DRV10866EVM User's Guide

This document is provided with the DRV10866 customer evaluation module (EVM) as a supplement to the DRV10866 (SBVS206) datasheet. It details the hardware implementation of the EVM.

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1 PCB

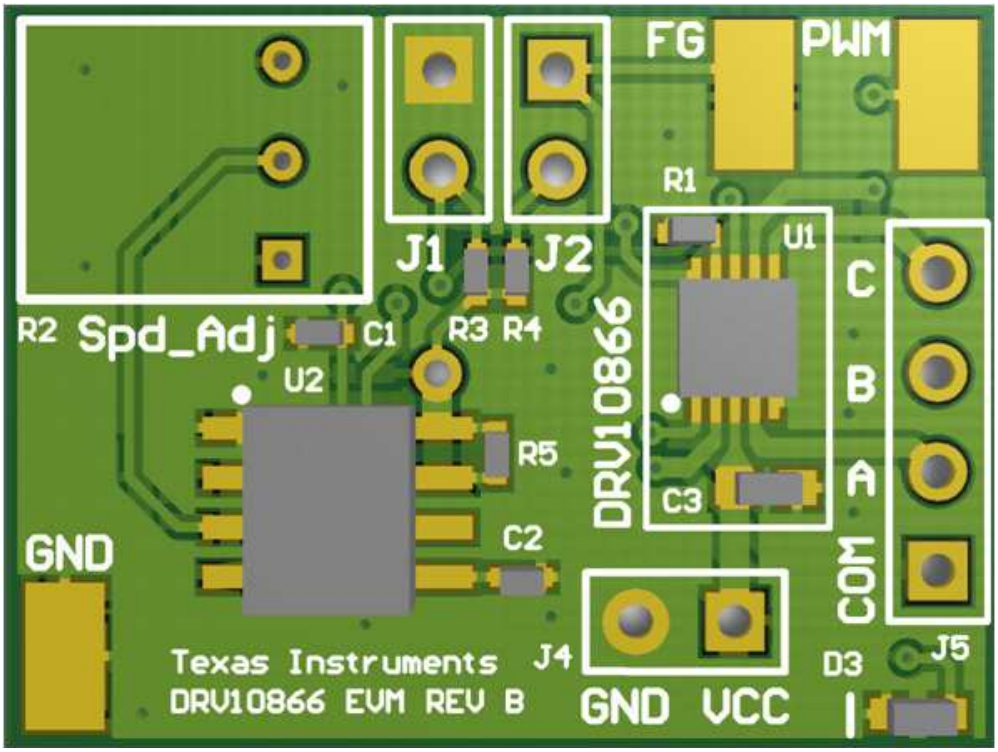

Figure 1. Top 3D View

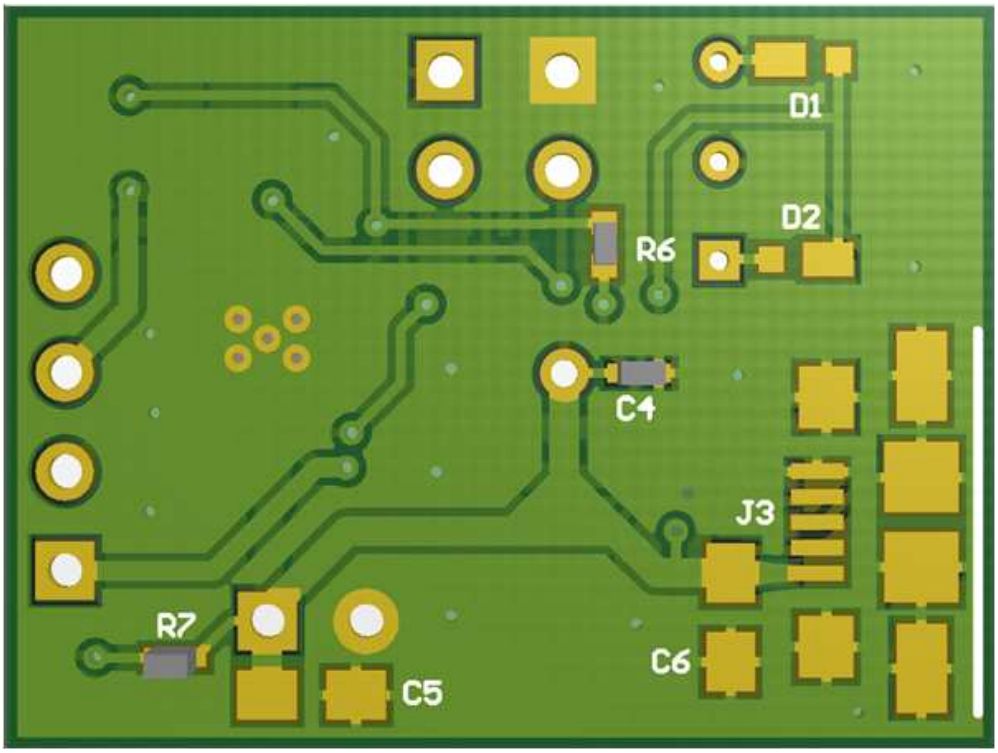

Figure 2. Bottom 3D View

2 INTRODUCTION

The DRV10866EVM is a complete solution for evaluating the DRV10866 5-V, three-phase sensorless BLDC motor driver. It includes a TLC555 timer configured to supply a PWM to the DRV10866, a potentiometer to adjust the speed of the motor by varying the duty cycle of the PWM, a jumper on the FG pin to allow the use of an external pull up resistor, and a jumper on the FGS pin to set ½ or normal frequency output on the FG pin. Power can be provided with the included micro-USB cable for 5 V or externally provided, up to 5.5 V, through the power header. The PWN, FG, and GND signals are all brought out to surface mounted test points.

The DRV10866EVM is configured so that connections to only the motor and power supply are required.

2.1 Power Connectors

