SN65HVD7xEVM Evaluation Module

This manual describes the SN65HVD7xEVM Evaluation Module (EVM). This EVM helps designers evaluate the device performance, supporting the fast development and analysis of data transmission systems using SN65HVD72/SN65HVD75/SN65HVD78 (referred to as SN65HVD7x) transceivers.

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1 Overview

These devices have robust 3.3-V drivers and receivers in a small package for demanding industrial applications. The bus pins are robust to ESD events, with high levels of protection to Human-Body Model and IEC Contact Discharge specifications. These devices each combine a differential driver and a differential receiver, which operate from a single 3.3-V power supply.The driver differential outputs and the receiver differential inputs are connected internally to form a bus port suitable for half-duplex (two-wire bus) communication. These devices all feature a wide common-mode voltage range making the devices suitable for multi-point applications over long cable runs. These devices are characterized from -40°C to 125°C.

NOTE: The EVM board comes with the SN65HVD75 (20 Mbps) device soldered on the board. The EVM kit comes with an IC sample pack that includes one SN65HVD72 (250 kbps) device and one SN65HVD78 (50 Mbps) device. Either device can be evaluated by replacing the SN65HVD75 with the desired speed grade device.

2 EVM Setup and Precautions

Figure 1 shows the schematic of the EVM. The EVM board has headers labeled from JMP1 to JMP14 (JMP5 is omitted) and two 3-pin terminal blocks labeled TB1 and TB2. These headers support device evaluation for a wide range of system configurations.

- Pin 1 (EARTH) is a second ground pin that allows applying an external voltage between GND and EARTH to simulate common-mode voltage conditions.
- Pin 2 (GND) is connected to the negative output or ground terminal of the PSU. This pin represents the ground potential of the device-under-test and the entire EVM. It also connects to various jumpers on the board.
- Pin 3 (VCC) is connected to the positive output of a regulated 3.3-V power supply unit (PSU) as it represents the positive supply voltage of the device-under-test and also connects to various jumpers on the board.

