参考文献

EVM User's Guide: TPSI31xxQ1EVM

TPSI31xx-Q1 评估模块

说明

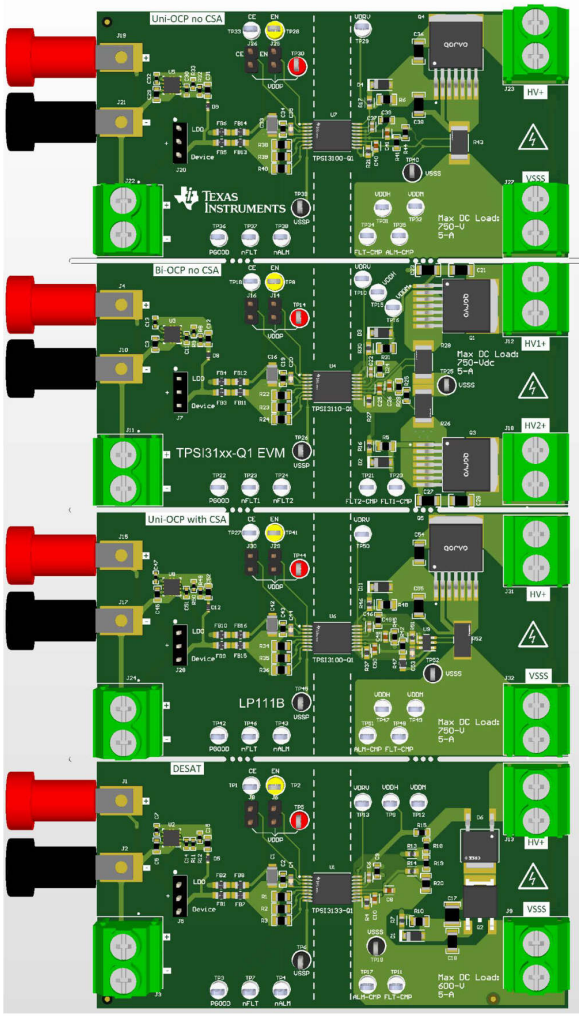
TPSI31xx-Q1 评估模块 (EVM) 可帮助设计人员评估 TPSI31xx-Q1 器件系列的运行情况和性能。该电路板采用 TPSI3100-Q1 及其相关型号，这是一款隔离式开关驱动器，具有集成的 15.8V 栅极电源和故障/警报指示灯。TPSI3100-Q1 是一款 5kVRMS 增强型隔离式开关驱动器，具有 1.5A 峰值拉电流和 3A 峰值灌电流。该器件能够产生 15.8V 稳压次级电源，该电源支持选择多种电源开关，例如 MOSFET、SiC MOSFET 和 IGBT。该 EVM 具有四种过流保护配置。此外，该 EVM 还包含一个可调节 5V LDO 来支持电池供电。

特性

- 4 个分线板：无电流检测放大器的单向过流保护（5A 警报、10A 故障），无电流检测放大器的双向过流保护（5A 故障），具有电流检测放大器的单向过流保护（5A 警报、10A 故障），DESAT（7A 警报、15A 故障）
- 电流检测放大器 (INA181-Q1)，用于降低功率耗散
- 超低噪声 LDO（5V 至 20V 输入），用于在可调电源不可用时为电路供电
- 驱动外部功率晶体管，包括用于常见穿孔和表面贴装封装的占位符
- 无需隔离式次级电源
- 5kVRMS 增强型隔离
- 具有 1.5A 峰值拉电流和 3A 峰值灌电流的 15.8V 栅极驱动
- 适用于外部辅助电路的高达 25mW、5V 电源
- 具有集成电压基准 +/-1.5% 的双通道隔离式高速比较器
- 用于故障和警报指示灯的开漏输出

应用

- 固态继电器（SSR）
- 混合动力、电动和动力总成系统
- 楼宇自动化
- 工厂自动化和控制



PCB 视图

1 评估模块概述

1.1 引言

TPSI31xx-Q1 是一款完全集成的隔离式开关驱动器，与外部电源开关结合使用时，可构成完整的隔离式固态继电器设计。TPSI31xx-Q1 可支持为各种交流或直流应用驱动单电源开关和双背对背并联电源开关。TPSI31xx-Q1 集成一个通信反向通道，该反向通道可通过开漏输出、PGOOD（电源正常状态）、FLT1（故障 1）和 ALM1（警报 1）将各种状态信息从次级侧传输到初级侧。TPSI31xx-Q1 集成式隔离保护功能极其稳健，与使用传统机械继电器和光耦合器的产品相比，其可靠性更高、功耗更低，且温度范围更宽。

本用户指南介绍了该 EVM 的连接器、测试点描述、原理图、物料清单和电路板布局布线。

1.2 套件内容

- TPSI31xx-Q1 评估模块电路

1.3 规格

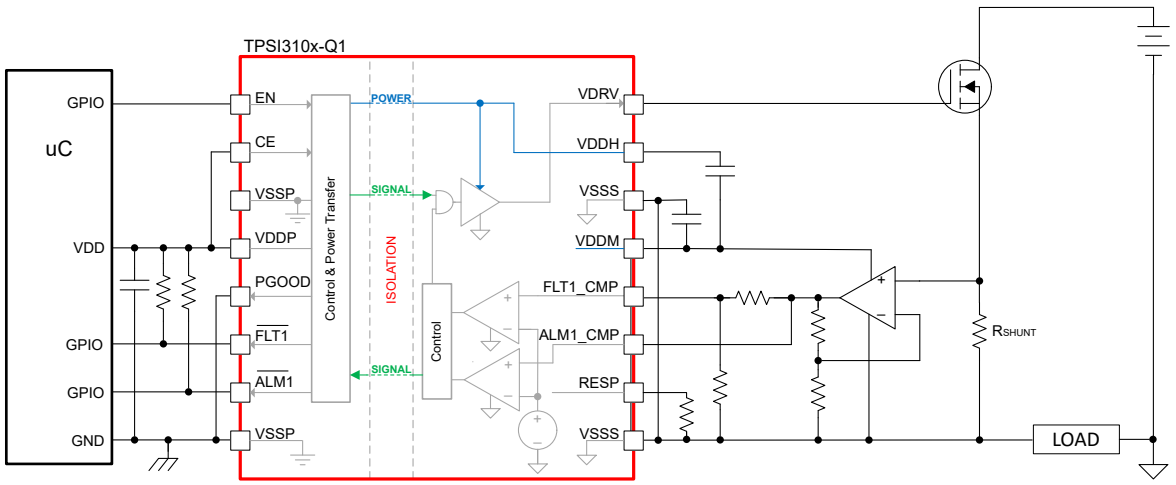


图 1-1. TPSI3100-Q1 简化原理图

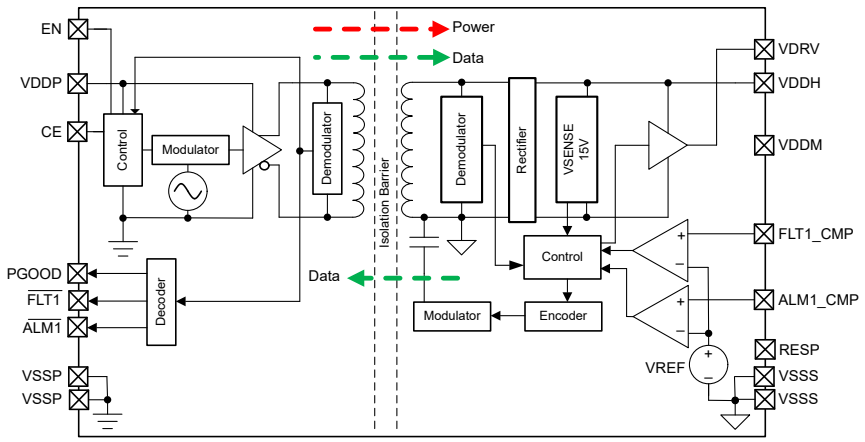


图 1-2. TPSI310x Q1 功能方框图

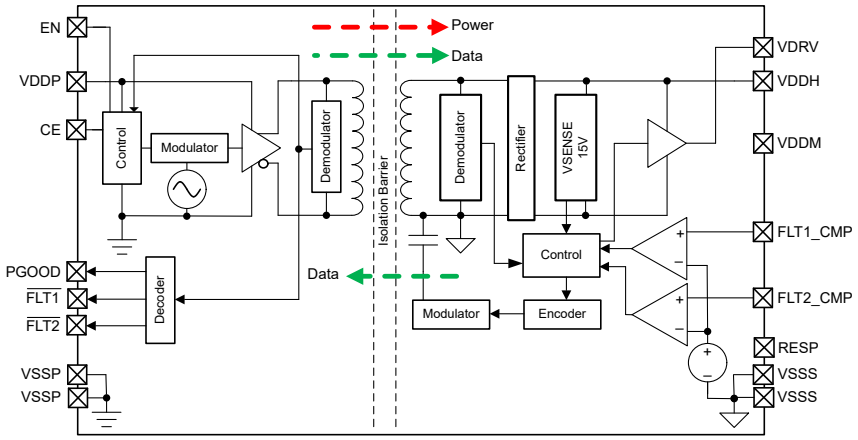


图 1-3. TPSI311x Q1 功能方框图

1.4 器件信息

TPSI31XXQ1EVM 是一款评估模块 (EVM)，旨在演示 TPSI31xx-Q1 系列器件在过流应用中的性能和功能。该系列包括下表中所示的器件，表中指出了各款器件在性能和功能上的差异。

