

User Manual

P726T0002, valid for P-726.1CD

CBo, 10/18/2019

PI

P-726.1CD

PIFOC High-Load Objective Scanner



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About this Document

This manual contains information necessary for the intended use of the P-726.1CD.

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.

Symbols and Typographic Conventions

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

CAUTION



Dangerous situation

If not avoided, the dangerous situation will result in minor injury.

- Actions to take to avoid the situation.

NOTICE



Dangerous situation

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

- Actions to take to avoid the situation.

INFORMATION

Information for easier handling, tricks, tips, etc.

Downloading Manuals

INFORMATION

If a manual is missing or problems occur with downloading:

- Contact our customer service department (p. 12).

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-726) or the product family (e.g., PIFOC) 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.

Safety

Intended Use

The P-726 is a laboratory device as defined by DIN EN 61010-1. It is intended to be used in interior spaces and in an environment which is free of dirt, oil and lubricants.

Based on its design and realization, the P-726 is intended for positioning and shifting microscope objectives on one axis.

The P-726 objective scanner can be mounted horizontally or vertically. The specifications refer to a vertically mounted objective scanner.

The intended use of the P-726 is only possible in a completely assembled and connected state.

The P-726 must be operated with a suitable controller that is available from PI. The controller must provide the required operating voltages. To ensure proper performance of the servo-control system, the controller must also be able to read out and process the signals from the position sensors.

The controller is not included in the scope of delivery of the P-726.

Safety Precautions

CAUTION



Dangerous voltage and residual charge on piezo actuators!

The P-726 is driven by piezo actuators. Temperature changes and compressive stresses can induce charges in piezo actuators. After being disconnected from the electronics, piezo actuators can also stay charged for several hours. Touching or short-circuiting the contacts in the connector of the P-726 can lead to minor injuries from electric shock. In addition, the piezo actuators can be destroyed by an abrupt contraction.

- Do **not** open the P-726.
- Discharge the piezo actuators before installation:
Connect the piezo actuator to the switched-off PI controller.
- Do **not** pull out the connector from the electronics during operation.



For P-726 with D-sub connector:

Touching the contacts in the connector can lead to an electric shock (max. 120 V DC) and minor injuries.

- Do **not** touch the contacts in the connector.
- Secure the connector of the piezo actuator with screws against being pulled out of the controller.

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 and there is a risk of electric shock. In the case of malfunction or failure of the system, touching the P-726 can result in minor injuries.

- Connect the P-726 to a protective earth conductor (p. 9) before start-up.
- Do **not** remove the protective earth conductor during operation.
- If the protective earth conductor has to be temporarily removed (e.g., for modifications), reconnect the P-726 to the protective earth conductor before starting it up again.

NOTICE



Unsuitable cables!

Unsuitable cables can damage the electronics.

- Only use cables from PI for connecting the P-726 to the electronics.

NOTICE



Destruction of the piezo actuator by electric flashovers!

The use of the P-726 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 such as 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 P-726 in environments that can increase the electric conductivity.
- Only operate the P-726 within the permissible ambient conditions and classifications (p. 14).

NOTICE



Destruction of the piezo actuator by continuously high voltage!

The constant application of high voltage to piezo actuators can lead to leakage currents and flashovers that destroy the ceramic.

If the P-726 is not used, but the controller is to remain switched on to ensure temperature stability:

- Set the piezo voltage to 0 V on the controller.

NOTICE



Uncontrolled oscillation!

Oscillations can cause irreparable damage to the P-726. Oscillations are indicated by a humming and can result from the following causes:

- The load and/or dynamics of operation differ too much from the calibration settings.
- The P-726 is operated near its resonant frequency.
- If you notice oscillations, stop the P-726 immediately.

INFORMATION

Extended cables can affect the performance of the P-726.

- Do **not** use cable extensions. If you need longer cables, contact our customer service department (p. 12).

