User's Guide

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ABSTRACT

This document is provided with the DRV84xxE, DRV89xx, and DRV8256x evaluation module (EVM) as a supplement to DRV84xxE, DRV89xx, and DR8256x Motor Driver datasheet. This user's guide details on how to use the EVM GUI application.

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1 Overview

The DRV84xxE_89xxP_8256x EVM is a platform to support prototyping and evaluation for the DRV84xxE, which is a medium-voltage dual H-bridge driver for stepper driving applications, the DRV89xx, which is a dual H-bridge motor driver with integrated FETs, and the DRV8256x, which is a paralleled dual H-bridge motor driver with integrated FETs.

The EVM uses an MSP430™ microcontroller and a USB interface chip to manage communication from the GUI software application installed on a PC computer with Windows®. The GUI sends serial commands to the MSP430 to control the device signals, monitor faults, read and write SPI registers, and drive a stepper motor or two brushed DC motors by issuing the step commands at the desired rate. This document describes the software and tools used to evaluate the devices listed above.

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2 Hardware and Software Setup

The hardware (HW) and software (SW) tools that follow are required for the evaluation of DRV84xxE, DRV89x, and DRV8256x:

- DRV84xxE_89xxP_8256x EVM
- Stepper motor or brushed DC motors
- Voltage supply from 4.5 to 48 V
  - DRV842x and DRV8932 from 4.5V to 33V
  - DRV843x, DRV8955, and DRV8256x from 4.5V to 48V

This document only describes the installation and usage of the DRV84xxE EVM GUI. For additional details on hardware connections refer to the DRV84xx_89xxP_8256x EVM User's Guide.

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3 GUI Application

3.1 Installation

Installation (For Desktop Version Only)

- Download the installable DRV84xx_82xx_89xx_x.x.x_installer_win.zip file (The file is inside the DRV89xxP_8256xEVM software.zip file. x.x.x is the GUI revision number).
- Extract the zip.
- Double click on the installer to install the GUI application. During the first installation, the installer prompts for installation of Cloud Agent. Please install it. During the installation, customer company's firewall may block "download from website" option for the GUI composer runtime installation, please download GUI runtime v7.4.1 from this link: https://software-dl.ti.com/ccs/non-esd/gui_composer/runtime/gcruntime-7.4.1-windows-installer.exe and save it to your local harddrive. And then, use "Install from File" option to install the GUI composer runtime.

3.2 Getting Started with DRV84xxE_89xxP_8256x EVM GUI

The EVM GUI and DRV84xxE_89xxP_8256x EVM allows the user to configure various settings required for BDC motor or stepper motor driving. The GUI lets the user adjust the motor speed, control the direction, control the step movement, configure various device settings, and monitor the device status.

Perform the following steps to begin using the GUI:

- Connect the stepper motor or brushed DC motor/s to the EVM.P
- Plug in the micro-USB cable to the PC.
- Enable the motor power supply. For additional details on hardware connections refer to the D RV84xx_89xxP_8256x EVM User's Guide

Click on DRV84xx_82xx_89xx EVM GUI shortcut either on the desktop or from the start menu to run the GUI application.

3.3 Use the DRV84xxE_89xxP_8256x EVM GUI

After open the GUI, the GUI landing page shown in the figure below.

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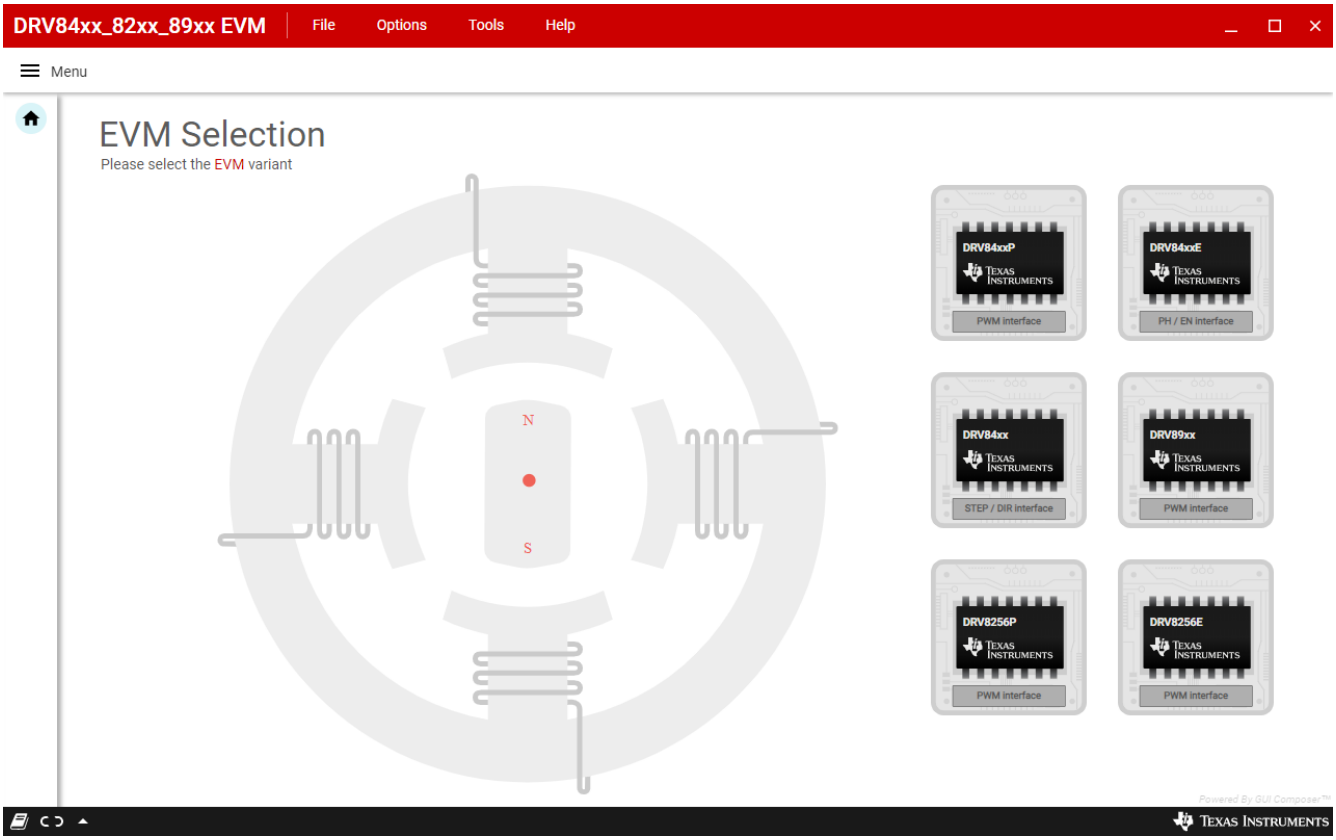

