MP135E

Q-545 Precision Linear Stage

User Manual

Version: 1.1.3 Date: 12.2.2021



This document describes the following products:

- **Q-545.140**
  Q-Motion® Linear stage, piezoelectric inertia drive, 13 mm travel range, linear encoder, 1 nm resolution, 7 N drive force, dimensions 45 × 48 × 15 mm (W × L × H)
- **Q-545.240**
  Q-Motion® Linear stage, piezoelectric inertia drive, 26 mm travel range, linear encoder, 1 nm resolution, 7 N drive force, dimensions 45 × 63 × 15 mm (W × L × H)

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Subject to change without notice. This manual is superseded by any new release. The latest release is available for download (p. 3) on our website.

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1 About this Document

In this Chapter

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Symbols and Typographic Conventions 1
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1.1 Objective and Target Audience of this User Manual

This manual contains information necessary for the intended use of the Q-545.

It assumes that the reader has a fundamental understanding of basic servo systems as well as motion control concepts and applicable safety procedures.

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

1.2 Symbols and Typographic Conventions

The following symbols and typographic conventions are used in this user manual:

CAUTION



Dangerous situation
Failure to comply could lead to minor injuries or damage to equipment.

- ➢ Precautionary measures for avoiding the risk.

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 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	Labeling of an operating element on the product (example: socket of the RS-232 interface)
	Warning sign affixed to the product that refers to detailed information in this manual.

1.3 Definition of Terms

Term	Explanation
Load capacity, horizontal	Maximum load capacity when the positioner is mounted horizontally. The contact point of the load is at the center of the motion platform. The load acts vertically. Specified in kg.
Load capacity, any	Maximum load capacity when the positioner is mounted in any orientation of the motion axis. The contact point of the load is at the center of the motion platform. The load acts vertically. Specified in kg.
Self-locking	Holding force of the drive in a power off condition. Specified in N.
Linear encoder	The linear encoder is an incremental sensor for detecting changes in position. Signals from the sensor are used for axis position feedback. After switching the controller 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 their own manuals.

Description	Document
E-873.1AT Q-Motion® controller for piezoelectric inertia drives, 1 axis, benchtop device (industry), SPI, TCP/IP, USB, RS-232, I/O, connector for joystick	PZ274E User manual
E-873.10C885 Q-Motion® controller module for PIMotionMaster, 1 axis, for systems with piezoelectric inertia drive	E873T0002 Technical note
PIMikroMove	SM148E Software manual

1.6 Downloading Manuals

INFORMATION

If a manual is missing or problems occur with downloading:

- ➢ Contact our customer service department (p. 45).

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

Intended Use 5
General Safety Instructions 5
Organizational Measures 6

2.1 Intended Use

The Q-545 is a laboratory device as defined by DIN EN 61010-1. It is intended for indoor use and use in an environment that is free of dirt, oil, and lubricants.

In accordance with its design, the Q-545 is intended for single-axis positioning, adjusting and shifting of loads at different velocities in interval mode. The Q-545 uses a piezoelectric inertia drive. The drive is self-locking at rest, requires no current, generates no heat, and maintains its position.

The Q-545 can be mounted in any orientation. The specifications of the Q-545 apply to horizontal mounting (p. 47).

The Q-545 is **not** intended for applications in areas where failure would be a considerable risk for people or the environment. For further information on the operating conditions of the Q-545, see "Technical Data" (p. 47).

The Q-545 is equipped with a linear encoder for direct position measuring.

It is only possible to use the Q-545 as intended when it is completely mounted and connected. The Q-545 must be operated with suitable electronics (p. 11). The electronics are not in the Q-545's scope of delivery.

2.2 General Safety Instructions

The Q-545 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 Q-545.

- Use the Q-545 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 Q-545.

2.3 Organizational Measures

User manual

- Always keep this user manual together with the Q-545.
  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 Q-545 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 Q-545 only after you have read and understood this user manual.

Personnel qualification

The Q-545 may only be installed, started, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

3 Product Description

In this Chapter

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Product View 8
Product Labeling 9
Scope of Delivery 10
Accessories 10
Suitable Electronics 11
Technical Features 11

3.1 Model Overview

The Q-545 is available in the following versions:

Order number	Product name
Q-545.140	Q-Motion® Linear stage, piezoelectric inertia drive, 13 mm travel range, linear encoder, 1 nm resolution, 7 N drive force, dimensions 45 × 48 × 15 mm (W × L × H)
Q-545.240	Q-Motion® Linear stage, piezoelectric inertia drive, 26 mm travel range, linear encoder, 1 nm resolution, 7 N drive force, dimensions 45 × 63 × 15 mm (W × L × H)

3.2 Product View

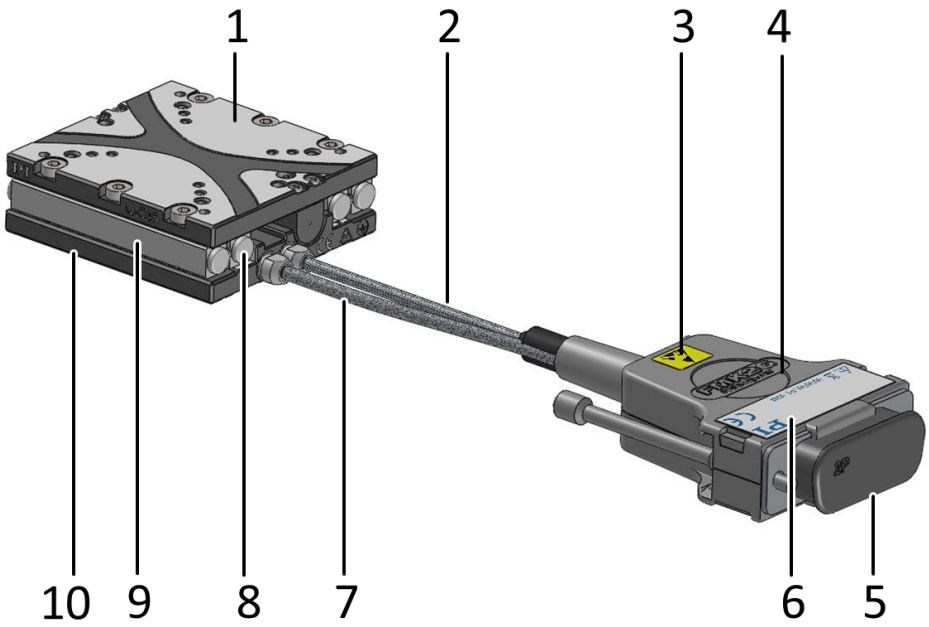


Figure 1: Example Q-545.140

1 Motion platform
2 Cable exit for drive connector
3 Warning sign "Electrostatic sensitive devices"
4 Connector for drive and sensor: D-sub 15 (m)
5 ESD protection cap
6 Type plate p. 9
7 Cable exit for sensor connector
8 Inner guide element (2×)
9 Outer guide element (2×)
10 Base body

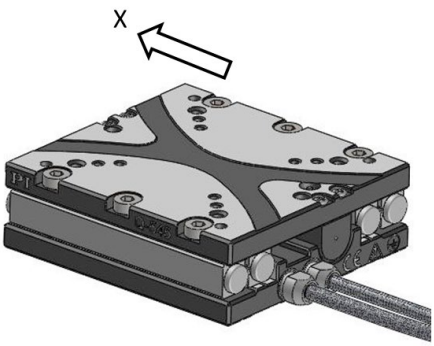


Figure 2: Direction of motion of the platform of the Q-545, Q-545.140 used as example

The arrow in the figure above shows the direction of motion on positive commanding.

3.3 Product Labeling

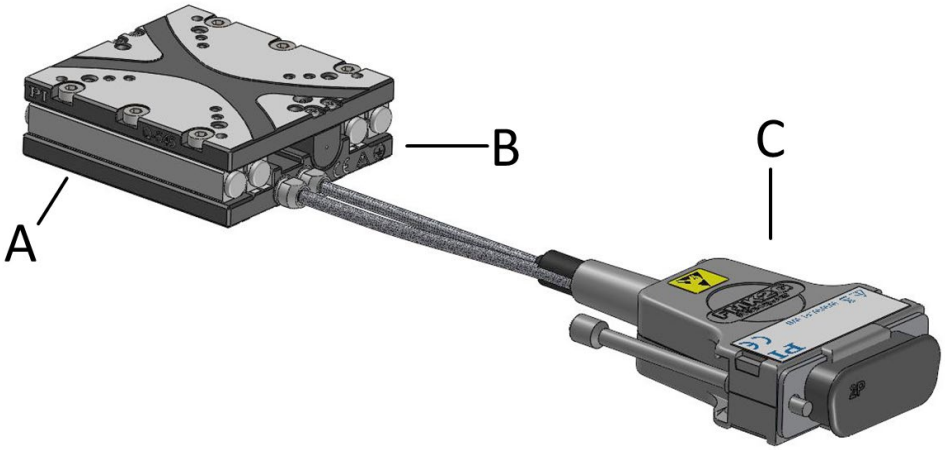


Figure 3: Example Q-545.140: Product labeling and type plate

Position	Labeling	Description
A, C	PI	Manufacturer's logo
B, C	CE	CE conformity mark
B, C	⚠	Warning sign "Pay attention to the manual!"
B	⏚	Symbol for the protective earth conductor, marks the protective earth connection of the Q-545 (p. 21)
C		Warning sign "Electrostatic-sensitive devices"
C	113064246	Serial number (example), individual for each Q-545 Meaning of each position (from the left): 1 = internal information, 2 and 3 = year of manufacture, 4 to 9 = consecutive number
C	Q-545.240	Product name (example), the characters following the period refer to the model
C		Old equipment disposal (p. 57)
C	WWW.PI.WS	Manufacturer's address (website)

3.4 Scope of Delivery

The Q-545 is delivered with the following components:

Item ID	Components
Q-545	Positioner according to order (p. 7)
5861500010	Screw set for mounting the Q-545, consisting of: ▪ 2 dowel pins, A2 2.5 m6 × 4 ISO 2338 ▪ 4 socket head screws, A2 M2.5x5 ISO 4762
MP139EK	Short instructions for the Q-5xx / Q-6xx Q-Motion® positioners

3.5 Accessories

Order number	Description
E-873.UHV1	Extension cable from the Q-545 to the electronics, D-sub 15 (f) to D-sub 15 (m), 1 m
E-873.UHV2	Extension cable from the Q-545 to the electronics, D-sub 15 (f) to D-sub 15 (m), 2 m
E-873.UHV3	Extension cable from the Q-545 to the electronics, D-sub 15 (f) to D-sub 15 (m), 3 m
E-873.UHV5	Extension cable from the Q-545 to the electronics, D-sub 15 (f) to D-sub 15 (m), 5 m
Q-145.1001	Adapter bracket for vertical mounting of Q-545.140 positioners. Material: Aluminum (3.3206), anodized; mass: 42 g; includes: ▪ 2 dowel pins, A2 2.5 m6 × 4 ISO 2338 ▪ 4 socket head screws, A2 M2.5x8 ISO 4762
Q-145.200	Adapter bracket for mounting Q-545.240 positioner vertically. Material: Aluminum (3.3206), anodized; mass: 49 g; includes: ▪ 2 dowel pins, A2 2.5 m6 × 4 ISO 2338 ▪ 4 socket head screws, A2 M2.5x8 ISO 4762

➢ To order, contact our customer service department (p. 45).

