

Renesas RA Family

Tracealyzer® for FreeRTOS debugging

Introduction

FreeRTOS is an RTOS from Amazon Web Services, which is based on a high-performance embedded kernel.

Percepio Tracealyzer® is the premier solution for visual trace diagnostics for developers of RTOS- or Linux-based embedded software systems.

This application note provides procedures to check FreeRTOS thread and object states (referred to as resources) during the development of applications in e² studio. The procedure for starting Tracealyzer® is also explained.

Target Device

RA6M3 MCU Group (R7FA6M3AH)

Operating Environment (using UART)

Target Board	EK-RA6M3
IDE	e ² studio version 2021-04 and FSP v3.0.0
Trace Tool	Percepio Tracealyzer® v4.4.2
OS	FreeRTOS 10.4.3
Toolchains	GNU Arm Embedded Toolchain: 9-2020-q2-major (GNU ARM Embedded 9.3.1.20200408)
Cable	FTDI TTL-232R-3V3 (USB to TTL Serial Cable)

Operating Environment (using J-Link RTT)

Target Board	EK-RA6M3
IDE	e ² studio version 2021-04 and FSP v3.0.0
Trace Tool	Percepio Tracealyzer® v4.4.2
OS	FreeRTOS 10.4.3
Toolchains	GNU Arm Embedded Toolchain: 9-2020-q2-major (GNU ARM Embedded 9.3.1.20200408)

Note: Please download and install tools from the following URL in advance.

- Quick Start Guide for e² studio for RA download site:
[Quick Start Guide for e² studio for RA](#)
- FSP with e² studio installer download site:
<https://github.com/renesas/fsp/releases>
- EK-RA6M3 Example Project Bundle - Sample Code download site:
[EK-RA6M3 Example Project Bundle - Sample Code](#)
- Tracealyzer® for FreeRTOS User Manual site:
[Tracealyzer® for FreeRTOS - User Manual](#)
- Percepio Tracealyzer® download site:
[Download Tracealyzer® - Percepio AB](#)

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1. Install FSP with e² studio

Refer to “2.1 Installing the FSP with e² studio Installer” of “Renesas e² studio 2021-04 or higher User’s Manual: Quick Start Guide”.

2. Install Tracealyzer®

Refer to Tracealyzer® for FreeRTOS User Manual.

3. Creating a project in e² studio

A project generation wizard is available in e² studio to generate an RA project with a project name and the associated device and board, including drivers.

Launch e² studio and choose a workspace folder in the e² studio Launcher. To create a new RA project, follow these steps:

1. Select **File** menu > **New** > **Renesas C/C++ Project** > **Renesas RA**.
2. Select the **Renesas RA: Renesas RA C/C++ Project** template. Click **Next** to continue.

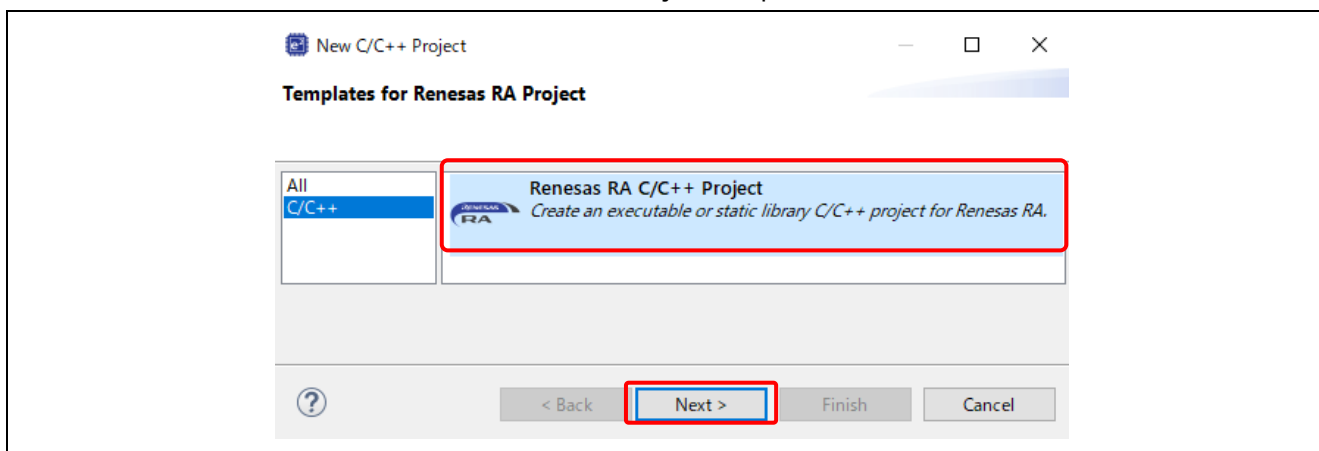


Figure 1. Template Selection

3. In the next dialog box, enter a project name and click **Next**.

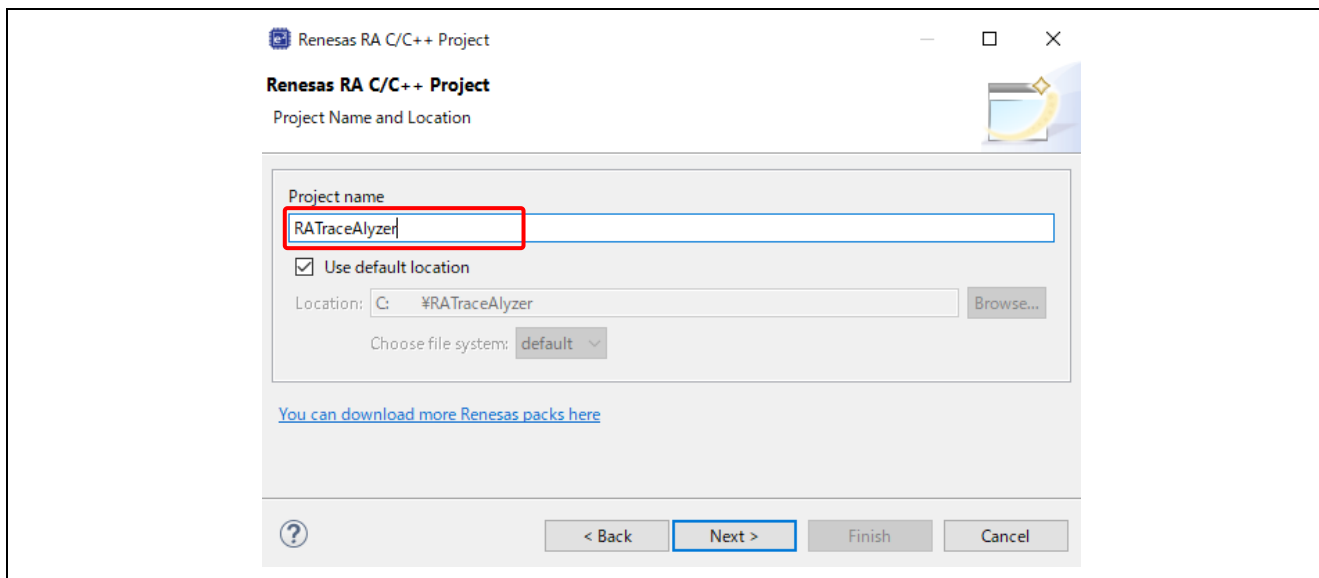


Figure 2. Project Name and Location

4. In the device selection dialog, enter device and tool information as follows.
 - FSP version: **3.0.0**
 - Board: **EK-RA6M3**
 - Device: **Auto selected**
 - Language: **C**
 - Toolchain version: Latest GNU Arm Embedded Toolchain approved for use with Renesas RA. (for example, **GCC ARM Embedded 9.3.1.20200408**)
 - Debugger: **J-Link ARM**
 - Click **Next** to continue

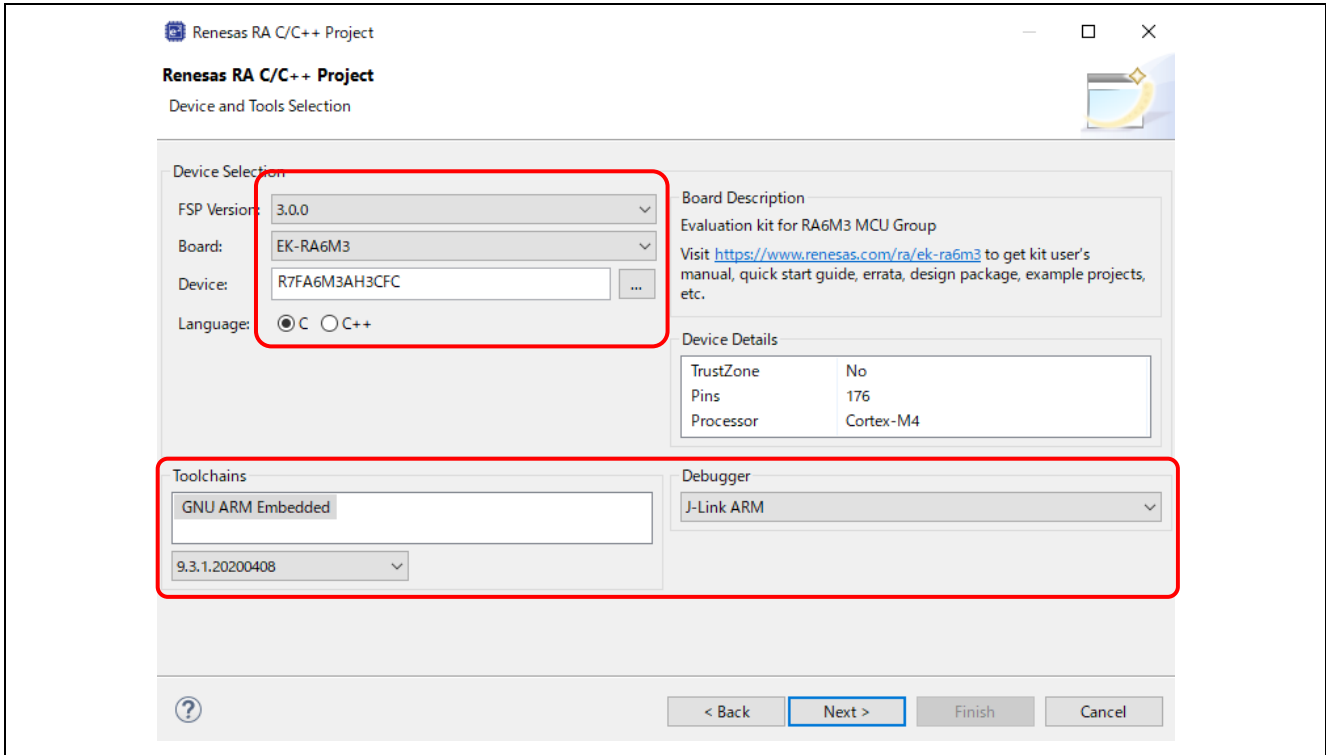


Figure 3. Create New Project for EK-RA6M3

5. Build Artifact Selection: **Executable**.
RTOS Selection: **FreeRTOS**

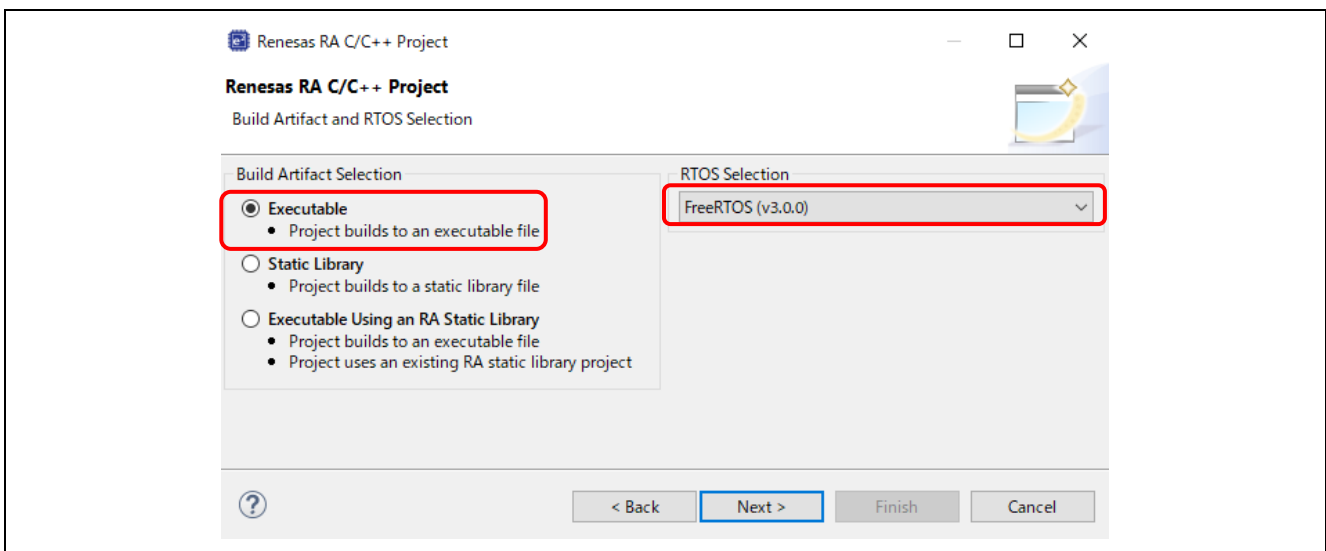


Figure 4. Build Artifact and RTOS Selection

6. In the project template dialog, select **FreeRTOS – Blinky – Static Allocation** and click **Finish**.

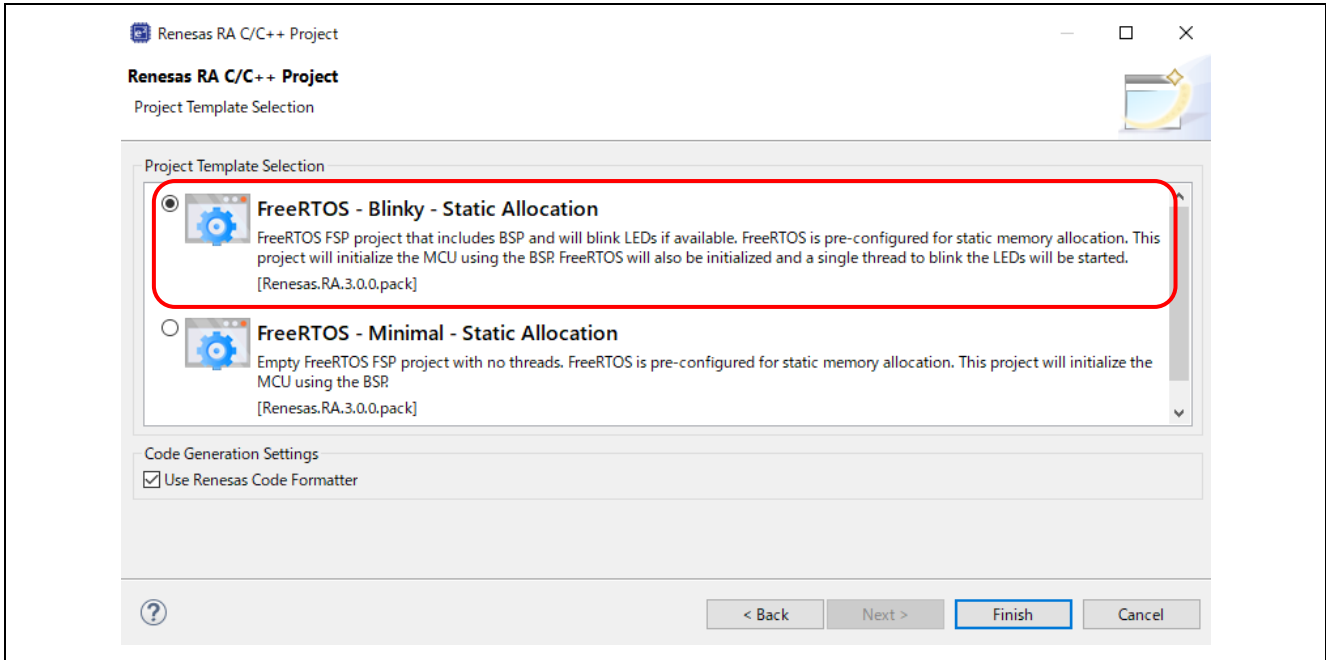


Figure 5. Project Template Selection

7. Once complete, e² studio creates a new project with the FSP Configuration perspective open and ready for project configuration.

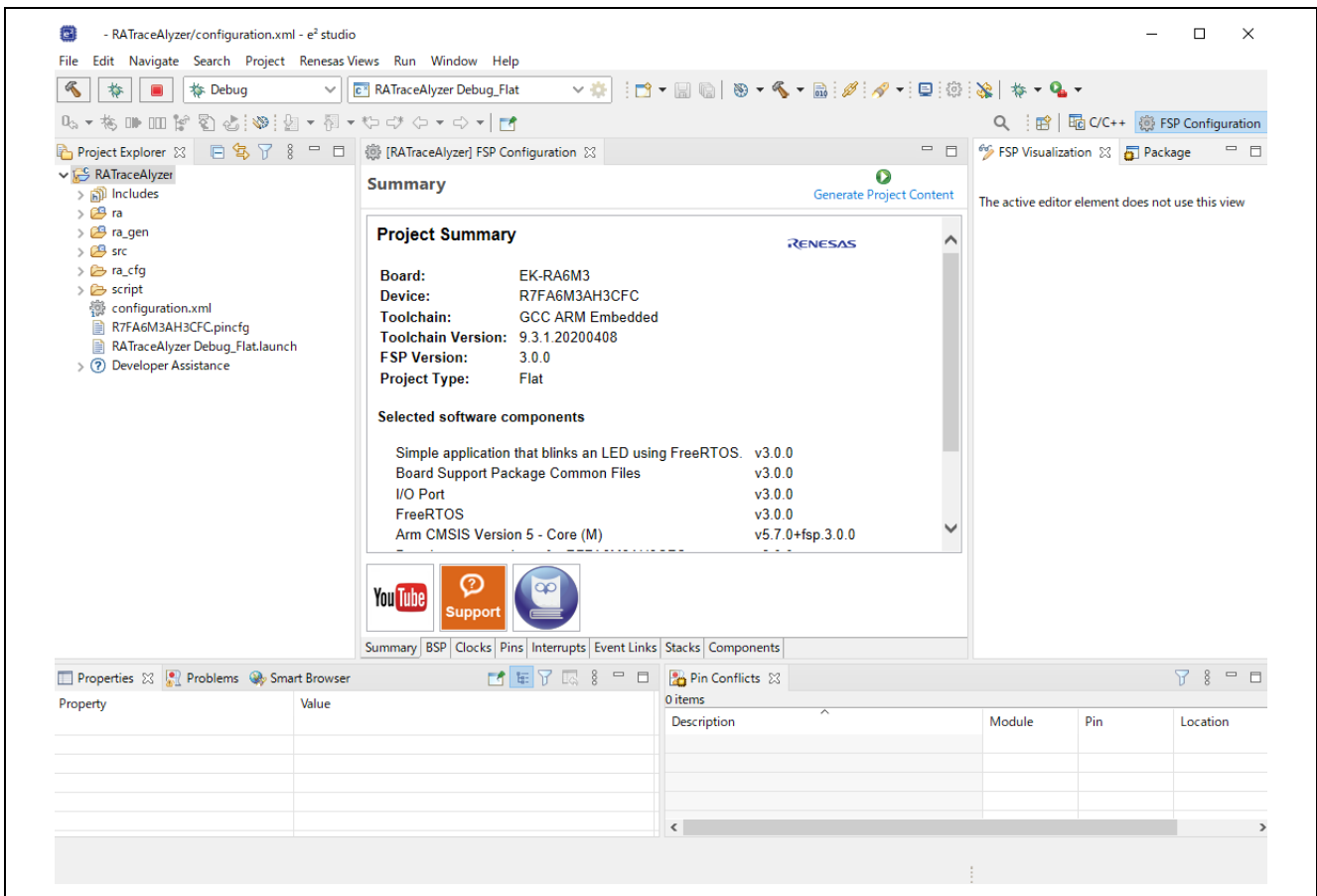


Figure 6. New Project for EK-RA6M3

4. Debugging via UART with Tracealyzer®

This section describes how to use Tracealyzer® with UART.

