

# Touch Sensors

## Overview

Touch sensors are finding their way into many applications, from mobile phones to remote controls and appliance control panels. Mechanical button and switch replacement continues to be implemented in a wide variety of applications. Touch sensors with simple linear or rotational sliders, rotary wheels and touch pads offer significant advantages for more intuitive user interfaces. They are more convenient to use without moving parts and provide increased reliability. Using touch sensors allows the designer greater freedom, while reducing overall system cost. The consumer can now enjoy a more appealing, intuitive interface often with a more contemporary look.

Freescale's touch sensors are designed to detect touch and even the presence of objects without relying on physical contact. Touch sensors can support multiple electrodes, where several different applications can be controlled by one sensor. By multiplexing the electrodes, the single sensor becomes an extension for detection at multiple points. For example, capacitive touch sensors are user interface controllers that manage multiple configurations of touch pads, sliders, rotary positions and mechanical keys. Freescale offers a broad portfolio of touch sensors as both standard products and software solutions for applications ranging from gaming controllers to occupant detection. Target markets include consumer, appliance, automotive, industrial, medical and networking.

## Applications

- Gaming controllers
- Home entertainment
- Home appliances
- Cellular handsets
- Portable media devices

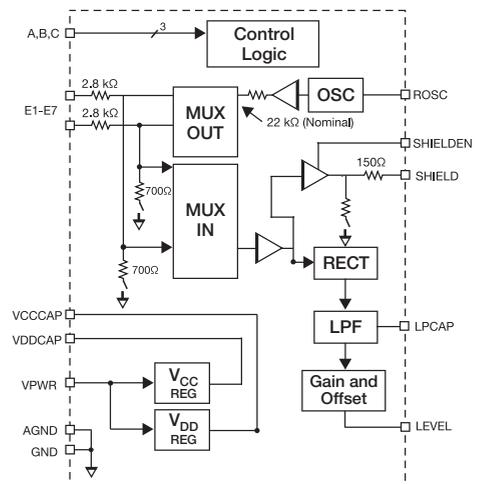
## Features

- Multiple electrode configurations
- Voltage operation range of 1.8 V–18 V
- Analog or digital (I<sup>2</sup>C) interface
- Minimal software integration
- Rotary wheel, linear sliders and touch pad options
- Temperature ranges from -40°C to +110°C
- Various package options

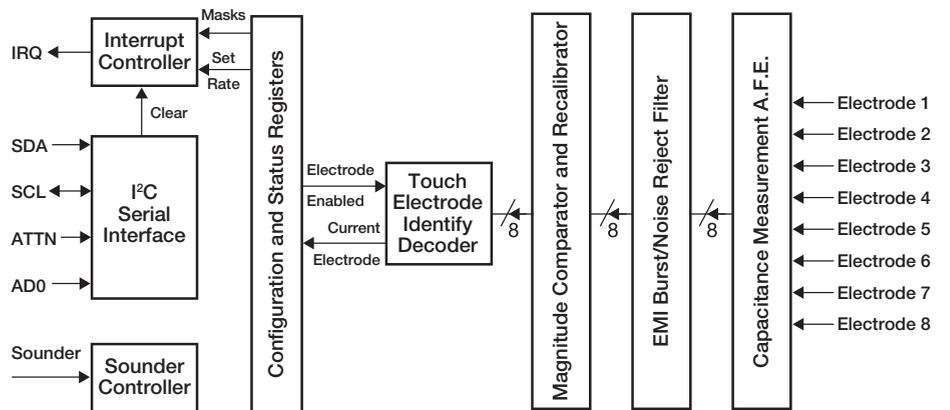
## Benefits

- Mechanical button and switch replacement on a wide variety of applications
- Provides more intuitive user interfaces
- Increases reliability without moving parts
- Allows greater design freedom
- Provides a more contemporary look
- Reduces overall system cost

