MCF51MM256

Low power demo and measurement engine demo

freescale semiconductor

Get to Know the TWR-MCF51MM-KIT

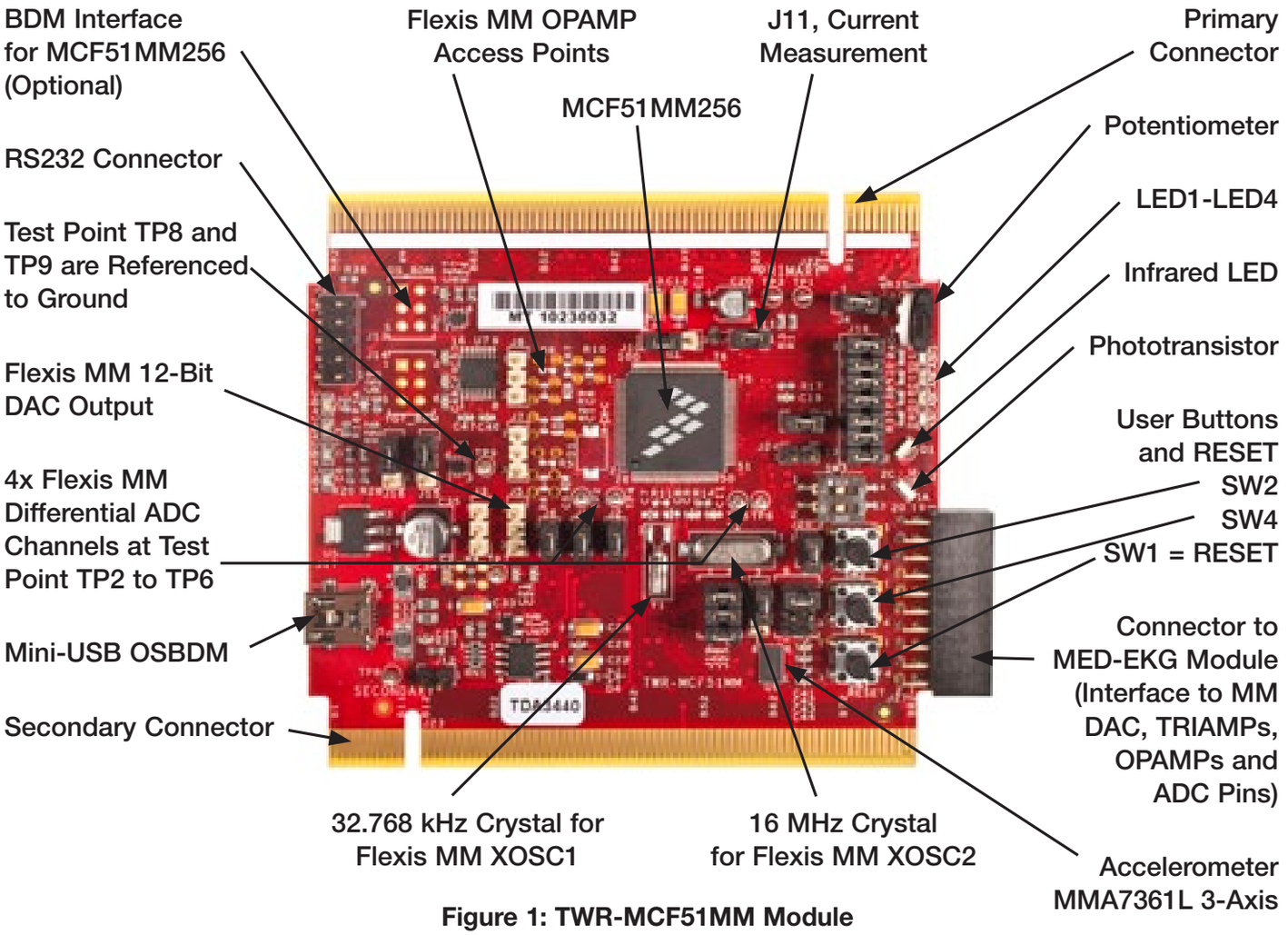
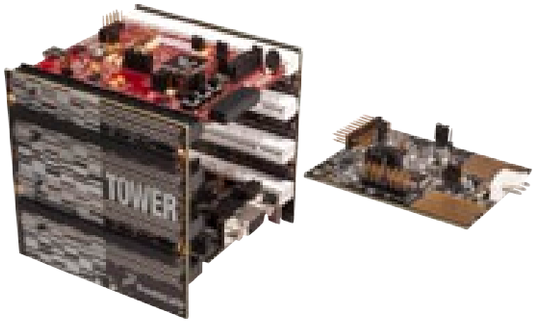


