DRV8816 Evaluation Module

This document is provided with the DRV8816 customer evaluation module (EVM) as a supplement to the DRV8816 data sheet. It details the hardware implementation of the EVM.

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1 PCB (Top-Assembly View)

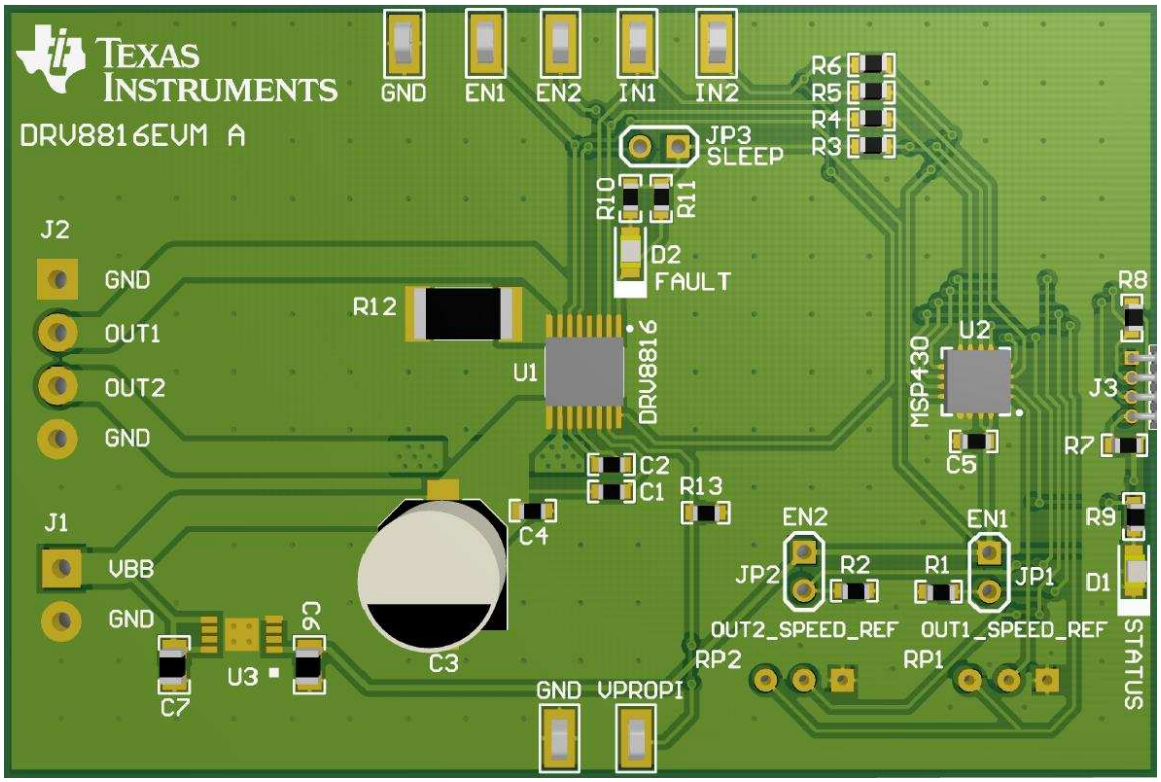


Figure 1. PCB (Top 3-D View)

2 Introduction

The DRV8816EVM is a complete solution for evaluating the DRV8816 dual ½ -H Bridge Motor Driver. It includes an MSP430 microcontroller that is preprogrammed to take input from two dedicated analog potentiometers, for PWM speed control of 2 brushed DC motors. Two enable jumpers provide the ability to HIZ the motor outputs. Power can be provided externally up to 38 volts through the power header. To expand beyond the included firmware capability, the MSP430 can be reprogrammed via an external MSP430 USB Stick Development Tool available at www.ti.com/tool/ez430-f2013.

2.1 Power Connectors

The DRV8816EVM uses a header for the application and monitoring of power. For the EVM, only a single power supply rail is necessary and an onboard 3.3-V regulator provides power to the MSP430 micro and logic core, VCC, of the DRV8816 motor driver. The minimum recommended VBB for the EVM is 8 V and the maximum is 38 V. See the data sheet for the DRV8816 (SLVSAI1) for complete voltage range information of the driver itself.

