

ABSTRACT

This user's guide describes the characteristics, operation, and use of the TCA6507EVM evaluation module. This document also reviews various aspects of hardware configuration and program operation, allowing designers to evaluate the TCA6507 at different loading conditions (pullup resistors and bus capacitance), VCC voltages, and output loads as needed. Throughout this document, the terms: evaluation board, evaluation module, and EVM are synonymous with the TCA6507EVM. This user's guide also includes an electrical schematic, printed circuit board (PCB) layout drawings, and a parts list for the EVM.

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Trademarks

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1 Introduction

1.1 Features

This EVM supports:

- On-board level shifter for operation of up to 5.5 V
- Seven LEDs for functionality testing
- One jumper to connect alternative output load

1.2 Applications

- Mobile phones
- Desktop and laptop computers
- Human-machine interface

2 EVM Setup

Equipment needed to evaluate the TCA6507:

- Power supply capable of supplying the desired voltage to the TCA6507 and I²C bus.
- 4-channel oscilloscope if users wish to observe I²C transactions on both sides of the level shifter.
- Microcontroller, processor, or digital analyzer which can send and receive I²C.

2.1 Power Selection

This EVM allows the user the option of powering the board using three different external power input test points denoted as TP5, TP6, and TP7. Users also have the option of using male-mating connectors which can be found next to each of these test points.

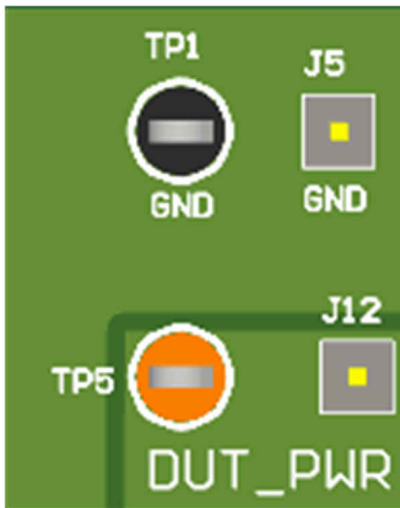


Figure 2-1. Power Configuration for DUT_PWR

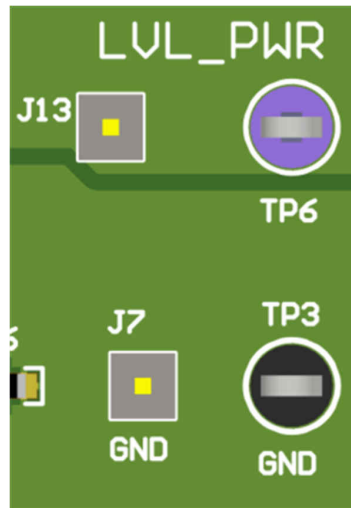


Figure 2-2. Power Configuration for LVL_PWR

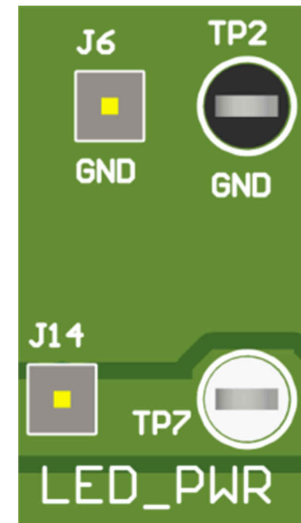


Figure 2-3. Power Configuration for LED_PWR

As seen in the images above, TP5 corresponds to the DUT (TCA6507) V_{CC} and V_{REF1} of the level shifter (PCA9306), TP6 corresponds to the V_{REF2} on the level shifter (PCA9306), and TP7 corresponds to the LED power supply.

2.2 Initial Setup

- If installed, jumpers J3 and J4 can disable the DUT and level shifter respectively; J3 and J4 must be removed for these devices to work properly.
- Jumpers J8, J9, and J10 enable the LED indicators to show if power is correctly supplied to the board. LED indicators lead to an increase in supply current.
- SDA and SCL lines are supplied through either the on-board headers or multipurpose test-points. Keep in mind that SCL_1 and SDA_1 can be driven by the level shifter; however, the user can directly supply these signals directly and disable the level shifter.

