

MP129E
Q-632 Miniature Rotation Stage
User Manual

Version: 1.1.2

Date: 16.05.2019



This document describes the following product:

- **Q-632.930**
Q-Motion® rotation stage, piezoelectric inertia drive, >360° rotation range, incremental encoder, 0.75 μ rad resolution, 6 mNm drive torque, 30 mm diameter, vacuum compatible to 10^{-6} hPa



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

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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 This manual is superseded by any new release.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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1.1 Objective and Target Audience of this User Manual

This manual contains information necessary for the intended use of the Q-632.

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.

INFORMATION

Information for easier handling, tricks, tips, etc.

Symbol/ Label	Meaning
1. 2.	Action consisting of several steps whose sequential order must be observed
➤	Action consisting of one or several steps whose sequential order is irrelevant
▪	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	Maximum load capacity in the vertical direction when the rotation stage is mounted horizontally. The contact point of the load is in the center of the motion platform.

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, 1 channel, USB interface	PZ274E User Manual
E-873.3QTU Q-Motion® controller for piezoelectric inertia drives, 3 axes, benchtop device (industry), TCP/IP, USB, I/O, joystick	PZ273E 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. 35).

INFORMATION

For products that are supplied with software (CD in the scope of delivery), access to the manuals is protected by a password. Protected content is only displayed on the website after entering the access data.

You need the product CD to get the access data.

For products with CD: Get access data

1. Insert the product CD into the PC drive.
2. Switch to the Manuals directory on the CD.
3. In the Manuals directory, open the Release News (file including *releasenews* in the file name).
4. Get the access data for downloading protected content in the "User login for software download" section of the Release News. Possible methods for getting the access data:
 - Link to a page for registering and requesting the access data
 - User name and password is specified
5. If the access data needs to be requested via a registration page:
 - a) Follow the link in the Release News.

- b) Enter the required information in the browser window.
- c) Click **Show login data** in the browser window.
- d) Note the user name and password shown in the browser window.

Downloading manuals

If you have requested access data for protected contents via a registration page (see above):

- Click the links in the browser window to change to the content for your product and log in using the access data that you received.

General procedure:

1. Open the website **www.pi.ws**.
2. If access to the manuals is protected by a password:
 - a) Click **Login**.
 - b) Log in with the user name and password.
3. Click **Search**.
4. Enter the product number up to the period (e.g., P-882) or the product family (e.g., PICMA® Bender) into the search field.
5. Click **Start search** or press the **Enter** key.
6. Open the corresponding product detail page in the list of search results:
 - a) If necessary: Scroll down the list.
 - b) If necessary: Click **Load more results** at the bottom of the list.
 - c) Click the corresponding product in the list.
7. Click the **Downloads** tab.

The manuals are shown under **Documentation**.
8. Click the desired manual and save it to the hard disk of your PC or to a data storage medium.

2 Safety

In this Chapter

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General Safety Instructions.....	5
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Measures for Handling Vacuum-Compatible Products	6

2.1 Intended Use

The Q-632 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-632 is intended for positioning, adjusting and rotating loads in a rotational axis at different velocities in interval operation. The Q-632 uses a piezoelectric inertia drive. The drive is self-locking at rest, requires no current, generates no heat, and maintains its position.

The Q-632 can be mounted in any orientation. The specifications of the Q-632 apply to horizontal mounting (p. 37).

The Q-632 is **not** intended for applications in areas where failure would be a considerable risk for people or the environment. The Q-632 is not intended for continuous operation. For further information on the operating conditions of the Q-632, see "Technical Data" (p. 37).

The Q-632 has a linear encoder for direct position detection and is designed for an ambient pressure to 10^6 hPa.

It is only possible to use the Q-632 as intended when it is completely mounted and connected. The Q-632 must be operated with suitable electronics (p. 10). The electronics are not in the scope of delivery of the Q-632.

2.2 General Safety Instructions

The Q-632 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-632.

- Use the Q-632 for its intended purpose only, and only when it is in perfect technical condition.
- Read the user manual.
- Eliminate any faults and malfunctions likely to affect safety immediately.

The operator is responsible for the correct installation and operation of the Q-632.

2.3 Organizational Measures

User manual

- Always keep this user manual available with the Q-632. 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-632 to other users, also include this user manual as well as other relevant information provided by the manufacturer.
- Use the device only if the user manual is complete. Missing information due to an incomplete user manual can result in minor injury and damage to equipment.
- Install and operate the Q-632 only after you have read and understood this user manual.

Personnel qualification

The Q-632 may only be installed, started, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

2.4 Measures for Handling Vacuum-Compatible Products

Attention must be paid to appropriate cleanliness when the rotation stage is to be used in a vacuum. All parts are cleaned at PI before assembly. Powder-free gloves are worn during assembly and measuring.

- Touch the rotation stage only with powder-free gloves.
- If necessary, wipe the rotation stage clean after unpacking.

