# STM8-TOUCH-LIB

## STM8 touch sensing library

**Data brief**

## Features

- Complete C source code library with firmware examples for all STM8 microcontrollers
- Both resistor-capacitor (RC) and charge transfer (CT) acquisition principles supported
- Multifunction capability to combine capacitive sensing functions with traditional MCU features (communications, LED/beeper/ LCD control)
- Configuration of STM8 GPIO as touchkey
- Flexible touchkey/wheel/slider configuration and combination
  - RC acquisition: up to 24 keys and 2 wheels/sliders supported
  - CT acquisition: up to 16 keys and 2 wheels/sliders supported
- Acquisition, filtering and calibration functions
- Enhanced processing features for optimized sensitivity and immunity
- Touch-sensing user interface through firmware API for status reporting and application configuration
- MCU resources
  - Minimized number of external components
  - Reduced MCU memory space
- Up to 8-bit wheel/slider resolution with only three capacitive sensing channels
- Active shield feature
- Compliance with MISRA
- Compliance with Cosmic, IAR and Raisonance C compilers

## Description

STMicroelectronics STM8-TOUCH-LIB is a touch sensing library that provides a complete robust free source-code solution to transform any 8-bit STM8 microcontroller into a capacitive touch sensing controller. This solution allows designers familiar with the use of standard microcontrollers to create higher-end human interfaces by replacing conventional electromechanical switches by touch sensing keys.

The STM8 touch sensing library is part of the application firmware. It allows combining various capacitive sensing touchkey, wheels or sliders with traditional MCU features (communications, control of LEDs, beeper or LCD) in the same application.

Two acquisition principles, RC and CT, are available and can be configured at compiling level. Both acquisition principles offer the same advanced processing algorithms to filter out noise and to compensate environmental parameters such as temperature, humidity, and power supply variation.

# 1 Resistor-capacitor (RC) acquisition principle

The RC acquisition principle consists in measuring the charge and discharge time duration of a RC cell made of the electrode capacitance ($C_X$) and a load resistor ($R_L$).

The RC acquisition is supported by all STM8S and STM8L microcontrollers and requires a direct connection of the device to earth to operate properly.

The main features are the following:

- Up to 24 touchkeys distributed over 3 GPIO ports
- Up to 2 wheels or sliders with 2 different hardware implementations (5 or 8 capacitive sensing channels)
- Capacitive sensing channels are acquired sequentially

# 2 Charge transfer (CT) acquisition principle

The charge transfer acquisition consists in charging the electrode capacitance ($C_X$) and transferring part of the accumulated charge into a sampling capacitor ($C_S$). This sequence is repeated until the voltage across $C_S$ reaches a given threshold. The number of transfers required to reach the threshold depends on the size of the electrode capacitance. This acquisition principle provides a better sensitivity and robustness than RC acquisition.

It requires a dedicated hardware composed of analog switches and STM8L MCU.

The charge transfer acquisition is only supported by STM8L101x and STM8L15x devices since it requires a dedicated hardware composed of analog switches used to interconnect several GPIOs which is only available on these products.