2.3 Alternate Configurations

- J1 allows P6 of the TCA6507 to connect to an off-board load without the need to desolder LED D5. If the user wants to use the on-board LED, jumper J1 must be installed.
- C1 and C2 are installed by the user to measure the consequences of varying parasitic capacitances.
 - The EVM does not come with these capacitors installed.
- R8, R9, R10, and R11 are replaceable if the user wants to test different pull-up resistors.



Figure 2-4. Resistors R9, R11 as Shown

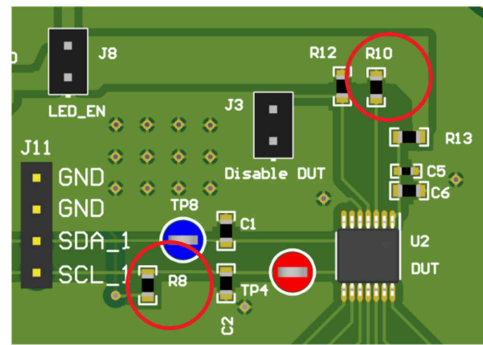


Figure 2-5. Resistors R8, R10 as Shown

3 Jumpers, Headers, Connectors, and Test Points

Table 3-1. Jumpers, Headers, and Connectors

Designator	Function
J1	Jumper that enables D5 or can be attached to an alternative load to the device.
J2	Header that can test the output of the TCA6507
J3	Jumper that disables the TCA6507
J4	Jumper that disables the PCA9306 (level shifter)
J5-J7	1x1 header for the negative, or the return path of the voltage supply of the device, connected to the GND pin
J8	Jumper that enables TCA6507 power LED indicator
J9	Jumper that enables the PCA9306 (level shifter) power LED indicator
J10	Jumper that enables LED power LED indicator
J11	Header that connects SCL and SDA lines for the TCA6507
J12	1x1 header for the positive supply of the TCA6507 and V_{REF1} of the PCA9306 (level shifter)
J13	1x1 header for the V_{REF2} of the PCA9306 (level shifter)
J14	1x1 header for the positive supply of the PCA9306 LEDs
J15	Header used to connect SCL and SDA lines for the PCA9306 (level shifter)

Table 3-2. Test Points

Designator	Function
TP1-TP3	Test point for the negative or the return path of the voltage supply of the device, connected to the GND pin
TP4	Test point for the SCL line of the TCA6507
TP5	Test point for the positive supply of the TCA6507 and V_{REF1} of the PCA9306 (level shifter)
TP6	Test point for the V_{REF2} of the PCA9306 (level shifter)
TP7	Test point for the positive supply of the PCA9306 LEDs
TP8	Test point for the SDA line of the TCA6507
TP9	Test point for the SCL line of the PCA9306 (level shifter)
TP10	Test point for the SDA line of the PCA9306 (level shifter)

