

EVM User's Guide: DRV8218EVM

DRV8218 Evaluation Module



Description

The DRV8218EVM allows for evaluation of the DRV8218 device. The evaluation module (EVM) has been programmed to work out of the box and begin driving loads right away. To simplify control and configuration, the EVM has headers for easy access to power supply and load connections, as well as onboard potentiometers for inputting PWM signals.

Get Started

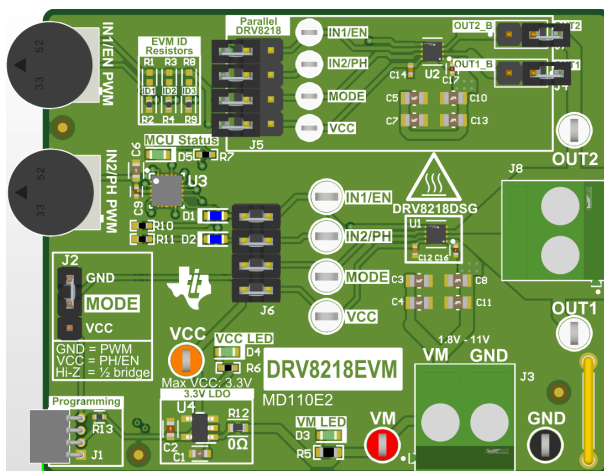
1. Order the EVM.
 - a. DRV8218EVM
2. Connect load and external power supply.
3. Use onboard potentiometers to control speed and direction of motor.

Features

- Onboard 3.3V LDO for digital voltage supply.
- Main signal header with removable shunts to disconnect main signals going from onboard MCU to DRV8218.
- Onboard potentiometers for input signal control.

Applications

- [Brushed DC motor, solenoid, and relay driving](#)
- [Electric toothbrush](#)
- [Beauty and grooming](#)
- [Electronic smart lock](#)
- [Water meters](#)
- [Gas meters](#)
- [Electricity meters](#)
- [Electronic and robotic toys](#)
- [IP network camera IR cut filter](#)
- [Video doorbell](#)
- [Blood pressure monitors](#)
- [Infusion pumps](#)



1 Evaluation Module Overview

1.1 Introduction

The DRV8218 is an H-bridge motor driver with PH/EN, PWM, and half-bridge control interfaces and a low power sleep mode.

The DRV8218 is an integrated H-bridge motor driver that supports a voltage range of 1.8 V to 11 V with up to 8 A peak current with four N-Channel power FETs, a charge pump regulator, and built-in protection circuitry. A tripler charge pump architecture enables operation down to 1.8 V, maintaining stable RDS(on) even at low battery voltages. All capacitors are integrated, minimizing PCB footprint and enabling 100% duty cycle operation. The DRV8218 includes integrated protection features such as undervoltage lockout (UVLO), overcurrent protection (OCP), and thermal shutdown (TSD).

This document is provided with the DRV8218 evaluation modules (EVMs) as a supplement to the DRV8218 datasheet. This user's guide covers EVM hardware setup and operational instructions.

1.2 Kit Contents

Table 1-1. DRV8218EVM Kit Contents

ITEM	QUANTITY
DRV8218EVM	1

1.3 Specification

The DRV8218EVM uses onboard potentiometers for control of the motor driver inputs. A 3.3V LDO generates a 3.3V rail from the power supply. The 3.3V rail is used to power the MSP430, and status LEDs. The J6 signal header uses removable shunts to pass the signals from the MCU to the motor driver. Remove any of these shunts to easily jump in external control signals to the driver if desired. Provide an external power supply to the J5 screw terminal within the operating range of the device. The DRV8218 supports 1.8V to 11V supply voltage range.

1.4 Device Information

The DRV8218 is an integrated H-bridge motor driver featuring four N-Channel power FETs, a charge pump regulator, and built-in protection circuitry. A tripler charge pump architecture enables operation down to 1.8V, maintaining stable RDS(on) even at low battery voltages. All capacitors are integrated, minimizing PCB footprint and enabling 100% duty cycle operation.

The device supports three control interface modes: PWM (IN1/IN2), phase/enable (PH/EN), and independent half bridge, as well as a parallel half-bridge mode. Each interface includes a low-power sleep mode that reduces quiescent current to under 120nA by shutting down most internal circuitry.

Output current reaches up to 8A peak, with a logic supply range of 1.8V to 5.5V and a motor supply range of 1.8V to 11V. Built-in protection includes undervoltage lockout (UVLO), overcurrent protection (OCP), and thermal shutdown (TSD). The DRV8218 is part of a pin-to-pin compatible family with scalable RDS(on) and supply voltage options.

The documents in [Table 1-2](#) provide information regarding Texas Instruments integrated circuits used in the assembly of the EVM. This user's guide is available from the TI web site under literature number SLVUDX4. Any letter appended to the literature number corresponds to the document revision that is current at the time of the writing of this document. Newer revisions are available from the TI web site at www.ti.com, or call the Texas Instruments Literature Response Center at (800) 477-8924 or the Product Information Center at (972) 644-5580. When ordering, identify the document by both title and literature number.

