Capacitive touch and MSP microcontrollers

A brief intro to capacitive touch and MSP's capacitive touch solutions

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What are capacitive buttons, sliders, wheels and proximity?

Capacitive buttons, sliders, wheels and proximity (BSWP), also known as mechanical button replacement (MBR) is a human machine interface technology using capacitive-sensing techniques. Capacitive BSWP uses touch-sensing electrodes that can be built into an existing PCB allowing for different shapes and sizes, thinner and more elegant designs without added cost. As the electrodes are not mechanical and mounted under plastic, glass or metal overlays, they are more reliable and easy to maintain.

Capacitive BSWP can be used in any HMI application. Some examples are shown in Figure 1.

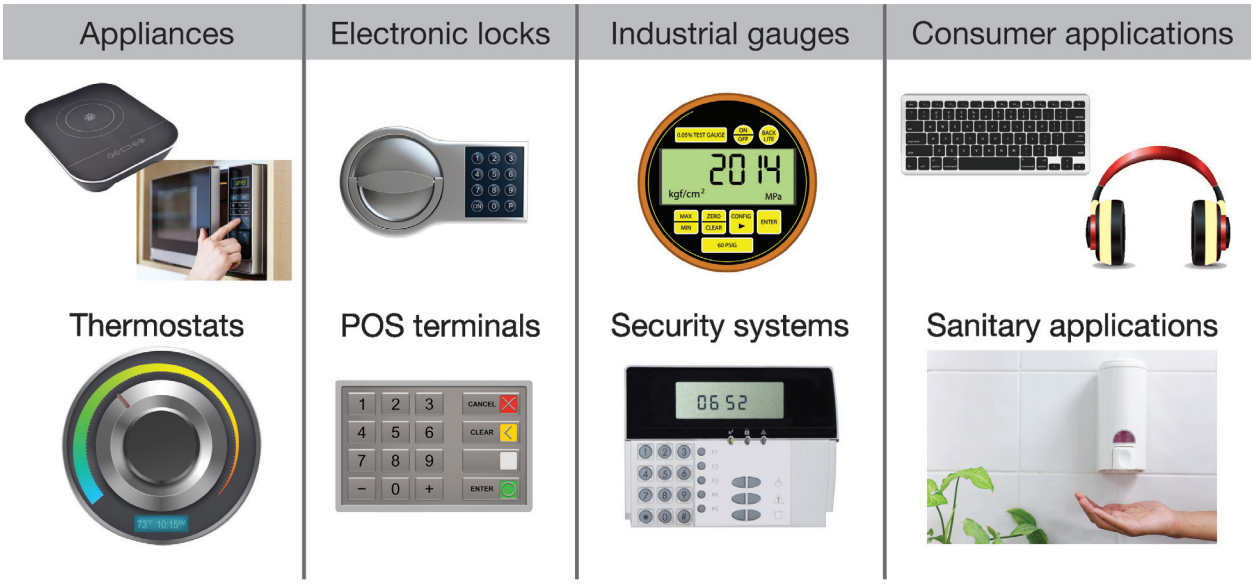

Figure 1: HMI applications for capacitive touch

Types of capacitance

Self capacitance

This method of measuring changes in capacitance with respect to earth ground is commonly referred to as self-capacitance measurement. Capacitive sensing is performing a measurement to detect a capacitive change to a sensor element, which can be any conductive material (copper PCB plane, a wire, etc.). The change can be due to human

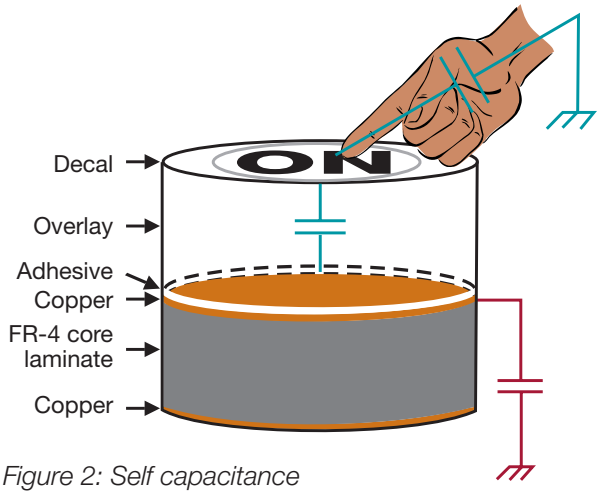

Figure 2: Self capacitance

interaction (finger, ear, hand, etc.) This is often termed “capacitive touch” or “proximity.” A user touches the top of the overlay. The overlay is an insulator, and acts as a dielectric between the user and the copper electrode. A touch causes the capacitance of the electrode to increase (typically 1–10pF),