器件型号	REF	比较器	锁存故障
TPSI3100-Q1	0.3V	1 个故障/1 个警报	否
TPSI3103-Q1	1.2V		
TPSI3100L-Q1	0.3V	1 个锁存故障/1 个警报	是
TPSI3103L-Q1	1.2V		
TPSI3110-Q1	0.3V	2 个故障	否
TPSI3113-Q1	1.2V		
TPSI3110L-Q1	0.3V	2 个锁存故障	是
TPSI3113L-Q1	1.2V		

2 硬件

2.1 其他图像

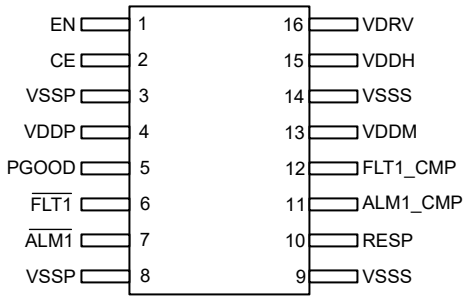


图 2-1. TPSI310x-Q1 DVX 封装 16 引脚 SSOP 顶视图

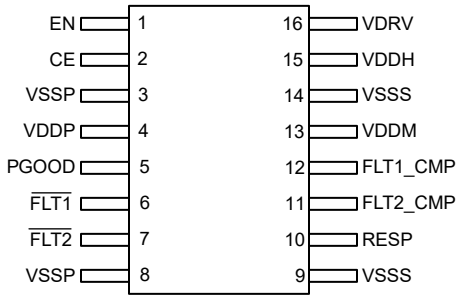


图 2-2. TPSI311x-Q1 DVX 封装 16 引脚 SSOP 顶视图

2.2 接头信息

单向 OCP，无 CSA

名称	说明
J19	低压 + 香蕉插孔输入
J21	低电压 - 香蕉插孔输入
J22	低电压 + 和 - 线输入
J23	高压 + 输入
J27	高压 - 输入 (VSSS)

双向 OCP，无 CSA

名称	说明
J4	低压 + 香蕉插孔输入
J10	低电压 - 香蕉插孔输入
J11	低电压 + 和 - 线输入
J12	高压 + 输入
J18	高压 - 输入 (VSSS)

单向 OCP，具有 CSA

名称	说明
J15	低压 + 香蕉插孔输入
J17	低电压 - 香蕉插孔输入
J24	低电压 + 和 - 线输入
J31	高压 + 输入
J32	高压 - 输入 (VSSS)

DESAT

名称	说明
J1	低压 + 香蕉插孔输入
J2	低电压 - 香蕉插孔输入
J3	低电压 + 和 - 线输入
J13	高压 + 输入
J9	高压 - 输入 (VSSS)

2.3 跳线信息

单向 OCP，无 CSA

名称	说明
J20	选择香蕉插孔/导线输入来连接到 LDO（位置 1-2）或直接连接到器件（位置 2-3）
J26	将芯片使能 (CE) 拉高至 VDDP
J25	将使能 (EN) 拉高至 VDDP

双向 OCP，无 CSA

名称	说明
J7	选择香蕉插孔/导线输入来连接到 LDO（位置 1-2）或直接连接到器件（位置 2-3）
J16	将芯片使能 (CE) 拉高至 VDDP
J14	将使能 (EN) 拉高至 VDDP

单向 OCP，具有 CSA

名称	说明
J28	选择香蕉插孔/导线输入来连接到 LDO（位置 1-2）或直接连接到器件（位置 2-3）
J30	将芯片使能 (CE) 拉高至 VDDP
J29	将使能 (EN) 拉高至 VDDP

DESAT

名称	说明
J5	选择香蕉插孔/导线输入来连接到 LDO（位置 1-2）或直接连接到器件（位置 2-3）

名称	说明
J8	将芯片使能 (CE) 拉高至 VDDP
J6	将使能 (EN) 拉高至 VDDP

2.4 测试点

单向 OCP，无 CSA

名称	说明
TP33	芯片使能 (CE)
TP28	使能 (EN)
TP30	器件电源输入 (VDDP)
TP36	电源正常状态 (PGOOD)
TP37	反相故障状态 (nFLT)
TP38	反转警报状态 (nALM)
TP39	器件电源接地 (VSSP)
TP29	器件驱动程序输出 (VDRV)
TP40	器件驱动程序输出基准 (VSSS)
TP31	自举电容的器件次级电源轨 (VDDH)
TP32	自举电容的器件次级电源轨 (VDDM)
TP34	器件次级故障比较器输入 (FLT-CMP)
TP35	器件次级警报比较器输入 (ALM-CMP)

双向 OCP，无 CSA

名称	说明
TP18	芯片使能 (CE)
TP8	使能 (EN)
TP14	器件电源输入 (VDDP)
TP22	电源正常状态 (PGOOD)
TP23	反相故障状态 (nFLT1)
TP24	倒置警报状态 (nFLT2)
TP26	器件电源接地 (VSSP)
TP10	器件驱动程序输出 (VDRV)
TP25	器件驱动程序输出基准 (VSSS)
TP15	自举电容的器件次级电源轨 (VDDH)
TP16	自举电容的器件次级电源轨 (VDDM)
TP21	器件次级故障比较器输入 (FLT2-CMP)
TP20	器件次级警报比较器输入 (FLT1-CMP)

单向 OCP，具有 CSA

名称	说明
TP27	芯片使能 (CE)
TP41	使能 (EN)
TP44	器件电源输入 (VDDP)
TP42	电源正常状态 (PGOOD)
TP46	反相故障状态 (nFLT)

名称	说明
TP43	反转警报状态 (nALM)
TP45	器件电源接地 (VSSP)
TP50	器件驱动程序输出 (VDRV)
TP52	器件驱动程序输出基准 (VSSS)
TP47	自举电容的器件次级电源轨 (VDDH)
TP49	自举电容的器件次级电源轨 (VDDM)
TP51	器件次级故障比较器输入 (ALM-CMP)
TP48	器件次级警报比较器输入 (FLT-CMP)

DESAT

名称	说明
TP1	芯片使能 (CE)
TP2	使能 (EN)
TP5	器件电源输入 (VDDP)
TP3	电源正常状态 (PGOOD)
TP7	反相故障状态 (nFLT)
TP4	反转警报状态 (nALM)
TP6	器件电源接地 (VSSP)
TP13	器件驱动程序输出 (VDRV)
TP19	器件驱动程序输出基准 (VSSS)
TP9	自举电容的器件次级电源轨 (VDDH)
TP12	自举电容的器件次级电源轨 (VDDM)
TP17	器件次级故障比较器输入 (ALM-CMP)
TP11	器件次级警报比较器输入 (FLT-CMP)

