

Renesas Synergy™ Platform

AE-CAP1 Out-of-Box Demonstration Programming Guidelines

Introduction

This guide covers how to reload the out-of-box (OOB) demonstration on the AE-CAP1 Kit. To follow this guide a full JTAG software installation is not needed, as a copy of a supported version is already included.

Besides providing instructions to reprogram the factory default program for the Buttons/Wheels/Slider (BWS) application board, AE-CAP1-BWS, this programming guide includes additional programming guides in appendices that tell you how to load OOB demonstration for the other application boards in the AE-CAP1 Kit, such as the Self-Capacitance button application board and the Mutual Capacitance button application board.

Version information

- Out-of-box demonstration version 1.1

Required Resources

To download and run the out-of-box demonstration, you need:

- Renesas AE-CAP1 Kit v1.1
- Serial to USB Converter (needed for some demonstration projects)
- Micro USB cables
- SEGGER J-Link® USB driver
- Capacitive Touch Workbench for Renesas Synergy™ (CTW for Synergy) v1.05.0033 and later
- e² studio v7.3.0 or later

Download all the required software from the Renesas Synergy Gallery (www.renesas.com/synergy/software).

Contents

1. Software and tools.....	3
2. AE-CAP1 Kit components.....	3
3. Installing the USB CDC device driver.....	4
4. Reloading the ae_cap1_bws_out_of_box_demo for AE-CAP1-S1 and AE-CAP1-BWS.....	5
5. Out-of-box demonstration notes for AE-CAP1-S1 and AE-CAP1-BWS.....	7
6. Reloading the out-of-box demonstration for AE-CAP1-S3 and AE-CAP1-BWS.....	8
7. Out-of-box demonstration notes for AE-CAP1-S3 and AE-CAP1-BWS.....	9
7.1 Standalone mode.....	9
7.2 Communication with Capacitive Touch Workbench for Renesas Synergy.....	9
8. Appendix.....	9
8.1 Out-of-box demo2 for AE-CAP1-S1 and AE-CAP1-BWS.....	9
8.1.1 Loading the ae_cap1_s1_out_of_box_demo2 on AE-CAP1-S1 and AE-CAP1-BWS.....	9
8.1.2 Out-of-box demo2 notes for AE-CAP1-S1 and AE-CAP1-BWS.....	10
8.2 Out-of-box demonstration for AE-CAP1-S1 and AE-CAP1-MC.....	11
8.2.1 Loading the out-of-box demonstration on AE-CAP1-S1 and AE-CAP1-MC.....	11
8.2.2 Out-of-box demonstration notes for AE-CAP1-S1 and AE-CAP1-MC.....	12
8.3 Out-of-box demo2 for AE-CAP1-S1 and AE-CAP1-MC.....	12
8.3.1 Loading the out-of-box demo2 for AE-CAP1-S1 and AE-CAP1-MC.....	12
8.3.2 Out-of-box demo2 notes for AE-CAP1-S1 and AE-CAP1-MC.....	12
8.4 Out-of-box demonstration for AE-CAP1-S1 and AE-CAP1-SC.....	13
8.4.1 Loading the out-of-box demonstration for AE-CAP1-S1 and AE-CAP1-SC.....	13
8.4.2 Out-of-box demonstration notes for AE-CAP1-S1 and AE-CAP1-SC.....	14
8.5 Out-of-box demonstration for AE-CAP1-S3 and AE-CAP1-MC.....	15
8.5.1 Loading the out-of-box demonstration on AE-CAP1-S3 and AE-CAP1-MC.....	15
8.5.2 Out-of-box demonstration notes for AE-CAP1-S3 and AE-CAP1-MC.....	15
8.6 Out-of-box demonstration for AE-CAP1-S3 and AE-CAP1-SC.....	16
8.6.1 Loading the out-of-box demonstration for AE-CAP1-S3 and AE-CAP1-SC.....	16
8.6.2 Out-of-box demonstration notes for AE-CAP1-S3 and AE-CAP1-SC.....	17
Revision History.....	19

1. Software and tools

Minimum PC requirements:

- Microsoft® Windows® 7 or Windows® 10 with Intel® Core™ family processor running at 2.0 GHz or higher (or equivalent processor)
- 8 GB memory
- 250-GB hard disk or solid-state drive (SSD)
- USB 2.0
- Connection to the Internet

This out-of-box demonstration requires the drivers that are installed with e² studio version 7.3.0 or later. You can find e² studio available for download at www.renesas.com/synergy/software.

2. AE-CAP1 Kit components

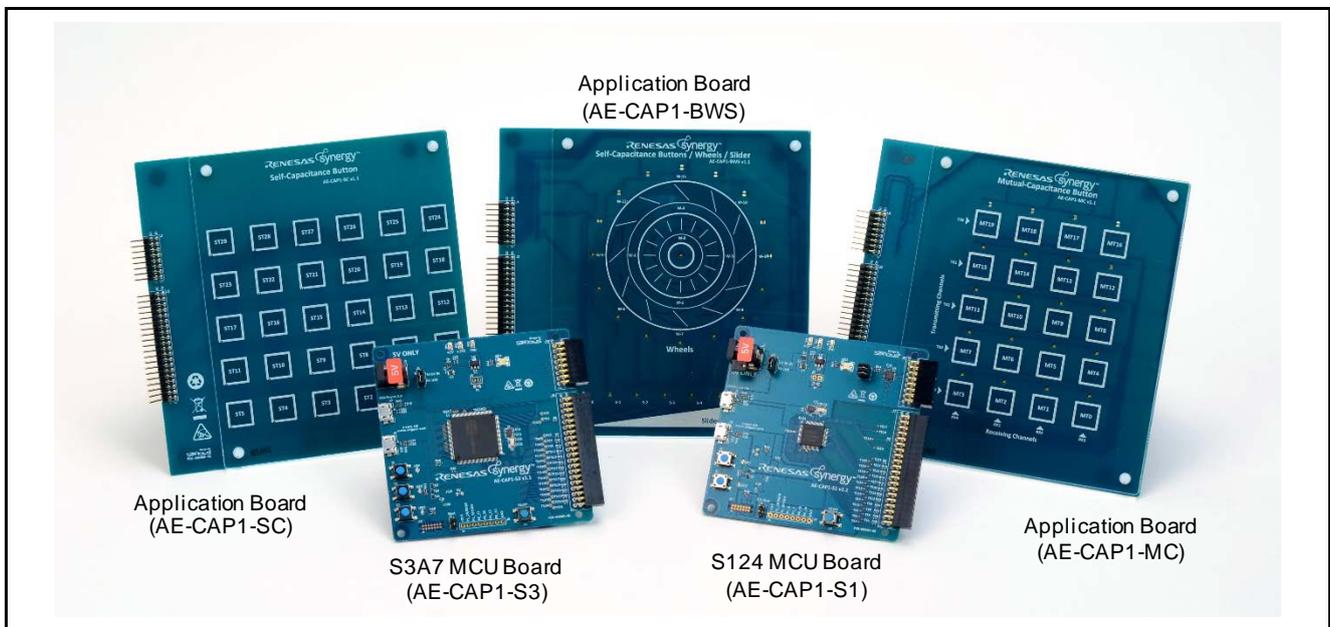


Figure 1. AE-CAP1 kit

This programming guide applies AE-CAP1 Application Example Kit, version 1.1. The out-of-box demonstration you load may be newer than (and improved from) the factory-installed demonstration version.

Before loading the demonstration code, unzip the file “ae_cap1_out_of_box_demo_image_programmer.zip” to view the following subfolders:

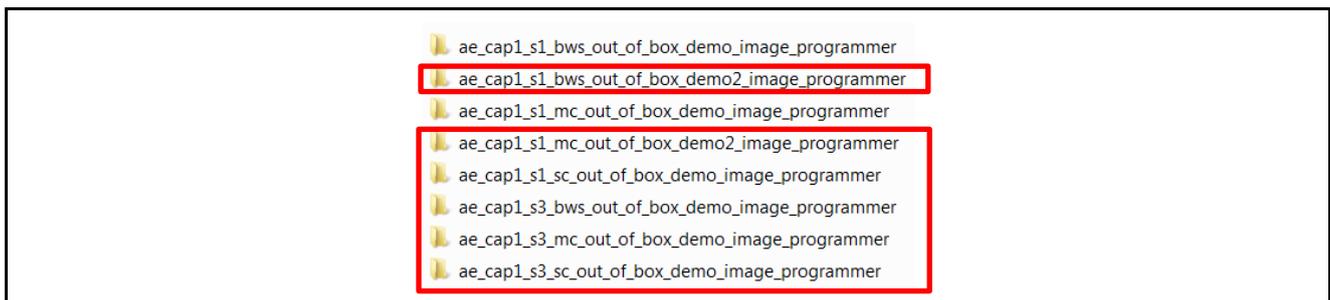


Figure 2. AE-CAP1 demonstration programs

Figure 2 lists demonstration programs that can communicate with the CTW for Synergy inside the red boxes. See the applicable programming guide to set up your hardware connections. See section 5 in *Application Example for Capacitive Touch (AE-CAP1) Quick Start Guide (r12qs0016eu0100)* to review how to communicate with the CTW for Synergy.

