Design Guidelines
IQ Switch® - ProxSense® Series
Design Guidelines

This design guideline aids designers with the easy integration of ProxSense® technology to new and existing designs. The guideline will give general recommendations for a quick-start design with easy referencing using FAQ. The design guidelines are for surface capacitance specifically, for projected capacitance guidelines, please refer to Application Note: AZD036.

Overview

What are the benefits of adding capacitive touch pads to a design?

It is purely aimed at replacing most mechanical pads without significant added costs. Mechanical deterioration of push-buttons over time is no longer a problem, yielding a more reliable solution. Furthermore, an aesthetic value is added to a design, leaving it with a sleek professional finish.

Why add proximity detection (AirButton®) to a design?

The ability to detect the proximity of a user to a device not only adds powerful functionality but also adds that 'WOW' factor to a design. The irony in this is that when implementing a capacitive sensor for touch input, the proximity feature can be implemented for almost no added cost. Azoteq's ProxSense® technology is able to detect very small (Fempto-Farad [fF] range) changes in the capacitance of an environment making the design around sensors important for proximity detection applications.

Proximity detection is very important in handheld battery applications, for power consumption, where the screen / MCU can wake-up from a proximity event.

- The LCD screen of music players / mobile phones remain OFF as long as it does not detect a user proximity; or
- The screen of a phone can be switched OFF once it detects a users' ear again saving valuable battery power.
- A mouse can be woken from a sleep state to continue communication with a computer once it detects a user.

The screen of non-battery applications could also be woken by a user for example a microwave oven or refrigerator.

Water faucets can actuate with the presence of a user or a table lamp can turn on with the wave of a hand.

Security alarms can be activated once an unauthorized entry is detected either in a window pane or on a door handle.

Navigation devices / tablets / e-readers can display a hidden menu / buttons on a touch screen, enabling larger viewing capacity with no user in the detection distance.

Azoteq holds the patent to "Trigger a GUI on a proximity event" and all this can happen preemptively (before user touches device)

What factors are the most important when designing a capacitive touch or proximity sensor?

The four most important factors to consider when designing with capacitive sensing technology is:

- Substrate thickness (thicker is better) – material on which pad/button is placed
- Pad/button size (bigger is better)
- Thickness of overlay (thinner is better) – material between user and pad/button
- Trace length to pad (shorter is better)

Possible questions regarding above mentioned factors will be addressed in this document.

Substrate

What is an electrode substrate?

The material on which the key electrodes are placed is called the substrate. The electrodes should be electrically conductive and in contact with the substrate material.

What substrate is best suited for a design and what thickness should it be?

Substrates include:

FR1 (CEM-1 or single sided PCB): Punch-able (unlike FR4, which must be routed). Lowest cost solution. This single sided PCB has traces and pads on one side and the PCB can thus be used as overlay material with the sense fields being projected back through the PCB. Alternatively, an overlay can be attached to the unpopulated side of the PCB.

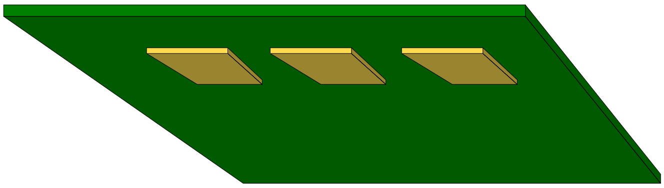

Figure 1.1 Single sided PCB.

FR4 (CEM-3 or double sided version of CEM-1) material PCBs: FR4 is 2 sided version of CEM-1, which is mostly known in Asia. Low cost. CEM-3 or FR4 can have traces and pads on either sides giving the designer more options in the design and layout. There are advantages to having the substrate thin (0.2mm), for example making it flexible. However, having it thicker (1.6mm or more) allows the designer to shield the sensor pads with GND (preferable a hatched pour) from the back. Increasing the thickness between GND and CX will reduce the parasitic capacitance, and allow longer proximity detection range.

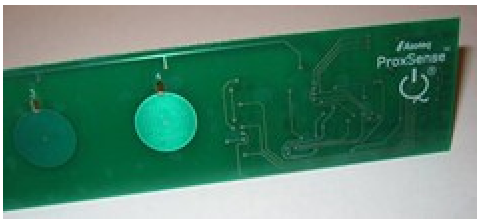

Figure 1.2 CEM-3 or FR4 Type PCB.

Flex-circuit PCBs: Pure flex-circuit PCBs can be used, which is flexible high-performance plastic substrates, such as polyimide and PEEK film. Flex-circuits can also be screen printed silver circuits on polyester which is less expensive. Care should be taken when designing double sided, and parasitic loads behind sensor lines will be high due to the very low thickness of the substrate.

Figure 1.3 Touch Pads on Flex-circuit with tail connector

ITO on glass: ITO (Indium Tin Oxide) is an electrically conductive and optically transparent material. It can be used for applications requiring clear electrodes used over small displays. ITO can also be used on PET films that can be etched into different electrode shapes. It should be noted that ITO is a resistive material, and if used in long thin traces can have a very high resistivity, which is unwanted for capacitive sensors.

