EVM User's Guide: LP-MSPM0G3507

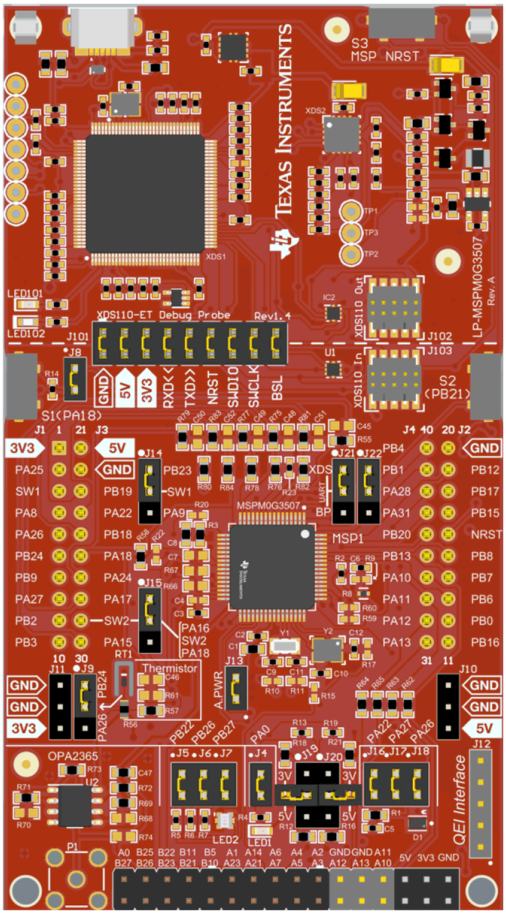
MSPM0G3507 LaunchPad Development Kit (LP-MSPM0G3507) Evaluation Module

Description

The MSPM0G3507 LaunchPad™ development kit is an easy-to-use evaluation module for the MSPM0G3507 microcontroller (MCU). The LaunchPad kit contains everything needed to start developing on the MSPM0Gxxxx microcontroller platform, including an onboard debug probe for programming, debugging, and EnergyTrace™ technology. The board also features onboard buttons, LEDs, an RGB LED, a light sensor, and a temperature sensor.

Features

- Onboard XDS110 debug probe
- EnergyTrace technology available for ultra-low-power debugging
- 2 buttons, 1 LED, and 1 RGB LED for user interaction
- Temperature sensor circuit
- Light sensor circuit
- External OPA2365 (default buffer mode) for ADC (up to 4Msps) evaluation
- Onboard 32.768kHz and 40MHz crystals
- RC filter for ADC input (unpopulated by default)



MSPM0G3507 LaunchPad Development Kit

1 Evaluation Module Overview

1.1 Introduction

The MSPM0G3507 is Arm® 32-bit Cortex®-M0+ CPU with a memory protection unit and frequency up to 80MHz. The device features 128KB of embedded flash memory combined with 32KB of on-chip RAM. The integrated high-performance analog peripherals include two 12-bit 4-Msps SAR ADCs, two zero-drift chopper op-amps (OPA), and one general-purpose amplifier (GPAMP) to help users design their system.

Rapid prototyping is simplified by the 40-pin BoosterPack™ plug-in module headers, which support a wide range of available BoosterPack plug-in modules. You 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.

Free software development tools are also available such as TI's Code Composer Studio™ IDE, IAR Embedded Workbench™ IDE, and Keil®µVision® IDE. Code Composer Studio IDE supports EnergyTrace™ technology when paired with the MSPM0G3507 LaunchPad™ development kit. Developer can easily measure the power consumption of their applications. 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 Cloud Developer Zone. MSPM0 MCUs are also supported by extensive online collateral, training with MSP Academy, and online support through the TI E2E™ support forums.

See the *MSPM0 Quick Reference Guide* for more resources surrounding MSPM0 devices.

1.2 Kit Contents

- MSPM0G3507 LaunchPad development kit
- 1 Micro USB cable
- 1 Quick Start Guide

1.3 Specification

LP-MSPM0G3507 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-MSPM0G3507 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 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.

