

## EVM User's Guide: TPS63820EVM

## TPS63820 评估模块

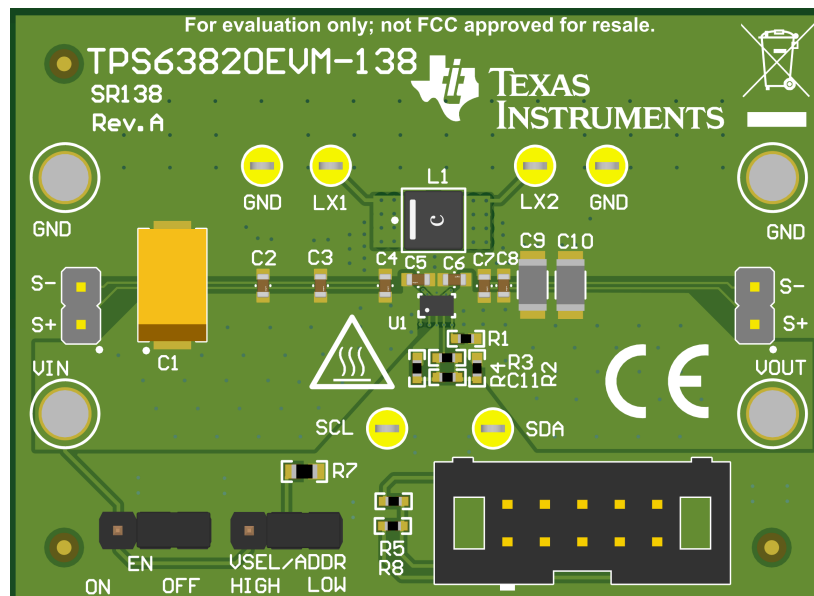


## 说明

TPS63820EVM 用于评估 TPS63820 的性能。  
TPS63820EVM 是高效、单电感器 4A 降压/升压转换器，具有内部补偿功能和低静态电流，采用 15 引脚、2.0mm × 1.2mm × 0.5mm DSBGA 封装。

## 特性

- 输出电流最高 4.0A (  $V_{in} \geq 3.0V$  ,  $V_{out} = 3.3V$  )
- $V_{in} = 3.6V$ 、 $V_{out} = 3.3V$ 、 $I_{out} = 2A$  时，效率高达 97.3%
- 2.3 $\mu A$  典型工作静态电流
- I<sup>2</sup>C 可配置、可通过 ADDR 引脚编程目标地址
- 输出放电功能
- 可选自动 PFM、超音速或强制 PWM 模式



TPS63820EVM 三维视图

## 1 评估模块概述

### 1.1 简介

本用户指南介绍了 TPS63820EVM 的操作和使用情况。该 EVM 旨在帮助用户轻松评估和测试 TPS63820 降压/升压转换器系列的运行和功能。该 EVM 的输出电压设置为 3.3V。输出电压可通过 I<sup>2</sup>C 接口在 1.2V 至 5.5V 之间进行编程。该 EVM 的工作输入电压范围为 1.8V 至 5.5V，当  $V_{in} \geq 3.0V$  且  $V_{out} = 3.3V$  时，输出电流可高达 4.0A。本文档包含硬件设置说明以及 EVM 的原理图和 PCB 布局。除非特别说明，否则本文档内的缩写词 EVM、TPS63820EVM 以及术语“评估模块”均代表 TPS63820。

### 1.2 套件内容

表 1-1. 套件清单

位号	数量	说明	材料类型	封装
PCB1	1	TPS63820EVM；电路板	EEE	塑料袋，ESD
BOX1	1	盒子，纸板	纸板	盒
FM1	2	泡沫，防静电	塑料	泡沫
LBL1	1	标签，小号和大号标准标签	纸，卡纸	纸
LIT1	1	文献，EVM 免责声明自述文件	纸，卡纸	纸

### 1.3 规格

表 1-2. 性能规格汇总

规格	条件	最小值	典型值	最大值	单位
输入电压		1.8		5.5	V
启动输入电压		2.0		5.5	V
输出电压		1.2		5.5	V
输出电流	$V_{IN} \geq 3.0V, V_{OUT} = 3.3V$	0		4.0	A

### 1.4 器件信息

TPS63820 是一款采用微型晶圆芯片级封装且具有 I<sup>2</sup>C 接口的低静态电流、4A 降压/升压转换器。TPS63820 具有 6.5A 的典型谷值电流限制和 1.8V 至 5.5V 的输入电压范围，可提供适用于系统前置稳压器和电压稳定器的电源。

