How-to Guide

This guide will show you our basic membrane switch design process so that you can better understand your own needs when it comes to planning your project.

Building a Quality Membrane Switch

The membrane switch is found in the consumer and commercial electronics market in all industries. The flex circuit, as it's also known, is flexible in its properties and its applications. They are suited to fields like communication, medical, industrial, & test and measurement.

It's a demanding and fast-paced marketplace, and Almax-RP embraces the challenge! For more than a decade, Almax-RP has been building the membrane switch with the specificity and quality required in this industry.
Membrane Switch Elements

There are three main parts to a membrane switch: a printed silver Circuit; the electrically insulating spacer and the top button layer, usually With a graphic overlay.

The circuit is screen printed onto a thin polyester layer with electrically Conductive silver ink. A spacer adhesive is bonded to the circuit and has Cutouts where the electronic switches are located.

Tactile switches use small metal domes made out of nickel or stainless steel which are placed between the layers. With a dome, you get a tactile Response that confirms you have pressed the button sufficiently. The domes Are secured with another adhesive film.

Non-tactile switches make electrical connection through silver conductive Ink printed on the back of the overlay.
Membrane Keypads

A membrane switch works through electrical contact between the keypad surface and the underlying circuits when the keys are pressed.

Each key, when depressed, makes a connection with the circuit. The keys can have a metal dome to make separate looking buttons or can be printed onto a flat surface.

Also known as a **Flex Circuit**, the membrane switch is designed and manufactured to meet a customer’s specific needs as well as their exact technical and ergonomic requirements.

A high quality, graphic interface can be used in numerous applications and can be made to highlight text print or icons. The keypad can even be back-lit for improved appearance. This does add additional costs and time.

The membrane keypad provides a low profile, reliable seal that will keep out moisture and debris that might short out a device. They work great in tight areas.
Membrane Switch Stack Structure

**Polyester** is used for the Graphic Overlay. It has excellent chemical resistance and flex life. Almax-RP can print either digitally or with screen-printing or a combination of both, to give you the right colors, textures and finishes for your design.

**Graphic Adhesive** bonds the overlay to the top circuit layer and is an acrylic adhesive.

**Dome Retainer** separates the overlay from the bottom circuit so that the switch stays open until the keys are pressed.

**Circuitry** is a .005” head stabilized polyester printed with silver conductive ink. This circuit ends in a flex tail that is the connector to the controller or other equipment.

**Backer Adhesive layer** connects the membrane switch to the product housing or enclosure. Almax-RP selects the correct thickness adhesive to match the ergonomic requirements of the customer.
Benefits of a Membrane Switch

• Used in some very hostile operating environments, Almax-RP membrane keypads and switches are durable and functional.

• You can promote your brand with your logo and designs on your keypads and equipment. Our flex circuits will improve the appearance of your electronic package, which can influence the decision making process of users of the product.

• Membrane keypads are custom designed and manufactured to meet your specific needs, including technical and ergonomic requirements.

• All our membrane products can come with a variety of polyester finishes. Some overlay materials are suitable for harsh or extreme outdoor conditions. All overlay materials keep out dust, moisture, and contaminants. They are also chemical resistant and can be anti-microbial if required.
Functional Uses for Membrane Switches

Membrane switches are user-equipment interface utilities. They give you control over your equipment. They are highly adaptable and suited to a variety of situations. Almax-RP has made Keypads for many different industries including:

- Industrial
- Medical
- Consumer Goods
- Appliances
- Test and Measurement
- Utilities
- Oil and Gas
- Scientific

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Silver Circuit printed Heat Stabilized Polyester Film.

**Silver Flex Circuit Elements:**
- Single Sided or Double Sided (with Thru-Hole)
- On Head Stabilized Polyester
- Can have Embedded SMD (LEDs)
- Come with Carbon on the tail
- Can have Printed resistors attached
- With or without EMC shielding
- Individually printed
- A combination of display and touch elements
- With or without metal domes for tactile response.
- With or without embossing (pillow or ring)
- Come with digital or screen printed Graphics

Graphic Overlay printed on a clear Polyester film or textured Polyester film.