The DRV10866EVM uses a combination of headers and a USB input jack (on bottom side) for the application/monitoring of power. For the EVM, only a single power supply rail is necessary. Minimum recommended V_{IN} for the EVM is 2 V and maximum is 5.5 V. Please see the datasheet for the DRV10866 for complete voltage range information of the driver itself. When power is supplied to the board a green LED (D3) in the bottom right corner should enable.

The overcurrent threshold setup pin sets the current limit for the device and is connected to a 3.8-kΩ resistor (R6) on the DRV10866EVM. This sets the current limit at 820 mA for the DRV10866. This resistor can be replaced and a new current limit set using the equation seen below. Please see the datasheet for the DRV10866 for more information on the overcurrent threshold setup pin.

$$I_{LIMIT}\ (mA) = 3120/R_{CS}\ (k\Omega) \quad (1)$$

VCC for the DRV10866 is directly taken off the micro USB jack supply or J4 power supply header. The J4 header is located on the top side of the EVM near the bottom right of the board as shown in Figure 3. The micro USB jack is located on the bottom side of the board as shown in Figure 4. The micro USB jack is only to supply power for the EVM and does not provide any additional functionality. Please choose only one method for providing power to the EVM.

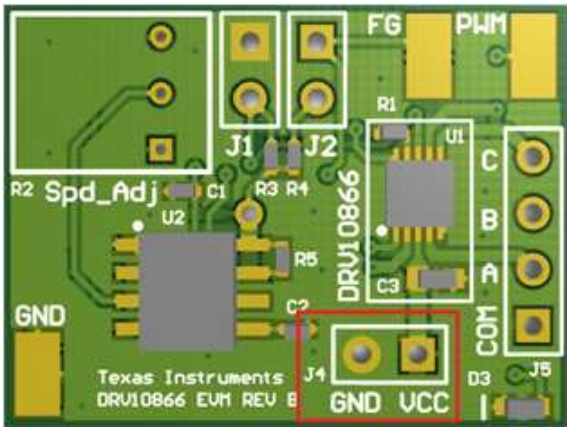

Figure 3. Top View (J4 Power Supply Header)

