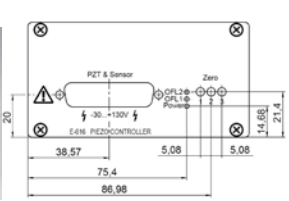
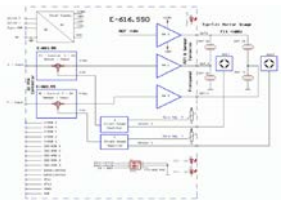
PZ219E User Manual
E-616.SS0G • E-616.S0G Bench-Top Controller
for Piezo Multi-Axis Tip/Tilt Platforms

Release: 1.0.3 Date: 11.01.2012

This document describes the following products:

- E-616.SS0G
  Multi-Channel Servo Controller for Piezo Tip/Tilt Platforms with SGS and Based on Differential Drive, Bench-Top
- E-616.S0G
  Multi-Channel Servo Controller for Piezo Tip/Tilt Mirror Stages with SGS and Based on Tripod Drive, Bench-Top





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: **Controller for Piezo Multi-Axis Tip/Tilt Platforms**
Model Numbers: **E-616**
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

Electrical equipment, which is intended to be integrated in other electrical equipment, only conforms to the cited EMC Standards and normative documents, if the user ensures a compliant connection when implementing the total system. Possible necessary measures are installation of the component in a suitable shielded enclosure and usage of suitable connectors.

March 23, 2009
Karlsruhe, Germany

Dr. Karl Spanner
President

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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-616 Bench-Top Controller for Piezo Multi-Axis Tip/Tilt Platforms. It assumes that the reader has a fundamental understanding of basic servo systems, as well as motion control concepts and applicable safety procedures.
Furthermore the manual describes the physical specifications of the E-616 Bench-Top Controller for Piezo Multi-Axis Tip/Tilt Platforms.

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 mechanics, submodules and the software tools which might be mentioned in this documentation are described in their own manuals. Current releases can be downloaded from the PI Website as PDF files (htt p://www .pi.ws). For updated releases contact your Physik Instrumente Sales Engineer or write info@pi.ws.

Contents

1 Introduction

1.1 Overview

The E-616 is a special controller for piezo based tip/tilt mirrors and tip/tilt platforms with high-resolution strain gauge sensors. A high peak output power of 10 W per channel allows dynamic operation of the tip/tilt mirrors for applications such as (laser) beam steering or stabilization. Average output power is 5 W.

All multi-axis piezo tip/tilt mirrors of PI are designed as parallel-kinematics: all actuators affect the same movable platform. Two orthogonal rotation axes share a common pivot point. For position controlled S-330.xSD or S-334.2SD tip/tilt mirrors the differential evaluation of two sensors per axis provides an improved linearity and resolution. E-616 Controllers together with tip/tilt platforms from PI make an ideally matched system and are available in two versions:

- E-616.S0G bench-top controller for tip/tilt platforms, based on tripod design (e.g. S-325): the platform is equipped with three piezo actuators spaced at 120° intervals
- E-616.SS0G bench-top controller for tip/tilt platforms, based on differential design (e.g. S-330 or S-334): four actuators operate in push-pull mode

Internal Coordinate Transformation Simplifies Control of Parallel Kinematics Designs

Parallel-kinematics requires the transformation of the commanded tilt angles into the corresponding linear motion of the individual actuators. In the E-616.S0G, this is taken care of by an integrated circuit for the S-325 tip/tilt platforms featuring three actuators, eliminating the need of additional external hardware or software. Additionally with the E-616.S0G all actuators can be commanded by an offset-voltage simultaneously. As a result a vertical motion, for example for optical path tuning, is obtained.

1.2 Prescribed Use

Based on their design and realization, E-616 bench-top controllers for piezo multi-axis tip/tilt platforms are intended to drive capacitive loads, in the present case, piezoceramic actuators. E-616 Controllers must not be used for applications other than stated in this manual, especially not for driving ohmic (resistive) or inductive loads.

Observe the safety precautions given in this User Manual.

The E-616 is a laboratory apparatus as defined by DIN EN 61010. It meets the following minimum specifications for safe operation (any more stringent specifications in the technical data table are, of course, also met):

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

1.3 Safety Precautions

Carefully read also the user manuals and / or technical notes of all other components involved, as e.g. of mechanics and software.
Failure to heed warnings in this manual can result in bodily injury or material damage or loss of warranty.

DANGER - HIGH VOLTAGE

E-616 Power Amplifiers output VERY HIGH VOLTAGES and HIGH CURRENTS which can cause death or injury! Working with these devices requires adequately trained and educated operating personnel. Follow general accident prevention rules!

- Do not touch the pins of the sub-D connector which carry the piezo output voltage and the sensor signals. The high voltage output may be active whenever the controller is turned on. Voltages between -30 V and 130 V can be present on the sub-D connector.
- Because grounding is not assured over the power connection, the ground stud on the rear panel must be connected to a Protective Ground

DANGER

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

Disconnect the E-616 from power when opening the case, and when resetting internal switches or jumpers.

When the E-616 must be operated with the case open, voltages of up to 130 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.

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

CAUTION

!

The product described is an ESD-sensitive (electrostatic discharge sensitive) device. Observe all precautions against static charge buildup before handling these devices.

Avoid touching circuit components, pins and PCB traces. Discharge any static charge 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.

CAUTION - AIR CIRCULATION

Provide for sufficient ventilation. Insufficient air flow will cause overheating and premature failure.
For detailed information on overheat protection see "Troubleshooting" (p. 36), second section.

CAUTION-RESONANT FREQUENCY

Most piezo actuators that can be connected to the E-616 can be destroyed by uncontrolled oscillation near the mechanical resonant frequency. If you observe resonance while configuring your system, switch off power to the actuators concerned immediately and follow the instructions in section "Dynamic Calibration" (p. 31).

CAUTION-CALIBRATION

If you inform PI about your application, your E-616 will be fully calibrated before being shipped. Tip/tilt platform and controller are matched and calibrated together. Do not interchange controller (whole devices or individual modules) and/or tip/tilt platforms when they are calibrated together. Respect the assignment of the tip/tilt platforms to the controllers, as indicated by the serial numbers on the labels affixed to the devices. Re-calibration should only be done by adequate trained personnel and after consultation with PI. Otherwise preset data will be lost. Only if an overflow LED (OFL1, OFL2) glows a zero-point adjustment will be necessary.

CAUTION-SYSTEM ASSIGNMENT

Connect only a matching tip/tilt platform to the corresponding E-616 Controller version: tip/tilt platforms such as S-325.3SD (tripod design) to E-616.S0x, SD-versions of S-330 series or S-334 tip/tilt platforms (differential design) to E-616.SS0x.

CAUTION - V-MON-MEASUREMENT

Be sure to use a suitable input impedance when you measure the following monitor voltages on the "Analog Interface" connector:
V-MON-X (pin 1), V-MON-Y (pin 2), and V-MON-1 to V-MON-3 (pins 3, 4, 5).
V-MON-X, V-MON-Y: Output impedance is 11 kΩ per channel
V-MON-1 to V-MON-3: Output impedance is 1 kΩ per channel
Your measurement device may get damaged if you measure without appropriate input impedance.

CAUTION - SGS-MON-MEASUREMENT

Be sure to use a suitable input impedance when you measure the following monitor voltages on the "Analog Interface" connector: SGS-MON-X (pin 9), SGS-MON-Y (pin 10), and SGS-MON-1 to SGS-MON-3 (pins 11, 12, 13).

SGS-MON-X, SGS-MON-Y: Output impedance is 50 Ω per channel

SGS-MON-1 to SGS-MON-3: Output impedance is 10 kΩ / 10 nF

Your measurement device may deliver false values if you measure without appropriate input impedance.

1.4 Model Survey

The following standard configurations of E-616 controllers are available:

E-616.SS0G	Multi-Channel Servo Controller / Driver for Piezo Tip/Tilt Mirror Platforms with SGS and Differential Drive, Bench-Top
E-616.S0G	Multi-Channel Servo Controller / Driver for Piezo Tip/Tilt Mirror Platforms with SGS and Tripod Drive, Bench-Top

Both versions are also available as OEM modules (E-616.SS0, E-616.S0), see Figure 1 below:

Figure 1: E-616.Sx Controller module with S-334 tip/tilt mirror

The OEM modules are described in a separate manual (PZ200E). You can download it from the PI website.

One E-802.55 servo module per tilt axis is integrated in the E-616 analog controllers. Find more information on these servo modules in the separate User Manual (PZ150E, included in the contents of delivery).

1.5 Optional Accessories for E-616

E-500.ACD — LabVIEW driver set for analog controllers, available free of charge upon request.