3 Product Description

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3.1 Product View

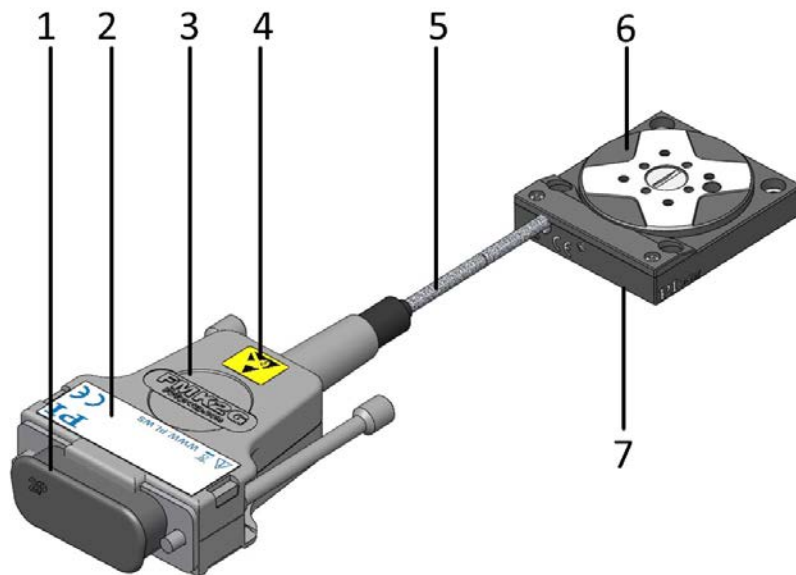


Figure 1: Q-632.930 rotation stage

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

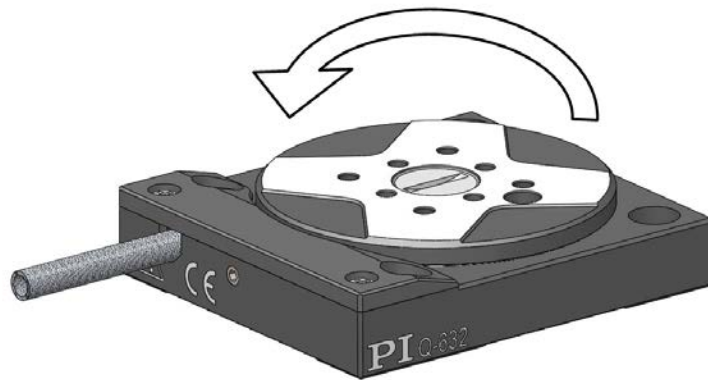


Figure 2: Direction of motion of the Q-632's platform

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

3.2 Product Labeling

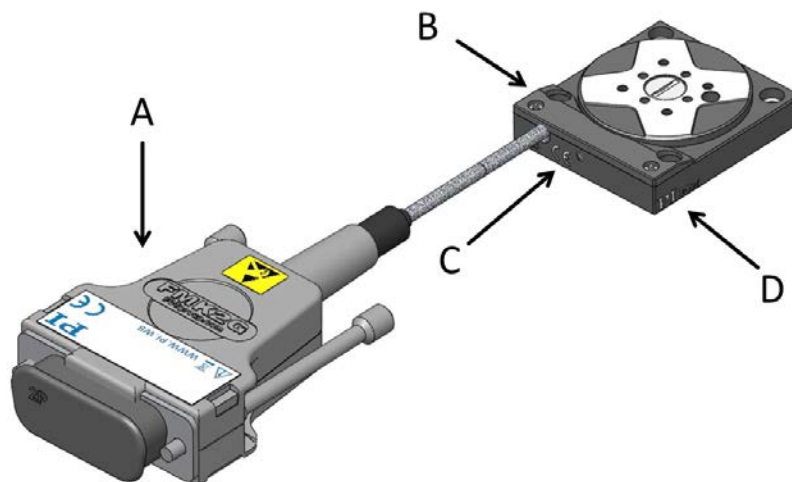








Figure 3: Product labeling and type plate of the rotation stage

Position	Labeling	Description
A	113064246	Serial number (example), individual for each Q-632 Meaning of each position (from the left): 1 = internal information, 2 and 3 = year of manufacture, 4 to 9 = consecutive number
A	Q-632.930	Product name
A, C		Warning sign "Pay attention to the manual!"
A		Old equipment disposal
A, C		CE conformity mark
A	WWW.PIMICOS.COM	Manufacturer's address (website)
A, D		Manufacturer's logo
A		Warning sign "Electrostatic-sensitive devices"
B		Symbol for the protective earth conductor, marks the position of the holes via which the Q-632 is to be connected to the protective earth conductor

3.3 Scope of Delivery

Item ID	Components
Q-632	Rotation stage according to the order
RPS32.5003	Screw set for mounting the Q-632, consisting of: <ul style="list-style-type: none"> ▪ 2 dowel pins, A2 1.5 m6 × 4 ISO 2338 ▪ 4 machine screws 1.4567 M2x4 (not required) ▪ 4 socket-head screws, A2 M2x6 ISO 4762
MP139EK	Short instructions for the Q-5xx / Q-6xx Q-Motion® positioners

3.4 Accessories

Order number	Description
E-873.UHV1	Air-side extension cable from the vacuum feedthrough or Q-632 to the electronics, D-sub 15 (f) to D-sub 15 (m), 1 m
E-873.UHV2	Air-side extension cable from the vacuum feedthrough or Q-632 to the electronics, D-sub 15 (f) to D-sub 15 (m), 2 m
E-873.UHV3	Air-side extension cable from the vacuum feedthrough or Q-632 to the electronics, D-sub 15 (f) to D-sub 15 (m), 3 m
Q-101.AP1	Adapter plate for mounting a Q-632 onto an optical table, for use in a vacuum to 10^{-6} hPa. Material: Aluminum alloy, anodized; mass: 8 g
C-815.VF	Vacuum feedthrough (drive and sensor signals), D-sub 15 (m/f), including C815T0003 technical note

- To order, contact our customer service department (p. 35).

3.5 Suitable Electronics

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-873.3QTU	Q-Motion® controller for piezoelectric inertia drives, 3 axes, benchtop device (industry), TCP/IP, USB, I/O, 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. 35).

3.6 Technical Features

3.6.1 Linear Encoder (Sensor)

The Q-632 is equipped with an optical linear encoder. Refer to the table in the "Specifications" section (p. 37) 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.

3.6.2 Reference Point Switch

The Q-632 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.

3.6.3 ID Chip

The Q-632 has an ID chip in the connector.

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

- Information on the rotation stage: 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-632's electrostatic-sensitive (also: ESD) components. For this reason, the Q-632 is supplied with ESD protection.

- Remove the ESD protection from the connection only when you connect the Q-632 to the controller.

INFORMATION

Attention must be paid to appropriate cleanliness when the rotation stage is to be used in a vacuum. All parts are cleaned at PI before assembly. Powder-free gloves are worn during assembly and measuring.

- Touch the rotation stage only with powder-free gloves.
- If necessary, wipe the rotation stage clean after unpacking.

1. Unpack the Q-632 with care.
2. If present, do **not** remove the ESD protection from the connection of the Q-632.
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

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5.1 General Notes on Installation

NOTICE



Heating up of the Q-632 during operation!

The heat produced during operation of the Q-632 can affect your application.

- Install the Q-632 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 side of the Q-632 is in contact with the surface on which the Q-632 is mounted.

NOTICE



Unwanted changes in position when mounted vertically!

The motion platform could move unexpectedly if the load exceeds the rotation stage's drive torque when the Q-632 is mounted vertically (e.g., due to pulling forces on the cable of the load). Unwanted changes in the position of the motion platform can damage the drive, the load or the surroundings.

- Take suitable measures to make sure that the load is lower than the drive torque (p. 37) when the rotation stage is mounted vertically, e.g., the cables connected to the load should have sufficient strain relief.