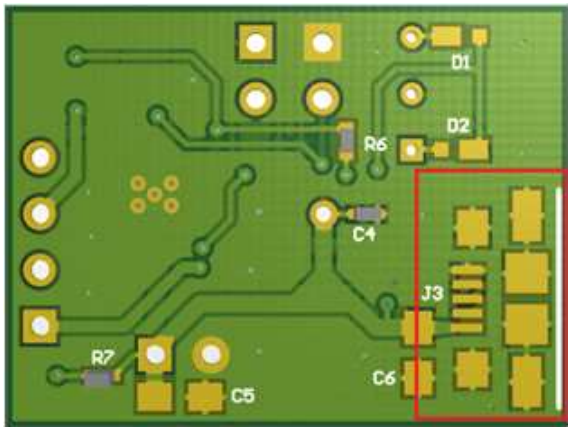

Figure 4. Bottom View (Micro USB Jack)

NOTE: It is only necessary to provide one source of power for the EVM. DO NOT connect to both the micro USB jack and the J4 power supply header.

2.2 Test Points

Test points are provided and labeled according to the inputs/outputs of the DRV10866 motor driver. The signals brought out to test points are labeled “FG”, “PWM”, and “GND”. The signal “PWM” is generated by circuitry on the EVM. In order to provide your own PWM signal to the motor driver, remove the 0-Ω resistor (R6) and connect your own PWM signal to the “PWM” test point. The “PWM” signal generated by the circuitry on the EVM is approximately 25 kHz and can be adjusted from 5% to 95% duty cycle by the potentiometer (R1) located on the EVM.

The FG signal's frequency represents the motor speed and phase information.

RPM = (FG x 60)/pole pairs (2)

Refer to the data sheet of the DRV10866 for more information regarding the FG pin.

2.3 Jumpers

There are two jumpers (J1 and J2) on the EVM that are normally installed.

One jumper connects the FG pin of the DRV10866 to a pull up resistor and the other jumper determines whether FG is ½ or normal frequency output by connecting FGS to either VCC or GND.

For normal operation right out of the box both jumpers should be installed.

2.3.1 FGS Frequency Generator Select (J1) Jumper

J1 can be found in the image below, Figure 5. Installing the jumper connects the FGS pin on the DRV10866 to GND. When the FGS pin is tied to GND, the FG output of the DRV10866 is set for normal frequency output. With the jumper out, the FGS pin pulls up to VCC. When the FGS pin is tied to VCC, the FG output of the DRV10866 is set for ½ of the original FG frequency. FGS is latched upon power to the EVM so power must be cycled in order for the FG output to change.

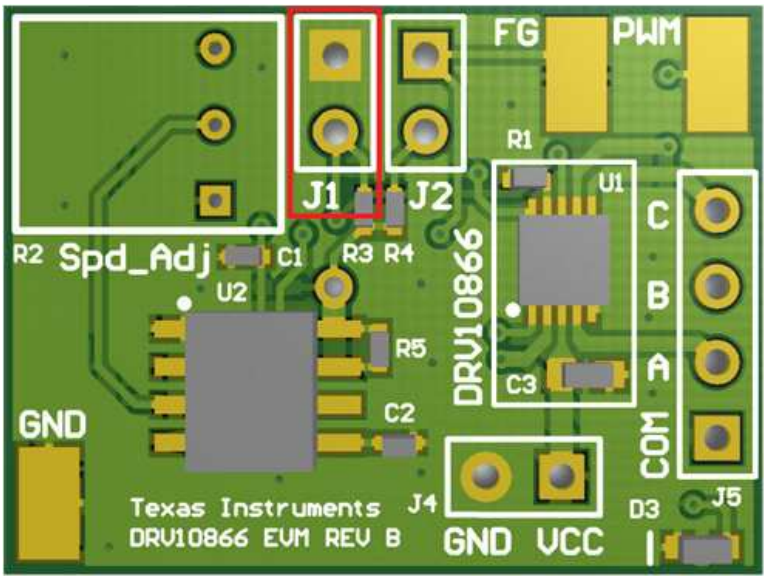

Figure 5. J1 Location

2.3.2 FG Pullup (J2) Jumper

JP2 can be found in Figure 6. Installing the jumper connects the FG pin of the DRV10866 to an on board pull up resistor.

