User Manual

PZ176, valid for E-464

BSc, ibs_CHe, 3/26/2025

E-464

PICA Piezo Amplifier

Original instructions
First printing: 3/26/2025

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Contents

1 Introduction

1.1 About this document

1.1.1 Objective and target group of this user manual

This user manual contains the information necessary for using the E-464 as intended.

We assume that the user has basic knowledge of closed-loop systems, motion control concepts, and applicable safety measures.

1.1.2 Symbols and typographic conventions

The following symbols and typographic conventions are used in the user manuals of PI:

DANGER

Imminently hazardous situation

If not avoided, the hazardous situation will result in death or serious injury.

➢ Actions to take to avoid the situation

WARNING

Possibly hazardous situation

If not avoided, the hazardous situation will result in serious injury.

➢ Actions to take to avoid the situation.

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.

Symbol/Label	Meaning
RS-232	Label on the product indicating an operating element (example: RS-232 interface socket)
	Warning sign on the product referring to detailed information in this manual.

1.1.3 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.

1.1.4 Other applicable documents

Product	Document
Housed Analog Piezo Electronics	PZ300EK Short Instructions
Analog Drivers	E500T0011 Technical Note

1.1.5 Downloading manuals

INFORMATION

If a manual is missing or problems occur with downloading:

➢ Contact our customer service department (p. 6).

Downloading manuals

1. Open the website **www.pi.ws**.
2. Search the website for the product number (e. g., E-464).
3. In the search results, select the product to open the product detail page.
4. Select ***Downloads***.

   The manuals are shown under ***Documentation***. Software manuals are shown under ***General Software Documentation***.
5. For the desired manual, select ***ADD TO LIST*** and then ***REQUEST***.
6. Fill out the request form and select ***SEND REQUEST***.

   The download link will be sent to the e-mail address entered in the form.

1.2 European declarations of conformity

For the E-464, declarations of conformity were issued according to the following European statutory requirements:

EMC Directive

RoHS Directive

The standards applied for certifying conformity are listed below.

EMC: EN 61326-1

Safety: EN 61010-1

RoHS: EN IEC 63000

1.3 Customer service

For inquiries and orders, contact your PI representative or send us an e-mail: 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.

2 Safety

2.1 Intended use

E-464 is a laboratory device as defined by DIN EN 61010-1. E-464 is intend for indoor use and in an environment free from corrosive and/or electrically conductive acids, alkalines, oils, vapors, and dust.

Based on their design and realization, E-464 PICA™ HVPZT - Piezo Amplifiers are intended to drive capacitive loads, in the present case, piezoceramic actuators. E-464 must not be used for applications other than stated in this manual, especially not for driving ohmic (resistive) or inductive loads.

It is only possible to use E-464 as intended when it is installed and connected properly, and when all measures described herein are adhered to.

2.2 General safety instructions

E-464 is built according to state-of-the-art technology and recognized safety standards. Improper use of the E-464 may result in personal injury and/or damage to the E-464.

- Use E-464 only for its intended purpose and when it is in perfect condition.
- Read the user manual.
- Eliminate any malfunctions that may affect safety immediately.

The operator is responsible for installing and operating the E-464 correctly

- Install the E-464 near the power supply so that the power plug can be quickly and easily disconnected from the mains.
- Use the components supplied (power cord) to connect the E-464 to the power supply.
- If one of the components supplied for connecting to the power supply has to be replaced, use a sufficiently rated component.

2.3 Organizational measures

User manual

- Always keep this user manual available with the E-464.
- Add all information from the manufacturer such as supplements or technical notes to the user manual.
- If you give E-464 to a third party, also include this user manual as well as other relevant information provided by the manufacturer.
- Only install and operate E-464 after you have read and understood this user manual.

