EVM User's Guide: LM7320-30EVM

LM7311、LM7320 和 LM7330 评估模块

说明

LM7320-30EVM 可评估 LM7311、LM7320 和 LM7330 电子保险丝器件的性能。LM7320-30EVM 配备 LM7311 和 LM7330 电子保险丝，用于评估 12V（典型值）和 5A（稳定状态）设计。

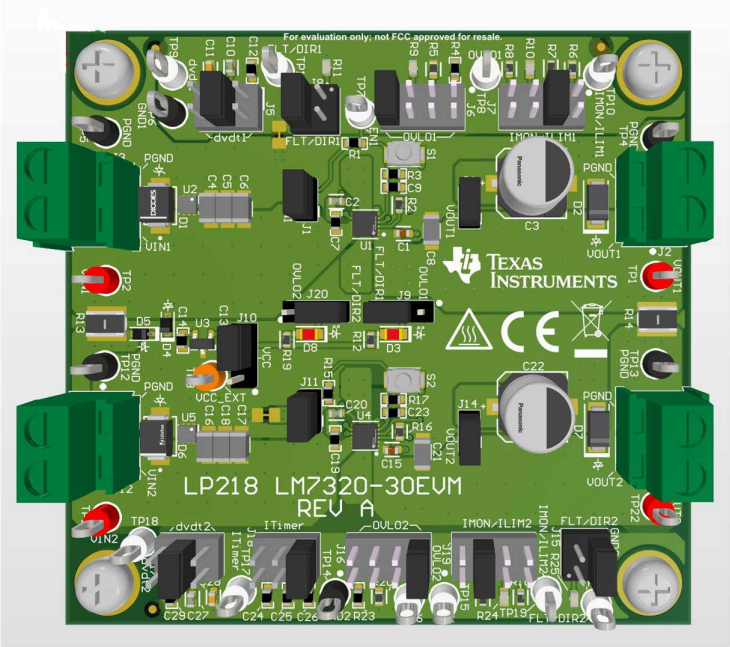
将 U1 插槽上的 LM7311 更换为 LM7320，即可对其进行评估。

特性

- 过压保护
- 具有可调节 UVLO 阈值的高电平有效使能端
- 可调节模拟电流监测和输出电压压摆率控制（使用板载跳线）
- 用于输出瞬态保护的肖特基二极管
- 用于指示故障的 LED 状态指示灯
- 启动和稳定状态期间的短路保护
- LM7320 和 LM7330 提供集成式内部智能 TVS 二极管
- 基于线性 ORing 的反向电流阻断

应用

- PC/笔记本电脑
- 显示器/扩展坞
- ePOS
- 工业 PC
- 移动电源
- 电动工具
- 多功能打印机



LM7320-30EVM 修订版 A

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1 评估模块概述

1.1 简介

LM7320-30EVM 电子保险丝评估板可对德州仪器 (TI) LM7311、LM7320-30 电子保险丝进行参考电路评估。表 1-1 介绍了电子保险丝的特性。

表 1-1. 电子保险丝特性

特性	LM7311	LM7320	LM7330
过压保护	24V 固定 OVP	24V 固定 OVP	24V/34V 引脚可选 OVP
导通电阻	33mΩ	20mΩ	20mΩ
最大持续电流	5A	7A	7A
IEC62368-3 支持	是，IEC61000-4-5 最高支持 35V 的电压	是，集成智能浪涌钳位	是，集成智能浪涌钳位
短路保护	是	是	是
精确的负载电流监测	是	是	是
可调输出压摆率控制	是	是	是
故障指示引脚	是	是	是
基于线性 ORing 的反向电流阻断	是	是	是

本 EVM 用户指南介绍了 LM7311、LM7320 和 LM7330 电子保险丝评估模块 (EVM)。



小心

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1.2 套件内容

表 1-2. LM7320-30EVM：套件内容

品类	说明	数量
LM7320-30EVM	用于 LM7311、LM7320 和 LM7330 电子保险丝的评估模块	1

1.3 规格

表 1-3 提供了 LM7320-30EVM 规格参数。

表 1-3. LM7320-30EVM 设计规格

参数	LM7311	LM7320	LM7330
输入电压范围 (V_{IN})	3.5V 至 23V	3.5V 至 23V	3.5 至 32V
最大 RMS 负载电流 ($I_{OUT(max)}$)	< 5A	<7A	<7A
过压保护阈值 (V_{TRIP})	24V	24V	24V、34V

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1.4 器件信息

LM7320-30EVM 支持评估 EPR 系列中的 LM7311、LM7320 和 LM7330 电子保险丝。LM7320 和 LM7330 默认装配在 EVM 上。在连接器 J3-2(+)、J3-1(-)、J12-2(+) 和 J12-1(-) 之间施加输入电源。连接器 J2-1(+)、J2-2(-) 和 J13-1(+) 以及 J13-2(-) 为 EVM 提供输出连接，如图 4-1 所示。图 3-1 提供了 EVM 测试设置。D2 和 D7 中的肖特基二极管将 LM7320-30 电子保险丝的 OUT 引脚上的负电压偏移钳位在最大绝对额定值内，从而保护输出。

故障指示灯（FLTB1 和 FLTB2）分别由 LED D3 和 D8 提供。

表 1-4. LM7320-30EVM 电子保险丝评估板选项和设置

EVM 功能	通道	Vin UVLO 阈值	Vin OVLO 阈值	输出压摆率 (dv/dt)
LM7311、LM7320 电子保险丝的性能评估	CH1	10.87V	24V	可选 - 5.4V/ms、0.5V/ms 和 0.25V/ms
LM7330 电子保险丝的性能评估	CH2	10.87V	24V/34V	可选 - 5.4V/ms、0.5V/ms 和 0.25V/ms

LM7320-30EVM 器件的其他信息包括：

- 承受输出端*热短路*情况
- 承受*上电至短路*情况
- 电路板可以热插拔
- 对电路板进行下电上电
- 电流负载监测

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2 硬件

2.1 一般配置

2.1.1 物理访问

表 2-1 列出了 LM7320-30EVM 电子保险丝评估板输入和输出连接器功能。表 2-3 和表 2-2 分别介绍了测试点的可用性和跳线的功能。表 2-4 详细介绍了信号 LED 指示灯的功能。

表 2-1. 输入和输出连接器功能

连接器	标签	说明
J3-2	VIN1 (+)	LM7311/LM7320 输入电源的正极端子
J3-1	VIN1(-)	LM7311/LM7320 输入电源的负极端子
J12-2	VIN2(+)	LM7330 输入电源的正极端子
J12-1	VIN2(-)	LM7330 输入电源的负极端子
J2-1	VOUT1(+)	LM7311/LM7320 输出电源的正极端子
J2-2	PGND(-)	LM7311/LM7320 输出电源的负极端子
J13-1	VOUT2(+)	LM7330 输出电源的正极端子
J13-2	PGND(-)	LM7330 输出电源的负极端子

表 2-2. 测试点说明

测试点	标签	说明
TP1	VOUT1	LM7320 输出电压
TP2	VIN1	LM7320 输入电压
TP3	VCC_EXT	外部上拉
TP7	EN1	LM7320 的高电平有效使能端
TP9	DVDT1	LM7320 的启动压摆率控制
TP10	IMON1	LM7320 电流监测器
TP11	FLT/DIR1	LM7320 的故障指示
TP15	EN2	LM7330 的高电平有效使能端
TP17	ITIMER2	LM7330 的过流消隐计时器
TP18	DVDT2	LM7330 的启动压摆率控制
TP19	ILIM2	LM7330 电流监控器
TP20	FLT/DIR2	LM7330 的故障指示
TP21	VIN2	LM7330 输入电压
TP22	VOUT2	LM7330 输出电压
TP4、TP5	PGND	LM7320 的公共电源接地
TP6	GND1	CH1 IC 接地信号
TP12、TP13	PGND	LM7330 的公共电源接地
TP14	GND2	CH2 IC 接地信号

