

EVM User's Guide: LP-MSPM0L2117

MSPM0L2117 评估模块



说明

LP-MSPM0L2117 LaunchPad™ 开发套件是适用于 MSPM0L2117 微控制器 (MCU) 的易于使用的评估模块。LaunchPad 套件包含 MSPM0L211x 和 MSPM0L112x 微控制器平台上开始开发所需要的全部资源，包括用于编程、调试和 EnergyTrace™ 技术的板载调试探针。该板还具有多个板载按钮、多个 LED、一个 RGB LED 和一个 LCD 面板。

MSPM0L2117 是一款 32 位 Arm® Cortex® M0+ CPU，频率高达 32MHz。该器件具有 128KB 闪存和 12KB SRAM。该器件还具有内部模拟功能，例如内部 ADC、电压基准和具有 8 位 DAC 的比较器。MSPM0L2117 是第二款具有 LCD 控制器的 MSPM0 器件，可支持 1 至 8 路复用器 LCD 面板。

开始使用

1. 从 ti.com 订购 [LP-MSPM0L2117](#)。
2. 转到 dev.ti.com 浏览代码示例。
3. 使用提供的 USB 电缆将 MSPM0L2117 插入 PC。
4. 使用 CCS Cloud 将代码直接从浏览器下载到 MSPM0L2117。

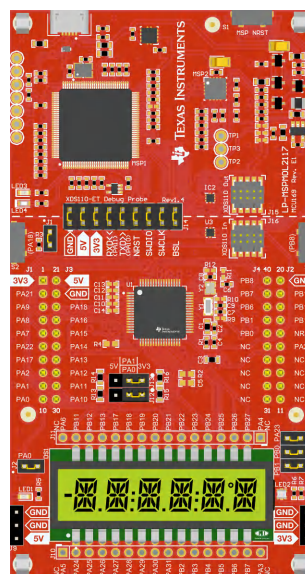
5. 下载用于桌面集成开发环境的 [CCS Theia](#)。
6. 下载用于桌面存储示例、演示和软件库的 [MSPM0 SDK](#)。

特性

- 板载 XDS110 调试探针
- 反向通道 UART，通过 USB 连接到 PC
- USB 供电
- 40 引脚 BoosterPack™ 接头
- 硬件用户界面
 - 两个按钮：1 个 LCD 面板、1 个 RGB LED、1 个红色 LED
- 外部时钟晶体

应用

- 电网基础设施
- 工厂自动化
- 电器
- 医疗和保健
- 测试和测量



LP-MSPM0L2117

1 评估模块概述

1.1 简介

MSPM0L2117 是一款 32 位 Arm® Cortex® -M0+ CPU，具有 LCD 控制器和增强的安全特性。该器件可用于各种任务，从具有 64 引脚的简单通用 MCU 到采用单相电子计量的完整应用级任务。开始使用 MSPM0L2117 的最简单方法是使用 LP-MSPM0L2117 LaunchPad™。该 LaunchPad 具有加载代码、调试和原型设计所需的所有开箱即用功能。

40 引脚 BoosterPack™ 插件模块接头简化了快速原型设计，支持市面上的多种 BoosterPack 插件模块。用户可以快速添加无线连接、图形显示、环境检测等功能。用户还可以设计自己的 BoosterPack 插件模块，或者从 TI 和第三方开发商已提供的众多插件模块中进行选择。

为使原型设计更加轻松，TI 提供了 MSPM0 软件开发套件 (SDK)，该套件包含各种用于演示如何使用内部外设的代码示例。

还提供了免费的软件开发工具，例如 TI 的 [Code Composer Studio™ IDE](#)。我们还支持第三方 IDE，例如 [IAR Embedded Workbench®](#) 和 [Arm® Kiel® µ Vision® IDE](#)。在与 LP-MSPM0L2117 LaunchPad 开发套件配套使用时，Code Composer Studio IDE 支持 [EnergyTrace™](#) 技术。有关 LaunchPad 开发套件、配套 BoosterPack 插件模块和可用资源的更多信息，请访问 [TI LaunchPad™ 开发套件门户](#)。要快速入门并了解 MSPM0 软件开发套件 (SDK) 中的可用资源，请访问 [TI 开发人员专区](#)。MSPM0 MCU 还有各种在线配套资料、[MSPM0 Academy](#) 培训，以及通过 [TI E2E™ 支持论坛](#) 提供的在线支持。

1.2 套件内容

- LP-MSPM0L2117 LaunchPad™ 开发套件
- USB 线缆
- 快速入门指南

1.3 规格

LP-MSPM0L2117 旨在与运行 Mac® (CCS) 的 PC、Linux® 或 Code Composer Studio™ 工作站配合使用。CCS 可以作为独立版本在工作站上运行，也可通过 Web (CCS Cloud) 访问，无需安装软件。此外，LP-MSPM0L2117 附带一个已加载的示例，可以通过 GUI 进行控制。请参阅下面的开箱即用说明。

该器件可以由内置 USB 电源以外的电源供电。此特性允许用户放弃 PC 连接。可直接供电或将电源施加到 3.3V 电源轨。使用外部电源时，不要超过 3.3V。利用板载 Arm® 10 引脚连接器，可以使用单独的 XDS110 外部调试器从外部完成编程。

1.4 器件信息

LP-MSPM0L2117 使用德州仪器 (TI) 的以下器件。

表 1-1. 器件信息

器件名称	说明	用途
MSP432E401YTPDT	具有 以太网™、CAN、1MB 闪存和 256kB RAM 的 SimpleLink™ 32 位 Arm® Cortex® -M4F MCU	XDS110 主机器件
MSPM0L2117SPNAR	具有 32MHz Arm® Cortex® 32 位 M0+ CPU、128kB 闪存和 12kB SRAM 的混合信号微控制器	评估器件
MSP430G2452IRSA16R	具有 16 位 RISC CPU、8kB 闪存和 256B SRAM 的混合信号微控制器	用于 EnergyTrace™ 技术的 DC/DC 控制器
TPD4E004RSER	用于高速数据接口的 4 通道 ESD 保护阵列	通过 USB 连接器保护 MSPM0L2117 免受 ESD 损坏
TPS73533DRBT	500mA、可调节、低静态电流、低噪声、高 PSRR、单路输出 LDO 稳压器	3.3V 电源 XDS110 和 MSPM0L2117
TPS2102DBVR	2.7V 至 4V 电源多路复用器、双输入、单输出电源开关	切换 XDS110 电源

2 硬件

2.1 硬件概述

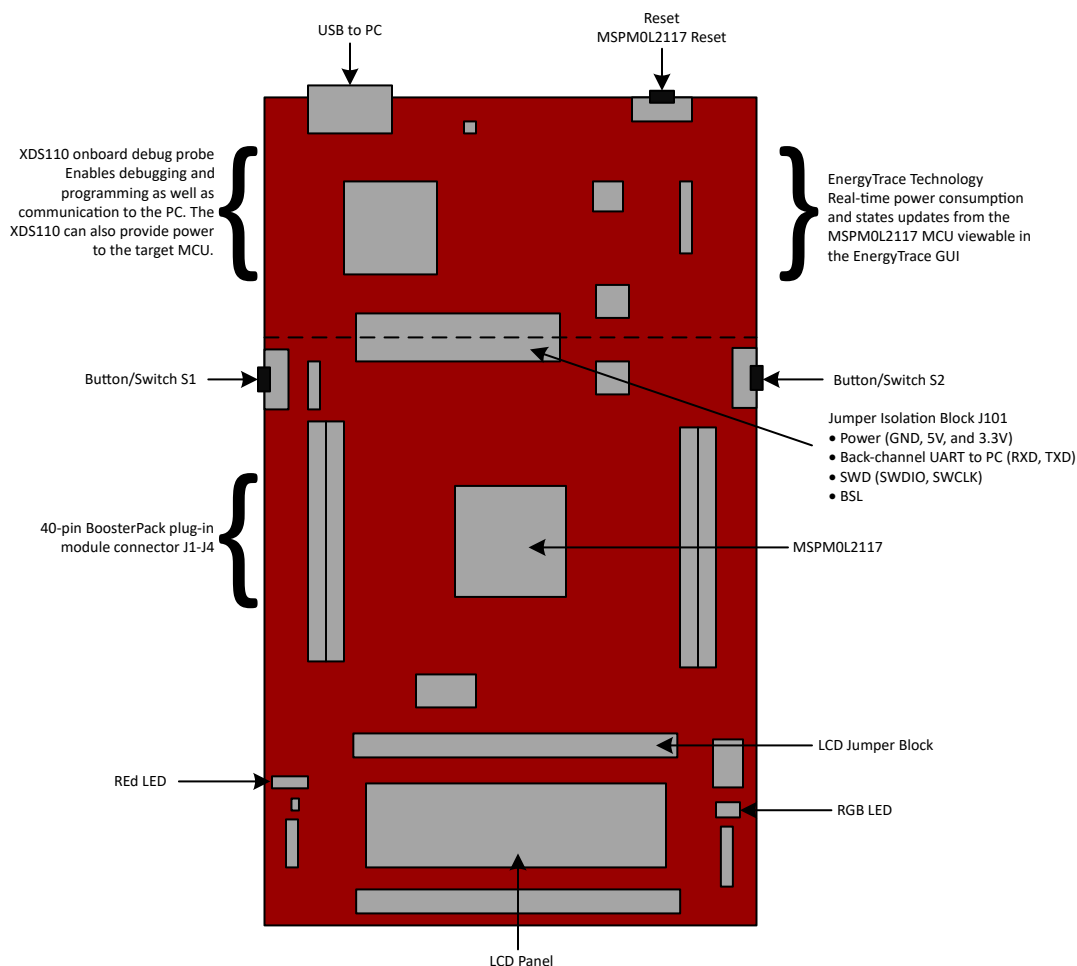


图 2-1. LP-MSPM0L2117 跳线和连接器图

LP-MSPM0L2117 具有许多硬件特性，允许用户完全访问 MSPM0L2117 引脚，同时仍提供板载连接以方便使用。分流连接为用户提供了一种轻松更改 LaunchPad™ 配置的方法。图 2-1 展示了这些分流器的位置。表 2-1 描述了每个分流器的连接。

