

E-621.SR

LVPZT Controller/Amplifier Module



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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-621.SR 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

RS-232



Meaning

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

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

Product	Document
E-816 Computer Interface and Command Interpreter Submodule	PZ116E User Manual
E-802 Servo Controller Submodule	PZ150E User Manual
E801B1008 Sensor Processing Submodule	PZ117E User Manual

1.1.5 Downloading manuals

INFORMATION

If a manual is missing or problems occur with downloading:

- Contact our customer service (p. 6).

Downloading manuals

1. Open the website **www.pi.ws**.
2. Search the website for the product number (e. g., E-621).
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-621.SR, declarations of conformity were issued according to the following European statutory requirements:

Low Voltage Directive

EMC Directive

RoHS Directive

The standards applied for certifying conformity are listed below.

Safety (Low Voltage Directive): EN 61010-1

EMC: EN 61326-1

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 if requested.

2 Safety

2.1 Intended use

E-621.SR is a laboratory device as defined by DIN EN 61010-1. E-621.SR is intended for indoor use and in an environment free from corrosive and/or electrically conductive acids, alkalines, oils, vapors, and dust.

The E-621.SR LVPZT Controller/Amplifier Module is designed for installation in a suitable chassis, e.g. the E-500.621 or E-501.621 provided by PI.

In accordance with its design, the E-621.SR LVPZT Controller/Amplifier Module is intended to drive capacitive loads, in the present case, piezoceramic actuators. The E-621.SR must not be used for applications other than stated in this manual, especially not for driving ohmic (resistive) or inductive loads.

E-621.SR can be used for both static and dynamic applications.

The E-621.SR can be operated in closed-loop mode using strain gauge sensors (SGS). Appropriate sensors are provided by PI and integrated in the mechanics according to the mechanics product specifications. Other sensors may be used as position sensors only with permission of PI.

It is only possible to use E-621.SR as intended when it is installed and connected properly, and when all measures described herein are adhered to.

2.2 General safety instructions

E-621.SR is built according to state-of-the-art technology and recognized safety standards. Improper use of the E-621.SR may result in personal injury and/or damage to the E-621.SR.

- Use E-621.SR 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-621.SR correctly

- Install the E-621.SR system near the AC outlet and such that the AC power plug can be reached easily.
- Only use the supplied power cord or a sufficiently dimensioned power cord to connect the E-621.SR to the power source.
- Both fuses are active and have to be replaced or checked if there is a fault. See "Replacing fuses" (p. 36) for how to replace the line power fuses.
- To disconnect the E-621.SR system from the power supply completely, remove the power plug from the wall socket, or remove the power cord from the E-621.SR system.

DANGER



Danger of death due to high voltage.

E-621.SR LVPZT Controller/Amplifier Modules generate voltages up to 130 V for driving LVPZTs which can cause death or serious injury.

When working with these devices or using PZT products from other manufacturers we strongly advise you to follow general accident prevention regulations.

All work done with and on the equipment described here requires adequate knowledge and training in handling High Voltages. Any cabling or connectors used with the system must meet the local safety requirements for the voltages and currents carried.

- Make sure that only adequately trained and educated personnel operates these devices.
- Disconnect the chassis from power when removing modules, and when resetting internal switches or jumpers.
- When a module removed from the chassis must be operated, use a 32-pin extension connector (P-895.00, not included). Voltages of up to 130 V can be exposed. Do not touch internal conductors.
- Be sure to connect pin 14a and 14c to a protective earth conductor.

2.3 Organizational measures

User manual

- Always keep this user manual available with the E-621.SR.
- Add all information from the manufacturer such as supplements or technical notes to the user manual.
- If you give E-621.SR to a third party, also include this user manual as well as other relevant information provided by the manufacturer.
- Only install and operate E-621.SR after you have read and understood this user manual.

General personnel qualification

E-621.SR may only be installed, started up, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

3 Product description



3.1 Front panel elements



INFORMATION


All front-panel connections except the USB lines are duplicated on the 32-pin main connector.
See "32-pin main connector" on p. 44 for details.



Figure 1: E-621.SR Front Panel

Name	Function
POWER	LED green / off. Permanent glow indicates that the E-621.SR is powered on.
OVERFLOW	LED yellow / off. Overflow signal, indicates power amplifier is so near the end of its range that it is no longer able to follow input changes properly (piezo voltage output outside of -30 V to 130 V range). If this LED glows in closed-loop operation (servo ON), a zero-point adjustment is necessary. Follow the instructions for "Open-loop zero-point adjustment" on p. 29. To avoid an overflow of the amplifier in open-loop operation, do not exceed the allowable control input range (see ANALOG INPUT).
ON TARGET	LED green / off. On target signal from E-802 servo controller submodule, indicates distance from target less than $\pm 0.19\%$ of range.
ANALOG INPUT -2 V to +12 V 	SMB coaxial, GND on outer line. Usage of this input line depends on the mode settings made with the SETTINGS DIP switches (see below): <ul style="list-style-type: none"> Analog mode: ANALOG INPUT is used as control input voltage which gives the target (either as voltage or position, depending on the servo mode; see below). The input signal should always be in the range of -2 V to 12 V. Note that excursions to -3 V or +13 V are possible but may cause overflow, especially with servo on, and reduce actuator lifetime, see "Lifetime of PICMA® actuators" on p. 46 for details. The control input voltage can also be a computer-generated analog signal (e.g. from a DAQ board). You can use PI's drivers for NI LabVIEW from a data storage device to generate that analog signal. See "Control modes" on p. 13 for details. Computer-controlled mode: ANALOG INPUT is used as trigger input signal for wave table operation and triggered motion (Active HIGH; LOW: 0 V to 0.5 V, HIGH: 3.0 V to 5.0 V, maximum 10 V; max. freq. 400 Hz; min. width: 200 μs). See the User Manual for E-816 Computer Interface and Command Interpreter Submodule (PZ116E) for more information.
SENSOR MONITOR 0 V to +10 V 	SMB coaxial, GND on outer line, 0 V to 10 V on inner line Filtered and processed sensor output value, 0 V to 10 V representing nominal travel range.

Name	Function																						
SETTINGS	<p>The ON position is on the left.</p> <table><tr><th>Switch</th><th>Function</th></tr><tr><td>1</td><td>Usage of ANALOG INPUT socket as control input.</td></tr><tr><td>2</td><td>Control input given by the E-816 computer interface submodule installed in E-621.SR.</td></tr><tr><td>3</td><td>Servo mode selection:<ul style="list-style-type: none">OFF (right) = servo off (open-loop operation)*ON (left) = servo on (closed-loop operation)</td></tr><tr><td>4</td><td>Usage of ANALOG INPUT socket as trigger input.</td></tr></table> <p>*To give the E-816 computer interface submodule complete control over the servo mode selection, DIP switch 3 must be set to open-loop operation (= right). When installing the E-621.SR in a custom chassis, for servo mode selection via the E-816 furthermore make sure that pin 28a on the main connector is not connected to pin 14a or 14c (i.e. the signal on pin 28a must not be LOW (0 V)).</p> <p>Switches 1, 2 and 4 determine the control mode (computer-controlled or analog) of the E-621.SR and hence the applicable control sources. See "Control modes" on p. 13 for details.</p> <table><tr><th>Switch</th><th>Computer-controlled mode</th><th>Analog mode</th></tr><tr><td>1</td><td>OFF</td><td>ON</td></tr><tr><td>2</td><td>ON</td><td>OFF</td></tr><tr><td>4</td><td>ON</td><td>OFF</td></tr></table> <p>Unpredictable behavior may result if switch 1, 2 and 4 are set incompatibly.</p>	Switch	Function	1	Usage of ANALOG INPUT socket as control input.	2	Control input given by the E-816 computer interface submodule installed in E-621.SR.	3	Servo mode selection: <ul style="list-style-type: none">OFF (right) = servo off (open-loop operation)*ON (left) = servo on (closed-loop operation)	4	Usage of ANALOG INPUT socket as trigger input.	Switch	Computer-controlled mode	Analog mode	1	OFF	ON	2	ON	OFF	4	ON	OFF
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Switch	Computer-controlled mode	Analog mode																					
1	OFF	ON																					
2	ON	OFF																					
4	ON	OFF																					
ZERO	Trim pot accessible with small screwdriver for sensor zero-point adjustment. Readjustment may become necessary with time or if the load is changed. Do the adjustment with Servo OFF. See Section "Open-loop zero-point adjustment" on p. 29 for more details.																						
PZT -30 V to +130 V  	2-conductor coaxial LEMO ERA.00.250 for piezo actuator drive voltage output. PZT ground is on the outer conductor (tied to case), PZT+ on the inner conductor. The drive voltage output is in the range of -30 V to 130 V.																						
SENSOR	4-conductor LEMO EPL.0S.304.HLN for sensor input. See "Strain gauge sensor wiring" on p. 45 for wiring.																						
RS-232	Serial connection to host PC. Sub-D 9 male, industry-standard RS-232. See the User Manual for E-816 Computer Interface and Command Interpreter Submodule (PZ116E) for more information.																						

Name	Function
USB 	Universal Serial Bus (USB Mini-B (m) socket) for connection to host PC. See the User Manual for E-816 Computer Interface and Command Interpreter Submodule (PZ116E) for more information.

3.2 Modes of operation

- **Control modes:** The E-621.SR can be operated in either analog mode or computer-controlled mode. The active mode determines the applicable control sources for the output voltage. See "Control modes" below for more information.
- **Servo modes:** The current servo mode determines if the motion axis is driven in open-loop (servo OFF) or closed-loop (servo ON) operation. In closed-loop operation a servo loop participates in the generation of the control value for the output voltage. The servo loop thus maintains the current axis position, based on a given target position and the position feedback of the corresponding sensor. See "Servo modes (ON / OFF)" below for more information.