3.6 Suitable Electronics

Order number	Description
E-873.1AT	Q-Motion® controller for piezoelectric inertia drives, 1 axis, benchtop device (industry), SPI, TCP/IP, USB, RS-232, I/O, connector for joystick
E-873.10C885	Q-Motion® controller module for PIMotionMaster, 1 axis, for systems with piezoelectric inertia drive

➢ To order, contact our customer service department (p. 45).

3.7 Technical Features

3.7.1 Linear Encoder (Sensor)

The Q-545 is equipped with an optical linear encoder. Refer to the table in the "Specifications" section (p. 47) for the encoder resolution.

Optical linear encoders measure the actual position directly (direct metrology). Therefore, errors occurring in the drivetrain such as nonlinearity, backlash or elastic deformation, cannot influence the measurement of the position.

3.7.2 Reference Switch

The Q-545 also has an optical reference switch.

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

3.7.3 ID Chip

The Q-545 has an ID chip in the connector.

The following data is stored as parameters on the ID chip:

- Information on the positioner: Type, serial number, date of manufacturer, hardware version
- Settings for the sensor: Interpolation rate, corrections to hysteresis, phase and offset, gain values

When switched on or rebooted, controllers from PI read the data from the ID chip.

For more information on ID chip detection, see the manual for the controller.

4 Unpacking

NOTICE



Electrostatic hazard

Touching the pins on the D-sub 15 connector can damage the Q-545's electrostatic-sensitive (also: ESD) components. For this reason, the Q-545 is supplied with ESD protection.

- ➢ Remove the ESD protection from the connection only when you connect the Q-545 to the controller.

1. Unpack the Q-545 with care.
2. If present, do **not** remove the ESD protection from the connection of the Q-545.
3. Compare the contents with the items listed in the contract and the packing list.
4. Inspect the contents for signs of damage. If there is any sign of damage or missing parts, contact PI immediately.
5. Keep all packaging materials and the ESD protection in case the product needs to be returned.

5 Installation

In this Chapter

General Notes on Installation 15
Avoiding Mounting Errors 17
Mounting the Q-545 onto an Underlying Surface and Connecting it to a Protective Earth Conductor 21
Building a Multi-Axis System 24
Fixing the Load to the Q-545 32
Connecting the Q-545 to the Electronics 34

5.1 General Notes on Installation

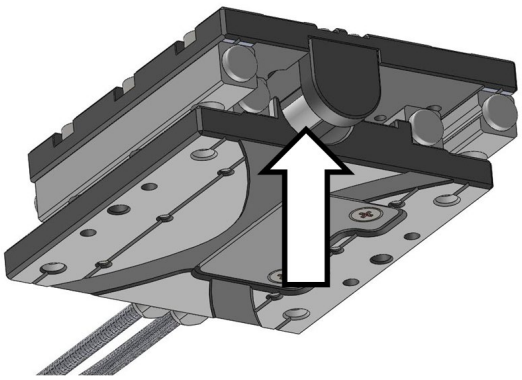


Figure 4: Accessible when the motion platform is driven out: Ceramic rod of the drive, example Q-545.140

NOTICE

Malfunction due to soiling!

Any soiling; e.g., dust, oil, lubricant or condensation, will render the Q-545 inoperable.

- Keep the Q-545 free of dirt and condensation.
- Avoid touching the drive's ceramic rod.

NOTICE

Electrostatic hazard

Touching the pins on the D-sub 15 connector can damage the Q-545's electrostatic-sensitive (also: ESD) components. For this reason, the Q-545 is supplied with ESD protection.

- Remove the ESD protection from the connection only when you connect the Q-545 to the controller.

NOTICE

Heating up of the Q-545 during operation!

The heat produced during operation of the Q-545 can affect your application.

- Install the Q-545 so that the application is not impaired by the dissipated heat.
- Ensure sufficient ventilation at the place of installation.
- Make sure that the complete bottom of the Q-545 is in contact with the surface on which the Q-545 is mounted.

NOTICE

Unwanted changes in position!

Unwanted changes in position are possible if a force acts on the motion platform (e.g., because of a cable attached to the load or when a heavy load is mounted vertically) that is greater than the self-locking of the drive (p. 47). You will see a definition of self-locking under "Terms" (p. 2).

Unwanted changes in the position of the motion platform can damage the drive, the load or the surroundings.

- Take appropriate measures to ensure that only a force less than the self-locking force acts on the motion platform: For example, cables attached to the load should have sufficient strain relief.

NOTICE

Damage from unsuitable cables!

Unsuitable cables can damage the electronics.

- Use cables provided by PI only for connecting the Q-545 to the electronics.

INFORMATION

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

INFORMATION

The positive direction of motion of the axis is specified in the product view (p. 8).

5.2 Avoiding Mounting Errors

Mounting the Q-545 onto an underlying surface

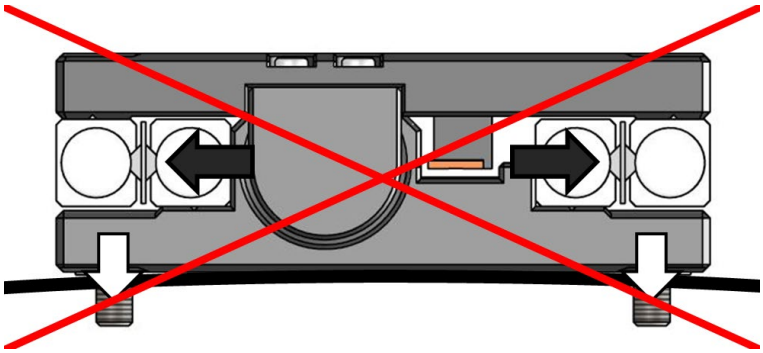


Figure 5: Incorrect mounting on an uneven surface, schematic representation

Line, black: Uneven underlying surface
Arrows, white: Effect of force by tightening the screws when fixing to the underlying surface
Arrows, black: The guide elements are pushed outwards, play occurs between the inner and outer guide elements

NOTICE

Warping of the Q-545 when mounted on uneven surfaces!
Mounting the Q-545 on an uneven surface could warp the Q-545. Warping reduces the accuracy, the drive force, and the maximum velocity.

- Mount the Q-545 onto a flat surface. The recommended flatness of the surface is ≤10 µm.
- When mounting, do not exceed the maximum torque specified in the instructions.
- For applications with large temperature changes:
  Only mount the Q-545 on surfaces that have the same or similar thermal expansion properties as the Q-545.

NOTICE

Protruding screw heads!
Protruding screw heads can damage the Q-545.

- Ensure that the screw heads do not protrude from countersunk holes so that they do not interfere with the motion.

Building a Multi-Axis System

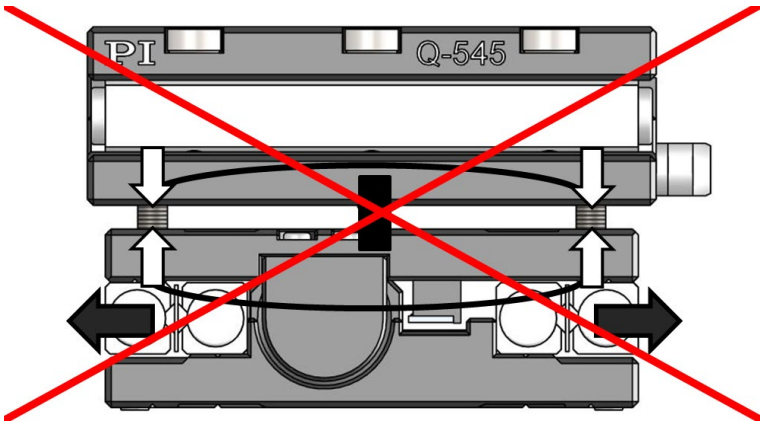


Figure 6: Incorrect mounting of an XY system; schematic representation

Bars, black:	Excessively long or thick locating pins for aligning the upper to the lower positioner
Arrows, white:	Effect of force by tightening the screws when fixing the upper to the lower positioner
Lines, black:	Warping of the upper and lower positioner's contact surfaces
Arrows, black:	The lower positioner's outer guide elements are pushed outwards and leads to play between the inner and outer guide elements

NOTICE

Unsuitable screws and locating pins!

Screws and locating pins inserted too deeply and/or excessively thick locating pins will damage the Q-545: Tightening the screws warps the positioner, which leads to play between the inner and outer guide elements.

- Before mounting, make sure that the screws and locating pins have the right length and thickness for the corresponding holes.
- Pay attention to the depth of the mounting holes (p. 51) in the motion platform.
- Pay attention to the maximum depth for inserting locating pins (p. 51) into the motion platform.

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 positioner.

- Include the masses of the positioner and the mounting adapter (p. 10) in the calculation of the load to be moved.
- For all positioners in a multi-axis system: Do **not** exceed the maximum permissible load.

Fixing the load to the Q-545



Figure 7: Incorrect mounting: Torque on the motion platform damages the positioner



Figure 8: Correct mounting: Hold the motion platform firmly to avoid torque on the motion platform

NOTICE

Impermissible torque and forces!

Torque and forces on the motion platform could damage the positioner.

- Hold the motion platform firmly to prevent it from moving when tightening the screws.
- Pay attention to the maximum torques specified in the instructions.

