EVM User's Guide: TPS7H5030EVM

TPS7H5030-SP 评估模块

说明

TPS7H5030EVM 演示了带有集成栅极驱动器的单个 TPS7H5030-SP 电流模式 PWM 控制器在升压配置中的工作情况。该电路板提供可用于组装额外元件和测试点的空间，可实现对定制配置和性能有效性的测试。

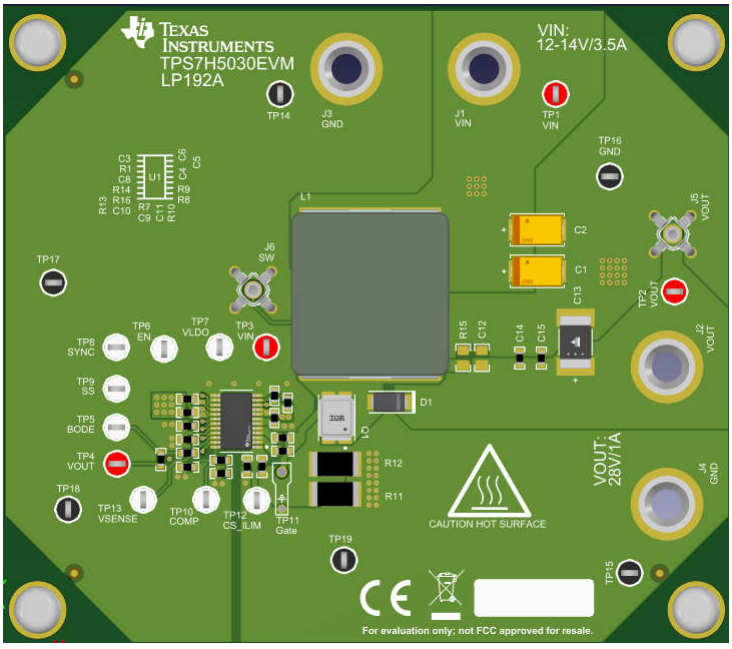
特性

此 EVM 具有以下特性：

- 输入电压范围：12V 至 14V
- 28V 1A 输出
- 500kHz 开关频率
- 在温度、辐射以及线路和负载调节范围内提供 0.6V ±1% 的基准电压
- 可调斜率补偿和软启动

应用

- 太空卫星电源
- 通信有效载荷
- 命令和数据处理
- 光学成像有效载荷
- 雷达成像有效载荷
- 卫星电力系统



EVM 板

1 评估模块概述

1.1 简介

TPS7H5030EVM 是 TPS7H5030-SP/-SEP 和 TPS7H5031-SP/-SEP 器件的评估模块 (EVM)，提供了一个以电气方式评估功能的平台。本用户指南提供有关 EVM 的详细信息（包括配置、原理图和 BOM）。

此 EVM 提供在不同条件下配置器件的灵活性，并提供可用于组装额外元件的空间以及用于监控器件引脚的多个连接选项。要在自定义配置下配置器件，请参阅 TPS7H5030-SP 数据表来计算需要更改的所有无源器件的值。

1.2 套件内容

- TPS7H5030EVM 板 (1)

1.3 规格

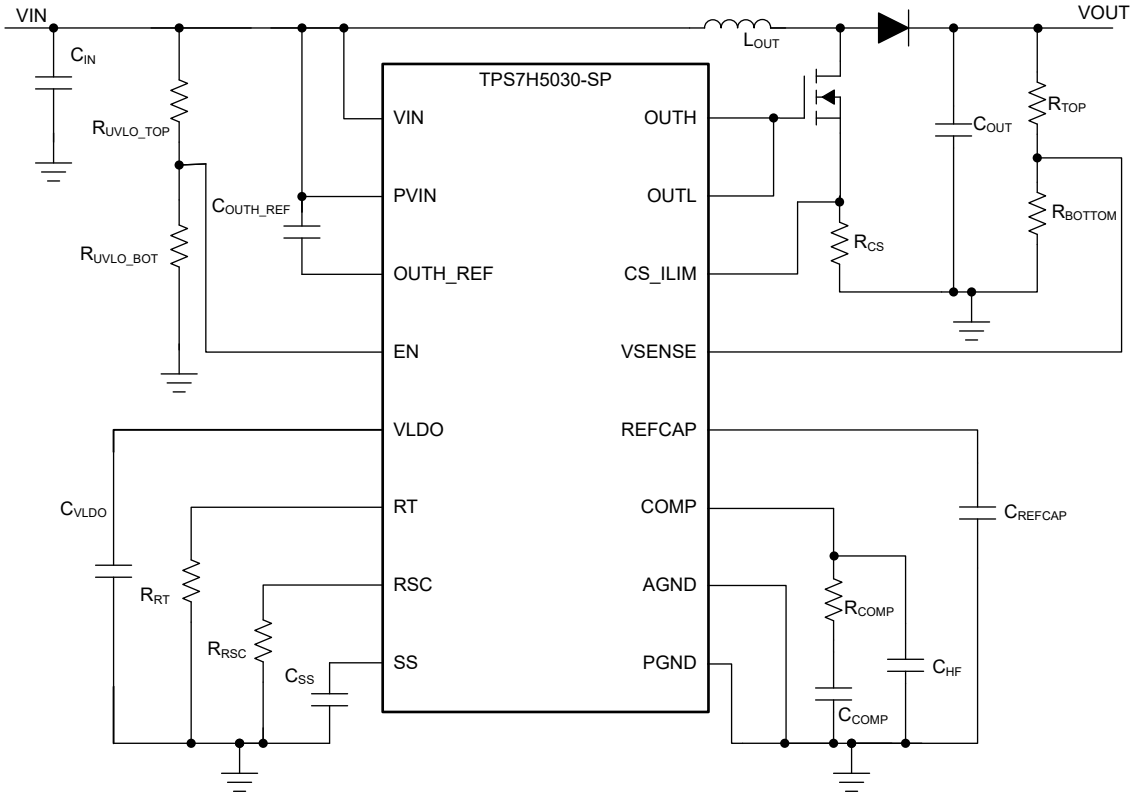


图 1-1. 简化版原理图

表 1-1. 默认配置选项

参数	规格	说明
输入电压 VIN	12V 至 14V	在 8V 至 14V 的器件输入电压范围内。
输出 VOUT	28V (1A)	器件输出能力范围内的常见电源轨电压。通过 R18 配置。
EN 连接 EN	EN 连接至 VIN	UVLO 由 VIN 至 EN 的分压器配置。通过填充 R4 并取消填充 R5 和 R6，可选择连接到 VLDO。

1.4 器件信息

TPS7H503x 是一款具有耐辐射加固保障的电流模式单端 PWM 控制器，配备集成的栅极驱动器，可用于基于硅功率半导体的转换器设计。TPS7H503x 集成了多个关键功能，例如软启动、使能和可调斜率补偿，同时保持较小的封装尺寸。该控制器还具有 0.6V ± 1% 的电压基准容差，可支持高精度电源转换器设计。

有关 TPS7H5030-SP、TPS7H5030-SEP、TPS7H5031-SP 或者 TPS7H5031-SEP 的更多信息，可以在器件数据表查看。

2 硬件

2.1 EVM 连接和测试点

表 2-1 中列出了电路板上的接口。

表 2-1. EVM 板连接

参考指示符	功能	
J1	VIN	电源输入和输出连接器
J2	VOUT	
J3	GND	
J4	GND	
J5	VOUT	紧凑型探头尖端连接器
J6	SW	
TP1	VIN	测试点
TP2	VOUT	
TP3	VIN	
TP4	VOUT	
TP5	BODE	
TP6	EN	
TP7	VLDO	
TP8	SYNC	
TP9	SS	
TP10	COMP	
TP11	栅极	探头尖端测试点
TP12	CS_ILIM	测试点
TP13	VSENSE	
TP14、TP15、TP16、TP17、TP18、TP19	GND	

