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CE220500 – Interfacing the I²C F-RAM with PSoC 4

Objective

This code example demonstrates how to interface Cypress I²C 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 the I²C 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), Arm® Cortex®-M3 assembler

Associated Parts:

- Cypress Serial NVRAMs: All I²C F-RAM™ and I²C nvSRAM parts including F-RAM processor companion and nvSRAM with RTC. This code example is validated with 256-Kbit I²C F-RAM, FM24W256.
- PSoC 4 family parts

Related Hardware:

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

Design

The key design features include, configuring the following:

- UART to display the result on a PC
- I2C Component (SCB mode) as I²C master
- Serial NVRAM Component to enable I²C NVRAM access
- Control Register to drive status LEDs

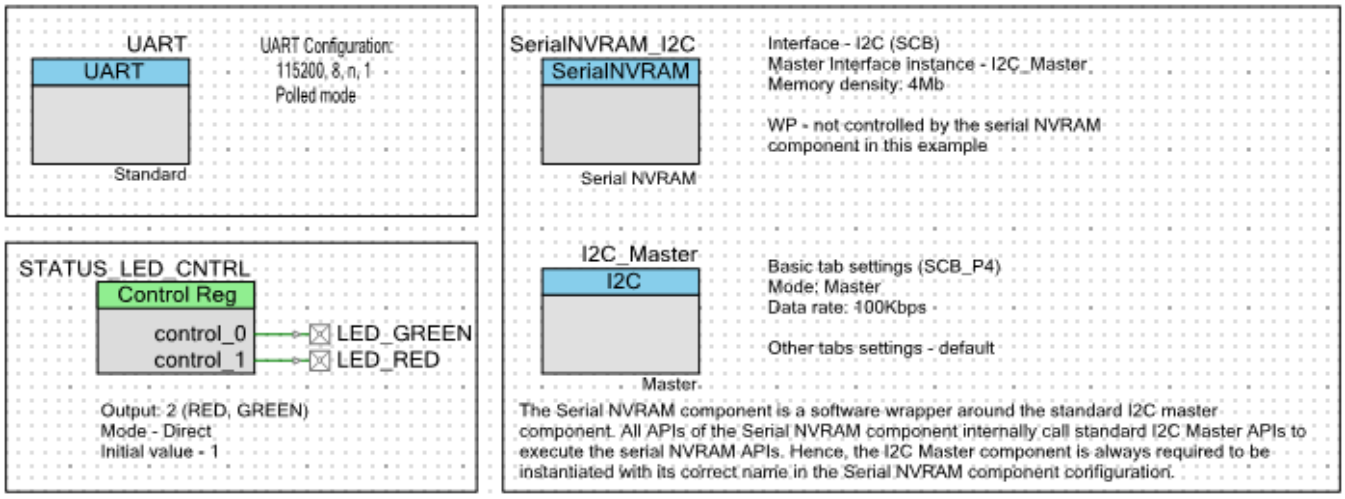
The code example demonstrates the use of the following features:

i. Write 1-Byte to an address of serial F-RAM
ii. Read 1-Byte from an address of serial F-RAM
iii. Write 16 bytes into serial F-RAM; burst write from a start address
iv. Read 16 bytes from serial F-RAM; burst read from a start address

Design Considerations

The I²C NVRAM Component uses PSoC 4 serial communication block (SCB) resources to enable the I²C master. Therefore, the I²C host speed and data throughput are primarily determined by the PSoC 4 device. Cypress I²C NVRAMs can support I²C access up to 3.4 MHz. However, the full speed can't be demonstrated on PSoC 4 platforms due to I²C speed limitations. See the PSoC 4 datasheet for more details on PSoC 4 I²C master capability and setup requirement to achieve the best performance. Figure 1 shows PSoC Creator design schematic of the code example.

