

EVM User's Guide: LP-MSPM0H3216

LP-MSPM0H3216 Evaluation Module



Description

The MSPM0H3216 LaunchPad™ development kit is an easy-to-use evaluation module for the MSPM0H3216 microcontroller (MCU). The LaunchPad kit contains everything needed to start developing on the MSPM0H321x microcontroller platform, including an onboard debug probe for programming and debugging. The board also features on board buttons, LEDs, and an RGB LED for quick integration of a simple user interface.

The MSPM0H3216 is an Arm® Cortex® 32-bit M0+ CPU with a frequency up to 32MHz. The device features 64KB of embedded flash memory combined with 8KB of on-chip RAM.

Get Started

1. Order the [LP-MSPM0H3216](#) from ti.com.
2. Navigate to [dev.ti.com](#) to browse for code examples.
3. Plug LP-MSPM0H3216 into a PC with the provided USB cable.
4. Download code directly from the browser to the MSPM0H3216 with CCS Cloud.
5. Download [CCS Theia](#) for a desktop integrated development environment.

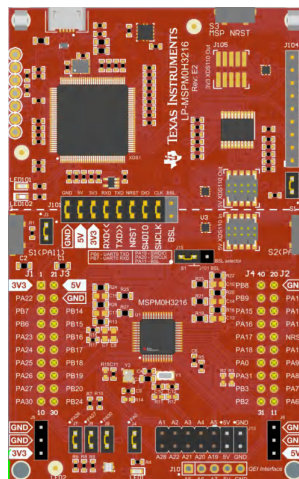
6. Download the [MSPM0 SDK](#) for desktop stored examples, demos, and software libraries.

Features

- Onboard XDS110 debug probe
- Backchannel UART through USB to PC
- USB powered
- 40-pin BoosterPack headers
- RC filter for ADC input
- Hardware user interfaces
 - Two buttons; 1 RGB LED, 1 Red LED
- External clock crystals

Applications

- [Battery charging and management](#)
- [Power supplies and power delivery](#)
- [Personal electronics](#)
- [Building security and fire safety](#)
- [Connected peripherals and printers](#)
- [Energy infrastructure](#)
- [Communication modules](#)
- [Medical and healthcare](#)
- [Lighting](#)



LP-MSPM0H3216

1 Evaluation Module Overview

1.1 Introduction

The MSPM0H3216 is a low-cost 5V microcontroller from the MSPM0 family based on the Arm(r) Cortex-M(r) M0+ processors architecture. The device can be used in a variety of tasks from simple housekeeping MCU to simple motor control. The easiest way to get started with MSPM0H3216 is with the LP-MSPM0H3216 LaunchPad. The LaunchPad has all the features to load code, debug, and prototype right out of the box.

Rapid prototyping is simplified by the 40-pin BoosterPack™ plug-in module headers, which support a wide range of available BoosterPack plug-in modules. Users can quickly add features like wireless connectivity, graphical displays, environmental sensing and much more. Design your own BoosterPack plug-in module or choose among many already available from TI and third-party developers.

To make prototyping easier, TI provides the MSPM0 software development kit (SDK) which has a variety of code examples to demonstrate how to use the internal peripherals.

Free software development tools are also available, such as TI's [Code Composer Studio™ IDE](#). We also support 3rd party IDEs such as [IAR Embedded Workbench® IDE](#) and [Arm®Keil®µVision® IDE](#). Code Composer Studio IDE supports [EnergyTrace technology](#) with the MSPM0H3216 LaunchPad development kit. More information about the LaunchPad development kit, the supported BoosterPack plug-in modules, and the available resources can be found at TI's [LaunchPad development kit portal](#). To get started quickly and find available resources in the MSPM0 software development kit (SDK), visit the [TI Developer Zone](#). The MSPM0 MCUs are also supported by extensive online collateral, training with [MSPM0 Academy](#) and online support through the [TI E2E support forums](#).

1.2 Kit Contents

- LP-MSPM0H3216 LaunchPad development kit
- USB cable
- Quickstart guide

1.3 Specification

LP-MSPM0H3216 is designed to be used in conjunction with a PC, Mac®, or Linux® workstation running Code Composer Studio (CCS). CCS can run as a stand-alone on a workstation or be accessed through the web (CCS Cloud) without the need for a software installation. Alternatively, LP-MSPM0H3216 ships with an example loaded, which can be controlled by a GUI. See the out of box description below.

The device can be powered from a power supply other than the build in USB power supply. This allows the user to forgo the PC connection. Power can be applied directly either to the 5V rail. When using an external power supply, make sure to not exceed 5V. Programming can be done externally with a separate XDS110 external debugger utilizing the on board Arm 10-pin connector.

1.4 Device Information

LP-MSPM0H3216 uses the following devices from Texas Instruments.

Table 1-1. Device Information

Device Name	Description	Purpose
MSP432E401YTPDT	SimpleLink™ 32-bit ARM Cortex-M4F MCU with Ethernet™, CAN, 1MB Flash and 256kB RAM	XDS110 Host Device
LSF0108PWR	Octal bidirectional multi-voltage-level translator	Level shifting between 3.3V and 5V
TPD4E004RSER	ESD-protection array for high-speed data interfaces, 4 channels	Protect LP-MSPM0H3216 from ESD damage through USB connector
TPS73533DRBT	500mA, adjustable, low quiescent current, low-noise, high-PSRR, single-output LDO regulator	3.3V power XDS110
MSPM0H3216SPTR	Mixed-signal Microcontroller with 32MHz Arm® Cortex®32-bit-M0+ CPU, 64kB flash, and 8kB SRAM	Evaluation device

