

# 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)

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## 1. Overview

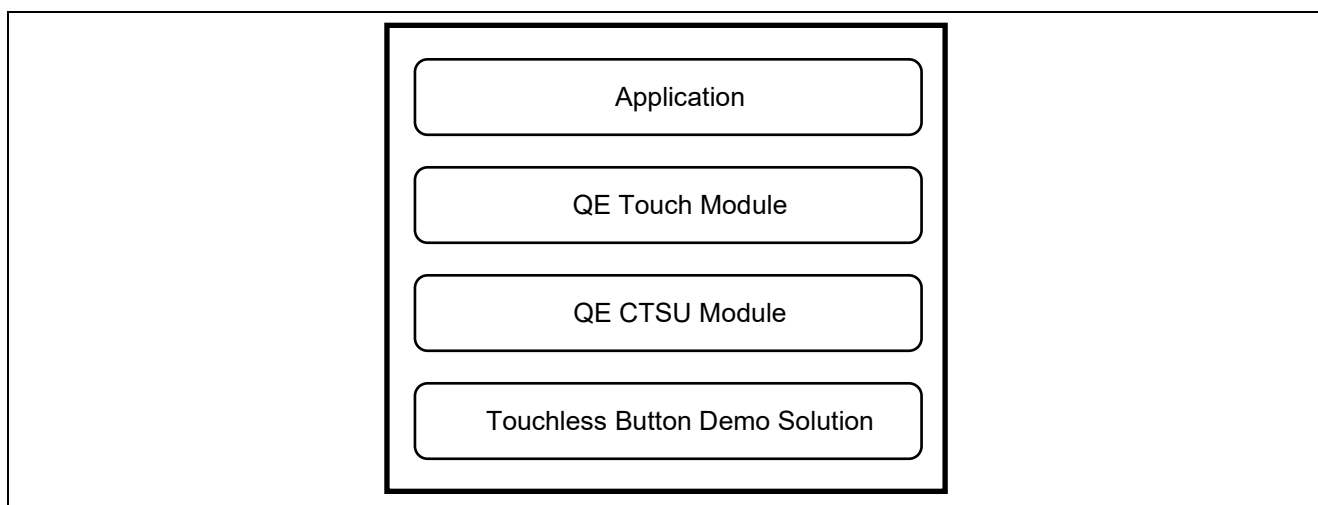
This application note describes sample software that runs on touchless button demo solution. For description of the corresponding hardware, please refer to 'Touchless Button Demo Solution (Hardware)' (R01AN5812EJ0101).

### 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<br>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 <sup>2</sup> 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.

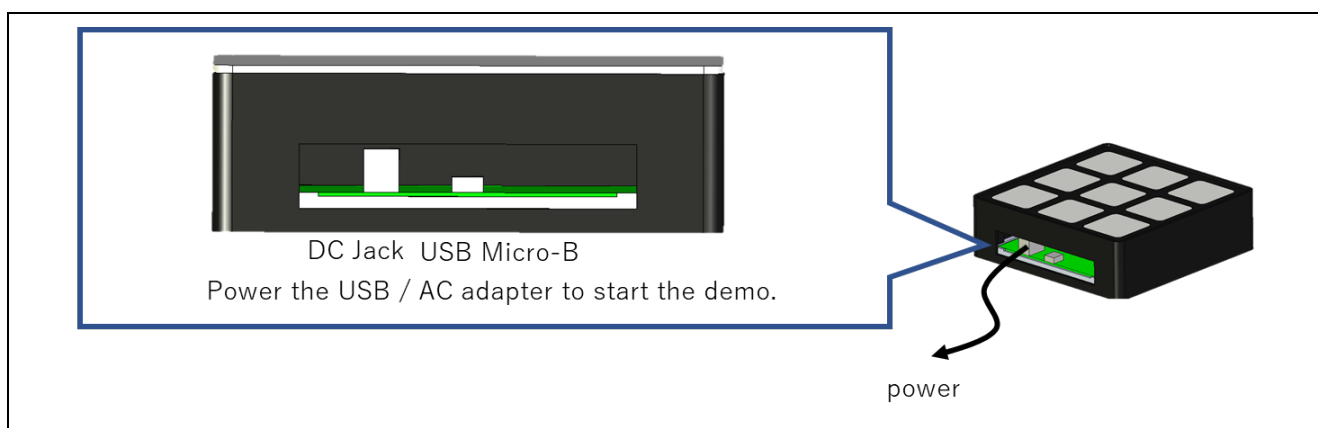


Figure 2.2 Device Connection Diagram

## 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)<br>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)<br>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           | <ul style="list-style-type: none"><li>- Change the project name.</li><li>- Add buzzer control source file and header file to the file structure.</li></ul>                                                                                                                                                                      |
|      |           | 4           | <ul style="list-style-type: none"><li>- Change operation voltage to 5.0V.</li><li>- Update the version of IDE.</li><li>- Update the version of Capacitive Touch Development Tool.</li><li>- Change the Figure2.1</li><li>- Add buzzer control initialization to the initialization of touchless button demo solution.</li></ul> |
|      |           | 5           | <ul style="list-style-type: none"><li>- Add buzzer control function to result notification.</li><li>- Add 'Build Option'.</li></ul>                                                                                                                                                                                             |

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

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

## 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.

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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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