Displaying POT Level with LEDs

Libero SoC and IAR Embedded Workbench Flow Tutorial for SmartFusion cSoC

Microsemi

Table of Contents

Introduction

This tutorial demonstrates how to develop an application that can be implemented on SmartFusion® customized system-on-chip (cSoC) device. After completing this tutorial you will be familiar with the following:

- Creating and implementing a Libero® system-on-chip (SoC) v10.0 project using SmartFusion.
- Configuring the peripherals using SmartDesign
- Configuring the analog compute engine (ACE)
- Generating the microcontroller subsystem (MSS) component
- Generating the programming file to program the SmartFusion cSoC device
- Opening the project in Embedded Workbench® for ARM® (EWARM) IDE from Libero SoC and writing application code
- Compiling application code
- Creating and launching a debug session
- Debugging and running the code using IAR

Tutorial Requirements

Software Requirements

This tutorial requires the following software installed on your PC:

- Libero SoC v10.0 (or later) that can be downloaded from: www.microsemi.com/soc/download/software/libero/files.aspx.
- IAR Embedded Workbench® v6.30.7 or later.

Hardware Requirements

This tutorial requires the following hardware:

- SmartFusion Evaluation Kit Board or SmartFusion Development Kit Board.
- Two USB cables (programming and communication) — one for connecting the programmer to your PC and the other to connect the universal asynchronous receiver/transmitter (UART) interface on the board to the PC.
- IAR supplied J-Link debugger hardware (not supplied with the SmartFusion Kit Board).

Associated Project Files

You can download the associated project files for this tutorial from the Microsemi website: www.microsemi.com/soc/download/rsc/?f=SmartFusion_LiberoIAR_POTlevel_tutorial_DF.

The IAR_Debugger_files folder contains the following files:

- SmartFusion_dss.ddf: DDF files allows you to see the MSS register map for all peripherals.

Note: Extract the Design Files to root directory (C:\).

You can download the programming file (*.stp) in release for this tutorial from the Microsemi website: www.microsemi.com/soc/download/rsc/?f=SmartFusion_LiberoIAR_POTlevel_tutorial_PF.

MSS Components Used

- ARM® Cortex™-M3 processor
- Clock conditioning circuitry (CCC)
- General purpose input/output (GPIO)
- UART_0
- ACE

Target Board

Smart Fusion Evaluation Kit Board (A2F-EVAL-KIT) or SmartFusion Development Kit Board (A2F-DEV-KIT).

Objective

The objective of this tutorial is to instruct how to configure the SmartFusion analog channels and ACE, used to monitor the voltage across the potentiometer. The UART is used to send the ADC results to a terminal program.

Design Steps

Following are the major steps to be executed for this tutorial:

- Create a Libero SoC v10.0 project and use the SmartFusion cSoC MSS configurator to configure ACE, adding a voltage monitor with flags.
- Generate the SmartFusion cSoC MSS component.
- Perform synthesis and layout, and generate a programming file to program the SmartFusion cSoC device.
- Program the SmartFusionA2F200M3F or A2F500M3F cSoC device.
- Open the software project in IAR Embedded Workbench IDE and write application code.

Run an application to monitor the voltage across the POT on the SmartFusion Evaluation Kit Board or Development Kit Board.

The hardware configuration has four flags:

- Over 1.0 V
- Over 1.5 V
- Over 2.0 V
- Over 2.5 V

The design monitors voltage across a potentiometer (POT) and the four flags are included for the voltage monitoring. These flags are used to drive the four LEDs on the board.

Working with Libero SoC and IAR

This section describes how to create a Libero SoC project, configure the microcontroller subsystem (MSS), and program the design on the SmartFusion board and run an application program in the IAR Workbench.

Step 1 - Creating a Libero SoC Project

1. Launch Libero SoC v10.0 (or later).
2. From the **Project** menu, select **New Project**. Enter the information as displayed in Figure 1 · .
   - Name: Voltage_Monitor
   - Location: <…> (For example, C:\Microsemiprj\POT_LED_Libero_IAR)
   - Family: SmartFusion
   - Die: If you are using SmartFusion Evaluation Kit Board, enter A2F200M3F; if you are using SmartFusion Development Kit Board, enter A2F500M3F.
   - Package: 484 FBGA
   - Speed: STD

   Leave others as default.

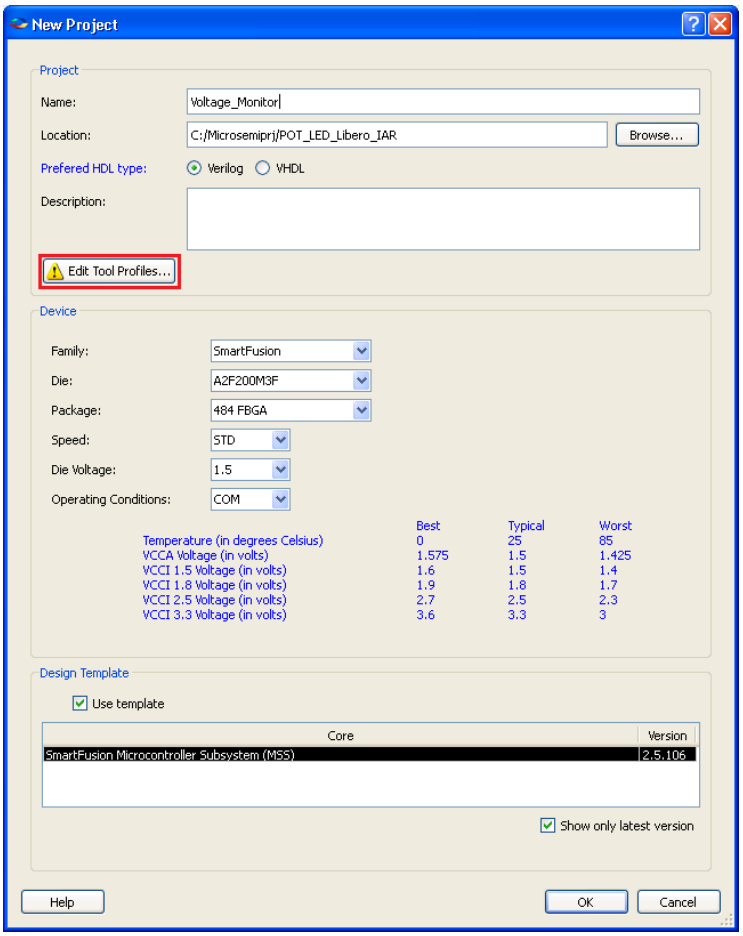


Figure 1 · New Project Dialog Box

Click **Edit Tool Profiles** and add IAR by clicking on Software IDE as shown in Figure 2 · .

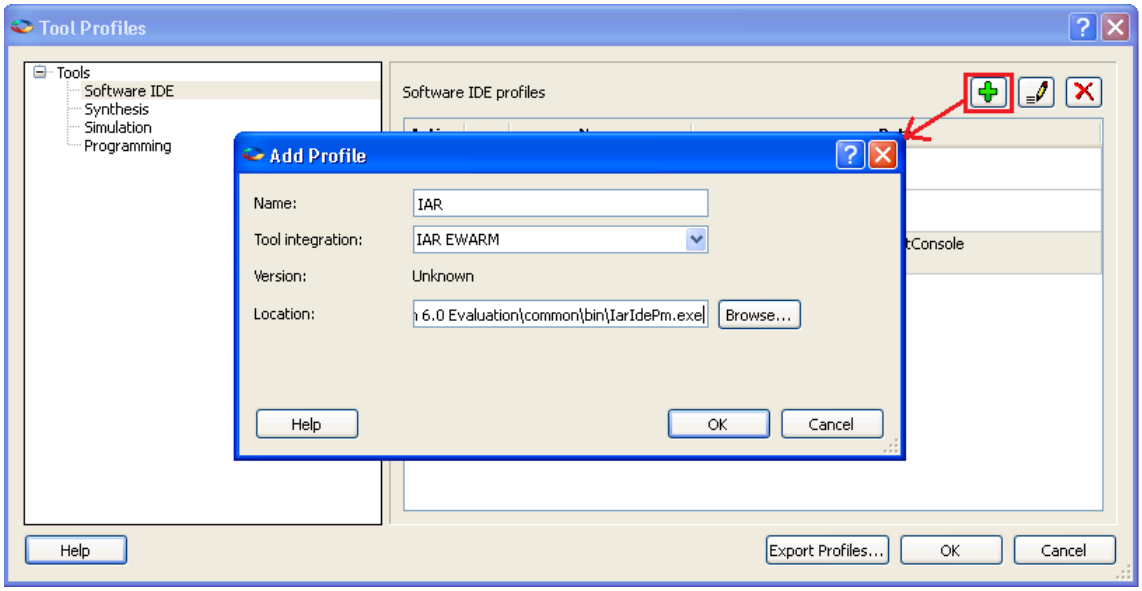


Figure 2 · Selecting IAR as Software IDE

3. After adding the Profile, click **OK** to close the Add Profile dialog window.

   Repeat the steps (3 and 4) above for Synthesis, Simulation, and Programming and then click **OK** to close the Tool Profiles dialog window.

4. Select the MSS core in New Project Dialog Box and click **OK.**

   Note: If SmartFusion cSoC MSS does not appear in the list, refer to Appendix A – Libero SoC Catalog Settings to find out how to set your repositories. If your vault does not have MSS core, download the core by double clicking on the core name in **Design template** in the **New Project Dialog Box**.

5. The project is created and the Libero SoC window is displayed, as shown in Figure 3 · . The SmartDesign “Voltage_Monitor” is created with the instantiation of MSS component.

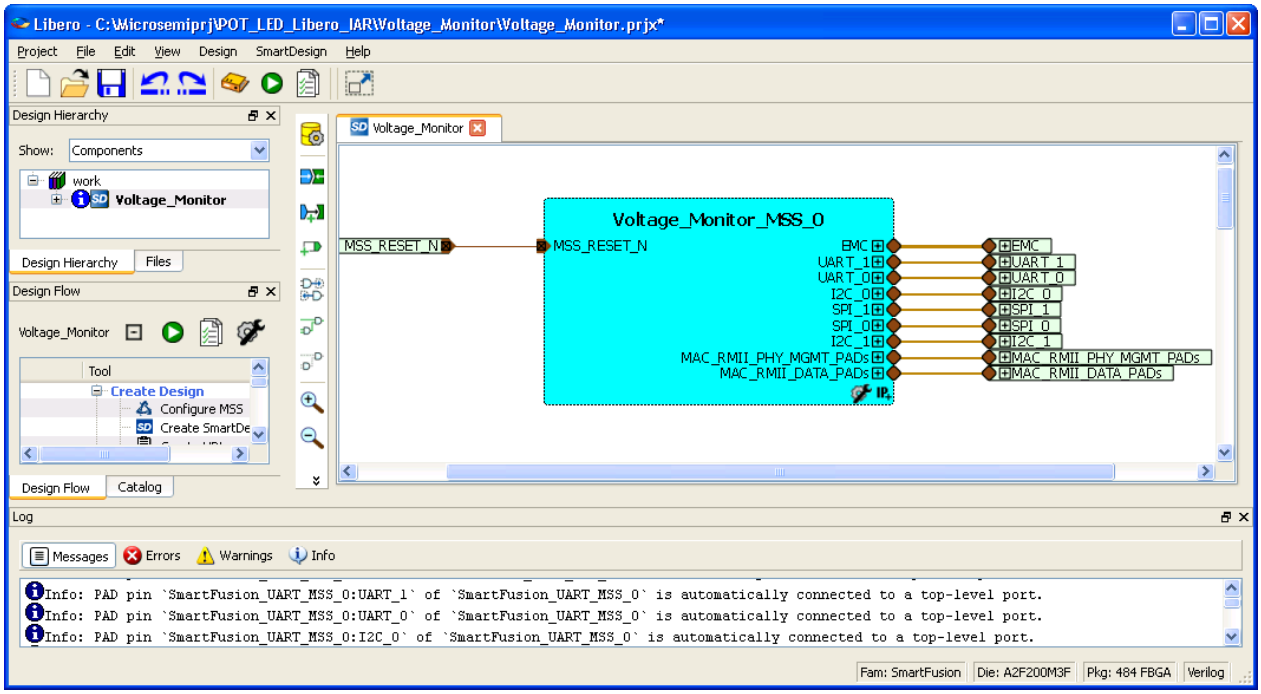


Figure 3 · The Libero Window After Creating New Project Wizard

Step 2 - Configuring MSS Peripherals

1. Double-click on **Voltage_Monitor_MSS_0** component to configure the MSS**.** The MSS is displayed in the SmartDesign Canvas in a new tab, as shown in Figure 4 · .

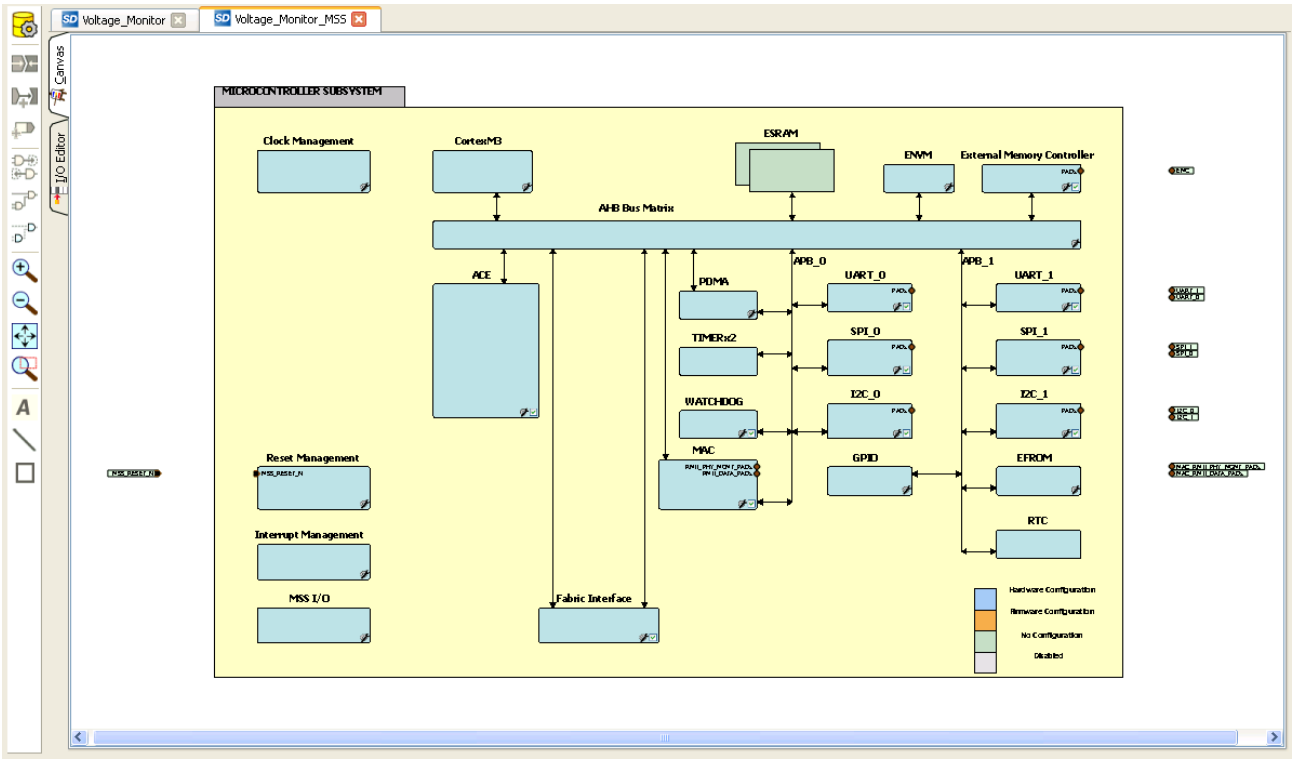


Figure 4 · MSS in the SmartDesign Canvas

The enabled MSS peripherals are highlighted in blue, and can be configured in the hardware. The disabled peripherals are shown in gray.

To disable a peripheral that is not required, select the peripheral, right-click, and clear the **Enabled** check box or, or clear the check box in the lower right corner of the peripheral box. The box turns grey to indicate that the peripheral has been disabled. Disabled peripherals can be enabled by repeating the procedure.

An enabled peripheral looks as shown in Figure 5 · .

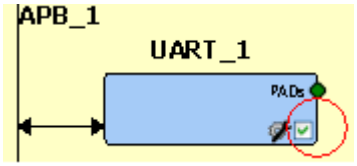


Figure 5 · Enabling the Peripheral

This example uses only the following peripherals: clock management, analog compute engine (ACE), GPIO, and UART_0.

2. Disable the following peripherals: MAC, fabric interface, SPI0, SPI1, I2C0, I2C1, UART1, and EMC.

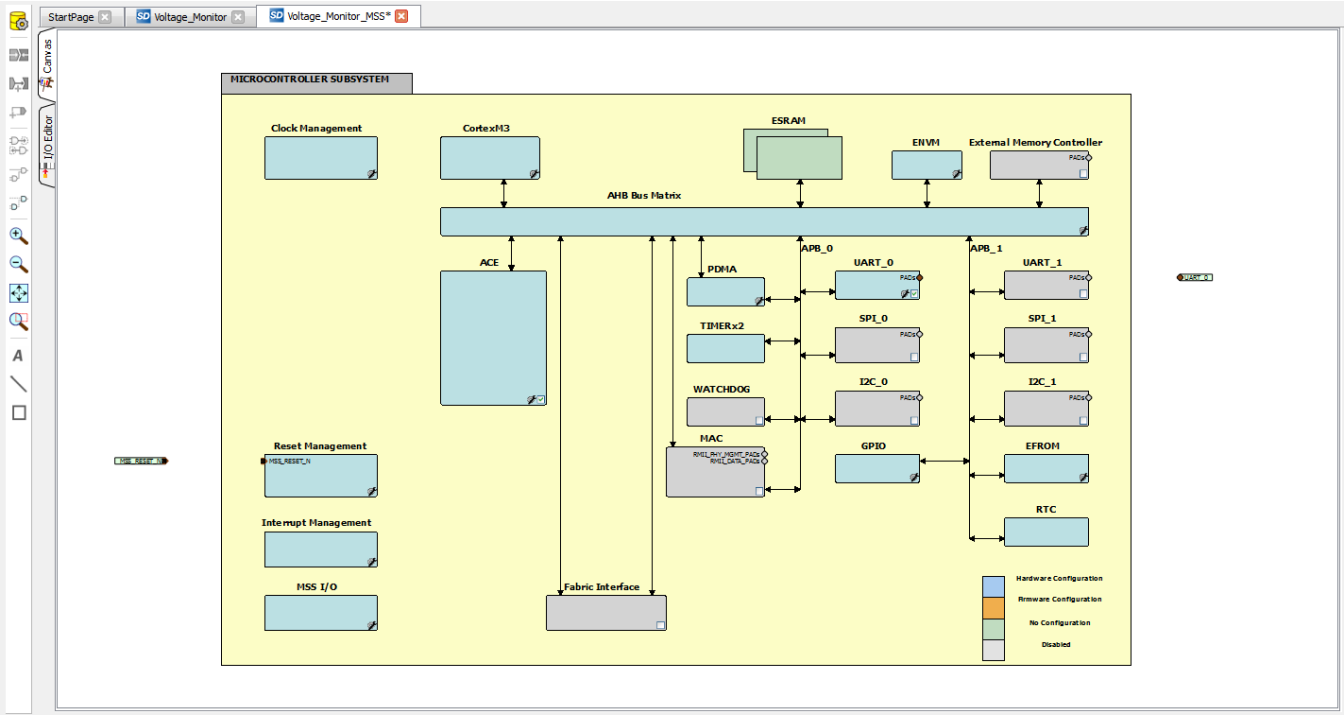


Figure 6 · Used MSS Peripherals

3. Double-click the **Clock Management** block and configure as shown below:
   - CLKA: On-chip RC Oscillator
   - MSS clock source: PLL output
   - MSS clock frequency: 80 MHz

   Use default settings for all other fields.

