EVM User's Guide: ISO228EVM

ISO228 Eight-Channel Isolated Digital Input Sink/Source Evaluation Module

TEXAS INSTRUMENTS

Description

The ISO1228EVM is an evaluation module (EVM) used to evaluate the 8-channel isolated digital input receiver ISO1228 in the 38-pin DFB SSOP package. The EVM can be used to evaluate sink, source, and sink/source mode operation with no change to the PCB circuitry. The board also has additional footprints that gives the user flexibility to add components to test a variety of common applications. The EVM features multiple test points and jumper options to evaluate the device with minimal external components.

Features

- Eight configurable IEC 61131-2 type 1, 2, or 3 isolated digital inputs
- Eight Sink/Source mode configurable inputs
- VCC1 logic supply voltage range 1.71V to 5.5V
- AVCC field supply voltage range 8V to 36V
- Serial SPI and parallel output options
- Programmable glitch filters
- TVS diodes for improved surge performance
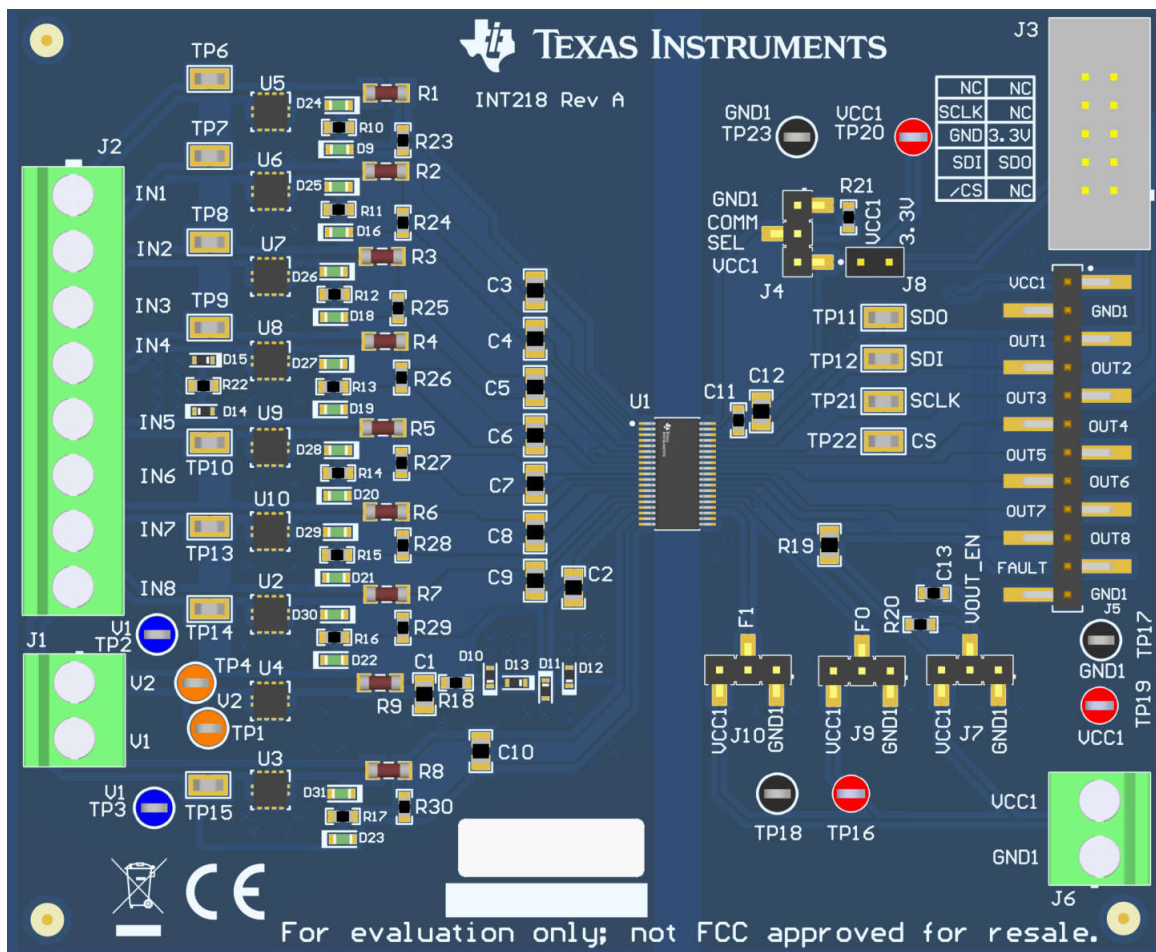
ISO228EVM