Table 1 outlines the functionality of each application project.

Table 1. OOB Program Summary

Software Project Name	Project Description
ae_cap1_s3_bws_out_of_box_demo	S3A7 application project for the AE-CAP1-BWS <ul style="list-style-type: none"> • 3 buttons, 2 wheels and 1 slider • LED indication on the AE-CAP1-BWS board • Communication with CTW for Synergy through USB
ae_cap1_s3_sc_out_of_box_demo	S3A7 application project for the AE-CAP1-SC <ul style="list-style-type: none"> • 30 buttons • LED indication on the AE-CAP1-SC • Communication with CTW for Synergy through USB
ae_cap1_s1_bws_out_of_box_demo	S124 application project for the AE-CAP1-BWS <ul style="list-style-type: none"> • 3 buttons, 2 wheels and 1 slider • LED indication on the AE-CAP1-BWS
ae_cap1_s1_bws_out_of_box_demo2	S124 application project for the AE-CAP1-BWS <ul style="list-style-type: none"> • 3 buttons, 2 wheels and 1 slider • LED indication on the AE-CAP1-BWS • Communication with CTW for Synergy through UART
ae_cap1_s1_sc_out_of_box_demo	S124 application project for the SC board <ul style="list-style-type: none"> • 28 buttons • LED indication on the AE-CAP1-SC • Communication with CTW for Synergy through UART
ae_cap1_s3_mc_out_of_box_demo	S3A7 application project for AE-CAP1-MC <ul style="list-style-type: none"> • 20 mutual capacitive touch buttons • LED indication on the AE-CAP1-MT board • Communication with CTW for Synergy through USB
ae_cap1_s1_mc_out_of_box_demo	S124 application project for AE-CAP1-MC <ul style="list-style-type: none"> • 20 mutual capacitance touch buttons • LED indication on the AE-CAP1-MC board
ae_cap1_s1_mc_out_of_box_demo2	S124 application project for the AE-CAP1-MC board <ul style="list-style-type: none"> • 20 mutual capacitance touch buttons • LED indication on the AE-CAP1-S124 board • Communication with CTW for Synergy through UART

3. Installing the USB CDC device driver

The S3A7 OOB projects communicate with CTW for Synergy through the USB CDC device port. To have the OOB project work properly, the USB CDC port needs to enumerate to a COM port on the PC.

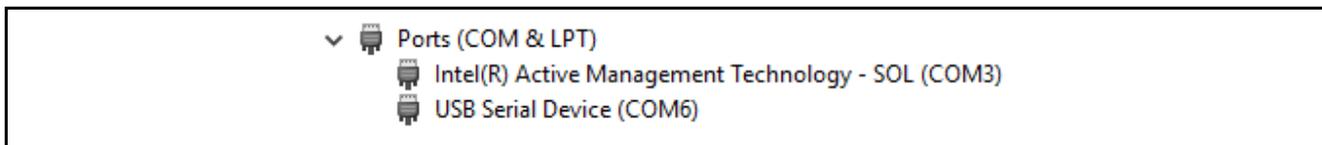


Figure 3. USB Serial Device COM Port on Windows 10

For Windows 10, there is no need to install a USB driver. The USB Serial Device enumeration occurs automatically with sample projects.

For Windows 7, you need to install the USB CDC/ACM device driver. The USB driver is attached with this application project (Windows_USB_serial_driver.zip). Unzip it to folder \Windows_USB_serial_driver.

1. When you download and run the application, the CDC/ACM device shows up in the Device Manager of your PC under the **Universal Serial Bus Controller** group as **UNKNOWN DEVICE**.
2. Right click on this device and select **Update Driver Software**.
3. When prompted for the location of the drivers, browse to the location \Windows_USB_serial_driver you created previously.

Once the driver is updated a new COM device shows up in the Device Manager.



Figure 4. Communications Port on Windows 7

4. Reloading the ae_cap1_bws_out_of_box_demo for AE-CAP1-S1 and AE-CAP1-BWS

This is the S124 AE-CAP1-BWS default factory demonstration. To reload the out-of-box demonstration, use the following steps.

