

# **LMH6586 User's Guide**

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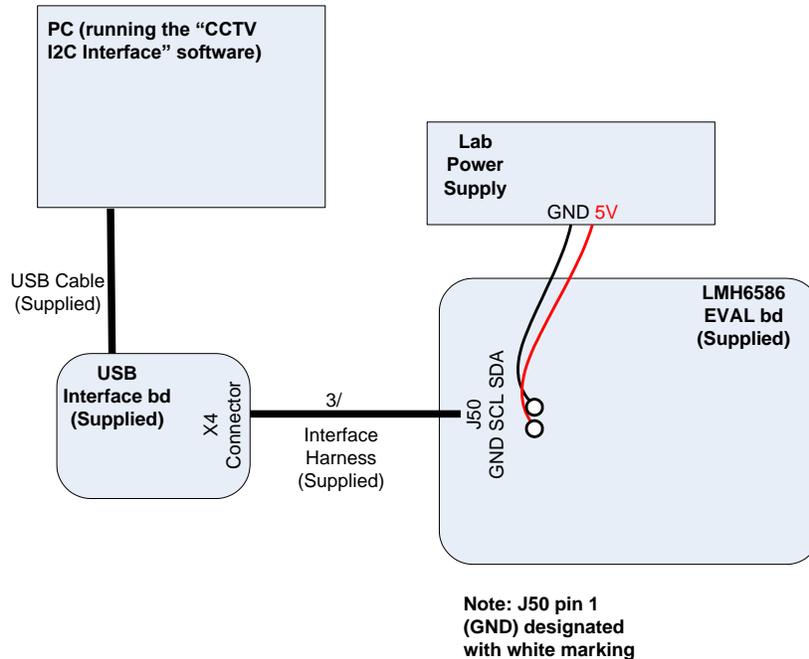
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## **1. Introduction**

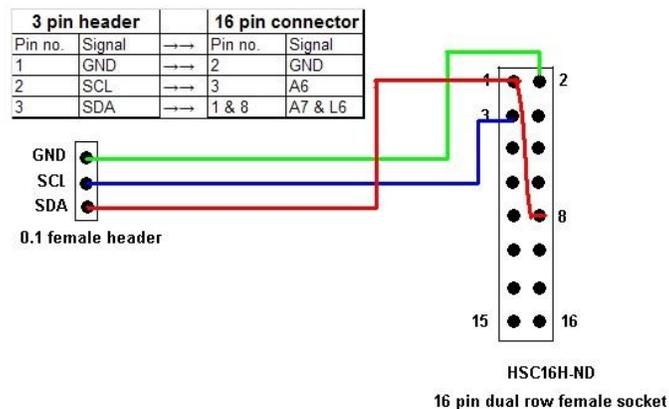
The LMH6586 evaluation board is designed by Texas Instruments to demonstrate the performance of the LMH6586 32x16 video Crosspoint switch. The board provides BNC connectors for 1/2 of the inputs and outputs (VIN0 - VIN31 (16 inputs), and OUT0 - OUT16 (8+1 outputs), even numbered channels only), potentiometers to adjust the clamp reference voltage and the sync detect threshold voltage. On-board jumpers allow the user to control the gain setting for the LMH6586 and to define logic inputs for device reset, power save and device address.

## 2. Setup

A USB Interface board (supplied), plugs into the evaluation board providing a graphical user interface (GUI) with a PC to program the LMH6586’s internal registers via I<sup>2</sup>C protocol. Figure 1 shows the connections between the PC, USB Interface board, and LMH6586 EVAL board. Figure 2 is the drawing for the harness that connects the LMH6586 EVAL board to the USB Interface board.



**Figure 1: LMH6586 EVAL Board Connection Block Diagram**



**Figure 2: LMH6586 Interface Harness**

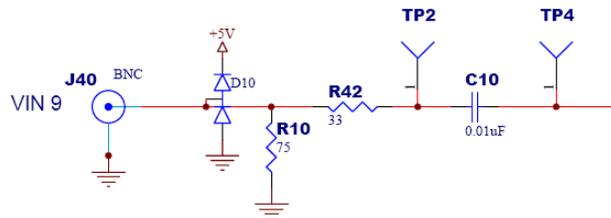
**Power Supplies**

The evaluation board requires a 5V power supply (0.5A capability or higher) and a ground connection to power the device.