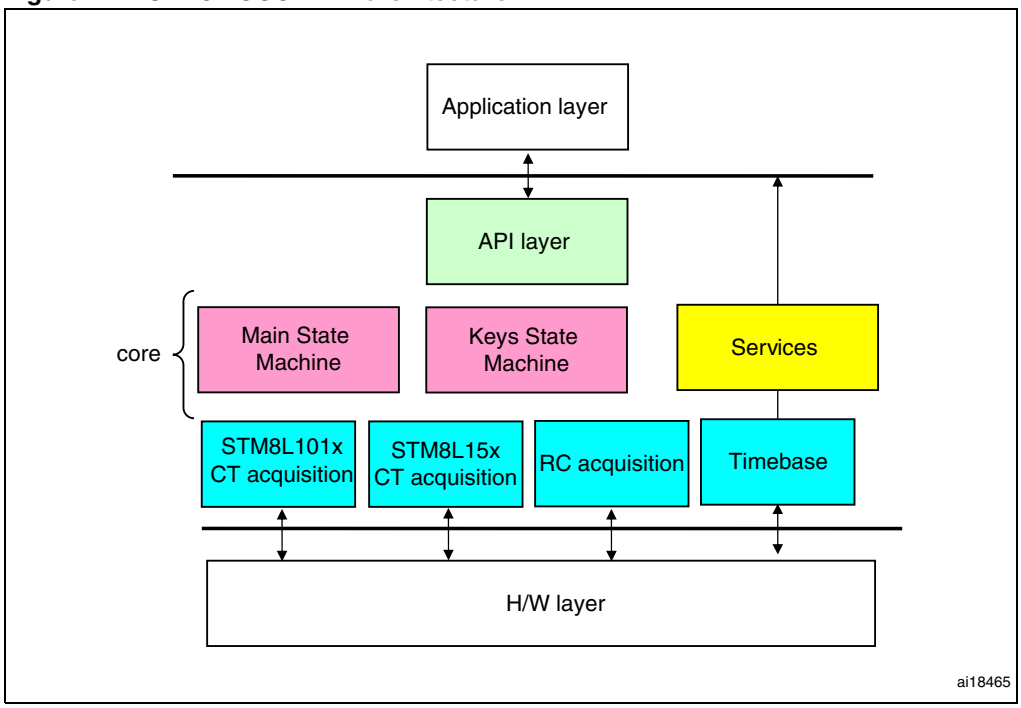
The main features are the following:

- Number touchkeys supported
  - Up to 6 touchkeys on STM8L101x MCUs
  - Up to 16 touchkeys on STM8L15x MCUs
- Up to 2 wheels or sliders with a single hardware implementation (3 capacitive sensing channels)
- Number of capacitive sensing channels acquired simultaneously
  - Up to 2 channels on STM8L101x MCUs
  - Up to 8 channels on STM8L15x MCUs

# 3 Library architecture

*Figure 1* shows the STM8-TOUCH-LIB firmware layers.

**Figure 1. STM8-TOUCH-LIB architecture**



# 4 MCU resources

*Table 1* shows the STM8 peripherals that are used by the STM8-TOUCH-LIB. Care must be taken when using them to avoid any misbehavior.

**Table 1. List of STM8 peripherals used by the STM8-TOUCH-LIB**

| Peripheral | Function | Acquisition principle |
|---|---|---|
| GPIOs | I/O control | RC, CT |
| 16-bit timer with 8-bit prescaler (TIM2 or TIM3) | $V_{IH}/V_{IL}$ measurement | RC |
| 8-bit timer (TIM4) | Generic timebase for the state machine | RC, CT |
| Comparator (COMP) | Charge transfer | CT |
| Routing interface (RI) | I/O control and charge transfer | CT |

## 4.1 Number of charge transfer capacitive sensing channels

*Table 2* and *Table 3* provide the maximum number of charge-transfer capacitive sensing channels for the STM8L101x and STM8L15x package, respectively.

**Table 2. STM8L101x resources used for CT acquisition**

| Acquisition group | I/O port | TSSOP20 / UFQFPN20 | | | | WFQFPN28 | | | VFQFPN32 / LQFP32 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | TSSOP pin | UFQFPN pin | Number of available pins | Usage | Pin | Number of available pins | Usage | Pin | Number of available pins | Usage |
| Group 1 | PB0 | 10 | 7 | 3 | 2 channels with one sampling capacitor | 12 | 4 | 3 channels with one sampling capacitor | 13 | 4 | 3 channels with one sampling capacitor |
| | PB1 | 11 | 8 | | | 13 | | | 14 | | |
| | PD0 | 9 | 6 | | | 8 | | | 9 | | |
| | PD1 | - | - | | | 9 | | | 10 | | |
| Group 2 | PB2 | 12 | 9 | 2 | 1 channel with one sampling capacitor | 14 | 4 | 3 channels with one sampling capacitor | 15 | 4 | 3 channels with one sampling capacitor |
| | PB3 | 13 | 10 | | | 15 | | | 16 | | |
| | PD2 | - | - | | | 10 | | | 11 | | |
| | PD3 | - | - | | | 11 | | | 12 | | |
| Maximum number of channels | | 3 with 2 sampling capacitors | | | | 6 with 2 sampling capacitors | | | 6 with 2 sampling capacitors | | |