表 2-3. 跳线说明和默认位置

跳线	标签	说明	默认跳线位置
J1	EN/UVLO1	1-2 位置将 UVLO 阈值设置为 10.88V	1-2
J4	VOUT1	1-2 位置向 LM7320/LM7311 接入 220 µ F 电容负载	断开

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表 2-3. 跳线说明和默认位置（续）

跳线	标签	说明	默认跳线位置
J5、J17	DVDT1、DVDT2	1-2 位置将输出压摆率设置为 5.4V/ms	3-4
		3-4 位置将输出压摆率设置为 0.5V/ms	
		5-6 位置将输出压摆率设置为 0.25V/ms	
J7	IMON/ILIM1	在 5A 负载下，1-2 位置将 IMON 引脚上的电压设置为 2.35V	1-2
		在 5A 负载下，3-4 位置将 IMON 引脚上的电压设置为 0.71V	
		在 5A 负载下，5-6 位置将 IMON 引脚上的电压设置为 0.44V	
		在 5A 负载下，7-8 位置将 IMON 引脚上的电压设置为 0.31V	
J17	IMON/ILIM2	在 7A 负载下，1-2 位置将 IMON 引脚上的电压设置为 2.35V	1-2
		在 7A 负载下，3-4 位置将 IMON 引脚上的电压设置为 0.71V	
		在 7A 负载下，5-6 位置将 IMON 引脚上的电压设置为 0.44V	
		在 7A 负载下，7-8 位置将 IMON 引脚上的电压设置为 0.31V	
J8	FLT/DIR1	1-2 位置设定故障期间 FLT/DIR1 的电压	断开
		3-4 位置将 FLT1 引脚接地	
J15	FLT/DIR2	1-2 位置设定故障期间 FLT/DIR2 的电压	断开
		3-4 位置将 FLT2 引脚接地	
J11	EN/UVLO2	1-2 位置将 UVLO 阈值设置为 10.88V	1-2
J14	VOUT2	1-2 位置接入 220 µF 电容负载至 LM7330	断开

表 2-4. LED 说明

LED	说明
D3	当开启时，表示 FLTb1 有效
D8	当开启时，表示 FLTb2 有效

2.1.2 测试设备和设置

电源：两台可调电源，输出为 0V 至 40V，输出电流限制为 0A 至 10A。

仪表：两台数字万用表 (DMM)。

示波器：DPO2024 或同等规格机型，配三个 10x 电压探头和一个额定电流为 30A 的直流电流探头。

负载：一个电阻负载或等效负载，在 40V 电压下可承受最高 10A 的直流负载。

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3 实现结果

3.1 测试设置和过程

本 EVM 用户指南介绍了 LM7311、LM7320 和 LM7330 电子保险丝的测试流程。确保评估板的跳线设置为默认设置，如表 3-1 所示。

表 3-1. LM7320-30EVM 电子保险丝评估板的默认跳线设置

J-1、J-11	J5、J17	J7、J19	J8、J15	J6、J16	J4、J14	J9、J10
1-2	3-4	1-2	断开	断开	断开	断开

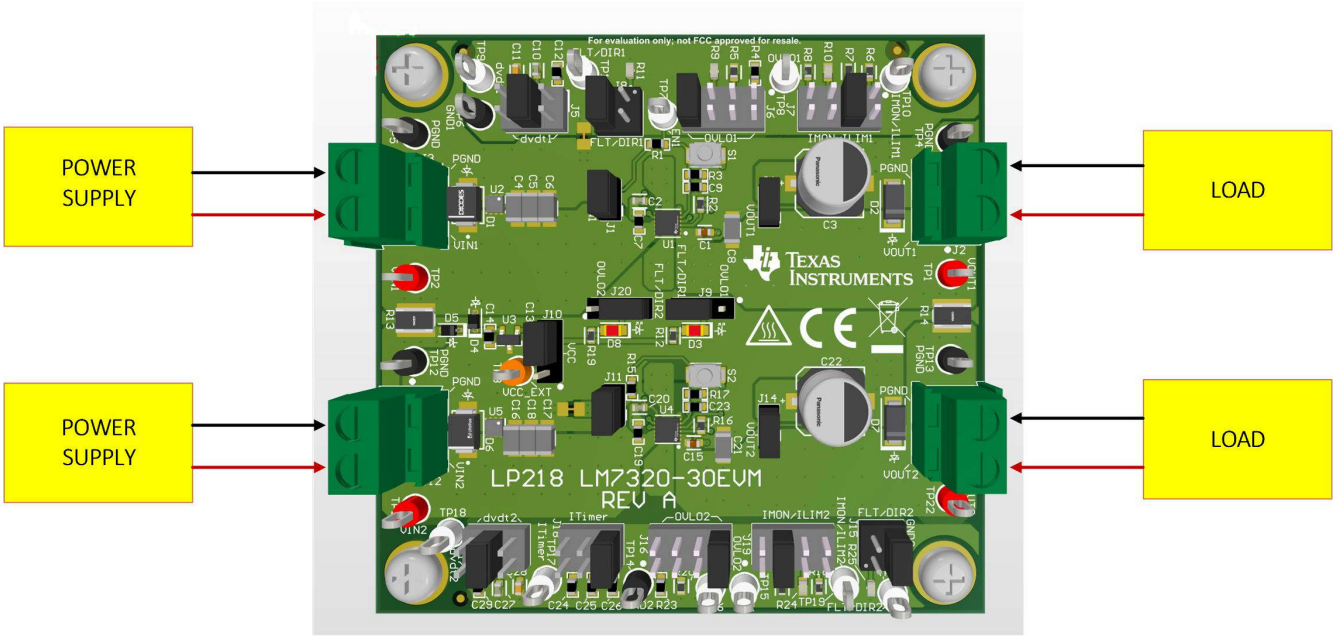


图 3-1. 带测试设备的 LM7320-30EVM 设置

在开始任何测试之前，请按以下说明进行操作，并在进行下一个测试之前再次重复操作：

1. 将电源输出 (VIN) 设置为零伏。
2. 关闭电源。
3. 将 EVM 上的跳线位置调整为默认配置，如表 3-1 所示。

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3.1.1 输入热插拔测试

按照以下说明在 LM7320 电子保险丝上执行输入热插拔测试：

1. 确认已按节 3.1 中的说明完成实验的初始设置。
2. 在跳线 J5 位置，如表 2-3 所详述将压摆率配置为所需启动值。
3. 将 J4 跳线设为 1-2 位置
4. 将电源的负极端子连接到连接器 J3-1。
5. 将输入电源电压设置为 12V，将电流限制设置为 10A。
6. 启用电源。然后将电源的正极端子连接到连接器 J3-2。
7. 使用示波器观察 VOUT1(TP1)、VIN1(TP2)、FLT1(TP11) 和输入电流的波形。