**Video Inputs and Outputs**

The evaluation board is populated with 16 BNC connectors for 1/2 the 32 inputs from VIN0 – VIN31 and 8 BNC connectors for 1/2 the 16 outputs from OUT0 – OUT15. There is an additional BNC connector coming from OUT16 of the LMH6586 which can be given to an external sync separator such as the LMH1980.

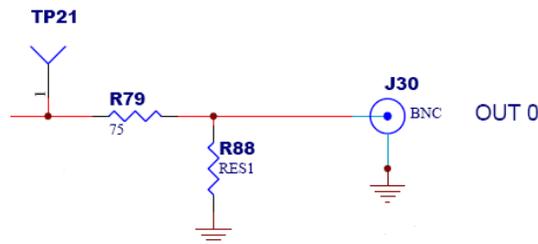
The inputs to the LMH6586 are AC coupled through a 0.01uF capacitor. Since the inputs are AC coupled, the CLAMP EN jumper (*JP4*) should be shorted to enable the clamp voltage for DC restoration. The LMH6586 can accept input video signals in the range of 0V to 1.5V. The input circuit for each input is shown below.



**Figure 3: Input Circuit Schematic**

*Note: Protection diode D10 not installed but can be added for extra protection in case of overvoltage*

The LMH6586 can provide output signals in the range of 0V to 3V depending on the gain setting determined by the GAIN jumper (*JP3*). The output circuit for each output is shown below.



**Figure 4: Output Circuit Schematic**

*Setup*
**Jumper Settings**

JUMPER	POSITION	FUNCTION
JP1	OPEN	DVDD not connected to +5V
	SHORTED	DVDD connected to external +5V supply
JP2	OPEN	LMH6586 is active
	SHORTED	LMH6586 is in power save mode
JP3	OPEN	LMH6586 gain is set to 1V/V
	SHORTED	LMH6586 gain is set to 2V/V
JP4	OPEN	Clamp is disabled
	SHORTED	Clamp is enabled
JP5	OPEN	LMH6586 is active
	SHORTED	LMH6586 is reset

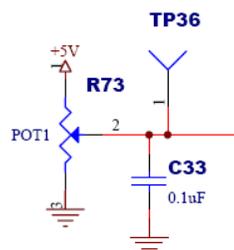
**Table 1: Jumper Settings**

JP7 (ADDR SEL 1)	JP6 (ADDR SEL 0)	FUNCTION
OPEN	OPEN	Device address set to 00
OPEN	SHORTED	Device address set to 01
SHORTED	OPEN	Device address set to 10
SHORTED	SHORTED	Device address set to 11

**Table 2: Device Address Jumper Settings**
**Clamp Enable Feature**

When jumper JP4 is shorted, the clamp enable feature of the LMH6586 is enabled. Since the inputs to the LMH6586 are AC coupled, DC restoration is required. This is accomplished using the clamp enable feature. The clamp enable feature clamps the sync tip of the input signal to the set level. The clamp voltage is set at the VCLAMP pin (*PIN 66*) using potentiometer *R73*. The clamp voltage can be measured at *TP36*. For optimum performance the clamp voltage should be fixed at 0.3V.

The clamp enable circuit is shown below.


**Figure 5: Clamp Enable Circuit**

**Video Detect**

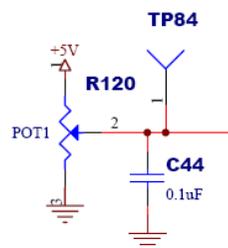
The LMH6586 can be setup to detect the presence or absence of video on each input by setting the appropriate bits in the video detect enable register and the video detect invert register for the respective inputs. The video detect threshold can be adjusted to eight different levels with a 3 bit programmable register. Each of the 32 video input channels can be configured individually to detect video or the loss of video using the accompanying software provided. The software is also used to set up the appropriate video detect threshold level.

The default video detect level at power on is blacker than black. So at power On, the video detect level should be adjusted to a suitable value.

**Sync Detect**

The LMH6586 can be setup to detect the loss of sync by setting the appropriate bits in the sync detect enable register for the respective inputs. The sync detect threshold level is adjusted using the potentiometer *R120* connected to the SSR pin (*PIN 65*). The sync detect threshold voltage can be measured at *TP84*. For optimum performance the sync detect threshold voltage should be adjusted to 0.35V.