Figure 3-1. DRV84xx_82xx_89xx EVM GUI (Landing Page)

Depending on the device populated on the EVM (check the label on the EVM), click on the appropiate EVM variant. For example, if the label on the EVM says DRV8424E, select the DRV84xxE box. The DRV84xxE GUI home page shown in Figure 3-2 but the home page for the DRV89xx and DRV8256P/E will be different. Motor Control Page will explain the differences in each GUI variant and how to properly interface with the GUI to drive a motor.

The application will try to establish communication with the device connected. A message showing 'Connected to Cloud Agent. Connecting to target…' will be displayed in the hardware connection status pane at the bottom of the screen. If the connection is successful, 'COMxx:9600 Connected to Target' message appears as shown in Figure 3-3 below.

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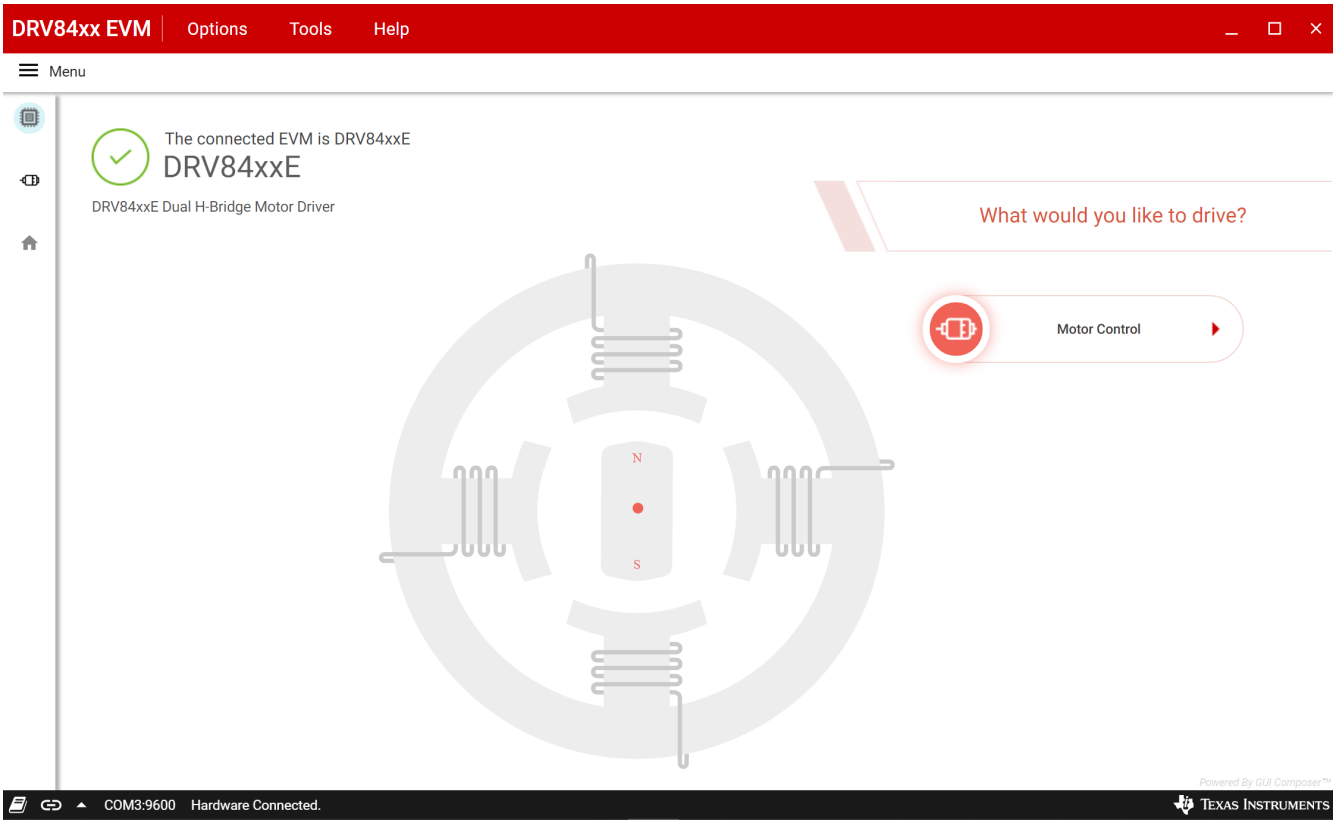

Figure 3-2. DRV84xxE EVM GUI (Home Page)

Figure 3-3. DRV84xxE EVM GUI (Device Connection Pane)

If the GUI fails to connect to the EVM, the hardware connection status pane will show the message ‘Hardware Not Connected’.