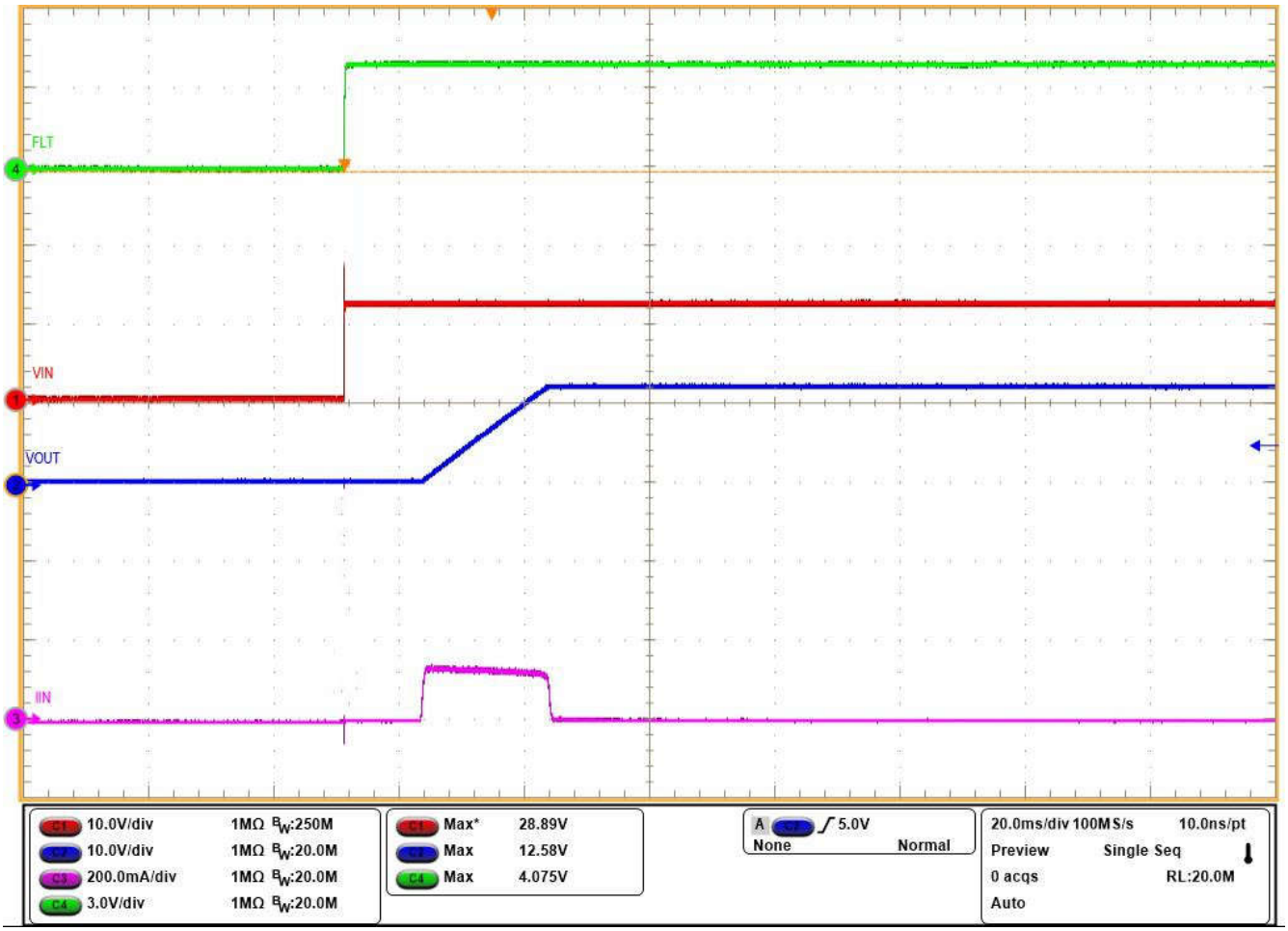


图 3-2. LM7311 电子保险丝输入热插拔特性曲线

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3.1.2 上电至短路

按照说明执行上电至短路测试：

1. 确认已按节 3.1 中的说明完成实验的初始设置。
2. 将输入电源电压设置为 12V，将电流限制设置为 30A。关闭电源。
3. 将电源的负极端子连接到 J3-1，将电源的正极端子连接到 J3-2。
4. 将 EVM 的输出端短接至地。例如，通过一根电缆将 VOUT1（连接器 J2-1）短接到 PGND（连接器 J2-2）。
5. 打开电源。