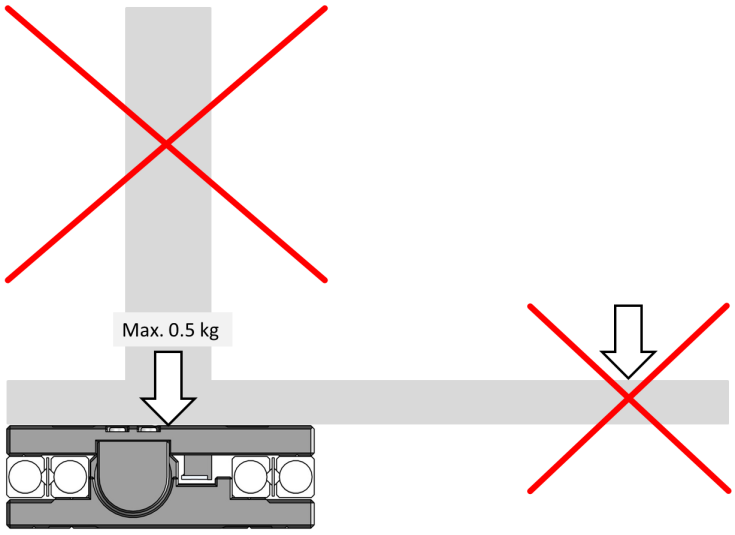


Figure 9: The load center should be in the middle of the motion platform

NOTICE

Damage due to unfavorable load center!

A load's center of gravity not at the center of the motion platform subjects the positioner to torque. The torque reduces the accuracy and could damage the positioner.

- Make sure that the gap between the load's center of gravity and the motion platform's center is as small as possible in all directions.
- Pay attention to the maximum permissible load capacity and holding force according to the specifications (p. 47) with respect to the mass and the method of fixing the load.
- Avoid rotary and tilting torques on the motion platform.

NOTICE

Unsuitable screws and locating pins!

Screws and locating pins inserted too deeply and/or excessively thick locating pins will damage the Q-545: Tightening the screws warps the positioner, which leads to play between the inner and outer guide elements.

- Before mounting, make sure that the screws and locating pins have the right length and thickness for the corresponding holes.
- Pay attention to the depth of the mounting holes (p. 51) in the motion platform.
- Pay attention to the maximum depth for inserting locating pins (p. 51) into the motion platform.

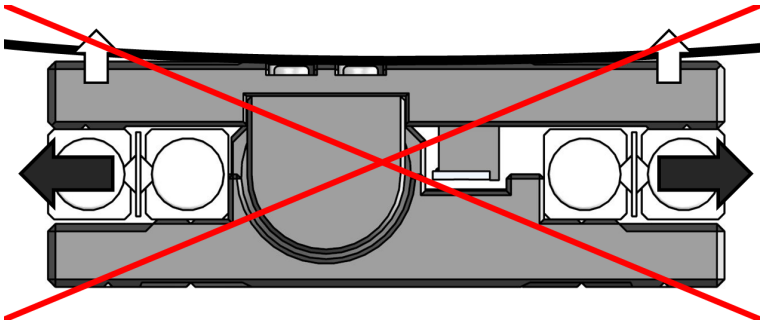


Figure 10: Incorrect mounting of a load; schematic representation

A load with an uneven contact surface (line, black) causes warping of the positioner's motion platform. Tightening the screws cause the motion platform to arch (effect of force shown by white arrows). The outer guide elements are pushed outwards (arrows, black), which leads to play between the inner and outer guide elements.

NOTICE



Damage due to mounting a load with uneven contact surface!
Mounting a load with an uneven contact surface could warp the Q-545. Warping reduces the accuracy, the drive force, and the maximum velocity.

- ➢ Fix a load onto the Q-545 only if its contact surface is flat. The recommended flatness for the contact surface is ≤10 µm.
- ➢ For applications with large temperature changes:
  Fix a load onto the Q-545 only if it has the same or similar thermal expansion properties as the Q-545.

INFORMATION

- ➢ To avoid unwanted changes in the position of the motion platform, ensure sufficient strain relief when cables are attached to the load.

5.3 Mounting the Q-545 onto an Underlying Surface and Connecting it to a Protective Earth Conductor

INFORMATION

The electrical contact of the Q-545 to the protective earth conductor is established via the surface, on which the Q-545 is mounted.

- The corresponding contact surfaces must be sufficiently conductive.
- The protective earth conductor is connected to the surface on which the Q-545 is mounted.
- The screws are secured against unintentional loosening; e.g., with thread-locking adhesive.

INFORMATION

- ➢ Pay attention to the applicable standards for connecting the protective earth conductor.

INFORMATION

- ➢ If there is any vibration in your application, secure the screw connection for the protective conductor in a suitable manner (e.g., with liquid adhesive) to prevent it from unscrewing by itself.

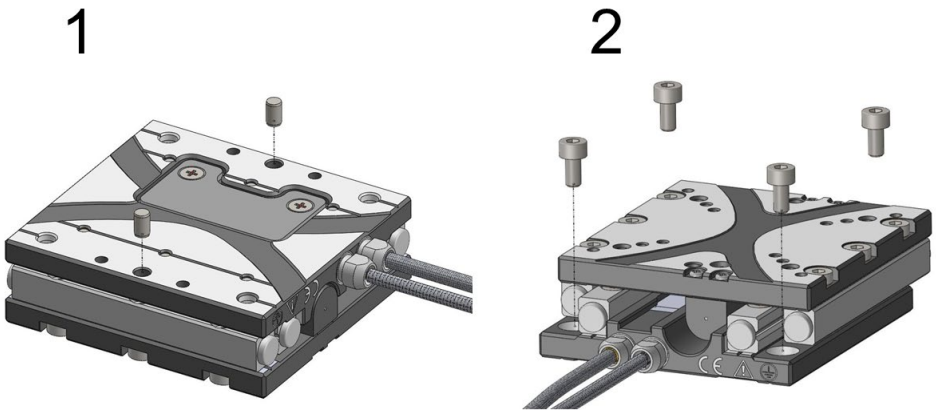
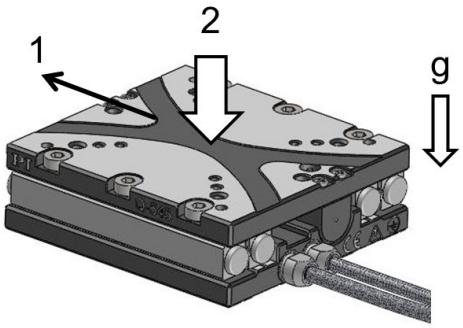
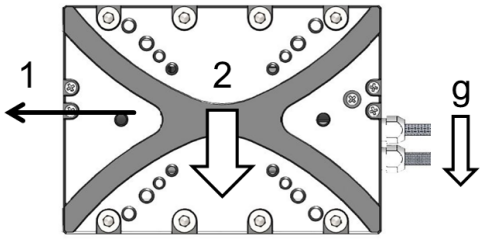
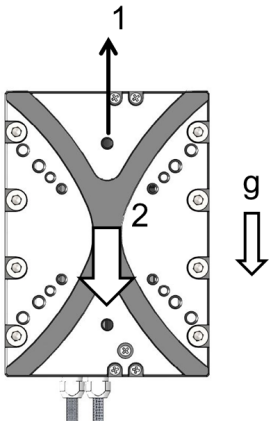


Figure 11: Example Q-545.140, left: View from below; right: View from top

1 Two locating holes in the bottom of the positioner are used for aligning on an underlying surface.
2 Four M2.5 screws are used to fix the positioner to an underlying surface.

Possible orientations of the Q-545

Orientation of the motion axis	Influencing factors
Horizontal mounting with horizontal orientation of the motion axis	 g = gravity 1 = positive direction of the motion axis 2 = load capacity, horizontal (p. 2), max. 0.5 kg
Vertical mounting with horizontal orientation of the motion axis	 g = gravity 1 = positive direction of the motion axis 2 = load capacity, any (p. 2), max. 0.1 kg

Orientation of the motion axis	Influencing factors
Any orientation of the motion axis; here: Vertical mounting with vertical orientation of the motion axis	 g = gravity 1 = positive direction of the motion axis 2 = load capacity, any (p. 2), max. 0.1 kg

Requirements

- ✓ You have read and understood the general notes on installation (p. 15).
- ✓ The Q-545 is disconnected from the electronics.
- ✓ You have provided a suitable underlying surface (for the required position and depth of the holes for accommodating the screws and locating pins, see "Dimensions" (p. 51)):
  - The surface must be connected to the protective earth conductor.
  - There are two locating holes with ∅ 2.5 mm H7 and four M2.5 mounting holes in the underlying surface.
  - The contact surfaces to the bottom of the positioner have to be sufficiently conductive to ensure that the protective earth conductor functions properly.
  - For applications with large temperature changes: The surface should have the same thermal expansion properties as the Q-545 (e.g., underlying surface made of aluminum).
  - The surface flatness is ≤10 µm.
- ✓ You have accounted for the space required to route cables according to regulations and without bending them.

Tools and accessories

- 5861500010 screw set from the scope of delivery of the Q-545 (p. 10):
  - 2 dowel pins, 2.5 m6 × 4 ISO 2338; for use as locating pins
  - 4 socket head screws, M2.5×5 ISO 4762
- Suitable tools for tightening the screws
- Thread-locking adhesive

Mounting the Q-545 onto an underlying surface and connecting it to a protective earth conductor

1. Aligning the Q-545 on the underlying surface using the locating pins:
   a) Insert the two locating pins into the locating holes in the bottom of the Q-545 (see figure above) or in the underlying surface.
   b) Put the Q-545 onto the underlying surface so that the locating pins are inserted into the corresponding locating holes on the other side.
2. Use four M2.5 screws to fix the Q-545 to an underlying surface.
   a) Push the Q-545's motion platform by hand until two of the four countersunk holes in the base body are accessible.
   b) Insert the screws into each of the two countersunk holes.
      - **Maximum torque: 72 Ncm**
   c) Make sure that the screw heads do not protrude from the countersunk holes.
   d) Repeat steps a) to c) for the other two countersunk holes in the Q-545's base body.
3. Secure the screws against unintentional loosening, e.g., with thread-locking adhesive.
4. Make sure that the contact resistance is <0.1 Ω at 25 A at all connection points relevant for mounting the protective earth conductor.
5. Check that the Q-545 is fixed firmly to the underlying surface.

