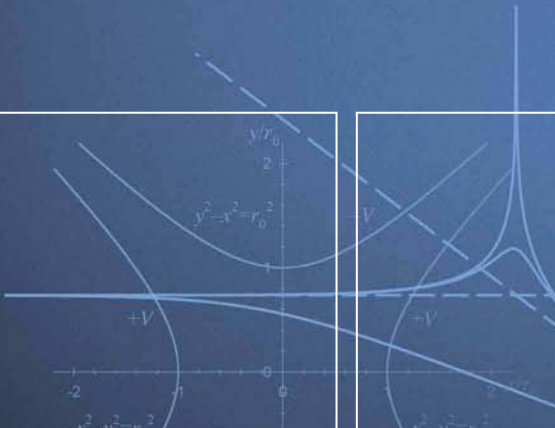




# COMPUTER MEASUREMENTS PIEZOELECTRIC ACTUATORS OPTOELECTRONIC SYSTEMS



$$Z_{x_{k-s}} = \sum_{(k=0.. \infty)} x_{k-s} \cdot z^{-k} = \sum_{(k=s.. \infty)} x_k \cdot z^{-k+s} = z^s \cdot \sum_{(k=s.. \infty)} x_k \cdot z^{-k}$$

$$Z_{x_{k-s}} = z^{-s} \cdot \left[ \sum_{(k=-s.. -1)} x_k \cdot z^{-k} + Z_{x_k} \right] \cdot \left[ \frac{2 \cdot \xi_1 \cdot 2 \cdot z}{\omega_1 \cdot T \cdot z + 1} + \left( \frac{1 \cdot 2 \cdot z - 1}{\omega_1 \cdot T \cdot z + 1} \right)^2 \right]$$

$$Z_{x_{k+s}} = \sum_{(k=0.. \infty)} x_{k+s} \cdot z^{-k} = \sum_{(k=s.. \infty)} x_k \cdot z^{-k+s} = z^s \cdot \left[ \sum_{(k=0.. \infty)} x_k \cdot z^{-k} \right]$$

$$Z_{x_{k+s}} = z^s \cdot \left[ Z_{x_k} - \sum_{(k=0.. s-1)} x_k \cdot z^{-k} \right] \cdot \left[ \frac{2 \cdot \xi_1 \cdot 2 \cdot z}{\omega_1 \cdot T \cdot (z-1) \cdot (z+1)} + \left( \frac{1 \cdot 2 \cdot z - 1}{\omega_1 \cdot T \cdot (z-1) \cdot (z+1)} \right)^2 \right]$$

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$$H(z) = \frac{z^2 \cdot (1 + 2 \cdot \xi_1 \cdot \varepsilon_1 + \varepsilon_1^2) + 2 \cdot z \cdot (1 - \varepsilon_1)}{z^2 \cdot (1 + 2 \cdot \xi_2 \cdot \varepsilon_2 + \varepsilon_2^2) + 2 \cdot z \cdot (1 - \varepsilon_2)}$$

# COMPUTER-CONTROLLED MEASUREMENT TECHNIQUE

## MODULAR DATA-ACQUISITION SYSTEM (DAS)

The DAS is a simple way for implementing customer-specific solutions. Due to its modularity, the user can combine various measuring modules for the desired functionality. The measuring modules use our UDB (Universal Device Bus) system. It combines an addressable serial data link according to the I<sup>2</sup>C standard with power supply rails for digital and analog circuits. For customer-built circuits, a hardware development kit is available.

<b>Housing</b>	19" 3U	19" 6U
<b>PSU</b>	1x 5V, 1x ±15V	2x 5V, 2x ±15V
<b>UDB positions (3U, 4HP each)</b>	15	2x15
<b>Total rack number</b>	up to 16	up to 8
<b>Total module number</b>	up to 240	
<b>Galvanic isolation</b>	✓	
<b>Data link</b>	buffered I <sup>2</sup> C	
<b>Data cable</b>	up to 50 m (100 kbit/s)	

### Available UDB Devices

- Digital-to-Analog Converters
- Analog-to-Digital Converters
- Digital Input/Output
- Combi-Cards
- Counters
- Programmable Timers
- Programmable Logic Arrays



## DATA-PROCESSING MODULES FOR THE DAS

Data-processing modules are intelligent measuring modules with analog-to-digital and/or digital-to-analog converters controlled by FPGAs and microcontrollers. They can be used for digital signal processing or generation.

- **DAS-DCD-2:** coordinate decoder for 2D position-sensitive detectors
- **DAS-DMP-2:** electrodynamic damping unit with 2 channels
- **DAS-CNT-2:** 2-channel counter with filters
- **DAC8+4+DO8I:** power supply unit with 4 power, 8 analog, and 8 digital outputs



## CUSTOMIZED SOLUTIONS

The data-processing modules can be adapted for various customer-specific solutions. We select the required hardware and program it.