2 Hardware

2.1 Hardware Overview

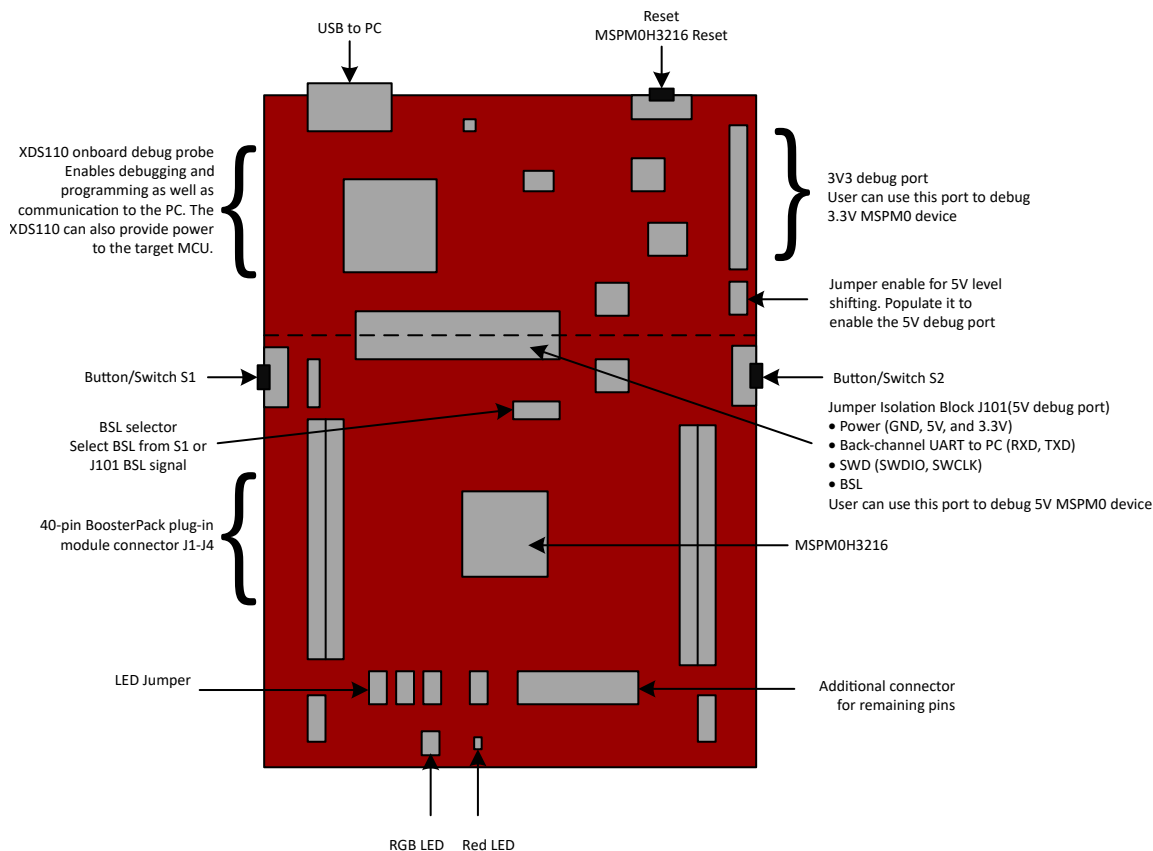


Figure 2-1. Diagram of LP-MSPM0H3216 Jumpers and Connectors

LP-MSPM0H3216 has many hardware features, which allow the user full access to the MSPM0H3216 pins, while still providing onboard connectivity for easy use. Shunt connections provide a way for the user to easily change LaunchPad configuration. The location of these shunts is shown in [Figure 2-1](#). The connection of each shunt is described in [Table 2-1](#). The default configuration is to have all shunts populated.

Table 2-1. Jumper Information

Jumper	Description	Default Setting	Connected Signal
J3	BSL Button	Populated	PA11: 47kΩ pull down resistor, switch pulls up to 5V
J4	Red LED connection	Populated	5V through LED and 680Ω resistor to PA0
J7	RGB Blue Connection	Populated	PB20 through 330Ω resistor and LED to ground.
J8	RGB Red Connection	Populated	PB24 through 510Ω resistor and LED to ground
J9	RGB Green Connection	Populated	PA30 through 510Ω resistor and LED to ground
J15	BSL selector	Left and center connection	BSL invoke by BSL button or J101 BSL signal depending on setting

2.3 XDS110 Debug Probe

LP-MSPM0H3216 features an onboard debug probe to streamline prototyping. The debugger used on this LaunchPad is the XDS110 variant with 5 V level-shifting, which supports 5V MSPM0 device derivatives. The integrated XDS110 debug probe is separated from the rest of the MSPM0H3216 circuitry, which is shown by the dashed silkscreen on the LaunchPad. The XDS110 is only connected through signals that pass through J101, in addition to a common ground.

Isolation Jumper Block

The isolation jumper block J101 allows the user to connect or disconnect signals that cross from the XDS110 domain into the MSPM0H3216 target domain. This includes XDFS110 SWD signals, application UART signals, 3.3V and 5.5V power, reset, and BSL invoke signal.

Jumper	Description
5V	5V rail from the USB
3V3	3.3V rail from the LDO
RXD<<	Backchannel UART: The target MSPM0H3216 receives data through this signal. The arrows indicate the direction of the signal.
TXD>>	Backchannel UART: The target MSPM0H3216 sends data through this signal. The arrows indicate the direction of the signal.
NRST	Reset signal
SWDIO	Serial Wire Debug: SWDIO data signal.
SWCLK	Serial wire debug: SWCLK clock signal.
BSL	Invoke pin for bootstrap loader. Allows the XDS110 to invoke BSL.

During normal prototyping all shunts except BSL are populated. However, there are some scenarios where a user needs to change these connections:

- To remove any and all influence from the XDS110 debug probe for high accuracy target power measurements
- To control 3.3V and 5V power flow between the XDS110 and target domains
- To expose the target MCU pins for other use than onboard debugging and application UART communication.
- To expose the programming and UART interface for the XDS110 so that the XDS110 can be used for devices other than the onboard MCU.
- To select the BSL signal instead of BSL button to invoke the bootstrap loader.

Application (*Backchannel*) UART

The backchannel UART allows communication with the USB host that is not part of the target application's main functionality. This is very useful during development, and also provides a communication channel to the PC host side. This can be used to create graphical user interfaces (GUIs) and other programs on the PC that communicate with the LaunchPad development kit.

On the host side, a virtual COM port for the application backchannel UART is generated when the LaunchPad development kit enumerates on the host. You can use any PC application that interfaces with COM ports, including terminal applications like HyperTerminal or Docklight, to open this port and communicate with the target application. You need to identify the COM port for the backchannel. On Windows PCs, Device Manager can assist.

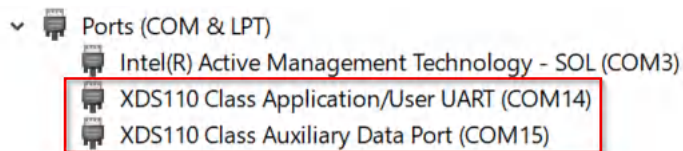


Figure 2-3. Application Backchannel UART in Device Manager

The backchannel UART is the *XDS110 Class Application/User UART* port. In this case, [Figure 2-3](#) shows COM14, but this port can vary from one host PC to the next. After identifying the correct COM port, configure the port in the host application according to documentation. The user can then open the port and begin communication from the host.

On the target MSPM0H3216 side, the backchannel UART is connected to UART0 (PB6, PB7). The XDS110 has a configurable baud rate; therefore, the PC application configuring the baud rate needs to be the same baud rate.

