This user guide details the TCAN10xx CAN (Controller Area Network) EVM transceiver operation. The TCAN10xx CAN EVM is configurable for use with all TI CAN transceiver families: TCAN10xx, TCAN33x, SN65HVD23x, SN65HVD25x, SN65HVD10x0, and SN65HVDA54x by replacing the transceiver and setting jumpers on the EVM as outlined in this document. This user guide explains the EVM configurations for basic CAN evaluation, various load and termination settings.

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1 Introduction

1.1 Overview

TI offers a broad portfolio of high speed (HS) CAN transceivers compatible with the ISO11898-2 high speed CAN standards. These include 5 V $V_{CC}$ only, 3.3 V $V_{CC}$ only, 5 V $V_{CC}$ with I/O level shifting and galvanic-isolated CAN transceivers. These CAN transceiver families include product mixes with varying features such as low-power standby modes with and without wake up, silent modes, loop back, and diagnostic modes.

TI's CAN EVM helps designers evaluate the operation and performance of various TI CAN transceivers. It also provides bus termination, bus filtering, and protection concepts. It is easily configured by the customer for the TCAN10xx, TCAN33x, SN65HVD23x, SN65HVD25x, SN65HVD10x0, and SN65HVDA54x CAN transceiver families as needed by jumper settings, simple soldering tasks, and replacement of standard components. A separate EVM is available for the galvanic-isolated CAN transceiver family.

1.2 CAN EVM

The CAN EVM has simple connections to all necessary pins of the CAN transceiver device, and jumpers where necessary to provide flexibility for device pin and CAN bus configuration. There are test points (loops) for all main points where probing is necessary for evaluation such as GND, $V_{CC}$, TXD, RXD, $CAN_H$, $CAN_L$, pin 8 (mode pin), or pin 5 (various functions). The EVM supports many options for CAN bus configuration. It is pre-configured with two 120-Ω resistors that are connected on the bus via jumpers: a single resistor is used with the EVM as a terminated line end (CAN is defined for 120-Ω impedance twisted pair cable) or both resistors in parallel for electrical measurements representing the 60-Ω load the transceiver "sees" in a properly terminated network (that is, 120-Ω termination resistors at both ends of the cable). If the application requires "split" termination, TVS diodes for protection, or Common Mode (CM) Choke, the EVM has footprints available for this via customer installation of the desired components.

Figure 1 shows the EVM board image.

![Figure 1. EVM PC Board](image-url)
Figure 2 shows the EVM schematic.
Table 1 lists the jumper connections for the EVM.

### Table 1. Jumper Connections

<table>
<thead>
<tr>
<th>Connection</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>JMP1</td>
<td>4-pin jumper</td>
<td>Used for mode selection on pin 8 (4.7-kΩ pullup to V_{CC}, 0-Ω pulldown to GND, customer-installable pulldown for devices with slew rate control R_s pin).</td>
</tr>
<tr>
<td>JMP2</td>
<td>10-pin header</td>
<td>Connection for access to all critical digital I/O, supply, and GND for driving the CAN transceiver externally with test equipment or interfaced to a processor EVM</td>
</tr>
<tr>
<td>JMP3</td>
<td>4-pin header</td>
<td>CAN bus connection (CANH, CANL) and GND</td>
</tr>
<tr>
<td>JMP4</td>
<td>2-pin jumper</td>
<td>Connect 120-Ω CAN termination to the bus. Used separately for a single termination if EVM is at end of the CAN bus and termination is not in the cable. Used in combination with JMP5 to get to second CAN termination to represent the combined 60-Ω load for CAN transceiver parametric measurement.</td>
</tr>
<tr>
<td>JMP5</td>
<td>2-pin jumper</td>
<td>Connect 120-Ω CAN termination to the bus. Used in combination with JMP4 to get to second CAN termination to represent the combined 60-Ω load for CAN transceiver parametric measurement.</td>
</tr>
<tr>
<td>JMP6</td>
<td>5-pin jumper</td>
<td>Functional use of pin 5. Options for use are:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A) 4.7-kΩ pullup to V_{CC} for transceiver with digital input on pin 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B) 0-Ω pulldown to GND for transceiver with digital input on pin 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C) Active split termination: for CAN transceiver with V_{REF} or SPLIT pin where active split termination is desired. Connect to V_{CM} and populate the components R7/R15 and C4 as required for the system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D) V_{RXD} (V_{IO}) for CAN transceivers with a separate V_{RXD} (V_{IO}) for I/O level shifting</td>
</tr>
<tr>
<td>TB1</td>
<td>2-pin jumper</td>
<td>V_{CC} supply and GND connection for the EVM</td>
</tr>
<tr>
<td>TP1</td>
<td>2-pin jumper</td>
<td>TXD, Device pin 1 test point</td>
</tr>
<tr>
<td>TP2</td>
<td></td>
<td>CANH (bus) test point</td>
</tr>
<tr>
<td>TP3</td>
<td></td>
<td>Device pin 8 test point</td>
</tr>
<tr>
<td>TP4</td>
<td></td>
<td>CANH via 330-Ω serial resistor test point</td>
</tr>
<tr>
<td>TP5</td>
<td></td>
<td>CANL (bus) test point</td>
</tr>
<tr>
<td>TP6</td>
<td></td>
<td>CANL via 330-Ω serial resistor test point</td>
</tr>
<tr>
<td>TP7</td>
<td></td>
<td>RXD, Device pin 4 test point</td>
</tr>
<tr>
<td>TP8</td>
<td></td>
<td>Device pin 5 test point</td>
</tr>
<tr>
<td>TP9</td>
<td></td>
<td>V_{CC} test point</td>
</tr>
<tr>
<td>TP10</td>
<td></td>
<td>GND test point</td>
</tr>
<tr>
<td>TP11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TP12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TP13</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2 2 EVM Setup and Operation