   After completing the configuration, click **OK**.

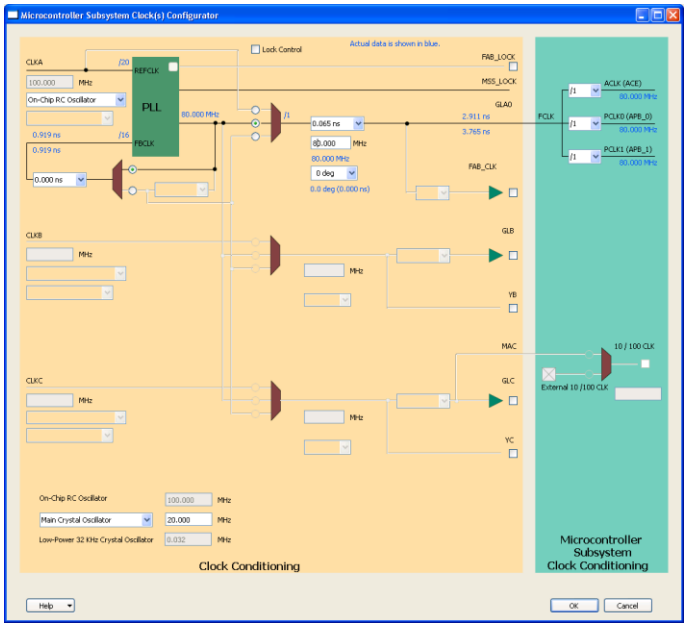


Figure 7 · MSS Clock Configuration

Configuring ACE

To configure ACE, double-click the ACE peripheral block and configure as follows:

1. Connect TM0 to the POT on the SmartFusion Evaluation Kit Board or the SmartFusion Development Kit Board. Configure a voltage monitor to measure the voltage across the POT and also to create flags to indicate when the voltage is greater than 1.0 V, 1.5 V, 2.0 V, and 2.5 V. These flags are used to illuminate the LEDs on the SmartFusion Evaluation Kit Board or the SmartFusion Development Kit Board.

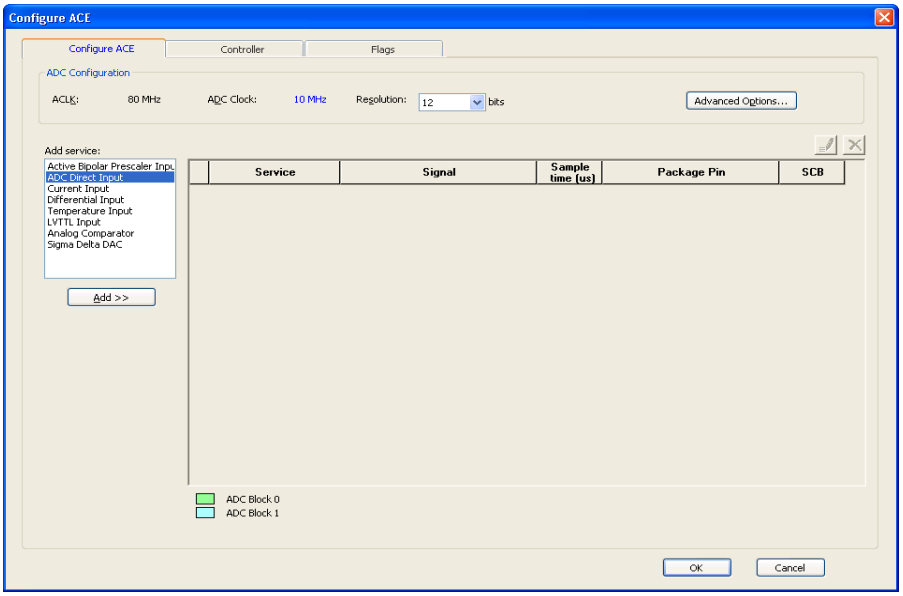


Figure 8 · MSS ACE Configuration

2. Select **ADC Direct Input** and click **Add** (or double-click ADC Direct Input) and enter the parameters as shown in Figure 9 · .
   - Signal name: TM0_Voltage
   - Send raw results to DMA: Cleared check box
   - Acquisition time: 10 µs
   - Filtering factor: None

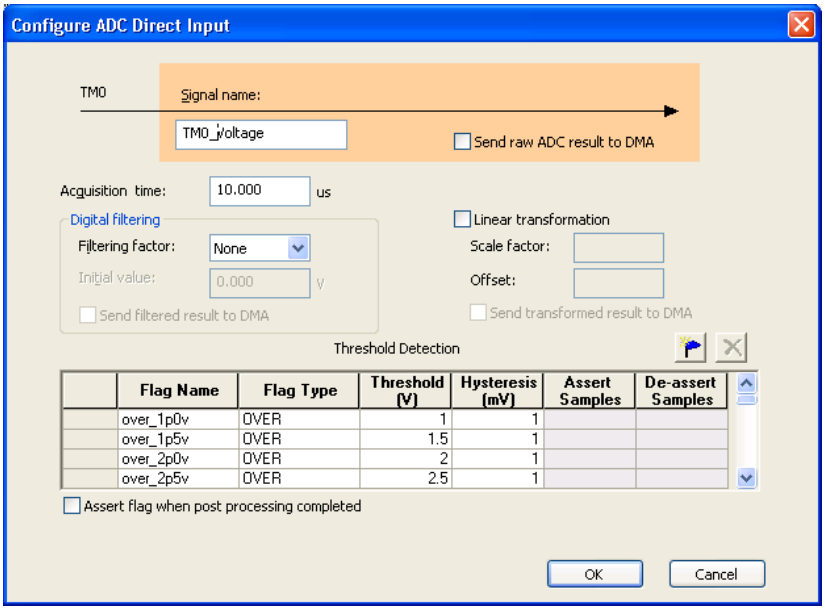


Figure 9 · MSS ADC Direct Input Configuration

3. Next, add the flags as shown in Table 1.

Table 1 · Flag Definitions

Flag Name	Flag Type	Threshold (V)	Hysteresis (mV)
over_1p0v	OVER	1	1
over_1p5v	OVER	1.5	1
over_2p0v	OVER	2	1
over_2p5v	OVER	2.5	1

4. Click **OK**.
5. Assign the ADC Direct Input Signal to the package pin W8 in the Configure ADC dialog box. The **Configure ACE** tab is displayed as shown in Figure 10 · .

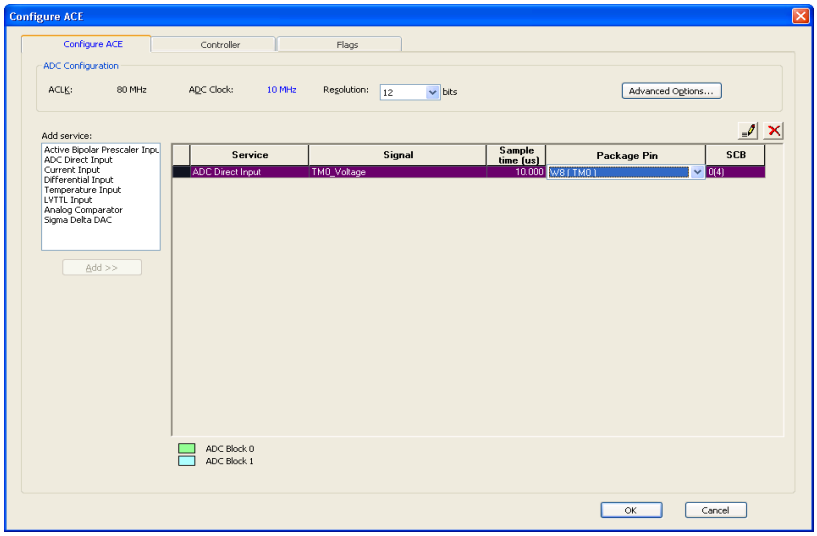


Figure 10 · MSS ACE Configuration With ADC Direct Input

6. The next step in configuring the ACE is to enable the sampling sequence. This configuration dialog is launched by clicking on the **Controller** tab (next to the **Configure ACE** tab).
7. Select **Manual** as the **Operating sequence entry** in the **Controller** tab and click **Insert operating sequence slot** button (see Figure 11 ·).

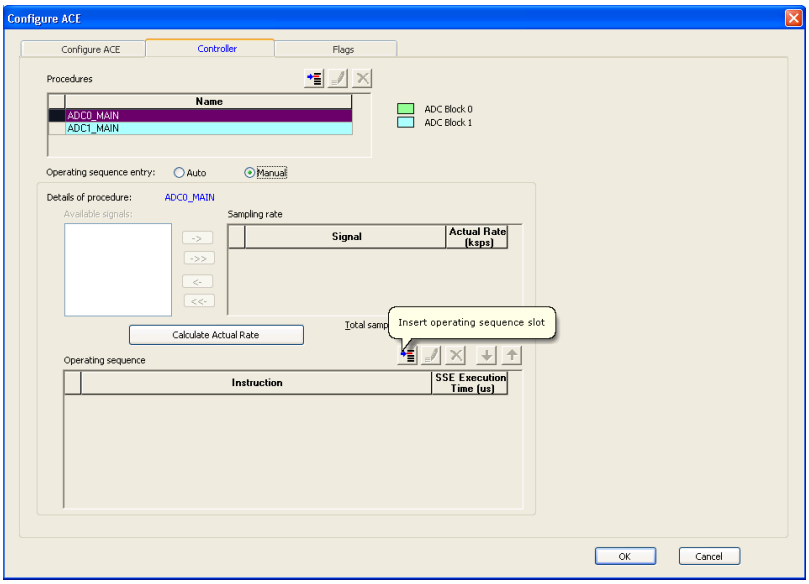


Figure 11 · MSS ACE Configuration to Enable Sampling Sequence

8. Select **SAMPLE**.

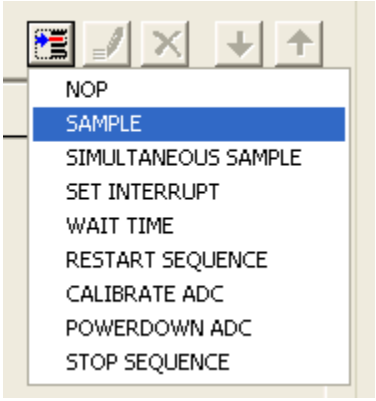


Figure 12 · Select SAMPLE

This displays the Configure SAMPLE window.

9. Select **TM0_voltage** and click **OK**.

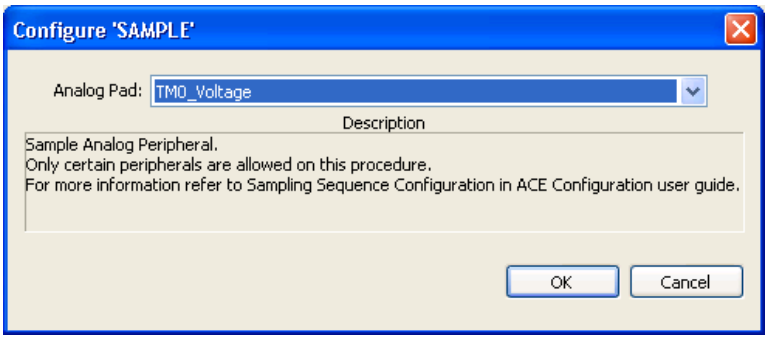


Figure 13 · Configure SAMPLE

10. Click **Insert operating sequence slot** and select **RESTART SEQUENCE**.

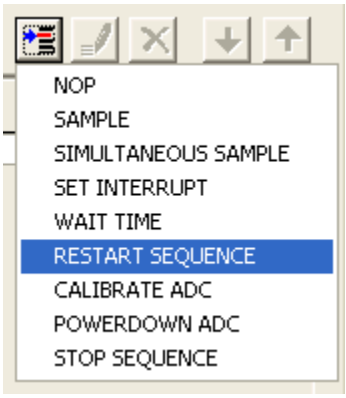


Figure 14 · Select Restart Sequence

11. Click **Calculate Actual Rate**.

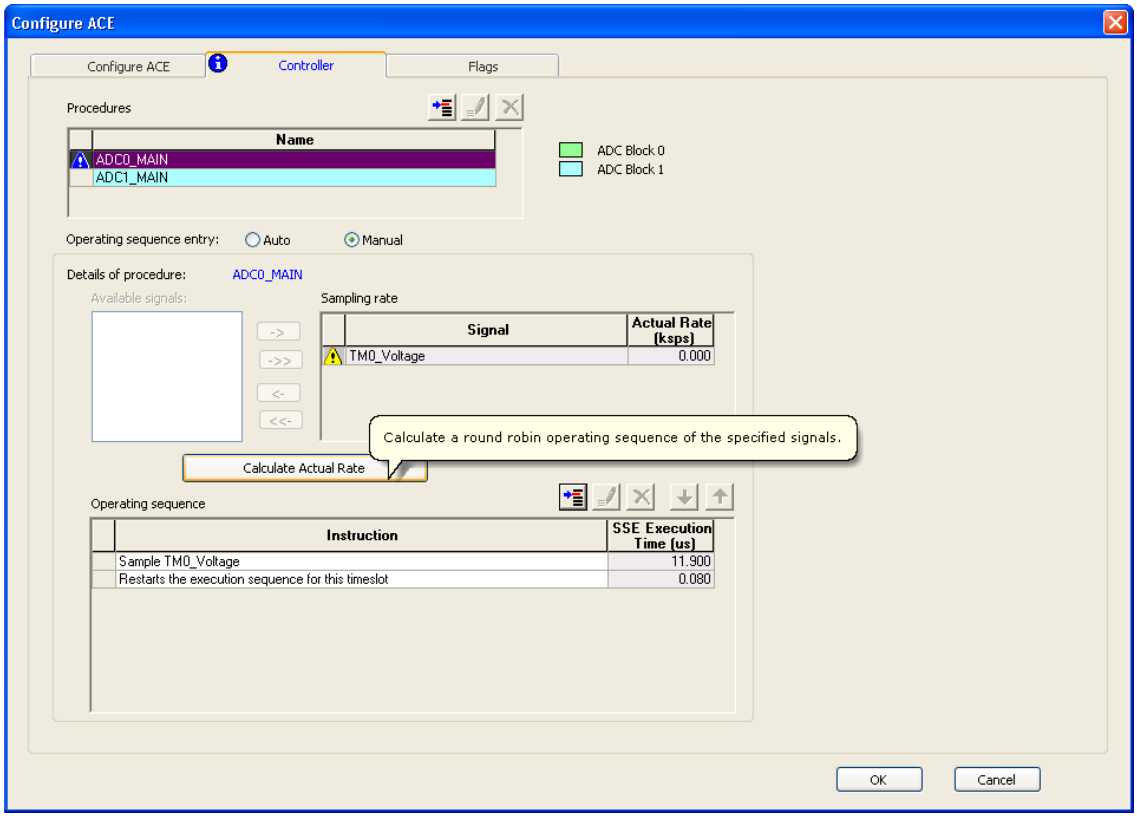


Figure 15 · MSS ACE Configuration: Calculate Actual Rate

12. The **Controller** tab window is displayed as shown in Figure 16 · .

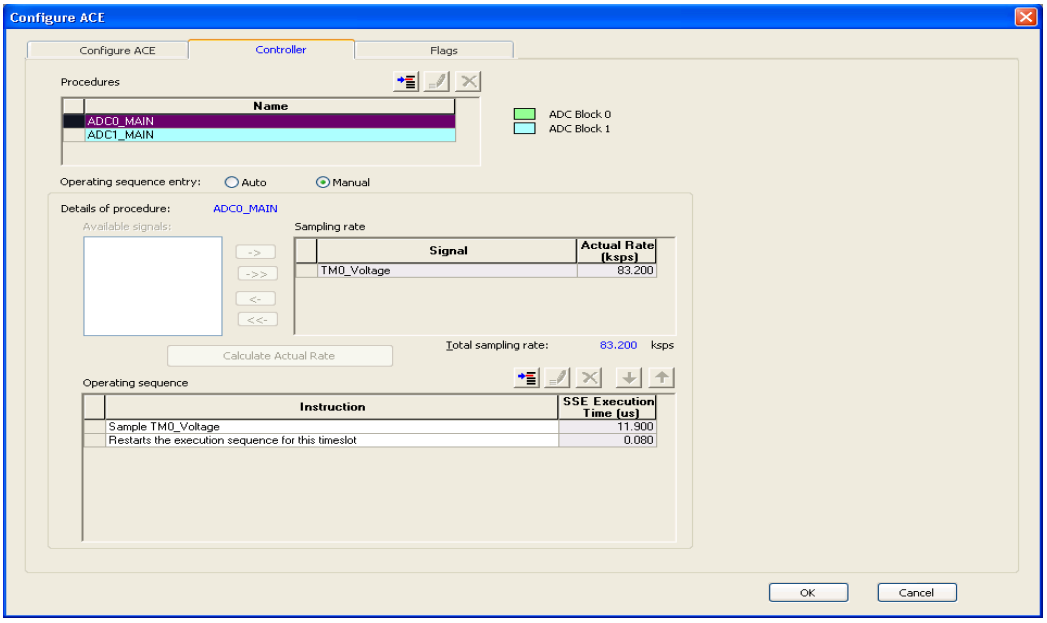


Figure 16 · MSS ACE Configuration: Controller Tab

13. Click the **Flags** tab in the Configure ACE window. This tab lists the flags set from PPE registers.
14. Click the **+** sign to expand the Flag registers group. The PPE_FLAGSn registers contain the user-defined flags.

15. Select **PPE_FLAGS0** (FLAGBANK0). PPE_FLAGS0 contains the 4 threshold flags assigned earlier. These are the flags that were defined when the direct input voltage service was configured. The flag register can be read by the Cortex-M3 processor. The flags also generate interrupts to the Cortex-M3 processor.

