BOOST-DRV8848

This document is provided with the BOOST-DRV8848 dual brushed-motor BoosterPack™ as a supplement to the DRV8848 datasheet (SLLSEL7). This application report details the hardware setup and operation of the BoosterPack.

Contents

List of Figures

1 Hardware Views

Figure 1 illustrates the BOOST-DRV8848 and Figure 2 pictures the BOOST-DRV8848 connected to the MSP430G2 LaunchPad™.

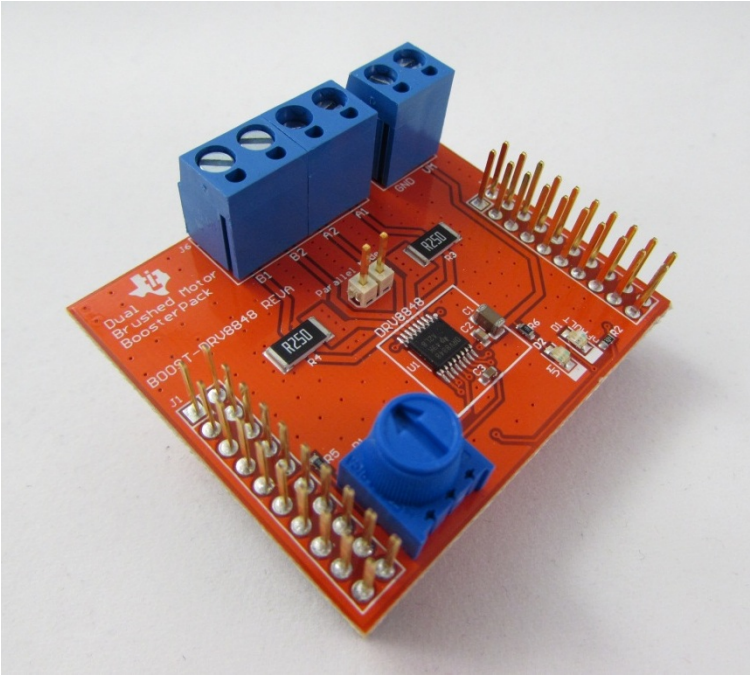

Figure 1. BOOST-DRV8848

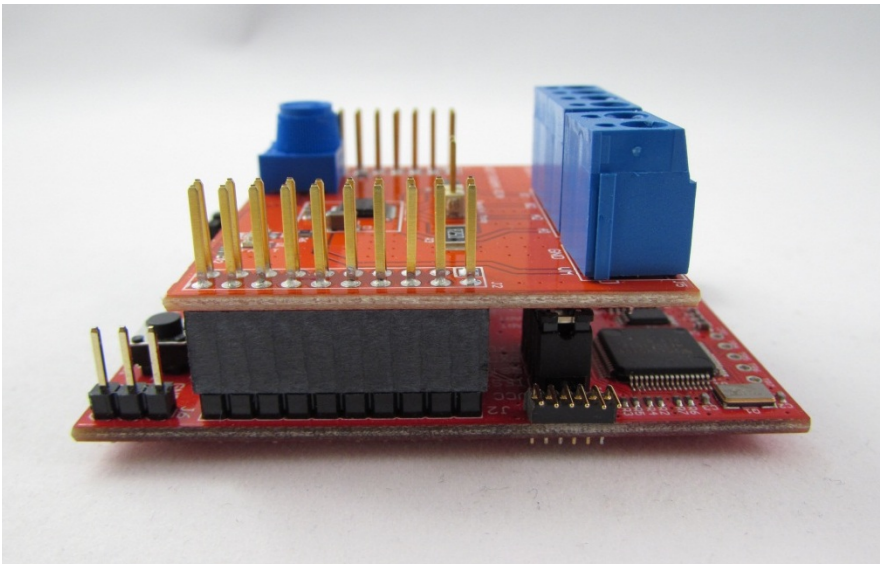

Figure 2. BOOST-DRV8848 on Top MSP430G2 LaunchPad

2 Introduction to the BOOST-DRV8848

The BOOST-DRV8848 is a dual brushed DC motor BoosterPack based on the DRV8848 dual H-bridge motor driver. This BoosterPack provides a fully-protected, brushed DC motor drive stage in order to evaluate your motor application.

2.1 Features

- Complete dual brushed DC motor drive stage in a small form factor (1.75 in x 2.0 in)
- High output current per H-bridge
  - 2-A peak
  - 1-A RMS
- Parallel mode available for higher current
- Wide power supply voltage range 4.0 V – 18.0 V
- Fully-protected drive stage including overcurrent, short-circuit, over-temperature, and undervoltage with reporting through the nFAULT pin
- Highlights the compactness of the DRV8848 solution
- Combine with TI LaunchPad kits to create a complete brushed DC motor drive and control platform
- Optimized for the MSP-EXP430G2 LaunchPad with a user-friendly application to get the motor spinning in minutes