The individual control and servo modes can be combined arbitrarily.

3.2.1 Control modes

The current control mode of the E-621.SR determines the applicable control sources for the output voltage and hence for the axis motion. It is selected with the **SETTINGS** DIP switches on the E-621.SR front panel.

Analog mode

Activated with the following settings (ON position is on the left):

1 = ON, 2 = OFF, 4 = OFF

The output voltage depends on the input voltage applied to the **ANALOG INPUT** SMB socket of the E-621.SR.

Control input from the E-816 computer interface submodule is ignored (i.e. move commands received via computer interface or from a running macro, trigger input or wave table output). The input signal should always be in the range of -2 V to 12 V. Note that excursions to -3 V or +13 V are possible but may cause overflow, especially with servo on, and reduce actuator lifetime, see "Lifetime of PICMA® actuators" on p. 46 for details.

The analog control input can be a computer-generated analog signal (e.g. from a DAQ board). You can use PI's drivers for NI LabVIEW from a data storage device to generate that analog signal.

Note: After installing the drivers, it is necessary to activate the analog functionality, see the Analog_Readme.txt file in the installation directory (C:\ProgramData\PI\LabVIEW).

In analog mode, control input from the E-816 computer interface submodule is ignored (i.e. move commands received via computer interface or from a running macro, trigger input or wave table output).

Computer-controlled mode

Activated with the following settings (ON position is on the left):

1 = OFF, 2 = ON, 4 = ON

The E-816 computer interface module installed in the E-621.SR controls the generation of the output voltage. Target values for the axis motion can be given by move commands (received via computer interface or from a running macro), trigger input or wave table output. The analog control input voltage on the **ANALOG INPUT** socket is ignored.

INFORMATION

In analog mode, the E-816 accepts all commands just as in computer-controlled mode. The only difference between the modes is the control source selection.

3.2.2 Servo modes (ON / OFF)

The servo mode determines if a motion axis is driven in open-loop (servo OFF) or closed-loop (servo ON) operation.

The servo mode can be set as follows:

- Using DIP switch 3 on the E-621.SR front panel:
OFF (right) = servo off (open-loop operation)
ON (left) = servo on (closed-loop operation)
- Using pin 28a on the 32-pin main connector:
Servo is on if pin 28a is connected to pin 14a or 14c (GND). In this case, switching to open-loop operation (servo OFF) is neither possible with DIP switch 3 on the front panel nor with the SVO command via the E-816 computer interface submodule.
By default and when installed in an E-50x.621 chassis from PI, pin 28a is not connected to pin 14a or 14c and hence set to servo off (open-loop operation)
- Via SVO command sent over the communications interface or received from a macro running on the E-816.
To give the E-816 complete control over the servo mode selection, DIP switch 3 on the E-621.SR front panel must be set to open-loop operation (= right). Furthermore make sure that pin 28a on the main connector is not grounded (i.e. not connected to pin 14a or 14c; the signal on pin 28a must not be LOW (0 V)).
Using the SVO? command, you can check the last sent SVO setting. SVO? does not report the setting of DIP switch 3 and pin 28a.
See E-816 User Manual for command descriptions.

INFORMATION

Servo control is implemented on a small PCB submodule (E-802.55). This submodule is included with the E-621.SR and comes already installed. "E-621.SR block diagram" on p. 17 answers most questions about how the various elements interact with each other.

The usage of the E-802 submodule depends on an on-board jumper, J1: With J1 in position 1-2 the E-802 is connected (factory default), and the servo mode can then be controlled by DIP switch 3, by pin 28a of the 32-pin main connector or by the E-816. If jumper J1 is in position 2-3 the E-802 submodule is completely bypassed no matter what the other settings.

Slew-rate limitation and notch filtering remain on even when servo mode is switched off. They will only be deactivated if the E-802 servo controller submodule is bypassed with J1 in position 2-3.

Normally, you do not need to change jumper J1. Access to J1 requires removing the E-621.SR module from the chassis. See "Components and adjustment elements" on p. 18 for more information.

Closed-loop operation

Any control input (control voltage on **ANALOG INPUT**, E-816 input like move commands and wave table output) is interpreted as target position. Based on this target position and on the position feedback of the corresponding sensor channel, the servo loop on the E-802 submodule generates the control value for the piezo output voltage. The servo loop thus maintains the axis position.

Closed-loop operation offers both drift-free and hysteresis-free positioning as well as immunity to load variations.

PI's standard calibration procedure assures that the piezo actuator reaches its nominal expansion when that position is commanded.

Open-loop operation

Any control input is interpreted as piezo voltage target. Open-loop operation omits the servo loop on the E-802 submodule, and the control input directly controls the piezo output voltage. The slew rate limitation and notch filter remain active (unless, of course, jumper J1 is in position 2-3).

When servo-mode is OFF, the system works like a linear amplifier with the piezo operating voltage proportional to the control signal input. (The sensor electronics works independently, and outputs the current piezo position even in open-loop mode, provided a sensor is properly connected. Since there is some variation among different piezos of the same model, the voltage required to bring the piezo to its nominal expansion will differ.)

INFORMATION

Closed-loop operation can be activated using a start-up macro. See the E-816 User Manual for more information.

3.3 Networking on I²C bus

It is possible to command up to twelve E-621.SRs over a single RS-232 or USB interface from a single host PC. The E-621.SR connected to the RS-232 or USB link (the master) relays commands to the other units (slaves) on the network. Responses from the slaves are then relayed by the master back to the PC.

The modules to be networked must be installed in the same chassis since networked units must have the I²C networking lines connected to each E-621.SR in parallel (pins 32a and 32c of the 32-pin main connector). The network bus lines are limited to a maximum length of 1 m and a maximum capacitance of 400 pF. With multiple E-625.CRs networking requires also sensor synchronization via pins 20a and 24a of the 32-pin main connector (see the E-621.CR User Manual PZ160E for details).

It may be necessary to power-cycle the system for proper detection of the master unit (i.e. the E-621.SR directly connected to the host PC).

For details regarding networking (e.g. channel name settings) see the User Manual of the E-816 computer interface module.

3.4 User electronics and sensor monitor signal

If you are connecting your own electronics to the sensor monitor signal, make sure it has sufficient input capacitance to eliminate high-frequency interference.

It may be necessary to add a 4.7 nF (ceramic NP0 or COC type) to the input connector. Use shielded cable if possible, otherwise make sure the lead pair is tightly twisted.

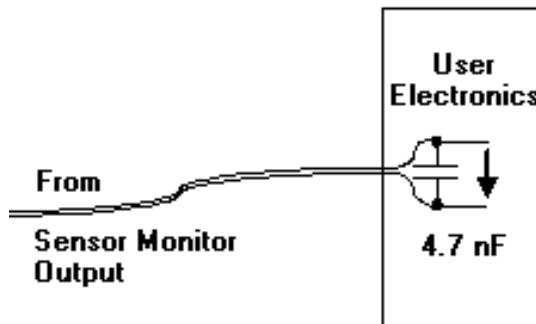


Figure 2: Electronics on Sensor Monitor line with required input capacitance

4 Electronics details

4.1 E-621.SR block diagram

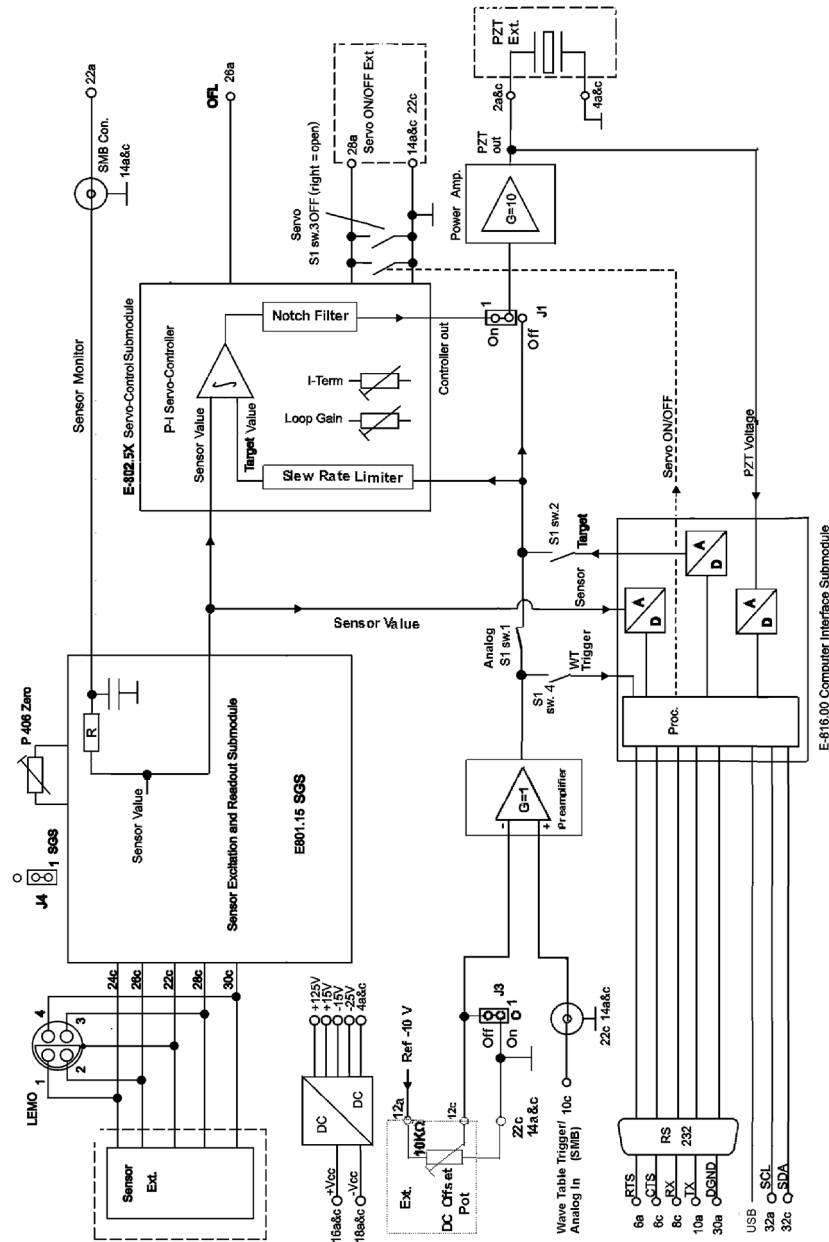


Figure 3: E-621.SR Block Diagram

NOTE:

Input signals on the analog input line (front panel SMB connector and main connector pin 10c) and the position of the external DC-offset potentiometer (if activated) are combined in the preamplifier stage. Depending on the DIP switch settings, the resultant signal will be used either as control input, or as digital input for triggering. If the signal on the SMB socket is to be used as trigger, DC offset must be deactivated or set to 0.

