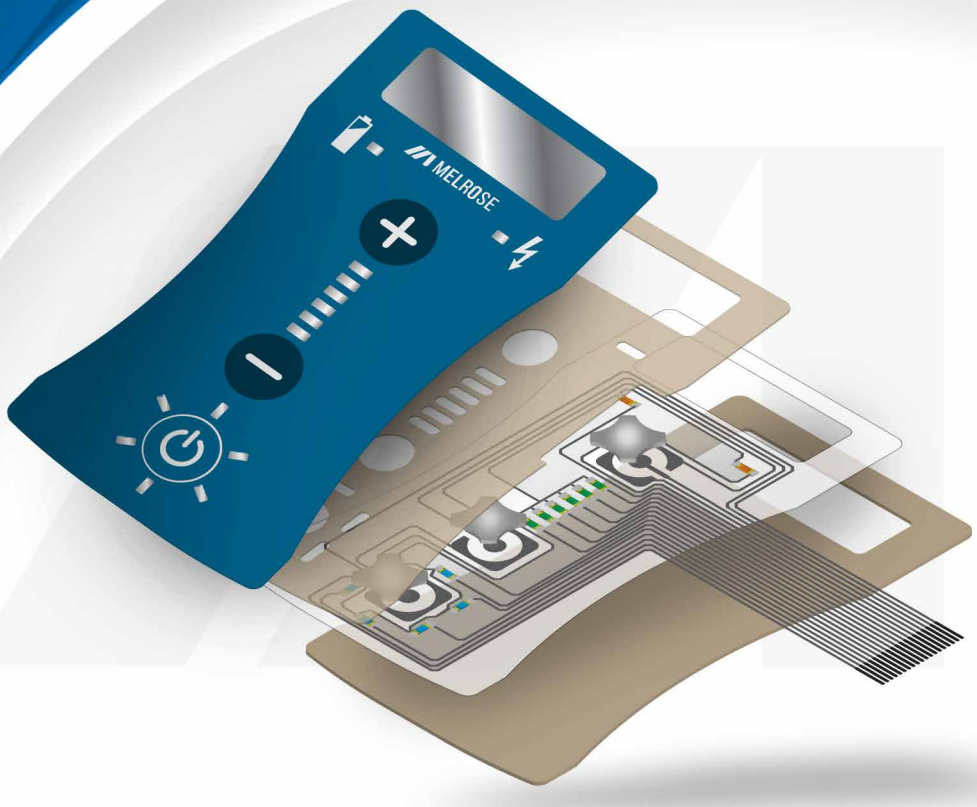
MELROSE



Technical Solutions Through Expertise and Partnership

MEMBRANE SWITCH
DESIGN GUIDE

www.melrose-nl.com

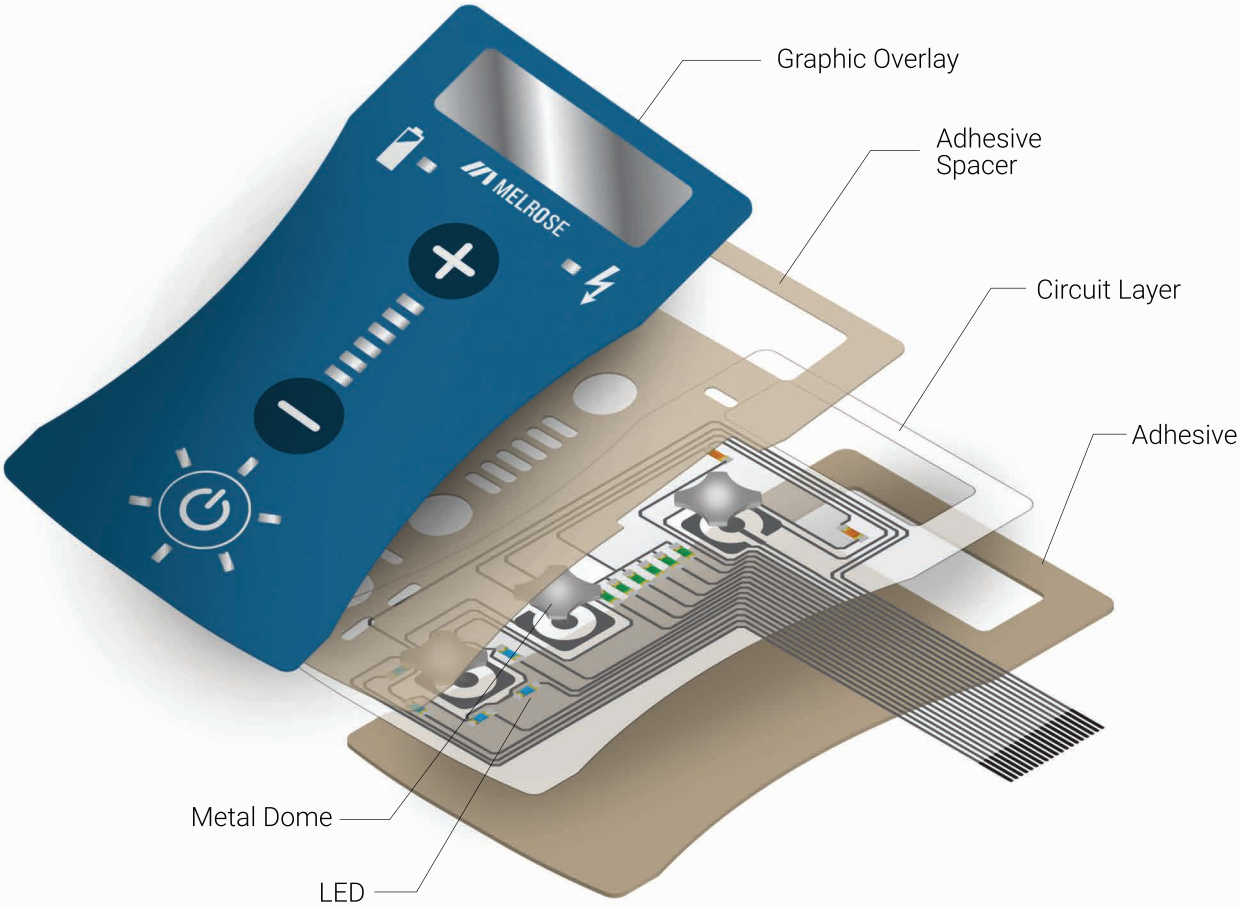
TABLE OF CONTENTS

1. Introduction 1
2. Checklist 2
3. Design Considerations 3, 4
    - 3.1 Graphic Overlays
    - 3.2 Button Domes
    - 3.3 Silicone Rubber Keypads
    - 3.4 Embossing
4. Electrical Layout 5
    - 4.1 Spacing & Pattern
    - 4.2 Termination Method
    - 4.3 ESD and EMI Shielding
5. Visual Feedback 6, 7
    - 5.1 LEDs
    - 5.2 Fiber Optics
    - 5.3 Light Guide Film
    - 5.4 Diplays and Lenses
6. Environmental Factors 8
    - 6.1 Choice of Overlay Materials
    - 6.2 Environmental Sealing
    - 6.3 Backer Adhesives
7. Drawings for Membrane Switch 9
    - 7.1 Engineering Drawings
    - 7.2 Design Artwork
    - 7.3 3D Models

1. Introduction

Within this design guide, we cover all the essential factors that influence design decisions for each layer of a membrane switch assembly.

Basic Structure of a Membrane Switch



2. Checklist

Use the following questions as guidelines to design your membrane switch:

- What environmental conditions will the product be expected to handle?
- Do you need a NEMA-4 or IP65 seal vs. water, humidity, dust, and gases?
- What are the dimensions of the keypad?
- Do you have enough room to rout circuits to the tail?
- How many buttons and LEDs will there be?
- Does your membrane switch need tactile or audible feedback?
- What role will lighting play in the user's experience?
- Will this part need transparent windows?
- Does your membrane switch require any ESD or EMI shielding?
- To what type of surface will this adhere to (ABS, metal, powder coat, etc.)?