1.4 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
MSPM0G3507SPMR	Mixed-Signal Microcontroller with 80MHz Arm Cortex 32-bit M0+ CPU, 128kB flash, and 32kB SRAM	Evaluation device
MSP430G2452IRSA16R	Mixed-Signal Microcontroller with 16-bit RISC CPU, 8kB Flash, and 256B SRAM	DC/DC controller for EnergyTrace technology
TPS73533DRBT	500mA, adjustable, low quiescent current, low-noise, high PSRR, single-output LDO regulator	3.3V power
TPS2102DBVR	2.7V to 4V power mux, dual-input, single-output power switch	Switches XDS110 power

1.5 Software Examples

- Out-of-Box Software Example
- SDK Examples

1.6 First Step: Out-of-Box Experience

An easy way to get started with the EVM is by using the preprogrammed out-of-box code. This code demonstrates some key features of the EVM and is meant to be used with the LP-MSPM0G3507 out-of-box demo GUI.

1.6.1 Connecting to the Computer

Connect the LaunchPad development kit using the included USB cable to a computer. A green power LED illuminates if power connects. For proper operation, drivers are needed. TI recommends that you get the drivers by installing an IDE such as TI's Code Composer Studio IDE or IAR Embedded Workbench IDE. Standalone drivers are also available.

1.6.2 Running the Out-of-Box Experience

Access the GUI Composer powered GUI for the Out-of-Box Experience (OoBE) through the TI Cloud Gallery. Alternatively, the GUI is provided with the MSPM0 SDK as well for offline operation. Figure 1-1 shows the welcome screen for the GUI. The GUI runs through three main examples:

- Blink LED – Change the rate of LED blinking
- Light Sensor – Read light sensor and plot results, and also modulate RGB brightness
- Thermistor – Read thermistor voltage and plot converted temperature over time. The RGB LED changes colors to signify differences of temperature measured.
- Function Generator – Generate sine, square, and sawtooth waveforms, sample with ADC, and plot on graph.