## 2 硬件

### 2.1 背景

TPS63820EVM 使用 TPS63820 集成电路 (IC)，输出电压设置为 3.3V。该 EVM 的工作输入电压范围为 1.8 V 至 5.5V。

本节介绍如何正确使用 TPS63820EVM。

### 2.2 输入和输出连接器、测试点和接头说明

#### 2.2.1 VIN 端子

来自 EVM 输入电源的正极输入电压连接。

#### 2.2.2 S+/S - (VIN 端子附近)

输入电压感测连接。测量此处的输入电压。

#### 2.2.3 GND 端子 (VIN 端子附近)

EVM 输入电源的输入电压 GND 回路连接。

#### 2.2.4 VOUT 端子

正输出电压连接。

#### 2.2.5 S+/S - (VOUT 端子附近)

输出电压感测连接。测量此处的输出电压。

#### 2.2.6 GND 端子 (VOUT 端子附近)

输出电压 GND 回路连接。

#### 2.2.7 测试点

##### 2.2.7.1 LX1、LX2

连接到 TPS63820 的 LX1 和 LX2 开关节点引脚的测试点

##### 2.2.7.2 SCL, SDA

连接到 TPS63820 的 SCL 和 SDA 引脚的测试点

#### 2.2.8 接头信息

##### 2.2.8.1 10 引脚插头

10 引脚接头，用于将 USB2ANY 适配器连接到 EVM。

#### 2.2.9 跳线信息

##### 2.2.9.1 跳线 EN

将跳线穿过引脚 EN 和 ON 可启用器件。将跳线穿过引脚 EN 和 OFF 可禁用器件。

##### 2.2.9.2 跳线 VSEL/ADDR

将跳线穿过 VSEL/ADDR 引脚并置于高电平、低电平或悬空状态，可配置三个不同的 I<sup>2</sup>C 目标地址。另请参阅表 3-1。

### 2.3 设置

要运行 EVM，请将电源的正极引线连接到 VIN 端子，负极引线连接到 GND 端子。将负载的正极引线连接到 VOUT 端子，负极引线连接到 GND 端子。使跳线跨接 VSEL/ADDR 和 LOW 引脚（如示例所示）。将跳线穿过引脚 EN 和 ON 可启用器件。

## 2.4 更改

该 EVM 的印刷电路板 (PCB) 经过设计可适应 TPS63820。保留额外的位置，用于额外的输入和输出电容器以及 I<sup>2</sup>C 上拉电阻。

### 2.4.1 IC U1 操作

此 EVM 需要适当的 I<sup>2</sup>C 接口 (例如 TI USB2ANY) 来配置 TPS63820。输出电压可通过 I<sup>2</sup>C 在 1.2V 至 5.5V 之间进行编程。有关详细配置，请参阅 [器件寄存器](#)。

### 3 软件

#### 3.1 软件设置

可从 ti.com ([TPS63820EVM GUI](#)) 获取图形用户界面 (GUI)，通过 TI USB2ANY ([USB2ANY](#)) 轻松对器件进行编程。或者，用户可以使用任何 I<sup>2</sup>C 标准编程工具或 I<sup>2</sup>C 主机来配置该器件。请注意 I<sup>2</sup>C 引脚规格，例如时序参数和适当的上拉电阻器。

TPS63820 具有三个可通过 ADDR 引脚配置的 I<sup>2</sup>C 目标地址。表 3-1 展示了 I<sup>2</sup>C 目标地址和 ADDR 引脚连接。

表 3-1. I<sup>2</sup>C 目标地址

ADDR 引脚连接	I <sup>2</sup> C 目标地址
低	0x75
高	0x76
悬空	0x77

#### 3.2 接口硬件设置

使用提供的 USB 电缆将 USB2ANY 适配器与 PC 连接在一起。使用提供的 10 引脚带状线缆，将 EVM 10 引脚连接器连接至 USB2ANY 适配器。带状电缆上的连接器键控可防止安装错误。

