

PZ296E E-413 Piezo Amplifier User Manual

1.2.0

08.05.2019



This document describes the following piezo amplifiers:

- E-413.30
3 channels for segmented tubes, -250 to 250 V, D-sub 15
- E-413.61
6 channels for PICA Shear actuators, -250 to 250 V, D-sub 15
- E-413.20
2 channels for segmented tubes, -250 to 250 V, D-sub 15
- E-413.41
4 channels for PICA Shear actuators, -250 to 250 V, D-sub 15



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The patents held by PI are found in our patent list: <http://www.physikinstrumente.com/en/about-pi/patents>

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Subject to change. This manual is superseded by any new release. The latest respective release is available for download (p. 3) on our website.

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1 About this Document

In this Chapter

Objective and Target Audience of this User Manual	1
Symbols and Typographic Conventions	1
Other Applicable Documents	2
Downloading Manuals	3

1.1 Objective and Target Audience of this User Manual

This user manual contains the information needed for the intended use of the E-413. Basic knowledge of motion control concepts and applicable safety measures is assumed. The latest versions of the user manuals are available for download (p. 3) on our website.

1.2 Symbols and Typographic Conventions

The following symbols and typographic conventions are used in this user manual:

DANGER



Immediate threat of danger

Failure to comply could lead to death or serious injury.

- Precautionary measures for avoiding.

CAUTION



Dangerous situation

Failure to comply could lead to minor injuries or cause damage to equipment.

- Precautionary measures for avoiding.

NOTICE




Dangerous situation

Failure to comply could cause damage to equipment.

- Precautionary measures for avoiding.

INFORMATION

Information for easier handling, tricks, tips, etc.

Symbol/ Label	Meaning
1. 2.	Action consisting of several steps with strict sequential order
➤	Action consisting of one or more steps without relevant sequential order.
▪	Bullet
p. 5	Cross-reference to page 5
RS-232	Labeling of an operating element on the product (example: RS-232 interface socket)
	Warning signs attached to the product that refer to detailed information in this manual.

1.3 Other Applicable Documents

The devices and software tools from PI mentioned in this documentation are described in their own manuals.

The latest versions of the user manuals are available on our website for download (p. 3).

Component	Document
Analog Controller Driver Library for use with NI LabVIEW software	PZ181E Software Manual

1.4 Downloading Manuals

INFORMATION

If a manual is missing or problems occur with downloading:

- Contact our customer service department (p. 31).

INFORMATION

For products that are supplied with software (CD in the scope of delivery), access to the manuals is protected by a password. Protected content is only displayed on the website after entering the access data.

You need the product CD to get the access data.

For products with CD: Get access data

1. Insert the product CD into the PC drive.
2. Switch to the Manuals directory on the CD.
3. In the Manuals directory, open the Release News (file including *releasenews* in the file name).
4. Get the access data for downloading protected content in the "User login for software download" section of the Release News. Possible methods for getting the access data:
 - Link to a page for registering and requesting the access data
 - User name and password is specified
5. If the access data needs to be requested via a registration page:
 - a) Follow the link in the Release News.
 - b) Enter the required information in the browser window.
 - c) Click **Show login data** in the browser window.
 - d) Note the user name and password shown in the browser window.

Downloading manuals

If you have requested access data for protected contents via a registration page (see above):

- Click the links in the browser window to change to the content for your product and log in using the access data that you received.

General procedure:

1. Open the website **www.pi.ws**.
2. If access to the manuals is protected by a password:

- a) Click **Login**.
- b) Log in with the user name and password.
3. Click **Search**.
4. Enter the product number up to the period (e.g., P-882) or the product family (e.g., PICMA® Bender) into the search field.
5. Click **Start search** or press the **Enter** key.
6. Open the corresponding product detail page in the list of search results:
 - a) If necessary: Scroll down the list.
 - b) If necessary: Click **Load more results** at the bottom of the list.
 - c) Click the corresponding product in the list.
7. Click the **Downloads** tab.

The manuals are shown under **Documentation**.
8. Click the desired manual and save it to the hard disk of your PC or to a data storage medium.

2 Safety

In this Chapter

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2.1 Intended Use

The E-413 is a laboratory device as defined by DIN EN 61010-1. It is intended for indoor use and use in an environment that is free of dirt, oil, and lubricants.

In accordance with its design, the E-413 is intended for driving capacitive loads (piezoceramic actuators) designed for a bipolar operating voltage ranging from -250 to 250 V:

- E-413.30, .20 models: For operating piezo tubes with segmented electrodes for lateral tube displacement (scanner tubes)
- E-413.61, .41 models: For operating piezo actuators such as PICA Shear or Picoactuator®

The E-413 may not be used for purposes other than those stated in this user manual. In particular, the E-413 may not be used to drive ohmic or inductive loads.

The E-413 can be used both for static and dynamic applications.

2.2 General Safety Instructions

The E-413 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-413.

- Use the E-413 for its intended purpose only, and only when it is in perfect technical condition.
- Read the user manual.
- Eliminate any malfunctions that may affect safety immediately.

