Single Axis Nanopositioning Controllers with Digital Servo

E-709 low-cost digital controller for capacitive sensors
E-753 Ultra-High Performance Single Channel Controller

Single Axis Nanopositioning Controllers with Analog Servo

The E-621.CR module USB, RS-232 and Analog Interfaces
E-625. Bench -Top1 Channel
E-665 Display Controller with USB, RS-232 and Analog Interfaces

10 Single-channel OEM module
PI provides high-level, robust, easy-to-use software tools for fast, seamless integration of motion systems into application control software.

The high quality of positioning systems is made apparent in daily operation by PI software. Starting with simple commissioning, through convenient operation with a graphical interface, to quick and simple integration in customized programs with high performance, PI software covers all aspects important to an application.

For uniform operation of nano and micropositioning systems, the universal PI General Command Set (GCS) is used. GCS operation is independent of the controller or drive principle used, so that several positioning systems can be controlled together, or new systems can be introduced with a minimum of programming effort. With GCS the development of custom application programs is simplified and less prone to errors, because the commands for all supported devices are identical in syntax and function. Through the use of the GCS command set with its convenient functions, the orientation phase and application development process is significantly accelerated. The GCS commands are available at the controller terminal, in macros and in the form of a universal driver set for LabVIEW (VIs), Windows dynamic link libraries (DLL) and Linux libraries. This facilitates the development of custom macros, as well as integration with programming languages like LabVIEW, C++ or MATLAB.

Easy integration in LabView. Quick access to the full functionality
Contact PI for our extensive library of software examples!

Communication between PI components is based upon a universal command set (GCS – General Command Set). It decouples hardware and software, and is used for all drive systems.
The E-709 opens up the possibilities of digital control for piezo-driven nanopositioning systems for the same price as analog controllers. It is available for capacitive sensors and nanopositioning stages which are equipped with cost effective measuring systems such as strain gauges or piezoresistive sensors. The advantage: higher precision, more control options and very simple operation. In addition, PI provides the full functionalities of its comprehensive software packages free of charge! The E-709 can also be used for applications providing analog control signals, maintaining the advantages of digital signal processing and parameter setting.

The target position is controlled via an analog signal, allowing system components with analog output (e.g. autofocus) to be integrated easily.

E-709 controllers are also offered without case. A lower cost version sold as the E-609 is available for purely analog control signals, maintaining the advantages of digital signal processing and parameter setting.

The limited linearity of these strain sensors can be improved by digital controllers, which use additional linearization algorithms to minimize the deviation between target and actual position. This improves the accuracy by up to one order of magnitude and achieves linearity values of up to 0.02%.

The E-709 is available for download at www.pi.ws.
Comparison of the linearity of a strain gauge sensor with analog controller (top) and the E-709 digital controller (bottom), which improves the linearity by up to one order of magnitude.
E-753 Ultra-High Performance Digital Piezo Controller, 1 Axis

The E-753 next-generation digital piezo controller is the result of PI’s 30+ years of experience with piezo motor control systems. It is ideal when it comes to meeting the most demanding accuracy and dynamic performance requirements of nanopositioning systems of the highest precision class. The E-753 replaces the E-750 controller.

Dynamic Digital Linearization (DDL, E-710.SCN). This optionally available control algorithm reduces the tracking error by a factor of up to 1000 and enables the spatial and temporal tracking during a dynamic scan.

The controller is perfectly suited for high-dynamics operation thanks to its high-resolution D/A converter and high-performance voltage amplifier. The high-speed processor with a sensor sampling rate of 100 kHz assures settling times in the millisecond range and below.

PI nanopositioning systems which are equipped with an ID-chip and calibrated with a digital controller have the mechanics-related calibration and servo-control parameters stored in the chip. The controller automatically adapts to the connected mechanics by the appropriate use of this data, so that recalibration is not necessary when system components are replaced.

The integrated wave generator can save and output periodic motion profiles. In addition to sine and triangle waves, arbitrary, user-defined profiles can be created.

