

High Power Piezo Controllers & Drivers

Single & Multi-Channel

HIGH PERFORMANCE



OEM



ENERGY RECOVERY

E-500 and E-501 Racks

Modular Piezo Nanopositioning Controller for High Power Amps

Analog Servo, Digital & Analog Interfaces



Configuration example: E-500 Chassis with optional modules: E-505, 200 W High-Power piezo amplifier (3 x), E-509.S servo-controller, E-517.i3 24-bit interface / display module



Configuration example: E-501 chassis with optional modules: E-503 piezo amplifier, E-509.C2A servo-controller for capacitive position sensors, E-517.i3 24-bit interface / display module

- Up to 3 Axes, Custom Systems up to 12 Axes and More
- Choice of Amplifier Modules for Low-Voltage and High-Voltage, 14 to 400 W Peak Power
- Choice of Position Servo Control Modules for SGS & Capacitive Sensors, 1 to 3 Channels
- Choice of PC Interface / Display Modules
- 19- & 9½-Inch Chassis

The E-500 modular piezo controller system offers a broad choice of control modules for nanopositioning systems and actuators. This includes piezo

amplifier and position servo controller modules for up to three channels with different features as well as display and interface modules. Flexible

configuration makes the system adaptable to a wide range of applications.

E-500 systems are assembled to order, tested, and, if a servo-controller is present, calibrated with the associated piezo mechanics.

Remote Control via Computer Interface

Installing the E-517, computer interface/display module (see p. 2-156) with 24-bit resolution makes possible control from a host PC.

Optionally, digital control via an external D/A converter is possible. For several D/A boards from National Instruments, PI offers a corresponding LabVIEW driver set which is compatible with the PI General Command Set (GCS), the command set used by all PI controllers. A further option includes the patented

Ordering Information

E-500.00
19"-Chassis for Modular Piezo Controller System, 1 to 3 Channels

E-501.00
9½"-Chassis for Modular Piezo Controller System, 1 to 3 Channels

E-500.ACD
LabVIEW Driver Set for Analog Controllers

E-500.HCD
HyperBit™ Functionality for Enhanced System Resolution (Supports Certain D/A Boards)

Ask about custom designs!

HyperBit™ technology providing enhanced system resolution.

Two chassis are available:

The E-500.00 19" rackmount chassis provides operating voltages for all compatible modules including amplifiers, servo-controllers, display and interface modules (see system configuration see p. 2-144).

Technical Data

Model	E-500.00	E-501.00
Function	19"-Chassis for Piezo Controller System: Amplifier Modules, Sensor- / Servo-Control Modules, Interface / Display Modules	9.5"-Chassis for Piezo Controller System: Amplifier Modules, Sensor- / Servo-Control Modules, Interface / Display Modules
Channels	1, 2, 3 (up to 3 amplifier modules)	1, 3 (1 amplifier module)
Dimensions	450 x 132 x 296 mm + handles	236 x 132 x 296 mm + handles
Operating voltage	90–264 VAC, 50–60 Hz	90–120 / 220–264 VAC, 50–60 Hz
Max. power consumption	180 W	80 W

Available Power Amp Modules for E-500 and E-501 Racks

E-505.00 is a high-performance amplifier module for the piezo servo-controller system E-500



E-505.00
Piezo Amplifier Module, 200 W,
-20 to 120 V, 1 Channel

E-505.10
Piezo Amplifier Module for
Switching Applications, 1000 W,
-20 to 120 V, 1 Channel

E-505.00S
Offset Voltage Supply for Tip/Tilt
Systems, One Fixed Voltage of
+100 V

- 200 W Peak Power
- Output Voltage Range -20 to 120 V

E-506.10 charge-controlled Piezo driver module



E-506.10
High Linearity Piezo Amplifier
Module, 30 W Average Output
Power, -30 to 130 V, 1 Channel

- Highly Linear Amplifier Module
- 280 W Peak Power
- Output Voltage Range -30 to 130 V

E-504.00F High-power amplifier module with energy recovery



E-504.00F
High-Power-Piezo Amplifier Modul
1 Channel, 280 W Peak Power,
100 W Average Power, -30 to 130 V

- Peak Power 280 W
- High Average Output Power 100 W
- Very Energy Efficient Through Energy Recovery
- Output Voltage Range -30 to 130 V

Available Servo & Interface Modules for E-500 and E-501 Racks

E-509 3-channel servo-controller module for nanopositioning systems with strain gauge sensors