2.2 最佳实践

以下信息用于传达运行此器件的最佳实践。

警告

表面高温！接触会导致烫伤。请勿触摸！

电路板上电后，某些元件可能会达到 55°C 以上的高温。在运行过程中或运行刚结束时，不得触摸电路板，因为可能存在高温。

3 实现结果

TPS7H5030EVM 针对 12V 输入和 14V 输入的默认配置下的测试结果显示在针对以下内容的本部分中：

- 启动
- 关断
- 输出电压纹波
- 负载阶跃
- 效率
- 频率响应

TPS7H5030EVM 及 TPS7H5031-SP 针对 12V 输入和 14V 输入的测试结果显示在针对以下内容的本部分中：

- 输出电压、开关节点和栅极
- 频率响应

3.1 评估设置

以下各部分介绍了使用 TPS7H5030EVM 在默认配置下执行的测试。详细设置如表 3-1 中所示。

表 3-1. 测试设置

规格	值
VIN	12V 或 14V
VOUT	28V
FSW	500kHz
R_CS	11mΩ
R_SC	118kΩ

3.2 启动

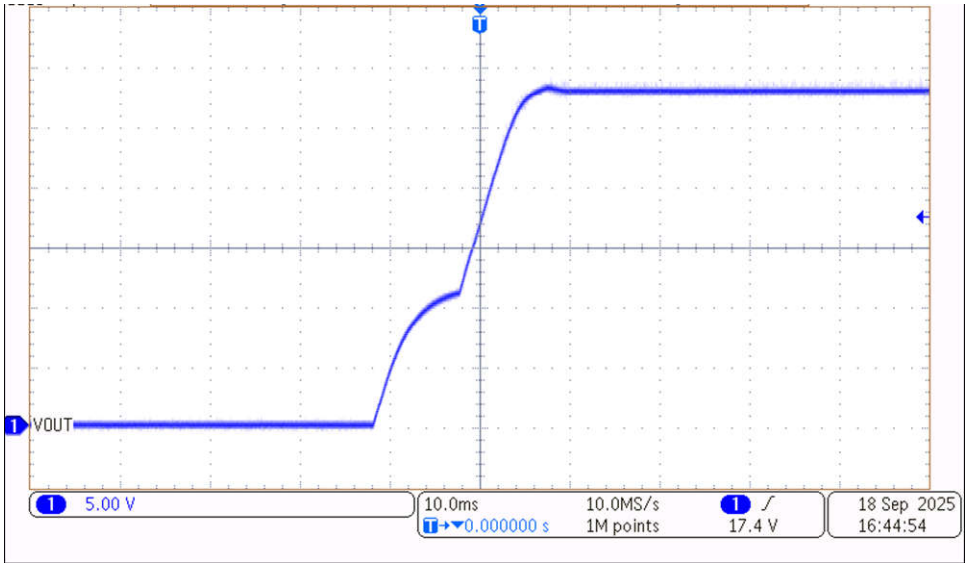