All parameters can be checked and reset via software. System setup and configuration is done with the included NanoCapture™ and PIMikroMove™ user interface software. Interfacing to custom software is facilitated with included LabVIEW drivers and DLLs. System programming is the same with all PI controllers, so controlling a system with a variety of different controllers is possible without difficulty.
Technical Data

Model E-753.1CD

Function Digital controller for single-axis piezo nanopositioning systems with capacitive sensors

Axes 1

Processor DSP 32-bit floating point, 60 MHz

Sampling rate, servo-control 26 kHz

Sampling rate, sensor 100 kHz

Servo characteristics P-I, two notch filters

Sensor type Capacitive

Sensor channels 1

Sensor bandwidth 5.6 kHz

Sensor resolution 17-bit

Ext. synchronization Yes

Amplifier

Output voltage -30 V to 135 V

Amplifier channels 1

Peak output power <5 ms 15 W

Average output power >5 ms 5 W

Peak current <5 ms 110 mA

Average current >5 ms 40 mA

Current limitation Short-circuit-proof

Resolution DAC 24-bit

Communication interfaces Ethernet, RS-232

Piezo connector Sub-D special connector

Sensor connection Sub-D special connector

Analog input LEMO, ±10 V, 18 bit

Digital input 2 x LEMO, TTL

Digital output 2 x LEMO, TTL

Command set GCS

User software NanoCapture™, PIMikroMove™

Software drivers LabVIEW drivers, DLLs

Supported functionality Wave generator, trigger I/O, data recorder

Display Status LEDs

Linearization 4th order polynomials, DDL (optional)

Separate protective ground connector Yes

Operating temperature range 5 to 50 °C

Overtemp protection Deactivation of the piezo voltage output at 85 °C

Mass 0.9 kg (controller)

Dimensions Controller: 264 x 125 x 48 mm (with rubber feet)

Power supply: 174 x 95 x 58 mm (with rubber feet)

Power consumption 10 W max.

Operating Voltage 24 VDC from external power supply (included)

Graphs reflect the large signal-current limitation of the amplifier circuit, not the actual bandwidth.
Analog Piezo Nanopositioning Controllers

Single Axis Controllers

10 Single-channel OEM module

The E-621.CR module USB, RS-232 and Analog Interfaces

E-625. Bench -Top1 Channel

E-665 Display Controller with USB, RS-232 and Analog Interfaces
The E-610 is an OEM amplifier & position servo-control board for low-voltage piezo actuators and positioning systems. It integrates a low-noise piezo amplifier which can output and sink peak currents of 180 mA in a voltage range of -20 to +120 V. Three versions are available: E-610.00 (only amplifier) and closed-loop versions E-610.S0 and E-610.C0 with additional components for position measurement and servo control.

Closed-Loop and Open-Loop Piezo Positioning
The units are designed to provide high-resolution operation of piezo actuators and positioning systems in voltage-controlled mode (open-loop) and in position-controlled mode (closed-loop).

In closed-loop position control mode, displacement of the piezo is highly linear and proportional to the analog signal. The servo modifies the amplifier output voltage based on the position sensor signal. Thus, positioning accuracy and repeatability down to the sub-nanometer range is possible, depending on the piezo mechanics and on the sensor type.

PI employs proprietary position sensors for fast response and optimum positioning resolution and stability in the nanometer range and below. For high-end applications, capacitance sensors provide direct and non-contact position feedback (direct metrology). Strain gauge sensors (SGS) are available for cost-effective applications. The integrated notch filters (adjustable for each axis) improve the stability and allow high-bandwidth operation closer to the resonant frequency of the mechanics.

In open-loop (voltage-controlled) operation the output voltage is determined by an external analog signal. Open-loop operation is ideal for applications where fast response and very high resolution with maximum bandwidth are essential. Here, commanding and reading the target position in absolute values is either not important or carried out by external position sensors (see p. 2-114).

Remote Control via Computer Interface
For digital-interface computer control, consider the E-621 (see p. 2-160) and E-625 (see p. 2-114) instead.

Alternatively control via PC using a D/A board is possible. PI offers a LabVIEW driver set which can be used with certain D/A boards from National Instruments.