Table 1-2. TI ICs Used in the DRV8218EVM and Corresponding Datasheets

Description	Datasheet
Main MSP430 MCU	MSP430FR2100
Onboard LDO	TPS7B6933
Motor Driver	DRV8218

2 Hardware

2.1 Additional Images

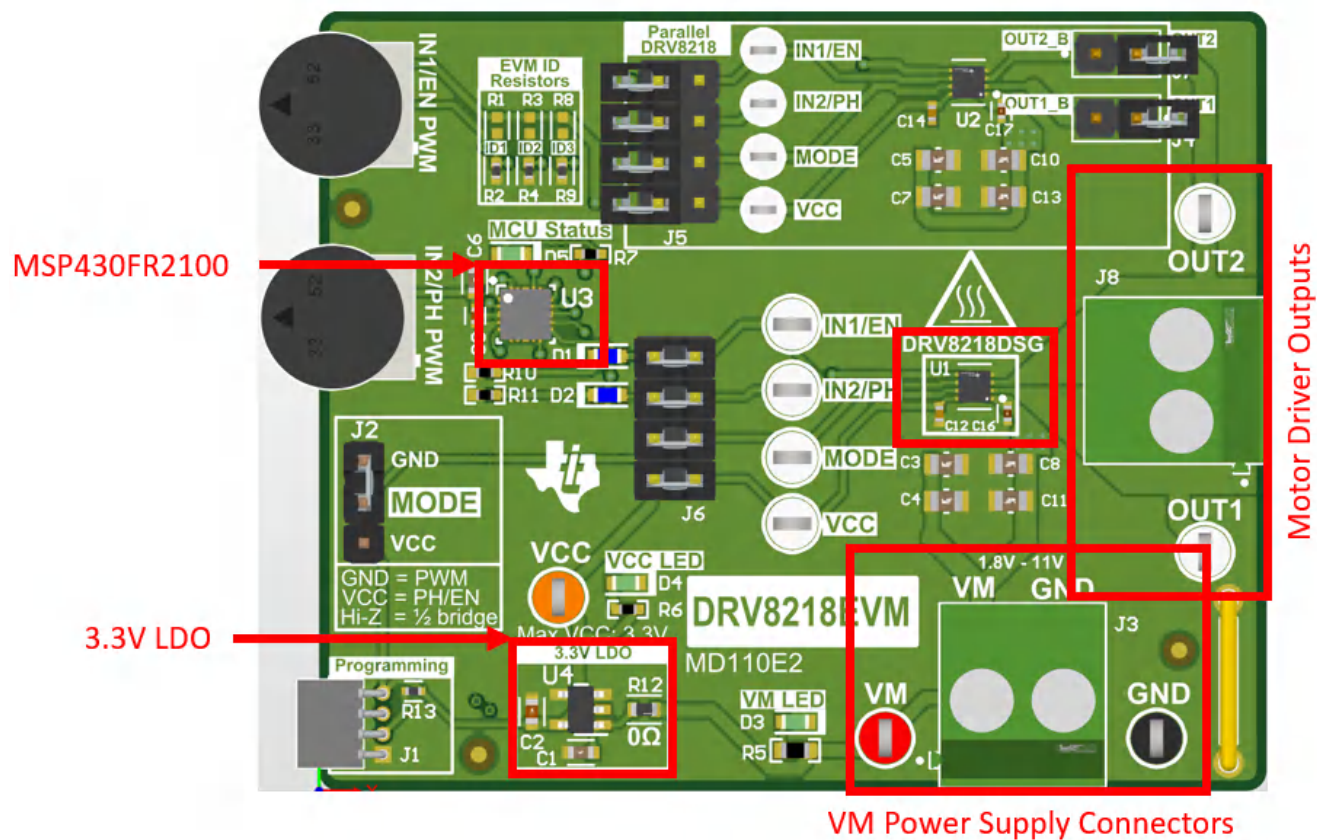


Figure 2-1. DRV8218EVM Top View

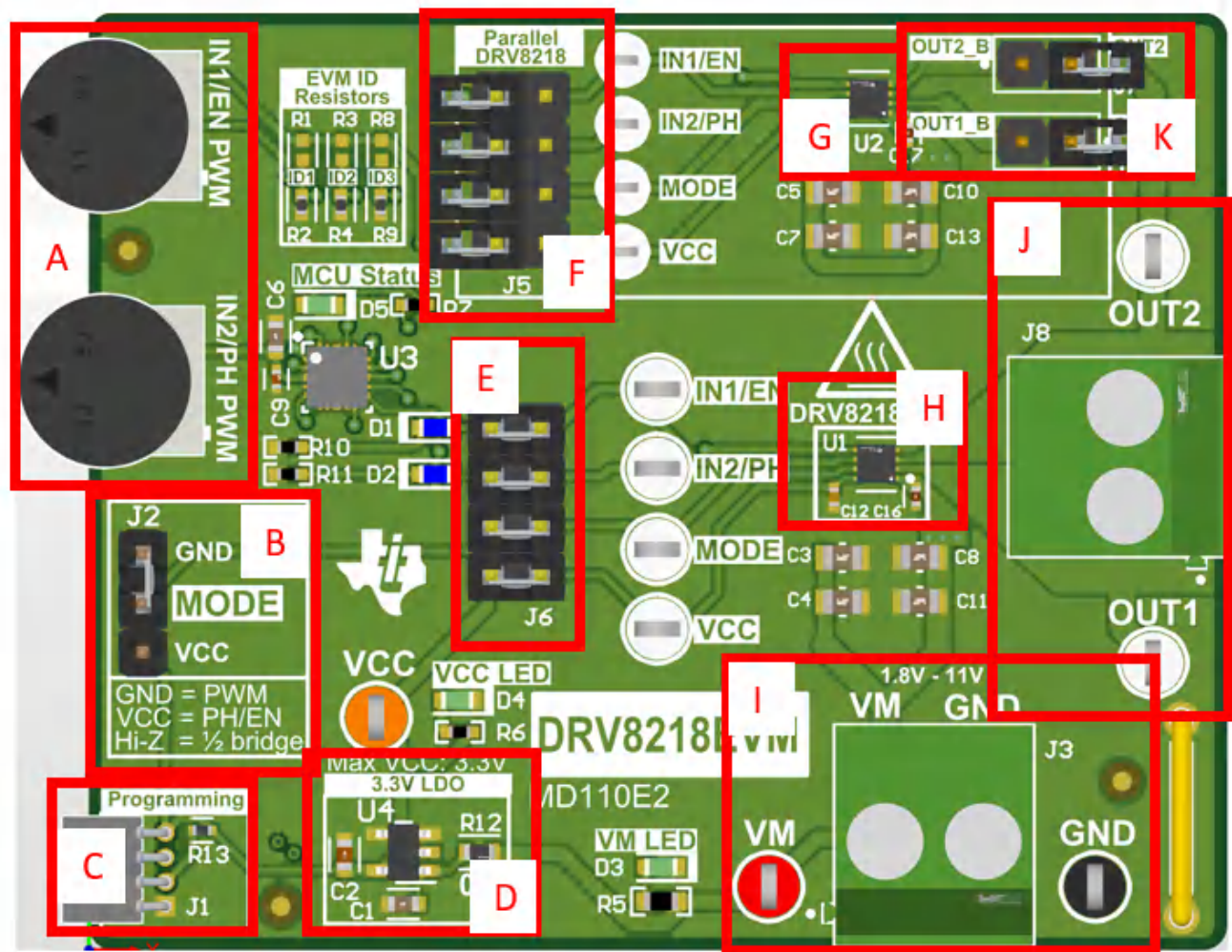


Figure 2-2. DRV8218EVM Header and Test Point Information

Table 2-1. Header and Test Point Description

Component Label	Description
A	Input potentiometers to control duty cycle of input signals to DRV8218.
B	Input control select - MODE to VCC: PH/EN - MODE to GND: PWM - MODE to Hi-Z: Independent half-bridge
C	4-pin connector to program MSP430FR2100 on the EVM
D	3.3V LDO
E	Main Signal Header (U1 device) - IN1/EN: Channel 1 input - IN2/PH: Channel 2 input - MODE: Input control select - VCC: 3.3V from LDO

Table 2-1. Header and Test Point Description (continued)

Component Label	Description
F	Main Signal Header (U2 device) • IN1/EN: Channel 1 input • IN2/PH: Channel 2 input • MODE: Input control select • VCC: 3.3V from LDO <i>ONLY USED WHEN PARALLELING DEVICES</i>
G	U2: DRV8218 Used during parallel operation
H	U1: DRV8218
I	VM power supply connectors
J	Motor driver output connectors
K	Parallel operation jumpers • Unpopulated for single device operation (U1) • Populated for parallel operation (U1 and U2)

2.2 Setup

2.2.1 Input Potentiometers and MODE Jumper

The MODE pin can be set to a corresponding control interface using the J2 jumper. The MODE pin selects the control interface by setting the pin either logic low, high, or Hi-Z.

Table 2-2. Control Mode Selection - MODE Pin

MODE STATE	CONTROL MODE
MODE = Logic Low	PWM
MODE = Logic High	PH/EN
MODE = Hi-Z	½ - Bridge

