EVM User's Guide: TPS25730AEVM

TPS25730A 评估模块

说明

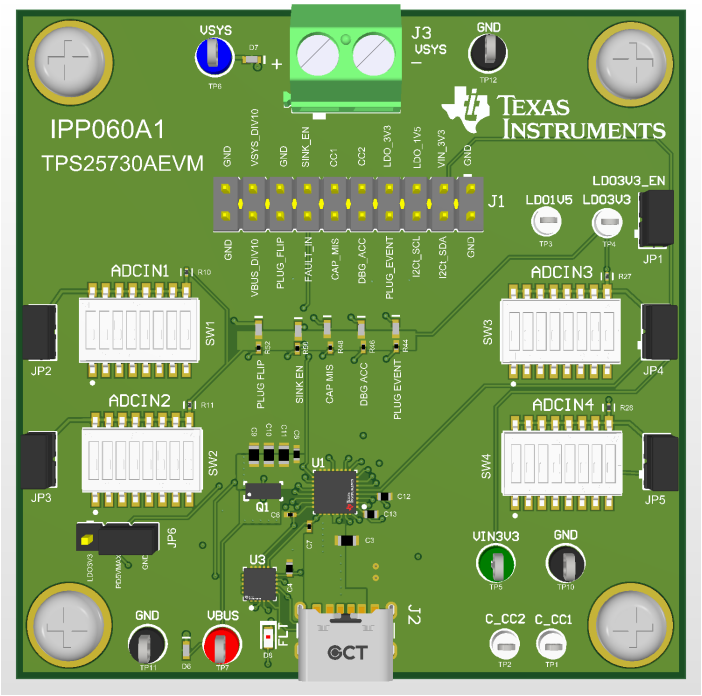
TPS25730A 评估模块 (EVM) 展示了 TPS25730A USB-PD 控制器的完整功能集。这种简单的电阻器配置设置可在 VBUS 电压、工作电流以及故障和诊断行为之间轻松切换。两个背对背 NFET 根据 USB-PD 控制器协商的 PDO 导通和关断。

开始使用

1. 订购 TPS25730AEVM
2. 下载数据表 (SLVSJG8)
3. 下载技术参考手册 (SLVUCJ7)
4. 获取 USB-PD 源适配器
5. 订购 TI PD 分析仪

特性

- 功能齐全的评估板，用于配置 TPS25730A USB-PD 控制器
- 通过 DIP 开关控制的电阻可实现可配置的灌电压和电流设置
- 指示灯 LED 用于显示诊断信息，例如能力不匹配和插拔事件等
- 用于 VBUS 和 ESD 短路保护的板载 TPD4S201RUKR 芯片



TPS25730AEVM 顶视图

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1 评估模块概述

1.1 简介

TPS25730AEVM 评估模块 (EVM) 通过使用四组开关来配置和测试 TPS25730A 器件，并利用端子块在负载状态下器件对进行测试。标记过的 LED 指示器件的状态。

TPS25730A 器件是一款用于纯受电应用的 USB-PD 控制器。TPS25730A 器件适用于仅通过 USB-PD 接收电力的器件，其工作电压在 USB-PD 3.2 规范定义的标准功率范围内（5V 至 20V）。实际上，这意味着采用该器件的设计会使用 USB-C® 连接器，并且与 USB-PD 3.2 规范兼容。要使用 TPS25730AEVM 评估模块，必须通过 USB-C 数据线将具有 USB-PD 功能的电源连接到 TPS25730AEVM 的 USB-C 端口。本用户指南介绍了如何使用 TPS25730AEVM 评估模块通过板载开关测试各种灌电流电源配置。

1.2 套件内容

TPS25730AEVM 的套件包含：

一个 TPS25730AEVM 评估模块

1.3 规格

本节介绍了 TPS25730A 的应用。

TPS25730A 是一款 USB-PD 控制器，可使用 USB-PD 规范通过 USB-C® 连接器向系统灌入功率，如图 1-1 中所示。由于电源设置可通过 ADCINx 引脚处的电压分压器进行配置，因此无需使用电可擦除可编程只读存储器 (EEPROM)，这有可能降低物料清单 (BOM) 成本并节省布板空间。此外，无需使用软件和图形用户界面 (GUI)，这有可能大大缩短开发时间。

如 节 2.6 中所述，在 ADCINx 引脚配置为所需设置的情况下，TPS25730A 通过 VSYS 引脚从与 USB-PD 兼容的电源灌入所协商数量的功率。

*通用串行总线电力输送规范*中详细说明了这种协商是如何进行的。此规范可在 USB 电力输送中获得。

以下列出了 USB-PD 规范中所阐述的指导原则的简要概述：

1. USB-C 数据线与电源连接，该电源被插入到 TPS25730AEVM 评估模块的 USB-C 端口。
2. 制定 5V 隐式 USB Type-C® 合约。
3. 源端的各项功能会通过通信线路以有序列表的形式传递给接收端。
4. 接收端根据 ADCINx 引脚的设置，从有序列表中请求特定电源数据对象 (PDO)。
5. 源端接受此请求并发送一条 PS_Ready 消息，以指示总线已准备好供电。
6. 源端通过 USB 数据线的 VBUS 线提供电力，经由由 TPS25730A 芯片控制的电源路径传输，并通过 VSYS 提供给负载。

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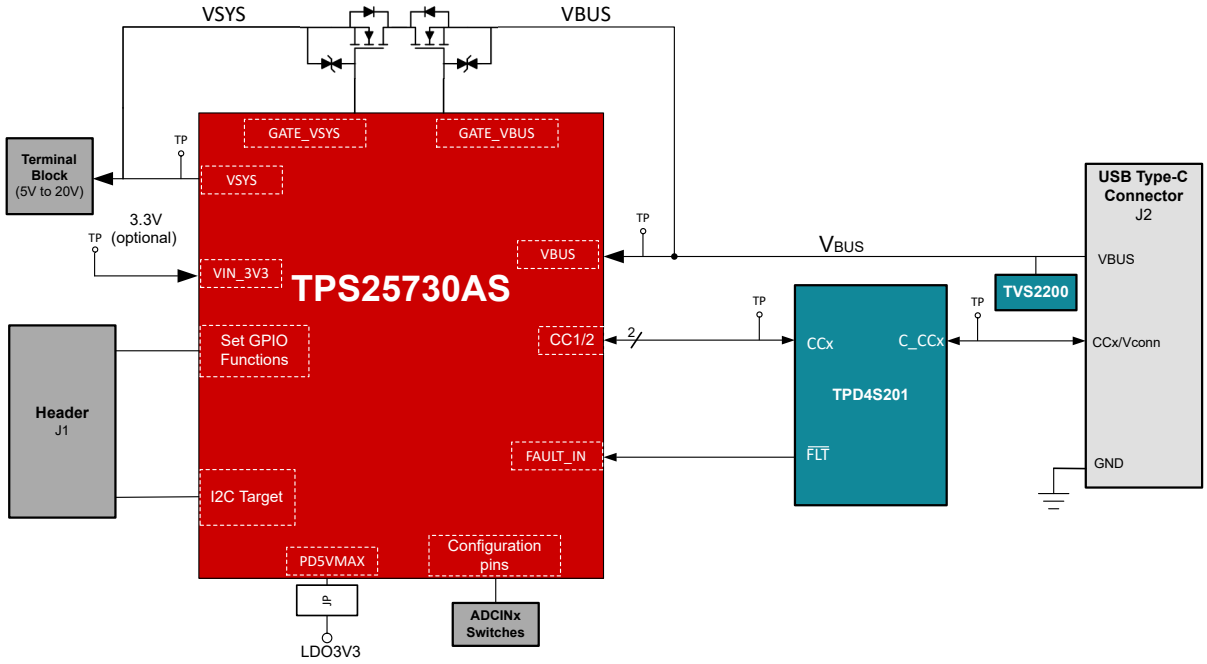