NOTE: $\overline{\text{FAULT}}$ stays asserted ($\overline{\text{FAULT}}$ = L) until VBB reaches VBBNFR to give the charge pump headroom to reach the under voltage threshold. $\overline{\text{FAULT}}$ is a status-only signal and does not affect any device functionality. The H-bridge portion still operates normally down to VBB = 8 V with $\overline{\text{FAULT}}$ asserted.

VBB for the DRV8816 is directly taken off the J1 power supply header. The J1 header is located near the bottom left corner of the board.

As previously mentioned, the MSP430 comes preprogrammed to control basic DC motor operation. If changing the firmware via the external ez430 development tool is desired, it is NOT necessary or recommended to provide any input power to the DRV8816EVM. Power is provided from the ez430 board.

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2.2 Test Points

Test points are provided and labeled for the inputs to the DRV8816 motor driver and also for the control signals back to the MCU. The inputs are labeled IN1 and IN2. The control inputs for enabling and disabling the motor outputs are labeled as EN1 and EN2. In addition, a test point labeled VPROPI is given to measure the voltage at the sense pin of the DRV8816. The purpose of this test point is to easily measure the average output current from the DRV8816. V_{SENSE} x 5 = VPROPI. V_{SENSE} = I_{SENSE} x R_{SENSE}. R_{SENSE} = 0.2 Ω. See the data sheet for the DRV8816 SLVSAI1 under sections SENSE and VPROPI for more details

2.3 Jumpers

There are three jumpers normally installed on the EVM.

Two jumpers, EN1 and EN2, control the enable inputs on the DRV8816 and are used to enable or disable the motors attached to OUT1 and OUT2. The other jumper, labeled SLEEP, controls the low-power state, or sleep state, on the DRV8816.

2.3.1 ENABLE Jumpers (EN1 and EN2)

The EN1 and EN2 jumpers are found in Figure 2. Installing the EN1 jumper provides a logic high to the DRV8816 EN1 pin and the motor connected to the OUT1 output is enabled. Installing the EN2 jumper provides a logic high to the DRV8816 EN2 pin and the motor connected to the OUT2 output is enabled.

