DRV8881P Evaluation Module

This document is provided with the DRV8881P customer evaluation module (EVM) as a supplement to the DRV8881P datasheet (SLVSD19). The user's guide details the hardware implementation of the EVM.

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1 PCB (Top View)

Figure 1 illustrates a typical board configuration.

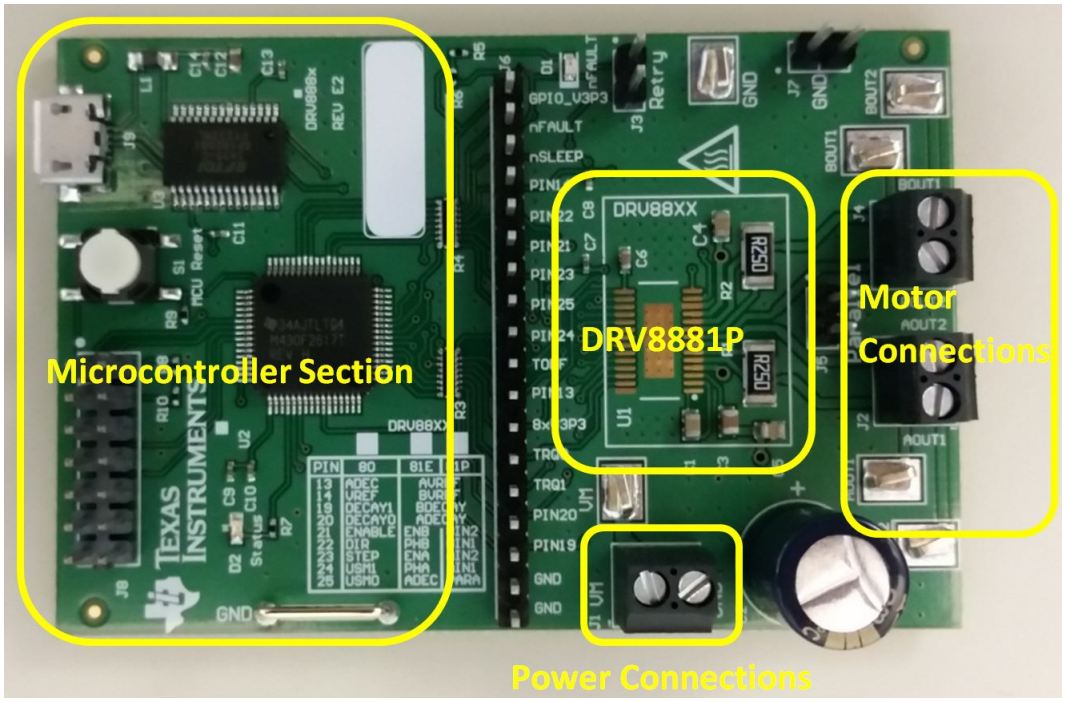

Figure 1. Typical Board Configuration (EVM Provided may Vary)

2 Introduction

The DRV8881P customer EVM is a platform revolving around the DRV8881P, a medium-voltage, dual H-bridge driver, and highly-configurable power stage. This device has been optimized to control one or two brushed DC motors, or a stepper motor. The DRV8881P can also be configured to drive a single-brushed DC motor using both output stages in parallel mode to increase the drive current.

The EVM houses a MSP430 microcontroller and an USB interface chip. The USB chip allows for serial communications from a PC computer where a Microsoft® Windows® application is used to schedule serial commands. These commands can be used to control each of the device's signals, and drive the motor or motors at the desired rate.

The microcontroller firmware outputs the control signals and PWM signals to move the motor. The firmware also monitors the nFAULT signal to alert the GUI that a FAULT has occurred.

This document details the operation of the EVM, as well as the hardware configurability of the evaluation module.

2.1 Connectors

The DRV8881PEVM offers access to the 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.

Apply VM according to datasheet-recommended parameters.

NOTE: VDD for the microcontroller is derived from the micro-USB connector.