The operator is responsible for the correct installation and operation of the E-413.

- Install the E-413 near the power supply so that the power plug can be quickly and easily disconnected from the mains.
- Use the components supplied (power supply and power cord) to connect the E-413 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.

If a protective earth conductor is not or not properly connected, dangerous touch voltages can occur on the E-413 in the case of malfunction or failure of the system. If there are touch voltages, touching the E-413 can result in serious injury or death from electric shock.

- Connect the E-413 to a protective earth conductor (p. 16) before startup.
- Do **not** remove the protective earth conductor during operation.
- If the protective earth conductor has to be removed temporarily (e.g., in the case of modifications), reconnect the E-413 to the protective earth conductor before restarting.

2.3 Organizational Measures

User manual

- Keep this user manual with the E-413 always.
The latest versions of the user manuals are available for download (p. 3) on our website.
- Add all information from the manufacturer to the user manual, for example supplements or technical notes.
- If you give the E-413 to other users, include this manual as well as all other relevant information provided by the manufacturer.
- Always work according to the complete user manual. If your user manual is incomplete and is therefore missing important information, serious or fatal injury as well as damage to the equipment can result.
- Install and operate the E-413 only after you have read and understood this user manual.

Personnel qualification

The E-413 may only be installed, started up, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

3 Product Description

In this Chapter

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Channel Configuration	10

3.1 Model Overview

The following E-413 piezo amplifier versions are available:

Model	Designation
E-413.30	Piezo amplifier for segmented tubes, 3 channels, -250 to 250 V, D-sub 15 socket
E-413.61	Piezo amplifier for PICA Shear actuators, 6 channels, -250 to 250 V, D-sub 15 socket
E-413.20	Piezo amplifier for segmented tubes, 2 channels, -250 to 250 V, D-sub 15 socket
E-413.41	Piezo amplifier for PICA Shear actuators, 4 channels, -250 to 250 V, D-sub 15 socket

3.2 Product View

3.2.1 Front Panel



Figure 1: E-413 piezo amplifier, front view

Labeling	Type	Function
PWR	LED green/off	Displays the ready state: <ul style="list-style-type: none"> Green: The E-413 is ready for operation Off: The E-413 is not ready for operation
24 V DC / 4 A	M8 panel plug, 4-pin (m) (p. 39)	Connector for the supply voltage
	Threaded bolt with mounting hardware for protective earth conductor	Protective earth connector (p. 16) The threaded bolt must be connected to a protective earth conductor because the E-413 is not grounded via the power adapter connector.
Ch 1 to 6 -250 V to +250 V	D-sub 15 (f) (p. 38)	Actuator connector Piezo voltage output -250 to 250 V; see "Channel Configuration" (p. 10) for details
Available per channel (Ch 1 to Ch 6):		
 -250 V to +250 V	Dummy plugs	Without function
Input	SMB panel plug	Control signal input -10 to 10 V See "Channel Configuration" (p. 10) for the assignment of the input channels to the output channels.
Monitor	SMB panel plug	Piezo voltage monitor output Piezo voltage/100, i.e., -2.5 to 2.5 V

3.2.2 Type Plate

Labeling	Function
	Data matrix code (example; contains the serial number)
E-413.30	Product name
PI	Manufacturer's logo
116056789	Serial number (example), individual for each E-413 Meaning of each position (from the left): 1 = internal information, 2 and 3 = year of manufacture, 4 to 9 = consecutive number

Labeling	Function
Country of origin: Germany	Country of origin
	Warning sign "Pay attention to the manual!"
	Old equipment disposal (p. 41)
	CE conformity mark
WWW.PI.WS	Manufacturer's address (website)

3.3 Scope of Delivery

Item number	Components
E-413	Piezo amplifier
C-501.24120M8	Separate 24 V wide input range power supply for use with line voltages of 100 to 240 V AC and voltage frequencies of 50 or 60 Hz, with M8 4-pin connector (f)
3763	Power cord
PZ296E	User manual for the E-413 (this document)
E500T0011	Technical note for PI analog driver for use with NI LabVIEW software

3.4 Accessories

Cable for connecting the actuators to the E-413

Order number	Description
E-815.AK014	Adapter cable D-sub 15 (m) / open end, 2 m (p. 39)

Cable for the control signal input and piezo voltage monitor output

Order number	Description
E-692.SMB	Adapter cable SMB/BNC, 1.5 m

- To order, contact our customer service department (p. 31).