The sync detect threshold circuit is shown below.

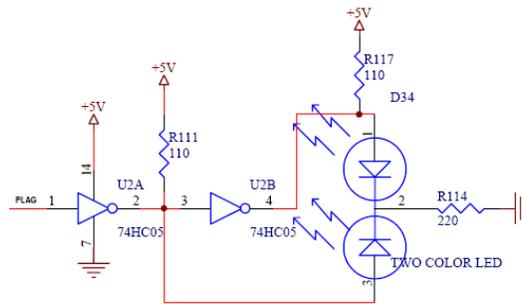


**Figure 6: Sync Detect Threshold Circuit**

**External Video Detect FLAG**

When there is a loss of sync or video (or a “*presence*” of video, depending on the setting of the respective bits in the video detect invert register) on any one of the 32 inputs, an external flag (*PIN 75*) is asserted and the two color video detect LED *D34* glows red. Under normal operation *D34* is green.

The video detect flag circuit is shown below.

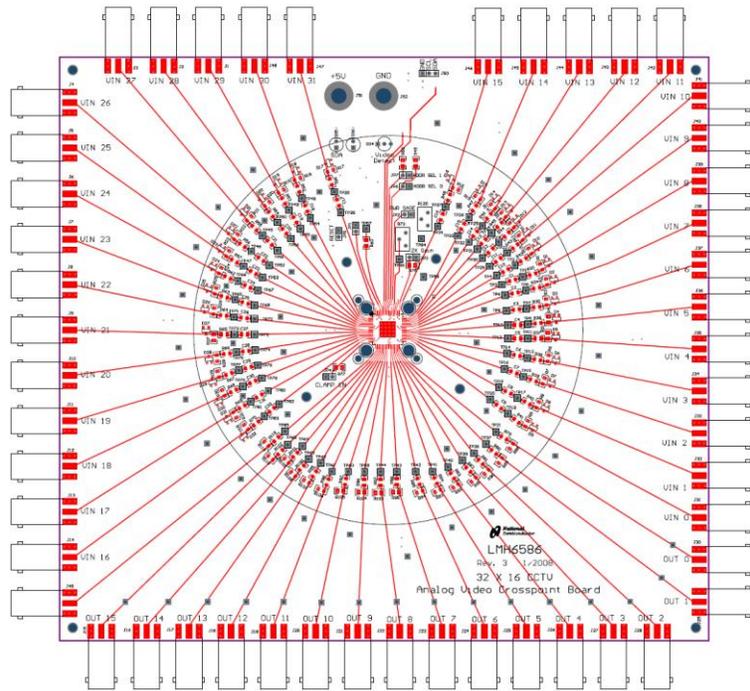


