This document is provided with the DRV8704 customer evaluation module (EVM) as a supplement to the DRV8704 datasheet (SLVSD29). The datasheet details the hardware implementation of the EVM.

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1 Printed Circuit Board (PCB) Layout

Figure 1 illustrates the typical EVM board configuration.

![Typical Board Configuration](image)

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

2 Introduction

The DRV8704 customer EVM is a platform built around the DRV8704, a dual H-bridge brushed DC motor driver with highly-configurable power stage. This device is optimized to drive two different brushed DC motors with variable current limiting and an internal 5-V LDO for powering peripheral devices.

The EVM includes two 555-timer circuits configured to switch at approximately 25 kHz with independently variable duty-cycles. Each 555 timer is tied to a jumper pin allowing the user to select which channel of the DRV8704 is receiving the PWM signal. This analog generation of PWM signals allows for standalone use of the EVM without any firmware being flashed onto a microcontroller.

If the user would like to control the EVM using an MCU, the two 10×1, 100-mil headers can be docked to TI's MSP430™ LaunchPad™ and controlled using whatever firmware is supplied by the user. SPI commands can be written or read by simply docking the EVM to a LaunchPad or tying into the 4 SPI pins with another MCU.
2.1 Connectors

The DRV8704EVM allows connections to VM (motor voltage) power rail via a terminal block (J9). A test clip labeled VM is available to probe the input power rail. Figure 2 shows the connections to the EVM.

Figure 2. EVM Connections

2.2 Test Points

Five SMT test points are provided for VM, MA1, MA2, MB1, and MB2 on each of their respective board planes. The DRV8704 output control signals are labeled and can be measured by probing the vias with the designated output label. Two 10×1, 100-mil headers on the board can be probed to monitor SPI signals going between the driver and external MCU, if connected. Each test point is labeled on the evaluation module and connects to a same named pin of the DRV8704.

Table 1. Test Point Labels and Descriptions

<table>
<thead>
<tr>
<th>Test Point Label</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA1</td>
<td>MA1, Motor A bridge connection 1</td>
</tr>
<tr>
<td>MA2</td>
<td>MA2, Motor A bridge connection 2</td>
</tr>
<tr>
<td>MB1</td>
<td>MB1, Motor B bridge connection 1</td>
</tr>
<tr>
<td>MB2</td>
<td>MB2, Motor B bridge connection 2</td>
</tr>
<tr>
<td>VM</td>
<td>VM, Motor voltage supply</td>
</tr>
<tr>
<td>AOUT1</td>
<td>AOUT1, Output node of bridge A out 1</td>
</tr>
<tr>
<td>A1HS</td>
<td>A1HS, Bridge A out 1 HS FET gate</td>
</tr>
<tr>
<td>A1LS</td>
<td>A1LS, Bridge A out 1 LS FET gate</td>
</tr>
<tr>
<td>AISENTP</td>
<td>AISENTP, Current sense resistor for bridge A</td>
</tr>
<tr>
<td>AISENN</td>
<td>AISENN, Ground at sense resistor for bridge A</td>
</tr>
</tbody>
</table>
Table 1. Test Point Labels and Descriptions (continued)

<table>
<thead>
<tr>
<th>Test Point Label</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2LS</td>
<td>A2LS, Bridge A out 2 LS FET gate</td>
</tr>
<tr>
<td>A2HS</td>
<td>A2HS, Bridge A out 2 HS FET gate</td>
</tr>
<tr>
<td>AOUT2</td>
<td>AOUT2, Output node of bridge B out 2</td>
</tr>
<tr>
<td>BOUT1</td>
<td>BOUT1, Output node of bridge B out 1</td>
</tr>
<tr>
<td>B1HS</td>
<td>B1HS, Bridge B out 1 HS FET gate</td>
</tr>
<tr>
<td>B1LS</td>
<td>B1LS, Bridge B out 1 LS FET gate</td>
</tr>
<tr>
<td>BISENP</td>
<td>BISENP, Current sense resistor for bridge B</td>
</tr>
<tr>
<td>BISENN</td>
<td>BISENN, Ground at sense resistor for bridge B</td>
</tr>
<tr>
<td>B2LS</td>
<td>B2LS, Bridge B out 2 LS FET gate</td>
</tr>
<tr>
<td>B2HS</td>
<td>B2HS, Bridge B out 2 HS FET gate</td>
</tr>
<tr>
<td>BOUT2</td>
<td>BOUT2, Output node of bridge B out 2</td>
</tr>
</tbody>
</table>

2.3 Jumpers

If the user is not controlling the DRV8704 using the LaunchPad headers, then the two LM555 timers are supplying the speed signals and must be properly configured for each of the four motor inputs. For motor A, the inputs AIN1 and AIN2 are located on the left side of the board and motor B inputs BIN1 and BIN2 are located on the right side of the board. The headers used to configure the speed and direction signals are shown in Table 2.