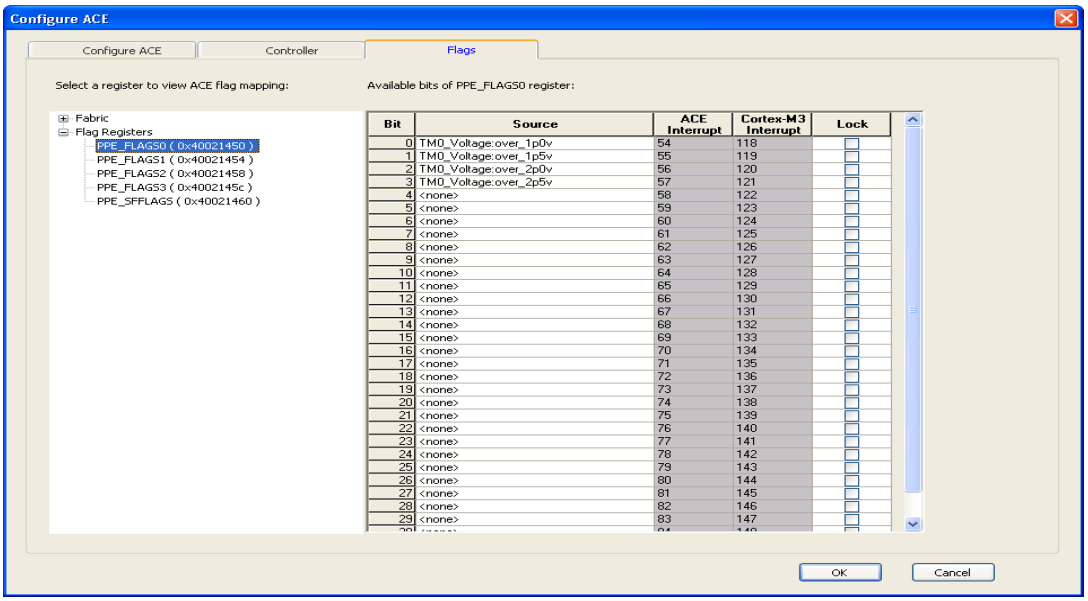


Figure 17 · ACE Flag Mapping – PPE Flag Registers

16. Click **OK** to close the ACE configuration window.

Configuring the General Purpose Input/Output (GPIO) Peripheral

Note: If you are not using the SmartFusion Evaluation Kit Board Revision E or later, or using the SmartFusion Development Kit Board, follow Appendix C. Skip Step 3 - Generating the MSS Component and Step 4 - Generating the Program File.

1. Double-click the **GPIO** block in the MSS component and configure as shown in Figure 18 · ; and click **OK**.

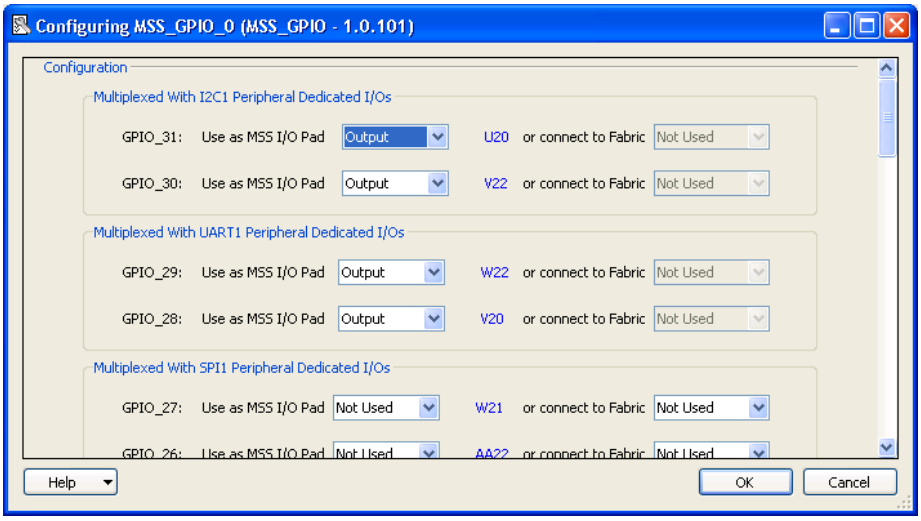


Figure 18 · MSS GPIO Configuration

2. This example requires GPIO_31, GPIO_30, GPIO_29, and GPIO_28 to be connected to LED_8 to LED_5 on the SmartFusion Evaluation Kit Board.
3. Click **File > Save** to save the Voltage_Monitor_MSS.

Step 3 - Generating the MSS Component

1. Right-click on **Voltage_Monitor_MSS_0** component on the **Voltage_Monitor** tab and select **Update Instance(s) with Latest Component** as shown in Figure 19 · .

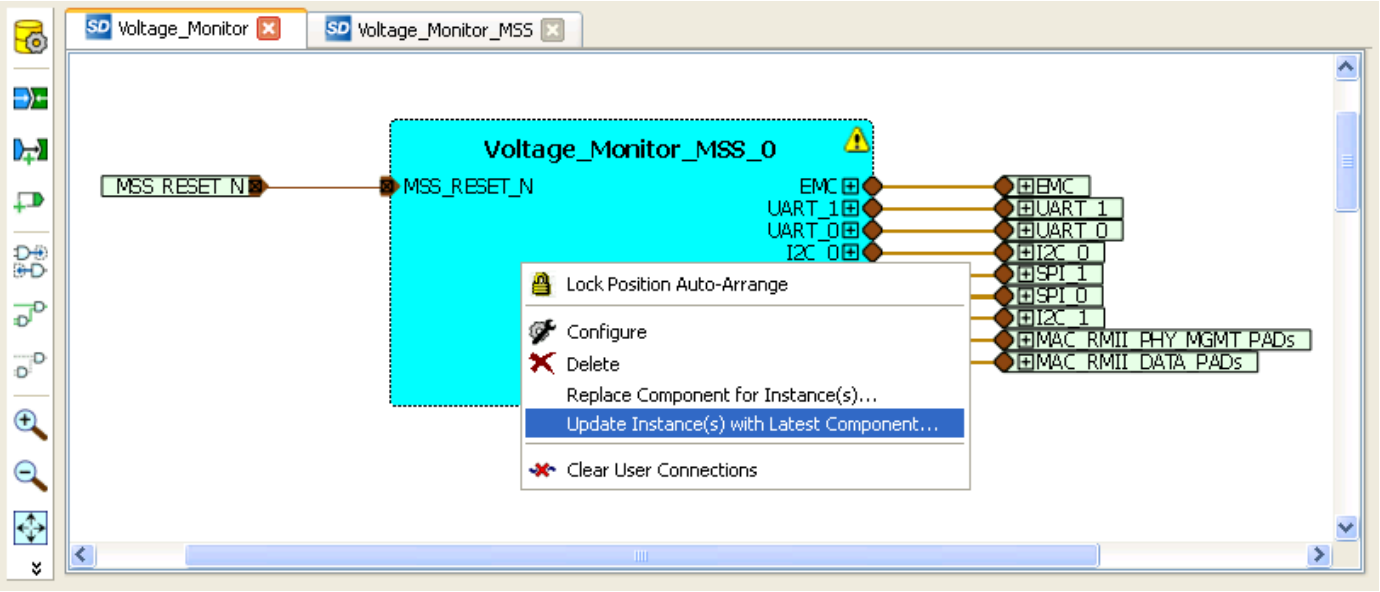


Figure 19 · Updating the MSS

2. Click **Design > Configure Firmware** as shown in Figure 20 · .

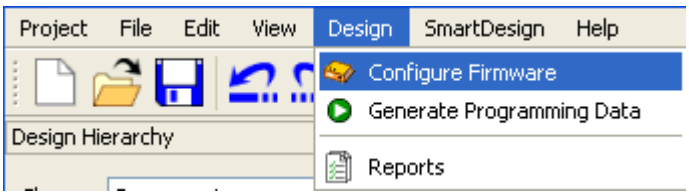


Figure 20 · Opening Design_Firmware

3. On the **DESIGN_FIRMWARE** tab, clear the **Generate** check boxes for all the peripherals for which you do not need to generate the firmware. Click Configuration on the SmartFusion_CMSIS_PAL_0 instance and select IAR Embedded Workbench as the configuration.

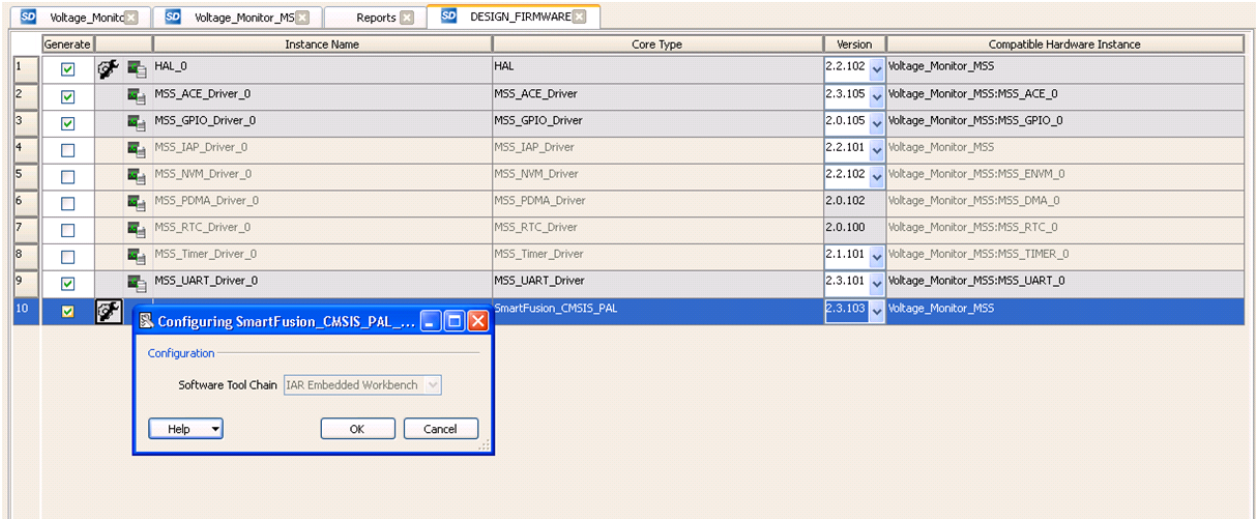


Figure 21 · Configuring SmartFusion_CMSIS_PAL_0

4. Check whether or not you are able to see the latest version of the drivers without any warning or error indicating that firmware is missing from the Vault. If missing, refer to the Appendix B – Firmware Catalog Settings.
5. Click **File > Save** to save the **Design_Firmware**.
6. **Save** the design and generate the component by clicking **Generate Component** or by selecting **SmartDesign > Generate Component**.

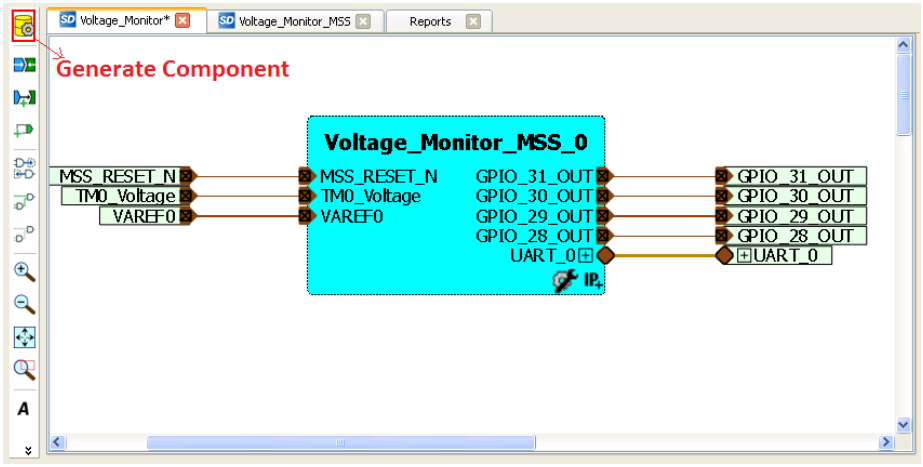


Figure 22 · Generating the MSS Component

7. After successful generation of MSS component the log window displays the message "**Info: 'Voltage_Monitor' was successfully generated. Open datasheet for details**". The datasheet has the Project information like Generated files, used IO's, Memory map, etc.
8. Confirm that the IAR folder is created with the folders and files as shown in Figure 23 · .

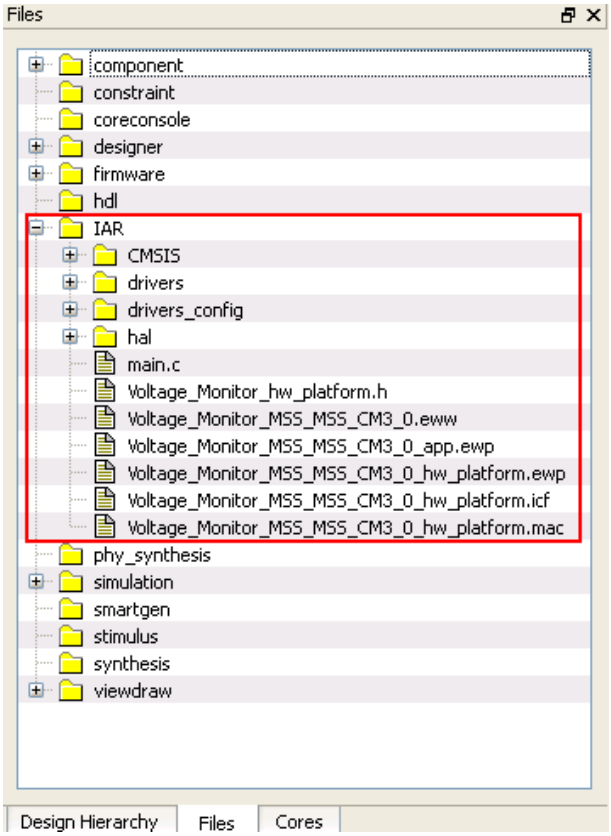


Figure 23 · Files Window

Step 4 - Generating the Program File

Libero SoC provides the push button flow for generating programming data of the project in a single step. By clicking Build button, you can complete the synthesis, Place and Route; verify timing and generating the programming file. You can also complete the flow by running the synthesis and place and route tools in interactive mode (step-by-step), for more information refer to the *Libero SoC Quick Start Guide*.

Push-button Design Flow

1. Click **Generate Programming Data** as shown in Figure 24 · to complete the place and route, verify timing and generate the programming file. This completes the *.fdb file generation.

Figure 24 · Generating Programming Data

2. The **Design Flow** window looks similar Figure 25 · .

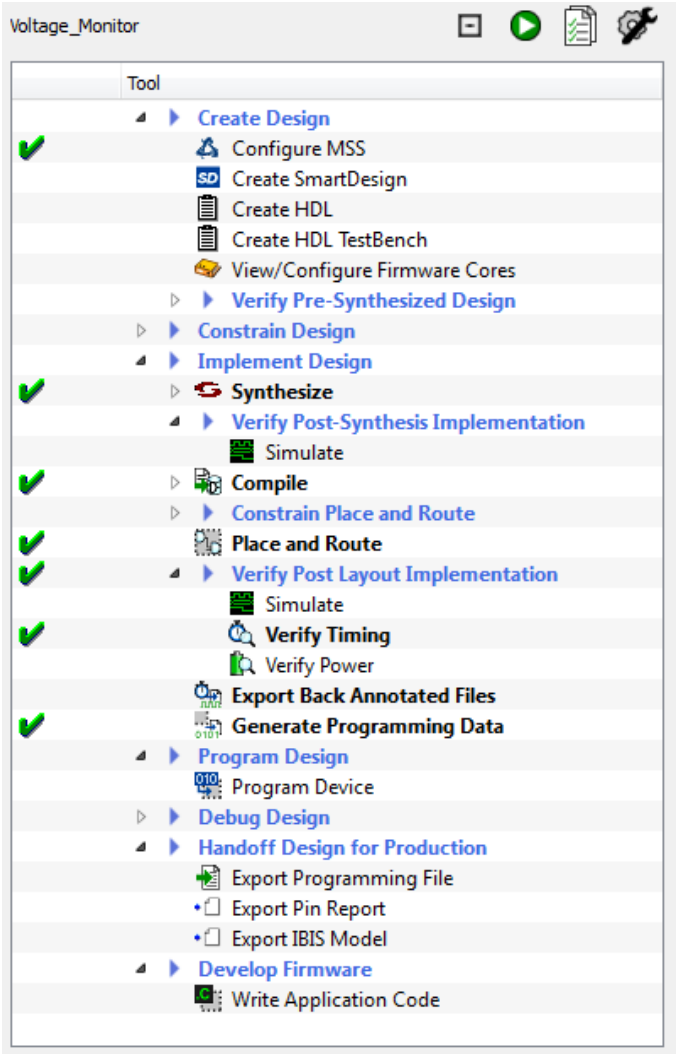


Figure 25 · Design Flow Window After Building the Project

Step 5 - Programming SmartFusion Board Using FlashPro

Before you proceed with programming the device, ensure that the low cost programming stick (LCPS) or FlashPro4 is properly connected to the board. Use the following details to ensure the correct jumper settings. Refer to the *SmartFusion Evaluation Kit User's Guide* and *SmartFusion Development Kit User's Guide* for additional information.

Jumper Settings for SmartFusion Evaluation Kit Board

- JP10: Short pin 1 and 2 using a jumper.
- JP7: Short pin 1 and 2 using a jumper for LCPS mode.
- J6: Connect pin 1 and 2 using the jumper.
- JP6: Connect pin 2 and 3 using the jumper.
- J13: Connect the USB cable to J13 connector. Install the FlashPro4 or FlashPro drivers if they are not already installed.
- J14: Connect second USB cable for power.
- JP11, JP12, JP13, and JP14: Short pin 2 and 3 using a jumper (in A2F - EVAL - REV E).

Jumper Settings for SmartFusion Development Kit Board

SW9 must be off (JTAGSEL = H) in order to program the SmartFusion device. SW9 remains in the off position for Libero SoC and SoftConsole programming. Make the jumper settings as shown in the following table:

Table 2 · Jumper Settings for Development Kit Board

Factory Default	Factory Default	Factory Default
JP1: 1–2	JP12: 1–2	JP21: 1–2
JP2: 1–2	JP13: 1–2	JP22: 2–3
JP4: 1–3; 7–9	JP14: 1–2	JP23: 1–2
JP5: 1–2; 3–4	JP15: 1–2	JP24: 1–2
JP6: 2–3	JP16: 2–3	JP27: 1–2
J7: 2–3; 6–7; 10–11; 14–15	JP17: 2–3	JP28: 1-2
JP7: 1–2	JP18: 1–2	J32: 1–2; 3–4; 5–6
JP8: 3-4; 7-8; 11-12; 15-16	JP19: 2–3	–
JP11: 1-2	JP20: 1–2	–

Programming the Device

1. Double click **Program Device** under **Program Design** in the **Design Flow** window to program the SmartFusion cSoC device.
2. Click **Yes** when it prompts that the I/O and timing constraints not yet set.

   Note: Do not interrupt the programming sequence; it may damage the device or the programmer. If you face any problems, contact Microsemi Tech Support at soc_tech@microsemi.com.

