Azoteq

World Leader in Capacitive Proximity Sensing

A Standards-Based Approach to Capacitive-Sensor EMC Problems

By J.D. van Wyk, M. Visser, and D.B. Rademeyer

Capacitive sensing is a highly accurate analog measurement process that detects changes in capacitance on the order of 10^{-15} to 10^{-12} Farads and is supported by extensive digital signal processing.

If it was feasible to position sensing ICs extremely close to sensing electrodes, noise would not be a problem. Alas, that's not the case. In most real-life capacitive sensing applications, a fair distance (a few mm's – cm's) exist between a sensing electrode and the IC.

Given the extremely small capacitance changes measured, it is no surprise that noise can wreak havoc if allowed to couple in between electrode and IC.

Noise can cause digital data corruption via illegal bit detections or timing anomalies.

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Articles

To enable next generation capacitive user interfaces and intelligent switch applications for users to interact naturally with products through capacitive proximity and touch

About Mutual Capacitance

Projected capacitance technology measures the change in capacitive coupling between two electrodes. The coupling between the electrodes is called "Mutual capacitance" / C_M and the electrodes are called the transmitter (Tx) and receiver (Rx).

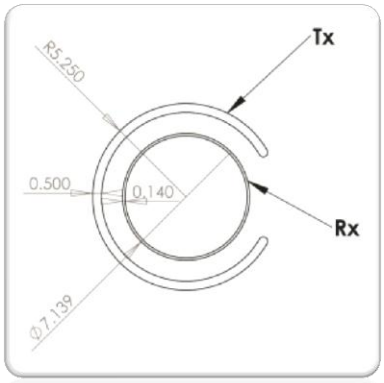
See the application note AZD008 for the differences between self-capacitance and projected capacitance technologies. In addition, how to relate the measured capacitance to charge transfers. For button layout design, see application note AZD036.

Projected Capacitance may yield a higher resolution response to touch and proximity events in applications where self-capacitance resolution suffers due to grounding (earth) effects which are beyond the control of the designer

Projected capacitance also requires fewer pins when applied to multi-channel IC solutions because buttons are multiplexed between pins.

Since projected capacitance is measured between two defined pins, in certain applications it is less susceptible to EMI.

One thing to keep in mind that whenever it is necessary to expose the mutual capacitance tracks to interference, it is generally better to expose the Tx track rather than the Rx track. This is dependent on the total copper area of the electrodes.



Ground Plane Distance

Even though Azoteq offers extreme capacitance measurement sensitivity, it is good practice to keep ground tracks in the vicinity of the touch as thin and as short as possible.

What is Parasitic Capacitance in a mutual capacitance system?

This is any mutual capacitance between the transmit and receive circuits that the user is unable to influence or that the user is able to unintentionally influence.

An example would be the capacitance caused due to transmit and receive tracks being close to each other outside the button area.

Clere Electronic Components Joins Azoteq's Expanding Representative Network

Clere Electronic Components Ltd has been appointed to represent Azoteq in the United Kingdom and Ireland as of April 1st, 2012.

Azoteq is represented in all the major US markets, central Europe and has an extensive Asian coverage.

Azoteq's ProxSense® offers the most sensitive capacitive sensing solutions with the highest signal to noise ratio (>1000:1) in the market today.

The high sensitivity enables proximity sensing up to 300 mm and the ability to implement touch solutions that can work through 20 mm cover materials.

"Azoteq partnered with Clere Electronic Components because they have more than 30 years of experience, an excellent team with vast experience and access to key customers", said Jean Viljoen, Azoteq's Marketing Manager for Europe and Asia.

"Clere Electronics is excited about the prospect of representing the ProxSense® portfolio" said Paul Bundy, Sales and Marketing Director at Clere. "Azoteq's innovation goes beyond the day to day solutions and this is what today's customer is looking for to differentiate himself."

Azoteq's ProxSense® offers the next generation of capacitive proximity and touch solutions. Proximity sensing enables new applications such as detecting when a user's hand approaches the product.

Features that can be implemented with proximity sensing include find-in-the-dark (enables backlight when hand approaches) and air gestures (wave hand to turn on/off, page and scroll).

The combination of proximity and touch presents the next evolution in user interfaces.

About Clere Electronic Components

Clere Electronics (www.clere.com) is an independent Distributor/Representative organization based in Kingsclere near Newbury in the southern part of England, serving primarily the UK and Ireland.