图 3-1 所示为快速适配器连接概览。

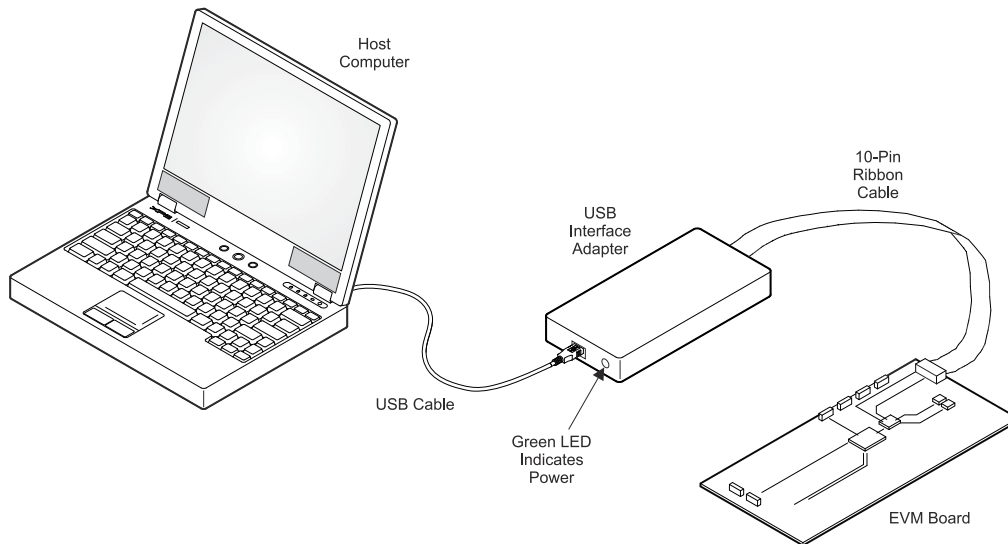


图 3-1. 快速连接概览

### 3.3 用户界面操作

启动时，GUI 将自动连接到 EVM。如果未连接，请选择 GUI 窗口左下角的 **Connect** 按钮，或刷新网页。下面几节简要概述了三个主要 GUI 屏幕。

#### 3.3.1 主屏幕

主屏幕简要概述了 TPS6382X (X = 0, 01, 1, 11) 器件。要开始评估该器件，请选择 **Start** 按钮，或点击 GUI 窗口左侧的 **Settings** 或 **Register Map** 图标。

