

Application Example for Capacitive Touch (AE-CAP1)

Quick Start Guide

Renesas Synergy™ Platform
Synergy Solutions
Kits: AE-CAP1

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General Precautions

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.

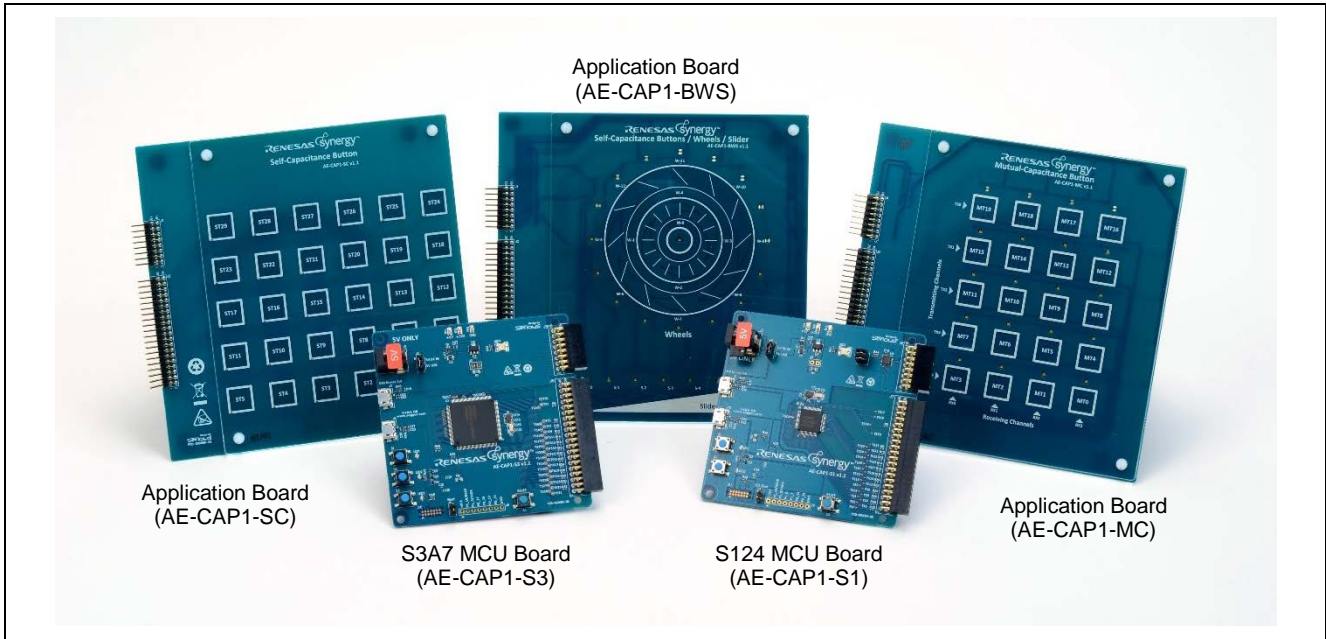
Renesas Synergy™ Platform

Application Example for Capacitive Touch (AE-CAP1)

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1. In the box

The Renesas Synergy™ Application Example for Capacitive Touch (AE-CAP1) kit includes five PCBs:



Not pictured are two USB A to Micro B Cables and a 5V output 2A 12w power adapter, as well as this Quick Start Guide (QSG).