1 Evaluation Module Overview

1.1 Introduction

This user's guide describes the evaluation module (EVM) for the ISO1228 isolated digital-input receiver. The ISO1228EVM allows designers to evaluate device performance for the fast development and analysis of isolated systems. The EVM supports evaluation of the ISO1228 SSOP package device, which helps the user to evaluate 8 channels that can be configured for IEC 61131-2 Type 1, 2, or 3 sink/source digital inputs.

This document provides the EVM operation and setup, and contains the EVM schematics, bill of materials, PCB layouts.

> **CAUTION**
>
> This evaluation module is made available for evaluation of isolator parameter performance only and is not intended for isolation voltage testing. To prevent damage to the EVM, any voltage applied as a supply or digital input/output must be maintained within the recommended operating range.

1.2 Kit Contents

This evaluation module contains ISO1228 device with a configuration for evaluating Type 1 or Type 3 digital inputs. To evaluate Type 2 digital inputs, please set RILIM = 1kΩ to support 3.5mA current on each channel and then connect each Type 2 digital input to two channels of ISO1228 such that the two channels consume a combined current of 7mA meeting the current requirement of each Type 2 digital input. Such configuration with ISO1228 allows for evaluation of four Type 2 digital inputs.

The major components of the ISO1228 evaluation module are:

- ISO1228 isolator
- On-board digital input connections
- Multiple on-board test points
- On-board SPI communication connections

To demonstrate functionality of the ISO1228, TI recommends the following (not included):

- DC power supply
- Oscilloscope
- Signal generator

1.3 Specification

The ISO1228 device is an integrated 8-channel isolated digital-input receiver configurable for IEC 61131-2 Type 1, 2, and 3 digital inputs. The device receives up to a 36V digital input signals and provides isolated digital outputs. A VCC1 logic supply voltage and AVCC field supply voltage is required for operation. The device offers many configurable options and built in features such as LED field side indications, fault indications, and cyclic redundancy check (CRC) allowing for versatility and robustness. These features make the ISO1228 an excellent choice for numerous applications, which utilize digital inputs, such as programmable logic controllers (PLC), motor drive digital inputs, and industrial transport digital inputs.

1.4 Device Information

The evaluation module contains one ISO1228 and all other passive components required for operation. Various components included in the evaluation module directly control the operation and functionality of the ISO1228. If necessary, components can be removed, added, or replaced to modify the behavior of the ISO1228 accordingly for any given application.

The full-bridge rectifier (D10, D11, D12, D13) connected to AVCC and AVSS allow for the supply to be plugged in either direction, enabling the EVM to be evaluated in sink or source mode.

The external resistor on the AVCC supply path, R_{ILIM} (R18) sets the current limit to the digital inputs. The current limit set by R_{ILIM} applies to all input channels. The R_{PAR} resistors (R10, R11, R12, R13, R14, R15, R16, and R17), between each INx and LEDx pins, are chosen according to the selected R_{ILIM} value. The R_{THR} resistors (R1, R2, R3, R4, R5, R6, R7, and R8), located on each input pin, can be used to set the voltage transition thresholds. These resistors also serve as current limiting resistors for any voltage transients occurring at input terminals. R_{SURGE} (R9) along with C_{SURGE} (C1) filter any surges or transients seen on the power supply.

For recommendations on selecting the R_{ILIM}, R_{PAR}, R_{THR}, or R_{SURGE} resistor values for each operational mode, see Table 1-1, Table 1-2, Table 1-3, or the ISO1228 Eight-Channel Isolated Digital Input Receiver data sheet. Two channels of ISO1228 can be connected to create one Type 2 input. Set RILIM = 1kΩ to support 3.5mA current on each channel, and connect each Type 2 digital input to two ISO1228 input terminals. Each two channel pair consumes a total current of 7mA and meet the current requirements of a Type 2 digital input. ISO1228 allows for evaluation of four Type 2 digital inputs using this method.