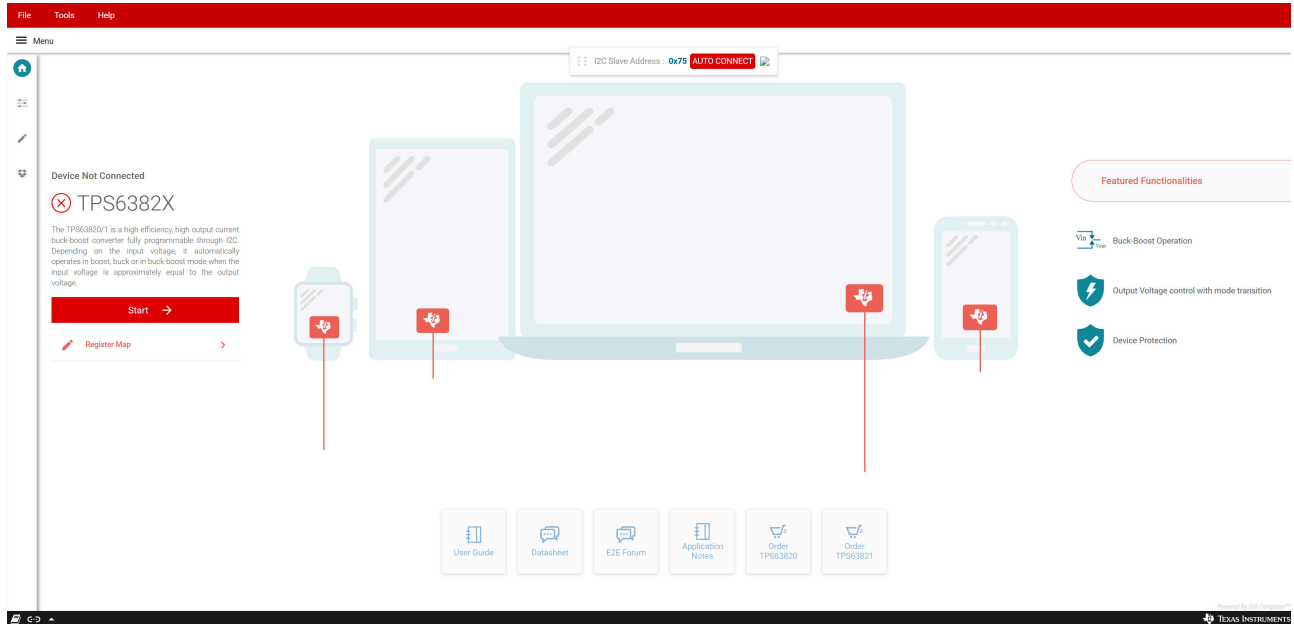


图 3-2. GUI 主屏幕

#### 3.3.2 设置屏幕

设置屏幕可用于控制 TPS63820 的输出电压和运行模式。

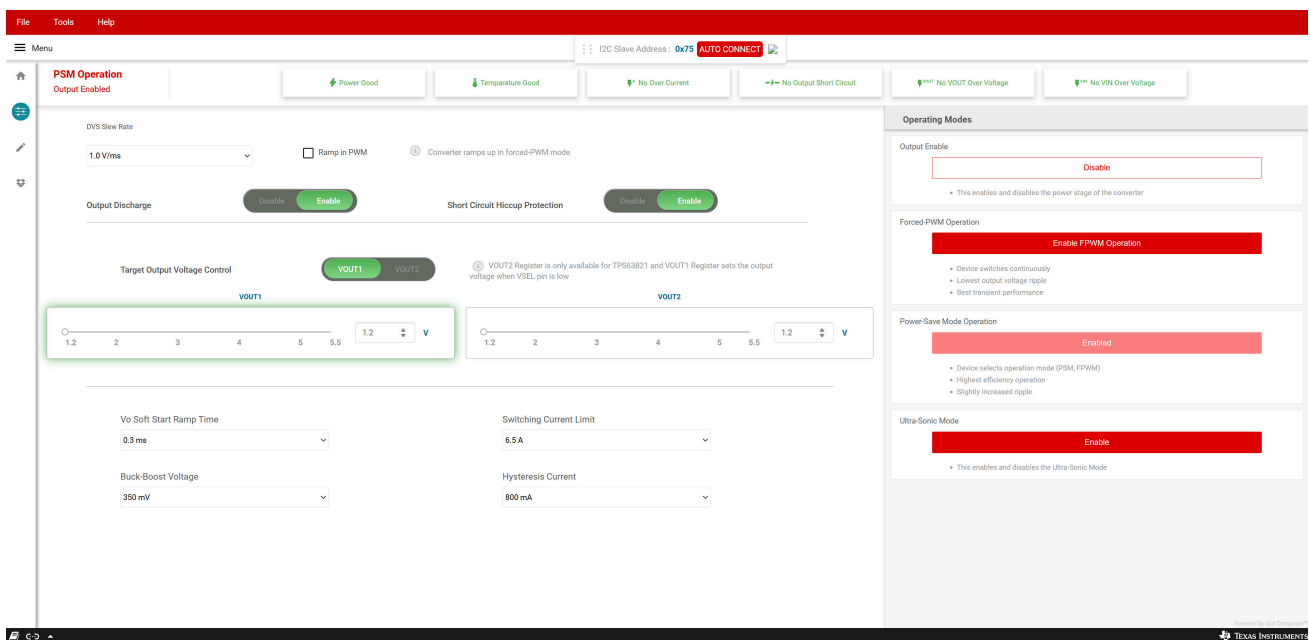


图 3-3. GUI 设置屏幕

### 3.3.3 寄存器映射屏幕

Register Map 屏幕展示了寄存器的所有参数。在此处，单一寄存器可被读取或写入器件（如果适用）。有关 TPS63820 寄存器的详细说明，请参阅 [器件寄存器](#)。

