QE for Capacitive Touch V3.5.0

Release Note

Thank you very much for using the QE for Capacitive Touch V3.5.0.

This release note covers product installation, restrictions, and so on. Please read this document before using the product.

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1. About QE for Capacitive Touch

1.1 Summary

QE for Capacitive Touch is an assistance tool for applications and operates under the e^2 studio integrated development environment. In the development of an embedded system based on an RX family, RA family, RL78 family or Renesas Synergy MCU that incorporates the capacitive touch sensing unit (hereafter the CTSU), this product facilitates the easy initialization of touch interfaces and tuning of their sensitivity, thus reducing development times.

To use this product, you will first need to add a project for the RX family, RA family, RL78 family or Renesas Synergy MCU and the capacitive touch sensor-related CTSU driver and Touch middleware.

1.2 Functions

The three functions below make it easy to develop applications that involve capacitive touch sensors.

1. Creating touch interface configurations
2. Tuning
3. Monitoring and parameter adjustment

Also, it is easy to develop gesture applications using e-AI. QE's three functions, "recording function", "AI generation function", and "monitoring and tuning function", support AI application development, which is a difficult process with many steps. Anyone can develop AI applications without the need for specialized AI skills

For more information, please refer to here. https://www.renesas.com/qe-eai-gesture

1.3 New Functions

1.3.1 SMS Function Support

SMS function for RL78/G22 and RL78/G23 is now supported.

1.3.2 Offset Tuning Target Value Improvement

Improved the target value for offset tuning of CTSU2 devices.

1.3.3 Operability of Monitoring Views Improvement

Operability of the CapTouch Status Chart (QE) view / CapTouch Multi Status Chart (QE) view has been improved. It is now possible to display graphs with fixed width, zoom in/out, and move them parallelly using the mouse.

1.3.4 Screen Flicker Improvement during Monitoring

Screen flickering during monitoring has been improved.

1.3.5 Workflow View Redesign

The workflow view of the plug-in version has been redesigned (e.g., font size), but there are no changes to the operating methods.

1.3.6 Renesas Technical Update Support (3 Frequency Measurement Setting Improvement)

For Renesas Technical Update (Document No: TN-RL*-A0136x/E, Notification of Corrections to Errors: Amendments to Descriptions and Limitations on the Capacitive Sensing Unit), the default settings for the 3 frequency measurement when using RL78/G22 and RL78/G23 has been changed.

1.4 Supported Environments

1.4.1 For Plugin Version

Windows 10 (64-bit version), Windows 11

Renesas e^2 studio 2022-10 (or later)

* If you are using a version of the e^2 studio earlier than 2022-10, please update it to 2022-10 or later.

1.4.2 For Standalone Version

Windows 10 (64-bit version) , Windows 11

1.5 Confirmed Debugging Tools

- RX Family
  - E2 emulator
  - E2 emulator Lite
  - J-Link
- RA Family
  - E2 emulator
  - E2 emulator Lite
  - J-Link
- RL78 Family
  - E2 emulator
  - E2 emulator Lite
- Renesas Synergy
  - J-Link

1.6 Supported Microcontrollers

- RX Family (only MCUs that incorporate the CTSU)
  - RX100 Series: RX113, RX130, RX140
  - RX200 Series: RX230, RX231, RX23W
  - RX600 Series: RX671
- RA Family (only MCUs that incorporate the CTSU)
  - RA2A Series: RA2A1
  - RA2E Series: RA2E1
  - RA2L Series: RA2L1
  - RA4M Series: RA4M1, RA4M2, RA4M3
  - RA4W Series: RA4W1
  - RA6M Series: RA6M1, RA6M2, RA6M3, RA6M4, RA6M5
- RL78 Family (only MCUs that incorporate the CTSU)
  - RL78/G16
  - RL78/G22
  - RL78/G23
- Renesas Synergy (only MCUs that incorporate the CTSU)
  - S1 Series: S124, S128, S1JA
  - S3 Series: S3A1, S3A3, S3A6, S3A7
  - S5 Series: S5D3, S5D5, S5D9
  - S7 Series: S7G2

