

EVM User's Guide: AMC038XEVM

AMC038X Evaluation Module



Description

The AMC038XEVM, in conjunction with one of the AMC038X devices, demonstrates a high-precision, high-voltage sensing design. The evaluation module is capable of measuring up to 1600V input voltages with no external voltage divider resistors needed. The design also includes a discrete power solution to generate the high side supply from the low side supply.

Get Started

1. Order the [AMC038XEVM](#).
2. Order the device needed to evaluate on [ti.com](#).
3. Evaluate performance on the bench.

Features

- Full-featured evaluation board for the AMC038X devices
- Screw terminals for easy access to inputs and outputs
- Optional isolated power to VDD1 from VDD2

Applications

- [Power delivery](#)
- [Onboard Chargers \(OBCs\)](#)
- [Traction inverter](#)
- [DC/DC converter](#)
- [Energy Storage System \(ESS\)](#)
- [EV charging](#)
- [Solar inverters](#)
- [Motor drives](#)
- [Frequency inverters](#)
- [Protection relays](#)



AMC038XEVM

1 Evaluation Module Overview

1.1 Introduction

This user's guide describes the characteristics, operation, and use of the AMC038XEVM. This evaluation module (EVM) is an evaluation and development kit for evaluating the precision, isolated amplifiers with an integrated, high-voltage resistive divider at the input. These devices are available with the integrated, high-voltage resistive dividers configured to accommodate high voltage systems. The three output options available for these devices are differential output, single-ended ratiometric (configurable gain) output, and digital modulator output.

Throughout this document, the abbreviation *EVM* and the term *evaluation module* are synonymous with the AMC038XEVM. This document includes how to set up the EVM, the printed circuit board (PCB) layout, schematics, and bill of materials (BOM).

The following pin and net names are synonymous or interconnected:

- AVDD = VDD1 = J1.2
- DVDD = VDD2 = J2.2
- VOUTP = VOUT = CLKIN = J3.2 = TP4
- VOUTN = VREF = DOUT = J3.1 = TP5
- AGND = GND1 = J1.1 = TP1
- DGND = GND2 = J2.1 = TP2 = TP3
- VSNS = TP6
- HVIN = VHV1 = turret connector

1.2 Kit Contents

[Table 1-1](#) details the contents included in the AMC038XEVM kit.

Table 1-1. AMC038XEVM Kit Contents

Item	Description	Quantity
AMC038XEVM	PCB	1

1.3 Specification

The AMC038XEVM provides the ability to evaluate various isolated data converter devices. The EVM includes component placeholders on the output that are configurable based on the device being tested. This provides a convenient method of evaluating a range of devices from one board able to be re-purposed. Refer to the data sheet of the installed device for detailed device specifications.

1.4 Device Information

The AMC038XEVM is compatible with a variety of devices. To determine the board configuration for the chosen device, refer to [Section 2.1.2](#).

For a list of available devices that can be evaluated, see [Table 5-1](#).

2 Hardware

Configuration of the output components requires determining the output type of the installed device.

2.1 Interfaces

The AMC038XEVM features one input design and 4 output configurations. The analog input to EVM is routed to a turret connector (VHV1). The output is accessible through a 2x1 terminal block (J3).

