EVM User's Guide: TPS25983EVM TPS25983
Evaluation Module for TPS25983 eFuse

TEXAS INSTRUMENTS

Description

The TPS25983EVM eFuse Evaluation Board allows reference circuit evaluation of TI's TPS25983 eFuse. The TPS25983 device is 2.7 V to 26 V, 18 A eFuse with integrated 2.7 mOhm FET, programmable undervoltage, overvoltage,overcurrent, inrush current protection, and configurable number of autoretries and retry delay features.

Features

- 2.7-V to 26-V (typ) operation
- 2 A to 20 A programmable current limit using onboard jumpers
- Programmable output voltage slew rate control
- Configurable number of auto-retries and retry-delay features

- Programmable current limit timer
- TVS diode for input transient protection
- On-board Schottky diode at output prevents negative spike during overcurrent faults
- LED status indication for Power Good output

Applications

- Hot-Swap, Hot-Plug
- Server standby rails
- Optical Modules
- PCIe, SSDs and HDDs
- Routers and Switches
- Industrial PC
- Digital TV
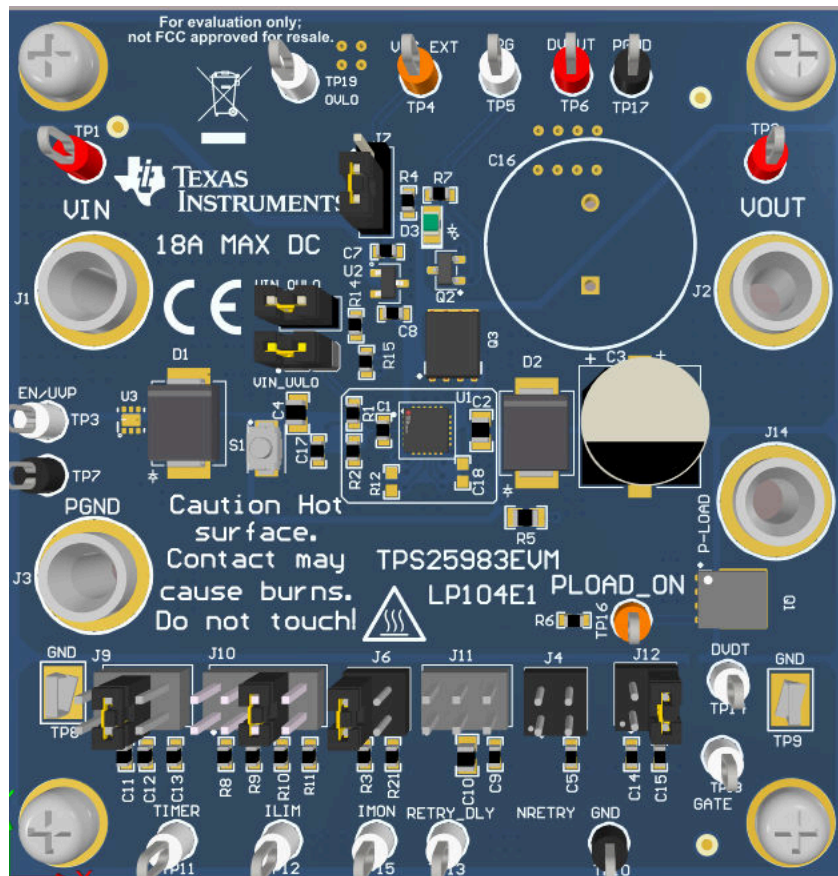
1 Evaluation Module Overview

1.1 Introduction

The TPS25983EVM eFuse Evaluation Board enables evaluation of TPS259830L eFuse from TPS25983 family. The input power is applied between connectors J1 and J3 while J2 and J3 provides the output connection to the load; refer to the schematic in Figure 3-1, and EVM test setup in Figure 2-1. D1/C1 provides input protection for the TPS259830L eFuse while D2/C2 provides output protection.

S1 allows U1 to be RESET or disabled. A power good (PG) indicator is provided by D3. Scaled device current can be monitored at TP15.

Table 1-1. TPS25983EVM eFuse Evaluation Board Options and Setting

Part Number	EVM Function	Vin Range	Vin UVLO	OV Cut-off	Current Limit		Fault Response
					Low Setting	Hi Setting	
TPS25983EVM eFuse Evaluation Board	2.7 V to 26 V, 18 A eFuse	2.7 V to 26 V	10.87 V	13.79 V	2 A	20 A	Configurable number of auto-retries and retry-delay

1.2 Kit Contents

Item	Description	Quantity
TPS25983EVM	PCB	1
Box	Cardboard BOX	1
Foam	Antistatic Foam	2
Label	Standard Label	1
Literature	EVM Disclaimer Read Me	1

1.3 Specification

The TPS25983EVM eFuse Evaluation Board enables evaluation of TPS25983 eFuse from TPS25983 family.

- 2.7-V to 26-V (typ) operation
- 2 A to 20 A programmable current limit using onboard jumpers
- Programmable output voltage slew rate control
- Configurable number of auto-retries and retry-delay features
- Programmable current limit timer
- TVS diode for input transient protection
- On-board Schottky diode at output prevents negative spike during overcurrent faults
- LED status indication for Power Good output

1.4 Device Information

TPS259830L device is used on the EVM and is a current limit variant. This device has a dVdT pin that can drive external FET, which helps in reverse current blocking when the device is off. TPS25983 eFuse is a highly integrated circuit protection and power management device in a small package. The device is operational over a wide input voltage range. The device is a robust defense against overloads, short-circuits, voltage surges, reverse current and excessive inrush current.

