

PZ 97E Operating Manual E-650 Piezo Amplifier for Multilayer Bending Actuators

Release: 1.1.0 Date: 2019-10-04



This document describes the following product(s):

- E-650.00
Piezo Amplifier, benchtop device
- E-650.OE
Piezo Amplifier, OEM module

For the E-650, an EU Declaration of Conformity has been issued in accordance with the following European directives:

EMC Directive
RoHS Directive

The applied standards certifying the conformity are listed below.

Safety (Low Voltage Directive): EN 61010-1
EMC: EN 61326-1
RoHS: EN 50581

If an electrical operating device is designed to be integrated in another electrical operating device: The operator is responsible for a standards compliant integration of the electrical device into the overall system.

©1999–2019 Physik Instrumente (PI) GmbH & Co. KG, Karlsruhe, Germany. The text, photographs, and drawings in this manual are protected by copyright. With regard thereto, Physik Instrumente (PI) GmbH & Co. KG retains all the rights. The use of any text, images and drawings is permitted only in part and only when indicating the source.

First printing 2019-10-04
Document Number PZ 97E, Release 1.1.0
E-650_User_PZ97E110.doc

Subject to change without notice. This manual is superseded by any new release. The latest respective release is available for download on our website (www.pi.ws).

Contents

1	Safety	2
1.1	Intended Use	2
1.2	General Safety Instructions	2
1.3	Organizational Measures	3
1.4	Personnel Qualification	4
2	Introduction	5
2.1	Model Overview	6
2.2	Scope of Delivery	6
3	E-650.00 Benchtop Device	7
3.1	Front Panel Elements.....	7
3.2	Rear Panel Elements	7
3.3	Operation	7
3.4	Block Diagram.....	8
3.5	Pin Assignment.....	8
3.6	C-501.15050H Power Supply.....	9
3.7	Specifications.....	9
4	E-650.OE OEM Module	10
4.1	Operation	10
4.2	Block Diagram.....	11
4.3	Specifications.....	11
4.4	Pin Assignment.....	12
5	Maximum Ratings	13
6	Ambient Conditions and Classifications	14
7	Cleaning	15
8	Customer Service	16
9	Old Equipment Disposal	17

1 Safety

1.1 Intended Use

The E-650 is a laboratory device according to 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.

The E-650 is designed and intended for driving capacitive loads (e. g. piezo ceramic actuators).

The E-650 must not be used for purposes other than those named in this user manual. In particular, the E-650 must not be used to drive ohmic or inductive loads.

The E-650 can be used for static as well as dynamic applications.

1.2 General Safety Instructions

The E-650 is built according to state-of-the-art technology and recognized safety standards. Improper use can result in personal injury and/or damage to the E-650.

- Only use the E-650 for its intended purpose, and only use it if it is in a good working order.
- Read the user documentation (user manuals, Technical Notes).
- Immediately eliminate any faults and malfunctions that are likely to affect safety.

The operator is responsible for the correct installation and operation of the E-650.

- Install the E-650 near the power source so that the power plug can be quickly and easily disconnected from the mains.
- Use the supplied components to connect the E-650 to the power source.
- If one of the supplied components for connecting to the power source has to be replaced, use a sufficiently dimensioned component.
- Only use cables and connections that meet local safety regulations.



If an E-650 OEM module is operated without a housing, live parts will be accessible. Touching the live parts can result in minor injury. Electrical, magnetic and electromagnetic fields emitted by live parts can disturb the E-650 OEM module and/or the environment.

- Only operate the E-650 OEM module when it is installed in a shielded housing that securely encloses all live parts and fulfills the requirements of electromagnetic compatibility.
- Since parts of the circuit will store charge, precautions must also be taken when the E-650 OEM module is not powered. After switching off the E-650 OEM module, wait a minute before you touch parts of the E-650 OEM module to be sure that any residual voltage has dissipated.

The E-650 contains electrostatic-sensitive devices (ESD) that can be damaged if handled improperly.