图 3-1. 12V 空载启动

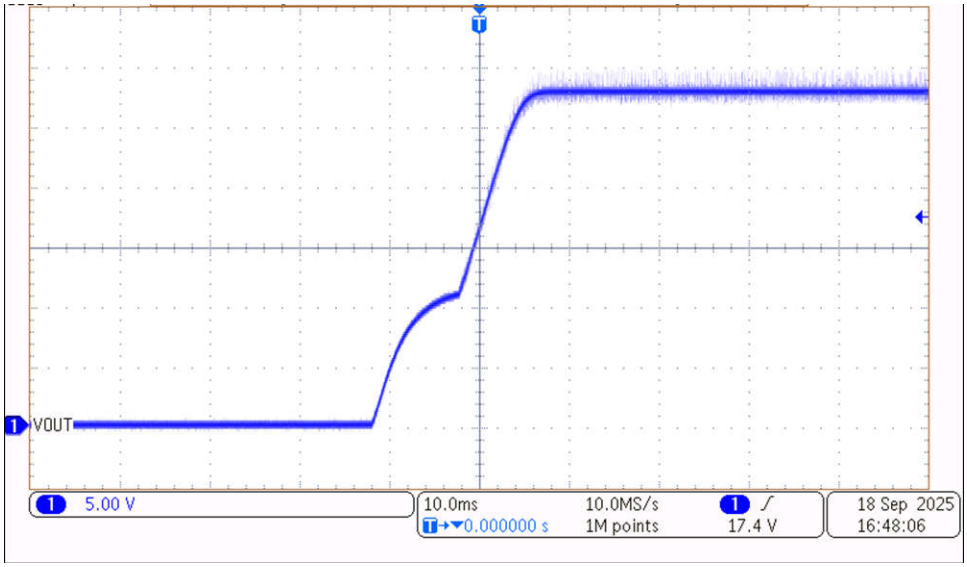


图 3-2. 12V 负载启动

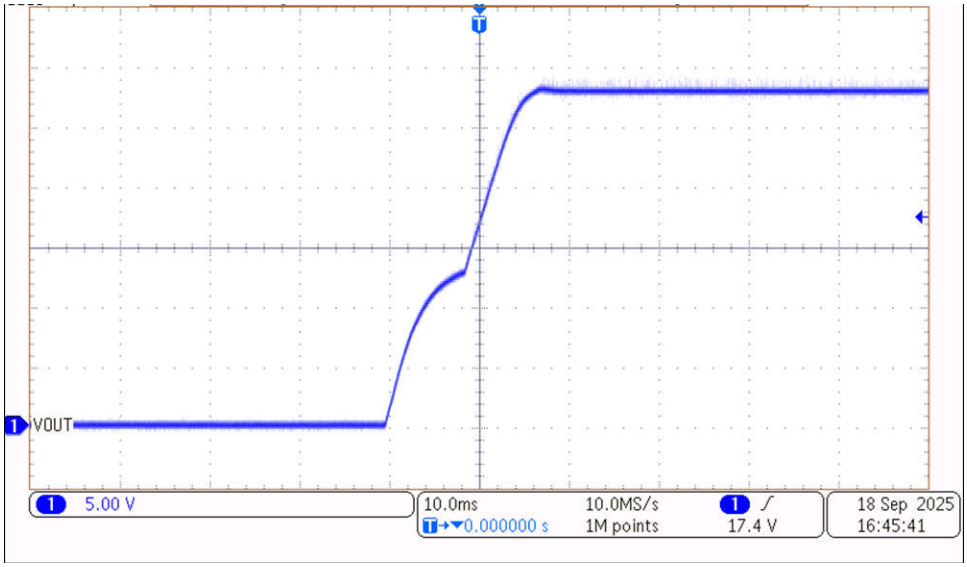


图 3-3. 14V 空载启动

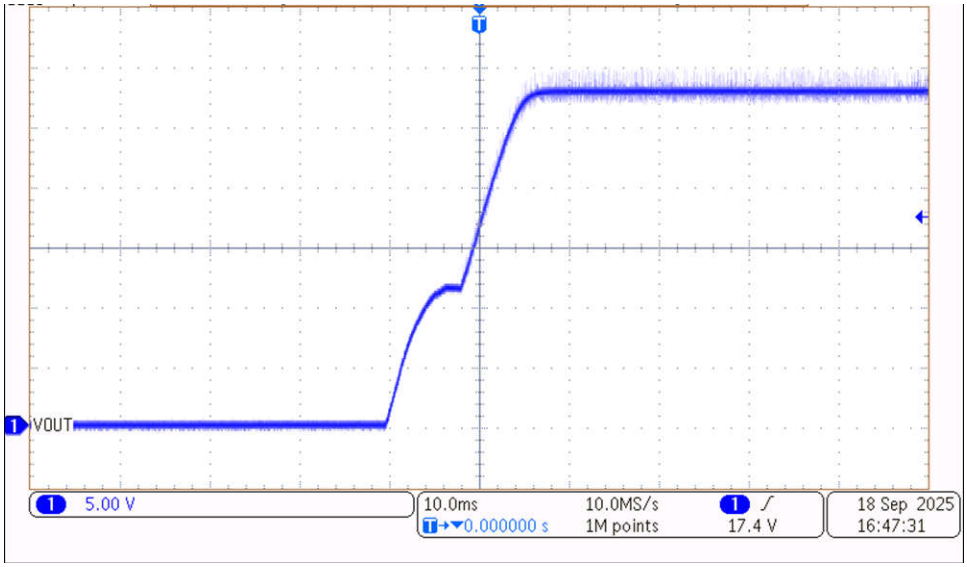


图 3-4. 14V 负载启动

3.3 关断

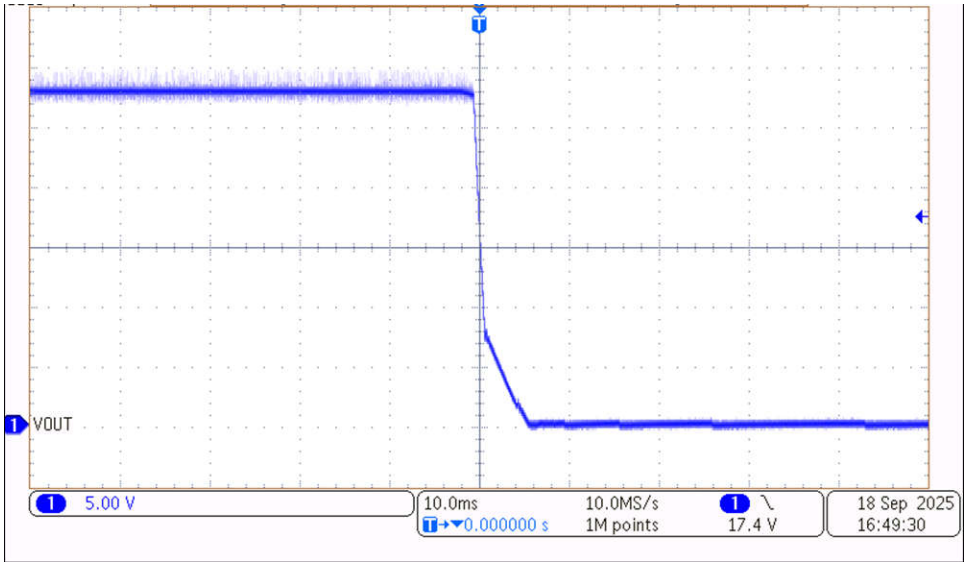


图 3-5. 12V 关断

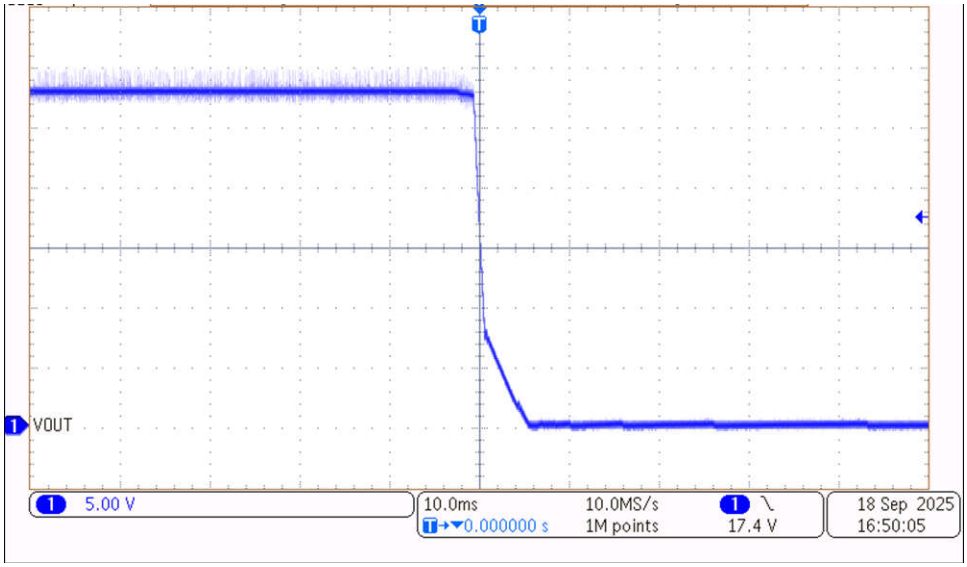


图 3-6. 14V 关断

3.4 输出电压纹波

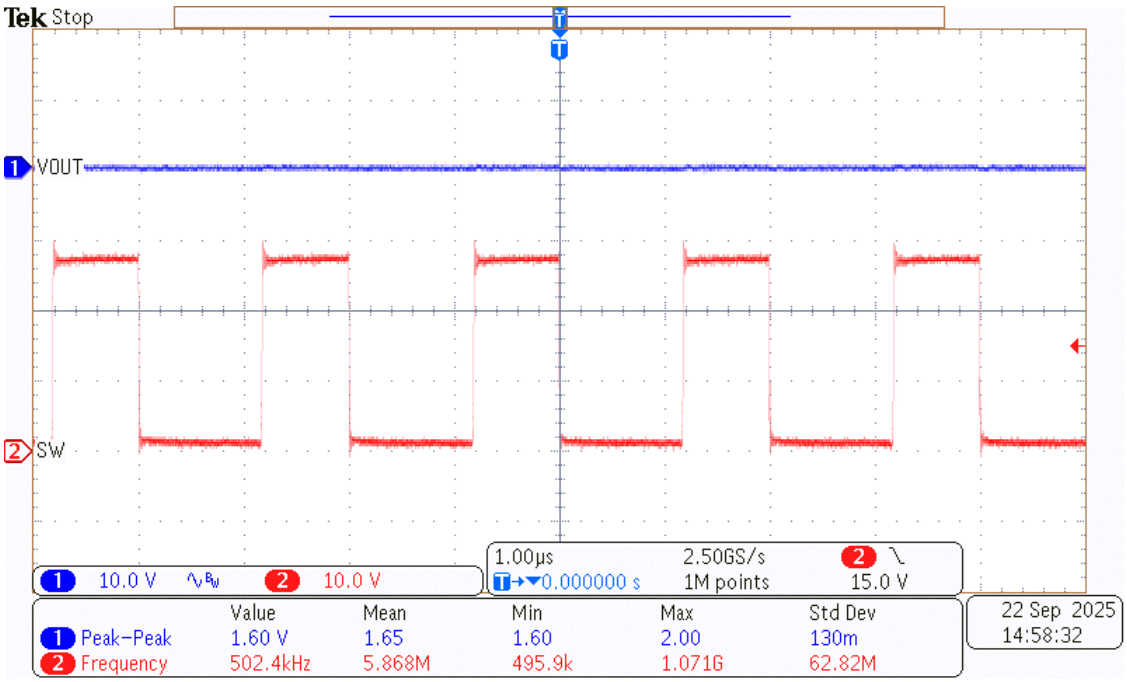


图 3-7. 12V 输出电压纹波

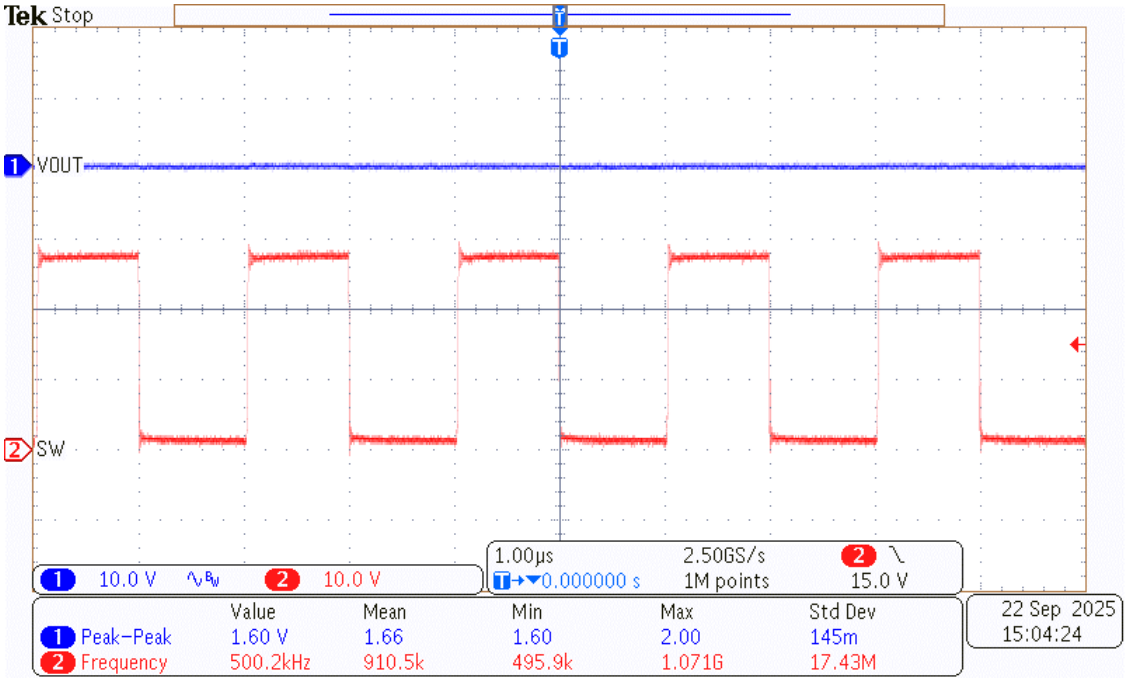


图 3-8. 14V 输出电压纹波

3.5 负载阶跃

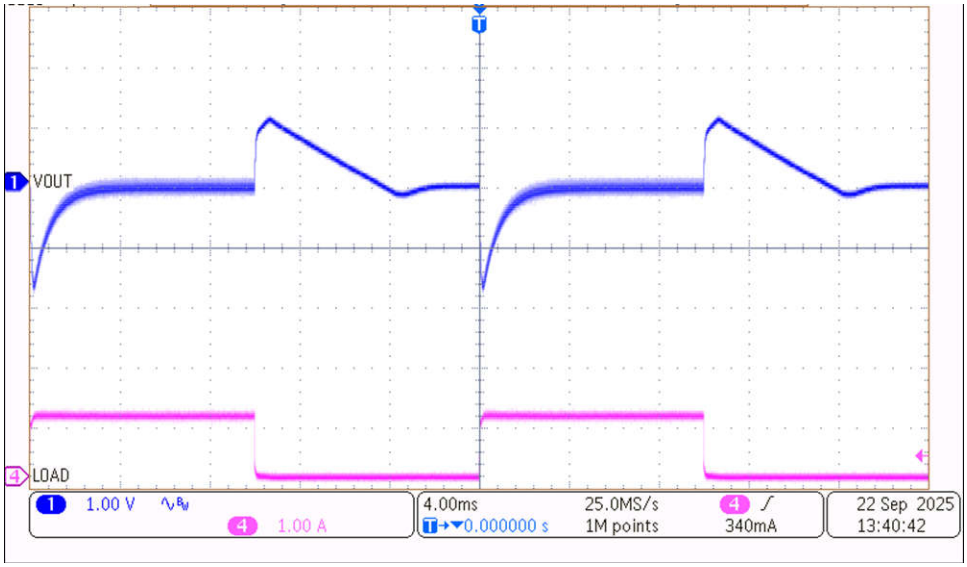