2.4 Measure Current Draw of the MSPM0H3216

To measure the current draw of the MSPM0H3216 MCU using a multimeter, use the 5V jumper on the J101 jumper isolation block. The current measured includes the target device, LaunchPad circuits, and any current drawn through the BoosterPack plug-in module headers. To measure ultra-low power, follow these steps:

- Remove the 5V jumper in the J101 isolation block, and attach an ammeter across this jumper.
- Consider the effect that the backchannel UART and any circuitry attached to the MSPM0H3216 can have on the current draw. Consider disconnecting these at the isolation jumper block, or at least consider the current sinking and sourcing capability in the final measurement.
- Make sure there are no floating inputs/outputs (I/Os) on the MSPM0H3216. This causes unnecessary extra current draw. Every I/O is either driven or, if the I/O is an input, is pulled or driven to a high or low level.
- Begin target execution.
- For the most accurate current measurements, place the device in Free Run mode and disconnect programming signals between the MSPM0H3216 and the debug portion of the board (header J101).
- Measure the current. Keep in mind that if the current levels are fluctuating, then getting a stable measurement can be difficult. Measuring the quiescent states is easier.

2.5 Clocking

The internal SYSOSC is 32MHz as default at the accuracy of 2.5%. The MCLK is sourced by 32MHz SYSOSC at default. CPUCLK is sourced directly from MCLK in RUN mode and disabled in other modes. The low-power clock (ULPCLK) can be sourced by MCLK and active in RUN and SLEEP mode by configuration. The part also includes an internal 32kHz oscillator, LFOSC, which is the default low frequency source. Included on the LaunchPad are two clock crystal options, 1 high-frequency 32MHz crystal (HFXT) and 1 low-frequency 32.728kHz crystal (LFXT). The crystals can be selected during application programming as the clock source for the high frequency and low frequency clocks.

For more clock tree details see Section 2.3 *Clock Module (CKM)* of the [MSPM0 H-Series Microcontrollers Technical Reference Manual](#).

2.6 BoosterPack Plug-in Module Pinout

The LaunchPad development kit adheres to the 40-pin LaunchPad development kit pinout standard, where pins are available. A standard was created to aid compatibility between LaunchPad development kits and BoosterPack plug-in modules across the TI ecosystem.

While most BoosterPack plug-in modules are compliant with the standard, some are not. If the reseller or owner of the BoosterPack plug-in module does not explicitly indicate compatibility with the MSPM0H3216 LaunchPad development kit, then compare the schematic of the candidate BoosterPack plug-in module with the LaunchPad development kit to verify compatibility. Conflicts can be resolved by changing the MSPM0H3216 device pin function configuration in software.

3 Software

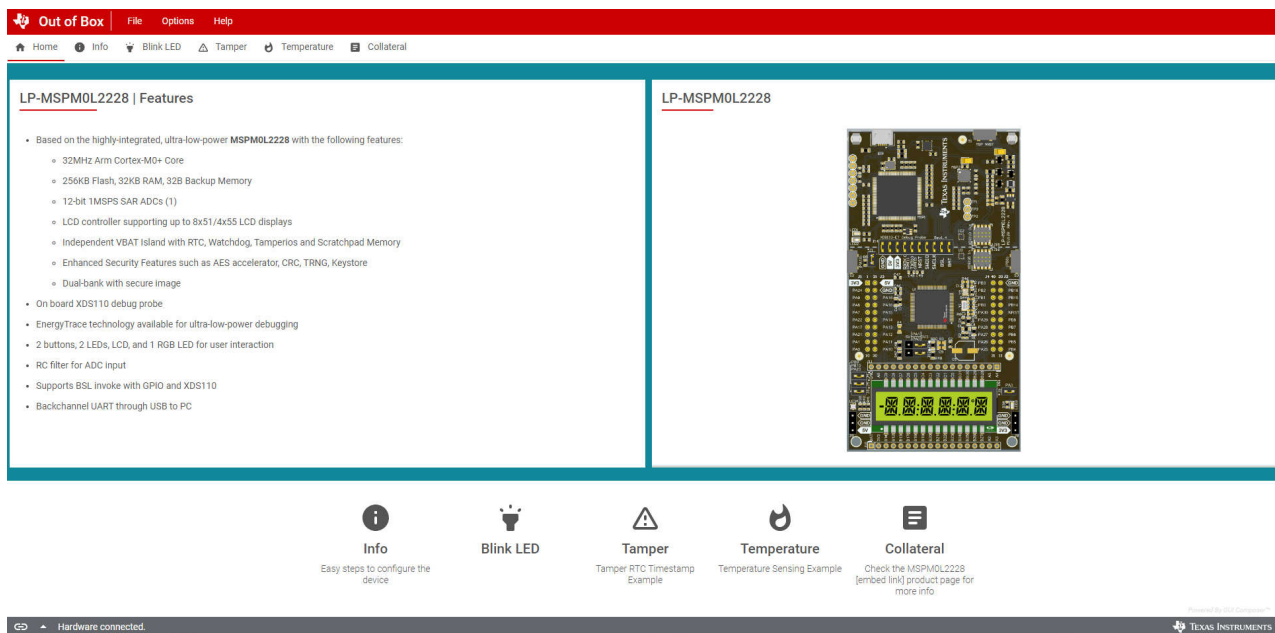
3.1 Software Development Options

There are multiple ways to prototype with LP-MSPM0H3216:

1. **Out-of-box GUI** - Choose this option for an easy demo of LP-MSPM0H3216.
Highlighting the LCD and VBAT features. (*Coming soon*)
2. **CCS Cloud** - Choose this option to get started quickly with minimal installation.
3. **CCS Theia** - Choose this option to work offline and have full access to debug features. See CCS Theia documentation to get started.
4. **CCS Eclipse** - This option is supported but is a legacy tool and is not covered in this guide.

3.2 Out-of-Box GUI

Get started with the out-of-box example on LP-MSPM0H3216. Simply navigate to the [Out-of-Box GUI](#) and plug in LP-MSPM0H3216 to a PC, Mac, or Linux workstation. This GUI provides control of the build in LED and a dashboard of the current state of LP-MSPM0H3216. Find instructions to start prototyping below.



3.3 CCS Cloud

1. Navigate to dev.ti.com. The user can be required to install CCS Cloud Agent. If so, then follow the steps to complete this installation.
2. Plug LP-MSPM0H3216 using a micro-USB cable. TI Developer Zone automatically detects that LP-MSPM0H3216 has been plugged in.
3. Click *Browse software and examples*, which opens the MSPM0 SDK in a new window.
4. In the left bar, navigate to Arm-based microcontrollers > Embedded Software > MSPM0 SDK > Examples > Development Tools > DriverLib > gpio_toggle_output > No RTOS > TI Clang Compiler > gpio_toggle_output.
5. Click the *Import* button in the top right corner of the screen. This action imports the project into CCS Cloud and open in a new window.
6. In CCS Cloud, click the debug icon in the left bar to open the debug view.
7. Click the *play* button to deploy the code to the device and open a debug session. By default, the debugger pauses the first line of code.
8. Click the blue *play* button to start the application.
9. The RGB LED on LP-MSPM0H3216 needs to be blinking.

Now, the user is ready to begin prototyping by modifying the code or by importing a different example code.

