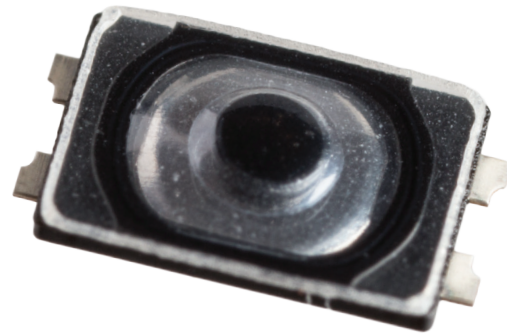


Improving Tactile Switch Actuation and Lifecycle

Advanced manufacturing methods have created new switch designs that set themselves apart from the pack



Many of us press tactile switches dozens of times every day and never think twice about them—as long as they work. Yet an unresponsive switch or one with the wrong force characteristics will get plenty of attention. And none of that attention will be positive. Though they seem like minor components on a smartphone, automotive dashboard or other consumer electronic device, tactile switches have the ability to influence perceptions of quality. True or not, a bad switch equals a bad device in the minds of many consumers.

So selecting the right switch really can be crucial if you want to avoid the possibility of a quality black eye. But what exactly makes a tactile switch right for the job? For one thing, it needs actuation force and deflection characteristics that meet the application requirements. For another, it has to work reliably for the life of the electronic device.

Many engineers wrongly think of switches as commodity items that can be selected straight off a datasheet. In reality, though, picking a durable switch with the right feel requires more than a look at its specs. Here's what to look for:

DIALING IN ACTUATION CHARACTERISTICS

One of the first things to understand about tactile switches is the value and limitations of actuation force specifications.

CLICK RATIO

$$(F_{ACT} - F_{CLI}) / F_{ACT} \times 100$$

Where:

F_{ACT} = Actuation Force F_{CLI} = Click Point Force

All tactile switches have actuation force characteristics that can be boiled down into a click ratio that expresses the relationship of the switch's actuation and contact forces. A higher ratio indicates a crisper or snappier switch feel. The travel distance, or deflection, of a pressed switch also contributes to its overall feel.

Force and travel specifications, which you can typically find on a datasheet, can be a good starting point in your search for a switch that "feels right" in its intended applications. Keep in mind, though, that the ideal switch feel will change with the application.

For example, portable consumer electronic devices will typically require crisp tactile switches with relatively high click ratios and shorter travel distances.

Light Touch Switch Feel

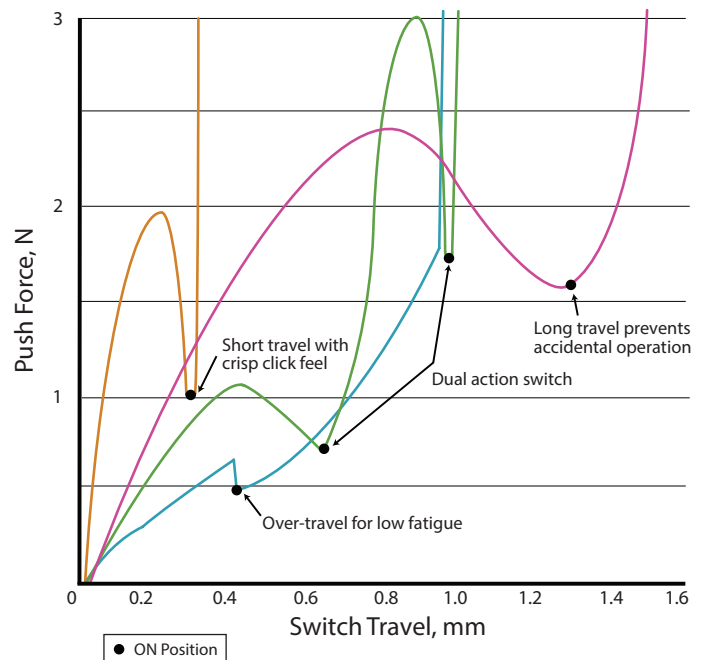


Figure 1

Automotive tactile switches, by contrast, tend to have lower click ratios and longer travel distances to prevent accidental actuation while driving. In general, each electronics application needs to strike a different balance between actuation forces and travel distance (see Figure 1).

Dialing in on the best switch feel for your application should always start with a careful review of force and travel specifications, but specs will only get you so far. In fact, one of the most common engineering mistakes is trying to select a tactile switch based solely on its specifications without considering its subjective feel in a

physical device. A better selection methodology uses the specs to narrow down your tactile switch choices to a few candidates. Then sample those candidates in your device or prototype to find the one that truly has the right switch feel.

