AN1292 Demonstration ReadMe for the dsPIC33EDV64MC205 Development Board (MPLAB X)

1.1 INTRODUCTION

This document describes the setup requirements for running the Sensor-less FOC algorithm with a PLL Estimator, which is referenced in AN1292 "*Sensorless Field Oriented Control (FOC) for a Permanent Magnet Synchronous Motor (PMSM) Using a PLL Estimator and Field Weakening (FW)"* using a dsPIC33EDV64MC205 Development Board.

1.2 SUGGESTED DEMONSTRATION REQUIREMENTS

MPLAB and Complier versions used:

- MPLAB® X IDE v4.01
- Released XC16 version 1.32B with part support compiler patch *xc16-v1.339-part-support-windows-installer-2017-10-18.exe*
- Latest Version of DMCI Plug-in
- Latest version of X2CScope Plug-in

Hardware used with part numbers:

- dsPIC33EDV64MC205 Development Board(04-10715_Rev_0.1)
- 24V Power Supply (AC002013) (available at www.microchipdirect.com)
- 24V Hurst Motor (AC300020) (available at www.microchipdirect.com)

Motor Control Application Firmware:

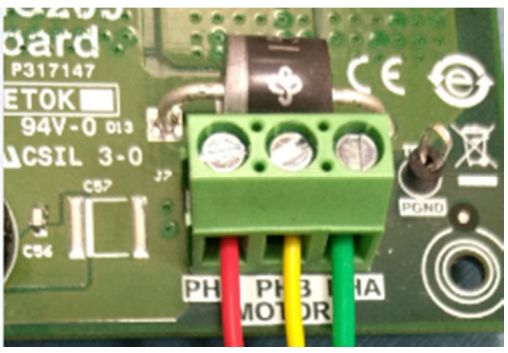
- AN1292_dsPIC33EDV64MC205_Development_Board_HURST_R1_RC1

1.3 HARDWARE SETUP

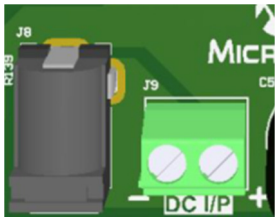
The following hardware setup allows the Sensor-less FOC algorithm. Motor Phase Currents required by the application is amplified by operational amplifiers internal to the dsPIC33EDV64MC205. Subsequently Amplified motor currents are measured using Analog to Digital Converter in the dsPIC33EDV64MC205.

1. Disconnect power to dsPIC33EDV64MC205 Development Board and set up the board for demonstration.
2. Connect the 3-phase wires from the motor to M1, M2 and M3 of the J7 connector.

   Note: As this is a sensor-less algorithm, the order in which the 3-phase wires are connected is not important.



3. Connect a 24V power supply to the dsPIC33EDV64MC205 Development Board, using the J8 connector. Alternatively 24VDC can be supplied through connector J9. Please ensure the polarity of the supply is matching as indicated.



4. Connect the programmer/debugger using the J2 connector.

1.4 SOFTWARE SETUP AND RUN

1.4.1 Basic Demonstration

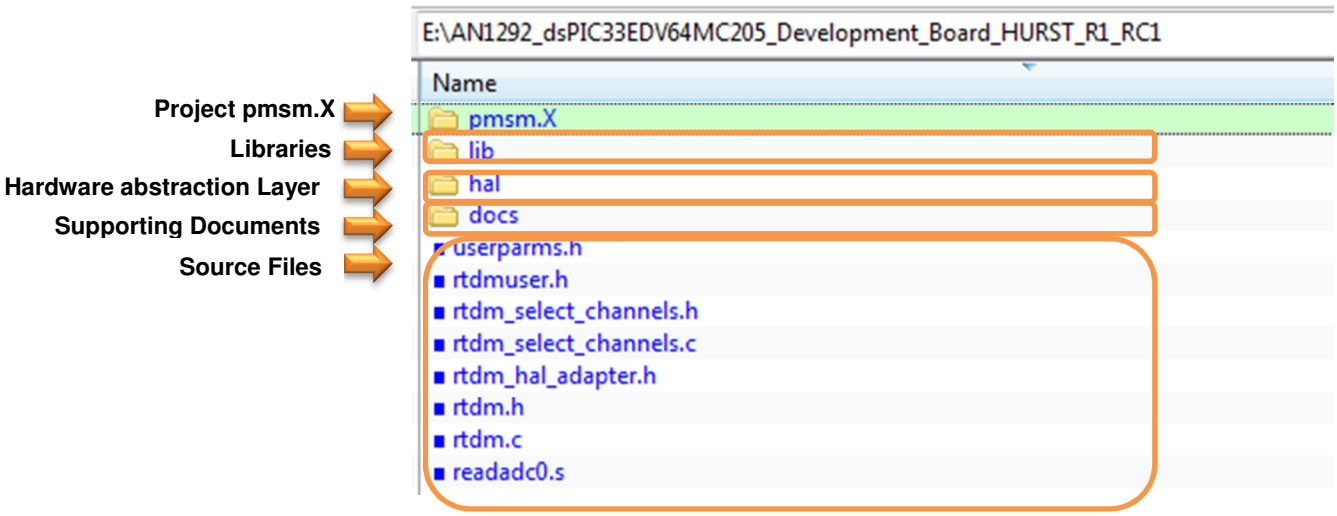
Install MPLABX IDE and Compiler version mentioned in the section 1.2 SUGGESTED DEMONSTRATION REQUIREMENTS.

This demonstration consists of running the motor using a push button and varying the speed with a potentiometer. The firmware is already configured for enabling the basic demonstration. If you use both MPLAB X IDE and MPLAB 8 IDE, please make sure you have your programmer/debugger set to run on MPLAB X IDE. In order to do so, you must run the MPLAB driver switcher as Administrator (MS Windows).