Figure 1: TWR-MCF51MM Module



TWR-MCF51MM-KIT
Freescale Tower System

The TWR-MCF51MM module is part of the Freescale Tower System, a modular development platform that enables rapid prototyping and tool re-use through reconfigurable hardware. Take your design to the next level and begin constructing your Tower System today.

Introduction

This lab is a step-by-step guide to running the Flexis MCF51MM256 low-power and on-chip measurement engine demos. Demos 1 through 4 demonstrate two of the lowest power modes, Stop 2 and Stop 3, and the effect of current adder when used with the external clock for time tracking applications. Demos 5 through 7 demonstrate the integrated 16-bit ADC, 12-bit DAC, OPAMP analog peripherals and the use of the programmable delay block (PDB) for measurement synchronizations.

Required Material

- Tower System—Built according to TWR-MCF51MM KIT Quick Start Guide
- Two mini-USB cables—One for TWR-SER and one for TWR-MCF51MM
- Multimeter (not provided)—You can still run part of this lab if you do not have this
- Ocilloscope—Optional
- LAB3.zip—Located in the “Software” tab, under the “Labs” section on the DVD. Follow the lab guide for installation
- Computer installed with:
  - CodeWarrior for Microcontrollers v6.3
  - MCF51MM256 service pack
  - P&E Embedded Multilink toolkit—Install this from the “Software” tab, “Development Tools” section on the DVD

The lab demonstrates

- Project build, download and run with CodeWarrior IDE
- Using multimeter to measure low-power mode current
- Using Serial Grapher Utility tool to display measurement results and waveforms
- CDC class application using Freescale’s USB stack

The following lab assumes the user has loaded the DVD at f:\ and has extracted all zipped files under working folder d:\work. Please replace the path if your environment is different.

LAB 3

Step-by-Step Guide

Configuring the Hardware

1. Assemble the Tower System and configure jumpers to default settings as shown in Step 2 of the Quick Start Guide (QSG). The TWR-MCF51MM module can be placed into any of the elevator levels, but it is recommended to put it on the top level of the Tower System for easy access to LEDs and switches.
2. Make sure jumper J16 on TWR-SER has pins 3 and 4 connected as shown in Figure 2 of the QSG.
3. Change jumper J10 on TWR-MCF51MM from the default setting to open (no jumper on J10).
4. If you have a multimeter, connect a multimeter in between J11. Make sure the meter is set to measure current: plus probe connects to pin 1 of J11 and minus probe connects to pin 2. If you do not have a multimeter, make sure jumper J11 is installed. You can still exercise the Measurement Engine Demo portion of this lab.

Connecting to the Computer

5. Make connections from the Tower System to the computer in the following order:
   a) Connect TWR-SER USB port to a USB port from the PC.
   b) Connect TWR-MCF51MM USB port to another USB port from the PC.
6. If this is the first time you are connecting the TWR-MCF51MM USB cable to your PC, Windows will install the OSBDM driver for the debugger. Follow the prompts to automatically detect and install the driver. If Windows cannot locate the driver automatically, please specify the following path: C:\Program Files\Freescale\CodeWarrior for Microcontrollers V6.3\Drivers\Osbdm-jm60.

Programming the MCF51MM256

7. Make sure all of the necessary software mentioned in the Required Material section above are installed on your PC.
8. Open CodeWarrior for Microcontrollers v6.3. Use the Windows Start Menu > All Programs > Freescale CodeWarrior > CodeWarrior Development Studio for Microcontrollers V6.3 > CodeWarrior IDE.

