

# **AMC1303, AMC1306, and AMC1336 Evaluation Module**

This user's guide describes the characteristics, operation, and use of the AMC13xxEVM (AMC1303EVM, AMC1306EVM, and AMC1336EVM). A complete circuit description as well as schematic diagram and bill of materials are included.

The following related documents are available through the Texas Instruments web site at [www.ti.com](http://www.ti.com).

**Table 1. Related Documentation**

| Device                  | Description   |
|-------------------------|---|
| <a href="#">AMC1303</a> | <a href="#">Small, High-Precision, Reinforced Isolated Modulator with Internal Clock</a>                                  |
| <a href="#">AMC1306</a> | <a href="#">AMC1306x Small-Size, Reinforced Isolated Delta-Sigma Modulators</a>   |
| <a href="#">AMC1336</a> | <a href="#">AMC1336 Small, High-Precision, Reinforced Isolated Delta-Sigma Modulator for Voltage Sensing Applications</a> |

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## 1 EVM Overview

### 1.1 Features

This EVM supports the following features:

- Full-featured evaluation board for the AMC1303, AMC1306, or AMC1336 single-channel delta-sigma modulator
- Configurable AVDD and DVDD power supplies
- Screw terminals for easy access to analog inputs and outputs

### 1.2 Introduction

The AMC1303, AMC1306, and AMC1336 devices are 1-bit modulators with an output buffer separated from the input interface circuitry by a silicon dioxide (SiO<sub>2</sub>) isolation barrier. The isolation barrier provides galvanic isolation of up to 8000 V<sub>PEAK</sub>. When used in combination with the AMC1210 or other digital filter, the AMC1303, AMC1306, and AMC1336 can be used to achieve 16-bit analog-to-digital (A/D) conversion with no missing codes.

For use in high-resolution measurement applications, an effective accuracy of 14-bits can be obtained with a digital filter bandwidth of 20 kHz at a modulator rate of 10 MHz.

Throughout this document, the abbreviation *EVM* and the term *evaluation module* are synonymous with the AMC1303EVM, AMC1306EVM, or the AMC1336EVM.

## 2 Analog Interface

The analog input to the AMC13xxEVM is routed from a two-wire screw terminal screw at J1. This screw terminal gives the user access to the inverting and non-inverting inputs of the AMC1303, AMC1306, or AMC1336 depending on which device is installed on the board.

### 2.1 Analog Inputs

The analog input to the AMC13xxEVM board is comprised of direct connection to AINP and AINN through 0-Ω resistors R1 and R2. If filtering is required, R/C filter circuit options are possible using the footprints for C4, C5 and C8. The input circuit for the AMC13xxEVM is illustrated in [Figure 1](#).

