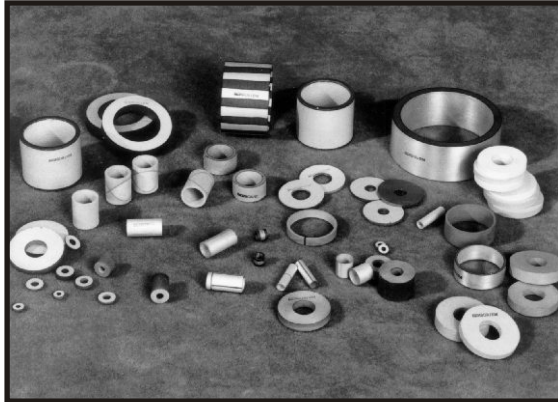


Piezoelectric Actuators (Stacks)

SENSORS & ACTUATORS



Features

- Compact and Lightweight
- Solid state
- Good efficiency
- Fast response
- Displacement proportional to applied voltage
- Large force
- Broad operating temperature range
- Excellent stability

Applications

- Positioning devices
- Motors and relays
- Translators
- Displacement devices
- Deformable mirrors
- Pumps

OVERVIEW

An actuator is a device that produces a displacement (movement) when voltage is applied. Actuators are used for many functions, including cancelling vibration, tool adjustment and control, micro-pumps, mirror positioning, wave generation, structural deformation, inspection systems and scanning microscopes. When a voltage is applied to the assembly, it produces small displacements with a high force capability. These actuators can be built from wide ranging piezoelectric materials offered by SensorTech, depending on the various end uses.

MULTILAYER PIEZOELECTRIC ACTUATORS

SensorTech's multilayer piezoelectric actuator is a device consisting of a number of piezoelectric elements in a stack. The elements are generally connected in parallel either through the electrode structure or the inclusion of brass electrodes between the elements (Figure-1).

DISPLACEMENT

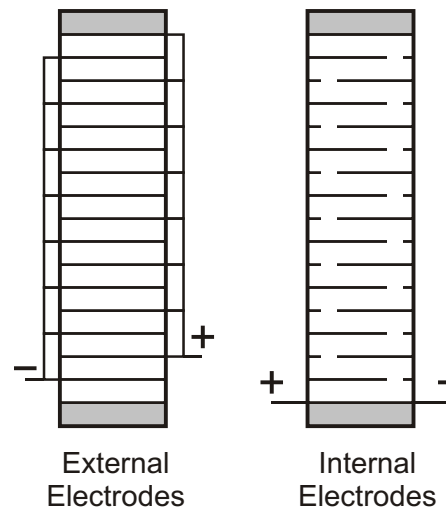
The total displacement of the stack assembly is the sum of displacements of each element. The displacement 'D' of the assembly is given by:

$$D = VNd_{33}$$

Where:

- V: is the voltage applied
- N: is the number of elements in the stack
- d_{33} : is the charge coefficient for the piezoelectric material used

Figure 1.



CUSTOM FABRICATION

Sensor can provide custom fabricated products with the following features:

- Internal/external electrodes
- Conformal coatings for protection
- Housing with standard electrical connectors
- Preload attachment
- Wide range of materials and shapes
- Power supplies and amplifiers
- Co-fired products

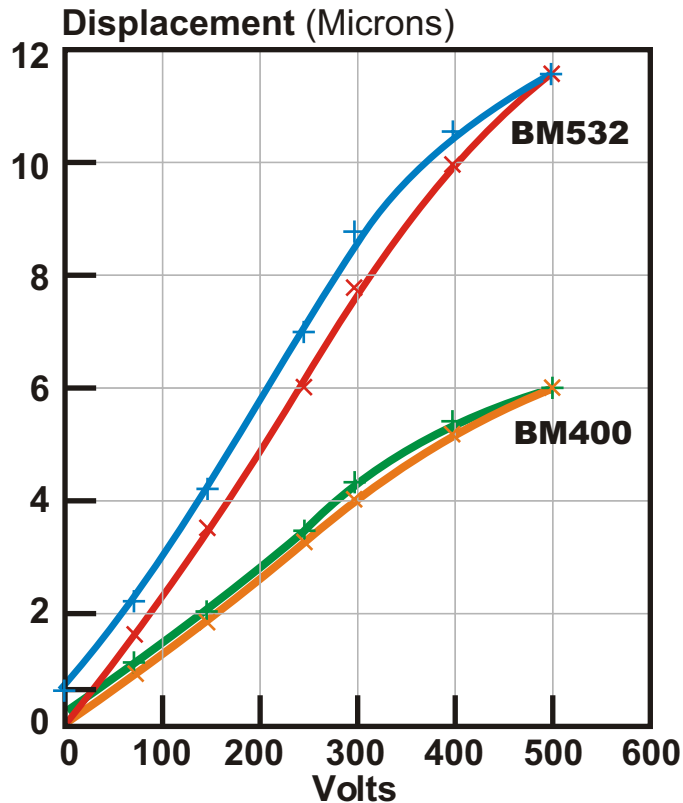
Piezoelectric Actuators (Stacks)

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Hysteresis:

All piezoelectric ceramics exhibit hysteresis. The magnitude of hysteresis depends on the type of ceramics and can vary from 3% to 20%. Hard materials such as BM400 have lower hysteresis (3-5%) where as softer materials such as BM532 have hysteresis in the range of 15-20%. The linearity of response also shows similar tendencies. Figure-2 shows typical hysteresis characteristics for the two materials.

