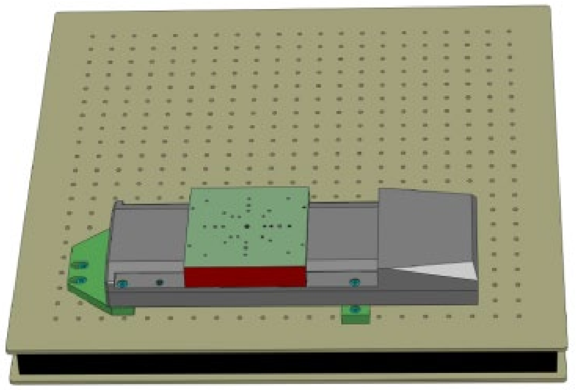


Figure 5: M-5x1 with adapter (M-590.00 three-point support) on a honeycomb plate

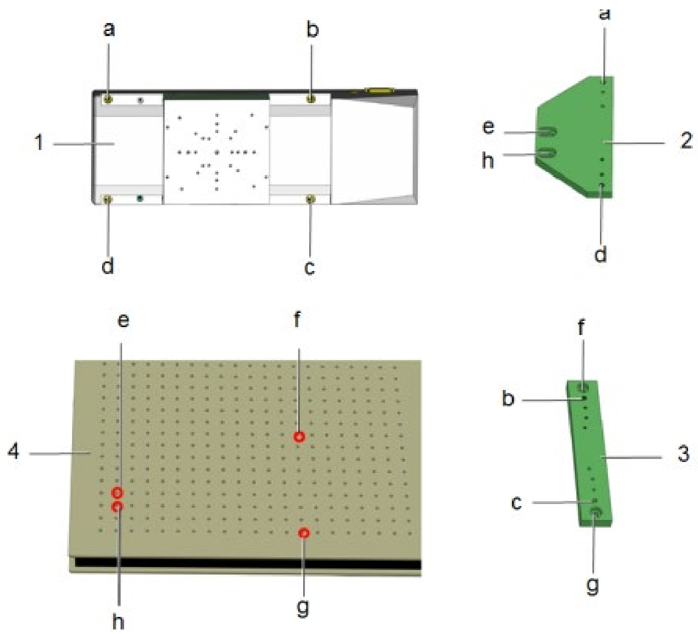


Figure 6: Individual components to be connected with relevant holes

1 Stage (here M-511)

2 Wide adapter plate, part of the M-590.00 three-point support

3 Narrow adapter plate, part of the M-590.00 three-point support

4 Honeycomb plate with 25 mm × 25 mm hole pattern (used holes emphasized)

a to h Holes for M6 screws.
Holes that are aligned during attachment are designated with the same letters.

Requirements

- ✓ You have read and understood the general notes on installation (p. 17).
- ✓ You have accounted for the space required to route cables according to regulations and without bending them.

Tools and accessories

- M-590.00 three-point support, two-part, available as an optional accessory (p.11).
- For attachment of the M-590.00 three-point support to the M-5x1:
  - 4 M6x30 screws, included in the scope of delivery
  - Hex key, AF 5, included in the scope of delivery
- For attaching the M-590.00 three-point support to the honeycomb plate:
  - 4 x M6 screws of a suitable length (not included in the scope of delivery), see "M-590.00 Three-Point Support, Two-Part" (p. 57) for the dimensions.
  - Suitable tool for tightening the screws

Attaching the stage to a honeycomb plate

1. Attach the two parts of the M-590.00 three-point support to the M-5x1:
   a) Put the two adapter plates on the honeycomb plate or on another level, clean and safe surface.
   b) Align the two adapter plates on the underlying surface approximately in the position of the mounting holes a to d in the base body of the positioner (see figure showing the individual parts to be connected).
   c) Put the positioner on the two adapter plates so that the holes a to d are approximately in line with each other.
   d) Align the two adapter plates so that the holes a to d each precisely in line.
   e) Completely screw in one M6x30 screw into each of the holes **a** to **d** on the positioner.
2. Attach the two parts of the M-590.00 three-point support to the honeycomb plate:
   a) Put the positioner to which the two adapter plates are attached on the honeycomb plate.
   b) Align the positioner so that the holes **e** to **h** in the honeycomb plate and the three-point support each in line (see figure of the individual parts to be connected).
   c) Completely screw in one M6 screw into each of the holes **e** to **h** of the three-point support.
3. Check that the positioner is securely mounted (zero play) on the honeycomb plate.

5.3 Fixing the Load to the M-5x1

NOTICE

Impermissibly high load on the positioner!

An impermissible high load impairs the motion of the platform and can damage the positioner.

➢ When considering the mass and mounting method of the load, pay attention to the specified maximum permissible forces that may act on the platform (p. 49).

➢

NOTICE

Excessively long screws!

The M-5x1 could be damaged by screws inserted too deeply.

➢ Pay attention to the depth of the mounting holes in the motion platform (p. 53, p. 54).

➢ Only use screws with the correct length for the respective mounting holes.

Requirements

✓ You have mounted the positioner onto an underlying surface properly (p. 18).

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

✓ You have prepared the load so that it can be fixed to the mounting holes in the upper platform (p. 54):

– The gap between the center of gravity of the load and the center of the platform is as small as possible in all directions.

– At least two points are provided for fixing the load on the platform (ideally: three fixing points).

Tools and accessories

- Screws of suitable length. Options:
  - At least two M4 screws
  - One M6 screw and at least one M4 screw
- Suitable tool for tightening the screws
- Optional: 2 to 4 locating pins for easy alignment of the load on the M-5x1, suitable for holes with Ø 4 mm; for tolerance data, see figure showing the holes in the motion platform; locating pins not included in the scope of delivery

Fixing the load

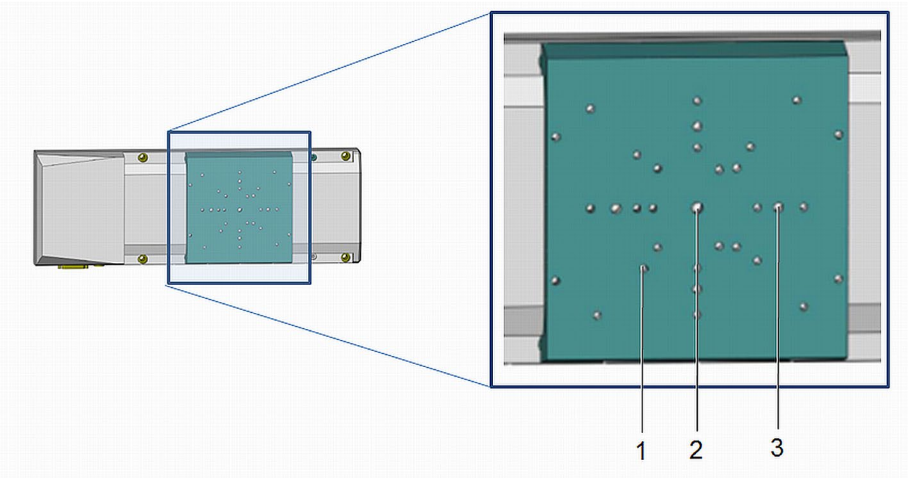


Figure 7: Holes in the motion platform of the M-5x1

1 M4 mounting hole, depth 8 mm (total of 27)
2 Central M6 mounting hole, depth 8 mm
3 Locating hole Ø 4 mm H7, depth 5 mm (total of 4)

1. Align the load so that the selected mounting holes in the platform can be used to fix it.

   If you use locating pins to align the load:

   a) Insert the locating pins into the locating holes in the motion platform or the load.
   b) Put the load on the platform so that the locating pins are inserted into the corresponding locating holes on the other side.

   The arrangement of the mounting and locating holes in the motion platform of the M-5x1 as well as the tolerance data can be found in the corresponding figure as well as in the dimensional drawing (p. 24).

