DRV8432EVM Motor Drive Evaluation Board

The DRV8432 customer evaluation module demonstrates the operation and performance of the DRV8432 device from TI. The EVM can be used with a MCU controller module or can be wired into an existing system.

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1 Introduction

1.1 Description

The DRV8432 is a dual full-bridge PWM motor driver. It has a maximum recommended supply voltage of 52.5 V. The DRV8432 is capable of delivering 2 x 7-A continuous output current and 2 x 12-A peak current per device. Furthermore, the outputs can be paralleled to drive 14-A continuous current or 24-A peak current. The DRV8432 has an advanced protection system consisting of short-circuit protection, overcurrent protection, undervoltage protection, and two-stage thermal protection.

The DRV8432EVM can be operated with either two full bridge outputs or 4 half bridge outputs. It can also be used in parallel mode to double the current capability. The unit can be operated with external PWM inputs using an MCU controller module or signal generator. The outputs and power supplies are connected using stripped wires by connecting them to the on-board terminal blocks. The EVM module also has hardware switches to control the modes and to allow a manual reset.

1.2 DRV8432EVM Features

- PWM input motor driver module
- Self-contained protection system (short-circuit and thermal)
- Double-side, plated-through PCB layout

1.3 DRV8432EVM Specifications

Table 1. Key Parameters

Output Stage Voltage	0 to 52.5 Volts
System Supply Voltage	12 Volts
Number of Output	4 × Half Bridge, 2 × Full Bridge, 1 × Paralleled Full Bridge
Output Current per Output Pin	Up to 12-A peak, 7 A continuous

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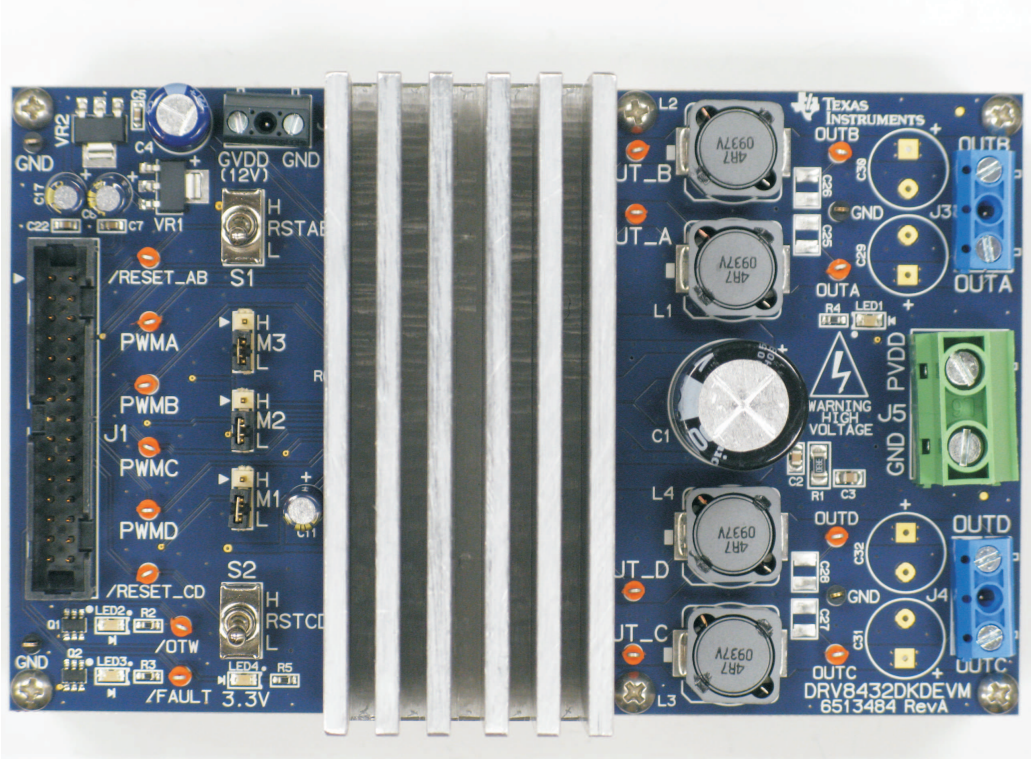