Table 1-1. Sink Mode R_{THR} Admissible Values (Ω)

SINK MODE							
R_{ILIM} = 0Ω, R_{PAR} = 13kΩ, R_{SURGE} = 1kΩ, (I_L = 2.5mA)				R_{ILIM} = 1kΩ, R_{PAR} = 10.7kΩ, R_{SURGE} = 1kΩ, (I_L = 3.5mA)			
	Min	Typical	Max		Min	Typical	Max
Type 1	180	1000	2400	Type 1	110	910	1740
Type 3	180	1000	1300	Type 3	110	910	930

Table 1-2. Source Mode R_{THR} Admissible Values (Ω)

SOURCE MODE							
R_{ILIM} = 0Ω, R_{PAR} = 13kΩ, R_{SURGE} = 1kΩ, (I_L = 2.5mA)				R_{ILIM} = 1kΩ, R_{PAR} = 10.7kΩ, R_{SURGE} = 1kΩ, (I_L = 3.5mA)			
	Min	Typical	Max		Min	Typical	Max
Type 1	180	1000	2400	Type 1	2000	2000	2000
Type 3	180	1000	1300	Type 3	Not Supported		

Table 1-3. Sink/Source Mode R_{THR} Admissible Values (Ω)

SINK/SOURCE MODE			
R_{ILIM} = 1kΩ, R_{PAR} = 13kΩ, R_{SURGE} = 1kΩ, (I_L = 3.5mA)			
	Min	Typical	Max
Type 1	180	1000	2400
Type 3	180	1000	1300

The on-board LEDs demonstrate the functionality of the ISO1228's field side LED indication feature. When a digital input signal crosses the programmable input voltage threshold V_{IH}, current being drawn from the digital inputs is diverted to the corresponding LED. The corresponding LED provides a visual indication of which channels are receiving valid digital input signals at any time. Additionally, by using the current from the digital input, no additional power is required from the device or system. When the digital input voltage falls below the programmable input voltage threshold V_{IL}, the current through LEDs is bypassed, resulting in the indicators switching off.

For a full list of components included in the ISO1228 evaluation module, see Section 3.3.

2 Hardware

2.1 Pin Configuration of the ISO1228

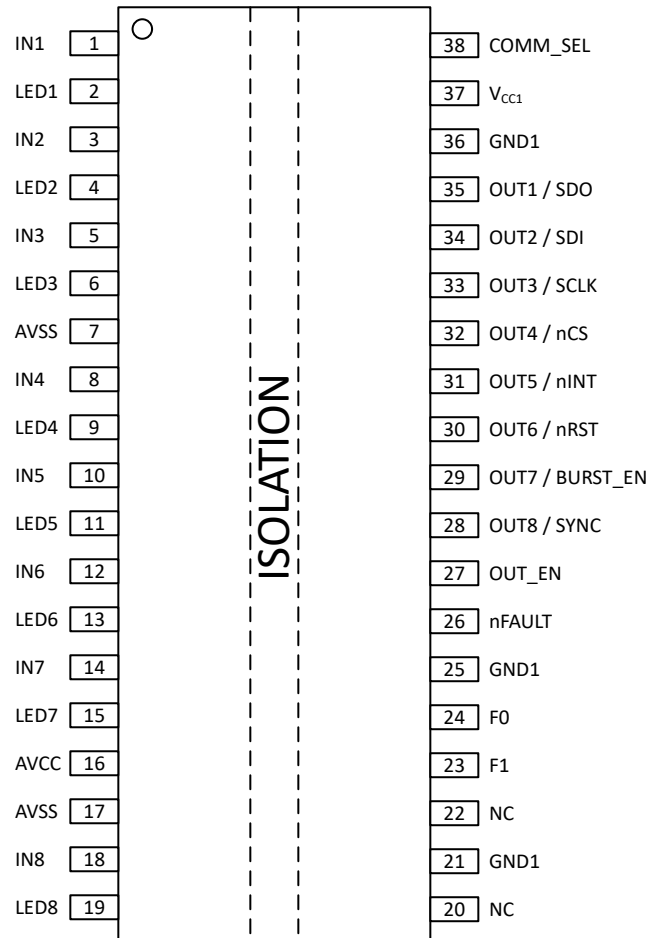The ISO1228 pin configuration in an 38 pin SSOP package is shown in Figure 2-1.