Ordering Information
E-610.00
Piezo Amplifier, 1 Channel, OEM Module, -30 to 130 V
E-610.C0
Piezo Amplifier / Servo-Controller, 1 Channel, OEM Module, -20 to 120 V, Capacitive Sensor
E-610.S0
Piezo Amplifier / Servo-Controller, 1 Channel, OEM Module, -30 to 130 V, SGS-Sensor
E-500.ACD
LabVIEW Driver Set for Analog Controllers
E-500.HCD
HyperBit™ Functionality for Enhanced System Resolution (Supports Certain D/A Boards)

An OEM version with a digital controller is available – the E-609.
## Technical Data

**Model**

<table>
<thead>
<tr>
<th>Model</th>
<th>E-610.00</th>
<th>E-610.00</th>
<th>E-610.50</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Function</strong></td>
<td>Piezo Amplifier, 1 Channel, OEM Module</td>
<td>Piezo Amplifier / Servo-Controller, OEM Module</td>
<td>Piezo Amplifier / Servo-Controller, OEM Module</td>
</tr>
<tr>
<td><strong>Sensor</strong></td>
<td>–</td>
<td>P-I (analog) + notch filter</td>
<td>P-I (analog) + notch filter</td>
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<tr>
<td><strong>Sensor type</strong></td>
<td>–</td>
<td>Capacitiv</td>
<td>SGS</td>
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### Amplifier

<table>
<thead>
<tr>
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<th>E-610.00</th>
<th>E-610.00</th>
<th>E-610.50</th>
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</thead>
<tbody>
<tr>
<td>Control input voltage range</td>
<td>-2 to +12 V</td>
<td>-2 to +12 V</td>
<td>-2 to +12 V</td>
</tr>
<tr>
<td>Output voltage</td>
<td>-30 to 130 V</td>
<td>-20 to 120 V</td>
<td>-30 to 130 V</td>
</tr>
<tr>
<td>Peak output power</td>
<td>18 W (&lt; 15 ms)</td>
<td>18 W (&lt; 50 ms)</td>
<td>18 W (&lt;15 ms)</td>
</tr>
<tr>
<td>Average output power</td>
<td>10 W</td>
<td>10 W</td>
<td>10 W</td>
</tr>
<tr>
<td>Peak current</td>
<td>180 mA (&lt; 15 ms)</td>
<td>180 mA (&lt; 50 ms)</td>
<td>180 mA (&lt;15 ms)</td>
</tr>
<tr>
<td>Average current</td>
<td>100 mA</td>
<td>100 mA</td>
<td>100 mA</td>
</tr>
<tr>
<td>Current limitation</td>
<td>Short-circuit proof</td>
<td>Short-circuit proof</td>
<td>Short-circuit proof</td>
</tr>
<tr>
<td>Noise, 0 to 100 kHz</td>
<td>1.6 mV&lt;sub&gt; rms&lt;/sub&gt;</td>
<td>0.5 mV&lt;sub&gt; rms&lt;/sub&gt;</td>
<td>1.6 mV&lt;sub&gt; rms&lt;/sub&gt;</td>
</tr>
<tr>
<td>Voltage gain</td>
<td>10 ±0.1</td>
<td>10 ±0.1</td>
<td>10 ±0.1</td>
</tr>
<tr>
<td>Input independence</td>
<td>100 kΩ</td>
<td>100 kΩ</td>
<td>100 kΩ</td>
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### Interfaces and operation

<table>
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<tr>
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<th>E-610.00</th>
<th>E-610.00</th>
<th>E-610.50</th>
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<tbody>
<tr>
<td>Input / Output</td>
<td>32-pin (male) on rear panel (DIN 41612 / D)</td>
<td>32-pin (male) on rear panel (DIN 41612 / D)</td>
<td>32-pin (male) on rear panel (DIN 41612 / D)</td>
</tr>
<tr>
<td>Piezo connector</td>
<td>LEMO</td>
<td>LEMO</td>
<td>LEMO</td>
</tr>
<tr>
<td>Sensor connection</td>
<td>–</td>
<td>LEMO</td>
<td>LEMO</td>
</tr>
<tr>
<td>DC Offset</td>
<td>External potentiometer (not included), adds 0 to 10 V to Control In</td>
<td>External potentiometer (not included), adds 0 to 10 V to Control In</td>
<td>External potentiometer (not included), adds 0 to 10 V to Control In</td>
</tr>
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### Miscellaneous