4.1 Copy and remove Tracealyzer® for FreeRTOS into a project

4.1.1 Copy Tracealyzer® for FreeRTOS source under the Tracealyzer® installation folder

Copy the Program Files\Percepio\Tracealyzer 4\FreeRTOS\TraceRecorder folder into workspace folder src using File Explorer.

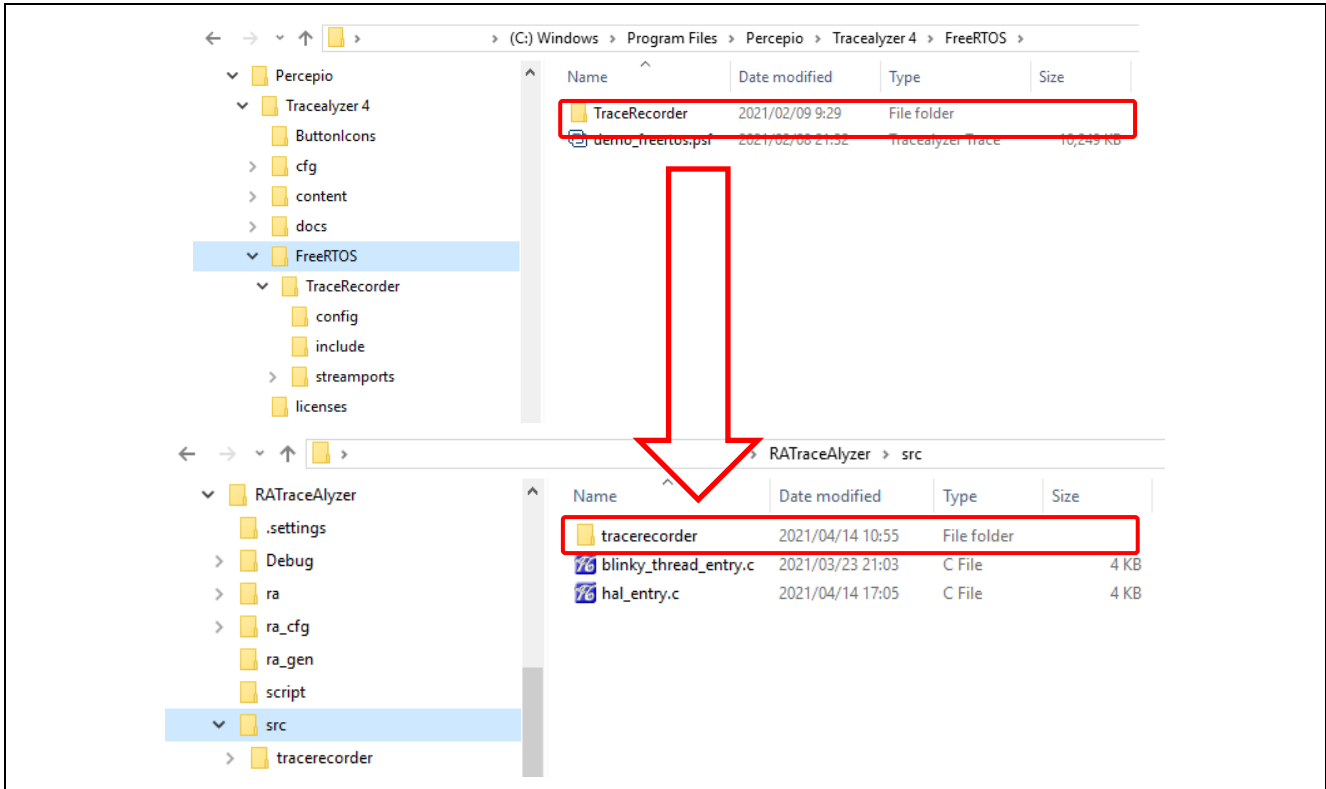


Figure 7. Copy Folder

4.1.2 Remove unnecessary folders

Remove all sub-folders in workspace folder src/TraceRecorder/streamports.

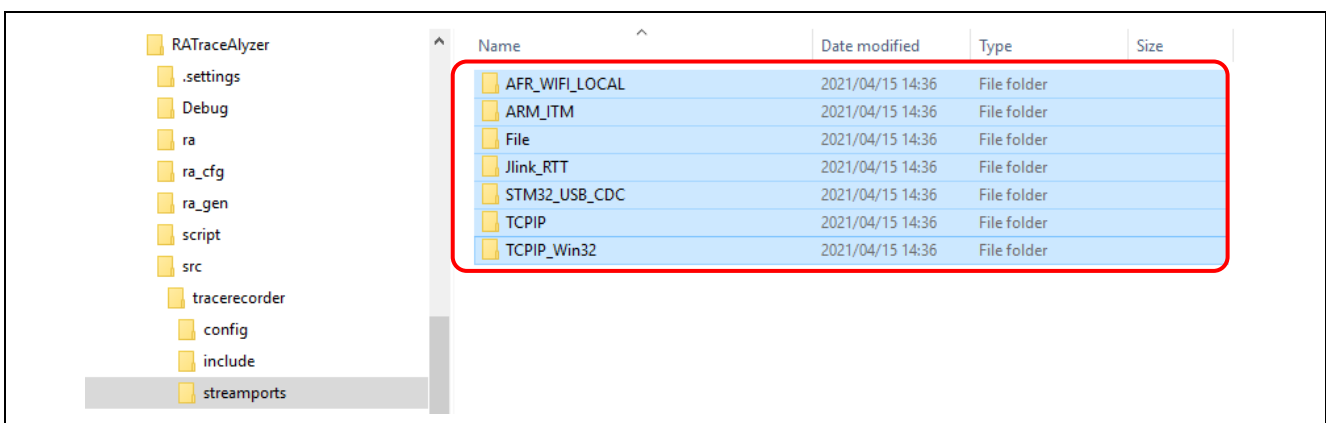


Figure 8. Remove Folder (UART)

4.2 FSP Configuration

4.2.1 UART driver settings

Use P410/P411 (SCI0) for UART communication. EK-RA6M3 is selected SPI0 as default.

ピン番号				Extbus				タイマ				通信インターフェース				アナログ		HMI										
BGA176	LOFP176	LGA145	LOFP144	LOFP100	電源、システム、クロック、デバッグ、CAC	割り込み	I/Oポート	外部バス	SDRAM	AGT	GPT	GPT	GPT	RTC	USBFS、CAN	SCI0, 2, 4, 6, 8 (30 MHz)	SCI1, 3, 5, 7, 9 (30 MHz)	IIC	SPI, QSPI	SSIE	ETHERC (MI)	ETHERC (RMII) (50 MHz)	USBHS	SDHI	ADC12	DAC12, A CMPS	CTSU	GLCDC, PDC
C15	40	D11	32	21	-	IRQ4	P411	-	-	AGTOA1	GTOVUP	GTI0C 9A	-	-	-	TXD07 /MOSI0 /SDA0	CTS3 /RTS3 /SS3	MOSIA _B	ET0_ER XD1	RMII0_RXD0_A	-	SD0_DAT0_A	-	-	-	TS07	PIX01	
C14	41	C12	33	22	-	IRQ5	P410	-	-	AGTOB1	GTOVLO	GTI0C 9B	-	-	-	RXD07 /MISO0 /SCL0	SC1	MISOA _B	ET0_ER XD0	RMII0_RXD1_A	-	SD0_DAT1_A	-	-	-	TS06	PIX00	

Figure 9. EK-RA6M3 on Pin Configuration

Disable SPI0 that is assigned “P410/P411” to use as SCI0 (UART Driver).

- Move to the **Pins** tab.
- Select **Peripherals > Connectivity:SPI > SPI0**.
- Operation Mode: **Disabled**.

The screenshot shows the FSP Configuration tool interface. The 'Pin Configuration' window is open, displaying a list of peripherals. 'SPI0' is selected under 'Connectivity:SPI'. The 'Operation Mode' for SPI0 is set to 'Disabled'. The 'Pin Group Selection' is 'Mixed'. The 'Module name' is 'SPI0' and the 'Usage' is 'For SPI, same Pin Group recommended'. The 'Pins' tab is selected at the bottom of the tool.

Figure 10. Disable SPI0 on Pin Configuration

Move to the **Stacks** tab. Add the UART Driver by clicking **New Stack > Driver > Connectivity > UART Driver on r_sci_uart**.

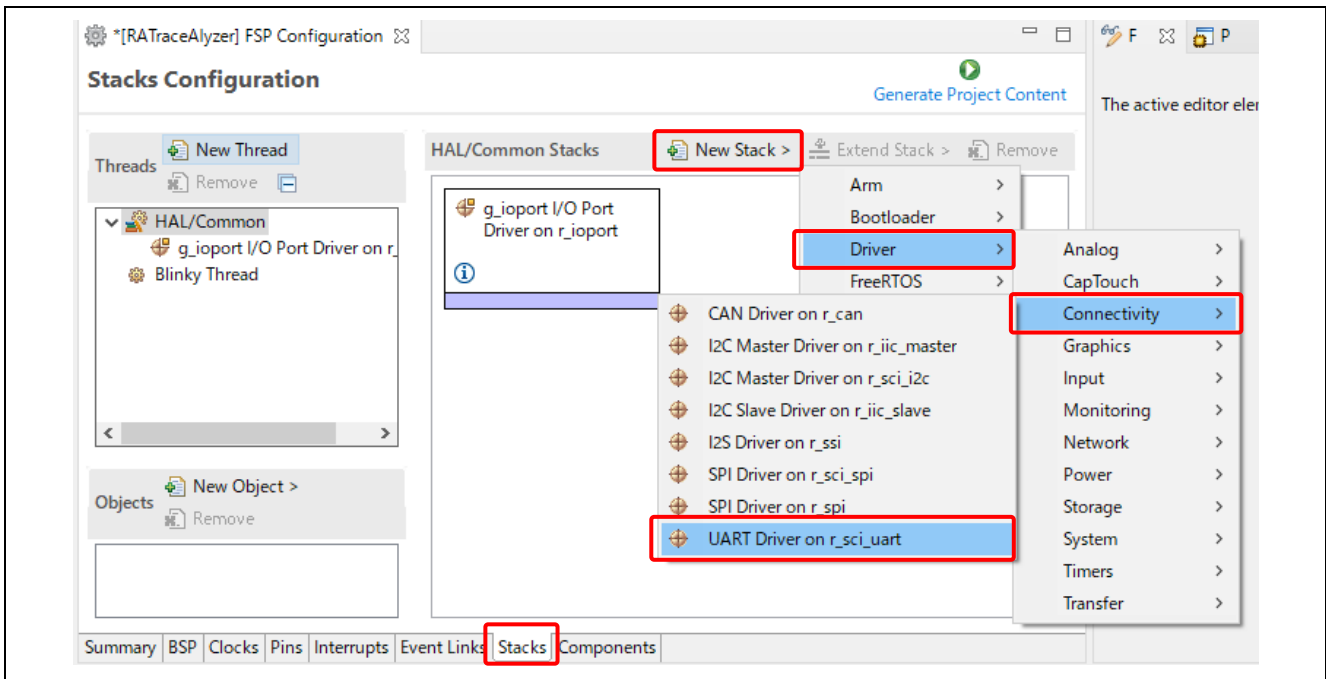


Figure 11. Add UART Driver on Stacks Configuration

Change the **Properties** of the UART driver as follows.

- Baud Rate: **921600**
- Callback: **sci_callback_tracealyzer**
- TXD_MOSI: **P411**
- RXD_MISO: **P410**

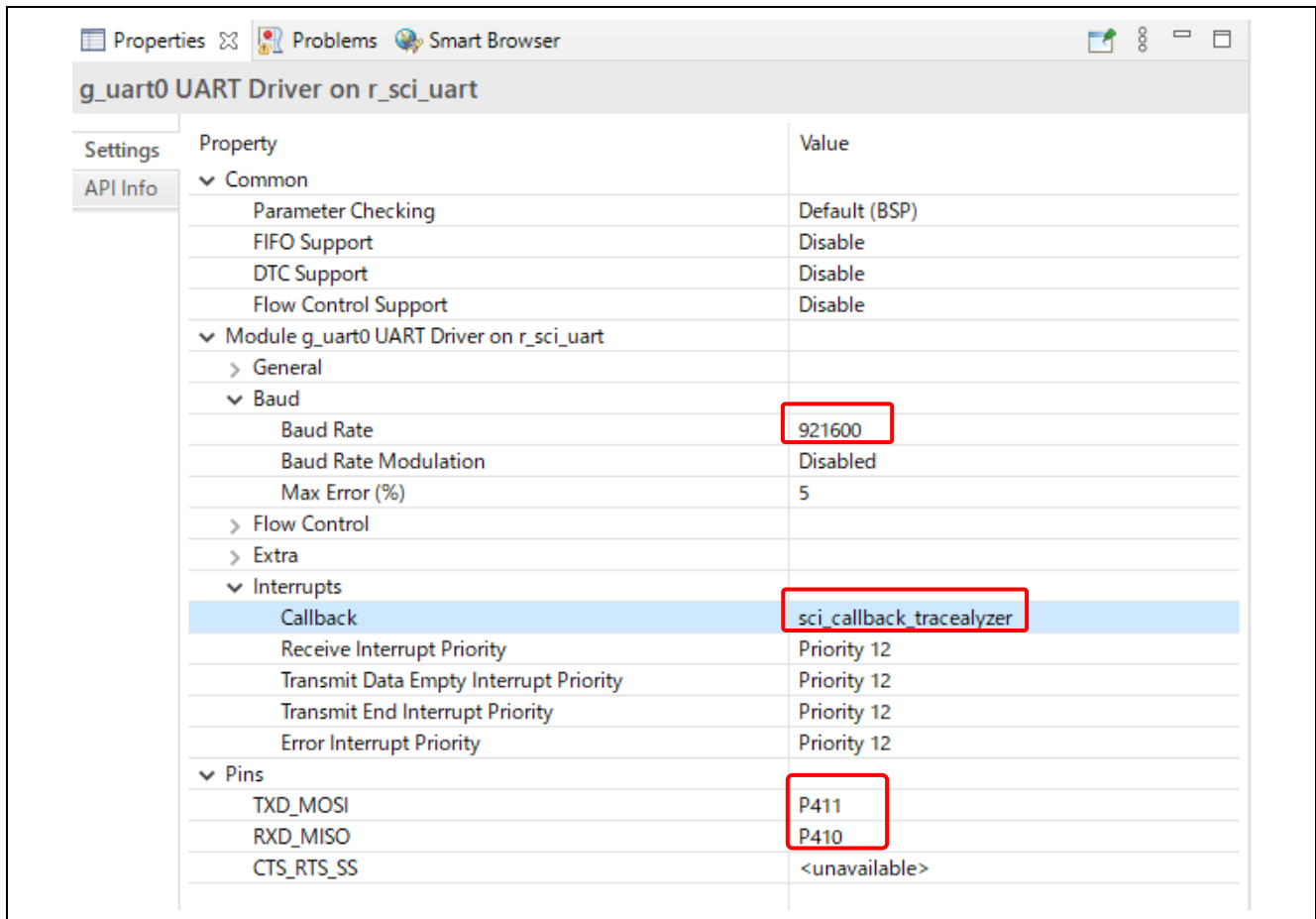


Figure 12. UART Properties

4.2.2 Blinky Thread settings

Add the Heap to the Blinky Thread as follows.

- Move to the **Stacks** tab.
- Select **Blinky Thread**.
- Click **New Stack > FreeRTOS > Memory Management > Heap 1**.

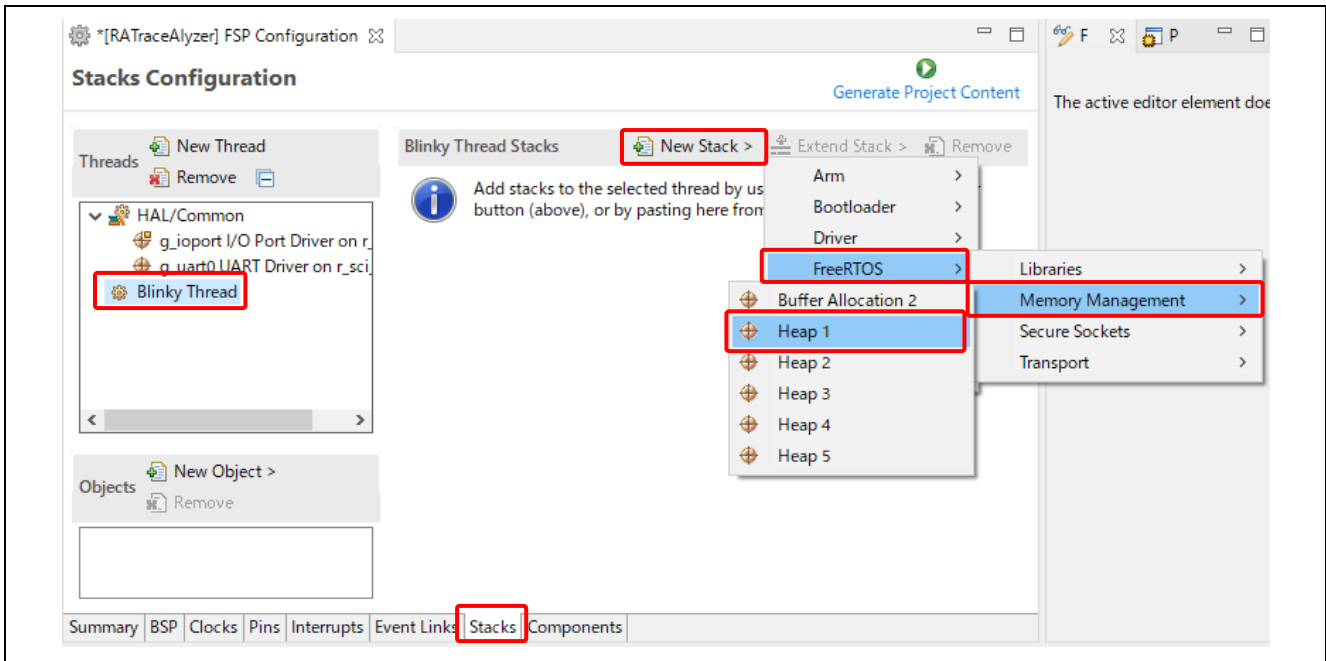


Figure 13. Add Heap on Stacks Configuration

Change the **Properties > General** on **Blinky Thread** as follows.