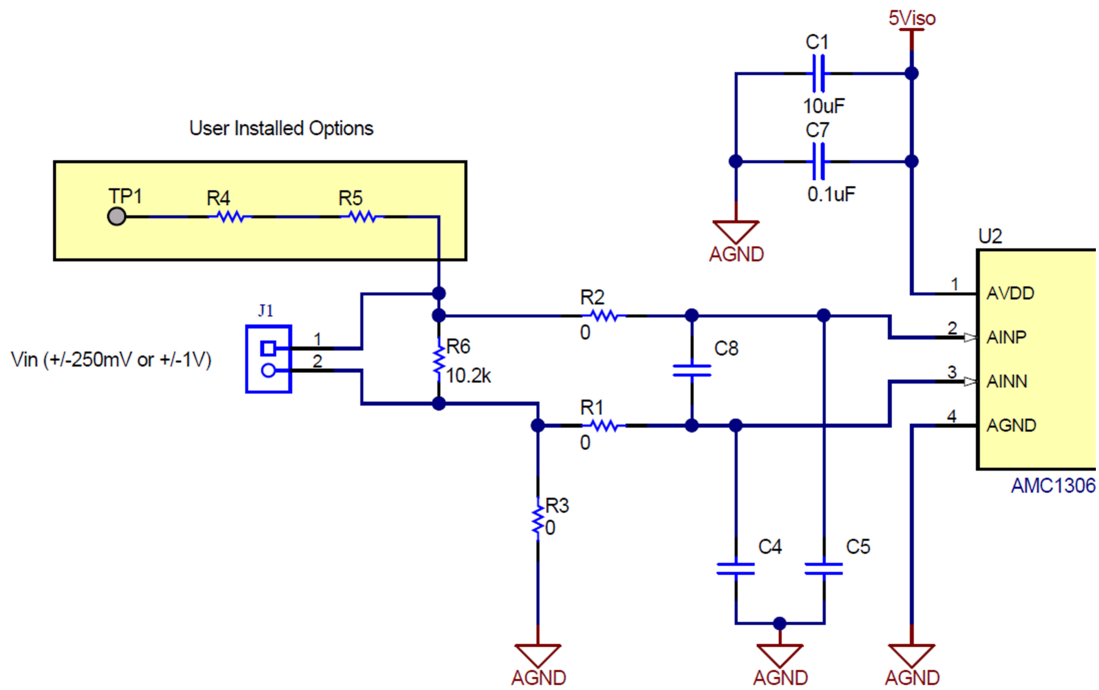


Figure 1. AMC13xxEVM Schematic: Analog Input Section

### 3 Digital Interface

The AMC13xxEVM digital input/output is a simple three terminal screw connector located at J4. J4 pin 1 is the output data from the modulator installed in location U2. For the AMC1306 and AMC1336, pin 7 is the modulator clock input as shown below. A 5 MHz to 20 MHz modulator clock can be applied to J4.2 referenced to J4.3. For the AMC1303, pin 7 is the modulator clock output which can be monitored at J4.2 relative to J4.3.

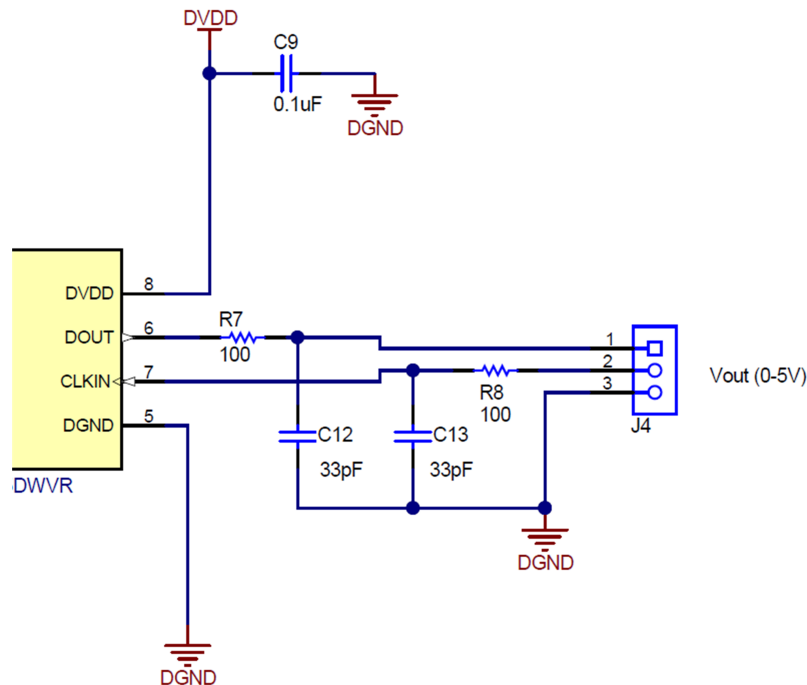


Figure 2. Digital I/O



The screw terminal at J3 allows the user to provide the DVDD source. The DVDD supply should be between 3 and 5.5 V<sub>DC</sub>.

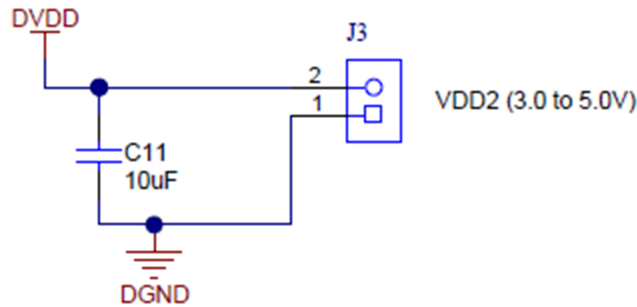


Figure 4. DVDD Input

#### 4.2 Isolated Power and Analog Inputs: J1 and J2

The isolated power input to the AMC13xxEVM printed circuit board (PCB) can be applied directly to J2 pins 1 and 2.

