DRV8803/04/05/06 Evaluation Module

User's Guide

Literature Number: SLVU574A
September 2011–Revised June 2012

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This document is provided as a supplement to the DRV8803/DRV8804/DRV8805/DRV8806 datasheets. It details the hardware implementation of the DRV8803/04/05/06 EVM Customer Evaluation Module (EVM).

1 PCB

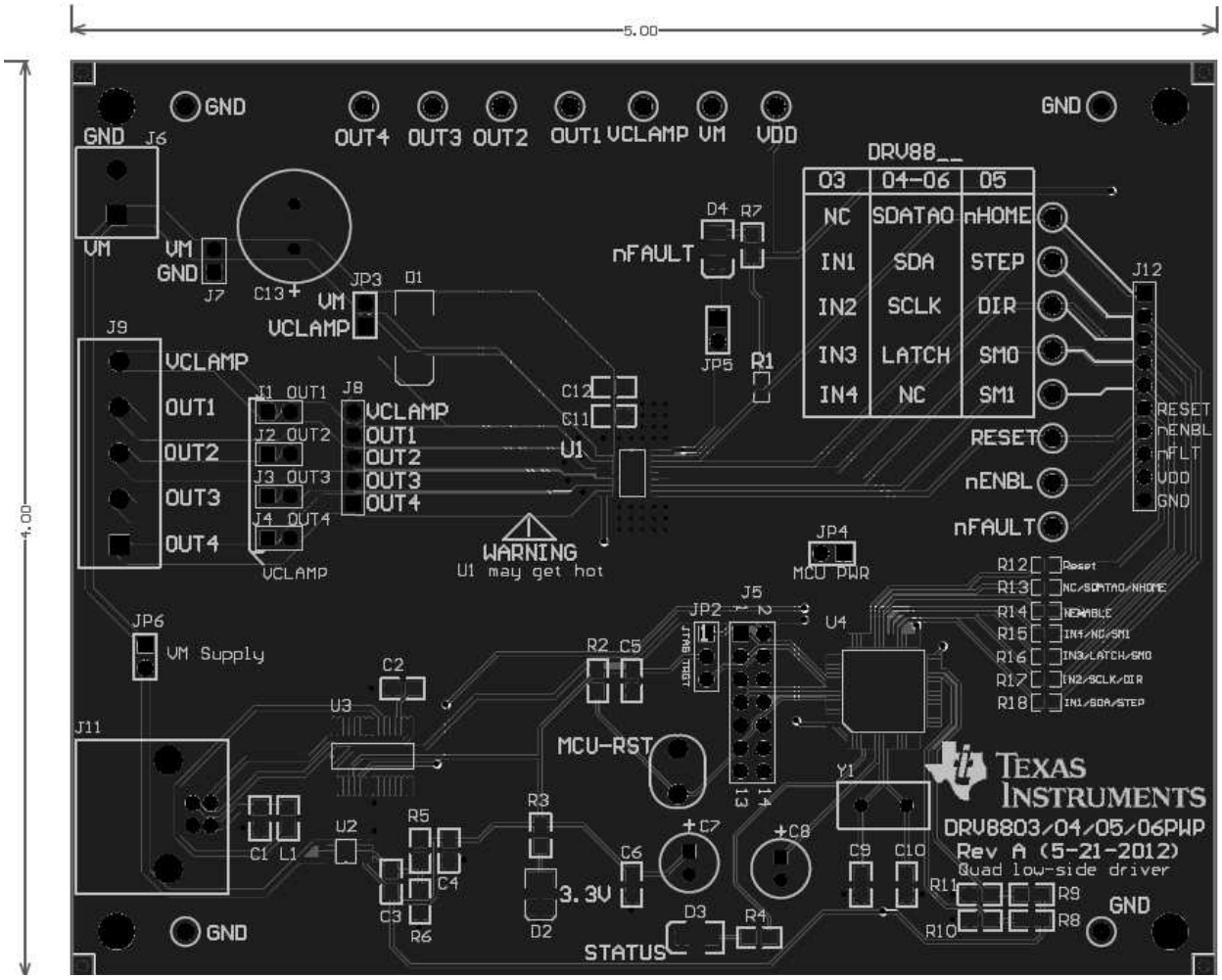


Figure 1. DRV8803/04/05/06 PCB

1.1 Test Points

Every pin on the DRV88xx device has been brought out to a test point, and labels on the silkscreen identify each signal. These are Kelvin connections and are not meant to be used to drive high currents. These can be used as a sense line.

For those pins that change functionality depending on the respective device being used, a table is provided with corresponding function name on its particular column.

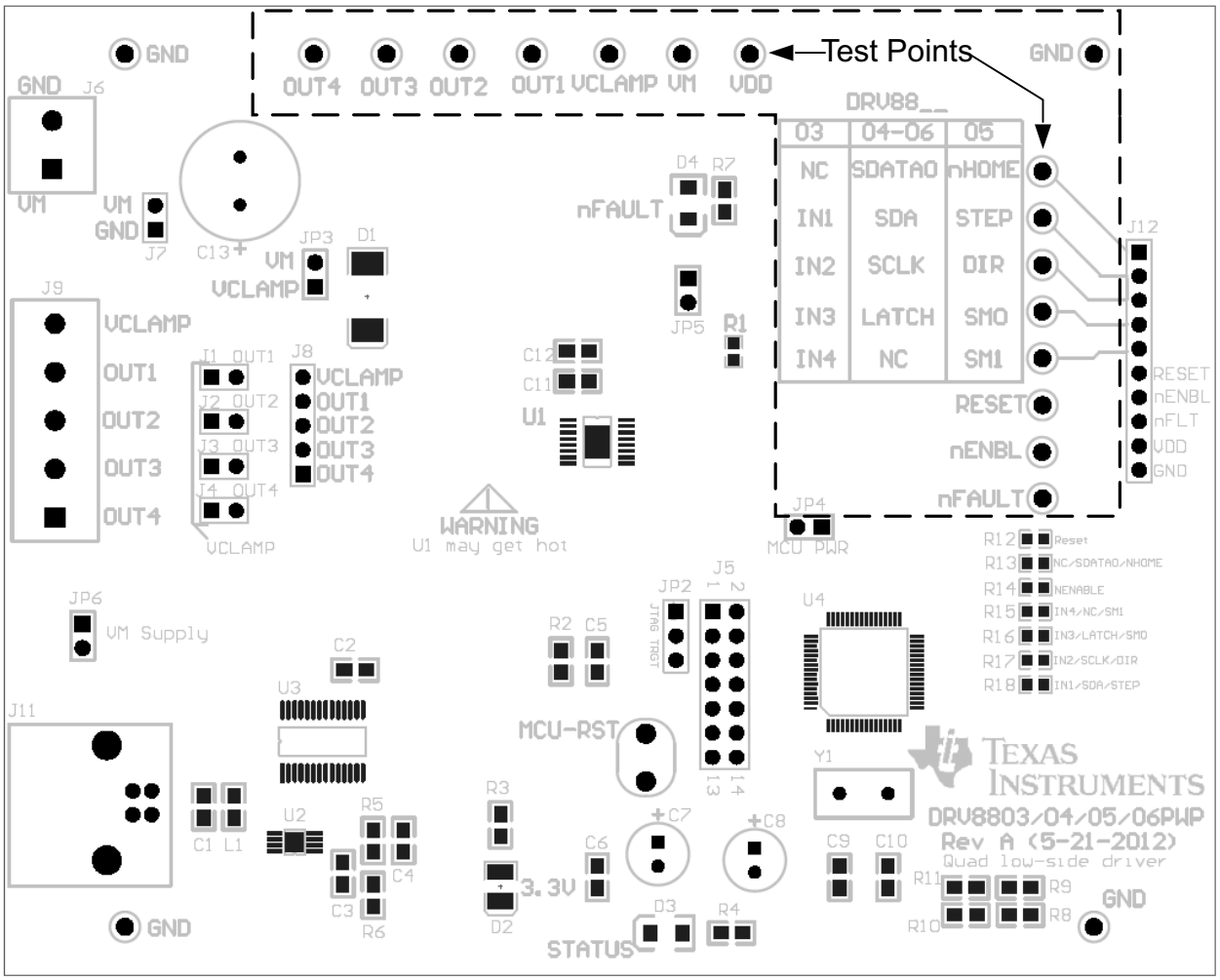


Figure 2. Test Points

1.2 Connectors

1.2.1 Power Connectors

The DRV88xx Customer EVM offers access to VM (Motor Voltage) power rail via a terminal block (J6) and header pins (J7). A set of test clips at the top of the board in parallel with the terminal block allows for the monitoring of the input power rail. The polarity of the terminal connections are mentioned in the silkscreen. User must power the EVM using the correct polarity. User must apply VM according to datasheet recommended parameters.