4.2 Components and adjustment elements

See also the E801B1008 and E-802 User Manuals for adjustment elements on those submodules which are not described here.

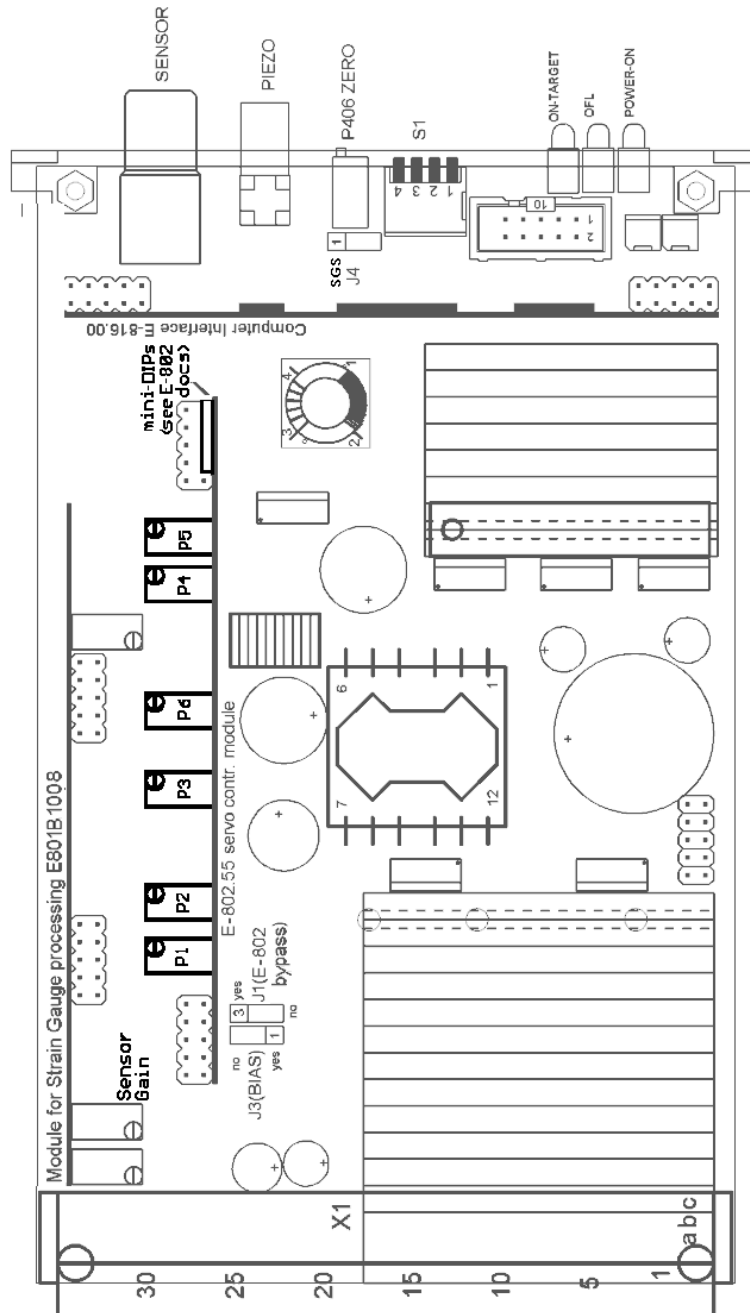


Figure 4: E-621.SR (viewed from component side, with bottom edge on top) component locations; adjustment elements shown in default settings

4.2.1 Jumpers

Jumpers are also shown on the block diagram on p. 17.

J1 Servo mode, notch filter and slew rate bypass

1-2: Factory setting: the servo-control mode depends on the setting of DIP switch 3 on the E-621.SR front panel, on pin 28a of the 32-pin main connector or on the SVO command settings. The slew rate limitation and notch filter are always ON.

2-3: E-802.55 submodule with servo control, slew rate limitation and notch filter is completely bypassed. No other combination of settings or commands can activate it.

J3 External DC offset potentiometer (not included):

1-2 activated (do not activate without wiring to the 32-pin main connector, p. 44)

2-3 deactivated



J4 Type of sensor activation/processing:

1-2 DC (SGS),

2-3 AC (do not use)

Must match the type of sensor-processing submodule installed (E801B1008 for SGS)

JP107 - JP109 shift the voltage range of the sensor processing circuitry. They must remain as set at the factory, i.e. for use with an E-802 servo controller submodule (positive polarity, 0 V-10 V).

Position of the Jumper JP107		
Polarity of Output	Positive	Negative

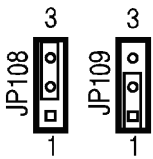
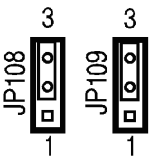
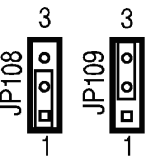
Typical Application	Using with PI's position control electronics	Using as a position detector	Special application
Position of Jumpers JP108 and JP109			
Voltage range of output	0V ~ 10V	-5V ~ +5V	-10V ~ 0V

Figure 5: E-621.SR sensor processing output settings

4.2.2 Switches

DIP switch block S1 is accessible through the front panel. (Do not confuse with the S1 damping control on the E-802 submodule, described in the E-802 User Manual).

sw1 (left switch)	ON (down)	Signal on <i>ANALOG IN/WTT</i> line used as analog input.
	OFF (up)	Signal on <i>ANALOG INPUT</i> line not used as analog input.
sw2	ON (down)	Control input from E-816 computer interface submodule used.
	OFF (up)	Control input from E-816 computer interface submodule not used.
sw3	ON (down)	Servo on .
	OFF (up)	Servo off; can be switched on by E-816 via SVO command or by grounding pin 28a of the 32-pin main connector.
sw4	ON (down)	Signal on <i>ANALOG INPUT</i> line used as trigger for wave table output or triggered motion.
	OFF (up)	Signal on <i>ANALOG INPUT</i> line not used as trigger for wave table output or triggered motion.

Unpredictable behavior may result if sw 1, 2 and 4 are set incompatibly. For admissible combinations, see "Front panel elements" on p. 10.

4.2.3 Potentiometers

The calibration procedures involve setting a number of trim pots. The P406 Zero potentiometer is accessible through a hole in the front panel. Others are located on the main board or on submodules. See also the User Manual of the respective submodule for more details.

4.3 E801B1008 sensor processing submodule

Sensor excitation and processing is implemented on a small, replaceable submodule.

SGS versions have an E801B1008 submodule which provides DC sensor excitation and readout.

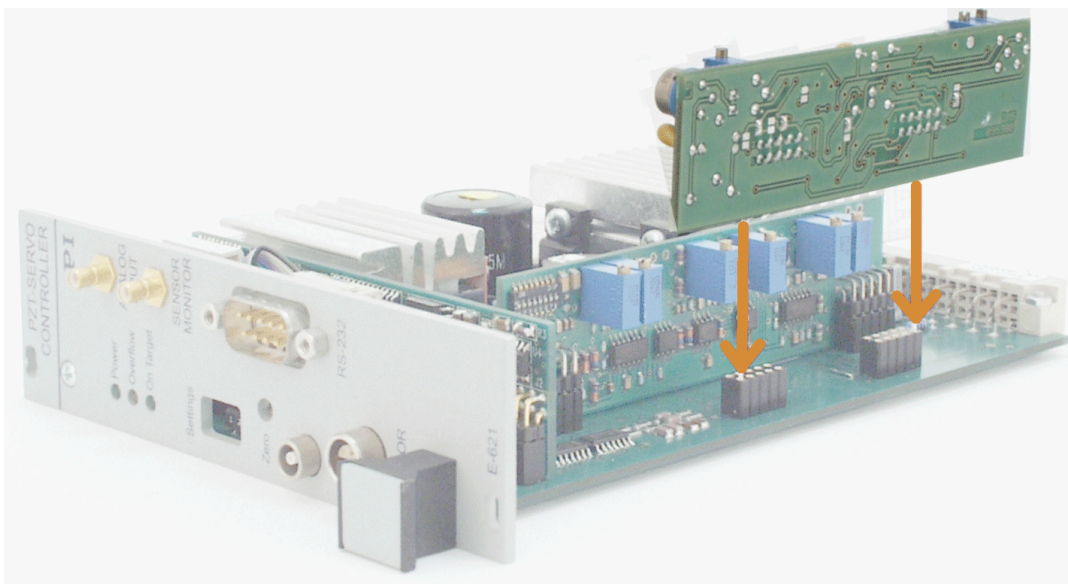


Figure 6: E801B1008 sensor excitation and readout submodule. Note and respect component-side orientation

Should you ever need to make any adjustments on the sensor submodule, refer to the E801B1008 User Manual for more details.