2 Hardware

2.1 Test Points and Connectors

Table 2-1 lists the TPS25983EVM eFuse Evaluation Board input and output connector functionality. Table 2-2 and Table 2-3 describe the test point availability and the jumper functionality. Table 2-4 describes the auto-retries and retry-delay settings.

Table 2-1. Input and Output Connector Functionality

Connector	Label	Description
J1	VIN	Power input connector to the positive rail of the input power supply.
J3	PGND	Ground connection for the power supply.
J2	VOUT	Power output connector to the positive side of the load.
J14	P-LOAD	Placeholder for connecting load such as power resistor between J2 and J14.

Table 2-2. Test Points Description

Test Points	Label	Description
TP1	VIN	Input power supply to the EVM
TP2	VOUT	Output from the EVM (Drain of Q3)
TP3	EN/UVP	Active high enable and undervoltage input
TP4	VCC_EXT	External power supply input for Power good pullup
TP5	PG	Power good test point
TP6	DVOUT	Output from the TPS25983 (Source of Q3)
TP7	PGND	System ground
TP8	GND	GND(IC GND)
TP9	GND	GND(IC GND)
TP10	GND	GND(IC GND)
TP11	ITIMER	Fault timer voltage
TP12	ILIM	Sets current limit threshold
TP13	RETRY_DLY	Sets retry delay time
TP14	DVDT	Output voltage ramp control
TP15	IMON	Load current monitor
TP16	LOAD_ON	Gate control for series MOSFET + Power load
TP17	PGND	System ground
TP18	GATE	Gate of external blocking FET Q3
TP19	OVLO	Overvoltage lockout pin

Table 2-3. Jumper and LED Descriptions

Jumper	Label	Description
J4	NRETRY	NRETRY setting number of auto-retries. Please refer Table 5 for details. 1-2 Position shorts to ground 3-4 Position sets 68 nF
J6	IMON	Current scale setting 1-2 Position sets 0.13 V/A 3-4 Position sets 0.25 V/A
J7	PG Pull-Up	PG Pull-Up voltage setting 1-2 Position sets external source "VCC_EXT" 3-4 Position sets 3.3 V
J8	VIN_UVLO	1-2 position connects UVLO pin to VIN resistor ladder.
J9	ITIMER	ITIMER setting (sets delay before entering into current limit) OPEN sets '0'sec delay 1-2 Position sets 200 µs delay 3-4 Position sets 2 ms delay 5-6 Position sets 20 ms delay

Table 2-3. Jumper and LED Descriptions (continued)

Jumper	Label	Description
J10	ILIM	Current limit setting 1-2 Position sets 2 A 3-4 Position sets 5 A 5-6 Position sets 18 A 7-8 Position sets 20 A
J11	RETRY_DLY	Retry delay setting OPEN sets 200 µs 1-2 Position sets "NO auto-retry" (latches OFF the device) 3-4 Position sets 1 s retry delay 5-6 Position sets 50 ms retry delay
J12	DVDT	Output voltage slew rate setting 1-2 Position sets 1.5 V/ms 3-4 Position sets 0.5 V/ms
J13	VIN_OVLO	1-2 position connects OVLO pin to VIN resistor ladder
D3 (GREEN – LED)	D3	Power good indicator. LED turns on when the internal FET fully turns ON

Table 2-4. Auto-retries and Retry Delay Settings

RETRY_DLY (J11 Position)	Retry Delay	NRETRY (J4 Position)	Number of Auto-Retries
OPEN	200 µs	OPEN	4
		1-2	Infinite
		2-3	16
1-2 Position	Latches OFF	X	0
3-4 Position	1 s	OPEN	4
		1-2	Infinite
		2-3	16
5-6 Position	50 ms	OPEN	4
		1-2	Infinite
		2-3	64

2.2 Test Equipment and Set Up

2.2.1 Power Supplies

One adjustable power supply 0 V to 30 V output, 0 A to 30 A output current limit.

2.2.2 Meters

One DMM minimum needed.

2.2.3 Oscilloscope

A DPO2024 or equivalent, three 10x voltage probes, and a DC current probe.

