World Leader in Capacitive Proximity Sensing

Advanced capacitive proximity sensing techniques to meet FCC SAR regulations in mobile devices

The sales of smart phones and tablets have exploded in the last few years. These devices place high demands on wireless connection performance. The FCC regulations for human exposure to electromagnetic radiation have become a limiting factor in the performance of wireless communication.

FCC SAR regulations dictate reduced output power levels in the presence of a human body. When power levels are reduced the data rate is also reduced and therefore the accurate detection of a human body is important to ensure the optimal data rate.

The article discusses specific examples where sensors are triggered by non-human objects, hence limiting the output power of the device when that is not required. Capacitive sensing techniques are proposed to distinguish between human and non-human sensor activation.

Further design criteria for the sensor location, sensor performance and software detection algorithms are discussed.

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Content

Azoteq enables next generation user interfaces for users to interact naturally with products through capacitive proximity and touch

Using a Slider to Support Multiple Buttons

Azoteq is committed to providing information to our customers for new products and new ways of using products. One such example is the use of a slider implementation to create multiple buttons.

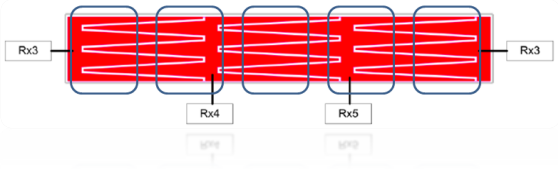
If the designer needs to have multiple buttons next to each other, they can use a slider layout and then designate certain position ranges as a button. One device that can be used for this type of application is the IQS333 which is a 7 (self) or 9 (mutual) channel device.

The IQS333 can provide two sliders with 11 bit resolution therefor allowing the designer to specify where they would like their buttons.

Another IC with the ability to have a configurable slider is the IQS263. The IQS263 is a three channel device that can be configured to have an 8-bit 2/3 channel slider.

These are just a couple of examples of ICs that can be used for this application.

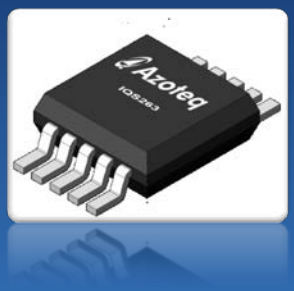
For more information, please email info@azoteq.com



Slider Layout with Specified Touch Areas

The picture above shows an example of a slider design for an IC using self-capacitance. The areas encompassed by the blue squares are designated touch buttons.

Azoteq's IQS263



The IQS263 ProxSense® IC is a 3-channel projected (or self) capacitive proximity and touch controller with best in class sensitivity, signal to noise ratio and power consumption. Full product link to Mouser is located here.

Some Features of the IQS263 are:

- Configurable 8-bit 2/3 channel slider or 3 channel scroll wheel
- Up to 80Hz report rate
- On chip Movement Detection algorithm
- SAR compliance in mobile devices
- Left and right flick gesture recognition
- <3 μ A Active sensing in LP mode

How capacitive sensing can reduce standby power in household appliances to well below 50mW

Consumer electrical appliances that are found in virtually every household, such as microwaves, personal computers and television sets, consume a significant amount of power when left in standby mode or even when switched off. Strict regulations are being set in place to limit this standby power, which is said to have exceeded 20 GW in the residential sector of industrialized countries.

Standby power consumption has become one of the largest individual electrical end uses of the residential sector, averaging at 10% (60W per home) [1] of the average power usage of households.

This article will show how to reduce standby power to well below 50 mW, while at the same minimizing cost/complexity and extending the product's expected life. Special attention is given to capacitive proximity sensing, which allows the designer to add a substantial amount of intelligence – waking up and enabling the electronic device only when required and permitting a visual indication to the user of what is required to access the specific features of the device.

The "Culprits"

The term 'off' has become an increasingly relative one as far as electronic appliances are concerned and can refer to the many lower power modes of modern electronic devices. The most popular low-power modes currently in use include standby, sleep, standby active and soft off mode. For the purposes of this article, all non-active modes in which the device is not performing its primary function will be referred to as standby mode.