- Minimal Stack Size: **512**
- Use Mutexes: **Enabled**
- Use Recursive Mutexes: **Enabled**
- Use Queue Sets: **Enabled**
- Enable Backward Compatibility: **Enabled**

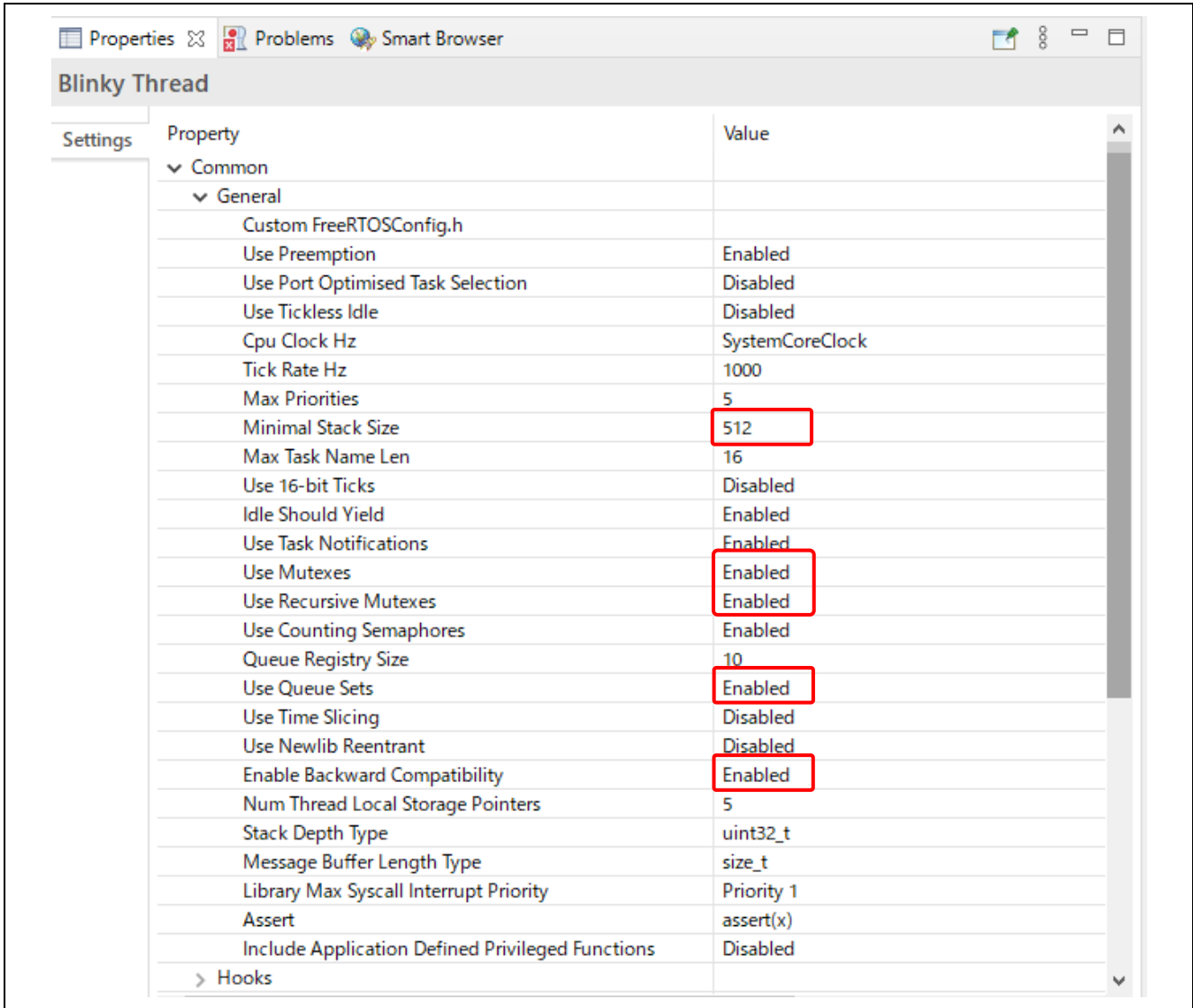


Figure 14. Blinky Thread Properties 1

Change the **Properties > Hooks, Stats, Memory Allocation, Timers** on **Blinky Thread** as follows.

- Use Idle Hook: **Disabled**
- Use Malloc Failed Hook: **Enabled**
- Use Trace Facility: **Enabled**
- Use Stats Formatting Functions: **Enabled**
- Support Dynamic Allocation: **Enabled**
- Total Heap Size: **262,144** (256 * 1,024)
- Timer Task Static Depth: **3,072** (1024 * 3)

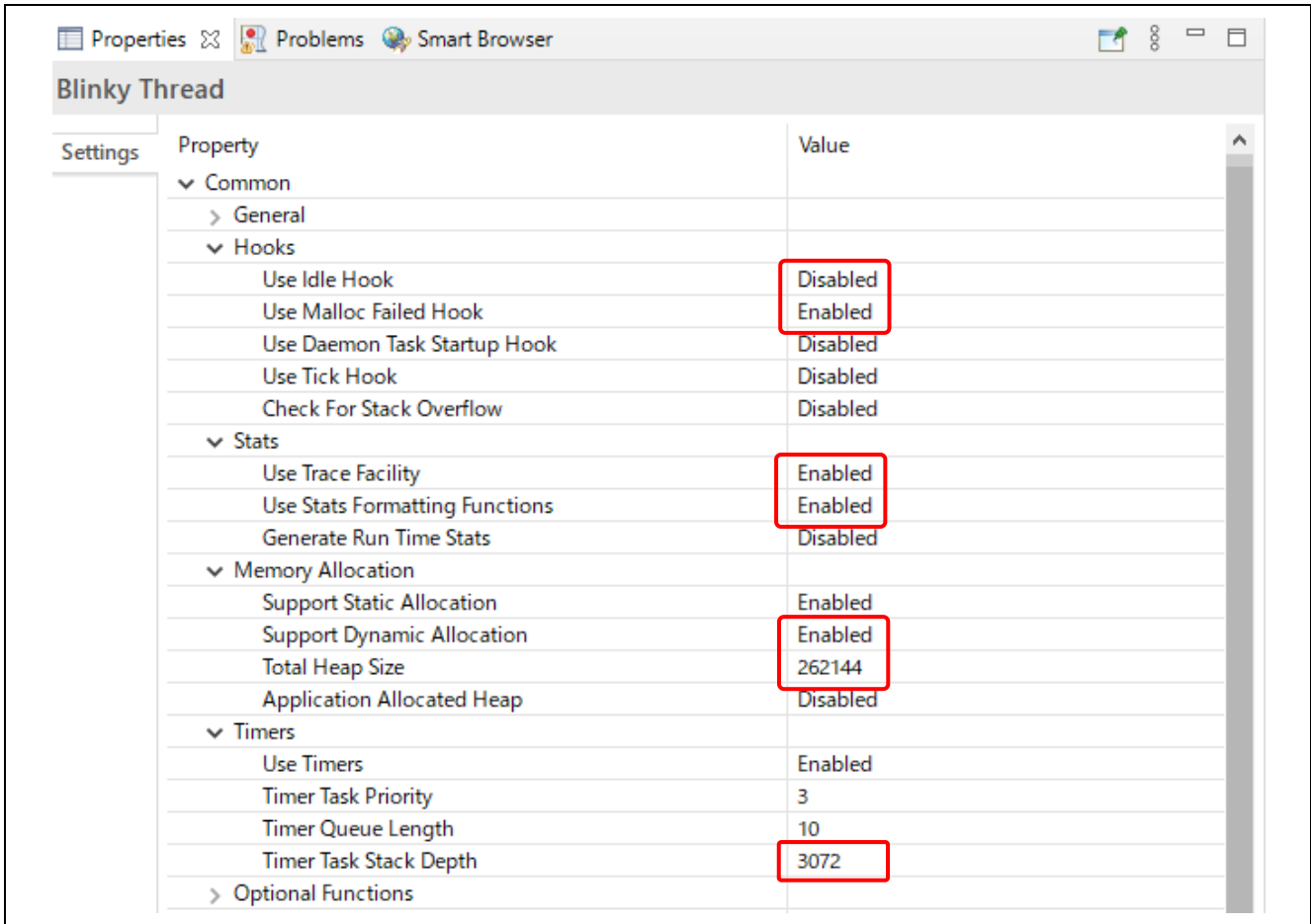


Figure 15. Blinky Thread Properties 2

Change the Properties (Optional Functions, RA, Logging) on Blinky Thread as follows.

- uxTaskGetStackHighWaterMark() Function: **Enabled**
- eTaskGetState() Function: **Enabled**
- xTimerPendFunctionCall() Function: **Enabled**
- xTaskAbortDelay() Function: **Enabled**
- Hardware Stack Monitor: **Enabled**
- Logging Include Time and Task Name: **Enabled**

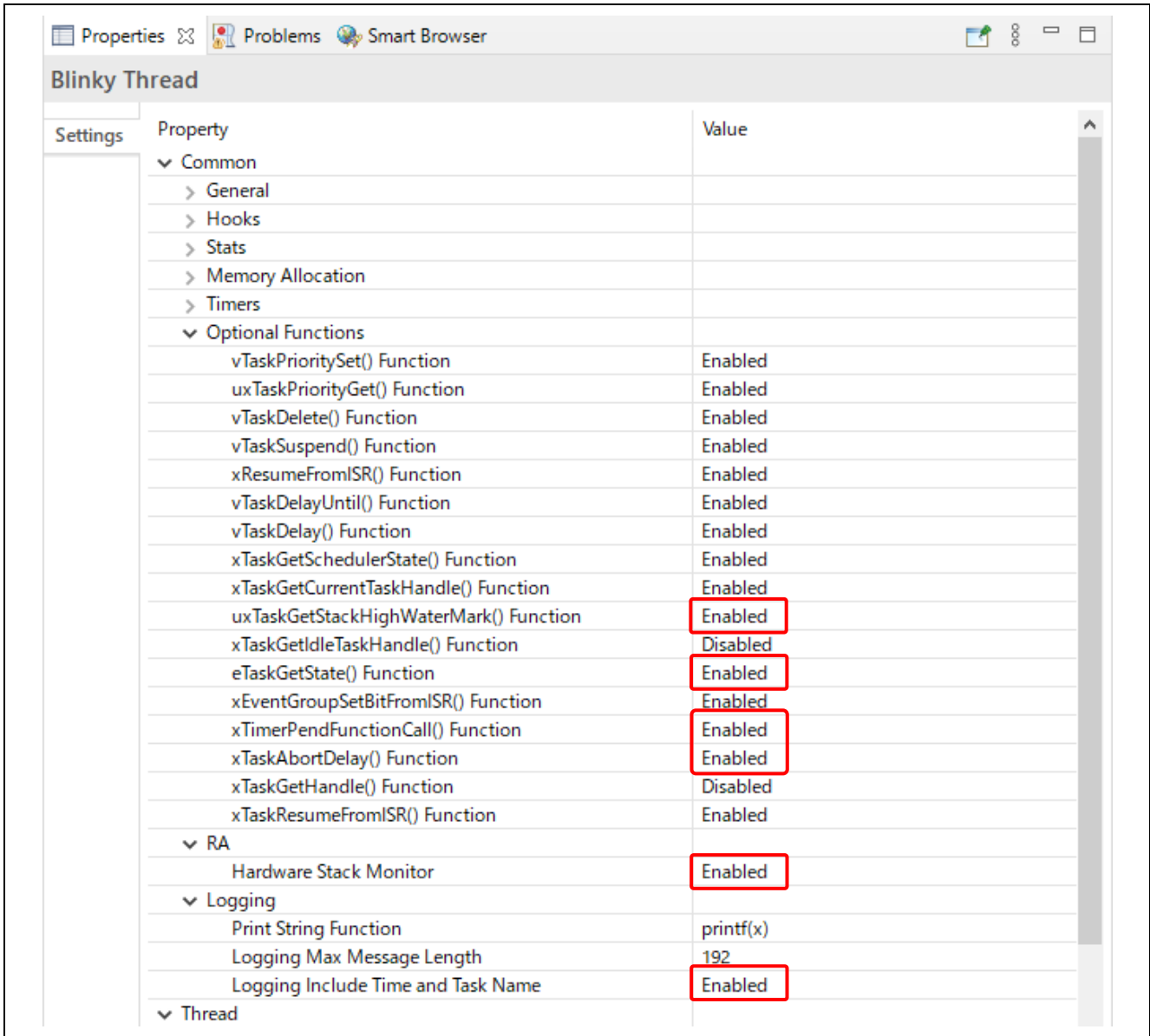



Figure 16. Blinky Thread Properties 3

4.2.3 Generate Project Content

Click on the  button to generate the source files.

4.3 Code editing for Tracealyzer® connections

4.3.1 Create folder and file for UART

- Create the `uart` folder and `trcStreamingPort.c` and `trcStreamingPort.h` files, for example.
- Make `trcStreamingPort.c` and `trcStreamingPort.h` as shown in Figure 18 and Figure 19.

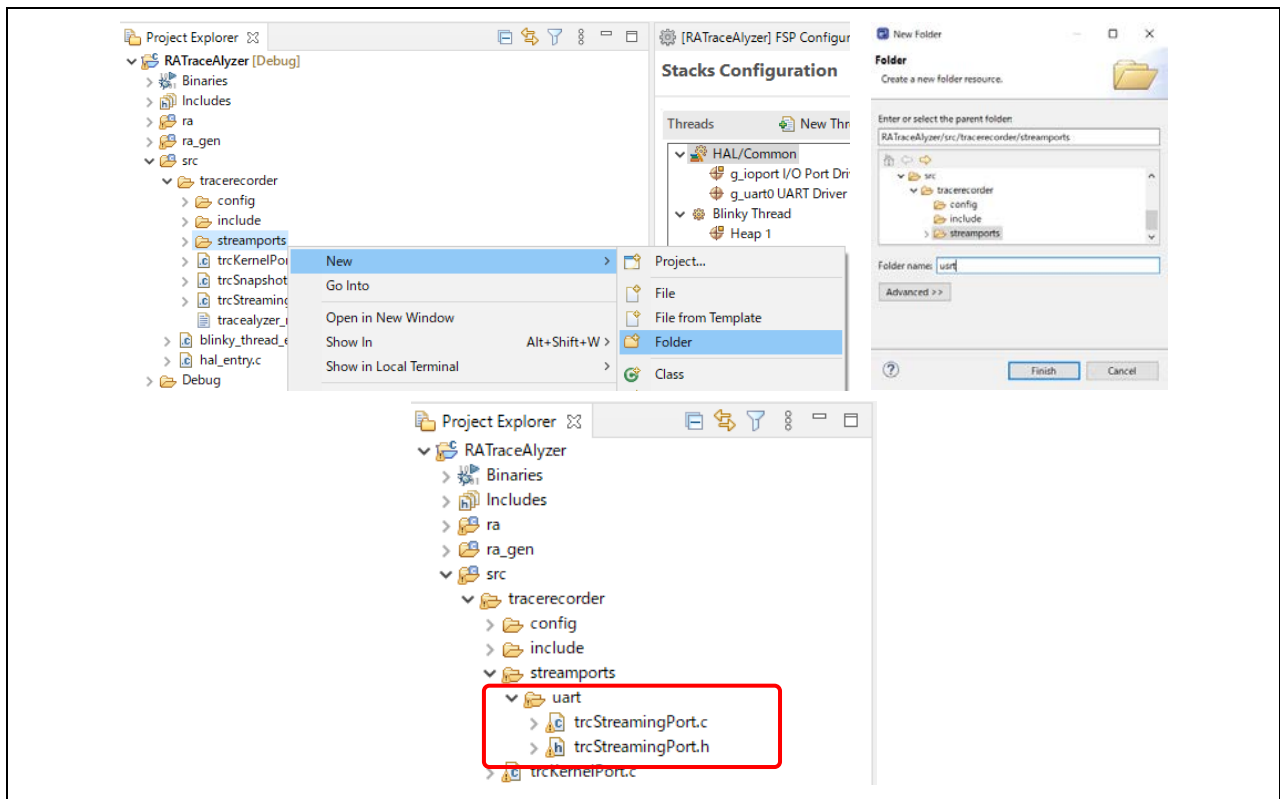


Figure 17. Create folder and file

— Create file: trcStreamingPort.c

```

#include "bsp_api.h"
#include "trcRecorder.h"
#include "r_sci_uart.h"
#include "r_uart_api.h"
#include <string.h>
#include "semphr.h"
#if (TRC_CFG_RECORDER_MODE == TRC_RECORDER_MODE_STREAMING)
#if (TRC_USE_TRACEALYZER_RECORDER == 1)
static uint8_t s_u8_string[1024];
static signed portBASE_TYPE xHigherPriorityTaskWoken;
static uint8_t sci_buffer[1024];
static uint32_t sci_current_received_size = 0;
extern sci_uart_instance_ctrl_t g_uart0_ctrl;
extern SemaphoreHandle_t semaphore_handle_1;

int32_t trcUartWrite(void* data, uint32_t size, int32_t *ptrBytesWritten)
{
    fsp_err_t err = FSP_SUCCESS;
    int32_t error_code = -1;
    if(size < sizeof(s_u8_string))
    {
        memcpy(s_u8_string, data, size);
        /* Writing to terminal */
        err = R_SCI_UART_Write (&g_uart0_ctrl, s_u8_string, size);
        if(err == FSP_SUCCESS)
        {
            xSemaphoreTake( semaphore_handle_1, portMAX_DELAY );
            *ptrBytesWritten = size;
            error_code = 0;
        }
    }
    return error_code;
}

int32_t trcUartRead(void* data, uint32_t size, int32_t *ptrBytesRead)
{
    if(sci_current_received_size == size)
    {
        memcpy(data, sci_buffer, sci_current_received_size);
        *ptrBytesRead = sci_current_received_size;
        sci_current_received_size = 0;
    }
    return 0;
}

void sci_callback_tracealyzer(uart_callback_args_t *p_args)
{
    if(UART_EVENT_RX_CHAR == p_args->event)
    {
        sci_buffer[sci_current_received_size] = (uint8_t ) p_args->data;
        if(sci_current_received_size == (sizeof(sci_buffer) - 1)) /* -1 means string
terminator after "\n" */
        {
            sci_current_received_size = 0;
        }
        else
        {
            sci_current_received_size++;
        }
    }
    else if(UART_EVENT_TX_COMPLETE == p_args->event)
    {
        xHigherPriorityTaskWoken = pdFALSE;
        xSemaphoreGiveFromISR(semaphore_handle_1, &xHigherPriorityTaskWoken);
        portYIELD_FROM_ISR( xHigherPriorityTaskWoken );
    }
    else
    {
    }
}
#endif /*(TRC_USE_TRACEALYZER_RECORDER == 1)*/
#endif /*(TRC_CFG_RECORDER_MODE == TRC_RECORDER_MODE_STREAMING)*/

```

Figure 18. Create trcStreamingPort.c

— Create file: trcStreamingPort.h

```
#ifndef TRC_STREAMING_PORT_H
#define TRC_STREAMING_PORT_H

#define TRC_STREAM_PORT_READ_DATA(_ptrData, _size, _ptrBytesRead) trcUartRead(_ptrData, _size,
_ptrBytesRead)
#define TRC_STREAM_PORT_WRITE_DATA(_ptrData, _size, _ptrBytesSent) trcUartWrite(_ptrData, _size,
_ptrBytesSent)

#endif
```

Figure 19. Create the trcStreamingPort.h

4.3.2 Add include file to task.c and timers.c

- #include "trcRecorder.h"

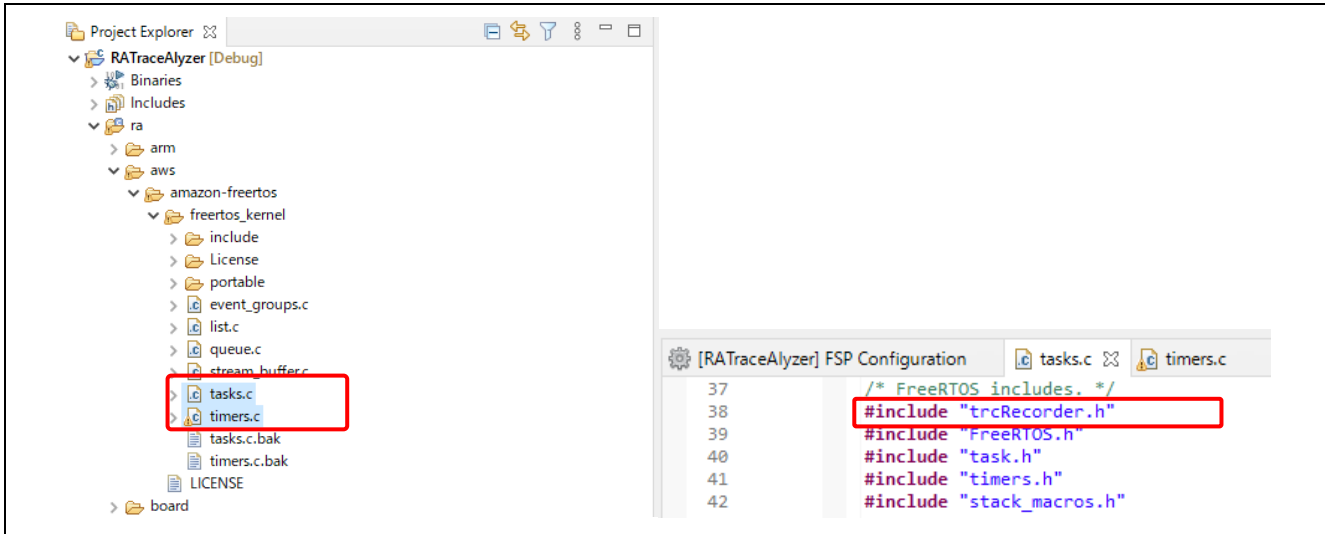


Figure 20. Add include to freertos_kernel

4.3.3 Add include files to trcKernelPort.c and trcStreamingRecorder.c

- #include "bsp_api.h"
- #include "trcRecorder.h"