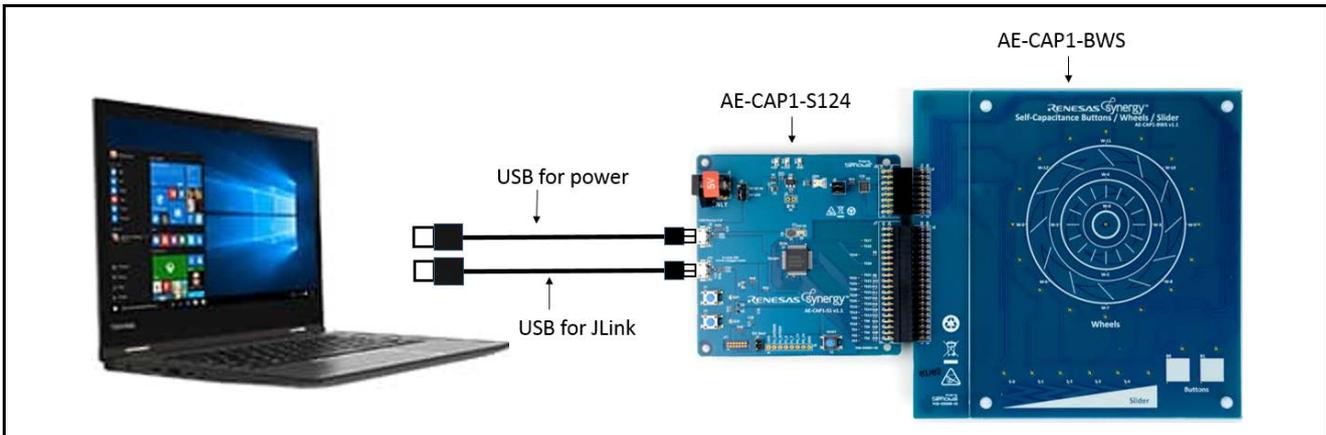


Figure 5. AE-CAP1-S1 and AE-CAP1-BWS

1. Leave jumper J4 open, orient jumper J2 towards the USB Device, and install jumpers for J5 as shown in Figure 6:

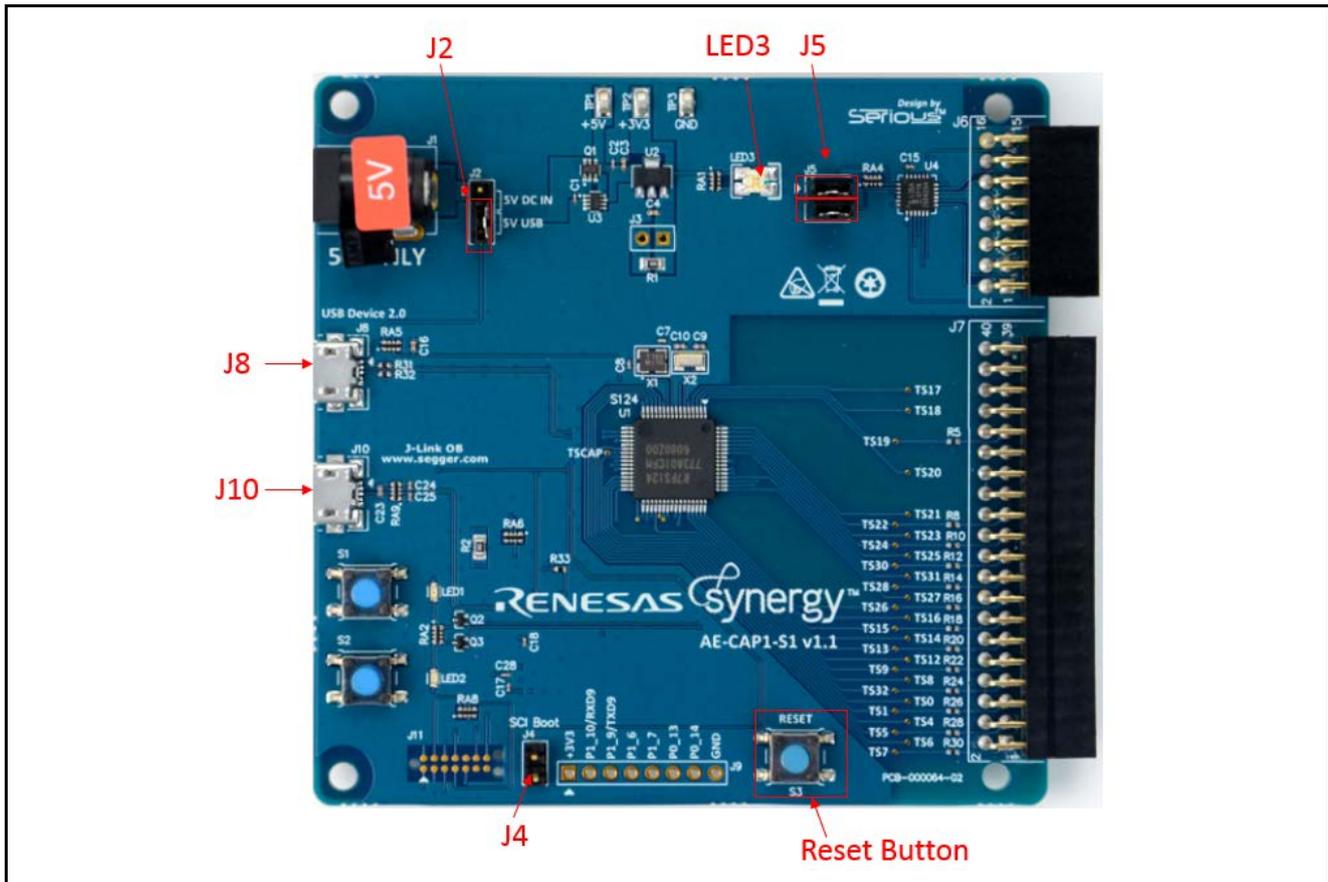


Figure 6. AE-CAP1-S1 setting for application board LED control

2. Connect the AE-CAP1-S1 from J8 to the PC using the USB cable (included) to power to the system. LED3 illuminates to indicate a good power connection.
3. Connect the AE-CAP1-S124 from J10 to the PC using the other USB cable (included) to provide the J-Link connection.
4. Navigate to folder \ae_cap1_s1_bws_out_of_box_demo_image_programmer.
5. Double-click on Program_A_CAP1_S124_BWS_App.bat in the files.

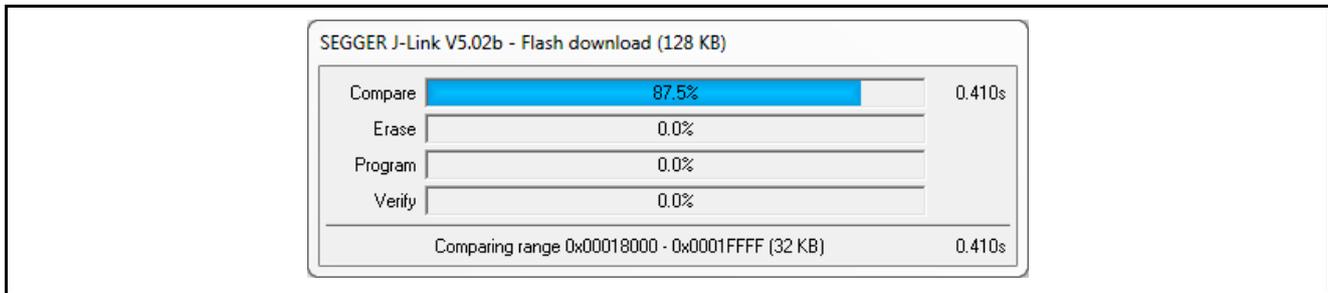


Figure 7. J-Link downloading

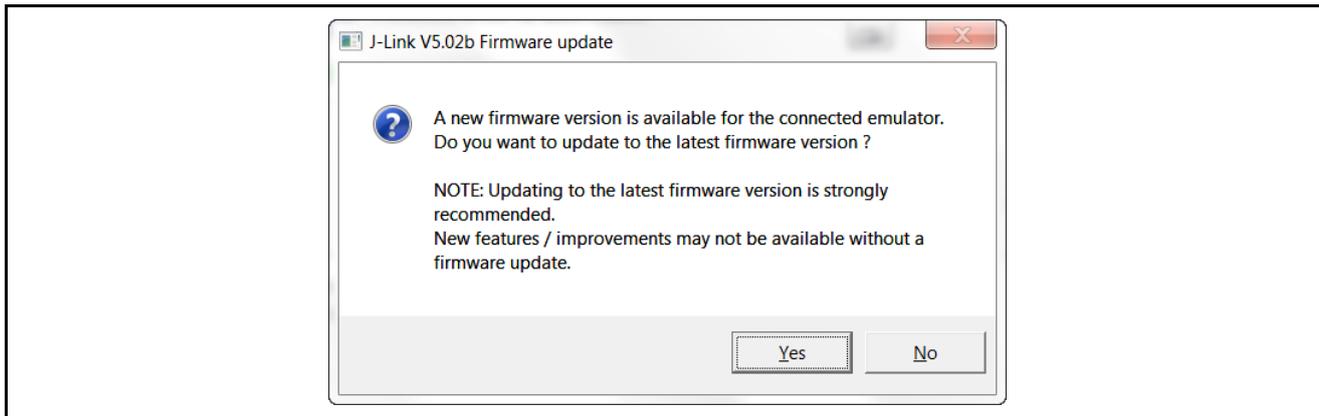


Figure 8. Update J-Link

Note: If the update J-Link firmware dialog box is displayed, it is recommended that you click **Yes**. A programming failure may occur if you update the firmware. If this occurs, double click on the .bat file again.

At this point, the out-of-box demonstration for AE-CAP1-BWS is reloaded onto the AE-CAP1-S1.

5. Out-of-box demonstration notes for AE-CAP1-S1 and AE-CAP1-BWS

The factory default demonstration for AE-CAP1-S1 and AE-CAP1-BWS only supports standalone mode operation with no communication with the CTW for Synergy. See Section 7.2 for steps to communicate with CTW for Synergy.

After successfully programming the system, press the **Reset** button to run the program. Observe that the following events occur on the system in sequence:

1. The system performs an auto-tuning test on the BWS board (about 2 seconds).
2. When this auto-tuning is finished, LED1 (Red) and LED2 (Green) on the AE-CAP1-S1 board blink 5 times. **Do not touch the board before the LED1 and LED2 start to blink.**
3. If auto-tuning is successful, LED2 (Green) continues to blink and the board is ready to accept user touch. Use the following steps for the LED signaling scheme on the AE-CAP1-BWS Application board:
 - a. Touch any of the buttons to illuminate the LED associated with that button. Try touching buttons B0 and B1 and W-0 and see the corresponding LED light up.
 - b. Slide a finger up and down the slider area to illuminate the LEDs along the top of the slider.
 - c. Move your finger along the inner wheel to observe the LEDs illuminate following your finger movement.
 - d. Move your finger along the outer wheel to observe the LEDs illuminate following your finger movement.
4. If auto-tuning is not successful, LED1 (Red) blinks to indicate a hardware issue. Use the following steps to fix the system:
 - a. Press the **Reset** button to restart the system.
 - b. Double check that the correct application board, AE-CAP1-BWS, is used.