2.1.1 Analog Input

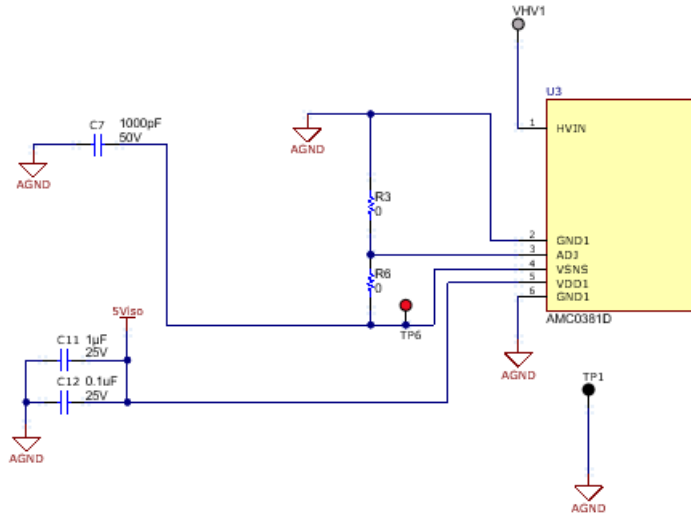


Figure 2-1. Analog Input Circuit Schematic

The analog input circuit for the AMC038XEVM is shown in [Figure 2-1](#).

The high voltage input is accessible through the turret connector (VHV1). The passive components R3 and R6 need to be populated and de-populated, respectively. The components do not need to be modified, and must be kept as is for all device variants. Also, present on the input side are decoupling capacitors. C11 and C12 provide decoupling for the high-side supply, and C7 provides stability for the VSNS node.

Using a signal generator or other voltage source, the user can apply an input signal directly to VHV1. The linear input voltage range of the EVM varies by device selected for the configuration of the user. Reference the device data sheet for more information.

2.1.2 EVM Output Configurations and Descriptions

The output schematic and the components that require modification based on the ordered output of the device and [Table 2-1](#) matches the output type to the corresponding circuit configuration is shown in [Figure 2-2](#).

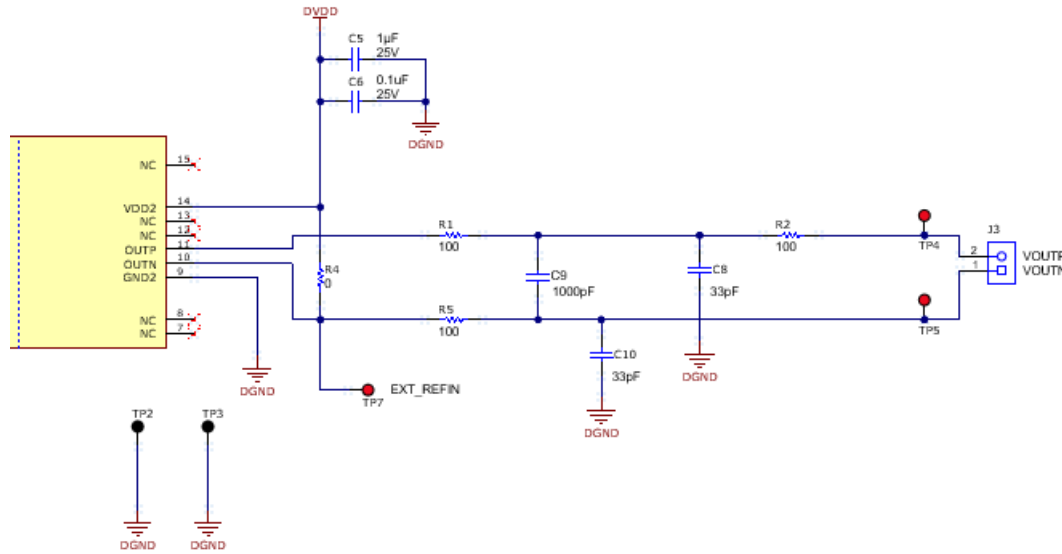


Figure 2-2. Output Circuit Schematic

Table 2-1. Output Type and Circuit Configuration Legend

Output Type\Component Configurations	R4	R1	R5	R2	C9	C8	C10
Differential output	Depopulated	Populated (100Ω recommended)	Populated (100Ω recommended, same as R1)	Populated with 0Ω	Populated (1nF recommended)	Populated (33pF recommended)	Populated (33pF recommended, same as C8)
Single-ended output: Vref to VDD	Populated with 0Ω	Populated (100Ω recommended)	Depopulated	Populated with 0Ω	Depopulated	Populated (1nF recommended)	Depopulated
Single-ended output: Vref set externally	Depopulated	Populated (100Ω recommended)	Depopulated	Populated with 0Ω	Depopulated	Populated (1nF recommended)	Populated (100nF recommended)
Modulator output	Depopulated	Populated with 0Ω	Populated (100Ω recommended)	Populated (100Ω recommended)	Depopulated	Populated (33pF recommended)	Populated (33pF recommended, Same as C8)

