EVM User's Guide: TPSI31xxQ1EVM
TPSI31xx-Q1 Evaluation Module

TEXAS INSTRUMENTS

Description

TPSI31xx-Q1 evaluation module (EVM) helps designers evaluate the operation and performance of the TPSI31xx-Q1 device family. The board features the TPSI3100-Q1 and variants, an isolated switch driver with integrated 15.8-V gate supply and fault/alarm indicators. The TPSI3100-Q1 is a 5-kVRMS reinforced isolated switch driver with 1.5-A peak source current and 3-A peak sink current. The device is able to generate a regulated secondary 15.8-V power supply, which allows for a wide selection of power switches such as MOSFETs, SiC MOSFETs, and IGBTs. The EVM features four overcurrent protection configurations. In addition, the EVM contains an adjustable 5-V LDO to support battery powering.

Features

- 4 breakout boards: Unidirectional overcurrent protection without current sense amplifier (5-A alarm, 10-A fault), Bidirectional overcurrent protection without current sense amplifier (5-A fault), Unidirectional overcurrent protection with current sense amplifier (5-A alarm, 10-A fault), DESAT (7-A alarm, 15-A fault)
- Current sense amplifier (INA181-Q1) for reducing power dissipation
- Ultralow-noise LDO (5-V to 20-V input) for powering the circuit if adjustable power supply is unavailable
- Drives external power transistors, including placeholders for common through-hole and surface-mount footprints
- No isolated secondary supply required
- 5-kVRMS reinforced isolation
- 15.8-V gate drive with 1.5-A peak source current and 3-A peak sink current
- Up to 25-mW, 5-V supply for external auxiliary circuitry
- Dual isolated high-speed comparators with integrated voltage reference +/-1.5%
- Open-drain outputs for fault and alarm indicators

Applications

- Solid State Relay (SSR)
- Hybrid, electric, and powertrain systems
- Building automation
- Factory automation and control
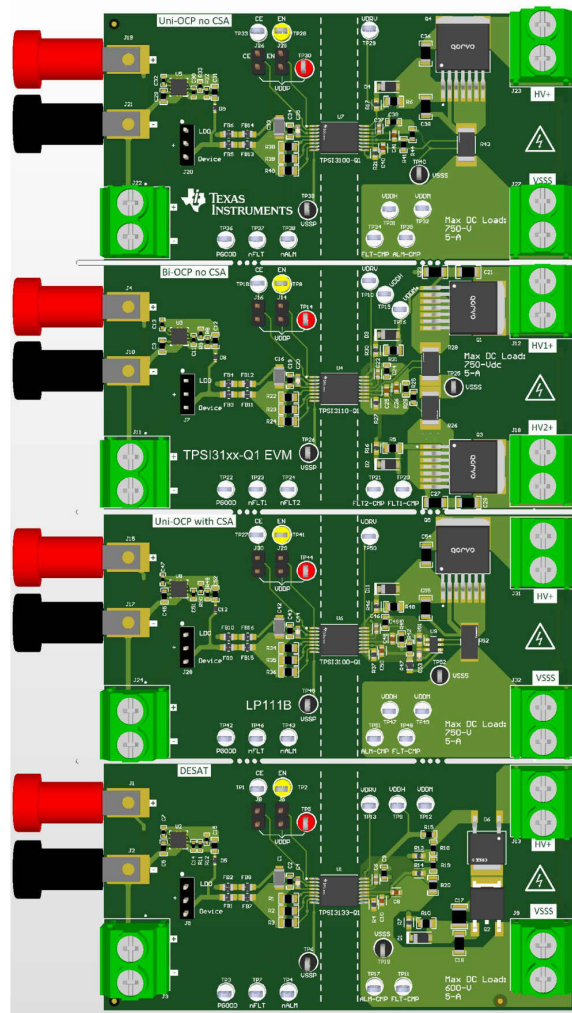
PCB View

1 Evaluation Module Overview

1.1 Introduction

The TPSI31xx-Q1 is a fully integrated isolated switch driver that, when combined with an external power switch, forms a complete isolated solid state relay design. The TPSI31xx-Q1 can support driving single power switch, dual back-to-back, parallel power switches for a variety of AC or DC applications. The TPSI31xx-Q1 integrates a communication back-channel that transfers various status information from the secondary side to the primary side via open-drain outputs, PGOOD (Power Good), FLT1 (Fault 1), and ALM1 (Alarm 1). The TPSI31xx-Q1 integrated isolation protection is extremely robust with much higher reliability, lower power consumption, and increased temperature ranges than those found using traditional mechanical relays and optocouplers.

This user's guide provides connectors, test point descriptions, schematic, bill of materials, and board layout of the EVM.

1.2 Kit Contents

- TPSI31xx-Q1 evaluation module circuit
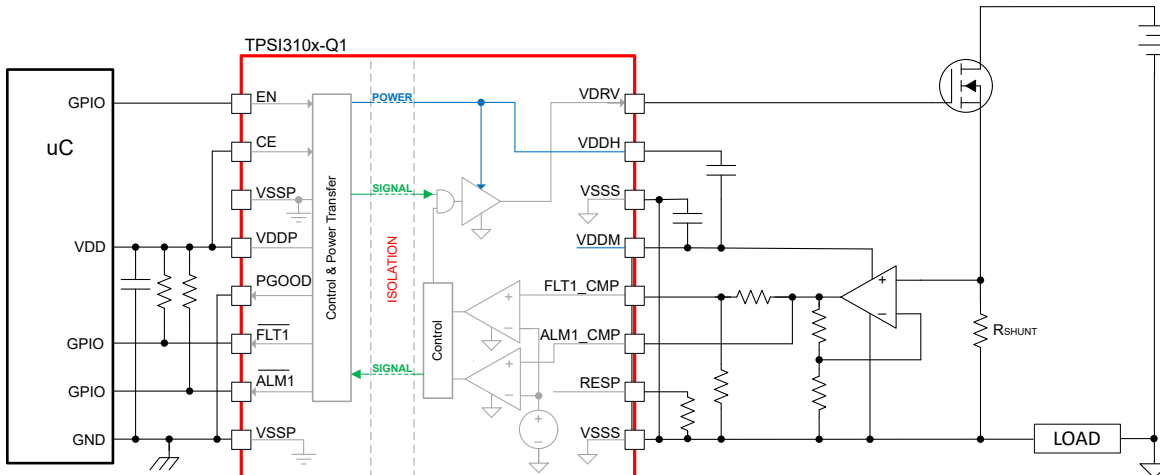
1.3 Specification

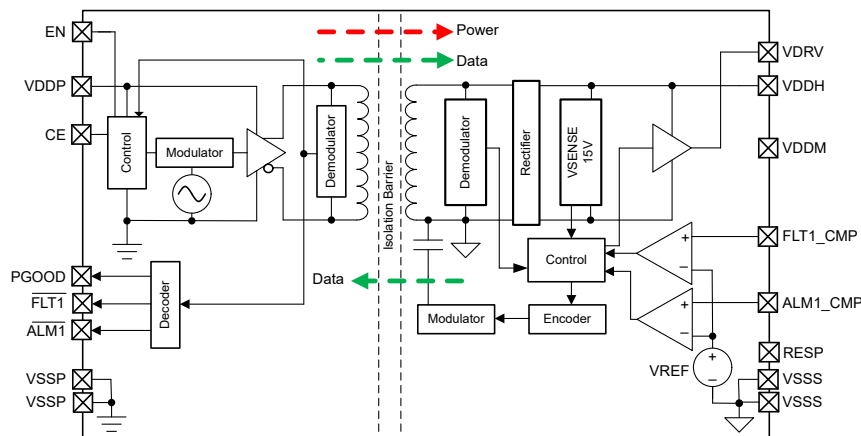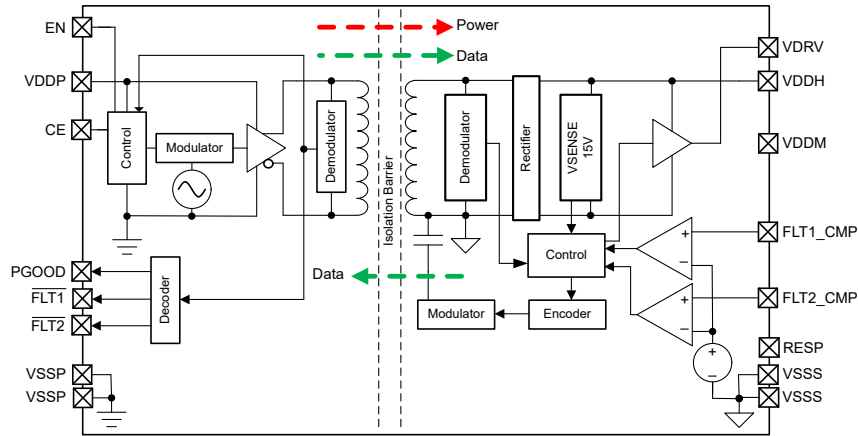**Figure 1-1. TPSI3100-Q1 Simplified Schematic**

Figure 1-2. TPSI310x-Q1 Functional Block Diagram

Figure 1-3. TPSI311x-Q1 Functional Block Diagram

1.4 Device Information

The TPSI31XXQ1EVM is an evaluation module (EVM) designed to demonstrate the performance and functionality of the TPSI31xx-Q1 family of devices in an overcurrent application. This family includes the devices shown in the table below with differences in performance and function noted.