图 1-1. TPS25730AEVM 方框图

1.4 器件信息

TPS25730AEVM 评估模块可以配置 TPS25730A 器件，无需对器件进行编程或使用软件。由于 TPS25730A 器件是一款适用于纯受电应用的 USB-PD 控制器，因此 TPS25730AEVM 评估模块的以下受电能力是可配置的：

- 最小电压
- 最大电压
- 工作电流
- 最大电流

TPS25730AEVM 评估模块通过 TPS25730A 器件的 ADCIN1、ADCIN2、ADCIN3、ADCIN4 和 PD5VMAX 输入引脚来配置所列出的功能。TPS25730AEVM 评估模块利用四组开关。每组开关对应于四个 ADCIN 引脚中的一个，而 PD5VMAX 引脚则是通过 TPS25730AEVM EVM 上的跳线进行配置的。

2 硬件

2.1 电源要求

TPS25730A 器件由位于 J2 的 USB-C® 连接器供电。电源必须连接到 USB-C 数据线，该数据线再连接到 TPS25730AEVM 评估模块的 USB-C 接口上。电源必须与 USB-PD 兼容，这样才能使 TPS25730AEVM 评估模块的所有功能得以充分发挥。具体而言，电源必须在 USB-PD 规范所定义的*标准功率范围* (SPR) 内运行；该规范将标准功率范围定义为电压在 5V 至 20V 之间，且电流不超过 5A。

运行所需的项目

- TPS25730AEVM 评估模块
- USB-C 电缆
- 支持 USB-PD 的电源

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2.2 接头信息

TPS25730AEVM 评估模块包含一个接头：J1。J1 接头包含多种引脚配置，可用于测试、评估和调试。TPS25730AEVM 顶层清晰地标记了接头引脚。有关引脚的说明，请参阅表 2-1。

TPS25730AEVM 评估模块具有一个端子块，可在 J3 处连接负载，从而能够在负载下测试 TPS25730A 器件。

表 2-1. J1 接头说明

引脚编号	引脚标签	说明
1	GND	EVM 的接地基准。
2	GND	EVM 的接地基准。
3	VIN_3V3	TPS25730A 器件的 VIN_3V3 引脚连接 3.3V 的电源。
4	I2Ct_SDA	TPS25730A 器件的 I2C 目标数据线。
5	LDO_1V5	来自 TPS25730A 器件的 LDO_1V5 引脚的 1.5V 输出电源。
6	I2Ct_SCL	TPS25730A 器件的 I2C 目标时钟线。
7	LDO_3V3	来自 TPS25730A 器件的 LDO_3V3 引脚的 3.3V 输出电源。
8	PLUG_EVENT	PLUG_EVENT 引脚指示连接的插拔事件。 高电平：存在连接。 低电平：不存在连接。
9	CC2	CC2 引脚用于 PD 协商。
10	DBG_ACC	DBG_ACC 引脚指示连接的调试附件。 高电平：存在调试附件。 低电平：不存在调试附件不。
11	CC1	CC1 引脚用于 PD 协商。
12	CAP_MIS	CAP_MIS 引脚表示源端和接收端之间的能力不匹配。 切换输出：能力不匹配。 无切换输出：无能力不匹配。
13	SINK_EN	SINK_EN 引脚指示灌电流路径的启用。 低电平：灌电流路径启用。 高电平：灌电流路径禁用。
14	FAULT_IN	FAULT_IN 引脚指示故障输入。 低电平：检测到故障。 高电平：未检测到故障。 **备注** 此引脚可被置为低电平，从而触发故障，导致端口断开连接。
15	GND	EVM 的接地基准。
16	PLUG_FLIP	PLUG_FLIP 引脚指示电缆插头的朝向。 高电平：CC2 已连接（顶面朝下）。 低电平：CC1 已连接（顶面朝上）。
17	VSYS_DIV10	VSYS 线路的电阻分压器输出。此输出引脚会将 VSYS 线的电压值除以 10，适用于数字示波器。例如，当 VSYS 为 20V 时，引脚 17 的测量值约为 2V。
18	VBUS_DIV10	VBUS 线路的电阻分压器输出。此输出引脚会将 VBUS 线的电压值除以 10，适用于数字示波器。例如，当 VBUS 为 20V 时，引脚 18 的测量值约为 2V。
19	GND	EVM 的接地基准
20	GND	EVM 的接地基准

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2.3 跳线信息

TPS25730AEVM 评估模块上有六个跳线，如下表所示。

表 2-2. 跳线说明

跳线位号	说明
JP1	LDO_3V3 引脚的 3.3V 输出。移除跳线可断开 GPIO 的 3.3V 电源。该操作也会断开 I2Ct 线路上的 3.3V 上拉电源。
JP2	将 SW1（开关一）连接到 ADCIN1 引脚。可以移除跳线，以连接外部电阻分压器网络。
JP3	将 SW2（开关二）连接到 ADCIN2 引脚。可以移除跳线，以连接外部电阻分压器网络。
JP4	将 SW3（开关三）连接到 ADCIN3 引脚。可以移除跳线，以连接外部电阻分压器网络。
JP5	将 SW4（开关 4）连接到 ADCIN4 引脚。可以移除跳线，以连接外部电阻分压器网络。
JP6	PD5VMAX 设置。将 JP6 跳线横跨在引脚 1 和 2 之间，以将 PD5VMAX 引脚连接到 LDO_3V3 引脚（器件设置的最大电压值为 5V）。将 JP6 跳线横跨在 2 号和 3 号引脚上，以将 PD5VMAX 引脚连接至 GND（器件的最大电压设置 = ADCIN2 设置）。

2.4 测试点

可用的测试点如下：

表 2-3. TPS25730AEVM 评估模块测试点

测试点	引脚
TP1	C_CC1
TP2	C_CC2
TP3	LDO_1V5
TP4	LDO_3V3
TP5	VIN_3V3
TP6	VSYS
TP7	VBUS
TP8	GATE_VSYS
TP9	GATE_VBUS
TP10	GND
TP11	GND
TP12	GND

2.5 LED 信息

TPS25730AEVM 评估模块通过与 TPS25730A 器件的通用输入输出 (GPIO) 事件相对应的 LED 来提供 TPS25730A 器件的状态信息。每个 LED 上都有对应的事件信息用丝网印刷的方式印上去。

表 2-4. LED 指示灯事件

LED	说明	LED 亮起的条件
$\overline{\text{SINK\_EN}}$	指示当启用 VSYS 引脚时的情况。可用于外部电源路径的 GPIO 控制。	启用 VSYS 引脚时，LED 会亮起。
PLUG_FLIP	指示 USB-C® 插头的方向。	当插头以倒置的方式插入时，LED 就会亮起。
DBG_ACC	指示是否连接了调试附件。	当调试附件连接上时，LED 就会亮起。
PLUG_EVENT	指示通过 USB-C® 插头与源器件的连接。	连接 USB-C® 数据线时，LED 亮起。
CAP_MIS	表明已连接电源与 TPS25730A 器件之间的能力不匹配。	当发生能力不匹配情况时，LED 会闪烁。
VBUS	指示何时存在 VBUS 电压。	存在 VBUS 时，LED 亮起。
VSYS	指示何时存在 VSYS 电压。	存在 VSYS 时，LED 亮起。
FLT	指示 TPD4S201 的故障何时置位。	当出现故障时，LED 就会亮起。

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2.6 配置 TPS25730AEVM

每个开关组只能将八个开关中的一个置于 ON 位置，总共有四个开关处于 ON 位置，才能成功配置。*ADCIN 配置*展示了 ADCIN 引脚可配置的相应设置。

备注

ADCIN3 和 ADCIN4 引脚共同根据这两个输入的组合确定工作电流和最大电流。ADCIN3 引脚本身并不能直接对应于工作电流，而 ADCIN4 引脚也不能直接对应于最大电流。

