EVM User's Guide: LP8868YQ1EVM

LP8868Y-Q1 评估模块

说明

LP8868YQ1EVM 能帮助设计人员评估适用于大电流 LED 驱动器应用的 LP8868Y-Q1 非同步降压/升压开关稳压器的运行和性能。LP8868Y-Q1 提供 4A 非同步降压/升压 LED 驱动器功能。该器件 4.5V 至 65V 的宽输入电压范围。该元件提供四种调光选项：模拟调光、PWM 调光、混合调光和灵活调光。每种调光模式都可使用简单的高和低电平信号，通过 PWM 或 EN 和 ADIM 或 HD 输入引脚进行配置。EVM 还提供全面的保护功能，包括 LED 开路保护和短路保护、检测电阻开路保护和短路保护、可配置的热折返和热关断。

开始使用

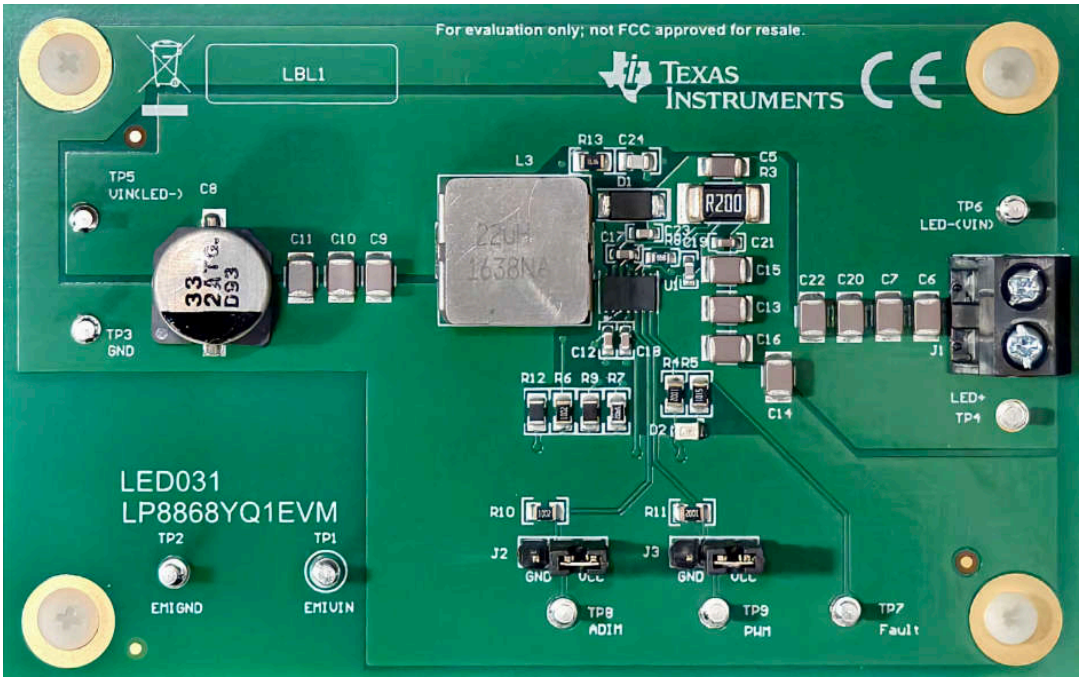
1. 订购 LP8868YQ1EVM。
2. 下载并查看 *LP8868-Q1 具有电感式快速调光功能的汽车多拓扑 LED 驱动器*数据表。

特性

- 宽输入电压：4.5V 至 65V
- 集成式 5.2A 和 150mΩ 金属氧化物半导体场效应晶体管 (MOSFET)
- 高精度功率场效应晶体管 (FET) 调光
- 开关频率为 100kHz 至 2.2MHz
- 全面保护特性

应用

- 汽车信息娱乐系统
- 汽车仪表组
- 抬头显示屏 (HUD)
- 汽车照明



LP8868YQ1EVM

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1 评估模块概述

1.1 简介

LP8868YQ1EVM 是一个 LED 驱动器，由 LP8868YQ1 降压/升压开关稳压器供电。EVM 设计为在 4.5V 至 65V 的输入电压范围内运行。该 EVM 默认输出电流设置为 1A，可在四个可配置的调光选项下运行。另请参阅 *LP8868-Q1 具有电感式快速调光功能的汽车多拓扑 LED 驱动器*数据表。通过在 ADIM/HD 引脚或 PWM/EN 引脚上施加 0-100% 占空比的 PWM 信号，器件能够分别在模拟调光或 PWM 调光模式下运行。