<b>CPU</b>	16-bit RISC or 32-bit ARM
<b>FPGA</b>	up to 3M gates
<b>NV RAM</b>	up to 4 MB
<b>LCD</b>	monochrome 128x64 or 240 x 160 pixel
<b>HMI</b>	keypad + rotary encoder(s)
<b>DAC(s)</b>	16-bit, 10 MS/s
<b>ADC(s)</b>	16-bit, 4 MS/s
<b>Options</b>	digital I/Os



# CONTROL OF PIEZOELECTRIC ACTUATORS

We offer a broad spectrum of amplifiers for controlling piezoelectric actuators. Our precise amplifiers with an extremely low noise and a correspondingly high dynamic range are used to control piezoelectric scanners in microscopy with subatomic resolution. On the other hand, our power amplifiers can deliver an output power of up to 1 kVA required to drive large actuators at high speeds.

## HIGH-VOLTAGE AMPLIFIERS (HV-AMP)

The high-voltage amplifiers provide output voltages in the range of several 100 V with an excellent accuracy capable to drive high capacitances of small piezoelectric actuators. The devices can optionally be digitally controlled or equipped with a digital waveform generator.



## Application examples of our amplifiers

- Scanning-Probe Microscopy (SPM)
- Optical systems
- Mechanical engineering
- Medical devices

## HIGH-VOLTAGE POWER AMPLIFIERS (HV-PA)

The power amplifiers aim at driving large piezoelectric actuators with high capacitances. They provide an output power between 100 and 1000 VA and voltages of up to ~1 kV. Several amplifiers include a digital waveform generator and/or a complete digital supervision and a remote control.

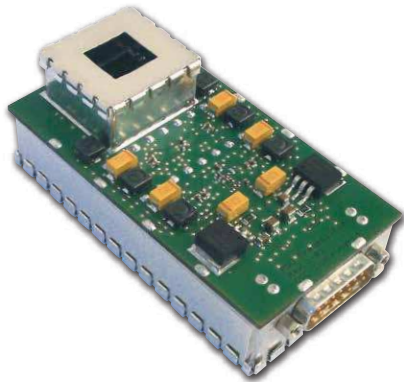


Product No.	HV-AMP 200-4	HV-AMP 200BN-2x2+1	HV-PA 500-1	HV-PA 150-2D	HV-PA 550-2D
Channels	4	5	1	1	1
Output voltage	±200 V	±200 V	±250 V	-10 ... +150 V	0 ... +1100 V
Amplification	20	20	250	internal waveform generator	internal waveform generator
Signal bandwidth	10 kHz	1.7 kHz	300 kHz	6 kHz	4 kHz
Power bandwidth	35 Hz @ 1 μF	15 Hz @ 1 μF	90 kHz @ 10 nF	110 Hz @ 70 μF	40 Hz @ 10 μF
Output noise	1.0 mV <sub>pp</sub>	130 μV <sub>pp</sub>	70 mV <sub>pp</sub>	6 mV <sub>pp</sub>	13 mV <sub>pp</sub>
Switchable offset	-	-	-	+70 V	+550 V
Output monitor	-	-	✓	✓	✓
Device supervision	current	current, temperature	current, temperature	full under CPU control	
Remote control	-	-	-	USB, TTL	USB, TTL
Housing	19" 2U	19" 2U	19" 6U	19" 6U	19" 6U
Weight	6.5 kg	10.5 kg	28 kg	27.5 kg	41 kg

# OPTOELECTRONIC SYSTEMS

We offer customized solutions in the following fields:

- Low-noise preamplifiers for photodiodes and other photo-detectors
- Counting modules and power supplies for PIN diodes or photomultipliers
- Laser-diode drivers with precise pulse control
- Position-sensitive detectors with high sensitivity



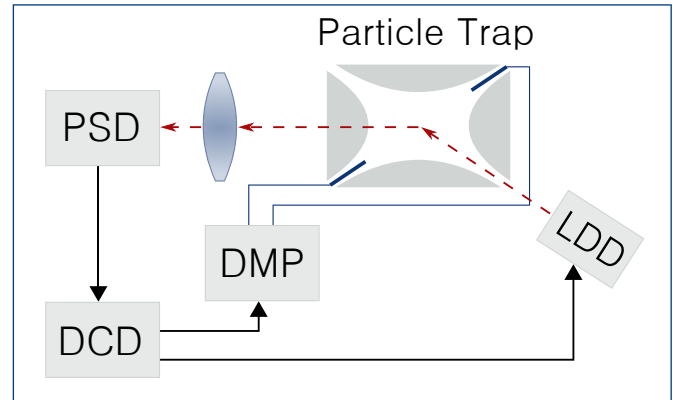
## Typical applications:

- Daly ion detectors
- Photodetectors for FT and grating spectrometers
- Positioning of micro- and nano-objects



# OPTOELECTRONIC DAMPING SYSTEM

The damping system is an example of a complex optoelectronic setup. It tracks the movement of a microparticle in an electrodynamic trap. The obtained coordinate signals are used to control the kinetic temperature of the microparticle.



## The system consists of

- **LDD** (Laser Diode Driver) provides the pulsed light
- **PSD** (Position-Sensitive Detector) measures the microparticle's position
- **DCD** (Coordinate-Decoder Unit) obtains the coordinate signals
- **DMP** (Damping-Control Unit) generates the damping signals



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