

# EVM User's Guide: AMC43xxDVVEVM

## AMC43xxDVV 评估模块



### 说明

AMC43xxDVVEVM 配合 AMC43xxDVV 系列器件之一，展示了一种集成了直流/直流转换器的隔离式高精度高压检测设计。该评估模块能够支持任何具有灵活输出滤波设计的 AMC43xxDVV 器件。该 EVM 包含端子块和测试点，可轻松应用输入信号和测量输出信号。

### 开始使用

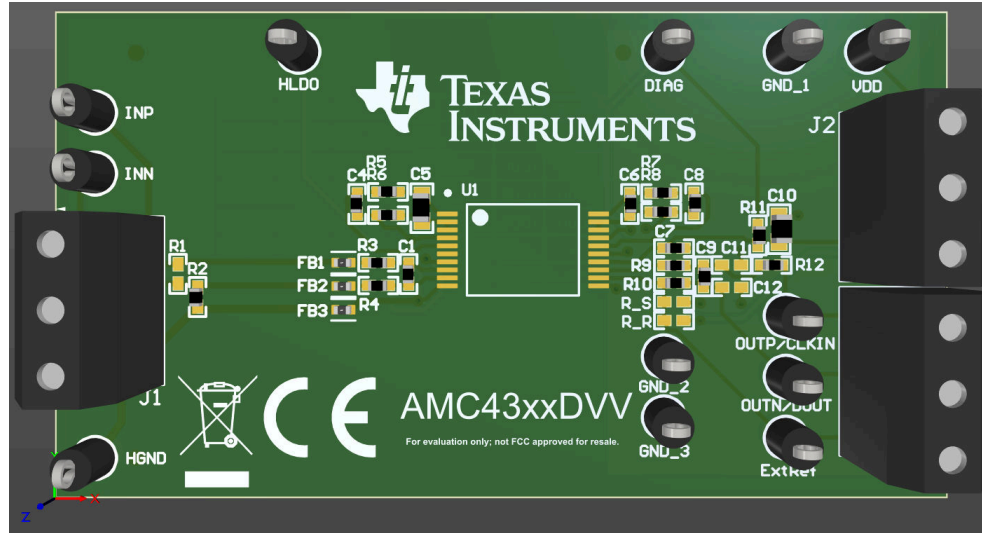
1. 订购 [AMC43xxDVVEVM](#)。
2. 在 [ti.com.cn](#) 上订购评估所需的 AMC43xxDVV 器件。
3. 在工作台上评估性能。

### 特性

- 用于 AMC43xxDVV 器件的全功能评估板
- 可配置的输出滤波，支持任何 AMC43xxDVV 器件
- 通过螺纹端子和测试点，可轻松访问输入和输出

### 应用

- 机架电源
- 服务器电源单元
- 车载充电器 (OBC)
- 牵引逆变器
- 直流/直流转换器
- 储能系统 (ESS)
- 电动汽车充电
- 光伏逆变器
- 电机驱动器
- 变频器
- 保护继电器



AMC43xxDVVEVM

## 1 评估模块概述

### 1.1 简介

本用户指南介绍了 AMC43xxDVVEVM 的特性、操作和使用情况。该评估模块 (EVM) 是一款评估与开发套件，用于评估高精度、隔离式放大器和调制器，并集成了用于为高压侧供电的隔离式直流/直流转换器。低压侧具有灵活的滤波结构，支持多个器件输出选项，例如差分、单端比例式（可配置增益）、单端输出（固定增益）和具有内部或外部时钟的调制器。EVM 背面有一张丝网印刷图表，列出了推荐的滤波元件及其安装位置。

本文档中的缩写词 *EVM* 和术语 *评估模块* 与 AMC43xxDVVEVM 具有相同的含义。本文档介绍了如何设置 EVM、印刷电路板 (PCB) 布局、原理图和物料清单 (BOM)。

以下引脚和网络名称是同义或互连的：

- INP = J1.1
- INN = J1.2
- AGND = GND1 = HGND = J1.3
- VDD = VDD = J2.1
- GND = GND\_1 = GND\_2 = GND\_3 = J2.2 = J2.3
- VOUP = OUP = VOUT = CLKIN = J3.3
- VOUTN = OUTN = REFIN = DOUT = J3.2

### 1.2 套件内容

表 1-1 详细说明了 AMC43xxDVVEVM 套件的内容。

表 1-1. AMC43xxDVVEVM 套件内容

条目	说明	数量
AMC43xxDVVEVM	PCB	1

### 1.3 规格

AMC43xxDVVEVM 能够用于评估多种 AMC43xxDVV 隔离式数据转换器器件。EVM 包括输出端的元件预留位置，可根据所测试的器件进行配置。这提供了一种便捷的方法，可通过一块可重复利用的电路板对多种器件进行评估。有关详细的器件规格，请参阅已安装器件的数据手册。

