User's Guide

SBOU178–November 2016

# INA1650EVM SoundPlus™ High Common-Mode Rejection Line Receiver Evaluation Module

This user's guide contains information for the INA1650 as well as support documentation for the INA1650 evaluation module (EVM). Included are the performance specifications, set-up procedure, modifications, measured data, printed circuit board (PCB) layout, schematic, and bill of materials of the INA1650EVM.

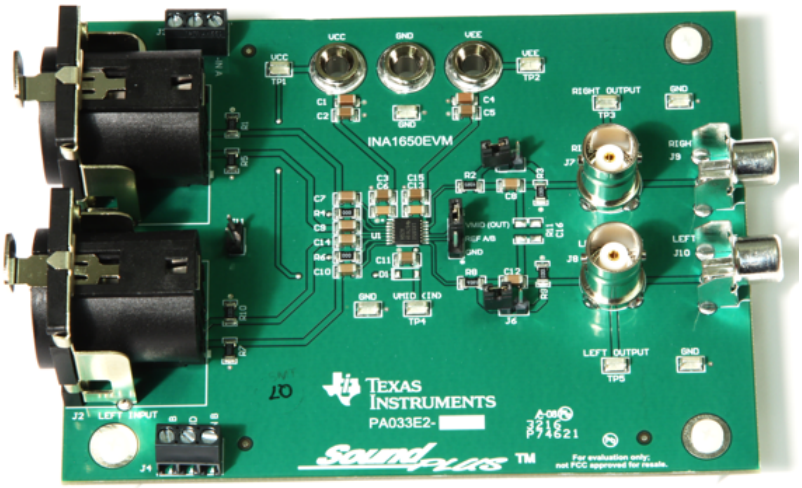



**Figure 1. INA1650 SoundPlus™ Evaluation Module (EVM)**

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## 1 Introduction

The INA1650 is a high common-mode rejection audio line receiver from the SoundPlus line of audio amplifier products from Texas Instruments. For a full list of electrical characteristics of the INA1650, please refer to the INA1650 product data sheet (SBOS818).

## 2 EVM Measured Performance Summary

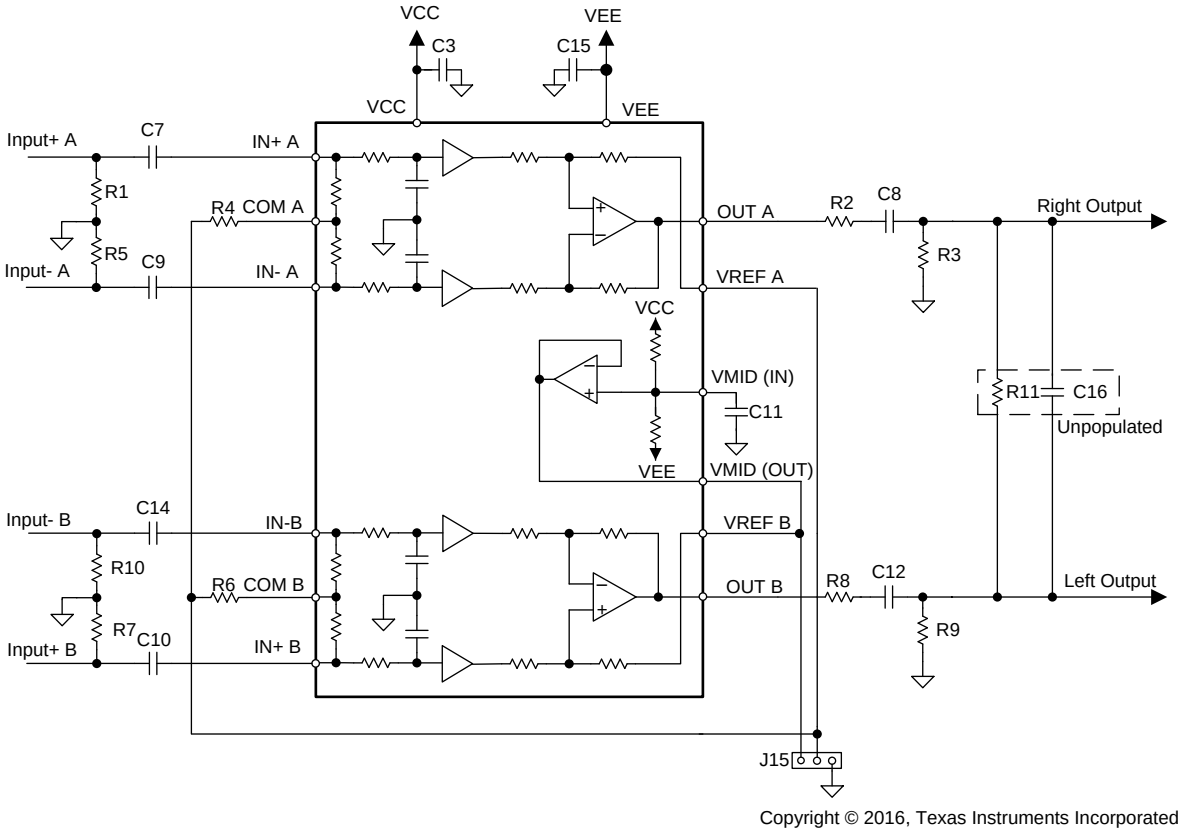
A summary of the INA1650EVM performance specifications is provided in Table 1. Specifications are given for a supply voltage of $V_S$ = ±15 V at an ambient temperature of 25°C, unless otherwise noted.

