RA2L1 Group

Touchless Button Demo Solution Sample Software

Introduction

This application note describes the software specification of capacitive touchless button demo solution (RTK0EG0036D01001BJ) as a sample application of self-capacitance method used in Capacitive Touch Sensing Unit2 (CTSU2), the hardware that detects the contact or approach of human body by measuring capacitance generated between touch electrodes and the human body.

Target Device

RA2L1 Group

Related Documents

1. RA Family Using QE and FSP to Develop Capacitive Touch Application (R01AN4934EJ0110)
2. RA2L1 Group Capacitive Touch Evaluation System User's Manual (R12UZ0084EJ0100)
3. RA2L1 Group Touchless Button Demo Solution (Hardware) (R01AN5812EJ0101)

Contents

1. Overview

This application note describes sample software that runs on touchless button demo solution. For description of the corresponding hardware, please refer to ‘Touchless Button Demo Solution (Hardware)' (R01AN5812EJ0101).

1.1 Software Structure

Figure 1.1 shows software structure of this application.

Capacitive measurement with CTSU2 employs software generated by QE for Capacitive Touch [RA], a development support tool for capacitive touch sensor application, and FSP configurator. The software is referred to as QE Touch module and QE CTSU module, respectively.

The application informs the detection result to the user via LEDs and buzzer sound on the touchless button demo solution.

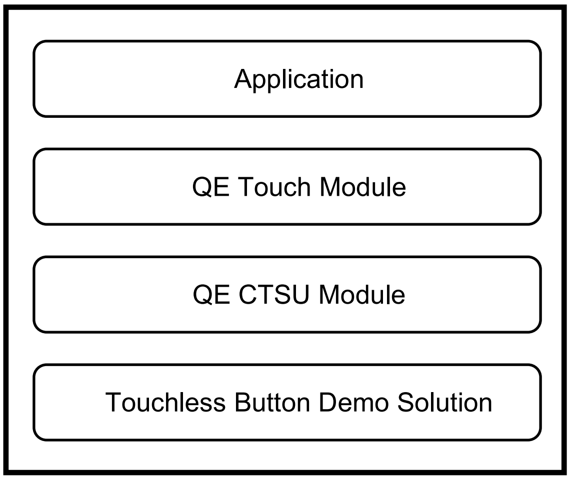

Figure 1.2 Software Structure Diagram

1.2 File Structure

Table 1.1 shows the file configuration used in this sample software. Source files and header files generated by QE touch module and FSP configurator have been omitted for brevity.

Table 1.2 File Structure

Folder/File Name			Description
touchless_sample_project_ra2l1			Project folder
	.cproject		C project file
	.project		Project file
	touchless_sample_project_ra2l1 Debug_Flat.launch		Debug configuration file
	configuration.xml		FSP configurator configuration file
	qe_gen		QE automatically generated file storage folder
		qe_touch_config.c	QE Touch configuration definition source file
		qe_touch_config.h	QE Touch configuration definition header file
		qe_touch_define.h	QE Touch configuration definition header file
		qe_touch_sample.c	Application file
	src		Source/header file storage folder
		r_touchless_led.c	Touchless button demo solution LED control source file
		r_touchless_led.h	Touchless button demo solution LED control header file
		r_touchless_buzzer.c	Touchless button demo solution buzzer control source file
		r_touchless_buzzer.h	Touchless button demo solution buzzer control header file
	QE-Touch		QE for Capacitive Touch generated folder
		touchless_sample_project_ra2l1.tifcfg	Touch I/F configuration file

2. Operation Confirmation

Table 2.1 lists the operating conditions of the software.

Table 2.2 Operating Environment

Item	Description
Evaluation board	RTK0EG0018C01001BJ
MCU used	RA2L1 (R7FA2L1AB2DFP)
Operating frequency	48MHz
Operating voltage	5.0V
Integrated Development Environment	e^2 studio V2021-04
C compiler	GNU ARM Embedded 9.2.1.20191025
Capacitance touch IDE	QE for Capacitive Touch[RA]　V1.3.0.
Emulator	E2 Emulator Lite

Figure 2.1 shows the connection diagram for the touchless button demo solution.

