参考文献

EVM User's Guide: DRV81315-Q1EVM DRV81325-Q1EVM

DRV813xx-Q1 评估模块

说明

DRV813xx-Q1 评估模块 (EVM) 可用于评估 DRV81315AQDDA、DRV81315QDDA、DRV81315AQDRL、DRV81325QD、DRV81325AQD 和 DRV81325AQDDA 器件。这些 EVM 已编程为开箱即用，可立即开始驱动负载。这些 EVM 展示了所选封装的低侧开关驱动器，其低导通电阻 $R_{DS(on)}$ 约为 100mΩ。这些 EVM 还支持在每个半桥上单独连接检测电阻，从而为需要电流控制的应用提供系统级电流检测。

开始使用

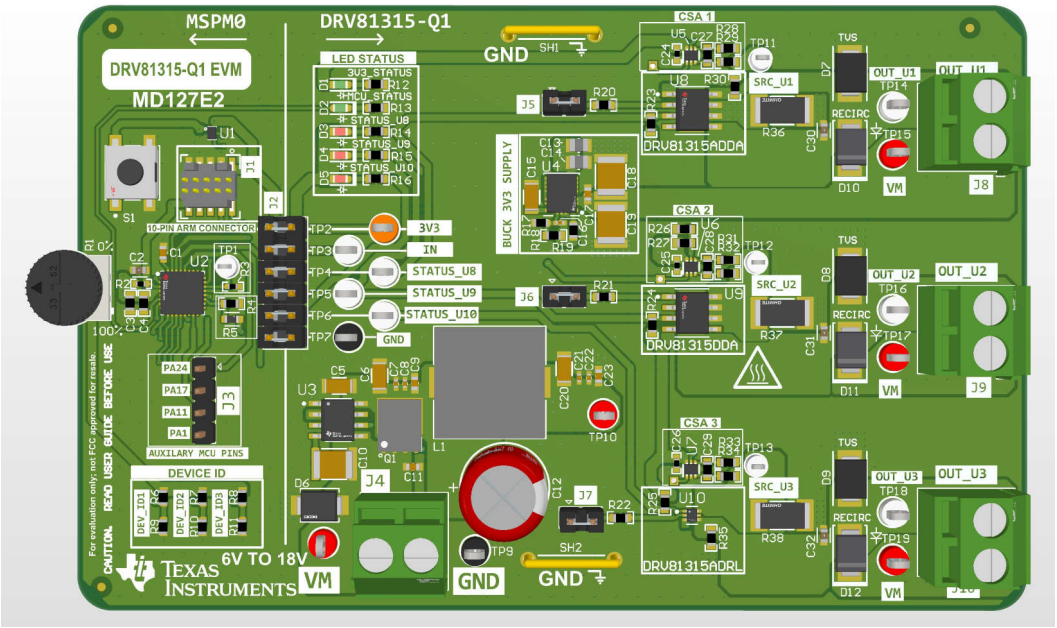
1. 订购 EVM。
   a. DRV81315-Q1EVM
   b. DRV81325-Q1EVM
2. 连接外部电源。
3. 将负载连接到输出端并施加输入信号。

特性

- 用于数字电压电源的板载 3.3V LDO
- 主信号接头通过可拆卸分流器来断开进入电机驱动器 IC 的主信号与 MCU 的连接
- 用于控制输入 PWM 信号的板载电位器
- 用于连接和断开每个驱动器的板载跳线
- 包含三种封装，便于评估
- 用于测量负载电流的板载电流放大器

应用

- 发送控制单元
- 照明
- 发动机管理
- 电池管理系统
- 座椅和车顶应用



DRV81315-Q1EVM

1 评估模块概述

1.1 简介

DRV81315-Q1 和 DRV81325-Q1 系列器件包含具备以下特性的低侧开关：

- DRV81315-Q1：DRV81315/A 是具有单通道保护功能的低侧开关，其低导通电阻 $R_{DS(on)}$ 为 100mΩ。可以通过 GPIO 接口的方式控制该器件。该开关具有过流、过热和输出过压保护功能，过压保护也可用于电感性负载退磁。故障报告以开漏 STATUS 输出形式提供。DRV81315A 还支持在关断状态下进行开路负载/接地短路检测诊断，并在 STATUS 引脚上报告。
- DRV81325-Q1：DRV81325/A-Q1 提供两个低侧开关，其低导通电阻 $R_{DS(on)}$ 为 120mΩ。可以通过并联接口的方式控制该器件。每条通道都具有过流、过热以及用于电感性负载退磁的输出过压保护功能。每条通道的故障报告均以开漏 STATUS 输出形式提供。

本文档随 DRV81315-Q1 和 DRV81325-Q1 评估模块 (EVM) 一起提供，作为 DRV81315/A-Q1 和 DRV81325/A-Q1 数据表的补充。本用户指南包括 EVM 硬件设置说明、GUI 安装和使用说明。

1.2 套件内容

表 1-1 列出了 EVM 套件的内含物。如果缺少任何元件，请联系最近的德州仪器 (TI) 产品支持中心。

表 1-1. 套件内容

项目	数量
DRV81315-Q1EVM、DRV81325-Q1EVM 之一	1

1.3 规格

DRV813xx-Q1EVM 已预先编程了固件，可进行评估。如果用户希望使用客户固件重新刷写板载 MCU (MSPM0G3507)，可板载一个 10 引脚连接器。降压转换器可提供 3.3V 电源轨，以通过 VM 电源电压为 MCU 供电。J2 信号接头使用可拆卸分流器将信号从 MCU 传递到电机驱动器。移除所有这些分流器，以便轻松将外部控制信号输入到驱动器。将匹配器件工作范围的外部电机电源连接到 J4 螺纹接线端子。DRV813xx-Q1EVM 支持 3V 至 5.5V 的输入电源电压以及 6V 至 18V 的输出负载电压范围。

1.4 器件信息

DRV81315-Q1 和 DRV81325-Q1 分别提供具有单通道和双通道保护功能的低侧开关，并集成了用于电感性负载退磁的输出过压保护功能。这些通道具有过流和过热保护功能。对于 DRV813xxA-Q1 型号，每条通道均以开漏 STATUS 输出形式提供故障报告。这些器件提供不同的封装，以在 EVM 上使用。

表 1-2 中的文档提供了有关该 EVM 装配件中使用的德州仪器 (TI) 集成电路的信息。本用户指南可从 TI 网站上获得，文献编号为 SLVUDT6。附加到文献编号的任何字母对应于撰写本文档时已有的最新文档修订版。可通过 TI 网站 www.ti.com.cn，也可以致电德州仪器 (TI) 文献响应中心（电话为 (800) 477-8924）或产品信息中心（电话为 (972) 644-5580）获取较新的修订版。订购时，可通过文档标题或文献编号识别文档。