Product Description

Product View

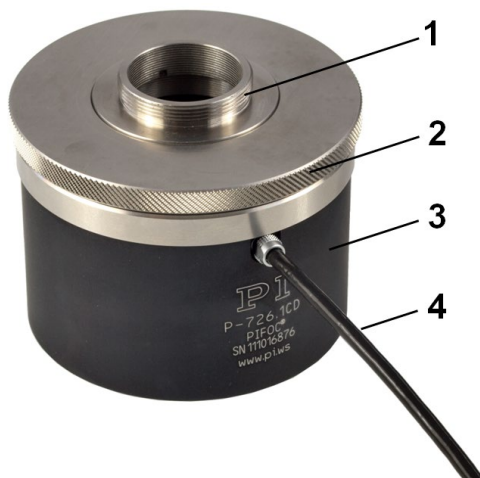


Figure 1: P-726.1CD with thread adapter (example)

- 1 Turret ring of the QuickLock adapter (to be ordered separately)
- 2 Knurled ring
- 3 Base body
- 4 Connecting cable

Scope of Delivery

Product number	Description
P-726.1CD	PIFOC high-load objective scanner
PZ240EK	Short instructions for piezo positioning systems
P726T0001	Technical note for QuickLock thread option for P-726

Suitable Controllers

Product number	Description
E-754	Digital piezo controller
E-709	Digital piezo controller
E-625	Piezo servo controller
E-665	Piezo amplifier / servo controller
E-500	Modular piezo controller system with E-505 high-power amplifier module and E-509 servo controller

Accessories

Product number	Description
P-726.04	P-726 PIFOC thread adapter M28 × 0.75
P-726.05	P-726 PIFOC thread adapter M32 × 0.75
P-726.06	P-726 PIFOC thread adapter M26 × 1/36"
P-726.11	P-726 PIFOC thread adapter M25 × 0.75
P-726.12	P-726 PIFOC thread adapter W0.8 × 1/36"
P-895.1DLC	Adapter cable D-sub 7W2 (f) to LEMO for piezo actuator nanopositioning systems with capacitive sensors, 1 channel, 0.3 m. Fits controllers with LEMO connectors (1 × voltage, 2 × sensor).

Installation

Connecting the P-726 to a Protective Earth Conductor

The P-726 has no separate protective earth connection. The system into which the P-726 is integrated (e.g., surrounding mechanical system) must be connected to a protective earth conductor (required cross-sectional area of the cable $\geq 0.75 \text{ mm}^2$).

When you connect the P-726 to a protective earth conductor:

1. Make sure that the contact resistance is **<0.1 Ω at 25 A** at all connection points relevant for mounting the protective earth conductor.
2. Observe the applicable standards for mounting the protective earth conductor.

Affixing the P-726 to the Microscope

Requirements

- ✓ You have read and understood the safety precautions (p. 5).

Tools and accessories

- P726T0001 technical note for PIFOC QuickLock Thread Option for P-726 (p. 8)
- QuickLock thread adapter (p. 8) (not included)
- Suitable tools

Affixing the P-726 to the microscope

- Install the P-726 as described in the P726T0001 technical note for PIFOC QuickLock thread option (p. 7).

Installing the Objective

Correct:

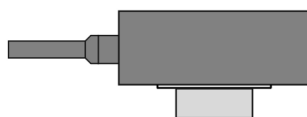


Figure 2: Center of load close to aperture

Incorrect:

Mounting the load incorrectly causes high strain on the flexure guides in the objective scanner, high torques and the danger of oscillations.

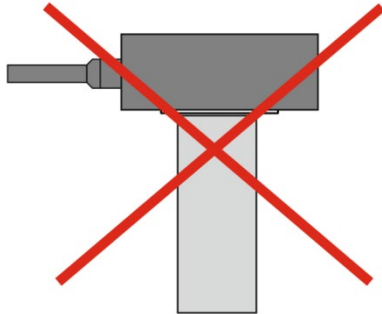


Figure 3: Center of load far below the aperture

Requirements

- ✓ You have read and understood the safety precautions (p. 5).

Tools and accessories

- P726T0001 technical note for QuickLock thread option for P-726 (p. 8)
- QuickLock thread adapter (p. 8) (not included)
- Objective to be installed
- Suitable tools

Installing the objective

- Screw the objective into the P-726. See the P726T0001 technical note (p. 7) for details.

Start-Up and Operation

Requirements

- ✓ You have read and understood the safety precautions (p. 5).

Start-up and operation

- Follow the instructions in the manual of the piezo controller used for start-up and operation of the P-726.