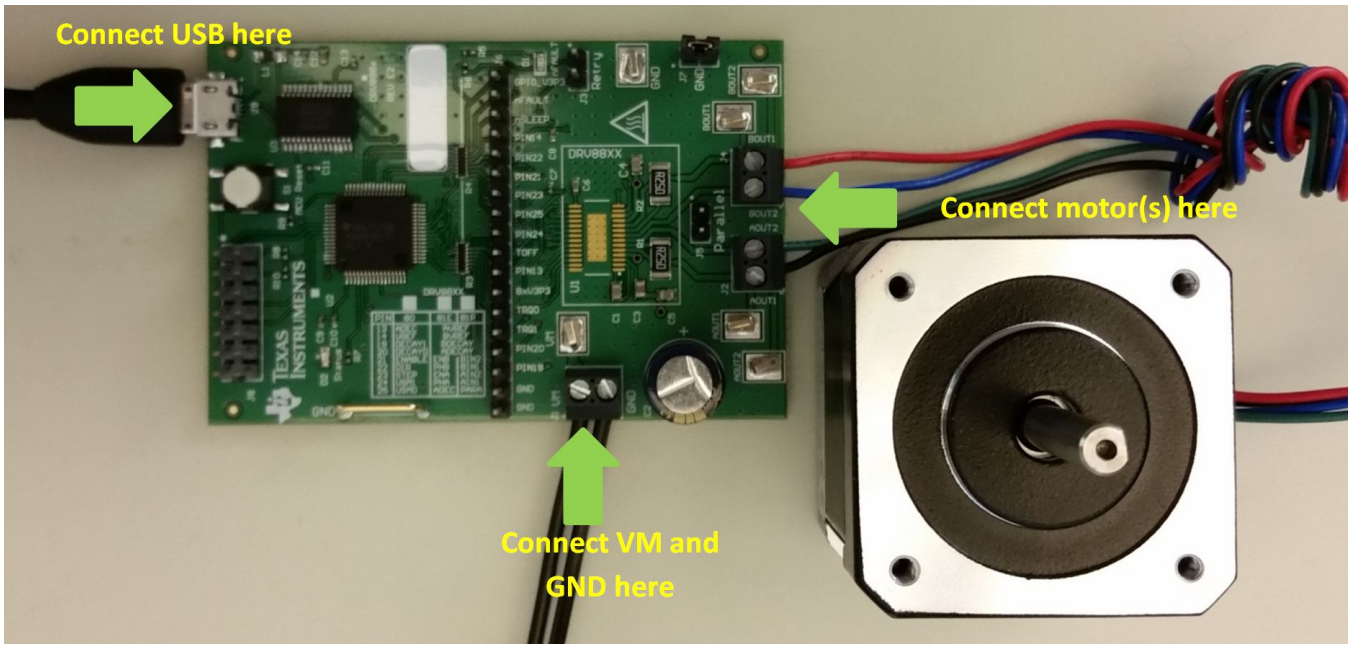

Figure 2. Connections (Stepper Motor Connection Shown)

2.2 Test Points

A 0.100-in pitch header connector (J6) provides access to every device signal in the event external control of the DRV8881P is desired. To disconnect the internal MSP430 microcontroller, remove resistor pack R3 and resistor R3. Table 1 describes the connections available on the J6 header. Each header pin is labeled on the evaluation module, and matches the pin of the DRV8881P.

Table 1. Connections to DRV8881P Using External Microcontroller

Header Label	Description
V3P3R or V3P3_GPIO	3.3 V after 33-Ω resistor
nFAULT	Fault output
nSLEEP	Sleep mode input
PIN14	BVREF, Comparator reference input
PIN22	BIN1
PIN21	BIN2
PIN23	AIN2
PIN25	PARA, Parallel mode
PIN24	AIN1
TOFF	Off-time selection
PIN13	AVREF, Comparator reference input
8xV3P3	Internal supply voltage
TRQ0	Torque (current level)
TRQ1	Torque (current level)
PIN20	ADECAY, Decay mode
PIN19	BDECAY, Decay mode
GND	Ground
GND	Ground

2.3 Jumpers

There are three jumpers on the DRV8881PEVM module. J5 is used to connect the two sense resistors in parallel. This allows use of one brushed motor at higher current. J7 is used to hold the shunt when not in use.

NOTE: J3 is not used and should not be populated.

2.4 Motor Outputs

Two motor connectors are provided. Connectors J2 and J4 are available as shown in Figure 1.

2.5 Operation of the EVM

The following steps describe how to operate the EVM:

1. Install the drivers and GUI. Refer to Appendix A at the end of this document for instructions.
2. Connect the wires of the one or two brushed motor(s) to terminals AOUT1, AOUT2, BOUT1, and BOUT2. Alternately, connect a stepper motor to terminals AOUT1, AOUT2, BOUT1, and BOUT2.
3. Connect the VM power supply but do not apply power at this step.
4. Connect the USB cable between the PC and the EVM. Once the USB is connected to the EVM, the Status LED begins to blink.
5. Open the GUI by double clicking the icon. It may take up to 30 seconds to establish a connection. If a connection is not established, select the COM port under the *Options* menu. The BaudRate is 9600.
6. Apply 6.5 to 45 V to the VM and GND connections.
7. Configure the current setting using the VREF slider. If the sense resistors have been changed, enter the new value of R_{ISENSE}.

