S-Touch™ controllers

Ultra-low-power solution for touch sensing

April 2010

S-Touch™ leading technology

Touch-sensing interfaces are simplifying the way people interact with technology. They have not only replaced traditional button-type user interfaces in many applications, but also opened up new markets with high consumer interest.

STMicroelectronics, as a leading semiconductor supplier, has developed the S-Touch family of touch-sensing controllers. These controllers offer highly-efficient solutions for advanced user interfaces. S-Touch controllers give designers the flexibility to create new attractive products with stylish features in applications such as LCD TVs, hi-fi, portable media players, mobile phones, notebooks, home appliances or white goods.

Using a fully hardware approach, S-Touch's fully digital architecture delivers the industry's fastest sampling time, ultra-low power consumption and tiny packages. Add to this ST's customer support, and you have every reason to be using S-Touch controllers.
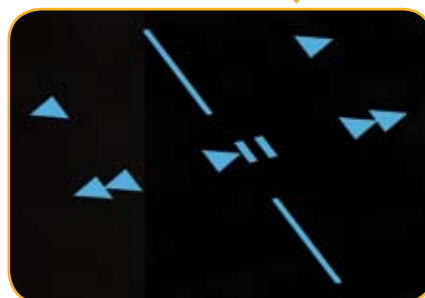
Portable media players

LCD TVs, monitors

TV control panels

- Touch keys, sliders
- Blinking and brightness control
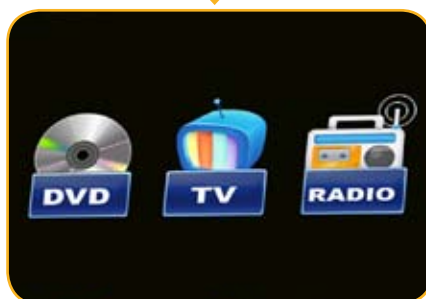
Music control panels

- Touch keys, wheels, sliders
- Blinking and brightness control

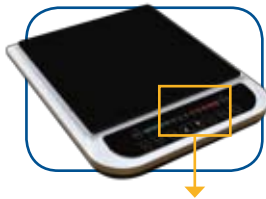## Car radios

Car radio control panels

- Touchscreens

Notebooks

Multimedia control bars

- Touch keys, sliders
- Blinking and brightness control

Telecom

Mobile phones

- Touchscreen

White goods, home appliances

Home appliance control panels

- Touch keys, sliders
- Blinking and brightness control
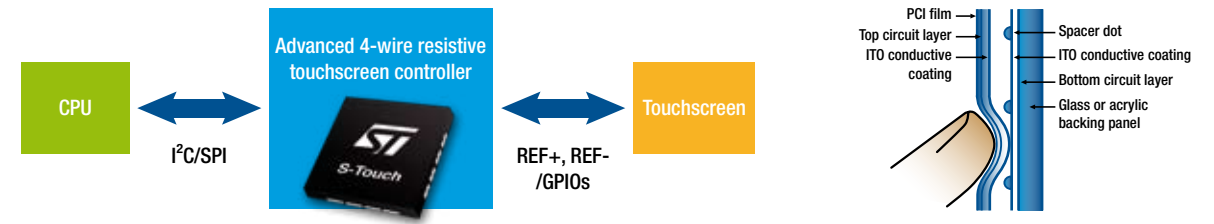
Solution for touchscreen applications

The S-Touch touchscreen controller is a four-wire resistive controller featuring autonomous functionality to minimize demands on the host processor. For embedded designers, this frees valuable CPU cycles to ease pressure on performance, power consumption and response times.

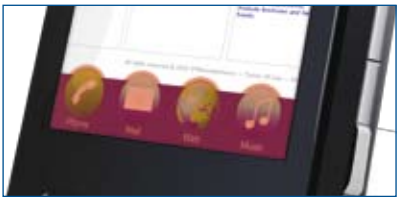| Function	Features	Products
Touchscreen	Advanced movement tracking to reduce CPU/bus use[2] Window masking[2] function for intelligent use of screen 4 kV HBM ESD protection[3] I²C (400 kHz) or SPI (1 MHz) serial interface 128-depth data buffering[2] Ultra-low power consumption: idle <1 µA Ultra-small package	STMPE610 STMPE811 STMPE812[1]

1. Available Q3 2010
2. Only for STMPE811, STMPE610
3. 8 kV HBM ESD protection for STMPE812

Advanced movement tracking
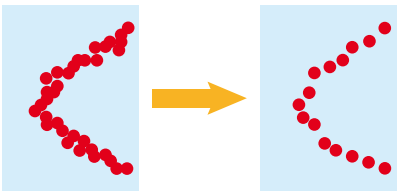
The host may set a value from 4 to 127 as the distance between the new touch position and the previous position so it may be considered as the valid new position. This reduces redundant, nearby data positions.