4 Hardware Design Files

4.1 Schematics

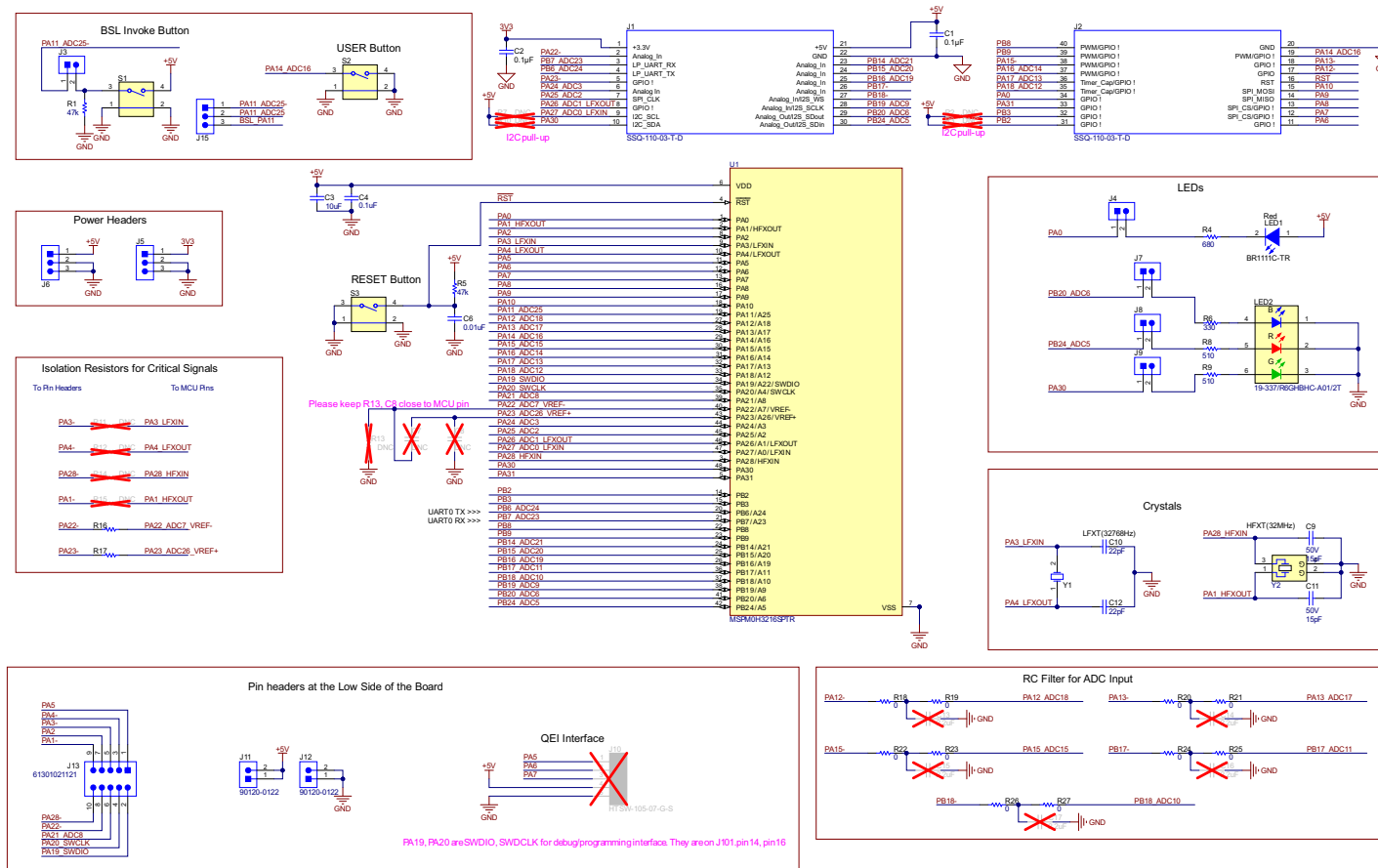


Figure 4-1. MSPM0H3216 Target Device Schematic

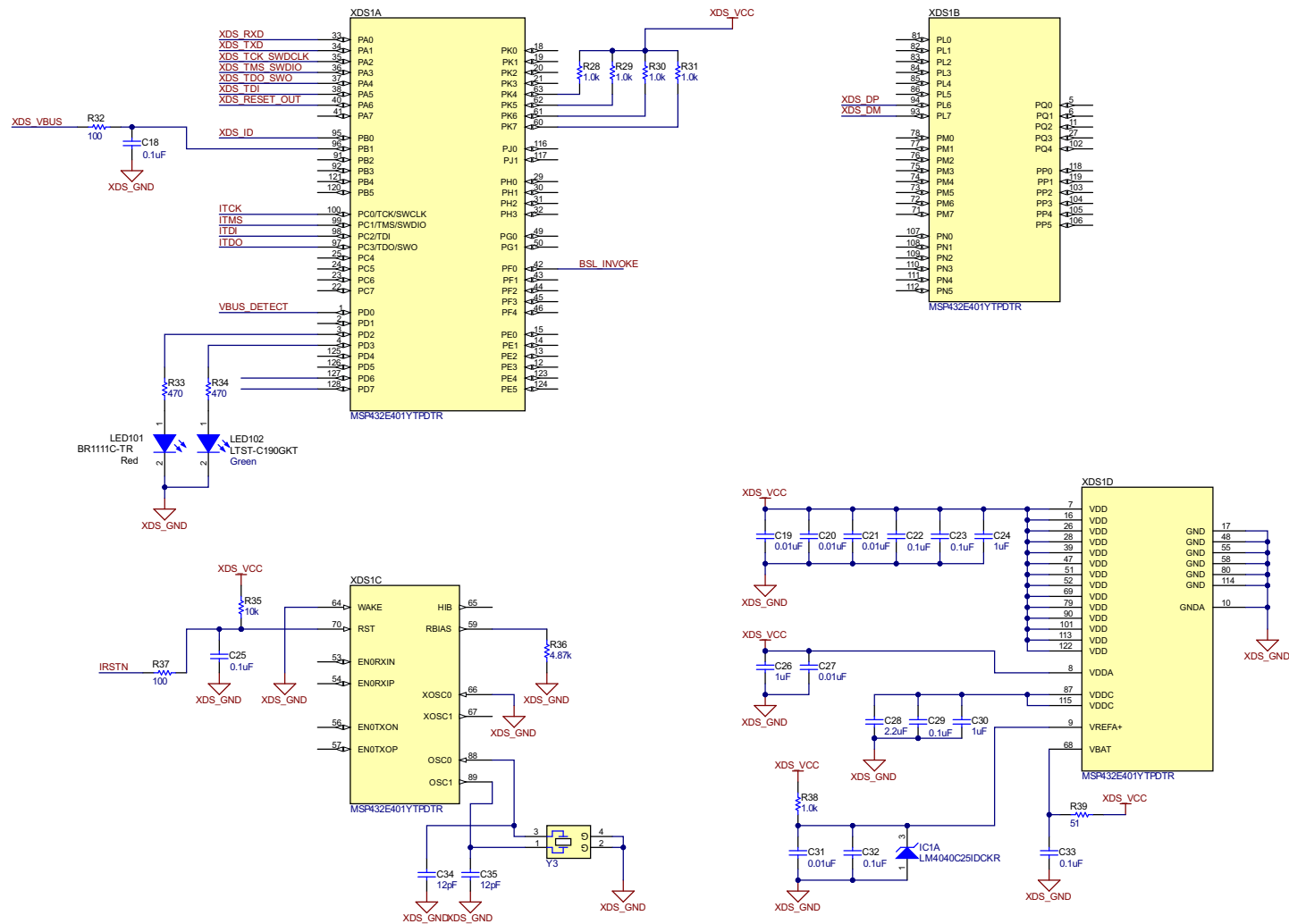


Figure 4-2. XDS110 Debug Probe Schematic