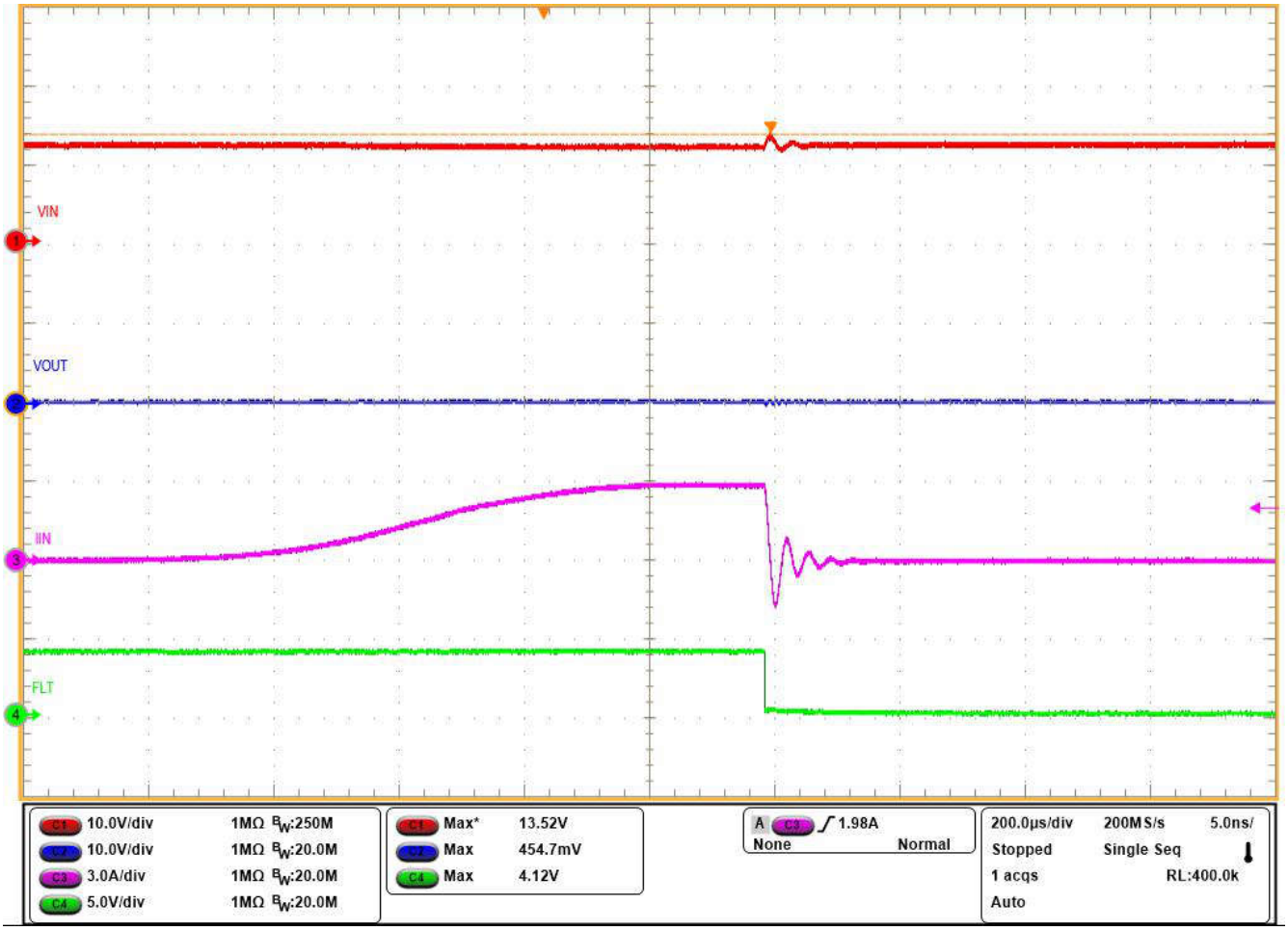


图 3-3. LM7311 上电至输出短路响应

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3.1.3 反向电流阻断测试

按照说明执行反向电流阻断测试：

1. 确认已按节 3.1 中的说明完成实验的初始设置。
2. 将第一个输入电源电压 VIN1 设置为 12V，将电流限制设置为 10A。
3. 将第二个电源电压设置为 14.5V，将电流限制设置为 10A。
4. 在端子 J2-2 和 J2-1 之间接入 25Ω 的电阻负载。
5. 将第一个电源正极端子连接到 J3-2，负极端子连接到 J3-1，开启第一个电源，确认 VOUT 对地电压为 12V 电压。
6. 使用第二个电源通过二极管在 VOUT 处施加 14.5V 电压。

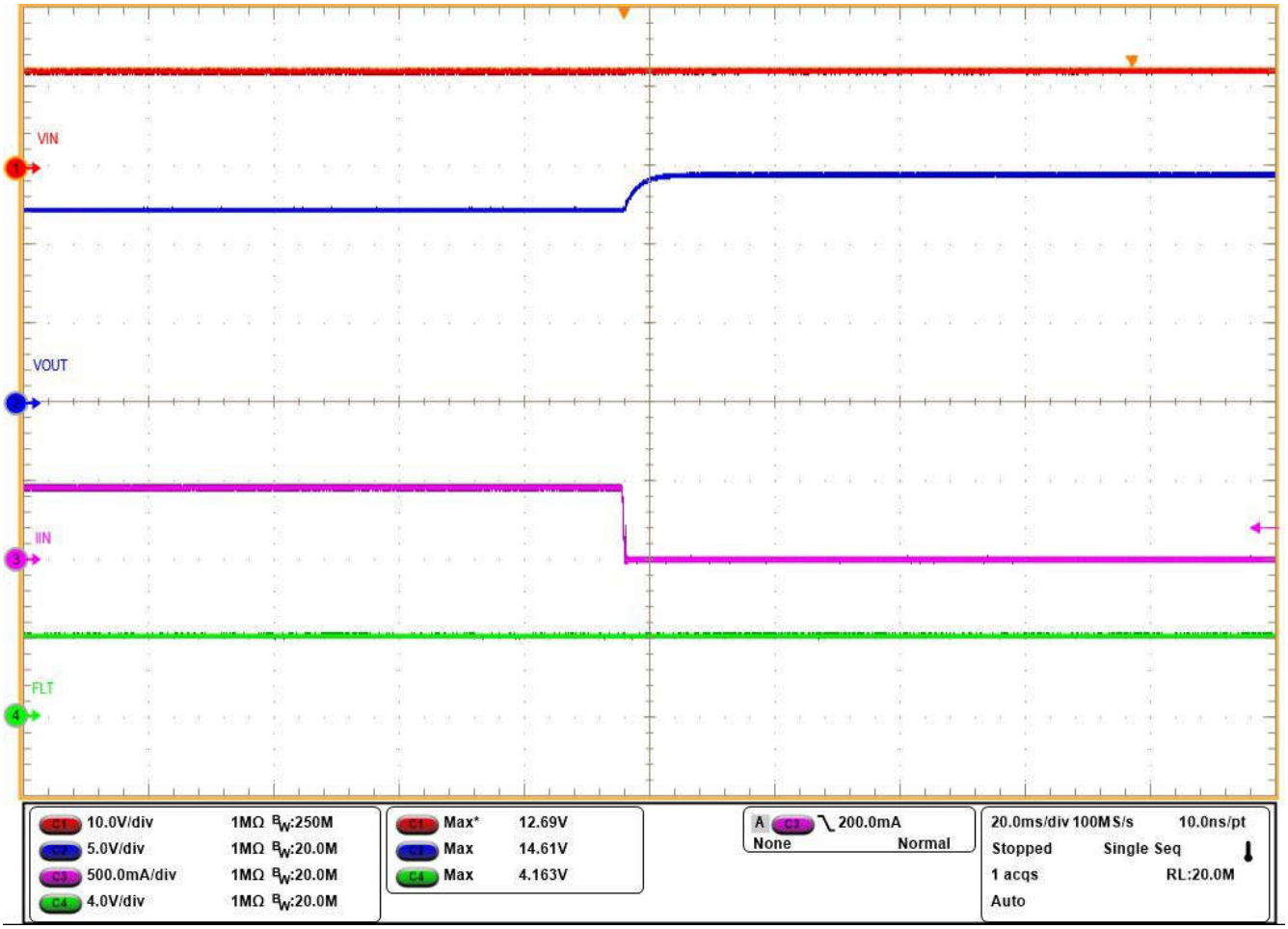


图 3-4. LM7311 的反向电流阻断测试响应

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3.1.4 过压锁定

按照以下说明执行过压保护测试：

1. 确认已按节 3.1 中的说明完成实验的初始设置。
2. 将输入电源电压 VIN1 设置为 12V，将电流限制设置为 10A。在 VIN1（连接器 J3-2）和 PGND（连接器 J3-1）之间施加电源并启用电源。
3. 将输入电源 VIN1 从 12V 增加到 25V。使用示波器观察波形。

