Application and design of membrane switches

The membrane switch is a control panel that has proven itself over the years as a very reliable solution for, among other things, standalone applications. Membrane switches are also used in combination with other operating techniques, such as resistive or capacitive touch screens. The switch is easy to apply and because of the adhesive layer on the back relatively easy to apply on a housing. The membrane switch comes in many shapes, sizes and surface-mounting variant.

Silkscreen
The printing of the membrane switches is done by screen printing:
The first print run is the conductive silver ink for the electrical circuit.
The second print run is graphite, which prevents the contacts wearing off on both the cable end and the keys.
For the final print run, an insulating layer is applied over the entire electrical circuit, with the exception of the contact surfaces, to protect it from external influences. Above this electrical circuit, a graphic film is applied using a screen printing technique, provided with images and colours.
When there is too little space or when the keys are in a matrix arrangement, tracks will have to cross over each other. This will be realised with a crossover. These crossovers are also made by using screen printing inks and have a low height so that the circuit remains relatively flat.
The circuit of a membrane switch is printed on polyester film with a thickness of 0.125 mm. After printing, the film is cut out by laser processing. A cable connected to a membrane switch can technically have any shape and/or size.

Design process
Usually a design engineer makes a layout of the front foil with the key positions and possible display recesses. Customer logos and colour schemes are also discussed and recorded. Based on this information, the producer’s engineer gets to work. The information is delivered as a PDF file, which is edited with the Adobe Illustrator drawing package.
Embossing possibilities

There are various options for the choice of key elevation (also called embossing) on the keys. The choice consists of edge-embossing, flat-embossing and dome-embossing. Dome-embossing must be carried out using a brass embossing stamp, while flat and edge embossing can also be carried out using a plastic embossing stamp.

With a plastic embossing stamp, a tolerance of +/-0.2mm at the height of the embossing must be taken into account. While with a brass embossing stamp, a height tolerance of +/-0.1 is feasible. Not every height of an embossing is possible. Heights of 0.3mm are standard. If a higher height has to be met, a higher embossing time is required. This will increase the cost price. Angular and sharp corners should be avoided as much as possible in an embossing, because in these places the film tends to tear and screen printing ink will break quickly in these places. The cost price of a plastic embossing stamp is about 1/3 of a brass version. In a plastic embossing, only one embossing height can be achieved, while in a brass embossing stamp, different heights are possible. Brass tools are well suited for higher and more complex runs where plastic tools are more suitable for smaller runs.

Displaywindow

The membrane switch also has a display window. It is preferable to use an anti-reflective polyester material (EBA) as a front foil. It is almost always coated with textured lacquer on the front. The textured lacquer gives the product a more matt look and the display is saved for a good transparent view. Embossing is normally not coated with textured lacquer to prevent ink breakage.

Cable

Often the cable position has already been determined by the client. It is important to know that a cable output (the position where the cable leaves the membrane switch) cannot be at a key or led position. This is due to the fact that the circuit is printed on a polyester film by means of screen printing. Preferably the centre of the cable should come at least 5mm out of the cutting edge of the membrane switch. If an IP67 value is applicable, this distance should be at least 7mm due to the waterproofness of the membrane switch.

Technically, the cables can have any shape and length. The limitations are: the increasing resistance values for long cables and the maximum length of the printing format in the screen printing machine. The cable end is adapted to the connector used on the PCB. Common cable ends have a pitch of 1.0, 1.25 or 2.54 mm. It is also important to consult the connector specifications on the cable thickness required to secure the cable in the connector.
• Is the membrane switch used at high temperatures with high humidity (tropics fixed)?
• Do special EMC requirements apply?
• Which IP value must the membrane switch meet (dust and water tightness)?
• Is double key operation required?
• Is the surface on which the diaphragm switch is mounted flat or curved?
• Is a window (glass or plastic) or a touchscreen mounted in the membrane switch?
• Are the keys equipped with a metal clicker or only with screen pushbuttons?
• Does foot control or metal object control apply?
• Is there a requirement for maximum weather resistance value of the keys? (cable length and track width)
• Are there other special SMD components?
• Is the membrane switch fitted to the housing by the customer or manufacturer?

SMD-components
When using SMD LEDs, it will always be necessary to assess whether they are suitable for use in a membrane switch. The standard height of the LEDs and other SMD components cannot exceed 0.7 mm. If the components are higher than 0.7 mm, an extra electrical circuit will have to be applied, which increases the cost price. The footprint of the components cannot be smaller than the 0603 SMD footprint.

Applying on housing
If the membrane switch is installed on the housing by the customer, a flat surface is required. During the installation of the membrane switch on the housing, the metal clickers cannot pass through their zero point, because the clicker can then fail. Only gold-plated clickers are used to ensure good guidance and contact when pressing the key.

The membrane switch is a proven application for many applications, performed by standalone machines that require limited electrical control. The switch comes in many shapes, sizes and body variants and is always developed as customer-specific. The input of the client is essential.

References / Downloads
• Specifications
• Technology sheet
• Flyer
• Landingpage

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