DRV8821/DRV8823 User's Guide

This document is provided as a supplement to the DRV8821/DRV8823 datasheet. It details the hardware implementation of the CPG003 DRV8821-23EVM-001 Customer Evaluation Module (EVM).

Contents

List of Figures

1 Block Diagram

1.1 Power Connectors

The DRV8821/DRV8823 Customer EVM offers access to VM (Motor Voltage) power rail via a terminal block (J1). A set of test clips in parallel with the terminal block allows for the monitoring of the input power rail.

User must apply VM according to datasheet recommended parameters.

> **NOTE:** VDD for logic and microcontroller is derived from USB interface.

1.2 Test Stakes

Every pin on the DRV8821/DRV8823 device has been brought out to a test stake. A label on the silkscreen identifies each signal.

For those pins that change functionality depending on device flavor, a table is provided with corresponding function name on its particular column.
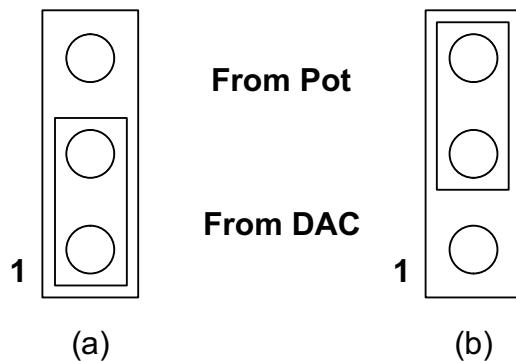
1.3 Jumpers

There are two styles of jumpers on the DRV8821-23EVM: two pin jumpers (JP3 and JP4) and three pin jumpers (JP1 and JP2).

Two pin jumpers are used to set AB DECAY or CD DECAY HI or LO.

Three pin jumpers are used to select the VREF from a pot or from the microcontroller's DAC outputs.
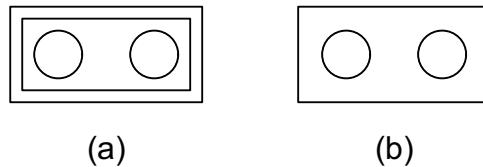
### 1.3.1 VREF Select Jumpers (JP1 and JP2)

Figure 1. VREF Select Jumpers (JP1 and JP2)

To configure the VREF select (either AB or CD) jumper, (a) Use position JPx-1:2 to select the MSP430 DAC output (default). (b) Use position JPx-2:3 to select the respective variable resistance potentiometer. These jumpers should not be left open as a lack of a reference voltage on the device will minimize current sourcing into the respective H Bridge, resulting in very poor motion or no motion at all.

1.3.2 DECAY Select Jumpers (JP3 and JP4)

Figure 2. DECAY Select Jumpers (JP3 and JP4)

To configure the DECAY select jumper: (a) place a jumper to set the respective DECAY signal HI. (b) remove the jumper to use internal pull down resistor and set the DECAY signal to LO.

1.4 Motor Outputs

There are three ways of connecting the bipolar stepper motor (for DRV8821) or the dual DC motors (for DRV8823) into the CPG003_DRV882123EVM-001 evaluation module: four pin header (J4 and J5), four position terminal block (J2 and J3) and test clips. We do not recommend the connection of a stepper motor into the test clips as these are Kelvin connections and not rated for high current output.

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 with the CD inside the USB_Driver folder.

2.2   Installing the CPG003_DRV882123-001 Evaluation Board Windows Application Software

Copy the contents of the "WindowsApplication" folder provided within the CD, into your hard disk.