Computer control can be implemented using a DAC-board in a PC to generate the analog input signal. PI offers a LabVIEW driver set which can be used with certain D/A boards. This driver set is compatible with the PI General Command Set (GCS) LabVIEW driver set available for all newer controllers from PI.

The PI Analog Controller drivers support all D/A converter boards from National Instruments that are compatible with DAQmx8.3. LabVIEW compatibility is given from version 7.1 upwards.

The driver set is also available for download from the PI website.

E-500.HCD — Access to HyperBit Functionality for Enhanced System Resolution (Supports Certain D/A Boards). PI's patented HyperBit technology for providing position resolution higher than that of the D/A board is in the E-500.ACD driver set. Activating HyperBit requires purchase of the password, which can be obtained from PI under Order No. E-500. HCD.

1.6 Unpacking

Unpack the E-616 bench-top controller for piezo multi-axis tip/tilt platforms with care. Compare the contents against the items covered by the contract and against the packing list.

The following components are included:

E-616	in ordered configuration
PZ219	User Manual for E-616.SS0G/E-616.S0G (this document)
PZ150E	User Manual for E-802 Servo-Control Submodule
C-663.PS	Power supply, 24 V DC

E-692.SMB	3 adapter cables for SMB/BNC, 1.5 m
819007423, 2515	15-pin sub-D connector with shell, without cable
E500T0011	Technical Note, contains access information for downloading the latest version of GCS LabVIEW driver set for analog controllers

Inspect the contents for signs of damage. If parts are missing or you notice signs of damage, contact PI immediately.
Save all packing materials in case the product need be shipped again.

2 Starting Operation

2.1 Calibrated System

If an E-616 Controller is ordered together with a tip/tilt platform, the system will be fully calibrated at PI according to your specifications before being shipped, and will come with a calibration information sheet.

CAUTION-CALIBRATION

!

If you inform PI about your application, your E-616 will be fully calibrated before being shipped. Tip/tilt platform and controller are matched and calibrated together. Do not interchange controller (whole devices or individual modules) and/or tip/tilt platforms when they are calibrated together. Respect the assignment of the tip/tilt platforms to the controllers, as indicated by the serial numbers on the labels affixed to the devices. Re-calibration should only be done by adequate trained personnel and after consultation with PI. Otherwise preset data will be lost. Only if an overflow LED (OFL1, OFL2) glows a zero-point adjustment will be necessary.

2.2 Front and Rear Panel Elements

2.2.1 Front Panel of the E-616 Controller

Figure 2: Front panel of the E-616 Controller

Front panel element	Function
25-pin sub-D socket "PZT & Sensor"	For connection of tip/tilt platforms with SGS sensors; appropriate tip/tilt platform (i.e. differential drive or tripod drive) depends on E-616 Controller model For pin assignment see "PZT & Sensor Connector of the E-616" (p. 48)
Zero 1 to Zero 3 potentiometers	For zero-point adjustment of the SGS-sensor channels 1 to 3
"OFL1" and "OFL2" LED	Green light for overflow of the amplifier, see "Zero-Point Adjustment" (p. 27) for more information
"POWER" LED	Green light glows permanently, indicates connection to power supply

NOTE

Note that sensor channel 3 (SGS-MON-3) and potentiometer Zero 3 are deactivated with the E-616 Controller based on differential drive.

NOTE

Overflow is Possible in Open-Loop Mode

In open-loop operation, exceeding the allowable control input range will cause an overflow condition of the corresponding amplifier. In this case the maximum amplifier output voltage is reached and cannot be exceeded. For further information see sections "Analog Control Input" respectively "Zero-Point Adjustment" (p. 27).

2.2.2 Rear Panel of the E-616 Controller

Figure 3: Rear panel of E-616 bench-top cotnroller

Rear panel element	Function
Analog Interface	Sub-D socket, 15 pins, includes monitor outputs (for amplifier output voltage, internal control voltage and sensor signals) and inputs for activation / deactivation of servo control. For pin assignment see "Pin Assignment of "Analog Interface"" (p. 49)
Control Input Θ X, Θ Y, Z	SMB sockets for control input, see “Analog Control Input”, (p. 20)
DC IN	24 V DC, 2 A, connector for power supply
Ground stud	For connection to a Protective Ground since grounding is not assured over the power connection

NOTE

Note that SMB socket Z for commanding a vertical motion is deactivated with the E-616.SS0 Controller for differential drive design.

NOTE

Note that the vertical motion commanded by the E-616 Controller for tripod design (Z-Offset) always is in open-loop mode, independent from the operation mode of the X and Y tilt axes.

2.3 Open-Loop and Closed-Loop Operation

DANGER

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

Disconnect the E-616 from power when opening the case, and when resetting internal switches or jumpers.

When the E-616 must be operated with the case open, voltages of up to 130 V can be exposed. Do not touch internal conductors.

!

CAUTION

The product described is an ESD-sensitive (electrostatic discharge sensitive) device. Observe all precautions against static charge buildup before handling these devices.

Avoid touching circuit components, pins and PCB traces. Discharge any static charge 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.

Open-Loop Operation

All E-616 versions can be operated in open-loop mode. Open-loop operation of the tip/tilt platform axes means that any control input provided by the user (ΘX, ΘY and for E-616.S0 Z as well) determines the output voltage directly.

Closed-Loop Operation

Closed-loop operation requires a position sensor and a servo module. Any control input provided by the user determines the position of the tip/tilt platform axes. The output voltage required to reach this target position is calculated internally by the servo-loop, based on the given target and the feedback of the position sensors. In position-control operation non-linearity and drift effects are compensated. E-616 Controllers feature one E-802.55 servo-control module per tilt axis. You find a description of the servo-control modules in the E-802 User Manual PZ150E.

Selection of Open-Loop and Closed-Loop Operation

By default all E-616 Controllers are set to closed-loop mode and are calibrated. To change to open-loop mode open the device and use the internal DIP switches. If these switches are set to open-loop mode, an external selection of the operation mode is possible using the rear "Analog Interface" connector.

To open the device proceed as follows:

- Disconnect from line voltage by removing the external power supply from line voltage.
- To remove the top cover of the E-616 Controller case unscrew the six labeled and the two rear cross-head screws, see Figure 4 below

Figure 4: The top cover of the case is removed via the six labeled and two rear cross-head screws

The DIP switches for operating mode selection are marked in the Figure 5 below.

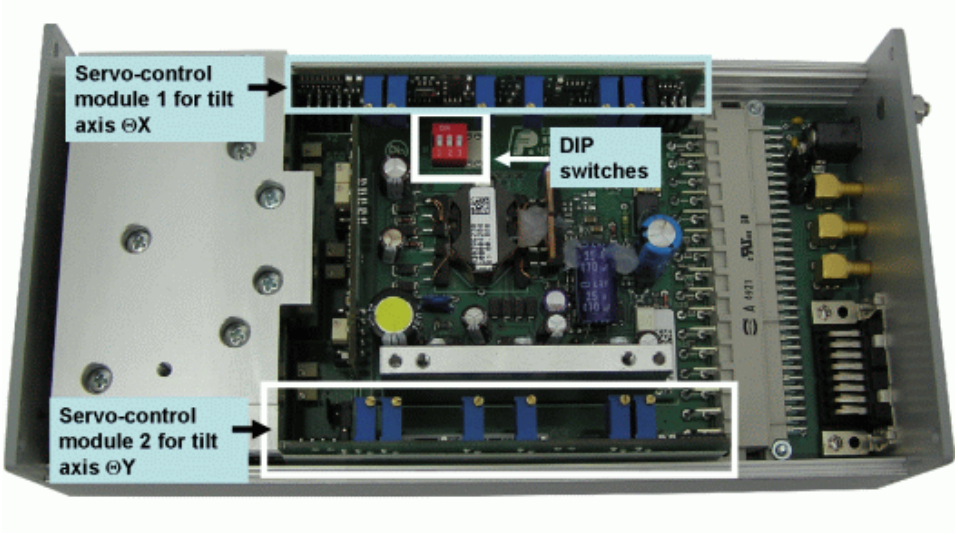


Figure 5: Assignment of servo-control modules to tilt axes and DIP switches to select Servo OFF/ON

- To change from closed-loop (servo-on) mode to open-loop (servo-off) mode use DIP switch 1 for servo-control module 1 and DIP switch 2 for servo-control module 2.

Servo-control module 1 is assigned to X-tilt axis, servo-control module 2 is assigned to Y-tilt axis.
To deactivate control of a tilt axis in principle set the corresponding DIP switch from On to Off.

NOTE

Separate Control of the Tilt Axes

Separate control of each of the two tilt axes is possible for both versions of the E-616 Controller. For example X tilt axis can be operated in closed-loop mode while Y tilt axis is in open-loop mode.

