Renesas Synergy™ Platform

Debugging ThreadX RTOS Applications Using TraceX

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ThreadX® is an RTOS from Express Logic which is based on a high-performance embedded kernel. This application note provides procedures to check ThreadX thread and object states (referred to as **resources**) during the development of applications in e² studio for Renesas Synergy™. The procedure for starting TraceX® is also explained. For the ThreadX specifications and functions, visit the Express Logic (http://rtos.com/) website. For TraceX specifications and functions, visit the Synergy Software (https://www.renesas.com/us/en/products/synergy.html) page. Under the **Development Tools** tab, select **TraceX**.

This application note explains examples using a project called **Blinky with ThreadX** that is available after installing the Renesas Synergy™ Software Package (SSP). For procedures covering operations with **Blinky with ThreadX**, see the *Renesas Synergy™ e² studio v6.2 or Greater Getting Started Guide* available on the Synergy Solutions Gallery (https://www.renesas.com/us/en/products/synergy/gallery.html). This document describes general usage of e² studio.

This application note supports SSP version 1.4.0 and later and e² studio version 6.2.0 and later.

Target Environment

The operations covered in this document were confirmed in the following environment.

- Renesas Synergy™ Software Package (SSP) v1.4.0 or later
- e² studio for Renesas Synergy™ v6.2.0 or later
- ThreadX (requires development/production license, see section 5.1, Licenses for ThreadX)
- Development Kit for DK-S7G2 Synergy MCU Group

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1. Blinky Project with ThreadX

Using the **Blinky Project** with **ThreadX** for this module demonstrates TraceX usage to track threads, as well as the Debug view in e² studio for executed functions.

To create a new Blinky with ThreadX project, perform the following steps:

1. Open Synergy Configuration e² studio. Click **File > New > Synergy C/C++ project**.

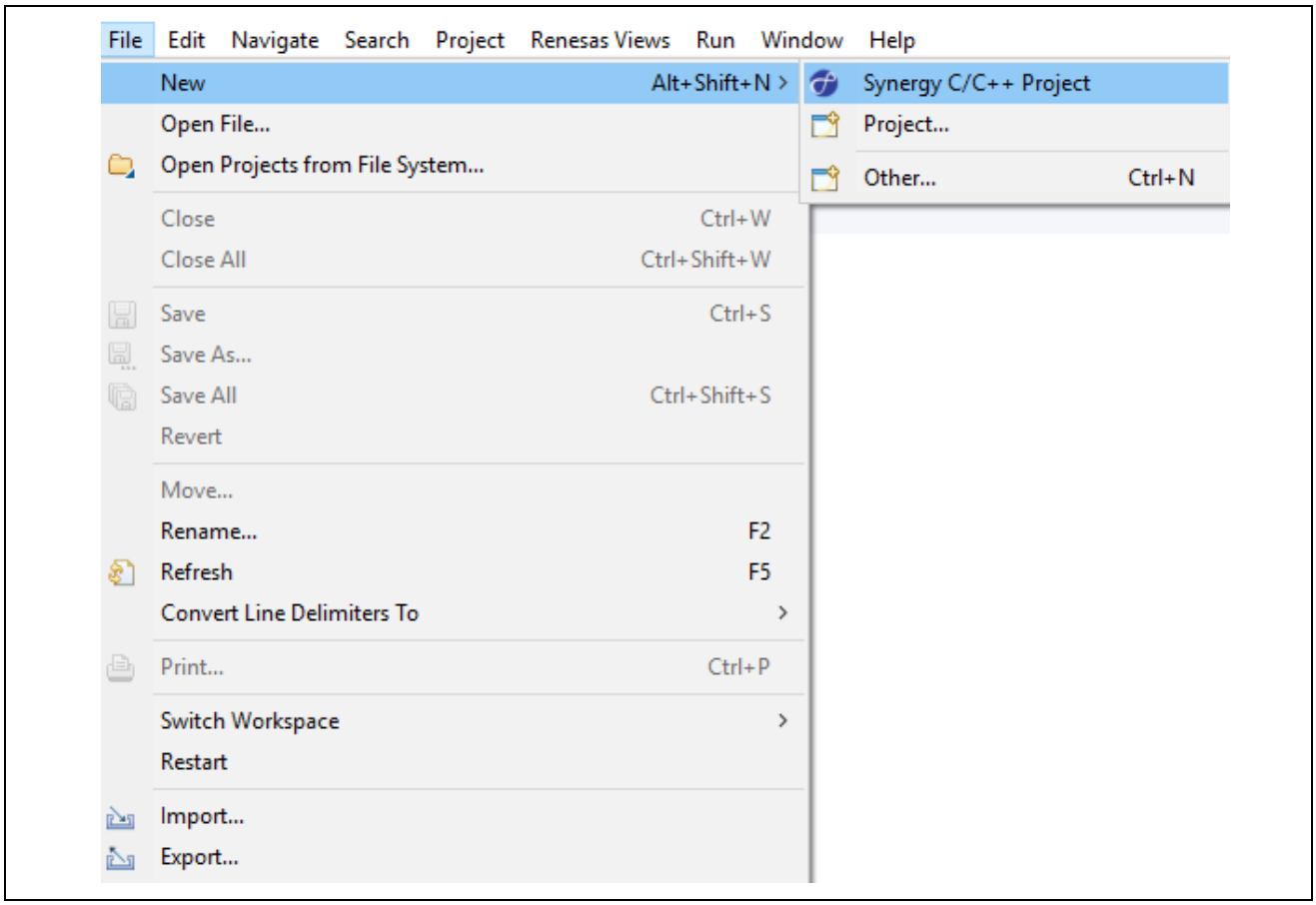

Figure 1 Creating a new project

2. Select the **Renesas Synergy C Executable Project** template **(**Figure 2). Click **Next** to continue.

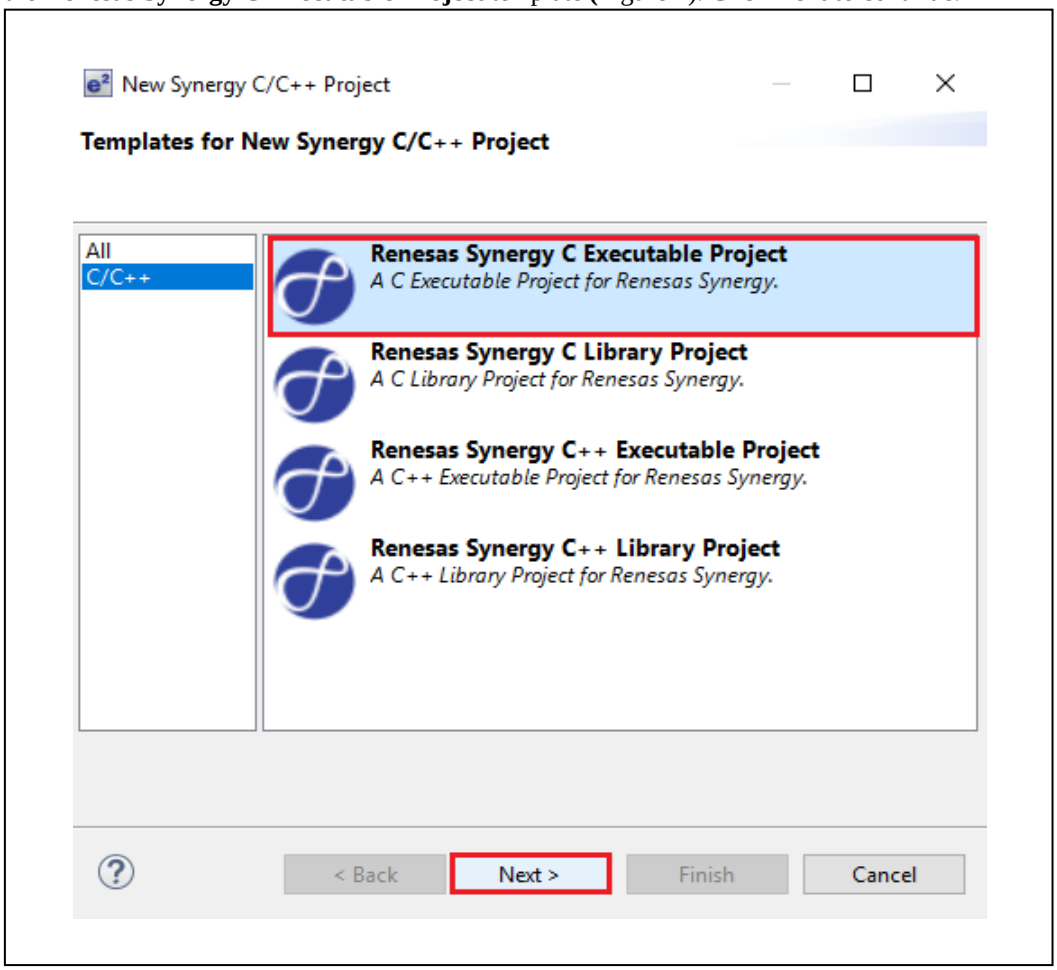

Figure 2 Selecting the Synergy C project template

3. Enter the name of the project, such as **Blinky_DK_S7G2**, as required in the dialog box (Figure 3). Click **Next**.
4. Make sure the License file (Figure 3) is set to the new **SSP version 1.4.0**.