Figure 1. I²C NVRAM Access – PSoC Creator Design Schematic

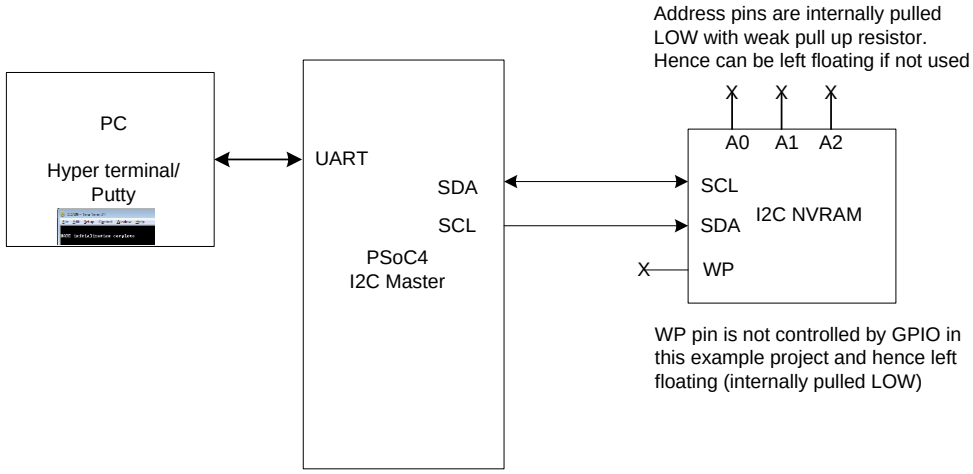


Hardware Setup

The hardware setup involves connecting the F-RAM or NVSRAM I²C interface pins with PSoC 4 I²C master pins. You can use either dedicated hardware as described in the Requirements section or can connect through jumper wires.

This example project uses the default configuration of Cypress' PSoC 4 Pioneer kit (CY8CKIT-042) and serial F-RAM development kit CY15FRAMKIT-001. Refer to CY8CKIT-042 PSoC 4 Pioneer kit and CY15FRAMKIT-001 Serial F-RAM Development Kit user guide for hardware connection details.

Figure 2. Hardware Setup Block Diagram

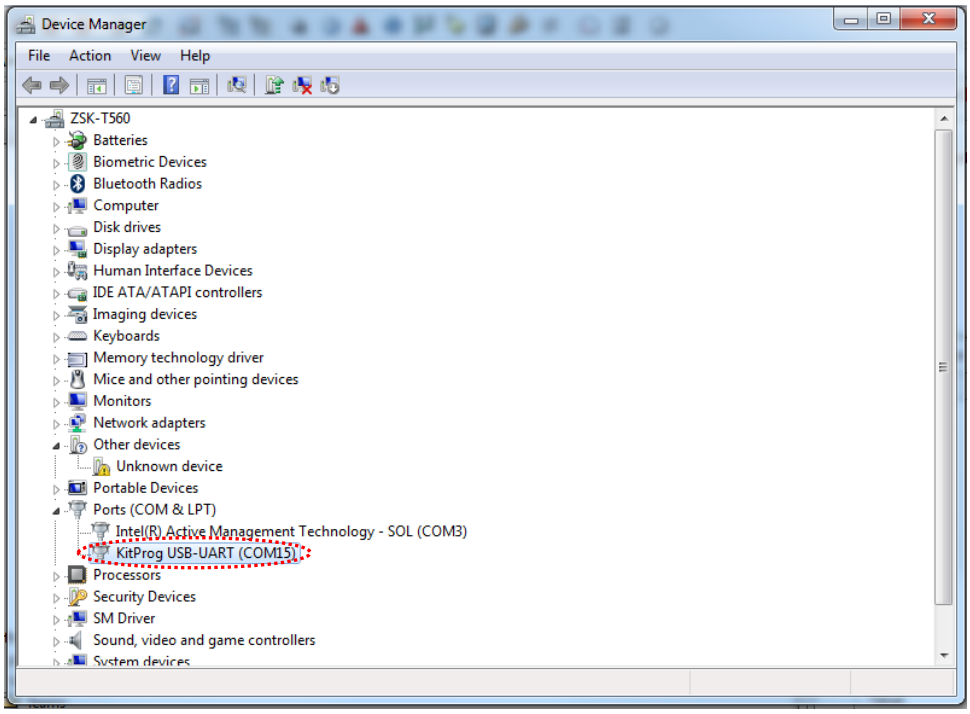


Software Setup

This section demonstrates the procedure to setup the serial (UART) connection using HyperTerminal or PuTTY on 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 demonstrate to determine the COM port number and setup the PuTTY to monitor the code example outputs on PC.