Table 2 lists the details of J2.

Table 2. J2: Analog Inputs

| Pin Number | Signal | Description  |
|------------|--------|--|
| J2.1       | AGND   | Connection to the AMC1303, AMC1306, or AMC1336 AGND terminal (pin 4) |
| J2.2       | AVDD   | Connection to the AMC1303, AMC1306, or AMC1336 AVDD terminal (pin 1) |

The analog input to the AMC13xxEVM printed circuit board (PCB) can be applied directly to J1 pins 1 and 2.

#### CAUTION

Carefully review the AMC1303, AMC1306, and AMC1336 product data sheets for the limitations of the analog input range, and ensure that the appropriate analog/digital voltages are applied prior to connecting any analog input to the EVM. The EVM uses the  $\pm 250$  mV versions of the devices for the AMC1303 and AMC1306. The EVM uses  $\pm 1$  V for the AMC1336.

Table 3 lists the details of J1.

Table 3. J1: Analog Inputs

| Pin Number | Signal | Description   |
|------------|--------|---|
| J1.1       | AINP   | Noninverting analog input to the AMC1303, AMC1306, or AMC1336 |
| J1.2       | AINN   | Inverting input to the AMC1303, AMC1306, or AMC1336           |

### 4.3 Device Operation

Once the analog and isolated power is applied to the AMC13xxEVM, the digital outputs become active. If the AMC1303 is installed at location U2, the device uses its own internal modulator clock. Screw terminal J4 has the connections as shown in [Table 4](#).

**Table 4. J4: AMC1303EVM Digital Output**

| Pin Number | Signal | Description                    |
|------------|--------|--------------------------------|
| J4.1       | DOUT   | AMC1303 bit stream data output |
| J4.2       | CLOCK  | AMC1303 modulator clock output |
| J4.3       | DGND   | Digital ground reference       |

If the AMC1306 is installed at location U2, the device requires an external modulator clock between 5 and 20 MHz. Screw terminal J4 has the connections as shown in [Table 5](#).

**Table 5. J4: AMC1306EVM, AMC1336EVM Digital Output**

| Pin Number | Signal | Description                             |
|------------|--------|---|
| J4.1       | DOUT   | AMC1306, AMC1336 bit stream data output |
| J4.2       | CLOCK  | AMC1306, AMC1336 modulator clock input  |
| J4.3       | DGND   | Digital ground reference                |

An analog input signal may be applied directly at screw terminal J1. Refer to [Figure 1](#) and [Table 3](#) for details. The linear analog input range,  $(V_{IN+}) - (V_{IN-})$ , is  $\pm 250$  mV for the AMC1303 and AMC1306. The linear analog input range,  $(V_{IN+}) - (V_{IN-})$ , is  $\pm 1$  V for the AMC1336.

For the AMC1303 and AMC1306, as the input voltage approaches the maximum input level of +250 mV, the 1s density of the modulator output will approach 92%. Likewise, when the input voltage approaches the lower limit of -250 mV the 1s density will be approximately 8%.

For the AMC1336, as the input voltage approaches the maximum input level of +1 V, the 1s density of the modulator output approaches 92%. Likewise, when the input voltage approaches the lower limit of -1 V the 1s density is approximately 8%.

## 5 Layout, BOM, and Schematic

This section contains the complete bill of materials, schematic diagram and printed circuit board (PCB) layout of the AMC1303/06EVM.

**NOTE:** Board layouts are not to scale. These are intended to show how the board is laid out; they are not intended to be used for manufacturing AMC13xxEVM PCBs.