NOTE: It is important to open the correct CodeWarrior product and version. Multiple CodeWarrior programs can be installed on the same computer.

9. In the CodeWarrior menu, select File > Open. Then browse to the following path and file: d:\work\LAB3\app\cdc\codewarrior\cfv1usbmm256\cfv1usbmm256.mcp.
10. In CodeWarrior, click on the Debug icon on the project panel toolbar to download the code to the internal flash of MCF51MM256. Click OK to the warning message: “loading a new application will stop the execution of the current one.” This will start the erasing and programming process and will show the debugger window when finished.
11. Close the debugger window and press the RESET button (SW1) on the TWR-MCF51MM. Windows will detect a new CDC device named “Virtual COM port.” Please select “install from a specific location (Advanced)” and choose the path d:\work\LAB3\app\cdc\inf for finding the driver setup file. A Windows message may pop up. Click “Continue Anyway” to finish the installation.
12. After CDC driver installation, you need to find the exact COM port Windows assigned to the CDC device in device manager. To access device manager, right click the My Computer icon from your Windows desktop, then select Manage. See the COM number as indicated in Figure 1.

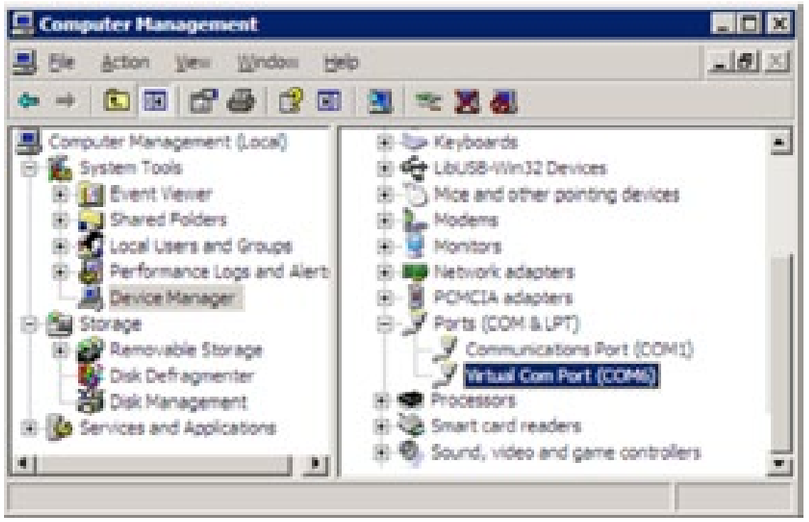


Figure 1: COM port assignment for USB CDC device in device manager window

NOTE: Different PCs may have a different COM number assigned to Virtual Com Port. A COM number larger than 8 is not supported by the Serial Port Graphing Utility used in this lab. If this happens, right click on the Virtual Com Port (COM#) > Properties > choose tab Port Settings > Advanced… > Select between 1 and 8 from COM Port Number. If COM 1 to 8 are all "in use," you can still select that as long as it does not conflict with another device. After assigning a COM number unplug and plug back in the USB from TWR-SER. You will then see the new COM number assigned to Virtual Com Port. Also try switching to another USB port from your PC.

13. Run Start menu > Programs > P&E Embedded Multilink Toolkit > Utilities > Serial Grapher Utility. Choose the same COM port number found in device manager, set baud rate to 115200 and click "open serial port and start demo." If you do not see a list of options in the terminal window as shown in Figure 2, press the Space key from your keyboard multiple times until you see the option menu from the terminal window.

