

DRV8809/DRV8810 EVM

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ABSTRACT

This document is provided as a supplement to the DRV8809/DRV8810 data sheet and Design-In Guide. It details the DRV8809 evaluation module (EVM), a board containing said device and all access points necessary for its evaluation. A second interface board houses the microcontroller, which supplies necessary signals for evaluating most features. It also explains how to install and set up the Windows® application that controls the EVM.

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1 General Description

The DRV8809 evaluation board offers designers an easy way to sample and test the DRV8809/DRV8810's four H-bridges, three DC-DC converters as well as its dual communication ports and monitoring signals. With the help of the CPG_COM USB-based interface board, the EVM quickly connects to any Windows®-based PC by means of a USB port connection. A Windows application offers a user-friendly interface to the many features the DRV8809/DRV8810 has to offer.

The DRV8809/DRV8810 EVM is controlled by an MSP430F1612 microcontroller, which receives asynchronous serial communication signals from the CPG_COM FTDI USB to serial protocol chip connecting the board to the PC. The same microcontroller then submits digital (control) and analog (reference) signals to the DRV8809/DRV8810. The EVM also offers the designer the capability of intercepting communication, control and reference so they may be provided with their own controlling unit.

Windows is a registered trademark of Microsoft.

Each DRV8809/DRV8810 pin is accessible through a series of loop-based test stakes. All of these test stakes are directly connected to the device's pin, allowing for Kelvin measurements.

The board is equipped with banana jack connectors to supply DC-DC converter and motor input power (VM in the range of 18 V to 36 V) as well as logic power (typically 3.3 V). It also includes banana jack connectors for the three DC-DC regulated outputs (OD_A, OD_B and OD_C) as well as the eight outputs for the four H-bridges.

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 DRV8809/DRV8810 Evaluation Board Windows Application Software

The included CD contains a SETUP.EXE file inside the WindowsApplication folder provided with the CD. Double click this file and follow instructions to properly install the software.

A quicker technique that may work on some systems is to copy the contents of the Support folder into any desired folder and then double click the "DRV8809-10_Rxpx_EVM.exe" file

2.3 Running the Windows Application Software

To run the application, double click the DRV8809-10__Rxpx_EVM.exe application icon found on the same folder into which the application was extracted.

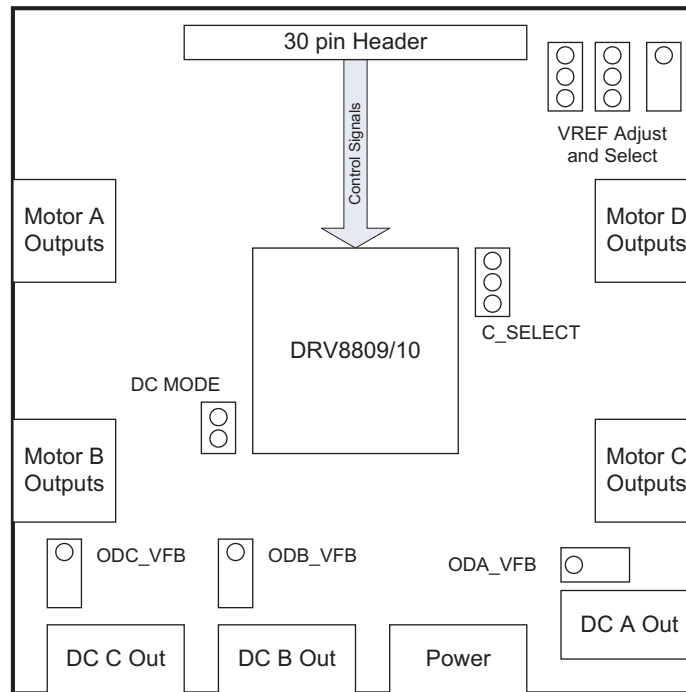
3 The Windows Application

The DRV8809/DRV8810 Windows application is the software counterpart for the DRV8809/DRV8810 EVM. It is in charge of connecting to the CPG_COM interface board and then sending respective serial commands as specified by the user using the interface.

