# Demonstration ReadMe for the dsPICDEM™ MCSM Development Board

## 1.1 INTRODUCTION

This document describes the demonstration setup requirements for using the application note *"Stepper Motor Control with dsPIC® DSCs"* with the dsPICDEM™ MCSM Development Board.

## 1.2 SUGGESTED DEMONSTRATION REQUISITES

MPLAB and C30 versions used:

- MPLAB version 8.36 (or later)
- C30 version v3.21 (or later)

Hardware used with part numbers (available at www.microchipdirect.com)

- dsPICDEM™ MCSM Development Board Kit (DV330021), which contains:
  - dsPICDEM™ MCSM Development Board
  - dsPIC33FJ32MC204 Plug-In-Module (PIM)
  - USB-to-mini-USB cable
  - Slotted Screwdriver
  - 24V Power Supply
  - Leadshine Stepping Motor (P/N 42HS03)

## 1.3 HARDWARE SETUP

The following hardware setup allows the stepper motor control algorithm to run on the dsPICDEM MCSM Development Board Kit.

1. Connect the Stepper Motor to the output header J8 with the following motor connection:

| J8 Pin Number | J8 Pin Name | Wire Color for Bipolar Parallel Connection |
|---|---|---|
| 1 | NC | – |
| 2 | M1 | Black + Yellow |
| 3 | DC+ | – |
| 4 | M2 | Green + Orange |
| 5 | M3 | Red + White |
| 6 | DC+ | – |
| 7 | M4 | Blue + Brown |
| 8 | NC | – |

2. Connect the programmer/debugger using the J1 or J2 connector.

3. Using a mini-USB cable, connect the computer to the J4 mini-USB connector.

4. For enhanced demonstration, the application requires the Real-Time Data Monitor (RTDM). Users can connect a mini-USB cable from their computer to the J4 connector of the dsPICDEM MCSM Development Board. Notice that when the development board is powered and connected to the USB host, the driver needs to be installed on the host for proper operation, as follows:
   a) Extract the `PC_USB_driver_for_win2k_xp_vista32_64.zip` archive file to a local directory. This file is part of the ZIP file of the code.
   b) When prompted to select the driver for new USB device found, select the driver from the ones provided corresponding to the operating system used: Windows 2000, XP, or Vista (32- or 64-bit). Wait for the indication that the new device was installed properly and is ready to be used. Once the USB driver is installed, it will emulate a Serial COM Port, visible in the Windows Device Manager.

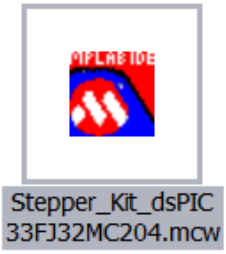
## 1.4 SOFTWARE SETUP AND RUN

### 1.4.1 Basic Demonstration

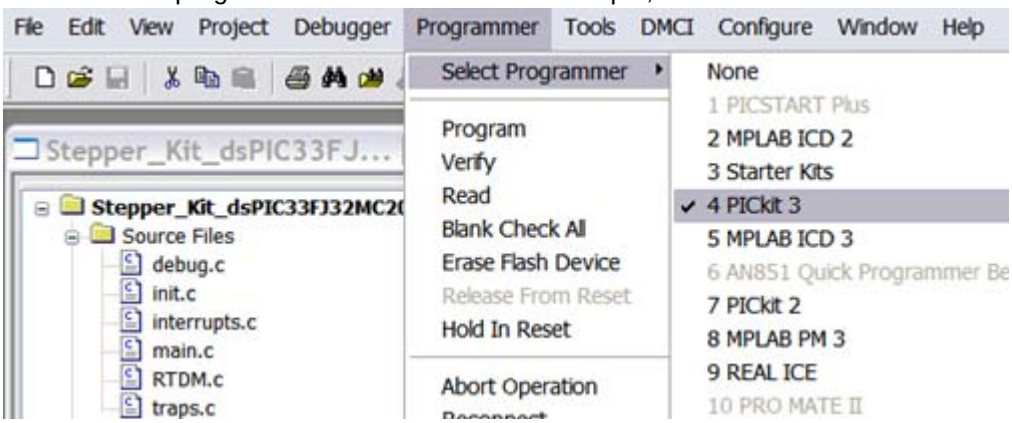
This demonstration consists of running the motor using a push button and varying the speed with a potentiometer. No real-time debugging is done for the basic demonstration.