3 实现结果

3.1 评估设置

以下波形显示过流保护电路在高侧与负载板串联连接的情况。负载板有助于提供两个电流水平：一个用于触发警报，另一个用于触发故障。

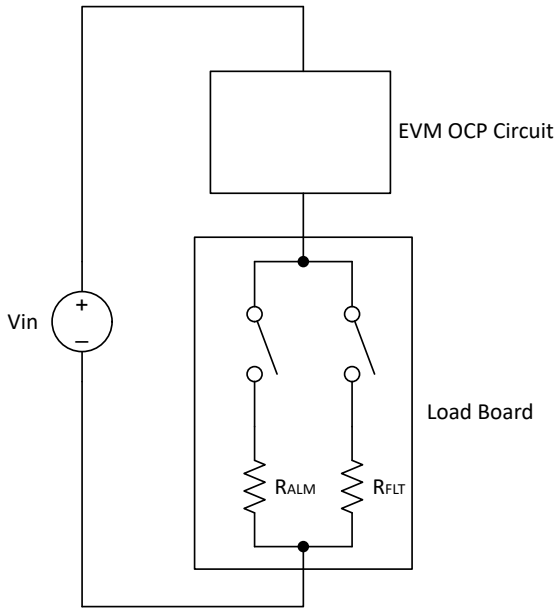


图 3-1. 简化的实验设置原理图

3.2 性能数据和结果

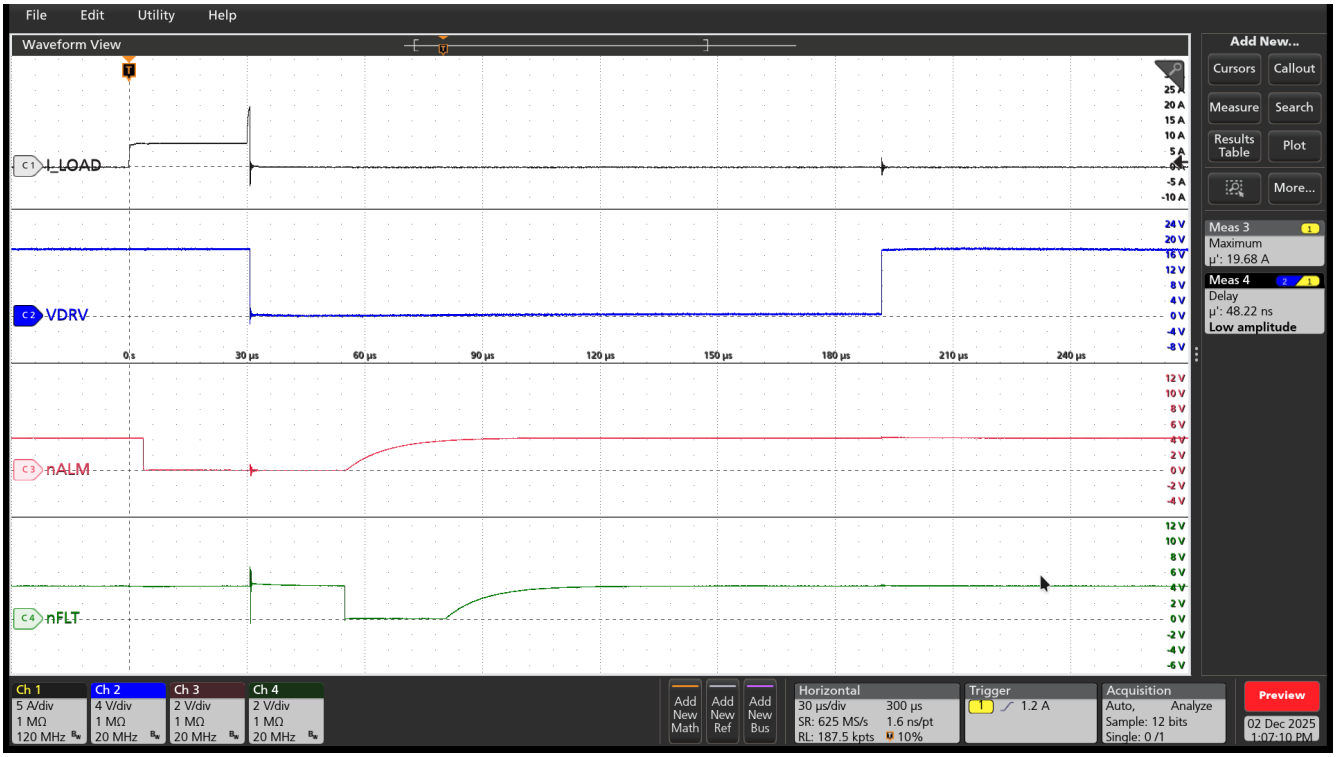


图 3-2. 无电流检测放大器的单向过流保护：两级检测（单向 OCP，无 CSA）

