Digital Piezo Controller

Modular Controller for up to 6 Axes for Highest Precision

E-712

- Up to 50 kHz servo update rate
- Highly stable 20-bit D/A converter
- Real-time operating system for excellent trajectory control
- Autoloading of calibration data from stage ID chip for interchangeability of controller and mechanics
- Flexible interfaces: TCP/IP, USB, RS-232; optional broadband analog inputs and outputs
- Extensive software package

Digital linearization for the highest accuracy

Linearization algorithms based on higher-order polynomials reduce the linearity error to less than 0.01 %. That is typically 10 times better than conventional controllers.

Fast periodic motion and data recording

During fast periodic motion, such as that typical for scanning applications, it is possible to increase the tracking accuracy by up to a factor of three using Dynamic Digital Linearization (DDL). The integrated wave generator can save and output periodic motion profiles. Preconfigured sine and triangle wave profiles are provided to support the user when defining the curve, but any user-defined waveforms are possible. Flexible configuration of the data recorder allows recording of the corresponding data.

Flexible analog inputs and real-time PIO

Each of the four optionally available analog inputs can be configured in two ways. As control input, the voltage applied is linked to one of the axes, e.g., for target values. Configuration as external sensor input allows reading of additional sensor signals, e.g., for autofocusing. Alternatively, the controller can be equipped with a fast 32-bit PIO (parallel I/O) for commanding. The PIO supports a restricted command set with 100,000 read and write commands per second required for motion.

Easy system connection

All parameters can be set and checked via software. Easy startup and system configuration can be done via the PIMikroMove utility program, which is in the scope of delivery. Connection to the customer's software is possible via LabView drivers and DLLs. System programming is identical for all PI controllers – combined control of a variety of different controllers is therefore possible without any problems.

Modular design

PI offers preconfigured controllers for 3- and 6-axis operation. Moreover, customers can put controllers together exactly as required. For this purpose, various types of housings and modules as well as additional accessories are available:

- E-712.R1, E-712.R3: 9.5" / 19" chassis for piezo voltages to 135 V, 3 to 6 axes
- E-712.R2, E-712.R4: 19" / 9.5" chassis for piezo voltages to ±250 V, 3 to 6 axes
- E-712.R5: Universal housing 19" 4 HE with CPCI bus
- E-712.M1, E-712.N1: Digital processor and interface modules, TCP/IP, USB, RS-232 interface
- E-711.AL4P, E-711.AL41: High-power amplifier modules, 4 channels, 8 W, -30 V to +135 V
- E-711.AM4, E-711.AM5, E-711.AM6: Amplifier modules for NEXLINE®, -250 to +250 V
- E-711.AM5A, E-711.AM5B: Amplifier modules for NEXLINE®, -250 V to +250 V, for drives with sensor
- E-711.AN4, E-711.AN40: Amplifier modules for NEXACT®
- E-711.C82: DC motor driver module, 2 axes
- E-711.SA3, E-711.SA6: Modules for incremental sensors
- E-711.SS3: Module for strain gauge sensors
- E-711.SC3H, E-711.SE3: Modules for capacitive sensors
- E-711.S3XC, E-711.0ET, E-711.0ET0: Digital sensor signal transmission, capacitive sensors
- E-711.0ATS: Sensor box for digital sensor signal transmission, for sensors with BiSS interface
- E-711.IA4: Analog interface module, 4 inputs and outputs
- E-711.IP: PIO interface module for fast data exchange
- E-711.iS3, E-711.iS6: SPI interface modules
- E-711.SAP, E-711.SAH, E-711.SAN: Sensor signal distributors for incremental sensors
- E-711.SAX, E-711.SAX1, E-711.SAX2, E-711.SAX5: Cables between digital piezo controller and sensor signal distributor

Specifications

Preconfigured controllers		
	E-712.3CD, E-712.3CDA	**E-712.6CD, E-712.6CDA**
Function	Modular digital controller for multi-axis piezo nanopositioning systems with capacitive sensors	Modular digital controller for multi-axis piezo nanopositioning systems with capacitive sensors
Axes	3	6
Processor	PC-based, 600 MHz, real-time operating system	PC-based, 600 MHz, real-time operating system
Sampling rate, servo control	50 kHz	20 kHz
Sampling rate, sensor	50 kHz	20 kHz

