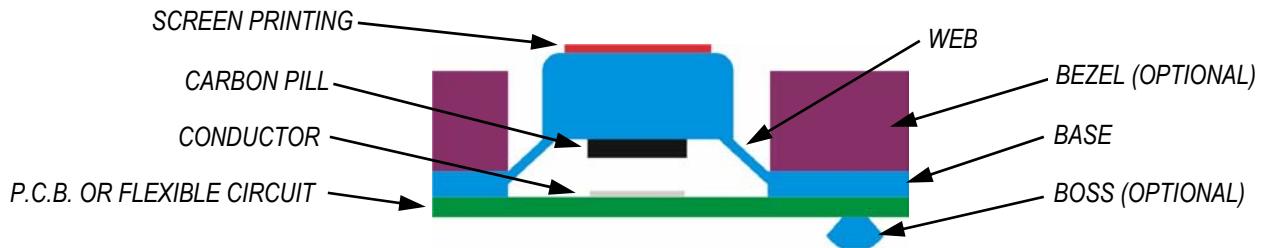


CONDUCTIVE RUBBER KEYPADS: Design Considerations



Conductive rubber keypads were developed nearly 30 years ago as a means to provide a less expensive momentary switch. This molded keypad alternative has grown in popularity as they can be made to look and feel like traditional mechanical switches while eliminating some of their inherent disadvantages. Like membrane switches, elastomeric keypads can be made to resist moisture and other harsh environmental conditions while providing a very user friendly interface.

Typical Components of a Conductive Rubber Keypad



Material Selection

Base materials can be blended to match any color specifications. Rubber materials come in hardnesses of 30 to 70 durometer though most applications utilize rubber that is between 40 and 60 durometer.

Base Colors—Bleed vs. Pre-mold

There are two ways to achieve multiple base colors. The first and most common is the bleed technique, which involves inserting multiple colored rubbers in the mold tool. These rubbers are allowed to bleed together in between color regions and result in an uneven transition between colors. This technique is typically used in conjunction with a bezel that covers where the colors bleed together.

The other technique involves pre-molding keys in different colors and inserting them in the mold tool during the molding process. This process results in clean transitions of colors for different keys. This technique is most commonly used where the base material will be exposed. Because pre-molding keys is a multiple step process, this technique is more costly than of bleeding the colors together.

Tactile Feel and Actuation Force

Rubber keypads can be designed so that they achieve a positive tactile response when the operator depresses the keypad. To achieve good tactile feel that is inherent in the rubber keypad the keypad should have at least .060" of travel and should have an actuation force of between 50 and 170 grams.

As an alternative, a tactile layer can be incorporated in between the rubber keypad and the circuitry layer, which will enable a good tactile feel even with small keys and minimal travel distances. This option, which utilizes either stainless steel domes or formed polydomes, does add cost to the project.

Rubber keypads should be designed with a minimum return force of 30 grams in order to eliminate the potential of sticking keys.

Electronic File Formats

Optimally, SSI's customers will supply electronic files of their rubber keypad designs. SSI can then more easily review the characteristics of the design and make any appropriate recommendations.

The desired file formats are as follows:

Design issues that effect life of rubber keypad:

**SHORTER
LIFE**

Harder < **Rubber Durometer** > Softer
Higher < **Actuation Force** > Lower
Longer < **Travel Distance** > Shorter

**LONGER
LIFE**

- .DWG files (AutoCad)
- .DXF files
- .STL files (SolidWorks)

Backlighting

Backlighting can be integrated into rubber keypads by utilizing translucent rubber as the base. This base rubber is then sprayed with an opaque ink on the front of the part. The part is then laser etched revealing the base material and allowing for light transmission in these areas.

Shorting Contacts

Shorting pads or contacts are often integrated into rubber keypads. The most common type of contact is the conductive pill which is molded onto the underside of the rubber keypad. Depending on the size of the keypad, multiple pills may be used to ensure that proper contact is made. Conductive pills are available in round, oval and rectangular shapes. The round and oval pills are the most common and are available in sizes of 1.5mm to 10mm in diameter (typically in increments of .5mm).