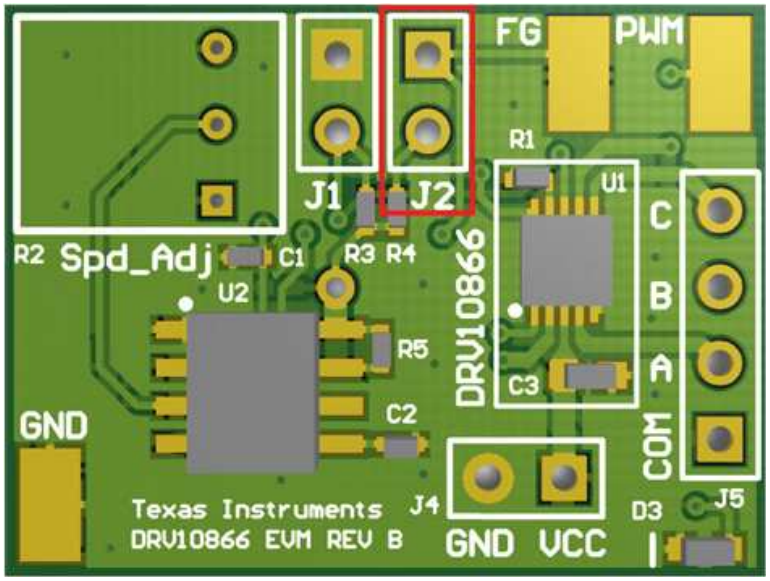

Figure 6. J2 Location

To make an external connection to FG, the jumper can be removed and pin 1 of the header provides a direct connection to the FG pin of the DRV10866. Pin 1 of J2 is highlighted in the image below, Figure 7. Note that if the jumper is removed, an external pull up resistor is needed for connection of FG to an external system. For more information regarding the FG pin please refer to the datasheet of the DRV10866.

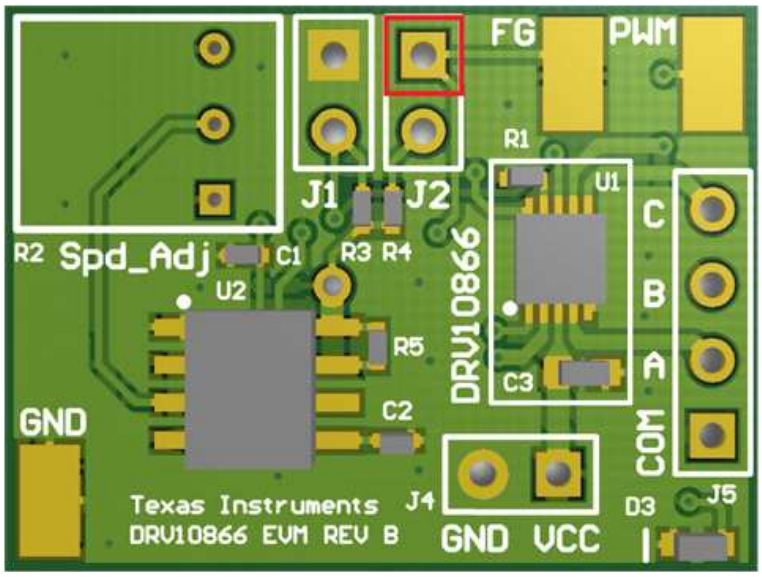

Figure 7. Pin 1 of J2

2.4 Speed Adjust Potentiometer (R1)

The speed adjust potentiometer (Spd_Adj) can be found in Figure 8. The potentiometer adjusts the duty cycle of the PWM signal which will in turn adjust the speed of the motor. In order to lower the duty cycle and in turn lower the speed, turn the potentiometer counter-clockwise. In order to increase the duty cycle and in turn increase the speed, turn the potentiometer clockwise.

