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CE220499 – Interfacing the SPI F-RAM with PSoC 4

Objective

This code example demonstrates how to interface Cypress SPI F-RAM devices with PSoC® 4 using dedicated serial NVRAM Component in PSoC Creator™.

Overview

This code example provides details on Serial NVRAM Component configuration to access SPI F-RAM using PSoC 4. This document also discusses the hardware and software setup and its configuration to execute the associated example project and validate results.

Requirements

Tool: PSoC Creator 4.1 or above

Programming Language: C (GCC 5.4.3), Arm® Cortex®-M3 assembler

Associated Parts:

- Cypress Serial NVRAMs: All SPI F-RAM™, SPI F-RAM processor companions, SPI nvSRAM, and SPI nvSRAM RTC parts. This code example is validated with 4-Mbit SPI F-RAM, CY15B104Q.
- Cypress PSoC: PSoC 4 family parts excluding PSoC 4000 devices which do not support SCB-SPI interface

Related Hardware:

- Serial NVRAM Kits: CY15FRAMKIT-001 is an Arduino-compatible F-RAM development board on PSoC 4 development kits.
- See Table 1 for details on supported PSoC 4 kits.
- This code example is validated with CY8CKIT-042 PSoC 4 Pioneer Kit.

Design

The key design features include configuring the following:

- UART to display result on PC
- SPI (SCB) as SPI master
- Serial NVRAM Component to enable SPI NVRAM access
- Control Register to drive Status LEDs

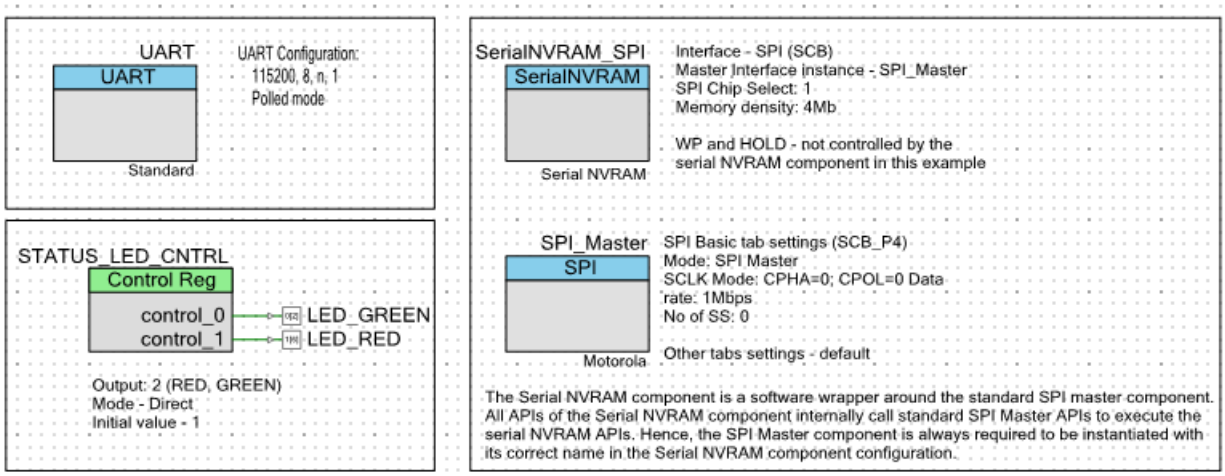
The code example demonstrates the use of the following features:

1. Write to serial F-RAM status register
2. Read from serial F-RAM status register
3. Write 1 byte to an address of serial F-RAM
4. Read 1 byte from an address of serial F-RAM
5. Write 16 bytes into serial F-RAM; burst write from a start address
6. Read 16 bytes from serial F-RAM; burst read from a start address

Design Considerations

The SPI NVRAM Component uses PSoC 4 serial communication block (SCB) resource to enable the SPI host; therefore, the SPI host speed and data throughput are primarily determined by the PSoC 4 device. Cypress SPI NVRAMs can support SPI access up to 40 MHz. However, the full speed cannot be demonstrated on any PSoC 4 platform due to SPI speed limitations. See the PSoC 4 datasheet for more details on PSoC 4 SPI master capability and setup requirement to achieve the best performance. Figure 1 shows PSoC Creator design schematic of the code example.