PART NUMBER	REF	COMPARATORS	LATCHED FAULT
TPSI3100-Q1	0.3 V	1 fault / 1 alarm	NO
TPSI3103-Q1	1.2 V		
TPSI3100L-Q1	0.3 V	1 latched fault / 1 alarm	YES
TPSI3103L-Q1	1.2 V		
TPSI3110-Q1	0.3 V	2 faults	NO
TPSI3113-Q1	1.2 V		
TPSI3110L-Q1	0.3 V	2 latched faults	YES
TPSI3113L-Q1	1.2 V		

2 Hardware

2.1 Additional Images

```
        EN  ⊏  1        16  ⊐  VDRV
        CE  ⊏  2        15  ⊐  VDDH
      VSSP  ⊏  3        14  ⊐  VSSS
      VDDP  ⊏  4        13  ⊐  VDDM
     PGOOD  ⊏  5        12  ⊐  FLT1_CMP
      FLT1  ⊏  6        11  ⊐  ALM1_CMP
      ALM1  ⊏  7        10  ⊐  RESP
      VSSP  ⊏  8         9  ⊐  VSSS
```
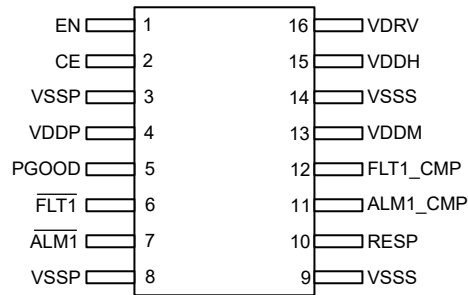
Figure 2-1. TPSI310x-Q1 DVX Package 16-Pin SSOP Top View

```
        EN  ⊏  1        16  ⊐  VDRV
        CE  ⊏  2        15  ⊐  VDDH
      VSSP  ⊏  3        14  ⊐  VSSS
      VDDP  ⊏  4        13  ⊐  VDDM
     PGOOD  ⊏  5        12  ⊐  FLT1_CMP
      FLT1  ⊏  6        11  ⊐  FLT2_CMP
      FLT2  ⊏  7        10  ⊐  RESP
      VSSP  ⊏  8         9  ⊐  VSSS
```
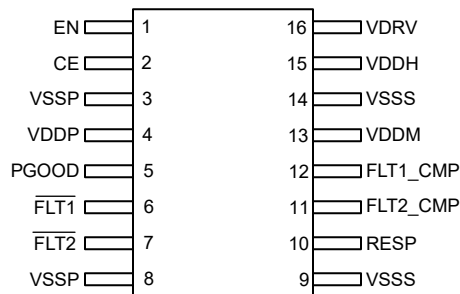
Figure 2-2. TPSI311x-Q1 DVX Package 16-Pin SSOP Top View

2.2 Header Information

Uni-OCP no CSA

Name	Description
J19	Low voltage + banana jack input
J21	Low voltage - banana jack input
J22	Low voltage + and - wire input
J23	High voltage + input
J27	High voltage - input (VSSS)

Bi-OCP no CSA

Name	Description
J4	Low voltage + banana jack input
J10	Low voltage - banana jack input
J11	Low voltage + and - wire input
J12	High voltage + input
J18	High voltage - input (VSSS)

Uni-OCP with CSA

Name	Description
J15	Low voltage + banana jack input
J17	Low voltage - banana jack input
J24	Low voltage + and - wire input
J31	High voltage + input
J32	High voltage - input (VSSS)

DESAT

Name	Description
J1	Low voltage + banana jack input
J2	Low voltage - banana jack input
J3	Low voltage + and - wire input
J13	High voltage + input
J9	High voltage - input (VSSS)

2.3 Jumper Information

Uni-OCP no CSA

Name	Description
J20	Select for banana jack/wire input to connect to LDO (position 1-2) or directly to device (position 2-3)
J26	Pull chip enable (CE) high to VDDP
J25	Pull enable (EN) high to VDDP

Bi-OCP no CSA

Name	Description
J7	Select for banana jack/wire input to connect to LDO (position 1-2) or directly to device (position 2-3)
J16	Pull chip enable (CE) high to VDDP
J14	Pull enable (EN) high to VDDP

Uni-OCP with CSA

Name	Description
J28	Select for banana jack/wire input to connect to LDO (position 1-2) or directly to device (position 2-3)
J30	Pull chip enable (CE) high to VDDP
J29	Pull enable (EN) high to VDDP

DESAT

Name	Description
J5	Select for banana jack/wire input to connect to LDO (position 1-2) or directly to device (position 2-3)
J8	Pull chip enable (CE) high to VDDP

Name	Description
J6	Pull enable (EN) high to VDDP

2.4 Test Points

Uni-OCP no CSA

Name	Description
TP33	Chip enable (CE)
TP28	Enable (EN)
TP30	Device power input (VDDP)
TP36	Power good status (PGOOD)
TP37	Inverted fault status (nFLT)
TP38	Inverted alarm status (nALM)
TP39	Device power ground (VSSP)
TP29	Device driver output (VDRV)
TP40	Device driver output reference (VSSS)
TP31	Device secondary power rail for bootstrap capacitance (VDDH)
TP32	Device secondary power rail for bootstrap capacitance (VDDM)
TP34	Device secondary fault comparator input (FLT-CMP)
TP35	Device secondary alarm comparator input (ALM-CMP)

Bi-OCP no CSA

Name	Description
TP18	Chip enable (CE)
TP8	Enable (EN)
TP14	Device power input (VDDP)
TP22	Power good status (PGOOD)
TP23	Inverted fault status (nFLT1)
TP24	Inverted alarm status (nFLT2)
TP26	Device power ground (VSSP)
TP10	Device driver output (VDRV)
TP25	Device driver output reference (VSSS)
TP15	Device secondary power rail for bootstrap capacitance (VDDH)
TP16	Device secondary power rail for bootstrap capacitance (VDDM)
TP21	Device secondary fault comparator input (FLT2-CMP)
TP20	Device secondary alarm comparator input (FLT1-CMP)

Uni-OCP with CSA

Name	Description
TP27	Chip enable (CE)
TP41	Enable (EN)
TP44	Device power input (VDDP)
TP42	Power good status (PGOOD)
TP46	Inverted fault status (nFLT)
TP43	Inverted alarm status (nALM)
TP45	Device power ground (VSSP)

Name	Description
TP50	Device driver output (VDRV)
TP52	Device driver output reference (VSSS)
TP47	Device secondary power rail for bootstrap capacitance (VDDH)
TP49	Device secondary power rail for bootstrap capacitance (VDDM)
TP51	Device secondary fault comparator input (ALM-CMP)
TP48	Device secondary alarm comparator input (FLT-CMP)

DESAT

Name	Description
TP1	Chip enable (CE)
TP2	Enable (EN)
TP5	Device power input (VDDP)
TP3	Power good status (PGOOD)
TP7	Inverted fault status (nFLT)
TP4	Inverted alarm status (nALM)
TP6	Device power ground (VSSP)
TP13	Device driver output (VDRV)
TP19	Device driver output reference (VSSS)
TP9	Device secondary power rail for bootstrap capacitance (VDDH)
TP12	Device secondary power rail for bootstrap capacitance (VDDM)
TP17	Device secondary fault comparator input (ALM-CMP)
TP11	Device secondary alarm comparator input (FLT-CMP)

3 Implementation Results

3.1 Evaluation Setup

The following waveforms feature the overcurrent protection circuit connected on the high-side in series with a load board. The load board helps deliver two current levels, one to trip the alarm, and another to trip the fault.
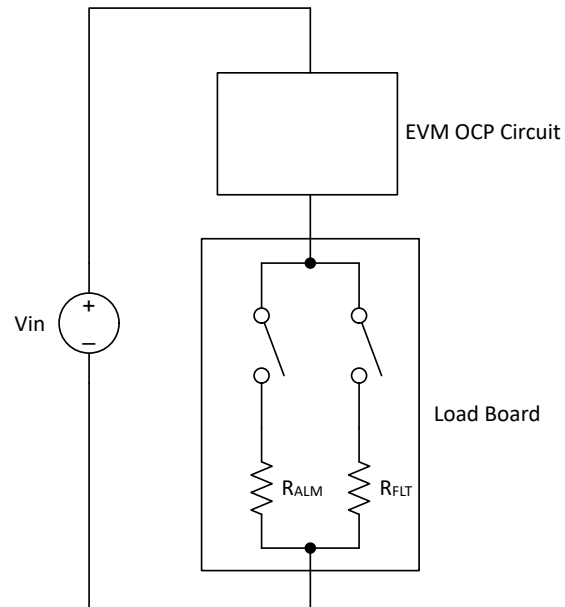