表 1-2. 相关器件文档

说明	数据表
主 MSPM0 MCU	MSPM0G3507
低侧开关	DRV81315-Q1、DRV81325-Q1
降压转换器	TPSM365R3

2 硬件

2.1 接头和测试点信息

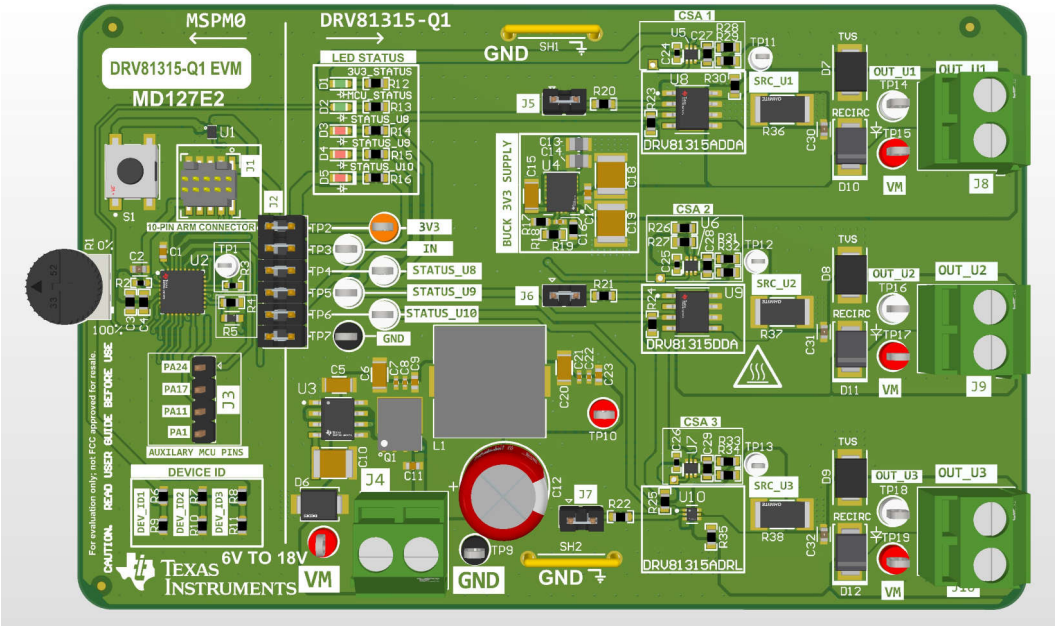


图 2-1. DRV81315-Q1EVM (MD127-001) 顶视图

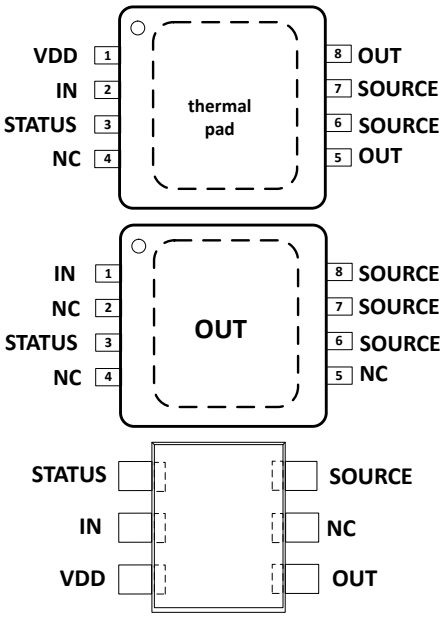


图 2-2. DRV81315-Q1 封装顶视图。自上至下：DRV81315AQDDA、DRV81315QDDA、DRV81315AQDRL

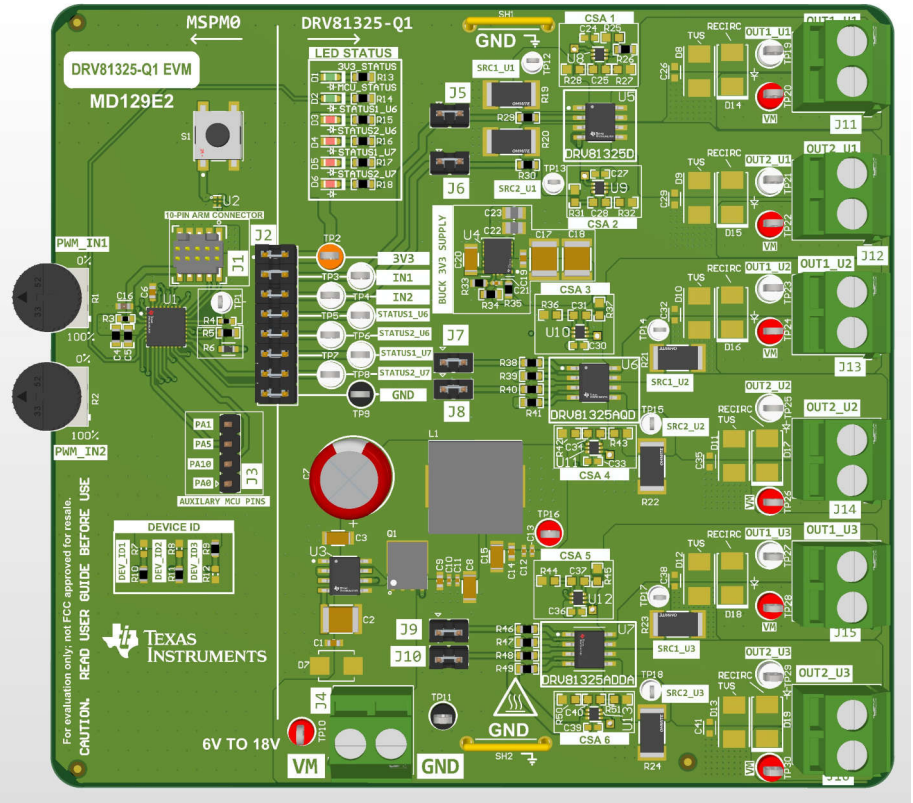


图 2-3. DRV81325-Q1EVM (MD129-001) 顶视图

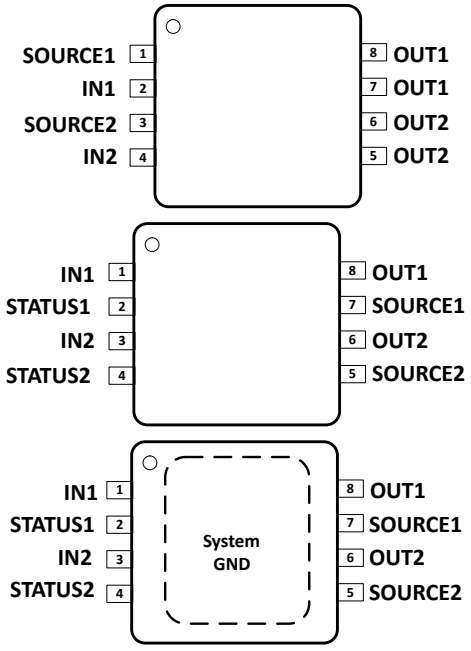


图 2-4. DRV81325-Q1 封装顶视图（自上至下）：DRV81325QD、DRV81325AQD、DRV81325AQDD

小心

表面高温。EVM 可能会用 FIRE 三角符号标记高表面温度。驱动高电流时，避免触摸标记的高温表面区域，以防止潜在的灼伤损害。

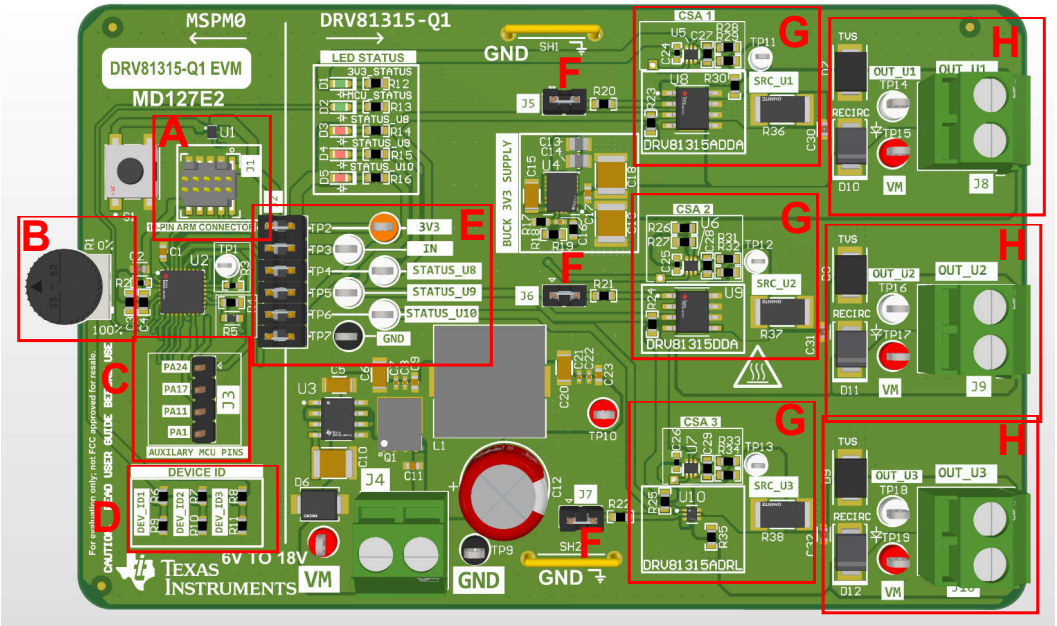


图 2-5. DRV81315-Q1EVM 接头和测试点信息

表 2-1. 接头和测试点说明 - DRV81315-Q1EVM

元件标签	说明
A	10 引脚编程接头。用于将新固件刷写到 MCU。
B	输入电位器。
C	用于未来改进的辅助 MCU 引脚。
D	用于固件识别的 EVM 型号 ID： • DRV81315-Q1EVM：000b • DRV81325-Q1EVM：100b
E	主信号接头： • **3V3**：来自 BUCK 3V3 电源的 3.3V。 • **IN**：来自 R1 电位器的硬件接口通道输入。 • **STATUS_U8**：DRV81315ADDA 器件的状态引脚。 • **STATUS_U9**：DRV81315DDA 器件的状态引脚。 • **STATUS_U10**：DRV81315ADRL 的状态引脚 • **GND**：GND 测试点。