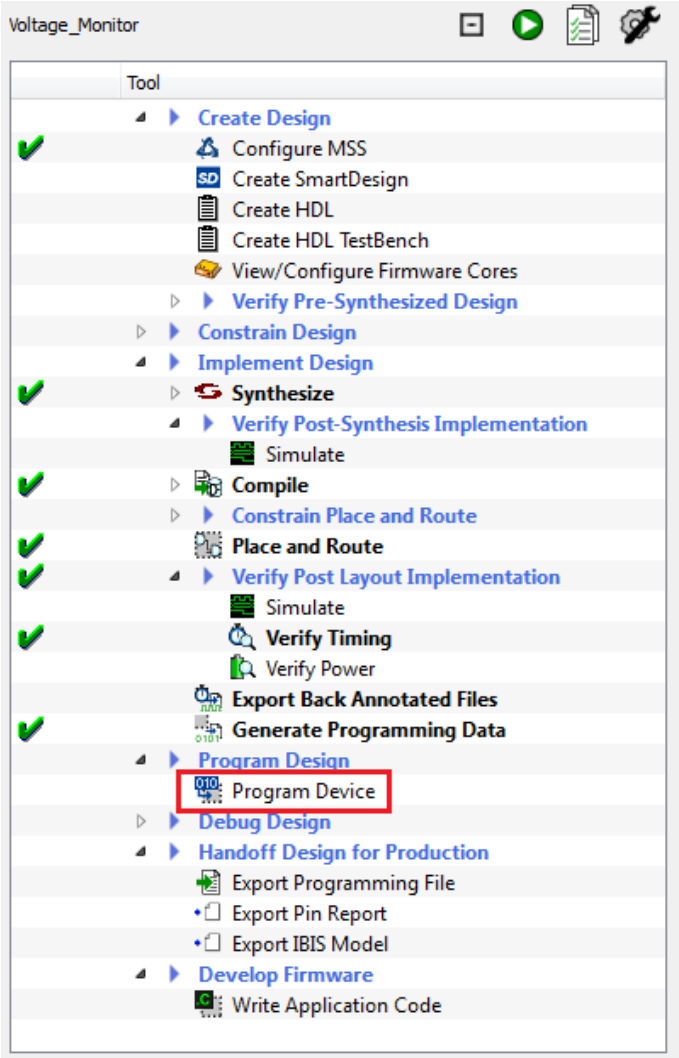


Figure 26 · Design Flow Window

You can also run FlashPro interactively by right-clicking on **Program Device** in **Design Flow** window and selecting **Open Interactively**. For more information on FlashPro refer to the *FlashPro user's guide*.

Step 6 - Building the Software Application Through IAR Embedded Workbench

1. From the Libero SoC open the IAR project by double clicking on **Write Application Code** under **Develop Firmware** in **Design Flow** window.

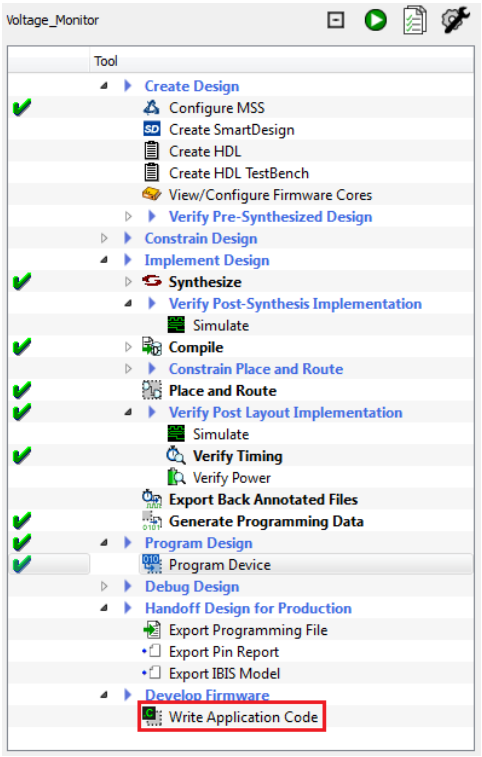


Figure 27 · Invoking IAR from Libero SoC

2. Your IAR workbench perspective will look like Figure 28 · .

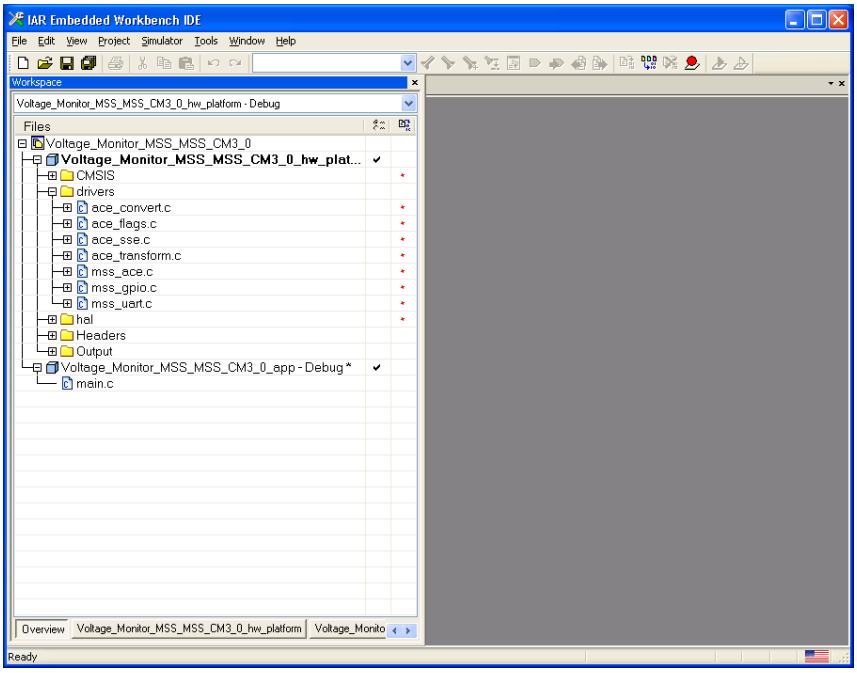


Figure 28 · IAR Workbench

3. Copy the code provided below and paste it in **main.c** file under SmartFusion_UART_HW_MSS_MSS_CM3_0_app project in the IAR editor and delete the existing code.

```
#include "mss_uart.h"
#include "mss_ace.h"
#include "mss_gpio.h"
#include <stdio.h>

#define  Microsemi_logo \
"\n\r \
**     **  *******   ******  *****    ****    *****  ******  **     **  *******
\n\r \
* *   * *     *     *        *    *  *    *  *       *       * *   * *     *
\n\r \
*  * *  *     *     *        *****   *    *   ****   ******  *  * *  *     *
\n\r \
*   *   *     *     *        *    *  *    *       *  *       *   *   *     *
\n\r \
*       *  *******   ******  *    *   ****   *****   ******  *       *  *******
"
main()
{
const uint8_t greeting[] =
      "\n\rWelcome to Microsemi's SmartFusion Voltage Monitor\n\n\r";
    const uint8_t * channel_name;


    /*Initialize and Configure GPIO*/
    MSS_GPIO_init();
    MSS_GPIO_config( MSS_GPIO_31 , MSS_GPIO_OUTPUT_MODE );
    MSS_GPIO_config( MSS_GPIO_30 , MSS_GPIO_OUTPUT_MODE );
    MSS_GPIO_config( MSS_GPIO_29 , MSS_GPIO_OUTPUT_MODE );
    MSS_GPIO_config( MSS_GPIO_28 , MSS_GPIO_OUTPUT_MODE );

    /*Initialize UART_0*/
    MSS_UART_init(
        &g_mss_uart0,
        MSS_UART_57600_BAUD,
        MSS_UART_DATA_8_BITS | MSS_UART_NO_PARITY | MSS_UART_ONE_STOP_BIT );

    /*Initialize ACE*/
    ACE_init( );

    MSS_UART_polled_tx_string( &g_mss_uart0, (const uint8_t*)Microsemi_logo );
    MSS_UART_polled_tx( &g_mss_uart0, greeting, sizeof(greeting) );

    channel_name = ACE_get_channel_name( TM0_Voltage );

    for (;;)
    {
        uint8_t display_buffer[32];
```

```
        uint16_t adc_result;
        int32_t adc_value_mv;

        adc_result   = ACE_get_ppe_sample( TM0_Voltage );
        adc_value_mv = ACE_convert_to_mV( TM0_Voltage, adc_result );

        if ( adc_value_mv < 0 )
        {
          snprintf((char*)display_buffer, sizeof(display_buffer),
                   "%s : -%.3fV\r\b", channel_name, ((float)(-adc_value_mv) /
(float)(1000)));
        }
        else
        {
          snprintf((char*)display_buffer, sizeof(display_buffer),
                 "%s : %.3fV\r\b", channel_name, ((float)(adc_value_mv) / (float)(1000)));
        }

        MSS_UART_polled_tx_string( &g_mss_uart0, display_buffer );
/* Checking the status of Voltage flags */
        int32_t flag_status_2p5v = ACE_get_flag_status(TM0_Voltage_over_2p5v);
        int32_t flag_status_2p0v = ACE_get_flag_status(TM0_Voltage_over_2p0v);
        int32_t flag_status_1p5v = ACE_get_flag_status(TM0_Voltage_over_1p5v);
        int32_t flag_status_1p0v = ACE_get_flag_status(TM0_Voltage_over_1p0v);

        /* Voltage flags are displayed on the LEDs through GPIO */
        uint32_t gpio_output;
        if ( flag_status_2p5v == FLAG_ASSERTED )
                gpio_output = ~(
                        MSS_GPIO_28_MASK |
                        MSS_GPIO_29_MASK |
                        MSS_GPIO_30_MASK |
                        MSS_GPIO_31_MASK );
        else
        if ( flag_status_2p0v == FLAG_ASSERTED )
                gpio_output = ~(
                        MSS_GPIO_28_MASK |
                        MSS_GPIO_29_MASK |
                        MSS_GPIO_30_MASK );
        else
        if ( flag_status_1p5v == FLAG_ASSERTED )
                gpio_output = ~(
                        MSS_GPIO_28_MASK |
                        MSS_GPIO_29_MASK );
        else
        if ( flag_status_1p0v == FLAG_ASSERTED )
                gpio_output = ~(
                        MSS_GPIO_28_MASK );
        else
                gpio_output = (
                        MSS_GPIO_28_MASK |
                        MSS_GPIO_29_MASK |
```

```
                        MSS_GPIO_30_MASK |
                        MSS_GPIO_31_MASK );

          MSS_GPIO_set_outputs( gpio_output );
        }
}
/*****************************************************************************/
```

4. To configure the options for the project, right-click the project name (*Voltage_Monitor_MSS_MSS_CM30_app*) and click **Options**.

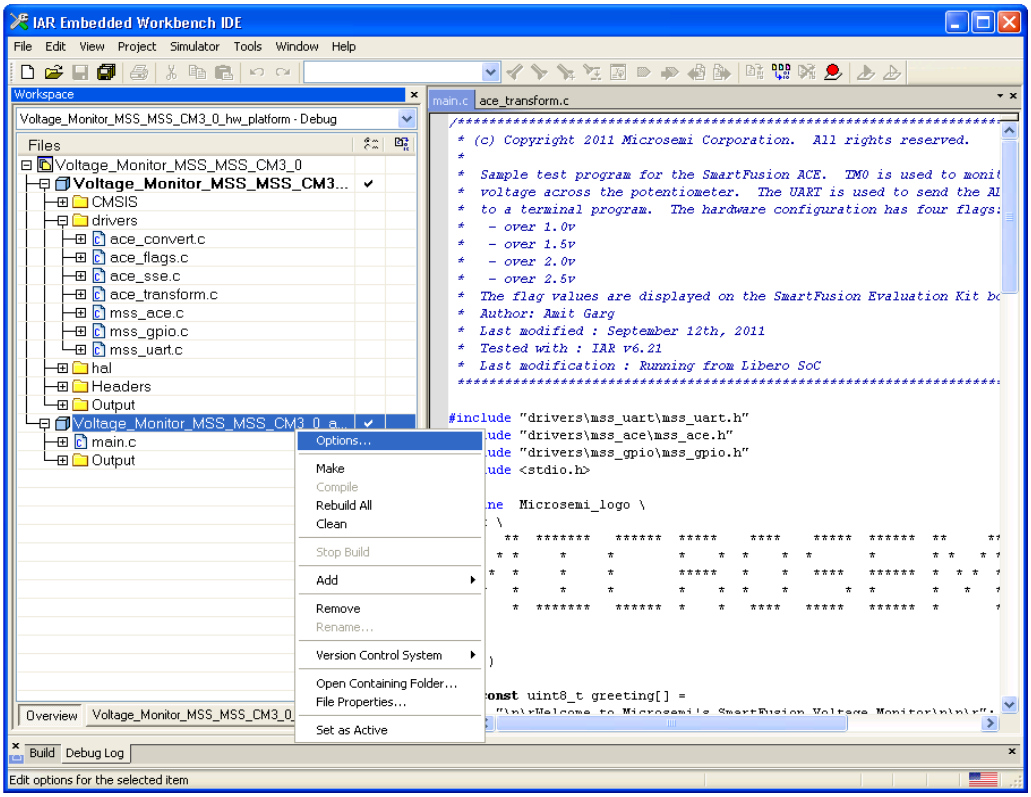


Figure 29 · Selecting Options for the Project

The **Options** available for the node Voltage_Monitor_MSS_MSS_CM30_app window are displayed in Figure 30 · .

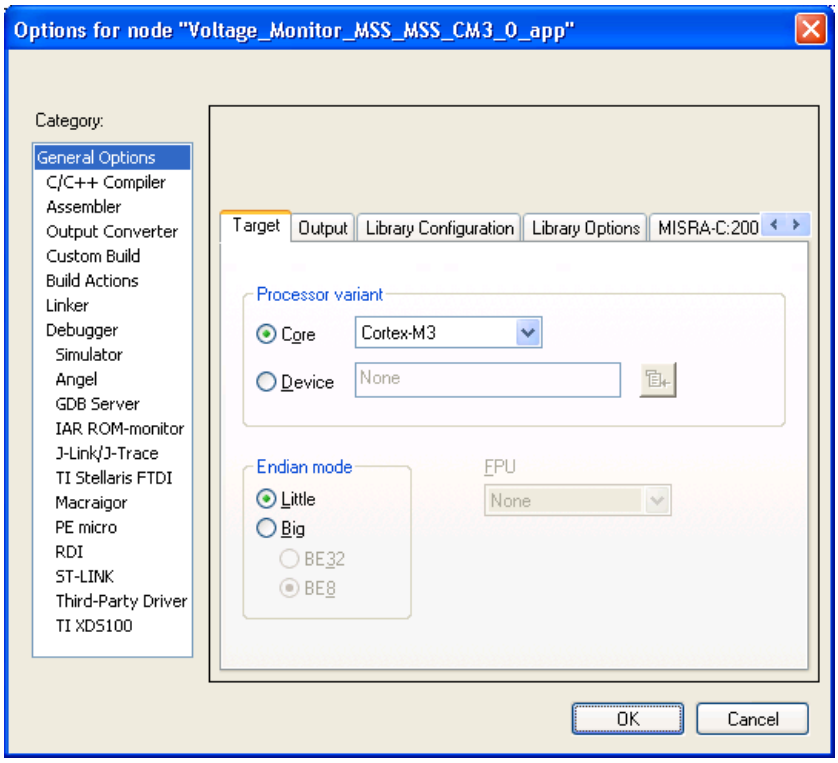


Figure 30 · Accessing the Options for Your Project

5. Click **Linker** under **Category** and add the **Linker configure file** (*Voltage_Monitor_MSS_MSS_CM3_0_hw_platform.icf* file,). Add the file that is available at C:\Microsemiprj\POT_LED_Libero_IAR\Voltage_Monitor\IAR folder by enabling the **Override** default. The *.icf file is a linker configuration file, which defines the segmentation of memory.

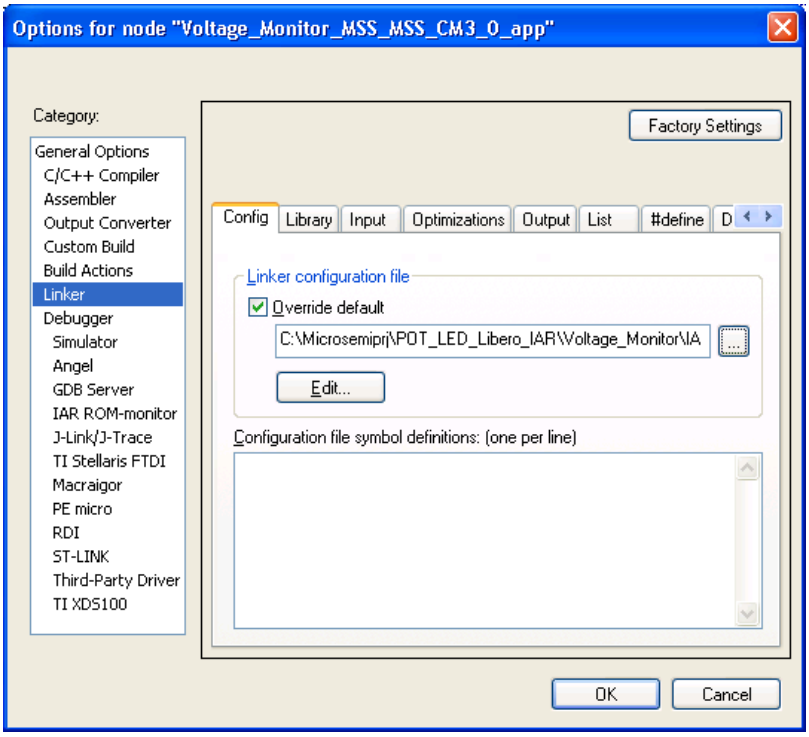


Figure 31 · Adding the Linker Configuration File

6. Click **Edit** to display the **Linker configuration file editor,** as shown in Figure 32 · . This window displays the **Vector Table**, **Memory Regions**, and **Stack/Heap Sizes** tabs.
7. Click on the **Memory Regions** tab to view the RAM/ROM regions.