本用户指南旨在介绍 LP8868YQ1EVM 评估模块。本用户指南可用作工程评估的参考文献，本用户指南中包含测试设置说明、原理图、印刷电路板 (PCB) 布局和物料清单 (BOM)。

在使用 LP8868YQ1EVM 时，请遵守以下预防措施。

警告

在选择 LED 元件（并非此 EVM 随附元件）时，用户必须查阅 LED 制造商提供的 LED 数据表，确认 EN62471 风险分组等级，并查看所选 LED 可能对眼睛带来的危害。务必考虑并落实使用有效的滤光和防护墨镜，并在观察强光源时充分了解周围的实验室环境，更大程度地降低或消除上述风险，从而避免与暂时性失明相关的事故。

警告

对于系统中连接的所有硬件和元件，与硬件的所有外部连接必须保持在建议的工作条件和预期用途范围内

1.2 套件内容

LP8868YQ1EVM 套件包含：

- (1) LP8868YQ1EVM

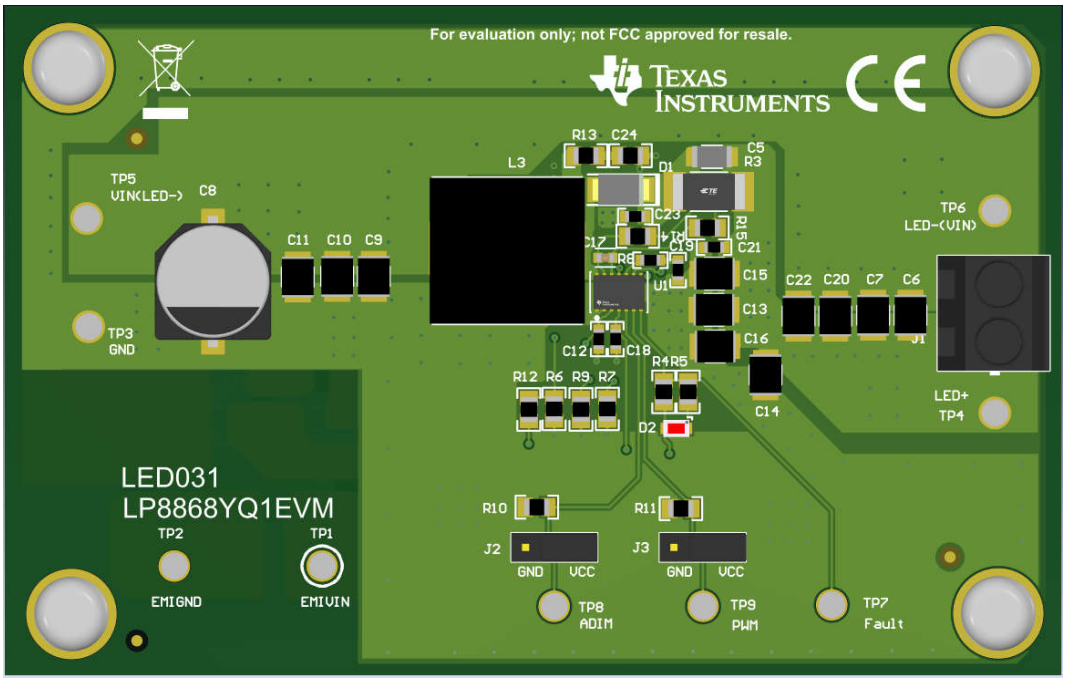


图 1-1. LP8868YQ1EVM 套件

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1.3 规格

LP8868YQ1EVM 旨在对器件的基本功能进行评估。更改跳线 J2 和 J3 有助于实现四种不同的调光模式。该电路板设计为 1A 输出电流，具有 37V LED+ 过压保护阈值。受限于输入和输出电容器额定电压，输入电压和 LED+ 电压需低于 50V。

1.4 器件信息

LP8868Y-Q1 是一款具有 4.5V 至 65V 宽输入范围的非同步恒流降压/升压转换器。通过集成低侧 NMOS 开关，该器件能够以高功率密度和高效率驱动 LED。该器件系列还支持单层 PCB 设计。开关频率可在 100kHz 至 2.2MHz 范围内进行配置，并具有可选的展频功能，可实现更好的 EMI 性能。