Discharging the P-726

The P-726 must be discharged before demounting. Demounting is necessary e.g., before cleaning or transporting the P-726 as well as for modifications

Discharging a P-726 that is connected to the controller

In closed-loop operation:

1. Switch off the servo mode on the controller.
2. Set the piezo voltage to 0 V on the controller.

In open-loop operation:

- Set the piezo voltage to 0 V on the controller.

Discharging a P-726 that is not connected to the controller

- Connect the P-726 to the switched-off PI controller for 10 seconds.

Maintenance

NOTICE



Misalignment from loosening screws on the base body!

The P-726 is maintenance-free and precisely aligned.

- Only loosen screws according to the instructions in this manual.
- Do **not** open the P-726.

Cleaning the P-726

Requirements

- ✓ You have discharged the piezo actuators of the P-726.
- ✓ You have disconnected the P-726 from the controller.

Cleaning the P-726

- When necessary, clean the surface of the P-726 with a cloth that is lightly dampened with a mild cleanser or disinfectant (e.g., alcohol or isopropyl alcohol).
- Do **not** do any ultrasonic cleaning.

Customer Service

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

- If you have questions concerning your system, provide the following information:
 - Product and serial numbers of all products in the system
 - Firmware version of the controller (if applicable)
 - Version of the driver or the software (if applicable)
 - 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 on our website (www.pi.ws).

Technical Data

Specifications

	P-726.1CD	Unit	Tolerance
Active axes	Z		
Motion and positioning			
Integrated sensor	Capacitive / direct measuring		
Travel range, closed loop	100	µm	
Resolution, closed loop	0.4	nm	typ.
Resolution, open loop	0.3	nm	typ.
Linearity error, closed loop	0.02	%	typ.
Repeatability	±3	nm	typ.
Crosstalk in X, Y	50	nm	typ.
Mechanical properties			
Stiffness in motion direction	3.4	N/µm	±20 %
Resonant frequency, no load	1120	Hz	±20 %
Resonant frequency, under load, 210 g	560	Hz	±20 %
Resonant frequency, under load, 310 g	480	Hz	±20 %
Push/pull force capacity in motion direction	100 / 50	N	max.
Load capacity	20	N	max.
Drive properties			
Piezo ceramic type	PICMA® P-885		
Electrical capacitance	6	µF	±20 %

	P-726.1CD	Unit	Tolerance
Miscellaneous			
Operating temperature range	-20 to 80	°C	
Material	Aluminum, steel		
Objective thread	M32		
Mass	575	g	±5 %
Cable length	1.5	m	±10 mm
Sensor/voltage connection	D-sub 7W2 (m)		
Recommended electronics	E-505, E-621, E-625, E-665, E-709, E-754		




The resolution of the system is limited only by the noise of the amplifier and the measuring technology because PI piezo nanopositioning systems are free of friction.

All specifications based on room temperature (22 °C ±3 °C).

Ask about customized versions.

Maximum Ratings

P-726 objective scanners are designed for the following operating data:

Maximum operating voltage	Maximum operating frequency (unloaded) ¹	Maximum power consumption ²
 -20 to 120 V	 100 Hz	 20 W

¹ To ensure stable operation, the maximum operating frequency is defined as approximately 1/3 of the mechanical resonant frequency.

² The heat generated by the piezo actuator during dynamic operation limits the value for maximum power consumption.

Details can be found online:

<http://piceramic.com/piezo-technology/properties-piezo-actuators/electrical-operation.html>

Ambient Conditions and Classifications

Area of application	For indoor use only
Maximum altitude	2000 m
Air pressure	1100 hPa to 1013 hPa
Relative humidity	Highest relative humidity 80 % for temperatures up to 31 °C Decreasing linearly to 50 % relative humidity at 40 °C
Storage temperature	-20 °C to 80 °C
Transport temperature	-25 °C to 85 °C
Overvoltage category	II
Protection class	I
Degree of pollution	1
Degree of protection according to IEC 60529	IP20

Dimensions

Dimensions in mm.