AN1292 Application Firmware version required for the demonstration is mentioned under the section 1.2 SUGGESTED DEMONSTRATION REQUIREMENTS.
`AN1292_dsPIC33EDV64MC205_Development_Board_HURST_Rx_RCxx` is implemented based on dsPIC33EDV64MC205 ,which is a Microchip dsPIC Digital Signal Controller with integrated MOSFET driver.

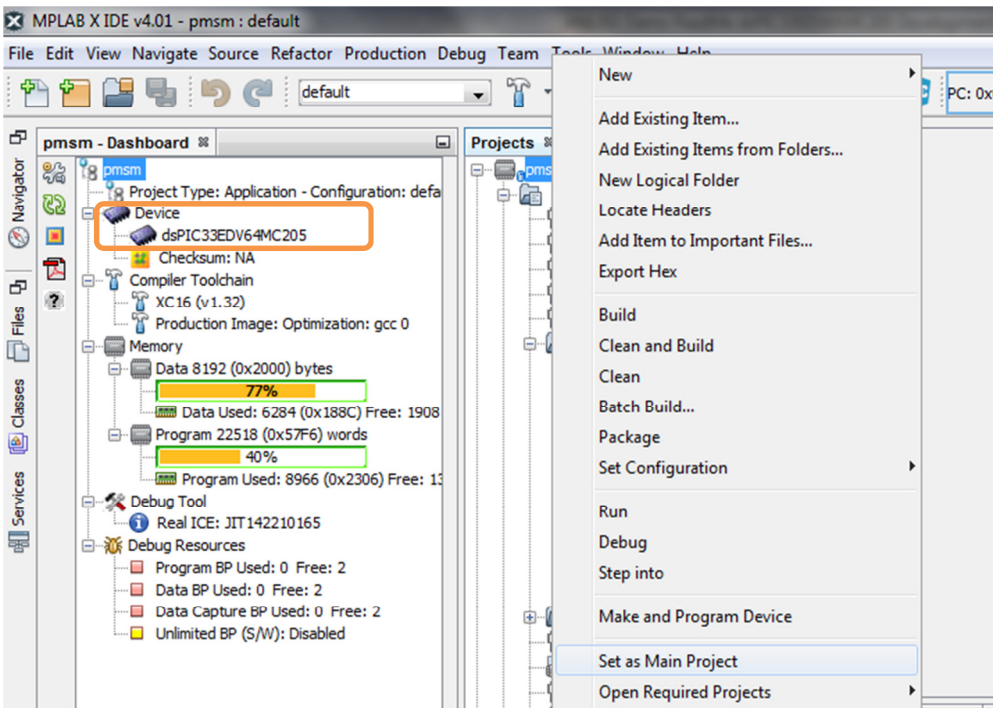
This Motor Control Demo Application is realized in `pmsm.X`. The Project configures and uses dsPIC DSC peripherals like PWM, ADC, UART etc. required for implementing algorithm Sensor-less Field Oriented Control (FOC) of Permanent Magnet Synchronous Motor (PMSM).For more details on AN1292 refer Microchip website.

The folder structure of demo application
`AN1292_dsPIC33CH128RMP508_EXTOPAMP_MCLV_2_HURST_Rx_Rxx` is shown below:

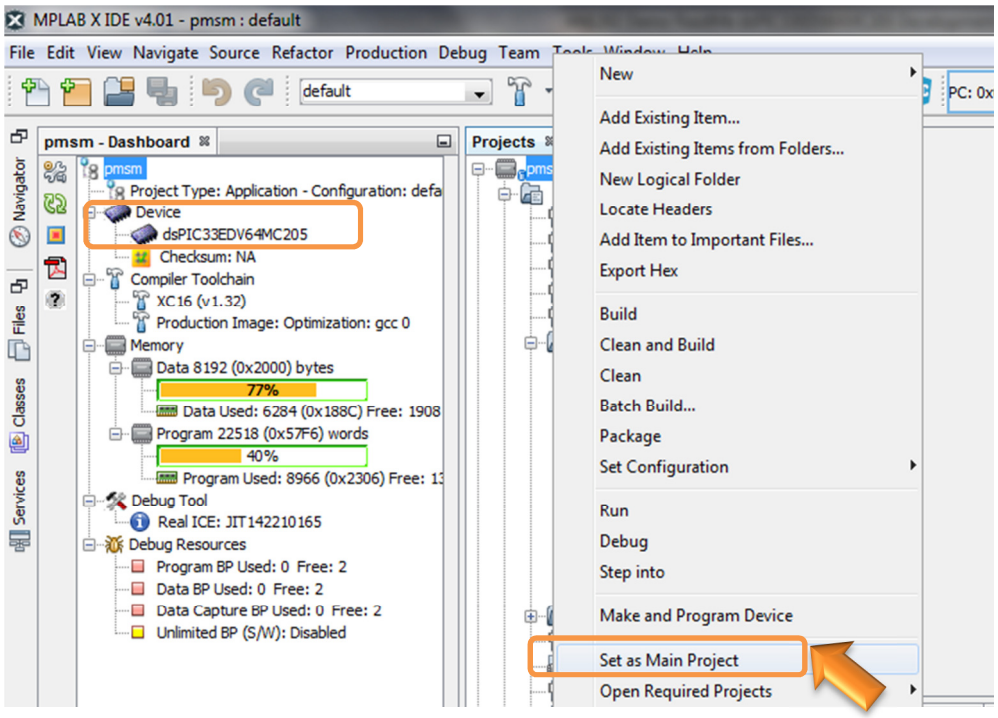


Follow the steps to setup and run the application:

1. Start MPLAB® X IDE v4.01 and open the Project workspace `pmsm.X` configured to use Device: **`dsPIC33EDV64MC205`**

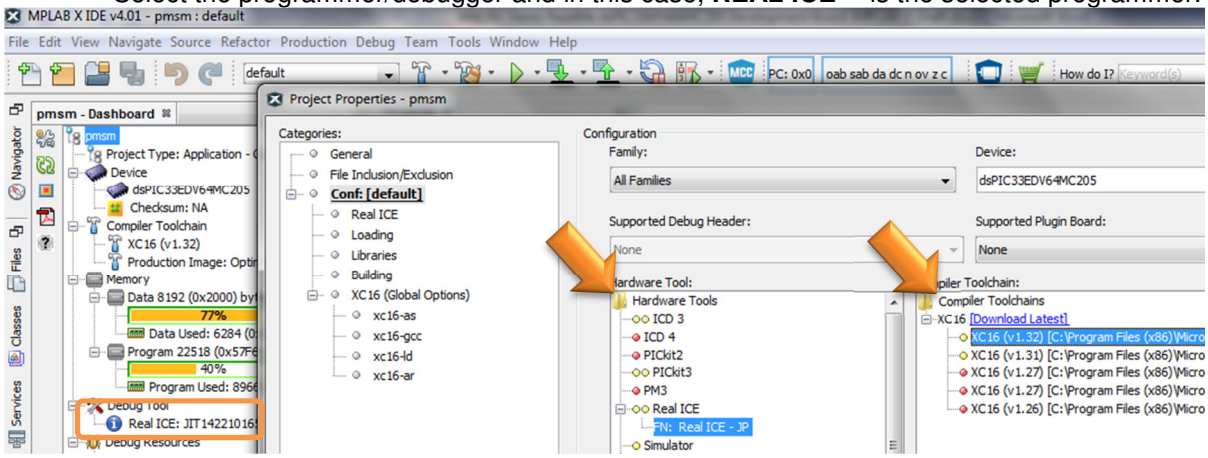


2. Right click on the project the Project `pmsm.X` and 'Set as Main Project' as shown

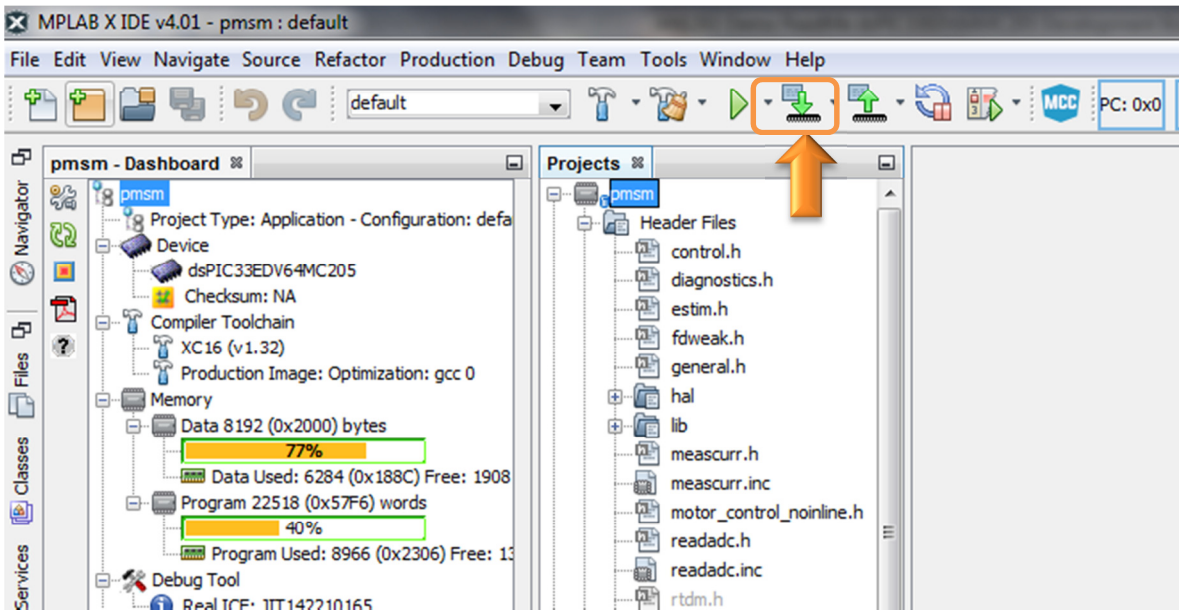


3. Open the `userparms.h (under pmsm.X->headerfiles)` in the porject `pmsm.X` and ensure that `BIDIRECTIONAL_SPEED`, `TUNING`, `OPEN_LOOP_FUNCTIONING`, and `TORQUE_MODE` are not defined.

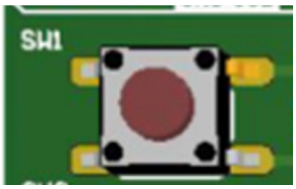
4. Right click on `pmsm.X` project on the left tab called “Project”, and select “Properties”.
   On the “conf” page:
   - The compiler tool chain **XC16 version 1.32**
   - Select the programmer/debugger and in this case, **REAL ICE™** is the selected programmer.



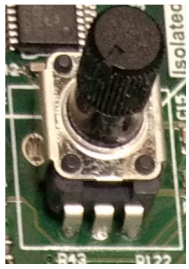
5. To program device dsPIC33EDV64MC205, click the “Make and Program the device main project” button on the toolbar.



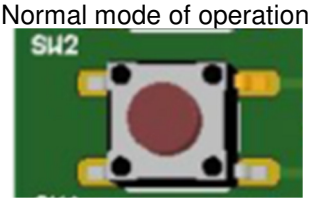
6. Run or stop the motor by pressing SW1. You can double the speed by pressing SW2.



7. Vary the motor speed using the potentiometer (labeled R43).



8. To enter the extended speed range of the motor, press SW2. Pressing SW3 again will enter the motor Normal mode of operation.