1. Extract the contents of the `Stepper_Kit_dsPIC33FJ32MC204.zip` file.


2. Go to the …`\Stepper_Kit_dsPIC33FJ32MC204` folder and double-click `Stepper_Kit_dsPIC33FJ32MC204.mcw` to open the file.

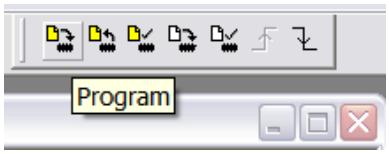



3. Select the programmer to be used. In this example, PICkit 3 is selected.




4. Build all (CTRL+F10 keys). Make sure the project builds with “Release” mode.


5. Download the code to the dsPICDEM™ MCSM Development Board.



6. Run/Stop motor by pressing S1. The motor will run on the following modes as the button is pressed. The sequence is completed once the button is pressed nine times, and then it will return to the initial state (1/2 Step).

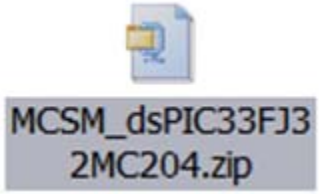

| Button Pressed N times | Operating Mode |
|---|---|
| 1 | 1/2 Step |
| 2 | 1/4 Step |
| 3 | 1/8 Step |
| 4 | 1/16 Step |
| 5 | 1/32 Step |
| 6 | 1/64 Step |
| 7 | Stop |
| 8 | Full Step (2-phase ON) |
| 9 | Full Step (Wave Drive) |

7. Vary the motor speed using the potentiometer.


### 1.4.2 Enhanced Demonstration using Real-Time Data Monitor (RTDM) and Data Monitor and Control Interface (DMCI)

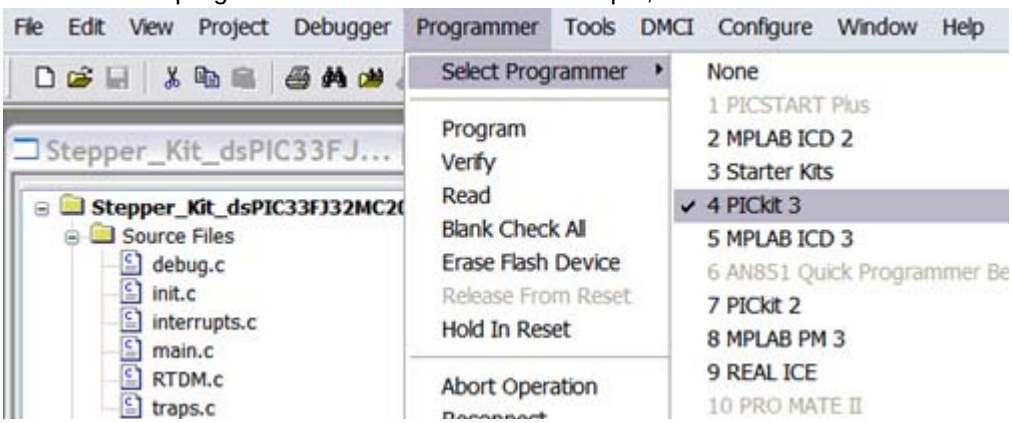
1. Make sure you have the correct hardware setup as previously described in **Section 1.3 “Hardware Setup”**.
2. In order to utilize RTDM communication for this demonstration, a mini-USB connection is required. Connect a mini-USB cable from your computer to the J4 connector of dsPICDEM MCSM Development Board.

