

DRV110 and DRV120 Evaluation Modules (EVM)

This document describes the features and operation of the DRV110 and DRV120 Evaluation Modules (EVM). This EVM is a Texas Instruments HV EVM providing the key components necessary for evaluation of a DRV110 or a DRV120 integrated circuit (IC). This document shows how to power the DRV110 and DRV120 ICs with the EVM and contains the schematic, a printed circuit board (PCB), and a bill of materials.



Figure 1. DRV110 and DRV120 EVM

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1 Background

The DRV110 IC is a power-saving pulse-width modulator (PWM) controller for solenoids with an internal supply regulator designed for a wide voltage range. The DRV120 IC provides similar load-current control with an integrated MOSFET switch output stage allowing a wide internal supply voltage range.

The 14-pin DRV110 and DRV120 IC are labeled on the board as U1. Peripheral components required to evaluate device features are also on the EVM. An external power supply and solenoid load (not provided with the EVM) must be wired to connectors on the EVM and the board must be configured before use. Various signals on the board can be accessed through test points and an output connector.

This EVM provides access to the features of the DRV110 or DRV120 ICs. Some modifications can be made to this module to test performance at different input and output voltages, currents and frequencies. Contact the TI Field Applications Group for more information.

2 Recommended Operating Conditions and Specifications

Never exceed operating conditions and ratings in [Table 1](#) and [Table 2](#).

Table 1. DRV110 and DRV120EVM Operating Conditions

Device	Parameter	Description	Connector	Min	Typ	Max	Unit	Notes
DRV110 DRV120	T_A	Operating ambient temperature	N/A	-40		35	°C	
DRV110	V_{DC}	DC supply voltage	P1: 1	7		48	V	
	I_{DC}	DC supply current	P1: 1		50	100 0	mA	
	V_{AC}	AC supply voltage	P2: 1,4	100		240	V_{rms}	50/60 Hz
	I_{AC}	AC supply current, P1: 1	P2: 1,4		50	500	mA_{rms}	Currents above 500 mA are only supported momentarily.
	V_{VLIMIT}	Intermediate supply node VLIMIT	P3: 1	7		18	V	Zener protected
DRV120	V_{DC}	DC supply voltage	P1: 1	7		28	V	
	I_{DC}	DC supply current	P1: 1		50	280	mA	
	V_{VLIMIT}	Intermediate supply node VLIMIT	P3: 1	7		28	V	Zener protected

Table 2. DRV110 and DRV120EVM Specification Summary

Device	Parameter	Operational Range
DRV110	I_{PEAK}	30–900 mA
	I_{HOLD}	30–150 mA
DRV120	I_{PEAK}	30–250 mA
	I_{HOLD}	30–100 mA
DRV110 DRV120	f_{PWM}	10–60 kHz
DRV110 DRV120	t_{KEEP}	Maximum 200 ms

3 Hardware Description

The EVM contains a switching transistor; Q2, a current sense resistor; R8, and a current recirculation diode; D1. Three 4-terminal connectors are provided for powering and measuring the EVM. The EVM is configured using jumpers. Test points are used to access signals on the board. Trimming potentiometers for external parameter settings to the DRV110 and DRV1120 ICs. See [Figure 2](#) for the EVM schematic.

3.1 Header Description

Descriptions of the 4-terminal connectors P1, P2 and P3 are shown in [Table 3](#).

Table 3. Header Description

Connector	Type	Label on the board	Description
P1: 1	Supply	VDC	Fuse protected DC supply voltage of the board
P1: 2	Load	COIL+	Terminal for inductive load, same potential as VDC terminal
P1: 3	Supply	GND	GND pin, ground node of the board
P1: 4	Load	COIL–	Terminal for inductive load
P2: 1-4	Supply ⁽¹⁾	AC, GND, GND, AC	Fuse protected AC supply voltage of the board
P3: 1	Output	VLIMIT	Intermediate supply voltage node with over voltage protection for DRV110 or DRV120 IC
P3: 2	Output	OUT	Connection to OUT pin of DRV110 or DRV120
P3: 3	Output	SENSE	Connection to SENSE pin of DRV110
P3: 4	Output	GND	GND pin, ground node of the board

⁽¹⁾ Only used with DRV110

3.2 Board Configuration and Jumper Description

The DRV110 and DRV120EVMs are designed for both the DRV110 and DRV120 ICs and can be operated from various types of power supplies. The jumper placement on the board must be correctly configured before power-up, as shown in [Table 4](#).