1.7 Supported Software

- Driver and middleware for capacitive touch sensor
  - RX Firmware Integration Technology (FIT)
    - CTSU driver: r_ctsu_qe V2.20 (or later)
    - Touch middleware: rm_touch_qe V2.20 (or later)
  - RA Flexible Software Package (FSP)
    - CTSU driver: r_ctsu V5.3.0 (or later)
    - Touch middleware: rm_touch V5.3.0 (or later)
  - RL78 Software Integration System (SIS)
    - CTSU driver: r_ctsu V1.50 (or later)
    - Touch middleware: rm_touch V1.50 (or later)
  - Renesas Synergy Software Package (SSP)
    - CTSU driver: r_ctsuv2 V2.6.0 (or later)
    - Touch framework: sf_touch_ctsuv2 V2.6.0 (or later)

2. Installation and Uninstallation

2.1 Installing This Product

Use either of the following procedure to install this product.

2.1.1 Install from the "Renesas Software Installer" menu of e² studio

1. Start e² studio.
2. Select the “Renesas Views” – “Renesas Software Installer” menu of e² studio to open the “Renesas Software Installer” dialog box.
3. Select the “Renesas QE” and click the “Next>” button
4. Select the “QE for Capacitive Touch (v3.5.0)” check box, and click the “Finish” button.
5. Check that the “Renesas QE for Capacitive Touch” check box is selected in the “Install” dialog box, and click the “Next>” button.
6. Check that the “Renesas QE for Capacitive Touch” check box is selected as the target of installation, and click the “Next>” button.
7. After confirming the license agreements, if you agree to the license, select the “I accept the terms of the license agreements” radio button, and click the “Finish” button.
8. If the dialog of the trust certificate is displayed, check that certificate, and click the “OK” button to continue installation.
9. When prompted to restart e² studio, restart it.
10. Start this product from the “Renesas Views” - “Renesas QE” menu of e² studio. For details about how to use this product, see the “Help” menu of e² studio.

2.1.2 Install using QE (zip file) downloaded from the Renesas website

A downloaded zip file has both a plugin version and a standalone version.

2.1.2.1 Install Plugin Version

1. Extract the downloaded zip file.
2. Start the e² studio.
3. Click on “Help”, and then click on the “Install New Software...” menu item to open the “Install” dialog box.
4. Click on the “Add...” button to open the “Add Repository” dialog box.
5. Click on the “Archive...” button, select the installation file (zip file under the QE-CapTouch folder) in the opened file selection dialog box, and then click on the “Open” button.
6. Click on the “OK” button in the “Add Repository” dialog box.
7. Expand the “Renesas QE” item shown in the “Install” dialog box, select the “Renesas QE for Capacitive Touch” check box, and then click on the “Next>” button.
   * If you check off the “Contact all update sites during install to find required software” checkbox, you can shorten the installation time.
8. Confirm that the installation target is “Renesas QE for Capacitive Touch”, and then click on the “Next>” button.
9. After checking the license, select the “I accept the terms of the license agreements” radio button if you agree it, and then click on the “Finish” button.
10. When the dialog box for selecting a trusted certificate appears, check the displayed certificate, and then click on the “OK” button to continue installation.
11. Restart the e² studio by following the instructions on the screen.
12. Start this product from the “Renesas Views” - “Renesas QE” menu of the e² studio.

2.1.2.2 Install Standalone Version

1. Extract the downloaded zip file.
2. Move the QE-CapTouch folder to any folder.
   * Avoid moving to the Windows folder or Program Files folder or folders whose name contain spaces.
3. Start this product from the “QE-CapTouch\eclipse\qe-captouch.exe” file.