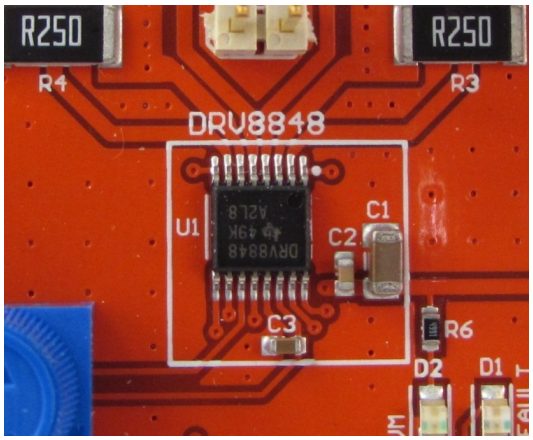

Figure 3. DRV8848 Solution Size

2.2 Pinout

The LaunchPad interfaces to the BoosterPack over the LaunchPad headers (J1 and J2). Figure 4 gives an overview of the various control and feedback signals.

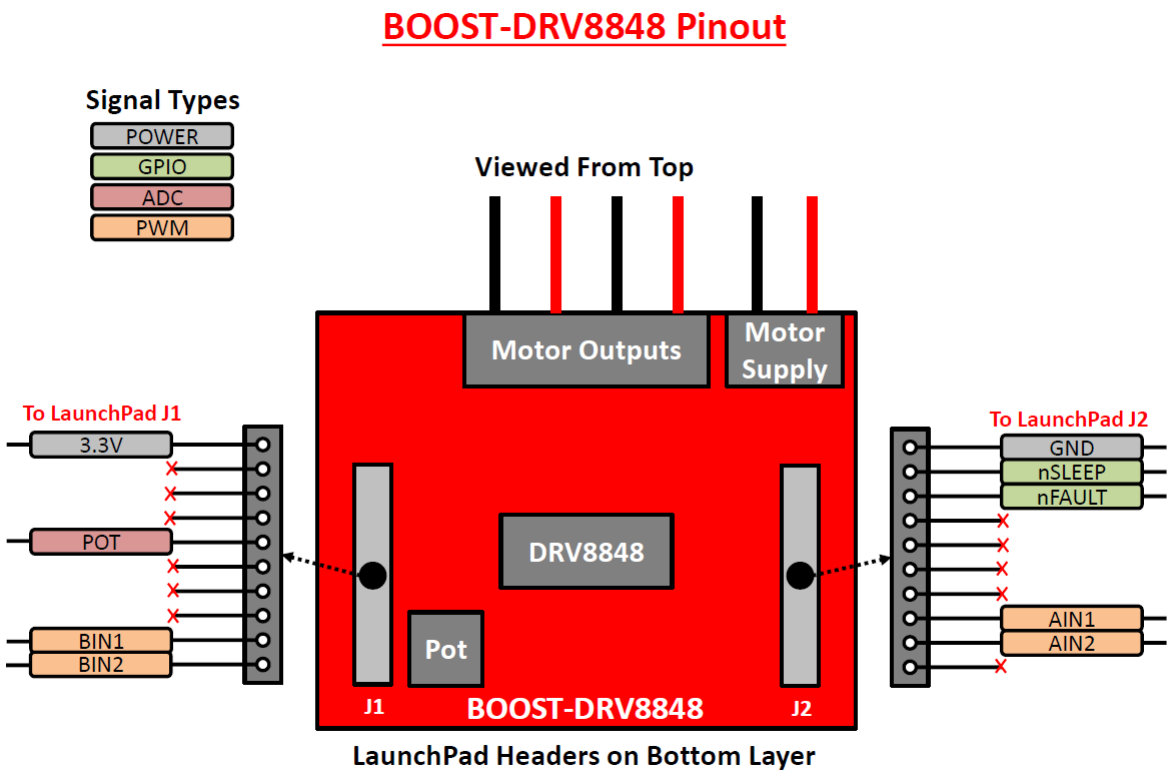

Figure 4. BOOST-DRV8848 Pinout

- Powered by an external power supply (4 V–18 V) that is connected to the terminal block header (J5)
- 4-pin terminal block header (J6) for connecting two brushed DC motors
- Parallel mode jumper in order to supply 2x current to a single brushed DC motor
- Fault reporting through the nFAULT signal and LED
- Onboard potentiometer for setting the current limit voltage (VREF)

3 Operating the Booster Pack

3.1 Requirements

The dual brushed DC motor BoosterPack is not a standalone evaluation board and requires a compatible LaunchPad kit to provide the appropriate control signals. In addition to the dual brushed DC motor BoosterPack and a compatible LaunchPad, you will require one/two brushed DC motors and sufficient power supply.

3.2 Launchpad Configuration

For the MSP-EXP430G2 LaunchPad, keep the P1.0 (LED1) and P1.6 (LED2) jumpers for correct operation of the *Status* indication of the BoosterPack firmware. Align the TXD and RXD jumpers horizontally for operation of the hardware UART with the software application.