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2 硬件

2.1 测试设置

本节介绍如何正确连接和设置 LP8868YQ1EVM。

2.1.1 系统和放大器要求

收集以下设备以使用 LP8868YQ1EVM：

- 直流电源：12V 或更高，6A 或更高
- LED 负载板

2.1.2 连接器说明

表 2-1 列出了 EVM 连接器和测试点。

表 2-1. EVM 连接器和测试点

参考指示符	功能
J1	用于 LED+ 和 LED- 的连接器
J2	ADIM/HD 可以选择连接至 V_{LDO} 或 GND
J3	EN/PWM 可以选择连接至 V_{LDO} 或 GND
TP1	与 EMI 滤波器的电源连接
TP2	与 EMI 滤波器的 GND 连接
TP3	无 EMI 滤波器的 GND 连接
TP4	LED+ 的测试点
TP5	无 EMI 滤波器的电源连接
TP6	LED- 的测试点
TP7	FAULT 测试点
TP8	ADIM/HD 信号输入
TP9	EN/PWM 信号输入

2.1.3 输入和输出连接

必须通过一对 20AWG 导线将能够提供 6A 电流的电源连接到 TP5 (VIN) 和 TP3 (GND)。必须通过一对 20 AWG 导线将 LED 负载连接到 TP4 和 TP6 或 J1。LED 负载的正极连接到 TP4 或 TP4 旁边的 J1 端子，LED 负载的负极连接到 TP6 或 TP6 旁边的 J1 端子。导线捻在一起并尽可能短，以便尽可能减少压降、电感和 EMI 传输。

TP8 和 TP9 是不同调光模式的控制信号输入端。表 2-2 显示了四种调光模式之一的配置。对于高电平信号，直流电压电平需高于 1.2V（通常为 3.3V）。EN/PWM 引脚或 ADIM/HD 引脚上的 PWM 信号应为方波，低电平为 GND，高电平电压高于 1.2V（通常为 3.3V）。在 PWM/EN 引脚上，PWM 信号的调光频率需要在 0.1kHz 到 50kHz 的范围内。而对于 ADIM/HD 引脚上的 PWM 信号，其调光频率应在 0.1kHz 到 100kHz 的范围内。

表 2-2. 调光模式配置

调光模式	EN/PWM 引脚	ADIM/HD 引脚
PWM 调光	PWM 信号	高
模拟调光	高	PWM 信号
混合调光	PWM 信号	低
灵活调光	PWM 信号	PWM 信号