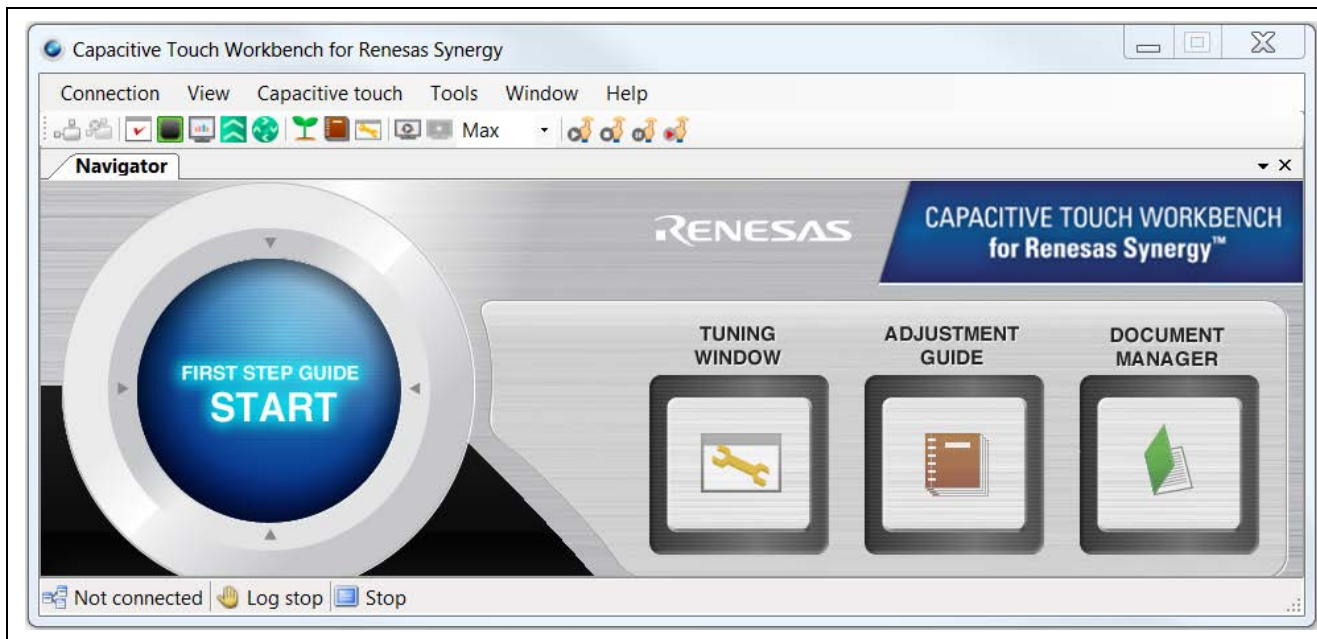
If any components from the box are missing or damaged, contact your local sales representative or the Renesas Electronics office for assistance.

2. Overview

The Renesas Synergy AE-CAP1 kit enables rapid evaluation, prototyping, development, and testing of the Renesas world-class capacitive touch technology with Synergy Platform Microcontrollers (MCUs) from the S3A7 or S124 group.

This QSG walks you through the setup and operation of the AE-CAP1 hardware, and the monitoring of the MCU's capacitive touch performance using the Capacitive Touch Workbench for Renesas Synergy™.

3. Capacitive Touch Workbench for Renesas Synergy™



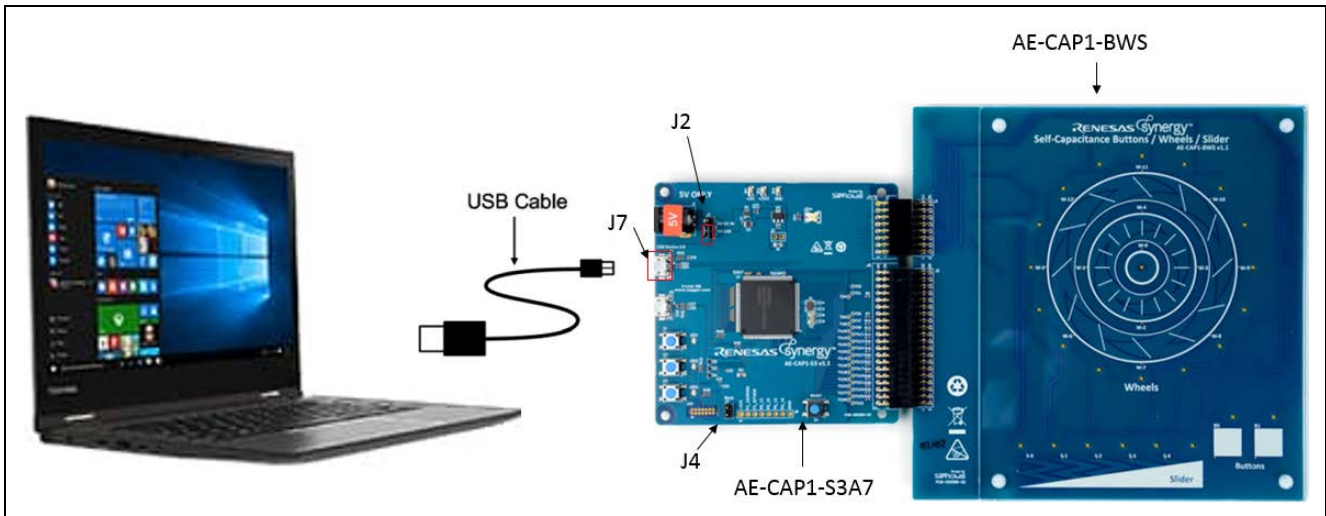
The Capacitive Touch Workbench for Renesas Synergy™ (CTW for Synergy) is a PC-based tool that aids tuning and optimization of touch-sensing parameters, and defines touch areas and buttons using your touch-enabled application on Synergy Kits.