Sensor	E-712.3CD, E-712.3CDA	E-712.6CD, E-712.6CDA
Controller type	P-I, two notch filters	P-I, two notch filters
Sensor type	Capacitive	Capacitive
Sensor channels	3	6
Sensor bandwidth (-3 dB)	10 kHz	10 kHz
Sensor resolution	18 (interpolated: 20) bits	18 (interpolated: 20) bits
External synchronization	Yes	Yes

Amplifier	E-712.3CD, E-712.3CDA	E-712.6CD, E-712.6CDA
Output voltage	-30 to 135 V	-30 to 135 V
Amplifier channels	4	8
Peak output power / channel*	25 W	25 W
Average output power / channel	8 W	8 W
Current limitation	Short-circuit proof	Short-circuit proof
Resolution DAC	20-bit	20-bit
Temperature sensor	Yes	Yes

Interfaces and operation	E-712.3CD, E-712.3CDA	E-712.6CD, E-712.6CDA
Communication interfaces	TCP/IP, USB, RS-232, SPI	TCP/IP, USB, RS-232, SPI
Piezo / sensor connector	Sub-D Mix 25W3	Sub-D Mix 25W3

Interfaces and operation	E-712.3CD, E-712.3CDA	E-712.6CD, E-712.6CDA
Analog inputs	E-712.3CD: None E-712.3CDA: LEMO: 4 × ±10 V differential; bandwidth: max. 25 kHz; resolution: 18 bit; max. impedance: 250 Ohm	E-712.6CD: None E-712.6CDA: LEMO: 4 × ±10 V differential; bandwidth: max. 25 kHz; resolution: 18 bit; max. impedance: 250 Ohm
Analog outputs	E-712.3CD: None E-712.3CDA: LEMO: 4 × ±10 V differential; bandwidth: max. 25 kHz; resolution: 16 bit	E-712.6CD: None E-712.6CDA: LEMO: 4 × ±10 V differential; bandwidth: max. 25 kHz; resolution: 16 bit
Digital inputs/outputs	MDR20: 8 × TTL	MDR20: 8 × TTL
Command set	PI General Command Set (GCS)	PI General Command Set (GCS)
User software	PIMikroMove	PIMikroMove
Application programming interfaces	API for C / C++ / C# / VB.NET / MATLAB / Python, drivers for NI LabVIEW	API for C / C++ / C# / VB.NET / MATLAB / Python, drivers for NI LabVIEW
Supported functions	Wave generator, trigger I/O, macros	Wave generator, trigger I/O, macros
Indicators	LEDs for OnTarget, Err, Power, Over Temp	LEDs for OnTarget, Err, Power, Over Temp
Linearization	4th-order polynomials, DDL option (Dynamic Digital Linearization)	4th-order polynomials, DDL option (Dynamic Digital Linearization)

Miscellaneous	E-712.3CD, E-712.3CDA	E-712.6CD, E-712.6CDA
Operating temperature range	5 to 40 °C	5 to 40 °C
Overheat protection	Max. 75 °C, deactivation of the voltage output	Max. 75 °C, deactivation of the voltage output
Mass	E-712.3CD: 5.35 kg E-712.3CDA: 5.53 kg	E-712.6CD: 5.78 kg E-712.6CDA: 5.96 kg
Dimensions	9.5" housing, 236 mm × 132 mm × 296 mm + handles (47 mm length)	9.5" housing, 236 mm × 132 mm × 296 mm + handles (47 mm length)
Max. power consumption	225 W	225 W
Operating voltage	100 to 240 VAC, 50 to 60 Hz	100 to 240 VAC, 50 to 60 Hz

Housing types and modules

Housing types	E-712.R1 / E-712.R3	E-712.R2 / E-712.R4	E-712.R5
Function	Chassis with power adapter	Chassis with power adapter	Chassis with cPCI bus
Piezo voltage range	-30 to 135 V	-250 to 250 V	up to -250 to 250 V
Channels	3 to 6	3 to 6	up to 12
Dimensions	E-712.R1: 9.5" (236 mm × 132 mm × 296 mm + handles (47 mm length)) E-712.R3: 19" (450 mm × 132 mm × 296 mm + handles (47 mm length))	E-712.R2: 19" (450 mm × 132 mm × 296 mm + handles (47 mm length)) E-712.R4: 9.5" (236 mm × 132 mm × 296 mm + handles (47 mm length))	19" (450 mm × 177 mm × 375 mm + handles (47 mm length))
Mass	.R1: 4.16 kg / .R3: 6.7 kg	.R2: 6.7 kg / .R4: 4.16 kg	4.4 kg
Operating voltage	100 to 240 VAC, 50-60 Hz	100 to 240 VAC, 50-60 Hz	100 to 240 VAC, 50-60 Hz
Line power fuses	2 × T2.5AH, 250 V**	2 × T2.5AH, 250 V**	2 × T3.15AH, 250 V**
Current consumption, max.	225 VA	225 VA	450 VA
Max. output power	100 W	100 W	200 W