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3 硬件设计文件

3.1 原理图

图 3-1 展示了 LP8868YQ1EVM 原理图。

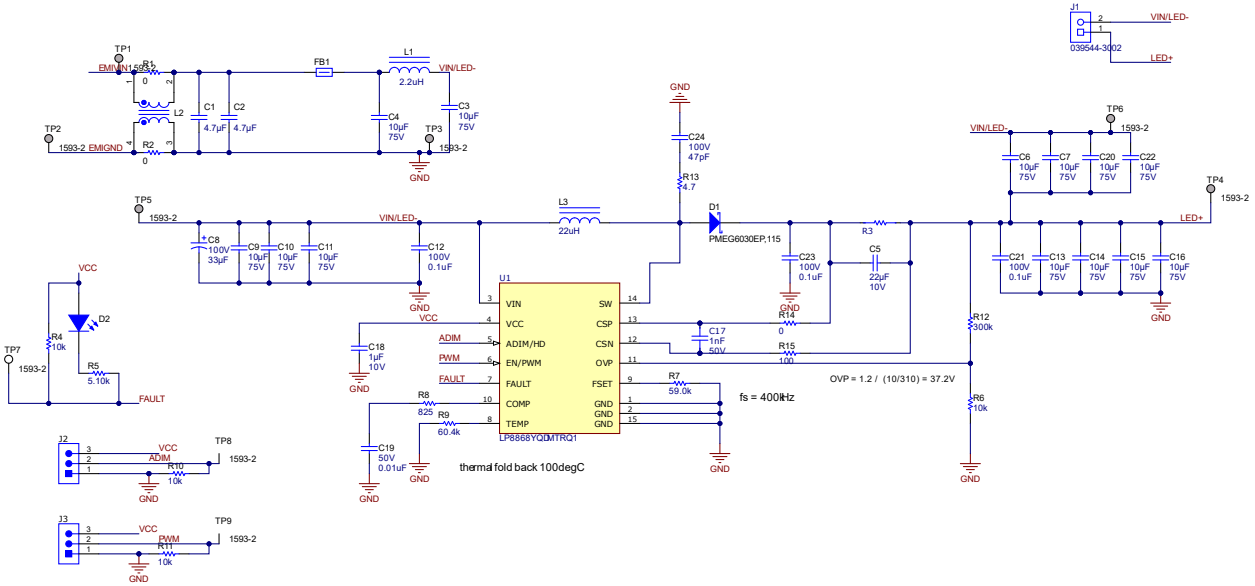


图 3-1. LP8868YQ1EVM 原理图

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3.2 布局

图 3-2、图 3-3、图 3-4 和图 3-5 显示了 LP8868YQ1EVM 印刷电路板 (PCB) 的布局。

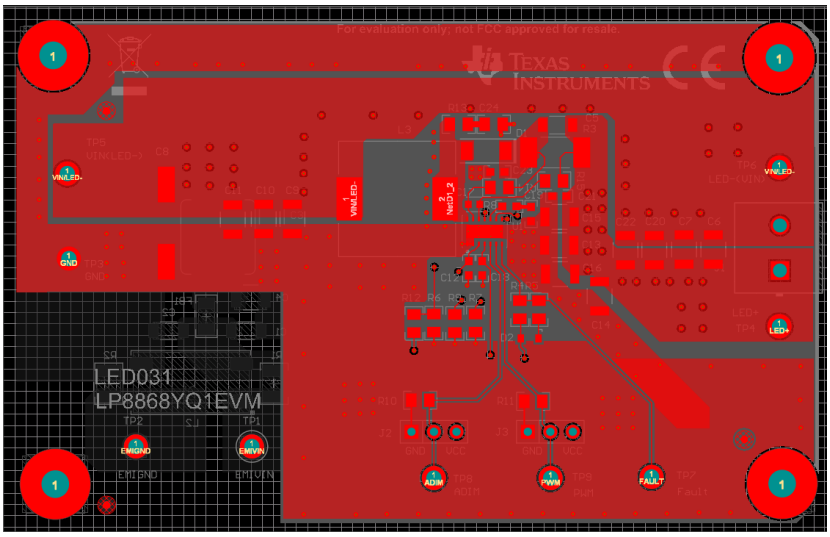


图 3-2. LP8868YQ1EVM 顶层

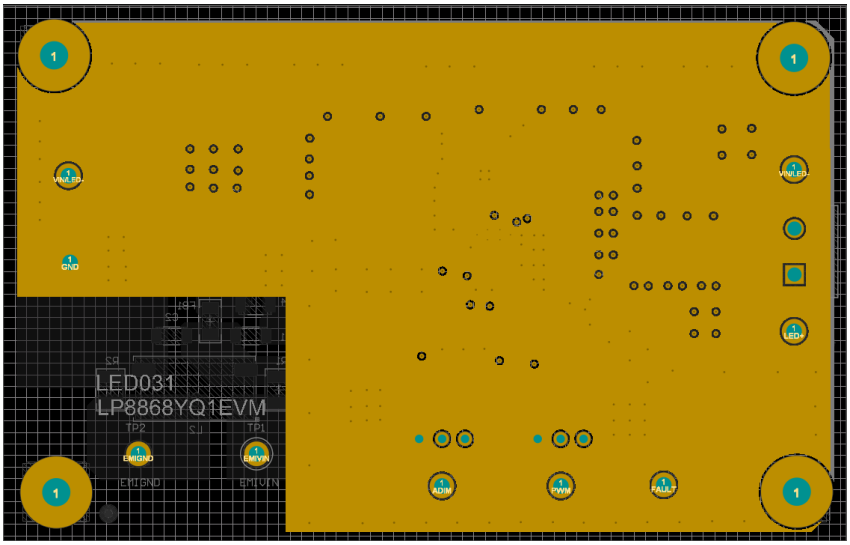


图 3-3. LP8868YQ1EVM 内层 1

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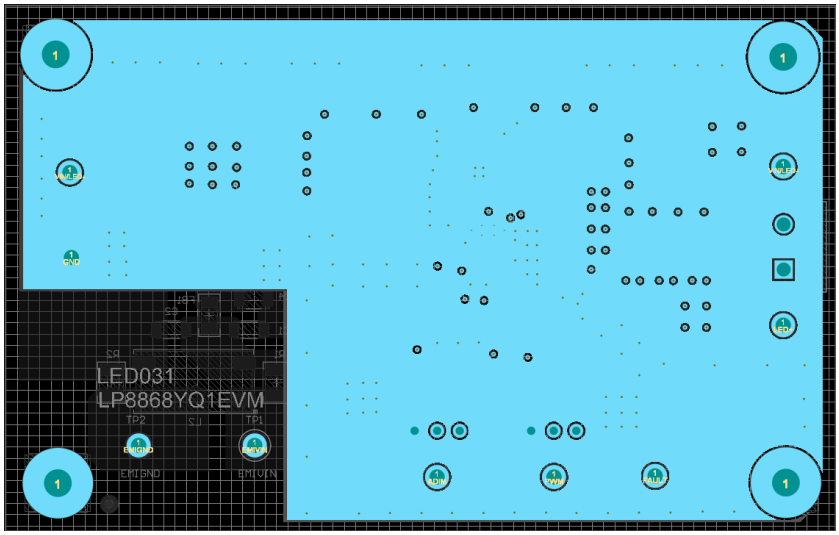