<table>
<thead>
<tr>
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<th>E-610.00</th>
<th>E-610.00</th>
<th>E-610.50</th>
</tr>
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<tbody>
<tr>
<td>Operating temperature range</td>
<td>+5° to +50° C</td>
<td>+5° to +50° C</td>
<td>+5° to +50° C</td>
</tr>
<tr>
<td>Dimensions</td>
<td>7HP/3U</td>
<td>7HP/3U</td>
<td>7HP/3U</td>
</tr>
<tr>
<td>Mass</td>
<td>0.3 kg</td>
<td>0.35 kg</td>
<td>0.35 kg</td>
</tr>
<tr>
<td>Operating Voltage</td>
<td>12 to 30 V DC, stabilized</td>
<td>12 to 30 V DC, stabilized</td>
<td>12 to 30 V DC, stabilized</td>
</tr>
<tr>
<td>Current consumption, max.</td>
<td>2 A</td>
<td>2 A</td>
<td>2 A</td>
</tr>
</tbody>
</table>
Modular & Bench-Top Piezo Nanopositioning Controller

The E-621.CR module features USB, RS-232 and Analog Interfaces

- Integrated 24-Bit USB Interface
- Network Capability with up to 12 Channels
- Up to 12 W Peak Power
- Position Control with Strain Gauge or Capacitive Sensor
- Notch Filter for Higher Bandwidth
- Additional Analog Interface
- Table for User-Defined Interface

The E-621 is equipped with an RS-232 and USB interface and precision 24-bit converters for exceptional positional stability and resolution. It integrates a low-noise piezo amplifier which can output and sink peak currents of 120 mA for low-voltage piezoelectric actuators. Servo-controller versions for position sensing with capacitive or SGS sensors are available.

Closed-Loop and Open-Loop Piezo Positioning

The E-621 controller module provides precision control of piezo actuators and positioning systems both in closed-loop and open-loop operation. The piezo controllers comprise additional circuitry for position sensing and servo-control. Displacement of the piezo is controlled by an analog signal. Positioning accuracy and repeatability down to the sub-nanometer range is possible, depending on the piezo mechanics and sensor type. High-resolution position sensors provide optimum positional stability and fast response in the nanometer range. Capacitive sensors measure position directly and without physical contact (direct metrology). Alternatively compact cost-effective strain gauge sensors (SGS) are available. The integrated notch filters (adjustable for each axis) improve stability and allow high-bandwidth operation closer to the resonant frequency of the mechanics.

In open-loop operation the output voltage is determined by an external analog signal. Open-loop operation is ideal for applications where fast response and very high resolution with maximum bandwidth are essential. Here, commanding and reading the target position in absolute values is either not important or carried out by external position sensors.

High-Resolution Digital Interface

The digital interface includes high-precision 24-bit A/D converters for optimum position stability and resolution and supports fast communication with the host-computer.

Multi-Axis Network for up to 12 Channels

Up to twelve E-621s for capacitive or SGS sensors can be networked and controlled over a single PC interface. The different modules are connected in parallel (not daisy-chained) over the link. Only an additional 10 ms internal bus communications time is required to reach any of the units behind the one actually connected to the host PC.

Waveform Memory

The built-in wave table can store user-defined data points internally. These values can then be output automatically (or under the control of an external signal) and programmed for point-by-point or full-scan triggering. Thus, trajectory profiles can be repeated reliably and commanded easily.

Software / GCS Command Set

The E-621 controller comes with Windows installation software, DLLs and LabVIEW drivers. The extensive command set is based on the hardware-independent General Command Set (GCS), which is common to all current PI controllers for both nano- and micropositioning systems. GCS reduces the programming effort in the face of complex multi-axis positioning tasks or when upgrading a system with a different PI controller.

Ordering Information

- **E-621.CR** Piezo Amplifier / Servo-Controller Module, 1 Channel, -30 to 130 V, Capacitive Sensor, USB, RS-232
- **E-621.SR** Piezo Amplifier / Servo-Controller Module, 1 Channel, -20 to 120 V, SGS-Sensor, USB, RS-232
- **E-500.621** 19”-Chassis for up to twelve E-621 Modules, Power Supply
- **E-501.621** 9,5”-Chassis for up to four E-621 Modules, Power Supply

The E-621 controller is available in different configurations, as shown in the image.
Technical Data: Modular Card

**Model:** E-621.SR / E-621.CR

**Function:** Power amplifier & piezo controller

**Sensor**
- Servo characteristics: P-I (analog), notch filter
- Sensor type: SGS (.SR) / capacitive (.CR)

**Amplifier**
- Control input voltage range: -2 to 12 V
- Output voltage: -20 to 120 V / -30 to 130 V
- Peak output power, <5 ms: 12 W
- Average output power: 6 W
- Peak current, <5 ms: 120 mA
- Average current: 60 mA
- Current limitation: Short-circuit-proof
- Noise, 0 to 100 kHz: 0.8 mVrms
- Voltage gain: 10 ±0.1
- Input impedance: 100 kΩ