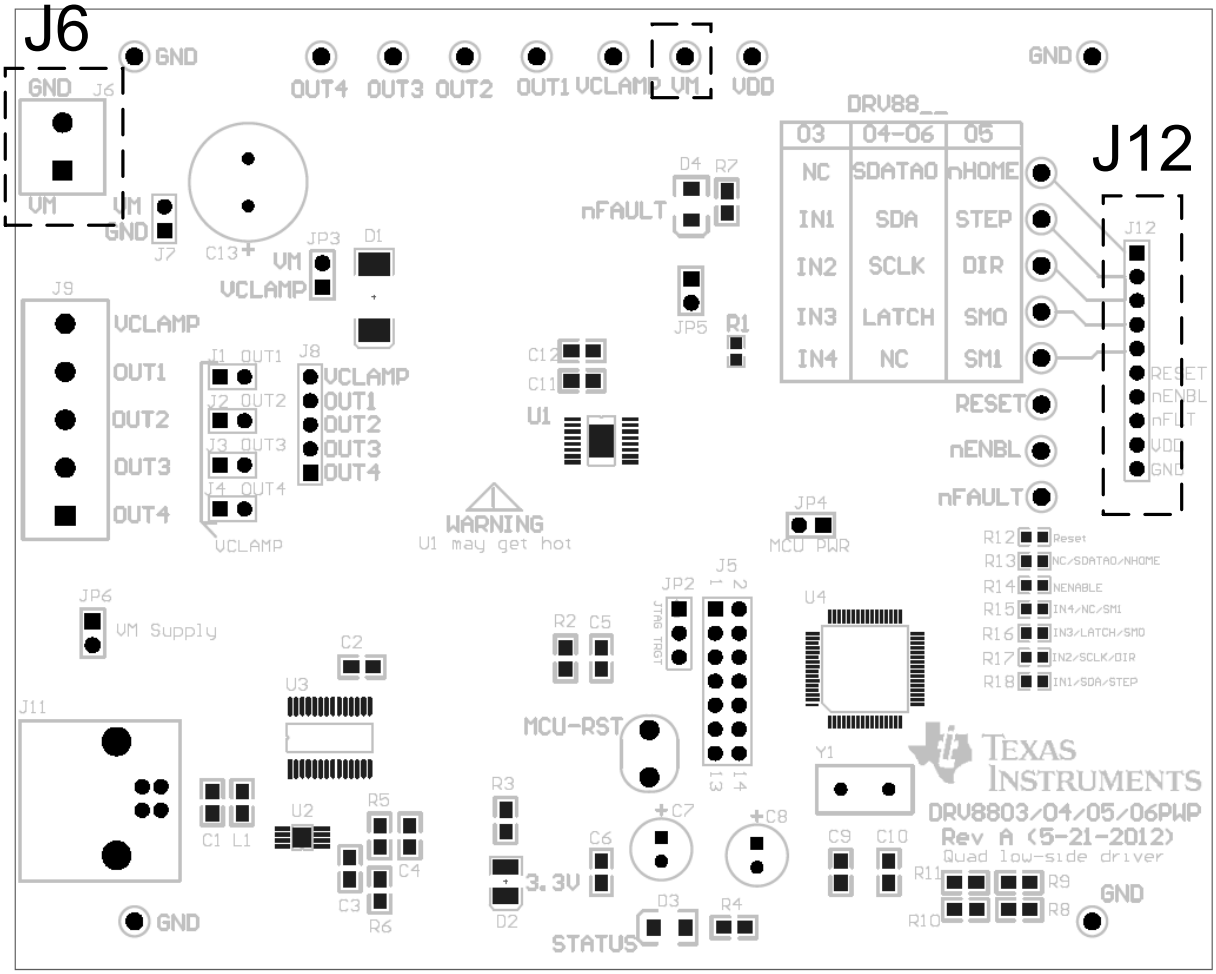


Figure 3. Power Connectors

1.2.2 Control Signals

The header J12 brings out all the control signals of the IC. For the pins that have multiple functionality depending on the IC used, the various functions are labeled in a table. The correct functionality can be ascertained from this table in the column corresponding to the IC being used. While the signals are being driven using the on-board MCU, these pins can be used to monitor the signals. However, the user can also apply external signals using this header. In such a case, the on-board MCU should be powered off by de-populating the MCU_PWR jumper. This will ensure that the there is no conflict between the signals applied externally and the signals being forced by the on-board MCU. If only a few signals are being driven externally and the user wants to retain the on-board MCU for the remaining signals, the corresponding resistors R12-R18 can be de-soldered to ensure that there is no conflict.

1.3 Jumpers/Resistors

nFault – If a jumper is applied at nFault (JP5), the LED (D4) will light in the case of a fault. Even if the jumper is not applied, the voltage of the nFault can be monitored across the two pin headers (JP5 or JP12).

LDO Supply – There is an LDO (TPS7A4001DGNT) on board that can regulate the VM voltage down to 3.3V. This voltage (VDD) is used to power the on board MCU (MSP430F2617) and is also used as the pull-up for the nFault pin. This voltage is used to light up the nFault LED. If a jumper is not applied to LDO supply (JP6), the onboard MCU is no longer powered. If a jumper is not applied, the user must drive the part using an external MCU by applying signals to the signal headers (J12), and the user must apply a VDD to implement the nFault LED function. If a jumper is applied the onboard MCU is powered on and can be used to drive the part.

NOTE: If the user is applying an external VDD, please ensure that the jumpers JP6 (LDO Supply) and JP4 (MCU_PWR) are de-populated.

MCU_PWR - Applying a jumper at MCU PWR (JP4) enables the MSP430 and logic on the EVM. If the jumper is not applied, the user must implement an MCU or apply signals to the signal headers (J12). If the jumper is not applied nFault still receives VDD (3.3 V). If jumper at (JP4) is applied, MCU-RST works as a manual reset button for the MCU.

NOTE: Both JP4 and JP6 must be populated to enable the on board MCU and use the DRV8803/04/05 EVM software.

Resistors – R8, R9, R10, R11 are resistors used to identify which device is being implemented on the EVM (DRV8803, 04, 05 or 06). The MCU powers up based on these resistors. However, the GUI can be used to select the device on the EVM too. If the user changes the DRV8803 to another flavor of the IC (namely DRV8804/05/06) the appropriate tab in the GUI should be selected and ‘CONFIGURE DEVICE’ should be selected.