Figure 1. SPI NVRAM Access – PSoC Creator Design Schematic

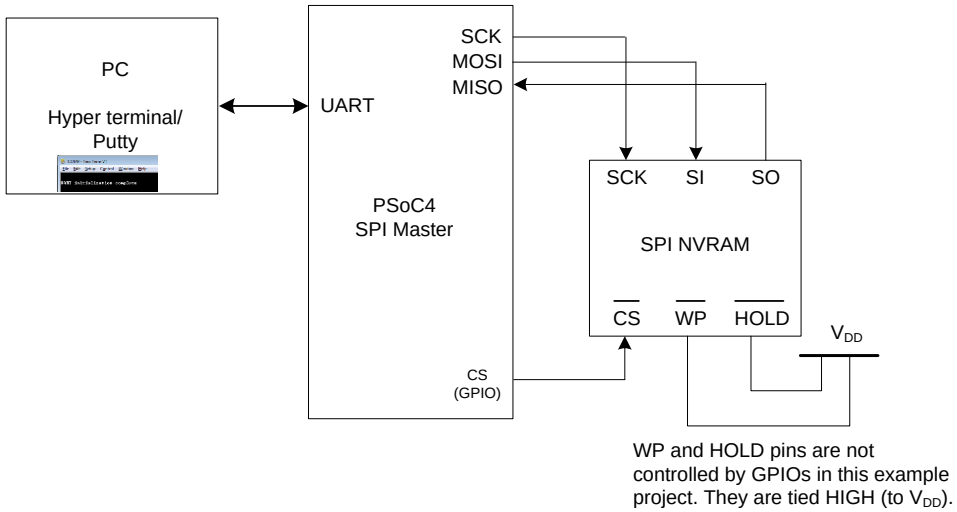


Hardware Setup

The hardware setup involves connecting the F-RAM or nvSRAM SPI interface pins with the PSoC 4 SPI master pins. You can use either dedicated hardware as described in the Requirements section or connect through jumper wires.

This example project uses the default configuration of Cypress' PSoC 4 Pioneer Kit (CY8CKIT-042) and an internal daughter board with 4-Mbit SPI F-RAM (CY15B104Q), connected to the PSoC 4 Pioneer Kit using jumper wires, as shown in Figure 2. See CY8CKIT-042 PSoC 4 Pioneer Kit for hardware connection details. If you use any readily available hardware, as described in the Requirements section, to run this code example, you may need to tweak the code to define the correct density and comment any non-supported opcodes, per SPI NVRAM device on the board.