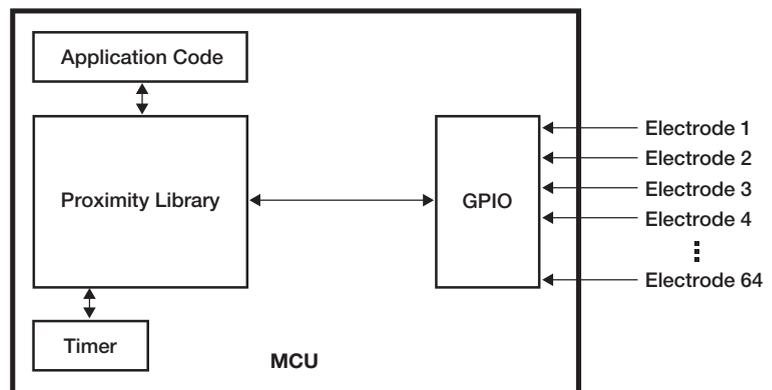
Electric-Field Block Diagram



MPR08x Block Diagram



MCU with Touch Sensing Software Block Diagram



**Touch Sensor Portfolio**

Product	Main Attributes	Shield Driver	No. of Channels	Communications	Package
MPR121	12 touch pads (12 electrodes), 1.71V–3.6V operation, -40°C to +85°C, digital position interface, debounced outputs	No	12	I <sup>2</sup> C	20-pin QFN
MPR031	I <sup>2</sup> C with IRQ, includes a sounder, three pads if IRQ is not being used, controls two electrodes with IRQ, extremely small package	No	3	I <sup>2</sup> C	8-pin uDFN
MPR032	I <sup>2</sup> C with IRQ, includes a sounder, three pads if IRQ is not being used, ability to be the second address on the I <sup>2</sup> C bus, extremely small package	No	3	I <sup>2</sup> C	8-pin uDFN
MC33941	7 electrodes supported, 9V–18V operation, -40°C to +110°C, 5V regulator, RF/environmental noise resistant	Yes	7	Analog	24-pin SOICW

**Touch Sensing for S08/V1 Microcontrollers**

Touch Sensing Software Solution	<ul style="list-style-type: none"> <li>• Complimentary (free)</li> <li>• Downloadable from <a href="http://freescale.com/touch">freescale.com/touch</a></li> <li>• Development kits available as a plug in module</li> <li>• Allows customer to perform both control and UI functions</li> </ul>
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**Development Tools**

KITMPR121EVM	Evaluation board as part of the Sensor Toolbox collection to demonstrate key touch sensor features for 12 touch pads
KITMPR03xEVM	Evaluation board as part of the Sensor Toolbox collection to demonstrate key touch sensor features for 2 or 3 touch pads
DEMOMPR031EVM	Small, self-contained board to demonstrate key touch sensor features
KITMC33941EVM	Evaluation kit featuring capacitive touch sensing with the MC33941 device. It can also be used with the MC34940 device.

**Documentation**

Document Number	Title	Description
SG1010	Product Selector Guide	Sensor device comparison
AN3889	MPR121 Capacitance Sensing Settings	Application note
AN3890	MPR121 Capacitance Sensing: Filtering and Timing	Application note
AN3891	MPR121 Baseline System	Application note
AN3892	MPR121 Jitter and False Detection	Application note
AN3893	MPR121 Touch Sensing	Application note
AN3894	MPR121 LED Driver System	Application note
AN3895	MPR121 Serial Communication	Application note
MPR031PRXSNSRWP	New Possibilities for Freescale Touch Sensors	Overview of application ideas for the MPR031 and MPR032 touch sensors
PROXIMITYWP	Touch Capacitive Sensor Technology for Touch Sensing Applications	Overview of Freescale's Touch Sensor products and technology
AN1985	Touch Panel Applications Using MC34940/MC33794 E-Field ICs	Application note describing touch panel applications
RDTOUCHFRM	Touch Panel Applications Using MC34940/MC33794 E-Field ICs	Application note describing touch panel applications
SITOUCHFRM	Touch Panel System Using E-Field Sensor Setup Instructions	User guide describing touch panel implementation

**Design Challenges**

Below are examples of several electrode layouts. Electrodes in Freescale touch sensors can be widely spaced due to shield driver circuitry, which isolates the electrode signals from external interference as they are transmitted through wires or coax cables to the sensor. This allows designers to use advanced sensing technology to develop large arrays of separate electrodes that can perform identical functions over a wider area. Use the shield driver if there is a need to remotely locate the electrodes. Keep the traces to the electrodes as small and thin as possible. Please see Freescale's application note AN1985, section 3.1 on electrode/pad design or contact your Freescale sales representative.

**Single Pad**

- Simple to implement
- Requires human body to be at virtual ground (For non-battery powered applications)
- Can be any shape
- A sensitive approach


**Multiplexed Pads**

- Can support more pads (e.g. eight electrode connections can support up to 36 pads)
- Uses human body to complete electrical path
- Can realize slider controls



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