**Figure 7: Video Detect FLAG Circuit**

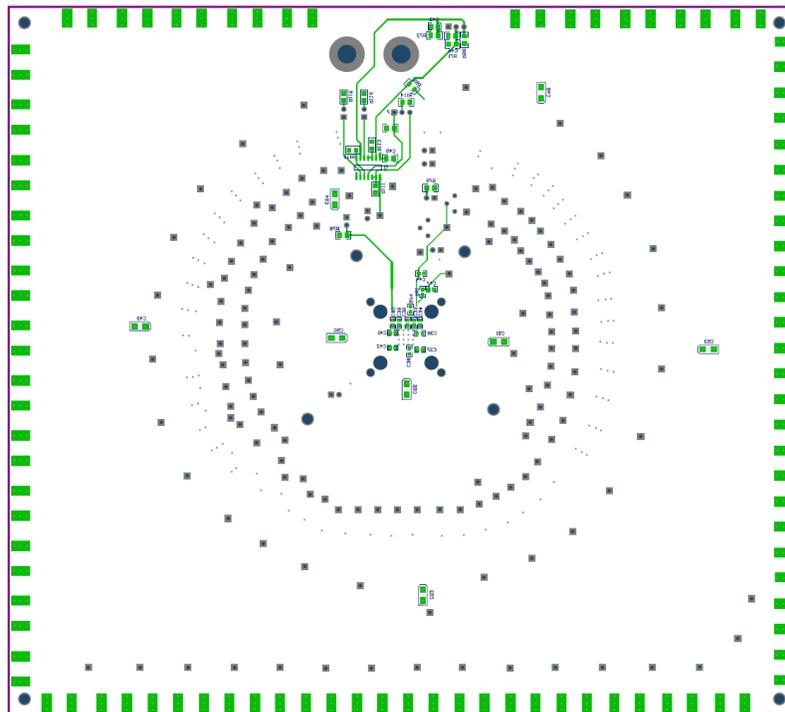
### Individual Channel Power Save

Each input and each output channel of the LMH6586 can be individually placed in power save mode by programming the appropriate bits in the registers 0x18h – 0x1Bh for the inputs and the registers 0x1Eh – 0x1Fh for the outputs. The accompanying software is used for this programming.

### 3. Board Layout



**Figure 8: LMH6586 Layout Top Layer**



**Figure 9: LMH6586 Board Layout Bottom Layer**

Schematic

4. Schematic and Bill of Materials (BOM)

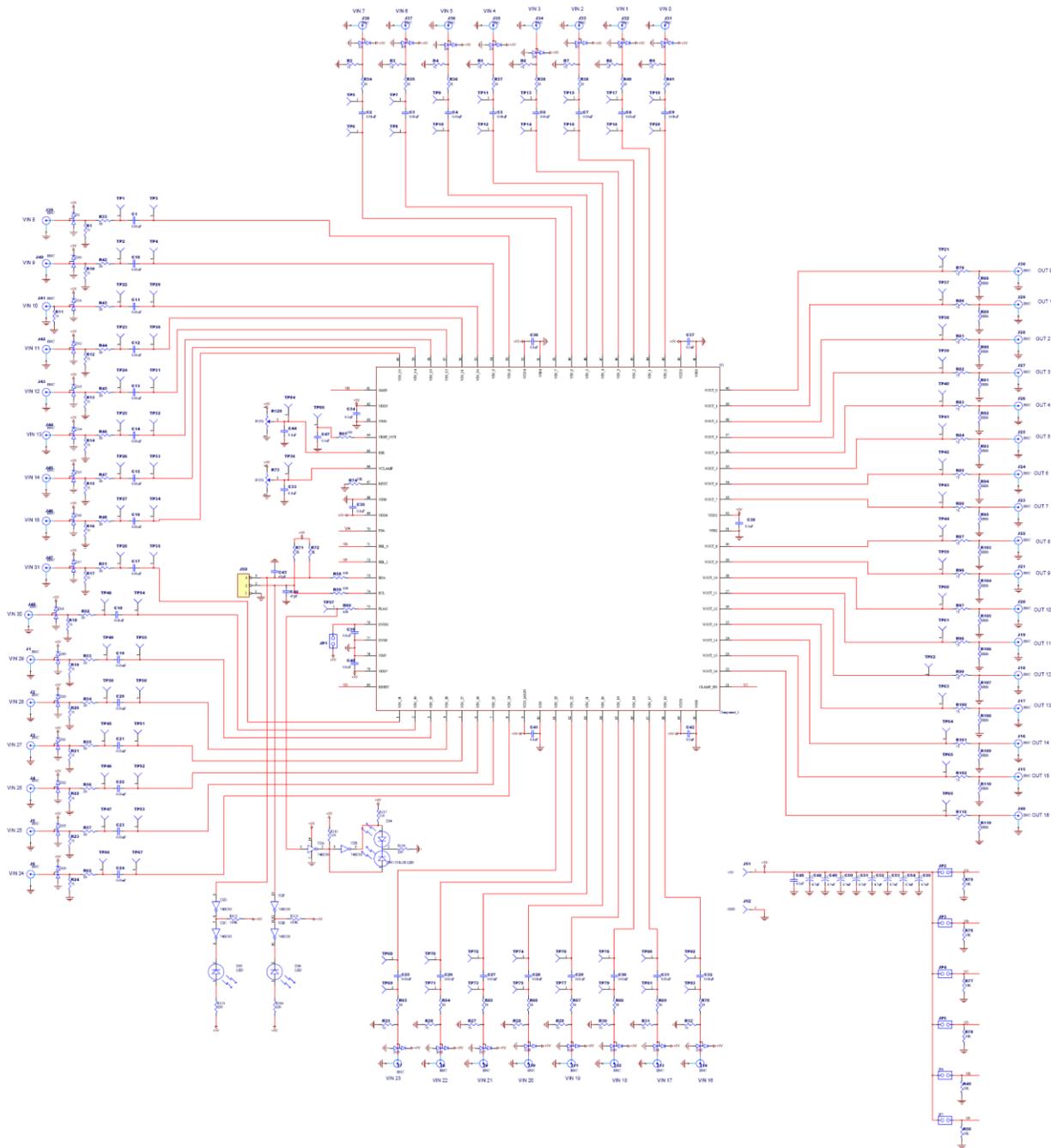


Figure 10: LMH6586 Board Schematic

Notes:

1. R77 is 1kohm.
2. Not all Input / Output BNC's shown are installed.
3. Input protection diodes D1-D32 (MMBD4148SE) not installed.

Part Type	Part Designator	QTY	PART #
2 pin header	JP1-JP7	7	<a href="#">WM6502-ND</a>
2 pin shorting shunt	JP1-JP7	7	<a href="#">A26227-ND</a>
BANANA Jack	J51, J52	2	<a href="#">575-8K-ND</a>
CAPACITOR, 100nF, X7R, 25V, 0805	C45	1	<a href="#">PCC1828CT-ND</a>
CAPACITOR, 100nF, X7R, 25V, 0603	C33-42, C44, C47	12	<a href="#">PCC2277CT-ND</a>
CAPACITOR, 10nF, X7R, 25V, 0603	C1-C32	32	<a href="#">PCC1763CT-ND</a>
RESISTOR, 2K, 1%, 0805	R71, R72	2	<a href="#">P2.00KCCT-ND</a>
CAPACITOR, 4.7uF, TANT, SIZE A	C48-C55	8	<a href="#">495-2197-1-ND</a>
RESISTOR, 10K, 1%, 0603	R74	1	<a href="#">RHM10.0KHCT-ND</a>
RESISTOR, 10K, 1%, 0805	R49, R50, R75, R76, R78	5	<a href="#">P10.0KCCT-ND</a>
RESISTOR, 33ohm, 1%, 0805	R33-R48, R51-R57, R62-R70	32	<a href="#">P33.0CCT-ND</a>
RESISTOR, 1K, 1%, 0805	R77	1	<a href="#">P1.00KCCT-ND</a>
CAPACITOR, 47pF, NPO, 50V, 0805	C43, C46	2	<a href="#">PCC470CGCT-ND</a>
74HC05	U2	1	<a href="#">296-1190-5-ND</a>
RESISTOR, 75, 1%, 0805	R1-R32, R79-R87, R96-R102, R118	49	<a href="#">P75.0CCT-ND</a>
RESISTOR, 100, 1%, 0603	R61	1	<a href="#">P100HCT-ND</a>
RESISTOR, 100, 1%, 0805	R58-R60	3	<a href="#">P100CCT-ND</a>
RESISTOR, 110, 1%, 0805	R111, R117	2	<a href="#">P110CCT-ND</a>
RESISTOR, 110K, 1%, 0805	R112, R113	2	<a href="#">P110KCCT-ND</a>
RESISTOR, 220, 1%, 0805	R114-R116	3	<a href="#">P220CCT-ND</a>
EDGE MOUNT BNC	J2, J4, J6, J8, J10, J12, J14, J16, J18, J20, J22, J24, J26, J28, J30, J31, J33, J35, J37, J39, J41, J43, J45, J48, J49	25	<a href="#">1097-1139-ND</a>
LMH6586	U1	1	<a href="#">LMH6586</a>
MMBD4148SE	D1- D32 (not installed)	32	<a href="#">MMBD4148SECT-ND</a>
3 PIN HEADER	J50	1	<a href="#">WM6503-ND</a>
2 PIN HEADER	JP1-JP7	7	<a href="#">WM6502-ND</a>
RED / GREEN LED	D34	1	<a href="#">754-1232-ND</a>
RED LED	D35	1	<a href="#">P559-ND</a>
GREEN LED	D36	1	<a href="#">P560-ND</a>
5K POT	R73, R120	2	<a href="#">3299Y-502LF-ND</a>
NOT STUFFED	R88-R95, R107, R108, R103-R106, R109, R110, R119	N/A	-

**Table 3: LMH6586 EVAL Board BOM**

## 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](http://www.ti.com/esh) or contact TI.

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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 is 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.

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### **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.

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