TPS2596EVM: Evaluation Module for TPS2596xx

This user's guide describes the evaluation module (EVM) for the TPS2596xx. The TPS2596xx is an eFuse with precision current limit, 2.7-V to 19-V supply voltage operation, programmable undervoltage, overvoltage, overcurrent and inrush current protection features.

Contents

List of Figures

List of Tables

1 Introduction

The TPS2596EVM allows reference circuit evaluation of TI's TPS2596xx devices. The TPS2596xx devices are available with both latching and auto-retry operation. For the TPS25962x variants, in case of an input overvoltage condition, internal clamping circuits limit the output to a safe fixed maximum voltage which is pin selectable. The TPS25963x variants provide an option to set a user-defined overvoltage cutoff threshold.

1.1 EVM Features

- General TPS2596EVM features include:
  - 2.7-V to 19.0-V (TYP) operation. Programmable undervoltage lockout.
    - CH1 Rising input voltage turn-on threshold – 3.85-V (TYP) if J5 installed, 2.53 V if J5 not installed
    - CH1 Falling Input voltage turn-off threshold (UVLO) – 3.53-V (TYP) if J5 installed, 2.42 V if J5 not installed
    - CH2 Rising Input voltage turn-on threshold – 3.85-V (TYP) if J7 installed, 2.53 V if J5 not installed
    - CH2 Falling Input voltage turn-off threshold (UVLO) – 3.53-V (TYP) if J7 installed, 2.42 V if J5 not installed
  - 0.125-A to 2-A programmable current limit
  - Selectable overvoltage clamp for TPS259621 and programmable overvoltage lockout for TPS259630
  - Programmable VOUT slew rate
  - Auto-Retry TPS259621
  - Latch-Off TPS259630
- Push button RESET signal
- Onboard 15-V TVS for input transient protection. The TVS needs to be removed if TPS2596EVM is intended to operate at input voltages greater than 15 V.
- Schottky diode at output prevents a negative spike when the load is removed

1.2 EVM Applications

- Energy meters
- Refrigerators
- Dishwashers
- Building automation
- White goods and appliances
- Adapter input protection

2 Description

The TPS2596EVM enables full evaluation of the TPS2596xx devices. The EVM supports two versions (Auto-Retry and Latch-Off) of the devices on two Channels (CH1 and CH2, respectively). Input power is applied at J1 (CH1) and J9 (CH2) while J2 (CH1) and J10 (CH2) provide the output connection to the load. Refer to the schematic in Figure 1, and EVM test setup in Figure 2. The TPS2596EVM supports evaluation of single layer and two layer PCB designs on CH1 and CH2 respectively. Refer to the TPS2596EVM layout in Figure 8 and Figure 9.

D2/C6 (CH1), D6/C14 (CH2) provide input protection for the TPS259621 and TPS259630 (U1 and U2, respectively) while D4/C1-C3 (CH1), D7/C10-C12 (CH2) provide output protection and inrush current demand from the load. S1 and S2 allow U1 and U2, respectively to be RESET or disabled. A fault (FLTb) indicator is provided by D3, D5 for CH1 and CH2, respectively. The EN/UVLO pin is recommended to operate below 6 V. To ensure that the EN/UVLO pin voltage is always less than 6 V, J5 and J7 need to be installed for CH1 and CH2 respectively for input voltages greater than 10 V.

Table 1. TPS2596EVM Options and Jumper Settings

Channel	Part Number	Jumper	Label	Jumper Position	Setting
CH1	TPS259621	J5	EN/UVLO	J5 Installed (for VIN1 > 10 V)	Device enables for Vin > 3.85 V
				J5 not Installed	Device enables for Vin > 2.53 V
		J3	OVCSEL	1-2	V_{CLAMP} set to 13.58 V
				3-4	V_{CLAMP} set to 5.45 V
				5-6	V_{CLAMP} set to 3.59 V
		J6	DVDT	1-2	Output slew rate set to 4.2 mV/us
				3-4	Output slew rate set to 1.91 mV/us
				5-6	Output slew rate set to 0.9 mV/us
		J4	ILIM	1-2	I_{LIM} set to 2 A
				3-4	I_{LIM} set to 1 A
				5-6	I_{LIM} set to 0.13 A
CH2	TPS259630	J7	EN/UVLO	J7 Installed (for VIN2 > 10 V)	Device enables for Vin > 3.85 V
				J7 not Installed	Device enables for Vin > 2.53 V
		J12	OVLO	1-2	V_{OVLO} set to 13.7 V
				3-4	V_{OVLO} set to 5.7 V
				5-6	V_{OVLO} set to 3.8 V
		J8	DVDT	1-2	Output slew rate set to 4.2 mV/µs
				3-4	Output slew rate set to 1.91 mV/µs
				5-6	Output slew rate set to 0.9 mV/µs
		J11	ILIM	1-2	I_{LIM} set to 2 A
				3-4	I_{LIM} set to 1 A
				5-6	I_{LIM} set to 0.13 A

3 Schematics

Figure 1 illustrates the schematic for this EVM.