Figure 3-1. Simplified Lab Setup Schematic
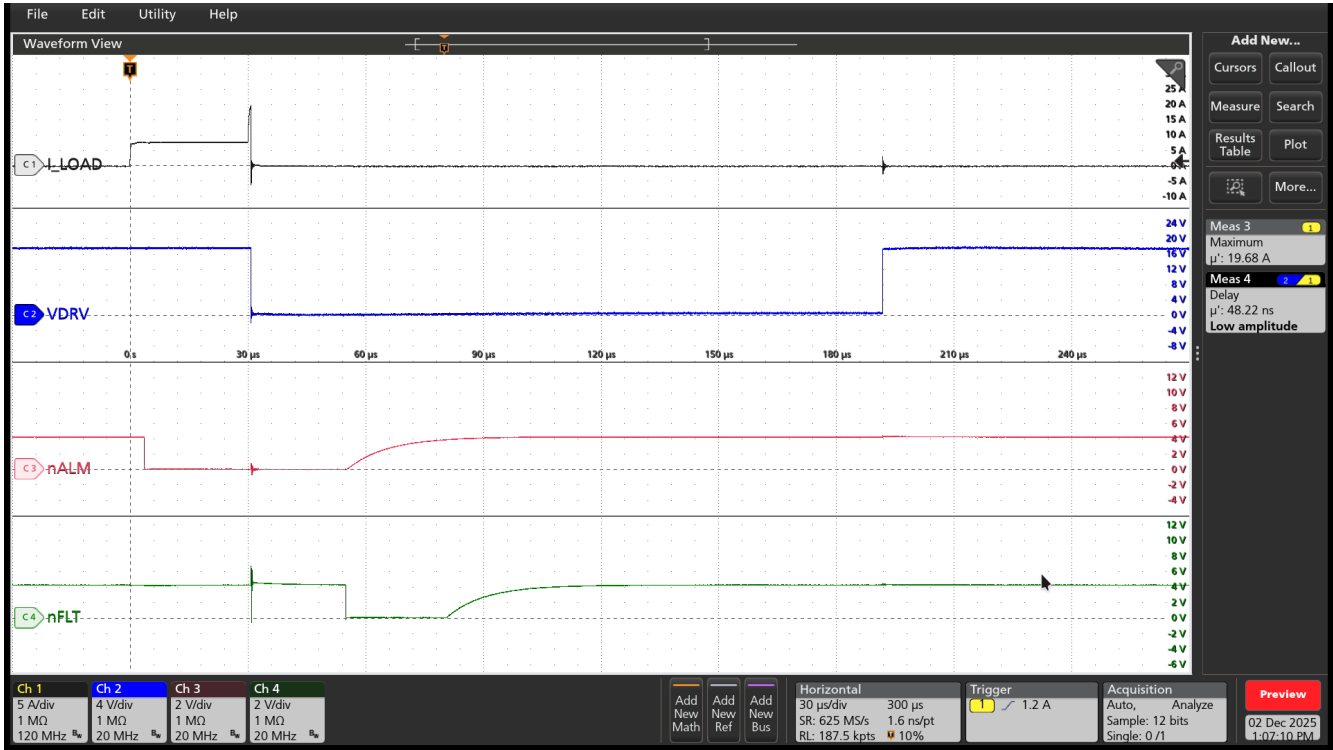
3.2 Performance Data and Results

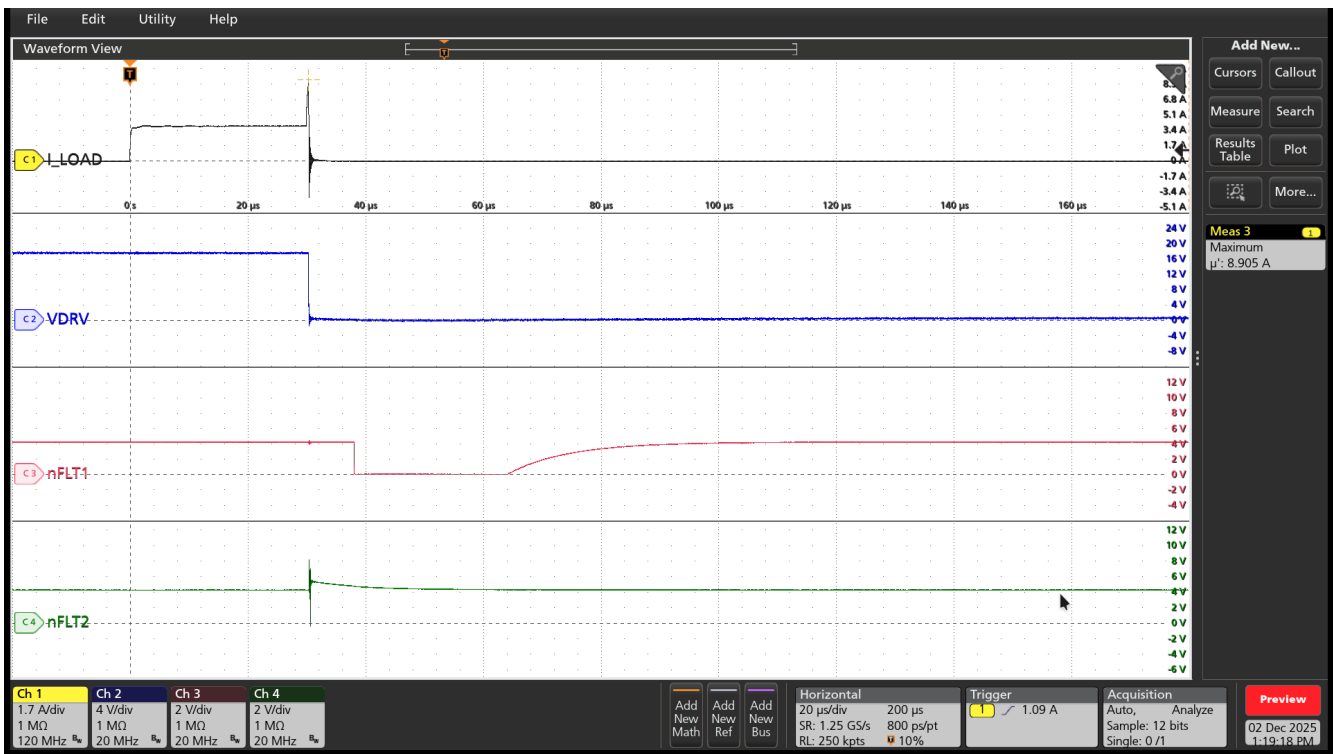**Figure 3-2. Unidirectional Overcurrent Protection without Current Sense Amplifier: Two-Level Detection (Uni-OCP no CSA)**

Figure 3-3. Bidirectional Overcurrent Protection without Current Sense Amplifier (direction A)
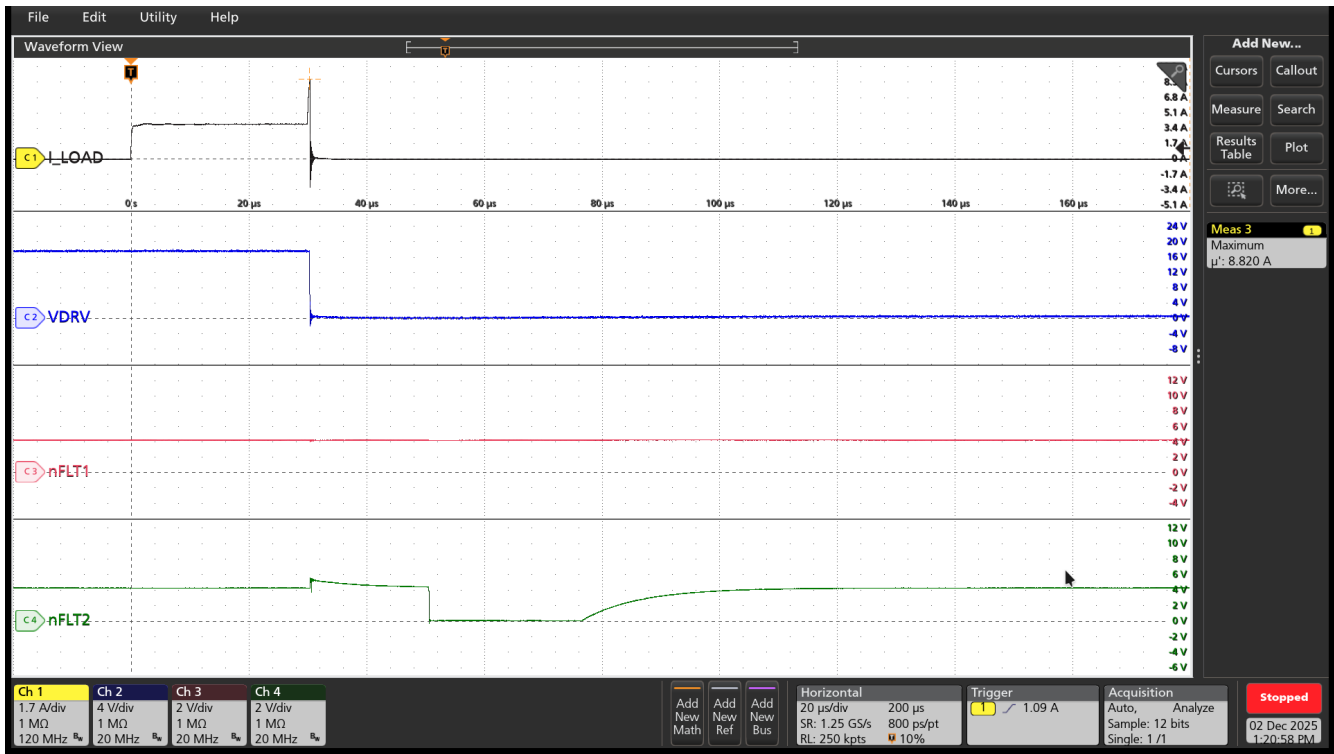
Figure 3-4. Bidirectional Overcurrent Protection without Current Sense Amplifier (direction B)
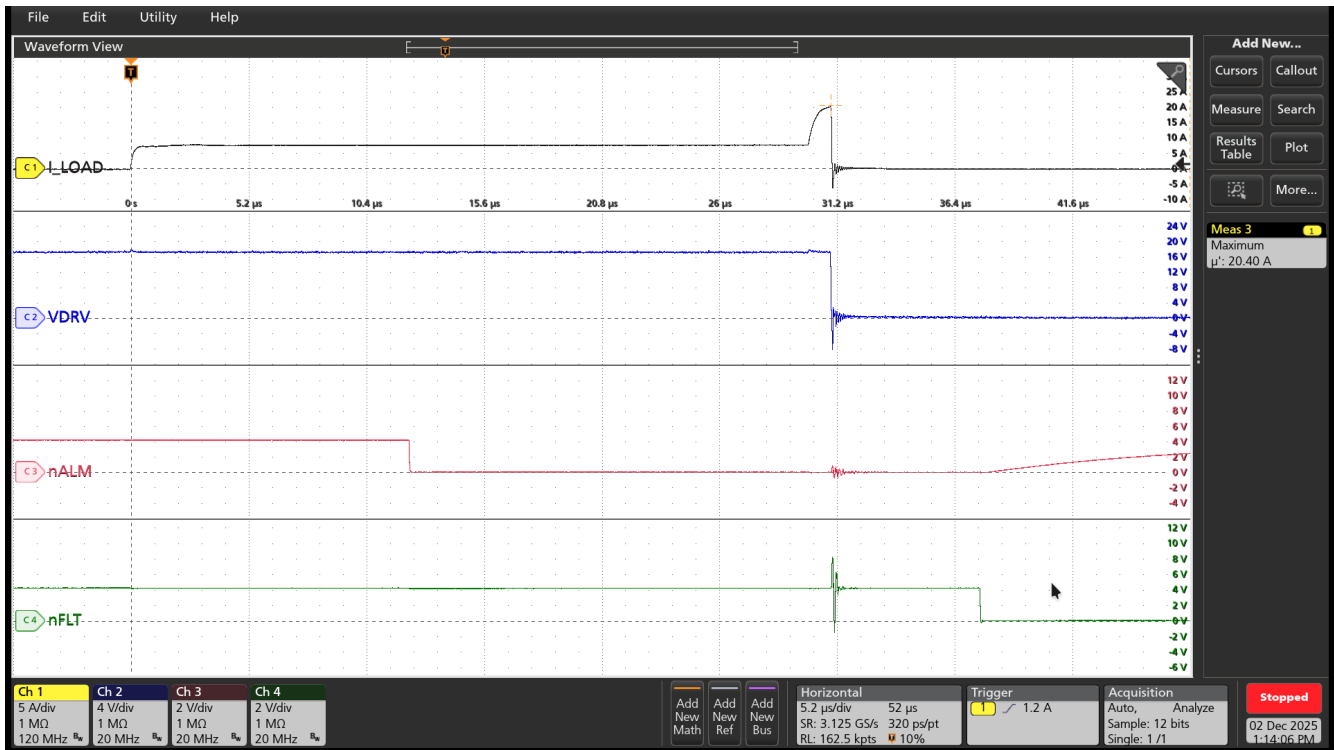
Figure 3-5. Unidirectional Overcurrent Protection with Current Sense Amplifier: Two Level Detection