General personnel qualification

E-464 may only be installed, started up, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

3 Product description

3.1 Control elements

Front panel

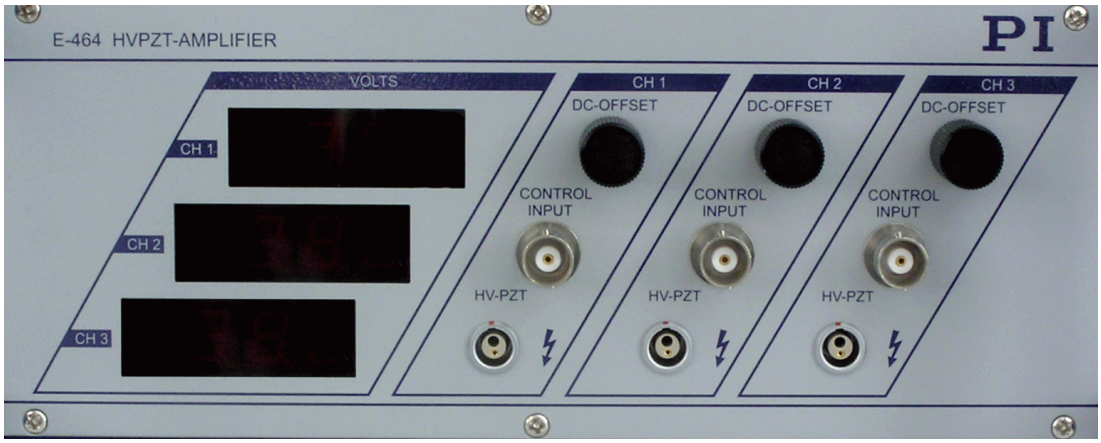


Figure 1: E-464 front panel with operating elements

The E-464 amplifier has 3 amplifier channels. Every channel provides the following operating elements:

DC Offset turning knob	10-turn potentiometer for DC Offset (see "Analog operation" p. 9)
CONTROL INPUT BNC socket	Connection of control signal (see "Analog operation" p. 9
HV-PZT LEMO socket	High-voltage output for PZT (see "Pin assignment" p. 18)
3 ½-digits LED display	Display for PZT high-voltage

Rear panel

The power connector (see "Connecting the voltage" p. 12 and "Replacing fuses" p. 15), input voltage selector and line fuses (p. 9) are located on the rear panel.

3.2 Analog operation

The output voltage is controlled by an analog signal (Control IN) applied to the BNC input added the DC-offset voltage. The magnitude of the sum must be in a range equal to 1/100th of the factory-set output voltage range (usually to 1100 V).

Control in signal

The external voltage applied to the "Control In" BNC socket can be anywhere in the range of -10 V to +10 V, but may not have an active swing more than 11 V wide.

DC offset potentiometer

Depending on the position of the potentiometer, a DC voltage between 0 V and 10 V is made available. If you require a constant DC-offset (e.g. 0), make sure the knob stays at the required position.

INFORMATION

Due to the constant gain of 100 the range of the Amplifier IN signal is set to 1/100 of the output voltage range. If an optional output range is set the Amplifier In signal has to be chosen accordingly.

The analog control signal range is always 1/100 of the output voltage range.

3.3 Control via PC

With the driver library for NI LabVIEW software, analog control via a PC is possible via certain D/A converter boards by National Instruments.

The drivers for NI LabVIEW from PI support all D/A converter boards by National Instruments that are compatible with DAQmx8.3. LabVIEW compatibility is given from version 7.1 of the driver library upwards. Connection of a sensor monitor signal from a sensor or servo module (e.g. E-509) is required to use this option.

For information on downloading the driver library from the PI website see the Technical Note E500T0011 (in the scope of delivery).

4 Unpacking

4.1 E-464 unpacking

1. Unpack the E-464 carefully.
2. Compare the contents with the scope of delivery according to the contract and the delivery note.
3. Inspect the contents for signs of damage. If there is any sign of damage or missing parts, contact PI immediately.
4. Keep all packaging materials in case the product needs to be returned.

4.2 Scope of delivery

Product number	Description
E-464.00	HVPZT Piezo Amplifier, 3 Channels, 1100 V, Bench-Top
3763	Power cord
PZ300EK	Short Instructions for Housed Analog Piezo Electronics
E500T0011	Technical Note "Analog Control via Driver Library for NI LabVIEW"

5 Installation and startup

5.1 Notes on installation and startup

DANGER

Danger of death due to high voltage!

E-464 Power Amplifiers output very high voltages and high currents which can cause death or injury.

- Make sure that only adequately trained and educated personnel operates these devices.
- During operation, do not touch any part which might be connected to the HV output.

DANGER

Improper wiring

Can lead to death, injury and damage to equipment.

- Modification of HIGH VOLTAGE Connectors should only be carried out by the manufacturer. Any unauthorized modification may jeopardize operating personnel. Treat HIGH VOLTAGES and HIGH CURRENTS with caution.