Master modules	E-712.M1	E-712.N1
Function	Digital processor and interface module	Digital processor and interface module
Supported drive type	Piezo nanopositioning systems (except PiezoWalk® systems)	Piezo nanopositioning systems, PiezoWalk® systems
Axes	up to 16	up to 16
Sampling rate, servo control	max. 50 kHz	max. 50 kHz
Sampling rate, sensor	max. 50 kHz	max. 50 kHz
Communication interfaces	TCP/IP, USB, RS-232, SPI	TCP/IP, USB, RS-232, SPI

Amplifier/driver	E-711.AL4P / E-711.AL41	E-711.AM4 / E-711.AM5 / E-711.AM6 / E-711.AM5A / E-711.AM5B	E-711.AN4 / E-711.AN40	E-711.C82
Function	Amplifier module	Amplifier module	Amplifier module	Driver module
Drive type	Piezo actuators	NEXLINE®	NEXACT®	DC motors
Channels	4	4	4	2
Average output power per channel	8 W	15 W	4 W	30 W
Output voltage	-30 to 135 V	-250 to 250 V	-10 to 45 V	0 to 24 V
Sensor input	--	E-711.AMx: -- E-711.AM5A: incremental, sin/cos E-711.AM5B: absolute, BiSS	--	Incremental: A/B, sin/cos Absolute: BiSS
Connector	E-711.AL4P: via E-711.SS3 or E-711.SC3H E-711.AL41: Sub-D 25W3	E-711.AM4: Sub-D 24W7 E-711.AM5: Sub-D 25 (f) E-711.AM6: Via the HD Sub-D 50 (f) of the E-712.R5 chassis E-711.AM5A / .AM5B: Sub-D 25 (f)	E-711.AN4: Sub-D 15 (f) E-711.AN40: Via the HD Sub-D 78 (f) of the E-712.R5 chassis	Sub-D 15 (f)