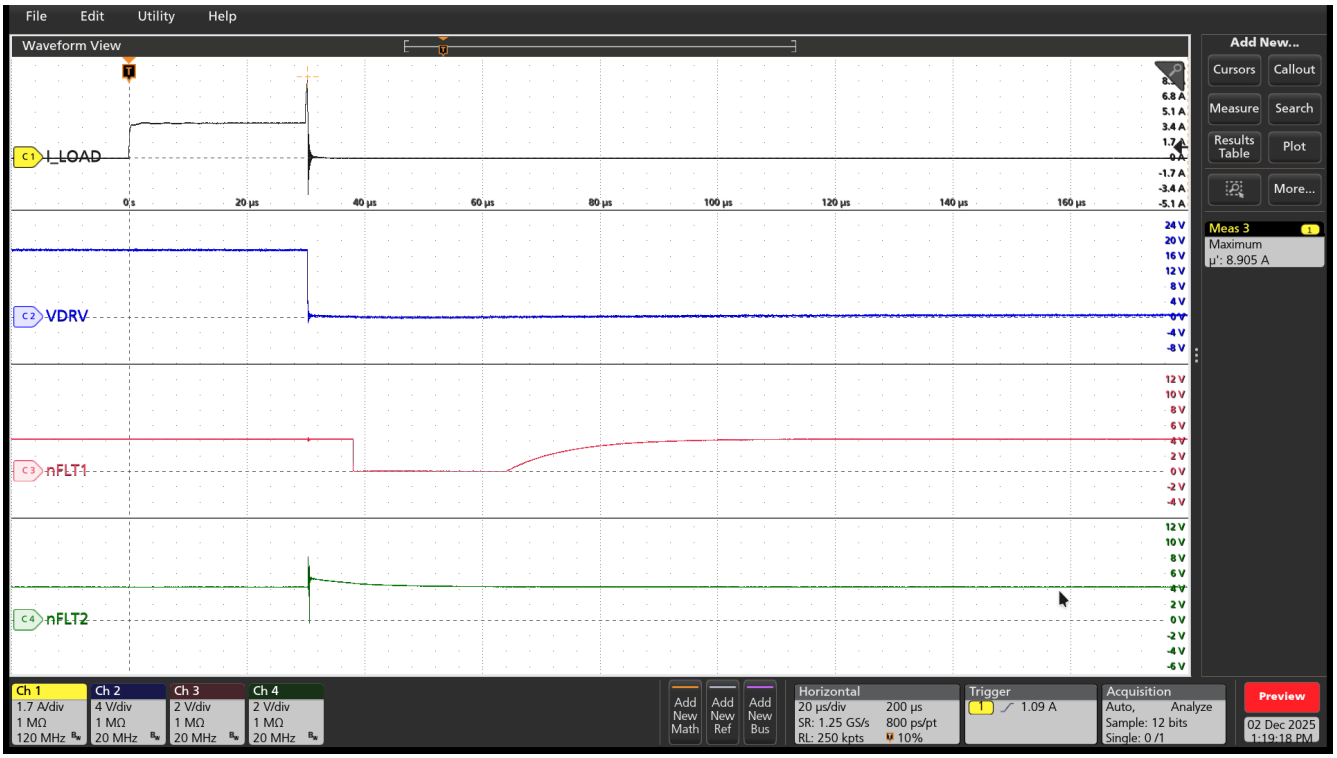


图 3-3. 无电流检测放大器的双向过流保护（方向 A）

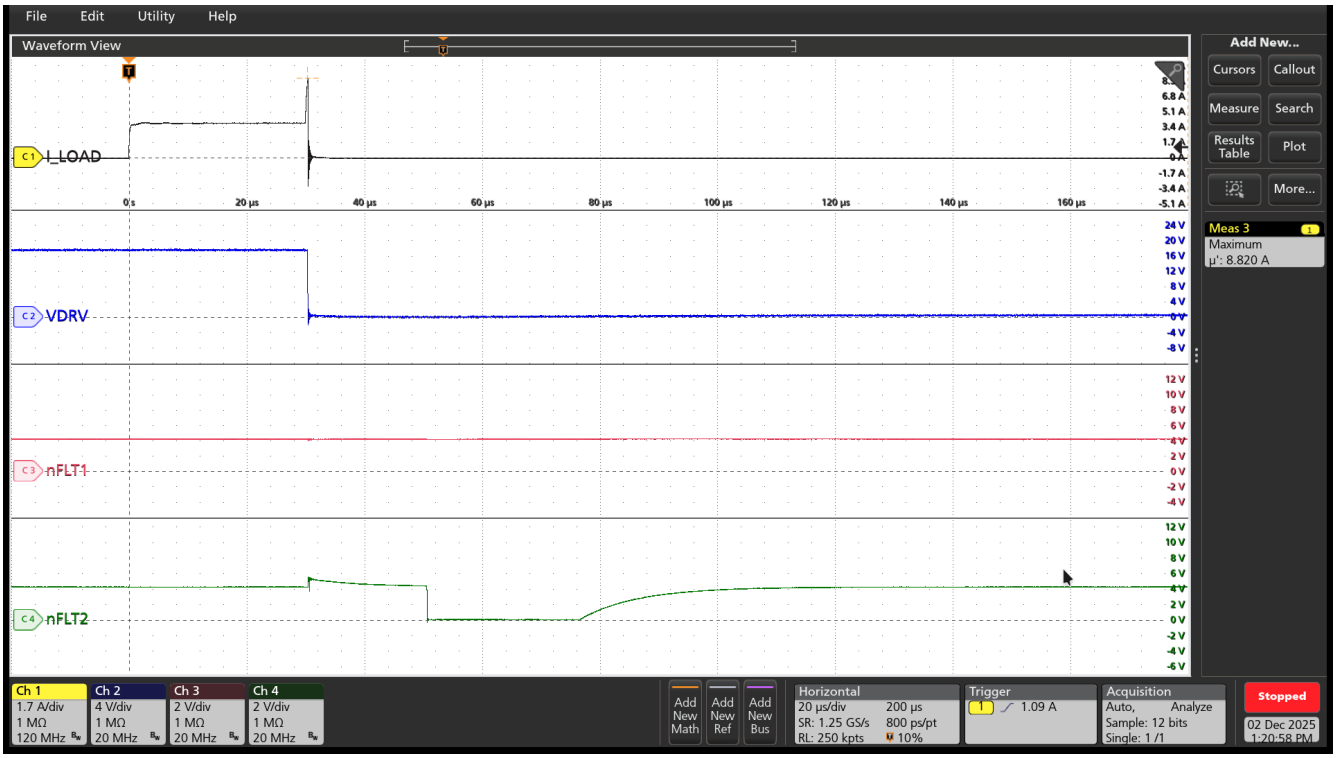


图 3-4. 无电流检测放大器的双向过流保护（方向 B）

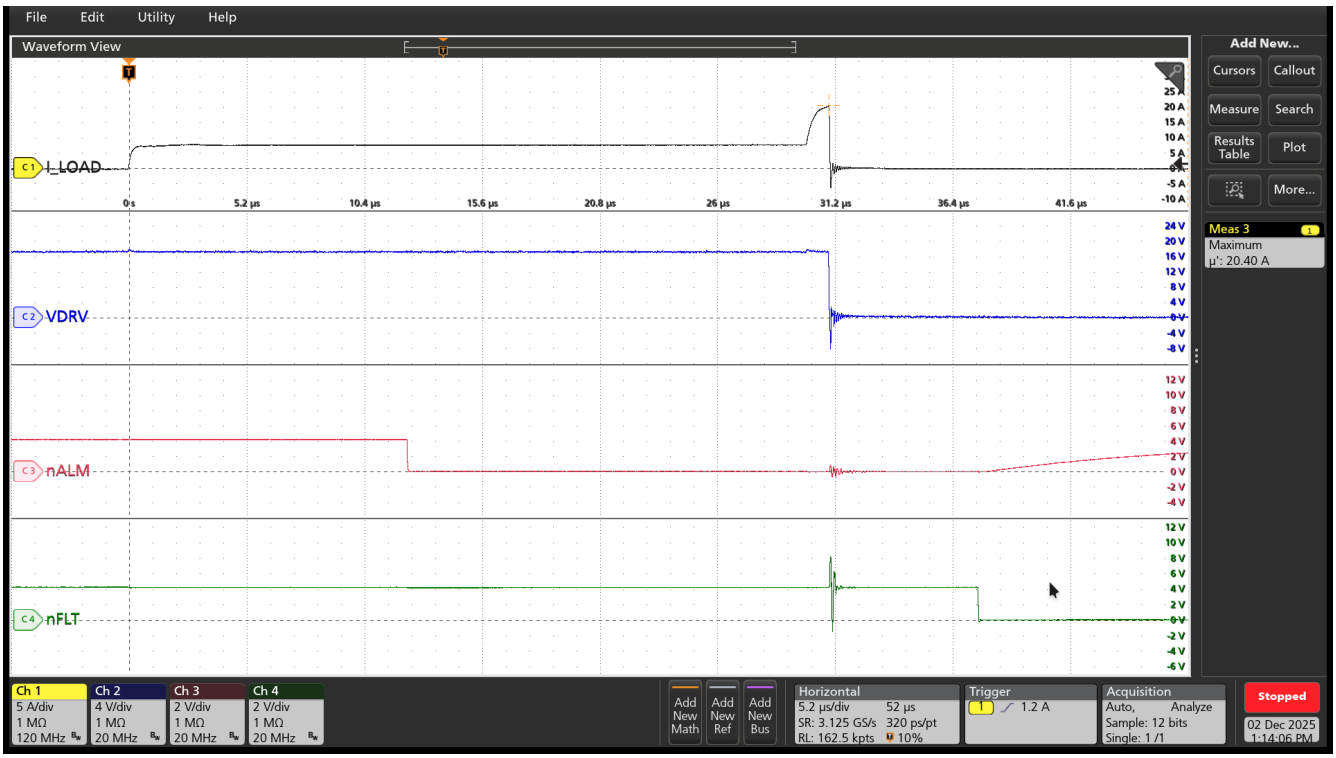


图 3-5. 具有电流检测放大器的单向过流保护：两级检测

DESAT：将 C8 和 C10 更改为 15pF

阅读文章 TPSI3133 的 DESAT 如何保护您昂贵的 SiC MOSFET 和 IGBT，了解有关 DESAT 的更多信息。