F	用于将 IN 输入端连接到 DRV81315-Q1 驱动器的 J5-J7 跳线。
G	具有电流源放大器元件的 DRV81315AQDDA/DRV81315QDDA/DRV81315AQDRL 驱动器元件。
H	DRV81315AQDDA/DRV81315QDDA/DRV81315AQDRL 驱动器输出连接器。
I	VM 电源输入。它提供降压转换器进而提供 3.3V 电压，同时为输出连接器提供高侧电源电压。

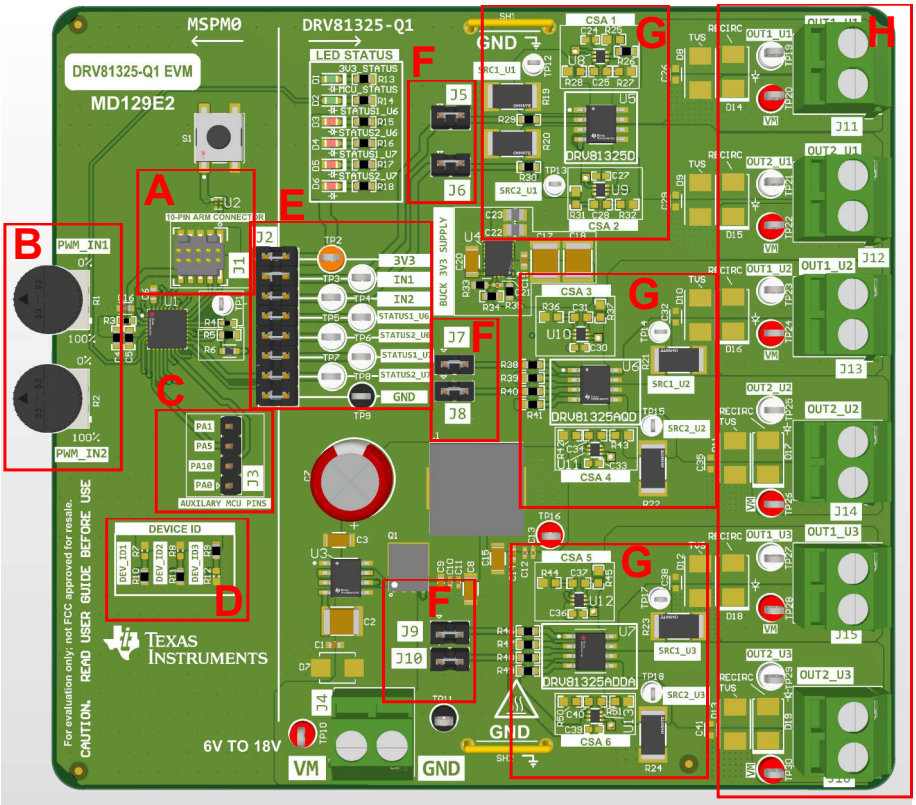


图 2-6. DRV81325-Q1EVM 接头和测试点信息

表 2-2. 接头和测试点说明 - DRV81325-Q1EVM

元件标签	说明
A	10 引脚编程接头。用于将新固件刷写到 MCU。
B	Input1 和 Input2 电位器
C	用于未来改进的辅助 MCU 引脚。
D	用于固件识别的 EVM 型号 ID： • DRV81315-Q1EVM：000b • DRV81325-Q1EVM：100b
E	主信号接头： • **3V3**：来自 BUCK 3V3 电源的 3.3V。 • **IN1**：来自 R1 电位器的硬件接口通道输入。 • **IN2**：来自 R2 电位器的硬件接口通道输入。 • **STATUS1_U6**：DRV81325AD 器件的 Status1 引脚。 • **STATUS2_U6**：DRV81325AD 器件的 Status2 引脚。 • **STATUS1_U7**：DRV81325ADDA 器件的 Status1 引脚。 • **STATUS2_U7**：DRV81325ADDA 器件的 Status2 引脚。 • **GND**：GND 测试点。
F	用于将 IN1 和 IN2 输入端连接到 DRV81325-Q1 驱动器的 J5-J10 跳线。
G	具有电流源放大器元件的 DRV81325QD/DRV81325AQD/DRV81325AQDDA 驱动器元件。
H	DRV81325QD/DRV81325AQD/DRV81325AQDDA 驱动器输出连接器。
I	VM 电源输入。它提供降压转换器进而提供 3.3V 电压，同时为输出连接器提供高侧电源电压。