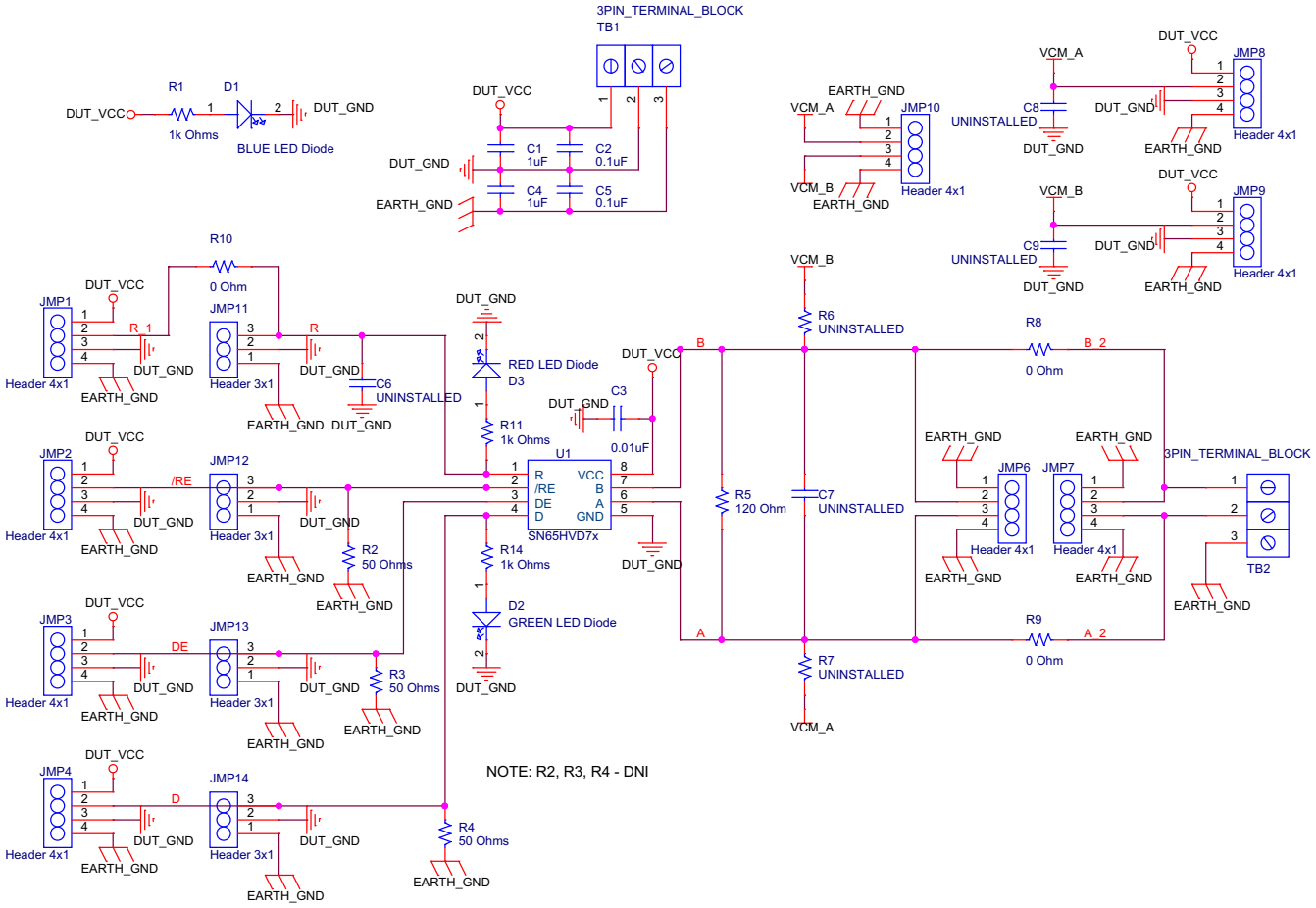

Figure 1. SN65HVD7xEVM Schematic

For the first measurements, ignore the common-mode simulation and connect EARTH to GND through a wire-bridge between pin 1 and pin 2 of TB1.

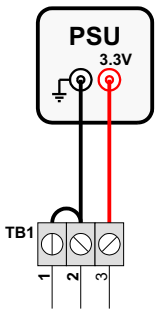

Figure 2. Bridging DUT_GND with EARTH_GND

While JMP2 to JMP4 are stimulation points, or headers through which the control and data signals for the SN65HVD7x are applied, JMP1, and JMP11 to JMP14 are probe points, or headers at which these signal can be measured.

Note that the 50-Ω resistors, R2, R3, and R4, have the index *n.a.*, indicating that these components are *not assembled*. Because signal generators have a typical source impedance of 50 Ω, their output signal is twice the required signal voltage, and assumes that the on-board 50-Ω resistors divide this voltage down to the correct signal level.

Without these resistors; however, this voltage divider action is not accomplished, and the generator output voltage must be reduced to 3.3 V to avoid damaging the transceiver inputs.

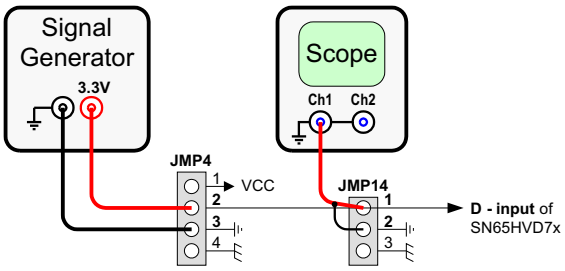

Figure 3. Example for Stimulus and Probe Points with JMP4 and JMP14

Figure 3 gives an example for entering a data signal into the driver section of the transceiver. The signal output of the generator is adjusted to 3.3 V. The generator's ground terminal is connected with pin 3, and the signal output terminal with pin 2 of JMP4. The data signal is measured through an oscilloscope with its signal input connected to pin 1 and its ground wire connected to pin 2 of JMP14.

The same setup applies to the DE and $\overline{RE}$ inputs through their corresponding headers JMP2 and JMP12 and JMP3 and JMP13. JMP1 however, must not receive a signal stimulus. Like JMP11, it represents the receiver output, R, of the SN65HVD7x.

Instead of using signal generators, the EVM can directly interface to the micro controller I/O. Then the non-assembled 50-Ω resistors are of no concern. However, for proper operation, it must be assured that the high-level input voltage $V_{IH} \geq 2$ V and the low-level input voltage $V_{IL} \leq 0.8$ V.