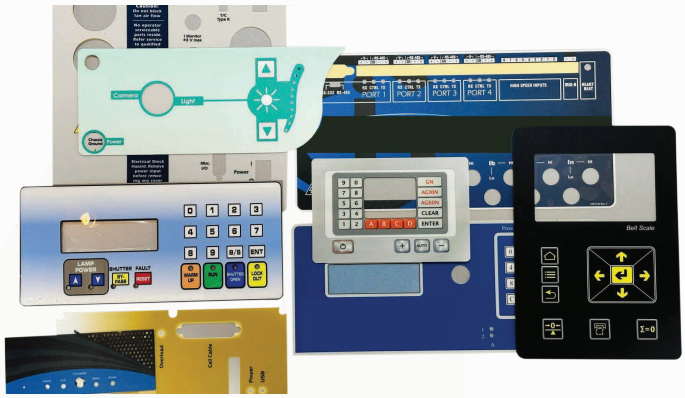
  is the surface textured or smooth?

3. Design Considerations

Here are the elements and structural choices to consider when determining the kind of experience you want the switch to deliver, when a button is pressed.

3.1 Graphic Overlays

If your application doesn't need tactile feedback, you only need to consider the material that forms the outer layer of your product's user interface (UI) - the graphic overlay.



The two most common choices here are polycarbonate and polyester, with the latter recommended by our engineers due to its durability, chemical resistance, and capacity to withstand over one million actuations.

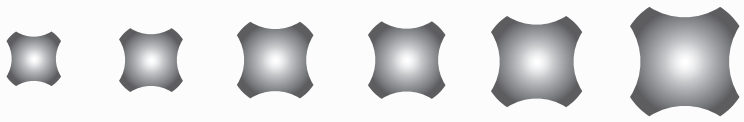
Polyester graphic overlays are available in various finishes and textures, including gloss and matte. For optimal tactile feedback and sensitivity, choose an overlay thickness between .006” and .008”.

3.2 Button Domes

To achieve sufficient tactile feedback or in some cases, an audible response, your membrane switch should incorporate a metal dome or a polydome. Shape, size, gram weight, and features for domes adjust the actuation force needed to activate a switch. To secure the dome, we may employ an additional adhesive layer known as a dome retainer.

You can select from various shapes and sizes for stainless steel metal domes, offering actuation forces ranging from 180 to 700 grams (with 340 grams being the most prevalent). Stainless steel metal domes are usually made with nickel to fulfill conductivity requirements, and range in size from 6mm up to 19mm, with 12mm being most common.

Plastic polydomes are thermo-formed from polyester that is initially screen printed with a silver conductive pad. This allows creation of multiple buttons across a single panel, presenting a cost-effective strategy for high-volume.



3.3 Silicone Rubber Keypads

Perfect for durability, chemical resistance, and increasing height relief and depth on buttons, keypads made from silicone rubber provide options for a more rugged interface.

These keypads can be custom-molded into various shapes, patterns, and colors, providing support for backlighting tailored to your application

3.4 Embossing

Embossing introduces raised tactile elements to the membrane switch, enhancing both the visual appeal and functionality of your graphic overlay. You can choose from three basic styles of embossing: pillow, dome, and rim

pillow rim dome

Pillow embossing raises the button above the surface like a pillow on a bed. It does have some limitations, such as requiring the height to be 2.5 times the material thickness. Typical height would be .012” to .015” above the overlay surface.

Rim embossing, also know as rail emboss, puts raised line around the edge of the button, without actually raising the rest of the surface. This is useful for someone locating the buttons by touch, who may be looking at something else during operation of your device. It also minimizes how far you need to press the button to actuate.

