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## **User's Manual — 3-Phase BLDC Motor Control using MC56F8257**

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# **Section 1. Introduction and Setup**

## **1.1 3-Phase BLDC Motor Control using MC56F8257 Introduction**

This application demonstrates a low power 3-phase (Brushless DC) BLDC motor drive software. It is focused on simple and “easy to understand” control approach of BLDC running on Freescale DSC MC56F8257. The control concept of the application is speed-closed loops BLDC drive using Hall position sensors. The application of this unipolar control allows operation throughout whole motor speed range starting from zero over the nominal speed and even motor reversal is achievable. It serves as an example of a BLDC motor control system for low voltage motor application. The application is designed for input voltage +24V DC. The HW is built on the Freescale Tower rapid prototyping system and contains following modules:

- TWR ELEVATOR
- TWR 56F8257
- TWR MC-LV3PH

The application supports both a manual user interface using push buttons and FreeMASTER control page communicating via USB-to-serial bridge.

## 1.2 About this Manual

Key items can be found in the following section of this manual:

- Introduction of demo [1.1 3-Phase BLDC Motor Control using MC56F8257 Introduction](#)
- Information about safety use of demo [1.3 Warnings](#)
- Setup instructions are found in [1.4 Setup Guide](#)
- USB to serial installation [1.5 USB-to-Serial Driver Installation](#)
- Demo code flashing configuration [1.6 Flashing Demo Code](#)

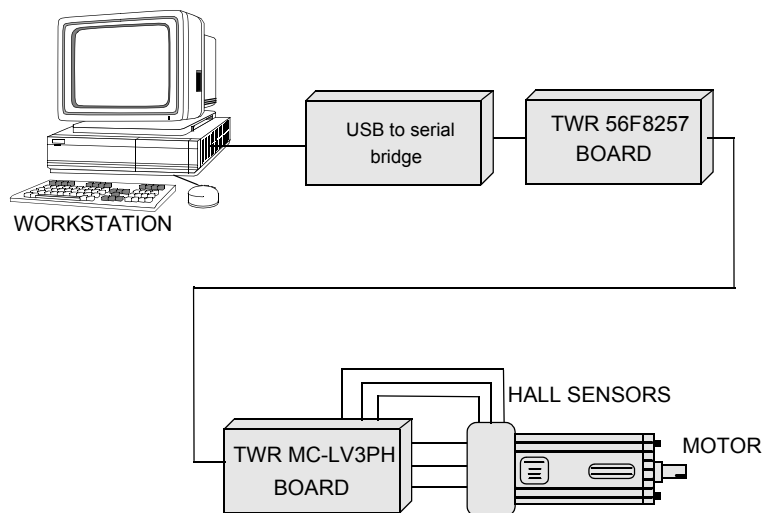


Figure 1-1 Systems Configurations

## 1.3 Warnings

The TWR-MC-LV3PH board includes power components that can reach temperatures hot enough to cause burns. To facilitate safe operation, 24-volt input power should come from a dc power supply that is current limited to no more than 4 amps.

The user should be aware of:

- Before moving scope probes, making connections, etc., it is generally advisable to power down the 24-volt supply.
- Wearing safety glasses, avoiding ties and jewelry, using shields, and operation by personnel trained in power electronics lab techniques are also advisable.
- **Do not plug any other cables into the demo system apart from the power supply cable, motor cables and USB communication cable. The demo can be powered only via the TWR-MC-LV3PH board power jack.**

- Do not connect any USB cable to the demo while the power is applied to the power stage module. Connecting a USB cable to the Tower Elevator Module can cause damage to the TWR-56F8257 and other systems!
- Only JTAG can be used for firmware upload.