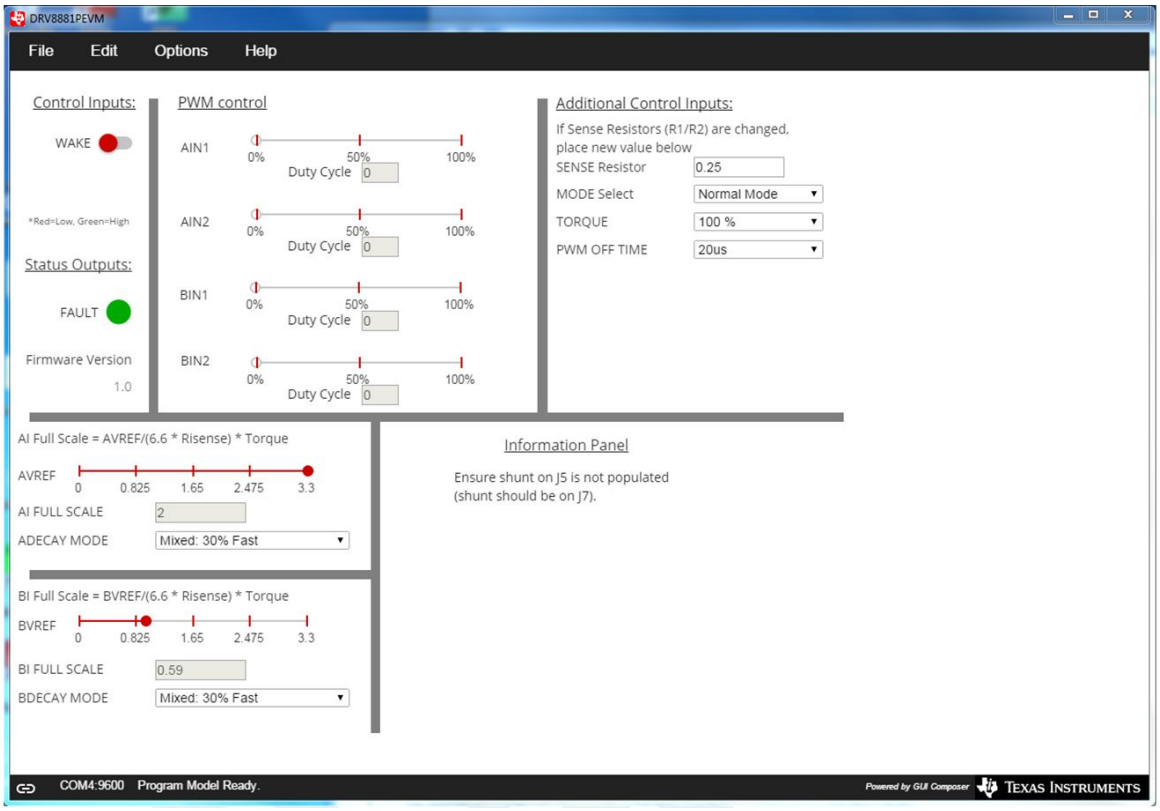

Figure 3. Initial GUI Screen

- The current is calculated using the VREF slider, and the Sense resistor value using the formula.

$$I_{FS} = \frac{xVREF}{6.6 \times R_{ISENSE}} \times Torque \quad (1)$$

The 12-bit DAC channels 0 and 1 are connected to the DRV8881E analog inputs AVREF and BVREF. Changing the DAC digital value from 0 to 4092 in steps of 4, changes the analog voltage at the xVREF pin from 0 V to VINT V. See equation Equation 2:

$$VREF = \frac{VINT}{4095} \times (VREF\_slider \times 4) \quad (2)$$

Where VINT is the output of the DRV8881P pin and VREF_slider is the slider value from 0 to 1023.

8. Wake the device for operation.
   (a) After setting the desired chopping current for the DRV8881P, enable the DRV8881P by pressing the WAKE toggle button. When toggled, WAKE will toggle between red and green.
   (b) If the WAKE toggle button is pressed during motor operation, the motor is immediately stopped and the motor control signals from the microcontroller are reset.