Figure 2. Hardware Setup Block Diagram

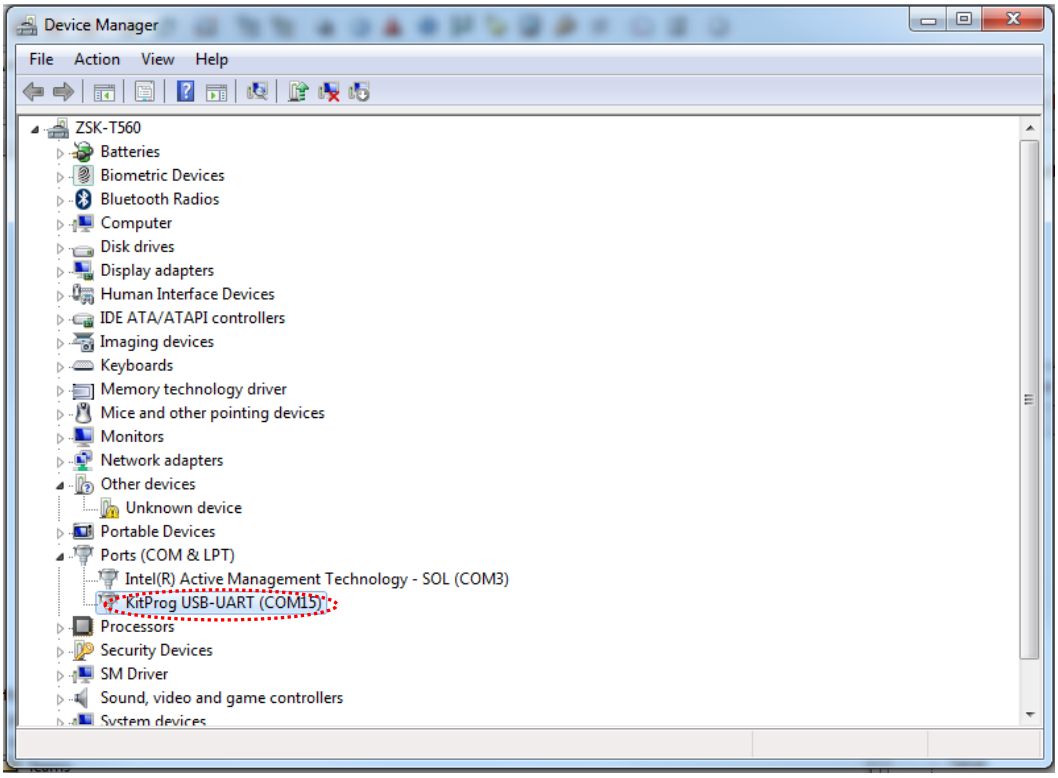


Software Setup

This section demonstrates the procedure to set up the serial (UART) connection using HyperTerminal or PuTTY on a PC to communicate with the PSoC 4 Pioneer Kit. This code example is created using PSoC Creator software as described in the Requirements section. PuTTY is a free SSH and Telnet client for Windows. You can download PuTTY from www.putty.org. Follow these instructions to determine the COM port number and set up PuTTY to monitor the code example outputs on a PC.

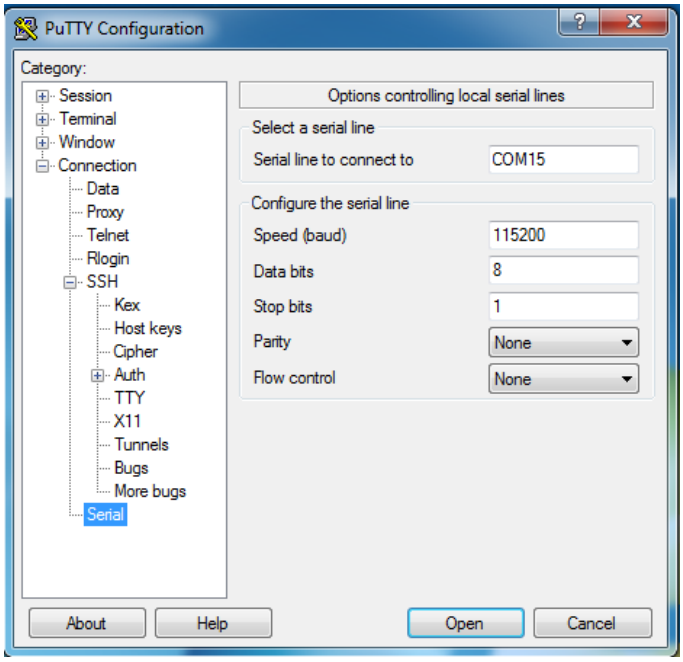
1. Connect PSoC 4 Pioneer Kit to the PC using USB Mini-B cable. The kit enumerates as KitProg USB-UART and is available under **Device Manager** > **Ports (COM & LPT)**. A communication port (COMx) is assigned to KitProg USB-UART, for example, COM15 is assigned to PSoC 4 Pioneer Kit on this sample setup as shown in Figure 3.