Figure 1.4 ITO on PET film.

Print on glass: PCB circuits can be printed directly onto glass. This is normally only a single sided solution. This reduces an overlay material, bonding material (PCB to overlay) and PCB into a single package. These solutions are also normally very aesthetically pleasing.

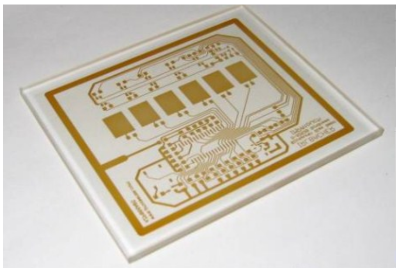

Figure 1.5 Touch Pads printed on glass.

In some cases no substrate is require, and the Touchpads can be made by placing conductive material directly onto the overlay. This could be done with conductive tape (copper tape / metal foil) or spring contacts.

Pads & Routing

What is: a button / pad / sense antenna / touch pad / touch key / electrode/ sense electrode?

All of the above can refer to a conductive electrode fixed to a substrate material (for mechanical strength) and used for capacitive measurement. Touch pads with lower resistivity will yield more sensitivity.

What size and shape can the pads be?

Although some shapes are better than others (for example rounded instead of sharp corners) the shape of the touch pad (button) is not as important as the following 3 factors which mainly contribute to the sensitivity of a pad:

- The **area** of the pad (A)
- The **permittivity** or dielectric constant of the overlay material (ε_r)
- The **thickness** of the overlay (d)

These factors can be directly related to the capacitance equation:

$$C = \frac{\varepsilon_0 \varepsilon_r A}{d} \quad \text{.......................................(1)}$$

(ε_0 is the permittivity of air)

- A larger pad or electrode area has more sensitivity and allows better detection of user touches and proximity, where a smaller pad will have a poorer detection capability. Thus, if A (area of pad) is increased, the capacitance is increased (which directly relates to the sensitivity).
- Using an overlay with a higher relative permittivity (ε_r) will yield a more sensitive pad (more about this in "**What material is best suited to use as an overlay?**").
- Increasing the thickness (d) of the overlay will decrease the sensitivity of the pad.

General:

- The pad should preferably be the size of a small finger, which is about 6mm to 7mm in diameter, but a touch pad from as little as 5mm x 5mm can also be used, but will require a thin overlay and should be properly tested.
- Bigger pads are better
- Touch pads can be implemented with a round pad that has a 7mm diameter or with a 7mm x 7mm square pad. The size of such a pad should be sufficient to also detect user proximities.
- The pad size and overlay graphic does not have to be the same size. It is good design practice to have a larger pad behind the overlay, as sensitivity falls off at the edges of a pad.
- For proximity applications a single trace of a few centimetres (depending on proximity distance) can be used. Proper layout guidelines should be considered for optimal proximity distance. (More about this in "**What should I know about trace lengths and trace routing?**")

For self-capacitive sensing, bigger electrodes will give more sensitivity, and avoiding sharp corners that form concentrations in field lines will allow for thicker overlays. The figure below shows different electrode variations of the same design (for self-capacitive sensing) for different overlay thicknesses (in order of increasing sensitivity).

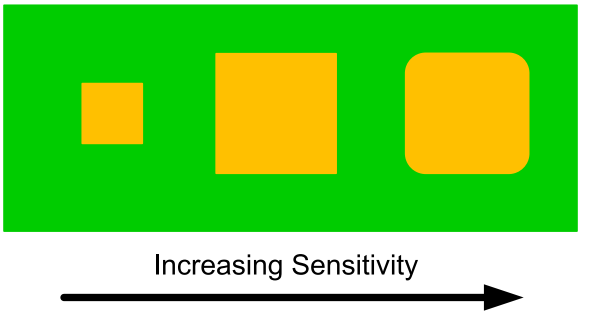

Figure 1.6 Self-capacitive buttons illustrated in order of increasing sensitivity by increasing the size of the electrode and removing sharp edges that form concentrations in field lines.

How close can the pads be to each other and other traces?

Pads adjacent to each other can either act as ground planes or cause interference (if not a multiple channel device), and if the distance between pads are not monitored, it will reduce the sensitivity of the system.

In most applications, the maximum sizes of the pads depend on the routing of the traces and adjacent pads. As a rule of thumb, the pads shouldn't be closer than double the overlay thickness from one another (edge to edge). Thus decreasing the pad size will increase the distance between adjacent pads.

This distance (and the distance to nearby traces) should be the maximum distance allowable for a design. This will have a very positive impact on the sensitivity of the system, and reduce the risk of false activation (triggering two buttons with one finger).

What is parasitic capacitance (C_P) and why is it bad?

Parasitic capacitances exist between electronic components or conducting objects because of their proximity to each other. Ground pours, traces, components or conductive housings can add C_P. Example:

- C_{P1} = between pad and component1
- C_{P2} = between Cx trace and component2

The capacitance between the hand and the pad (C_{HAND}) will increase as the hand approaches the pad (distance (d) reduces).