### 1.4 器件信息

AMC43xxDVVEVM 与多种器件兼容。要确定所选器件的电路板配置，请参阅节 2.1.2。

有关可评估的可用器件的列表，请参阅表 5-1。

## 2 硬件

配置输出元件时需要确定已安装器件的输出类型。

### 2.1 接口

AMC43xxDVVEVM 具有一种输入设计和 6 种输出配置。EVM 的模拟输入通过端子块 J1 和测试点 INP、INN 和 HGND 进行路由。可通过端子块 J3、测试点 OUTP/CLKIN、OUTN/DOUT 和 ExtRef 访问输出。低侧电源可通过端子块 J2 和测试点 VDD、GND\_1、GND\_2 和 GND\_3 进行访问。可通过测试点访问 VDDA2 和 DIAG。

#### 2.1.1 模拟输入

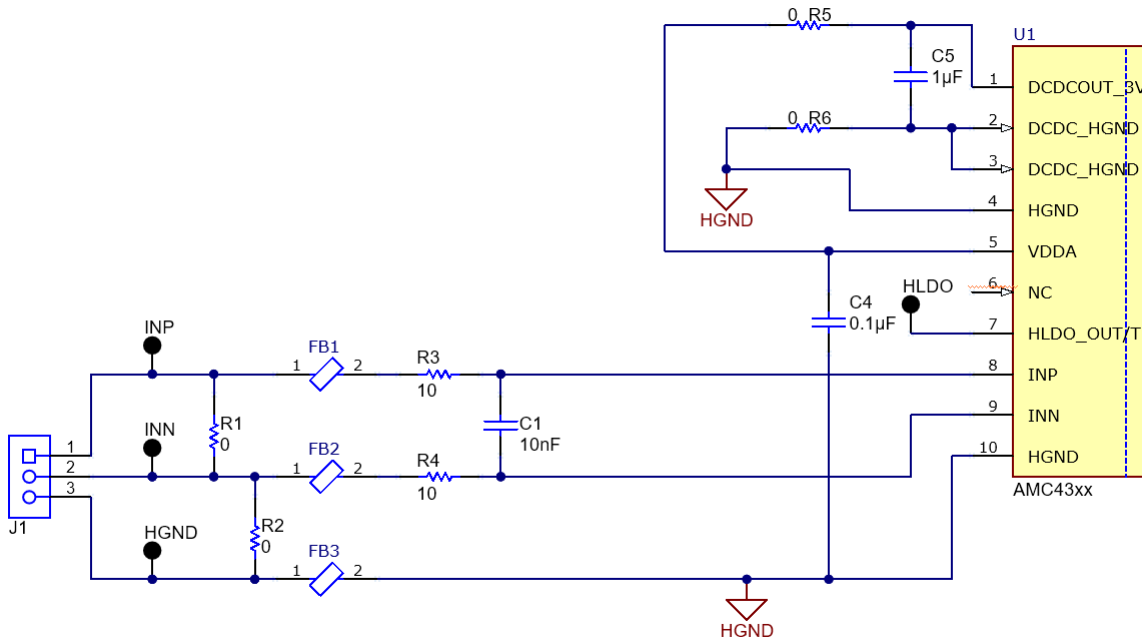


图 2-1. 模拟输入电路原理图

图 2-1 展示了 AMC43xxDVVEVM 的模拟输入电路。

EVM 的模拟输入通过端子块 J1 和测试点 INP、INN 和 HGND 进行路由。无源元件 R3、R4 和 C1 构成一个截止频率为 796kHz 的标准 RC 抗锯齿滤波器。默认情况下，R2 将 INN 连接到 HGND、以验证在未组装 R1 的情况下，输入信号是否保持在 AMC43xxDVV 的输入共模电压范围规格内。为符合 EMC 标准，默认情况下会安装 FB1、FB2 和 FB3，但并非所有应用都需要安装。根据 AMC43xxDVV 在具体应用中的具体用途，可能需要调整铁氧体磁珠的选型。欲了解更多信息，请参阅各自的数据手册。

通过使用信号发生器或其他电压源，用户可将输入信号直接施加到相对于 INN 和 HGND 的 INP 引脚。EVM 的线性输入电压范围取决于已安装的器件。有关更多详细信息，请参阅器件数据手册。