表 2-1. 跳线信息

跳线	说明	默认设置	连接的信号
J12	漏极开路 I/O 上拉	右侧和中间连接	PA0 : 4.7k 上拉电阻器连接到 5V 或 2.2k 上拉电阻器连接到 3.3V，具体取决于设置
J13	漏极开路 I/O 上拉	右侧和中间连接	PA1 : 4.7k 上拉电阻器连接到 5V 或 2.2k 上拉电阻器连接到 3.3V，具体取决于设置
J2	红色 LED 连接 (LED3)	已组装	通过 LED 和 470 Ω 电阻器连接到 PA0 的 3.3V 电压
J4	RGB 蓝色连接	已组装	PA23 经过 220 Ω 电阻器并将 LED 接地
J5	RGB 红色连接	已组装	PB10 经过 220 Ω 电阻器并将 LED 接地
J6	RGB 绿色连接	已组装	PB9 经过 220 Ω 电阻器并将 LED 接地
J1	BSL 按钮	已组装	PA18 : 47k Ω 下拉电阻器，开关上拉至 3.3V

2.2 电源要求

LP-MSPM0L2117 只需插入 USB 并组装调试器跳线块即可为器件供电。借助板载 LDO，5V USB 电源通过 500mA 电源转换为 3.3V。也可以通过外部电源使用 3.3V 或 5V 接头为 LaunchPad™ 供电。3.3V 轨上的电压不能超过 3.3V，5V 轨上的电压不能超过 5V。

图 2-2 展示了 LP-MSPM0L2117 上的电源连接。

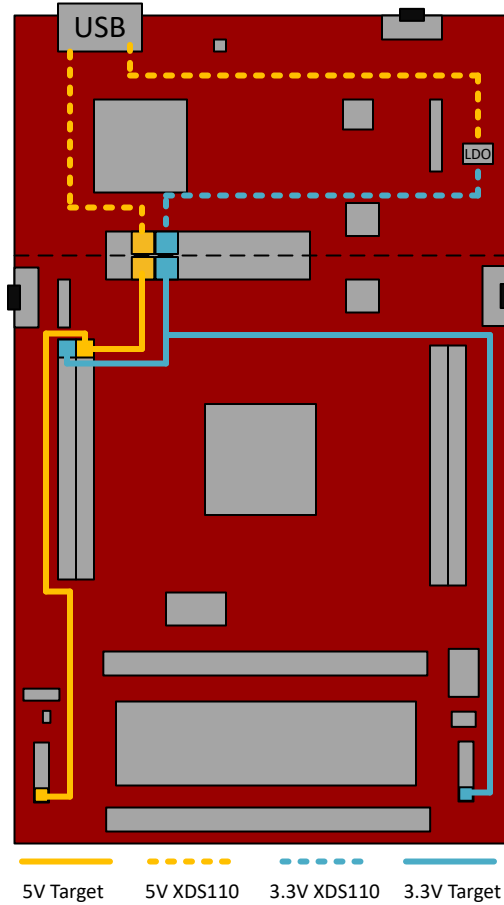


图 2-2. LP-MSPM0L2117 电源连接

2.3 XDS110 调试探针

LP-MSPM0L2117 具有板载调试探针，可简化原型设计。此 LaunchPad™ 上使用的调试器是 XDS110 型号，它支持所有 MSPM0 器件衍生产品。集成式 XDS110 调试探针与 MSPM0L2117 电路的其余部分分离，如 LaunchPad 上的虚线丝印所示。除了公共接地之外，XDS110 只能通过经过 J101 的信号进行连接。

2.3.1 隔离跳线块

利用隔离跳线块 J14，用户可以连接或断开从 XDS110 域进入 MSPM0L2117 目标域的信号。这包括 XDS110 SWD 信号、应用 UART 信号、3.3V 和 5.5V 电源、复位和 BSL 调用源。

表 2-2. 隔离跳线块

跳线	说明
5V	来自 USB 的 5V 电源轨
3V3	来自 LDO 的 3.3V 电源轨
RXD<<	反向通道 UART：目标 MSPM0L2117 通过该信号接收数据。箭头指示信号的方向。
TXD>>	反向通道 UART：目标 MSPM0L2117 通过该信号发送数据。箭头指示信号的方向。
NRST	复位信号
SWDIO	串行线调试：SWDIO 数据信号
SWCLK	串行线调试：SWCLK 时钟信号
BSL	为引导加载程序调用引脚。允许 XDS110 调用 BSL。

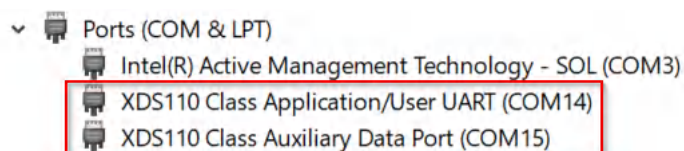
在正常原型设计期间，大多数分流器均已组装。但是，在某些情况下用户需要打开这些连接：

- 完全消除 XDS110 调试探针的影响，以实现高精度目标功率测量
- 控制 XDS110 和目标域之间的 3.3V 和 5V 功率流
- 释放目标 MCU 引脚，用于除板载调试和应用 UART 通信以外的其他目的。
- 提供 XDS110 的编程和 UART 接口，使其可用于板载 MCU 以外的器件。

2.3.2 应用 (反向通道) UART

该反向通道 UART 可实现与 USB 主机进行通信 (不属于目标应用的主要功能)。此特性在开发过程中非常实用，而且还能提供与 PC 主机侧进行通信的通道。这可以用于在与 LaunchPad™ 开发套件通信的 PC 上创建图形用户界面 (GUI) 和其他程序。

在主机侧，当 LaunchPad 开发套件在主机上进行枚举时，将生成一个用于应用反向通道 UART 的虚拟 COM 端口。您可以使用任何与 COM 端口连接的 PC 应用程序 (包括 HyperTerminal™ 或 Docklight™ 等终端应用程序) 来打开该端口并与目标应用程序通信。用户需要找出对应于反向通道的 COM 端口。在使用 Windows® 操作系统的 PC 上，设备管理器可以提供协助。



A. Intel® 是 Intel Corporation 的商标。

图 2-3. 设备管理器中的应用反向通道 UART

反向通道 UART 为 XDS110 Class Application/User UART 端口。此时，图 2-3 展示了 COM14，但该端口可能因主机 PC 而异。确定了正确的 COM 端口后，请根据文档在主机应用中配置该端口。然后，用户可以打开该端口并开始与主机进行通信。

在目标 MSPM0L2117 侧，反向通道 UART 连接到 UART0 (PA10、PA11)。XDS110 具有可配置的波特率；因此，PC 应用程序配置的波特率必须是同一波特率。

2.4 测量 MSPM0L2117 的电流消耗

要使用万用表测量 MSPM0L2117 MCU 的电流消耗，请使用 J101 隔离跳线块上的 3V3 跳线。测量的电流包括目标器件和 LaunchPad™ 电路以及任何通过 BoosterPack™ 插件模块接头消耗的电流。要测量超低功耗，请按照下列步骤操作：

- 拆下 J14 隔离块中的 3V3 跳线，并在该跳线上连接一个电流表。
- 应考虑反向通道 UART 和任何连接到 MSPM0L2117 的电路可能对电流消耗产生的影响。考虑在隔离跳线块上断开这些器件和电路，或者至少在最终测量中考虑灌电流和拉电流能力。
- 确保 MSPM0L2117 上没有悬空输入/输出 (I/O)。这会引起不必要的额外电流消耗。每个 I/O 都会进行驱动，如果 I/O 是输入，则将其拉或驱动至高电平或低电平。
- 开始执行目标。
- 要超准确地测量电流，请将器件置于 *自由运行* 模式，并断开 MSPM0L2117 与电路板调试部分（接头 J14）之间的编程信号。
- 测量电流。请记住，如果电流出现波动，则可能难以获得稳定的测量结果。在静态状态下进行测量会更轻松。

2.5 时钟

内部 SYSOSC 默认为 32MHz（精度为 2.5%）。默认情况下，MCLK 以 32MHz SYSOSC 为源。CPUCLK 在运行模式下直接以 MCLK 为源，在其他模式下禁用。低功耗时钟 (ULPCLK) 可以 MCLK 为源，并通过配置在 *运行* 和 *睡眠* 模式下激活。该器件还包含内部 32kHz 振荡器 LFOSC，这是默认的低频源。该 LaunchPad™ 包含两个时钟晶体选项，即 1 个高频 32MHz 晶体 (HFXT) 和 1 个低频 32.728kHz 晶体 (LFXT)。在应用程序编程期间，可以选择晶体作为高频和低频时钟的时钟源。