NOTICE

Damage to the actuator due to overvoltage or reverse polarity

Excessively high voltages will destroy the active element in the actuator.

A reverse polarity can also damage the actuator: A polarity inversion of the voltage will be tolerated by a unipolar piezo actuator only up to ca. 25 % of the maximum voltage. A higher turnover voltage will depolarize the PZT and damage it permanently.

- Do not expose piezo actuators to voltages too far outside their operating range.
- Make sure the polarity of the connections is correct.

NOTICE

Air Circulation

Vertical mounting prevents internal convection. Insufficient air flow will cause overheating and premature failure.

- Do not cover the ventilation slots on the top side of the E-464.
- Install the device horizontally with 3 cm air circulation area.

5.2 Connecting the voltage

Unless you request otherwise, upon delivery the E-464 will be set up for the voltage predominant in your country, either

AC: 115 V / 50 Hz to 60 Hz

or

AC: 230 V / 50 Hz to 60 Hz

To adapt the E-464 to a different line voltage, the line power fuses must be replaced. See "Replacing fuses" (p. 15) for instructions and for the required fuse types.

Connecting the voltage

- ➢ Connect the included power cord from the E-464 rear panel to an appropriate power outlet.

5.3 Connecting the actuator

Requirements

- ✓ You have read and understood the general safety instructions (p. 7).

Connecting the actuator

- ➢ Connect the piezo actuator to the E-464 HV output.

INFORMATION

If you are connecting other actuators or wiring your own connector, read the discussion of actuator type carefully and any documentation that came with the actuator.

5.3.1 Bipolar actuators

Here the output voltage swing is so chosen that the actuator sees both negative and positive high voltages. The output always has one lead at 0 V, and here the other is in a zero-crossing range, commonly·±500·V.

5.3.2 Unipolar actuators

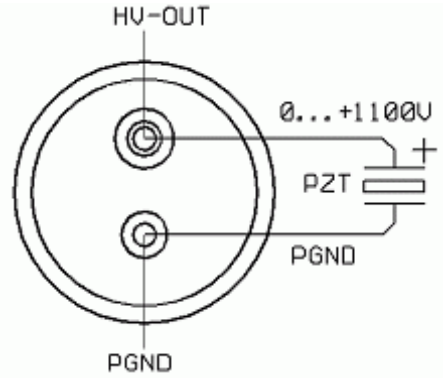
The denomination of "positive" and "negative" polarity of piezo actuators does not refer to their direction of motion. Unipolar piezos of any polarity will elongate when a voltage is applied.

The denomination "positive" and "negative" refers to the sign of the voltage applied to the piezo actuator.

5.3.3 Wiring example

In the wiring example shown on the right, a "positive" piezo is connected so as to have 0 V to +1100 V applied. To achieve this, the positive terminal (possibly labeled "+1100 V") is connected to the variable HV-Out and the negative terminal to PGND.

Standard piezo actuators from PI have a positive polarity and come with suitable LEMO plugs.



5.4 First startup

INFORMATION

If only one or two amplifier channels are operated, the full output power becomes available to the channels in use (see specifications table).

Requirements

- ✓ You have connected the E-464 amplifier to the power supply (p. 13).
- ✓ You have connected the piezo actuator to the appropriate amplifier channel (p. 13).

Starting up the actuator

1. Turn the DC offset potentiometer full counterclockwise (CCW).
2. Make sure that the voltage at ***Control In*** is set to 0 V.
3. With the switch on the rear panel of the housing switch on the power.
4. Command the first motion of the piezo actuator by turning the offset potentiometer full clockwise (CW) then back full CCW to run the actuator over the complete nominal travel range The PZT voltage can be seen on the display, make sure that the full voltage swing is attained
5. If an external analog signal is used, connect the signal source to the ***Control In*** BNC socket. If the signal range is not 1/100 of the output voltage. (p. 9)

6 Maintenance

6.1 Replacing fuses

Unless otherwise requested, the unit will be set up for the power predominant in your country. New line-power fuses are required when changing the supply voltage.

Both fuses are active and have to be checked if there is a fault.