图 3-9. 12V 负载阶跃

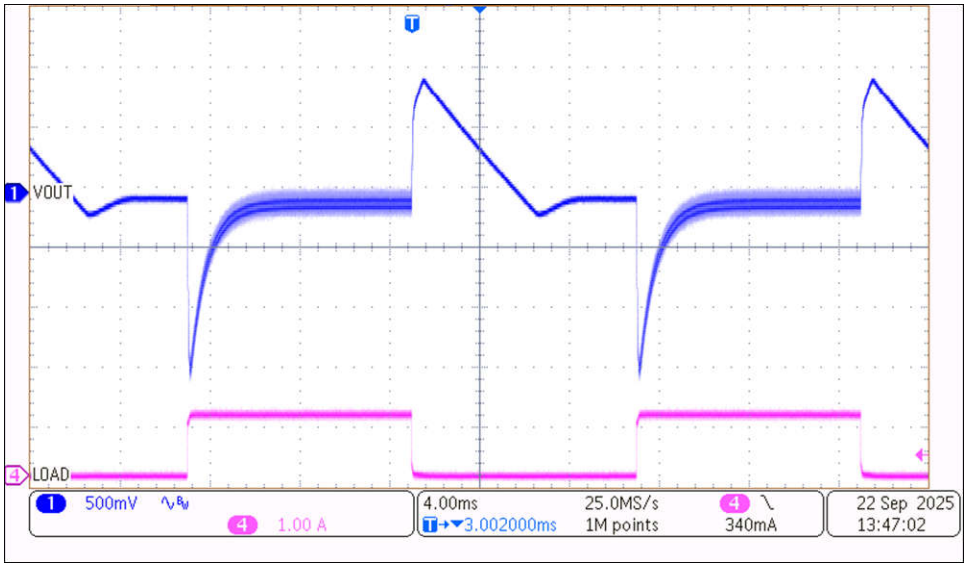


图 3-10. 14V 负载阶跃

3.6 效率

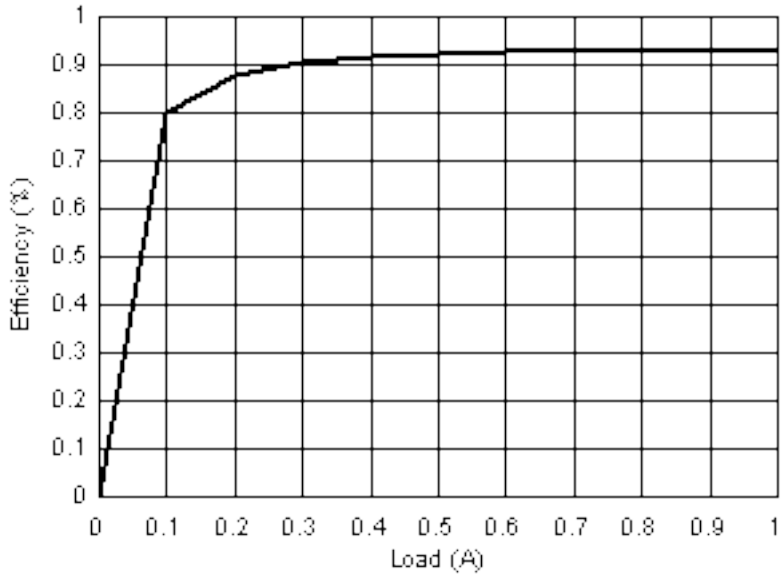


图 3-11. 12V 效率

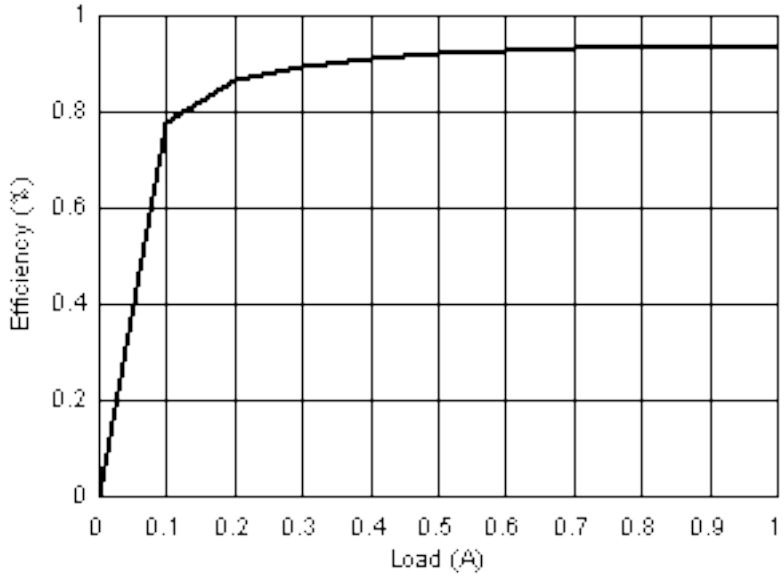


图 3-12. 14V 效率

3.7 频率响应

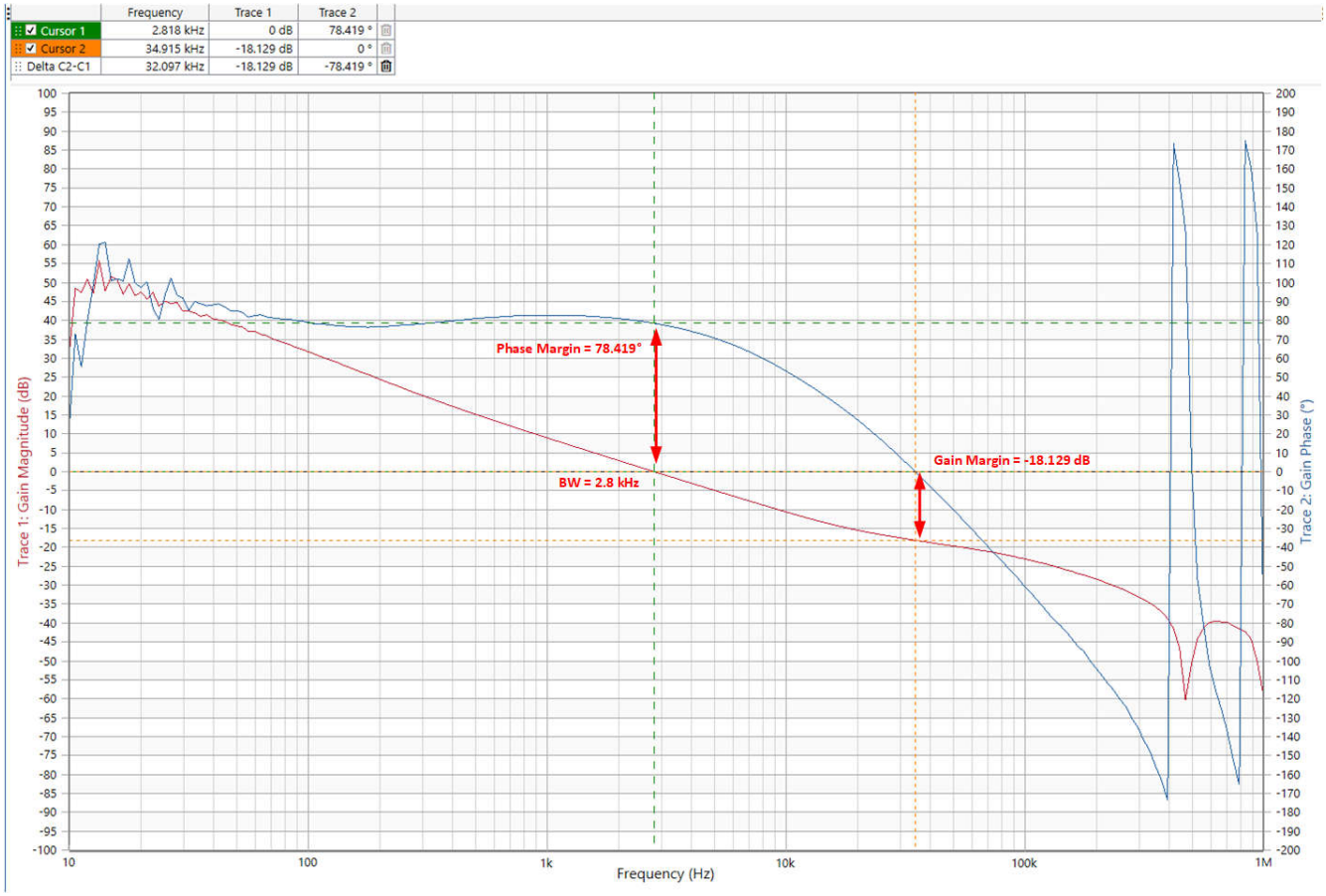


图 3-13. 12V 频率响应

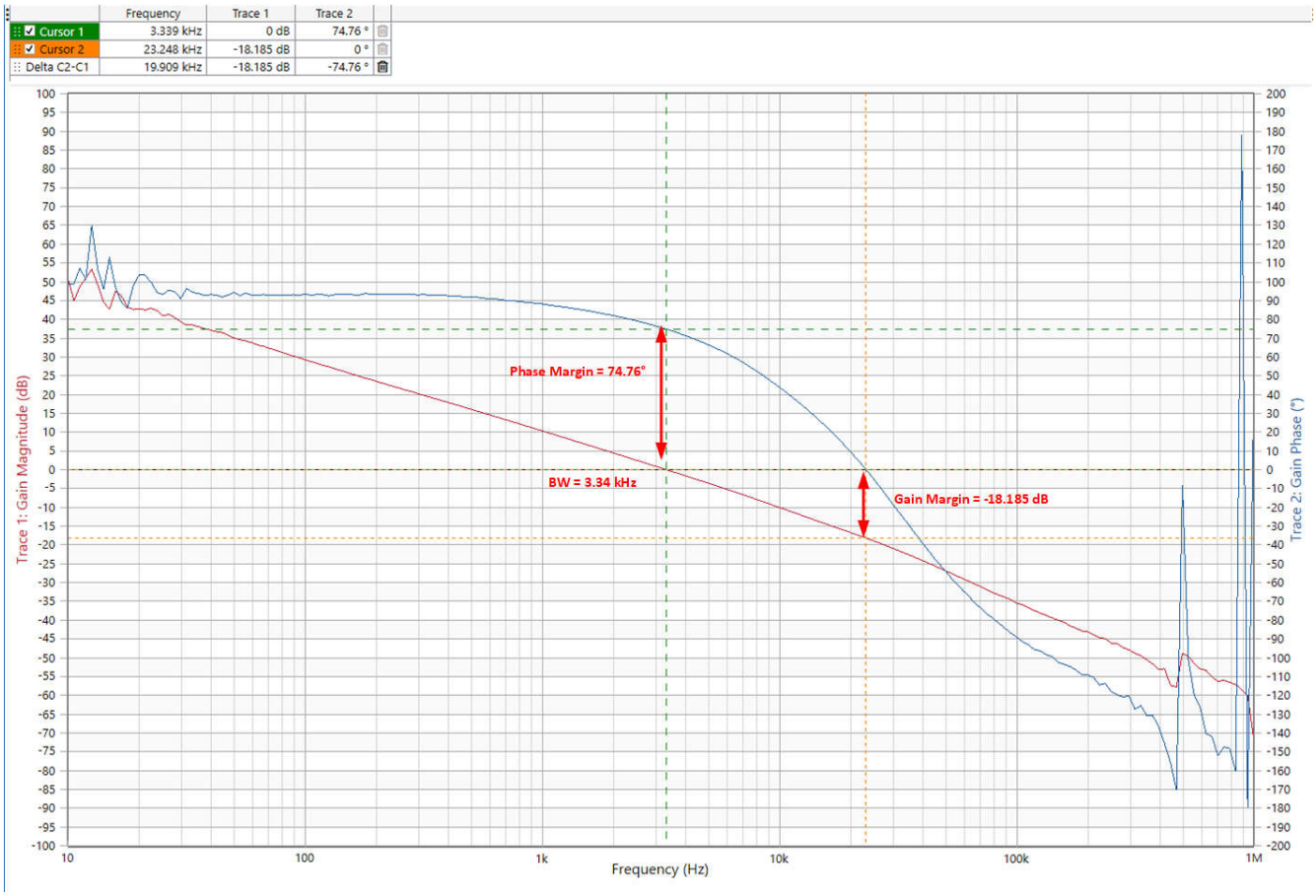


图 3-14. 14V 频率响应

3.8 TPS7H5031-SP 结果

TPS7H5030EVM 兼容 TPS7H5031-SP 和 TPS7H5031-SEP。以下部分表示使用 TPS7H5030EVM 和 TPS7H5031-SP 进行的测试。表 3-2 中显示了详细设置以及对默认配置的任何更改