## 2.1.2 EVM 输出配置和说明

输出原理图和需要根据器件的有序输出进行修改的元件及，如图 2-2 所示，表 2-1 将输出类型与相应的电路配置进行了匹配。

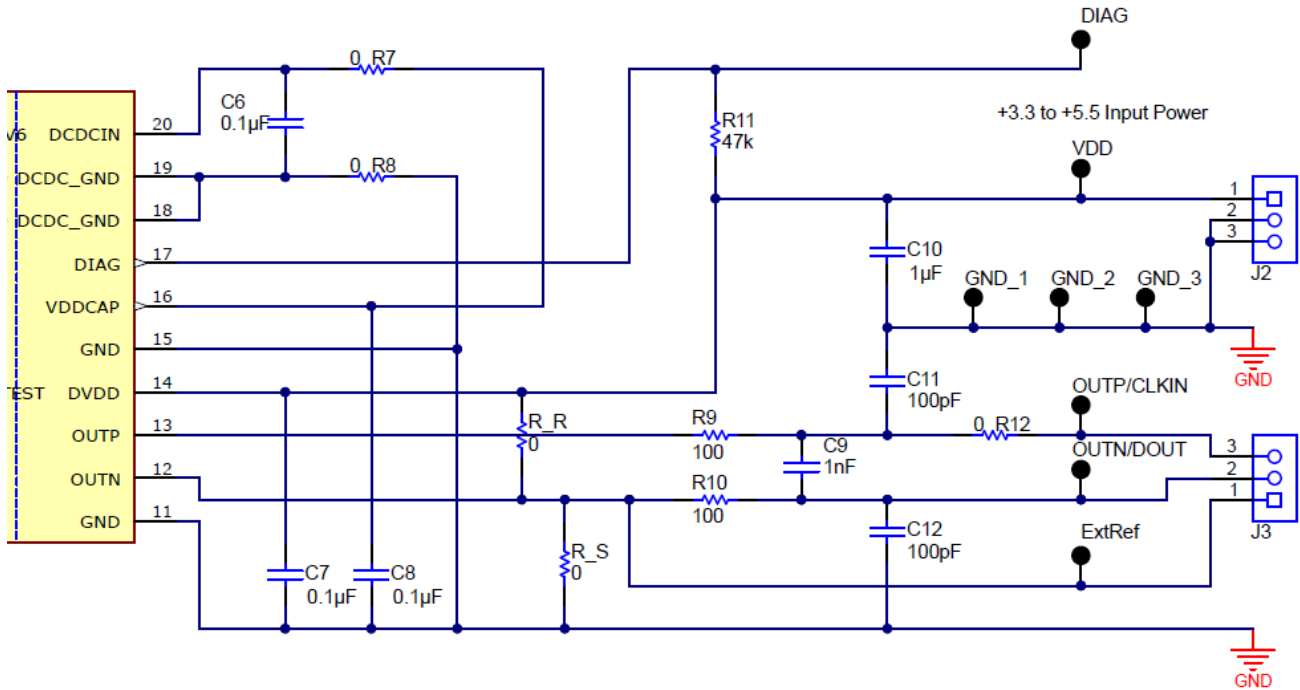


图 2-2. 输出电路原理图

表 2-1. 输出类型和电路配置图例

器件输出类型	R_R	R_S	R9	R10	C9	C11	C12	R12
差分输出 (差分)	未组装	未组装	100 Ω	100 Ω	1nF	100pF	100pF	0 Ω
具有内部基准的固定增益单端输出 (SE Int)	未组装	0 Ω	100 Ω	未组装	未组装	100pF	未组装	0 Ω
具有 VDD 基准的固定增益比例式输出 (R Int)	0 Ω	100nF	100 Ω	未组装	未组装	100pF	未组装	0 Ω
具有外部基准 (SE/R Ext) 的单端与比例式输出	未组装	100nF	100 Ω	未组装	未组装	100pF	未组装	0 Ω
内部时钟调制器 (Mod. Int.)	未组装	未组装	100 Ω	100 Ω	未组装	100pF	100pF	0 Ω
外部时钟调制器 (Mod. Ext.)	未组装	未组装	0 Ω	100 Ω	未组装	100pF	100pF	100 Ω

## 2.1.3 放大器输出

### 2.1.3.1 差分输出 (差分)

组装无源器件 R9、R10 和 C9 作为低通差分滤波器，以衰减高频噪声分量。组装 C11 和 C12 以帮助滤除任何共模噪声。

VDD 和 GND 可通过 J2 端子块进行访问。C7、C8 和 C10 用作 VDD 的去耦电容器，有助于保持电源稳定。

用户可以使用示波器观察相对于 J2.3 (GND) 的 J3.3 (OUTP) 和 J3.2 (OUTN) 上的差分输出信号。

### 2.1.3.2 具有内部基准的固定增益单端输出 (SE Int)

组装 R\_S 后, REFIN 直接连接到 GND 并使用固定增益设置输出电压的偏移量。组装无源器件 R9 和 C11 作为低通滤波器, 以衰减高频噪声分量。

VDD 和 GND 可通过 J2 端子块进行访问。C7、C8 和 C10 用作 VDD 的去耦电容器, 有助于保持电源稳定。

用户可以使用示波器观察相对于 J2.3 (GND) 的 J3.3 (OUTP) 上的差分输出信号。

### 2.1.3.3 具有 VDD 基准的固定增益比例式输出 (R Int)

当 R\_R 组装有  $0\Omega$  电阻器且 R\_S 组装有外部去耦电容器时, REFIN 连接到 VDD 并可从 J3.2 访问。比例式输出增益由施加的 VDD 电压设置。组装无源器件 R9 和 C11 作为低通滤波器, 以衰减高频噪声分量。