Table 2. Motor Input Pins and Assigned Headers

<table>
<thead>
<tr>
<th>Motor Input Pin</th>
<th>Assigned Headers</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIN1</td>
<td>J1, J2</td>
</tr>
<tr>
<td>AIN2</td>
<td>J3, J4</td>
</tr>
<tr>
<td>BIN1</td>
<td>J5, J6</td>
</tr>
<tr>
<td>BIN2</td>
<td>J7, J8</td>
</tr>
</tbody>
</table>

Table 3 shows the different connection states for both motor A and motor B inputs.

**NOTE:** The direction the motor will spin in is dependent on the polarity of the motor lead connections to the bridge connections. Refer to the motor datasheet to determine which phase should be connected to each terminal block.

Table 3. Motor Input Pin States and Output Conditions

<table>
<thead>
<tr>
<th>xIN1</th>
<th>xIN2</th>
<th>Motor x Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Low</td>
<td>Full speed forward current</td>
</tr>
<tr>
<td>High</td>
<td>High</td>
<td>Brake, Low-side slow decay</td>
</tr>
<tr>
<td>Low</td>
<td>Low</td>
<td>Coast, H-bridge disabled</td>
</tr>
<tr>
<td>Low</td>
<td>High</td>
<td>Full speed reverse current</td>
</tr>
<tr>
<td>High</td>
<td>PWM</td>
<td>Reverse current + Slow decay</td>
</tr>
<tr>
<td>PWM</td>
<td>High</td>
<td>Forward current + Slow decay</td>
</tr>
<tr>
<td>Low</td>
<td>PWM</td>
<td>Reverse current + Fast decay</td>
</tr>
<tr>
<td>PWM</td>
<td>Low</td>
<td>Forward current + Fast decay</td>
</tr>
<tr>
<td>PWM</td>
<td>PWM</td>
<td>No output</td>
</tr>
<tr>
<td>No Connection</td>
<td>No Connection</td>
<td>External controller connected</td>
</tr>
</tbody>
</table>
2.4 **Duty-Cycle Potentiometers (R1 and R3)**

To control the speed of motors A and B, the blue potentiometers located in the bottom left and right corners of the EVM can be used to vary the duty-cycle of the control signal sent to each motors’ respective input channels. The potentiometer with the label “Motor A Control” can be used to vary the duty-cycle of the PWM input available to AIN1/AIN2 and the potentiometer with the label “Motor B Control” can be used to vary the duty-cycle of the PWM input available to BIN1/BIN2.

![Motor Speed Control Potentiometer](image)

**Figure 3. Motor Speed Control Potentiometer**

2.5 **Motor Outputs**

Two motor connectors are provided through J10 and J11 as shown in Figure 2.

2.6 **Operation of the EVM**

Use the following steps to operate the EVM:

1. Connect two brushed DC motors to connectors J10 and J11.
2. Adjust the motor (A or B) control potentiometers R1 and R3 to a minimum voltage by turning them all the way counter-clockwise.
3. Connect VM and GND to the J9 connector. If the DRV8704 EVM is powered, a green status LED will be lit.
4. Configure the AIN1, AIN2, BIN1, and BIN2 jumpers as desired. If using the PWM signals, adjust the motor (A or B) control potentiometers clockwise to increase speed and the respective motor (A or B, depending on which potentiometer is adjusted) will start to turn.
5. To change direction, reconfigure the AIN1/AIN2 or BIN1/BIN2 connections to provide desired input states as described in the DRV8704 data sheet ([SLVSD29](#)).
2.7 SPI Operation of the EVM

To operate the DRV8704 using SPI registers and an MSP430 LaunchPad, the following instructions are a guide on how to configure the EVM. For an introduction to SPI communication programming an Energia SPI library function definition, use the following link: [http://energia.nu/reference/spi](http://energia.nu/reference/spi)

1. Once the pads have been connected, locate R22 connected to the SLEEP Net and remove from the board. This will stop the Zener diode and voltage divider circuit from automatically pulling up the SLEEP pin on the DRV8704.

   **CAUTION**
   
   Failure to remove R22 prior to powering on the EVM while the LaunchPad is connected will damage the LaunchPad.

2. To operate the EVM using only SPI commands, remove the jumpers from headers J1/J2, J3/J4, J5/J6, and J7/J8.

3. Next, locate the solder pads for R17, R18, R19, R20, R21, and R26 as shown in Figure 4. These pads need to be connected using 0-Ω, 0402 package resistors in order to control the DRV8704 using just an MCU.

   ![LaunchPad Headers](image)

   **Figure 4. LaunchPad Headers**

4. Now the EVM has been configured for use with an MSP430 LaunchPad and can be docked using the J12 and J13 headers as shown in Figure 2. User supplied firmware can now be used to control the DRV8704EVM.
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CAUTION

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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.
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- 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.

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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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http://www.tij.co.jp/lads/ti_ja/general/eStore/notice_01.page

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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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