2.2 Updating This Product (for Plugin Version)

If you have already installed this product, you can update it in the same way as the procedure for installation 2.1.2.1.

2.3 Uninstalling This Product

Follow the procedure below to uninstall this product.

2.3.1 Uninstall Plugin Version

1. Start the e^2 studio.
2. Select “Help -> About e^2 studio” to open the “About e^2 studio” dialog box.
3. Click the “Installation Details” button to open the “e^2 studio Installation Details” dialog box.
4. Select “Renesas QE for Capacitive Touch” displayed on the “Installed Software” tabbed page and click on the “Uninstall...” button to open the “Uninstall” dialog box.
5. Check the displayed information and click on the “Finish” button.
6. When you are prompted to restart the e^2 studio, restart it.

2.3.2 Uninstall Standalone Version

1. Delete the QE-CapTouch folder.

3. Notes / Restrictions

3.1 Usage Considerations

Please pay attention to the following items.

3.1.1 Notes on View Operation

1. When floating (detaching from e^2 studio) each view in QE for Capacitive Touch, it may not function correctly.
   Please use each view without floating.

3.1.2 Notes on Tuning

1. If there are multiple debugging configurations in the target project, automatic tuning may fail. Please check whether it is possible to debug the target board manually. If there are multiple debugging configurations in the target project, the configurations used for debugging in the last time is chosen to automatic tuning. If the debug configuration used in last time is different from the project for automatic tuning, QE cannot start debugging. Before starting automatic tuning, please debug target project once.
2. When the “Automatic Tuning Processing” dialog box is waiting for key input, pressing the “Cancel” / “Help” button is not possible.
3. When using the version shown below, the value set in the "Target Value of Offset Tuning" field in the tuning process using advanced mode will not be applied and no effect will be obtained.
   - RX FIT V2.00 or earlier
   - RA FSP V3.4.0 or earlier
   - RL78 SIS V1.10 or earlier
   - Synergy SSP V2.1.0 or earlier
4. When using FSP V3.5.0 or earlier with a product equipped with CTSU, the tuning function using serial communication cannot be used for the mutual capacitance method touch I/F with the DTC function enabled.
   Please use FSP V3.6.0 or later.
5. When using FSP V4.3.0 or later on a board without a sub-clock (e.g. Capacitive Touch Evaluation System for RA2L1), the project is not executed up to the main() function and the tuning function cannot be used.
   Change the FSP's “BSP” property – “Subclock Populated” setting to "Not Populated".
6. When using RL78/G22, the tuning function cannot be used for touch I/F configuration that include current sensor.

3.1.3 Notes on Monitoring

1. When using FSP V3.3.0 or V3.4.0, the monitoring function cannot be used. Please set "Support for QE monitoring using UART" of rm_touch property to "Enabled". Or please use FSP V3.5.0 or later.
2. When monitoring using serial communication on the RX family, set the TX buffer size of the SCI FIT module (r_sci_rx) to the same size as the QE monitoring buffer (g_touch_monitor_buf).
   The QE monitoring buffer size is the value defined by the TOUCH_MONITOR_BUFFER_SIZE macro.
3. If you need to perform memory access while monitoring using serial communication on RL78/G16, the following settings are required.
   - Set "Pseudo-RRM/DMM function setting" to "Used" in Smart Configurator.
   - In the C/C++ build settings of the project, set the address in “Tool Settings” – “Linker” – “Device” – “Reserve working memory for RRM/DMM function (-rrm)” so that the first 4 bytes of RAM are not used.

- In the debug configuration, set "Debugger" - "Debug Tool Settings" - "Allow to access by stopping execution while running" to "Yes".

3.1.4 Notes on Serial Connection

1. Before connecting to RL78/G23-128p Fast Prototyping Board (FPB) using a serial port, see the documentation that came with the FPB.
2. If you use RL78 SIS (V1.30 or earlier) and CC-RL compiler (V1.12.00 or later), and set the optimization level of CC-RL compiler to "-Olite", serial tuning cannot be performed on RL78 family.
   If you want to perform serial tuning, please use RL78 SIS V1.40 or later, or set the optimization level of CC-RL compiler to "-Onothing".