NOTICE



Lubricants, dirt, condensation!

Dirt, oil, lubricants and condensation will render the motor/drive inoperable.

- Keep the Q-632 free from lubricants.
- Keep the Q-632 free from dirt and condensation.

NOTICE**Damage from unsuitable cables!**

Unsuitable cables can damage the electronics.

- Use cables provided by PI only for connecting the Q-632 to the electronics.

INFORMATION

The positive direction of motion is a counterclockwise rotation.

INFORMATION

The Q-632 can be mounted on an optical stage with the Q-101.AP1 adapter plate. The adapter plate is available (p. 9) as an accessory.

5.2 Mounting the Q-632 onto an Underlying Surface and Connecting it to a Protective Earth Conductor

NOTICE**Protruding screw heads!**

Protruding screw heads can damage the Q-632.

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

NOTICE**Warping of the Q-632 when mounted on uneven surfaces!**

The Q-632 could warp if mounted on an uneven surface. Warping reduces the accuracy.

- Mount the Q-632 onto an even surface. The recommended flatness of the surface is $\leq 2 \mu\text{m}$.
- For applications with large temperature changes:
Mount the Q-632 only onto surfaces that have the same or similar thermal expansion properties as the Q-632.

INFORMATION

The contact of the Q-632 with the protective earth conductor is made as follows:

- Holes that are used for attaching the Q-632:
 - Four countersunk holes with $\varnothing 2.2 \text{ mm} / \varnothing 4.2 \text{ mm}$ in the base body of the Q-632
- Suitable conductive screws (p. 9)
- Protective earth conductor connected to the surface that the Q-632 is mounted on
- The screws are secured against unintentional loosening, e.g., with locking paint or threadlocker

INFORMATION

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

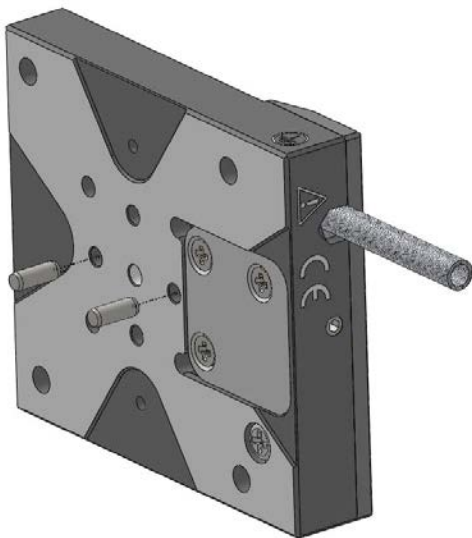


Figure 4: Bottom side of the Q-632: Two of the four available locating holes can be used for alignment on a surface

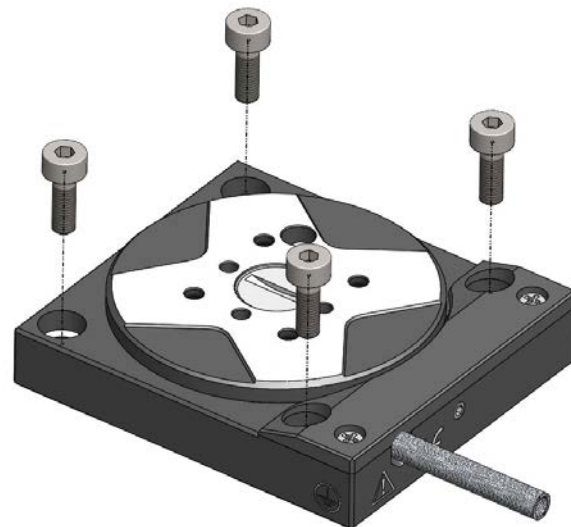


Figure 5: Top of the Q-632: The rotation stage is fixed to the underlying surface with four screws: 4 socket head screws (outlying countersunk holes)

Requirements

- ✓ You have read and understood the general notes on installation (p. 15).
- ✓ The Q-632 is **not** connected to 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. 40)):
 - The underlying surface must be connected to a protective earth conductor.
 - Two locating holes with $\varnothing 1.5 \text{ mm H7}$ and four M2 mounting holes are available in the surface.
 - The holes for accommodating the screws 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-632 (e.g., underlying surface made of aluminum).
- The surface flatness is $\leq 2 \mu\text{m}$.
- ✓ You have accounted for the space required to route cables according to regulations and without bending them.

Tools and accessories

- RPS32.5003 screw set from the scope of delivery of the Q-632 (p. 9):
 - 2 dowel pins, 1.5 m6 × 4 ISO 2338; for use as locating pins
 - 4 socket head screws, M2×6 ISO 4762
- Suitable screwdriver

Mounting the Q-632 onto an underlying surface and connecting it to a protective earth conductor

1. Insert the two locating pins into the locating holes in the bottom of the Q-632 (see figure above) or in the underlying surface.
2. Put the Q-632 onto the underlying surface so that the locating pins are inserted into the corresponding locating holes on the other side.
3. Mount the Q-632 on the surface.
 - a) Insert one M2 socket head screw into one of the four outlying countersunk holes ($\varnothing 2.2 \text{ mm} / \varnothing 4.2 \text{ mm}$) in the base body of the Q-632.
 - b) Tighten the socket head screw with a maximum torque of 35 Ncm.
 - c) Make sure that the screw head does not protrude from the countersunk hole.
 - d) Repeat the steps a) to c) for the other three outlying countersunk holes in the base body of the Q-632.
4. Make sure that the contact resistance at all connection points relevant for mounting the protective earth conductor is $< 0.1 \Omega$ at 25 A.
5. Check that the Q-632 is fixed firmly to the underlying surface.

5.3 Fixing the Load to the Q-632

NOTICE



Impermissibly high forces and torques!

Impermissibly high forces and torques that are applied to the motion platform can damage the Q-632.

- For fixing type and mass of the load, pay attention to the maximum permissible forces according to the specifications (p. 37).
- Avoid tilting torques at the motion platform.

NOTICE



Excessively long screws!

The Q-632 can be damaged by excessively long screws.

- Note the depth of the mounting holes in the motion platform (p. 40).
- Use screws of the correct length for the respective mounting holes only.