Almost any product with an external power supply, LED or display that runs continuously, a remote control, a battery-charging functionality or any type of monitoring functionality will draw power continuously. Table 1 provides a condensed overview of some of the most common household appliances, together with their typical standby power consumption.

Appliance	Typical standby power consumption	Contribution to total household standby power consumption
Major appliances	1.4W	13%
Televisions	3.6W	7%
Set top boxes	12.1W	4%
Other home entertainment	3.9W	20%
Computers and peripherals	5.2W	30%
Telephones and other office equipment	3.6W	8%
Monitoring and continuous appliances (alarm systems etc.)	1.1W	10%
Other products	0.4W	5%
External power supplies	1W	N/A (distributed across the device range)

Table 1: Typical Household Appliance Standby Power Consumption

Addressing Standby Power Consumption

There are in essence three broad strategies available to reduce the standby power in household electrical appliances:

1. *Social education.* Educating the public on what to look for when purchasing an electronic appliance, as well as encouraging users to unplug devices not in use.
2. *Technological innovation.* This involves the implementation of innovative technology to improve the efficiency of power supplies, thereby minimizing the power consumed in relation to the functions being used.
3. *Intelligent device behavior and interaction.* This deals with the intelligent activation of low-power modes through user monitoring.

Full Application Note on here.

Page 1 Continued

The examples include most common triggers, such as mobile device covers, glass and metal. The ability of the sensor to adapt to the environment is a key aspect in accurate sensing when in proximity to human and non-human objects.

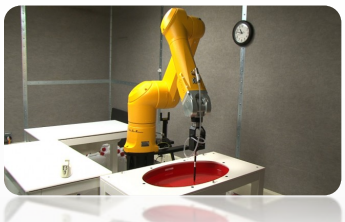
Introduction

The regulations imposed by the FCC (Federal Communications Commission) define a specific absorption rate (SAR), which is a safe measure of the rate at which RF signals are absorbed by the human body. Designers of wireless mobile devices tend to prefer higher output power levels for optimal performance of their product. By adhering to the FCC SAR regulations, output power is reduced in cases where it is required, although also due to a variety of false triggers. Dropped connections and degraded upload performance are more likely to occur as a result of lowered wireless signal output power. The rejection of false triggers is a key aspect of optimizing the performance of a wireless connection.

Solutions are required to distinguish between relevant activations and false activations. Offered in this article are techniques dependent on human behavior and human capability. Proposed is the use of multiple capacitive sensors with advanced adaptive characteristics, strategically placed in order to effectively solve the problem at hand.

Capacitive Sensing

As opposed to IR solutions, capacitive sensing technology is preferred because of lower power consumption, the fact that an aperture is not essential and that it is not sensitive to ambient light conditions. Additional advantages include the small real estate required for the sensor and the low cost of such a solution. Capacitive sensing can be done between a single electrode and the circuit common ground (self-capacitance), or between two electrodes (mutual capacitance). Each method has its advantages, but because of the largely variable parasitic capacitance between the circuit common ground and earth in mobile devices, mutual capacitance techniques are preferred.



Azoteq SAR Standards

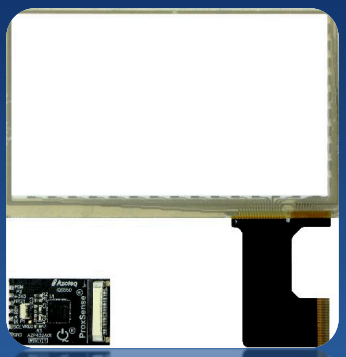
Azoteq SAR solutions are designed to adhere to the following standards:

- IEC 62209-2 ed1.0 standard
- FCC standard (KDB 616217 - D04 SAR for laptop and tablets v01)

Full Application Note on here.

ProxSense® Modules

Azoteq is committed to making things easier for our customers. One way that we do this is by providing modules that are pre-tuned. More information on these modules is located on Azoteq's Website under Products -> ProxSense® Modules.



The IQS550-TS43 is a ProxSense® Module available today!

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