AN2967
Application note

Implementing a driven shield on STM8T and STM8TS capacitive sensors

Introduction

The STM8T and STM8TS capacitive sensors opens up a new dimension to capacitive sensing by detecting user's proximity up to 30 cm. This is a key feature for many end-applications such as personal navigation devices (PNDs) or stove tops which are equipped with backlighting that switches on when a user is detected. Proximity detectors are also implemented in white goods, automotive devices, palm tops, and on any type of kitchen or office appliance where the display needs to be turned on to allow some parameters to be adjusted by the user.

To enhance their application appearance and ease-of-use, designers can choose to add proximity detection as an extra feature. The alternative is to implement it to save energy, allowing the product to remain in sleep mode and only wake up when it detects a user in its proximity.

1 Interference with proximity detection range

Unfortunately in many cases the end-application consists of a metal enclosure or large grounded metal objects, as can be seen in stove tops or microwave ovens. Metal objects, ground planes or traces close by a proximity sensing electrode dramatically influence the sensor detection range. Refer to *Figure 1* and *Figure 2*, for a comparison of the propagation of the electrical field without and with metal objects in the electrode proximity.

Figure 1. Electrical propagation from a sense pad and its trace

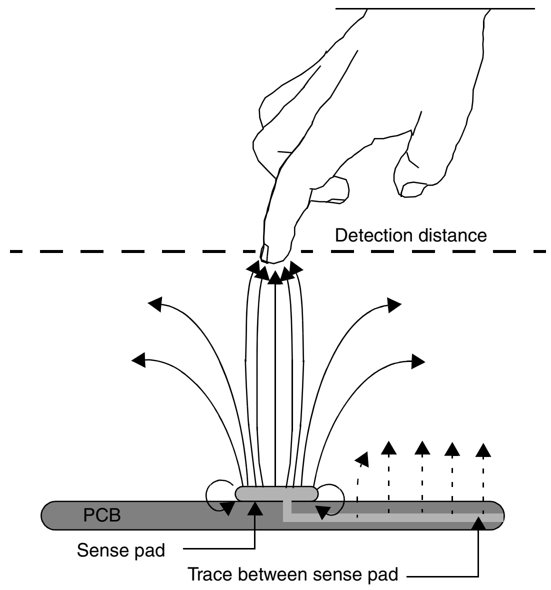
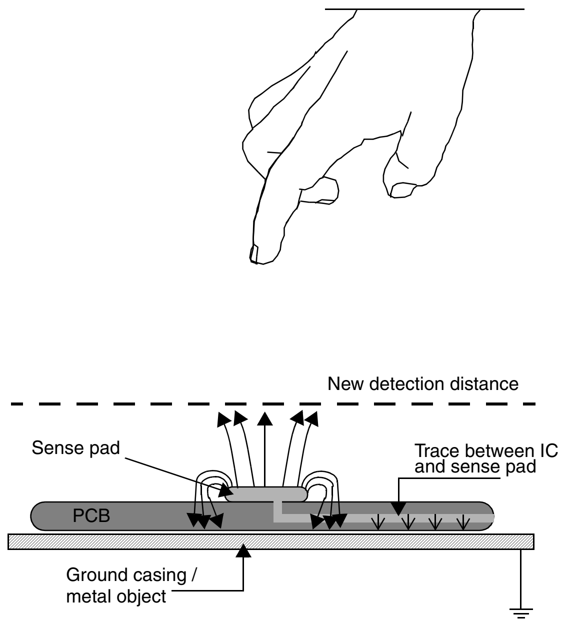


Figure 2. Electrical propagation from a sense pad and its trace in the presence of a ground casing / metal object



The propagation from a certain area of a sense pad is directly equivalent to the surface area of that part of the sense pad. For example, the longer the trace (more extended area) between the IC and the sense pad, the more the propagation from that trace will be. A similar phenomenon occurs for the sense antenna.

Figure 1 illustrates the propagation from a trace and sense pad. Adding a ground plane around the sense antenna causes the electrical propagation to mainly go towards this plane, as shown in *Figure 2*. The reduction of sensitivity shown in *Figure 2* can also be caused by components, metal objects or other traces that could results in stray capacitances.

2 Possible shield solutions

The driven shield available on selected STM8T/STM8TS capacitive sensors can be used to decrease the negative influence a ground plane or metal object on the proximity detection range. The shield should always be at the same potential as the sense antenna.

For this reason some STM8T/STM8TS devices feature a SHLDIN pin to which a CX channel can be connected (see *Figure 5*). The SHDLOUT pin then has the same potential as the CX channel.