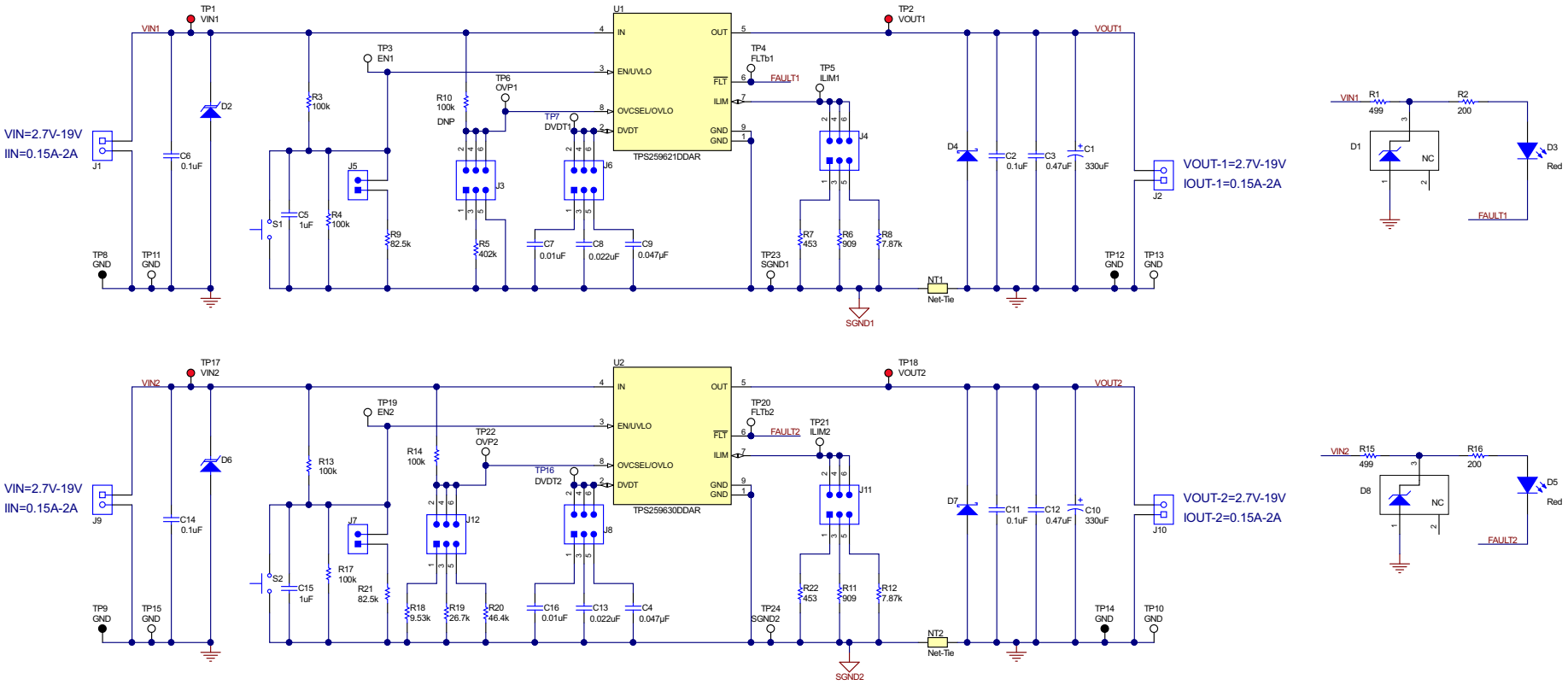

Figure 1. TPS2596EVM Schematic

4 General Configurations

This section describes the physical access, test equipment and set up, and the test setup and procedures for this EVM.

4.1 Physical Access

Table 2 lists the TPS2596EVM input and output connector functionality.

Table 2. Input and Output Connector Functionality

Connector		Label	Description
J1	CH1	VIN1(+), GND(–)	CH1 Input power supply to the EVM
J2		VOUT1(+),GND(–)	CH1 Output power from the EVM
J9	CH2	VIN2(+), GND(–)	CH2 Input power supply to the EVM
J10		VOUT2(+),GND(–)	CH2 Output power from the EVM

Table 3 describes the test point availability.

Table 3. Test Points Description

Channel	Test Points	Label	Description
CH1	TP1	VIN1	CH1 Input power supply to the EVM
	TP3	EN1	CH1 Active high enable and under voltage input
	TP6	OVP1	CH1 OVCSEL pin voltage
	TP5	ILIM1	CH1 Current monitor. Load current ≈ V_{ILIM1} / (647 µA/A × R_{ILIM1})
	TP7	DVDT1	CH1 DVDT pin voltage
	TP2	VOUT1	CH1 Output from the EVM
	TP4	FLTb1	CH1 Fault test point
	TP8, TP12	GND	GND
	TP11, TP13	GND	GND
	TP23	SGND1	CH1 Signal GND
CH2	TP17	VIN2	CH2 Input power supply to the EVM
	TP19	EN2	CH2 Active high enable and under voltage input
	TP22	OVP2	CH2 OVLO pin voltage
	TP21	ILIM2	CH2 Current monitor. Load current ≈ V_{ILIM2} / (647 µA/A × R_{ILIM2})
	TP16	DVDT2	CH2 DVDT pin voltage
	TP18	VOUT2	CH2 Output from the EVM
	TP20	FLTb2	CH2 Fault test point
	TP9, TP14	GND	GND
	TP15, TP10	GND	GND
	TP24	SGND1	CH2 Signal GND

Table 4 describes the LED functionality.

Table 4. LEDs Descriptions

LED	Description
D3 (RED)	CH1 circuit fault indicator. LED turns on when the internal MOSFET is disabled due to a fault condition such as overload, short circuit and overvoltage
D5 (RED)	CH2 circuit fault indicator. LED turns on when the internal MOSFET is disabled due to a fault condition such as overload, short circuit and overvoltage

4.2 Test Equipment and Setup

4.2.1 Power Supplies

One adjustable power supply: 0-V to 20-V output, 0-A to 3-A output current limit.