3.1.5 Notes on creating touch interface configuration

1. The RAM size of the MCU may be exceeded depending on the number of touch interfaces (buttons, sliders, wheels, etc.). Please create the touch interface configuration considering the amount of memory used by the touch function and the user program. Pay particular attention to MCU, which has a maximum RAM size of 2 KB.

3.1.6 Notes on Standalone Version

1. It may be slow to enable / disable the internal toolbar buttons of each view. Please move the focus to another view once.
2. The 3D gesture recognition is not available in the standalone version. Please use the plugin version.

3.1.7 Notes on TrustZone

1. When using TrustZone with RA6M4 etc., the tuning processing cannot be performed on the non-secure side. Please perform the tuning process on the secure side and use results on the non-secure side.

3.1.8 Notes on Automatic Judgement Function (Auto Sensing by Hardware)

1. When using the automatic judgement function, tuning and monitoring using serial communication are not available.
2. Even when you start monitoring, there may be cases where the monitoring data is not updated. After pausing and resuming the program, please start monitoring again.
3. When the touch threshold or hysteresis value is changed in the CapTouch Parameters view and then written to the target board, the value may not change to the specified value or may change to a value different from the specified value.
   In the case of touch threshold, change the hysteresis value to a sufficiently small value before writing.
   In case of hysteresis, please change the value of touch threshold to a sufficiently large value before writing.
4. The SNRSUM in the Standard Deviation Measurement Result is for reference only.
5. When there are auto and software judgement configuration in touch I/F configuration, touch I/F configuration which can be monitored are listed below.

Ex)	Method 1	Method 2	Method 3	Monitoring
1	Software judgement	Software judgement	Auto judgement	Method 1,2 : Monitoring available Method 3 : Monitoring unavailable
2	Auto judgement	Software judgement	Software judgement	Method 1 : Monitoring available Method 2,3 : Monitoring unavailable
3	Software judgement	Auto judgement	Software judgement	Method 1 : Monitoring available Method 2,3 : Monitoring unavailable

3.1.9 Notes on LV Mode

1. Tuning and monitoring in LV mode are not supported. Support for LV mode is planned for future releases.

3.1.10 Notes on CapTouch Workflow (QE) View

1. The workflow view has been changed from CapTouch Main (QE) view to CapTouch Workflow (QE) view starting from QE for Capacitive Touch V3.2.0. When QE for Capacitive Touch is updated to V3.2.0 with the CapTouch Main (QE) view displayed, an error message "Could not create the view" appears in the CapTouch Main (QE) view.

   [Workaround]
   Close the CapTouch Main (QE) view and use the CapTouch Workflow (QE) view.

2. If you press the "Maximize"/"Restore" button in the e^2 studio window while playing a tutorial video with the video window maximized, you will not be able to maximize the video window again.

   [Workaround]
   Close and re-open the CapTouch Workflow (QE) view.

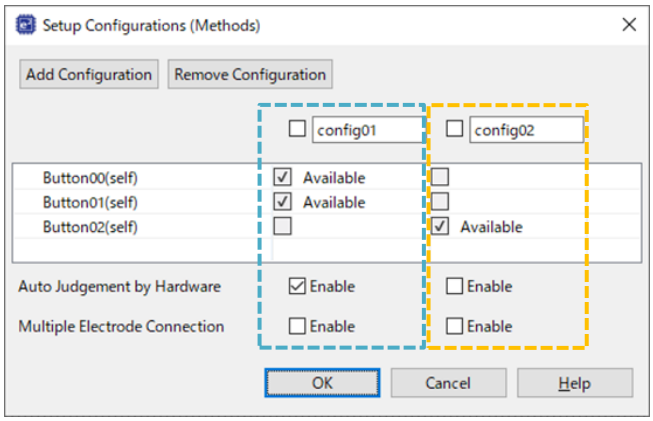
3. The workflow cannot be opened if WebView2 Runtime is not installed on your PC.