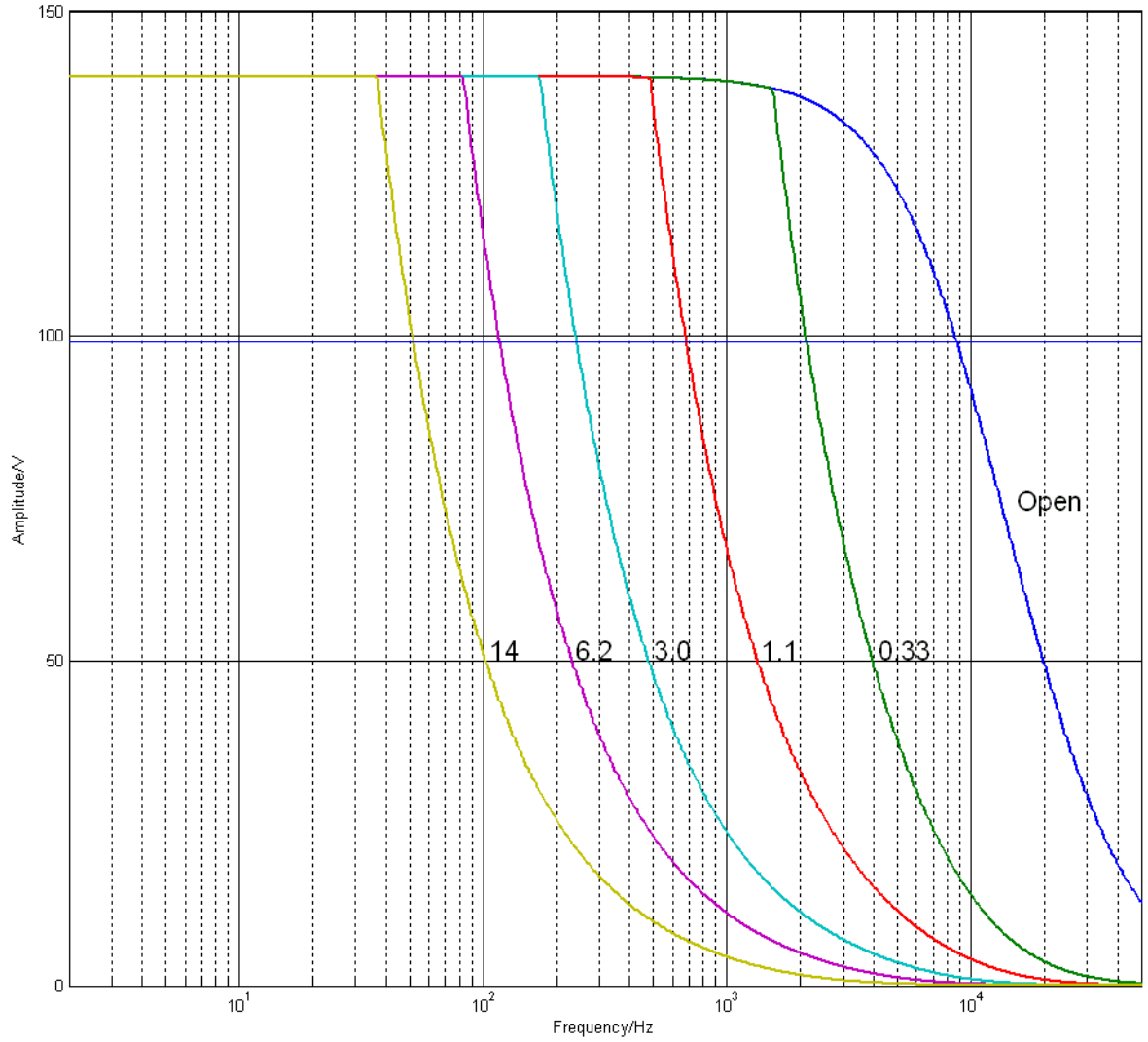
I/O: Sensor modules	E-711.SA3 / E-711.SA6	E-711.SS3	E-711.SC3H / E-711.SE3
Function	Module for incremental sensors	Module for strain gauge sensors	Module for capacitive sensors
Sensor type	Incremental sensors (analog sin/cos, V_{pp})	Strain gauge sensors, temperature sensors	E-711.SCH3: capacitive 2-electrode sensors E-711.SE3: PISeca capacitive 1-electrode sensors
Channels	3 / 6	4	3
Sensor connector	1 × / 2 × HD Sub-D 26 (m)	Sub-D 37 (f)	Sub-D 25W3 / 3 × Lemo triaxial socket
Sensor bandwidth	300 kHz	10 kHz	10 kHz / 5 kHz
A/D resolution	Interpolation factor selectable	18 bits (interpolated)	18 bits (interpolated: 20 bits)

I/O: Sensor signal transmission	E-711.S3XC	E-711.0ET / E-711.0ET0	E-711.0ATS
Function	Set for digital sensor signal transmission, consisting of: Interface module, sensor box with signal processing electronics	Set for digital sensor signal transmission, consisting of: Interface module, sensor box with signal processing electronics; E-711.0ET additionally with sensor cable	Sensor box for digital sensor signal transmission
Sensor type	Capacitive 2-electrode sensors	PISeca capacitive 1-electrode sensors	Absolute-measuring or incremental encoders via 32-bit BiSS interface
Channels	3	3	8
Sensor connector	Sub-D 25W3	3 × Lemo triaxial socket	8 × Sub-D 9 (f)
Sensor bandwidth	10 kHz	max. 5 kHz	N/A
A/D resolution	18 bits (interpolated: 20 bits)	20 bits interpolated	N/A