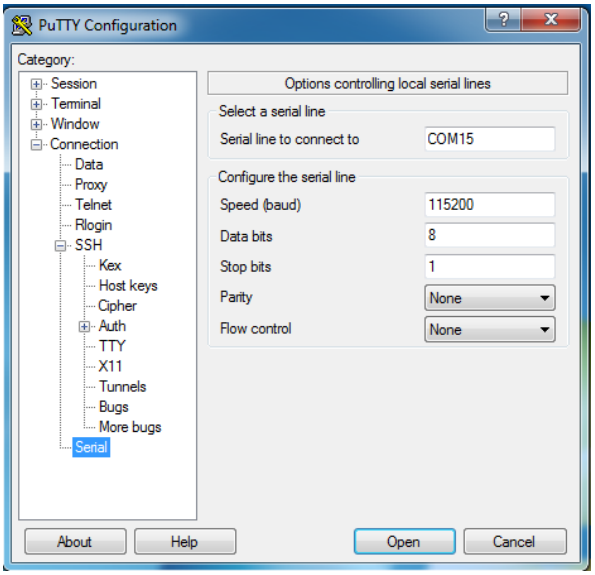
1. Connect PSoC 4 Pioneer Kit to the PC using USB Mini-B cable. The kit enumerates as KitProg USB-UART and is available under the **Device Manager** > **Ports (COM & LPT)**. A communication port (COMx) is assigned to KitProg USB-UART; for example, COM15 is assigned to PSoC 4 Pioneer Kit on the sample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

Figure 3. KitProg USB-UART in Device Manager



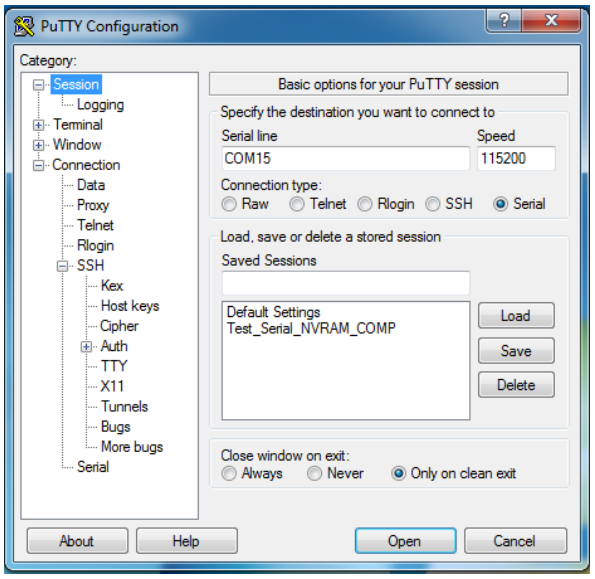
2. After you download and install PuTTY, double-click the PuTTY icon and select **Serial** under **Connection**.
3. A new window opens where the communication port can be selected. Do the following in the **Options controlling local serial lines** section:
    - Enter the PSoC 4 Port (COM & LPT), COMx, 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 **Parity** and **Flow control**.