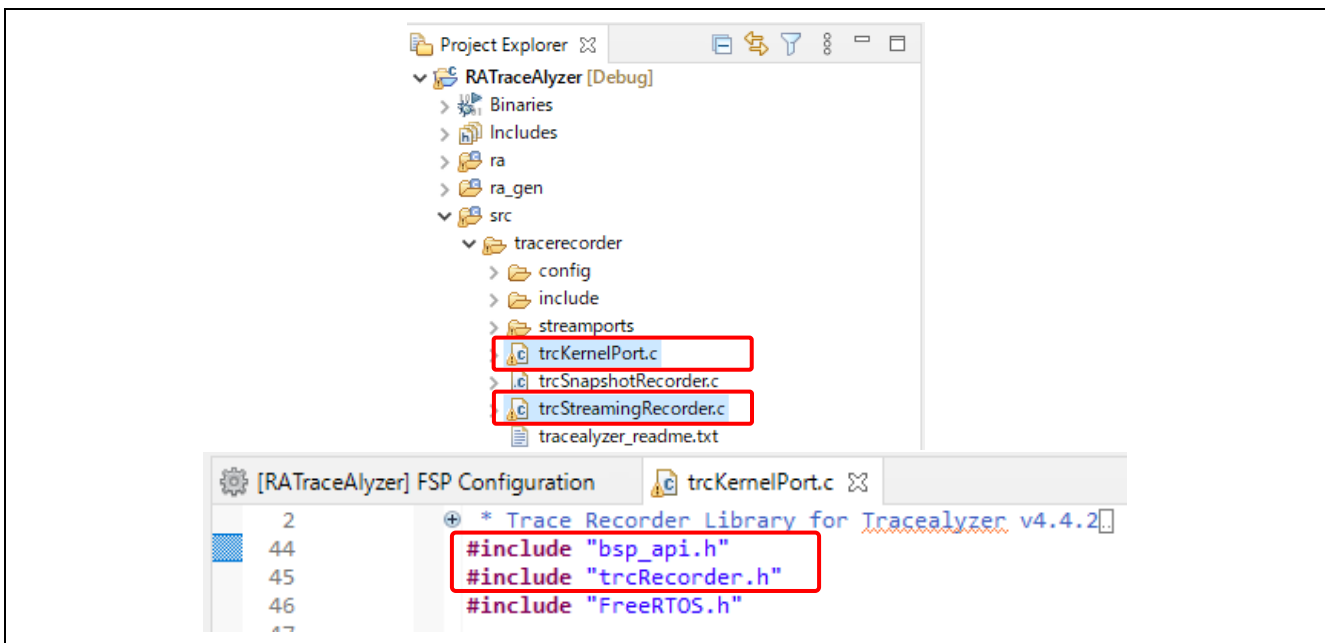


Figure 21. Add include tracerecorder

4.3.4 Change macro definitions in trcConfig.h

Change only the red part of the macro definitions in `trcConfig.h` as follows.

- `#include "bsp_api.h"`
- `///error "Trace Recorder: Please include your processor's header file here and remove this line."`
- `#define TRC_CFG_HARDWARE_PORT TRC_HARDWARE_PORT_ARM_Cortex_M`
- `#define TRC_CFG_RECORDER_MODE TRC_RECORDER_MODE_STREAMING`
- `#define TRC_CFG_FREERTOS_VERSION TRC_FREERTOS_VERSION_10_4_1`

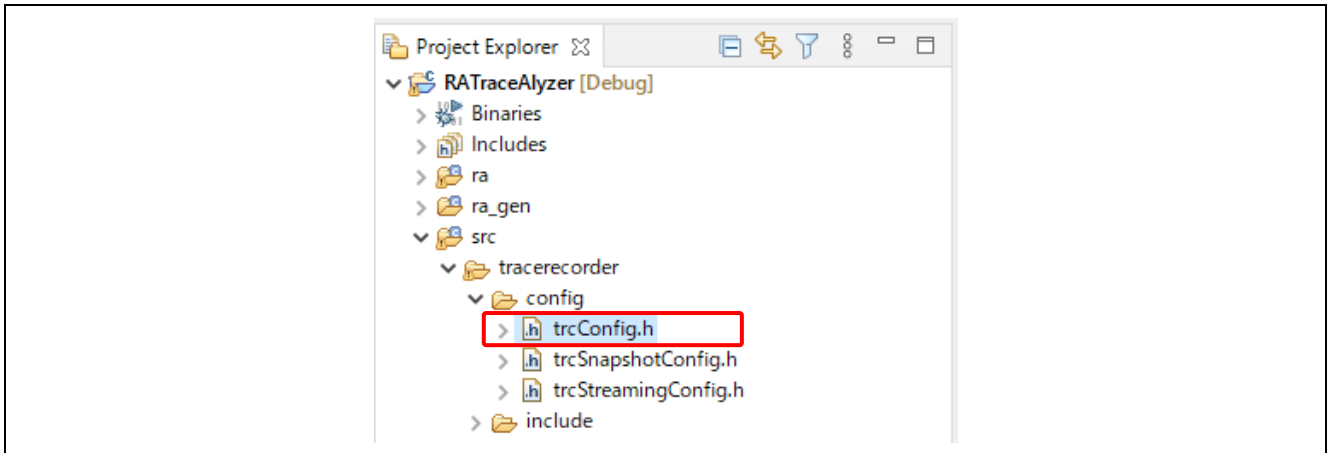


Figure 22. Change the define in `trcConfig.h`

4.3.5 Add Include path to e² studio properties

Select menu **Project > Properties**, then click **Settings > Includes** to add the Include path.

- `"${workspace_loc}/${ProjName}/src/tracerecorder}"`
- `"${workspace_loc}/${ProjName}/src/tracerecorder/config}"`
- `"${workspace_loc}/${ProjName}/src/tracerecorder/include}"`
- `"${workspace_loc}/${ProjName}/src/tracerecorder/streamports/uart}"`

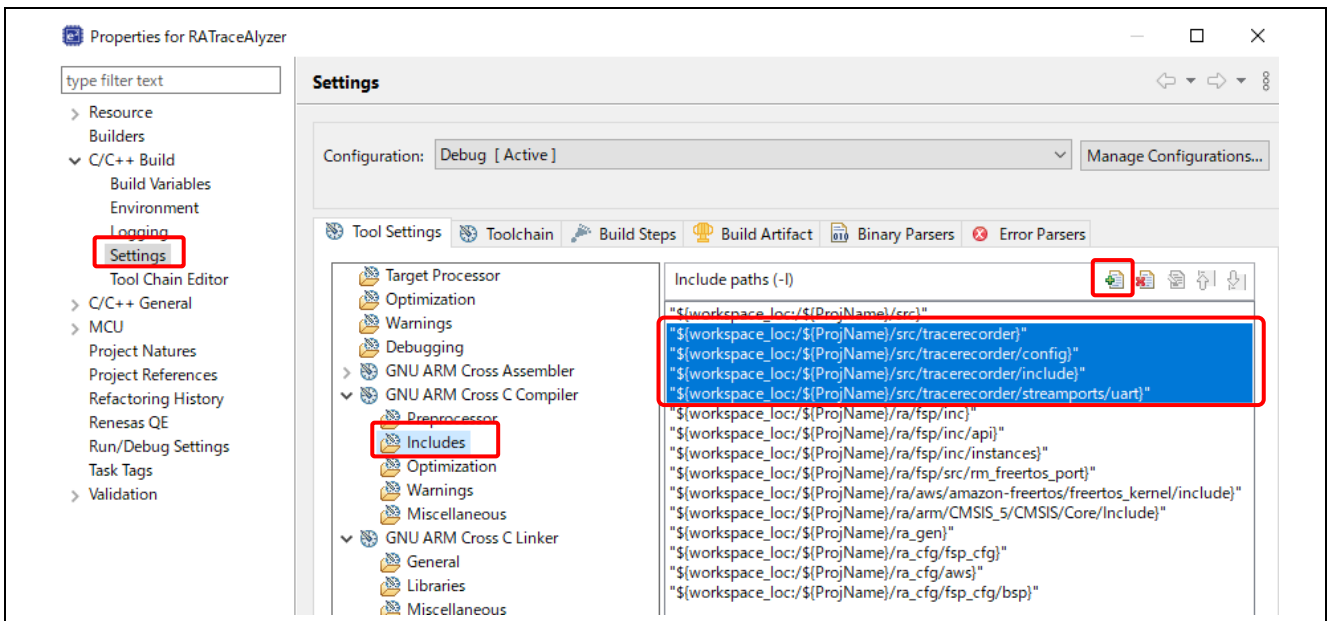


Figure 23. Setting Include paths in project properties

4.3.6 Add code to hal_entry.c

Add source code in red to hal_entry.c.

```

#include "bsp_api.h"
#include "trcRecorder.h"
#include "FreeRTOS.h"
#include "semphr.h"
#include "hal_data.h"

SemaphoreHandle_t semaphore_handle_1;
StaticSemaphore_t semaphore_handle_1_memory;
void R_BSP_WarmStart(bsp_warm_start_event_t event);

/*****
*****//**
* This function is called at various points during the startup process. This implementation
uses the event that is
* called right before main() to set up the pins.
*
* @param[in] event Where at in the start up process the code is currently at
*****
*****/
void R_BSP_WarmStart (bsp_warm_start_event_t event)
{
    if (BSP_WARM_START_RESET == event)
    {
#if BSP_FEATURE_FLASH_LP_VERSION != 0

        /* Enable reading from data flash. */
        R_FACI_LP->DFLCTL = 1U;

        /* Would normally have to wait tDSTOP(6us) for data flash recovery. Placing the enable
here, before clock and
        * C runtime initialization, should negate the need for a delay since the initialization
will typically take more than 6us. */
#endif
    }

    if (BSP_WARM_START_POST_C == event)
    {
        /* C runtime environment and system clocks are setup. */

        /* Configure pins. */
        R_IOPORT_Open(&g_ioport_ctrl, &g_bsp_pin_cfg);
    }

    fsp_err_t err = FSP_SUCCESS;

    /* Initialize UART channel with baud rate 115200 */
    err = R_SCI_UART_Open (&g_uart0_ctrl, &g_uart0_cfg);
    if (FSP_SUCCESS != err)
    {
    }
    semaphore_handle_1 = xSemaphoreCreateBinaryStatic (&semaphore_handle_1_memory);
    vTraceEnable(TRC_INIT);
}

```

Figure 24. Change the UART Streaming hal_entry.c

4.3.7 Build the project

Right-click on the project and select **Build Project**.

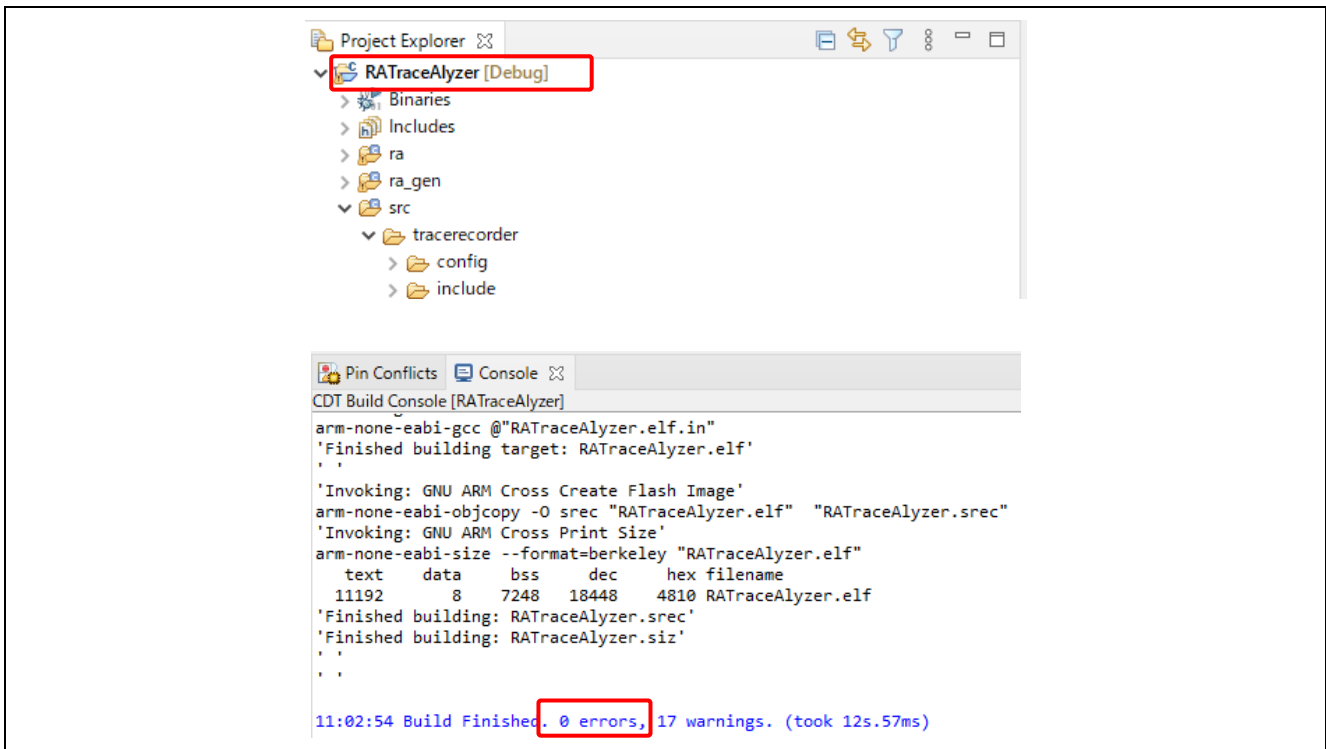


Figure 25. Build Project

4.4 Connect PC and EK-RA6M3 Board

The figure below shows the connection between the host PC and the EK-RA6M3 board.

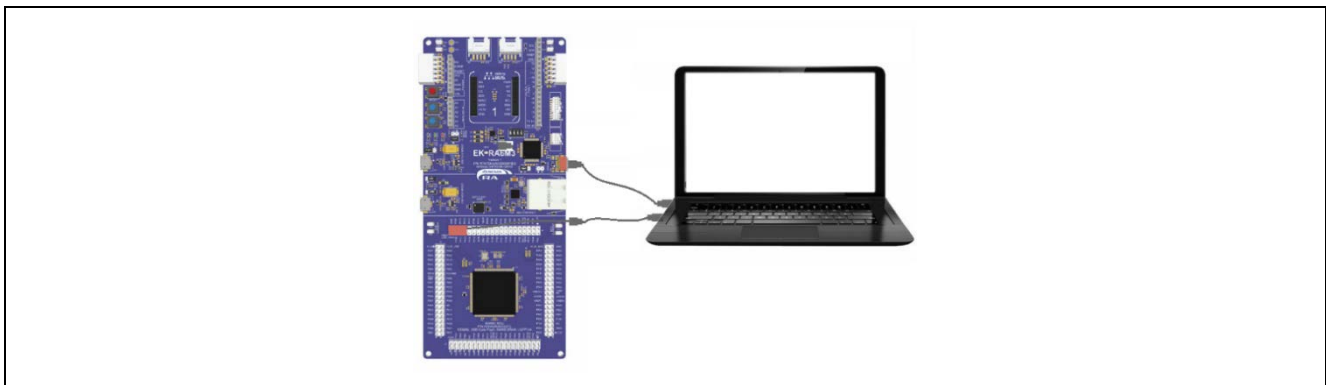


Figure 26. EK-RA6M3 Board Connection

The hardware settings are as follows:

Table 1. Jumper Connection Summary for Different Debug Modes

Debug Modes	J8	J9	J29
Debug on-board	Jumper on pins 1-2	Open	Jumpers on pins 1-2, 3-4, 5-6, 7-8

Terminal connection (UART):

- PC port TXD: ORANGE - EK-RA6M3 board P410 (RXD_MISO)
- PC port RXD: YELLOW - EK-RA6M3 board P411 (TXD_MOSI)
- PC port GND: BLACK - EK-RA6M3 board GND

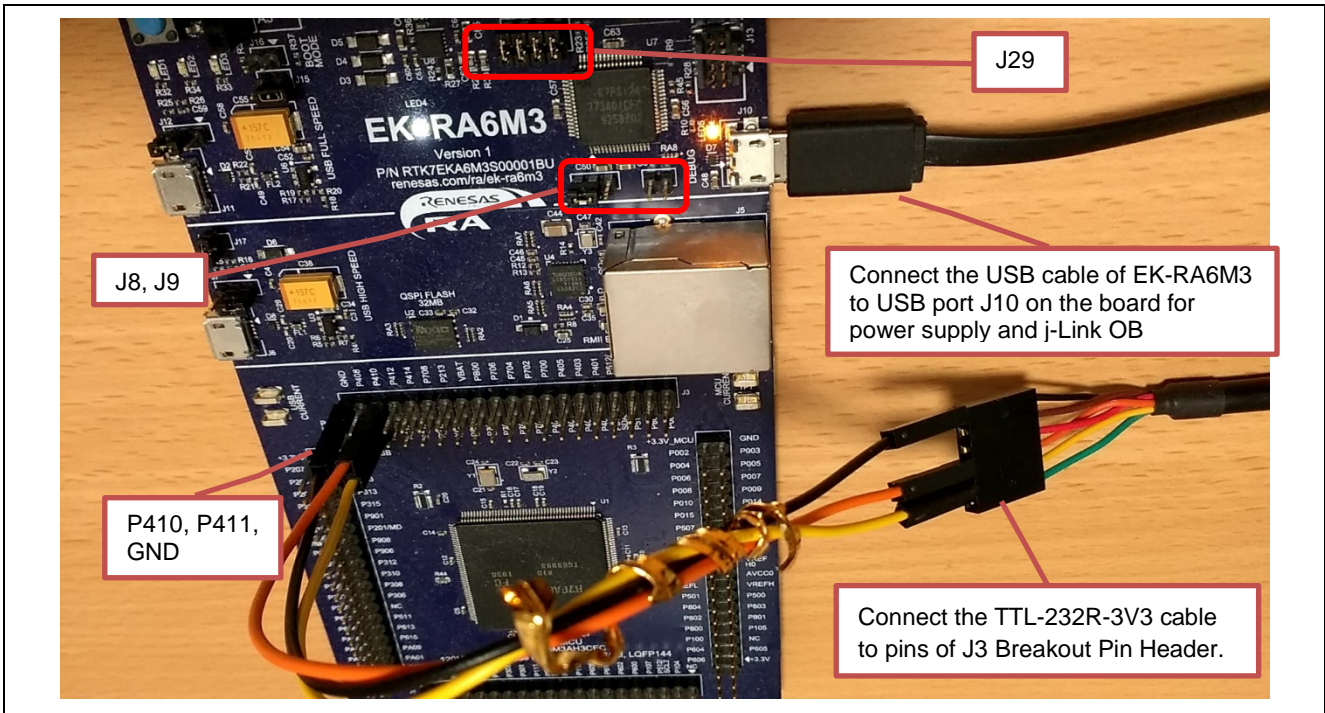


Figure 27. Connection between PC and EK-RA6M3 Board

4.5 Using the RTOS Resource View

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

4.5.1 Displaying the RTOS Resources View

Because the **RTOS Resources** view functions only with the debugger running, start the debugger and select **Renesas Views > Partner OS > RTOS Resources**. When the **Select OS** dialog box is displayed, select FreeRTOS as shown in Figure 28. The **RTOS Resources** view appears as shown in Figure 29.