Figure 3. KitProg USB-UART in Device Manager



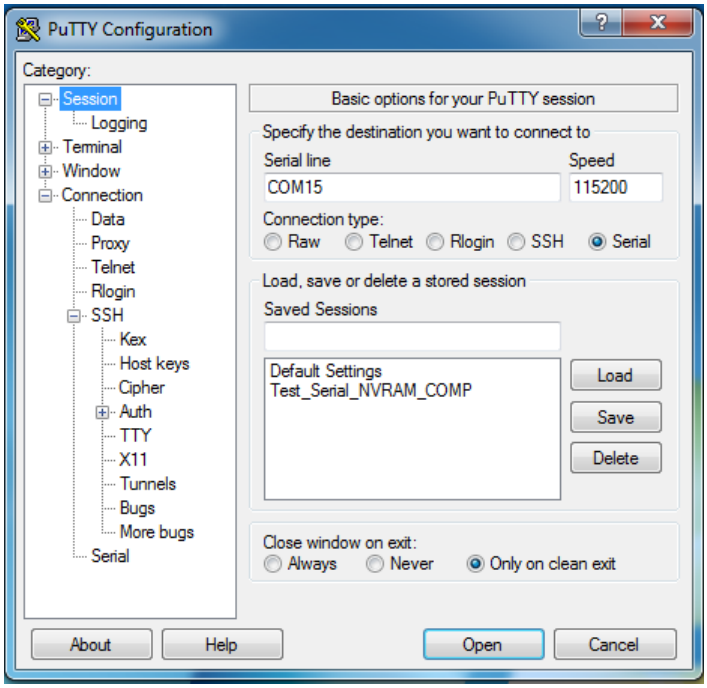
2. After you download and install PuTTY, double-click the PuTTY icon. In the PuTTY Configuration window, select **Connection** > **Serial** under **Category**.
3. A new window opens where the communication port can be selected. In the **Options controlling local serial lines** section:
   - Enter the PSoC 4 Port (COM & LPT), COMx, in **Serial line to connect to**. This code example uses **COM15**. Verify the COM setting for your setup and select the appropriate COMx.
   - Enter **Speed (baud)**, **Data bits**, and **Stop bits**.
   - Select the **Parity** and **Flow control**.

Figure 4. Open New Connection



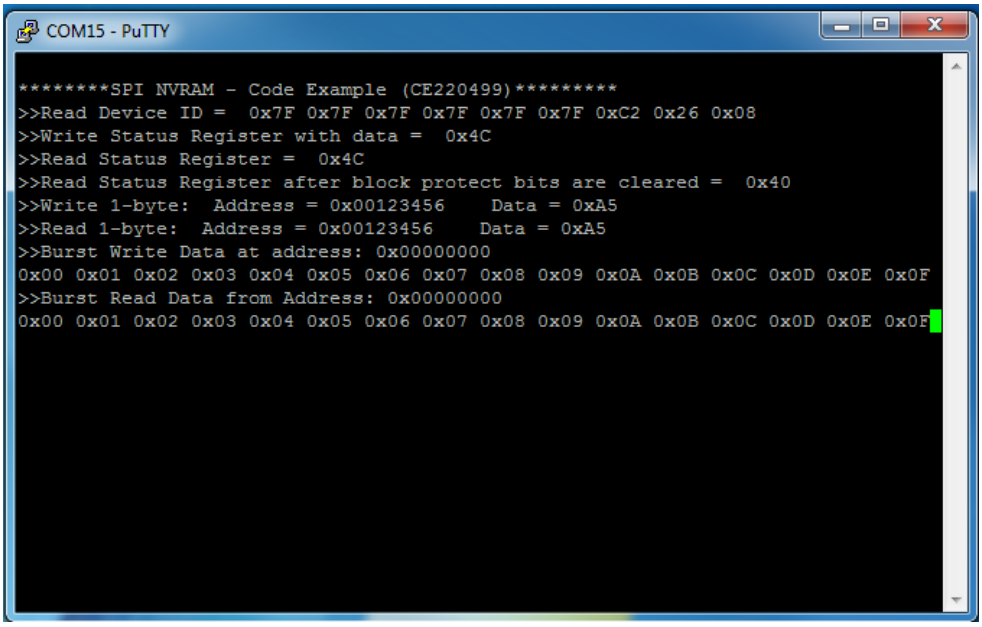
4. Select **Session** under **Category**. Select **Serial** as the **Connection type** as shown in Figure 5. You can save this current session and **load** the settings when required. Enter a name in Saved Sessions and click **Save**. Click **Open** to proceed.