## 1.4 Setup Guide

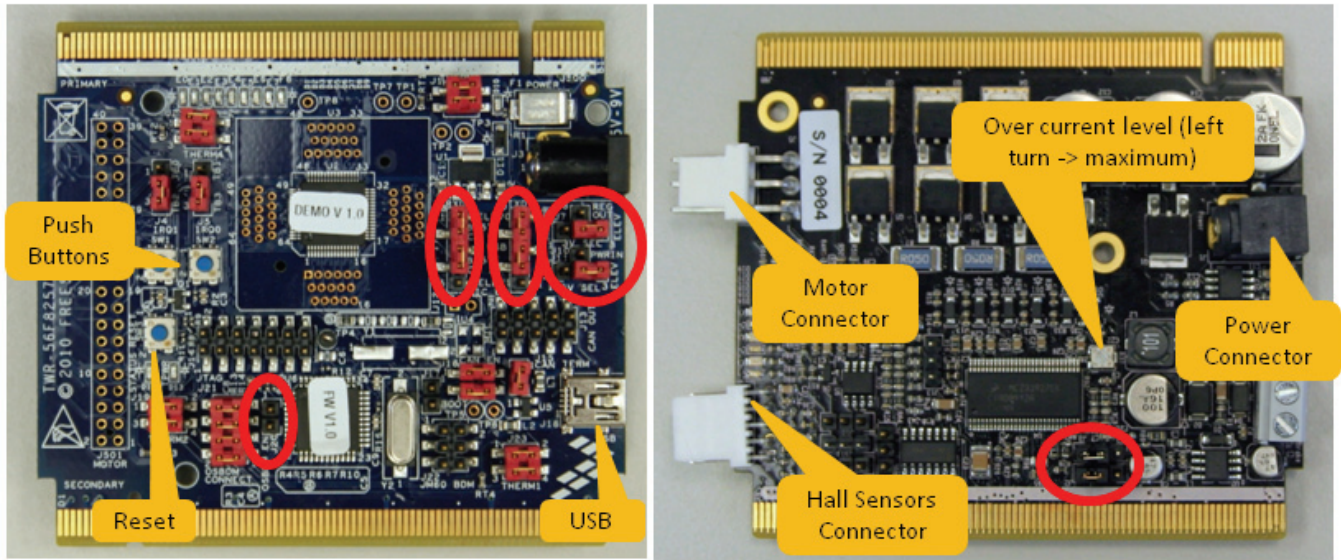
Follow these steps to set up the board:

1. Check jumper settings on board TWR-56F8257 REV B and Check jumper settings on board TWR-MC-LV3PH(see [Table 1 Board Jumper Setting](#) and [Figure 1-2 Configuration of Jumpers](#))

TWR-56F8257		TWR-MC-LV3PH	
Jumper	Setting	Jumper	Setting
J7 (3V_SEL)	1 2-3	J2 (VDDA)	1 2-3
J11 (5V_SEL)	1 2-3	J3 (GNDA)	1 2-3
J20 (OSBDM)	1 2		
J8 (RxD)	1-2 3-4 5		
J9 (TxD)	1-2 3-4 5		