4 Board Layout

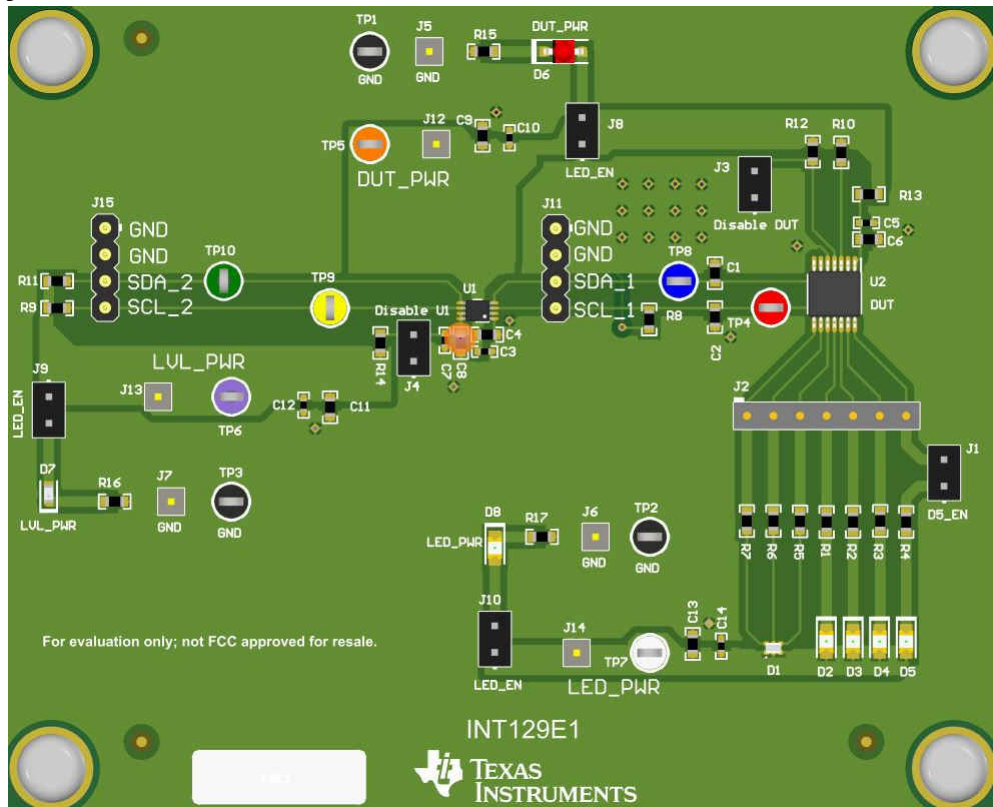


Figure 4-1. Board Layout

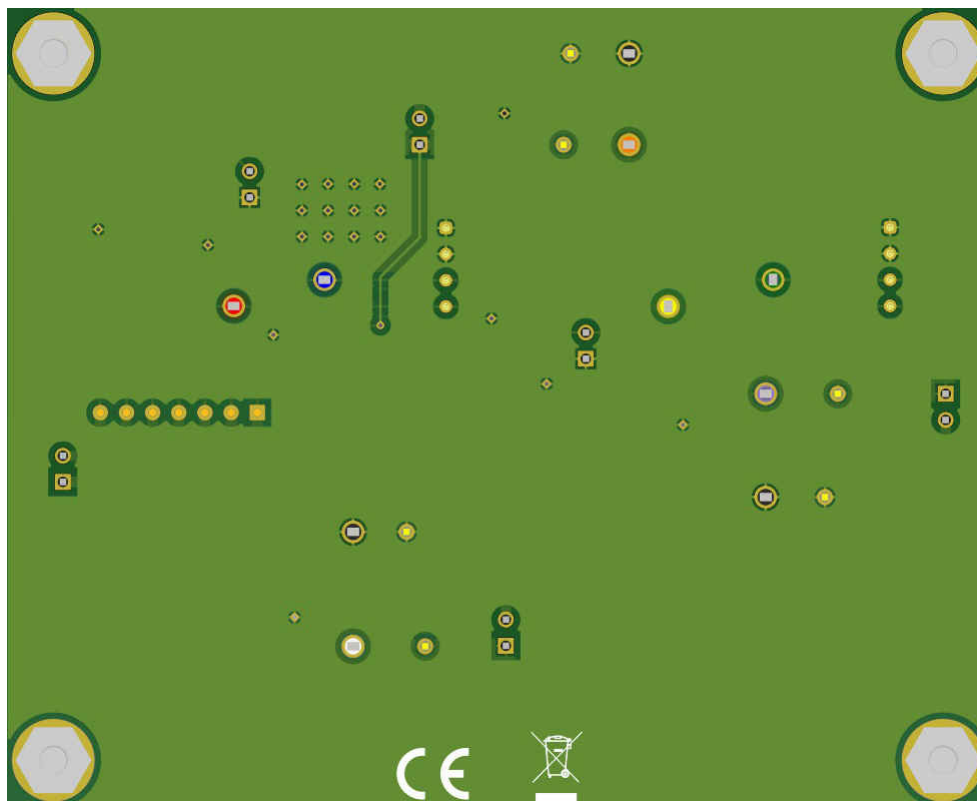


Figure 4-2. Board Layout

5 Schematic

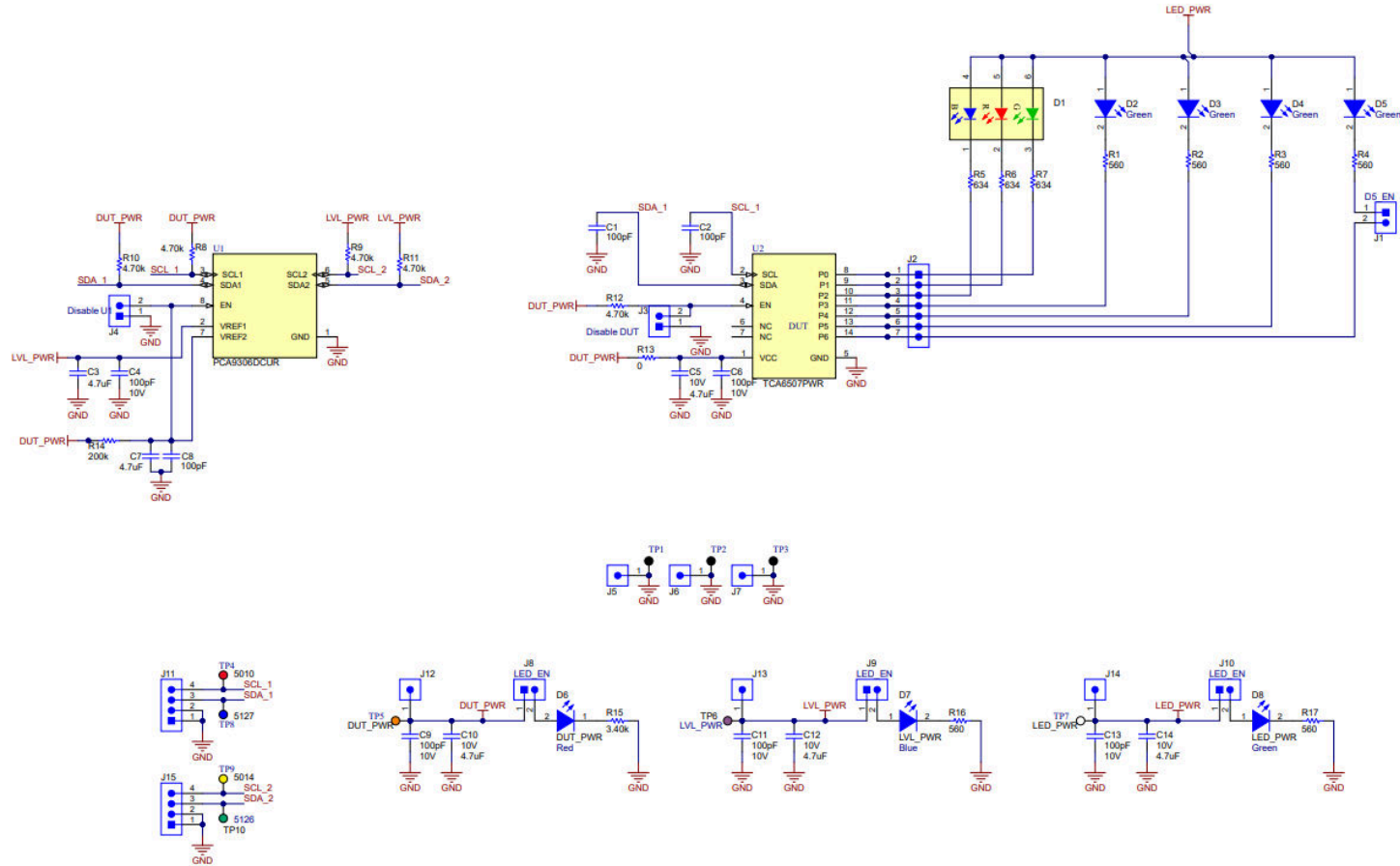


Figure 5-1. Schematic

6 Bill of Materials

Fitted	Description	Designator	Part Number	Quantity	Manufacturer	Package Reference	Value
Fitted	Printed circuit board	!PCB1	INT129	1	Any		
Fitted	CAP, CERM, 100 pF, 10 V, +/- 10%, X7R, 0603	C1, C2, C4, C6, C8, C9, C11, C13	0603ZC101KAT 2A	8	AVX	0603	100 pF
Fitted	CAP, CERM, 4.7 uF, 10 V, +/- 10%, X5R, 0402	C3, C5, C7, C10, C12, C14	C1005X5R1A47 5K050BC	6	TDK	0402	4.7 uF
Fitted	LED, RGB, TH	D1	19-337/ R6GHBHC-A01/2T	1	Everlight	1.6 x 1.6 mm	RGB
Fitted	LED, green, SMD	D2, D3, D4, D5, D8	LG R971-KN-1	5	OSRAM	2 x 1.25 mm	Green
Fitted	LED, red, SMD	D6	HLMP-Q150-F0011	1	Avago	2.08 x 2.21 mm	Red
Fitted	LED, blue, SMD	D7	LB Q39G-L2N2-35-1	1	OSRAM	BLUE 0603 LED	Blue
Fitted	Machine screw, round, #4-40 x 1/4, nylon, Phillips panhead	H1, H2, H3, H4	NY PMS 440 0025 PH	4	B&F Fastener Supply	Screw	
Fitted	Standoff, hex, 0.5"L #4-40 nylon	H5, H6, H7, H8	1902C	4	Keystone	Standoff	
Fitted	Header, 2.54 mm, 1x2, tin, black, TH	J1, J3, J4, J8, J9, J10	PEC01DAAN	6	Sullins Connector Solutions	Header, 2.54 mm, 2x1, TH	
Fitted	Header, 100 mil, 7x1, gold, TH	J2	TSW-107-07-G-S	1	Samtec	7x1 Header	
Fitted	Header, 2.54 mm, 1x1, gold, TH	J5, J6, J7, J12, J13, J14	HTSW-101-07-G-S	6	Samtec	Header, 2.54 mm, 1x1, TH	
Fitted	Header, 100 mil, 4x1, gold, TH	J11, J15	TSW-104-07-G-S	2	Samtec	4x1 Header	
