



An Introduction to *smartTOUCH* Technology



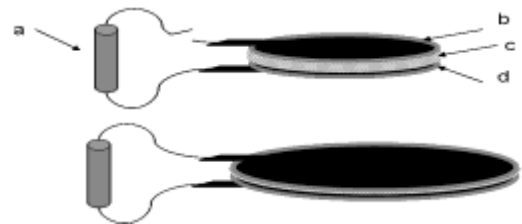
SmartTOUCH Development Kit

Artificial Muscle (AMI), Inc.'s new *smartTOUCH* haptic actuators revolutionize tactile feedback by enabling a whole new world of alternatives to traditional actuator technologies. *SmartTOUCH* actuators enable customization and programming of haptics effects and vibratory feedback into products ranging from the latest handheld multimedia devices to medical instrumentation displays to toys, offering a wide dynamic range of configurable, localized haptic effects that provide a more compelling user experience. AMI offers a wide range of *smartTOUCH* actuator configurations including Z-Mode, X-Mode, XY-Mode and Inertial-Mode.

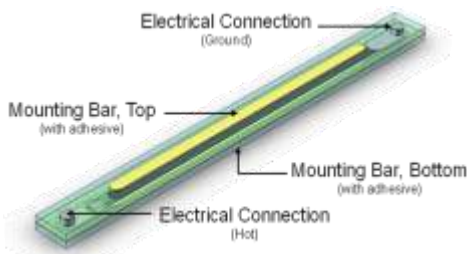
Technology Overview

SmartTOUCH is the haptic feedback product line of the AMI *smartMOVE* actuator technology. The fundamental operating mechanism of *smartMOVE* products is based on a dielectric elastomer type electroactive polymer that has been commonly referred to as Electroactive Polymer Artificial Muscle (EPAM). *SmartMOVE* EPAM consists of a thin layer of dielectric polymer film between two conductive, compliant electrodes. When a voltage potential is applied across the electrodes, the Maxwellian pressure causes the electrodes to attract each other, and since the film is elastomeric and incompressible, the film contracts in thickness and expands in area. The technology is essentially an elastomeric capacitor that is capable of changing capacitance by applying a voltage or by an external mechanical force. *SmartMOVE* polymer film is turned into an actuator by attaching frames or materials that direct the motion into the desired axes.

- Construction of a *smartMOVE* EPAM device.
 (a) power supply and electronics (b) top electrode layer (c) dielectric elastomer film (d) bottom electrode layer
 Top: Voltage off Bottom: Voltage on

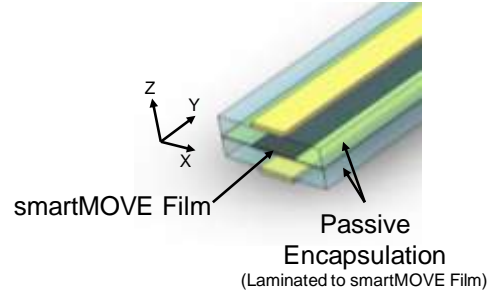
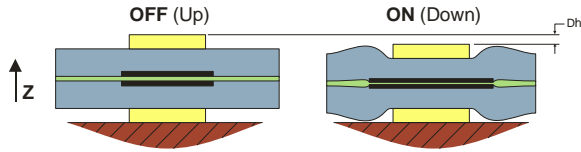


Z-Mode Actuator Construction



In the basic *smartTOUCH* Z-Mode actuator, the *smartMOVE* film is laminated between two layers of passive encapsulant. The rigid mounting bars serve as the mechanical connection between the grounded frame or housing and the moving surface. There is an electrical connection on each end that contains a flex circuit that can be attached with solder or conductive adhesive. The Z-Mode uses the active dielectric film to change the total thickness of the actuator.

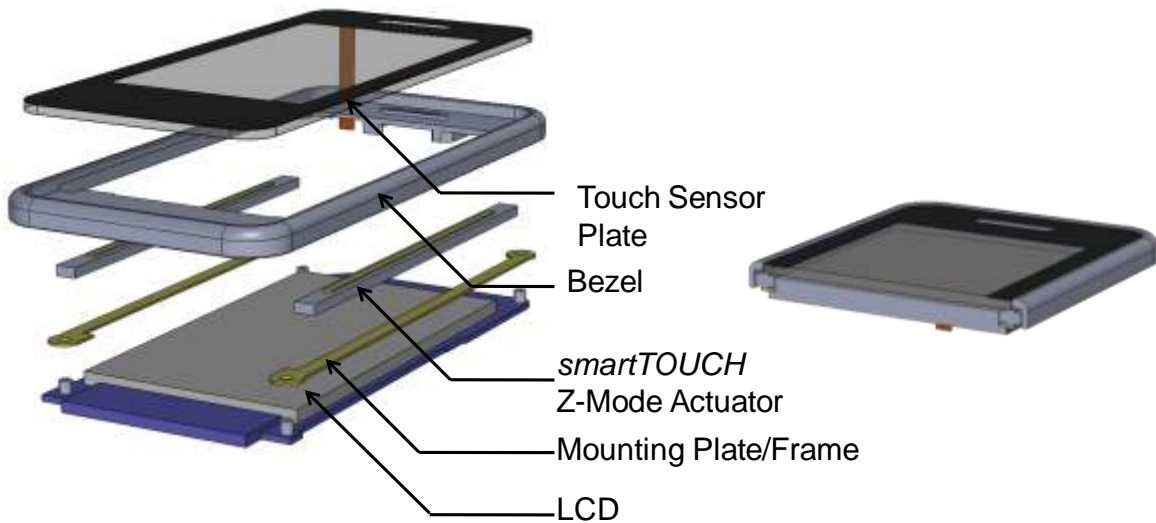
The thickness change is enhanced by transmitting the motion of the film through the passive encapsulation. The passive layer serves to amplify the thickness change due to the passive slab deformation in area by the film, the volume is thus conserved, and a decreased thickness is achieved by shear forces.



The passive layer in this case has no electric field applied to it, and all the active properties of the laminate structure come from the underlying polymer film layer. The name Z-Mode describes the enhanced thickness change in the Z-axis direction.

Touch Screen Haptic Application

There are multiple options for connecting the actuator in a touch screen application. The actuators can be mounted between a mechanical ground such as a frame and the moving component (typically a touch sensor plate). In the example below, the actuators are integrated into a touch screen device with the actuators mounted between the Touch Sensor Plate and the Frame. There are a variety of other connection options available for the actuators, and the product integration requirements of total device thickness or width of the gap between touch sensor plate and LCD, and the bezel size will determine the optimal connection method.



A *smartTOUCH* Z-Mode Actuator Integrated into Mobile Touch Screen Device

Product and Contact Information

AMI has *smartTOUCH* Development Kits, as well as Z-Mode and planar actuators available in a number of different configurations to qualified customers. If you are interested in any of these products, please contact AMI directly or visit our website at www.artificialmuscle.com for further information.

Preliminary – Information Subject to Change

● Artificial Muscle, Inc. ● 749 N Mary Ave Sunnyvale CA 94085 USA ● Tel: 408-215-7320 ● www.artificialmuscle.com ●