有关时钟树的更多详细信息，请参阅 [MSPM0L 系列微控制器技术参考手册](#) 中的 *时钟模块 (CKM)*。

2.6 BoosterPack 插接模块引脚布局

LaunchPad™ 开发套件遵循 40 引脚 LaunchPad 开发套件引脚排列标准（如果引脚可用）。对于 TI 生态系统而言，创建标准旨在帮助实现 LaunchPad 开发套件与 BoosterPack™ 插件模块之间的兼容性。

虽然大多数 BoosterPack 插接模块符合该标准，但仍有些不符合标准。如果 BoosterPack 插件模块的经销商或所有者没有明确指出该模块与 LP-MSPM0L2117 LaunchPad 开发套件的兼容性，请将候选 BoosterPack 插件模块的原理图与 LaunchPad 开发套件进行比较，以验证兼容性。可以通过在软件中更改 MSPM0L2117 器件的引脚功能配置来解决冲突。

2.7 液晶显示器 (LCD)

MSPM0L2117 中包含一个板载 LCD。LCD 由 MSPM0L2117 的内部 LCD 驱动器驱动。LaunchPad™ 包含无源器件，可支持电荷泵或内部电阻梯配置。[图 2-4](#) 展示了 LCD 段布局布线，[表 2-3](#) 展示了 LCD 段映射。

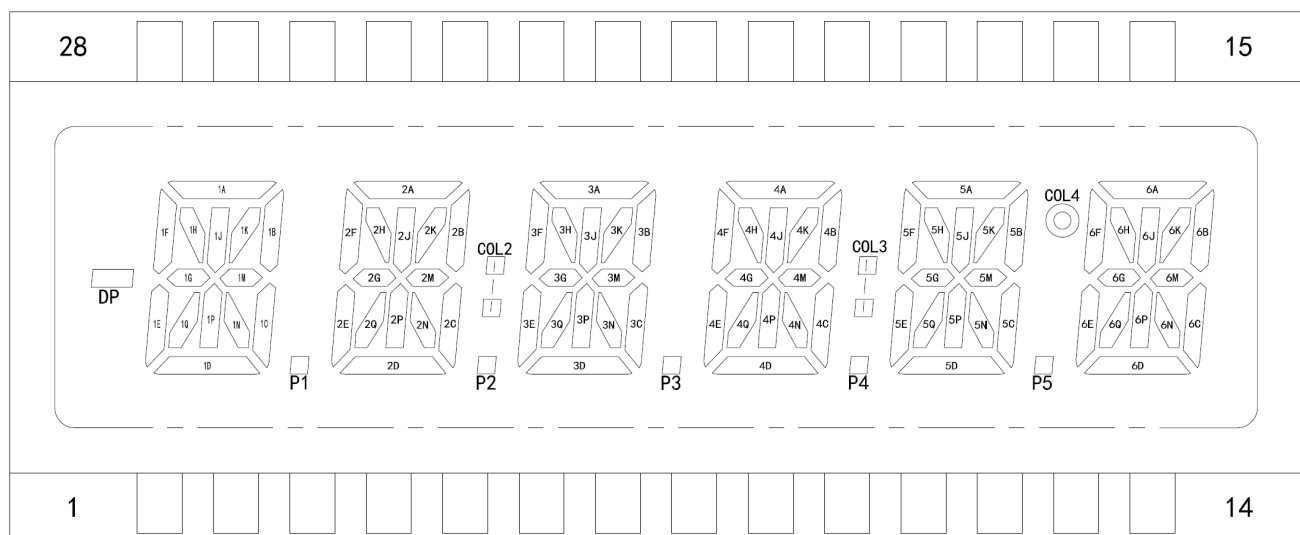


图 2-4. LCD 段布局

表 2-3. LCD 段映射

LP 引脚	引脚功能	LCD 引脚	COM1	COM2	COM3	COM4
PA24	LCD26	1	2D	2E	2F	-
PA25	LCD27	2	2Q	2G	2H	2A
PA26	LCD28	3	2N	2P	2J	2K
PA27	LCD29	4	P2	2C	2M	2B
PA28	LCD30	5	3D	3E	3F	COL2
PA29	LCD31	6	3Q	3G	3H	3A
PA30	LCD32	7	3N	3P	3J	3K
PA31	LCD45	8	P3	3C	3M	3B
PB2	LCD47	9	4D	4E	4F	-
PB3	LCD48	10	4Q	4G	4H	4A
PB4	LCD33	11	COM1	-	-	-
PB5	LCD34	12	-	COM2	-	-
PB9	LCD7	13	-	-	COM3	-
PB10	LCD35	14	-	-	-	COM4
PB27	LCD44	15	-	6C	6M	6B
PB26	LCD43	16	6N	6P	6J	6K
PB25	LCD42	17	6Q	6G	6H	6A
PB24	LCD24	18	6D	6E	6F	COL4
PB23	LCD41	19	P5	5C	5M	5B
PB22	LCD40	20	5N	5P	5J	5K
PB21	LCD39	21	5Q	5G	5H	5A
PB20	LCD23	22	5D	5E	5F	COL3
PB19	LCD20	23	P4	4C	4M	4B
PB18	LCD19	24	4N	4P	4J	4K
PB17	LCD18	25	P1	1C	1M	1B
PB13	LCD38	26	1N	1P	1J	1K
PB12	LCD37	27	1Q	1G	1H	1A
PB11	LCD36	28	1D	1E	1F	DP

3 软件

3.1 软件开发选项

使用 LP-MSPM0L2117 进行原型设计的方法有多种：

1. [CCS Cloud](#) - 选择此选项可快速开始，只需极少的安装。
2. [CCS Theia](#) - 选择此选项可脱机工作并拥有对调试功能的完全访问权限。要开始使用，请参阅 [CCS Theia](#) 文档。

3.2 CCS Cloud

1. 前往 [dev.ti.com](#)。用户需要安装 CCS Cloud Agent。如果尚未安装 CCS Cloud Agent，请按照以下步骤完成安装。
2. 使用 micro-USB 电缆插入 LP-MSPM0L2117。TI 开发人员专区会自动检测 LP-MSPM0L2117 是否已插入。
3. 点击 *Browse software and examples*，这将在新窗口中打开 MSPM0 SDK。
4. 在左侧栏中，转到基于 Arm 的微控制器 > Embedded Software > MSPM0 SDK > Examples > Development Tools > DriverLib > gpio_toggle_output > No RTOS > TI Clang Compiler > gpio_toggle_output。
5. 点击屏幕右上角的 *Import* 按钮。此操作会将工程导入到 CCS Cloud 中并在新窗口中打开。
6. 在 CCS Cloud 中，点击左侧栏中的调试图标以打开调试视图。
7. 点击 *play* 按钮将代码部署到器件并打开调试会话。默认情况下，调试器会暂停第一行代码。
8. 点击蓝色的 *play* 按钮启动应用程序。
9. LP-MSPM0L2117 上的 RGB LED 需要闪烁。