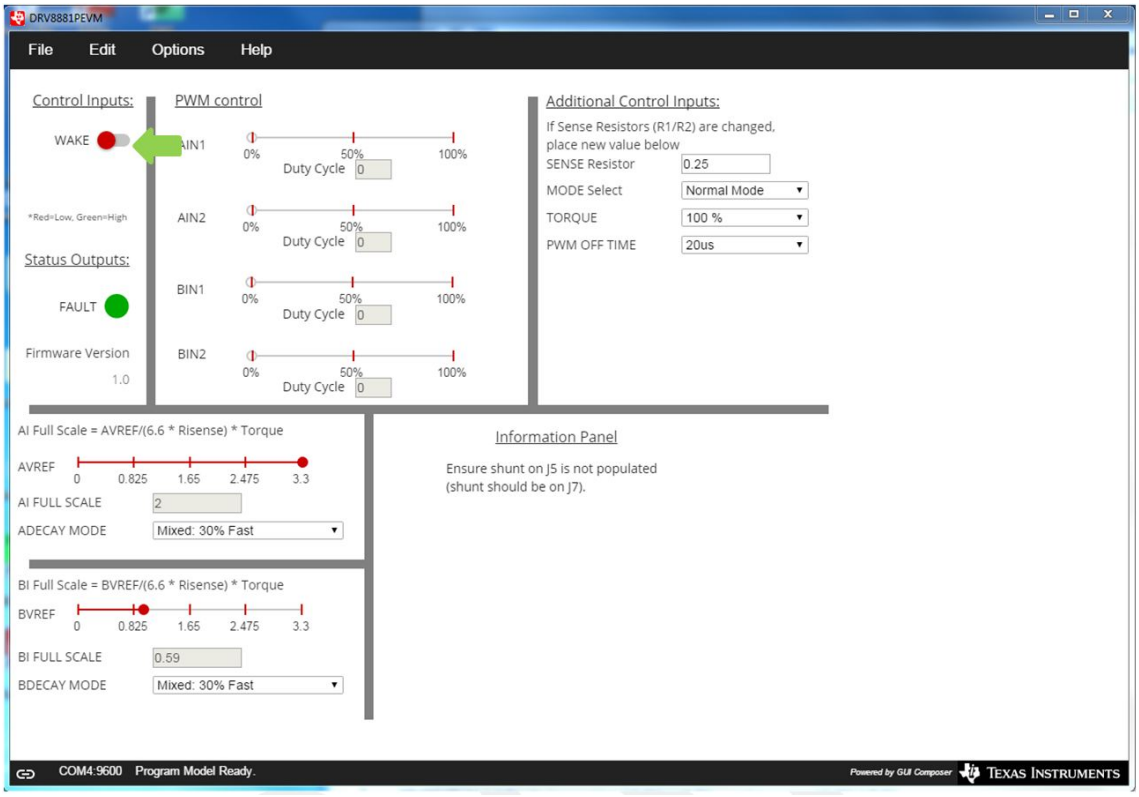

Figure 4. Wake Device

9. The DRV8881P EVM is now awake and can be commanded to turn the motor. This can be done by sliding the AINx or BINx sliders.
   (a) For slow decay mode, decreasing xIN1 while holding xIN2 at 100% will cause the brushed motor to run in one direction. Decreasing xIN2 while holding xIN1 at 100% will cause the brushed motor to run in the opposite direction.
   (b) For fast decay mode, increasing xIN1 while holding xIN2 at 0% will cause the brushed motor to run in one direction. Increasing xIN2 while holding xIN1 at 0% will cause the brushed motor to run in the opposite direction.
10. As an extra precaution, the motor can be stopped by selecting the WAKE toggle button. Once selected, the motor is stopped. To re-enable the motor, re-select the WAKE toggle button.

2.6 Normal Mode Operation

By default, Normal operation mode is selected. This configuration allows the user to connect one or two brushed motors for evaluation. If transitioning to normal mode from either parallel mode or stepper mode, the following actions will take place:

1. The AINx and BINx sliders will appear.
2. The chopping current will be recalculated.

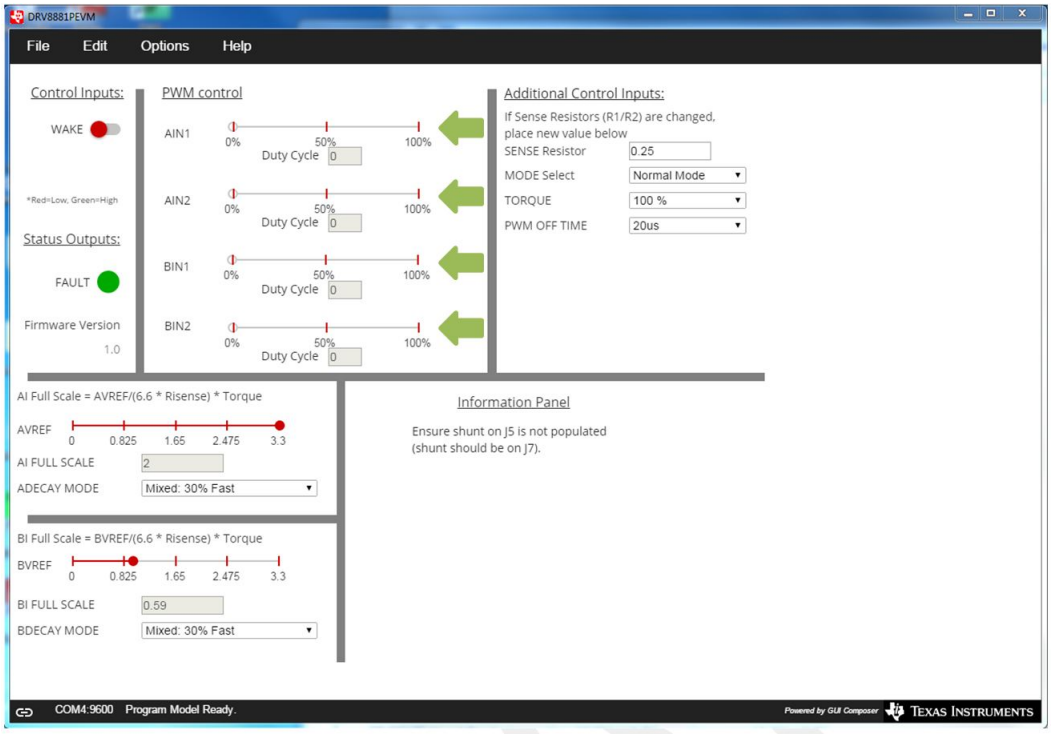

Figure 5. Normal Mode

2.7 Parallel Mode Operation

A feature of the DRV8881P is the ability to operate a single motor in parallel mode, effectively doubling the current capability. When using parallel mode, the motor must be connected across both AOUT1/BOUT1 and AOUT2/BOUT2. This will require a small jumper wire to connect the two outputs at connectors J2 and J4.

To use this feature, set the “Mode Select” pulldown to “Parallel”. When parallel mode is activated, the following actions will take place:

1. The BINx sliders will disappear.
2. The chopping current will be recalculated.
3. A message describing how to connect the motor will appear. The message will also instruct the user to move the shunt from J7 to J5.

NOTE: The shunt on J5 is only used for parallel mode. It should be placed on J7 for storage during all other operations.

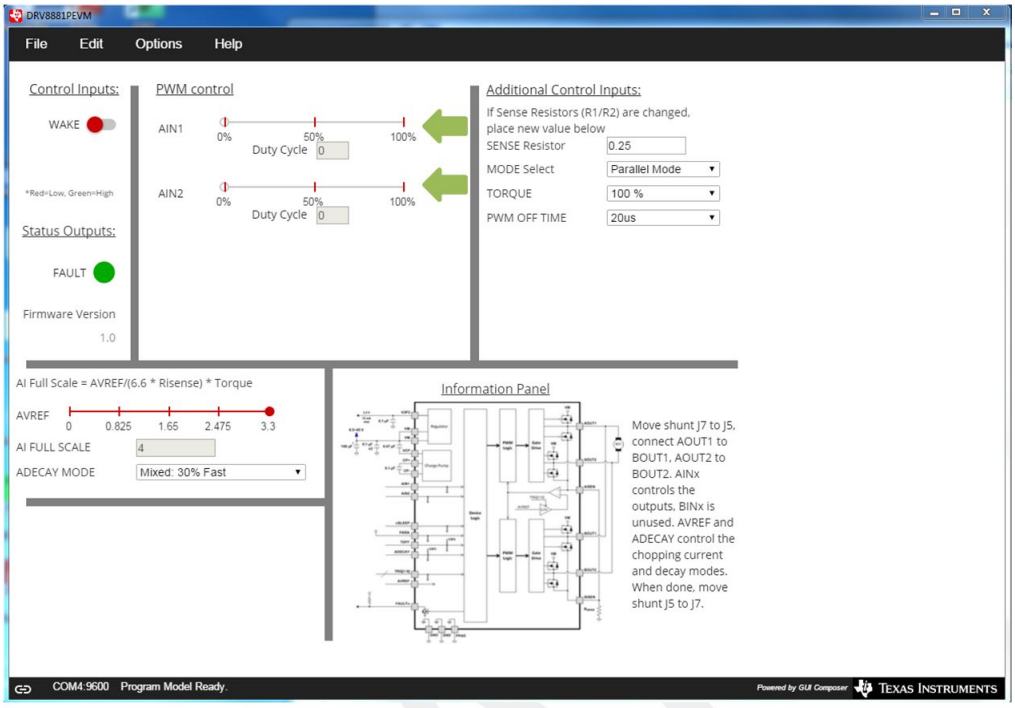

Figure 6. Parallel Mode

Parallel mode can now be controlled using the AINx sliders. The operation is the same as normal mode.

(a) For slow decay mode, decreasing AIN1 while holding AIN2 at 100% will cause the brushed motor to run in one direction. Decreasing AIN2 while holding AIN1 at 100% will cause the brushed motor to run in the opposite direction.

(b) For fast decay mode, increasing AIN1 while holding AIN2 at 0% will cause the brushed motor to run in one direction. Increasing AIN2 while holding AIN1 at 0% will cause the brushed motor to run in the opposite direction.

