

EVM User's Guide: XTREVM-TRANSMITTER

XTR200 Evaluation Module



Description

The XTREVM-TRANSMITTER is a precision transmitter design comprised of the XTR200 current and voltage transmitter. The XTR200 is a high voltage, precision, output driver for 3-wire current or voltage systems, designed for standard industrial signals. This EVM is designed to be used with the sensor measurement board (SNSR-DUAL-ADC-EVM) as a field transmitter evaluation platform.

Get Started

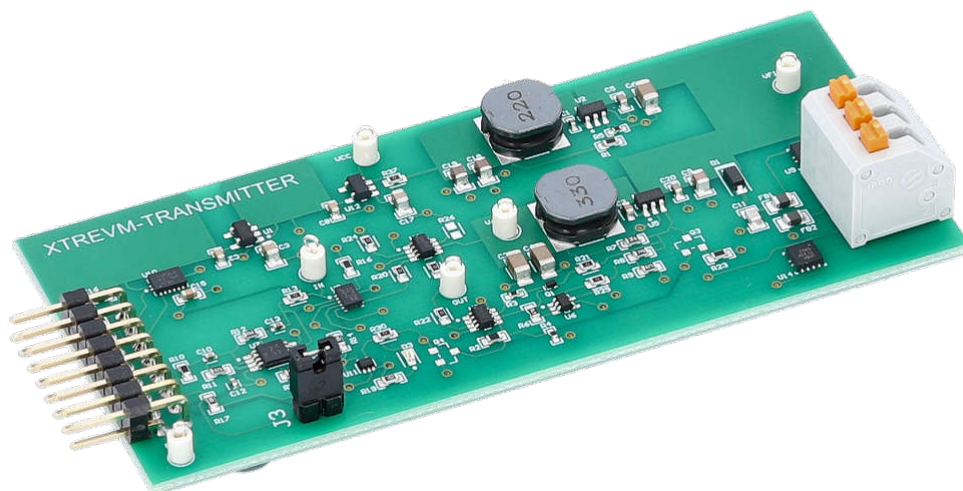
1. Order the input sensor board: [SNSR-DUAL-ADC-EVM](#)
2. Order the discrete output transmitter board: XTREVM-TRANSMITTER
3. Download the firmware source code from the reference design page: [TIDA-011026](#)
4. Download the [XTR200 datasheet](#)
5. Download the [TIDA-011026 reference design guide](#)

Features

- System level board compatible with the SNSR-DUAL-ADC-EVM
- PWM input with fourth order PWM filter
- Adaptive power circuitry
- XTR200 current and voltage transmitter output
- Loop protection circuitry using TPS26611 and TVS3301
- MCU interface providing power output (3.3V) and SPI

Applications

- [Flow transmitter](#)
- [Level transmitter](#)
- [Pressure transmitter](#)
- [Temperature transmitter](#)
- [Analog output module](#)



XTREVM-TRANSMITTER Board

1 Evaluation Module Overview

The XTREVM-TRANSMITTER implements a 4-20mA, 3-wire field transmitter. The design uses the XTR200 as the primary transmitter driver (current or voltage) and input to the XTR200 is a PWM input from the sensor board SNSR-DUAL-ADC-EVM. The XTR200 is a high-voltage, precision, output driver for 3-wire current or voltage systems. The device integrates a low-leakage PMOS output transistor and short-circuit protection, reducing the need for external components. The EVM uses a pin header interface to connect to a microcontroller (MCU). This EVM design is based on the TIDA-011026 reference design.

1.1 Introduction

The XTREVM-TRANSMITTER EVM design incorporates a 3-wire XTR current or voltage transmitter using the XTR200. The XTR200 takes in an input from PWM signal from MCU that is filtered by 4th order active low-pass filter (LPF). The system can switch between current and voltage mode and output 0-20mA, 4-20mA, and 0-10V output ranges. This board interfaces with the SNSR-DUAL-ADC-EVM that contains the MCU. MCU communicates via GPIO and SPI to control the XTR200 and identify board for the software.