This section describes the setup and operation of the EVM for parameter performance evaluation.

2.1 Overview and Basic Operation Settings

2.1.1 VCC Power Supply (TB1, TP9, or JMP2)

The basic setup of the CAN EVM uses a single power supply required to evaluate standard 5-V or 3.3-V single-supply transceiver device performance. For single-supply transceivers, connect the 5 V or 3.3 V VCC supply to the TB1 jumper header, or the VCC and GND test-point loops. The power supplied should meet the required specification of VCC for the transceiver being tested. LED D3 is used to indicate VCC presence.

2.1.2 I/O Power Supply VRXD or VIO (JMP2, JMP6, or TP8)

For devices with I/O level shifting, a second supply pin for the I/O or RXD pin is on pin 5 of the transceiver device. A second power supply is needed to test one of these devices. Connect this power supply via JMP2, JMP6, or TP8. Install a local buffering and decoupling capacitor at C6 if the EVM is used for one of these devices.

2.1.3 Main Supply and I/O Header (JMP2)

All key I/O and supply GND functions are brought to this header. It may be used on either interface to test equipment or a short cable could be made to connect to an existing customer-application board with a CAN controller.

Table 2. JMP2 Pin Definitions

<table>
<thead>
<tr>
<th>Pin</th>
<th>Connection</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MODE</td>
<td>Pin 8 of transceiver, normally used for mode control, examples: SHDN, FAULT, R5l, S, STB</td>
</tr>
<tr>
<td>2</td>
<td>TXD</td>
<td>Pin 1 of transceiver, TXD (transmit data)</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>Pin 2 of transceiver, GND</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td>Pin 2 of transceiver, GND</td>
</tr>
<tr>
<td>5</td>
<td>RXD</td>
<td>Pin 4 of transceiver, RXD (receive data)</td>
</tr>
<tr>
<td>6</td>
<td>GND</td>
<td>Pin 2 of transceiver, GND</td>
</tr>
<tr>
<td>7</td>
<td>VCC</td>
<td>Pin 3 of transceiver, VCC</td>
</tr>
<tr>
<td>8</td>
<td>GND</td>
<td>Pin 2 of transceiver, GND</td>
</tr>
<tr>
<td>9</td>
<td>P5</td>
<td>Pin 5 of transceiver, various functions depending on transceiver, examples: VREF, SPLIT, VRXD, VIL, LBK, EN, AB, and No Connect (NC)</td>
</tr>
<tr>
<td>10</td>
<td>VRXD</td>
<td>Connects to Jumper JMP6 VRXD header to allow flexibility in using the device with power supply for I/O on pin 5 of the transceiver</td>
</tr>
</tbody>
</table>

This header is arranged to provide a separate ground for each signal pair (TXD/GND and RXD/GND). If the EVM is being used with lab equipment, connect separate cables to these main points via simple 2-pin header connectors. If connecting the board to a processor-based system, connect a single cable with all power and signals via a 10-pin header cable to this port.