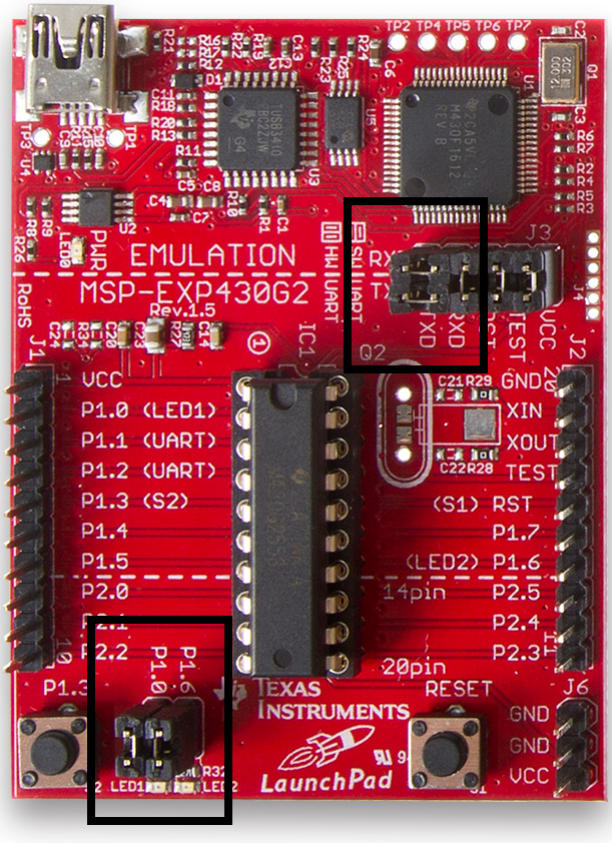

Figure 5. MSP-EXP430G2 Jumper Location

For other LaunchPads, ensure that the appropriate jumpers are configured on pins that the BOOST-DRV8848 BoosterPack utilizes.

3.3 Hardware Connection

1. Plug the dual brushed DC motor BoosterPack onto the LaunchPad as shown in Figure 2. The MSP430G2 LaunchPad will dock with the outer row of the 20-pin headers. The inner row is provided to maintain compatibility with 40-pin LaunchPads. **Orient the terminal block headers towards the USB connector.**
2. Connect the brushed motors to the **terminal block header J6**.
3. Connect the power supply that will power the brushed motor BoosterPack's DRV8848 to the **terminal block header J5**. The connections have been labeled **VM** and **GND**. For full performance, ensure as much current as your motor may demand is supplied. The brushed motor BoosterPack has a designed operating range from **4.0–18 V, up to 1-A RMS/2 A peak for each H-Bridge**.
4. Enable the power supply.
5. Enable the controller and spin the motor! The BOOST-DRV8848 dual brushed DC motor BoosterPack, combined with a TI LaunchPad, will provide a complete brushed DC motor evaluation platform. With the MSP-EXP430G2 LaunchPad and a MSP430G2553, you can take full advantage of TI's **pre-written brushed motor control application (see Section 4 for additional details)**.

NOTE: At high currents the drive stage can increase to high temperatures.

4 Brushed Motor Demo Application

4.1 Introduction

As previously mentioned, the BOOST-DRV8848 dual brushed DC motor BoosterPack has been optimized to work together with the MSP430G2 Launchpad to provide a complete brushed motor evaluation platform. With the demo application provided, the brushed motor can be up and spinning in minutes. **To get started with TI's pre-written brushed control application, follow the steps outlined in the next section.**

4.2 Setting up the BOOST-DRV8848 Firmware

1. Load the BOOST-DRV8848 brushed motor control application onto the MSP430G2553 by first downloading the latest version of Code Composer Studio™ (CCS). This application was developed in CCS v6.0.0. http://processors.wiki.ti.com/index.php/Download_CCS.
2. Obtain the BOOST-DRV8848 firmware and GUI, by downloading the *BOOST-DRV8848 Hardware and Software Files* from the tool folder, www.ti.com/tool/boost-drv8848. This zip folder contains the complete hardware design files, including the Altium source files, Gerbers, BOM, and schematic, as well as the Brushed DC Motor Demo firmware and GUI.
3. Flash the MSP430G2553 on the MSP430G2 LaunchPad with the firmware provided. The MSP430G2 LaunchPad, an MSP430G2553, and mini-USB cable are required. The flash can be done in one of the following two ways:
4. Method 1: Loading the binary .out file (preferred)
   - Open Code Composer Studio.
   - Select **View -> Target Configuration** (Figure 6)
   - Right click on the **User Defined** folder and select **New Target Configuration** (Figure 6)
   - Give the *Target Configuration* a name and select **Finish**