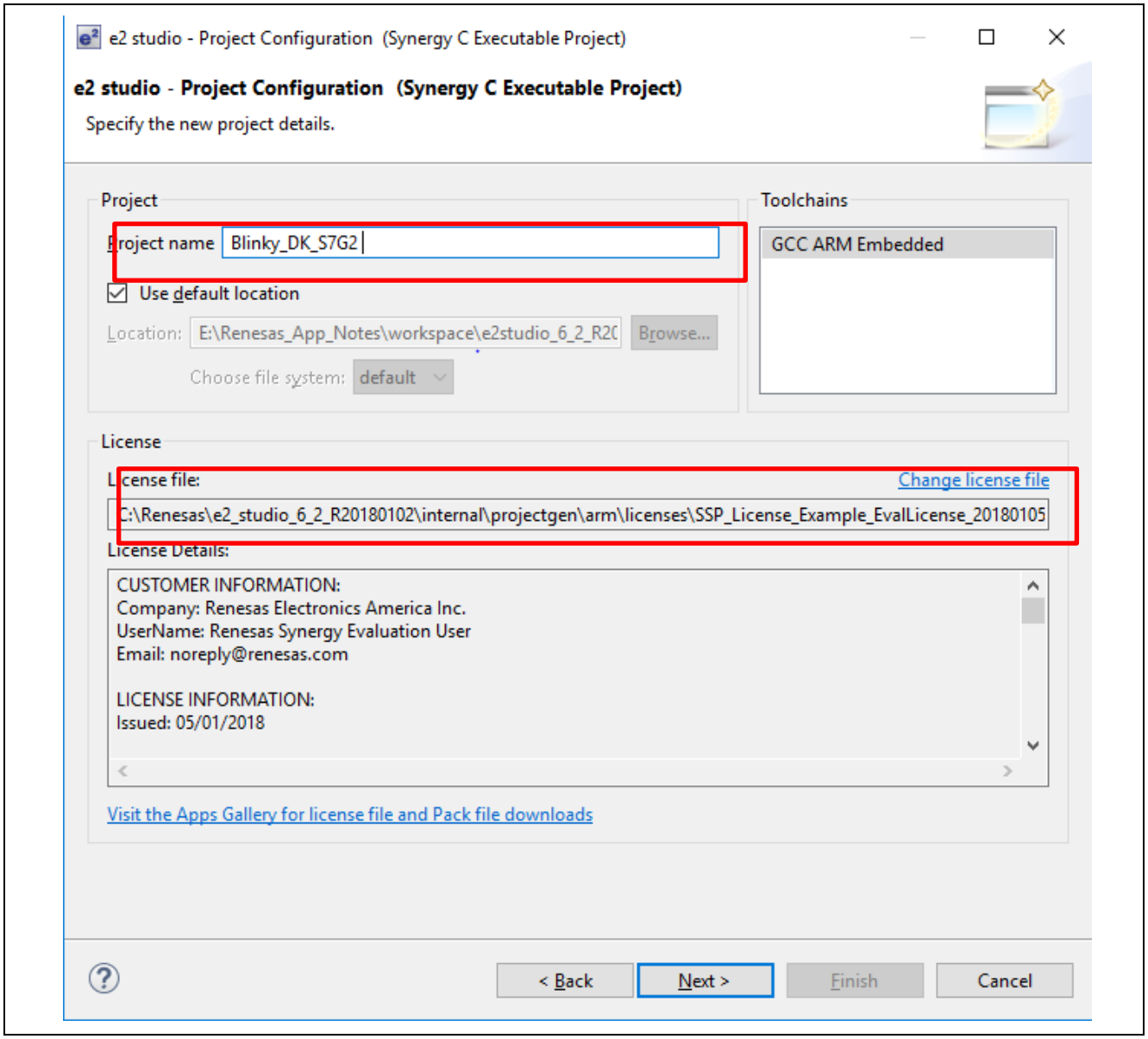

Figure 3 Entering the project name and license file

5. Make sure the SSP version and the board values are correct in the **Device Selection** (Figure 4). Click **Next** to continue.

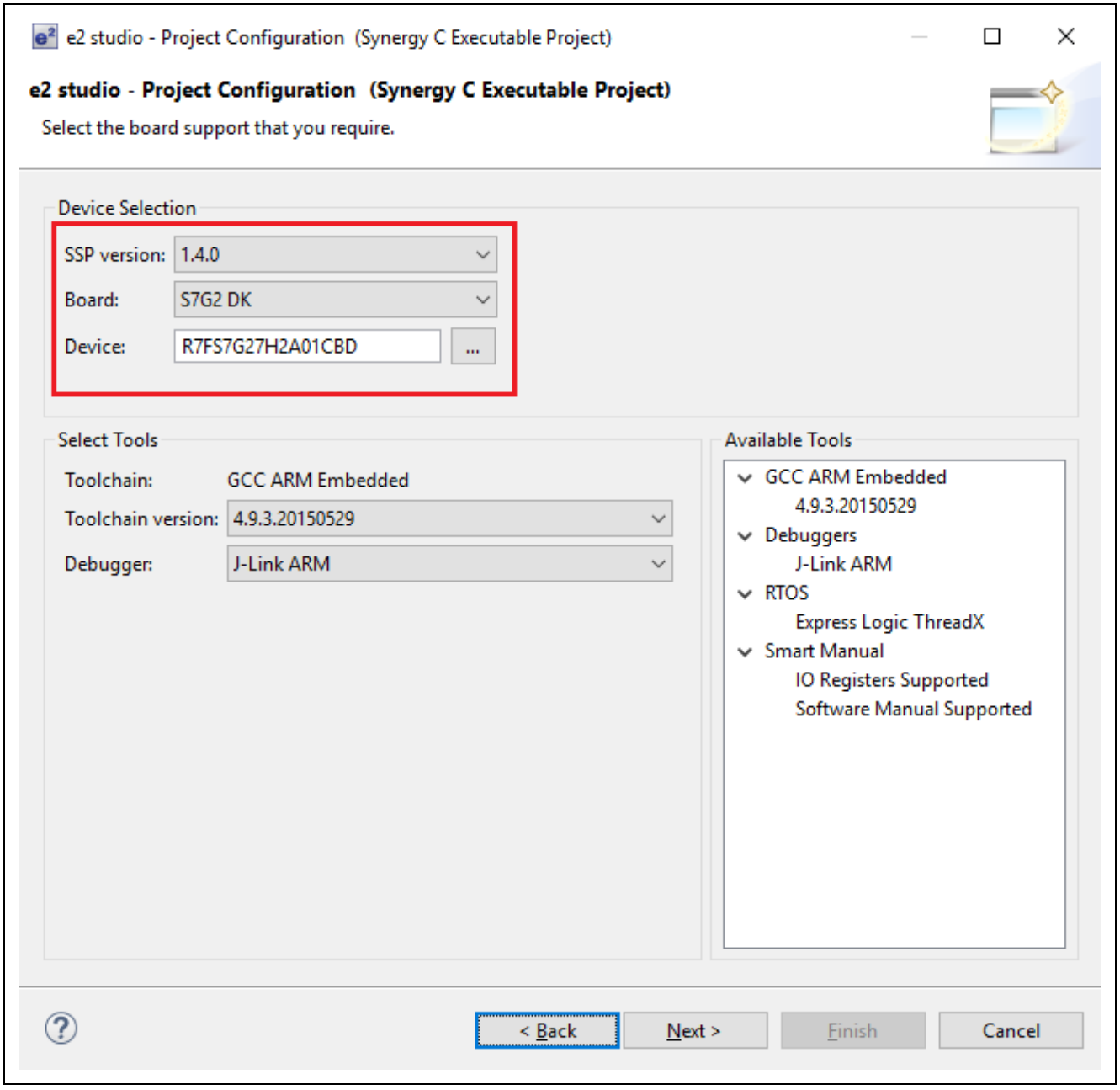

Figure 4 Selecting the board and device version

6. Select the **Project Template Selection** type as **Blinky with ThreadX** (). Click **Finish**.

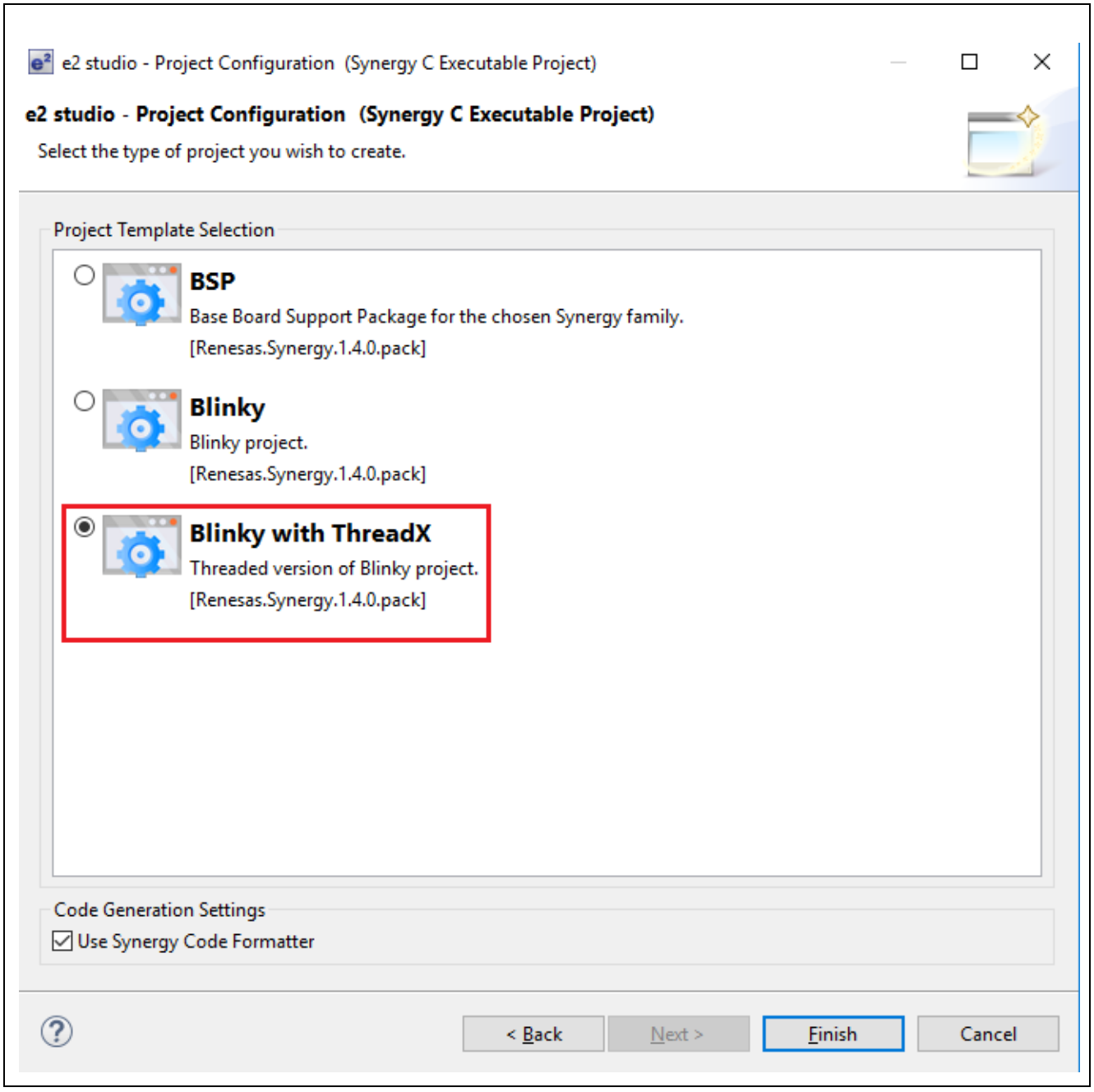

Figure 5 Selecting a project template

A new project is added into the project explorer window with the provided name.