2.1.4 TXD Input (JMP2 or TP1)

The TXD (pin 1) of the transceiver, transmit data is routed to JMP2 and TP1. The signal path to the JMP2 header is pre-installed with a 0-Ω series resistor, R10.

2.1.5 RXD Output (JMP2 or TP7)

The RXD (pin 4) of the transceiver, receive data is routed to JMP2 and TP7. The signal path to the JMP2 header is pre-installed with a 0-Ω series resistor, R13.
2.1.6 MODE Select or Pin 8 (JMP1, JMP2, or TP3)

Pin 8 of the transceiver is normally a mode control pin of the device. Pin 8 of the device is routed to JMP1, JMP2, and TP7.

2.1.7 MODE - JMP1 Configurations (3-Way Jumper)

If using separate I/O inputs JMP1 is used to configure pin 8 to a pullup to \( V_{CC} \) or pulldown to GND configuration. For most devices, when pin 8 is pulled to GND, the device is in “normal” or high speed mode. R3 is pre-installed with 0-Ω resistor to GND for this purpose. For most devices, when pin 8 is pulled to \( V_{CC} \) the device is in a silent or low power standby mode. Devices with slope control mode use the resistance to ground value to determine the slope of the driver output. R2 is left open for customers who want to install a resistance to ground and use slope mode.

2.1.8 JMP2 Configuration

Using header JMP2 which assumes all the digital I/O signals, \( V_{CC} \), GND are routed to an external system. Ensure that the MODE (JMP1) jumper settings are not conflicting with signals to JMP2.

2.1.9 TP3 Configuration

This connects directly to device pin 8. Ensure JMP1 configuration is not conflicting if TP3 is used as the input connection.

2.1.10 Pin 5 (JMP6, JMP2 or TP8)

Pin 5 of the transceiver have various uses depending on the transceiver. Examples are \( V_{REF} \), SPLIT, \( V_{RXD} \), \( V_{IO} \), LBK, EN, AB and No Connect (NC). Pin 5 of the device is routed to JMP6, JMP2 and TP8.

2.1.11 Pin 5 – JMP6 Configurations (4-Way Jumper)

If using separate I/O inputs, JMP6 is used to configure pin 5 to: pullup to \( V_{CC} \), pulldown to GND, \( V_{RXD} \) or \( V_{IO} \) supply input, or \( V_{REF} \) or SPLIT termination output.

- **\( V_{REF} \) or SPLIT termination:** If the device and application support split termination, set JMP6 to \( V_{CM} \) (V common mode) to drive the \( V_{REF} \) or SPLIT pin common mode stabilizing voltage output to the center tap of the split termination capacitor. Install these components on the EVM as outlined in the CAN bus termination section.

- **No Connection:** If the device and application require no use of pin 5, leave it open. If the device has the \( V_{REF} \) or SPLIT pin but the application is not using the pin for split termination then add a capacitor on C6 to improve EMC performance.

- **2nd Mode or Control Input:** if the device and application use pin 5 as a second mode or control pin, then set JMP6 as either a pullup to \( V_{CC} \) or pulldown to GND, as necessary.

- **I/O and RXD level-shifting supply:** if the device and application used with \( V_{IO} \) or \( V_{RXD} \) to level shift I/O pins on the transceiver then set JMP6 to \( V_{RXD} \) connecting pin 5 of the device to the \( V_{RXD} \) pin on JMP2. Install local buffering and bypass capacitor C6.

2.1.12 JMP2 Configuration

Using header JMP2 assumes all the digital I/O signals, \( V_{CC} \), and GND are routed to an external system. Ensure that pin 5 (JMP6) jumper settings are not conflicting with signals to JMP2. For power supply \( V_{RXD} \), set the jumper to route JMP2 supply input to the transceiver pin.

