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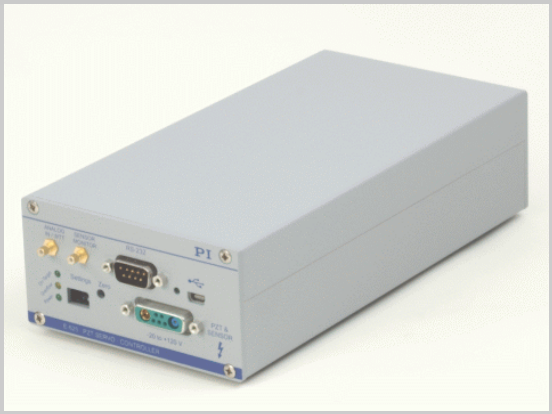
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PZ167E User Manual

E-625 LVPZT Controller/Amplifier

Release: 1.4.0 Date: 2009-04-14



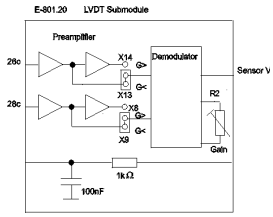
This document describes the following product(s)*:

- E-625.SR
  LVPZT Controller/Amplifier, Single Channel, for Strain Gauge Sensors
- E-625.LR
  LVPZT Controller/Amplifier , Single Channel, for LVDT Sensors

Capacitive sensor E-625 versions are described in a separate manual, PZ 166E. The E-625.C0 is described in PZ187.







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Declaration of Conformity

according to DIN EN ISO/IEC 17050:2005-01

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

The manufacturer hereby declares that the product

Product Name: **LVPZT Controller/Amplifier**

Model Numbers: **E-625**

Product Options: **all**

complies with the following European directives:

2006/95/EC, Low voltage directive (LVD)

2004/108/EC, EMC-Directive

The applied standards certifying the conformity are listed below.

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

Electromagnetic Immunity: EN 61000-6-1

Safety (Low Voltage Directive): EN 61010-1

April 09, 2009
Karlsruhe, Germany

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About This Document

Users of This Manual

This manual is designed to help the reader to install and operate the E-625 LVPZT Controller/Amplifier. It assumes that the reader has a fundamental understanding of basic servo systems, as well as motion control concepts and applicable safety procedures.
The manual describes the physical specifications and dimensions of the E-625 LVPZT Controller/Amplifier as well as the hardware installation procedures which are required to put the associated motion system into operation.
This document is available as PDF file on the product CD. Updated releases are available for download from www.pi.ws or via email: contact your Physik Instrumente Sales Engineer or write info@pi.ws.

Conventions

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

WARNING

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



DANGER

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



CAUTION

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

!

NOTE

Provides additional information or application hints.

Related Documents

The hardware components and the software tools which might be delivered with E-625 LVPZT Controller/Amplifiers are described in their own manuals. All documents are available as PDF files on the product CD. Updated releases are available for download from www.pi.ws or via email: contact your Physik Instrumente Sales Engineer or write info@pi.ws..

E-801 User Manual, PZ117E
E-802 User Manual, PZ150E
E-816 User Manual, PZ116E
E-816 DLL Software Manual, PZ120E
E-816 LabVIEW Software Manual, PZ121E
Analog Controller LabView Driver Library Software Manual, PZ181E
PIMikroMove™Software Manual, SM148E

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1 Introduction

1.1 Model Survey

The E-625 amplifier/controller is a stand-alone desktop device designed to drive and control the displacement of a low-voltage piezoelectric stage or actuator (LVPZT). The following models are described in this manual; each supporting a different position-sensor type:

E-625.LR	LVPZT controller, provides AC sensor processing for usage with LVDT sensors (equipped with E-801.2x sensor submodule)
E-625.SR	LVPZT controller, provides DC sensor processing for usage with strain gauge sensors (SGS; equipped with 801.1x sensor submodule)

Both models come with an E-802 Servo-Controller and an E-816 Computer Interface and Command Interpreter installed as standard.

Networking of E-625's with each other allows controlling up to 12 devices over a single RS-232 or USB computer interface. Networking requires additional wiring and setup.

E-625s for use with capacitive sensors are described in detail in their own manual, PZ166. The E-625.C0 is the same as the E-625.CR, except that it has the analog control interface only. It is described in User Manual PZ187.

1.2 Prescribed Use

Based on their design and realization, the E-625 LVPZT Controller/Amplifier is intended to drive capacitive loads, in the present case, piezoceramic actuators. The E-625 must not be used for applications other than stated in this manual, especially not for driving ohmic (resistive) or inductive loads.

E-625s can be operated in closed-loop mode using position sensors. The type of position sensor used must be compatible with the E-625 model to which it is attached: in particular linear variable differential transformers (LVDT) require the AC excitation provided by the E-625.LR, and strain gauge sensors (SGS) require DC exitation provided by the E-625.SR.

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.

Observe the safety precautions given in this User Manual.

E-625s meet the following minimum specifications for operation*:

- Indoor use only
- Altitude up to 2000 m
- Ambient temperature from 5°C to 40°C
- Relative humidity up to 80% for temperatures up to 31°C, decreasing linearly to 50% relative humidity at 40°C
- Line voltage fluctuations of up to ±10% of the line voltage
- Transient overvoltages as typical for public power supply
  Note: The nominal level of the transient overvoltage is the standing surge voltage according to the overvoltage category II (IEC 60364-4-443).
- Degree of pollution: 2

1.3 Safety Precautions

DANGER



High Voltage: Read This Before Operation:

E-625 LVPZT Controller/Amplifiers generate voltages up to 120 V for driving LVPZTs. The output power may cause 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

* Any more stringent specifications in the Technical Data table are, of course, also met.

must meet the local safety requirements for the voltages and currents carried.

Be sure to connect the grounding stud on the rear panel to a protective ground!

Procedures which require opening the case should be carried out by authorized, qualified personnel only.

Disconnect unit from power when opening the case, and when resetting internal switches or jumpers.

When the unit must be operated with the case open, voltages of up to 120 V can be exposed. Do not touch internal conductors.



WARNING

Connect the AC power cord of the external power supply to the wall socket (100 to 240 VAC).

To disconnect the system from the supply voltage completely, remove the power plug from the wall socket, or remove the power supply connector from the E-625.

Install the system near the AC outlet and such that the AC power plug can be reached easily.

CAUTION

Place the system in a location with adequate ventilation to prevent internal heat build-up. 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.

CAUTION

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

CAUTION

Thermally stable systems have the best performance. For a thermally stable system, switch on the E-625 at least one hour before you start working with it.

CAUTION

If the piezo stage starts oscillating (humming noise):

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 stage at its resonant frequency even though the notch filter by default is also active in open-loop operation.

