

Controllers for PiezoWalk® Linear Actuators

Single-Axis Controllers for NEXLINE® and NEXACT® Actuators

NOVEL



PRECISE



NETWORKABLE

E-861 PiezoWalk® Controller & Driver for NEXACT® Actuators

Networkable Controller for NEXACT® Linear Drives and Positioners



PiezoWalk® System: E-861.1A1 NEXACT® Controller with open-loop N-310.01 NEXACT® linear drive; suitable for installation in stage with linear encoder

Ordering Information

E-861.1A1
NEXACT® Controller, 1 Channel,
Linear Encoder

Easy System Setup, Comprehensive Software

All parameters can be set and checked by software. System setup and configuration is done with the included PIMikro-Move user-interface software. Interfacing to custom software is facilitated with included Lab-View drivers and DLLs. With the PI General Command Set (GCS), system programming is the same with all PI controllers, so controlling a system with a variety of different controllers is possible without difficulty.

- For NEXACT® Drives and Positioning Systems
- Complete System with Controller, Integrated Power Amplifiers and Software
- Open-Loop Operation, or Closed-Loop with Linear Encoder
- High Performance at Low Cost
- Daisy-Chain Networking for Multi-Axis Operation
- Non-Volatile Macro Storage for Stand-Alone Functionality with Autostart Macro
- I/O for Automation, Joystick for Manual Operation
- Parameter Changes On-the-Fly

The new, compact E-861 controller is designed to operate NEXACT® linear drives and closed-loop positioning systems using them, simply and precisely. In perfect harmony with the mechanics, the E-861 supports both motion modes of the PiezoWalk® stepping drive: for longer moves, the stepping mode, and for moves shorter than typically 7 µm, the analog mode, which provides high-dynamics positioning with resolutions of less than 1 nm. The NEXACT® drive design minimizes piezo operating voltages to 45 V and below.

Flexible Automation

E-861 controllers offer a number of features to support automation and handling. For example, macros can be stored in non-volatile memory.

A programmable autostart macro allows stand-alone operation without external communication. Upon power-up, the macro with its internal command sequence is executed automatically.

For easy synchronization of motion with internal or external trigger signals, four input and four output lines are provided.

Multi-Axis Operation

Up to 16 E-861 controllers can be networked and controlled over a single PC interface.

Such daisy chain networks are flexible, can be extended at any time and are compatible with other PI controllers (e.g. DC servo-motor and stepper motor controllers).

Technical Data

Model	E-861.1A1
Function	Controller for NEXACT® drives / systems
Drive type	NEXACT® linear drive
Channels	1
Motion and control	
Servo characteristics	P-I-D servo control, parameter change on-the-fly
Trajectory profile modes	Trapezoidal
Encoder input	Analog encoder input sine-cosine, interpolation circuit preset for differential transmission, 1 V _{pp} amplitude and 2.5 V offset of the encoder signal
Stall detection	Servo off, triggered by programmable position error
Input limit switch	2 x TTL (pull-up/pull-down, programmable)
Input reference switch	1 x TTL
Electrical properties	
Output power	max. 40 W
Output voltage	-10 to +45 V
Current consumption	max. 2 A
Interfaces and operation	
Communication interfaces	USB 1.0, RS-232 (9-pin (m) Sub-D)
Motor connector	Sub-D 15-pin (f) High Density
Sensor connector	Sub-D 15-pin (m) High Density
Controller network	Up to 16 units on single interface
I/O ports	4 analog/digital in, 4 digital out (TTL)
Command set	PI General Command Set (GCS)
User software	PI MikroMove, PI Terminal
Software drivers	GCS-DLL, LabVIEW drivers
Supported functionality	Start-up macro; data recorder for categories like current position or velocity; internal safety circuitry: watchdog timer
Manual control (optional)	Joystick, Y-cable for 2D motion, pushbutton box
Miscellaneous	
Operating voltage	24 V included: external power supply, 24 V, 2.0 A
Operating temperature range	0 to +50 °C
Mass	1.1 kg
Dimensions	206 x 130 x 66 mm (with mounting rails)

E-755 Digital NEXLINE® Controller for PiezoWalk® Actuators Controller for Picometer-Precision PiezoWalk® Linear Actuators / Positioners



E-755 digital NEXLINE® controller with N-214 nanopositioner, 20 mm travel range.