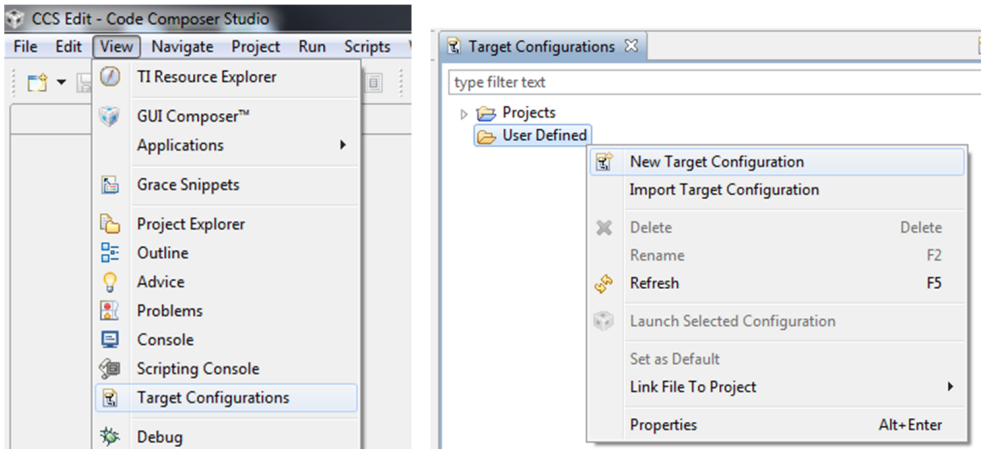

Figure 6. Target Configuration

- Set up the *Target Configuration* as shown in Figure 7. Save the *Target Configuration* file.

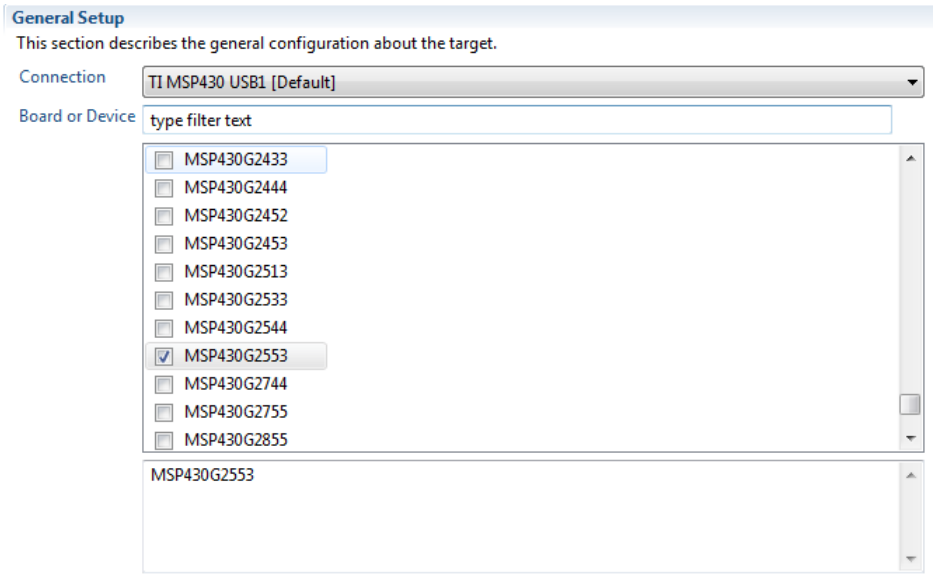

Figure 7. Target Configuration Setup

- Go back to **View -> Target Configurations**
- Right click the newly-created *Target Configuration* file and select **Launch Selected Configuration** (see Figure 8)

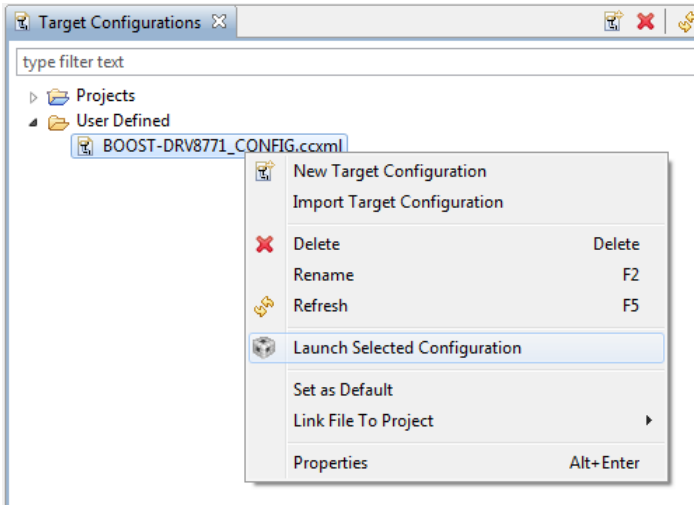

Figure 8. Launch Selected Configuration

- In the *Debug Menu*, right click on the **TI MSP430 USB1_0** connection and select **Connect Target** (see Figure 9)