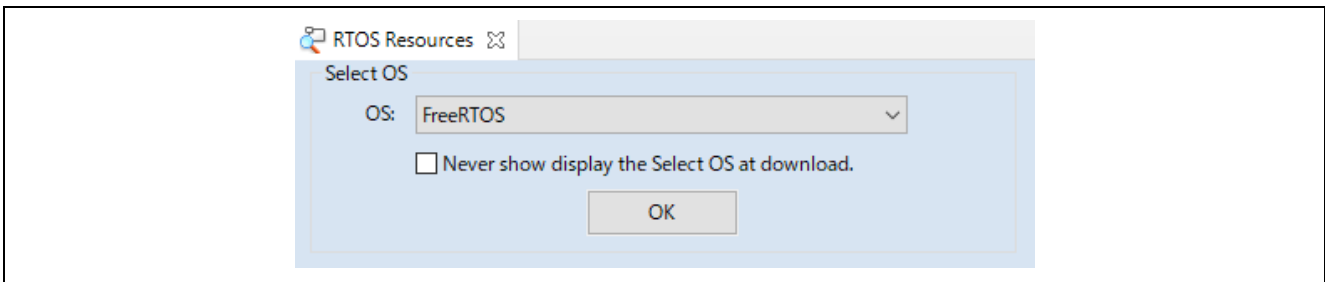


Figure 28. Selecting the OS

Stack	Task	Queue	Timer				
No.	TaskName	Base/ActualPriority	State	EventObject	TotalTickCount	DeltaTickCount	
1	Blinky Thread	1/1	BLOCKED	None	-(-%)	-(-%)	
2	IDLE	0/0	READY	None	-(-%)	-(-%)	
3	Tmr Svc	3/3	SUSPENDED	None	-(-%)	-(-%)	
4							
5							

Figure 29. RTOS Resources view

4.5.2 Context menu

Display the context menu by right-clicking the mouse on the RTOS Resources view.

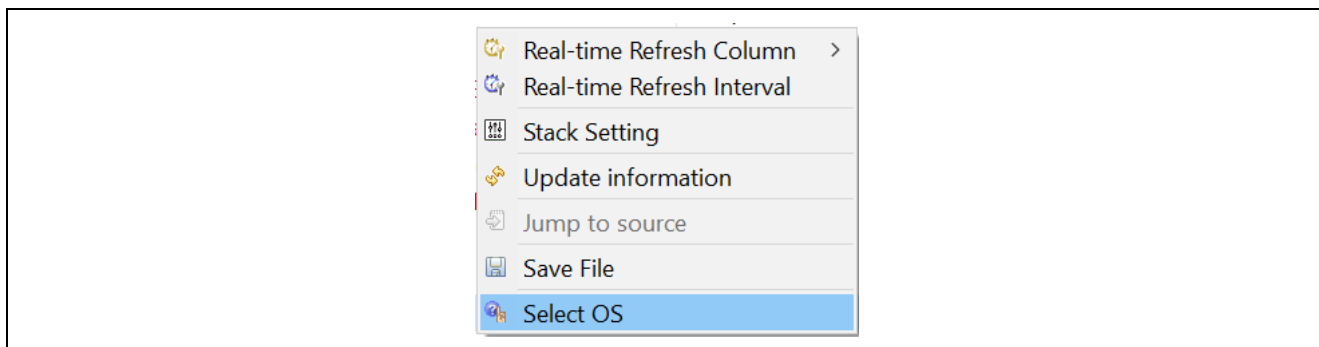


Figure 30. Context menu

Explanation:

- Real-time Refresh Column:**
 Allows real-time display for the displayed items.
 This is not valid while the program is running.
- Real-time Refresh Interval:**
 Specifies interval time for updating of the real-time display. The specifiable range is 500ms to 10000ms.
 This is not valid while the program is running.
- Stack Setting:**
 Enables/disables Stack Loading and stack threshold setting for stack alert function.
 This is not valid while a program is running.
- Update information:**
 Updates the information.
- Jump to source:**
 Opens an editor view displaying the source code of the task/thread or handler. Double-clicking the task/thread or handler also opens an editor view.
 This is not valid while the program is running.
- Save File:**
 Saves the data of the current tab in the text file (*.txt).
 This is not valid while the program is running.
- Select OS:**
 Opens the **Select OS** dialog box.
 This is not valid while the program is running.

4.5.3 Stack setting

Enable load stack data and set stack threshold.

1. Open the context menu and select **Stack Setting**.
2. To load stack data to the **RTOS Resource** view, check **Enable loading Stack data** checkbox in the **Stack Setting** dialog. If this option is not enabled, stack data will not be loaded in the next debugging session.

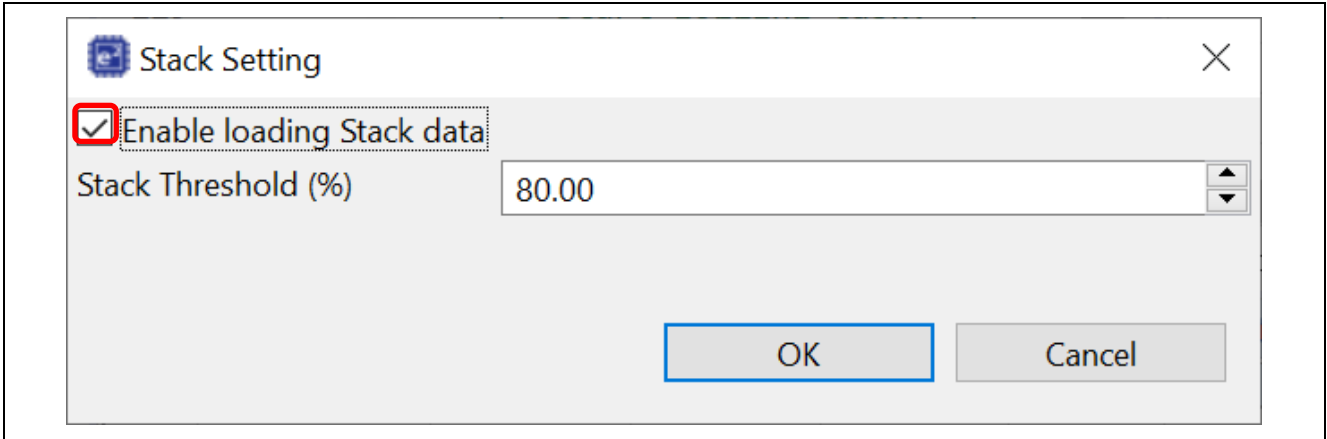


Figure 31. Enable loading stack data

3. The desired threshold value can be set in the **Stack Threshold (%)** textbox. Click **OK** to save the setting.

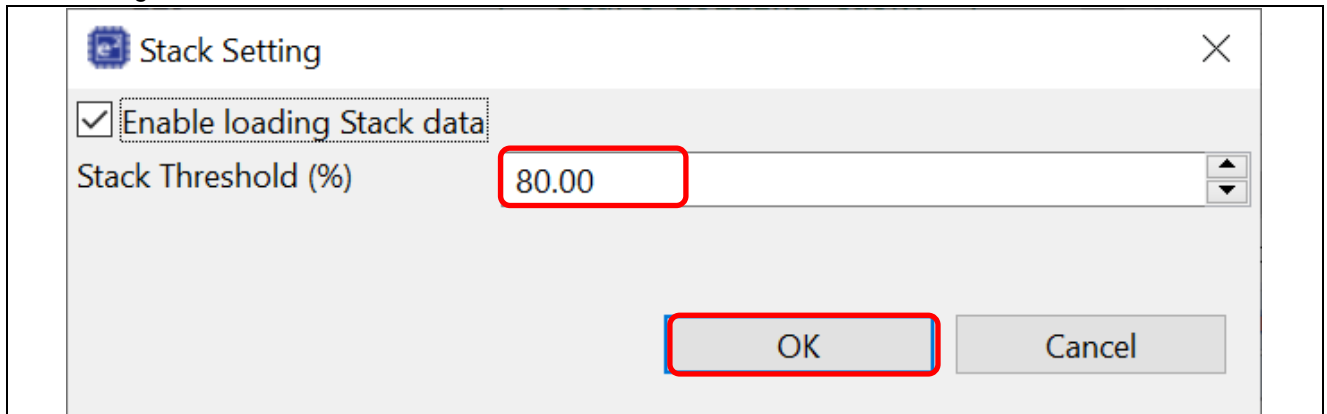


Figure 32. Set up threshold value

4. Run then suspend the target project to load stack data. The stack threshold warning will pop up if the threshold set is met.

There are 2 types of warning popup: **Stack Threshold Warning** (list of threads which reached stack threshold value set as above) and **Stack Overflow Warning** (reached 100%).

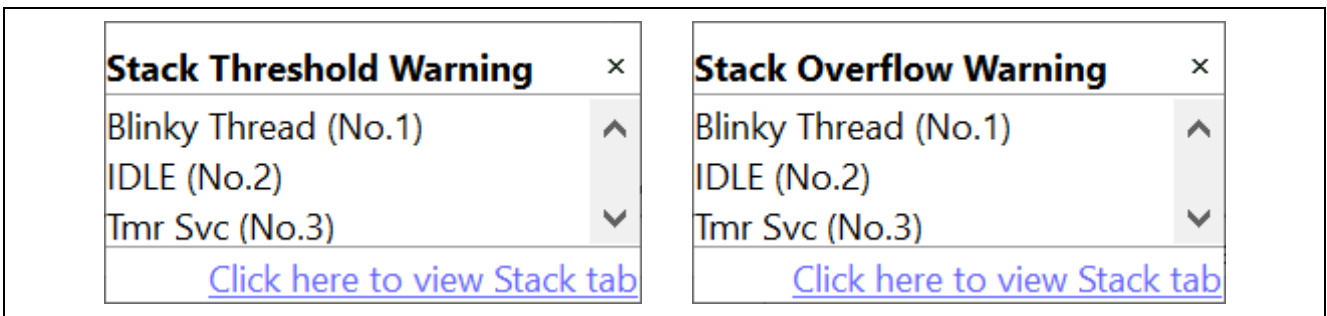


Figure 33. Stack Threshold Warning popup (left) and Stack Overflow Warning popup (right)

4.5.4 Tab menu

Table 2 show display items for each tab.

Table 2. Contents of each tabbed window

Name of tabbed window in the RTOS Resources view	Displayed information and selections	Information to be displayed
Stack	No.	Row index
	TaskName	The name assigned to the task upon creation
	StartOfStack	The address of the start of stack
	EndOfStack	The address of the end of stack
	TopOfStack	The address of the top of the stack where it is last written to when the context of the stack was saved
	StackSize(bytes)	Total stack size
	StackUsageSize	Stack usage at high water mark
	StackUsageRatio	Percentage of usage at high water mark relative to total stack size
Task	No.	Row index
	TaskName	The name assigned to the task upon creation
	Base/ActualPriority	The base priority used by the priority inheritance mechanism/The actual priority used by the task
	State	State of the task which includes "RUNNING", "READY", "BLOCKED" and "SUSPENDED"
	EventObject	The name of the queue which causes the task to be blocked
	TotalTickCount	The total number of tick count for the task to be active
	DeltaTickCount	The number of tick count for the task to be active since previous suspend event
Queue	No.	Row index
	Name (Type)	The name assigned to the queue upon registration and its type (Queue, Semaphore, or Mutex)
	Address	The address of the queue handle
	MaxLength	Size per item in the queue (in bytes)
	ItemSize	Message size
	CurrentLength	Number of items currently stored in the queue
	#WaitingTx	Number of tasks blocked while waiting to send to the queue
	#WaitingRx	Address where the message queue starts
EndAddress	Address where the message queue ends	
Timer	No.	Row index
	Name	The current period of the timer in system ticks
	Period	Automatic reload enable/disable. "On" when auto reload is enabled, which resets the timer each time it expires, "Off" when auto reload is disabled which does nothing when the timer expires
	CallbackFn	Address and <Name> of the callback function which executes each time the timer ends
	TimerID	The numeric ID of the timer assigned in hexadecimal format when it was created

4.6 Start debugging a project with Tracealyzer®

4.6.1 Launch debugger on e² studio

Select menu **Run > Debug** to launch the debugger.

4.6.2 Launch Tracealyzer®

Launch installed Tracealyzer 4 on PC.

4.6.3 Set Recording Settings

Click **Recording settings** on Tracealyzer and select **PSF Streaming Settings** on Tracealyzer. Set the following.

- Device: **COM8** (user pc system port)
- Data bits: **8**
- Data rate: **921600**
- Handshake: **None**
- Parity: **None**
- Stop bits: **One**

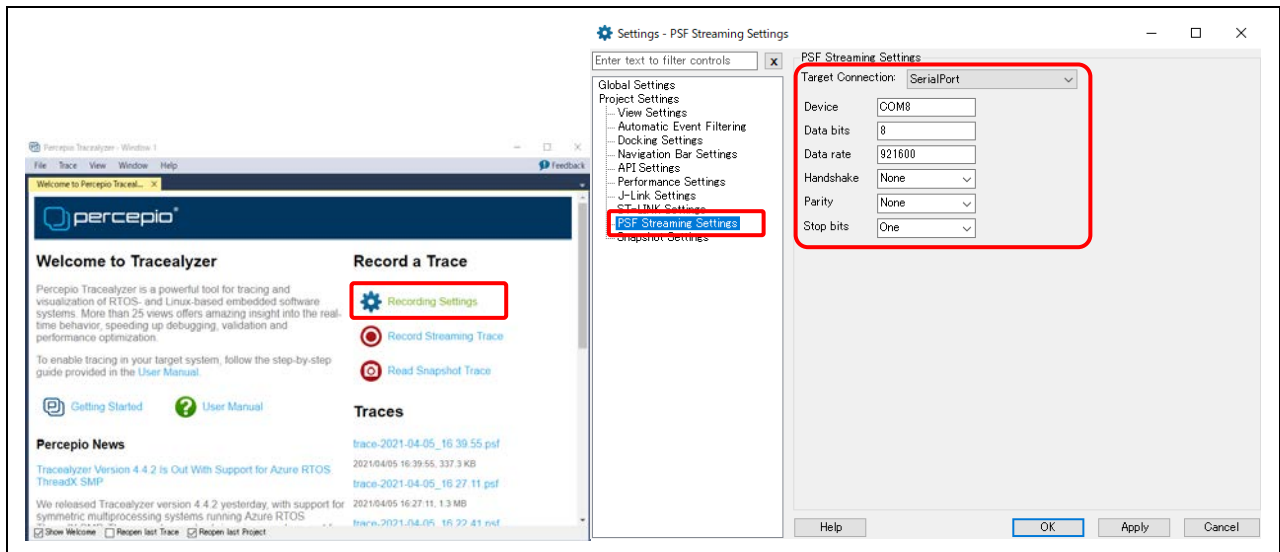


Figure 34. Set to Record UART Settings

4.6.4 Start Recording a Trace

Click **Record Streaming Trace** to start recording a Trace.

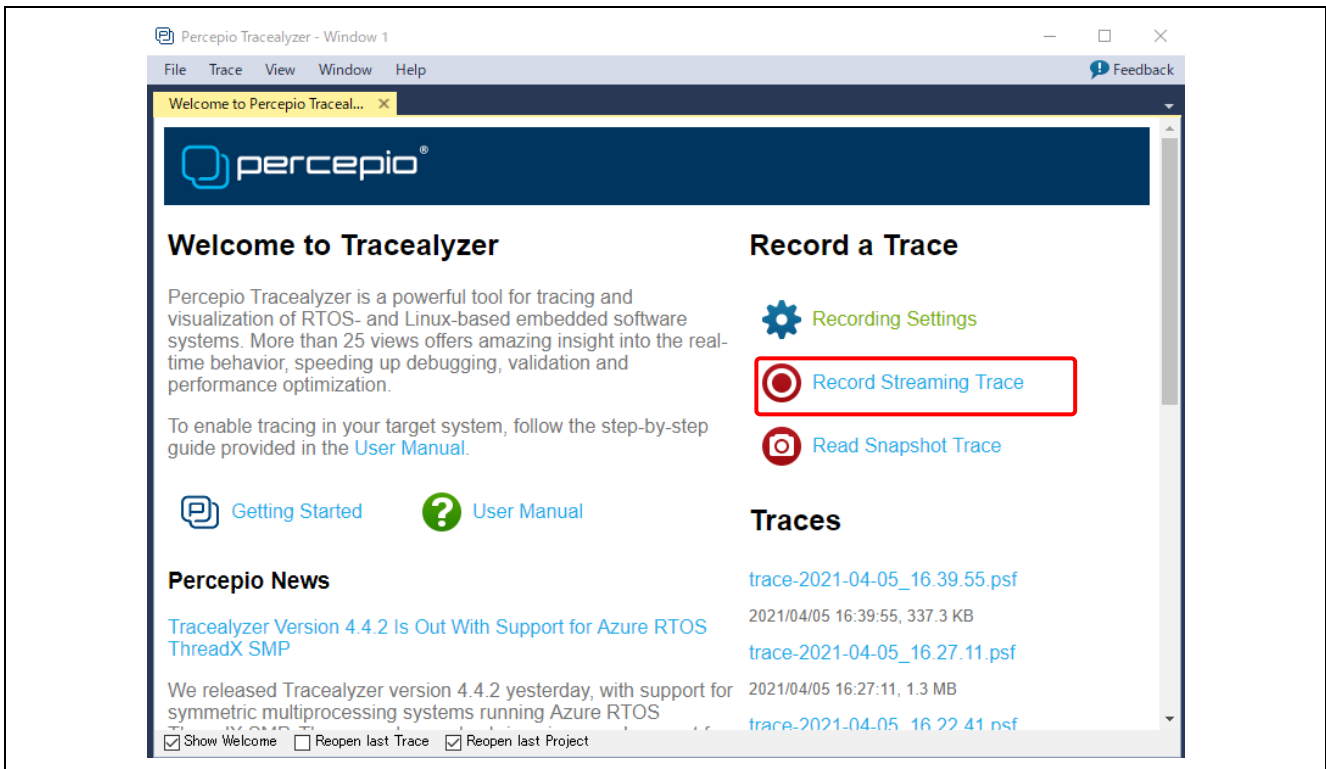


Figure 35. Start Record Streaming Trace

4.6.5 Trace information is displayed

Various analysis modes are provided. For more information, see **Help** tab.

