User's Guide

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ABSTRACT

This document is provided with the DRV8434A evaluation module (EVM) as a supplement to the DRV8434A stepper motor driver datasheet. This user's guide describes the installation and usage of the DRV8434A EVM graphical user interface (GUI) with the DRV8434AEVM.

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Trademarks

1 Overview

The DRV8434AEVM is a platform to support prototyping and evaluation for the DRV8434A, a medium-voltage dual H-bridge driver for stepper motor driving applications with analog stall detection function.

The EVM uses an MSP430™ microcontroller and a USB interface chip to manage communication with the GUI software application installed on a computer. The GUI sends serial commands to the MSP430 to control the device signals, monitor faults, and drive a stepper motor.

2 Hardware and Software Setup

The hardware (HW) and software (SW) tools that follow are required for the evaluation of DRV8434A:

- DRV8434AEVM
- Stepper motor
- Power supply with 4.5 to 48 V output, rated to support the motor specifications
- Micro-USB cable
- DRV8434A EVM GUI installer

For details on hardware connections refer to the DRV8434AEVM User's Guide.

3 GUI Application

3.1 Installation

- To install the standalone GUI application on a Windows computer, use the DRV8434A_x.x.x_installer_win.zip file, located inside the DRV8434AEVM software.zip file which can be downloaded from DRV8434AEVM software link, x.x.x is the GUI revision number.
- Extract the zip file. Double click the executable file to install the GUI application. Be sure to install the GUI composer runtime. If the computer's firewall prevents the "download from website" option for the GUI composer runtime installation, download the GUI composer runtime installer from, https://software-dl.ti.com/ccs/non-esd/gui_composer/runtime/gcruntime-8.0.0-windows-installer.exe. Use the "Install from File" option to install the GUI composer runtime.
- During GUI application installation a pop up window will appear as shown in the Figure 3-1. Click on 'Install' to install the USB driver required for the DRV8434AEVM operation.

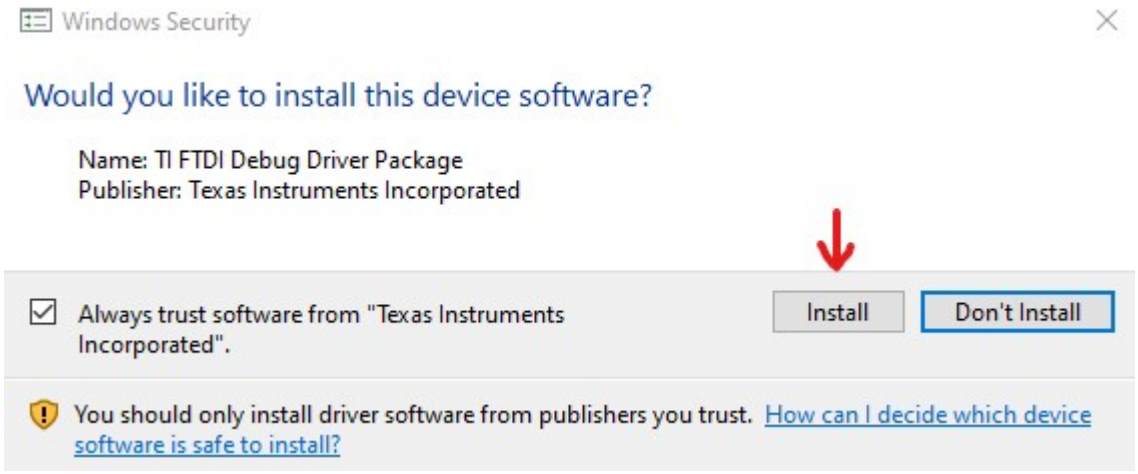

Figure 3-1. Installation pop up window

3.2 Getting Started with the DRV8434A EVM GUI

The DRV8434A EVM GUI allows the user to configure various settings required for driving a stepper motor using a DRV8434AEVM. The GUI lets the user set the motor speed, control the direction and the number of steps to spin, configure stall detection settings, and monitor the device status.

- Connect the stepper motor to the EVM.
- Plug in the DRV8434AEVM USB cable to the PC.
- Switch on the motor power supply.
- Click on DRV8434AEVM GUI shortcut either on the desktop or from the start menu to run the GUI application.

For additional details on hardware connections refer to the DRV8434AEVM User's Guide.

3.3 Using the DRV8434A EVM GUI

The GUI Home page will appear as shown in the Figure 3-2.