NOTE

Selection of Operating Mode by "Analog Interface" Connector

When DIP switches 1 and 2 are in OFF position then servo control can be activated / deactivated by pins 6 (Servo-1 OFF/ON) and 7 (Servo-2 OFF/ON) of the rear "Analog Interface" connector. Use TTL signals for these pins (0 V to 0.5 V = LOW = Servo ON; 3 V to 5 V = HIGH = Servo OFF).

NOTE

Note that the vertical motion commanded by the E-616 Controller for tripod design (Z-Offset) always is in open-loop mode, independent from the operation mode of the X and Y tilt axes.

2.4 Analog Control Input

For all E-616 models tip/tilt motion of the mirror platform is commanded by analog signals. Control input signals generated by external signal sources are connected to SMB sockets ΘX (Input X), ΘY (Input Y) and with the E-616.S0G tripod controller to Z (Z-Offset).

Computer control can be implemented using a DAC-board in a PC to generate the analog input signal. PI offers a LabVIEW driver set which can be used with certain D/A boards. This driver set is compatible with the PI General Command Set (GCS) driver set available for all newer controllers from PI. A further option includes the patented HyperBit technology providing enhanced system resolution.

Download instructions are in "Download of the GCS LabVIEW Driver Set for Analog Controllers" (p. 23).

NOTE - RANGE OF CONTROL INPUT FOR E-616.SS0 AND E-616.SS0G

By default E-616 Controllers are preset for closed-loop mode. There are different ranges of control input for closed-loop and for open-loop mode.
For E-616.SS0 and E-616.SS0G following control input ranges are valid:

- X- Input, Y-Input, closed-loop: 0 to +10 V
- X-Input, Y-Input, open-loop: -2 to +12 V

If you apply voltage exceeding these ranges the overflow LEDs glow.

NOTE - CONTROL INPUT RANGE FOR E-616.S0 AND E-616.S0G

With calibration of the tripod controllers E-616.S0x an offset voltage is applied to the piezo actuators to achieve a maximum tip/tilt range.

By default E-616 Controllers are preset for closed-loop mode. There are different ranges of control input for closed-loop and for open-loop mode.
For E-616.S0 and E-616.S0G following control input ranges are valid:

Closed-loop mode for tilt axes:

- X- Input, Y-Input: -5 to +5 V
- Z-Offset: -3 to +3 V

Open-loop mode for tilt axes:

- X-Input, Y-Input: -7 to +7 V
- Z-Offset: -3 to +3 V

If you apply voltage exceeding these ranges the overflow LEDs glow.

2.5 Initial Operation

DANGER - HIGH VOLTAGE

E-616 Power Amplifiers output VERY HIGH VOLTAGES and HIGH CURRENTS which can cause death or injury! Working with these devices requires adequately trained and educated operating personnel. Follow general accident prevention rules!

- Do not touch the pins of the sub-D connector which carry the piezo output voltage and the sensor signals. The high voltage output may be active whenever the controller is turned on. Voltages between -30 V and 130 V can be present on the sub-D connector.
- Because grounding is not assured over the power connection, the ground stud on the rear panel must be connected to a Protective Ground

!

CAUTION

The product described is an ESD-sensitive (electrostatic discharge sensitive) device. Observe all precautions against static charge buildup before handling these devices.

Avoid touching circuit components, pins and PCB traces. Discharge any static charge 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.

CAUTION - AIR CIRCULATION

Provide for sufficient ventilation. Insufficient air flow will cause overheating and premature failure.
For detailed information on overheat protection see "Troubleshooting" (p. 36), second section.

CAUTION-RESONANT FREQUENCY

Most piezo actuators that can be connected to the E-616 can be destroyed by uncontrolled oscillation near the mechanical resonant frequency. If you observe resonance while configuring your system, switch off power to the actuators concerned immediately and follow the instructions in section "Dynamic Calibration (p. 31)".

CAUTION-SYSTEM ASSIGNMENT

Connect only a matching tip/tilt platform to the corresponding E-616 Controller version: tip/tilt platforms such as S-325.3SD (tripod design) to E-616.S0x, SD-versions of S-330 series or S-334 tip/tilt platforms (differential design) to E-616.SS0x.

CAUTION - V-MON-MEASUREMENT

Be sure to use a suitable input impedance when you measure the following monitor voltages on the "Analog Interface" connector:
V-MON-X (pin 1), V-MON-Y (pin 2), and V-MON-1 to V-MON-3 (pins 3, 4, 5).
V-MON-X, V-MON-Y: Output impedance is 11 kΩ per channel
V-MON-1 to V-MON-3: Output impedance is 1 kΩ per channel

Your measurement device may get damaged if you measure without appropriate input impedance.

CAUTION - SGS-MON-MEASUREMENT

Be sure to use a suitable input impedance when you measure the following monitor voltages on the "Analog Interface" connector:
SGS-MON-X (pin 9), SGS-MON-Y (pin 10), and SGS-MON-1 to SGS-MON-3 (pins 11, 12, 13).

SGS-MON-X, SGS-MON-Y: Output impedance is 50 Ω per channel
SGS-MON-1 to SGS-MON-3: Output impedance is 10 kΩ / 10 nF

Your measurement device may deliver false values if you measure without appropriate input impedance.

Do not interchange controller (whole devices or individual modules) and / or tip/tilt platforms if they are matched and calibrated together. Controller and tip/tilt platforms that were calibrated together are not exchangeable. The serial number of the corresponding tip/tilt platform is given on the calibration label of the E-616.
The device is factory set to open-loop mode.

Getting Started

1 Connect the ground stud on the rear panel of the bench-top device to a Protective Ground.

2 Optionally:
To read the monitor channels connect the "Analog Interface" sub-D connector via the included connector (order no. 819007423). Respect the corresponding pin assignment, see "Pin Assignment of "Analog Interface""

3 Connect the rear SMB inputs ΘX (X-Input), ΘY (Y-Input), and with E-616.S0.G Z (Z-Offset) to a suitable power supply, for control input range see step 7

4 Connect the E-616 to the tip/tilt platform via the 25-pin sub-D socket on its front panel

5 Connect the DC IN power supply socket (rear panel) of the E-616 to the included C-663.PS power supply

6 Connect the C-663.PS power supply to line power. Permanent glow of the green Power LED indicates that the device is powered up

7 To cause tip/tilt motion of the X-axis respectively Y-axis apply signals in the following control input ranges to SMB sockets ΘX respectively ΘY:
0 V to +10 V for E-616.SS0G
-5 V to +5 V for E-616.S0G

If at least one of the green overflow LEDs glows, then a zero-point is necessary. Follow the instructions for zero-point adjustment, see "Zero-Point Adjustment in Closed-loop Operation with E-616 Controllers" (p. 27)

2.6 Download of Analog GCS LabVIEW Driver Set

Updated releases of GCS LabVIEW drivers for analog controllers from PI and the corresponding manuals are available for download at www.pi.ws. While the manuals are freely accessible, you need a password for the

software download. This password is provided in the E500T0011 Technical Note delivered with the controller.
To download from the PI Website, proceed as follows:

1 On the www.pi.ws front page, click on "Download/Support" in the "Service" section on the left

2 On the "Download/Support" page, click on "Manuals and Software Downloads"

3 On the "PI Download Server" page, enter the Username and the Password which are provided in the separate Technical Note and click on "Login"

4 Click on "Download" in the navigation bar across the top

5 Click on the "E Piezo Drivers & Nanopositioning" category

6 Click on "E-500"

7 Click on "Software" (if you click on "Documents" you will get the latest manuals)

8 Click the "Download " button below the latest CD mirror (includes the manuals that were with the release)

2.7 Monitor Signals

CAUTION - V-MON-MEASUREMENT

!

Be sure to use a suitable input impedance when you measure the following monitor voltages on the "Analog Interface" connector:
V-MON-X (pin 1), V-MON-Y (pin 2), and V-MON-1 to V-MON-3 (pins 3, 4, 5).
V-MON-X, V-MON-Y: Output impedance is 11 kΩ per channel

V-MON-1 to V-MON-3: Output impedance is 1 kΩ per channel

Your measurement device may get damaged if you measure without appropriate input impedance.

Monitoring the Output Voltage

The monitor channels of the rear "Analog Interface" connector display the output voltage of the servo-control modules as well as the output voltage of the amplifiers. Be sure to choose a suitable input impedance for your measurement device when you measure the monitor voltage!

The output voltage of both servo-control modules is axis-related for E-616.SS0 and for E-616.S0. The corresponding monitor voltages are displayed by pins 1 (V-MON-X) and 2 (V-MON-Y) of the "Analog Interface" connector. The amplifiers multiply the servo-control output voltage by 10. With the E-616.S0 Controller the axis-related V-MON signal is transformed to a channel-related voltage first.