### 5.1 Printed Circuit Board Layout

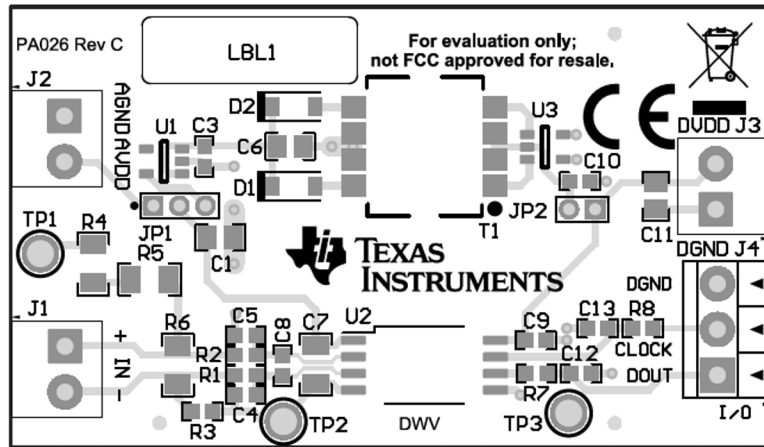


Figure 5. AMC13xxEVM Silkscreen

## 5.2 Bill of Material

**Table 6. AMC13xxEVM Bill of Materials**

| Designators  | Description   | Manufacturer        | Mfg. Part Number                                      |
|--------------|---|---------------------|---|
| C1, C6, C11  | CAP, CERM, 10 uF, 10 V, +/- 10%, X5R, 0805  | Kemet               | C0805C106K8PACTU                                      |
| C3, C9       | CAP, CERM, 0.1 uF, 25 V, +/- 10%, X7R, 0603   | AVX                 | 06033C104KAT2A  |
| C7           | CAP, CERM, 0.1 uF, 50 V, +/- 10%, X7R, 1206   | Yageo America       | CC1206KRX7R9BB104                                     |
| C10          | CAP, CERM, 1 uF, 10 V, +/- 10%, X5R, 0603   | Kemet               | C0603C105K8PACTU                                      |
| C12, C13     | CAP, CERM, 33 pF, 50 V, +/- 5%, C0G/NP0, AEC-Q200 Grade 0, 0603   | TDK                 | CGA3E2NP01H330J080AA                                  |
| D1, D2       | Diode, Schottky, 20 V, 0.5 A, SOD-123   | ON Semiconductor    | MBR0520LT1G   |
| J1, J2, J3   | Terminal Block, 3.5mm Pitch, 2x1, TH  | On-Shore Technology | ED555/2DS   |
| J4           | Terminal Block, 3.5mm Pitch, 3x1, TH  | On-Shore Technology | ED555/3DS   |
| JP1          | Header, 2mm, 3x1, Tin, TH   | Samtec              | TMM-103-01-T-S  |
| JP2          | Header, 2mm, 2x1, Tin, TH   | Samtec              | TMM-102-01-T-S  |
| LBL1         | Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll  | Brady               | THT-14-423-10   |
| R1, R2, R3   | RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603   | Panasonic           | ERJ-3GEY0R00V   |
| R7, R8       | RES, 100, 5%, 0.1 W, AEC-Q200 Grade 0, 0603   | Vishay-Dale         | CRCW0603100RJNEA                                      |
| SH-J1, SH-J2 | Shunt, 2mm, Gold plated, Black  | Samtec              | 2SN-BK-G  |
| T1           | Transformer, 45.6 uH SMT  | Coilcraft           | DA2303-ALB  |
| TP2, TP3     | Terminal, Turret, TH, Double  | Keystone            | 1573-2  |
| U1           | Single Output LDO, 150 mA, Fixed 5 V Output, 2.7 to 10 V Input, with Low IQ, 5-pin SOT-23 (DBV), -40 to 125 degC, Green (RoHS & no Sb/Br) | Texas Instruments   | TPS76350DBVR  |
| U2           | Small Reinforced Isolated Modulator With +/-250mV Input and CMOS Interface, DWV0008A (SOIC-8)   | Texas Instruments   | AMC1306M25DWVR or<br>AMC1303M2510DWVR<br>AMC1336MDWVR |
| U3           | Low-Noise 350 mA, 410 kHz Transformer Driver, DBV0005A (SOT-23-5)   | Texas Instruments   | SN6501DBVR  |
| TP1          | Terminal, Turret, TH, Double  | Not Installed       |   |
| R4, R5, R6   | RES, 10.2 k, 1%, 0.25 W, 1206   | Not Installed       |   |
| C4, C5, C8   | CAP, CERM, 10 pF, 50 V, +/- 5%, C0G/NP0, 0603   | Not Installed       |   |



### 5.3 Schematic

Figure 6 illustrates the AMC1306EVM schematic.