DESAT: Changed C8 and C10 to 15 pF

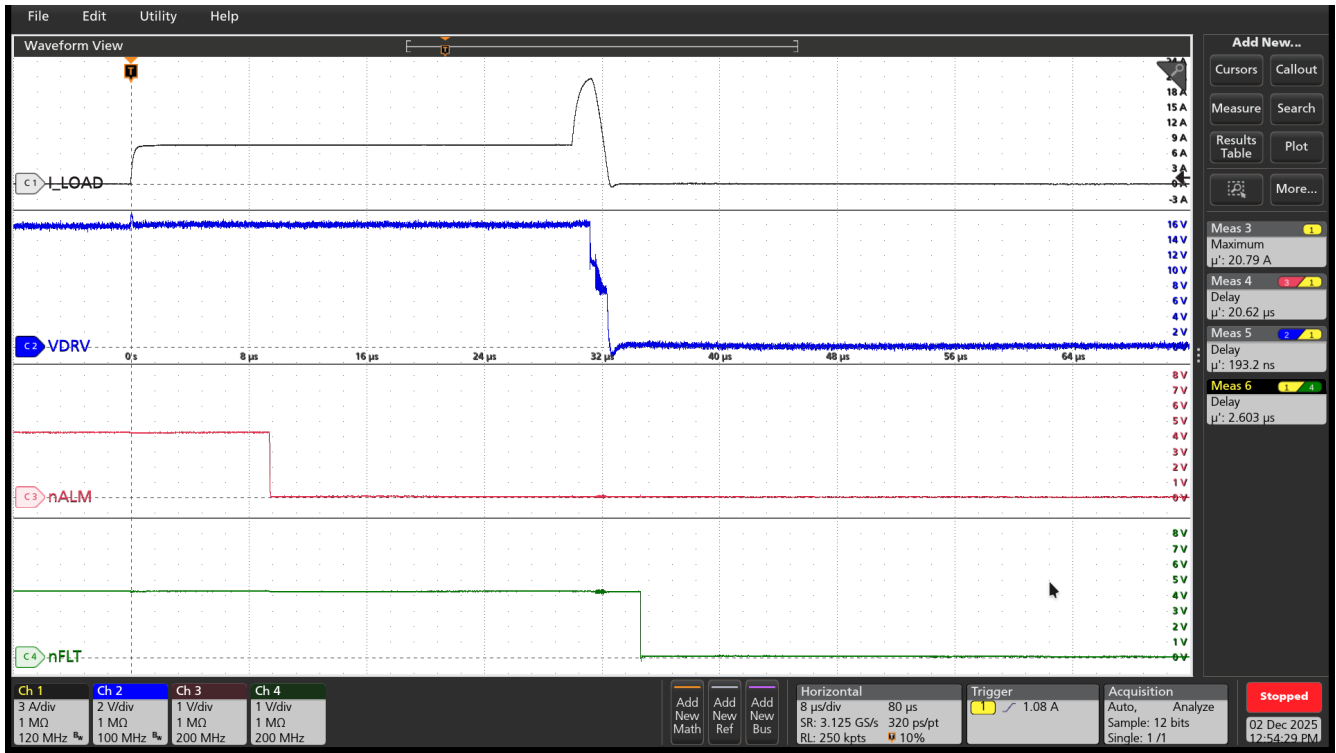Read more about DESAT in article, How TPSI3133 DESAT Can Protect Your Expensive SiC MOSFETs and IGBTs.

Figure 3-6. DESAT: Two Level Detection
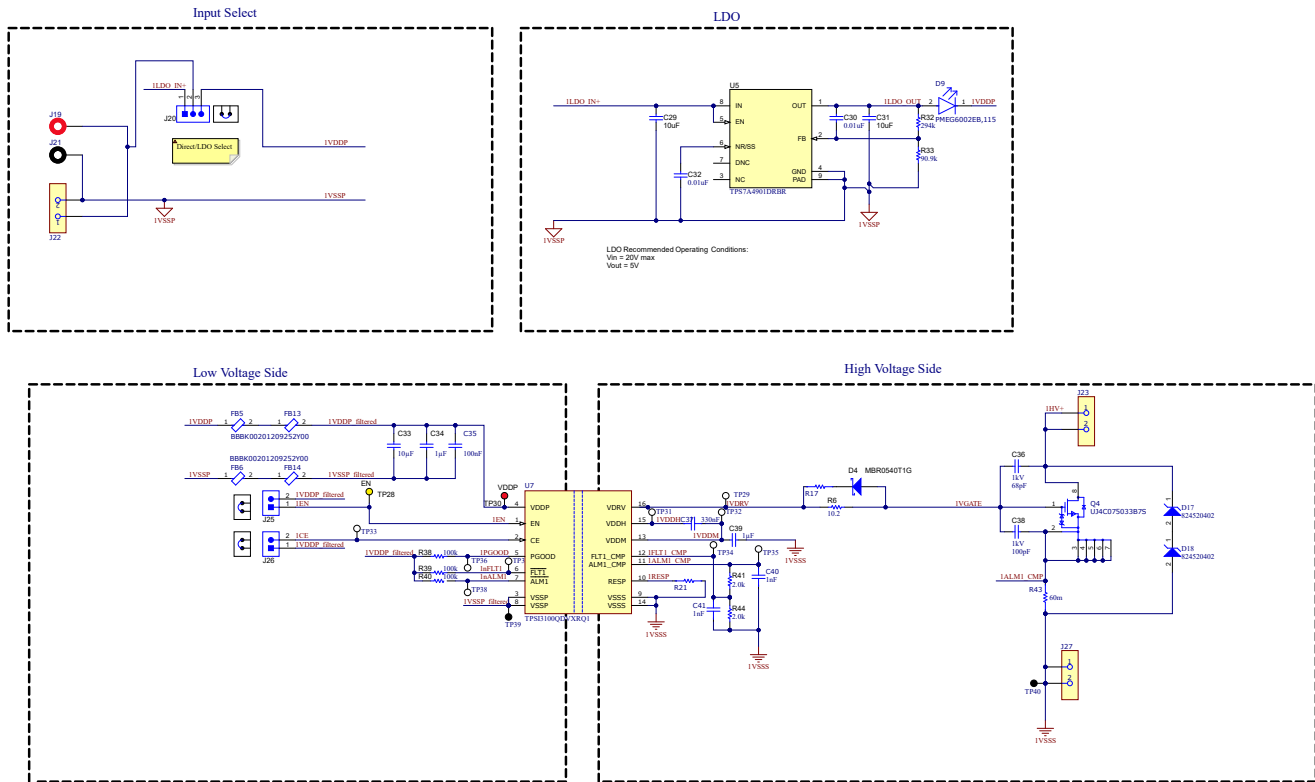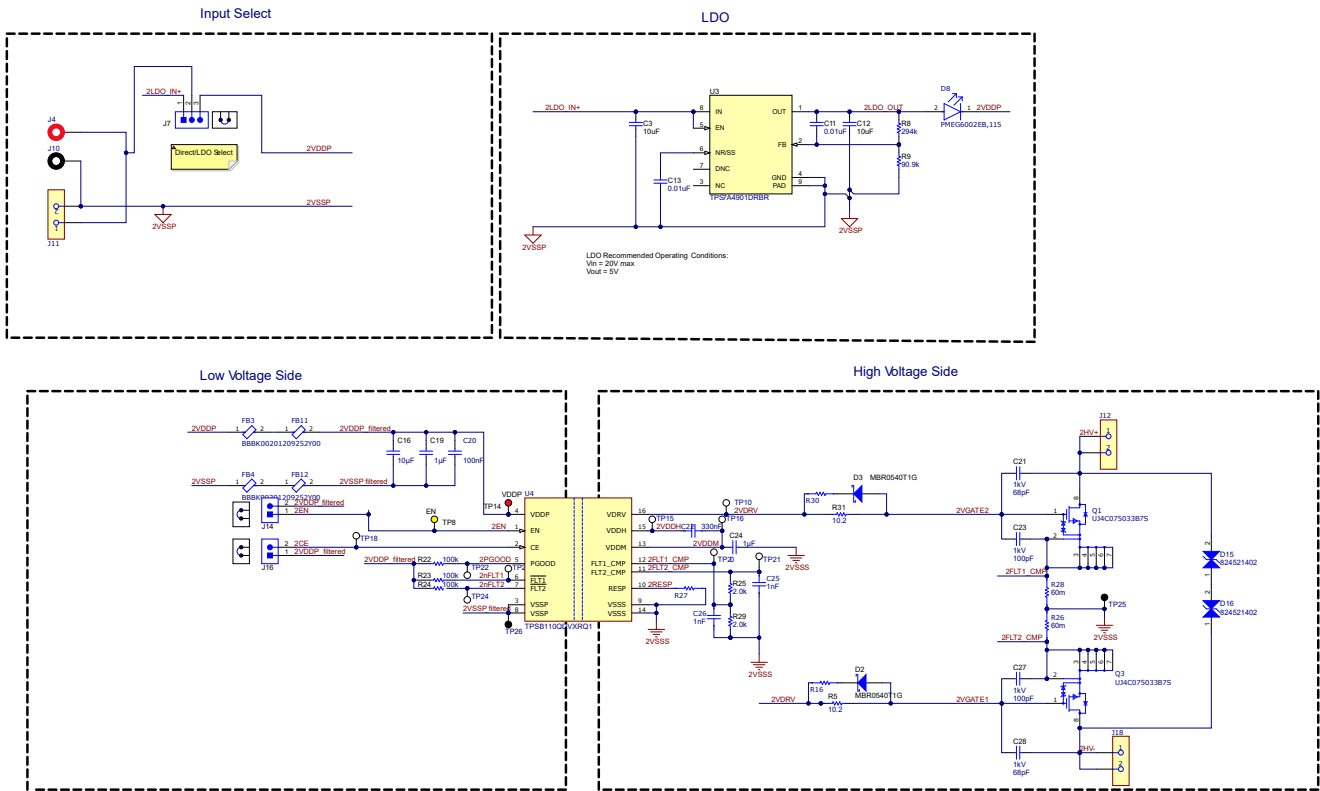
4 Hardware Design Files