现在，用户可以通过修改代码或导入不同的示例代码来开始原型设计。

4 硬件设计文件

4.1 原理图

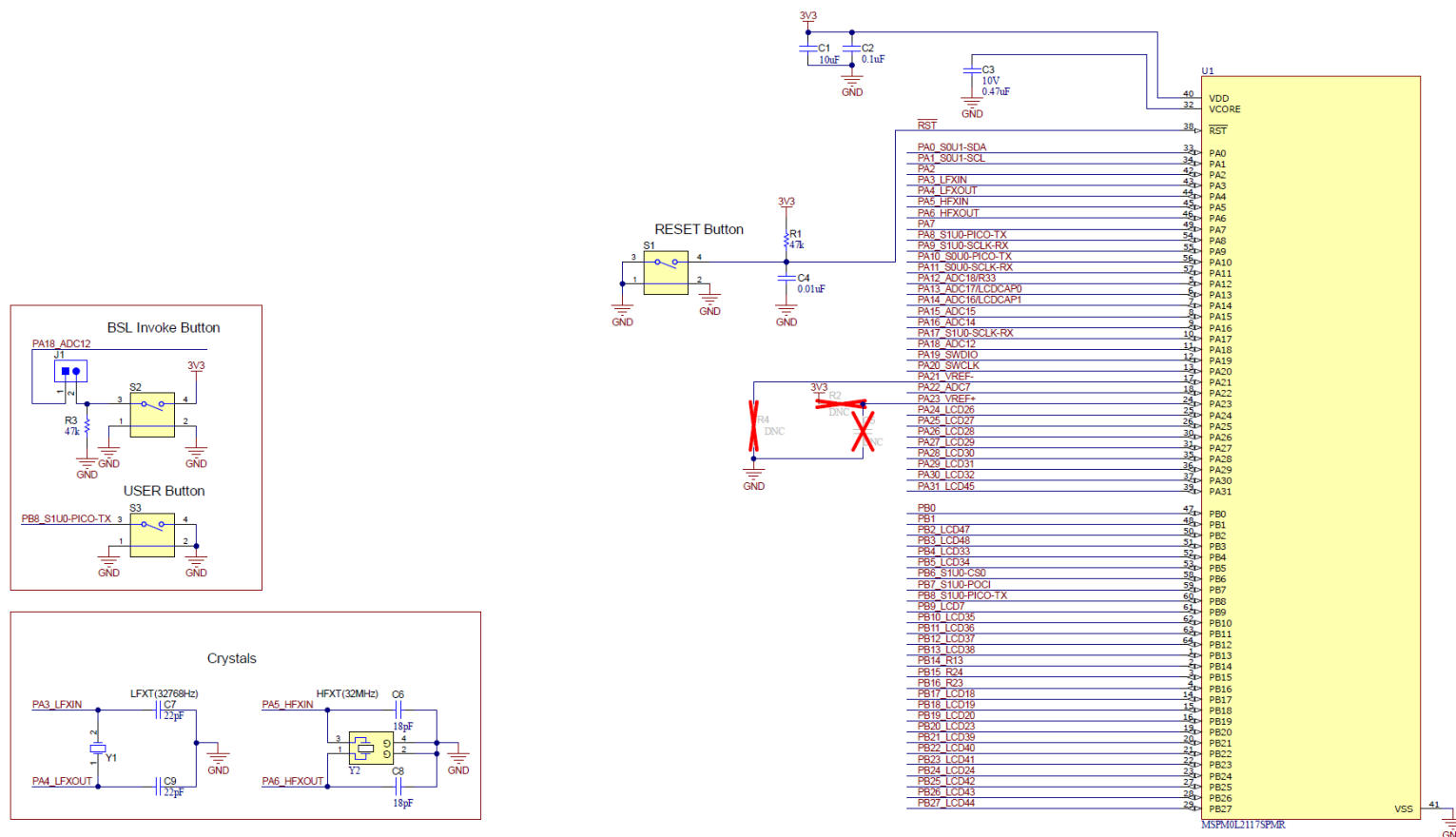
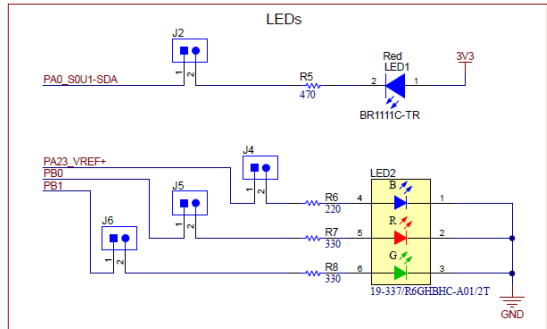
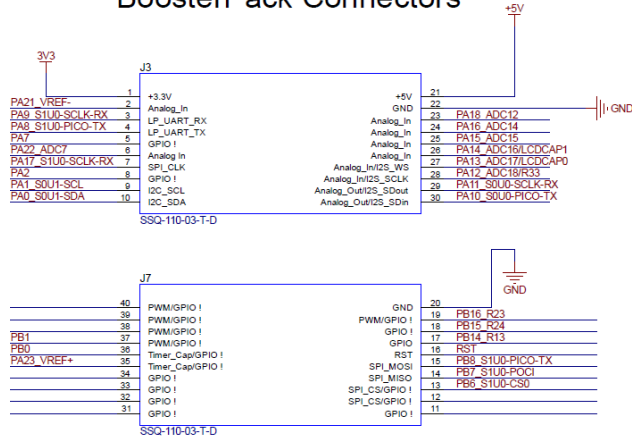


图 4-1. MSPM0L2117 目标器件原理图

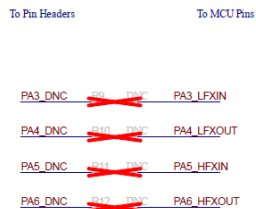
BoosterPack Connectors



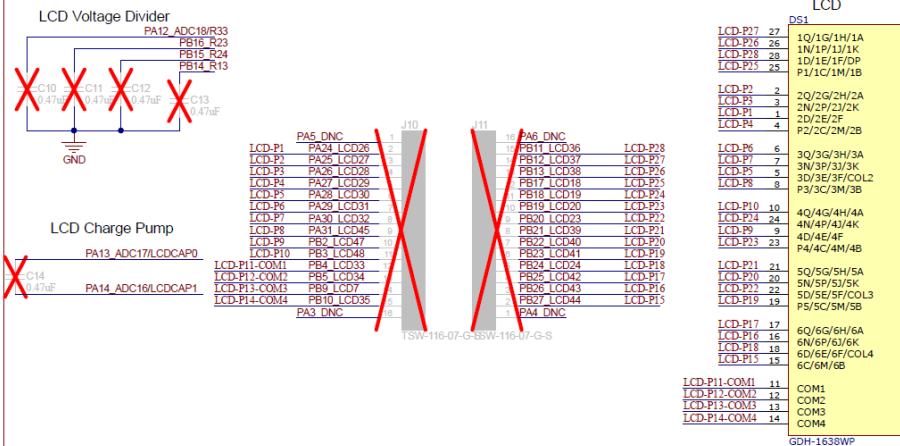
Power Headers



Isolation Resistors for Critical Signals



LCD setting



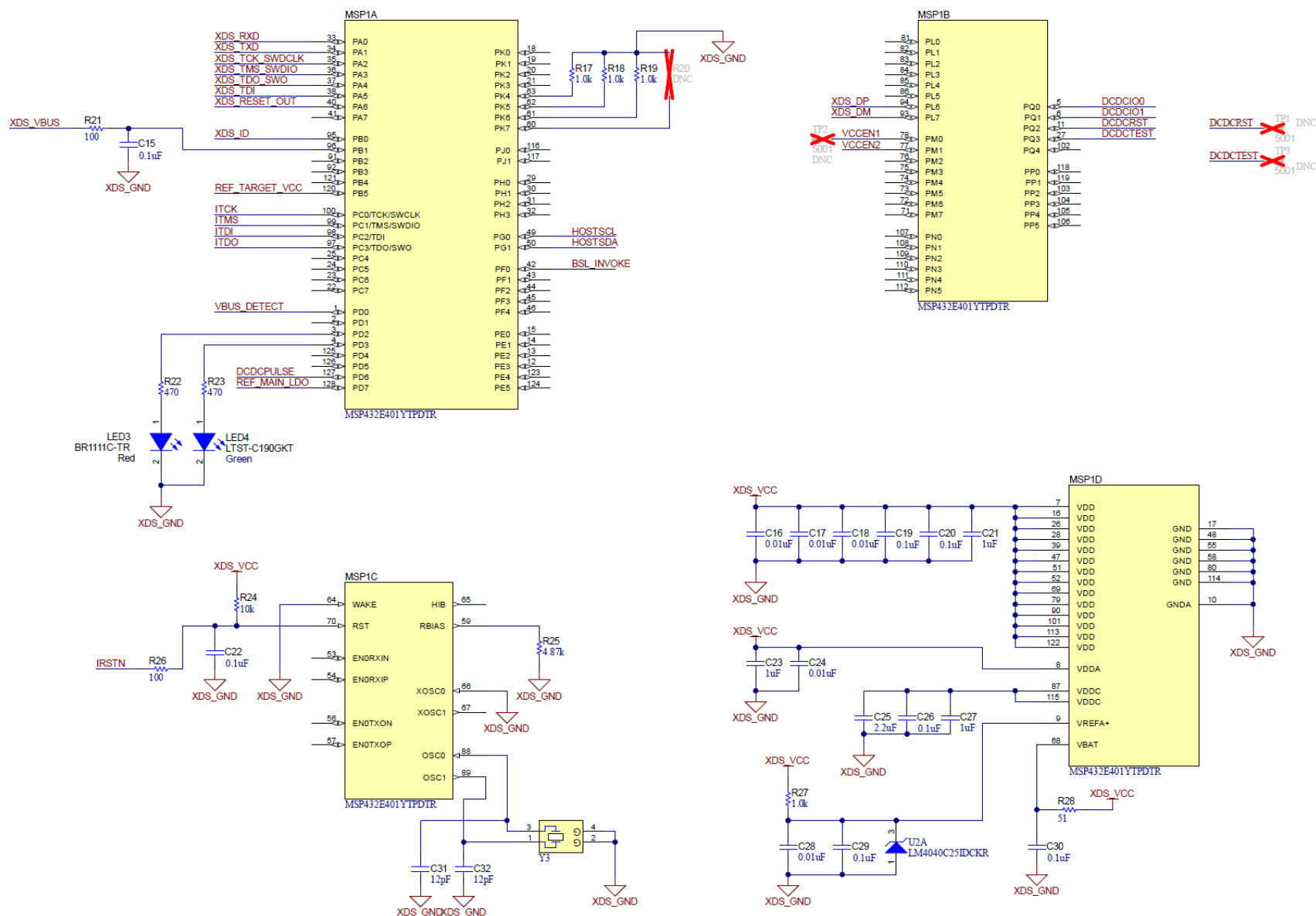


图 4-3. XDS110 调试探针原理图

Software-controlled DCDC converter

Energy measurement method protected under U.S. Patent
Application 13/329,073 and subsequent patent applications

