

## EVM User's Guide: LP-MSPM0G5187

# MSPM0G5187 评估模块



### 说明

MSPM0G5187 LaunchPad™ 开发套件是适用于 MSPM0G511x 和 MSPM0G5187 微控制器 (MCU) 的易于使用的评估模块。LaunchPad 套件包含 MSPM0G511x 和 MSPM0G5187 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。该板包含三个按钮、两个 LED (一个是 RGB LED)、两个 USB-C 连接器 (一个用于 MSPM0 USB 接口)、一个 microSD™ 插槽、一个麦克风、一个音频 ADC 和 40 多个引脚。该开发板通过将 ADC 和 ADC 低通滤波器占位符放置在理想位置以及使用 launchpad 提供的外部基准选项来改善模拟结果。

### 开始使用

1. 从 [ti.com](https://ti.com) 订购 [LP-MSPM0G5187](#)。
2. 转到 [dev.ti.com](https://dev.ti.com) 浏览代码示例。
3. 使用提供的 USB 电缆 (USB1) 将 LP-MSPM0G5187 插入 PC。
4. 使用 CCS Cloud 将代码直接从浏览器下载到 MSPM0G5187。
5. 下载适用于桌面集成开发环境的 [Code Composer Studio™ IDE](#)。

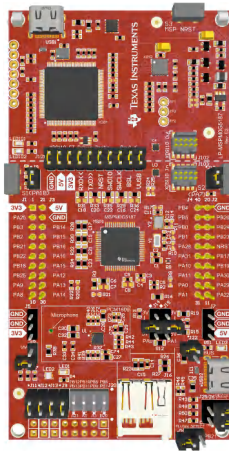
6. 下载用于桌面存储示例、演示和软件库的 [MSPM0 SDK](#)。

### 特性

- 板载 XDS110 调试探针 (USB Type-C™ 连接器)
- 反向通道 UART, 通过 USB 连接到 PC
- USB 供电型
- 40 引脚 BoosterPack™ 接头
- 硬件用户界面
  - 两个按钮、1 个 RGB LED 和 1 个红色 LED
  - 1 个 USB-C™ 连接器支持 USB 2.0 FS
  - 1 个麦克风和 1 个音频 ADC
- 外部时钟晶体
  - 40MHz HFXT | 32KHz LFXT

### 应用

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LP-MSPM0G5187

## 1 评估模块概述

### 1.1 简介

MSPM0G5187 是一款 Arm® Cortex® -M0+ 32 位 CPU，具有双组闪存和增强的安全功能，支持高达 80MHz 的频率。该器件可适用于多种任务，既可用于集成 USB 2.0 FS 和串行音频接口 (SAI) 的小型个人电子模块，也可用于完整应用系统，通过 LIN 接口、闪存 ECC 和 SRAM ECC 满足汽车电子领域的需求。此外，该器件集成了神经网络处理单元 (NPU)，可支持 M0+ 平台内的边缘 AI。开始使用 MSPM0G5187 的简单方法是使用 LP-MSPM0G5187 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。

该器件采用 128kB 双组闪存、32kB SRAM 和 8kB 数据闪存存储器。该器件还集成了多种内部模拟功能，包括一个 12 位 ADC、两个电压基准源，以及一个内置 8 位参考 DAC 的高速比较器。MSPM0G5187 是先进的 MSPM0 器件，具有 USB 2.0 FS、SAI 和 NPU。

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。您还可以设计您自己的 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。TI 还支持第三方 IDE，如 IAR Embedded Workbench® 和 Arm® Kiel® μ Vision® IDE。在与 MSPM0G5187 LaunchPad™ 开发套件配套使用时，Code Composer Studio IDE 支持 EnergyTrace™ 软件技术。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-MSPM0G5187 LaunchPad™ 开发套件
- USB-A 转 USB-C™ 电缆
- 快速入门指南

### 1.3 规格

LP-MSPM0G5187 旨在与运行 Code Composer Studio™ (CCS) 的 PC、Mac® 或 Linux® 工作站配合使用。CCS IDE 可以在工作站上独立运行，也可通过 Web (CCS Cloud) 访问，无需安装软件。此外，LP-MSPM0G5187 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-MSPM0G5187 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                          |
| MSPM0G5187SPMR     | 具有 80MHz Arm® Cortex® 32 位 M0+ CPU、128kB 闪存和 32kB 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 LP-MSPM0G5187 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 MSPM0G5187          |
| 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                         |
| PCM1809IRTER       | 一款低功率音频模数转换器 (ADC)，可支持最多两个模拟通道的同步采样。                                 | 从麦克风采样语音数据                           |

## 2 硬件

### 2.1 硬件概述

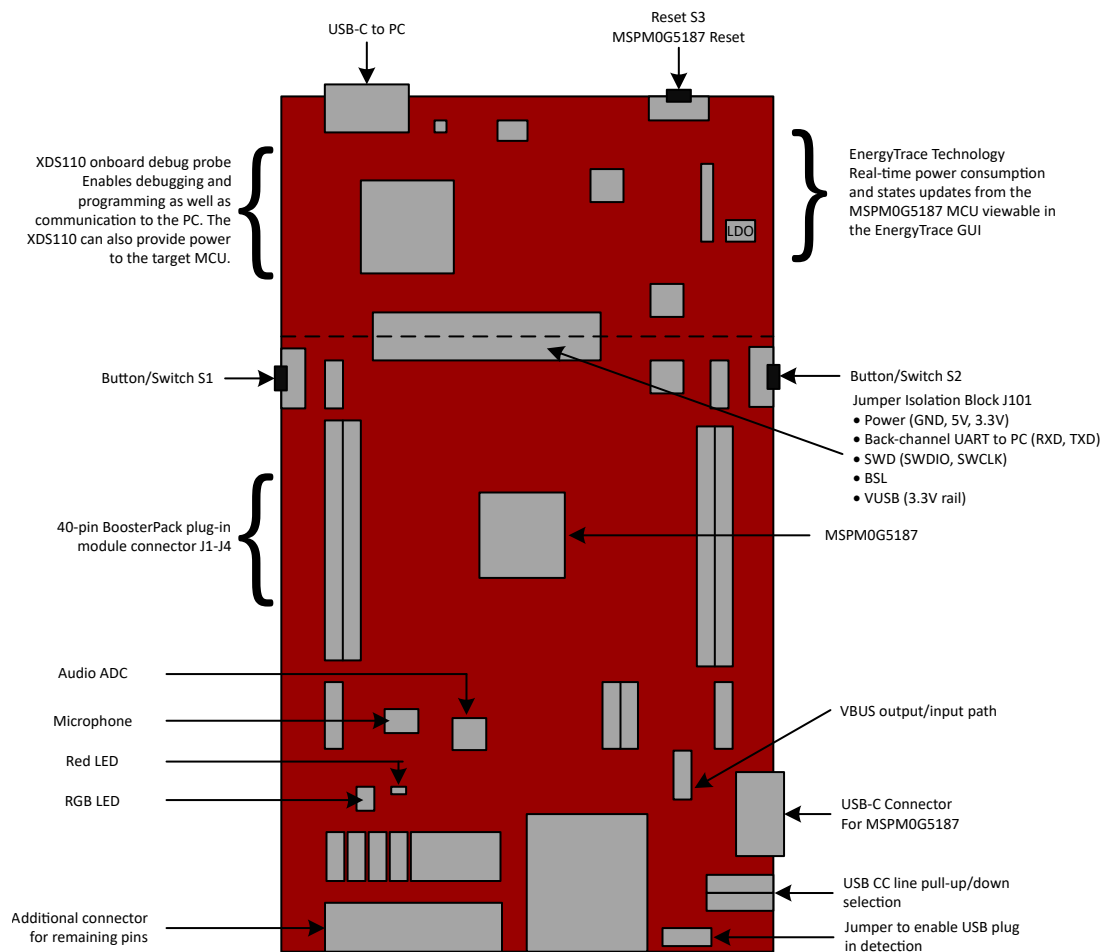


图 2-1. LP-MSPM0G5187 跳线和连接图

LP-MSPM0G5187 具有许多硬件特性，允许用户完全访问 MSPM0G5187 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。默认配置是组装所有分流器。