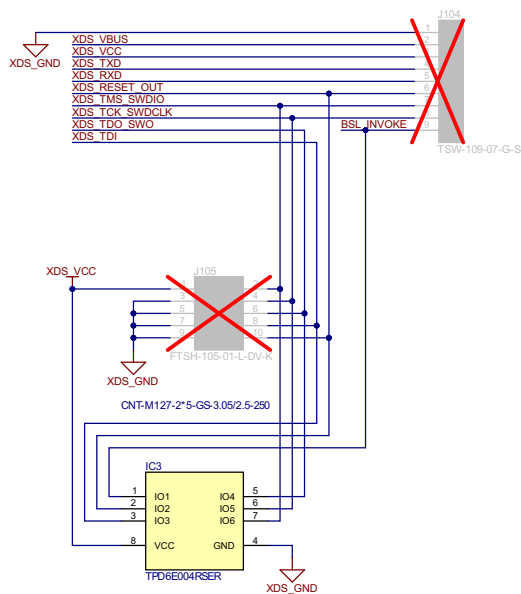


Figure 4-3. XDS110 Target Interface (3V3) Schematic

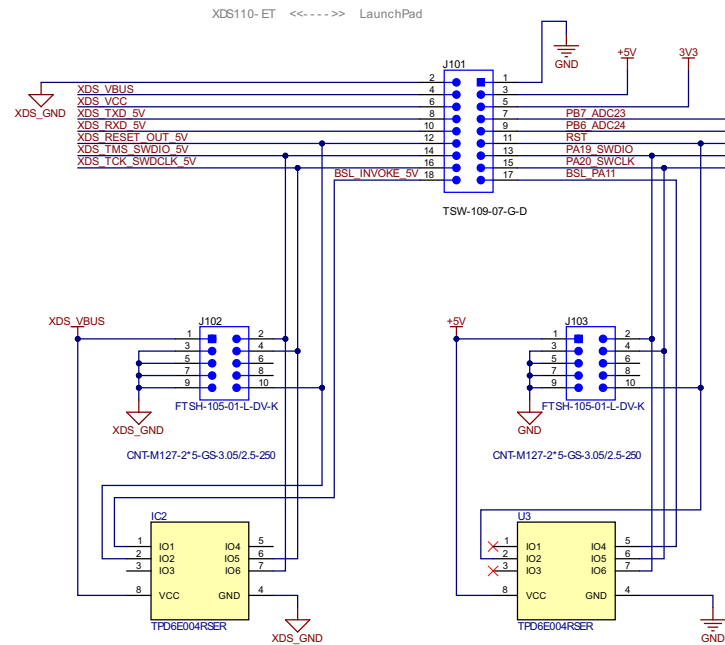
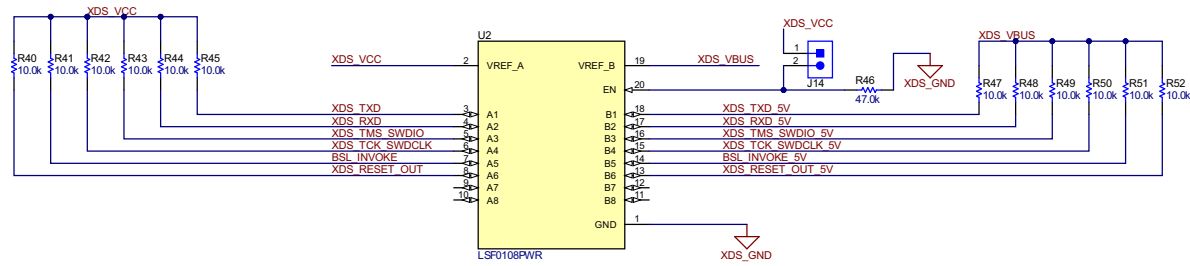