Otherwise the piezo stage could be irreparable damaged.

1.4 Unpacking

Unpack the E-625 LVPZT Controller/Amplifier with care. Compare the contents against the items ordered and against the packing slip. The following items should be included:

- Controller unit (E-625)
- Separate power supply C-890.PS, wide-range (100-240 VAC), 15 V, with barrel connector
- K050B0002 Barrel-to-Switchcraft adapter for power supply connection
- 3763 line cord
- RS-232 null-modem cable for PC connection (C-815.34)
- 000014651 USB cable (USB-A (m)/USB Mini-B (m)) for PC connection

- SMB/BNC adapter cables (E-692.SMB) 1.5 m, two units
- User Manual for E-625 (PZ167E), this document
- User Manual for E-816 Computer Interface and Command Interpreter Submodule (PZ116E)
- User Manual for E-802 Servo-Control Submodule (PZ150E)
- User Manual for E-801 Sensor Excitation and Readout Submodule (PZ117E)
- CD for E-816-interface devices with software and documentation (E-816.CD)

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

Save all packing materials in the event the product needs to be shipped elsewhere.

1.5 Additional Components

Contact your PI Sales Engineer or write info@pi.ws, if you need the following accessory:

E-665.CN network cable, 0.3 m, for interlinking multiple E-625s (I^2C bus), see “Networking on I^2C Bus” on p. 18 for details.

2 Quick Start

2.1 Supply Power Connection

WARNING



Connect the AC power cord of the external power supply to the wall socket (100 to 240 VAC).

To disconnect the system from the supply voltage completely, remove the power plug from the wall socket, or remove the power supply connector from the E-625.

Install the system near the AC outlet and such that the AC power plug can be reached easily.

Be sure to connect the GND stud on the E-625 rear panel to a protective ground!

The E-625 comes with a 15 V wide-range-input power supply that can be used with line voltages from 100 VAC to 240 VAC at 50 or 60 Hz.

To power on the E-625, proceed as follows:

1. Because grounding is not assured over the power connection, connect the E-625 chassis to a protective ground via the grounding pin on the rear panel (see Fig. 2 on p. 14)

2. Connect the included Barrel-to-Switchcraft adapter (K050B0002, see figure below) to the "DC IN 12-30 V" Switchcraft socket of the E-625



3. Connect the included wide-range power supply to the barrel socket of the adapter on the E-625

4 Connect the AC power cord of the power supply to the wall socket. When the green “Power” LED glows, the E-625 is ready for operation

2.2 First Steps

CAUTION

Thermally stable systems have the best performance. For a thermally stable system, switch on the E-625 at least one hour before you start working with it.

CAUTION

If the piezo stage starts oscillating (humming noise):

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 stage at its resonant frequency even though the notch filter by default is also active in open-loop operation.

Otherwise the piezo stage could be irreparable damaged.

1 Make sure the E-625 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. 11 and "Modes of Operation” on p. 15 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 the analog LabVIEW driver set from PI (see step 4 below).
To give the E-816 computer interface submodule complete control over the servo mode selection, DIP switch 3 on the E-625 front panel must be set to open-loop operation (= up).

3 Connect the piezo stages/actuators to the proper E-625 units. If your system was calibrated by PI, the

controllers and stages 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 IN/WTT” 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. 11 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 the PI LabVIEW Analog Driver set provided on the included E-816 CD to generate that analog signal. Install that driver set by running Setup on the E-816 CD. See the driver documentation on the E-816 CD for operation

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 to 10 V representing nominal travel range. See “User Electronics and Sensor Monitor Signal” on p. 19 for further specifications

6 Optional: If you want to work with multiple E-625s, interconnect their I^2C bus lines. See “Networking on I^2C Bus” on p. 18 for details

7 Switch on the E-625 as described in “Supply Power Connection” on p. 8

8 Command motion of the connected piezo stage/actuator:

Analog mode: Change the control input signal on “ANALOG IN/WTT” in the range of 0 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 zero-point adjustment given in Section 4.2.1 on p. 23. To avoid an overflow of the amplifier in open-loop operation, do not exceed the allowable control input range (-2 to +12 V).

3 Operation

The E-625 amplifier/controller is a stand-alone desktop device designed to drive and control the displacement of a low-voltage piezoelectric stage or actuator (LVPZT) in a system with sensor position feedback (LVDT or SGS sensors, depending on model type).

Operation involves the user commanding a motion and the E-625 supplying the required voltage on the piezo output line for the piezo to execute the commanded motion.

E-625s can be used for both static and dynamic applications. High output stability and low noise assures stable nanopositioning. Because LVPZT translators have high capacitances, the amplifier is designed to supply appropriately high peak currents for dynamic applications. Excellent linearity and stability allows the use of E-625s in precision measurement and control systems.

3.1 Front and Rear Panel Elements

3.1.1 Front Panel Elements



Fig. 1: E-625 Front Panel, no difference between .LR and .SR models

ANALOG IN/WTT
SMB coaxial, GND on outer line. Usage of this input line depends on the mode settings made with the “Settings” DIP switches (see below):

- Analog mode: ANALOG IN/WTT 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 0 to 10 V (excursions to -2 or +12 V may cause overflow, especially with servo on, and reduce actuator lifetime). The control input voltage can also be a computer-generated analog signal (e.g. from a DAQ board). You can use the PI LabVIEW Analog Driver set provided on the E-816 CD to generate that analog signal. See “Control Modes” on p. 15 for details
- Computer-controlled mode: ANALOG IN/WTT is used as trigger input signal for wave table operation and triggered motion (Active HIGH; LOW: 0 to 0.5 V, HIGH: 3.0 to 5.0 V, maximum 10 V; max. freq. 400 Hz; min. width: 5 µs). See the User Manual for E-816 Computer Interface and Command Interpreter Submodule (PZ116E) for more information

SENSOR MONITOR
SMB coaxial, GND on outer line, 0 to 10 V on inner line
Filtered and processed sensor output value, 0 to 10 V representing nominal travel range.

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.

USB socket 
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.

On Target LED, green
On target signal from E-802 servo-control submodule, indicates distance from target less than ±0.19% of range.

Overflow LED, yellow

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 -20 V to 120 V range). If this LED glows in closed-loop operation (servo ON), a zero-point adjustment is necessary. Follow the instructions for zero-point adjustment given in Section 4.2.1 on p. 23. To avoid an overflow of the amplifier in open-loop operation, do not exceed the allowable control input range.

Power LED, green

Permanent glow indicates that the E-625 is powered on.

Settings DIP switch block

The ON position is down.