表 2-1. 跳线信息

| 跳线    | 说明               | 默认设置 | 连接的信号                                        |
|-------|------------------|------|----------------------------------------------|
| J1-J4 | BoosterPack™ 接头块 | 未组装  | 关于 BoosterPack™ 引脚 1 至 40 的标准连接，请参阅原理图了解详细信息 |
| J5    | 3.3V 电源接头        | 未组装  | GND 和 3.3V 的附加引脚连接                           |
| J6    | 模拟电源接头           | 未组装  | OFF 用于断开 SD 插槽、麦克风和音频 ADC 的电源 (PCM1809)      |
| J7    | 5V 电源接头          | 未组装  | GND 和 5V 的附加引脚连接                             |
| J8    | BSL 调用           | 已组装  | 将 PA18 连接到 S1 按钮                             |
| J9    | 红色 LED           | 已组装  | 将 PA0 连接到红色 LED                              |
| J10   | S2 跳线            | 已组装  | 将 PA7 连接到 S2 按钮                              |

表 2-1. 跳线信息 ( 续 )

| 跳线      | 说明                                   | 默认设置           | 连接的信号                                        |
|---------|--------------------------------------|----------------|----------------------------------------------|
| J11     | RGB ( 蓝色 ) LED                       | 已组装            | 将 PB13 连接到 RGB ( 蓝色 ) LED                    |
| J12     | RGB ( 红色 ) LED                       | 已组装            | 将 PBA17 连接到 RGB ( 红色 ) LED                   |
| J13     | RGB ( 绿色 ) LED                       | 已组装            | 将 PA24 连接到 RGB ( 绿色 ) LED                    |
| J14     | 开漏上拉选择器                              | 组装：顶部和中间 (1-2) | 用于 PA0 的 3.3V 或 5V 连接的上拉选择器                  |
| J15     | 开漏上拉选择器                              | 组装：顶部和中间 (1-2) | 用于 PA1 的 3.3V 或 5V 连接的上拉选择器                  |
| J17-J19 | LP-MSPM0G5187 引脚扩展接头 ( 未标记 - 电路板底部 ) | 不适用            | 请参阅原理图了解详细信息                                 |
| J20     | LP-MSPM0G5187 引脚扩展接头 ( 未标记 - 电路板底部 ) | 未组装            | 请参阅原理图了解详细信息                                 |
| J21     | LP-MSPM0G5187 引脚扩展接头 ( 未标记 - 电路板底部 ) | 不适用            | 请参阅原理图了解详细信息                                 |
| J22     | USB2 电源接头                            | 未组装            | 进行连接以从板载 5V 电压启用 USB2 VBUS ( 仅适用于 USB 主机模式 ) |
| J23     | USB2 VBUS 检测接头                       | 未组装            | 将 PB21 连接到 USB2 VBUS ( 具有 2/5 分压电阻器电路 )      |
| J24、J25 | USB2 CC 线路上拉或下拉选择器                   | 组装：右侧和中间 (1-2) | USB CC 线路的上拉和下拉选择器，默认为通过 5.11K $\Omega$ 进行下拉 |
| J101    | XDS110-ET 隔离块                        | 已组装            | GND、5V、3V3、RXD、TXD、NRST、SWDIO、SWCLK、BSL、VUSB |
| J102    | XDS110-ET OUT                        | 未组装            | GND、3V3、SWDIO、SWCLK、NRST                     |
| J103    | XDS110-ET IN                         | 未组装            | GND、3V3、SWDIO、SWCLK、NRST                     |

## 2.2 电源要求

LP-MSPM0G5187 只需插入 USB 并组装调试器跳线块即可为器件供电。通过板载 LDO，5V USB 电源转换为 3.3V，并提供 500mA 电源电流。也可以通过外部电源并使用 3.3V 或 5V 接头为 LaunchPad™ 供电。VUSB 用于 MSPM0 USB PHY 电源，为 3.3V。3.3V 轨上的电压不能超过 3.3V，5V 轨上的电压不能超过 5V。

右下角有第二个 USB-C™ 连接器，它支持 MSPM0G5187 上的 USB 2.0 FS。USB-C 连接器具有 5V 电源轨 VBUS。仅当 MSPM0G5187 在主机模式下工作时，使用 J22 中的 5V 目标来生成 VBUS。否则，请使 J22 保持断开状态。

备注

如果 USB1 ( XDS 侧 ) 和 USB2 ( MCU 侧 ) 连接到不同的电源, 请勿连接 J22。

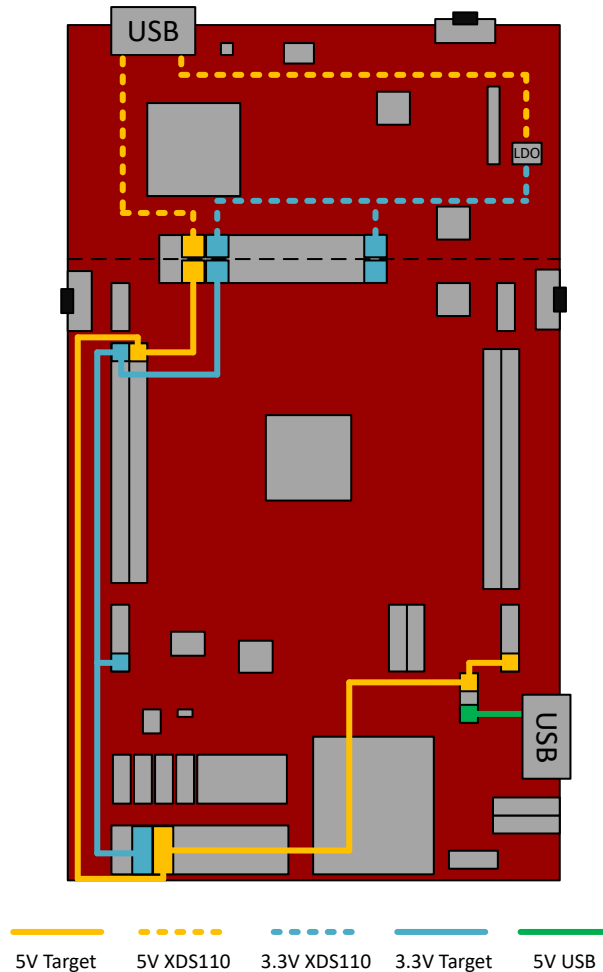


图 2-2. LP-MSPM0G5187 电源连接

## 2.3 XDS110 调试探针

LP-MSPM0G5187 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 MSPM0G5187 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。

### 隔离跳线块

利用隔离跳线块 J101，用户可以连接或断开从 XDS110 域进入 MSPM0G5187 目标域的信号。这包括 XDS110 SWD 信号、应用 UART 信号、3.3V 和 5V 电源、USB PHY 供电以及复位信号。

| 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 MSPM0G5187 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 MSPM0G5187 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。                |
| VUSB  | MSPM0G5187 USB PHY 电源，3.3V 电源轨               |

## 2.4 测量 MSPM0G5187 的电流消耗

要使用万用表测量 MSPM0G5187 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：

1. 拆下 J101 隔离块中的 3V3 和 VUSB 跳线，并在该 3V3 跳线上连接一个电流表。
2. 考虑 VUSB 通道（为 MSPM0 USB PHY 供电）、反向通道 UART 以及连接到 MSPM0G5187 的任何电路对电流消耗的影响。考虑在隔离跳线块上断开反向通道 UART，或者至少在最终测量中考虑灌电流和拉电流能力。如果 USB 接口与 MSPM0G5187 一起使用，请将 VUSB 连接至 3V3。
3. 移除 J6 中的跳线以断开板载模拟元件，包括 SD 卡、麦克风和音频 ADC。
4. 确保 MSPM0G5187 上没有悬空输入或输出 (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。
5. 开始执行目标。
6. 要超准确地测量电流，请将器件置于 *自由运行* 模式，并断开 MSPM0G5187 与电路板调试部分（接头 J101）之间的编程信号。
7. 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 由 SYSOSC 提供。SYSPLL 可用于生成高达 80MHz 的时钟信号, 从而为 MCLK 提供时钟源。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。该器件还支持 FLL, 可用于为 USB 外设生成精确的 60MHz 时钟 (FLLCLK)。