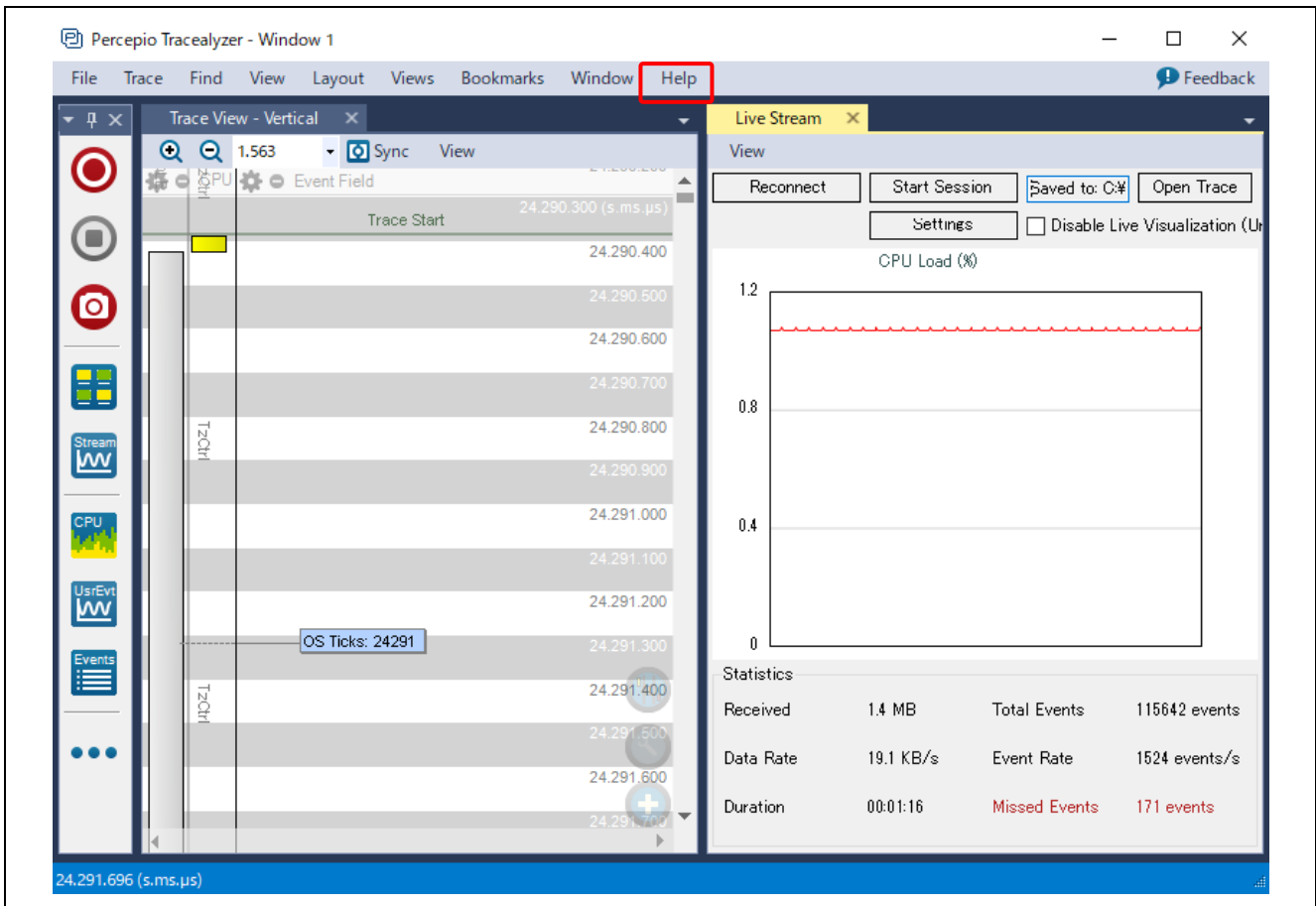


Figure 36. Displayed Trace information

5. Debugging via J-Link RTT with Tracealyzer®

This section describes how to use Tracealyzer® in J-Link RTT.

5.1 Copy and Remove Tracealyzer® for FreeRTOS into a project

5.1.1 Copy Tracealyzer® for FreeRTOS source under the Tracealyzer® installation folder

Copy the Program Files\Percepio\Tracealyzer 4\FreeRTOS\TraceRecorder folder into workspace folder src using File Explorer.

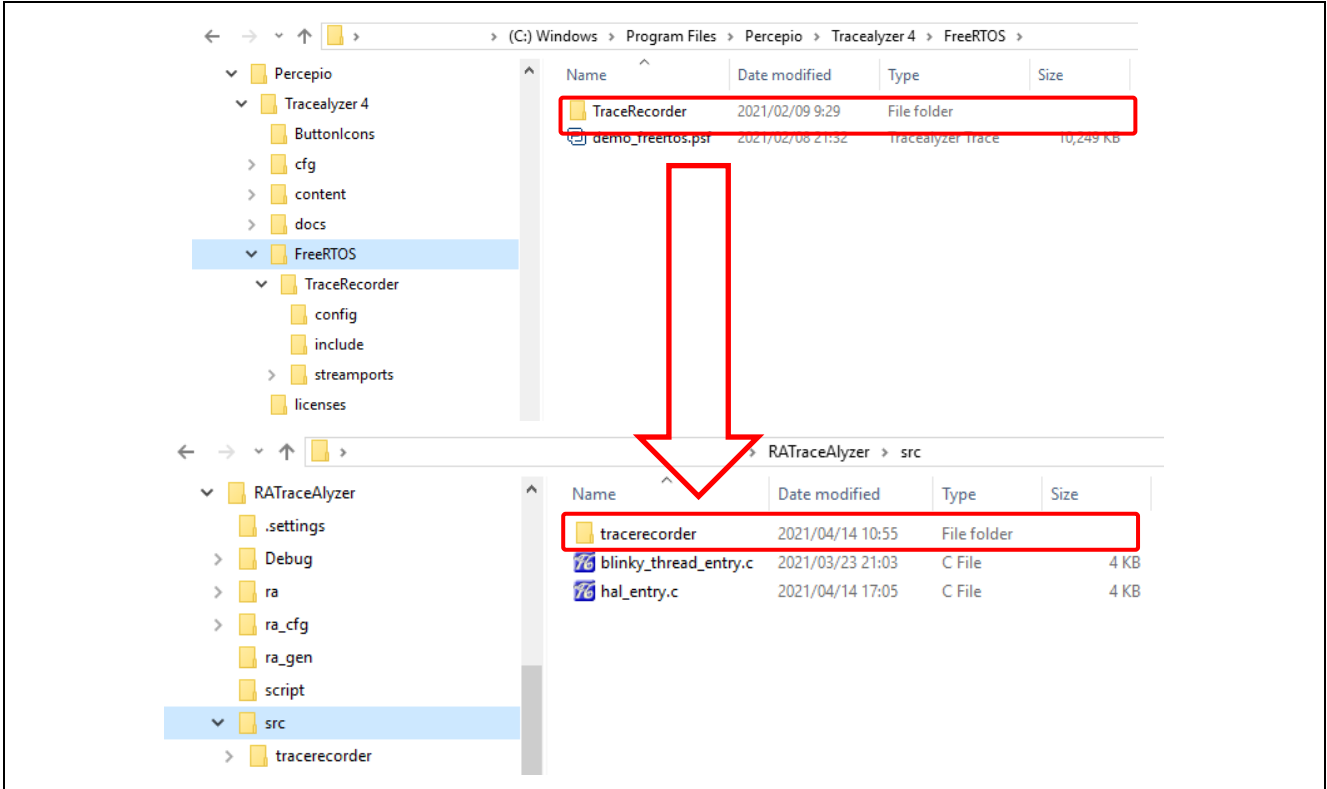


Figure 37. Copy Folder

5.1.2 Remove unnecessary folders

1. Remove sub-folders marked in red in workspace folder src/TraceRecorder/streamports as shown in Figure 5-2.

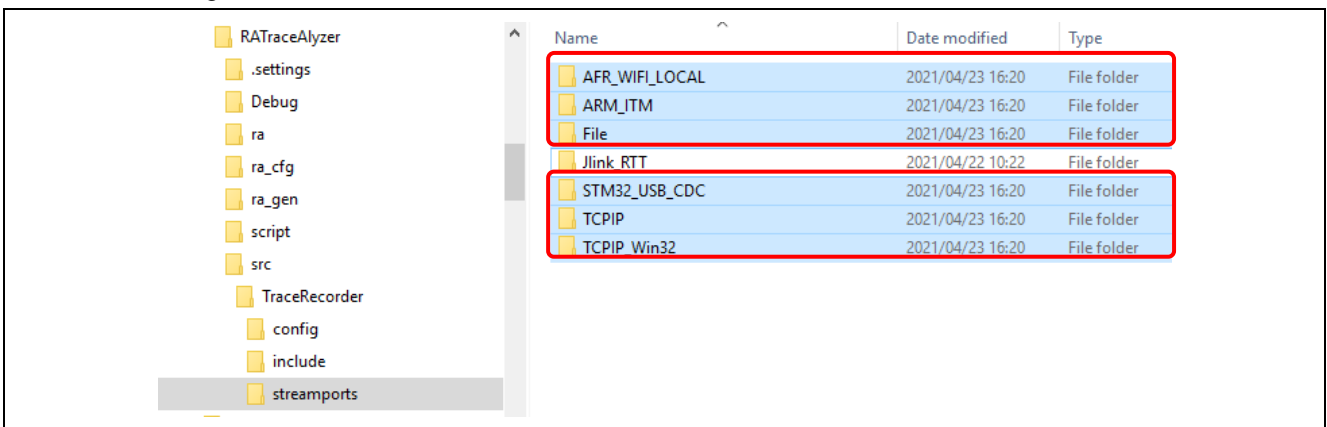


Figure 38. Remove Folder (J-Link RTT)

2. Copy J-Link RTT files in EK-RA6M3 Example Project Bundle - Sample Code. Overwrite the files in the `\ek_ra6m3\sci_uart\sci_uart_ek_ra6m3_ep\e2studio\src\SEGGER_RTT` folder into workspace folder `src/TraceRecorder/streamports` using File Explorer.
 - File `SEGGER_RTTc`
 - File `SEGGER_RTT_printfc`
 - File `SEGGER_RTTh`
 - File `SEGGER_RTT_Confh`

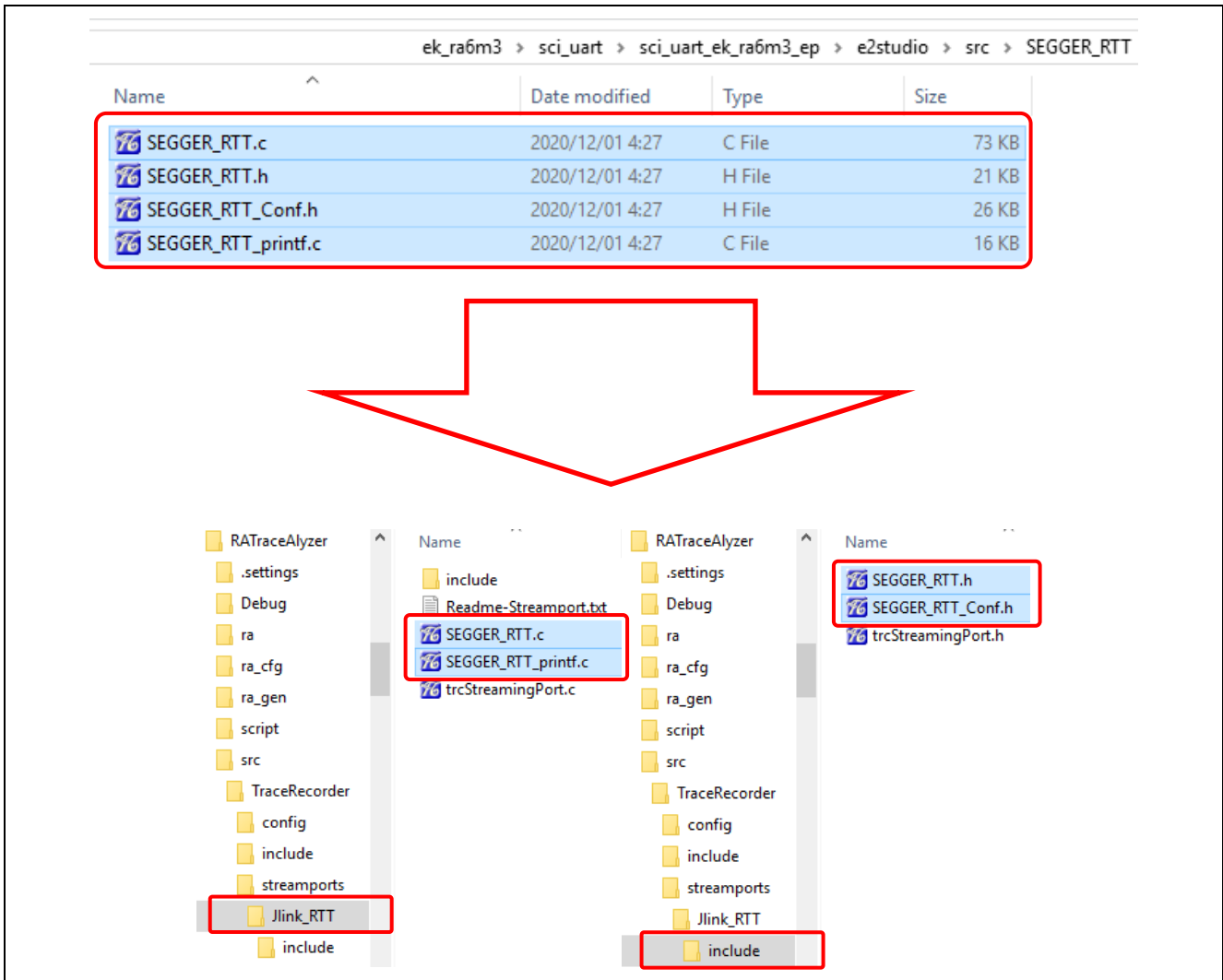


Figure 39. Copy the SEGGER_RTT files

5.2 FSP Configuration

5.2.1 Blinky Thread Settings

Add the Heap to the Blinky Thread as follows.

- Move to the **Stacks** tab.
- Select **Blinky Thread**.
- Click **New Stack > FreeRTOS > Memory Management > Heap 1**.

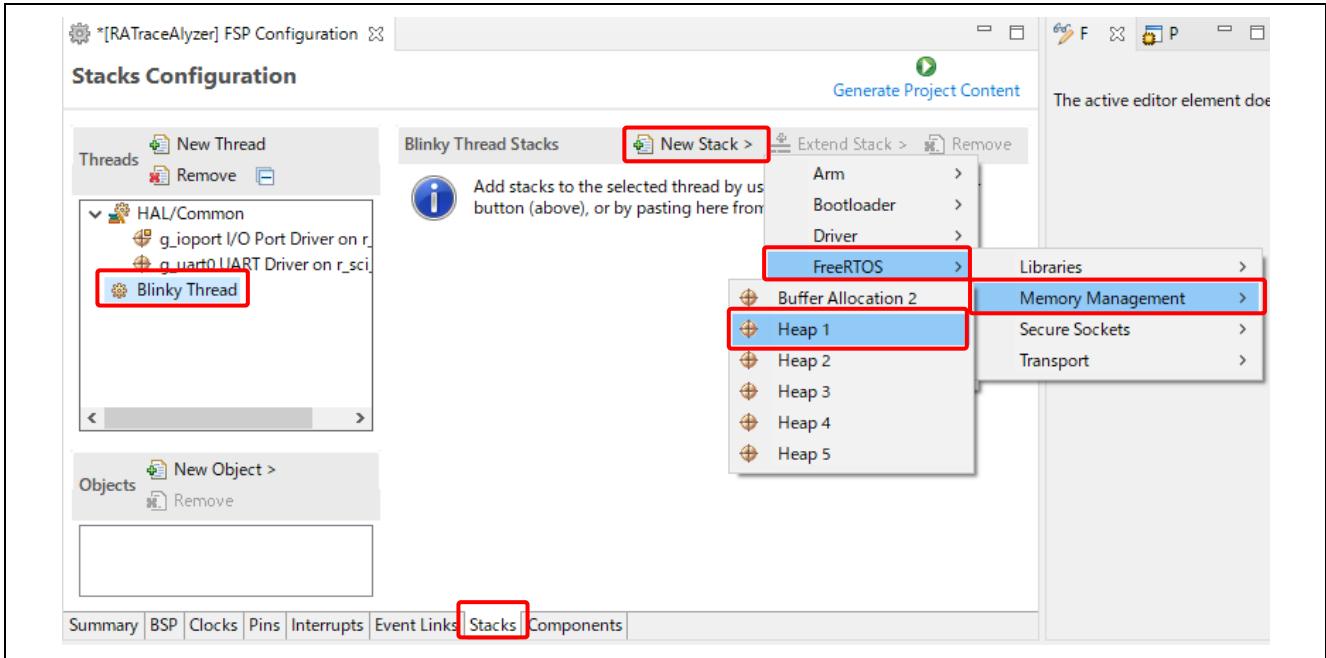


Figure 40. Add Heap on Stacks Configuration

Change the **Properties > General** on **Blinky Thread** as follows.

- Minimal Stack Size: **512**
- Use Mutexes: **Enabled**
- Use Recursive Mutexes: **Enabled**
- Use Queue Sets: **Enabled**
- Enable Backward Compatibility: **Enabled**

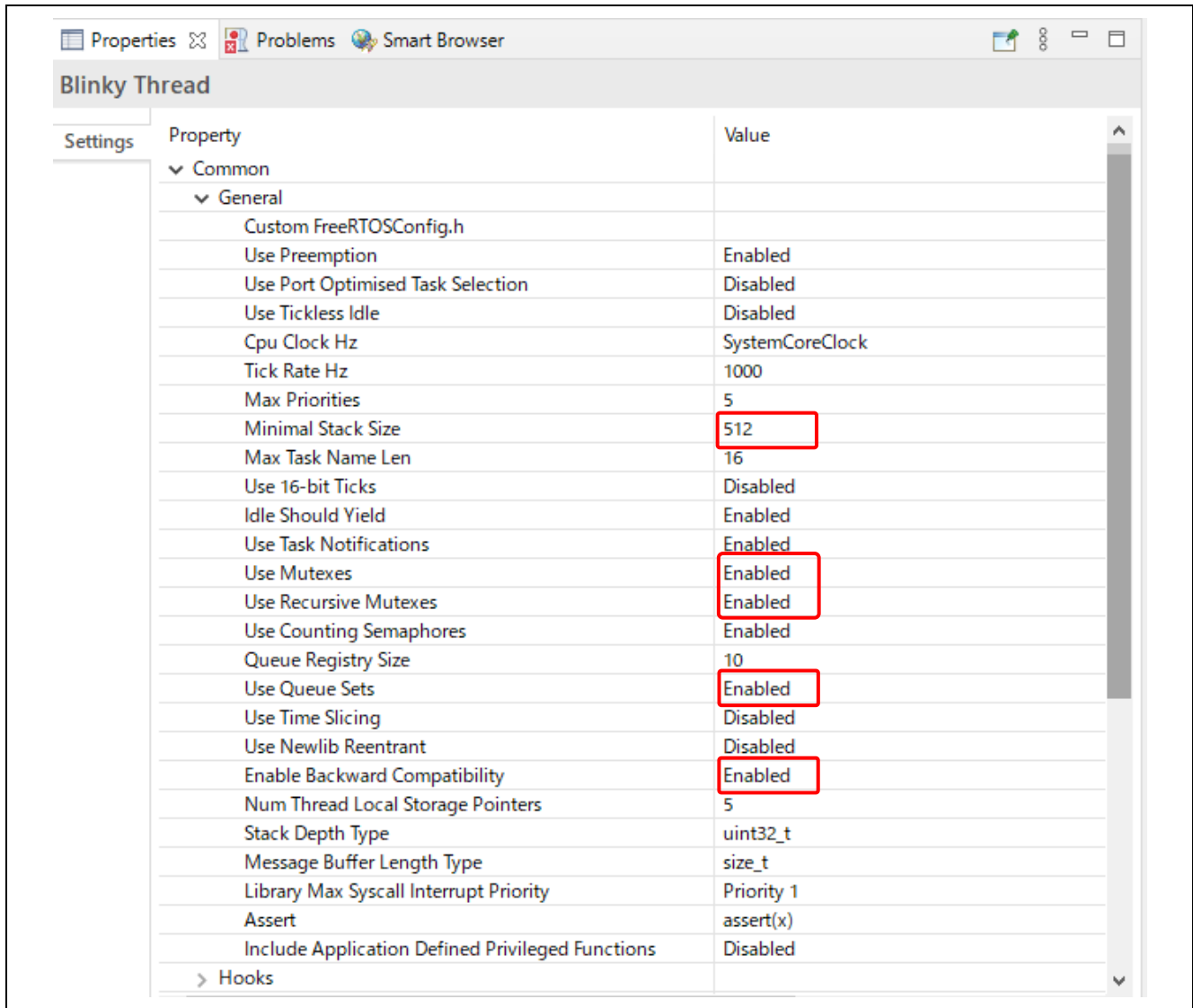


Figure 41. Blinky Thread Properties 1

Change the **Properties > Hooks, Stats, Memory Allocation, Timers** on **Blinky Thread** as follows.