Left Pin	#		#	Right Pin
IN1	1		38	COMM_SEL
LED1	2		37	V_{CC1}
IN2	3		36	GND1
LED2	4		35	OUT1 / SDO
IN3	5		34	OUT2 / SDI
LED3	6		33	OUT3 / SCLK
AVSS	7		32	OUT4 / nCS
IN4	8	ISOLATION	31	OUT5 / nINT
LED4	9		30	OUT6 / nRST
IN5	10		29	OUT7 / BURST_EN
LED5	11		28	OUT8 / SYNC
IN6	12		27	OUT_EN
LED6	13		26	nFAULT
IN7	14		25	GND1
LED7	15		24	F0
AVCC	16		23	F1
AVSS	17		22	NC
IN8	18		21	GND1
LED8	19		20	NC

Figure 2-1. ISO1228 Isolated Digital-Input Receiver Pin Configuration

2.2 EVM Board Block Diagram and Image

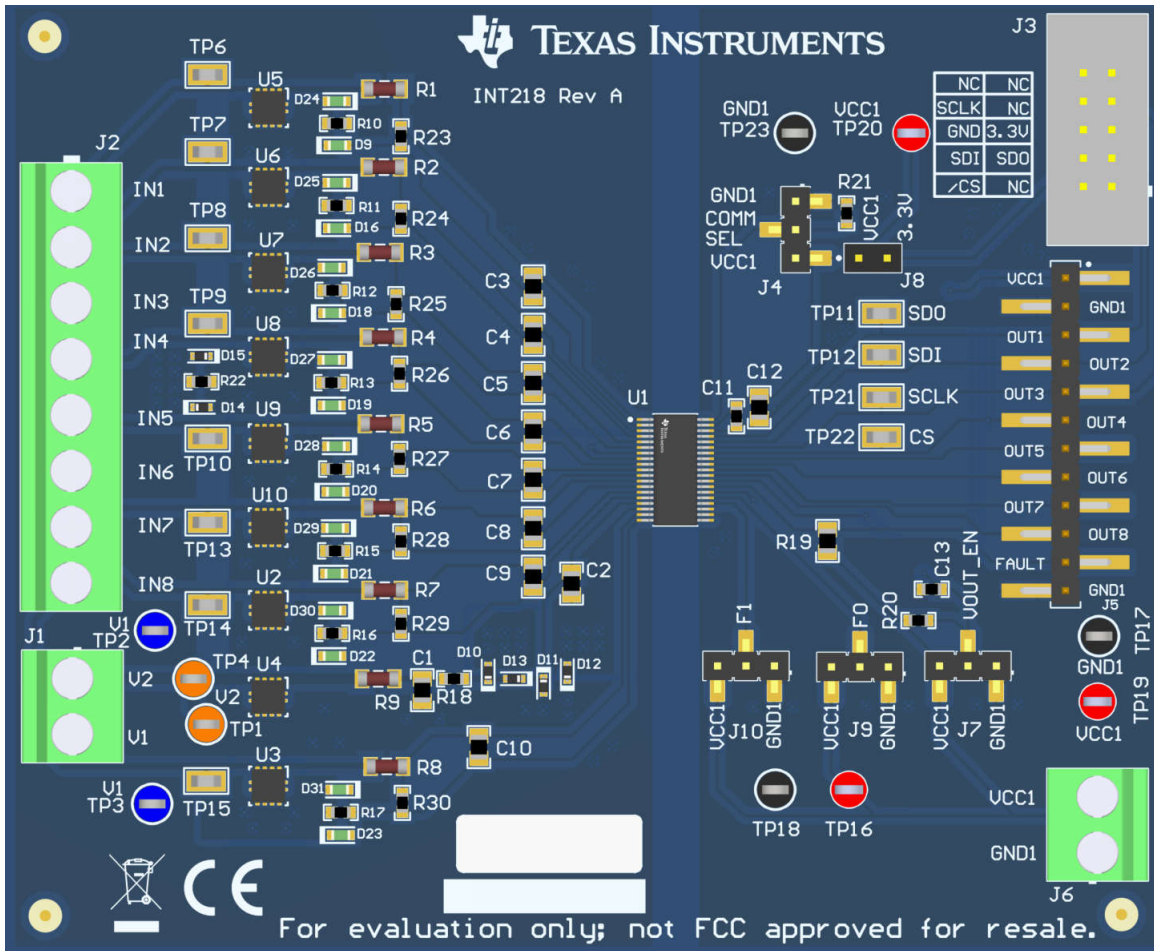The top view of the EVM PCB is shown in Figure 2-2.

