



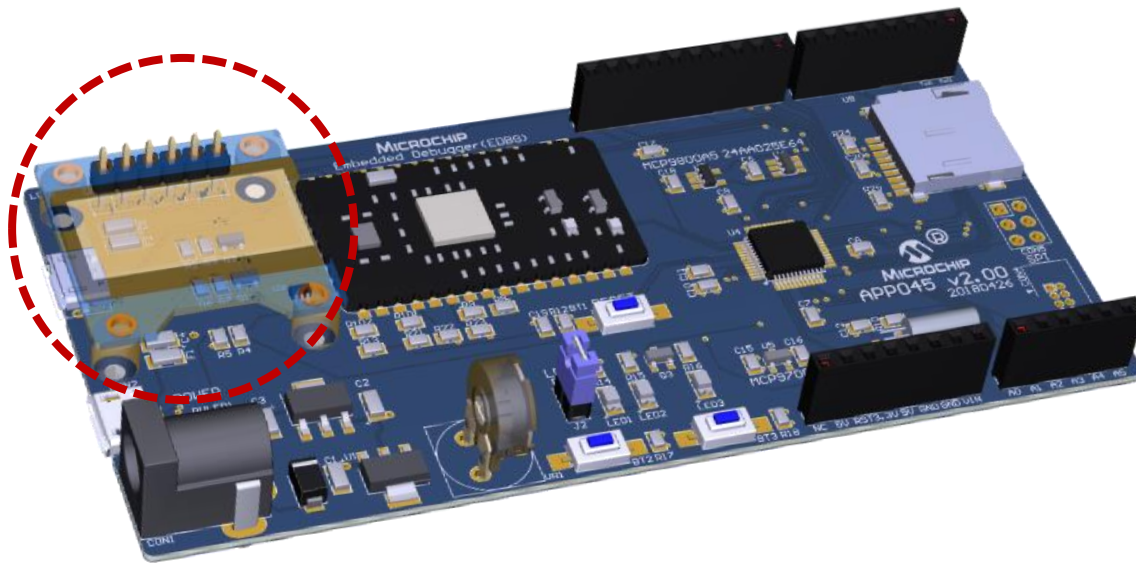
MICROCHIP

Regional Training Centers

Section 12
OLED SSD1306

OLED Graphic Display

- SSD1306
128 x 64 Dot Matrix OLED/PLED Segment/Common Driver
with Controller.



Monochrome Graphics Library

u8glib

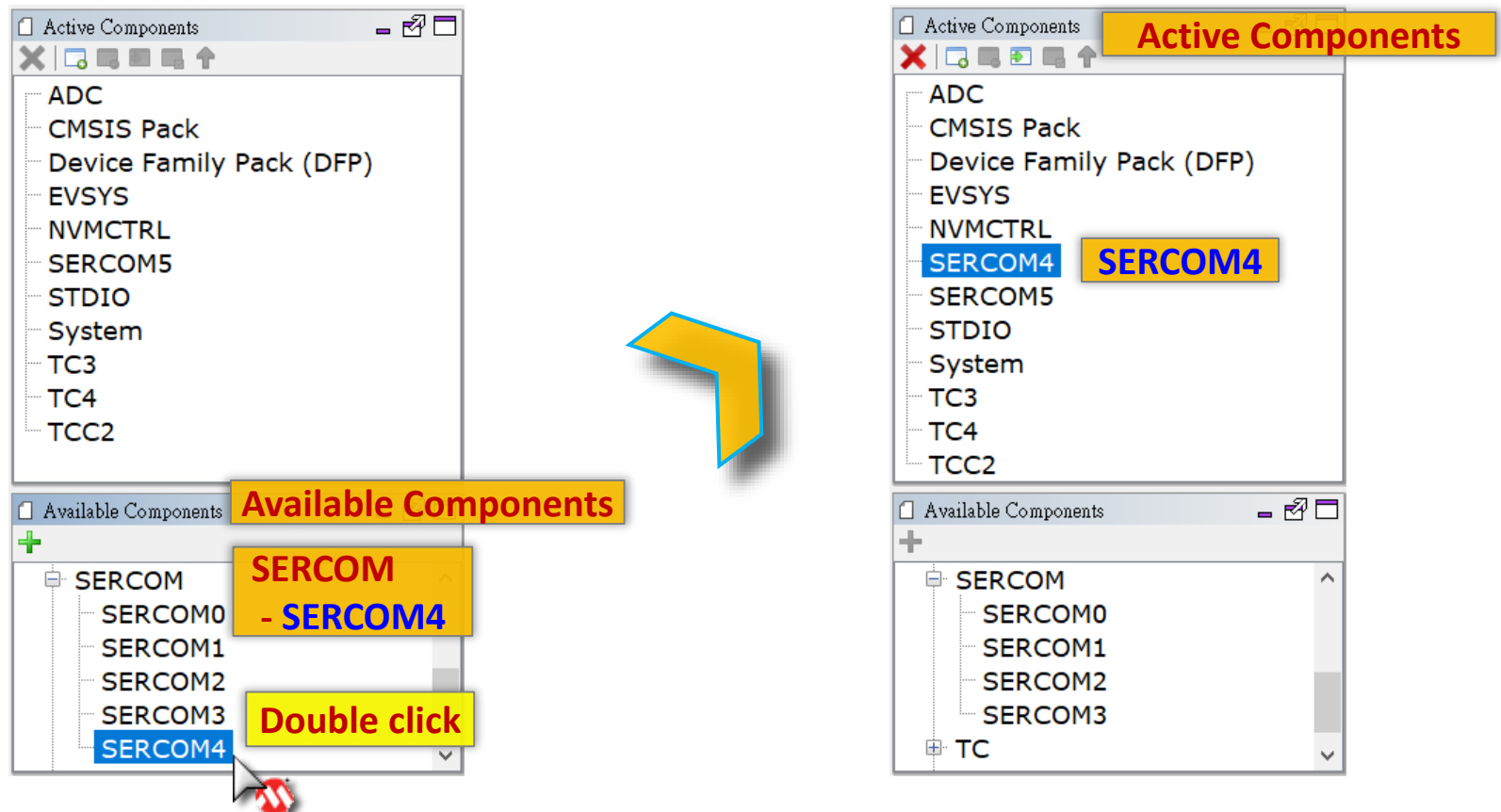
- A graphics library with support for many different monochrome displays.
- Differ environments version support,
 - ◆ Arduino (ATMEGA and ARM)
 - ◆ AVR (ATMEGA)
 - ◆ ARM (with example for LPC1114) (no SAMD21 , unfortunately !!)
- Provide initial function for SSD1306 and a lot of function like draw the line, box, circle, picture, etc....
Please refer online document.