- E-509.C1A**
Sensor / Piezo Servo-Control
Capacitive Sensor, 1 Channel
- E-509.C2A**
Sensor / Piezo Servo-Control
Capacitive Sensors, 2 Channels
- E-509.C3A**
Sensor / Piezo Servo-Control
Capacitive Sensors, 3 Channels
- E-509.S1**
Sensor / Piezo Servo-Control
SGS Sensor, 1 Channel
- E-509.S3**
Sensor / Piezo Servo-Control
SGS-Sensors, 3 Channels

- High-Speed Analog Servo for Piezo with Capacitiv & SGS
- 1-, 2- and 3-Channel Versions
- Improves Linearity, Increases Piezo Stiffness
- Eliminates Drift and Hysteresis
- Notch Filter for Higher Bandwidth
- ILS Circuitry Maximizes Capacitive Sensor Linearity

The E-517 piezo display and D/A converter module, provides USB and TCP/IP connectivity



- E-517.i1**
Interface / Display Module,
24 Bit D/A, TCP/IP, USB, RS-232,
Single Channel
- E-517.i3**
Interface / Display Module,
24 Bit D/A, TCP/IP, USB, RS-232,
3 Channels

- Low-Noise 24-bit D/A Converter
- Sample Rate 25 kHz
- TCP/IP, USB, IEEE 488 and RS-232 Interfaces
- 6-Digit Display for Voltage and Position
- 1- & 3-Channel Versions
- Wave Generator with Programmable Trigger-I/O

The E-509.E3 module offers sensor signal read-out and servo control for three channels



- E-509.E3**
PISeCa™ Sensor / Piezo Servo-
Control Module for Single-
Electrode Capacitive Sensor
Probes, 3 Channels
- E-509.E03**
PISeCa™ Modular Signal
Conditioner Electronics for Single
Electrode Capacitive Sensors,
3 Channels

- E-509.E03: 3-Channel Signal Conditioner Module
- E-509.E3: 3-Channel Sensor Module with Additional Servo Controllers for Piezo Positioning Systems
- Integrated Linearization System (ILS) for Maximum Linearity

E-618 High-Power Piezo Amplifier

High Currents up to 20 A, High Dynamics



- Peak Power 3200 W
- Peak Current of up to 20 A
- Micro Second Rise Time
- 15 kHz Bandwidth for High Dynamics Applications
- Piezo Ceramics Protection with Temperature Sensor
- Analog and Optional Digital Interfaces

The E-618 piezo amplifier offers high currents for dynamic operation which make it ideally suited for fast switching applications (here: the E-618.10G 9.5" chassis version)

The E-618 high-power amplifier/controller is specifically designed for ultra-high-dynamics operation of piezo actuators (translators). It can output and sink a peak current of 20 A and an average current of 800 mA in a voltage range of -30 to 130 V.

Besides the amplifier module, three standard configurations are available:

- E-618.10G is a bench-top amplifier in a 9.5" chassis, for open-loop operation (1 channel)
- E-618.1G is the amplifier module in a 19" rackmount chassis that can hold additional interface / display modules
- E-618.20G is a 2-channel version in a 19" rackmount chassis

Fast Switching

The amplifier features a high bandwidth of more than 15 kHz combined with extremely short rise times in the microsecond range and a high output power. This makes it ideal for fast switching applications for valves, pumps, for microstructure and material testing. Furthermore, it is perfectly suited for systems for active vibration control.

Piezo Overtemperature Protection

To protect the mechanics especially in high-dynamics applications, the E-618 features a temperature sensor input and controller circuit that shuts down the amplifier if the PZT exceeds the maximum temperature threshold.

Analog and Digital Control

All E-618 amplifiers come with a high bandwidth analog interface. An optional 24-bit computer interface is available as E-517.

Note: Spezial Connector Required

The high electrical currents require adequate connectors and cabling. Therefore, standard piezo systems and actuators have to be adapted.

Technical Data

Model	E-618.10
Function	Power amplifier module for PICMA® multilayer piezo actuators
Amplifier	
Input voltage	-2 to +12 V
Output voltage*	-30 to 130 V
Peak output power	3200 W (<0.3 ms)
Average output power	100 W (>0.3 ms)
Peak current	20 A (<0.3 ms)
Average current	0.8 A (>0.3 ms)
Current limitation	Short-circuit-proof
Voltage gain	10 ±0.1
Ripple, noise, 0 to 100 kHz	200 mV _{pp} / 24 mV _{rms} (no load), 2 mV _{rms} (1 µF)
Input impedance	100 kΩ
Interfaces and operation	
Piezo connector	LEMO EGG.1B.302.CLL, with security cover
Control input	BNC
Temperature sensor (piezo actuator)	PT 1000; LEMO socket; deactivation of the piezo voltage output at 150 °C
Display	Power, PZT temp overflow LEDs
DC Offset	10-turn pot., adds +10 to 0 V to Control In
Miscellaneous	
Operating temperature range	+5 °C to +50 °C (10 % derated over 40 °C)
Dimensions	215 x 123 x 185 mm 42HP / 3U 19" rackmount chassis
Mass	2.65 kg
Operating voltage	100 – 120 or 220 – 240 VAC, selectable
Max. power consumption	15 VA (no load) 160 VA (max. load)