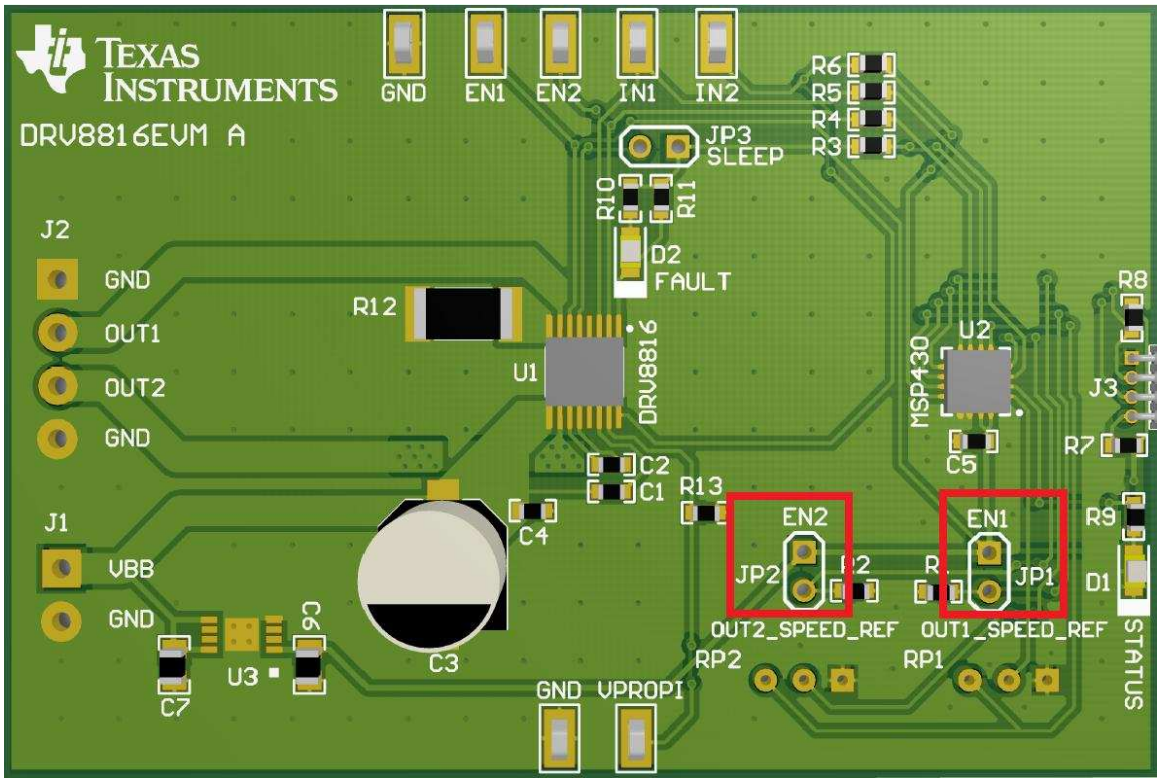


Figure 2. ENABLE Jumpers (EN1 and EN2)

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2.3.2 SLEEP SELECT (SLEEP) Jumper

The SLEEP jumper is found in Figure 3. Installing the jumper places the DRV8816 in an ACTIVE state and the motors spin. Removing the jumper places the DRV8816 in a low power consumption, or sleep state, and the motor outputs along with internal circuitry will be turned OFF.

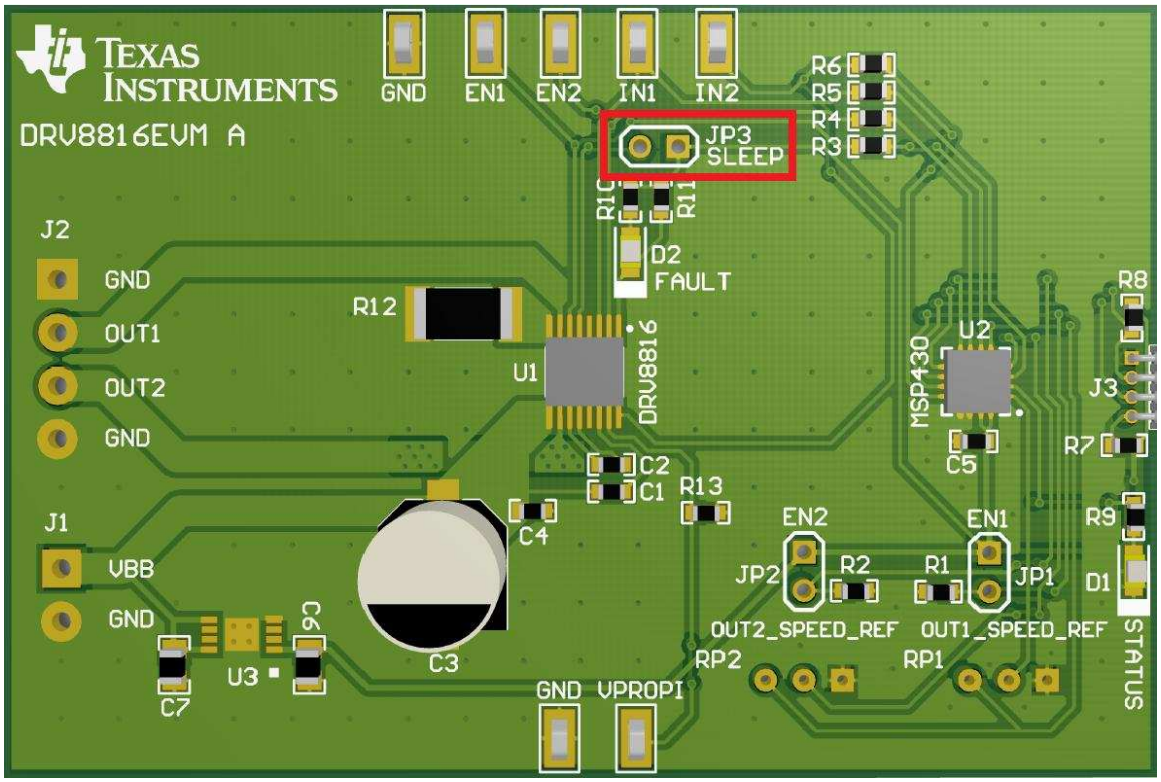


Figure 3. SLEEP SELECT (SLEEP) Jumper

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2.4 Speed Adjust Potentiometer (RP1 and RP2)

The speed adjust potentiometers are found in Figure 4. Turning the wheel counter-clockwise will slow down the input PWM duty cycle to the DRV8816 and the motor turns slower. Turn the wheel clockwise and the motor spins faster. RP2 controls the motor connected across OUT2 and GND. RP1 controls the motor connected across OUT1 and GND.