<https://github.com/olikraus/u8glib/wiki/userreference>



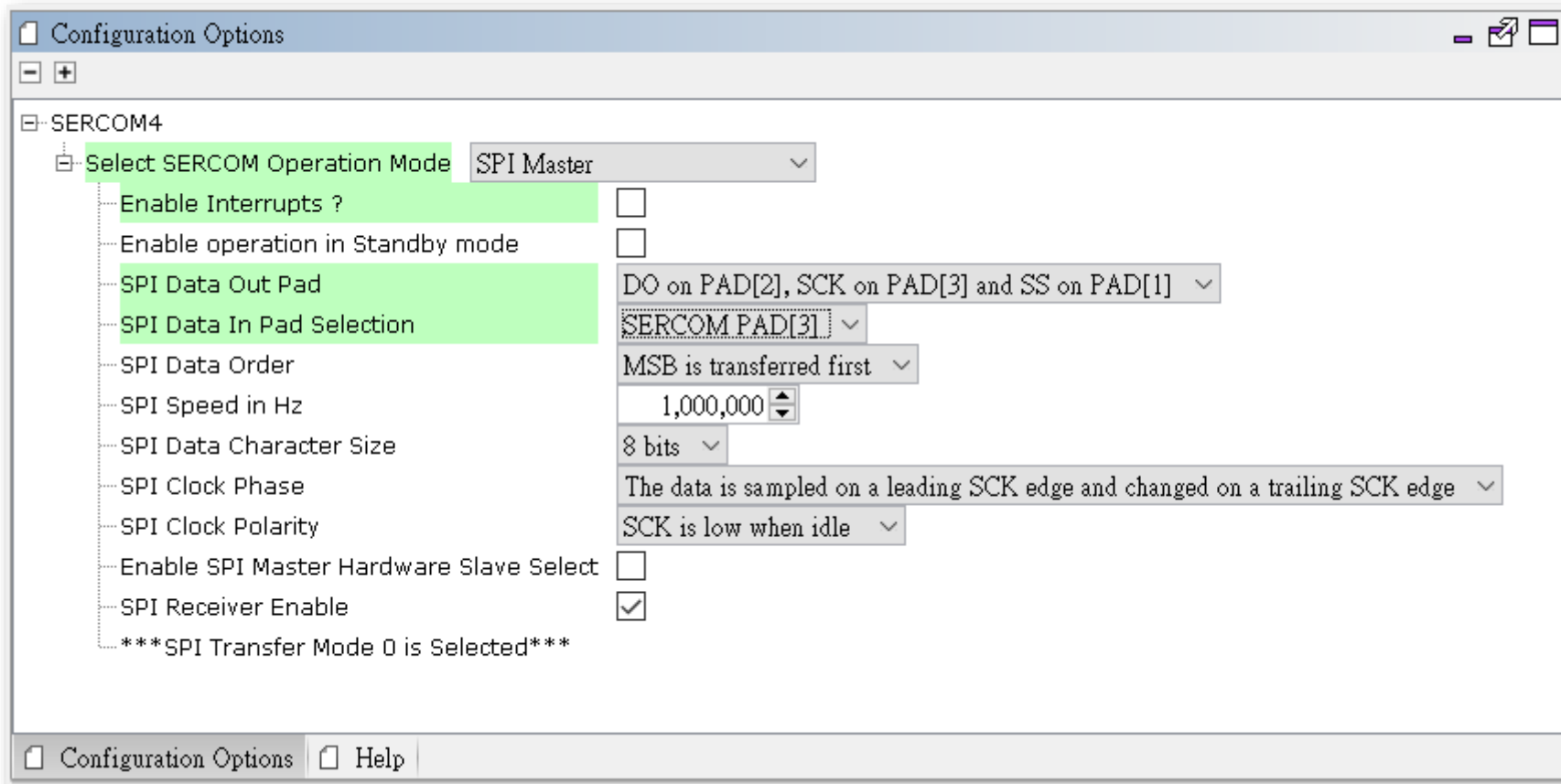
Add SERCOM Function using MHC

- Find **SERCOM** component in Available Components window.
- Double click **SERCOM4** to add to Active Components window.



SERCOM4 SPI Polling

Configuration Options Example



u8glib Code Example

```
u8g_t OLED_Instance;
extern const uint8_t Elite_Logo[];

delay_init();
u8g_InitHWSPI(&OLED_Instance, &u8g_dev_ssd1306_128x64_hw_spi);
u8g_SetFont(&OLED_Instance, u8g_font_6x10);
u8g_SetFontRefHeightExtendedText(&OLED_Instance);
u8g_SetDefaultForegroundColor(&OLED_Instance);
u8g_SetFontPosTop(&OLED_Instance);

u8g_FirstPage(&OLED_Instance);
do
{
    u8g_DrawBitmap(&OLED_Instance, 0, 0, 16, 64, Elite_Logo);
    u8g_DrawLine(&OLED_Instance, 5, 60, 118, 60);
    u8g_DrawBox(&OLED_Instance, 120, 59, 3, 3);
    u8g_DrawBox(&OLED_Instance, 124, 59, 3, 3);
}while (u8g_NextPage(&OLED_Instance));
```

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- Try to add OLED control function to your project.
- Show bitmap logo and other graphic on your OLED display.
- Create your own Logo.
- u8glib & logo file could be found at

[.\Appendix\u8glib_APP045v2.00\](#)

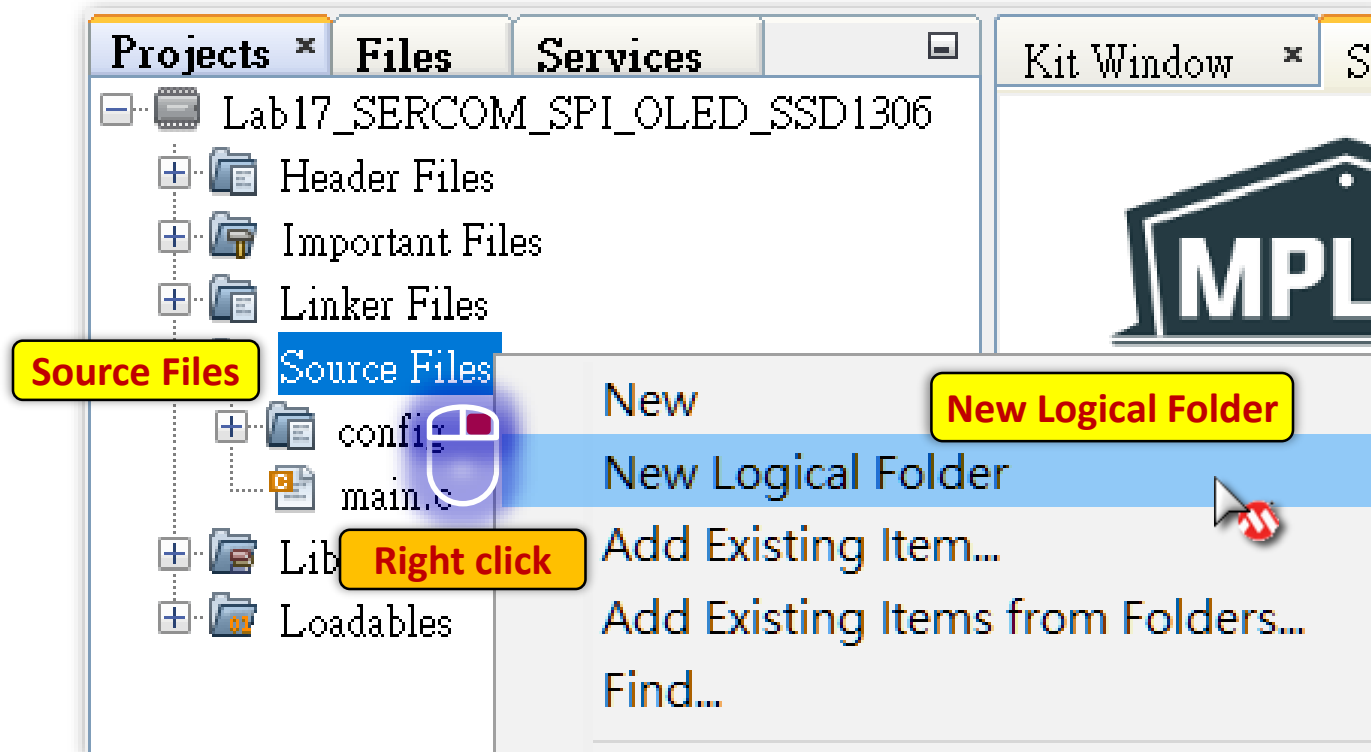
- Logo image create application at

[.\Tools\LCDAssistant.exe](#)