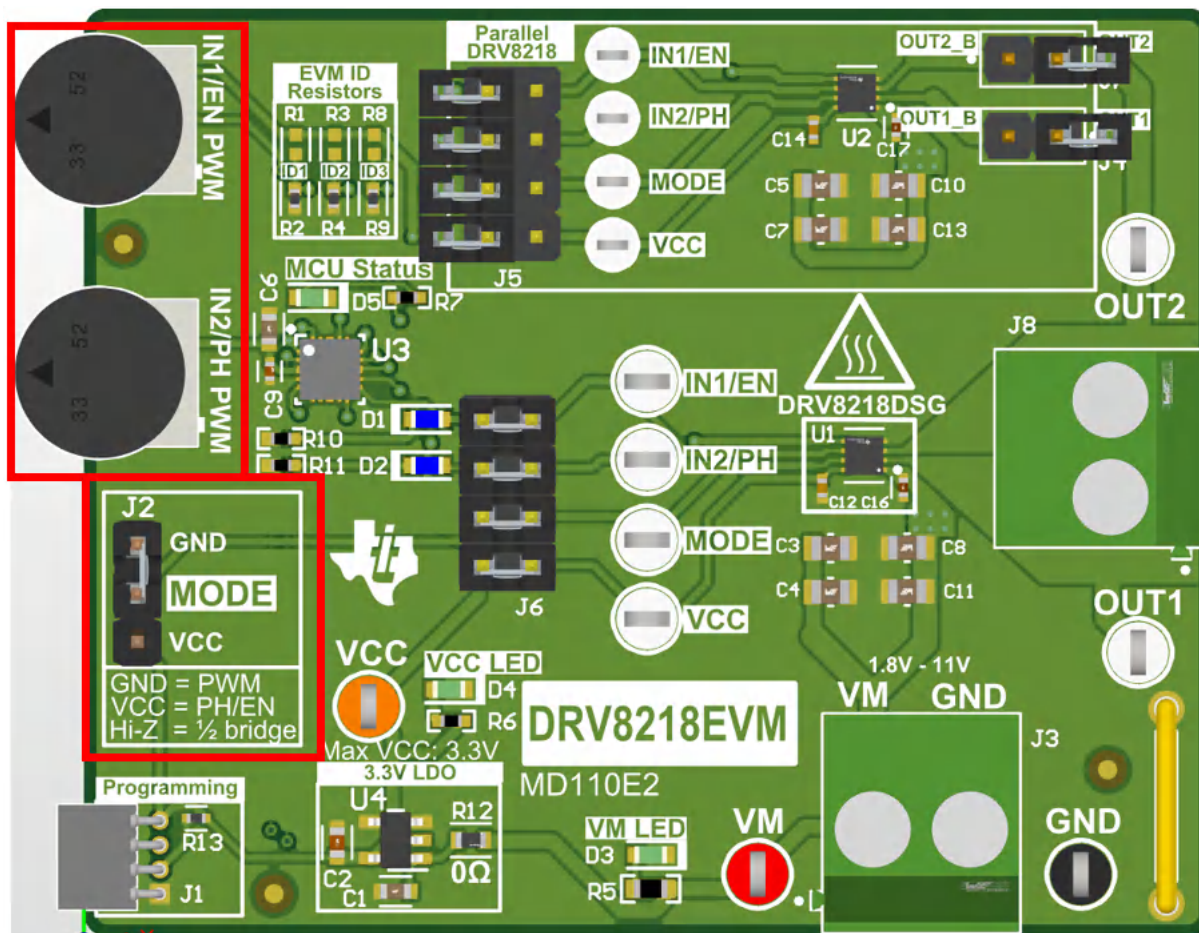


Figure 2-3. DRV8218EVM - MODE Pin Selection and Input Potentiometers

2.2.2 PWM Mode (MODE = Logic Low)

When the MODE pin is tied to GND or logic low, the control interface is set to PWM mode. In PWM mode, the two input pins IN1 and IN2 are used to drive the outputs pins (OUT1 and OUT2) using PWM or 100% duty cycle. The PWM mode allows for the H-Bridge to recirculate the current during PWM off time through both Coast mode (H-Bridge Hi-Z) or Brake mode (low-side slow decay).

Table 2-3. PWM Mode Control

IN1	IN2	OUT1	OUT2	Description
LOW- turn IN1/EN PWM pot completely counter-clockwise	LOW- turn IN2/PH PWM pot completely counter-clockwise	Hi-Z	Hi-Z	Coast (H-bridge Hi-Z)/ Low-power automatic sleep mode
PWM - turn IN1/EN PWM pot in any position	HIGH- turn IN2/PH PWM pot completely clockwise	L	H	Reverse (OUT2 -> OUT1)
HIGH- turn IN1/EN PWM pot completely clockwise	PWM - turn IN2/PH PWM pot in any position	H	L	Forward (OUT1 -> OUT2)
HIGH- turn IN1/EN PWM pot completely clockwise	HIGH- turn IN2/PH PWM pot completely clockwise	L	L	Brake (low-side slow decay)

2.2.3 PH/EN Mode (MODE = Logic High)

When the MODE pin is tied to 3.3V or logic high, the control interface is set to PH/EN mode. In PH/EN mode only one PWM signal is needed on EN pin to control speed of the motor and a GPIO (high or low) signal is needed on PH pin to control direction. The PH/EN mode allows for the H-Bridge to enter a Brake state (low-side slow decay) when the EN pin is pulled low.

Table 2-4. PH/EN Mode Control

EN	PH	OUT1	OUT2	Description
LOW- turn IN1/EN PWM pot completely counter-clockwise	X	L -> Hi-Z	L -> Hi-Z	Brake (low-side slow decay) for tAUTOSLEEP, then auto-sleep mode (H-Bridge Hi-Z)
PWM - turn IN1/EN PWM pot in any position	LOW- turn IN2/PH PWM pot completely counter-clockwise	L	H	Reverse (OUT2 -> OUT1)
PWM - turn IN1/EN PWM pot in any position	HIGH- turn IN2/PH PWM pot completely clockwise	H	L	Forward (OUT1 -> OUT2)

2.2.4 Half-Bridge (MODE = Hi-Z)

When the MODE pin is floating (Hi-Z), the device is in half-bridge control mode. This mode allows for each half bridge to be directly controlled to support high-side slow decay (or brake), driving two independent loads, or paralleling the outputs for higher current capability for a single load.

Table 2-5. Half-Bridge Mode Control

IN1	IN2	OUT1	OUT2	Description
0	X	L	X	OUT1 low-side on
1	X	H	X	OUT1 high-side on
X	0	X	L	OUT2 low-side on
X	1	X	H	OUT2 high-side on

2.2.5 Parallel Multiple Drivers

The DRV8218EVM supports the ability to parallel two devices to drive one load with lower RDS(on) than a single driver. PWM or PH/EN mode is recommended when using multiple DRV8218 in parallel so that the devices can automatically handle the dead time. If half-bridge mode is used, the dead time must be manually inserted between turning off a high-side FET and turning on the low-side FETs to avoid shoot-through.

The connections for parallel mode are made easy with jumper connections on the EVM. To connect the corresponding input and output signals together, populate all jumpers on J5 and J7.