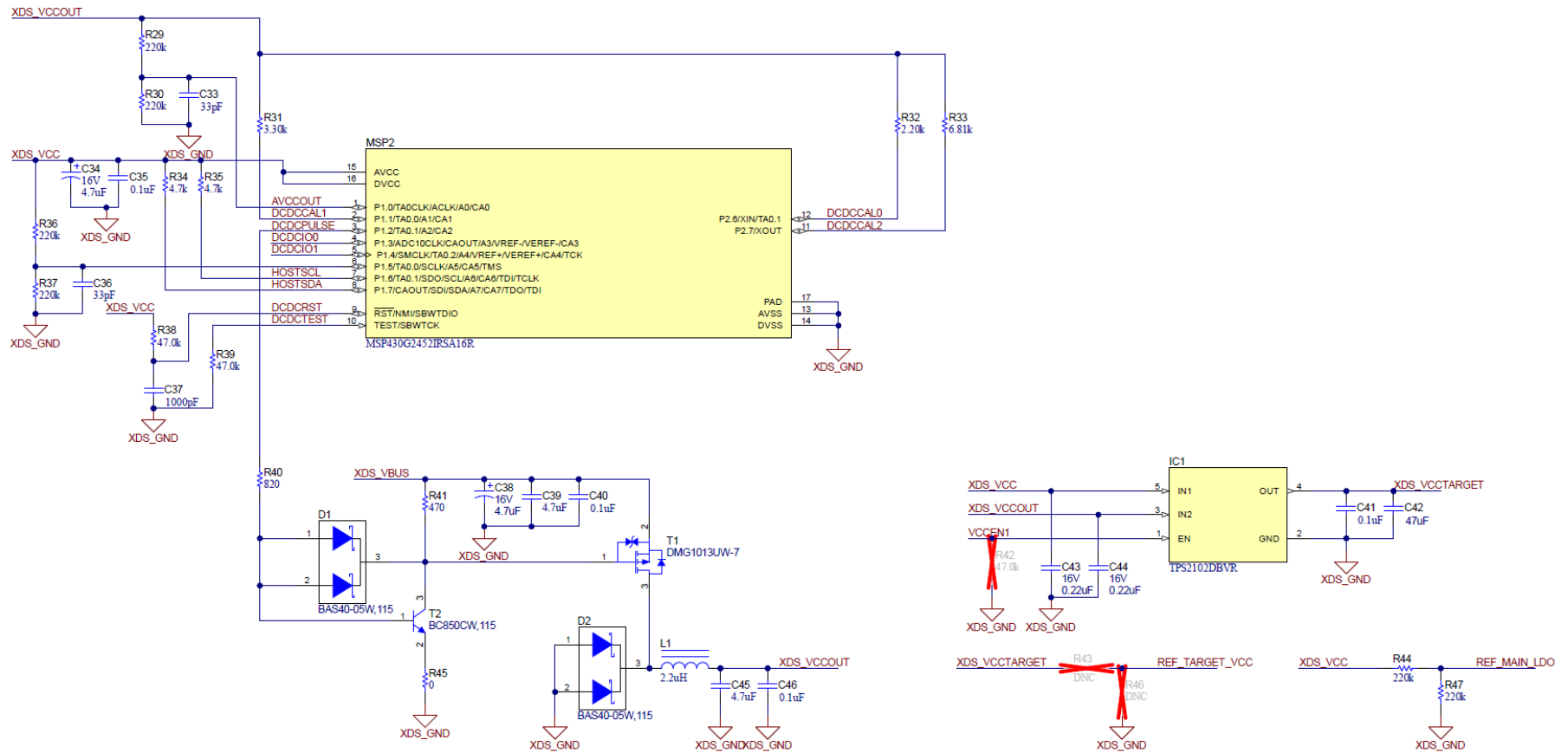


图 4-4. XDS110 EnergyTrace™ 原理图

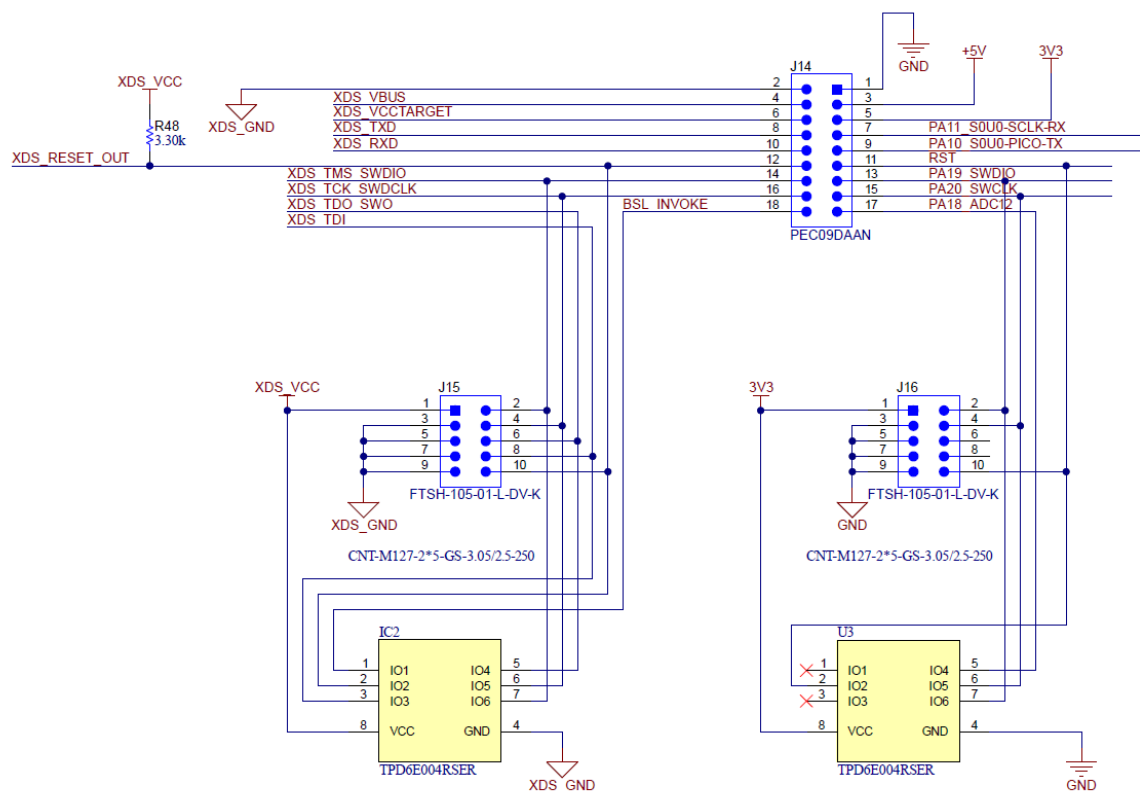


图 4-5. XDS110 目标接口原理图

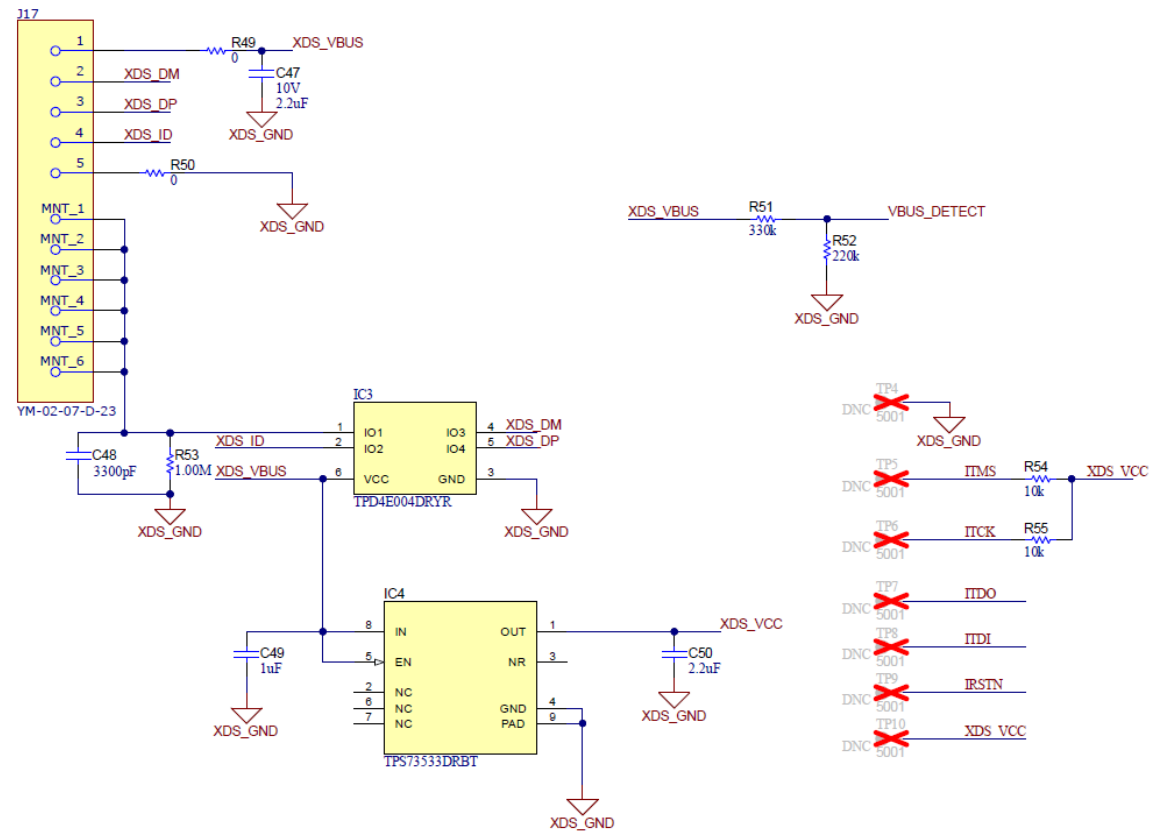


图 4-6. XDS110 USB 电源原理图

4.2 PCB 板层

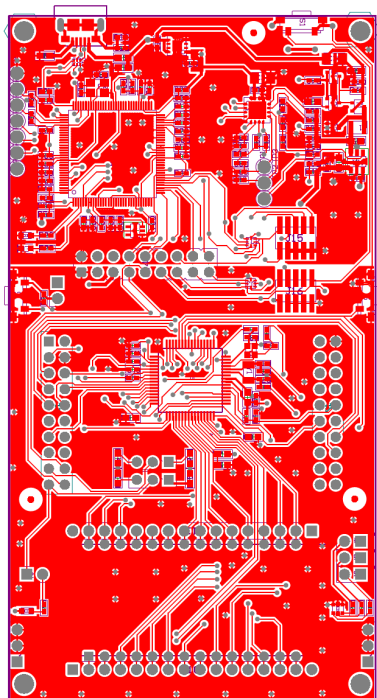


图 4-7. PCB 顶层

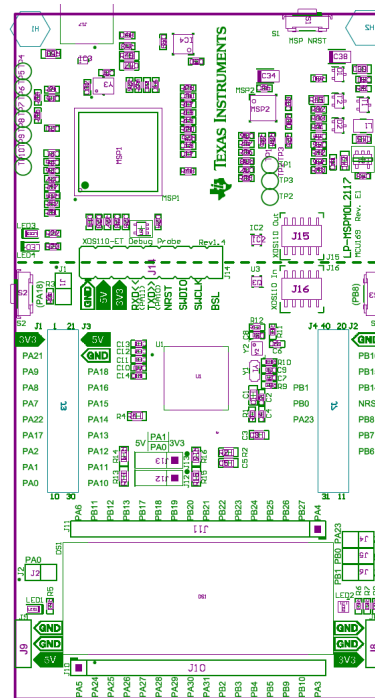


图 4-8. PCB 顶部覆盖层

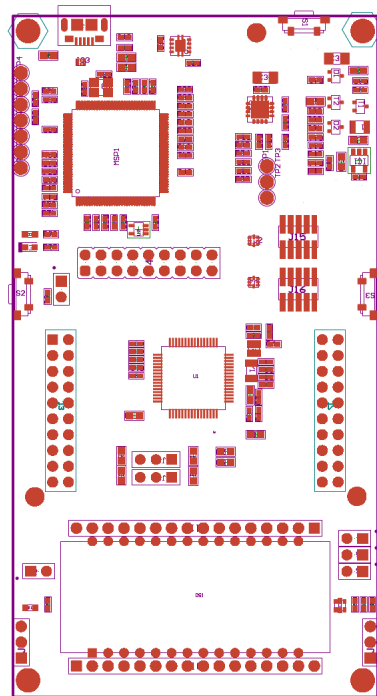


图 4-9. PCB 顶部焊接层

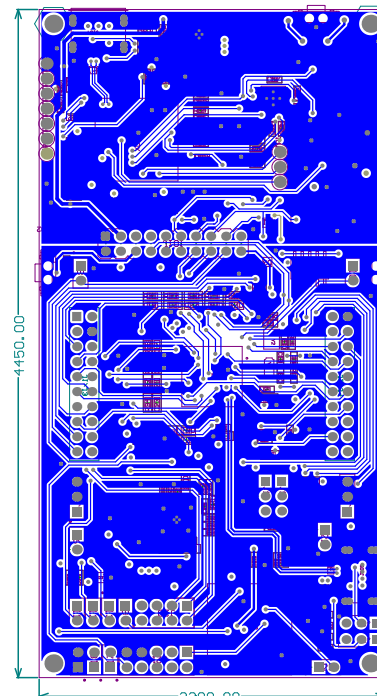


图 4-10. PCB 底层

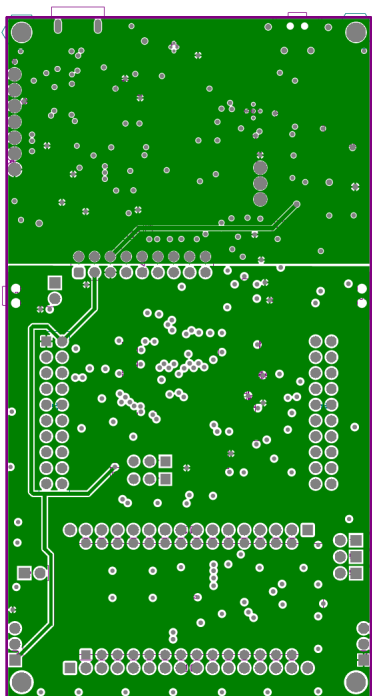


图 4-11. PCB VCC 平面

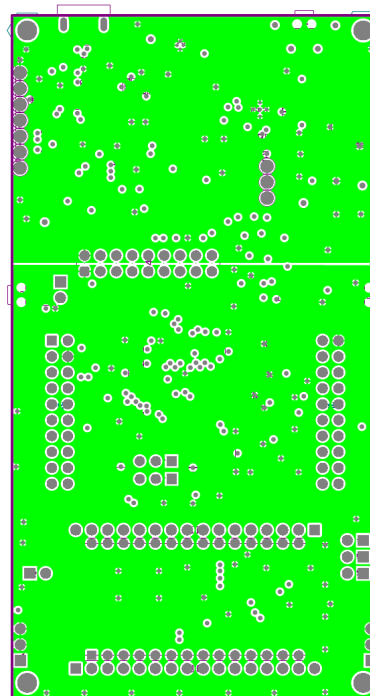


图 4-12. PCB GND 平面

4.3 物料清单 (BOM)

表 4-1. 物料清单

位号	数量	值	说明	器件型号	制造商
!PCB1	1		印刷电路板	MCU128	不限
C1	1	10 μ F	电容, 陶瓷, 10 μ F, 6.3V, $\pm$ 20%, X5R, 0603	GRM188R60J106ME84	MuRata
C2	1	0.1 μ F	电容, 陶瓷, 0.1 μ F, 50V, $\pm$ 20%, X5R, 0402	GRM155R61H104ME14D	MuRata
C3	1	0.47 μ F	电容, 陶瓷, 0.47 μ F, 10V, $\pm$ 10%, X5R, 0603	C0603C474K8PACTU	Kemet
C4	1	0.01 μ F	电容, 陶瓷, 0.01 μ F, 16V, $\pm$ 10%, X5R, 0402	GRM155R61C103KA01D	MuRata
C6	1	18pF	电容, 陶瓷, 18pF, 50V, $\pm$ 5%, C0G/NP0, 0402	CL05C180JB5NNNC	Samsung Electro-Mechanics
C7	1	22pF	电容, 陶瓷, 22pF, 50V, $\pm$ 5%, C0G/NP0, 0402	GRM1555C1H220JA01D	MuRata
C8	1	18pF	电容, 陶瓷, 18pF, 50V, $\pm$ 5%, C0G/NP0, 0402	CL05C180JB5NNNC	Samsung Electro-Mechanics
C9	1	22pF	电容, 陶瓷, 22pF, 50V, $\pm$ 5%, C0G/NP0, 0402	GRM1555C1H220JA01D	MuRata
C15	1	0.1 μ F	电容, 陶瓷, 0.1 μ F, 6.3V, $\pm$ 10%, X7R, 0402	GRM155R70J104KA01D	MuRata
C16	1	0.01 μ F	电容, 陶瓷, 0.01 μ F, 25V, $\pm$ 10%, X7R, 0402	GRM155R71E103KA01D	MuRata