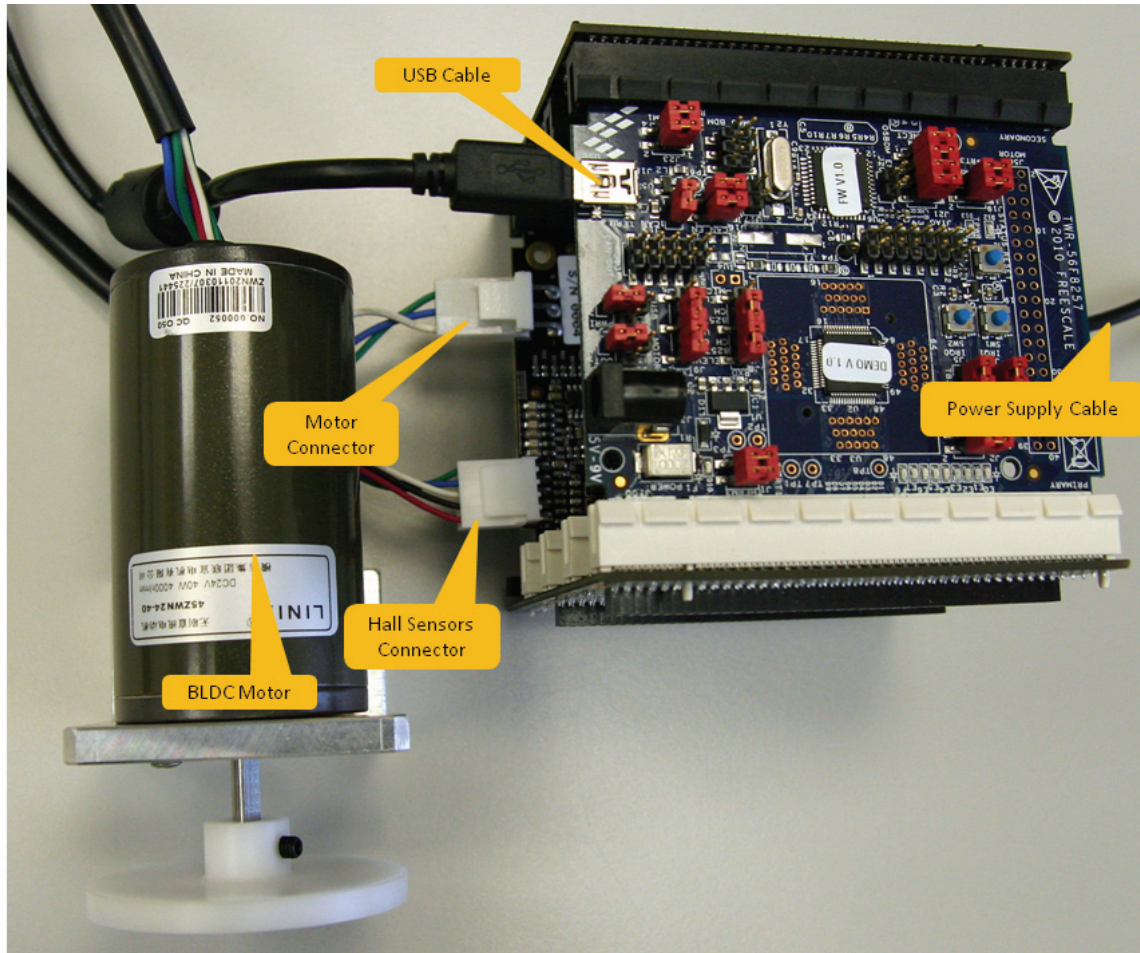
**Table 1 Board Jumper Setting**

- All jumpers and other hardware switches not specifically described are expected in factory-default positions. Please refer to the board User's Guide for the default settings.



**Figure 1-2 Configuration of Jumpers**

2. Plug TWR-56F8257 and TWR-MC-LV3PH modules into TWR-ELEVATOR. **Be careful, it is very important to connect side of the board which is marked by white stripe to the white connector of the elevator.** Recommended order of the board is:
  - TRW-56F8257
  - Empty
  - Empty
  - TWR-MC-LV3PH
3. Connect enclosed BLDC motor to proper board connectors, Hall sensor connector to J8 and motor phase wires to J5 (both on TWR-MC-LV3PH). See [Figure 1-3 3ph.BLDC Motor Control using MC56F8257](#)