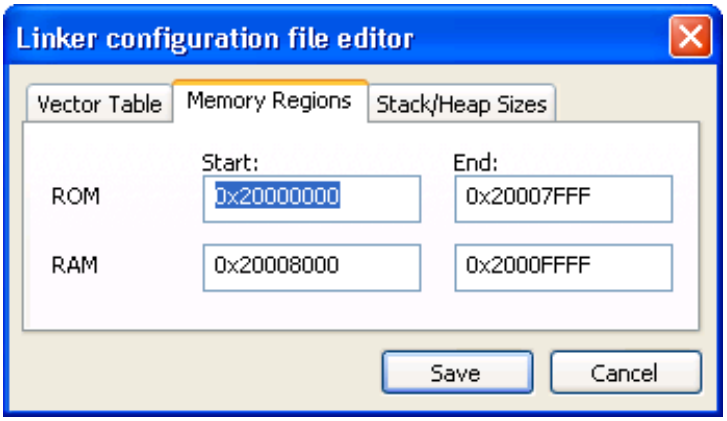


Figure 32 · The Linker Configuration File Editor – Memory Regions Tab

8. Click the **Stack/Heap Sizes** tab to view the Stack/Heap sizes. Click **Save.**

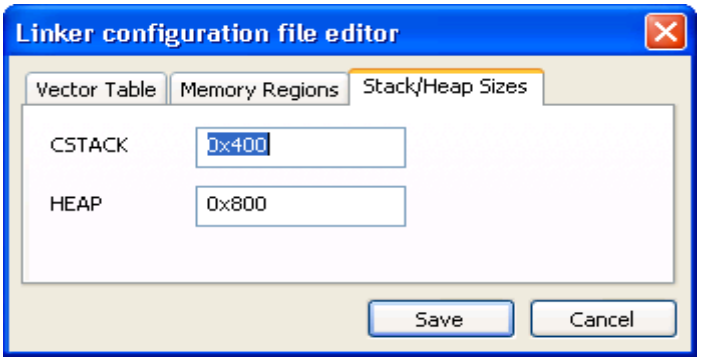


Figure 33 · The Linker Configuration File Editor – Stack/Heap Sizes Tab

9. Click the **Debugger** category. Under the **Setup** tab, select the **Driver** as **J-Link/J-Trace** using the drop-down list.

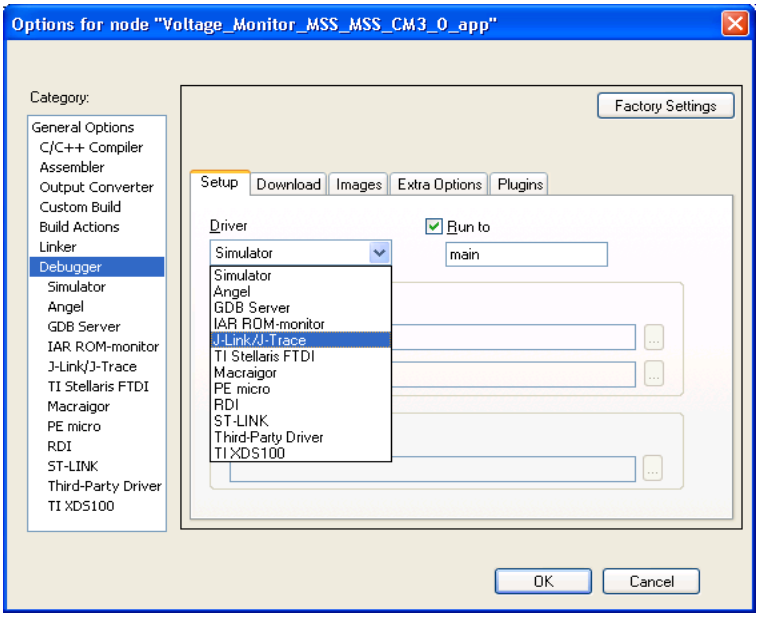


Figure 34 · Selecting the Driver as J-Link/J-Trace for the Debugger

10. Select the **Use macro file(s)** listed under **Setup macros** (see Figure 35 ·). Browse to the Voltage_Monitor *_MSS_MSS_CM3_0_hw_platform.mac* file which is available in which is available in C:\ Microsemiprj\POT_LED_Libero_IAR\Voltage_Monitor\IAR folder. The purpose of this file is to remap the ESRAM to the 0th location.
11. Select the **Override default** option listed under the **Device description file** (see Figure 35 ·). Browse to the *SmartFusion_dss.ddf file* which is available in C:\ Microsemiprj\POT_LED_Libero_IAR\Voltage_Monitor\IAR folder. DDF files allows user to see the MSS Register map for all peripherals.

    Note: The Debugger files provided in the attached zip folder have been extracted to the project directory where you will store the EWARM project. For example, C:\Microsemiprj\UART_Libero_IAR\SmartFusion_UART_HW\IAR.

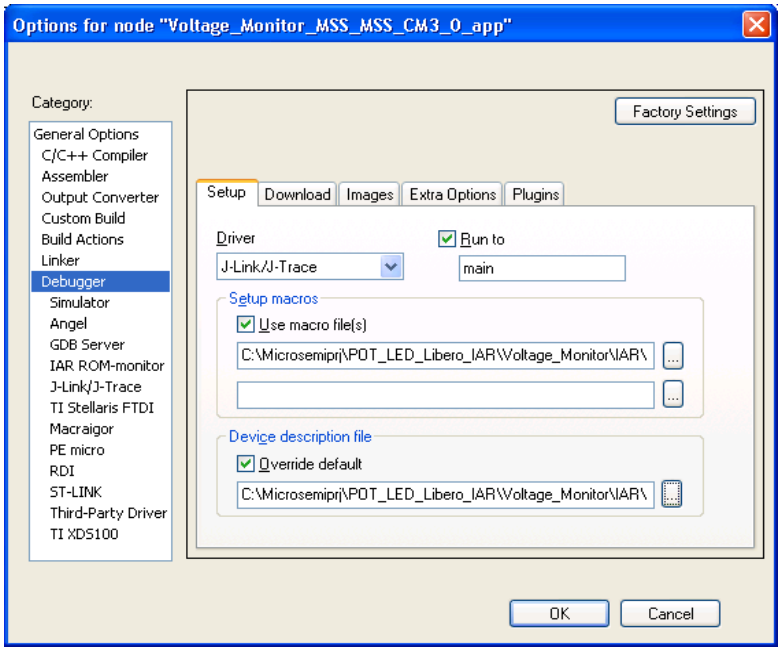


Figure 35 · Setting up Macros for the Debugger

12. Under the **Download** tab, select **Verify download**.

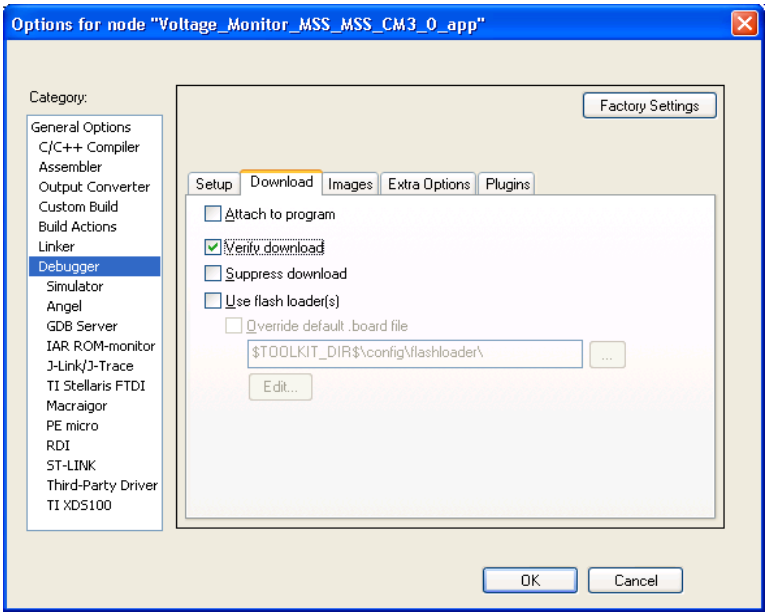


Figure 36 · Download Verification Settings for the Debugger

13. Click **J-Link/J-Trace** category. Under the **Setup** tab, select **Reset** as **Core** as shown in Figure 37 · :

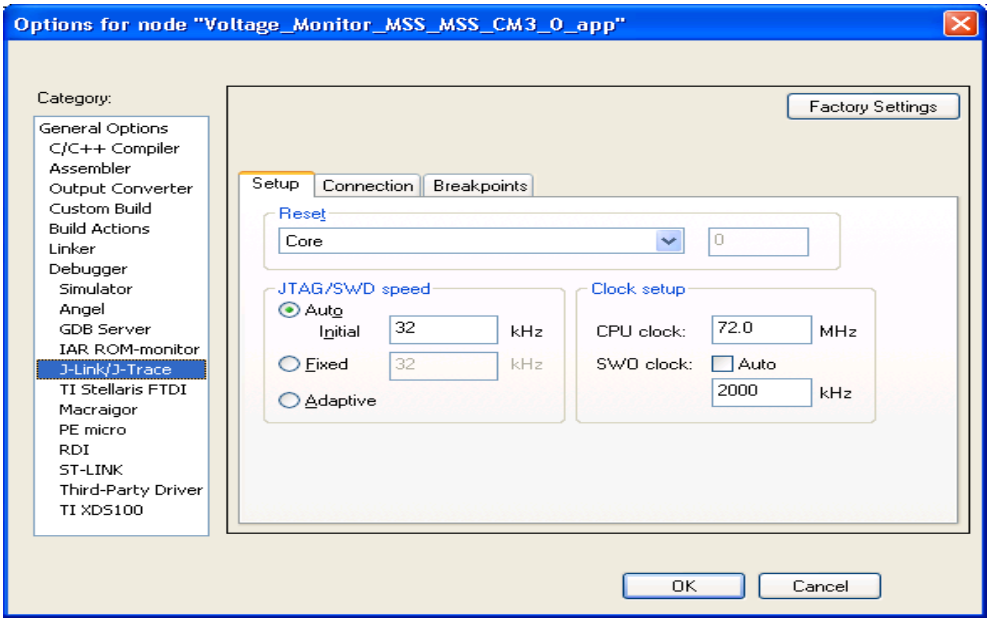


Figure 37 · J-Link/J-Trace Setup

14. Click **OK** to close this window and build the project.
15. Right-click on Voltage_Monitor_MSS_MSS_CM3_0_hw_platform and select **Make**.

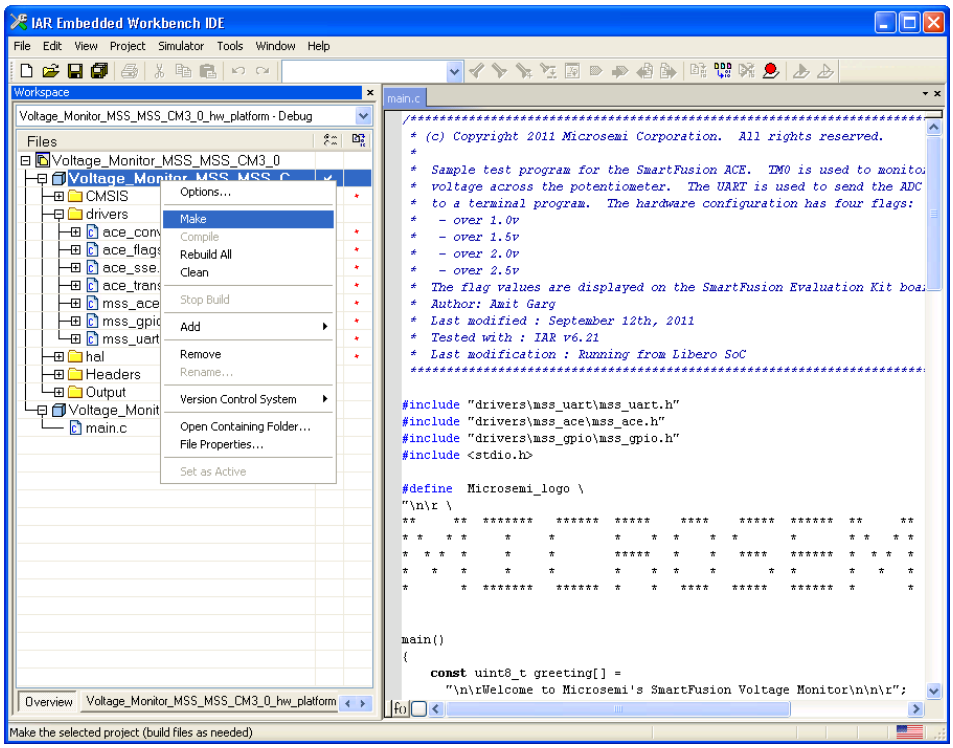


Figure 38 · Make the Hardware Platform

16. Right-click on **Voltage_Monitor_MSS_MSS_CM3_0_app** project name and select **Set as Active**.

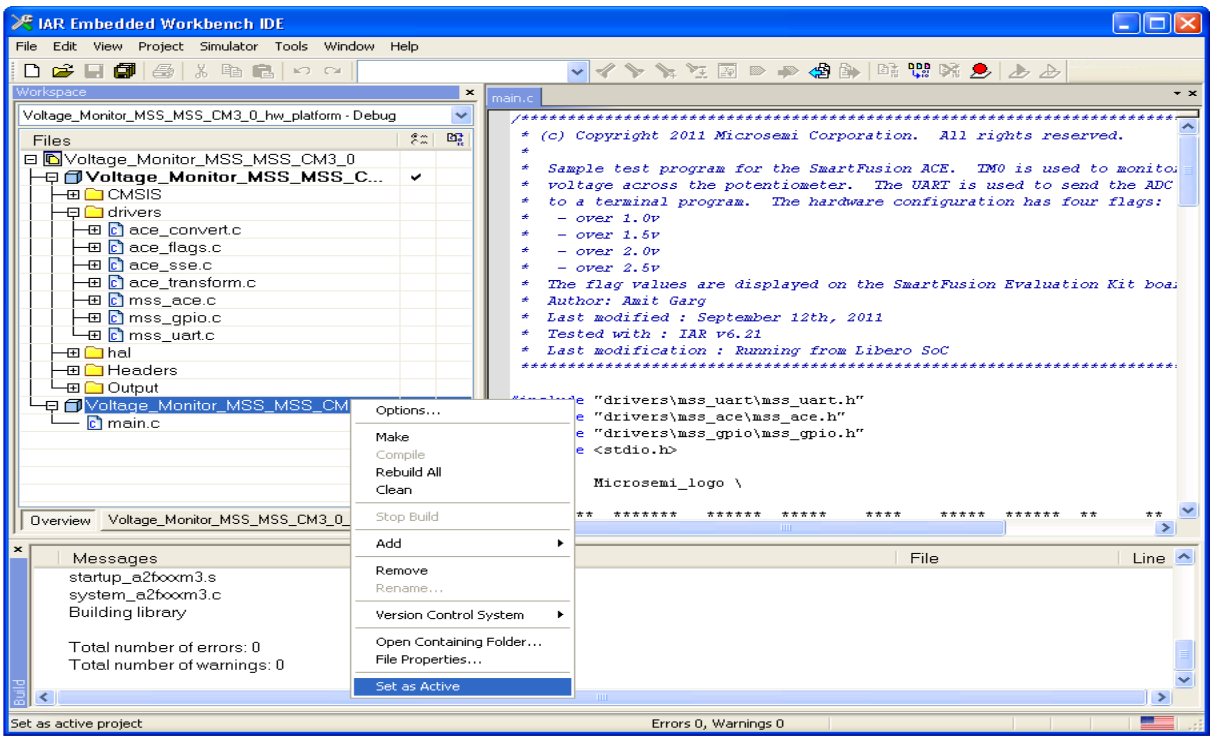


Figure 39 · Select Active Project

17. Right-click on the **Voltage_Monitor_MSS_MSS_CM3_0_app** project name and select **Clean**.

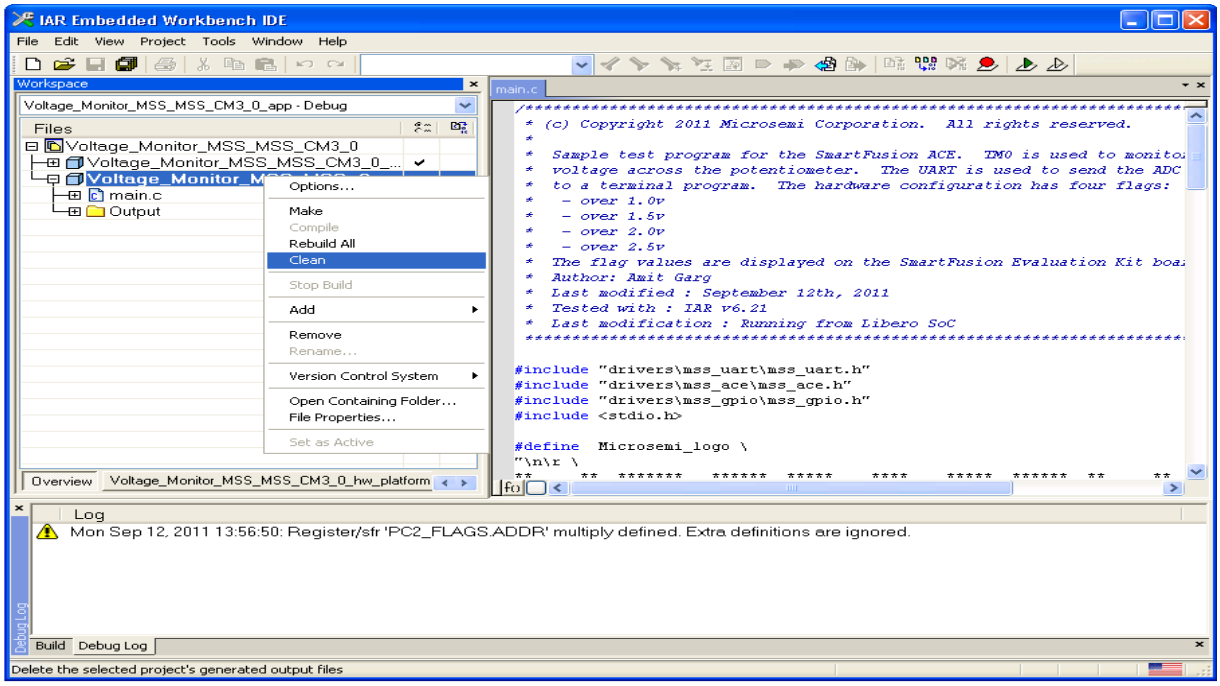


Figure 40 · Building a Clean Project

18. After cleaning the project, the **Messages** log window shows that some files were deleted.

Figure 41 · Files Deleted Message

19. Right-click on the **Voltage_Monitor_MSS_MSS_CM3_0_app** project name and click **Rebuild All**.
20. Ensure that no errors appear in the **Messages** log window and follow the next steps to configure the HyperTerminal.

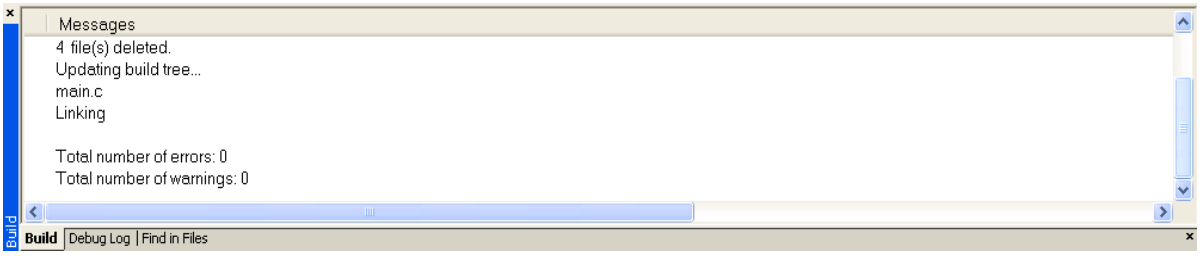


Figure 42 · Error-Free Message Log

Step 7 - Configuring the Serial Terminal Emulation Program

Prior to running the application program, you need to configure the terminal emulator program (HyperTerminal, included with Windows®) on your PC. Perform the following steps to use the SmartFusion Evaluation Kit Board or the SmartFusion Development Kit Board:

1. Connect a second mini USB cable between the USB connector on the SmartFusion Evaluation Kit Board or the SmartFusion Development Kit Board and a USB port of your computer. If Windows prompts you to connect to Windows Update, select **No**, **not at this time** and click **Next**.
2. If the SFE USB to RS232 Controller drivers are automatically detected (this can be verified in Device Manager), as shown in Figure 43 · , proceed to next step; otherwise follow the Step 8 - Installing Drivers for the USB to RS232 Bridge.

