EVM User's Guide: TLIN1124AEVM

TLIN1124A Evaluation Module

Description

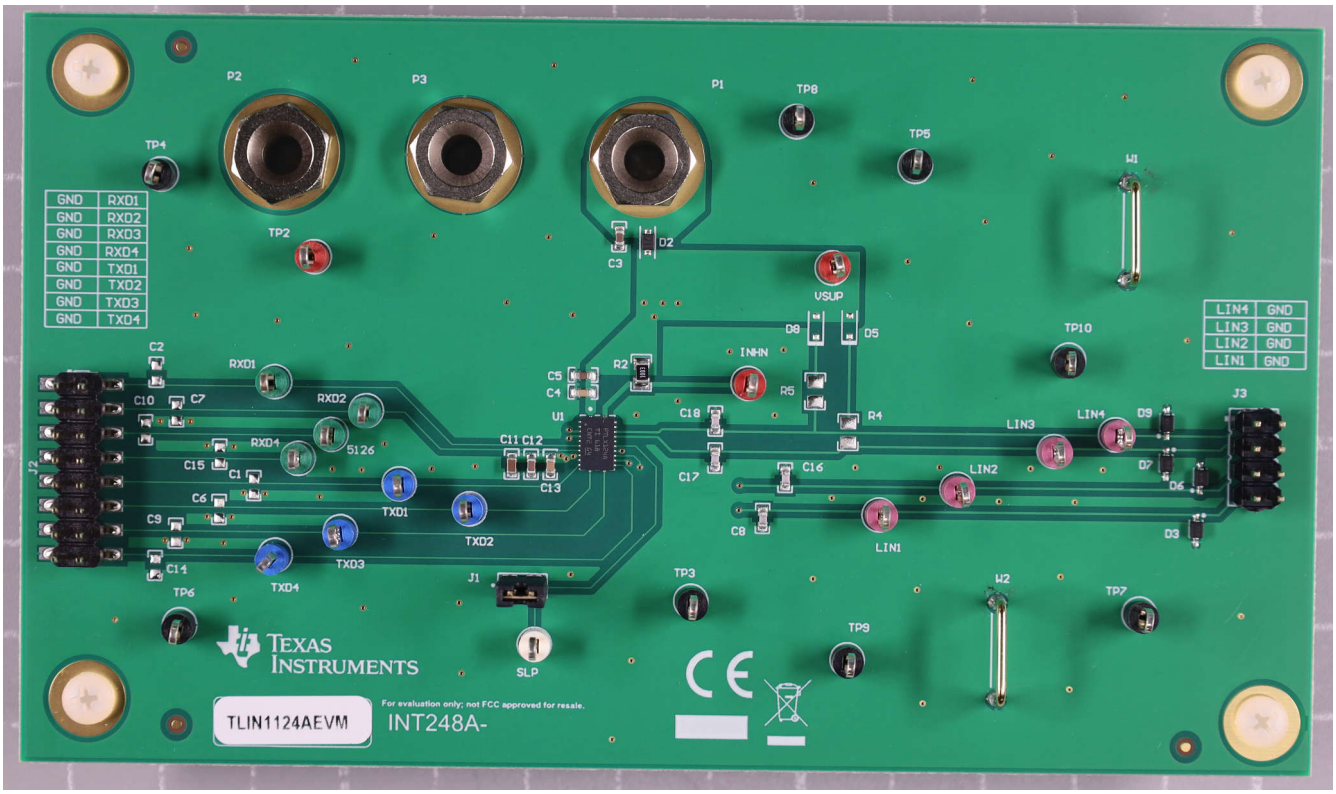
The TLIN1124AEVM provides users with the ability to evaluate the TI TLIN1124A-Q1 device. The TLIN1124AEVM comes with a populated TLIN1124A-Q1 device, along with connectors and test points to monitor and evaluate all pins and signals to and from the transceiver. This EVM also has the footprints for a commander-node pull-up at each of the four LIN channels, along with locations for capacitive filtering and transient voltage protection through a protection diode.