Table 4. Board Configuration

Device	Function	Jumper	Placement	Power Configuration	Comment
DRV110 DRV120	Board configuration	JP1	Insert jumper to close load-current recirculation path	N/A	Inserted by default
		JP2	Insert jumper to connect OSC to 1-M Ω trimmer		
DRV110 (leave open with DRV120)	Supply configuration	JP3	Insert jumper to select 10-k Ω series resistor R3	7-48 VDC, 1 A	Selection based on supply voltage and desired supply current.
		JP4	Insert jumper to select 200-k Ω series resistor R2	100-240 VAC, 1 A	
		JP5	Insert jumper to select 300-k Ω series resistor R1	100-240 VAC, 1 A	
DRV120 (leave open with DRV110)	Supply configuration	JP6	Insert jumper to bypass R1, R2, and R3 series resistors	7-28 VDC, 1 A	Inserted by default in DRV120
	Board configuration	JP7	Insert jumper to connect OUT to VCOIL	N/A	
		JP8	Insert jumper to bypass R10 series resistor		
DRV110 DRV120	Enable DRV110 and DRV120	JP9	Insert jumper to disable the device, leave open to enable	N/A	

3.3 Device Parameter Settings

The operating point and parameters of DRV110 and DRV120 are adjusted using components on the EVM as shown in [Table 5](#).

Table 5. Device Parameter Settings

Designator	Description	Comment
R3	10-k Ω trimmer, sets V_{IN} current of DRV110	Resistance value increases clockwise
R4	1-M Ω trimmer, sets I_{PEAK}	Resistance value increases clockwise
R5	1-M Ω trimmer, sets I_{HOLD}	Resistance value increases clockwise
R6	1-M Ω trimmer, sets f_{PWM}	Resistance value increases clockwise

3.4 Test Points

Test points of the board are show in [Table 6](#).

Table 6. Test Point Description

Designator	Description
TP1	Current SENSE pin of DRV110
TP2	OUT pin
TP3	EN pin
TP4	KEEP pin
TP5	OSC pin
TP6	PEAK pin
TP7	HOLD pin
TP8	STATUS pin
TP9	GND pin
TP10	VLIMIT net
TP11	V_{IN} pin
TP12	GND pin

