Azoteq

World Leader in Capacitive Proximity Sensing

How capacitive sensing can reduce standby power in household appliances

By Gerrit de Villiers, Azoteq

Consumer electrical appliances consume a significant amount of power when left in standby mode or even when switched off. Standby power consumption has become one of the largest individual electrical end uses of the residential sector, averaging 10% (60W per home) [1] of the average power usage of households. Strict regulations are being set in place to limit standby power consumption, which is said to have exceeded 20 GW in the residential sector of industrialized countries.

This article shows how to reduce standby power to well below 50 mW, while at the same time 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, such as 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.

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Content

To enable next generation capacitive user interfaces and intelligent switch applications for users to interact naturally with products through capacitive proximity and touch

Application Documentation

Azoteq has a wealth of knowledge and it is readily available for all to see. Located on Azoteq's website at www.azoteq.com, a good amount of documentation is located under the design tab.

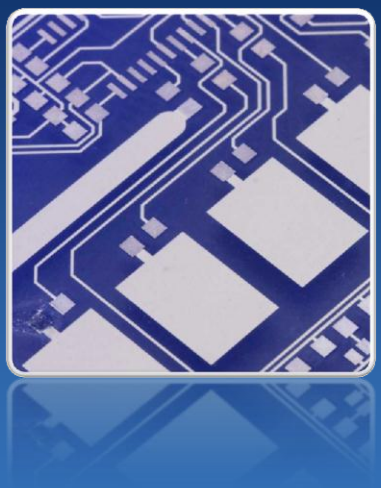
There are datasheets on all devices that Azoteq has available, from self-capacitance to mutual capacitance devices as well as one or multi-channel devices.

Azoteq's Application Notes will aid you in designing your product. Some notes that are available are:

- CAPPO Hardware Design (Designing for Touch on Metal)
- I²C example code
- Wear&Play™ Auto ON-OFF for portable devices
- Mutual Capacitance Button Layout Guideline
- ESD Performance Overview
- Application notes can be found here

Application Notes

Azoteq has Application Notes that range from sample code to design guidelines



Reference Designs

Azoteq also offers reference designs for different ICs and some PCB layouts such as:

- Examples for a PCB layout for a Scroll Wheel and a Slider
- Reference Designs for Capacitive Sensors with differentiated Touch and Proximity Outputs
- Reference Designs for Capacitive Sensor with differentiated Touch and Proximity Outputs through I²C
- Reference Designs for Key Projected Capacitive Sensors with I²C interface
- Reference Designs can be found here

Page 1 Continued

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 1.1 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 [2]

Addressing standby power consumption

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

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.

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.

Intelligent device behavior and interaction: This deals with the intelligent activation of low-power modes through user monitoring.

Social education has its practical limits. Even technological innovation has limits in terms of cost and what is possible given the energy required to keep circuit blocks active.

The third strategy is where the author believes room exists for dramatic improvement in terms of intelligently choosing to disable certain functionality based on whether the user is present or not. The following section offers a few suggestions and examples of user detection and the successive enabling/disabling of electronic circuits.

Intelligent low-power modes with capacitive proximity sensing

Traditionally, low-power modes are activated after a certain fixed delay, the time interval being dependent on the device. However, in many appliances this can limit the usefulness of and features presentable to the user. For example, it is highly desirable to display the current status or the time of day on appliances such as ovens, microwaves and DVD players, but it is useful to do so only when the user is in proximity of the appliance.

Intelligent low-power modes with capacitive proximity sensing are a practical solution due to…

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..the extremely low power consumption (in the order of 3-10 uA) [3] and the low implementation cost of the sensors available today.

Figure 1 illustrates the capacitive proximity sensing principle in which a low-cost PCB copper pour acts as a sense pad to detect the presence of the user. Detection distances of up to 10 cm are easily obtainable, while up to 30 cm and more can be obtained with special attention to the electrode design.

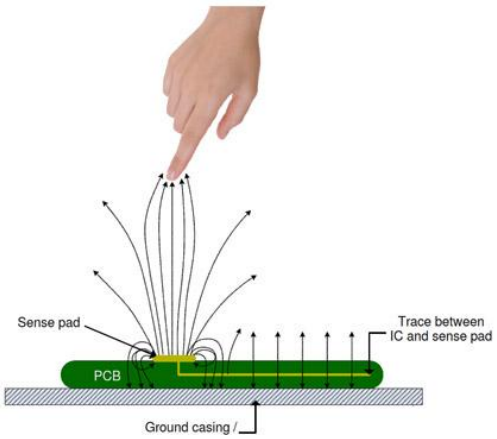

Figure 1 - Capacitive proximity sensing with a sense pad on an inexpensive PCB.