**Interfaces and operation**
- Interface / communication: USB, RS-232 (9-pin Sub-D connector, 9.6-115.2 kBaud), 24-bit A/D, 20-bit D/A
- Piezo connector: LEMO ERA.00.250.CTL (.SR) / Sub-D Special (.CR)
- Sensor connection: LEMO EPL.0S.304.HLN (.SR) / Sub-D Special (.CR)
- Control input sockets: SMB
- Sensor monitor output: SMB
- Controller network: up to 12 channels, parallel
- Command set: PI General Command Set (GCS)
- User software: PiMikroMove™
- Software drivers: LabVIEW drivers, DLLs
- Supported functionality: Wave table, 256 data points, external trigger, 16 macros
- DC Offset: External potentiometer (not included), adds 0 to + 10 V to Control In

**Miscellaneous**
- Operating temperature range: +5 °C to +50 °C (10 % derated over 40 °C)
- Overheat protection: Deactivation at 75°C
- Dimensions: 7HP/3U
- Mass: 0.6 kg
- Operating Voltage: 12 to 30 V DC, stabilized
- Current consumption, max.: 2 A

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Technical Data: Bench Top Version

**Model:** E-625.SR / E-625.CR

**Function:** Piezo Amplifier / Servo-Controller

**Axes:** 1

**Sensor**
- Servo characteristics: P-I (analog), notch filter
- Sensor type: SGS (.SR) / capacitive (.CR)

**Amplifier**
- Control input voltage range: -2 to 12 V
- Min. output voltage: -20 to 120 V / -30 to 130 V
- Peak output power, <5 ms: 12 W
- Average output power: 6 W
- Peak current, <5 ms: 120 mA
- Average current: 60 mA
- Current limitation: Short-circuit-proof
- Noise, 0 to 100 kHz: 0.8 mVrms
- Voltage gain: 10 ±0.1
- Input impedance: 100 kΩ

**Interfaces and operation**
- Interface / communication: USB, RS-232 (9-pin Sub-D connector, 9.6-115.2 kBaud), 24-bit A/D and 20-bit D/A
- Piezo connector: LEMO ERA.00.250.CTL (.SR) / Sub-D Special (.CR)
- Sensor connection: LEMO EPL.0S.304.HLN (.SR) / Sub-D Special (.CR)
- Control input sockets: SMB
- Sensor monitor socket: SMB
- Controller network: up to 12 channels, parallel
- Command set: PI General Command Set (GCS)
- User software: PiMikroMove™
- Software drivers: LabVIEW drivers, DLLs
- Supported functionality: Wave table, 256 data points, external trigger, 16 macros

**Miscellaneous**
- Operating temperature range: +5 to +50 °C
- Overheat protection: Deactivation at 75°C
- Dimensions: 205 x 105 x 60 mm
- Mass: 1.05 kg
- Operating voltage: 12 to 30 V DC, stabilized (power supply included)
- Current consumption: 2 A
E-665 Piezo Nanopositioning Controller with Display

The E-665 is a bench-top piezo linear amplifier and position servo-controller with integrated high-speed 24-bit computer interface and a high-bandwidth analog interface. It integrates a low-noise piezo amplifier which can output and sink peak currents of 360 mA for low-voltage piezoelectric actuators (-20 to 120 V). Servo-controller versions for position sensing with capacitive or SGS sensors are available.

Closed-Loop Piezo Positioning
PI employs proprietary position sensors for fast response and optimum positioning resolution and stability in the nanometer range and below. For high-end applications, capacitance sensors provide direct and non-contact position feedback (direct metrology). Strain gauge sensors (SGS) are available for cost-effective applications.

High-Resolution Digital Interface
The digital interface includes high-precision 24-bit A/D converters for optimum position stability and resolution and supports fast communication with the host-computer.

Waveform Memory
The built-in wave table can store user-defined datapoints internally. These values can then be output automatically (or under the control of an external signal). Thus, trajectory profiles can be repeated reliably and commanded easily.

Multi-Axis Network for up to 12 Channels
Up to twelve E-665s for capacitive or SGS sensors can be networked and controlled over a single PC interface. The different modules are connected in parallel (not daisy-chained) over the link providing higher data rates than possible with serial links.