3.5 Channel Configuration

Depending on the model, the E-413's channels are configured as follows:

- E-413.30, .20: There are two outputs for each channel. The second output always outputs the voltage of the first output with reversed sign ("inverted"). Intended for operating piezo tubes with segmented electrodes for lateral tube displacement (scanner tubes).
- E-413.61, .41: Individual channels for operating piezo actuators such as the PICA Shear or Picoactuator®

E-413.30, .20

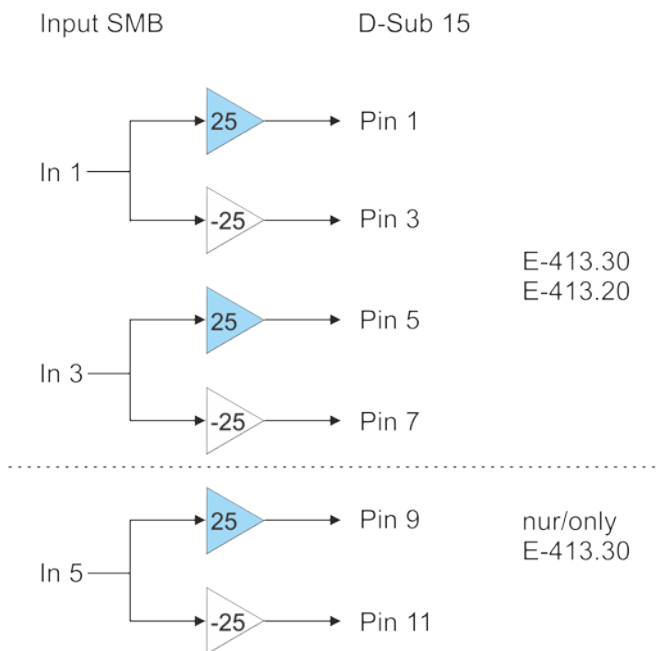


Figure 2: E-413.30, E-413.20: Two outputs with different signs for each channel

E-413.61, .41

Input SMB

D-Sub 15

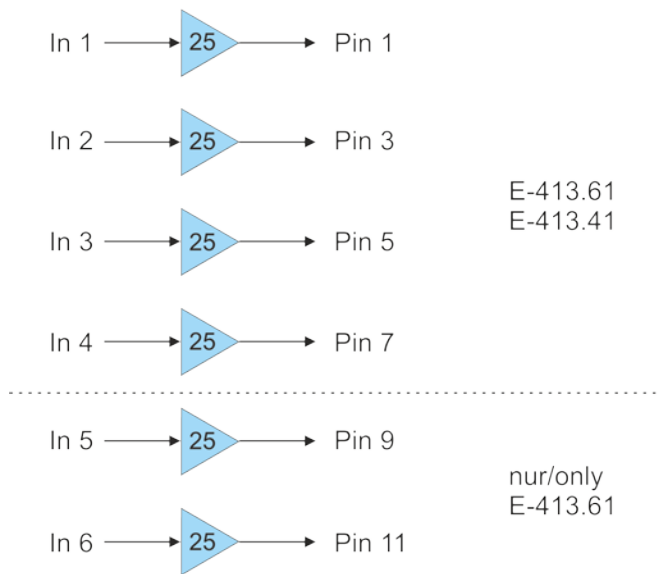


Figure 3: E-413.61, .41: Independent channels

4 Unpacking

1. Unpack the E-413 with care.
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 any parts are damaged or missing, contact our customer service department (p. 31) immediately.
4. Keep all packaging materials in case the product needs to be returned.

5 Installation

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Connecting the Control Input Voltage	21
Connecting the Power Supply to the E-413	21

5.1 General Notes on Installation

- Install the E-413 near the power source so that the power plug can be quickly and easily disconnected from the mains.
- Only use cables and connectors that meet local safety regulations.

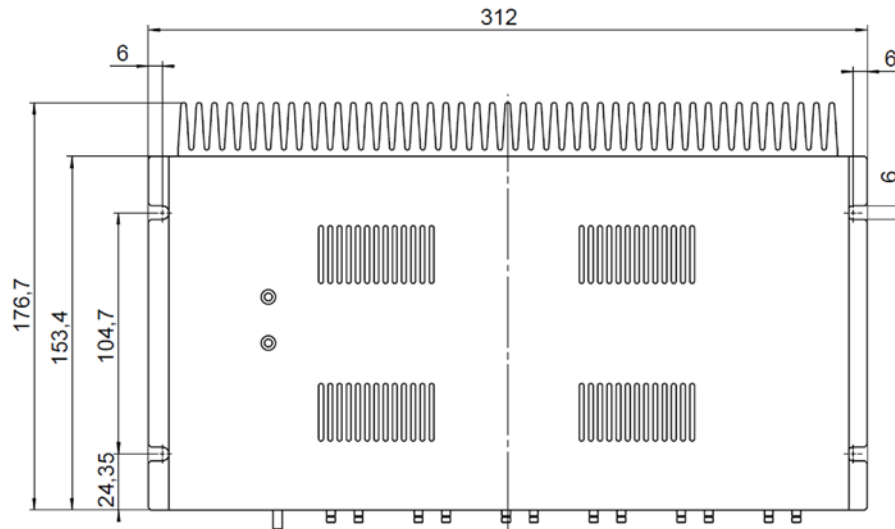
5.2 Ensuring Ventilation

High temperatures can overheat the E-413.

- Make sure that all ventilation holes in the E-413's housing are not obstructed.
- Set up the E-413 with a distance of at least 10 cm to the top and rear panels and at least 5 cm to the sides. If this is not possible, make sure that the surroundings are cooled sufficiently.
- Ensure sufficient ventilation at the place of installation.
- Keep the ambient temperature at a noncritical level (between 5 °C and 40 °C).