3. Extract the contents of the `Stepper_Kit_dsPIC33FJ32MC204.zip` file.

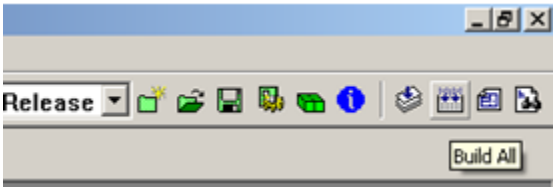


4. Go to the …\Stepper_Kit_dsPIC33FJ32MC204 folder and double-click Stepper_Kit_dsPIC33FJ32MC204.mcw to open the file.

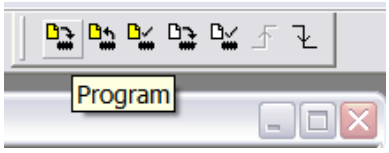

5. Select the programmer to be used. In this example, PICkit 3 is selected.



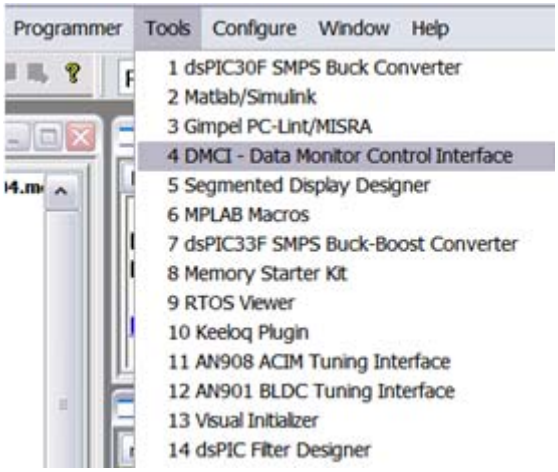

6. Build all (ctrl+F10 keys). Make sure the project builds with “Release” mode.




7. Download the code to the dsPICDEM™ MCSM Development Board.

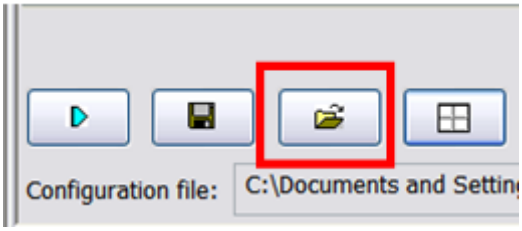



8. Open the DMCI window by selecting *Tools>DMCI – Data Monitor Control Interface.*



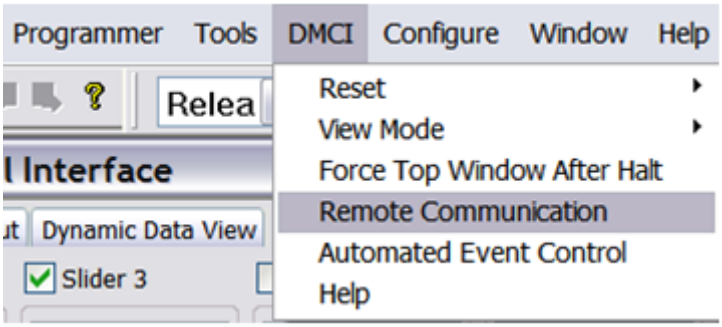
9. Click the **Load Profile** button, and from the same folder where your project resides, load the `MCSM DMCI demo.dmci` file, which contains a previously configured profile.



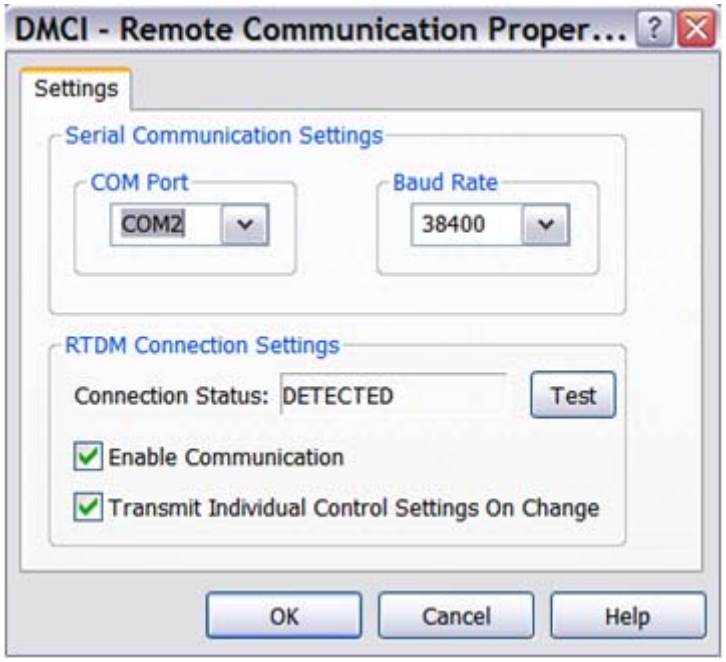

10. The DMCI window appears as follows:


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

11. Select *DMCI>Remote Communication* to connect RTDM with your computer.



12. The Remote Communication needs to be established, as indicated in the following figure. The communication baud rate should be set to 38400, while the COM port used depends on your particular settings.