2. Use the screws to fix the load on the selected mounting holes in the platform.
3. Check that the load is firmly seated to the platform of the positioner.

5.4 Building a Multi-Axis System

The M-5x1 can be used in multi-axis systems.

Typical combinations:

- XY system (p. 31)
- Z system (p. 33) (XZ or XYZ combination)

Contact our customer service department for possible combinations with other positioners. (p. 47).

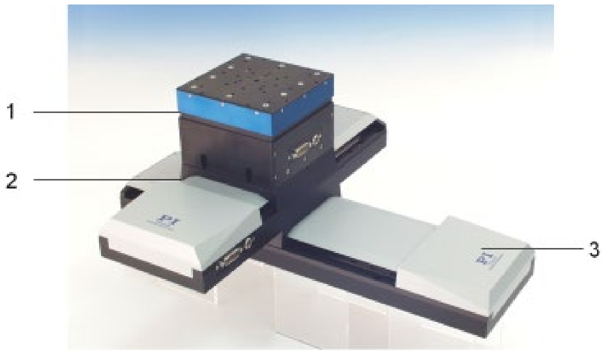


Figure 8: Example of an XYZ system: two M-511.DD1 positioners / one M-501.1PD Z stage

1 *M-501.PD Z stage, directly mounted*

2 *Upper stage (here: M-511.DD1), directly mounted*

3 *Lower stage (here: M-511.DD1)*

5.4.1 General Notes on Building a Multi-Axis System

NOTICE

Impermissibly high load on the positioners!

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

- Include the masses of the positioners that are moved and of the mounting adapters in the calculation of the load to be moved.
- For all positioners in a multi-axis system: Do **not** exceed the maximum permissible load.
- If the positioner is mounted vertically, make sure that the installed load is lower than the holding force of the drive.
- **Note that in the switched-off state, the holding force is absent.**

NOTICE

Excessively long screws!

The lower positioner could be damaged by screws inserted too deeply.

- Pay attention the depth of the mounting holes in the motion platform of the lower positioner.
- Only use screws with the correct length for the respective mounting holes.

NOTICE

Wear from moving the platform by hand!

Moving the platform by hand increases wear in the case of positioners with a gearhead.

➢ In the case of the M-5x1.DG1 und .PG1 models, move the platforms by hand only if they cannot be moved in any other way.

➢ Only install and operate the multi-axis system after you have read and understood the user manuals for all components of the multi-axis system.

➢ If you require special mounting adapters, contact our customer service department (p. 47).

5.4.2 Building an XY system

Designations in these instructions:

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

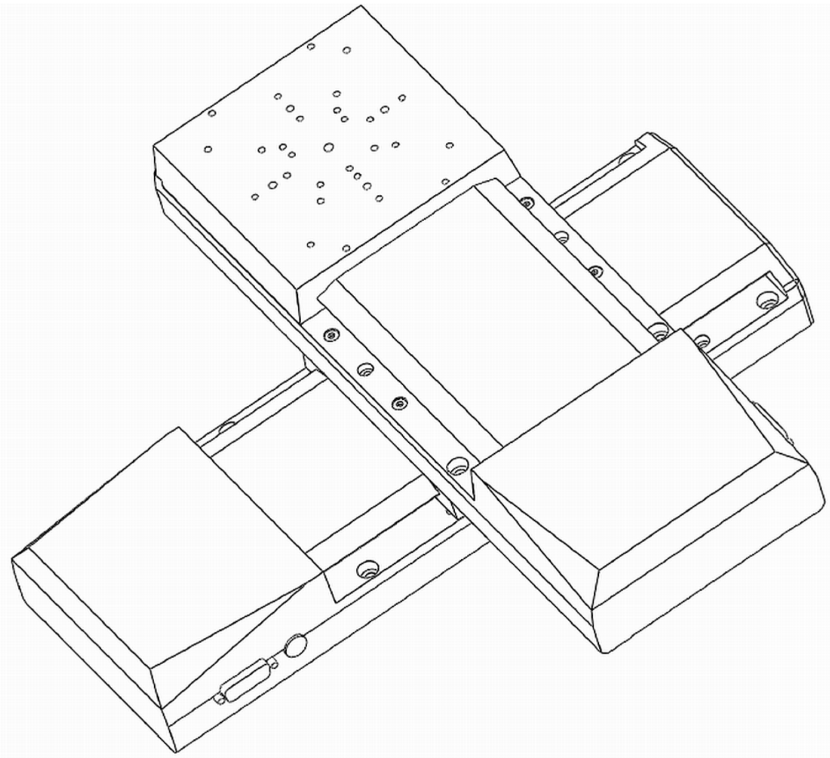


Figure 9: Example: XY system consisting of two M-511 positioners

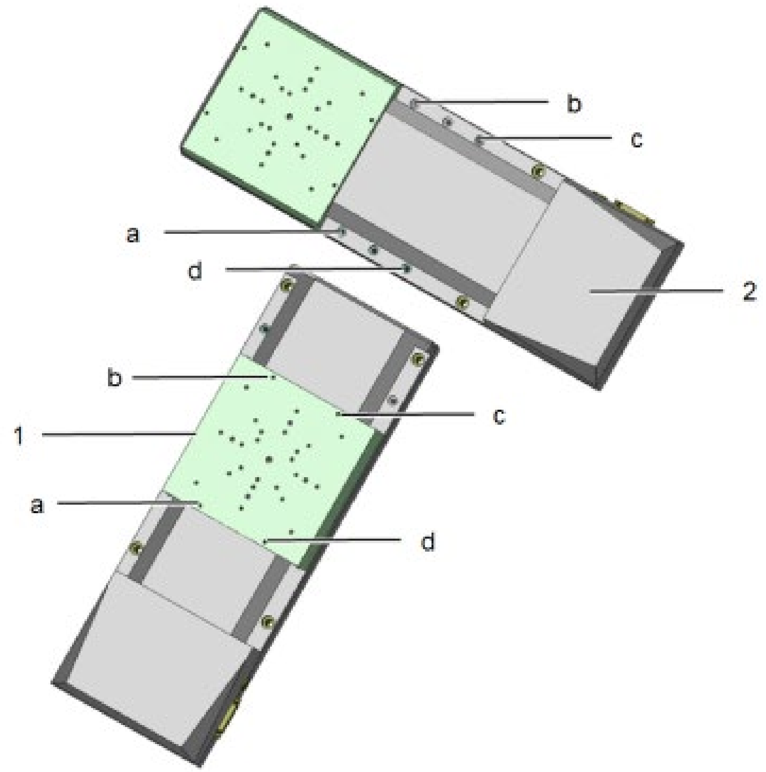


Figure 10: Example: Building an XY system with two M-511 positioners

1 Lower positioner with
a – d) M4 mounting holes in the platform

2 Upper positioner (motion platform at the positive end of the travel range) with
a – d) mounting holes with counterbore for M4 socket head screws in the base body of the positioner

Holes that are aligned during attachment are marked with the same letter.

Requirements

- ✓ You have read and understood the general notes on installation (p. 17).
- ✓ You have read and understood the general notes on building a multi-axis system (p. 25).
- ✓ You have accounted for the space required to route cables according to regulations and without bending them.
- ✓ The positioners are disconnected from the power adapter and controller.
- ✓ You have mounted the lower positioner onto an underlying surface properly. (p. 18).