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Step 1

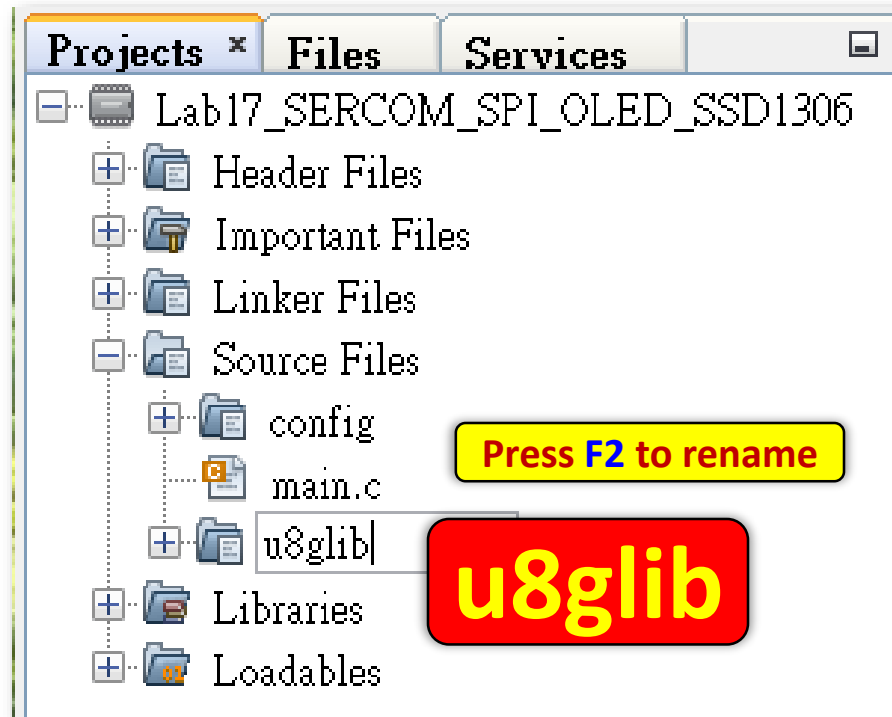
- ◆ Add **New Logical Folder** under **Source Files**
- ◆ Right click **Source Files** ▶ **New Logical Folder**



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Step 2

- Press **F2** to rename **New Folder** to **u8glib**

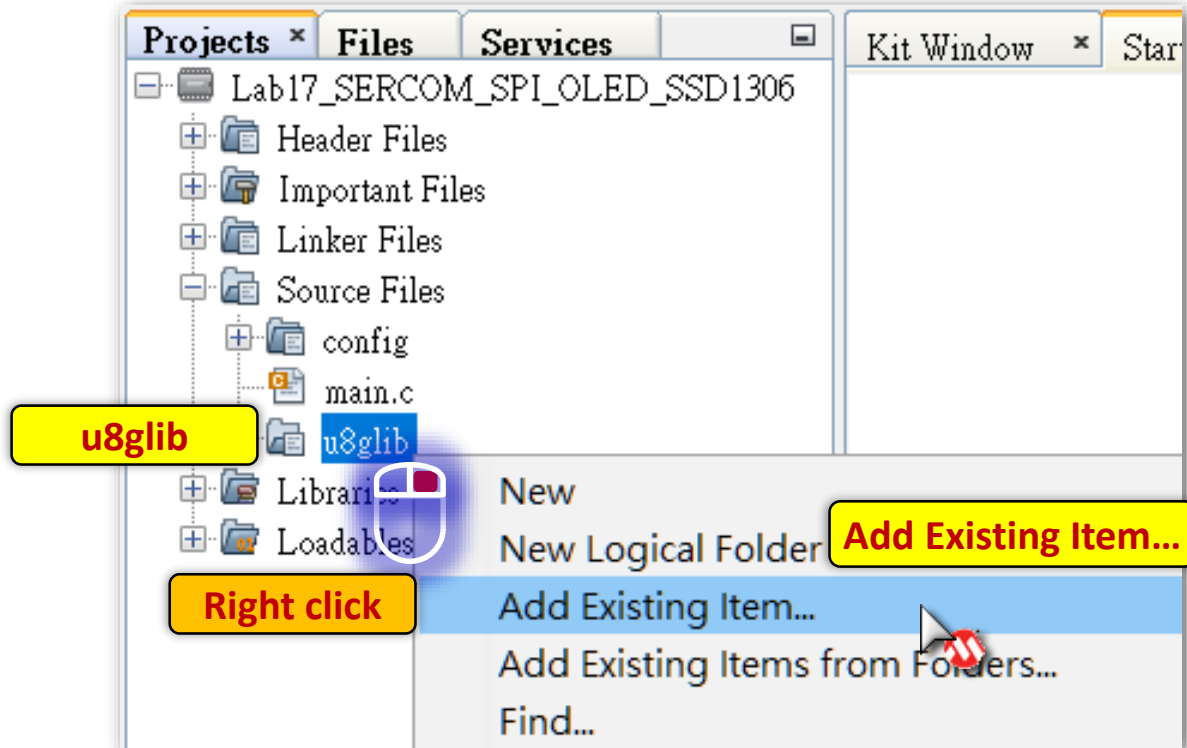


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Step 3

- ◆ Add files into new folder

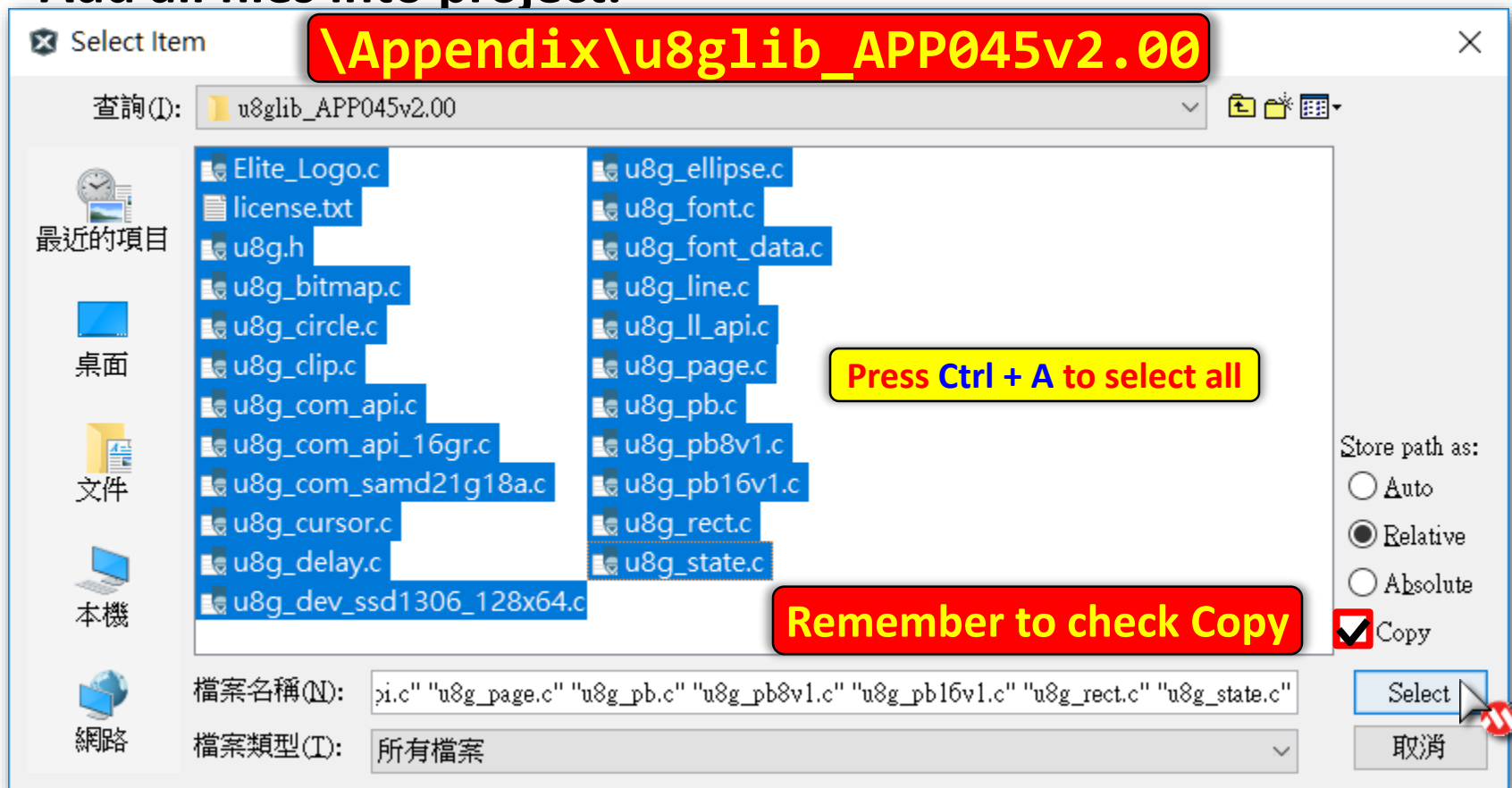
Right click **u8glib** ► **Add Existing item...**