- Use Idle Hook: Disabled
- Use Malloc Failed Hook: Enabled
- Use Trace Facility: Enabled
- Use Stats Formatting Functions: Enabled
- Support Dynamic Allocation: Enabled
- Total Heap Size: 262,144 (256 * 1,024)
- Timer Task Static Depth: 3,072 (1024 * 3)

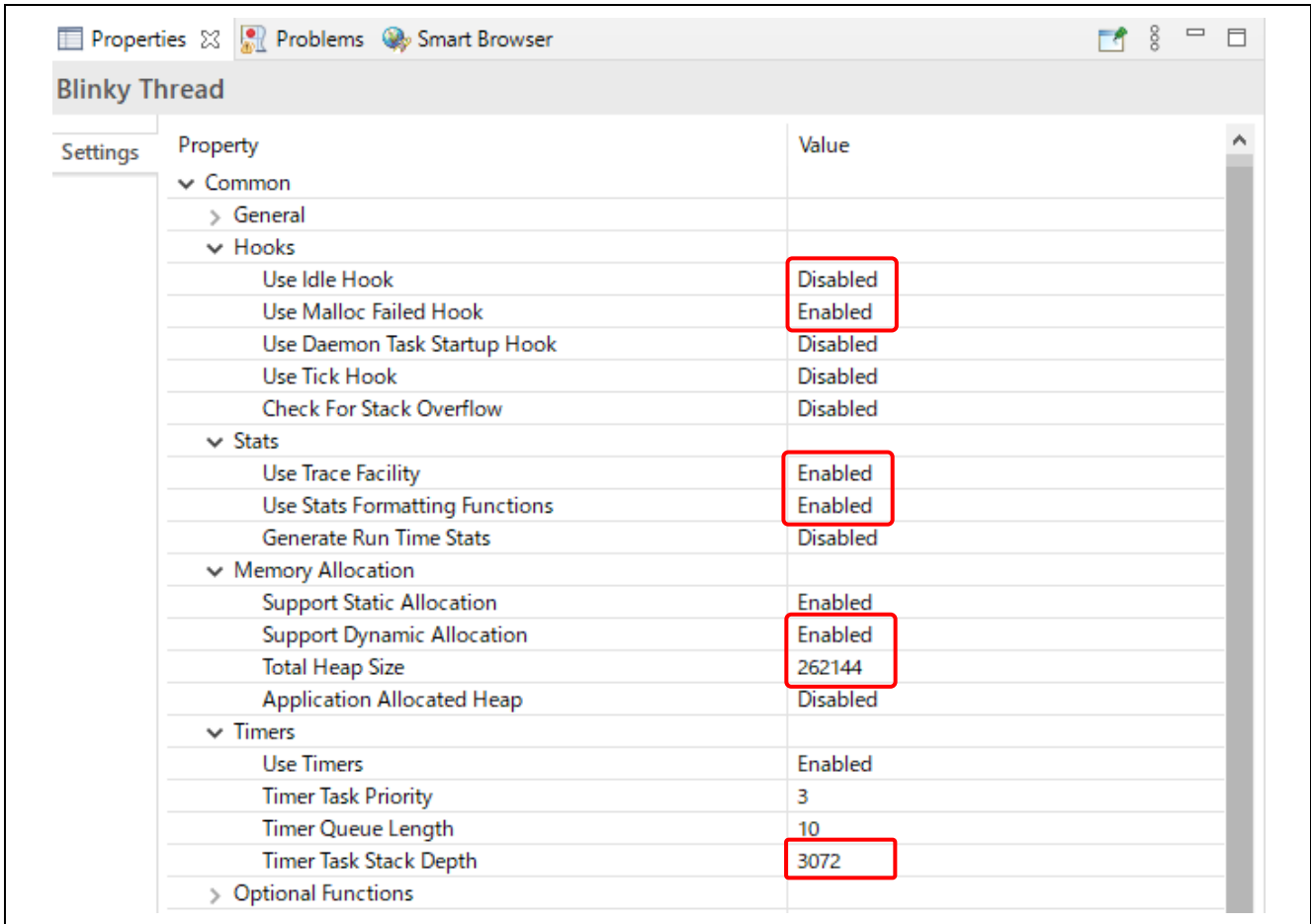


Figure 42. Blinky Thread Properties 2

Change the **Properties > Optional Functions, RA, Logging** on **Blinky Thread** as follows.

- uxTaskGetStackHighWaterMark() Function: **Enabled**
- eTaskGetState() Function: **Enabled**
- xTimerPendFunctionCall() Function: **Enabled**
- xTaskAbortDelay() Function: **Enabled**
- Hardware Stack Monitor: **Enabled**
- Logging Include Time and Task Name: **Enabled**

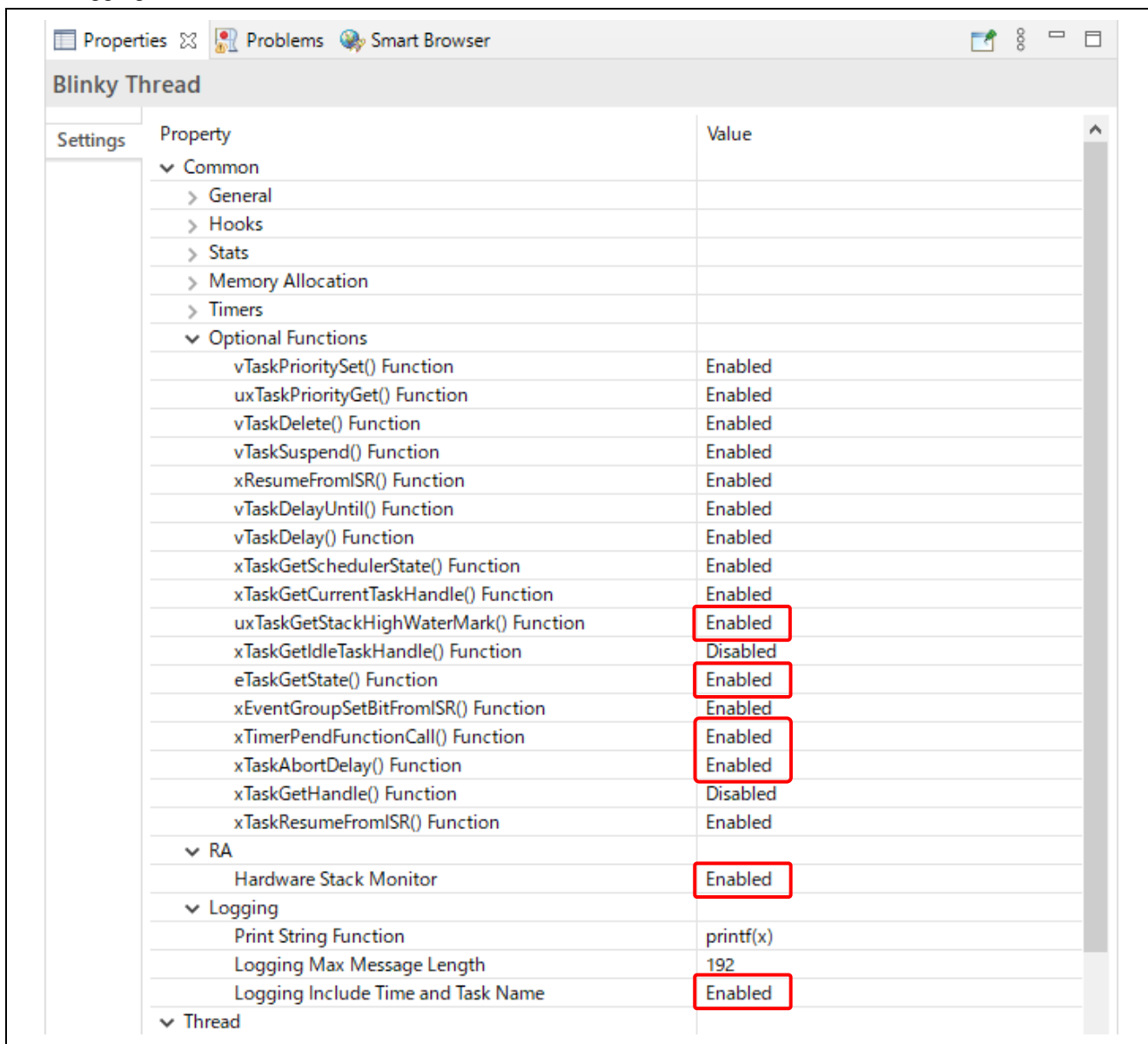



Figure 43. Blinky Thread Properties 3

5.2.2 Generate Project Content

Click on the  button to generate the source files.

5.3 Code editing for Tracealyzer® connections

5.3.1 Add include file to task.c and timers.c

- #include "trcRecorder.h"

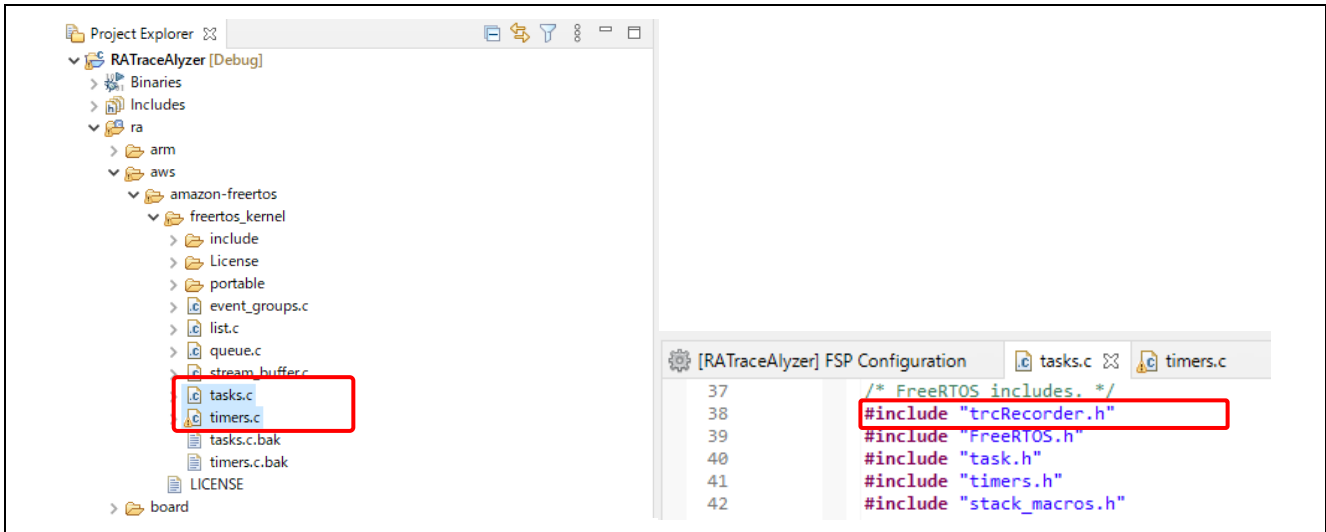


Figure 44. Add include to freertos_kernel

5.3.2 Add include files to trcKernelPort.c and trcStreamingRecorder.c

- #include "bsp_api.h"
- #include "trcRecorder.h"

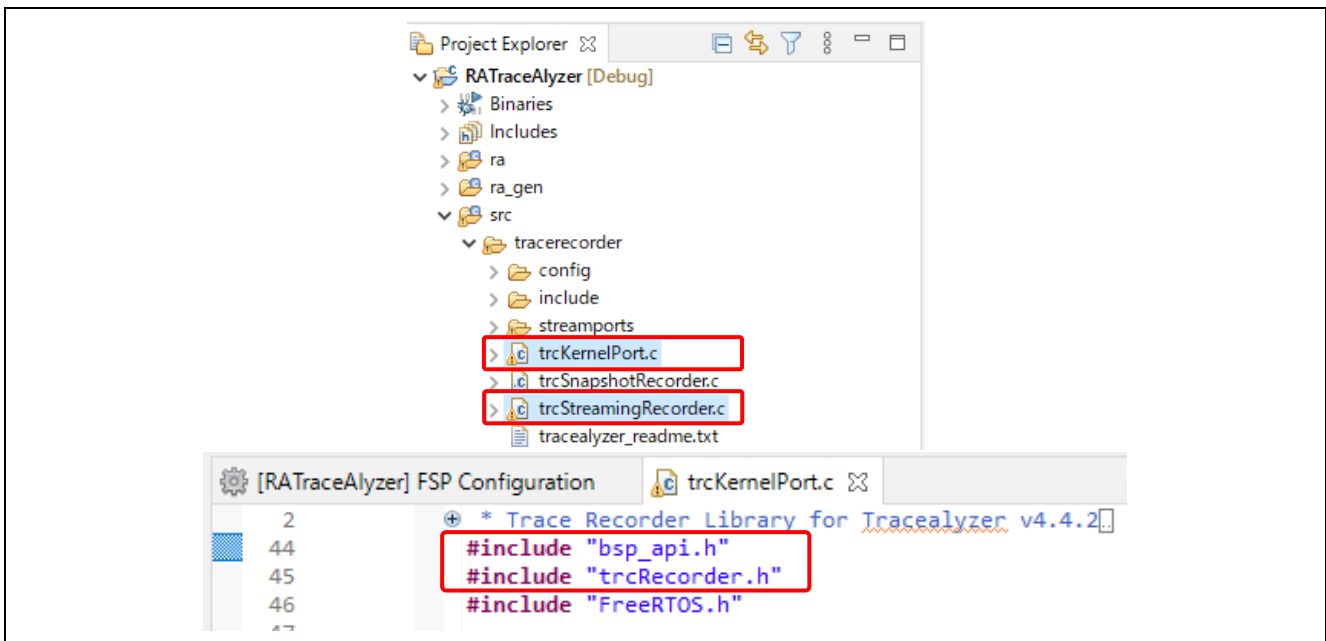


Figure 45. Add include tracerecorder

5.3.3 Change macro definitions in trcConfig.h

Change only the red part of macro definitions `trcConfig.h` as follows.

- `#include "bsp_api.h"`.
- `//#error "Trace Recorder: Please include your processor's header file here and remove this line."`.
- `#define TRC_CFG_HARDWARE_PORT TRC_HARDWARE_PORT_ARM_Cortex_M.`
- `#define TRC_CFG_RECORDER_MODE TRC_RECORDER_MODE_STREAMING.`
- `#define TRC_CFG_FREERTOS_VERSION TRC_FREERTOS_VERSION_10_4_1.`

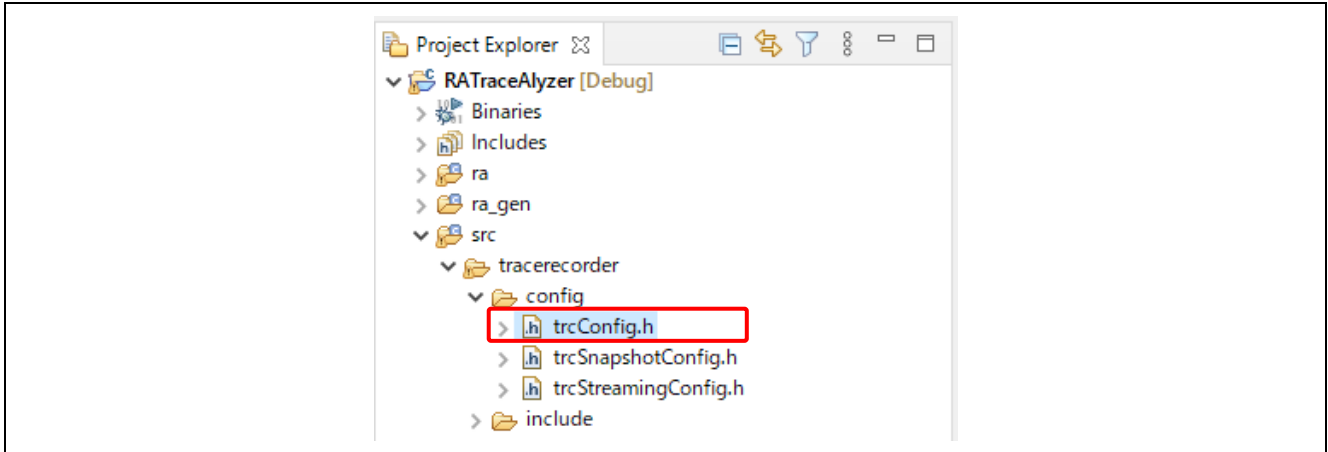


Figure 46. Change the define in trcConfig.h

5.3.4 Add Include path on e2 studio properties

Select menu **Project > Properties**, then click **Settings > Includes** to add the Include path .

- `"${workspace_loc}/${ProjName}/src/tracerecorder"`
- `"${workspace_loc}/${ProjName}/src/tracerecorder/config"`
- `"${workspace_loc}/${ProjName}/src/tracerecorder/include"`
- `"${workspace_loc}/${ProjName}/src/tracerecorder/streamports/Jlink_RTT/include"`

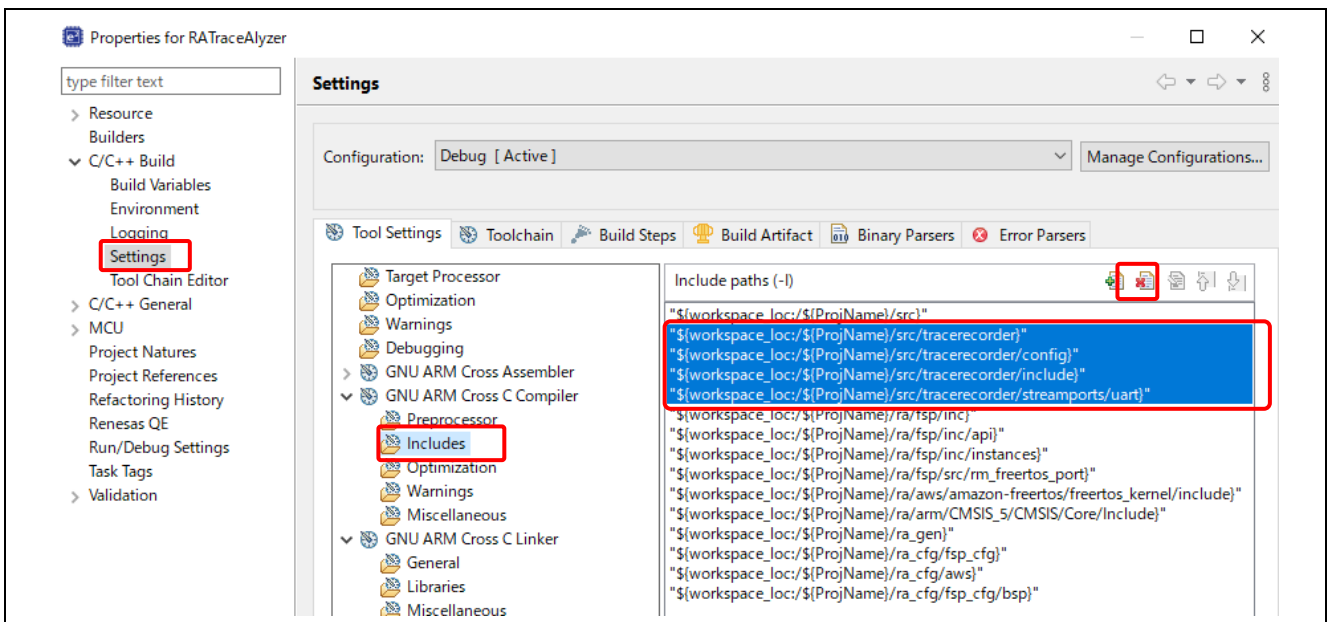


Figure 47. Settings Include paths of project properties

5.3.5 Add code to hal_entry.c

Add source code in red to hal_entry.c.

```

#include "bsp_api.h"
#include "trcRecorder.h"
#include "FreeRTOS.h"
#include "semphr.h"
#include "hal_data.h"

void R_BSP_WarmStart(bsp_warm_start_event_t event);

/*****
*****//**
 * This function is called at various points during the startup process. This implementation
 * uses the event that is
 * called right before main() to set up the pins.
 *
 * @param[in] event Where at in the start up process the code is currently at
*****
*****/
void R_BSP_WarmStart (bsp_warm_start_event_t event)
{
    if (BSP_WARM_START_RESET == event)
    {
#if BSP_FEATURE_FLASH_LP_VERSION != 0

        /* Enable reading from data flash. */
        R_FACI_LP->DFLCTL = 1U;

        /* Would normally have to wait tDSTOP(6us) for data flash recovery. Placing the enable
        here, before clock and
        * C runtime initialization, should negate the need for a delay since the initialization
        will typically take more than 6us. */
#endif
    }

    if (BSP_WARM_START_POST_C == event)
    {
        /* C runtime environment and system clocks are setup. */

        /* Configure pins. */
        R_IOPORT_Open(&g_ioport_ctrl, &g_bsp_pin_cfg);
    }

    vTraceEnable(TRC_INIT);
}

```

Figure 48. Change the J-Link RTT Streaming hal_entry.c

5.3.6 Build the project

Right-click on the project and select **Build Project**.