表 2-5. ADCIN 配置

ADCINx 引脚	对应设置
ADCIN1	最小电压
ADCIN2	最大电压
ADCIN3 和 ADCIN4	工作电流和最大电流

TPS25730AEVM 评估模块上的每个开关组的标记开关编号都对应于一个 ADCIN 解码值，该值列于*开关编号与 ADCIN 解码值之间的关系*表中。

表 2-6. 开关编号和 ADCIN 解码值之间的关系

ADCIN 开关编号	ADCIN 解码值
1	0
2	1
3	2
4	3
5	4
6	5
7	6
8	7

2.6.1 最小电压配置

USB 电力输送受电能力的最小电压可根据表 2-7 进行设置。当接收到的 USB PD 供电能力不符合最小和最大电压范围时，会根据 USB PD 请求设置“能力不匹配”位。当最小电压设置为大于 5V 时，将设置受电能力中的“较高能力”位。

表 2-7. 受电能力的最小电压配置 – ADCIN1 解码

ADCIN1 解码值	最小电压配置
0	5V
1	9V
2	12V
3	15V
4	20V
5	保留
6	保留
7	保留

2.6.2 最大电压配置

USB 电力输送受电能力的最大电压可根据表 2-8 进行设置。当接收到的 USB PD 供电能力不符合最小和最大电压范围时，会根据 USB PD 请求设置“能力不匹配”位。

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表 2-8. 受电能力的最大电压配置 - ADCIN2 解码

ADCIN2 解码值	PD5VMAX 解码值	最大电压配置	“能力不匹配”时自动禁用受电方
0	1	5V	是
1	1	5V	否
0	0	9V	是
1	0	9V	否
2	0	12V	是
3	0	12V	否
4	0	15V	是
5	0	15V	否
6	0	20V	是
7	0	20V	否

2.6.3 灌电流配置

根据表 2-9 配置灌电流。该配置会在 USB PD 请求消息中设置工作电流和最大电流。工作电流定义为受电端正常工作所需的电流。最大电流定义为受电端可以使用的最大电流。如果工作电流是受电端正常工作所需的最大电流，则工作电流和最大电流可以相同。当 PD 的供电能力无法满足运行电流需求时，就会出现能力不匹配的情况。当工作电流设置为 0A 时，不会设置“能力不匹配”位。

表 2-9. ADCIN3 和 ADCIN4 灌电流配置

ADCIN3	ADCIN4	工作电流	最大电流
0	0	0	1.5A
0	1	0	3A
0	2	0	4A
0	3	0	5A
0	4	0.5A	1.5A
0	5	0.5A	3A
0	6	0.5A	4A
0	7	0.5A	5A
1	0	1A	1.5A
1	1	1A	3A
1	2	1A	4A
1	3	1A	5A
1	4	1.5A	1.5A
1	5	1.5A	3A
1	6	1.5A	4A
1	7	1.5A	5A
2	1	2A	3A
2	2	2A	4A
2	3	2A	5A
2	5	2.5A	3A
2	6	2.5A	4A
2	7	2.5A	5A
3	1	3A	3A
3	2	3A	4A
3	3	3A	5A
3	6	3.5A	4A
3	7	3.5A	5A
4	2	4A	4A

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表 2-9. ADCIN3 和 ADCIN4 灌电流配置（续）

ADCIN3	ADCIN4	工作电流	最大电流
4	3	4A	5A
4	7	4.5A	5A
5	3	5A	5A

2.6.4 完整示例

如果系统需要接受 5V 至 20V 电压，并以 3A 的电流运行，则请为 ADCIN1、ADCIN2、ADCIN3 和 ADCIN4 引脚确定合适的 ADCIN 解码值。*示例设置*表详细说明了相应的设置。

表 2-10. 示例设置

ADCIN 引脚	期望的行为	ADCIN 解码值	要打开的 ADCIN 开关
ADCIN1	最小电压：5V	0	1
ADCIN2	最大电压：20V	7	8
ADCIN3 ADCIN4	工作电流：3A	3	4
	最大电流：3A	1	2

在 5V 的最低电压配置下，ADCIN1 引脚的解码值为 0。当 ADCIN2 引脚的输入电压达到最大值 20V 时，其解码后的数值为 7。对于 ADCIN3 和 ADCIN4 引脚的组合，要达到 3A 工作电流和 3A 最大电流的组合要求，其解码值分别为 3 和 1。（请参阅表 2-6）。

将以下开关设置为开启状态：

- ADCIN1 引脚的开关 1
- ADCIN2 引脚的开关 8
- ADCIN3 引脚的开关 4
- ADCIN4 引脚的开关 2

将所有其他开关都调至关闭位置。

将 PD5VMAX 引脚的跳线跨接在 2 号和 3 号引脚上，以此将 PD5VMAX 引脚与 GND 接地端连接起来。

一旦完成配置，将电源插入 USB-C® 接口即可。PLUG_EVENT 引脚的 LED 指示灯会亮起，以表明电缆已插入。如果 CAP_MIS 引脚的“能力不匹配”位被设置（这种情况会在源器件无法提供至少 15W 的最小功率，或者无法提供 5V 至 20V（包括 5V 和 20V）的电压范围内时发生），该引脚的 LED 指示灯会持续闪烁。如果插头倒置插入，插头指示灯上的 LED 就会亮起。

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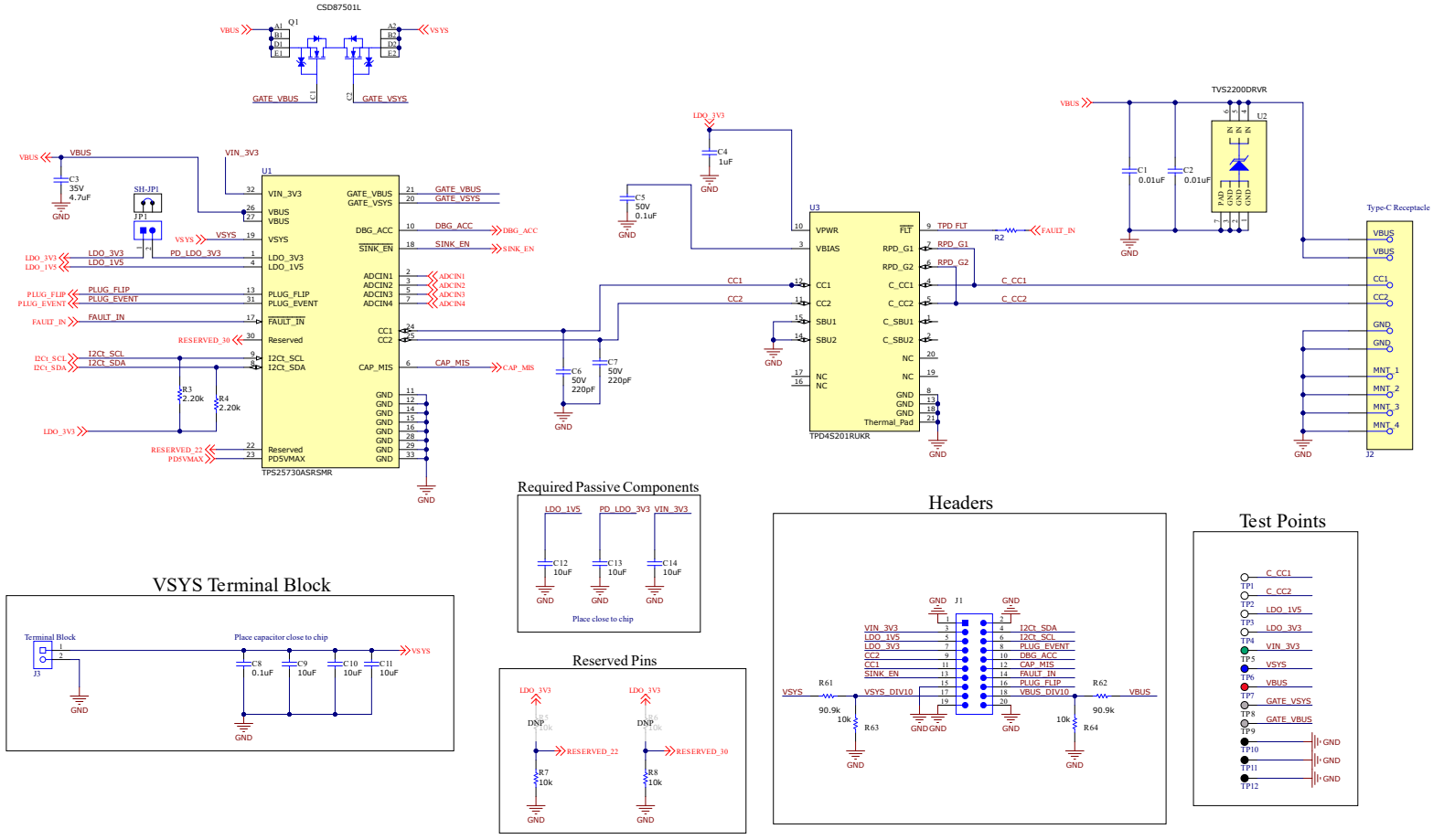
3 硬件设计文件