5.4 Building a Multi-Axis System

The Q-545 can be used in multi-axis systems.

Typical combinations:

- XY system (p. 25)
- Z system (p. 27) (XZ or XYZ combination)

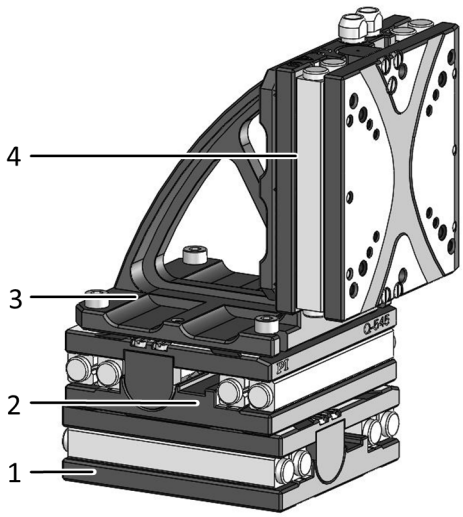


Figure 12: Example for an XYZ system: Three Q-545.140 mounted using an adapter bracket

1 Lower positioner
2 Middle positioner
3 Q-145.1001 adapter bracket
4 Upper positioner

5.4.1 General Information on Building a Multi-Axis System

- Install and operate the multi-axis system only after you have read and understood the user manuals for all components of the multi-axis system.
- If you need special mounting adapters, contact our customer service department (p. 45).

5.4.2 Building an XY System

INFORMATION

Any model of the Q-545 can be used as lower or upper positioner.

Designations in these instructions:

- **Lower positioner**: Forms the basis of the multi-axis system (X axis); is mounted onto an underlying surface
- **Upper positioner**: Forms the Y axis of the multi-axis system; is mounted on the lower positioner rotated by 90°

Requirements

- ✓ You have read and understood the general notes on installation (p. 15).
- ✓ You have read and understood the general notes on setting up a multi-axis system (p. 25).
- ✓ The positioners are disconnected from the electronics.
- ✓ You have fixed the lower positioner onto an underlying surface properly and connected (p. 21) it to a protective earth conductor.
- ✓ You have accounted for the space required to route cables according to regulations and without bending them.

Tools and accessories

- 5861500010 screw set from the scope of delivery of the Q-545 (p. 10):
  - 2 dowel pins, 2.5 m6 × 4 ISO 2338; for use as locating pins
  - 4 socket head screws, M2.5×5 ISO 4762
- Suitable tool for tightening the screws

Building an XY System

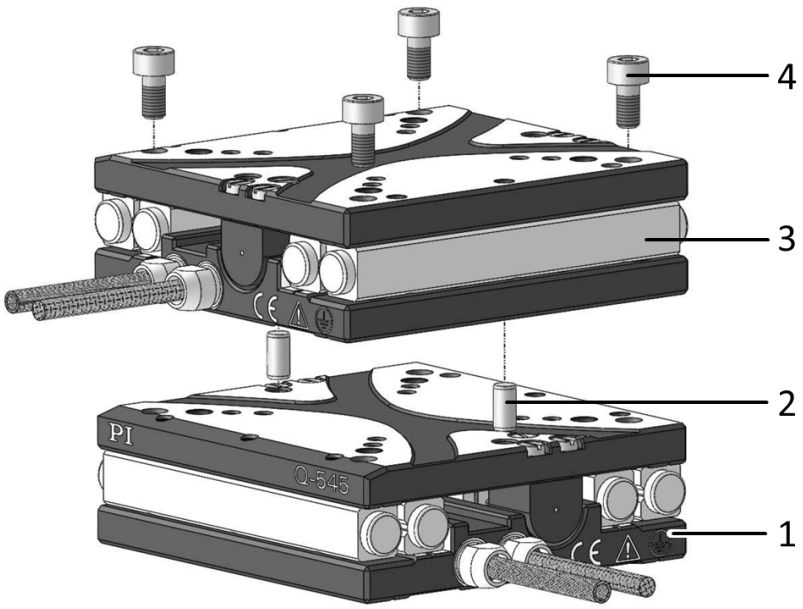


Figure 13: Example: Mounting a Q-545.140 on a Q-545.140

1 Lower positioner
2 2 dowel pins, 2.5 m6 × 4 ISO 2338; for use as locating pins
3 Upper positioner
4 4 socket head screws, M2.5×5 ISO 4762

1. Insert the two locating pins into the locating holes in the bottom of the upper Q-545 or in the motion platform of the lower Q-545 (see figure above). It must be possible to insert the locating pins easily.
2. Put the upper Q-545 onto the lower Q-545 so that the locating pins are inserted into the corresponding locating holes on the other side.
3. Use four M2.5 screws to fix the upper Q-545 to the lower Q-545:
   a) Push the motion platform of the upper Q-545 by hand until two of the four countersunk holes in the base body are accessible.
   b) Insert the screws into each of the two countersunk holes.
      - **Maximum torque: 72 Ncm**
   c) Make sure that the screw heads do not protrude from the countersunk holes.
   d) Repeat steps a) to c) for the other two countersunk holes in the base body of the upper Q-545.
4. Check that the upper Q-545 is fixed firmly to the lower Q-545.

5.4.3 Building a Z System with an Adapter Bracket

NOTICE



Inserting screws and locating pins too deeply!

Screws and locating pins inserted too deeply will damage the Q-545.

- Pay attention to the depth of the mounting holes (p. 51) in the motion platform.
- Pay attention to the maximum depth for inserting locating pins (p. 51) into the motion platform.
- Use screws and locating pins with the correct length for the respective holes only.

Pay attention to the following order when you align the adapter bracket on the lower positioner:

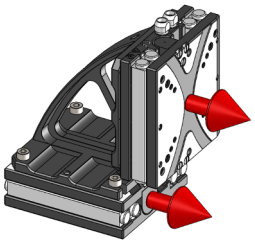
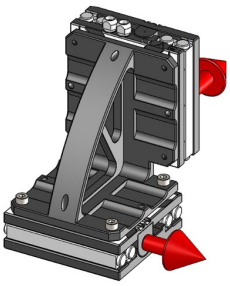
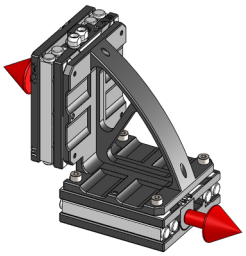
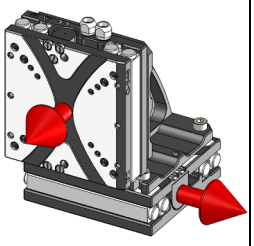
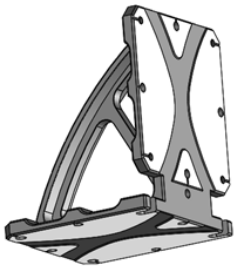
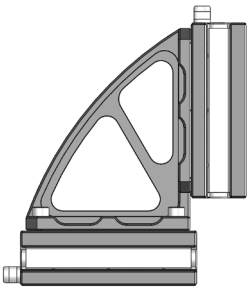
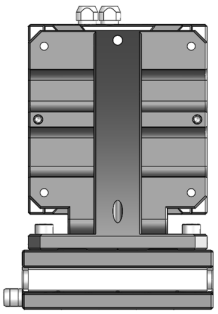
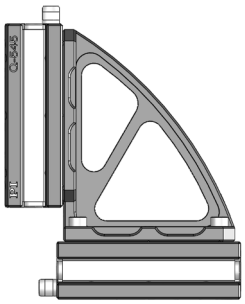
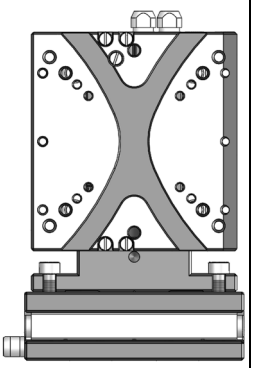
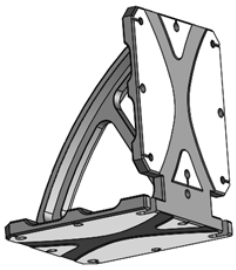
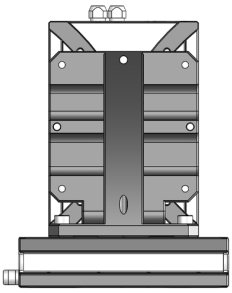
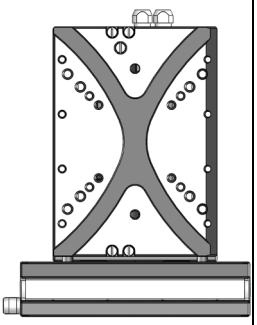
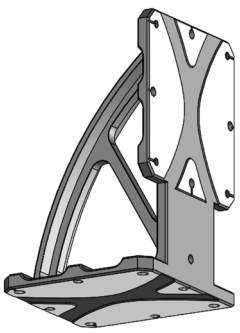
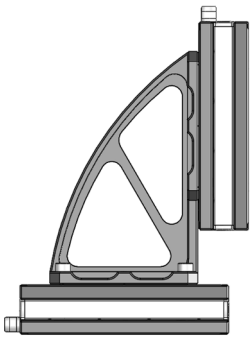
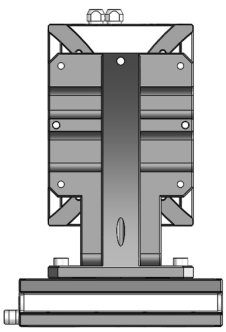
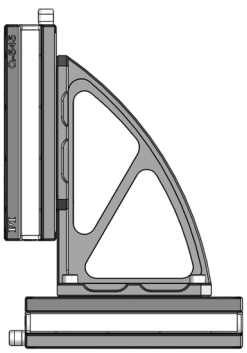
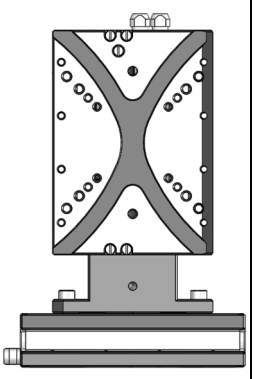
1. Insert the locating pins into the short side of the adapter bracket **from below**.
2. Make sure that the locating pins are inserted **up to the limit stop**.
3. Put the adapter bracket onto the motion platform of the lower positioner.