Fitted	Thermal transfer printable labels, 0.650" W x 0.200" H - 10,000 per roll	LBL1	THT-14-423-10	1	Brady	PCB Label 0.650 x 0.200 inch	
Fitted	RES, 560, 5%, 0.1 W, 0603	R1, R2, R3, R4, R16, R17	CRCW0603560 RJNEA	6	Vishay-Dale	0603	560
Fitted	RES, 634, 1%, 0.1 W, 0603	R5, R6, R7	CRCW0603634 RFKEA	3	Vishay-Dale	0603	634
Fitted	RES, 4.70 k, 0.1%, 0.1 W, 0603	R8, R9, R10, R11, R12	RT0603BRD07 4K7L	5	Yageo America	0603	4.70 k
Fitted	RES, 0, 0%, 0.25 W, AEC-Q200 Grade 0, 0603	R13	PMR03EZPJ00 0	1	Rohm	0603	0

Fitted	Description	Designator	Part Number	Quantity	Manufacturer	Package Reference	Value
Fitted	RES, 200 k, 1%, 0.1 W, 0603	R14	CRCW0603200 KFKEA	1	Vishay-Dale	0603	200 k
Fitted	RES, 3.40 k, 0.1%, 0.1 W, 0603	R15	RT0603BRD07 3K4L	1	Yageo America	0603	3.40 k
Fitted	Test point, multipurpose, black, TH	TP1, TP2, TP3	5011	3	Keystone	Black multipurpose testpoint	
Fitted	Test point, multipurpose, red, TH	TP4	5010	1	Keystone	Red multipurpose testpoint	
Fitted	Test point, multipurpose, orange, TH	TP5	5013	1	Keystone	Orange multipurpose testpoint	
Fitted	Test point, multipurpose, purple, TH	TP6	5129	1	Keystone	Purple multipurpose testpoint	
Fitted	Test point, multipurpose, white, TH	TP7	5012	1	Keystone	White multipurpose testpoint	
Fitted	Test point, multipurpose, blue, TH	TP8	5127	1	Keystone	Blue multipurpose testpoint	
Fitted	Test point, multipurpose, yellow, TH	TP9	5014	1	Keystone	Yellow multipurpose testpoint	
Fitted	Test point, multipurpose, green, TH	TP10	5126	1	Keystone	Green multipurpose testpoint	
Fitted	2-Bit bidirectional I2C bus and SMBus voltage-level shifter, DCU0008A (VSSOP-8)	U1	PCA9306DCUR	1	Texas Instruments	DCU0008A	
Fitted	Low-voltage 7-bit I2C and SMBus LED driver with intensity control and shutdown, 1.65 to 3.6 V, -40 to 85 degC, 14-pin SOP (PW14), green (RoHS & no Sb/Br)	U2	TCA6507PWR	1	Texas Instruments	PW0014A	
Not Fitted	Fiducial mark. There is nothing to buy or mount.	FID1, FID2, FID3	N/A	0	N/A	N/A	

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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.

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3 Regulatory Notices:

3.1 United States

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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 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

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.

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

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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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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.

-
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 - 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.
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8. *Limitations on Damages and Liability:*

8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMNITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

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