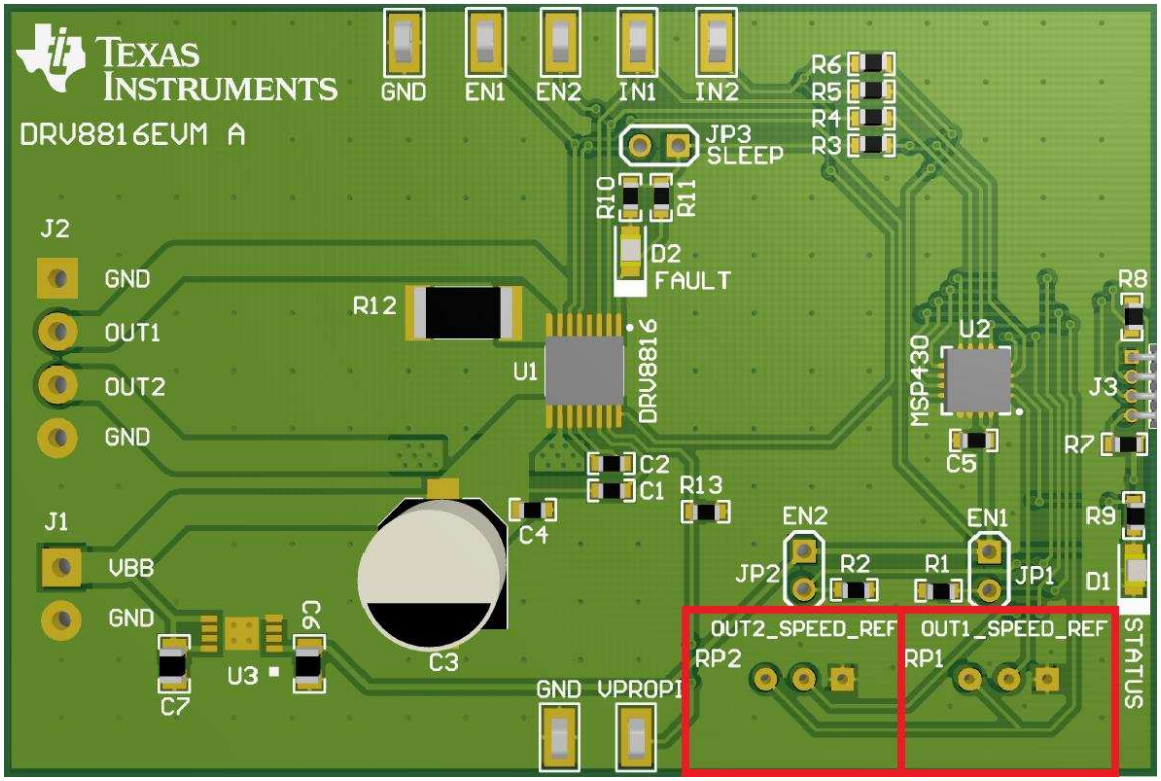


Figure 4. Speed Adjust Potentiometer (RP1 and RP2)

2.5 Motor Outputs

2.5.1 Dual Motor Control

This mode allows for up to two motors to be controlled independently. Connect a DC motor across OUT1 and GND. If desired, connect an additional DC motor across OUT2 and GND. To reverse motor direction of one of the motors, replace the connection from that motor to GND with a connection from that motor to VBB. This can be done with both motors if desired.

2.5.2 Single Motor Control

This mode allows for bidirectional control of one motor. Connect a DC motor across OUT1 and OUT2. Reversing direction os now controlled by the potentiometer. This is covered in the Single Motor Operation section in more detail.