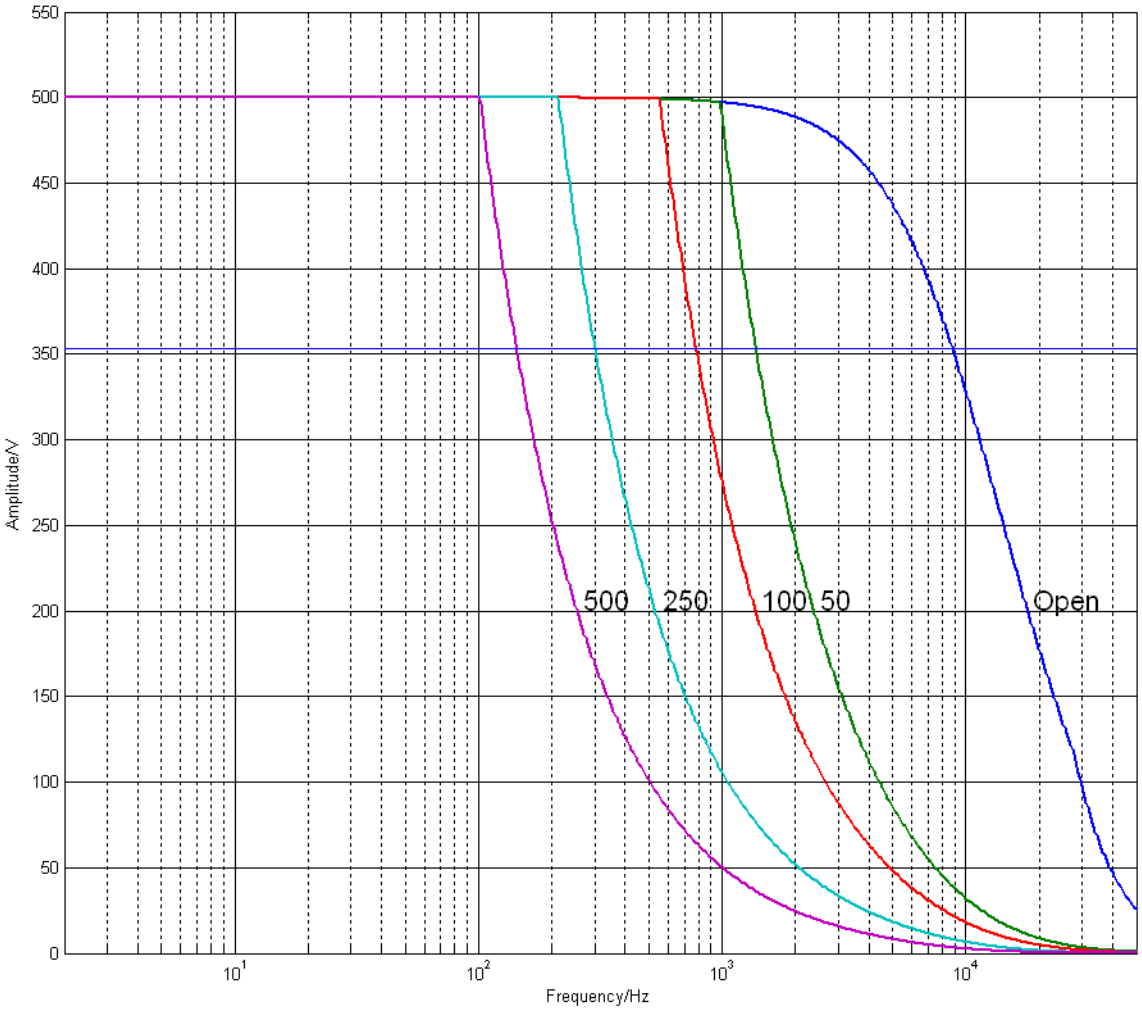
I/O: Interface modules	E-711.IA4	E-711.IP	E-711.iS3 / E-711.iS6
Function	Analog interface module	Parallel input/output interface module for fast data exchange	SPI master interface module
Input/output	4 × analog input 4 × analog output	Parallel input/output	SPI
Channels	4	15	3 / 6
Resolution	Input: 18 bit Output: 16 bit	32-bit	32-bit
Bandwidth	Input: max. 25 kHz Output: max. 12 kHz	N/A	N/A
Connector	8 × LEMO EPG.00.302.NLN	HD Sub-D 62 (f) for connecting to a digital interface card of the PC via the cable included (K040B0121)	Display port

* The maximum output power is limited by the power supply of the housing and the number of available modules.
** unless stated otherwise on the type plate of the housing
Ask about customized versions.