Window masking

The host may define a rectangle within the full window so that if the touch position falls outside of the defined window, the touch is simply ignored.

Active area   Non-active area

Data buffer (FIFO)

With data buffer

Without data buffer
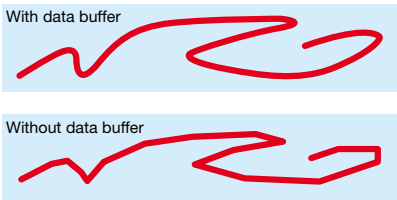
128 sets of data buffers in the touchscreen controller ensure that no data is missing, even if the CPU is busy. Each data buffer contains a 12-bit x-coordinate, a 12-bit y-coordinate and an 8-bit touch pressure interrupt on FIFO full, FIFO empty and FIFO reaching programmable threshold.

S-Touch™ technology for capacitive touch keys, wheels and sliders

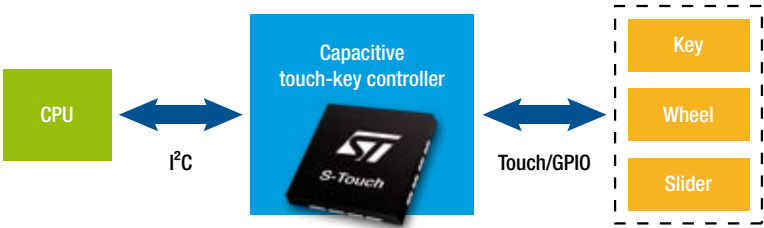The S-Touch capacitive touch-key controller is based on an impedance change detection engine with an all digital, ultra-low-power capacitance measurement architecture. The high sensitivity of the device ensures excellent performance, even with a relatively small sensor pad size (0.30 cm²) under a few millimeters of plastic/glass overlay. Capacitive sensor pads can be built with any conductive material, including standard PCB pads, Flex-PCB, ITO (indium tin oxide).

S-Touch™ capacitive touch-key block diagram

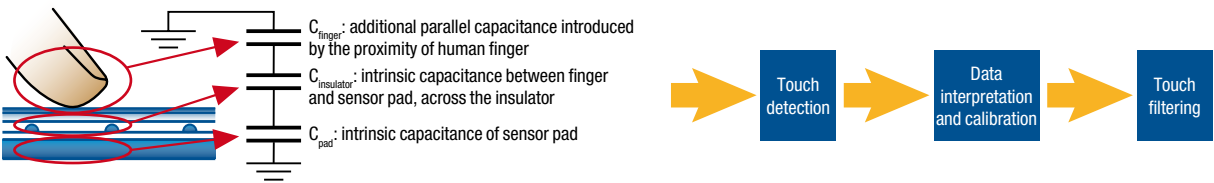| Function	Features	Products
Touch keys	Ultra-low power consumption: 1.8 µA in hibernate mode Ultra-fast sampling time (typ. 2 ms) Highly innovative calibration method enabling high tolerance to environmental changes Intelligent environment tracking calibration (ETC) No external component on sensor lines Ultra-small packages	STMPE321 STMPE821 STMPE1208S
Wheels, sliders	Support for up to 24 highly-sensitive channels Automatic and independent channel calibration Auto-tuning without external components 8 independent PWMs to control up to 16 LEDs Ultra-low power consumption: 5 µA in hibernate mode Built-in ratiometric engine supporting 256-step slider/wheel Proximity sensing capability	STMPE16M31 STMPE24M31 STMPE16M31PX[1] STMPE24M31PX[1]

1. Available Q2 2010

Touch detection

Touching the touch pad increases the capacitance and results in a change of impedance. This is a direct indication of capacitance added by the touch.

Data interpretation and calibration

Environmental factors (temperature, humidity) affect the capacitance value. The calibration unit ensures consistent sensitivity of keys, even when there are significant shifts in temperature, humidity, device lot and PCB.