If the GUI is opened without connecting the EVM, the hardware connection status pane will show ‘Error: no serial ports found’.

If there are more than one EVM boards connected, the first matching device will be connected automatically. In order to switch to another EVM:

1. Click Options -> Serial Port. A serial port configuration popup is displayed as shown below in Figure 3-4.
2. Choose the appropriate port and baud rate.
3. Click OK

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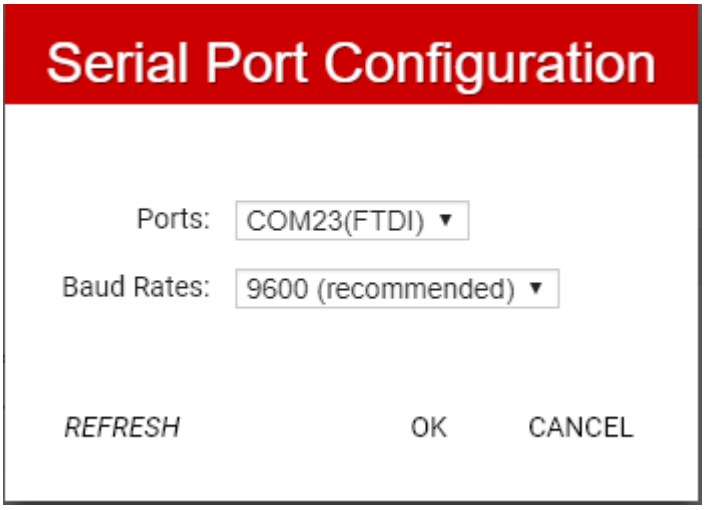

Figure 3-4. Serial Port Configuration

Once the correct device is connected, the home page will show a message ‘Device Connected’ with a green check mark as shown in Figure 3-2

Click on the ‘Stepper Motor’ button to open the motor control page.

3.3.1 Motor Control Page

The motor control page will look different depending on the EVM GUI variant selected in the home page. Figure 3-5 to Figure 3-8 show the motor control page for the different GUI variants. The DRV84xxE GUI (shown in Figure 3-5) includes various controls to sleep/wake the driver and control the motor by configuring various parameters such as AVREF_VAL, control mode and so forth. Hovering over the (?) icon to the right of a control displays a brief description about the control.

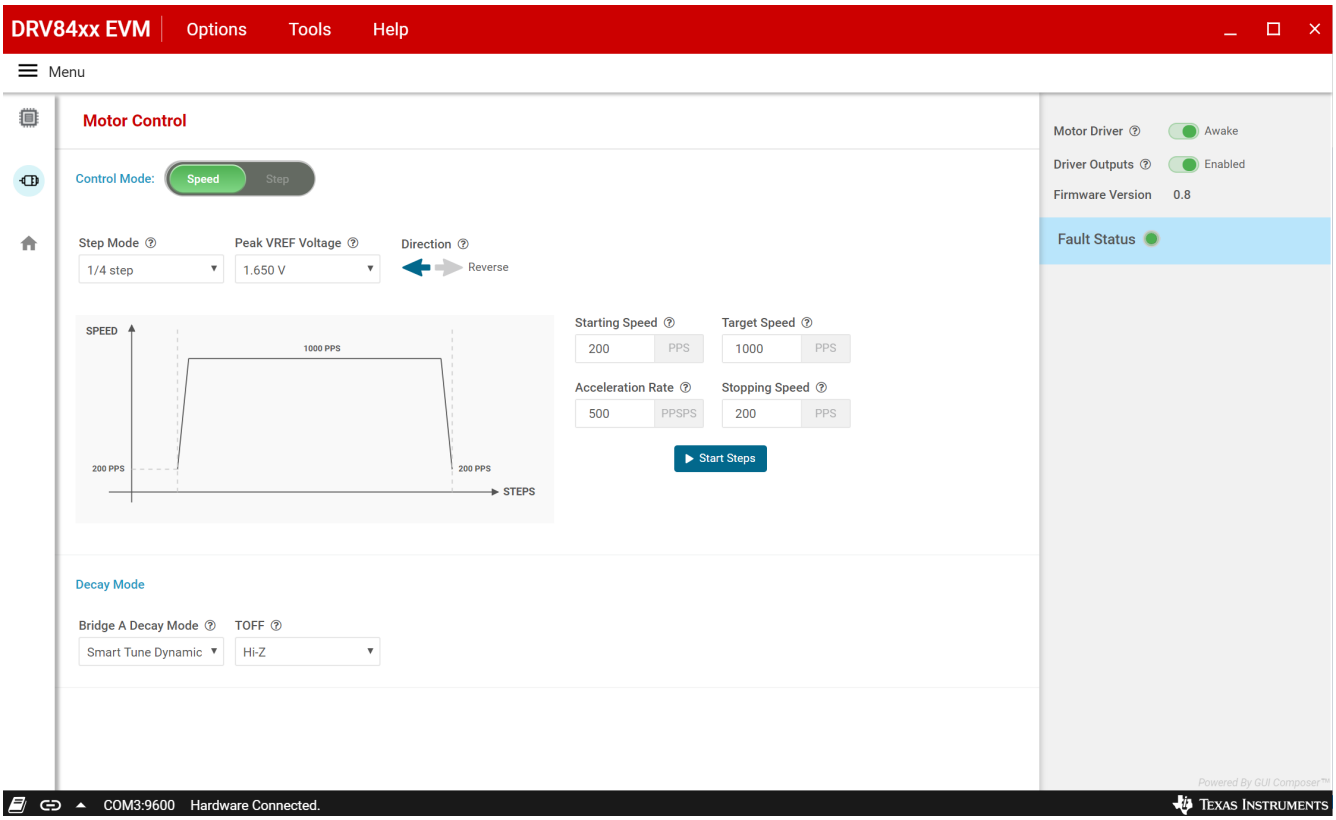

Figure 3-5. DRV84xxE EVM GUI (Motor Control Page)