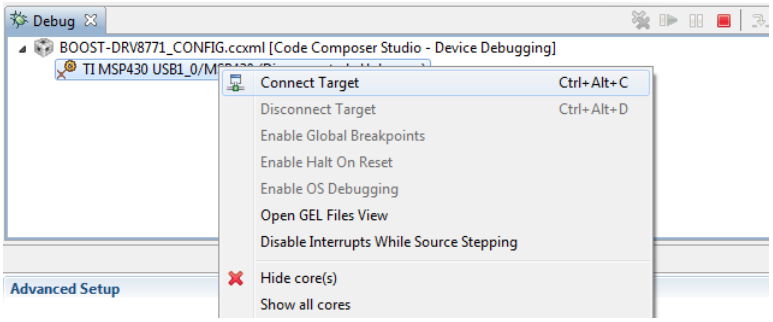

Figure 9. Connect Target Selection

- After the device connects, go to **Run -> Load -> Load Program** (see Figure 10). Browse to the **BOOST-DRV8848 Hardware and Software Files** folder that was downloaded from the tool folder. Go into the *Application* subdirectory and then go into the GUI subdirectory. Select the **appProgram.out** file (Application\BOOST-DRV8848_GUIvX.X\appProgram.out).

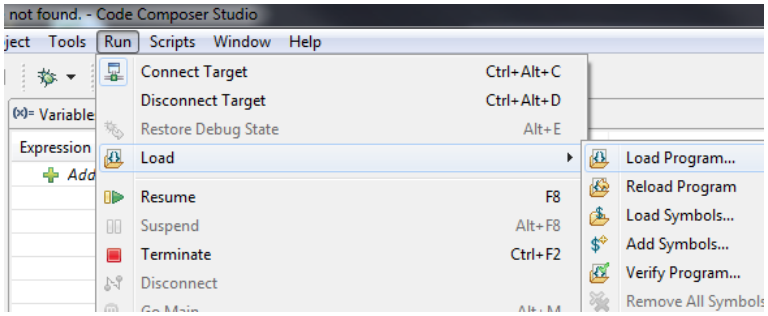

Figure 10. Load Program Selection

- After a short delay, the appProgram.out file is loaded onto the MSP430G2553 (see Figure 11). An error message may display saying that the source was not found. Receiving this message is OK, as long as the binary was loaded.

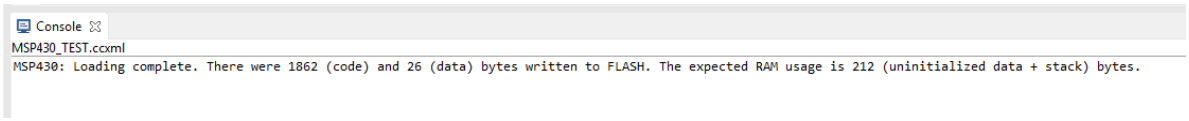

Figure 11. Load Program Complete

- Close CCS

5. Method 2: Flashing the project through CCS debugger
   - Open Code Composer Studio
   - **Go to File -> Import**
   - Select **Existing CCS Eclipse Projects** under the **Code Composer Studio** tab

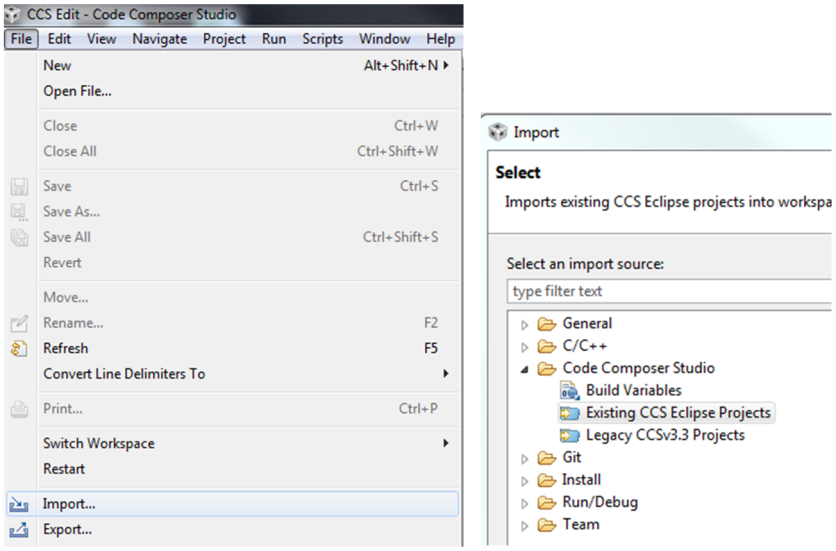

Figure 12. Existing CCS Eclipse Projects

   - Check the **Copy projects into workspace** option and then browse to the **BOOST-DRV8848_FIRMWAREvX.X** directory located with the *Application* folder within the **BOOS-DRV8848 Hardware and Software Files** folder. The project should now show up in the **Discovered Projects** section. Ensure that it is checked and select **Finish**.
   - Select the BOOST-DRV8848_FIRMWAREv1.0 project in the **Project Explorer** and click the **Debug** icon.
   - CCS now builds the project and loads it onto the MSP430G2533.
   - Update the binary file that the GUI is referencing (since CCS has recompiled it). Replace the **appProgram.out** file (Application\BOOST-DRV8848_GUIvX.X\appProgram.out) with the **BOOST-DRV8848_FIRMWAREvX.X.out** file (Application\BOOST-DRV8848_FIRMWAREvX.X\Debug\BOOST-DRV8848_FIRMWAREvX.X.out). Delete the old “appProgram.out” and rename the new file to “appProgram.out
   - Close CCS

