EVM User's Guide: LP-MSPM0G3708

MSPM0G3708 LaunchPad™ Development Kit

Description

The MSPM0G3708 LaunchPad™ development kit is an evaluation module for the MSPM0G3708 microcontroller (MCU). The LaunchPad kit contains everything needed to start development on the MSPM0Gx70x and MSPM0Gx73x microcontroller platform, including an onboard debug probe for programming, debugging, and EnergyTrace™ technology. The board includes three buttons, one RGB LED, external crystals and on-board low-pass filters to pair with the Sigma Delta ADCs of MSPM0G3708.

Get Started

1. Order the LP-MSPM0G3708 from ti.com.
2. Navigate to dev.ti.com to browse for code examples.
3. Plug LP-MSPM0G3708 into a PC with the provided USB cable.
4. Download code directly from the browser to the MSPM0G3708 with CCS Cloud.

OR

1. Order the LP-MSPM0G3708 from ti.com.
2. Navigate to dev.ti.com to browse for code examples.
3. Plug LP-MSPM0G3708 into a PC with the provided USB cable.
4. Download CCS for a desktop integrated development environment.
5. Download the MSPM0 SDK for desktop stored examples, demos, and software libraries.

Features

- Header block for Delta Sigma ADC inputs.
- Onboard XDS110 debug probe
- USB-Powered with on-board LDO to convert 5V to 3.3V
- 40-pin BoosterPack™ headers
- Hardware User Interfaces
  - Two buttons, 1 RGB LED
- External Clock Crystals
- Backchannel UART through USB to PC

Applications

- Electricity Meters: Commercial and Residential
- Grid Infrastructure
- Appliances
- Power Quality Meters
- Battery Test Equipment
- Battery Management Systems
- Test and Measurement
- Factory Automation and Control
- Building automation

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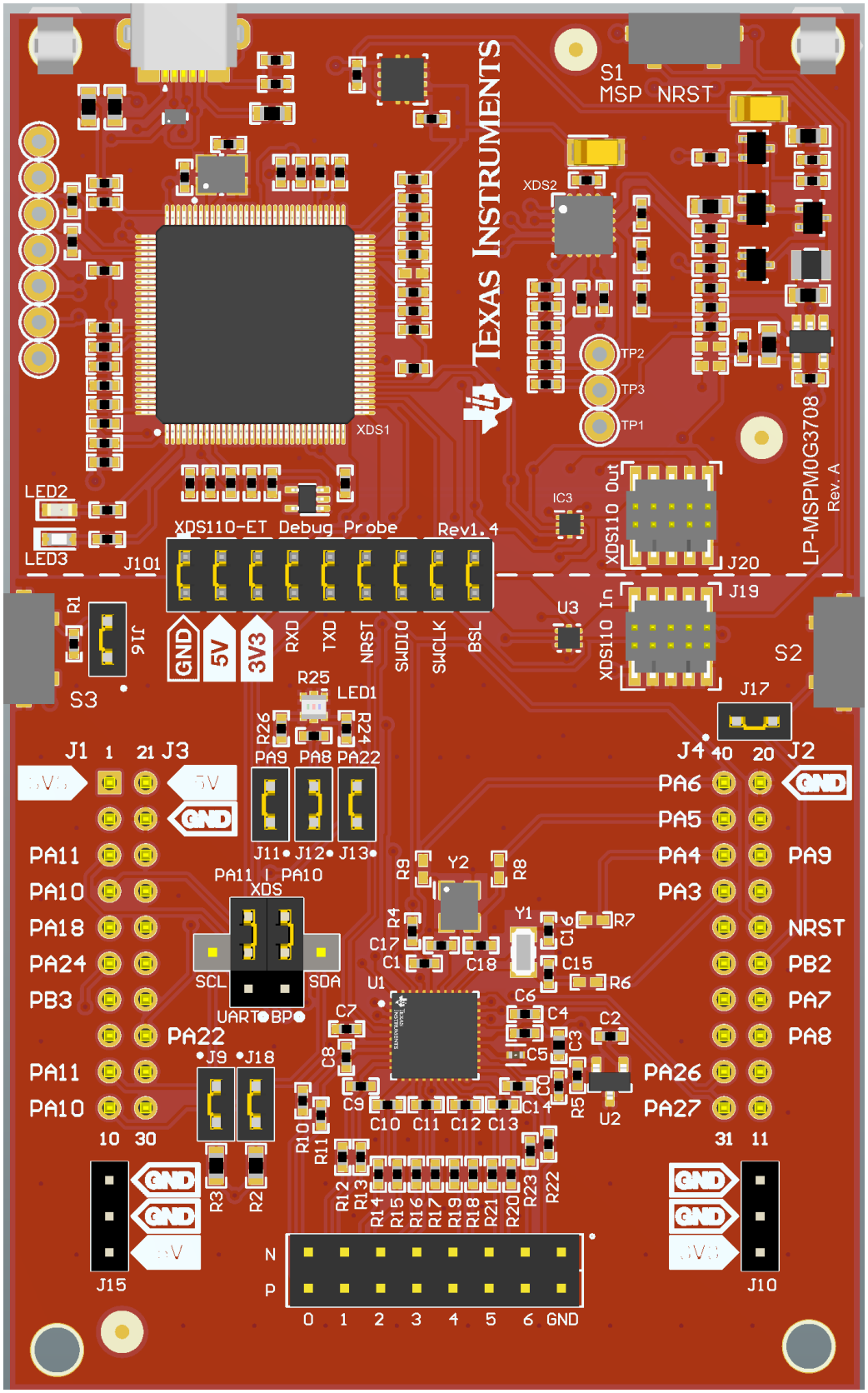


Figure 1-1. LP-MSPM0G3708

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1 Evaluation Module Overview

1.1 Introduction

The MSPM0G3708 is an Arm® Cortex® M0+ 32-bit CPU with dual-bank flash and enhanced security features with a frequency up to 80MHz. The device features multiple 24-bit sigma delta ADCs, which are used to precisely and simultaneously convert analog signals into digital codes. The easiest way to get started with the MSPM0G3708 is with the LP-MSPM0G3708 LaunchPad™. The LaunchPad has all the features to load code, debug, and prototype right out of the box.

The device features 256kB of dual-bank flash with 32kB of SRAM and 8kB of data flash memory. The device contains internal analog such as two 12-bit SAR ADCs, internal voltage references, up to eight 24-bit Sigma Delta ADCs, and two comparators with 8-bit reference DACs. The MSPM0G3708 is the first MSPM0 device which features Sigma Delta ADCs for high precision measurements.

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 you own BoosterPack plug-in module or choose among many already available from TI and third-party developers. The bottom header row features inputs for the Sigma Delta ADC signal chain including passive components for ADC signal conditioning.

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. TI also supports 3rd party IDEs, such as IAR Embedded Workbench® IDE and Arm®Keil®µVision® IDE. Code Composer Studio IDE supports EnergyTrace™ technology with the MSPM0G3708 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.

1.2 Kit Contents

- LP-MSPM0G3708 Launchpad Development Kit
- USB Cable
- Quick-start Guide

1.3 Specification

LP-MSPM0G3708 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-MSPM0G3708 can be configured and programmed with the TI Energy Metrology Studio GUI.

The device can be powered from a power supply other than the built-in USB power supply. This design allows the user to forgo the PC connection. Power can be applied directly to the 3.3V rail. When using an external power supply, make sure to not exceed 3.3V. Programming can be done externally with a separate XDS110 external debugger utilizing the on-board Arm 10-pin connector, or with connections from an ARM M0+ programmer to the SDWIO and SWCLK pin.