2.2 LED 和连接器信息

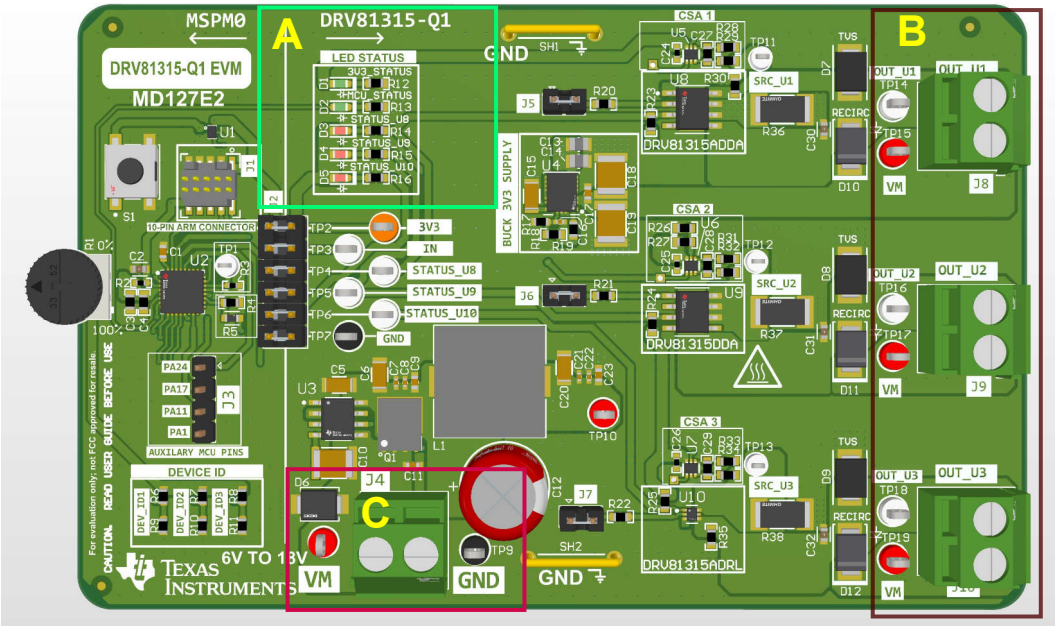


图 2-7. DRV81315-Q1 EVM LED 和连接器

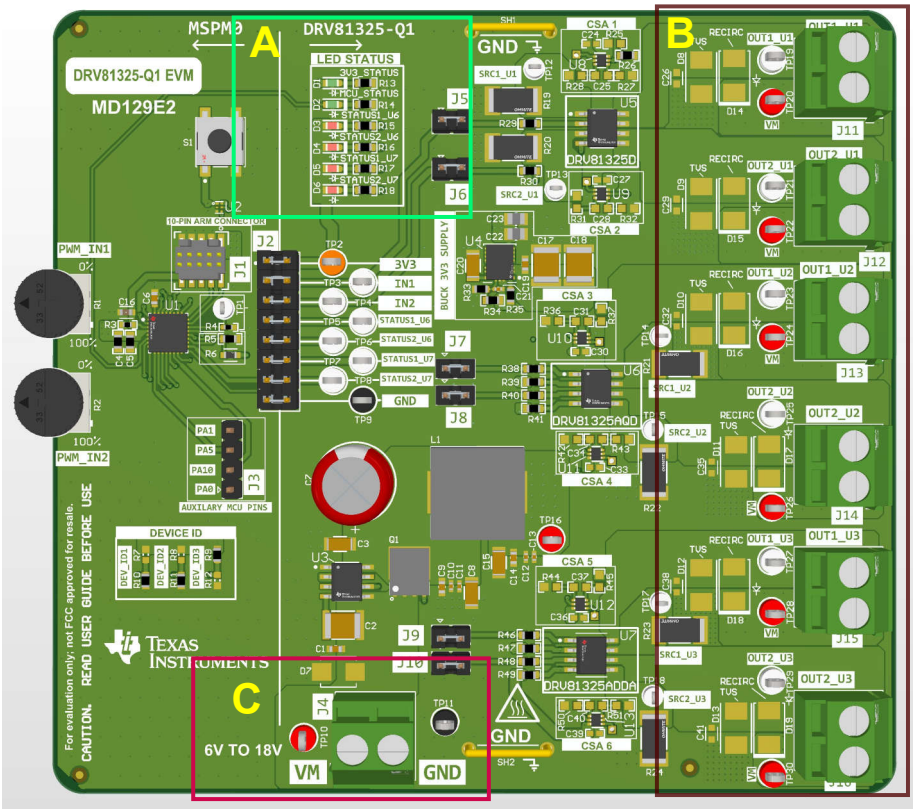


图 2-8. DRV81325-Q1 EVM LED 和连接器

表 2-3. LED 和连接器说明

元件标签	说明
A	LED 指示灯： • **3V3 STATUS：当 3.3V 未处于活动状态时熄灭**。**ON** 当 3.3V 时处于活动状态。 • **MCU_STATUS：**当 MCU 处于活动状态时，LED 以大约 1 秒的频率闪烁。如果停止闪烁，请拔下 EVM，然后将其重新连接到计算机。 • **STATUSx_Ux：OFF** 器件正常运行。**ON** 过热时触发过流保护。
B	DRV813xx-Q1 驱动器输出连接器。
C	输入电源连接器。电源线可直接连接到螺纹接线端子，也可夹持到连接器两侧的测试点。

2.3 硬件设置

EVM 硬件经过专门设计和配置，可简化设置并开始启动负载。EVM 在接头的适当位置带有跳线。表 2-1 和表 2-2 中列出了跳线（也称为分流器）的说明。

要使用 EVM 功能，请按如下步骤操作：

1. 将电位器设置为 0%，并插上每个驱动器的相关输入 PWM 跳线（DRV81315-Q1EVM 中为 J5 至 J7，DRV81325-Q1EVM 中为 J5 至 J10）。
2. 将电源（低于 18V）连接到电源连接器。打开电源。LED D1 (3.3V) 必须稳定亮起，而 LED D2（MCU 状态）需要以 1s 的间隔闪烁。
3. 将负载连接至相应的输出连接器。
4. 现已完成设置。有关设置图像，请参阅图 2-9。