The field supply power is regulated by two buck converters and provides local power to the board. The XTR200 power supply is regulated by an adaptive power circuit. This circuit adjusts the supply voltage of the XTR200 as voltage output of the module increases to maintain sufficient headroom to drive the output load. The board also contains protections scheme using TPS2661 and TVS diodes to cover overcurrent, overvoltage, reverse polarity, and transient protection of the output.

1.2 Kit Contents

The kit contains the XTREVM-TRANSMITTER PCB board.

Download the latest versions of the related software from [ti.com](https://www.ti.com).

1.3 Specification

[Table 1-1](#) provides the XTREVM-TRANSMITTER board specifications.

Table 1-1. Specifications

Parameter	Value
Field supply voltage	8V to 36V
Output current range	0mA to 27mA
Output voltage range	0V to 12V
Input voltage range	0V to 5V
Power supply output	3.3V
Power supply output current	2mA
Communication interface	SPI

1.4 Device Information

The XTR200 is a precision 3-wire current or voltage transmitter. The output can be configured to either current or voltage output mode by setting the MODE pin.

The XTREVM-TRANSMITTER is an output transmitter board that interfaces with the sensor board SNSR-DUAL-ADC-EVM that contains the ADC and MCU. For proper evaluation, use this board with the sensor board. The board contains test point and jumpers to allow an external DAC input and bypass the PWM filtering. More details on this configuration can be found in [Section 2.2](#).

2 Hardware

2.1 Power Requirements

The XTREVM-TRANSMITTER is powered through terminal block J1 as shown in Figure 2-1. Field supply must be between 8V to 36V for proper operation of the board. Field supply feeds into two buck converters. One of which powers the XTR200 and TPS2661 in an adaptive power circuit. The other buck converter is used to step down the supply voltage to two LDOs to generate 5V and 3.3V. The 5V supply powers the PWM circuitry and the 3.3V provides power to the sensor board MCU.

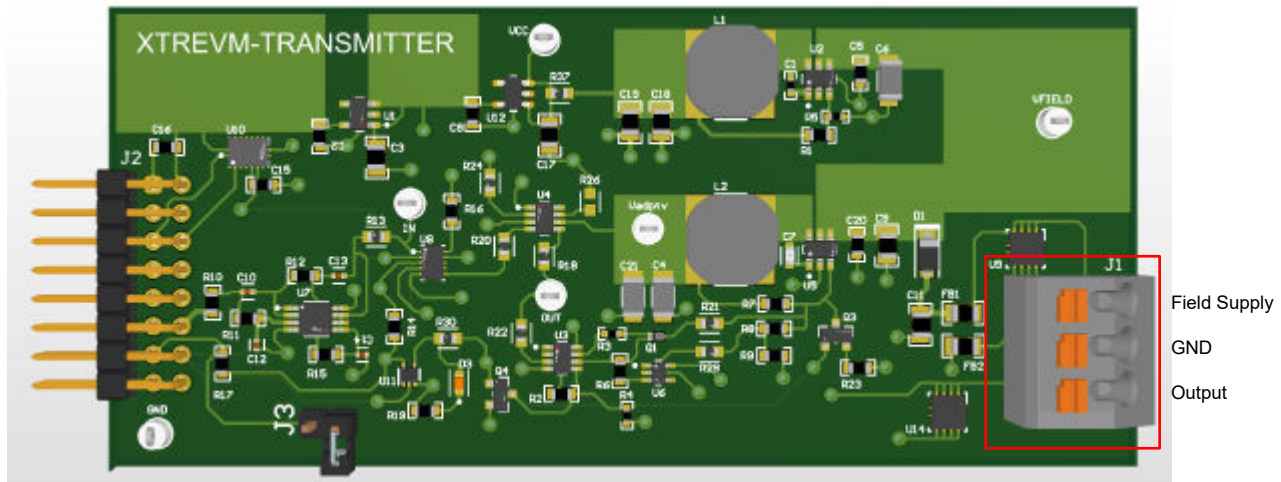


Figure 2-1. Power Connection

2.2 Setup

The XTREVM-TRANSMITTER can be combined with a SNSR-DUAL-ADC-EVM which uses a MSPM0G1507 and two ADS122S14 ADCs to measure sensor inputs. Figure 2-2 shows the full field transmitter platform setup. The 16-pin header (J2) on the XTREVM-TRANSMITTER connects with connector J2 on SNSR-DUAL-ADC-EVM. This connector provides input voltage, SPI communication, and supply voltage to sensor board.