表 3-2. 测试设置

规格	值
VIN	12V 或 14V
VOUT	20V
FSW	500kHz
R_14	309 Ω

3.8.1 输出电压、开关节点、栅极和负载

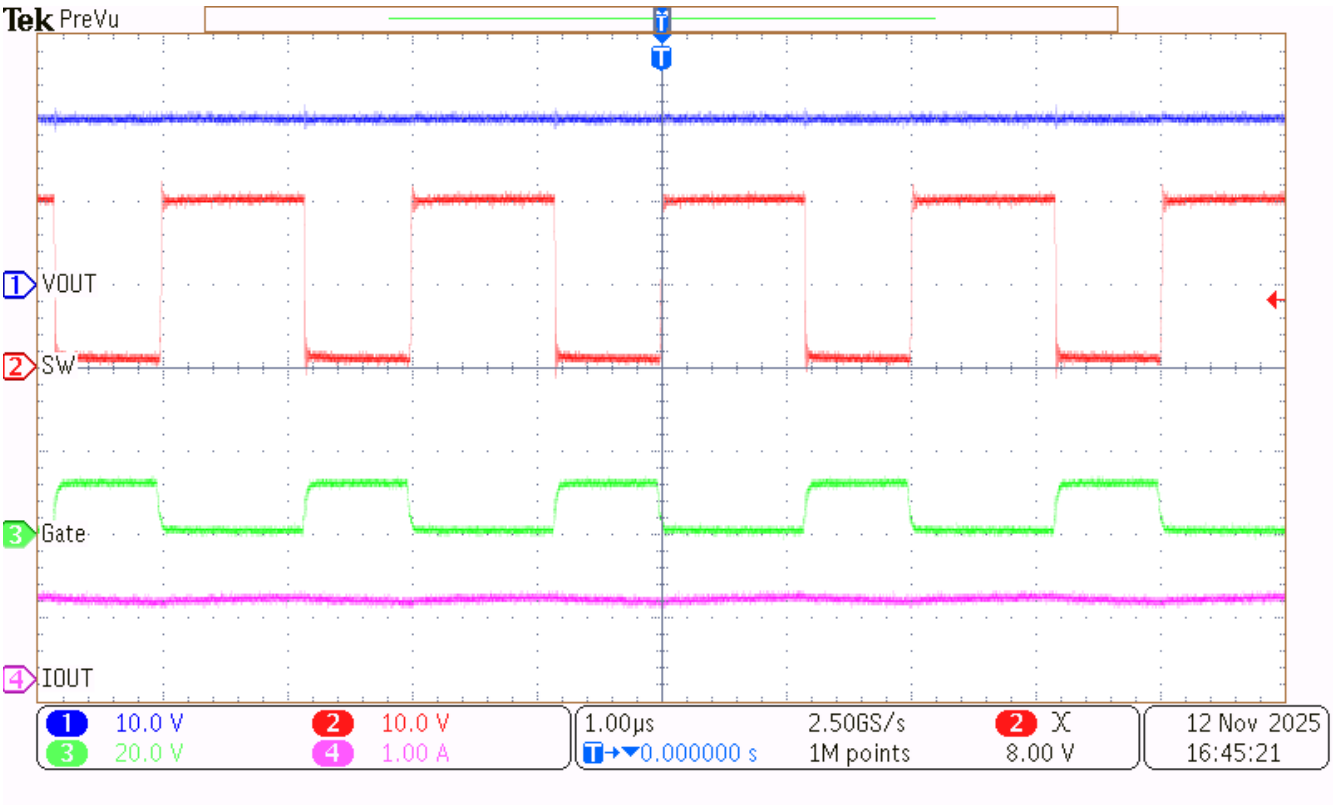


图 3-15. 12V 输出电压、开关节点、栅极和负载

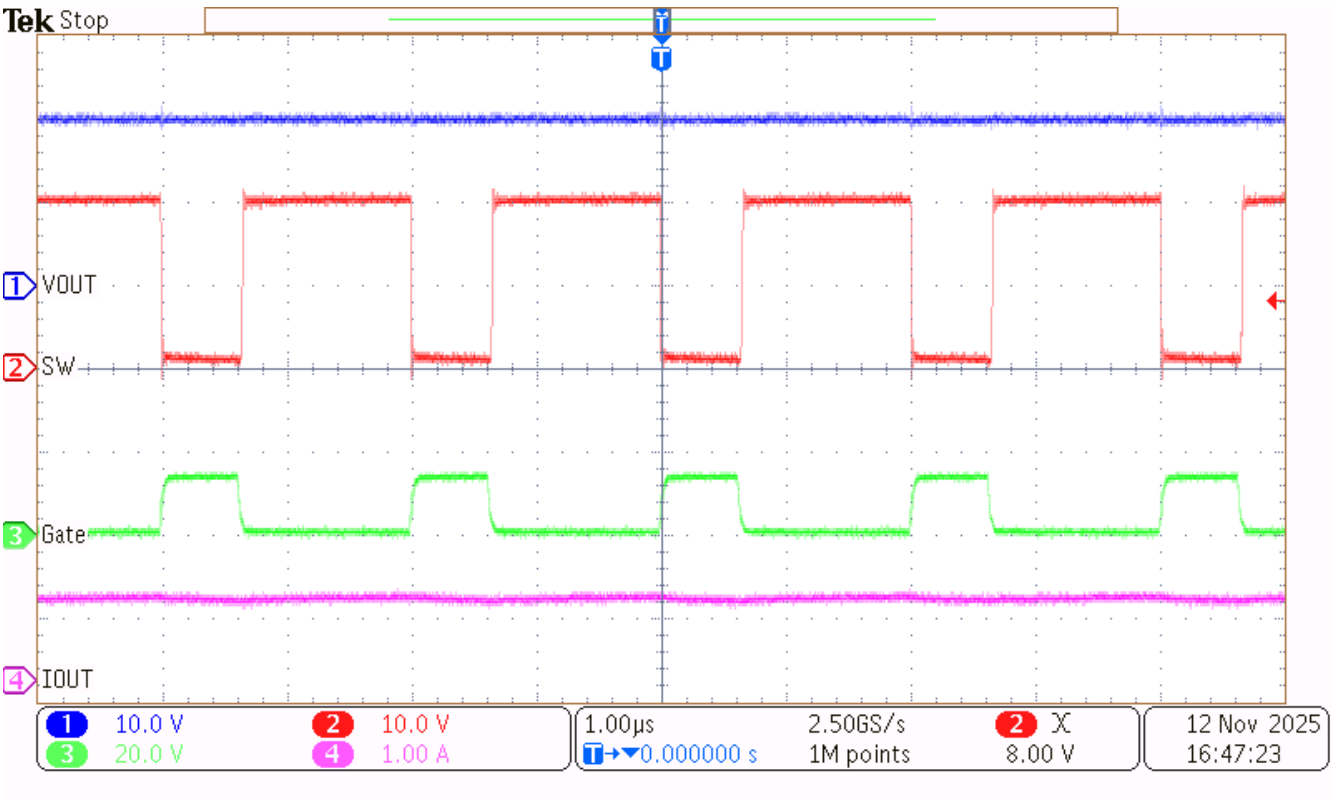


图 3-16. 14V 输出电压、开关节点、栅极和负载

3.8.2 频率响应

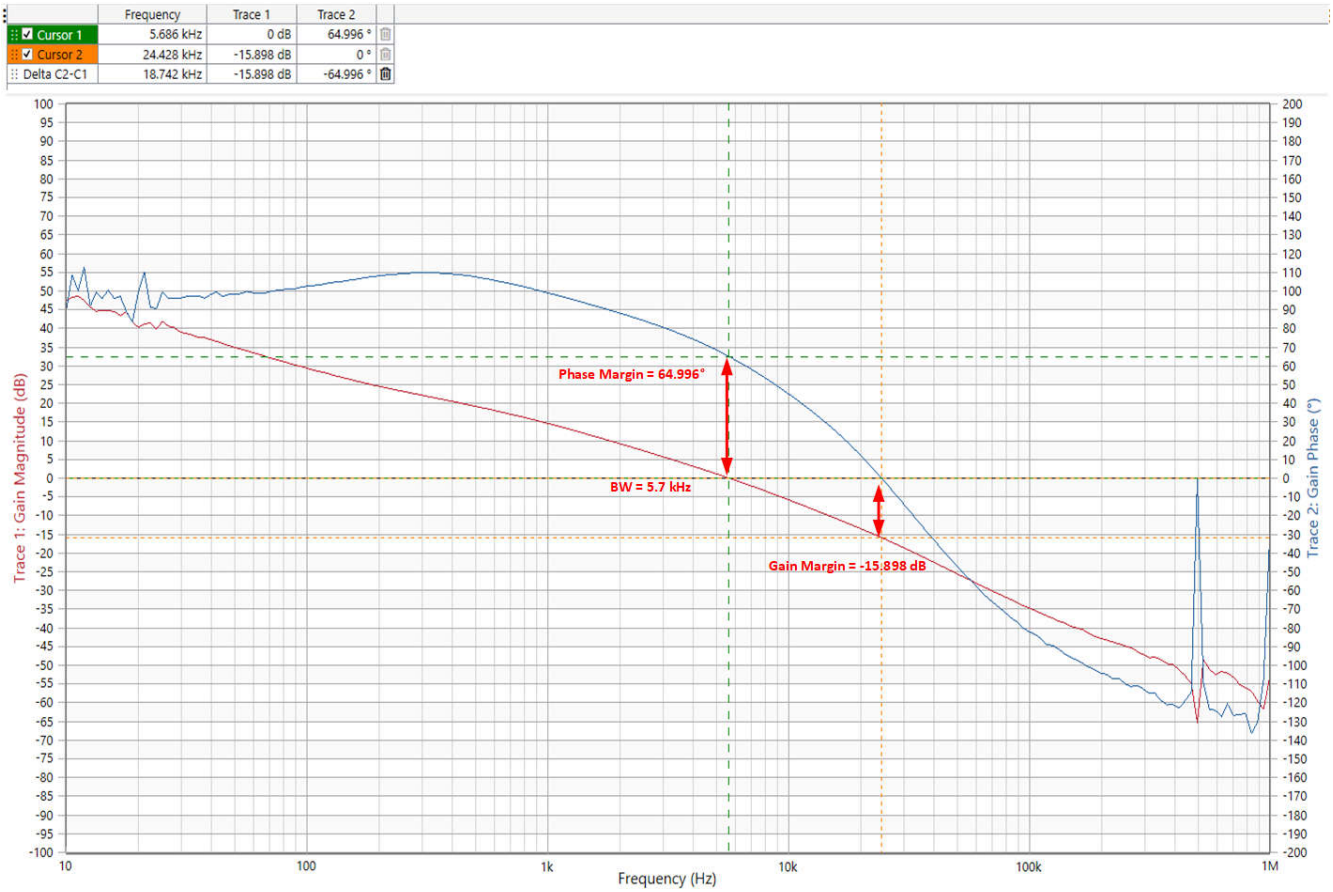