**Table 1. INA1650EVM Measured Performance Summary**

| Specification | Test Conditions | Measured Performance |
|---|---|---|
| Common-Mode Rejection Ratio (CMRR) | $V_{IN}$ = 1 Vrms at 1 kHz | –90 dB |
| THD+N at 1 kHz | $V_{IN}$ = +22 dBu | –120 dB |
| Second Harmonic – Left Channel | $V_{OUT}$ = 10 Vrms, F = 1 kHz | –134.35 dBc |
| Second Harmonic – Right Channel | $V_{OUT}$ = 10 Vrms, F = 1 kHz | –130.88 dBc |
| Start Up Time | | 1.5 s |

## 3 Modifications

This EVM is designed to provide access to the features of and measure the performance of the INA1650. Modifications of the INA1650EVM can be made and include; adjusting the ac-coupled corner frequency, filtering the VMID (IN) pin, adjusting the start-up time, increasing the common-mode input impedance, and configuring the EVM for a single-ended input to a differential output. A simplified schematic of the INA1650EVM is displayed in Figure 2. For a full schematic of the INA1650EVM, see Figure 15.




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**Figure 2. Simplified INA1650EVM Schematic**


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### 3.1 AC-Coupled Corner Frequency

Capacitors C7, C9, C10, and C14 provide the option to ac couple the input of the INA1650 and capacitors C8 and C12 provide the option to ac couple the output of the INA1650. Equation 1 and Equation 2 calculate the high pass corner frequency of input A and input B due to capacitors, C7, C9, C10, and C14 on the input.

$$f_{corner_in\ A} = \frac{1}{\Pi \times C_7 \times R_{in}} \quad (1)$$

$$f_{corner_in\ B} = \frac{1}{\Pi \times C_{10} \times R_{in}}$$

where

- $C_7 = C_9$ and $C_{10} = C_{14}$
- $R_{IN}$ is the differential input impedance of the INA1650 (2)

Equation 3 and Equation 4 calculate the high-pass corner frequency due to capacitors C8 and C12 and resistors R2, R3, R8, and R9 on the output.

$$f_{corner_out\ A} = \frac{1}{2\Pi \times (R_2 + R_3) \times C_8} \quad (3)$$

$$f_{corner_out\ B} = \frac{1}{2\Pi \times (R_8 + R_9) \times C_{12}} \quad (4)$$

Resistors R2, R3, R8, and R9 form a voltage divider on the output of the INA1650 and will attenuate the output signal. Equation 5 and Equation 6 calculate the attenuation of channel A and channel B output, respectively.

$$Attenuation_A = \frac{R_3}{R_2 + R_3} \quad (5)$$

$$Attenuation_B = \frac{R_9}{R_8 + R_9} \quad (6)$$

### 3.2 Filtering the VMID (IN) Pin

Capacitor C11 provides an option to filter the input to the internal reference buffer, VMID (IN). Equation 7 calculates the cut-off frequency due to C11.

$$f_{cut\ off\ VMID\ IN} = \frac{1}{2\Pi \times 250\ k\Omega \times C_{11}} \quad (7)$$


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### 3.3 Start-Up Time

Capacitor C11 increases the settling time of the VMID (OUT) pin due to the resistance of the internal voltage divider for VMID (IN) and C11 creating an RC time constant. Equation 8 calculates one RC time constant.

$$\tau_{RC} = 250\ k\Omega \times C_{11} \quad (8)$$

Figure 3 displays the rate at which an RC circuit charges to its final value. Notice at one time constant, the voltage across the capacitor is at 63.2% of its final value.

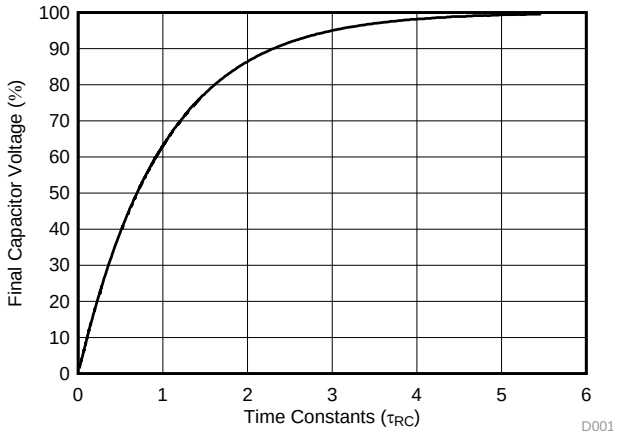



**Figure 3. RC Charging Rate**

Table 2 shows the final capacitor voltage at multiple time constants.

**Table 2. Final Capacitor Voltage**

| Time Constant ($\tau_{RC}$) | Final Capacitor Voltage (%) |
|---|---|
| 1 | 63.2% |
| 2 | 86.4% |
| 3 | 95.0% |
| 4 | 98.1% |
| 5 | 99.3% |
| 6 | 99.7% |

To decrease the settling time of the VMID (OUT) voltage the Zener diode, D1, can be populated. The Zener voltage of the diode should be chosen to be greater than 100 mV more than one half of the supply voltage. Equation 9 calculates the recommended Zener voltage of the diode (Vz). Note that due to the leakage current of the Zener diode interacting with the internal voltage divider resistance an error may be seen on the VMID (OUT) pin.

$$V_Z \geq \frac{1}{2} V_{CC} + 100\ mV \quad (9)$$

### 3.4 Increasing the Common-Mode Input Impedance

The high CMRR of many line receivers can be degraded by source impedance mismatches in the system. Resistors R4 and R6 provide an option to increase the common-mode input impedance of the INA1650 to reduce the effects of source impedance mismatch. For an explanation on the effects of increasing the common-mode input impedance please refer to section 8.1.2 of the INA1650 product data sheet (SBOS818).


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### 3.5 Single-Ended Input to Differential Output

Jumper J11 allows the INA1650EVM to convert single-ended signals to differential signals. To set up the EVM to create a differential output from a single-ended input, first place a shunt across J11, then remove resistors R3 and R9, and finally, install resistor R11 and capacitor C16 if required in the design. To apply a single-ended signal, insert a jumper wire from –IN A to GND and +IN B to GND into terminal blocks J3 and J4, respectively, and insert a wire into +IN A of terminal block J3 and tighten down the screws of the terminal blocks. The single-ended input can then be applied through the wire connected to +IN A. Figure 4 shows how the connections should be made for a single-ended input to differential output.