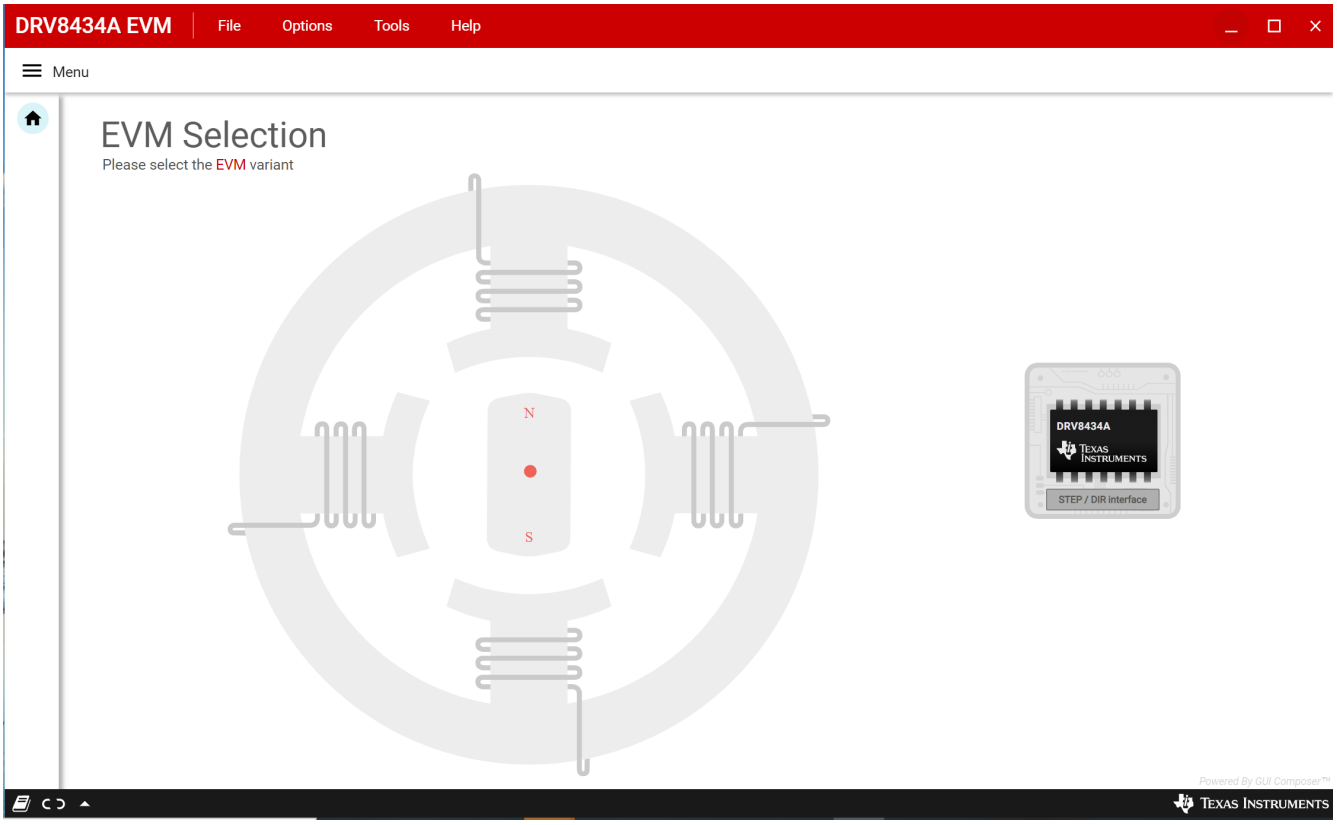

Figure 3-2. DRV8434A EVM GUI (Home Page)

Now click on the 'DRV8434A' thumbnail. The DRV8434A EVM GUI Motor Driver page will appear as shown in the Figure 3-3.

The GUI application will attempt to establish communication with the DRV8434AEVM. A message showing ‘Connecting to target…’ will be displayed in the hardware connection status pane at the bottom of the screen. Upon successful connection, ‘COMx:9600 Hardware Connected.’ message will be displayed in the status pane.