2.2.4 Loads

One resistive load or equivalent which can tolerate up to 30 A DC load @ 24 V and capable of the output short.
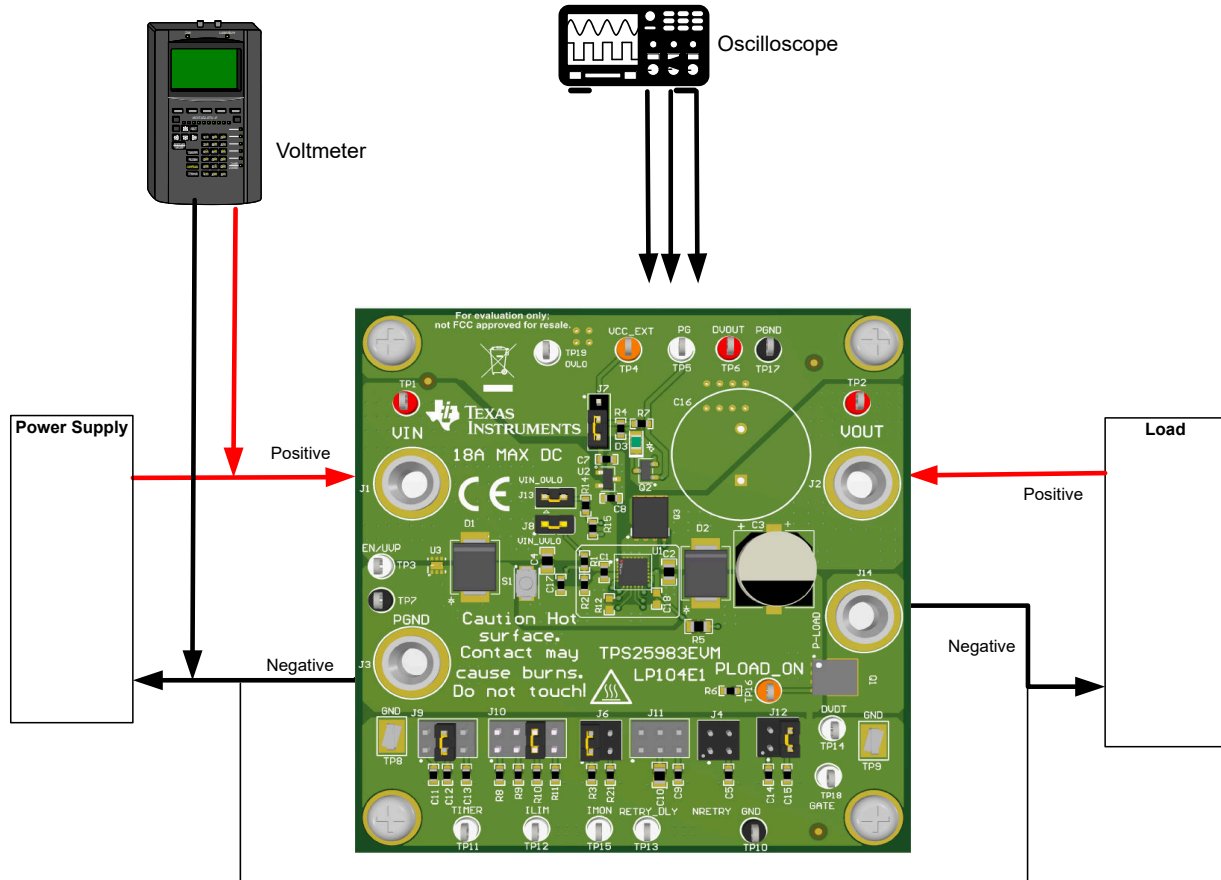
2.3 Test Setup and Procedures

In this user guide, the test procedure is described for TPS25983 device.

Make sure the evaluation board has default jumper settings as shown in Table 2-5.

Table 2-5. Default Jumper Setting for TPS25983EVM eFuse Evaluation Board

J4	J6	J7	J8	J9	J10	J11	J12	J13
Open	1-2	2-3	Install	3-4	5-6	Open	1-2	Install

Figure 2-1. TPS25983EVM Setup with Test Equipment

Follow the below instructions before starting any test and repeat again before moving to next test.

- Set the power supply output (VIN) to zero volts.
- Turn ON the power supply and set the power supply output (VIN) to 12 V, current limit = 20 A.
- Turn OFF the power supply.
- Set the jumper setting on EVM to default position as shown in Table 2-5.

2.3.1 Hot-Plug Test

Use the following instructions to measure the inrush current during Hot-Plug event.

1. For checking inrush current control capability, insert additional capacitance of 1800 uF at C16 terminals. Total output capacitance = 1800 uF + 220 uF approx. 2 mF.
2. Set Jumper J12 in 3-4 position to set Cdvdt at 10 nF for o/p slew rate of 0.5 V/ms.
3. Set the input supply voltage VIN to 12 V and current limit of 5 A. Enable the power supply.
4. Hot-plug the supply between input connectors J1 and J3.
5. Observe the waveform at VOUT (TP2) with an oscilloscope to measure the slew rate and rise time of the eFuse with a given input voltage of 12 V.

Figure 2-2 shows an example of inrush current captured on the TPS25983EVM eFuse Evaluation Board.
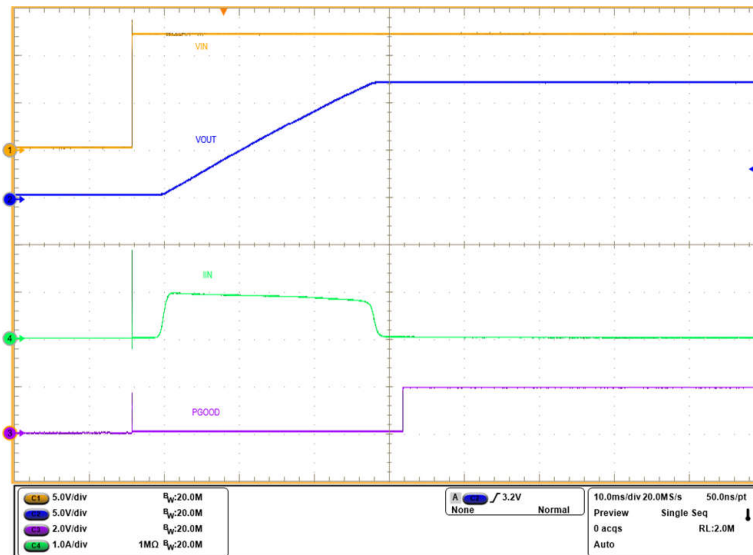
Figure 2-2. TPS25983 Output Rise Profile (VIN = 12 V, CdVdT = 10 nF, COUT = 2 mF, No-load)

2.3.2 Current Limit Test

Use the following instructions to perform current limit test.

