Introduction

Our membrane switches are custom designed to meet the needs of specific but varied types of applications. For this reason, we’ve compiled the guidelines contained in this document based on our many years of experience manufacturing membrane switches. This guide was created in order to help make sure that all aspects of a project are weighed in and considered in order to maximize the quality, applicability and reliability of the final product.

Even though we can assist you at any step of the design process, this document was created to help you define your membrane switch project’s specific requirements so that we can get the key information we need to first quote you accurately, then to proceed with the product’s design and manufacturing.

These guidelines describe the considerations that need to be assessed in order to make the right product design decisions. Please read them carefully. The “Minimal Information Requirements” section at the end of this document details the basic information we need from you in order to quote you accurately and start the design process on the right foot. If you have any questions, please do not hesitate to contact your BLB customer representative.

Thank you!
Basic Membrane Switch Construction & Terminology

Exploded View of Typical Membrane Switch Construction

Schematic of Optional Environmental Seal

Without environmental seal

With environmental seal

Possible moisture infiltration
Graphic Overlay Material Selection

It is very important to choose the proper overlay material to maximize the product's aesthetic qualities as well as its durability under the intended usage conditions.

The two most typical types of materials used in making graphic overlays for membrane switch keyboards are polycarbonate (Lexan) and polyester. Both come in a variety of finishes from textured to polished surfaces with polished types coming with a range of protective coatings that affect optical clarity. Both also come in varying thicknesses from 0.005” to 0.030” for polycarbonate (0.010” is most typical) and 0.005” to 0.010” for polyester with 0.008” being the most used.

Of the two type, polyester is the most resistant and has greater tensile strength. This allows it to withstand millions of actuations before cracking or fracturing. It is also more resistant to embossing which can weaken polycarbonate overlays from the start. Finally, polyester also has greater resistance to a broader range of chemicals.

On the other hand, polycarbonate is significantly cheaper to buy and is slightly easier to print and emboss but the actual savings from these processing benefits are typically negligible in the final product's price.

Graphic Design Considerations

- **Drawings** : Provide drawings that clearly show the dimensions and location of all physical characteristics and elements of the switch (windows, keys, holes and openings, etc) including text sizes and fonts used.
- **Colors** : Clearly label each color area on your drawing and provide Pantone (PMS) numbers for each color and/or physical samples that can be used for matching colors.
- **Borders & Outlines** : Please take into consideration when working on the graphic design of the overlay that any mis-registration will be visually accentuated when outlines are drawn close to cut-outs or outer edges of switch, or with circles within circles (a hole within a graphical outline circle for example).

**Embossing**

The optional embossing of graphic overlays serves two purposes. One is to offer an attractive appearance to the overlay and the other is more practical and serves to guide the user's fingers to the proper areas for key actuation. BLB can emboss overlays in the two following ways:

1. **Ring emboss** : only the contour of an element is raised.
2. **Raised or Pillow emboss** : the whole of a specific area (like a key for example) is raised above the rest of the keypad's surface.

Please consider the following processing constraints when planning your overlay's embossing. For both types of embossing the maximum emboss height for both polyester and polycarbonate is between 0.050”
and 0.060". Typical embossing height ranges between 0.020" and 0.040".

Ring Emboss  Pillow Emboss

General Manufacturing Tolerances

- **Edge clearance**: individual keys' edges should be at a minimum of 0.125" from the edge of the switch panel. For switches with environmental gaskets, add a minimum of 0.25" to that number.
- **Printed circuit clearance**: similarly, allow at least 0.125" between any printed circuitry and the switch's edge as well as any windows. Also, allow a minimum of 0.063" between any printed circuitry and any holes or cut-outs within the switch, 0.125" would be better here as well.
- **In-between keys clearance**: avoid placing too many keypads in a small area as well as making keypads too small. Keypads smaller than 0.375" can be difficult to operate and offer a less than optimal tactile feel to the user.

Cutout Position & Clearance Specifications

1. 0.063" minimum clearance between holes and cutouts
2. 0.063" minimum hole diameter
3. 0.100" minimum clearance between edges and holes or cutouts
4. 0.063" minimum slot widths (may be greater depending on circuit layer thickness)
5. 0.032" minimum inside and outside corner radii

Tooling

Standard tooling for membrane switches is steel rules dies. Those dies can typically achieve a tolerance of +/- 0.005" when cutting material up to 0.025" in thickness. When cutting material of 0.030" and over, steel rule dies quickly lose their accuracy and sharpness especially with multiple layered pieces like membrane switches. For this reason, graphical overlays are often cut to their final size and shape separately from the circuit layer in order to maintain accuracy and sharpness on the most visible part of the switch.

In those cases, the circuit layer part of the switch is cut about 0.020" smaller on each side than the overlay and any cutouts or holes within the switch are cut 0.020" to 0.030" larger than their counterparts on the overlay.

Working this way can increase the initial tooling cost of the project as well as increase the unit price of each switch because of the increased time that one-on-one final assembly requires, but sometimes this is the only way to achieve acceptable results with regards to accuracy and aesthetics for thicker switch constructions like those with two circuit layers and/or spacers for inserts and/or electrostatic shielding, etc.

Embedded LEDs

BLB can build membrane switches with LEDs embedded inside the switch as a substitute to mounting them on a PCB behind the switch. This method can prove quite effective, especially when a PCB is not required (or practical) directly behind the membrane switch.