3 Powering Up the EVM and Taking Measurements

The generally recommended procedure for taking measurements is listed:

1. Install the required ground connections.
2. Connect the oscilloscope with the respective probe points you want to measure.
3. Adjust the power-supply to 3.3 V.
4. Adjust the generator outputs for a 3.3-V maximum output signal level, or check the logic switching levels of the controller I/O.
5. Connect the power supply conductor with pin 3 of TB1 and observe the blue LED (D1) turning on.
6. Connect signal conductors from the controller or the generator with their corresponding EVM inputs at JMP2 to JMP4.
7. Logic high at the receiver output, R, will turn on the red LED (D3), and logic high at the driver input, D, turns on the green LED (D2). If D is left open, an internal 100-kΩ pull-up resistor provides logic high instead. However, due to the small input current, D2 will remain off.

3.1 Measurement Examples

Each of the following measurement examples show the equivalent circuit diagram and the corresponding EVM setup. Only the measurement relevant headers and terminal blocks are shown, and not necessarily at their exact location on the EVM.

1. Standard Transceiver Configuration

   Normal transceiver operation requires both the driver and the receiver sections being active. Therefore, the receiver enable pin ($\overline{RE}$) must be at logic low potential and the driver enable pin (DE) at logic high.

   Transmit data entering at the D-input terminal appear as the differential output voltage ($V_{OD} = V_A - V_B$) on the bus wires, A and B. Via the active receiver, it is possible to sense the data traffic in transmit direction.

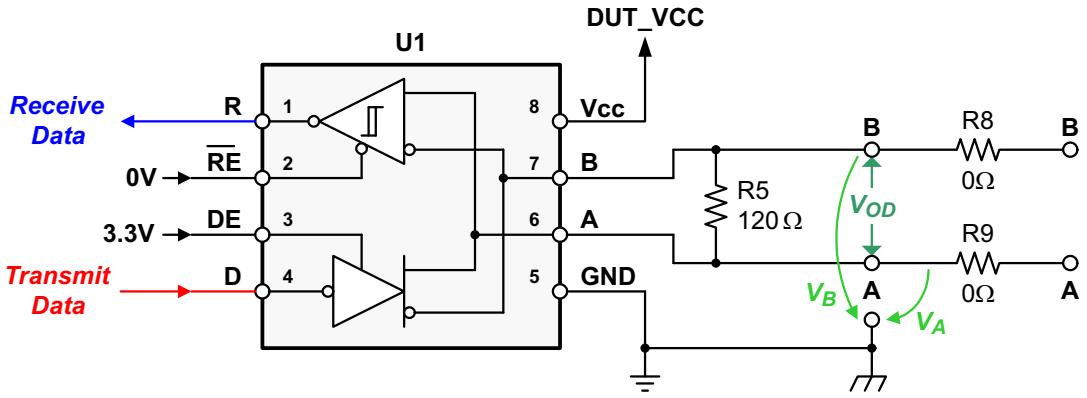

Figure 4. Transceiver Configuration for Normal Operation

Figure 5 shows the corresponding EVM setup. EARTH and GND receive the same reference potential, PSU-ground, through the wire-bridge from pin 1 to pin 2 at the terminal block, TB1, while pin 3 (VCC) is connected to the 3.3-V output of a power-supply unit (PSU).