2. Using TraceX

TraceX is software that displays transitions of threads running under the ThreadX operating system on the PC. TraceX can be directly started from the e² studio. The following procedures describe how to download, install, and start using TraceX.

2.1 Installing TraceX

1. Select **TraceX** under the **Development Tools** tab on the Renesas Synergy™ Gallery (https://synergygallery.renesas.com/) website (Figure 6).

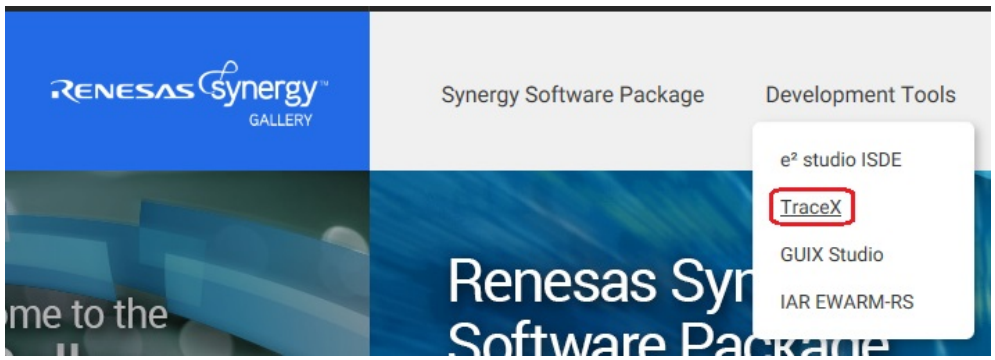

Figure 6 Navigating to the TraceX download page

2. On the TraceX download page, click **DOWNLOAD** (Figure 7) to download and install TraceX on the PC.

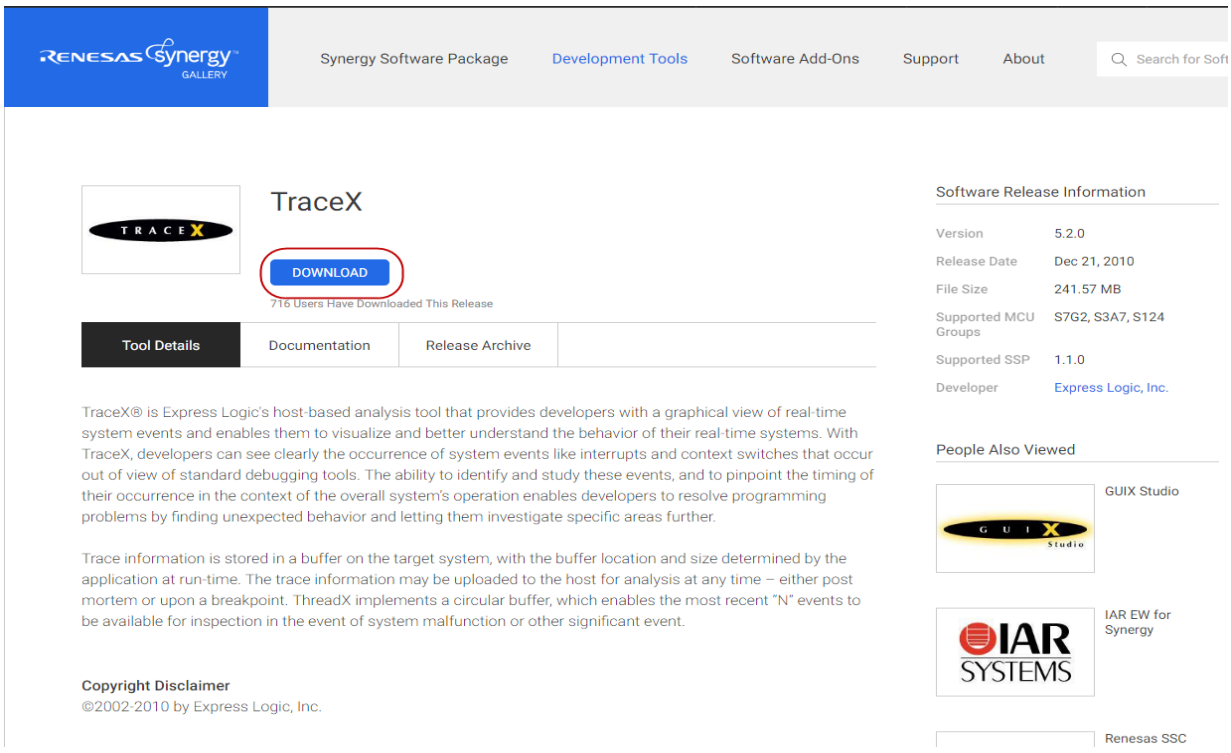

Figure 7 Downloading TraceX

3. Once downloaded, unzip the application file.

Note: **Always Run the installer setup as an Administrator when installing TraceX software**. To become an Administrator, right-click the installer setup and select **Run as Administrator** from the drop-down menu. If the installer setup is not run as an Administrator, the installation will exit with an error, such as missing files.

2.2 Procedure for Starting TraceX

This procedure describes how to start TraceX from the e² studio.

1. Register the source code files for ThreadX in the e² studio by using the configuration editor (Figure 8 and Figure 9) for the e² studio version installed.
2. Open the **Threads** tab page, specify items (1) to (5) in order, and register the source files.

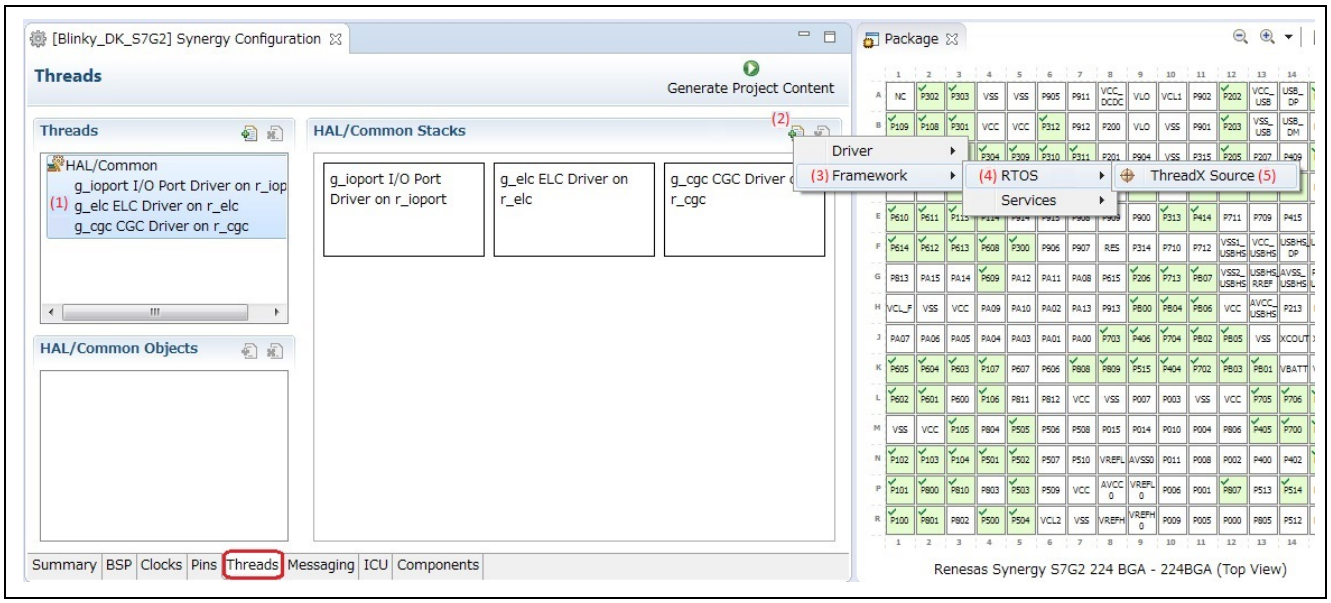

Figure 8 Registering source files for ThreadX (v5.3.1 and earlier versions of the e² studio)

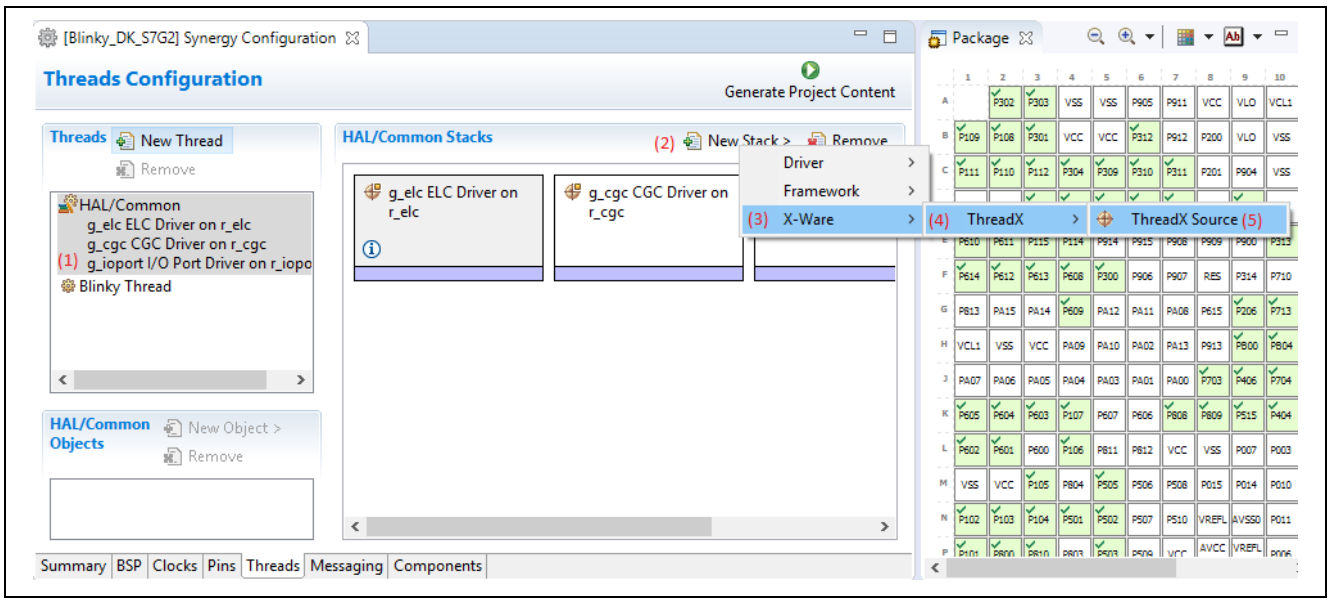

Figure 9 Registering source files for ThreadX (v5.3.1 and later versions of e² studio)