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1.4 Device Information

Device Name	Description	Purpose
MSP432E401YTPDTR	SimpleLink™ 32-bit ARM Cortex®-M4F MCU with Ethernet, CAN, 1MB Flash and 256kB RAM	XDS110 Host Device
MSPM0G3708SZFUR	Mixed-Signal Microcontroller with 80MHz Arm® 32-bit Cortex® M0+ CPU, 256kB Flash, 32kB SRAM, and integrated Sigma Delta ADCs	Evalution Device
MSP430G2452IRSA16R	Mixed-Signal Microcontroller with 16-bit RISC CPU, 8kB Flash, and 256B SRAM	DC/DC controller for EnergyTrace Technology
TPD6E004RSER	ESD-protection array for high-speed data interfaces, 6channels	Protect LP-MSPM0G3708 from ESD damage through programming interface
TPS73533DRBT	500mA, adjustable, low quiescent current, low-noise, high-PSRR, single-output LDO regulator	3.3V power XDS110 and MSPM0G3708
TPS2102DBVR	2.7V to 4V power mux, dual-input, single-output power switch	Switches XDS110 power
TPD4E004DYR	ESD-protection array for high-speed data interfaces, 4 channels	Protect LP-MSPM0G3708 from ESD damage through USB connector
LM4040C25IDCKR	Precision Micropower Shunt Voltage Reference	Provide reference to MSP432E401Y
REF3012AIDBZT	1.2V Voltage Reference	Provide external reference option for Sigma Delta ADCs on the MSPM0G708

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2 Hardware

2.1 Hardware Overview

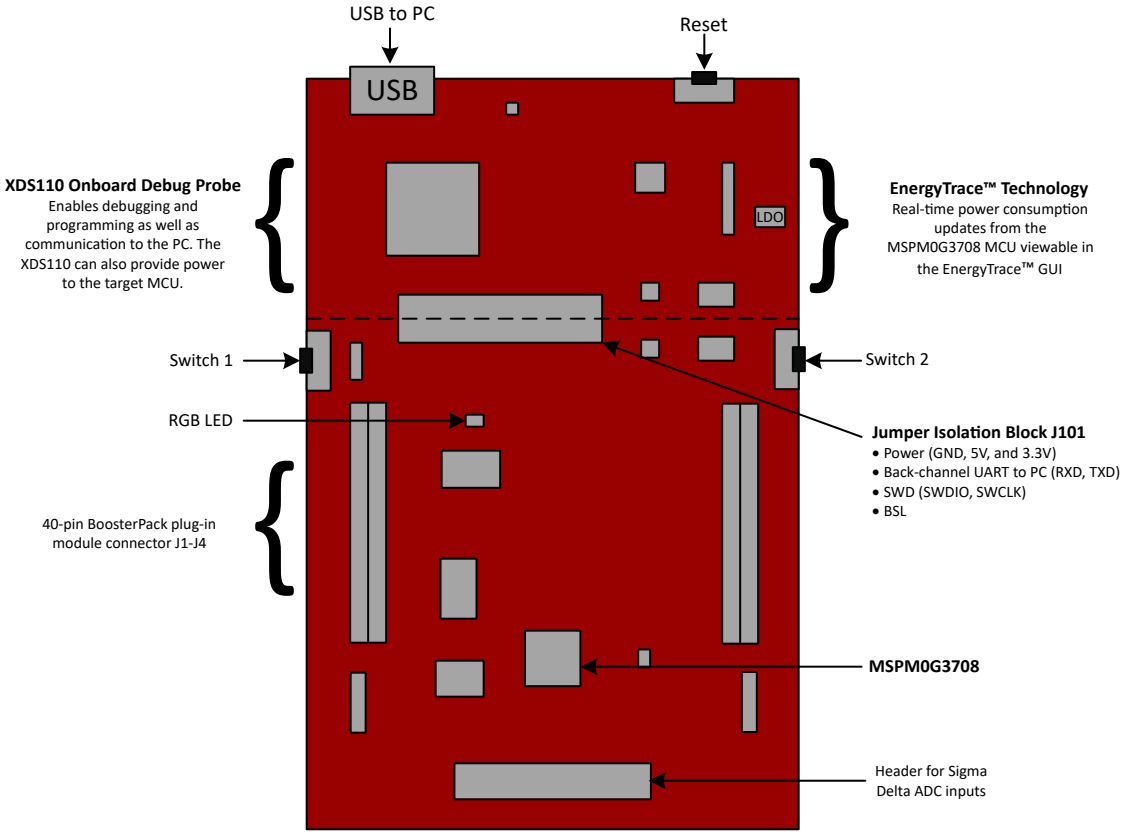


Figure 2-1. Diagram of LP-MSPM0G3708 Jumpers and Connections

LP-MSPM0G3708 has hardware features, which allow the user full access to the MSPM0G3708 pins, while still providing onboard connectivity for easy use. Shunt connections provide a way for users to change Launchpad connections. Figure 2-1 shows the location of these shunts. The connection of each shunt and the default placement is described in Section 2.2.

2.2 Jumper Information

Table 2-1. Jumper Table

Jumper	Description	Default Setting	Connected Signal
J1-J4	BoosterPack Header	Unpopulated	BoosterPack standard connection for 40-pin header
J13	RGB LED(Blue)	Populated	Connects PA22 to the RGB (Blue) LED
J12	RGB LED (Red)	Populated	Connects PA8 to the RGB (Red) LED
J11	RGB LED (Green)	Populated	Connects PA9 to the RGB (Green) LED
J16	BSL Invoke	Populated	Connects PA18 to the S1 Button
J15	5V Power Header	Unpopulated	Additional pin connections for 5V and GND
J10	3.3V Power Header	Unpopulated	Additional pin connections for 3.3V to GND
J9	I2C Pull Up	Populated	I2C SDA pull-up for PA10
J18	I2C Pull Up	Populated	I2C SCL pull-up for PA11
PA11 | PA10 Jumper Junction	Multi-selection interface for PA11 and PA10 operation	Populated between PA11 and PA10 to the UART XDS operation	See Section 2.2.1.
Bottom N P Header Block	Header block for the Sigma Delta ADC inputs	Unpopulated	See Section 2.2.2.

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Table 2-1. Jumper Table (continued)

Jumper	Description	Default Setting	Connected Signal
J101	Isolation bridge between XDS110 and Evaluation Device	Populated	Connects the XDS110 portion of the board to the MSPM0G3708 for programming, power, and debug.
J102	XDS110 Out	Unpopulated	Header interface to connect an Arm 10-Pin connector to the XDS110 on-board debugger output.
J103	XDS110 In	Unpopulated	Header interface to connect an Arm 10-pin connector to the MSPM0G3708.

2.2.1 PA10 and PA11 Connection Terminals

PA10 and PA11 are connected using a 4-way connection terminal. The center right pin is the connection for PA10 to the MSPM0G3708 and the center left pin is the connection for PA11 to the MSPM0G3708. The top pins of the connection block connect PA10 and PA11 to the BoosterPack™ pins for UART, the bottom pins connect PA10 and PA11 to the XDS110 UART through J101, and the outside left or right pins connect PA10 and PA11 to the I2C connections.

PA10 Jumper Connection	PA11 Jumper Connection	Functionality
Center Right : Bottom Right	Center Left: Bottom Left	BoosterPack™ UART (Pin 3 and 4).
Center Right: Top Right	Center Left: Top Left	XDS110 UART, requires J101 RXD and TXD to be populated.
Center Right : Middle Right	Center Left : Middle Left	I2C connections
Center Right : Center Left	Center Left : Center Right	Shorts PA10 and PA11 (useful for UART echo)

2.2.2 Bottom Sigma Delta Header Block

The bottom header block provides input connections for the Sigma Delta ADCs. The rows are connections for the specific inputs, with the N row for SD24xN inputs and the P row for the SD24xP inputs. The column denotes which Sigma Delta ADC instance the input is for. For example, Column 0 has the N connection for SD240N and the P connection for SD240P.

	0	1	2	3	4	5	6	7	GND
N	SD24.0N	SD24.1N	SD24.2N	SD24.3N	SD24.4N	SD24.5N	SD24.6N	SD24.7N	GND
P	SD24.0P	SD24.1P	SD24.2P	SD24.3P	SD24.4P	SD24.5P	SD24.6P	SD24.7P	GND

2.3 Power Requirements

The LP-MSPM0G3708 only needs the USB plugged in and the debugger jumper block populated to power the device. With the onboard LDO, the 5V USB supply is converted to 3.3V with a supply of 500mA. The LaunchPad can also be powered by the 3.3V or 5V headers using an external supply. Do not exceed 3.3V on the 3.3V rail or 5V on the 5V rail.