Features

- Quad LIN channels
- Integrated termination
- Wide voltage operation
- Comprehensive protection
- Easy connectivity
- Test points

Applications

- Body electronics and lighting
- Automotive infotainment and cluster
- Hybrid electric vehicles and PowerTrain™ systems
- Industrial transportation



TLIN1124AEVM-Q1 PCB

1 Evaluation Module Overview

1.1 Introduction

The TLIN1124A-EVM is designed to help users evaluate the TLIN1124A-Q1 automotive quad Local Interconnect Network (LIN) physical layer transceiver. The EVM provides easy access to all device pins and includes the necessary support circuitry for comprehensive evaluation of the features and performance of the device.

The following includes more information regarding the features of the EVM:

- Quad LIN channels - Evaluate all four independent LIN transceiver channels
- Integrated termination - Built-in commander and responder pull-up resistors on the TLIN1124A-Q1 device, as well as footprints for external pull-up networks on each LIN pin
- Wide voltage operation - Banana jack connectors included for each voltage supply
  - VSUP - 5V to 28V
  - VIO - 2.97V to 5.5V
- Comprehensive protection - Integrated ESD protection on all LIN pins plus footprints for external protection diodes and filter capacitance
- Easy connectivity - Headers for MCU interface and LIN bus connections
- Test points - Convenient access points for all devices pins that can be used for measurement and debugging, as well as several options on the board for ground connections

1.2 Kit Contents

Evaluation module for the TLIN1124A-Q1 device

1.3 Specification

TI offers a broad range of LIN transceivers, single, dual, and quad channel devices. These transceivers all have a broad input voltage range for the VSUP supply, with product mixes with varying features such as local wake-up, sleep, standby, and normal mode operation, inhibit feature for external enabling of system-level power, watchdog functionality, as well as interrupt notification.

This EVM allows the evaluation of the TLIN1124A-Q1 device. This device allows users to have access to four different LIN channels and removes the need for external pull-up circuitry for commander mode as these pull-up networks are integrated into the transceiver. INH is included on this device as a way to enable an external power supply. The device, like all other TI TLIN transceivers, has access to multiple modes of operation, including Sleep, Standby, and Normal mode.

1.4 Device Information

The TLIN1124-Q1 is a quad-channel LIN transceiver with built-in commander mode pull-up networks for each channel. There is one mode control pin, SLP, that is active high and places the device into Normal mode when at a logic-low voltage level. There are two voltage supply pins, VSUP and VIO, to enable all function and features on the device. VSUP is meant to be a battery supply voltage, and VIO is the logic-level voltage reference for all logic pins: TXD, RXD, and SLP.

For more information about the TLIN1124A-Q1, please reference the TLIN1124A-Q1 Automotive Quad Local Interconnect Network (LIN) Transceiver with Integrated Commander Pull-up Resistor and Inhibit datasheet.

2 Hardware

2.1 Power Requirements

There are two power supplies on the TLIN1124A-Q1: VIO and VSUP.

2.1.1 VIO

VIO is the logic-level reference voltage for translating all logic signals on the device. These signals are SLP, TXD, and RXD. The recommended VIO voltage range is from 3.0V to 5.0V

2.1.2 VSUP

VSUP is the main supply of the TLIN1124A-Q1. Use VSUP as the battery supply for Automotive applications. If VSUP is not supplied in the correct range, the device does not function correctly. The recommended VSUP voltage range is from 5.0V to 28.0V.

2.2 Setup

The TLIN1124AEVM comes assembled and setup out of the box, but there are a few tools and supplies needed to power and evaluate the PCB.

2.2.1 Power and Ground

Access both power supplies, VIO and VSUP, as well as the PCB ground on the topside of the board through banana jacks. Use three banana jack cables to properly power the board: one for VIO, one for VSUP, and one for ground. See Section 2.1 for the recommended voltage ranges for VIO and VSUP.

2.2.2 LIN Communication

Each of the four LIN channels have headers and test points assigned to all TXD, RXD, and LIN pins. Reference Section 2.3 for specific details on the headers and test points. All test points are also labeled on the PCB silkscreen.

To adequately exercise and evaluate the LIN channels, use a function generator capable of at least 100kHz, and from 0V to 5V square. Connect this to one of the four TXD pins. Observe the output on the corresponding LIN pin with the voltage level swinging between ground and VSUP. Additionally, see the output on the corresponding RXD pin with the voltage level swinging between ground and VIO. Use an oscilloscope capable of at least 10V per division and 50µs per division.