VDD 和 GND 可通过 J2 端子块进行访问。C7、C8 和 C10 用作 VDD 的去耦电容器, 有助于保持电源稳定。

用户可以使用示波器观察相对于 J2.3 (GND) 的 J3.3 (OUTP) 上的差分输出信号。

### 2.1.3.4 具有外部基准 (SE/R Ext) 的单端与比例式输出

如果未组装 R\_R 并且 R\_S 组装了外部去耦电容器, 则可从 J3.2 和 ExtRef 测试点访问 REFIN。比例式输出增益由施加的 ExtRef 电压设置。组装无源器件 R9 和 C11 作为低通滤波器, 以衰减高频噪声分量。

VDD 和 GND 可通过 J2 端子块进行访问。C7、C8 和 C10 用作 VDD 的去耦电容器, 有助于保持电源稳定。

用户可以使用示波器观察相对于 J2.3 (GND) 的 J3.3 (OUTP) 上的差分输出信号。

## 2.1.4 调制器输出

### 2.1.4.1 内部时钟调制器 (Mod.Int.)

当使用具有调制器输出和内部时钟的器件时, 可通过 J3 连接器连接到器件的 DOUT 和 CLKOUT 引脚。组装无源器件 R9 和 C11, 将其用作针对该器件输出时钟的低通输入滤波器。组装 R10 和 C12 作为 DOUT 上的低通滤波器。这些滤波器必须具有较高的截止频率, 通常至少为时钟频率的 10 倍, 主要用于稳定数字信号, 并减少过冲和 高频纹波。

VDD 和 GND 可通过 J2 端子块进行访问。C7、C8 和 C10 用作 VDD 的去耦电容器, 有助于保持电源稳定。

用户可以使用示波器观察相对于 J2.3 (GND) 的 J3.3 (CLKOUT) 和 J3.2 (DOUT) 上的差分输出信号。

### 2.1.4.2 外部时钟调制器 (Mod.Ext.)

在使用具有调制器输出和外部时钟的器件时, J3 连接器可连接至该器件的 DOUT 和 CLKIN 引脚。组装无源器件 R12 和 C11 作为进入器件的时钟的低通输入滤波器。组装 R10 和 C12 作为 DOUT 上的低通滤波器。这些滤波器必须具有较高的截止频率, 通常至少为时钟频率的 10 倍, 主要用于稳定数字信号, 并减少过冲和 高频纹波。

VDD 和 GND 可通过 J2 端子块进行访问。C7、C8 和 C10 用作 VDD 的去耦电容器, 有助于保持电源稳定。

用户可以使用示波器观察相对于 J2.3 (GND) 的 J3.3 (CLKIN) 和 J3.2 (DOUT) 上的差分输出信号。

## 2.2 VDD 电源

该 EVM 需要一个电源轨, VDD 和 GND。

VDD 和 GND 可通过 J2 端子块进行访问。C7、C8 和 C10 用作 VDD 的去耦电容器, 有助于保持电源稳定。

内部隔离式直流/直流转换器生成高侧电源。C6、C5 和 C4 都用作去耦电容器, 用于提高隔离式直流/直流转换器的稳定性。R5、R6、R7 和 R8 都是隔离式直流/直流初级和次级反馈环路中铁氧体磁珠的  $0\Omega$  占位符。在典型应用中, 这些元件并非必需, 但为便于测试而设置。通过使用 VDDA2 测试点可访问施加在  $\Delta-\Sigma$  调制器上的电源。

## 2.3 EVM 操作

以下部分介绍如何验证器件和组件的正确焊接以及 EVM 的一般操作。

### 2.3.1 模拟输入

EVM 的模拟输入通过端子块 J1 和测试点 INP、INN 和 HGND 进行路由。

输入电压范围取决于所选择和安装的器件；有关允许的最大输入电压，请参阅器件数据手册。

表 2-2 列出了输入连接的详细信息。

**小心**

请仔细查看所选器件的数据表，了解模拟输入范围限制，并确保在将任何模拟输入连接至 EVM 之前施加适当的模拟和数字电压。

**表 2-2. 模拟输入**

引脚编号	信号	说明
J1.1	INP	连接至已安装器件的 INP。
J1.2	INN	连接至已安装器件的 INN。
J1.3	HGND	连接至已安装器件的 HGND。

### 2.3.2 输出和 VDD 电源

输出取决于所选和安装的器件，可在 J3.3 和 J3.2 上观察。

**表 2-3. 差分输出 (差分)**

引脚编号	信号	说明
J2.1	VDD	连接至已安装的器件 VDD2/VDD 端子。
J2.2、J2.3	GND	连接至已安装器件的 GND 端子。
J3.3	OUTP	已安装器件的正模拟输出。
J3.2/J3.1	OUTN	已安装器件的负模拟输出。

