

**Bedienungsanleitung
Spannungsverstärker NV40/1CL**

**instruction manual
voltage amplifier NV40/1CL**



Bitte die Bedienungsanleitung vor dem Anschalten des Gerätes sorgfältig lesen.
Beachten Sie bitte insbesondere die Sicherheitshinweise!

Read carefully before switching on the power! Please see also instructions for
safety, using piezoelectric actuators and power supplies!

230V / 50Hz

115V / 60Hz

Seriennummer / serial number: E -





Bedienungsanleitung Seite 3 ... 17
(deutsch)

Instruction manual pages 19 ... 33
(english)

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**COMPETENCE
IN PRECISION**

1. introduction

This manual describes the voltage amplifier NV40/1CL from **piezosystem jena**. You will also find additional information regarding piezoelectric products.

definition:

All systems from **piezosystem jena** such as electronics, actuators and optical systems are called units.

2. certification of piezosystem jena

The company piezosystem jena GmbH has been certified by DIN EN ISO 9001 since 1999.





3. Declaration of conformity

EU-Declaration of conformity

This certificate is issued for the system:

voltage amplifier NV40/1CL

manufactured at:

piezosystem jena GmbH

Pruessingstrasse 27

07745 Jena / Germany

The system as described above herewith complies with the requirements of the European standards as follows:

EN 50082 (DIN VDE 0875 part 11) group 1, part 2

EN 55011, class B

declaration issued by:

piezosystem jena GmbH

Bernd Schmidt

(head of the electronic department)

Jena, Feb.15th, 2001



4. instructions for using piezoelectrical elements and power supplies

- Piezoelectric actuators from piezosystem jena are controlled by voltages up to 150V. These values can be quite hazardous. Therefore read the installation instructions carefully and only authorized personal should handle the power supply.
- After transportation, piezoelectric actuators should be allowed to adapt for approximately 2 hours to the room temperature before being switched on.
- Piezoelectric actuators are made from ceramic materials with and without metallic casings. The piezo-ceramic is a relatively brittle material. This should be noted when handling piezoelectrical actuators. All piezo-elements are sensitive to bending or shock forces.
- Due to the piezomechanical effect piezo-actuators can generate electrical charges by changing the mechanical load or the temperature or such actions described above.
- Piezoelectric actuators are able to work under high compressive forces, only actuators with pre-load can be used under tensile loads (these tensile forces must be less then the pre-load, given in the data sheet).
- Please note that the acceleration of the ceramic material (e.g., caused by fall down, discharging or high dynamic application) will occur.
- After excitation of the actuators by a voltage in the upper control range, the ceramic will move and generate an opposite high voltage after disconnection.
- Heating of the ceramic material will occur during dynamic operation and is caused by structure conditional loss processes. This may cause failure if the temperature exceeds specified values cited below.
- With increasing temperature, up to the Curie temperature (usual values approx. 140°C - 250°C), the piezoelectric effect disappears.
- Piezoelectric actuators such stacks or various tables work electrically as a capacitance. These elements are able to store electrical energy over a long period (up to some days) and the stored energy may be dangerous.
- If the actuator remains connected to the drive electronics, it is unloaded within a second after shutdown and quickly reaches harmless voltage values.
- Piezo-actuators can generate voltages by warming or cooling only (caused by the longitudinal change). The discharge potential should not be ignored due to the inner capacitance. This effect is insignificant at usual room temperature.
- Piezo-actuators from piezosystem jena are adjusted and glued. Any opening of the unit will cause misalignment or possible malfunction and the guarantee will be lost.
- Please contact piezosystem jena or your local representative, if there are any problems with your actuator or power supply.



Caution!

Shock forces may damage the built-in ceramic element. Please avoid such forces, and handle the units with care, otherwise the guarantee will be lost.

5. safety instructions

- Do not open the units! There are no user serviceable parts inside and opening or removing covers may expose you to dangerous shock hazards or other risks. Refer all servicing to qualified service personnel.
- Allow adequate ventilation around the units so that heat can properly dissipate. Do not block ventilated openings or place the units near a radiator, oven or other heat sources. Do not put anything on top of the units except those that are designed for that purpose (e.g. actuators).
- Do not spill any liquids into the cabinet or use the units near water.
- Do not insert objects of any kind into the cabinet slots, as they may touch dangerous voltage points, which can be harmful or fatal or may cause electric shock, fire or equipment failure.
- Do not place any heavy objects on any cables (e.g. power cords, sensor cables, actuator cables, optical cables). Damage may cause malfunction or shock or fire!
- Do not place the units on a sloping or unstable cart, stand or table as they may fall or not work accurately.
- Work with the units only in a clean and dry environment! Only specially prepared units (e.g. actuators) can work under other conditions!
- Please use only original parts from piezosystem jena.
- piezosystem jena does not give any warranty for damages or malfunction caused by additional parts not supplied by piezosystem jena. Additional cables or connectors will change the calibration and other specified data. This can change the specified properties of the units and cause them to malfunction.
- Piezoelements are sensitive systems capable of the highest positioning accuracy. They will demonstrate their excellent properties only if they are handled correctly! Please mount them properly only at the special mounting points.