Almax-RP.com
Graphic Overlays

• Use graphic overlays to set your company apart from the competition. A uniquely designed interface will provide your customer a unique experience and help your brand stand out.

• Flex circuits with Graphic Overlays make the appearance of electronic equipment much more appealing. A better looking and nicely functioning keypad will make happy end users.

• The Graphic Overlay is the visible part of a membrane switch assembly. It is printed on high quality polycarbonate film, which has a flexible, chemically bonded and UV-cured coating. The coating may be textured, fine or velvet. These materials are compatible with solvent & UV curing screen inks and also digital printers.
Graphic Overlays continued

We print mostly digital overlays so any amount of colors can be printed. We use screen-printing to add texture, window tints or specialty coatings. We can print silver and grey backgrounds and we use transparent inks for different colored windows.
Artwork

Vector artwork is the preferred format for graphics that you want On your Overlays. You can specify colors using the Pantone system And you can use as many colors as you want since we do digital printing.

If you need us to we can create the necessary vector artwork from image files or a concept sketch.

Preferred format is Adobe Illustrator (.AI) or vector .PDF
Another way we connect a membrane switch to a circuit board is by using Female Solder Pin Connectors. These are made of thermoplastic with fiberglass. They are used with Nicomatic contacts and can be either all-female contacts or long-male pins.

A flexible membrane switch is connected with a flex tail that is cut from the circuit material. The tail is then connected to a circuit board with a Zif Connector or Female Solder Pin Connector.
Determining the Preferred Pitch for the tail contacts

1mm is the preferred pitch for tail contacts. We can do .5mm if you need, but then we would need to go to a copper circuit on thin flexible polyimide instead of a screen printed silver circuit on polyester. If we go with a copper circuit there will be increased tooling costs and lead times.

Copper

Silver
Connectors

These are the connectors we mostly work with.

- Female 0.1” Nicomatic
- Male 0.1”
- Screen-printed Silver ZIF
- Copper Flex ZIF
- Wire
- Female .05” Nicomatic
Taking Care of Flex Circuits

• A good general rule of thumb for handling flexible tails of the keypad is to not crease the flex tail. Tails are designed to work effectively when bent, however, creasing and re-creasing the tail can cause damage.

• Also, it’s good to avoid bending a membrane switch more than necessary Before application to a surface. Over bending of an unapplied membrane Switch can damage the tactile domes, LEDs, and other sensitive electronic parts.

Taking Care of Tactile Domes

• Tactile domes can be damaged if they are pressed while the membrane is not against a hard surface. For best results avoid pressing the domes unless they are against a hard surface.
Taking Care of Tactile Domes cont.

- Once a membrane switch has been applied to a surface it cannot be removed and re-used. Pulling a membrane switch off of a surface once it has been applied can damage the tactile domes, LEDs and other sensitive electronic parts.

- Avoid bending a membrane switch more than necessary before application to a surface. Over-bending of an unapplied membrane switch can damage the tactile domes, LEDs and other sensitive electronic parts.

Actuation Force for Tactile Keys

Actuation force for a tactile key is determined by dome selection, i.e. 280g, 340g, 400g. Actuation force for a non-tactile key is determined by multiple factors that changes with every keypad design. Non-tactile keys have an average actuation force of about 6 oz (170 g) but can vary +/- 3 oz depending on spacer thickness, switch size, overlay material, and printed circuit design.
Membrane switches need to withstand high stresses from repetitive use and exposure to a variety of environments and conditions. Almax-RP’s staff is committed to maximizing the durability and quality of our switch components.

Through-Hole Connectors

This is what is usually used in circuit boards and they occasionally come into play with flex circuits. In through-hole construction the silver is transferred from one side of the polyester material to the other. Almax-RP can make a double-sided silver circuit with through holes to accommodate tight specifications.
Considerations

As you design your membrane keypad keep some things in mind:

• **End User Operating Environment**
  – Make your design with a worst-case situation in mind to ensure best durability and functionality.
  – Outdoor use can bring moisture, temperature, and UV rays into play so be sure to ask for special outdoor overlay materials if needed.
  – Durable overlay materials and adhesives play the biggest role in keeping contamination and other environmental pollutants from affecting the circuit integrity.
  – Almax-RP can help you select the best design options for a modern membrane switch, including adhesives, LED lighting or Backlighting, and sealing options.
Corrective Action

What happens if you receive a part that doesn’t work?