Figure 1. The TI DRV8432EVM Motor Drive Evaluation Board – Top View

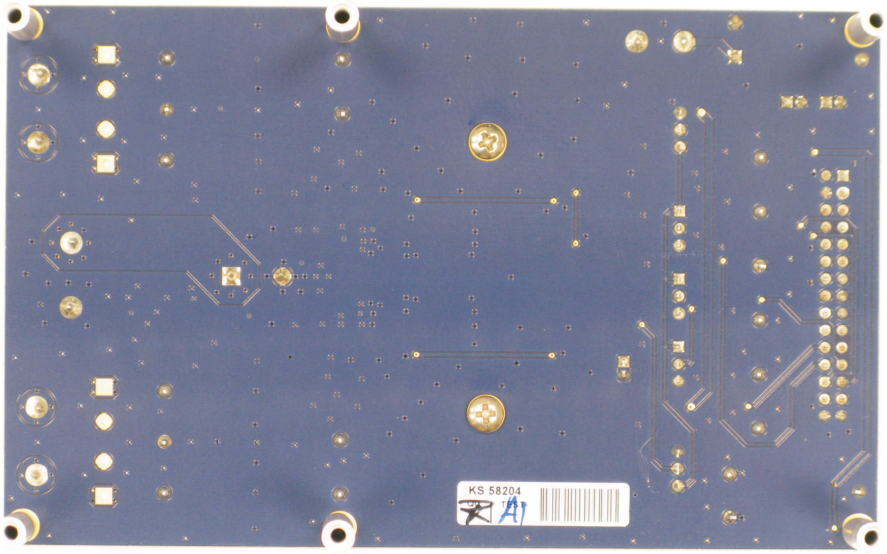

Figure 2. The TI DRV8432EVM Motor Drive Evaluation Board – Bottom View

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2 Operation

2.1 Quick Start List for Stand-Alone Operation

Follow these steps to use the DRV8432EVM stand-alone or when connecting it into existing circuits or equipment. Connections to the EVM module can be made by inserting stripped wire for the power supplies and output connections.

2.1.1 Power Supply

Two power supplies are required to power up the EVM. One is needed for system power, logic and gate drive, while the second is for the output stage power supply. Use enough wire gauge such that the impedance is relatively low. The output stage supply should use at least AWG 19 wire.

Table 2. Power Supply Requirements

Description	Voltage Range	Current Requirements	Wire Size
System Power Supply	12 V	1 A	26 AWG
Output Stage Power Supply	0 – 52.5 V	14 A	19 AWG

2.1.2 Evaluation Module Preparation

Inputs and Outputs

1. Ensure that all external power sources are set to OFF.
2. Connect load(s) across the outputs (OUTX) or between the outputs and ground depending on the configuration requirement.
3. Connect an external 12-V power supply to the terminal block marked GVDD and GND (J2). Make sure the wires are connected with correct polarities.
4. Connect an external regulated power supply adjustable from 0 V–52.5 V to the terminal block marked PVDD and GND (J5). Make sure the wires are connected with correct polarities.

Control Signals

1. Install the mode jumpers on M3, M2, and M1 depending on the mode desired. See "Mode Pin Configurations" table for details.
2. Set RESET_AB (S1) and RESET_CD (S2) switches to low (RESET) position. If using an external MCU to control RESET, place the S1 and S2 switches in the middle position.
3. Prepare the PWM signals needed to control the power stage and make sure that PWM logic is 3.3 V not 5 V. 5 V will damage the device inputs.

2.1.3 Power Up

The DRV8432 device doesn't require a special power-up sequence, but the following sequence is recommended for the EVM.

1. Turn on GVDD (12 V) power supply.
2. Enable PWM signals.
3. Set RESET_AB (S1) and RESET_CD (S2) switches to high (NORMAL OPERATION) position.
4. Turn on the external PVDD power supply to the desired voltage gradually.
5. Adjust the duty cycle of PWM input signals to the desired value. The EVM should begin to operate normally.