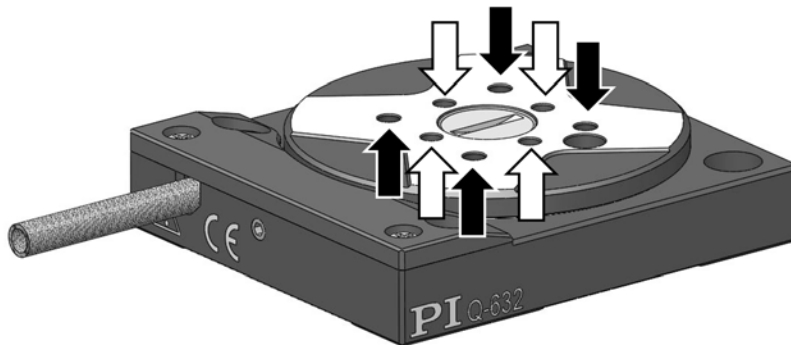


Figure 6: Black arrows indicate locating holes for alignment of the load, whereas white arrows indicate threaded holes for fixing the load

Requirements

- ✓ You have read and understood the general notes on installation (p. 15).
- ✓ You have fixed the Q-632 onto an underlying surface (p. 16) properly.
- ✓ The Q-632 is **not** connected to 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. 40)):
 - 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 made two to four locating holes of \varnothing 1.5 mm H7 in the load for accommodating locating pins.

Tools and accessories

- 4 M2 screws of suitable length (p. 40)
- Suitable tool for tightening the screws
- Optional: 2 to 4 locating pins of suitable length, for locating holes with \varnothing 1.5 mm H7

Fixing the load to the Q-632

1. Align the load on the Q-632 so that the mounting holes in the load and the holes in the motion platform are aligned.
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) Place the load on the motion platform so that the locating pins can be inserted into the corresponding locating holes on the other side.
2. Fix the load using the screws.
 - Maximum torque: 35 Ncm.
3. Check that the load is fixed firmly to the motion platform of the Q-632.

5.4 Connecting the Q-632 to the Electronics

INFORMATION

The Q-632 and the electronics can be delivered as a preconfigured system.

- If a connection assignment is given on the labels of the Q-632 and/or electronics, pay attention to this assignment when connecting the Q-632.

5.4.1 Overview: Connecting for Atmospheric Operation

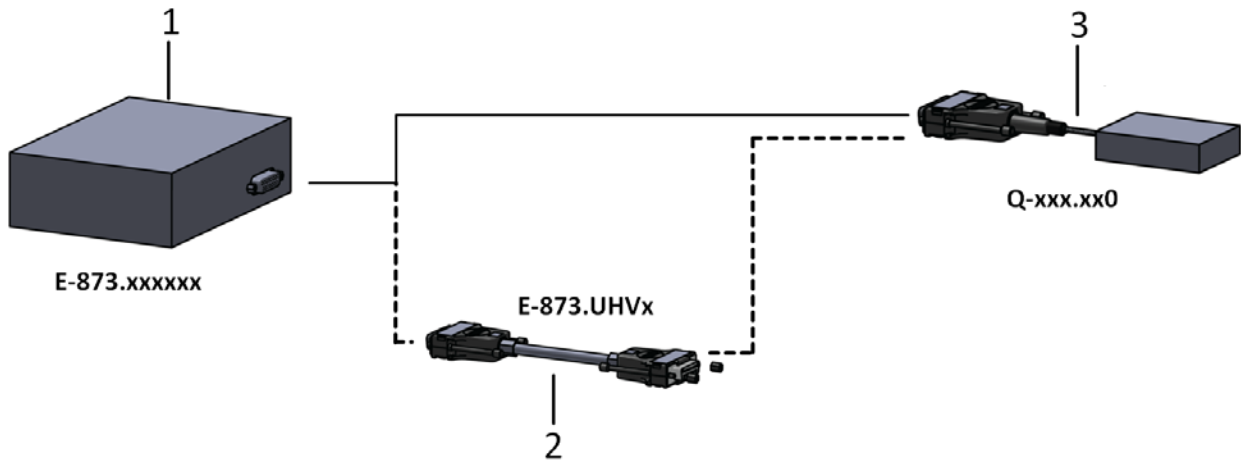


Figure 7: Options for connecting the Q-632 to suitable electronics for atmospheric operation

- 1 Controller
- 2 Extension cable
- 3 Mechanics

5.4.2 Overview: Connecting for Operating in a Vacuum

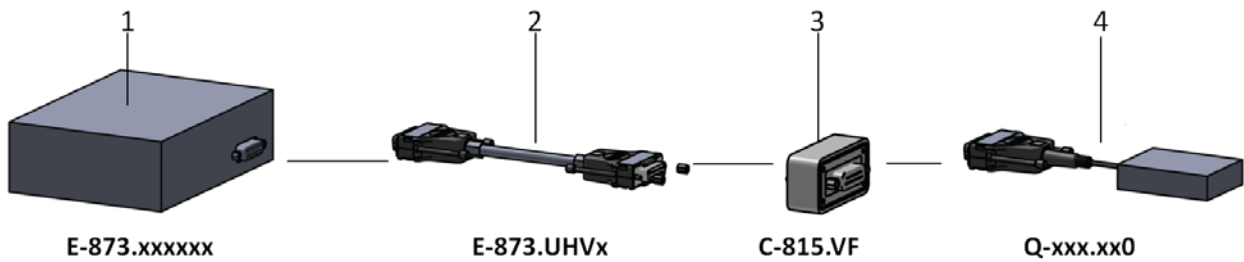


Figure 8: Connecting the Q-632 to suitable electronics for operating in a vacuum

- 1 Controller
- 2 Extension cable
- 3 Vacuum feedthrough for pressure to 10^{-6} hPa
- 4 Mechanics