6. Reloading the out-of-box demonstration for AE-CAP1-S3 and AE-CAP1-BWS

This is the S3A7 AE-CAP1-BWS default factory demonstration. Use the following steps to reload the out-of-box demonstration:

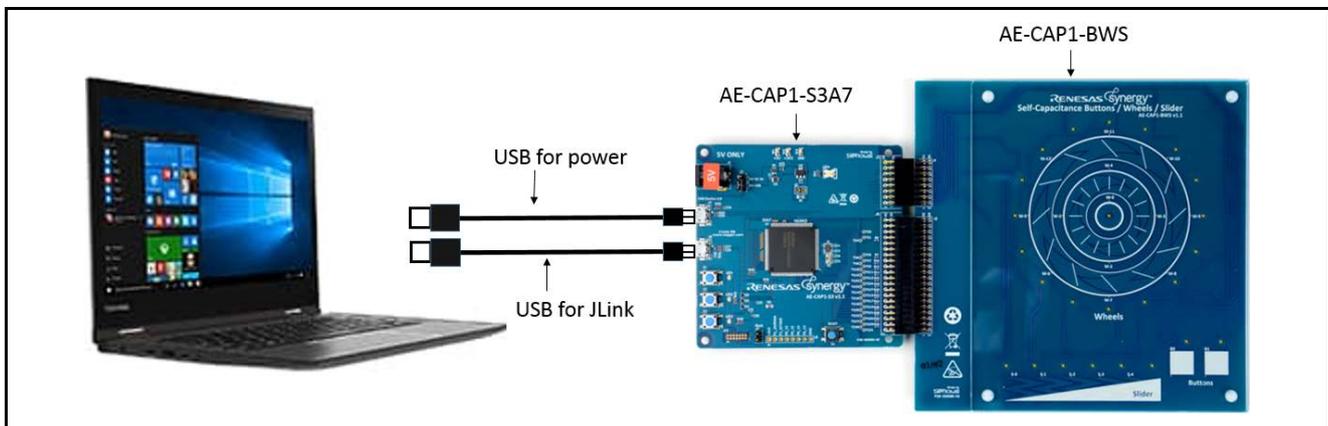


Figure 9. AE-CAP1-S3 and AE-CAP1-BWS

1. Leave jumper J4 open and orient jumper J2 towards the USB Device.

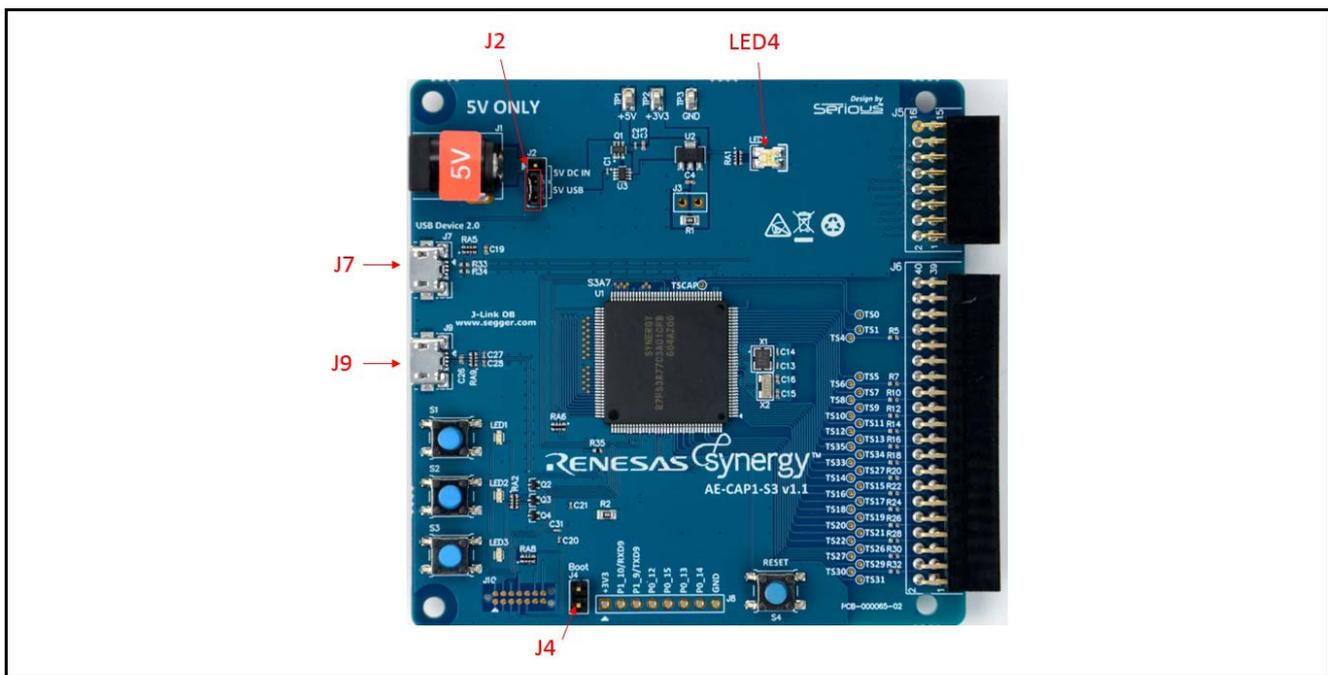


Figure 10. AE-CAP1-S3 setting

2. Connect the AE-CAP1-S3 from J7 to the PC using the USB cable (included) to power the system. LED4 illuminates to indicate a good power connection.
3. Connect the AE-CAP1-S3 from J9 to the PC using the other USB cable (included) that provides the J-Link connection.
4. Navigate to folder \ae_cap1_s3_bws_out_of_box_demo_image_programmer.
5. Double-click Program_AE_CAP1_S3A7_BWS_App.bat in the files (see Figure 7).

Note: If the update J-Link firmware dialog box is displayed, it is recommended that you click **Yes**. A programming failure may occur if you update the firmware. If this occurs, double click on the .bat file again. See Figure 8 for details.

At this point, the out-of-box demonstration for AE-CAP1-BWS is reloaded onto the AE-CAP1-S3.

7. Out-of-box demonstration notes for AE-CAP1-S3 and AE-CAP1-BWS

7.1 Standalone mode

After successfully programming the system, press the Reset button to run the program. Observe that the following events occur on the system in sequence:

1. The system performs an auto-tuning test on the BWS board (about 2 seconds).
2. When auto-tuning is finished, LED1 (Red), LED2 (Yellow) and LED3 (Green) on the AE-CAP1-S3 board blinks 5 times. **Do not touch board before LED1, LED2 and LED3 start to blink.**
3. If auto-tuning is successful, LED3 (Green) continues to blink and the board is ready to accept a user's touch. Use the following LED signaling scheme on the AE-CAP1-BWS Application board:
 - a. Touch any button to illuminate the LED associated with that button. Try touching buttons B0 and B1 and W-0 and observe that the corresponding LED illuminates.
 - b. Slide a finger up and down the slider area to illuminate the LEDs along the top of the slider.
 - c. Move your finger along the inner wheel to observe the LEDs illuminate following your finger movement.
 - d. Move your finger along the outer wheel to observe the LEDs illuminate following your finger movement.
4. If auto-tuning is not successful, LED1 (Red) blinks to indicate a hardware issue. Use the following steps to fix the system:
 - a. Press the Reset button to restart the system.
 - b. Double check that the correct application board AE-CAP1-BWS is used.

7.2 Communication with Capacitive Touch Workbench for Renesas Synergy

Review section 3.1 and section 5 in the *Application Example for Capacitive Touch (AE-CAP1) Quick Start Guide* (r12qs0016eu0100) to communicate with the CTW for Synergy. See Table 2 for the AE-CAP1-BWS silkscreen button mapping to the CTW for Synergy S3A7 touch sensor channel number:

Table 2. Silk Screen Button Mapping to Touch Sensor Channels

CTW for Synergy Assignment	AE-CAP1-BWS Mark
TS31	B0
TS30	B1

8. Appendix

8.1 Out-of-box demo2 for AE-CAP1-S1 and AE-CAP1-BWS

8.1.1 Loading the ae_cap1_s1_out_of_box_demo2 on AE-CAP1-S1 and AE-CAP1-BWS

Use the following steps to load the AE-CAP1-BWS out-of-box demo2 for the system:

