

PZ210E User Manual
E-462 Piezo Amplifier
Release: 1.1.0 Date: 20 July 2011



This document describes the following products:

- E-462.00
HVPZT Piezo Amplifier, 10 to 1000 V, Bench Top
- E-462.OE1
HVPZT Piezo Amplifier Module, 10 to 1000 V,
OEM-Version



Physik Instrumente (PI) GmbH & Co. KG is the owner of the following company names and trademarks: PI®, PIC®, PICMA®, PLine®, PIFOC®, PiezoWalk®, NEXACT®, NEXLINE®, NanoCube®, NanoAutomation®

The following designations are protected company names or registered trademarks of third parties:
LabVIEW

The products described in this manual are in part protected by the following patents:
US-Patent No. 6,950,050

Copyright 1999–2011 by Physik Instrumente (PI) GmbH & Co. KG, Karlsruhe, Germany.
The text, photographs and drawings in this manual enjoy copyright protection. With regard thereto, Physik Instrumente (PI) GmbH & Co. KG reserves all rights. Use of said text, photographs and drawings is permitted only in part and only upon citation of the source.

Document Number PZ210E BSc, BRo, Release 1.1.0
E-462_User_PZ210E110.doc

Subject to change without notice. This manual is superseded by any new release. The newest release is available for download at www.pi.ws (<http://www.pi.ws>).

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: **Piezo Amplifier**

Model Numbers: **E-462**

Product Options: **all**

complies with the following European directives:

2006/95/EC, Low-voltage directive

2004/108/EC, EMC Directive

The applied standards certifying the conformity are listed below.

Electromagnetic Emission: EN 61000-6-3, EN 55011 (05/98)+
A1(08/99) class A,
EN 55022 (09/98)

Electromagnetic Immunity: EN 61000-6-1

Safety (Low Voltage Directive): EN 61010-1

April 4, 2008
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-462 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-462 Piezo Amplifier as well.

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.

Any optional elements which might be mentioned in this documentation are described in their own manuals. Current releases can be downloaded from the PI Website as PDF files (www.pi.ws (<http://www.pi.ws>)). Updated releases are available for download from www.pi.ws or by email: contact your Physik Instrumente Sales Engineer or write info@pi.ws.

Contents

1	Introduction	2
1.1	Overview.....	2
1.2	Prescribed Use.....	2
1.3	Safety Precautions.....	3
1.4	Unpacking.....	4
1.5	Computer Control.....	5
2	Start-Up	6
2.1	E-462.00.....	6
2.1.1	Front and Rear Panel Elements.....	7
2.1.2	Control Signal.....	8
2.1.3	Starting Operation.....	8
2.1.4	Power Supply for E-462.00.....	9
2.2	E-462.OE1.....	10
2.2.1	Connections.....	10
2.2.2	Dimensions.....	11
2.2.3	Control Signal.....	11
3	Customer Service	13
4	Disposal	14
5	Technical Data	15
5.1	Specifications.....	15
5.2	Connectors.....	16
5.2.1	High-Voltage Connector.....	16
5.2.2	Control Input.....	16
5.2.3	Supply Power Connector.....	16

1 Introduction

1.1 Overview



The E-462.00 piezo driver is a low-cost amplifier/driver for PICA high-voltage PZTs. It can output a peak current of 0.5 mA and is specially designed for static and quasi-static applications.

Analog Control

E-462 amplifiers are designed to provide precise control of open-loop piezo positioning systems. The amplifier output voltage is determined by an analog control signal.

PCB-Mount Version for OEMs

The E-462.OE1 version is fully enclosed in a metal case and designed for mounting on circuit boards. All input connections are via 6 header pins located on the bottom. The PZT (piezo) high voltage output is via a coaxial cable with LEMO connector.

If dynamic (>1 Hz) PZT operation is required, please consider instead the E-464 (3-channel bench-top amplifier), E-470 or E-508 amplifiers (modular systems with sensor/servo option).

1.2 Prescribed Use

Based on their design and realization, E-462 Piezo Amplifiers are intended to drive capacitive loads, in the present case, piezoceramic actuators.

E-462s 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-462 is a laboratory apparatus as defined by DIN EN 61010. It meets the following minimum specifications for safe operation (any more stringent specifications in the technical data table are, of course, also met):

- Indoor use only
- Altitude up to 2000 m
- Temperature range 5°C to 40°C
- Max. relative humidity 80% for temperatures up to 31°C, decreasing linearly to 50% relative humidity at 40°C
- Line voltage fluctuations not greater than $\pm 10\%$ of the line voltage
- Transient overvoltages as typical for public power supply
Note: The nominal level of the transient overvoltage is the standing surge voltage according to the overvoltage category II (IEC 60364-4-443).
- Degree of pollution: 2

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.



DANGER—IMPROPER WIRING

E-462 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 PZT HV output!

Make sure that your actuator (or actuator cable shield) is connected to a protective earth conductor.

DANGER—IMPROPER WIRING

Improper wiring of HIGH VOLTAGE connectors can cause death, injury or damage. 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.