Figure 5. Select Communication Type in PuTTY



5. The COM terminal window displays the code example results as shown in Figure 6. You may have to reprogram PSoC 4 with the code example hex file or reset PSoC 4 (already programmed) to restart the code execution and monitor the result.

Figure 6. Result Displayed on PuTTY



Alternatively, you can run the HyperTerminal, if supported on your PC, to monitor the above result.

Design-Wide Resources

Make sure that V_{DDD} (**PSoC Creator** > **Design Wide Resources** > **System** tab) is set to 2.7 V or above, as shown in Figure 7, to drive the STATUS_LED. Also, make sure that PSoC 4 I/O voltage is set correctly to match the SPI NVRAM operating range (V_{DD}/ V_{CC}).

Figure 7. V_{DD} Setting using Design Wide Resources

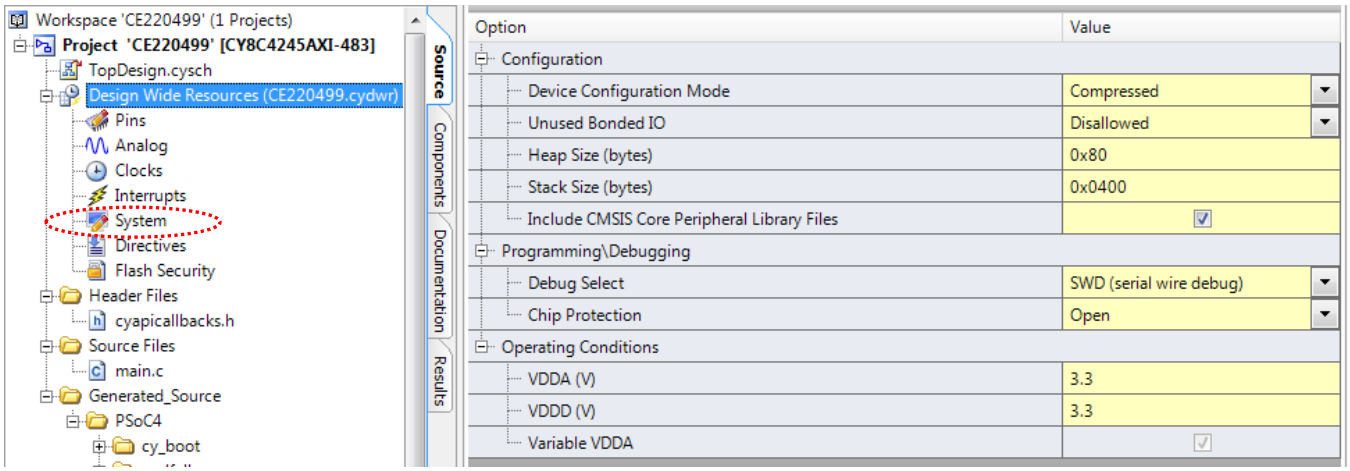
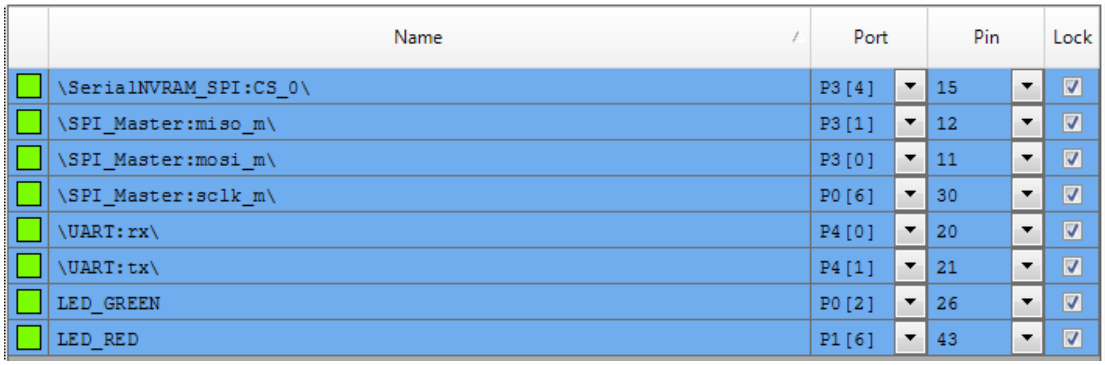


