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PIEZO STACK ACTUATORS

APC International, Ltd. supplies piezo stack actuators in an extensive array of dimensions, strokes, forces, and power requirements, to meet virtually any need:

- high loads - up to 10,000 N
- large displacements - up to 0.15-0.20% of piezo stack height
- small size
- bare piezo stacks / encased piezo stacks
- mechanical pre-stress / no pre-stress
- co-fired (150 V maximum)
- discrete stack (150 V / 500 V / 1000 V maximum)
- Basic (planar face) and spherical endpieces available
- high dynamic drives
- high volume production capability
- custom design and engineering services available
- amplifiers, electronic switches, other auxiliary apparatus available
- competitive pricing
- fast delivery



BACKGROUND INFORMATION

FIRST STEPS TOWARDS PIEZOACTION eBOOK

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Basics of Stack Actuators

Piezo materials are materials that will generate an electric charge when they are deformed, or conversely, they will deform when electrically charged. The latter is the inverse piezoelectric response and the response responsible for actuation.

An **actuator** is essentially a motor, or a generator of motion, usually linear and limited in range. A piezo actuator will generate a linear displacement when an electric field is applied, and this displacement is also capable of applying a force, and therefore the actuator is capable of doing work. The amount of force that can be applied depends on the cross sectional area of the actuator.

The amount of movement that a piezo device can yield is equal to the amount of voltage applied times the d33 or the piezo electric coefficient. This piezoelectric coefficient, d33, is a figure of merit for the piezo material relating to the efficiency of the material in transferring the electrical energy to mechanical energy. Please note that this movement does not depend on the dimensions of the piezo element. Therefore, when one stacks piezo elements together, there is a multiplying effect on the amount of movement that is achieved. However, the amount of voltage that can be applied will depend on the material and the thickness of each element. A stack of 2 piezo elements will have twice the movement at the same applied voltage as a single piezo element, and a stack of 3 piezo elements will exhibit 3 times the movement as a single element with the same applied voltage, etc. This is the basis for multilayer actuators.

Multilayer actuators are essentially many stacked layers of piezo material acting in concert. There are low voltage actuators, usually operating at up to 200 volts, and high voltage actuators operating at up to 1000 volts.

Low voltage actuators are co-fired multilayer actuators. These have very thin ceramic layers that are made by casting a ceramic / organic slurry to form a tape, dried, electroded with a thin precious metal electrode, usually a silver palladium electrode, the electrode tape is stacked, laminated, and fired to a dense ceramic / electrode package. The fired package is cut to size exposing the electrodes and the electrical connections are made. The stack is poled by applying a DC field to activate the piezo material and a protective insulating coating is applied.

High voltage actuators are constructed with discrete sintered, poled ceramic **disks, rings or plates** with thin metal leaf electrodes interlaced between the ceramics. The device is bonded together with a high quality adhesive. These stack actuators are often enclosed in metal casing with an appropriate pre stress applied. Other options for these actuators can be casings specially designed to manage the heat generated during operation, or include the possibility of position sensing for the piezoelectric stack actuator.

Piezo actuator movements will be on the order of a hundred micro meters supporting a load of 7 kN/cm². Therefore one must be aware of the advantages of piezo actuators to be sure that they are the correct choice for the application compared to conventional motors.

The advantages of piezo motors over conventional motors are: Fast response without delay, Very high acceleration rates, Very high power generation, Compact design, High mechanical power density, Consumes power only when motion is generated, Operates in vacuum and at Cryogenic conditions, have no rotating parts, and are unaffected by magnetic fields.

Care must be taken when mounting piezo actuators that all resulting applied stress on the actuator is axial and is a purely compressive stress. Piezo actuators can be designed with various end pieces to ensure appropriate loading.

Applications for piezo actuators include fiber modulation for communications, precise positioning devices, proportioning valves, electrical switches, micro pumps, ink jet printers, and anti-vibration devices.

APC carries a variety of piezo actuator power supplies / amplifiers to operate our piezo actuators in your electromechanical system.

Low Voltage Piezoelectric Stack Actuators (150 V maximum)

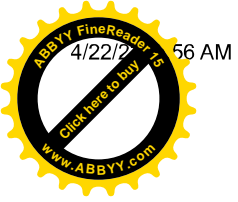
APCI Catalog No.	Product Description	Dimensions (a x b x l, mm)	Semi-bipolar Stroke* (µm)	Unipolar Stroke** (µm)	Capacitance (nF)	*Resonance Frequency (kHz)	Stiffness (N/µm)	Optimum Comp. Load up to (N)
45-1090	Pst150/2x3/5	2x3x5	6.5	5	70	150	45	300
45-1140	Pst150/2x3/7	2x3x9	13	9	170	100	25	300
45-1141	Pst150/2x3/20	2x3x18	28	20	340	50	12	300
45-1142	Pst150/3.5x3.5/7	3.5x3.5x9	13	9	350	100	50	800
45-1143	Pst150/3.5x3.5/20	3.5x3.5x18	28	20	800	50	25	800
45-1080	Pst150/5x5/7	5x5x9	13	9	800	100	120	1600
45-1130	Pst150/5x5/20	5x5x18	28	20	1800	50	60	1600
45-1150	Pst150/7x7/20	7x7x18	28	20	3600	50	120	3500
45-1160	Pst150/10x10/20	10x10x18	28	20	7200	50	250	7000
Custom	Custom	Values to be Determined by Customer and APC International						

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APC PIEZO CALCULATOR

Calculate the most common physical & electrical properties of our piezo products with ease!

Check out our **Sale Items**



*Semi-bipolar activation -30 to +150 volts **Unipolar activation 0 to +150 volts



Useful Resources for Designing and Selecting a Custom Piezo Stack Actuator

- [Stack Actuator Background Information](#)
- eBook: [First Steps Towards Piezoactuation](#)
- [Stack Actuators: Introduction of Basic Principles and Theory](#)
- [APC Stack & Ring Technical Data Catalog](#)
- [Piezo Amplifiers: Introduction of Basic Principles and Theory](#)
- [APC Amplifier Technical Data Catalog](#)
- [APC Low Voltage Multilayer Actuator Catalog](#)

Have questions about APC International's piezo products? [Contact us](#) or call us at (570)726-6961 to learn more information.

Contact APC International today to discuss your piezoelectric ceramic or piezo device requirements.

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