4.2.2 Meters

One DMM minimum needed and may require more, if simultaneous measurements are needed.

4.2.3 Oscilloscope

A DPO2024 or Lecroy 424 oscilloscope or equivalent, three 10X voltage probes and a DC current probe

4.2.4 Loads

One resistive load or equivalent which can tolerate up to 3-A DC load at 12 V and are capable of the output short.

4.3 Test Setup and Procedures

Figure 2 shows a typical test setup for the TPS2596EVM. Connect J1/J9 to the power supply and J2/J10 to the load.

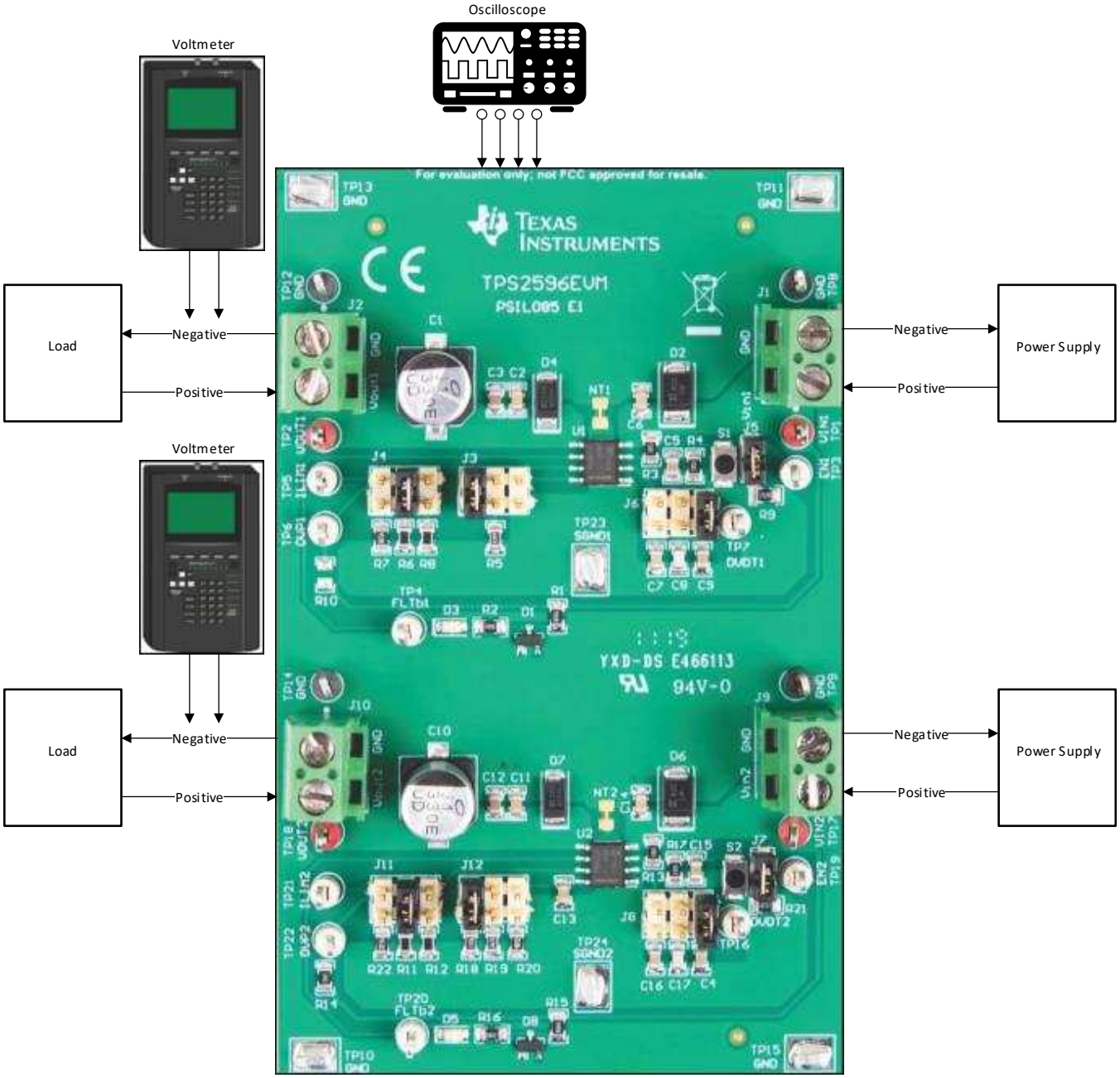

Figure 2. EVM Setup with Test Equipment

4.3.1 Test Procedure

Use the following steps to test the EVM:

1. Set the power-supply output VIN to 0 V.
2. Turn on the power supply and set the output voltage and current limit according to Table 5.

Table 5. Power Supply Setting for TPS2596EVM

EVM	Channel	Voltage Set Point	Power Supply Current Limit
TPS2596EVM	CH1(J1)	12 ± 0.2 V	3 A ± 0.25 A
	CH2(J9)		

3. Turn off the power supply. Hook up CH1 and CH2 of the TPS2596EVM assembly as shown in Figure 2.
4. The default EVM jumper setting is shown in Table 6.