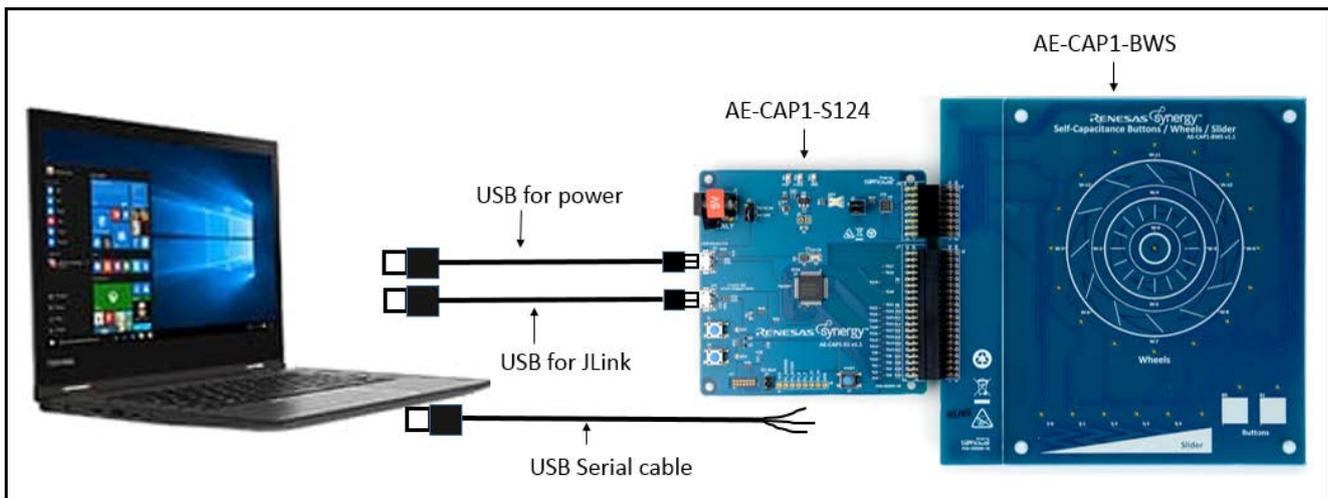


Figure 11. AE-CAP1-S1 and AE-CAP1-BWS with UART monitoring

1. On the AE-CAP1-S1, leave jumper J4 open, orient jumper J2 towards the USB Device, and un-install jumpers from J5 (leave J5 open). See Figure 6 for jumper locations J4, J2, and J5.
2. Connect the AE-CAP1-S1 from J8 to the PC using the USB cable (included) to power the system. LED3 illuminates to indicate a good power connection.
3. Connect the AE-CAP1-S124 from J10 to the PC using the other USB cable (included) to provide the J-Link connection.
4. Connect the AE-CAP1-S124 J9 through a Serial to USB converter (see Figure 12) to the PC. **The USB Serial conversion cable is not included in the kit.**

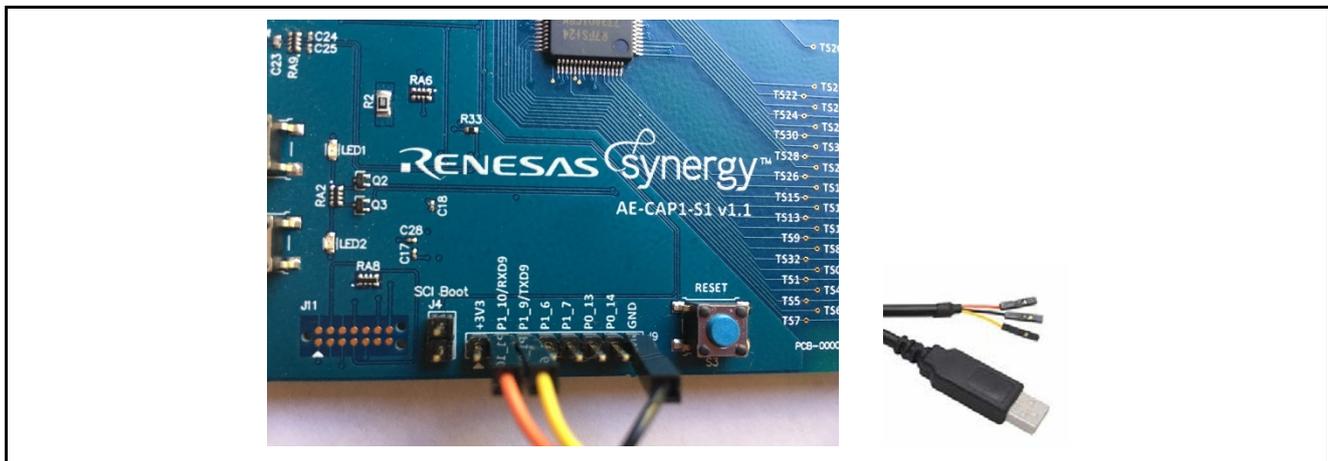


Figure 12. USB Serial Cable Connection on AE-CAP1-S1

5. Navigate to folder \ae_cap1_s1_bws_out_of_box_demo2_image_programmer.
6. Double-click Program_AE_CAP1_S124_BWS_UART_Monitor_App.bat in the files. See Figure 8 for details.

Note: If the update J-Link firmware dialog box displays, it is recommended that you click **Yes**. A programming failure may occur if you update the firmware. If this occurs, double-click the .bat file again. See Figure 7 for details.

At this point, the out-of-box demo2 for AE-CAP1-BWS is reloaded onto the AE-CAP1-S1.

8.1.2 Out-of-box demo2 notes for AE-CAP1-S1 and AE-CAP1-BWS

Standalone mode

After successfully programming the system, press the Reset button to run the program. Observe that the following events occur on the system in sequence:

1. The system performs an auto-tuning test on the BWS board (about 2 seconds).
2. When this auto-tuning is finished, LED1 (Red) and LED2 (Green) on the AE-CAP1-S1 board blink 5 times. **Do not touch the board before LED1 and LED2 start to blink.**
3. If auto-tuning is successful, LED2 (Green) continues to blink and the board is ready to accept touch sensing user inputs. **Note that the LED on the AE-CAP1-BWS board is not active with the demonstration code.**
4. If auto-tuning is not successful, the LED1 (Red) blinks to indicate a hardware issue. Use the following steps to fix the system:
 - a. Press the Reset button to restart the system.
 - b. Double check that the correct application board AE-CAP1-BWS is used.

Communication with Capacitive Touch Workbench for Renesas Synergy (CTW for Synergy)

To establish communication with CTW for Synergy, select a UART baud rate of 115200.

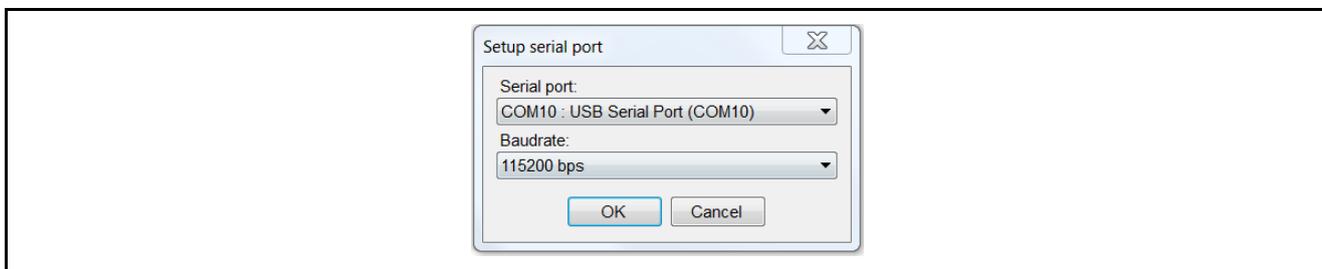


Figure 13. UART Baudrate Setting

See Table 3 to map the silk screen button marking to the touch sensor channel assignment:

Table 3. S124 AE-CAP1-BWS Silk Screen Marking Mapping to Sensor Touch Channels

CTW for Synergy Assignment	AE-CAP1-BWS Mark
TS06	B0
TS07	B1

See section 5 in the *Application Example for Capacitive Touch (AE-CAP1) Quick Start Guide* (r12qs0016eu0100) to review how to communicate with the CTW for Synergy.