Monitor channels of the amplifier output voltage:

- E-616.SS0:

  The amplifiers PA1 and PA2 are assigned to the tilt axes in a one-to-one ratio, whereas the output of amplifier PA3 is set fixed to 100 V. The monitor channels V-MON-1 to V-MON-3 display one-hundredth of the actual output voltage:
  V-MON-1 is assigned to pin A-18 and amplifier PA1
  V-MON-2 is assigned to pin C-18 and amplifier PA2
  V-MON-3 is assigned to pin A-16 and amplifier PA3

- E-616.S0:

  The three amplifier channels are related to the tilt axes X and Y via the transformation unit. The output voltage (V-MON-1 to V-MON-3) is split by a voltage divider and one-hundredth of the actual output voltage is displayed as V-MON signal:
  V-MON-1 is assigned to pin 3 and amplifier PA1
  V-MON-2 is assigned to pin 4 and amplifier PA2
  V-MON-3 is assigned to pin 5 and amplifier PA3

  The channel-related monitor signals V-MON-1, V-MON-2 and V-MON-3 are calculated by the axis-related signals V-MON-X and V-MON-Y as follows:

  V-MON-1 = 0.1 Y
  V-MON-2 = 0.1 (+0.867 X - 0.5 Y)
  V-MON-3 =0.1 (-0.867 X - 0.5 Y)

  where:
  X = V-MON-X (X-Out)
  Y = V-MON-Y (Y-Out)

! CAUTION - SGS-MON-MEASUREMENT

Be sure to use a suitable input impedance when you measure the following monitor voltages on the "Analog Interface" connector: SGS-MON-X (pin 9), SGS-MON-Y (pin 10), and SGS-MON-1 to SGS-MON-3 (pins 11, 12, 13).

SGS-MON-X, SGS-MON-Y: Output impedance is 50 Ω per channel

SGS-MON-1 to SGS-MON-3: Output impedance is 10 k kΩ / 10 nF

Your measurement device may deliver false values if you measure without appropriate input impedance.

Monitoring the Sensor Signals

The sensor signals can be displayed related to channels (SGS-MON-1, SGS-MON-2 and with E-616.S0 SGS-MON-3) and related to axes (SGS-MON-X, SGS-MON-Y). The corresponding monitor channels are available on the rear 15-pin main connector. Be sure to choose a suitable input impedance for your measurement device when you measure the monitor voltage!

- E-616.SS0:

  The sensor channels can be assigned to the tilt axes X and Y in a 1-to-1 ratio. Therefore SGS-MON-1 equals SGS-MON-X, SGS-MON-2 equals SGS-MON-Y.
  Channels SGS-MON-X (pin 9) and SGS-MON-Y (pin 10) display the differential sensor signals for the X- and the Y-axis. Each sensor signal is based on a pair of sensors, each pair is assigned to the corresponding tilt axis.

- E-616.S0:

  A transformation unit connects the three sensor channels and both tilt axes.
  The sensor monitor channels SGS-MON-1 (pin 11), SGS-MON-2 (pin 12) and SGS-MON-3 (pin 13) display the signals of the sensors attached to the piezo actuators.
  The sensor monitor signals SGS-MON-X (pin 9) and SGS-MON-Y (pin 10) display the position of the tilt axes calculated by the transformation unit.

  The axis-related sensor signals SGS-MON-X and SGS-MON-Y are derived from the channel-related sensor signals as follows:

  SGS-MON-X = 0.867 (S2 -S3)
  SGS-MON-Y = S1 - 0.5 (S2+S3)

  where:
  S1 = SGS-MON-1 (sensor signal 1)
  S2 = SGS-MON-2 (sensor signal 2)
  S3 = SGS-MON-3 (sensor signal 3)

3 Calibration

3.1 Zero-Point Adjustment

NOTE

Zero-Point Adjustment Only in Case of Overflow

Performing a zero-point adjustment is only required when at least one of the overflow LEDs (OFL1, OFL2) glows!

A proper zero-point adjustment is precondition for complete expansion of the piezo actuators over the maximum tilt range. Performing zero-point adjustment avoids exceeding the possible amplifier output range. Thus an overflow of the amplifier is prevented.

Variation of temperature between calibration and operation of the controller may require a zero-point adjustment. The green overflow LEDs on the front panel indicate whether a zero-point adjustment must be performed.
To adjust the zero-point use the three Zero 1 to Zero 3 potentiometers on the front panel, see Figure 6 below. These potentiometers shift the sensor output signal (SGS-MON), and in closed-loop mode also the servo-control output (V-MON-X, V-MON-Y) and the amplifier output (V-MON-1, V-MON-2 and, with E-616.S0G, V-MON-3).

With the E-616.SS0G Controller for tip/tilt platforms based on differential drive potentiometer Zero 3 is deactivated since there is no third sensor channel.

Figure 6: Potentiometer Zero 1 to Zero 3 for zero-point adjustment, and overflow LEDs

! CAUTION - V-MON-MEASUREMENT

Be sure to use a suitable input impedance when you measure the following monitor voltages on the "Analog Interface" connector:

V-MON-X (pin 1), V-MON-Y (pin 2), and V-MON-1 to V-MON-3 (pins 3, 4, 5).

V-MON-X, V-MON-Y: Output impedance is 11 kΩ per channel

V-MON-1 to V-MON-3: Output impedance is 1 kΩ per channel

Your measurement device may get damaged if you measure without appropriate input impedance.

The device is shipped calibrated and factory set to closed-loop operation. Following instructions refer to zero-point adjustment in closed-loop operation.
For zero-point adjustment proceed as follows:

- With E-616.SS0G:

1. Display the monitor signal V-MON of the amplifier channel with an overflow (V-MON-1, V-MON-2)
2. To avoid an offset to the sensor signals caused by hysteresis effects perform a complete tip/tilt motion of both tilt axes:
   Apply a control input voltage in the range of 0 V to +10 V to X-Input (SMB socket ΘX) respectively to Y-Input (SMB socket ΘY)
3. Apply a control input voltage of 0 V to X-Input and Y-Input, to set the platform back to its initial position
4. Adjust the corresponding Zero potentiometer until you obtain 0 V as V-MON-signal (corresponds to 0 V amplifier output voltage)
5. Now change the control input signal for ΘX respectively ΘY in the range from 0 V to +10 V

The overflow LEDs should no longer glow. Permanent glow may indicate failure of the device.

- With E-616.S0G:

1. Display the monitor signal V-MON of the amplifier channel with an overflow (V-MON-1, V-MON-2, V-MON-3)
2. To avoid an offset to the sensor signals caused by hysteresis effects perform a complete contraction / expansion cycle by commanding a vertical motion. Apply a control input signal with a voltage range from -3 V to +3 V to Z-Offset (SMB socket Z)
3. Apply a control input voltage of 0 V to Z-Offset

4 Apply a control input voltage of 0 V to X-Input (SMB socket ΘX) and to Y-Input (SMB socket ΘY), to set the platform back to its initial position

5 Adjust the Zero potentiometer corresponding to the chosen V-MON channel until you obtain +0.5 V as V-MON-signal (corresponds to +50 V amplifier output voltage) - repeat this procedure for each of the three V-MON channels

6 Now change the control input signal for ΘX and ΘY in the range from -5 V to +5 V

The overflow LEDs should no longer glow. Permanent glow may indicate failure of the device.

Zero-Point Adjustment in Open-Loop Mode

!

CAUTION - SGS-MON-MEASUREMENT

Be sure to use a suitable input impedance when you measure the following monitor voltages on the "Analog Interface" connector: SGS-MON-X (pin 9), SGS-MON-Y (pin 10), and SGS-MON-1 to SGS-MON-3 (pins 11, 12, 13).

SGS-MON-X, SGS-MON-Y: Output impedance is 50 Ω per channel

SGS-MON-1 to SGS-MON-3: Output impedance is 10 kΩ / 10 nF

Your measurement device may deliver false values if you measure without appropriate input impedance.

NOTE

To avoid an overflow of the amplifier in open-loop mode do not exceed the allowable control input range.

Zero-point adjustment can be performed in open-loop mode as well.
To do so proceed as follows:

- With E-616.SS0G:

1 Display the sensor monitor signals SGS-MON for the sensor channel to be adjusted (SGS-MON-1, SGS-MON-2)

2 To avoid an offset to the sensor signals caused by hysteresis effects perform a complete tilt motion of both tilt axes: Apply a

control input signal in the range from -2 V to 12 V to X-Input respectively to Y-Input

3 Apply a control input voltage of 0 V to ΘX and ΘY, to set the platform back to its initial position

4 Adjust the corresponding Zero potentiometer until you obtain 0 V as SGS-MON-signal

The OFL LEDs no longer glow if you change to closed-loop mode.