Switch	Function
1	Usage of ANALOG IN/WTT socket as control input
2	Control input given by the E-816 computer interface submodule installed in E-625
3	Servo mode selection: OFF (up) = servo off (open-loop operation)* ON (down) = servo on (closed-loop operation)
4	Usage of ANALOG IN/WTT socket as trigger input

*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 (= up).

Switches 1, 2 and 4 determine the control mode (computer-controlled or analog) of the E-625 and hence the applicable control sources. See “Control Modes” on p. 15 for details

Switch	Computer-Controlled Mode	Analog Mode
1	OFF	ON
2	ON	OFF
4	ON	OFF

Unpredictable behavior may result if sw 1, 2 and 4 are set incompatibly.

Zero potentiometer

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. 23 for more details.

PZT
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 -20 to 120 V.

SENSOR
4-conductor LEMO EPL.0S.304.HLN for sensor input. Wiring depends on sensor type. See Section 9.4.3 on p. 45 (.SR models) or 9.4.4 on p. 45 (.LR models)

3.1.2 Rear Panel Elements



Fig. 2: E-625 Rear Panel Elements

Network
Sub-D 9f socket with lines for networking (I^2C bus). For pinout see p. 44.

Ground stud
Because grounding is not assured over the power connection, the ground stud must be connected to a protective ground. Note that it, the metal case, and the piezo output ground are the same, but are not tied directly to the DC in or logic grounds.

DC IN 12-30 V
Socket for power supply; use Barrel-to-Switchcraft adapter (K050B0002) with C-890.PS wide-range (100-240 VAC) 15 V power supply (both included with E-625). For pinout see p. 44.

3.2 Modes of Operation

Control modes: The E-625 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-625 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-625 front panel.

- **Analog mode:**

  Activated with the following settings (ON position is down):
  1 = ON, 2 = OFF, 4 = OFF

  The output voltage depends on the input voltage applied to the “ANALOG IN/WTT” SMB socket of the E-625.
  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 nominal input voltage range is 0 to +10 V for a 0 to 100 V output voltage swing. For some applications, where the full expansion capability of the piezo translators is needed, the full output voltage range of -20 to +120 V can be used. The equivalent input voltage range is then -2 to +12 V. For maximum piezo lifetime, excursions above 100 V and below -10 V should be kept as short and as infrequent as possible.

  The analog control input can be a computer-generated analog signal (e.g. from a DAQ board). You can use the PI LabVIEW Analog Driver set provided on the E-816 CD to generate that analog signal. This driver set also includes

the Hyperbit™ drivers which make possible position resolution higher than that of the DAQ board used. New releases of the LabVIEW Analog Driver set are available from the download area at www.pi.ws. See the E500T0011 Technical Note and the manual of the LabVIEW Analog Driver set provided on the E-816 CD for instructions. For the Hyperbit™ extension, contact your PI Sales Engineer.

- **Computer-controlled mode:**

  Activated with the following settings (ON position is down):
  1 = OFF, 2 = ON, 4 = ON

  The E-816 computer interface module installed in the E-625 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 IN/WTT” socket is ignored.

Notes

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 current 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-625 front panel:
  OFF (up) = servo off (open-loop operation)
  ON (down) = servo on (closed-loop operation)

- Via axis-specific SVO commands sent over the communications interface or received from a macro running on the E-816.
  Using the SVO? command, you can check the last sent SVO settings on a per-axis basis

Notes

Servo-control is implemented on a small PCB submodule (E-802.55). This submodule is included with the E-625 and comes already installed. The block diagram on p. 29 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 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 top cover. See Sections “Opening the Case” on p. 21 and “Components and Adjustment Elements” on p. 30 for more information.

- **Closed-loop operation**:

  Any control input (control voltage on “ANALOG IN/WTT”, 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.)

Notes

To give the E-816 complete control over the servo mode selection, DIP switch 3 on the E-625 front panel must be set to open-loop operation (= up).

SVO? does not report the setting of DIP switch 3 for the servo mode but only the last sent SVO settings.

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-625s over a single RS-232 or USB interface from a single host PC. The E-625 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.

Networking E-625s requires busing of “Network” socket lines 3 and 4 and a GND among them (pinout on p. 44). With multiple E-625.CRs networking requires also sensor synchronization via busing of lines 7 and 8 (see the E-625.CR User Manual PZ166E for details).

Note

The I^2C network may also include E-665 LVPZT controllers.

Interlink all units to be networked before you power them up. Otherwise it may be necessary to power-cycle all units for proper detection of the master unit (i.e. the unit directly connected to the host PC). To interlink the units, use E-665.CN cables (not included) with the “Network” sockets on the rear panels as shown in the figure below. The E-665.CN cables provide all required busing lines. They have piggyback sub-D connectors allowing more than one cable to be plugged into a single E-625. Because of the bus capacitance limit of 400 pF, at most three such cables can be used.

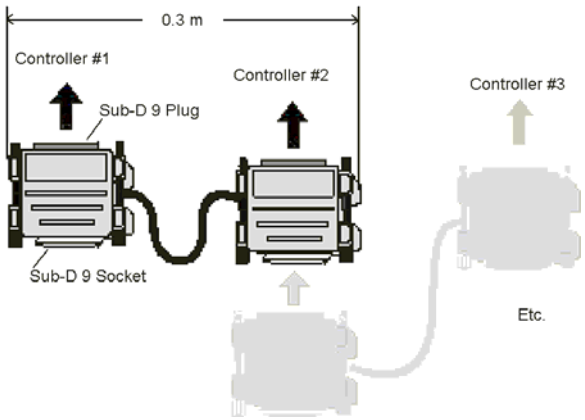


Fig. 3: E-665.CN networking cable

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.

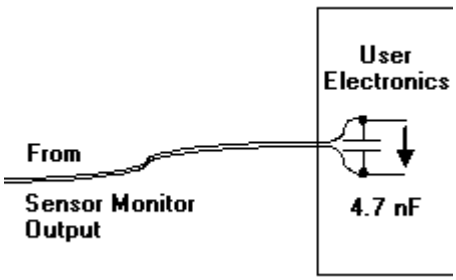


Fig. 4: Electronics on Sensor Monitor line with required input capacitance

4 Calibration

If PI had sufficient knowledge of your application and you ordered your system components together, they will be 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. Reference to the block diagram (p. 29) can aid in understanding the scope of the various control elements.

4.1 Opening the Case

DANGER

Procedures which require opening the case should be carried out by authorized, qualified personnel only.

Disconnect unit from power when opening the case, and when resetting internal switches or jumpers.

When the unit must be operated with the case open, voltages of up to 120 V can be exposed. Do not touch internal conductors.