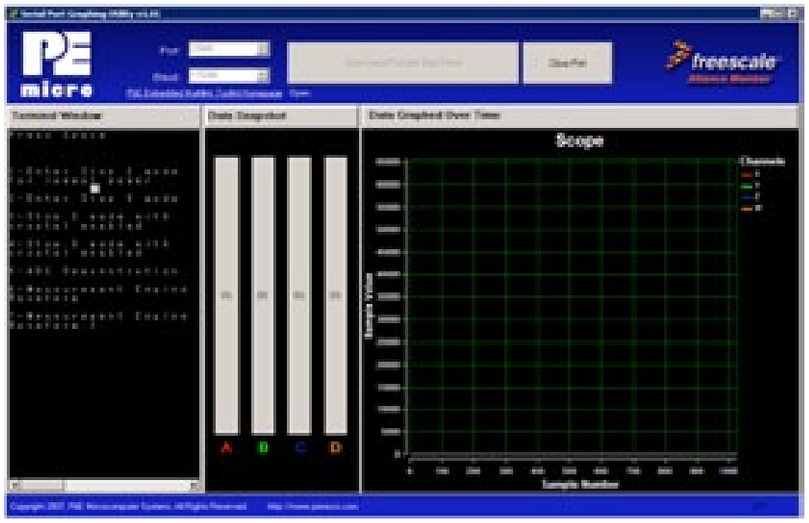


Figure 2: Low power and measurement engine demo

Running the Low Power Demo

14. Demos 1 to 4 are low power demos. The following steps are for Demo 1. Demos 2 to 4 are similar. Ensure Demo 2 to Demo 4 follow similar steps below:
    - To measure current:
        - Press “1” in terminal window to run Demo 1. In Demo 1, MCF51MM256 enters stop2 mode (see Figure 3), which is lowest power mode.
        - You may need to adjust your multimeter setting for lower current reading scale.
    - To exit stop2 mode:
        - If you decreased the multimeter current reading scale to measure Stop2 current, return your multimeter back to the higher current scale setting to allow enough current flow for run mode after recovering from Stop2 mode.
        - Click “Close port” in Serial Grapher tool.
        - Press the RESET button from TWR-MCF51MM.
        - Click “Open Serial Port and Start Demo” and wait for the message: “STOP2 RECOVERY DETECTED.”
        - Keep pressing the Space key until you return to the option menu for the next demo.

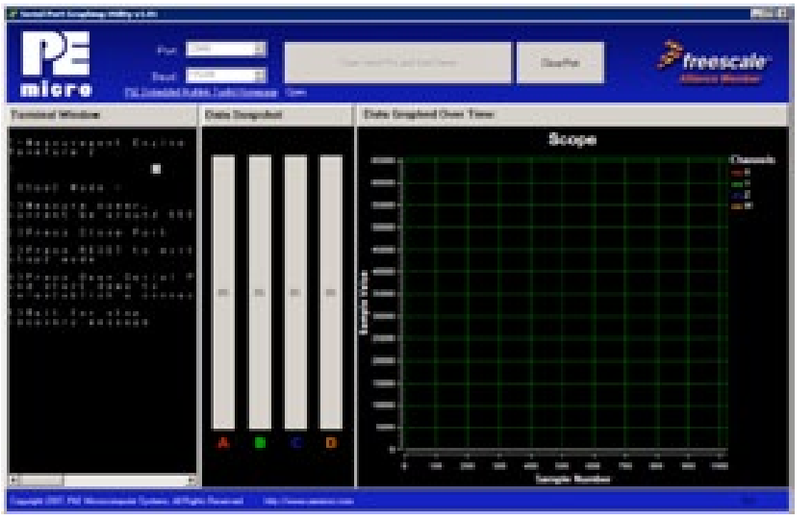


Figure 3: Stop2 mode message

Note: Note: The MCU will not enter true stop modes if it is in debug mode, and you may see a higher current. To exit the debug mode, please close the debugger window and press RESET(SW1) from the TWR-MCF51MM.

Tip: When developing low power applications for the MCF51MM series, make sure unused pins are configured to a static state to avoid excessive current draw due to floating pins. Please refer to the init_board routine in the main.c file from the LAB3.zip project.

Running the Measurement Engine Demo

15. Press “5” in the terminal window to start the ADC demonstration. The DAC module is used to create a signal which is then measured by the ADC. In this demo, you can see the offset error between the DAC output and the ADC (see Figure 4). To stop the demo, press the SW4 button a few times from TWR-MCF51MM until you see “IRQ INTERRUPT PRESS SPACE.” Then press the Space key to return to the option menu.