- With E-616.S0G:

1 Display sensor monitor signal SGS-MON of the sensor channel to be adjusted (SGS-MON-1, SGS-MON-2, SGS-MON-3)

2 To avoid an offset to the sensor signals caused by hysteresis effects perform a complete contraction / expansion cycle by commanding a vertical motion. Apply an input signal with a voltage range from -3 V to +3 V to Z-Offset (SMB socket Z)

3 Apply a control input voltage of 0 V to Z-Offset

4 Apply a control input voltage of 0 V to ΘX und ΘY, to set the platform back to its initial position

5 Adjust the Zero potentiometer corresponding to the chosen SGS-MON channel until you obtain approximately 5 V as SGS-MON signal - repeat this procedure for each of the three SGS-MON channels

The OFL LEDs no longer glow if you change to closed-loop mode.

3.2 Servo-Controller Dynamic Calibration

DANGER

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

Disconnect the E-616 from power when opening the case, and when resetting internal switches or jumpers.

When the E-616 must be operated with the case open, voltages of up to 130 V can be exposed. Do not touch internal conductors.

!

CAUTION

The product described is an ESD-sensitive (electrostatic discharge sensitive) device. Observe all precautions against static charge buildup before handling these devices.

Avoid touching circuit components, pins and PCB traces. Discharge any static charge 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.

Dynamic calibration is necessary when the response time of the actuators has increased, in case of overshoot or when the mechanics starts oscillating. A change of applied load is the cause most often. Dynamic calibration adjusts servo parameters as P-term, I-Term and the notch filter frequency of the integrated E-802.55 servo-control modules.

To adjust servo-control parameters proceed as follows:

1. Disconnect the device from power supply
2. Open the device, see Figure 7
3. Tune the corresponding potentiometers, see Figure 8.
   Read Section 3.2 "Equipment Needed for Calibration" and Section 4 "Dynamic Calibration" in the servo-control module User Manual (PZ150E) for more details.

Figure 7: The top cover of the case is removed via the six labeled and two rear cross-head screws

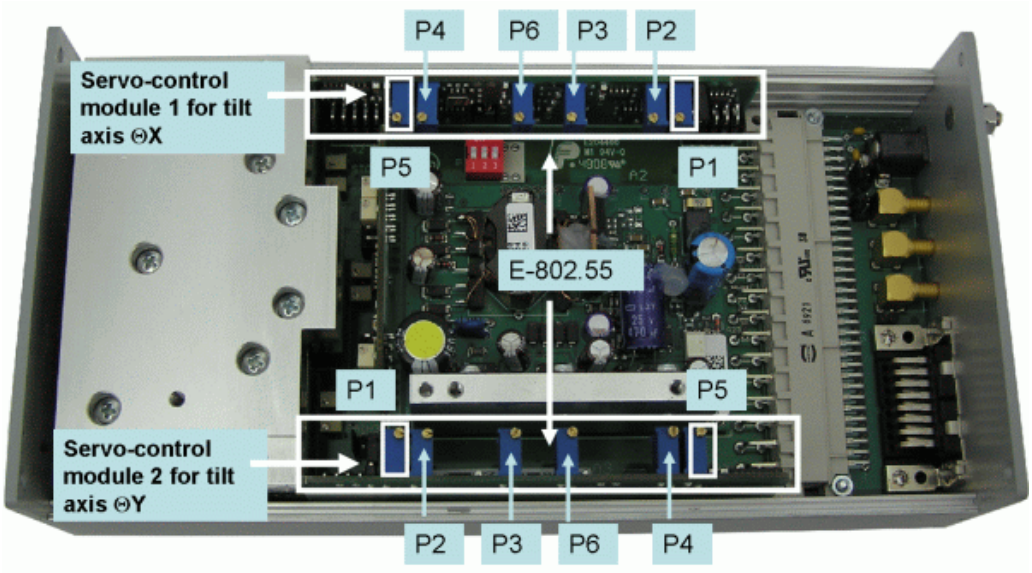


Figure 8: Potentiometer assignment of E-802.55 servo-control modules for adjustment of control parameters

Assignment of function to potentiometer:

P1	Slew Rate Limitation
P2	Loop Gain (P-Term)
P3	Integration Time Constant (I-Term)
P4	Notch Frequency
P5	is factory set for internal use, is not to be changed
P6	is factory set for internal use, is not to be changed

4 System Description

4.1 The E-616.SS0x Controller

The E-616.SS0 controller module and the E-616.SS0G bench-top controller are designed for tip/tilt platforms based on differential drive. The differential drive of the S-330 and S-334 series tip/tilt platforms is based on two pairs of actuators operating in push-pull mode to realize tilt motion. Each pair of actuators is interconnected electrically so that one actuator expands while the other contracts. With this principle of operation, pure vertical motion in the Z-axis is not possible.
Each pair of actuators, i.e. each tilt axis, is assigned to one E-802.55 servo-control module, to one sensor channel and to one amplifier channel. To bring both axes in their initial position the output of the third amplifier channel is fixed to 100 V.
The following assignment is valid for E-616.SS0x Controllers:

- Tilt axis X:

Control input:	X-Input
Sensor monitor signal:	SGS-MON-1 (equals SGS-MON-X)
One tenth of internal control voltage:	V-MON-X
One-hundredth of amplifier output voltage:	V-MON-1
Servo control:	Servo-control module 1
Overflow display:	OFL 1
Zero-point adjustment:	Potentiometer Zero 1

- Tilt axis Y:

Control input:	Y-Input
Sensor monitor signal:	SGS-MON-2 (equals SGS-MON-Y)
One tenth of internal control voltage:	V-MON-Y
One-hundredth of amplifier output voltage:	V-MON-2
Servo control:	Servo-control module 2
Overflow display:	OFL 2
Zero-point adjustment:	Potentiometer Zero 2

4.2 The E-616.S0x Controller

The E-616.S0 controller module and the E-616.S0G bench-top controller are designed for open-loop and closed-loop control of the S-325 series tip/tilt platforms. These tip/tilt platforms are driven by three piezo actuators arranged symmetrically around the center point of the mirror platform. The

controller features two servo-control modules for both tip/tilt axes as well as one sensor channel and one amplifier channel for each of the three actuators.

The combination of this controller version with an S-325 tip/tilt platform offers the following advantages compared to systems based on differential drive: firstly internal coordinate transformation facilitates direct commanding of angles without any calculation efforts for the user. Secondly a simultaneous vertical motion of the three actuators is possible.

NOTE

Note that the vertical motion commanded by the E-616 Controller for tripod design (Z-Offset) always is in open-loop mode, independent from the operation mode of the X and Y tilt axes.

Coordinate Transformation

The E-616.S0x Controller is designed to command S-325 series tip/tilt platforms based on a tripod design. This controller version integrates a circuit performing transformation of the commanded tilt angles into corresponding linear motion of the individual actuators. The three actuators are supplied by corresponding amplifier output voltage. A complicated external calculation of the linear motion of the three actuators is omitted.

Due to the internal transformation unit of E-616.S0 controllers there is no one-to-one assignment of tilt axes to sensor and amplifier channels. Multiple amplifiers and multiple sensors can be involved in the motion of one tilt axis, just as one amplifier or one sensor can participate in the motion of more than one tilt axis.

Therefore the axis-related sensor signals (SGS-MON-X, SGS-MON-Y) are calculated from the channel-related sensor signals (SGS-MON-1 to SGS-MON-3).

This is done applying following formulas:
SGS-MON-X = 0.867 (S2 -S3)
SGS-MON-Y = S1 - 0.5 (S2+S3)

where:
S1 = SGS-MON-1 (sensor signal 1)
S2 = SGS-MON-2 (sensor signal 2)
S3 = SGS-MON-3 (sensor signal 3)

Monitor signals of the amplifier output voltage (V-MON-1 to V-MON-3) are calculated using the output voltage of the axis-related servo-control modules (V-MON-X, V-MON-Y).

Calculation is performed using the following formulas:
V-MON-1 = 0.1 Y
V-MON-2 = 0.1 (+0.867 X - 0.5 Y)
V-MON-3 = 0.1 (-0.867 X - 0.5 Y)

where:
X = V-MON-X (X-Out)
Y = V-MON-Y (Y-Out)

Commanding Vertical Motion

With the E-616.S0x, vertical motion can be commanded using Z-Offset, irrespective of the current operating mode of the tilt axes.