Mutual capacitance

Mutual capacitance involves measuring a change in capacitance just like self-capacitance, with one big difference: we define both plates of the capacitor, instead of utilizing earth ground as the second plate. Note: Mutual capacitance may also be referred to as projected capacitance.

Mutual capacitance electrodes actually consist of two separate electrode structures, and they require two pins from the microcontroller—a transmit electrode and a receive electrode. When a user touches an area on the panel where a Tx meets an Rx, the mutual capacitance between those Tx and Rx electrodes is reduced. This is because the user’s interaction has the effect of disturbing the electric field propagation between the two electrodes. Users are coupled to earth ground, and the human body is a conductor. Placing a finger in between two mutual capacitance electrodes has roughly the same effect as placing ground between them—it reduces electric field coupling between them, which reduces the capacitance. Typical changes in mutual capacitance due to a touch are small—usually less than 1pF.

Comparison of MSP microcontrollers (MCUs) CapTIvate™ touch technology verses capacitive-touch IOs

MSP MCU has offered button, sliders, wheels and proximity solution in the past using pin oscillator technology (also called Capacitive Touch IO). CapTIvate Touch technology is significant upgrade to legacy MSP430™ capacitive touch as shown in the table on the following page.

To learn more about CapTIvate Touch technology visit **www.ti.com/captivate**.

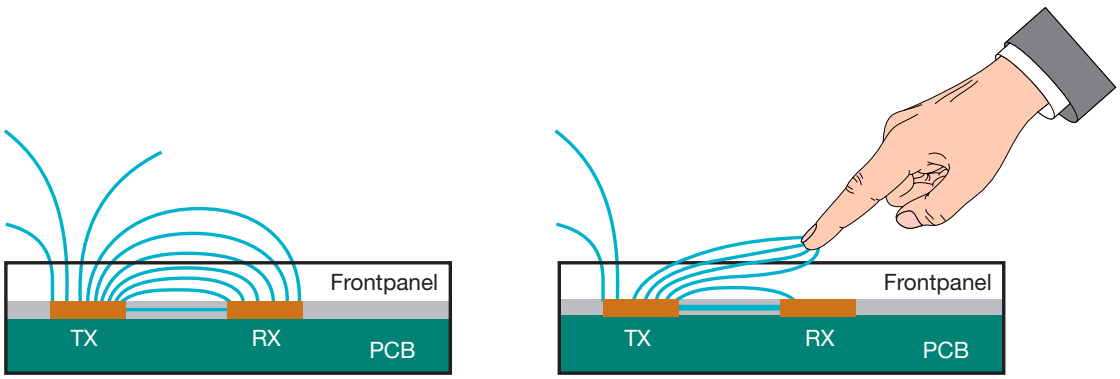

Figure 3: Mutual capacitance

Feature	CapTIvate™ touch technology	MSP430™ capacitive touch IOs
Technology	Charge transfer	Pin oscillator
Noise performance	Frequency hopping, dedicated oscillator for better noise performance to meet EMC standards—IEC61000-4-6, IEC61000-4-4, IEC61000-4-2	No
Scan times	500 µsec for 4 electrodes (64× faster)	32 msec for 4 electrodes
Capacitance measurement	Self, Mutual, Both	Only self
System design	CapTIvate technology library in ROM Dedicated timers/oscillators/regulators	Library in Flash Library uses MCU timers
Tuning	Design Center, real-time, tune all sensors	Manual, tuning
Zero CPU wake on touch	Yes	No
MSP devices supported	MSP430FR2633 MSP430FR2533 MSP430FR2632 MSP430FR2532	MSP430G2xx2 MSP430G2xx3 MSP430G2xx5 MSP430FR58xx MSP430FR59xx MSP430FR4xx MSP430F5xx MSP432P401

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