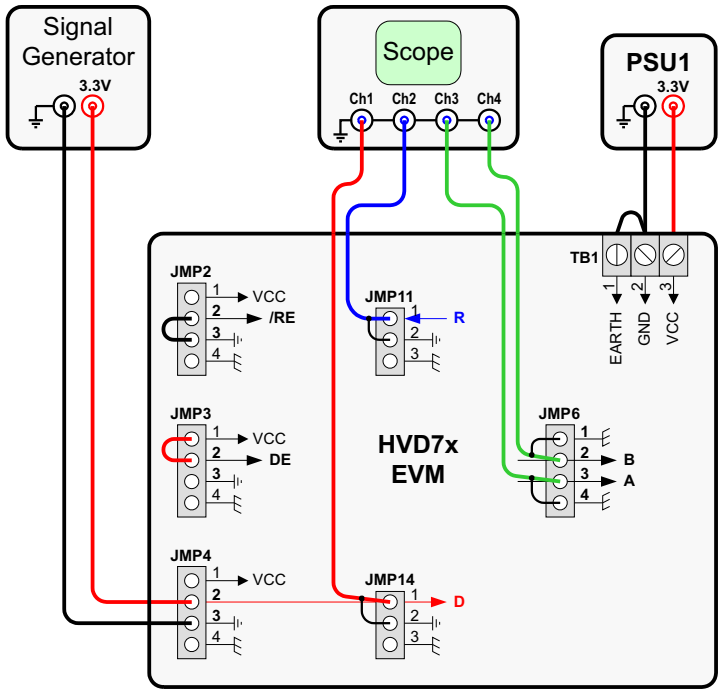

Figure 5. SN65HVD7xEVM Setup for Normal Transceiver Operation

The low potential for $\overline{RE}$ is provided by the wire-bridge from pin 2 to pin 3 at JMP2, and the high potential for DE through a wire-bridge from pin 2 to pin 1 at JMP3. Data from the signal generator enter the board at pin 2 and pin 3 of JMP4. This data is measured via channel 1, which is connected to pin 1 and pin 2 of JMP14. Channel 2 measures the receive data at JMP11, and channels 3 and 4 the bus voltages, V_A and V_B, at JMP6.

2. Operation Under Maximum Load

   EIA-485 (RS-485) specifies three maximum load parameters: a maximum differential load of 60 Ω, a maximum common-mode load of 375 Ω for each bus wire, and a receiver common-mode voltage range from –7 V to +12 V. Figure 6 reflects these requirements through R5, R8, R9, and V_{CM}. Note that under maximum load conditions the transceiver must be capable of sourcing and sinking bus currents of up to 55 mA. The purpose of this test is to show the robustness of V_{OD} over the entire common-mode voltage range at maximum load.

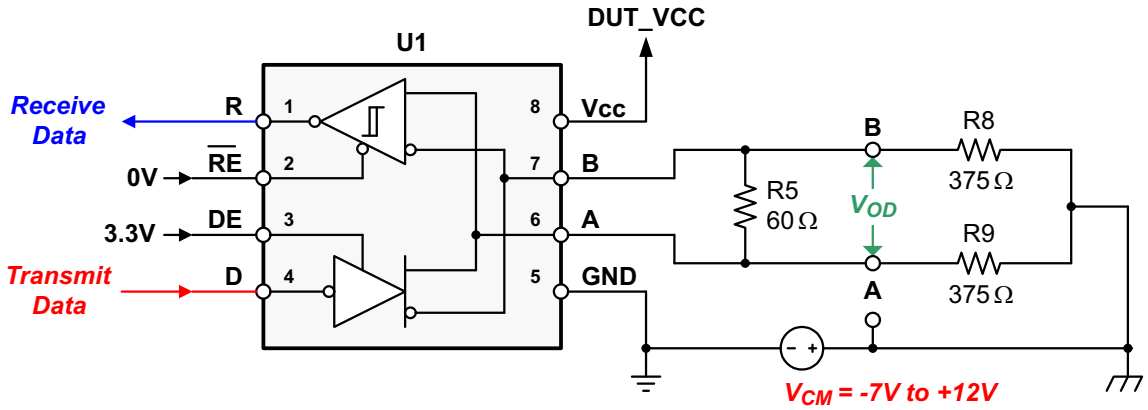

Figure 6. Configuration for Maximum Loading

While the cable connections of the signal generator and the oscilloscope remain the same as in the previous example, the following board changes need to be implemented to reflect maximum load conditions:

- replace R5 (120-Ω default) with 60 Ω
- replace R8 and R9 (0-Ω default) with 375 Ω
- connect pin 2 of JMP7 with pin 1 and pin 3 with pin 4
- replace the previous wire-bridge at TB1 with a second power supply unit (PSU2) and connect the ground terminals of both, PSU1 and PSU2 with a wire-bridge, as shown in Figure 7.