Designations in these instructions:

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

Recommended Z Systems

The following adapter bracket and positioner combinations are recommended:

	Orientation of adapter bracket and upper positioner to the lower positioner:			
Combination of positioners and adapter brackets:	0° 	90° 	180° 	270° 
2 Q-545.140 +  Q-145.1001				
2 Q-545.240 +  Q-145.1001	Not possible. The motion platforms of the positioners collide with each other.		Not possible. The motion platforms of the positioners collide with each other.	
2 Q-545.240 +  Q-145.200				

Requirements

- ✓ You have read and understood the general notes on installation (p. 15).
- ✓ You have read and understood the general notes on setting up a multi-axis system (p. 25).
- ✓ You have accounted for the space required to route cables according to regulations and without bending them.
- ✓ If you are building an XZ combination: You have mounted the lower positioner onto an underlying surface properly.
- ✓ If you are building an XYZ combination: You have attached the positioners for the X and Y axis (p. 25) properly.

Tools and accessories

- Suitable adapter bracket; for combination options, see "Recommended Z Systems" (p. 27). The following brackets are available as optional accessory (p. 10):
  - For Z systems: Q-145.1001 or Q-145.200 adapter bracket.

  For the diameter and position of the holes in the adapter bracket, see "Dimensions" (p. 51)
- Mounting kit from the scope of delivery of the adapter bracket:
  - 2 dowel pins, 2.5 m6 × 4, for use as locating pins
  - 4 socket head screws M2.5x8
- Mounting kit from the scope of delivery of the positioner (p. 10):
  - 2 dowel pins, 2.5 m6 × 4, for use as locating pins
  - 4 socket head screws M2.5x5
- Hex key AF 2

Building a Z system

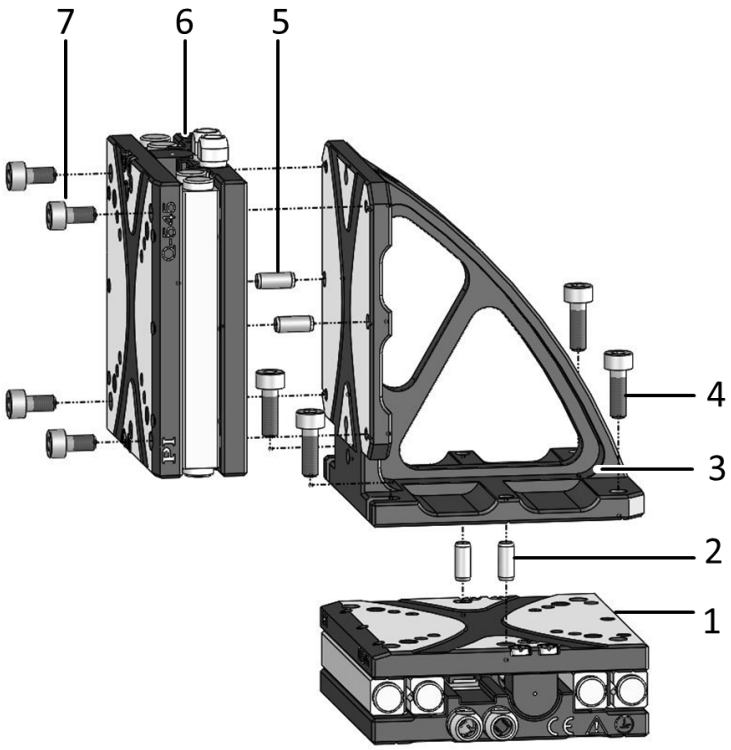


Figure 14: Example: Building an XZ system consisting of two Q-545.140s and a Q-145.1001 adapter bracket

1 Lower positioner
2 2 dowel pins, 2.5 m6 × 4 for use as locating pins; from the scope of delivery of the adapter bracket
3 Q-145.200 adapter bracket
4 4 socket head screws M2.5x8 for mounting the adapter bracket on the lower positioner; from the scope of delivery of the adapter bracket
5 2 dowel pins, 2.5 m6 × 4 for use as locating pins; from the scope of delivery of the positioner
6 Upper positioner
7 4 socket head screws M2.5x5 for mounting the upper positioner on the adapter bracket; from the scope of delivery of the positioner

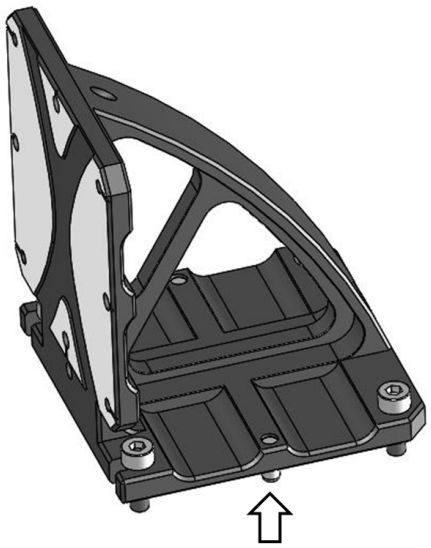


Figure 15: Adapter bracket with screws and locating pins. The locating pins for alignment on the lower positioner must be inserted into the bracket from below and up to the limit stop.

1. Fix the upper positioner to the long side of the adapter bracket:
   a) Align the upper positioner so that the cable exit points away from the origin of the sides of the adapter bracket; i.e., upwards in the Z system.
   b) Insert the 2.5 m6 × 4 locating pins into the locating holes in the bottom of the upper positioner or in the long side of the adapter bracket.
   c) Put the positioner on the long side of the adapter bracket so that the locating pins are inserted into the corresponding locating holes on the other side.
   d) Mount the positioner using four M2.5x5 screws according to step 3 of the instructions in "Building an XY System" (p. 25).
2. Fix the short side of the adapter bracket to the motion platform of the lower positioner:
   a) Insert the 2.5 m6 × 4 locating pins into the locating holes in the short side of the adapter bracket from below and up to the limit stop (see figure above).
   b) If you set up a Z system consisting of a Q-145.1001 adapter bracket and two positioners Q-545.240: Align the adapter bracket so that the positioner's motion platforms **cannot** collide with each other; see "Recommended Z Systems" (p. 27) for permissible orientations.
   c) Put the short side of the adapter bracket on the motion platform of the lower positioner so that the locating pins are inserted into the corresponding locating holes in the platform.
   d) Insert four M2.5x8 screws into the mounting holes of the adapter bracket.
   e) Tighten the screws.
      - **Maximum torque: 72 Ncm**
3. Check that the adapter bracket and the upper positioner are fixed firmly.

5.5 Fixing the Load to the Q-545

Requirements

- ✓ You have read and understood the general notes on installation (p. 15).
- ✓ You have mounted the positioner onto an underlying surface (p. 21) properly or on a Q-545 (p. 24).
- ✓ The positioner is disconnected from the electronics.
- ✓ You have prepared the load so that it can be fixed to the motion platform (for the required position and depth of the holes for accommodating the screws and locating pins, see "Dimensions" (p. 51)):
  - The gap between the center of gravity of the load and the center of the motion platform is as small as possible in all directions.
  - Four points are provided for fixing the load to the motion platform.
  - If you use locating pins for aligning the load: You have drilled two locating holes with Ø 2.5 mm H7 into the load to accommodate the locating pins.

Tools and accessories

- Screws of suitable length (p. 51). Options:
  - M2 screws
  - M2.5 screws
- Suitable tool for tightening the screws
- Optional: 2 locating pins of suitable length, for locating holes with Ø 2.5 mm H7

Fixing the load to the Q-545

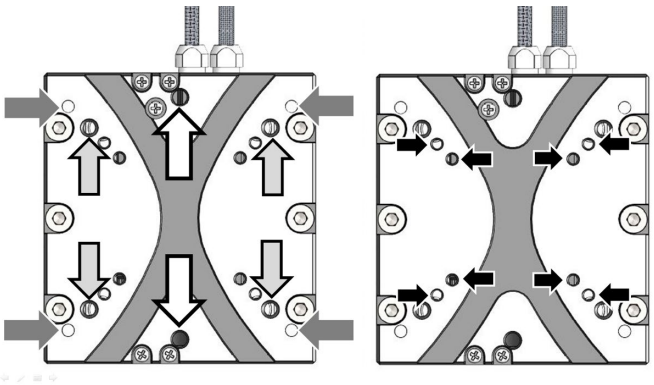


Figure 16: Q-545.140

The arrows identify the following mounting holes in the Q-545.140's motion platform:

For aligning the load:

White arrows:	Locating holes Ø 2.5 mm H7, depth 2.5 mm

For fixing the load:

Dark-gray arrows:	M2.5 threaded holes, depth 4 mm
Light-gray arrows:	M2.5 threaded holes, depth 4 mm
Black arrows:	M2 threaded holes, depth 4 mm

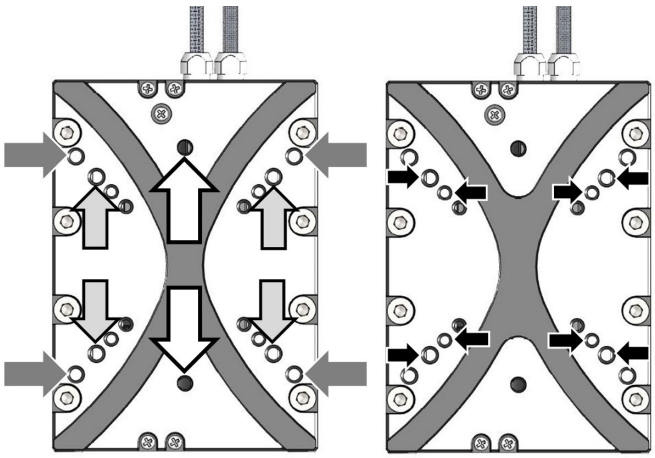


Figure 17: Q-545.240

The arrows identify the following mounting holes in the Q-545.240's motion platform:

For aligning the load:

White arrows:	Locating holes Ø 2.5 mm H7, depth 1.4 mm

For fixing the load:

Dark-gray arrows:	M2.5 threaded holes, depth 4 mm
Light-gray arrows:	M2.5 threaded holes, depth 4 mm
Black arrows:	M2 threaded holes, depth 4 mm

1. Align the load on the Q-545 so that the mounting holes in the load and the holes in the motion platform are in line.

   If you use locating pins to align the load:

   a) Insert the locating pins into the locating holes in the motion platform or in the load.