图 3-17. 12V 频率响应

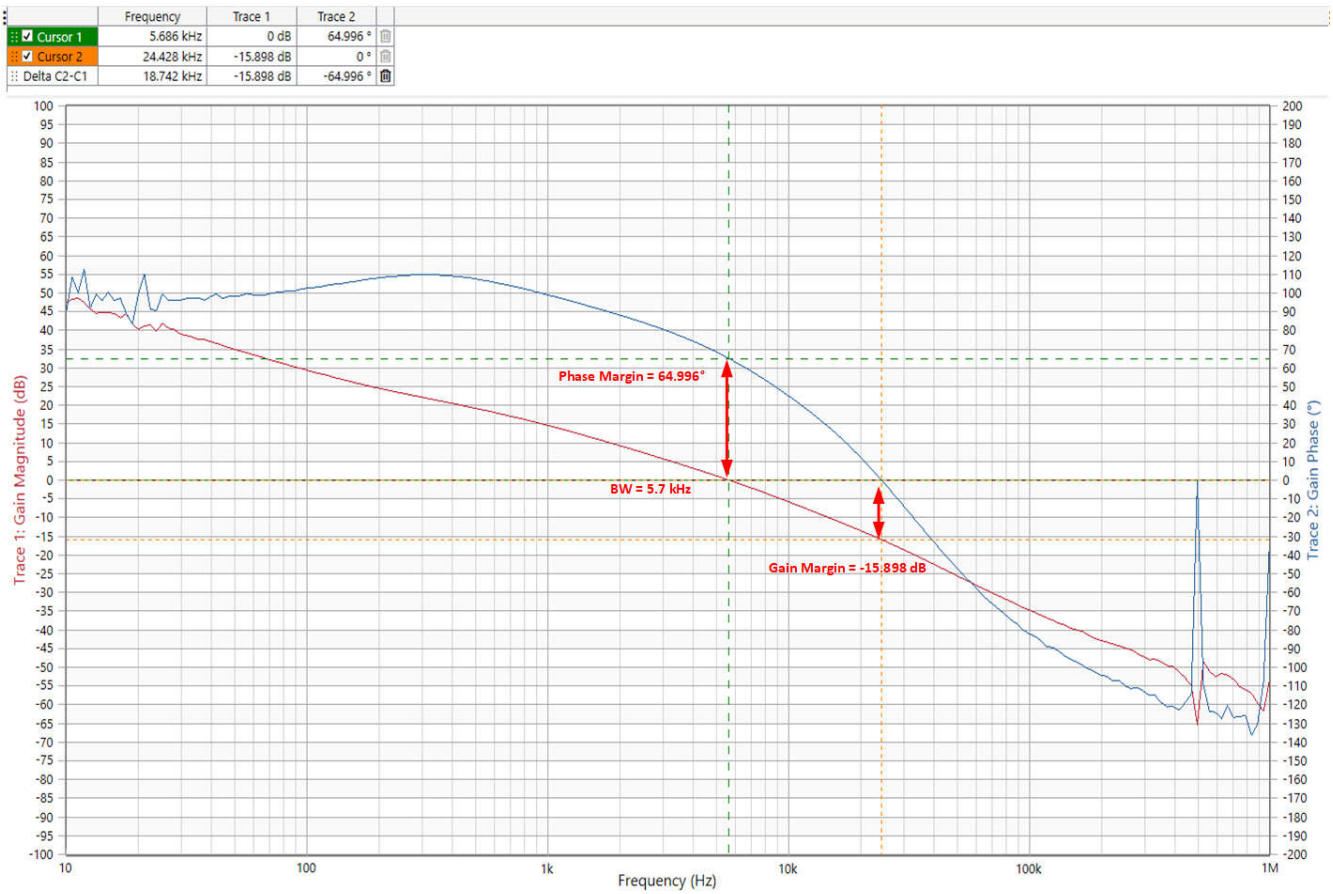


图 3-18. 14V 频率响应

4 硬件设计文件

4.1 原理图

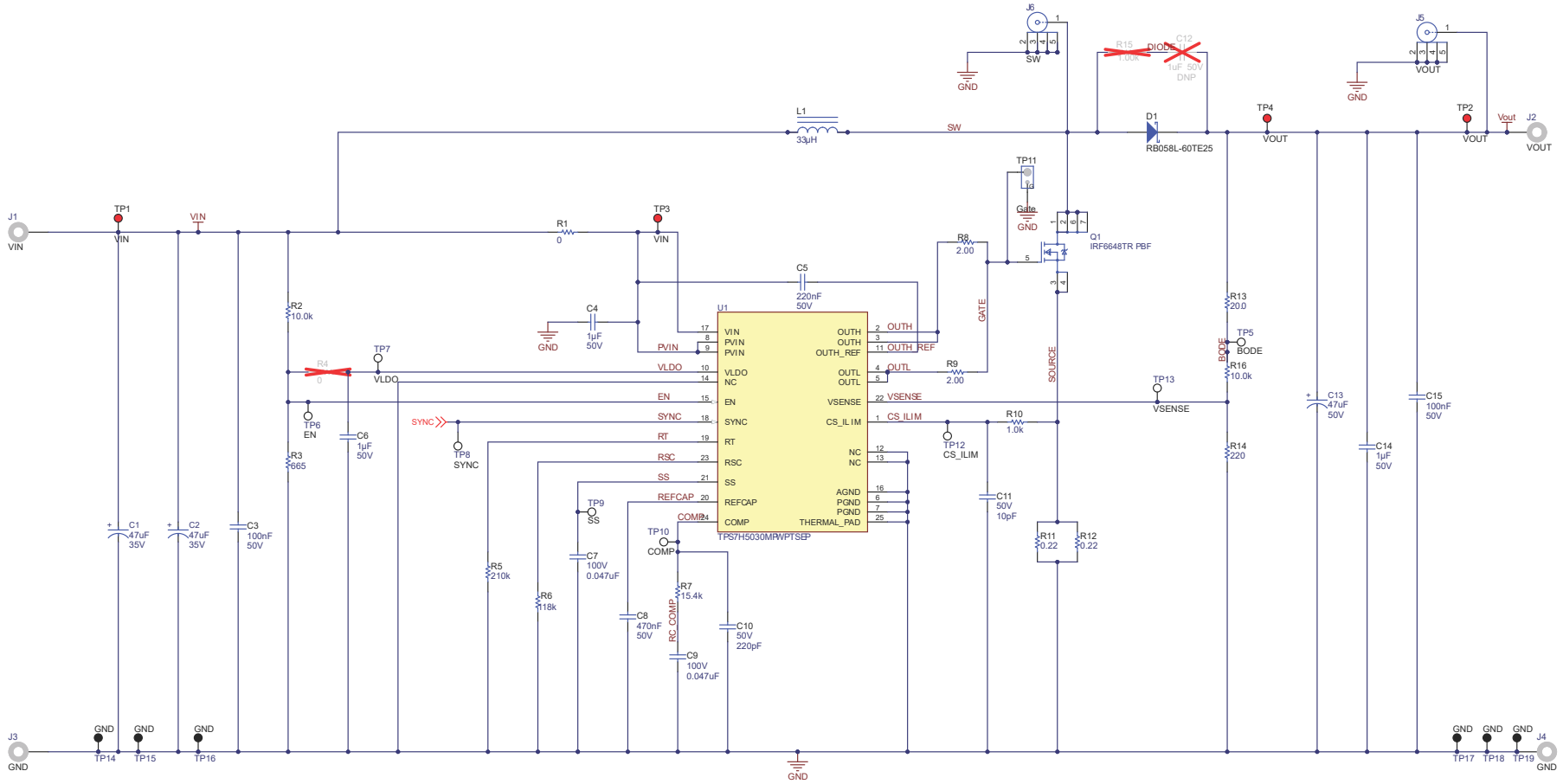


图 4-1. 默认 EVM 原理图

4.2 PCB 布局

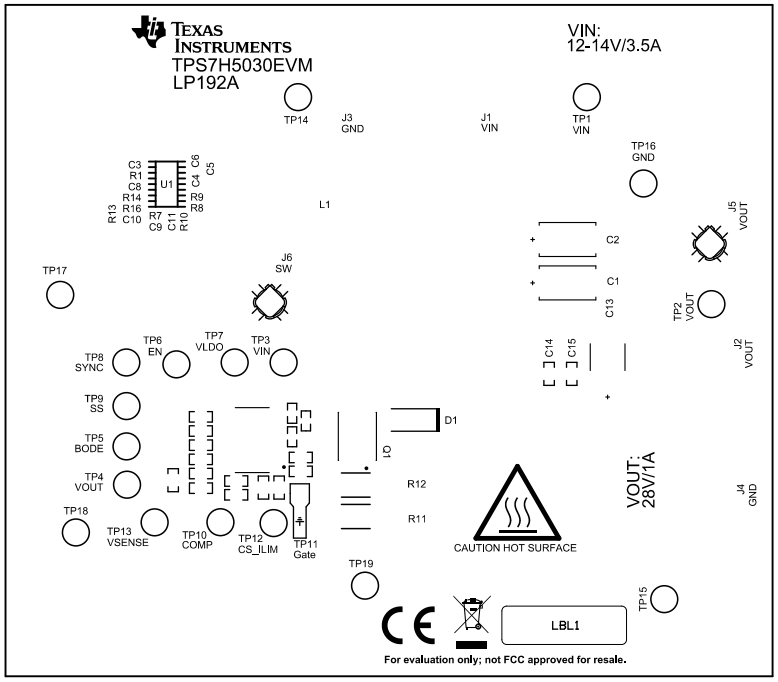


图 4-2. 顶层丝印层

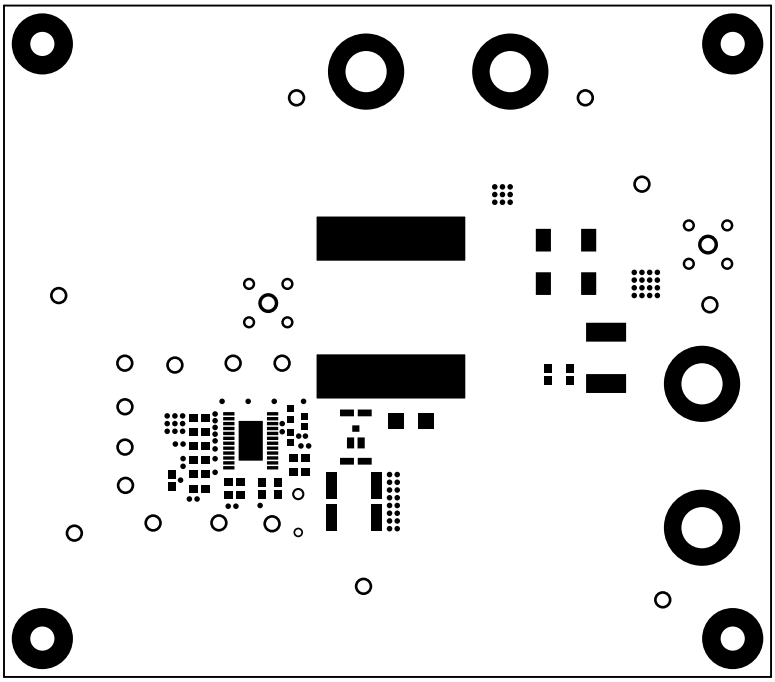