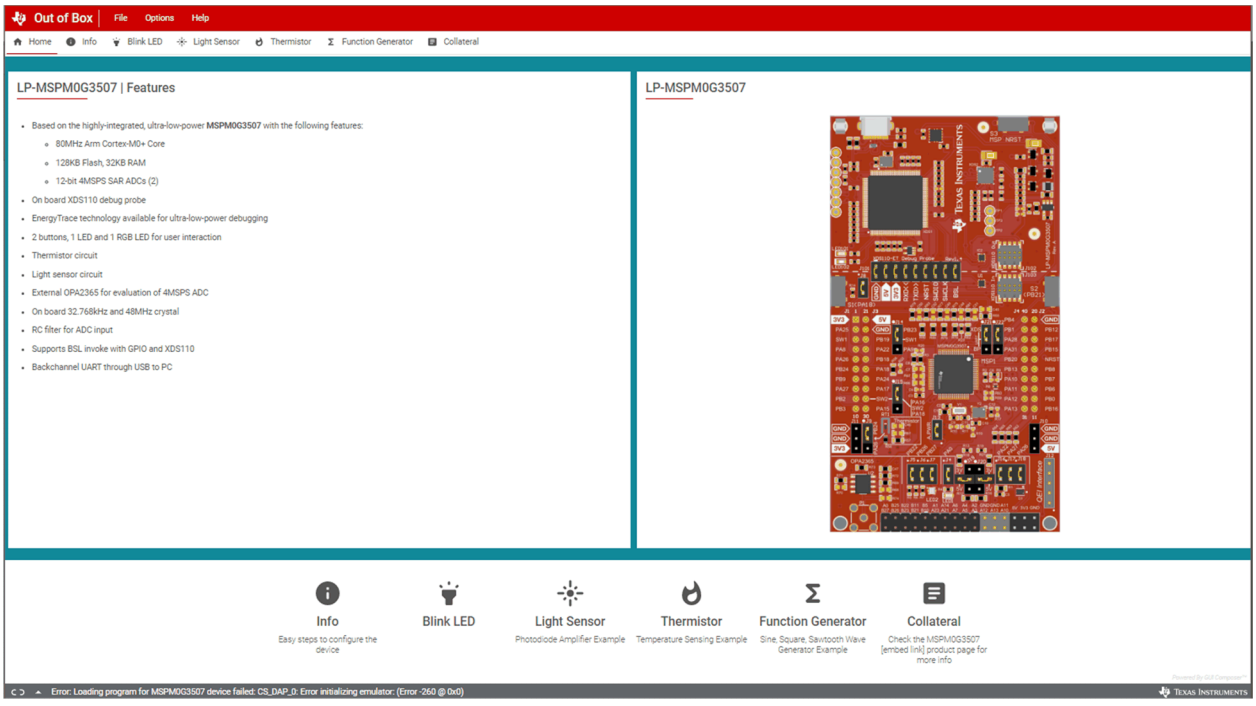


Figure 1-1. Out-of-Box Experience Welcome Screen

1.7 Next Steps: Looking Into the Provided Code

After the EVM features have been explored, the fun can begin. It's time to open an integrated development environment and start editing the code examples. See Section 4 for available IDEs and where to download them. The quickest way to get started using the LaunchPad development kit is to use TI's cloud development tools. The cloud-based Resource Explorer provides access to all of the examples and resources in MSPM0 SDK.

Code Composer Studio Cloud is a simple Cloud-based IDE that enables developing and running applications on the LaunchPad development kit. SysConfig for MSPM0 is another graphical tool that can be utilized to easily and quickly setup your MSPM0G3507 device, pins, and peripherals to fit your development needs. The out-of-box source code and more code examples are provided and available on the download page. Code is licensed under BSD, and TI encourages reuse and modifications to fit specific needs. Section 1.5 describes all functions in detail and provides a project structure to help familiarize you with the code. With the XDS110 debug probe, debugging and downloading new code is simple. A connection between the EVM and a PC through the provided USB cable is all that is needed.

2 Hardware

Figure 2-1 shows an overview of MSPM0G3507 LaunchPad development kit hardware.

