General Remarks

ASI / ASC

ASI and ASC are advanced functionalities of piezoelectric systems offered by ***piezosystem jena*** for automatic sensor identification, and the ability to exchange single parts of a system. Actuators and electronics can be exchanged, without new calibration procedure. These systems can remain on location or in the field without any time or money being spent for additional shipping.

ASI Function:

Automatic Sensor Identification

The ASI function allows you to exchange the same type of actuator and use it with the same amplifier. Actuators for an ASI compatible amplifier are equipped with an external preamplifier.
New calibration is no longer necessary (valid only for standard calibration).

ASC Function:

Automatic System Calibration

In addition to the ASI function ASC provides even more functionality for our customers. The integrated circuit built into a closed loop actuator contains also the parameters for its calibration and other information such as:

- motion
- name
- axis
- serial number
- PID-control and filter setting

Thus the electronics can identify not only the actuator, but also its calibration data. The actuator can be used with a different type of electronic, without needing to be recalibrated. The new system works immediately and at its peak performance.
Another significant advantage is the full function generator setup. The full function generator setup contains standard values for amplitude, offset, frequency, and so on. All of this information is stored inside an ID-chip that is located on the actuator's connector. The setup is immediately active again after switching on the electronic.

Blocking Forces

Mechanically, a piezo actuator can be treated as a mechanical spring with a spring constant (stiffness). If the actuator is operated with the maximum voltage but it is fixed between walls with an infinitely high stiffness the actuator cannot move. It generates its maximum forces called blocking forces.

Cables

piezosystem jena uses cable with high voltage signal insulation and shielding protection. For vacuum applications, the standard cable comes with Teflon, Polyimide or Kapton insulation material for no out-gassing. Other cables in various lengths are also available upon request.

Cable Length

open loop actuators	1 m
with sensor preamplifier	2 m
with SG-sensor without sensor preamplifier	1.2 m
with CAP-sensor without sensor preamplifier	1.6 m
prepared for vacuum/outside vacuum	0.6 m / 2.0 m

Calibration Procedure

Each closed loop system will be calibrated to provide the highest possible accuracy and to achieve the fastest possible response. The calibration is done with a high resolution interferometer set up. Unless otherwise noted, all calibrations are done at 22°C ±1K with a pressure and humidity compensated laser interferometer. A calibration protocol is provided with each calibrated system.

Standard Calibration:

If not otherwise specified, all closed loop systems are calibrated related to our "standard calibration conditions" (external load, dynamic behavior, position of installation).

Customized Calibration:

If the piezo system has to work under different conditions a special calibration might be necessary. Please ask our team for assistance in advance.

Closed Loop Operation

To overcome creep (drift) and hysteresis and to compensate for changing environmental conditions (e.g. forces from outside), a piezo system can be equipped with a measurement system. The closed loop electronics uses the feedback from the position sensor to control the motion of the piezo system. ***piezosystem jena*** uses mainly strain gauge sensors or capacitive sensors.
Elements equipped with a strain gauge sensor are named with the suffix SG. Elements with integrated capacitive sensors are named with the suffix CAP.

Connectors Voltage

controller	connector type
analog amplifiers (not nanoX)	LEMO 0S.302
for nanoX	ODU L-series 3pin
digital amplifiers	D-Sub 15
high power amplifiers	D-Sub 15 5W1

Sensor

controller	sensor
SG non-external preamplifier	LEMO 0S.304
CAP non-external preamplifier	LEMO 0S.650
external preamplifier SG or CAP	ODU L-series 4pin
digital amplifiers	D-Sub 15

Cryogenic Application

piezosystem jena can modify most of the elements to be usable at cryogenic temperatures. Please note that the original motion of the system is reduced when used at low temperature.

Drift / Creep

Creep (drift) describes a movement of the position of a piezo actuator after the input change (voltage change) has stopped. The creep of piezoceramics is based on a change of the remanent polarization of the ceramics even if the applied voltage does not change anymore.

To overcome the effect of creep, the piezo system has to be equipped with a sensor and feedback control electronics (see also ***chapter 3.8*** of the piezoline).

External Sensor Pre-Amplifier

The preamplifier makes the sensor signal insensitive to external disturbances.
It is often located in a small box installed along the cable of the actuator.

Hysteresis

Piezo actuators show hysteresis in their large signal behavior. Hysteresis is also based on the remanent polarization of the piezo ceramic material. The motion caused by this polarization shows a time delay related to the motion caused by the applied voltage.

To overcome the effect of hysteresis, the system has to be equipped with a measurement system and closed loop control electronics. (see also ***chapter 3.2*** of the piezoline)

Linearity

The linearity describes the difference of the position measured by the integrated measurement system of the actuator compared to the exactly measured position using a laser beam interferometer.
Each calibrated system (closed loop system) made by ***piezosystem jena*** comes with a calibration protocol indicating the linearity and repeatability.
Data for linearity given in the catalog are typical values measured for many elements of the same type of actuator (stage). Values for linearity for a particular system may differ from catalog values. Data given in the calibration protocol are related to well-defined environmental conditions. If the measurements conditions vary compared to the conditions stated in the calibration protocol, linearity data may change. (see also ***chapter 9.5*** of the piezoline).

Noise

Position noise is the variation of the position in the element (or measurement signal) even if the system is not moving. Noise values in this catalog are peak to peak values. Other publications often use other values for noise. RMS values are 2-3 times smaller compared to peak to peak values. However, the piezo element with its unlimited mechanical resolution reproduces all electric signals which are within its frequency response capability. Mechanical resolution calculated from RMS values result in better data than they are in reality.

Open Loop Operation

The actuator is operated without a measurement system. Displacement is approximately correlated to the drive voltage. Non-linearity, hysteresis and creep are not compensated.

Push and Pull Force

Piezoceramic stacks can withstand high pressure push forces (push forces are opposite to the direction of motion). However due to their construction as a multilayer element they can only withstand low pull forces (tensile forces in the direction of motion). Piezo stages consist of multilayer piezoceramic stacks integrated into a special construction for the magnification of motion. This construction can include different kinds of preloading mechanisms allowing for higher compressive and tensile forces to the piezo stages.

Push and pull forces specified in this catalog indicate maximum forces to be applied to the piezo stages, or piezo actuators without mechanically damaging the elements.
If the applied forces are higher than the specified values the elements can be damaged and might not work properly.

Repeatability

The repeatability designates the error which arises if the same position from the same direction is permanently approached.
The repeatability for each calibrated system (closed loop system) is shown in the calibration protocol supplied with the calibrated system.
Data for repeatability given in the catalog are typical values measured for many elements of the same type of actuator (stage). Values for repeatability for a particular system may differ from catalog values.
Data given in the calibration protocol are related to well defined environmental conditions. If the measurement conditions vary compared to the conditions stated in the calibration protocol, repeatability data may change. (see also ***chapter 9.5*** of the piezoline).