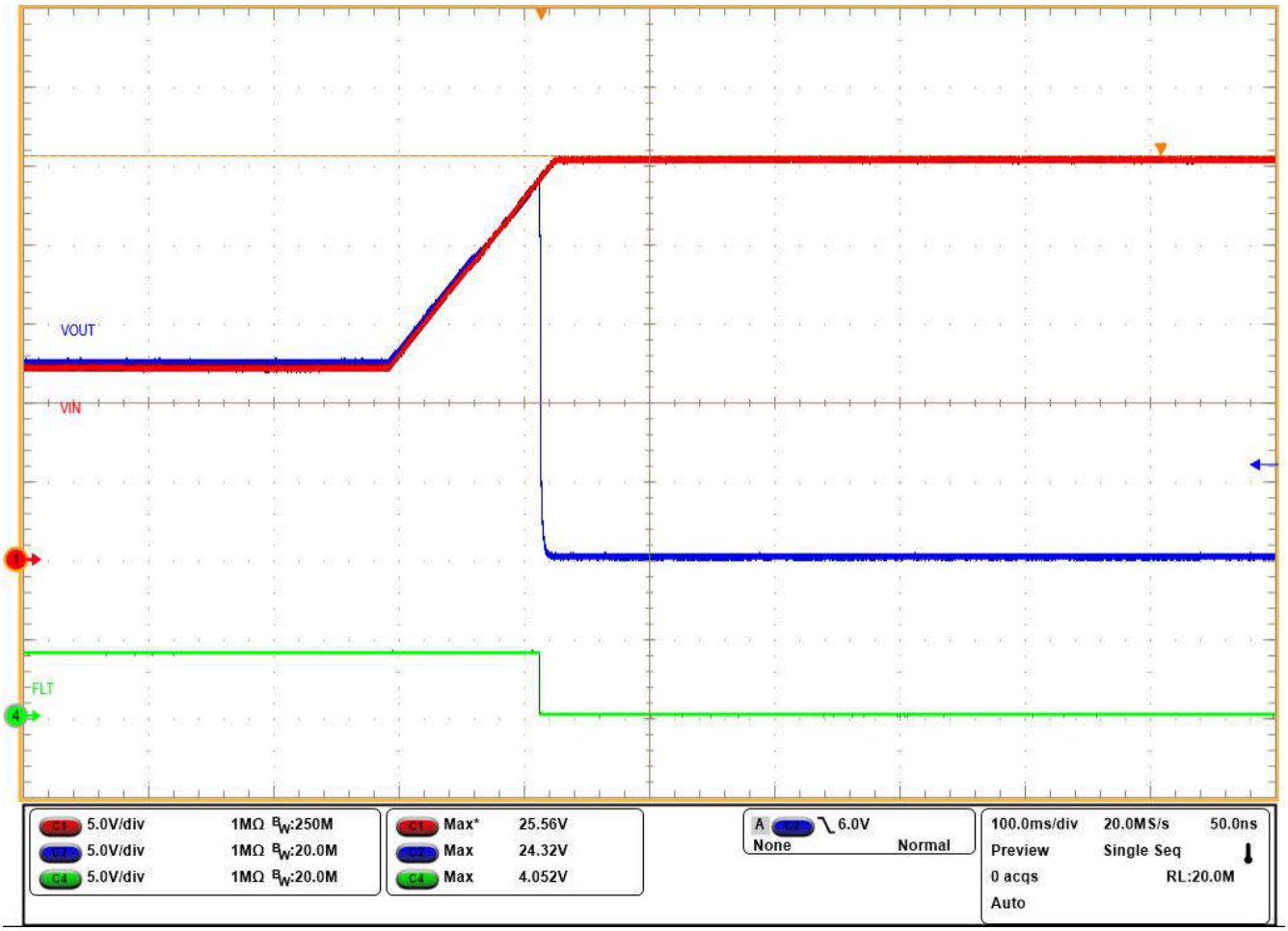


图 3-5. LM7311 电子保险丝的过压锁定响应

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3.1.5 IMON 引脚测试

按照以下说明在 LM7320 电子保险丝上执行输入热插拔测试：

1. 确认已按节 3.1 中的说明完成实验的初始设置。
2. 在跳线 J5 位置，如表 2-3 所详述将压摆率配置为所需启动值。
3. 将电源的负极端子连接到连接器 J3-1。
4. 将输入电源电压设置为 12V，将电流限制设置为 10A。
5. 将电源的正极端子连接到连接器 J3-2。启用电源。
6. 在输出端连接 10Ω 的电阻负载。
7. 在整个测试过程中，使用示波器观察 IMON(TP10)、VIN(TP2)、VOUT(TP1) 和输入电流的波形。

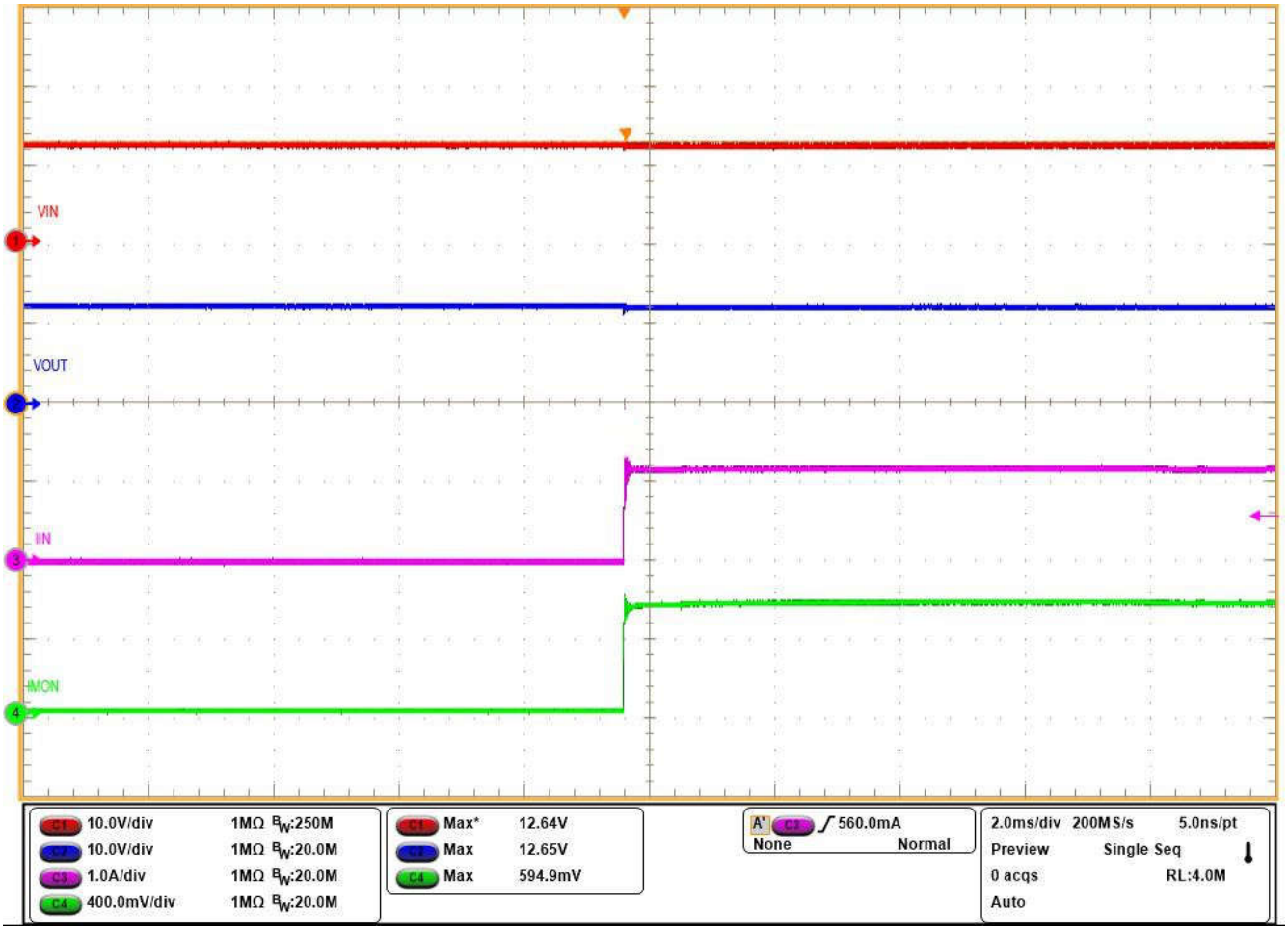


图 3-6. LM7311 的 IMON 引脚测试

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3.1.6 输出热短路

按照以下说明执行输出热短路测试：

1. 确认已按节 3.1 中的说明完成实验的初始设置。
2. 将输入电源电压 VIN1 设置为 12V，并在 VIN1（连接器 J3-2）和 PGND（连接器 J3-1）之间连接电源。
3. 打开电源，为 EVM 上电。
4. 例如，通过一根短电缆将器件的输出端 VOUT1（连接器 J2-1）短接到 PGND（连接器 J2-2）。
5. 使用示波器观察波形。

