control design

ESSENTIALS OF
ROBUST PIEZO SWITCHES

A Control Design Essentials Guide, by the editors of *Control Design*

About the Control Design Essentials Series

The mission of the Control Design Essentials series is to provide industrial machinery designers with an up-to-date, top-level understanding of a range of key machine automation topics. Our intent is to present essential engineering concepts in a practical, non-commercial fashion, together with a review of the latest technology and marketplace drivers—all in a form factor well suited for onscreen consumption. Check in at ControlDesign.com/Essentials for other installments in the series.

—The Control Design Editorial Team

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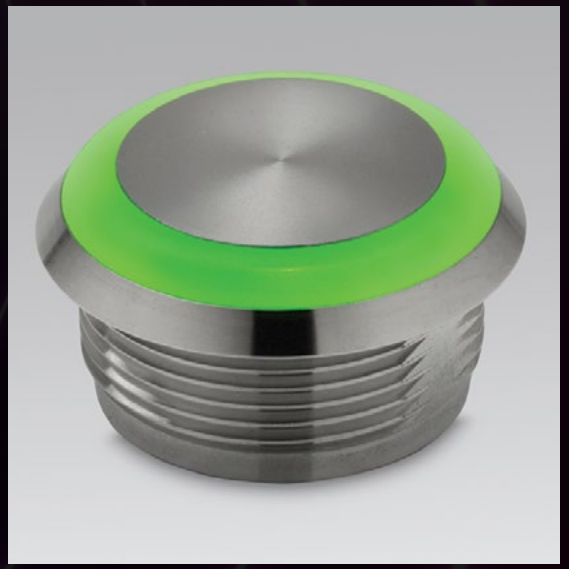
STATE-OF-THE-ART PIEZO SWITCHES

Pushbutton switches are a timeless part of most past, present and future industrial control systems. They are available in many configurations and sizes, but few switches are as robust and reliable as piezo switches. By design, these piezo switches can meet the demands of the toughest applications where conventional pushbuttons don't work well or don't work at all.

From power washdowns and chemical cleanings to submerging and freezing, piezo switches easily exceed the limits of conventional pushbuttons, operating effectively in the most demanding environments. Even covered in milk, oil, grease, sludge, molasses or bacteria, these solid-state pushbuttons provide reliable electrical and mechanical performance.

The conventional pushbutton switch is a mechanism that opens or closes an electrical circuit when pressed by a user. The external button physically operates the mechanical spring and switch contacts that are typically sealed inside an enclosure or electrical cabinet. Capacitive switches require little more than a zero-force human touch, but adding other materials to the touch, such as fluids, clothing, rags, gloves, metal, debris and electrical noise to the mix, may complicate switch actuation. For challenging applications, a piezo switch's design and technology turns a small touch force into a very reliable signaling method.



SOLID PERFORMANCE OF PIEZO SWITCHES

Piezo switches are designed for demanding applications where reliability is a must. The design is basically a stainless-steel cylinder with a solid-state output. The piezo switches don't provide mechanical feedback. However, when pressed with force of about a 1/4 lb or more by a finger, a gloved hand or an elbow, the device momentarily conducts a typical 24VAC/DC signal up to 1A. The mostly solid-state piezo switch, with no moving parts, is extremely durable over the long term (> 50 million cycles).

The switch's one-piece construction also provides exceptional protection for use in even the most extreme environments. The pressed surface is simply flat metal and completely sealed, protecting the device from high-pressure water spray/steam cleaning (IP69K) and continuous immersion (IP68). Not only does this prevent ingress of liquids and other contaminates, its short, uni-body metal construction and smooth surface is easily cleaned.

These piezo switches handle a wide temperature range (-40 °C to + 75 °C) and are rugged enough to stand up to corrosion, outside, in the rain or the most extreme environment.

TECHNOLOGY BEHIND PIEZO SWITCHES

As the name suggests, piezo switches are based on the piezoelectric effect—electricity from pressure. At the heart of the effect is the piezo element, which converts force or pressure, such as a push or knock, or vibration to voltage for use in switches and other sensors. Conversely, it can also convert voltage to vibration for use in alarm horns and buzzers, sounding various tones and beeps.

In a piezo switch, the piezo element is adhered inside of a machined metal housing approximately 0.015 inches from the top surface (activation surface) of the housing (switch body). When the switch activation surface is pressed, it transfers the applied force to the piezo element which produces a charge (voltage). This charge, generated in solid materials such as ceramics and crystals when mechanically stressed, turns on a semiconductor device such as a field effect transistor, activating the switch output.

Piezo elements generate only one pulse output per press, even if the pressing force is maintained. The output pulse duration depends on the switch's electronic circuit. Typically, the pulse's leading edge is generated by the rising edge of the push force, from zero to a few pounds. When the rising edge of the force disappears, either by removal of the force or by reaching a steady-state force, the output pulse's trailing edge drops down.

With the advancements in automation controllers, a simple momentary pulse to an input is all that is required to transmit a user's request to the control system, such as a PLC. The need for a maintained signal, dual contacts, tactile response or mushroom head in a push-button switch is not often needed, except with safety functions, such as an emergency stop.

Piezo switches often include a dot or ring LED embedded in or around the activation surface, which is used to indicate switch status. The LED is controlled by a separate PLC output and the program within the PLC. The program may make the LED stay on or flash until the next switch press or for a period of time.

SOLID PIEZO SWITCHING FOR THE TOUGHEST APPLICATIONS

Many applications can benefit by designing in or retrofitting a piezo switch. Switches made with 316L stainless steel material provide a robust design and ease of cleaning that make it a perfect fit for medical, food processing, commercial kitchen equipment, outdoor control, chemical plants and oil and gas industries. It's a metal switch with no moving parts capable of operating in extreme environments.

Focusing on food processing and medical industries, the sleek, smooth switch surface provides a hygienic design. The lack of button operators or caps prevents ingress of foreign objects for food safety. The sleek design also prevents bacteria buildup, and it keeps debris from interfering with switch activation.

In the food-processing industry, switches are essentially submerged due to food safety and clean-in-place requirements. Commercial kitchens often sterilize switches used in beverage dispensing, bump bar and steamer equipment. These are all applications that benefit from the use of piezo switches. The same is true for applications requiring control switches in extremely hazardous environments such as chemical plants and oil and gas.

Labs, clean rooms, luxury appliances, military vehicle systems, correction facilities and emergency call boxes are just some of the many other areas a piezo switch functions well. From sleek and sanitary control functions to harsh and demanding applications in vandal-prone areas and mass transit systems, the use of a piezo switch ensures long life, ease of cleaning, excellent environmental protection rating and high temperature capability. It provides solid performance in just about any application.

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Start here to learn more about IDEC piezo switches for food, beverage, oil and gas, and many other processing and industrial automation applications.

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