Application Note: AZD033
IQS127 Automatic soap dispenser application - IR replacement

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1 Introduction

This document describes the IR sensor replacement with an IQS127 ProxSense™ capacitive sensor, in an automatic soap dispenser application. The IQS127 is a cost effective single channel touch and proximity sensor offered in a TSOT23-6 package. For this study, an off-the-shelf soap dispenser was modified.

2 IR sensor removal

Two types of IR proximity detection are commonly employed, low range “always ON” infrared detection and long range pulsed infrared detection. Both infrared sensor types usually interface with a microcontroller, and can easily be replaced by a single ProxSense™ capacitive sensor in the majority of applications.

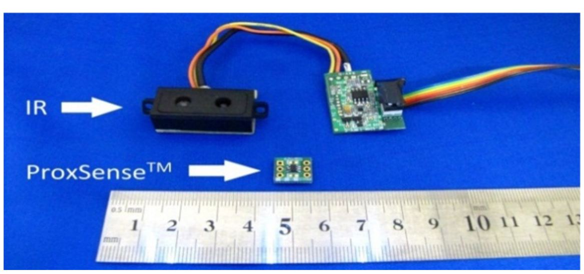


Figure 2.1 IR circuitry (top), ProxSense™ (bottom)

In the case of the soap dispenser, pulsed IR was employed. In Figure 2.1 the IR detection circuitry is compared to the ProxSense™ circuit board. The IR circuitry is easily removed at the interface to the microcontroller, as the detection circuitry simply outputs a LOW or HIGH signal in the event of a positive detection.

3 IQS127 ProxSense™ sensor integration

The IQS127 is extremely easy to set up and integrate into new and existing applications by following a few simple steps:

- Set up the IQS127 for active high or active low operation on detection (default active low).
- Design and integrate an appropriate sense antenna. (See section 3.1)
- Interface the IQS127 to a microcontroller or other control circuit.

The IQS127 requires very few external components; see section 4.2 for a typical design.

3.1 Integration of IQS127 and sense antenna

Due to its small size the IQS127 is easily and rapidly integrated into the automatic soap dispenser.

Figure 3.1 illustrates the integrated sense antenna inside the automatic soap dispenser, as well as the IQS127.

A passive ground plane can be used to shield areas where no proximity should be detected; in this case the lower sides or back of the soap dispenser, as can also be seen in Figure 3.1.

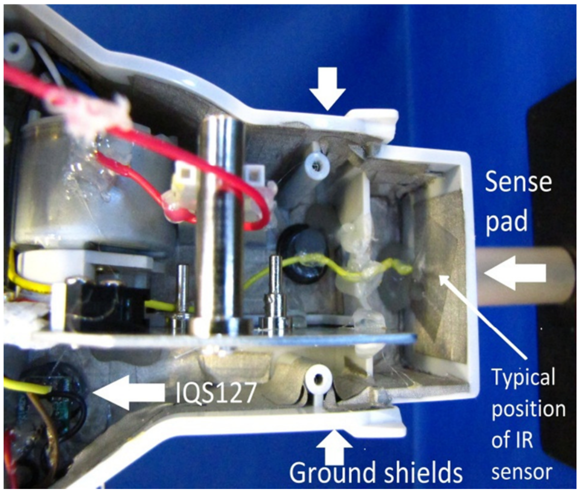


Figure 3.1 Soap dispenser sense antenna and ground shield

From the figure, the lower left, right and rear sides of the soap dispenser are shielded with a ground plane to prevent proximity detection in these directions. For more effective shielding ensure that the antenna sensing wire (Cx) is not resting directly against these planes, but at least 5mm away.

Other more compact ground shield configurations can be effectively used to achieve directionality and prevent unwanted detections at specific positions by etching them on a PCB in strategic locations such as illustrated in Figure 3.2.

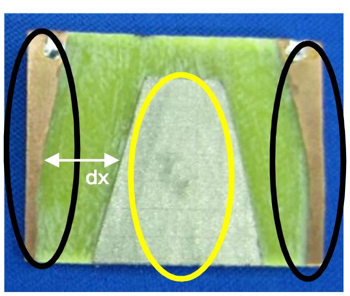


Figure 3.2 Azoteq soap dispenser sense antenna (yellow circle) and ground shields (black circles)

The sense antenna depicted in figure 3.2 is mounted facing downwards and is an effective design that prevents false proximity detections from the sides of the soap dispenser.

The distance (dx) between the sense plate and ground shields is a key parameter, for the obtained sensing distance is directly proportional to the spacing between the electrodes. The implemented spacing (dx) was approximately 9mm.

It is also important to keep the IQS127 as close to this sense antenna as possible.