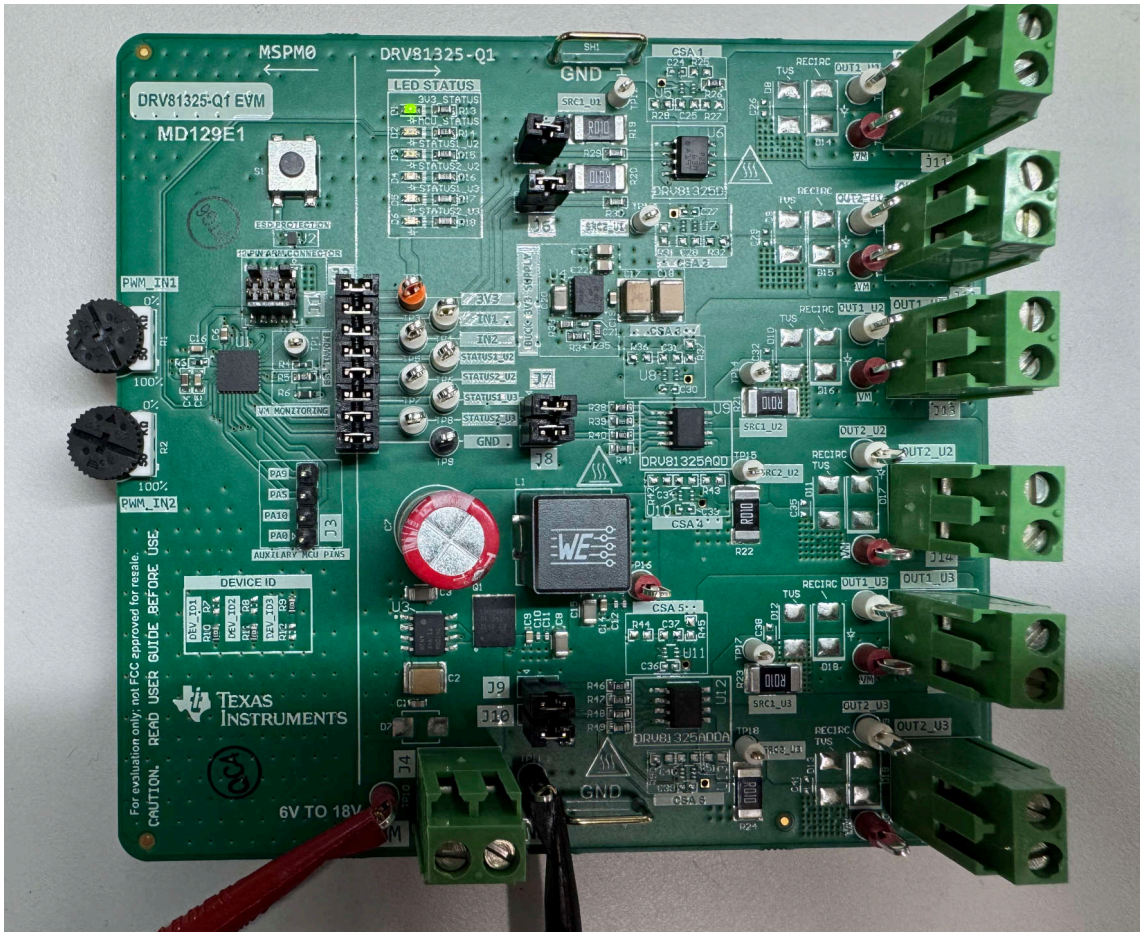


图 2-9. 硬件设置

3 硬件设计文件

每个 EVM 的原理图、物料清单 (BOM)、PCB 布局和 3D 模型 STEP 文件可在各自产品文件夹页面的*设计文件* 部分下载。

- https://www.ti.com/tool/DRV81315-Q1EVM#design-files
- https://www.ti.com/tool/DRV81325-Q1EVM#design-files

3.1 原理图

图 3-1 显示了 DRV81315-Q1EVM 的原理图。请从*设计文件* 部分下面的任意 EVM 工具文件夹下载*硬件设计文件* , 查看其他器件的原理图。适用于 DRV81315-Q1EVM 的 DRV81315-Q1EVM Hardware Files.zip 和适用于 DRV81325-Q1EVM 的 DRV81325-Q1EVM Hardware Files.zip。