XTREVM-TRANSMITTER can be connected as a 3-wire field transmitter on the output with field supply, GND, and output load attached to connector J1.

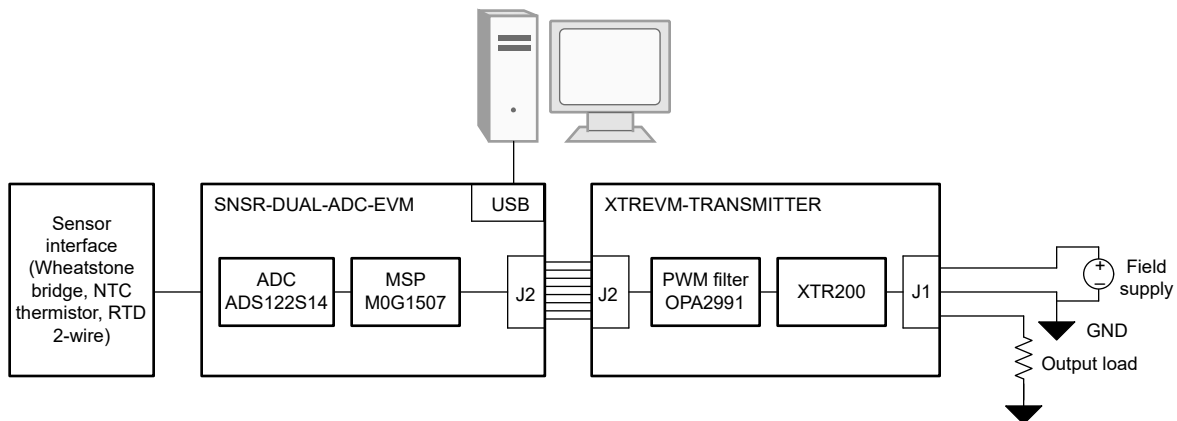


Figure 2-2. Field Transmitter Platform Block Diagram

The XTREVM-TRANSMITTER can be configured to bypass the PWM filter and receive external inputs directly to the XTR200 to evaluate without the SNSR-DUAL-ADC-EVM in a debug mode. Jumper J3 is required to be shorted to allow for the XTR200 to be turned on and the input from a DAC or external voltage source can be applied to test point "IN", as shown in Figure 2-3. This configuration does not allow for error flag monitoring or output disable feature. The mode by default is set to current-mode.