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Step 4

- ◆ Select folder in **\Appendix\u8glib_APP045v2.00**
- ◆ Add all files into project.



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Step 5

Setup SERCOM4 SPI Configuration.

The screenshot shows the 'Configuration Options' dialog for the SERCOM4 peripheral. The 'SERCOM4' section is expanded, and the 'Select SERCOM Operation Mode' is set to 'SPI Master'. The 'Enable Interrupts?' checkbox is unchecked, highlighted with a red box and the text 'Uncheck !!'. The 'SCK' pin is configured to PAD[3] and the 'MOSI' pin to PAD[2], with a note 'DO on PAD[2], SCK on PAD[3] ...'. The 'SERCOM PAD[0]' is set to 'SERCOM PAD[0]'. The 'MSB is transferred first' checkbox is checked, highlighted with a yellow box and the text 'MSB is transferred first'. The 'SPI Speed in Hz' is set to '1,000,000', highlighted with a yellow box and the text '1,000,000'. The 'SPI Data Character Size' is set to '8 bits', highlighted with a yellow box and the text '8 bits'. The 'SPI Clock Phase' is set to 'The data is sampled on a leading SCK edge and changed on a trailing SCK edge'. The 'SPI Clock Polarity' is set to 'SCK is low when idle'. The 'Enable SPI Master Hardware Slave Select' checkbox is unchecked. The 'SPI Receiver Enable' checkbox is checked. The status bar at the bottom indicates '***SPI Transfer Mode 0 is Selected***', highlighted with a yellow box and the text 'Mode 0'.

Configuration Options

SERCOM4

Select SERCOM Operation Mode: SPI Master

Enable Interrupts ? ☐ **Uncheck !!**

Enable operation in Standby mode ☐

SPI Data Out Pad: DO on PAD[2], SCK on PAD[3] and SS on PAD[1] **DO on PAD[2], SCK on PAD[3] ...**

SPI Data In Pad Selection: SERCOM PAD[0] **SERCOM PAD[0]**

SPI Data Order: MSB is transferred first **MSB is transferred first**

SPI Speed in Hz: 1,000,000 **1,000,000**

SPI Data Character Size: 8 bits **8 bits**

SPI Clock Phase: The data is sampled on a leading SCK edge and changed on a trailing SCK edge

SPI Clock Polarity: SCK is low when idle

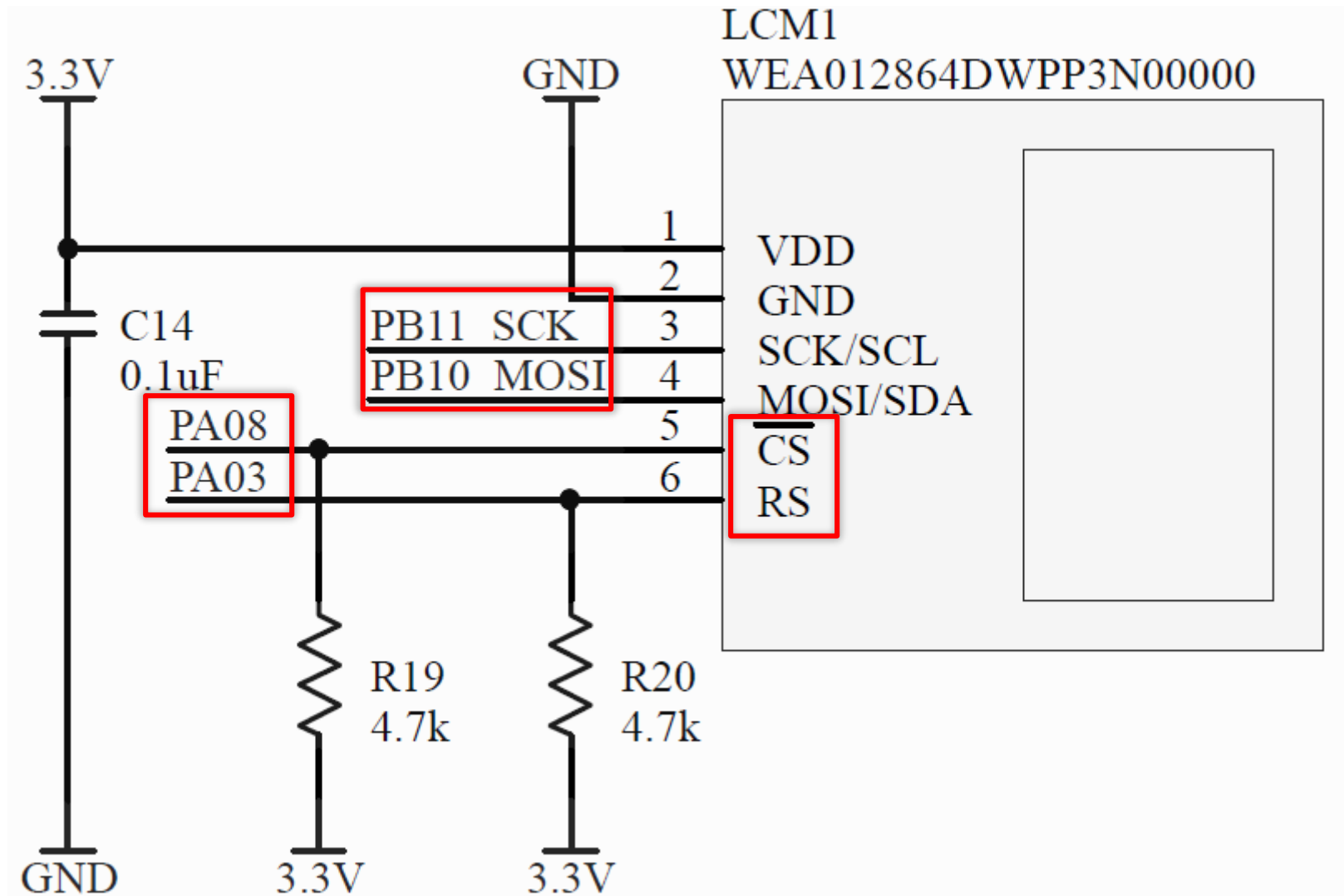
Enable SPI Master Hardware Slave Select ☐

SPI Receiver Enable ☒

SPI Transfer Mode 0 is Selected **Mode 0**

Configuration Options Help

APP045 OLED SSD1306 Schematic



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Step 6

Pin Table Configuration of SERCOM4

The top screenshot shows the Pin Table for the ATtiny10F. The package is set to TQFP48. The SERCOM4 module is selected, and its pins (SERCOM4_PAD0 to SERCOM4_PAD3) are listed. The pins PB10 and PB11 are highlighted in blue, indicating they are enabled. A yellow arrow points to the 'Click' button, which is used to enable the pins.