5.3 Mounting the E-413

The E-413 can be used as benchtop device or mounted in any orientation on an underlying surface.



Tools and accessories

- Suitable screws
- Suitable screwdriver

Mounting the E-413

1. Bore the required holes into the surface.

The arrangement of the recesses in the mounting rails of the E-413 can be found in the figure.

2. Use two screws on each side to fix the E-413 to the recesses in the mounting rails.

5.4 Connecting the E-413 to the Protective Earth Conductor

The E-413 must be connected to a protective earth conductor because it is not grounded via the power adapter connection.

INFORMATION

- Pay attention to the applicable standards for connecting the protective earth conductor.


Requirements

- ✓ You have read and understood the general notes on installation (p. 15).
- ✓ The E-413 is not connected to the power supply.

Tools and accessories

- Suitable protective earth conductor:
 - Cable cross section $\geq 0.75 \text{ mm}^2$
 - Contact resistance $< 0.1 \text{ ohm}$ at 25 A at all connection points relevant for attaching the protective earth conductor
- Mounting hardware for the protective earth conductor, sits on the protective earth connector (threaded bolt) in the following order on delivery of the E-413, starting from the housing:
 - Safety washer
 - Nut
 - Flat washer
 - Toothed washer
 - Nut
- Suitable wrench

Connecting the E-413 to the protective earth conductor

1. If necessary, attach a suitable cable lug to the protective earth conductor.
2. Remove the outer nut from the protective earth connector on the front panel of the E-413 (threaded bolt (p. 7) marked with )
3. Connect the protective earth conductor:
 - a) Push the cable lug of the protective earth conductor onto the threaded bolt.
 - b) Screw the nut onto the threaded bolt. In this way, the cable lug attached to the protective earth conductor is wedged between the toothed washer and the nut.
 - c) Tighten the nut with at least three turns and a torque of 1.2 Nm to 1.5 Nm.

5.5 Connecting the Actuators

DANGER



Risk of electric shock!

If cables are not properly connected to piezo actuators, dangerous touch voltages are possible and could lead to serious injury or death by electric shock.

- Cables may only be connected to piezo actuators by qualified electricians.
- Pay attention to the safety information and instructions in the manual for the piezo actuator.
- Connecting cables with open end: Connect the cable to the E-413 only when the open cable end has been properly connected to a piezo actuator.

Requirement

- ✓ If signal sources are connected to the **Input** sockets: The signal sources are switched off or their output is 0 V.
- ✓ You have read and understood the documentation for the piezo actuators.

Tools and accessories

- Piezo actuators designed for a bipolar operating voltage ranging from -250 to 250 V and equipped with a suitable connecting cable. A connecting cable with open end is available as an optional accessory (p. 9).
- If necessary: Suitable extension cable
- Optional: Suitable measuring device for the piezo voltage monitor outputs. An SMB/BNC adapter cable is available as an optional accessory.

Connecting the actuators

- Connect the actuators to the E-413's D-sub 15 socket. See connection diagrams in the figures below for some selected configurations.
- Secure the connectors against unintentional removal.
- If you want to monitor the piezo voltages: Connect a suitable measuring device to the **Monitor** connectors.

The following connection diagrams show the front of each socket on the E-413.

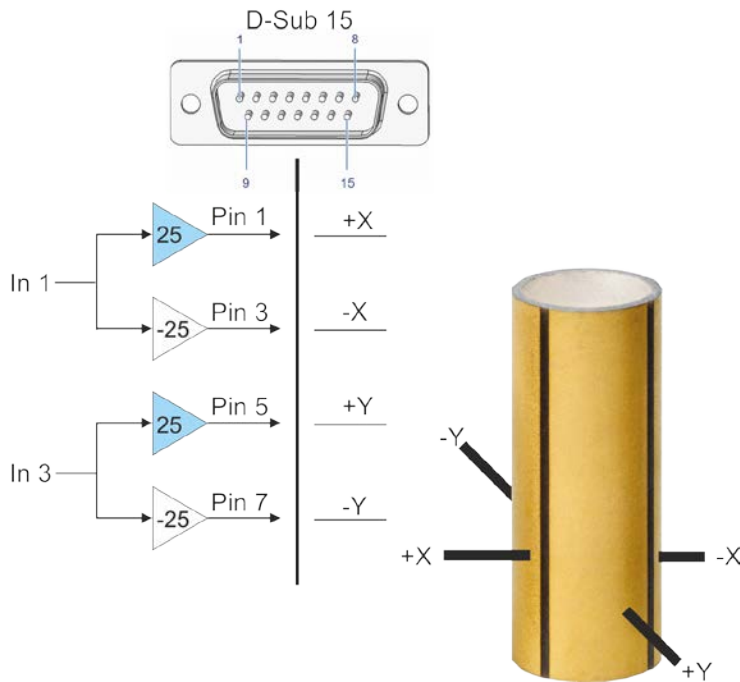


Figure 4: E-413.30 and .20: Connection diagram for a piezo tube with segmented outer electrodes and unsegmented inner electrode, displacement in the X and Y direction