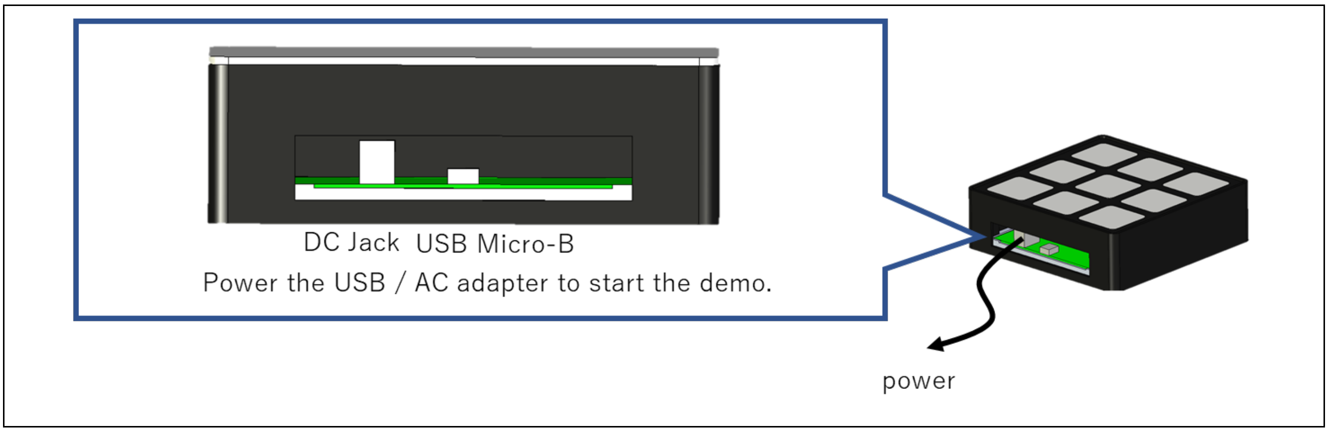

Figure 2.2 Device Connection Diagram

3. Sample Application

The following sample application using Touchless Button Demo Solution has been added to this sample software, based on QE Touch module application file qe_touch_samplet.c.

3.1 Touchless button demo solution Initialization

The following initialization function has been added before main function loop.

- r_touchless_led_initialize () - LED control initialization.
- r_touchless_buzzer_initialize () - Buzzer control initialization.

3.2 Results Notification

After R_TOUCH_DataGet() is called in the main function loop, function r_touchless_led_control () , r_touchless_buzzer_control () has been added to notify the user of the proximity (touch includes) detection results.

It ensures that r_touchless_led_control (), r_touchless_buzzer_control () is called for each touch measurement cycle. Measure the capacitance of each of 9 button electrodes. The proximity or touch is detected when the human body (fingers, hands, etc.) approaches and the measured value exceeds the threshold value, the related LED turns on and buzzer output is controlled.

3.3 Build Option

The sample application supports result notification via the following LED.

- Turns on the LED when proximity (touch includes) of 9 electrodes is detected
- Dim the LED according to the measured value of 9 electrodes

The above result notification can be switched with following build options.

Table 3.1 Build option（r_touchless_led.h）

Item	Description
ENABLE_LED_TOGGLE_LIGHT	Defined: LED lighting enabled (default) Not defined: LED dimming enabled

It is possible to enable or disable buzzer.

The enable/disable of buzzer can be switched with following build options.

Table 3.2 Build option（r_touchless_buzzer.h）

Item	Description
ENABLE_RING_BUZZER	Defined: Buzzer ringing enable (default) Not defined: Buzzer ringing disable

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Revision History

Rev.	Date	Description	
		Page	Summary
1.00	2021.3.17	-	First edition release
1.01	2021.5.21	3	- Change the project name. - Add buzzer control source file and header file to the file structure.
		4	- Change operation voltage to 5.0V. - Update the version of IDE. - Update the version of Capacitive Touch Development Tool. - Change the Figure2.1 - Add buzzer control initialization to the initialization of touchless button demo solution.
		5	- Add buzzer control function to result notification. - Add ‘Build Option’.

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   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

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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.
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   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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