*Max. 85°C, deactivation of the piezo voltage output (internal overtemp protection)

Ordering Information

E-618.10
High-Power-Piezo Amplifier Module, 1 Channel, -30 to 130 V, 20 A

E-618.10G
High-Power-Piezo Amplifier, 1 Channel, -30 to 130 V, 20 A, Bench-Top

E-618.1G
High-Power-Piezo Controller, 1 Channel, -30 to 130 V, 20 A, Controller & Interface / Display Upgrade possible, 19"

E-618.20G
High-Power-Piezo Amplifier, 2 Channels, -30 to 130 V, 20 A, 19"

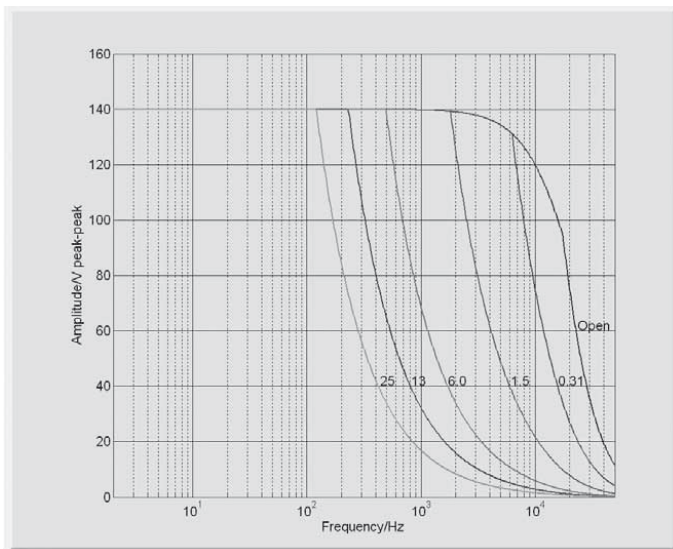
Accessories

E-618.X11
Piezo Cable, 1 m, Solderable End

E-618.X01
Extension Cable, 1 m

E-618.X03
Extension Cable, 3 m

Ask about custom designs!



E-618: operating limits with various PZT loads (open-loop), capacitance is measured in µF

E-617 High-Power OEM Piezo Amplifier

Top-Hat & OEM Modules with Energy Recovery for High-Dynamics 24/7 Operation



The E-617.001 high-power piezo amplifier is intended for top-hat-rail mounting in switching cabinets

- Peak Power to 280 W
- High Currents to 2000 mA
- Energy Recovery for Low Power Consumption
- OEM Module and Top-Hat-Rail Versions

The E-617 is an exceptionally efficient, high-power, piezo amplifier for low-voltage piezo actuators. Providing peak power of up to 280 W and average power of 100 W, it can output and sink a peak current of 2000 mA. This allows driving high-capacitance piezo actuators at frequencies in the kilohertz range.

Energy Recovery Operating Principle

The working principle of the E-617 series is ideally suited for high-dynamics scanning and switching applications.

The innovative, efficient circuitry reduces power consumption and heat dissipation, especially in dynamic applications. Charge is transferred to the piezo actuator using low-loss PWM techniques. When the actuator is discharged, the

energy not consumed is fed through the energy recovery circuitry for reuse in the next charging cycle.

Two models are available: The E-617.001 version is equipped for top-hat rail mounting which makes it ideal for automation and industry applications. The E-617.00F version is a compact module for chassis mounting.

High Performance with High Capacitive Loads

The E-617 amplifiers provide precision control of piezo actuators and positioning systems in open-loop operation with an analog control voltage amplified by the factor 10. Such analog operation is ideal for applications where fast response and very high resolution are essential, but where commanding and reading the target

position absolutely is either not important or carried out by external position sensors.

Power Supply / Contents of Delivery

Only one unipolar stabilized voltage in the range of 23 to 26 V is required to operate the E-617.

All connections of the E-617.001 top-hat rail module are conveniently provided on the front of the device. All inputs and outputs of the E-617.00F OEM module are via a 32-pin rear connector. Mating connectors are included.