2.3   Running the Windows Application Software

To run the application, double click the CPG003_DRV8821-23EVM-001_R1p0.exe application icon found on the same folder the application was extracted into.
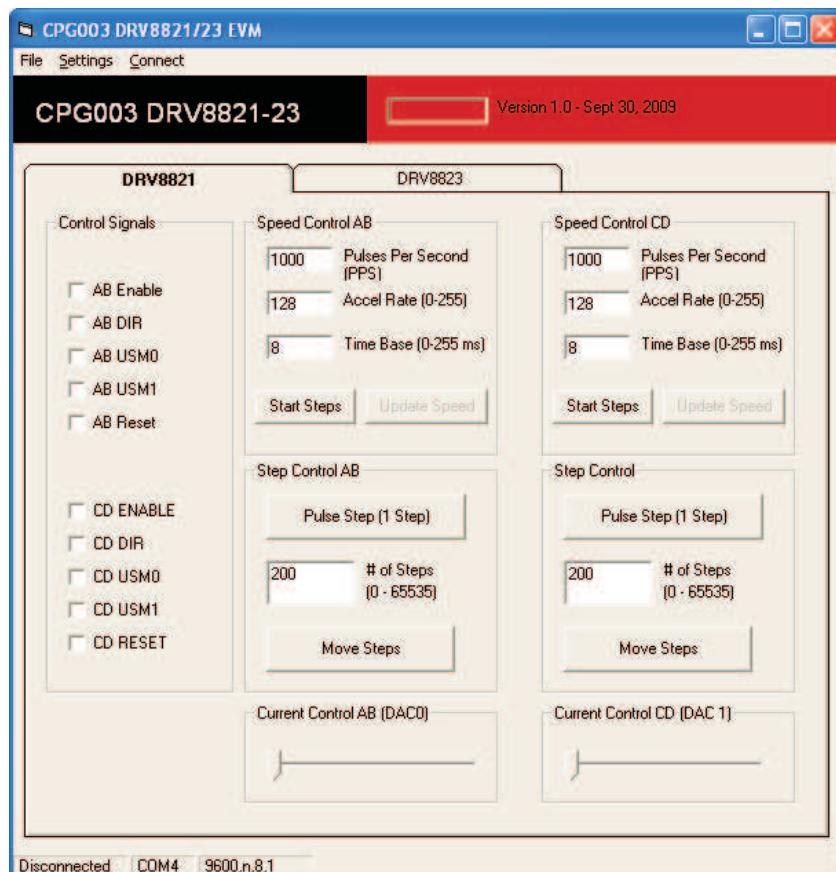
3   The Windows Application

The CPG003_DRV8821-23EVM Windows application is the software counterpart for the CPG003_DRV8821-23EVM-001 EVM. It allows the PC computer to connect to the MSP430F1612 microcontroller though an USB interface chip. Once connection is established and commands are sent, microcontroller takes care of configuring control signals and administering certain levels of automation, such as STEP generation (for DRV8821) or SPI communications (for DRV8823).

The graphical user interface (GUI) has been designed to allow for all of the DRV8821/DRV8823 device's functionality to be tested without having to intervene with the hardware, except for the proper configuration of jumpers, when needed.
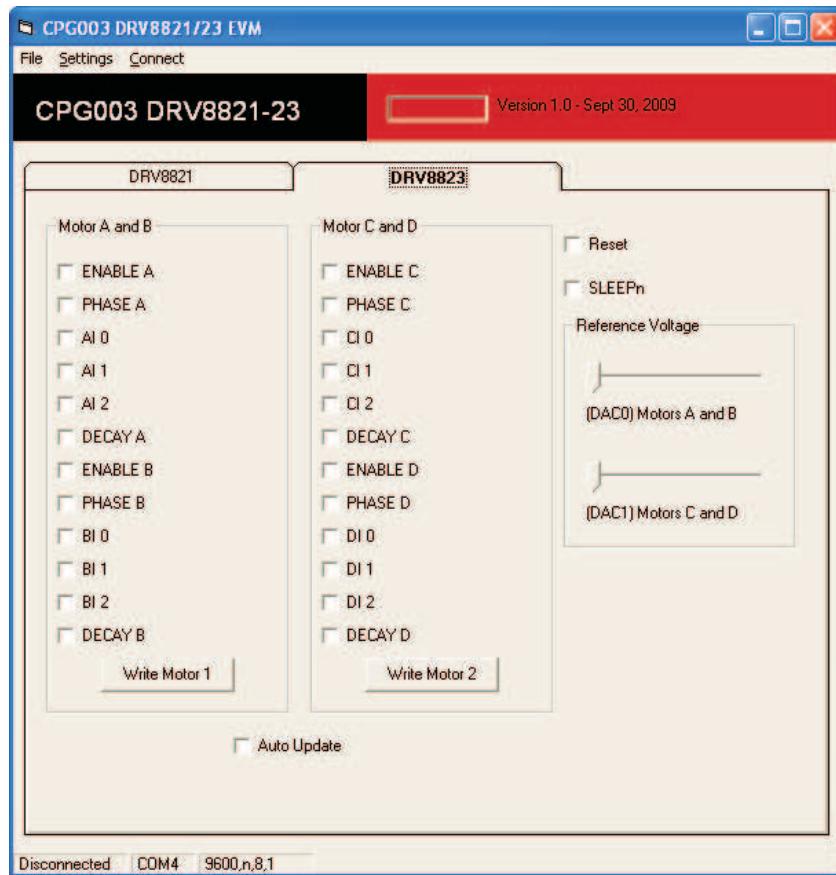
Figure 3 and Figure 4 show the CPG003_DRV8821-23EVM-001_R1p0.exe main screen. The application is divided into two tabs: One for the DRV8821 and one for the DRV8823. The menu contains items to configure and enable/disable the serial port.