Polydomes provide greater aesthetic design flexibility, but come with a higher tooling cost. It is an excellent choice for intricate shapes, including multi-level designs and detailed logos. Again, this would mostly be used for high volume production

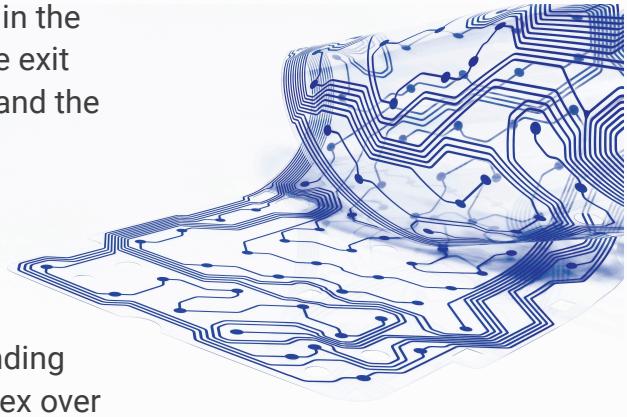
4. Electrical Layout

4.1 Spacing and Pattern

Consider operation of the contact points (buttons) in your membrane switch. Initially, establish required number of buttons and LEDs, where the ground(s) are in pinout, pinout type, and pitch (circuit width).

4.2 Termination Method

To determine the termination of the electrical circuitry in the membrane switch, first, consider the tail length and the exit location, which is influenced by your product's design and the integration of the membrane switch into it.



Next, assess the tail's design. If there's sufficient space and the path isn't intricate, a cost-effective approach is to use a ribbon cable with screen-printed silver. For more compact designs that may involve bending and creasing the ribbon cable, opt for etched copper flex over polyimide (Kapton).

Afterward, contemplate how the circuitry will physically connect with the printed circuit board. One straightforward option is to incorporate a solder tab stitched onto the tail and soldered directly to the printed circuit board. Alternatively, design ribbon cables to slide into board-mounted connector housings.

4.3 ESD and/or EMI Shielding

Shielding constitutes the third crucial consideration.

ESD (Electrostatic Discharge) shielding for your product might be necessary to dissipate a static charge by screen-printing a grid pattern using conductive silver ink - this grid can be grounded to a trace on your interface panel and connected to a ground plane on the product.

Full conductive laminates, tapes, and foils can be embedded inside the product - offering a higher level of dissipative properties, but at higher cost.

When selecting:
ESD shielding technique, take into account absorptive properties of the outer materials in use.
EMI, consider the distance to the EMI power source, and the amount of EMI generated.

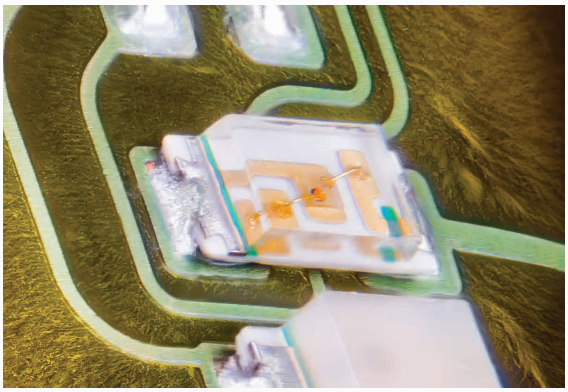
5 Visual Feedback

The lighting choices and displays integrated into your membrane switch will influence the user experience. Here are a few options you can select from :

5.1 LEDs

Light-emitting diodes (LEDs) offer a dependable light source with low power demands, along with a diverse range of colors and intensities.

If the buttons themselves need to light up, we can position side-firing LEDs around the buttons of the switch assembly. Additional diffusing layers or tinted colors, can be incorporated to achieve a more balanced appearance.



5.2 Fiber Optics

For illuminating specific areas of your membrane switch, you can direct an LED through optical fibers. This method is advantageous for many applications, being widely used due to its cost-effectiveness and low operating temperatures.

However, there's a limitation to address: the presence of a bulky pigtail. To overcome this, specify woven fiber optic pads. While they are more expensive, they provide a compact, low-power, and well-controlled backlighting solution.

It's important to note that this layer may impact the switch actuation force

5.3 Light Guide Film (LGF)

LGF technology employs a light-diffusing plastic material to uniformly backlight extensive areas with LED sources.

One notable advantage of LGF is its cost-effectiveness, being more budget-friendly than woven fiber optic pads. However, to achieve a similar effect, a higher number of LEDs is required.