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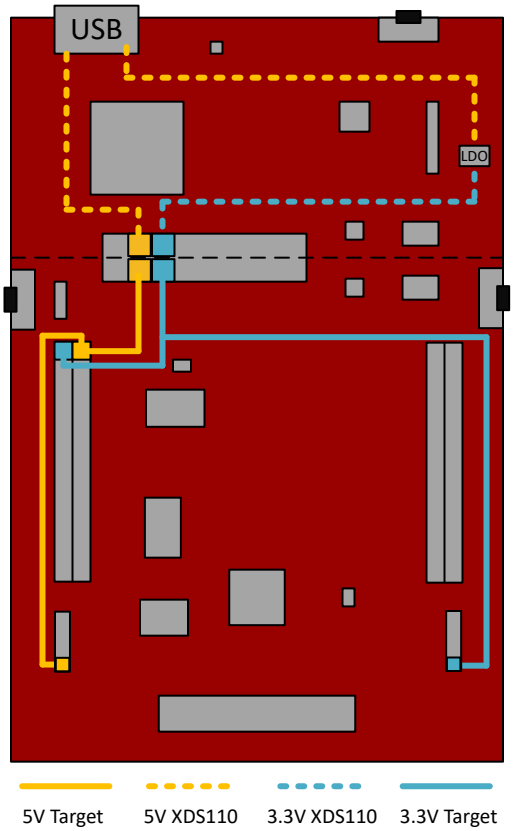


Figure 2-2. LP-MSPM0G3708 Power Connections

2.4 XDS110 Debug Probe

LP-MSPM0G3708 features an onboard debug probe to streamline prototyping. The debugger used on this LaunchPad is the XDS110 variant, which supports all MSPM0 device derivatives. The integrated XDS110 debug probe is separated from the rest of the MSPM0G3708 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.

2.4.1 Isolation Jumper Block

The isolation jumper block J101 allows the user to connect or disconnect signals that cross from the XDS110 domain into the MSPM0G3708 target domain. This includes XDS110 SWD signals, application UART signals, 3.3V and 5V power, and reset.

Jumper	Description
5V	5V rail from the USB.
3V3	3.3V rail from the LDO.
RXD<<	Backchannel UART: The target MSPM0G3708 receives data through this signal. The arrow indicates the direction of the signal.
TXD>>	Backchannel UART: The target MSPM0G3708 sends data through this signal. The arrow indicates 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.

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2.5 Measure Current Draw of the MSPM0G3708

To measure the current draw of the MSPM0G3708 MCU using a multimeter, use the 3V3 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:

1. Remove the 3V3 jumper in the J101 isolation block, and attach an ammeter across the 3V3 jumper.
2. Consider the effect that the backchannel UART and any circuitry attached to the MSPM0G3708 can have on the current draw. Consider disconnecting the backchannel UART at the isolation jumper block, or at least consider the current sinking and sourcing capability in the final measurement.
3. Make sure there are no floating inputs or outputs (I/Os) on the MSPM0G3708. Floating inputs or outputs cause 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.
4. Begin target execution.
5. For the most accurate current measurements, place the device in Free Run mode and disconnect programming signals between the MSPM0G3708 and the debug portion of the board (header J101).
6. Measure the current. Remember that if the current levels are fluctuating, then getting a stable measurement can be difficult. Measuring the quiescent states is easier.

2.6 Clocking

The internal SYSOSC is 32MHz by default with an accuracy of 2.5%. The MCLK is sourced by the SYSOSC by default. The SYSPLL can be used to generate a clock signal up to 80MHz, which can be used to source MCLK. 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. Two clock crystal options are included on the LaunchPad, one option is a high-frequency 40MHz crystal (HFXT), and the other option is a low-frequency 32.768kHz crystal (LFXT). Select the crystals during application programming as the clock source for the high frequency and low frequency clocks. For more clock tree details, see the *Clock Module (CKM)* section of the *MSPM0 G-Series 80MHz Microcontrollers* technical reference manual.

2.7 BoosterPack Plug-in Module Pinout

The LaunchPad development kit adheres to the 40-pin LaunchPad development kit pinout standard, where pins are available. Standardized LaunchPad development kit pinouts enable 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 MSPM0G3708 LaunchPad development kit, then compare the schematic of the candidate BoosterPack plug-in module with the LaunchPad development kit to verify compatibility. Resolve compatibility challenges by changing the MSPM0G3708 device pin function configuration in software.

2.8 Sigma Delta ADC Inputs

The MSPM0G3708 features sigma delta ADCs. The dedicated jumper block for the sigma delta ADCs allows for a central location to place the critical signals. There are RC filters for each sigma delta ADC to allow for better results, and users can swap out the passive components to change the filter to the respective input signal frequency. The board is created with the LaunchPad ecosystem, so performance of the sigma deltas can perform worse than a board specialized for the user's application.

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3 Software

3.1 Software Development Options

There are multiple ways to prototype with LP-MSPM0G3708. TI recommends installing the MSPM0 SDK when using any non-cloud based option.

1. Code Composer Studio Cloud - Choose this option to get started with MSPM0 with minimal installation
   a. TI Cloud Agent Required
2. Code Composer Studio IDE - Choose this option to work offline and have full access to debug features
3. TI Energy Metrology Studio - Choose this option for Energy Metrology specific applications, allowing users to configure the device and use TI's Energy Metrology code.

3.2 TI Energy Metrology Studio

The TI Energy Metrology Studio is GUI which assists user's in configuring the MSPM0G3708 for metrology functionality. Users can configure, calibrate, and view results with the GUI.

Full details on the TI Energy Metrology Studio can be found in the TI Energy Metrology Studio User's Guide.

3.3 Software Development: CCS

Below instructions are for the Code Composer Studio IDE.

1. Install Code Composer Studio (CCS) and the MSPM0 SDK.
2. After installation open CCS and navigate to the top left, then select "File"
3. Select Import Projects
4. Click browse then navigate to the MSPM0 SDK install, the default path is C:\ti\mspm0_sdk_x_xx_xx_xx, where x is the version number.
5. Navigate through examples > nortos > LP_MSPM0G3708 > riverlib, and click on gpio_toggle_output then select folder
6. Click on the ticlang version of the example and click finish, then the example is imported.
7. Plug in the LP-MSPM0G3708 into the PC with a USB cable
8. Right click on the gpio_toggle_output example and select "debug project" or "flash project", this action starts the programming of the device.
9. Once flashed, run the program and observe the flashing lights on the board.

Explore any additional code examples and the .sysconfig file to start development.