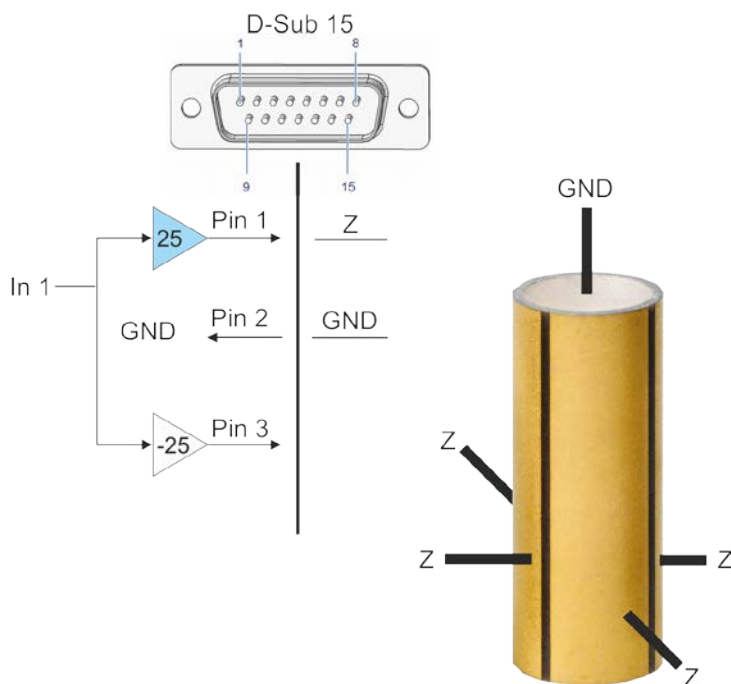


Figure 5: E-413.30 and .20: Connection diagram for a piezo tube with segmented outer electrodes and unsegmented inner electrode, displacement in the Z direction

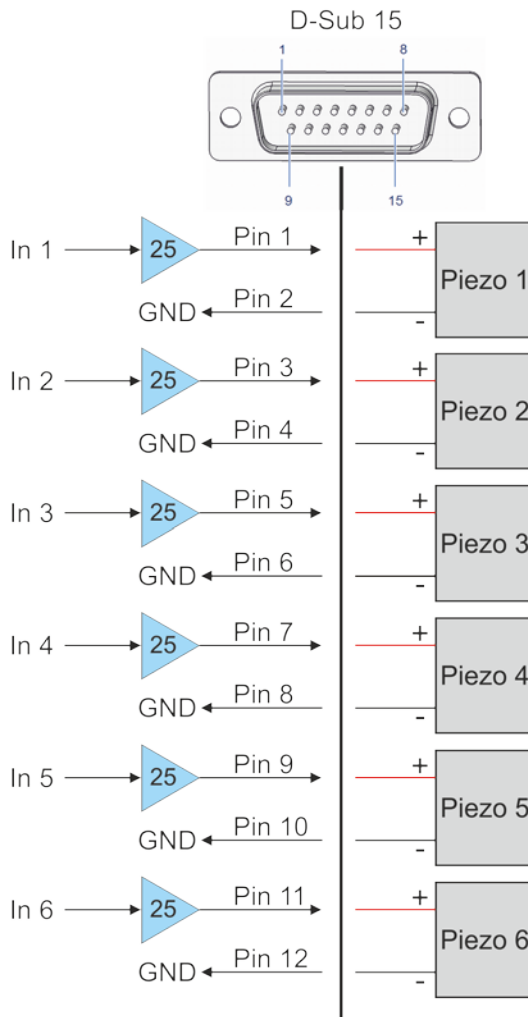


Figure 6: E-413.61: Connection diagram for piezo actuators. For the E-413.41 model, no connections are made to pins 9 to 12.

5.6 Connecting the Control Input Voltage

Requirement

- ✓ The signal sources for the control voltages are switched off or their output is 0 V.

Tools and accessories

- Signal sources for control voltages ranging from -10 to 10 V. The control voltages can also be computer-generated analog signals (e.g., from a DAQ board). You can use the PI analog drivers for NI LabVIEW to generate the analog signals (see E500T0011 technical note and PZ181E manual).

An SMB/BNC adapter cable is available as an optional accessory (p. 9).

Connecting the control input voltage

- Connect the signal sources to the **Input** connectors. See "Connecting Actuators" (p. 18) for connection diagrams with possible configurations.

5.7 Connecting the Power Supply to the E-413

Requirements

- ✓ The power cord is **not** connected to the power socket.

Tools and accessories

- 24 V wide input range power supply included (for line voltages between 100 and 240 V AC at 50 or 60 Hz)
- Power cord supplied
- Alternative: Sufficiently sized power cord

Connecting the E-413 to the power supply

1. Connect the power adapter's M8 connector (f) to the E-413's 24 V connector.
2. Secure the connectors against unintentional removal.
3. Connect the power cord to the power adapter.

