

### Membrane Switch Design Guide

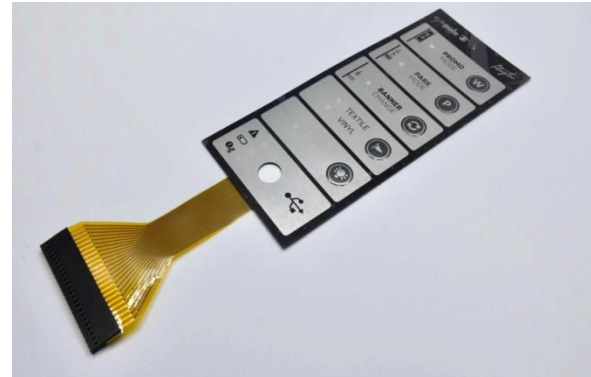
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## Membrane Switch Design Guide

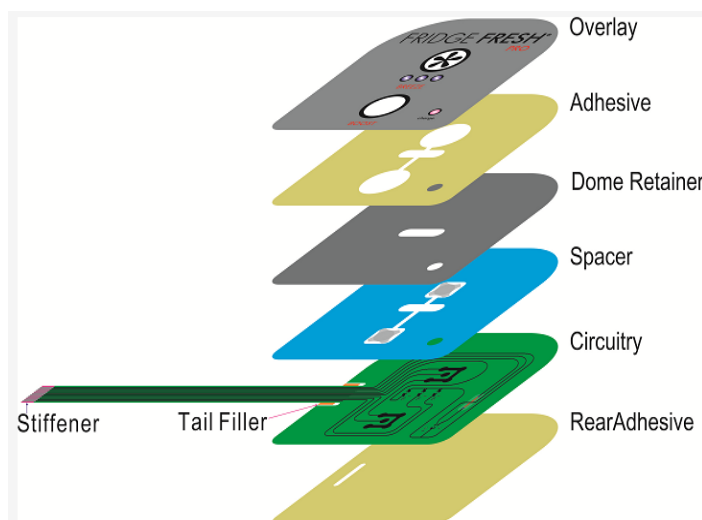
### Niceone-tech Imaging

Niceone-tech is a company composed of a professional team with 15 years of experience in membrane switches, silicone and plastic products. We specialize in customizing membrane switches, silicone and plastic products. The main markets of Niceone-tech's products are military, medical, industrial and other markets. Regardless of the number of products, Niceone-tech will produce high-quality, high-value custom membrane switches, silicone products, plastic products, etc. If it is small batch production, we have a dedicated engineering team to produce products under 100pcs, and the delivery time can usually be controlled within 15 days. If it is mass production, we have a dedicated production team to meet the various requirements of customers.



### Niceone-tech's membrane switch panel design Process

In order to facilitate customers to understand membrane switches and various components, Niceone-tech will use a project to give customers some guidance and suggestions. After understanding and confirming the product requirements, our engineering team will design and actually produce the drawings to produce samples and large goods. This can also save customers a lot of precious time.



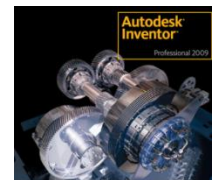
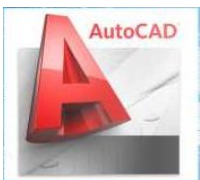
## Design for the artwork

Niceone-tech believes that customers also know that drawings are one of the most important processes for producing goods. Therefore, in the design stage, Niceone-tech will give us feedback and professional opinions according to the needs and design of the customer. After consultation after time, the drawings will be completed.

## E-files

In order to give customers drawings in 2-3 days, Niceone-tech recommends that customers provide AutoCAD, SolidWorks, CorelDraw, Illustrator, and Inventor files. To avoid the problem of missing fonts, the file is best to transfer all fonts out of Curves or outlines.

If you are not sure whether the file is feasible, you can send the file to [info@niceone-tech.com](mailto:info@niceone-tech.com), our team will help you verify the inspection.



## Overlay

The panel is an important part of the membrane switch, and often a good-looking panel can directly impress customers. Niceone-tech as a factory will help customers provide different design elements such as Pantone color number, RAL color number, CMYK processing and gradient, transparent window, whether the surface is rough or smooth. Whether the window needs to be reflective or extinct. In the design process, if you are not sure, we can draw an Overlay surface drawing. It includes colors, material handling, windows, and material selection.