C17	1	0.01 μ F	电容, 陶瓷, 0.01 μ F, 25V, $\pm$ 10%, X7R, 0402	GRM155R71E103KA01D	MuRata
C18	1	0.01 μ F	电容, 陶瓷, 0.01 μ F, 25V, $\pm$ 10%, X7R, 0402	GRM155R71E103KA01D	MuRata
C19	1	0.1 μ F	电容, 陶瓷, 0.1 μ F, 6.3V, $\pm$ 10%, X7R, 0402	GRM155R70J104KA01D	MuRata
C20	1	0.1 μ F	电容, 陶瓷, 0.1 μ F, 6.3V, $\pm$ 10%, X7R, 0402	GRM155R70J104KA01D	MuRata
C21	1	1 μ F	电容, 陶瓷, 1 μ F, 25V, $\pm$ 10%, X5R, 0402	C1005X5R1E105K050BC	TDK
C22	1	0.1 μ F	电容, 陶瓷, 0.1 μ F, 6.3V, $\pm$ 10%, X7R, 0402	GRM155R70J104KA01D	MuRata
C23	1	1 μ F	电容, 陶瓷, 1 μ F, 25V, $\pm$ 10%, X5R, 0402	C1005X5R1E105K050BC	TDK
C24	1	0.01 μ F	电容, 陶瓷, 0.01 μ F, 25V, $\pm$ 10%, X7R, 0402	GRM155R71E103KA01D	MuRata
C25	1	2.2 μ F	电容, 陶瓷, 2.2 μ F, 6.3V, $\pm$ 10%, X5R, 0402	GRM155R60J225KE95D	MuRata
C26	1	0.1 μ F	电容, 陶瓷, 0.1 μ F, 6.3V, $\pm$ 10%, X7R, 0402	GRM155R70J104KA01D	MuRata
C27	1	1 μ F	电容, 陶瓷, 1 μ F, 25V, $\pm$ 10%, X5R, 0402	C1005X5R1E105K050BC	TDK
C28	1	0.01 μ F	电容, 陶瓷, 0.01 μ F, 25V, $\pm$ 10%, X7R, 0402	GRM155R71E103KA01D	MuRata
C29	1	0.1 μ F	电容, 陶瓷, 0.1 μ F, 6.3V, $\pm$ 10%, X7R, 0402	GRM155R70J104KA01D	MuRata
C30	1	0.1 μ F	电容, 陶瓷, 0.1 μ F, 6.3V, $\pm$ 10%, X7R, 0402	GRM155R70J104KA01D	MuRata
C31	1	12pF	电容, 陶瓷, 12pF, 50V, $\pm$ 5%, C0G/NP0, 0402	GRM1555C1H120JA01D	MuRata
C32	1	12pF	电容, 陶瓷, 12pF, 50V, $\pm$ 5%, C0G/NP0, 0402	GRM1555C1H120JA01D	MuRata
C33	1	33pF	电容, 陶瓷, 33pF, 50V, $\pm$ 5%, C0G/NP0, 0402	GRM1555C1H330JA01D	MuRata
C34	1	4.7 μ F	电容, 钽, 4.7 μ F, 16V, $\pm$ 10%, 4 Ω , SMD	TAJA475K016RNJ	AVX