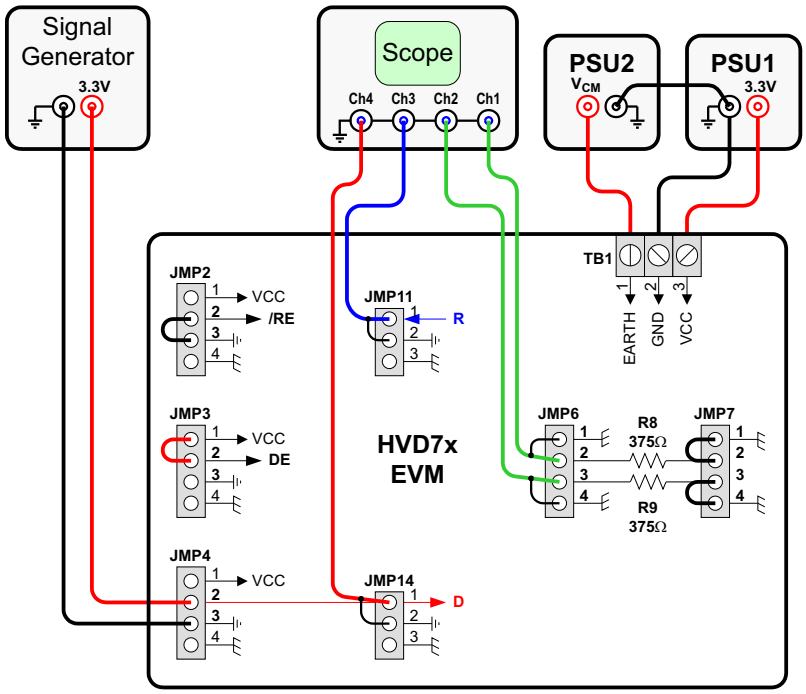

Figure 7. SN65HVD7xEVM Setup for Maximum Loading

Note that Figure 7 only shows the wiring of PSU2 for positive common-mode voltages. For negative V_{CM}, connect the ground terminal of PSU2 with pin 1 of TB1 (EARTH), and the V_{CM}-output of PSU2 with the ground terminal of PSU1.

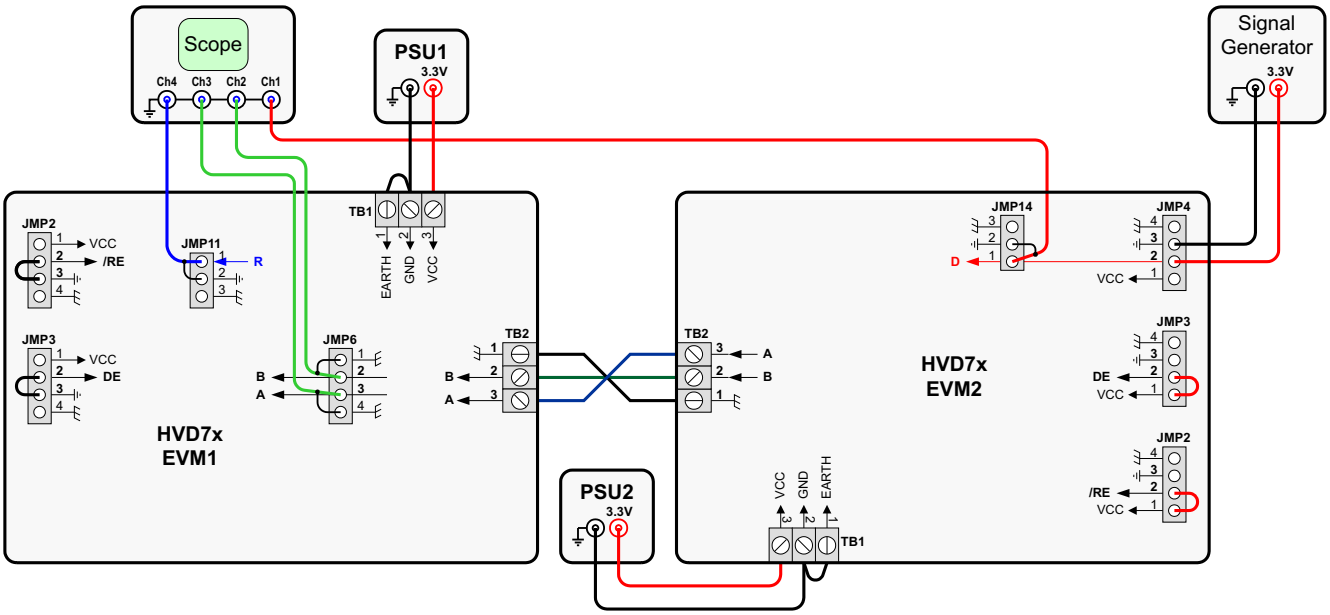

Figure 8. SN65HVD7xEVM Configurations: Left as Receiver EVM, Right as Transmitter EVM