Note that tilt angle and vertical motion are interdependent. Values for nominal tilt motion respectively for nominal vertical motion in the data table of the tripod tip/tilt platforms (User Manual PZ148E for S-325 series tip/tilt platforms) refer to pure nominal tilt motion respectively to pure nominal vertical motion.

To calculate the actual possible tip/tilt motion and vertical motion read Section 5 "Working Principle" of User Manual PZ148E for S-325 tip/tilt mirrors.
Note: the maximum control input for Z-Offset ranges from -3 V to +3 V without any additional tip/tilt motion. Z-Offset input is multiplied by a gain of 20.

5 Troubleshooting

Positioner does not move.

Cables not connected properly:

- Check the connecting cables.

Check whether the allowable control input range was met:

- E-616.SS0 / E-616.SS0G:

  X- Input, Y-Input, closed-loop: 0 to +10 V
  X-Input, Y-Input, open-loop: -2 to +12 V

- E-616.S0 / E-616.S0G:

  Closed-loop mode of tilt axes:
  X- Input, Y-Input: -5 to +5 V
  Z-Offset: -3 to +3 V
  Open-loop mode of tilt axes:
  X-Input, Y-Input: -7 to +7 V
  Z-Offset: -3 to +3 V

The E-616 amplifier output channel is deactivated

If the internal temperature goes out of range (75 °C / 167 °F) the voltage output will be deactivated. The tip/tilt platform stops moving. After a cooling-down period, at a hardware temperature of 60 °C / 140 °F, the voltage output is reactivated automatically.
How to avoid overheating:

- To avoid overheating, reduce the ambient temperature. Note that the difference in ambient temperature and hardware temperature is about 20 Kelvin (1 Kelvin corresponds to 1 °C, a temperature difference of 20 Kelvin equals a difference of 36 °F).

- E-616.Sx OEM Controller modules need to be installed with a suitable air circulation area. Forced air cooling must be provided to prevent internal heat build-up.

- Place the E-616 bench-top controllers 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. If this is not possible reduce the ambient temperature.

6 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)

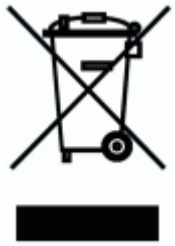
7 Old Equipment Disposal

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



8 Technical Data

8.1 Specifications

	E-616.S0G	E-616.SS0G
Function	Controller for piezo tip/tilt mirror systems with strain gauge sensors, tripod drive	Controller for piezo tip/tilt mirror systems with strain gauge sensors, differential drive
Tilt axes	2	2
Sensor		
Servo characteristics	P-I (analog), notch filter	P-I (analog), notch filter
Sensor type	SGS	SGS
Sensor channels	3	2
Ext. synchronization	200 kHz TTL	200 kHz TTL
Amplifier		
Control input voltage range	X-, Y- tilt axes: -7 V to +7 V Z-Offset: -3 V to +3 V	-2 V to +12 V
Output voltage range	-30 V to +130 V	-30 V to +130 V
Amplifier channels	3	3
Peak output power per channel	10 W	10 W
Average output power per channel	5 W	5 W
Peak current	100 mA	100 mA
Average current per channel	50 mA	50 mA
Current limitation	Short-circuit-proof	Short-circuit-proof
Voltage gain	X-, Y- tilt axes: 10 Z-Offset: 20	10
Amplifier bandwidth, small signal	3 kHz	3 kHz
Amplifier bandwidth, large signal	See frequency diagram	See frequency diagram
Ripple, noise, 0 to 100 kHz	<20 mVpp <2 mVrms	<20 mVpp <2 mVrms
Amplifier resolution	<1 mV	<1 mV

Interfaces and operation		
Piezo / sensor connector	25-pin sub-D connector	25-pin sub-D connector
Analog input	3 x SMB	2 x SMB
Sensor monitor output	0 to +10 V for nominal displacement	0 to +10 V for nominal displacement
Sensor monitor socket	15-pin sub-D connector	15-pin sub-D connector
Display	LEDs for Power and Overflow	LEDs for Power and Overflow
Miscellaneous		
Operating temperature range	5 °C to 50 °C	5 °C to 50 °C
Overheat protection	Max. 75 °C, deactivation of the piezo voltage output	Max. 75 °C, deactivation of the piezo voltage output
Dimensions	205 mm x 105 mm x 54.1 mm, without feet	205 mm x 105 mm x 54.1 mm, without feet
Mass	1200 g	1200 g
Operating voltage	23 V to 26 V DC	23 V to 26 V DC
Power consumption	30 W	30 W

8.2 Rating

Input at:	**Maximum operating voltage** 	**Maximum operating frequency (without load)** 	**Maximum power consumption** 
Barrel connector	24 V DC	⎓	30 W

8.3 Frequency Response Diagram

In order to achieve minimum distortion of the output waveform, it is important to ensure that the amplitude of higher-frequency control input is reduced in proportion to the fall-off of the output voltage at these frequencies. For exact information on maximum operating frequency with a given piezo load (capacitance), refer to the individual operating limit graphs in the Figure 9 below.

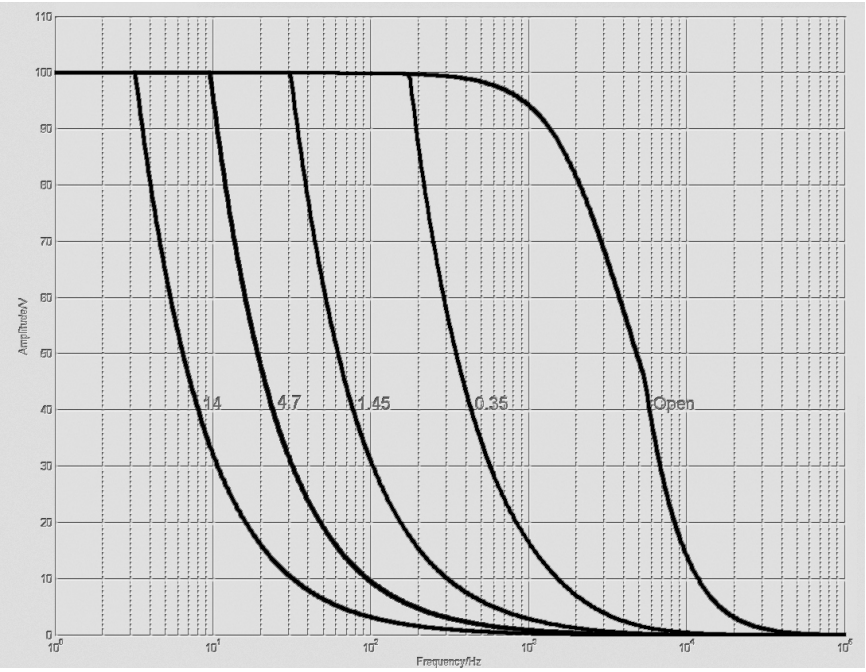


Figure 9: PZT loads (open-loop), capacitance is measured in µF

Note that the operating limits of a given piezo amplifier depend on the amplifier power, the amplifier design, and, of course, on the capacitance of the piezo actuator. The capacitance of piezo ceramics changes significantly with amplitude, temperature, and load-up to approximately 200 % of the unloaded, small-signal capacitance at room temperature.

The following equations describe the relationship between (reactive) drive power, actuator capacitance, operating frequency and drive voltage. The average power a piezo driver has to be able to provide for sinusoidal operation is given by:

$$Pa \approx C \cdot Umax \cdot Up\text{-}p \cdot f$$

Peak power for sinusoidal operation is:

$$Pmax \approx \pi \cdot C \cdot Umax \cdot Up\text{-}p \cdot f$$

Where:

Pa = average power [W]

Pmax = peak power [W]

C = piezo actuator capacitance [Farad], [As/v]

f = operating frequency [Hz]

Umax = nominal voltage of the amplifier [V]

Up-p = peak-to-peak drive voltage [V]

8.4 Block Diagram for E-616.SS0x

The block diagram shows the structure of an E-616.SS0x Controller for tip/tilt mirrors with differential drive.