8.2 Out-of-box demonstration for AE-CAP1-S1 and AE-CAP1-MC

8.2.1 Loading the out-of-box demonstration on AE-CAP1-S1 and AE-CAP1-MC

Use the following steps to load the out-of-box demonstration for the system with AE-CAP1-S1 and AE-CAP1-MC:

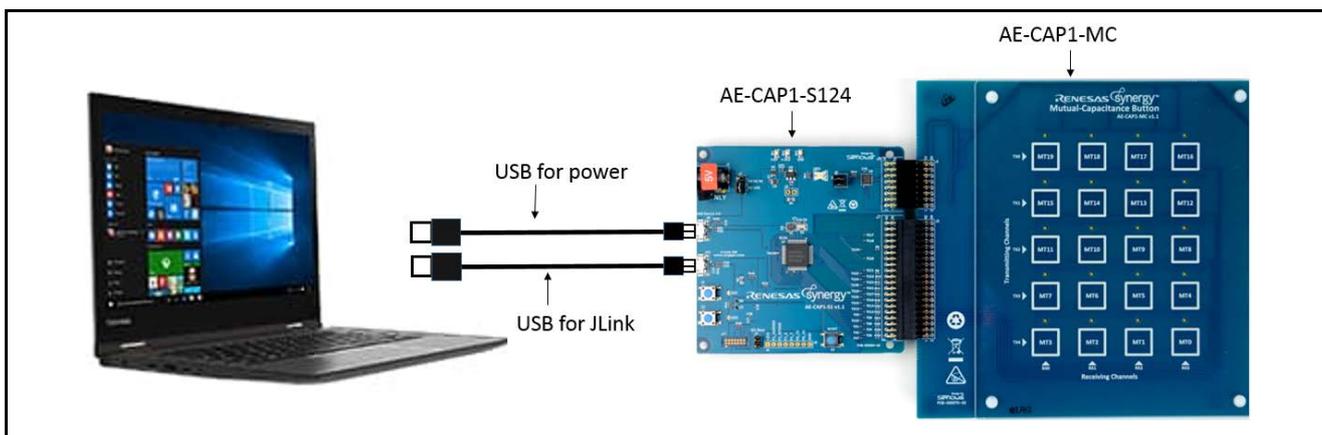


Figure 14. AE-CAP1-S1 and AE-CAP1-MC

1. Use the same settings from Figure 6 to set up AE-CAP1-S1 jumpers.
2. Connect the AE-CAP1-S1 from J8 to the PC using the USB cable (included) to power to the system. LED3 illuminates to indicate a good power connection.
3. Connect the AE-CAP1-S124 from J10 to the PC using the other USB cable (included) to provide the J-Link connection.
4. Navigate to folder \ae_cap1_s1_mc_out_of_box_demo_image_programmer.
5. Double-click Program_AE_CAP1_S124_MC_App.bat in the files. See Figure 7 for details.

Note: If the update J-Link firmware dialog box displays, it is recommended that you click **Yes**. A programming failure may occur if you update the firmware. If this occurs, double-click the .bat file again. See Figure 8 for details.

At this point, the out-of-box demonstration for AE-CAP1-S1 and AE-CAP1-MC is loaded.

8.2.2 Out-of-box demonstration notes for AE-CAP1-S1 and AE-CAP1-MC

After successfully programming the system, press the Reset button on the AE-CAP1-S1 (see Figure 6). Observe that the following events occur on the system in sequence:

1. The system performs an auto-tuning test on the Mutual capacitance button board (about 2 seconds).
2. When this auto-tuning is finished, LED1 (Red) and LED2 (Green) on the AE-CAP1-S1 board blinks 5 times. **Do not touch board before LED1 and LED2 start to blink.**
3. If auto-tuning is successful, LED2 (Green) continues to blink and the board is ready to accept user touch sensing inputs. When pressed, the LED on top of the button illuminates and turns off when it is pressed to release.
4. If auto tuning is not successful, LED1 (Red) blinks to indicate a hardware issue. Use the following steps to fix the system:
 - a. Press the Reset button to restart the system.
 - b. Double check that the correct application board AE-CAP1-MC is used.

8.3 Out-of-box demo2 for AE-CAP1-S1 and AE-CAP1-MC

8.3.1 Loading the out-of-box demo2 for AE-CAP1-S1 and AE-CAP1-MC

See Figure 14 to connect the AE-CAP1-S1 and AE-CAP1-MC board. See Figure 12 to connect the USB Serial conversion cable between AE-CAP1-S1 and PC. Use the following steps to load the out-of-box demo2 for the system:

1. On the AE-CAP1-S1, leave jumper J4 open, orient jumper J2 towards the USB Device, and un-install jumpers from J5 (leave J5 open). See Figure 6 for jumper locations J4, J2, and J5.
2. Connect the AE-CAP1-S1 from J8 to the PC using the USB cable (included) to power the system. LED3 illuminates to indicate a good power connection.
3. Connect the AE-CAP1-S124 from J10 to the PC using the other USB cable (included) to provide the J-Link connection.
4. Navigate to folder \ae_cap1_s1_mc_out_of_box_demo2_image_programmer.
5. Double-click on Program_AE_CAP1_S124_MC_UART_Monitor_App.bat in the files. See Figure 7 for details.

Note: If the update J-Link firmware dialog box displays, it is recommended that you click **Yes**. A programming failure may occur if you update the firmware. If this occurs, double-click the .bat file again. See Figure 8 for details.

At this point, the out-of-box demo2 for AE-CAP1-MC is loaded onto the AE-CAP1-S1.

8.3.2 Out-of-box demo2 notes for AE-CAP1-S1 and AE-CAP1-MC

Standalone mode

After successfully programming the system, press the **Reset** button to run the program. Observe that the following events happen on the system in sequence:

1. The system performs an auto-tuning test on the Mutual-capacitance board (about 2 seconds).
2. When this auto-tuning is finished, LED1 (Red) and LED2 (Green) on the AE-CAP1-S1 board blinks 5 times. **Do not touch board before LED1 and LED2 start to blink.**
3. If auto-tuning is successful, LED2 (Green) continues to blink and the board is ready to accept touch sensing user inputs. **Note that the LED on the AE-CAP1-MC board is not active with the demonstration code.**
4. If auto-tuning is not successful, LED1 (Red) blinks to indicate a hardware issue. Use the following steps to fix the system:
 - a. Press the Reset button to restart the system.
 - b. Double check that the correct application board AE-CAP1-MC is used.

Communication with CTW for Synergy

To establish communication with CTW for Synergy, select UART baud rate of 115200 (see Figure 13). Table 4 maps the marking on the AE-CAP1-MC to the touch button assignment in CTW for Synergy for S124:

Table 4. CTW for Synergy S124 Mutual Button Mapping with AE-CAP1-MC Board Silk Screen Marking

CTW for Synergy Assignment	AE-CAP1-MC Mark	CTW for Synergy Assignment	AE-CAP1-MC Mark	CTW for Synergy Assignment	AE-CAP1-MC Mark
Mtx0	MT16	Mtx7	MT9	Mtx14	MT2
Mtx1	MT12	Mtx8	MT5	Mtx15	MT19
Mtx2	MT8	Mtx9	MT1	Mtx16	MT15
Mtx3	MT4	Mtx10	MT18	Mtx17	MT11
Mtx4	MT0	Mtx11	MT14	Mtx18	MT7
Mtx5	MT17	Mtx12	MT10	Mtx19	MT3
Mtx6	MT13	Mtx13	MT6		

See section 5 in the *Application Example for Capacitive Touch (AE-CAP1) Quick Start Guide* (r12qs0016eu0100) to review how to communicate with the CTW for Synergy.

8.4 Out-of-box demonstration for AE-CAP1-S1 and AE-CAP1-SC

8.4.1 Loading the out-of-box demonstration for AE-CAP1-S1 and AE-CAP1-SC

Use the following steps to load the out-of-box demonstration for the system with AE-CAP1-S1 and AE-CAP1-SC:

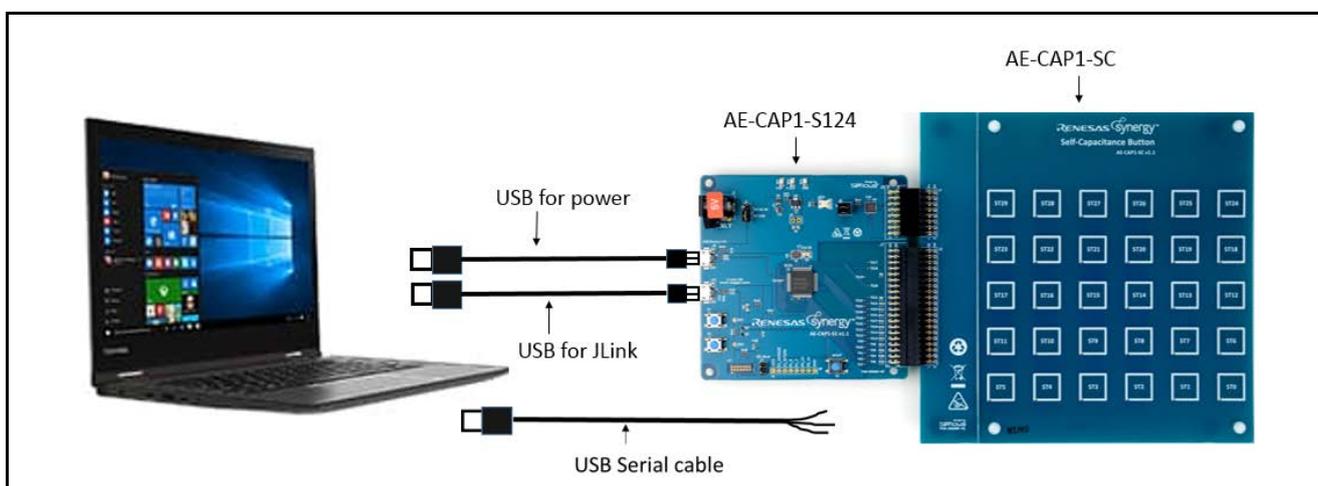


Figure 15. AE-CAP1-S1 and AE-CAP1-SC

1. On the AE-CAP1-S1, leave jumper J4 open, orient jumper J2 towards the USB Device, and un-install jumpers from J5 (leaving J5 open). See Figure 6 for jumper locations J4, J2, and J5.