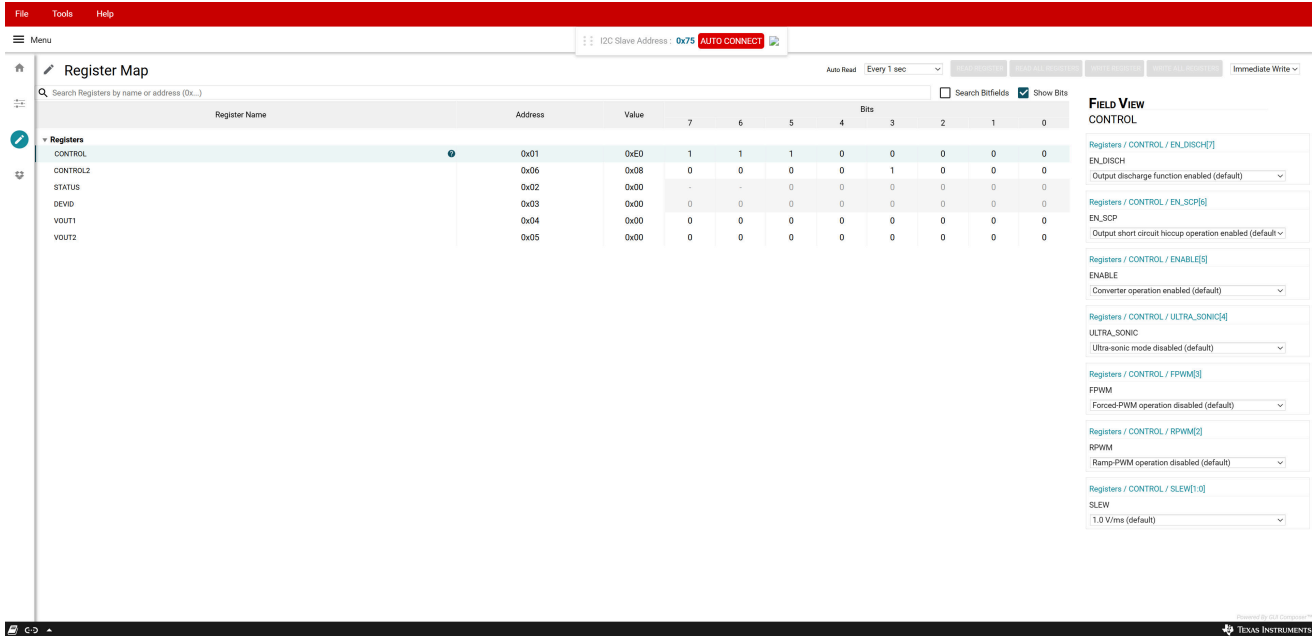


图 3-4. GUI 寄存器映射屏幕

### 3.4 器件寄存器

表 3-2 列出了器件寄存器的存储器映射寄存器。表 3-2 中未列出的所有寄存器偏移地址都应视为保留的位置，并且不得修改寄存器内容。

表 3-2. 器件寄存器

地址	首字母缩写词	寄存器名称	部分
0x01	控制	控制寄存器	<a href="#">转到</a>
0x02	状态	状态寄存器	<a href="#">转到</a>
0x03	DEVID	DEVID 寄存器	<a href="#">转到</a>
0x04	VOUT1	VOUT1 寄存器	<a href="#">转到</a>
0x06	CONTROL2	Control2 寄存器	<a href="#">转到</a>

#### 3.4.1 寄存器 CONTROL (寄存器地址：0x01；默认：0xE0 或 0x40)

返回设备寄存器。

表 3-3. 寄存器 CONTROL 格式

7	6	5	4	3	2	1	0
EN_DISCH	EN_SCP	ENABLE	ULTRA_SONIC	FPWM	RPWM	SLEW[1:0]	
R/W	R/W	R/W	R/W	R/W	R/W	R/W	

说明：R/W = 读/写；R = 只读

表 3-4. 寄存器 CONTROL 字段说明

位	字段	类型	复位	说明
7	EN_DISCHG	R/W	X	启用输出放电功能。 0：禁用输出放电功能（适用于 TPS638201） 1：启用输出放电功能（适用于 TPS63820）
6	EN_SCP	R/W	1	启用输出短路保护（断续）。 0：禁用输出短路保护 <b>1：启用输出短路保护</b>
5	ENABLE	R/W	X	该位控制转换器的运行。 0：禁用转换器运行（TPS638201 的启动值） 1：启用转换器运行（TPS63820 的启动值）
4	ULTRA_SONIC	R/W	0	该位控制超音速模式功能。 <b>0：禁用超音速模式</b> 1：启用超音速模式
3	FPWM	R/W	0	该位控制强制 PWM 功能。 <b>0：禁用强制 PWM 运行</b> 1：启用强制 PWM 运行
2	RPWM	R/W	0	该位控制斜坡 PWM 功能。 <b>0：禁用斜坡 PWM 运行</b> 1：启用斜坡 PWM 运行
1:0	SLEW[1:0]	R/W	00	这些位控制 DVS 功能的转换率。 <b>00：±1V/ms</b> 01：±5V/ms 10：±10V/ms 11：±25V/ms

### 3.4.2 寄存器 STATUS (寄存器地址：0x02；默认：0x00)

返回 [设备寄存器](#)。

表 3-5. 寄存器 STATUS 格式

7	6	5	4	3	2	1	0
NIL[1:0]		VIN_OVP	VOUT_OVP	SC	OC	TSD	PG
R		R	R	R	R	R	R

说明：R/W = 读/写；R = 只读

表 3-6. 寄存器 STATUS 字段说明

位	字段	类型	复位	说明
7:6	NIL[1:0]	R	00	未使用。 这些位在读取时始终返回 0。
5	VIN_OVP	R	0	该位显示 VIN 过压功能的状态。 <b>0：正常运行</b> 1：检测到 VIN 过压事件。
4	VOUT_OVP	R	0	该位显示 VOUT 过压功能的状态。 <b>0：正常运行</b> 1：检测到 VOUT 过压事件。
3	SC	R	0	该位显示输出短路功能的状态。 <b>0：正常运行</b> 1：检测到输出短路事件。
2	OC	R	0	该位显示过流功能的状态。 <b>0：正常运行</b> 1：检测到过流事件。
1	TSD	R	0	该位显示热关断功能的状态。 <b>0：温度正常</b> 1：检测到过热事件。

表 3-6. 寄存器 STATUS 字段说明 (续)