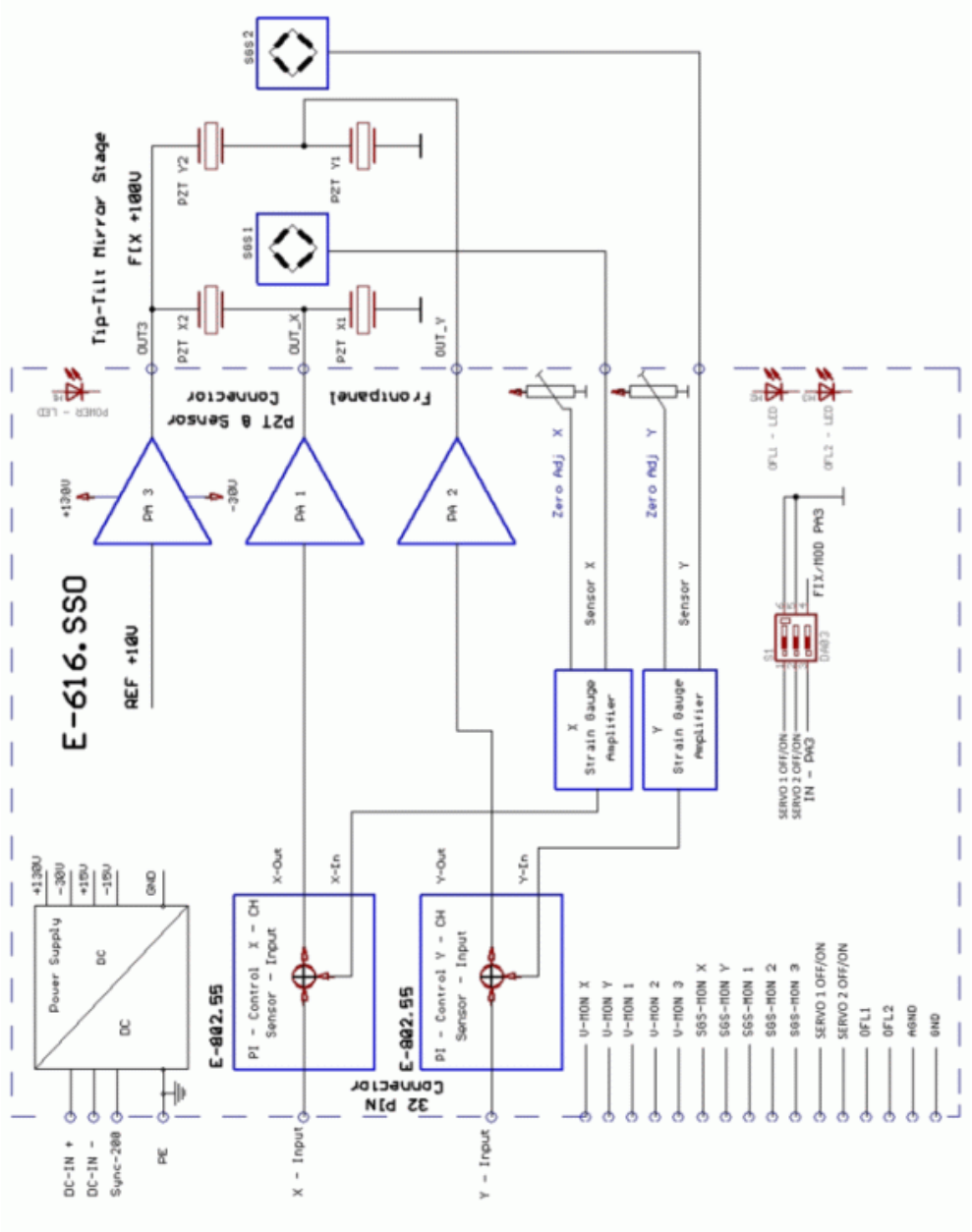


Figure 10: Block diagram of the E-616.SS0x Controller for tip/tilt platforms of S-330 and S-334 series

V-MON X represents the servo-control output X-Out, whereas V-MON Y represents the servo-control output Y-Out. SGS-MON X represents X-In, SGS-MON Y represents Y-In.

NOTE - RANGE OF CONTROL INPUT FOR E-616.SS0 AND E-616.SS0G

By default E-616 Controllers are preset for closed-loop mode. There are different ranges of control input for closed-loop and for open-loop mode.
For E-616.SS0 and E-616.SS0G following control input ranges are valid:

- X- Input, Y-Input, closed-loop: 0 to +10 V
- X-Input, Y-Input, open-loop: -2 to +12 V

If you apply voltage exceeding these ranges the overflow LEDs glow.

The amplifier output voltage ranges from -30 V to + 130 V.

8.5 Block Diagram for E-616.S0x

The block diagram shows the structure of the tripod E-616.S0x Controller:

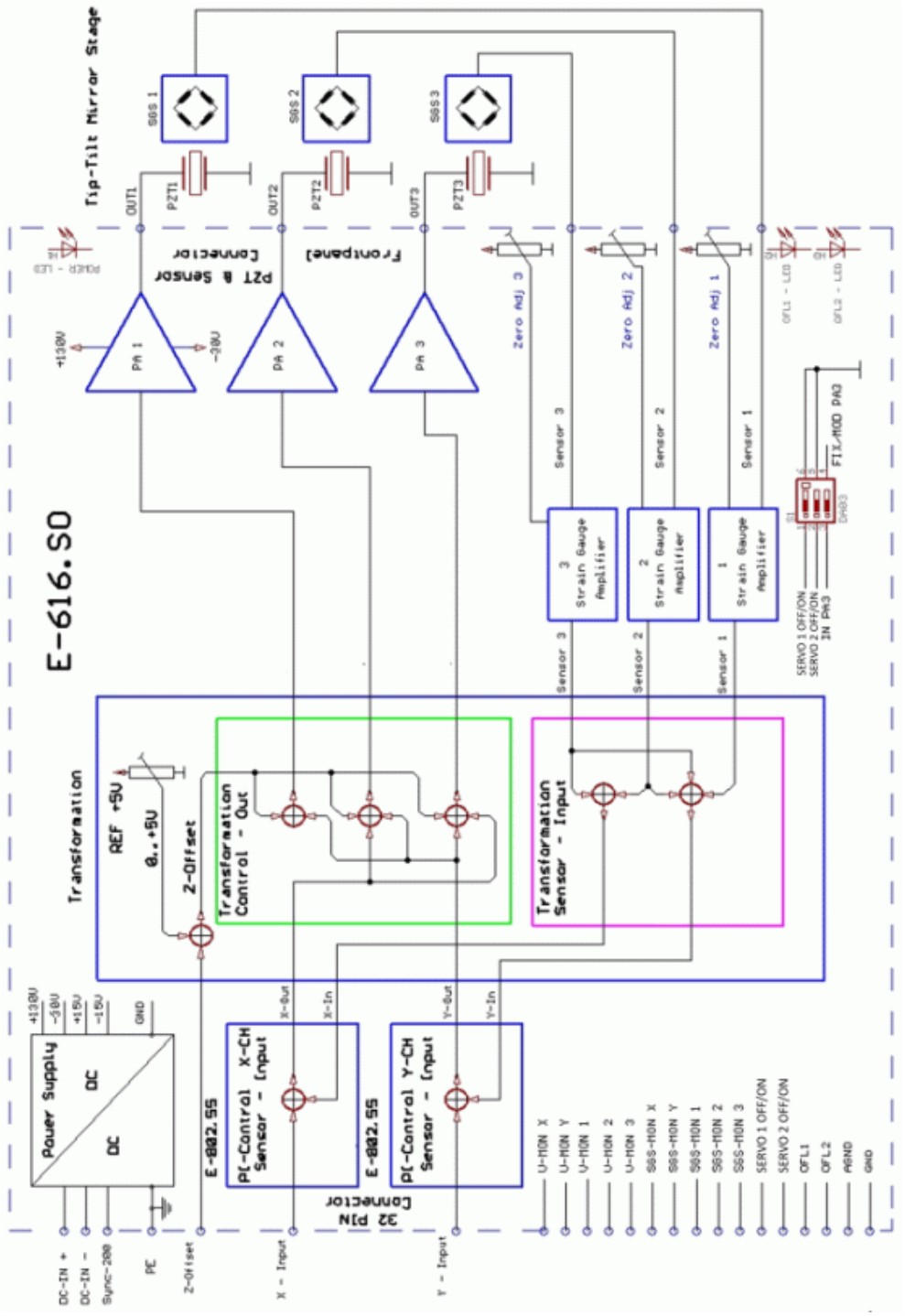


Figure 11: Block diagram of the E-616.S0x Controller for S-325.3SD tip/tilt platforms

V-MON X represents the servo-control output X-Out, whereas V-MON Y represents the servo-control output Y-Out. SGS-MON X represents X-In, SGS-MON Y represents Y-In.

The formulas for calculation of the axis position (SGS-MON-X, SGS-MON-Y) from the three sensor signals (SGS-MON-1 to SGS-MON-3) are in section "The E-616.S0x Controller" (p. 33), as well as the calculation of the channel-related amplifier output voltage V-MON-1 to V-MON-3 from the axis-related V-MON-X and V-MON-Y-channels.

To obtain the maximum tilt range the actuators of the tripod drive are supplied with an offset voltage when the system is calibrated. For valid control input ranges see below.