Table 6. Default Jumper Setting for TPS2596EVM

Channel	Jumper	Label	Default Jumper Setting
CH1	J5	EN/UVLO	1-2
	J3	OVCSEL/OVLO	1-2
	J6	DVDT	5-6
	J4	ILIM	3-4
CH2	J7	EN/UVLO	1-2
	J12	OVCSEL/OVLO	1-2
	J8	DVDT	5-6
	J11	ILIM	3-4

5. CH1 and CH2 can be tested one by one for TPS2596EVM.
6. Ensure that the output load is disabled and the power supply is set properly for the design under test (DUT). Connect the negative probe of DMM to TP10, TP11, TP13 or TP15 (GND). Turn on the power supply, and verify that the voltages shown in Table 7 are obtained.

Table 7. TPS2596 DMM Readings at Different Test Points

Voltage Test on (CH1)	Measured Voltage Reading	Voltage Test on (CH2)	Measured Voltage Reading
VIN1 (TP1)	12 ± 0.5 V	VIN2 (TP17)	12 ± 0.5 V
EN1 (TP3)	3.73 ± 0.3 V	EN2 (TP19)	3.73 ± 0.3 V
VOUT1 (TP2)	12 ± 0.5 V	VOUT2 (TP18)	12 ± 0.5 V
ILIM1 (TP5)	0 V	ILIM2 (TP21)	0 V

4.3.1.1 CH1 (J1)

Use the following steps to test CH1 (J1).

1. Press the EVM RST switch, S1, and verify that the voltage at VOUT1 (TP2) starts falling slowly below 12 V. Release S1.
2. Reduce the input voltage on VIN1 and monitor VOUT1. Verify that VOUT1 (TP2) starts falling and is fully turned off when VIN1 (TP1) reaches 3.53 V (±0.3 V).
3. Adjust the power supply voltage to 12 V.
4. Increase the input voltage on VIN1 and monitor VOUT1. Verify that VOUT1 (TP2) is clamped to V_{CLAMP} when VIN1 (TP1) exceeds Output Clamp Threshold V_{OVC}.
5. Adjust the power supply voltage to 12 V.
6. Turn off the power supply.

4.3.1.2 For CH2 (J5)

Use the following steps to test CH2 (J9).

1. Press the EVM RST switch, S2 and verify that the voltage at VOUT2 (TP18) starts falling slowly below 12 V and the red FLTb2 LED (D7) turns ON. Release S2.
2. Reduce the input voltage on VIN2 and monitor VOUT2. Verify that VOUT2 (TP18) starts falling and is fully turned off when VIN2 (TP17) reaches 3.53 V (±0.3 V).
3. Adjust the power supply voltage to 12 V.
4. Increase the input voltage on VIN2 and monitor VOUT2. Verify that VOUT2 (TP18) starts increasing and then turns off when VIN2 (TP17) exceeds Overvoltage Protection Threshold. Verify that the FLTb2 red LED (D5) turns ON.
5. Adjust the power supply voltage to 12 V.
6. Turn off the power supply.

4.3.1.3 Current Limit Test

Use the following steps to conduct the current limit test.

1. Verify all three current limits (CH1 and CH2, with only 1 channel powered at a time) and verify the latch and auto-retry feature. Setup the oscilloscope as shown in Table 8.

Table 8. TPS2596EVM Oscilloscope Setting for Current Limit Test(1)(2)

Oscilloscope Setting	CH1 Probe Points	CH2 Probe Points
Channel 1 = 5 V/div	TP2 = VOUT1	TP18 = VOUT2
Channel 2 = 5 V/div	TP1 = VIN1	TP17 = VIN2
Channel 4 = 1 A/div	Input current into J1 +ve wire	Input current into J5 +ve wire
Trigger source = Channel 4		
Trigger level = 0.6 A ±0.1 A		
Trigger polarity = +ve		
Trigger mode = Single sequence		
Time base	200 ms/div	200 ms/div

(1) If an electronic load is used, ensure that the output load is set to constant resistance mode and not constant current mode.
(2) Measuring current limit values on the oscilloscope can cause 8% error from anticipated values listed in Table 8.

2. The jumper setting for the different current limit test is shown in Table 9.

Table 9. TPS2596EVM Jumper Settings for Current Limits

Jumper Position		Load Current Limit
J4 (CH1)	J11 (CH2)	
1-2	1-2	2.0 A ± 0.15 A
3-4	3-4	1.0 A ± 0.08 A
5-6	5-6	0.13 A ± 0.13 A

3. Set the output load at 5.0 Ω ± 0.5 Ω on CH1 and then enable the load. Turn on the VIN1 power supply and verify that input current is limited, as per the setting in the Table 9. Verify the device is in auto-retry mode and that the FLTb1 RED LED (D3) turns on and off as shown in Figure 3. The level of the current pulse should match with the load current limit (based on the respective jumper setting), as shown in Table 9.