3.1 原理图

Revision History				
Rev	ECN #	Approved Date	Approved by	Notes
N/A	N/A	N/A	N/A	N/A



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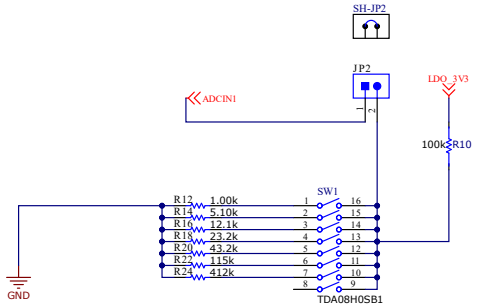
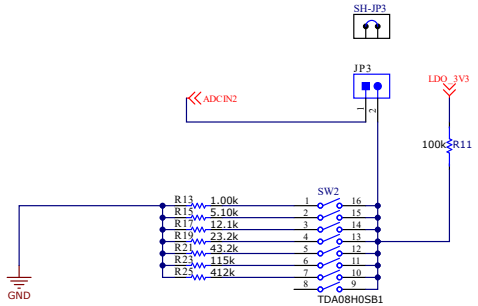


Switch 1 On: Setting 0
Switch 2 On: Setting 1
Switch 3 On: Setting 2
Switch 4 On: Setting 3
Switch 5 On: Setting 4
Switch 6 On: Setting 5
Switch 7 On: Setting 6
Switch 8 On: Setting 7



Switch 1 On: Setting 0
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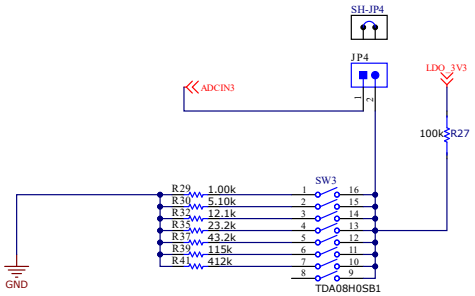
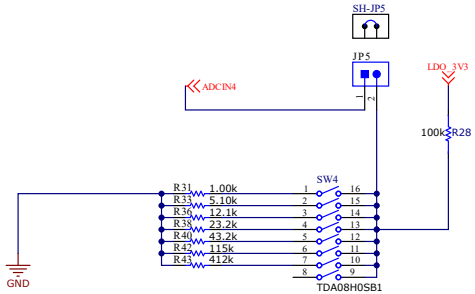
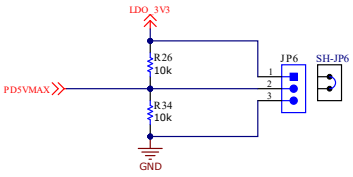


Switch 1 On: Setting 0
Switch 2 On: Setting 1
Switch 3 On: Setting 2
Switch 4 On: Setting 3
Switch 5 On: Setting 4
Switch 6 On: Setting 5
Switch 7 On: Setting 6
Switch 8 On: Setting 7



Switch 1 On: Setting 0
Switch 2 On: Setting 1
Switch 3 On: Setting 2
Switch 4 On: Setting 3
Switch 5 On: Setting 4
Switch 6 On: Setting 5
Switch 7 On: Setting 6
Switch 8 On: Setting 7



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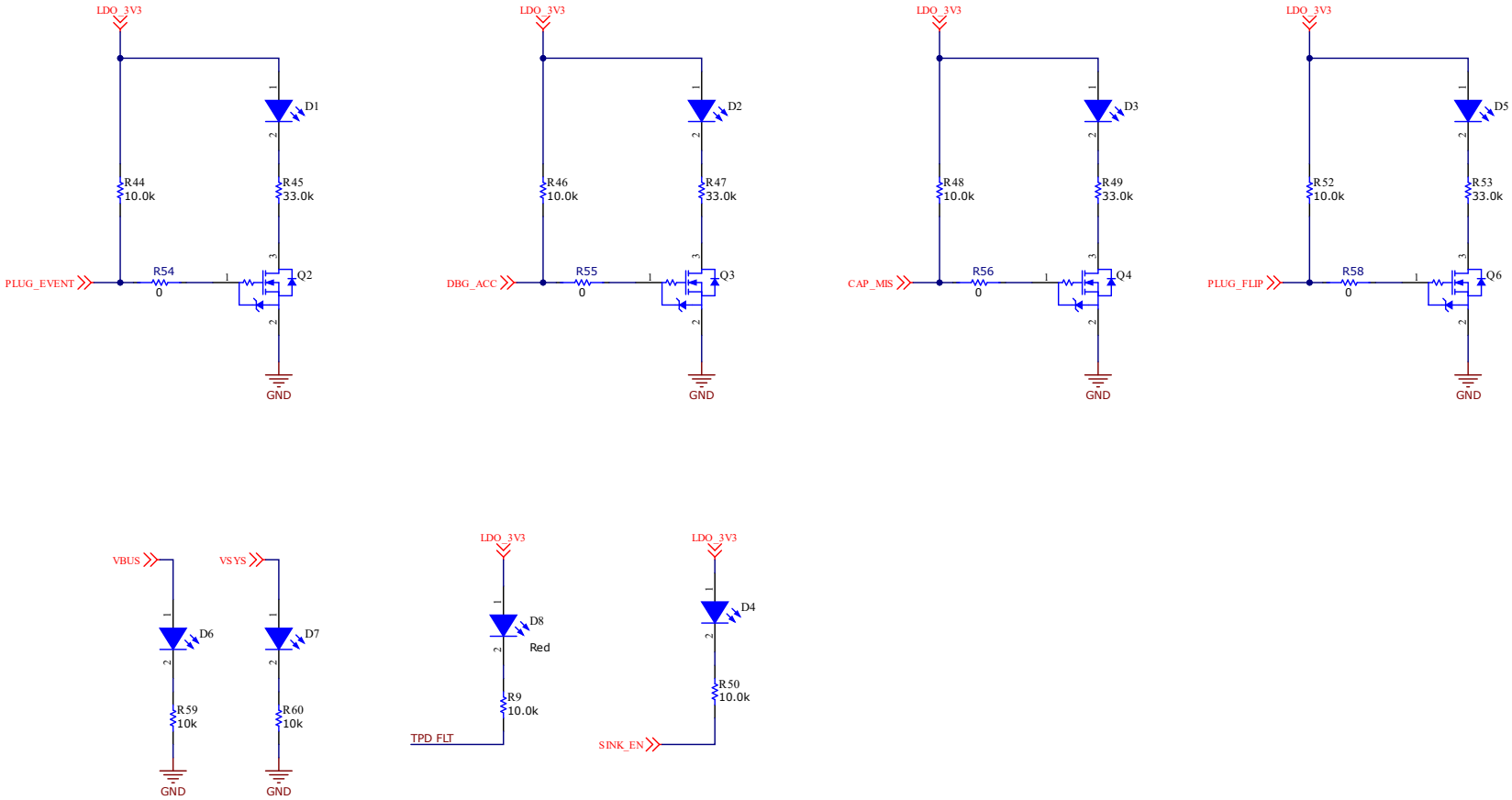