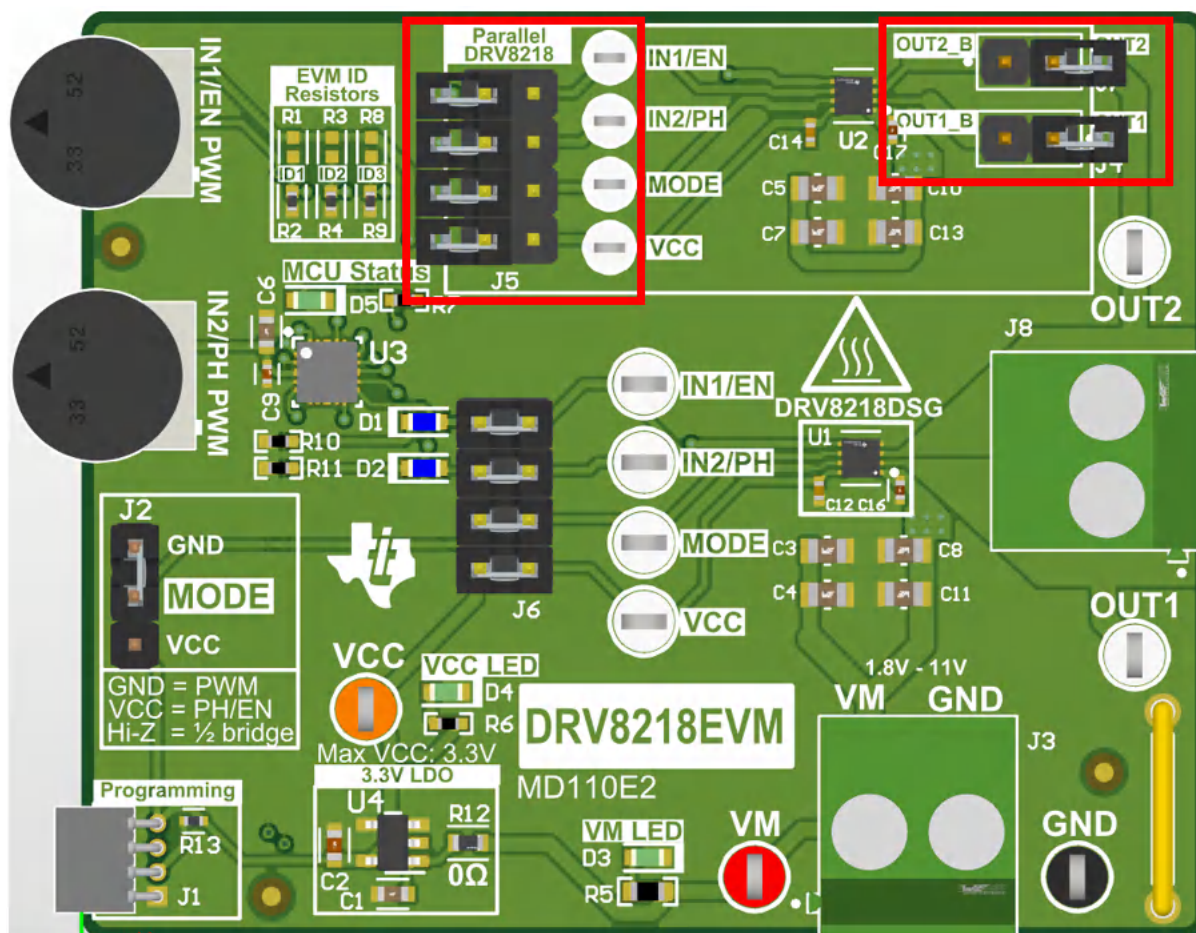


Figure 2-4. DRV8218EVM - Parallel Mode Connections

3 Hardware Design Files

The schematics, bill of materials (BOM), PCB layout, and 3D model STEP file for each EVM can be downloaded on the respective product folder page under the Design Files section.

- <http://www.ti.com/tool/DRV8218EVM#design-files>

3.1 Schematics

The following images below show DRV8218EVM schematics. These schematics are available for download from the Hardware Design Files from the EVM tool folder under the Design Files section.