The bottom screenshot shows the Pin Table after the pins have been enabled. The pins PB10 and PB11 are now highlighted in green, indicating they are enabled. A yellow arrow points to the 'Green is Enable' label, which is used to confirm the status of the pins.

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Step 7

Pin Table Configuration of GPIO

The image shows two screenshots of the Pin Table configuration tool for a TQFP48 package. The top screenshot shows the initial state where the GPIO module is selected, and pins PA03 and PA08 are highlighted in blue. Red boxes and yellow labels 'PA03' and 'PA08' are placed over these pins. A yellow 'Click' label with a mouse cursor icon is positioned over the PA03 pin, and another 'Click' label is over the PA08 pin. A yellow arrow points from the top screenshot to the bottom screenshot. The bottom screenshot shows the result after clicking: the pins are now labeled 'GPIO_PA03' and 'GPIO_PA08' in yellow, and the corresponding cells in the GPIO module row are highlighted in green. A yellow label 'Green is Enable' points to the green cell for GPIO_PA03.

Top Screenshot: Initial Pin Table Configuration

Module	Function	PA00	PA01	PA02	PA03	GND	VDD	ADC	ADC	PA04	PA05	PA06	PA07	PA08	LED	PA10	PA11	VDDIO	GNDIO	SERCOM
	GCLK_IO5																			
	GCLK_IO6																			
	GCLK_IO7																			
GPIO	GPIO																			
	I2S_FS0																			

Bottom Screenshot: Final Pin Table Configuration

Module	Function	PA00	PA01	PA02	GPIO_PA03	GND	VDD	ADC	ADC	PA04	PA05	PA06	PA07	GPIO_PA08	LED	PA10	PA11	VDDIO	GNDIO	SERCOM
	GCLK_IO5																			
	GCLK_IO6																			
	GCLK_IO7																			
GPIO	GPIO																			
	I2S_FS0																			

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Step 8

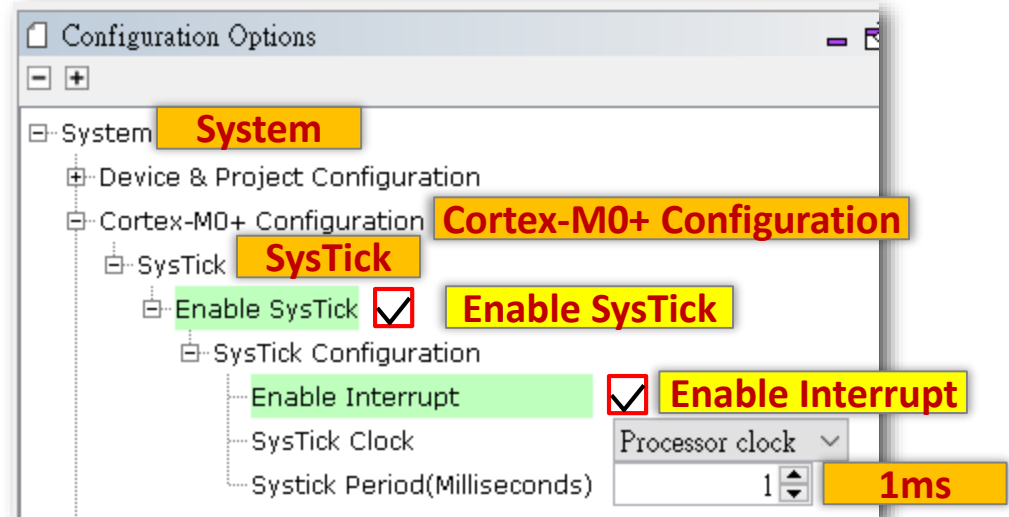
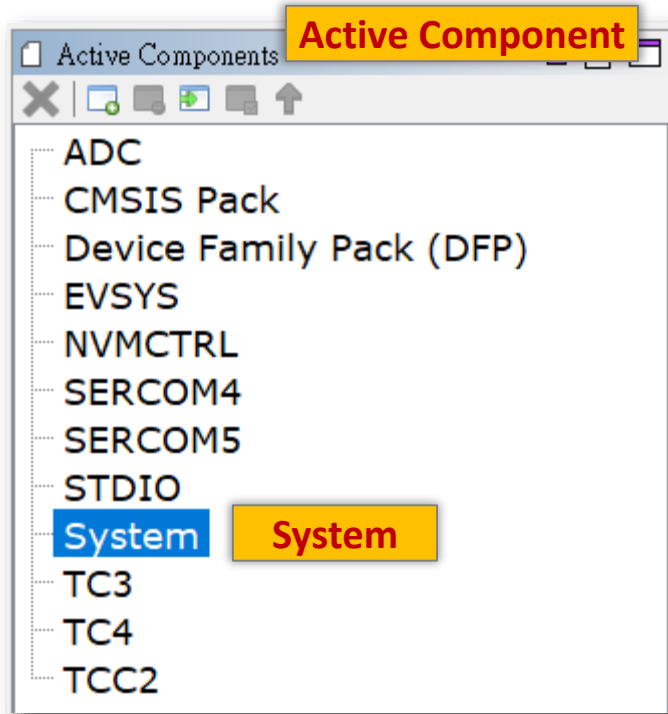
Pin Setting of GPIO for direction and custom name.

Pin Settings								
Order:	Pins	Table View	<input checked="" type="checkbox"/> Easy View					
Pin Number	Pin ID	Custom Name	Function	Mode	Direction	Latch	Pull Up	Pull Down
1	PA00		Available	Digital	High Im...	Low	<input type="checkbox"/>	<input type="checkbox"/>
2	PA01			Digital	High Im...	Low	<input type="checkbox"/>	<input type="checkbox"/>
3	PA03	SSD1306_RS_PIN		Digital	Out	High	<input type="checkbox"/>	<input type="checkbox"/>
4	PA03	SSD1306_RS_PIN	GPIO	Digital	Out	High	<input type="checkbox"/>	<input type="checkbox"/>
5	GNDANA			Digital	High Im...	Low	<input type="checkbox"/>	<input type="checkbox"/>
6	VDDANA			Digital	High Im...	Low	<input type="checkbox"/>	<input type="checkbox"/>
7	PB08	ADC_AIN2	ADC_AIN2	Analog	High Im...	n/a	<input type="checkbox"/>	<input type="checkbox"/>
8	PB09	ADC_AIN3	ADC_AIN3	Analog	High Im...	n/a	<input type="checkbox"/>	<input type="checkbox"/>
9	PA04		Available	Digital	High Im...	Low	<input type="checkbox"/>	<input type="checkbox"/>
10	PA05		Available	Digital	High Im...	Low	<input type="checkbox"/>	<input type="checkbox"/>
11	PA06			Digital	High Im...	Low	<input type="checkbox"/>	<input type="checkbox"/>
12	PA08	SSD1306_CS_PIN		Digital	Out	High	<input type="checkbox"/>	<input type="checkbox"/>
13	PA08	SSD1306_CS_PIN	GPIO	Digital	Out	High	<input type="checkbox"/>	<input type="checkbox"/>
14	PA09	LED2	GPIO	Digital	Out	Low	<input type="checkbox"/>	<input type="checkbox"/>