Only the DIP switch block (S1) and the Zero potentiometer are accessible without opening the case. To access other adjustment elements, it is necessary to remove the top cover. To do this, unscrew and remove the crosshead screws on the front and rear panel and pull off the top cover of the case.

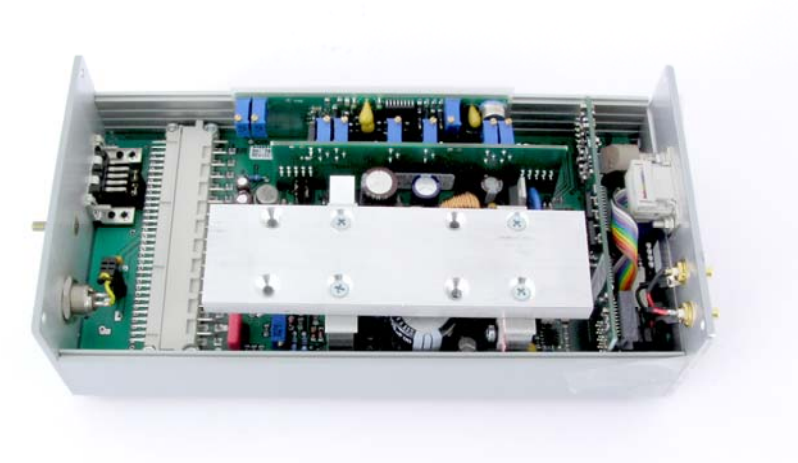


Fig. 5: E-625 with cover off

4.2 Sensor Connection and Adjustment

If you inform PI about your application, your E-625s will be fully calibrated before being shipped. It is usually not necessary for you to do anything more than adjust the zero point before operating the system.

CAUTION

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-625 front panel, see the wiring diagrams on p. 45 and p. 45. Depending on the E-625 model you have, the submodule for either DC or AC sensor excitation is installed:

- The E-625.LR provides AC sensor processing: it is equipped with the E-801.2x submodule and is primarily for LVDT sensors.
- The E-625.SR provides DC sensor processing (it is equipped with the 801.1x 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 “E-801 Sensor Processing Submodule” section, starting on p. 32 for more details on the sensor submodules.

As seen in the block diagrams, the sensor signal goes through the E-801sensor readout electronics and then branches to the E-816 computer-interface submodule and the E-802 servo-control submodule.

Since the servo-control 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 E-801 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.

4.2.1 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. DIP switch 3 must be OFF	Set DIP switch 3 OFF. Make sure that servo is not set on with SVO command.

4. Exercise the piezo over the nominal expansion range	Command voltages from 0 to 100 V, e.g. with SVA command	Apply an analog signal in the range of 0-10 V to “ANALOG IN/WTT”
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 IN/WTT”
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 in spite 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.

4.2.2 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 85-105 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 µm resolution

DANGER

Procedures which require opening the case should be carried out by authorized, qualified personnel only.

Disconnect unit from power when opening the case, and when resetting internal switches or jumpers.

When the unit must be operated with the case open, voltages of up to 120 V can be exposed. Do not touch internal conductors.

OPEN-LOOP SENSOR RANGE	Computer-Controlled Mode	Analog Mode
1. Make adjustment elements accessible	Open the case (qualified, authorized personal only)	Open the case (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. DIP switch 3 must be OFF	Set DIP switch 3 OFF. Make sure that servo is not set on with SVO command.
5. Exercise the piezo over the nominal expansion range	Command voltages from 0 to 100 V, e.g. with SVA command	Apply an analog signal in the range of 0-10 V to “ANALOG IN/WTT”
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 IN/WTT”
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 Section 4.2.1.	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 Section 4.2.1
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 E-801xx until the value at the “SENSOR MONITOR” SMB socket on the front panel is 10 V. See the User Manual of the E-801 Sensor Processing Submodule for component designation and location.
10.	Recheck	It may be necessary to repeat the last steps until stable readings are obtained.

4.2.3 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.

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.

DANGER

Procedures which require opening the case should be carried out by authorized, qualified personnel only.

Disconnect unit from power when opening the case, and when resetting internal switches or jumpers.

When the unit must be operated with the case open, voltages of up to 120 V can be exposed. Do not touch internal conductors.

CLOSED-LOOP SERVO STATIC GAIN	Computer-Controlled Mode	Analog Mode
1. Make adjustment elements accessible	Open the case (qualified, authorized personal only)	Open the case (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.
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 IN/WTT” SMB socket 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 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 E-801.x sensor module	
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.

4.3 Servo-Control Dynamic Characteristics

The object of servo-control dynamic calibration is to regulate behavior such as overshoot, ringing and settling time. The servo-control 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 1Hz to 1 kHz and an ohmmeter with a range from 0.1 to 100 k-ohm.

DANGER

Procedures which require opening the case should be carried out by authorized, qualified personnel only.

Disconnect unit from power when opening the case, and when resetting internal switches or jumpers.

When the unit must be operated with the case open, voltages of up to 120 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-control 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).