Tools and accessories

- 4 M4 screws of a suitable length from the scope of delivery of the upper positioner
  - If an M-5x1 is mounted to another M-5x1 as in the figure above: 2 M4x30 screws
- Hex key AF 3, included in the positioner's scope of delivery

Building an XY System

1. If necessary: Allow access to the required mounting holes in the base body of the upper positioner. Possible measures:
   - Starting up and operating the upper positioner temporarily (p. 37), and commanding the motion platform to a suitable position
   - Moving the motion platform of the upper positioner by hand (p. 45)
2. Position the upper positioner rotated by 90° on the platform of the lower positioner (see above figure).
3. Align the upper positioner so that the mounting holes in the upper and lower positioner are in line (holes **a** to **d** in the above figure).
4. Completely screw in one M4 screw into each of the holes.
5. Check that the upper positioner is securely mounted (zero play).

5.4.3 Building a Z System with an Adapter Bracket

➢ If you are using a Z stage for the Z axis (e.g., M-501.PD), follow the instructions in "Building an XY system" for setting up the multi-axis system (p. 26).

Designations in these instructions:

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

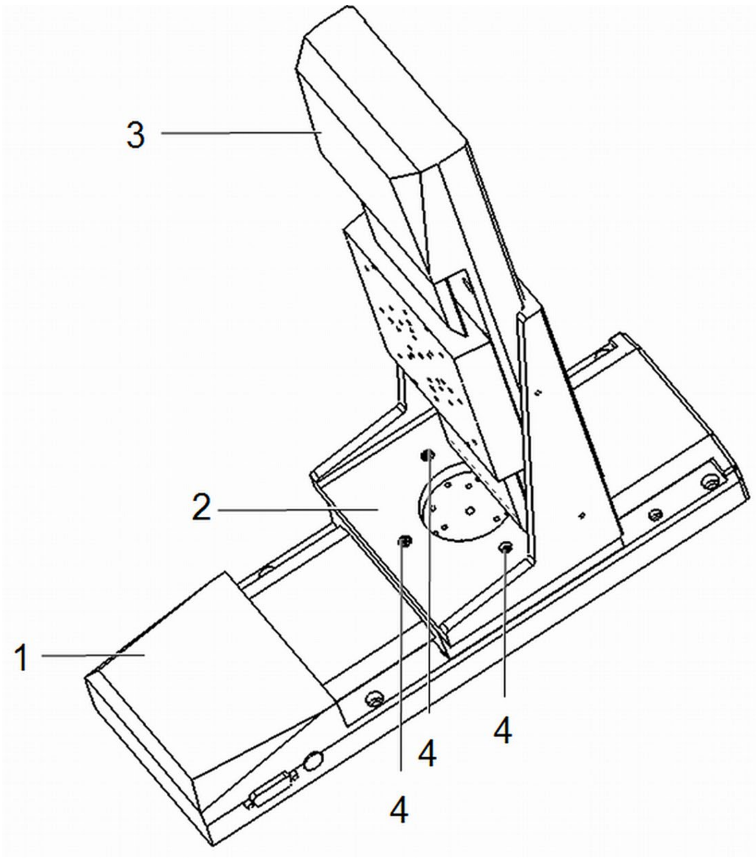


Figure 11: Example: XZ combination consisting of two M-511 positioners

1	Lower positioner
2	M-592.10 adapter bracket
3	Upper positioner
4	M4 screw

Requirements

- ✓ You have read and understood the general notes on installation (p. 17).
- ✓ You have read and understood the general notes on building a multi-axis system (p. 25).
- ✓ You have accounted for the space required to route cables according to regulations and without bending them.
- ✓ The positioners are disconnected from the power adapter and controller.
- ✓ If you are building an XZ combination: You have mounted the lower positioner onto an underlying surface properly (p. 18).
- ✓ If you are building an XYZ combination: You have attached the positioners for the X and Y axis properly (p. 26).

Tools and accessories

- Suitable adapter bracket, available as an optional accessory (p. 11):
  - M-592.10 if using an M-5x1 positioner as the Z axis
- For attaching the Z axis to the adapter bracket: 4 M4 screws of a suitable length from the scope of delivery of the upper positioner
  - When an M-5x1 is used as Z axis as in the figure above: 4 M4x30 screws
- For attaching the adapter bracket to the lower positioner: M4 screws of a suitable length from the scope of delivery of the lower positioner
  - When the M-592.10 adapter bracket is attached to an M-5x1: three M4x16 screws
- Hex key AF 3, included in the positioner's scope of delivery

Building a Z system

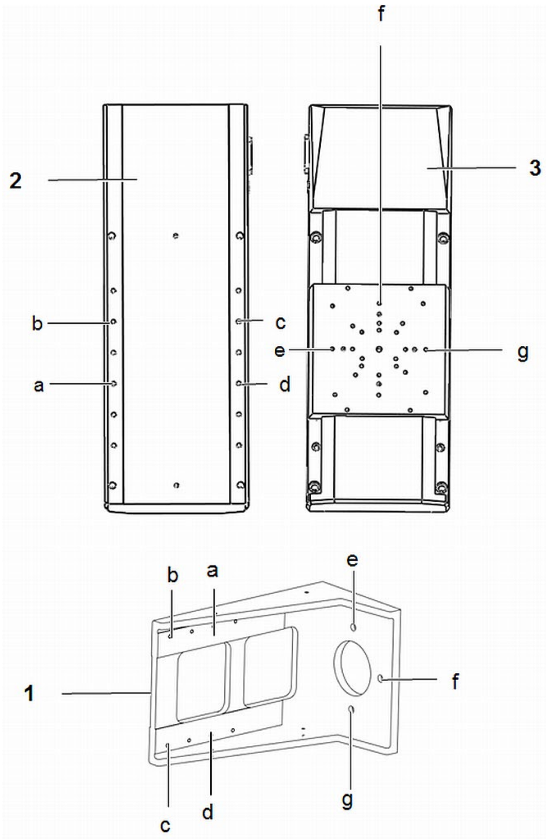


Figure 12: Example: Building an XZ combination with two M-511 positioners

1 M-592.10 adapter bracket

2 Upper positioner (view of bottom)

3 Lower positioner

a – g: Mounting holes:
Holes that are aligned during attachment are marked with the same letter

1. If necessary: Allow access to the required mounting holes in the base body of the upper positioner. Possible measures:
   - Starting up and operating the upper positioner temporarily (p. 37), and commanding the motion platform to a suitable position
   - Moving the motion platform by hand (p. 45)
2. Fix the upper stage to the adapter bracket.

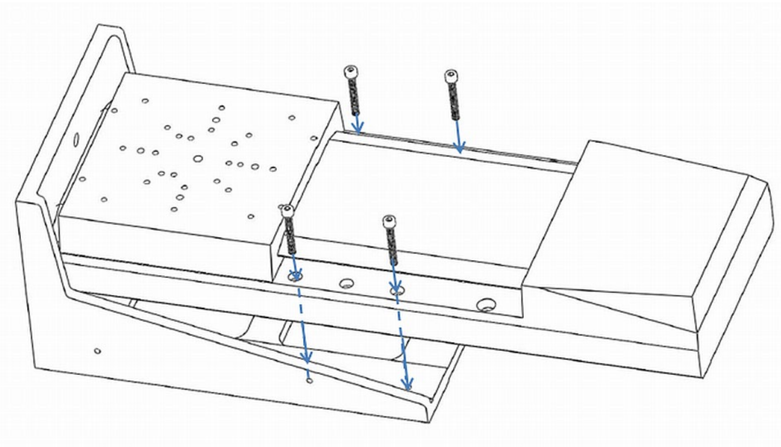


Figure 13: Attaching the upper positioner to the adapter bracket

a) Position the upper positioner on the long surface of the adapter bracket as in the figure:

 – The positioner lies on the inside of the bracket.

 – The motor cover of the positioner faces the open end of the inside of the bracket (i.e., upwards in the Z system).

 – The required mounting holes in the positioner and the bracket in line (holes **a** to **d** in the above example).

b) Completely screw in one M4 screw into each of the holes.