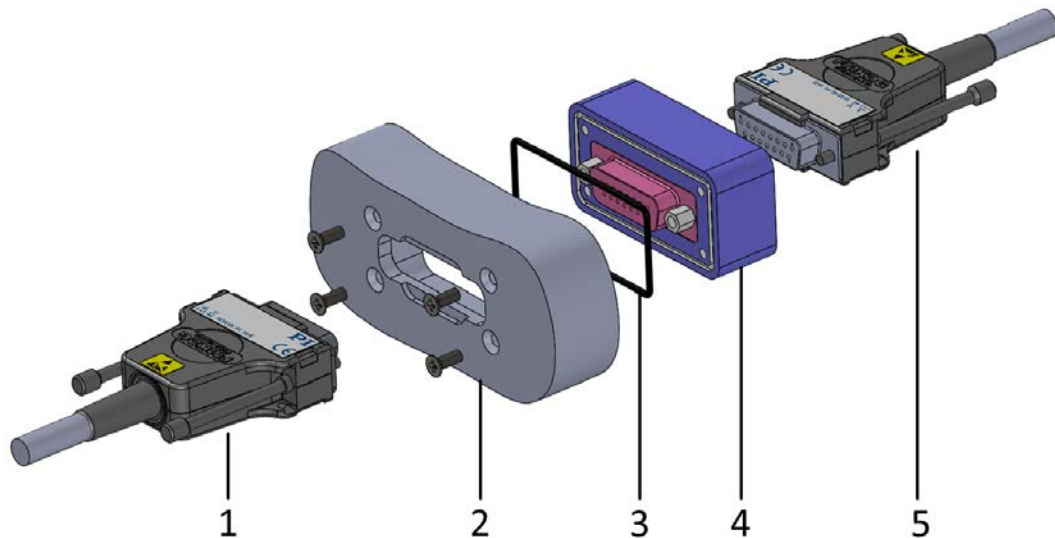


Figure 9: Example for installing the C-815.VF vacuum feedthrough. Left: Vacuum side, right: Air side

- 1 Q-632's connector on the vacuum side
- 2 Example of a vacuum feedthrough, part of a vacuum chamber
- 3 Sealing ring
- 4 C-815.VF vacuum feedthrough
- 5 Connector on the air side of the extension cable for connecting to the electronics.

Tools and accessories

- Four M3 stainless steel countersunk screws of suitable length (ISO 7046)

Installing the vacuum feedthrough

- For C-815.VF vacuum feedthrough: Install the vacuum feedthrough so that the D-sub 15 (f) socket is in the vacuum chamber.
- Pay attention to the maximum torque of 0.9 Nm.

5.4.3 Connecting the Q-632 to the Electronics

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 the Q-632 is to be operated in a vacuum:
 - E-873.UHVx extension cable, available as optional accessory (p. 10)
 - Suitable vacuum feedthrough, available as an optional accessory (p. 10):
C-815.VF (suitable for use in a vacuum to 10^{-6} hPa)
 - Suitable tools for installing the vacuum feedthrough

Connecting the Q-632 to the electronics

1. Prepare the Q-632 for connecting:
 - Remove the ESD protection from the Q-632's connector.

When a Q-632 is to be operated in a vacuum:

 - Installing the vacuum feedthrough:
 - a) Obtain the dimensions from the corresponding dimensional drawing.
 - b) Make sure that the vacuum feedthrough is aligned correctly:
C-815.VF: Vacuum side = D-sub 15 (f)
 - c) Make a suitable opening in the vacuum chamber.
 - d) Install the vacuum feedthrough.
2. Connect the electronics to the Q-632 and if necessary, any further components as shown in the connection diagram above.
3. Take suitable measures to prevent the extension cable from being disconnected accidentally.

6 Startup and Operation

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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-632 in the case of malfunction or failure of the system. If touch voltages exist, touching the Q-632 can result in minor injuries from electric shock.

- Connect the Q-632 to a protective earth conductor (p. 16) 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-632 to the protective earth conductor before restarting.

CAUTION



Burning from hot surface!

The surface of the Q-632 and its vicinity can heat up during operation. Touching the Q-632 and surrounding parts can result in minor injuries from burning.

- Cool the Q-632 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-632 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-632 can overheat during continuous operation as a result.

- Pay attention to the recommended operating time according to the operating frequency in step mode (p. 39).
- 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-632.

- Operate the Q-632 only with controllers/drivers and original accessories from PI.
- Do **not** exceed the operating voltage range (p. 38) for which the Q-632 is specified.
- Operate the Q-632 only when the operating voltage is properly connected; see "Pin Assignment" (p. 44).

NOTICE**Operating frequency too high!**

An excessively high operating frequency can cause damage to the Q-632.

- Operate the Q-632 only with controllers/drivers and original accessories from PI.
- Do **not** exceed the operating frequency range (p. 38) specified for the Q-632.

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-632 is not used for a longer period of time, e.g., several days, switch the electronics off.

NOTICE**Destruction of the piezo actuator due to electric flashovers!**

Using the Q-632 in environments that increase the electrical conductivity can lead to the destruction of the piezo actuator 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-632 in environments that can increase the electric conductivity.
- Operate the Q-632 only within the permissible ambient conditions and classifications (p. 39).

NOTICE**Damage due to collisions!**

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

- Make sure that no collisions are possible between the rotation stage, the load to be moved, and the surroundings in the motion range of the rotation stage.
- 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. 39).
- Stop the motion immediately if an electronics malfunction occurs.

NOTICE**Increased wear due to short travel range!**

- If you only move the Q-632 over a short travel range (<math><20^\circ</math>), it is necessary to fully rotate the motion platform once at regular intervals.

INFORMATION

The Q-632'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-632

INFORMATION

If the parameters of the electronics are not adapted to the Q-632 and the application (load, orientation of the Q-632), the Q-632 will either not move or not move satisfactorily.

- Only operate the Q-632 when the parameters of the electronics have been correctly set.
- Depending on the electronics used, pay particular attention either to the parameter setting for the operating frequency in step mode or to the velocity in closed-loop operation.

E-873.3QTU:

- Operating frequency in step mode via the parameter with ID 0x1F000400

E-873.1Ax / E-873.10C885

- Velocity via `VEL` (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. 25).
- ✓ You have installed (p. 15) the rotation stage 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-632

1. Start and operate the rotation stage (see user manual for the electronics).
Startup includes the following steps:
 - Selecting the positioner type
 - Defining the reference point of the axis
 - Commanding of first motion for testing

2. If necessary: Adapt the parameters for the operating frequency in step mode or the velocity (see the user manual for the electronics) to your application (see also "General Notes on Startup and Operation" (p. 25) and "Operating Time" (p. 39)).

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

7 Maintenance

In this Chapter

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Performing a Maintenance Run.....	31
Cleaning the Q-632	31

7.1 General Notes on Maintenance

NOTICE



Damage due to improper maintenance!

Improper maintenance can lead to misalignment and failure of the Q-632.

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

7.2 Performing a Maintenance Run

The maintenance run must comprise at least one full rotation of the motion platform of the Q-632.