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3.2 PCB 布局

图 3-1 至图 3-6 展示了 EVM PCB 布局。

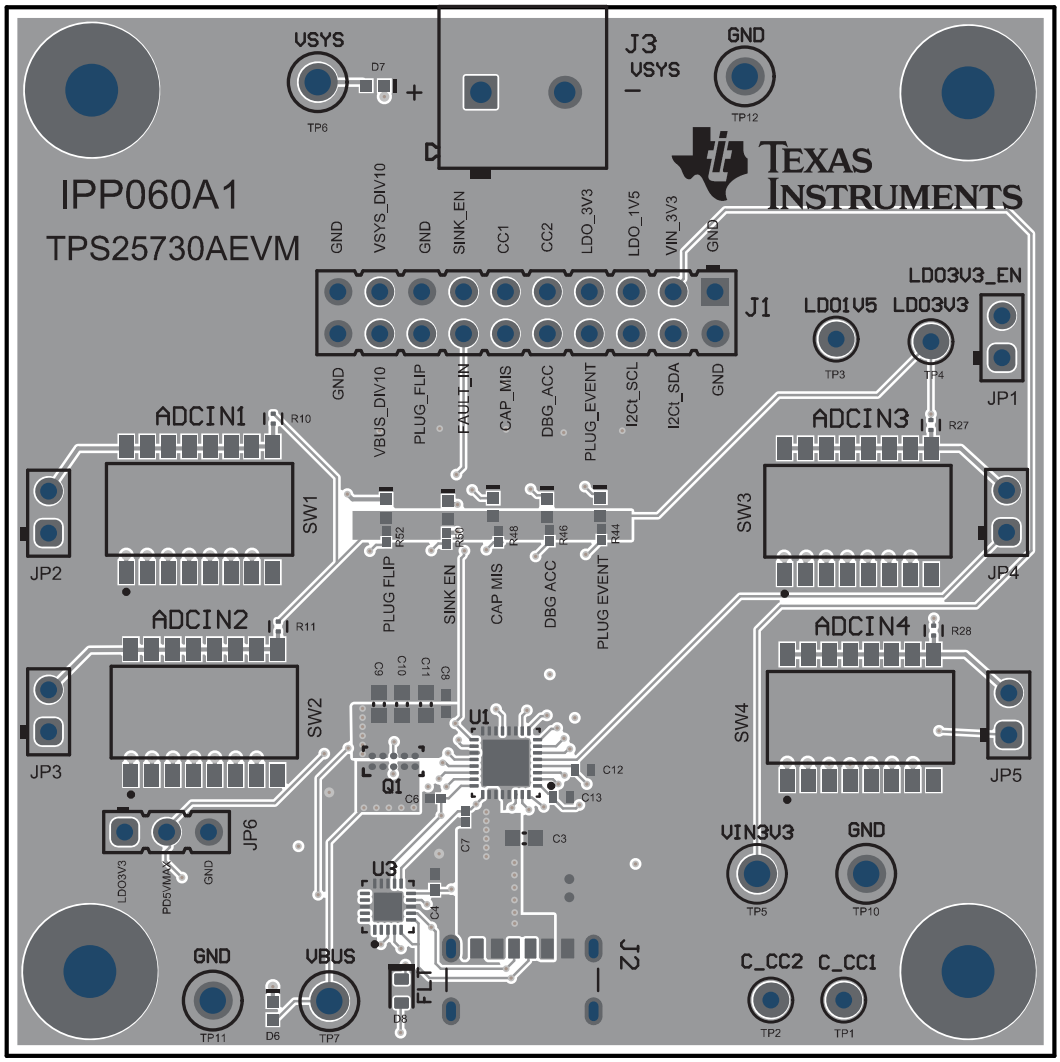

图 3-1. TPS25730AEVM 顶部复合视图

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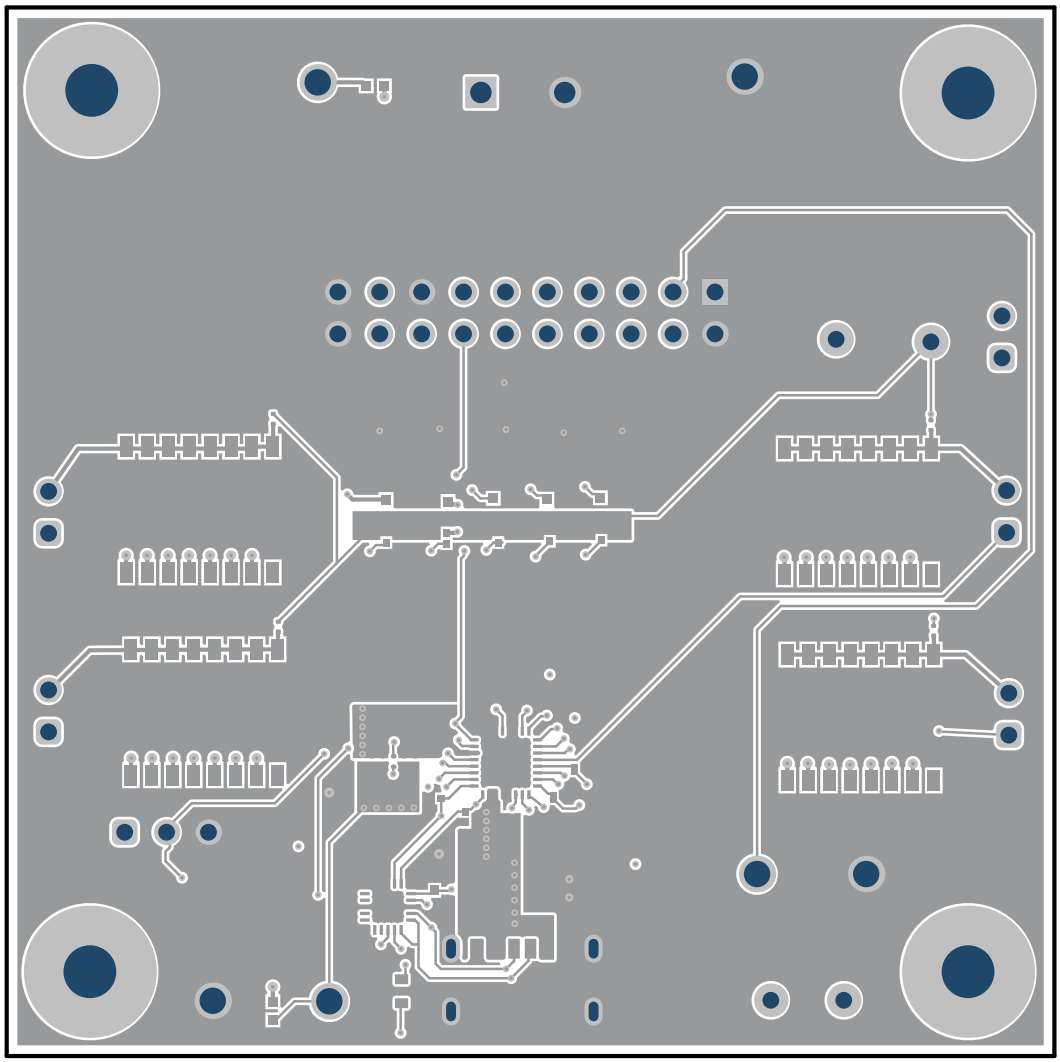