## Material selection

The choice of the first layer of the membrane switch depends on the customer's needs. The most important practicality and durability of the covering layer is an important part of the entire product. According to the needs of different customers, Niceone-tech's professional industry knowledge will bring customers the most cost-effective choice. For example: products with windows, we generally recommend that customers will use Autotype EBG material, because of its scratch-resistant characteristics, the performance of products with windows is very superior. The window is not easy to scratch, which means that the product life is longer. Part of PET and PC as panel materials can even be driven 1 million times. Although PC can also be used as a panel, compared with PET, its service life is not as good as PET.

**Table 1 – Niceone-tech Membrane Switch Overlay Material Guide**

| Material     | Base Film                  | Finish  | Thickness  | U.L. Rating | Recommended for Outdoor Use (Sunlight) | Hard-coated | Enhancements: |                   | Resistance to:       |                    |
|--------------|----------------------------|---------|------------|-------------|----------------------------------------|-------------|---------------|-------------------|----------------------|--------------------|
|              |                            |         |            |             |                                        |             | Embossing     | Selective Texture | Industrial Chemicals | Household Cleaners |
| Autotex F    | Polyester                  | Fine    | .006-.010" | 94HB*       | No                                     | Yes         | Yes           | N/A               | Good                 | Good               |
| Autotex V    | Polyester                  | Velvet  | .006-.010" | 94HB*       | No                                     | Yes         | Yes           | N/A               | Good                 | Good               |
| Autoflex EBG | Polyester                  | Gloss   | .005-.010" | 94HB*       | No                                     | Yes         | Yes           | Yes               | Good                 | Good               |
| Autoflex EBA | Polyester                  | Matte   | .005-.010" | 94HB*       | No                                     | Yes         | Yes           | Yes               | Good                 | Good               |
| Autotex XE   | Polyester                  | Velvet  | .008-.010" | 94VTM-2     | Yes                                    | Yes         | Yes           | N/A               | Good                 | Good               |
| Marnot XL    | Polycarbonate or Polyester | Various | .007-.030" | 94-V2       | No                                     | Yes         | Yes           | Yes               | Good                 | Good               |
| 8010 Lexan   | Polycarbonate              | Gloss   | .007-.030" | 94VTM-2     | No                                     | No          | Yes           | Yes               | Poor                 | Fair               |
| 8B35 Lexan   | Polycarbonate              | Velvet  | .005-.020" | 94VTM-2     | No                                     | No          | Yes           | N/A               | Poor                 | Fair               |
| HP-92W Lexan | Polycarbonate              | Gloss   | .007-.030" | 94HB        | Yes                                    | Yes         | No            | Yes               | Fair                 | Good               |
| HP-40 Lexan  | Polycarbonate              | Matte   | .007-.030" | 94HB        | No                                     | Yes         | No            | Yes               | Fair                 | Good               |
| HP-12 Lexan  | Polycarbonate              | Matte   | .007-.030" | 94HB        | No                                     | Yes         | No            | Yes               | Fair                 | Good               |
| FR-60 Lexan  | Polycarbonate              | Gloss   | .010-.040" | 94-V0       | No                                     | No          | Yes           | No                | Poor                 | Fair               |
| FR-65 Lexan  | Polycarbonate              | Velvet  | .010-.020" | 94-V0       | No                                     | No          | Yes           | No                | Poor                 | Fair               |

**Thickness of adhesive**

In order to get the excellent tactile feedback of the stainless steel dome, the choice of force is very important, and the choice of overlay panel thickness is also very important. The structure of this layer will generally be controlled between 0.13-0.2mm. If the panel material is too thin, it is easy to break, and if it is too thick, it will feel poor. However, some customers also need thicker materials and not too excellent tactile feedback.

**Color matching**

The limit of niceone-tech's acceptable standard range in Delta-E is less than or equal to 2. Niceone-tech can match colors with Pantone color and RAL color Numbers, and AI files are required for digital color printing. If the customer does not have any color number, we will ask the customer to provide the color swatch or chip 25\*25mm to match the color, or we will make the color file for the customer's confirmation.

## Finish:

Polyester and polycarbonate overlays are commonly used materials for panels, conventionally divided into several types, fine sand and coarse sand, gloss, velvet or scratch resistant. Niceone-tech with windows will recommend the use of EBG materials or EBA. The materials are scratch-resistant and the windows are transparent. Some materials such as XE series or HP92W series can resist ultraviolet rays. The ink printed by Niceone-tech is generally on the back of the material, so that the ink will not be damaged over time. If customers want velvet materials and transparent windows, Niceone-tech will recommend that customers use window inks to satisfy.