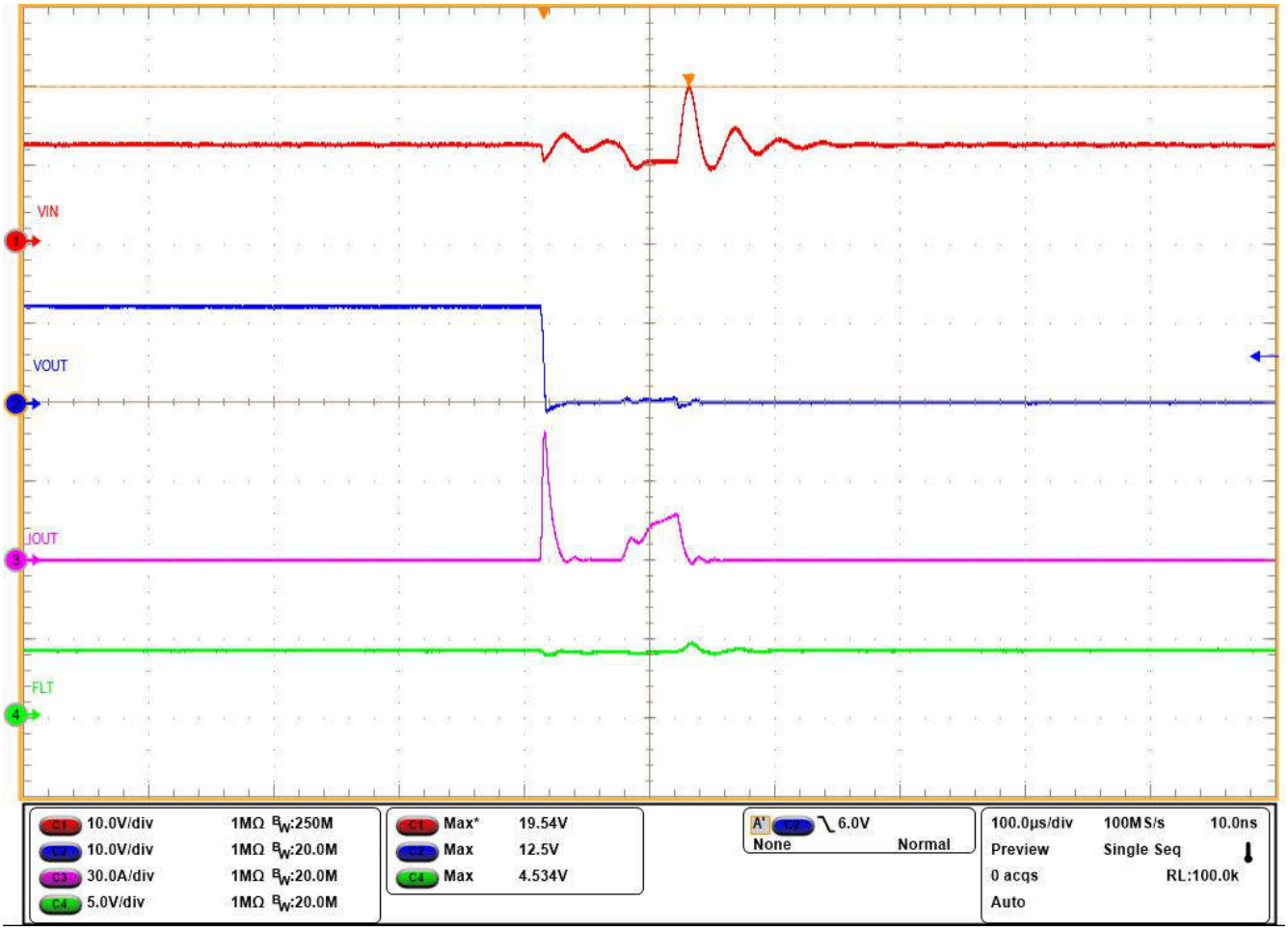


图 3-7. LM7311 的输出热短路响应

备注

验证有足够的输入电容器来消除输入端的电压突降。最好结合电解电容器和陶瓷电容器。使用这些电容器，可以在短路期间在短时间内提供大电流。

获得可重复和相似的短路测试结果可能会很困难。以下因素会导致结果变化：

- 源旁路
- 输入引线
- 电路板布局布线
- 组件选择
- 输出短路方法
- 短路的相对位置
- 仪表

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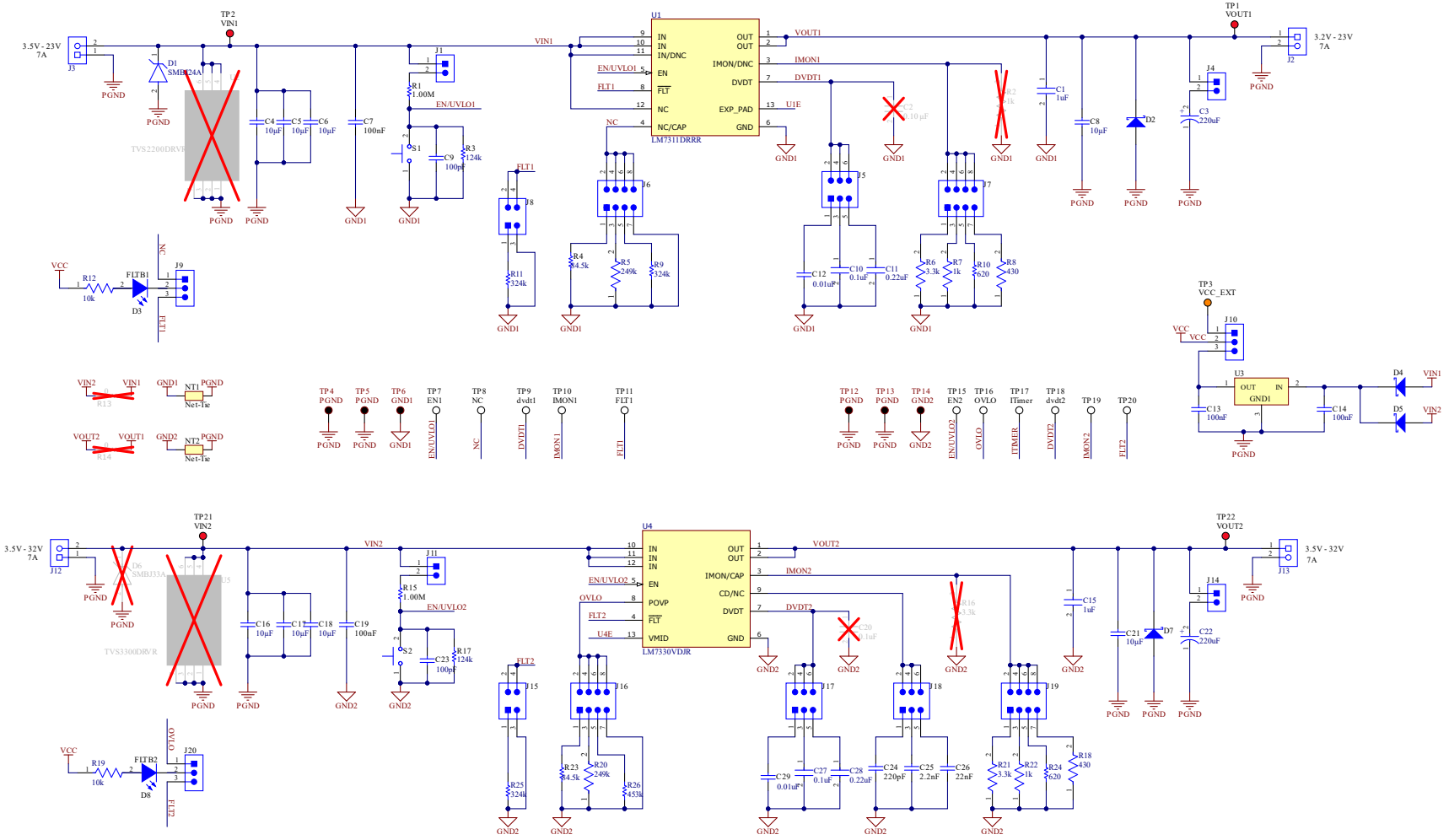
实际短路呈现出一定程度的随机性，因为短路在微观上会弹跳和形成电弧。验证使用适当的配置和方法来获得真实的结果。因此，不要期望看到与本用户指南中的波形完全相同的波形，因为每个设置都不同。