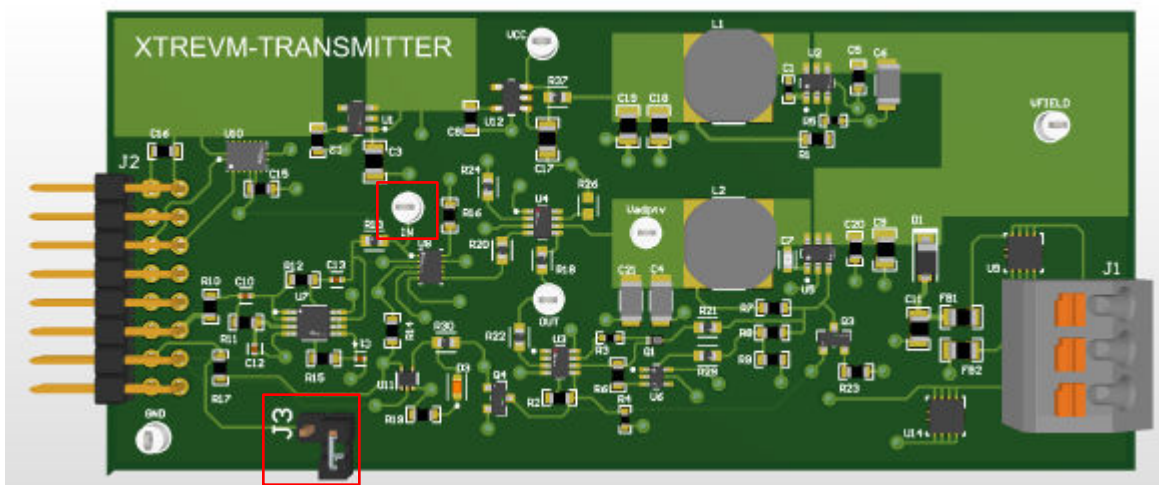


Figure 2-3. Alternative Input Configuration

2.3 Header Information

Table 2-1 outlines the communication and power transfer between XTREVM-TRANSMITTER board and SNSR-DUAL-ADC-EVM through J1.

Table 2-1. J1 Connector Pinout

Pin	Signal
1	GND
2	VDD 3.3V
3	Not used
4	Not used
5	ID0
6	SCLK
7	Not used
8	Not used
9	Not used
10	SDO
11	Not used
12	PWM input
13	Output disable (OD)
14	Mode select (MODE)
15	Not used
16	Error flag (EF)

2.4 Jumper Information

Table 2-2 shows the XTREVM-TRANSMITTER jumper descriptions and functions.

Table 2-2. Jumper descriptions

Jumper	Silkscreen Name	Description
J1	J1	Field connector for field supply and output
J3	J3	Output disable for XTR200 Open (default): XTR200 output is disabled. To enable connect the SNSR-DUAL-ADC-EVM and program via GPIO Closed: XTR200 output is enabled. Do not connect the sensor board when shorted.

2.5 Test Points

[Table 2-3](#) shows the test points available on the XTREVM-TRANSMITTER.

Table 2-3. Test point descriptions

Test point	Silkscreen name	Description
TP1	GND	GND connection for debug
TP2	OUT	Field transmitter output for debug, same output as J1
TP3	VFIELD	Field supply voltage for monitoring
TP4	IN	XTR200 input for monitoring or for alternative input voltage if not using sensor board
TP5	VCC	LDO_IN test point for buck output debug
TP6	Vadptv	Output of the adaptive power circuitry for monitoring

3 Software

The SNSR-DUAL-ADC-EVM controls the host communication with the XTREVM-TRANSMITTER. For more information on MCU command structure and software for this board, see the [TIDA-011026 reference design](#).