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Step 9

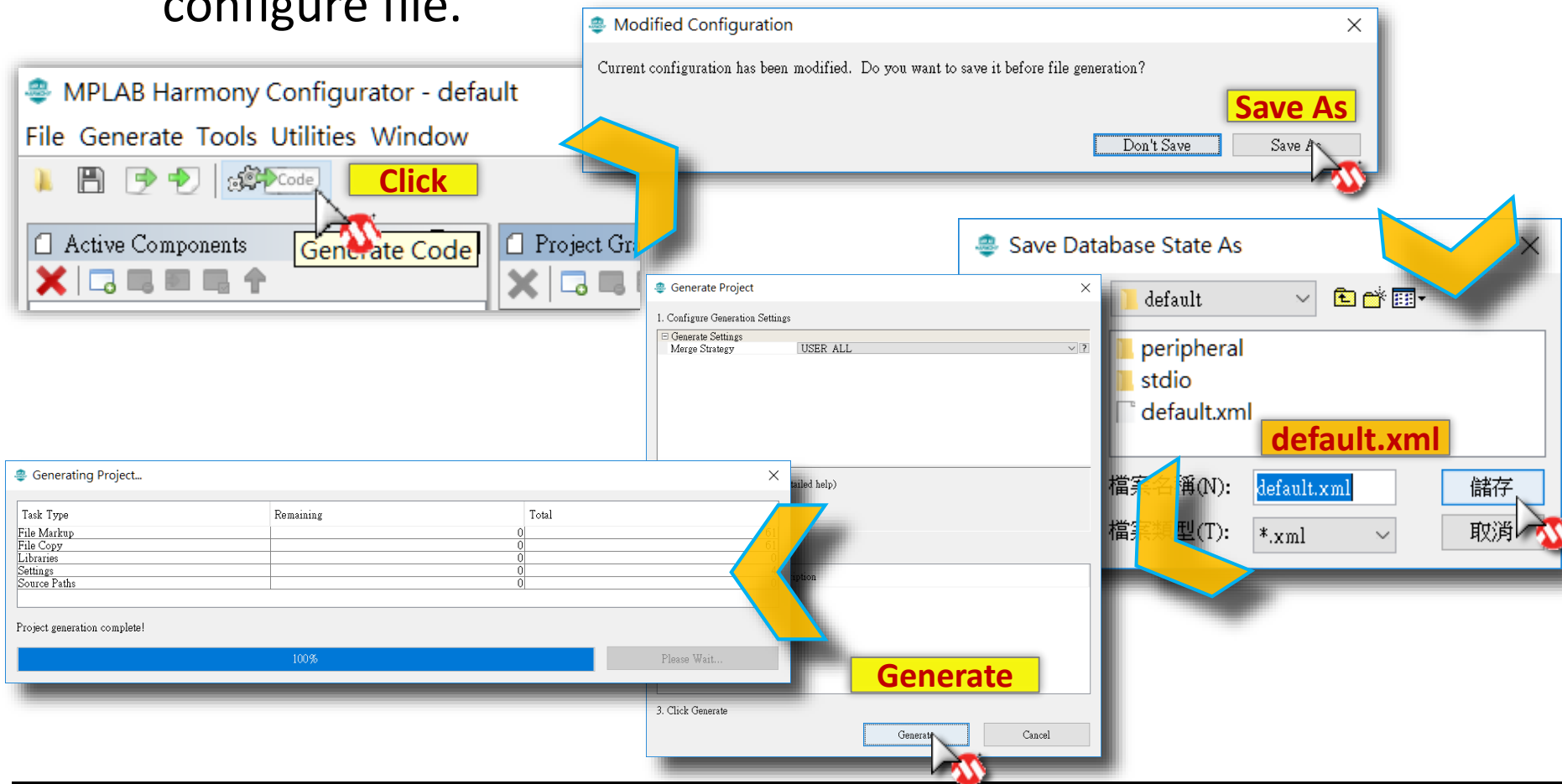
- ◆ Select exist module **System** in **Active Component**.
- ◆ Enable **SysTick** for **Delay Function**.



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Step 10

- Click  to Generate Code and save changes to MHC configure file.



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Step 11

a Add code segment to your project

```
// TODO 17.01
#include "../Lab17_SERCOM_SPI_OLED_SSD1306.X/u8g.h"

// TODO 17.02
u8g_t OLED_Instance;
extern const uint8_t Elite_Logo[];
uint8_t DisplayBuffer[4][64];
...
int main (void)
{
    ...
    // TODO 17.03
    SYSTICK_TimerStart();

    u8g_InitHWSPI( &OLED_Instance, &u8g_dev_ssd1306_128x64_hw_spi );
    u8g_SetFont( &OLED_Instance, u8g_font_6x10 );
    u8g_SetFontRefHeightExtendedText( &OLED_Instance );
    u8g_SetDefaultForegroundColor( &OLED_Instance );
    u8g_SetFontPosTop( &OLED_Instance );
    ...
}
```

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Step 12

a Add code segment to your project

```
...
int main (void)
{
    ...
    // TODO 17.04
    u8g_FirstPage(&OLED_Instance);
    do
    {
        u8g_DrawBitmap( &OLED_Instance, 0, 0, 16, 64, Elite_Logo );
        u8g_DrawLine( &OLED_Instance, 5, 60, 118, 60 );
        u8g_DrawBox( &OLED_Instance, 120, 59, 3, 3 );
        u8g_DrawBox( &OLED_Instance, 124, 59, 3, 3 );
    }
    while ( u8g_NextPage( &OLED_Instance ) );

    SYSTICK_DelayMs( 2000 );

    while ( true )
    { ...
```

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Step 13

a Add code segment to your project

```
...
int main (void)
{
    ...
    while ( true )
    {
        ...
        if (TC3_IsOverflow)
        {
            ...
            // TODO 17.05
            sprintf( (char *) DisplayBuffer[0], "Hello World!!" );
            u8g_FirstPage(&OLED_Instance);
            do
            {
                u8g_DrawStr( &OLED_Instance, 0, 0, DisplayBuffer[0] );
                u8g_DrawStr( &OLED_Instance, 0, 10, DisplayBuffer[1] );
                u8g_DrawStr( &OLED_Instance, 0, 20, DisplayBuffer[2] );
                u8g_DrawStr( &OLED_Instance, 0, 30, DisplayBuffer[3] );
            }
            while (u8g_NextPage(&OLED_Instance));
        }
        ...
    }
}
```

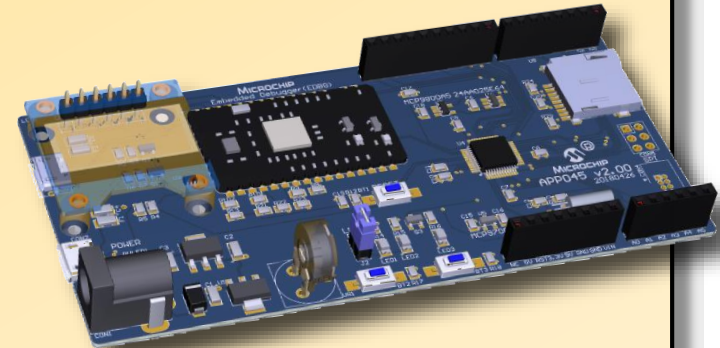
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Step 14

- a** Add code segment to your project, compiler and programming to see the result.

```
...
int main (void)
{
    ...
    while ( true )
    {
        ...
        if( USART5_IsReceived )
        {
            ...
            // TODO 17.06
            sprintf( (char *) DisplayBuffer[3],
                    "Received Data : %1c", USART5_ReceiveData[0] );
        }

        if( ADC_IsCompleted )
        {
            ...
            // TODO 17.07
            sprintf( (char *) DisplayBuffer[1], "VR1 Value : %4d", ADC_Result[0] );
            sprintf( (char *) DisplayBuffer[2], "Temp. Value: %4d", ADC_Result[1] );
        }
    }
    ...
}
```