   [Workaround]
   Download and install WebView2 (x64 version) from the Microsoft web page.（FAQ:3000670）

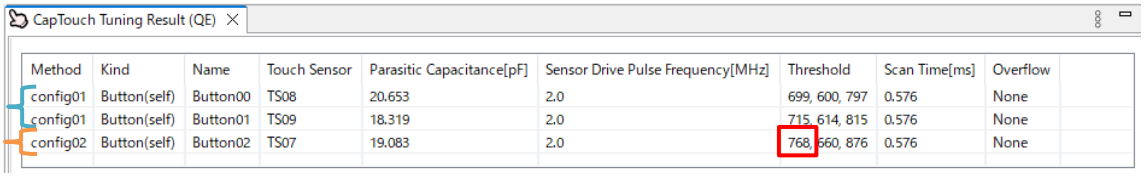
3.1.11 Notes on CapTouch Tuning Result (QE) View

1. When there are auto and software judgement configuration in touch I/F configuration, the threshold values for software judgement displayed in the CapTouch Tuning Result (QE) view are incorrect.
   Out of the three displayed threshold values, the correct value is twice the first threshold value.

Example :
Config01 : Auto judgement
Config02 : Software judgement



Button02 Threshold : 768×2 = 1536



Method	Kind	Name	Touch Sensor	Parasitic Capacitance[pF]	Sensor Drive Pulse Frequency[MHz]	Threshold	Scan Time[ms]	Overflow
config01	Button(self)	Button00	TS08	20.653	2.0	699, 600, 797	0.576	None
config01	Button(self)	Button01	TS09	18.319	2.0	715, 614, 815	0.576	None
config02	Button(self)	Button02	TS07	19.083	2.0	768, 660, 876	0.576	None

3.1.12 Notes on Using e² studio 2023-01 to 2024-04

1. Renesas Synergy projects are not available.
   Use e² studio 2022-10.

3.1.13 Notes on Installation

1. When installing QE for Capacitive Touch V3.5.0 plugin version, the “Trust Artifacts” dialog box displays the QE for Capacitive Touch plugin as unsigned.
   Check “Unsigned” and click the “Trust Selected” button to continue the installation.

3.2 Functional Restrictions

There are restrictions in QE for Capacitive Touch V3.5.0.

3.2.1 Restrictions on Standalone Version

1. Help files are not existed.

3.2.2 Restrictions on RL78/G16 monitoring function

1. When using RL78/G16, monitoring using an emulator is not available. Please use serial communication for monitoring.
   When debugging by memory access during monitoring, refer to 3.1.3 Notes on Monitoring.

3.2.3 Restrictions on monitoring function of Auto judgement

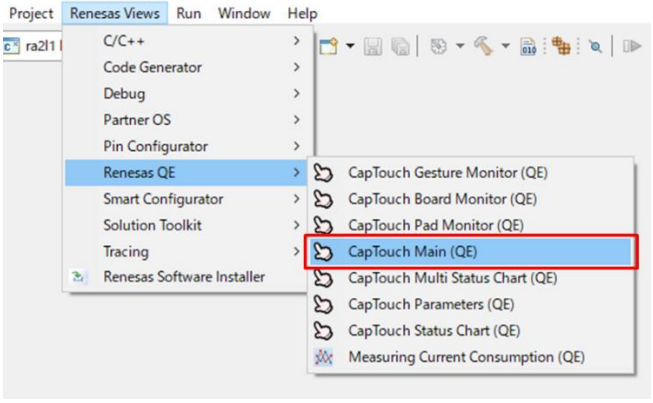
1. When monitoring a touch I/F configuration with auto judgement, the output parameter file function in the CapTouch Parameters (QE) view is not available.