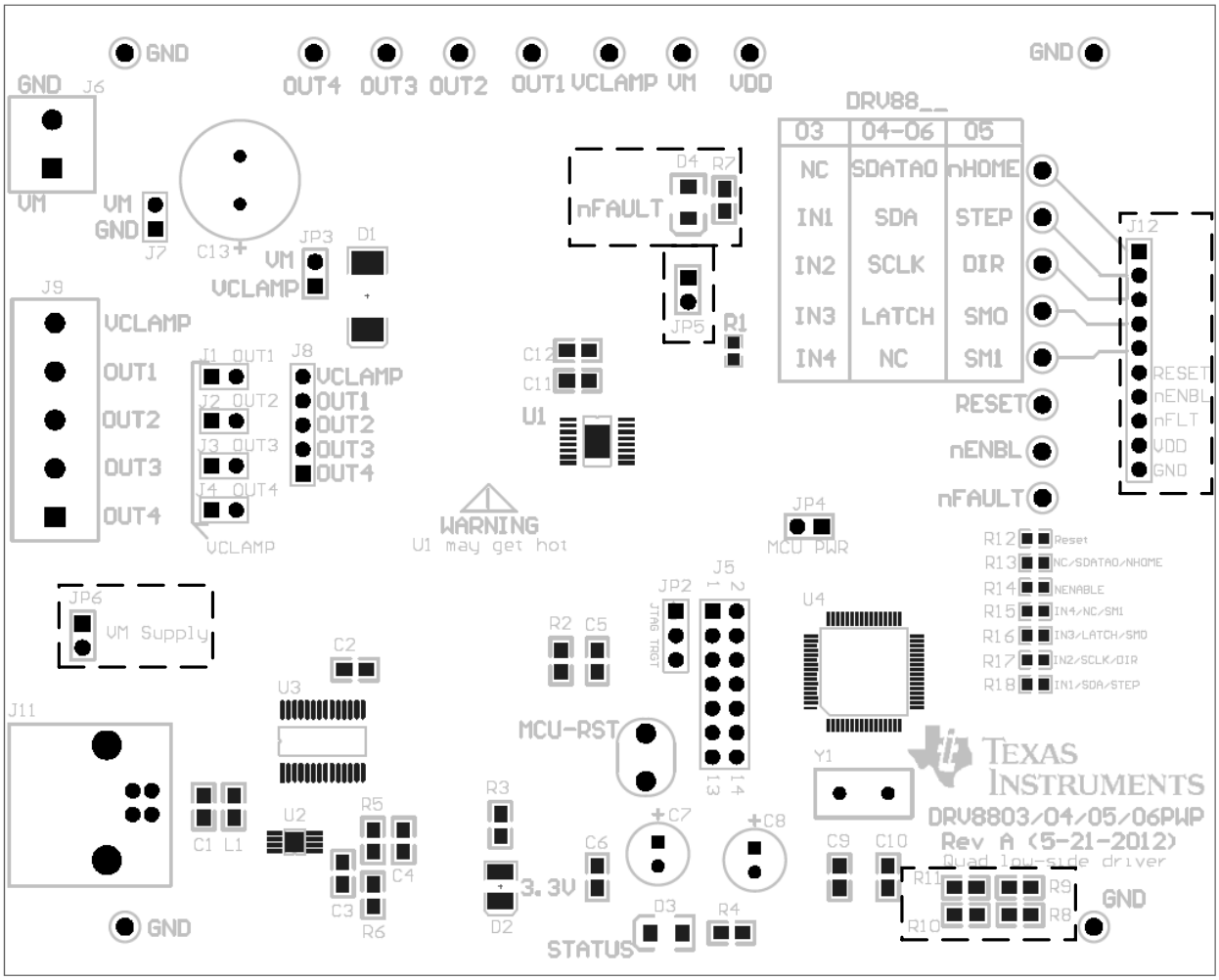


Figure 4. Jumpers/Resistors

1.4 Motor Outputs

There are two ways of connecting a bipolar stepper motor into the EVM: five pin header (J8), and five position terminal block (J9). The optimal way to connect a DC motor is the two pin headers (J1/J2/J3/J4). Although feasible, we do not recommend the connection of any motor into the test clips as these are Kelvin connections and are not rated for high current output. All pins are labeled on the silk-screen for clarity.

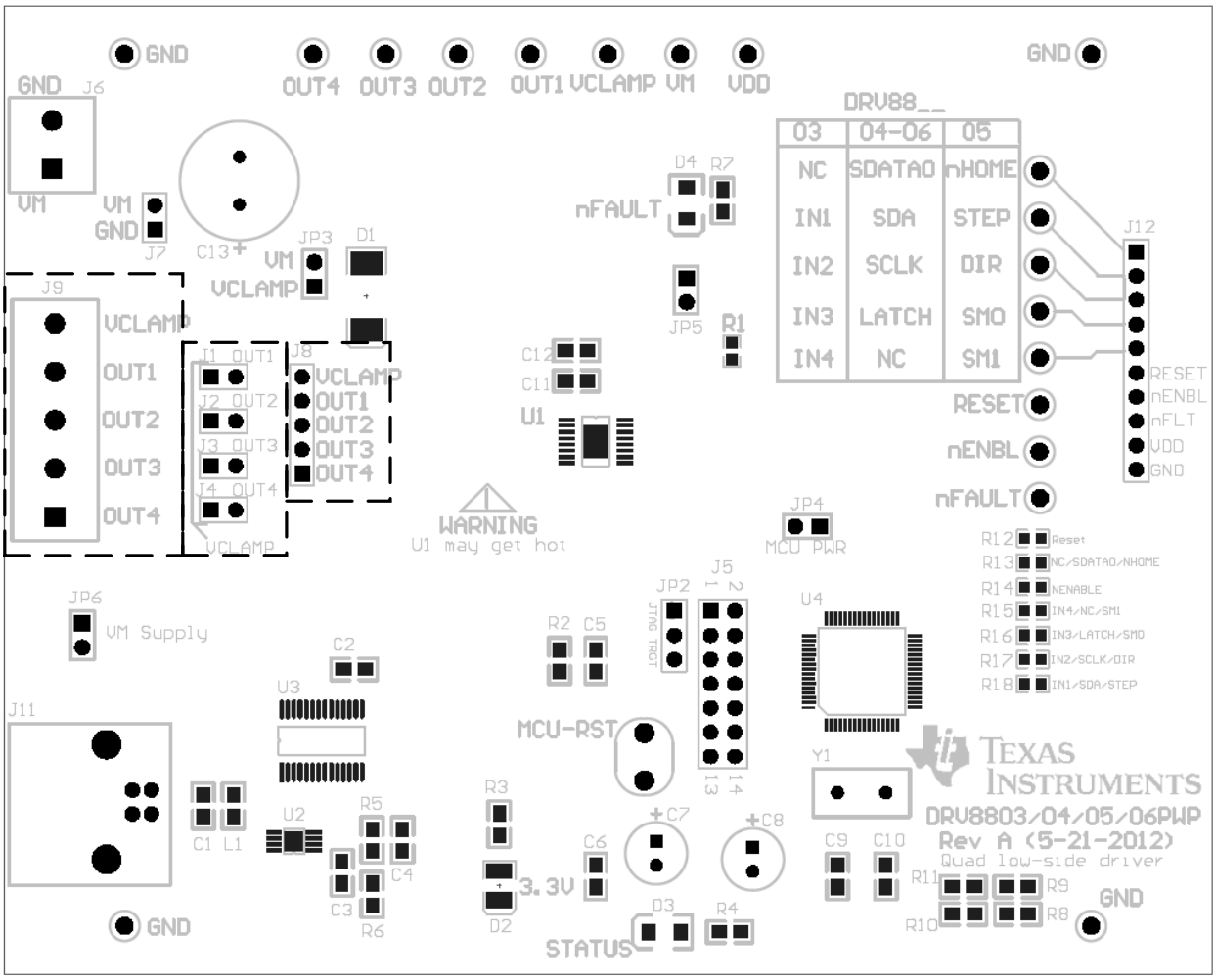


Figure 5. Motor Outputs

2 Installing Drivers and Software

2.1 Installing the FTDI USB Driver

Instructions on how to install the FTDI USB driver on a Windows based computer are detailed in the "USB_Drivers_Install_Readme.pdf" file supplied on the DRV8803/04/05 web page at www.ti.com.

2.2 Installing the DRV8803-04-05 Evaluation Board Windows Application Software

Copy the contents of the "WindowsApplication" folder provided on the DRV8803/04/05 web page at www.ti.com, into your hard disk.

2.3 Running the Windows Application Software

To run the application, double click the AMD003_DRV88xx_R0p2.exe application icon found on the same folder the application was extracted into.

3 The Windows Application

The DRV8803-04-05 EVM Windows application is the software counterpart for the DRV8803/04/05. It allows the PC to connect to the MSP430F2617 microcontroller though an USB interface chip.

The Graphical User Interface (GUI) has been designed to allow for all of the DRV88xx device's functionality to be tested without having to intervene with the hardware, except for the proper configuration of jumpers, when needed.

3.1 DRV8803

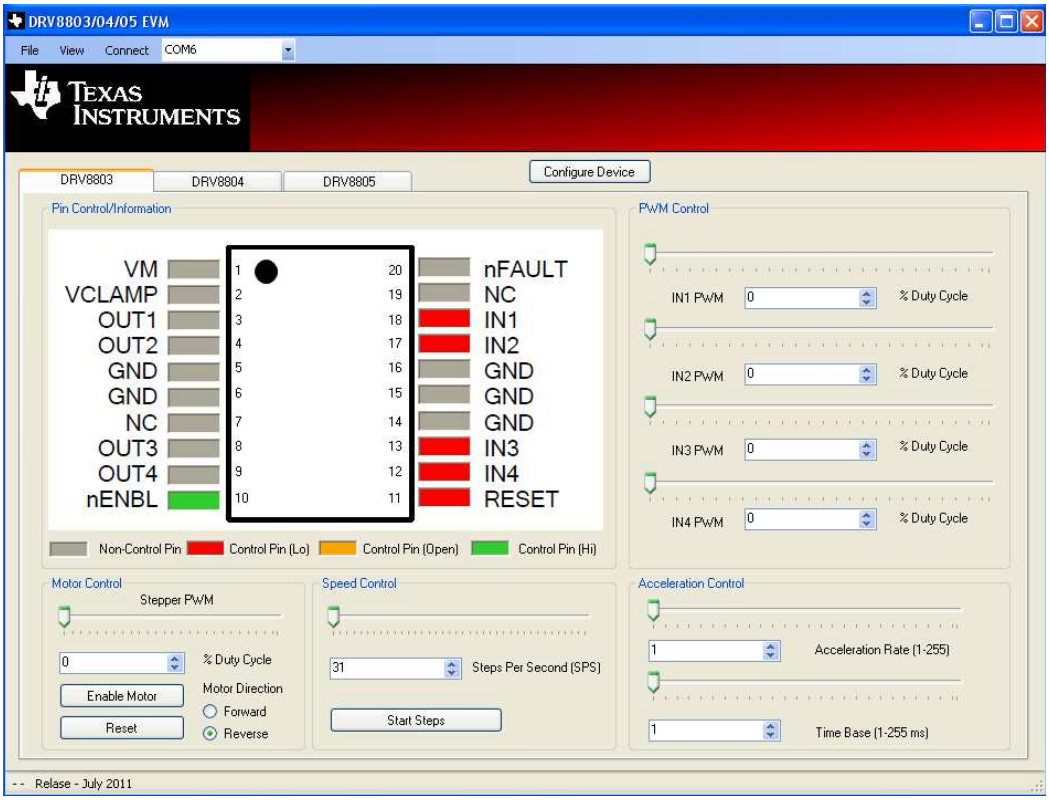


Figure 6. DRV8803 Tab

The DRV8803 tab contains a diagram of the device which includes pin control and information about control signals including: nENBL, RESET, IN1, IN2, IN3, and IN4. It also includes corresponding controls to these pins (Enable Motor button, Reset button, and INx PWM and Duty Cycle number boxes).