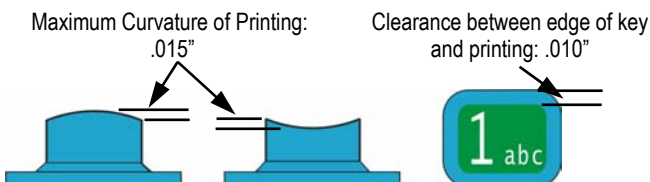
Other types of contacts include gold plated and screen printed contacts. Various contact resistances can be achieved by utilizing these different contacts.

| Type of Contact | Contact Resistance |
|------------------------|--------------------|
| Screen printed contact | <500 ohms |
| Conductive pill | <150 ohms |
| Gold plated contact | <5 ohms |

Screen Printing

Rubber keypads can be decorated by screen printing graphics on the face of the part. Colors can be matched to PMS colors or custom matched to color chips.

Optimally, the keypad tops will be flat if screen printing is required. The maximum curvature of the keytops is .015". Also, screen printing should be kept .010" from the edge or radius of the keypad.



Over Coating

When keypad graphics will be exposed to conditions more severe than normal (high abrasion applications, excessive number of actuations, etc.) coatings can be added to extend the longevity of the graphics.

Types of coatings include: screen printing (overcoating), silicone spray, polyurethane spray, parylene coating. The table below shows the protection that these coatings provide.

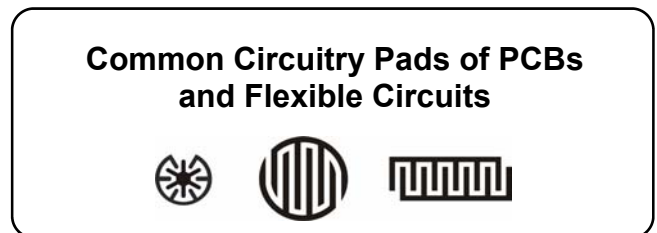
Yet another type of coating that is available is epoxy capping. This process involves depositing an epoxy resin on the top of the key. This process simulates an in-molded keycap and provides a value-added 3-dimensional look in addition to dramatically extending the life of the graphics.

These coatings also can provide chemical resistance as well. The polyurethane, parylene and epoxy coating offer the greatest protection against chemicals.

| Type of Coating | Effect on Longevity |
|----------------------------|---------------------|
| No Coating | — |
| Screen print Coating | 2 times |
| Silicone Spray Coating | 3 times |
| Polyurethane Spray Coating | 4 times |
| Parylene Coating | 10 times |
| Epoxy Capping (Encap) | 20 times |

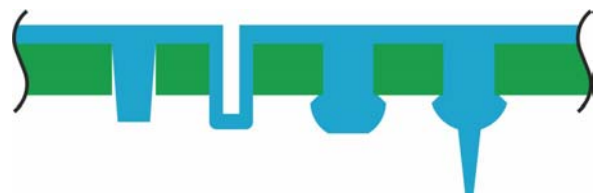
Integration with PCBs and Flex Circuits

Rubber keypads are always used in conjunction with a printed circuit board or flexible circuit. It is the PCB or flexible circuit that provides the circuitry traces while the rubber keypad act as the overlay and shorting pad.