2.1.3 Amplifier Output

2.1.3.1 Differential Output

When using a device with a differential output, the J3 connector provides access to the VOUTP and VOUTN output pins of the device. The passive components of R1, R5, and C9 are populated as a low-pass differential filter to attenuate high frequency noise components. C8 and C10 are populated to help with the filtering of any common-mode noise. VDD2 and GND2 are accessible through the J2 connector. C5 and C6 serve as decoupling capacitors for VDD2 and help keep the supply stable.

Using an oscilloscope, the user can observe the differential output signal on J3.2 (VOUTP) and J2.1 (VOUTN).

2.1.3.2 Single-Ended Output, Fixed Gain

When using a device with a single-ended output, the J3 connector provides access to the VOUT and VREF output pins of the device.

When R4 is populated and R5 is depopulated, VREF is directly tied to VDD2 and sets the gain for the output. The passive components of R1 and C8 are populated as a low-pass filter to attenuate high frequency noise components. VDD2 and GND2 are accessible through the J2 connector. C5 and C6 serve as decoupling capacitors for VDD2 and help keep the supply stable.

Using an oscilloscope, the user can observe the output signal on J3.2 (VOUT) with respect to J2.1 (GND2).

2.1.3.3 Single-Ended Output, Ratiometric Gain

When using a device with a single-ended output, the J3 connector provides access to the VOUT and VREF output pins of the device.

When R5 is populated and R4 is depopulated, VREF is accessible from J3.1 and needs to be connected to a reference voltage to set the gain of the output. The passive components of R1 and C8 are populated as a low-pass filter for VOUT to attenuate high frequency noise components. C10 is populated to stabilize the VREF voltage. VDD2 and GND2 are accessible through the J2 connector. C5 and C6 serve as decoupling capacitors for VDD2 and help keep the supply stable.

Using an oscilloscope, the user can observe the output signal on J3.2 (VOUT) with respect to J2.1 (GND2).

2.1.4 Modulator Output

2.1.4.1 External Clock

When using a device with a modulator output, the J3 connector provides access to the DOUT and CLKIN pins of the device. The passive components of R2 and C8 are populated as a low-pass input filter for the clock coming into the device. R2 and C10 are populated as a low pass filter on DOUT. These filters must have a high cut-off frequency and are mainly to stabilize the digital signals and reduce overshoot and high frequency ripples. VDD2 and GND2 are accessible through the J2 connector. C5 and C6 serve as decoupling capacitors for VDD2 and help keep the supply stable.

Using an oscilloscope, the user can observe the output signal on J3.1(DOUT) and clock on J3.2(CLKIN) with respect to J2.1 (GND2).

2.2 Power Supplies

The EVM requires two separate power rails, VDD1 & VDD2 or AVDD & DVDD. VDD1 is on the high-voltage side of the amplifier coupons and VDD2 is on the low-voltage side of the amplifier coupons. Similarly, AVDD is on the high-voltage side of the modulator coupons and DVDD is on the low-voltage side of the modulator coupons. Effectively, the high-voltage power rails (VDD1 and AVDD) function alike and the low-voltage power rails (VDD2 and DVDD) function alike.

2.2.1 VDD1/AVDD Input

The EVM provides access to VDD1/AVDD and GND1 through the J1 connector. The power supply must be between the devices recommended operating conditions with respect to ground. Typically 3.3-5V for both power supplies. This supply can be provided externally or the onboard transformer and LDO circuit can be used to provide the supply from the low-side (VDD2) supply. To use an external supply, the jumper for JP2 needs to be populated between JP2.1 and JP2.2 and JP1 must not be populated with a jumper. To use the transformer+LDO, the jumper for JP2 needs to be populated between JP2.2 and JP2.3 and JP1 needs to be populated with a jumper.