3.5 Schematic

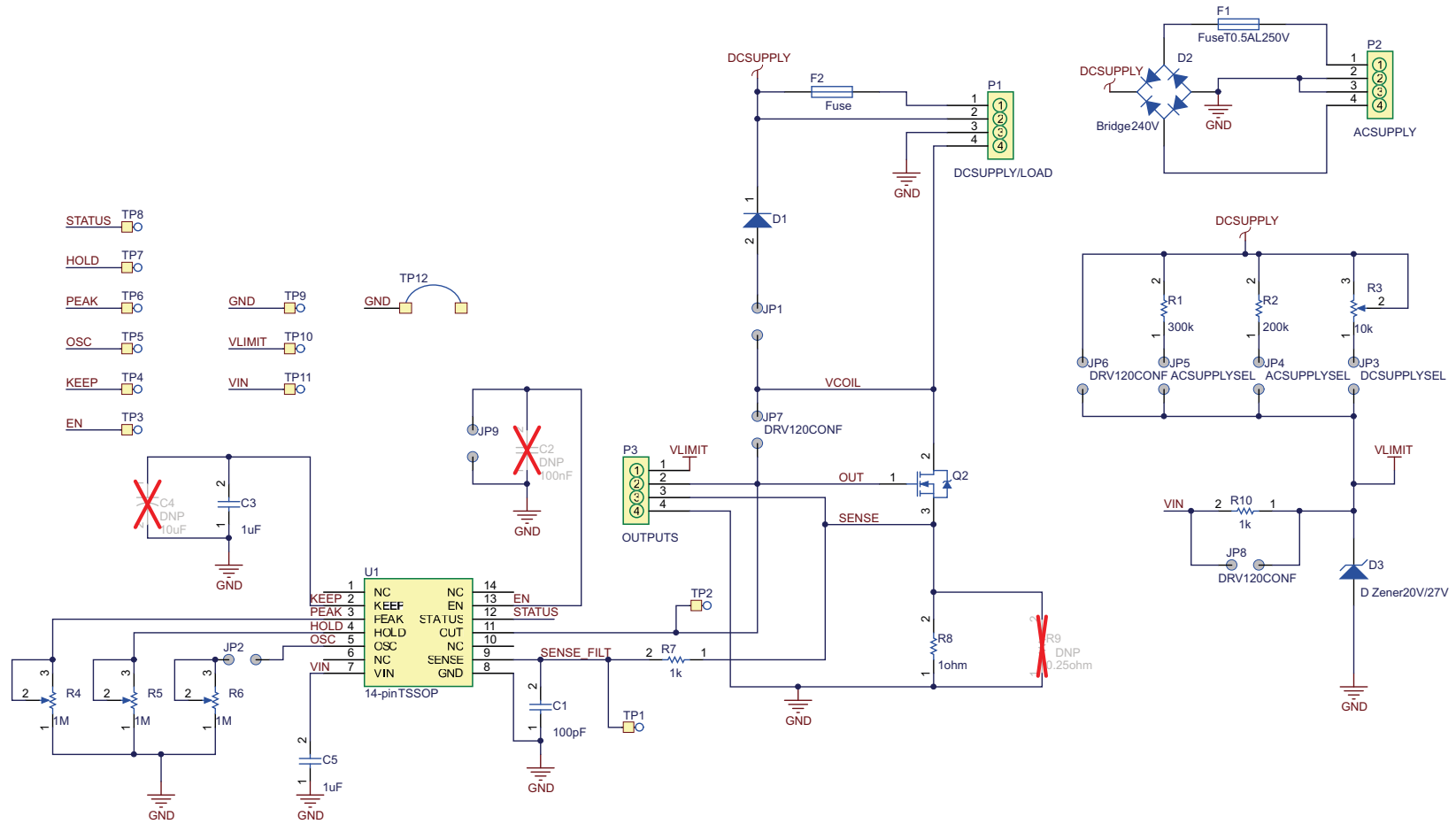


Figure 2. DRV110EVM Schematic

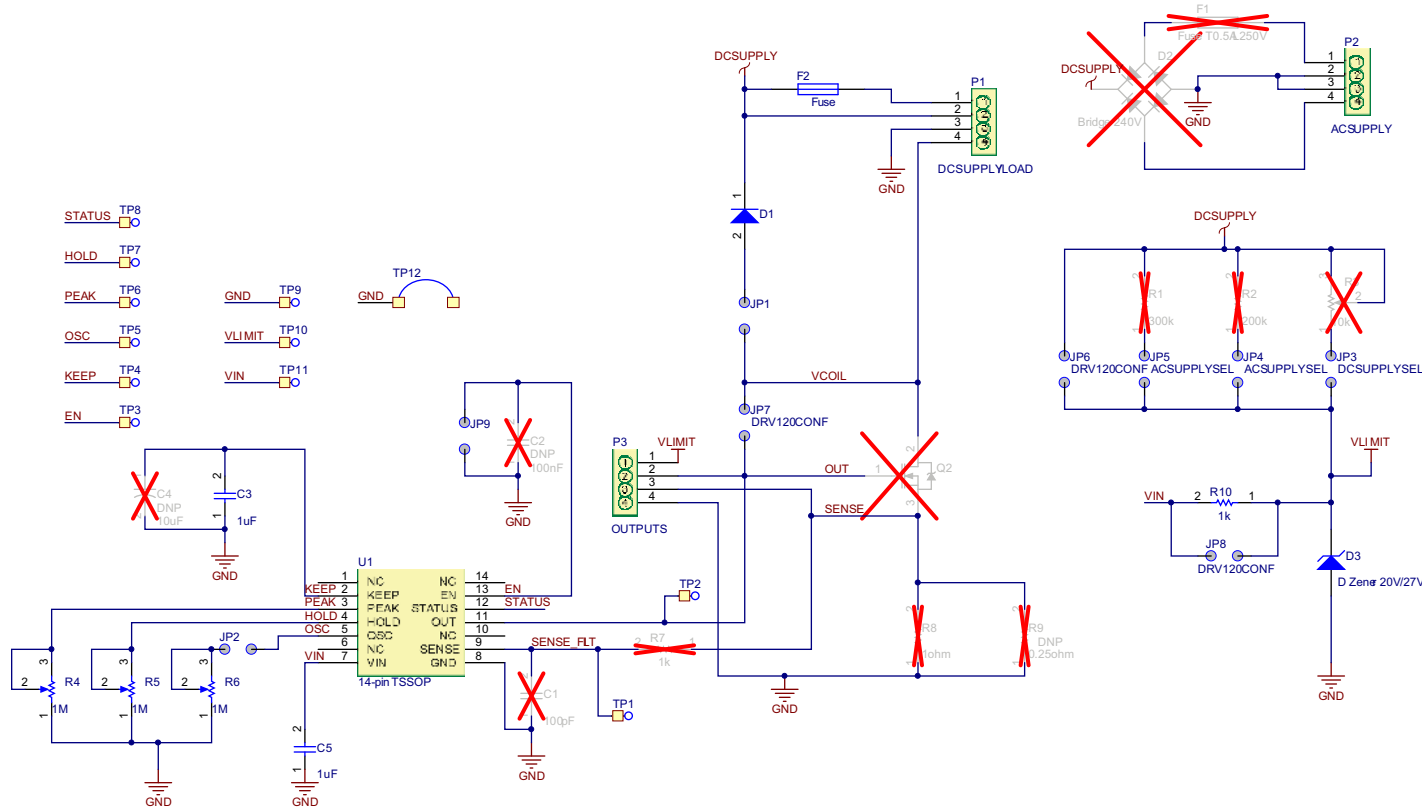


Figure 3. DRV120EVM Schematic

3.6 DRV110 and DRV120EVM Board Layouts

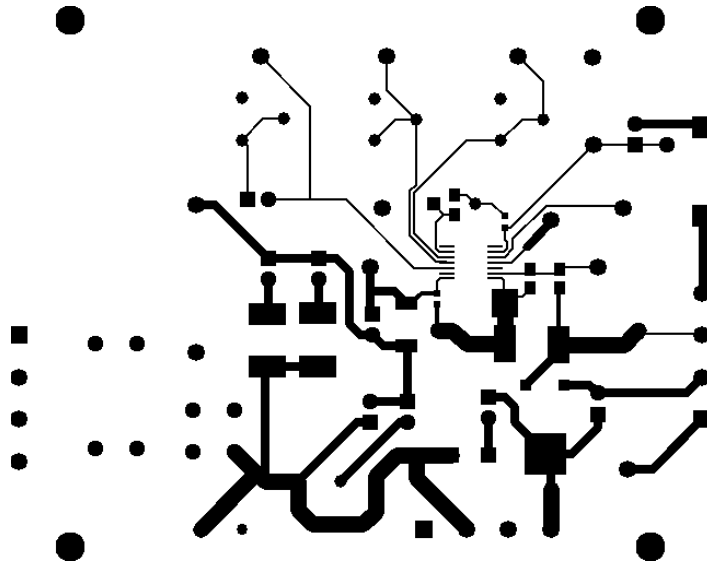


Figure 4. Top Layer Board Layout

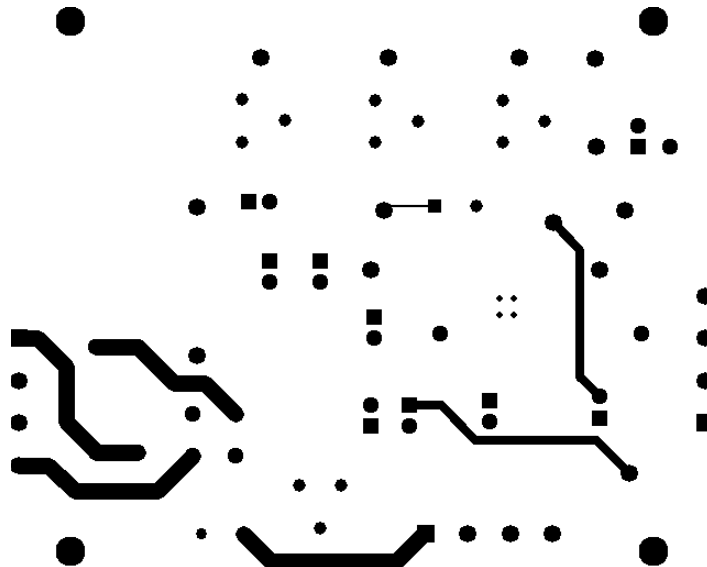


Figure 5. Bottom Layer Board Layout

4 Operation

4.1 Safety

WARNING

This EVM does not provide any kind of safety isolation, therefore, all voltages on the EVM are considered hazardous. Use isolated equipment when working with the EVM. Minimize the risk of fire hazard by replacing fuse F1 only with fuse T0.5AL250V.

Power supply connectors of the EVM, P1 and P2, are protected by fuses F1 and F2, respectively. The supply pin of the DRV110 or DRV120 IC is protected by Zener-diode; D3, allowing time for power supply overcurrent protection to trip. It is not intended to carry significant currents continuously.