图 3-2. TPS25730AEVM 顶层

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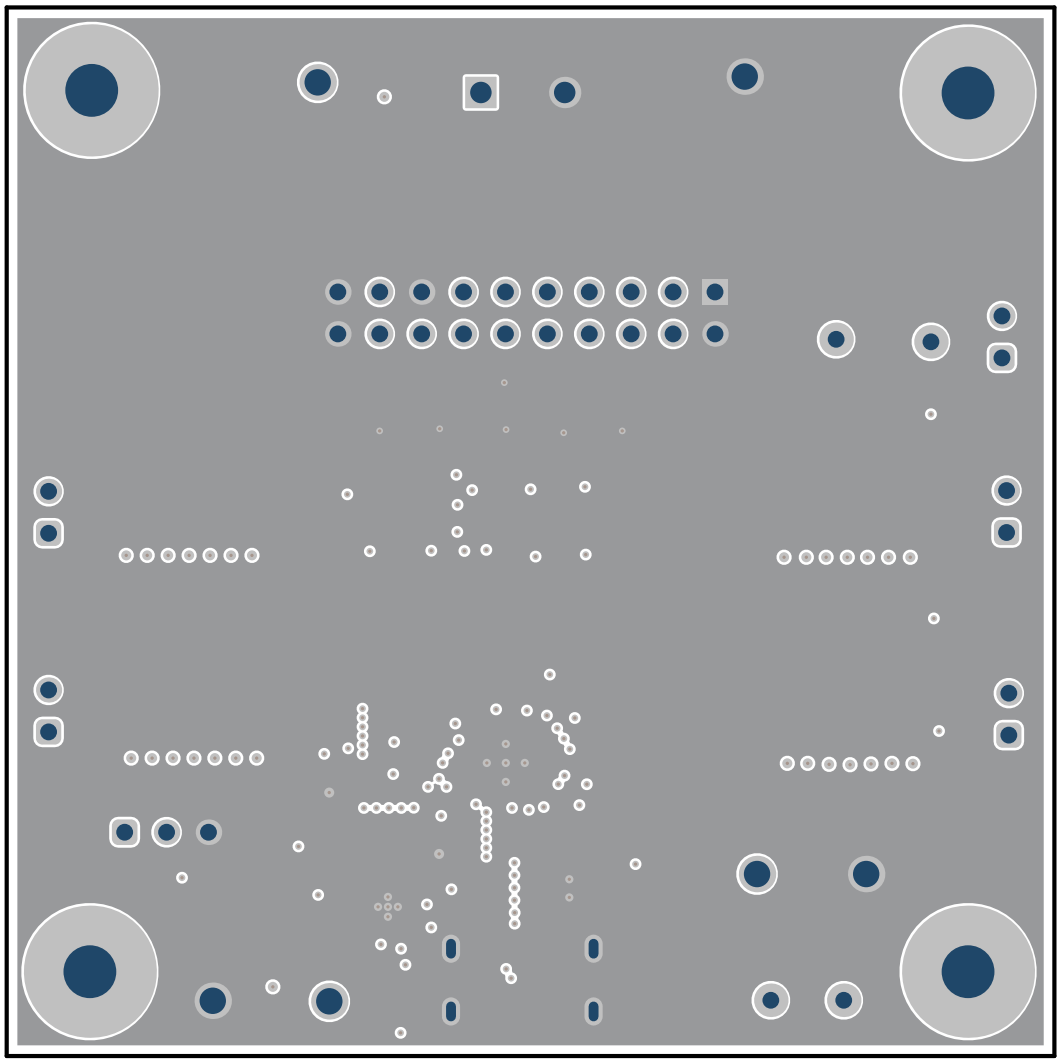

图 3-3. TPS25730AEVM 接地平面

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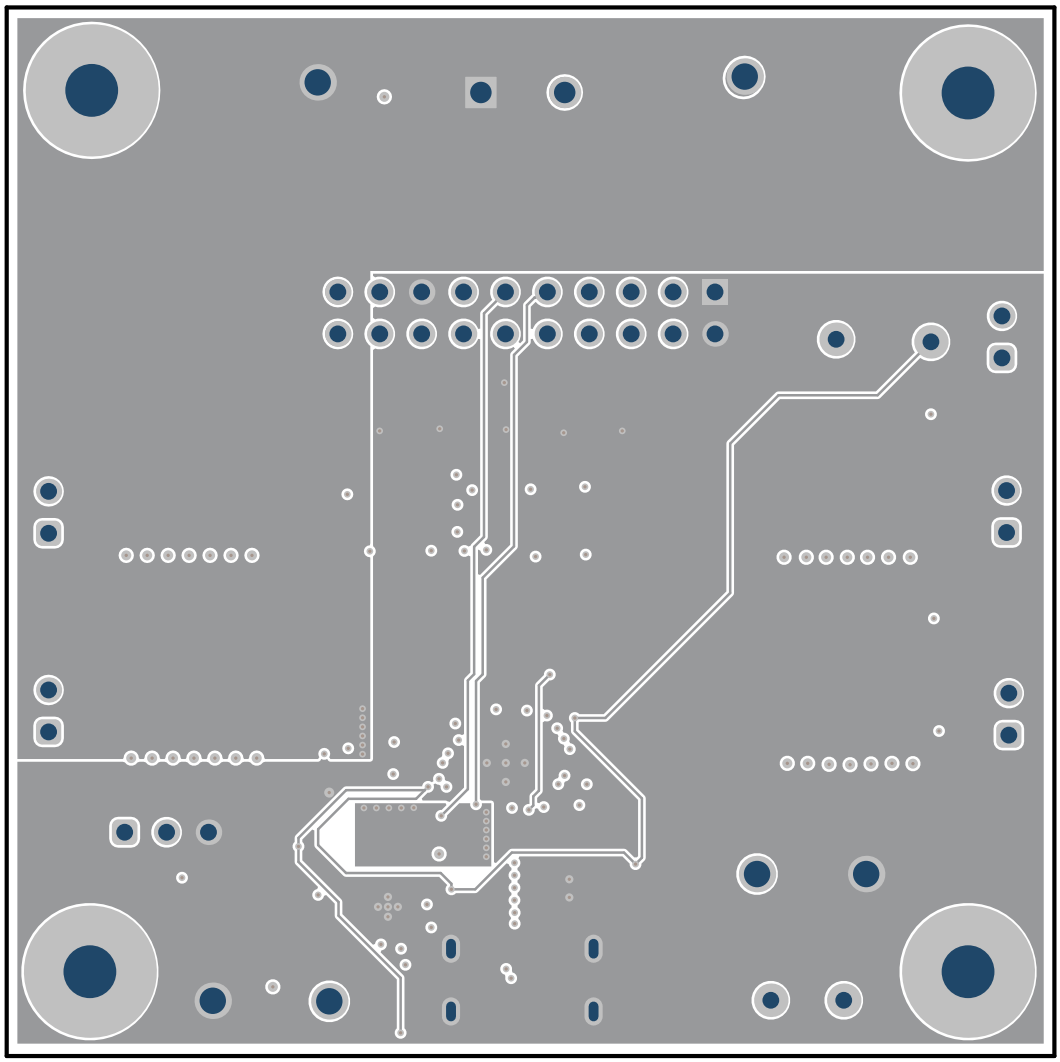