Due to the profile of a surface mount LED in relation to the thickness of a membrane switch, it is almost always necessary to emboss the graphic overlay to provide clearance for the LED even though surface mount LEDs for membrane switch applications are very small.

Keys Tactile Feedback & Actuation Force

Tactile feedback can be achieved within a membrane switch using metal domes (usually steel) of varying sizes, shapes and actuation force. As a rule, the smaller the dome, the harder it is to achieve acceptable tactile feel but domes as small as 8 millimeters...
can be used.

Stainless steel domes have actuation forces that range between 12 to 16 ounces with a typical variation of approximately +/- 3 ounces.

Keep in mind that the use of tactile domes can put greater stress on the graphic overlay material but most designs can easily reach actuation levels over 1,000,000.

**Connectors**

Typically, the flexible tail that exits a membrane switch has a single row trace on 0,100” centers. The standard connector that BLB uses to connect this type of tail is a single row connector designed for flexible circuits which interface with 0,025” square posts also on 0,100” centers.

Additionally, BLB can design the circuit’s exit tail so that it will slide into PCB mounted ZIF or LIF connectors. Those connectors commonly come in 0,049” (1,25mm) and 0,039” (1mm) spacing between traces. We do not recommend the use of 0,039” trace spacing connectors due to potential manufacturing tolerances problems as well as increased resistivity in the traces and the increased danger of migration between traces that may cause short circuits.

**Electrical Layout and Specifications**

- It is highly recommended to provide BLB with even a basic schematic and/or pin out of either a common bus or X-Y matrix circuit. If the circuit uses a non-standard configuration, providing a schematic becomes essential.
- The resistance of any closed loop in the circuit is normally between 50 and 200 Ohms while typical resistance is usually less than 100 Ohms for most applications. The total physical dimension of the keypad and the actual length of the circuit’s tail have a direct influence on these numbers
- Switch contacts and traces should not carry more than 50mA and a maximum of 24V DC. Power rating should be below 1.5 watts.

**Adhesive Selection**

A wide variety of pressure sensitive adhesives are available to bond the switch to all types of substrates. The selection of the most appropriate adhesive will depend on several factors such as environmental conditions, the type of substrate (metal, plastics or paint) and the smoothness of the surface.

The most commonly used adhesive is 3M’s 7952 (467MP, 200 Series). This adhesive will bond very well to smooth metals and high energy plastics. For rougher surfaces, 3M’s 468MP adhesive will provide better bonding since it is 2.5 times thicker than the 467.

For harder to bond to surfaces like low energy plastics and powdered paints, adhesives from 3M’s 300 Series would be the best choice (#9471 300LSE for example).

For maximum adhesion, surfaces should be thoroughly cleaned and be completely exempt of dust or grease before installing the switch. Most adhesives also have a dwell (or cure) time of several days and typically reach 90% of their maximum bond in 72 hours. No testing of the bonding strength of the switch to the surface should be done within the first 72 hours of installation.

Specifications for different types of adhesives are available upon request from your BLB customer representative.

**Information Requirements for Switch Design & Pricing**

1- Provide Accurate Design Information:

Please provide information that is as complete and accurate as possible from the beginning of the project in order to get precise pricing and eliminate potential manufacturing errors. If additional information is provided that changes the scope or specifications of the project after our quote is issued or a PO is received, BLB cannot guarantee any pricing provided before being notified of the changes or additions.

In order for BLB to provide an accurate quote as well as start the design phase on the right foot, please provide the following basic information to your BLB representative at the time of the quote request:

1. Overall Switch Size
2. Keypad Size & Location
3. LEDs locations
4. LEDs types and colors
5. Rounded Corners diameters
6. Size & locations of cutouts
7. Size & locations of transparent windows
8. Location of tail(s) & exit slot(s)
2- 
Answer Design Questions quickly:
Once we have received your quote request or purchase order, the design information you provided will be reviewed and analyzed and we will compile any questions we may have. A BLB representative will contact you shortly thereafter to address these questions. Your active participation is critical in resolving these issues for providing an accurate quote as well as the timely design and production of your product.

3- 
Graphic Artwork and Circuitry Schematic Approval:
Within 2 weeks of placing a purchase order, you will receive a fax or email with artwork of our circuitry layout as well as graphic overlay design for approval. Please look over those documents carefully and contact us quickly with any changes that might be required or sign off the documents and send them back to us as quickly as possible. Changes will be sent back again for approval so your timely feedback is essential.

4- 
File formats for drawings and artwork
Here are the file formats we require for your drawings and artwork. They are listed in order of preference:
1. Illustrator files (.ai, versions 11,0 (CS) or older)
2. Portable Document Format (.pdf)
3. Encapsulated Postscript (.eps)
4. CorelDraw (.cdr, versions 8 and older)
5. AutoCAD (.dwg, .dxf, versions 2000 and older)
6. Detailed blueprint (hard copy)

Specific AutoCAD instructions:
1. Reduce file to two layers (drawing layer and dimensions layer)
2. Purge all symbols, blocks and XREFs
3. Send an exported PDF or EPS file along native DWG or DXF files for comparison.

Quotes Requests Processing Time:
Please allow a minimum of 3 days for the preparation of a quote on a new membrane switch product. If pricing is requested for modifications to an existing product, this delay may be shortened to 48 or 24 hours.

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