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4 Hardware Design Files

4.1 Schematics

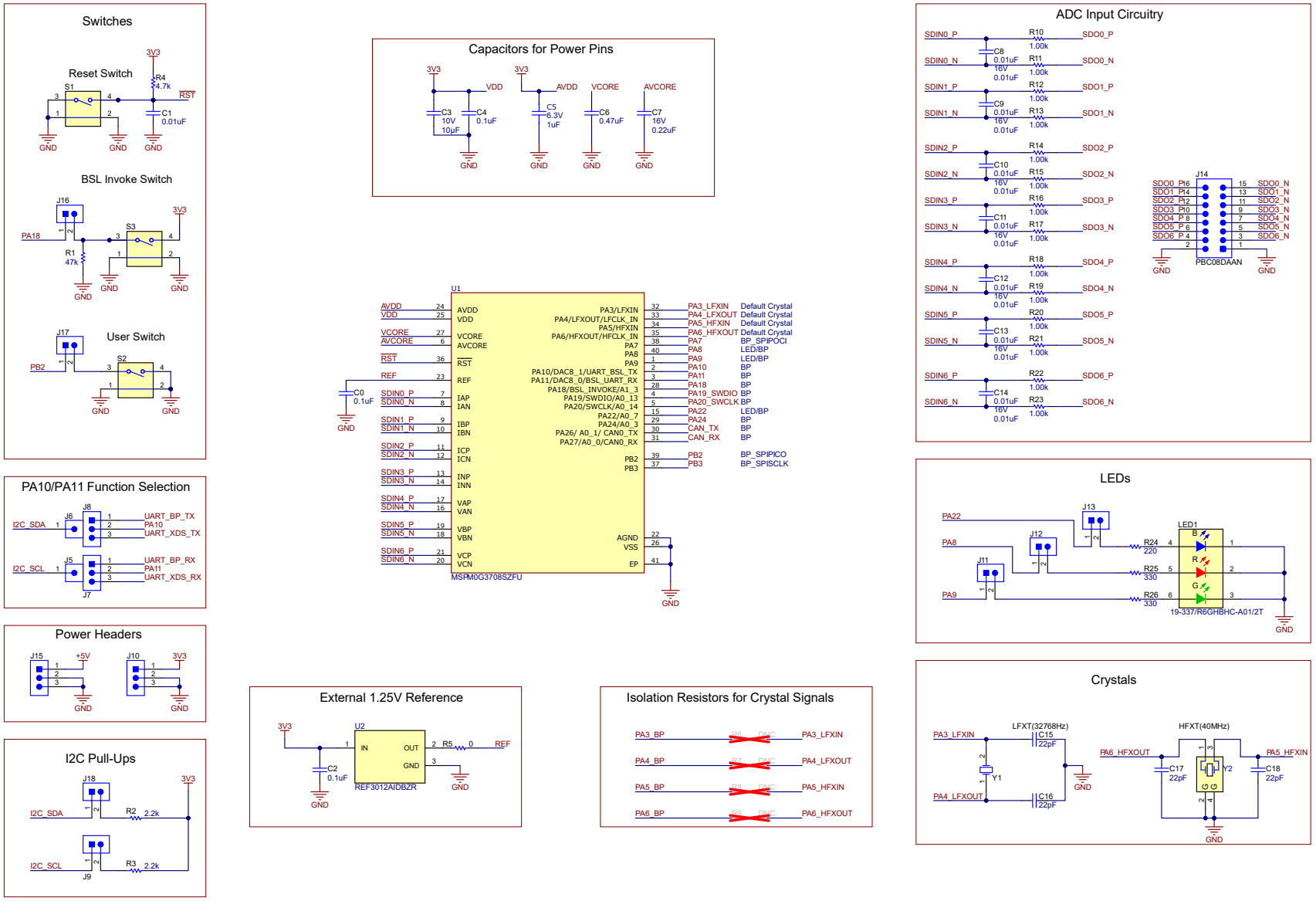


Figure 4-1. MSPM0G3708 Target Device Schematic

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BoosterPack Connectors

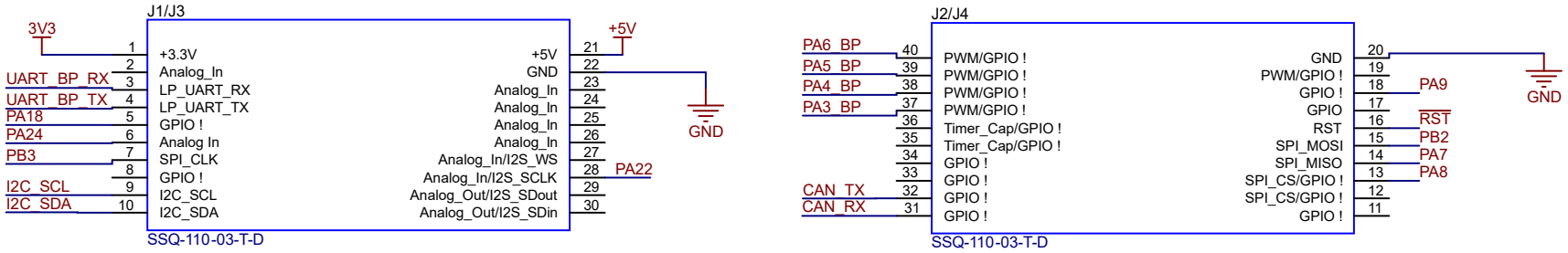


Figure 4-2. BoosterPack Connectors

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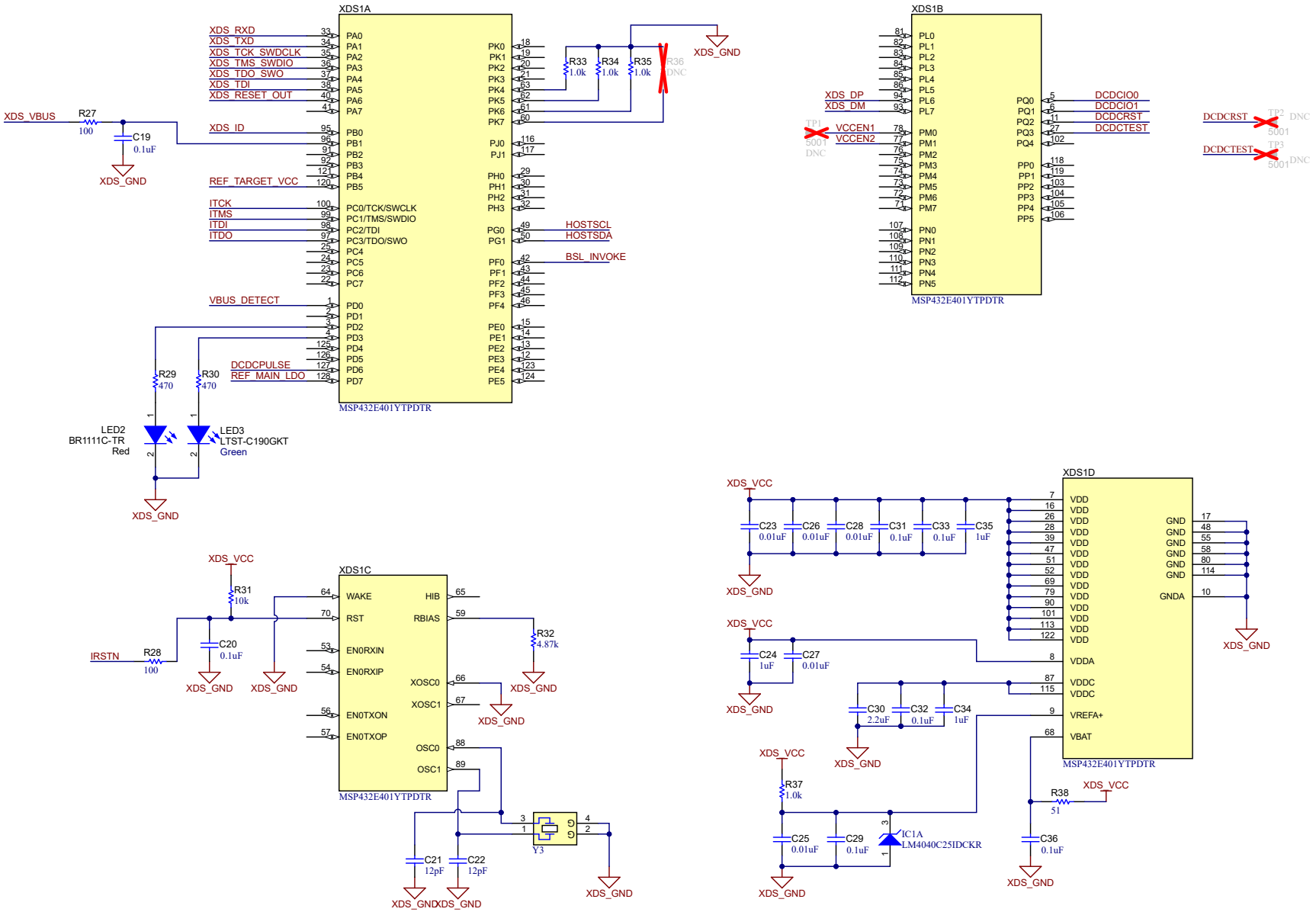


