

# Rarely Asked Questions

Strange but true stories from the call logs of Analog Devices



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## CAPACITIVE SENSORS: Rugged Enough for the Real World?

**Q.** I've seen cap sensors used in consumer electronics, but are they rugged enough to function in a harsh industrial environment?

**A.** The answer is an emphatic yes! Capacitive sensors are already used for industrial precision measurement of pressure, proximity, position and liquid levels. Capacitive sensors are rapidly replacing switches, buttons, scroll bars and jog wheels as the preferred choice for human to machine interface in industrial and consumer applications.

Capacitive sensor IC's work essentially by detecting changes in an electric field between a set of pads. The electric field is generated by the capacitive sensor. Changes in the field are caused when an object passes through the field. The electric field fluctuations are proportional to changes in capacitance. A capacitance-to-digital converter (CDC) processes the change in capacitance and provides a digital output, which can then be connected to a microcontroller or other digital interface. Since the sensors have no moving mechanical parts, they are inherently more reliable than their earlier mechanical predecessors.

In rugged industrial applications that require a control device to tolerate sustained exposure to conditions such as wide swings in temperature, humidity, dirt, electrostatic discharge (ESD), accidental spills, or prolonged exposure to moisture, capacitive sensors excel. Capacitive sensors also provide the user with the ability to select the right "tactile feel" for control device in the industrial setting.

The capacitive sensor pads are covered by a thin layer of protective plastic. The pads are therefore impervious to dirt and liquid infiltration. The plastic thickness can vary depending on the application. For these situations the sensor can be tuned to compensate for variations in the plastic thickness. This is especially



important in "wet" applications or where the sensor pad may be subjected to frequent exposure to liquids, moisture and cleansing agents. The protective plastic barrier also helps augment the sensors on-chip ESD protection.

In addition to being durable, capacitive sensors can be made to automatically adapt to their local environment. Some of the newer devices feature an Adaptive Environmental Compensation (AEC) algorithm, which continuously monitors the capacitance level of the sensor and compensates for any variations in ambient temperature, humidity and even degradation of the sensors dielectric material over time. The AEC helps ensure accurate and reliable operation no matter what the local environment is.

So, next time your design calls for a switch, button, scroll bar, jog wheel, or the need to make precision measurements, rest assured that there is a capacitive sensor that can handle the task. Capacitive sensors provide a smart and rugged alternative to traditional choices.

**To learn more about Capacitive Sensors**  
 Go to: <http://rbi.ims.ca/5698-100>

**Have a question involving a perplexing or unusual analog problem? Submit your question to:**

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