图 3-4. TPS25730AEVM 电源层

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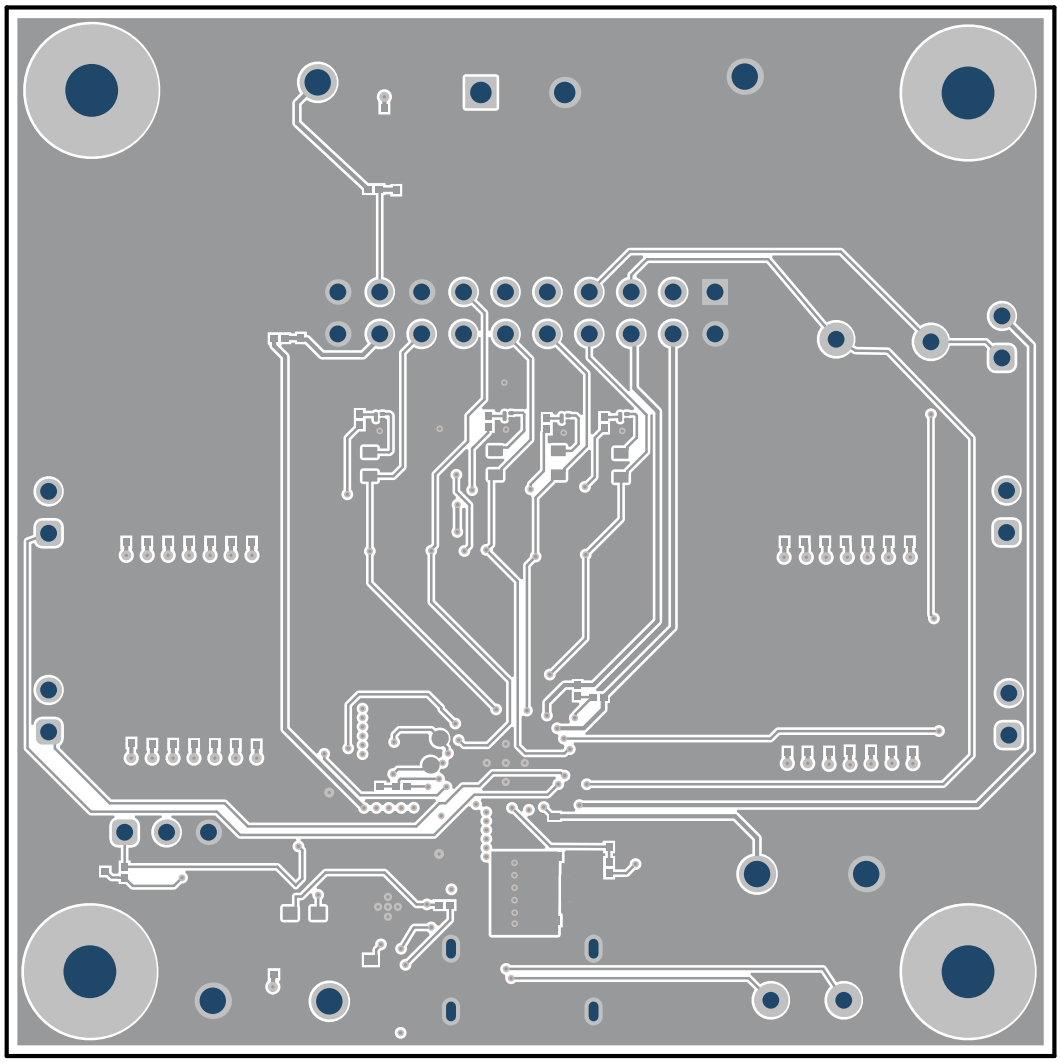

图 3-5. TPS25730A 底层

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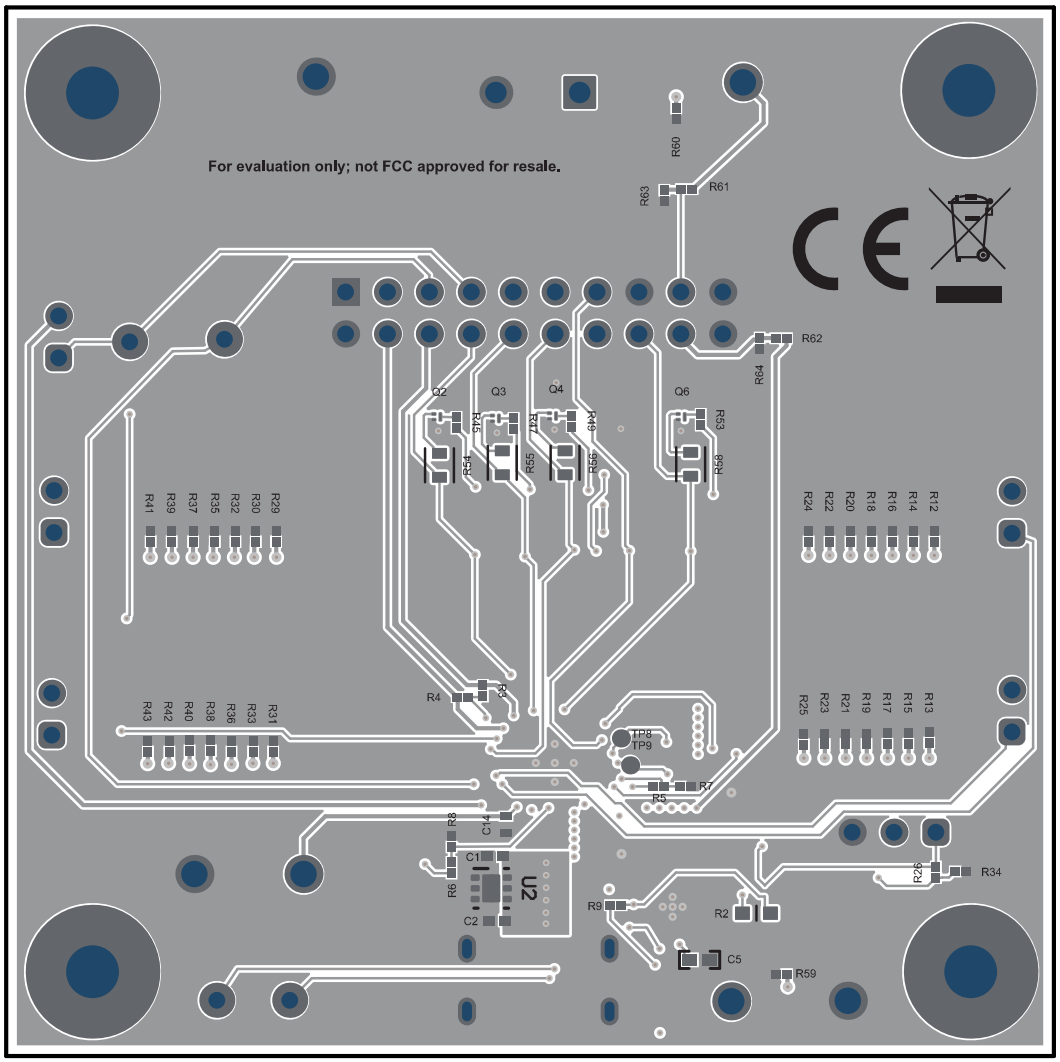

图 3-6. TPS25730A 底部复合视图

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3.3 物料清单 (BOM)

