

PZ176E User Manual

E-464 PICA™ HVPZT - Piezo Amplifier

Release: 1.0.1 Date: 10.07.2007



This document describes the following product:

- E-464.00
PICA™ HVPZT - Piezo Amplifier, 3 Channels



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Declaration of Conformity

according to ISO / IEC Guide 22 and EN 45014

Manufacturer:	Physik Instrumente (PI) GmbH & Co. KG	
Manufacturer's Address:	Auf der Römerstrasse 1 D-76228 Karlsruhe, Germany	

The manufacturer hereby declares that the product

Product Name: **Power Amplifier for HVPZT**

Model Numbers: **E-464**

Product Options: **all**

complies with the following European directives:

73/23/EEC, Low voltage directive

89/336/EEC, EMC-Directive

The applied standards certifying the conformity are listed below.

Electromagnetic Emission: EN 61000-6-3, EN 55011

Electromagnetic Immunity: EN 61000-6-1

Safety (Low Voltage Directive): EN 61010-1

February 19, 2007
Karlsruhe, Germany



Dr. Karl

Spanner
President

About this Document

Users of this Manual

This manual is designed to help the reader to install and operate the E-464 PICA™ HVPZT - Piezo Amplifier. It assumes that the reader has a fundamental understanding of motion control concepts and applicable safety procedures.

The manual describes the physical specifications and dimensions of the E-464 PICA™ HVPZT - Piezo Amplifier as well as the installation procedures which are required to put the system into operation.

Conventions

The notes and symbols used in this manual have the following meanings:

WARNING

Calls attention to a procedure, practice or condition which, if not correctly performed or adhered to, could result in injury or death.



DANGER

Indicates the presence of high voltage (> 50 V). Calls attention to a procedure, practice or condition which, if not correctly performed or adhered to, could result in injury or death.



CAUTION

Calls attention to a procedure, practice, or condition which, if not correctly performed or adhered to, could result in damage to equipment.



NOTE

Provides additional information or application hints.

The motion controller and the software tools which might be mentioned in this documentation are described in their own manuals. All documents are available as PDF files via download from the PI Website (www.pi.ws (<http://www.pi.ws>)). For updated releases contact your Physik Instrumente sales engineer or write info@pi.ws (<mailto:info@pi.ws>).

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1 Introduction

1.1 Overview



Figure 1: E-464 bench top piezo amplifier for three channels

The E-464 is a bench-top piezo driver/amplifier for PICA™ high-voltage PZTs. Its three low-noise, 4-quadrant amplifiers provide a gain of 100 and can output and sink a peak current of 25 mA and an average current of > 3 mA each. If only 1 channel is operated, an average output power of 12 W can be achieved.

Three 3½-digit LED displays show the output voltage of each individual channel.

Analog Control

E-464 amplifiers are designed to provide precise control of open-loop piezo positioning systems. The amplifier output voltage is determined by the analog signal at the Control Input combined with the DC-offset potentiometer setting.

1.2 Prescribed Use

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-464s must not be used for applications other than stated in this manual, especially not for driving ohmic (resistive) or inductive loads.

Observe the safety precautions given in this User Manual.

The E-464 meets the specifications as defined by DIN EN 61010 for safe operation under normal ambient conditions. See the specifications table for details (see "Specifications" p. 13).

1.3 Safety Precautions

Carefully read also the user manuals and/or technical notes of all other components involved, such as controllers or software.
Failure to heed warnings in this manual can result in bodily injury or material damage or loss of warranty.



DANGER—HIGH VOLTAGE

E-464 Power Amplifiers output VERY HIGH VOLTAGES and HIGH CURRENTS which can cause death or injury!

Take special care if connecting products from other manufactures. Follow general accident prevention rules!

Working with these devices requires adequately trained and educated operating personnel.

During operation, do NOT touch any part which might be connected to the HV output!



WARNING

PZTs Sensitive to Overvoltage or Reverse Polarity

Exposing some PZTs to voltages too far outside their operating range will destroy the active element in the actuator. Make sure that both the polarity and the voltage as seen by the PZT are within the allowable range.

Be especially vigilant regarding polarity when using older actuators, adapter cables and controllers set up for non-standard voltage ranges.



CAUTION

Read this before operating the equipment covered in this manual. Always keep the User Manual safe and close to the described device. In case of loss or damage to the instructions, please order a new copy from your PI distributor or download one from www.pi.ws (<http://www.pi.ws>). Also keep and add all further information (e.g. extended instructions or Technical Notes) to the User Manual.

CAUTION—AIR CIRCULATION

Do not cover the ventilation slots on the top side of the E-464. The device needs to be installed horizontally with 3 cm air circulation area. Vertical mounting prevents internal convection. Insufficient air flow will cause overheating and premature failure.



1.4 Computer Control

Optionally digital control via a D/A converter is possible. For several D/A boards from National Instruments PI offers a corresponding LabVIEW[®] driver set which is compatible with the PI General Command Set (GCS), the command set used by all PI controllers. A further option includes the patented Hyperbit[™] technology providing enhanced system resolution.