3. Fix the adapter bracket to the lower stage.

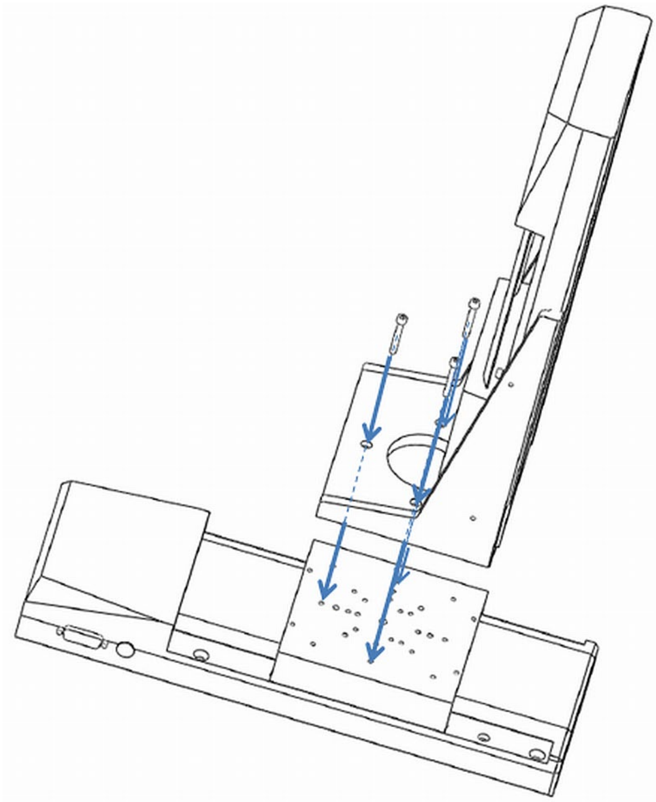


Figure 14: Attaching the adapter bracket to the lower positioner

a) Position the adapter bracket to which the upper stage is fixed on the motion platform of the lower stage as in the figure.

   – The open end of the short side of the bracket faces the motor cover of the lower positioner.

   – The required mounting holes in the bracket and the lower positioner are in line (holes **e** to **g** in the example above).

b) Completely screw in one M4 screw into each of the holes.

4. Check that the adapter bracket and the upper positioner are fixed firmly (zero play).

5.5 Connecting the M-5x1 to a Controller

Requirements

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

Tools and accessories

- Motor cable suitable for the controller (p. 12)
- Suitable tools for tightening the screws to the connections

Connecting a controller to the M-5x1

1. Connect the positioner to the controller using a suitable motor cable.
2. Use the integrated screws to secure the connections against accidental disconnection.

5.6 Connecting the Power Adapter to the M-5x1

Connecting a power adapter is only necessary for the M-5x1.DD1, .DD2, .EC, .PG1, and .PD1 models.

Requirements

- ✓ The power cord is **not** connected to the power socket.

Tools and accessories

- 24 V wide input range power supply included (for line voltages between 100 and 240 V AC at 50 or 60 Hz)
- Alternative: Sufficiently rated power adapter that provides 24 V DC with a maximum of 2.0 ampere
- Adapter included for the power adapter connection; barrel connector to M8 4-pole connector (f)
- Alternative: Sufficiently rated adapter
- Power cord supplied
- Alternative: Sufficiently sized power cord

Connecting the power adapter to the M-571

- Connect the M8 connector (f) of the adapter to the M8 panel plug of the M-5x1.
- Connect the barrel connector on the adapter to the barrel connector socket of the power adapter.
- Connect the power cord to the power adapter.

6 Startup and Operation

6.1 General Notes on Startup

CAUTION

Risk of crushing by moving parts!

Risk of minor injury from crushing between the moving parts of the positioner or the load and a fixed part or obstacle.

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

NOTICE

Damage due to collisions!

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

- Make sure that no collisions are possible between the positioner, the load to be moved, and the surroundings in the motion range of the positioner.
- Do not place any objects in areas where they could be caught by moving parts.
- Stop motion immediately if a controller malfunction occurs.
- If possible, adapt the travel range limits of your mechanical system in the software that you use for commanding the motion.

NOTICE

Damage if the wrong controller is connected!

Connecting a positioner to an unsuitable controller can damage the positioner or controller.

- Only connect the positioner to a suitable controller (p. 12). If you are using controllers and software from other manufacturers, check the technical data to make sure that they are suitable before starting up and operating the positioner!

NOTICE

Operating voltage excessively high or incorrectly connected!

Excessively high or incorrectly connected operating voltages could cause damage to the M-5x1.

- **Do not** exceed the operating voltage range (p. 51) specified for the M-5x1.
- Operate the M-5x1 only when the operating voltage is properly connected; see "Pin assignment" (p. 54)

NOTICE

Damage or considerable wear due to high acceleration!

High accelerations can cause damages to or considerable wear of the mechanical system.

- Stop the motion immediately if a controller malfunction occurs.
- Ensure that the end of the travel range is approached at low velocity.
- Determine the maximum velocity for your application.

NOTICE

Unintentional motion!

The M-5x1 may move unintentionally when connecting it to the controller. Defective software or incorrect operation of the software may also cause unintentional motion.

- Do not place any objects in areas where they could be caught by moving parts.
- Before connecting the M-5x1, check whether a macro is defined as the startup macro in the controller, and cancel selection of the startup macro if necessary.

NOTICE

Unintentional motion after brake deactivated!

In the case of positioners with a motor brake: The deactivation of the brake can cause unintentional motion of the positioner.

- Secure the positioner against moving unintentionally before you deactivate the brake by command!

INFORMATION

The repeatability of the positioning is only ensured when the reference switch is always approached from the same side. Controllers from PI fulfill this requirement due to the automatic direction sensing for reference moves to the reference switch.

6.2 Startup and Operation of the Positioner

Requirements

- ✓ You have read and understood the general notes on startup (p. 37).
- ✓ When starting up and operating with a load or in a multi-axis system: You have installed the positioner properly (p. 17).
- ✓ You have read and understood the user manual for the controller.
- ✓ You have read and understood the manual for the PC software.
- ✓ The controller and the required PC software have been installed. All connections on the controller have been set up (see "Connecting the M-5x1 to the controller" (p. 24) and the user manual for the controller).

Starting up the positioner

1. M-5x1.DD1, .DD2, .PD1, .PG1 und .EC models only: Connect the power adapter’s cord to the power socket.
2. Start up the controller (see user manual of the controller).

   Configure the controller during startup using the PC software for the positioner (refer to the user manual for the controller, and the PC software):

   – If you are using a controller from PI: Select the entry in the positioner database that matches the positioner model exactly (p. 39).

   – If you are using a controller from another manufacturer: Enter the parameters into the corresponding PC software that exactly match the positioner model; see the overview of the operating parameters (p. **Fehler! Textmarke nicht definiert.**).
3. Start a few motion cycles for testing purposes (refer to the user manual for the controller).

6.2.1 M-5x1 Entries in the PI Positioner Database

For PI controllers, you can select the connected positioner from a positioner database in the corresponding PC software. The appropriate operating parameters are loaded into the controller. You can find a detailed description in the user manual for the controller or in the manual for the PC software used.

7 Maintenance

7.1 General Notes on Maintenance

NOTICE

Damage due to improper maintenance!

Removing caps and screws could lead to contamination and failure of the M-5x1.

- Do not loosen **any** screws on the positioner.
- Do not remove **any other** caps except the protective caps.

7.2 Performing Maintenance

Depending on the operating conditions and the period of use of the M-5x1, the following maintenance measures are required:

Maintenance run

The maintenance run serves the purpose of distributing the existing lubricant.

- After 500 operating hours or at least after 1 year, carry out a maintenance run over the entire travel range, in order for the lubricant present to be equally distributed.
- If the M-5x1 is to be operated continuously over a small travel range (< 20% of the entire travel range) in an industrial environment, do a maintenance run across the entire travel range every 2,000 motion cycles.