4.1 Schematics

Figure 4-1. Unidirectional Overcurrent Protection without Current Sense Amplifier
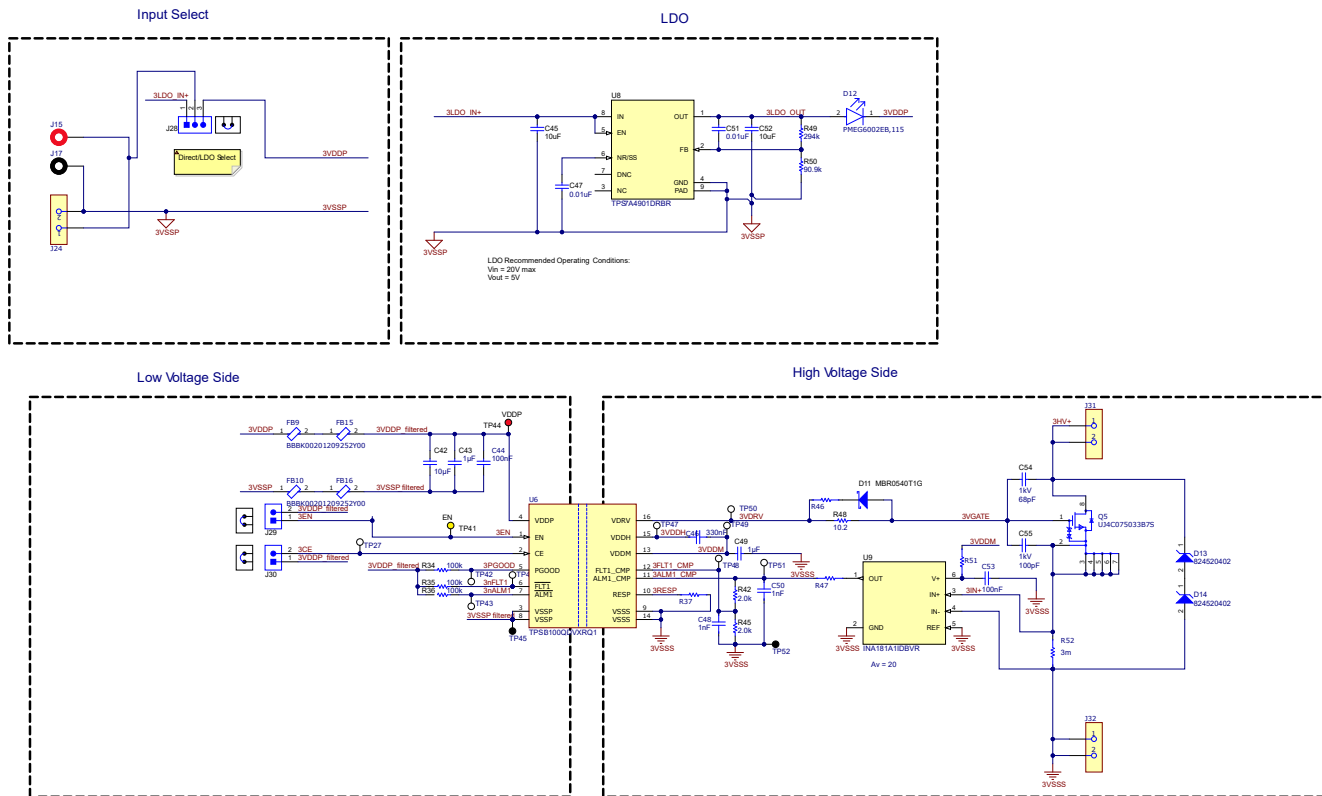
Input Select