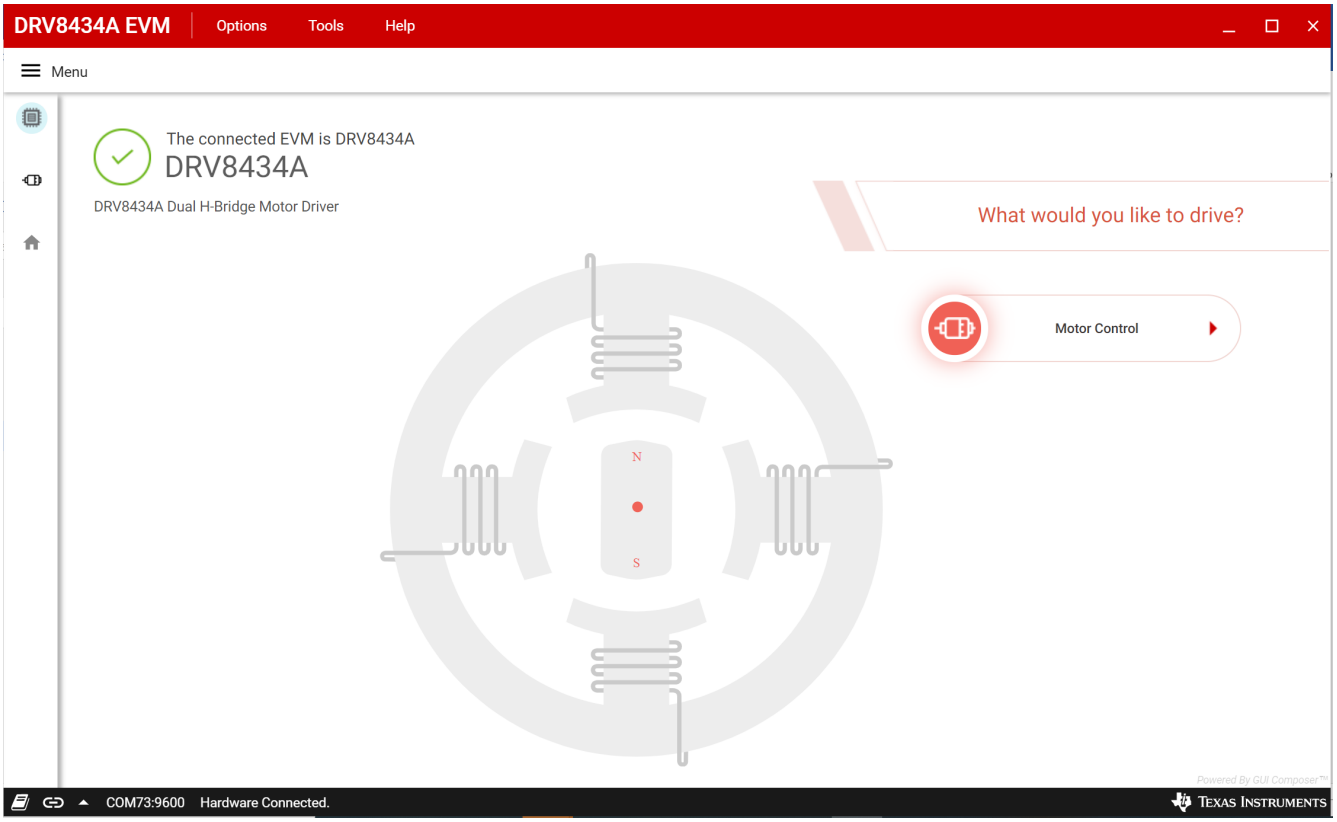

Figure 3-3. DRV8434A EVM GUI (Motor Driver Page)

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 prior to connecting the EVM to the computer, follow the directions displayed in the status pane, see the Figure 3-4.

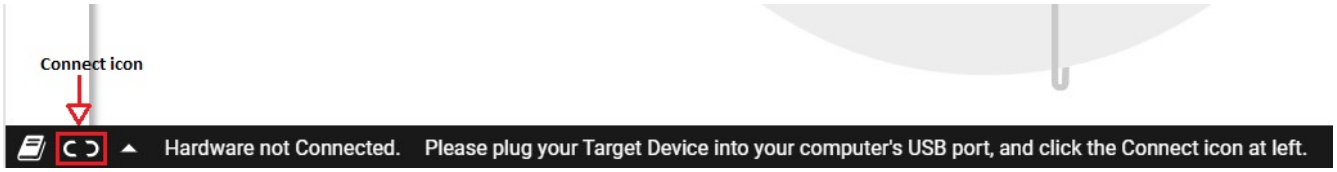

Figure 3-4. Reconnecting the EVM

If multiple EVM boards are connected to the computer, the first matching device will be connected automatically. In order to switch to another EVM:

Click Options -> Serial Port. A serial port configuration popup is displayed as shown below in the Figure 3-5.

Choose the appropriate port and baud rate.

Click OK.

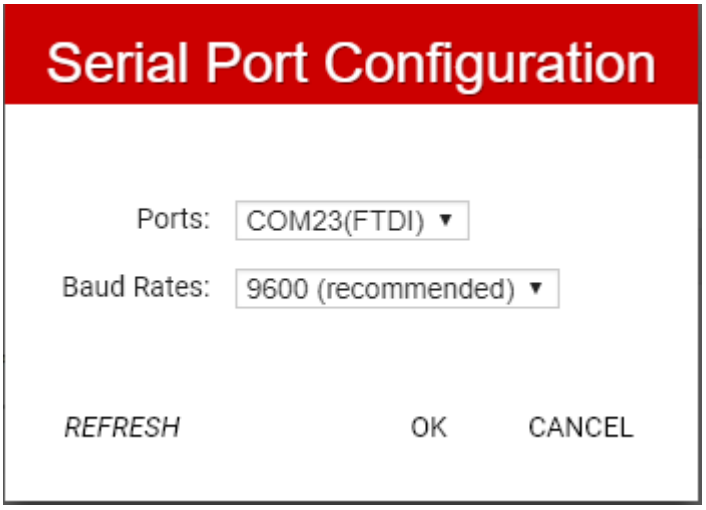

Figure 3-5. Serial Port Configuration

Once the desired EVM is connected, the home page will show the message 'Hardware Connected.' with a green check mark at the top left of the GUI Motor Driver page as shown in the Figure 3-3.

Click on the 'Motor Control' thumbnail to open the motor control page.