Figure 4. Open New Connection



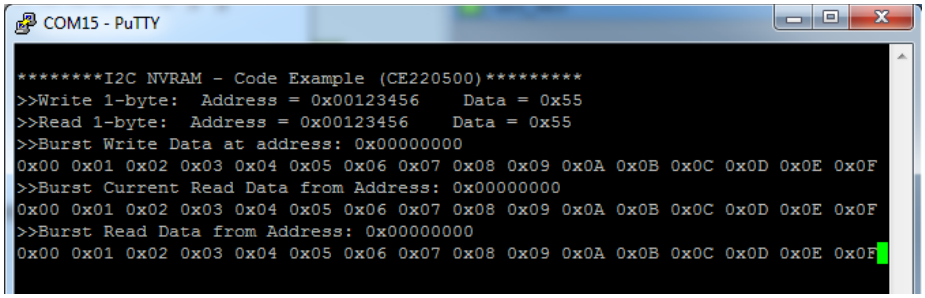
4. Select **Session** under **Category.** Select **Serial** under **Connection type** as shown in Figure 5. You can save this current session and **load** the settings when required. Enter a name in **Saved Sessions** and click **Save**. Click **Open** to proceed.

Figure 5. Select Communication Type in PuTTY



5. The COM terminal window then 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 I^2C NVRAM operating range (V_{DD}/ V_{CC}).

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

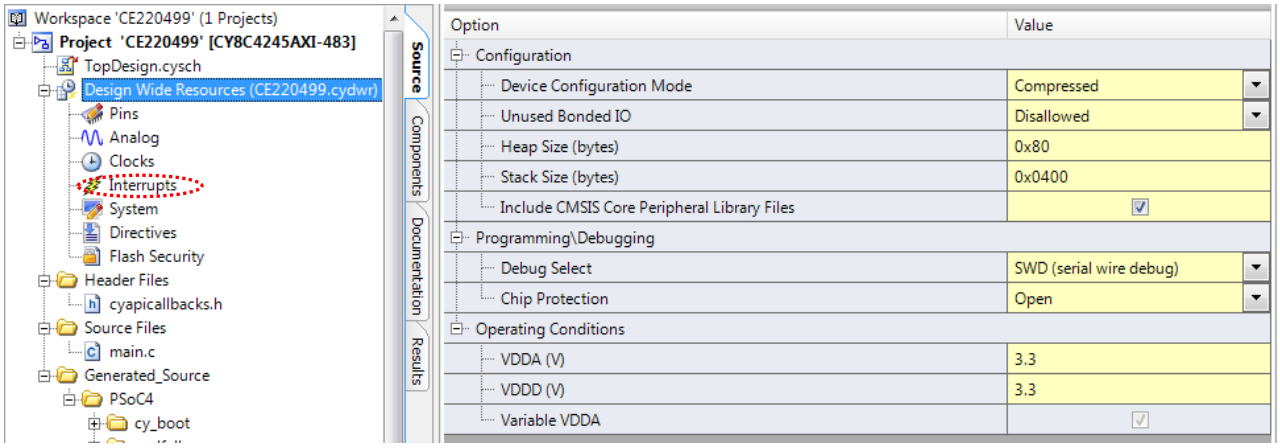


Figure 8 shows the pin assignment for the code example.

Figure 8. PSoC 4 Pin Assignments for Code Example

Name	Port	Pin	Lock
\I2C_Master:scl\	P4[0]	20	☑
\I2C_Master:sda\	P4[1]	21	☑
\UART:rx\	P0[4]	28	☑
\UART:tx\	P0[5]	29	☑
LED_GREEN	P0[2]	26	☑
LED_RED	P1[6]	43	☑

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-040	CY8C4014LQS-422
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	CY8CKIT-040
\I2C_Master:scl\	P4[0]	P3[5]	P4[0]	P1[2]
\I2C_Master:sda\	P4[1]	P3[4]	P4[1]	P1[3]
\UART:rx\	P0[4]	P3[0]	P7[0]	UART is not supported through SCB [Note 1]
\UART:tx\	P0[5]	P3[1]	P7[1]	
LED_GREEN	P0[2]	P3[6]	P2[6]	P1[1] [Note 2]
LED_RED	P1[6]	P2[6]	P0[6]	P3[2] [Note 2]

Note 1: The device can chose Software Transmit UART component and configure it accordingly to monitor results.