3. Disable the **Show linkage warning** shown in Figure 10 (e² studio v6.2.0 or later).

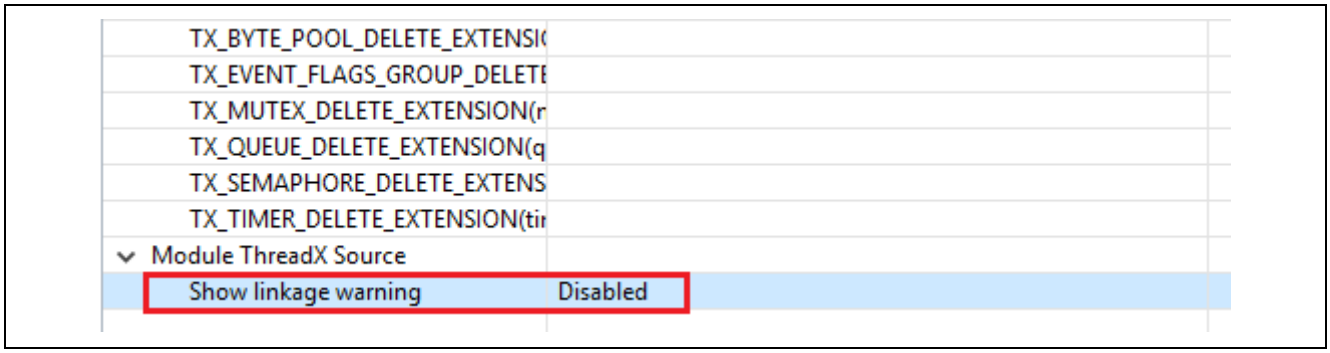

Figure 10 Disabling the Linkage Warning Error

4. Check the **Properties** tab page and set the **Event Trace** to **Enabled**. Set the **Trace Buffer Name**, **Trace Buffer Size**, and **Trace Buffer Number Registries** (see Figure 11), then update and build the project.

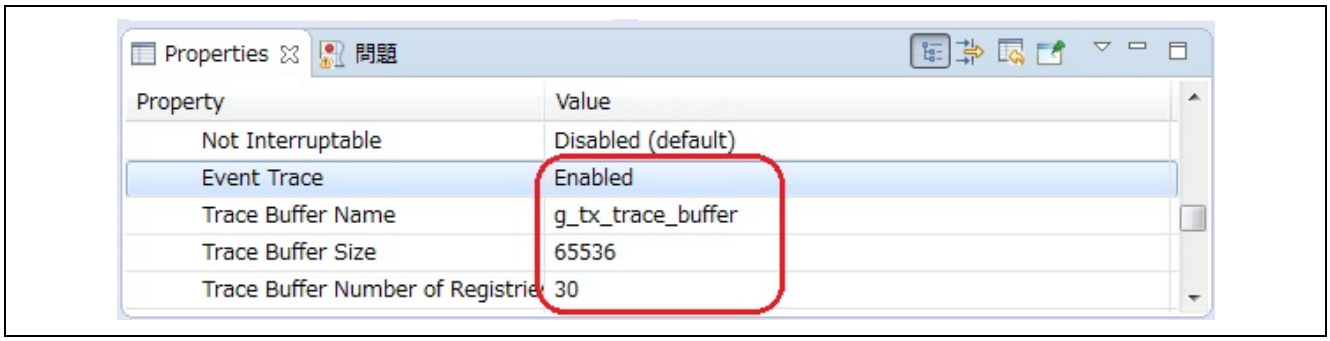

Figure 11 Setting the Event Trace

Note: The **Trace Buffer Size** on the **S1 Devices** is less than 16 KB and is based on the available RAM apart from the application.

5. When building is completed, start the debugger and execute the program by selecting **Run** > **Resume** from the menu.

   If this process is repeated twice, an LED blinks on and off with an interval of one second. You may suspend execution of the program by selecting **Run** > **Suspend** from the menu bar.

6. Use **TraceX** to check the result of the program's execution. Set the method of starting **TraceX**. When the **Run** > **Launch TraceX Debugging** menu item (Figure 12) is selected, a dialog box to start **TraceX** opens (Figure 13).

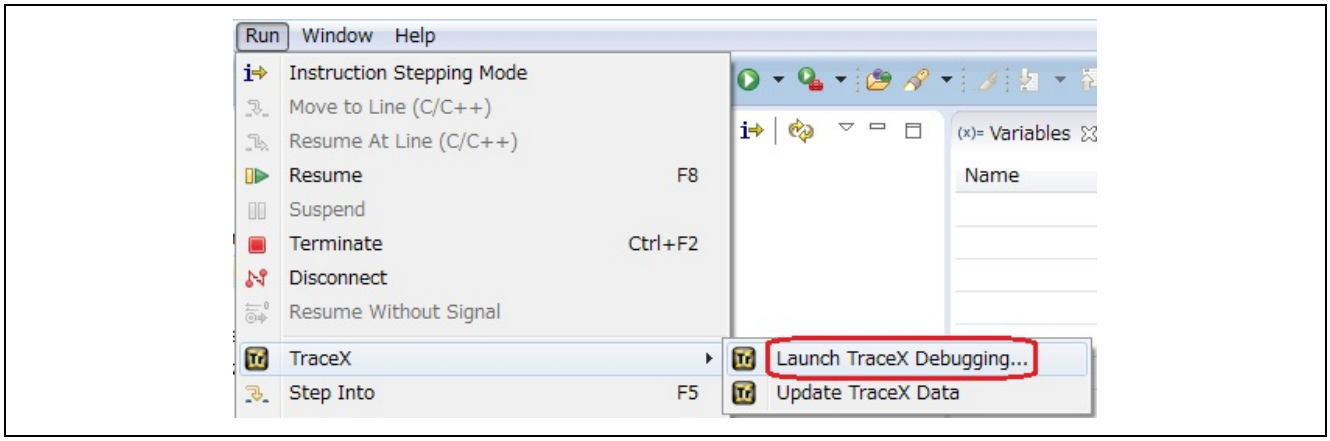

Figure 12 Setting the Start of TraceX Debugging

Note: The parameters to launch TraceX in Figure 13 are the values specified in Figure 11.

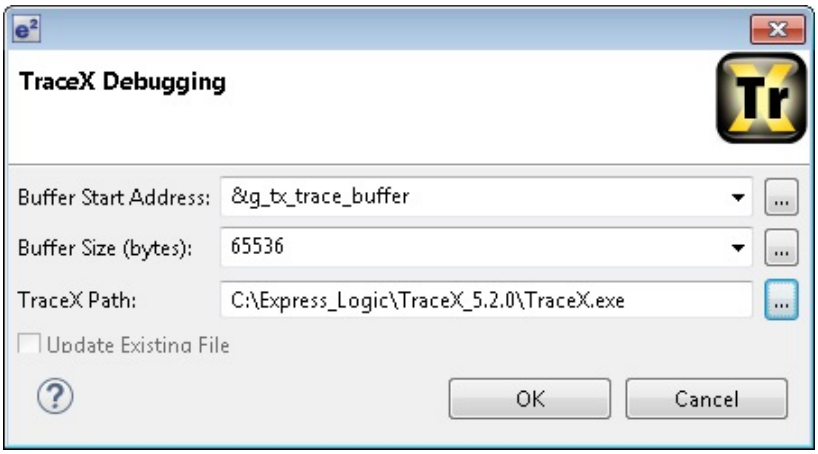

Figure 13 Setting the parameters for starting TraceX

7. Click **OK**. TraceX starts and transitions from the program executions that are displayed. Alternatively, the path to TraceX can be specified by opening the **Preferences** dialog box of the **e² studio** from the **Window > Preferences** menu and selecting **C/C++ > Renesas > TraceX**.