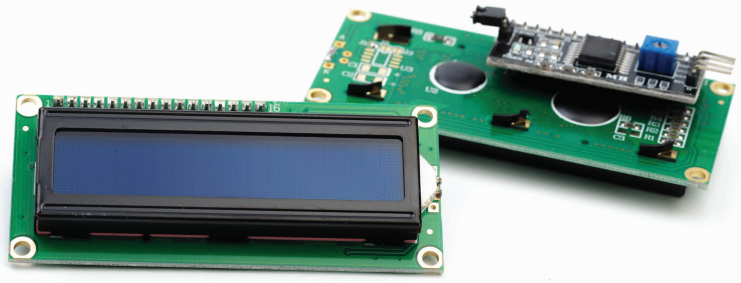
If the device will be used in dim or no lighting, then this is a highly effective method. LGF can be a good choice for applications with high-volume production and cost considerations.

5.4 Display and Lenses

If there's a need to incorporate a display into the membrane switch, it's essential to specify the appropriate materials for the cutout in the graphic overlay.

For example, LCDs generally require transparent materials, while brighter LED displays offer the flexibility to use darker materials.

Coatings can be applied for additional functional properties, such as anti-reflective coatings, in any case.



6 Environmental Factors

6.1 Choice of Overlay Materials

The material you select for the overlay of your membrane switch significantly influences its long-term durability and interface reliability.

As mentioned before, polyester is the recommended material for membrane switch applications. It offers durability, chemical resistance, dimensional stability, and inherent dielectric properties.

To create unique designs, you can choose from various materials, inks, and coatings.

6.2 Environmental Sealing

Membrane switches are inherently designed to withstand moderate exposure to moisture and spills.

However, to guarantee environmental integrity, it's important to maintain as much distance as possible between any circuitry in the keypad and the external edge of the switch assembly.

Certain applications may demand additional moisture resistance, and in such cases, you have the option to incorporate pressure-sensitive seals or gaskets.

Furthermore, silicone rubber keypads provide a comprehensive solution for sealing a product from moisture, dust, and various environmental conditions. Additionally, they offer a level of resistance to vibrations.

6.3 Backer Adhesives

There are a variety of adhesives available for bonding the membrane switch to a substrate, but there is no one-size-fits-all solution.

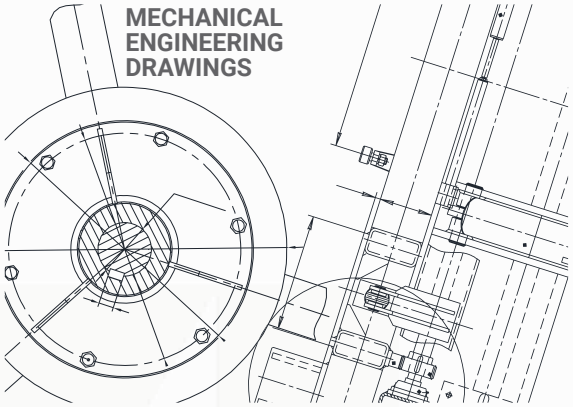
First, you need to understand the surface energy of your underlying material. High surface energy materials are more receptive to adhesion, while low surface energy materials require special adhesives. Also, consider whether the surface is flat or curved, textured or smooth, and painted or unfinished.

7 Drawing for Membrane Switch

7.1 Engineering Drawings

It is necessary to distinctly outline all the physical characteristics and dimensions of your membrane switch, encompassing copy and color breaks.

We need a mechanical drawing that provides dimensions and details of features.



7.2 Design Artwork

When designing artwork such as logos, symbols, and other design elements, use scalable vector artwork (EPS, AI, etc.). It provides a much better resolution than pixel based files such as PNG, JPG, or TIFF.

7.3 3D Models

3D files allow OEMs and suppliers to streamline the entire design and production process. The most common format used in this context is STP.

Get in touch with us !

Our specialists will work with you to understand your application, identify suitable materials, and provide services that will allow you to move from design to mass production.