User Manual

P726T0002, valid for P-726.1CD

CBo, 6/10/2020

P-726.1CD

PIFOC High-Load Objective Scanner

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Contents

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).

Downloading manuals

1. Open the website **www.pi.ws**.
2. Search the website for the product number (e.g., P-726) or the product family (e.g., PIFOC).
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.

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.

It is only possible to use the P-726 as intended 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 P-726 before installation:
  Connect the P-726 to the switched-off PI controller, which is equipped with an internal discharge resistor.
- Do **not** pull the connector out of 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 P-726 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. 8) before startup.
- 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.

When the P-726 is not used but the controller remains 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

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

P-726.xx QuickLock Thread Adapter Sets for P-726

The P-726.xx QuickLock thread adapters are available with apertures that have various different inner diameters:

Product number	QuickLock thread adapter	
	Thread size	Aperture diameter
P-726.04	M28 x 0.75 mm	23 mm
P-726.05	M32 x 0.75 mm	27 mm
P-726.06	M26 x 1/36"	21 mm
P-726.11	M25 x 0.75 mm	21 mm
P-726.12	W0.8 x 1/36"	16 mm
P-726.04	M28 x 0.75 mm	23 mm

➢ To order, contact our customer service department (p. 12).

Adapter Cables

Product number	Description
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).

➢ To order, contact our customer service department (p. 12).

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 ≥0.75 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. Pay attention to the applicable standards for mounting the protective earth conductor.

Fixing the P-726 to the Microscope

P-726 PIFOC positioners are installed using QuickLock thread adapters.

Component Overview

Fig. 3: PIFOC exploded view, as mounted on non-inverted microscope

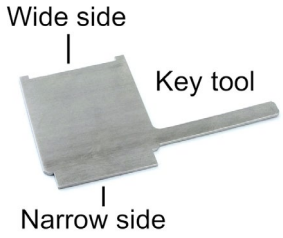

Fig. 2: Included key tool

Fig. 4: Recesses in the turret ring

Mounting the P-726.xx QuickLock Thread Adapter Set

NOTICE

Possible damage due to excessive torque!

Only moderate torque is required to fix the objective ring in the PIFOC body.

➢ Use the key tool supplied for tightening the objective ring.

Requirements

✓ The PIFOC positioner is **not** connected to the electronics.

Tools and accessories

- P-726.xx QuickLock thread adapter set (p. 7)
- Key tool supplied (refer to Fig. 2, p. 8)

Mounting the P-726.xx QuickLock thread adapter set

1. Screw the objective ring into the PIFOC using the key tool supplied. Use the wide side of the key tool to engage the recesses in the ring. Grip the tool by hand only.

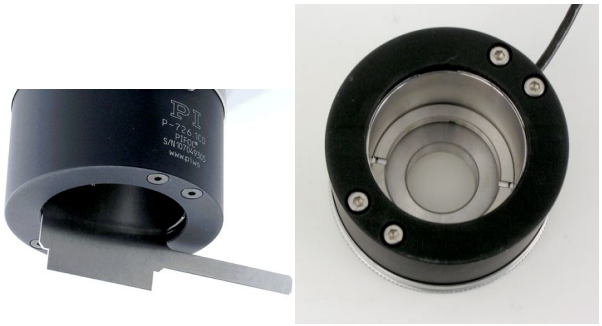

Fig. 5: Objective ring with recesses inside PIFOC can be tightened with key tool

2. Insert the turret ring into the knurled ring.

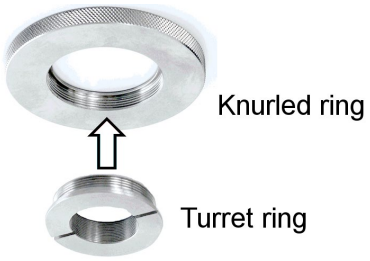

Fig. 6: Insertion of turret ring into knurled ring

3. Screw the turret ring together with the knurled ring clockwise into the microscope (not shown). Use the narrow side of the key tool to engage the recesses in the ring. Grip the tool by hand only.
4. Affix the PIFOC to the microscope: Align the PIFOC with the knurled ring and screw the knurled ring onto the PIFOC.