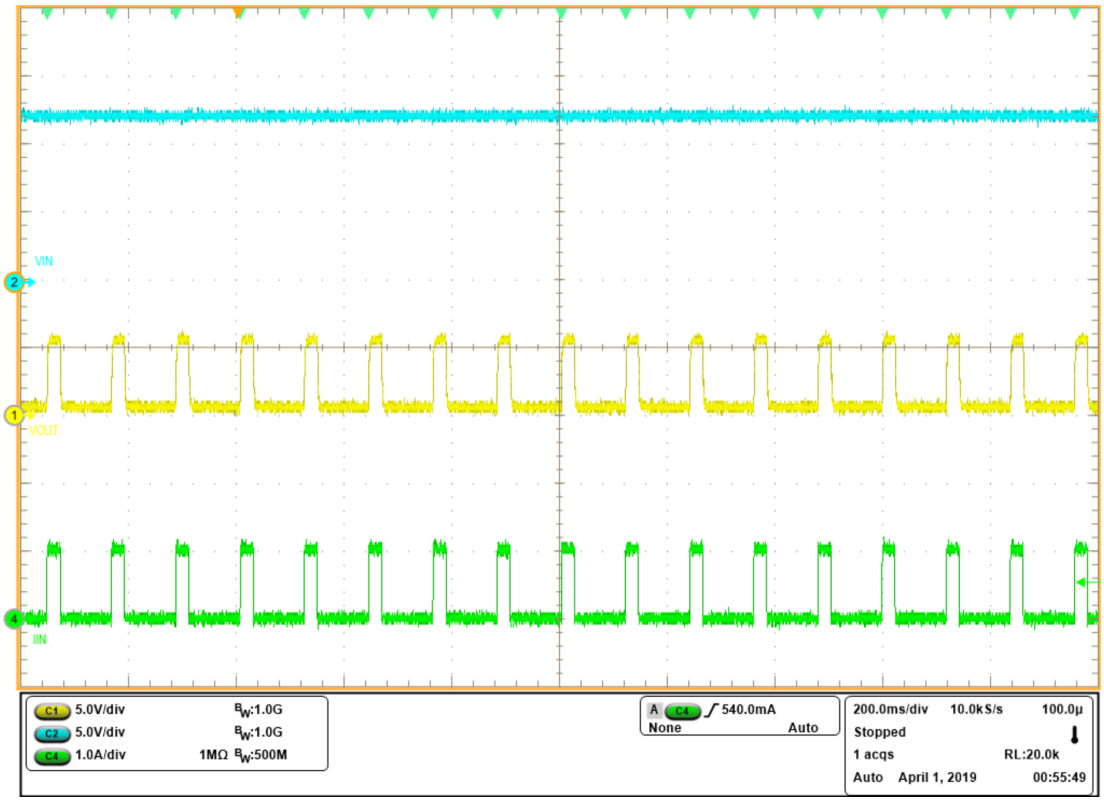

Figure 3. J4 = 3-4, Current Limit (1.0 A) Test Auto Retry (CH1)

4. Set the output load at 5.0 Ω ± 0.5 Ω on CH2 and then enable the load. Turn on the VIN2 power supply and verify that input/output current is limited as per the setting in Table 9. Verify the device is in latched-off mode and that the FLTb2 RED LED (D5) turns ON as shown in Figure 4. The level of the current pulse should match with the load current limit (based on the respective jumper setting) as shown in Table 9.

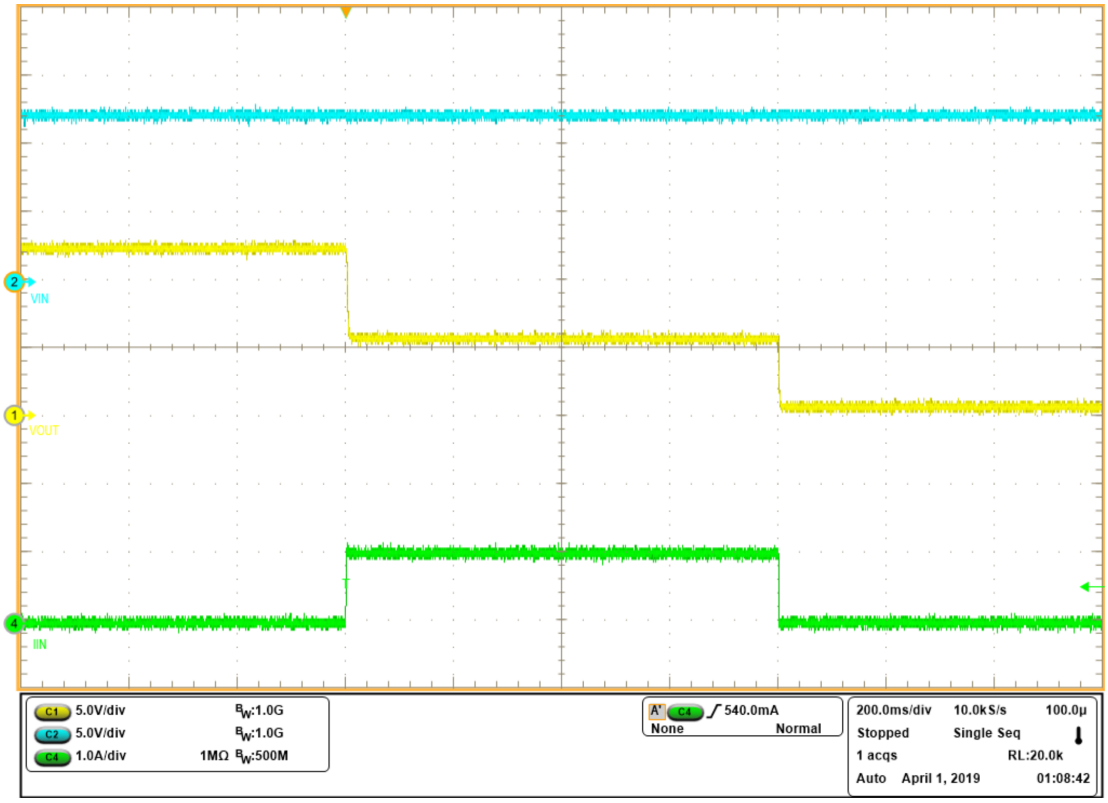

Figure 4. J11 = 3-4, Current Limit (1.0 A) Test with Latch (CH2)

5. Set the input power supply to zero volts and disconnect all equipment from the DUT.

4.3.1.4 Overvoltage Test

Use the following steps to conduct the overvoltage test.