C_P is undesired in a capacitive application as it is added to the capacitance of a pad (C_{PAD}) to form $C_{ENVIRONMENT}$.

$C_{TOTAL} = C_{HAND} + C_{ENVIRONMENT}$, according to this formula, C_{HAND} will have a larger effect on the total capacitance if $C_{ENVIRONMENT}$ is smaller. C_{PAD} is fixed for a certain design, but the designer can decrease C_P by good design practices, which would dramatically increase system sensitivity.

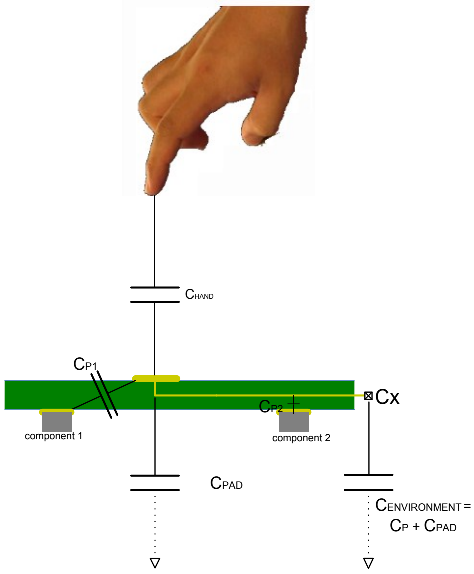

Figure 1.7 Parasitic Capacitance.

Although ProxSense devices can compensate for parasitic capacitance, having large ground areas close to the sensing area can still reduce proximity range by attracting the field lines.

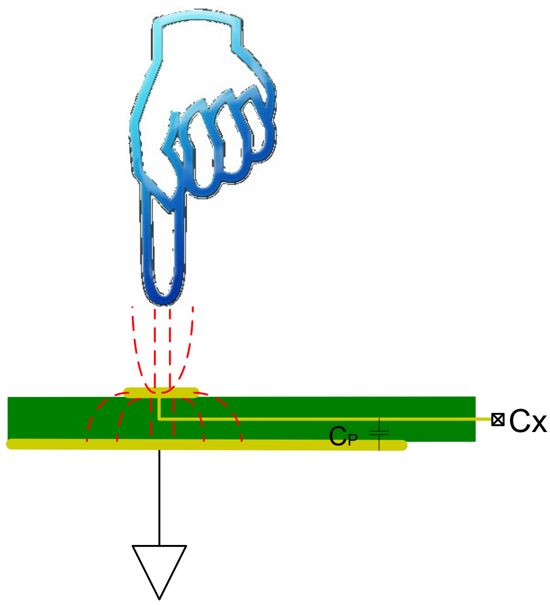

Figure 1.8 Ground planes below the sensing area will reduce proximity range.

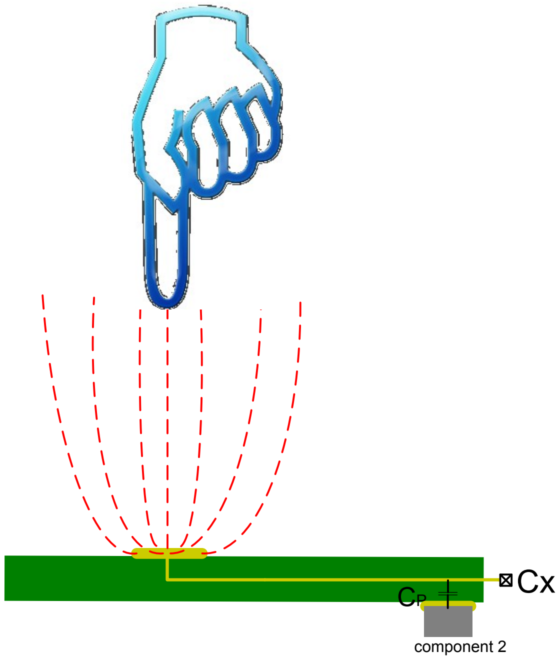

Figure 1.9 Proximity range will be longer than in Figure 1.8 even if the C_P and Cx pad area are the same.

Can a LED be placed in the center of a pad?

Yes. In many applications the touch pad is placed on the top of the PCB and a back-lighting LED is placed on the bottom layer (shining through the PCB). This LED is then able to provide feedback when the specific pad is touched or the LED can light up the pad with user proximity.

This will, however, add C_P to the pads. It should be considered whether the additional C_P added is acceptable, as this will significantly reduce proximity detection distance (especially in devices without the ATI function. See **"What is the 'ATI' technology?"** Extra C_P is however acceptable if only a touch detection is required.

It should be noted that LEDs' terminals can float if it is used in the open collector configuration as in the figure below. This can potentially cause a false detection or a stuck condition once the floating traces are given a potential. A capacitor (C_{FLOAT} ≥ **10nF**) should be placed on this node to prevent mentioned problem.