2.2.2 VDD2/DVDD Input

The EVM provides access to VDD2/DVDD and GND2 through the J2 connector. The power supply must be between the devices recommended operating conditions with respect to ground. Typically 3.3-5V for both power supplies.

2.3 EVM Operation

The following section describes how to verify correct soldering of your devices and components as well as general operation of the EVM.

2.3.1 Analog Input and VDD1/AVDD Power

The analog supply voltage can be applied directly to J1.2 (AVDD) with respect to J1.1 (AGND). The analog input can be applied to the double turret connector (VHV1) with respect to AGND. The input voltage range is dependent on the device selected and installed; refer to the device data sheet for the max input voltages allowed.

The details of an input connection are listed in [Table 2-2](#).

CAUTION

Carefully review the selected device data sheet for limitations of the analog input range and make sure the appropriate analog and digital voltages are applied prior to connecting any analog input to the EVM.

Table 2-2. Analog Input

Pin Number	Signal	Description
J1.2	VDD1/AVDD	Connection to the installed VDD1/AVDD of the device.
J1.1	GND1/AGND	Connection to the installed GND1/AGND terminal of the device.
VHV1	HVIN	Analog input to the installed device.

2.3.2 Outputs and VDD2/DVDD Power

The analog supply voltage can be applied directly to J2.2 (DVDD) with respect to J2.1 (DGND). The outputs can be observed at J3.1 and J3.2 and are dependent on the device selected and installed.

Table 2-3. Differential Output

Pin Number	Signal	Description
J2.2	VDD2/DVDD	Connection to the installed VDD2/DVDD terminal of the device.
J2.1	GND2/DGND	Connection to the installed GND2/DGND terminal of the device.
J3.2	VOU TP	Positive analog output from the installed device.
J3.1	VOU TN	Negative analog output from the installed device.

Table 2-4. Single-Ended Output

Pin Number	Signal	Description
J2.2	VDD2/DVDD	Connection to the installed VDD2/DVDD terminal of the device.
J2.1	GND2/DGND	Connection to the installed GND2/DGND terminal of the device.
J3.2	VOUT	Analog output from the installed device.
J3.1	VREF	Reference voltage for output gain.

Table 2-5. External Clock

Pin Number	Signal	Description
J2.2	VDD2/DVDD	Connection to the installed VDD2/DVDD terminal of the device.
J2.1	GND2/DGND	Connection to the installed GND2/DGND terminal of the device.
J3.2	CLKIN	Clock input for the installed device.
J3.1	DOUT	Digital output from the installed device.

2.3.3 Test Procedure

To verify the connections of the assembled EVM, TI recommends to run a test procedure.

2.3.3.1 Equipment Setup

1. Two five-volt sources for high-side and low-side power supply.
2. The 5V sources must be limited to 50mA.
3. Oscilloscope *or* digital multimeter (DMM) with at least 6.5 digits of resolution.
4. A high voltage supply for the input.

2.3.3.2 Procedure

1. Set the first 5V (+/-10%) source and limit the current to 50mA as noted above. Connect the EVM voltage source to the connectors VDD2/DVDD pin referenced to GND2/DGND. Turn on the power source and make sure there is no more than the specified current limit in the device data sheet drawn.
2. Set the second 5V (+/-10%) source and limit the current to 50mA as noted above. Connect the EVM voltage source to the connectors VDD1/AVDD pin referenced to GND1/AGND. Turn on the power source and make sure there is no more than the specified current limit in the device data sheet drawn.
3. Tie input to ground. Use the oscilloscope or the DMM to verify that isolated power is present on both supplies. Measure the output of the device referenced to GND2/DGND and verify:
 - a. For amplifiers using either the oscilloscope or the DMM: the isolated voltage is within the common-mode output voltage (typ. 1.44V for differential output, VREF/2 for single-ended output).
 - b. For modulators using the oscilloscope: the digital output is a stream of ones and zeros that are high 50% of the time and low 50% of the time.
 - c. For modulators using the DMM: the DMM is about 50% magnitude of DVDD.