该 LaunchPad™ 包含两个时钟晶体选项, 即一个高频 40MHz 晶体 (HFXT) 和一个低频 32.768kHz 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 [MSPM0G 系列微控制器技术参考手册](#) 的时钟模块 (CKM) 一节。

## 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 MSPM0G5187 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 MSPM0G5187 器件的引脚功能配置来解决冲突。

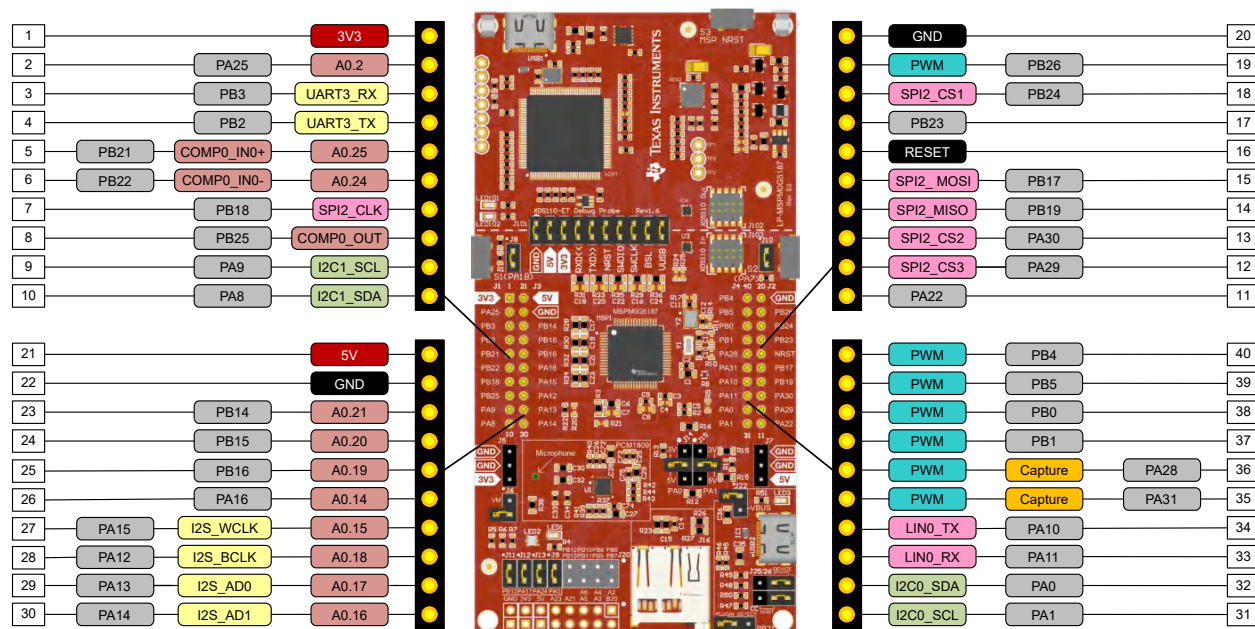


图 2-3. BoosterPack 插接模块连接器引脚布局

## 3 软件

### 3.1 软件开发选项

使用 LP-MSPM0G5187 进行原型设计的方法有多种：

1. 开箱即用 GUI - 选择此选项可轻松演示 LP-MSPM0G5187。
2. [CCS Cloud](#) - 选择此选项可快速开始, 只需极少的安装。
3. [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。
4. [CCS Eclipse](#) - 该选项受支持, 但是个旧工具, 本指南中未涉及。



## 3.2 开箱即用 GUI

借助 LP-MSPM0G5187 上的开箱即用示例开始使用。只需转到 *开箱即用 GUI* 并将 LP-MSPM0G5187 插入 PC、Mac® 或 Linux® 工作站。此 GUI 提供对内置 LED 的控制以及 LP-MSPM0G5187 当前状态的仪表板。GUI 功能可能需要 *TI Cloud Agent* 浏览器扩展。

更多有关 GUI 的信息将在完整版中提供，并且可以在 [TI 开发人员专区](#) 中找到。

## 3.3 CCS Cloud

1. 前往 [dev.ti.com](https://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-MSPM0G5187。TI 开发人员专区会自动检测 LP-MSPM0G5187 是否已插入。
3. 点击 *Browse Software And Examples*，会在新窗口中打开 MSPM0 SDK。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。
4. 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。
5. 在 CCS Cloud 中，点击左侧栏中的 *debug* 图标以打开调试视图。
6. 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。
7. 点击蓝色的 *play* 按钮启动应用程序。
8. LP-MSPM0G5187 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

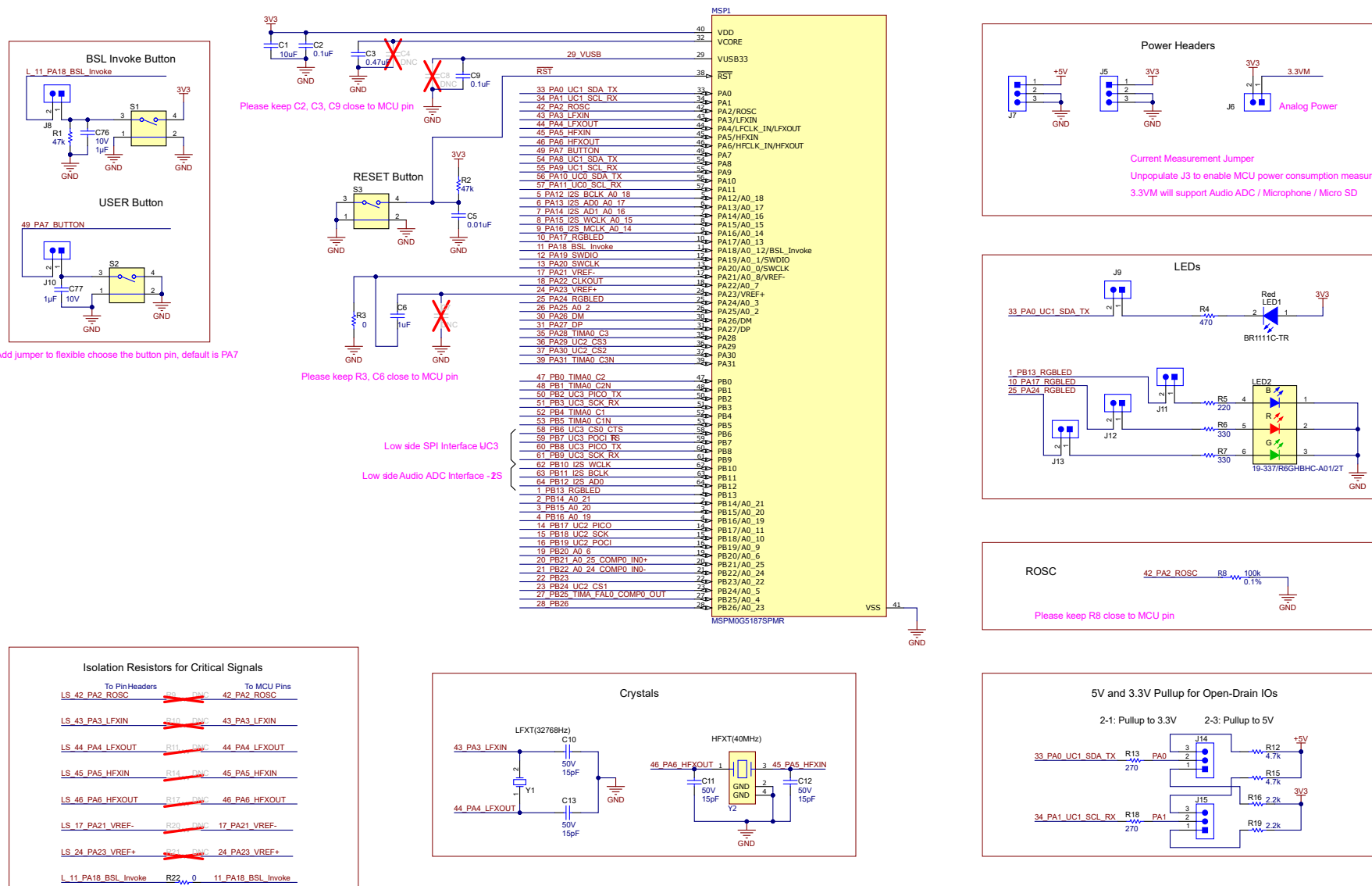
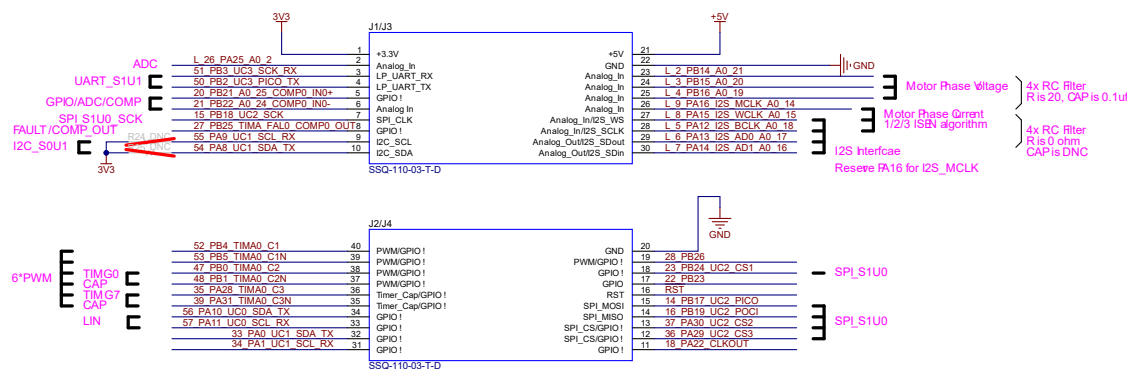
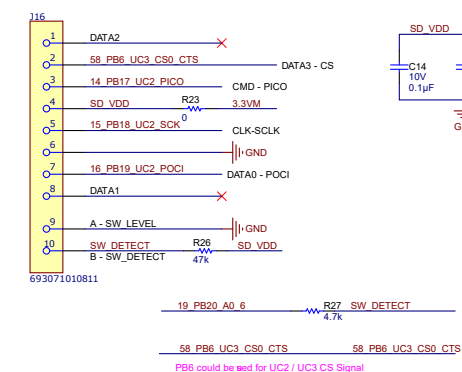