The company was started in 1978 and has developed into a specialist, technically focused organization dealing in franchised lines which generally require more than an off-the-shelf solution.

Their flexible approach enables them to offer customers the best solutions for their requirements, whether as a distributor to support lower volumes, prototype and development or as a representative for mass production needs.

Over the 30+ years they have developed all of the logistics and support systems required for today's market and are a registered ISO 9001:2008 supplier.

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But all is not lost. By following some basic principles, making use of sensing solutions with high signal-to-noise ratios (Azoteq offers industry leading 1000:1 SNR) and noise mitigation technology, it is possible to realize applications that will withstand all kinds of noisy abuse. This article will look at relevant EMC standards, noise threats, and what to do to achieve compliance for capacitive sensing applications.

Relevant Standards

Deciding which of the plethora of EMC standards apply to a given product or design can be confusing for the uninitiated. Even for people active in EMC, clarity is not always possible without a bit of effort.

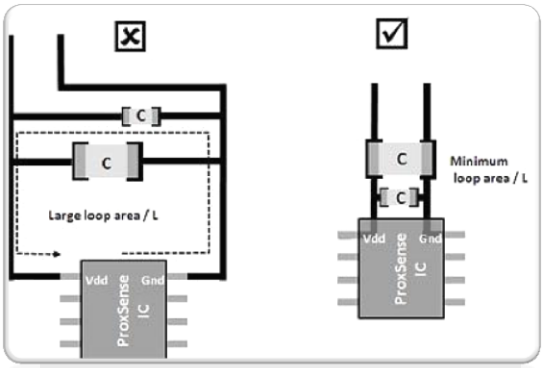
EMC standards can be split into two groups, generic and product-specific standards. Generic standards give general guidance on what is applicable and how to test for specific compliance. However, for a given family of products such as household appliances, committees for specific products determine what is required for compliance. Product-specific standards generally call upon or refer to the generic standard. Obviously, the number of product-specific standards is quite large. Therefore, we will review only generic standards.

For EMC, the most important considerations are: Does the Device Under Test (DUT) cause other devices or systems to malfunction, and does the DUT itself malfunction due to a lack of immunity to unintentionally received electromagnetic energy?

To determine whether the Device Under Test (DUT) cause other devices or systems to malfunction, we do emissions testing to determine the amount of energy radiated into the space around the DUT or conducted into the cables connecting the DUT to other devices and systems.

These emissions need to be less than the limit of the relevant EMC standard. Capacitive sensing ICs consume extremely little power, typically in the low µW range. Therefore, emissions by capacitive sensing applications are typically in the nW - mW range, and compliance is seldom a problem.

Full Article can be found on EE Times Design here.



Decoupling Capacitors

Proper decoupling of ICs is the first defense against radiated interference.

However, for a specific capacitor value a resonant point exists above which impedance increases again.

Therefore, use a range of capacitors placed as close as possible to the IC.

Feed and return path for the capacitors should have minimum inductance (Figure above).

Use 0402/ 0603 size 10pF, 100pF, 1nF, 100nF, and 1µF if cost/space is not constrained, and 100pF and 1µF if money and board space is tight.

Tips & Tricks
Mutual Capacitance Pad Layout

Here are some things to keep in mind designing a mutual capacitance button:

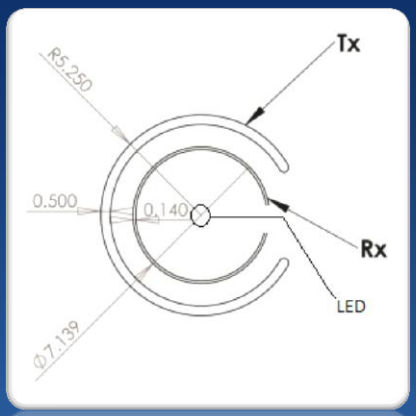
1. The Transmitter electrode (Tx) and the Receiver electrode (Rx) should never be physically connected, only close enough to couple with each other.

2. The Tx should be placed around the Rx.

3. You can design the Tx to be circular around a circular Rx.

4. Closely coupled Tx and Rx keys are good for touch, while loosely coupled Tx and Rx keys are good for proximity.

5. More can design layout tips can be found on Azoteq's website here.



Designing the mutual capacitance button like above allows you to place a LED to backlight your button on a single layer PCB.

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