4.

CAUTION



The board can heat up under high power or improper use conditions. Contact can cause burns. Do not touch. Take the proper precautions when operating.

CAUTION



Electric shocks are possible when connecting the board to high voltage inputs. The board must be handled with care by a professional. For safety, use of isolated test equipment with overvoltage or overcurrent protection is highly recommended.

Depending on the mounted device, apply the appropriate DC full-scale linear input signal to the VHV1 turret connection. Typically: 400V, 600V, 1000V, 1600V.

- a. To use the TP6 test point connection to VSNS as an alternate input signal injection point is also possible. If using the TP6 test point, then a 1V signal can be applied instead.

CAUTION

Only use one of the input pins for signal injection. Do not input a signal on both the VHV1 and TP6 test points.

5. Measure the output with the oscilloscope or the DMM.
 - a. For amplifiers using either the oscilloscope or the DMM: Verify that the output voltage reaches the full-scale output for the installed device.
 - i. 2.V FSR for differential amplifiers.
 - ii. VREF FSR for single-ended amplifiers.
 - b. For modulators using the oscilloscope: Verify that the digital output is proportional to the expected conversion.
 - i. For a positive full scale linear input, the digital output needs to be high about 90% of the time.
 - c. For modulators using the DMM: Verify that the digital output is proportional to the expected conversion. Apply a DC input signal.
 - i. For a positive full scale linear input, the digital output needs to be about 90% magnitude of DVDD.

3 Hardware Design Files

3.1 Schematics

Figure 3-1 shows the full schematic

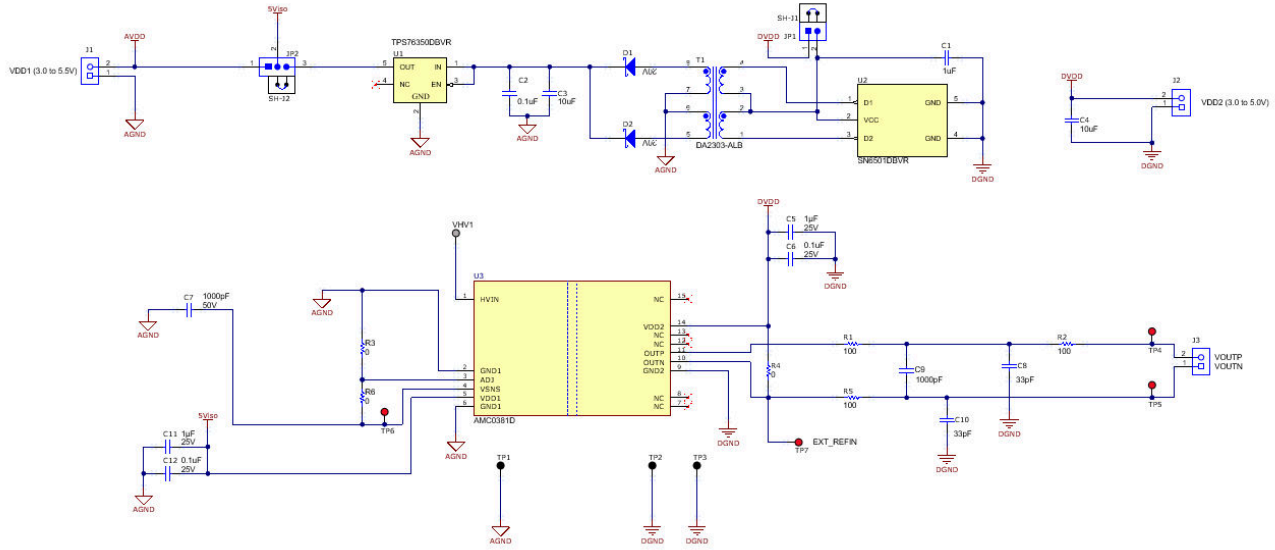


Figure 3-1. Full Schematic

3.2 PCB Layout

Figure 3-2 and Figure 3-3 show the top and bottom printed circuit board (PCB) drawings of the AMC038XEVM, respectively.