To use CTW for Synergy to perform sensor tuning and sensor data monitoring, you first need to download the workbench and its accompanying user manual from 'SSP Utilities' section of the Synergy Software Package (SSP) on the Synergy Gallery website: <https://synergygallery.renesas.com>.

Windows versions supported: The CTW for Synergy supports Windows 7 and Windows 10. See the latest version of the *Capacitive Touch Workbench for Renesas Synergy™ User's Manual* for system requirements, installation instructions, and supported Synergy MCU Groups and Kits.

4.2 AE-CAP-S3 and AE-CAP1-BWS Out-of-Box Demo

4.2.1 Connecting the AE-CAP1-S3 and BWS board components



S3A7 Buttons/Wheels/Slider application board connections

1. Connect the AE-CAP1-S3 and the AE-CAP1-BWS boards together.
 - J4 is used to boot from on-chip flash memory programming routine. Keep it open.
 - J2 is used to select power. J2 is set by default to 5V USB. Use the default setting.
2. Connect J7 to your Windows PC using the included USB cable.

4.2.2 Install USB CDC Driver for Windows 7 PC

The AE-CAP1-S3 communicates with CTW for Synergy via the USB port.

1. For Windows 7, install the USB CDC Device driver.
 - See *AE-CAP1 Out-of-Box Demo Programming Guidelines*. See the [References](#) section for a link.
2. Install the USB CDC driver before proceeding.
 - There is no need to install the USB driver for Windows 10 PC.

4.2.3 Running the AE-CAP1-S3 and BWS Out-of-Box Demo

To observe and operate the system:

1. At power on, the system performs an auto-tuning test on the BWS board (approximately 2 seconds).
2. When the auto-tuning is done, AE-CAP1-S3 board LED1 (Red), LED2 (Yellow) and LED3 (Green) blinks five (5) times.

Note: Do not touch the boards before LED1, LED2 and LED3 start to blink.

3. If auto-tuning is successful, LED3 (Green) continues to blink.
 - A. Touch buttons B0 and B1 and W-0. Observe the corresponding LEDs light up
 - B. Using your finger, slide the slider.
 - Observe the corresponding LEDs light up with your finger movement.
 - C. Move your finger along the inner and outer wheel.
 - Observe the LEDs lighting up with your finger movement.
4. If auto-tuning fails, LED1 (Red) alone blinks to indicate a hardware failure.
 - If you get a hardware failure:
 - A. Make sure you are using the correct application board, AE-CAP1-BWS.
 - B. Make sure the boards you are using are placed on a non-conductive surface.