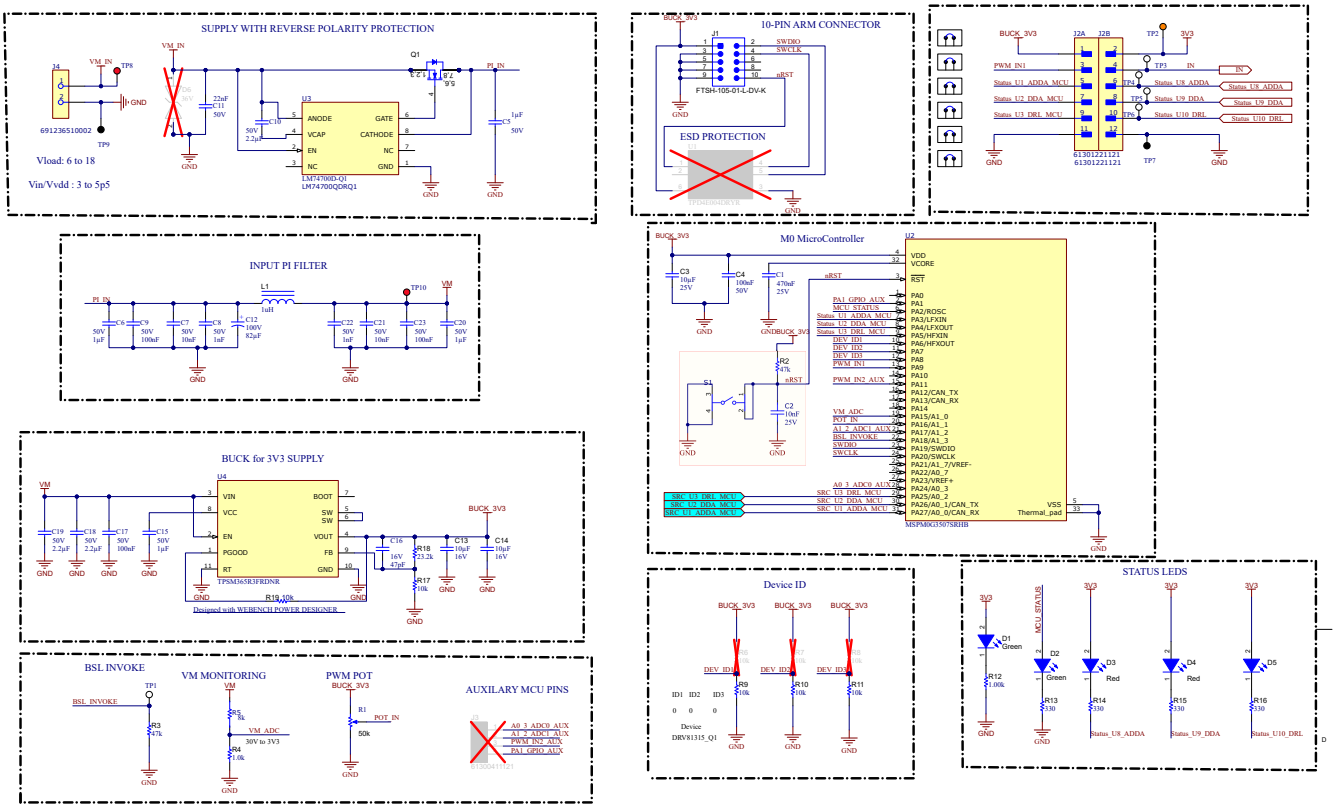


图 3-1. 输入电源组件和 MSPM0G3507 控制器

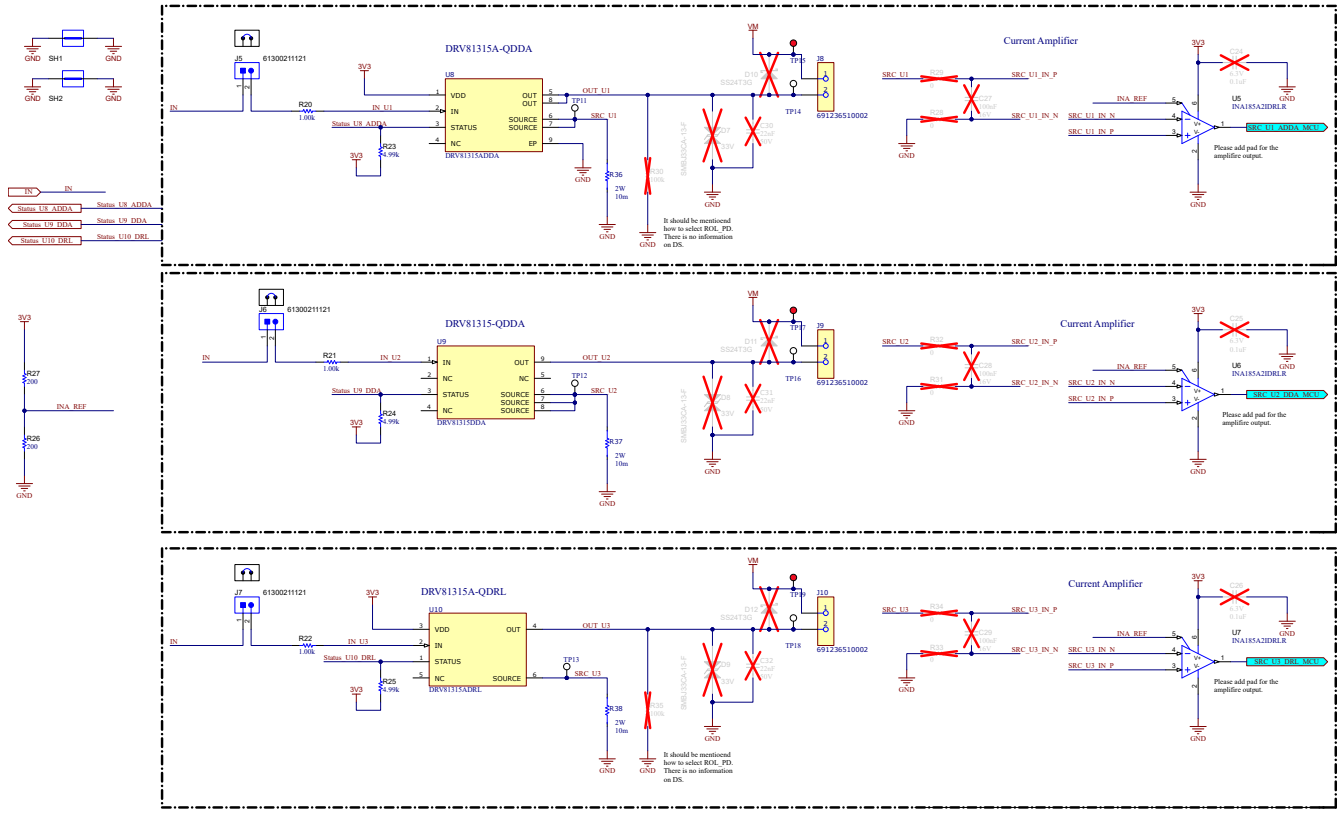


图 3-2. DRV81315-Q1 驱动器配置

3.2 PCB 布局

图 3-3 至图 3-6 显示了 EVM 的各 PCB 层。可以在上述给定 EVM 的*硬件设计文件*中下载 Altium 源文件。

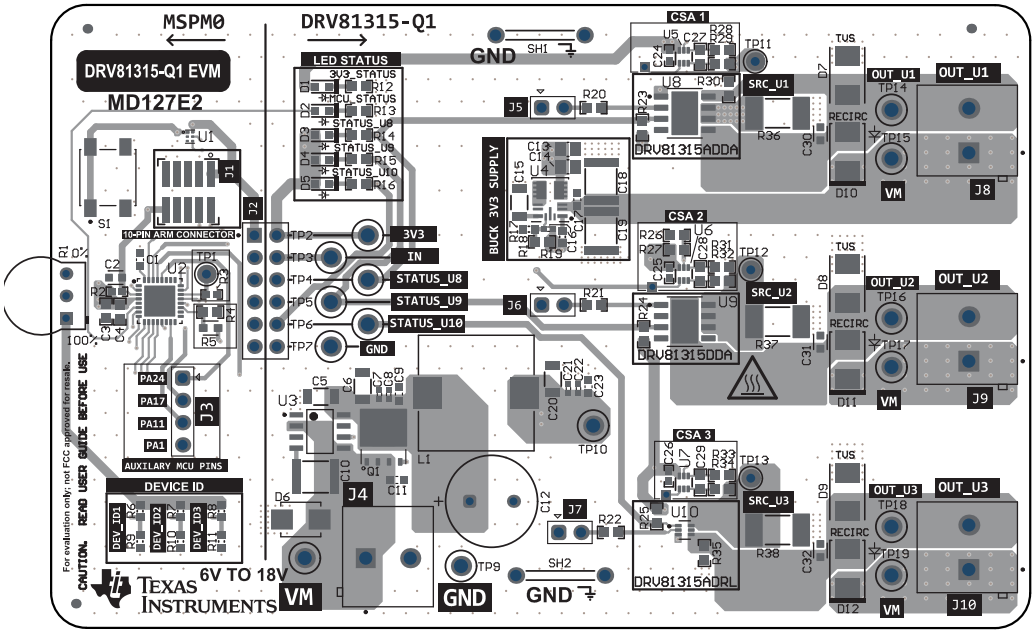


图 3-3. 顶视图

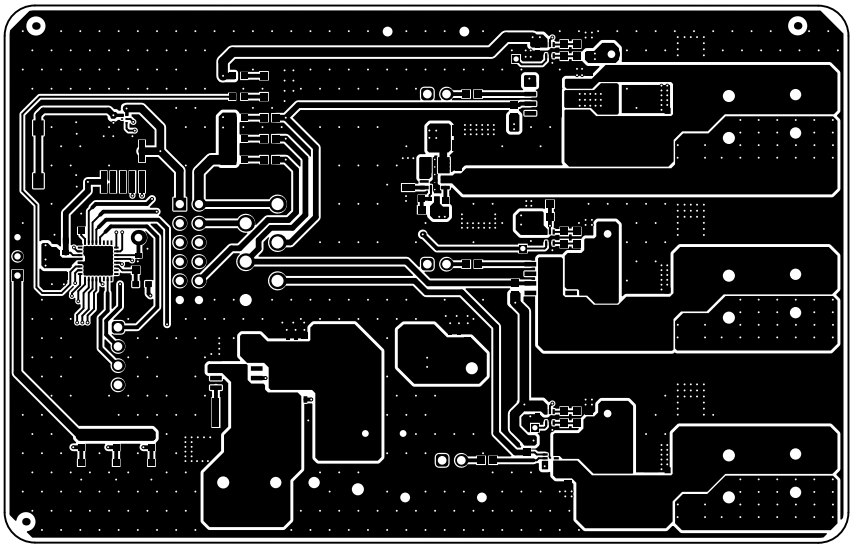


图 3-4. 顶层

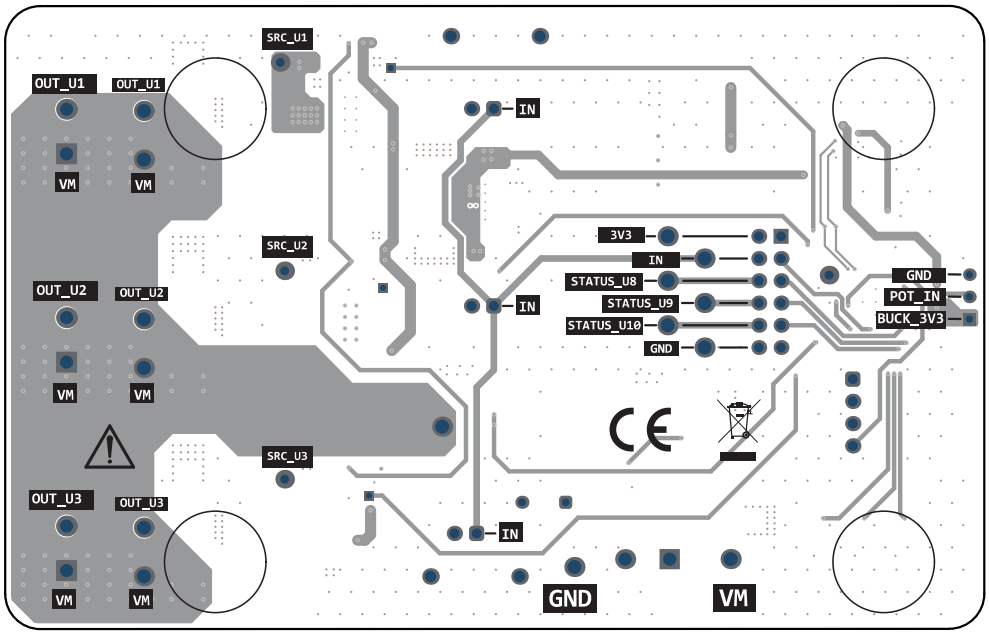


图 3-5. 底视图

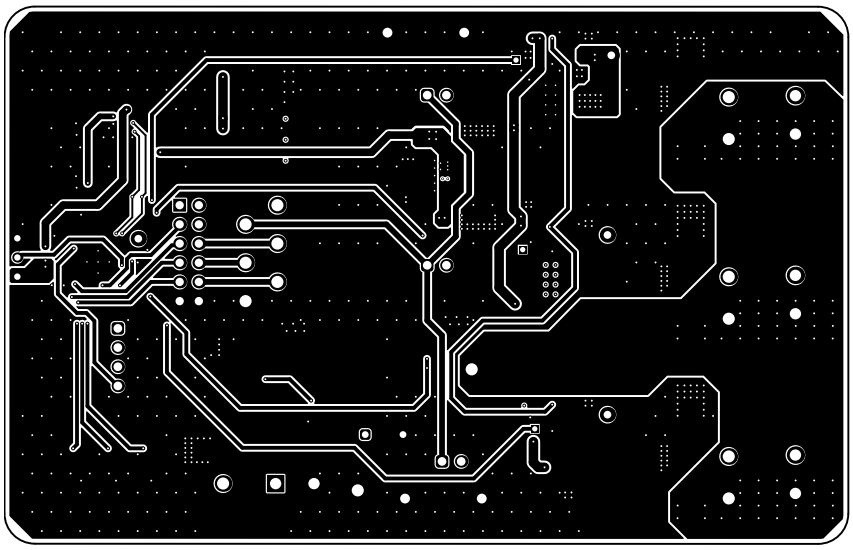


图 3-6. 底层

3.3 物料清单 (BOM)

表 3-1 提供了 DRV81315-Q1EVM 的器件清单。其他 EVM 具有类似的 BOM，可以在上述*硬件设计文件* 中获取。

表 3-1. 物料清单 (DRV81315-Q1EVM)

位号	数量	值	说明	封装参考	器件型号	制造商
!PCB1	1		印刷电路板		MD127-001	不限
C1	1	470nF	WCAP-CSGP 多层陶瓷贴片电容器，通用，尺寸 0603，X7R II 类，470nF，25VDC	0603	885012206075R	Wurth Elektronik
C2	1	10nF	10000pF ±10% 25V 陶瓷电容器 X7R 0603（公制 1608）	0603	885012206065	Wurth Electronics
C3	1	10uF	电容，陶瓷，10µF，25V，+/- 10%，X5R，0603	0603	GRM188R61E106KA73D	MuRata
C4	1	0.1uF	电容，陶瓷，0.1µF，50V，+/-10%，X7R，0603	0603	885012206095	Wurth Elektronik
C5、C6、C15、C20	4	1µF	WCAP-CSGP 多层陶瓷贴片电容器，通用，尺寸 1206，X7R，1µF，50VDC	1206	885012208093	Wurth Elektronik
C7、C21	2	10nF	WCAP-CSGP 多层陶瓷贴片电容器，通用，尺寸 0402，X7R，10nF，50VDC	0402	885012205067	Wurth Elektronik
C8、C22	2	1nF	WCAP-CSGP 多层陶瓷贴片电容器，通用，尺寸 0402，X7R，1nF，50VDC	0402	885012205061	Wurth Elektronik