9. Press SW1 to stop the motor.

1.4.2 Data visualization through DMCI Plug-in of MPLABX

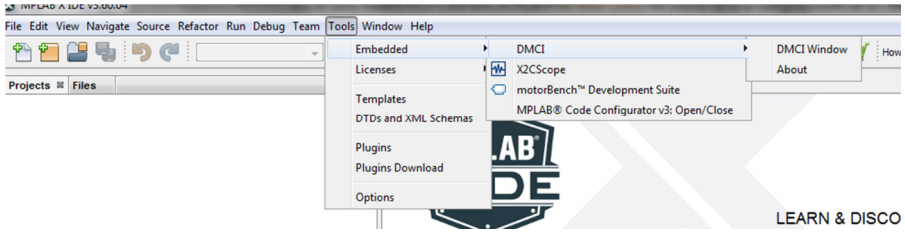
The application firmware comes with initialization required to interface Controller with Host PC to enable Data visualization through DMCI plug-in

1. Ensure DMCI Plug-in is installed. For additional information on DMCI follow the link

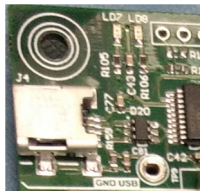
   http://microchipdeveloper.com/mplabx:dmci

   For addition information on RTDM follow the link

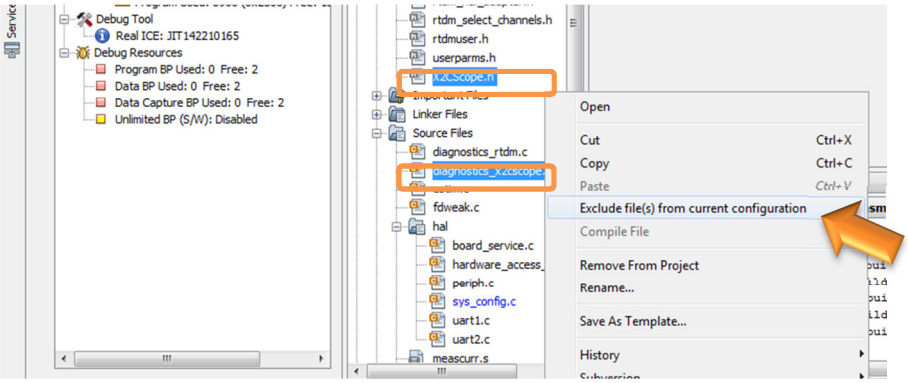
   http://www.microchip.com/development-tools/resources/real-time-data-monitoring-tool---rtdm



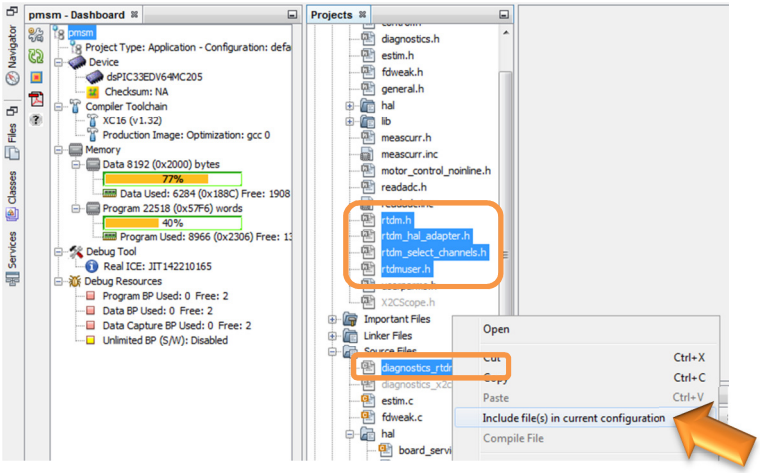
2. In order to utilize RTDM communication for this demonstration, a mini-USB connection is required. Connect a mini-USB cable from your computer to the J4 connector on the dsPIC33EDV64MC205 Development board, labeled USB.



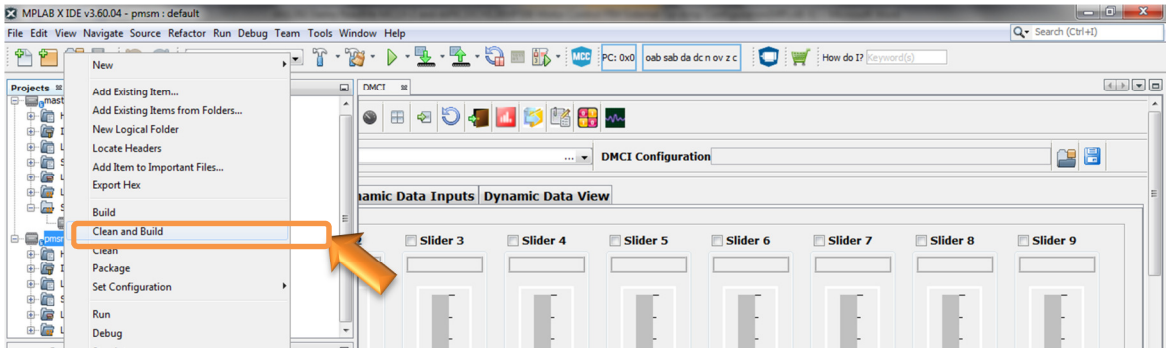
3. Ensure application is configured and running as described under Section 1.4.1 Basic Demonstration by following steps 1 through 9.
4. Select files **X2Cscope.h and diagnostics_x2cscope.c**,then righclick and set **Exclude file(s) from current configuration**



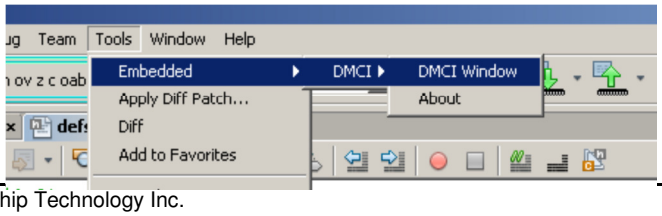
5. Select files **rtdm.h,rtdm_hal_adapter.h,rtdm_select_channels.h,rtdmuser.h,and diagnostics_rtdm.c ,** then rightclick and set **Include file(s) from current configuration** to add these files as part of current Project Configuration. This will allow RTDM interface related files to be added to the project, required to enable RTDM interface.



