RX140 Group

RX140 Capacitive Touch Evaluation System Sample Code

Introduction

This document describes the sample code for the RX140 Capacitive Touch Evaluation System.

Target Device

RX140 (R5F51406ADFN)

Contents

1. Overview

This sample code is software that operates with capacitive touch in the RX140 Capacitive Touch Evaluation system.

The following is added to the project created by e² studio.

- Components generated by the smart configurator
- Capacitive touch configuration files and applications tuning with QE for Capacitive Touch (QE)
- LED control application

The functions are shown below.

1. Capacitive touch function operates all electrodes (3 buttons, slider, wheel, shield) of Capacitive Touch Evaluation Application Board.
2. Press the capacitive touch buttons, slider and wheel to control the LEDs on Capacitive Touch Evaluation Application Board.
3. Enables USB serial interface to control serial communication and supports QE serial monitor and serial tuning. For more information on serial monitoring and serial tuning, refer to QE Help and How to tune via serial communication using the standalone app of QE. | Renesas.
4. LED control is performed in conjunction with the push button on CPU board. Pressing SW2, LED 2 lights up. Pressing SW3, LED3 lights up.

2. Environment for Confirming Operation

The operation of this sample code has been confirmed the following environment.

Table 2-1 Operating Environment

Item	Description
MCU	RX140 (R5F51406ADFN)
Operating frequency	HOCO 48MHz
Operating voltage	5.0V
Evaluation board	RX140 Capacitive Touch Evaluation System (Product No: RTK0EG0039S01001BJ) • RX140 CPU Board (Product No: RTK0EG0038C01001BJ) • Capacitive Touch Evaluation Application Board — Self-Capacitance Buttons / Wheel / Slider Board (Product No: RTK0EG0019B01002BJ)
Integrated development environment	Renesas e² studio Version 2022-04 (22.4.0)
C Compiler	Renesas CC-RX V3.04.00
Development Assistance Tool for Capacitive Touch Sensors	QE for Capacitive Touch V3.1.0
Emulator	Renesas E2 Emulator Lite

3. Software specification

3.1 Software structure diagram

Figure 3-1 shows the software structure diagram of this sample code.
This software uses components generated by the smart configurator.