1. Place jumper J9 in 3-4 Position to set 2 ms for ITIMER.
2. Set the input supply voltage VIN to 12 V and current limit of 25 A and enable the power supply.
3. Place jumper J10 in 7-8 Position to set 18 A current limit.
4. Set the electronic load to 17 A and connect between VOUT and GND. Enable the electronic load.
5. Now apply overload of 7 A (using resistive load of 1.66 Ohm) between VOUT and GND.
6. The device allows the overload current for the programmed ITIMER period for example, 2 ms and then switches OFF.
7. Place jumper J10 at other settings to test at various current limits.

Figure 2-3 shows an example of current limit at 18 A on the TPS25983EVM eFuse Evaluation Board.
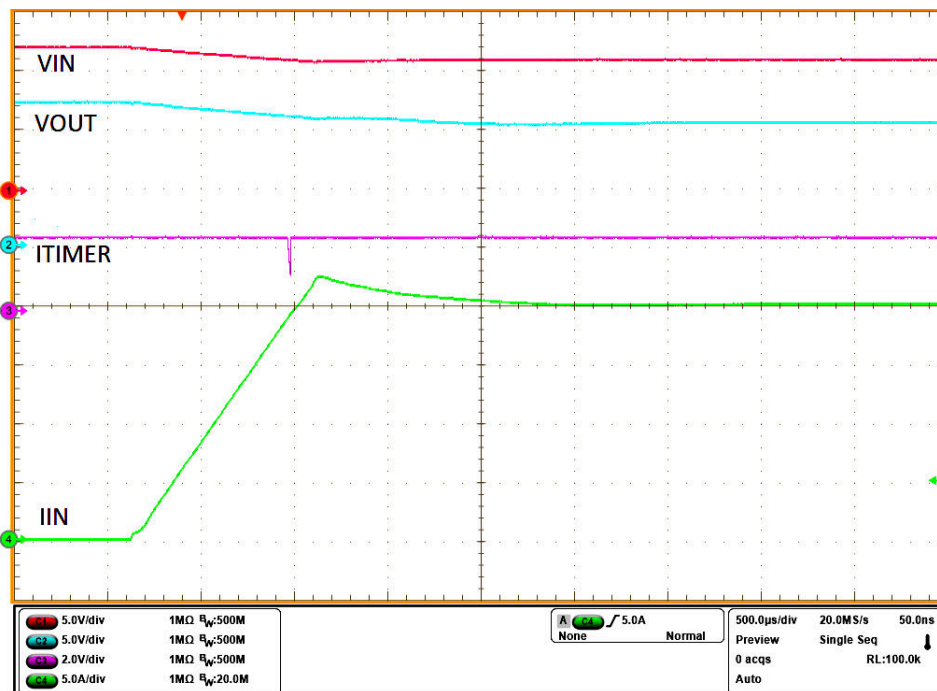
Figure 2-3. Over Current Response of TPS25983 for 18 A Current Limit Setting

2.3.3 Output Hot-Short Test

Use the following instructions to perform output Hot-Short test.

1. Set the input supply voltage VIN to 12 V and current limit of 15 A. Turn ON the power supply.
2. Short the output of the device for example, VOUT to GND with a shorter cable.
3. Observe the waveforms using an oscilloscope.

Figure 2-4 shows test waveform of output hot-short on the TPS25983EVM eFuse Evaluation Board.
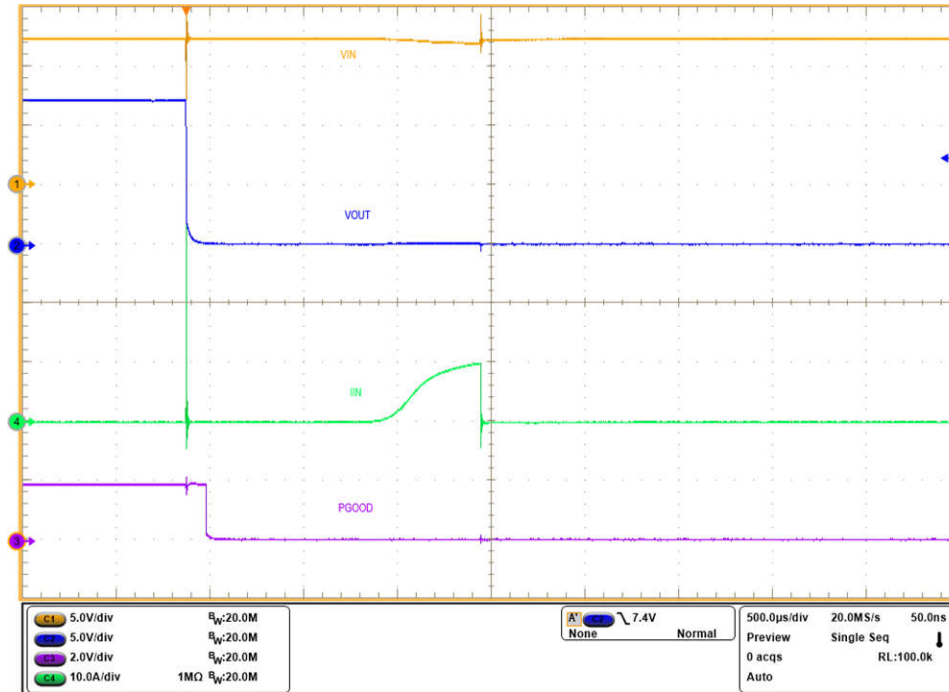

Figure 2-4. Output Hot-Short Response of TPS25983 Device

2.3.4 Wakeup into Short Test

Use the following instructions to perform wakeup into short test.