Figure 4-3. XDS110 Debug Probe Emulator Schematic

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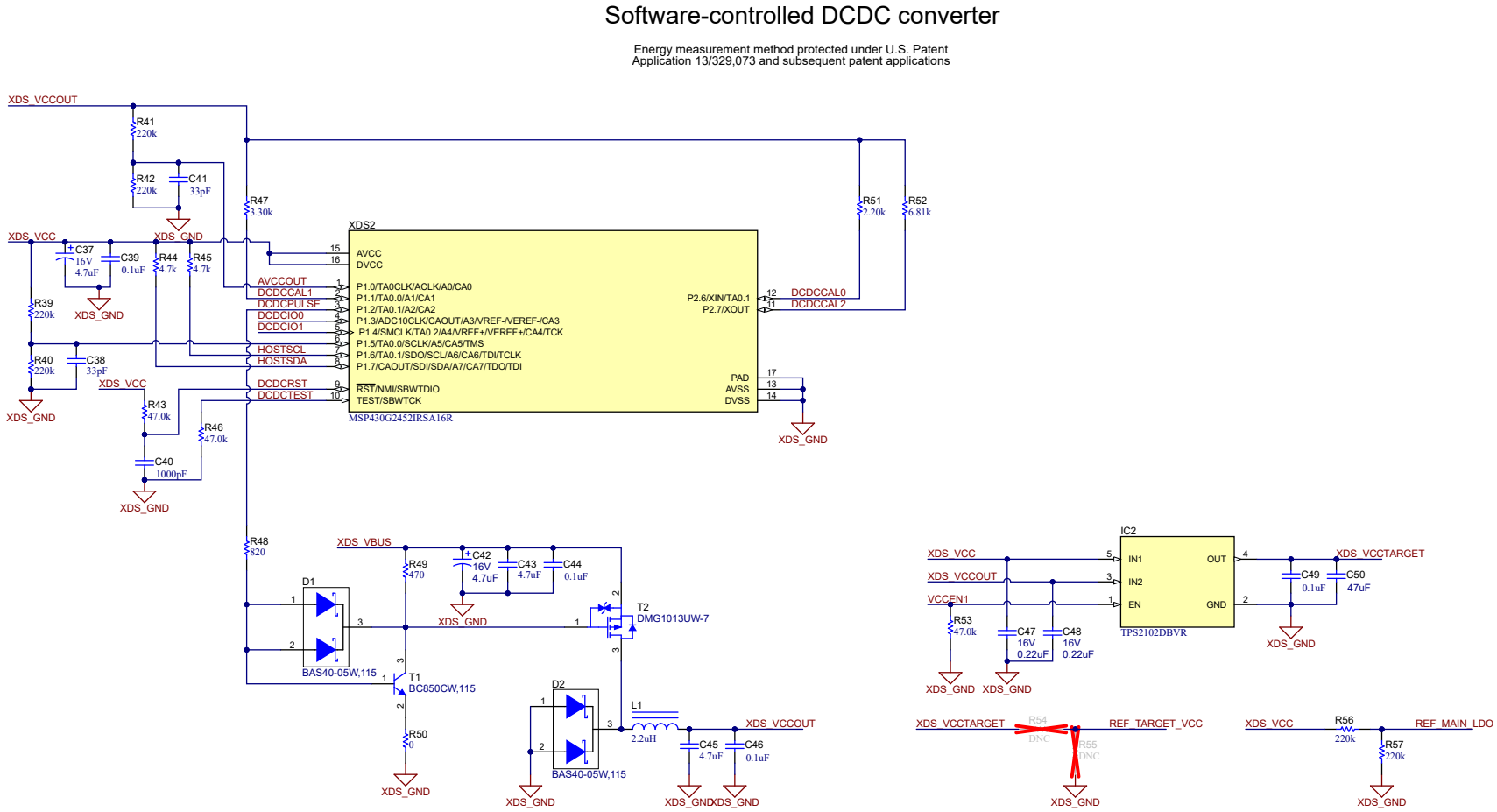


Figure 4-4. XDS110 EnergyTrace Schematic

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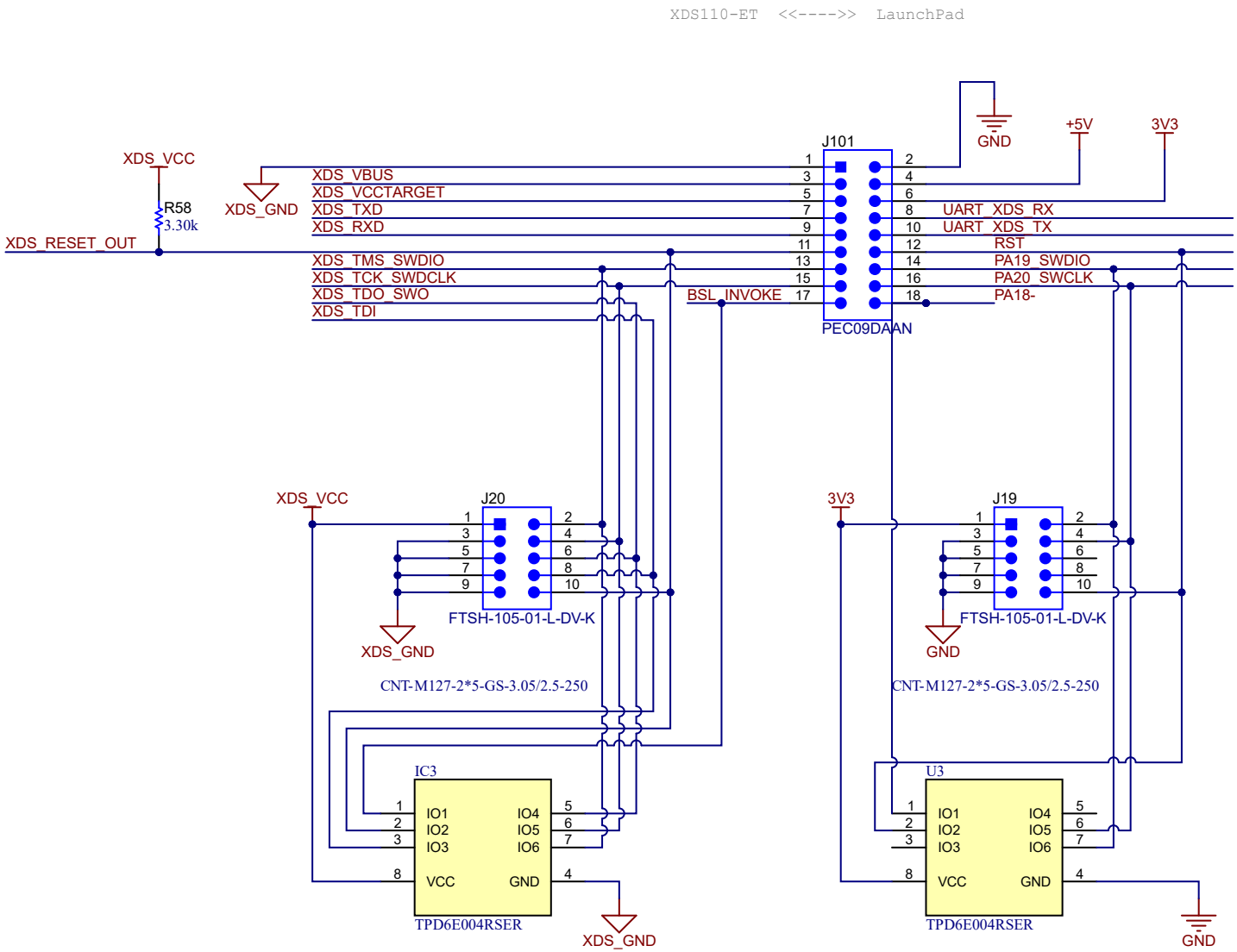