Figure 8 shows the pin assignments for the code example.

Figure 8. PSoC 4 Pin Assignments for Code Example



To switch the code example from CY8CKIT-042 to any other PSoC 4 kit, change the project's device with the help of Device Selector called from the project's context menu as shown in Table 1.

Table 1. Supported PSoC 4 Development Kits Versus PSoC 4 Parts

Development Kit	Device
CY8CKIT-042	CY8C4245AXI-483
CY8CKIT-042-BLE	CY8C4248LQI-BL583
CY8CKIT-044	CY8C4247AZI-M485

The port (pin) assignments for the supported kits are shown in Table 2.

Table 2. Pin Assignment on Supported Development Kits

Code Example - Pin Name	PSoC 4 Development Kit - Port Name		
	CY8CKIT-042	CY8CKIT-042-BLE	CY8CKIT-044
\SerialNVRAM_SPI:CS_0\	P3[4]	P0[2]	P2[7]
\SPI_Master:miso_m\	P3[1]	P0[1]	P6[1]
\SPI_Master:mosi_m\	P3[0]	P0[0]	P6[0]
\SPI_Master:sclk_m\	P0[6]	P0[3]	P6[2]
\UART:rx\	P4[0]	P3[0]	P7[0]
\UART:tx\	P4[1]	P3[1]	P7[1]
LED_GREEN	P0[2]	P3[6]	P2[6]
LED_RED	P1[6]	P2[6]	P0[6]

Components

Table 3 lists the PSoC Creator Components used in this example and the hardware resources used by each Component.

Table 3. PSoC Creator Components

Component	Instance Name	Hardware Resources
SerialNVRAM	SerialNVRAM_SPI	Serial NVRAM Block in **System** > **External Memory Interface** Component category
SPI	SPI_Master	SPI (SCB Mode) in **Communication**> **SPI** Component category
UART	UART	UART (SCB Mode) in **Communication** Component category
Control Reg	STATUS_LED_CNTRL	Control Register in **Digital** > **Registers** Component category

Figure 9 to Figure 12 show the Component configuration for the code example project.