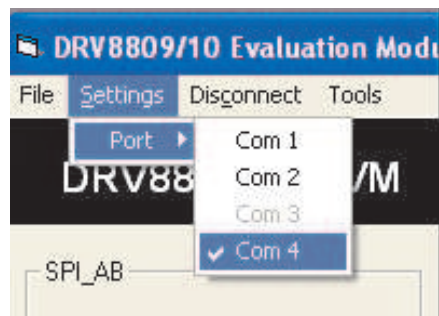
The graphical user interface (GUI) has been designed to allow for most of the DRV8809/DRV8810's functionality to be tested without having to intervene with the hardware. Some functions, however, do require the board to be modified.

Instances requiring modifications have to do with wiring the H-bridges in parallel to obtain large sized DC motor (two H-bridges in parallel) interface or ultra large sized motor (four H Bridges in parallel) interface, as detailed on the DRV8809/DRV8810 data sheet. Pairing both DC regulators OD_B and OD_C in parallel also requires hardware modifications.

The following illustration shows the DRV8809-10_R1p0_EVM.exe main screen. It contains menu items to configure and enable/disable the serial port, frames with function control for the serial peripheral interfaces SPI_AB and SPI_CD, output control for the DRV8809/DRV8810's input signals, digital-to-analog-converter (DAC) output and stepper motor control. All of these frames are explained in the following sections.



3.1 Menu



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

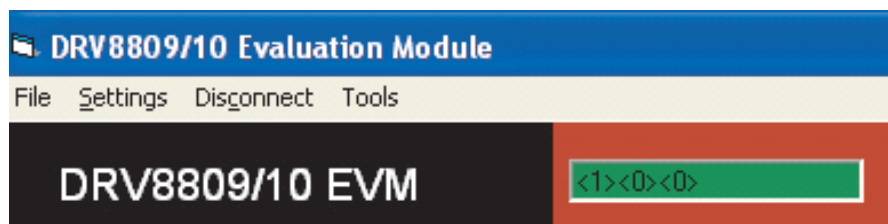
- File** Exit – Terminates the Application
- Settings** Port – Selects from COM1 to COM4. Default is COM4

The Serial Port actual port number defaults to that 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”
- Tools** AutoUpdate – When checked, automatically updates the value of the digital signals residing on the Output Control frame box.

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.
2. Press Connect. If the port is available, the menu changes the “Connect” caption to “Disconnect”. Press Disconnect to disable the serial communications.
3. Start sending serial commands as desired.
4. <1><0><0>: should return on the text box as an acknowledge. It also changes from red to green, as shown below:



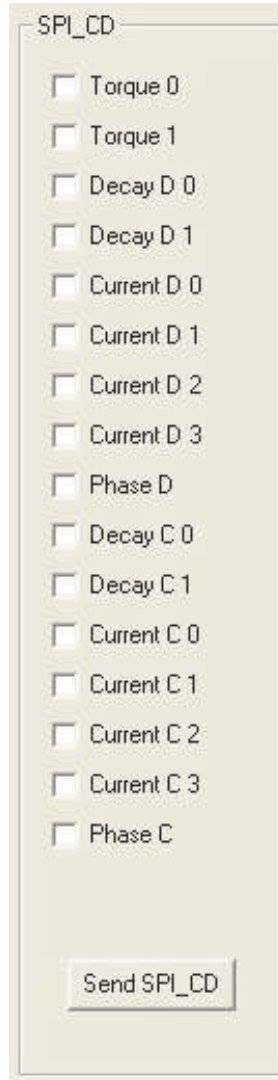
3.2 SPI_AB Synchronous Peripheral Interface Port



The DRV8809/DRV8810 SPI_AB port can be interfaced through this easy-to-follow set of frames.

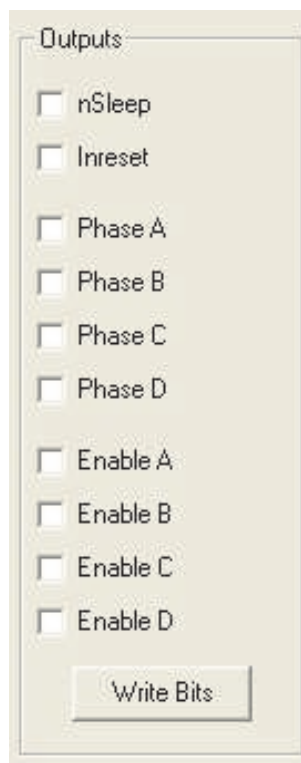
Because the SPI_AB port can interface three different registers (SETUP, EXTENDED and STEPPER), the Option Buttons select how the frame and the checkboxes look. The previous illustration shows the three possible ways the frame looks. A checked Checkbox represents a 1 or a true state. Pressing the “Send SPI_AB” button, sends a command to the MSP430 to send the pertinent SPI packet to the DRV8809/DRV8810 through the SPI_AB port.