表 4-1. 物料清单 (续)

位号	数量	值	说明	器件型号	制造商
C35	1	0.1 μ F	电容, 陶瓷, 0.1 μ F, 6.3V, $\pm 10\%$, X7R, 0402	GRM155R70J104KA01D	MuRata
C36	1	33pF	电容, 陶瓷, 33pF, 50V, $\pm 5\%$, C0G/NP0, 0402	GRM1555C1H330JA01D	MuRata
C37	1	1000pF	电容, 陶瓷, 1000pF, 50V, $\pm 10\%$, X7R, AEC-Q200 1 级, 0402	GCM155R71H102KA37D	MuRata
C38	1	4.7 μ F	电容, 钽, 4.7 μ F, 16V, $\pm 10\%$, 4 Ω , SMD	TAJA475K016RNJ	AVX
C39	1	4.7 μ F	电容, 陶瓷, 4.7 μ F, 16V, $\pm 10\%$, X5R, 0603	GRM188R61C475KAAJ	MuRata
C40	1	0.1 μ F	电容, 陶瓷, 0.1 μ F, 6.3V, $\pm 10\%$, X7R, 0402	GRM155R70J104KA01D	MuRata
C41	1	0.1 μ F	电容, 陶瓷, 0.1 μ F, 6.3V, $\pm 10\%$, X7R, 0402	GRM155R70J104KA01D	MuRata
C42	1	47 μ F	电容, 陶瓷, 47 μ F, 6.3V, $\pm 20\%$, X5R, 0603	GRM188R60J476ME15D	MuRata
C43	1	0.22 μ F	电容, 陶瓷, 0.22 μ F, 16V, $\pm 10\%$, X7R, 0402	GRM155R71C224KA12D	MuRata
C44	1	0.22 μ F	电容, 陶瓷, 0.22 μ F, 16V, $\pm 10\%$, X7R, 0402	GRM155R71C224KA12D	MuRata
C45	1	4.7 μ F	电容, 陶瓷, 4.7 μ F, 16V, $\pm 10\%$, X5R, 0603	GRM188R61C475KAAJ	MuRata
C46	1	0.1 μ F	电容, 陶瓷, 0.1 μ F, 6.3V, $\pm 10\%$, X7R, 0402	GRM155R70J104KA01D	MuRata
C47	1	2.2 μ F	电容, 陶瓷, 2.2 μ F, 10V, $\pm 10\%$, X5R, 0603	C0603C225K8PACTU	Kemet
C48	1	3300pF	电容, 陶瓷, 3300pF, 50V, $\pm 10\%$, X7R, 0402	GRM155R71H332KA01D	MuRata
C49	1	1 μ F	电容, 陶瓷, 1 μ F, 25V, $\pm 10\%$, X5R, 0402	C1005X5R1E105K050BC	TDK
C50	1	2.2 μ F	电容, 陶瓷, 2.2 μ F, 6.3V, $\pm 10\%$, X5R, 0402	GRM155R60J225KE95D	MuRata
D1	1	40V	二极管, 肖特基, 40V, 0.12A, AEC-Q101, SOT-323	BAS40-05W,115	Nexperia
D2	1	40V	二极管, 肖特基, 40V, 0.12A, AEC-Q101, SOT-323	BAS40-05W,115	Nexperia
DS1	1		GDH-1638WP	GDH-1638WP	Xiamen Ocular Optics
FID1	1		基准标记。没有需要购买或安装的元件。	不适用	不适用
FID2	1		基准标记。没有需要购买或安装的元件。	不适用	不适用
FID3	1		基准标记。没有需要购买或安装的元件。	不适用	不适用
H1	1		垫片支架, 尼龙 66	MAE-10	Kang Yang
H2	1		垫片支架, 尼龙 66	MAE-10	Kang Yang
IC1	1		2.7V-4V 双路输入/单路输出 MOSFET, 0.5A 主输入/0.1A 辅助输入, 低电平有效使能端, 通信温度, DBV0005A (SOT-23-5)	TPS2102DBVR	德州仪器 (TI)
IC2	1		用于高速数据接口的低电容 ± 15 kV ESD 保护阵列, 6 通道, -40 至 +85°C, 8 引脚 UQFN (RSE), 绿色环保 (符合 RoHS 标准, 无镉/无溴)	TPD6E004RSER	德州仪器 (TI)

表 4-1. 物料清单 (续)

位号	数量	值	说明	器件型号	制造商
IC3	1		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), 绿色环保 (符合 RoHS 标准, 无铍/溴)	TPD4E004DRYR	德州仪器 (TI)
IC4	1		500mA、可调节、低静态电流、低噪声、高 PSRR、单路输出 LDO 稳压器、DRB0008A (VSON-8)	TPS73533DRBT	德州仪器 (TI)
J1	1		接头, 100mil, 2x1, 锡, TH	90120-0122	Molex
J2	1		接头, 100mil, 2x1, 锡, TH	90120-0122	Molex
J3	1		插座, 2.54mm, 10x2, 锡, TH	SSQ-110-03-T-D	Samtec
J4	1		接头, 100mil, 2x1, 锡, TH	90120-0122	Molex
J5	1		接头, 100mil, 2x1, 锡, TH	90120-0122	Molex
J6	1		接头, 100mil, 2x1, 锡, TH	90120-0122	Molex
J7	1		插座, 2.54mm, 10x2, 锡, TH	SSQ-110-03-T-D	Samtec
J8	1		接头, 100mil, 3x1, 锡, TH	PEC03SAAN	Sullins Connector Solutions
J9	1		接头, 100mil, 3x1, 锡, TH	PEC03SAAN	Sullins Connector Solutions
J10	1		接头, 100mil, 16x1, 金, TH	TSW-116-07-G-S	Samtec
J11	1		接头, 100mil, 16x1, 金, TH	TSW-116-07-G-S	Samtec
J12	1		接头, 100mil, 3x1, 锡, TH	PEC03SAAN	Sullins Connector Solutions
J13	1		接头, 100mil, 3x1, 锡, TH	PEC03SAAN	Sullins Connector Solutions
J14	1		接头, 2.54mm, 9x2, 锡, TH	PEC09DAAN	Sullins Connector Solutions
J15	1		接头 (有罩), 1.27mm, 5x2, 金, SMT	FTSH-105-01-L-DV-K	Samtec
J16	1		接头 (有罩), 1.27mm, 5x2, 金, SMT	FTSH-105-01-L-DV-K	Samtec
J17	1		Micro USB 5F B 型 Smt	YM-02-07-D-23	Yang Ming
L1	1	2.2 μ H	电感, 绕线型, 陶瓷, 2.2uH, 0.89A, 0.13 Ω , SMD	CBC2518T2R2M	Taiyo Yuden
LED1	1	红色	LED, 红色, SMD	BR1111C-TR	Stanley Electric Co., LTD
LED2	1	RGB	LED, RGB, SMD	19-337/R6GHBHC-A01/2T	Everlight
LED3	1	红色	LED, 红色, SMD	BR1111C-TR	Stanley Electric Co., LTD
LED4	1	绿色	LED, 绿色, SMD	LTST-C190GKT	Lite-On
MSP1	1		MSP432E401YTPDT、PDT0128A (TQFP-128)	MSP432E401YTPDTR	德州仪器 (TI)

表 4-1. 物料清单 (续)