Figure 9. Serial NVRAM Component Configuration and Parameter Settings

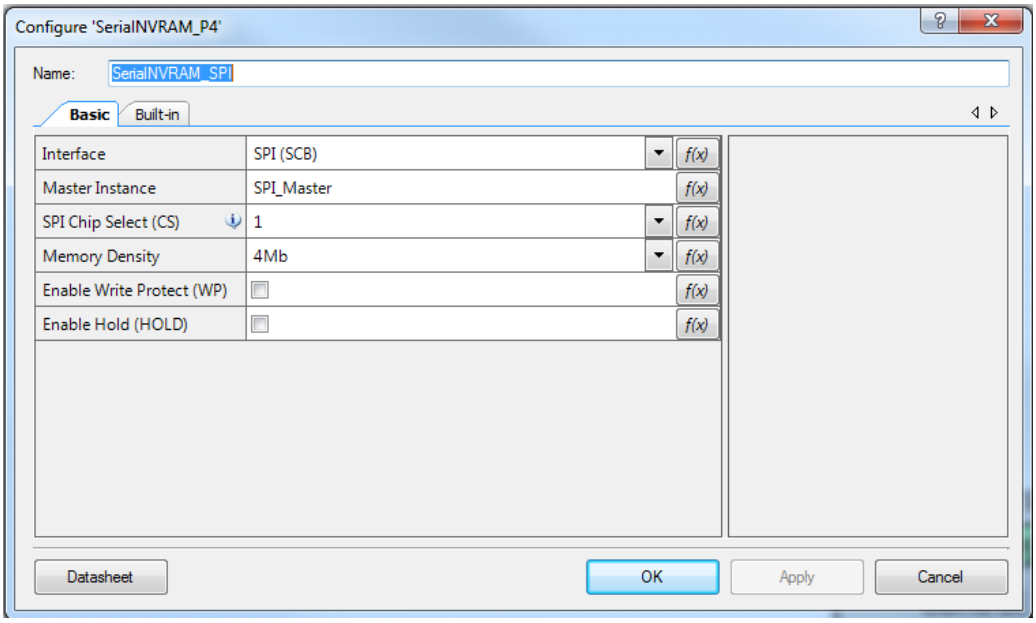
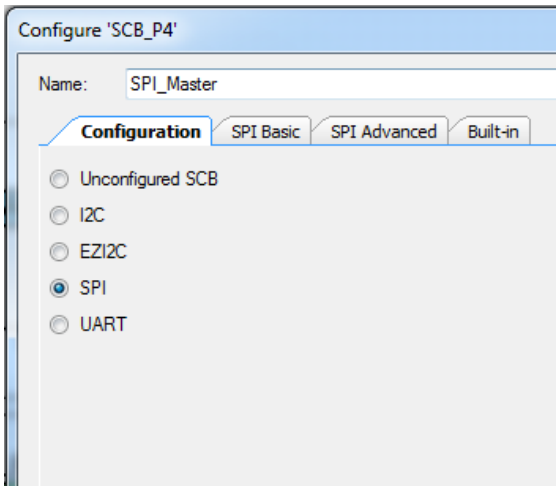