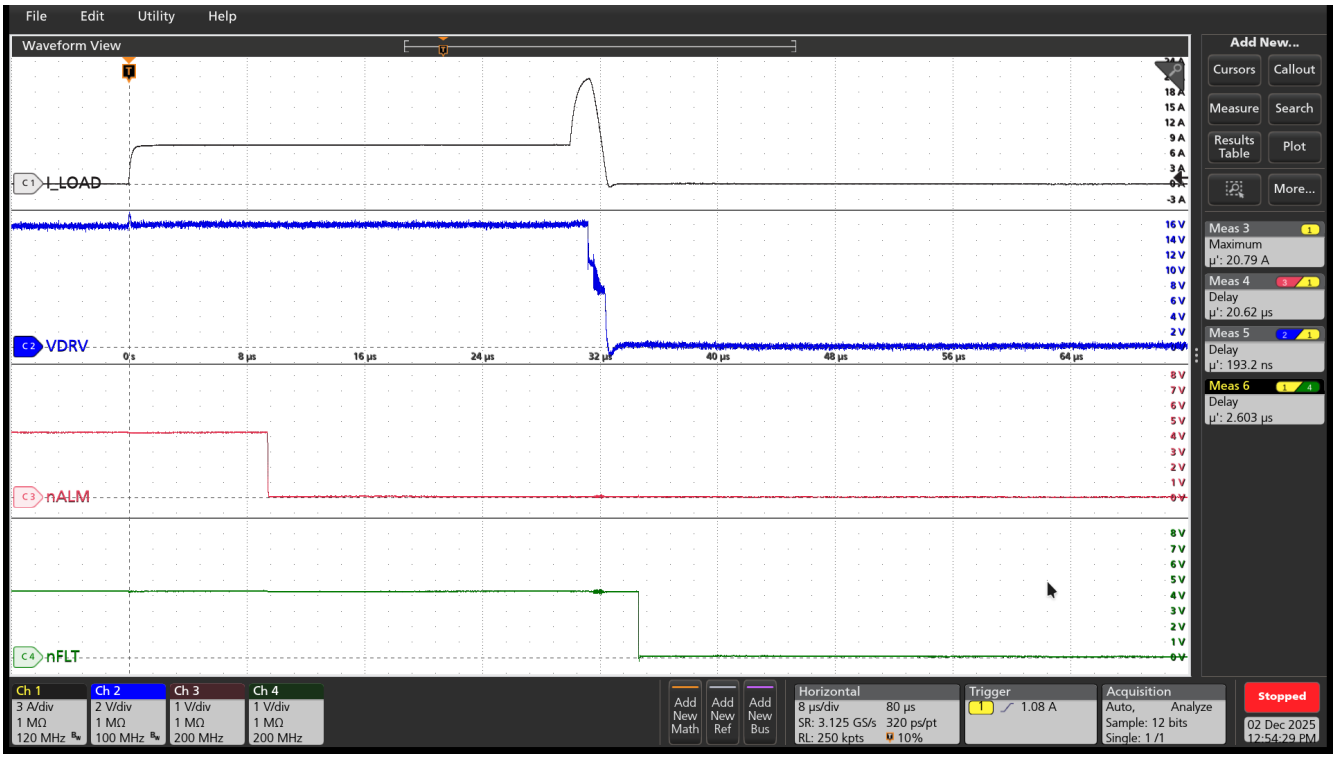


图 3-6. DESAT：两级检测

4 硬件设计文件

4.1 原理图

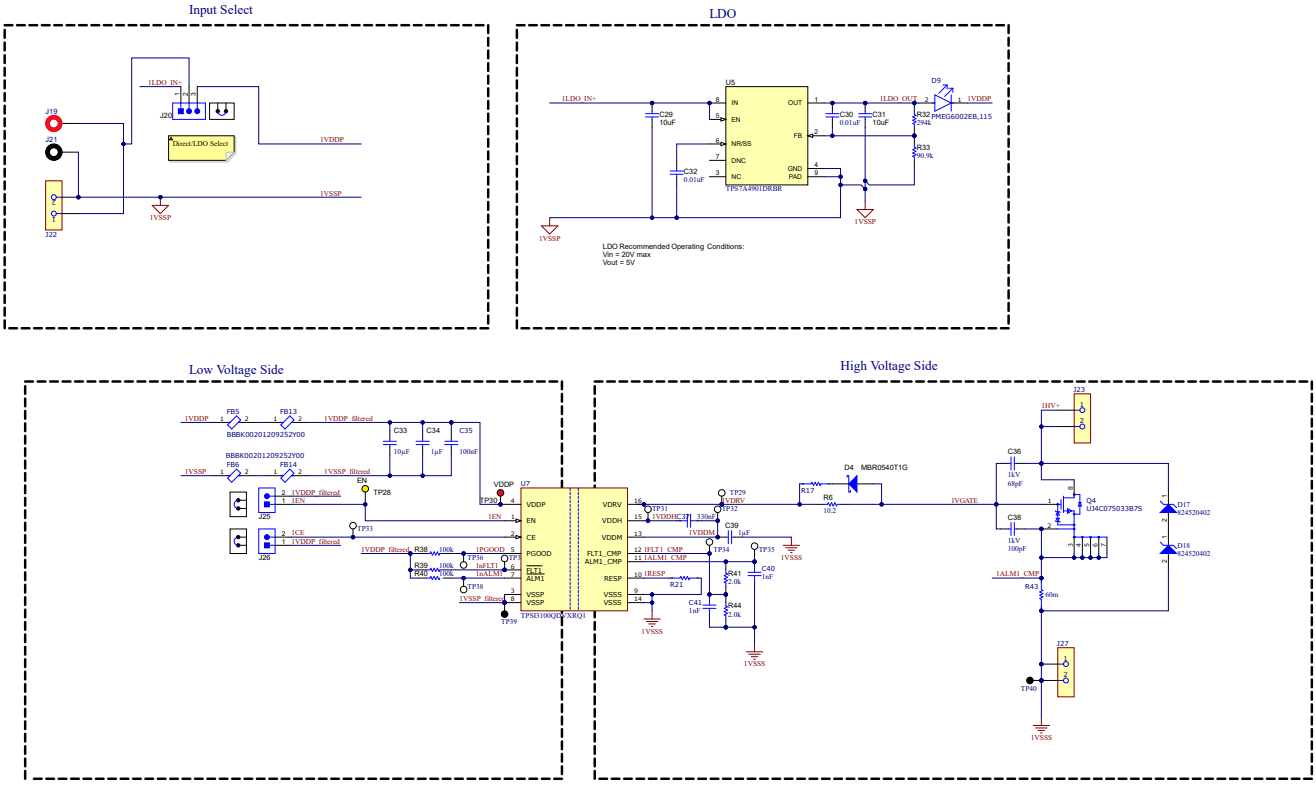


图 4-1. 无电流检测放大器的单向过流保护

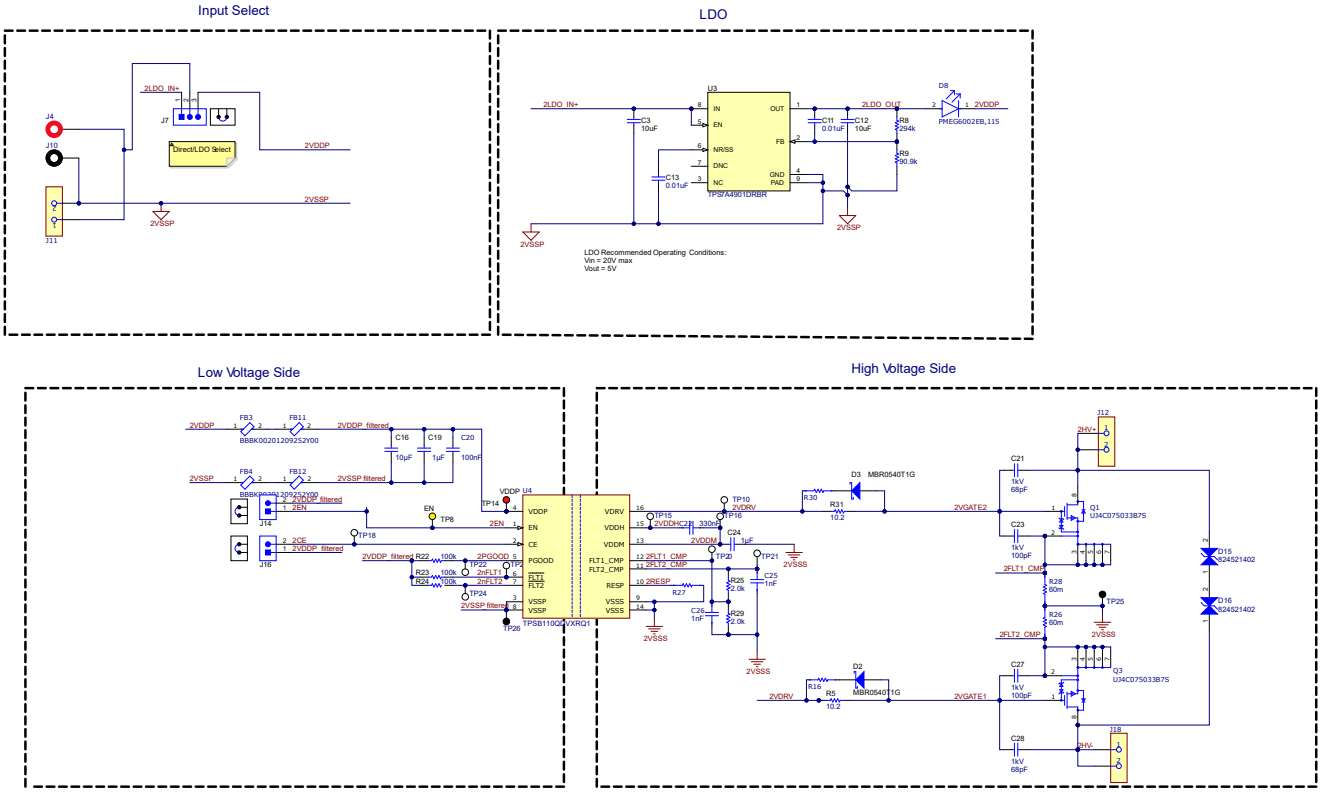


图 4-2. 无电流检测放大器的双向过流保护