Figure 4-5. XDS110 Target Interface Schematic

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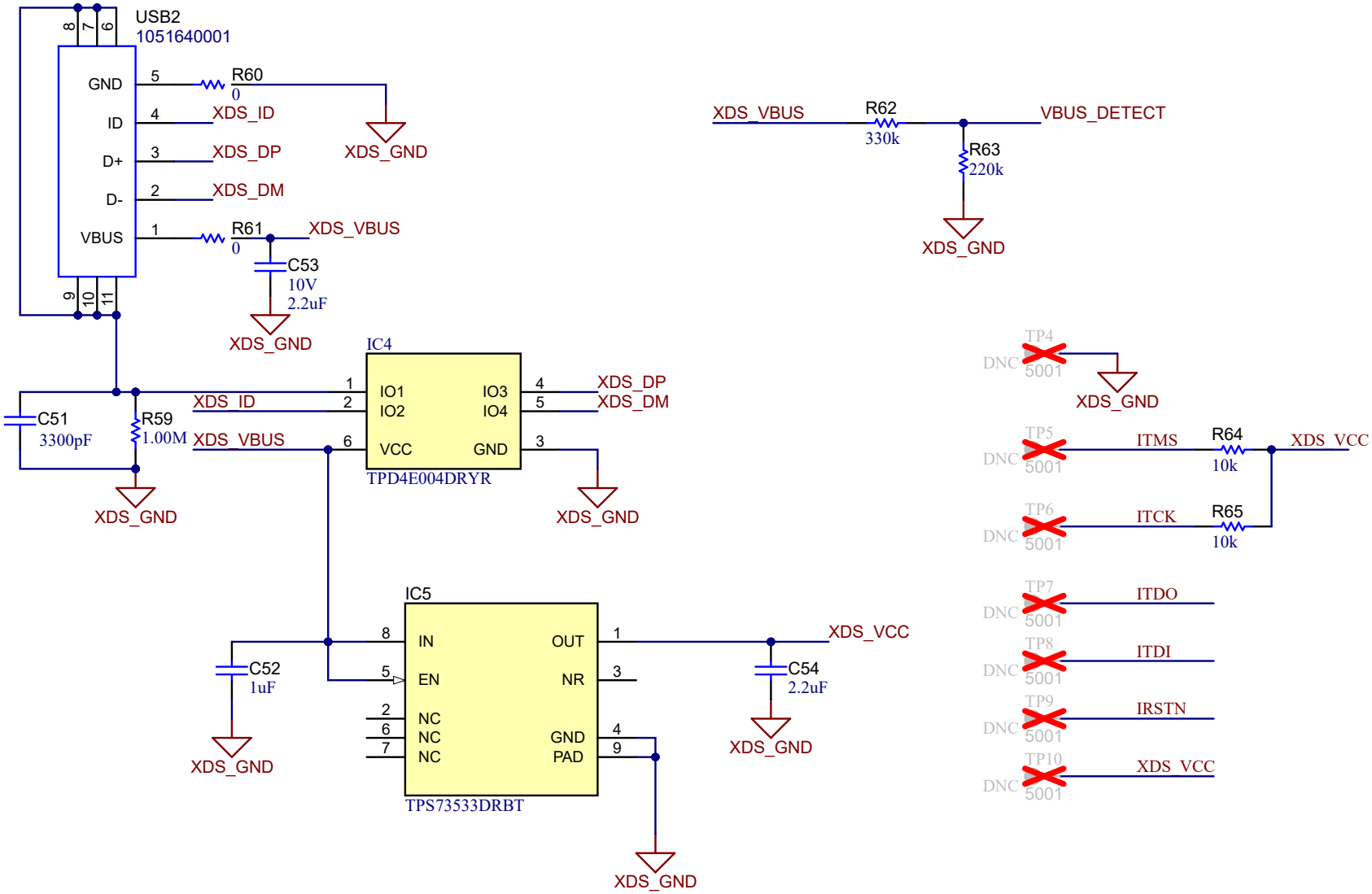