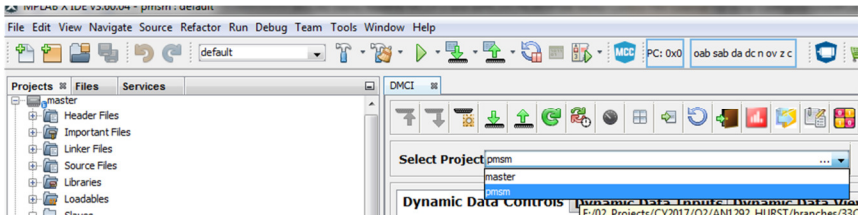
6. Right click on the project pmsm.X and clean and build the project



7. Open the DMCI window by selecting Tools>Embedded>DMCI>DMCI Window.

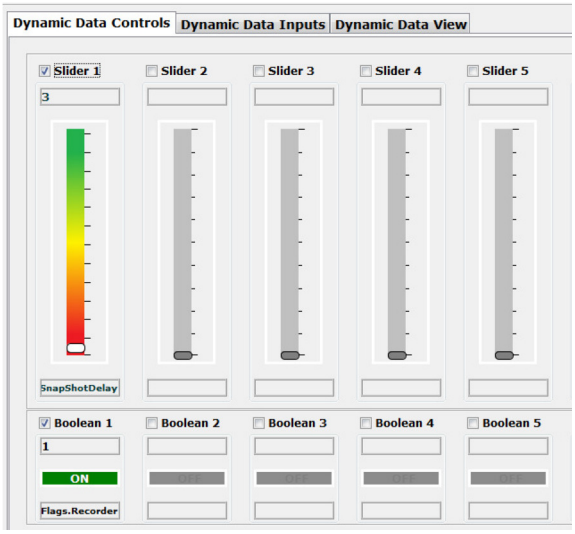


8. Open the DMCI window and select pmsm.X project as shown



9. Click the Load Profile icon, and from the same folder where your project resides, load the Demo.xml file in pmsm.X folder, which contains a previously configured profile

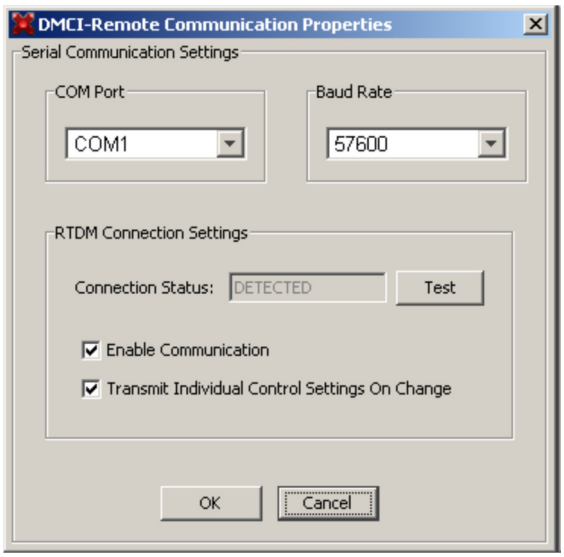
10. The DMCI window appears as follows:



Please consult the *"Real-Time Data Monitor User's Guide"* (DS70567) for additional settings needed for a RDTM connection. This document explains the steps needed for the proper communication settings between the Host and Embedded side.

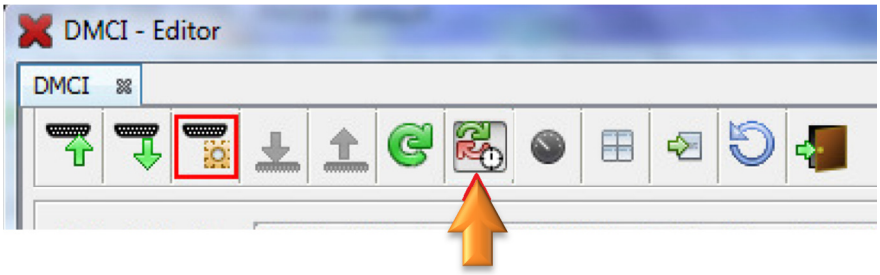
11. Select Serial Settings to connect RTDM with your computer..

12. Remote Communication needs to be established, as indicated in the following figure (the communication baud rate should be set to 57600, while the COM port used depends on your particular settings).