3.3 SPI_CD Port



The DRV8809/DRV8810 SPI_CD port can be interfaced through this easy-to-follow frame. Because the SPI_CD port only interfaces to the STEPPER register, there are no option buttons as with the previous SPI_AB frame. A checked checkbox represents a 1 or a true state. Pressing the “Send SPI_CD” button, sends a command to the MSP430 to send the pertinent SPI packet to the DRV8809/DRV8810 , through the SPI_CD port.

3.4 Output Control



Signals controlling the DRV8809/DRV8810 can be controlled within this panel. NSLEEP and In-Reset are used continuously both during startup as well as any other instance when the user wishes to configure the device. PHASEx and ENABLEx are used during run time (if the device was configured on the QUAD H-bridge operation mode) to control DC motor operation. A checked checkbox represents a 1 or a true state. Pressing the Write Bits, executes the “Write Bits” command at the MSP430, which in turn toggles the bits accordingly

Note: If the Auto Update menu option under Tools is checked, there is no need to press the “Write Bits” button. Every time a checkbox changes state, the actual logic state is transmitted to the DRV8809/DRV8810. The Auto Update option is enabled as a default when the Windows application is started.

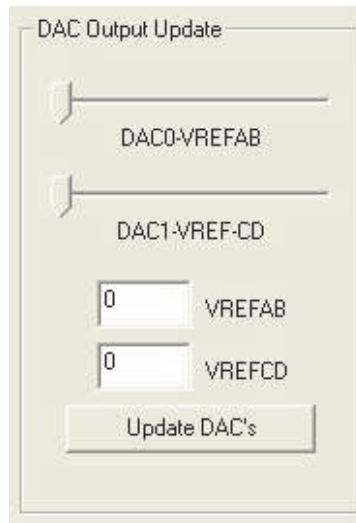
3.5 Updating DAC Output Adjust (Reference Voltage VREFAB and VREFCD)

There are two ways to set the VREFAB and VREFCD analog voltages when using this application.

1. By sliding the DAC0-VREFAB and DAC1-VREFCD slider bars
2. By typing a number from 0 to 4095 into the VREFAB and VREFCD text boxes and pressing the Update DAC's button

The CPG_COM board has two 12 bit DAC channels (DAC0 and DAC1) which in turn are connected to the two analog VREF inputs on the DRV8809/DRV8810 (VREFAB and VREFCD respectively)

Changing the DAC digital value from 0 to 4095, changes the analog voltage at the VREF pin from 0 V to 2.5 V respectively.



Use either tool to set the VREF analog voltage with precision, using the formula:

$$VREF_{xx} = DACx \frac{2.5V}{4095}$$

Where:

VREF_{xx} is the output voltage and DAC_x is a number from 0 to 4095.

Operating the Sliding Bars

When dragging each lever, a number pops up on top of the lever being dragged. This number is proportional to the slider position. This number is anywhere from 0 to 4095.

When the dragging comes to a stop, and the mouse button released, the particular value is sent to the MSP430 and the DAC is updated.

Operating the Text Boxes

The most accurate procedure to set the VREF value is by typing a number from 0 to 4096 on the respective box. Pressing the Update DAC's button sends a command to the MSP430 microcontroller on the CPG_COM board, which sets the analog output.

When the Update DAC's button is pressed, the slider bars moved to the position directly proportional with the value that was sent to the interface board.

When the sliders are dragged to a new position, the Text Boxes are left unaltered.

Note: For the MSP430 DACs to have any effect on the respective VREF analog input, Jumpers JP2 and JP3 on the EVM must be set to the correct position. Otherwise, VREFAB and VREFCD are configured as per the R12 potentiometer position.

3.6 Mode Select

The DRV8809/DRV8810 can be configured to operate in one out of eight different modes:

1. Dual Stepper
2. Stepper and Large DC
3. Stepper and Dual Small DC
4. Large DC and Dual Small DC
5. Dual Large DC
6. Quad Small DC
7. Large Stepper

8. Ultra Large DC

These eight modes are selected by writing to the Motor Select bits on the SETUP register (SETUP [2:0]).