5 Electronics Details

5.1 E-625 Block Diagram

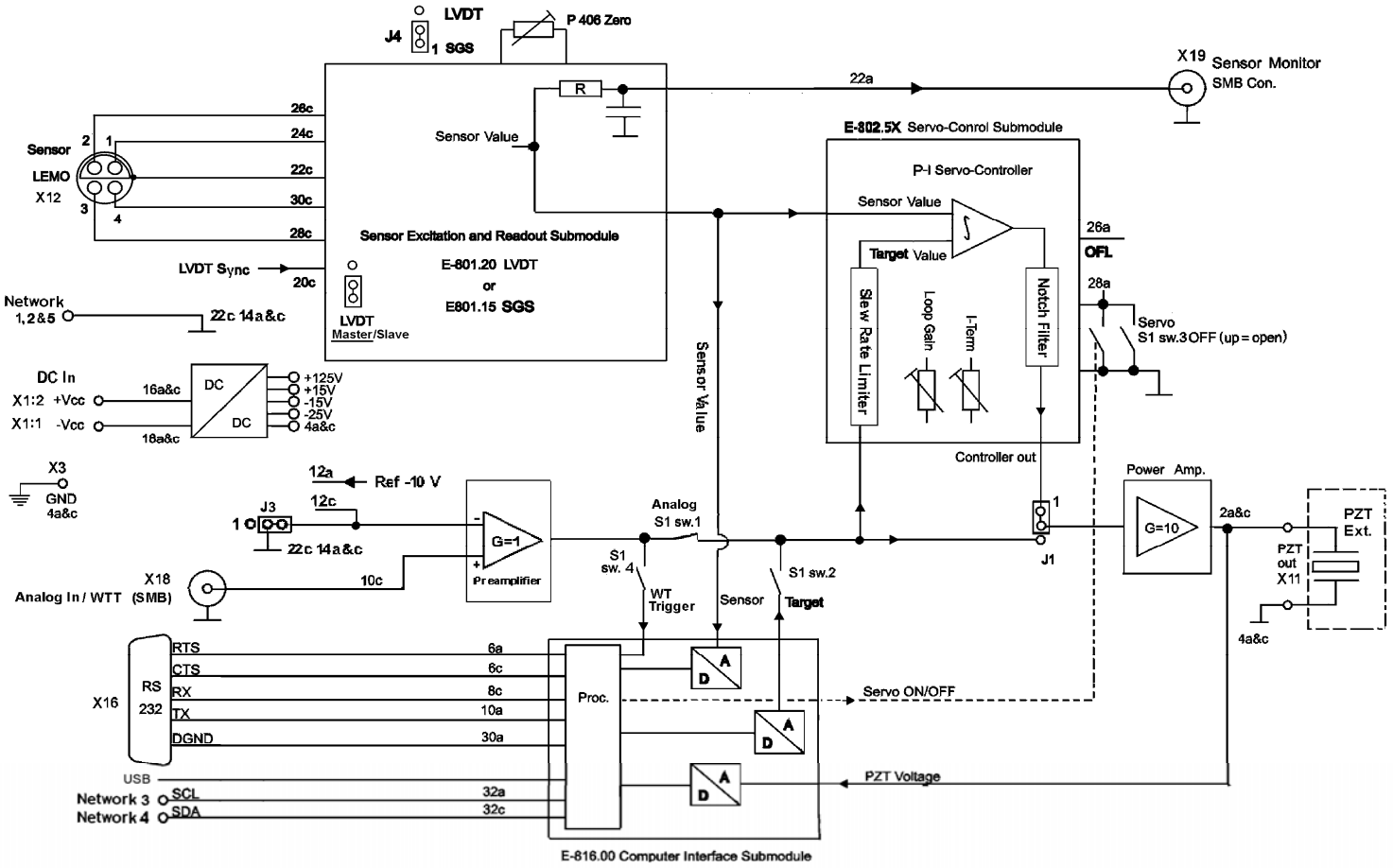


Fig. 6: E-625 Block Diagram

NOTE:
Depending on the switch settings, input signals on the analog input line will be used either as control input, or as digital input for triggering.
IPin numbers 2a through 32c refer to the internal 32-pin connector and are given for informational purposes only.

5.2 Components and Adjustment Elements

See also the E-801 and E-802 User Manuals for adjustment elements on those submodules which are not described here.

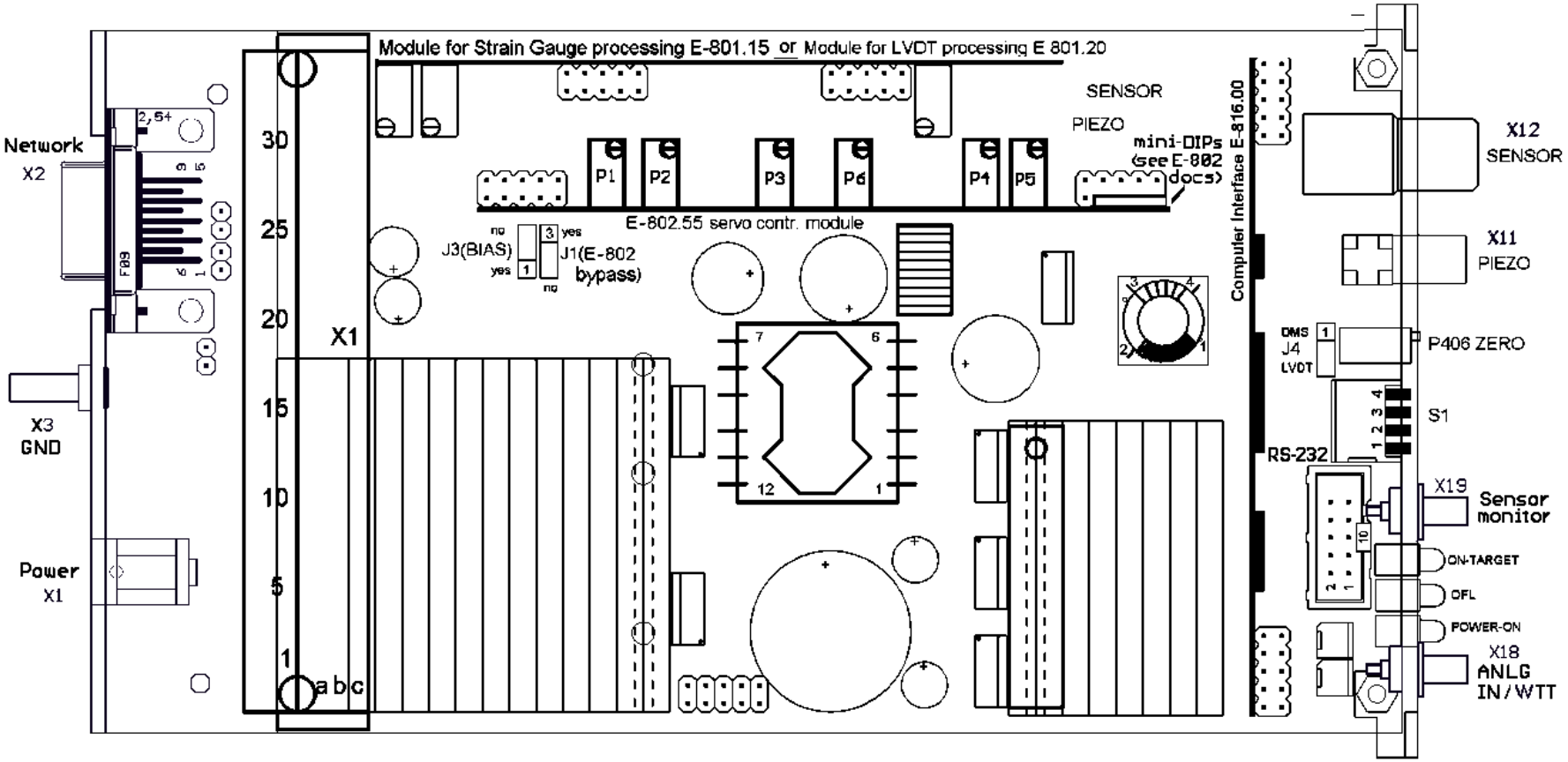


Fig. 7: E-625 (viewed from component side) component locations; adjustment elements shown in default settings

5.2.1 Jumpers

Jumpers are also shown on the block diagram on p. 29.