- Avoid touching assemblies, pins and PCB traces.
- Before you touch the E-650, discharge yourself of any electric charges, e.g., by wearing an antistatic wrist strap.
- Only handle and store the E-650 in environments that dissipate existing static charges to earth in a controlled way and prevent electrostatic charges (ESD protected workstation or electrostatically protected area, in short EPA).
- Before cleaning, disconnect the E-650 from the power source by removing the mains plug.

1.3 Organizational Measures

User documentation (user manual, Technical Notes):

- Always keep this user documentation available by the E-650.
- The latest versions of the user documentation are available from PI.
- Add all information given by the manufacturer to the user documentation, for example supplements or Technical Notes.
- If you pass the E-650 on to other users, also turn over the user documentation as well as other relevant information provided by the manufacturer.

- Only use the device on the basis of the complete user documentation. Missing information due to an incomplete user documentation can result in minor injury as well as property damage.
- Only install and operate the E-650 after having read and understood this user manual.

1.4 Personnel Qualification

The E-650 may only be installed, started up, operated, and cleaned by authorized and qualified staff.

2 Introduction

E-650.00 is a benchtop amplifier especially designed for PICMA[®] multilayer bender actuators from PI such as the PL-112 to PL-140. It contains one amplifier that can output and sink a peak current of 300 mA.

An OEM version is also available (E-650.OE, see p. 10).

Features:

- Specially Designed to Drive Multilayer "Bimorph" Actuators
- Benchtop device only: LCD Voltage Display
- Output Voltage Range 0 to 60 V
- One Fixed Voltage for Full Differential-Voltage Control

The PICMA[®] actuators require full differential-voltage control with constant voltages of 0 V and +60 V and a variable voltage from 0 V to +60 V (see Fig. 1). Note that a control input voltage of 5 V corresponds to a PZT variable output of about +30 V, which puts the actuator in the middle position (i.e. deflection $\approx 0 \mu\text{m}$).

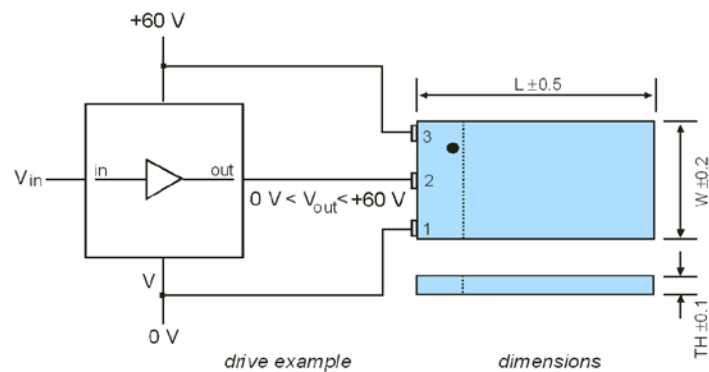


Fig. 1. PICMA[®] multilayer bender actuator with full differential-voltage control,

Pin assignment:

1	0 V [or GND]
2	0 V to +60 V
3	+60 V

2.1 Model Overview

E-650.00	Piezo amplifier for multilayer bender actuators, benchtop device
E-650.OE	Piezo OEM amplifier for multilayer bender actuators, OEM module

2.2 Scope of Delivery

PZ97E	User manual for E-650, this document
-------	--------------------------------------

E-650.00 benchtop device only:

C-501.15050H	Wide-range, 15 V power supply, 50 W, with power cord (#3763)
E-650.90	OEM cable for PZT connection, D-sub 9 (m) to open end, 1.5 m

3 E-650.00 Benchtop Device

3.1 Front Panel Elements

A 3 1/2 digit LCD display reads the output voltage.

Marking	Element
"DC-Offset"	10-turn potentiometer for DC bias 0 to +60 Volts
"PZT Monitor"	Piezo voltage monitor, 0 ...+10 V, BNC connector
"PZT Output"	Piezo voltage, D-sub 9 (f) socket, see p. 8 for ,pinout
"Control Input"	Analog control voltage input, BNC connector
"Power"	Power on/off toggle switch LED (green) for power-on indication

3.2 Rear Panel Elements

Power connector for +15 VDC input

3.3 Operation

External operation:

Output voltage is controlled by an analog signal applied to the BNC input, ranging from 0 to 10 V. Multiplying by the gain factor of 6, an output voltage range of 0 to 60 V results. The DC offset potentiometer can be used to bias the control input voltage. The control voltage is applied to the input socket (BNC connector) "Control Input", Input range: 0 ...+10 V.