- **Special Control Algorithms for NEXLINE® Nanopositioning Linear-Motor Actuators**
- **32-Bit Digital Filters**
- **24-Bit DAC Resolution**
- **Fully Programmable Low-Pass and Notch Filters**
- **Non-Volatile User Settings and Last-Position Data**
- **Daisy-Chain Networking for up to 16 Axes**
- **PI GCS (General Command Set) Compatible**

E-755 digital single-axis nanopositioning controllers are designed to drive the patented NEXLINE® nanopositioning linear drives. Combining advanced control technology and sensor signal processing with special drive algorithms, the E-755 can provide precision motion control over hundreds of millimeters with picometer-range resolution. Coordinated action of shearing and clamping piezo elements is what allows NEXLINE® to

break through the barriers of conventional nanopositioning actuators.

The E-755 offers two different control modes for the NEXLINE® walking drives: a high-resolution, high dynamics direct piezo mode, with basically unlimited resolution (analog mode), and a long-range stepping mode with theoretically unlimited travel range.

High-Resolution Servo-Control

E-755 controllers are based on powerful 32-bit DSPs and come in open- and closed-loop versions. Both versions feature four high-resolution (24-bit) linear amplifiers with the output range of ± 250 V required to control a single-axis NEXLINE® drive. For the closed-loop models, high-resolution incremental position sensors are supported by special excitation and read-out electronics.

The sensors supported may provide better than nanometer resolution. A power-down routine in the E-755 firmware saves the current position, allowing a closed-loop system to be ready for operation without referencing next time it is powered up.

NEXLINE® Working Principle for Application Flexibility

NEXLINE® PiezoWalk® drives are ideal wherever high loads must be positioned very precisely over long distances and then perhaps subjected to small-amplitude dynamic adjustment, as for active vibration control. By varying the characteristics of the longitudinal and shear piezo elements, the step size, dynamic operating range (analog travel), clamping force, speed and stiffness can all be optimized for a particular application.

NEXLINE® PiezoWalk® piezoceramic clamping and shearing elements act directly on a moving runner that is coupled to the moved part in the application. While the runner can be moved large distances

Ordering Information

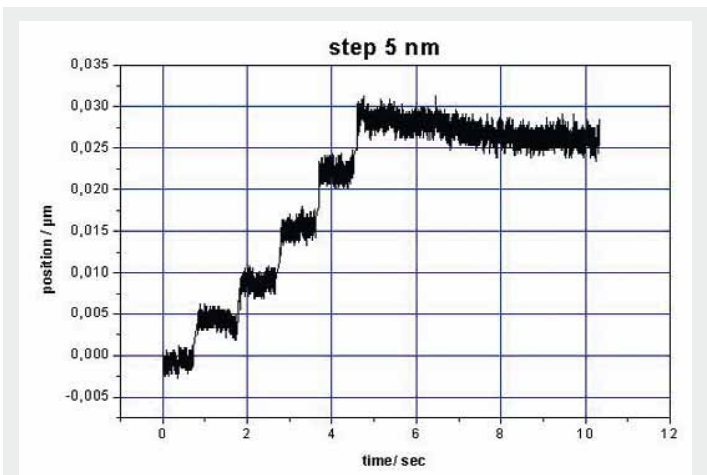
E-755.1A1
Digital Controller for NEXLINE® Nanopositioning Linear Drives, Incremental Sensors

E-755.101
Digital Controller for NEXLINE® Nanopositioning Linear Drives

in step mode, high-dynamics positioning over distances of less than one step is possible with resolutions far below one nanometer in analog mode. The patented PiezoWalk® thus overcomes the limitations of conventional nanopositioning actuators and combines long travel ranges with high resolution and stiffness.