Note

Board layouts are not to scale. These layouts are intended to show how the board is laid out, and are not intended to be used for manufacturing the AMC038XEVM PCB.

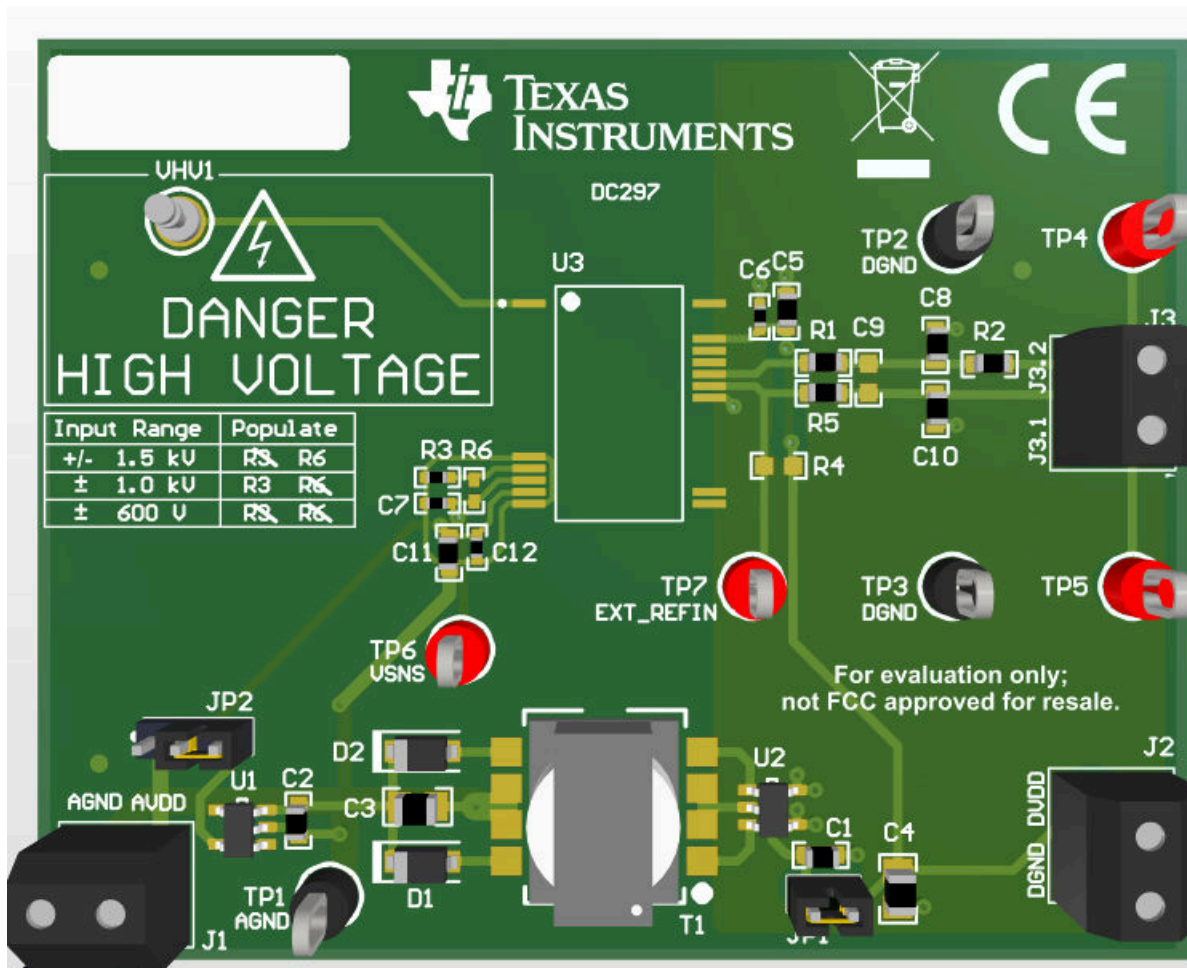