E-500.ACD CD with Driver Set for Analog Controllers, available free of charge upon request
Computer control can be implemented using a DAC-board in a PC to generate the analog input signal. PI offers a LabVIEW[™] driver set which can be used with certain D/A boards. This driver set is compatible with the PI General Command Set (GCS) LabVIEW[™] driver set available for all newer controllers from PI.

The PI Analog Controller drivers support all D/A converter boards from National Instruments that are compatible with DAQmx8.3. LabVIEW[™] compatibility is given from version 7.1 upwards. Connection of a sensor monitor signal from a sensor- or servo-module (e.g. E-509) is required.

The driver set is also available for download from the PI website.

E-500.HCD Access to HyperBit[™] Functionality for Enhanced System Resolution
(Supports certain D/A boards.)
PI's patented Hyperbit[™] technology for providing position resolution higher than that of the D/A board is in the E-500.ACD driver set. Activating Hyperbit[™] requires purchase of the password, which can be obtained from PI under Order No. E-500.HCD.

1.5 Unpacking

Unpack the E-464 PICA™ HVPZT - Piezo Amplifier with care. Compare the contents against the items covered by the contract and against the packing list.

The following components are included:

E-464.00	HVPZT Piezo Amplifier, 3 Channels, 1100 V, Bench-Top
3763	line cord
PZ176E	User Manual for E-464.00 (this document)
E500T0011	Technical Note for GCS LabVIEW driver set

Inspect the contents for signs of damage. If parts are missing or you notice signs of damage, contact PI immediately.

Save all packing materials in case the product need be shipped again.

2 Operation

2.1 Front and Rear Panel Elements



Figure 2: 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. 8)
"CONTROL INPUT" BNC socket	Connection of control signal (see "Analog Operation" p. 8)
"HV-PZT" LEMO socket	High-voltage output for PZT (see "Connectors" p. 14)
3 ½-digits LED Display	Display for PZT high-voltage

The power connection (see "Line Voltage Connection" p. 6), input voltage selection and line fuses (p. 10) are located on the rear panel.

2.2 Line Voltage Connection

Unless you request otherwise, upon delivery the E-464 will be set up for the voltage predominant in your country, either
115 V ~ / 50-60 Hz

or

230 V ~ / 50-60 Hz

To adapt the E-464 to a different line voltage, the line power fuses must be replaced. See AC Power and Line Power Fuses (p. 10) for instructions and for the required fuse types.

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

2.3 Piezo Actuator Connection



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Working with these devices requires adequately trained and educated operating personnel.

During operation, do NOT touch any part which might be connected to the HV output!



DANGER—IMPROPER WIRING CAN CAUSE DEATH, INJURY, DAMAGE AND VOID WARRANTY

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 respect.

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



WARNING

PZTs Sensitive to Overvoltage or Reverse Polarity

Exposing some PZTs to voltages too far outside their operating range will destroy the active element in the actuator. Make sure that both the polarity and the voltage as seen by the PZT are within the allowable range.

Be especially vigilant regarding polarity when using older actuators, adapter cables and controllers set up for non-standard voltage ranges.

2.3.1 Bipolar Piezo 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.

2.3.2 Unipolar Piezo Actuators

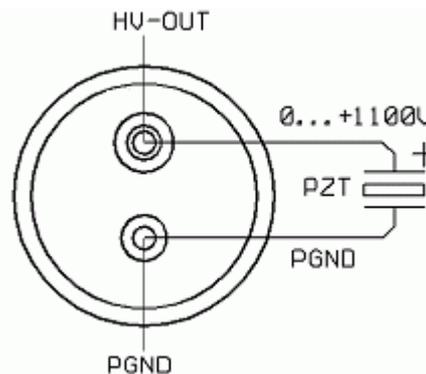
The notation of "positive" and "negative" polarity of piezo actuators does not refer to their direction of motion. Unipolar piezos of any polarity will elongate when a higher voltage is applied to their (+) than to their (-) terminal.

"Positive" and "negative" refers to the sign of the voltage on the core of the cable.

All standard PI piezo actuators with 3-conductor LEMO connectors have positive polarity.

2.3.3 Wiring Example

In the wiring example shown at right, a "positive" piezo is connected so as to have 0 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.



2.4 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 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 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.

NOTE

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.

2.5 First Operation

- 1 Connect the sensor cable to the corresponding socket
- 2 Turn the DC offset potentiometer full counterclockwise (CCW)
- 3 Make sure that voltage at "Control In" is set to 0 V
- 4 Connect the amplifier to line power. The connection is on the rear panel, see "Line Voltage Connection" section (see "Line Voltage Connection" p. 6)
- 5 Turn on the line power
- 6 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
- 7 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

NOTE

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

3 Maintenance

WARNING—LINE VOLTAGE

E-464s need to be installed in such a way that they can quickly and easily be separated from the line voltage. Before cleaning the E-464, changing the AC fuses and removing or installing modules, switch the device off and disconnect it from the line power.