Stepper control is implemented by controls in group boxes including: Motor Control, Speed Control, and Acceleration control.

3.2 DRV8804

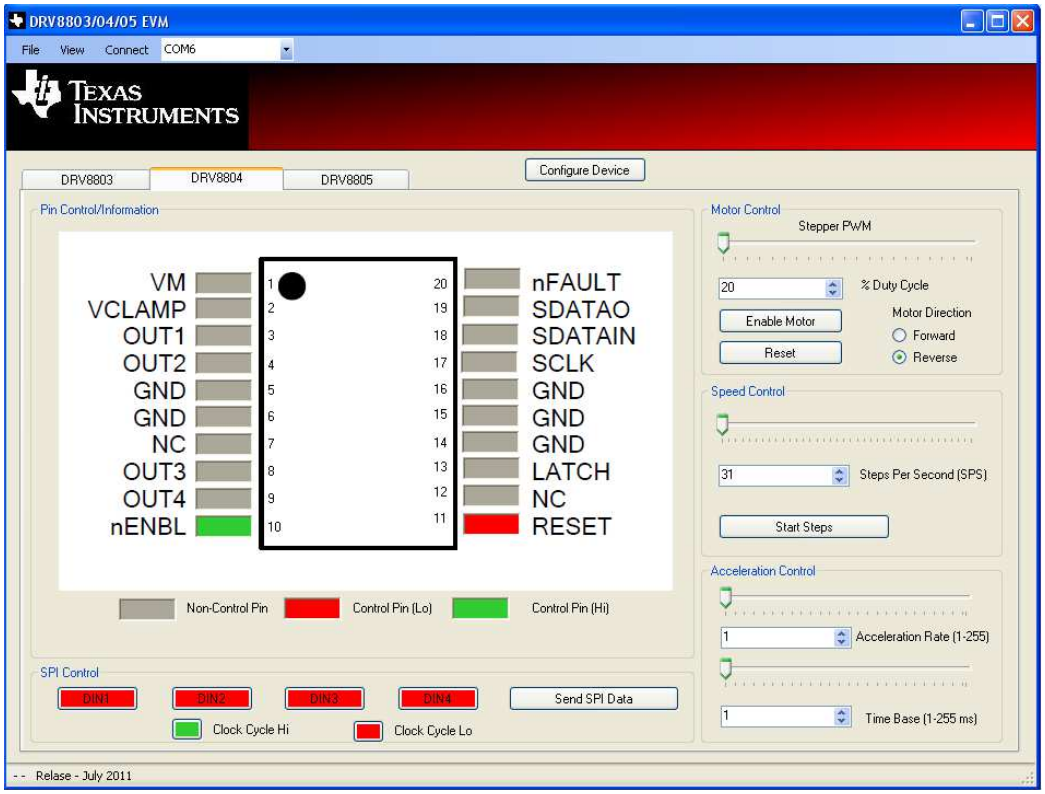


Figure 7. DRV8804 Tab

The DRV8804 tab contains a diagram of the device which includes pin control and information about control signals including: nENBL, and RESET. It also includes corresponding controls to these pins (Enable Motor button, and Reset button).

Stepper control is implemented by controls in group boxes including: Motor Control, Speed Control, and Acceleration control.

The DRV8804 tab also contains SPI package control in group box SPI Control.

3.3 DRV8805

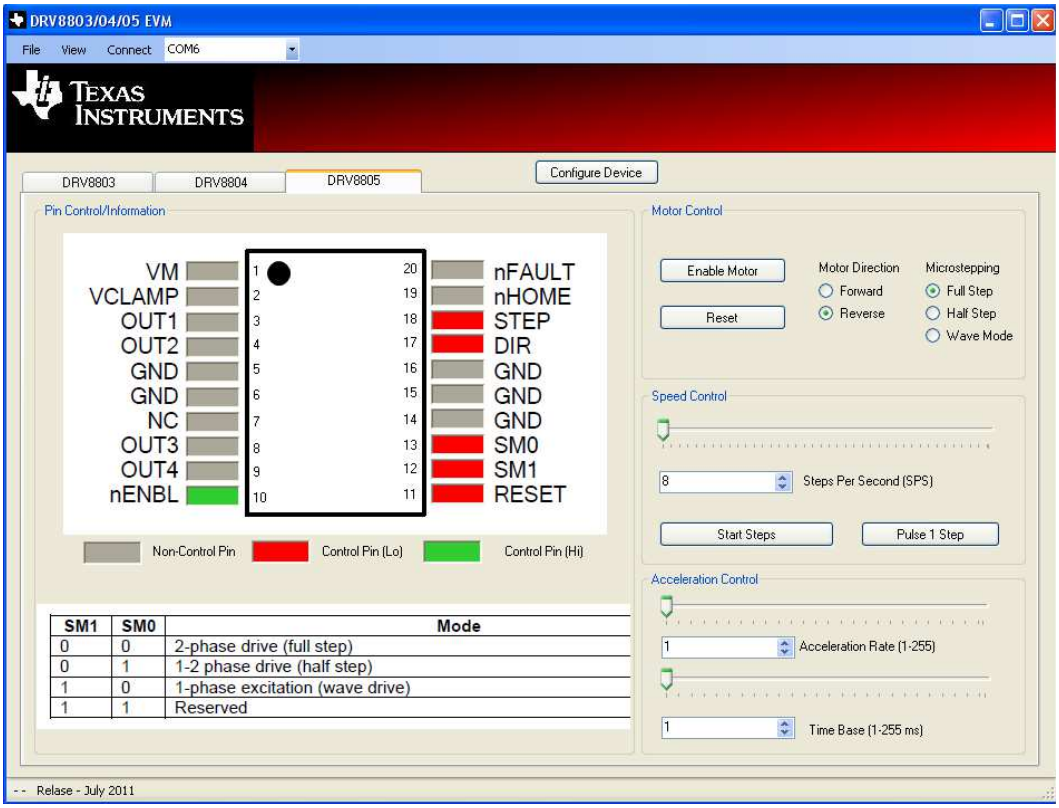


Figure 8. DRV8805 Tab

The DRV8805 tab contains a diagram of the device which includes pin control and information about control signals including: nENBL, RESET, SM1, SM0, DIR, and STEP. It also includes corresponding controls to these pins (Enable Motor button, Reset button, Motor Direction radio buttons, Microstepping radio buttons, and Pulse 1 step button).

Stepper control is implemented by controls in group boxes including: Motor Control, Speed Control, and Acceleration control.

The DRV8805 tab also contains a look up table detailing the functionality of pins SM1 and SM0.