C9、C17、C23	3	100nF	WCAP-CSGP 多层陶瓷贴片电容器，通用，尺寸 0603，X7R，100nF，50VDC	0603	885012206095	Wurth Elektronik

表 3-1. 物料清单 (DRV81315-Q1EVM) （续）

位号	数量	值	说明	封装参考	器件型号	制造商
C10、C18、C19	3	2.2μF	WCAP-CSGP 多层陶瓷贴片电容器，通用，尺寸 1812，X7R，2.2μF，50VDC	18012	885012210032	Wurth Elektronik
C11	1	22nF	WCAP-CSGP 多层陶瓷贴片电容器，通用，尺寸 0603，X7R，22nF，50VDC	0603	885012206091	Wurth Elektronik
C12	1	82μF	WCAP-ATUL 铝电解电容器，径向，THT，D10 x H20mm，82μF，100V	10mm 直径 x 20mm 高	860040875004	Wurth Elektronik
C13、C14	2	10uF	电容器，陶瓷，10μF，16V，+/- 20%，X5R，0805	0805	885012107014	Wurth Elektronik
C16	1	47pF	WCAP-CSGP 多层陶瓷贴片电容器，通用，尺寸 0402，NP0，47pF，16VDC	0402	885012005029	Wurth Elektronik
D1、D2	2	绿色	LED，绿色，SMD	LED_0603	150060VS75000	Wurth Elektronik
D3、D4	2	红色	LED，红色，SMD	LED_0603	150060RS75000	Wurth Elektronik
D5	1		LED，红色，SMD	LED_0603	150060RS75000	Wurth Elektronik
FID1、FID2、FID3	3		基准标记。没有需要购买或安装的元件。	不适用	不适用	不适用
H1、H2、H3、H4	4		Bumpon，半球形，0.44 X 0.20，透明	透明 Bumpon	SJ-5303 (CLEAR)	3M
J1	1		接头（有罩），1.27mm，5x2，金，SMT	接头（有罩），1.27mm，5x2，SMT	FTSH-105-01-L-DV-K	Samtec
J2	1		THT 垂直引脚接头 WR-PHD，间距 2.54mm，双排，12 引脚	HDR12	61301221121	Wurth Electronics
J4、J8、J9、J10	4		2 位，线至板，端子块，与板齐平，0.200" (5.08mm)，穿孔	HHR2	6.91237E+11	Wurth Electronics