Bosses

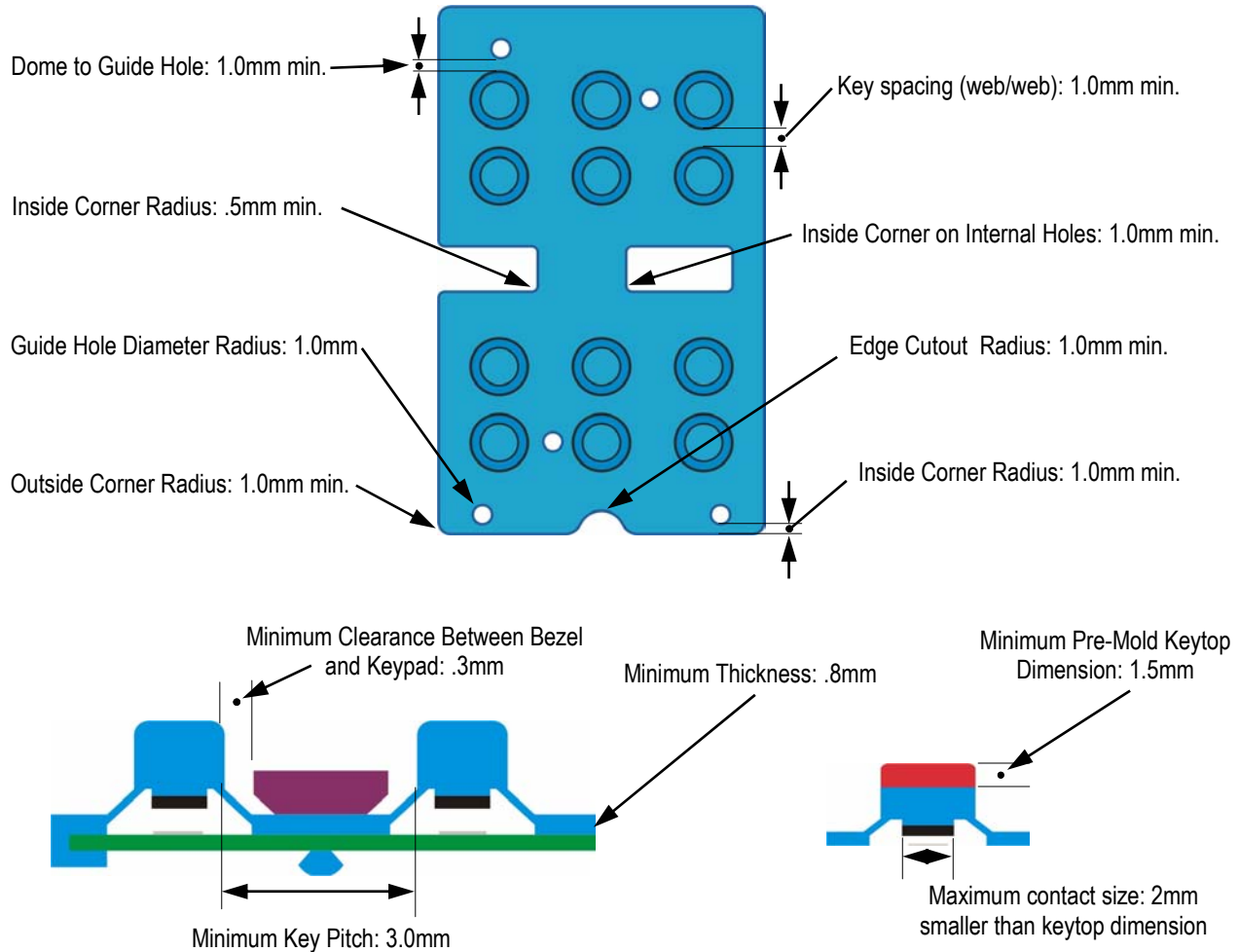
Bosses are formed appendages that are used to affix the rubber keypad to a printed circuit board or sub-panel. The following illustration shows some of the shapes and sizes that are common.



General Specifications

- Actuation Force: 50 to 500 grams
- Contact Resistance: <200 ohms
- Cycle life: 500k—5 million
- Operating Temperature: -20 deg. C to 180 deg. C
- Storage Temperature: -30 deg. C to 250 deg. C
- Dimensional Tolerance: <2" : .004"-.010"; >2" +/- .5%
- Insulation Resistance: 100 megohms/250V DC
- Contact Bounce: <15 msec.
- Travel: .6mm to 3.0mm
- Actuation Force: 60-300 grams
- Voltage Breakdown: 25kv
- Dielectric Strength: 24kv/mm of thickness