3.3.1 Motor Control Page

Figure 3-6 shows the motor control page. It includes various controls and settings to drive a stepper motor. Hovering the mouse pointer over the (?) icon to the right of a control or setting displays a brief description about it.

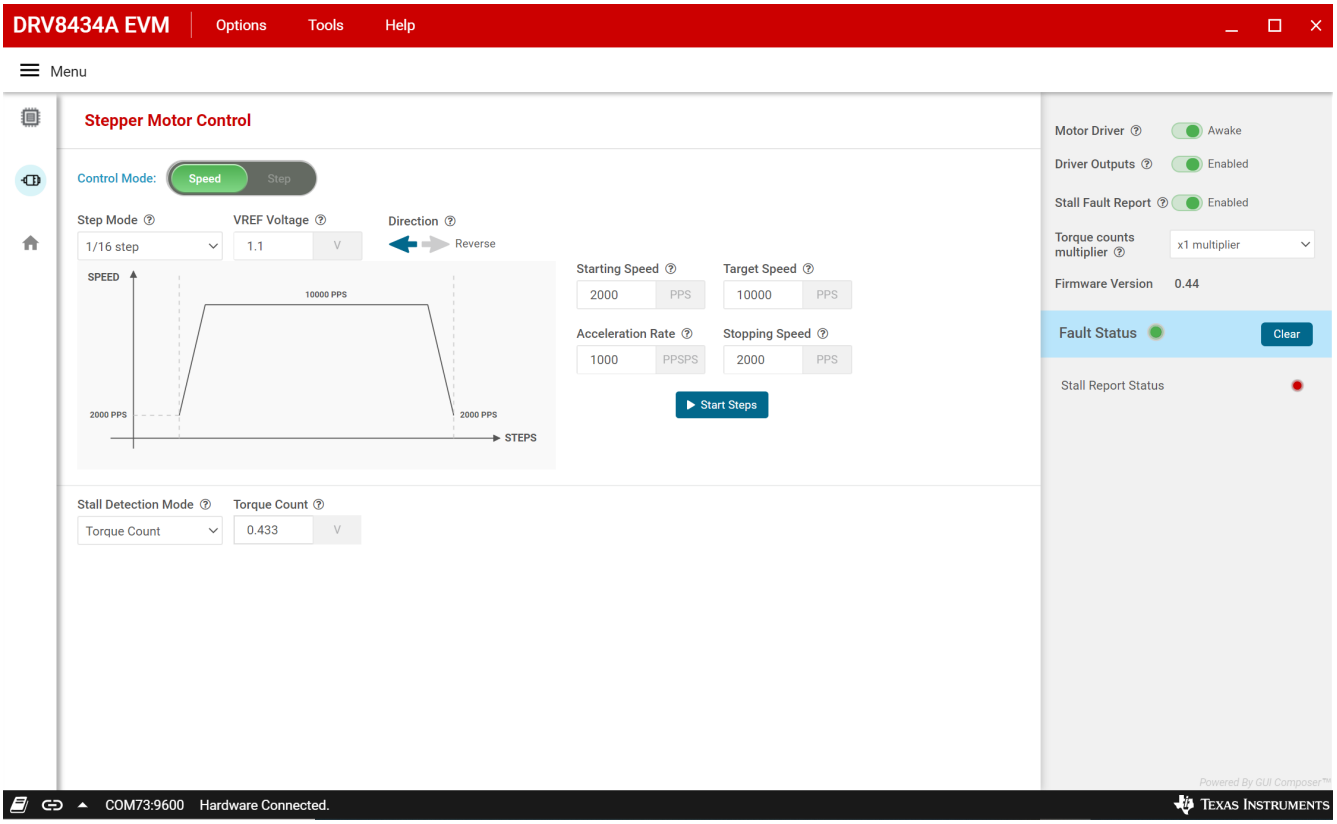

Figure 3-6. DRV8434A EVM GUI (Motor Control Page)

3.3.1.1 Control Mode

The GUI allows the user to control the stepper motor operation profile in two modes – Speed Mode and Step Mode. To toggle between the two modes, click on the Control Mode widget located at the top left of the Motor Control page.

3.3.1.2 Speed Mode

The Speed Mode enables the driver to spin a stepper motor continuously at a desired target speed. The user can configure the starting speed, stopping speed, acceleration rate, and the target speed. Stepper motor controls are active only when ‘Motor Driver' is set to Awake. ‘Start Steps’ button is active only when ‘Driver Outputs' is set to Enabled. When the ‘Start Steps’ button is clicked, the motor begins to spin at the starting speed and accelerates to the target speed according to the configured acceleration rate.

When the ‘Start steps’ button is clicked, the microcontroller generates step pulses at a rate specified by the 'Starting Speed' PPS (pulses per second) 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 displayed by the embedded graph of the GUI.

During acceleration and deceleration, the step PPS signal is updated by the microcontroller every 32 ms based on the integer value of the 'Acceleration Rate' PPSPS (Pulses per second, per second) divided by 32 ms. 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, acceleration will be skipped. The stopping speed must also be less than or equal to the target speed.