Relubrication

Under laboratory conditions, the positioner needs relubrication in exceptional cases only. The lubrication intervals must be defined individually for continuous industrial use.

- If you have any questions on relubricating, contact our customer service department (p. 47).

7.3 Cleaning the M-5x1

Requirements

✓ You have disconnected the positioner from the controller.

Cleaning the positioner

- If necessary, clean the surfaces of the positioner using a cloth dampened with a mild cleanser or disinfectant.

8 Troubleshooting

8.1 General Notes on Troubleshooting

For the M-5x1.DD1 and .DD2 models, the following applies:

CAUTION

Risk of glare and irritation!

The linear encoder of the M-5x1 uses a class 2 laser in accordance with DIN EN60825-1:2007. Technical data of the laser: $L_{max} \leq 1$ mW, λ=655 nm.

The laser is fully shielded before dispatch and when the M-5x1 is used as intended. Radiation can only be emitted by the laser if the M-5x1 is opened. The laser beam can dazzle and irritate the eyes.

- ➢ **Do not** open or disassemble the M-5x1.
- ➢ Contact our customer service department in case of any malfunction of the M-5x1.

8.2 Possible Causes and Correction

Problem	Possible causes	Solution
Reduced positioning accuracy	Warped base body	➢ Mount the M-5x1 on an even surface. The recommended flatness of the surface is 10 µm.
	When the M-5x1 is mounted vertically: The load exceeds the holding force of the drive.	If you move loads of over 10 N when the M-5x1 is mounted vertically: ➢ Use a positioner with a motor brake (M-5x1.DD2) or with a gearhead (M-5x1.DG1, .PG1).
	Increased wear due to small motion over a long period of time	➢ Perform a maintenance run over the entire travel range (p. 41).
Function impairment after system modification	▪ Controller was replaced. ▪ M-5x1 was replaced by another model.	Controller from PI: ➢ Load the parameters from the positioner database that correspond to the combination of controller and the M-5x1 model.

Problem	Possible causes	Solution
		Controller from a third-party supplier: ➢ Check the operating parameters.
Mechanics do not move; no operating noise can be heard.	Controller and/or power adapter are connected incorrectly or defective.	➢ Check all connecting cables. ➢ Check the controller. ➢ If applicable: Check the positioner's power adapter.
	When a PI controller is used: Axis motion error.	Motion error = the difference between the current position and the commanded position exceeds the specified maximum value in closed-loop operation. For example, motion errors can be caused by malfunctions of the drive or the position sensor of the positioner. 1. Read out the error code of the controller in the PC software. If there is a motion error, error code -1024 is output. 2. Check your system and make sure that all axes can be moved safely. 3. Switch the servo mode on in the PC Software for the affected axis. Refer to the user manual for the controller for details.
	The motion platform has triggered the "inner" limit switch (p. 12).	If you use a controller from PI: 1. Switch the servo mode on in the PC software for the affected axis again. 2. Command an axis motion away from the limit switch in the PC software.
	The motion platform has triggered the "outer" limit switch (p. 12).	➢ Push the motion platform away from the limit switch by hand (p. 45).

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

8.3 Moving the Platform by Hand

NOTICE

Wear from moving the platform by hand!

Moving the platform by hand increases wear in the case of positioners with a gearhead.

➢ In the case of the M-5x1.DG1 und .PG1 models, move the platforms by hand only if they cannot be moved in any other way.

INFORMATION

In the following cases, it can be necessary to move the platform by hand:

- Allow access to the mounting holes for M4 screws in the base body of the positioner.
- Push the motion platform away from the outer limit switch to re-establish the operational readiness of the positioner.

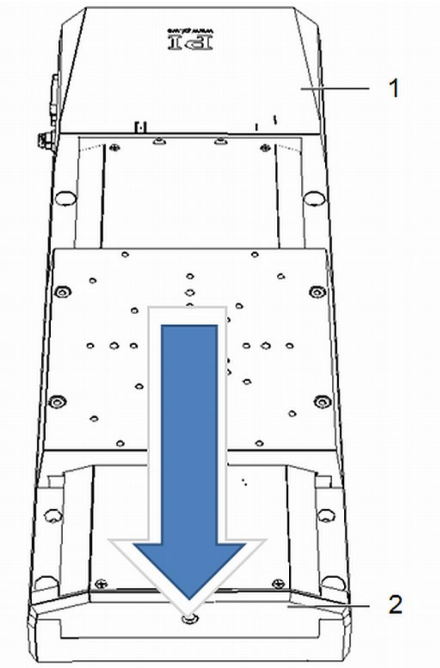


Figure 15: Position of the spindle access (cap removed)

1 Motor cover

2 Front face

Requirements

The positioner is **not** connected to the power adapter and the controller.

Tools

- Hex key, AF 3 (included in the scope of delivery)

Moving the platform manually

1. Remove the drive-screw access cap on the front face of the positioner (for the position see figure).
2. Insert the hex key into the drive-screw access until you feel resistance.
3. Turn the hex key as far as necessary:
   - Clockwise rotation: Platform moves away from the motor cover
   - Counterclockwise rotation: Platform moves in the direction of the motor cover

Rotary motion is transferred directly to the ball screw.

9 Customer Service

For inquiries and orders, contact your PI sales engineer or send us an email (service@pi.de).

- If you have 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)
  - PC operating system (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 on our website (p. 2).

10 Technical Data

10.1 Specifications

10.1.1 Data Table

Motion	M-5x1.DD1 / .DD2	M-5x1.DG1 / .PG1	M-5x1.EC / .PD1	Unit	Tolerance
Active axis	X	X	X		
Travel range	M-511: 102 (4‘‘) / M-521: 204 (8‘‘) / M-531: 306 (12‘‘)			mm	
Pitch (rotational crosstalk in θY during motion in X)	±25 or 35	±35	±35	µrad	Typ.
Yaw (rotational crosstalk in θZ during motion in X)	±25 or 35	±35	±35	µrad	Typ.
Straightness (linear crosstalk in Y during motion in X)	±1	±1	±1	µm	Typ.
Flatness (linear crosstalk in Z during motion in X)	±1	±1	±1	µm	Typ.
Maximum velocity in X, unloaded	50	6	100	mm/s	

Positioning:	M-5x1.DD1 / .DD2	M-5x1.DG1 / .PG1	M-5x1.EC / .PD1	Unit	Tolerance
Integrated sensor	Incremental linear encoder	Incremental rotary encoder	Incremental rotary encoder		
Sensor signal	A/B quadrature, RS-422	A/B quadrature, RS-422	A/B quadrature, RS-422		
Sensor resolution	50			nm	
Sensor resolution		2048	4096	Count/U	
Minimum incremental motion	0.1	0.4	0.5	µm	Typ.
Backlash in X		1	1	µm	Typ.