2.1.4 Fault Conditions

When the device shuts down due to any fault conditions, flip RESET_AB and/or RESET_CD switches to low and back to HIGH to clear the fault and reset the device. If this doesn't work for any reason, turn 12-V GVDD power supply off and on again to clear the latch. Please inspect the board and test condition carefully to understand the problem before next operation.

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Table 3. Mode Pin Configurations

MODE PINS			OUTPUT CONFIGURATION	DESCRIPTION
M3	M2	M1		
0	0	0	2 FB or 4 HB	Dual Full Bridges (two PWM inputs each full bridge) or four half bridges with cycle-by-cycle current limit
0	0	1	2 FB or 4 HB	Dual full bridges (two PWM inputs each full bridge) or four half bridges with OC latching shutdown (no cycle-by-cycle current limit)
0	1	0	1 PFB	Parallel full bridge with cycle-by-cycle current limit
0	1	1	1 FB	Dual Full Bridges (one PWM input each full bridge with complementary PWM on second half bridge) with cycle-by-cycle current limit
1	x	x		Reserved

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3 Schematics, PCB Layers, and Bill of Materials

3.1 DRV8432EVM Schematic

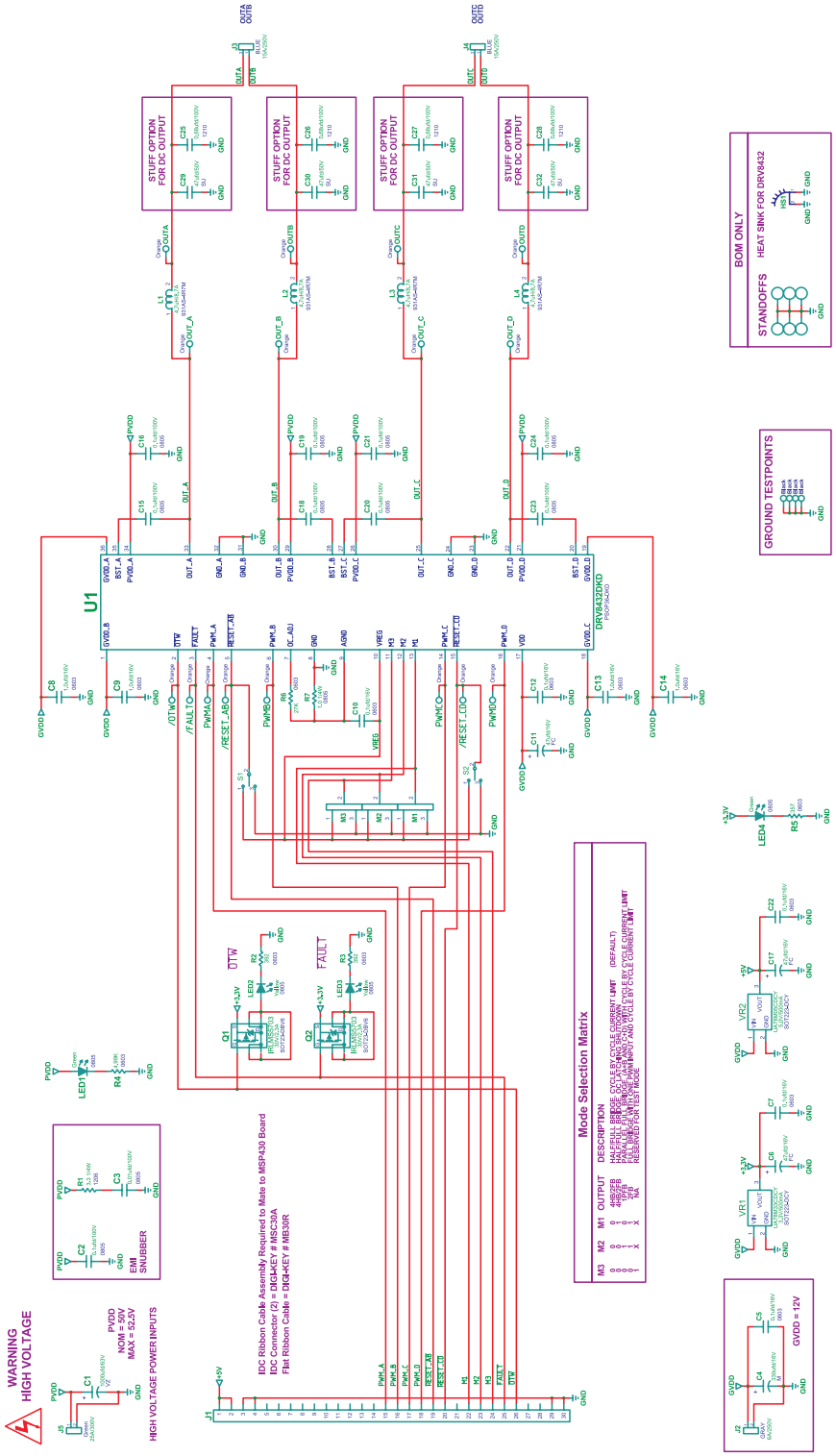

Figure 3. DRV8432EVM Schematic

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3.2 DRV8432EVM PCB Layers

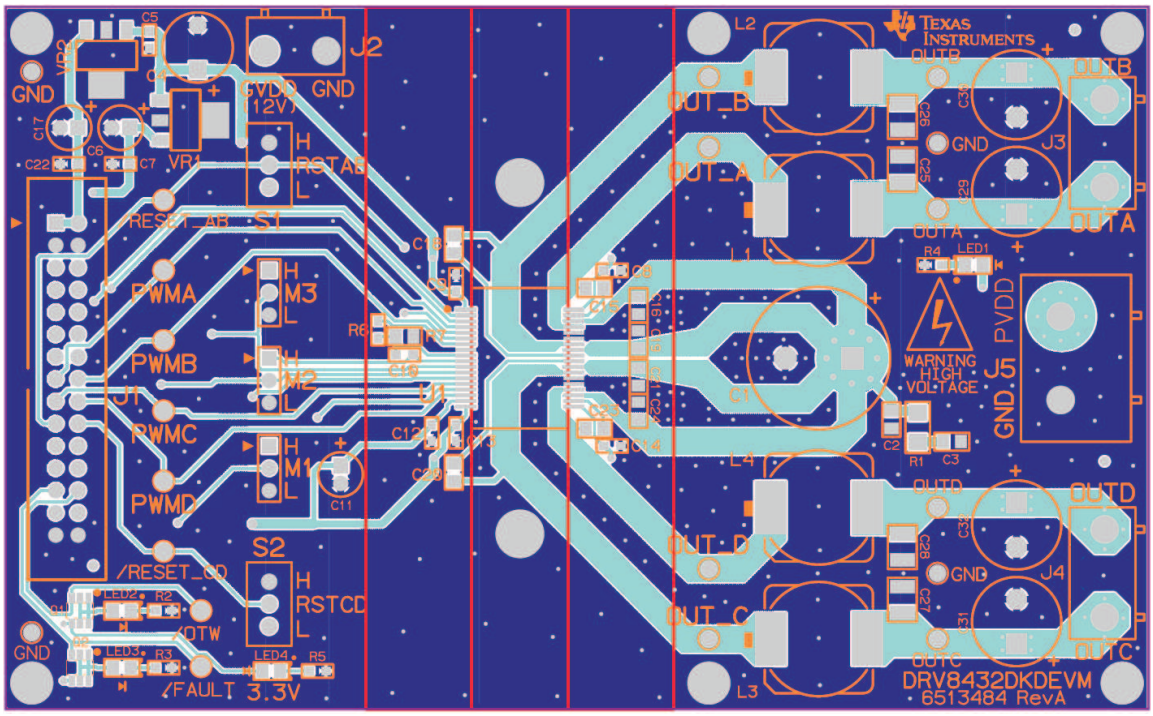

Figure 4. DRV8432EVM – Top Layer Composite

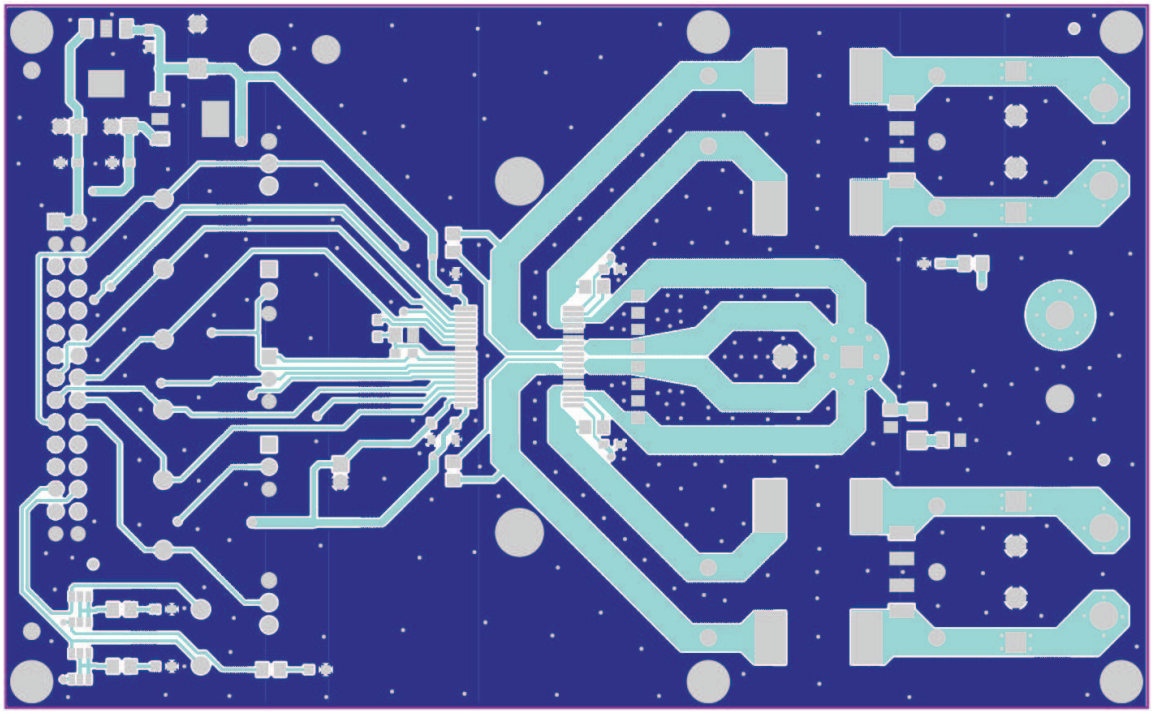

Figure 5. DRV8432EVM – Top Layer Copper

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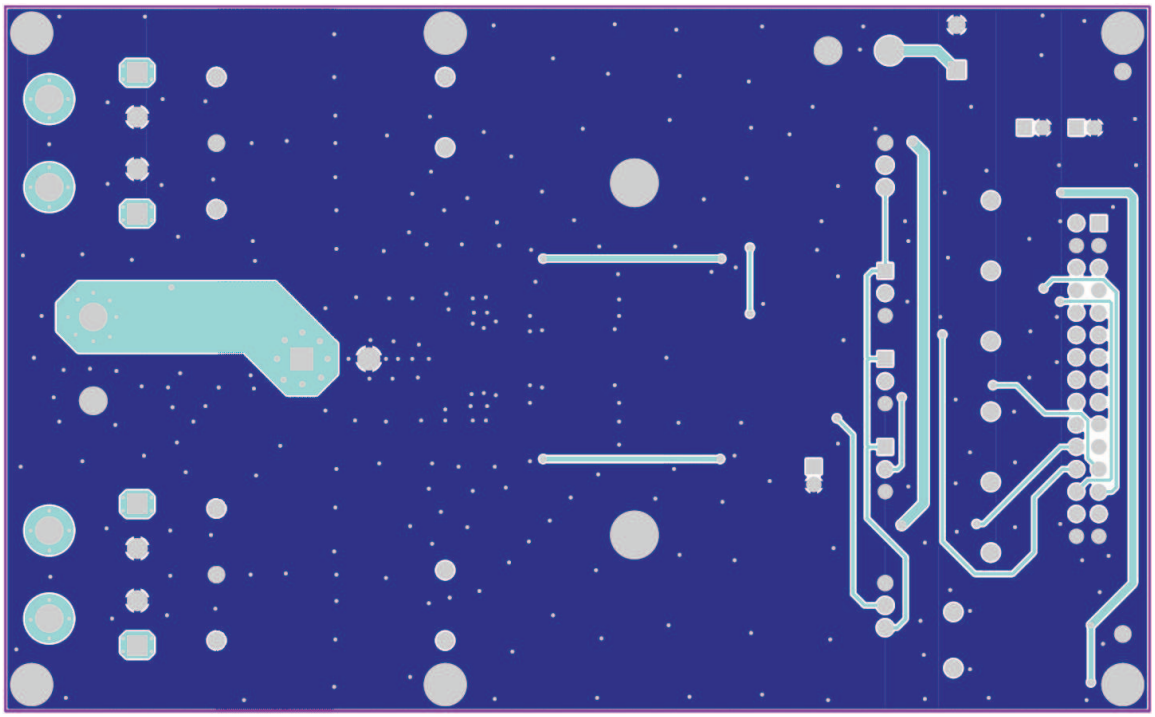