1. Set the input supply voltage VIN to 12 V and current limit of 10 A. Turn OFF the power supply.
2. Short the output of the device for example, VOUT to GND with a shorter cable.
3. Turn ON the power supply.

Figure 2-5 shows test waveform of wakeup into output short on the TPS25983EVM eFuse Evaluation Board.
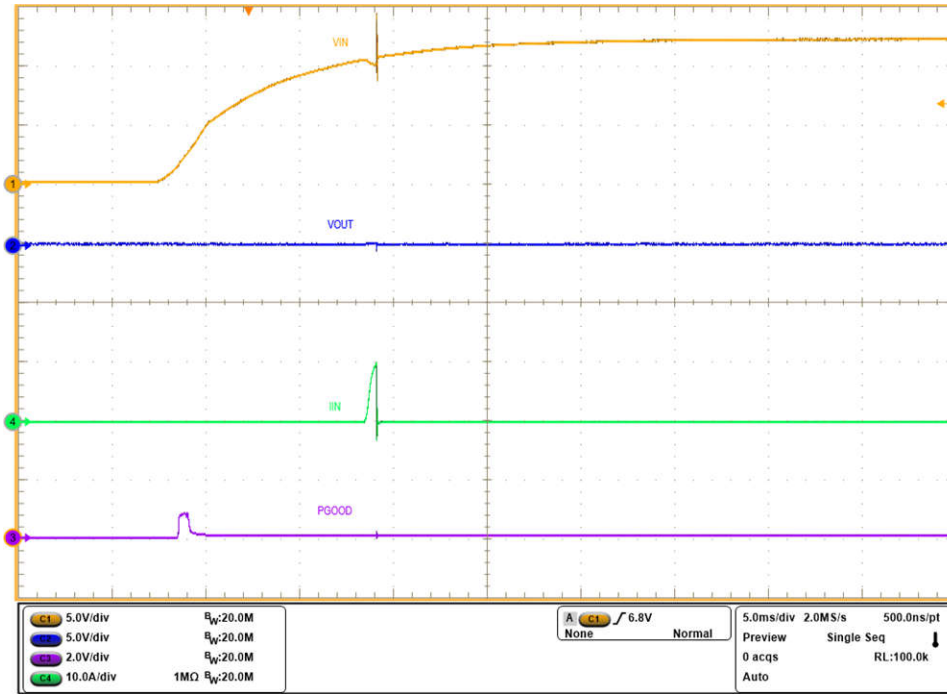

Figure 2-5. Test Waveform of Wakeup Into Output Short for TPS25983 Device

2.3.5 Overvoltage Cut-off Test

Use the following instructions to perform overvoltage protection test.

1. Remove input TVS diodes.
2. Set the input supply voltage VIN to 12 V and current limit of 5 A. Apply the supply between input connectors J1 and J3 and enable the power supply.
3. Set the load resistance to 24 Ω and connect between VOUT and GND.
4. Increase the input supply VIN from 12 V to 18 V and observe the waveforms using an oscilloscope.

Figure 2-6 shows over voltage response of TPS25983 on TPS25983EVM eFuse Evaluation Board.
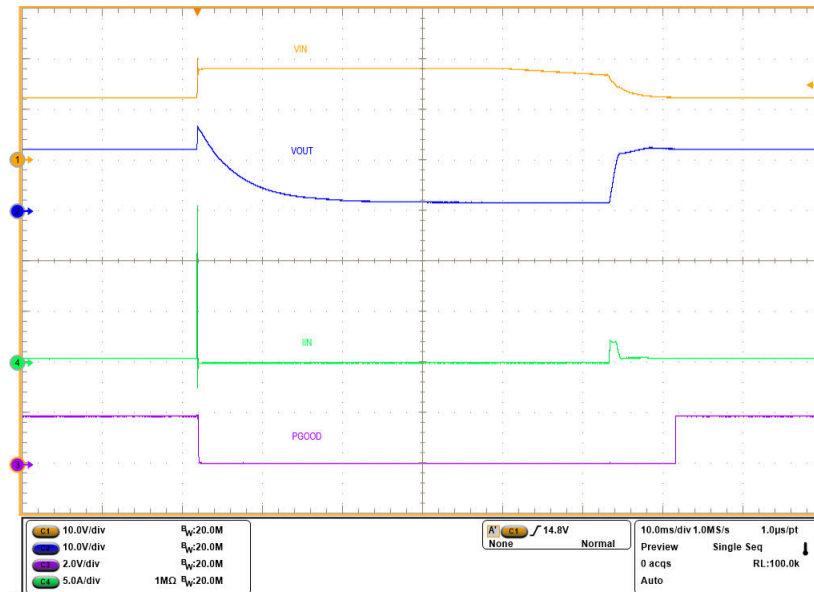
Figure 2-6. Over Voltage Protection Response of TPS25983 Device