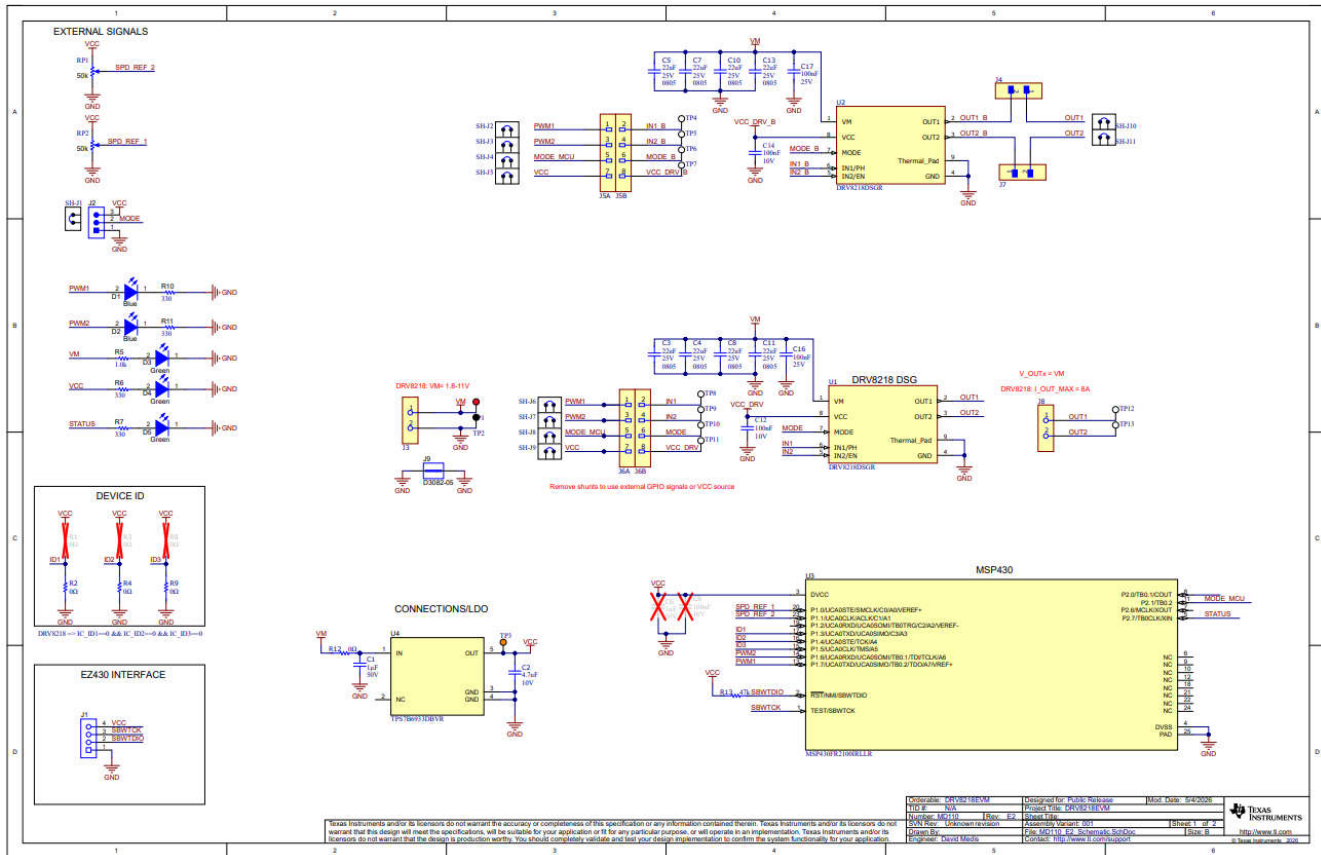


Figure 3-1. DRV8218EVM Schematic

3.2 PCB Layouts

The following figures show the PCB layers of the EVM. The Altium source files can be downloaded in the Hardware Design Files for a given EVM.