Figure 6. DRV8432EVM – Bottom Copper

3.3 Bill of Materials for DRV8432DKD_EVM

Table 4. Bill of Materials

QTY	REF DES	Description	Vendor	Vendor Part No.	MANU	MANU Part No.
1	U2	MOTOR DRIVE POWER AMP, PSOP3_36-DKD, RoHS	Texas Instruments	DRV8432DKD	Texas Instruments	DRV8432DKD
1	VR1	VOLT REG 3.3 V, 500 mA, SOT223-DCY, RoHS	Digi-Key	296-13424-1	Texas Instruments	UA78M33CDCYR
1	VR2	VOLT REG 5.0 V, 500 mA, SOT223-DCY, RoHS	Digi-Key	296-12290-1	Texas Instruments	UA78M05CDCYR
2	Q1, Q2	MOSFET, P-Chan 30 V, 2.4 A, SOT23-DBV6, RoHS	Digi-Key	IRLMS5703PBFCT	International Rectifier	IRLMS5703TRPBF
2	LED1, LED4	LED, GREEN 2.0 V, SMD0805, RoHS	Digi-Key	67-1553-1	Lumex Opto	SML-LXT0805GW-TR
2	LED2, LED3	LED, YELLOW 2.0 V, SMD0805, RoHS	Digi-Key	67-1554-1	Lumex Opto	SML-LXT0805YW-TR
1	C3	CAP SMD0805 CERM, 0.01 µF, 100 V, 10%, X7R, RoHS	Digi-Key	PCC1991CT	Panasonic	ECJ-2VB2A103K
5	C5, C7, C10, C12, C22	CAP SMD0603 CERM 0.1 µF, 16 V, 10%, X7R, RoHS	Digi-Key	PCC1762CT	Panasonic	ECJ-1VB1C104K
9	C2, C15, C16, C18, C19, C20, C21, C23, C24	CAP SMD0805 CERM 0.1 µF, 100V 10% X7R, RoHS	Digi-Key	445-1418-1	TDK	C2012X7R2A104K
4	C8, C9, C13, C14	CAP SMD0603 CERM 1.0 µF, 16V 10% X5R, RoHS	Digi-Key	PCC2224CT	Panasonic	ECJ-1VB1C105K
3	C6, C11, C17	CAP 47UFD 16-V RAD ALUM ELEC FC, RoHS	Digi-Key	P11196	Panasonic	EEU-FC1C470
1	C4	CAP 330UFD 16-V RAD ALUM ELEC M 20%, RoHS	Digi-Key	P10371TB	Panasonic	ECA-1CM331B
1	C1	CAP 1000UFD 63-V RAD ALUM ELEC VZ, RoHS	Digi-Key	493-1359	Nichicon	UVZ1J102MHD
1	R7	RESISTOR SMD0805 1.0 Ω, 1/4W, 1%, RoHS	Digi-Key	RHM1KCT	ROHM	ESR10EZPJ1R0

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Table 4. Bill of Materials (continued)

