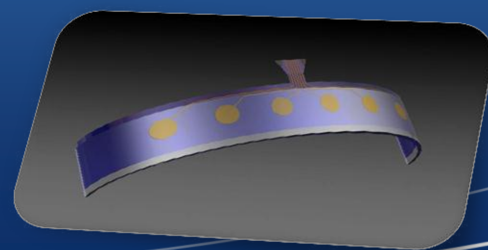
Azoteq

World Leader in Capacitive Proximity Sensing



Electrode design in capacitive touch sensor applications

By Dr. Cheok Thng, Chief Technologist at Locus/Azoteq

Introduction

Capacitive sensors work by detecting the change of capacitance introduced by the finger touching near the electrode. Such change is so small that detecting it unambiguously is challenging, and has become the primary task for the application design.

For the self-capacitive sensor, the sensor IC measures the capacitance of a sensor port with respect to the circuit ground. Two conductive plates are required, one connected to the sensor port and the other one to the circuit ground to form a capacitive transducer. So the ground plane is not just like a shield in the standard PCB layout design, but it is also an indispensable part of a two-plate capacitor.

Being the front end of the sensor, the electrode's ability pick up the signal from the finger has a direct and significant impact on the overall performance.

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Content

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

What is DYCAL and why is it Unique

DYCAL

Did you know that the IQS128 is widely used as the SAR compliance sensor for a large portion of the world's tablet computers?

DYCAL is Azoteq's answer to ensure correct operation in cases of environmental drift during user activation.

DYCAL dynamically calibrates the touch and release thresholds and places a high priority on successful sensor de-activation.

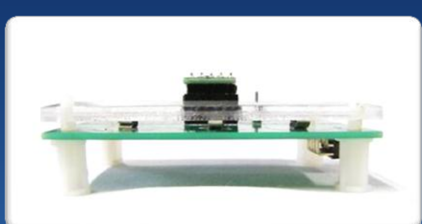
The patented algorithm addresses the problem of a "stuck-key" in situations where long periods of sensor activations are expected.

With DYCAL the chances of getting stuck in an activation is practically eliminated.

Where DYCAL can be used:

- SAR compliancy sensors
- On-ear detection (mobile phones - LCD activation/deactivation)
- Digital cameras (Viewfinder/LCD switching)
- Occupancy sensors
- Auto ON/OFF 3D glasses, headphones
- High risk equipment (power cut-off on release)

Which Devices are DYCAL Available on?



DYCAL is available on different devices to suit your needs!

	Standalone	1wire	I2C	Self Capacitance	Projected Capacitance
IQS128	•	•		•	
IQS142	•	•		•	
IQS152	•	•			•
IQS242	•		• (stream)	•	
IQS252	•	•			•
IQS253			•	•	•

Page 1 Continued

Basic principle

The reason an external object would increase the capacitance of the transducer, is that the electric field projected from the transducer polarizes the object, and the polarized charges in return attract more charges from the source to join the transducer (see Figure 1). The increase in the charge storage on the electrodes means the increase in the capacitance.

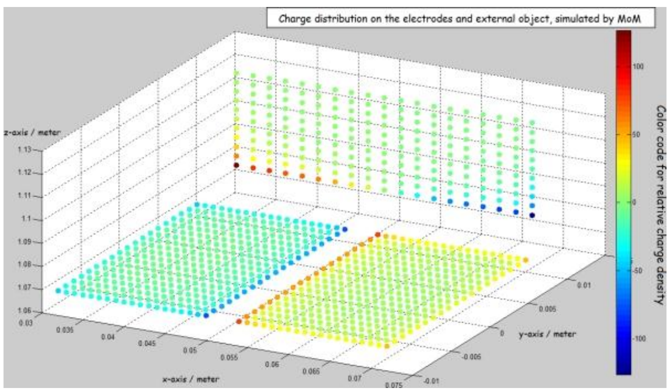


Figure 1: Charge distribution on the electrodes (horizontal plates) and the external object (vertical plate), as simulated by Method of Moment. The polarization on the vertical plate is x10 to enhance visibility).

The capacitance is more sensitive to the external object, if the electric field is projected more into the air to reach the object. The electric-field projection or distribution depends of the transducer's layout design, and therefore the layout design has a direct effect on the transducer's sensitivity.

In the classic parallel plate capacitor, the electric field is so confined in between the plates that the capacitance could hardly be influenced by the external object. This means that a touch pad directly above the ground plane is a poor capacitive transducer.

When the plates are shifted apart from overlapping, more electric field will project into the air, and the capacitance will be more sensitive to the finger's influence.