The shield can be implemented in two different ways:

- The shield can protect a whole system as shown in *Figure 3*.
- The shield can protect only the trace. In this case the sense antenna is isolated 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

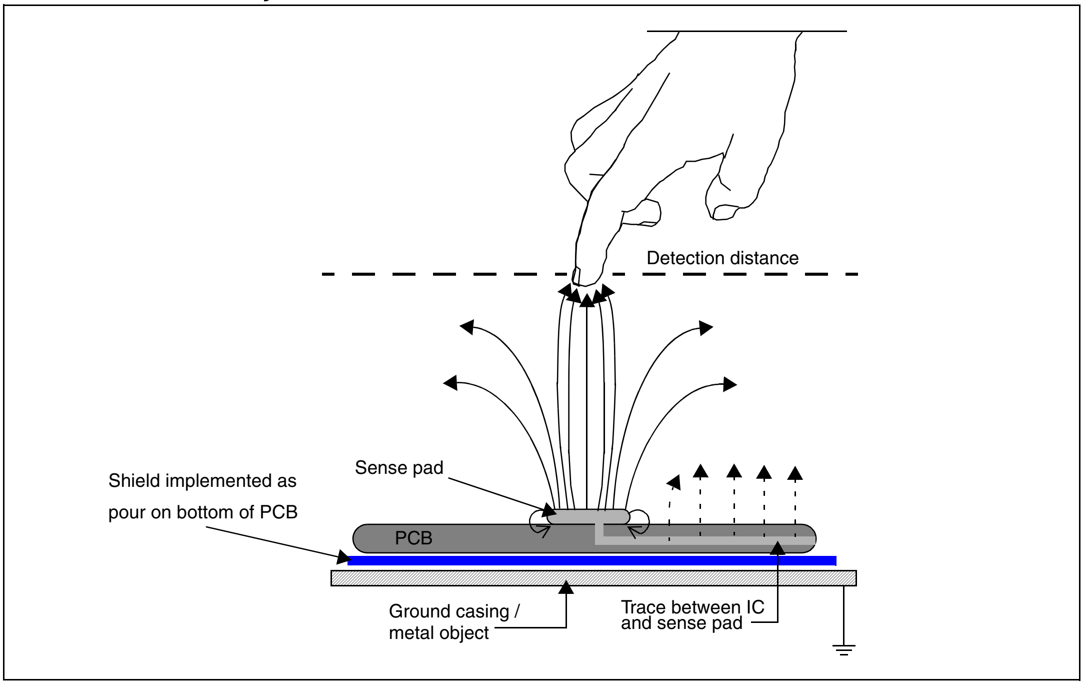
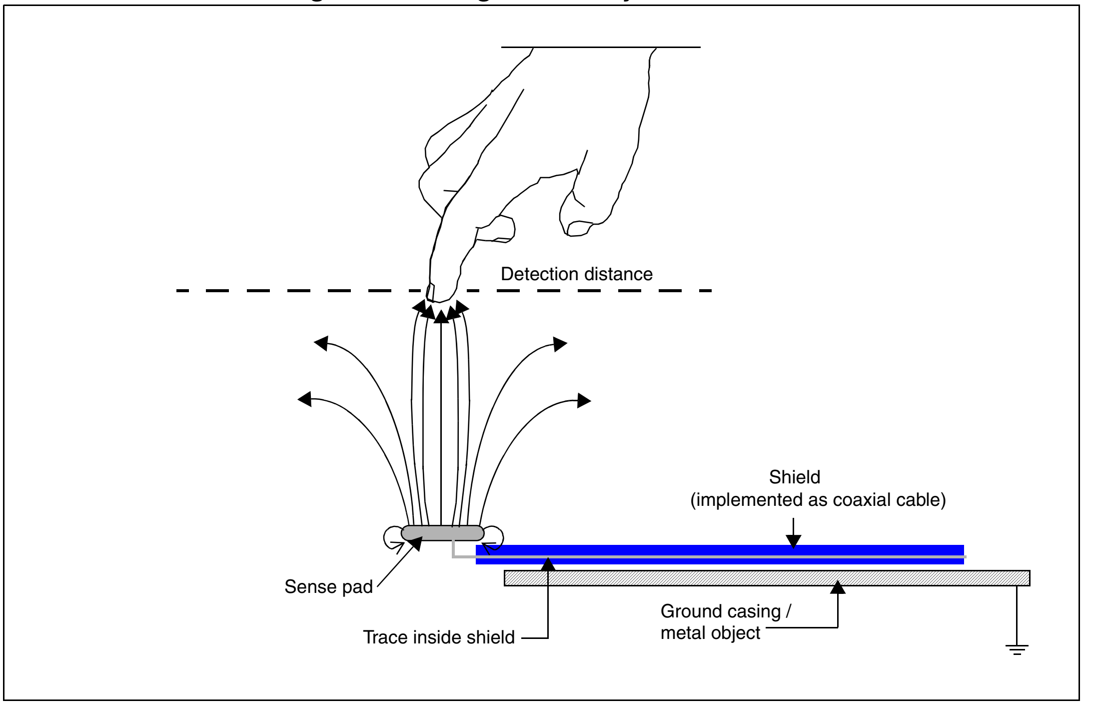