**表 2-4. 具有内部基准的固定增益单端输出 (SE Int)**

引脚编号	信号	说明
J2.1	VDD	连接至已安装的器件 VDD2/VDD 端子。
J2.2、J2.3	GND	连接至已安装器件的 GND 端子。
J3.3	OUT	已安装器件的 SE 模拟输出。
J3.2/J3.1	REFIN	已安装器件的 REFIN 模拟输入。已安装了 R_S 的 GND。

**表 2-5. 具有 VDD 基准的固定增益比例式输出 (R Int)**

引脚编号	信号	说明
J2.1	VDD	连接至已安装的器件 VDD2/VDD 端子。
J2.2、J2.3	GND	连接至已安装器件的 GND 端子。
J3.3	OUT	已安装器件的 SE 模拟输出。
J3.2/J3.1	REFIN	已安装器件的 REFIN 模拟输入。已安装 R_R 的 VDD。

**表 2-6. 具有外部基准 (SE/R Ext) 的单端与比例式输出**

引脚编号	信号	说明
J2.2	VDD2/VDD	连接至已安装的器件 VDD2/VDD 端子。
J2.1	GND	连接至已安装器件的 GND 端子。
J3.2	OUT	已安装器件的 SE 模拟输出。
J3.2/J3.1	REFIN	已安装器件的 REFIN 模拟输入。

**表 2-7. 内部时钟调制器 (Mod.Int.)**

引脚编号	信号	说明
J2.1	VDD	连接至已安装的器件 VDD2/VDD 端子。
J2.2、J2.3	GND	连接至已安装器件的 GND 端子。
J3.3	CLKOUT	已安装器件的输出时钟。

**表 2-7. 内部时钟调制器 (Mod.Int.) (续)**

引脚编号	信号	说明
J3.2/J3.1	DOUT	已安装器件的调制器数据输出。

**表 2-8. 外部时钟调制器 (Mod.Ext.)**

引脚编号	信号	说明
J2.1	VDD	连接至已安装的器件 VDD2/VDD 端子。
J2.2、J2.3	GND	连接至已安装器件的 GND 端子。
J3.3	CLKIN	已安装器件的输入时钟。
J3.2/J3.1	DOUT	已安装器件的调制器数据输出。

### 2.3.3 测试程序

要验证组装的 EVM 的连接，TI 建议运行测试程序。

#### 2.3.3.1 设备设置

1. 一个用于低侧电源 VDD 的 5V 电源。
2. 该 5V 电源必须限制为 100mA。
3. 示波器或数字万用表 (DMM)，分辨率至少为 6.5 位。
4. 用于输入的信号发生器。

#### 2.3.3.2 过程

1. 如上所述，设置 5V ( $\pm 10\%$ ) 电源并将电流限制为 100mA。将 EVM 电压源连接至以 GND 为参考的连接器 VDD 引脚。打开电源，并确保电流不超过器件数据表中指定的电流限制。
2. 使用 J1 从外部将输入接地，焊接短接 R1 或连接 INP = INN = HGND。
3. 使用示波器或 DMM 验证 VDD 和 VDDA2 电源上是否存在隔离式电源。测量以 GND 为参考的器件输出并验证：
  - a. 对于放大器：隔离电压在共模输出电压（差分输出的典型值为 1.44V，单端输出为  $REFIN/2$ ）范围内。
  - b. 对于使用示波器的调制器：数字输出是由 1 和 0 组成的比特流，且该比特流 50% 的时间处于高电平，50% 的时间处于低电平。
  - c. 对于使用 DMM 的调制器：DMM 约为 VDD 的 50% 幅度。

4.

小心



在高功率或使用不当的情况下，电路板会发热。接触会导致烫伤。请勿触摸。操作时请采取适当的预防措施。

小心



将电路板连接到高压输入端时可能会发生电击。电路板应由专业人员小心处理。为安全起见，强烈建议使用具有过压或过流保护功能的隔离式测试设备。

移除输入短路连接后，根据安装的器件，相对于 INN = HGND，向 INP 或 J1.1 施加适当的直流满量程线性输入信号。

5. 使用示波器或 DMM 测量输出。

- a. 对于使用示波器或 DMM 的放大器：验证输出电压是否达到已安装器件的满标量程输出。
  - i. 差分放大器为 2V FSR。
  - ii. 单端放大器为 REFIN FSR。
- b. 对于使用示波器的调制器：验证数字输出是否与预期的转换成比例。
  - i. 对于正向满标度线性输入，数字输出需要在约 90% 的时间处于高电平。
- c. 对于使用 DMM 的调制器：验证数字输出是否与预期的转换成比例。施加直流输入信号。
  - i. 对于正向满标度线性输入，DMM 读数需要约为 VDD 值的 90%。