Touch filtering

When multiple keys are located close together, keys near the touched key sense an increased capacitance due to the proximity of the finger.

C_{finger}: additional parallel capacitance introduced by the proximity of human finger

$C_{insulator}$: intrinsic capacitance between finger and sensor pad, across the insulator

C_{pad}: intrinsic capacitance of sensor pad

Total capacitance sensed by the sensing circuit = (C_{finger} in series with $C_{insulator}$) + C_{pad}

S-Touch designer support

Touch-sensor basic function description

A capacitive sensor electrode is a conductive pad used for the measurement of finger capacitance. It is connected to the sense input of the S-Touch™ controller IC.

Button

The S-Touch™ controller IC measures the capacitance of the button electrode. The button has the basic function of detecting the finger's presence. Any button shape can be implemented, such as square, circle, triangle or others.

Slider

The slider function is used to detect finger movement in a one dimensional direction. One example of its application is volume control.

S1   S2   S3   S4

Wheel

A finger scrolling on the wheel causes a capacitance increase on a few electrodes. The increase of capacitance on the electrodes is then calculated to give the exact location of the finger.

Development tools and software

Samples and evaluation kits can be ordered from our website www.st.com/stouch for quick evaluation and design prototyping.

Evaluation boards for STMPE610, STMPE811, STMPE821, STMPE1208S, STMPExxM31

STEVAL-ICB001V1

General capacitive sensor evaluation board
Features: wheel, slider and touch keys, LCD display for standalone demo, PDA form factor
Typical applications: portable equipment, mobile, white goods, industrial
Products: STMPE1208S, ST72F63BK6M1, L6920D, LD1117S33TR, ST2378E

STEVAL-IHI001V1 + STEVAL-IHI002V1

STEVAL-IHI001V1

This demonstration board is designed to simulate the user interface of a modern washing machine featuring 35 LEDs, 8 keys, a buzzer
Typical applications: home appliances, white goods, ovens, cooking hobs
Products: ST7LITE49M, STLED316S, L5970D

STEVAL-IHI002V1

This board is designed to work as a daughterboard for the STEVAL-IHI001V1. Once plugged in, the STEVAL-IHI002V1 is automatically detected by the motherboard, replacing the mechanical keys by a wheel, a slider and five touch keys
Product: STMPE1208S

STEVAL-ICB003V1

Front panel based on the STLED316S LED driver and STMPE1208S capacitive touch sensor
Features: 4 LEDs (7 segments), 8 LEDs (3 mm), 8 touch keys
Products: STMPE1208S, STLED316S

S-Touch designer support

S-Touch™ support	Description	Reference number	Products	Technology
Application notes	S-Touch™ devices: system considerations	AN2693	Capacitive	Touch key
	S-Touch™ PCB and layout guidelines	AN2733	Capacitive	Touch key
	S-Touch™ design procedure	AN2734	STMPE321, STMPE821, STMPE1208S	Touch key
	S-Touch™ hardware tuning guidelines	AN2801	STMPE321, STMPE821, STMPE1208S	Touch key
	A programming guide for the touch module in capacitive S-Touch™ devices	AN2802	STMPE321, STMPE821, STMPE1208S	Touch key
	S-Touch™ system integration test	AN2805	STMPE321, STMPE821, STMPE1208S	Touch key
	STEVAL-IHI002V1, capacitive touch-sensing keyboard based on the STMPE1208S	AN2843		Touch key
	STEVAL-IHI001V1 demonstration board: washing machine user interface based on the ST7LITE49M and STLED316S	AN2786	STMPE1208S, Motherboard	Touch key
	PCB design guidelines for STMPE16M31, STMPE24M31	AN3176	STMPE16M31, STMPE24M31	Wheels, sliders
	STMPE811 PCB design guidelines	AN2748	STMPE811, STMPE610	Touchscreen
	STMPE811 PCB reference code for touchscreen controller operation	AN2807	STMPE811, STMPE610	Touchscreen
	S-Touch™ STMPE811 touchscreen controller advanced features	AN2825	STMPE811, STMPE610	Touchscreen
Technical notes	Calibration procedure for a resistive touchscreen system based on the STMPE811	TN0074	STMPE811, STMPE610	Touchscreen
User manuals	STEVAL-ICB001V1, touch sensor demonstration board based on STMPE1208S	UM0604	STMPE1208S	Touch key
	STEVAL-IHI001V1 demonstration board	UM0557	STMPE1208S	Touch key
	STEVAL-PCC009V3, STM32-based STMPE821 capacitive touch demonstration kit	UM0868	STMPE821, STM32	Touch key
	STEVAL-ICB003V1 front panel demonstration board based on the STLED316S and the STMPE1208S	UM0756	STMPE1208S	Touch key
	STEVAL-PCC009V1, universal USB to serial communication interface based on the STM32x	UM0726	STMPExxM31, STM32	Touch key
	S-Touch™ tuning Windows PC GUI over STEVAL-PCC009V1	UM0757	STMPExxM31, STM32	Touch key
	STEVAL-ICB004V1, Advanced resistive touchscreen controller demonstration kit based on the STMPE811	UM0772	STMPE811	Touchscreen