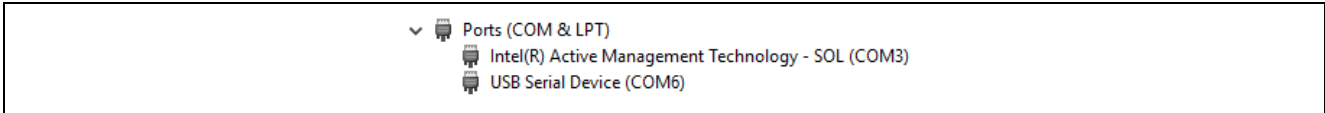
5. Running touch sensor monitoring using the Capacitive Touch Workbench for Renesas Synergy

5.1 Configuring the PC for touch sensor monitoring

Note: Only the Out-of-Box Demo for the S3A7 MCU Board is able to communicate with the CTW for Synergy. Sample applications for the S124 MCU Board that can be used CTW for Synergy can be downloaded from <http://www.renasssynergy.com/kits/ae-cap1>.

- When the S3A7 device green LED continues to blink (successful auto-tuning), open the Device Manager on your PC. Double check the enumeration exists.

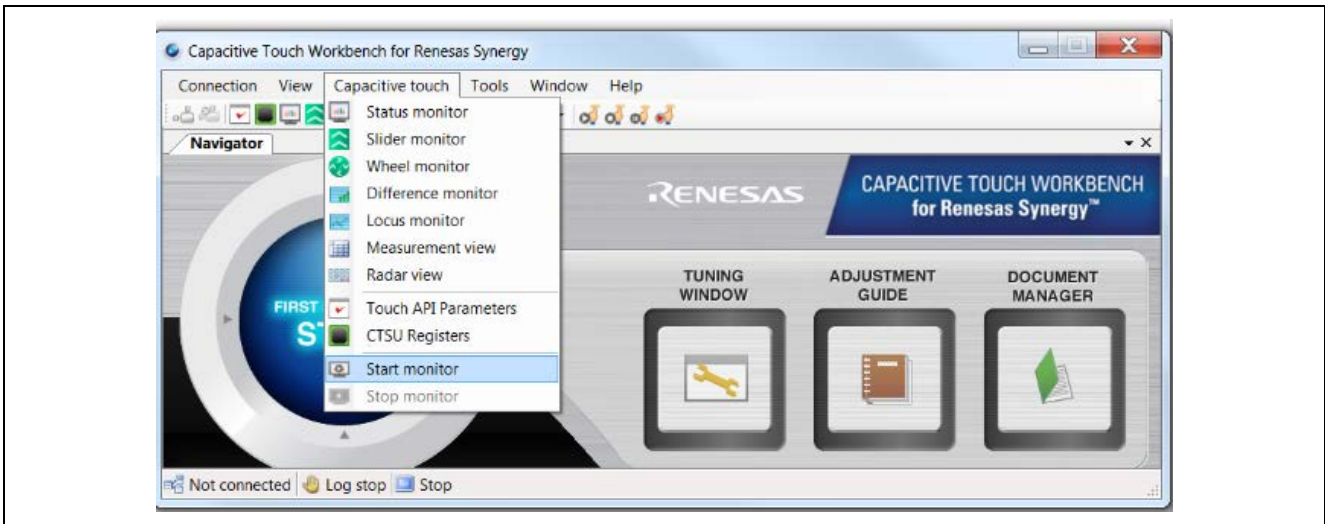
On a Windows 10 PC, the USB connection enumerates as a COM Port named **USB Serial Device**. Your COM number may be different from the one shown.



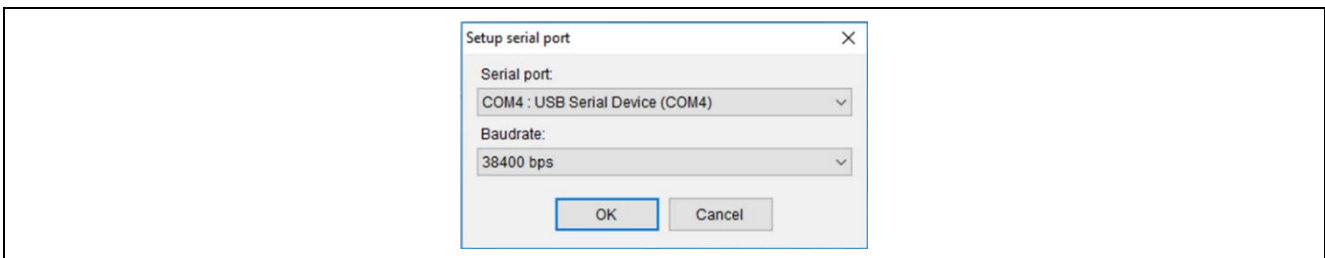
- For Windows 7 system, install the USB CDC Device driver according to *AE-CAP1 Out-of-Box Demo Programming Guidelines*. See the [References](#) section for a link.