The DRV8821 tab contains frames with GPIO control for DRV8821's control signals, speed, acceleration and number of steps control for both stepper motors AB and CD, and current control through the microcontroller's DACs.


Figure 3. CPG003_DRV8821-23EVM-001_R1p0.exe Main Screen (DRV8821)

The DRV8823 tab contains two frames with the bits that make up the 16-bit serial registers which contain the control signals to properly articulate each motor. Also GPIO signals such as Reset and SLEEPn are made accessible through check boxes. Finally, two sliders adjust the reference voltage through the microcontroller's DAC outputs.

Figure 4. CPG003_DRV8821-23EVM-001_R1p0.exe Main Screen (DRV8823)

3.1 The Menu

3.1.1 SETUP Register

The menu at the top of the application offers a series of quick options for how the COM port is to behave.

File → Exit - Terminates the application.

Settings → Port - Selects from COM1 to COM4. 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".

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

1. Go to Settings → Port 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.
2. Press Connect. If the port is available, the menu changes the "Connect" caption to "Disconnect". Press Disconnect in order to disable the serial communications.
3. <1><0><0> should return on the text box as an acknowledge. The text box also changes from red to green, as shown in Figure 5.
4. The application is ready for use.
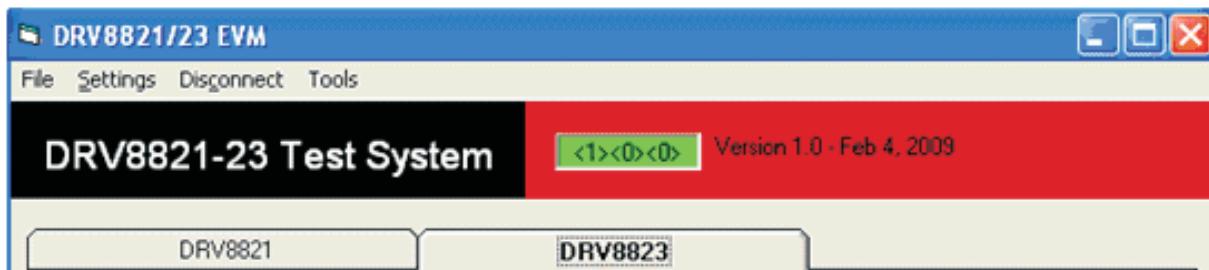
Figure 5. Acknowledgement Text Box

3.2 DRV8821 GPIO Control Signals

Once the application is communicating with the interface board, the control signals can be actuated by checking or un-checking check boxes on the Control Signals frame.
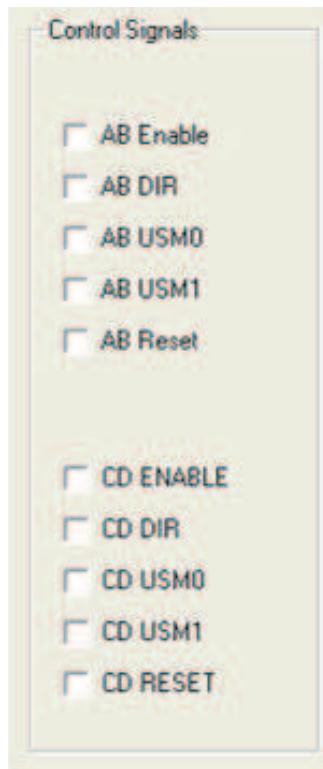
Figure 6. Control Signals Frame

A checked checkbox translates to a HI level on the respective control signal. Un-checked checkboxes translate to a LO level on the respective control signals.

3.3 Updating DAC Output for Current Control (VREF)

If the DRV8821 has been configured to accept VREF analog voltages through the microcontroller DAC outputs (refer to Jumpers section), then the slider bar on the Current Control frame can be used to set the VREF voltage.