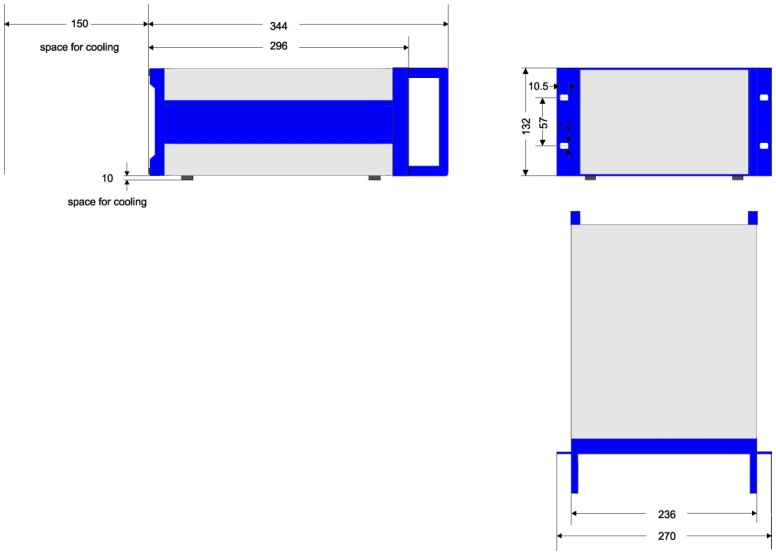
Drawings / Images



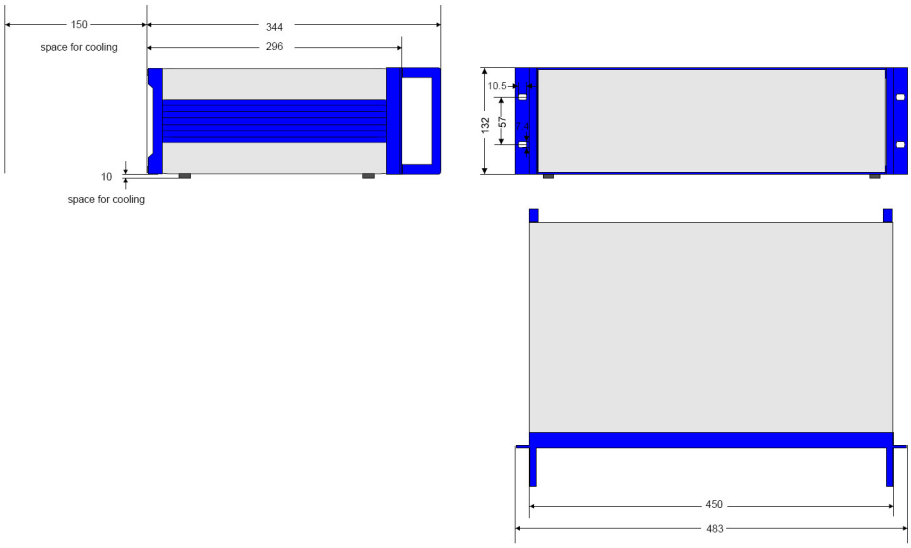
E-712 with E-711.AL4P amplifier: Operating limits with different piezo loads, capacitance is measured in µF



E-712 with E-711.AM4 amplifier: Operating limits with different piezo loads, capacitance is measured in nF



9.5" housing types E-712.R1 and .R4, dimensions in mm



19" housing types E-712.R2 and .R3, dimensions in mm

Ordering Information

Preconfigured controllers

E-712.3CD
Modular digital piezo controller, 3 axes, capacitive sensors, TCP/IP, USB, RS-232, SPI interfaces for communication

E-712.3CDA
Modular digital piezo controller, 3 axes, capacitive sensors, analog inputs and outputs, TCP/IP, USB, RS-232, SPI interfaces for communication

E-712.6CD
Modular digital piezo controller, 6 axes, capacitive sensors, TCP/IP, USB, RS-232, SPI interfaces for communication

E-712.6CDA
Modular digital piezo controller, 6 axes, capacitive sensors, analog inputs and outputs, TCP/IP, USB, RS-232, SPI interfaces for communication

Housing types

E-712.R1
9.5" housing with power adapter for the E-712 modular digital piezo controller, for piezo voltages to 135 V, 3 to 6 axes

E-712.R2
19" housing with power adapter for the E-712 modular digital piezo controller, for piezo voltages to ±250 V, 3 to 6 axes