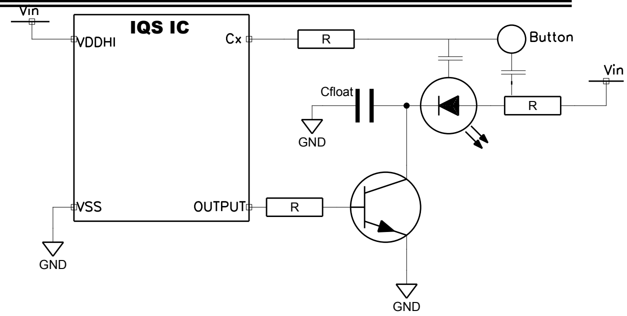

Figure 1.10 LED switching with transistor.

What should I know about trace lengths and trace routing?

After the mechanical constraints of a project has been fixed, the routing to and close to pads are probably the most important aspect over which the designer has control. Good routing and pad placement practices will greatly increase sensitivity and in turn proximity and touch detection ranges.

Pad traces (Cx lines)

Components: It is very important to place the R_{CX} (R_{RX} & R_{TX} for projected) resistor as close as possible to the IC. This will increase RF immunity. The supply capacitors on VDDHI & VREG should also be placed as close to the IC as possible.

Length & thickness: The trace length between pad and IC should be kept as short as possible. Trace thickness of 0.2mm is good, while thinner is better.

Placement: Routing to touch pads should be as short as possible, as this will reduce parasitic capacitance (C_P).

Vias: The jumps between layers should be kept as few as possible, as this induces unnecessary C_P which reduces sensitivity.

Routing to other pads or other components should not occur behind touch pads.

If possible: Place pads on TOP layer (pad closer to user). Route traces leading to pads on BOTTOM layer. Connect with via.

The touch pad traces should be properly spaced, as this will decrease coupling between sensors, and increase sensitivity (maximum allowable for design).

Preferably, routing should not be done between pads, as this can cause false touch detections, if the user were to accidentally touch these.

Try to keep the pads a minimum length of the overlay thickness (d) away from any trace or at least 5mm.

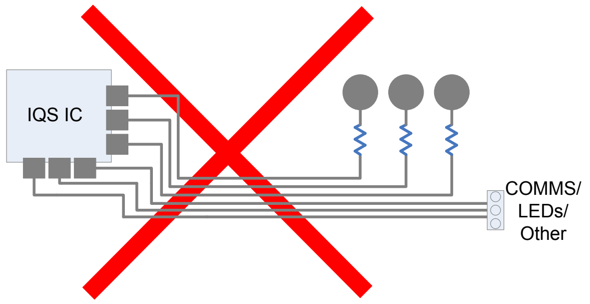

Figure 1.11 Bad layout.

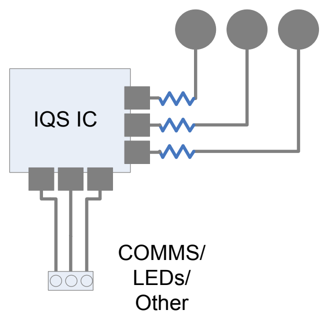

Figure 1.12 Good layout.

The figure above illustrates Good layout due to the shorter Cx traces, R_{CX} resistors are closer to the IC and Cx traces aren't parallel to COMMS or any other traces such as LED feed lines.

Example:

Pads placed on Top layer. Via connects to trace on Bottom layer. Traces routed as far as possible from pads. Some routing near the pads, which is for LEDs to indicate touch and proximity conditions. These traces should be kept to a minimum, and routed as far away as possible from the pad traces and pads. It would be ideal to have no other traces near the touch pads, but as in this example, it is not always possible. No other unnecessary traces routed directly behind pads.

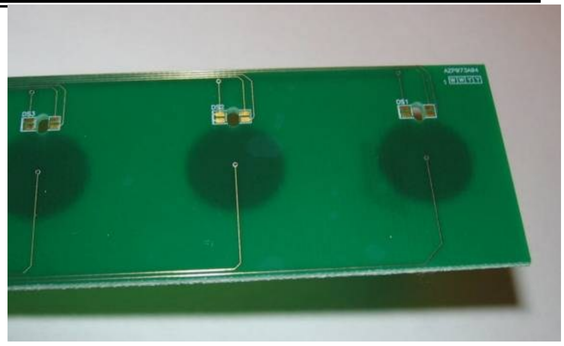

Figure 1.13 Example PCB.

What are the effects of 'floating pours' close to a pad?

'Floating pours' can be any electrical conductor not connected to a fixed potential or used as communication line.

'Floating pours' close to pads are highly undesirable. These pours can potentially build up charge due to electric fields being radiated (an electric field is present whenever a potential difference exist between two conducting elements). These pours could be sporadically discharged, causing a capacitance shift of the environment. This will be measured and will cause a false proximity event or stuck condition.

Floating pours near traces can pick up the emitted fields and re-radiate them, which could potentially cause strange behavior. Touching such floating conductors can also trigger false touch detections.

Floating pours should be connected to system grounds directly or through a 10nF – 68nF capacitor.