2.1.13 TP8 Configuration

This connects directly to device pin 5. Ensure JMP6 configuration is not conflicting if TP8 is used as an input connection.
2.2 Using CAN Bus Load, Termination, and Protection Configurations

The CAN EVM is populated with two 120-Ω power resistors selectable via jumpers between CANH and CANL. When using one resistor, the EVM is used as a terminated end of a bus. For electrical measurements to represent the total loading of the bus, use both 120-Ω resistors in parallel to give the standard 60-Ω load for parametric measurement. The EVM also has footprints for split termination, if needed for the application. Table 3 summarizes how to use these termination options. If using split termination, match the resistors. Calculate the common mode filter frequency using: \( f_C = \frac{1}{(2\pi RC)} \). Normally, the split capacitance is in the range of 4.7 nF to 100 nF. Keep in mind this is the common-mode filter frequency, not a differential filter that impacts the differential CAN signal directly.

### Table 3. Bus Termination Configuration

<table>
<thead>
<tr>
<th>Termination Configuration</th>
<th>120-Ω Resistors</th>
<th>Split Termination Footprints</th>
<th>Split Termination Footprints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard termination (120 Ω)</td>
<td>shorted</td>
<td>open</td>
<td>N/A</td>
</tr>
<tr>
<td>60-Ω load - electrical parameters</td>
<td>shorted</td>
<td>shorted</td>
<td>N/A</td>
</tr>
<tr>
<td>Split termination (common mode stabilization)</td>
<td>open</td>
<td>open</td>
<td>60 Ω, 60 Ω, populated</td>
</tr>
</tbody>
</table>

The EVM also has footprints for various protection schemes to enhance robustness for extreme system-level EMC requirements. Table 4 summarizes these options.

### Table 4. Protection and Filtering Configuration

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Footprint Reference</th>
<th>Use Case</th>
<th>Population and Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series resistors or common mode choke</td>
<td>R9/R14 or L1 (common footprint)</td>
<td>Direct CAN transceiver to bus connection</td>
<td>R9 and R14 populated with 0 Ω (default population)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Series resistance protection, CAN transceiver to bus connection</td>
<td>R9 and R14 populated with MELF resistor as necessary for harsh EMC environment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CM choke (bus filter)</td>
<td>L1 populated with CM choke to filter noise as necessary for harsh EMC environment</td>
</tr>
<tr>
<td></td>
<td>C2/C7 or D1/D2</td>
<td>Transient and ESD protection</td>
<td>To add extra protection for system level transients and ESD protection, TVS diode population option via D1/D2 footprint or varistor population via C2/C7 footprint.</td>
</tr>
</tbody>
</table>
2.3 Using Customer Installable I/O Options for Current Limiting, Pullup and Pulldown, Noise Filtering

The CAN EVM has footprints on the PCB for the installation of various filtering and protection options to adapt the EVM to match CAN network topology requirements if the EVM is being used as a CAN node.

Each digital input or output pin has footprints allowing for series current-limiting resistors (default populated with 0 Ω), pullup or down resistors (depending on pin use), and a capacitor to GND which allows for RC filters when configured with a series resistor. Table 5 lists these features for each of the digital input and output pins of the EVM. Replace or populate the RC components as necessary for the application.