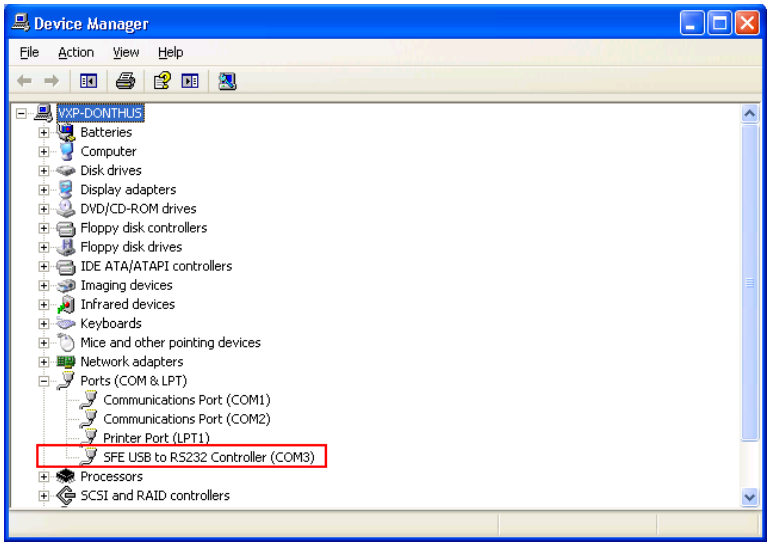


Figure 43 · Device Manager Listing SFE USB to RS232 Controller Drivers

3. From the Windows **Start** menu, select **Programs > Accessories > Communications > HyperTerminal**. This opens HyperTerminal. If your PC does not have HyperTerminal, use any free serial terminal emulation program like PuTTY or Tera Term. Refer to the *Configuring Serial Terminal Emulation Programs* tutorial for configuring the HyperTerminal, Tera Term, and PuTTY.
4. Enter **Hyperterminal** in the **Name** field in the **Connection Description** dialog box and click **OK**.

Figure 44 · New Connection

5. Select the appropriate COM port (to which USB-Rs232 drivers are pointed) from the **Connect using** drop-down list and click **OK**.

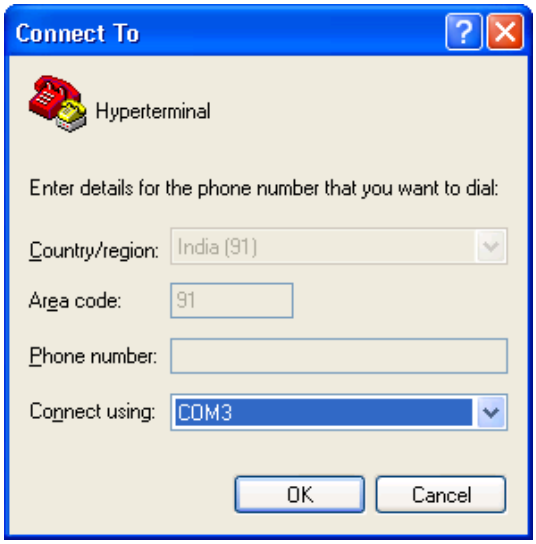


Figure 45 · Selecting the COM Port

6. Set the following in the **COM Properties** window and click **OK**:
   - Bits per second: 57600
   - Data bits: 8
   - Parity: None
   - Stop Bits: 1
   - Flow control: None

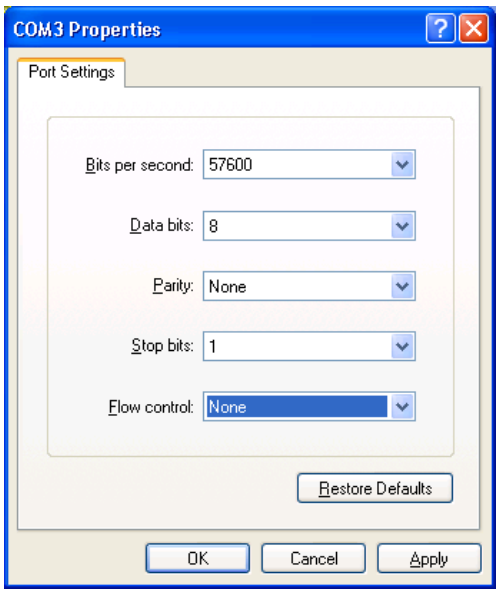


Figure 46 · Setting the COM Properties

7. Click **OK** to close the UART_Hyperterminal Properties dialog box.

Next time you can directly open HyperTerminal (without configuring) by selecting, **Programs > Accessories > Communications > HyperTerminal > Hyperterminal**.

Step 8 - Installing Drivers for the USB to RS232 Bridge

Note: To install the USB-RS232 drivers, you should have administrative privileges for your PC.

Use the following steps to install drivers for the USB to RS232 Bridge:

1. Unzip the USB_Drivers.zip file and browse to the USB Drivers folder. Refer to the instructions in the readme.txt file contained in the zip file.
2. Double click (run) **PreInstaller.exe**.
3. Accept the default installation location and click **Install**.
4. Click **Continue Anyway** if prompted.
5. When the installation is complete, click **OK**. The Ports (COM & LPT) section of the Device Manager lists SFE USB to RS232 Controller under the Ports section of the Device Manager.

Step 9 - Debugging the Application Project Using IAR

Follow the steps given below to debug the application project using IAR:

1. Connect J-link Box to Board and PC using the following connection tips:
   - Connect the J-Link ARM to the RVI-Header of the SmartFusion Evaluation Kit Board or the SmartFusion Development Kit Board.
   - JP7: Connect pin 2 and 3 for IAR debugging mode.
   - JP10: Connect pin 2 and 3.
   - J6: Connect pin 1 and 2.

2. In the IAR Workbench click **Download and Debug**:

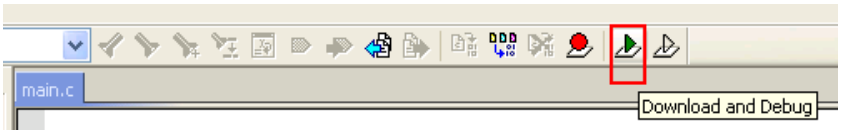


Figure 47 · Download and Debug the Project

3. The Workbench window is displayed as shown in Figure 48 · .

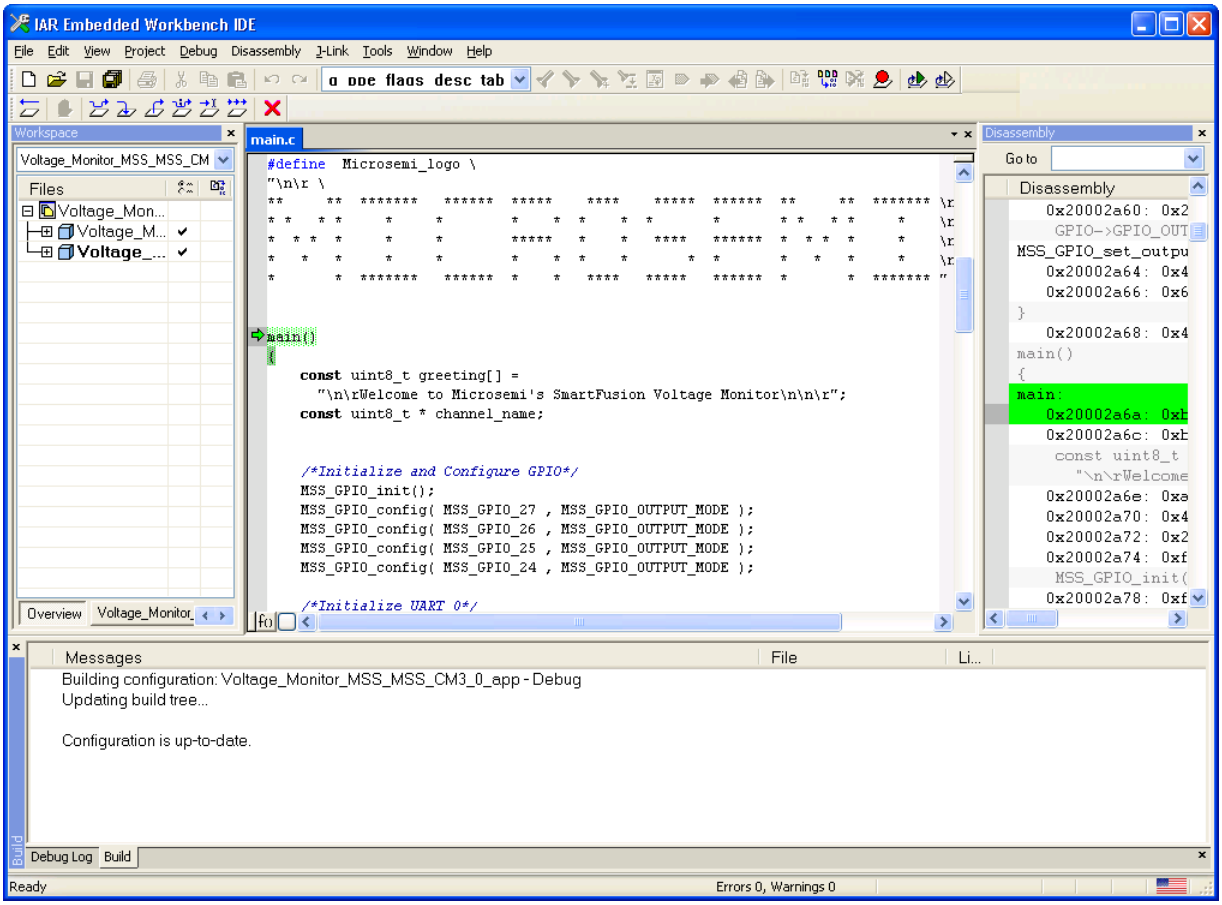


Figure 48 · IAR Workbench After Downloading the Project

4. Click **Go**.

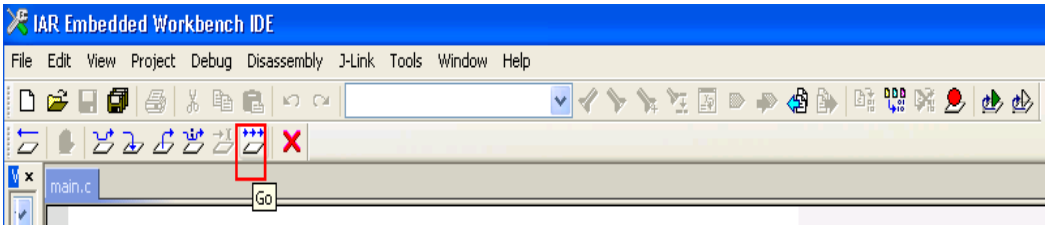


Figure 49 · Run the Project

5. Observe the HyperTerminal window. It should display the greeting message with Microsemi name as shown in Figure 50 · .

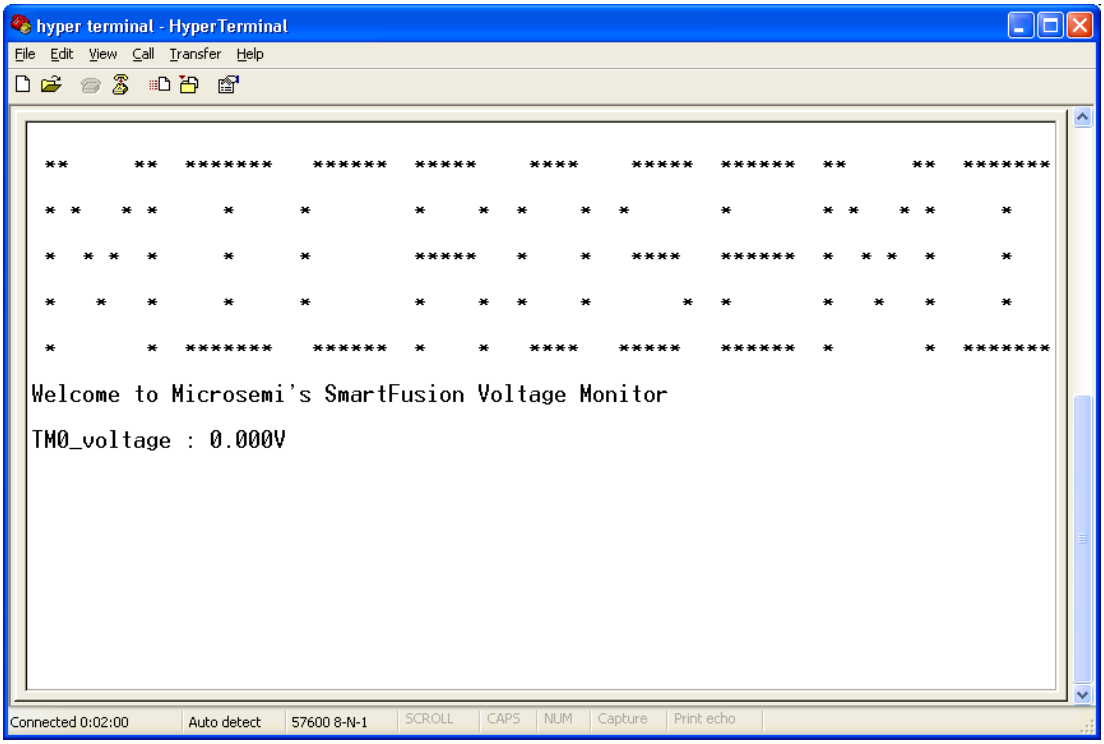


Figure 50 · UART HyperTerminal Window

Note: If you try typing some alphabetic characters, you will find they are echoed in the terminal window.

6. To observe the state of the UART0 registers, click **View > Register**. In the **Register** pane, select **UART_0** from the drop-down list.

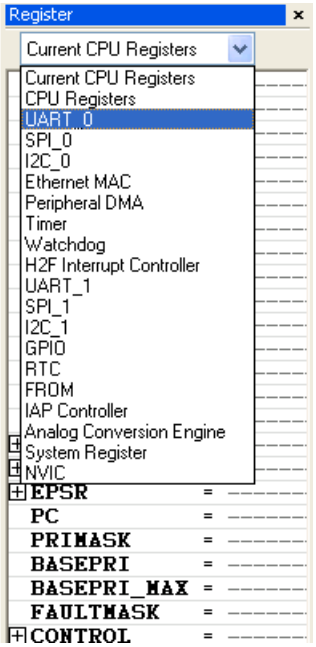


Figure 51 · Current CPU Registers

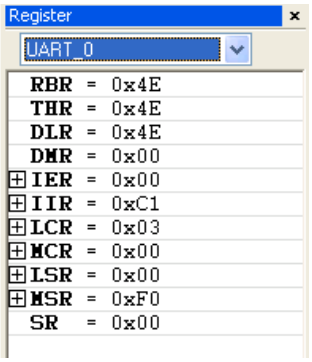


Figure 52 · UART_0 Registers

7. Move the POT on the SmartFusion Evaluation Kit Board or the SmartFusion Development Kit Board. The voltage measurement is displayed on HyperTerminal and the LEDs are illuminated on the SmartFusion Evaluation Kit Board or the SmartFusion Development Kit Board when one of the voltage monitor flags is asserted.
8. Adjust the POT and observe that the voltage measurement is continuously updated.

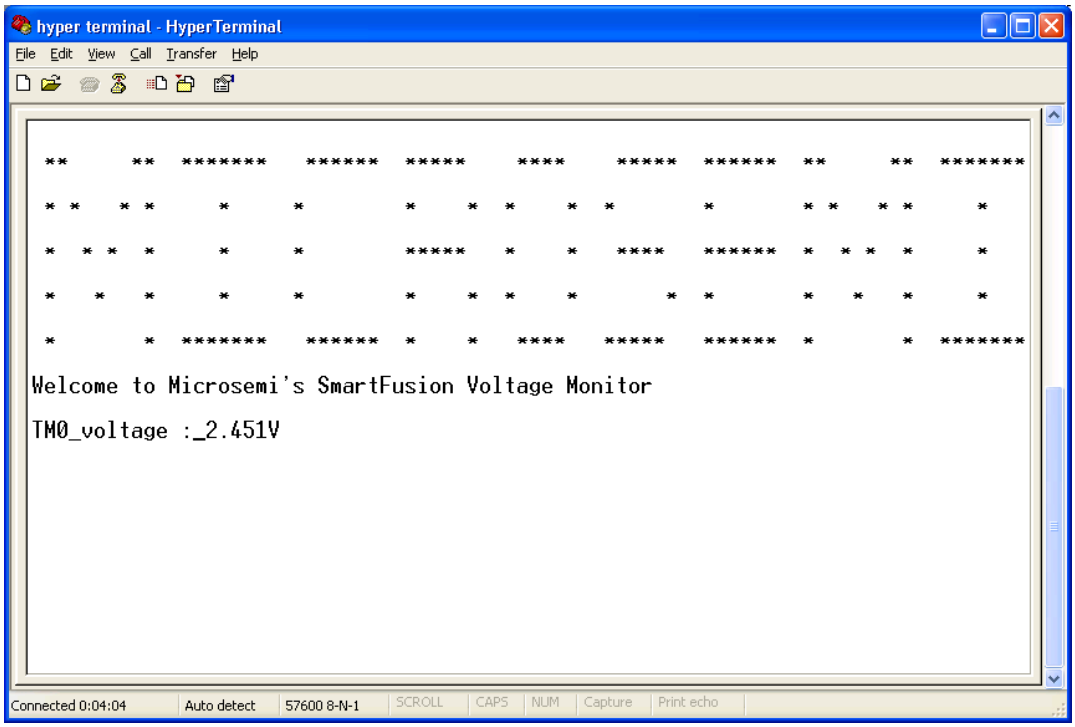


Figure 53 · HyperTerminal Window (2.451 V)

9. Observe the state of the LEDs as the POT is adjusted. Confirm that the flags work as specified in the ACE configurator.
10. To stop debugging click **Stop Debugging**.

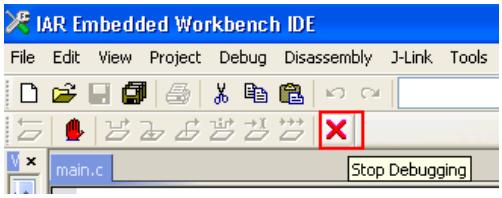


Figure 54 · Stop Debugging

This concludes the tutorial.