What to consider when a design has a metal chassis / housing?

The chassis / housing of an application, many times grounded, should be kept away from pours and pads where possible. Bad design on this element decreases sensitivity through the C_P it adds.

An active driven shield can be added between the sensing electrodes (pads and pad traces) and metal chassis. See: "**Why use an active driven shield?**" for more information on the shielding function.

What is the effect of a 'ground pour'?

Sensitivity: Ground pours close to a pad (closer than 5mm) are undesirable in capacitive sensing. Ground pours cause parasitic capacitance (C_P) which in turn lowers the sensitivity of a system. More C_P is present, if the sensing area is parallel to a ground pour (i.e. sensing area and ground pours are located on opposite sides of a PCB). Although new generation IC's can compensate for larger C_P in the system, GND around the sensing area will still attract the field lines which can cause a perceived reduction in sensitivity.

EMC immunity: Ground pours greatly improve EMC immunity when placed around and on the opposite side of a ProxSense® IC. It is recommended to place ground pours for applications requiring improved EMC immunity. It should be noted that a clearance between the 'ground pour' and any sensing lines (Cx pour and traces) should be kept. Please refer to the application notes on EMC design for further details (AZD051 & AZD052).

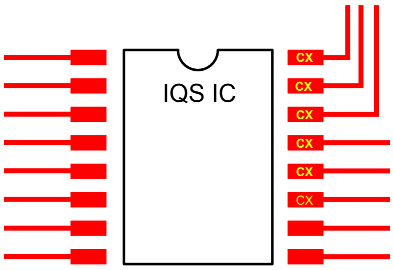

Figure 1.14 Step1: IQS IC with traces

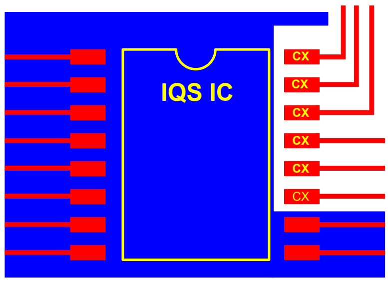

Figure 1.15 Step2: IQS IC with traces (TOP) and 'ground pour' added on BOTTOM side (not close to CXs).

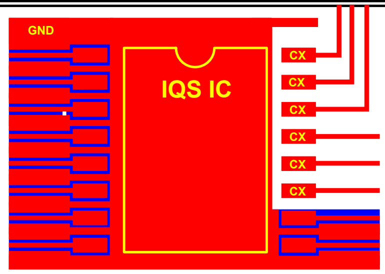

Figure 1.16 Step3: IQS IC with traces and 'ground pour' added on TOP and between other traces (not close to CXs).

Overlay

What is an overlay and why use one?

An overlay is a non-conductive material used to isolate the touch pad from the user. The two important factors to consider when choosing an overlay are:

- Material
- Thickness

Advantages:

- Overlays are generally used to increase the robustness of a design, enabling the design to withstand higher levels of ESD, as the user is not able to directly touch the bare PCB / pad.
- Overlays add to the aesthetic value of a design. The overlay can have screen-printing done on the side that is in contact with the sensing pads. (screen-printing must be mirrored) This will increase the aesthetics of the product. The user will then see this screen printing graphic through the overlay.
- The size of the pad behind the printed graphic pad can be much bigger without affecting the users' interpretation of the pad. This will increase sensitivity of the system and make it easier to use.

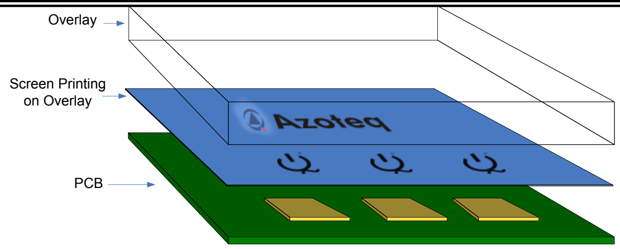

Figure 1.17 Graphics on bottom of Overlay.

Can capacitive sensing work through a conducting material (metal)?

No, ProxSense® cannot sense through a metal (conductive) object. This rule holds for all basic capacitive sensing technologies. Azoteq, however, has a technology called CAPPO™ (Capacitive Pressure Only) which is able to work through metal. This technology uses fluctuations in the metal, caused by pressure of a touch. Please refer to the application note on CAPPO for more details (AZD042).

What material is best suited to use as an overlay?

Conductive materials cannot be used as an overlay.

Different materials have different permittivity values (ε_r), which are directly linked to the propagation ability of an electric field through a material.

The higher the epsilon value, the better the electric field will propagate through the material. (This can be seen from Equation 1, increasing ε_r, will increase Capacitance, which in turn increases sensitivity)

Typical overlay materials include Perspex / Plexiglas (ε_r = 2 to 3), glass (ε_r = 7 to 8), but other plastic materials or even a PCB board, as mentioned above, can be used.