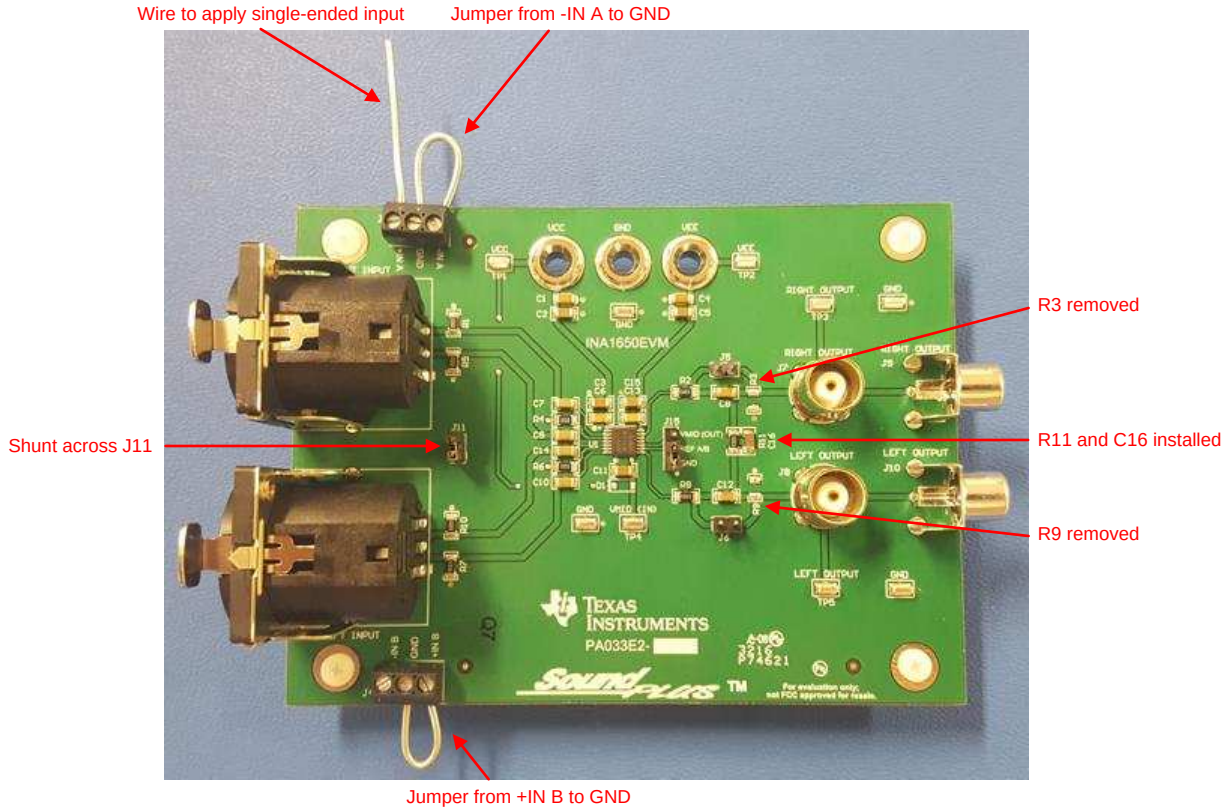



**Figure 4. Single-Ended Input to Differential Output Connections**

Using a differential output changes the high pass corner frequency equations stated in Equation 3 and Equation 4. Equation 10 calculates the high-pass corner frequency due to R2, R8, R11, C8, and C12.

$$f_{c_out_HP_diff} = \frac{1}{\Pi \times C_8 \times (2 \times R_2 + R_{11})} \quad (10)$$

where

- $R_2 = R_8$ and $C_8 = C_{12}$

The capacitor C16 of the differential output configuration creates a low pass filter. Equation 11 calculates the low pass corner frequency.

$$f_{c_out_LP_diff} = \frac{1}{2\Pi \times C_{16} \times ((2 \times R_2) \| R_{11})} \quad (11)$$

where

- $R_2 = R_8$ and $C_8 = C_{12}$


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# 4 Test Setup and Results

This section describes how to properly connect, set up, and use the INA1650EVM. This section also includes measured data of the INA1650EVM to display typical performance of the INA1650EVM. Measurements include:

- Common-mode rejection ratio (CMRR)
- THD+N vs. Amplitude
- THD+N vs. Frequency
- Fast-Fourier Transform (FFT)

The *THD+N vs. Amplitude*, *THD+N vs. Frequency*, and *FFT* measurements were taken using an *Audio Precision APx555*. All measurements used ±15-V supplies at an ambient temperature of 25 °C.

## 4.1 Power Supply Connections

The power supply connections for the INA1650EVM are provided through the use of the banana jacks or test points located at the top of the EVM. The positive power supply connections are labeled as VCC, the negative power supply connections are labeled as VEE, and the ground connections are labeled as GND. For the minimum and maximum supply voltages of the INA1650EVM, please refer to the INA1650 product data sheet (SBOS818).

## 4.2 Input Connections

Input signals for the right channel (channel A) and left channel (channel B) input are applied to the INA1650EVM through the use of the female XLR connectors J1 and J2 or terminal blocks J3 and J4, respectively. The female XLR connectors follow the standard female XLR pin out with pin 1 connected to ground, pin 2 connected to the positive input, and pin 3 connected to the negative input. The terminal block connections are labeled as +IN A and +IN B for the positive inputs, -IN A and –IN B for the negative inputs, and GND for the ground connections.

## 4.3 Output Connections

The right and left channel output connections are provided through BNC connectors, J7 and J8, RCA jacks, J9 and J10, and test points TP3 and TP5, respectively. The right channel outputs are labeled as RIGHT OUTPUT and the left channel outputs are labeled as LEFT OUTPUT. The RCA jacks provide a connection to a load while the BNC connectors and test points provide a way to measure the performance of the INA1650 while a load is connected.


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### 4.4 VREF A, VREF B, COM A, and COM B Connections

Jumper J15 provides the option to connect pins VREF A, VREF B, COM A, and COM B to ground or VMID (OUT). In single supply operation, a shunt should be place in the upper position (pins 2 to 3) of J15, as indicated by the red box in Figure 5, to connect VREF A, VREF B, COM A, and COM B pins to VMID (OUT).