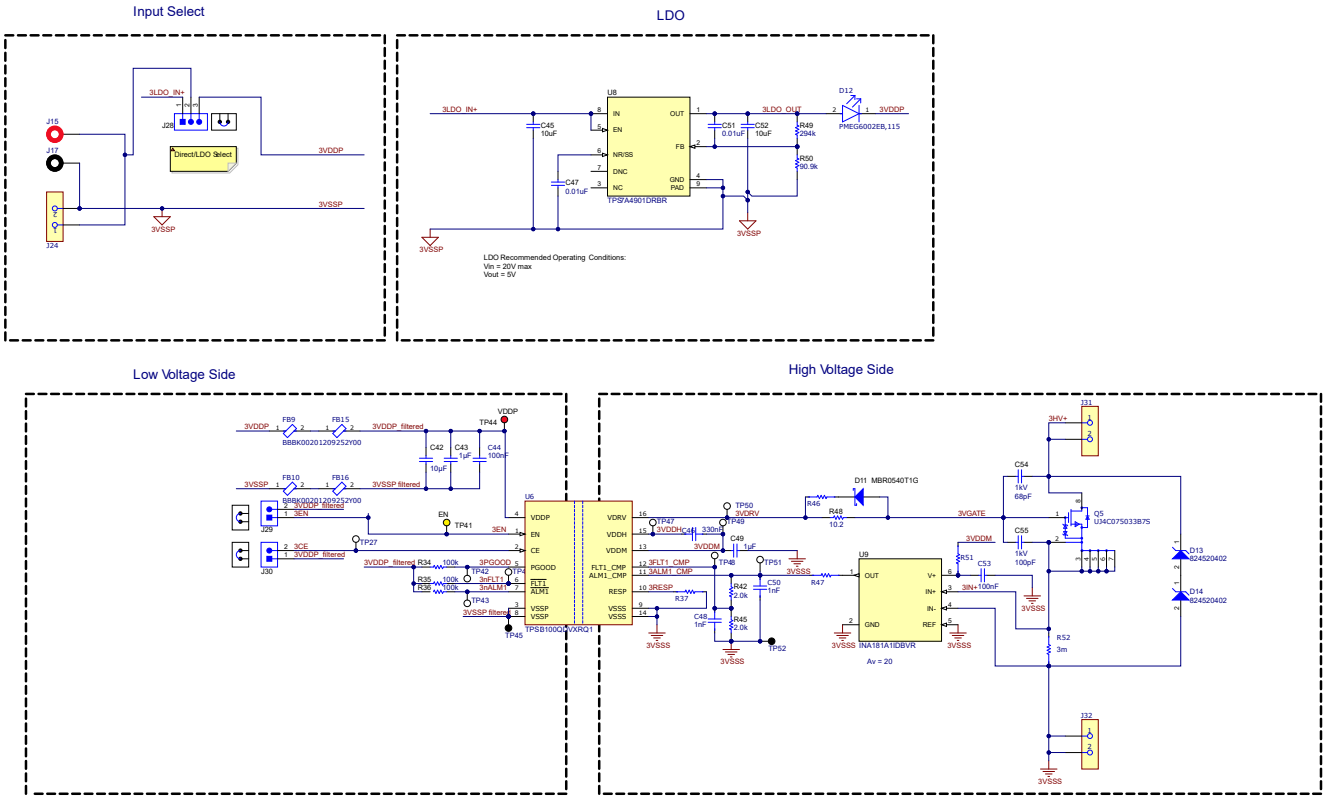


图 4-3. 采用电流检测放大器的单向过流保护

阅读文章 TPSI3133 的 DESAT 如何保护您昂贵的 SiC MOSFET 和 IGBT，了解有关 DESAT 的更多信息。

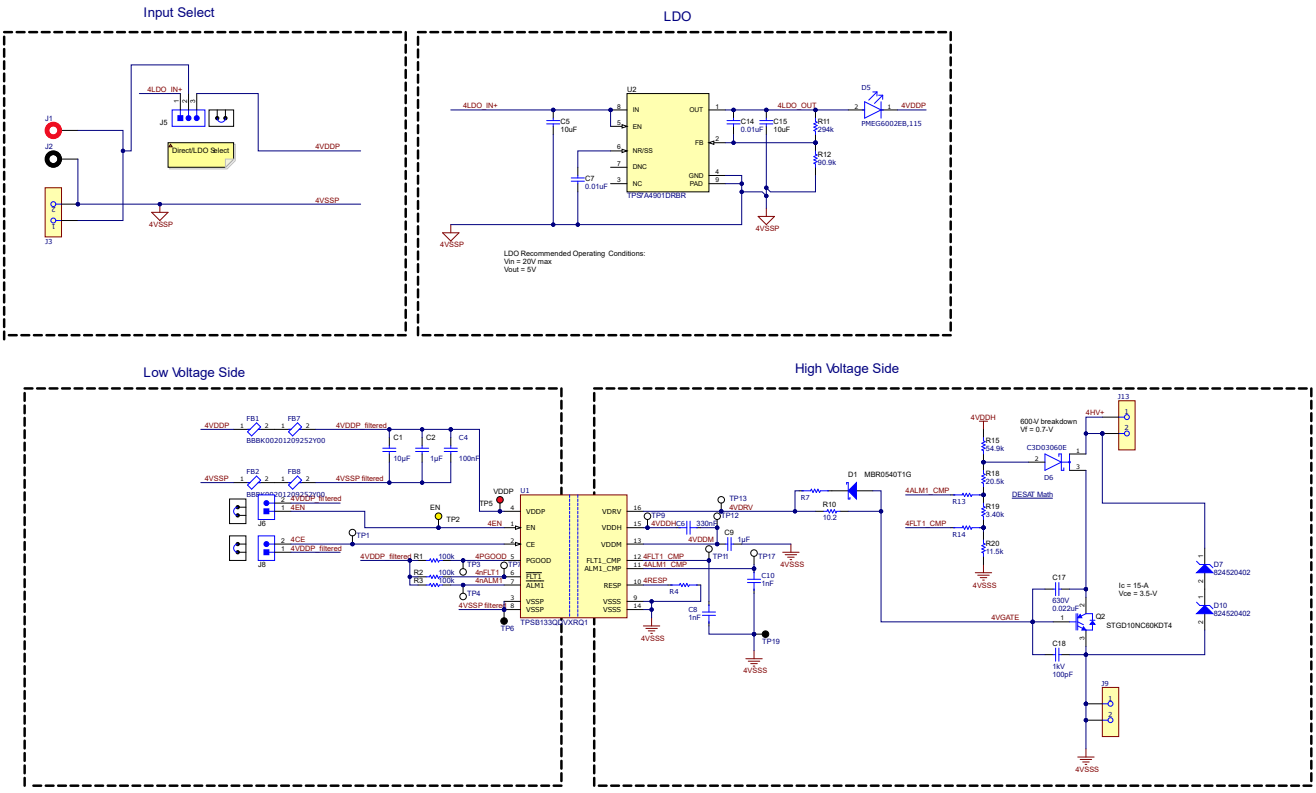


图 4-4. DESAT

4.2 PCB 布局

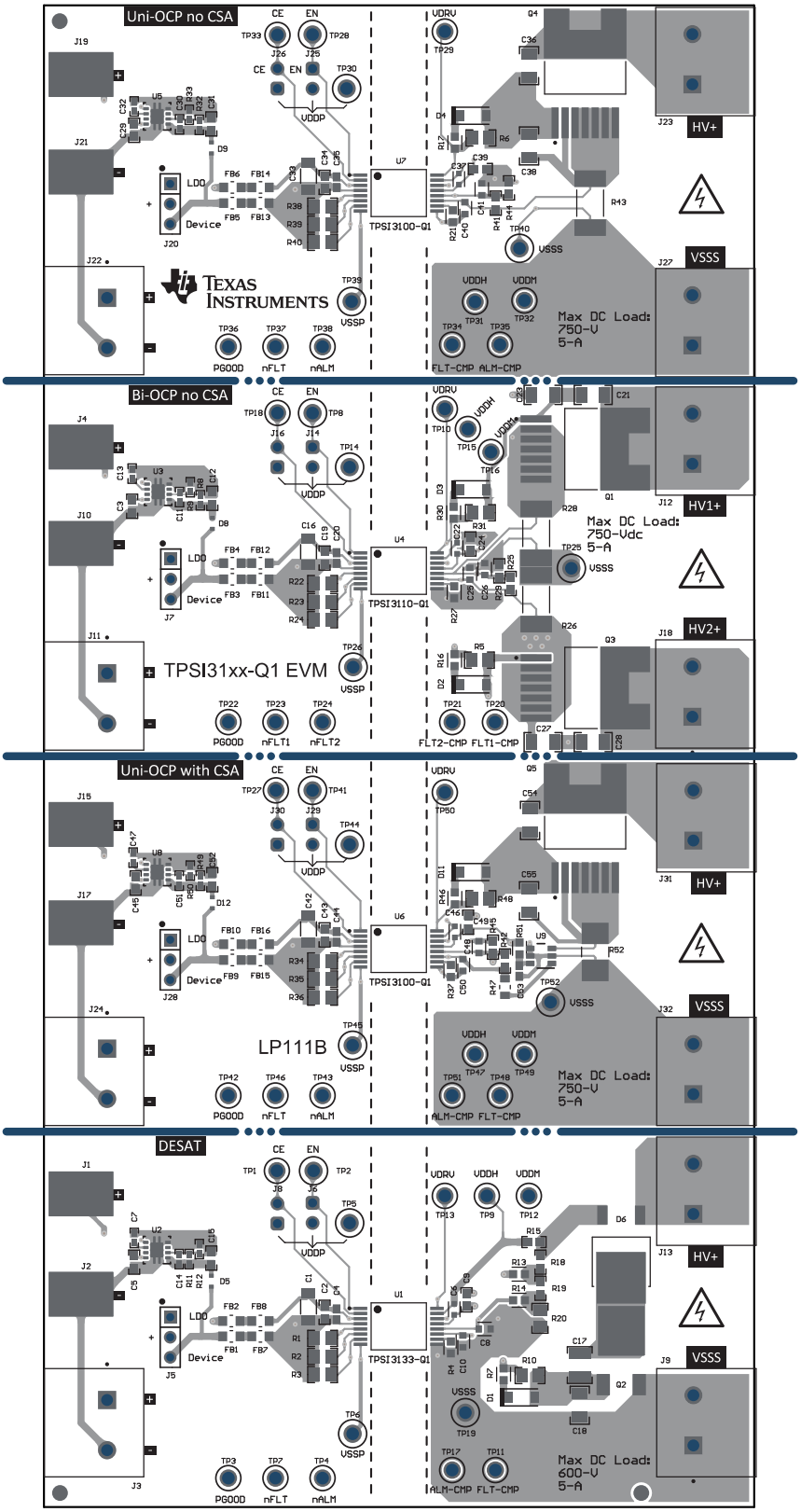


图 4-5. 顶视图组合