3.4 DRV8806

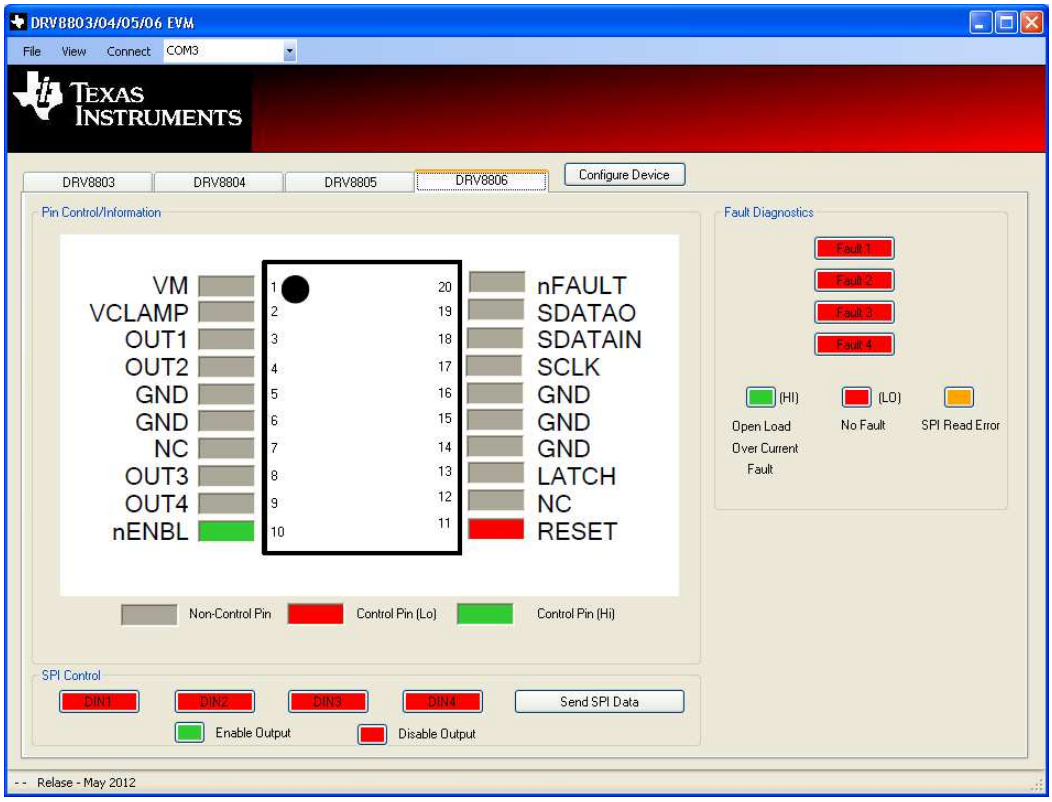


Figure 9. DRV8806 Tab

The DRV8806 tab contains a diagram of the device which includes pin control and information about control signals. Clicking on the nENBL and RESET will toggle the respective control signal state.

The DRV8806 tab also contains SPI packaging control in the SPI Control box. Since DRV8806 is based around a read back SPI which offers diagnostics information, said output is made available at the Fault Diagnostics group box.

3.5 GUI Description/Functionality

3.5.1 The Menu Bar

Figure 10. Menu

The menu at the top of the application offers a series of quick options for how the COM port is to behave, and an option to view functional block diagrams of the respective chip. Please refer to the datasheet for the most updated functional block diagrams.

File:

Exit - Terminates the application.

Com Port Selection Box:

Port - Selects port from drop down combo box. Default is COM4.

The Serial Port actual port number defaults to what we have specified on the "USB_Drivers_Install_Readme.pdf". However, any port between COM 1 and COM 4 are equally usable.

Connect: Opens the Serial Port. When this menu item is pressed, its caption changes to "Disconnect".

Disconnect: Closes the Serial Port. When this menu item is pressed, its caption changes to "Connect".

Configure Device: This button will clear all parameters back to original settings, and also identify for the MCU which device is being implemented on the EVM (DRV8803/04/05).

After opening the application, the order of events should be:

Go to Com Port Selection Box and choose the COM Port where the FTDI device has been configured to work. If the COM port is 4, then this step can be skipped, as application defaults to COM4.

Press Connect. If the port is available, the menu changes the "Connect" caption to "Disconnect". Press Disconnect if wanting to disable the serial communications.

After toggling the enable pin command button, 1-0-0 should return on the status strip at the bottom of the application as an acknowledgement of communication between the com port and the device.

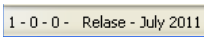


Figure 11. Status Strip

View: Under view there is an option "Schematic" which takes the user to a menu of different device schematics that are available for viewing.

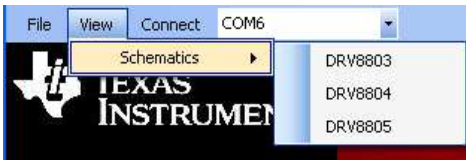


Figure 12. View

This will take you to a window resembling the following:

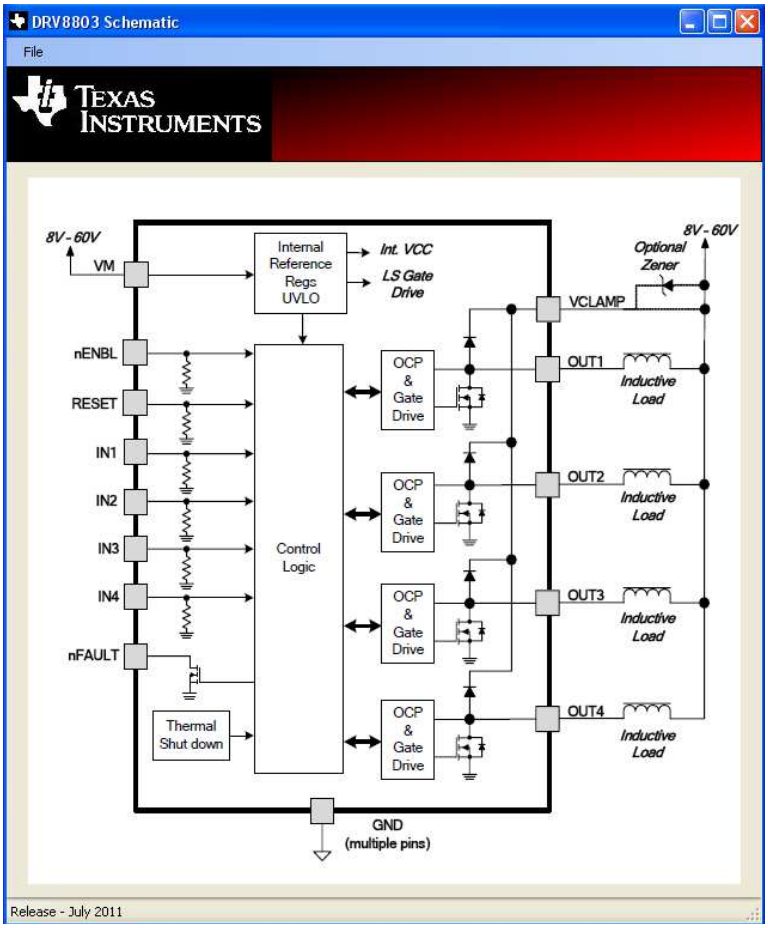
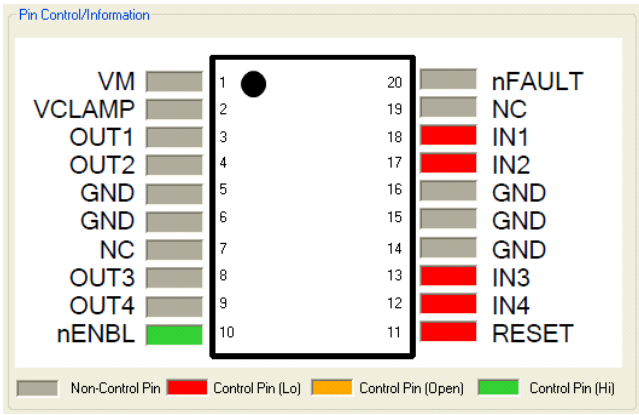


Figure 13. Schematic Window

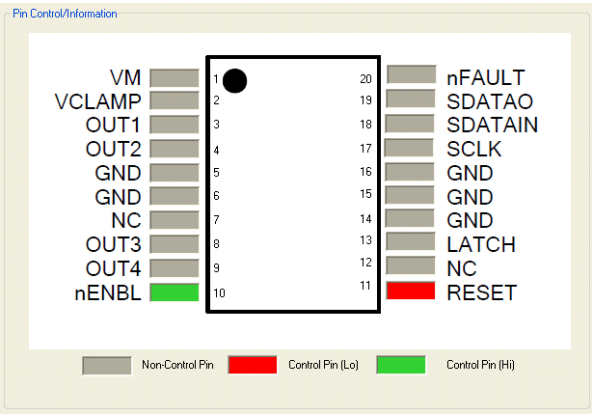
3.6 DRV880x GPIO Control Signals

Once the application is communicating with the interface board, the control signals can be actuated by clicking on pins to send each control hi (green), lo (red), or in special cases open (orange). Each tab will have a different set of control signals depending on the device being interfaced with.

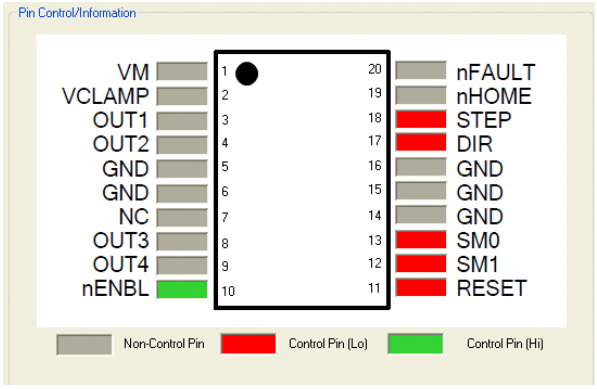
Functionality of control signals is identical across the platform. A green pin translates to a HI level on the respective control signal, a red pin translates to a LO level on the respective control signals, and in special cases, an orange pin translates to an open signal, and a gray pin translates to a non-control pin.