图 4-3. 顶部阻焊层

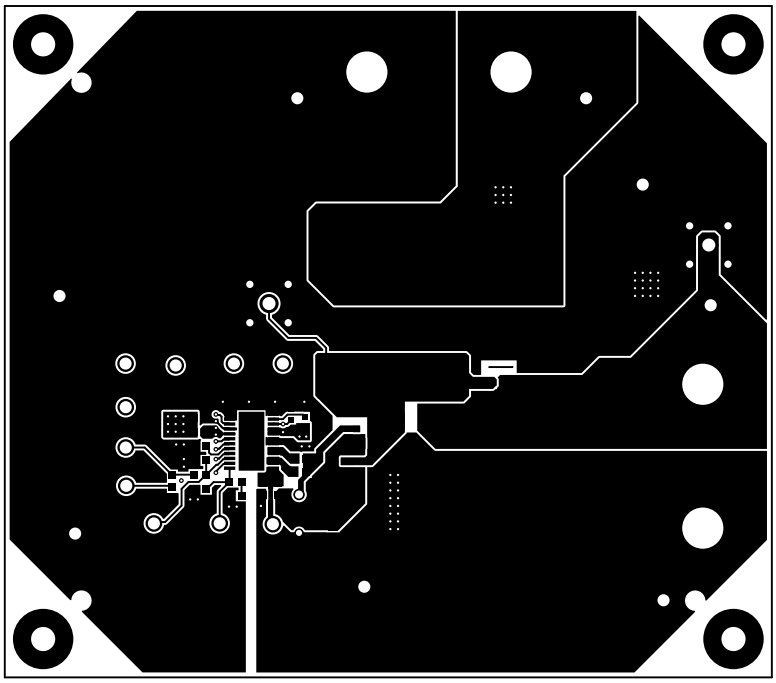


图 4-4. 第 1 层 (顶部)

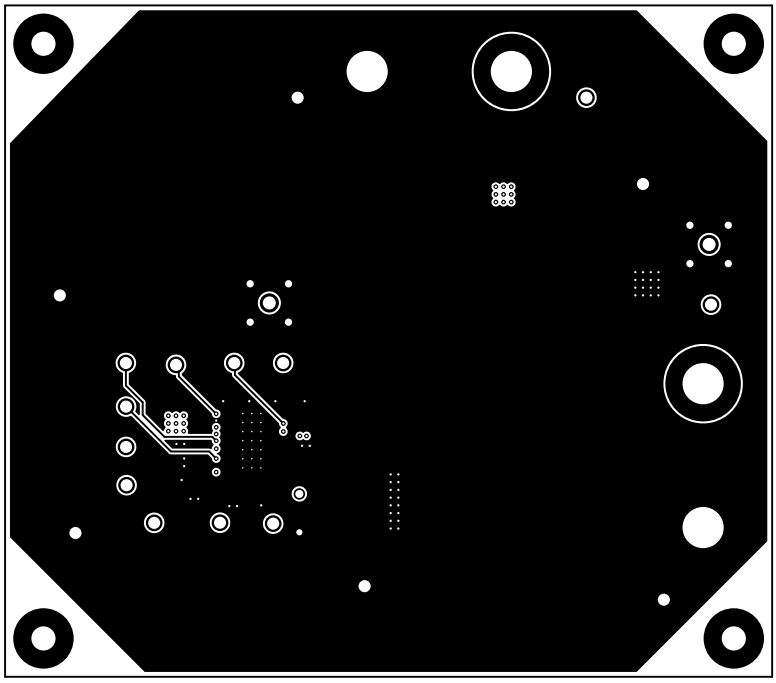


图 4-5. 第 2 层

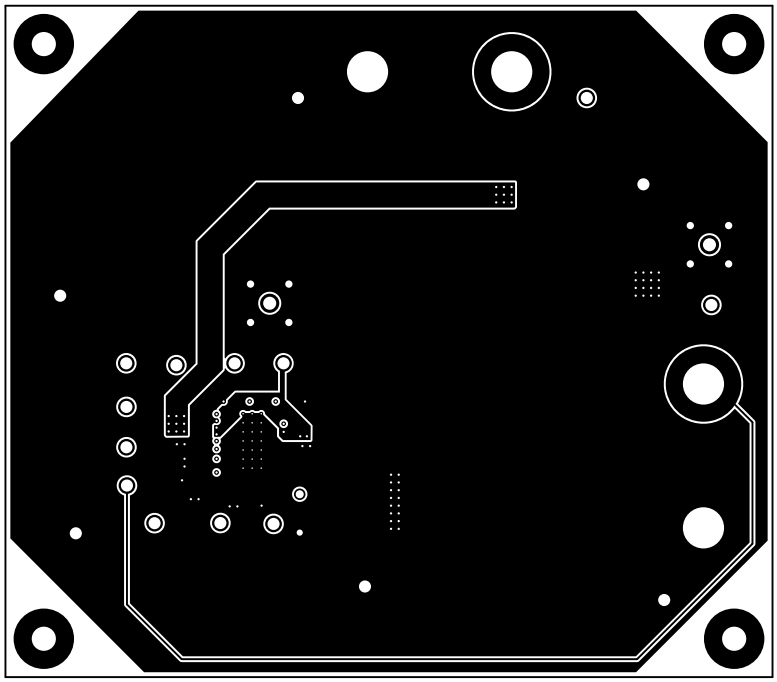


图 4-6. 第 3 层

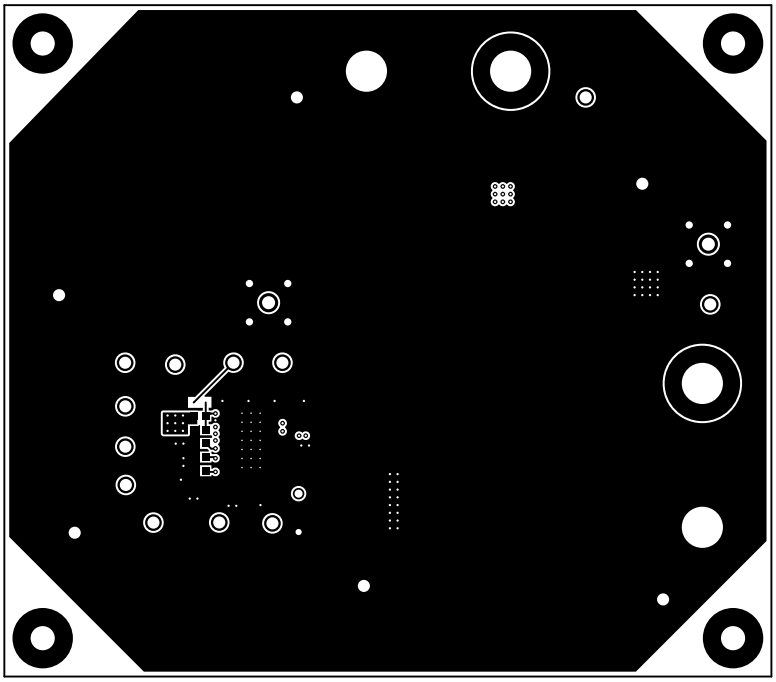


图 4-7. 第 4 层 (底部)