5.2 Launching touch sensor monitoring

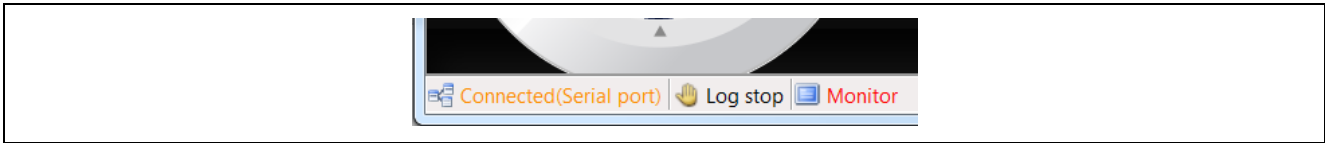
- From the Windows Start menu, launch the  Renesas CTW for Synergy (CTW for Synergy) icon.



- Click **Start monitor** from the menu. The Start monitor menu is under the **Capacitive touch** tab on top of CTW for Synergy application window.



- On the pop-up window, select the COM port corresponding to the enumerated COM port you identified earlier. Windows 10 is shown in the example. The system supports the baudrates available in the dropdown menu.

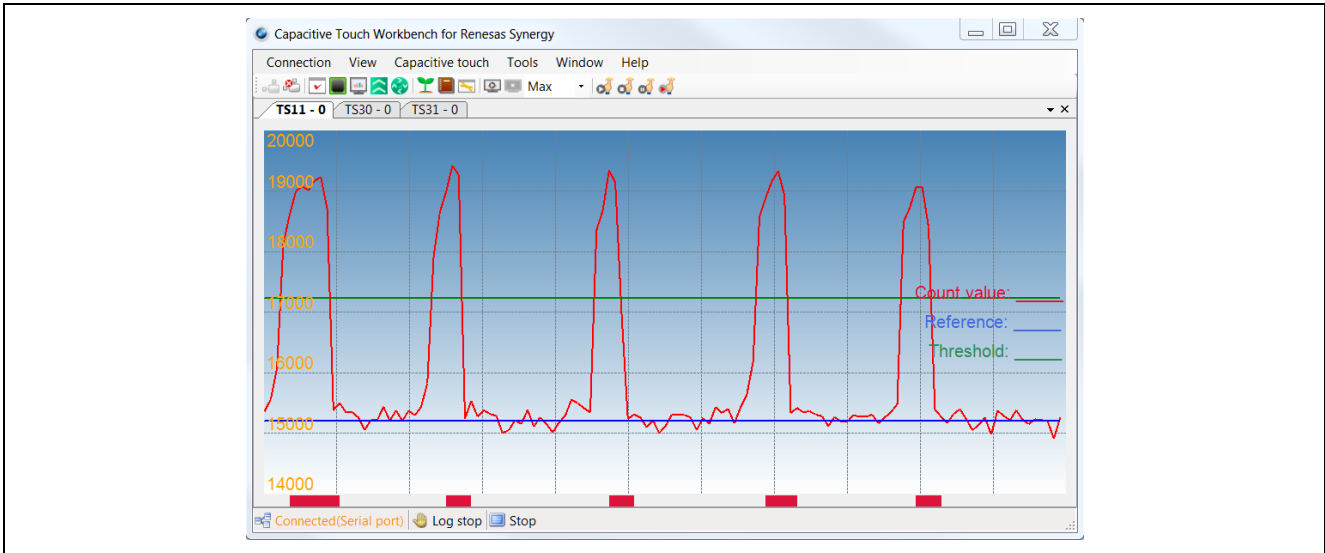


- Click OK and wait momentarily. Notice that the connection status (at the bottom of the window) changes. The black status **Not connected** changes to the orange status **Connected (Serial port)**.