<table>
<thead>
<tr>
<th>Device Pin</th>
<th>Jumperable</th>
<th>Series R</th>
<th>Pullup</th>
<th>Pulldown</th>
<th>C to GND</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>Description</td>
<td>Type</td>
<td>Pullup</td>
<td>Pulldown</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>TXD</td>
<td>Input</td>
<td>N/A</td>
<td>N/A</td>
<td>R10</td>
<td>R6 PU</td>
</tr>
<tr>
<td>2</td>
<td>RXD</td>
<td>Output</td>
<td>N/A</td>
<td>N/A</td>
<td>R13</td>
<td>R5 PU</td>
</tr>
<tr>
<td>5</td>
<td>NC</td>
<td>No Connect</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>SHDN</td>
<td>Input</td>
<td>R18 (JMP6)</td>
<td>R19 (JMP6)</td>
<td>R17</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>FAULT</td>
<td>Output</td>
<td>N/A</td>
<td>N/A</td>
<td>R17</td>
<td>N/A</td>
</tr>
<tr>
<td>8</td>
<td>S, R_s, STB</td>
<td>Input</td>
<td>R1 (JMP1)</td>
<td>R2/R3 (JMP1)</td>
<td>R4</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>NC</td>
<td>No Connect</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Device Pin</th>
<th>Jumperable</th>
<th>Series R</th>
<th>Pullup</th>
<th>Pulldown</th>
<th>C to GND</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>Description</td>
<td>Type</td>
<td>Pullup</td>
<td>Pulldown</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>V_{REF} and SPLIT</td>
<td>Output</td>
<td>N/A</td>
<td>N/A</td>
<td>R17</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>V_{RXD} and V_{IO}</td>
<td>Supply Input</td>
<td>N/A</td>
<td>N/A</td>
<td>R17</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>AB, EN, and LBK</td>
<td>Input</td>
<td>R18 (JMP6)</td>
<td>R19 (JMP6)</td>
<td>R17</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table 5. RC Filter and Protection Lists
The TCAN10xx family of devices interface CAN protocol controllers with the physical bus in accordance to the ISO 11898 standard. These devices are compatible with the ISO 11898 High Speed CAN (Controller Area Network) Physical Layer standards: 11898-2. Standard versions are designed for data rates of 1 megabit per second (Mbps) in CAN networks and additional devices are designed to meet at least 2 Mbps in CAN FD networks. The devices include many protection features providing device and CAN network robustness.

![Figure 3. TCAN1042 Basic Block Diagram](image)

Table 6. EVM Connection Settings for TCAN1042

<table>
<thead>
<tr>
<th>Connection</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>JMP1</td>
<td>Mode selection: Pullup to $V_{CC}$ for silent mode, pulldown to GND for normal mode</td>
</tr>
<tr>
<td>JMP2</td>
<td>Connection for access to all critical digital I/O, supply, and GND if being externally driven by test equipment or interfaced to a processor EVM. Note: ensure that JMP1, JMP6, and TB1 settings do not conflict with JMP2, if it is used.</td>
</tr>
<tr>
<td>JMP3</td>
<td>CAN bus connection (CANH, CANL) and GND as necessary if interfacing EVM to a CAN network</td>
</tr>
<tr>
<td>JMP4</td>
<td>Connect if necessary for a single CAN network termination</td>
</tr>
<tr>
<td>JMP5</td>
<td>Connect if necessary for in parallel with JMP4 to get a 60-Ω load to measure CAN parametrics</td>
</tr>
<tr>
<td>JMP6</td>
<td>TCAN1042 $V_{IO}$ - Level-shifting for applications that require 3.3-V operation. Connect to 5-V supply for 5-V applications and 3.3-V for 3.3-V applications.</td>
</tr>
</tbody>
</table>
STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. **Delivery:** TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, or documentation (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms and conditions set forth herein. Acceptance of the EVM is expressly subject to the following terms and conditions.

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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 any defects that are 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. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.

2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, 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.

3 **Regulatory Notices:**

3.1 **United States**

3.1.1 Notice applicable to EVMs not FCC-Approved:
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

Concerning EVMs Including Radio Transmitters:
This device complies with Industry Canada license-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.

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/lads/ta/ta1/general/eStore/notice_01.page

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 by Radio Law of Japan to follow the instructions below with respect to EVMs:

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 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.
6. **Disclaimers:**

6.1 **EXCEPT AS SET FORTH ABOVE, EVMS AND ANY WRITTEN DESIGN MATERIALS PROVIDED WITH THE EVM (AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

6.2 **EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS AND CONDITIONS SHALL BE CONSTRUED AS GRANTING OR CONFINING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT MADE, CONCEIVED OR ACQUIRED PRIOR TO OR AFTER DELIVERY OF THE EVM.

7. **USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.** USER WILL 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 HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS AND CONDITIONS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

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

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8.2 **Specific Limitations.** IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY WARRANTY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS AND CONDITIONS, OR ANY USE OF ANY TI EVM PROVIDED HEREUNDER, EXCEED THE TOTAL AMOUNT PAID TO TI FOR THE PARTICULAR UNITS SOLD UNDER THESE TERMS AND CONDITIONS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM AGAINST THE PARTICULAR UNITS SOLD TO USER UNDER THESE TERMS AND CONDITIONS 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.

10. **Governing Law:** These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

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