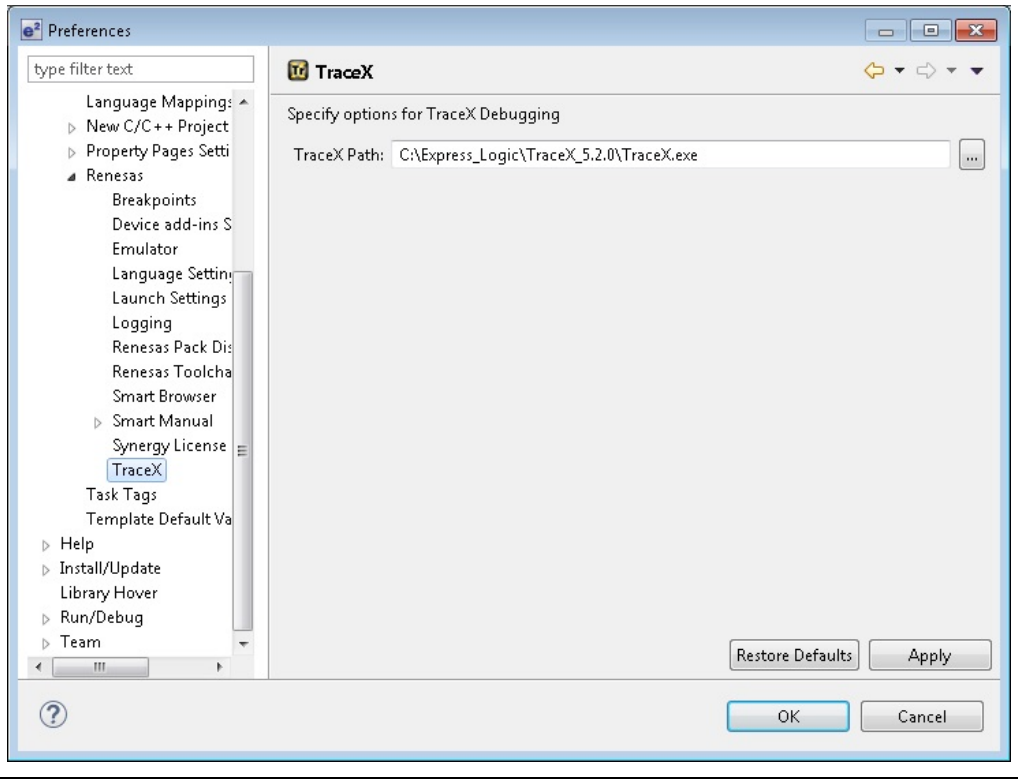

Figure 14 Setting the TraceX path

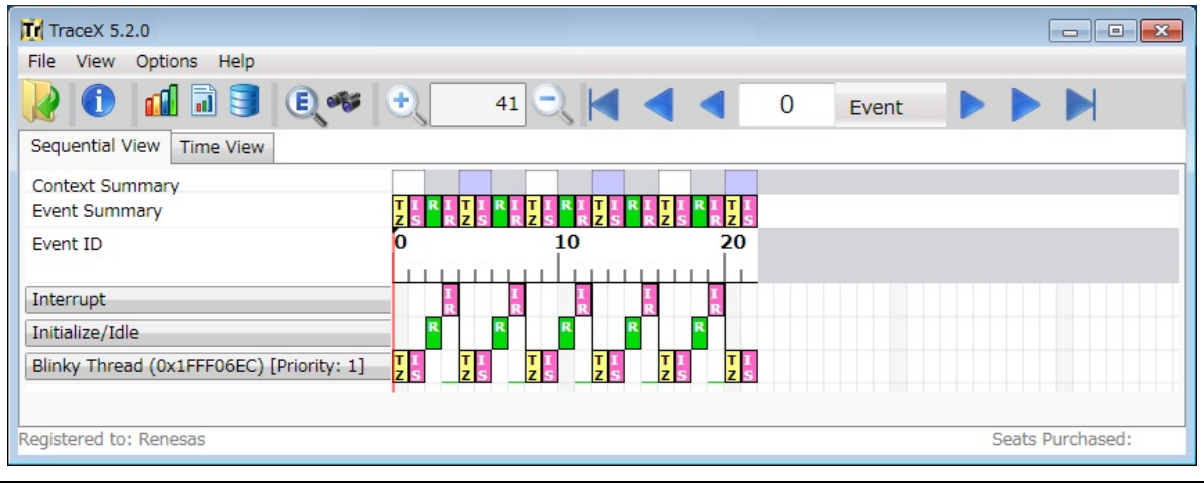

Figure 15 Starting TraceX

8. After the program is executed from the **Run** > **Resume** menu, suspend execution of the program from the **Run** > **Suspend** menu, then start TraceX and check that the data was updated.

   When TraceX is started the second and subsequent times, you do not need to set the parameters again. Start TraceX from the **Run** > **Update TraceX Data** menu (Figure 16).

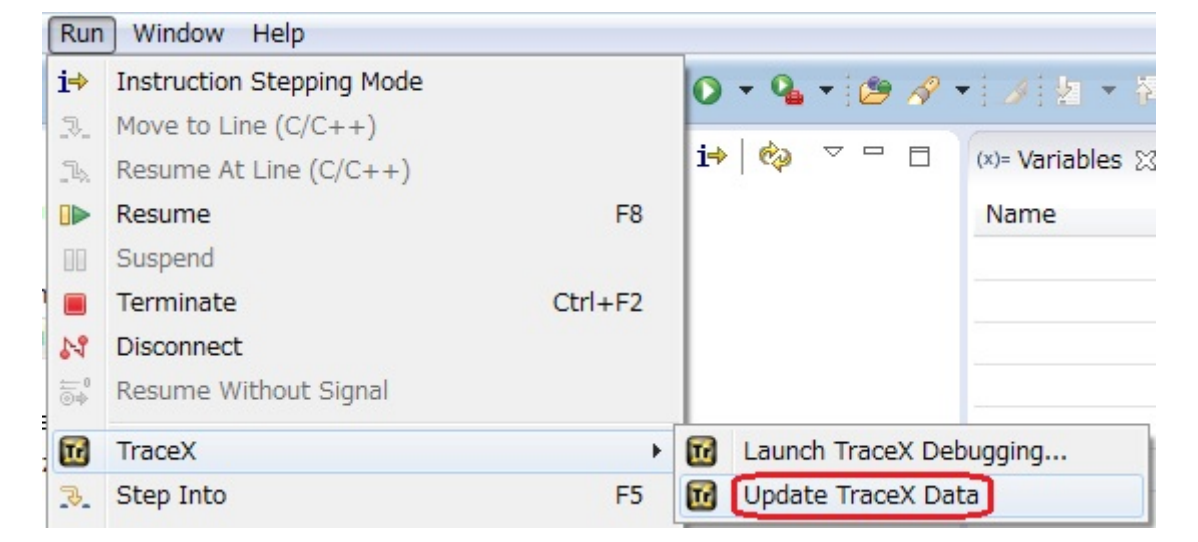

Figure 16 Updating TraceX data

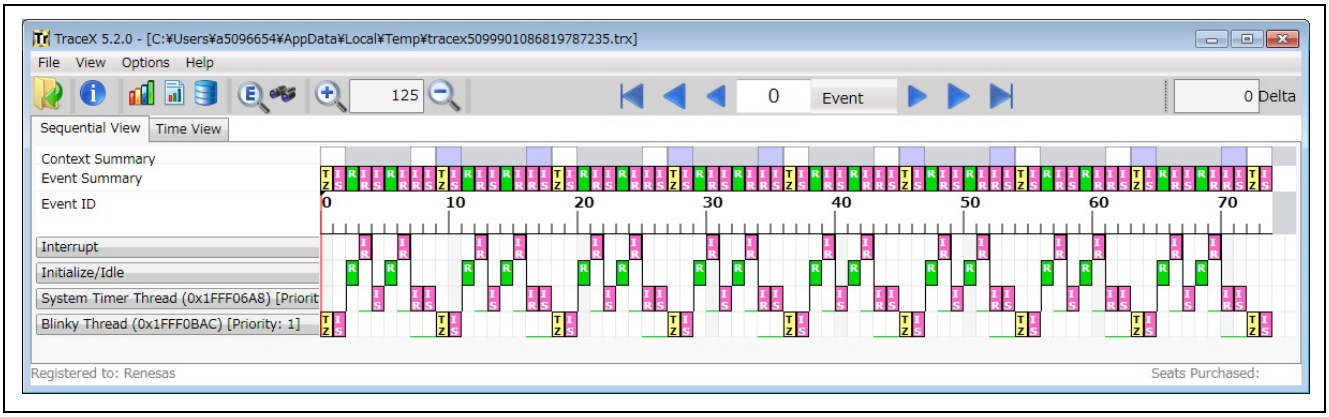

Figure 17 Display after TraceX data is updated

3. Using the RTOS Resource View Function

The e² studio has an RTOS resource view function that displays the state of resources of ThreadX. This procedure describes how to use the RTOS resource view.

Note: If you are using the RTOS Resources function in e² studio version 5.3.1 and later, refer to the following section. Set the **Display of Executed Functions in Debut View**, and set the **RTOS Integration in Debug View** to **No**.

3.1 Displaying the RTOS Resources View

Because the RTOS Resources view functions only with the debugger running, first you need to build a project, such as **Blinky with ThreadX** (see section 2.2), then start the debugger and select **Renesas Views > Partner OS > RTOS Resources**. When the **Select OS** dialog box displays, select **ThreadX (R)** as shown in Figure 18. The **RTOS Resources** view appears.

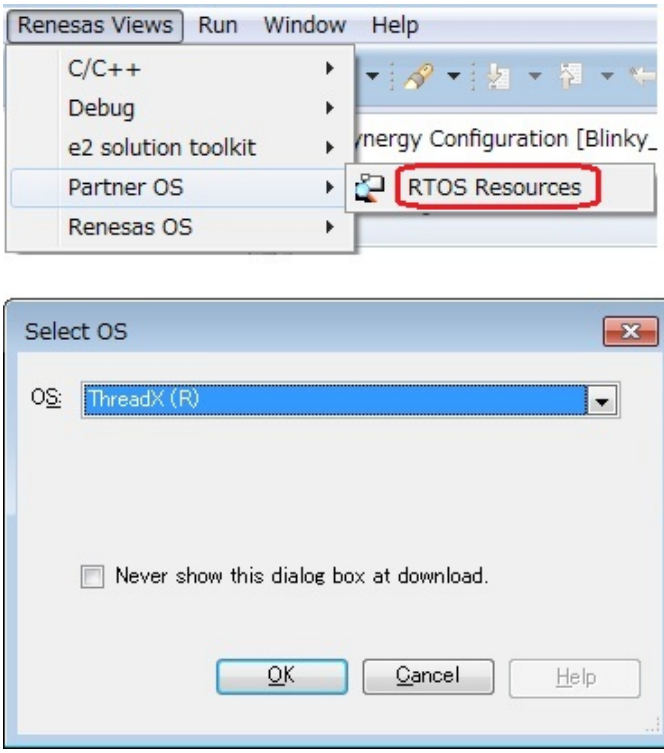

Figure 18 Specifying the RTOS resources and the OS

For e² studio version 5.3.1 and later, select the OS in the **RTOS Resources** view (Figure 19 and Figure 20), rather than in the dialog box.

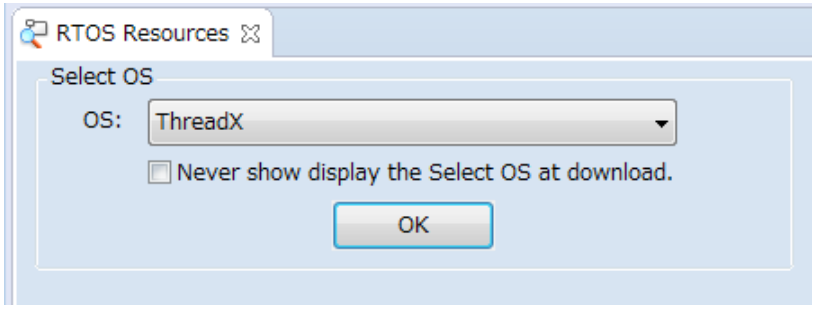

Figure 19 Selecting the OS in v5.3.1 and later versions of the e² studio

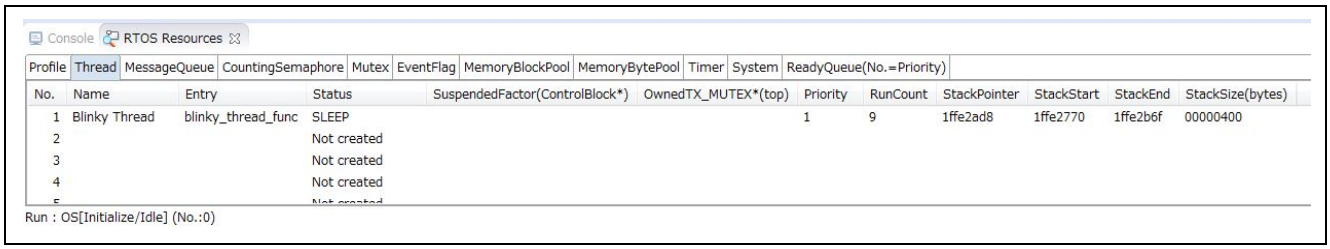

Figure 20 RTOS Resources view

The tabbed pages from **Thread** to **ReadyQueue(No.=Priority)** show the state of each resource. Select a tabbed page to check the state of a given resource.