**Table 3. STM8L15x resources used for CT acquisition**

| Acquisition group | I/O port | STM8L151 (no LCD) | | | | | | | | | STM8L152 (with LCD) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | WFQFPN28 | | | WFQFPN32 / LQFP32 | | | VFQFPN48 / LQFP48 | | | WFQFPN32 / LQFP32 | | | VFQFPN48 / LQFP48 | | |
| | | Pin | Number of available pins | Usage | Pin | Number of available pins | Usage | Pin | Number of available pins | Usage | Pin | Number of available pins | Usage | Pin | Number of available pins | Usage |
| Group 1 | PA6 | - | 2 | 1 channel with 1 sampling capacitor | 6 | 3 | 2 channels with 1 sampling capacitor | 7 | 3 | 2 channels with 1 sampling capacitor | 6 | 3 | 2 channels with 1 sampling capacitor | 7 | 3 | 2 channels with 1 sampling capacitor |
| | PA5 | 5 | | | 5 | | | 6 | | | 5 | | | 6 | | |
| | PA4 | 4 | | | 4 | | | 5 | | | 4 | | | 5 | | |
| Group 2 | PC7 | - | 2 | 1 channel with 1 sampling capacitor | - | 2 | 1 channel with 1 sampling capacitor | 46 | 3 | 2 channels with 1 sampling capacitor | - | 2 | 1 channel with 1 sampling capacitor | 46 | 3 | 2 channels with 1 sampling capacitor |
| | PC4 | 25 | | | 29 | | | 43 | | | 29 | | | 43 | | |
| | PC3 | 24 | | | 28 | | | 42 | | | 28 | | | 42 | | |
| Group 3 | PC2 | 23 | 1 | cannot be used for touch sensing | 27 | 3 | 2 channels with 1 sampling capacitor | 41 | 3 | 2 channels with 1 sampling capacitor | 27 | 3 | 2 channels with 1 sampling capacitor | 41 | 3 | 2 channels with 1 sampling capacitor |
| | PD7 | - | | | 24 | | | 36 | | | 24 | | | 36 | | |
| | PD6 | - | | | 23 | | | 35 | | | 23 | | | 35 | | |
| Group 4 | PD5 | - | 2 | 1 channel with 1 sampling capacitor | 22 | 3 | 2 channels with 1 sampling capacitor | 34 | 3 | 2 channels with 1 sampling capacitor | 22 | 3 | 2 channels with 1 sampling capacitor | 34 | 3 | 2 channels with 1 sampling capacitor |
| | PD4 | 20 | | | 21 | | | 33 | | | 21 | | | 33 | | |
| | PB7 | 19 | | | 20 | | | 31 | | | 20 | | | 31 | | |
| Group 5 | PB6 | 18 | 3 | 2 channels with 1 sampling capacitor | 19 | 3 | 2 channels with 1 sampling capacitor | 30 | 3 | 2 channels with 1 sampling capacitor | 19 | 3 | 2 channels with 1 sampling capacitor | 30 | 3 | 2 channels with 1 sampling capacitor |
| | PB5 | 17 | | | 18 | | | 29 | | | 18 | | | 29 | | |
| | PB4 | 16 | | | 17 | | | 28 | | | 17 | | | 28 | | |
| Group 6 | PB3 | 15 | 3 | 2 channels with 1 sampling capacitor | 16 | 3 | 2 channels with 1 sampling capacitor | 27 | 3 | 2 channels with 1 sampling capacitor | 16 | 3 | 2 channels with 1 sampling capacitor | 27 | 3 | 2 channels with 1 sampling capacitor |
| | PB2 | 14 | | | 15 | | | 26 | | | 15 | | | 26 | | |
| | PB1 | 13 | | | 14 | | | 25 | | | 14 | | | 25 | | |
| Group 7 | PB0 | 12 | 3 | 2 channels with 1 sampling capacitor | 13 | 3 | 2 channels with 1 sampling capacitor | 24 | 3 | 2 channels with 1 sampling capacitor | 13 | 3 | 2 channels with 1 sampling capacitor | 24 | 3 | 2 channels with 1 sampling capacitor |
| | PD3 | 11 | | | 12 | | | 23 | | | 12 | | | 23 | | |
| | PD2 | 10 | | | 11 | | | 22 | | | 11 | | | 22 | | |
| Group 8 | PD1 | 9 | 2 | 1 channel with 1 sampling capacitor | 10 | 2 | 1 channel with 1 sampling capacitor | 21 | 3 | 2 channels with 1 sampling capacitor | 10 | 1 | cannot be used for touch sensing | 21 | 3 | 2 channels with 1 sampling capacitor |
| | PD0 | 8 | | | 9 | | | 20 | | | - | | | 20 | | |
| | PE5 | - | | | - | | | 19 | | | - | | | 19 | | |
| Maximum number of channels | | 10 channels with 7 sampling capacitors | | | 14 channels with 8 sampling capacitors | | | 16 channels with 8 sampling capacitors | | | 13 channels with 7 sampling capacitors | | | 16 channels with 8 sampling capacitors | | |