After the target speed PPS value is reached, the acceleration stops and the motor continues to spin until the 'Stop Steps' button is clicked. Immediately after the 'Stop Steps' button is clicked, the microcontroller performs the same actions as it did during acceleration, but in the reverse order to decelerate the motor until the stopping speed PPS value is reached. The motor stops spinning when the stopping speed PPS value is reached. Figure 3-7 shows the acceleration and deceleration graph and the settings and controls of the Speed Mode.

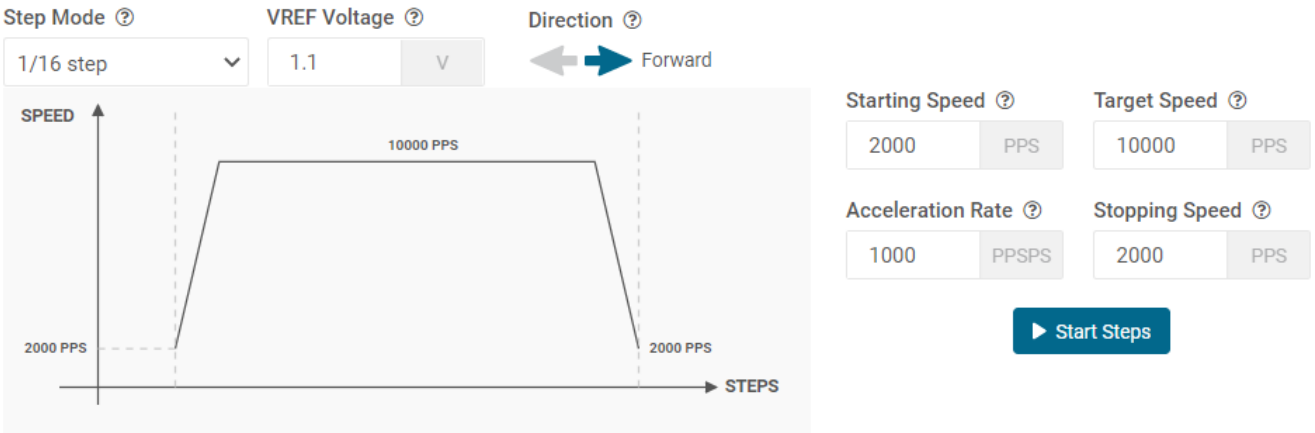

Figure 3-7. Settings and Controls of the Speed Mode

3.3.1.3 Step Mode

The Step Mode enables the driver to spin a stepper motor by a desired number of steps. The step mode can be activated by clicking "Step" on the "Control Mode" widget located on the top left of the Motor Control page. Stepper motor controls are active only when ‘Motor Driver' is set to Awake. Start’ button is active only when ‘Driver Outputs' is set to Enabled. When the ‘Start Steps’ button is clicked, the motor starts spinning at the starting speed and accelerates with the configured 'Acceleration Rate' to reach the target speed, until the 'Steps to Stop' value is reached. At this point the motor decelerates with the configured 'Acceleration Rate' until the number of steps is completed after which it stops.

The acceleration and deceleration profiles work similarly to the Speed Mode, except the number of steps at which the deceleration starts and the motor stops are a function of the 'Steps to Stop' and 'Acceleration Rate' parameters.

In addition to the input parameters of the 'Speed Mode' described in Section 3.3.1.2, two additional parameters are included in the step mode:

- Number of Steps: This parameter is the desired number of steps the stepper motor will spin.
- Steps to Stop: The number of step pulses issued to the driver are constantly monitored. When the current step is equal to the 'Steps to Stop' parameter, deceleration is started. If the value of the 'Steps to Stop' parameter is larger than the number of steps, the motor stops abruptly without deceleration after spinning the desired number of steps.

The configuration is displayed by the embedded graph of the GUI. The graph is only representative of the speed profile and does not dynamically model the value of the 'Number of Steps'. If the 'Reciprocate' slider is enabled, the stepper motor spins the set number of steps in one direction, then switch direction and spin the set number of steps in the opposite direction, repeating these actions continuously until the 'Stop Steps' button is clicked. Figure 3-8 shows the acceleration and deceleration graph and the settings and controls of the Step Mode.