Appendix A – Libero SoC Catalog Settings

Listed below are the steps to show how to configure your vault location and set up the repositories in Libero SoC.

1. On the **Catalog** window, click **Options**.

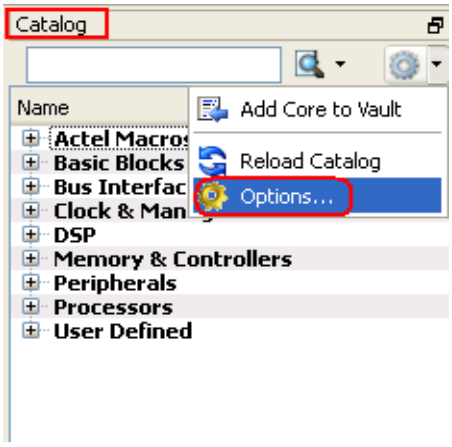


Figure 55 · Catalog – Options

2. The **Options** window is displayed. Click **Repositories** under **Vault/Repositeries Settings** add the following in the address field:
   - www.actel-ip.com/repositories/SgCore
   - www.actel-ip.com/repositories/DirectCore
   - www.actel-ip.com/repositories/Firmware

   Note: Click **Add** after entering each path.

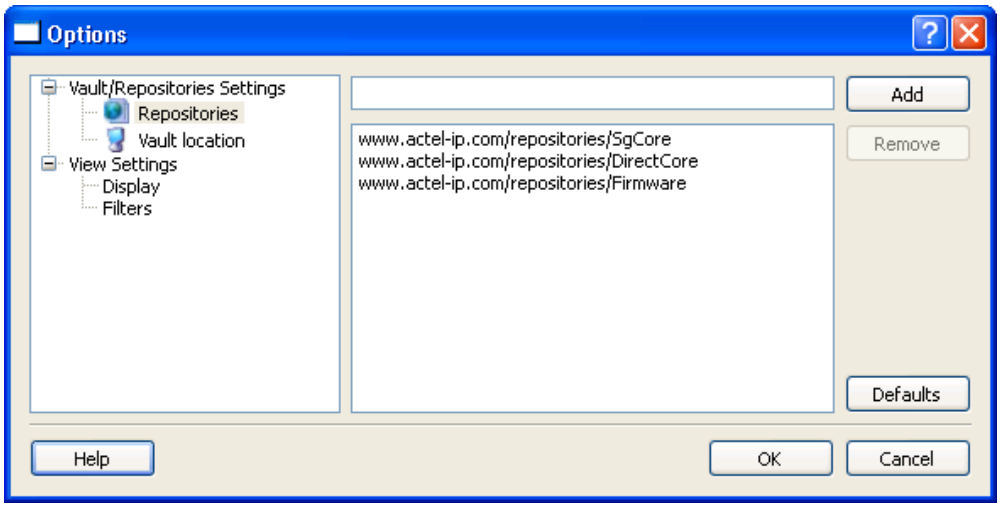


Figure 56 · Setting Repositories

3. Click on **Vault location** under **Vault/Repositeries Settings** the **Options** window. Browse to a location on your PC to set the vault location where the IPs can be downloaded from the repositories.

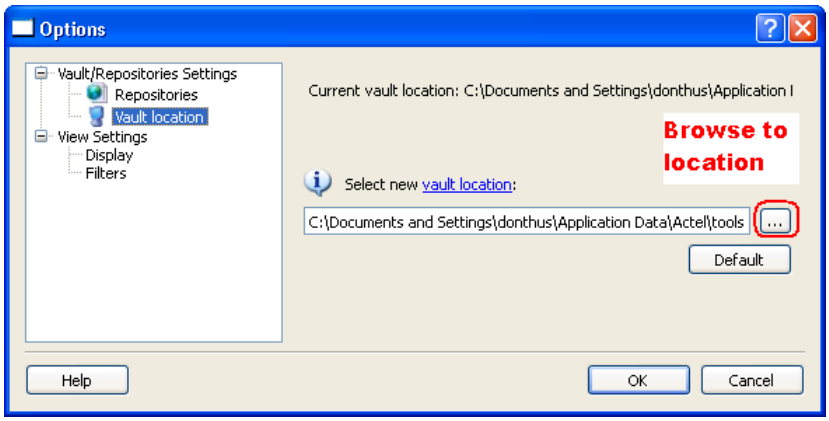


Figure 57 · Setting the Vault Location

4. Click **OK.**

Appendix B – Firmware Catalog Settings

1. Open the **<Libero Installation directory>\Designer\bin\catalog.exe**.
2. Select **Tools > Vault/Repositories Settings**, from the **Firmware Catalog** widow.

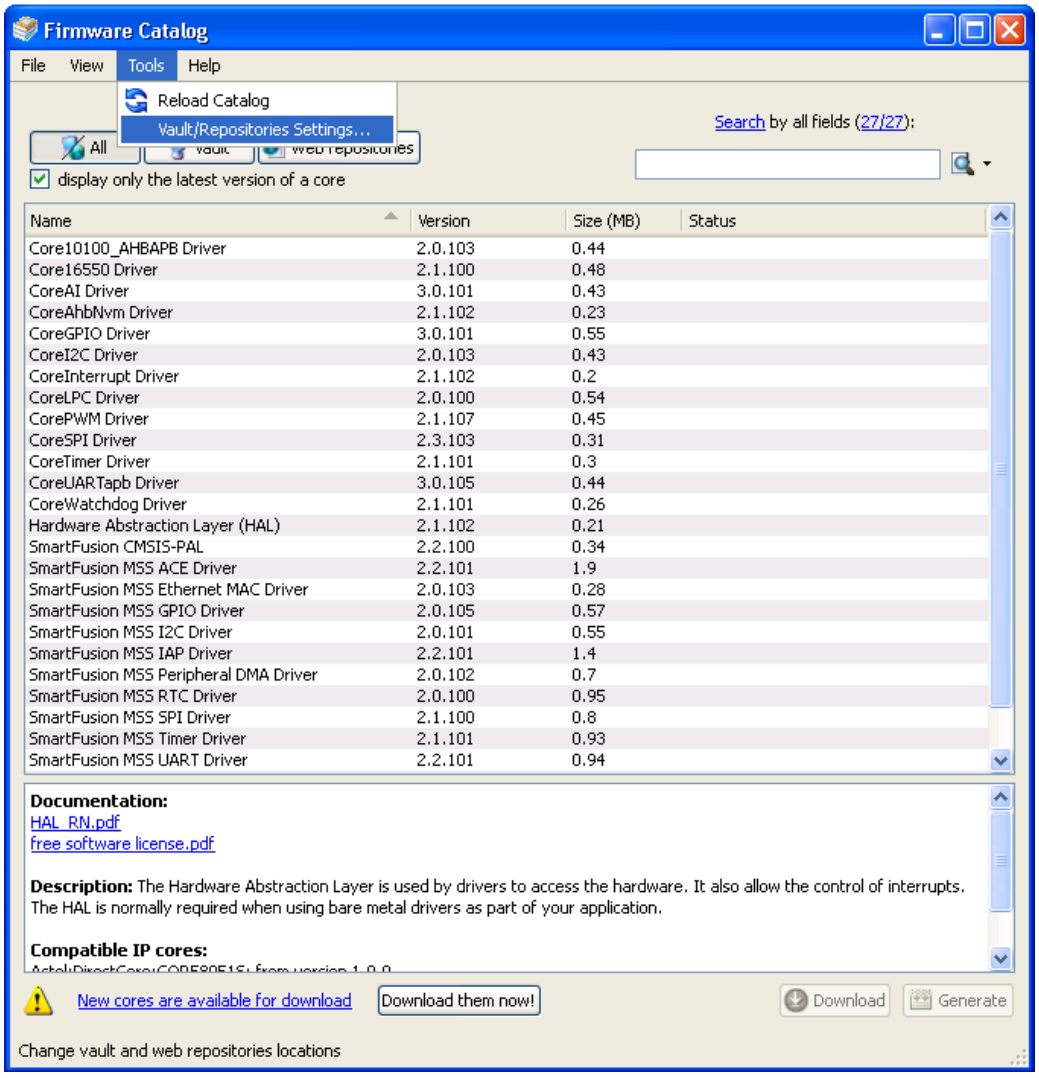


Figure 58 · Firmware Catalog Settings

3. Select **Repositories** under **Vault/Repositories Settings** in the **Options** dialog box.
4. Confirm that the following repositories are displayed (add them if needed):
   - www.actel-ip.com/repositories/SgCore
   - www.actel-ip.com/repositories/DirectCore
   - www.actel-ip.com/repositories/Firmware
5. Add the above mentioned paths in the address field if required by selecting the repository and clicking **Add**.

If new cores are available for download, click **Download them now!** to download the new cores to the vault.

Appendix C

Configuring the GPIO Peripheral

1. Double-click the GPIO block in the MSS component, configure as shown in Figure 59 · , and click OK.

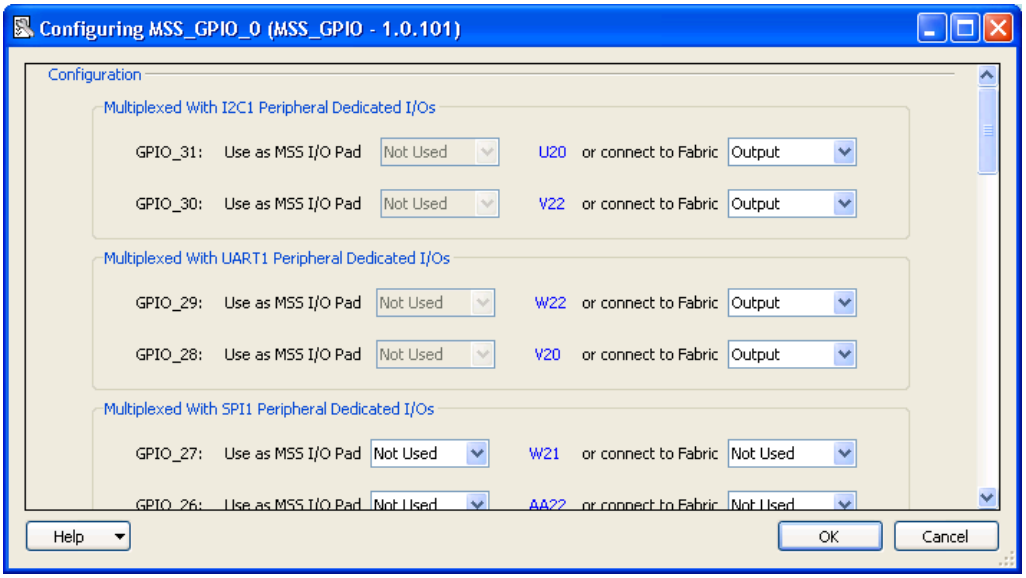


Figure 59 · Configure MSS_GPIO_0

This example requires GPIO_31, GPIO_30, GPIO_29, and GPIO_28 to be connected to LED_4 to LED_1 on the SmartFusion Evaluation Kit Board (D4 to D1 on the SmartFusion Development Kit Board). These signals will be routed through the fabric to I/O pins H17, C19, B20, and B19, respectively.

2. Click **File > Save** to save the Voltage_Monitor_MSS.

Generating the MSS Component

1. Right-click on Voltage_Monitor_MSS_0 component on the **Voltage_Monitor** tab and select Update Instance(s) with Latest Component.

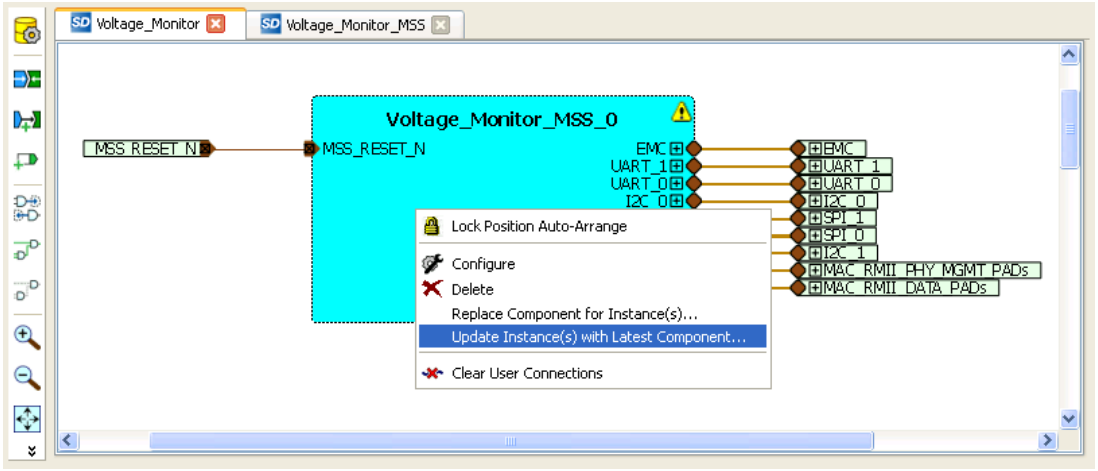


Figure 60 · Updating the MSS

2. Promote the M2F_GPIO [31:28] pins to top level.

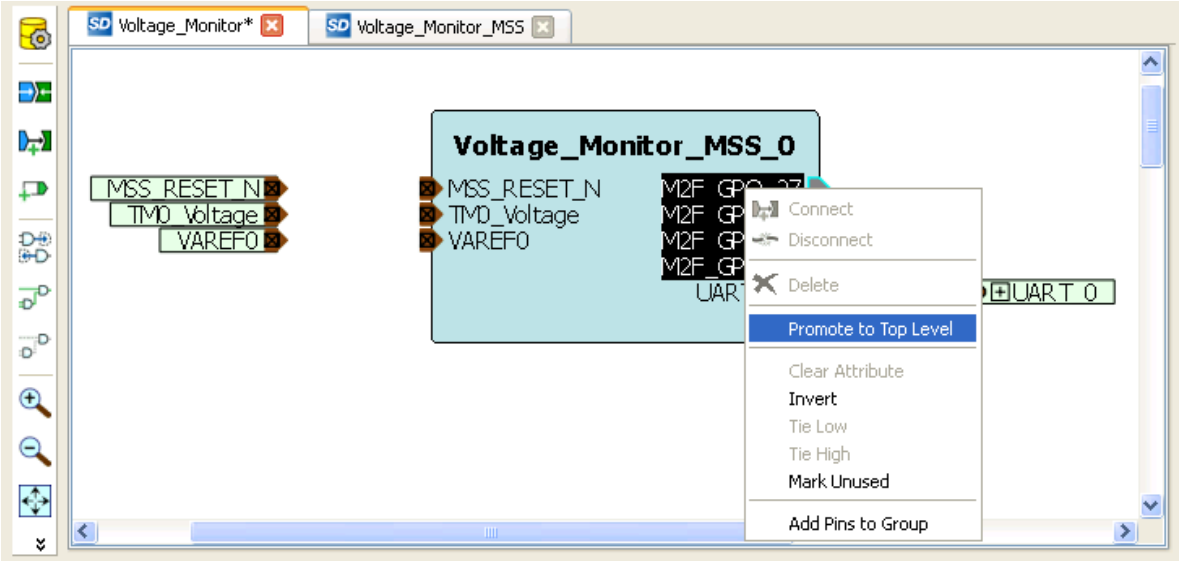


Figure 61 · GPIO Pins Promoted to Top Level

3. Click **Design > Configure Firmware** as shown in Figure 62 · .

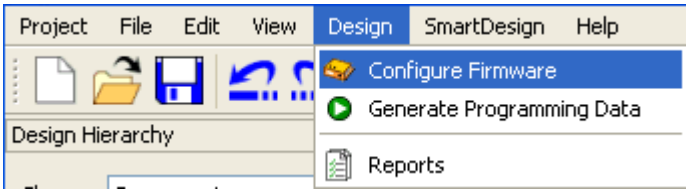
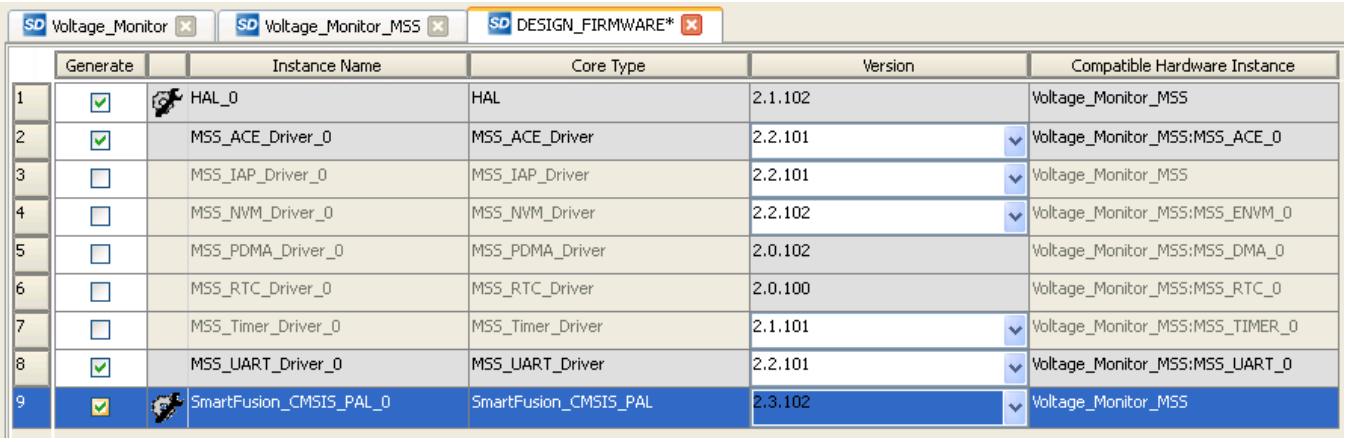


Figure 62 · Opening Design_Firmware

4. On the **DESIGN_FIRMWARE** tab, clear the Generate check boxes for all the peripherals for which you do not need to generate the firmware. Click Configuration on the SmartFusion_CMSIS_PAL_0 instance and select SoftConsole as the configuration.



	Generate	Instance Name	Core Type	Version	Compatible Hardware Instance
1	☑	HAL_0	HAL	2.1.102	Voltage_Monitor_MSS
2	☑	MSS_ACE_Driver_0	MSS_ACE_Driver	2.2.101	Voltage_Monitor_MSS:MSS_ACE_0
3	☐	MSS_IAP_Driver_0	MSS_IAP_Driver	2.2.101	Voltage_Monitor_MSS
4	☐	MSS_NVM_Driver_0	MSS_NVM_Driver	2.2.102	Voltage_Monitor_MSS:MSS_ENVM_0
5	☐	MSS_PDMA_Driver_0	MSS_PDMA_Driver	2.0.102	Voltage_Monitor_MSS:MSS_DMA_0
6	☐	MSS_RTC_Driver_0	MSS_RTC_Driver	2.0.100	Voltage_Monitor_MSS:MSS_RTC_0
7	☐	MSS_Timer_Driver_0	MSS_Timer_Driver	2.1.101	Voltage_Monitor_MSS:MSS_TIMER_0
8	☑	MSS_UART_Driver_0	MSS_UART_Driver	2.2.101	Voltage_Monitor_MSS:MSS_UART_0
9	☑	SmartFusion_CMSIS_PAL_0	SmartFusion_CMSIS_PAL	2.3.102	Voltage_Monitor_MSS

Figure 63 · Firmware Configuration Settings – CMSIS Peripheral

5. Check whether or not you are able to see the latest version of the drivers without any warning or error indication the firmware is missing from the Vault. If missing, refer to Appendix B – Firmware Catalog Settings.
6. Click **File > Save** to save the **Design_Firmware**.