图 3-4. LP8868YQ1EVM 内层 2

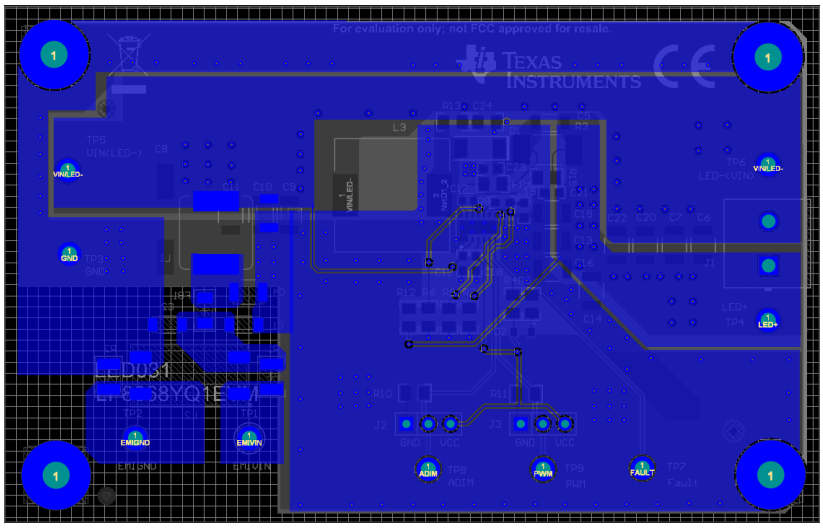


图 3-5. LP8868YQ1EVM 底层

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3.3 物料清单

表 3-1 显示了 LP8868YQ1EVM 物料清单。

表 3-1. LP8868YQ1EVM 物料清单

位号	数量	值	说明	封装	器件型号	制造商
C1, C2	2	4.7uF	电容，陶瓷，4.7µF，50V，±10%，X7R，AEC-Q200 1 级，1206	1206	CGA5L3X7R1H475K160AE	TDK
C3、C4、C6、C7、C9、C10、C11、C13、C14、C15、C16、C20、C22	13	10uF	电容，陶瓷，10µF，75V，±20%，X7R，AEC-Q200 1 级，1210	1210	CGA6P1X7R1N106M250AC	TDK
C5	1		电容，陶瓷，22UF，10V，X7S，1206	1206	CGA5L1X7S1A226M160AC	TDK
C8	1	33uF	电容，铝制，33µF，100V，±20%，1Ω，AEC-Q200 1 级，SMD	直径 10mm	EEE-TG2A330P	Panasonic
C12、C21、C23	3	0.1uF	电容，陶瓷，0.1uF，100V，±10%，X7S，AEC-Q200 1 级，0603	0603	CGA3E3X7S2A104K080AB	TDK
C17	1	1nF	1000pF ±10% 50V 陶瓷电容器 X7R 0603（公制 1608）	0603	C0603X102K5RAC7867	KEMET
C18	1	1uF	电容，陶瓷，1µF，10V，±10%，X7R，AEC-Q200 1 级，0603	0603	LMK107B7105KAHT	Taiyo Yuden
C19	1	0.01uF	电容，陶瓷，0.01µF，50V，±5%，C0G/NP0，AEC-Q200 1 级，0603	0603	CGA3E2C0G1H103J080AA	TDK
C24	1	47pF	电容，陶瓷，47pF，100V，±5%，C0G/NP0，0805	0805	08051A470JAT2A	AVX
D1	1	60V	二极管，肖特基，60V，3A，SOD-128	SOD-128	PMEG6030EP,115	Nexperia
D2	1	红色超高亮	LED，红色超高亮，SMD	2.2x1.3x1.4mm	VLMS20J2L1-GS08	Vishay-Semiconductor
FB1	1	50Ω	铁氧体磁珠，50Ω（100MHz 时），12A，1206	1206	BLM31SN500SZ1L	MuRata
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	1		端子块，5.08mm，2x1，TH	端子块，5.08mm，2x1，TH	039544-3002	Molex
J2、J3	2		接头，100mil，3x1，金，TH	PBC03SAAN	PBC03SAAN	Sullins Connector Solutions
L1	1	2.2uH	电感器，屏蔽，铁粉，2.2uH，10.5A，0.0137Ω，SMD	322x158x322mil	IHLP3232DZER2R2M01	Vishay-Dale
L2	1	9uH	耦合电感器，9uH,10A，0.0036Ω，SMD	12.9x6.6mm	PLT10HH501100PNL	MuRata
L3	1	22uH	电感器，屏蔽，铁粉，22uH，5.5A，0.0313Ω，SMD	IHLP-5050FD	IHLP5050FDER220M5A	Vishay-Dale

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表 3-1. LP8868YQ1EVM 物料清单（续）