Note: The **Profile** tab is reserved for future extensions.

Table 1 Contents of each tabbed window

Name of tabbed window in the RTOS Resources view	Displayed information and selections	Information to be displayed
Thread (e² studio v5.0.0 and earlier versions)	Name	Names of the threads
	Entry	Functions that start each of the threads
	Status	State of the thread
	Suspended Factor (Control Block*)	Resource that is the source of suspension
	OwnedTX_MUTEX*(top)	Acquired top mutex
	Priority	Priority
	RunCount	Number of times the thread is executed
	StackPointer	Current stack pointer
	StackStart	Address where the stack starts
	StackEnd	Address where the stack ends
	StackSize(bytes)	Stack size
Thread (e² studio v5.3.1 and later versions)	Name	Names of the threads
	Entry	Functions that start each of the threads
	Status	State of the thread
	Suspended Factor (Control Block*)	Resource that is the source of suspension
	OwnedTX_MUTEX*(top)	Acquired top mutex
	Priority	Priority
	RunCount	Number of times the thread has been executed
Stack (e² studio v5.3.1 and later versions)	Name	Names of the threads
	Entry	Functions that started each of the threads
	StackPointer	Current stack pointer
	StackStart	Address where the stack starts
	StackEnd	Address where the stack ends
	StackSize(bytes)	Stack size
	MaxStackUsage(bytes)	Maximum of the stack used currently
MessageQueue	Name	Names of the message queues
	UsedCount	Number of message queues in use
	FreeCount	Number of available message queues
	TotalCount	Total number of message queues
	MessageSize	Message size
	SuspendedTX_THREAD*(top)	Thread at the top of waiting threads in a queue

Name of tabbed window in the RTOS Resources view	Displayed information and selections	Information to be displayed
	SuspendedCount	Number of suspended threads
	StartAddress	Address where the message queue starts
	EndAddress	Address where the message queue ends
CountingSemaphore	Name	Names of the semaphores
	SemaphoreCount	Number of semaphores
	SuspendedTX_THREAD*(top)	Thread at the top of waiting threads in a queue
	SuspendedCount	Number of suspended threads
Mutex	Name	Names of the mutexes
	OwnerTX_THREAD*	Acquiring thread
	OwnerCount	Number of owners
	SuspendedTX_THREAD*(top)	Thread at the top of waiting threads in a queue
	SuspendedCount	Number of suspended threads
EventFlag	Name	Names of the event flags
	Flag	Current flag pattern
	SuspendedTX_THREAD*(top)	Thread at the top of waiting threads in a queue
	SuspendedCount	Number of suspended threads
MemoryBlockPool	Name	Names of the memory blocks
	FreeCount	Number of available blocks
	TotalCount	Total number of blocks
	BlockSize(bytes)	Block size
	TotalSize(bytes)	Total size of memory block pools
	SuspendedTX_THREAD*(top)	Thread at the top of waiting threads in a queue
	SuspendedCount	Number of suspended threads
	StartAddress	Top address of a memory block pool
MemoryBytePool	Name	Names of the memory pools
	Free(bytes)	Number of available bytes
	Total(bytes)	Total size of memory byte pools
	FragmentCount	Number of fragments
	SuspendedTX_THREAD*(top)	Thread at the top of waiting threads in a queue
	SuspendedCount	Number of suspended threads
	StartAddress	Address where the memory byte pool starts
Timer	Name	Names of the timers
	Remaining Tick	Remaining time
	Re-initialization Tick	Cycle time
System	SystemClock	System clock
ReadyQueue(No.=Priority)	QueuedTX_THREAD*(top)	Top ready thread

4. Displaying Executed Functions in the Debug View

e² studio version 5.3.1 and later has an additional feature which shows executed functions per thread (Figure 21).

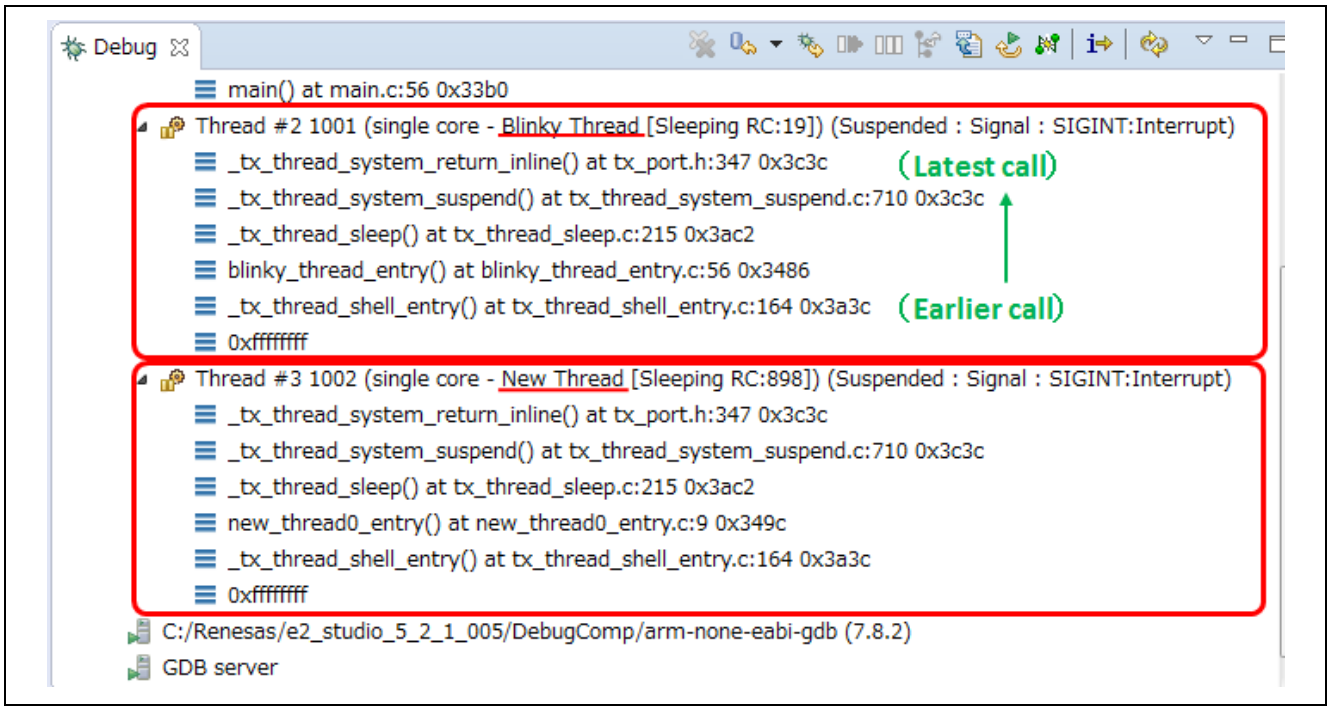

Figure 21 Displaying functions in thread units

4.1 Setting the Display of Executed Functions in the Debug View

This feature is set in the **Debug Configurations** dialog box.

1. **Select the Run > Debug Configurations** menu and open the **Debug Configurations** dialog box.
2. Select the **Debugger** tab and the **Debug Tool Settings** tab.
3. Set **RTOS Integration in Debug View** to **Yes**. If you select No, this feature is not available. This selection by default is set to Yes.

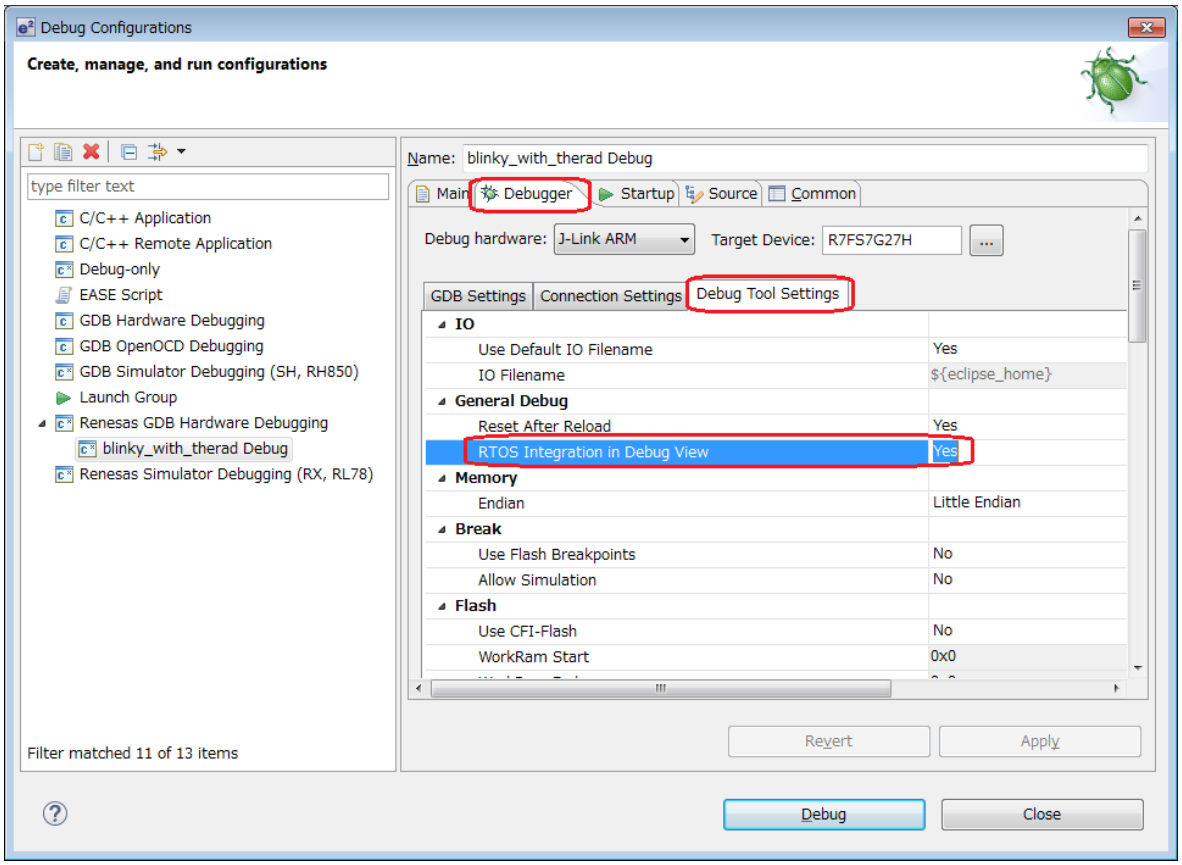

Figure 22 Setting for the display of executed functions

4.2 Confirming the Display of Executed Functions

This feature displays information on the following items:

- Function names
- Parameters and local variables
- Register values

In Figure 23, the `blinky_thread_entry()` function is selected in the **Debug** view, so the **Variables** view shows the local variables after the function is executed, and the **Registers** view shows the register values.