4.3 Setting up the BOOST-DRV8848 GUI

1. To the run the BOOST-DRV8848 GUI, first download the latest version of the GUI Composer Runtime. Register for a TI account if you don’t already have one. Select the appropriate version for your operating system and follow the installation instructions.

   http://processors.wiki.ti.com/index.php/Category:GUI_Composer#GUI_Composer_Downloads
2. After installing the GUI Composer Runtime, copy the BOOST-DRV8848_GUIvX.X folder, located in the *Application* directory of the BOOST-DRV8848 Hardware and Software Files folder and paste this folder into the GUI Composer webapps folder located in the “C:\ti\guicomposer\webapps\” directory. If a non-default installation directory was selected in Step 1, the top-level directory may differ.
3. To run the GUI, double click the BOOST-DRV8848_GUIvX.X.exe file within the BOOST-DRV8848_GUIvX.X folder of the webapps directory. A shortcut to this .exe can be created in order to start it from other file locations.

NOTE: Ensure that the GUI "exe" is exactly two levels below the GUI Composer "webapps" folder. The GUI will not start if this is incorrect. The path should look similar to this "C:\ti\guicomposer\webapps\BOOST-DRV8848_GUIvX.X\BOOST-DRV8848_GUIvX.X.exe".

If a non-default installation directory was selected in Step 1, the top-level directory may differ.

4.4 Spinning the Brushed Motor

After a successful launch of the BOOST-DRV8848_GUIvX.X.exe, the screen in Figure 13 should pop up. A small period of time may be needed before the GUI connects and the GUI Widgets populate (red X's appear on the widgets while the GUI is connecting). If the GUI does not load after a few minutes (X's disappear), a connection issue may have occurred. Try restarting the application.

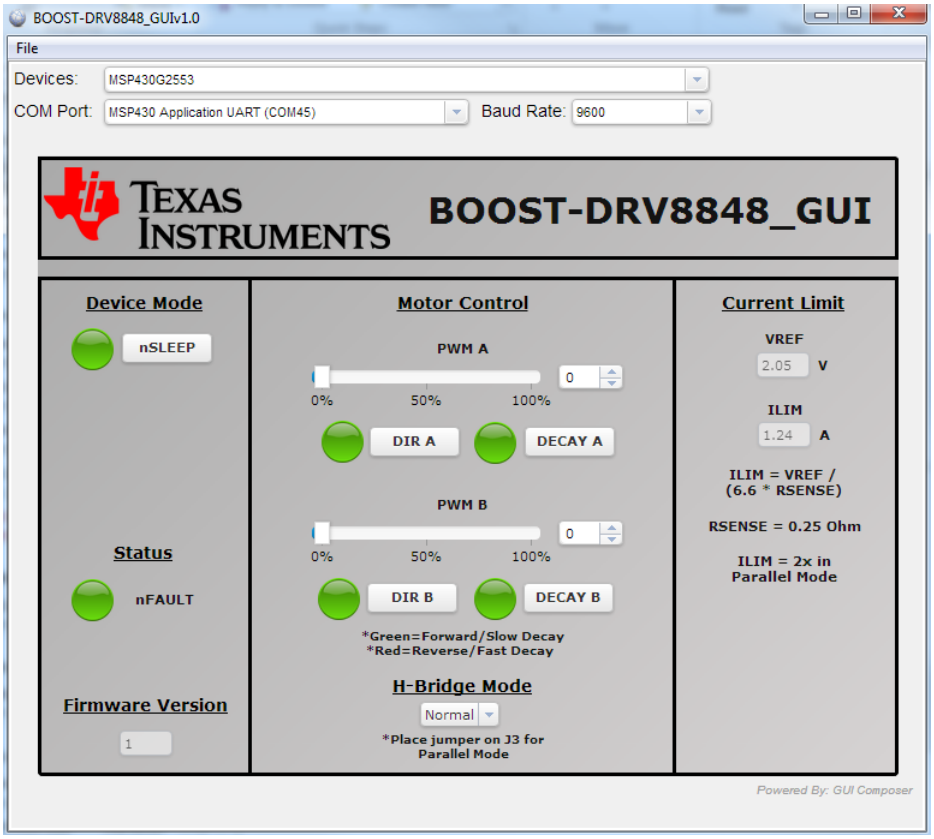

Figure 13. BOOST-DRV8848 GUI

4.4.1 Quick Start

1. Set the **nSLEEP** pin high in order to enable the DRV8848 device.
2. If you want to operate just one motor with twice the output current of the DRV8848, switch to **Parallel Mode**. The device operates in **Normal Mode** per default. In *Parallel Mode*, a jumper must be placed on **J3**.
3. Ensure the **Current Limit** is set for your motor requirements. The **Current Limit** can be adjusted with the **VREF** potentiometer (R1).
4. Adjust the speed of the attached motor by sliding the bars for the **PWM duty cycle**.
5. Choose the decay mode and the direction of the motor by setting the respective buttons **DECAY** and **DIR** for the desired motor.

