Application Note: AZD009
Implementation of Driven Shield

1. Introduction

The ProxSense™ range of ICs opens up a new dimension to capacitive sensing by enabling the designer to detect the Proximity of a user to a product of up to 30cm away. This is essential in many designs where a product such as a personal navigational devices (PND), or a stove tops backlighting will illuminate with the detection of a users proximity. This proximity detector can also be implemented into white goods, automotive devices, palm tops or any kitchen or office appliances where the display should be turned on to adjust some parameters.

The designer can implement this as an added technological feature, or to add to the aesthetics and ease-of-use of the product, or simply to save power by leaving the product in sleep-mode and only waking it with a user proximity.

2. Interference with Proximity Detection Range

Unfortunately in many applications the product consist of a metal enclosure or large grounded metal objects, as can be seen in stove tops, microwave ovens, etc. Metal objects, ground planes or traces close by a proximity sensing electrode dramatically influence the detection range of the sensor. This can be seen from the propagation of the electrical field in the following figures.

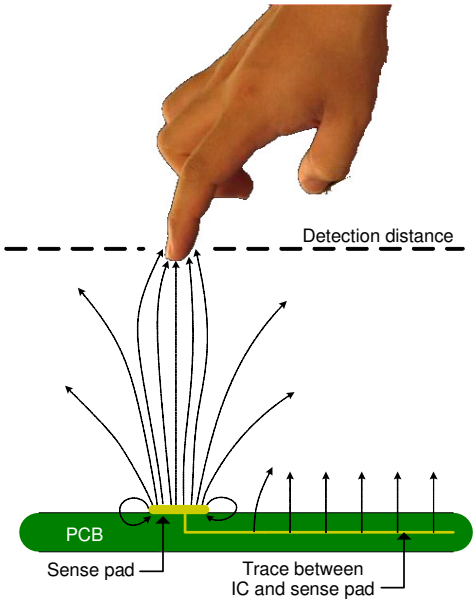

Figure 2: Electrical propagation from a sense pad and its trace

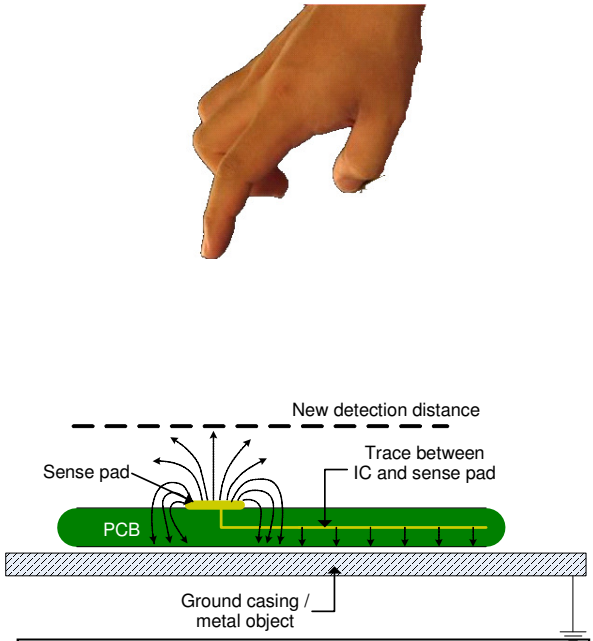

Figure 1: Electrical propagation from a sense pad and its trace in the presence of a ground casing / metal object

The amount of propagation from a certain area of a sense pad is directly equivalent to the surface area of that part of the sense pad. Example: The longer the trace (longer = more area) between the IC and sense pad, the more the propagation from that trace will be. Similar for the sense antenna. The propagation from a trace and sense pad can be seen in Figure 1. Adding a ground plane around the sense antenna causes the electrical propagation to mainly go towards this plane. This can be seen in Figure 2. The reduction of sensitivity shown in Figure 2 can also be caused by components, metal objects or other traces that could cause stray capacitances.

3. Possible Shield Solutions

The driven shield available on selected ProxSense™ ICs can be used to decrease the negative influence a ground plane or metal object has on the proximity detection range. The shield should always be at the same potential as the sense antenna. For this reason there is a SHLDIN pin on some ICs to which a CX channel can be connected. See Figure 5. The SHDLOUT pin will then have the same potential as this CX channel.

A shield can be used to shield a total system as shown in Figure 3, or the trace can be shielded and the sense antenna can then be placed away from any interference source (i.e. ground plane, metal object, other traces, user influence on that trace) as shown in Figure 4.

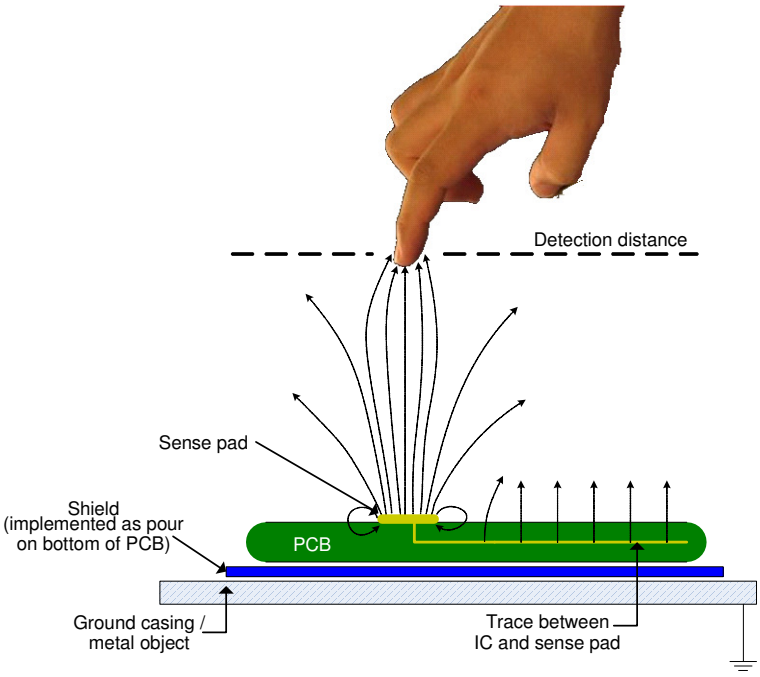

Figure 3: Shield implemented as pour between sense pad and ground casing / metal object