Figure 10. SPI (SCB mode) Configuration and Parameter Settings



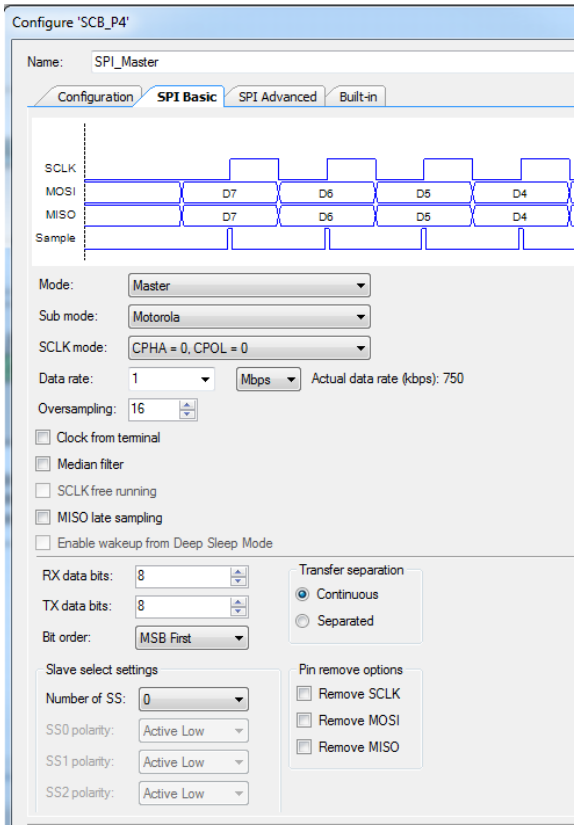


Figure 11. UART (SCB mode) Configuration and Parameter Settings

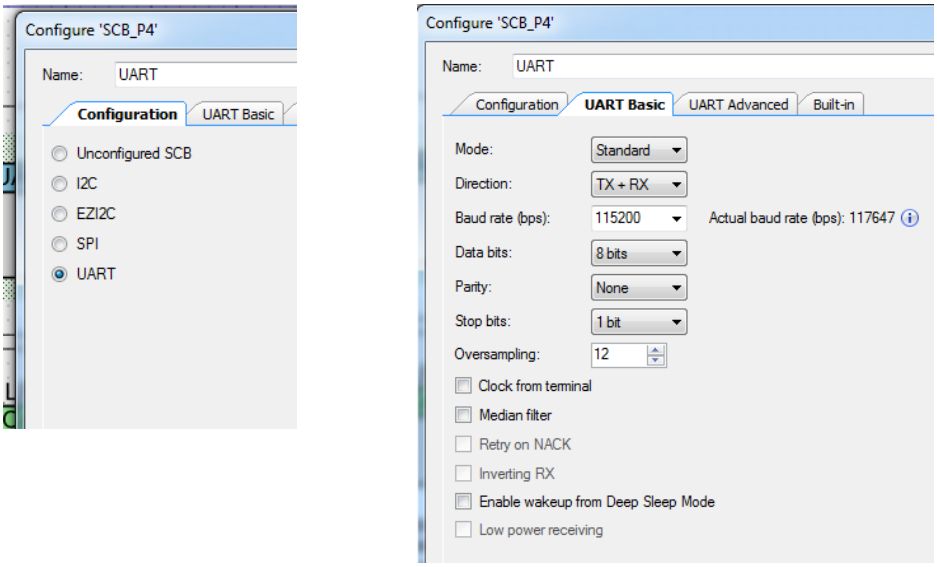
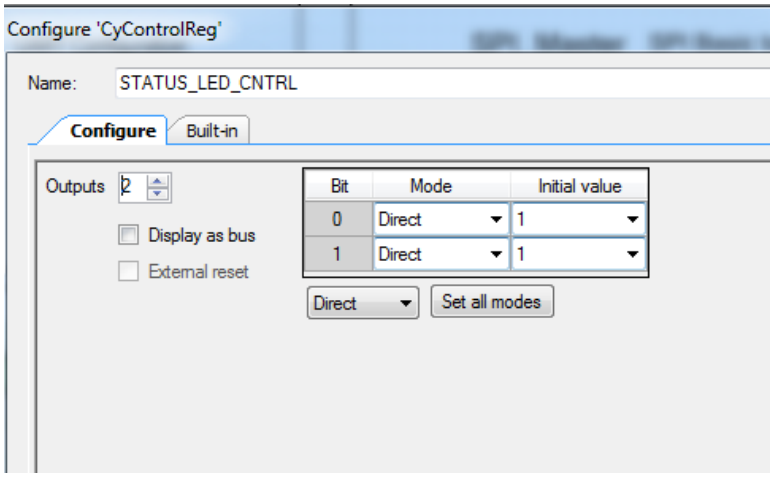


Figure 12. Control Register Configuration and Parameter Settings



Related Documents

Application Notes	
AN304 – SPI Guide for F-RAM™	Describes SPI F-RAM design in a system
AN64574 – Designing with Serial Peripheral Interface (SPI) nvSRAM	Describes SPI nvSRAM design in a system
Component Datasheets (Right click on the component in PSoC Creator schematic to access the component datasheet)	
Serial NVRAM	Serial NVRAM component configuration for different serial interfaces (SPI and I^2C) and API details
SPI	SPI interface SCB mode
UART	UART configuration SCB mode
Control Reg	Allows firmware to set values to use for digital signals
Device Documentation	
CY15B104Q	4-Mbit, SPI F-RAM datasheet
All Serial NVRAM Datasheets	Serial (SPI and I2C) NVRAM (F-RAM and nvSRAM)
Development Kit Documentation	
CY8CKIT-042 PSoC 4 Pioneer Kit	Development kit for the PSoC 4200 device family
CY15FRAMKIT-001 Serial F-RAM Development Kit	Development kit for Cypress's serial F-RAMs. This kit has a wide operating range (2.7V to 5.5V), 256-Kbit SPI F-RAM in 8-pin SOIC package

Document History

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Document Number: 002-20499

Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	5955510	ZSK	11/07/2017	New code example

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