LDO

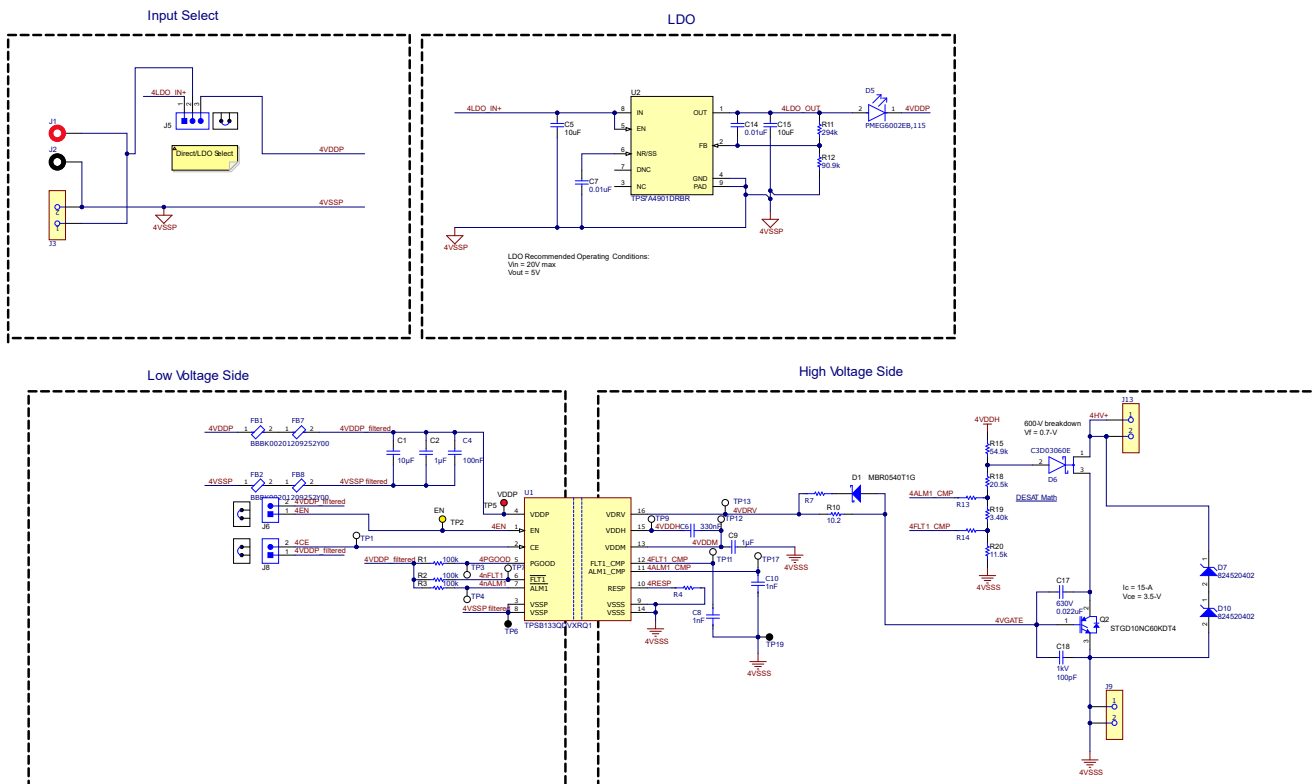Low Voltage Side

High Voltage Side

Figure 4-2. Bidirectional Overcurrent Protection without Current Sense Amplifier

Figure 4-3. Unidirectional Overcurrent Protection with Current Sense Amplifier

Read more about DESAT in article, How TPSI3133 DESAT Can Protect Your Expensive SiC MOSFETs and IGBTs.
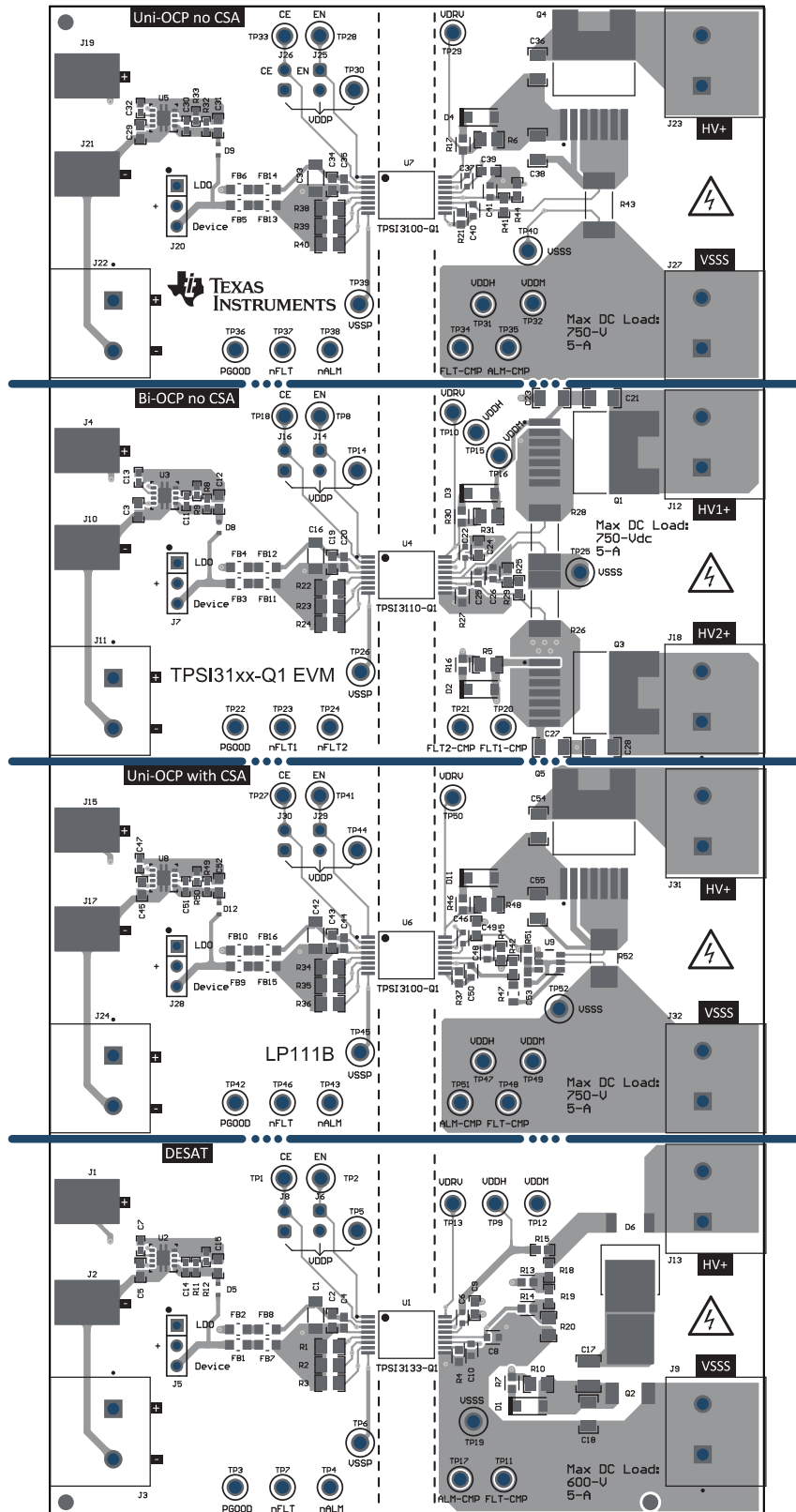