With Tactile Switches, always try before you buy.

IMPROVING RELIABILITY

A nice switch feel won't matter much if the switch doesn't work reliably for the life of the device.

A NEW WAY TO SEAL TACTILE SWITCHES

Tactile switches for consumer electronics and medical applications increasingly require IP 67 protection against the ingress of liquids and other contaminants. And that's a good thing since sealed tactile switches will have a much better chance of reaching their maximum lifecycle.

Traditionally, an adhesively bonded silicone membrane has been used to seal the switch (see Figure 2). Panasonic's new manufacturing method for IP 67 tactile switches uses a patented laser welding process to seal the switches with a thin nylon film that goes over the actuator, rather than under it (See Figure 5).

This new method offers a couple of advantages over the silicone membrane:

- **Preserves crisp switch feel.** The laser welded nylon film has only a negligible affect on actuation force and click ratio. To take one example, the click ratio changed from 70.15% without the laser welded film to 68.28% with it—for a minor two percent change (See Figure 4).
- **Protects against side loads.** Placing the thin film over the actuator has the side benefit of offering some protection against side loads, which helps prevent damage to the switch.

Traditional membrane construction leaves the actuator exposed to damage from side loads.

The laser welding process is available on a variety of Panasonic Light Tough Tactile Switches. **For more information visit, na.industrial.panasonic.com/products/electromechanical/switches.**

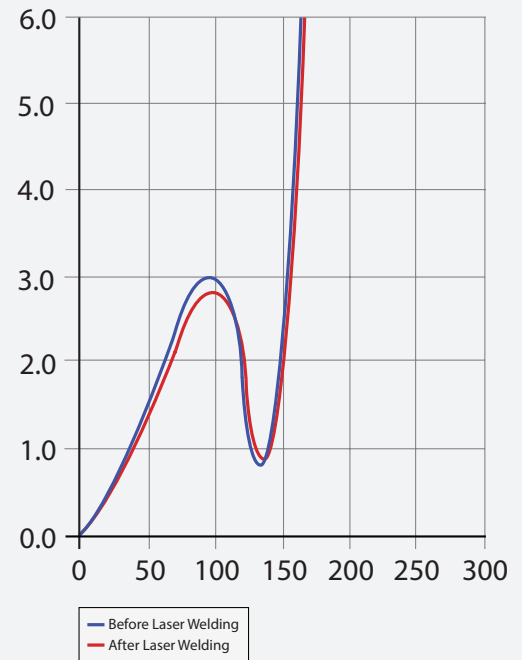


Figure 4

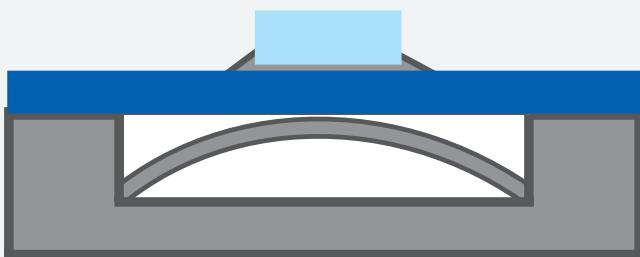


Figure 2

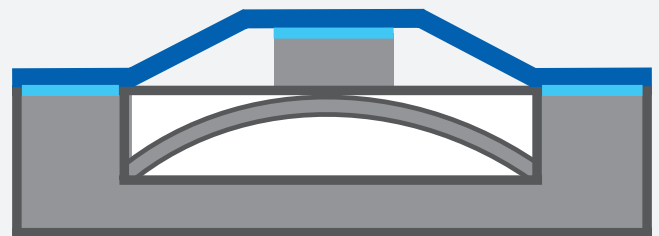


Figure 3

The best switches will typically offer a life expectancy measured from 100,000 to more than a million press-and-release cycles. Like force and travel specifications, the predicted lifecycle for every switch is readily available on its datasheet.

Whether that switch reaches that lifecycle is another question. Tactile switches vary widely in their manufacturing quality and in their protection against liquids and other contaminants.

Since ingress of contaminants represents a key failure mode for switches, tactile switches for consumer and automotive applications increasingly need to meet IP 67 standards for protection against dust and liquid infiltration. Today's wearable devices, for instance, nearly always require IP 67 tactile switches that withstand some exposure to sun screen, lotion and water.