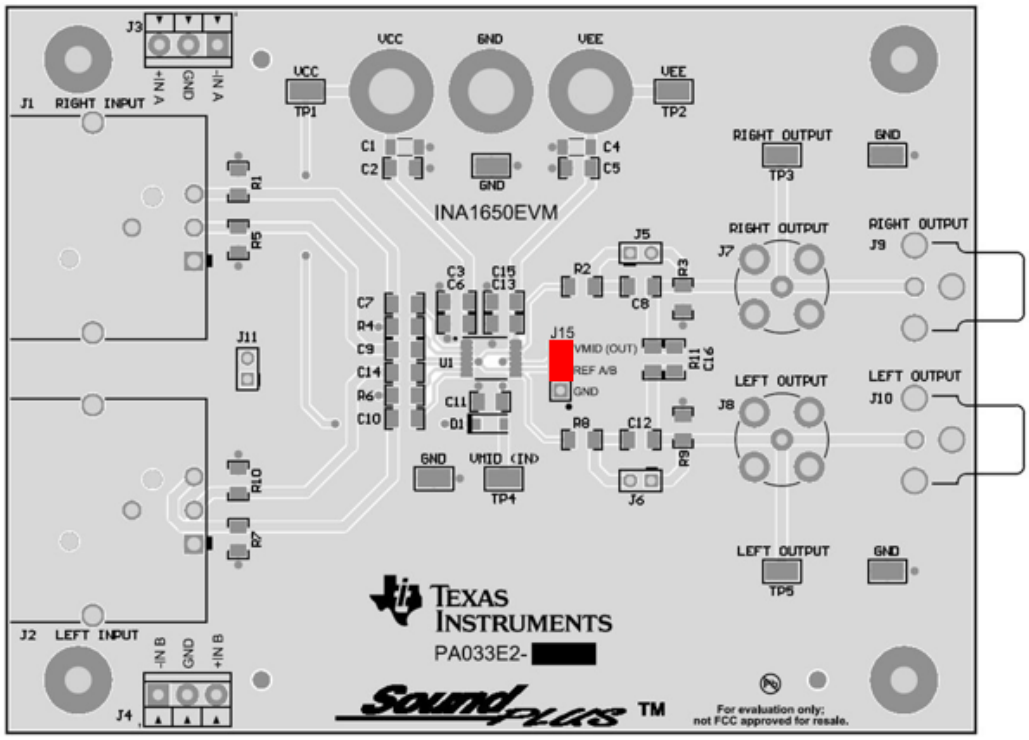



**Figure 5. J15 Connection for Single-Supply Operation**

For dual-supply operation, a shunt should be placed in the lower position (pins 1 to 2) of J15, as indicated by the red box in Figure 6, to connect VREF A, VREF B, COM A, and COM B pins to ground (GND).


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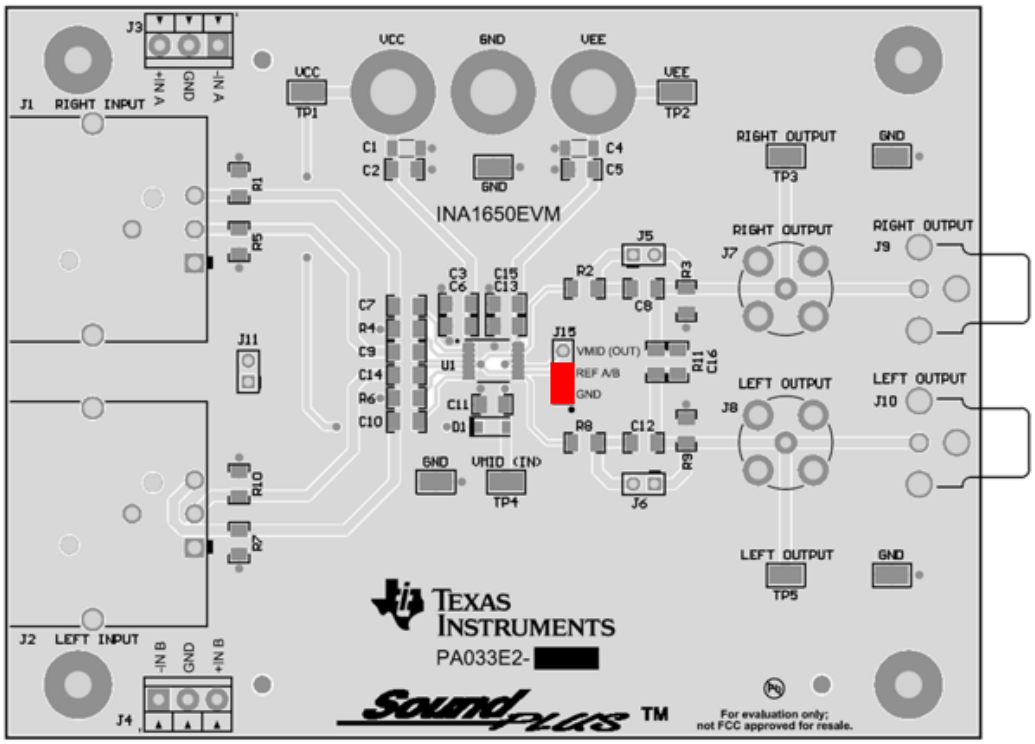



**Figure 6. J15 Connection for Dual Supply Operation**


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### 4.5 Common-Mode Rejection Ratio

The common-mode rejection ratio measurement was performed by applying a 1-Vrms common-mode signal to the input and measuring the gain of the signal at the output. The frequency of the input signal was swept from 20 Hz to 90 kHz and the measurement bandwidth of the *Audio Precision APx555* was set to 90 kHz. Differences in common-mode rejection between the left and right channel can occur and may vary from part to part. Figure 7 shows a measurement of the common-mode rejection ratio.