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2.6 Operation of the EVM

2.6.1 Dual Motor Operation

Use the following steps to operate the EVM with up to two motors with single direction speed control:

1. Connect a DC motor across OUT1 and GND. If desired, connect an additional DC motor across OUT2 and GND.
2. Adjust the potentiometer, RP1, to minimum voltage by turning the wheel counter-clockwise all the way. This minimizes the motor speed of the motor connected across OUT1. If using a second motor perform this process with potentiometer RP2 as well.
3. Apply power to J1 header
4. Turn potentiometer, RP1, clockwise and the motor connected across OUT1 starts to turn. Continue adjusting, as desired, until the maximum speed is reached. If using a second motor perform this process with potentiometer RP2 as well.
5. The direction of the motor turning can be reversed, if desired, by removing the connection from GND to the motor and connecting the motor to VBB. If this is done, the potentiometer associated with controlling the motor will operate in reverse and thus should be turned all the way clockwise before powering on the board and then slowly turned counter-clockwise to speed up the motor.

2.6.2 Single Motor Operation

Use the following steps to operate the EVM with a signal motor and bidirectional speed control:

1. Connect a motor across OUT1 and OUT2.
2. Adjust both potentiometers, RP1 and RP2, to minimum voltage by turning both wheels counter-clockwise all the way. This minimizes the motor speed.
3. Apply power to J1 header
4. To spin the motor in one direction, turn potentiometer, RP1, clockwise and the motor will start to turn. Continue adjusting, as desired, until you reach maximum speed.
5. To spin in the other direction, turn potentiometer, RP1, counter-clockwise all the way and then turn potentiometer, RP2, clockwise and the motor will start to turn in the opposite direction. Continue adjusting, as desired, until maximum speed is reached.

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3 DRV8816 Schematic

Figure 5 shows the DRV8816EVM schematic.