Figure 4-4. DESAT

4.2 PCB Layouts
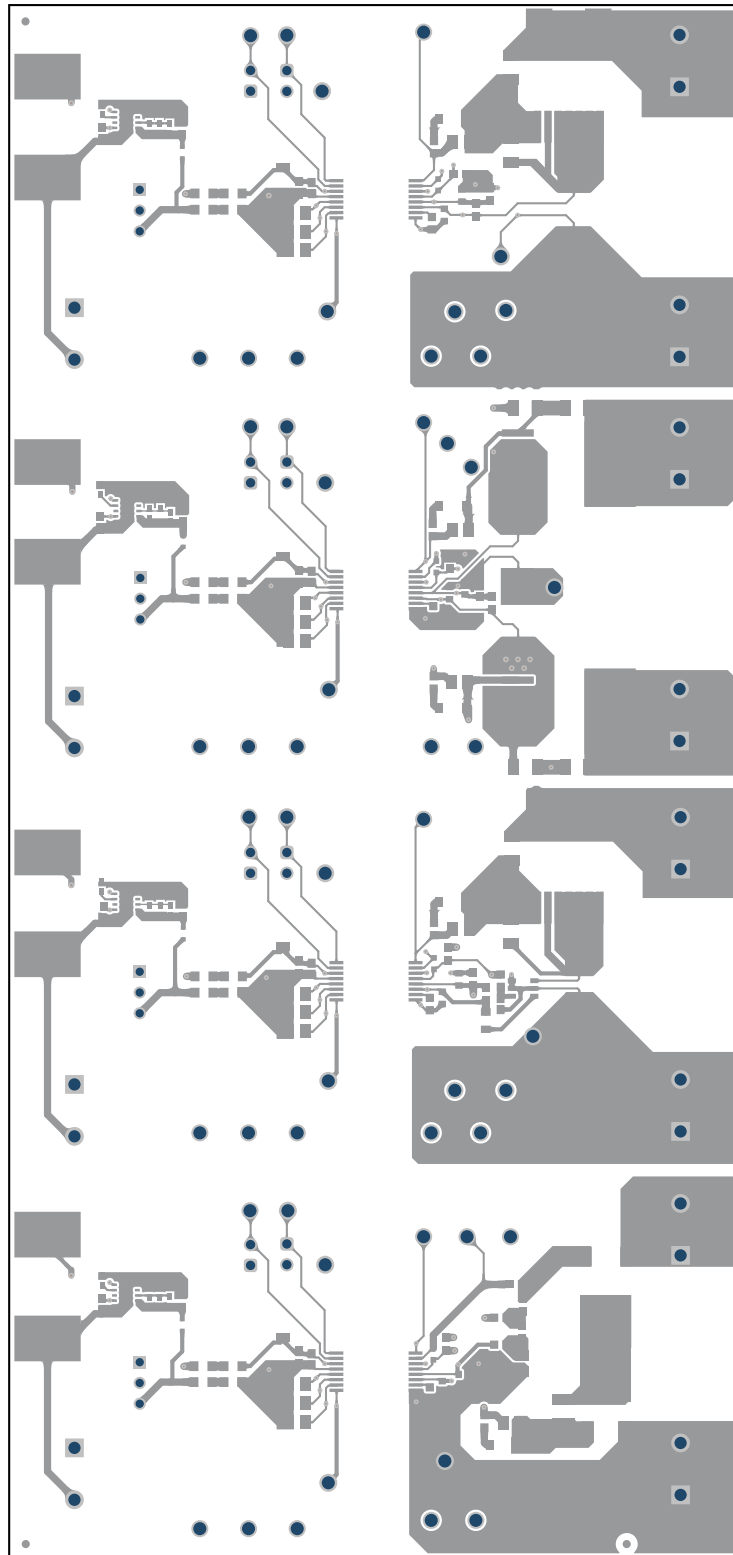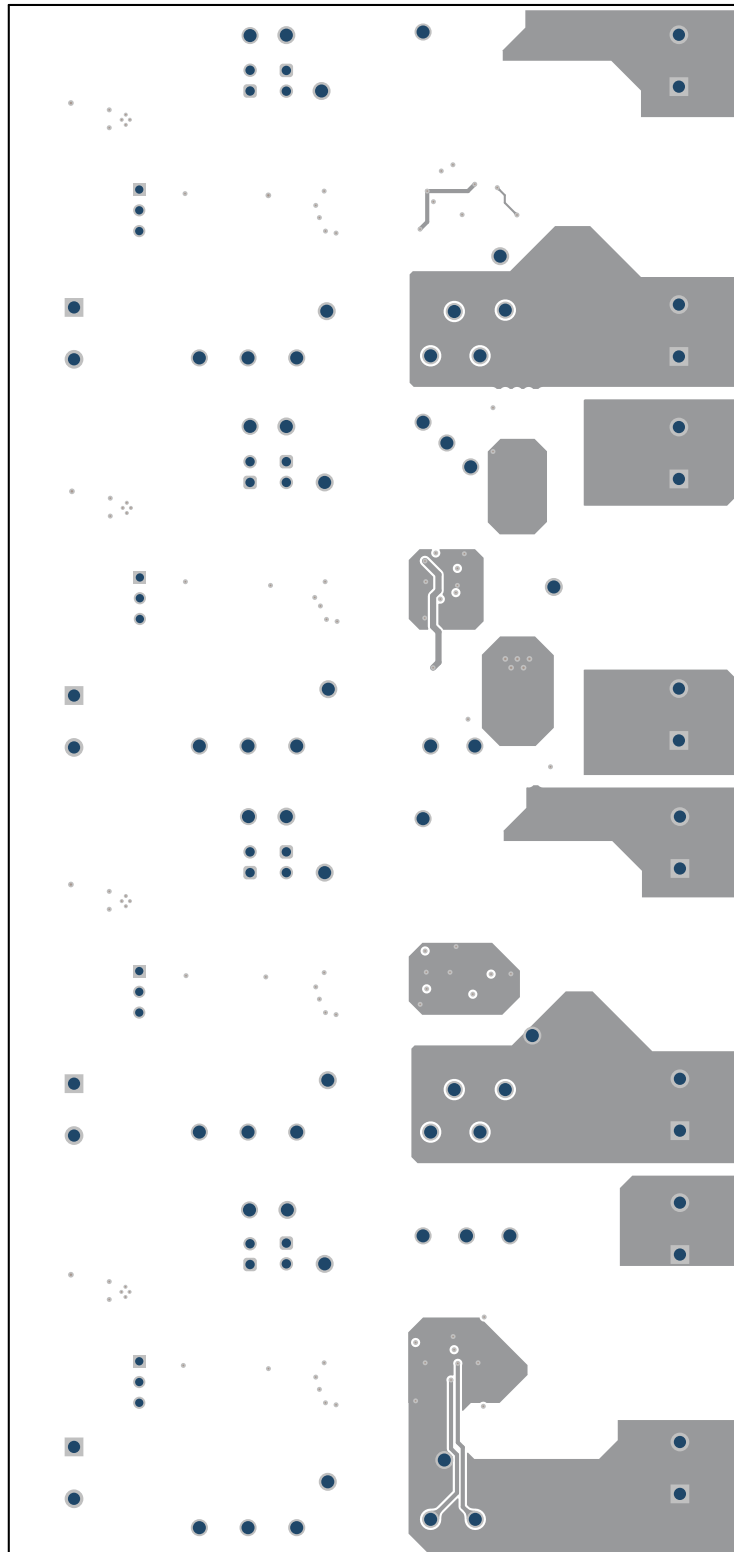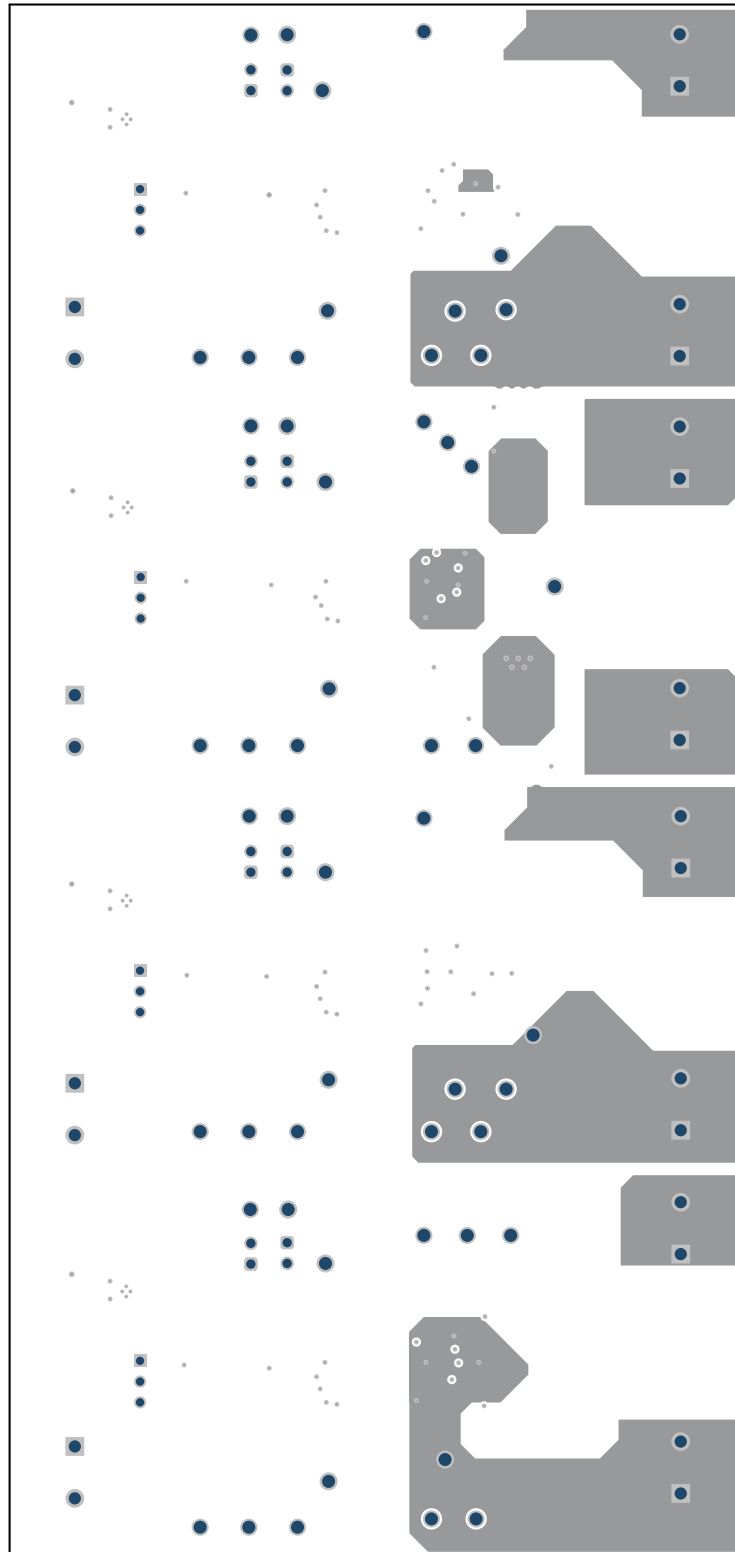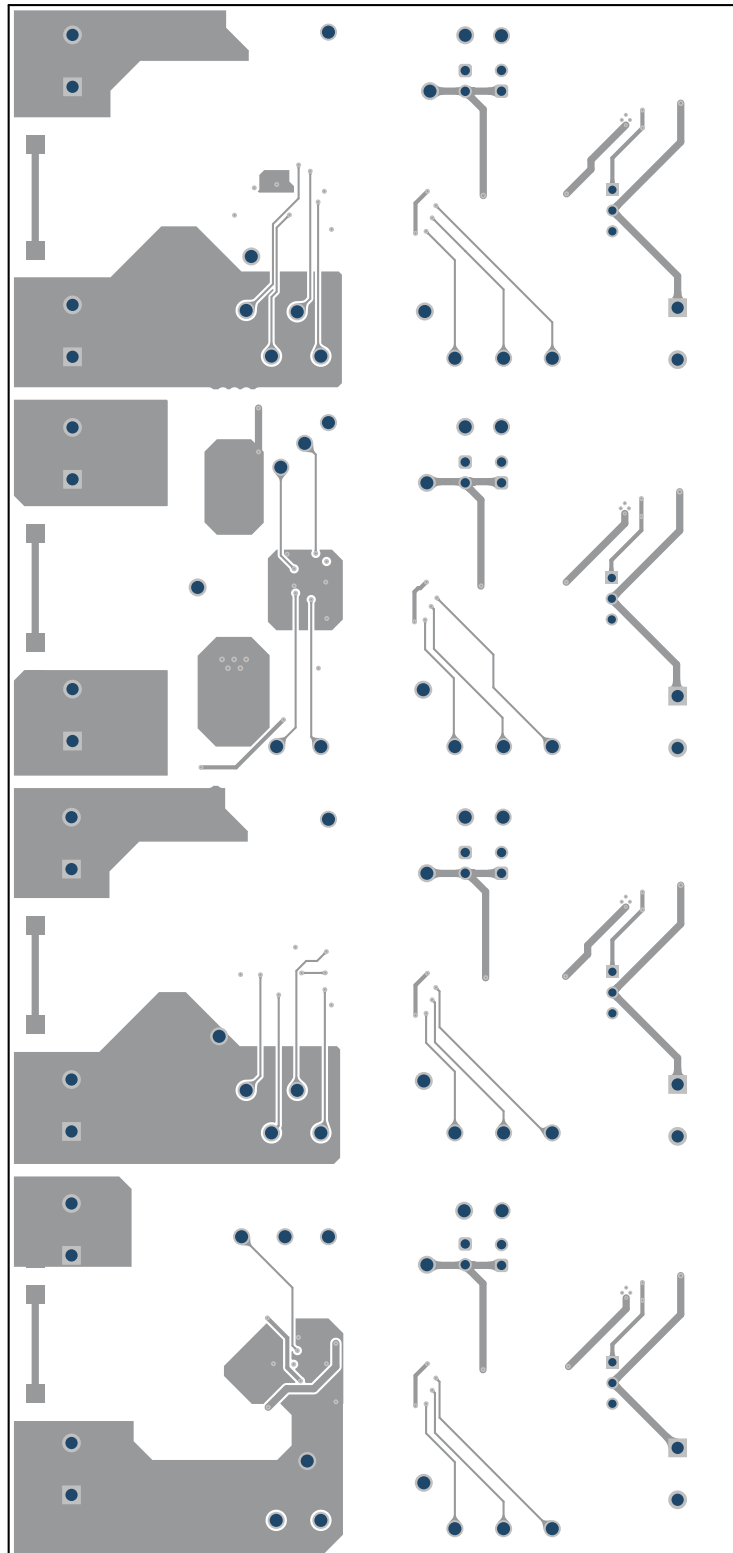