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

2. Fix the load using the screws.

   – **Maximum torque for M2 screws: 35 Ncm**

   – **Maximum torque for M2.5 screws: 72 Ncm**

3. Check that the load is fixed firmly to the motion platform of the positioner.

5.6 Connecting the Q-545 to the Electronics

INFORMATION

The Q-545 and the electronics can be delivered as a preconfigured system.

➢ If a connection assignment is given on the labels of the Q-545 and/or electronics, pay attention to this assignment when connecting the Q-545.

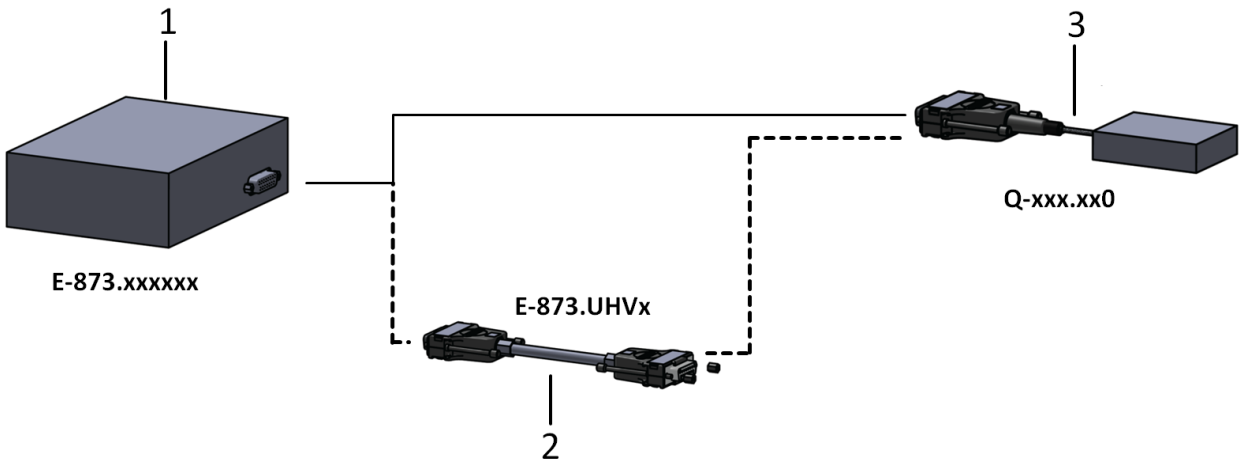


Figure 18: Options for connecting the Q-545 to suitable electronics for atmospheric operation

1 Controller
2 Extension cable
3 Mechanics

Requirements

- ✓ You have read and understood the general notes on installation (p. 15).
- ✓ You have installed the electronics.
- ✓ You have read and understood the user manual for the electronics.
- ✓ The electronics are **not** connected to the supply voltage.

Tools and accessories

- If necessary: E-873.UHVx extension cable, available as optional accessory (p. 10)

Connecting the Q-545 to the electronics

1. Prepare the Q-545 for connecting:
   - Remove the ESD protection from the Q-545's connector.
2. Connect the electronics to the Q-545 and if necessary, the extension cable as shown in the connection diagram above.
3. Take suitable measures to prevent the extension cable from being disconnected accidentally.

6 Startup and Operation

In this Chapter

General Notes on Startup and Operation 37
Starting and Operating the Q-545 39

6.1 General Notes on Startup and Operation

CAUTION



Risk of electric shock if the protective earth conductor is not connected!
If a protective earth conductor is not or not properly connected, dangerous touch voltages can occur on the Q-545 in the case of malfunction or failure of the system. If there are touch voltages, touching the Q-545 can result in minor injuries from electric shock.

- Connect the Q-545 to a protective earth conductor (p. 21) before startup.
- Do **not** remove the protective earth conductor during operation.
- If the protective earth conductor has to be removed temporarily (e.g., in the case of modifications), reconnect the Q-545 to the protective earth conductor before restarting.

CAUTION



Burning from hot surface!
The surface of the Q-545 and its vicinity can heat up during operation. Touching the Q-545 and surrounding parts can result in minor injuries from burning.

- Cool the Q-545 so that the temperature of its surface and surrounding parts does **not** exceed 65 °C.
- If sufficient cooling is not possible: Make sure that the hot Q-545 and its surrounding parts **cannot** be touched.
- If sufficient cooling and protection against contact are not possible: Mark the danger zone in accordance with the legal regulations.

NOTICE



Overheating during continuous operation!
The highest velocity is achieved at maximum operating frequency; however, the Q-545 can overheat during continuous operation as a result.

- Pay attention to the recommended operating time according to the operating frequency in step mode (p. 50).
- Ensure sufficient ventilation at the place of installation.

NOTICE



Operating voltage too high or incorrectly connected!

Operating voltages that are too high or incorrectly connected can cause damage to the Q-545.

- Operate the Q-545 only with controllers/drivers and original accessories from PI.
- Do **not** exceed the operating voltage range (p. 49) for which the Q-545 is specified.
- Operate the Q-545 only when the operating voltage is properly connected; see "Pin Assignment" (p. 55).

NOTICE



Operating frequency too high!

An excessively high operating frequency can cause damage to the Q-545.

- Operate the Q-545 only with controllers/drivers and original accessories from PI.
- Do **not** exceed the operating frequency range (p. 49) specified for the Q-545.

NOTICE



Reduced lifetime of the piezo actuator due to permanently high voltage!

Applying a high static voltage to piezo actuators continuously reduces the lifetime of the piezo ceramic.

- If the Q-545 is not used for a longer period of time, e.g., several days, switch the electronics off.

NOTICE



Destruction of the piezo actuators due to electric flashovers!

Using the Q-545 in environments that increase the electrical conductivity can lead to the destruction of the piezo actuators of the drive by electric flashovers. Electric flashovers can be caused by moisture, high humidity, liquids and conductive materials (e.g. metal dust). In addition, electric flashovers can also occur in certain air pressure ranges due to the increased conductivity of the air.

- Avoid operating the Q-545 in environments that can increase the electrical conductivity.
- Operate the Q-545 only under permissible ambient conditions and classifications (p. 49).

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 can be caught by moving parts.
- Stop the motion immediately if an electronics malfunction occurs.

NOTICE

Considerable wear due to high operating frequency!
A high operating frequency in step mode can cause considerable wear on the mechanics.

- Reduce the operating frequency of the electronics in step mode (step frequency) respectively the velocity, see the user manual for the electronics.
- Reduce the operating time with a high operating frequency (p. 50).
- Stop the motion immediately if an electronics malfunction occurs.

NOTICE

Increased wear due to small working range!
Using a small working range permanently increases the wear in this area.

- If possible: Select another part of the travel range for the working range in regular intervals.

INFORMATION

The Q-545's parameters can be adapted. Changing parameter values can cause undesirable results.

- Create a backup copy on the PC before changing the parameter settings; see "Saving Parameter Values in a Text File" in the user manual for the electronics. You can then restore the original settings at any time.
- You can find information on adapting the parameter values under "Adapting Settings" in the user manual for the electronics.

6.2 Starting and Operating the Q-545

INFORMATION

If the parameters of the electronics are not adapted to the Q-545 and the application (load, orientation of the Q-545), the Q-545 will either not move or not move satisfactorily.

- Operate the Q-545 only when the parameters of the electronics have been correctly set.
- Pay particular attention to the velocity in closed-loop operation.

INFORMATION

The inertia drive generates noise in step mode. The noise generation depends on the current step frequency.

INFORMATION

If you use the software from the scope of delivery of the electronics, the operating parameters can be loaded from *PIMicosStages3.dat*. The records in the positioner database are updated regularly.

- ➢ Install the PI Update Finder from the product CD for the electronics onto your PC and update *PIMicosStages3.dat* on your PC.

Further information can be found in the user manual for the electronics.

Requirements

- ✓ You have read and understood the general notes on startup and operation (p. 37).
- ✓ You have installed (p. 15) the positioner correctly.
- ✓ You have read and understood the user manual for the electronics.
- ✓ You have read and understood the manual for the PC software.
- ✓ The electronics and the required PC software have been installed. All connections to the electronics have been made (see user manual for the electronics).

Starting and operating the Q-545

1. Start and operate the positioner (see user manual for the electronics).
   Startup includes the following steps:
   - Selecting the positioner type
   - Referencing method for the axis
   - Commanding of first motion for testing
2. If necessary: Adapt the velocity (refer to the user manual for the electronics) to your application (also refer to "General Notes on Startup and Operation" (p. 37) and "Operating Time" (p. 50)).

   PIMikroMove is used in the user manual for the electronics to describe startup and operation.

7 Maintenance

In this Chapter

General Notes on Maintenance 41
Performing a Maintenance Run 41
Cleaning the Q-545 41

7.1 General Notes on Maintenance

NOTICE



Damage due to improper maintenance!
Improper maintenance can lead to misalignment and failure of the Q-545.

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

7.2 Performing a Maintenance Run

The maintenance run must cover the entire travel range.

- ➢ Perform the maintenance run after every 10 million steps.

7.3 Cleaning the Q-545

Requirements

- ✓ You have disconnected the positioner from the controller.

Cleaning the positioner

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

8 Troubleshooting

Problem	Possible causes	Solution
Function impairment after system modification	▪ The electronics were replaced ▪ The positioner was replaced	➢ Load the parameter set from the positioner database that corresponds to the Q-545 model. ➢ If necessary: Set the parameters for the electronics in PIMikroMove so that they correspond to the application (load, orientation) of the Q-545 model (see the user manual for the electronics).
No or limited motion	The cable is not connected correctly or is defective	➢ Check the connecting cable(s)
	Excessive load	➢ Reduce the load. Pay attention to the information in the "Technical Data" section (p. 47).
	Parameters of the electronics incorrectly set	➢ See the "Function impairment after system modification" problem in this table.
	Unfavorable operating frequency for step mode	➢ Adapt the operating frequency for step mode (for details, see "Starting and Operating the Q-545" (p. 39) and manual for the electronics).
	Warped base body	➢ Pay attention to the maximum torque when fixing the positioner. ➢ Avoid tilting torques when fixing the positioner and load: Hold the base body of the positioner. ➢ Mount the Q-545 on a flat surface. The recommended flatness of the surface is 10 µm. ➢ As specified in the instructions (p. 21), use locating pins with a suitable length and thickness only when fixing the positioner
	Unfavorable load mounting	➢ Pay attention to the maximum torque when mounting the load (p. 32). ➢ Keep the gap between the center of gravity of the load and the center of the motion platform as small as possible in all directions. ➢ As specified in the instructions (p. 32), use locating pins with a suitable length and thickness only when aligning the load

Problem	Possible causes	Solution
	Unsuitable ambient conditions	➢ Operate the Q-545 in a clean environment only and only under permissible ambient conditions (p. 49).
	Drive wear	➢ Replace the Q-545 and make sure that the operating parameters of the electronics are adapted to the positioner.
	Drive is blocked	➢ Release the blockage by carefully moving the motion platform back and forth by hand. ➢ Contact our customer service department (p. 45).
	When fixing a load or an adapter bracket to the positioner's motion platform: Dowel pin was pushed too deeply into the motion platform	➢ Contact our customer service department (p. 45).
Limitation in accuracy, drive force, and maximum velocity	Play between the inner and outer guide elements due to warped base body or motion platform	➢ For possible causes, see "Warped base body" and "Unfavorable load mounting" in this table.
Unwanted motion	▪ The cables attached to the load can exert pull forces on the positioner. ▪ The self-locking force could be exceeded.	➢ Make sure that the cables attached to the load have sufficient strain relief ➢ Make sure that you do not exceed the maximum permissible load. The value of the maximum permissible load depends on the orientation of the motion axis (p. 47).