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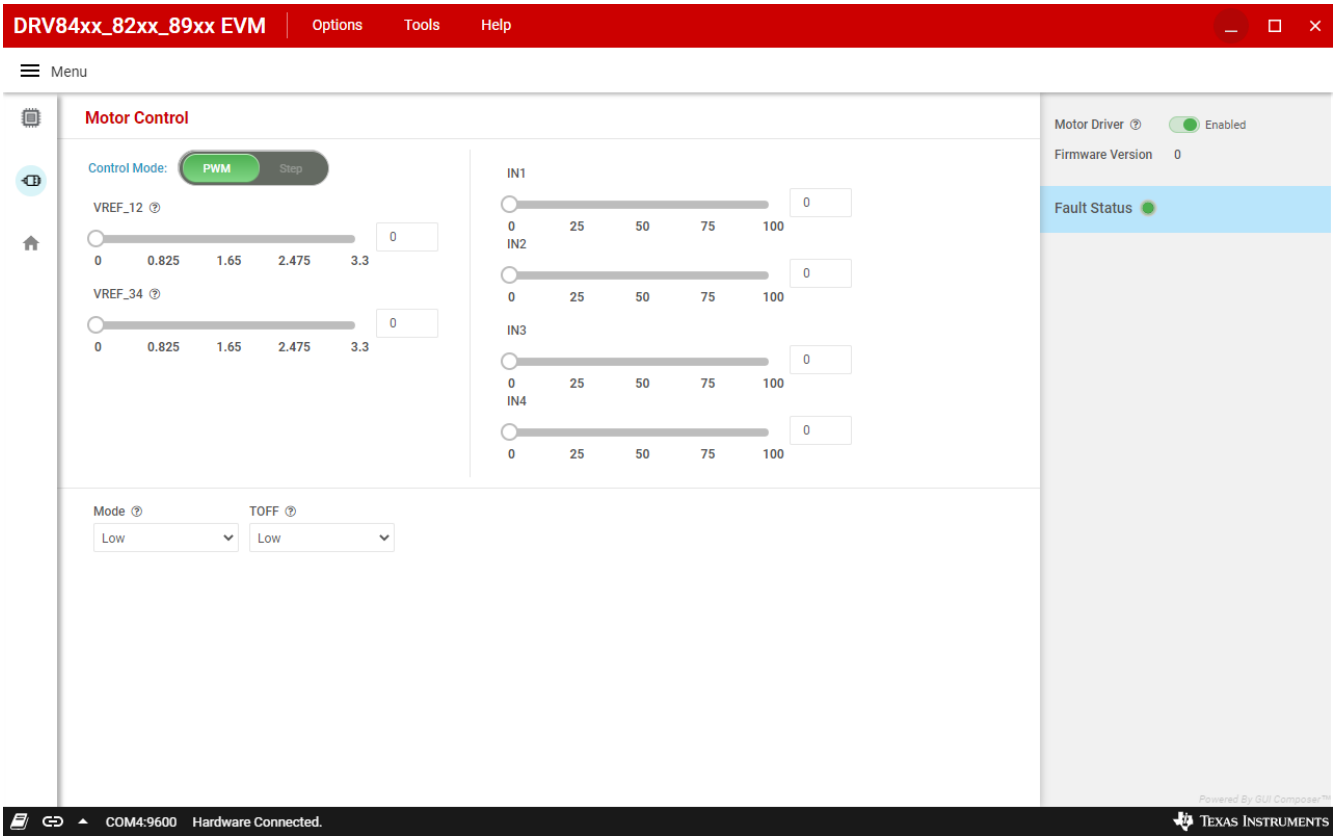

Figure 3-6. DRV89xx EVM GUI (Motor Control)