表 3-1. 物料清单 (DRV81315-Q1EVM) （续）

位号	数量	值	说明	封装参考	器件型号	制造商
J5、J6、J7	3		接头，2.54mm，2x1，金，TH	接头，2.54mm，2x1，TH	61300211121	Wurth Elektronik
L1	1	1μH	电感器，屏蔽鼓芯，铁粉，1uH，15A，0.0027Ω，SMD	电感器，12.6x3.3x12.6mm	74437377010	Wurth Elektronik
Q1	1	80V	MOSFET，N 沟道，80V，100A，DNK0008A (VSON-CLIP-8)	DNK0008A	CSD19502Q5B	德州仪器 (TI)
R1	1	50k	修整电位器，50K，0.5W，TH	9.53mm x 8.89mm	3352T-1-503LF	Bourns
R2、R3	2	47k	电阻，47k，5%，0.063W，AEC-Q200 0 级，0402	0402	CRCW040247K0JNED	Vishay-Dale
R4	1	1.0k	电阻，1.0k，5%，0.1W，0603	0603	RC0603JR-071KL	Yageo
R5	1	8k	8kΩ ±0.1% 0.1W，1/10W 片式电阻器 0603（公制 1608）薄膜	0603	RT0603BRE078KL	Yageo
R9、R10、R11、R17、R19	5	10k	电阻，10k，5%，0.1W，0603	0603	RC0603JR-0710KL	Yageo
R12、R20、R21、R22	4	1.00k	电阻，1.00k，1%，0.1W，0603	0603	RC0603FR-071KL	Yageo
R13、R14、R15、R16	4	330	电阻，330，5%，0.1W，0603	0603	RC0603JR-07330RL	Yageo
R18	1	23.2k	电阻，23.2k，1%，0.1W，0603	0603	RC0603FR-0723K2L	Yageo
R23、R24、R25	3	4.99k	电阻，4.99k，1%，0.1W，0603	0603	RC0603FR-074K99L	Yageo
R26、R27	2	200	电阻，200，1%，0.1W，0603	0603	RC0603FR-07200RL	Yageo

表 3-1. 物料清单 (DRV81315-Q1EVM) （续）

位号	数量	值	说明	封装参考	器件型号	制造商
R36、R37、R38	3	10m	10mΩ ±0.5% 2W 片上电阻 2512（公制 6432），汽车 AEC-Q200，电流检测，防潮金属膜	2512	PCS2512DR0100ET	Ohmite
S1	1		触控开关 SPST-NO 顶部驱动表面贴装	SMT_SW_6MM2_6MM2	430481025816	Wurth Electronics
SH1、SH2	2		1mm 非绝缘短路插头，10.16mm 间距，TH	短路插头，10.16mm 间距，TH	D3082-05	Harwin
SH1-J2、SH2-J2、SH3-J2、SH4-J2、SH5-J2、SH6-J2、SH-J5、SH-J6、SH-J7	9		分流器，2.54mm，金，黑色	分流器，2.54mm，黑色	60900213421	Wurth Elektronik
TP1、TP11、TP12、TP13	4		测试点，微型，白色，TH	白色微型测试点	5002	Keystone Electronics
TP2	1		测试点，通用，橙色，TH	橙色通用测试点	5013	Keystone
TP3、TP4、TP5、TP6、TP14、TP16、TP18	7		测试点，通用，白色，TH	白色通用测试点	5012	Keystone Electronics
TP7、TP9	2		测试点，多用途，黑色，TH	黑色通用测试点	5011	Keystone Electronics
TP8、TP10、TP15、TP17、TP19	5		测试点，多用途，红色，TH	红色通用测试点	5010	Keystone Electronics
U2	1		具有 CAN-FD 接口 VQFN32 的混合信号微控制器	VQFN32	MSPM0G3507SRHB	德州仪器 (TI)
U3	1		LM74700QDRQ1	SOIC8	LM74700QDRQ1	德州仪器 (TI)
U4	1		采用 HotRod QFN 封装的 3V 至 65V 输入、1V 至 13V 输出、600mA 同步降压转换器电源模块	QFN-FCMOD11	TPSM365R3FRDNR	德州仪器 (TI)
U5、U6、U7	3		DRL0006A (SOT-5X3-6) 双向高精度低侧和高侧电压输出电流检测放大器	DRL0006A	INA185A2IDRLR	德州仪器 (TI)

表 3-1. 物料清单 (DRV81315-Q1EVM) （续）

位号	数量	值	说明	封装参考	器件型号	制造商
U8	1		具有保护功能的低侧开关 HSOIC8	HSOIC8	DRV81315ADDA	德州仪器 (TI)
U9	1		具有保护功能的低侧开关 HSOIC8	HSOIC8	DRV81315DDA	德州仪器 (TI)
U10	1		具有保护功能的低侧开关 SOT563	SOT6	DRV81315ADRL	德州仪器 (TI)
C24、C25、C26	0	0.1uF	电容器，陶瓷，0.1µF，6.3V，+/-20%，X5R，0402	0402	885012105001	Wurth Elektronik
C27、C28、C29	0	0.1uF	电容，陶瓷，0.1µF，16V，+/-10%，X7R，0603	0603	885012206046	Wurth Elektronik
C30、C31、C32	0	22nF	0.022µF ±10% 50V 陶瓷电容器 X7R 0603（公制 1608）	0603	885012206091	Wurth Electronics
D6	0		58.1V 钳位，10.3A Ipp，Tvs 二极管，表面贴装，SMB	SMB	SMBJ36CA-13-F	Diodes Inc
D7、D8、D9	0	33V	二极管，TVS，双向，33V，SMB	SMB	SMBJ33CA-13-F	Diodes Inc.
D10、D11、D12	0	40V	二极管，肖特基，40V，2A，AEC-Q101，SMB	SMB	SS24T3G	ON Semiconductor
J3	0		接头，2.54mm，4x1，金，TH	接头，2.54mm，4x1，TH	61300411121	Wurth Elektronik
R6、R7、R8	0	10k	电阻，10k，5%，0.1W，0603	0603	RC0603JR-0710KL	Yageo
R28、R29、R31、R32、R33、R34	0	0	电阻，0，5%，0.1W，AEC-Q200 0 级，0603	0603	ERJ-3GEY0R00V	Panasonic
R30、R35	0	100k	电阻，100k，1%，0.1W，0603	0603	RC0603FR-07100KL	Yageo

表 3-1. 物料清单 (DRV81315-Q1EVM) （续）

位号	数量	值	说明	封装参考	器件型号	制造商
U1	0		用于高速数据接口的 ESD 保护阵列，4 通道，-40 至 +85°C，6 引脚 SON (DRY)，环保（符合 RoHS 标准，无锑/溴）	DRY0006A	TPD4E004DRYR	德州仪器 (TI)

4 其他信息

4.1 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 semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems.

User shall operate the Evaluation Kit within TI’s recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI’s recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI’s instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 *Regulatory Notices:*

3.1 *United States*

3.1.1 *Notice applicable to EVMs not FCC-Approved:*

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。

https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。 技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・インスツルメンツ株式会社

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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.

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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