- Do the maintenance run after every 10 million steps.

7.3 Cleaning the Q-632

Requirements

- ✓ You have disconnected the rotation stage from the electronics.

Cleaning the rotation stage

Only when the rotation stage is **not** used in vacuum:

- When necessary, clean the surfaces of the rotation stage with a cloth that is lightly dampened with a mild cleanser or disinfectant.

Only when the rotation stage is used in vacuum:

- Touch the rotation stage only with powder-free gloves.
- If necessary, wipe the rotation stage clean.

8 Troubleshooting

Problem	Possible causes	Solution
Function impairment after system modification	<ul style="list-style-type: none"> ▪ The electronics were replaced ▪ The rotation stage has been replaced 	<ul style="list-style-type: none"> ➤ Load the Q-632's parameter set from the positioner database. ➤ If necessary: Set the parameters for the electronics in PIMikroMove so that they correspond to the application (load, orientation) of the Q-632 (see user manual for the electronics).
No or limited motion	The cable is not connected correctly or is defective	<ul style="list-style-type: none"> ➤ Check the connecting cable(s)
	Excessive load	<ul style="list-style-type: none"> ➤ Reduce the load. Pay attention to the information in the "Technical Data" section (p. 37). ➤ Take suitable measures to make sure that the load exerts a torque that is lower than the drive torque (p. 37) when the rotation stage is mounted vertically, e.g., cables connected to the load should have sufficient strain relief.
	Parameters of the electronics incorrectly set	<ul style="list-style-type: none"> ➤ See the "Function impairment after system modification" problem in this table.
	Operating voltage too low	<ul style="list-style-type: none"> ➤ Provide an operating voltage of 48 V.
	Unfavorable operating frequency for step mode	<ul style="list-style-type: none"> ➤ Depending on the electronics used: Adapt the operating frequency for step mode or the velocity in closed-loop operation (p. 28) (For details, see the manual for the electronics).
	Warped base body	<ul style="list-style-type: none"> ➤ Mount the Q-632 on a flat surface. The recommended flatness of the surface is 2 µm.
	Unfavorable load mounting	<ul style="list-style-type: none"> ➤ Pay attention to the maximum torque when mounting the load (p. 19). ➤ 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.

Problem	Possible causes	Solution
	Unsuitable ambient conditions	➤ Operate the Q-632 in a clean environment only and under permissible ambient conditions (p. 39).
	Drive wear	➤ Replace the Q-632 and make sure that the operating parameters of the electronics are adapted to the rotation stage.
	Drive is blocked	➤ Release the blockage carefully by turning the motion platform back and forth by hand. ➤ Contact our customer service department (p. 35).

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. 35).

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

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10.1 Specifications

10.1.1 Data Table

Motion and positioning	Q-632.930	Unit	Tolerance
	Rotation stage with position sensor for closed-loop operation		
Active axis	θ_z		
Rotation range	>360	°	
Integrated sensor	Incremental encoder		
Sensor resolution	0.75	μrad	
Minimum incremental motion	3	μrad	typ.
Unidirectional repeatability	6	μrad	typ.
Maximum velocity, closed loop	20	°/s	

Mechanical properties	Q-632.930	Unit	Tolerance
Load capacity, any orientation	0.1	kg	
Self-locking	7	mN·m	min.
Drive torque	6	mN·m	typ.
Length	36	mm	
Width	32	mm	
Height	8	mm	
Turntable diameter	29	mm	

Drive properties	Q-632.930	Unit	Tolerance
Motor type	Piezoelectric inertia drive		

Miscellaneous	Q-632.930	Unit	Tolerance
Operating temperature range	0 to 40	°C	
Material	Aluminum, steel		
Mass without cable	25	g	±10 %
Cable length	1	m	
Connector	D-sub 15		
Recommended electronics	E-873.1AT, E-873.3QTU, E-873.10C885		

For operation in a vacuum, we recommend a reduced duty cycle of 20% and a reduced rotation speed of 50% compared to a standard environment.

Specifications tested with E-873.1AT

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

10.1.2 Maximum Ratings

The Q-632 rotation stage is designed for the following operating data:

Maximum Operating Voltage	Maximum Operating Frequency	Maximum Power Consumption
48 V	20 kHz	10 W

10.1.3 Ambient Conditions and Classifications

Pay attention to the following ambient conditions and classifications for the Q-632:

Area of application	For indoor use only
Maximum altitude	2000 m
Air pressure	1100 hPa to 10 ⁻⁶ 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(acc. to IEC 60529)	IP20

10.2 Operating Time

The velocity and the duration of motion affect the lifetime of the rotation stage. In order to prevent overheating and increased wear, the duration of motion at the specified velocity may not exceed the values specified in the following table.

Velocity in °/s	Maximum duration of motion in s ^{1,2}	Idle time in s
20	10	10
15	30	10
10	Any	0

¹ With the following restraints: Without load, at 20 °C, 48 V supply voltage, and ±0.2 A charging current

² It is essential to install effective thermal transfer in order to reach the specified duration of motion.