7. Save the design and generate the component by clicking **Generate Component** or by selecting **SmartDesign > Generate Component**.

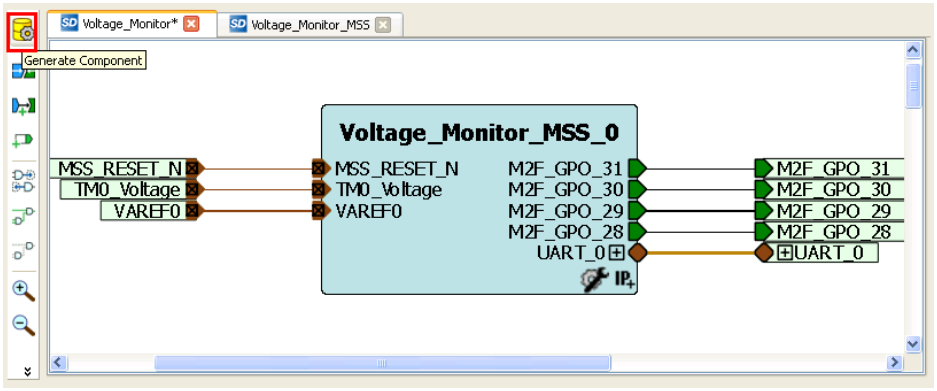


Figure 64 · Generating the MSS Component

8. After successful generation of project the log window displays the message "**Info: 'Voltage_Monitor' was successfully** generated**. Open datasheet for details**". The datasheet has the Project information like Generated files, used IO's, and Memory map etc.
9. Confirm that the IAR folder is created with the folders and files as shown in Figure 65 · .

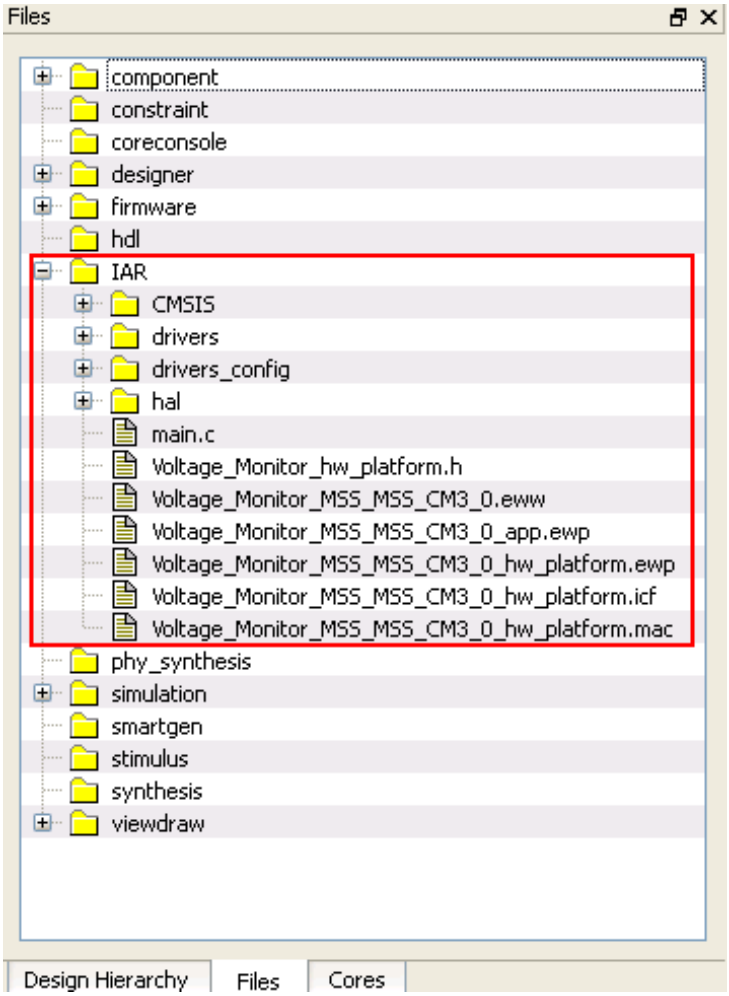


Figure 65 · Files Window

Generating the Program File

Libero SoC provides the push button flow for Generating programming data of the project in a single step. By clicking **Generate Programming Data**, you can complete the synthesis, place and route, verify timing and generating the programming file. You can also complete the flow by running the synthesis and place and route tools in interactive mode (step-by-step), for more information refer to the *Libero SoC Quick Start Guide*.

Push-button Design Flow

1. Click **Edit I/O attributes** under **Constrain place and route** in the **Design Flow** window.

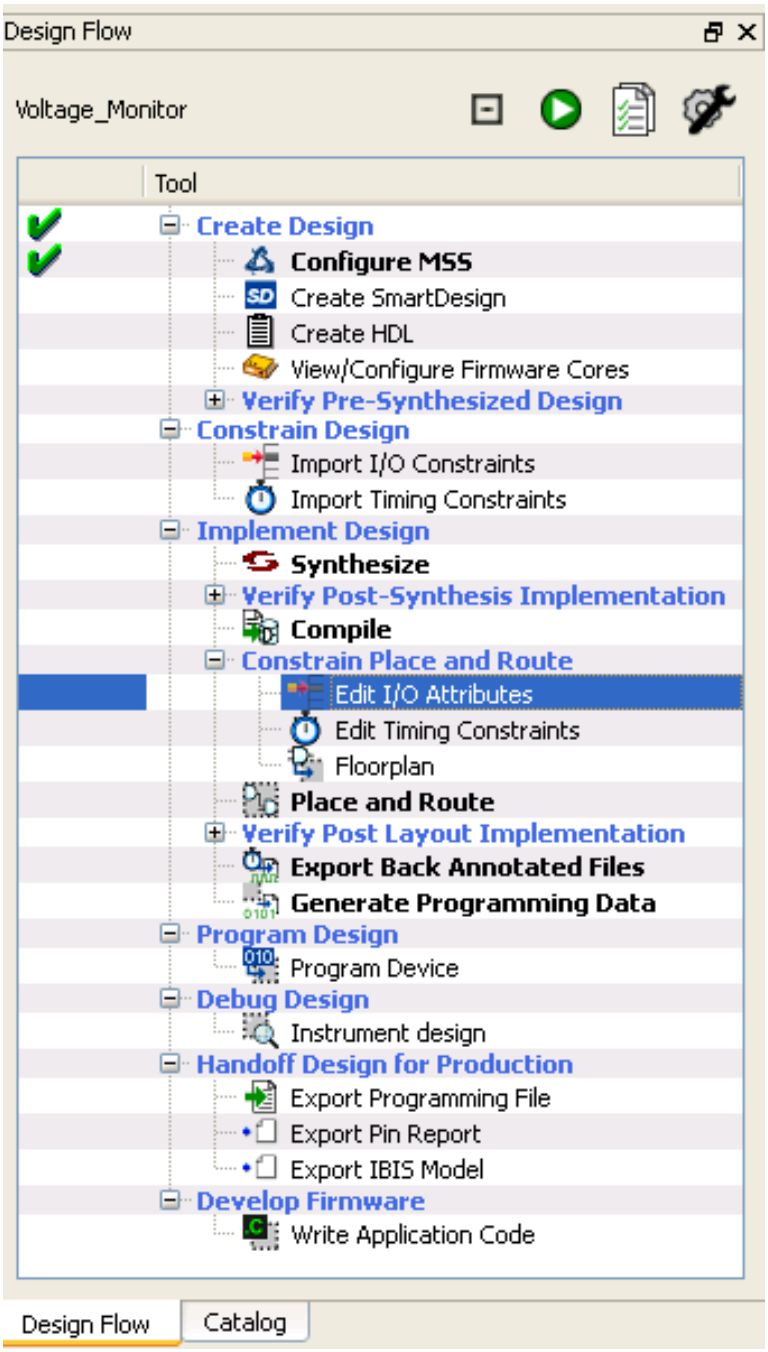


Figure 66 · Edit I/O Attributes

2. Make the following pin assignments in **MultiView Navigator** window as shown in Figure 67 · .
   - GPO_28 to B19
   - GPO_29 to B20
   - GPO_30 to C19
   - GPO_31 to H17

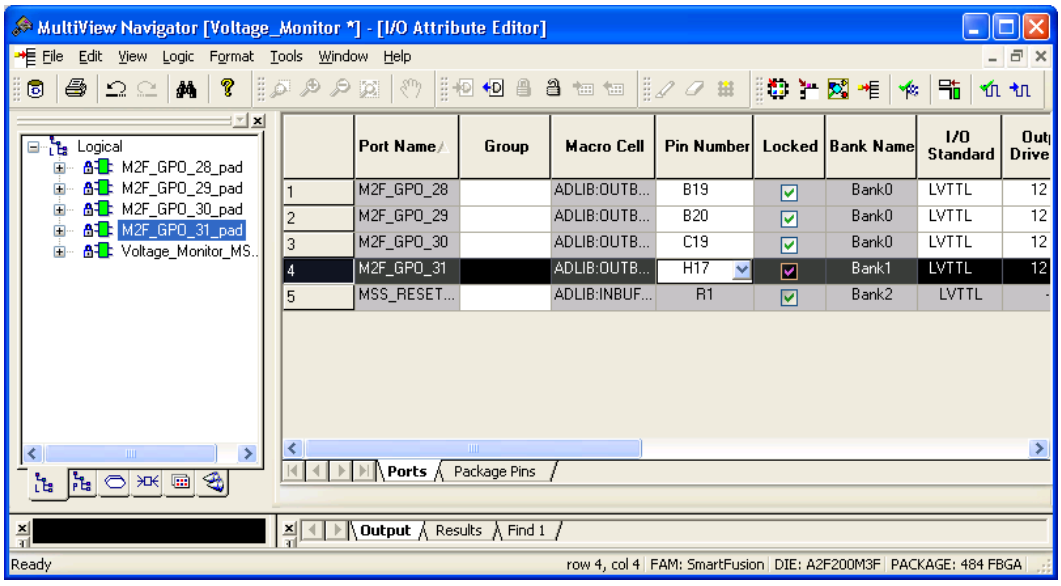


Figure 67 · MultiView Navigator GUI

3. Commit and check the edits using **File > Commit and Check**. Connect any errors that are reported in the MVN log window.
4. Close the **MultiView Navigator** using **File > Exit**.
5. Close the **Designer** window and select **Yes** when it prompts to save changes.

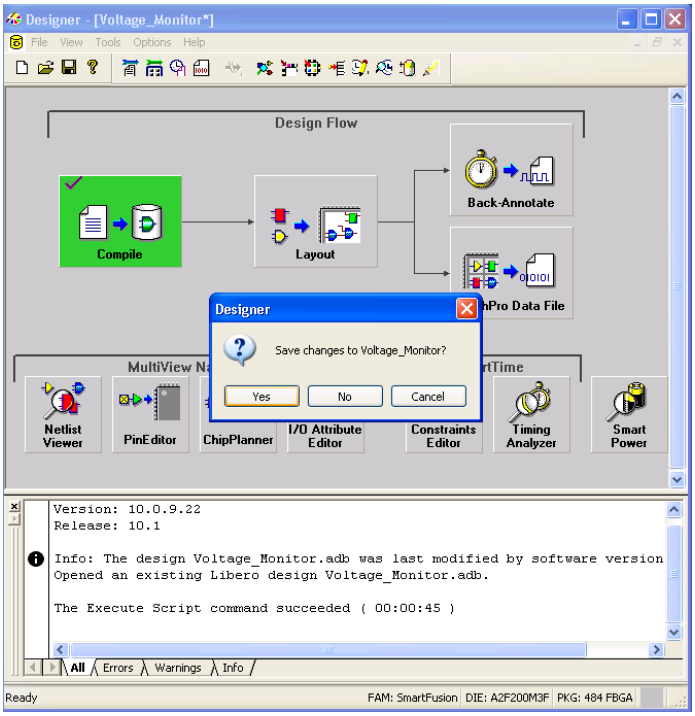


Figure 68 · Designer Window

6. Click **Generate Programming Data** to complete the place and route, verify timing and generate the programming file. This completes the.fdb file generation.

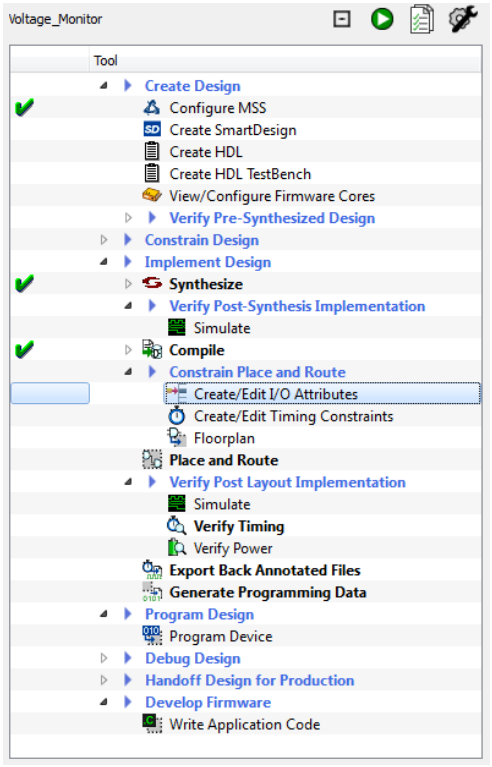


Figure 69 · Generating Programming Data

7. The **Design Flow** window looks as shown in Figure 70 · .

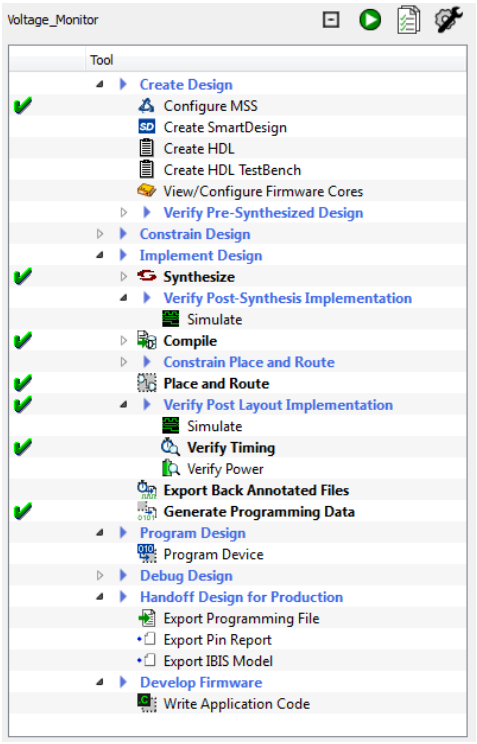


Figure 70 · Design Flow Window After Building the Project

8. Follow Step 5 - Programming SmartFusion Board Using FlashPro.

List of Changes

Revision	Changes	Page
Revision 6 (May 2012)	Modified Software Requirements under Tutorial Requirements section (SAR 38349)	3
	Replaced Figure 6 · (SAR 38349)	8
	Replaced Figure 21 · (SAR 38349)	14
	Replaced Figure 25 · (SAR 38349)	16
	Replaced Figure 26 · (SAR 38349)	18
	Replaced Figure 27 · (SAR 38349)	19
	Modified Step 6 - Building the Software Application Through IAR Embedded Workbench (SAR 38349)	19
	Replaced Figure 69 · and Figure 70 · (SAR 38349)	44
Revision 5 (November 2011)	Updated the document for Libero SoC v10.0 (SAR 35044).	

Note: The revision number is located in the part number after the hyphen. The part number is displayed at the bottom of the last page of the document. The digits following the slash indicate the month and year of publication.

Product Support

Microsemi SoC Products Group backs its products with various support services, including Customer Service, Customer Technical Support Center, a website, electronic mail, and worldwide sales offices. This appendix contains information about contacting Microsemi SoC Products Group and using these support services.

Customer Service

Contact Customer Service for non-technical product support, such as product pricing, product upgrades, update information, order status, and authorization.

From North America, call **800.262.1060**
From the rest of the world, call **650.318.4460**
Fax, from anywhere in the world **408.643.6913**

Customer Technical Support Center

Microsemi SoC Products Group staffs its Customer Technical Support Center with highly skilled engineers who can help answer your hardware, software, and design questions about Microsemi SoC Products. The Customer Technical Support Center spends a great deal of time creating application notes, answers to common design cycle questions, documentation of known issues and various FAQs. So, before you contact us, please visit our online resources. It is very likely we have already answered your questions.

Technical Support

Visit the Microsemi SoC Products Group Customer Support website for more information and support (http://www.microsemi.com/soc/support/search/default.aspx). Many answers available on the searchable web resource include diagrams, illustrations, and links to other resources on website.

Website

You can browse a variety of technical and non-technical information on the Microsemi SoC Products Group home page, at http://www.microsemi.com/soc/.

Contacting the Customer Technical Support Center

Highly skilled engineers staff the Technical Support Center. The Technical Support Center can be contacted by email or through the Microsemi SoC Products Group website.

Email

You can communicate your technical questions to our email address and receive answers back by email, fax, or phone. Also, if you have design problems, you can email your design files to receive assistance. We constantly monitor the email account throughout the day. When sending your request to us, please be sure to include your full name, company name, and your contact information for efficient processing of your request.

The technical support email address is soc_tech@microsemi.com.

My Cases

Microsemi SoC Products Group customers may submit and track technical cases online by going to My Cases.

Outside the U.S.

Customers needing assistance outside the US time zones can either contact technical support via email (soc_tech@microsemi.com) or contact a local sales office. Sales office listings can be found at www.microsemi.com/soc/company/contact/default.aspx.

ITAR Technical Support

For technical support on RH and RT FPGAs that are regulated by International Traffic in Arms Regulations (ITAR), contact us via soc_tech_itar@microsemi.com. Alternatively, within My Cases, select **Yes** in the ITAR drop-down list. For a complete list of ITAR-regulated Microsemi FPGAs, visit the ITAR web page.

Microsemi Corporate Headquarters
One Enterprise, Aliso Viejo CA 92656 USA
Within the USA: +1 (949) 380-6100
Sales: +1 (949) 380-6136
Fax: +1 (949) 215-4996

Microsemi Corporation (NASDAQ: MSCC) offers a comprehensive portfolio of semiconductor solutions for: aerospace, defense and security; enterprise and communications; and industrial and alternative energy markets. Products include high-performance, high-reliability analog and RF devices, mixed signal and RF integrated circuits, customizable SoCs, FPGAs, and complete subsystems. Microsemi is headquartered in Aliso Viejo, Calif. Learn more at **www.microsemi.com**.

50200214-6/05.12