2.8 Stepper Mode Operation

The DRV8881P EVM provides the ability to operate a stepper motor in full step mode. The firmware provides the necessary timing pulses on the AINx/BINx input signals to drive the stepper at the desired speed and direction.

To use the stepper feature, set the “Mode Select” pulldown to “Stepper”.

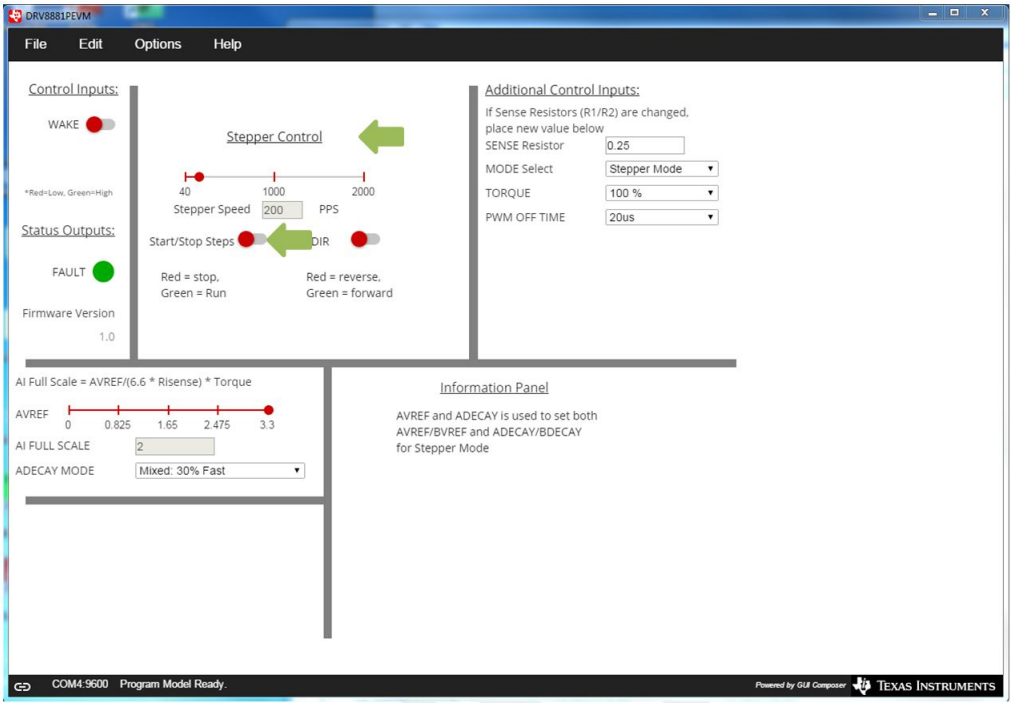

Figure 7. Stepper Mode

Set the desired stepper step and direction, and then select “RUN”. The stepper speed and direction can be changed as the motor is running, but may cause the motor to stall.

2.9 EVM documentation

The EVM schematics, layout, and bill of materials (BOM) are provided in the hardware file (SLVC625). The GUI, USB drivers, and MSP430F2617 source code are provided in the software file (SLVC629).

A.1 Driver and GUI Installation Instructions

Use the following steps to install the driver and GUI:

1. Installing the FTDI driver:
   In many cases, connecting the EVM to the computer will automatically install the FTDI driver. If necessary, download the driver from the software file. Unzip it and install the USB driver:
   - If using Windows XP, run \USB driver\CDM v2.10.00 WHQL Certified.exe
   - If using Windows 7, go to the \USB driver\ folder , right-click *CDM v2.10.00 WHQL Certified.exe* and select *Properties*, go to the *Compatibility* tab, check “Run this program in compatibility mode for”, select “Windows XP (Service Pack 2)”, OK. Then run *CDM v2.10.00 WHQL Certified.exe* and click “Yes” to the pop-up window.
2. Running the application software
   Locate the file *DRV8881PEVM_installer.zip* in the Application folder. Unzip the file to any location, then double click the file *GUIComposerApp-v1.setup-win_2.0.3.exe* in the unzipped folder.
   The installer will begin. The following images will appear:

   Select *Yes* to continue (see Figure 8).