Table 1.1 Material properties[1]

Material	Permittivity (ε_r)	Breakdown voltage (V/mm) (approx.)
Air	1	1180
Glass (standard)	7.6 – 8.0	7800
Plexiglas	2.8	17,700
Mylar	3	295,200
FR4	5.2	27,500
Nylon	3.2	16,000

What thickness (d) should an overlay be?

The overlay thickness can range between 1mm and 10mm with an optimal distance being between 3-4mm. The thinner (d decreased) an overlay is, the more sensitive the system will be. This can be seen from Equation 1.

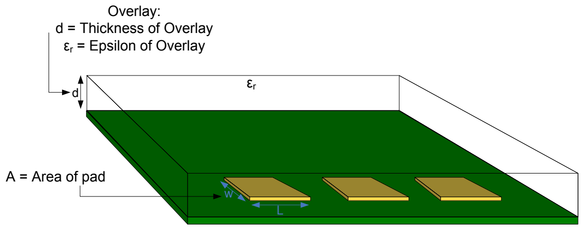

Figure 1.18 Pad size and Overlay dimensions.

[1] Relative permittivity values are given for reference only. Designers should verify the overlays they intend to use.

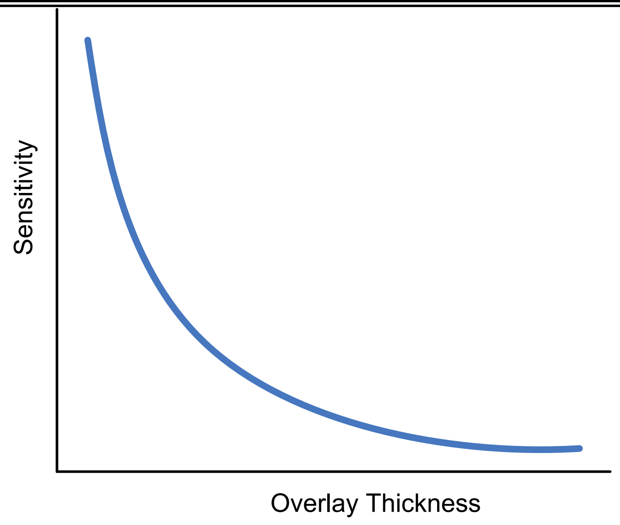

Figure 1.19 Overlay thickness vs Sensitivity.

How should an overlay material be mounted to a substrate?

Good contact between an overlay and the sensing pads is very import when installing the overlay. The overlay should be directly mounted to the substrate containing the sensing pad and preferably touching the sensing pads. A touch should not influence the contact made between the overlay and the sensing pads, as this can cause stuck key conditions. Preferably, adhesives (non conducting glue / double sided adhesive tape) or other mechanical compression mechanisms (plastic screws / spring clips / etc) can be used to fix the overlay to the substrate containing the touch pads.

3M has 2 adhesive materials (467&468) which are widely used for capacitive sensing applications.

What happens if there is an air-gap between the touch pad and overlay?

An air gap will decrease the sensitivity of the system and is highly undesirable.

An air gap reduces sensitivity of a capacitive application as the field cannot be emitted directly through an overlay and has to go through another medium (with low dielectric constant) before passing through the overlay which effectively reduces the field strength.

Technologies

How does surface/self and projected capacitance work and how to relate it to transfers?

Surface or Self capacitance makes use of the parallel plate capacitor theory: $C = (\varepsilon_r \varepsilon_o A)/d$. The capacitance is measured between the electrode and earth.

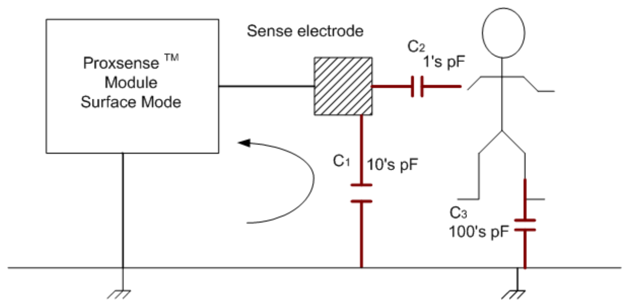

Figure 1.20 Self Capacitance Representation.

- As a finger approaches the electrode the distance (d) between electrode and earth decreases, effectively increasing the capacitance (C).
- Q = CV. With C increasing, it will yield the charge (Q) per transfer will also increase.
- This will decrease the amount of transfers required to charge the electrode.

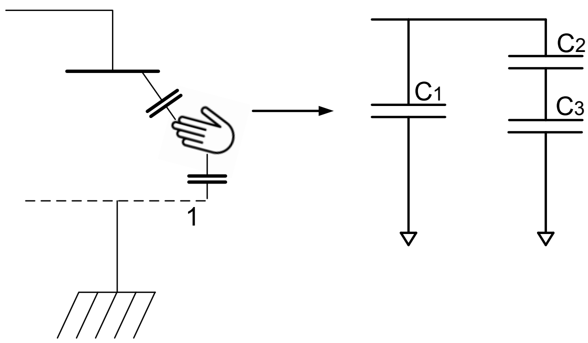

Figure 1.21 Self Capacitance Circuit.