10.3 Dimensions

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

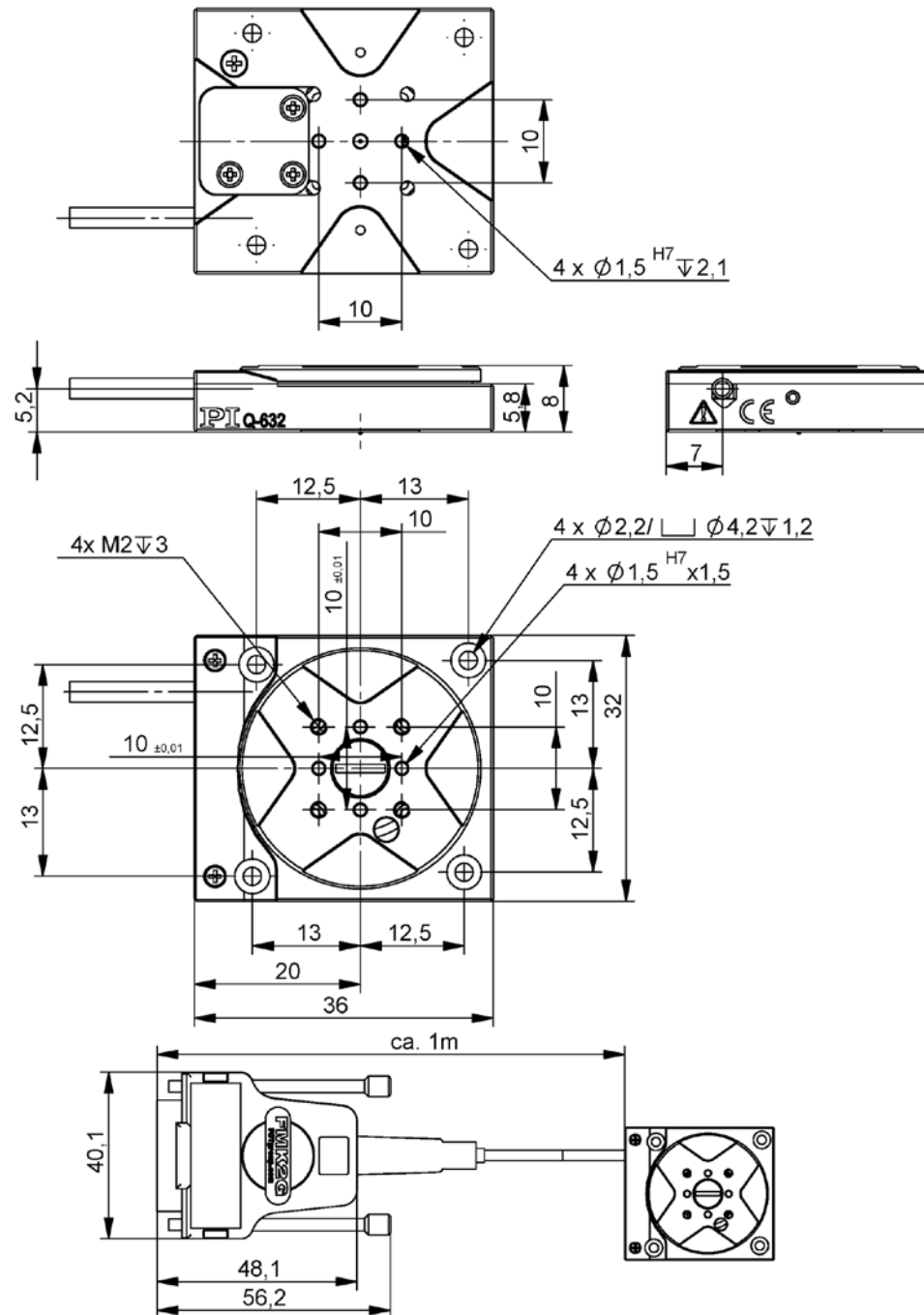


Figure 10: Q-632.930

10.3.1 Q-101.AP1 Adapter Plate

Dimensions in mm.