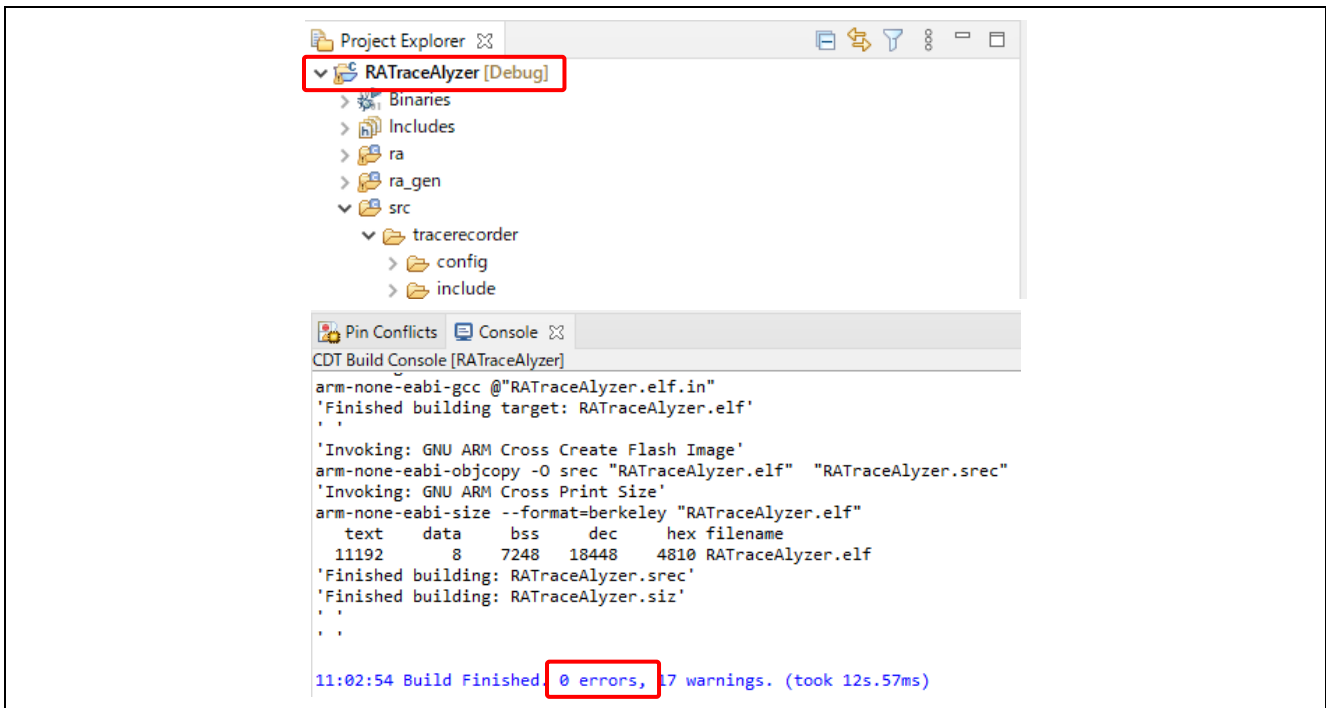


Figure 49 Build Project

5.4 Connect PC and EK-RA6M3 Board

The picture below shows the connection between the host PC and the EK-RA6M3 board.

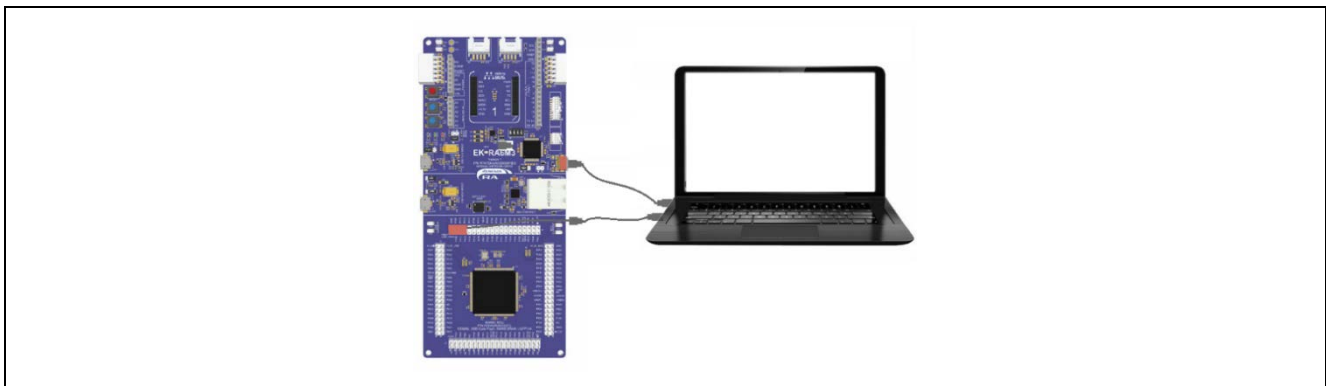


Figure 50. EK-RA6M3 Board Connection

The hardware settings are as follows:

Table 3. Jumper Connection Summary for Different Debug Modes

Debug Modes	J8	J9	J29
Debug on-board	Jumper on pins 1-2	Open	Jumpers on pins 1-2, 3-4, 5-6, 7-8

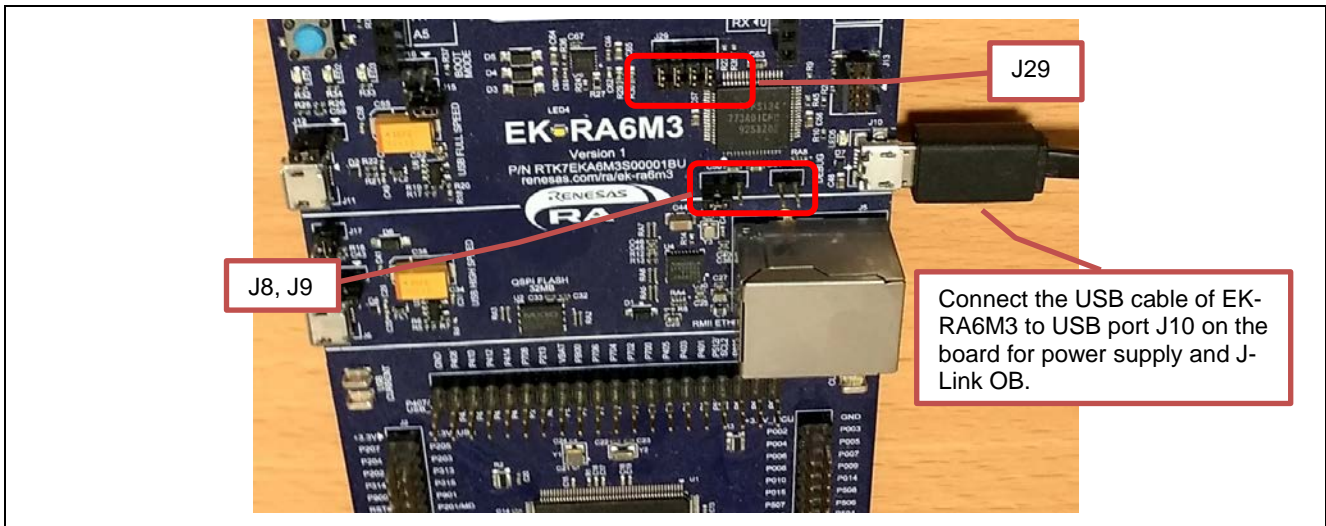


Figure 51. Connection between PC and EK-RA6M3 Board

5.5 Using the RTOS Resource View

Refer to section 4.5, Using the RTOS Resource View.

5.6 Start debugging a project with Tracealyzer®

5.6.1 Launch debugger on e² studio

Select menu **Run > Debug** to launch the debugger.

5.6.2 Launch Tracealyzer®

Launch installed Tracealyzer 4 on PC.

5.6.3 Set to Recording Settings

Refer to Figure 52 to get the RTT control block address in the map file, See code in red.

```

*(COMMON)
COMMON          0x1ffe2fa4
0xa8 ./src/TraceRecorder/streamports/Jlink_RTT/SEGGER_RTT.o
              0x1ffe2fa4                _SEGGER_RTT
    
```

Figure 52. RATraceAlyzer.map (map file)

Click **Recording settings** on Tracealyzer, then select **J-Link Settings** and **PSF Streaming Settings** on Tracealyzer. Set the following.

- Select Target Device: **R7FA6M3AH**. (EK-RA6M3)
- Set RTT Control Block Address: **0x1FFE2FA4**. See **Error! Reference source not found**.

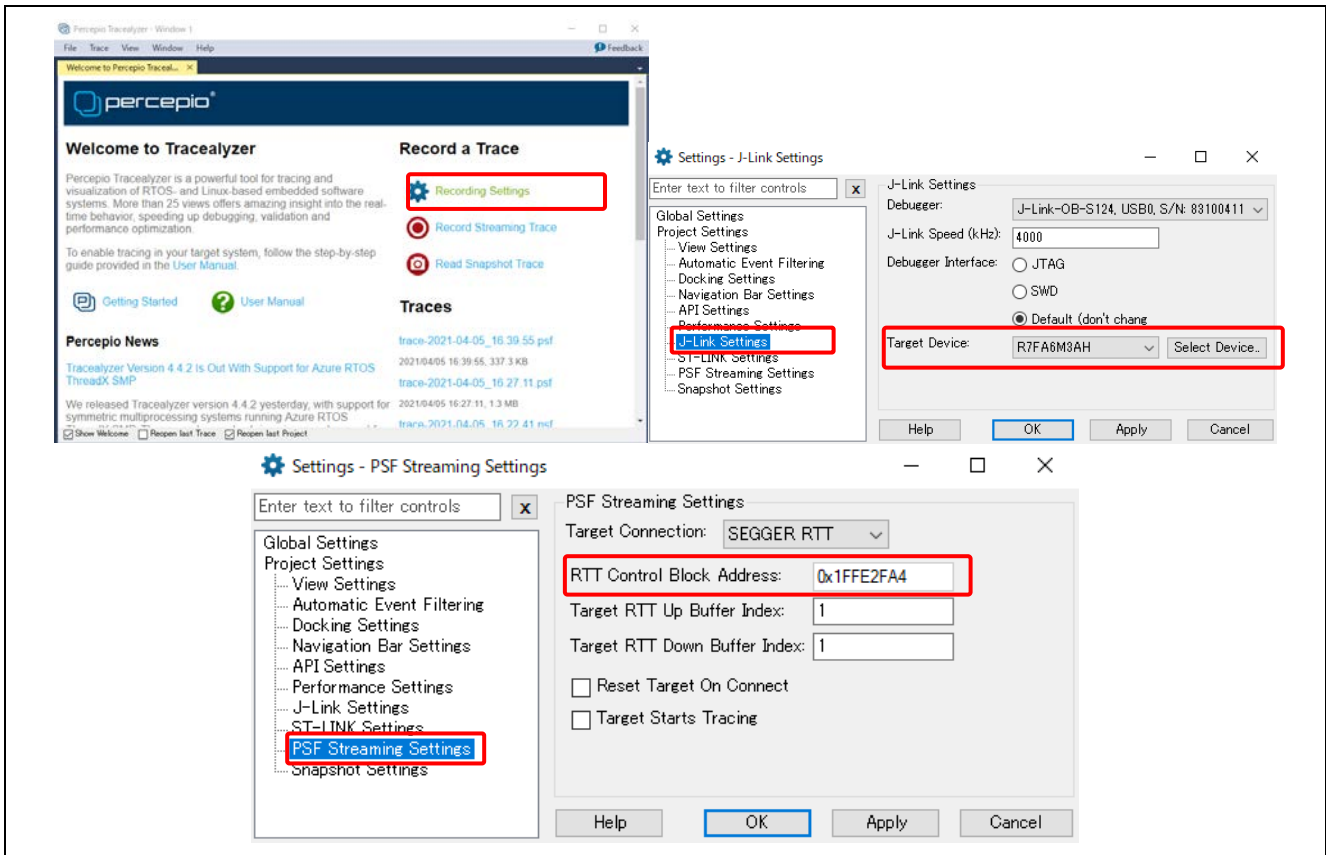


Figure 53. Set to Recording J-Link RTT Settings

5.6.4 Start Recording a Trace

Click Record Streaming Trace to start recording a trace.

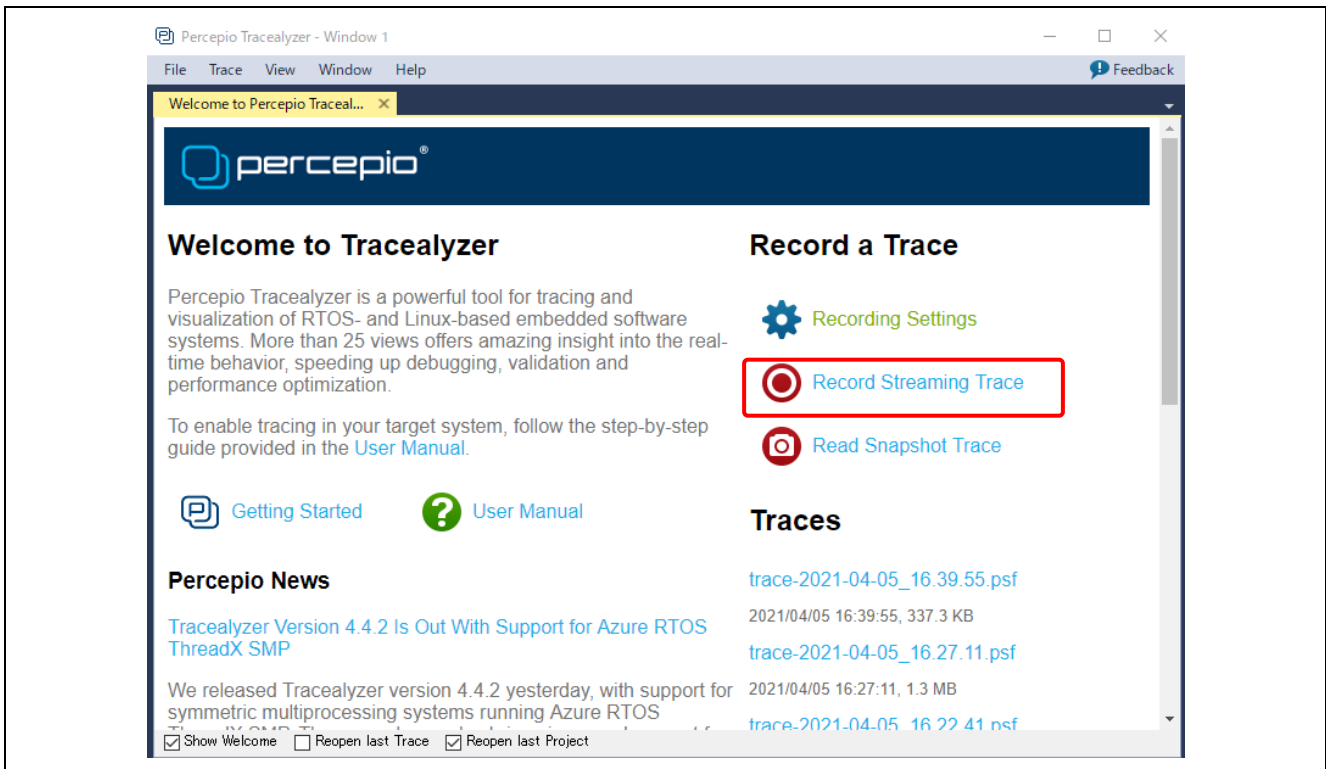


Figure 54. Start Record Streaming Trace

5.6.5 Trace information is displayed

Various analysis modes are provided. For more information, see the **Help** tab.

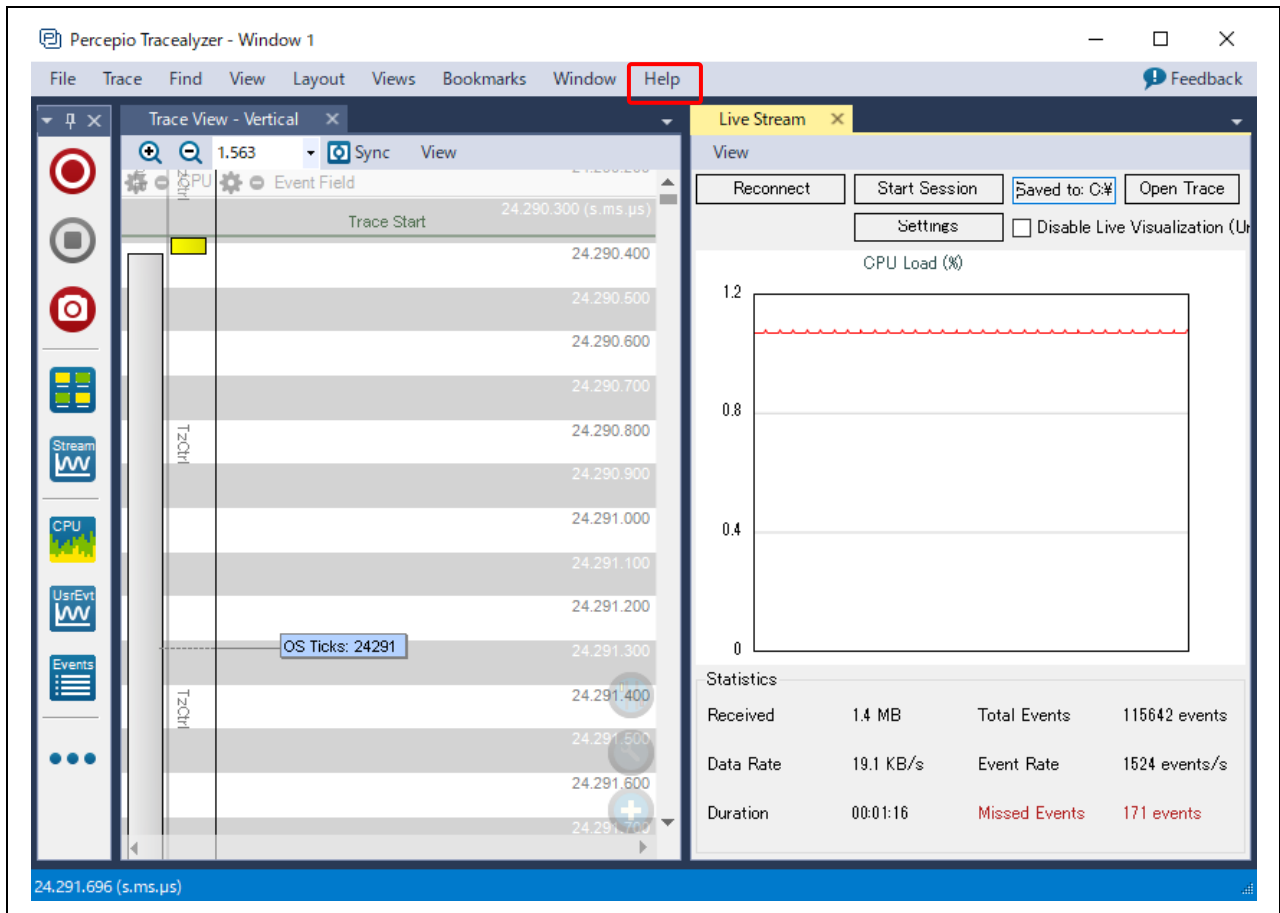


Figure 55. Displayed Trace information

Website and Support

Visit the following URLs to learn about key elements of the RA family, download components, and related documentation, and get support.

RA Product Information	www.renesas.com/ra
RA Product Support Forum	www.renesas.com/ra/forum
RA Flexible Software Package	www.renesas.com/FSP
Renesas Support	www.renesas.com/support

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Jul.22.21	—	First release document

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

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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

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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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