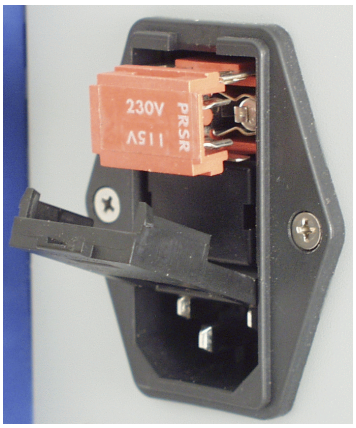


Figure 2: Position of the line fuses and fuse carrier; only one of two fuses is visible

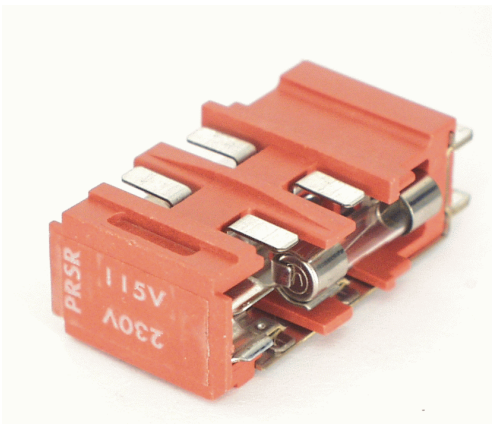


Figure 3: Fuse carrier

Replacing the fuses

1. Switch off the E-464 and remove the power cord.
2. Wait a minute to be sure that any residual voltage has dissipated.
3. Pry open the door that covers the fuse carrier and take out the fuse carrier.
4. Be sure to replace both fuses with fuses of the type appropriate for the new voltage:

   220 V to 240 V AC IEC* 0.8 AT (slow blow)

   100 V to 120 V AC IEC* 1.6 AT (slow blow)
5. Turn the fuse carrier so that the valid voltage setting (115 V or 230 V) is visible through the opening in the cover.
6. Replace the fuse carrier and close the cover.
7. Reconnect the E-464 to the power supply and switch it on.

* IEC fuses are cited

6.2 Cleaning

The outside surface of the case can be cleaned using mild detergents or disinfectant solutions. Organic solvents must not be used.

7 Troubleshooting

Fault: Positioner does not move	
Possible causes	**Remedial measures**
Cable not connected correctly or defect	➢ Check the cable connections. ➢ Check the connection cables. ➢ Note the required voltage range for the analog signal at ***Control In***. The control input range is basically one one-hundredth of the output voltage (p. 9).

8 Technical data

8.1 Specifications

8.1.1 Data table

	E-464.00
Function	Power amplifier for PICA high-voltage piezo actuators
Amplifier	
Output voltage	0 V to 1100 V
Amplifier channels	3
Average output power per channel	> 3.5 W (max. 12 W for single-channel operation)
Peak power per channel, <5 ms	25 W
Average output current per channel	> 3.5 mA (max. 12 W for single-channel operation)
Peak current per channel, <5 ms	25 mA
Amplifier bandwidth, small signal	1 kHz
Amplifier bandwidth, large signal	3.5 Hz (660 nF); 35 Hz (70 nF)
Ripple, noise, 0 to 100 kHz	5 mV_{rms} 50 mV_{pp} (100 nF)
Current limitation	Short-circuit proof
Voltage gain	100 ±1
Input impedance	100 kΩ
Input voltage range	0 V to 11 V
Interfaces and operation	
Piezo connection	3 × LEMO EGG.0B.701.CJL1173
Analog input	3 × BNC
DC offset setting	3 × 10-turn potentiometer, adds 0 V to 10 V to the input voltage
Display and indicators	3 × 3½-digit LED display
Miscellaneous	
Operating voltage	100 V to 120 V or 220 V to 240 V AC, selectable (fuse change required)
Power consumption	65 VA
Operating temperature range	5 °C to 50 °C (above 40 °C, power derated)
Mass	4.3 kg
Dimensions	236 mm × 88 mm × 273 mm + handles