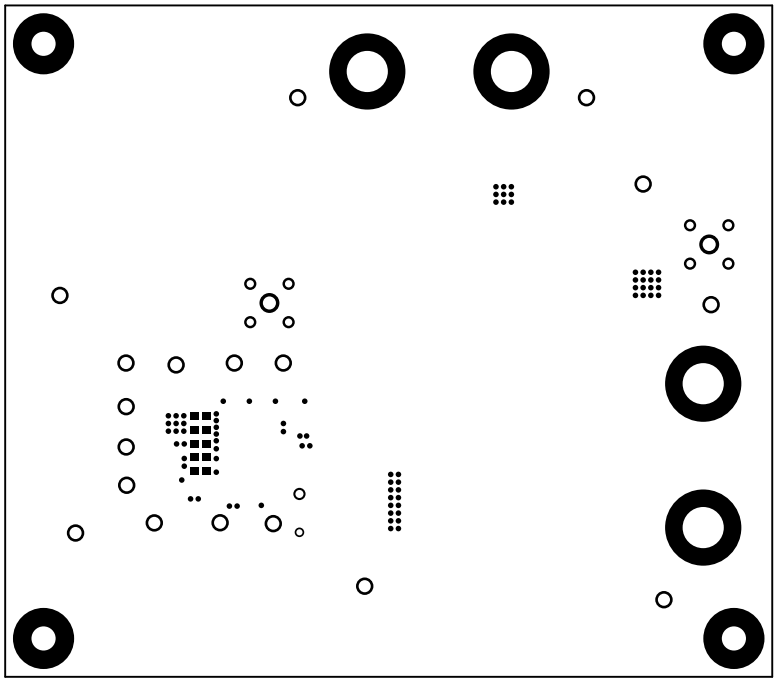


图 4-8. 底部阻焊层

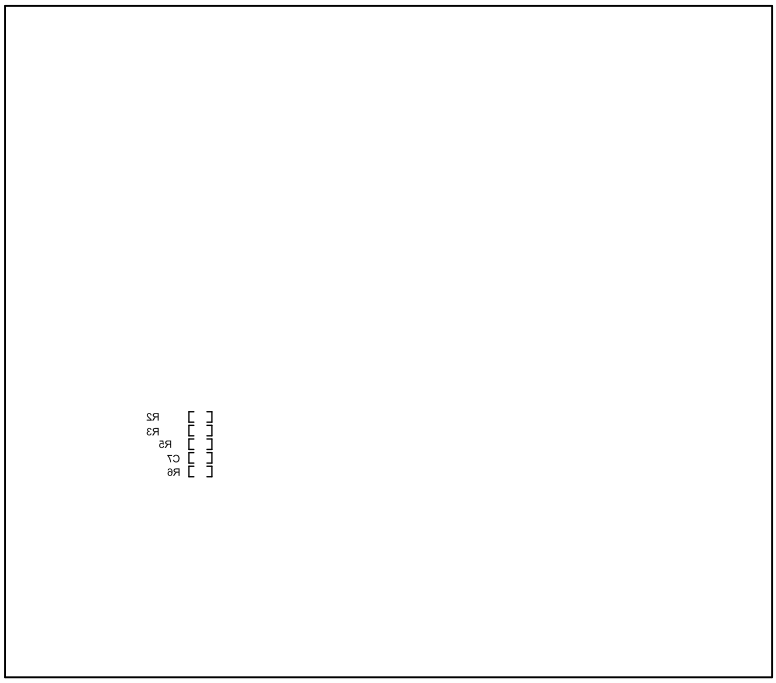


图 4-9. 底层丝印层

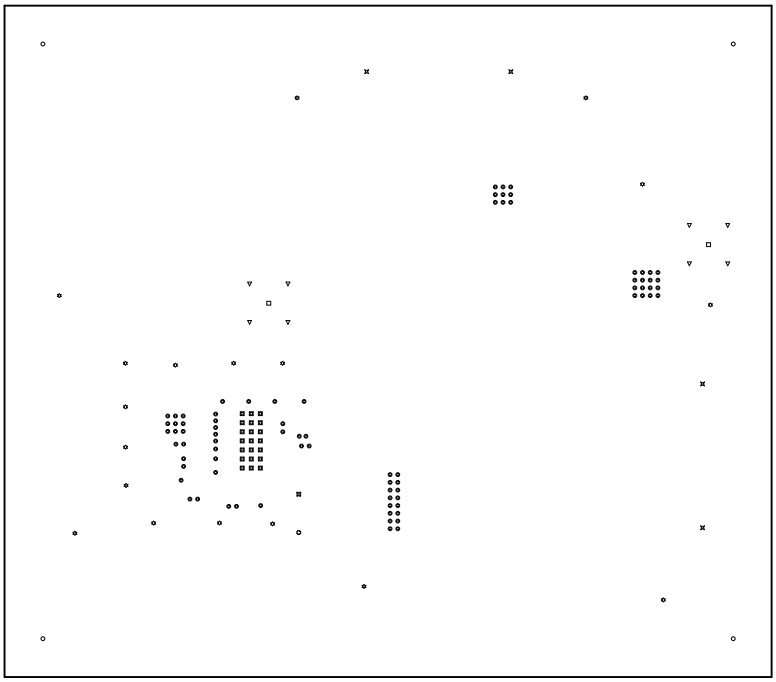


图 4-10. 钻孔图

4.3 物料清单 (BOM)

位号	数量	值	说明	封装参考	器件型号	制造商
C1、C2	2	47µF	电容，固体钽，47uF，35V，E CASE，10%，(7.3mm x 4.3mm x 4.1mm)，SMD，7343-43，0.055Ω，125 T/R	2917	TPME476K035R0055	KYOCERA AVX
C3、C15	2	0.1uF	电容，陶瓷，0.1µF，50V，+/-10%，X7R，AEC-Q200 1 级，0603	0603	06035C104KAZ2A	AVX
C4、C6、C14	3	1uF	电容，陶瓷，1uF，50V，+/-10%，X7R，0603	0603	UMK107AB7105KA-T	Taiyo Yuden
C5	1	0.22µF	电容，陶瓷，0.22µF，50V，+/-10%，X7R，AEC-Q200 1 级，0603	0603	GCJ188R71H224KA01D	MuRata
C7、C9	2	0.047uF	电容，陶瓷，0.047uF，100V，+/-10%，X7S，0603	0603	C1608X7S2A473K080AB	TDK
C8	1	0.47µF	电容，陶瓷，0.47uF，50V，± 10%，X7R，AEC-Q200 1 级，0603	0603	CGA3E3X7R1H474K080AE	TDK
C10	1	220pF	电容，陶瓷，220pF，50V，+/-1%，C0G/NP0，0603	0603	06035A221FAT2A	AVX
C11	1	10pF	电容，陶瓷，10pF，50V，+/-1%，C0G/NP0，0603	0603	C0603C100F5GAC7867	Kemet
C13	1	47µF	47µF 模制钽聚合物电容器 50V 2917（7343 公制）100mΩ（100kHz 时）	2917	T59EE476M050E0100	Vishay
D1	1	60V	二极管，肖特基，60V，3A，AEC-Q101，SMA	SMA	RB058L-60TE25	RΩ
H1、H2、H3、H4	4		机械螺钉，圆头，#4-40 x 1/4，尼龙，飞利浦盘形头	螺钉	NY PMS 440 0025 PH	B&F Fastener Supply
H5、H6、H7、H8	4		六角螺柱，0.5"L #4-40，尼龙	螺柱	1902C	Keystone
J1、J2、J3、J4	4		标准香蕉插头，非绝缘，5.5mm	Keystone_575-4	575-4	Keystone
J5、J6	2		紧凑型探头尖端电路板测试点，TH，25 件装	TH 示波器探头	131-5031-00	Tektronix

位号	数量	值	说明	封装参考	器件型号	制造商
L1	1	33uH	电感，屏蔽，金属复合材料，33µH，10.5A，0.0154Ω，AEC-Q200 0 级，SMD	非标准	SRP2313AA-330M	Bourns
LBL1	1		热转印打印标签，0.650" (宽) x 0.200" (高) - 10,000/卷	PCB 标签，0.650 x 0.200 英寸	THT-14-423-10	Brady
Q1	1		N 通道 60V 86A (Tc) 2.8W (Ta)、89W (Tc) 表面贴装 DIRECTFET™ MN	WDSON5	IRF6648TRPBF	Infineon
R1	1	0	电阻，0，5%，0.1W，AEC-Q200 0 级，0603	0603	ERJ-3GEY0R00V	Panasonic
R2、R16	2	10.0k	电阻，10.0k，0.01%，0.1W，0603	0603	BLU0603-1002-TT10W	RCD Components
R3	1	665	电阻，665，0.5%，0.1W，0603	0603	RT0603DRE07665RL	Yageo America
R5	1	210k	电阻，210k，0.5%，0.1W，0603	0603	RT0603DRE07210KL	Yageo America
R6	1	118k	电阻，118k，0.5%，0.1W，0603	0603	RT0603DRE07118KL	Yageo America
R7	1	15.4k	电阻，15.4k，0.1%，0.1W，0603	0603	RG1608P-1542-B-T5	Susumu Co Ltd
R8、R9	2	2	电阻，2.00，1%，0.125W，0603	0603	MCT06030C2008FP500	Vishay/Beyschlag
R10	1	1.0k	电阻，1.0k，5%，0.1W，AEC-Q200 0 级，0603	0603	CRCW06031K00JNEA	Vishay-Dale
R11、R12	2	0.22	电阻，0.22，1%，2W，2512	2512	CSRN2512FTR220	Stackpole Electronics Inc
R13	1	20	电阻，20.0，0.1%，0.1W，0603	0603	RT0603BRD0720RL	Yageo America
R14	1	220	电阻，220，0.1%，0.1W，0603	0603	RG1608P-221-B-T5	Susumu Co Ltd
TP1、TP2、TP3、TP4	4		测试点，多用途，红色，TH	红色通用测试点	5010	Keystone Electronics
TP5、TP6、TP7、TP8、TP9、TP10、TP12、TP13	8		测试点，通用，白色，TH	白色通用测试点	5012	Keystone Electronics

位号	数量	值	说明	封装参考	器件型号	制造商
TP14、TP15、TP16、TP17、TP18、TP19	6		测试点，多用途，黑色，TH	黑色通用测试点	5011	Keystone
U1	1		具有集成栅极驱动器的耐辐射加固保障 500kHz 电流模式 PWM 控制器	HTSSOP24	TPS7H5030MPWPTSEP	德州仪器 (TI)
C12	0	1uF	电容，陶瓷，1uF，50V，+/- 10%，X6S，0805，C2012X6S1H105K125AB	0805	C2012X6S1H105K125AB	TDK
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
R4	0	0	电阻，0，5%，0.1W，AEC-Q200 0 级，0603	0603	ERJ-3GEY0R00V	Panasonic
R15	0	1.00k	电阻，1.00k，1%，0.125W，AEC-Q200 0 级，0805，CRCW08051K00FKEA	0805	CRCW08051K00FKEA	Vishay-Dale

5 合规信息

- 德州仪器 (TI)，*TPS7H5030EVM EU RoHS 符合性声明 (DoC)*

6 其他信息

6.1 商标

所有商标均为其各自所有者的财产。

7 相关文档

- 德州仪器 (TI)，*TPS7H502x-SP/-SEP 和 TPS7H503x-SP/-SEP 系列带集成栅极驱动器的抗辐射电流模式 PWM 控制器* 数据表

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.

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

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最后更新日期：2025 年 10 月