Figure 3-2. AMC038XEVM Top PCB Drawing

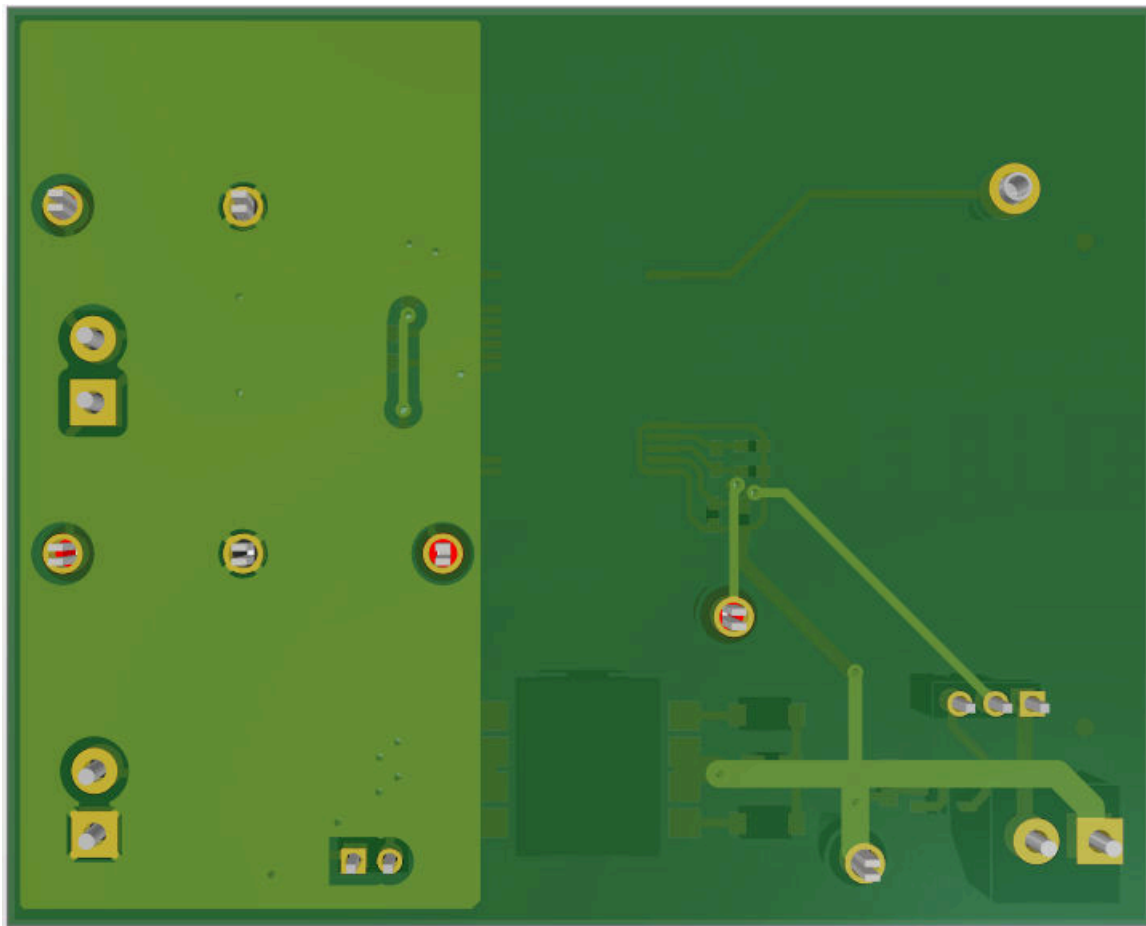


Figure 3-3. AMC038XEVMBottom PCB Drawing

3.3 Bill of Materials

The AMC038XEVM bill of materials (BOM) is shown in [Table 3-1](#).