NOTE - CONTROL INPUT RANGE FOR E-616.S0 AND E-616.S0G

With calibration of the tripod controllers E-616.S0x an offset voltage is applied to the piezo actuators to achieve a maximum tip/tilt range.

By default E-616 Controllers are preset for closed-loop mode. There are different ranges of control input for closed-loop and for open-loop mode.
For E-616.S0 and E-616.S0G following control input ranges are valid:

Closed-loop mode for tilt axes:

- X- Input, Y-Input: -5 to +5 V
- Z-Offset: -3 to +3 V

Open-loop mode for tilt axes:

- X-Input, Y-Input: -7 to +7 V
- Z-Offset: -3 to +3 V

If you apply voltage exceeding these ranges the overflow LEDs glow.

8.6 Dimensions of E-616 Bench-Top Controller

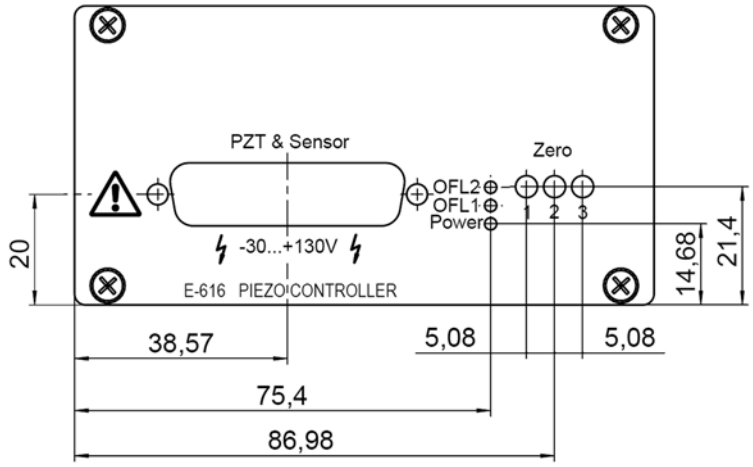


Figure 12: Dimensions of E-616 bench-top controller in mm, front panel, decimal places separated by commas in drawings

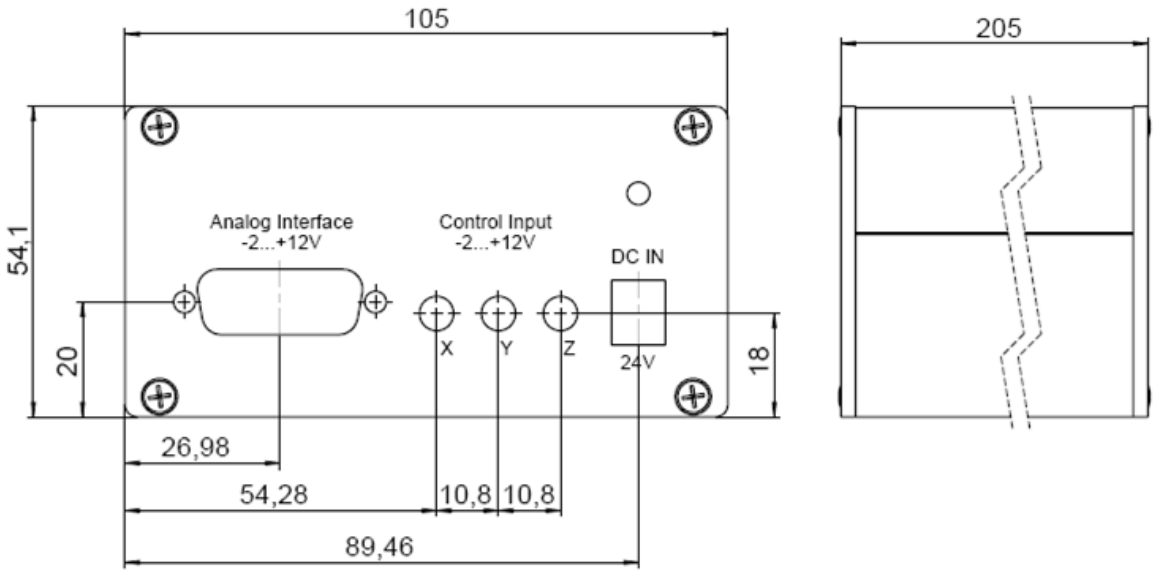


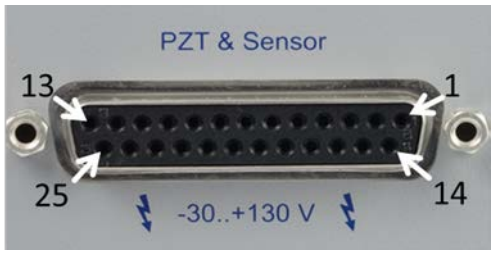
Figure 13: Dimensions of E-616 bench-top controller in mm, rear panel (left), side view (right), decimal places separated by commas

8.7 Pin Assignments

8.7.1 PZT & Sensor Connector of the E-616

The 25-pin sub-D connector of the E-616 Controller for tip/tilt platforms features pin assignment as follows:

Pin	Function
1	SGS3 B1+
2	not connected
3	SGS2 B1+
4	SGS Reference
5	SGS1 B1+
6	SGS Reference
7	internal use
8	internal use
9	internal use
10	GND
11	PZT1 OUT
12	PZT2 OUT
13	PZT3 OUT
14	SGS3 B2-
15	not connected
16	SGS2 B2-
17	SGS GND
18	SGS1 B2-
19	SGS GND
20	internal use
21	internal use
22	internal use
23	PZT1 GND
24	PZT2 GND
25	PZT3 GND



SGS B1+ corresponds to the SGS1 sensor bridge signal connected to the positive input of the strain gauge amplifier. The SGS1 B- signal is connected to the negative input of the strain gauge amplifier. Further sensor channels are connected accordingly.

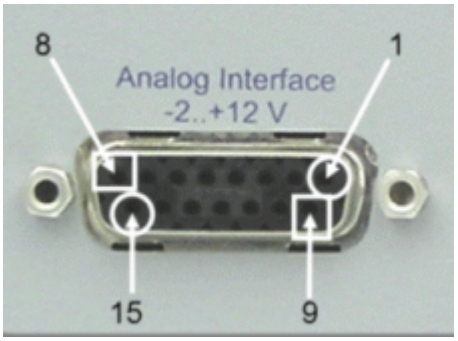
NOTE

Pins 1 (SGS3 B1+) and 14 (SGS3 B2-) are not active with E-616.SS0G Controllers for differential drive of tip/tilt platforms.

8.7.2 Pin Assignment of "Analog Interface"

The following pin assignment is valid for the 15-pin "Analog Interface" connector of the E-616 bench-top controller:

Pin	Function
1	V-MON-X
2	V-MON-Y
3	V-MON-1
4	V-MON-2
5	V-MON-3
6	Servo-1 OFF/ON
7	Servo-2 OFF/ON
8	AGND
9	SGS-MON-X
10	SGS-MON-Y
11	SGS-MON-1
12	SGS-MON-2
13	SGS-MON-3
14	OFL1
15	OFL2



V-MON-X and V-MON-Y correspond to the signals X-Out and Y-Out on the block diagram, see "Block Diagram of the E-616.SS0x Controller" (p. 43) respectively "Block Diagram of the E-616.S0x Controller" (p. 45).

V-MON-1 to V-MON-3 correspond to one-hundredth of the output voltage of the amplifiers PA1 to PA3.

With E-616.SS0G Controllers for differential drive the following is valid: SGS-MON-1 equals SGS-MON-X, SGS-MON-2 equals SGS-MON-Y. Note: SGS-MON-3 is not active here.

With E-616.S0G Controllers for tripod drive the following is valid: SGS-MON-X corresponds to X-In, SGS-MON-Y corresponds to Y-In on the block diagram. SGS-MON-1 to SGS-MON-3 represent the the amplified sensor signals measured between strain gauge amplifiers and transformation board.

NOTE

Note that sensor channel 3 (SGS-MON-3) and potentiometer Zero 3 are deactivated with the E-616 Controller based on differential drive.

NOTE

Selection of Open-Loop and Closed-Loop Mode (Servo OFF/ON Pins)

By default E-616 Controllers are set to closed-loop mode by an internal DIP switch. Selection of open-loop mode requires to open the device, see section "Open-Loop and Closed-Loop Operation (p. 17)".

When DIP switches 1 and 2 are in OFF position then servo control can be activated / deactivated externally by commanding pin 6 of the rear "Analog Interface" sub-D connector (Servo-1 OFF/ON) for tilt axis X and pin 7 (Servo-2 OFF/ON) for tilt axis Y.
For example setting pin 6 to HIGH results in open-loop mode of tilt axis X, setting this pin to LOW results in closed-loop mode.