图 4-1. MSPM0G5187 目标器件原理图

## BoosterPack™ Connectors

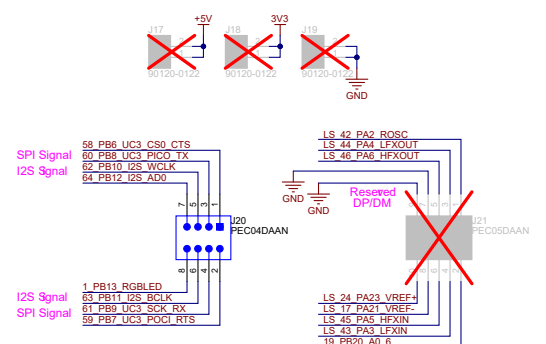


## MicroSD™ Memory Card Interface



When SD plug in, the SPI interface used in BoosterPack will be occupied

## Pin headers at the Low Side of the Board



## RC Filter for ADC Input

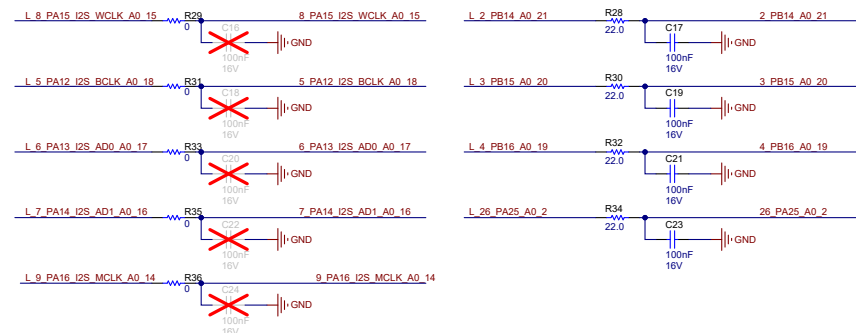
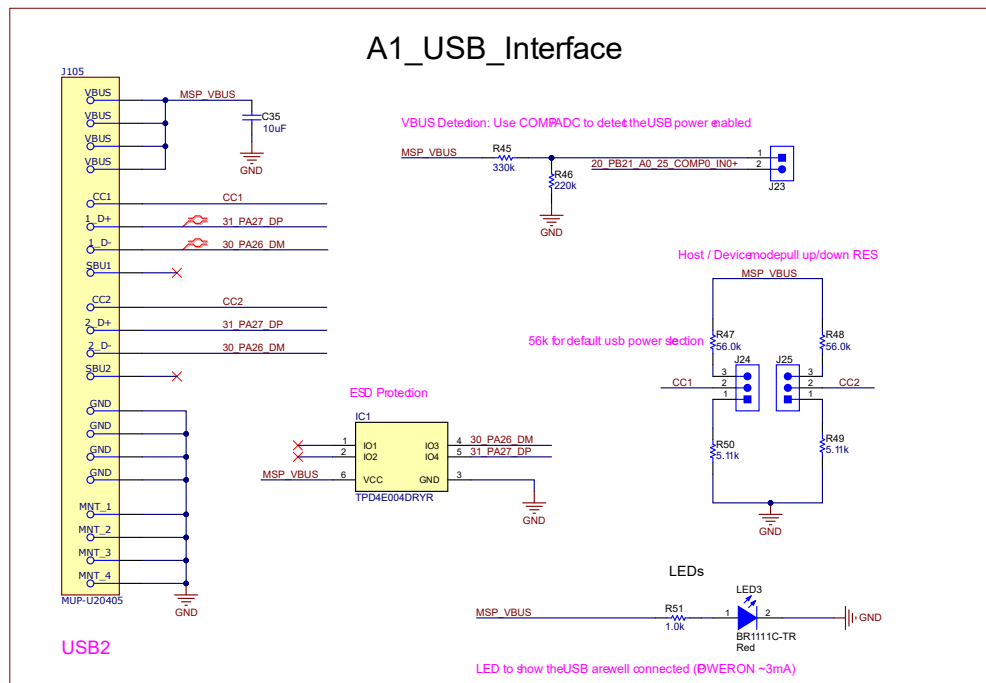
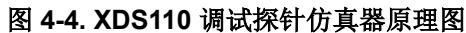