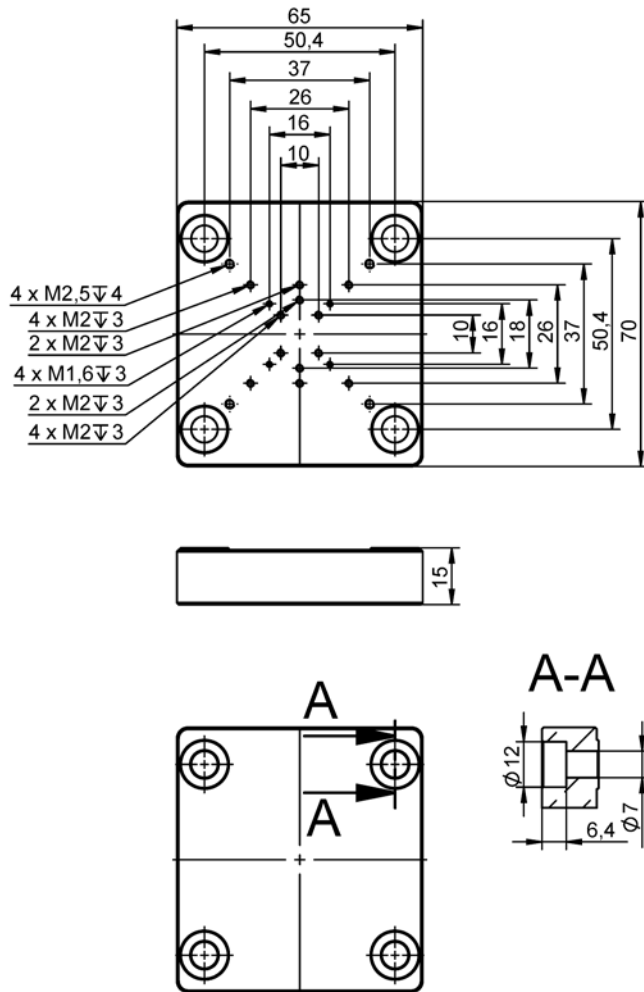


Figure 11: Q-101.AP1 adapter plate

10.3.2 C-815.VF Vacuum Feedthrough for 10^{-6} hPa

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

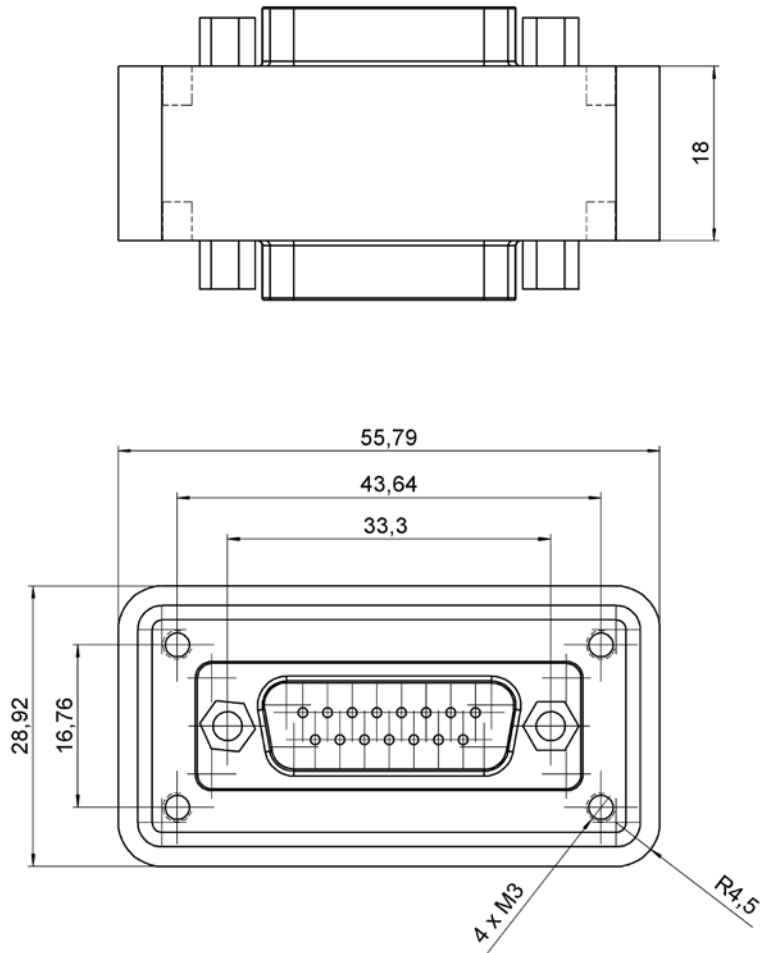


Figure 12: C-815.VF vacuum feedthrough D-sub 15 (m/f)

Recommended vacuum chamber opening for the C-815.VF vacuum feedthrough for 10^{-6} hPa

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

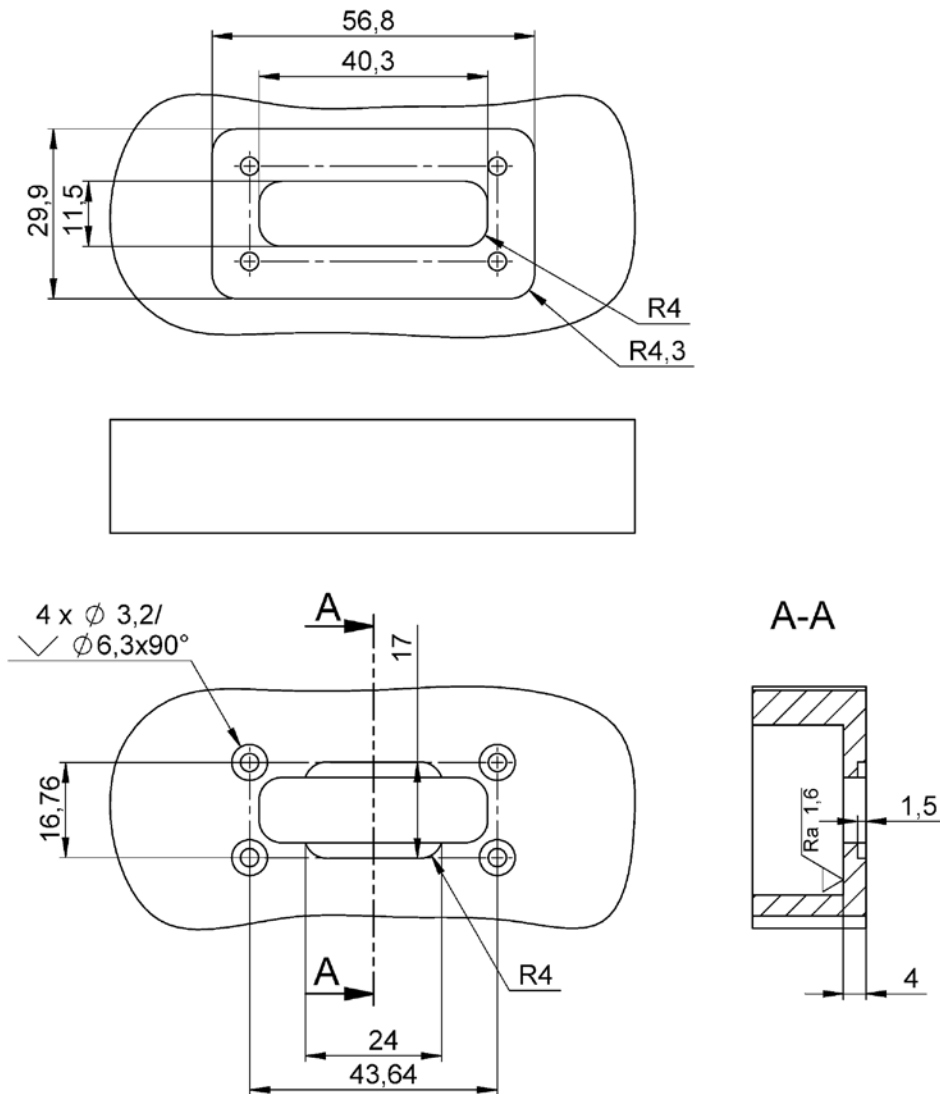


Figure 13: Top: View of the opening on the air side; middle: Section of the vacuum chamber as specified by the customer; bottom: View from the vacuum side

10.4 Pin Assignment

10.4.1 Q-632.930 (Vacuum Compatible to 10^{-6} hPa)

Connector: D-sub 15 (m)

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

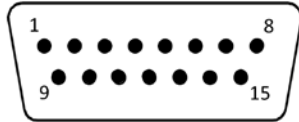


Figure 14: D-sub 15 (m) connector

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.

10.4.2 C-815.VF Vacuum Feedthrough

D-sub 15 (m/f)

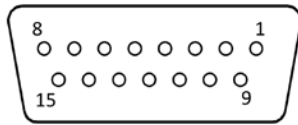


Figure 15: Vacuum side: D-sub 15 (f)

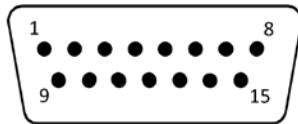


Figure 16: Air side: D-sub 15 (m) panel plug

Vacuum side (f)			Air side (m)
Pin	Signal	Function	Pin
1	REF -	Reference signal differential (-)	1
2	Motor (-)	Motor signal differential (-)	2
3	Motor (+)	Motor signal differential (+)	3
4	V _{DD}	Supply voltage (+5 V)	4
5	-	-	5
6	ID chip data	ID chip data	6
7	SIN -	Encoder A (-)	7
8	COS -	Encoder B (-)	8
9	Motor (-)	Motor signal differential (-)	9
10	GND	GND	10
11	Motor (+)	Motor signal differential (+)	11
12	-	-	12
13	REF +	Reference signal differential (+)	13
14	SIN +	Encoder A (+)	14
15	COS +	Encoder B (+)	15

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 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 EU Declaration of Conformity

For the Q-632, 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