Positioning:	M-5x1.DD1 / .DD2	M-5x1.DG1 / .PG1	M-5x1.EC / .PD1	Unit	Tolerance
Unidirectional repeatability	0.1	0.4	0.5	µm	Typ.
Bidirectional repeatability	±0.2	±1	±1	µm	Typ.
Limit switches	Hall effect	Hall effect	Hall effect		
Reference switch	Hall effect	Hall effect	Hall effect		

Mechanical properties	M-5x1.DD1 / .DD2	M-5x1.DG1 / .PG1	M-5x1.EC / .PD1	Unit	Tolerance
Guide	Recirculating Ball Bearing Guide	Recirculating ball bearing guide	Recirculating ball bearing guide		
Drive screw type	Ball screw	Ball screw	Ball screw		
Drive screw pitch	2	2	2	mm	
Gear ratio i		29.6 : 1			
Holding brake	- / Electromagnetic safety brake				
Moved mass in X, unloaded	530	530	530	g	
Permissible push force in Y	200	200	200	N	Max.
Permissible push force in Z	1000	1000	1000	N	Max.
Permissible torque in θX	40	40	40	N m	Max.
Permissible torque in θY	20	20	20	N m	Max.
Permissible torque in θZ	20	20	20	N m	Max.
Overall mass	5000 (M-511) / 6100 (M-521) / 7200 (M-531)			g	
Material	Black anodized aluminum	Black anodized aluminum	Black anodized aluminum		

Drive properties	M-5x1.DD1 / .DD2	M-5x1.DG1 / .PG1	M-5x1.EC / .PD1	Unit	Tolerance
Drive Type	DC motor with Active Drive	DC gear motor / DC gear motor with Active Drive	Brushless DC motor / DC motor with Active Drive		
Nominal voltage	24	- / 24	24	V	
Peak voltage		12 / -		V	

Drive properties	M-5x1.DD1 / .DD2	M-5x1.DG1 / .PG1	M-5x1.EC / .PD1	Unit	Tolerance
Drive force in negative direction of motion in X	80	80	80	N	Typ.
Drive force in positive direction of motion in X	80	80	80	N	Typ.

Note on pitch, yaw, straightness, flatness: Specified value applies per 100 mm
Note on gear ratio: (28/12)4 ~ 29.6 : 1

10.1.2 Maximum Ratings

M-5x1 positioners are designed for the following operating data. They are **not** suitable for continuous operation.

Model	Maximum operating voltage	Operating Frequency	Maximum power consumption
M-5x1.DD1, .DD2, .EC, .PD1, .PG1	24 V	0 Hz	60 W
M-5x1.DG1	12 V	0 Hz	3 W

10.1.3 Ambient Conditions and Classifications

Pay attention to the following ambient conditions and classifications for the M-5x1:

M-5x1 model	.DD1, .DD2	.DG1, .PD1, .PG1, .EC
Area of application	For indoor use only	
Maximum altitude	2000 m	
Relative humidity	Maximum relative humidity 80 % for temperatures up to 31 °C Decreasing linearly to 50 % relative humidity at 40 °C	
Storage temperature	10 °C to 50 °C	-20 °C to 65 °C
Transport temperature	10 °C to 50 °C	-20 °C to 65 °C
Supply fluctuations	Not more than ± 10% of the nominal voltage	
Degree of pollution	2	
Degree of protection according to IEC 60529	IP40	

10.1.4 Limit Switch Specifications

Type	Magnetic (Hall effect) sensor
Supply voltage	+5 V/GND, supplied via the motor connector
Signal output	TTL level
Signal logic	Active high. The signal level changes when passing the limit switch: ▪ Normal motor operation: low (0 V) ▪ Limit switch reached: high (+5 V)

10.1.5 Reference Switch Specifications

Type	Magnetic (Hall effect) sensor
Supply voltage	+5 V/GND, supplied by the motor controller through the motor connector.
Signal output	TTL level
Signal logic	Direction sensing by means of different signal levels on the left- and right-hand of the reference switch: The signal level changes from 0 to +5 V when the reference switch is passed.

10.2 Dimensions

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

10.2.1 Positioner M-5x1

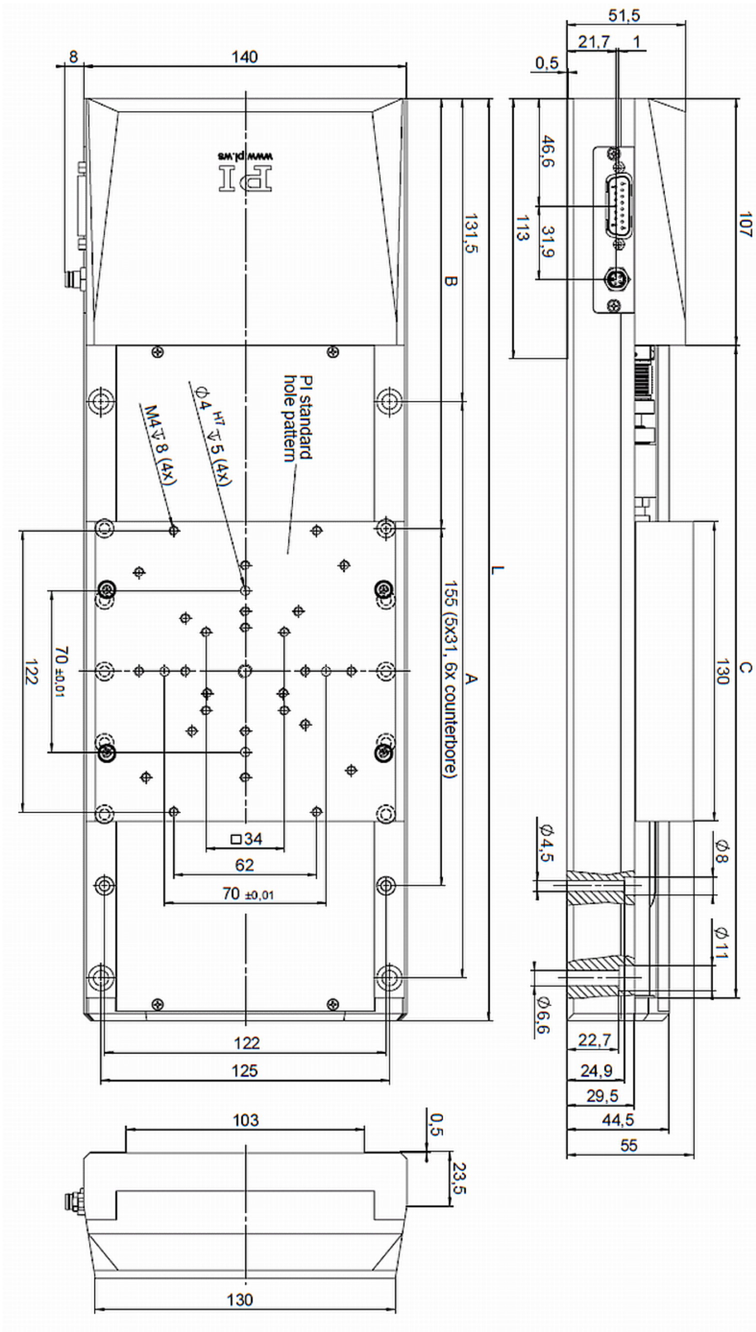


Figure 16: Dimensions of the M-5x1

Models	L	A	B	C
M-511.xxx	400	250	186.5	283
M-521.xxx	500	350	236.5	383
M-531.xxx	600	450	286.5	483

10.2.2 Hole Pattern of the Motion Platform

The platform is attached to the stage via the countersunk holes.

27 undimensioned holes: M4 thread, 8 mm depth, core hole drilled through.

The four H7 Ø 4 mm holes with a depth of 5 mm are intended as locating holes.