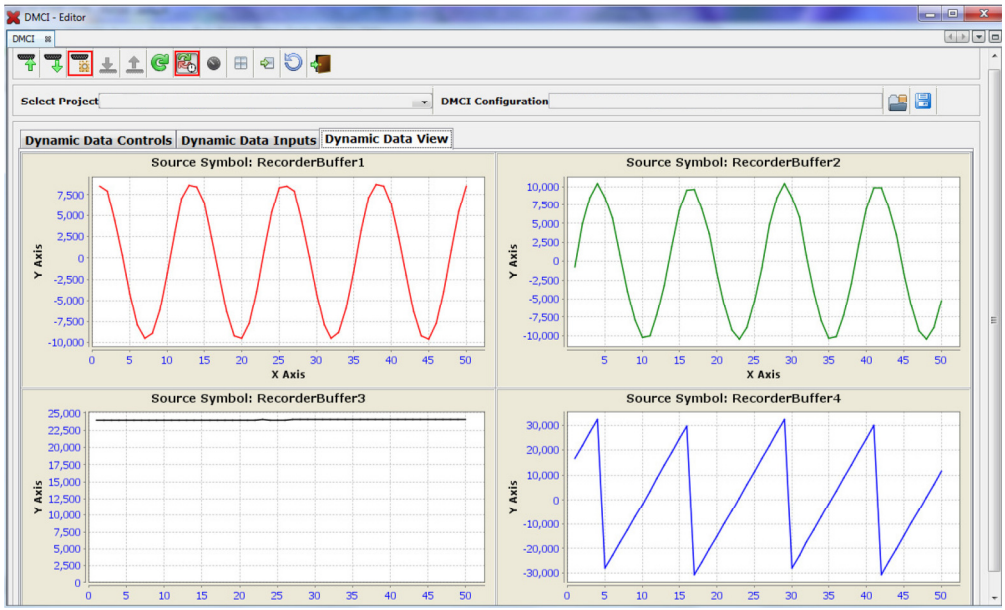


13. Once communication is detected, make sure the **Enable Communication** box is checked and click **OK**.

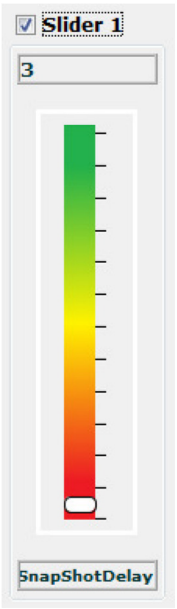
14. To plot variables in real time, enable Automated Event Control by clicking the automatic event execution icon found on the toolbar.



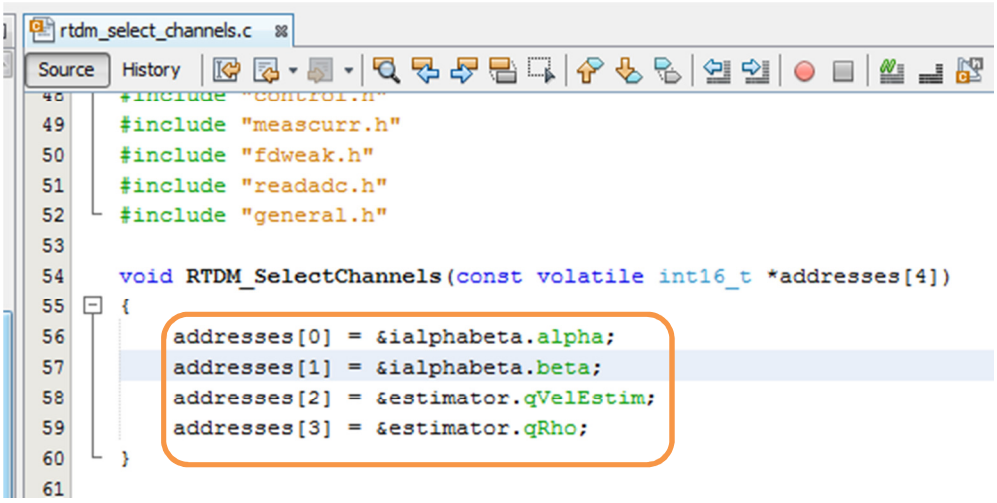
15. The DMCI window shows variables plotted in real time, which is updated automatically.



16. To change the time window to see more time on each plot, change the value of the SnapShotDelay, which controls how the buffers are being filled in the code.



17. The variables displayed through DMCI/RTDM plug-in is set in rtdm_select_channels.c ,user may change the varibles to be displayed by modifying the address assigned to the arrays addresses[0],addresses[1],addresses[2] and addresses[3].The array addresses[0] corresponds to Graph1, addresses[1] corresponds to Graph2 ,and so on.

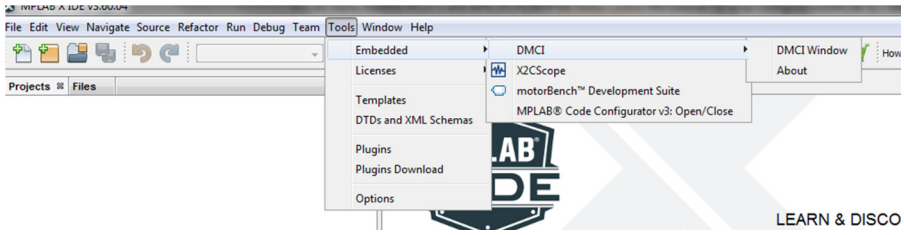


1.4.3 Data visualization through X2CScope Plug-in of MPLABX

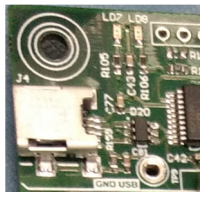
The application firmware comes with initialization required to interface Controller with Host PC to enable

Data visualization through X2C Scope plug-in.X2C-Scope is a third-party plugin for MPLAB X which facilitates real-time diagnostics.

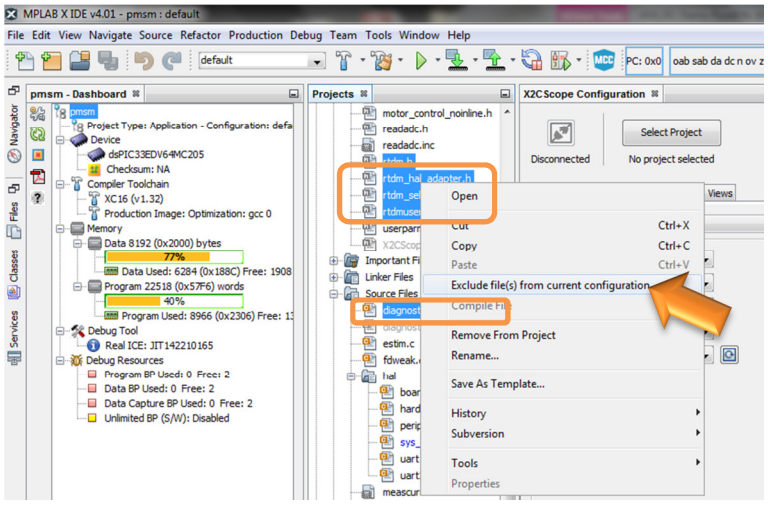
1. Ensure X2C Scope Plug-in is installed. For additional information on how to set up a plug-in refer to http://microchipdeveloper.com/mplabx:tools-plugins-available