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4 硬件设计文件

4.1 原理图

图 4-1 显示了 EVM 原理图。



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4.2 PCB 图

图 4-2 和图 4-3 展示了 EVM 的元件放置方式。

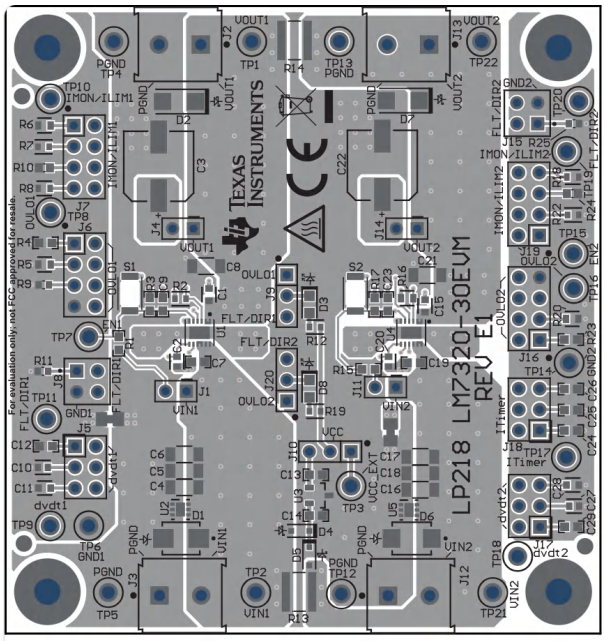


图 4-2. LM7320-30EVM 电路板：顶层组件

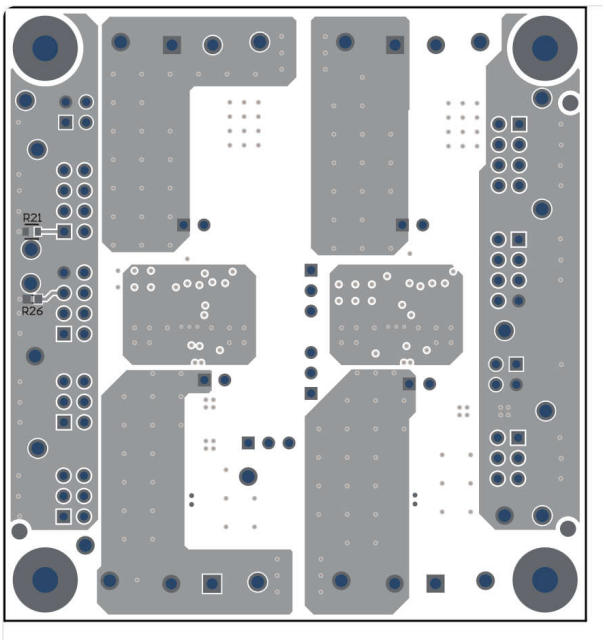


图 4-3. LM7320-30EVM 电路板：底层组件

备注

模拟信号网络（如 IMON、DVDT）的布线必须尽可能远离电源网络（如 VIN、VOUT 和 PGND）。

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4.3 物料清单 (BOM)

表 4-1 列出了 EVM BOM

表 4-1. 物料清单

指示符	数量	值	说明	封装	器件型号	制造商	备注
!PCB1	1		印刷电路板		LP218	不限	
C1, C15	2		电容，陶瓷，1UF，50V，X7R，0603	FP-CC0603-DB-MFG	CL10B105KB9VPJC		
C3、C22	2		电容，铝，220UF，20%，50V，SMD	FP-FTF-MFG			
C4、C5、C6、C8、C16、C17、C18、C21	8	10uF	电容，陶瓷，10µF，50V，±10%，X7R，AEC-Q200 1 级，1206	1206_190	CGA5L1X7R1H106K160AC	TDK	
C7、C19	2	0.1uF	电容，陶瓷，0.1µF，50V，±10%，X7R，0603	0603	C1608X7R1H104K080AA	TDK	
C9、C23	2	100pF	电容，陶瓷，100pF，50V，±5%，C0G/NP0，0603	0603	885012006057	Wurth Elektronik	
C10、C27	2	0.10 µ F	电容，陶瓷，0.1UF，50V，X7R，0603	FP-C0603C-CF-MFG	C0603C104K5RACTU	KEMET	
C11、C28	2	220nF	0.22µF，50V，陶瓷电容器，X7R 0603（公制 1608），0.063" 长 × 0.031" 宽 (1.60mm × 0.80mm)	FP-CC0603-DA-MFG	CC0603KRX7R9BB224	YAGEO	
C12、C29	2	0.01uF	电容，陶瓷，0.01uF，50V，±5%，C0G/NP0，0603	0603	GRM1885C1H103JA01D	MuRata	
C13、C14	2	0.1uF	电容，陶瓷，0.1µF，50V，±10%，X7R，0603	0603	06035C104KAT2A	AVX	
C24	1	220pF	电容，陶瓷，220pF，50V，±10%，X7R，0603	0603	C0603C221K5RACTU	Kemet	
C25	1	2200pF	电容，陶瓷，2200pF，50V，±10%，X7R，0603	0603	C0603C222K5RAC	Kemet	
C26	1	0.022uF	电容，陶瓷，0.022uF，50V，±10%，X7R，0603	0603	C0603X223K5RACTU	Kemet	

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表 4-1. 物料清单（续）

指示符	数量	值	说明	封装	器件型号	制造商	备注
D1	1		TVS 二极管，24V，38.9V SMB	FP-SMB-MFG	SMBJ24A	Diodes Inc	
D2、D7	2	30V	二极管，肖特基，30V，3A，SMA	SMA	B330A-13F	Diodes Inc.	
D3	1	FLTB1	LED，红色，SMD	LED_LTST-C170_Red	LTST-C170KRKT	Lite-On	
D4、D5	2	30V	二极管，肖特基，30V，0.2A，SOD-323	SOD-323	BAT54WS-7F	Diodes Inc.	
D6	1		TVS 二极管，33V，53.3V，DO214AA	FP-SMBJ-MFG	SMBJ33A	Littelfuse Inc	DNL
D8	1	FLTB2	LED，红色，SMD	LED_LTST-C170_Red	LTST-C170KRKT	Lite-On	
H1、H2、H3、H4	4		机械螺钉，圆头，#4-40 x 1/4，尼龙，飞利浦盘形头	NY PMS 440 0025 PH	NY PMS 440 0025 PH	B&F Fastener Supply	
H5、H6、H7、H8	4		六角螺柱，0.5"L #4-40，尼龙	Keystone_1902C	1902C	Keystone	
J1、J4、J11、J14	4		接头，100mil，2x1，锡，TH	CONN_PEC02SAAN	PEC02SAAN	Sullins Connector Solutions	
J2、J3、J12、J13	4		端子块，2x1，5.08mm，TH	TEC_282841-2	282841-2	TE Connectivity	
J5、J17、J18	3		接头，100mil，3x2，锡，TH	SULLINS_PEC03DAAN	PEC03DAAN	Sullins Connector Solutions	
J6、J7、J16、J19	4		接头，100mil，4x2，锡，TH	CONN_PEC04DAAN	PEC04DAAN	Sullins Connector Solutions	
J8、J15	2		接头，100mil，2x2，锡，TH	Sullins_PEC02DAAN	PEC02DAAN	Sullins Connector Solutions	
J9、J10、J20	3		接头，100mil，3x1，锡，TH	CONN_PEC03SAAN	PEC03SAAN	Sullins Connector Solutions	
R1、R15	2	1.00Meg	电阻，1.00M，1%，0.1W，0603	0603	RC0603FR-071ML	Yageo America	
R3、R17	2	124k	电阻，124k，1%，0.1W，AEC-Q200 0 级，0603	0603	CRCW0603124KFKEA	Vishay-Dale	
R4、R23	2	84.5k	电阻，84.5k，1%，0.1W，0603	0603	RC0603FR-0784K5L	Yageo	
R5、R20	2		249k	Vishay_CRCW0603e3_MFG	CRCW0603249KFKEA	Vishay Dale	