# 5 Memory resources

The STM8-TOUCH-LIB size depends on the following parameters:

- Acquisition principle (RC or CT)
- C compiler and options: memory model, size or speed optimization
- Number of capacitive sensing channels used and type (touchkey or/and wheel or slider)

For further information on memory resources for RC and CT acquisition, refer to *Section 5.1*.

## 5.1 RC acquisition memory resources

### Prerequisites

- COSMIC STM8 C Compiler 16-KByte version release 4.3.1 dated 02 July 2009
- Compiler options: +modsl0 +compact +split
- Sections counted for RAM: ZRAM_TSL_IO + ZRAM_TSL + ZRAM_TSLMCK + RAM_TSL_IO + RAM_TSL + RAM_TSLMCK
- Sections counted for ROM: CODE_TSL_IO + CONST_TSL_IO + CONST_TSL + CONST_TSLMCK + CODE_TSL + CODE_TSLMCK

### RAM and ROM requirements

*Table 4* gives the RAM and ROM memory space required to use the STM8-TOUCH-LIB for RC acquisition.

**Table 4. Typical RAM and ROM memory space required for RC acquisition**

| Configuration | RAM (bytes) | ROM (bytes) |
|---|---|---|
| STM8S207<br>5x single-channel keys | ~120 | ~2350 |
| STM8L101x<br>3x single-channel keys | ~90 | ~2350 |

## 5.2 CT acquisition memory resources

### Prerequisites

- COSMIC STM8 C Compiler 16-Kbyte version release 4.3.1 dated 02 July 2009
- Compiler options: +modsl0 +compact +split
- Sections counted for RAM: ZRAM_TSL_IO + ZRAM_TSL + ZRAM_TSLMCK + RAM_TSL_IO + RAM_TSL + RAM_TSLMCK
- Sections counted for ROM: CODE_TSL_IO + CONST_TSL_IO + CONST_TSL + CONST_TSLMCK + CODE_TSL + CODE_TSLMCK

### RAM and ROM requirements

*Table 4* gives the RAM and ROM memory space required to use the STM8-TOUCH-LIB for CT acquisition.

**Table 5. Typical RAM and ROM memory space required for CT acquisition**

| Configuration | RAM (bytes) | ROM (bytes) |
|---|---|---|
| STM8L101x<br>3x single-channel keys | ~90 | ~1800 |
| STM8L15X<br>10x single-channel keys | ~220 | ~1700 |
| STM8L15X<br>10x single-channel keys +<br>1x multichannel key | ~280 | ~4200 |

# 6 Revision history

Table 6. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 27-Sep-2010 | 1 | Initial release. |