Should the sense antenna have a capacitance that is extremely low, the Automatic Tuning Implementation (ATI) of the IQS127 could fail to reach its target of 900, greatly diminishing the sensing range. In this case, the sensing antenna surface can be increased, or a discrete capacitance in the range of 2pF can be connected to the IQS127 Cx pin to ground to correct this problem.

3.2 Interfacing the IQS127 to a microcontroller

The IQS127 can be operated in active high or low modes depending on the desired application.

- Connect pin POUT of the IQS127 to any microcontroller input pin as usual, to signal proximity detection.

Figure 3.3 shows the connection of the IQS127 output to the automatic soap dispenser microcontroller PCB.

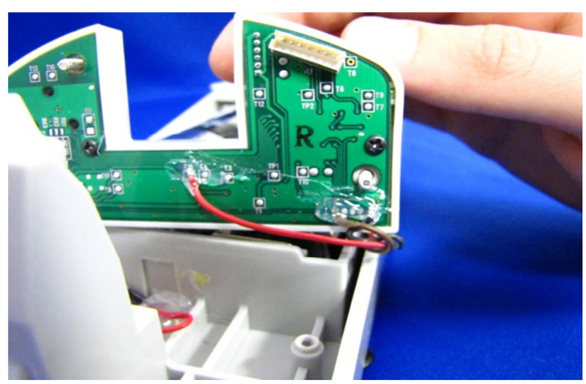


Figure 3.3 Connection of IQS127 output to microcontroller PCB

3.3 Final completed product

Figure 3.4 illustrates the completed automatic soap dispenser product in operation. Proximity detection is indicated in the figure by the bright blue lit LED.

Figure 3.4 Completed automatic soap dispenser unit

4 Comparison and reference design

4.1 Advantages of ProxSense™ capacitive sensing over IR

This application note showed that it can be easily retro-fitted to IR units without requiring modification to the plastic housing. Main advantages of Azoteq capacitive proximity detection include the simplicity of implementation, low cost, robustness and extreme reliability, extremely low power consumption, and tolerance to dirt build up.

Table 4.1 forms a summary and comparison of the most important features of ProxSense™ capacitive sensing vs. IR sensing technologies.

Table 4.1 Comparison of Proxsense™ and IR sensing technologies

	Azoteq Capacitive Sensing	Infrared Proximity Sensing
Device	IQS127x	Competing IR
Distance / Range	0mm~150mm	0mm~150mm
Operating Voltage	1.8V~5V	1.71V~3.6V
Power consumption	12uA	500uA~150mA
Controller Cost (US$)	Sub 0.16	0.45~1.65
Sensing Electrode	Can be copper foil or copper on a PCB	Requires translucent lens
Tolerance to dirt build up	100%	Sensor will stop working.

From Table 4.1, the greatest advantage is the low power consumption, significantly extending the operating life of a battery power application like the soap dispenser, and the tolerance to dirt build up.

Moreover, ProxSense™ capacitive sensors can be integrated into much smaller volumes and confined spaces due to its minute size.

Taking into account all features and benefits, it is clear that ProxSense™ sensors provide impeccable flexibility and performance, and does so at a fraction of the cost of competing technologies.

4.2 Reference/Typical design

A typical design that can be used in the majority of applications is provided in Figure 4.1.

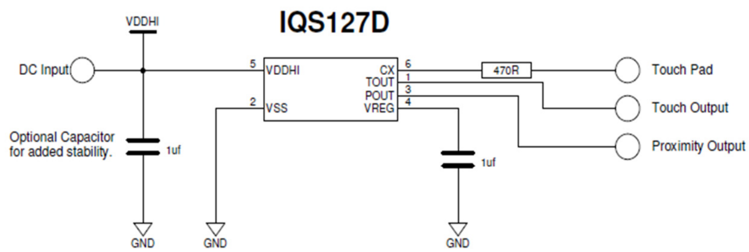
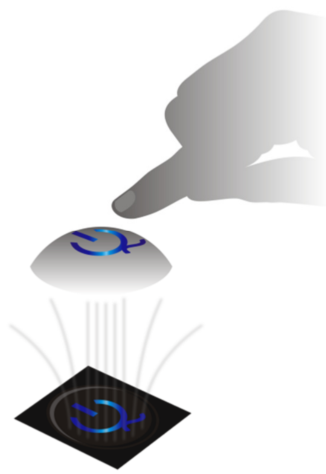


Figure 4.1 Reference design

The two outputs, Touch Output and Proximity Output, are illustrated in the figure. The two outputs are digital and can be set up to operate in active HIGH or active LOW mode; they can simply be connected and interfaced to any microcontroller.



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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 7,119,459 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, US7,772,781, US 7,781,980 B2, EP 1 120 018 B1, EP 1 206 168 B1, EP 1 308 913 B1, EP 1 530 178 B1, ZL 99 8 14357.X, AUS 761094

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