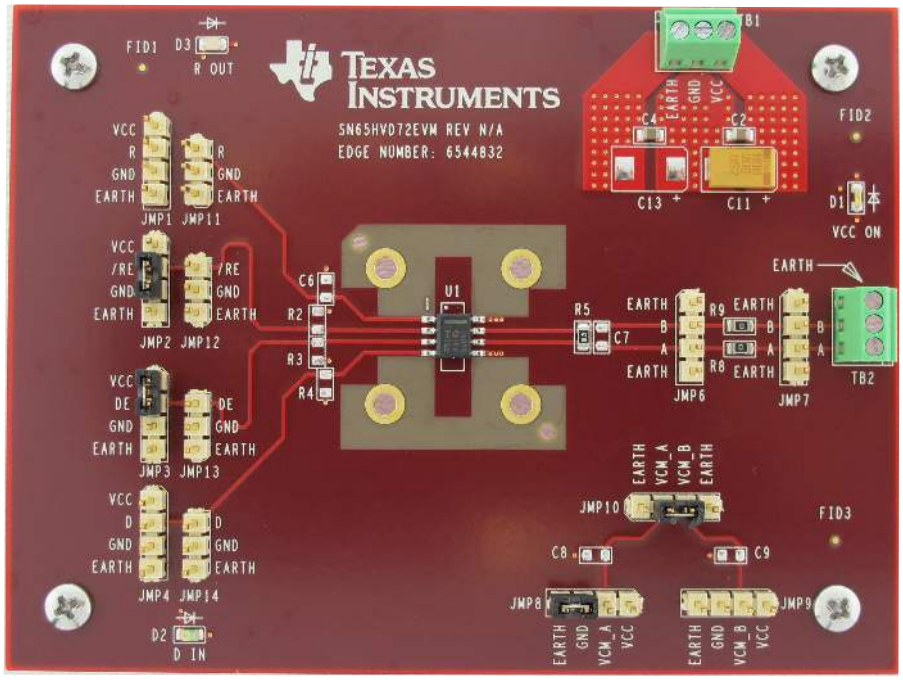

Figure 9. Top View of SN65HVD7xEVM

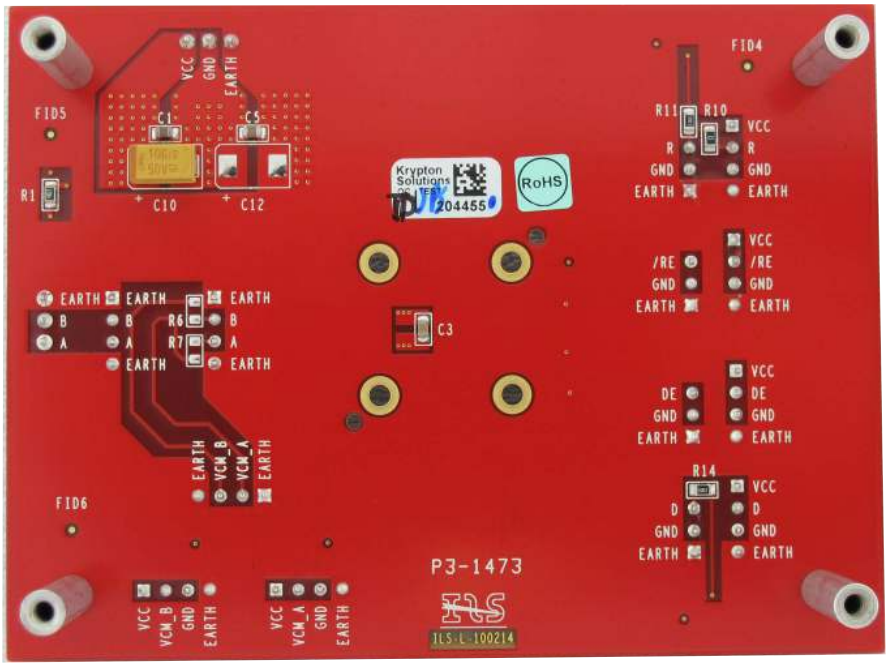

Figure 10. Bottom View of SN65HVD7xEVM

For detailed information on the device parameters see the SN65HVD7x data sheet (Lit.# SLLSE11).

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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.

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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.

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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
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- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs including detachable antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

Concernant les EVMs avec appareils radio

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

【Important Notice for Users of this Product in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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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.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

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