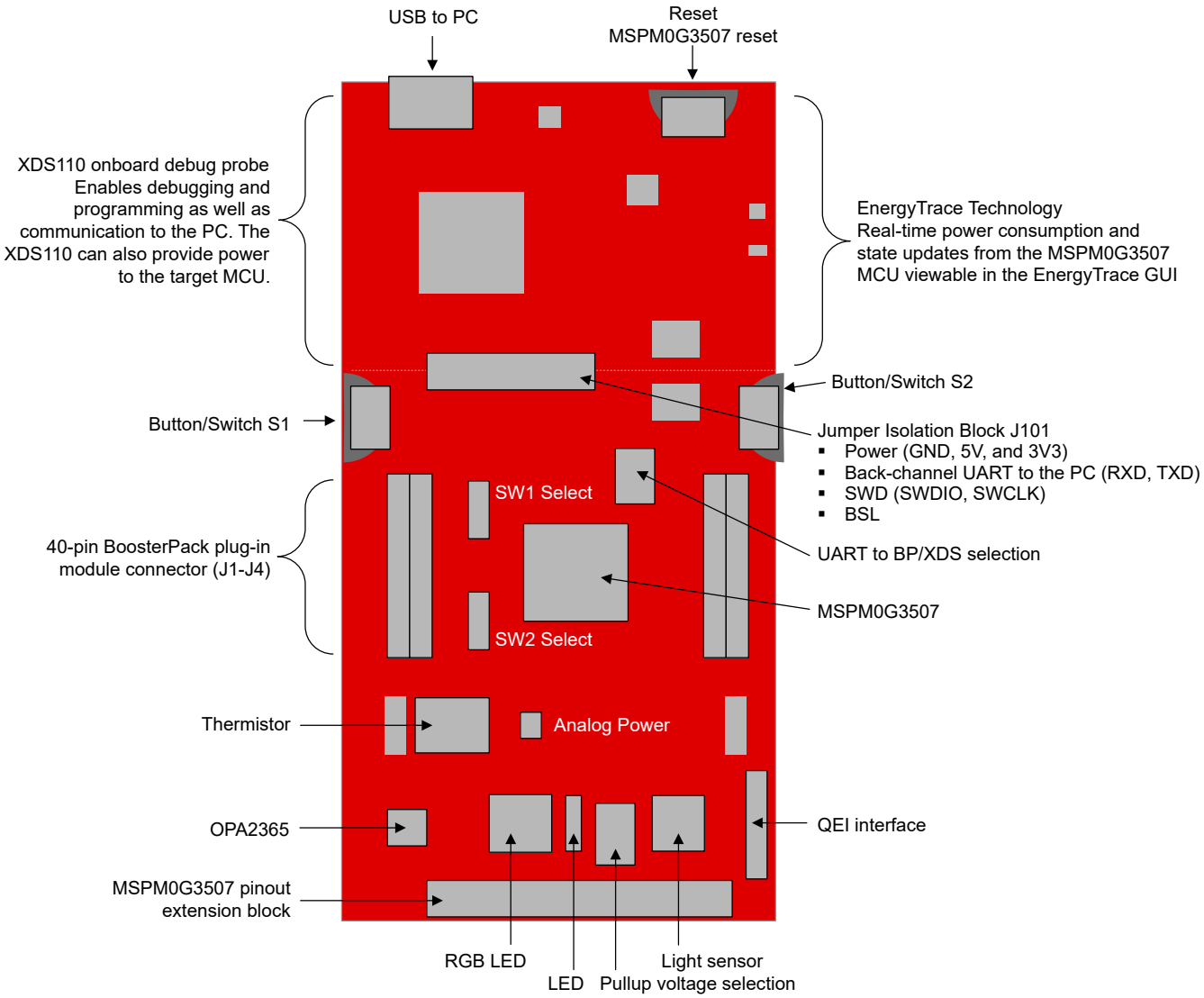


Figure 2-1. MSPM0G3507 LaunchPad Development Kit Hardware

2.1 Jumper Map

Table 2-1 lists the default installation of the jumpers.

Table 2-1. LaunchPad Kit Header Description and Jumper Shunt Installation

Jumper	Description	Default setting	Connected Pin or Signal	Low Power Measurement Recommendation
J101	XDS110-ET isolation block	Installed	GND, 5V, 3V3, RXD, TXD, NRST, SWDIO, SWCLK, BSL	OFF to disconnect from XDS-110 circuitry
J102	XDS110-ET OUT	NA	GND, 3V3, SWDIO, SWCLK, NRST	No external connection
J103	XDS110-ET IN	NA	GND, 3V3, SWDIO, SWCLK	No external connection
J1/J3	BoosterPack pin header	NA	See schematic for details	No external connection
J2/J4	BoosterPack pin header	NA	See schematic for details	No external connection
J4	Red LED1	Installed	PA0 to LED	OFF to disconnect pin from LED
J5	RGB LED2 – blue channel	Installed	PB22 to RGB LED	OFF to disconnect pin from RGB LED
J6	RGB LED2 – red channel	Installed	PB26 to RGB LED	OFF to disconnect pin from RGB LED
J7	RGB LED2 – green channel	Installed	PB27 to RGB LED	OFF to disconnect pin from RGB LED
J8	S1 Button and BSL invoke	Installed	PA18	OFF to avoid current from external pulldown depending on pin configuration
J9	Thermistor signal selection	(1) short to (2) PB.24	PB24 to thermistor circuit	OFF to disconnect from thermistor circuit
J10	5V power header	NA	5V, GND	No external connection
J11	3V3 power header	NA	3V3, GND	No external connection
J12	QEI interface header	NA	PA29, PA30, PB14, 3V3, GND	No external connections
J13	Analog power – power to thermistor and OPA2365	Installed	3V3	OFF to disconnect power to thermistor, and OPA2365 circuits
J14	SW1 selection to BP header – PA9/PB23	(1) short to (2) PB.23	PB23 to J1.3	Don't care if not used in BoosterPack connector
J15	SW2 selection to BP header – PA16/PA18	(1) short to (2) PA16	PA16 to J3.29	Don't care if not used in BoosterPack connector
J16	OPA0_OUT for light sensor circuit	Installed	PA22 to light sensor	OFF to disconnect from photodiode circuit
J17	OPA0_IN0- for light sensor circuit	Installed	PA27 to light sensor	OFF to disconnect from photodiode circuit
J18	OPA0_IN0+ for light sensor circuit	Installed	PA26 to light sensor	OFF to disconnect from photodiode circuit
J19	PA0 Open-drain IO pullup	(1) Short to (2) 3.3V	PA0 to 3V3	OFF if pin initialized as output low or input with pullup or pulldown
J20	PA1 Open-drain IO pullup	(1) Short to (2) 3.3V	PA1 to 3V3	OFF if pin initialized as output low or input with pullup or pulldown
J21	UART0_TX selection	(1) short to (2) XDS_UART function	PA10 to XDS	OFF to disconnect pin
J22	UART0_RX selection	(1) short to (2) XDS_UART function	PA11 to XDS	OFF to disconnect pin
J23-J28	MSPM0G3507 pin extension header (unlabeled – bottom of board)	NA	See schematic for details	No external connection