### 3 硬件设计文件

#### 3.1 原理图

图 3-1 展示了完整的原理图

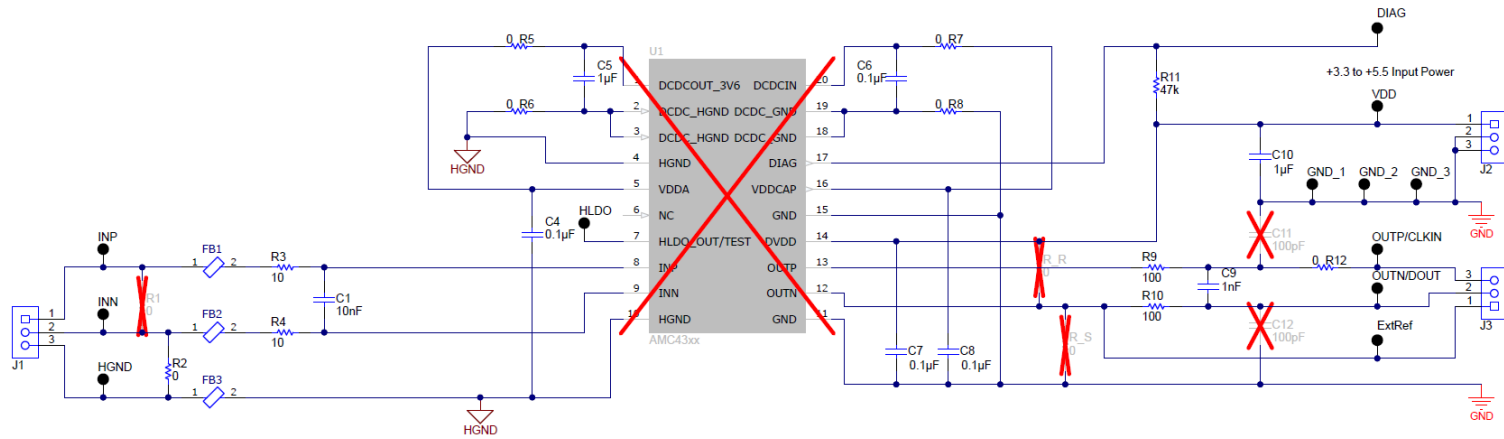


图 3-1. 完整的原理图

### 3.2 PCB 布局

图 3-2 和图 3-5 分别展示了 AMC43xxDVVEVM 的顶部和底部印刷电路板 (PCB) 图。

#### 备注

电路板布局未按比例显示。这些布局布线旨在显示电路板的布局布线方式，并不用于制造 AMC43xxDVVEVM PCB。

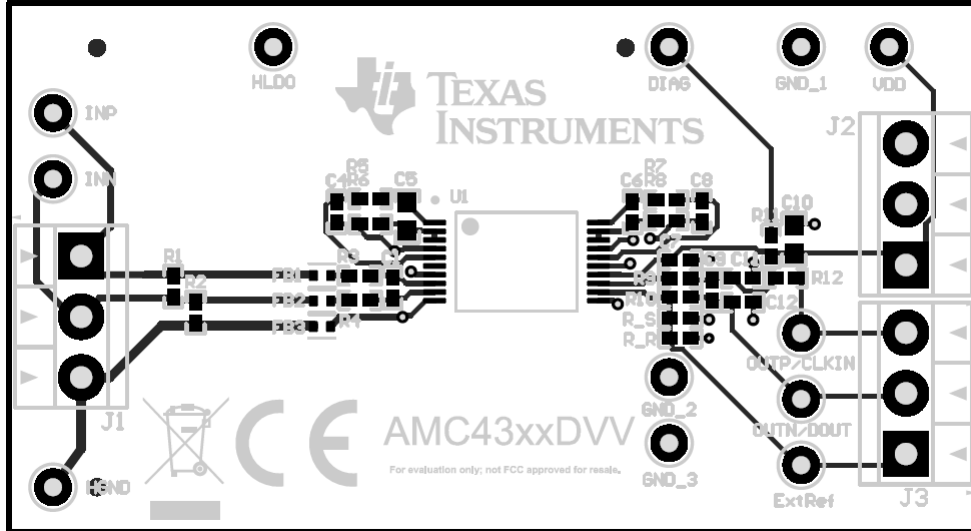


图 3-2. AMC43xxDVVEVM 顶部 PCB 图

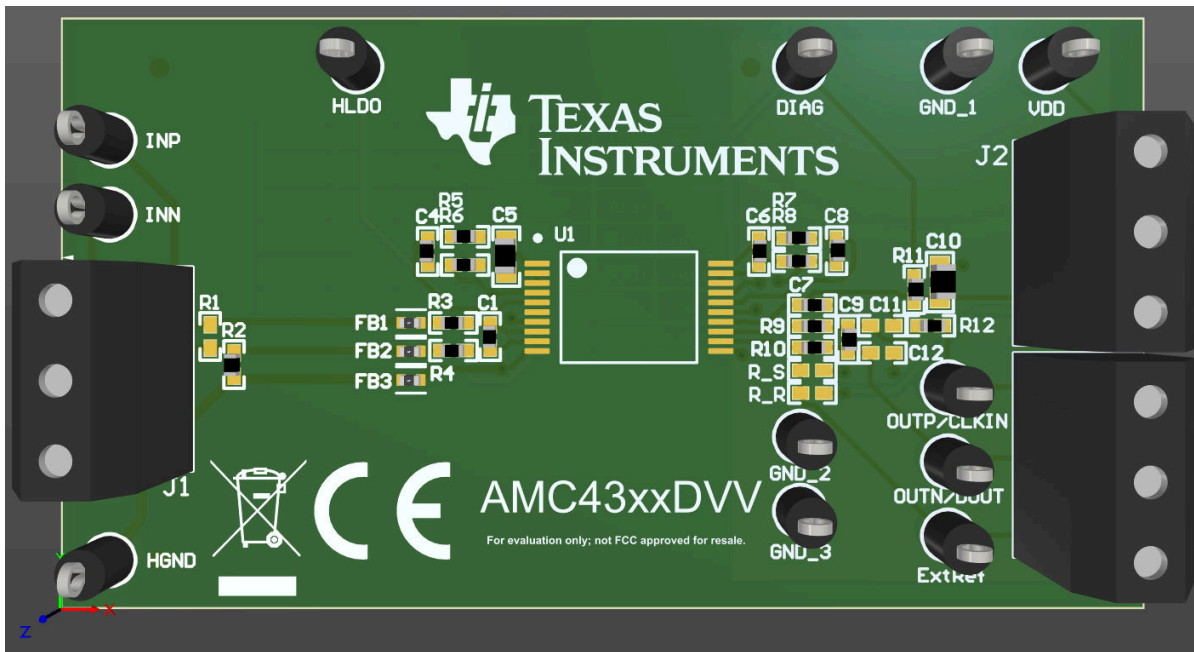


图 3-3. AMC43xxDVVEVM 顶部 3D PCB 图

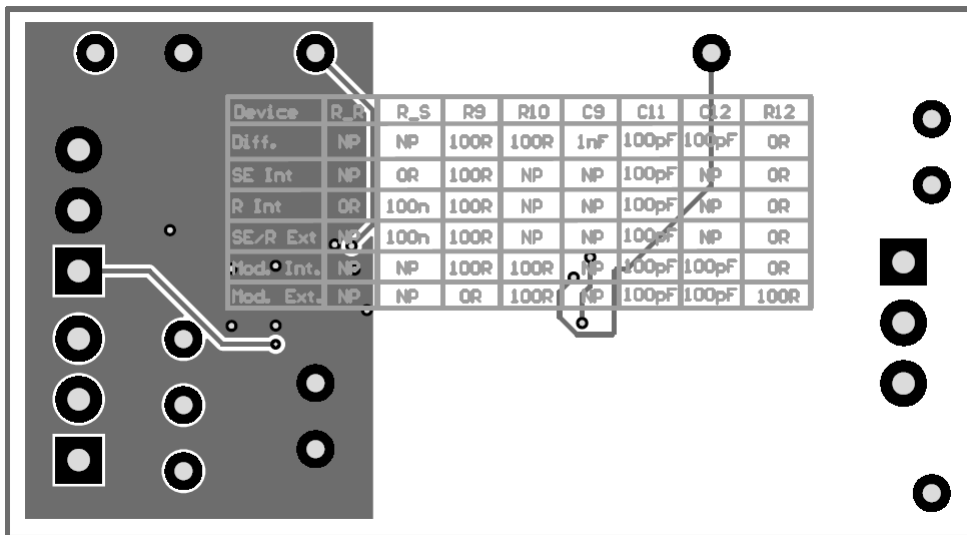


图 3-4. AMC43xxDVVEVM 顶部 PCB 图

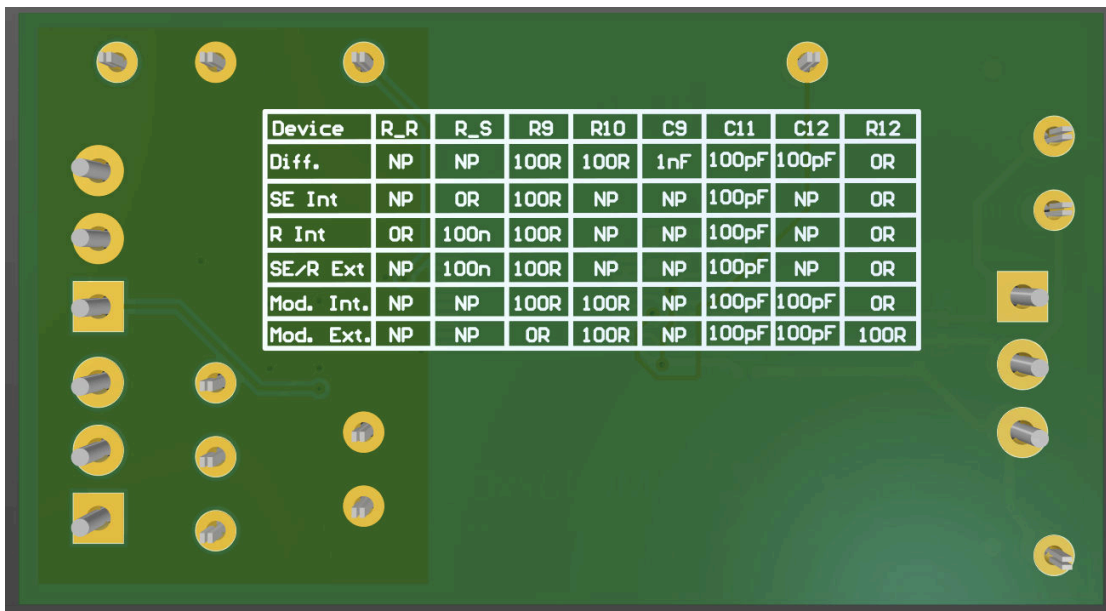


图 3-5. AMC43xxDVVEVM 底部 3D PCB 图

### 3.3 物料清单

表 3-1 展示了 AMC43xxDVVEVM 物料清单 (BOM)。

表 3-1. 物料清单

位号	说明	制造商
C1	电容, 陶瓷, 0.01uF, 16V, +/-10%, X7R, 0402	Wurth Elektronik
C4、C6、C7、C8	电容, 陶瓷, 0.1uF, 16V, +/- 5%, X7R, AEC-Q200 1 级, 0402	MuRata
C5、C10	电容, 陶瓷, 1uF, 16V, +/-10%, X5R, 0603	AVX
C9	电容, 陶瓷, 1000pF, 16V, +/-10%, X7R, AEC-Q200 1 级, 0402	Yageo
DIAG, ExtRef, GND_1, GND_2, GND_3, HGND, VDDA2, INN, INP, OUTN/DOUT, OUTP/CLKIN, VDD	测试点, 微型, 黑色, TH	Keystone Electronics
FB1、FB2、FB3	一个 1.8kOhms、100MHz 的电源, 信号线铁氧体磁珠 0402 ( 1005 公制 ) 210 mA 2.1Ohm	Wurth Electronics
J1、J2、J3	端子块, 3.5mm 间距, 3x1, TH	On-Shore Technology
R2、R5、R6、R7、R8、R12	电阻, 0, 5%, 0.063W, AEC-Q200 0 级, 0402	Vishay-Dale
R3、R4	电阻, 10, 5%, 0.063W, AEC-Q200 0 级, 0402	Vishay-Dale
R9、R10	电阻, 100, 1%, 0.063W, AEC-Q200 0 级, 0402	Stackpole Electronics Inc
R11	电阻, 47k, 5%, 0.063W, AEC-Q200 0 级, 0402	Vishay-Dale

## 4 其他信息

### 4.1 商标

所有商标均为其各自所有者的财产。

## 5 相关文档

如需以下任何 TI 文档的副本, 请致电 (800) 477-8924 联系德州仪器 (TI) 文献咨询中心或致电 (972) 644-5580 联系产品信息中心 (PIC)。订购时, 请通过文档标题或文献编号识别文档。更新的文档也可以通过我们的网站 [www.ti.com](http://www.ti.com) 获取。

- [隔离式信号链解决方案工程师指南](#) 电子书
- [比较隔离式放大器和隔离式调制器](#) 应用说明
- [隔离式放大器](#) 页面
- [隔离式 ADC](#) 页面

表 5-1. 相关器件