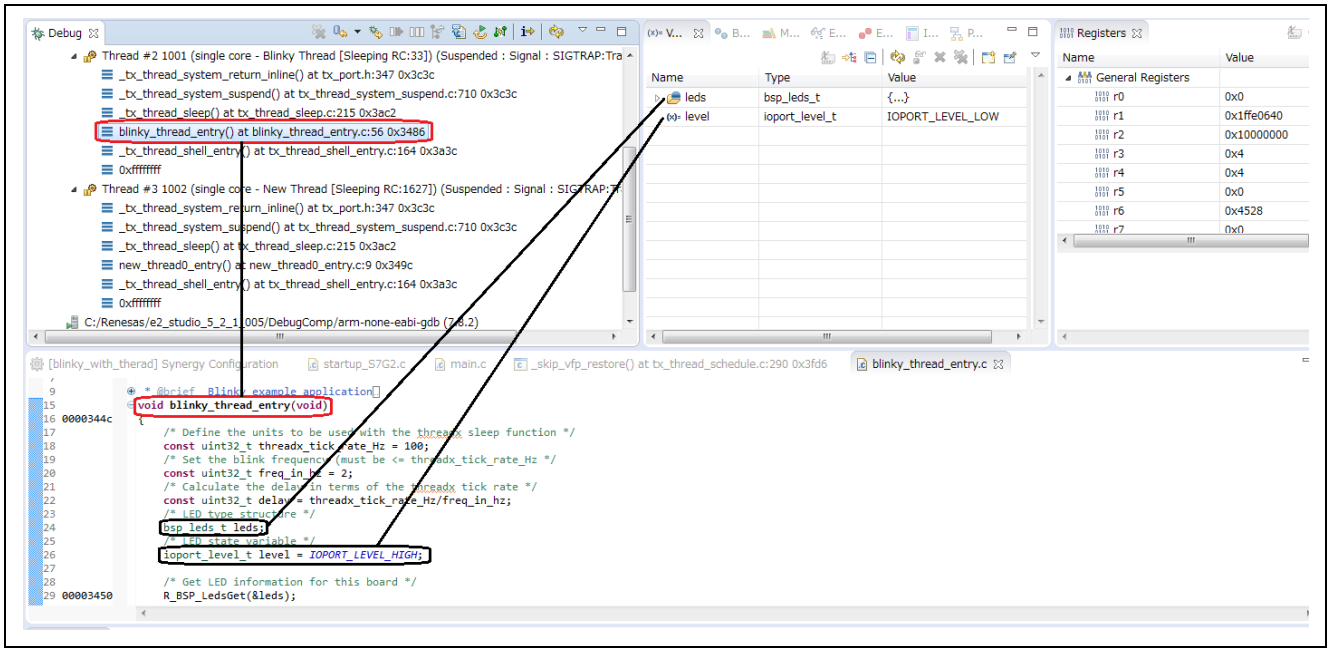

Figure 23 Displaying local variables and registers while functions are running

5. Appendix

5.1 Licenses for ThreadX

The RTOS resource functions and TraceX are available under the SSP evaluation license. However, the ThreadX source files are not accessible (Figure 24). To access to the ThreadX source files, the SSP development and production license must be registered using the following procedure.

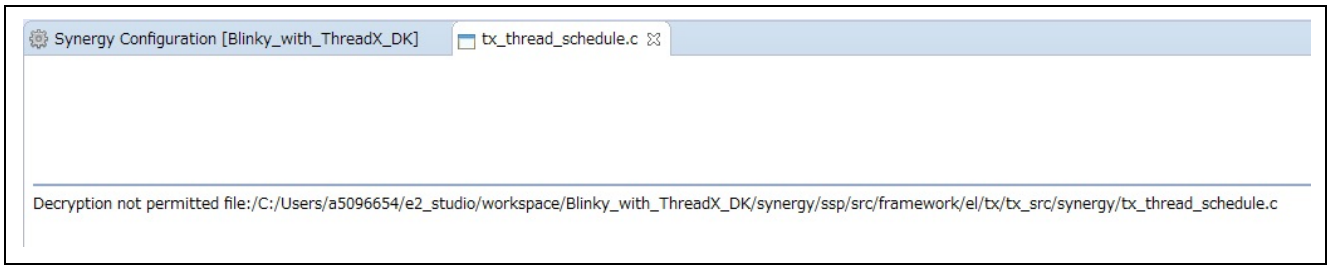

Figure 24 Source files for ThreadX are not accessible under evaluation license

5.1.1 Registering and Storing the Development and Production License of the SSP

Register the development and production license of the SSP by clicking **Create a Developer/Production License** on the SSP page of the Renesas Synergy website (https://www.renesas.com/us/en/products/synergy/software/ssp.html).

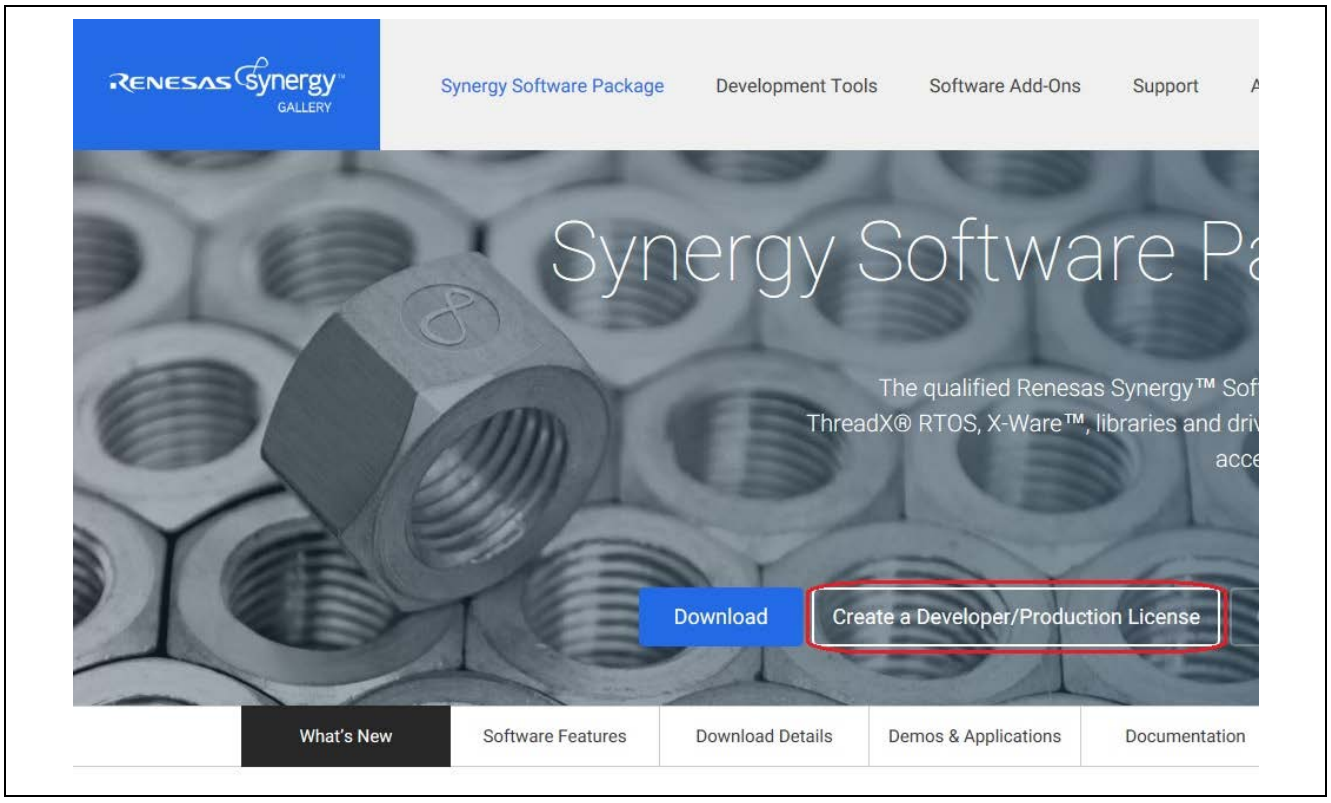

Figure 25 Checking of licenses

If you have registered for a license, store the information in the license file.