4.4 E-802 servo controller submodule

The E-802 is a small plug-in PCB that processes the control signal for the amplifier driving the piezoelectric translators. Slew rate limitation, notch filter and servo-control loop are all implemented on the E-802.

The servo-loop logic compares the control voltage input and the signal of the position sensor to generate the amplifier control signal using an analog proportional-integral (P-I) algorithm.

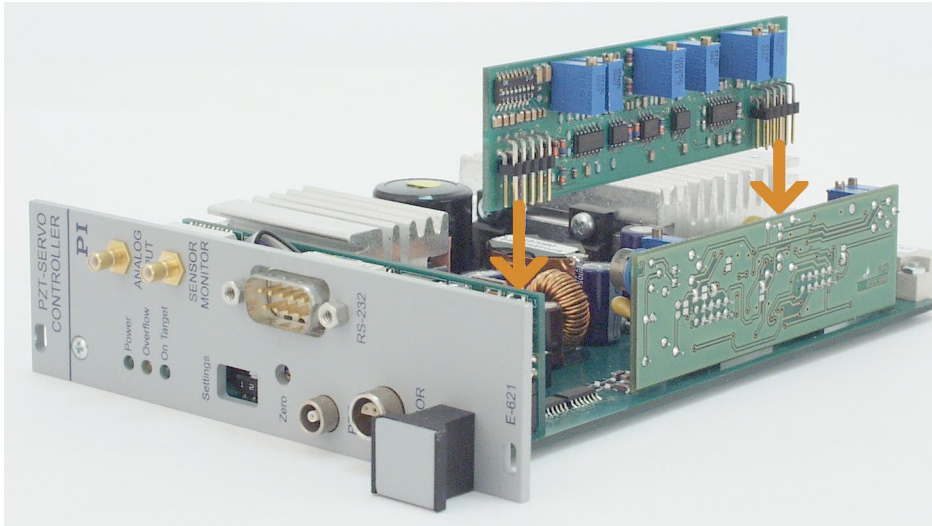


Figure 7: E-802 servo controller submodule location on E 621. Note and respect component-side orientation

For calibration procedures, see "Servo-control static gain calibration", p. 33 and "Servo-control dynamic characteristics", p. 34. The E-802 submodule is described in detail in a separate user manual.

5 Unpacking

5.1 Unpacking the E-621.SR

INFORMATION

According to your order, the E-621.SR LVPZT Controller/Amplifier Module comes separately or installed in an E-500.621 or E-501.621 chassis.

1. Unpack the E-621.SR 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.

5.2 Scope of delivery

Product number	Description
C-815.34	RS-232 null-modem cable for PC connection
588	32-pin multipoint socket connector (DIN 416123) for installing the E-621.SR module in custom electronics
E-692.SMB	SMB/BNC adapter cable, 1.5 m, two units
000036360	USB cable (USB-A (m)/USB Mini-B (m)) for PC connection
C-990.CD1	Data storage device with PC software from PI
PZ115	User manual for E-621.SR (this document)

6 Installation

If PI had sufficient knowledge of your application and you ordered your system components together, they will have been shipped preinstalled and preconfigured. Do not adjust potentiometers unnecessarily and be aware that many adjustment points are interdependent and effect both computer-controlled and analog operating modes.

NOTICE



Risk of damage due to electrostatic discharge

E-621.SR modules are ESD-sensitive (electrostatic discharge sensitive) devices.

- Observe all precautions against static charge buildup before handling these devices.
- Avoid touching circuit components, pins and PCB traces.
- Discharge any static electricity you may have on your body by briefly touching a conductive, grounded object before you touch any electronic assembly.
- Pose PCBs only on conductive surfaces, such as ESD-safe transport containers (envelopes, foam).
- Electronic subassemblies must always be kept and transported/shipped in conductive packaging.
- Make sure that no conductive particles of any kind (metallic dust or shavings, broken pencil leads, loose screws) contact the device circuitry.

NOTICE



Air Circulation

Place the E-621.SR system in a location with adequate ventilation. Insufficient air flow will cause overheating and premature failure.

- Do not cover the ventilation slots on the top side of the E-621.SR.
- Allow at least 10 cm (4 inches) clearance from the top and the rear of the unit and 5 cm (2 inches) from each side

Only the DIP switch block (S1) and the Zero potentiometer are accessible without removing the E-621.SR from the chassis.

6.1 Installing the E-621.SR installed in a chassis

This section is only relevant if the E-621.SR comes installed in an E-500.621 or E-501.621 chassis provided by PI.

Unless you request otherwise, upon delivery the E-621.SR 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

The power connection and the line fuses are located on the rear panel of the E-500.621 or E-501.621 chassis. The chassis is equipped with a wide-range power supply and with fuses that are admissible for both 115 V and 230 V operation. No settings need be changed when connecting the system to a different supply voltage. The orientation of the fuse carrier is irrelevant.

Connecting the voltage

- Connect the included power cord from the E-500.621 or E-501.621 chassis in which the E-621.SR is installed to a grounded wall socket (220 V to 240 V AC or 100 V to 120 V AC).



Figure 8: E-621.SRs installed in compatible PI chassis (E-500.621 in this example) are automatically networked

6.2 Installing the E-621.SR not installed in a chassis

This section is only relevant if the E-621.SR modules come without chassis.

Before operation is possible, the E-621.SR must be installed in a suitable chassis.

INFORMATION

E-621.SR is only compatible with E-50x.621 chassis but incompatible with other chassis of PI's E-500-series.

For a custom or OEM installation, consider the following:

- Networked units must have the I²C networking lines connected to each E-621.SR in parallel (pins 32a and 32c). The network bus lines are limited to a maximum length of 1 m and a maximum capacitance of 400 pF. See "Networking on I2C bus" on p. 16 for details.
- Each unit requires sufficient power. A DC-DC converter is installed on the main board of the E-621.SR module with an input voltage range of 12 V to 30 V DC (recommended supply 15 V). This converter generates -25 V and +125 V for the power amplifier and +/- 15 V for the sensor and servo controller. When powering up the module, the DC-DC converter needs a peak current of about 1.5 A to start oscillating. The power supply should have a buffer capacitor or should be able to supply the 1.5 A per E-621.SR for at least 1 second. The inputs and outputs of the DC-DC converter are not connected internally. Using a unipolar power supply, we recommend connecting the negative supply at pin 18a and 18c with the Test GND at pin 14a and 14c. This provides a defined GND level and helps to minimize noise. Be sure to connect pin 14a and 14c to a protective ground.
- If a DC-offset potentiometer is to be used, connect the wiper to pin 12c, the zero-offset contact (presumably CCW) to pin 22c, 14a or 14c (GND) and the other contact (CW) to pin 12a. Make sure the external pot is activated with J3 in position 1-2.
- By connecting pin 28a on the main connector to pin 14a or 14c (GND), the E-621.SR is set to closed-loop operation (servo ON). In this case, switching to open-loop operation (servo OFF) is neither possible with DIP switch 3 on the front panel nor with the SVO command via the E-816 computer interface submodule.

Installing the E-621.SR

1. Install the E-621.SR in a suitable chassis.
2. Connect the required input and output lines via the 32-pin main connector.
To do this, you can use the included multipoint socket connector (588). For pinout see "32-pin main connector" on p. 44.
3. Connect the power cord from the chassis in which the E-621.SR is installed to a grounded wall socket (220 V to 240 V AC or 100 V to 120 V AC).

7 Startup and operation

7.1 Startup

NOTICE



Risk of damage to configuration data

Incorrect calibration may lead to damage to the internal configuration data due to erroneous operation.

- Calibrate E-621.SR only after consultation with PI.

NOTICE



If the piezo positioner starts oscillating (humming noise)

If not avoided, the dangerous situation will result in damage to the equipment.

- In closed-loop operation, switch off the servo immediately. The load and / or the dynamics of operation probably differ too much from the setup for which the system was calibrated.
- In open-loop operation, stop the motion immediately. Do not operate the piezo positioner at its resonant frequency even though the notch filter by default is also active in open-loop operation.

INFORMATION

Thermally stable systems have the best performance. For a thermally stable system, switch on the E-621.SR at least one hour before you start working with it.

1. Make sure the E-621.SR is switched off.
2. Make the DIP switch settings required for the control mode (analog or computer-controlled) and the servo mode (ON or OFF) you wish to use. See "Front panel elements" on p. 10 and "Modes of operation" on p. 13 for details.

Notes:

The servo must be ON in analog mode, when you want to work with a computer-generated signal (e.g. from a DAQ board) and PI's drivers for NI LabVIEW (see step 5 below).

To give the E-816 computer interface submodule complete control over the servo mode selection, DIP switch 3 on the E-621.SR front panel must be set to open-loop operation (= right). When installing the E-621.SR in a custom chassis, for servo mode selection via the E-816 furthermore make sure that pin 28a on the main connector is not grounded (i.e. not connected to pin 14a or 14c).

3. Connect the piezo positioners/actuators to the proper E-621.SR units. If your system was calibrated by PI, the controllers and positioners are not interchangeable. Respect the assignment given by the serial numbers marked on the calibration label of the controller.

4. Connect a suitable signal source to the **ANALOG INPUT** SMB socket. Depending on the control-mode selection, this input signal is either used as control input (in analog mode), or as trigger signal for wave table output and triggered motion (in computer-controlled mode). See "Front panel elements" on p. 10 for signal details.

In analog mode, the control input voltage can also be a computer-generated analog signal (e.g. from a DAQ board). You can use PI's drivers for NI LabVIEW from a data storage device to generate that analog signal.