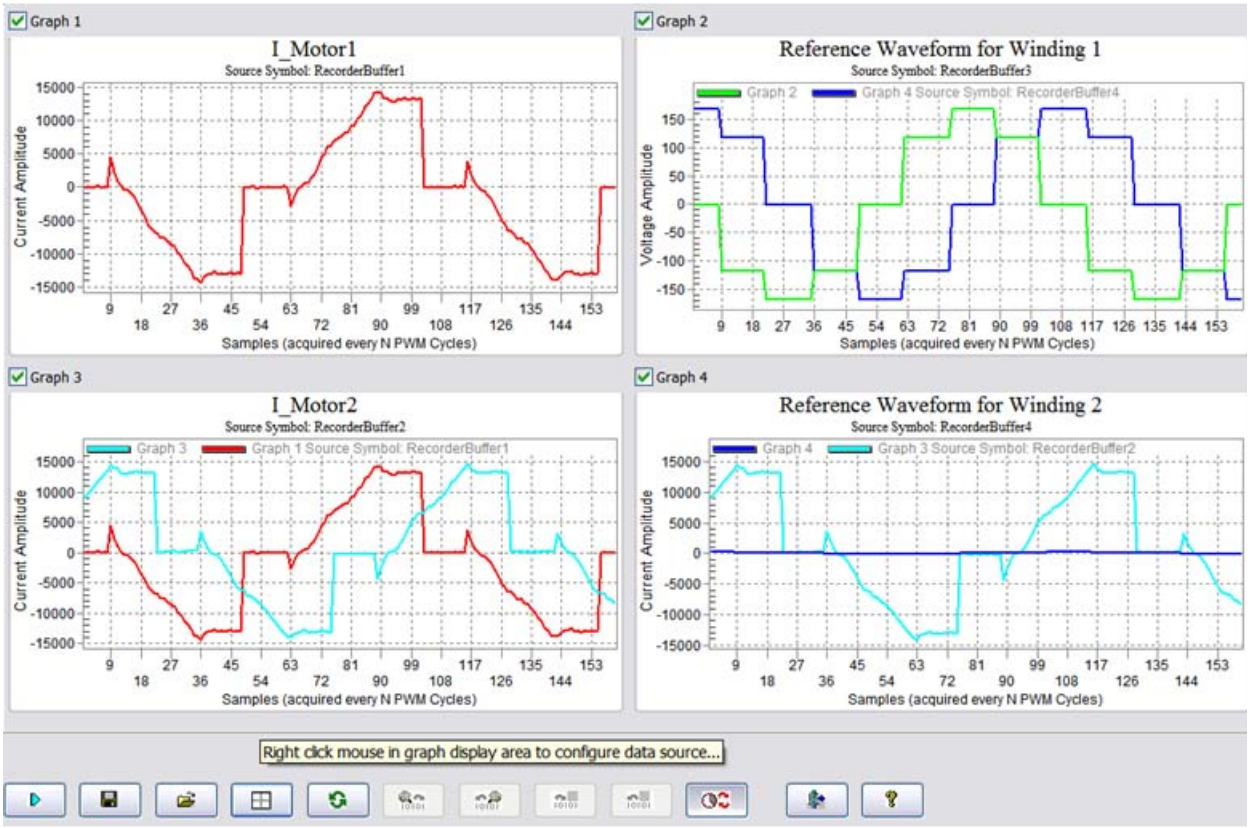

13. Once communication is detected, make sure the **Enable Communication** box is checked and click **OK**.
14. Press the “START/STOP” button from DMCI to start the motor at initial speed.