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-625 front panel 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 Provision for DC offset potentiometer (not included or described):
1-2 activated (do not activate without rewiring)
2-3 deactivated

J4 Type of sensor activation/processing:
1-2 DC (strain gauge only),
2-3 AC (primarily LVDT)
Must match the type of sensor-processing submodule installed (E-801.2x for AC, i.e. LVDT sensor; E-801.1x for DC, i.e. SGS sensor)

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-Control submodule (positive polarity, 0-10 V)

Position of the Jumper JP107		
Polarity of Output	Positive	Negative

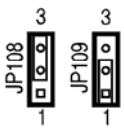
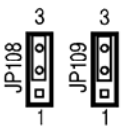
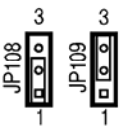
Typical Application	Using with PI's position control electronics	Using as a position detector	Special application
Position of Jumpers JP108 and JP109			
Voltage range of output	0V ~ 10V	-5V ~ +5V	-10V ~ 0V

Fig. 8: E-625 sensor processing output settings

5.2.2 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 “ANALOG IN/WTT” line used as analog input
	OFF (up)	Signal on “ANALOG IN/WTT” 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
sw4	ON (down)	Signal on “ANALOG IN/WTT” line used as trigger for wave table output or triggered motion
	OFF (up)	Signal on “ANALOG IN/WTT” 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. 11.

5.2.3 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.

5.3 E-801 Sensor Processing Submodule

Sensor excitation and processing is implemented on small, replaceable submodules.

SGS versions have E-801.1x submodules which provide DC sensor excitation and readout. LVDT versions have E-801.2x submodules which provide AC sensor excitation. They can also be connected to SGS sensors if necessary.

On systems with more than 1 networked LVDT version, it is not necessary to synchronize the LVDT excitation frequencies.

Should you ever need to make any adjustments on the sensor submodules, refer to the E-801 User Manual for more details.

5.4 E-802 Position Servo-Control Board

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 sensor signal to generate the amplifier control signal using an analog proportional-integral (P-I) algorithm.

For calibration procedures, see "Servo-Control Static Gain Calibration", p. 26 and "Servo-Control Dynamic Characteristics", p. 28. The E-802 submodule is described in detail in a separate user manual.

6 Troubleshooting

Stage does not move

Cable not connected properly

→ Check the connecting cable(s)

Stage or stage cable is defective

→ If a working stage of the same type is available, exchange the defective stage to test a new combination of E-625 and stage. Since stage and E-625 always form a calibrated system, the performance with the new stage will probably be lower than with the original stage. If the new stage is to be used permanently and in normal operation, a new calibration is required. See “Calibration” on p. 21 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. 15 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 (“Control Modes”, p. 15).

No control signal applied or signal out of range

→ In analog mode, apply an analog control signal to the “ANALOG IN/WTT” SMB socket to command the axis motion. Unless your stage has a custom calibration, the signal should always be in the range of 0 to 10 V (excursions to -2 or +12 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 LabVIEW Analog Driver Set, 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 ERR? command. Note that the response to this command contains only the error code of the master unit. See the ERR? 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 stage (axis identifier also required with single-axis systems!)

Incorrect configuration

→ Check the parameter settings on the E-816 computer interface module with the SPA? command.

The high voltage output of the E-625 is deactivated

→ If the internal temperature goes out of range (75 °C or higher), the high voltage output of the E-625 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.

How to avoid overheating:

Keep the ambient temperature at a noncritical value: Note that the difference between ambient temperature and internal temperature of the E-625 normally is about 20 Centigrade (36 Fahrenheit) degrees.
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.

Communication with controller does not work

Communication cable is wrong or defective

→ 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

→ 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.

→ The first time you connect over the USB interface, be sure you are logged on the PC as a user having administrator rights. After the E-625 is powered on, a message will appear saying that new hardware has been detected. Follow the on-screen instructions and insert the E-816 CD. The required hardware driver is found in the \USB_Driver directory.

Controller was power-cycled or rebooted

→ With USB connections, communication can not be maintained after the E-625 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

→ Close the other program.

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. PI Terminal, and entering `*IDN?`. Note that multi-character commands are transferred as terminated by a LF (line feed) character and are executed only after the LF is received.

Unsatisfactory system performance

The sensor values are not reliable, and the whole system is instable.

→ Only thermally stable systems can have the best performance. For a thermally stable system, power on the E-625 at least one hour before you start working with it.

The stage starts to oscillate, or shows nonsatisfying settling behaviour.

→ 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. 28 for details.

Overflow LED glows

The output of the amplifier is being clipped at one of its limits.

→ Try to adjust the sensor reading window as described in "Open-Loop Zero-Point Adjustment" on p. 23 (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 ±10% of the stage 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 in spite of zero point adjustment may indicate hardware failure. Contact your Physik Instrumente Sales Engineer.

Custom software accessing PI drivers does not run.

Wrong combination of driver routines/Vis

→ Check if system runs with Terminal program. If yes read the software manual and compare sample code from the E-816 CD to check the necessary driver routines.

7 Customer Service

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

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

8 Old Equipment Disposal

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

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

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

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



9 Technical Data

9.1 Specifications

	E-625.SR, E-625.LR
Function	Piezo Amplifier / Servo-Controller
Axes	1
Sensor	
Servo characteristics	P-I (analog), notch filter
Sensor type	SGS with .SR, LVDT with .LR
Sensor resolution	20-bit
Amplifier	
Control input voltage range	-2 to 12 V
Min. output voltage	-20 to 120 V
Peak output power, < 5 ms	12 W
Average output power	6 W
Peak current, < 5 ms	120 mA
Average current	60 mA
Current limitation	Short-circuit-proof
Noise, 0 to 100 kHz	0.8 mVrms
Ripple of Uout	20 mVpp at low frequencies, 40 mVpp (spikes) at 30 kHz
Voltage gain	10 ±0.1
Input impedance	100 kΩ

Interfaces and operation	
Interface / communication	USB, RS-232 (9-pin Sub-D connector, 9.6 - 115.2 kBaud), 24-bit A/D and 20-bit D/A resolution
Piezo connector	LEMO ERA.00.250.CTL
Sensor connection	LEMO EPL.0S.304.HLN
Control input / trigger input socket	SMB
Sensor monitor socket	SMB
Sensor monitor output	0 to +10 V for nominal expansion
Controller network	up to 12 channels
Supported functionality	Wave table with 256 data points, external trigger, 16 macros
Miscellaneous	
Operating temperature range	+5 to +50 °C (10% derated over 40 °C)
Overheat protection	Deactivation at 75°C
Dimensions	205 x 105 x 60 mm
Mass	1.05 kg
Operating voltage	12 to 30 V DC, stabilized (C-890.PS 15 V wide-range power supply included)
Current consumption	2 A