6 Startup

In this Chapter

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6.1 General Notes on Startup

DANGER



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 on the E-413 in the case of malfunction or failure of the system. If there are touch voltages, touching the E-413 can result in serious injury or death from electric shock.

- Connect the E-413 to a protective earth conductor (p. 16) before startup.
- Do **not** remove the protective earth conductor during operation.
- If the protective earth conductor has to be removed temporarily (e.g., in the case of modifications), reconnect the E-413 to the protective earth conductor before restarting.

CAUTION



Burning from hot surface!

The surface of the E-413 and its vicinity can heat up during operation. Touching the E-413 and surrounding parts can result in minor injuries from burning.

- Cool the E-413 so that the temperature of its surface and surrounding parts does **not** exceed 65 °C.
- If sufficient cooling is not possible: Make sure that the hot E-413 and its surrounding parts **cannot** be touched.
- If sufficient cooling and protection against contact are not possible: Mark the danger zone in accordance with the legal regulations.

NOTICE**Reduced lifetime of the piezo ceramic due to continuous high voltage!**

Applying a high static voltage to piezo actuators continuously reduces the lifetime of the piezo ceramic.

If the E-413 is not being used but should remain switched on:

- Set the control signal (Input sockets) to 0 V.

INFORMATION

The E-413 generates a voltage spike at the piezo voltage output when it is switched on and switched off. A connected piezo actuator starts a corresponding motion that is perceived by a clicking noise. This behavior is not a problem and does **not** affect the piezo actuator.

6.2 Switching on the E-413

Requirement

- ✓ You have read and understood the general notes on startup (p. 23).
- ✓ You have connected the E-413 to the power adapter (p. 21).
- ✓ If signal sources are connected to the **Input** sockets: The signal sources are switched off or their output is 0 V.

Switching the E-413 on

- Connect the power cord of the power adapter to the power socket.

The **PWR** LED on the front panel indicates the E-413's ready state:

- Green: The E-413 is ready for operation
- Off: The E-413 is not ready for operation

6.3 Starting Motion

Requirement

- ✓ You have read and understood the documentation for the piezo actuators.
- ✓ You have connected the E-413 to the actuators (p. 18).
- ✓ You have connected the E-413 to the signal sources (p. 21).
- ✓ You have switched on the E-413 (p. 24).

Starting Motion

- Change the control signals within the range from -10 V to +10 V.
The actuators generate the corresponding motion.

7 Maintenance

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7.1 General Notes on Maintenance

The E-413 is maintenance-free.

7.2 Cleaning the E-413

NOTICE



Short circuits or flashovers!

The E-413 contains electrostatic-sensitive devices that can be damaged by short-circuiting or flashovers when cleaning fluids penetrate the housing.

- Before cleaning, disconnect the E-413 from the power source by removing the mains plug.
- Prevent cleaning fluid from penetrating the housing

- When necessary, clean the surfaces of the E-413's housing using a cloth dampened with a mild cleanser or disinfectant.

8 Troubleshooting

Problem	Possible causes	Solution
Piezo actuator does not move	Cable not connected correctly	➤ Check the cable connections.
	piezo actuator or cable defective	➤ Replace the defective piezo actuator with a suitable piezo actuator and test the new combination.
	Control signal exceeds the permissible range	➤ Check the control voltage. If you generate the control voltage with a DAQ board and the analog drivers for NI LabVIEW software: ➤ Check that the analog drivers and the data acquisition board are working correctly.

If the problem that occurred with your system is not listed in the table above or cannot be solved as described, contact our customer service department (p. 31).

9 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.

The latest versions of the user manuals are available for download (p. 3) on our website.

10 Technical Data

In this Chapter

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10.1 Specifications

10.1.1 Data Table

	E-413.30 / .20	E-413.61 / .41
Function	Piezo amplifier for scanner tubes	Piezo amplifiers for PICA Shear, Picoactuator®
Channels	3 / 2 There are two outputs for each channel. The second output always outputs the voltage of the first output with reversed sign ("inverted").	6 / 4
Amplifier	E-413.30 / .20	E-413.61 / .41
Input voltage range	-10 to 10 V	-10 to 10 V
Output voltage	-250 to 250 V Inverted output: 250 to -250 V	-250 to 250 V
Output voltage monitoring	-2.5 to 2.5 V Inverted output: 2.5 to -2.5 V	-2.5 to 2.5 V
Peak output power/output (<1 ms)	50 W	50 W
Average output power/output	>10 W	>10 W
Peak current/output (<1 ms)	100 mA	100 mA
Average output current/output	>20 mA	>20 mA
Current limitation	Short-circuit proof	Short-circuit proof