4 Hardware Design Files

4.1 Schematics

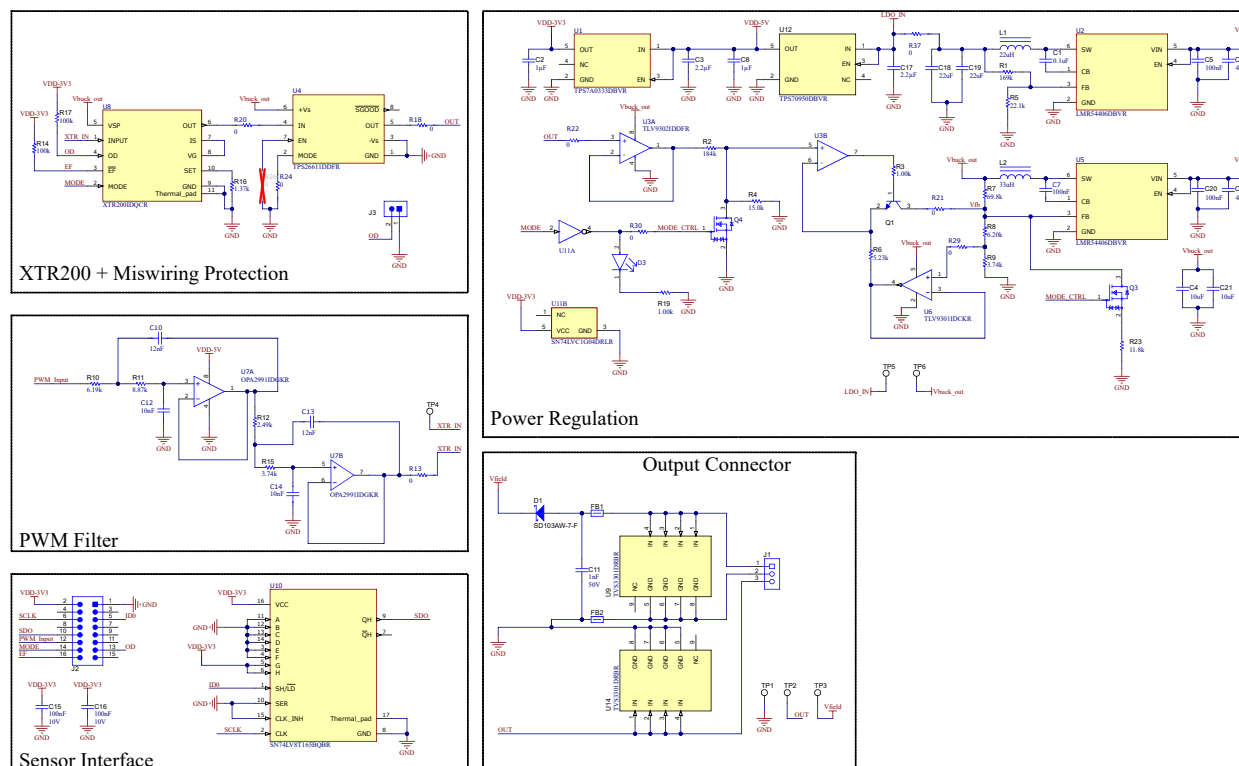


Figure 4-1. Schematic

4.2 PCB Layouts

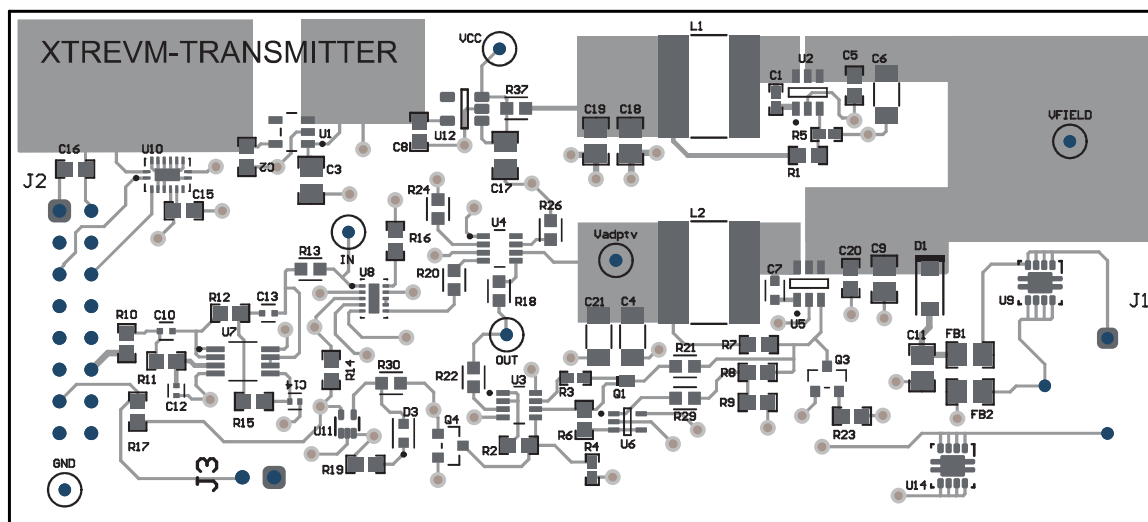


Figure 4-2. Top Layer

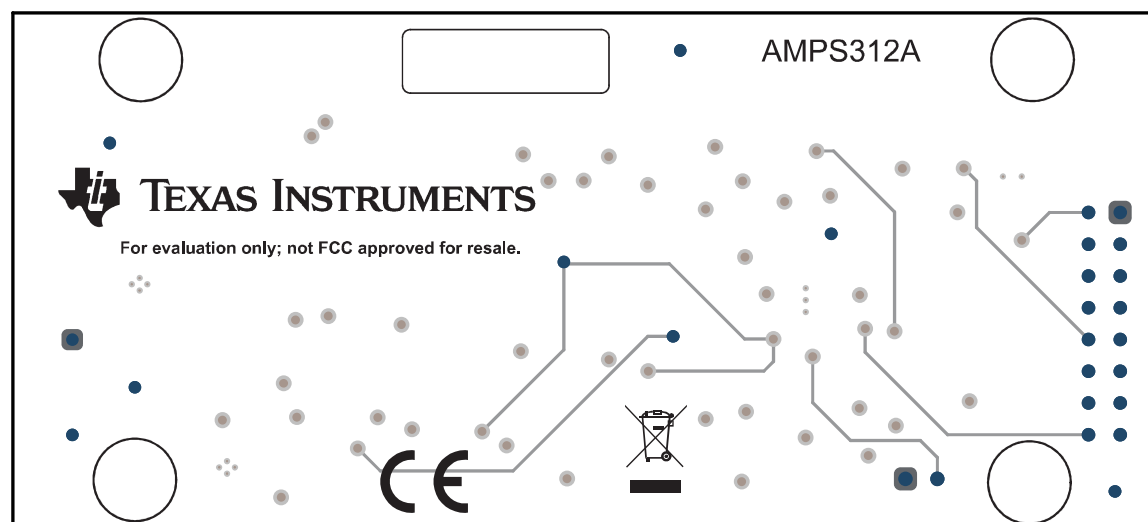


Figure 4-3. Bottom Layer

4.3 Bill of Materials (BOM)

Table 4-1. Bill of Materials

DESIGNATOR	QUANTITY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PARTNUMBER	MANUFACTURER
!PCB1	1		Printed Circuit Board		XTR200_FT	Any
C1	1	0.1uF	CAP, CERM, 0.1uF, 16V, +/- 10%, X7R, 0402	0402	GRM155R71C104KA88D	MuRata
C2, C8	2	1uF	CAP, CERM, 1uF, 16V, +/- 10%, X7R, 0603	0603	8.85012E+11	Wurth Elektronik
C3, C17	2	2.2uF	CAP, CERM, 2.2uF, 16V, +/- 10%, X7R, 0805	0805	GRM21BR71C225KA12L	MuRata
C4, C21	2	10uF	CAP, CERM, 10uF, 35V, +/- 10%, X6S, 1206	1206	C3216X6S1V106K160AC	TDK
C5, C20	2	0.1uF	CAP, CERM, 0.1uF, 100V, +/- 10%, X7R, 0603	0603	GRM188R72A104KA35D	MuRata
C6	1	4.7uF	CAP, CERM, 4.7uF, 50V, +/- 10%, X7R, 1206	1206	GRM31CR71H475KA12L	MuRata