Dimensional Requirements



Dimensional Tolerances Chart

| Dimension (inches) | Tolerance | Dimension (mm) | Tolerance |
|--------------------|-----------|----------------|---------------|
| 0 - .394" | +/- .004" | 0-10 | +/- .10 mm |
| .395" - .787" | +/- .006" | 10-20 | +/- .15 mm |
| .788" - 1.180" | +/- .008" | 20-30 | +/- .20 mm |
| 1.181" -1.969" | +/- .010" | 30-50 | +/- .25 mm |
| 1.970"-2.759" | +/- .014" | 50-70 | +/- .35 mm |
| 2.760"-3.937" | +/- .018" | 70-100 | +/- .45 mm |
| >3.938" | +/- .5% | >100 | >100 +/- .05% |

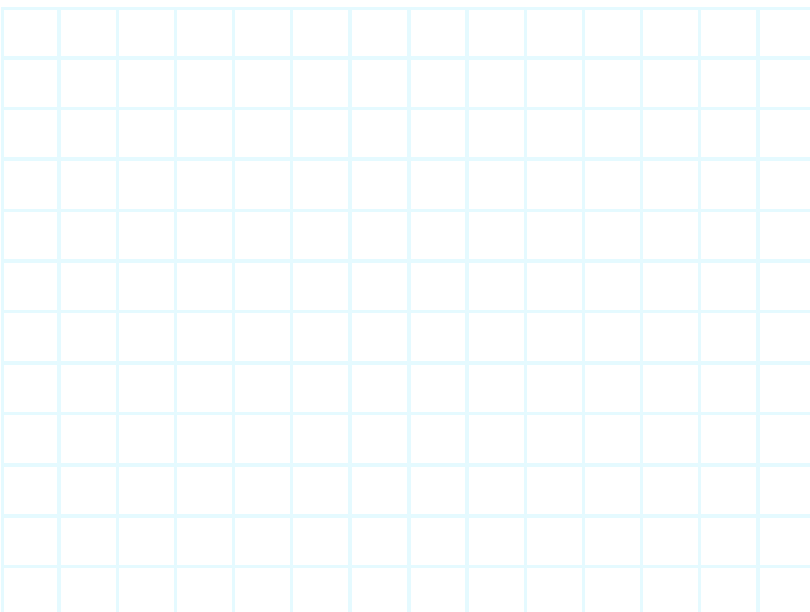
Actuation Forces of Certain Key Shapes & Styles

| NAME OF SHAPE | CONE | DOUBLE CONE | BELL/CONE | CONE | DOUBLE CONE | FLAT |
|-------------------------|--------------|--------------|--------------|--------------|--------------|--------------|
| PROFILE OF SHAPE | | | | | | |
| FORCE VS. TRAVEL | | | | | | |
| TYPICAL ACTUATION FORCE | 20-250 grams | 20-250 grams | 20-200 grams | 20-150 grams | 20-150 grams | 20-100 grams |

Can you provide us with the following essential information?

- Overall size of part
- Base thickness of keypad
- Keytop dimensions
- Radii dimensions
- Keypad dimensions and locations
- Actuation force (grams)
- Durometer of rubber
- Legends/copy (incl. PMS colors)
- PMS colors of base materials
- PMS colors of screen printed colors
- Mounting hole sizes and locations
- Cut away sizes and locations
- Mounting boss details
- Metal or Polydome required?
- Flexcircuit or PCB required?

Sketch/Notes:



What Design Factors Most Effect Cost?

- Overall Size of part ★★★
- Epoxy Capping ★★★
- Parylene Coating ★★★
- Silicon Spray Coating ★★★
- Polyurethane Spray Coating ★★★
- Number of base colors (pre-molded) ★★★
- Number of base colors (bleed) ★★★
- Thickness of keys ★★★
- Number of screen printed colors ★★★
- Conductive Pills required ★★★
- Quantity of parts ordered ★★
- Number of keys ★★
- Screen printed Coating ★★
- Number of Cutaways ★

(★★★=significant effect, ★★=moderate effect, ★=little effect)

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