Components on the EVM may become hot in normal use or because of abnormal configuration or violation of the operating conditions.

CAUTION

Do not leave the EVM powered when unattended.

4.2 Power-up Procedure

CAUTION

Always assume the entire EVM has fully-accessible and active high voltages.

When using the EVM to change measurement setup, access jumpers, wire test instruments, supplies or loads, use the following procedures:

1. De-energize the TI HV EVM and all its inputs, outputs and electrical loads before performing any electrical or diagnostic measurements. Revalidate that the TI HV EVM power has been safely de-energized.
2. Once the EVM is de-energized, proceed with the required electrical circuit configurations, wiring, measurement equipment connections, and other application needs. Continue to assume the EVM circuit and measuring instruments are electrically live.
3. Once EVM readiness is complete, energize the EVM.

Before connecting a load to the EVM it is recommended to test that board configuration and device power supply biasing is correctly set. The following procedure is recommended:

1. Ensure jumpers JP1 and JP2 are in place and that JP9 is left open.
2. Configure the board to test DRV110 or DRV120.
3. Configure the board to the power-supply type used.
4. Turn trimmers R4, R5, and R6 in a counter clockwise direction, as far as they go.
5. If a 14-V (V_{IN}) voltage is used for DRV110, ensure the V_{IN} pin current is limited by the series resistance. It is always a good practice, when applicable, to use too much resistance first and then to decrease the resistance and observe the effect on supply voltages.
6. During this procedure use a current limit in the EVM power supply. This current limit, along with Zener diode D3, protects device V_{IN} pin for over voltage.
7. Increase the power-supply voltage, if applicable, and observe supply voltages V_{IN} and VLIMIT on the board.