4. Old and New Workflow Comparison

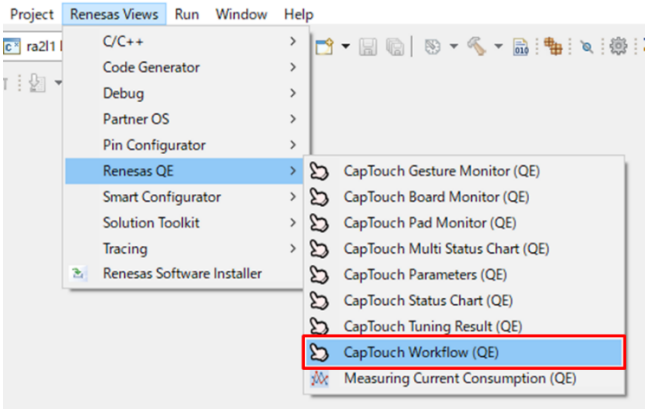
The workflow view has been redesigned in QE for Capacitive Touch V3.2.0. The differences between the old and new workflows are described below.

4.1 How to open the workflow

- Old Workflow
  Open the workflow view from the "Renesas Views" - "Renesas QE" - "CapTouch Main (QE)" menu.

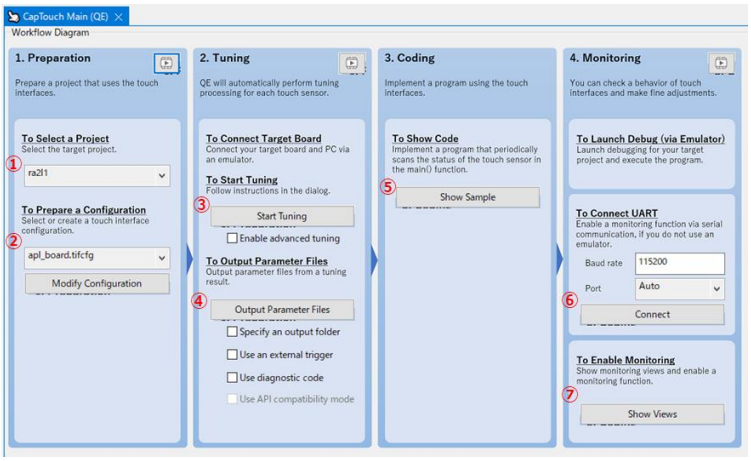


- New Workflow
  Open the workflow view from the “Renesas Views” – “Renesas QE” – “CapTouch Workflow (QE)” menu.



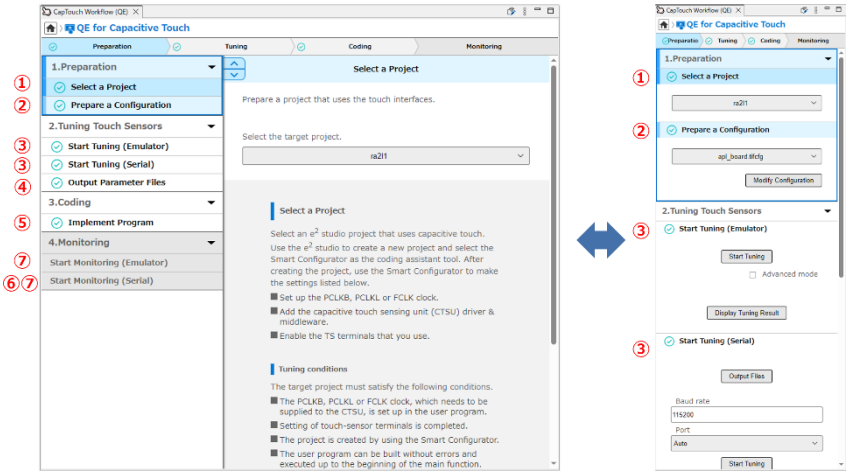
4.2 How to perform the steps

- Old Workflow
  All setting items are displayed. Steps are performed from left to right in the workflow.