15. In order to change speed with a slider, turn the “DMCI / POT” Boolean to the **ON** position.

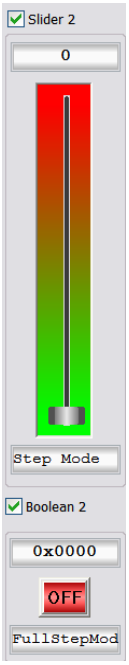
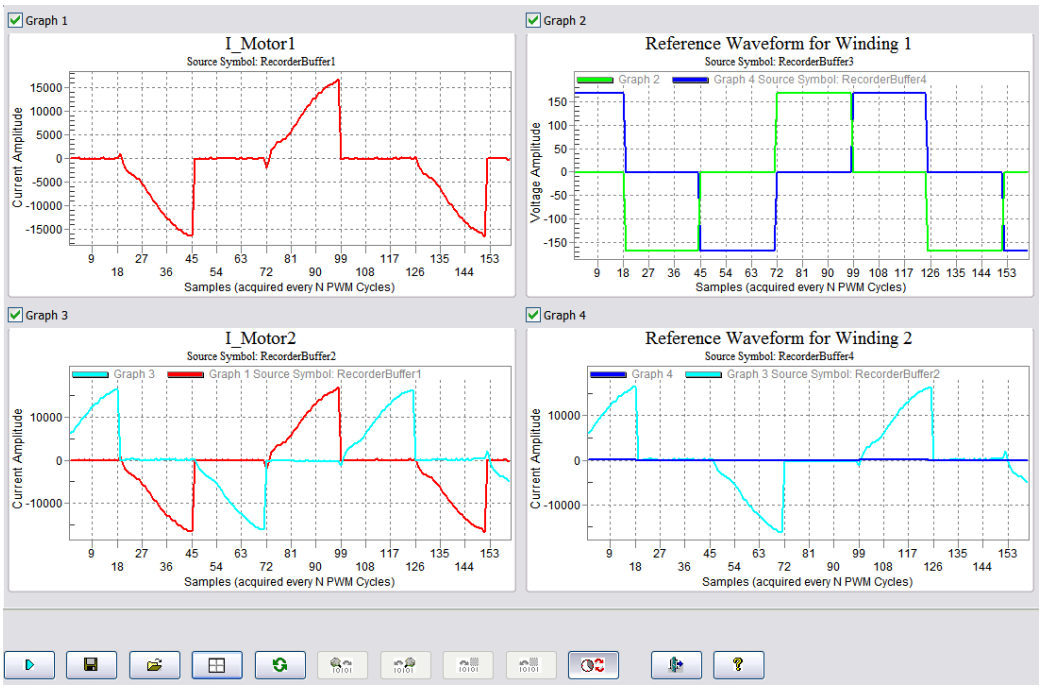
16. Vary the speed of the motor by setting the value of the “DMCI Speed” slider to 300.


17. To plot variables in real time, enable Automated Event Control by clicking the following icon on DMCI.

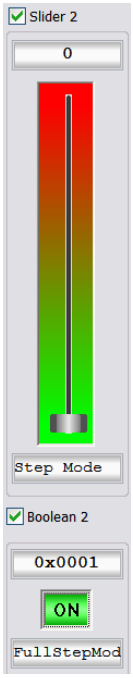
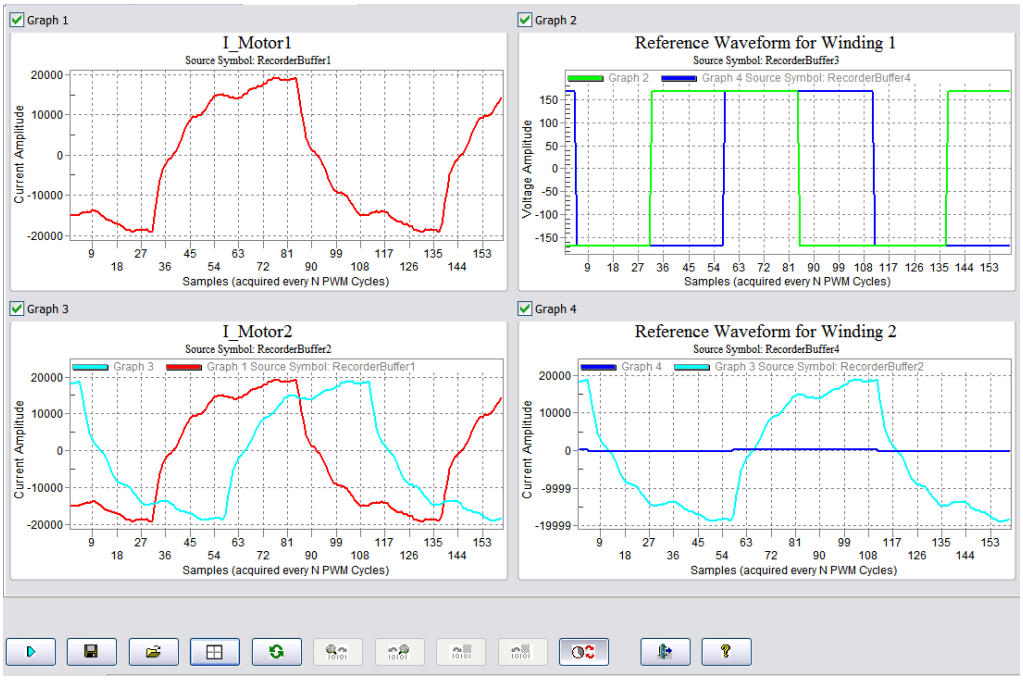
18. In the DMCI window, click the **Dynamic Data View** tab. The following figure shows variables plotted in real time, and updated automatically. The motor is now running in *Half Step mode with fixed voltage reference*.