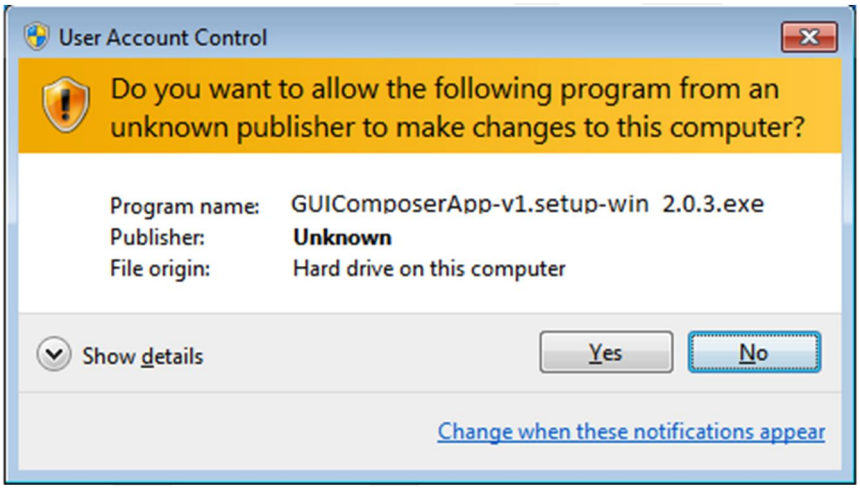

Figure 8. User Account Control Window

Select *Yes* to continue (see Figure 9).

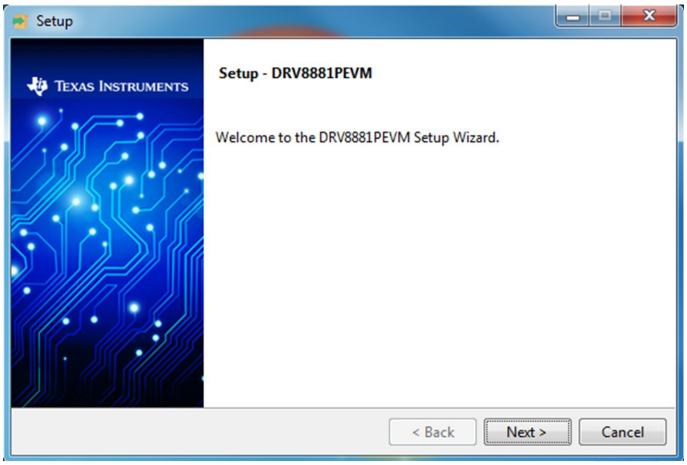

Figure 9. EVM Setup Wizard

Select *I accept the agreement* and *Next* to continue(see Figure 10).

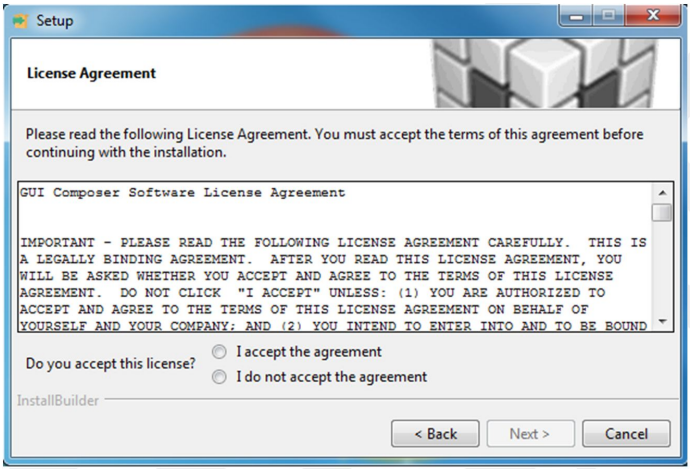

Figure 10. License Agreement

Select *Next* to continue (see Figure 11).

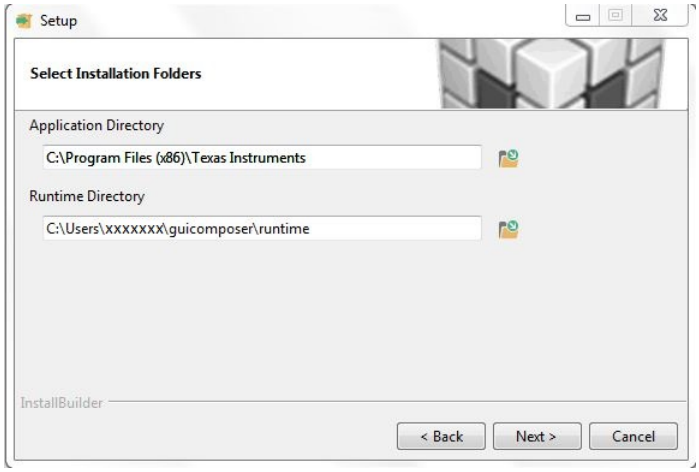

Figure 11. Installation Folders

At this point, a few options may appear. If the GUI Composer Runtime has not been previously installed, select *Download from web* and *Next* to continue (see Figure 12).