表 3-1 列出了 EVM BOM

表 3-1. TPS25730AEVM 物料清单

位号	数量	值	说明	封装参考	器件型号	制造商
C1, C2	2	0.01uF	CAP，CERM，0.01 µF，50V，±5%，X7R，0402	0402	C0402C103J5RACTU	Kemet
C3	1	4.7uF	电容，陶瓷，4.7 µF，35V，±10%，X5R，0603	0603	GRM188R6YA475KE15D	MuRata
C4	1	1uF	电容，陶瓷，1 µF，35V，±10%，X5R，0402	0402	GRM155R6YA105KE11D	MuRata
C5	1	0.1uF	电容，陶瓷，0.1 µF，50V，±10%，X5R，0402	0402	C1005X5R1H104K050BB	TDK
C6、C7	2	220pF	电容，陶瓷，220pF，50V，±10%，X7R，AEC-Q200 1 级，0201	0201	CGA1A2X7R1H221K030BA	TDK
C8	1	0.1uF	电容，陶瓷，0.1 µF，35V，±10%，X5R，0402	0402	GMK105BJ104KV-F	Taiyo Yuden
C9、C10、C11	3	10uF	电容，陶瓷，10 µF，35V，±20%，X5R，0603	0603	GRM188R6YA106MA73D	Murata
C12、C13、C14	3	10uF	电容，陶瓷，10 µF，10V，±20%，X5R，0402	0402	CL05A106MP5NUNC	Samsung Electro-Mechanics
D1、D2、D3、D4、D5、D6、D7	7	白色	LED，白色，SMD	0402，白色	LW QH8G-Q2S2-3K5L-1	OSRAM
D8	1	红色	LED，红色，SMD	1.6x0.8mm	TLMS1000-GS08	Vishay-Semiconductor
H1、H2、H3、H4	4	不适用	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	不适用	六角螺柱，0.5"L #4-40，尼龙	螺柱	1902C	Keystone
J1	1	不适用	接头，10x2，2.54mm，锡，TH	接头，10x2，2.54mm，锡，TH	TSW-110-07-T-D	Samtec
J2	1	不适用	24（6+18 虚拟）位置 USB-C (USB TYPE-C) USB 2.0 插座连接器	CONN_USB	USB4125-GF-A-0190	GCT
J3	1	不适用	端子块，5.08mm，2x1，TH	2POS 端子块	1715721	Phoenix Contact
JP1、JP2、JP3、JP4、JP5	5	不适用	接头，2.54mm，2x1，金，TH	接头，2.54mm，2x1，TH	TSW-102-08-G-S	Samtec
JP6	1	不适用	接头，2.54mm，3x1，金，TH	接头，2.54mm，3x1，TH	HMTSW-103-07-G-S-240	Samtec
Q1	1	30V	MOSFET，2 沟道，N 沟道，30V，A，YJG0010A (PICOSTAR-10)	YJG0010A	CSD87501L	德州仪器 (TI)
Q2、Q3、Q4、Q6	4	20V	MOSFET，N 沟道，20V，0.5A，YJM0003A (PICOSTAR-3)	YJM0003A	CSD15380F3	德州仪器 (TI)
R2	1	0	0Ω 跳线片上电阻 0603（公制 1608），防潮厚膜	0603	RC0603FR-100RL	Yageo
R3、R4	2	2.20k	电阻，2.20k，1%，0.05W，0201	0201	CRCW02012K20FKED	Vishay-Dale
R7、R8、R26、R34	4	10k	电阻，10k，5%，0.05W，0201	0201	RC0201JS-7D10KL	Yageo America
R9	1	10.0k	电阻，10.0k，1%，0.05W，0201	0201	CRCW020110K0FKED	Vishay-Dale

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表 3-1. TPS25730AEVM 物料清单（续）

位号	数量	值	说明	封装参考	器件型号	制造商
R10、R11、R27、R28	4	100k	100kΩ ±1% 0.05W，1/20W 片上电阻 0201（公制 0603），汽车 AEC-Q200 厚膜	0201	ERJ-1GNF1003C	Panasonic Electronic Components
R12、R13、R29、R31	4	1.00k	电阻，1.00k，1%，0.05W，0201	0201	RC0201FR-071KL	Yageo America
R14、R15、R30、R33	4	5.10k	电阻，5.10k，1%，0.05W，0201	0201	RC0201FR-075K1L	Yageo America
R16、R17、R32、R36	4	12.1k	电阻，12.1k，1%，0.05W，0201	0201	RC0201FS-7D12K1L	Yageo America
R18、R19、R35、R38	4	23.2k	电阻，23.2k，1%，0.05W，0201	0201	RC0201FR-0723K2L	Yageo America
R20、R21、R37、R40	4	43.2k	电阻，43.2k，1%，0.05W，0201	0201	RC0201FR-0743K2L	Yageo America
R22、R23、R39、R42	4	115k	电阻，115k，1%，0.05W，0201	0201	RC0201FR-07115KL	Yageo America
R24、R25、R41、R43	4	412k	电阻，412k，1%，0.05W，0201	0201	RC0201FR-07412KL	Yageo America
R44、R46、R48、R50、R52	5	10.0k	电阻，10.0k，1%，0.05W，0201	0201	RC0201FS-7D10KL	Yageo America
R45、R47、R49、R53	4	33.0k	电阻，33.0k，1%，0.05W，0201	0201	RC0201FR-0733KL	Yageo America
R54、R55、R56、R58	4	不适用	0Ω 跳线 0.1W，1/10W 片上电阻 0603（公制 1608），汽车类 AEC-Q200 厚膜	0603	ERJ-3GEY0R00V	Panasonic
R59、R60	2	10k	电阻，10k，5%，0.05W，0201	0201	RC0201JR-7D10KL	Yageo America
R61、R62	2	不适用	电阻，90.9k，1%，0.05W，0201	0201	RC0201FR-0790K9L	Yageo America
R63、R64	2	不适用	电阻，10k，5%，0.05W，0201	0201	RC0201JR-0710KL	Yageo America
SH-JP1、SH-JP2、SH-JP3、SH-JP4、SH-JP5、SH-JP6	6	1x2	分流器，100mil，镀金，黑色	顶部闭合 100mil 分流器	SPC02SYAN	Sullins Connector Solutions
SW1、SW2、SW3、SW4	4	不适用	超微型表面贴装半间距 DIP 开关，–40°C 至 85°C，16 引脚 SMD (DIP)，RoHS，管装	不适用	不适用	C&K Components
TP1、TP2、TP3、TP4	4	不适用	测试点，微型，白色，TH	白色微型测试点	5002	Keystone Electronics
TP5	1	不适用	测试点，通用，绿色，TH	绿色通用测试点	5126	Keystone Electronics
TP6	1	不适用	测试点，通用，蓝色，TH	蓝色多用途测试点	5127	Keystone Electronics

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表 3-1. TPS25730AEVM 物料清单（续）

位号	数量	值	说明	封装参考	器件型号	制造商
TP7	1	不适用	测试点，多用途，红色，TH	红色通用测试点	5010	Keystone Electronics
TP10、TP11、TP12	3	不适用	测试点，多用途，黑色，TH	黑色通用测试点	5011	Keystone Electronics
U1	1	不适用	针对电源应用进行了优化且具有集成电源开关的 USB Type-C® 和 USB PD 控制器	VQFN32	TPS25730ASRSMR	德州仪器 (TI)
U2	1	不适用	22V 精密浪涌保护钳位器，DRV0006A (WSON-6)	DRV0006A	TVS2200DRVR	德州仪器 (TI)
U3	1	不适用	USB Type-C® 28V SPR 端口保护器：VBUS 短路过压和 IEC ESD 保护	WQFN20	TPD4S201RUKR	德州仪器 (TI)
R5、R6	0	10k	电阻，10k，5%，0.05W，0201	0201	RC0201JS-7D10KL	Yageo America

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4 其他信息

4.1 商标

USB-C® and USB Type-C® are registered trademarks of USB Implementers Forum.
所有商标均为其各自所有者的财产。

5 修订历史记录

注：以前版本的页码可能与当前版本的页码不同

Changes from MARCH 25, 2026 to APRIL 13, 2026 (from Revision * (March 2026) to Revision A (April 2026)) **Page**

- 更新了*说明*部分以反映 EVM....1
- 更新了*特性*部分以反映 EVM....1

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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。

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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.

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