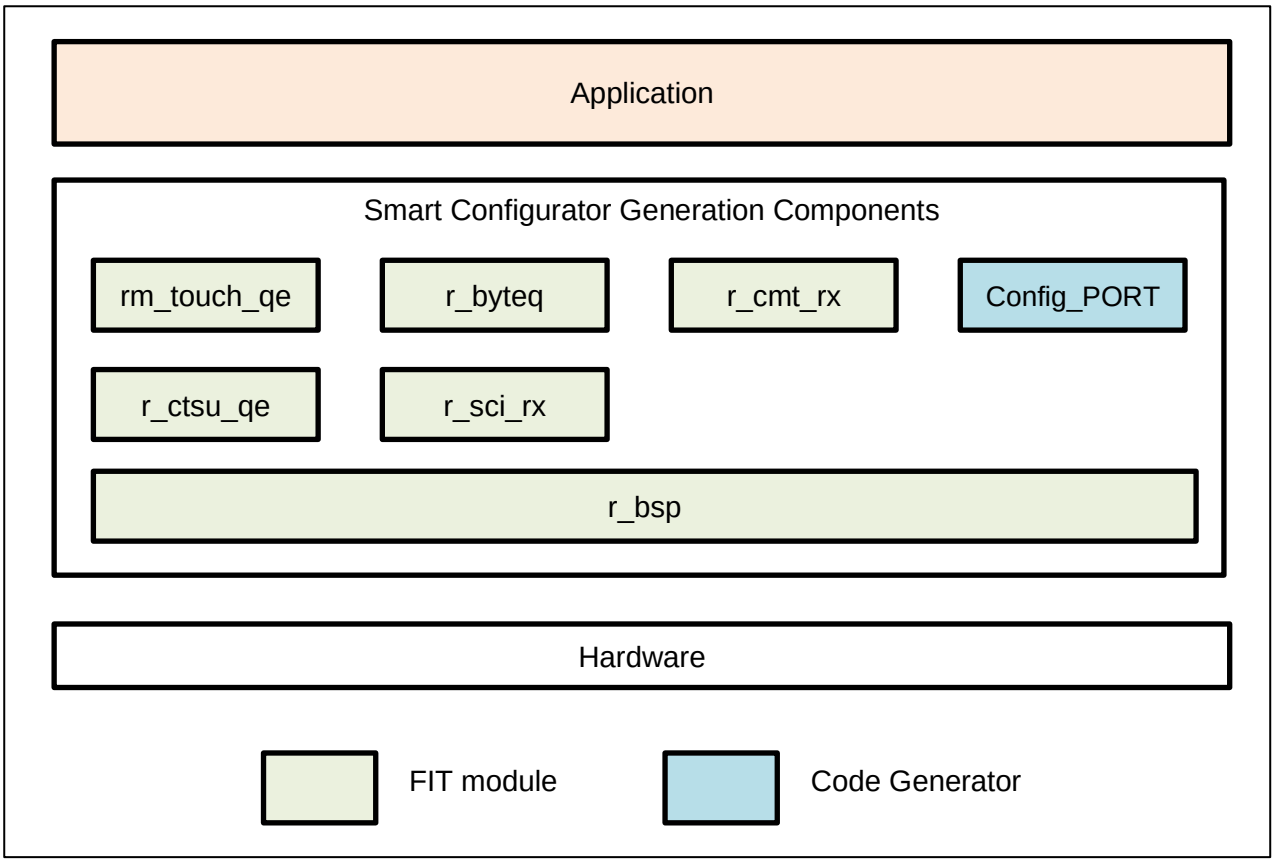

Figure 3-1 Software structure diagram

Table 3-1 shows a list of components and versions. Refer to the smart configurator for component settings.

Table 3-1 Component list

Component	Version	Configuration
Board Support Packages. (r_bsp)	7.10	r_bsp(used)
Byte-based circular buffer library. (r_byteq)	2.00	r_byteq(used)
CMT driver (r_cmt_rx)	5.10	r_cmt_rx(used)
CTSU QE API (r_ctsu_qe)	2.10	r_ctsu_qe(used)
Ports	2.3.0	Config_PORT(PORT: used)
SCI Driver (r_sci_rx)	4.30	r_sci_rx(used)
Touch QE API (rm_touch_qe)	2.10	rm_touch_qe(used)

3.2 File structure

This is the file structure of this sample code.

The project configuration file and smart configurator generation file of the development environment are omitted.

```
rx140_rssk_sample
 │
 ├──QE-Touch
 │     qe_tuning20220415161847.log          ・・・QE Tuning log
 │     rx140_rssk_sample.tifcfg             ・・・Touch interface configuration file
 │
 ├──qe_gen
 │     qe_touch_config.c                    ・・・Touch configuration source
 │     qe_touch_config.h                    ・・・Touch configuration header
 │     qe_touch_define.h                    ・・・Touch define header
 │     qe_touch_sample.c                    ・・・Touch sample application
 │
 └──src
    │  rx140_rssk_sample.c                  ・・・Main file
    │  r_rssk_switch_led.c                  ・・・Switch & LED function source
    │  r_rssk_switch_led.h                  ・・・Switch & LED function header
    │  r_rssk_touch_led.c                   ・・・Touch electrode LED function source
    │  r_rssk_touch_led.h                   ・・・Touch electrode LED function header
    │
    └──smc_gen
       ├──Config_PORT                       ・・・PORT Driver folder
       ├──general                           ・・・general setting folder
       ├──rm_touch_qe                       ・・・TOUCH FIT folder
       ├──r_bsp                             ・・・BSP folder
       ├──r_byteq                           ・・・BYTEQ FIT folder
       ├──r_cmt_rx                          ・・・CMT FIT folder
       ├──r_config                          ・・・FIT configuration folder
       ├──r_ctsu_qe                         ・・・CTSU FIT folder
       ├──r_pincfg                          ・・・PIN configuration folder
       └──r_sci_rx                          ・・・SCI FIT folder
```

3.3 Processing Flowchart

Figure 3-2 shows processing flowchart of this sample code.