Note: After installing the drivers, it is necessary to activate the analog functionality, see the Analog_Readme.txt file in the installation directory (C:\ProgramData\PI\LabVIEW).

5. Optional: Connect a suitable measurement device to the **SENSOR MONITOR** SMB socket. This socket carries the filtered and processed sensor output value, with 0 V to 10 V representing nominal travel range. See "User electronics and sensor monitor signal" on p. 16 for further specifications.
6. Switch on the E-621.SR.
7. Command motion of the connected piezo positioner/actuator:

Analog mode: Change the control input signal on **ANALOG INPUT** in the range of 0 V to 10 V

Computer-controlled mode: Follow the instructions in "First Steps" in the E-816 Computer Interface Submodule User Manual.

If at the yellow **OVERFLOW** LED glows in closed-loop operation (servo ON), then a zero-point adjustment is necessary. Follow the instructions for "Open-loop zero-point adjustment" on p. 29. To avoid an overflow of the amplifier in open-loop operation, do not exceed the allowable control input range.

7.2 Sensor connection and adjustment

If PI had sufficient knowledge of your application, your E-621.SRs will have been shipped fully calibrated. It is usually not necessary for you to do anything more than adjust the zero point before operating the system.

INFORMATION

Calibration should only be done after consultation with PI, otherwise the internal configuration data may be destroyed by erroneous operation.

Position sensors are connected to the **SENSOR** socket on the E-621.SR front panel, see the "Strain gauge sensor wiring" on p. 45. The E-621.SR provides DC sensor processing (it is equipped with the E801B1008 sensor submodule) and is for SGS sensors.

The output from the sensor-processing submodule is an analog signal that is directly proportional to the piezo's expansion and is available at **SENSOR MONITOR** on the front panel. See the "E801B1008 sensor processing submodule" section, starting on p. 21 for more details on the sensor submodules.

As seen in the block diagram, the sensor signal goes through the E801B1008 sensor readout electronics and then branches to the E-816 computer-interface submodule and the E-802 servo controller submodule.

Since the servo controller and computer interface submodules see "copies" of the sensor signal, it is important that the zero point and gain in the sensor circuitry be properly adjusted. The zero point is especially likely to need correction. There are offset (zero-point) and range adjustment potentiometers on the E801B1008 sensor submodule.

In addition to the adjustments on the analog side, there are digital offset and range corrections on the E-816 computer interface submodule. The A/D converter on the E-816 is always precalibrated and its offset and gain values stored in EPROM are not customer modifiable. If the hardware adjustments are exact, then the Osen (sensor offset) digital correction factor should be set to 0 and Ksen, the sensor coefficient, should be set to a value equal to the travel range (in μm) divided by 10 volts (the nominal sensor readout electronics output range). See the E-816 User Manual for details.

7.2.1 Open-loop zero-point adjustment

Zero-point calibration has the following goals:

- Make the full travel range available: If the electrical zero point is adjusted properly, the full output voltage range of the amplifier can be used. This prevents overflow conditions from occurring.
- Preserve the piezo actuators in the mechanics: The point of zero sensor readout should correspond to zero or a (small) negative output voltage. This technique can reduce the average applied voltage without loss of displacement and thereby increase piezo lifetime.

There might be some small deviation of the electrical zero-point caused by thermal drift or changes in mechanical loading. Let the system warm up for several minutes before setting the zero point.

This procedure can be carried out either in computer-controlled or in analog mode. If you use analog mode, you will need a voltmeter. In computer-controlled mode the voltmeter is helpful but not required. Before starting, install the positioner(s) with the same loads and in the same positions as they will have in your application.

Open-loop sensor zero point	Computer-controlled mode	Analog mode
1. Set DIP switches on the front panel for operating mode	sw1 OFF, sw2 ON, sw4 ON; connect RS-232 or USB cable to this unit.	sw1 ON, sw2 OFF, sw4 OFF
2. Power up	After power-on, establish communications, e.g. with PITerminal.	
3. Set up for servo-off operation	Send SVO A 0 where A is the axis identifier. Make sure that servo is not set on with DIP switch 3 or pin 28a.	Set DIP switch 3 OFF. Make sure that servo is not set on with pin 28a or SVO command.
4. Exercise the piezo over	Command voltages from 0 V	Apply an analog signal in the

Open-loop sensor zero point	Computer-controlled mode	Analog mode
the nominal expansion range	to 100 V, e.g. with SVA command.	range of 0 V-10 V to ANALOG INPUT (DC offset must be 0 or OFF (J3 2-3))
5. Command 0 V	Command a voltage of 0 volts by sending SVA A 0 where A is the axis identifier.	Put 0 V on ANALOG INPUT .
6. Read sensor	Send POS? A where A is the axis identifier, or read the value at the SENSOR MONITOR SMB socket on the front panel with a voltmeter.	Read the value at the SENSOR MONITOR SMB socket on the front panel with a voltmeter.
7. Correct zero	Adjust the Zero potentiometer on the front panel so that the sensor-monitor signal is +1 V.	

After successful zero-point adjustment, the **OVERFLOW** LED should no longer glow in closed-loop operation. Permanent glow of this LED inspite of zero-point adjustment may indicate hardware failure. To avoid an overflow of the amplifier in open-loop operation, do not exceed the allowable control input range.

7.2.2 Open-loop sensor range adjustment

The object of open-loop sensor range calibration is to assure that when the piezo is at nominal expansion the sensor will report the nominal-expansion position. (Note that the voltage required to cause the piezo to expand to its nominal value will not be exactly 100 V, but somewhere in the 85 V-105 V range.)

All piezo positioning systems ordered together with a piezo translator are delivered with performance test documents to verify the system performance.

The system ordered is calibrated in our labs prior to shipment. Normally there is no need for the customer to perform a full calibration. Only if the piezo, the sensor, extension cable or the mechanical setup is changed, may new calibration be necessary.

Open-loop sensor range adjustment requires an external measuring device with 0.1 μ m resolution and a 32-pin extension connector (P-895.00, not included).

INFORMATION

Procedures which require removing the E-621.SR module from the chassis should be carried out by authorized, qualified personnel only.

Disconnect the chassis from power when removing modules, and when resetting internal switches or jumpers.

When a module removed from the chassis must be operated, use a 32-pin extension connector (P-895.00, not included). Voltages of up to 130 V can be exposed. Do not touch internal conductors.

Open-loop sensor range	Computer-controlled mode	Analog mode
1. Make adjustment elements accessible	Remove E-621.SR from the chassis and connect via P-895.00 extension connector (qualified, authorized personal only).	Remove E-621.SR from the chassis and connect via P-895.00 extension connector (qualified, authorized personal only).
2. Set DIP switches on the front panel for operating mode	sw1 OFF, sw2 ON, sw4 ON, connect RS-232 or USB cable to this unit.	sw1 ON, sw2 OFF, sw 4 OFF
3. Power up	After power-on, establish communications, e.g. with PITerminal.	
4. Set up for servo-off operation	Send SVO A 0 where A is the axis identifier. Make sure that servo is not set on with DIP switch 3 or pin 28a.	Set DIP switch 3 OFF. Make sure that servo is not set on with pin 28a or SVO command.
5. Exercise the piezo over the nominal expansion range	Command voltages from 0 V to 100 V, e.g. with SVA command	Apply an analog signal in the range of 0 V-10 V to ANALOG INPUT (DC offset must be 0 or OFF (J3 2-3)).
6. Command 0 V	Command a voltage of 0 volts by sending SVA A 0 where A is the axis identifier	Put 0 V on ANALOG INPUT .
7. Check/adjust zero-point	Send POS? A where A is the axis identifier, or read the value at the SENSOR MONITOR SMB socket on the front panel with a voltmeter. If necessary, adjust the zero point as described in "Open-loop zero-point adjustment" on p. 29.	Read the value at the SENSOR MONITOR SMB socket on the front panel with a voltmeter. If necessary, adjust the zero point as described in "Open-loop zero-point adjustment" on p. 29.
8. Expand the piezo to its nominal expansion as indicated by external gauge	Use a series of commands like SVA A 90 followed by repeated SVR A 1 (A is the axis identifier).	Increase analog input voltage slowly.
9. Adjust sensor gain	Adjust the sensor gain on the sensor submodule E801B1008 until the value at the SENSOR MONITOR SMB socket on the front panel is 10 V. See the User Manual of the E801B1008 Sensor Processing Submodule for component designation and location.	

Open-loop sensor range	Computer-controlled mode	Analog mode
10. Recheck	It may be necessary to repeat the last steps until stable readings are obtained.	

7.2.3 Servo-control static gain calibration

The object of servo-control static gain adjustment is to assure that the piezo moves to the nominal travel range end position when that position is commanded in servo-on mode (in analog mode, 10 V control input).

You will need an external measuring device and a 32-pin extension adapter to access the potentiometers mentioned while the unit is in operation (P-895.00, not included).

Since the servo controller uses the sensor signal as a basis, the analog sensor zero point and open-loop range should be adjusted before the static servo-gain is set.

This procedure can be carried out with the unit in either computer-controlled or analog mode. If done in analog mode, you will also need a highly accurate voltage source and meter.

INFORMATION

Procedures which require removing the E-621.SR module from the chassis should be carried out by authorized, qualified personnel only.

Disconnect the chassis from power when removing modules, and when resetting internal switches or jumpers.

When a module removed from the chassis must be operated, use a 32-pin extension connector (P-895.00, not included). Voltages of up to 130 V can be exposed. Do not touch internal conductors.