位	字段	类型	复位	说明
0	PG	R	0	该位显示电源正常比较器的状态。 <b>0</b> : 电源正常 <b>1</b> : 检测到电源不正常事件。

### 3.4.3 寄存器 DEVID (寄存器地址 : 0x03 ; 默认 : 0x20)

返回 [设备寄存器](#)。

表 3-7. 寄存器 DEVID 格式

7	6	5	4	3	2	1	0
MANUFACTURER[3:0]			MAJOR[1:0]			MINOR[1:0]	
R			R			R	

说明 : R/W = 读/写 ; R = 只读

表 3-8. 寄存器 DEVID 字段说明

位	字段	类型	复位	说明
7:4	MANUFACTURER[3:0]	R	0010	这些位用于标识器件制造商。 <b>0010</b> : 德州仪器 (TI)
3:2	MAJOR[1:0]	R	00	这些位用于标识器件的主要版本。 <b>00</b> : A (初始器件) <b>01</b> : B (第一个主要版本) <b>10</b> : C (第二个主要版本) <b>11</b> : D (第三个主要版本)
1:0	MINOR[1:0]	R	00	这些位用于标识器件的次要版本。 <b>00</b> : 0 (初始器件) <b>01</b> : 1 (第一个次要版本) <b>10</b> : 2 (第二个次要版本) <b>11</b> : 3 (第三个次要版本)

### 3.4.4 寄存器 VOUT1 (寄存器地址 : 0x04 ; 默认 : 0x54)

返回 [设备寄存器](#)。

表 3-9. 寄存器 VOUT1 格式

7	6	5	4	3	2	1	0
VOUT1[7:0]							
R/W							

说明 : R/W = 读/写 ; R = 只读

表 3-10. 寄存器 VOUT1 字段说明

位	字段	类型	复位	说明
7:0	VOUT1[7:0]	R/W	0101 0100	输出电压 = 1.200 + (VOUT1[7:0] × 0.025)V (范围下限) (默认值 = 3.3V)

### 3.4.5 寄存器 CONTROL2 (寄存器地址 : 0x06 ; 默认 : 0x08)

返回 [设备寄存器](#)。

表 3-11. 寄存器 CONTROL2 格式

7	6	5	4	3	2	1	0
SS_RAMP		CURRENT_LIMIT		BB_WINDOW		HYS_CURRENT	
R/W		R/W		R/W		R/W	

说明 : R/W = 读取/写入 ; R = 只读

表 3-12. 寄存器 CONTROL 字段说明

位	字段	类型	复位	说明
7:6	SS_RAMP	R/W	00	定义 Vout 软启动斜坡的斜坡时间 <b>00 : 0.3ms</b> 01 : 1.1ms 10 : 4.0ms 11 : 7.5ms
5:4	CURRENT_LIMIT	R/W	00	定义谷值开关电流限制 <b>00 : 6.5A</b> 01 : 5.3A 10 : 3.6A 11 : 2.7A
3:2	BB_WINDOW	R/W	10	定义降压/升压电压窗口 00 : 200mV 01 : 275mV <b>10 : 350mV</b> 11 : 450mV
1:0	HYS_CURRENT	R/W	00	定义磁滞电流。 <b>00 : 800mA</b> 01 : 1000mA 10 : 750mA 11 : 1100mA