Remote Control via Computer Interface

Optionally, digital control via an external D/A converter is possible. For several D/A boards from National Instruments, PI offers a corresponding LabVIEW driver set which is compatible with the PI General Command Set (GCS), the command set used by all PI controllers. A further option includes the patented Hyperbit™ technology providing enhanced system resolution.

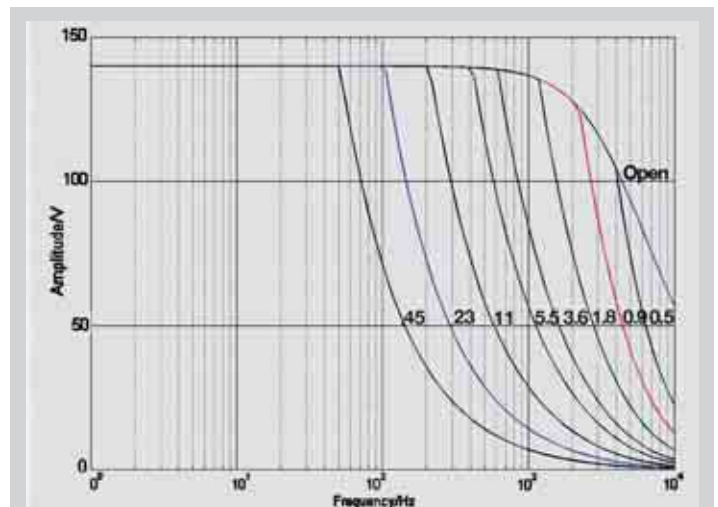
Ordering Information

- E-617.001**
High-Power-Piezo Amplifier with Energy Recovery, 1 Channel, -30 to 130 V, 100 W, Top-Hat Rail
- E-617.00F**
High-Power-Piezo Amplifier with Energy Recovery, OEM-Module, 1 Channel, -30 to 130 V, 100 W

The same functionality and specifications are available in the E-504 amplifier module. see p. 2-148.



E-617.00F high-power piezo amplifier OEM module



E-617: operating limits with various PZT loads (open-loop), capacitance is measured in μF

Technical Data

Model	E-617.001	E-617.00F
Function	High-Power-Piezo Amplifier with Energy Recovery, 1 Channel, -30 to 130 V, for Top-Hat Rail mounting	High-Power-Piezo Amplifier with Energy Recovery, OEM-Module, 1 Channel, -30 to 130 V
Amplifier		
Input voltage	-2 to +12 V	-2 to +12 V
Output voltage	-30 to +130 V	-30 to +130 V
Peak output power <5 ms	280 VA	280 VA
Average output power >5 ms	Equivalent to 100 W reactive power	Equivalent to 100 W reactive power
Peak current, <5 ms	2000 mA	2000 mA
Average current, >5 ms	1000 mA	1000 mA
Current limitation	Short-circuit-proof	Short-circuit-proof
Voltage gain	10 ±0.1	10 ±0.1
Amplifier bandwidth, small signal	3.5 kHz	3.5 kHz
Ripple, noise, 0 to 100 kHz	<30 mV _{rms} <100 mV _{pp}	<30 mV _{rms} <100 mV _{pp}
Capacitive base load (internal)	2.5 µF	2.5 µF
Suggested capacitive load	>3 µF	>3 µF
Output impedance	0.5 Ω	0.5 Ω
Amplifier resolution	1 mV	1 mV
Amplifier classification	class D (switching amp), 100 kHz	class D (switching amp), 100 kHz
Input impedance	100 kΩ	100 kΩ
Interfaces and operation		
Piezo connector	Phoenix-plug connector MINI-COMBICON 3-pin MC1.5/3-ST-3.81	LEMO ERA.00.250.CTL (front); DIN 41612 32-pin (rear)
Analog input	Phoenix-plug connector MINI-COMBICON 6-pin IMC1.5/6-ST-3.81	SMB
DC-Offset	External potentiometer (not included), adds 0 to + 10 V to Control In	External potentiometer (not included), adds 0 to + 10 V to Control In
Miscellaneous		
Operating temperature range	+5 to +50 °C (10% derated over 40 °C)	+5 to +50 °C (10% derated over 40 °C)
Dimensions	205 x 105 x 60 mm	7HP/3U
Mass	1 kg	0.35 kg
Operating voltage	23 to 26 VDC, stabilized, on Phoenix plug MINI-COMBICON 3-pin IMC1.5/3-ST-3.81	23 to 26 VDC, stabilized, on 32-pin rear connector
Max. power consumption	<30 W	<30 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



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