Figure 2-2. ISO1228EVM PCB Diagram

2.3 EVM Setup and Operation

This section describes the basic setup and operation of the EVM for performance evaluation. An example of one potential configuration for operating the ISO1228EVM is shown in Figure 2-3. In this setup, the digital input signal from the signal generator is connected between one of the INx pins and AVSS. The field side power supply is connected at AVCC and AVSS. The logic side power supply is connected at VCC1 and GND1. All output signals are monitored using an oscilloscope on the corresponding OUTx pin.
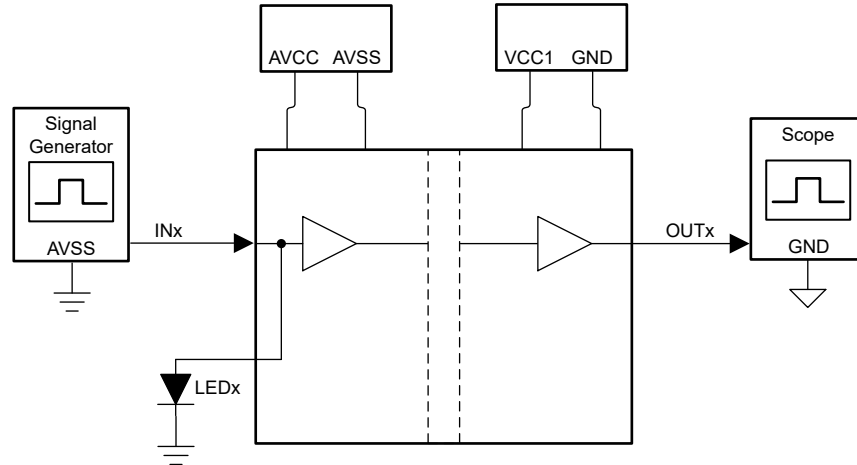
Figure 2-3. Basic EVM Operation

The ISO1228EVM has many *do not populate* (DNP) footprints for components which can be populated to apply different test conditions to the device. All possible test configurations that can be achieved by modifying different components of the EVM is shown in Table 2-1.

Table 2-1. Component Configurations

Component	Description
D1, D2, D3, D4, D5, D6, D7, D8	Can be added for additional surge protection
C3, C4, C5, C6, C7, C8, C9, C10	Can be added for additional filtering control on the input pins
R1, R2, R3, R4, R5, R6, R7, R8	R_{THR}, Replace to modify voltage transition thresholds
R10, R11, R12, R13, R14, R15, R16, R17	R_{PAR}, Replace according to R_{ILIM} selection
R18	R_{ILIM}, Replace to modify current limit drawn from each digital input
Sink/Source Mode	The EVM can be operated in sink, source, and sink/source mode without needing to modify any components.

2.3.1 EVM Jumper Settings

The ISO1228EVM has several configurable jumpers that can be used to modify the behavior of the ISO1228. All jumpers are left open by default, which program the ISO1228 EVM to operate in the parallel interface mode with enabled outputs and digital filtering of 1ms on the channels. Alternative jumper configurations and the resulting device behaviors are explained below.

The COMM_SEL pin of the ISO1228 controls the output options and is configurable with jumper J4. The available configurations of the COMM_SEL pin is described in Table 2-2.

Table 2-2. Comm_Sel Pin Jumper Descriptions

Jumper	Configuration	Description
J4	All pins open (default)	Parallel interface mode enabled (default)
	Pin 1-Pin 2 shorted (COMM_SEL tied to Ground)	Parallel interface mode enabled
	Pin 2-Pin 3 shorted (COMM_SEL tied to VCC1)	Serial interface mode enabled

The F0 and F1 pins of the ISO1228 control the digital filter settings. Since each pin has three potential states, there are 9 distinct combinations and digital low pass filters. Pin F0 can be configured with jumper J9 and pin F1 can be configured with jumper J10. All potential combinations of pin F0 and F1 is shown in Table 2-3. The digital filters can also be programmed through the SPI registers. If any SPI filter Enable register bit is flipped, the states of the F0 and F1 pins are ignored.