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Result

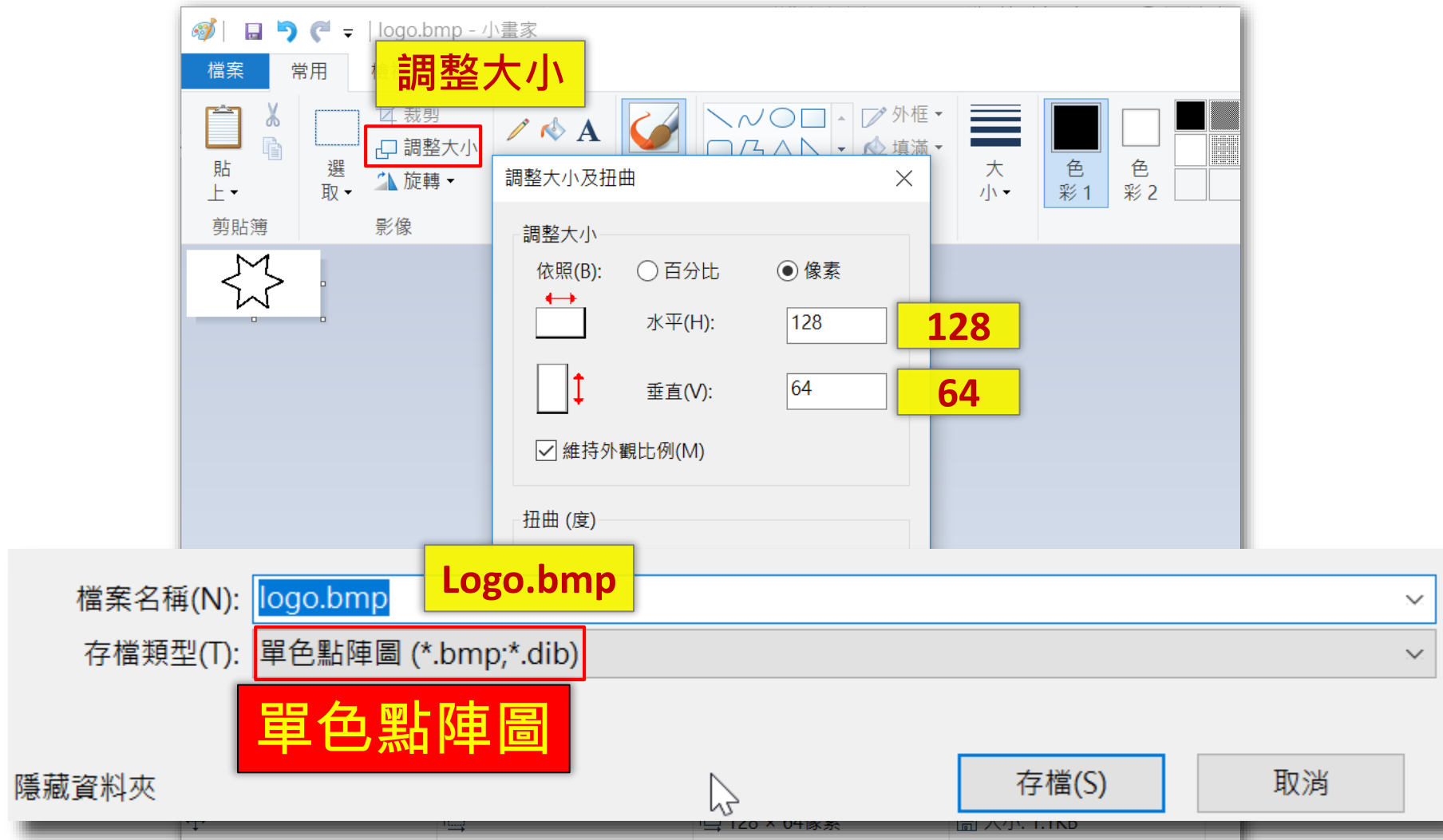


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Create your own logo

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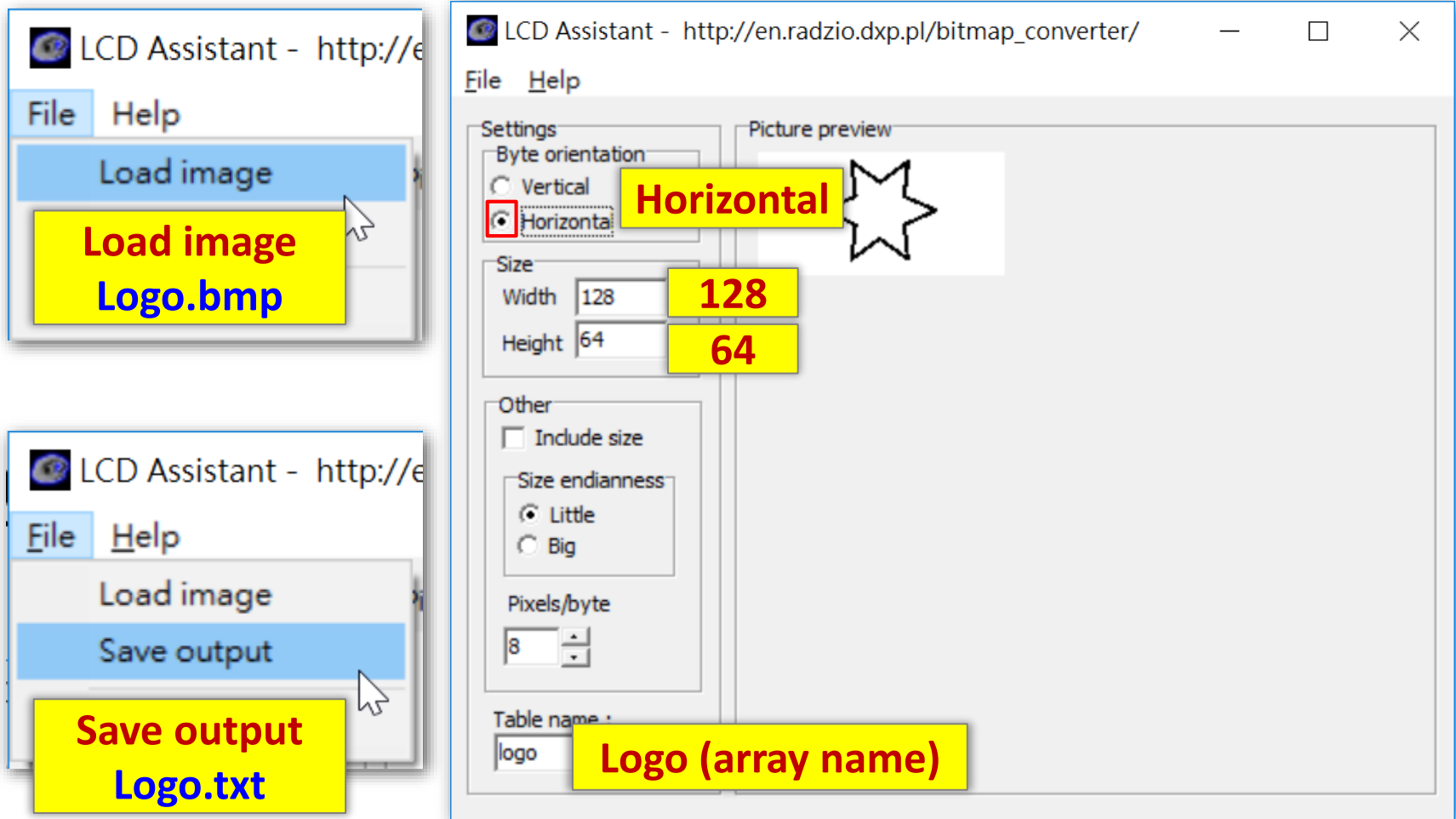
Create your own logo