Figure 4. Shield implemented as coaxial cable shielding trace between sense pad and IC from ground casing / metal object



3 Advantages of the shield function

Some STM8T and STM8TS capacitive sensors have a built-in shielding function. The advantages of the shield include:

- The sensing antenna (pad) is separated from the sealed electronics.
- The designer can shield the sensing wire from unwanted influences such as ground planes, metal objects and other traces on the PCB. The shield also counters environmental interference such as water flowing into a water pipe or people passing past the sensing wire.
- The shield enhances proximity detection when it is used with battery (DC) applications.
- An integrated driven shield allows to achieve high performance at virtually no additional cost.

4 Connecting the shield

Ideally, a coaxial cable should be used for the shield. A R_X (typically 2 kΩ) resistor should be connected to the CX pin corresponding to the sensing electrode to be shielded. The other side of the R_X resistor is connected to the center core of the coaxial cable. This node is also connected to the SHLDIN pin. The device has an internal buffer so that the shield does not add any load impedance to the CX pin.

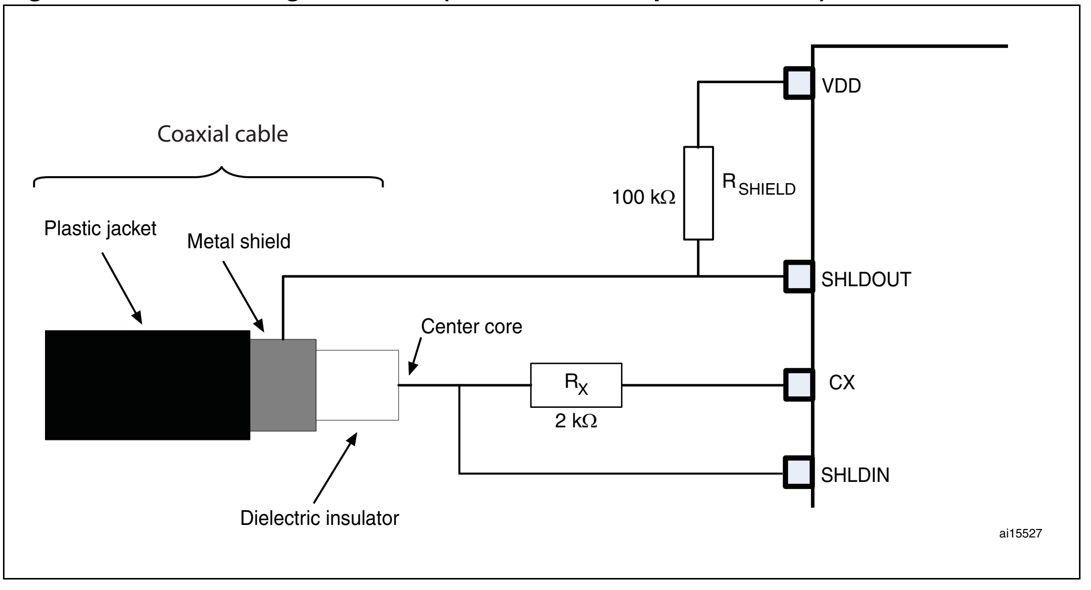
Note: The SHLDOUT pin should be connected to the metallic shield part of the coaxial cable. A pull-up resistor (R_{SHIELD}) should be added between SHLDOUT and VDD (100 kΩ $\leq R_{SHIELD} \leq$ 1 MΩ). A smaller R_{SHIELD} ensures better shielding but increases current consumption.

Refer to *Figure 5* for a description of shield implementation using a coaxial cable.

Note: 1 Some products do not feature a SHDLIN pin. This connection is made inside the IC. It still requires an external R_{SHIELD} *to be connected between SHLDOUT and VDD.*

2 For some devices, it is recommended to use a dedicated CX which sensitivity level can be set independently from the others. This channel can then be used as proximity sensing antenna, with advanced sensitivity and minimal parasitic influences.

Figure 5. Connecting the shield (coaxial cable implementation)



5 Revision history

Table 1. Document revision history

Date	Revision	Changes
04-May-2009	1	Initial release.