## 4 硬件设计文件

### 4.1 原理图

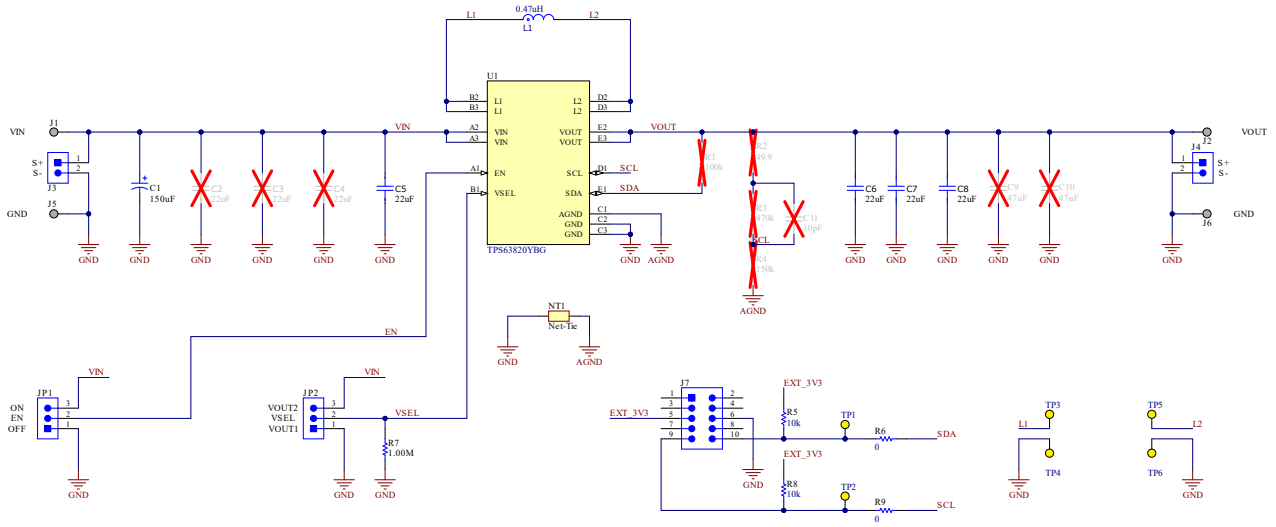


图 4-1. TPS63820EVM 原理图

## 4.2 电路板布局

本节提供了 TPS63820EVM 电路板布局布线和图示。

图 4-2 和 图 4-5 展示了顶层和底层的元件放置方式和 PCB 布局。图 4-3 和 图 4-4 展示了两个内层的 PCB 布局。

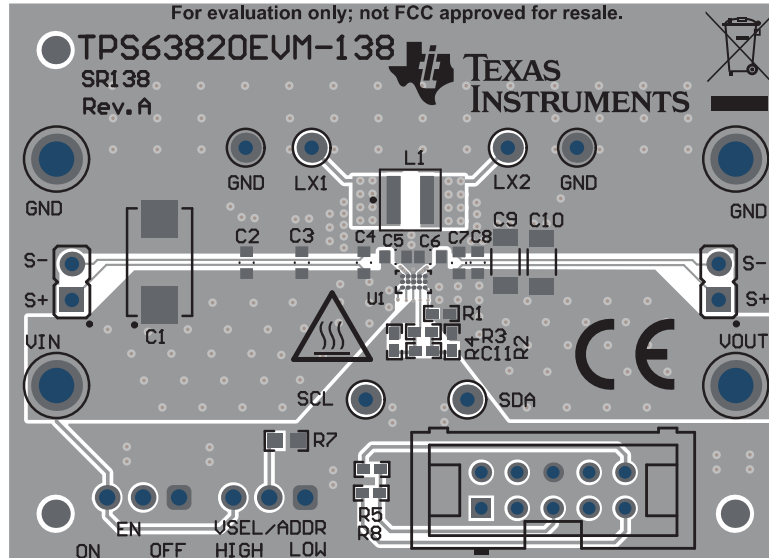


图 4-2. TPS63820EVM PCB - 顶层

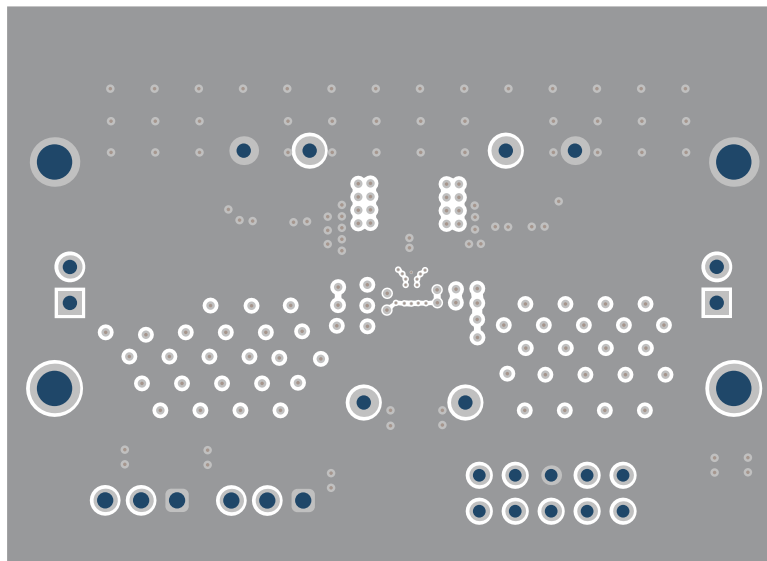


图 4-3. TPS63820EVM PCB - 信号层 1

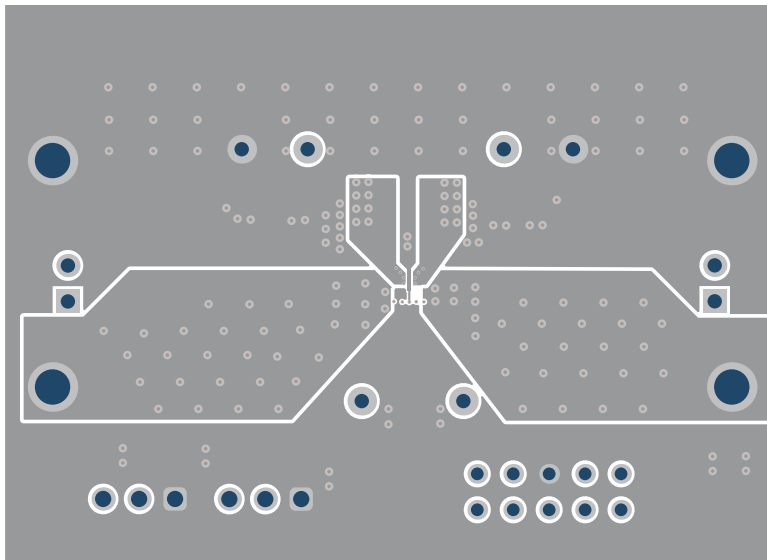


图 4-4. TPS63820EVM PCB - 信号层 2

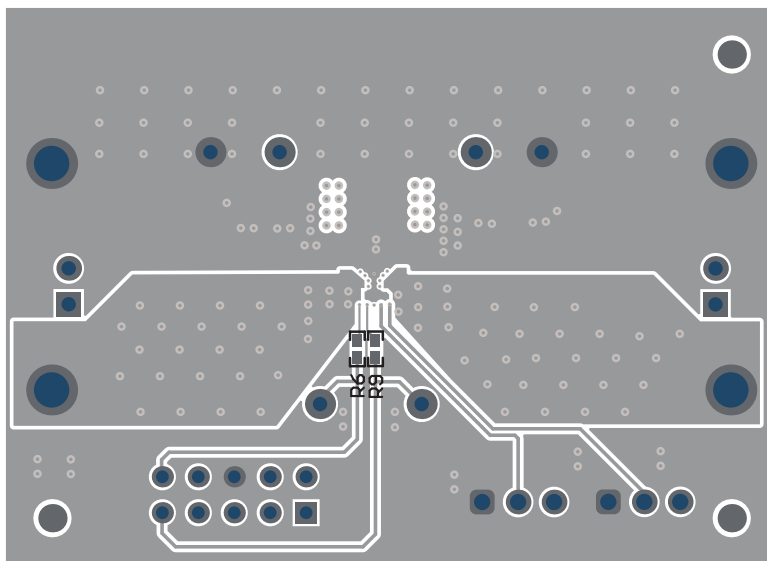


图 4-5. TPS63820EVM PCB - 底层

### 4.3 物料清单

**表 4-1. TPS63820EVM 物料清单**

位号	数量	值	器件型号	制造商	说明	封装参考
C1	1	150uF	T530D157M010ATE005	Kemet	电容, 钽聚合物, 150uF, 10V, +/-20%, 0.005Ω, 7343-31 SMD	7343-31
C5、C6、C7、C8	4	22μF	GRT188R61A226ME13D	Murata	多层陶瓷电容器, 22uF, 10V, X5R ±20%, 0603, 纸质 T/R	0603
FID1、FID2、FID3、FID4、FID5、FID6	6		不适用	不适用	基准标记。没有需要购买或安装的元件。	不适用
J1、J2、J5、J6	4		1502-2	Keystone	引脚, 双转塔, TH	Keystone1502-2
J3、J4	2		PBC02SAAN	Sullins Connector Solutions	接头, 100mil, 2x1, 金, TH	Sullins 100mil, 1x2, 绝缘体上方 230mil
J7	1		XG4C-1031	Omron Electronic Components	接头 (有罩), 100mil, 5x2, 金, TH	TH, 10 引线, 接头体 8.5mm x 20mm, 间距 2.54mm
JP1、JP2	2		61300311121	Würth Elektronik	接头, 2.54mm, 3x1, 金, TH	接头, 2.54mm, 3x1, TH
L1	1	0.47uH	XGL4015-471MEC	Coilcraft	屏蔽功率电感器, 0.47uH 20%, 13A, 最大 7.5mΩ DCR, AECQ200, 4.0x4.0x1.5mm	SMT_IND_4MM0_4MM0
R5、R8	2	10k	CRCW040210K0JNED	Vishay-Dale	电阻, 10k, 5%, 0.063W, AEC-Q200 0级, 0402	0402
R6、R9	2	0	CRCW04020000Z0ED	Vishay-Dale	电阻, 0, 5%, 0.063W, AEC-Q200 0级, 0402	0402
R7	1	1.00Meg	CRCW06031M00FKEA	Vishay-Dale	电阻, 1.00M, 1%, 0.1W, AEC-Q200 0级, 0603	0603
SH-JP1、SH-JP2	2	1x2	SPC02SYAN	Sullins Connector Solutions	分流器, 100mil, 镀金, 黑色	顶部闭合 100mil 分流器
TP1、TP2、TP3、TP4、TP5、TP6	6		5004	Keystone Electronics	测试点, 微型, 黄色, TH	黄色微型测试点
U1	1		TPS63820YBG	德州仪器 (TI)	具有 I <sup>2</sup> C 接口的 4A 降压/升压转换器, DSBGA15	DSBGA15

## 5 其他信息

### 5.1 商标

所有商标均为其各自所有者的财产。

## 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 semiconductor 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 DEGRADATION 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/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/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/lstds/ti\\_ja/general/eStore/notice\\_02.page](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page)

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#### 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.

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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.
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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, INDEMNITY 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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