DRV8803



DRV8804/06



DRV8805

Figure 14. GPIO Control Signals

nENBL – Control appears on all three devices. Toggling it LO (red) enables the chip, and toggling it HI (green) disables the chip. Automatically toggles in correspondence to the Enable Button on all three chips (See motor control).

Reset – Control appears on all three devices. Must be toggled LO (red) in order for the device to operate. If toggled HI (green) and then LO (red) it resets the chip. Automatically toggles in correspondence to Reset Button (See motor control).

INx – Control appears on the DRV8803 device. Toggling HI (green) sets PWM of input X to a duty cycle of 100%. Toggling LO (red) sets PWM of input X to a duty cycle of 0%. Automatically toggles in correspondence to INx sliders and % duty cycle combo boxes (See PWM control). The pin will show orange if the user selects anything other than a 0% of 100% duty cycle. If user clicks pin to toggle from orange the pin will go LO (red).

STEP – Control appears on the DRV8805 device. Toggling LO (red) and then HI (green) will enable a bipolar stepper motor to step once. Toggles in correspondence to Pulse 1 Step button (See speed control).

DIR – Control appears on the DRV8805 device. Toggling HI (green) will allow the motor to operate in the forward direction, while toggling LO (red) will allow the motor to operate in the reverse direction. Automatically toggles in correspondence to Motor Direction radio buttons (See Motor Control)

SMx – Control appears on the DRV8805 device. Toggling these pins selects the mode that the motor is operating in (microstepping – full, half, wave mode, reverse). The following look up table shows the combinations and their results:

SM1	SM0	Mode
0	0	2-phase drive (full step)
0	1	1-2 phase drive (half step)
1	0	1-phase excitation (wave drive)
1	1	Reserved

Figure 15. SMx

Automatically toggles in correspondence to microstepping radio buttons (see motor control).

3.7 PWM Control

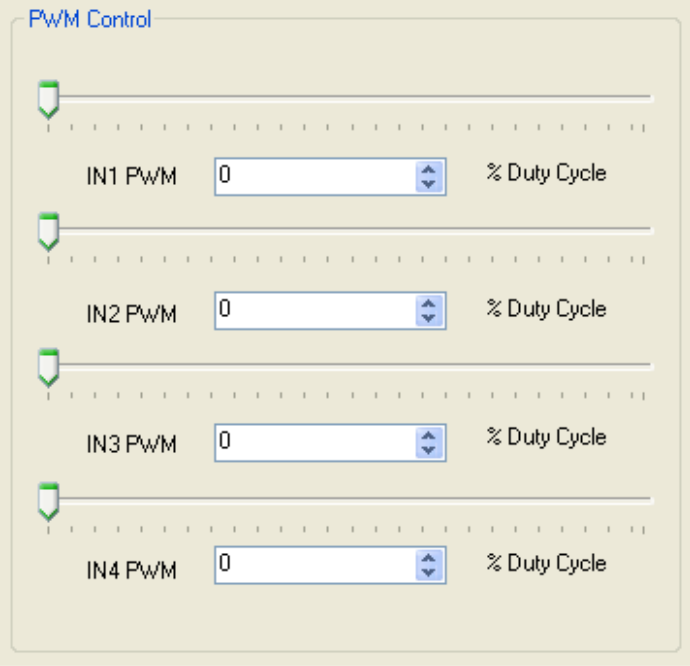


Figure 16. DRV8803 PWM Control

The DRV8803 can be utilized to control DC motors. For the purpose to control DC motor speed, a slider is provided which applies a PWM to each respective input. The PWM slider consists of an 8 bit number so positions from 0 to 255 are obtained. The MSP430 directly transforms this 8 bit number into the respective duty cycle. PWM frequency is around 31.25 KHz.

When the slider bar is moved across, the Duty Cycle indicator is updated accordingly. When the duty cycle is set from the selector, the slide bar is updated accordingly. The resulting duty cycle is an integer number between 0 and 100 and it is computed according to the equation:

$$\%\text{Duty Cycle} = \text{PWM} / 255 \times 100 \quad (1)$$

Each corresponding pin on the chip indicator is toggled automatically. If the duty cycle is 0% the corresponding chip is toggled to LO (red). If the duty cycle is 100% the corresponding pin is toggled to HI (green). If the duty cycle is set to anything besides 100% or 0% the corresponding pin is toggled (orange).

3.8 Motor Control

The Windows Application, in conjunction with the MSP430F2617 microcontroller, utilizes a series of timers to coordinate the rate of steps sent to the device. Once all the control signals are configured accordingly, the motor is ready to be turned.

The DRV8803/04/05 Customer EVM allows for the possibility of coordinating step rates such that accelerating and decelerating profiles are achieved. Both acceleration and deceleration are controlled by the same parameters Acceleration Rate and Time Base.

When the motor starts, the controller will accelerate the motor in order to reach the Pulses Per Second speed. Acceleration Rate is an 8 bit number (0 to 255) that gets added to the current Pulses Per Second speed and Time Base is an 8 bit number (0 to 255) that specifies how many milliseconds will elapse from one speed increase to the next. Once the specified Pulses Per Second has been achieved, the acceleration stops.

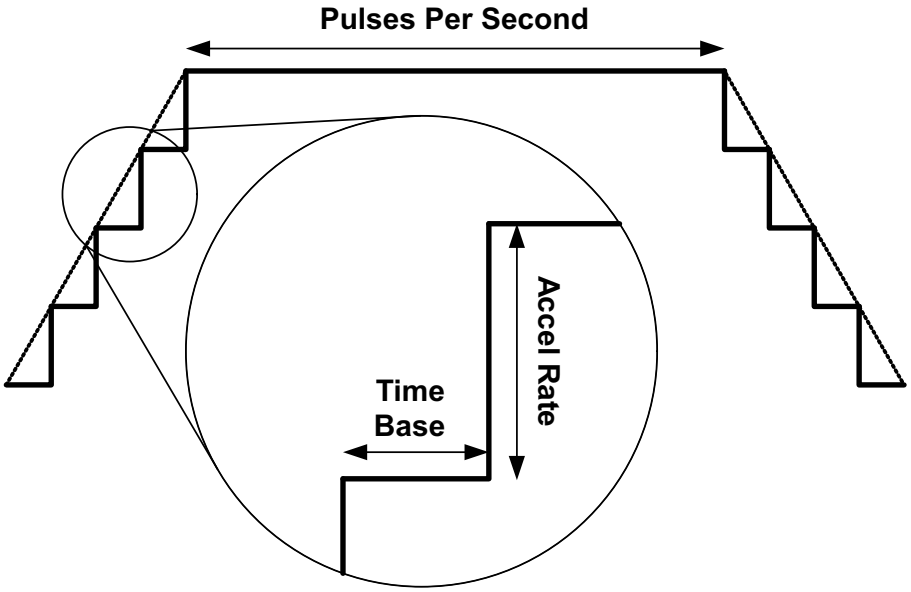


Figure 17. Motor Control

Same as described before but inversed, happens when the motor is commanded to stop.