19. To run motor in *Wave mode with fixed voltage reference*, the “Step Mode” slider has to be set to **zero**, indicating that a full step control is done, and also set the “FullStepMode” boolean to the **OFF** position. All of these controls are located in the **Dynamic Data Control** tab.

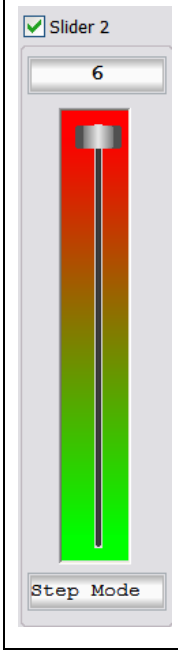
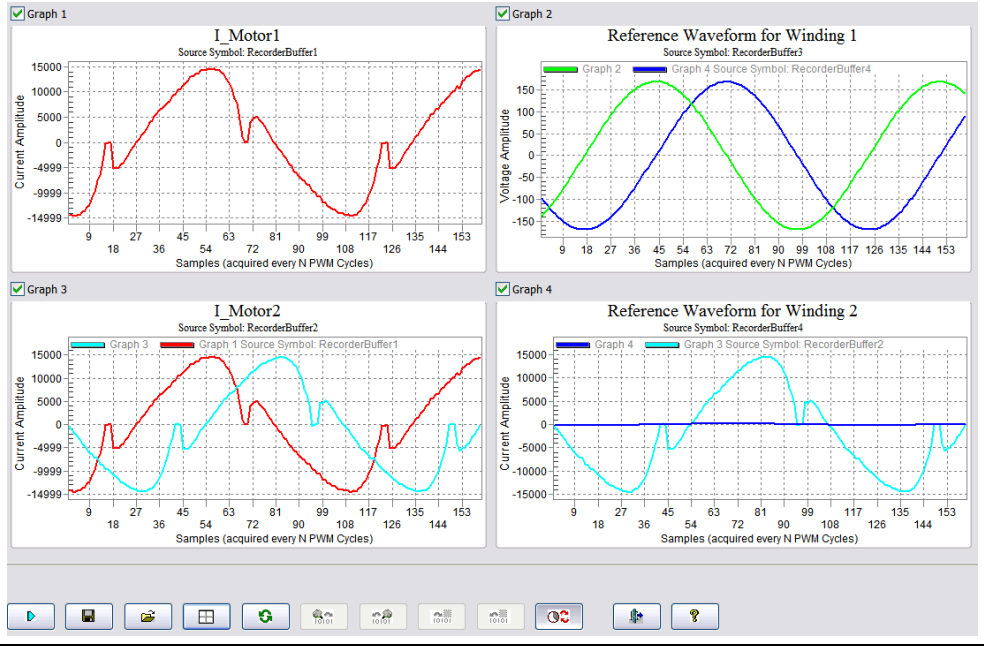
| Slider and Boolean | Resultant Graphs |
|---|---|
|  |  |

20. To run the motor in *Full Step (2-phase ON) mode*, the “Step Mode” slider has to be set to **zero**, indicating that a full step control is done, and also set the “FullStepMode” Boolean control to the **ON** position.