4.4.2 GUI Walkthrough (Normal Mode)

Figure 14 illustrates the GUI in normal mode.

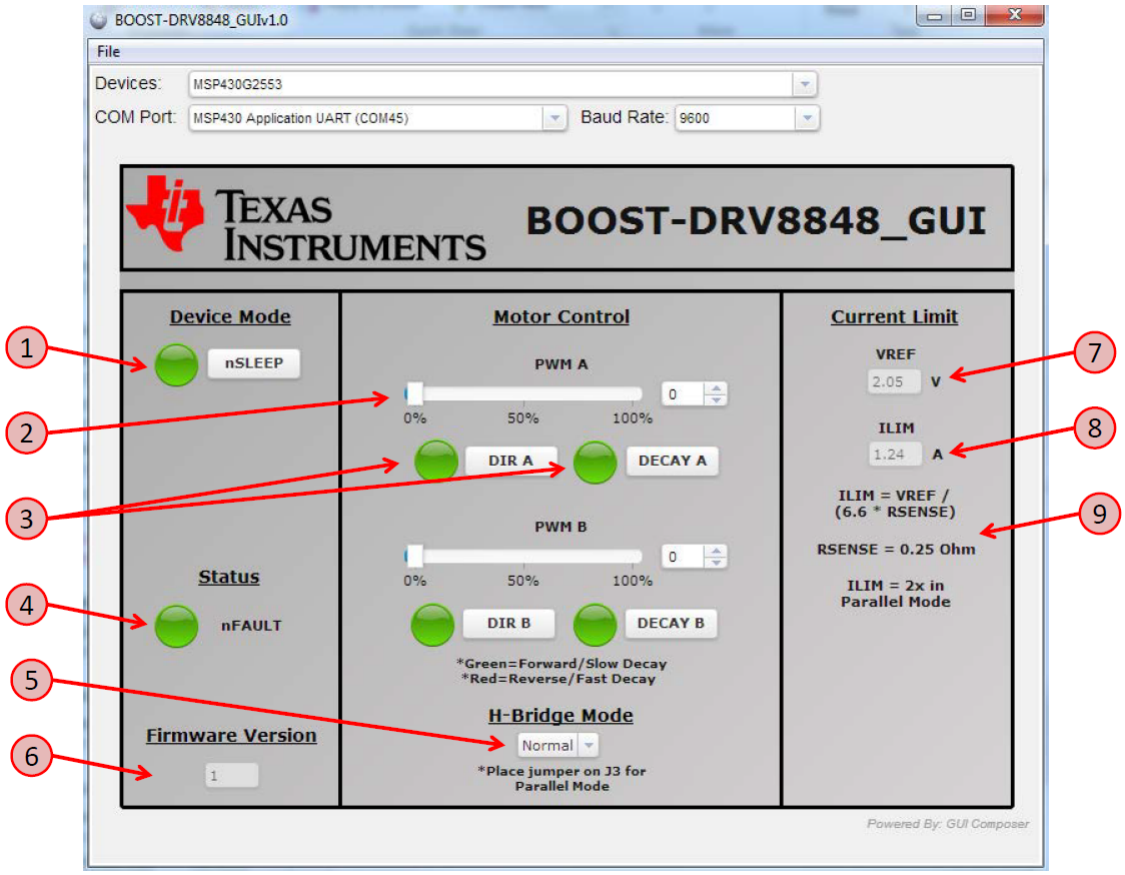

Figure 14. GUI (Normal Mode)

The numeric labels indicated in Figure 14 are described in the following numbered list:

1. The nSLEEP button directly controls the nSLEEP pins of the DRV8848. Red indicates LOW (0 V) and green indicates HIGH (3.3 V). Logic HIGH to enable device, logic LOW to enable low power sleep mode and reset all internal logic.
2. The PWM slide controls the duty cycle of the applied voltage to the motor. The duty cycle directly affects the speed of the motor.
3. The DIR and DECAY buttons control the direction and decay mode of the motor. See the DRV8848 datasheet SLLSEL7 for more information on decay modes.
4. nFAULT will assert when the DRV8848 is reporting a FAULT condition. See the DRV8848 datasheet for more information on the various FAULT conditions.
5. The DRV8848 can operate two brushed DC motors simultaneously with an output current up to 1-A RMS. The DRV8848 can also parallel the outputs to deliver 2x the current to a single motor. This button controls the DRV8848 output mode. Place the J3 jumper on the BoosterPack.
6. Revision number reported by the firmware
7. The voltage set by the R1 potentiometer on the BoosterPack (resistor divider from DVDD). This voltage controls the current limit of the DRV8848.
8. Calculated current limit for the DRV8848
9. The equation for determining the current limit from the VREF voltage and RSENSE resistance.