Table 2-3. F0 and F1 Pin Jumper Descriptions

Option	Jumper	Configuration	Description
1	J9	All pins open (default)	1ms filter averaging time (default)
	J10	All pins open (default)	
2	J9	Pin 1-Pin 2 shorted (F0 tied to ground)	0ns filter averaging time
	J10	Pin 1-Pin 2 shorted (F1 tied to ground)	
3	J9	All pins open (default)	1µs filter averaging time
	J10	Pin 1-Pin 2 shorted (F1 tied to ground)	
4	J9	Pin 2-Pin 3 shorted (F0 tied to VCC1)	10µs filter averaging time
	J10	Pin 1-Pin 2 shorted (F1 tied to ground)	
5	J9	Pin 1-Pin 2 shorted (F0 tied to ground)	200µs filter averaging time
	J10	All pins open (default)	
6	J9	Pin 2-Pin 3 shorted (F0 tied to VCC1)	3ms filter averaging time
	J10	All pins open (default)	
7	J9	Pin 1-Pin 2 shorted (F0 tied to ground)	10ms filter averaging time
	J10	Pin 2-Pin 3 shorted (F1 tied to VCC1)	
8	J9	All pins open (default)	30ms filter averaging time
	J10	Pin 2-Pin 3 shorted (F1 tied to VCC1)	
9	J9	Pin 2-Pin 3 shorted (F0 tied to VCC1)	100ms filter averaging time
	J10	Pin 2-Pin 3 shorted (F1 tied to VCC1)	

The OUT_EN pin of the ISO1228 acts as the output enable control and is configurable with jumper J7. The available configurations of the OUT_EN/NC pin is shown in Table 2-4.

Table 2-4. OUT_EN Pin Jumper Description

Jumper	Configuration	Description
J7	All pins open (default)	Output enabled (default)
	Pin 1-Pin 2 shorted (OUT_EN tied to Ground)	Output pins are tri-stated
	Pin 2-Pin 3 shorted (OUT_EN tied to VCC1)	Output enabled