## LED/LCD windows

The LED/LCD window will have different requirements on the membrane switch. LCD windows require transparency instead of a matte effect, so different treatments need to be done according to different materials. Autotype EBG sometimes requires anti-glare treatment, and Autotype F150 and V150 require window oil to make the window transparent. It may need screen printing colors and so on. LED window, the raw material is transparent or the color is transparent

## Embossing



## Circuit Production:

There are many options for the route. Depends on the customer's requirements for product resistance, performance, and the entire product. Niceone-tech provides printing silver oil, UV ink and carbon oil in PET circuits as a commonly used structural standard. When PET cannot meet the needs of customers, we also provide Flex printing copper and PCB circuit. Compared with PET, its performance is more stable, the resistance is lower, and some electronic accessories can also be soldered. If the customer wants to make a new type of backlit membrane switch, we highly recommend using PCB or Flex printing copper as the circuit. We will recommend 0.1-0.18mm for the thickness of the circuit.

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## Circuit type:

**PET:** One of the most commonly used circuit materials for membrane switches. Silk screen conductive ink, carbon paste and UV ink on the surface of this material

**Flexible Printed Circuit(FPC)** By etching the copper foil, gold is plated on the bare copper foil. And the substrate is Kapton polyimide. The electrical performance is more superior, the resistance is stable, and the wiring can be more dense.

**Printed Circuit Board** A membrane switch that is constructed with a rigid lower PCB circuit.

## Electrical Schematics:

Niceone-tech has a dedicated engineering team to design Electrical Schematics. If the customer has already designed himself, our project will be optimized according to the customer's drawings. Depending on the product, some product customers want to save costs and continue to use PET as the circuit. Electrical Schematics is more complicated. At this time, we will try to bridging, through-hole printing, or multiple circuit layers to meet customer needs. The Niceone-tech team will analyze the optimal solution of the circuit and maximize the performance. In this way, we can meet the needs of customers with high quality and low cost.

## Circuit Tail Connectors

- Berg ®/FCI ® (Standard)
- Molex ®
- CrimpFlex ® (Standard)
- Solder tabs
- Amp ®
- ZIF ®
- Male or female connector pins
- CJT chinese brand



## Circuit Tail Length

The tail of the circuits. PET circuit generally use UV ink or transparent mylar to protect the tail of the circuit to protect the silk screen. At the same time, the longer the tail, the greater the resistance. FPC circuit will not have the problem of excessive resistance. At the same time, the stability is better.

## Backlight Options

### Light Guide Film (LGF)

The light guide film is a thin film material. The light guide film is placed under the panel. The LEDs guide the light through the light guide film on the logo and buttons that need to be lit. Some membrane switches, Niceone-tech can even control the thickness within 1mm, and the brightness is very even.



### Light Emitting Diodes (LED)

Due to the long life and low loss of LEDs, they will be installed on the circuit layer or the individual LEDs layer. It is usually the standard of the membrane switch signal. Sometimes customers will also ask Niceone-tech to install LEDs in the middle of the shrapnel with holes to light up the pattern of the keys.

### Electroluminescent (EL) Lighting.

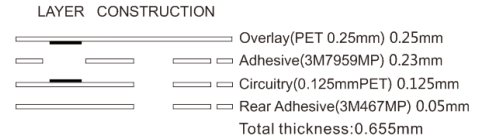
EL film is a product that is converted into light energy by voltage. Because it does not generate too much heat during the working process, it is also called a cold light film. The working time can generally reach 2000-5000 hours, and the overall brightness is relatively uniform. It is also commonly used for the backlight option of membrane switches.

### Fiber Optic Lighting.

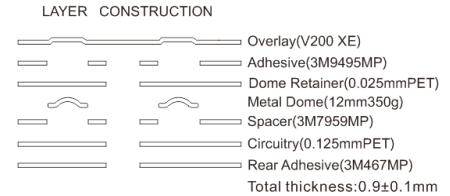
Fiber optic is thin plastic fibers. The way of light source is to distribute the large area of light evenly in the membrane switch area through LEDs. Due to stable performance and low loss. It can be used for 10,000 hours.