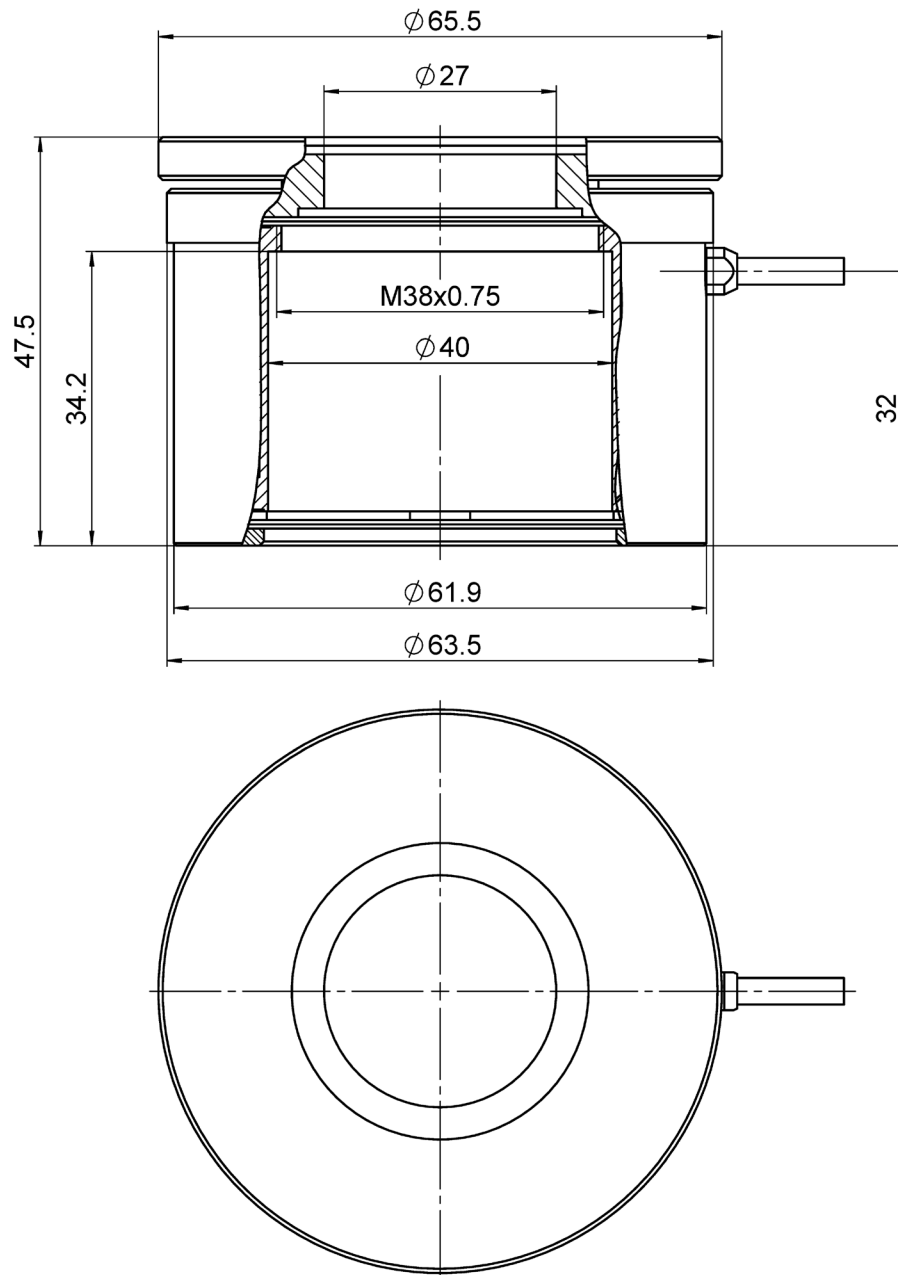


Figure 4: Dimensions of the P-726.1CD

Pin Assignment

D-sub 7W2 (m) connector

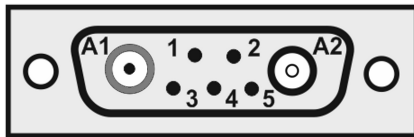


Figure 5: D-sub 7W2 (m) connector (front view)

Pin	Signal	Function
A1 inner conductor	Input	Piezo voltage +
A2 inner conductor	Output	Probe sensor signal (nonmoving part of the capacitive sensor)
A2 outer conductor	GND	Shield
1	Bidirectional	Data line for ID chip
2	GND	Shield of Target Ground of ID chip when switched on
3	Input	Piezo voltage –
4	N.C.	Not connected
5	Input	Target sensor signal (movable part of the capacitive sensor)

The connector shell is connected to the cable shield.

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