As a shortcut, the Mode Select frame holds a Combo Box with the eight options. Selecting one of these options modifies the content of the three Motor Select bits on the SPI_AB frame (three LSB's). It does not, however send the SPI message to the device.

Consideration must be taken to ensure the control signals (such as NSLEEP and In-Reset) are set properly for the selected mode to be configured accordingly. In other words, In-Reset must be HI, and nSLEEP must be LO.



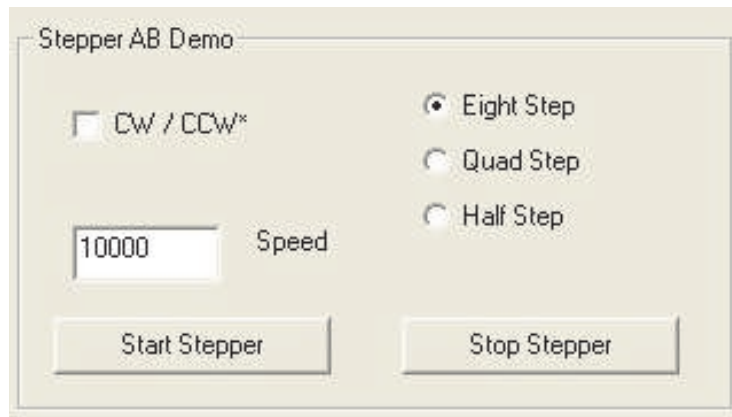
3.7 Stepper AB Demo

The CPG_COM Interface board supplied with the DRV8809/DRV8810 EVM has been programmed to supply the procedure steps necessary to control a stepper connected to H-bridges A and B, with direction, microstepping degrees and speed. The Stepper AB Demo frame allows to configure said parameters.

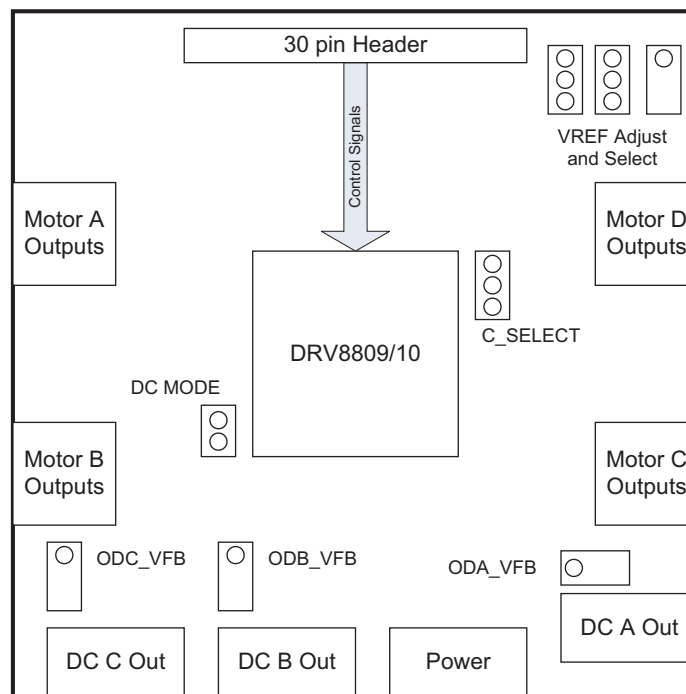
**CW/CCW*
Checkbox** When checked, the stepper moves Clockwise. When not checked, the stepper moves counterclockwise.

Note: CW and CCW are relative to how the motor was wired.

Steps	User can select from Half Step, Quad Step and Eight Step.
Speed	A number from 1000 to 65535, which translates into the period of each step as a multiple of 250 ns. Per example, 1000 means one step every 250 us or 4000 steps per second.
Start Stepper	Starts the stepper motion according to the direction, stepping rate and stepping speed selected. When pressed, "Start Stepper" switches to "Update Stepper"
Update Stepper (Not visible)	Updates the stepper motion with the direction, stepping rate and stepping speed selected. Allows modification of stepper behavior during normal run time.
Stop Stepper	Stops stepper running engine. When pressed, returns "Update Stepper" button to "Start Stepper" button.



4 DRV8809/DRV8810 EVM



The DRV8809/DRV8810 EVM creates an easy-to-follow environment critical for the proper evaluation of the numerous features found on the device. The four fully configurable and controllable H-bridges, along with the three DC-DC regulator outputs, are accessible through banana jacks.