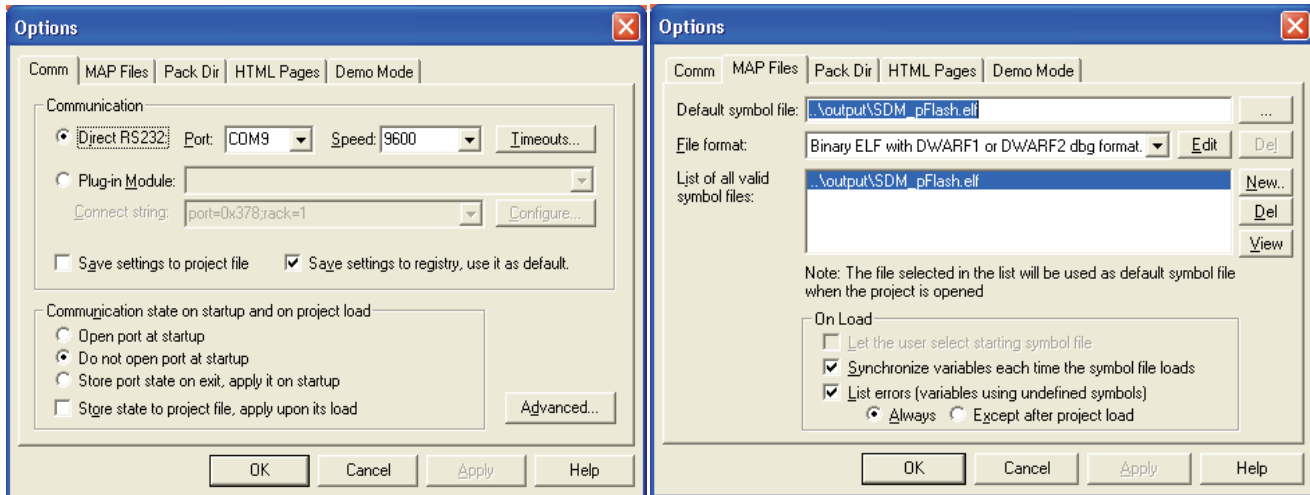


**Figure 1-3 3ph.BLDC Motor Control using MC56F8257**

4. Plug-in 24-Volt DC power supply jack into J1 TWR-MC-LV3PH power supply connector
5. Load a BLDC motor control application to a MC56F8257 device (See [1.6 Flashing Demo Code](#))
6. Push one of push buttons SW1 or SW2 to start motor running to a required direction.
7. If you want to operate the demo via FreeMASTER, connect Mini-B USB cable between TWR-56F8257 board and USB port of your computer. New USB device should be detected and USB driver will be required. See [1.5 USB-to-Serial Driver Installation](#) chapter to install the



driver.



**Figure 1-4 FreeMASTER Configuration**

8. Start FreeMASTER 1.2.31.1 - Go to Start -> Programs->FreeMaster ->FreeMaster and open the application project "project...\FreeMASTER\PMSM\_Speed\_VC\_8025\_DEMO.pmp. If FreeMaster is not installed on your computer, please, use Freescale web [www.freescale.com/freemaster](http://www.freescale.com/freemaster) and install FreeMASTER application
9. Set proper COM number and speed (**9600 bauds**) in FreeMASTER options. (see [Figure 1-4 FreeMASTER Configuration](#))
10. If SDM\_pFlash.elf file cannot be found, select proper path using Project-> Select Symbol File and ELF/SDM\_pFlash.elf and click OK
11. The FreeMASTER window consists of three panes: the Project Tree panel on the left side, the Detail View pane on the top and the Variable Watch panel at the bottom. If there are question marks displayed in the Variable Watch panel, this indicates that the communication between the PC and the target device was not established. Click on the "Start/Stop communication (CTRL+K)" button of the toolbar to (re-)connect (or go to project-> options (CTRL+T) and select the "Open port at startup" option) and then save the FreeMASTER project (CTRL+S). The communication will be established immediately after startup, the next time the FreeMASTER project is run.
12. If there are still problems with the communication, go to project->options (CTRL+T) and check the communication setting. Check if the Direct RS232 item is set to proper COM port number. This COM port number depends on PC configuration because USB driver installs a virtual COM port (usually the last COM port in the list. The communication speed for the application is set to 9600 Bauds. Switch the suitcase power switch ON.
13. The main control screen should be displayed now, see [Figure 1-5 FreeMASTER Main Control Page](#)