2.2 Block Diagram

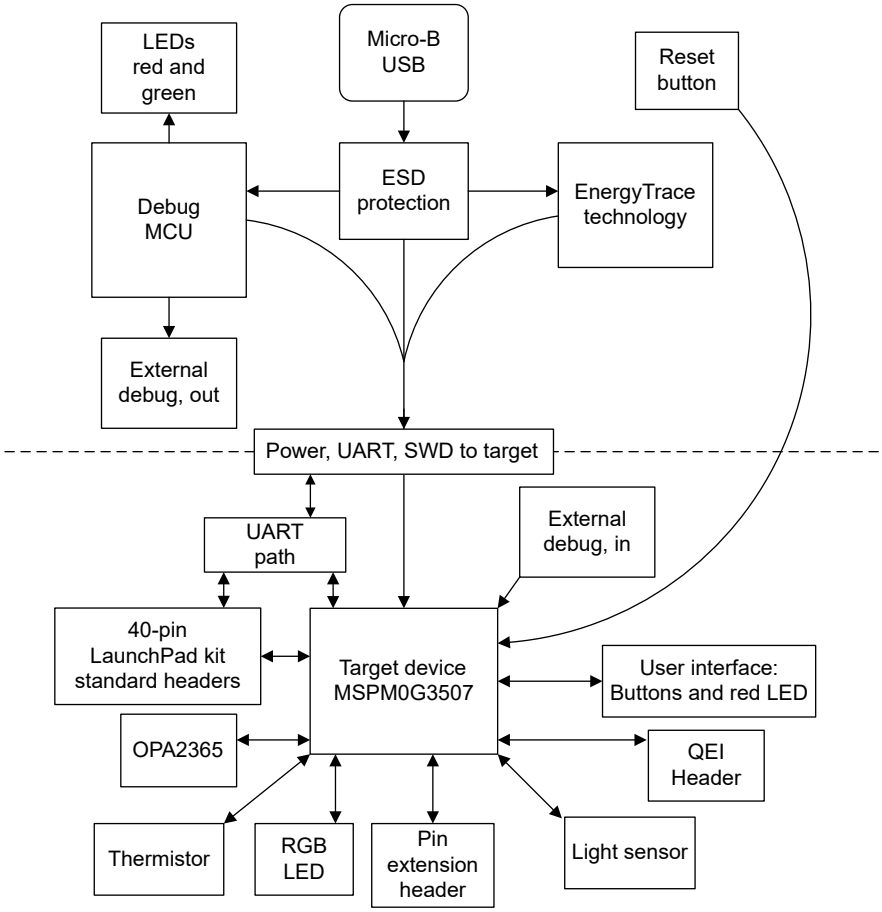


Figure 2-2. Block Diagram

2.3 Hardware Features

2.3.1 MSPM0G3507 MCU

The MSPM0G3507 devices provide 128KB of embedded flash program memory with built-in error correction code (ECC) and 32KB of SRAM with hardware parity. The devices also incorporate a memory protection unit, 7-channel DMA, math accelerator, and a variety of high-performance analog peripherals such as two 12-bit 4-Msps ADCs, a configurable internal shared voltage reference, one 12-bit DAC, three high speed comparators with built-in reference DACs, two zero-drift op-amps with programmable gain, and one general-purpose amplifier. The devices also offer intelligent digital peripherals such as two 16-bit advanced control timers, three 16-bit general purpose timers, one 32-bit high resolution timer, two windowed-watchdog timers, and one RTC with alarm and calendar mode. These devices provide data integrity and encryption peripherals (AES, CRC, TRNG) and enhanced communication interfaces (four UART, two I2C, two SPI, and one CAN 2.0/FD).

Device feature include:

- 1.62V to 3.6V operation
- Arm 32-bit Cortex-M0+ with memory protection unit, up to 80MHz
- 128KB of flash with built-in ECC and 32KB of SRAM with hardware parity
- Two 12-bit 4-Msps ADCs
- 12-bit DAC
- Two zero-drift zero-crossover chopper op-amps
- Two 16-bit advanced control timers
- Three 16-bit general-purpose timers
- One 32-bit high-resolution time
- 60 GPIO