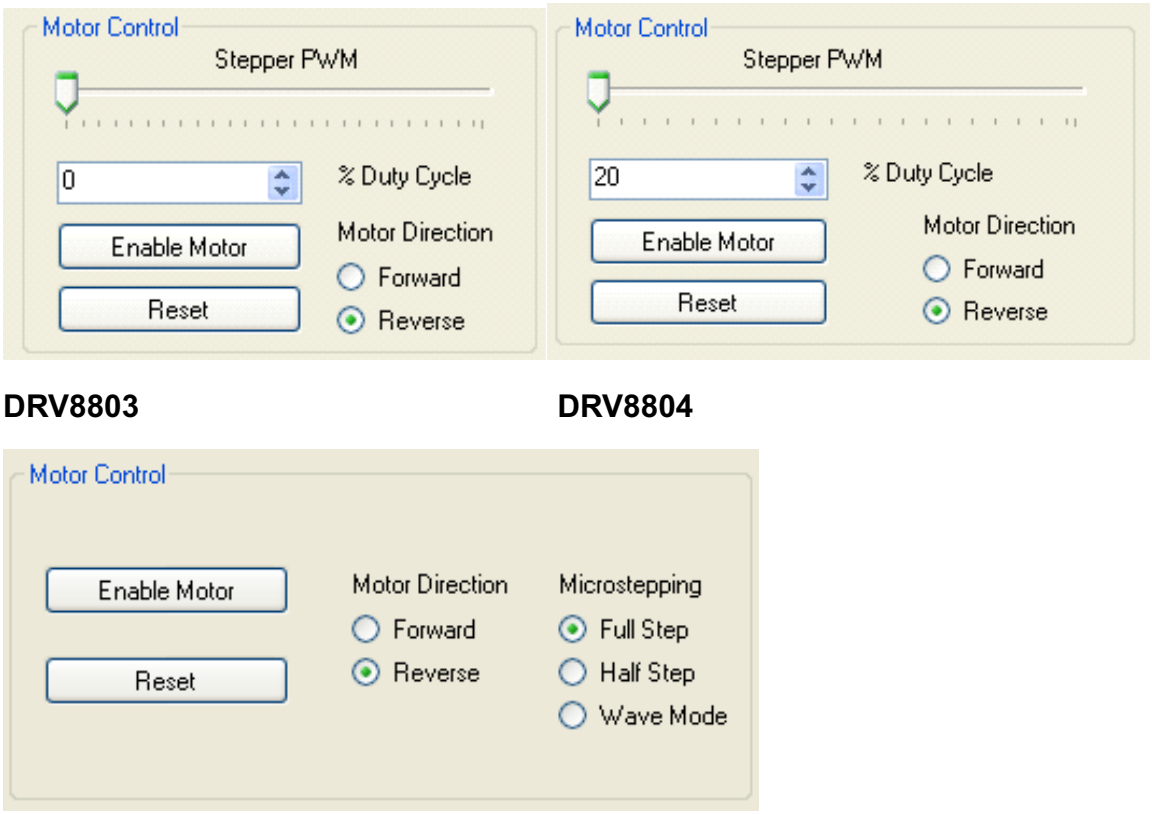


Figure 18. DRV88003/04/05 Motor Control Windows

Stepper PWM Slide Bar – Appears on the DRV8803 and DRV8804. On the DRV8803 this sets all of the INx PWM slide bars to whatever the Stepper PWM slide bar is set to. This controls the PWM rate of the stepper. On the DRV8804, the stepper PWM controls the PWM rate of the stepper and calculates the corresponding duty cycle which updates automatically as the slider is moved. If the user sets the % duty cycle, the position of the slider is updated automatically.

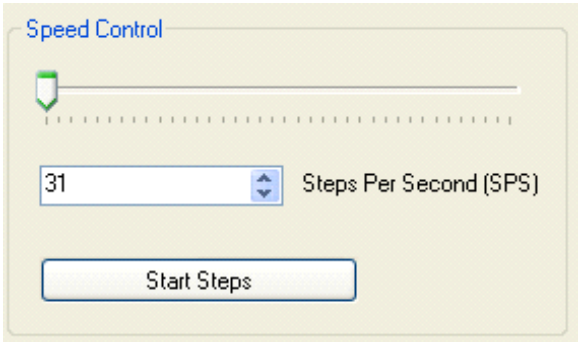
Enable Motor Button – Appears on all three devices. This enables the motor and automatically toggles the corresponding pin (see DRV88xx GPIO signals).

Reset Button – Appears on all three devices. This automatically sends the reset pin either HI (green) then LO (red) or LO (red) then HI (green) effectively resetting your device. (Reset pin must be LO for motor to operate – see DRV88xx GPIO signals).

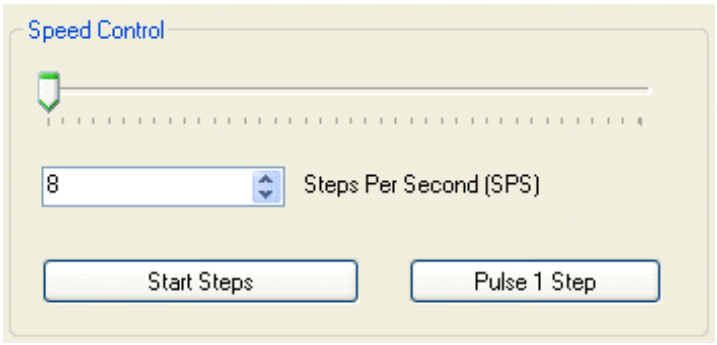
Motor Direction Radio Buttons – Appears on all three devices. Always defaults to reverse direction on default. Determines whether the motor is operating in forward or reverse direction. Automatically toggles corresponding direction pin in the case of the DRV8805 (see DRV88xx GPIO signals).

Microstepping – Appears on the DRV8805. Determines the mode that the motor is operating in and automatically toggles the corresponding SMx pin (see DRV88xx GPIO signals).

3.9 Speed Control



DRV8803/04



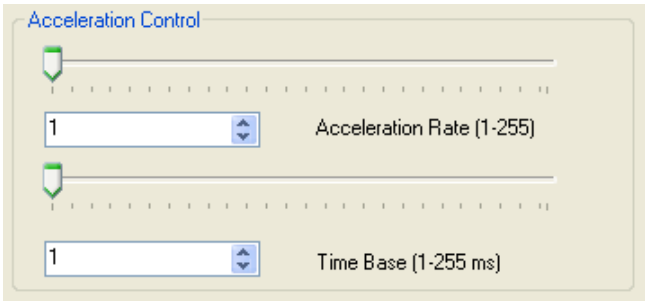
DRV8805

Figure 19. DRV88003/04/05 Speed Control Windows

Speed Control/Start Steps - The speed is set by either using the slide control, or selecting the Steps per Second value in the Steps Per Second number box. Using either control the other will be updated automatically. Pressing the “Start Steps” button, will start the timer and the motor will step at the rate specified by the Steps Per Second number Box/Slider. Once the “Start Steps” button is pressed it becomes the “Stepping (Pause Steps)” button. Press the “Stepping (Pause Steps)” button to stop the stepper motion. The Steps Per Second rate is updated automatically anytime the slider of the number box is used.

Pulse 1 Step – Control only applies to the DRV8805. Clicking this button will step the motor once, and also toggle the corresponding STEP pin HI (green) then LO (red) or LO (red) then HI (green) (see DRV88xx GPIO signals). A step takes place when the pin goes from LO (red) to HI (green)

3.10 Acceleration Control



DRV8803/04/05

Figure 20. DRV88003/04/05 Acceleration Control Windows

Each respective control (slide bar or number box) automatically updates the other when it is being used.

When the motor starts, the controller will accelerate the motor in order to reach the Steps Per Second speed (see Speed Control). Acceleration Rate is an 8 bit number (0 to 255) that gets added to the current Pulses Per Second speed and Time Base is an 8 bit number (0 to 255) that specifies how many milliseconds will elapse from one speed increase to the next. Once the specified Pulses Per Second has been achieved, the acceleration stops.

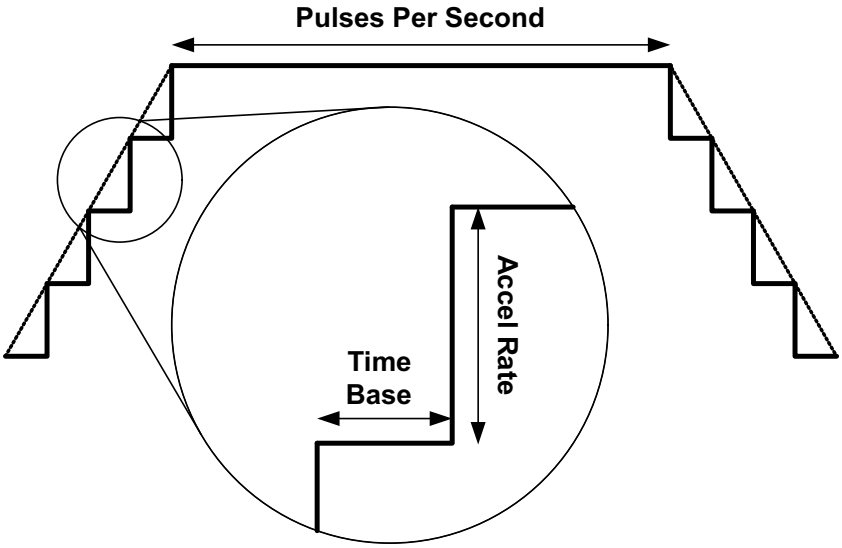


Figure 21. Acceleration Control

Same as described before but inversed, happens when the motor is commanded to stop.

Acceleration profile automatically updates when either slide bar or number box is changed.

3.11 Diagnostic Output

The DRV8806 will return data on every SPI transaction. This data contains valuable information as to whether each output was subjected to a fault or not. If a fault was present, the logic state is the SPI data packet is HI (green), whereas no fault present are represented by LO (red).