Lab17 SERCOM - SPI SSD1306 OLED

Create your own logo

Execute `\Tools\LCDAssistant.exe`, load image and save output to `Logo.txt`



Lab17 SERCOM - SPI SSD1306 OLED

Open Logo.txt and copy content of array

```
const unsigned char logo [] = {
```

0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0xC0, 0x00, 0x00, 0x06, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0xE0, 0x00, 0x00, 0x0E, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0xF0, 0x00, 0x00, 0x0F, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,

Copy

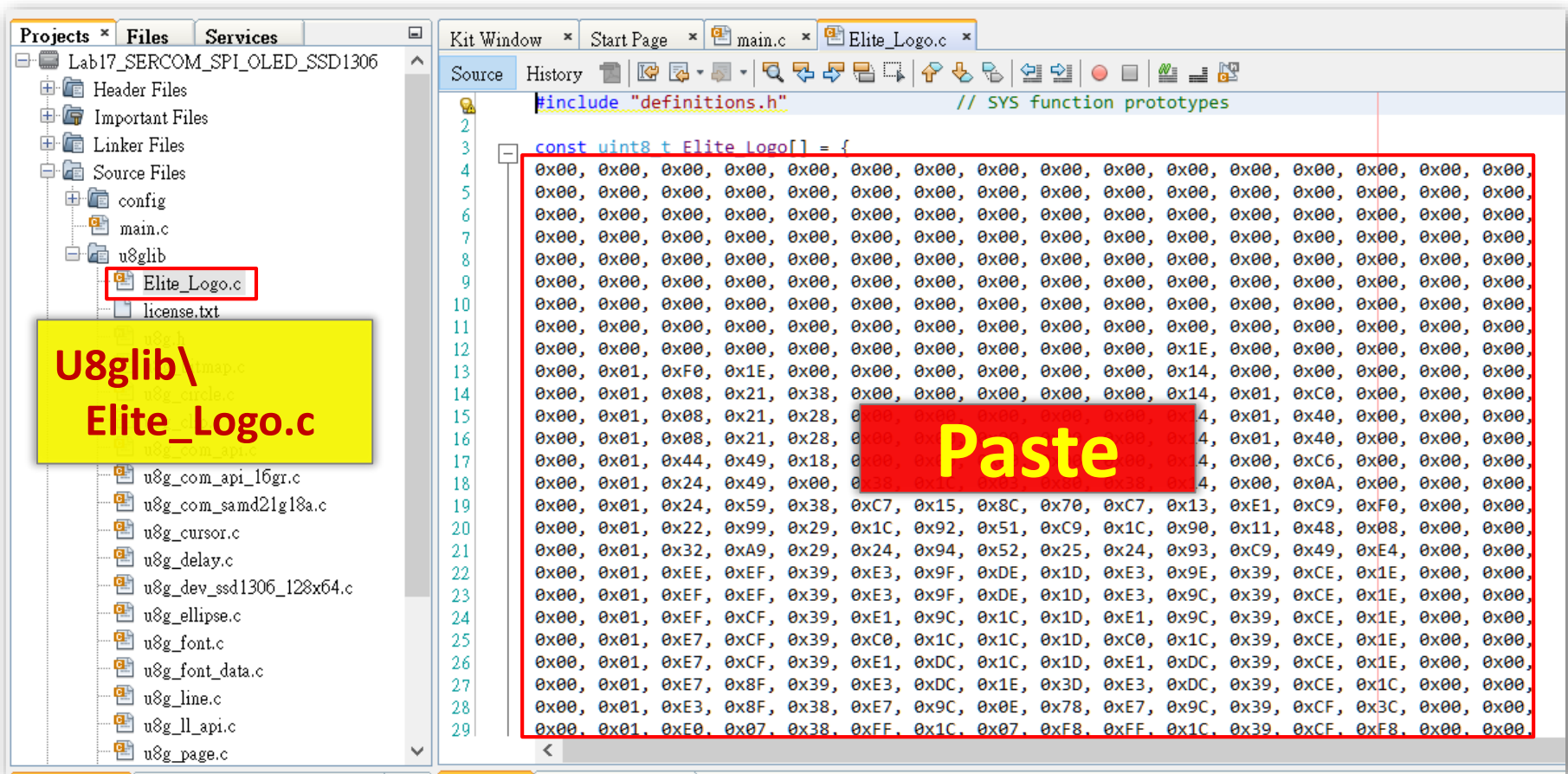
[illegible]

} ;

Copy image HEX in Logo.txt

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Replace `Elite_Logo[]` content in `Elite_Logo.c`



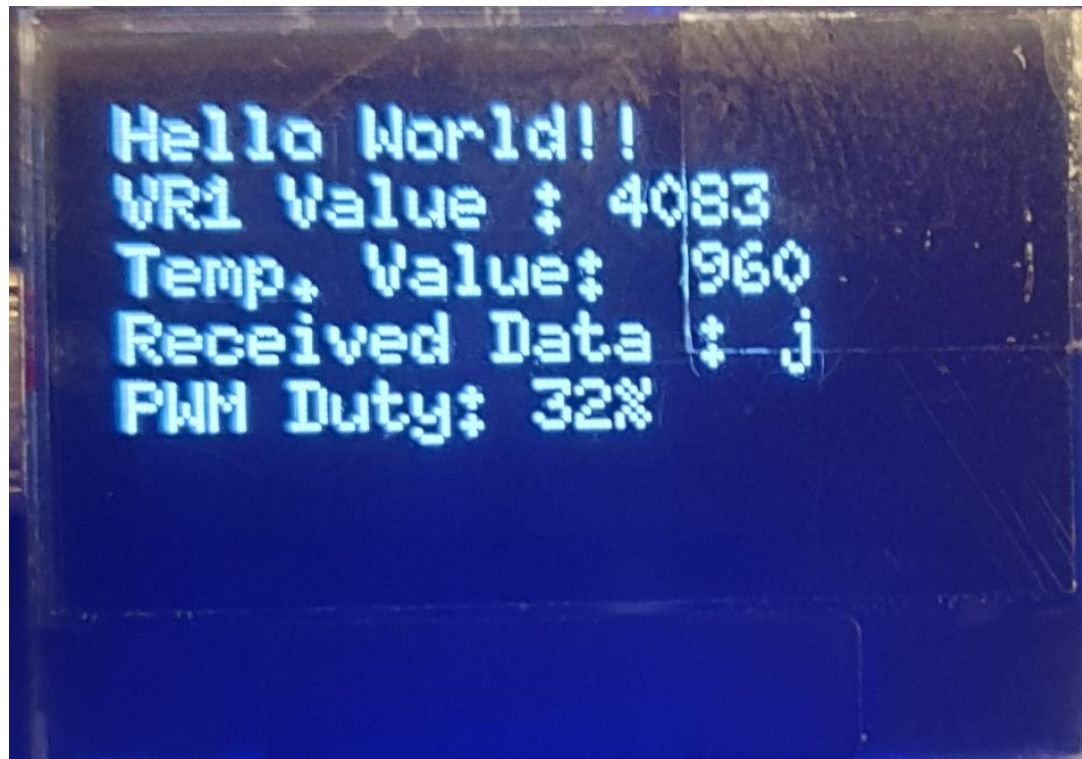
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Result



Bonus Lab

- Try add extra row on OLED to shows PWM duty as below.



- Let's go!**