OPERATION MANUAL
FOR THE PIEZOCONCEPT CONTROLLER
WITH ANALOG INTERFACE
0 to 10V analogue input
High speed version (4 amps)

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IMPORTANT SAFETY INFORMATION

The high voltage drivers can produce hazardous voltages and currents. Use caution when operating the drivers and when handling the linear actuators. Piezoactuators have large capacitance and are capable of storing hazardous amounts of electrical energy over long periods of time. Various conditions such as load and temperature changes can also cause piezoactuators to accumulate charge.

Before disconnecting the DB-9 connector from the PIEZOCONCEPT controller, first set the command voltage to 0.0V, then turn the AC power to the PIEZOCONCEPT controller off, and finally wait one minute before disconnecting.

IMPORTANT

All Technical Information, recommendations, and examples related to PIEZOCONCEPT Products made in this manual are based on information believed to be correct. The purchaser or user should determine the suitability of each product before using. The purchaser or user assumes all risks and liability whatsoever in connection with the use of any and all PIEZOCONCEPT products or services.

CONTENTS

1 INTRODUCTION

The PIEZOCONCEPT controller is a complete control package required for operating all PIEZOCONCEPT nanopositioning systems. The PIEZOCONCEPT controller includes a low noise, low drift 150 V driver, position sensing electronics, and closed loop proportional-integral (PI) feedback control. With Proportional-Integral control, the bandwidth of the feedback loop is determined by the integration time constant of the integral term. The closed loop command position is supplied through the front panel BNC input. The driver is capable of supplying 150 mA at 150 V.

The PIEZOCONCEPT controller is available in one, two and three channel versions. Each PIEZOCONCEPT controller has been factory adjusted for its complimentary nanopositioning device. This adjustment includes setting the offset of the position sensing electronics. Under stable environmental conditions readjustment of this setting is not necessary. Each nanopositioning stage and each channel on the PIEZOCONCEPT controller are clearly labeled for identification.

TABLE 1: PIEZOCONCEPT CONTROLLER SPECIFICATIONS

OUTPUT VOLTAGE RANGE	-10 to +150 V
OUTPUT CURRENT	150 mA
ANALOG INTERFACE	0 to 10.0V FRONT PANEL BNC
FRONT PANEL ACCESSIBLE OUTPUT SIGNALS	OUTPUT VOLTAGE ÷ 10 (-1.0 to +15.0V) POSITION SIGNAL (0.0 to 10.0 V)
FRONT PANEL ADJUSTMENTS	SENSOR OFFSET
CONNECTOR TYPE	DB-9
POWER REQUIREMENT	100-240 VAC

1.1 Front panel connections

Each channel has the following front panel connections:

- Input : Analog input for command voltage (0.0 to 10.0V)
- Sensor output : 0.0 to 10.0 V buffered output on a BNC connector*
- HV/10 : HV÷10 (-1 to +15.0V) output on a BNC connector
- DB-9 : 9-Pin D-Type connector to nanopositioning stage
- Offset: adjustment for position sensing circuit

*The sensor output signal of 0.0 to 10.0 V corresponds to a stage displacement of zero to the maximum displacement value.

1.2 Rear panel connections

The rear panel connections for the PIEZOCONCEPT controller has the following specifications

- AC-Power : 220 V Power
- FUSE : 4A fuse
- USB connector with 4 TTL outputs (optionally)

2 INSTALLATION

2.1 Installing a single channel system

To set up a single channel system use the following procedures.

a) Install the nanopositioning stage as described in its **"INSTALLATION AND OPERATION MANUAL"**.

b) Turn the power of the PIEZOCONCEPT controller off.

c) Connect the DB-9 connector of the nanopositioning stage to the PIEZOCONCEPT controller and tighten down the screws.

d) Set the command signal voltage to 0.0V.

e) Turn on the PIEZOCONCEPT controller.

f) The command signal will now control the displacement of the nanopositioning stage.

g) Set the command signal to 0.0 V before turning off the system.

h) Never disconnect the DB-9 connector while the power is on. Wait one minute, to allow the PZT to discharge, before removing the DB-9 connector.

2.2 Installing a multiple channels system

To set up a multiple channels system follow the procedures listed in **Section 2.1** for each channel. Be certain that the correct PIEZOCONCEPT controller channel is used for each nanopositioning stage. Both the nanopositioning stages and the different axes on the PIEZOCONCEPT controller are clearly labeled.

3 OPERATING THE PIEZOCONCEPT CONTROLLER USING THE ANALOG INTERFACE - CLOSED LOOP OPERATION

To operate the PIEZOCONCEPT controller in analog mode apply the command signal to the front panel BNC labeled input. Use a stable power supply or external DAC. The input voltage

range is 0 to 10.00V corresponding to zero stage displacement to maximum stage displacement. Do not exceed this voltage range.