Figure 7. Current Control Frame

The 12-bit DAC channels, 0/1, are connected to the DRV8821/DRV8823 VREF analog inputs ABVREF and CDVREF. Changing the DAC digital value from 0 to 4095 changes the analog voltage at the respective VREF pin from 0 V to 2.5 V respectively, following Equation 1.

$$VREF = DAC\_VALUE \bullet \frac{2.5\ V}{4095}$$

(1)

Where:

1. VREF is the output voltage.
2. DAC_VALUE is a number from 0 to 4095.

3.4 Operating the Stepper Motor (DRV8821)
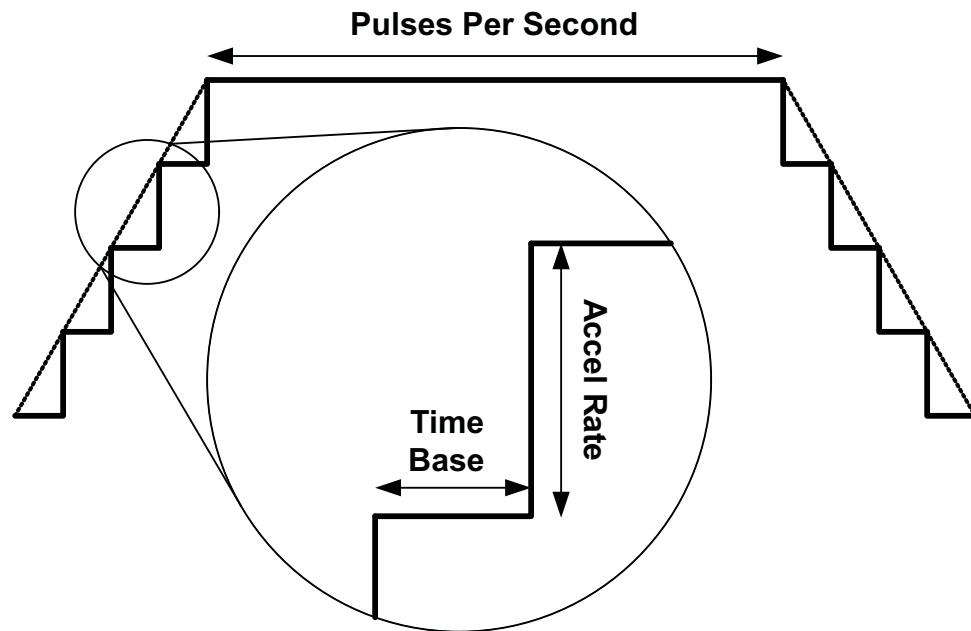
3.4.1 Turning the Stepper Motor

The Windows application, in conjunction with the MSP430F1612 microcontroller, utilizes a series of timers to coordinate the rate of steps sent to the device. Once all the control signals are configured accordingly, (ENABLEn = LO, SLEEPn = HI, RESETn = HI; DIR, USM0 and USM1 can be HI or LO depending on preferred mode of operation; SRn must be L, if external diodes are not populated), the motor is ready to be turned.

The DRV8821-23EVM-001 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.
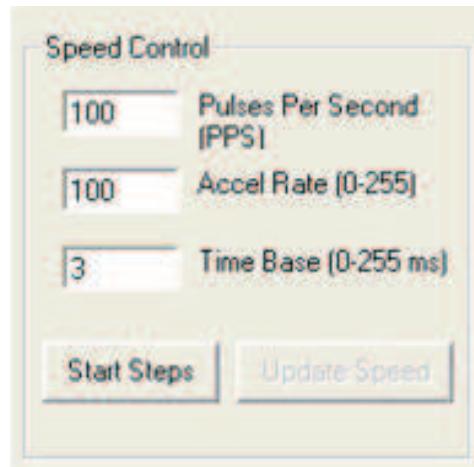
When the motor starts, it always starts at the slowed PPS speed (62 pulses per second). The controller will accelerate the motor in order to reach the PPS speed. Acceleration rate is an 8-bit number (0 to 255) that gets added to the current PPS speed and time base is an 8-bit number (0 to 255) that specifies how many milliseconds will elapse from one speed increase to the next. Once the specified PPS has been achieved, the acceleration stops.

The inverse of the above described will command the motor to stop.

Figure 8. Turning the Stepper Motor

The Windows application frame to control speed, acceleration and deceleration, as well as motor start and stop is shown in Figure 9.