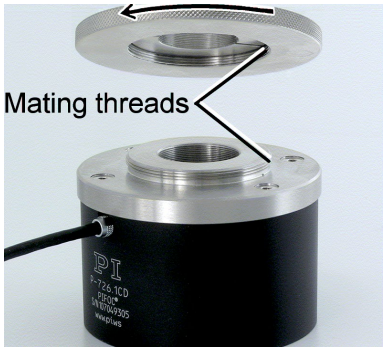

Fig. 7: Screwing the knurled ring onto the PIFOC

5. Screw the objective into the objective ring of your PIFOC.

Fig. 8: Objective installed in PIFOC

Startup and Operation

Requirements

✓ You have read and understood the safety precautions (p. 4).

Startup and operation

➢ Follow the instructions in the manual of the piezo controller used for startup 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.

➢ Loosen any screws only when instructed in this manual.

➢ Do **not** open the P-726.

Cleaning the P-726

NOTICE

Damage from ultrasonic cleaning!
Ultrasonic cleaning can damage the P-726.

➢ Do **not** do any ultrasonic cleaning.

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).

Removing the P-726 from the Microscope

Requirements

✓ The PIFOC positioner is **not** connected to the electronics.

Tools and accessories

- Key tool supplied (refer to Fig. 2, p. 8)

Removing the P-726 from the microscope

1. Remove the PIFOC from the microscope (not shown): Hold the PIFOC by the base body with one hand and unscrew the knurled ring from the PIFOC with the other hand as shown in the figure below.

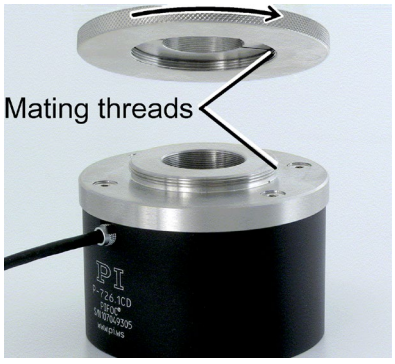

Fig. 9: Unscrewing the knurled ring

2. If the turret ring needs to be removed from the microscope, use the narrow side of the key tool to unscrew the ring from the microscope (not shown). Grip the tool by hand only.

3. If the objective needs to removed, unscrew it from the PIFOC body. The objective ring will probably remain in the PIFOC.

Fig. 10: Objective installed in PIFOC

4. If the objective ring is still in the PIFOC and needs to be removed, use the wide side of the key tool supplied to unscrew the ring from the PIFOC. Grip the tool by hand only.

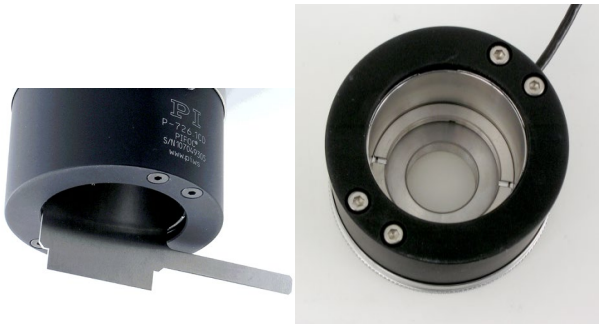

Fig. 11: Objective ring with recesses inside PIFOC can be loosened with key tool

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.

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 %
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 (no load)[1]	Maximum power consumption[2]
-20 to 120 V	100 Hz	20 W

[1] To ensure stable operation, the maximum operating frequency has been defined as around one third of the mechanical resonant frequency.

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

Details can be found at the following website:
https://www.physikinstrumente.com/en/technology/piezo-technology/properties-piezo-actuators/electrical-operation/

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.