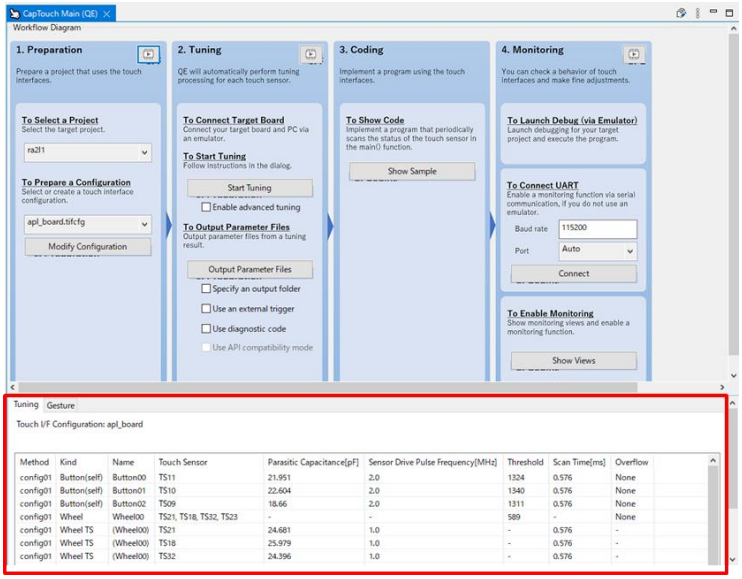
- New Workflow
  - Guide style
    Click each menu on the left to display the setting items. Steps are performed from top to bottom in the menu.
  - Simple style
    All setting items are displayed. Steps are performed from top to bottom in the workflow.

* The setting items for both styles are the same as for the old workflow.

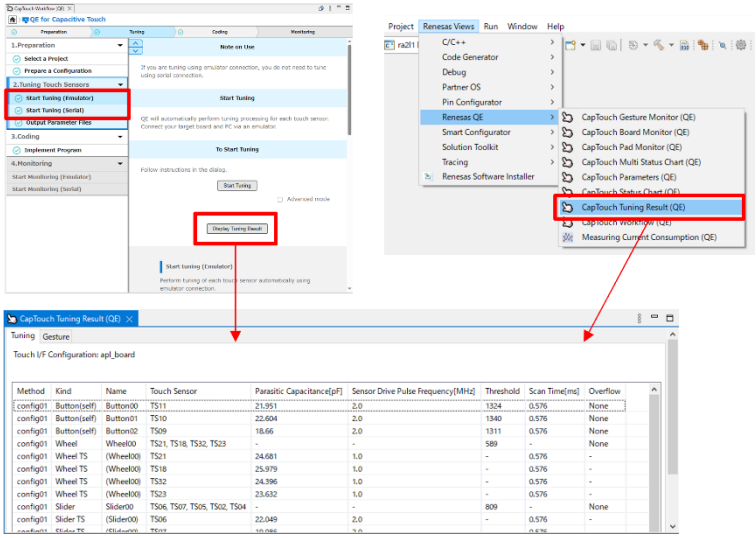


4.3 How to open the workflow

- Old Workflow
  The results of the touch sensor tuning are displayed at the bottom of the workflow.



- New Workflow
  The results of the touch sensor tuning are displayed in the “CapTouch Tuning Result (QE)” view.
  The view can be displayed in the following ways.
  ① ”Display Tuning Result“ button in the “Start Tuning” step.
  ② “Renesas Views” - “Renesas QE” - “CapTouch Tuning Result (QE)” menu.



4.4 Others

1. Projects created with previous versions of QE for Capacitive Touch (V3.1.0 or earlier) can be used without modification.
2. The workflow of the standalone version is the same as the previous version.