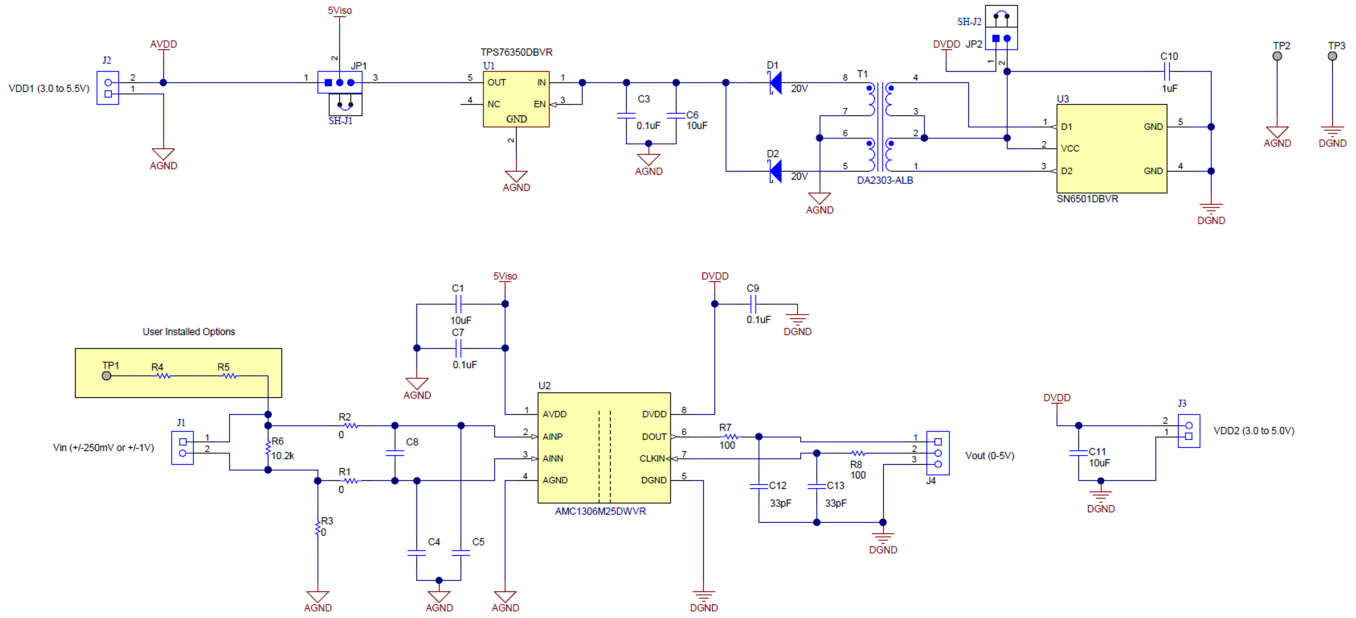


Figure 6. AMC1306EVM Schematic

### 5.4 Trademarks

All trademarks are the property of their respective owners.

### Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| <b>Changes from A Revision (July 2019) to B Revision</b>                 | <b>Page</b> |
|--|-------------|
| • Changed AMC1336 description in <i>Related Documentation</i> table..... | 1           |
| • Changed <i>AMC13xxEVM Silkscreen</i> figure.....                       | 7           |

| <b>Changes from Original (January 2017) to A Revision</b>   | <b>Page</b> |
|---|-------------|
| • Added AMC1336EVM to document.....   | 1           |
| • Changed <i>VDD1</i> to <i>AVDD</i> and <i>VDD2</i> to <i>DVDD</i> in <i>Power Supplies</i> section.....                 | 4           |
| • Changed <i>Signal</i> column in <i>J2: Analog Inputs</i> table.....   | 5           |
| • Changed clock output to clock input in <i>CLOCK</i> row of <i>J4: AMC1306EVM, AMC1336EVM Digital Output</i> table ..... | 6           |
| • Changed <i>AMC13xxEVM Bill of Materials</i> table.....  | 8           |

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##### 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**

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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.

#### 3.2 Canada

##### 3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247

#### **Concerning EVMs Including Radio Transmitters:**

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

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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.

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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.

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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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3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive):*

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- 
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    - 4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.
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      - 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.
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