3 Hardware Design Files

3.1 Schematic

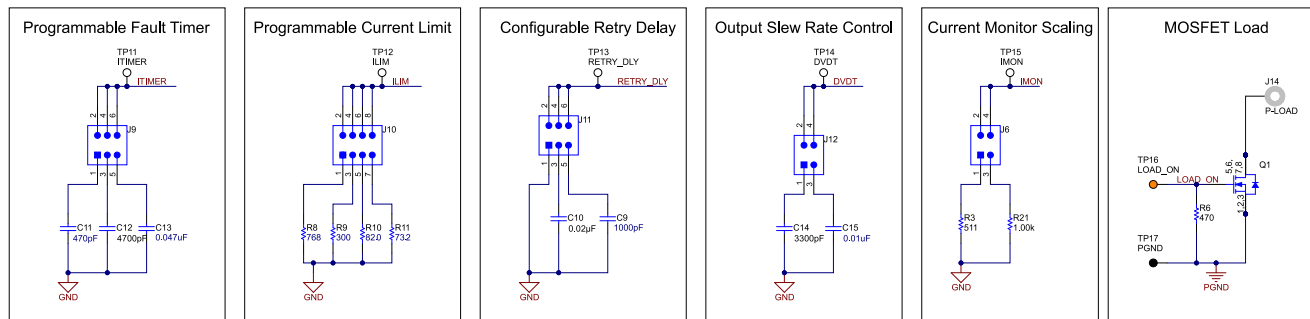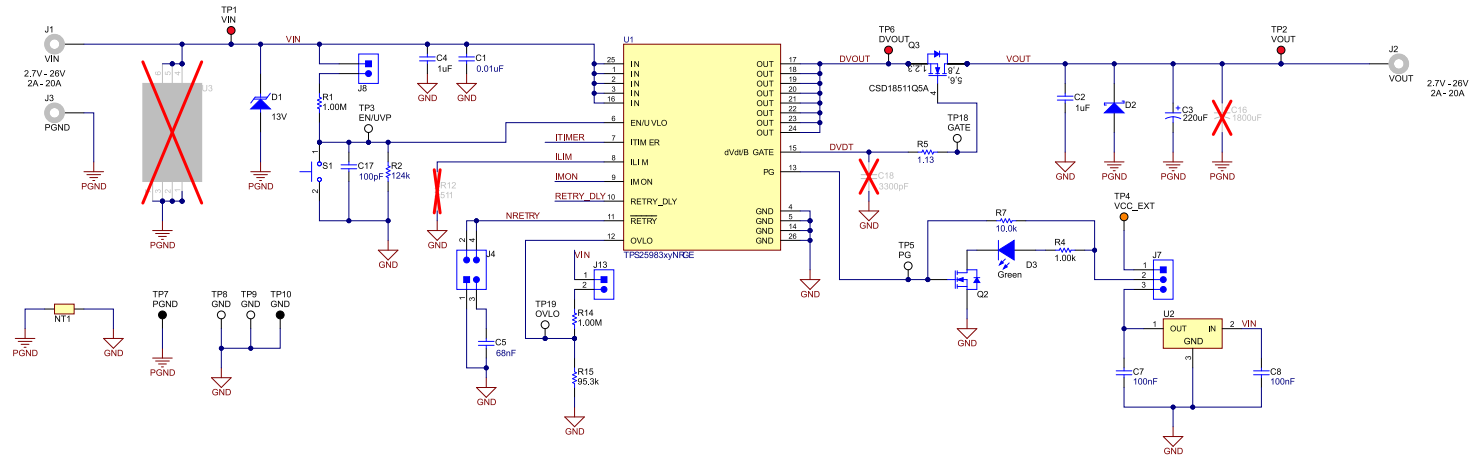Figure 3-1 illustrates the EVM schematic.