If the problem with your system is not listed in the table above or cannot be solved as described, contact our customer service department (p. 45).

9 Customer Service

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

- If you have any questions concerning your system, provide the following information:
  - Product and serial numbers of all products in the system
  - Firmware version of the controller (if applicable)
  - Version of the driver or the software (if applicable)
  - Operating system on the PC (if applicable)
- If possible: Take photographs or make videos of your system that can be sent to our customer service department if requested.

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

10 Technical Data

In this Chapter

Specifications 47
Operating Time 50
Velocity and Force 50
Dimensions 51
Pin Assignment 55

10.1 Specifications

10.1.1 Data Table

Motion and positioning	Q-545.140	Q-545.240	Unit	Tolerance
Active axis	X	X		
Travel range	13	26	mm	
Maximum velocity, closed loop	8	8	mm/s	
Minimum incremental motion	6	6	nm	typ.
Pitch	250	250	µrad	typ.
Yaw	100	250	µrad	typ.
Linearity	2	2	µm	typ.

Drive properties	Q-545.140	Q-545.240	Unit	Tolerance
Drive force	7	7	N	typ.
Self-locking	8	8	N	min.
Motor type	Piezoelectric inertia drive	Piezoelectric inertia drive		

Mechanical properties	Q-545.140	Q-545.240	Unit	Tolerance
Maximum load capacity, horizontal	0.5	0.5	kg	

Mechanical properties	Q-545.140	Q-545.240	Unit	Tolerance
Maximum load capacity, any	0.1	0.1	kg	
Mass without cable and connector	105	135	g	±10 %
Mass incl. cable and connector	216	245	g	±10 %
Guide type	Crossed roller bearing with anti-creep system	Crossed roller bearing with anti-creep system		
Axial stiffness	1.5	1.5	N/µm	±10 %
Lateral stiffness	9	10	N/µm	±10 %

Positioning	Q-545.140	Q-545.240	Unit	Tolerance
Integrated sensor	Linear encoder	Linear encoder		
Sensor resolution	1	1	nm	
Reference switch	Optical	Optical		
Bidirectional repeatability	100	200	nm	
Sensor signal	Analog, 1 Vpp	Analog, 1 Vpp		

Miscellaneous	Q-545.140	Q-545.240	Unit	Tolerance
Operating temperature range	0 to 50	0 to 50	°C	
Cable length	2	2	m	±5 %
Motor / sensor connector	D-sub 15 (m)	D-sub 15 (m)		
Material	Aluminum	Aluminum		
Recommended electronics	E-873.1AT, E-873.10C885	E-873.1AT, E-873.10C885		

Specifications tested with E-873.1AT

The specifications were determined on an underlying surface with a flatness of 2 µm.

10.1.2 Maximum Ratings

The Q-545 positioner is designed for the following operating data:

Maximum operating voltage	**Maximum Operating Frequency**	**Maximum power consumption**
50 V	20 kHz	30 W

10.1.3 Ambient Conditions and Classifications

Pay attention to the following ambient conditions and classifications for the Q-545:

Area of application	For indoor use only
Maximum altitude	2000 m
Air pressure	1100 hPa to 0,1 hPa
Relative humidity	Highest relative humidity 80 % for temperatures up to 31 °C Decreasing linearly to 50 % relative humidity at 40 °C
Operating temperature	0 °C to 40 °C
Storage temperature	-20 °C to 70 °C
Transport temperature	-20 °C to 70 °C
Maximum bakeout temperature:	80 °C, for 2 hours, only in **switched-off** state
Overvoltage category (according to EN 60664-1 / VDE 0110-1)	II
Protection class (according to EN 61140 / VDE 0140 1)	I
Degree of pollution (according to EN 60664 1 / VDE 0110 1)	1
Degree of protection(according to IEC 60529)	IP20

10.2 Operating Time

The operating frequency in step mode respectively the velocity and operating time affect the lifetime of the positioner. In order to prevent overheating and increased wear, the operating time at the specified operating frequency or velocity may not exceed the values specified in the following table.

Operating frequency in Hz [1,2]	Velocity in mm/s [2]	Maximum duration of motion in s [3]	Idle time in s
16000	8	10	10
10000	5	As desired	0

[1] See "Starting and operating the Q-545" (p. 39) and the user manual for the electronics for the relevant parameters.

[2] At 50 V supply voltage, ±0.6 A charging current and without load, the operating frequency corresponds approximately to the specified velocity

[3] Applicable at 20 °C. It is essential to install effective thermal transfer in order to reach the specified duration of motion.

10.3 Velocity and Force

The following figure illustrates which combinations of velocity and drive force can be generated by the Q-545.