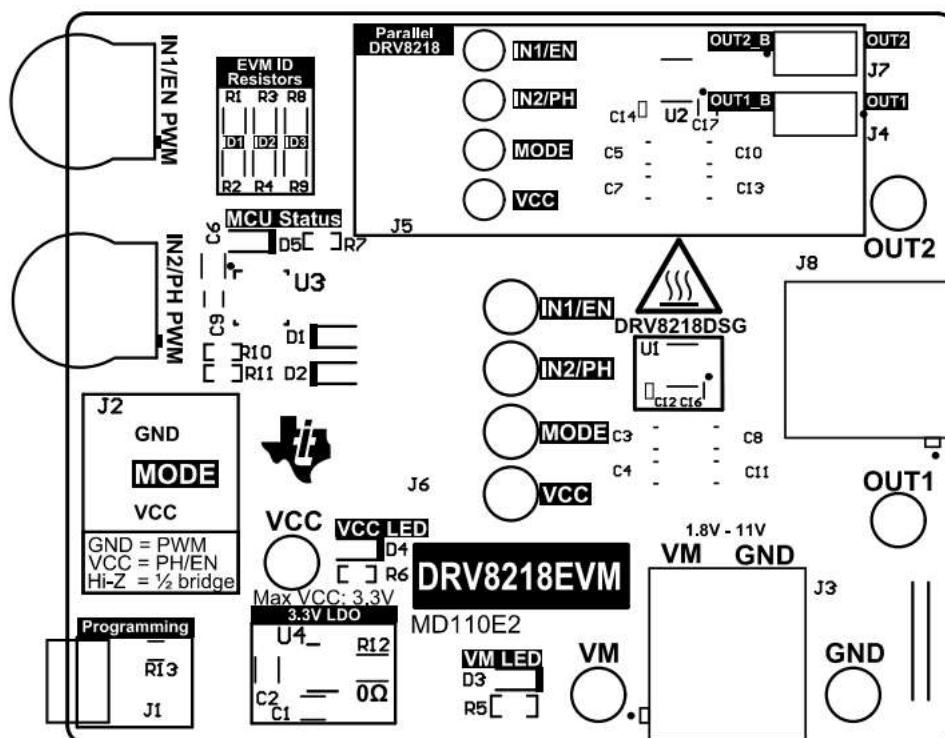


Figure 3-2. Top View

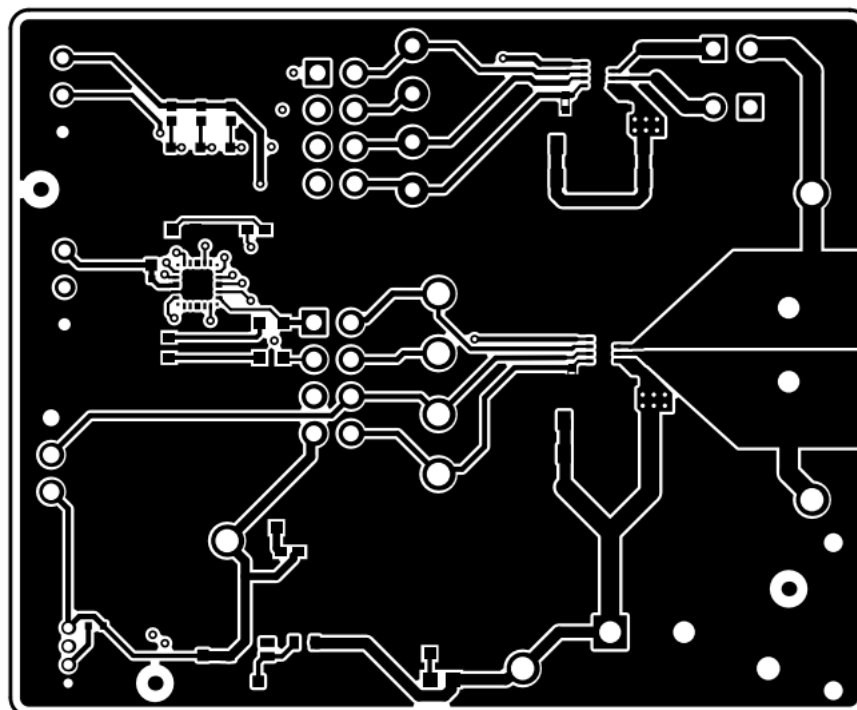


Figure 3-3. Top Layer

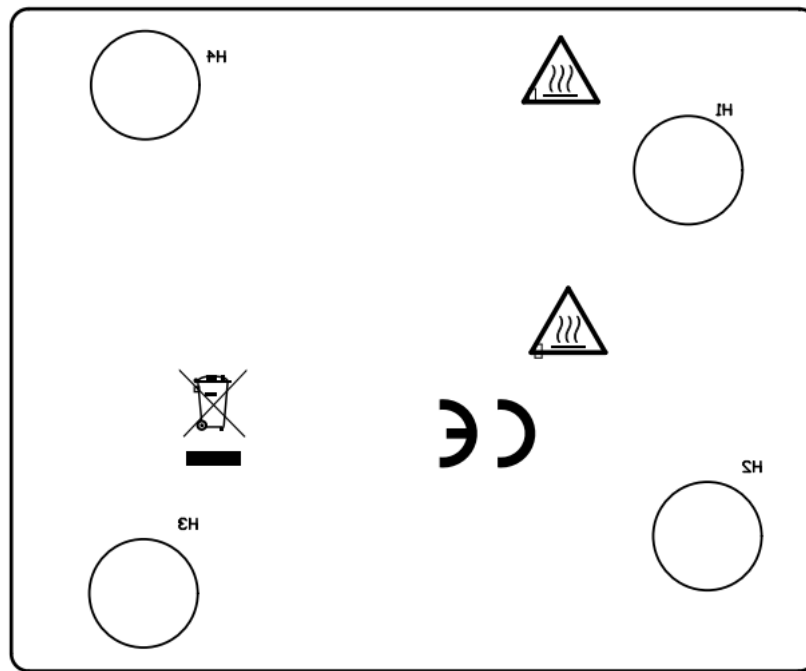


Figure 3-4. Bottom View

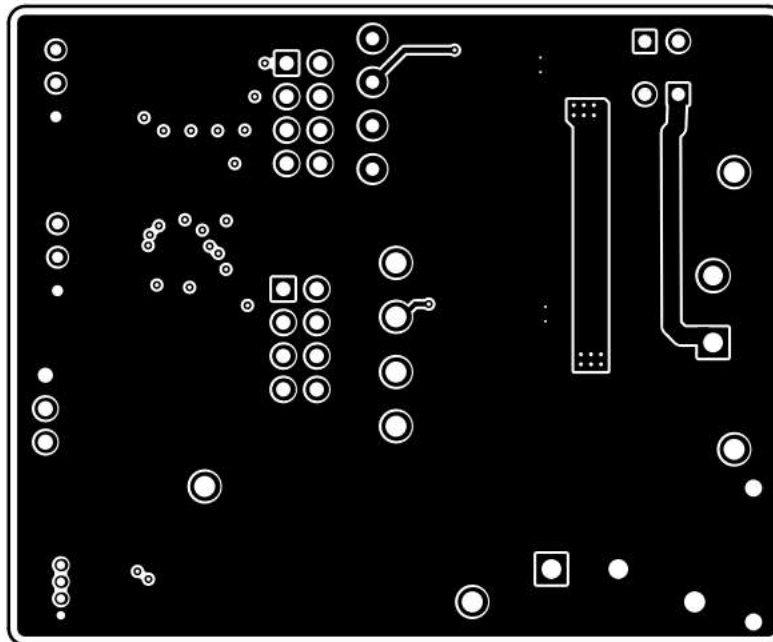


Figure 3-5. Bottom Layer

3.3 Bill of Materials (BOM)

The following provides the parts list for DRV8218EVM.