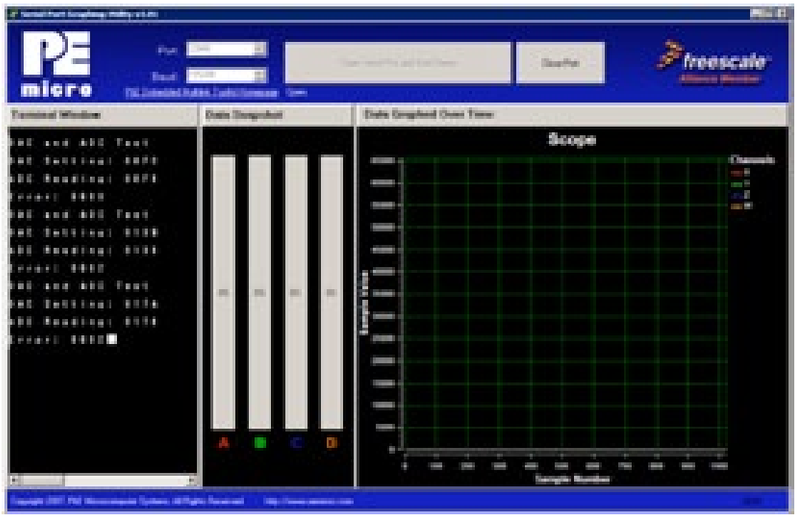


Figure 4: ADC demonstration

16. Press “6” in the terminal window to show the measurement engine functionality. The DAC module is used to output 16 points per period sine wave which is then measured by the 16-bit ADC. The red waveform is the data that is sent to the DAC (translated to 16-bit values). The green waveform is the data measured by the ADC. A 20 kHz waveform is generated by the DAC and 16-bit ADC readings are taken during each period. Press SW4 a few times to exit this mode and press the Space key to return to the option menu (see Figure 5).

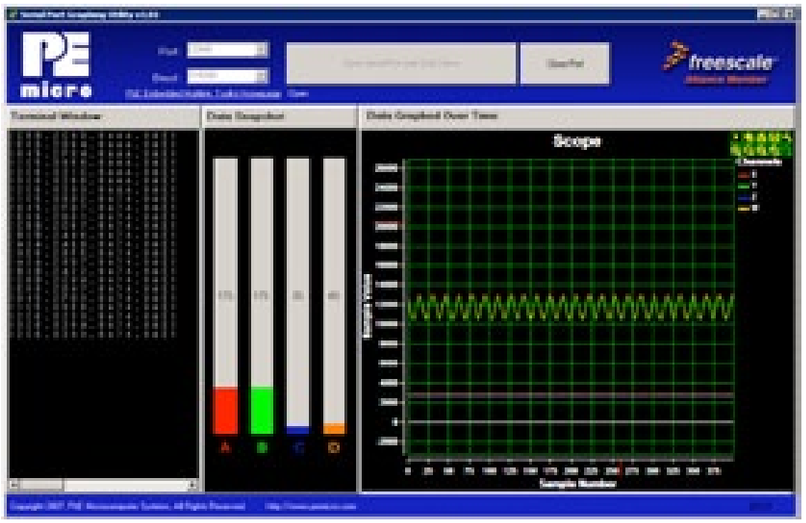


Figure 5: Measurement engine waveform 1

17. Press “7” to run Demo 7. Demo 7 shows one of the programmable gain features from Flexis MM on-chip operational amplifier (OPAMP). The DAC output is amplified by the OPAMP module’s programmable gain (gain set to 4.5). This output is measured by the 16-bit ADC. In Figure 6, the red waveform is the data that is sent to the DAC (translated to 16-bit values). The green waveform is the data measured by the ADC. A 20 kHz waveform is generated by the DAC and 16-bit ADC readings are taken during each period. On the TWR-MCF51MM module, the DAC output can be measured at jumper J5 (pin 2). The Op-Amp output can be measured at the header J27 (pin 9). Press SW4 a few times to exit this mode (see Figure 6). Note: For each probe, adjust your oscilloscope voltage per division to about 100 mV and time per division to 40 us scale and set the probes to the AC coupling setting.

Figure 6: Measurement engine waveform 2

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