STEVAL-ICB002V1[1]

The STEVAL-ICB002V1 daughterboard is based on the STMPE821 8-channel capacitive touch-key controller. This board connects to the STM32-based STEVAL-PCC009V3 interface board.

Product: STMPE821, STM32F103VBT6

1. STEVAL-PCC009V3 interface board included

STEVAL-ICB004V1

The system is designed to demonstrate the high-performance resistive touch-sensing capabilities of the STMPE811 and STMPE610 touchscreen controllers.

Products: STMPE610, STMPE811, STM32F103T8U6

STEVAL-ICB005V1[2]

This evaluation board is designed to simulate the multimedia bar user interface for notebook applications featuring touch keys and a slider for volume control with LEDs for backlighting.
The STEVAL-PCC009V1, STM32-based board, is used to demonstrate the performance of the STMPExxM31 devices.

Product: STMPE24M31, STM32F103

2. STEVAL-PCC009V1 interface board included

S-Touch products

Touch-sensing technology		Part number	Package	Operating voltage	Interface	GPIOs	PWM
Touch keys	Capacitive touch	STMPE321	QFN12, 2.2 x 1.5 mm	1.65 to 1.95 V	I²C	3	-
	Capacitive touch	STMPE821	QFN16, 2.6 x 1.8 mm	2.7 to 3.6 V	I²C	8	4
	Capacitive touch	STMPE1208S	QFN40, 5.0 x 5.0 mm	2.5 to 5.5 V	I²C	12 ; 12	-
Wheels, sliders	Capacitive touch	STMPE16M31	QFN32, 4.0 x 4.0 mm	2.7 to 5.5 V	I²C	16	16
	Capacitive touch	STMPE24M31	QFN40, 5.0 x 5.0 mm	2.7 to 5.5 V	I²C	24	16
	Capacitive touch with proximity	STMPE16M31PX[1]	QFN32, 4.0 x 4.0 mm	2.7 to 5.5 V	I²C	16	16
	Capacitive touch with proximity	STMPE24M31PX	QFN40, 5.0 x 5.0 mm	2.7 to 5.5 V	I²C	24	16
Touchscreens	Touchscreen 4-wire resistive	STMPE610	QFN16, 3.0 x 3.0 mm	1.8 to 3.3 V	SPI/I²C	6	-
	Touchscreen 4-wire resistive	STMPE811	QFN16, 3.0 x 3.0 mm	1.8 to 3.3 V	SPI/I²C	8	-
	Touchscreen 4-wire resistive	STMPE812[2]	Flip-chip 12, 2.1 x 1.6 mm	1.8 to 3.3 V	I²C	4	1
	Capacitive touchscreen	STMPExxM28[3]	-	-	-	-	-

1. Available Q2 2010
2. Available Q3 2010
3. Available Q4 2010

S-Touch controller packages
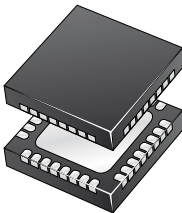

Flip-chip 12
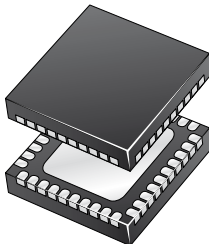2.1 x 1.6 mm

QFN12
2.2 x 1.5 mm

QFN16
2.6 x 1.8 mm

QFN16
3 x 3 mm

QFN32
4 x 4 mm

QFN40
5 x 5 mm

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