Figure 2. Hysteresis Characteristics



Force Characteristics

The stress-strain characteristic for BM532 and BM400 materials are shown in Figure-3. The slope of the stress-strain characteristic is the compliance of the piezoelectric material under the applied field.

The force F (Newtons) is specified by the equation: $F = [D/T] \times [A/S_{33}^E]$

Where:

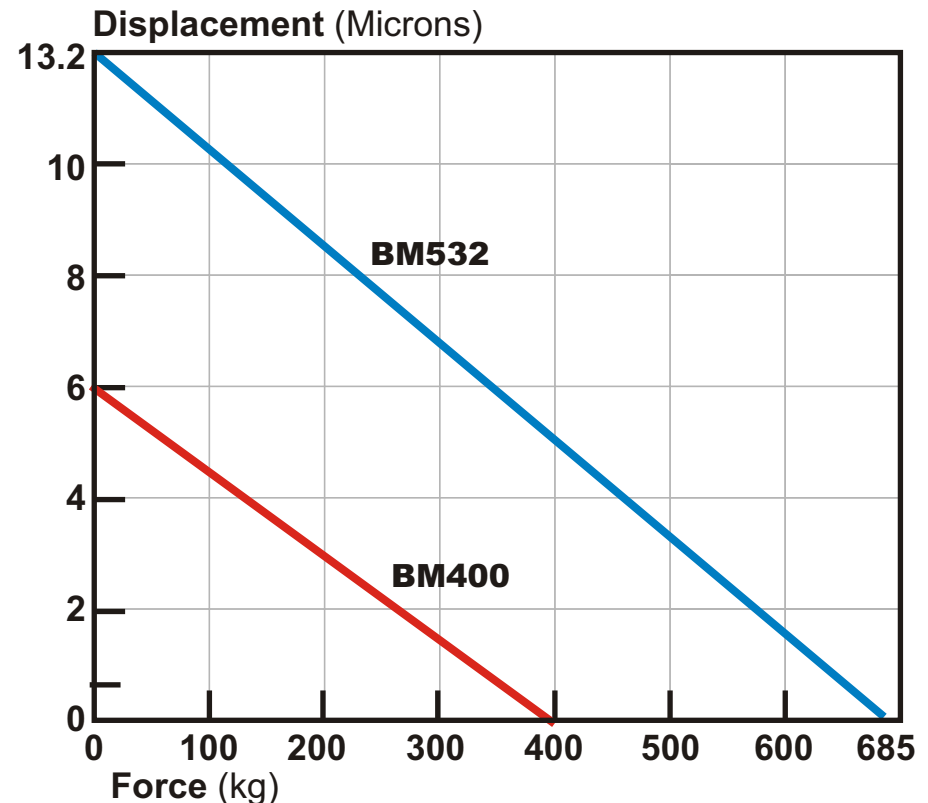
T: is the length of the stack

A: is the area of the elements

D: is the displacement

S_{33}^E : is the compliance of the piezoelectric material

Figure 3. Force vs Displacement



Piezoelectric Actuators (Stacks)

SENSORS & ACTUATORS

Table 2. Standard Actuator Specifications

Maximum voltage: -35V to +200V

Part No.	Height	Area	Displacement @200V	Blocked Force @200v	Capacitance
	mm	mm ²	µm	N	nF
SJ12-05-0303-00	5	3 x 3	5.8	540	60
SJ12-10-0303-00	10	3 x 3	11.6	540	120
SJ12-15-0303-00	15	3 x 3	20.3	540	210
SJ12-20-0303-00	20	3 x 3	26.1	540	270
SJ12-25-0303-00	25	3 x 3	34.8	540	360
SJ12-30-0303-00	30	3 x 3	40.6	540	420
SJ12-40-0303-00	40	3 x 3	55.1	540	570
SJ12-50-0303-00	50	3 x 3	69.6	540	720
SJ12-05-0505-00	5	5 x 5	6.2	1500	200
SJ12-10-0505-00	10	5 x 5	12.4	1500	400
SJ12-15-0505-00	15	5 x 5	21.7	1500	700
SJ12-20-0505-00	20	5 x 5	27.9	1500	900
SJ12-25-0505-00	25	5 x 5	37.2	1500	1,200
SJ12-30-0505-00	30	5 x 5	43.4	1500	1,400
SJ12-40-0505-00	40	5 x 5	58.9	1500	1,900
SJ12-50-0505-00	50	5 x 5	74.4	1500	2,400
SJ12-05-0707-00	5	7 x 7	6.4	2940	440
SJ12-10-0707-00	10	7 x 7	12.8	2940	880
SJ12-15-0707-00	15	7 x 7	22.4	2940	1,540
SJ12-20-0707-00	20	7 x 7	28.8	2940	1,980
SJ12-25-0707-00	25	7 x 7	38.4	2940	2,640
SJ12-30-0707-00	30	7 x 7	44.8	2940	3,080
SJ12-40-0707-00	40	7 x 7	60.8	2940	4,180
SJ12-50-0707-00	50	7 x 7	76.8	2940	5,280
SJ12-05-1010-00	5	10 x 10	6.4	6000	880
SJ12-10-1010-00	10	10 x 10	12.8	6000	1,760
SJ12-15-1010-00	15	10 x 10	22.4	6000	3,080
SJ12-20-1010-00	20	10 x 10	28.8	6000	3,960
SJ12-25-1010-00	25	10 x 10	38.4	6000	5,280
SJ12-30-1010-00	30	10 x 10	44.8	6000	6,160
SJ12-40-1010-00	40	10 x 10	60.8	6000	8,360
SJ12-50-1010-00	50	10 x 10	76.8	6000	10,560