C7	1	100nF	0.1 μ F $\pm$ 10% 50V Ceramic Capacitor X7R 0603 (1608 Metric)	0603	KGF15AR71H104KT	KYOCERA AVX
C9	1	4.7uF	CAP, CERM, 4.7uF, 50V, +/- 10%, X5R, 0805	0805	GRM21BR61H475KE51L	MuRata
C10, C13	2	12nF	0.012 μ F $\pm$ 10% 16V Ceramic Capacitor X7R 0402 (1005 Metric)	0402	CC0402KRX7R7BB123	Yageo
C11	1	1000pF	CAP, CERM, 1000pF, 50V, +/- 10%, X7R, 0805	0805	CC0805KRX7R9BB102	Yageo America
C12, C14	2	10nF	Chip Multilayer Ceramic Capacitors for General Purpose, 0402, 10000pF, X7R, 15%, 5%, 50V	0402	GRM155R71H103JA88D	Murata
C15, C16	2	0.1uF	CAP, CERM, 0.1uF, 10V, +/- 10%, X7R, 0603	0603	8.85012E+11	Wurth Elektronik
C18, C19	2	22uF	CAP, CERM, 22uF, 10V, +/- 20%, X5R, 0805	0805	GRM21BR61A226ME44L	MuRata
D1	1	40V	Diode, Schottky, 40V, 0.35A, SOD-123	SOD-123	SD103AW-7F	Diodes Inc.
D3	1		Orange 605nm LED Indication - Discrete 2V 0603 (1608 Metric)	0603	LTST-C190KFKT	Lite-On
FB1, FB2	2	600ohm	Ferrite Bead, 600ohm @ 100MHz, 0.2A, 0805	0805	742792041	Wurth Elektronik