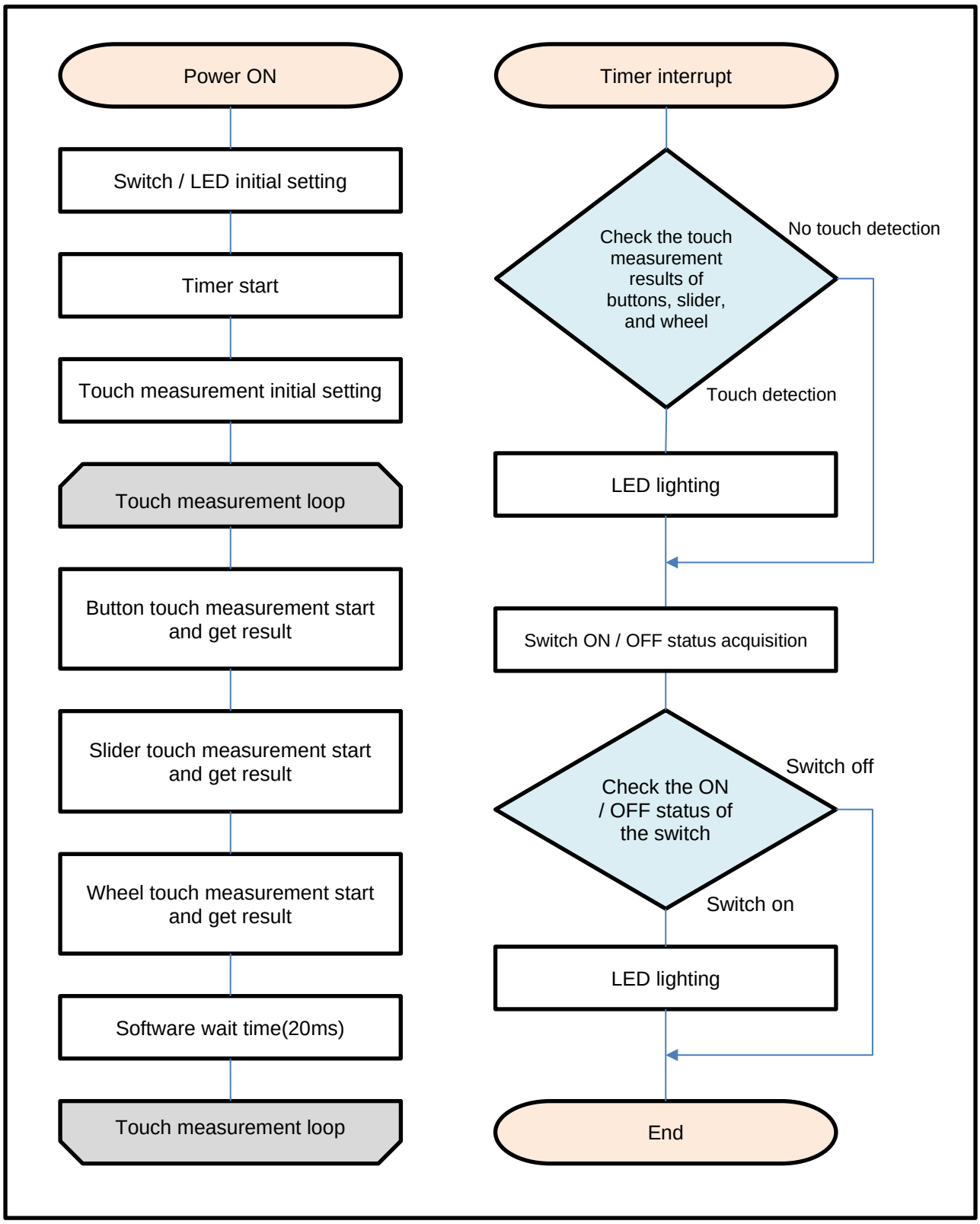

Figure 3-2 Processing Flowchart

4. Capacitive touch settings

These are the touch interface configuration, configuration (method) settings and tuning results of this sample code. These use the tuning function of QE.

4.1 Touch interface configuration

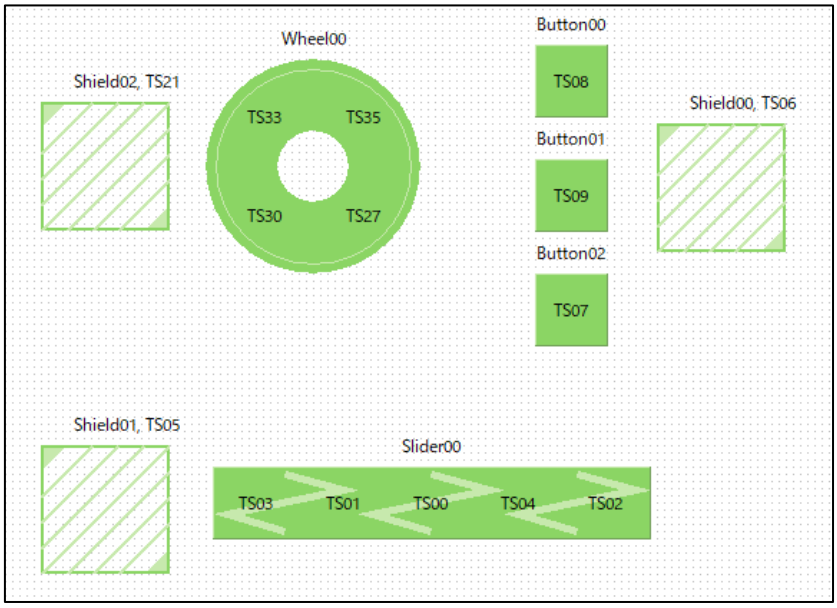

Figure 4-1 Touch interface configuration

4.2 Configuration (methods) settings

config01 sets 3 buttons and shield (TS06)

config02 sets slider and shield (TS05)

config03 sets wheel and shield (TS21)