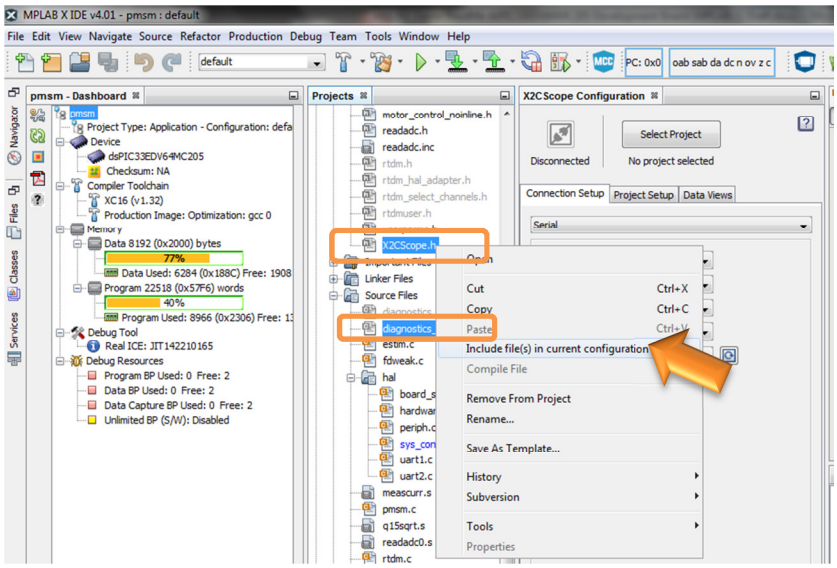
2. In order to utilize X2C Scope communication for this demonstration, a mini-USB connection is required. Connect a mini-USB cable from your computer to the J4 connector on the dsPIC33EDV64MC205 Development board, labeled USB.



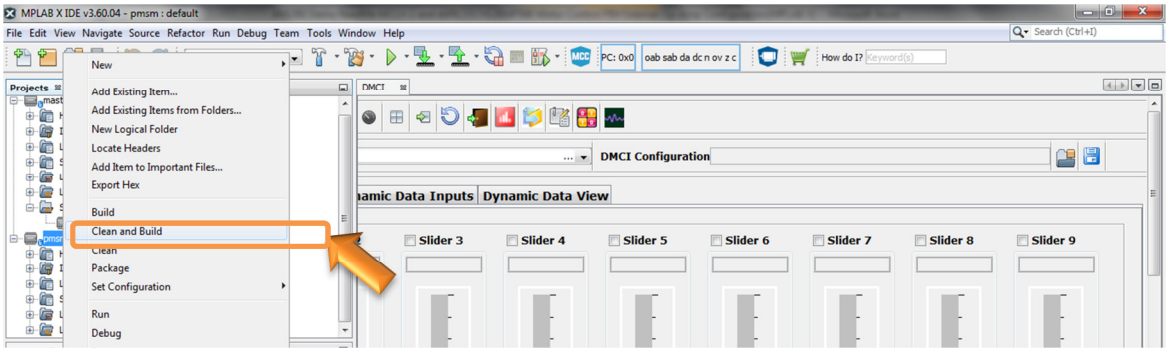
3. Ensure application is configured and running as described under Section 1.4.1 Basic Demonstration by following steps 1 through 9.
4. Select files **rtdm.h,rtdm_hal_adapter.h,rtdm_select_channels.h,rtdmuser.h,and diagnostics_rtdm.c,**then right click and set **Exclude file(s) from current configuration**



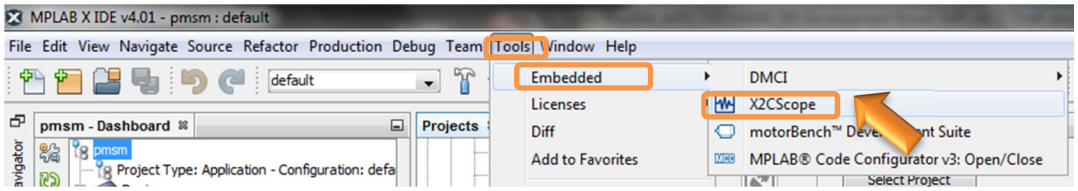
5. Select files **X2Cscope.h and diagnostics_x2cscope.c**, then right click and set **Include file(s) from current configuration** to add these files as part of current Project Configuration. This will allow X2C Scope interface related files to be added to the project, and is required to enable X2C Scope.



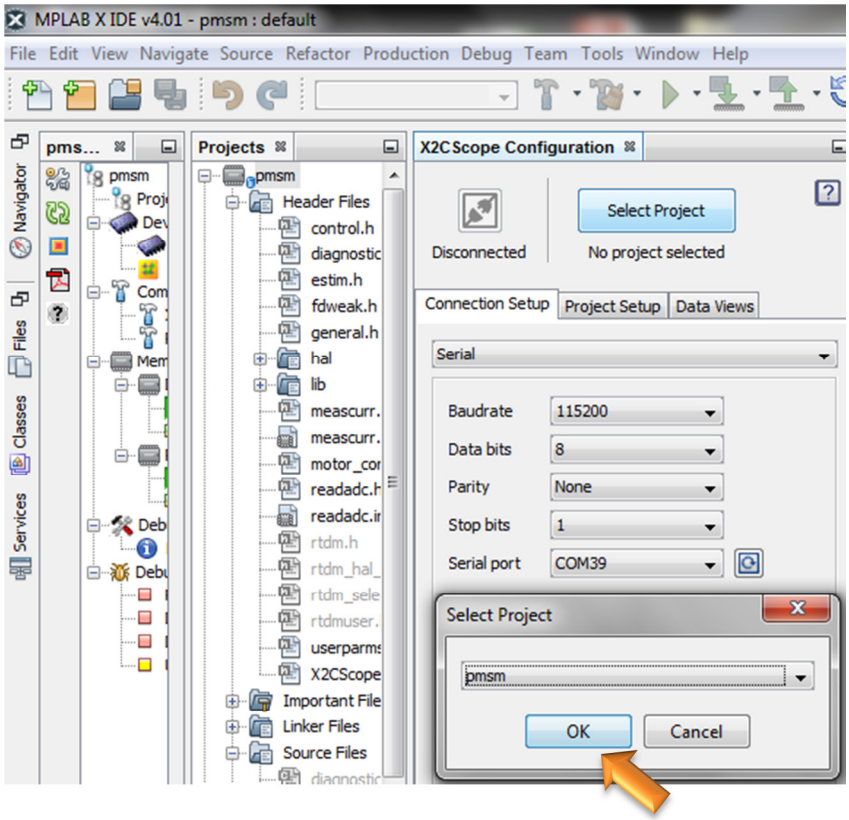
6. Right click on the project pmsm.X and clean and build the project