5.3 Experimenting with sensor monitoring options

Several windows are available to monitor status and fine-tune existing capacitive touch thresholds. For details on window options and usage, see *Capacitive Touch Workbench for Renesas Synergy User's Manual* on the Synergy Software Package 'SSP Utilities' section at the Synergy Gallery website: <https://synergycastle.renesas.com>.

5.3.1 Monitoring status

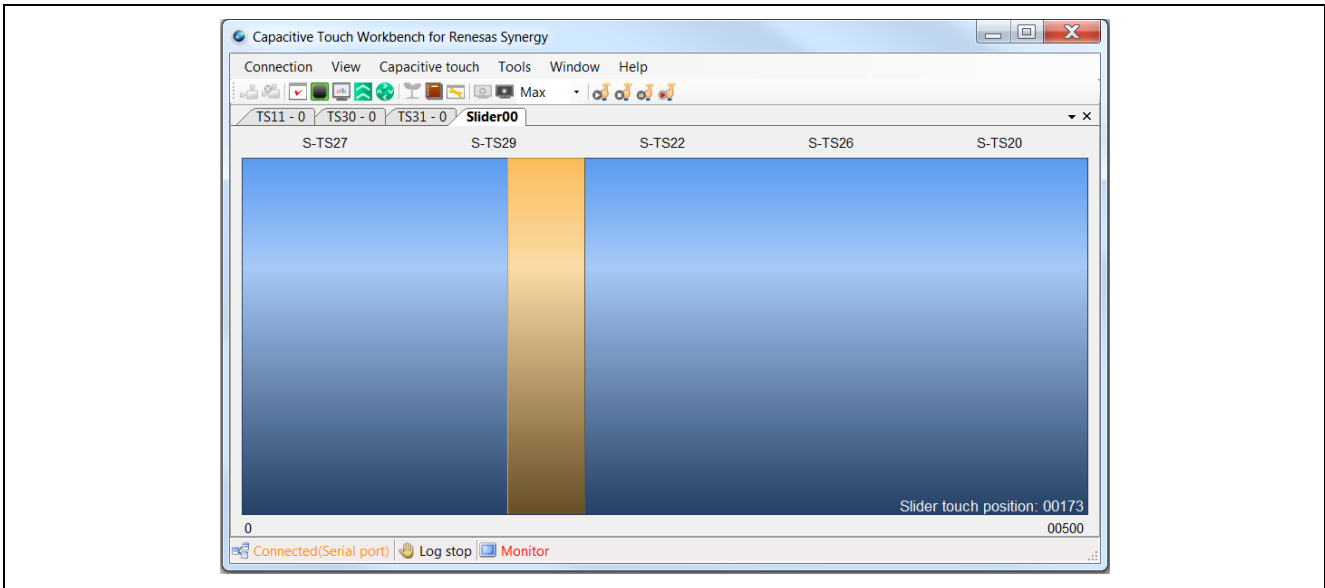


Status Monitor

Click **Capacitive Touch > Status Monitor** to bring up the configured channel one at a time.

In the example shown, observe the blue sensor baseline, the green threshold, and the red sensor count value. A bump on the red line that passes the threshold value represents a sensed touch event. TS11 correlates to the center button W-0 on the wheel and TS30/31 correlate to the buttons B0 and B1 on the lower right.