Table 3-1. Bill of Materials

Designator	Description	Manufacturer	Mfg. Part Number
C1	CAP, CERM, 1uF, 10V, +/- 10%, X5R, 0603	Kemet	C0603C105K8PAC7867
C2	CAP, CERM, 0.1uF, 25V, +/- 10%, X7R, 0603	AVX	KGM15BR71E104KT
C3, C4	CAP, CERM, 10uF, 10V, +/- 10%, X5R, 0805	Kemet	C0805C106K8PAC7800
C5, C11	CAP, CERM, 1uF, 25V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	MuRata	GCM188R71E105KA64D
C6, C12	CAP, CERM, 0.1uF, 25V, +/- 10%, X7R, 0402	MuRata	GRM155R71E104KE14D
C7	CAP, CERM, 1000pF, 50V, +/- 10%, X7R, 0402	MuRata	GRM155R71H102KA01D
C8, C10	CAP, CERM, 33pF, 50V, +/- 5%, C0G/ NPO, AEC-Q200 Grade 0, 0603	TDK	CGA3E2NP01H330J080AA
D1, D2	Diode, Schottky, 20V, 0.5A, SOD-123	ON Semiconductor	MBR0520LT1G
J1, J2, J3	Terminal Block, 3.5mm Pitch, 2x1, TH	On-Shore Technology	ED555/2DS
JP1	Header, 2mm, 2x1, Tin, TH	Samtec	TMM-102-01-T-S
JP2	Header, 2mm, 3x1, Tin, TH	Samtec	TMM-103-01-T-S
LBL1	Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	Brady	THT-14-423-10
R1	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	Panasonic	ERJ-3GEY0R00V
R2, R5	RES, 100, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW0603100RJNEA
R3	RES, 0, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	Vishay-Dale	CRCW04020000Z0ED
SH-J1, SH-J2	Shunt, 2mm, Gold plated, Black	Samtec	2SN-BK-G
T1	Transformer, 45.6 uH SMT	Coilcraft	
TP1, TP2, TP3	Test Point, Multipurpose, Black, TH	Keystone Electronics	5011
TP4, TP5, TP6, TP7	Test Point, Multipurpose, Red, TH	Keystone Electronics	5010
U1	Single Output LDO, 150mA, Fixed 5V Output, 2.7 to 10V Input, with Low IQ, 5-pin SOT-23 (DBV), -40 to 125 degC, Green (RoHS & no Sb/Br)	Texas Instruments	TPS76350DBVR
U2	Low-Noise 350mA, 410kHz Transformer Driver, DBV0005A (SOT-23-5)	Texas Instruments	SN6501DBVR
VHV1	Terminal, Turret, TH, Double	Keystone	1593-2

4 Additional Information

4.1 Trademarks

All trademarks are the property of their respective owners.

5 Related Documentation

To obtain a copy of any of the following TI documents, call the Texas Instruments Literature Response Center at (800) 477-8924 or the Product Information Center (PIC) at (972) 644-5580. When ordering, please identify this document by the title and literature number. Updated documents can also be obtained through our website at www.ti.com.

- [Comparing Isolated Amplifiers and Isolated Modulators](#)
- [Isolated Amplifiers](#)
- [Isolated ADCs](#)

Table 5-1. Related Devices

Devices	Documentation
AMC0380D	SBASAT0
AMC0381D	SBASAT1
AMC0386	SBASAT2

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying 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 set forth herein. User's acceptance of the EVM is expressly subject to the following terms.
 - 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 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.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。技術適合証明を受けていないものご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。日本テキサス・イ

ンスツルメンツ株式会社

東京都新宿区西新宿 6 丁目 2 4 番 1 号

西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。 <https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html>

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.

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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 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.
 - 6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS 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, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.
 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. 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 OR THE USE OF THE EVMS , 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 TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

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.

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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