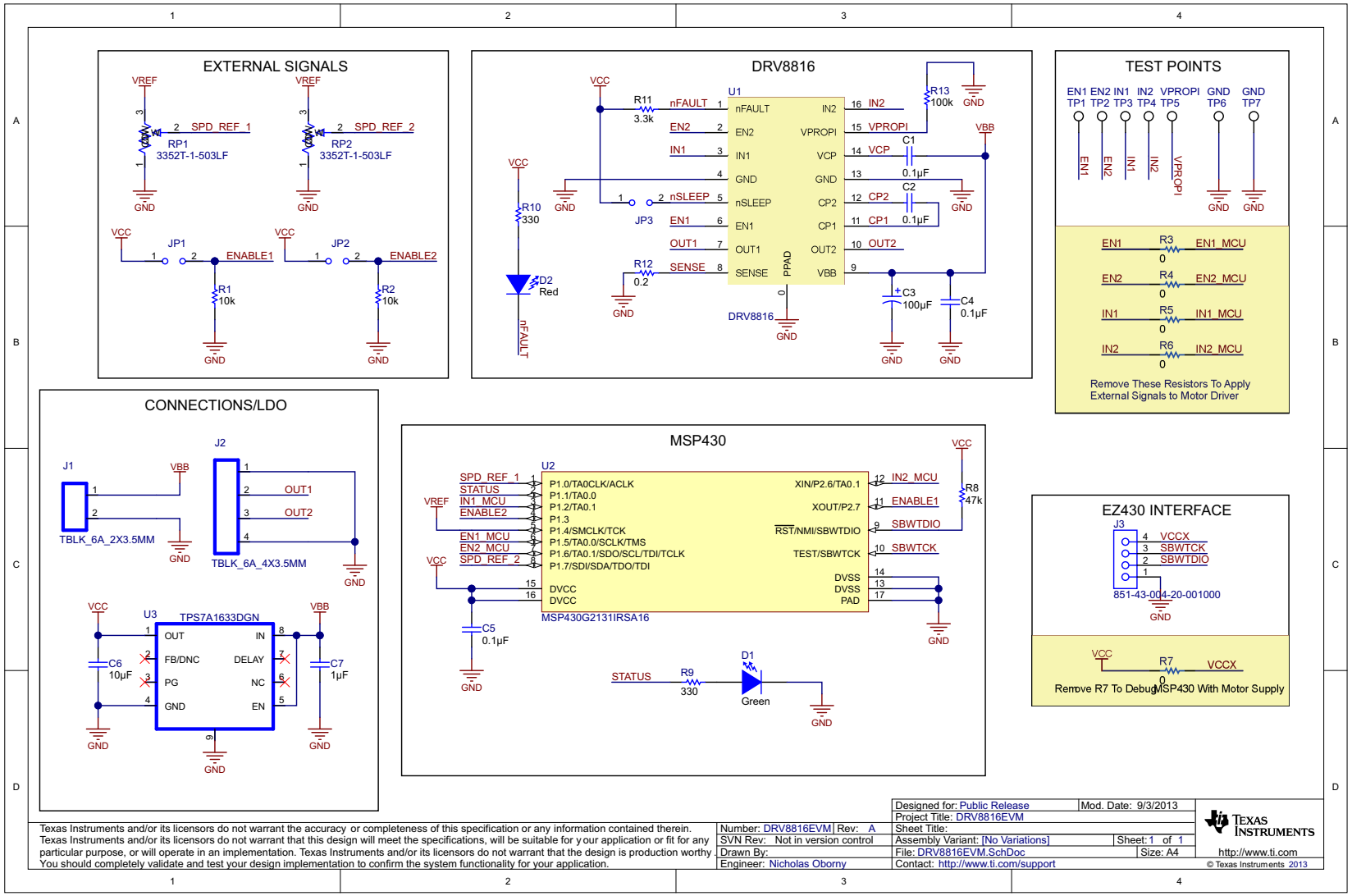


Figure 5. DRV8816EVM Schematic

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4 DRV8816 Bill of Materials

Table 1 is the BOM for the DRV8816EVM.

Table 1. DRV8816EVM Bill of Materials

Designator	Quantity	Description	PartNumber	Manufacturer
PCB	1	Printed Circuit Board	DRV8816EVM	Any
C1, C2, C4	3	CAP, CERM, 0.1uF, 50V, +/-10%, X7R, 0603	C1608X7R1H104K	TDK
C3	1	CAP, AL, 100uF, 50V, +/-20%, 0.34 ohm, SMD	EEE-FK1H101P	Panasonic
C5	1	CAP, CERM, 0.1uF, 16V, +/-20%, X7R, 0603	C0603C104M4RACTU	Kemet
C6	1	CAP, CERM, 10uF, 10V, +/-10%, X7R, 0805	GRM21BR71A106KE51L	MuRata
C7	1	CAP, CERM, 1uF, 50V, +/-10%, X7R, 0805	GRM21BR71H105KA12L	MuRata
D1	1	LED, Green, SMD	LTST-C171GKT	Lite-On
D2	1	LED, Red, SMD	LTST-C170KRKT	Lite-On
J1	1	Terminal Block, 2-pin, 6-A, 3.5mm	ED555/2DS	OST
J2	1	Terminal Block, 4-pin, 6-A, 3.5mm	ED555/4DS	OST
J3	1	SOCKET .050" GRID SIP 4 POS R/A, TH	851-43-004-20-001000	Mill-Max
JP1, JP2, JP3	3	Header, Male 2-pin, 100mil spacing,	PEC02SAAN	Sullins
R1, R2	2	RES, 10k ohm, 5%, 0.1W, 0603	CRCW060310K0JNEA	Vishay-Dale
R3, R4, R5, R6, R7	5	RES, 0 ohm, 5%, 0.1W, 0603	CRCW06030000Z0EA	Vishay-Dale
R8	1	RES, 47k ohm, 5%, 0.1W, 0603	CRCW060347K0JNEA	Vishay-Dale
R9, R10	2	RES, 330 ohm, 5%, 0.1W, 0603	CRCW0603330RJNEA	Vishay-Dale
R11	1	RES, 3.3k ohm, 5%, 0.1W, 0603	CRCW06033K30JNEA	Vishay-Dale
R12	1	RES, 0.2 ohm, 1%, 2W, 2512	CSRN2512FKR200	Stackpole Electronics Inc
R13	1	RES, 100k ohm, 1%, 0.1W, 0603	CRCW0603100KFKEA	Vishay-Dale
RP1, RP2	2	Potentiometer, 3/8 Cermet, SingleTurn, Flat	3352T-1-503LF	Bourns
TP1, TP2, TP3, TP4, TP5, TP6, TP7	7	PC Test Point, Miniature	5019	Keystone
U1	1	DMOS Dual ½-H Bridge Motor Drivers	DRV8816	Texas Instruments
U2	1	Mixed Signal MicroController, RSA0016B	MSP430G2131IRSA16	Texas Instruments
U3	1	IC, 60-V, 6-A IQ, 100-mA, LDO Voltage Regulator	TPS7A1633DGN	Texas Instruments

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User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

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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

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

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.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

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

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-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.

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.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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.

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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If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product 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 this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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