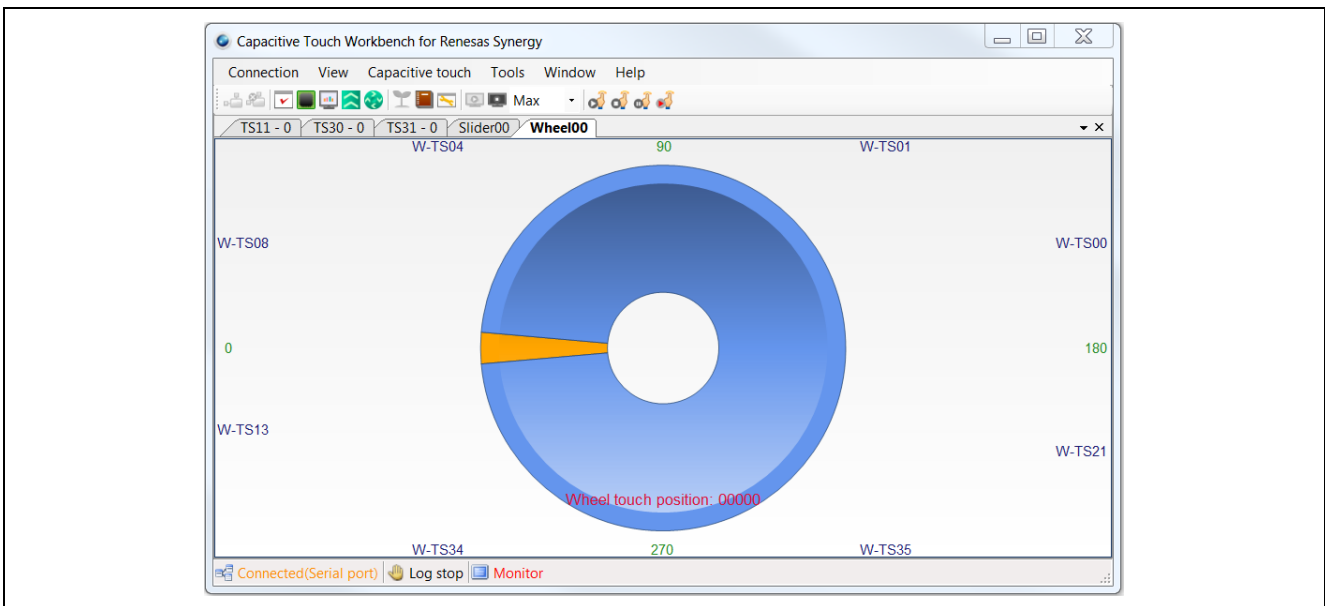
5.3.2 Monitoring the slider



Slider Monitor

1. Click **Capacitive Touch > Slider Monitor** to bring up below slider view.
2. Run your finger across the Slider on the BWS board.
Observe the yellow band going left and right following the finger movement.

5.3.3 Monitoring the wheel



Wheel Monitor

1. Click **Capacitive Touch > Wheel Monitor** to bring up below wheel view.
Wheel00 corresponds to the outer wheel with the demo code.
2. Run your finger along the outer Wheel.
Observe the yellow arrow spin around following the finger movement. Similarly, you can right click anywhere in the Wheel00 window to activate Wheel01 as the inner wheel and observe the behavior

6. References

1. To learn more about the Synergy Software Package, development tools, and utilities visit <http://www.renesassynergy.com/ssp> and <http://www.renesassynergy.com/tools>.
2. Download the application note, *AE-CAP1 Out-of-Box Programming Guide*, from <http://www.renesassynergy.com/docs> to learn more about hardware and software for this kit. This application includes S124 MCU Board projects to communicate with the CTW for Synergy via the UART port.
3. Download the application note, *Capacitive Touch Hardware Design and Layout Guide*, from <http://www.renesassynergy.com/docs> to learn about the hardware design guidelines for Renesas capacitive touch applications.
4. Download the application note, *Synergy Capacitive Touch Tuning*, from <http://www.renesassynergy.com/docs> to learn about the capacitive touch tuning with CTW for Synergy.

Next steps

Learn more about:

- Synergy kits at <http://www.renesassynergy.com/kits>
- Synergy Microcontrollers at <http://www.renesassynergy.com/microcontrollers>
- Synergy AE-CAP1 Application Projects at <http://www.renesassynergy.com/kits/ae-cap1>
- Synergy Software at <http://www.renesassynergy.com/software>
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Website and Support

Support: <https://synergygallery.renesas.com/support>

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Revision History

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		Page	Summary
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1.01	Apr 9, 2018	-	Minor update

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