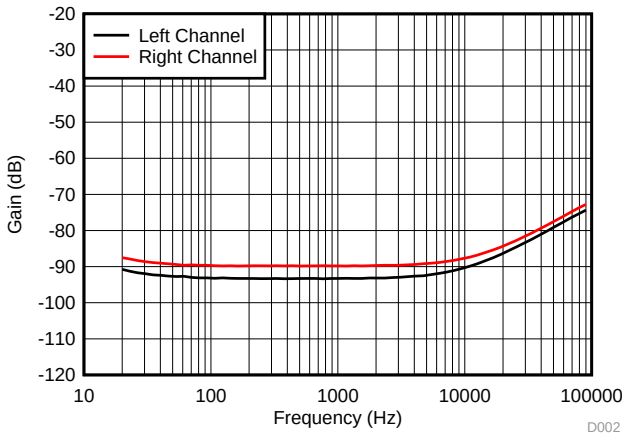



**Figure 7. Common-Mode Rejection Ratio (CMRR) Measurement ±15-V Supplies, 1-$V_{RMS}$ Input, 90-kHz MBW**

### 4.6 THD+N vs. Amplitude

The *THD+N vs. Amplitude* measurement was performed by sweeping the output signal amplitude from 1 mVrms to 13 Vrms at a frequency of 1 kHz. The measurement bandwidth of the *Audio Precision APx555* was set to 22 kHz. Figure 8 shows a measurement of the *THD+N vs. Amplitude*.

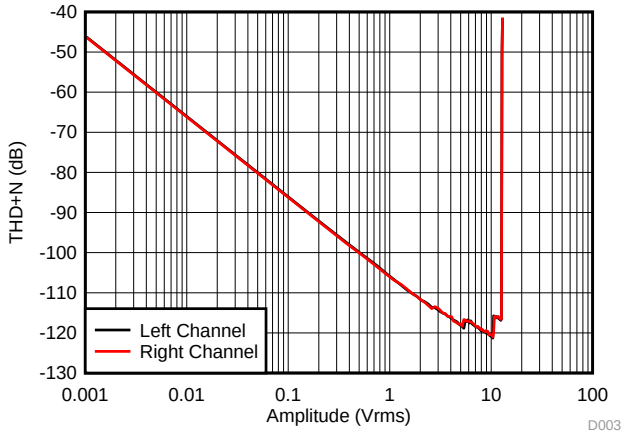



**Figure 8. THD+N vs. Amplitude Measurement ±15-V supplies, 1-kHz output, 22-kHz MBW**


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## 4.7 THD+N vs. Frequency

The *THD+N vs. Frequency* measurements were performed by sweeping the input signal from 20 Hz to 20 kHz with the measurement bandwidth of the *Audio Precision APx555* set to 90 kHz. Figure 9 shows the *THD+N vs. Frequency* measurement with an amplitude of 1 Vrms on the output of the INA1650. Note that capacitors C8 and C12 on the output of the INA1650 can increase distortion at low frequencies due to non-linear effects of the capacitors. Therefore, capacitors C8 and C12 are not populated and a shunt is installed across jumpers J5 and J6.

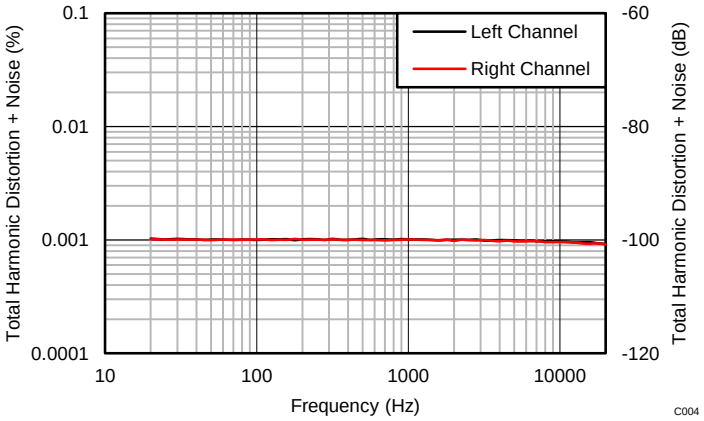



**Figure 9. THD+N vs. Frequency Measurement with 1 Vrms Output ±15-V Supplies, 1-$V_{RMS}$ Output, 90-kHz MBW**

Figure 10 shows the *THD+N vs. Frequency* measurement with an amplitude of 10 Vrms on the output of the INA1650.

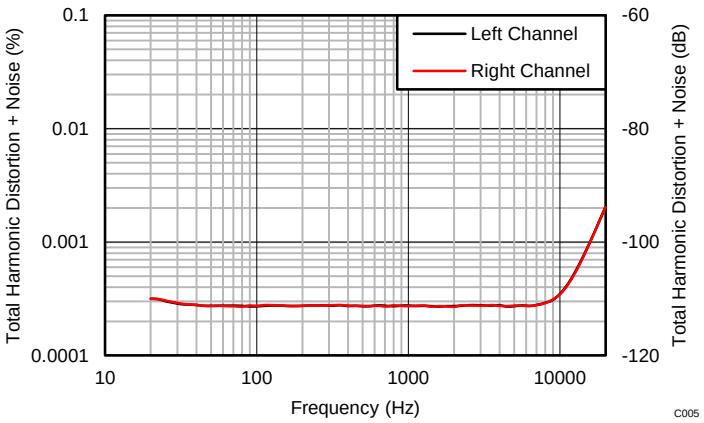



**Figure 10. THD+N vs. Frequency Measurement With 10 Vrms Output ±15-V Supplies, 10-$V_{RMS}$ Output, 90-kHz MBW**


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## 4.8 Fast-Fourier Transform (FFT)

The *FFT* measurements were taken with a 1-kHz, 10-Vrms signal on the output of the INA1650. A 10 Vrms fundamental corresponds to 0 dBc in all *FFT* measurements. Figure 11 shows an *FFT* of the left channel. The second harmonic was measured to be –134.35 dBc.