Closed-loop servo static gain	Computer-controlled mode	Analog mode
1. Make adjustment elements accessible	Remove E-621.SR from the chassis and connect via P-895.00 extension connector (qualified, authorized personal only).	Remove E-621.SR from the chassis and connect via P-895.00 extension connector (qualified, authorized personal only).
2. Set DIP switches on the front panel for operating mode	sw1 OFF, sw2 ON, sw 4 ON, connect RS-232 or USB cable to this unit.	sw1 ON, sw2 OFF, sw4 OFF
3. Power up	After power-on, establish communications, e.g. with PITerminal.	
4. Set servo ON	Send SVO A 1 where A is the axis identifier.	Set DIP switch 3 ON or connect pin 28a to pin 14a or 14c.

Closed-loop servo static gain	Computer-controlled mode	Analog mode
5. Check for oscillation	If the piezo goes into oscillation, you will have to perform the dynamic adjustments (especially notch filter) first.	
6. Set external gauge to 0	Send MOV A 0 where A is the axis identifier, and set external gauge to 0.	Put 0 V analog input on the ANALOG INPUT SMB socket (DC offset must be to 0 or OFF (J3 2-3)) and set external gauge to 0.
7. Command a position equal to the end of the nominal travel range	e.g. send MOV A 100 where A is the axis identifier The piezo should expand to the nominal expansion, and the output on the SENSOR MONITOR SMB socket should be exactly 10 V. Verify this with the external gauge and meter.	Using an appropriately accurate source apply +10.0000 V to the analog input. The piezo should expand to the nominal expansion, and the output on the SENSOR MONITOR SMB socket should be exactly 10 V. Verify this with the external gauge and meter.
8. Adjust sensor monitor output	To adjust the SENSOR MONITOR output to exactly 10.000 V use the GAIN Fine Adjust potentiometer on the servo controller submodule, E-802.55.	
9. Adjust piezo expansion	To adjust the expansion without changing the SENSOR MONITOR output (servo control is on.) use the gain adjustment potentiometer on the E801B1008 sensor submodule.	
10. Repeat the last steps several times until stable results are obtained		

This adjustment can only be done accurately for one control mode (analog mode or computer-controlled mode). If you use the unadjusted mode, 1 % error in the sensor monitor output voltage can be expected.

7.3 Servo-control dynamic characteristics

The object of servo-control dynamic calibration is to regulate behavior such as overshoot, ringing and settling time. The servo controller submodule also has a notch filter which makes it possible to eliminate vibration at the mechanical resonant frequency of the system.

Dynamic calibration procedures require an oscilloscope (a digital storage oscilloscope is recommended), frequency generator to output square and sine functions from 1 Hz to 1 kHz and an ohmmeter with a range from 0.1 k-ohm to 100 k-ohm and, depending on the installation, a 32-pin extension adapter to allow access to the trim potentiometers while the board is in operation.

INFORMATION

Procedures which require removing the E-621.SR module from the chassis should be carried out by authorized, qualified personnel only.

Disconnect the chassis from power when removing modules, and when resetting internal switches or jumpers.

When a module removed from the chassis must be operated, use a 32-pin extension connector (P-895.00, not included). Voltages of up to 130 V can be exposed. Do not touch internal conductors.

The dynamic calibration procedures are described in the User Manual for the E-802.55 servo controller submodule (execution in analog mode). Using the wave table of the E-816 computer interface module it should also be possible to perform them in computer-controlled mode without an external frequency generator.

Note that the notch filter and slew rate limiter are not deactivated by the servo-off line. Resetting the notch filter frequency in this mode (open-loop via servo-off signal) can cause the piezo output voltage to change by as much as 5 %. To deactivate the notch filter and slew rate limiter, use jumper J1 in position 2-3 to remove the E-802 from the circuit entirely (see block diagram below).

8 Maintenance

8.1 Replacing fuses on E-50x.621 chassis

The line fuses are located on the rear panel of the E-500.621 or E-501.621 chassis. The fuses are admissible for both 115 V and 230 V operation. Both fuses are active and have to be replaced if there is a fault.

DANGER



Risk of electric shock

An E-621.SR system requires a supply voltage of 100 V to 120 V AC or 220 V to 240 V AC (line voltage). Touching the line voltage can result in serious or even lethal injury due to electric shock.

- Remove the power cord from the E-621.SR's housing before you change the line fuses.

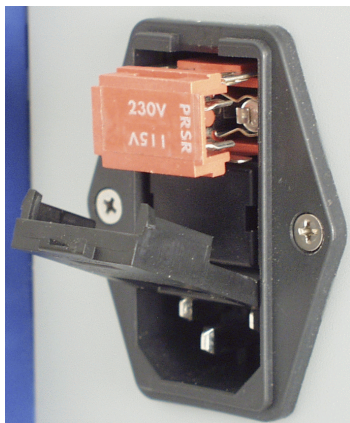


Figure 9: Position of the line fuses and fuse carrier; only one of two fuses is visible

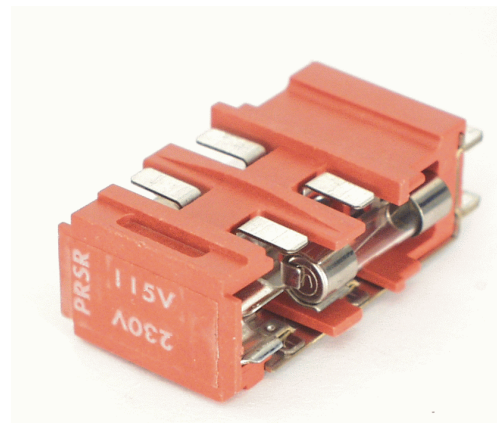


Figure 10: Fuse carrier

Replacing the fuses

1. Switch off the E-621.SR system and disconnect it from the power supply.
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:

IEC 4 AT (slow blow)

Note: IEC-standard fuses are designed to carry the nominal current indefinitely. Other fuse rating standards differ.

5. Reinstall the carrier and close the door.
6. Reconnect the E-621.SR system to the power supply and switch it on again.

9 Troubleshooting

Fault: Positioner does not move	
Possible causes	Remedial measures
Cable not connected properly	➤ Check the connecting cable(s).
Positioner or positioner cable is defective	➤ If a working positioner of the same type is available, exchange the defective positioner to test a new combination of E-621.SR and positioner. Since positioner and E-621.SR always form a calibrated system, the performance with the new positioner will probably be lower than with the original positioner. If the new positioner is to be used permanently and in normal operation, a new calibration is required. See "Installation" on p. 24 for details.
Incorrect control mode of the piezo channel	➤ The applicable control sources for the axis motion depend on the current control mode (analog or computer-controlled mode, see "Control modes" on p. 13 for details). In analog mode, move commands (received via interface or from a running macro), trigger input and wave table output are ignored and may provoke an error message. In computer-controlled mode, the axis motion can be commanded by move commands received via interface or from a running macro, by trigger input and wave table output. Respect the prioritization of the individual sources (see the User Manual of the E-816 computer interface submodule for details). Check the DIP switch setting on the front panel for the current control mode ("Front panel elements", p. 10).
No control signal applied or signal out of range	➤ In analog mode, apply an analog control signal to the ANALOG INPUT SMB socket to command the axis motion. The signal should always be in the range of -2 V to 12 V (excursions to -3 V or +13 V may cause overflow, especially with servo on, and reduce actuator lifetime). If you generate the analog signal with a DAQ board in a PC running LabVIEW and using PI's drivers for NI LabVIEW, check the driver and the DAQ board for proper operation. Move commands or wave table commands may provoke errors and are ignored.
Wrong command or wrong syntax	➤ Check the error code with the <i>ERR?</i> command. Note that the response to this command contains only the error code of the master unit. See the <i>ERR?</i> description in the User Manual of the E-816 computer interface submodule for the complete error reference.
Wrong axis commanded	➤ Check if the correct axis identifier is used and if the commanded axis is that of the desired positioner (axis identifier also required with single-axis systems.)

Fault: Positioner does not move	
Possible causes	Remedial measures
Incorrect configuration	<ul style="list-style-type: none"> ➤ Check the parameter settings on the E-816 computer interface module with the <i>SPA?</i> command.
High voltage output of the E-621.SR deactivated	<p>If the internal temperature goes out of range (75 °C or higher), the high voltage output of the E-621.SR will be deactivated. In that case the mechanics will no longer move. When the internal temperature falls below 60 °C, the high voltage output is reactivated automatically</p> <ul style="list-style-type: none"> ➤ Keep the ambient temperature at a noncritical value: Note that the difference between ambient temperature and internal temperature of the E-621.SR normally is about 20 °C. ➤ Place the system in a location with adequate ventilation. Allow at least 10 cm (4 inches) clearance from the top and the rear of the unit and 5 cm (2 inches) from each side. If this is not possible, keep the ambient temperature low. ➤ When using the wave table output, it is recommended to reduce the frequency and/or the amplitude and/or the output duration to avoid overheating.

Fault: Unsatisfactory system performance	
Possible causes	Remedial measures
The sensor values are not reliable, and the whole system is instable.	<ul style="list-style-type: none"> ➤ Only thermally stable systems can have the best performance. For a thermally stable system, power on the E-621.SR at least one hour before you start working with it.
The positioner starts to oscillate or shows nonsatisfying settling behaviour.	<ul style="list-style-type: none"> ➤ Your system will be fully calibrated before being shipped. But due to load changes in the application, some calibration settings may no longer be suitable. See "Servo-control dynamic characteristics" on p. 34 for details.

Fault: OVERFLOW LED glows	
Possible causes	Remedial measures
The output of the amplifier is being clipped at one of its limits.	<ul style="list-style-type: none"> ➤ Try to adjust the sensor reading window as described in "Open-loop zero-point adjustment" on p. 29 (a small deviation of the electrical zero-point may be caused by thermal drift or changes in mechanical loading). Adjustments to the zero point should not exceed $\pm 10\%$ of the positioner travel. After successful zero-point adjustment, the OVERFLOW LED should no longer glow in closed-loop operation. To avoid an overflow of the amplifier in open-loop operation, do not exceed the allowable control input range. Permanent glow of the OVERFLOW LED inspite of zero-point adjustment may indicate hardware failure. Contact your Physik Instrumente Sales Engineer or write service@pi.de.