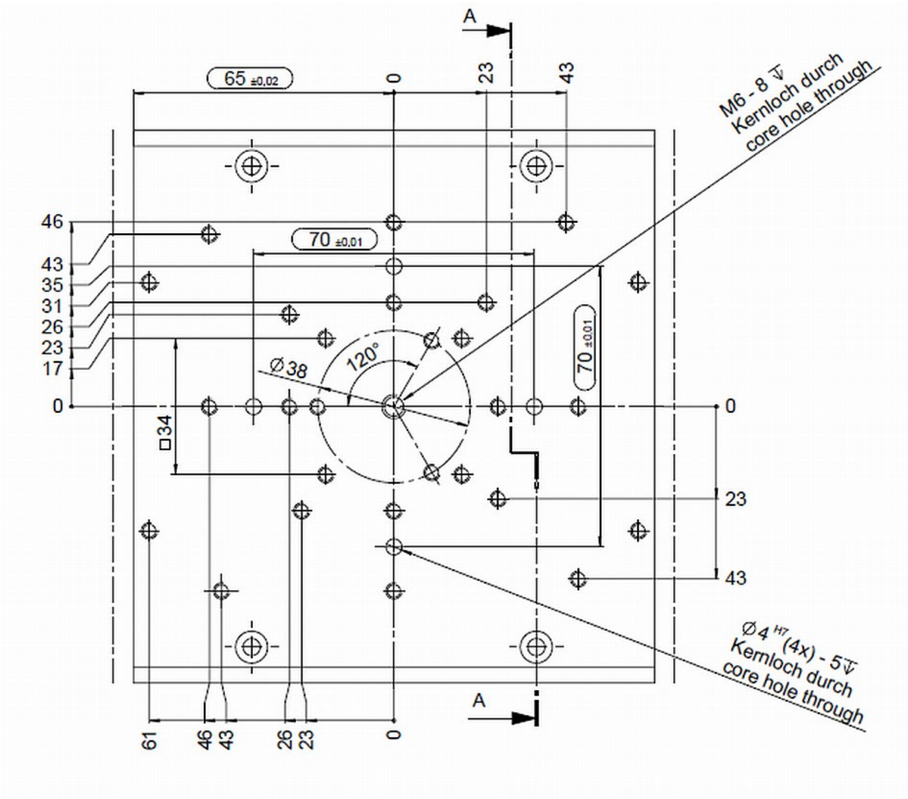


Figure 17: Hole pattern on the motion platform (PI standard hole pattern)