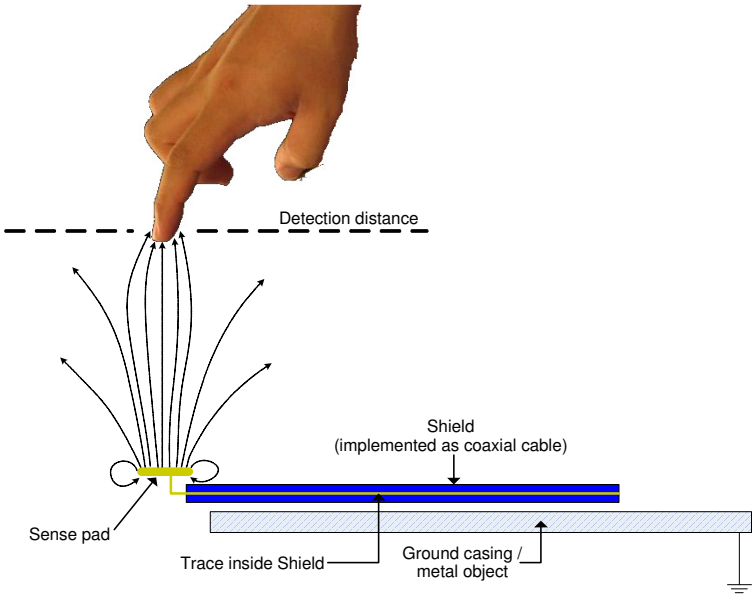

Figure 4: Shield implemented as coaxial cable shielding trace between sense pad and IC from ground casing / metal object

4. Advantages of Shield Function

Selected ProxSense™ ICs have a shielding function built-in. The advantages of the shield include:

- The shield enables the user to separate the sensing antenna (pad) from the sealed electronics.
- The shield enables the designer to shield the sensing wire from unwanted influences such as ground planes, metal objects and other traces on the PCB. The shield will also counter environmental interference such as water passing in a water pipe or people passing over the sense wire.
- The shield enhances proximity detection when used with battery(DC) applications.
- Integrated driven shield adds high performance at virtually no additional cost.

5. Connecting the Shield

Ideally, a coaxial cable is used for the shield. A Rx (nominally 2kΩ) resistor should be connected to the Cx pin (the sense antenna to be shielded), and the other side of the Rx resistor is connected to the centre core. This is the signal that will be shielded. This node is also connected to the SHLDIN pin. The IC has an internal buffer so that the shield doesn't add any load impedance to the CX pin.

The SHLDOUT pin should be connected to the metallic shield part of the coaxial cable. A pull-up resistor (R) should be added between SHLDOUT and VDDHI (100kΩ ≤ R ≤ 1MΩ).
NOTE: Smaller R ensures better shielding but increases current usage.

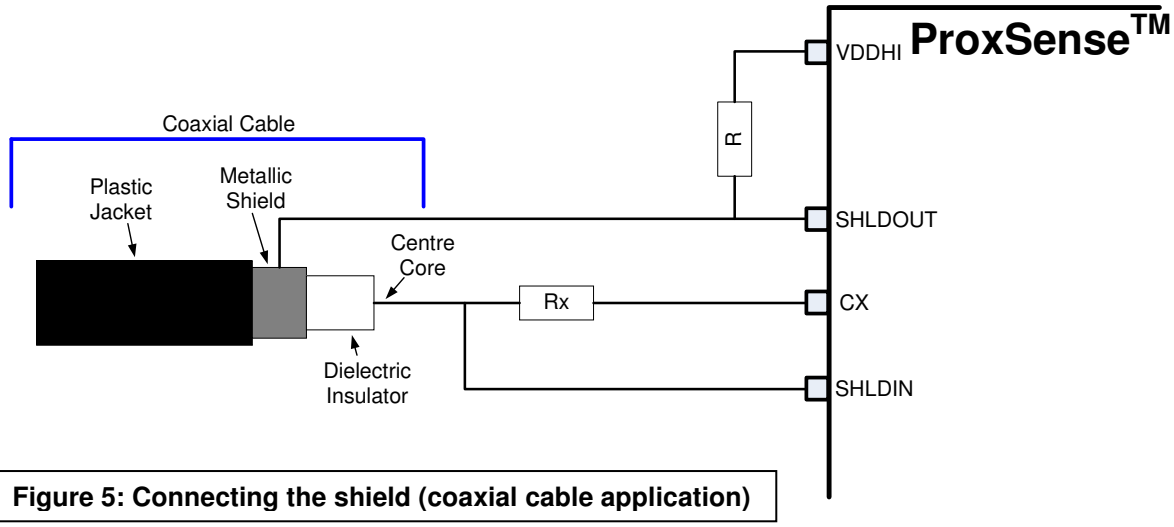

Figure 5: Connecting the shield (coaxial cable application)

Note: The IQS125 doesn't have a SHDLIN pin, this connection is made inside the IC. It still requires the external R between SHLDOUT and VDDHI.

Note: For the IQS221, the driven shield is normally used in conjunction with CX8, seeing that this channel has its own sensitivity levels. This channel can then be used as proximity sensing antenna, with its advanced sensitivity and minimal parasitic influences.