Immediately unplug your unit from the wall outlet and refer servicing to qualified service personnel under the following conditions:

- when the power supply cord or plug is damaged
- if liquid has been spilled or objects have fallen into the unit
- if the unit has been exposed to rain or water
- if the unit has been dropped or the housing is damaged



6. instructions for checking the function of the system / quick start

When you open the package, please check to make sure all the necessary parts are complete (see packing list) and nothing is damaged.

Check the electronics and the actuator for any visible damage:

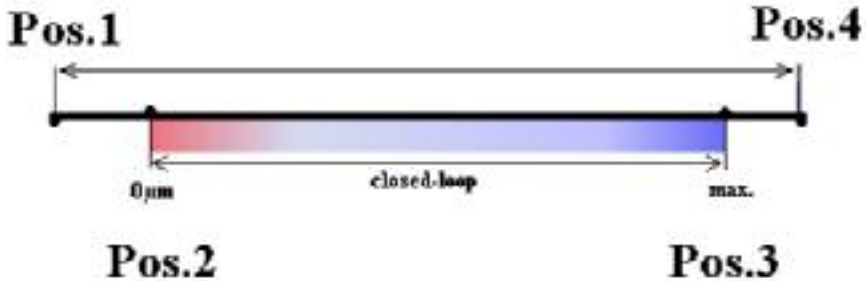
- The top and bottom plate of the actuator (if it does not have another shape) should be parallel each to each other, without scratches.
- If there is any damage to the system please contact our local representative immediately!
- If the packaging material is damaged please confirm this with the shipping company.

Before you switch on the system, please check:

- The main voltage supplied in your country is the same as installed for the system. (Check the voltage label on the backside of the electronics!)
- The potentiometer should be in maximum counter clockwise position (Pos. 0 or Pos.1 depending on the operation mode)
- The power switch should be in the off position
- Connect the power cable.
- Connect the piezo-element by using the LEMO connector.
- Be sure the cables are connected properly to the electronics

Switch the system on (power = on)

- The red LED indicates the power supply is warming up. After a short delay time the amplifier modules are switched on (green LED).
- The displays shows the minimum position of the actuator (Pos. 1) in open loop operation (see sketch 1 on page 25)



sketch 1: open loop - closed loop motion

Turn the potentiometer into the maximum clockwise position (Pos. 4). The display shows the maximum position. The total motion in open loop regime is Pos. 4 - Pos. 1

Turn the potentiometer into the maximum counter clockwise position (Pos. 1)

Switch on the closed loop for this channel (closed loop = on).

- The actuator moves to its zero position in closed loop regime (Pos. 2), the displays shows 0.0 μm if there is no offset to the system
offset is accomplished by the offset potentiometer or external offset (e.g. a load)

Because of the fast motion of the actuator to Pos. 2 a noise, crack can be heard. This is normal and not a malfunction.

Turn the potentiometer to the clockwise position again. The actuator makes its maximum movement in closed loop regime - Pos. 3. The total motion in closed loop regime is Pos. 3 - Pos. 2. The specific value for that axis is given in the calibration curve of the actuator.

Turn the potentiometer to its counter clockwise zero position, switch off the closed loop switch (closed loop = off)

If the procedure is done you can switch off the electronics.

Before you switch off the electronics, be sure that the potentiometer is in the left zero position and the closed loop switch is switched off!



7. Interface setup

- Connect the RS232 serial connectors of your IBM compatible computer and the NV40/1 CL by using a standard interface line.
- Switch ON both units
- The communication between voltage amplifier and computer can be realized by using any terminal program (normally it is part of your operation system, please refer your OS documentation)
- RS232 parameters: COMx: 9600,n,8,1
- You will see following echo on your screen: "NV40/1 CL"

8. How to operate the NV40/1 CL

8.1. Common introduction

The voltage amplifier NV40/1 CL was especially developed for one channel positioning tasks. The primary drive for developing the system was simple service and universal usage of the unit.