## Non-Tactile:

The panel is generally flat and has no snap domes. The feel is relatively poor, but the life is long. And it can be made very thin. The size of the load is determined by the adhesive tape and the spacer. Colleague spacing holes and larger-diameter switches drive more slightly.



**Tactile:** The most conventional structure of the membrane switch. Usually the panel is embossed. The domes of different forces are installed under the panel to obtain a good tactile feedback.



## Which dome is we should choice?



Niceone-tech select the most suitable dome based on the customer's product drawings. If the drawings are not shown, we will choose the most suitable load as considered by the Nicole-tech engineering team when proofing. Generally speaking, 10.0mm and 12.2mm domes are the most commonly used and have the highest economic benefit.

## Actuation Force/Design Table 2

|                          | Non-Tactile                             | Tactile Metal Dome            | Tactile Polydome              | Notes                          |
|--------------------------|-----------------------------------------|-------------------------------|-------------------------------|--------------------------------|
| Key Travel               | .005" - .020"<br>.13 - .5 mm            | .015" - .040"<br>.38 - 1.0 mm | .015" - .040"<br>.38 - 1.0 mm | (1) GL 50397 /<br>ASTM F2592   |
| Operating Force          | 80 - 340 g<br>3 - 12 oz                 | 110 - 1700 g<br>4 - 60 oz     | 110 - 600 g<br>4 - 21 oz      | (1,2) GL 50397 /<br>ASTM F2592 |
| Actuation Life           | > 1M cycles Up<br>to 5M+                | > 1M cycles<br>Up to 5M       | > 1M cycles                   | (3) GL 50393 /<br>ASTM F1578   |
| Operating Temp           | -30 to 70°C<br>-22 to 158°F             | -30 to 70°C<br>-22 to 158°F   | -20 to 50°C<br>-4 to 122°F    | (4)                            |
| Storage Temp             | -40 to 70°C<br>-40 to 158°F             | -40 to 70°C<br>-40 to 158°F   |                               | (4) < 50% RH;                  |
| Humidity                 | 12 - 90% RH                             | 12 - 90% RH                   | 12 - 90% RH                   | (4) Non condensing             |
| Minimum Tail Bend Radius | 0.063" (1.6 mm) - 25 cycles min at 20°C |                               |                               | GL 50399 /<br>ASTM F1683       |



## Shielding layer

The shielding layer has three functions

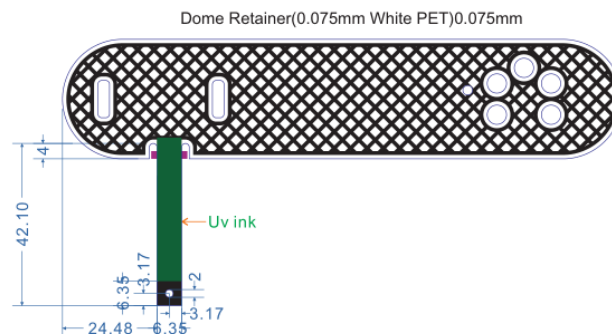
- (1) Safely discharge potentially harmful static electricity to avoid damage to sensitive electronic components.
- (2) The shielded membrane switch is protected from radio frequency interference and electromagnetic interference of the surrounding environment.
- (3) Reduce or eliminate the radiation of radio frequency interference and electromagnetic interference through reflection or absorption.

Nicone-tech can design suitable shielding layer according to customers' products. Nicone-tech recommends that customers use these three methods to protect the line:

1. Use conductive aluminum foil copper foil
2. Print PET circuit with conductive ink in a grid, bus-bar or full-coating format.
3. Use a waterproof frame to protect the membrane switch.

## Shield Termination Methods

Tab: A wire is separately drawn at the Dome Retainer layer to link the screw or metal plate of the product.



## Connector

Through through-hole printing, the shielding layer is connected to a pin of the connector, generally a ground wire.

### **What products Niceone-tech could supply?**

Membrane switches  
Silicone rubber keypad  
Silicone rubber products  
Overlay panels.  
Label/Nameplates  
Printing Circuit Board(PCB)  
Flex copper (FPC)

### **Niceone-tech Engineering Capability**

Overlay Design  
Membrane switch design  
LGF membrane switch design  
Circuit design  
Tooling design  
Silicone rubber keypad design

### **Quality System & Certifications**

Facility certification is to ISO 9001:2015

Each employee is trained and certified to specific processes, and records are maintained for all activities.



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