位号	数量	值	说明	器件型号	制造商
MSP2	1		MSP430G2x52、MSP430G2x12 混合信号微控制器， RSA0016B (VQFN-16)	MSP430G2452IRSA16R	德州仪器 (TI)
R1	1	47k	电阻，47k，5%，0.063W，0402	CRCW040247K0JNED	Vishay-Dale
R3	1	47k	电阻，47k，5%，0.063W，0402	CRCW040247K0JNED	Vishay-Dale
R5	1	470	电阻，470，5%，0.063W，0402	CRCW0402470RJNED	Vishay-Dale
R6	1	220	电阻，220，5%，0.063W，0402	CRCW0402220RJNED	Vishay-Dale
R7	1	330	电阻，330，5%，0.063W，0402	CRCW0402330RJNED	Vishay-Dale
R8	1	330	电阻，330，5%，0.063W，0402	CRCW0402330RJNED	Vishay-Dale
R13	1	4.7k	电阻，4.7k，5%，0.1W，0603	RC0603JR-074K7L	Yageo
R14	1	4.7k	电阻，4.7k，5%，0.1W，0603	RC0603JR-074K7L	Yageo
R15	1	2.2k	电阻，2.2k，5%，0.1W，0603	RC0603JR-072K2L	Yageo
R16	1	2.2k	电阻，2.2k，5%，0.1W，0603	RC0603JR-072K2L	Yageo
R17	1	1.0k	电阻，1.0k，5%，0.063W，0402	CRCW04021K00JNED	Vishay-Dale
R18	1	1.0k	电阻，1.0k，5%，0.063W，0402	CRCW04021K00JNED	Vishay-Dale
R19	1	1.0k	电阻，1.0k，5%，0.063W，0402	CRCW04021K00JNED	Vishay-Dale
R21	1	100	电阻，100，5%，0.063W，AEC-Q200 0 级，0402	CRCW0402100RJNED	Vishay-Dale
R22	1	470	电阻，470，5%，0.063W，0402	CRCW0402470RJNED	Vishay-Dale
R23	1	470	电阻，470，5%，0.063W，0402	CRCW0402470RJNED	Vishay-Dale
R24	1	10k	电阻，10k，5%，0.063W，0402	CRCW040210K0JNED	Vishay-Dale
R25	1	4.87k	电阻，4.87k，1%，0.063W，AEC-Q200 0 级，0402	CRCW04024K87FKED	Vishay-Dale
R26	1	100	电阻，100，5%，0.063W，0402	CRCW0402100RJNED	Vishay-Dale
R27	1	1.0k	电阻，1.0k，5%，0.063W，0402	CRCW04021K00JNED	Vishay-Dale
R28	1	51	电阻，51，5%，0.063W，AEC-Q200 0 级，0402	CRCW040251R0JNED	Vishay-Dale
R29	1	220k	电阻，220k，1%，0.0625W，0402	RC0402FR-07220KL	Yageo America
R30	1	220k	电阻，220k，1%，0.0625W，0402	RC0402FR-07220KL	Yageo America
R31	1	3.30k	电阻，3.30k，1%，0.1W，AEC-Q200 0 级，0402	ERJ-2RKF3301X	Panasonic
R32	1	2.20k	电阻，2.20k，1%，0.063W，0402	CRCW04022K20FKED	Vishay-Dale
R33	1	6.81k	电阻，6.81k，1%，0.063W，0402	CRCW04026K81FKED	Vishay-Dale
R34	1	4.7k	电阻，4.7k，5%，0.063W，0402	CRCW04024K70JNED	Vishay-Dale
R35	1	4.7k	电阻，4.7k，5%，0.063W，0402	CRCW04024K70JNED	Vishay-Dale
R36	1	220k	电阻，220k，1%，0.0625W，0402	RC0402FR-07220KL	Yageo America
R37	1	220k	电阻，220k，1%，0.0625W，0402	RC0402FR-07220KL	Yageo America

表 4-1. 物料清单 (续)

位号	数量	值	说明	器件型号	制造商
R38	1	47.0k	电阻, 47.0k, 1%, 0.0625W, 0402	RC0402FR-0747KL	Yageo America
R39	1	47.0k	电阻, 47.0k, 1%, 0.0625W, 0402	RC0402FR-0747KL	Yageo America
R40	1	820	电阻, 820, 1%, 0.063W, 0402	RC0402FR-07820RL	Yageo America
R41	1	470	电阻, 470, 5%, 0.063W, 0402	CRCW0402470RJNED	Vishay-Dale
R44	1	220k	电阻, 220k, 1%, 0.0625W, 0402	RC0402FR-07220KL	Yageo America
R45	1	0	电阻, 0, 5%, 0.1W, 0603	RC0603JR-070RL	Yageo
R47	1	220k	电阻, 220k, 1%, 0.0625W, 0402	RC0402FR-07220KL	Yageo America
R48	1	3.30k	电阻, 3.30k, 1%, 0.1W, AEC-Q200 0 级, 0402	ERJ-2RKF3301X	Panasonic
R49	1	0	电阻, 0, 5%, 0.1W, 0603	RC0603JR-070RL	Yageo
R50	1	0	电阻, 0, 5%, 0.1W, 0603	RC0603JR-070RL	Yageo
R51	1	330k	电阻, 330k, 1%, 0.0625W, 0402	RC0402FR-07330KL	Yageo America
R52	1	220k	电阻, 220k, 1%, 0.0625W, 0402	RC0402FR-07220KL	Yageo America
R53	1	1.00Meg	电阻, 1.00M, 1%, 0.063W, 0402	CRCW04021M00FKED	Vishay-Dale
R54	1	10k	电阻, 10k, 5%, 0.063W, 0402	CRCW040210K0JNED	Vishay-Dale
R55	1	10k	电阻, 10k, 5%, 0.063W, 0402	CRCW040210K0JNED	Vishay-Dale
S1	1		开关, SPST, 0.05A, 12VDC, SMD	1188E-1K2-V-TR	Diptronics
S2	1		开关, SPST, 0.05A, 12VDC, SMD	1188E-1K2-V-TR	Diptronics
S3	1		开关, SPST, 0.05A, 12VDC, SMD	1188E-1K2-V-TR	Diptronics
SH-J1	1	J101 : 1-2	分流器, 100mil, 镀金, 黑色	SNT-100-BK-G	Samtec
SH-J2	1	J101 : 3-4	分流器, 100mil, 镀金, 黑色	SNT-100-BK-G	Samtec
SH-J3	1	J101 : 5-6	分流器, 100mil, 镀金, 黑色	SNT-100-BK-G	Samtec
SH-J4	1	J101 : 7-8	分流器, 100mil, 镀金, 黑色	SNT-100-BK-G	Samtec
SH-J5	1	J101 : 9-10	分流器, 100mil, 镀金, 黑色	SNT-100-BK-G	Samtec
SH-J6	1	J101 : 11-12	分流器, 100mil, 镀金, 黑色	SNT-100-BK-G	Samtec
SH-J7	1	J101 : 12-13	分流器, 100mil, 镀金, 黑色	SNT-100-BK-G	Samtec
SH-J8	1	J101 : 15-16	分流器, 100mil, 镀金, 黑色	SNT-100-BK-G	Samtec
SH-J9	1	J101 : 17-18	分流器, 100mil, 镀金, 黑色	SNT-100-BK-G	Samtec
SH-J10	1	J1 : 1-2	分流器, 100mil, 镀金, 黑色	SNT-100-BK-G	Samtec
SH-J11	1	J2 : 1-2	分流器, 100mil, 镀金, 黑色	SNT-100-BK-G	Samtec
SH-J12	1	J8 : 1-2	分流器, 100mil, 镀金, 黑色	SNT-100-BK-G	Samtec
SH-J13	1	J15 : 1-2	分流器, 100mil, 镀金, 黑色	SNT-100-BK-G	Samtec
SH-J14	1	J25 : 1-2	分流器, 100mil, 镀金, 黑色	SNT-100-BK-G	Samtec

表 4-1. 物料清单 (续)

位号	数量	值	说明	器件型号	制造商
SH-J15	1	J27 : 1-2	分流器, 100mil, 镀金, 黑色	SNT-100-BK-G	Samtec
SH-J16	1	J13 : 1-2	分流器, 100mil, 镀金, 黑色	SNT-100-BK-G	Samtec
T1	1	-20V	MOSFET, P 沟道, -20V, -0.82A, SOT-323	DMG1013UW-7	Diodes Inc.
T2	1	45V	晶体管, NPN, 45V, 0.1A, SOT-323	BC850CW,115	NXP Semiconductor
U1	1		MSPM0L2117SPMR	MSPM0L2117SPMR	德州仪器 (TI)
U2	1		精密微功耗并联电压基准、0.5% 精度、2.5V、15ppm/°C、15mA、-40 至 85°C、5 引脚 SC70 (DCK)、绿色环保 (符合 RoHS 标准, 无镉/溴)	LM4040C25IDCKR	德州仪器 (TI)
U3	1		用于高速数据接口的低电容 ±15kV ESD 保护阵列, 6 通道, -40 至 +85°C, 8 引脚 UQFN (RSE), 绿色环保 (符合 RoHS 标准, 无镉/无溴)	TPD6E004RSER	德州仪器 (TI)
USB1	1		电缆, USB-A 至微型 USB-B, 0.3m	AK67421-0.3	Assman WSW
Y1	1		晶振, 32.768KHz, 12.5pF, SMD	X1A0001410014	Epson
Y2	1		晶振, 32MHz, 10pF, SMD	Q22FA1280009200	Epson
Y3	1		晶振, 16MHz, 8pF, SMD	NX3225GA-16.000M-STD-CRG-1	NDK

5 其他信息

5.1 商标

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6 相关文档

6.1 补充内容

以下各项是开始使用 MSPM0 的重要学习材料。

- [MSPM0 Academy](#)
- [MSPM0-SDK 代码示例](#)
- [TI 高精度实验室](#)

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 DEGRADATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 Regulatory Notices:

3.1 United States

3.1.1 Notice applicable to EVMs not FCC-Approved:

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

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

CAUTION

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

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

FCC Interference Statement for Class A EVM devices

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

FCC Interference Statement for Class B EVM devices

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

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

3.2 Canada

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

Concerning EVMs Including Radio Transmitters:

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

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

Concernant les EVMs avec appareils radio:

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

Concerning EVMs Including Detachable Antennas:

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

Concernant les EVMs avec antennes détachables

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

3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/sds/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.

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3.4 European Union

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

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

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:

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