Caution:

The voltage amplifier NV40/1 CL controls piezoelements with integrated measuring system. In this case, all units, piezoactuator, measuring system and voltage amplifier must be calibrated on each other. Calibration occurs before the delivery. In both operating modes (OPEN loop=ON and/or closed loop=OFF), the measured motion of the actuator will be displayed in microns.

Please note: If power to the amplifier is lost, the system automatically reverts to open loop status. In order to operate in closed loop again, the closed loop button must be pressed in order to switch it on.

Systems without measuring system:

If you bought the voltage amplifier without actuator and/or with an actuator without measuring system, you can work with it in the non-controlled operation mode. In that case, we will adjust the display to show the actuator voltage in volts (-10...150V) instead of the motion in microns.

In case of a subsequent adaptation of a measuring system, a calibration of the electronics is necessary. To do so, actuator, electronics and measuring system must be send to **piezosystem jena** for calibration. This is an additional expenditure combined with costs. We would ask you to contact our service to decide if a subsequent calibration is possible.



8.2. technical data

Power supply	115V 60Hz	230V 50Hz
max. current	500mA	250mA
Fuses	2x 500mA slow	2x 250mA slow
Dimensions wxdxh [mm]	170x200x70	
Mass [kg]	1,7	
Number of channels	1	
Display	position in open loop operation mode, LED; 4 digits	
Power [W]	6	
Output current [mA]	40	
Output voltage (OUT)	-10 ... +150V (adjustable manual or by software)	
Output connector (OUT)	LEMO 0S 250	
modulation input (MOD)	0-10V BNC	
Inner resistance	10k Ω	
monitor voltage (MON)	0 ... +10V BNC	
Noise of the output voltage	0,4mV _{RMS} @ 500Hz	
bandwidth [Hz]	350 (without connected actuator)	
polarity	positive	

table 1: technical data NV40/1CL



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8.3. Initiation

Please connect the amplifier with the wall socket by using the included power supply cable, please note the correct voltage. The power switch and the fuse casing are located on the backside of the unit.

The power LED “on” lights up after switched on the amplifier (short initialization time). The display announces the motion of the actuator.

There is a backside RS232 socket available, to realize a remote-controlled operation via any terminal program.

The device switches into the open loop when the unit is switched on. Pay attention to the correct assignment of modulation signal and monitor signal on the front-panel BNC sockets, if you use this.

Please, switch off the device and contact our technical staff, if the red error LED is lit.

The actuators are driven by voltages up to +150V. Please pay attention to shock hazard protection.

8.4. Service

The actuator is connected to the power supply by a LEMO socket. The potentiometer is used for the level of the output voltage (offset, DC level). The rest position of the actuator is hereby adjusted. An external triggering signal on the range of 0...+10V (mod input socket) can control the output voltage. Utilizing this input high dynamic scanning functions are possible. In the closed loop operating mode, the operating frequency reduces. The absolute values are essentially dependent on the capacitance of the actuator and the load. The operating frequency is in the range of 1Hz to about 20Hz in closed loop operation. If you have a special demand for the closed loop function, please contact our technical service department

To avoid damage to the actuators, it is recommended to adjust the potentiometer to the extreme counter clockwise position before switching on the amplifier.

By superposition of the modulating voltage and adjusted offset, voltages up to 170V can occur. This operating state is to be avoided to protect the ceramics and increase the MTBF. In addition, the error-LED lights up in the case of a limit error. No disconnection of the overvoltage occurs!

We recommend you switch on the amplifier approx. 2 hours before the measurement in the sub- μ m range takes place to guarantee stable temperature circumstances.



A constant temperature environment is necessary for precise positioning tasks. Please note, that a temperature change of $\Delta T = 5K$ will cause a $20\mu m$ increase in length of a 20cm steel rod.

The special qualities of piezo-ceramics like hysteresis and drift can cause inaccuracies in the case of nonobservance and are compensate in closed loop function.

These basic qualities of piezo-elements are described in the “piezoline” tutorial in our catalog. Do not hesitate to contact our staff, if you need further information.

8.5. Light-emitting diodes

After turning on, the left “on” LED announces data set ready.

The display shows the non-controlled actuator motion immediately (See also on page).

The actuator is outside of the controlled range by adjusting the potentiometer to the extreme counter clockwise position (most negative point of the total control range (Pos.1 to Pos.4).

If it is then switched by actuating the closed loop switch into the controlled operating status, the actuator moves to the zero position of the control range (Pos.1). Depending on the position set currently, the actuator may carry out a jump. This is because the closed loop control range (closed loop range) is approximately 80% of the open loop control range. If the adjustable potentiometer is then turned into the clockwise position, the controlled maximum motion is covered and announced by the display. This way depends on the specifications of the actuator and can vary depending on actuator model.