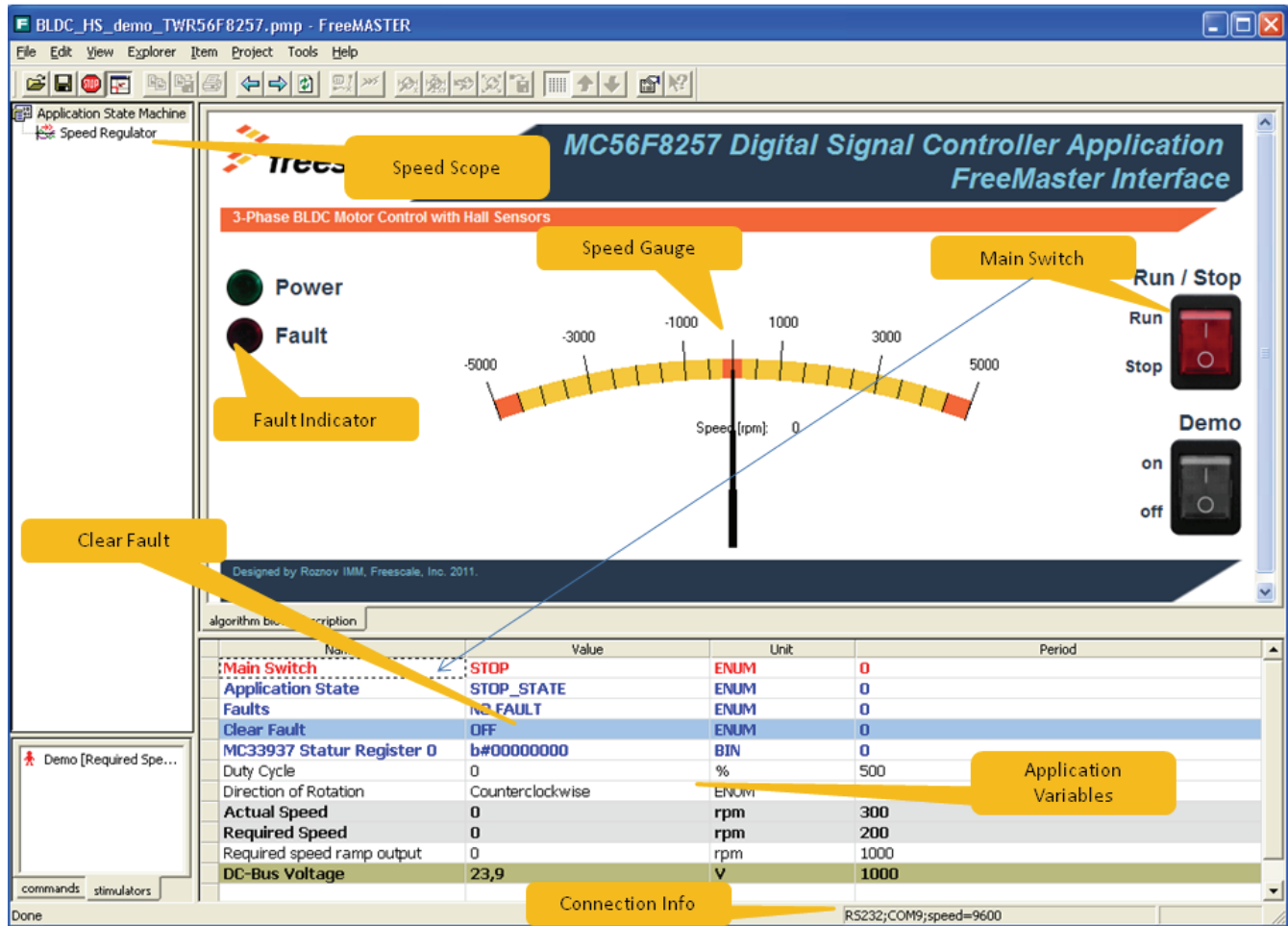


Figure 1-5 FreeMASTER Main Control Page

14. To get the motor running set non-zero Required Speed or click on Speed Gauge to set the Required Speed. When the Required Speed value is set, the Main Switch turns on.
15. To stop motor click Main Switch or set Main Switch variable to OFF, or set Required speed to zero.
16. The required speed can be set using push buttons in parallel with FreeMASTER control. Pushing both buttons together the motor goes to STOP state.
17. The application detects three Fault states - over-current, over-voltage and under-voltage faults. When a fault state is detected, the red LED D5 (on TWR-MC-LV3PH board) is lit and red Fault icon on FreeMASTER control page is lit as well. To clear the fault push the RESET button on TWR-56F8257 or set the variable Clear Fault to ON. The application goes to STOP state if the Fault source not pending.
18. The FreeMASTER control page enables to run motor based on predefined speed profile turning Demo Switch on.

## 1.5 USB-to-Serial Driver Installation

1. Check if jumper J20 on TWR-56F8257 is unplugged
1. Plug USB cable Mini-B USB into PC and TWR-56F8257 (J18)
2. “*FOUND NEW HARDWARE USB Device*” in bubble will appear in right bottom screen corner



**Figure 1-6 USB-to-Serial Bridge Device Detection**

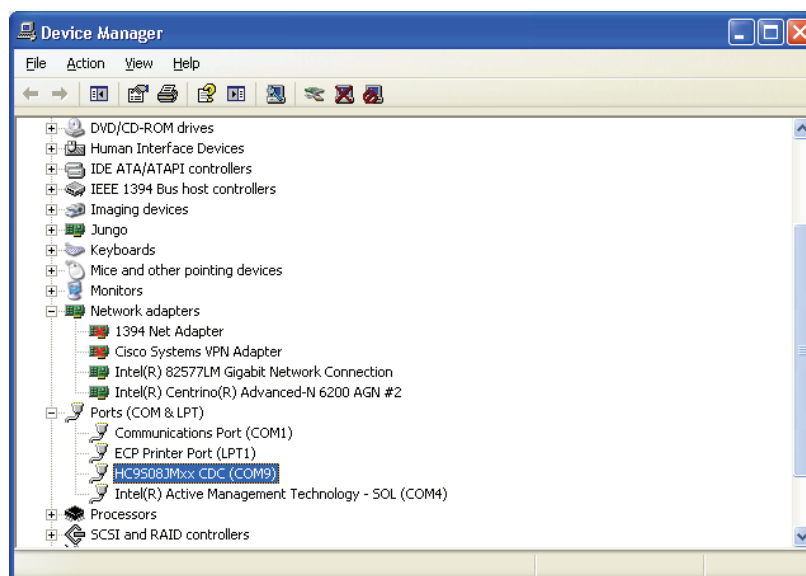
3. “*Found New Hardware Wizard*” will appear in new window. Select Install from a list or specific location (Advanced) and click Next to continue.
4. Select the path to driver folder “project...\USB\_driver
5. If driver is properly installed, following window will appear