1. Verify all three overvoltage limits (CH1 and CH2, with only 1 channel powered at a time) and verify the latch and auto-retry feature. Setup the oscilloscope as shown in Table 10.

Table 10. TPS2596EVM Oscilloscope Setting for Overvoltage Test

Oscilloscope Setting	CH1 Probe Points	CH2 Probe Points
Channel 2 = 5 V/div	TP1 = VIN1	TP17 = VIN2
Channel 4 = 5 V/div	TP2 = VOUT1	TP18 = VOUT2
Trigger source	Channel 2	Channel 2
Trigger polarity = +ve		
Trigger mode = Single sequence		
Time base	50 ms/div	50 ms/div

2. The jumper setting for the different overvoltage limit test is shown in Table 11.

Table 11. TPS2596EVM Jumper Settings for Over Load Limits

CH1 Jumper Setting, J3	CH1 Output Clamp Threshold	CH2 Jumper Setting, J12	CH2 Overvoltage Lockout Threshold
1-2	13.58 V	1-2	13.58 V
3-4	5.45 V	3-4	5.45 V
5-6	3.59 V	5-6	3.59 V

3. Adjust the VIN1 power supply voltage to a value less than output clamp threshold and turn it ON. Increase the VIN1 power supply voltage to a value above the clamp threshold. The level of the output voltage clamp should match with the clamp threshold (based on the respective jumper setting), as shown in Table 10. Figure 5 shows the overvoltage test for jumper setting, J3 = 1-2.

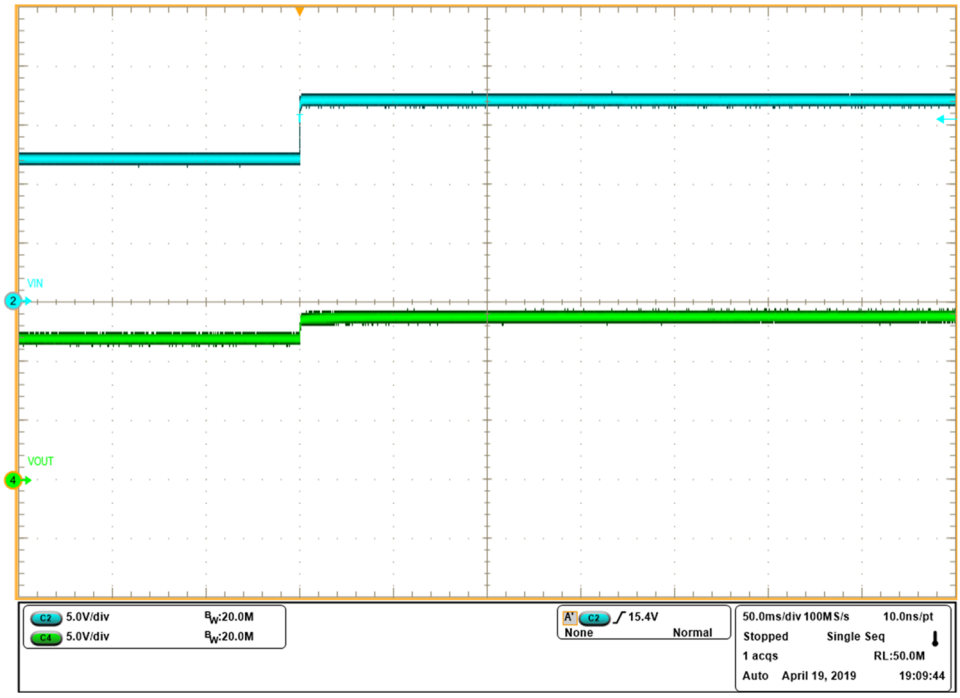

Figure 5. J3 = 1-2, Overvoltage Test (CH1)

4. Adjust the VIN2 power supply voltage to a value less than output lockout limit and turn it ON. Increase the VIN2 power supply voltage to a value above the lockout threshold. Verify the device turns OFF when VIN2 is increased beyond overvoltage lockout threshold (based on the respective jumper setting) and that the FLTb2 RED LED (D5) turns ON. Figure 6 shows overvoltage test for jumper setting, J12 = 1-2.