5 Bill of Materials
Table 7. DRV110 BOM

Designator	Digi-Key Part Number	Quantity	Description
C1	445-1329-1-ND	1	CAP CER 100PF 50V 5% NP0 0805
C3	399-5763-1-ND	1	CAP CER 1UF 10V 5% X8L 0805
C5	587-1437-1-ND	1	CAP CER 1UF 35V 10% X5R 0603
D1	497-3776-1-ND	1	DIODE FAST 600V 2A HE SMB
D2	W04GDI-ND	1	RECT BRIDGE GPP 400V 1.5A WOG
D3	1N5357BGOS-ND	1	DIODE ZENER 20V 5W AXIAL
F1	3521K-ND	2	CLIP FUSE 2AG/5MM THM W/LEGS 10A
F1 (mate)	MJS 500-R -ND	1	FUSE 500MA 250V SLOW 5X15 BULK
F2	507-1111-ND	1	FUSE SLOW 250VAC 1A RADIAL
JP1, JP2, ..., JP9	609-4434-ND	9	CONN HEADER 2POS VERT T/H
JP1, JP2, ..., JP9 (mate)	A26227-ND	9	SHUNT, ECON, PHBR 15 AU, BLACK
P1, P2, P3	A98232-ND	3	TERM BLOCK HEADER 4POS 5.08MM
P1, P2, P3 (mate)	A98225-ND	3	TERM BLOCK PLUG 4POS 5.08MM
Q2	497-2483-1-ND	1	MOSFET N-CH 600V 1A DPAK
R1	541-300KXCT-ND	1	RES 300K OHM 1W 5% 2512 SMD
R2	541-200KXCT-ND	1	RES 200K OHM 1W 5% 2512 SMD
R3	3310Y-001-103L-ND	1	POT 10K OHM 9MM SQ PLASTIC
R4, R5, R6	3310Y-001-105L-ND	3	POT 1.0M OHM 9MM SQ PLASTIC
R7	RMCF0805JT1K00CT-ND	1	RES 1K OHM 1/8W 5% 0805 SMD
R8	541-1.00AAFCT-ND	1	RES 1.00 OHM 1W 1% 2512 SMD
R10	RHM1.00KBFCT-ND	1	RES 1.00K OHM 1/2W 1% 2010 SMD
TP9	5001K-ND	1	TEST POINT PC MINI .040"D BLACK
TP10, TP11	5000K-ND	2	TEST POINT PC MINI .040"D RED
TP1, TP2, ..., TP8	5002K-ND	8	TEST POINT PC MINI .040"D WHITE
TP12	952-1474-1-ND	1	JUMPER TIN SMD
U1	n/a	1	DRV110
C2		1	NOT ASSEMBLED
C4		1	NOT ASSEMBLED
R9		1	NOT ASSEMBLED

Table 8. DRV120 BOM

Designator	Digi-Key Part Number	Quantity	Description
C3	399-5763-1-ND	1	CAP CER 1UF 10V 5% X8L 0805
C5	587-1437-1-ND	1	CAP CER 1UF 35V 10% X5R 0603
D1	497-3776-1-ND	1	DIODE FAST 600V 2A HE SMB
D3	1N5361BRLGOSCT-ND	1	DIODE ZENER 27V 5W AXIAL
F2	507-1111-ND	1	FUSE SLOW 250VAC 1A RADIAL
JP1, JP2,...., JP9	609-4434-ND	9	CONN HEADER 2POS VERT T/H
JP1, JP2,...., JP9 (mate)	A26227-ND	9	SHUNT, ECON, PHBR 15 AU,BLACK
P1, P2, P3	A98232-ND	3	TERM BLOCK HEADER 4POS 5.08MM
P1, P2, P3 (mate)	A98225-ND	3	TERM BLOCK PLUG 4POS 5.08MM
R4, R5, R6	3310Y-001-105L-ND	3	POT 1.0M OHM 9MM SQ PLASTIC
R10	RHM1.00KBFCT-ND	1	RES 1.00K OHM 1/2W 1% 2010 SMD
TP9	5001K-ND	1	TEST POINT PC MINI .040"D BLACK
TP10, TP11	5000K-ND	2	TEST POINT PC MINI .040"D RED
TP1, TP2,...., TP8	5002K-ND	8	TEST POINT PC MINI .040"D WHITE
TP12	952-1474-1-ND	1	JUMPER TIN SMD
U1	n/a	1	DRV120
C1		1	NOT ASSEMBLED
C2		1	NOT ASSEMBLED
C4		1	NOT ASSEMBLED
R9		1	NOT ASSEMBLED
Q2		1	NOT ASSEMBLED
F1		2	NOT ASSEMBLED
R7		1	NOT ASSEMBLED
R8		1	NOT ASSEMBLED
R1		1	NOT ASSEMBLED
R2		1	NOT ASSEMBLED
R3		1	NOT ASSEMBLED
D2		1	NOT ASSEMBLED

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit www.ti.com/esh or contact TI.

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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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2. 実験局の免許を取得後ご使用いただく。
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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.

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