2. Connect the AE-CAP1-S1 from J8 to the PC using the USB cable (included) to power the system. LED3 illuminates to indicate a good power connection.
3. Connect the AE-CAP1-S124 from J10 to the PC using the other USB cable (included) to provide the J-Link connection.
4. Navigate to folder \ae_cap1_s1_sc_out_of_box_demo_image_programmer.
5. Double-click on Program_AE_CAP1_S124_SC_UART_Monitor_App.bat in the files. See Figure 7 for details.

Note: If the update J-Link firmware dialog box displays, it is recommended that you click **Yes**. A programming failure may occur if you update the firmware. If this occurs, double-click the .bat file again. See Figure 8 for details.

At this point, the out-of-box demonstration for AE-CAP1-SC is loaded onto the AE-CAP1-S1.

8.4.2 Out-of-box demonstration notes for AE-CAP1-S1 and AE-CAP1-SC

Standalone mode

After successfully programming the system, press the Reset button to run the program. Observe that the following events occur on the system in sequence:

1. The system performs an auto-tuning test on the self-capacitance button board (2 seconds).
2. When this auto-tuning is finished, LED1 (Red) and LED2 (Green) on the AE-CAP1-S1 board blinks 5 times. **Do not touch board before LED1 and LED2 start to blink.**
3. If auto-tuning is successful, LED2 (Green) continues to blink and the board is ready to accept touch sensing user inputs. When pressed, LED1 (Red) illuminates and turns off when it is pressed to release.
4. If auto-tuning is not successful, LED1 (Red) blinks to indicate a hardware issue. Use the following steps to fix the system:
 - a. Press the Reset button to restart the system.
 - b. Double check that the correct application board AE-CAP1-SC is used.

Communication with CTW for Synergy

To establish communication with CTW for Synergy, select the UART baud rate of 115200 (see Figure 13).

Table 5 maps the marking on the AE-CAP1-SC to the touch sensor channel on the S124:

Table 5. S124 AE-CAP1-SC Board Silk Screen to Sensor Channel Mapping

CTW for Synergy Assignment	AE-CAP1-SC Mark	CTW for Synergy Assignment	AE-CAP1-MC Mark	CTW for Synergy Assignment	AE-CAP1-MC Mark
TS00	ST5	TS13	ST10	TS23	ST21
TS01	ST4	TS14	ST11	TS24	ST20
TS02	ST6	TS15	ST12	TS25	ST19
TS04	ST3	TS16	ST13	TS26	ST14
TS05	ST2	TS17	ST29	TS27	ST15
TS06	ST1	TS18	ST28	TS28	ST16
TS07	ST0	TS19	ST27	TS30	ST18
TS08	ST7	TS20	ST26	TS31	ST17
TS09	ST8	TS21	ST23		
TS12	ST9	TS22	ST22		

See section 5 in the *Application Example for Capacitive Touch (AE-CAP1) Quick Start Guide* (r12qs0016eu0100) to review how to communicate with the CTW for Synergy.

8.5 Out-of-box demonstration for AE-CAP1-S3 and AE-CAP1-MC

8.5.1 Loading the out-of-box demonstration on AE-CAP1-S3 and AE-CAP1-MC

Follow these steps to load the out-of-box demonstration for the system with AE-CAP1-S3 and AE-CAP1MC:

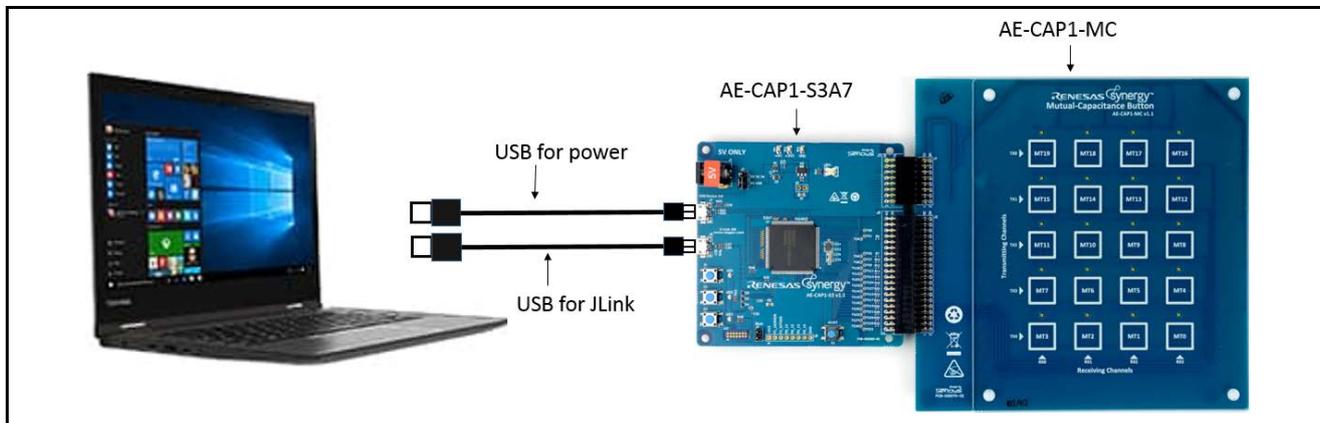


Figure 16. AE-CAP1-S3 and AE-CAP1-MC

1. See Figure 10 to set up jumpers on the AE-CAP1-S3. Leave jumper J4 open and orient jumper J2 towards the USB Device.
2. Connect the AE-CAP1-S1 from J7 to the PC using the USB cable (included) to power the system. LED4 illuminates to indicate a good power connection.
3. Connect the AE-CAP1-S3A7 from J9 to the PC using the other USB cable (included) to provide the J-Link connection.
4. Navigate to folder \ae_cap1_s3_mc_out_of_box_demo_image_programmer.
5. Double-click Program_AE_CAP1_S3A7_MC_App.bat in the files. See Figure 7 for details.

Note: If the update J-Link firmware dialog box displays, it is recommended that you click **Yes**. A programming failure may occur if you update the firmware. If this occurs, double-click the .bat file again. See Figure 8 for details.

At this point, the out-of-box demonstration for AE-CAP1-MC is loaded onto the AE-CAP1-S3.

8.5.2 Out-of-box demonstration notes for AE-CAP1-S3 and AE-CAP1-MC

Standalone Mode

Upon successfully programming the system, press the Reset button to run the program. Observe that the following events happen on the system in sequence:

1. The system performs an auto-tuning test on the Mutual capacitance board (about 2 seconds).
2. When this auto-tuning is finished, LED1 (Red), LED2 (Yellow), and LED3 (Green) on the AE-CAP1-S3 board blinks 5 times. **Do not touch board before LED1, LED2 and LED3 start to blink.**
3. If auto tuning is successful, LED3 (Green) continues to blink and the board is ready to accept user touch sensing inputs. When pressed, the LED on top of the button illuminates and turns off when it is released.
4. If auto-tuning is not successful, LED1 (Red) blinks to indicate a hardware issue. Use the following steps to fix the system:
 - a. Press the Reset button to restart the system.
 - b. Double check that the correct application board AE-CAP1-MC is used.