Figure 3-1. TPS25983EVM eFuse Evaluation Board Schematic

3.2 PCB Layouts

Figure 3-2 shows component placement of the EVAL Board and Figure 3-3 shows PCB layout images.
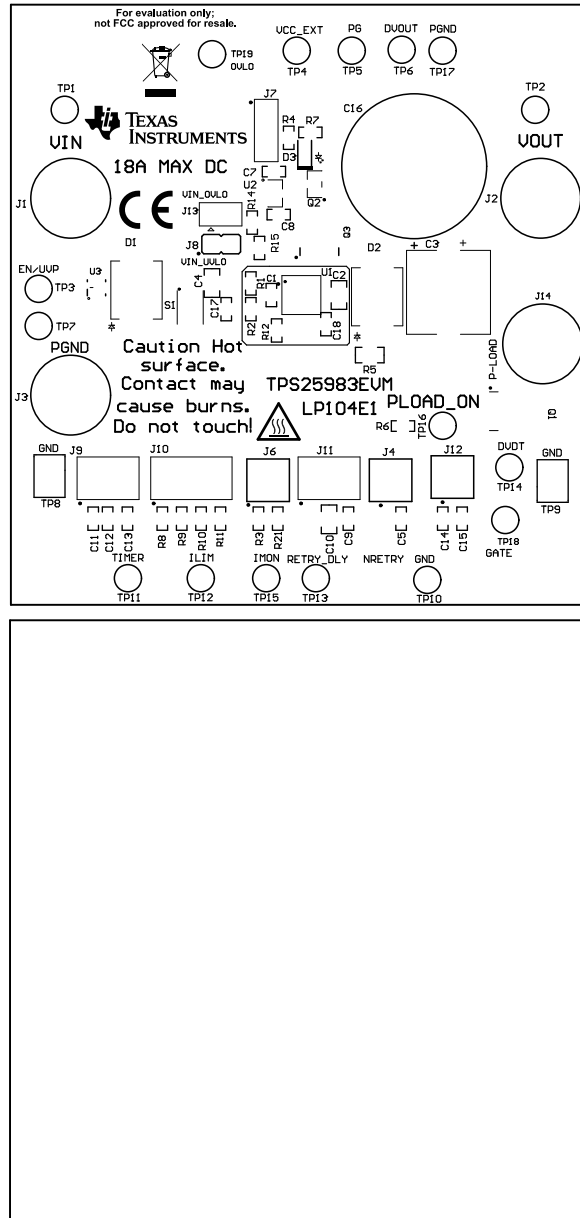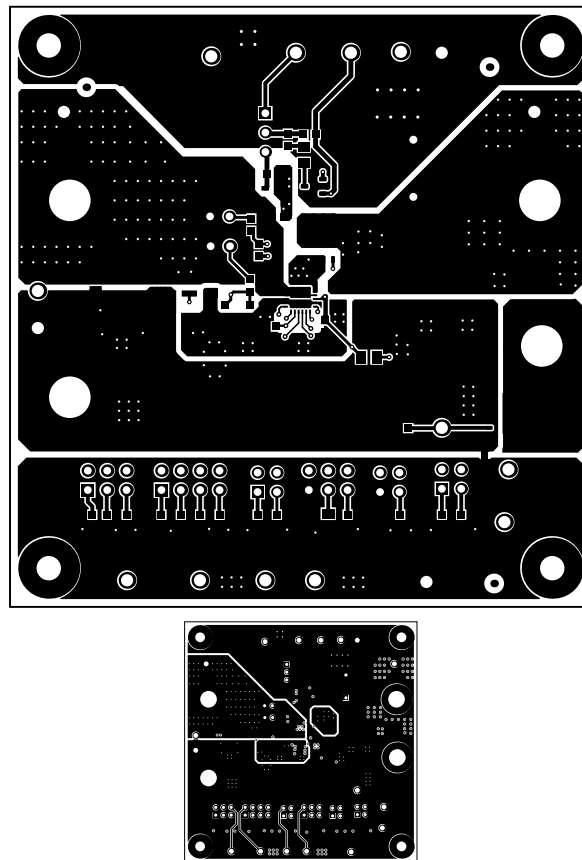

Figure 3-2. TPS25983EVM Board (a) Top Assembly (b) Bottom Assembly

Figure 3-3. TPS25983EVM Board (a) Top Layer (b) Bottom Layer

3.3 Bill Of Materials (BOM)

Table 3-1 lists the EVM BOM.

Table 3-1. TPS25983EVM Bill of Materials

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
!PCB1	1		Printed Circuit Board		LP104	Any		
C1	1	0.01uF	CAP, CERM, 0.01 uF, 50 V, +/- 5%, X7R, 0603	603	C0603C103J5RACTU	Kemet		
C2, C4	2	1uF	CAP, CERM, 1 uF, 35 V, +/- 10%, X7R, 0805	805	GMK212B7105KG-T	Taiyo Yuden		
C3	1	220uF	CAP, AL, 220 uF, 35 V, +/- 20%, 0.15 ohm, SMD	SMT Radial G	EEE-FC1V221P	Panasonic		
C5	1	0.068uF	CAP, CERM, 0.068 µF, 25 V,+/- 10%, X7R, 0603	603	8.85012E+11	Wurth Elektronik		
C7, C8	2	0.1uF	CAP, CERM, 0.1 uF, 50 V, +/- 10%, X7R, 0603	603	06035C104KAT2A	AVX		
C9	1	1000 pF	CAP, CERM, 1000 pF, 25 V, +/- 10%, C0G/NP0, 0603	603	C0603C102K3GACTU	Kemet		
C10	1	0.02uF	CAP, CERM, 0.02 µF, 50 V,+/- 5%, C0G/NP0, 0805	805	GRM21B5C1H203JA01L	MuRata		
C11	1	470 pF	CAP, CERM, 470 pF, 50 V, +/- 5%, C0G/NP0, 0603	603	06035A471JAT2A	AVX		
C12	1	4700 pF	CAP, CERM, 4700 pF, 50 V, +/- 5%, X7R, 0603	603	C0603C472J5RACTU	Kemet		
C13	1	0.047uF	CAP, CERM, 0.047 uF, 100 V, +/- 10%, X7S, 0603	603	C1608X7S2A473K080AB	TDK		
C14	1	3300 pF	CAP, CERM, 3300 pF, 50 V, +/- 10%, X7R, 0603	603	C0603X332K5RACTU	Kemet		
C15	1	0.01uF	CAP, CERM, 0.01 uF, 50 V, +/- 5%, C0G/NP0, 0603	603	GRM1885C1H103JA01D	MuRata		
C17	1	100 pF	CAP, CERM, 100 pF, 50 V, +/- 5%, C0G/NP0, 0603	603	8.85012E+11	Wurth Elektronik		
D1	1	13 V	Diode, TVS, Uni, 13 V, 21.5 Vc, 1500 W, 73 A, SMC	SMC	SMCJ13A-TR	STMicroelectronics		
D2	1	30 V	Diode, Schottky, 30 V, 5 A, SMC	SMC	B530C-13-F	Diodes Inc.		
D3	1	Green	LED, Green, SMD	LED_0805	LTST-C170KGKT	Lite-On		
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply		
H5, H6, H7, H8	4			Standoff	1902C	Keystone		