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
!PCB1	1		Printed Circuit Board		MD110	Any

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
C1, C6	2	1 μ F	1 μ F $\pm$ 10% 50V Ceramic Capacitor X7R 0603 (1608 Metric)	0603	885012206126	Würth Electronics
C2	1	4.7 μ F	4.7 μ F $\pm$ 20% 10V Ceramic Capacitor X5R 0603 (1608 Metric)	0603	885012106012	Würth Electronics
C3, C4, C5, C7, C8, C10, C11, C13	8	22 μ F	Ceramic Capacitor 0805 22 μ F $\pm$ 20% 25V X5R	0805	885012107019	Würth
C9	1	100nF	0.1 μ F $\pm$ 10% 10V Ceramic Capacitor X7R 0402 (1005 Metric)	0402	885012205018	Würth Electronics
C12, C14	2		0.1 μ F $\pm$ 10% 10V Ceramic Capacitor X7R 0402 (1005 Metric)	0402	885012205018	Würth Elektronik
C16, C17	2	100nF	CAP, CERAMIC, 0402, X7R, 100nF, 25V, $\pm$ 15 %, SMD	0402	885012205085	Würth Electronics
D1, D2	2	Blue	LED, Blue, SMD	LED_0603	150060BS75000	Würth Elektronik
D3, D4, D5	3	Green	LED, Green, SMD	LED_0603	150060VS75000	Würth Elektronik
FID1, FID2, FID3	3		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
H1, H2, H3, H4	4		Bumpon, Cylindrical, 0.312 X 0.200, Black	Black Bumpon	SJ61A1	3M
J1	1		SOCKET .050" GRID SIP 4 POS R/A, TH	R/A 4x1 receptacle	851-43-004-20-001000	Mill-Max
J2	1		Header, 2.54mm, 3x1, Gold, TH	Header, 2.54mm, 3x1, TH	61300311121	Würth Elektronik
J3, J8	2		2 Position Wire to Board Terminal Block Horizontal with Board 0.200" (5.08mm) Through Hole	HHR2	691236510002	Würth Electronics
J4, J7	2		Connector Header Through Hole 2 position 0.100" (2.54mm)	HDR2	PH1-02-UA	Adam Tech
J5, J6	2		CONN HEADER VERT 8POS 2.54MM	HDR8	61300821121	Würth Electronics
J9	1		1mm Uninsulated Shorting Plug, 10.16mm spacing, TH	Shorting Plug, 10.16mm spacing, TH	D3082-05	Harwin
R2, R4, R9	3	0 Ω	0 Ohms Jumper 0.1W, 1/10W Chip Resistor 0402 (1005 Metric) - Thick Film	0402	CR0402-10W-000T	Venkel
R5	1	1.0k	RES, 1.0 k, 5%, 0.25 W, AEC-Q200 Grade 0, 0603	0603	ESR03EZPJ102	Rohm

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
R6, R7, R10, R11	4	330	RES, 330, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW0402330RFKE D	Vishay-Dale
R12	1	0Ω	0 Ohms Jumper 0.1W, 1/10W Chip Resistor 0603 (1608 Metric) Automotive AEC-Q200 Thick Film	0603	ERJ-3GEY0R00V	Panasonic
R13	1	47k	47 kOhms ±5% 0.1W, 1/10W Chip Resistor 0402 (1005 Metric) Automotive AEC-Q200 Thick Film	0402	ERJ-2GEJ473X	Panasonic
RP1, RP2	2	50k	Trimming Potentiometer, 50K, 0.5W, TH	9.53x8.89mm	3352T-1-503LF	Bourns
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8, SH-J9, SH-J10, SH-J11	11		Shunt, 2.54mm, Gold, Black	Shunt, 2.54mm, Black	60900213421	Würth Elektronik
TP1	1		Test Point, Multipurpose, Red, TH	Red Multipurpose Testpoint	5010	Keystone Electronics
TP2	1		Test Point, Multipurpose, Black, TH	Black Multipurpose Testpoint	5011	Keystone Electronics
TP3	1		Test Point, Multipurpose, Orange, TH	Orange Multipurpose Testpoint	5013	Keystone Electronics
TP4, TP5, TP6, TP7	4		Test Point, Miniature, White, TH	White Miniature Testpoint	5002	Keystone Electronics
TP8, TP9, TP10, TP11, TP12, TP13	6		Test Point, Multipurpose, White, TH	White Multipurpose Testpoint	5012	Keystone Electronics
U1, U2	2		DRV8218DSGR	WSON8	DRV8218DSGR	Texas Instruments
U3	1		16MHz Ultra-Low-Power Microcontroller With 1KB FRAM, 0.5KB SRAM, 12 IO, 8 ch 10-bit ADC, RLL0024A (VQFN-24)	RLL0024A	MSP430FR2100IRLL R	Texas Instruments
U4	1		40V Ultralow-Iq Low-Dropout Regulator, DBV0005A (SOT-23-5)	DBV0005A	TPS7B6933DBVR	Texas Instruments
R1, R3, R8	0	0Ω	0 Ohms Jumper 0.1W, 1/10W Chip Resistor 0402 (1005 Metric) - Thick Film	0402	CR0402-10W-000T	Venkel

4 Additional Information

Trademarks

All trademarks are the property of their respective owners.

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.
 - 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software
 - 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.
2. *Limited Warranty and Related Remedies/Disclaimers:*
 - 2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
 - 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.

WARNING

Evaluation Kits 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 shall operate the Evaluation Kit within TI's recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI's recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI's instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGRADATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

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 instructions, 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/sds/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。

<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html>

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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2. 実験局の免許を取得後ご使用いただく。
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3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/sds/ti_ja/general/eStore/notice_02.page

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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.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

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