Extreme Actuator Lifetime

To eliminate long-term offset voltages, which limit the lifetime of conventional piezo drives, the E-755 controller uses a special procedure to bring the actuator to a full-holding-force, zero-voltage condition, no matter where it may be along its travel range. Due to the resulting long lifetime, NEXLINE® nanoposition-



Steps of 5 nm performed by a system consisting of an N-214 NEXLINE® nanopositioner and an E-755.1A1 controller, measured by a high-resolution interferometer. Note the excellent system response to consecutive 5 nm step commands. In this case the closed-loop resolution is limited by the linear encoder in the N-214 (5 nm / increment); the E-755 can work with linear encoders with sub-nanometer resolution

Application Examples

- Semiconductor technology
- Quality assurance testing in semiconductor industry
- Astronomical telescopes
- Truss structures
- Active vibration control
- Alignment in high magnetic fields, as in particle physics, atomic fusion and superconductivity research

ing actuators are ideal for installation in inaccessible locations deep inside complex equipment, where nanometer-precise alignment and vibration cancellation are required.

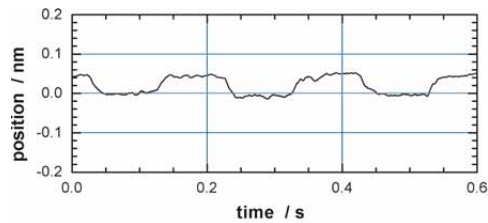
Linearization

E-755-controlled nanopositioning systems provide outstanding linearity, achieved by digital polynomial linearization. The linearization can improve linearity to

0.001 % over the full travel range. The products described in this datasheet are in part protected by the following patents:
German Patent No. 10148267
US Patent No. 6,800,984



Six-axis nonmagnetic Hexapod with N-215-based NEXLINE® high-load actuators for use in high magnetic fields. The system is driven by six E-755 controllers and additional hardware/firmware to automatically perform the necessary parallel-kinematics coordinate transformation



Steps of 50 picometers with a NEXLINE® drive in open-loop mode measured with external, ultra-high-resolution, capacitive sensor

Technical Data

Model	E-755.1A1	E-755.101
Function	Digital controller for NEXLINE® nanopositioning linear drives with incremental encoder	Digital controller for NEXLINE® nanopositioning linear drives
Axes	1	1
Processor	DSP 32-bit floating point, 50 MHz	DSP 32-bit floating point, 50 MHz
Sensor		
Sensor channels	1	–
Servo update time	0.2 ms	–
Sensor sampling time	0.1 ms	–
Dynamic cycle time	0.2 ms	0.1 ms
Servo characteristics	P-I, notch filter	–
Sensor type	Incremental sensor	–
Amplifier		
Amplifier channels	4	4
Output voltage	-250 to +250 V	-250 to +250 V
Peak output power per channel	5.5 W	5.5 W
Average output power per channel	3 W, limited by temperature sensor	3 W, limited by temperature sensor
Peak current	44 mA	44 mA
Average current per channel	25 mA, limited by temperature sensor	25 mA, limited by temperature sensor
Current limitation	Short-circuit-proof	Short-circuit-proof
Resolution DAC	24 bit	24 bit
Interfaces and operation		
Communication interfaces	RS-232	RS-232
Piezo connector	Sub-D Special	Sub-D Special
Sensor connector	15-pin sub-D connector	–
Controller network	Daisy-chain, up to 16 units	Daisy-chain, up to 16 units
Command set	GCS	GCS
User software	PIMikroMove™, NanoCapture™, PITerminal	PIMikroMove™, NanoCapture™, PITerminal
Software drivers	LabVIEW drivers, DLLs	LabVIEW drivers, DLLs
Supported functionality	NEXLINE® Control algorithms (closed-loop), data recorder, position storage	NEXLINE® Control algorithms (open-loop), data recorder
Display	Status LEDs	Status LEDs
Linearization	4th order polynomial	4th order polynomial
Miscellaneous		
Operating temperature range	5 to 50 °C	5 to 50 °C
Overtemp protection	Deactivation at 70 °C	Deactivation at 70 °C
Dimensions	264 x 260 x 47 mm	264 x 260 x 47 mm
Mass	2.3 kg	2.3 kg
Operating voltage	24 V (power supply included)	24 V (power supply included)
Power consumption	48 W, 2 A max.	48 W, 2 A max.

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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