| Slider and Boolean | Resultant Graphs |
|---|---|
|  |  |



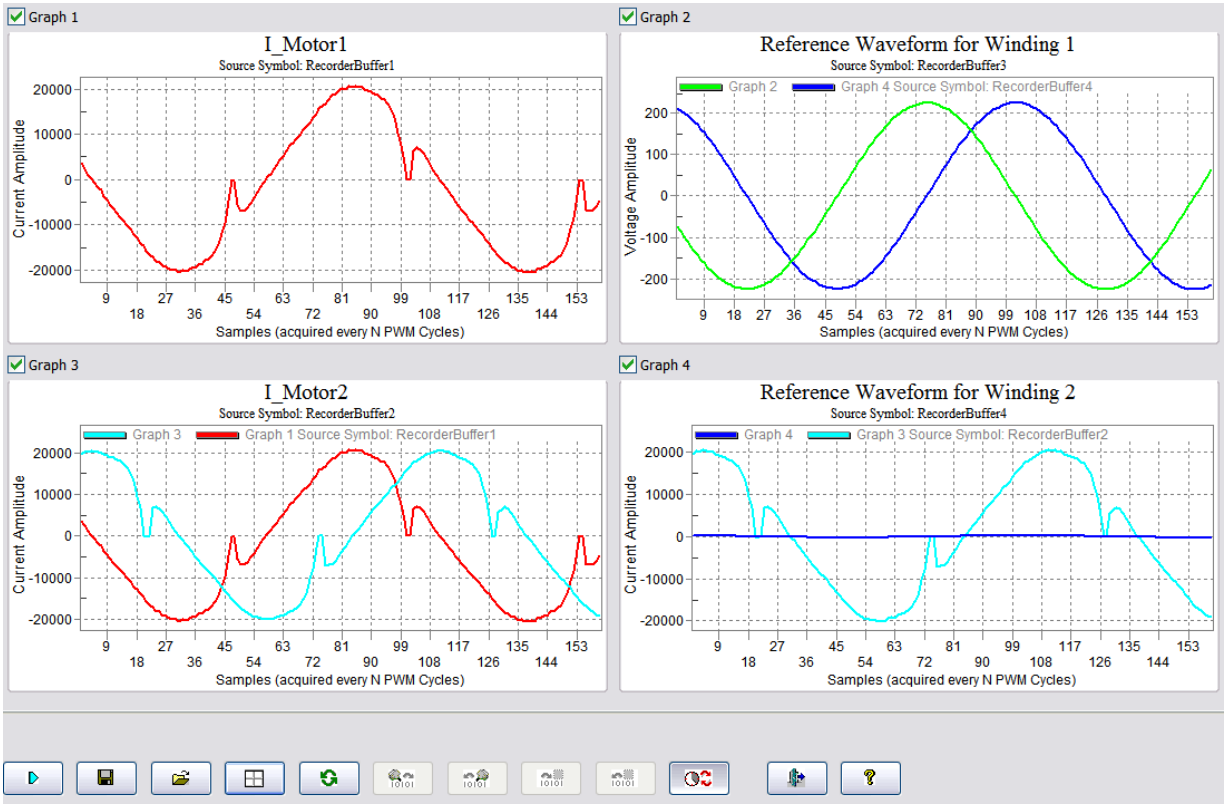
21. To run the motor in *1/64 micro-stepping mode with fixed voltage reference*, set the value of Step Mode to 6.

| Slider and Boolean | Resultant Graphs |
|---|---|
|  |  |

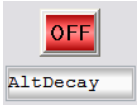
The following table shows the relationship between the “Step Mode” slider values and the operating modes.

| “Step Mode” Slider Value | Mode |
|---|---|
| 0 | Full Step |
| 1 | 1/2 Step |
| 2 | 1/4 Step |
| 3 | 1/8 Step |
| 4 | 1/16 Step |
| 5 | 1/32 Step |
| 6 | 1/64 Step |

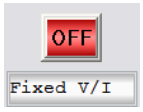
22. To enable *Fixed Current Mode*, set the “Fixed V/I” boolean control to the **ON** position. If this boolean control is **OFF**, fixed voltage control will be done. The following graph shows the *1/64 micro-stepping mode with fixed current reference*.




23. To change to Alternate Decay modes, which use both slow and fast decay modes, set the “Alt Decay” boolean to the **ON** position.