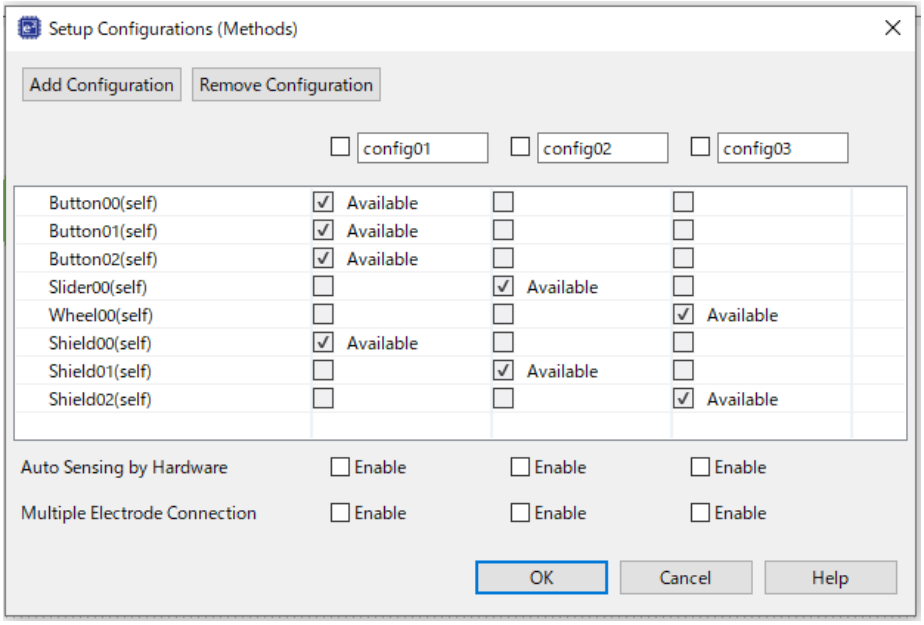

Figure 4-2 Configuration (methods) setting

4.3 Tuning results

Table 4-1 shows tuning results in QE tuning. Sample code operates with the setting values shown in the QE tuning result list.

Since the values in QE tuning result list depend on the operating environment at QE tuning, these values may change at QE tuning again.

Table 4-1 QE tuning result list

methods	Button name	Touch senser	Parasitic capacitance [pF]	Drive pulse frequency [MHz]	Threshold	Scan time[ms]	so	snum	sdpa
config01	Button00	TS08	9.139	1	715	0.576	0x027	0x07	0x0F
config01	Button01	TS09	8.625	1	591	0.576	0x022	0x07	0x0F
config01	Button02	TS07	8.806	1	640	0.576	0x025	0x07	0x0F
config01	Shield00	TS06	47.458	1	-	-	-	-	-
config02	Slider00	TS03	8.285	1	557	0.576	0x01F	0x07	0x0F
config02	Slider00	TS01	7.451	1	557	0.576	0x017	0x07	0x0F
config02	Slider00	TS00	8.972	1	557	0.576	0x023	0x07	0x0F
config02	Slider00	TS04	8.701	1	557	0.576	0x024	0x07	0x0F
config02	Slider00	TS02	8.979	1	557	0.576	0x027	0x07	0x0F
config02	Shield01	TS05	46.618	1	-	-	-	-	-
config03	Wheel00	TS33	11.215	1	661	0.576	0x03C	0x07	0x0F
config03	Wheel00	TS35	11.583	1	661	0.576	0x03F	0x07	0x0F
config03	Wheel00	TS27	9.215	1	661	0.576	0x029	0x07	0x0F
config03	Wheel00	TS30	9.125	1	661	0.576	0x028	0x07	0x0F
config03	Shield02	TS21	43.243	1	-	-	-	-	-

so : Variables for sensor offset settings
snum : Variables for setting the measurement period
sdpa : Clock division setting variable

5. Website and Support

For information on capacitive touch, download tools and documentation, and technical support, please visit the website below.

RX140 Capacitive Touch Evaluation System	renesas.com/rssk-touch-rx140
Renesas Capacitive Touch Solution	renesas.com/solutions/touch-key
QE for Capacitive Touch	renesas.com/qe-capacitive-touch
Renesas Support	renesas.com/support

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	27.Apr.2022	-	First edition issued

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

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1. Precaution against Electrostatic Discharge (ESD)

   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on

   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state

   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.
4. Handling of unused pins

   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.
5. Clock signals

   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.
6. Voltage application waveform at input pin

   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).
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