The 30-pin header contains access to signals coming from the CPG_COM microcontroller such as the two SPI_AB and SPI_CD ports, ENABLE_x, PHASE_x, In-Reset and NSLEEP.

Other control pins such as C_SELECT and DC_MODE, which are only set during power up, are taken care of by jumpers.

Each device pin can be interconnected or measured at the loop based test stake.

Four variable resistor potentiometers are available to set the three DC-DC regulator bias point (Feedback Voltage) and the motion control current bias point (VREFAB and VREFCD). The Two VREF analog inputs are taken care by a single potentiometer, or by the microcontroller on the interface board as selected through jumpers.

4.1 Jumpers

The DRV8809/DRV8810 EVM has four jumpers, which must be configured prior to its operation. This section details how to configure these jumpers.

C_SELECT Jumper

The three-pin header (JP5) allows for the configuration of how the three DC regulators start up during power up, as specified on the DRV8809/DRV8810 data sheet.

ERRATA The JP5 documentation silk screen text is inverted on the DRV8809/DRV8810 EVM RA. A 200K position silk screen label corresponds to the GND label and vice versa.



GND Jumper
C_SELECT = 0V



200K Jumper
C_SELECT = 1.67V



No Jumper
C_SELECT = 3.3V

CSELECT	ODA	ODB	ODC
0 V to .3 V	OFF	OFF	OFF
1.3 V to 2.0 V	As selected by DC_MODE		
3.0 V to 3.3 V	ON	ON	ON

DC_MODE Jumper

This two-pin header (JP4) connector sets the DC_MODE voltage at power up. The DC_MODE pin is internally pulled up, so leaving the jumper disconnected places the device in Parallel DC-DC converter mode (OD_B and OD_C operate in parallel mode). Placing a shunt jumper between both pins grounds the DC_MODE pin. In this case, the three DC regulators operate in individual mode.



No Jumper
DC_MODE = HI



With Jumper (default)
DC_MODE = LO

DCDC_Mode	CSELECT	Timing Delay	Description
L	0 V to 0.3 V	NONE	No regulator is enabled.
L	1.3 V to 2.0 V	NONE	No regulator is enabled.
L	3.0 V to 3.3 V	1.6ms	Ch-A followed by Ch-B and Ch-C
H	0 V to 0.3 V	NONE	No regulator is enabled.
H	1.3 V to 2.0 V	1.6ms	Ch-B and Ch-C followed by Ch-A
H	3.0 V to 3.3 V	1.6ms	Ch-A followed by Ch-B and Ch-C

VREF Jumpers

As explained on the Windows application section, there are two ways to modify the VREF current control analog input. Either by utilizing the CPG_COM interface board's DACs or by modifying a shared potentiometer resistor (R12). Jumpers JP2 and JP3 choose this option.



JPx-1:2 (default)
Use DAC as VREF Source



JPx-2:3
Use DAC as VREF Sot

4.2 DC-DC Converter Output Voltage Potentiometers

Each EVM's DC-DC converter output voltage can be set by changing the respective potentiometer resistance setting.

1. R9 for OD_A
2. R8 for OD_B
3. R7 for OD_C

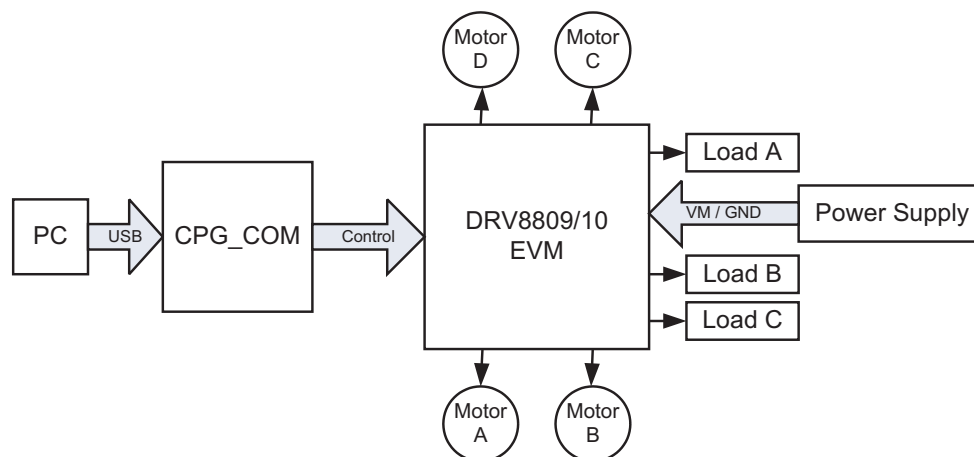
4.3 DC-DC Converter Output Voltage Test Point

Each DC-DC converter channel has a loop test point, as well as the banana jack, to measure the regulated output voltage.