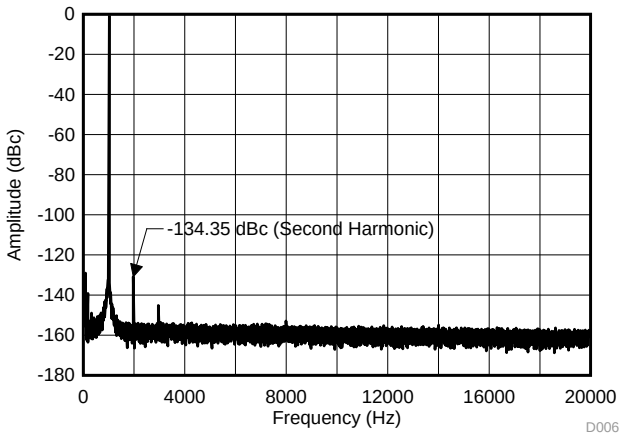



**Figure 11. Left Channel FFT Measurement 1 kHz, 10-$V_{RMS}$ Output**

Figure 12 shows an *FFT* measurement of the right channel. The second harmonic was measured to be –130.88 dBc.

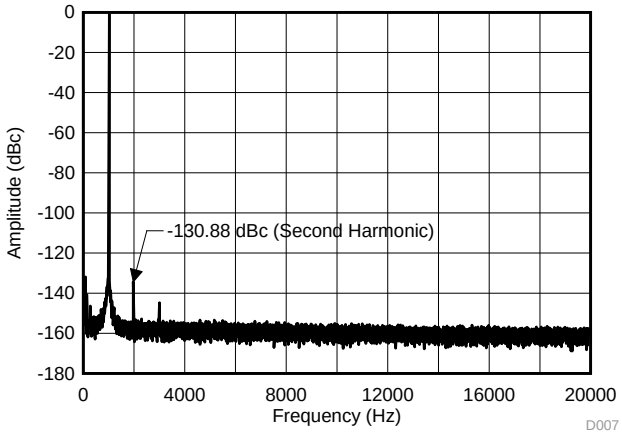



**Figure 12. Right Channel FFT Measurement 1 kHz, 10-$V_{RMS}$ Output**


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# 5 Board Layout

This section provides a description of the INA1650EVM board layout and layer illustrations.

## 5.1 Layout

The board layout for the INA1650EVM is shown in Figure 13 and Figure 14. The top layer consists of all signal traces and is poured with a solid ground plane. The traces of the positive input (IN+ A, IN+ B) and negative input (IN- A, IN- B) were kept as balanced as possible to reduce the possibility of a differential voltage from developing due to trace impedance mismatch. The decoupling capacitors, C3, C6, C15, and C13, were positioned as close as possible to the power supply pins of the device. Minimal traces were routed on the bottom layer so that a large solid ground plane could be poured. Vias were placed at the ground connection of every component to provide a low-impedance path on the bottom layer back to the supply ground. The traces from J15 to VREF A and VREF B were kept as short as possible to maintain the exceptional common-mode rejection of the INA1650.