Manual Operation:

Output voltage can be set by a 10-turn, DC offset potentiometer in the range of 0 to 60 V.

3.4 Block Diagram

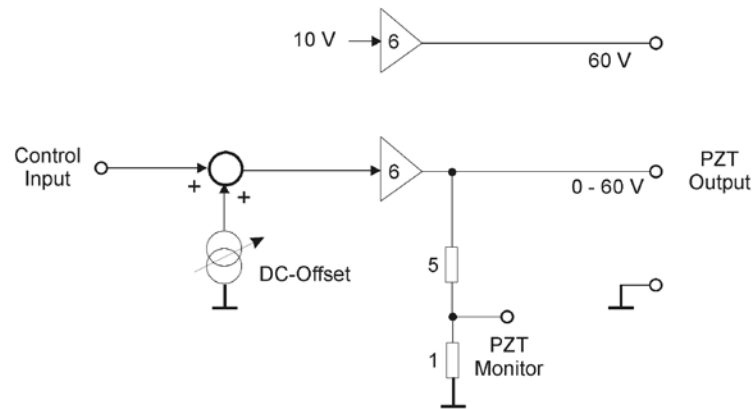


Fig. 2: Block Diagram

3.5 Pin Assignment

"PZT Output" connector

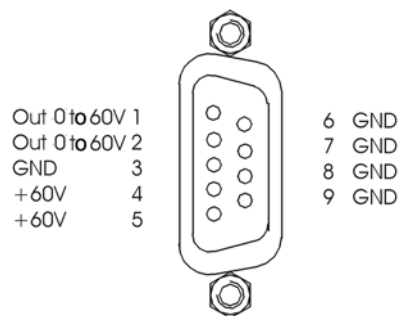


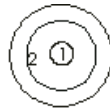
Fig. 3: Pin Assignment

Pin 1 is internally connected to pin 2 and pin 4 is internally connected to pin 5, so that the appropriate output voltages are present on both pins of such a "pair" in parallel. It is also possible to connect two bender actuators (sharing the same connector), but they cannot be commanded separately.

3.6 C-501.15050H Power Supply

3.34A @+15VDC output,
100-240 VAC input

- 1: Center pin, +15VDC, 2.1 mm diameter
2: GND



3.7 Specifications

TECHNICAL DATA: E-650.00	
Function	Power amplifier
Channels	1
Maximum output power	18 W
Average output power	6 W
Peak output current < 5 ms	300 mA
Average output current > 5 ms	100 mA per channel
Current limitation	Short-circuit proof
Control input voltage	0 to +10 V
Output voltage	0 to 60 V; one additional fixed voltage of 60 V
Polarity	positive
DC offset setting	0 to 60 V w / 10-turn pot
Voltage gain	6 ±0.1
Input impedance	100 kΩ
Frequency response	600 Hz @ 1000 nF load 6 kHz @ no load
Display	3 1/2 digit, LCD
Control input socket	BNC
PZT voltage output socket	9 pin D-sub (f)
Dimensions	160 x 125 x 50 mm
Weight	0.7 kg (w/o P/S)
Operating voltage	15 V DC (external power supply in the scope of delivery)

4 E-650.OE OEM Module



Fig. 4: E-650.OE OEM Amplifier for Piezo Bender Actuators

4.1 Operation

Output voltage is controlled by an analog signal ranging from 0 to 10 V. Multiplying by the gain factor of 6, an output voltage range of 0 to 60 V results. A fixed voltage of 60 V is also available for biasing the bender actuator.