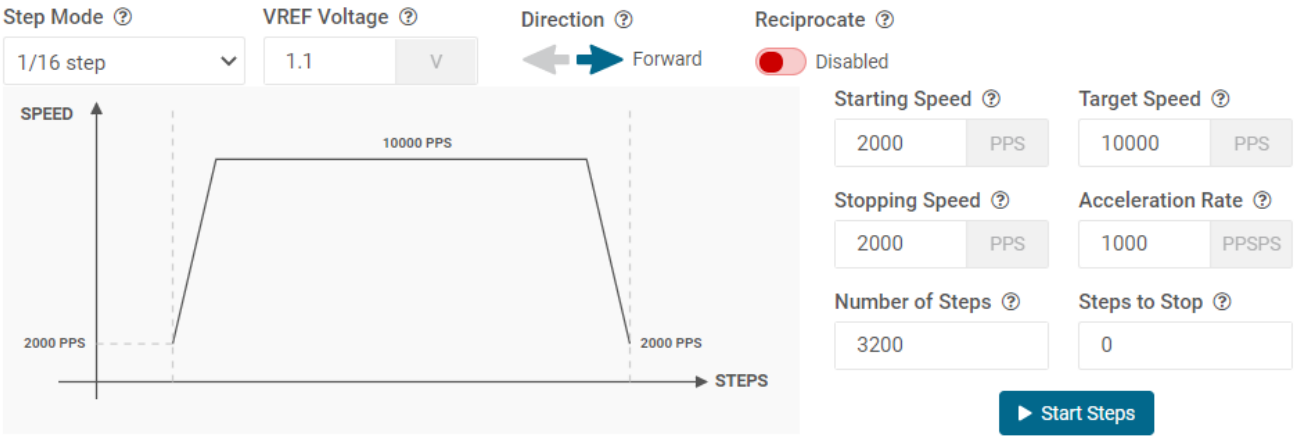

Figure 3-8. Settings and Controls of the Step Mode

Figure 3-9 graphically demonstrates three stop condition examples based on the target speed, acceleration rate, stop speed and the number of steps parameters.

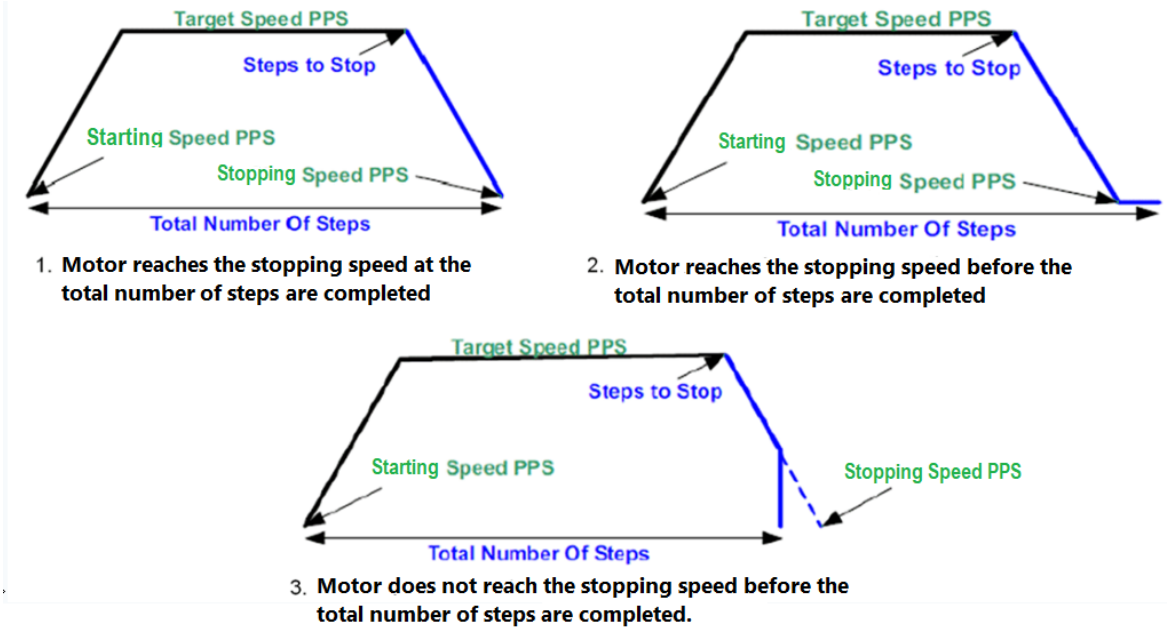

Figure 3-9. Stop Condition Examples

3.3.2 Stall Detection

This section covers the steps necessary to evaluate stall detection using the GUI. The ‘Speed’ setting of the ‘Control Mode’ is recommended for evaluating the stall detection features of the driver. Setting VREF to a lower value will make it easier to manually stall the motor during learning as well as during stall detection evaluation.

The DRV8434A detects a stepper motor stall using two different stall detection modes along with a learning mode.

- Torque Count Mode: This is the default setting of the stall detection mode in the GUI. In order to detect a motor stall in this mode, learning must be performed first. The stall threshold for this mode is automatically stored in the device after a successful learning. Prior to switching to learning mode the motor is started in torque count mode with desired motor driver parameters. While the motor is running the corresponding torque count voltage is displayed under ‘Torque Count’, see Figure 3-10. Torque count analog voltage is available on the TRQ_CNT/STL_TH pin of the driver.