Table 4-1. Bill of Materials (continued)

DESIGNATOR	QUANTITY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PARTNUMBER	MANUFACTURER
H1, H2, H3, H4	4		Bump, Hemisphere, 0.25X 0.075, Clear	75x250 mil	SJ5382	3M
J1	1		Terminal Block, 3 Position, 3.81mm, Tin, R/A, TH	Terminal Block, 3 Position, 3.81mm, R/A, TH	6.91412E+11	Würth Elektronik
J2	1		Header, 2.54mm, 8x2, Gold, R/A, TH	Header, 2.54mm, 8x2, R/A, TH	61301621021	Würth Elektronik
J3	1		Header, 2.54mm, 2x1, Gold, TH	Header, 2.54mm, 2x1, TH	61300211121	Würth Elektronik
L1	1	22uH	Inductor, Drum Core, Ferrite, 22 uH, 2.2A, 0.1ohm, SMD	Inductor, 8x4x8mm	SRN8040-220M	Bourns
L2	1	33uH	Inductor, Drum Core, Ferrite, 33 uH, 1.7A, 0.145ohm, SMD	Inductor, 8x4x8mm	SRN8040-330M	Bourns
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650x 0.200 inch	THT-14-423-10	Brady
Q1	1	40V	Transistor, NPN, 40V, 0.2A, 3-UFDFN	3-UFDFN	MMBT3904LP	Diodes Inc.
Q3, Q4	2		N-Channel 30V 500mA (Ta) 690mW (Ta) Surface Mount SOT-23-3 (TO-236)	SOT23-3	NTR4003NT3G	On Semiconductor
R1	1	169k	RES, 169k, 1%, 0.1W, AEC-Q200 Grade 0, 0603	0603	CRCW0603169KFKEA	Vishay-Dale
R2	1	184k	RES, 184k, 0.1%, 0.1W, 0603	0603	RT0603BRD07184KL	Yageo America
R3	1	1.00k	RES, 1.00k, 0.1%, 0.063W, 0402	0402	ERA-2AEB102X	Panasonic
R4	1	15.0k	RES, 15.0k, 1%, 0.063W, 0402	0402	RC0402FR-0715KL	Yageo America
R5	1	22.1k	RES, 22.1k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW040222K1FKED	Vishay-Dale
R6	1	5.23k	RES, 5.23k, 0.1%, 0.1W, 0603	0603	RT0603BRD075K23L	Yageo America
R7	1	69.8k	RES, 69.8k, 0.1%, 0.1W, 0603	0603	RT0603BRD0769K8L	Yageo America
R8	1	6.20k	RES, 6.20k, 0.1%, 0.1W, 0603	0603	RG1608P-622B-T5	Susumu Co Ltd

Table 4-1. Bill of Materials (continued)