Communication with CTW for Synergy

See section 3.1 in the *Application Example for Capacitive Touch (AE-CAP1) Quick Start Guide* (r12qs0016eu0100) to set up the communication and section 5 to review how to communicate with the CTW for Synergy. Reference below table to map the marking on the AE-CAP1-MC to the touch sensor channel on the S3A7:

Table 6. CTW for Synergy S3A7 Mutual Button Mapping with AE-CAP1-MC Board Silk Screen Marking

CTW for Synergy Assignment	AE-CAP1-MC Mark	CTW for Synergy Assignment	AE-CAP1-MC Mark	CTW for Synergy Assignment	AE-CAP1-MC Mark
Mtx0	MT4	Mtx7	MT13	Mtx14	MT18
Mtx1	MT0	Mtx8	MT9	Mtx15	MT7
Mtx2	MT12	Mtx9	MT17	Mtx16	MT3
Mtx3	MT8	Mtx10	MT6	Mtx17	MT15
Mtx4	MT16	Mtx11	MT2	Mtx18	MT11
Mtx5	MT5	Mtx12	MT14	Mtx19	MT19
Mtx6	MT1	Mtx13	MT10		

8.6 Out-of-box demonstration for AE-CAP1-S3 and AE-CAP1-SC

8.6.1 Loading the out-of-box demonstration for AE-CAP1-S3 and AE-CAP1-SC

Use the following steps to reload the out-of-box demonstration for the system with AE-CAP1-S3 and AE-CAP1-SC:

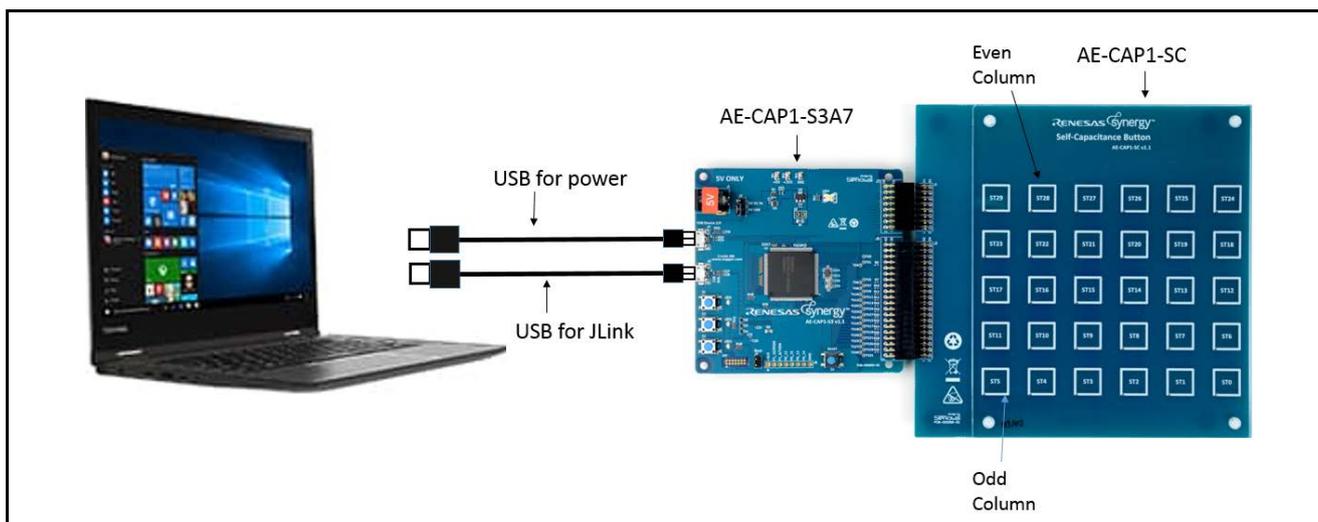


Figure 17. AE-CAP1-S3 and AE-CAP1-SC

1. See Figure 10 to set up jumpers on the AE-CAP1-S3. Leave jumper J4 open and orient jumper J2 towards the USB Device.
2. Connect the AE-CAP1-S3 from J7 to the PC using the USB cable (included) to power the system. LED4 illuminates to indicate a good power connection.
3. Connect the AE-CAP1-S3A7 from J9 to the PC using the other USB cable (included) to provide the J-Link connection.
4. Navigate to folder \ae_cap1_s3_sc_out_of_box_demo_image_programmer.
5. Double-click Program_AE_CAP1_S3A7_SC_App.bat in the files. See Figure 7 for details.

Note: If the update J-Link firmware dialog box displays, it is recommended that you click Yes. A programming failure may occur if you update the firmware. If this occurs, double-click the .bat file again. See Figure 8 for details.

At this point, the out-of-box demonstration for AE-CAP1-SC is loaded onto the AE-CAP1-S3.

8.6.2 Out-of-box demonstration notes for AE-CAP1-S3 and AE-CAP1-SC

Standalone Mode

After successfully programming the system, press the Reset button to run the program. Observe that the following events occur on the system in sequence:

1. The system performs an auto-tuning test on the self-capacitance board (about 2 seconds).
2. When this auto-tuning is finished, LED1 (Red), LED2 (Yellow), and LED3 (Green) on the AE-CAP1-S3 board blinks 5 times. **Do not touch board before LED1, LED2 and LED3 start to blink.**
3. If auto-tuning is successful, LED3 (Green) continues to blink and the board is ready to accept user touch sensing inputs.
 - a. Press the buttons on the odd columns of the AE-CAP1-SC board (see Figure 17). Observe that LED1 (Red) illuminates and turns off after it is released.
4. Press the buttons on the even columns of the AE-CAP1-SC board (see Figure 17). Observe that LED2 (Yellow) illuminates and turns off when it is pressed to release.
5. If auto-tuning is not successful, LED1 (Red) blinks to indicate a hardware issue. Use the following steps to fix the system:
 - a. Press the Reset button to restart the system.
 - b. Double check that the correct application board AE-CAP1-SC is used.

Communication with CTW for Synergy

See section 3.1 in the *Application Example for Capacitive Touch (AE-CAP1) Quick Start Guide* (r12qs0016eu0100) to set up the communication and section 5 to review how to communicate with the CTW for Synergy. See Table 7 to map AE-CAP1-SC silk screen marking to S3A7 sensor touch channels:

Table 7. S3A7 AE-CAP1-SC Silk Screen Marking to Touch Sensor Channel Mapping

CTW for Synergy Assignment	AE-CAP1-SC Mark	CTW for Synergy Assignment	AE-CAP1-SC Mark	CTW for Synergy Assignment	AE-CAP1-SC Mark
TS00	ST29	TS12	ST18	TS22	ST4
TS01	ST28	TS13	ST19	TS26	ST5
TS04	ST27	TS14	ST12	TS27	ST2
TS05	ST26	TS15	ST13	TS29	ST3
TS06	ST24	TS16	ST10	TS30	ST0
TS07	ST25	TS17	ST11	TS31	ST1
TS08	ST22	TS18	ST8	TS32	ST15
TS09	ST23	TS19	ST9	TS33	ST14
TS10	ST20	TS20	ST6	TS34	ST17
TS11	ST21	TS21	ST7	TS35	ST16

Website and Support

Visit the following vanity URLs to learn about key elements of the Synergy Platform, download components and related documentation, and get support.

Synergy Software	www.renesas.com/synergy/software
Synergy Software Package	www.renesas.com/synergy/ssp
Software add-ons	www.renesas.com/synergy/addons
Software glossary	www.renesas.com/synergy/softwareglossary
Development tools	www.renesas.com/synergy/tools
Synergy Hardware	www.renesas.com/synergy/hardware
Microcontrollers	www.renesas.com/synergy/mcus
MCU glossary	www.renesas.com/synergy/mcuglossary
Parametric search	www.renesas.com/synergy/parametric
Kits	www.renesas.com/synergy/kits
Synergy Solutions Gallery	www.renesas.com/synergy/solutionsgallery
Partner projects	www.renesas.com/synergy/partnerprojects
Application projects	www.renesas.com/synergy/applicationprojects
Self-service support resources:	
Documentation	www.renesas.com/synergy/docs
Knowledgebase	www.renesas.com/synergy/knowledgebase
Forums	www.renesas.com/synergy/forum
Training	www.renesas.com/synergy/training
Videos	www.renesas.com/synergy/videos
Chat and web ticket	www.renesas.com/synergy/resourcelibrary

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	May.02.17	—	Initial release
1.01	Nov.22.17	—	Updated software versions and document references
1.02	Apr.04.18	—	Updated for SSP v1.4.0
1.03	Apr.02.19	—	Updated for SSP v1.6.0

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The intended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.
 - "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.
 - "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user's manual or other Renesas Electronics document.
6. When using Renesas Electronics products, refer to the latest product information (data sheets, user's manuals, application notes, "General Notes for Handling and Using Semiconductor Devices" in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
7. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
9. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
10. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
11. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.

(Note1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.

(Note2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev. 4.0-1 November 2017)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.

Contact information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:
www.renesas.com/contact/.