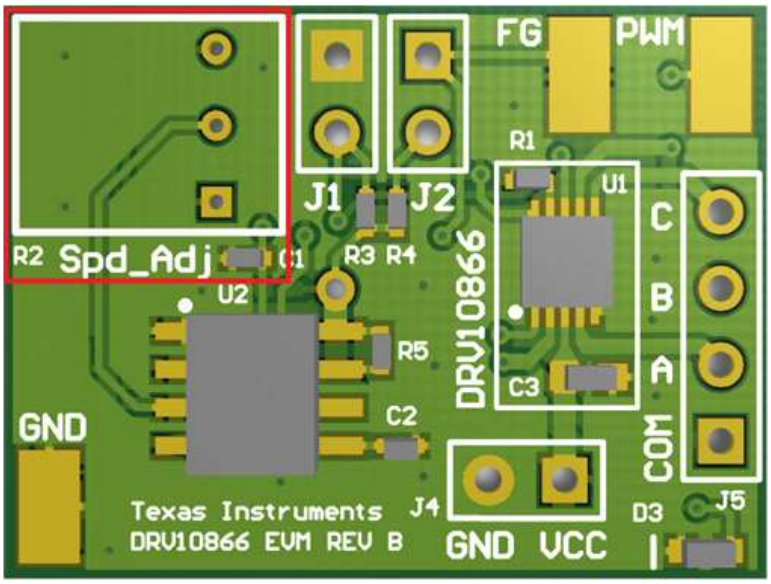

Figure 8. Speed Adjust Potentiometer

The onboard PWM signal for the DRV10866 is generated by a circuit based upon the Texas Instruments TLC555 low power timer. It is capable of an approximately 25-kHz output that can be adjusted from 5% to 95% duty cycle. This square output signal will switch from 0 V to VCC.

In order to provide an external PWM signal to the DRV10866, first remove the 0-Ω resistor (R6). Next, connect the external PWM signal to the “PWM” surface mounted test point. For more information on the PWM input required by the DRV10866 please refer to the datasheet.

2.5 Motor Outputs

Connect a three-phase 5-V BLDC motor to pins A, B, C, and COM of the header J5. Polarity is not critical for A, B, and C. If you wish to rotate the motor in the opposite direction switch two out of the three wires to A, B, and C. The motor outputs are located on J5 as shown in Figure 9.

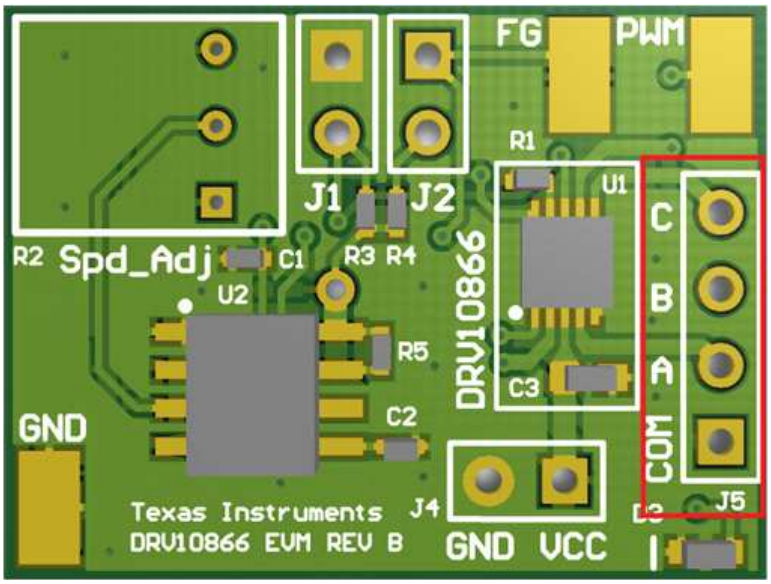

Figure 9. Motor Outputs

2.6 Operation of the EVM

1. Connect a 5-V, three-phase BLDC motor to pins A, B, C, and COM of J5.
2. Adjust the “Spd_Adj” potentiometer R2 to minimum voltage by turning it all the way counter-clockwise. This will minimize the motor speed.
3. Apply power to the J4 header or with external USB cable plugged into a computer USB jack. DO NOT connect to both the micro USB jack and the J4 power supply header.
4. Adjust the “Spd_Adj” potentiometer clockwise towards the motor outputs to increase speed and the motor will start to turn. Continue adjusting as desired.
5. To change direction, switch two out of the three wires to A, B, and C.