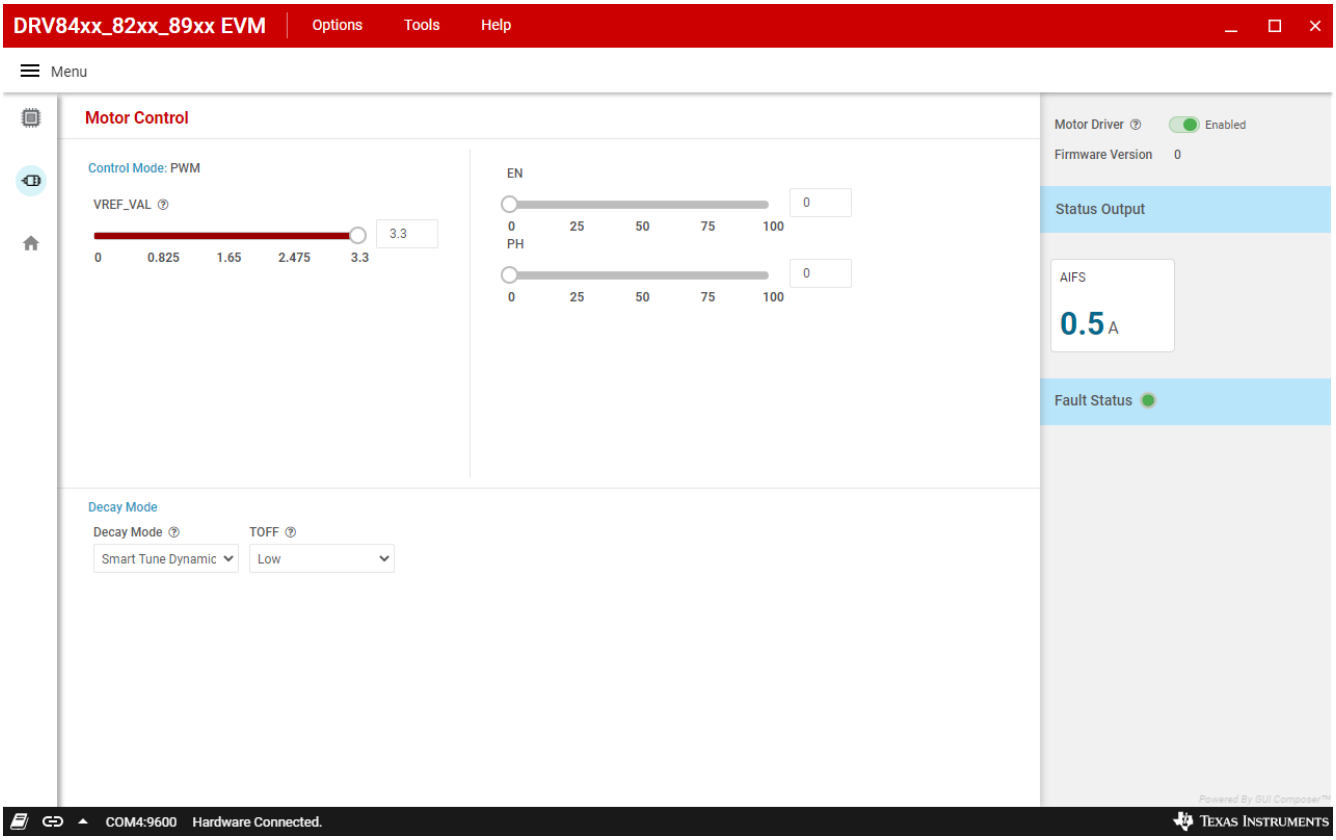

Figure 3-7. DRV8256E EVM GUI (Motor Control)

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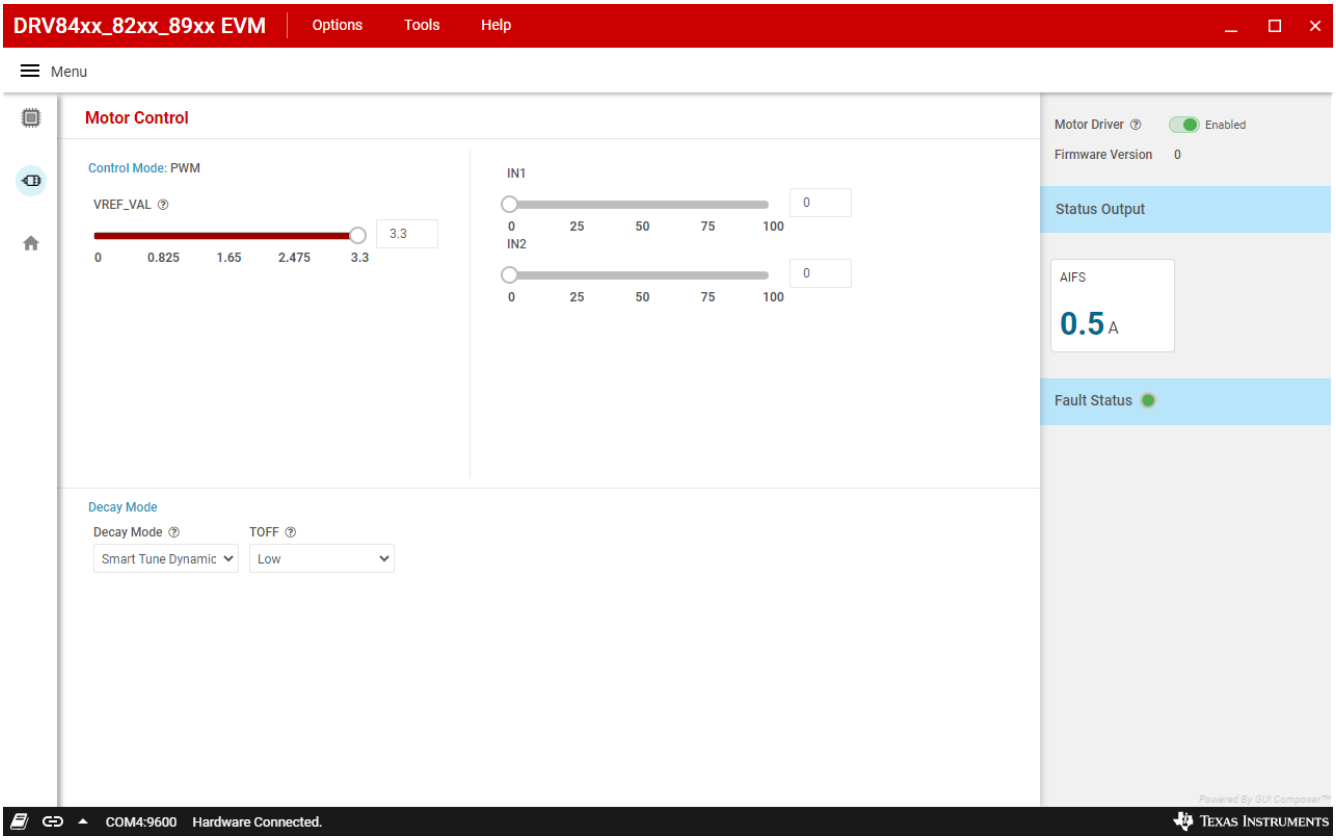