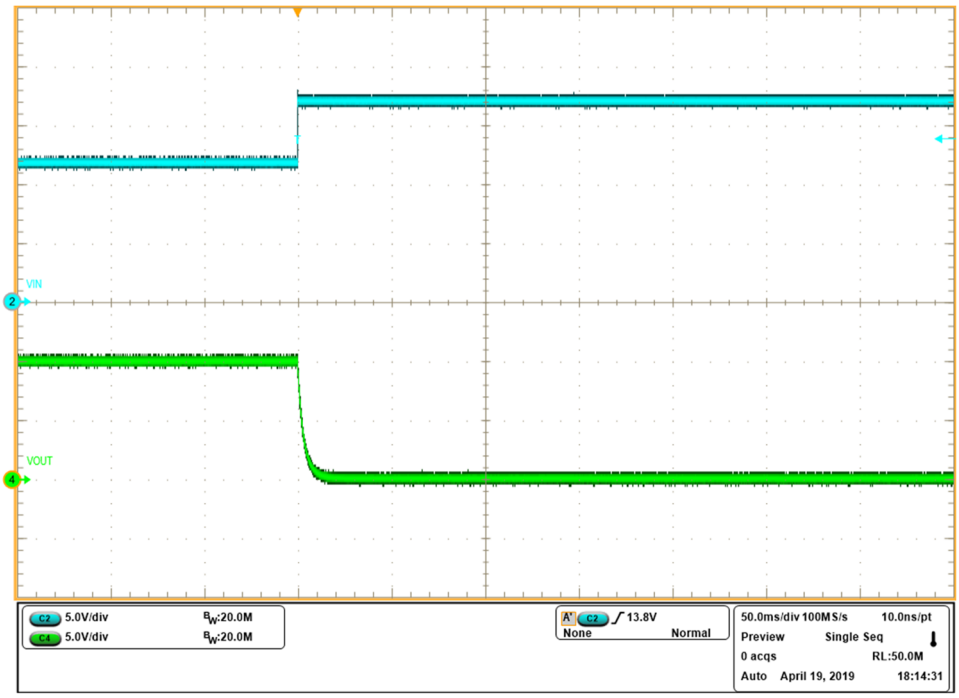

Figure 6. J12 = 1-2, Overvoltage Test (CH2)

5 EVM Assembly Drawings and Layout Guidelines

5.1 PCB Drawings

Figure 7 through Figure 9 show component placement and layout of the EVM.

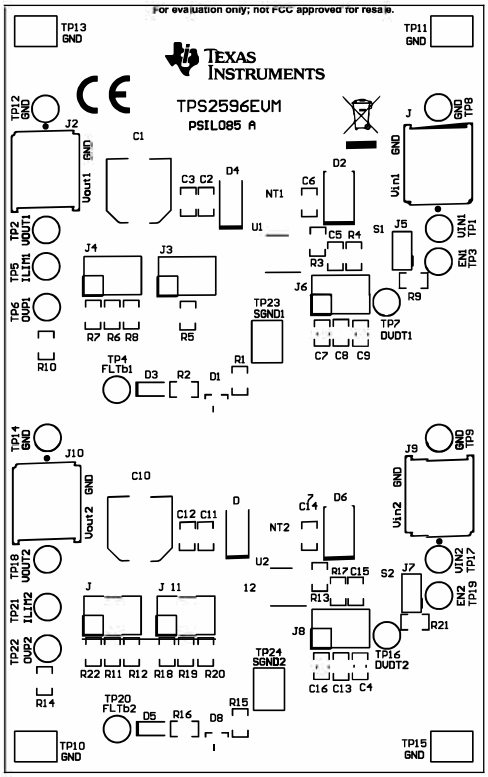

Figure 7. Top Side Placement

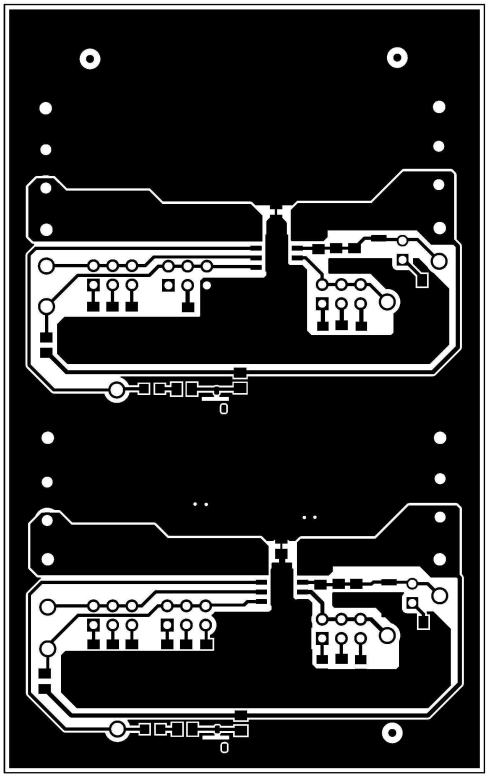

Figure 8. Top Layer

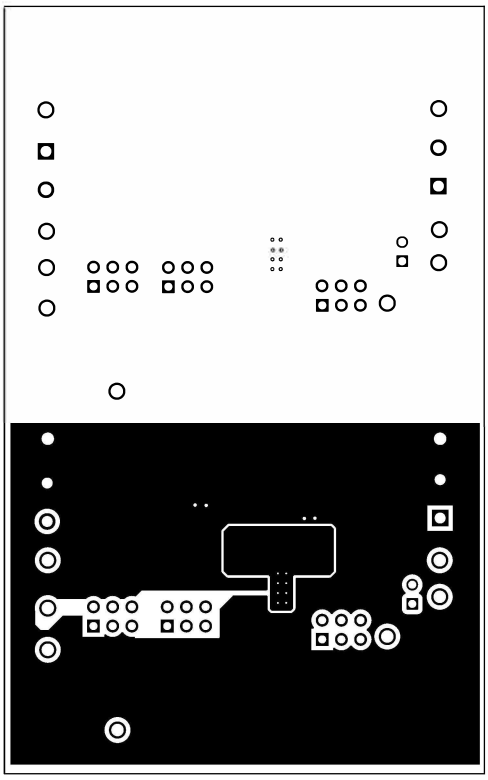

Figure 9. Bottom Layer

6 Bill of Materials (BOM)

Table 12 lists the BOM for this EVM.