Figure 4-6. XDS110 USB Power Schematic

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4.2 PCB Layouts

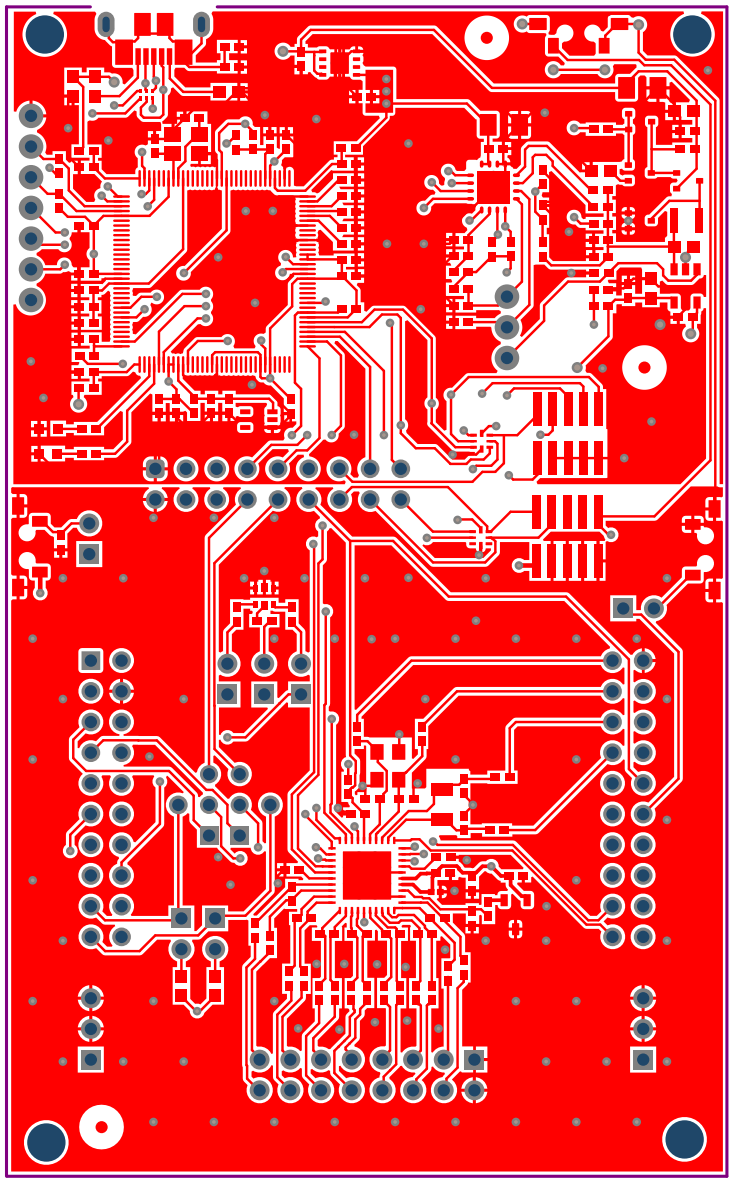


Figure 4-7. Top Layer

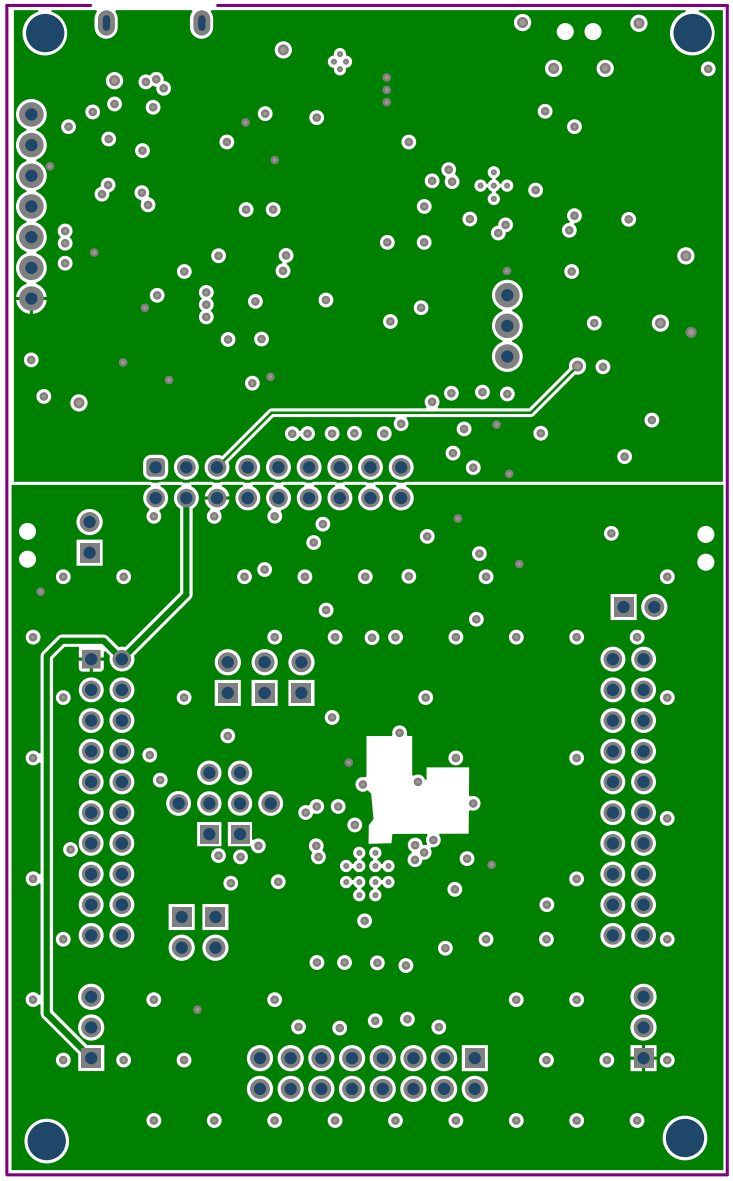


Figure 4-8. VCC Layer

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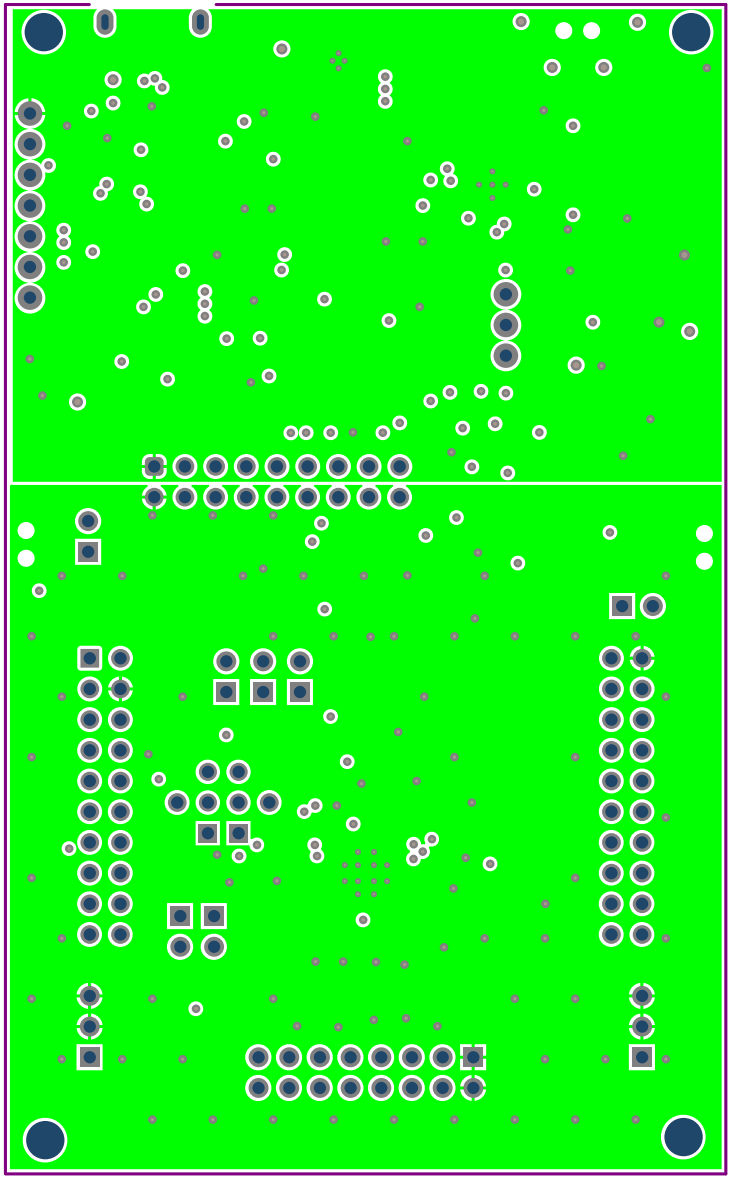


Figure 4-9. GND Layer

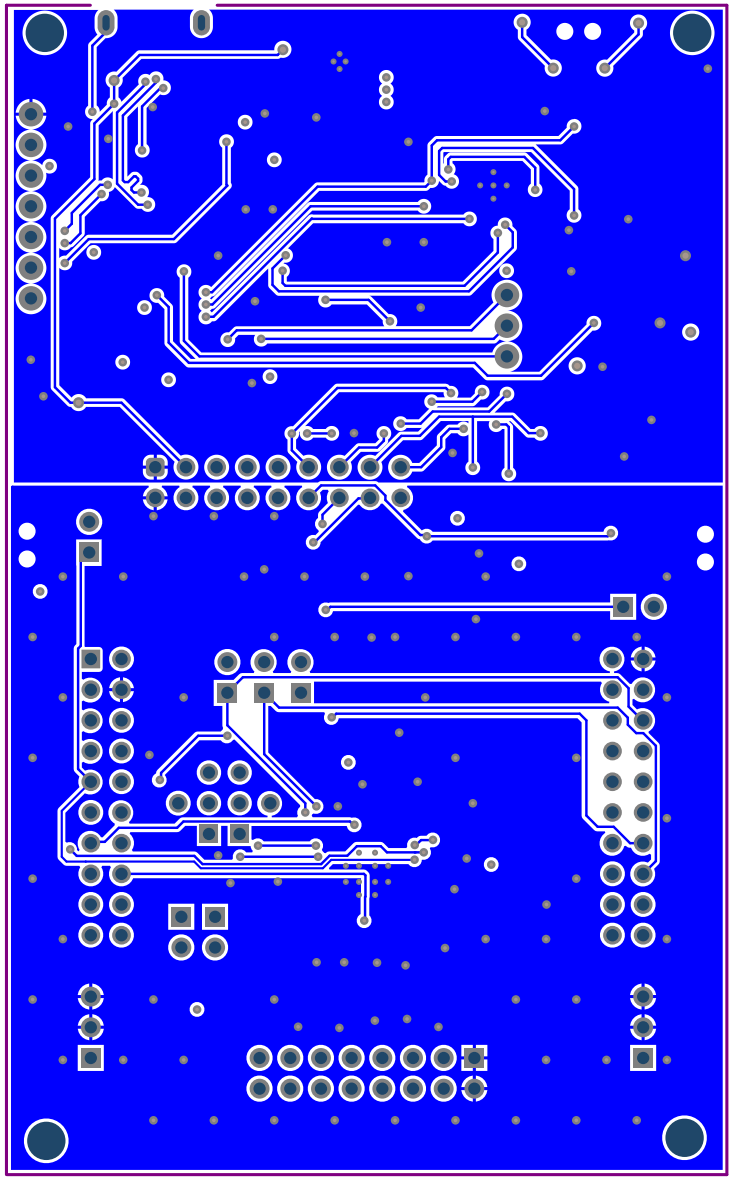


Figure 4-10. Bottom Layer

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4.3 Bill of Materials (BOM)

Designator	Quantity	Value	Description	Package Reference	Part Number
!PCB1	1		Printed Circuit Board		LP-MSPM0G3708
C0, C2, C4	3	0.1µF	CAP, CERM, 0.1µF, 50V, ± 20%, X5R, 0402	0402	GRM155R61H104ME14D
C1, C8, C9, C10, C11, C12, C13, C14	8	0.01µF	CAP, CERM, 0.01µF, 16V, ± 10%, X5R, 0402	0402	GRM155R61C103KA01D
C3	1	10µF	CAP, CERM, 10µF, 10V,± 20%, X5R, 0402	0402	0402ZD106MAT2A
C5	1		CAP CER 1µF 6.3V X7R 0402	0402	CL05B105KQ5NQNC
C6	1	0.47µF	CAP, CERM, 0.47µF, 6.3V, ± 10%, X5R, 0402	0402	GRM155R60J474KE19D
C7	1	0.22µF	CAP, CERM, 0.22µF, 16V, ± 10%, X7R, 0402	0402	C1005X7R1C224K050BC
C15, C16, C17, C18	4	22pF	CAP, CERM, 22pF, 50V, ± 5%, C0G/NP0, 0402	0402	GRM1555C1H220JA01D
C19, C20, C29, C31, C32, C33, C36, C39, C44, C46, C49	11	0.1µF	CAP, CERM, 0.1µF, 6.3V, ± 10%, X7R, 0402	0402	GRM155R70J104KA01D
C21, C22	2	12pF	CAP, CERM, 12pF, 50V, ± 5%, C0G/NP0, 0402	0402	GRM1555C1H120JA01D
C23, C25, C26, C27, C28	5	0.01µF	CAP, CERM, 0.01µF, 25V, ± 10%, X7R, 0402	0402	GRM155R71E103KA01D
C24, C34, C35, C52	4	1µF	CAP, CERM, 1µF, 25V, ± 10%, X5R, 0402	0402	C1005X5R1E105K050BC
C30, C54	2	2.2µF	CAP, CERM, 2.2µF, 6.3V, ± 10%, X5R, 0402	0402	GRM155R60J225KE95D
C37, C42	2	4.7µF	CAP, TA, 4.7µF, 16V, ± 10%, 4Ω, SMD	3216-18	TAJA475K016RNJ
C38, C41	2	33pF	CAP, CERM, 33pF, 50V, ± 5%, C0G/NP0, 0402	0402	GRM1555C1H330JA01D
C40	1	1000pF	CAP, CERM, 1000pF, 50V, ± 10%, X7R, AEC-Q200 Grade 1, 0402	0402	GCM155R71H102KA37D
C43, C45	2	4.7µF	CAP, CERM, 4.7µF, 16V, ± 10%, X5R, 0603	0603	GRM188R61C475KAAJ
C47, C48	2	0.22µF	CAP, CERM, 0.22µF, 16V, ± 10%, X7R, 0402	0402	GRM155R71C224KA12D
C50	1	47µF	CAP, CERM, 47µF, 6.3V, ± 20%, X5R, 0603	0603	GRM188R60J476ME15D
C51	1	3300pF	CAP, CERM, 3300pF, 50V, ± 10%, X7R, 0402	0402	GRM155R71H332KA01D
C53	1	2.2µF	CAP, CERM, 2.2µF, 10V, ± 10%, X5R, 0603	0603	C0603C225K8PACTU
D1, D2	2	40V	Diode, Schottky, 40V, 0.12A, AEC-Q101, SOT-323	SOT-323	BAS40-05W,115
FID1, FID2, FID3	3		Fiducial mark. There is nothing to buy or mount.	N/A	N/A
H1, H2	2		Spacer Support, Nylon 66	Spacer Nylon Support	MAE-10
IC1	1		Precision Micropower Shunt Voltage Reference, 0.5% accuracy, 2.5V, 15ppm / °C, 15mA, -40 to 85°C, 5-pin SC70 (DCK), Green (RoHS & no Sb/Br)	DCK0005A	LM4040C25IDCKR
IC2	1		2.7-4V Dual In/Single Out MOSFET, 0.5A Main/0.1A Aux Input, Act-Low Enable, Comm. Temp., DBV0005A (SOT-23-5)	DBV0005A	TPS2102DBVR
IC3, U3	2		Low-Capacitance ± 15kV ESD Protection Array for High-Speed Data Interfaces, 6 Channels, -40 to +85°C, 8-pin UQFN (RSE), Green (RoHS & no Sb/Br)	RSE0008A	TPD6E004RSER