E-712.R3
19" housing with power adapter for the E-712 modular digital piezo controller, for piezo voltages to 135 V, 3 to 6 axes

E-712.R4
9.5" housing with power adapter for the E-712 modular digital piezo controller, for piezo voltages to ±250 V, 3 to 6 axes

E-712.R5
Universal housing 19" 4 HE with CPCI bus

Master modules

E-712.M1
Digital processor and interface module, TCP/IP, USB, RS-232, SPI

E-712.N1
Digital PiezoWalk® processor and interface module, TCP/IP, USB, RS-232, SPI

Amplifier

E-711.AL4P
High-power amplifier module for the E-712 modular digital piezo controller, 4 channels, 8 W, -30 V to +135 V

E-711.AL41
High-power amplifier module for the E-712 modular digital piezo controller, 4 channels, 8 W, -30 V to +135 V, Sub-D 25W3 (f)

E-711.AM4
Amplifier module for NEXLINE®, for the E-712 modular digital piezo controller, -250 V to +250 V

E-711.AM5
Amplifier module for NEXLINE®, for the E-712 modular digital piezo controller, -250 V to +250 V, Sub-D 25 (f)

E-711.AM6
Amplifier module for NEXLINE®, for the E-712 modular digital piezo controller, -250 V to +250 V, without external connector

E-711.AM5A
Amplifier module for NEXLINE®, for the E-712 modular digital piezo controller, -250 V to +250 V, incremental sensor input sin/cos

E-711.AM5B
Amplifier module for NEXLINE®, for the E-712 modular digital piezo controller, -250 V to +250 V, absolute encoder

E-711.AN4
NEXACT® amplifier module, for the E-712 modular digital piezo controller

E-711.AN40
NEXACT® amplifier module, for the E-712 modular digital piezo controller, without external connector

E-711.C82
DC motor driver module, for the E-712 modular digital piezo controller, 2 axes

Sensor modules

E-711.SA3
Module for incremental sensors, 3 channels, for the E-712 modular digital piezo controller

E-711.SA6
Module for incremental sensors, 6 channels, for the E-712 modular digital piezo controller

E-711.SS3
Module for strain gauge sensors, 3 channels, for the E-712 modular digital piezo controller

E-711.SC3H
Module for capacitive sensors, 3 channels, for the E-712 modular digital piezo controller

E-711.SE3
Module for PISeca capacitive 1-electrode sensors, 3 channels, for the E-712 modular digital piezo controller

Sensor signal transmission

E-711.S3XC
Digital sensor signal transmission, 3 channels, capacitive sensors, for the E-712 modular digital piezo controller

E-711.0ET
Digital sensor signal transmission, 3 channels, PISeca sensors, for the E-712 modular digital piezo controller, with 10 m cable

E-711.0ET0
Digital sensor signal transmission, 3 channels, PISeca sensors, for the E-712 modular digital piezo controller, without cable

E-711.0ATS
Sensor box for digital sensor signal transmission, 3 channels, incremental or absolute sensors with BiSS interface, for the E-712 modular digital piezo controller

Interface modules

E-711.IA4
Analog interface module for E-712 modular digital piezo controller, 4 inputs and outputs

E-711.IP
PIO interface module for the E-712 modular digital piezo controller

E-711.IS3
SPI interface module for the E-712 modular digital piezo controller, 3 channels

E-711.IS6
SPI interface module for the E-712 modular digital piezo controller, 6 channels

Accessories

E-711.SAP
Sensor signal distributor for the E-712 modular digital piezo controller, 3 channels, for PIOne incremental sensors

E-711.SAH
Sensor signal distributor for the E-712 modular digital piezo controller, 3 channels, for Heidenhain incremental sensors

E-711.SAN
Sensor signal distributor for the E-712 modular digital piezo controller, 3 channels, for Numerik Jena incremental sensors

E-711.SAX
Cable between the digital piezo controller and sensor signal distributor, HD Sub-D 26

E-711.SAX1
Cable between the digital piezo controller and sensor signal distributor, HD Sub-D 26, 3 m

E-711.SAX2
Cable between the digital piezo controller and sensor signal distributor, HD Sub-D 26, 5 m

E-711.SAX5
Cable between the digital piezo controller and sensor signal distributor, HD Sub-D 26, 15 m