Table 12. TPS2596EVM Bill of Materials(1)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
!PCB	1		Printed Circuit Board		PSIL085	Any		
C1, C10	2	330 uF	CAP, AL, 330 uF, 25 V, +/- 20%, 0.16 ohm, SMD	HA0	EMZA250ADA331MHA0G	Chemi-Con		
C2, C6, C11, C14	4	0.1 uF	CAP, CERM, 0.1 uF, 50 V, +/- 5%, X7R, 0805	0805	08055C104JAT2A	AVX		
C3, C12	2	0.47 uF	CAP, CERM, 0.47 uF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0805	0805	GCM21BR71H474KA55L	MuRata		
C4, C9	2	0.047 uF	CAP, CERM, 0.047 µF, 25 V,+/- 5%, C0G/NP0, AEC-Q200 Grade 1, 0805	0805	C0805C473J3GACTU	Kemet		
C5, C15	2	1 uF	CAP, CERM, 1 uF, 25 V, +/- 10%, X7R, 0805	0805	C0805C105K3RACTU	Kemet		
C7, C16	2	0.01 uF	CAP, CERM, 0.01 uF, 50 V, +/- 5%, C0G/NP0, 0805	0805	08055A103JAT2A	AVX		
C8, C13	2	0.022 uF	CAP, CERM, 0.022 uF, 50 V, +/- 1%, C0G/NP0, 0805	0805	C0805C223F5GACTU	Kemet		
D1, D8	2	4.3 V	Diode, Zener, 4.3 V, 225 mW, SOT-23	SOT-23	MMBZ5229BLT1G	ON Semiconductor		
D2, D6	2	15 V	Diode, TVS, Uni, 15 V, 24.4 Vc, SMB	SMB	SMBJ15A-13-F	Diodes Inc.		
D3, D5	2	Red	LED, Red, SMD	Red 0805 LED	LTST-C170KRKT	Lite-On		
D4, D7	2	20 V	Diode, Schottky, 20 V, 2 A, SMA	SMA	B220A-13-F	Diodes Inc.		
H1, H2, H3, H4	4		Bumpon, Hemisphere, 0.44 X 0.20, Clear	Transparent Bumpon	SJ-5303 (CLEAR)	3M		
J1, J2, J9, J10	4		Terminal Block, 2x1, 5.08mm, TH	10.16x15.2x9mm	282841-2	TE Connectivity		
J3, J4, J6, J8, J11, J12	6		Header, 100mil, 3x2, Tin, TH	3x2 Header	PEC03DAAN	Sullins Connector Solutions		
J5, J7	2		Header, 100mil, 2x1, Tin, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions		
R1, R15	2	499	RES, 499, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	CRCW0805499RFKEA	Vishay-Dale		
R2, R16	2	200	RES, 200, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	CRCW0805200RFKEA	Vishay-Dale		
R3, R4, R13, R14, R17	5	100 k	RES, 100 k, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	CRCW0805100KFKEA	Vishay-Dale		

(1) Unless otherwise noted in the Alternate Part Number and/or Alternate Manufacturer columns, all parts may be substituted with equivalents.

Table 12. TPS2596EVM Bill of Materials[(1)] (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
R5	1	402 k	RES, 402 k, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	ERJ-6ENF4023V	Panasonic		
R6, R11	2	909	RES, 909, 0.1%, 0.125 W, 0805	0805	RT0805BRD07909RL	Yageo America		
R7, R22	2	453	RES, 453, 0.1%, 0.125 W, 0805	0805	RT0805BRD07453RL	Yageo America		
R8, R12	2	7.87 k	RES, 7.87 k, 0.1%, 0.125 W, 0805	0805	RT0805BRD077K87L	Yageo America		
R9, R21	2	82.5 k	RES, 82.5 k, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	CRCW080582K5FKEA	Vishay-Dale		
R18	1	9.53 k	RES, 9.53 k, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	CRCW08059K53FKEA	Vishay-Dale		
R19	1	26.7 k	RES, 26.7 k, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	CRCW080526K7FKEA	Vishay-Dale		
R20	1	46.4 k	RES, 46.4 k, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	CRCW080546K4FKEA	Vishay-Dale		
S1, S2	2		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, SH-J8	8		Shunt, 100mil, Gold plated, Black	Shunt 2 pos. 100 mil	881545-2	TE Connectivity		
TP1, TP2, TP17, TP18	4		Test Point, Multipurpose, Red, TH	Red Multipurpose Testpoint	5010	Keystone		
TP3, TP4, TP5, TP6, TP7, TP16, TP19, TP20, TP21, TP22	10		Test Point, Multipurpose, White, TH';	White Multipurpose Testpoint	5012	Keystone		
TP8, TP9, TP12, TP14	4		Test Point, Multipurpose, Black, TH	Black Multipurpose Testpoint	5011	Keystone		
TP10, TP11, TP13, TP15, TP23, TP24	6		Test Point, Compact, SMT	Testpoint_Keystone_Compact	5016	Keystone		
U1	1		2.7- 19 V, 0.15-2 A, 80-mΩ eFuse with accurate current limiting, DDA0008E (HSOIC-8)	DDA0008E	TPS259621DDAR	Texas Instruments		Texas Instruments
U2	1		2.7- 19 V, 0.15-2 A, 80-mΩ eFuse with accurate current limiting, DDA0008E (HSOIC-8)	DDA0008E	TPS259630DDAR	Texas Instruments	TPS259630DDAT	Texas Instruments
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A		

Table 12. TPS2596EVM Bill of Materials[(1)] (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
R10	0	100 k	RES, 100 k, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	CRCW0805100KFKEA	Vishay-Dale		

Revision History

Changes from Original (April 2019) to A Revision	Page
• Updated Schematic Figure 1	4
• Updated EVM Setup with Test Equipment Figure 2	7
• Updated Figure 7, Figure 8 and Figure 9	14
• Updated Bill of Materials (BOM) Table 12	16

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), 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 will 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 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.

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

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265