4.2 Block Diagram

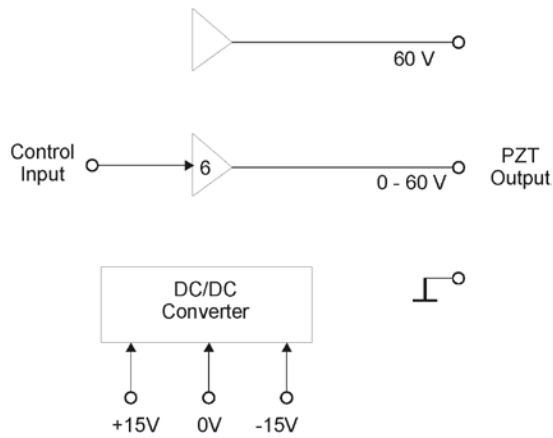


Fig. 5: E-650.OE Block diagram

4.3 Specifications

TECHNICAL DATA: E-650.OE	
Function	Power amplifier
Channels	1
Maximum output power	8 W
Average output power	4 W
Peak output current < 5 ms	140 mA
Average output current > 5 ms	60 mA per channel
Current limitation	Short-circuit proof
Control input voltage	0 to +10 V
Output voltage	0 to 60 V; one additional fixed voltage of 60 V
Polarity	positive
Voltage gain	6 ±0.1
Input impedance	100 kΩ
Frequency response	200 Hz @ 1000 nF load 3 kHz @ no load
Input/Output	Via 8 soldering pins on bottom
Dimensions	70 x 42 x 30 mm
Weight	0.15 kg
Operating voltage	±15 V, 315 mA max.

4.4 Pin Assignment

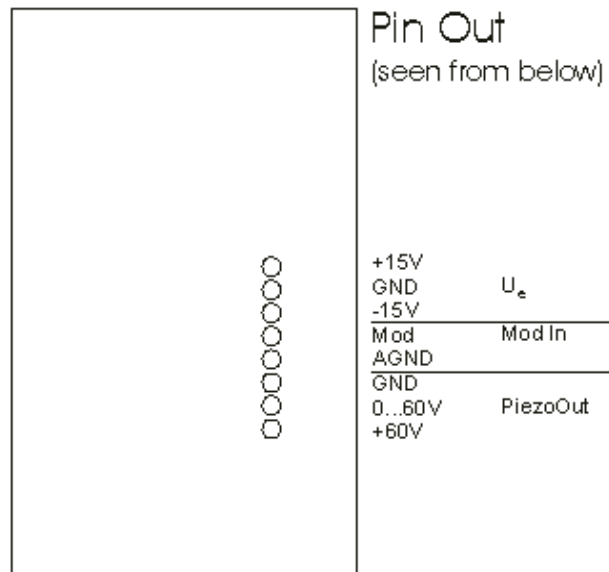






Fig. 6: E-650.OE Pin Assignment

5 Maximum Ratings

The E-650 is designed for the following operating data:

Maximum Operating Voltage 	Operating Frequency 	Maximum Power Consumption 
15 V		E-650.00: 24 W E-650.OE: 4.5 W

6 Ambient Conditions and Classifications

The following ambient conditions and classifications must be observed for the E-650:

Area of application	For indoor use only
Maximum altitude	2000 m
Relative humidity	Highest relative humidity 80% for temperatures up to 31°C Decreasing linearly to 50% relative humidity at 40°C
Operating temperature	5 to 50 °C
Storage temperature	0°C to 70°C
Transport temperature	-25°C to +85°C
Overvoltage category	II
Protection class	I
Degree of pollution	2
Degree of protection according to IEC 60529	IP20

7 Cleaning

E-650.00 bench-top units only:

- 1 Disconnect the E-650.00 from the power source.
- 2 Wait a minute to be sure that any residual voltage has dissipated.
- 3 Clean the housing surfaces of the E-650.00 using mild detergents or disinfectant solutions. Prevent cleaning fluid from penetrating the housing.

8 Customer Service

For inquiries and orders, contact your PI sales engineer or send us an email (<mailto: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.

Only PI service personnel must repair the E-650.

The latest versions of the user manuals are available for download on our website.

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) 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