Figure 3-8. DRV8256P EVM GUI (Motor Control)

3.3.1.1 Control Modes

The GUI allows the user to control the stepper motion profile in two modes – Speed Mode and Step Mode. To toggle between the modes, use the toggle button at the top of the screen.

3.3.1.2 Speed Mode

In the DRV84xxE GUI variant, Speed Mode allows the user to spin the stepper motor continuously at a desired speed. The user configures the starting speed, stopping speed, acceleration rate, and target speed. Stepper controls are enabled only when ‘Motor Driver' control is enabled. ‘Start Steps’ button is enabled only when ‘Driver Outputs' control is enabled for example, AEN and BEN pins are set to high. When the ‘Start Steps’ button is clicked, the motor begins spinning at the starting speed and accelerates to the target speed according to the configured acceleration rate. The acceleration profile in the microcontroller firmware accepts the starting-speed PPS signal and target-speed PPS signal as a clock cycle number.

When the ‘Start steps’ button is clicked, the PWM timer generates steps at a rate specified by the 'Starting Speed' PPS parameter. When ‘Stop Steps’ is clicked, the motor starts decelerating at the ‘Acceleration Rate’ configured to reach the stopping speed and eventually stop. The configuration is visualized by the embedded graph shown on the GUI screen.

When accelerating or decelerating, the PPS signal is adjusted every 32 ms based on the integer value of PPSPS / 32 ms. Acceleration rates must be between 1 and 65,535 PPSPS. The step rate increases by the calculated value until the target speed is reached.

The starting speed must be less than or equal to the target speed. If the starting speed and target speed are equal, the EVM firmware will not perform an acceleration routine. The stopping speed must also be less than or equal to the target speed. The target speed is limited to a range between 200 and 40,000 PPS.

The 'Start Steps' command computes how frequently automatic speed updates are issued and a second timer is used to change the speed according to the programmed acceleration rate profile. Once clicked, the motor will begin spinning according to the parameters set in the GUI.

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When the target speed PPS value is reached, the acceleration profile ends and the motor continues running until the 'Stop Steps' button is clicked. When the stepper is commanded to stop, the controller performs the same actions as it did while accelerating, but in reverse order to decelerate until the stop speed PPS value is reached, in which case the motor fully stops.

Figure 3-9 shows the acceleration profile and the role each parameter plays during speed computation.

Figure 3-9. Controls Available for Speed Mode

3.3.1.3 Step Mode

The DRV84xxE and DRV89xx GUI variants have step mode which allows the user to move the stepper motor a configured number of steps. In the 89xx GUI variant, stepper mode can be activated by clicking "STEP" on the "Control Mode" widget located on the top left of the motor control page. Stepper controls are enabled only when 'Motor Driver' control is enabled. Steps' button is enabled only when 'Driver Outputs' control is enabled for example, AEN and BEN pins are set to high. When the 'Start Steps' button is clicked, the motor starts spinning at the starting speed and accelerates at the rate configured to reach until the number of steps is reached after which it stops.

The acceleration and deceleration profiles work similarly as before, except when the deceleration routine starts and when the motor stops are a function of the 'Steps to Stop' and deceleration rate parameters.

The configuration can be visualized in the graph embedded in the GUI. If the "Reciprocate" button is enabled, the stepper will travel the set number of steps, then reverse direction. It will do this continuously until 'Stop Steps' is clicked. Figure 3-10 shows the controls available in Step Mode.

Figure 3-10. Controls Available for Step Mode in the DRV84xxE GUI Variant

The parameters from 'Speed Mode' are reused as well, and they operate the same as described in Section 3.3.1.2. Two new parameters have been added to properly control the limited number of steps actuation. These parameters are described as follows:

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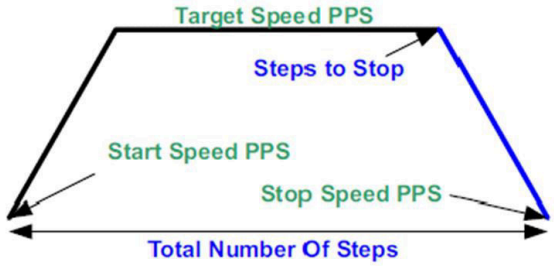
Number of Steps	This parameter is the number of steps that the controller will issue.
Steps to Stop	The controller is continuously monitoring the step being issued and when the current step is equal to the 'Steps to Stop' parameter, a deceleration profile is issued. If the value of the 'Steps to Stop' parameter is larger than the number of steps, then the motor stops abruptly and without undergoing a deceleration profile.