器件	输入类型	输出类型	文档
AMC4330D	双极 ( 交流 )	差分	<a href="#">SLVSLH4</a>
AMC4330R	双极 ( 交流 )	比例式	<a href="#">SLVSLH5</a>
AMC4311D	单极 ( 直流 )	差分	<a href="#">SBASB87</a>
AMC4311R	单极 ( 直流 )	比例式	<a href="#">SLVSLG2</a>
AMC4336	双极 ( 直流 )	调制器	<a href="#">SLVSLJ8</a>

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  - 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software
  - 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.
2. *Limited Warranty and Related Remedies/Disclaimers:*
  - 2.1 These terms 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 a nonconforming EVM if (a) the nonconformity was 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, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.
  - 2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

### **WARNING**

**Evaluation Kits 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 shall operate the Evaluation Kit within TI's recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI's recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI's instructions for electrical ratings of interface circuits such as input, output and electrical loads.**

**NOTE:**

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

### 3 Regulatory Notices:

#### 3.1 United States

##### 3.1.1 Notice applicable to EVMs not FCC-Approved:

**FCC NOTICE:** This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

##### 3.1.2 For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:

#### **CAUTION**

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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

#### **FCC Interference Statement for Class A EVM devices**

*NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.*

#### **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 or RSS-247

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

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

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

#### **Concernant les EVMs avec appareils radio:**

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

#### **Concerning EVMs Including Detachable Antennas:**

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

### Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

#### 3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see [http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/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。

<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html>

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 to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

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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#### 3.4 European Union

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

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

- 
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.
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    - 6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS 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 EPIDEMIC FAILURE WARRANTY OR 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.
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8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMNITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM 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.

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