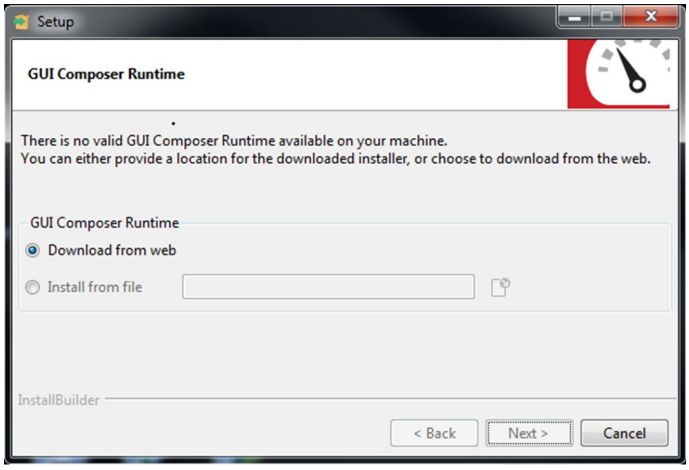

Figure 12. GUI Composer Runtime Selection

If the GUI has been previously installed, a message similar to Figure 13 may appear. If so, select *Yes*, then *Next* to continue (see Figure 13).

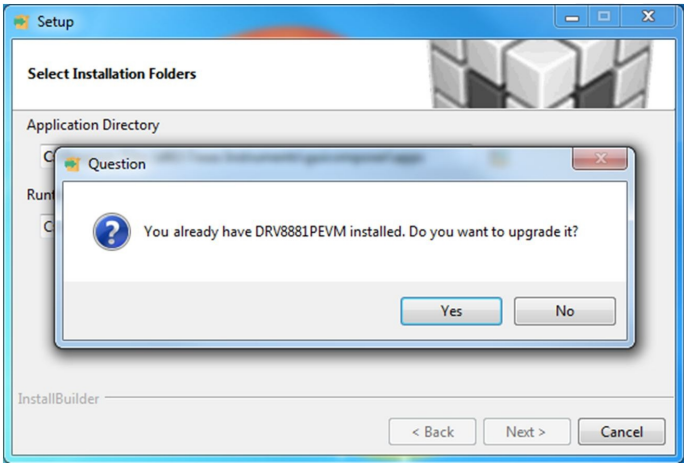

Figure 13. Possible Upgrade Question

Select *Next* to continue (see Figure 14).

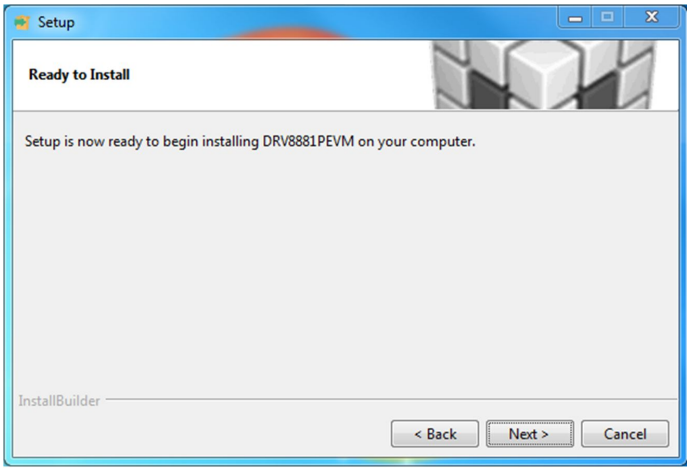

Figure 14. Ready to Install

Click the desired results, then select *Finish* to complete (see Figure 15).

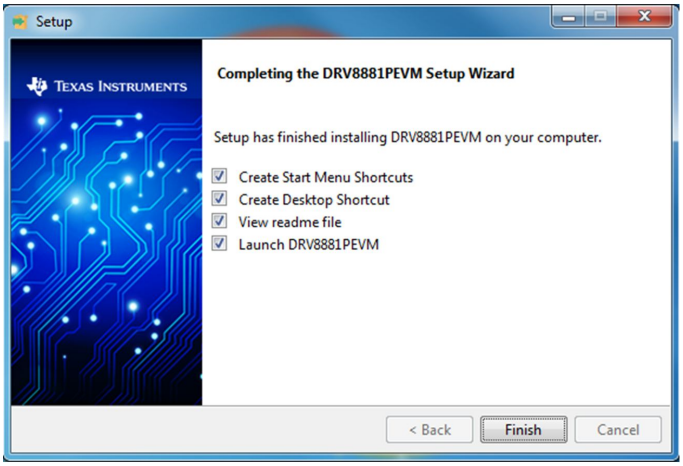

Figure 15. Completed

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3 *Regulatory Notices:*

   3.1 *United States*

      3.1.1 *Notice applicable to EVMs not FCC-Approved:*

      This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

      3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

      CAUTION

      This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

      Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

      FCC Interference Statement for Class A EVM devices

      NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

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3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
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If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

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