Fault: Communication with controller does not work	
Possible causes	Remedial measures
Communication cable is wrong or defective	<ul style="list-style-type: none"> ➤ Check cable. Does it work properly with another device? For RS-232, a null-modem cable must be used.
The interface is not configured correctly	<ul style="list-style-type: none"> ➤ With the RS-232 interface, check port and baud rate (set via BDR command). The serial port on the E-816 is preset to the following parameters: 115,200 baud, 8 data bits, 1 stop bit, no parity, RTS/CTS. It is recommended that the host PC have a "genuine" RS-232 interface on board. If the host PC uses a USB-to-serial adapter instead, data loss could occur during communication, especially when transferring large amounts of data. ➤ If you use the USB interface and after switching on the E-621.SR a dialog appears with the message that the driver for the hardware is missing: Install the USB driver from a data storage device. The installation files for the USB drivers are located on the data storage device in the directory \SingleSetups.
Controller was power-cycled or rebooted	<ul style="list-style-type: none"> ➤ With USB connections, communication can not be maintained after the E-621.SR is power-cycled or the E-816 digital operation module is reset. The connection must then be closed and reopened.
Another program is using the interface	<ul style="list-style-type: none"> ➤ Close the other program.

Fault: Communication with controller does not work	
Possible causes	Remedial measures
Specific software has problems	➤ See if the system works with some other software, e.g. a terminal or development environment. You can, for example, test the communication by simply starting a terminal program, e.g. PITerminal, and entering <i>*IDN?</i> . Note that multi-character commands are transferred as terminated by a LF (line feed) character and are executed only after the LF is received.

Fault: Custom software accessing PI drivers does not run	
Possible causes	Remedial measures
Wrong combination of driver routines/Vis	➤ Check if system runs with Terminal program. If so, read the information in the corresponding manual for the PC software and compare the sample code on a data storage device with your program code.

10 Technical data

10.1 Specifications

10.1.1 E-621.SR data table

	E-621.SR
Function	Power amplifier & piezo controller
Sensor	
Controller type	P-I (analog) + notch filter
Sensor type	SGS (.S)
Amplifier	
Input voltage range	-2 V to 12 V
Output voltage	-30 V to 130 V
Peak current, < 50 ms	120 mA
Average output current	60 mA
Current limitation	Short-circuit proof
Noise, 0 to 100 kHz	0.8 mVrms
Voltage gain	10 ±0.1
Input impedance	100 kΩ
Interfaces and operation	
Communication interfaces	USB, RS-232 (Sub-D 9 (m)), 24-bit A/D, 20-bit D/A
Piezo connection	LEMO ERA.00.250.CTL (.SR)
Sensor connection	LEMO EPL.05.304.HLN (.SR)
Analog input	SMB
Sensor monitor output	SMB
Controller network	up to 12 channels, parallel
Command set	PI General Command Set (GCS)
User software	PIMikroMove
Software drivers	NI LabVIEW drivers, DLLs
Supported functions	Wave table, 256 data points, external trigger, 16 macros
DC offset setting	External potentiometer (not in the scope of delivery), adds 0 V to 10 V to the input voltage
Miscellaneous	
Operating temperature range	5 °C to 50 °C (above 40 °C, power derated)
Overheat protection	Deactivation at 75 °C
Dimensions	7 HP/3 RU

	E-621.SR
Mass	0.6 kg
Operating voltage	12 V to 30 V DC, stabilized
Max. current consumption	2 A

10.1.2 E-621.SR chassis

Chassis Model	E-500.621	E-501.621
E-621.SR modules (max.)	12	4
Operating voltage	100 V to 240 V AC, 50 Hz-60 Hz	100 V to 240 V AC, 50 Hz-60 Hz
Dimensions	450 x 132 x 296 mm + handles	236 x 132 x 296 mm + handles

10.2 Ambient conditions and classifications

The following ambient conditions and classifications for the E-621.SR must be observed:

Area of application	For indoor use only
Maximum altitude	2000 m above msl
Relative humidity	Highest relative humidity 80 % for temperatures up to 31 °C Decreasing linearly to 50 % relative air humidity at 40 °C
Overvoltage category	II
Supply voltage fluctuations	Max. ± 10 % of the nominal voltage
Protection class	I
Degree of pollution	2
Degree of protection according to IEC 60529	IP20

10.3 Frequency response diagram

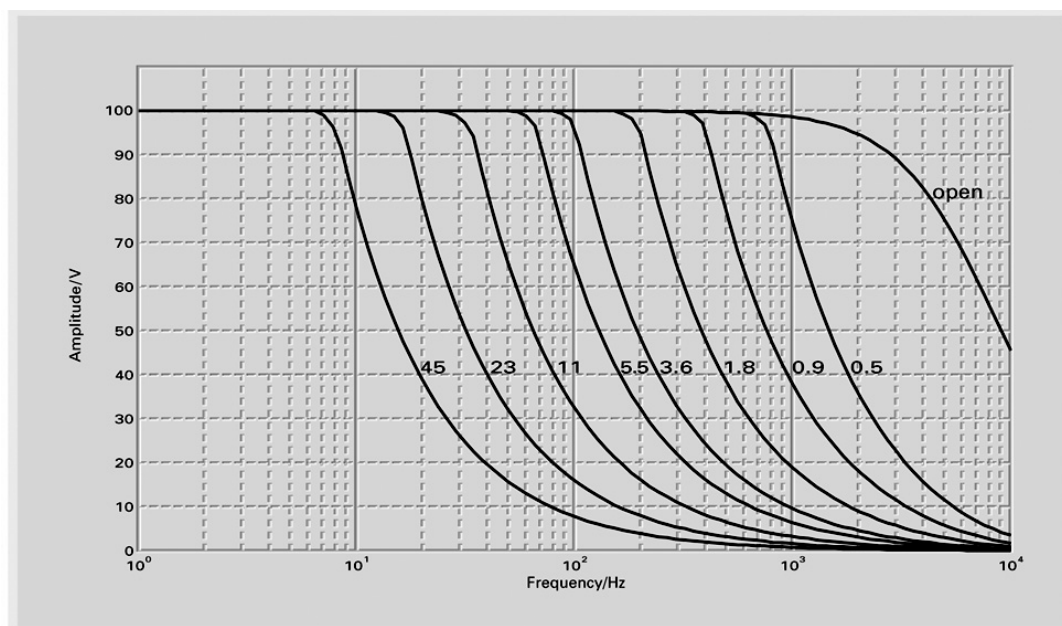


Figure 11: E-621.SR open-loop frequency response with various piezo loads. Values shown are capacitance in μF

10.4 Pin assignment

10.4.1 32-pin main connector

Because the DIN 41612 connector standard includes types with more pins, the 32 pins of the "D" version all carry even number designations and are in rows "a" and "c".

Function	Pin			Function
PZT output	a	2	c	PZT output
PZT GND	a	4	c	PZT GND
RS-232/RTS	a	6	c	RS-232/CTS
Internal use	a	8	c	RS-232/RX
RS-232/TX	a	10	c	Analog input / trigger input (use depends on the settings of DIP switches 1 and 4)
Pot 10 kOhm (-10 V)	a	12	c	Pot wiper
Pot 10 kOhm (GND)***	a	14	c	Pot 10 kOhm (GND), also Test GND***
+VCC supply	a	16	c	+VCC supply
-VCC supply	a	18	c	-VCC supply
Internal use	a	20	c	Internal use
Monitor sensor	a	22	c	GND for Sensor, Test, Analog In
Internal use	a	24	c	Sensor excitation
Overflow (TTL, active-low)	a	26	c	Sensor inverting input
Servo ON/OFF select*	a	28	c	Sensor non-inverting input
GND for RS-232	a	30	c	GND for sensor excitation
I ² C SCL-signal**	a	32	c	I ² C SDA signal**

*0 V = LOW, 5 V = HIGH, Active LOW (LOW = servo ON; default is HIGH). Servo is on if pin 28a is connected to pin 14a or 14c (GND). In this case, switching to open-loop operation (servo OFF) is neither possible with DIP switch 3 on the front panel nor with the SVO command via the E-816 computer interface submodule.

**If E-621.SRs are networked outside a single E-50x.621 chassis, the SCL and SDA bus lines are limited to a maximum length of 1 m and a maximum capacitance of 400 pF.