When not in use it is advisable to switch off the controller. Never disconnect the DB-9 connector when the power supply is on.

4 OFFSET ADJUSTMENT

The range and offset of the position sensing electronics have been factory adjusted. In multiple channel systems, it is important to connect the correct nanopositioning stage to each channel on the PIEZOCONCEPT controller. These axes are clearly marked on both the PIEZOCONCEPT controller and the nanopositioning stages.

In closed loop mode the high voltage output operates between -0.5 V and 135.0V. The 15V overhead for the higher voltage is necessary for the Proportional-Integral controller to work. The Proportional-Integral controller uses this voltage to compensate for minor temperature and environmental changes as well as creep and hysteresis.

A change in room temperature by a few degrees will shift the offset of the high voltage output. An increase in temperature may shift the output range from -0.5V-135.0V to 0.0V-140.0V. Under such circumstances no adjustment is necessary since the PI circuit has enough overhead to compensate for creep and hysteresis. Typically, environmental changes such as temperature effect only the offset and not the total range.

IT IS ALWAYS BEST TO CONTROL THE ENVIRONMENTAL CONDITIONS RATHER THAN CONTINUOUSLY ADJUSTING THE SENSING ELECTRONICS. USE THE NANOPOSITIONING SYSTEM IN A TEMPERATURE CONTROLLED ROOM AND MINIMIZE THE AMOUNT OF TIMES THE STAGES REINSTALLED.

Once the new nanopositioning stage is installed it is advisable to adjust the offset of the position sensing circuit. Once adjusted, no further adjustment should be necessary unless the stage is reinstalled or the temperature changes by more than 5 degrees. Use the following procedure to set the offset.

a) With the nanopositioning stage installed and connected to the PIEZOCONCEPT controller and the PIEZOCONCEPT controller on, monitor the HV/10 output signal using a calibrated voltmeter

b) Apply 0.0 V to the command signal input and wait a minute, the slow voltage drift is the Proportional-Integral circuit compensating for creep in the PZT.

c) Using an insulated screw driver adjust the front panel offset screw so that the HV/10 output signal is between -1.0 V and -0.5 V. Adjust slowly while monitoring the signal. Clockwise increases the voltage.

Another way to adjust the offset is to send a 0/+10V sinusoid and adjust the offset screw with the screwdriver if saturation on one or on the other side of the sensor signal is present.

5 TROUBLE SHOOTING

The PIEZOCONCEPT controller is a high precision instrument and therefore must be operated in a quiet, both physical and electrical, environment. Both electrical and vibration noise can be picked up in the PIEZOCONCEPT controller and/or the nanopositioning stage. This noise can be observed on the HV/10 BNC output.

1-5 Hz Low frequency noise is typically due to building vibrations and can be caused by foot traffic or vehicle traffic. This type of noise is often time dependant. It can be eliminated through careful vibration isolation of the nanopositioning stage (contact us for quotation on those product).

50,100 Hz This noise is caused by ground loop interference. It results from a slight difference in the ground potentials of the nanopositioning stage and the PIEZOCONCEPT controller. This problem can be identified by electrically isolating the nanopositioning stage, for example by placing it on a piece of paper. If the noise level decreases the grounds are at a different potential

6 RECOMMENDATION

If the nanopositioner is disconnected from the PIEZOCONCEPT controller, we recommend to by-pass the piezoactuator with the electric jumper which is provided (See the photo below). This will increase its lifetime.

When the stage is not in use during the day time, best is to apply voltage close to 0V. Indeed, the voltage that you apply on the analogue input or via the USB interface is between 0V and 10V. This voltage is multiplied by around 15 when it is sent to the piezoactutaor. This is only

a simple rule of thumb. So if you apply 0V or slightly positive (like 1V), you won't apply more than 15V on the piezoactuator and you won't accelerate the aging of the piezo. On the contrary, applying 10V on the analogue input for an extended period of time is to be avoided. So when at rest, best is to apply 0V to 1V. If you have a voltage generator, the easiest is to switch it off and you will get 0V. If you use the USB, just ask 0µm.

At the end of the day, best is to switch off the controller. Before switching off the controller, please apply 0V to the analogue input. There is a reason to that : the controller has high capacitance that discharge into the piezostack when you switch off the controller. The piezostack can support more additional charges when it is empty than when it is full. This is why it is best to apply 0V before switching off the controller.

Finally, when you switch off the controller, it is recommended to wait at least one minute before switching on again.