CAUTION

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.



1.4 Unpacking

Unpack the E-462 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-462	Piezo amplifier as ordered
E-660.PS	Wall-plug power supply. With E-462.00 only.
PZ210	User manual for E-462
E500T0011	Technical Note for Analog 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.

1.5 Computer Control

Optionally, the control input voltage can be provided by a D/A converter. 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 on free CD on request or for download. See the included E500T0011 Technical Note for details.

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 LabVIEW 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.

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.

2 Start-Up

WARNING—INPUT POWER

E-462s need to be installed in such a way that they can quickly and easily be separated from their input power source.



NOTE

The E-462.00 and E-462.OE1 are not equipped with active discharge circuitry but have a 5-M-ohm, 3.9-nF RC network. Therefore, PZT charge and discharge times will differ.

Installation and startup procedure depends on whether the E-462.00 or the E-462.OE1 is concerned.

2.1 E-462.00

DANGER—HIGH VOLTAGE

E-462 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 PZT HV output!

Make sure that your actuator (or actuator cable shield) is connected to a protective earth conductor.



2.1.1 Front and Rear Panel Elements

The E-462.00 piezo amplifier offers 1 channel with the following operating elements on the front panel:

- | | |
|----------------------------|--|
| “DC-OFFSET” knob | 1-turn potentiometer for DC offset (see “Control Signal” p. 8) |
| “CONTROL INPUT” BNC socket | Connection of control signal (see “Control Signal” p. 8) |
| “PZT” LEMO socket | High-voltage output for PZT (see “Connectors” p. 16) |



Fig. 1: E-462 front and rear panels

The supply power connection is located on the rear panel.

- | | |
|-------------|--|
| 12 V SUPPLY | Mini phone jack (tip positive) for connection of included E-660.PS (see p. 9). |
|-------------|--|

2.1.2 Control Signal

Output voltage is controlled by an analog signal applied to the BNC input; it plus the DC offset make up the Amplifier IN signal which must be in the 0 to 10 V range.

Control In Signal

An external voltage in the range of 0 to 10 V can be applied to the “CONTROL INPUT” BNC socket.

DC Offset Potentiometer

Depending on the position of the “DC-OFFSET” knob, 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.

2.1.3 Starting Operation

Observe the safety precautions (p. 3) given in this User Manual!
Proceed as follows.

- 1 With the E-462 powered down, connect the piezo actuator to the HV output.
- 2 Turn the “DC-OFFSET” knob fully counterclockwise (CCW).
- 3 Make sure that voltage at “Control Input” is set to 0 V.
- 4 Connect the E-462 to supply power. The connection is on the rear panel.
- 5 Command the first motion of the piezo actuator by turning the “DC-OFFSET” knob fully clockwise (CW) to run the actuator over the nominal travel range, then turn the knob back fully CCW. Make sure that the full voltage swing is attained.
- 6 If an external analog signal is used, connect the signal source to the “CONTROL INPUT” BNC socket. If the input signal range is not 0 to +10 V, use the “DC-OFFSET” knob to bias it accordingly. The output signal will be 100 times the sum of the DC offset and the control input.

2.1.4 Power Supply for E-462.00

The E-462.00 bench top unit includes a wall-plug power supply (E-660.PS) with interchangeable prong sets. Slide the appropriate prong set into the body until it clicks in place. Note that to remove a prong set it is necessary to press the plastic tab marked “Push”.



Fig. 2: E-660.PS with Interchangeable prongs

2.2 E-462.OE1

DANGER—HIGH VOLTAGE

E-462 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!

Make sure that your actuator and pin 3 or 5 of the E-462.OE1 are connected to a protective earth conductor.



Figure 1: E-462.OE1 OEM module has HV cable on top and pins on the bottom (not shown) for PCB mounting

2.2.1 Connections

Observe the safety precautions (p. 3) when handling the E-462.OE1!

The piezo voltage output is on a short cable on the top side. The connector is the standard LEMO socket PI uses for high-voltage piezo actuators (see “Connectors” p. 16). With the unit powered down, connect the piezo actuator to the LEMO socket.

The E-462.OE1 module is designed for PCB mounting. All connections except for the piezo voltage output are made via the pins on the bottom side.

Connect pin 3 or 5 to a protective earth conductor.

Pin	Function
1	Supply Power (GND)
2	Supply Power 12 V DC $\pm 10\%$
3	GND
4	Output reference voltage +5 V
5	GND
6	Input control voltage, 0 to 5 V

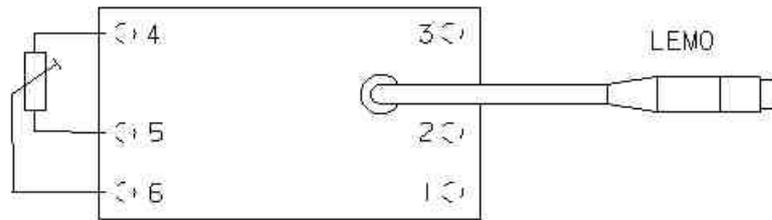


Figure 2: E-462.OE1, top view, shown wired for manual operation with an external potentiometer using the on-board 5 V DC reference voltage.