3 Hardware Design Files

3.1 Schematics
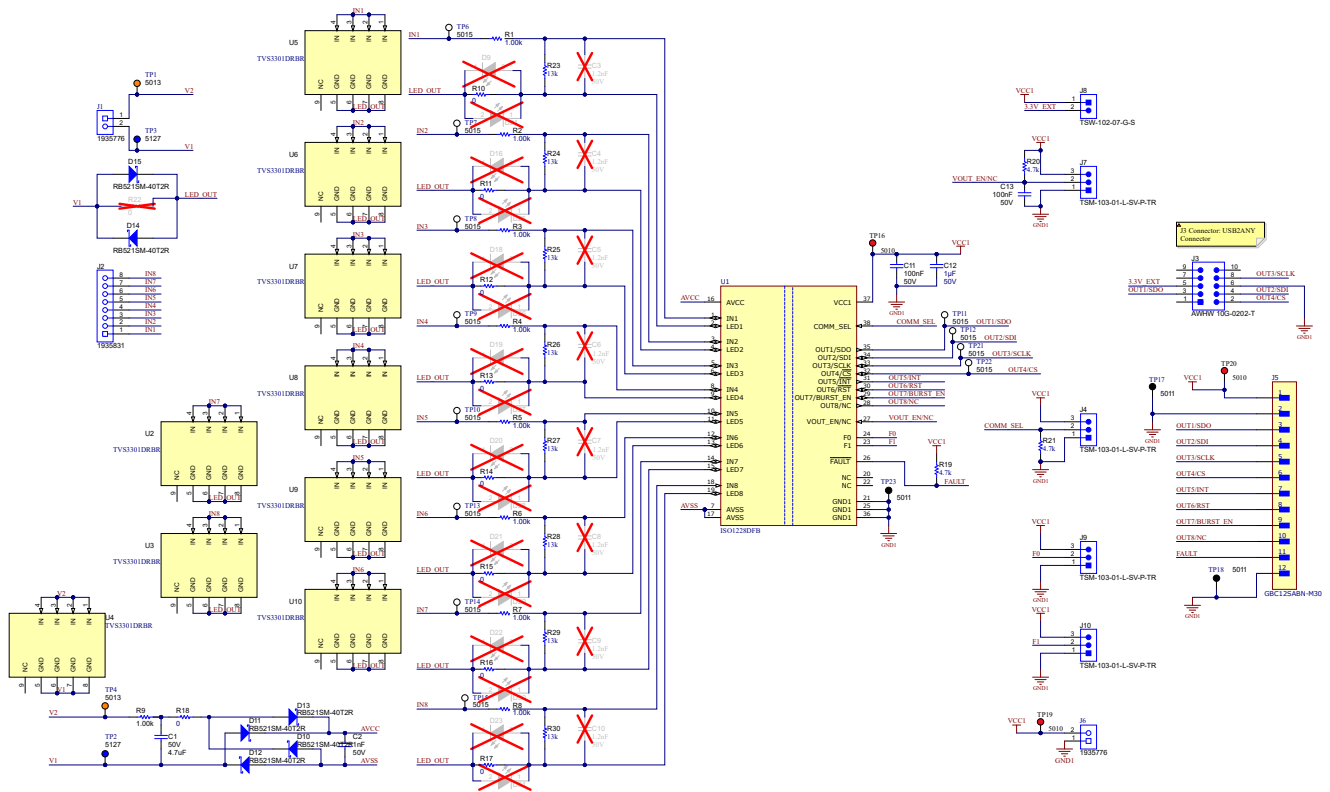
The ISO1228EVM schematic is shown in Figure 3-1.

Figure 3-1. ISO1228EVM Schematic

3.2 PCB Layouts

The top and bottom views of the PCB layout of the EVM are shown in Figure 3-2 and Figure 3-4. The top composite view of the EVM is shown in Figure 3-3.

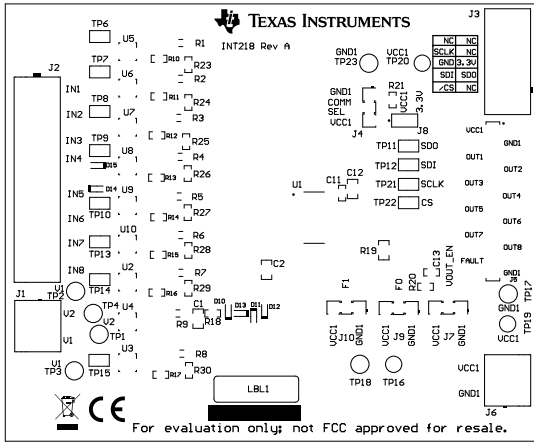**Figure 3-2. ISO1228EVM PCB Layout - Composite (Top View)**

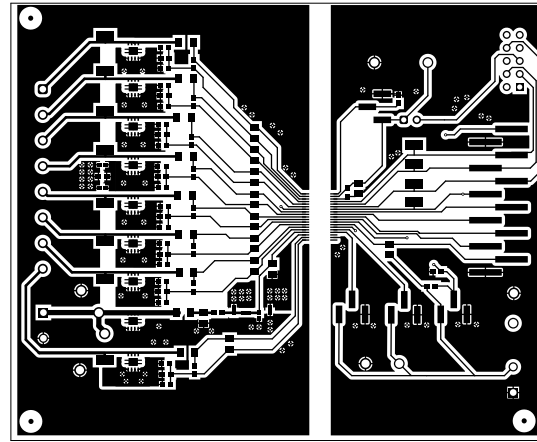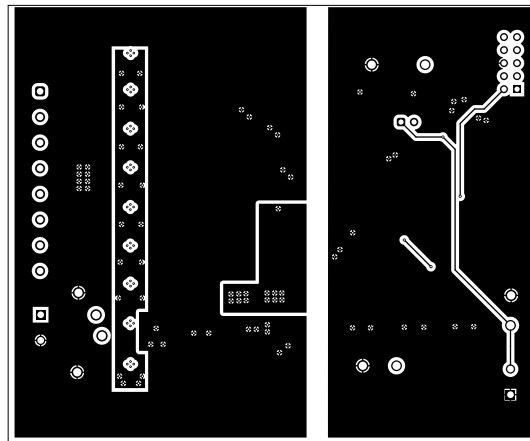**Figure 3-3. ISO1228EVM PCB Layout - Top Layer**

Figure 3-4. ISO1228EVM PCB Layout - Bottom Layer

3.3 Bill of Materials

The bill of materials (BOM) for this EVM is listed in Table 3-1.