图 4-2. BoosterPack™ 连接器





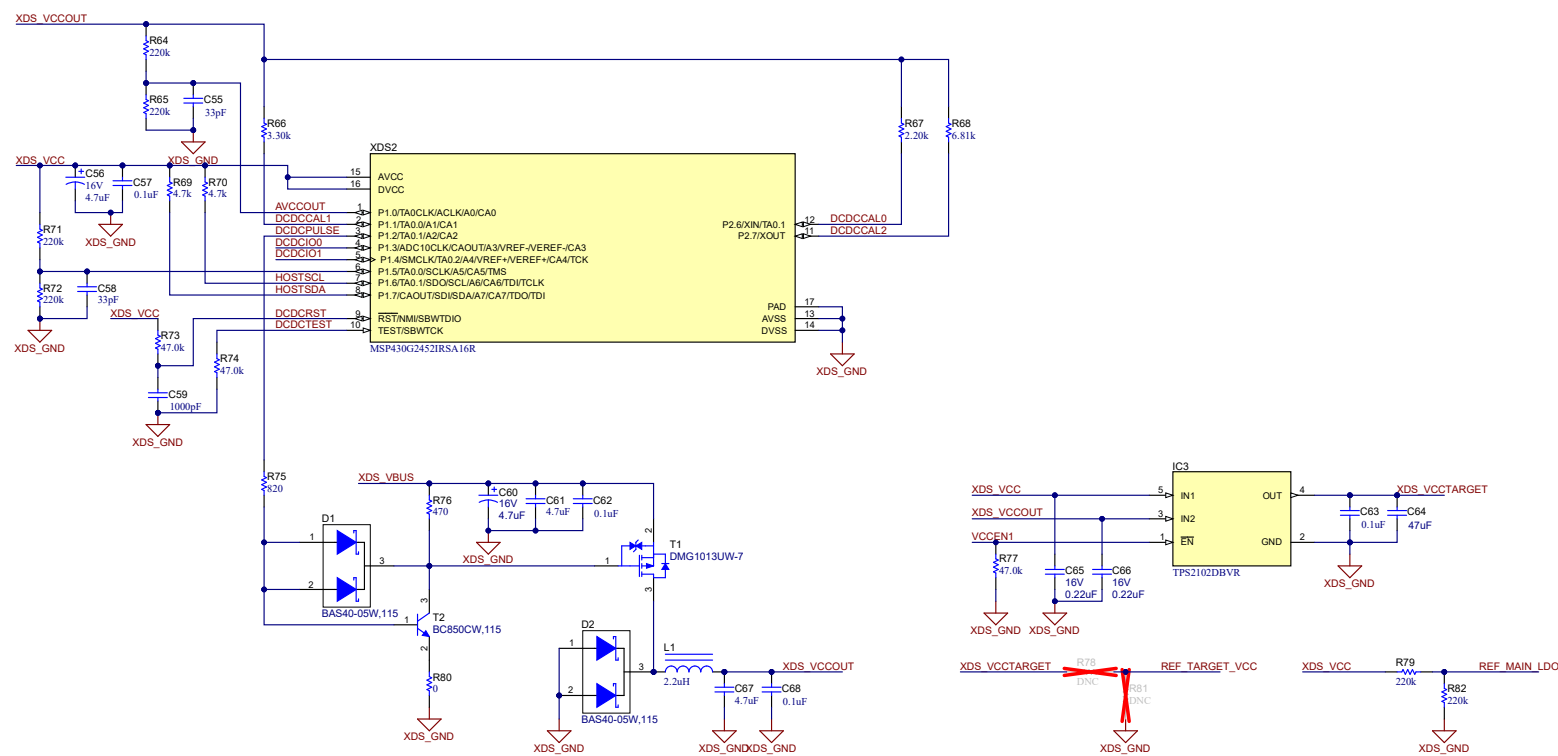


图 4-5. XDS110 EnergyTrace™ 原理图

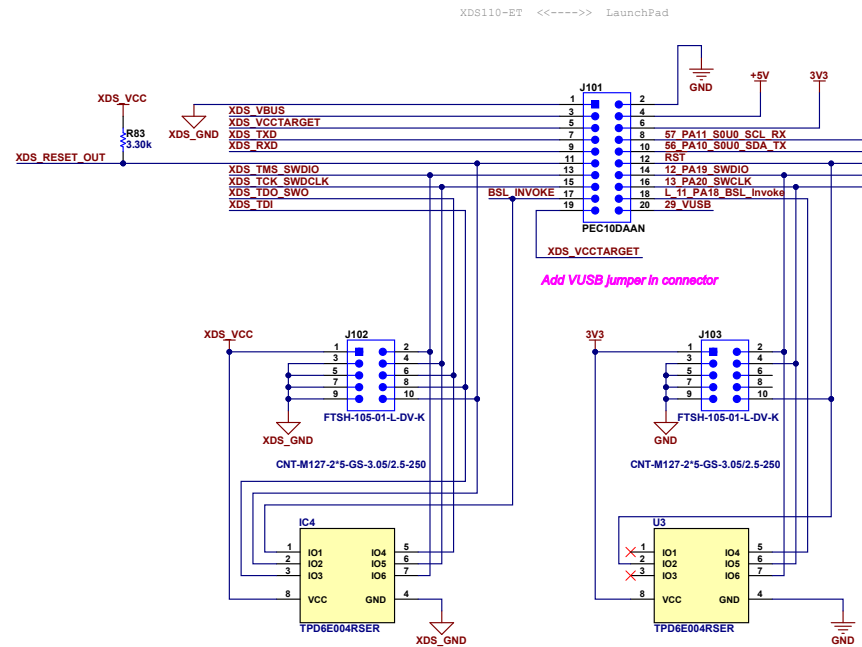


图 4-6. XDS110 目标接口原理图



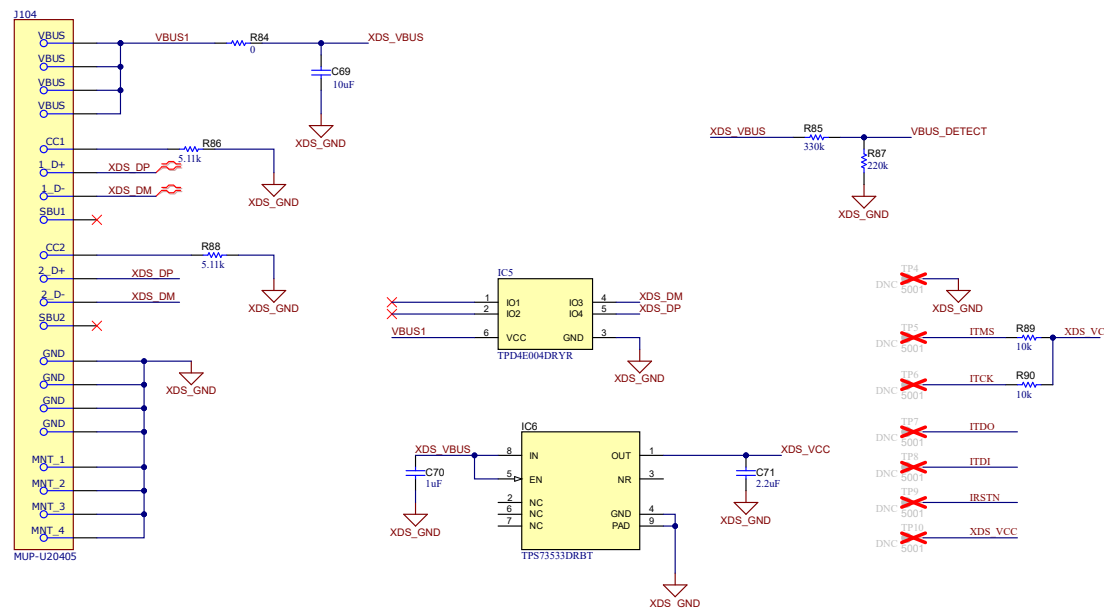


图 4-7. XDS110 USB 电源原理图

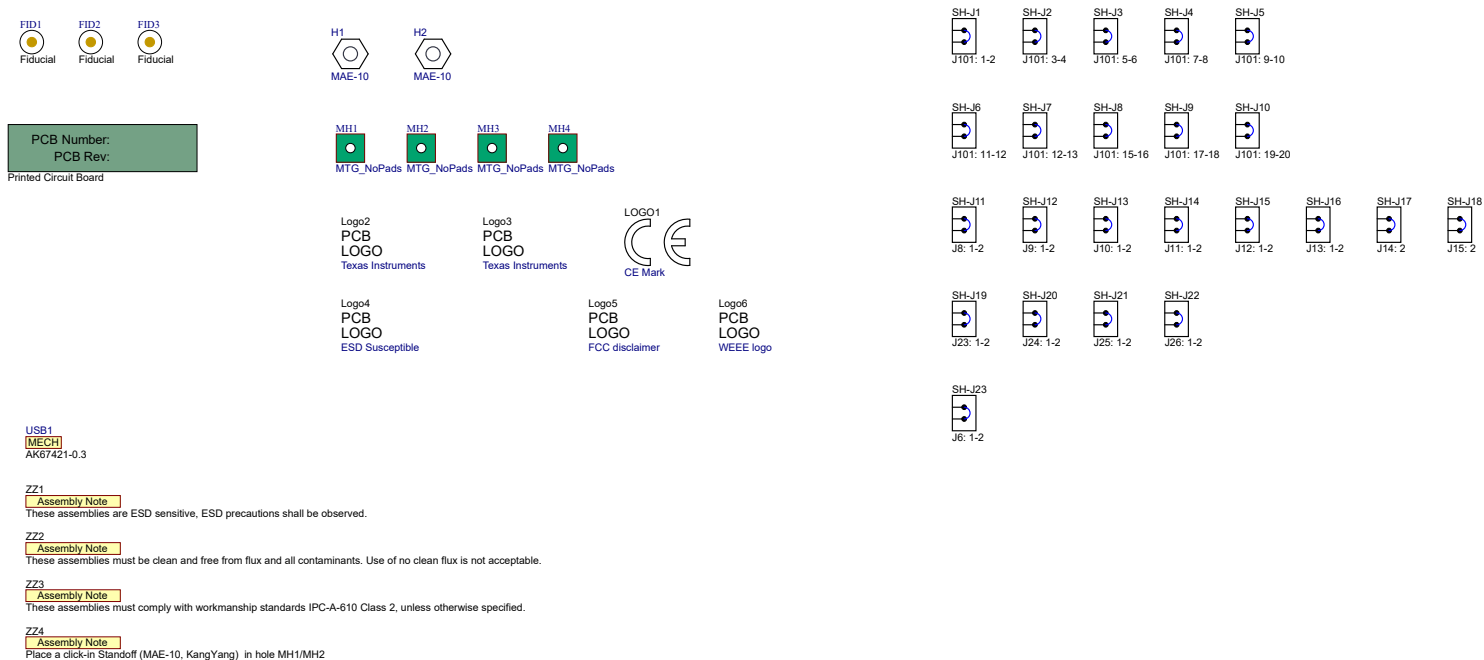


图 4-8. 跳线和支架

## 4.2 PCB 布局

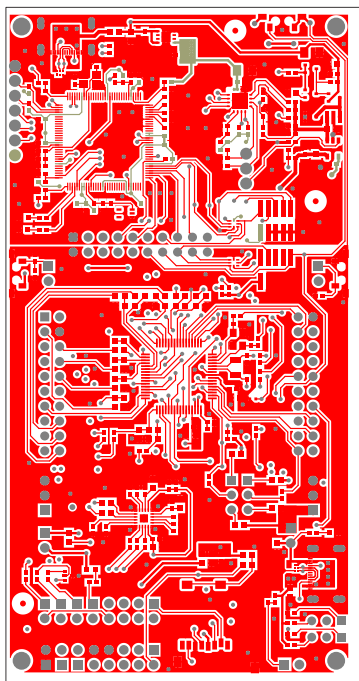


图 4-9. 顶层和覆盖层 (第 1 层)

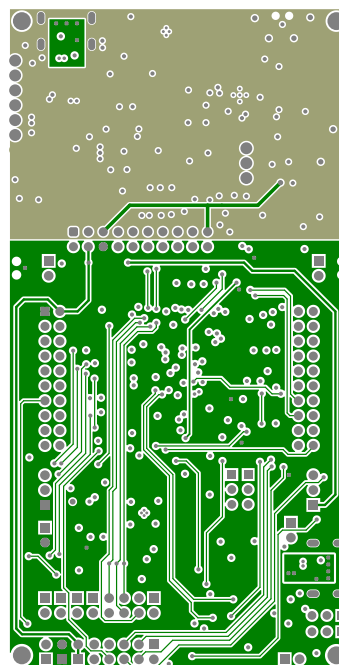


图 4-10. VCC 平面 (第 2 层)

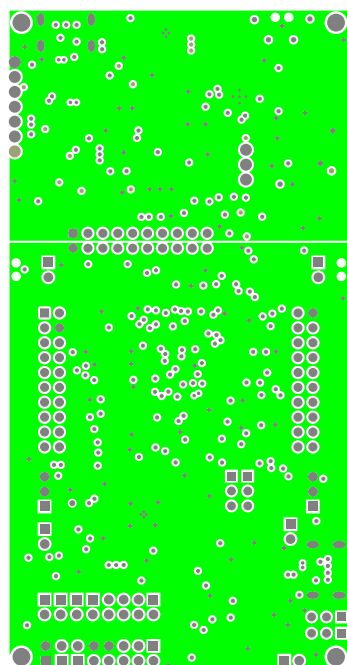


图 4-11. 接地平面 (第 3 层)

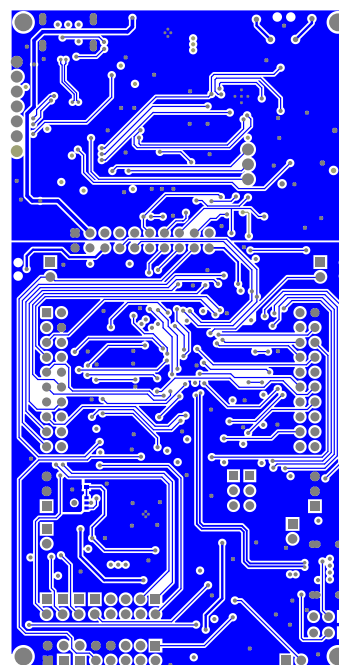


图 4-12. 底层和覆盖层 (第 4 层)

## 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              | 封装参考    | 制造商         |
|---------------------------------------------|----|--------|----------------------------------------------------|-------------------|---------|-------------|
| !PCB1                                       | 1  |        | 印刷电路板                                              | MCU170            |         | 不限          |
| C1、C35、C69                                  | 3  | 10μF   | 电容, 陶瓷, 10μF, 6.3V, ±20%, X5R, 0603                | CC0603MRX5R5BB106 | 0603    | Yageo       |
| C2、C9、C31、C72、C73、C74、C75                   | 7  | 0.1μF  | 电容, 陶瓷, 0.1μF, 50V, ±20%, X5R, 0402                | CC0402KRX5R9BB104 | 0402    | Yageo       |
| C3                                          | 1  | 0.47μF | 电容, 陶瓷, 0.47μF, 6.3V, ±10%, X5R, 0402              | CC0402KRX5R5BB474 | 0402    | Yageo       |
| C5                                          | 1  | 0.01μF | 电容, 陶瓷, 0.01μF, 16V, ±10%, X5R, 0402               | CC0402KRX7R7BB103 | 0402    | Yageo       |
| C6                                          | 1  | 1μF    | 电容, 陶瓷, 1μF, 25V, ±10%, X5R, 0603                  | CC0603KRX5R8BB105 | 0603    | Yageo       |
| C10、C11、C12、C13                             | 4  | 15pF   | 电容, 陶瓷, 15pF, 50V, ±5%, C0G/NP0, 0402              | CC0402JRNPO9BN150 | 0402    | Yageo       |
| C14                                         | 1  | 0.1μF  | 电容, 陶瓷, 0.1μF, 10V, ±10%, X7R, 0402                | CC0402KRX7R6BB104 | 0402    | Yageo       |