2.2.2 Dimensions

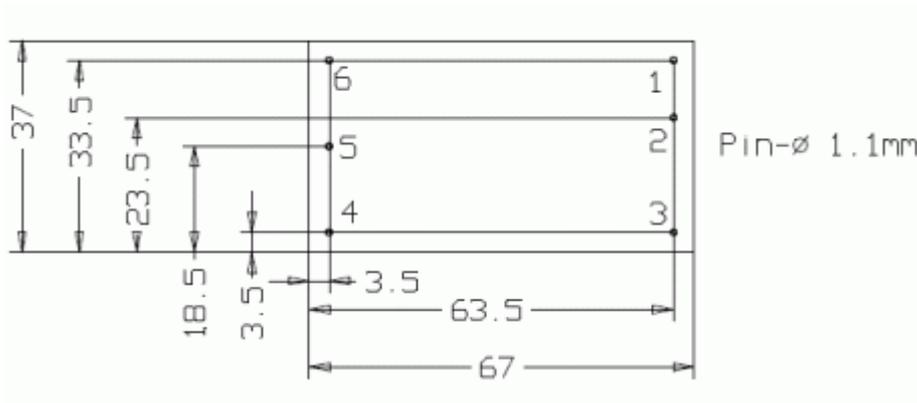


Figure 3: E-462.OE1, bottom view, dimensions in millimeters

2.2.3 Control Signal

Output voltage is controlled by an analog signal in the 0 to 5 V range. The signal can be generated with one of the following options:

- Connect an external signal source to pins 5 and 6.
- Interconnect pins 4, 5 and 6 via an external potentiometer as shown in Figure 2 above. This option uses the 5 V DC reference available on pin 4.

3 Customer Service

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)
- Version of drivers and / or host software (if present)
- Operating system on host PC (if present)

4 Disposal

In accordance with EU directive 2002 / 96 / EC (WEEE), as of 13 August 2005, electrical and electronic equipment may not be disposed of in the member states of the EU mixed with other wastes.

To meet the manufacturer's product responsibility with regard to this product, Physik Instrumente (PI) GmbH & Co. KG will ensure environmentally correct disposal of old PI equipment that was first put into circulation after 13 August 2005, free of charge.

If you have such old equipment from PI, you can send it to the following address postage-free:

Physik Instrumente (PI) GmbH & Co. KG
Auf der Römerstr. 1
76228 Karlsruhe, Germany



5 Technical Data

5.1 Specifications

	E-462.00	E-462.OE1	Units
Function	Power amplifier for PICA high-voltage PZTs	Power amplifier for PICA high-voltage PZTs	
Amplifier			
Channels	1	1	
Output voltage	10 to 1000	10 to 1000	V
Average output power	0.3	0.3	W
Peak output power < 5ms	0.5	0.5	W
Max. average output current	0.3	0.3	mA
Peak output current < 5 ms	0.5	0.5	mA
Current limitation	Short-circuit-proof	Short-circuit-proof	
Ripple, noise 0 to 100 kHz	50 50 (100 nF)	50 50 (100 nF)	mV _{RMS} mV _{P-P}
Voltage gain	100 ±1	200 ±1	
Control input voltage	0 to +10	0 to +5	V
Input impedance	10	10	kΩ
Frequency response	Static and quasi-static applications only	Static and quasi-static applications only	
Interface and operation			
PZT voltage output socket	LEMO EGG.0B.701.CJL1173	LEMO PHG.0B.701.CJL1173 D42	
Control input socket	BNC	Header pins	
DC-Offset	1-turn pot., adds 0 to +10 V to Control input	-	
Miscellaneous			
Dimensions	250 x 150 x 73	67 x 38 x 20	mm
Mass	0.5	0.25	kg
Operating voltage	12 ±10 %	12 ±10 %	VDC
Max. operating current	90	90	mA
Operating temperature range	+5°C to +50°C (over 40°C, max. av. power derated 10%)	+5°C to +50°C (over 40°C, max. av. power derated 10%)	°C
Power supply	Wall-plug unit	-	

5.2 Connectors

5.2.1 High-Voltage Connector

Type:

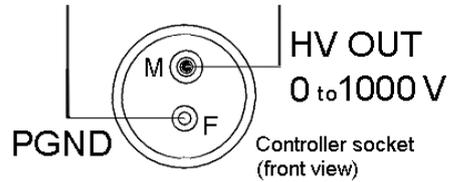
E-462.00: LEMO EGG.0B.701.CJL.1173

E-462.OE1: LEMO PHG.0B.701.CJL1173 D42

Pin Assignments:

HV OUT: HV output, up to 1000 V

PGND: Power ground



5.2.2 Control Input

E-462.00: BNC connector, center positive

E-462.OE1: header pins 5 and 6 (see p. 10)

5.2.3 Supply Power Connector

E-462.00: Industry standard 2-conductor mini phone jack, tip positive, 12 VDC

E-462.OE1: header pins 1 and 2 (see p. 10)