Table 3-1. Bill of Materials

Item	Designator	Description	Part Number	Manufacturer	Quantity
1	C1	CAP, CERM, 4.7uF, 50V, +/- 10%, X6S, 0805	C2012X6S1H475K125AC	TDK	1
2	C2	CAP, CERM, 1000pF, 50V, +/- 10%, X7R, 0805	C0805C102K5RAC7800	Kemet	1
3	C11, C13	CAP, CERM, 0.1uF, 50V, +/- 10%, X7R, 0603	C0603C104K5RAC7867	Kemet	2
4	C12	CAP, CERM, 1µF, 50V,+/- 10%, X7R, 0805	CL21B105KBFNFNE	Samsung	1
5	D10, D11, D12, D13, D14, D15	Diode, Schottky, 40V, 0.2A, SOD-523	RB521SM-40T2R	Rohm	6
6	H1, H2, H3, H4	Bumpon, Hemisphere, 0.44 X 0.20, Clear	SJ-5303 (CLEAR)	3M	4
7	J1, J6	Terminal Block, 2x1, 5mm, Green, TH	1935776	Phoenix Contact	2
8	J2	Terminal Block, 5mm, 8x1, R/A, TH	1935831	Phoenix Contact	1
9	J3	Header(Shrouded), 2.54mm, 5x2, Gold, TH	AWHW 10G-0202-T	Assman WSW Components	1
10	J4, J7, J9, J10	Header, 2.54mm, 3x1, Gold, SMT	TSM-103-01-L-SV-P-TR	Samtec	4
11	J5	Connector Header Surface Mount 12 position 0.100" (2.54mm)	GBC12SABN-M30	Sullins	1
12	J8	Header, 100mil, 2x1, Gold, TH	TSW-102-07-G-S	Samtec	1
13	R1, R2, R3, R4, R5, R6, R7, R8, R9	RES, 1.00 k, 1%, 0.25 W, AEC-Q200 Grade 1, 1.4x3.6mm	SMM02040C1001FB300	Vishay Draloric	9
14	R10, R11, R12, R13, R14, R15, R16, R17, R18	RES, 0, 5%, 0.1 W, 0603	RC0603JR-070RL	Yageo	9
15	R19	RES, 4.7 k, 5%, 0.125 W, AEC-Q200 Grade 0, 0805	ERJ-6GEYJ472V	Panasonic	1
16	R20, R21	RES, 4.7 k, 5%, 0.1 W, 0603	CR0603-JW-472ELF	Bourns	2
17	R23, R24, R25, R26, R27, R28, R29, R30	RES, 13 k, 5%, 0.1 W, 0603	RC0603JR-0713KL	Yageo	8
18	TP1, TP4	Test Point, Multipurpose, Orange, TH	5013	Keystone Electronics	2
19	TP2, TP3	Test Point, Multipurpose, Blue, TH	5127	Keystone Electronics	2
20	TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP21, TP22	Test Point, Miniature, SMT	5015	Keystone Electronics	12
21	TP16, TP19, TP20	Test Point, Red, Through Hole, RoHS, Bulk	5010	Keystone	3
22	TP17, TP18, TP23	Test Point, Multipurpose, Black, TH	5011	Keystone Electronics	3
23	U1	Eight-Channel Isolated Digital Input with Current Limit and Diagnostics	ISO1228DFB	Texas Instruments	1
24	U2, U3, U4, U5, U6, U7, U8, U9, U10	33V Bidirectional Flat-Clamp Surge Protection Device, DRB0008A (VSON-8)	TVS3301DRBR	Texas Instruments	9
25	C3, C4, C5, C6, C7, C8, C9, C10	CAP, CERM, 1200pF, 50V, +/- 10%, X7R, 0805	08055C122KAT2A	AVX	0
26	D9, D16, D18, D19, D20, D21, D22, D23, D24, D25, D26, D27, D28, D29, D30, D31	LED, Green, SMD	150060VS75000	Wurth Elektronik	0
27	R22	RES, 0, 5%, 0.1 W, 0603	RC0603JR-070RL	Yageo	0

4 Additional Information

4.1 Trademarks

All trademarks are the property of their respective owners.

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2. *Limited Warranty and Related Remedies/Disclaimers*:

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   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 DEGREDATION 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/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。

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２４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/lsds/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.

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, INDEMITY 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.

IMPORTANT NOTICE AND DISCLAIMER