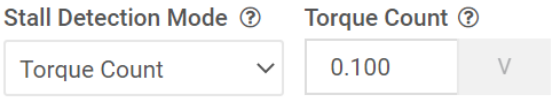

Figure 3-10. Torque Count mode

- Learning Mode: This mode is used for stall threshold learning or relearning. Learning mode is selected while the motor is running in the torque count mode. After switching to learning mode the ‘Learn Status’ shows ‘Learn In Progress’. The motor is intentionally stalled to initiate learning. Learning completion is indicated by ‘Learn Success’ as well as the ‘Stall Report Status’ LED widget turns green from red. The intentional stall is released. The result is displayed under the ‘Learning Mode Result’, see Figure 3-11. Learning result analog voltage is available on the TRQ_CNT/STL_TH pin of the driver in learning mode. Switch back to torque count mode for detecting a motor stall. The ‘Fault Status’ and ‘Stall Report Status’ LED widgets may turn red indicating a stall fault immediately after switching to the torque count mode. Clicking on ‘Clear’ button will issue an nSLEEP reset pulse to the driver to clear a pending stall fault. The LED widgets will turn green after a clear. The driver is now ready for motor stall detection in torque count mode.The torque count and learning result voltages are displayed in the GUI with limited precision for evaluation purpose. If an accurate measurement is desired, a precision calibrated multimeter can be connected between TRQ_CNT/STL_TH and GND pins of the J3 header in the EVM.

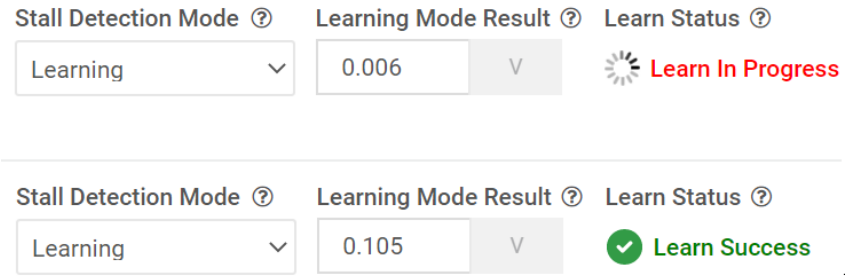

Figure 3-11. Learning mode

- Stall Threshold Mode: In this stall detection mode a desired stall threshold analog voltage is input on the TRQ_CNT/STL_TH pin of the driver. For convenience the GUI automatically copies the most recent successful learning result, displays it under ‘Stall Threshold’ as well as output the analog voltage to this pin of the driver. Stall threshold input can be modified to any desired value using the GUI. See Figure 3-12. The motor must be running at a desired target speed before switching to this mode. If the motor is started from zero speed in this mode the driver will assume a stall and generate a stall fault. Clicking ‘Clear’ after the motor reaches the desired target speed will clear a pending stall fault.

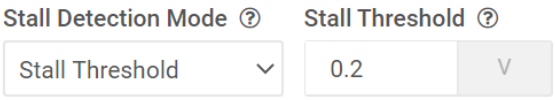

Figure 3-12. Stall Threshold mode

Stall fault reporting can be enabled (default) or disabled using the GUI. The torque counts can be upscaled by eight times in the driver using the ‘Torque counts multiplier’ GUI setting. The default setting is no upscaling. See Figure 3-13.

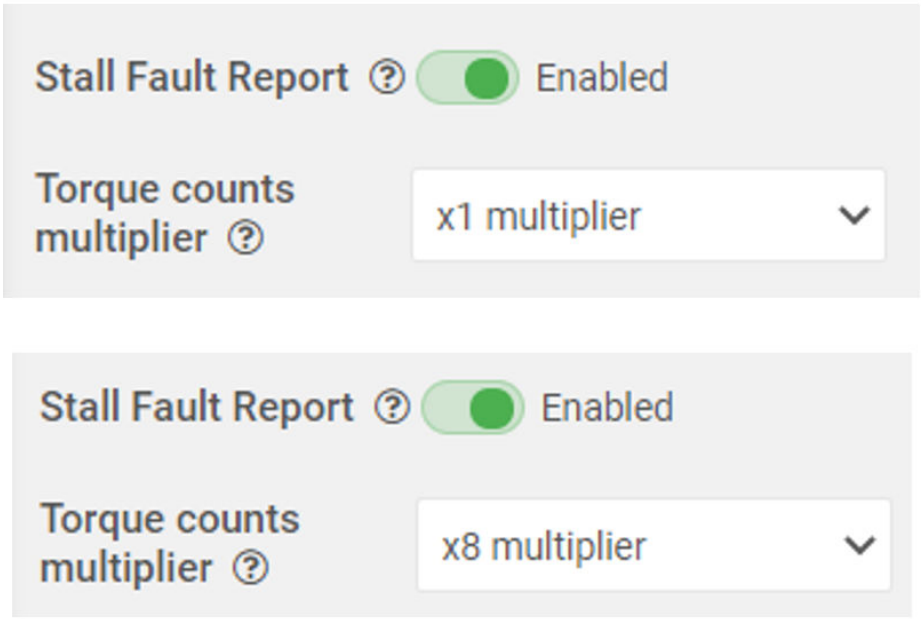

Figure 3-13. Stall Fault Report and Torque counts multiplier settings

3.3.3 Fault Status Monitoring

The fault status section in the right side of the GUI allows the user to monitor the fault status of the driver. The LED widget stays green when a driver fault or a stall has not occurred. When the LED widget turns red, it indicates a driver fault or a stall has occurred. Clicking the 'Clear' button issues an nSLEEP reset pulse as specified in the DRV8434A datasheet.