Figure 4-5. Top View Composite

Figure 4-6. PCB Top Outer Layer (top view)

Figure 4-7. PCB Internal Layer 1 (top view)

Figure 4-8. PCB Internal Layer 2 (top view)

Figure 4-9. PCB Outer Bottom Layer (bottom view)

4.3 Bill of Materials (BOM)

Bill Of Materials

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
!PCB1	1		Printed Circuit Board		LP111	Any
C1, C16, C33, C42	4	10uF	CAP, CERM, 10 µF, 25 V,+/- 5%, X7R, AEC-Q200 Grade 1, 1206	1206	C1206C106J3RACAUTO	Kemet
C2, C9, C19, C24, C34, C39, C43, C49	8	1uF	CAP, CERM, 1 uF, 25 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	GCM188R71E105KA64D	MuRata
C3, C5, C12, C15, C29, C31, C45, C52	8	10uF	CAP, CERM, 10 uF, 25 V, +/- 20%, X5R, 0603	0603	GRT188R61E106ME13D	MuRata
C4, C20, C35, C44, C53	5		CAP CER 0.1UF 50V X7R 0603	0603	C0603R104K5RAC	Kemet
C6, C22, C37, C46	4	330nF	Cap Ceramic 330nF 25V X7R 10% Pad SMD 0603 +125°C Automotive T/R	0603	CGA3E3X7R1E334K080AB	TDK
C7, C11, C13, C14, C30, C32, C47, C51	8	0.01uF	CAP, CERM, 0.01 uF, 25 V, +/- 10%, X7R, 0402	0402	GRM155R71E103KA01D	MuRata
C8, C10, C25, C26, C40, C41, C48, C50	8	1nF	1000 pF ±10% 16V Ceramic Capacitor X7R 0603 (1608 Metric)	0603	CC0603KRX7R7BB102	YAGEO
C17	1	0.022uF	CAP, CERM, 0.022 uF, 630 V, +/- 10%, X7R, 1210	1210	GRM32QR72J223KW01L	MuRata
C21, C28, C36, C54	4	68pF	CAP, CERM, 68 pF, 1000 V, +/- 5%, U2J, 1206	1206	GRM31A7U3A680JW31D	MuRata
D1, D2, D3, D4, D11	5	40V	Diode, Schottky, 40 V, 0.5 A, SOD-123	SOD-123	MBR0540T1G	ON Semiconductor
D5, D8, D9, D12	4		DIODE SCHOTTKY 60V 200MA SOD523	SOD523	PMEG6002EB,115	Nexperia
D6	1		Diode Silicon Carbide Schottky 600 V 11A (DC) Surface Mount TO-252-2	TO-252-2	C3D03060E	Cree

FB1, FB2, FB3, FB4, FB5, FB6, FB7, FB8, FB9, FB10, FB11, FB12, FB13, FB14, FB15, FB16	16		2.5 kOhms @ 100 MHz 1 Signal Line Ferrite Bead 0805 (2012 Metric) 200mA 700mOhm	0805	BBBK00201209252Y00	Pulse Electronics
H1, H2, H3, H4, H5, H6, H7, H8, H9, H10, H11, H12, H13, H14, H15, H16	16		Bumpon, Hemisphere, 0.44 X 0.20, Clear	Transparent Bumpon	SJ-5303 (CLEAR)	3M
J1, J4, J15, J19	4		Banana Jack Insul Nylon Red, TH	Banana Jack Insul Nylon Red, TH	108-0902-001	Cinch Connectivity
J2, J10, J17, J21	4		Banana Jack Insul Nylon Black, TH	Banana Jack Insul Nylon Black, TH	108-0903-001	Cinch Connectivity
J3, J9, J11, J12, J13, J18, J22, J23, J24, J27, J31, J32	12			CONN_TERM_BLOCK2	6.91251E+11	Wurth Electronics
J5, J7, J20, J28	4		Header, 100mil, 3x1, Tin, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions
J6, J8, J14, J16, J25, J26, J29, J30	8		Header, 2.54 mm, 2x1, Gold, TH	Header, 2.54mm, 2x1, TH	61300211121	Wurth Elektronik
Q1, Q3, Q4, Q5	4		MOSFET N-Channel 750 V 44A (Tc) 197W (Tc) Surface Mount D2PAK-7	D2PAK7	UJ4C075033B7S	Qorvo
Q2	1	600 V	Transistor, IGBT, 600 V, 20 A, DPAK	DPAK	STGD10NC60KDT4	STMicroelectronics
R1, R2, R3, R22, R23, R24, R34, R35, R36, R38, R39, R40	12	100k	RES, 100 k, 5%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	ERJ-6GEYJ104V	Panasonic
R4, R7, R13, R14, R16, R17, R21, R27, R30, R37, R46, R51	12	0	0 Ohms Jumper Chip Resistor 0603 (1608 Metric) Metal Element	0603	WSL060300000ZEA9	Vishay
R5, R6, R10, R31, R48	5	10.2	RES, 10.2, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	CRCW080510R2FKEA	Vishay-Dale
R8, R11, R32, R49	4	294k	RES, 294 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0402	0402	ERJ-2RKF2943X	Panasonic
R9, R12, R33, R50	4	90.9k	RES, 90.9 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0402	0402	ERJ-2RKF9092X	Panasonic

R15	1	54.9k	RES, 54.9 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060354K9FKEA	Vishay-Dale
R18	1	20.5k	RES, 20.5 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060320K5FKEA	Vishay-Dale
R19	1	3.40k	RES, 3.40 k, 1%, 0.1 W, 0603	0603	M55342K12B3E40T	TT Electronics/IRC
R20	1	11.5k	RES, 11.5 k, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	ERJ-6ENF1152V	Panasonic
R25, R29, R41, R42, R44, R45	6	2.0k	RES, 2.0 k, 5%, 0.1 W, 0603	0603	RC0603JR-072KL	Yageo
R26, R28, R43	3	60m	Res Metal Strip 2512 0.06 Ohm 1% 3W ±50ppm/°C Pad SMD Automotive T/R	2512	CRA2512-FZ-R060ELF	Bourns
R47	1	0	RES SMD 0 OHM JUMPER 1/8W 0805	0805	RC0805FR-070RL	Yageo
R52	1	3m	Res Metal Plate 2512 0.003 Ohm 1% 3W ±75ppm/C Pad SMD Automotive T/R	2512	ERJ-MS4SF3M0U	Panasonic
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8, SH-J9, SH-J10, SH-J11, SH-J12	12	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec
TP1, TP3, TP4, TP7, TP9, TP10, TP11, TP12, TP13, TP15, TP16, TP17, TP18, TP20, TP21, TP22, TP23, TP24, TP27, TP29, TP31, TP32, TP33, TP34, TP35, TP36, TP37, TP38, TP42, TP43, TP46, TP47, TP48, TP49, TP50, TP51	36		Test Point, White, Through Hole, RoHS, Bulk	5012		Keystone
TP2, TP8, TP28, TP41	4		Test Point, Multipurpose, Yellow, TH	Yellow Multipurpose Testpoint	5014	Keystone Electronics
TP5, TP14, TP30, TP44	4		Test Point, Multipurpose, Red, TH	Red Multipurpose Testpoint	5010	Keystone Electronics

TP6, TP19, TP25, TP26, TP39, TP40, TP45, TP52	8		Test Point, Multipurpose, Black, TH	Black Multipurpose Testpoint	5011	Keystone Electronics
U1	1		TPSI3133QDVXRQ1	SSOP16	TPSI3133QDVXRQ1	Texas Instruments
U2, U3, U5, U8	4		Vin 3V to 36V, 150mA, Ultra-Low-Noise, High-PSRR Low-Dropout (LDO) Linear Regulator, DRB0008A (VSON-8)	DRB0008A	TPS7A4901DRBR	Texas Instruments
U4	1		Automotive Reinforced Isolated Switch Driver with Integrated 15-V Gate Supply and Fault Indicators	SSOP16	TPSI3110QDVXRQ1	Texas Instruments
U6, U7	2		Automotive Reinforced Isolated Switch Driver with Integrated 15-V Gate Supply and Fault/Alarm Indicators	SSOP16	TPSI3100QDVXRQ1	Texas Instruments
U9	1		Bidirectional, Low- and High-Side Measurement, Multichannel, Voltage Output, Current-Sense Amplifier, DBV0006A (SOT-6)	DBV0006A	INA181A1IDBVR	Texas Instruments
C18, C23, C27, C38, C55	0	100pF	CAP, CERM, 100 pF, 1000 V, +/- 5%, U2J, 1206	1206	GRM31A7U3A101JW31D	MuRata
D7, D10, D13, D14, D17, D18	0		824520402 Tvs Diode, Unidir, 400V, Smb Rohs Compliant: Yes			
D15, D16	0		824521402 Tvs Diode, Bidir, 400V, Do-214Aa Rohs Compliant: Yes			
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A

5 Additional Information

5.1 Trademarks

All trademarks are the property of their respective owners.

6 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision * (November 2023) to Revision A (January 2026)   **Page**

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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 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.