Figure 4-4. XDS110 Target Interface (5V) Schematic

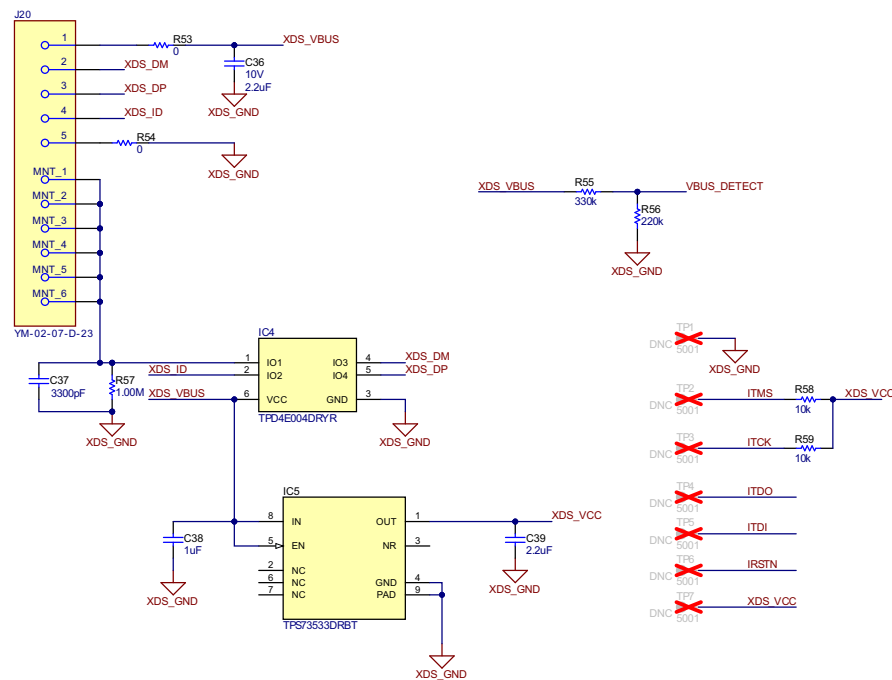


Figure 4-5. XDS110 USB Power Schematic

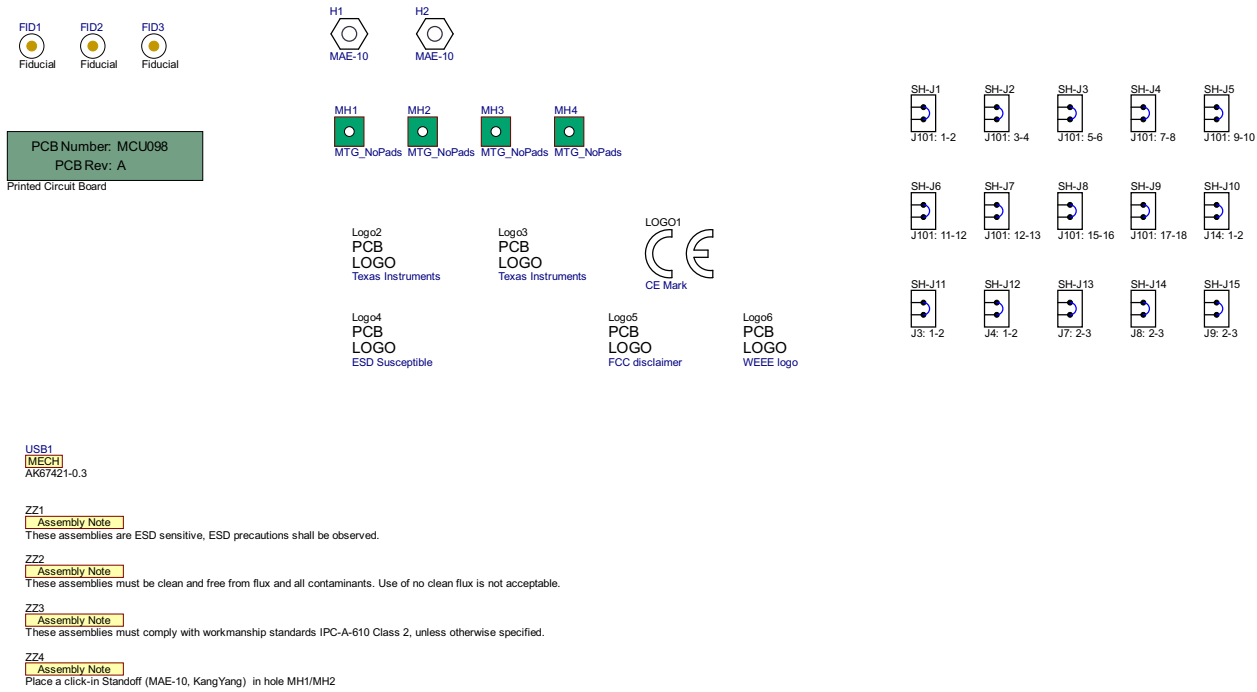


Figure 4-6. Hardware Schematic

4.2 PCB Layout

Layer 1: Top, signal

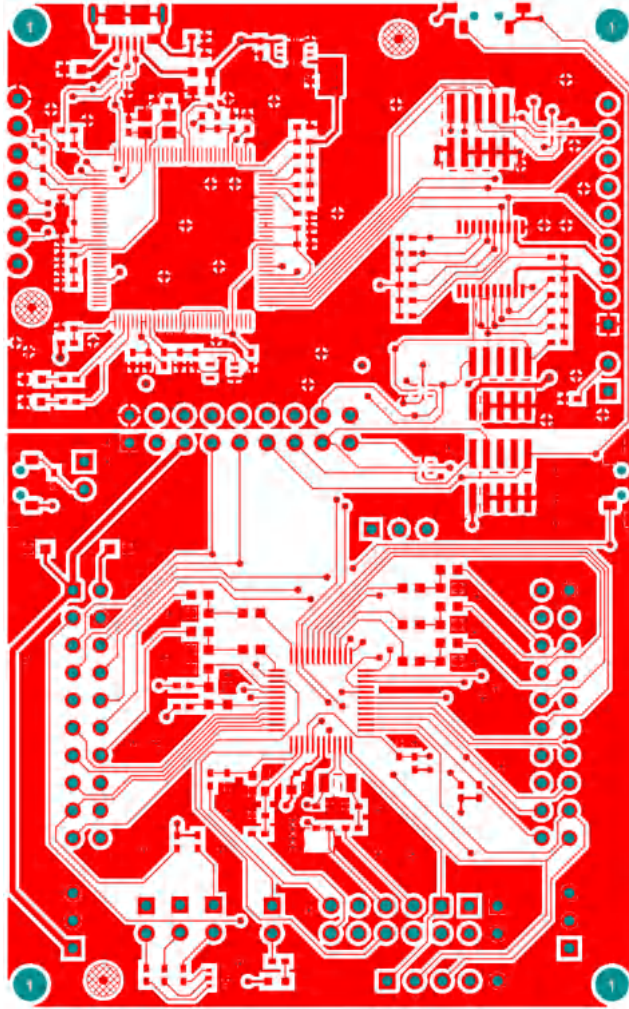


Figure 4-7. Layer 1: Top, signal and power

Layer 2: VDD

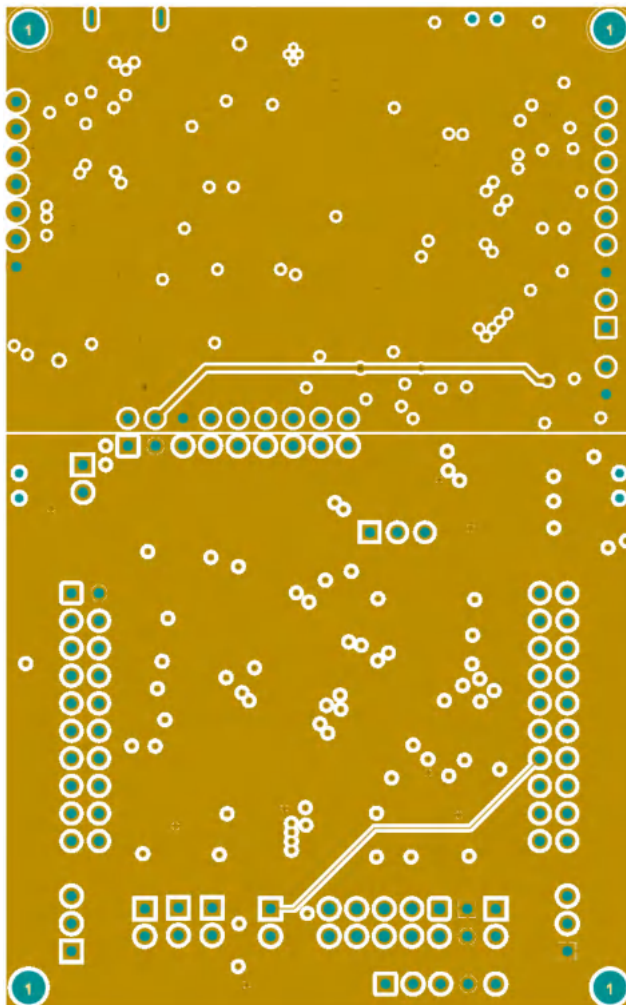


Figure 4-8. Layer 2: VDD

Layer 3: GND

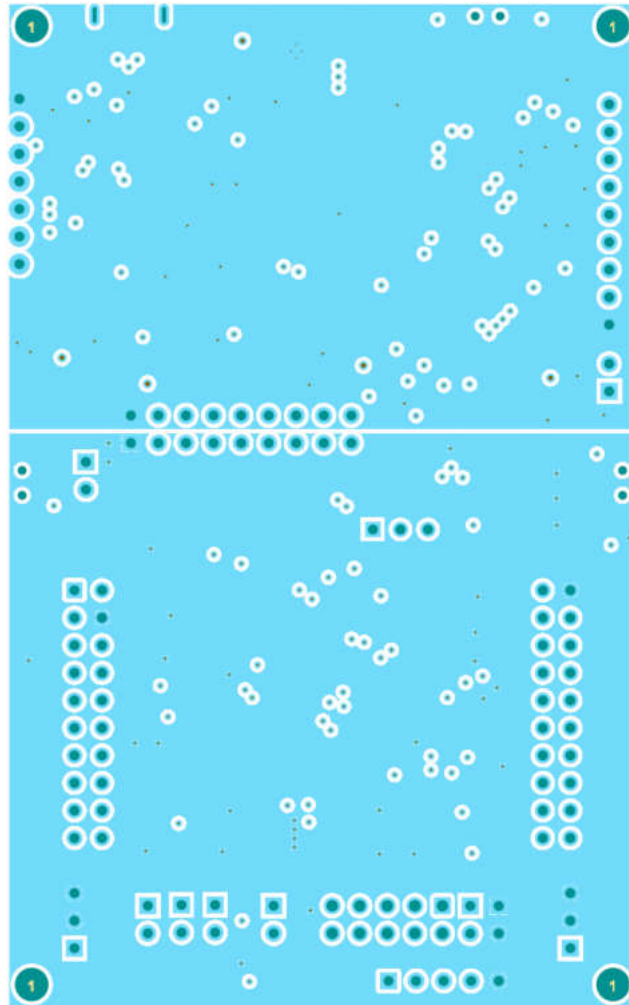


Figure 4-9. Layer 3: GND

Layer 4: Bottom, signal

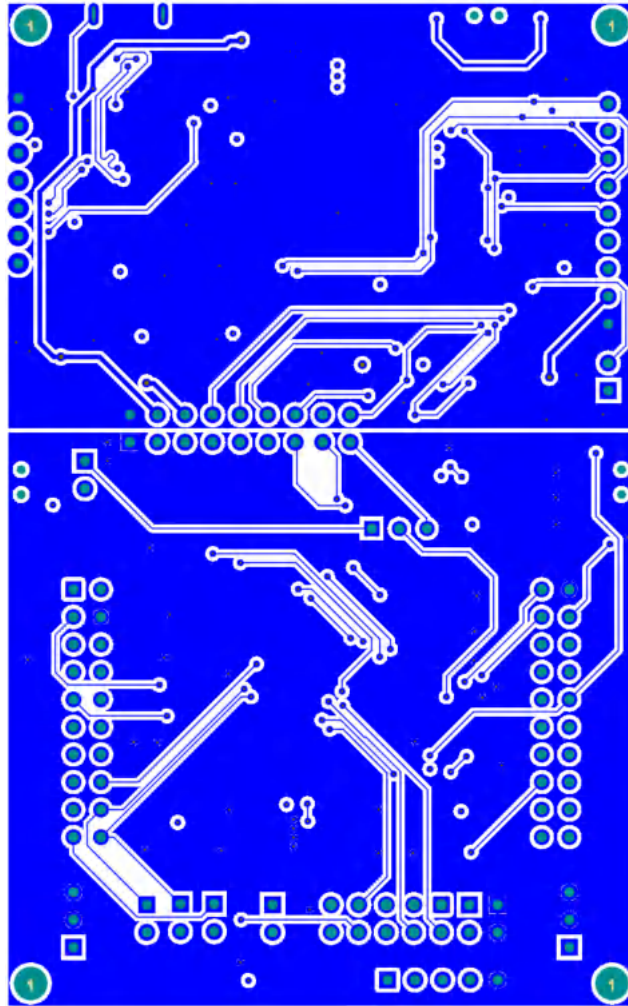


Figure 4-10. Layer 4: Bottom, signal

4.3 Bill of Materials (BOM)

Table 4-1. Bill of Materials

Designator	Quantity	Value	Description	Part Number	Manufacturer
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	15	J101: 1-2, J101: 3-4, J101: 5-6, J101: 7-8, J101: 9-10, J101: 11-12, J101: 12-13, J101: 15-16, J101: 17-18, J14: 1-2, J3: 1-2, J4: 1-2, J7: 2-3, J8: 2-3, J9: 2-3	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
R18, R19, R20, R21, R22, R23, R24, R25, R26, R27, R53, R54	12		RES, 0, 5%, 0.1 W, 0603	RC0603JR-070RL	Yageo
R40, R41, R42, R43, R44, R45, R47, R48, R49, R50, R51, R52	12	10.0k	RES, 10.0 k, .1%, .0625 W, 0402	RT0402BRD0710KL	Yageo America
C18, C22, C23, C25, C29, C32, C33	7	0.1uF	CAP, CERM, 0.1 uF, 6.3 V, +/- 10%, X7R, 0402	GRM155R70J104KA01D	MuRata