3.3.4 The Side-Bar Menu

Use the side-bar menu in the left pane of the GUI to navigate to the various GUI pages at any time. Click on the hamburger button in the top-left corner of the GUI to expand the side-bar menu. The 'Motor Driver', 'Motor Control' and 'Home' pages menu are displayed in the side-bar.

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 the Figure 3-14.

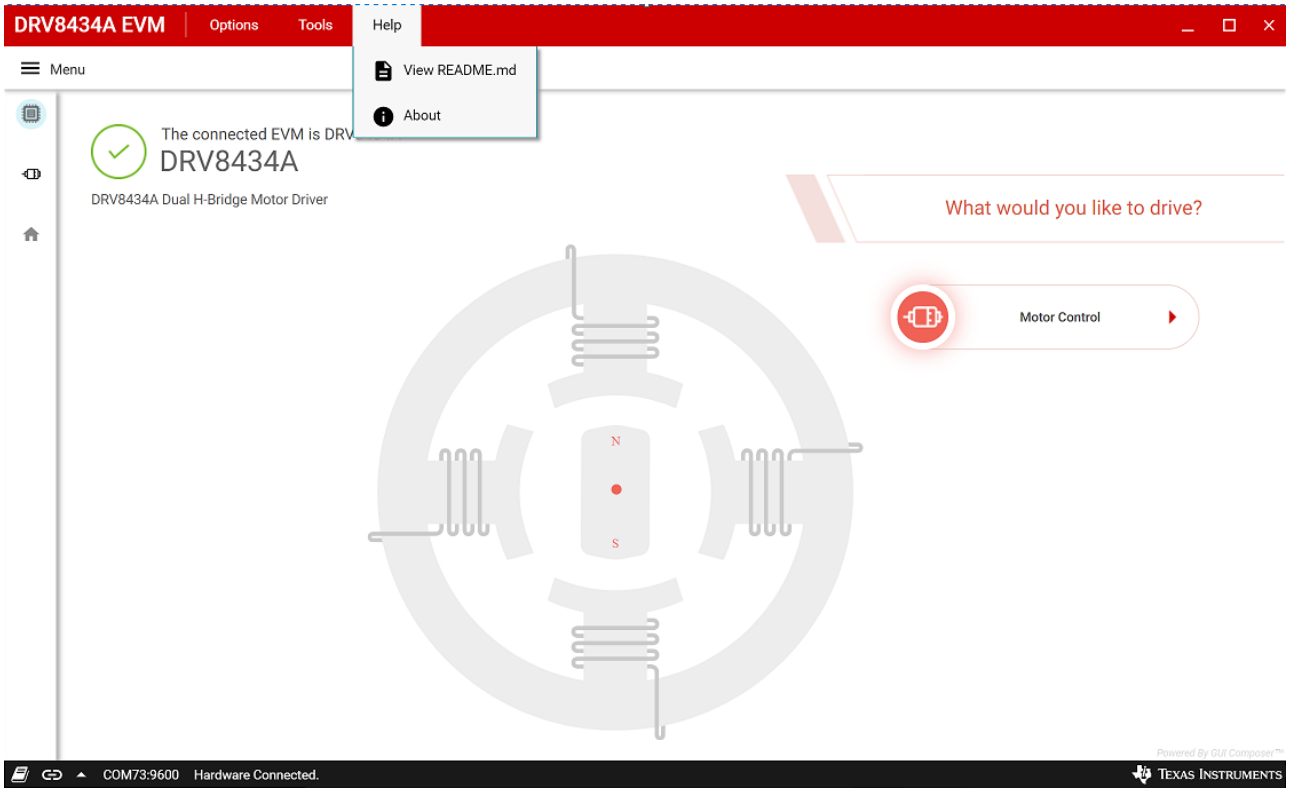

Figure 3-14. DRV8434A EVM GUI (Menu Bar – Help menu)

3.3.5.1 File Menu

The file menu, available in the home page of the GUI allows the user to program the DRV8434AEVM with the firmware version that comes with the GUI. An MSP-FET (sold separately https://www.ti.com/tool/MSP-FET) is required. Connect the MSP-FET and the DRV8434AEVM to the computer and the JTAG cable of the MSP-FET to the header J2 of the DRV8434AEVM with proper orientation. Click on the 'Program DRV8434A Device...' in the file menu. The status will be displayed in the 'Program Loading Status' pop up window.

3.3.5.2 Options Menu

The options menu allows the user to modify the serial port configuration using the GUI.

3.3.5.3 Tools Menu

The tools menu allows the user to open the log pane at the bottom of the GUI by selecting the 'Log pane' in this menu. 'Scripting' is currently not supported.

3.3.5.4 Help Menu

The help menu allows the user to select and view the 'README.md' file contents and the 'About' information of the GUI.

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