10.2.3 M-592.10 Adapter Bracket

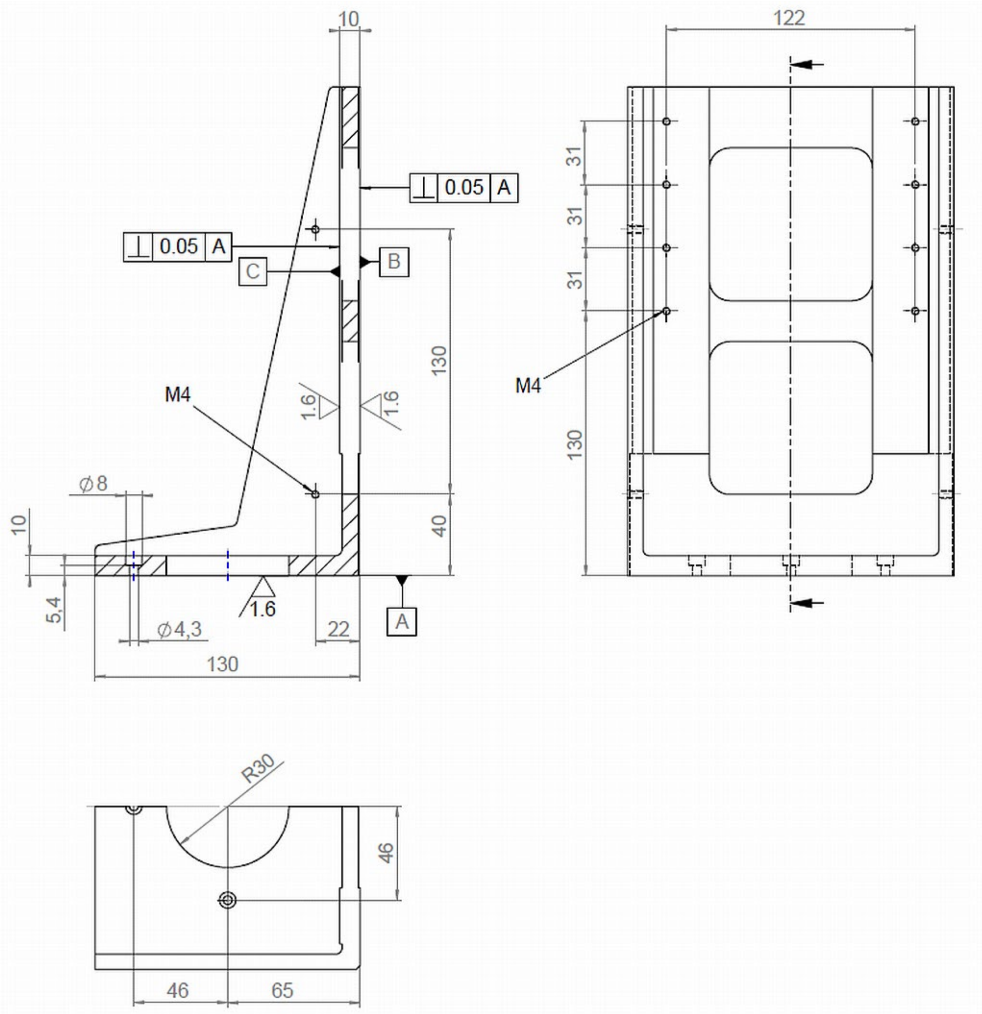


Figure 18: M-592.10 adapter bracket

10.2.4 M-500.206 Adapter Plate

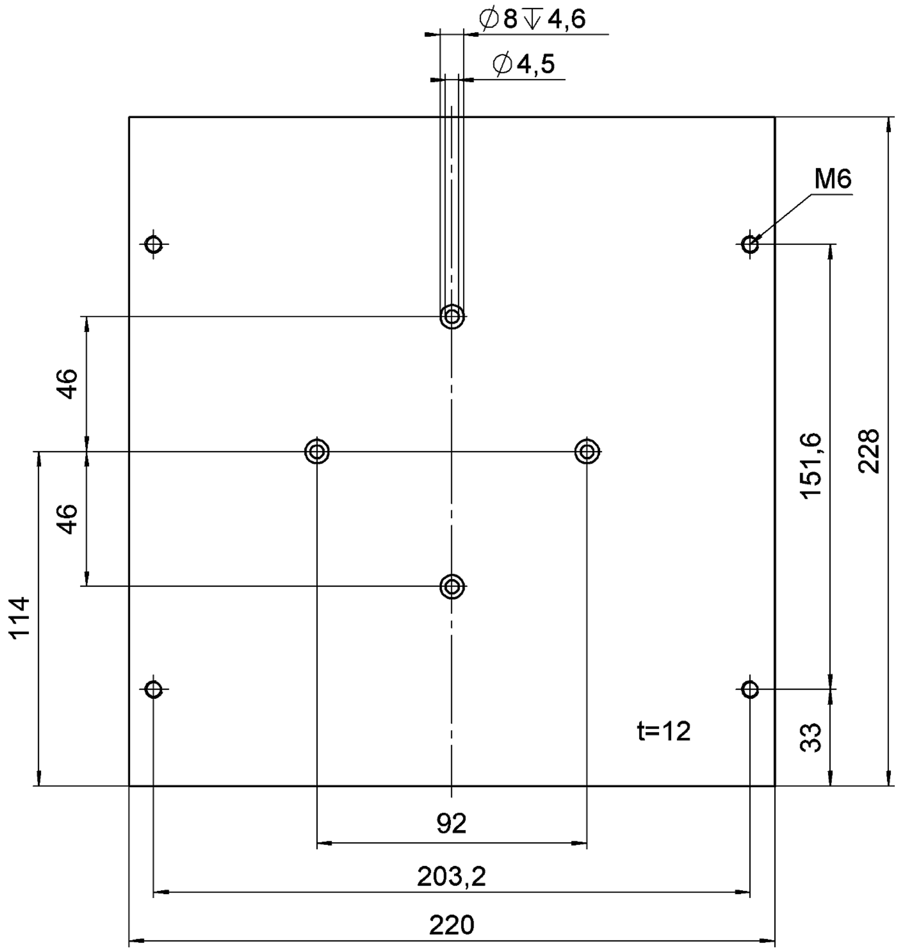


Figure 19: M-500.206 adapter plate

10.2.5 M-590.00 Three-Point Support, Two-Part

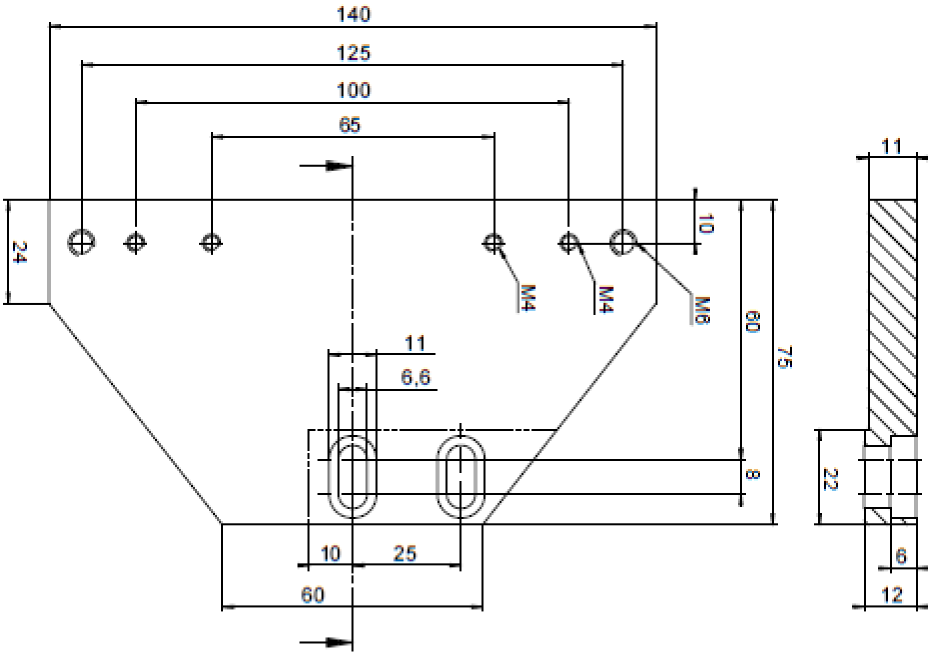


Figure 20: Wide adapter plate (M59000001)

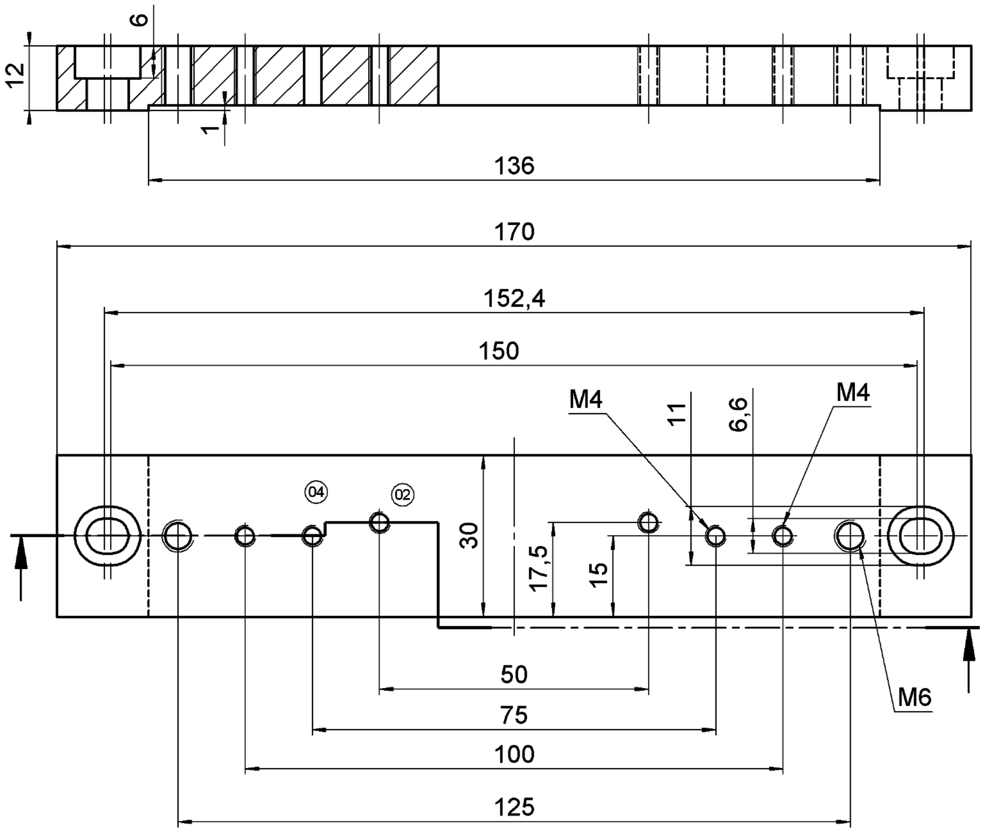


Figure 21: Narrow adapter plate (M59000002)

10.3 Pin Assignment

10.3.1 D-sub 15 (m) Controller Connector

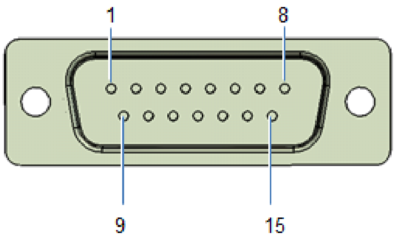


Figure 22: D-sub 15 (m), front view

Pin	Signal	Direction
1	M-5x1.DD2: motor brake M-5x1.DD1, .PD1, .DG1, .PG1, .EC: internal	Input
2	M-5x1.DG1: motor (+) M-5x1.DD1, .DD2, .PD1, .PG1: internal; must not be connected M-5x1.EC: not connected	Input
3	M-5x1.DD1, .DD2, .PD1, .PG1, .EC: MAGN (PWM magnitude) M-5x1.DG1: internal; must not be connected	Input
4	+ 5 V	Input
5	Limit_P (positive limit switch)	Output
6	ID chip (for future use)	Bidirectional
7	Encoder A (-)	Output
8	Encoder B (-)	Output
9	M-5x1.DG1: motor (-) M-5x1.DD1, .DD2, .PD1, .PG1: internal; must not be connected M-5x1.EC: not connected	Input
10	GND	GND
11	M-5x1.DD1, .DD2, .PD1, .PG1, .EC: SIGN (PWM sign) M-5x1.DG1: internal; must not be connected	Input
12	Limit_N (negative limit switch)	Output
13	Reference	Output
14	Encoder A (+)	Output
15	Encoder B (+)	Output

10.3.2 M8 (m) Power Adapter Connector

Connecting a power adapter is only necessary for the M-5x1.DD1, .DD2, .EC, .PG1, and .PD1 models.

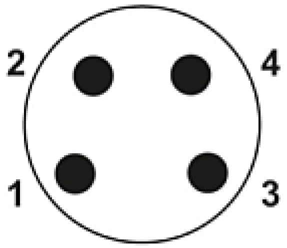


Figure 23: Phoenix M8 panel plug, front view

Pin	Signal	Direction
1	GND	GND
2	GND	GND
3	24 V DC supply voltage	Input
4	24 V DC supply voltage	Input

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.

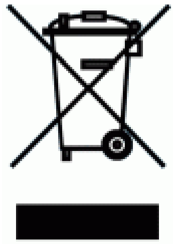
In order to fulfill the responsibility as the product manufacturer, PI miCos GmbH undertakes environmentally correct disposal of all old PI miCos equipment made available on the market after 13 August, 2005 without charge.

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

PI miCos GmbH

Freiburger Strasse 30

79427 Eschbach, Germany



12 European Declarations of Conformity

For the M-5x1, declarations of conformity were issued in accordance with the following European directives:

- EMC Directive
- RoHS Directive

The standards applied for certifying conformity are listed below.

- EMC: EN 61326-1
- Safety: EN 61010-1
- RoHS: EN IEC 63000