J3, J4, J7, J8, J9, J14	6		Header, 100mil, 2x1, Tin, TH	90120-0122	Molex
R28, R29, R30, R31, R38	5	1.0k	RES, 1.0 k, 5%, 0.063 W, 0402	CRCW04021K00JNED	Vishay-Dale
C19, C20, C21, C27, C31	5	0.01uF	CAP, CERM, 0.01 uF, 25 V, +/- 10%, X7R, 0402	GRM155R71E103KA01D	MuRata
C24, C26, C30, C38	4	1uF	CAP, CERM, 1 uF, 25 V, +/- 10%, X5R, 0402	C1005X5R1E105K050BC	TDK
S1, S2, S3	3		Switch, SPST, 0.05 A, 12 VDC, SMD	1188E-1K2-V-TR	Diptronics
R35, R58, R59	3	10k	RES, 10 k, 5%, 0.063 W, 0402	CRCW040210K0JNED	Vishay-Dale
FID1, FID2, FID3	3		Fiducial mark. There is nothing to buy or mount.	Fiducial	
IC2, IC3, U3	3		Low-Capacitance + / - 15 kV ESD Protection Array for High-Speed Data Interfaces, 6 Channels, -40 to +85 degC, 8-pin UQFN (RSE), Green (RoHS & no Sb/Br)	TPD6E004RSER	Texas Instruments
LED1, LED101	2	Red	LED, Red, SMD	BR1111C-TR	Stanley Electric Co., LTD
C9, C11	2	15pF	CAP, CERM, 15 pF, 50 V, +/- 5%, C0G/NP0, 0402	CC0402JRNPO9BN150	Yageo America
C1, C2	2	0.1uF	CAP, CERM, 0.1 uF, 25 V, +/- 10%, X5R, 0603	CL10A104KA8NNNC	Samsung Electro-Mechanics
R1, R5	2	47k	RES, 47 k, 5%, 0.063 W, 0402	CRCW040247K0JNED	Vishay-Dale
R32, R37	2	100	RES, 100, 5%, 0.063 W, AEC-Q200 Grade 0, 0402, RES, 100, 5%, 0.063 W, 0402	CRCW0402100RJNED	Vishay-Dale
R33, R34	2	470	RES, 470, 5%, 0.063 W, 0402	CRCW0402470RJNED	Vishay-Dale

Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	Part Number	Manufacturer
R8, R9	2	510	RES, 510, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW0402510RJNED	Vishay-Dale
J102, J103	2		Header(Shrouded), 1.27mm, 5x2, Gold, SMT	FTSH-105-01-L-DV-K	Samtec
C28, C39	2	2.2uF	CAP, CERM, 2.2 uF, 6.3 V, +/- 10%, X5R, 0402	GRM155R60J225KE95D	MuRata
C34, C35	2	12pF	CAP, CERM, 12 pF, 50 V, +/- 5%, C0G/NP0, 0402	GRM1555C1H120JA01D	MuRata
C10, C12	2	22pF	CAP, CERM, 22 pF, 50 V, +/- 5%, C0G/NP0, 0402	GRM1555C1H220JA01D	MuRata
H1, H2	2		Spacer Support, Nylon 66	MAE-10	Kang Yang
R16, R17	2	0	RES, 0, 5%, 0.063 W, 0402	RC0402JR-070RL	Yageo America
LED2	1	Rgb	LED, RGB, SMD	19-337/R6GHBHC-A01/2T	Everlight
USB1	1		Cable, USB-A to micro USB-B, 0.3 m	AK67421-0.3	Assman WSW
C36	1	2.2uF	CAP, CERM, 2.2 uF, 10 V, +/- 10%, X5R, 0603	C0603C225K8PACTU	Kemet
R57	1	1.00Meg	RES, 1.00 M, 1%, 0.063 W, 0402	CRCW04021M00FKED	Vishay-Dale
R36	1	4.87k	RES, 4.87 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW04024K87FKED	Vishay-Dale
R39	1	51	RES, 51, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW040251R0JNED	Vishay-Dale
R6	1	330	RES, 330, 5%, 0.063 W, 0402	CRCW0402330RJNED	Vishay-Dale
R4	1	680	RES, 680, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW0402680RJNED	Vishay-Dale
C6	1	0.01uF	CAP, CERM, 0.01 uF, 16 V, +/- 10%, X5R, 0402	GRM155R61C103KA01D	MuRata
C4	1	0.1uF	CAP, CERM, 0.1 uF, 50 V, +/- 20%, X5R, 0402	GRM155R61H104ME14D	MuRata
C37	1	3300pF	CAP, CERM, 3300 pF, 50 V, +/- 10%, X7R, 0402	GRM155R71H332KA01D	MuRata
C3	1	10uF	CAP, CERM, 10 uF, 6.3 V, +/- 20%, X5R, 0603	GRM188R60J106ME84	MuRata
IC1	1		Precision Micropower Shunt Voltage Reference, 0.5% accuracy, 2.5V, 15 ppm / degC, 15mA, -40 to 85 degC, 5-pin SC70 (DCK), Green (RoHS & no Sb/Br)	LM4040C25IDCKR	Texas Instruments
U2	1		Octal Bidirectional Multi-Voltage-Level Translator, PW0020A (TSSOP-20)	LSF0108PWR	Texas Instruments
LED102	1	Green	LED, Green, SMD	LTST-C190GKT	Lite-On
XDS1	1		MSP432E401YTPDT, PDT0128A (TQFP-128)	MSP432E401YTPDTR	Texas Instruments
U1	1		Mixed-Signal Microcontrollers	MSPM0H3216SPTR	Texas Instruments
Y3	1		Crystal, 16MHz, 8pF, SMD	NX3225GA-16.000M-STD-CRG-1	NDK
J5	1		Header, 100mil, 3x1, Tin, TH	PEC03SAAN	Sullins Connector Solutions
J6	1		Header, 100mil, 3x1, Tin, TH	PEC03SAAN	Sullins Connector Solutions
J15	1		Header, 100mil, 3x1, Tin, TH	PEC03SAAN	Sullins Connector Solutions
!PCB1	1		Printed Circuit Board	Printed Circuit Board	Any
Y2	1		Crystal, 32MHz, 10pF, SMD	Q22FA1280009200	Epson
R46	1	47.0k	RES, 47.0 k, 1%, 0.0625 W, 0402	RC0402FR-0747KL	Yageo America

Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	Part Number	Manufacturer
R56	1	220k	RES, 220 k, 1%, 0.0625 W, 0402	RC0402FR-07220KL	Yageo America
R55	1	330k	RES, 330 k, 1%, 0.0625 W, 0402	RC0402FR-07330KL	Yageo America
J1	1		Receptacle, 2.54mm, 10x2, Tin, TH	SSQ-110-03-T-D	Samtec
J2	1		Receptacle, 2.54mm, 10x2, Tin, TH	SSQ-110-03-T-D	Samtec
IC4	1		ESD-Protection Array for High-Speed Data Interfaces, 4 Channels, -40 to +85 degC, 6-pin SON (DRY), Green (RoHS & no Sb/Br)	TPD4E004DRYR	Texas Instruments
IC5	1		500mA, Adjustable, Low Quiescent Current, Low-Noise, High-PSRR, Single-Output LDO Regulator, DRB0008A (VSON-8)	TPS73533DRBT	Texas Instruments
J101	1		Header, 100mil, 9x2, Gold, TH	TSW-109-07-G-D	Samtec
Y1	1		Crystal, 32.768KHz, 12.5 pF, SMD	X1A0001410014	Epson
J20	1		Micro USB 5F B Type Smt	YM-02-07-D-23	Yang Ming

5 Additional Information

5.1 Trademarks

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6 Related Documentation

6.1 Supplemental Content

The following items are important learning materials to get started with MSPM0.

- [MSPM0 Academies](#)
- [MSPM0-SDK Code examples](#)
- [TI Precision Labs](#)

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/lstds/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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2. 実験局の免許を取得後ご使用いただく。
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3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page

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

3.4 European Union

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

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

-
4. *EVM Use Restrictions and Warnings:*
 - 4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.
 - 4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.
 - 4.3 *Safety-Related Warnings and Restrictions:*
 - 4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.
 - 4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.
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 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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