Electrically charged conductive objects close to one another will form an E-field. Unlike the 'surface' technology, 'projected' technology measures the change in capacitive coupling between 2 electrodes. The coupling between the electrodes is called "Mutual capacitance" / C_M and the electrodes are called the transmitter (CTx) and receiver (CRx).

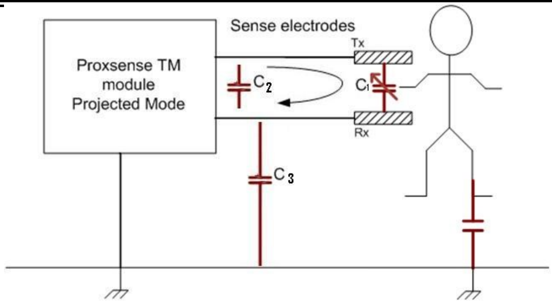

Figure 1.22 Projected Capacitance representation

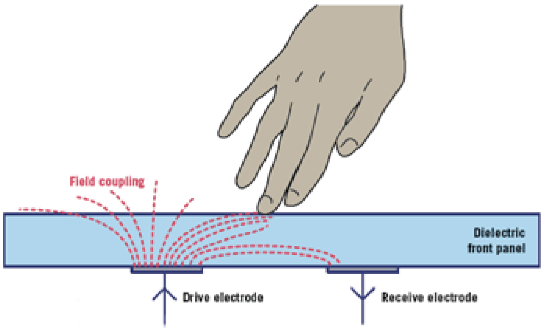

Figure 1.23 Finger on electrodes

- As a finger (conductive object) approach and the electrodes couple more with the finger, it effectively "steals" some of the charge. This will result in the C_M between the electrodes to decrease.
- Q = CV. With C_M decreasing, it will yield the charge (Q) per transfer will decrease
- This will increase the amount of transfers required to transfer the same amount of charge. Therefore counts go up when touching projected applications.

What are OTP bits and how are they configured?

OTP (One Time Programmable) bits are option bits on an IC, where each option are configurable only once. Different configurations on a single IC can be changed more than once.

Not all devices contain OTP bits and the devices that contain these bits can work in their default state. The OTP bits enable the designer to fine-tune certain settings on an IC (with almost no extra cost) to a certain design.

Azoteq offers a Configuration Tool (CTxxx) and accompanying software (USBProg.exe) that can be used to program the OTP user options for prototyping purposes. More details regarding the configuration of the device with the USBProg program is explained by application note: "AZD007 – USBProg Overview" which can be found on the Azoteq website.

Alternate programming solutions also exist. For further enquiries regarding this matter please contact Azoteq at ProxSenseSupport@azoteq.com or the local distributor.

EMC & ESD Immunity

EMC: High RF immunity has been designed into ProxSense® ICs. The immunity enables the IC to withstand RF emissions, normally without any added components. RF immunity can be further increased by:

- Adding a ground pour under the IC (except Cx traces) as mentioned previously.
- Adding 100pF capacitors in parallel to the V_{DDHI} and V_{REG} (some ICs: V_{DD}), will drastically improve immunity.
- Placing components (especially R_{CX} resistors) as close as possible to IC.

There are 3 important application notes available for designing for robust EMC capacitive sensing. Please refer to AZD015, AZD051 & AZD052.

ESD: All ProxSense® ICs are designed with internal clamp diodes to specifically aid basic HBM ESD protection. See datasheet for each ICs' ratings.

Using a touch pads behind an overlay material, increases the ESD immunity drastically. The breakdown voltage through a specific material can be seen from Table 1.1. For example, using a 2mm glass overlay will yield ESD protection of more than 15kV.

It should be noted that ESD can curve around or punch through an overlay which could potentially cause damage to a system, thus emphasizing that care should be taken when designing the touch pads part of the module.

TVS diodes will improve ESD immunity, but it should be noted that TVS diodes can potentially decrease RF immunity due to the TVS diode acting as a diode detector circuit and coupling the RF power into the specific line. However, if using TVS diodes, the capacitance caused by the diode should be kept as low as possible (< 5pF).

Is ProxSense® waterproof and what effect will water have on a design?

The ProxSense® technology is not waterproof if designed with its default settings. However, the overlay can be designed to contain the electronics in a waterproof container. Water can contain impurities which will make it conductive and will then interact with the sensing antenna. Certain products have the ability to be set up so that it can withstand interference from water. For more details on waterproof design, please see application note AZD012.

Is a ProxSense® pad scratch proof?

Yes, scratches on an overlay will have minimal impact on sensing.

It should be noted that the damage done to the overlay is only a scratch and should not impact the sensing electrode (mechanical fluctuations of the overlay may cause false detections). Large scrapes may cause the overlay to have different thickness at different areas which will have an impact on sensitivity as the thickness is no longer constant over all buttons.

What is ICI and what advantage does it give?