**Figure 1-7 Driver Successful Installation**

6. After successful installation new COM port with HC9S08JMxx CDC name will appear in Device Manager

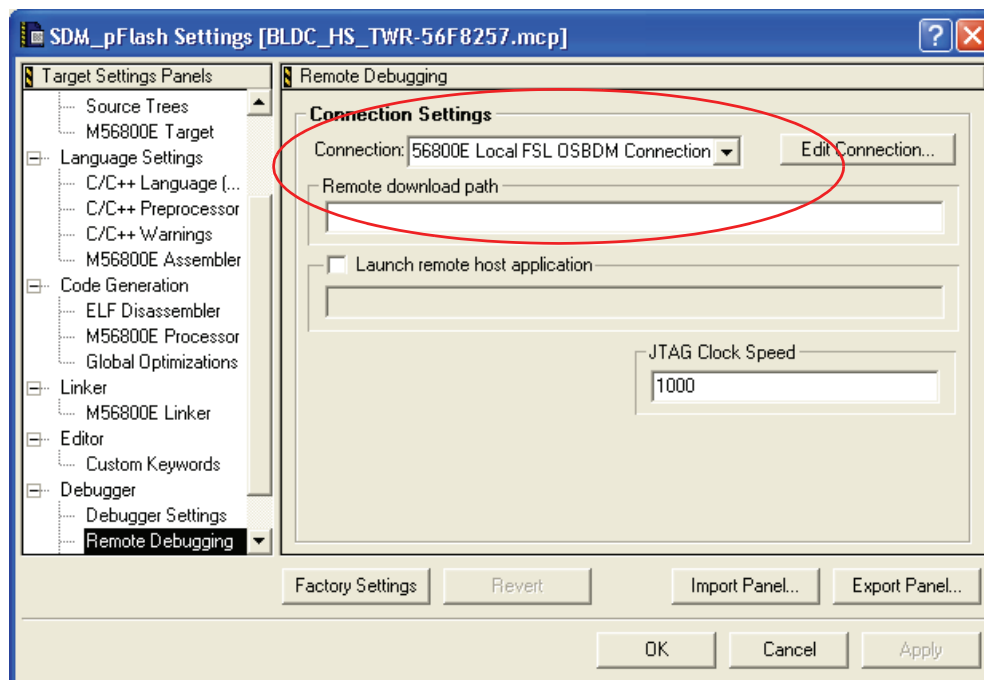


**Figure 1-8 Virtual COM Port**

## 1.6 Flashing Demo Code

The CodeWarrior Development Studio for 56800/E Digital Signal Controllers ([link](#)) can be used for programming code into the FLASH memory via JTAG or OSBDM interface. The flashing procedure is as follows:

1. Run CodeWarrior for DSC56800E v8.3 and open the project with the application code. Choose the Connection Settings in Project/SDM\_pFlash Settings (Alt + F7) in Remote debugging tab (see [Figure 1-9 CodeWarrior Connection Setting](#))



**Figure 1-9 CodeWarrior Connection Setting**

2. Select “56800E Local FSL OSBDM Connection” for flashing via OSBDM (USB) interface or “56800E Local USB Connection” in case of USB-TAP usage.
3. For OSBDM connection plug jumper J20 on TWR-56F8257 board, plug power supply to TWR-MC-LV3PH and USB cable to J18 on TWR-56F8257 board.
4. Windows will detect new USB device (Open Source BDM). The driver is already installed together with CodeWarrior v8.3 so choose automatic installation.
5. Flash the code using Debug button or pressing F5.
6. After the code is loaded, unplug the USB cable and jumper J20, and plug USB cable again to be in USB-to-serial bridge mode
7. Push the RESET button and the application should now run from the FLASH.



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