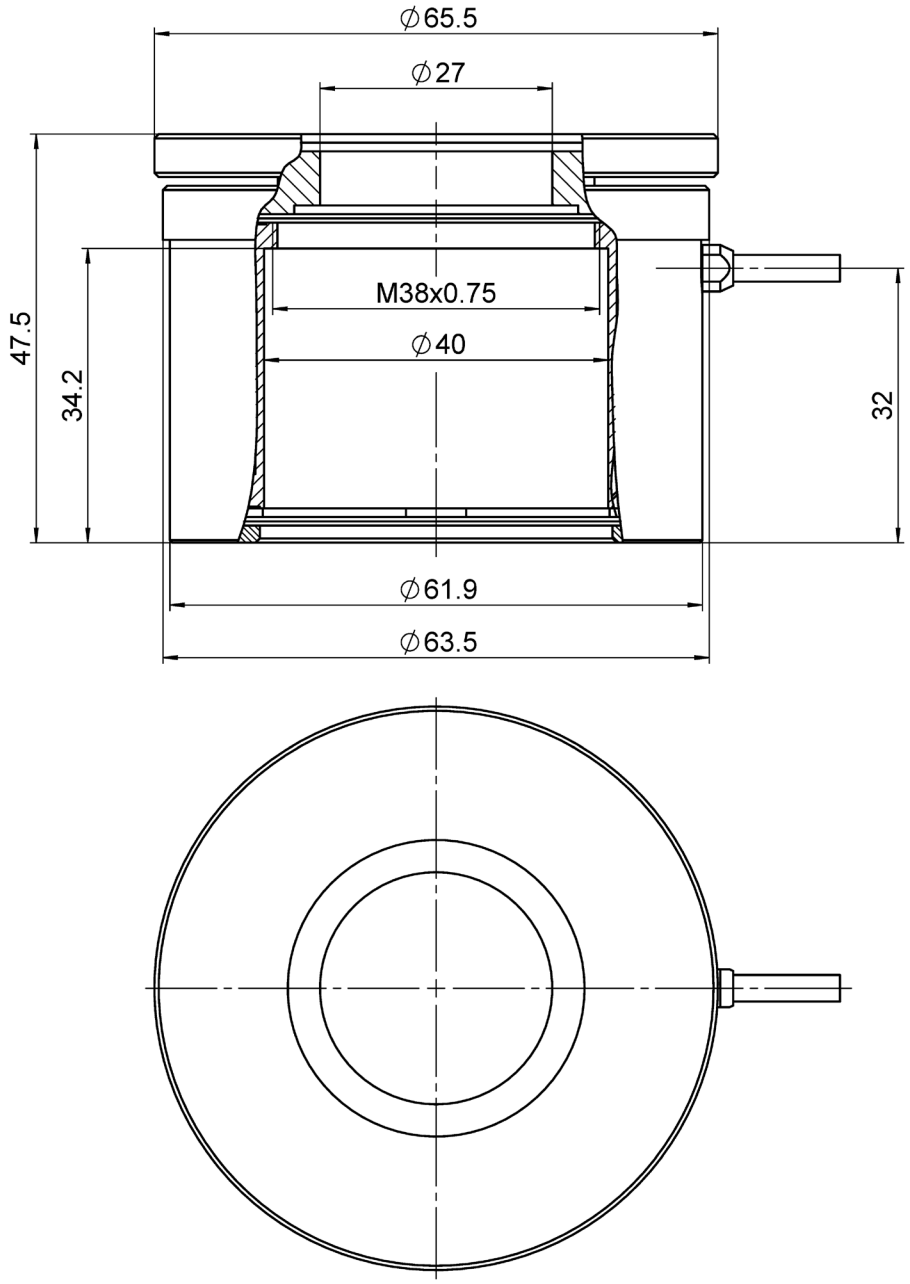

Figure 12: Dimensions of the P-726.1CD

Pin Assignment

D-sub 7W2 (m) connector

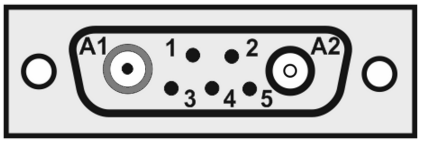

Figure 13: D-sub 7W2 (m) connector (front view)

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 cable shield is connected to the connector shell.

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

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D-76228 Karlsruhe, Germany