| C15、C36                                     | 2  | 10μF   | 电容, 陶瓷, 10μF, 16V, ±20%, X5R, 0603                 | EMK107BBJ106MA-T  | 0603    | Taiyo Yuden |
| C17、C19、C21、C23                             | 4  | 0.1μF  | 电容, 陶瓷, 0.1μF, 16V, ±10%, X7R, AEC-Q200 1 级, 0603  | AC0603KRX7R7BB104 | 0603    | MuRata      |
| C25、C26、C33、C34                             | 4  | 1μF    | 电容, 陶瓷, 1μF, 10V, ±10%, X5R, 0402                  | CC0402KRX5R6BB105 | 0402    | MuRata      |
| C27、C28、C29                                 | 3  | 10μF   | 电容, 陶瓷, 10μF, 10V, ±10%, X6S, 0603                 | CC0603KRX5R7BB106 | 0603    | TDK         |
| C30、C32                                     | 2  | 1μF    | 电容, 陶瓷, 1μF, 16V, ±10%, X7R, 0603                  | CC0603KRX7R7BB105 | 0603    | TDK         |
| C37、C41、C42、C44、C48、C51、C52、C57、C62、C63、C68 | 11 | 0.1μF  | 电容, 陶瓷, 0.1μF, 6.3V, ±10%, X7R, 0402               | CC0402KRX7R5BB104 | 0402    | MuRata      |
| C38、C39、C40、C46、C50                         | 5  | 0.01μF | 电容, 陶瓷, 0.01μF, 25V, ±10%, X7R, 0402               | CC0402KRX7R8BB103 | 0402    | MuRata      |
| C43、C45、C49、C70                             | 4  | 1μF    | 电容, 陶瓷, 1μF, 25V, ±10%, X5R, 0402                  | CC0402KRX5R8BB105 | 0402    | TDK         |
| C47、C71                                     | 2  | 2.2μF  | 电容, 陶瓷, 2.2μF, 6.3V, ±10%, X5R, 0402               | CC0402KRX5R5BB225 | 0402    | MuRata      |
| C53、C54                                     | 2  | 12pF   | 电容, 陶瓷, 12pF, 50V, ±5%, C0G/NP0, 0402              | CC0402JRNPO9BN120 | 0402    | MuRata      |
| C55、C58                                     | 2  | 33pF   | 电容, 陶瓷, 33pF, 50V, ±5%, C0G/NP0, 0402              | CC0402JRNPO9BN330 | 0402    | MuRata      |
| C56、C60                                     | 2  | 4.7μF  | 电容, 钽, 4.7μF, 16V, ±10%, 4Ω, SMD                   | TAJA475K016RNJ    | 3216-18 | AVX         |
| C59                                         | 1  | 1000pF | 电容, 陶瓷, 1000pF, 50V, ±10%, X7R, AEC-Q200 1 级, 0402 | AC0402KRX7R9BB102 | 0402    | Yageo       |
| C61、C67                                     | 2  | 4.7μF  | 电容, 陶瓷, 4.7μF, 16V, ±10%, X5R, 0603                | CC0603KRX5R7BB475 | 0603    | Yageo       |