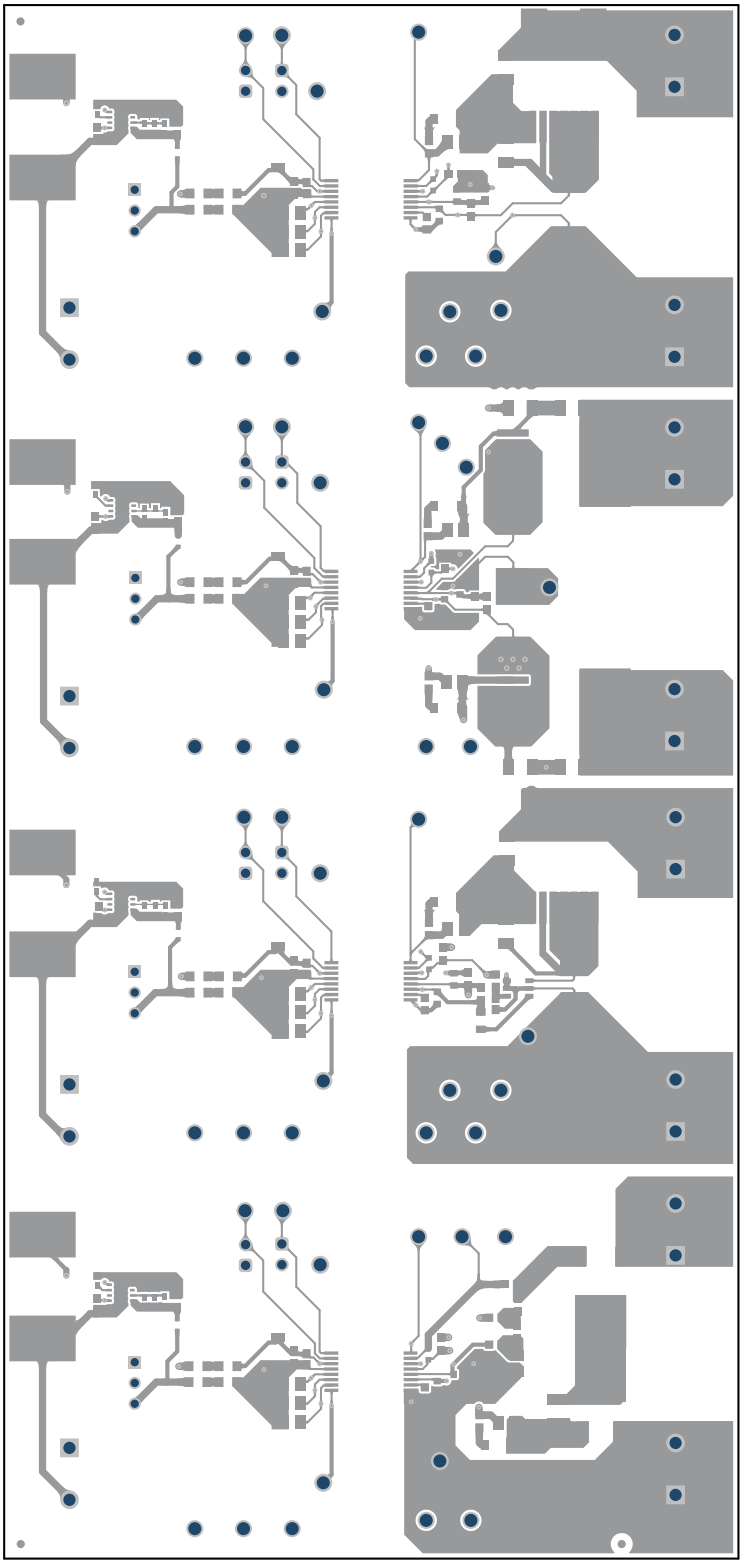


图 4-6. PCB 顶层外层（顶视图）

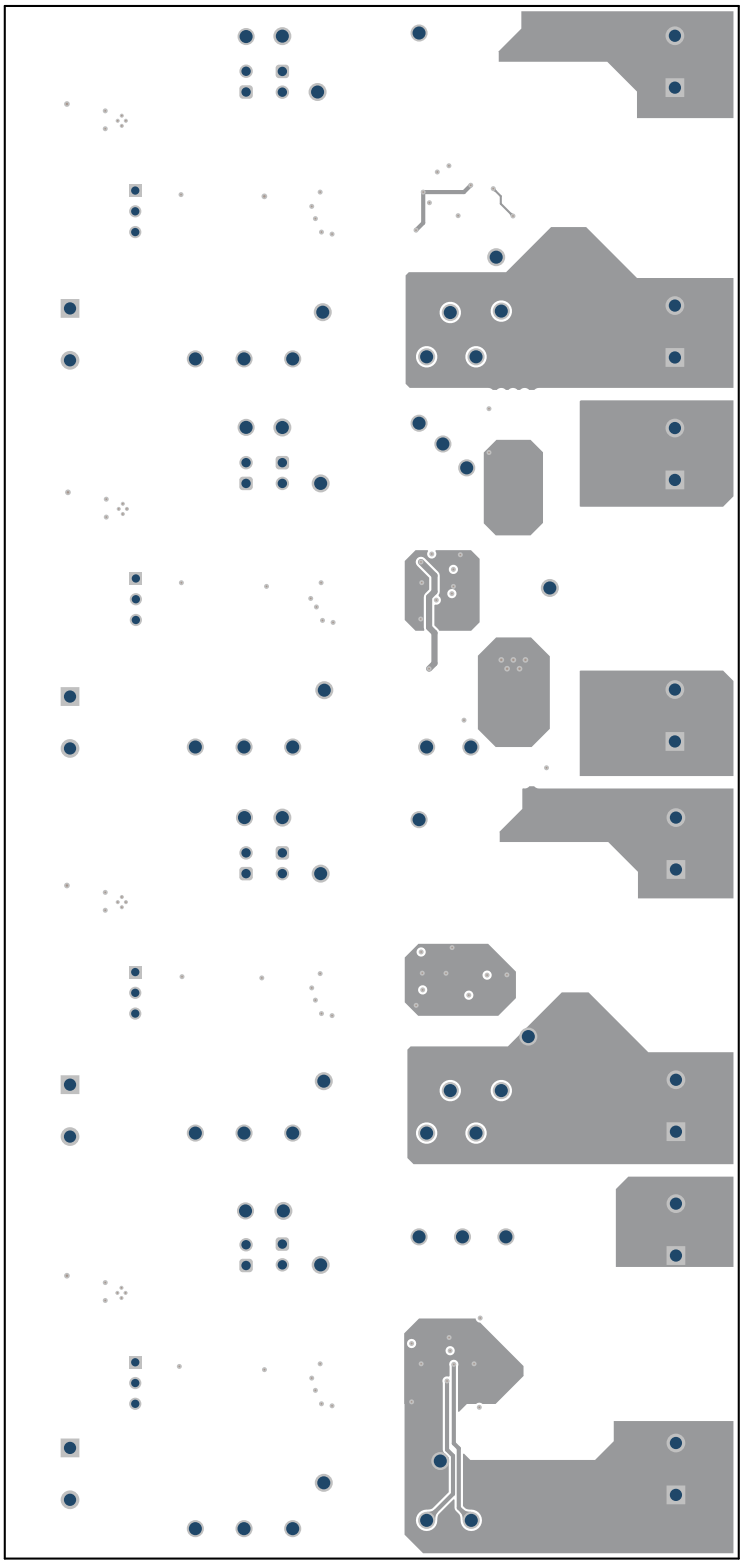


图 4-7. PCB 内层 1（顶视图）

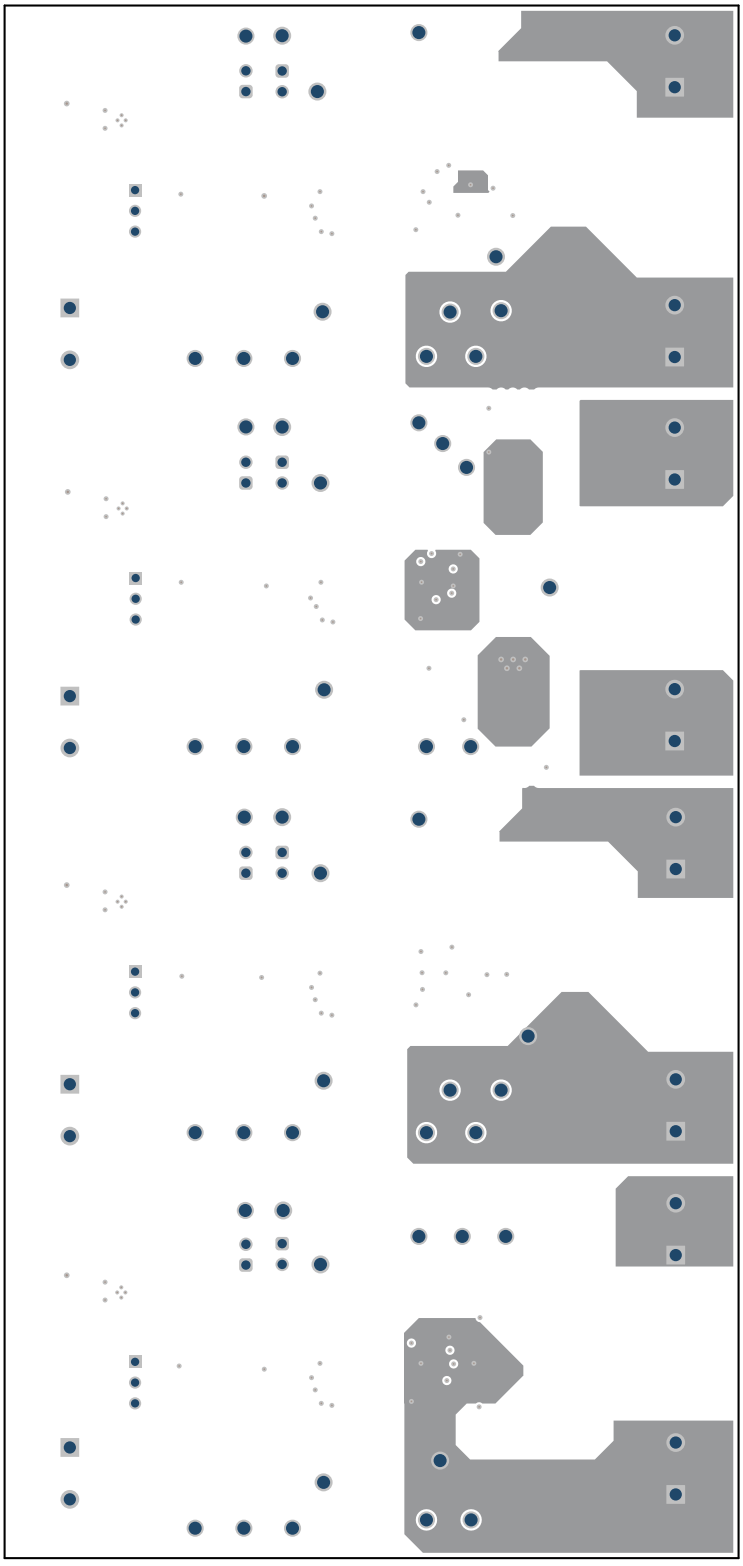


图 4-8. PCB 内层 2（顶视图）

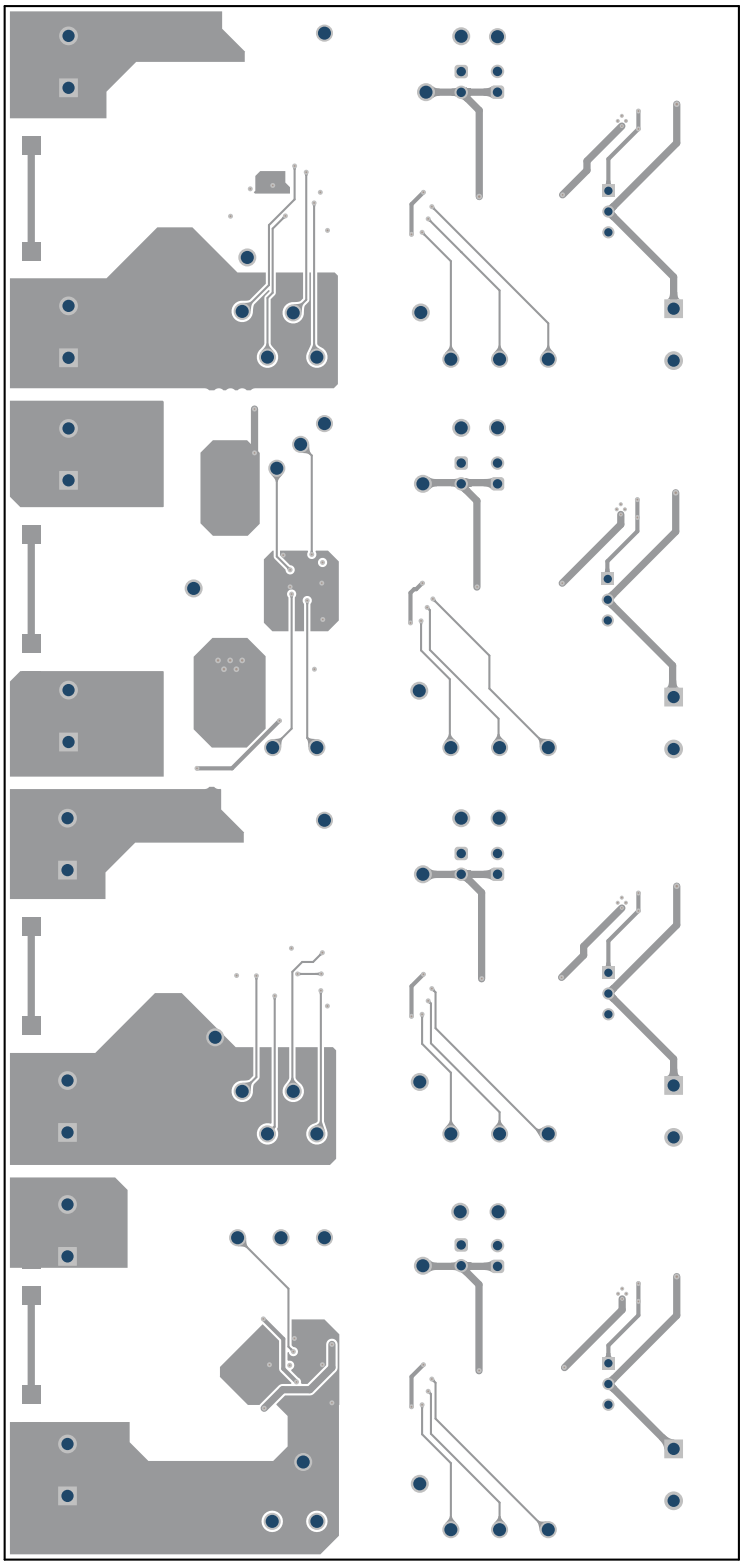


图 4-9. PCB 外底层（底视图）

4.3 物料清单 (BOM)