Amplifier	E-413.30 / .20	E-413.61 / .41
Voltage gain	25 ±0.1 Inverted output: -25 ±0.1	25 ±0.1
Bandwidth, small signal	≥20 kHz	≥20 kHz
Ripple, noise, 0 to 10 kHz	<1 mV _{rms} 5 mV _{pp} <200 μV _{rms} at <10 kHz bandwidth, 100 nF actuator load at the output	<1 mV _{rms} 5 mV _{pp} <200 μV _{rms} at <10 kHz bandwidth, 100 nF actuator load at the output
Capacitive base load (internal)	2 nF	2 nF
Sensible external actuator capacity	>2 nF	>2 nF
Output impedance	1 kΩ, 2 nF	1 kΩ, 2 nF
Input impedance	100 kΩ	100 kΩ

Interfaces and operation	E-413.20, .30, .41, .61
Piezo connector	D-sub 15 (f)
Analog input	SMB plug connector
Monitor output	SMB plug connector

Miscellaneous	E-413.20, .30, .41, .61
Operating temperature range	5 to 40 °C
Dimensions	320 mm × 200 mm × 60 mm
Mass	1.5 kg
Operating voltage	24 V / 4 A ±2 %, in the scope of delivery: External power adapter
Current consumption	Maximum load approx. 3 A No load approx. 750 mA

10.1.2 Maximum Ratings

The E-413 is designed for the following operating data:

Input on:	Maximum operating voltage	Operating frequency	Fused current consumption
			
M8 4-pin	24 V	—	4 A

10.1.3 Ambient Conditions and Classifications

The following ambient conditions and classifications for the E-413 must be observed:

Area of application	For indoor use only
Maximum altitude	2000 m
Air pressure	1100 hPa to 0.1 hPa
Relative humidity	Highest relative humidity 80 % for temperatures up to 31 °C Decreasing linearly to 50 % relative air humidity at 40 °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

10.2 Operating Limits

The following diagram shows the operating limits for various piezo loads. The capacitance values in a curve's label are specified in nF.

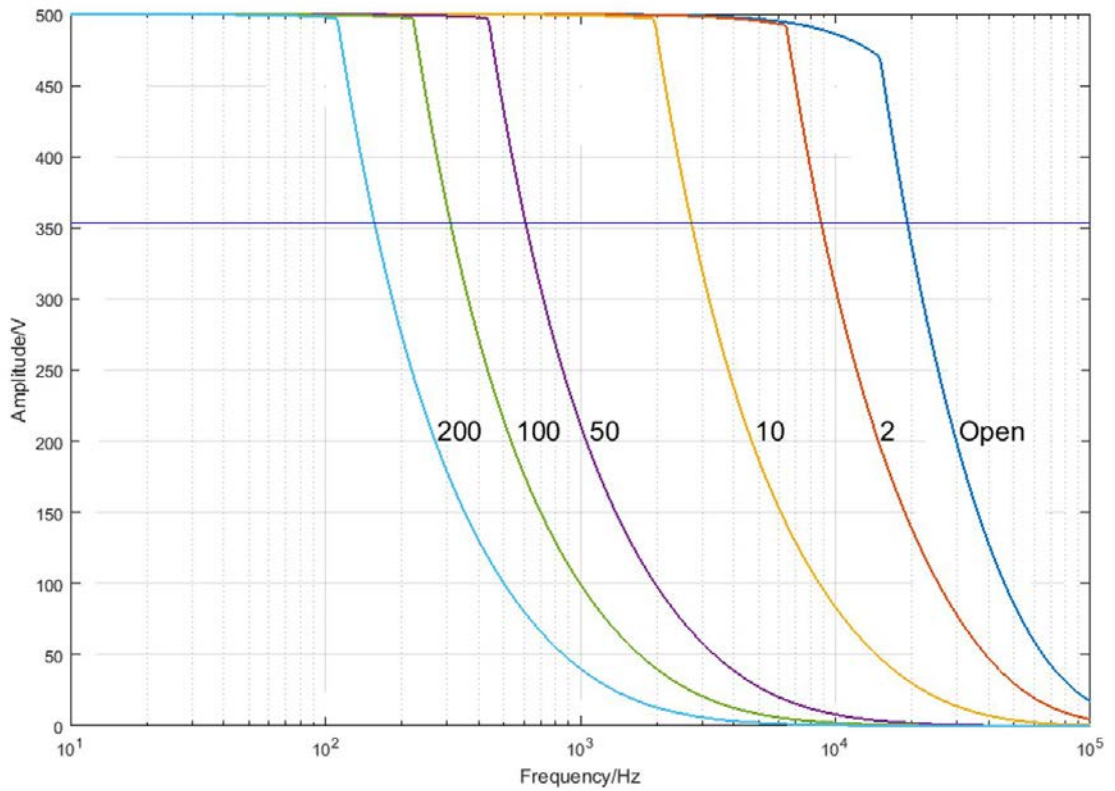


Figure 7: Operating limits

10.3 Dimensions

Dimensions in mm. Note that the decimal points are separated by a comma in the drawings.