8.2 Operating limits

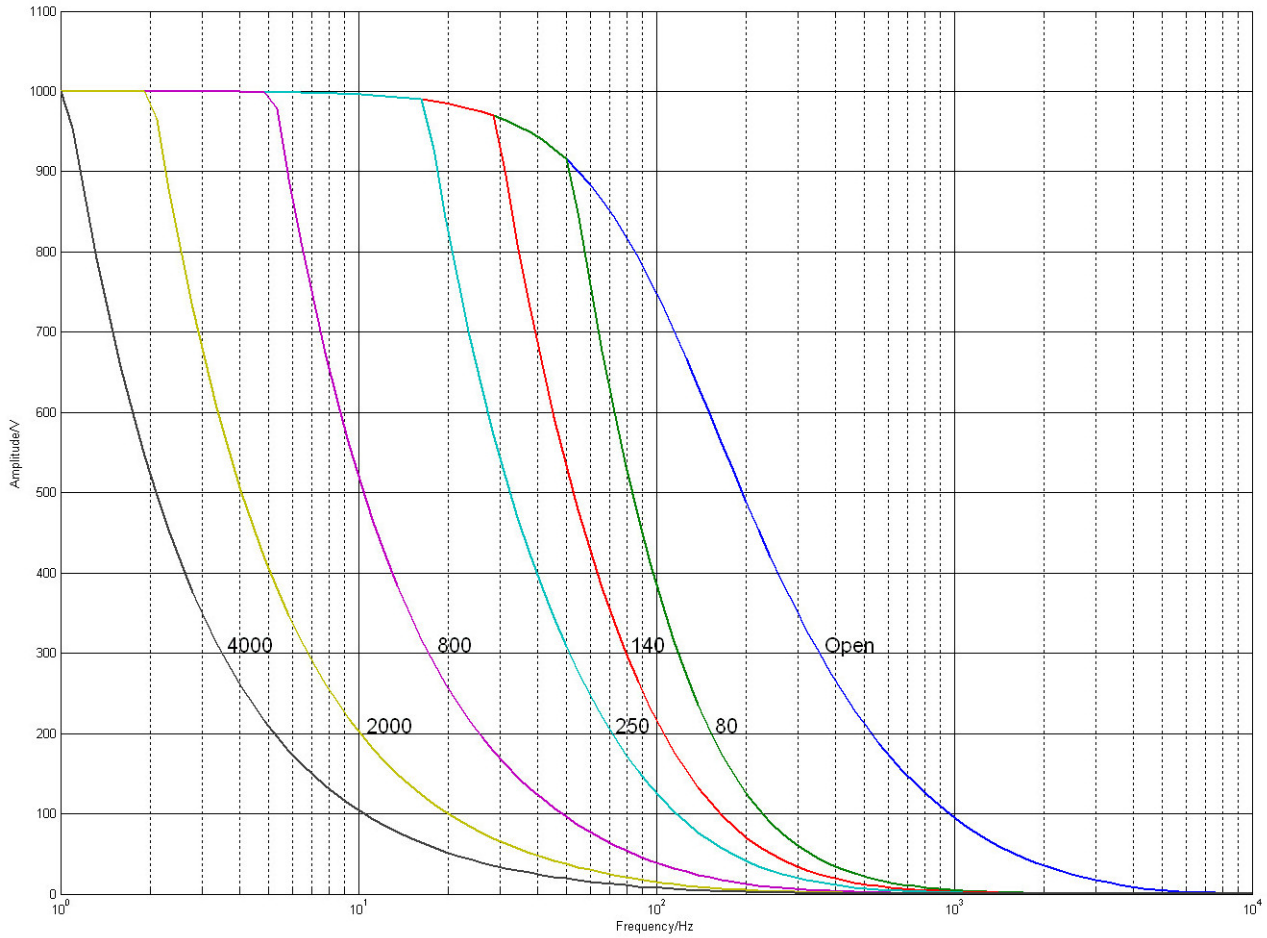


Figure 4: E-464: operating limits with various PZT loads, values shown are capacitance in nF

8.3 Pin assignment

8.3.1 2-pin high-voltage connector

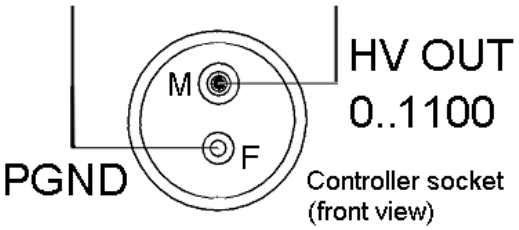
Typ: LEMO
EGG.0B.701.CJL.1173

Pin Assignments:

HV OUT: HV output, up to 1100 V

PGND: Power ground

Housing: cable shield, for protective ground



9 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) SE & 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) SE & Co. KG

Auf der Römerstr. 1

D-76228 Karlsruhe, Germany