A reference capacitor is used in the charge transfer technique of capacitive sensing to store and measure charge collected on a touch pad. ICI (Internal Capacitor Implementation) has moved this component on chip, reducing pin count and components required. Designs now have a dimension less to be designed, significantly simplifying designs.

What is the ‘ATI’ technology?

ATI (Antenna Tuning Implementation) is a technique used by some ProxSense® ICs to match itself to the antenna connected to it.

This adjustment is made for optimal performance and without requiring external tuning components (as most capacitive sensing technologies require).

ATI adjusts internal circuitry according to two parameters, the ATI ‘multiplier’ and the ATI ‘compensation’. The ‘multiplier’ can be viewed as a course adjustment and the ‘compensation’ as a fine adjustment. These adjustments are used to set the counts (CS - Current Sample) value to a preferred amount (differs for each IC, depending on sampling rate required).

See Application Note: AZD027 for a complete explanation of this technology.

What is an active driven shield?

An active driven shield is a signal produced by a ProxSense® IC, which is a replication of the Cx signal. This signal will ideally not be influenced if touched through an overlay. The active driven shield will dynamically change if the Cx changes.

Why use an active driven shield?

- The sensing antenna can be separated from the sealed electronics
- The Cx traces leading to the sensing antenna can be shielded from unwanted environmental interference like water passing in a water pipe or people passing over the sense wire.
- Shield plane can be placed on the opposite side of PCB from sensing antenna to minimise the effect of ground planes / grounded conductors, increasing sensitivity.

How and when to implement an active driven shield?

See application note AZD009 for a complete overview of implementing the active driven shield.

What is ‘zoom’ when power modes are mentioned and on which ICs can it be found?

Many ProxSense® ICs has the ‘zoom’ function either default enabled or it is possible to enable it through an OTP bit. (See datasheet of IC to determine if this function is available.)

The ‘zoom’ function enables an IC to draw minimum power in its normal running state (power consumption dependent on power mode chosen), and once a proximity event is detected, the IC will ‘zoom’ to full power mode and have the reaction speed as required by the application. Note that using the ‘zoom’ function will reduce the reaction speed of the first proximity detection after the device has been left to go into a low power mode.

Debugging

The IC is not working, what to do?

1. Check VDDHI is above rated value given in IC datasheet.
2. Check VREG voltage. This is the internal regulator voltage of all ProxSense® ICs. The voltage should normally be lower than the supply voltage (VDDHI) and can be found in the datasheet of each IC.
3. For the following ICs check the CS pin voltage and compare with datasheet: IQS120, IQS123, IQS124, IQS125, IQS126, IQS240, IQS221, IQS222, IQS410.
4. Check that there is activity on the CX pins (surface) or CTX (projected). Make sure the charge transfers can be observed.
5. Please note, if using the I^2C / SPI communication protocol, the ICs’ RDY line (available on most ICs) will indicate when data is available on the bus. ICs without RDY line should be polled to determine if data is available.
6. I^2C lines are software open drain and require pull up resistors between the I^2C lines and VDDHI.

How to avoid detection from touching another buttons’ tracks?

1. Layout is the starting point for false detections through touching traces close to touch pads. The traces of other pads should be routed on the opposite side of the PCB (if possible) to the touch pads. The traces should also be routed away from pads.
2. Multiple channel ICs normally has data that it presents to a controller IC. This data contains the raw values of the capacitive measurements taken. The data will also show which channels has the largest change/delta in capacitance caused by a touch event. This is a good way to filter out unwanted touches.
3. The IQS221 has a minimum mode which gives only the largest touch it detects out on its TOx pins.

What to do if the overlay is not flat / a distance away from the PCB where the capacitive controller IC is located.

Options exist to connect the controller PCB to an overlay, these include:

- Placing springs attached to PCB and pressing against overlay
- Placing conductive rubber instead of springs in these gaps
- Having an FPC (Flexible Printed Circuit) attached to the overlay.

For more details on curved overlays, please refer to AZD075.

Appendix A. Contact Information

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Please visit www.azoteq.com for a list of distributors and worldwide representation.

The following patents relate to the device or usage of the device: US 6,249,089 B1; US 6,621,225 B2; US 6,650,066 B2; US 6,952,084 B2; US 6,984,900 B1; US 7,084,526 B2; US 7,084,531 B2; US 7,265,494 B2; US 7,291,940 B2; US 7,329,970 B2; US 7,336,037 B2; US 7,443,101 B2; US 7,466,040 B2 ; US 7,498,749 B2; US 7,528,508 B2; US 7,755,219 B2; US 7,772,781 B2; US 7,781,980 B2; US 7,915,765 B2; US 7,994,726 B2; US 8,035,623 B2; US RE43,606 E; US 8,288,952 B2; US 8,395,395 B2; US 8,531,120 B2; US 8,659,306 B2; US 8,823,273 B2; EP 1 120 018 B2; EP 1 206 168 B1; EP 1 308 913 B1; EP 1 530 178 A1; EP 2 351 220 B1; EP 2 559 164 B1; CN 1330853; CN 1783573; AUS 761094; HK 104 1401

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