The red error-LED announces a malfunction or overload. Please, try to avoid overload in this case. Immediately switch off the amplifier, if the error LED is still illuminated by reduction of the control signal. It is possible, that the actuator protection mechanisms are not functioning.

8.6. Modulation input: mod

An analogous modulation signal of 0 to +10V can be driven into this socket to realize a remote-controlled operation. A sum of the BNC socket voltage and the offset voltage set at the potentiometer “DC-level” occurs. The local-mode voltage is also in the range of 0 to +10V. Both, externally driven voltages and internal OFFSET must be less then +10V. Voltages outside of the permissible field are signaled by the error-LED.



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8.7. Monitor output: mon

The pre-processed sensor signal is available at the mon socket. The mon voltage is 0 to +10V representing 0 to 100% motion in closed loop operation. The range of adjustment outside of the assured and controlled range of adjustment is the systems control reserve.

Connected measuring instruments must have at least 100k Ω input resistance. The output is not short-circuit-proof, do not add any voltages.

8.8. Actuator connection: out

Please plug in the actuator here. The output voltage is in the range of -10...150V.

8.9. RS232 interface

In the case of controlling the amplifier over the interface, the potentiometer DC level is deactivated. The motion of the actuator is always announced in microns at the display. If any equipment with the actuator is provided without a measuring system, the current actuator voltage is always to be seen on the display.

Communication with the NV40/1 CL occurs via the RS232 interface (ASCII character concatenation). The character string must be concluded with ENTER. ASCII characters less then 20h (hexadecimal) except for ENTER (13h), will be ignored.

A valid command looks like:

command , parameter

parameter is:10.34 --> 10,34 μ m or Volt

If the internal processor recognizes the command it is carried out. If the sent command is not in the intern command list or was sent erroneously, an error report would be created. The report describes the occurred error.

Interface set up: 9600 Baud, 1 Start / Stop-Bit, no parity

command	description
cl <CR>	closed loop on
ol <CR>	closed loop off
i1 <CR>	remote control via RS232 active
i0 <CR>	remote control via RS232 not active

table 2: software commands



8.9.1. write-command wr

wr,10.29<CR> open loop:10.29V; closed loop:10.29µm

The command wr outputs a voltage to the actuator in the open loop operating mode. In the closed loop operation the motion is shown in µm.

8.9.2. read-command rd

rd<CR>; response: rd,10.25<CR><LF>

The system response to the rd command is the actuator motion in microns always.

Caused by the differing resolutions of analog-to-digital converter A/D and D/A, deviations of both values in control electronics are possible. These deviations are always less than the specified tolerances for the positioning accuracy.

8.9.3. Error reports

Possible error reports which can be read via a terminal program:

Error report	description
err,1<CR><LF>	// unknown command
err,2<CR><LF>	// to many characters in the command
err,3<CR><LF>	// to many characters in the parameter
err,4<CR><LF>	// to many parameter
err,5<CR><LF>	// wrong character in parameter
err,6<CR><LF>	// wrong separator
err,7<CR><LF>	// overload

table 3: error reports



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8.10.Possibilities of the error correction

It can happen in rare cases that the main fuse breaks when switching on the amplifier. It is in addition to the main switch on the backside of the case. For replacement the AC power connector is to be removed and the protection fuse is to be replaced. Replace the fuse only with same ratings.

Please protect the power cords from harm or shorts which could cause malfunction of the equipment. Large strains on the cords can lead to interruptions. On systems without closed loop function, the voltage on the display can also be read without actuator sensor combination.

Error	possible correction
nothing happens after switching on the device	Check power cord and fuses
LED error is illuminated	Check the position of the adjustable potentiometer and the amplitude of the modulation signal. High modulating voltage overdrives the amplifier. Decrease the modulation signal or reduce the control voltage until error-LED is off.
erroneous, illogical display values	Check the sensor cable and connection

table 4: possibilities of the error correction

The equipment is calibrated before delivery for the appropriate actuator with integrated measuring system. An exchange of the actuator amplifier combination leads to inaccuracies in setting movement and positioning accuracy is lost. If the equipment is damaged during effort of another actuator, no assurance can be undertaken!

The equipment concept makes adaptations to customer preferences possible concerning the technical threshold values such as the main voltage or the output voltage. Please, contact our technical service department in order to discover the possibilities for your specific problem.

Adaptations are always to be paid by the customer.



9. Your notes