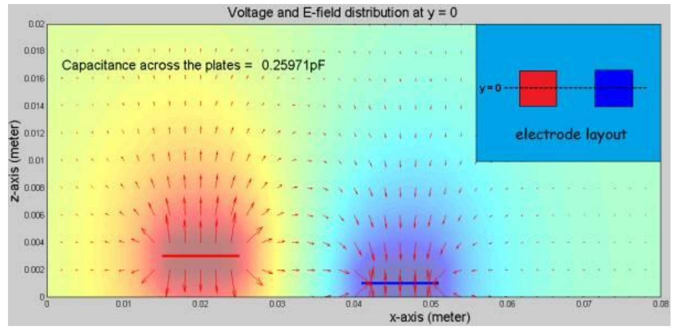


Figure 2: Non-overlapping plates project electric field into the air, result in higher sensitivity. (Simulated by Method of Moment).

In a simulation for a pair of shifted electrodes with equal size, the change of capacitance due to a finger 2mm above the touch pad is as much as 31%, an amount that is unambiguous to the sensor IC. But when the finger moves to the ground plane, 2mm above, the same amount of signal can also be read. With similar signal levels, the sensor IC cannot differentiate the touch on the touch-pad, from the touch on the ground plane.

Methods to control sensitivity of electrodes

As the objective is to make the touch-pad the only sensing port, methods to sensitize the touch pad, and to desensitize the ground plane is very much needed.

One common method is by putting the touch pad closer to the user, and hiding the ground plane deeper inside the housing.

Another method which is the centre piece of this article is by having a bigger ground plane compared to the touch pad….

Full article can be found on EDN here. The video on this subject can be found here.

How to Deal with Curved Surfaces

When dealing with incorporating capacitive touch into new projects, you do not always have the luxury of having a flat surface. Here are some ways to deal with curved surfaces or areas away from your PCB layer:

Conductive rubber can be used to easily and reliably interface standard PCB touch-keys to a curved surface;

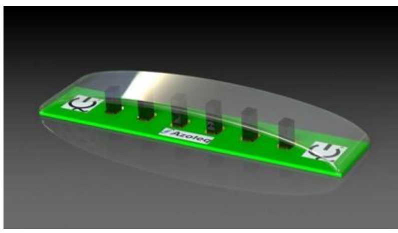


Figure 1: Use of conductive rubber

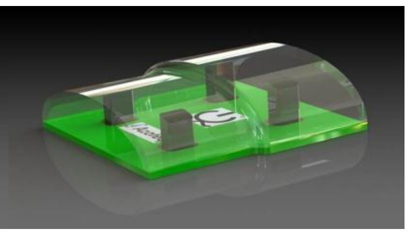


Figure 2: Conductive rubber pillars can also be applied to applications with a curved surface that includes variations in level

A PCB with a thickness of 0.2 mm can be used as an inexpensive alternative to interface touch-keys to a curved surface such as the arc in the figure; however the disadvantage here is that it has limited flexibility before brittle fracture occurs.

Figure 3: Example of a PCB interface to touch keys

Utilizing flexible printed circuits (FPCs) is a very effective method to custom design touch-keys for attachment to non-uniform surfaces, however FPC design and manufacturing is a much more expensive process.

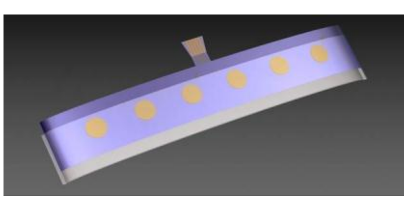


Figure 4: Example of touch buttons on a FPC

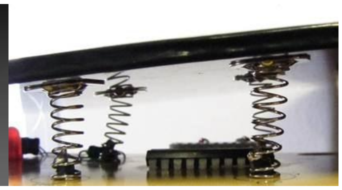
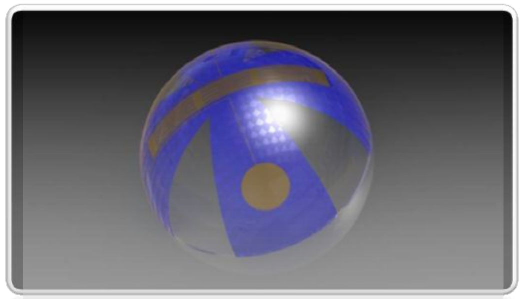


Figure 5: Simple helical springs soldered to a PCB pad is a common way to deal with this problem



Flexible Printed Circuits (FPCs)

Utilizing flexible printed circuits which curve on 2 axes, a 3D touch interface can easily be created

For more information on dealing with curved surfaces, please contact your local Sales office

Using Azoteq's ProxSense® in Windows 8 applications

With Windows 8 on the horizon to come out in October, there are some things that you can do to help you navigate through the new Operating System.

One such product that you can make easily using Azoteq's ProxSense® is a proximity sensor to bring up the Windows 8 Charms bar or other menu options.

The IQS127 or IQS128 would be a great fit for a project needing only proximity.

Let Azoteq help you with all of your Capacitive Proximity and Touch needs!

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