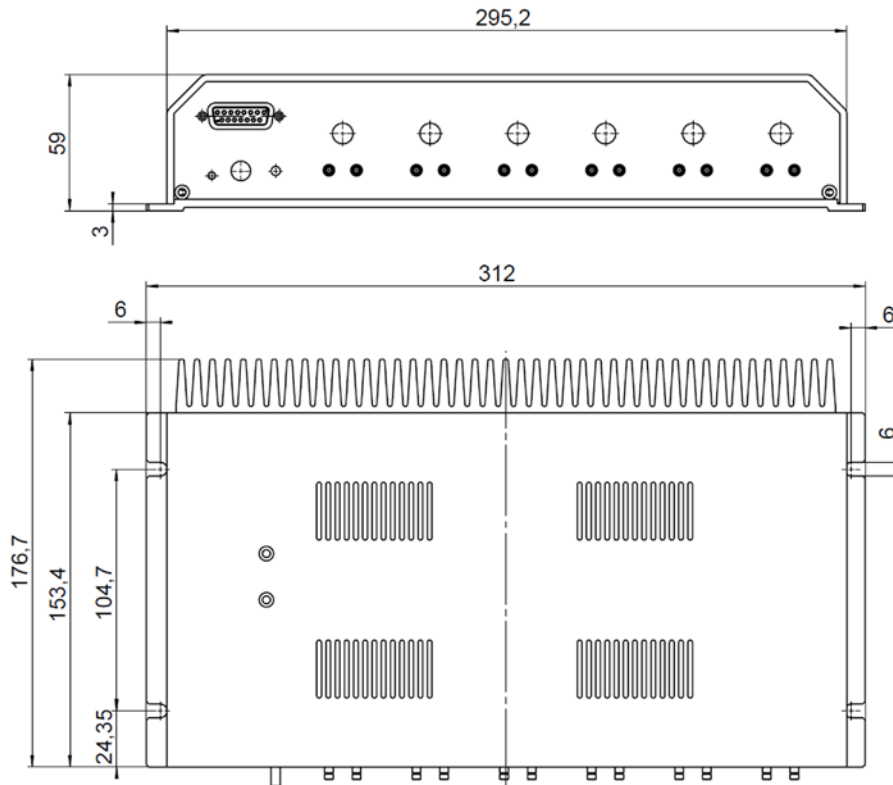


Figure 1: E-413 dimensions in mm. Note that the decimal points are separated by a comma in the drawings

10.4 Pin Assignment

10.4.1 Ch 1 to 6 D-sub 15 (f)

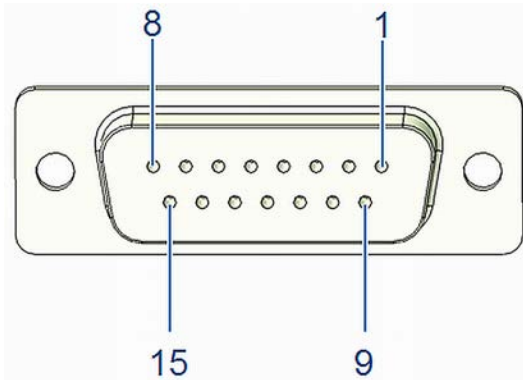


Figure 8: D-sub 15 socket

Pin No.	Signal E-413.30, .61 / E-413.20, .41	Function E-413.30, .61 / E-413.20, .41
1	Output 1	Output 1
9	Output 5 / n.c.	Output 5 / not connected
2	GND	Ground output 1
10	GND / n.c.	Ground output 5 / not connected
3	Output 2	Output 2
11	Output 6 / n.c.	Output 6 / not connected
4	GND	Ground output 2
12	GND / n.c.	Ground output 6 / not connected
5	Output 3	Output 3
13	n.c.	Not connected
6	GND	Ground output 3
14	n.c.	Not connected
7	Output 4	Output 4
15	n.c.	Not connected
8	GND	Ground output 4

Outputs 1 to 6: ± 250 V

Connector shell: Protective earth conductor/GND, protective earth conductor and GND have the same potential

10.4.2 E-815.AK014 Cable for Connecting to a D-sub 15 (f)

D-sub 15 (m), open end, 2 m

Pin No.	Wire color / wire pair	Function on the E-413's D-sub 15 socket
1	Brown / pair 1	Output 1
9	Green / pair 5	Output 5 / not connected
2	Black / pair 1	Ground output 1
10	Black / pair 5	Ground output 5 / not connected
3	Red / pair 2	Output 2
11	Blue / pair 6	Output 6 / not connected
4	Black / pair 2	Ground output 2
12	Black / pair 6	Ground output 6 / not connected
5	Orange / pair 3	Output 3
13		Not connected
6	Black / pair 3	Ground output 3
14		Not connected
7	Yellow / pair 4	Output 4
15		Not connected
8	Black / pair 4	Ground output 4

The connector shell is connected to the cable shield.

10.4.3 Power Supply Connector 24 V DC

Phoenix M8 panel plug, 4-pin, male



Pin	Function
1	GND (power)
2	GND (power)
3	Input: 24 V DC
4	Input: 24 V DC

11 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



12 EU Declaration of Conformity

For the E-413, an EU Declaration of Conformity has been issued in accordance with the following European directives:

Low Voltage Directive

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