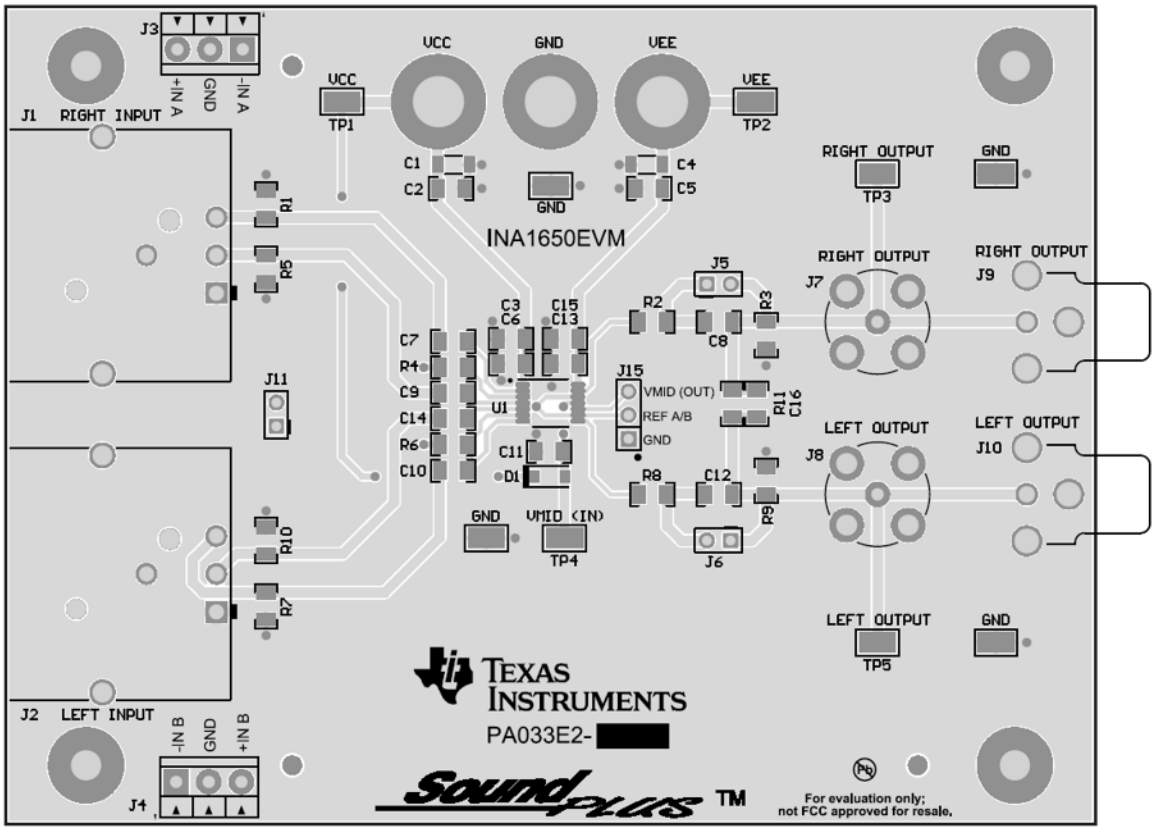



**Figure 13. Top Layer PCB Layout**


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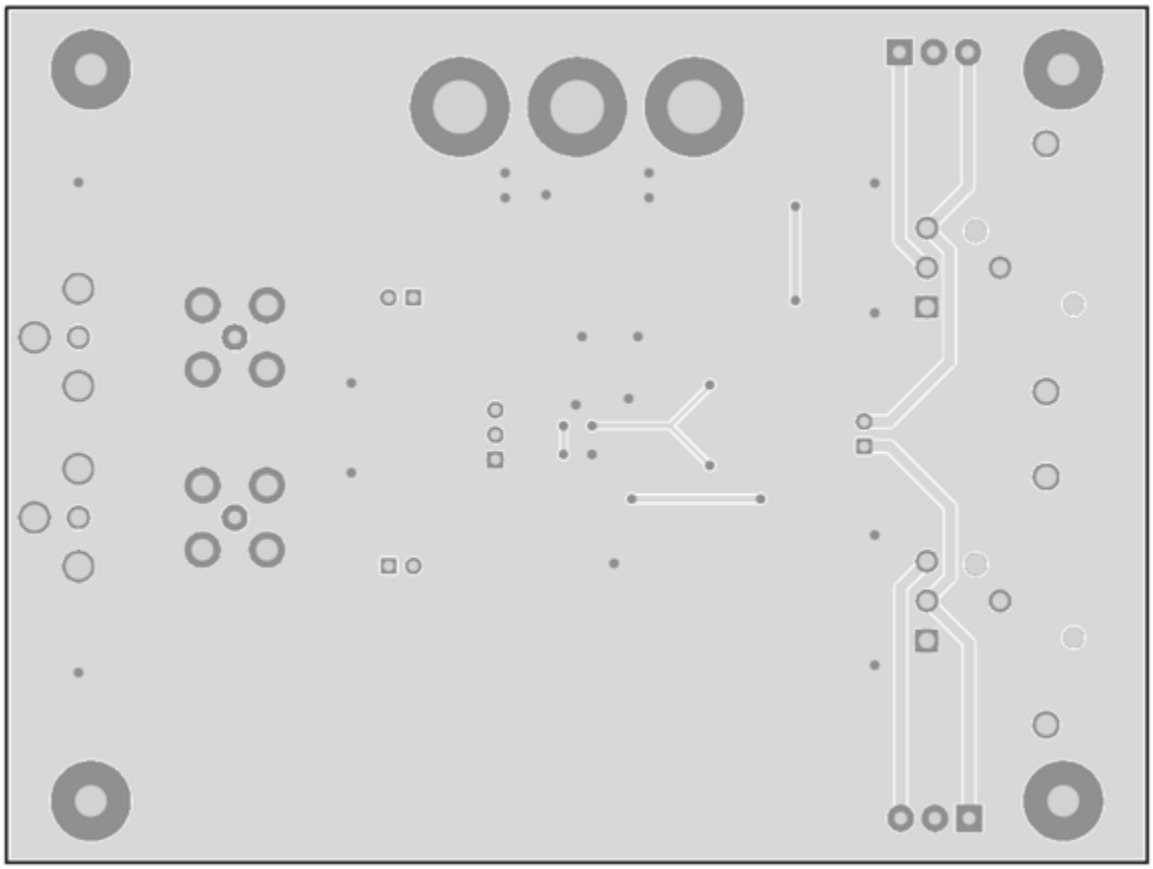