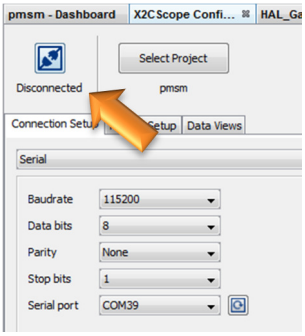
7. Open the X2C Scope window by selecting Tools>Embedded>X2CScope Window.



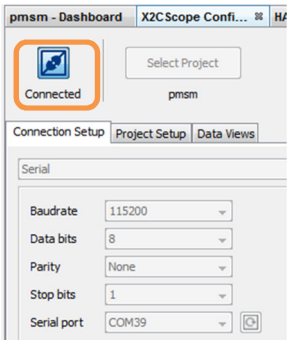
8. Open the DMCI window and select pmsm.X project as shown.



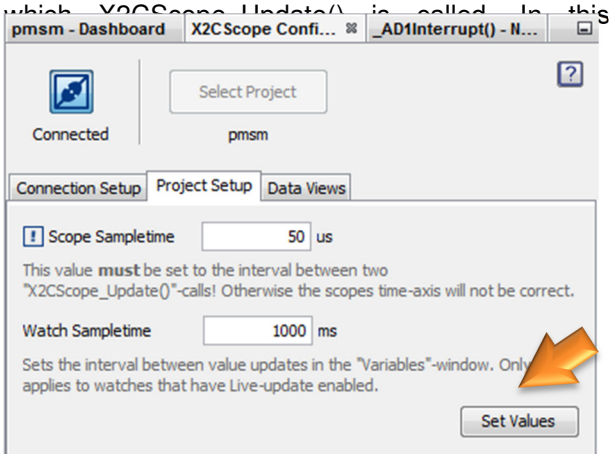
9. Remote Communication needs to be established, as indicated in the following figure (the communication baud rate should be set to 115200, while the COM port used depends on your particular settings).



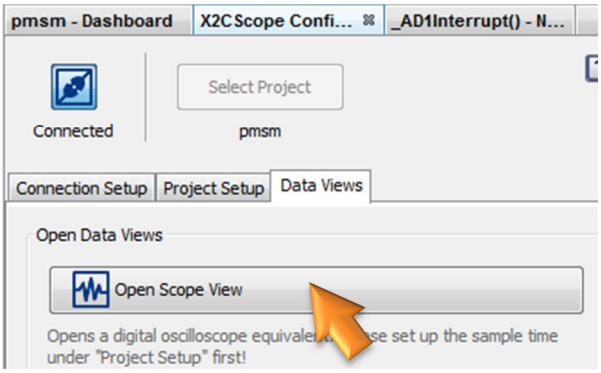
10. Once COM port is detected, click **Disconned**, and it will be turn into **Connected,**if the link is established as programmed.



11. Set the project setup as shown below and click Set Values.Set Scope Sampling time as interval at which X2CScope_Update() is called. In this application it is every 20 KHz(50us).

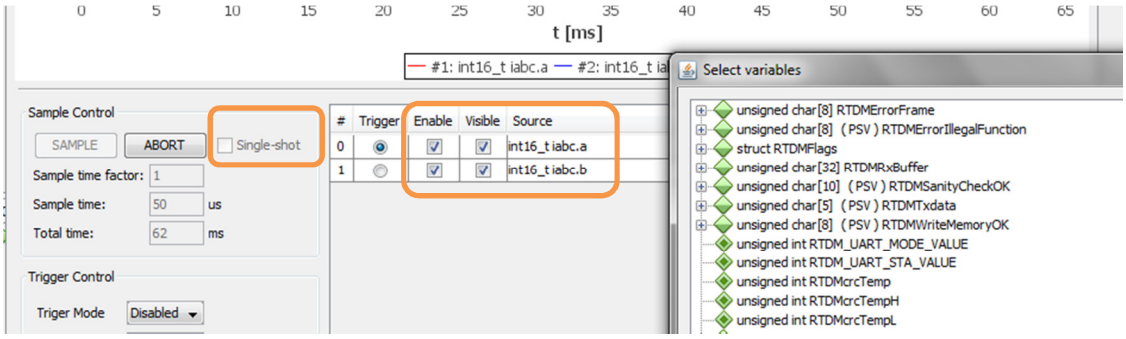


12. When the setup is established, click on Open Scope View(under sub window Data Views).This opens ip the X2C Scope window.



13. In the window select the variables user may want to watch.Click on the source ,a window Select Variables opens upon the screen.From the select variables list ,choose the variable that you want to view. Then ensure Enable,Visible check boxes are checked as shown.

    To view data plots continuously uncheck **Sinlge-shot** . When Single-shot is checked it captures the data once and stops,if trigger occurs.



14. The X2C Scope window shows variables plotted in real time, which is updated automatically.