Extensive Software Support
The controllers are delivered with Windows operating software.

The extensive command set is based on the hardware-independent General Command Set (GCS), which is common to all current PI controllers for both nano- and micropositioning systems. GCS reduces the programming effort in the face of complex multi-axis positioning tasks or when upgrading a system with a different PI controller.

The GCS commands are available at the controller terminal, in macros and in the form of a universal driver set for LabVIEW (VIs) or Windows dynamic link libraries (DLL).

Ordering Information

- **E-665.CR**
  - Piezo Amplifier / Servo-Controller, 1 Channel, -20 to 120 V, Capacitive Sensor, USB, RS-232

- **E-665.SR**
  - Piezo Amplifier / Servo-Controller, 1 Channel, -20 to 120 V, SGS-Sensor, USB, RS-232

- **E-665.CO**
  - PIFOC® Piezo Amplifier / Servo-Controller, 1 Channel, Capacitive Sensor

- **E-665.S0**
  - PIFOC® Piezo Amplifier / Servo-Controller, 1 Channel, SGS Sensor

- **E-625.CN**
  - Network Cable for Networking of Two E-625

E-665: operating limits with various PZT loads (open-loop), capacitance is measured in µF
## Technical Data

<table>
<thead>
<tr>
<th><strong>Model</strong></th>
<th>E-665.SR, E-665.CR</th>
</tr>
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<tbody>
<tr>
<td><strong>Function</strong></td>
<td>Piezo amplifier &amp; position servo-controller with digital interface</td>
</tr>
<tr>
<td><strong>Axes</strong></td>
<td>1</td>
</tr>
</tbody>
</table>

### Sensor

| **Servo characteristics** | P-I (analog), notch filter |
| **Sensor type** | SGS (.SR) / capacitive (CR) |

### Amplifier

| **Control input voltage range** | -2 to +12 V |
| **Min. output voltage** | -20 to 120 V |
| **Peak output power, < 20 ms** | 36 W |
| **Average output power** | 12 W |
| **Peak current, < 20 ms** | 360 mA |
| **Average current** | 120 mA |
| **Current limitation** | Short-circuit-proof |
| **Noise, 0 to 100 kHz** | 0.5 (.SR) / 4.0 (.CR) mV$_{\text{rms}}$ |
| **Voltage gain** | 10 ±0.1 |
| **Input impedance** | 100 k\(\Omega\) |

### Interfaces and operation

| **Interface / communication** | USB and RS-232 (9-pin Sub-D connector, 9.6–115.2 kBaud), 24-bit A/D, 20-bit D/A |
| **Piezo connector** | LEMO ERA.00.250.CTL (.SR) / Sub-D special (.CR) |
| **Sensor connection** | LEMO EPL.0S.304.HLN (.SR) / Sub-D special (.CR) |
| **Analog input** | BNC |
| **Sensor monitor socket** | BNC |
| **Controller network** | up to 12 channels, parallel |
| **Command set** | PI General Command Set (GCS) |
| **User software** | PiMikroMove™ |
| **Software drivers** | LabVIEW drivers, DLLs |
| **Supported functionality** | Wave table, 256 data points, external trigger, 16 macros |
| **Display** | 2 x 4½-digits, LED |
| **DC Offset** | 10-turn pot., adds 0 to 10 V to Control In |

### Miscellaneous

| **Operating temperature range** | 5 to 50 °C (10 % derated over 40 °C) |
| **Overheat protection** | Deactivation at 85 °C |
| **Dimensions** | 236 x 88 x 273 mm + handles |
| **Mass** | 2.5 kg |
| **Operating voltage** | 100–120 / 220–240 VAC, 50–60 Hz (linear power supply) |
| **Max. power consumption** | 50 W |
Program Overview

- Piezo Ceramic Actuators & Motors
- Piezo Nanopositioning Systems and Scanners
- Active Optics / Tip-Tilt Platforms
- Capacitive Nanometrology Sensors
- Piezo Electronics: Amplifiers and Controllers
- Hexapod 6-Axis Positioners / Robots
- Micropositioning Stages & Actuators
- Photonics Alignment Systems, Solutions for Telecommunications
- Motor Controllers
- Ultrasonic Linear Motors

Request or download the complete PI Nanopositioning & Piezo Actuator Catalog