5. Related Videos

Many videos about this product are published in the Renesas website.

- Getting Started with QE for Capacitive Touch for RX (old version)
  - https://www.renesas.com/video/getting-started-qe-capacitive-touch
- Getting Started with QE for Capacitive Touch for RL78
  - https://www.renesas.com/video/getting-started-qe-capacitive-touch-rl78
- Getting Started with QE for Capacitive Touch for RA
  - https://www.renesas.com/us/en/video/getting-started-qe-capacitive-touch-ra
- QE for Capacitive Touch [Tutorial -Settings-] for RX (old version)
  - https://www.renesas.com/video/qe-capacitive-touch-tutorial-settings
- QE for Capacitive Touch [Tutorial -Tuning-] for RX (old version)
  - https://www.renesas.com/video/qe-capacitive-touch-tutorial-tuning
- QE for Capacitive Touch [Tutorial -Monitoring-] for RX (old version)
  - https://www.renesas.com/video/qe-capacitive-touch-tutorial-monitoring
- QE for Capacitive Touch Tutorial: Settings for RL78
  - https://www.renesas.com/video/qe-capacitive-touch-tutorial-settings-rl78
- QE for Capacitive Touch Tutorial: Tuning for RL78
  - https://www.renesas.com/video/qe-capacitive-touch-tutorial-tuning-rl78
- QE for Capacitive Touch Tutorial: Serial Monitoring for RL78
  - https://www.renesas.com/video/qe-capacitive-touch-tutorial-serial-monitoring-rl78
- QE for Capacitive Touch Tutorial: Step 1 Configuration for RA
  - https://www.renesas.com/us/en/video/qe-capacitive-touch-tutorial-step-1-configuration-ra
- QE for Capacitive Touch Tutorial: Step 2 Tuning for RA
  - https://www.renesas.com/us/en/video/qe-capacitive-touch-tutorial-step-2-tuning-ra
- QE for Capacitive Touch Tutorial: Step 3 Monitoring for RA
  - https://www.renesas.com/us/en/video/qe-capacitive-touch-tutorial-step-3-monitoring-ra
- QE for Capacitive Touch Feature - Measuring Standard Deviation
  - https://www.renesas.com/video/qe-capacitive-touch-feature-measuring-standard-deviation
- QE for Capacitive Touch Feature - Check Monitoring Values Using The Monitoring Log Feature
  - https://www.renesas.com/video/qe-capacitive-touch-feature-check-monitoring-values-using-monitoring-log-feature
- QE for Capacitive Touch Feature – A New Workflow Diagram in QE V3.2.0.
  - https://www.renesas.com/us/en/video/qe-capacitive-touch-feature-new-workflow-diagram-qe-v320
- QE for Capacitive Touch Tips - Warning Message Appeared During Tuning
  - https://www.renesas.com/video/qe-capacitive-touch-tips-warning-message-appeared-during-tuning
- How to tune via serial communication using the standalone app of QE.
  - https://www.renesas.com/video/how-tune-serial-communication-using-standalone-app-qe
- How to migrate the touch modules from version 1.1 to version 2.0 using the compatible APIs with QE tool.
  - https://www.renesas.com/video/how-migrate-touch-modules-version-11-version-20-using-compatible-apis-qe-tool
- QE for Capacitive Touch Tutorial: How to Tune via Serial Communication Using the Plug-in
  - https://www.renesas.com/us/en/video/qe-capacitive-touch-tutorial-how-tune-serial-communication-using-plug
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- QE for Capacitive Touch Tutorial: How to create the gesture data
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- QE for Capacitive Touch Tutorial: How to monitor gesture AI
  - https://www.renesas.com/video/qe-capacitive-touch-tutorial-how-monitor-gesture-ai

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	May.31.24	-	First edition issued.

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.
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.).
7. Prohibition of access to reserved addresses

   Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.
8. Differences between products

   Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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(Rev.5.0-1 October 2020)

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