物料清单

位号	数量	值	说明	封装参考	器件型号	制造商
!PCB1	1		印刷电路板		LP111	不限
C1、C16、C33、C42	4	10µF	电容，陶瓷，10µF，25V，+/-5%，X7R，AEC-Q200 1 级，1206	1206	C1206C106J3RACAUTO	Kemet
C2、C9、C19、C24、C34、C39、C43、C49	8	1µF	电容，陶瓷，1µF，25V，+/-10%，X7R，AEC-Q200 1 级，0603	0603	GCM188R71E105KA64D	MuRata
C3、C5、C12、C15、C29、C31、C45、C52	8	10µF	电容，陶瓷，10µF，25V，+/-20%，X5R，0603	0603	GRT188R61E106ME13D	MuRata
C4、C20、C35、C44、C53	5		电容，陶瓷，0.1UF，50V，X7R，0603	0603	C0603R104K5RAC	Kemet
C6、C22、C37、C46	4	330nF	电容，陶瓷，330nF，25V，X7R，10%，焊盘 SMD，0603，+125°C，汽车 T/R	0603	CGA3E3X7R1E334K080AB	TDK
C7、C11、C13、C14、C30、C32、C47、C51	8	0.01uF	电容，陶瓷，0.01µF，25V，+/- 10%，X7R，0402	0402	GRM155R71E103KA01D	MuRata
C8、C10、C25、C26、C40、C41、C48、C50	8	1nF	1000pF ±10% 16V 陶瓷电容器 X7R 0603（公制 1608）	0603	CC0603KRX7R7BB102	YAGEO
C17	1	0.022uF	电容，陶瓷，0.022µF，630V，+/-10%，X7R，1210	1210	GRM32QR72J223KW01L	MuRata
C21、C28、C36、C54	4	68pF	电容，陶瓷，68pF，1000V，+/-5%，U2J，1206	1206	GRM31A7U3A680JW31D	MuRata
D1、D2、D3、D4、D11	5	40V	二极管，肖特基，40V，0.5A，SOD-123	SOD-123	MBR0540T1G	ON Semiconductor

D5、D8、D9、D12	4		二极管肖特基 60V 200MA SOD523	SOD523	PMEG6002EB,115	Nexperia
D6	1		二极管碳化硅肖特基 600V 11A (DC) 表面贴装 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		1 个 2.5kΩ（100MHz 时）信号线铁氧体磁珠 0805（2012 公制）200mA 700mΩ	0805	BBBK00201209252Y00	Pulse Electronics
H1、H2、H3、H4、H5、H6、H7、H8、H9、H10、H11、H12、H13、H14、H15、H16	16		Bumpon，半球形，0.44 X 0.20，透明	透明 Bumpon	SJ-5303 (CLEAR)	3M
J1、J4、J15、J19	4		香蕉插头，红色绝缘尼龙，TH	香蕉插头，红色绝缘尼龙，TH	108-0902-001	Cinch Connectivity
J2、J10、J17、J21	4		香蕉插头，黑色绝缘尼龙，TH	香蕉插头，黑色绝缘尼龙，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		接头，100mil，3x1，锡，TH	接头，3 引脚，100mil，锡	PEC03SAAN	Sullins Connector Solutions
J6、J8、J14、J16、J25、J26、J29、J30	8		接头，2.54mm，2x1，金，TH	接头，2.54mm，2x1，TH	61300211121	Wurth Elektronik
Q1、Q3、Q4、Q5	4		MOSFET N 沟道 750V 44A (Tc) 197W (Tc) 表面贴装 D2PAK-7	D2PAK7	UJ4C075033B7S	Qorvo
Q2	1	600V	晶体管，IGBT，600V，20A，DPAK	DPAK	STGD10NC60KDT4	STMicroelectronics
R1、R2、R3、R22、R23、R24、R34、R35、R36、R38、R39、R40	12	100k	电阻，100k，5%，0.125W，AEC-Q200 0 级，0805	0805	ERJ-6GEYJ104V	Panasonic

R4、R7、R13、R14、R16、R17、R21、R27、R30、R37、R46、R51	12	0	0Ω 跳线片式电阻器 0603（公制 1608），金属元件	0603	WSL060300000ZEA9	Vishay
R5、R6、R10、R31、R48	5	10.2	电阻，10.2，1%，0.125W，AEC-Q200 0 级，0805	0805	CRCW080510R2FKEA	Vishay-Dale
R8、R11、R32、R49	4	294k	电阻，294k，1%，0.1W，AEC-Q200 0 级，0402	0402	ERJ-2RKF2943X	Panasonic
R9、R12、R33、R50	4	90.9k	电阻，90.9k，1%，0.1W，AEC-Q200 0 级，0402	0402	ERJ-2RKF9092X	Panasonic
R15	1	54.9k	电阻，54.9k，1%，0.1W，AEC-Q200 0 级，0603	0603	CRCW060354K9FKEA	Vishay-Dale
R18	1	20.5k	电阻，20.5k，1%，0.1W，AEC-Q200 0 级，0603	0603	CRCW060320K5FKEA	Vishay-Dale
R19	1	3.40k	电阻，3.40k，1%，0.1W，0603	0603	M55342K12B3E40T	TT Electronics/IRC
R20	1	11.5k	电阻，11.5k，1%，0.125W，AEC-Q200 0 级，0805	0805	ERJ-6ENF1152V	Panasonic
R25、R29、R41、R42、R44、R45	6	2.0k	电阻，2.0k，5%，0.1W，0603	0603	RC0603JR-072KL	Yageo
R26、R28、R43	3	60m	电阻，金属条，2512，0.06Ω，1%，3W，±50ppm/°C，焊盘 SMD，汽车 T/R	2512	CRA2512-FZ-R060ELF	Bourns
R47	1	0	电阻，SMD，0Ω，跳线，1/8W，0805	0805	RC0805FR-070RL	Yageo
R52	1	3m	电阻，金属条，2512，0.003Ω，1%，3W，±75ppm/°C，焊盘 SMD，汽车 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	分流器，100mil，镀金，黑色	分流器	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		测试点，白色，穿孔，RoHS，大容量	5012		Keystone
TP2、TP8、TP28、TP41	4		测试点，通用，黄色，TH	黄色通用测试点	5014	Keystone Electronics
TP5、TP14、TP30、TP44	4		测试点，多用途，红色，TH	红色通用测试点	5010	Keystone Electronics
TP6、TP19、TP25、TP26、TP39、TP40、TP45、TP52	8		测试点，多用途，黑色，TH	黑色通用测试点	5011	Keystone Electronics
U1	1		TPSI3133QDVXRQ1	SSOP16	TPSI3133QDVXRQ1	德州仪器 (TI)
U2、U3、U5、U8	4		3V 至 36V 输入电压、150mA、超低噪声、高 PSRR、低压降 (LDO) 线性稳压器 DRB0008A (VSON-8)	DRB0008A	TPS7A4901DRBR	德州仪器 (TI)
U4	1		具有集成 15V 栅极电源和故障指示灯的汽车类增强型隔离式开关驱动器	SSOP16	TPSI3110QDVXRQ1	德州仪器 (TI)
U6、U7	2		具有集成 15V 栅极电源和故障/警报指示灯的汽车类增强型隔离式开关驱动器	SSOP16	TPSI3100QDVXRQ1	德州仪器 (TI)

U9	1		DBV0006A (SOT-6) 双向多通道低侧和高侧电压输出电流检测放大器	DBV0006A	INA181A1IDBVR	德州仪器 (TI)
C18、C23、C27、C38、C55	0	100pF	电容，陶瓷，100pF，1000V，+/-5%，U2J，1206	1206	GRM31A7U3A101JW31D	MuRata
D7、D10、D13、D14、D17、D18	0		824520402 Tvs 二极管，单向，400V，SMB，符合 Rohs 标准：是			
D15、D16	0		824521402 Tvs 二极管，双向，400V，DO-214Aa，符合 Rohs 标准：是			
FID1、FID2、FID3	0		基准标记。没有需要购买或安装的元件。	不适用	不适用	不适用

5 其他信息

5.1 商标

所有商标均为其各自所有者的财产。

6 修订历史记录

注：以前版本的页码可能与当前版本的页码不同

Changes from Revision * (November 2023) to Revision A (January 2026)	Page
• 更新了最新板版本的板图像、原理图和表。	3

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 2 4 番 1 号

西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/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.

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