Before attempting to evaluate LIN communication, verify that the SLP pin is in the logic-low state. This places the transceiver into Normal mode where LIN communication is enabled. If a waveform is asserted on TXD and the corresponding LIN pin is not responding or at ground level, then the device is not in Normal mode. This means that the SLP pin is asserted high; verify the state of the SLP pin before exercising any of the LIN channels.

2.3 Header and Jumper Information

Table 2-1 refers to all connectors, test points, and clips on the EVM, along with a description of the functions.

Table 2-1. Header and Jumper Hardware Information

CONNECTION	TYPE	DESCRIPTION
J1	2-pin header	Connection to the SLP pin Shunt populated: Device is in Normal mode Shunt not populated: Device is in Sleep mode
J2	2 × 8-pin header	All odd-numbered pins connect to ground, even-numbered pins are RXD and TXD connections: 2 - RXD1, 4 - RXD2, 6 - RXD3, 8 - RXD4, 10 - TXD1, 12 - TXD2, 14 - TXD3, 16 - TXD4
J3	2 × 4-pin header	All even-numbered pins connect to ground, odd-numbered pins are LIN bus connections: 1 - LIN4, 2 - LIN3, 3 - LIN2, 4 - LIN1
P1	Banana jack	VSUP supply
P2	Banana jack	VIO supply
P3	Banana jack	Ground connection for EVM

Table 2-1. Header and Jumper Hardware Information (continued)

CONNECTION	TYPE	DESCRIPTION
TP1	Test point	VSUP test point
TP2	Test point	VIO test point
TP3 - TP10	Test point	Ground connection test points
TP11	Test point	SLP test point
TP12	Test point	INHN test point
TP13 - TP16	Test point	TXD test points: TP13 - TXD1, TP14 - TXD2, TP15 - TXD3, TP16 - TXD4
TP17 - TP20	Test point	RXD test points: TP17 - RXD1, TP18 - RXD2, TP19 - RXD3, TP20 - RXD4
TP21 - TP24	Test point	LIN test points: TP21 - LIN1, TP22 - LIN2, TP23 - LIN3, TP24 - LIN4
W1 and W2	Ground clip	Clips for extra ground connections

3 Hardware Design Files

3.1 Schematics

Figure 3-1 shows the EVM schematic.