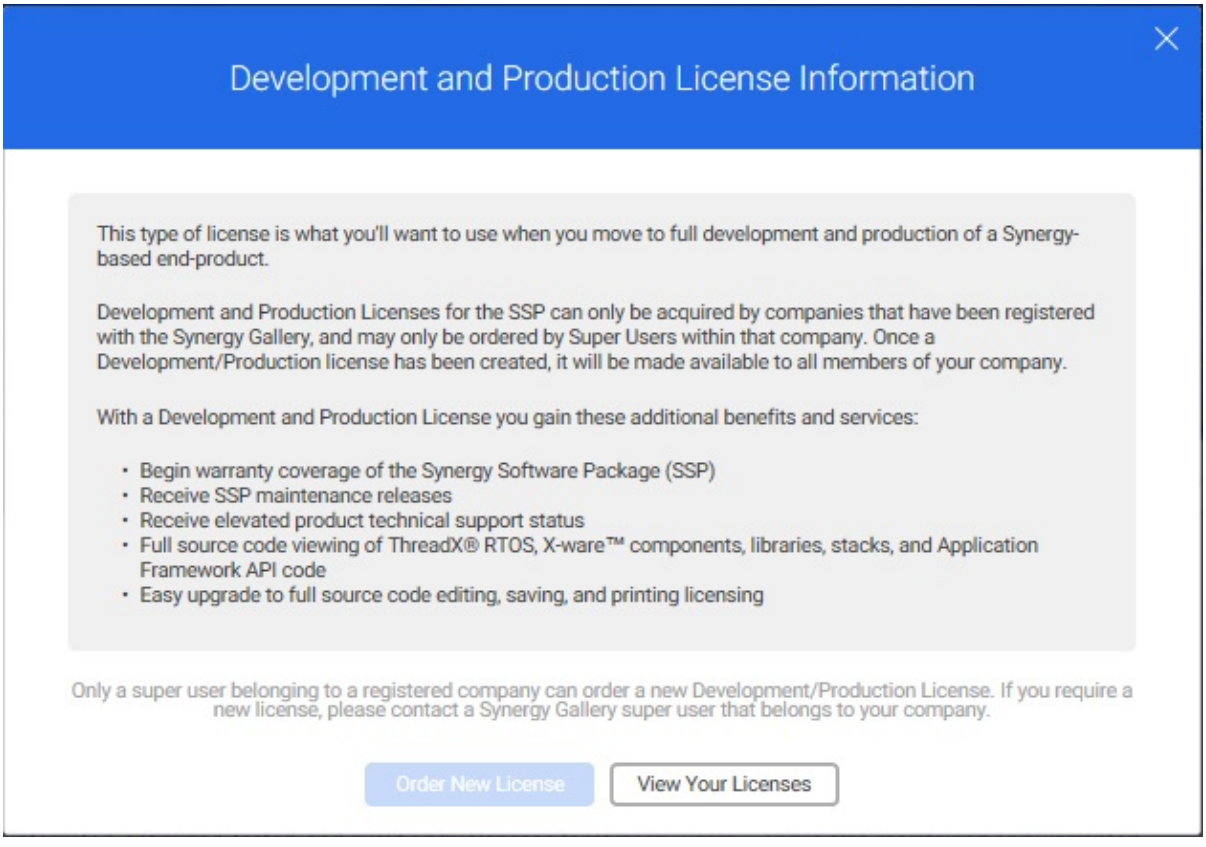

Figure 26 Displaying the license information

To store the license file, save the XML files for the target SSP on the PC. It is recommended that you copy these files to the following directory where the e² studio is installed.

…Renesas\e2_studio\internal\projectgen\arm\Licenses

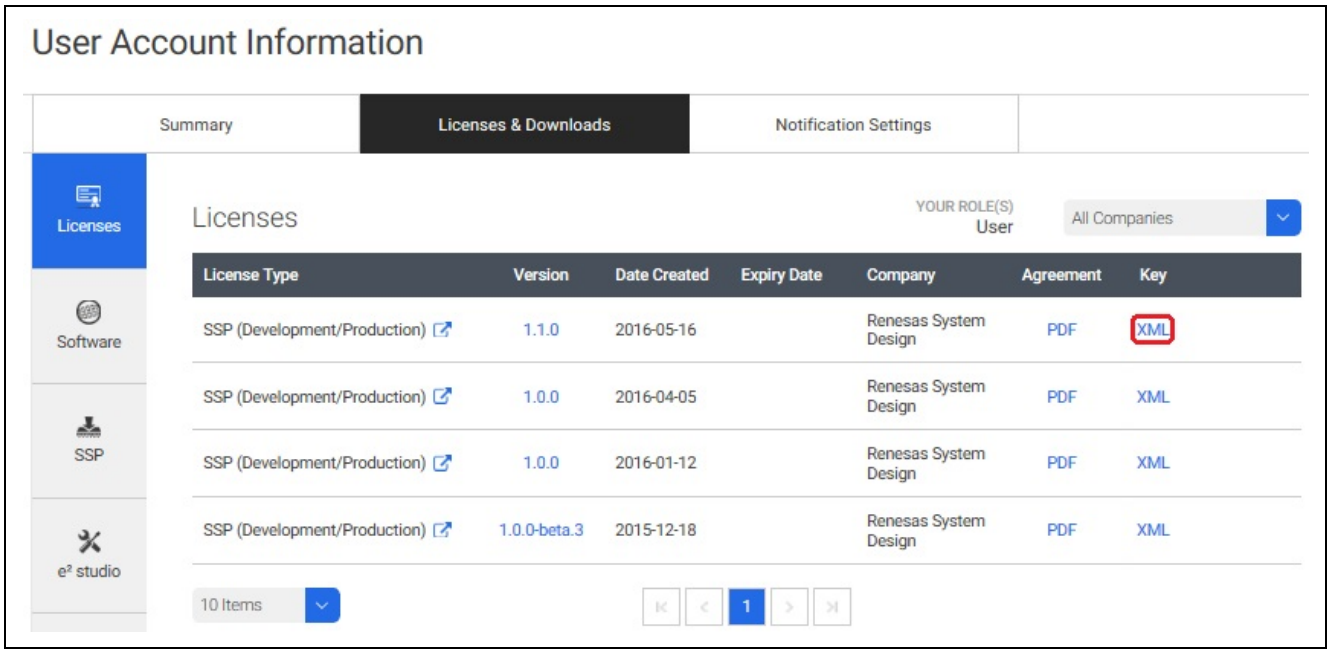

Figure 27 Storing license files

5.1.2 Registering License Files with e² studio

Register the stored license files with the e² studio. When registration is completed, the source files for ThreadX become accessible. When a new project is created, the license files are registered using the project wizard. If the project is already created, the license files are registered from the **Window > Preferences** menu. The following procedure describes registration of the **Blinky with ThreadX** project that is already created.

1. Select the **Window > Preferences** menu to open the **Properties dialog box** and the **C /C++> Renesas > Synergy License** selection in the **Preferences** window (Figure 28).

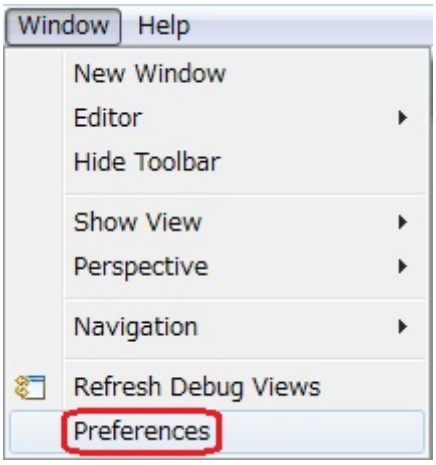

Figure 28 Selecting the Window > Preferences menu

2. Click the **Browse (…)** button and select the license file that was stored in section 5.1.1 When you click **OK,** the license file is registered.

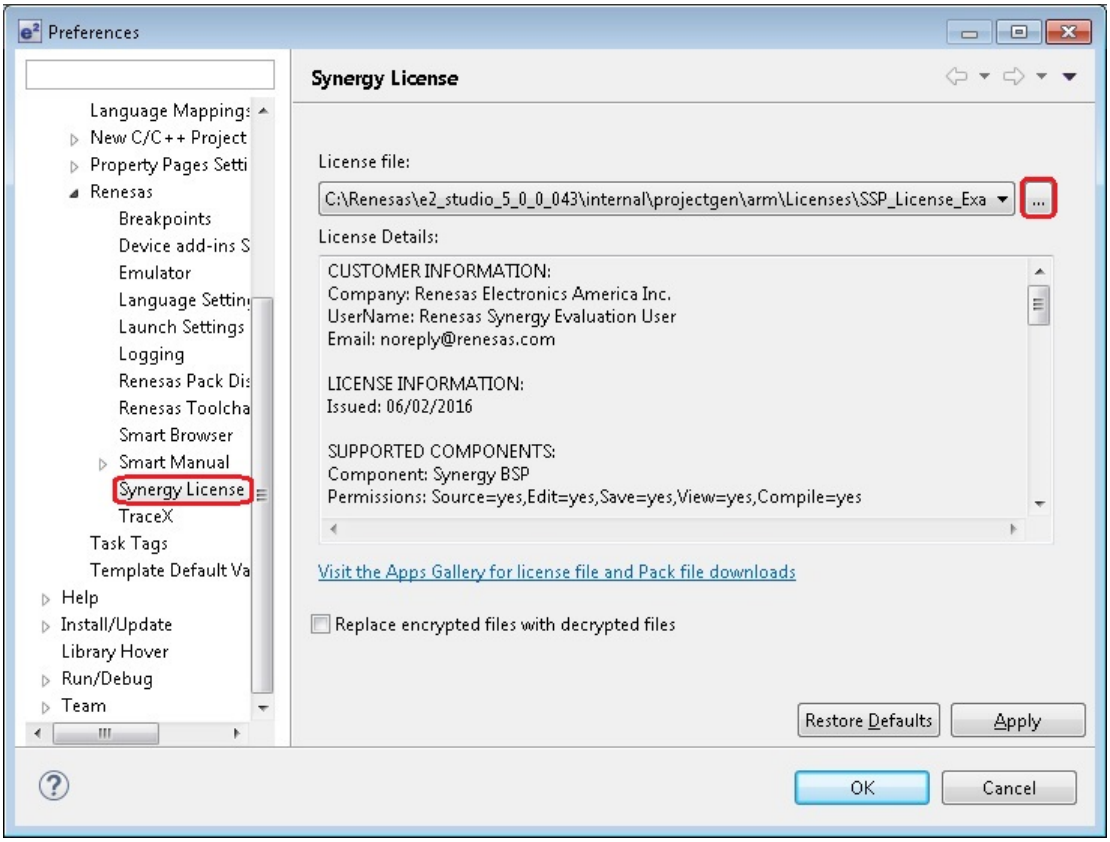

Figure 29 Registering the license in the dialog box

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

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Aug 24, 2016	-	First edition
1.01	Nov 14, 2016	11	Addition of Chapter 3 and other corrections
1.02	Apr 6, 2017	All	Supported version of SSP and e^2 studio ISDE updated
1.03	Jun 29, 2017	All	Updated for SSP v1.3.0 and e^2 studio 5.4.0.018
1.04	Jul 12, 2017	All	Updated for new project and minor changes
1.10	Aug 1, 2017	-	Initial Release
1.11	Feb 14, 2018	-	Updated for SSP v1.4.0
1.12	Sep 10, 2018	-	Updated for SSP v1.5.0

Notice

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