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Designator	Quantity	Value	Description	Package Reference	Part Number
IC4	1		ESD-Protection Array for High-Speed Data Interfaces, 4 Channels, -40 to +85°C, 6-pin SON (DRY), Green (RoHS & no Sb/Br)	DRY0006A	TPD4E004DRYR
IC5	1		500mA, Adjustable, Low Quiescent Current, Low-Noise, High-PSRR, Single-Output LDO Regulator, DRB0008A (VSON-8)	DRB0008A	TPS73533DRBT
J1/J3, J2/J4	2		Receptacle, 2.54mm, 10x2, Tin, TH	10x2 Receptacle	SSQ-110-03T-D
J5, J6	2		Header, 2.54mm, 1x1, Gold, TH	Header, 2.54mm, 1x1, TH	HTSW-101-07G-S
J7, J8, J10, J15	4		Header, 100mil, 3x1, Tin, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN
J9, J11, J12, J13, J16, J17, J18	7		Header, 100mil, 2x1, Tin, TH	Header 2x1	90120-0122
J14	1		Header, 100mil, 8x2, Gold, TH	PBC08DAAN	PBC08DAAN
J19, J20	2		Header(Shrouded), 1.27mm, 5x2, Gold, SMT	Header(Shrouded), 1.27mm, 5x2, SMT	FTSH-105-01L-DV-K
J101	1		Header, 2.54mm, 9x2, Tin, TH	Header, 2.54mm, 9x2, TH	PEC09DAAN
L1	1	2.2µH	Inductor, Wirewound, Ceramic, 2.2µH, 0.89A, 0.13Ω, SMD	2.5 × 1.8 × 1.8mm	CBC2518T2R2M
LED1	1	Rgb	LED, RGB, SMD	1.6 × 1.6mm	19-337/R6GHBHC-A01/2T
LED2	1	Red	LED, Red, SMD	1.6 × 0.8mm	BR1111C-TR
LED3	1	Green	LED, Green, SMD	1.6 × 0.8 × 0.8mm	LTST-C190GKT
R1	1	47k	RES, 47k, 5%, 0.063W, 0402	0402	CRCW040247K0JNED
R2, R3	2	2.2k	RES, 2.2k, 5%, 0.1W, 0603	0603	RC0603JR-072K2L
R4	1	4.7k	RES, 4.7k, 5%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW04024K70JNED
R10, R11, R12, R13, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23	14	1.00k	RES, 1.00k, 1%, 0.0625W, 0402	0402	RC0402FR-071KL
R24	1	220	RES, 220, 5%, 0.063W, 0402	0402	CRCW0402220RJNED
R25, R26	2	330	RES, 330, 5%, 0.063W, 0402	0402	CRCW0402330RJNED

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Designator	Quantity	Value	Description	Package Reference	Part Number
R27	1	100	RES, 100, 5%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW0402100RJNED
R28	1	100	RES, 100, 5%, 0.063W, 0402	0402	CRCW0402100RJNED
R29, R30, R49	3	470	RES, 470, 5%, 0.063W, 0402	0402	CRCW0402470RJNED
R31, R64, R65	3	10k	RES, 10k, 5%, 0.063W, 0402	0402	CRCW040210K0JNED
R32	1	4.87k	RES, 4.87k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW04024K87FKED
R33, R34, R35, R37	4	1.0k	RES, 1.0k, 5%, 0.063W, 0402	0402	CRCW04021K00JNED
R38	1	51	RES, 51, 5%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW040251R0JNED
R39, R40, R41, R42, R56, R57, R63	7	220k	RES, 220k, 1%, 0.0625W, 0402	0402	RC0402FR-07220KL
R43, R46, R53	3	47.0k	RES, 47.0k, 1%, 0.0625W, 0402	0402	RC0402FR-0747KL
R44, R45	2	4.7k	RES, 4.7k, 5%, 0.063W, 0402	0402	CRCW04024K70JNED
R47, R58	2	3.30k	RES, 3.30k, 1%, 0.1W, AEC-Q200 Grade 0, 0402	0402	ERJ-2RKF3301X
R48	1	820	RES, 820, 1%, 0.063W, 0402	0402	RC0402FR-07820RL
R50, R60, R61	3	0	RES, 0, 5%, 0.1W, 0603	0603	RC0603JR-070RL
R51	1	2.20k	RES, 2.20k, 1%, 0.063W, 0402	0402	CRCW04022K20FKED
R52	1	6.81k	RES, 6.81k, 1%, 0.063W, 0402	0402	CRCW04026K81FKED
R59	1	1.00Meg	RES, 1.00M, 1%, 0.063W, 0402	0402	CRCW04021M00FKED
R62	1	330k	RES, 330k, 1%, 0.0625W, 0402	0402	RC0402FR-07330KL
S1, S2, S3	3		Switch, SPST, 0.05A, 12VDC, SMD	7.8 × 3.5mm	1188E-1K2V-TR
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8, SH-J9, SH-J10, SH-J11, SH-J12, SH-J13, SH-J14, SH-J15, SH-J16, SH-J17, SH-J18	18	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G
T1	1	45V	Transistor, NPN, 45V, 0.1A, SOT-323	SOT-323	BC850CW,115
T2	1	-20V	MOSFET, P-CH, -20V, -0.82A, SOT-323	SOT-323	DMG1013UW-7
U1	1		MSPM0G3708SZFU	LGA40	MSPM0G3708SZFU
U2	1		1.25V, 50ppm / °C, 50uA Series (Bandgap) Voltage Reference, -40 to 125°C, 3-pin SOT-23 (DBZ), Green (RoHS & no Sb/Br)	DBZ0003A	REF3012AIDBZR
USB1	1		Cable, USB-A to micro USB-B, 0.3m		AK67421-0.3

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Designator	Quantity	Value	Description	Package Reference	Part Number
USB2	1		Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT	Receptacle, USB 2.0, Micro B, 5 Pos, 0.65mm Pitch, R/A, SMT	1051640001
XDS1	1		MSP432E401YTPDT, PDT0128A (TQFP-128)	PDT0128A	MSP432E401YTPDTR
XDS2	1		MSP430G2x52, MSP430G2x12 Mixed Signal Microcontroller, RSA0016B (VQFN-16)	RSA0016B	MSP430G2452IRSA16R
Y1	1		Crystal, 32.768KHz, 12.5pF, SMD	SMD, 2-Leads, Body 3.2 × 1.5mm	FC-135 32.7680KA-A3
Y2	1		Crystal, 40MHz, 12pF, SMD	2.5 × 3.2mm	ECS-400-12-33Q-JES-TR
Y3	1		Crystal, 16MHz, 8pF, SMD	3.2 × 0.75 × 2.5mm	NX3225GA-16.000M-STD-CRG-1

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5 Additional Information

5.1 Compliance and Certifications

LP-MSPM0G3708 EU DoC available upon request

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