Detecting the presence of a user enables the design engineer to easily add and implement various features, while at the same time requiring lower standby power, as illustrated in **Figure 2**.

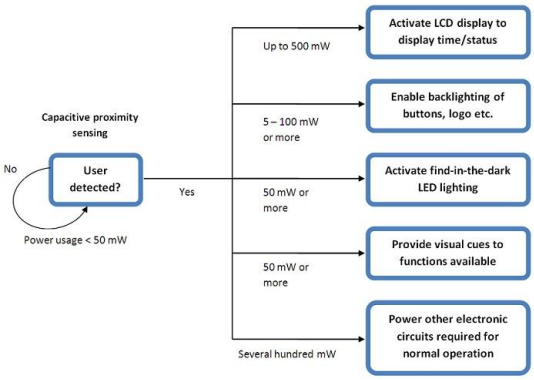

Figure 2 - Intelligent power saving by enabling various functionality only when needed.

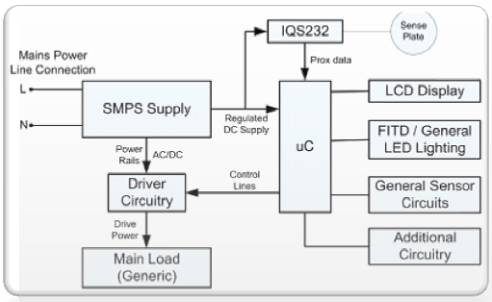

Figure 3

Secondary side display and LED lighting enable/disable with capacitive proximity sensing.

Standby power saving includes:

The LCD can be switched off completely: up to 500 mW power savings if a small LCD color display is used.

The LED backlighting and find-in-the-dark lighting can be disabled: the power savings possible can range from a single 5 mW LED to several LEDs totaling 100 mW or more.

Full Article can be found on Embedded.com here

Proximity and Touch Videos

Azoteq has many videos that demonstrate how our ICs can help your product. These videos are located on Azoteq's website under the Technology Tab.

These videos are also available on Azoteq's YouTube channel at www.youtube.com/azoteqweb.

List of Available Videos:

Corporate	Air Slider
Water Immunity	Keyboard Track pad
Edge Touch for Appliances	RF Noise Immunity
Metal Touch	Remote Control
Auto Tuning	Cell Phone Applications
Air Gestures	Air Button

Azoteq's Videos help you visualize just some of the many applications that ProxSense® can enhance

Sales

Azoteq International
Jean Viljoen
+27 21 863 0033
jean.viljoen@azoteq.com

Azoteq USA
Kobus Marneweck
+1 512 538 1995
kobusm@azoteq.com

Azoteq Asia
Lina Yu
+86 (138) 2696 0845
linayu@azoteq.com.cn

Distributors

Worldwide
Mouser Electronics
+1 800 346 6873
Sales@mouser.com

Worldwide
Future Electronics
+1 514 694 7710

Taiwan
Holy Stone Enterprise Co. Ltd
Terry Chiang
+886 2 2659 6722 ext 302
terrychiang@holystone.com.tw

South Korea
PCTRONIX Corp
Sunny Baek
+82 2 886 0401/2
sunny@pctronix.co.kr

South Korea
SPCorporation
Moon Pack
+82 16 729 6070
+82 2 3012 6070
mpack671@yahoo.co.kr

China
Infortech
Summer Yin
+86 21 51087875 ext 355
summer_yin@infortech.net.cn

South East Asia
Locus Marketing Pte. Ltd
Sam Liew
+65 6299 7308
+65 6292 5848
samliew@locus.com.sg

Representatives

USA- Southern California
O'Donnell South
+1 310 781 2255
sales@odas.com

USA- Northern California
O'Donnell Associates North
+1 408 456 2950
wepich@odonnell.com

Europe – UK, Ireland
Clere Electronics
+44 (0) 1635 291666
peb@clere.com

USA- GA, NC, SC, TN, MS, AL
Quantum Marketing, Inc
+1 310 781 2255
jeannette.ayerbe@qmirep.com

USA- TX, LA
Logic 1 Sales
+1 512 656 4686
david_lykes@logic1sales.com

USA- NY, NJ, PA, DE, MD, VA
Analectro
+1 856 795 6676
sales@analectro.com

Central Europe
ActiveRep GmbH
+49 (0) 812 2227 9270
+49 (0) 171 3098 721
brendon.hutton@activerep.com