表 4-1. 物料清单 (续)

| 位号                               | 数量 | 值      | 说明                                                                                        | 器件型号                          | 封装参考                                | 制造商           |
|----------------------------------|----|--------|-------------------------------------------------------------------------------------------|-------------------------------|-------------------------------------|---------------|
| C64                              | 1  | 47μF   | 电容, 陶瓷, 47μF, 6.3V, ±20%, X5R, 0603                                                       | CL10A476MQ8QRNC               | 0603                                | Samsung       |
| C65、C66                          | 2  | 0.22μF | 电容, 陶瓷, 0.22μF, 16V, ±10%, X7R, 0402                                                      | CC0402KRX7R7BB224             | 0402                                | Yageo         |
| C76、C77                          | 2  | 1μF    | 电容, 陶瓷, 1μF, 10V, ±20%, X5R, 0402                                                         | CC0402MRX5R6BB105             | 0402                                | Yageo America |
| D1、D2                            | 2  | 40V    | 二极管, 肖特基, 40V, 0.12A, AEC-Q101, SOT-323                                                   | BAS40-05W,115                 | SOT-323                             | Nexperia      |
| FID1、FID2、FID3                   | 3  |        | 基准标记。没有需要购买或安装的元件。                                                                        | 基准                            | Fiducial10-30                       | 不适用           |
| H1、H2                            | 2  |        | 垫片支架, 尼龙 66                                                                               | MAE-10                        | KY_MAE-10                           | Kang Yang     |
| IC1、IC5                          | 2  |        | 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, 无镉/溴)            | TPD4E004DRYR                  | DRY0006A                            | 德州仪器 (TI)     |
| IC2                              | 1  |        | 精密低功耗并联电压基准、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                | DCK0005A_N                          | 德州仪器 (TI)     |
| IC3                              | 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                   | DBV0005A_N                          | 德州仪器 (TI)     |
| IC4、U3                           | 2  |        | 用于高速数据接口的低电容 ±15kV ESD 保护阵列, 6 通道, -40°C 至 85°C, 8 引脚 UQFN (RSE), 绿色环保 (符合 RoHS 标准, 无镉/溴) | TPD6E004RSER                  | RSE0008A                            | 德州仪器 (TI)     |
| IC6                              | 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                  | DRB0008A                            | 德州仪器 (TI)     |
| J1/J3                            | 1  |        | 插座, 2.54mm, 10x2, 锡, TH                                                                   | NS-203-SH0135-203S-Y-2*10P(F) | BoosterPack_40pin_J1J3              | NS-TECH       |
| J2/J4                            | 1  |        | 插座, 2.54mm, 10x2, 锡, TH                                                                   | NS-203-SH0135-203S-Y-2*10P(F) | BoosterPack_40pin_J2J4              | NS-TECH       |
| J5                               | 1  |        | 接头, 100mil, 3x1, 锡, TH                                                                    | NS-201-SH0385-201S-1*3P(F)    | PEC03SAAN_Launchpad_3V3             | NS-TECH       |
| J6、J8、J9、J10、J11、J12、J13、J22、J23 | 9  |        | 接头, 100mil, 2x1, 锡, TH                                                                    | NS-201-SH0386-201S-1*2P(F)    | CONN_90120-0122                     | NS-TECH       |
| J7                               | 1  |        | 接头, 100mil, 3x1, 锡, TH                                                                    | NS-201-SH0385-201S-1*3P(F)    | PEC03SAAN_Launchpad_5V0             | NS-TECH       |
| J14、J15、J24、J25                  | 4  |        | 接头, 100mil, 3x1, 锡, TH                                                                    | NS-201-SH0385-201S-1*3P(F)    | CONN_PEC03SAAN                      | NS-TECH       |
| J16                              | 1  |        | 9 (8 + 1) 位置卡连接器安全数字 - microSD™ 表面贴装、直角镀金                                                 | TF CFARD 1.85H PUSH_PUSH      | FP-693071010811_CONN_SMT_MEMORY-MFG | ZEGECC        |

表 4-1. 物料清单 (续)

| 位号                                     | 数量 | 值     | 说明                                                                | 器件型号                        | 封装参考                       | 制造商           |
|----------------------------------------|----|-------|-------------------------------------------------------------------|-----------------------------|----------------------------|---------------|
| J20                                    | 1  |       | 接头, 100mil, 4x2, 锡, TH                                            | NS-201-SH0384-201S-2*4P(F)  | CONN_PEC04DAAN             | NS-TECH       |
| J101                                   | 1  |       | 接头, 2.54mm, 10x2, 锡, TH                                           | NS-201-SH0384-201S-2*10P(F) | SULLINS_PEC10DAAN          | NS-TECH       |
| J102、J103                              | 2  |       | 接头 (有罩), 1.27mm, 5x2, 金, SMT                                      | FTSH-105-01-L-DV-K          | Samtec_FTSH-105-01-x-DV-K  | Samtec        |
| J104、J105                              | 2  |       | 充电器中采用的 16 引脚 USB C 连接器, 顶部贴装型, 壳高 1.63, 长度 6.9, USB Type-C 连接器   | MUP-U20405                  | FP-MUP-U20405_USB_CONN-MFG | MUP           |
| L1                                     | 1  | 2.2μH | 电感, 绕线型, 陶瓷, 2.2μH, 0.89A, 0.13 Ω, SMD                            | CBC2518T2R2M                | CBC2518                    | Taiyo Yuden   |
| LED1、LED3、LED101                       | 3  | 红色    | LED, 红色, SMD                                                      | LTST-C190KRKT               | 1111C_Red                  | Lite-On       |
| LED2                                   | 1  | RGB   | LED, RGB, SMD                                                     | 19-337/R6GHBHC-A01/2T       | 19-337_RGB                 | Everlight     |
| LED102                                 | 1  | 绿色    | LED, 绿色, SMD                                                      | LTST-C190GKT                | LED_LTST-C190              | Lite-On       |
| MSP1                                   | 1  |       | 具有 USB 2.0-FS 接口的混合信号微控制器                                         | MSPM0G5187SPMR              | PM0064A-MFG                | 德州仪器 (TI)     |
| R1、R2、R40、R42、R43、R44                  | 6  | 47k   | 电阻, 47k, 5%, 0.063W, 0402                                         | AC0402JR-0747KL             | 0402                       | Yageo         |
| R3、R23、R29、R31、R33、R35、R36、R38、R80、R84 | 10 | 0     | 电阻, 0, 5%, 0.1W, 0603                                             | RC0603JR-070RL              | 0603                       | Yageo         |
| R4、R57、R58、R76                         | 4  | 470   | 电阻, 470, 5%, 0.063W, 0402                                         | AC0402JR-07470RL            | 0402                       | Yageo         |
| R5                                     | 1  | 220   | 电阻, 220, 5%, 0.063W, 0402                                         | AC0402JR-07220RL            | 0402                       | Yageo         |
| R6、R7                                  | 2  | 330   | 电阻, 330, 5%, 0.063W, 0402                                         | AC0402JR-07330RL            | 0402                       | Yageo         |
| R8                                     | 1  |       | 电阻薄膜, 0402, 100K Ω, 0.1%, 1/16W, ±25ppm/°C, 模制 SMD, SMD 穿孔载体, T/R | AT0402BRD07100KL            | FP-ERA-2AEB104X_0402-MFG   | Yageo         |
| R12、R15、R27                            | 3  | 4.7k  | 电阻, 4.7k, 5%, 0.1W, 0603                                          | RC0603JR-074K7L             | 0603                       | Yageo         |
| R13、R18                                | 2  | 270   | 电阻, 270, 5%, 0.063W, 0402                                         | CRCW0402270RJNED            | 0402                       | Vishay-Dale   |
| R16、R19                                | 2  | 2.2k  | 电阻, 2.2k, 5%, 0.1W, 0603                                          | RC0603JR-072K2L             | 0603                       | Yageo         |
| R22、R37、R39、R41                        | 4  | 0     | 电阻, 0, 5%, 0.063W, 0402                                           | RC0402JR-070RL              | 0402                       | Yageo America |
| R26                                    | 1  | 47k   | 电阻, 47k, 5%, 0.1W, 0603                                           | RC0603JR-0747KL             | 0603                       | Yageo         |
| R28、R30、R32、R34                        | 4  | 22.0  | 电阻, 22.0, 1%, 0.1W, 0603                                          | RC0603FR-0722RL             | 0603                       | Yageo         |
| R45、R85                                | 2  | 330k  | 电阻, 330k, 1%, 0.0625W, 0402                                       | RC0402FR-07330KL            | 0402                       | Yageo America |
| R46、R64、R65、R71、R72、R79、R82、R87        | 8  | 220k  | 电阻, 220k, 1%, 0.0625W, 0402                                       | RC0402FR-07220KL            | 0402                       | Yageo America |