1. OD_AREG for OD_A
2. OD_BREG for OD_B
3. OD_CREG for OD_C

Note: These test points are not to be confused with ODA_SW, ODB_SW and ODC_SW. The later corresponds to the switch output and probing these yield the unregulated output prior to the Buck converter circuitry (i.e., diode, inductor, filter cap and resistor network).

5 Connecting the Module



The DRV8809/DRV8810 EVM system connects to a PC computer's USB Port. The USB Port's 5-V source is enough to power the logic (MSP430 microcontroller, USB to Serial converter chip and the DRV8809/DRV8810 logic needs).

The DRV8809/DRV8810 board requires a power source for the Motor H-bridges and DC-DC converters. VM must be at least 17 V DC for the device to power up normally.

When power is applied, the DRV8809/DRV8810 start with its defaults loaded at the respective registers. The MSP430 holds the device on reset by pulling down the nRESET signal. All configuration must take place by sending the proper commands through the USB port using the provided Windows application.

6 Examples

6.1 Setting up the Serial Communications

The following steps can be used to setup the Serial COMM Port.

1. Connect the DRV8809/DRV8810 EVM system to the USB port on your computer.
2. D2 LED on the CPG_COM should be solid red and D3 should be flashing. This implies the MSP430 is up and running.
3. Start the Windows application. Always connect the USB first and execute the application later. This ensures the Windows application finds the COM Port.
4. Configure the serial port (Settings->Port->COMx) to operate with the same COM port for which the CPG_COM was configured.
5. Press Connect. Serial communications are established if the serial COM port is available.

6.2 Configuring the DRV8809/DRV8810 as a four small DC motor controller

The following steps can be used to configure the DRV8809/DRV8810 as a four small DC motor controller. Most of these steps apply for all other modes.

1. Connect a DC motor to the OUTA+ and OUTA- banana jacks.
2. Make sure VM greater than 17 V has been applied between the VM and GND banana jacks.
3. In the windows application, and after serial communications have been established, Uncheck nSleep and check nReset at the Outputs Frame.
4. If not on Auto Update mode (Tools -> Auto Update is not checked), press Write Bits at the Outputs frame. Specified as "press Write Bits" on subsequent steps.
The device has entered Sleep Mode and has the SPI_AB port configured to access the SETUP and EXTENDED Registers
5. Press the Setup Option Button at the SPI_AB frame. Caption should change as to reflect the SETUP's register bit content.
6. Check Motor Select 0 and Motor Select 2. Uncheck Motor Select 1. Leave all other check boxes as unchecked.

Note: A shortcut for writing the three Motor Select bits can be found on the Mode Select frame and its combo box list. Choose one of the eight options, and the three Motor Select bits are updated accordingly.

7. Press the Send SPI_AB Button.
If the command was successful, the Acknowledge Indicator Text Box should have become green and display the three bytes <1> <0> <0> in it. The device has been configured as a four small DC motor controller
8. Check the nSleep checkboxes at the Outputs frame.
9. If not on Auto Update mode (Tools -> Auto Update is not checked), press Write Bits at the Outputs frame.
The device's H-bridges are now enabled and operational.
10. Check the Enable A check box at the Outputs frame. and press Write Bits
Because the Enable A line is asserted, the DC motor connected at the H-bridge A should be moving.
11. Check the Phase A check box at the Outputs frame and press Write Bits.
12. Move the DAC0/VREFAB lever to the right. The DC motor should move faster as more current is

being allowed to flow.

13. Uncheck the Enable A check box in the Outputs frame and press Write Bits.
The DC motor should stop as it has been disabled.

7 **DRV8809/DRV8810 EVM Schematic**

Please see the “DRV8809/10_EVM_Schematic.pdf” file included on the CD for a better view of this schematic.

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