QTY	REF DES	Description	Vendor	Vendor Part No.	MANU	MANU Part No.
1	R1	RESISTOR SMD1206 3.3 Ω, 1/8W 5%, RoHS	Digi-Key	P3.3PCT	Panasonic	ERJ-8RQJ3R3V
1	R5	RESISTOR SMD0603 357 Ω, 1% THICK FILM 1/10W, RoHS	Digi-Key	P357HCT	Panasonic	ERJ-3EKF3570V
2	R2, R3	RESISTOR SMD0603 392 Ω, 1%, THICK FILM 1/10W, RoHS	Digi-Key	P392HCT	Panasonic	ERJ-3EKF3920V
1	R4	RESISTOR SMD0603 4.99 kΩ, 1%, THICK FILM 1/10W, RoHS	Digi-Key	P4.99KHCT	Panasonic	ERJ-3EKF4991V
1	R6	RESISTOR SMD0603, THICK FILM, 27 kΩ, 5% 1/10W, RoHS	Yageo	311-27KGRCT	Panasonic	RC0603JR-0727KL
4	L1, L2, L3, L4	INDUCTOR, 4.7 µH, 8.7 A, TYPE D128C, RoHS	TOKO	931AS-4R7M	TOKO	931AS-4R7M
3	M1, M2, M3	HEADER THRU MALE 3 PIN 100 LS GOLD, RoHS	Digi-Key	S1011E-03-ND	Sullins	PBC03SAAN
1	J1	HEADER SHROUDED 100 LS MALE GOLD 2 × 15 PINS, RoHS	Digi-Key	MHC30K	3M	N2530-6002-RB
1	J5	TERMINAL BLOCK 2PIN 25 A/300 V, GREEN 9.52 mm, PITCH 12-24AWG, RoHS	Digi-Key	ED2677	On Shore Technology	OSTT7022150
1	J2	TERMINAL BLOCK 2PIN 6 A/250 V, BLACK 7 mm PITCH 16-28AWG, RoHS	Digi-Key	ED1534	On Shore Technology	ED655/2DS
2	J3, J4	TERMINAL BLOCK 2PIN 15 A/250 V, BLUE 10 mm PITCH 14-22AWG, RoHS	Digi-Key	ED1627	On Shore Technology	ED600/2DS
16	$\overline{\text{OTW}}$, $\overline{\text{FAULT}}$ PWMA, PWMB, PWMC, PWMD, OUTA, OUT_A, OUTB, OUT_B, OUTC, OUT_C, OUTD, OUT_D, $\overline{\text{RESET_AB}}$, $\overline{\text{RESET_CD}}$	PC testpoint, orange, RoHS	Digi-Key	5003K	Keystone Electronics	5003
4	GNDx4	PC TESTPOINT, BLACK, RoHS	Digi-Key	5001	Keystone Electronics	5001K
2	S1, S2	SWITCH, SPST VERT-PCB ON-OFF-ON MINIATURE TOGGLE, RoHS	Digi-Key	ATE1E-2M3-10-Z	Copal Electronics	563-1159
3	M1(2-3), M2(2-3), M3(2-3)	SHUNT, BLACK AU FLASH 0.100 LS	Digi-Key	S9001	Sullins	SPC02SYAN
1	HS1	HEATSINK ALUMINUM, 35 × 80 × 38 mm 40 mm PITCH	Heavy Metal	HeatSink_DRV-EVM_35Wx80Lx38T-40P	Heavy Metal	HeatSink_DRV-EVM_35Wx80Lx38T-40P
6	N/A	4-40 SCREW, STEEL 0.250 in	Digi-Key	H342	Building Fasteners	PMS 440 0025 PH
6	N/A	STANDOFF, 4-40, 1.0 in × 1/4 in, ALUM RND F-F	Digi-Key	2030K	Keystone Electronics	2030
2	N/A	4-40 SPACER, ROUND, 0.125 in THICK, ALUMINUM	Digi-Key	2036	Keystone Electronics	2036K

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REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

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.

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

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.

【Important Notice for Users of this Product in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

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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EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure 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.
3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please 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 result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's 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, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

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