**Figure 14. Bottom Layer PCB Layout**

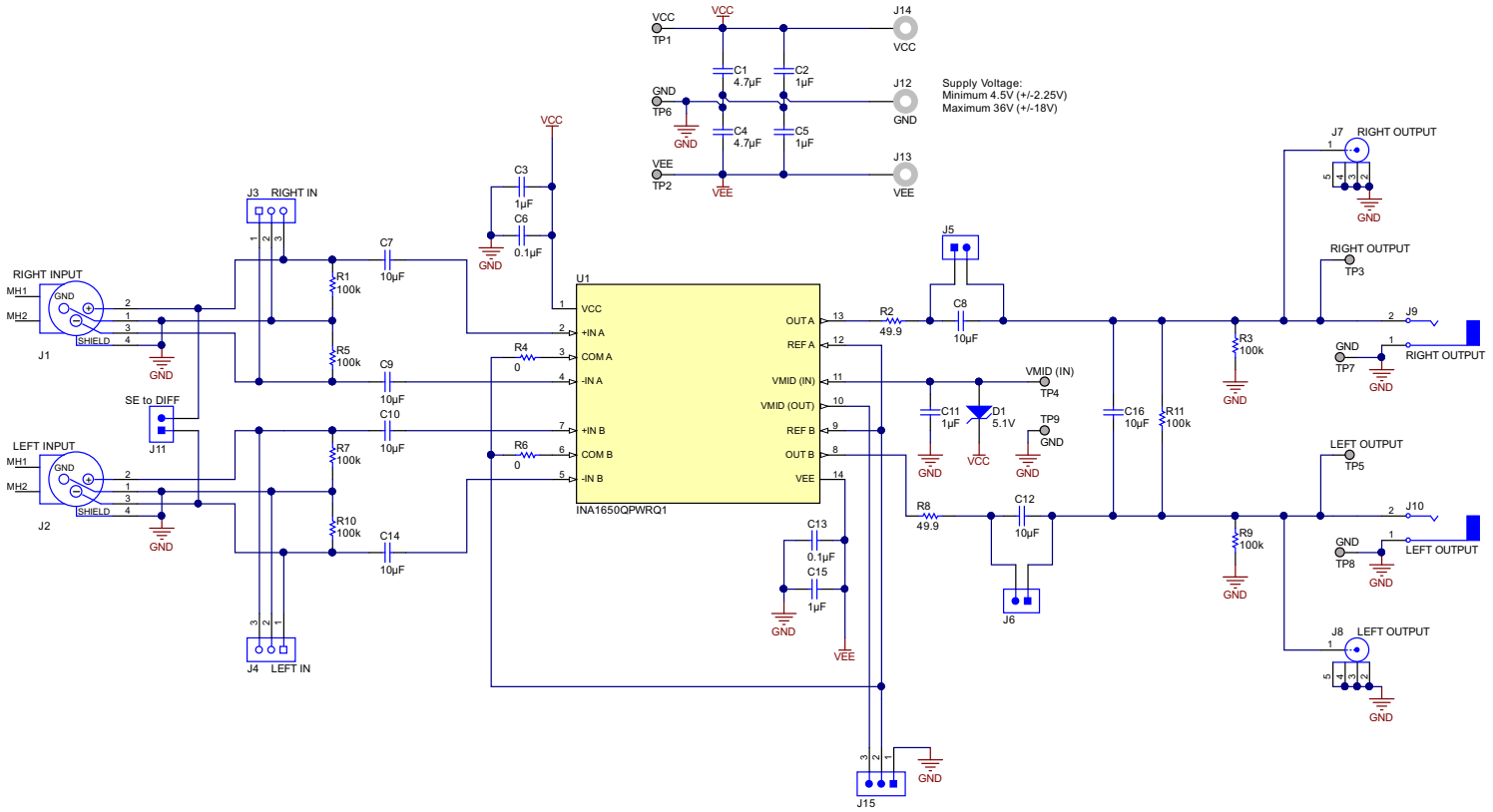

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# 6 Schematic, Bill of Materials, and Reference

This section contains the schematic, bill of materials, and references for the INA1650EVM.

## 6.1 Schematic

Figure 15 illustrates the EVM schematic.




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**Figure 15. Schematic**



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## 6.2 Bill of Materials

Table 3 lists the INA1650EVM BOM.

**Table 3. INA1650EVM Bill of Materials**

| Designator | Qty | Value | Description | Package Reference | Part Number | Manufacturer |
|---|---|---|---|---|---|---|
| PCB | 1 | | Printed-Circuit Board | | PA033 | Any |
| C1, C4 | 2 | 4.7uF | CAP, CERM, 4.7 µF, 50 V, +/- 20%, X7R, 1206_190 | 1206-190 | C3216X7R1H475M160AC | TDK |
| C2, C3, C5, C11, C15 | 5 | 1uF | CAP, CERM, 1 µF, 50 V, +/- 10%, X7R, 1206 | 1206 | GRM31MR71H105KA88L | Murata |
| C6, C13 | 2 | 0.1uF | CAP, CERM, 0.1 µF, 50 V, +/- 5%, X7R, 1206 | 1206 | C1206C104J5RACTU | Kemet |
| C7, C9, C10, C14 | 4 | 10uF | CAP, CERM, 10 µF, 35 V, +/- 10%, X7R, 1206 | 1206 | GMK316AB7106KL | Taiyo Yuden |
| 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, J2 | 2 | | Receptacle, 160mil, 3 Position, R/A, TH | Receptacle, 160mil, 3 Position, R/A, TH | PQG3FRA112 | Switchcraft |
| J3, J4 | 2 | | Terminal Block, 3.5mm Pitch, 3x1, TH | 10.5x8.2x6.5mm | ED555/3DS | On-Shore Technology |
| J5, J6, J11 | 3 | | Header, 100mil, 2x1, Tin, TH | Header, 2 PIN, 100mil, Tin | PEC02SAAN | Sullins Connector Solutions |
| J7, J8 | 2 | | Connector, TH, BNC | Amphenol_112404 | 112404 | Amphenol Connex |
| J9 | 1 | | RCA Jack, 1Pos, Tin, Red, R/A, TH | RCA Jack, 1Pos, R/A, TH | RCJ-012 | CUI Inc. |
| J10 | 1 | | RCA Jack, 1Pos, Tin, White, R/A, TH | RCA Jack, 1Pos, R/A, TH | RCJ-013 | CUI Inc. |
| J12, J13, J14 | 3 | | Standard Banana Jack, Uninsulated, 5.5mm | Keystone_575-4 | 575-4 | Keystone |
| J15 | 1 | | Header, 100mil, 3x1, Tin, TH | Header, 3 PIN, 100mil, Tin | PEC03SAAN | Sullins Connector Solutions |
| R1, R3, R5, R7, R9, R10 | 6 | 100k | RES, 100 k, 1%, 0.25 W, 1206 | 1206 | CRCW1206100KFKEA | Vishay-Dale |
| R2, R8 | 2 | 49.9 | RES, 49.9, 1%, 0.25 W, 1206 | 1206 | CRCW120649R9FKEA | Vishay-Dale |
| R4, R6 | 2 | 0 | RES, 0, 5%, 0.25 W, 1206 | 1206 | CRCW12060000Z0EA | Vishay-Dale |
| SH-J1, SH-J2, SH-J3 | 3 | 1x2 | Shunt, 100mil, Gold plated, Black | Shunt | 969102-0000-DA | 3M |
| TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9 | 9 | | Test Point, Miniature, SMT | Test Point, Miniature, SMT | 5019 | Keystone |
| U1 | 1 | | SoundPlus High Common-Mode Rejection Line Receiver, PW0014A | PW0014A | INA1650IPWR | Texas Instruments |
| C16 | 0 | | | 1206 | | |
| D1 | 0 | | | SOD-123 | | |
| R11 | 0 | | | 1206 | | |
| C8, C12 | 0 | | | 1206 | | |

## 6.3 Reference

- *INA1650 SoundPlus™ High Common-Mode Rejection Line Receiver* data sheet (SBOS818)



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# STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including demonstration software, components, and/or documentation which may be provided together or separately (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 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms and conditions do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   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/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lsds/ti_ja/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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2. 実験局の免許を取得後ご使用いただく。
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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 CONFERRING 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:*

   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 ANDCONDITIONS OR THE USE OF THE EVMS PROVIDED HEREUNDER, 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 ONE YEAR AFTER THE RELATED CAUSE OF ACTION HAS OCCURRED.

   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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No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

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