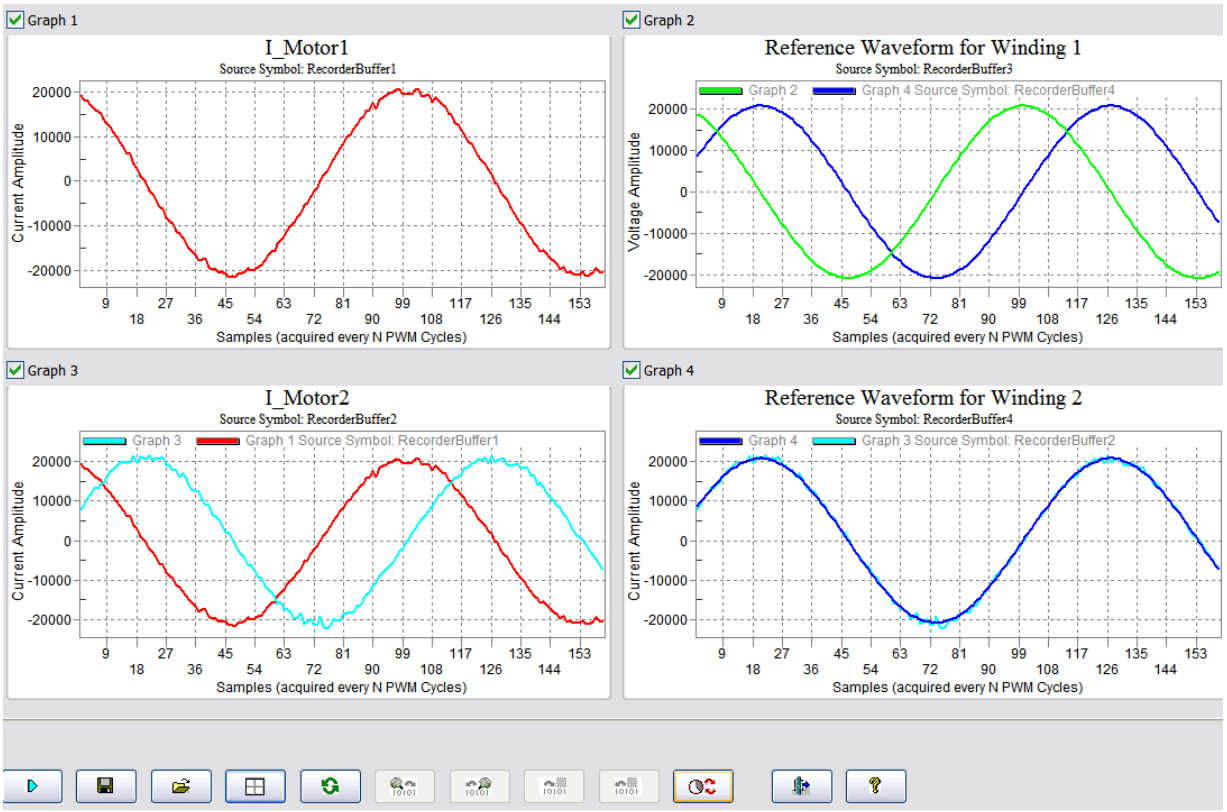


24. To enable *Current Control Loop Mode*, set the “CurCtrlLoop” Boolean control to the **ON** position. If this Boolean control is **OFF**, fixed voltage/current control will be done depending on the status of the “Fixed V/I” Boolean control. The following graph shows the *1/64 micro-stepping mode with Current Control Loop*. The current control loop mode can be used on the following step modes.


| “Step Mode” Slider Value | Mode |
|---|---|
| 0 | Full Step |
| 1 | 1/2 Step |
| 2 | 1/4 Step |
| 3 | 1/8 Step |
| 4 | 1/16 Step |
| 5 | 1/32 Step |
| 6 | 1/64 Step |

**Note:** When the current control loop mode is enabled, the scale for the speed reference is higher than the scale used for fixed V/I mode. This is an expected behavior since in current control loop the motor can achieve higher speeds. Please refer to the application note software for more information.



25. To enable *Position Control Mode*, set the “CurCtrlLoop” Boolean control to the **ON** position. The following table shows the possible modes that can operate in Position Control**.** The “DMCI position” slider controls the number of degrees that the rotor will rotate before it stops.


**Note:** The “DMCI position” slider resolution is expressed in quarter steps. Therefore, every four numbers equals one full step movement.

| “Step Mode” Slider Value | Step Resolution | Control Mode |
|---|---|---|
| 0 | Full Step | Fixed Voltage |
| 1 | 1/2 Step | Fixed Voltage |
| 2 | 1/4 Step | Fixed Voltage |
| 3 | 1/8 Step | Fixed Voltage |
| 4 | 1/16 Step | Fixed Voltage |
| 5 | 1/32 Step | Fixed Voltage |
| 6 | 1/64 Step | Fixed Voltage |
| 0 | Full Step | Fixed Current |
| 1 | 1/2 Step | Fixed Current |
| 2 | 1/4 Step | Fixed Current |
| 3 | 1/8 Step | Fixed Current |
| 4 | 1/16 Step | Fixed Current |
| 5 | 1/32 Step | Fixed Current |
| 6 | 1/64 Step | Fixed Current |
| 0 | Full Step | Current Control Loop |
| 1 | 1/2 Step | Current Control Loop |
| 2 | 1/4 Step | Current Control Loop |
| 3 | 1/8 Step | Current Control Loop |
| 4 | 1/16 Step | Current Control Loop |
| 5 | 1/32 Step | Current Control Loop |
| 6 | 1/64 Step | Current Control Loop |

26. Users can capture more or less data by changing the value of the “View Zoom” slider. This value is in number of half PWM cycles, so if a number 10 is set here, every data point will be captured in 10 half PWM periods, which in the software is 10 * (0.5/40,000Hz) = 125 µs per point. For a DMCI window of 160 points, each window will capture a total of 160 * 125 µs = 20 ms.