3.1 AC Power and Line Power 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.

CAUTION

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



Figure 3: Position of the line fuses and fuse carrier, only one of two fuses visible



Figure 4: Fuse carrier

To access the line power fuses, proceed as follows:

- 1 Switch off the E-464 and remove the line 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 pry out the fuse carrier (see figures above)
- 4 Be sure to replace both fuses with fuses of the type appropriate for the new voltage:
220 VAC to 240 VAC IEC* 0,8 AT (slow blow)
100 VAC to 120 VAC IEC* 1,6 AT (slow blow)
- 5 Rotate the fuse carrier so that the valid voltage setting (115 V or 230 V) will show through the window when the door is closed
- 6 Reinstall the carrier and close the door

3.2 Cleaning

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

* IEC fuses are cited: other fuse standards may require higher nominal current rating

4 Troubleshooting

Positioner does not move.

Cables not connected properly:

- Check the connecting 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 (see "Analog Operation" p. 8)

4.1 Customer Service

Still having problems? Call your PI representative or write to info@pi.ws; please have the following information about your system ready:

- Product codes and serial numbers of all products in the system
- Current firmware version of the controller (if present)
- Software version of drivers and / or host software (if present)
- Operating system on host PC (if present)



5 Technical Data

5.1 Specifications

	E-464.00
Function	Power amplifier for PICA™ high-voltage PZTs
Amplifier	
Output voltage	0 to +1000 V (optionally: -250 to +750; -500 to +500; +250 to -750; 0 to -1000)
Amplifier channels	3
Average output power per channel	>3.5 W (up to 12 W if 1 channel is operated)
Peak output power per channel, < 5 ms	25 W
Average current per channel	>3.5 mA (up to 12 mA if 1 channel is operated)
Peak current per channel, < 5ms	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 _{P-P} (100 nF)
Current limitation	Short-circuit-proof
Voltage gain	+100 ±1
Control input voltage	0 to 10 V
Input impedance	100 kΩ
Interface and operation	
PZT voltage output socket	LEMO EGG.0B.701.CJL1173
Control input socket	3 x BNC
DC Offset	3 x 10-turn pot, adds 0 to +10 V to Control IN
Display	3 x 3½-digit LED display for output voltages
Miscellaneous	
Operating voltage	100 - 120 or 220 - 240 VAC, selectable (fuse change required)
Operating temperature range	+5°C to +50°C (over 40°C, max. av. power derated 10%)

Mass	4.3 kg
Dimensions	236 x 88 x 273 mm + handles

5.2 Frequency Response Diagram

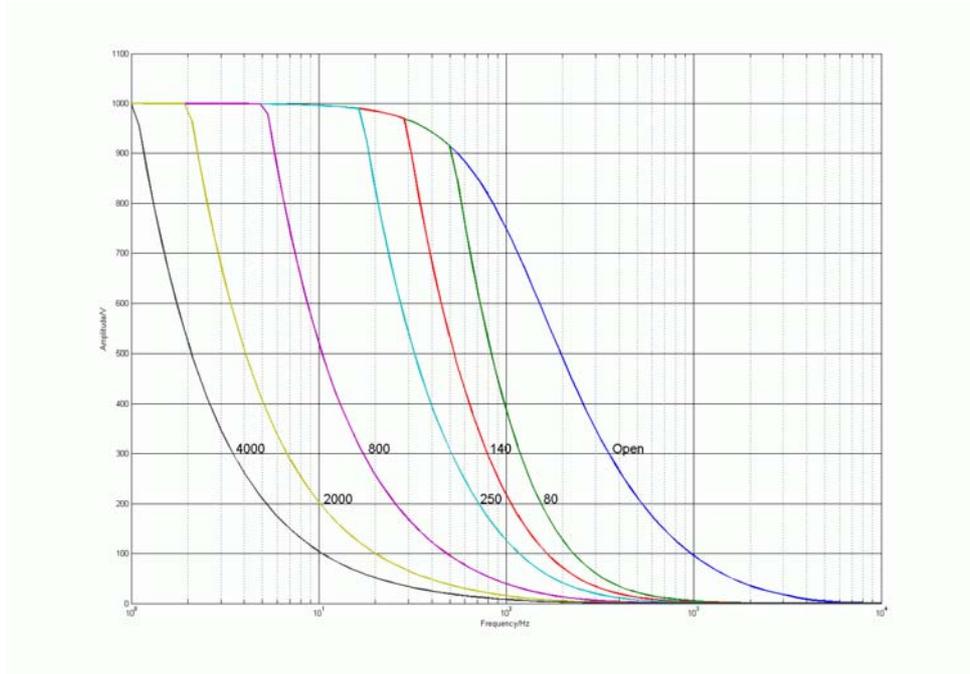


Figure 5: E-464, operating limits with various PZT loads. Values shown are capacitance in nF

5.3 Connectors

5.3.1 2-Pin High-Voltage Connector

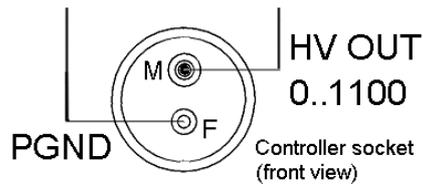


DANGER—IMPROPER WIRING CAN CAUSE DEATH, INJURY, DAMAGE AND VOID WARRANTY

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 respect.

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



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