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表 4-1. 物料清单（续）

指示符	数量	值	说明	封装	器件型号	制造商	备注
R6、R21	2		电阻厚膜，3.3kΩ，1%，0.33W，100ppm/°C，0603	FP-CRCW0603-HPe3-MFG	CRCW06033K30FKEA	Vishay Dale	
R7、R22	2		电阻，1KΩ，1%，1/10W，0603	FP-RC0603-0_55-IPC_C	RMCF0603FT1K00	Stackpole Electronics Inc	
R8、R18	2		430Ω ±5% 0.1W 0603 厚膜片上电阻，符合 AEC-Q200 标准	FP-RMCF0603-MFG	RMCF0603FT430R	Stackpole Electronics Inc	
R9、R11、R25	3			RESC1608X55X30LL15T15	ERJ-3EKF3243V	Panasonic	
R10、R24	2			RESC1609X50X30ML10T20	CRCW0603620RFKEA	Vishay Dale	
R12、R19	2		电阻，10KΩ，1%，1/10W，0603	FP-RC0603-0_55-IPC_C	RC0603FR-0710KL	YAGEO	
R26	1			RESC1608X55X30ML15T15	ERJ-3EKF4533V	Panasonic	
S1、S2	2		开关，SPST-NO，0.05A，12VDC，SMT	SW_SKRKAE	SKRKAEE020	Alps	
SH-J1、SH-J2、SH-J3、SH-J4、SH-J5、SH-J6、SH-J7、SH-J8、SH-J9、SH-J10、SH-J11、SH-J12、SH-J13、SH-J14、SH-J15、SH-J16	16	1x2	分流器，100mil，镀金，黑色	SPC02SYAN	SPC02SYAN	Sullins Connector Solutions	SH-J1-（J1-引脚 1、2），SH-J2-（J20-引脚 2、3），SH-J3-（J18-引脚 5、6），SH-J4-（J4-引脚 1、2），SH-J5-（J5-引脚 3、4），SH-J6-（J6-引脚 7、8），SH-J7-（J7-引脚 3、4），SH-J8-（J8-引脚 3、4），SH-J9-（J9-引脚 2、3），SH-J10-（J10-引脚 2、3），SH-J11-（J11-引脚 1、2），SH-J12-（J17-引脚 3、4），SH-J13-（J19-引脚 3、4），SH-J14-（J14-引脚 1、2），SH-J15-（J15-引脚 3、4），SH-J16-（J16-引脚 7、8）
TP1、TP2、TP21、TP22	4		测试点，多用途，红色，TH	Keystone5010	5010	Keystone	

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表 4-1. 物料清单（续）

指示符	数量	值	说明	封装	器件型号	制造商	备注
TP3	1		测试点，通用，橙色，TH	Keystone5013	5013	Keystone	
TP4、TP5、TP6、TP12、TP13、TP14	6		PC 测试点，通用，黑色	Keystone5011	5011	Keystone	
TP7、TP8、TP9、TP10、TP11、TP15、TP16、TP17、TP18、TP19、TP20	11		测试点，通用，白色，TH	Keystone5012	5012	Keystone	
U1	1		LM7311DRRR	DRR0012H-MFG	LM7311DRRR	德州仪器 (TI)	
U3	1		100mA 准低压降线性稳压器，3 引脚 SOT-23，无铅	DBZ0003A_N	LM3480IM3-3.3/NOPB	德州仪器 (TI)	
C2、C20	2	0.10 µ F	电容，陶瓷，0.1UF，50V，X7R，0603	FP-C0603C-CF-MFG	C0603C104K5RACTU	KEMET	DNL
R2	1		电阻，1KΩ，1%，1/10W，0603	FP-RC0603-0_55-IPC_C	RMCF0603FT1K00	Stackpole Electronics Inc	DNL
R13、R14	2	0	0Ω 宽体跳线片式电阻，1812（公制 4532），1218 防潮厚膜	FP-RC1218JK-070RL_1218-MFG	RC1218JK-070RL	Yageo	DNL
R16	1		电阻厚膜，3.3kΩ，1%，0.33W，100ppm/°C，0603	FP-CRCW0603-HPe3-MFG	CRCW06033K30FKEA	Vishay Dale	DNL
U2	1		22V 精密浪涌保护钳位器，DRV0006A (WSON-6)	DRV0006A	TVS2200DRVR	德州仪器 (TI)	DNL
U4	1		LM7330VDJR	VDJ0012A-MFG	LM7330VDJR	德州仪器 (TI)	
U5	1		33V 精密浪涌保护钳位器，DRV0006A (WSON-6)	DRV0006A	TVS3300DRVR	德州仪器 (TI)	DNL

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5 其他信息

5.1 商标

所有商标均为其各自所有者的财产。

6 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 Revision * (August 2026) to Revision A (October 2026)	Page
• 将 LM7320 更改为 LM7311，用于评估 12V（典型值）和 5A（稳定状态）设计	1
• 添加了 LM7320 评估信息	1
• 删除了 LM7311DRRR 信息	1
• 更新了电路板图像。	1
• 添加了最大持续电流特性信息	2
• 删除了集成智能浪涌钳位特性信息	2
• 添加了 IEC62368-3 特性信息	2
• 已更改，以合并短路保护信息	2
• 从表 1-3 中删除了最大输出电容和输出电压压摆率参数	2
• 删除了说明中的第四步和第五步	6
• 添加了第三步	7
• 删除了第五步中的电子负载和输出信息	7
• 将第七步中的 EN1(TP7) 更改为 FLT1(TP11)	7
• 删除了第二步	8
• 整个测试过程中的 15V 已改为 14V	9
• 添加了第四步	9
• 删除了上一版本的第六步	9
• 输入电源 VIN1 的最大值已从 24V 更改为 25V	10
• 更新了第六步	11
• 删除了上一版本的第二步	12
• 更新了节 4.1 中的图像。	14
• 更新了 节 4.2。	15
• 更新了 节 4.3。	16

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STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

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

2 *Limited Warranty and Related Remedies/Disclaimers*:

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

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

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

WARNING

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

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

NOTE:

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

3 *Regulatory Notices:*

3.1 *United States*

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

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

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

CAUTION

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

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

FCC Interference Statement for Class A EVM devices

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

FCC Interference Statement for Class B EVM devices

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

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

3.2 *Canada*

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

Concerning EVMs Including Radio Transmitters:

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

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

Concernant les EVMs avec appareils radio:

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

Concerning EVMs Including Detachable Antennas:

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

Concernant les EVMs avec antennes détachables

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

3.3 *Japan*

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

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

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

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

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

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

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

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

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

東京都新宿区西新宿 6 丁目 2 4 番 1 号

西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html

3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

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