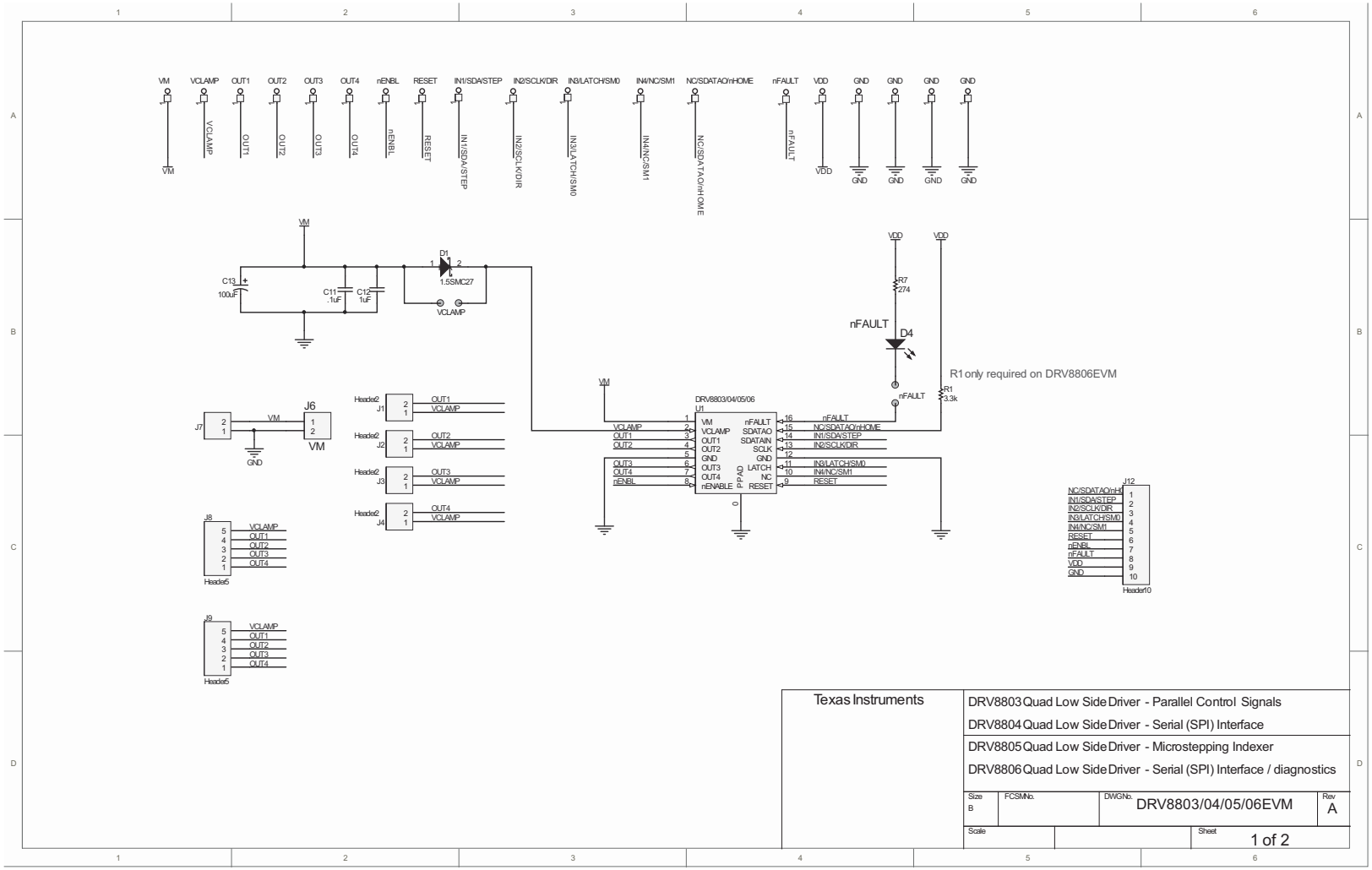
Faults generated on a per output basis could be caused by an open load or by over current. User must refer to the device's datasheet for more details on how the fault scheme operates.

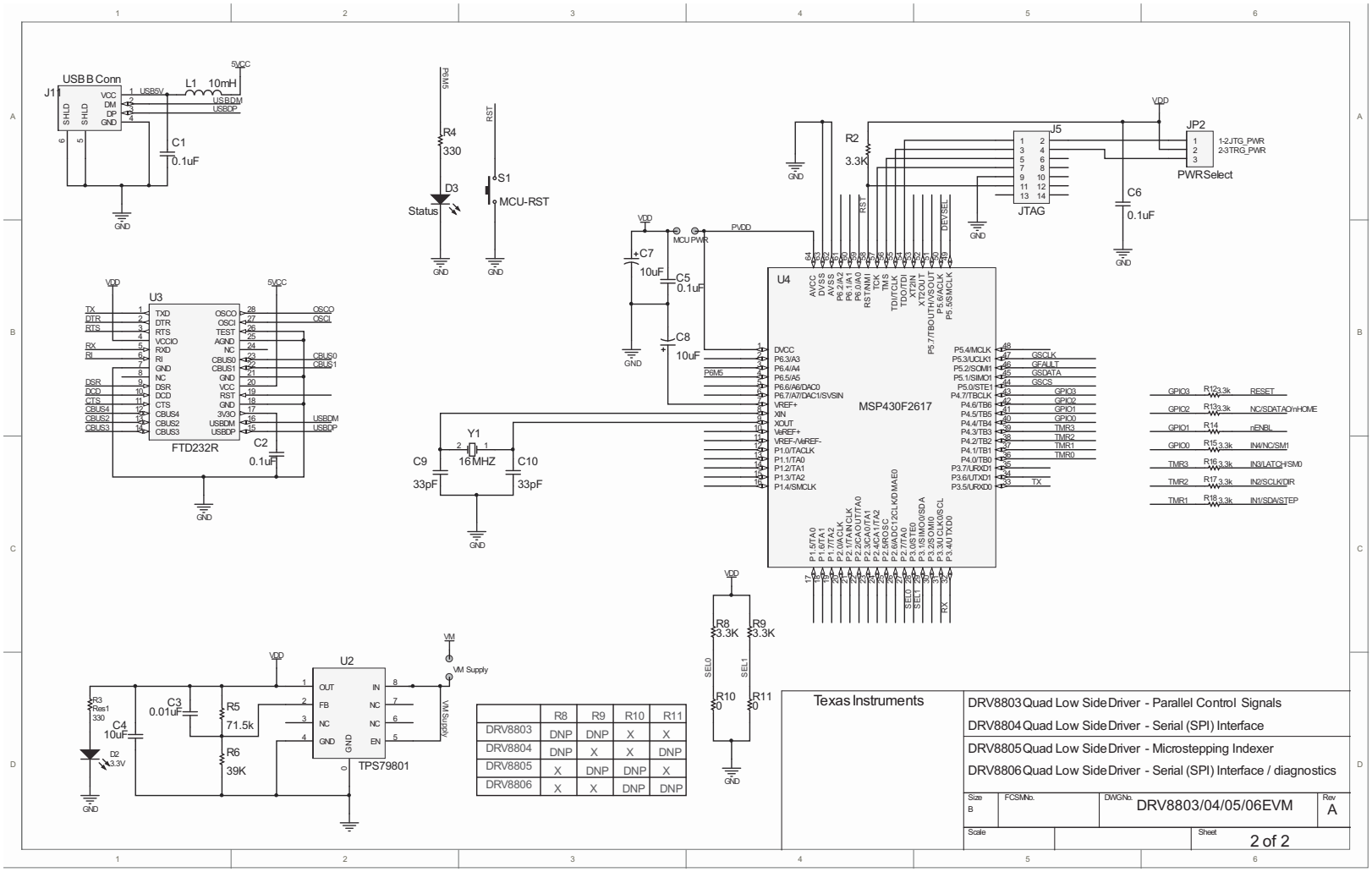
3.12 Controlling the EVM Using External Signals

If the user wishes to run the IC using their own external signals/MCU, this can be achieved easily. The only thing the user needs to do is powered down the MCU using the jumper JP4 labeled MCU_PWR on the EVM. This removes the power to the MCU and allows the user to control the input signals using the header J12. The silkscreen can be used to identify the various signals. The resistors R12-18 are meant to protect the MCU from 5V signals (if applied) to the input pins. The user can de-solder them for better performance. Please note that once these resistors are de-soldered, the user cannot use the on-board MCU.

4 Schematics

Schematics for the DRV8803/04/05/06 can be found on the following pages.





	R8	R9	R10	R11
DRV8803	DNP	DNP	X	X
DRV8804	DNP	X	X	DNP
DRV8805	X	DNP	DNP	X
DRV8806	X	X	DNP	DNP

Evaluation Board/Kit Important Notice

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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of -0.3 V to 65 V and the output voltage range of -0.3 V to 65 V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

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During normal operation, some circuit components may have case temperatures greater than 85°C. The EVM is designed to operate properly with certain components above 85°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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