Table 3-1. TPS25983EVM Bill of Materials (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
J1, J2, J3, J14	4		Standard Banana Jack, Uninsulated, 8.9mm	Keystone575-8	575-8	Keystone		
J4, J6, J12	3		Header, 100mil, 2x2, Tin, TH	Header, 2x2, 2.54mm, TH	PEC02DAAN	Sullins Connector Solutions		
J7	1		Header, 100mil, 3x1, Tin, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions		
J8	1		Header, 100mil, 2x1, Gold, TH	Sullins 100mil, 1x2, 230 mil above insulator	PBC02SAAN	Sullins Connector Solutions		
J9, J11	2		Header, 100mil, 3x2, Tin, TH	3x2 Header	PEC03DAAN	Sullins Connector Solutions		
J10	1		Header, 100mil, 4x2, Tin, TH	Header, 4x2, 100mil, Tin	PEC04DAAN	Sullins Connector Solutions		
J13	1		Header, 100mil, 2x1, Tin, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions		
Q1	1	30 V	MOSFET, N-CH, 30 V, 100 A, DNK0008A (VSON-CLIP-8)	DNK0008A	CSD17573Q5B	Texas Instruments		
Q2	1	60 V	MOSFET, N-CH, 60 V, 115 A, SOT-23	SOT-23	2N7002	Fairchild Semiconductor		
Q3	1	40 V	MOSFET, N-CH, 40 V, 100 A, DQJ0008A (VSONP-8)	DQJ0008A	CSD18511Q5A	Texas Instruments		None
R1, R14	2	1.00Meg	RES, 1.00 M, 1%, 0.1 W, 0603	603	RC0603FR-071ML	Yageo America		
R2	1	124k	RES, 124 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	603	CRCW0603124KFKEA	Vishay-Dale		
R3	1	511	RES, 511, 1%, 0.1 W, 0603	603	RC0603FR-07511RL	Yageo America		
R4, R21	2	1.00k	RES, 1.00 k, 1%, 0.1 W, 0603	603	RC0603FR-071KL	Yageo America		
R5	1	1.13	RES, 1.13, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	805	CRCW08051R13FKEA	Vishay-Dale		
R6	1	470	RES, 470, 1%, 0.1 W, 0603	603	RC0603FR-07470RL	Yageo America		
R7	1	10.0k	RES, 10.0 k, 0.1%, 0.1 W, 0603	603	RG1608P-103-B-T5	Susumu Co Ltd		
R8	1	768	RES, 768, 1%, 0.1 W, 0603	603	RC0603FR-07768RL	Yageo		
R9	1	300	RES, 300, 1%, 0.1 W, 0603	603	RC0603FR-07300RL	Yageo		
R10	1	82	RES, 82.0, 1%, 0.1 W, 0603	603	RC0603FR-0782RL	Yageo		
R11	1	73.2	RES, 73.2, 1%, 0.1 W, 0603	603	RC0603FR-0773R2L	Yageo		
R15	1	95.3k	RES, 95.3 k, 1%, 0.1 W, 0603	603	RC0603FR-0795K3L	Yageo		

Table 3-1. TPS25983EVM Bill of Materials (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
S1	1		Switch, SPST-NO, 0.05 A, 12 VDC, SMT	3.9x2.9mm	SKRKAEE020	Alps		
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7	7	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec	969102-0000-DA	3M
TP1, TP2, TP6	3		Test Point, Multipurpose, Red, TH	Red Multipurpose Testpoint	5010	Keystone		
TP3, TP5, TP11, TP12, TP13, TP14, TP15, TP18, TP19	9		Test Point, Multipurpose, White, TH	White Multipurpose Testpoint	5012	Keystone		
TP4, TP16	2		Test Point, Multipurpose, Orange, TH	Orange Multipurpose Testpoint	5013	Keystone		
TP7, TP10, TP17	3		Test Point, Multipurpose, Black, TH	Black Multipurpose Testpoint	5011	Keystone		
TP8, TP9	2		Test Point, Compact, SMT	Testpoint_Keystone_Compact	5016	Keystone		
U1	1		TPS25983	VQFN24	TPS25983xyNRGE	Texas Instruments		
U2	1		100 mA, Quasi Low-Dropout Linear Voltage Regulator, 3-pin SOT-23, Pb-Free	DBZ0003A	LM3480IM3-3.3/NOPB	Texas Instruments		
C16	0	1800uF	CAP, AL, 1800 uF, 35 V, +/- 20%, 0.028 ohm, TH	D18xL20mm	UPW1V182MHD6	Nichicon		
C18	0	3300 pF	CAP, CERM, 3300 pF, 50 V, +/- 10%, X7R, 0603	603	C0603X332K5RACTU	Kemet		
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A		
R12	0	511	RES, 511, 0.1%, 0.1 W, 0603	603	RT0603BRD07511RL	Yageo America		
U3	0		22-V Precision Surge Protection Clamp, DRV0006A (WSON-6)	DRV0006A	TVS2200DRVR	Texas Instruments		Texas Instruments

4 Additional Information

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All trademarks are the property of their respective owners.

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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.

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    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 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