3 Schematic and Bill Of Materials

The following pages contain the DRV10866EVM schematic and bill of materials.

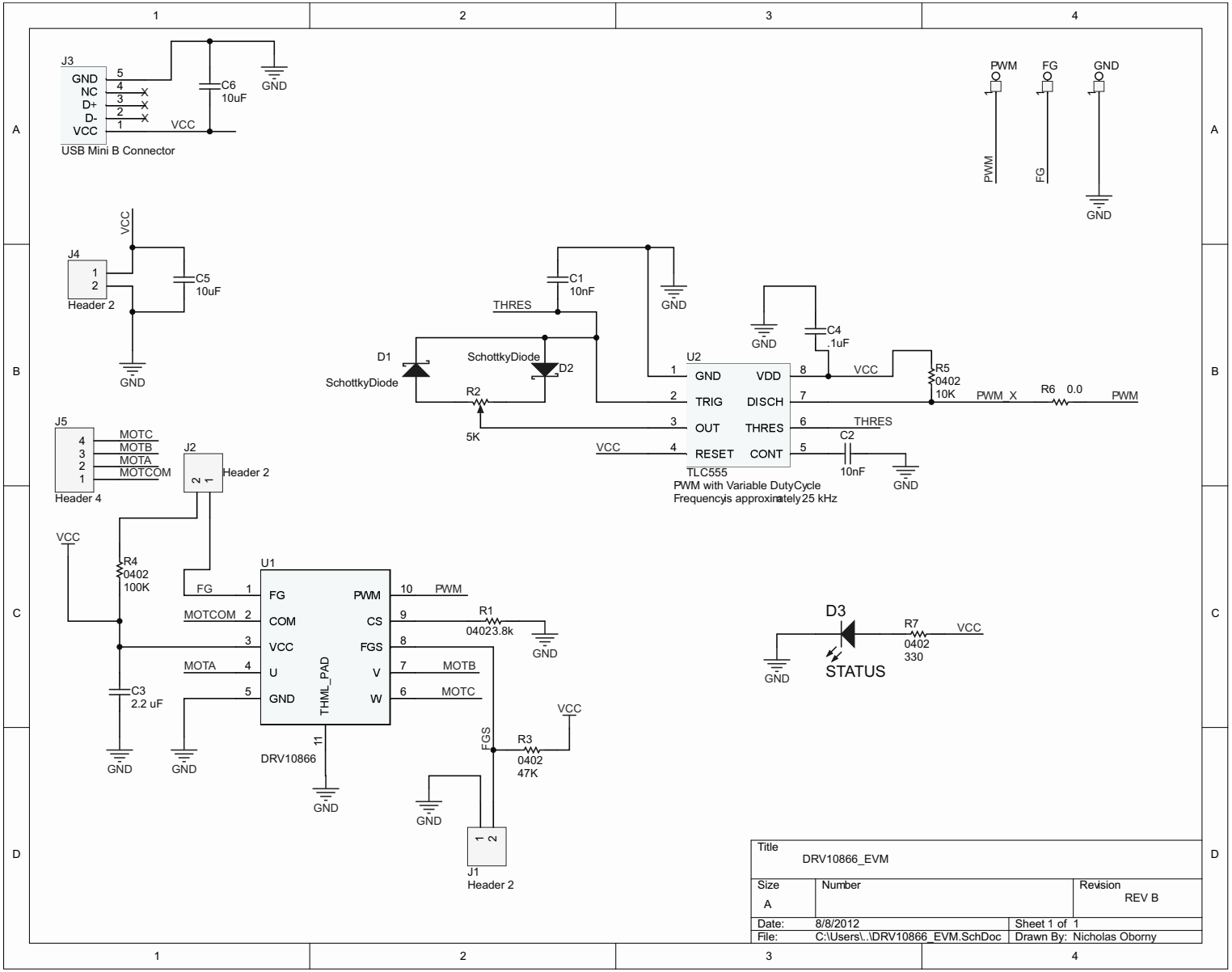

Figure 10. DRV10866EVM Schematic

Table 1. DRV10866EVM Bill of Materials

Item No.	Qty	Designator	Vendor	Vendor Part #	Manufacturer	Part No.	Description
1	1	C3	DigiKey	587-2909-1-ND	Taiyo Yuden	TMK107ABJ225KA-T	CAP CER 2.2UF 25V 10% X5R 0603
2	1	C4	DigiKey	490-3261-1-ND	Murata Electronics North America	GRM155R71C104KA88D	CAP CER 0.1UF 16V 10% X7R 0402
3	1	D3	DigiKey	754-1116-1-ND	Stanley Electric & Co	HBR1105W-TR	LED 1.6X0.8MM 570NM GRN CLR SMD
4	1	J3	DigiKey	A97799CT-ND	TE Connectivity	1981584-1	CONN RCPT MICRO USB TYPE AB
5	1	J5	DigiKey	3M9449-ND	3M	961104-6404-AR	CONN HEADER VERT SGL 4POS GOLD
6	1	R1	DigiKey	P3.83KLCT-ND	Panasonic - ECG	ERJ-2RKF3831X	RES 3.83K OHM 1/10W 1% 0402 SMD
7	1	R2	DigiKey	3352T-502LF-ND	Bourns Inc.	3352T-1-502LF	POT 5.0K OHM THUMBWHEEL CERM ST
8	1	R3	DigiKey	P47KJCT-ND	Panasonic - ECG	ERJ-2GEJ473X	RES 47K OHM 1/10W 5% 0402 SMD
9	1	R4	DigiKey	P100KJCT-ND	Panasonic - ECG	ERJ-2GEJ104X	RES 100K OHM 1/10W 5% 0402 SMD
10	1	R5	DigiKey	P10KJCT-ND	Panasonic - ECG	ERJ-2GEJ103X	RES 10K OHM 1/10W 5% 0402 SMD
11	1	R6	DigiKey	311-0.0JRCT-ND	Yageo	RC0402JR-070RL	RES 0.0 OHM 1/16W 0402 SMD
12	1	R7	DigiKey	P330JCT-ND	Panasonic - ECG	ERJ-2GEJ331X	RES 330 OHM 1/10W 5% 0402 SMD
13	1	U1	Supplied	Supplied	Texas Instruments	Supplied	5-V, Three-Phase Sensorless BLDC Motor Driver
14	1	U2	DigiKey	296-10341-1-ND	Texas Instruments	TLC555QDR	IC OSC MONO TIMING 2.1MHZ 8-SOIC
15	2	C1, C2	DigiKey	445-1260-1-ND	TDK Corporation	C1005X7R1E103K	CAP CER 10000PF 25V 10% X7R 0402
16	2	C5, C6	DigiKey	445-7645-1-ND	TDK Corporation	C2012X5R1C106M/0.85	CAP CER 10UF 16V 20% X5R 0805
17	2	D1, D2	DigiKey	MSS1P4-M3/89AGICT-ND	Vishay General Semiconductor	MSS1P4-M3/89A	DIODE SCHOTTKY 1A 40V MICROSMP
18	3	FG, GND, PWM	Mouser	534-5019	Keystone Electronics	5019	PC TEST POINT MINIATURE SMT
19	3	J1, J2, J4	DigiKey	3M9447-ND	3M	961102-6404-AR	CONN HEADER VERT SGL 2POS GOLD

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from A Revision (December 2012) to B Revision	Page
• Changed wording of 1. in *Section 2.6*; deleted Figure 10	7

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   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

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   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

3 *Regulatory Notices:*

   3.1 *United States*

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

      FCC NOTICE: 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 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. 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

3.3 *Japan*

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

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

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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3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

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.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

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