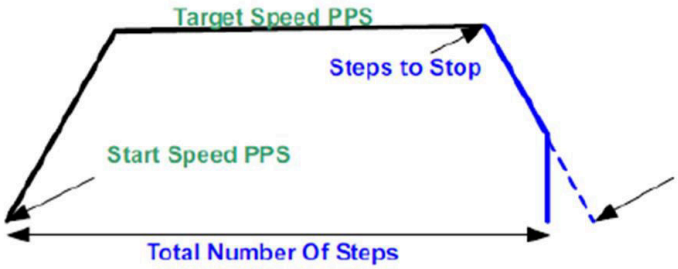
When a deceleration profile is issued, the controller decreases the speed until reaching the value of the 'Stopping Speed' parameter. If the 'Number of Steps' parameter is met before the deceleration profile is complete, then the motor stops at the current speed. If the stopping speed is met before all the number of steps is issued, then the motor rotates at the stop speed value until all the steps are executed.

Ideally, the system should resemble the case in which the controller executes all the commanded steps at a speed as close as possible to the stop speed. In the event this is not possible because of the particular parameters that were selected, stopping the motor at a speed very close to the 'Stopping Speed' parameter is often good enough to ensure good motion quality and application performance.



1. Motor reaches stop speed at the stop speed

2. Motor reaches stop speed before the stop speed is reached



3. Motor runs out of steps before reaching stop speed.

Figure 3-11. Stop Conditions

3.3.1.4 PWM Control Mode

The DRV89xx and DRV8256P GUI variants are set to PWM control mode be fault. However, only in the DRV89xx GUI can the control mode be changed to Step mode. Figure 3-6 and Figure 3-8 show the PWM motor control page for the DRV89xx and DRV8256P GUI respectively.

In the DRV89xx GUI, widgets "VREF_12" and "VREF_34" are used to set the current regulation reference voltage for each full bridge. A lower reference voltage will set a lower current regulation threshold value. The "IN1" to "IN4" widgets set the duty cycle for the input signals IN1-IN4. The "TOFF" widget sets the current regulation decay time depending on the value selected. Finally, the "MODE" widget is only applicable if a DRV8955PEVM is connected. If a DRV8932PEVM is connected, leave the "MODE" widget set to its default value "LOW". The "MODE" widget is used to set the different half bridge parallel modes offered by the DRV8955. When "MODE" is set as "LOW", the device is configure as a standard mode where each half-bridge can be individually control by IN1-IN4. If "MODE" is set as "HIGH", OUT1 and OUT2 (control by IN2) are paralleled and OUT3 and OUT4 (control by IN4) are paralleled to allow to drive higher currents. When "MODE" is set as "HI-Z", all 4 half-bridges are paralleled and are control by IN4 input signal. If "MODE" is set as "300kΩ to GND", each half bridge can be enabled and disabled by the EN1-EN4 switches as shown in Figure 3-12.

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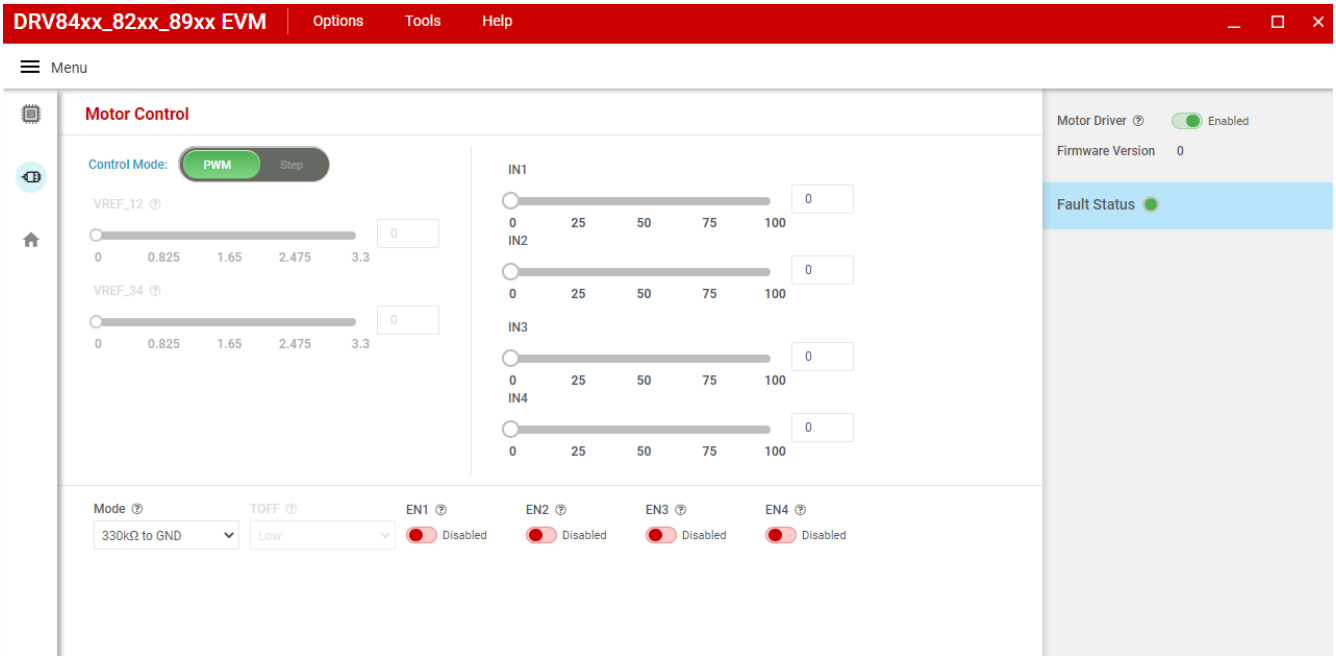

Figure 3-12. DRV89xx GUI Motor Control Page When MODE is set to "330kΩ to GND"

3.3.2 Decay Mode

Decay refers to how the driving currents recirculate in H-bridge FETs during the off time. Using the GUI, users can configure the decay mode for each bridge.