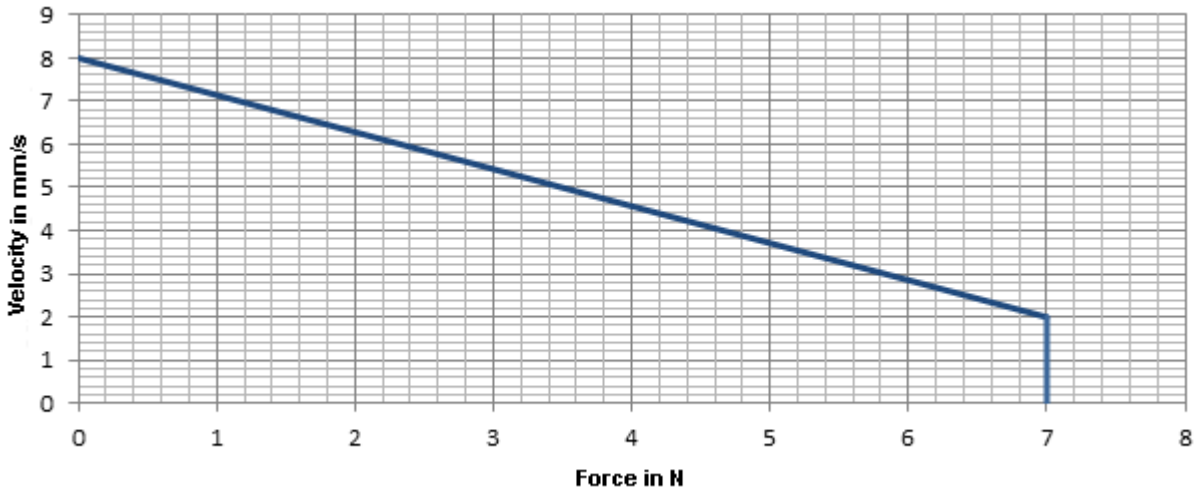


Figure 19: Relation between velocity and drive force of the Q-545

10.4 Dimensions

10.4.1 Q-545.140

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

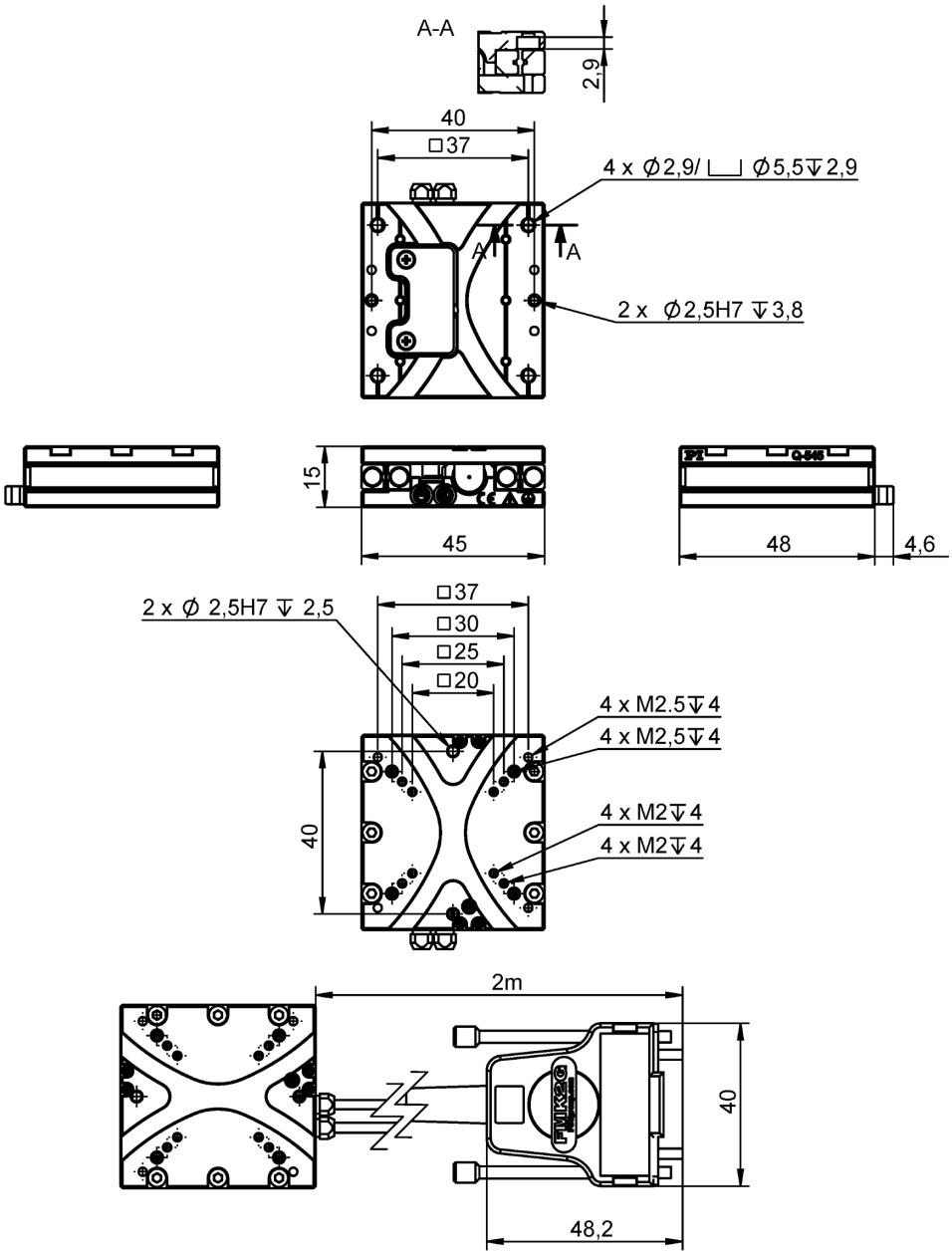


Figure 20: Q-545.140

10.4.2 Q-545.240

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

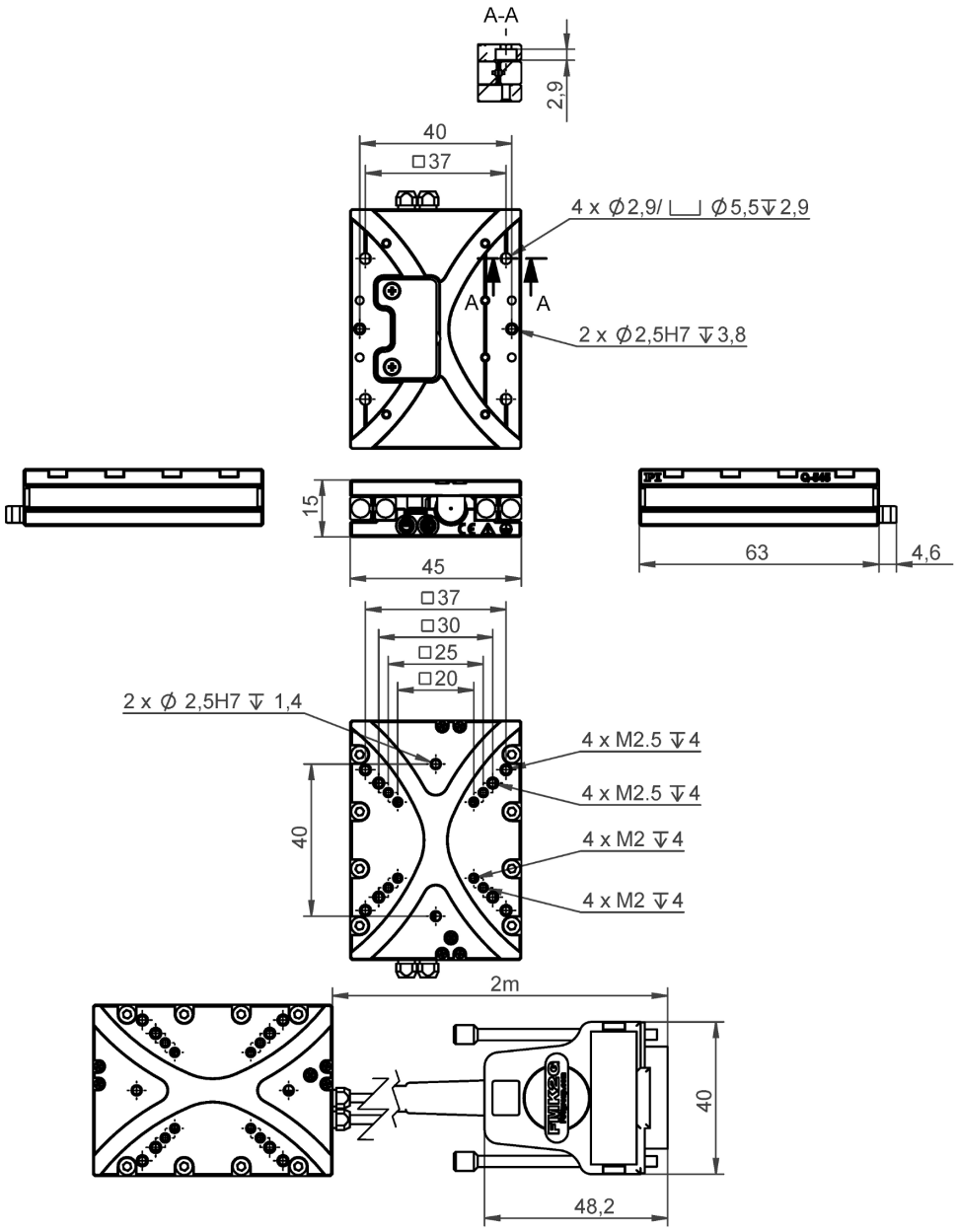


Figure 21: Q-545.240

10.4.3 Q-145.1001 Adapter Bracket

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

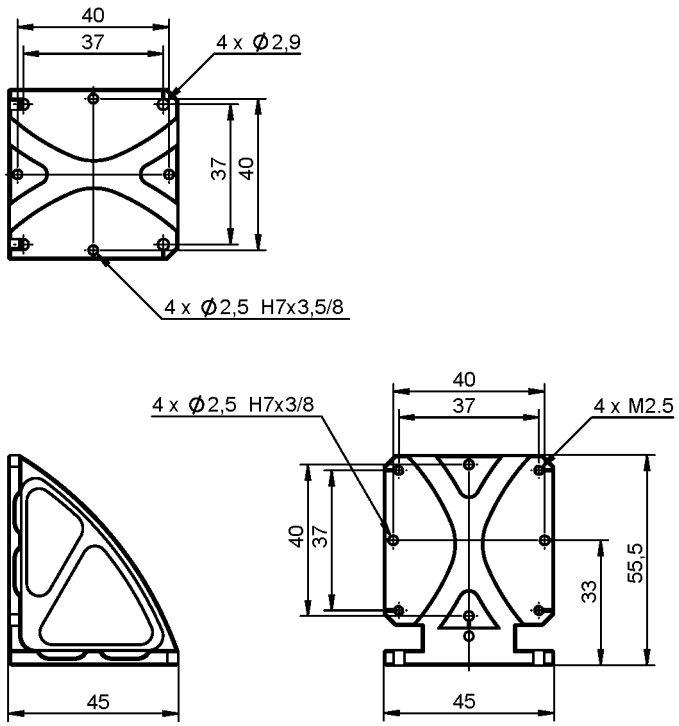


Figure 22: Q-145.1001 adapter bracket

10.4.4 Q-145.200 Adapter Bracket

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

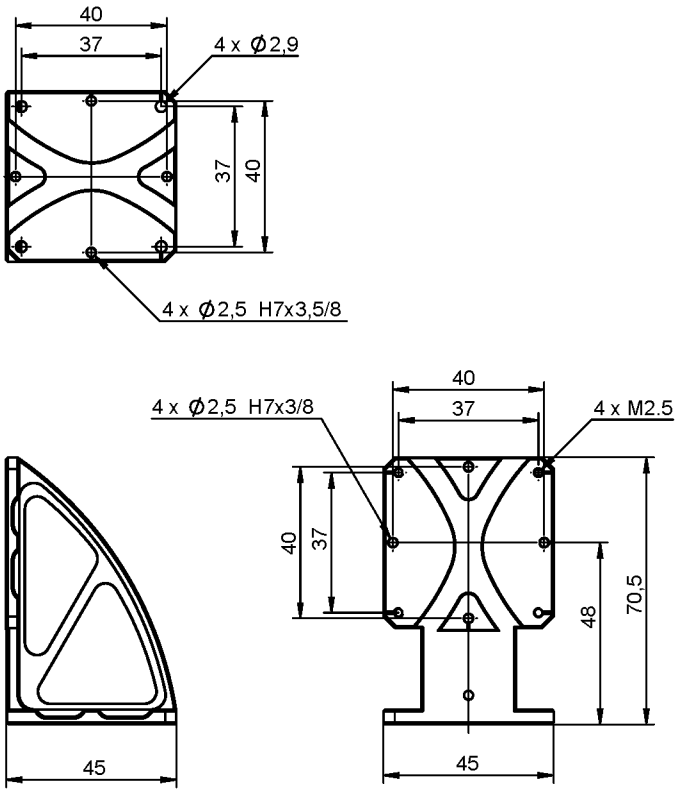


Figure 23: Q-145.200 adapter bracket

10.5 Pin Assignment

Connector: D-sub 15 (m)

The D-sub 15 connector (m) transmits the signals from the drive, the sensor, and the ID chip.

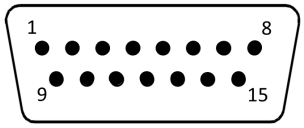


Figure 24: D-sub 15 (m) connector

Pin	Signal*	Function	Direction
1	REF -	Reference signal differential (-)	Output
2	Motor (-)	Motor signal differential (-)	Input
3	Motor (+)	Motor signal differential (+)	Input
4	V_{DD}	Supply voltage (+5 V)	Input
5	-	-	-
6	ID chip data	ID chip data	Output
7	SIN -	Encoder A (-)	Output
8	COS -	Encoder B (-)	Output
9	Motor (-)	Motor signal differential (-)	Input
10	GND	GND	GND
11	Motor (+)	Motor signal differential (+)	Input
12	-	-	-
13	REF +	Reference signal differential (+)	Output
14	SIN +	Encoder A (+)	Output
15	COS +	Encoder B (+)	Output

* The "-" sign indicates that the corresponding pin has not been assigned.

The cable shield is connected to the connector shell.

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 EU Declaration of Conformity

For the Q-545, an EU Declaration of Conformity has been issued in accordance with the following European directives:

Low Voltage Directive

EMC Directive

RoHS Directive

The applied standards certifying the conformity are listed below.

Safety (Low Voltage Directive): EN 61010-1

EMC: EN 61326-1

RoHS: EN 50581 or EN IEC 63000