DESIGNATOR	QUANTITY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PARTNUMBER	MANUFACTURER
R9	1	3.74k	RES, 3.74k, 0.1%, 0.1W, 0603	0603	RT0603BRD073K74L	Yageo America
R10	1	6.19k	RES, 6.19k, 1%, 0.1W, 0603	0603	RC0603FR-076K19L	Yageo
R11	1	8.87k	RES, 8.87k, 0.5%, 0.1W, 0603	0603	RT0603DRE078K87L	Yageo America
R12	1	2.49k	RES, 2.49k, 0.5%, 0.1W, 0603	0603	RT0603DRE072K49L	Yageo America
R13, R18, R20, R21, R22, R24, R29, R30, R37	9	0	0 Ohms Jumper Chip Resistor 0603 (1608 Metric) Metal Element	0603	WSL060300000ZEA9	Vishay
R14, R17	2	100k	RES, 100k, 0.1%, 0.1W, 0603	0603	RG1608P-104B-T5	Susumu Co Ltd
R15	1	3.74k	RES, 3.74k, 0.5%, 0.1W, 0603	0603	RT0603DRE073K74L	Yageo America
R16	1	1.37k	RES, 1.37k, 0.1%, 0.1W, 0603	0603	RT0603BRD071K37L	Yageo America
R19	1	1.00k	RES, 1.00k, 0.5%, 0.1W, 0603	0603	RT0603DRE071KL	Yageo America
R23	1	11.8k	RES, 11.8k, 0.1%, 0.1W, 0603	0603	RT0603BRD0711K8L	Yageo America
SH-J1	1		Shunt, 2.54mm, Gold, Black	Shunt, 2.54mm, Black	60900213421	Wurth Elektronik
TP1, TP2, TP3, TP4, TP5, TP6	6		Test Point, Miniature, White, TH	White Miniature Testpoint	5002	Keystone Electronics
U1	1		Nanopower-IQ 200nA 200mA low-dropout (LDO) voltage regulator with fast transient response	SOT-23-5	TPS7A0333DBVR	Texas Instruments
U2, U5	2		Buck Converter, Adjustable, 4V-36V Input, 1-28V 1A Output, SOT23-6	SOT23-6	LMR54406DBVR	Texas Instruments
U3	1		Dual, 40V, 1MHz, low-power operational amplifier 8-SOT-23-THIN -40 to 125	SOT-23	TLV9302IDDFR	Texas Instruments
U4	1		50V, universal 4-20mA, $\pm$ 20mA current loop protector 8-SOT-23-THIN -40 to 125	TSOT23-8	TPS26611DDFR	Texas Instruments

Table 4-1. Bill of Materials (continued)

DESIGNATOR	QUANTITY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PARTNUMBER	MANUFACTURER
U6	1		40V, 1MHz, RRO Operational Amplifiers for Cost-Sensitive Systems	SC70-5	TLV9301IDCKR	Texas Instruments
U7	1		40V, dual-channel, 4.5MHz, rail-to-rail input/output, low-offset-voltage, low-noise op amp 8-VSSOP -40 to 125	VSSOP8	OPA2991IDGKR	Texas Instruments
U8	1		XTR200IDQCR	WSO10	XTR200IDQCR	Texas Instruments
U9, U14	2		33V Bidirectional Flat-Clamp Surge Protection Device, DRB0008A (VSON-8)	DRB0008A	TVS3301DRBR	Texas Instruments
U10	1		1.65V to 5.5V 8-bit parallel-load shift register with voltage translation	WQFN16	SN74LV8T165BQBR	Texas Instruments
U11	1		Single Inverter, DRL0005A, LARGE T&R	DRL0005A	SN74LVC1G04DRLR	Texas Instruments
U12	1		150mA, 30V, Ultra-Low IQ, Wide Input Low-Dropout Regulator with Reverse Current Protection, DBV0005A (SOT-23-5)	DBV0005A	TPS70950DBVR	Texas Instruments
R26	0	0	0 Ohms Jumper Chip Resistor 0603 (1608 Metric) Metal Element	0603	WSL060300000ZEA9	Vishay

5 Related Documentation

5.1 Supplemental Content

- [TIDA-011026 Field transmitter platform: Three-wire 4mA to 20mA interface reference design](#)
- [SNSR-DUAL-ADC-EVM evaluation module](#)
- [XTR200 Precision 3-wire current and voltage transmitter](#)

6 Additional Information

6.1 Trademarks

All trademarks are the property of their respective owners.

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/sds/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 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/sds/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, 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.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2023, Texas Instruments Incorporated

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you fully indemnify TI and its representatives against any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#), [TI's General Quality Guidelines](#), or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products. Unless TI explicitly designates a product as custom or customer-specified, TI products are standard, catalog, general purpose devices.

TI objects to and rejects any additional or different terms you may propose.

Copyright © 2026, Texas Instruments Incorporated

Last updated 10/2025