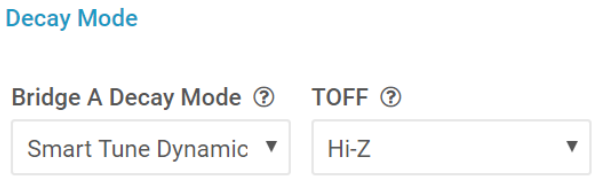

Figure 3-13. DRV84xxE EVM GUI (Decay Mode)

Decay mode and appropriate TOFF values can be configured in this section. .

3.3.3 Fault Monitoring

The fault monitor section at the right side of the screen allows the user to monitor the fault. The LED staying green indicates ‘No Fault’. When the LED turns red, it indicates that a fault has occurred.

3.3.4 Use the Side-Bar Menu

Use the side-bar menu in the left pane to navigate to the different pages at any time. Click on the hamburger button in the top-left corner of the GUI to expand the side-bar menu. The following pages that are displayed in the side-bar menu:

- Home (landing page)
- Motor control (motor control page)
- Motor driver (DRV84xxEEVM GUI home page)

3.3.5 Menu Bar Options

The following menus are available in the menu bar displayed at the top of the GUI as shown in Figure 3-14.

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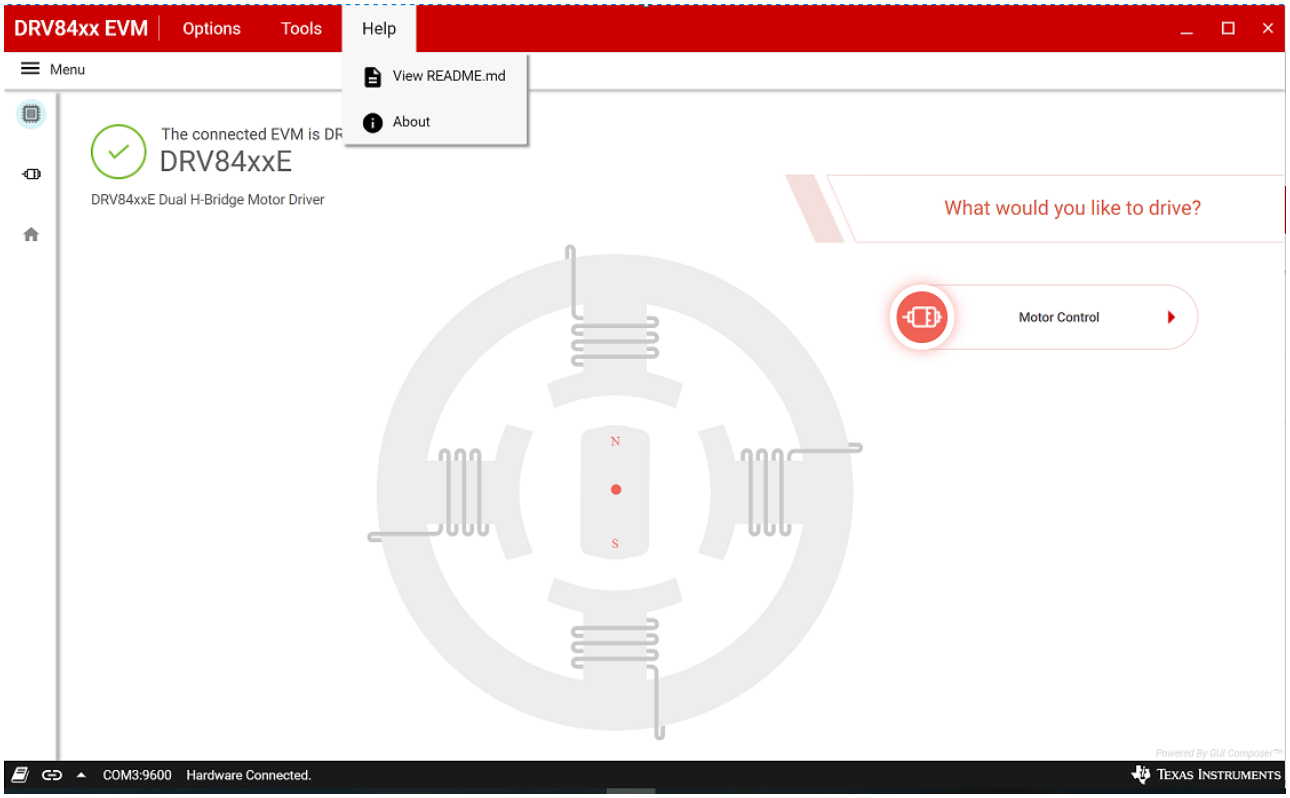

Figure 3-14. DRV84xxE EVM GUI (Menu Bar – Help Option)

3.3.5.1 File Menu

The user can load the firmware (.out) file onto the onboard MSP430 by clicking file menu and selecting an appropriate motor driver device to match the EVM variant. For the firmware load to work, MSP430 FET needs to be plugged into the J2 connector on the EVM board.

3.3.5.2 Options Menu

This menu provides the option to configure the serial port communication settings.

3.3.5.3 Tools Menu

The "log pane" option in this menu is to open a log pane at the bottom of the GUI which shows the GUI actions.

3.3.5.4 Help Menu

The Help Menu contains options to view Readme File and About Section. The About Section displays the installed software information, including the application version.

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