You can request an RMA and we will send one to you. Parts will then be returned and we will evaluate and send a corrective action report. If found to be a manufacturing problem we will issue a credit memo or replace the parts.
What You Should be able to Provide

In order for us to best serve you, your drawings should have the following included items:

- Outside dimensions of the membrane
- Number of colors on the graphic overlay
- Tactile response (buttons designed with snap domes) or
- Non-tactile response (buttons designed with a shorting layer)
- Emboss on keys (yes/no)
- Button shape and size
- Tail exit location
- Tail length
- Location of any surface mount components such as resistors or LEDs.
- A Pinout listing of any and all buttons
- Type of connector desired
- EMI Shielding (yes/no)

We prefer a .dwg or .dxf for the mechanical construction, and an .AI for the graphic artwork. We can also work with a vector .pdf
Almax-R{ membrane switch panels are typically cut with a medium-speed CO2 laser, with occasional use of steel rule dies resulting in a dimensional tolerance of +/- .010 inch.

Bezel openings, recessed mounting areas, and other mounting situations introduce additional tolerances, so the total stack-up tolerance is really what to consider. A membrane switch panel that fits too tightly into equipment or has gaps between the membrane switch panel and the housing can lead to problems, most of which will contribute to premature device failure.
Almax-RP Quality Control

100% Inspection

All membrane keypads and circuits are individually tested for electrical functionality. Electrical testing is done manually during the circuit build-up and then is done to ALL parts when finished using a Mistral Keypad Test System. A testing report is generated for each lot of parts tested.

1) LEDs are tested for functionality and proper visibility with 10mA forward current with a forward voltage between 1.2 and 4.1 V.
2) LEDs are tested for back current leakage at 5V potential with a cutoff of 100uA.
3) Switches are tested for functionality with 100Ω max resistance through an activated switch.
4) All pins are tested for 1,000,000 Ω isolation between pins.

Dimensional Inspection

All parts are inspected for dimensional conformance to product drawings.

1) Outside dimensions are measured to specifications using calipers.
2) Windows, cutouts, and other key features are measured to specifications using calipers.
3) Tail length is measured to specifications using calipers.
Almax-RP Quality Control

Visual & Color Inspection

All parts are inspected to ensure the visual appearance of the parts match the product drawings

1) All parts are inspected under a digital microscope for defects.
2) Colors are checked to match standardized color swatches using the Pantone and CYMK color systems.
3) Words, images, and other key features are checked for conformance to Product drawings.

All parts are color inspected to ensure the visual appearance of the parts match product drawings using a digital Spectrophotometer. Spectrophotometers are used in many industries that need accurate colors. This device matches the color produced to the color requested in the drawing. Pantone Colors are generally used, along with CYMK to produce the correct colors. These measurements allow colors to be consistent with different substrates and manufacturing processes.
OUR GUARANTEE

- Almax-RP products are 100% guaranteed for quality and workmanship.
- Our products are 100% electrically tested prior to shipment.
- We will return your request for quote in one day or less.
- **Blanket orders with scheduled shipments** are accepted within a 12 month period.

Almax-RP is a **U.S. Manufacturer** and has a design team ready to work closely with you from start to finish.

We have a wide range of experience in this industry and can meet or exceed your application requirements.

**U.S. Manufacturing**
**Tucson, Arizona**
Almax Rapid Prototyping of Membrane Switches

Almax-RP’s U.S. based design engineer will work closely with you, and will offer expert recommendations, support, and follow-up. Almax-RP will make a dependable design built in our Tucson facility to meet your product requirements.

Our strength is our personalized service and our rapid prototyping service. You get excellent parts, within budget, that look great, and delivered on time!

Get 5 Prototypes in 5 days for only $1000. This can include embossing and LEDs. Certain more complicated designs may be slightly higher in cost.

REQUEST A QUOTE TODAY!

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