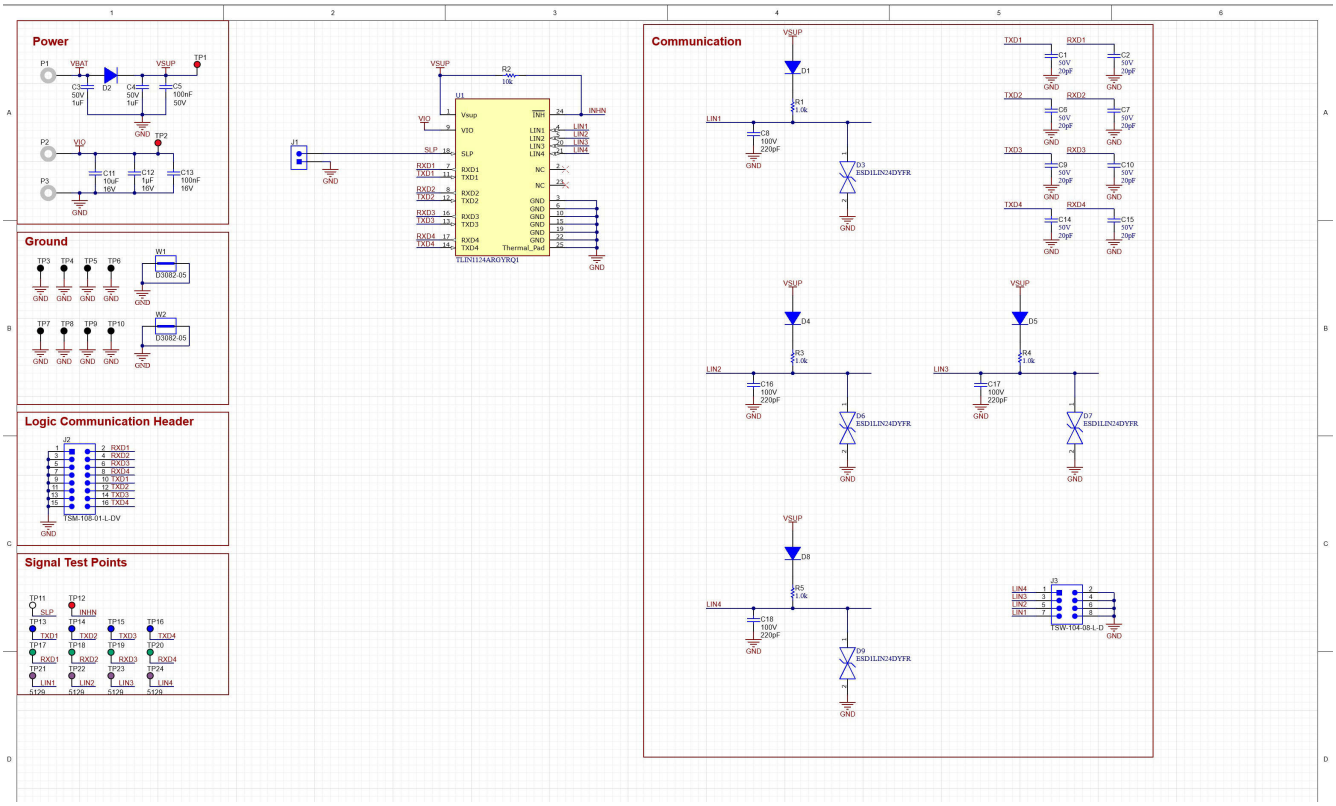


Figure 3-1. TLIN1124AEVM Schematic

3.2 PCB Layouts

Figure 3-2. TLIN1124AEVM Layout Top Side

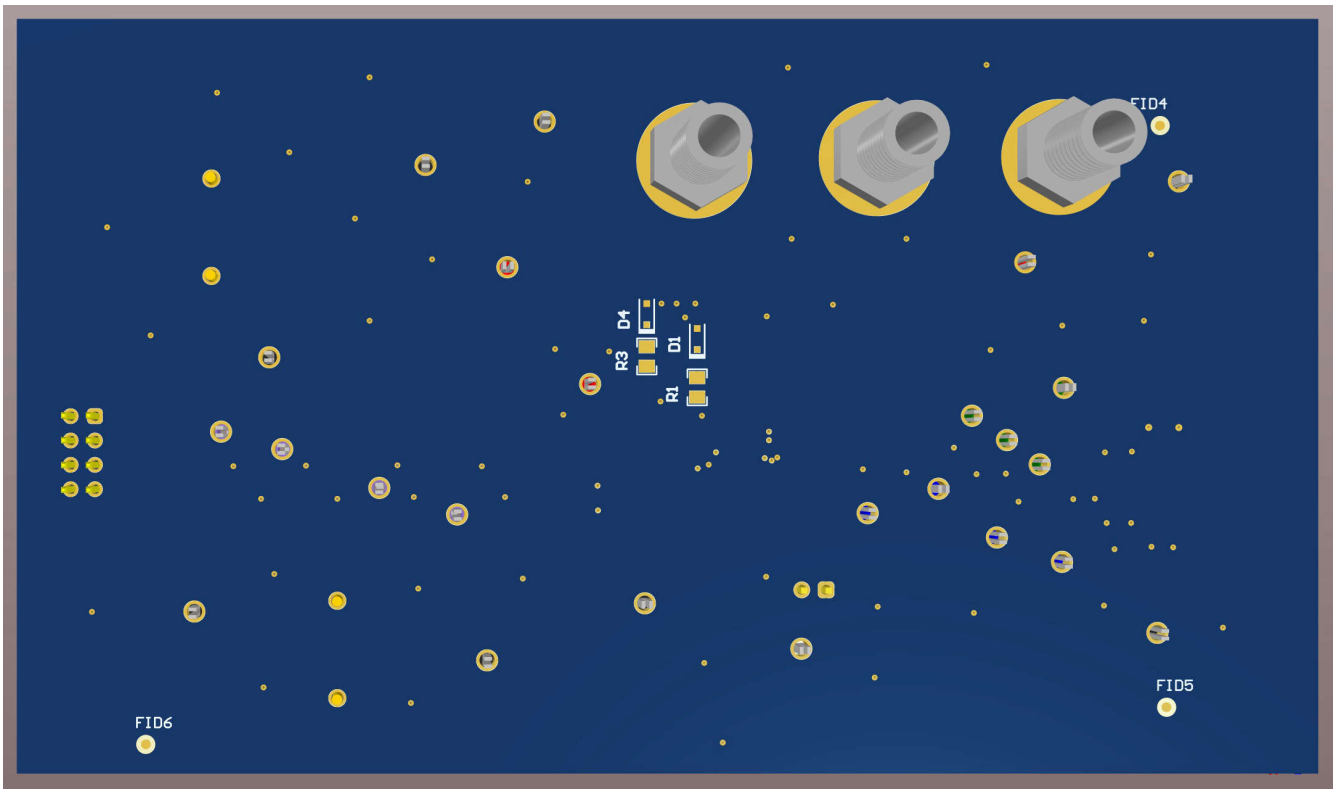


Figure 3-3. TLIN1124AEVM Layout Bottom Side

3.3 Bill of Materials (BOM)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
C3, C4	2	1uF	CAP, CERM, 1 uF, 50 V, +/- 10%, X7R, 0603	603	UMK107AB7105KA-T	Taiyo Yuden
C5	1	0.1uF	CAP, CERM, 0.1 uF, 50 V, +/- 10%, X7R, 0603	603	GRM188R71H104KA93D	MuRata
C8, C16, C17, C18	4	220pF	CAP, CERM, 220 pF, 100 V, +/- 10%, X7R, 0603	603	06031C221KAT2A	AVX
C11	1	10uF	CAP, CERM, 10 uF, 16 V, +/- 20%, X5R, 0603	603	GRM188R61C106MAALD	MuRata
C12	1	1uF	CAP, CERM, 1 uF, 16 V, +/- 10%, X7R, 0603	603	C1608X7R1C105K080AC	TDK
C13	1	0.1uF	CAP, CERM, 0.1 µF, 16 V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	603	0603YC104K4T4A	AVX
D2	1	75V	Diode, Switching, 75 V, 0.15 A, AEC-Q101, SOD-323	SOD-323	1N4148WS-7-F	Diodes Inc.
D3, D6, D7, D9	4		24-V, 1-Channel ESD Protection Diode	SOD323	ESD1LIN24DYFR	Texas Instruments
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone
J1	1		Header, 100mil, 2x1, Gold, TH	2x1 Header	TSW-102-07-G-S	Samtec
J2	1		Header, 2.54mm, 8x2, Gold, SMT	Header, 2.54mm, 8x2, SMT	TSM-108-01-L-DV	Samtec
J3	1		Header, 2.54mm, 4x2, Gold, TH	Header, 2.54mm, 4x2, TH	TSW-104-08-L-D	Samtec
P1, P2, P3	3		Standard Banana Jack, Uninsulated, 15A	Banana Jack	108-0740-001	Cinch Connectivity
R2	1	100k	RES, 100 k, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	805	CRCW0805100KFKEA	Vishay-Dale

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
TP1, TP2, TP12	3		Test Point, Multipurpose, Red, TH	Red Multipurpose Testpoint	5010	Keystone
TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10	8		Test Point, Multipurpose, Black, TH	Black Multipurpose Testpoint	5011	Keystone
TP11	1		Test Point, Multipurpose, White, TH	White Multipurpose Testpoint	5012	Keystone
TP13, TP14, TP15, TP16	4		Test Point, Multipurpose, Blue, TH	Blue Multipurpose Testpoint	5127	Keystone
TP17, TP18, TP19, TP20	4		Test Point, Multipurpose, Green, TH	Green Multipurpose Testpoint	5126	Keystone
TP21, TP22, TP23, TP24	4		Test Point, Multipurpose, Purple, TH	Purple Multipurpose Testpoint	5129	Keystone Electronics
U1	1		Automotive Quad Local Interconnect Network (LIN) Transceiver with integrated commander pull-up resistor and Inhibit	VQFN24	TLIN1124ARGYRQ1	Texas Instruments
W1, W2	2		1mm Uninsulated Shorting Plug, 10.16mm spacing, TH	Shorting Plug, 10.16mm spacing, TH	D3082-05	Harwin

4 Additional Information

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   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

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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.

NOTE:

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

3 *Regulatory Notices:*

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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 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.

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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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4.3 *Safety-Related Warnings and Restrictions:*

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Last updated 10/2025