位号	数量	值	说明	封装	器件型号	制造商
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
R1、R2	2	0	电阻，0，1%，0.75W，AEC-Q200 0 级，1210	1210	CRCW12100000Z0EAHP	Vishay-Dale
R3	1	0.2	200MΩ，±1%，2W，片上电阻 2512（公制 6432），抗硫化，汽车 AEC-Q200，电流检测，金属元件	2512	TLRP3A20WR200FTE	TE Connectivity
R4、R6、R10、R11	4	10k	电阻，10k，5%，0.125W，AEC-Q200 0 级，0805	0805	CRCW080510K0JNEA	Vishay-Dale
R5	1	5.10k	电阻，5.10k，0.1%，0.125W，0805	0805	RG2012P-512-B-T5	Susumu Co Ltd
R7	1	59.0k	电阻，59.0k，1%，0.125W，AEC-Q200 0 级，0805	0805	ERJ-6ENF5902V	Panasonic
R8	1	825	电阻，825，1%，0.1W，AEC-Q200 0 级，0603	0603	CRCW0603825RFKEA	Vishay-Dale
R9	1	60.4k	电阻，60.4k，1%，0.125W，AEC-Q200 0 级，0805	0805	CRCW080560K4FKEA	Vishay-Dale
R12	1	300k	电阻，300k，5%，0.125W，AEC-Q200 0 级，0805	0805	CRCW0805300KJNEA	Vishay-Dale
R13	1	4.7	电阻，4.7，5%，0.25W，0805	0805	CRM0805-JW-4R7ELF	Bourns
R14	1	0	电阻，0，5%，0.125W，AEC-Q200 0 级，0805	0805	CRCW08050000Z0EA	Vishay-Dale
R15	1	100	电阻，100，0.01%，0.125W，0805	0805	RNCF0805TKY100R	Stackpole Electronics Inc
SH-J1、SH-J2	2	1x2	分流器，100mil，镀金，黑色	顶部闭合 100mil 分流器	SPC02SYAN	Sullins Connector Solutions
TP1、TP2、TP3、TP4、TP5、TP6、TP7、TP8、TP9	9		引脚，双转塔，TH	Keystone1593-2	1593-2	Keystone
U1	1		具有电感式快速调光功能的 65V、4A 降压/升压 LED 驱动器	VSON14	LP8868YQDMTRQ1	德州仪器 (TI)

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4 其他信息

4.1 商标

所有商标均为其各自所有者的财产。

5 Revision History

注：以前版本的页码可能与当前版本的页码不同

Changes from Revision * (November 2025) to Revision A (March 2026)	Page
•	4
• 更改了原理图说明	5
• 更新了布局图像	6
• 更改了物料清单	8

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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。

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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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