4.4.3 GUI Walkthrough (Parallel Mode)

Figure 15 illustrates the GUI in parallel mode.

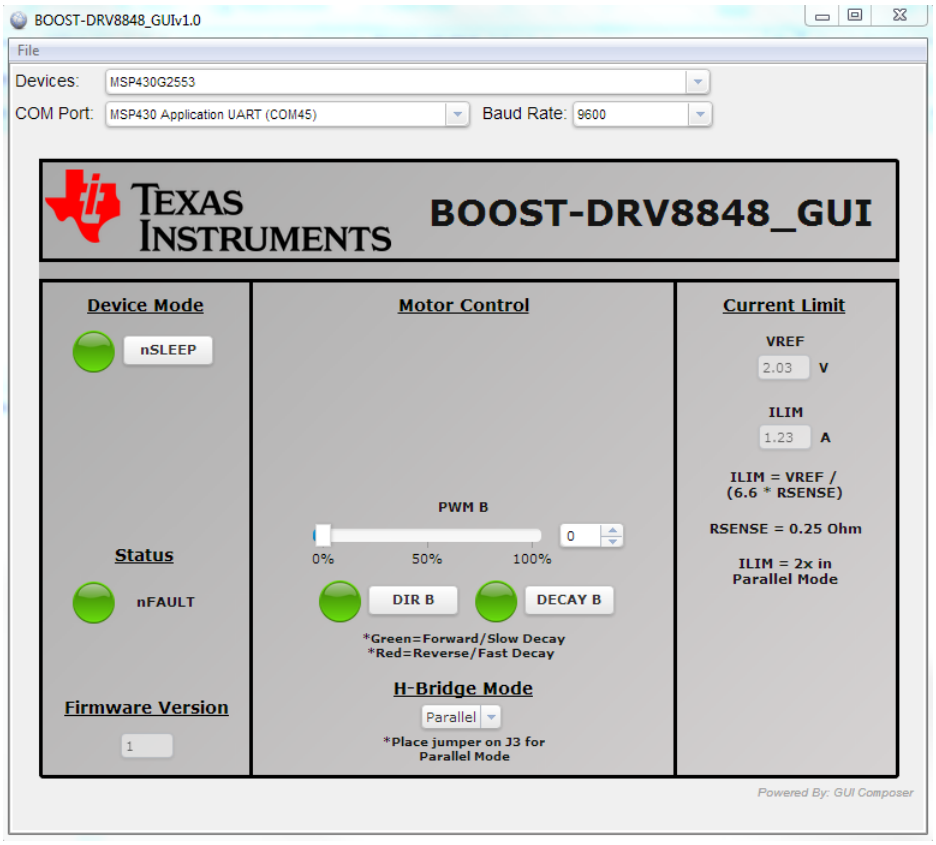

Figure 15. GUI (Parallel Mode)

- In Parallel Mode, both outputs are controlled through the B motor inputs.

- See Figure 16 for the schematic connections. You must parallel the outputs from the terminal block header (J6).

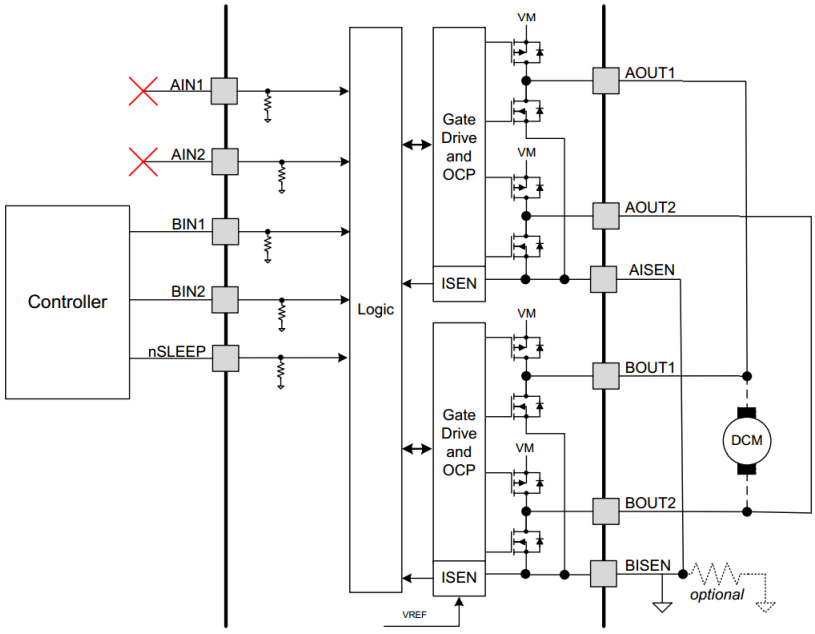

Figure 16. Parallel Mode Operation

5 Hardware Files (Schematic/Gerber)

The complete design files can be found in the tool folder (http://www.ti.com/tool/boost-drv8848) including the schematic, gerbers, layout files, PCB views, and bill of materials.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265