Protecting tactile switches to IP 67 levels goes a long way to improving their lifespan, but there are typically trade-offs. Most suppliers implement IP 67 by adhesively bonding a silicone elastomeric membrane to the switch—between its interior metal dome and the exterior actuator button (See Figure 2).

This arrangement effectively seals the switch, but the silicone makes the switch feel less crisp. If you compare two tactile switches with identical push forces, one with and one without the IP 67 membrane, the switch with the membrane will usually feel a bit spongy. The membrane approach to sealing switches also leaves the actuator at the top of the switch, exposing it to side loads, which can be another point of failure for tactile switches.

The longevity provided by IP 67 typically outweighs the tradeoffs in switch feel, even with increased exposure to side loads. Yet it's important to be aware of these tradeoffs when selecting tactile switches with a silicone membrane, especially if you're trying to optimize for switch feel.

Another approach to sealing switches to IP 67 levels has emerged over the last year. Rather than bond a silicone membrane under the actuator, this new patented method laser welds a nylon-based thin film over the actuator (See Figure 3). The new method has a clear edge over the traditional membrane construction when it comes to switch feel and protection from loads. (See sidebar, A New Way To Seal Tactile Switches.)

Whatever type of sealed switch you select, it's important to realize that IP 67 rating does not mean that the switch is hermetically sealed all the way to the board. Nor does it mean the switch can go through a board washing process.

Laser Welding Process

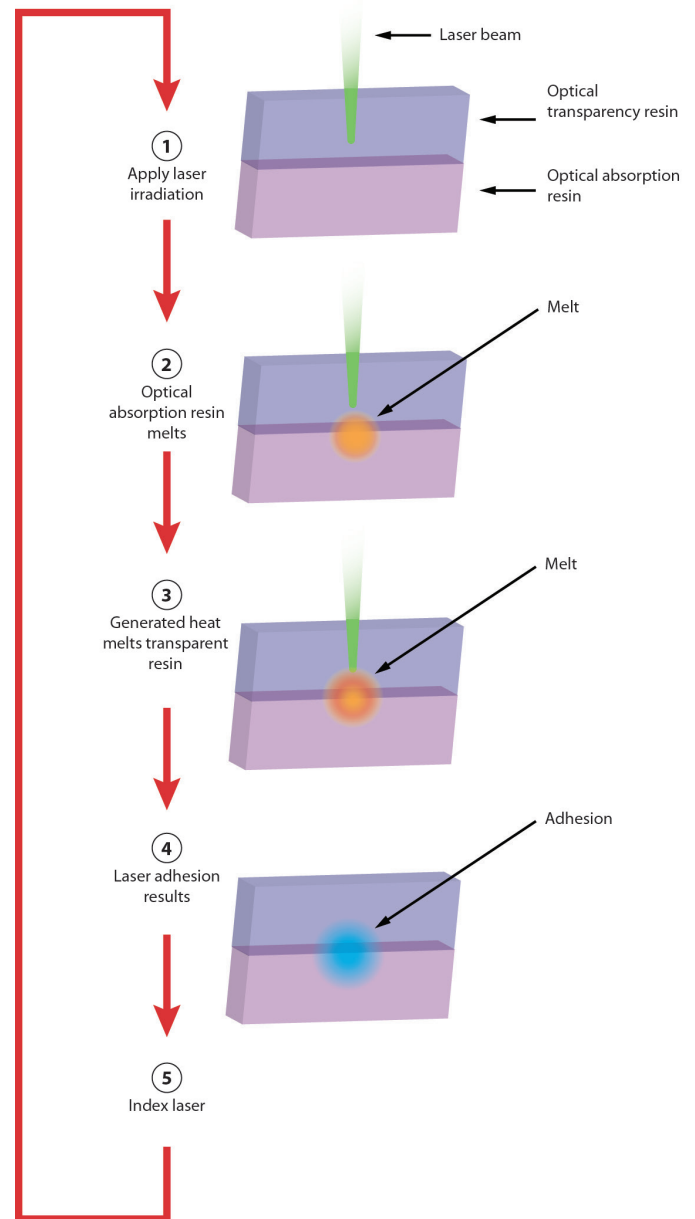


Figure 5

A proprietary laser process (US Patent 8835787) permanently welds a nylon-based thin film over the actuator.

With those caveats in mind, though, IP 67 switches will typically last longer in the field. And if you pick them carefully, these switches can protect without sacrificing switch feel.

For more information on Panasonic Tactile Switches, visit: na.industrial.panasonic.com/products/electromechanical/switches