表 4-1. 物料清单 ( 续 )

| 位号              | 数量 | 值     | 说明                                                                                        | 器件型号                       | 封装参考                           | 制造商               |
|-----------------|----|-------|-------------------------------------------------------------------------------------------|----------------------------|--------------------------------|-------------------|
| R47、R48         | 2  | 56.0k | 电阻, 56.0k, 1%, 0.063W, AEC-Q200 0 级, 0402                                                 | RK73H1ETTP5602F            | 0402                           | PANASONIC ( 松下 )  |
| R49、R50、R86、R88 | 4  | 5.11k | 电阻, 5.11k, 1%, 0.063W, AEC-Q200 0 级, 0402                                                 | AC0402FR-075K11L           | 0402                           | Yageo             |
| R51             | 1  | 1.0k  | 电阻, 1.0k, 5%, 0.1W, AEC-Q200 0 级, 0402                                                    | ERJ-2GEJ102X               | 0402                           | Panasonic         |
| R52、R53、R54、R62 | 4  | 1.0k  | 电阻, 1.0k, 5%, 0.063W, 0402                                                                | AC0402JR-071KL             | 0402                           | Yageo             |
| R56、R61         | 2  | 100   | 电阻, 0, 5%, 0.063W, AEC-Q200 0 级, 0402, 电阻, 100, 5%, 0.063W, 0402                          | AC0402JR-07100RL           | 0402                           | Yageo             |
| R59、R89、R90     | 3  | 10k   | 电阻, 10k, 5%, 0.063W, 0402                                                                 | AC0402JR-0710KL            | 0402                           | Yageo             |
| R60             | 1  | 4.87k | 电阻, 4.87k, 1%, 0.063W, AEC-Q200 0 级, 0402                                                 | AC0402FR-074K87L           | 0402                           | Yageo             |
| R63             | 1  | 51    | 电阻, 51, 5%, 0.063W, AEC-Q200 0 级, 0402                                                    | AC0402JR-0751RL            | 0402                           | Yageo             |
| R66、R83         | 2  | 3.30k | 电阻, 3.30k, 1%, 0.1W, AEC-Q200 0 级, 0402                                                   | AC0402FR-073K3L            | 0402                           | Yageo             |
| R67             | 1  | 2.20k | 电阻, 2.20k, 1%, 0.063W, 0402                                                               | RMCF0402FT2K20             | 0402                           | Stackpole         |
| R68             | 1  | 6.81k | 电阻, 6.81k, 1%, 0.063W, 0402                                                               | AC0402FR-076K81L           | 0402                           | Yageo             |
| R69、R70         | 2  | 4.7k  | 电阻, 4.7k, 5%, 0.063W, 0402                                                                | AC0402JR-074K7L            | 0402                           | Yageo             |
| R73、R74、R77     | 3  | 47.0k | 电阻, 47.0k, 1%, 0.0625W, 0402                                                              | RC0402FR-0747KL            | 0402                           | Yageo America     |
| R75             | 1  | 820   | 电阻, 820, 1%, 0.063W, 0402                                                                 | RC0402FR-07820RL           | 0402                           | Yageo America     |
| S1、S2、S3        | 3  |       | 开关, SPST, 0.05A, 12VDC, SMD                                                               | THBM02-LAB                 | SW_1188E                       | HONGJU            |
| T1              | 1  | -20V  | MOSFET, P 沟道, -20V, -0.82A, SOT-323                                                       | DMG1013UW-7                | SOT-323                        | Diodes Inc.       |
| T2              | 1  | 45V   | 晶体管, NPN, 45V, 0.1A, SOT-323                                                              | BC850CW,115                | SOT-323                        | NXP Semiconductor |
| U1              | 1  |       | 立体声通道、32 位、192kHz Burr-Brown 音频 ADC                                                       | PCM1809IRTER               | RTE0020A-MFG                   | 德州仪器 (TI)         |
| U2              | 1  |       | 具有差分输出的超低噪声麦克风, LGA-4                                                                     | ICS-40720                  | LGA_CAV-4                      | InvenSense        |
| XDS1            | 1  |       | MSP432E401YTPDT、PDT0128A (TQFP-128)                                                       | MSP432E401YTPDTR           | PDT0128A                       | 德州仪器 (TI)         |
| XDS2            | 1  |       | MSP430G2x52、MSP430G2x12 混合信号微控制器, RSA0016B (VQFN-16)                                      | MSP430G2452IRSA16R         | RSA0016B                       | 德州仪器 (TI)         |
| Y1              | 1  |       | 晶振, 32.768KHz, 12.5pF, SMD                                                                | X1A0001410014              | Epson_FC-135                   | Epson             |
| Y2              | 1  |       | 晶振 40MHz $\pm 10$ ppm (Tol) $\pm 20$ ppm ( 稳定性 ) 12pF FUND 40 $\Omega$ 4 引脚 Mini-CSMD T/R | ECS-400-12-33Q-JEN-TR      | FP-X1E0000210179_TSX-322 5-MFG | ECS               |
| Y3              | 1  |       | 晶振, 16MHz, 8pF, SMD                                                                       | NX3225GA-16.000M-STD-CRG-1 | NDK_NX3225GA                   | NDK               |

表 4-1. 物料清单 (续)

| 位号     | 数量 | 值            | 说明                  | 器件型号   | 封装参考         | 制造商     |
|--------|----|--------------|---------------------|--------|--------------|---------|
| SH-J1  | 1  | J101 : 1-2   | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J2  | 1  | J101 : 3-4   | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J3  | 1  | J101 : 5-6   | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J4  | 1  | J101 : 7-8   | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J5  | 1  | J101 : 9-10  | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J6  | 1  | J101 : 11-12 | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J7  | 1  | J101 : 12-13 | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J8  | 1  | J101 : 15-16 | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J9  | 1  | J101 : 17-18 | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J10 | 1  | J101 : 19-20 | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J11 | 1  | J8 : 1-2     | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J12 | 1  | J9 : 1-2     | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J13 | 1  | J10 : 1-2    | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J14 | 1  | J11 : 1-2    | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J15 | 1  | J12 : 1-2    | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J16 | 1  | J13 : 1-2    | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J17 | 1  | J14 : 2      | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J18 | 1  | J15 : 2      | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J19 | 1  | J23 : 1-2    | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J20 | 1  | J24 : 1-2    | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J21 | 1  | J25 : 1-2    | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J22 | 1  | J26 : 1-2    | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |
| SH-J23 | 1  | J6 : 1-2     | 分流器, 100mil, 镀金, 黑色 | 2228CG | SNT-100-BK-G | Nextron |



## 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 instructions, 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](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.

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#### 4 EVM Use Restrictions and Warnings:

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

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

##### 4.3 Safety-Related Warnings and Restrictions:

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

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

#### 6. Disclaimers:

6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

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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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