9.2 Frequency Response Diagram

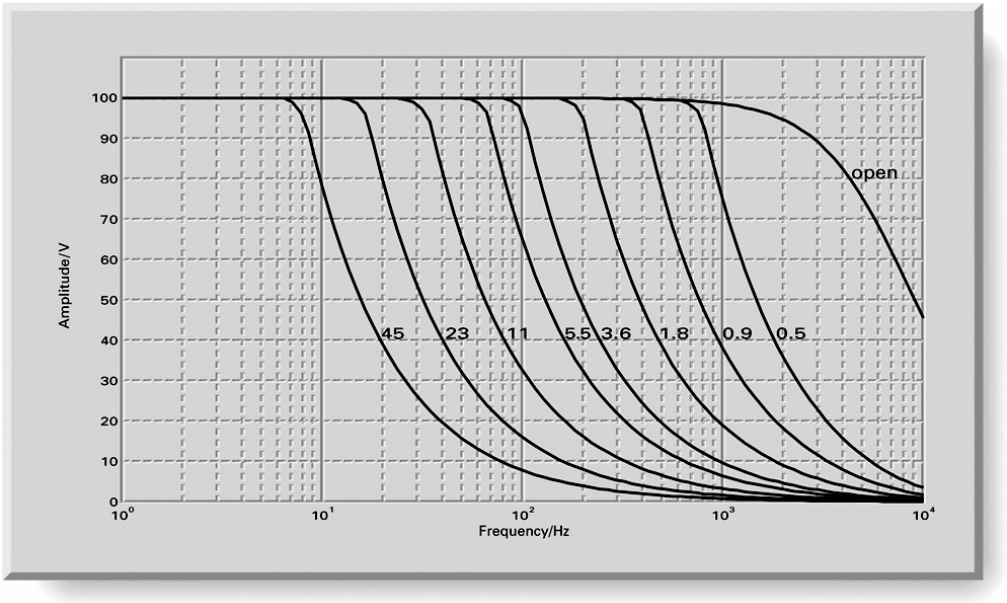


Fig. 9: E-625 open-loop frequency response with various piezo loads. Values shown are capacitance in µF

9.3 Dimensions

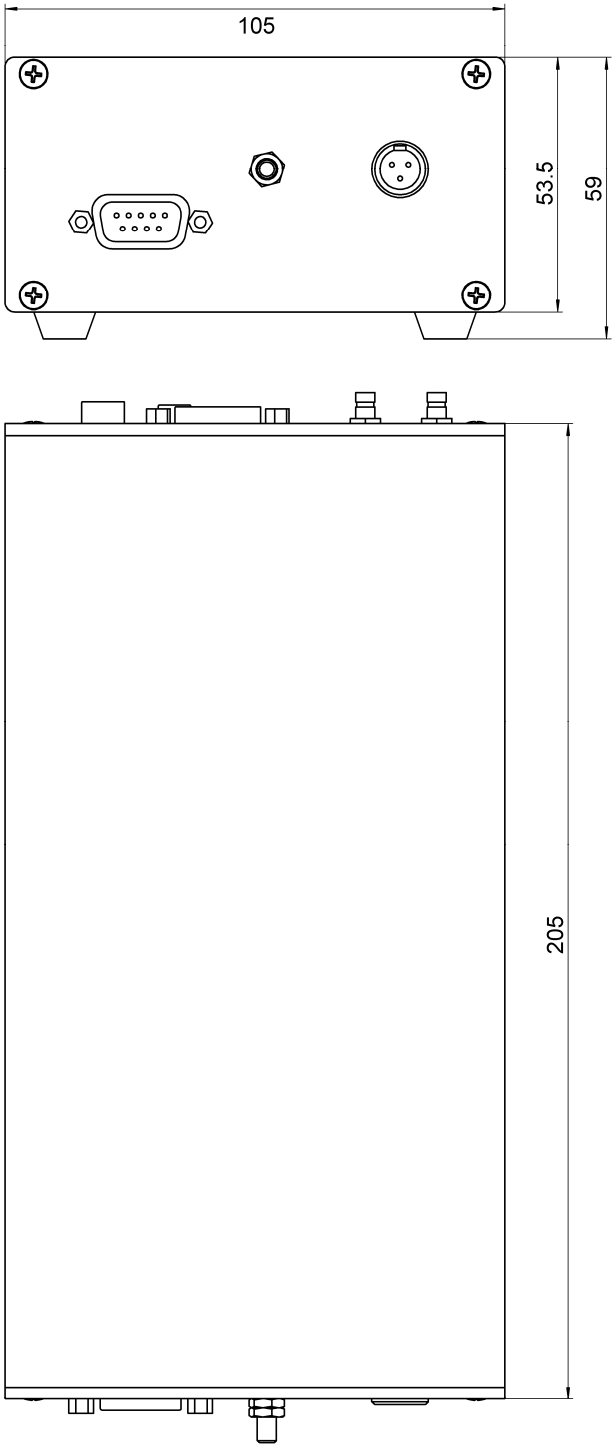


Fig. 10: E-625 dimensions in mm

9.4 Pin Assignments

9.4.1 Network

Sub-D 9 female with the following pinout:

Pin 1,2 & 5	GND
Pin 3	SCL (I^2C networking)*
Pin 4	SDA (I^2C networking)*
Pin 7	reserved (line used by E-625.CR models)
Pin 8	reserved (line used by E-625.CR models)
Pin 6	n.c.
Pin 9	n.c.

*The SCL and SDA bus lines are limited to a maximum length of 1 m and a maximum capacitance of 400 pF.

A cable with convenient piggy-back sub-D 9-pin connectors is available as E-665.CN for networking E-625s (see p. 18).

9.4.2 Power Connector

Pin 1	Power supply GND
Pin 2	12 to 30 VDC (15 V recommended), stabilized
Pin 3	n.c.

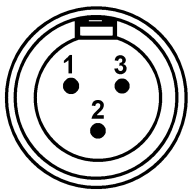


Fig. 11: E-625 Power connector, viewed from outside case.

Because grounding is not assured over the power connection, the ground stud on the E-625 rear panel must be connected to a protective ground. Note that it, the metal case, and the PZT output ground are the same, but are not tied directly to the DC in or logic grounds.