***Pins 14a and 14c should be connected to a protective ground

10.4.2 Strain gauge sensor wiring

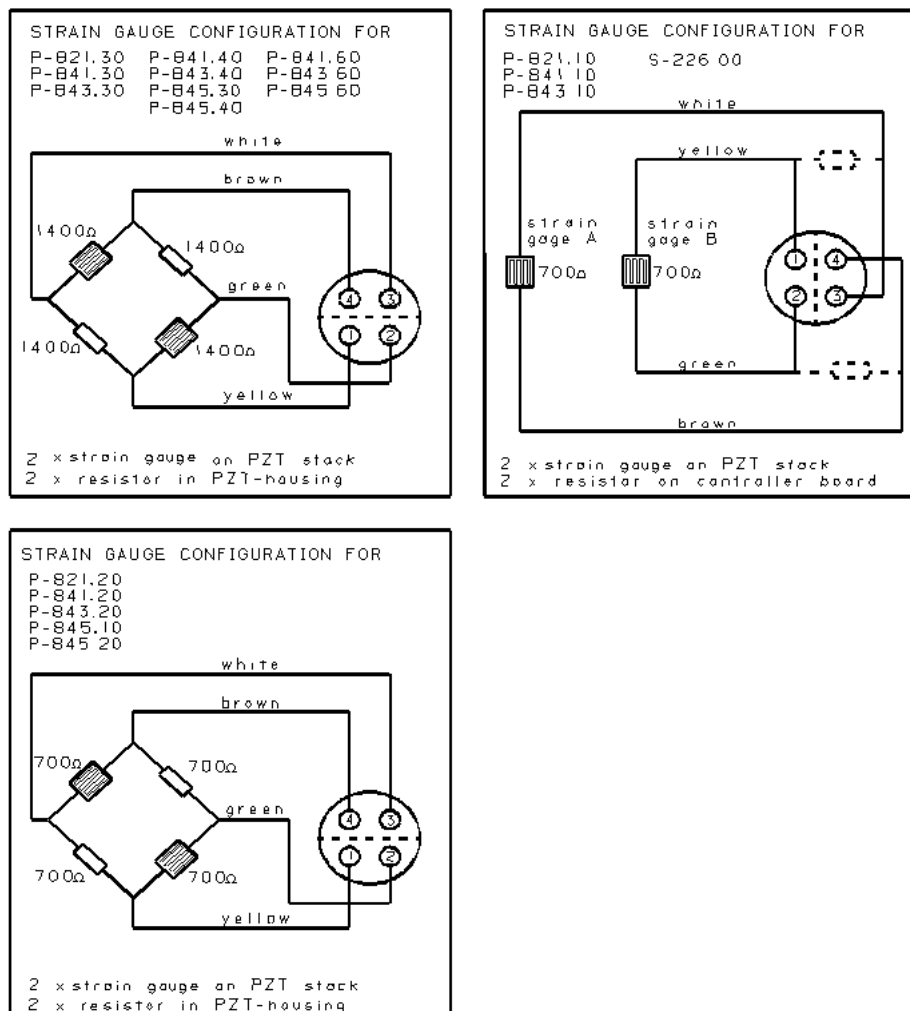


Figure 12: Pin configurations and wiring for various different positioners

11 Appendix

11.1 Lifetime of PICMA® actuators

The following factors can have an impact on the actuator lifetime and must be considered:

- Applied voltage
- Temperature
- Relative humidity

The effect of each individual factor on the lifetime can be read off the diagrams shown below. The lifetime calculated in hours simply results as the product of all three values read off the diagrams.

The impact of the applied voltage is particularly important. With decreasing voltage the lifetime increases exponentially. This must always be taken into consideration in an application. The recommended maximum range of the control input voltage for the E-621.SR amplifier module therefore is -2 V to 12 V, resulting in a piezo voltage range of -20 V to 120 V. A control input range of -3 V to 13 V is possible (results in -30 V to 130 V piezo voltage), but will reduce the actuator lifetime accordingly.

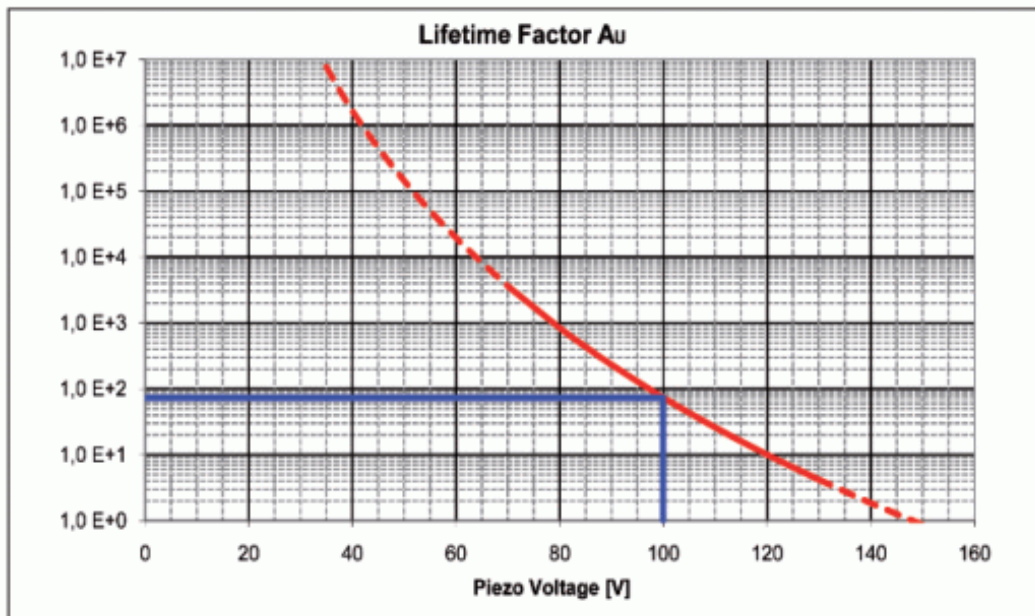


Figure 13: Interdependency between the mean MTTF of a PICMA® actuator and the value of the voltage applied

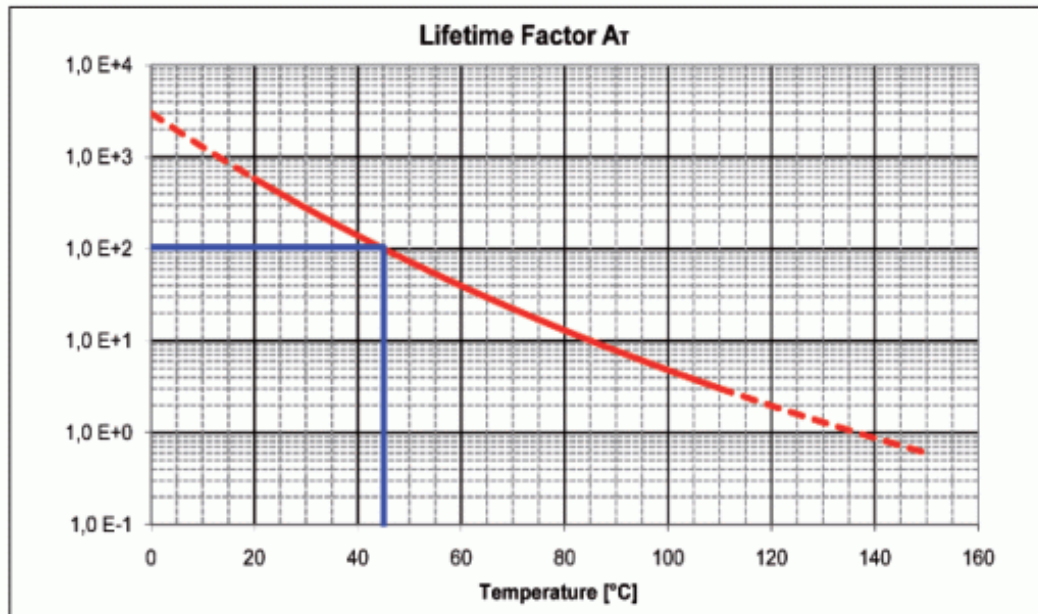


Figure 14: Interdependency between the mean MTTF of a PICMA[®] actuator and the ambient temperature

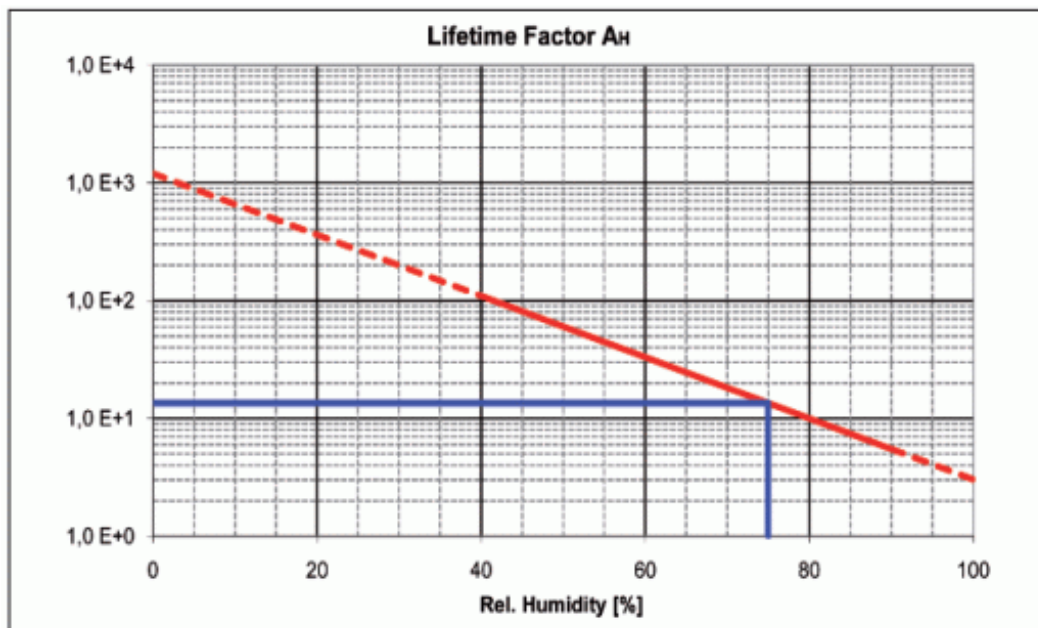


Figure 15: Interdependency between the mean MTTF of a PICMA[®] actuator and the relative humidity

Example:

The simple formula $MTTF = A_U \cdot A_T \cdot A_F$ provides a quick estimate of the reliability in hours.

For example, the values for 75 % RH ($A_F=14$), 100 VDC ($A_U=75$) and 45 °C ($A_T=100$) result in an approximate MTTF of 105,000 h, i. e. more than 11 years (see markings on the diagrams).

12 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