Note 2: The code example uses the Control Register Component to control the status LED drive. The PSoC 4000 device on CY8CKIT-040 kit doesn't support the Control Register Component; therefore, the status LEDs should be driven through individual I/O controls and code example should be modified accordingly.

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_I2C	Serial NVRAM Block in **System** > **External Memory Interface** component category
I2C	I2C_Master	I^2C (SCB Mode) in **Communication** > **I2C** 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

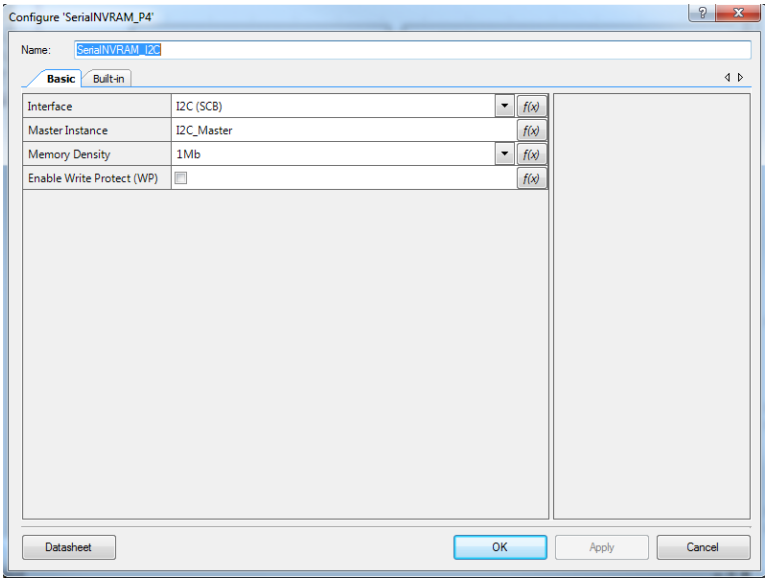


Figure 10. I²C (SCB Mode) Configuration and Parameter Settings

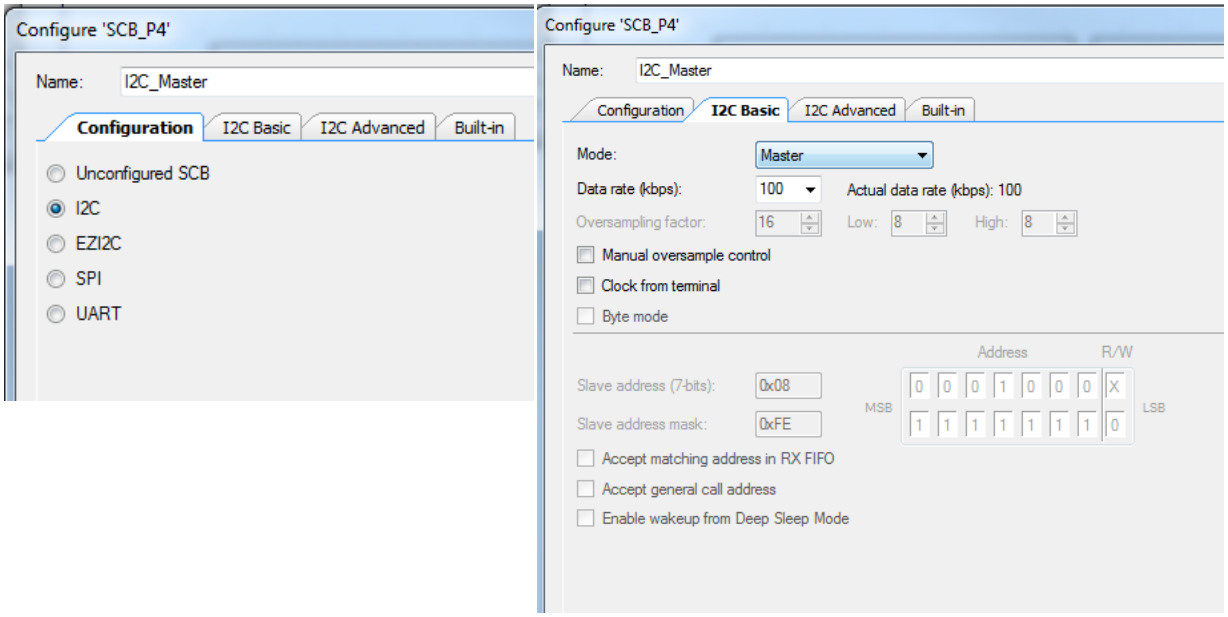


Figure 11. UART (SCB Mode) Configuration and Parameter Settings

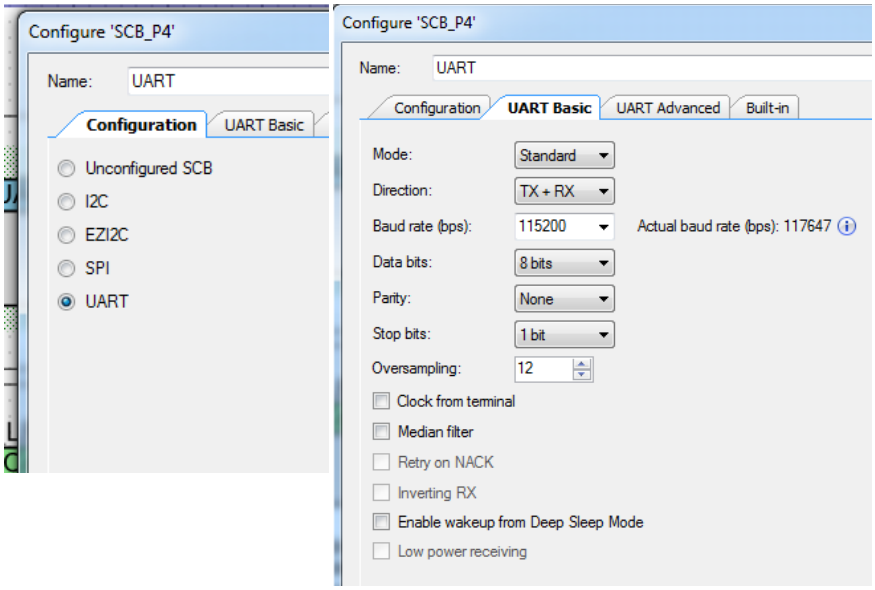
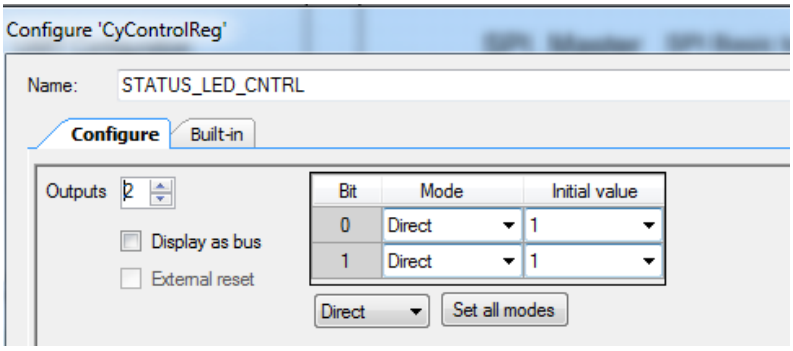


Figure 12. Control Register Configuration and Parameter Settings



Related Documents

Application Notes	
AN96578 – Designing with I2C F-RAM	Describes I²C F-RAM design in a system
Component Datasheets (Right click on the component in PSoC Creator schematic to access the component datasheet)	
SerialNVRAM	Serial NVRAM component configuration for different serial interfaces (SPI and I2C) and API details
I2C	I2C interface SCB mode
UART	UART configuration SCB mode
Control Reg	Allows firmware to set values to use for digital signals
Device Documentation	
FM24W256	256Kb, I2C 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 I2C F-RAM in 8-pin SOIC package

Document History

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Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	5955430	ZSK	11/07/2017	New code example

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