Figure 9. Speed cnotrol Frame
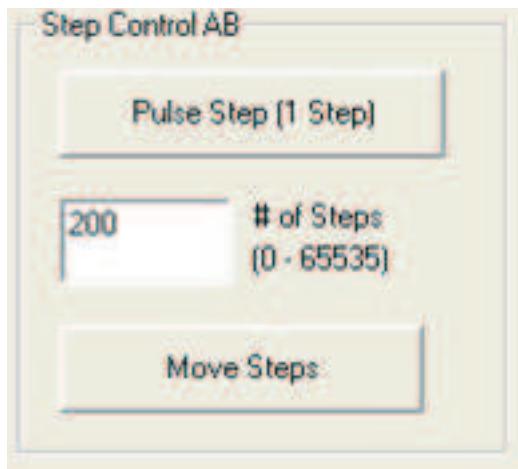
Pressing the "Start Steps" button, will start the timer and pulses will be generated at the rate specified by the decimal number at the PPS text box. Once the "Start Steps" button is pressed it becomes the "Stepping" button. Press the "Stepping" button to stop the stepper motion.

When the motor is stepping, the "Update Speed" button becomes enabled. Speed can be updated by modifying the PPS text box and then pressing the "Update Speed" button. The "Speed" button is disabled every time the motor is not turning because the stepping has been halted by pressing the "Stepping" button.

3.4.2 Step by Step control

The Step Control frame has a series of tools to control the stepping of the motor on a predetermined number of steps fashion.

The "Pulse Step" button allows for a single step to be issued. Remember that a STEP takes place when STEP goes from LO to HI.

Figure 10. Step Control Frame

To move the motor a number of steps and then stop, fill the # of Steps text box with a decimal number from 0 to 65535 and the motor will move that number of steps at the speed specified on the PPS text box. No acceleration or deceleration takes place under this function.

3.5 *Operating the Motors (DRV8823)*

The Windows application gives access to both serial registers on the DRV8823 bit by bit, very similar to the GPIO section on the DRV8821 tab. If the "Auto Update" checkbox is checked, checking any of the checkboxes on the respective frame, will update the serial register. If the "Auto Update" checkbox is unchecked, the button "Write Motor x" must be pressed for these bit states to be transmitted to the device.
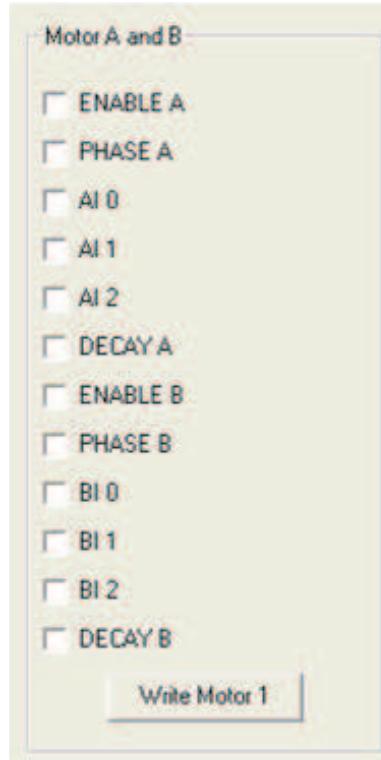
Figure 11. Motor A and B Frame

A checked checkbox translates to a 1 on the respective serial register bit. Un-checked checkboxes translates to a 0 on the respective serial register bits.

3.6 Updating DAC Output for Reference Voltage

If the DRV8823 has been configured to accept VREF analog voltages through the microcontroller's DAC outputs (refer to Jumpers section), then the slider bar on the Reference Voltage frame can be used to set the VREF voltage.

Figure 12. Reference Voltage Frame

The 12-bit DAC channels, 0/1, are connected to the DRV883 VREF analog inputs ABVREF and CDVREF. Changing the DAC digital value from 0 to 4095 changes the analog voltage at the respective VREF pin from 0 V to 2.5 V respectively, following Equation 2.

$$VREF = DAC\_VALUE \bullet \frac{2.5\ V}{4095}$$

(2)

Where:

1. VREF is the output voltage.
2. DAC_VALUE is a number from 0 to 4095.

4 Schematic

A schematic is available in the form of a PDF file ("CPG003_Schematic.pdf") inside the EVM_Related folder on the supplied CD.

IMPORTANT NOTICE