9.4.3 Strain Gauge Sensor Wiring

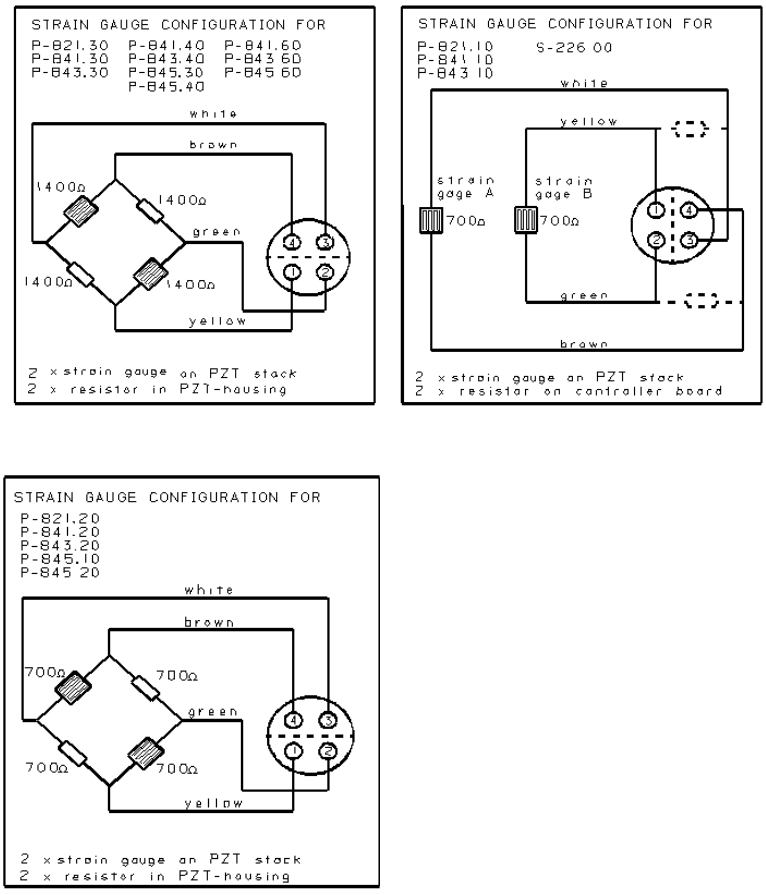


Fig. 12: Pin configurations and wiring for various different stages

9.4.4 Linear Variable Differential Transformer (LVDT) Sensor Wiring

Sensors working on the principle of LVDTs usually have a coil with a primary winding, two secondary windings and a moving core. If an AC current is applied to the primary winding, it produces a magnetic field which is concentrated by the soft iron or ferrite core. The magnetic field then passes through the two secondary windings and induces a voltage in each. If the core is moved from the central position, one secondary winding receives more magnetic flux than the other and the induced voltages are different—proportional to the motion. LVDT transducers normally operate at 3 to 5 Vrms, at frequencies between 1 and 20 kHz, and have a typical current consumption

between 10 and 50 mA.

The output signal from an LVDT can be expressed as a sensitivity in mV output voltage per volt of supply voltage and per millimeter displacement. Typical LVDT output sensitivity is in the range of about 100 to 250 mV/V•mm, depending on the type.

LVDTs have to be used in conjunction with E-625.LR versions, which are equipped with the E-801.2x AC sensor submodules.

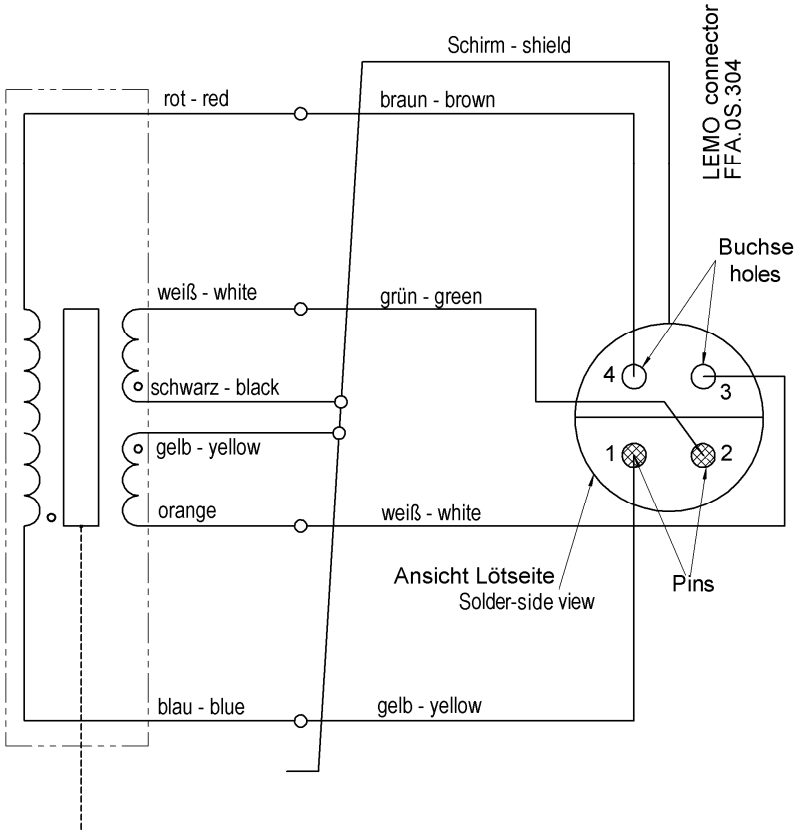


Fig. 13: LVDT wiring diagram

10 Appendix

10.1 Internal 32-Pin Connector

The pinout of this internal connector is provided for informational purposes only.

Pin	Function	Pin	Function
2a	PZT output	**2c**	PZT output
4a	PZT GND (tied to case)	**4c**	PZT GND (tied to case)
6a	RS-232/RTS	**6c**	RS-232/CTS
8a	Internal use	**8c**	RS-232/RX
10a	RS-232/TX	**10c**	Analog input / trigger input (use depends on sw1 and sw4 settings)
12a	Pot* 10 kOhm (-10V)	**12c**	Pot* wiper
14a	Pot* 10 kOhm (GND)	**14c**	Pot* 10 kOhm (GND), also Test GND
16a	+VCC supply	**16c**	+VCC supply
18a	-VCC supply	**18c**	-VCC supply
20a	Internal use	**20c**	nc (reserved)
22a	Monitor, sensor	**22c**	nc (reserved)
24a	Internal use	**24c**	nc (reserved)
26a	Overflow (TTL, active-low)	**26c**	nc (reserved)
28a	Servo ON/OFF select	**28c**	nc (reserved)
30a	GND for RS-232	**30c**	nc (reserved)
32a	I^2C SCL-signal**	**32c**	I^2C SDA signal**

* DC-offset pot is not included or described with this product. It is deactivated by jumper X8.

**The SCL and SDA bus lines are limited to a maximum length of 1 m and a maximum capacitance of 400 pF; they appear on the “Network” connector.



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