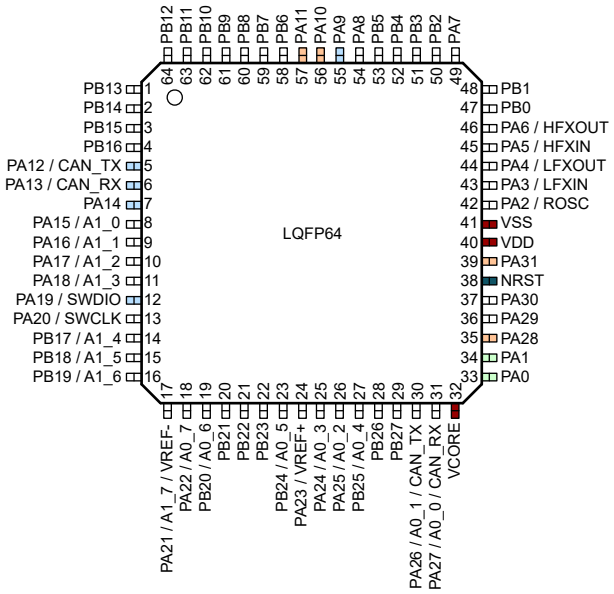


Figure 2-3. LQFP64 Pinout (Top View)

2.3.2 XDS110-ET Onboard Debug Probe With EnergyTrace Technology

To keep development easy and cost effective, TI's LaunchPad development kits integrate an onboard debug probe, which eliminates the need for expensive programmers. The MSPM0G3507 has the XDS110 debug probe (see Figure 2-4), which is a simple and low-cost debugger that supports all MSPM0 device derivatives.

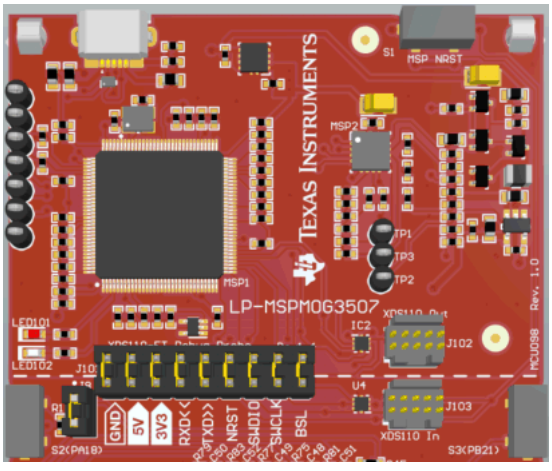


Figure 2-4. LP-MSPM0G3507 Debugger

The XDS110 ET also provides a "backchannel" UART-over-USB connection with the host, which can be very useful during debugging and for easy communication with a PC. More details can be found in Section 2.3.4.

2.3.3 Debug Probe Connection Isolation Jumper Block

The isolation jumper block at jumper J101 allows the user to connect or disconnect signals that cross from the XDS110-ET domain into the MSPM0G3507 target domain. This includes XDS110-ET SWD signals, application UART signals, and 3.3V and 5V power.

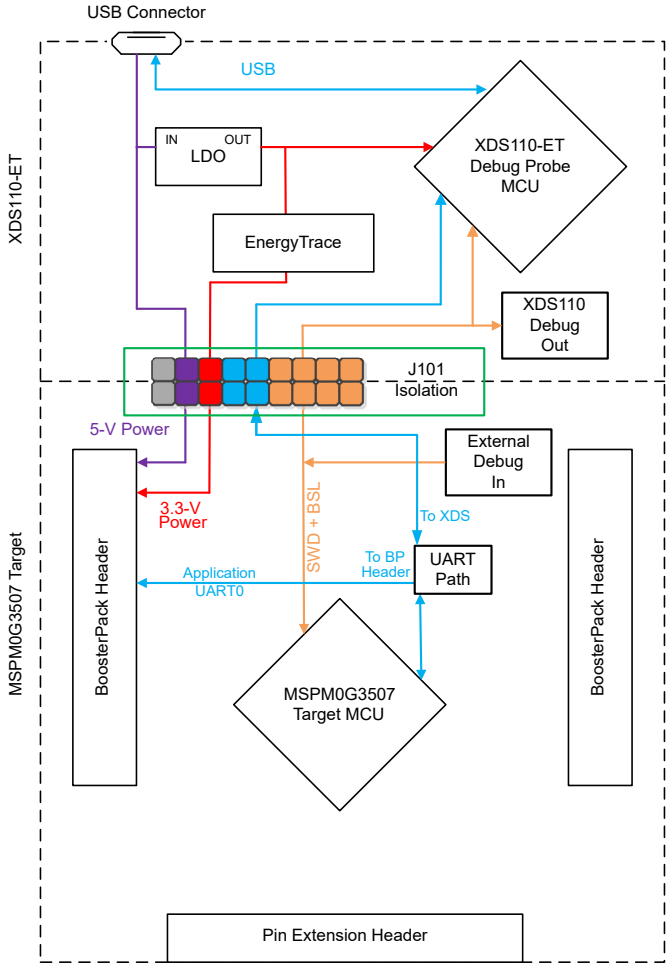


Figure 2-5. Isolation Jumper Block

Reasons to open these connections:

- To remove any and all influence from the XDS110-ET debug probe for high accuracy target power measurements
- To control 3.3V and 5V power flow between the XDS110-ET 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 of the XDS110-ET so that the programming and UART interface can be used for devices other than the onboard MCU.

Jumper	Description
GND	Ground
5V	5V VBUS from USB
3V3	3.3V rail, derived from VBUS in the XDS110-ET domain
RXD<<	Backchannel UART: The target M0G3507 receives data through this signal. The arrows indicate the direction of the signal
TXD>>	Backchannel UART: The target M0G3507 sends data through this signal. The arrows indicate the direction of the signal
NRST	RST signal
SWDIO	Serial wire debug: SWDIO data signal.
SWCLK	Serial wire debug: SWDCLK clock signal
BSL	Bootstrap loader signal

2.3.4 Application (or Backchannel) UART

The backchannel UART allows communication with the USB host that is not part of the main functionality of the target application. 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.

Figure 2-5 shows the pathway of the backchannel UART. The backchannel UART is the UART on UART0 (PA10, PA11) depending on the jumper settings on headers J21 and J22.

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.

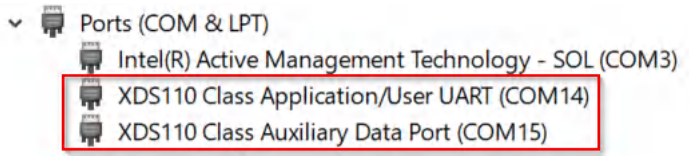


Figure 2-6. Application Backchannel UART in Device Manager

The backchannel UART is the "XDS110 Class Application/User UART" port. In this case, Figure 2-6 shows COM14, but this port can vary from one host PC to the next. After identifying the correct COM port, configure in your host application according to the documentation. The user can then open the port and begin communication from the host.

On the target MSPM0G3507 side, the backchannel is connected to the UART0 module. The XDS110-ET has a configurable baud rate; therefore, the PC application configuring the baud rate to be the same as what is configured on the UART0 is important.

2.3.5 Using an External Debug Probe Instead of the Onboard XDS110-ET

Many users have a preferred external debug probe and want to bypass the XDS110-ET debug probe to program the MSPM0 target MCU. The bypass is enabled by jumpers on isolation block J101 and the connector J103. Using an external debug probe is simple, and full JTAG access is provided through J103.

1. Remove jumpers on the JTAG signals on the J101 isolation block, including NRST, SWDIO and SWCLK.
2. Plug any Arm debug probe into J103.
   a. J103 follows the Arm Cortex Debug Connector standard outlined in Cortex-M Debug Connectors.
3. Plug USB power into the LaunchPad development kit, or power the kit externally.
   a. Make sure that the jumpers across 3V3 and GND are connected if using USB power.
   b. External debug probes do not provide power, the VCC pin is a power sense pin.

c. For more details on powering the LaunchPad development kit, see Section 2.4

2.3.6 Using the XDS110-ET Debug Probe With a Different Target

The XDS110-ET debug probe on the LaunchPad development kit can interface to most Arm Cortex-M devices, not just the onboard target MSPM0G3507 device. This functionality is enabled by the J102 10-pin Cortex-M JTAG connector and a 10-pin cable. Header J102 follows the Cortex-M Arm standard, however, pin 1 is not a voltage sense pin. The XDS110- ET outputs only 3.3V JTAG signals. If another voltage level is needed, the user must provide level shifters to translate the JTAG signal voltages. Additionally, 3.3V of output power can be sourced from the XDS110-ET when jumper JP102 is connected. This allows the XDS110-ET to power the external target at 3.3V through pin 1. EnergyTrace functionality is not available when programming an external target.

1. Remove jumpers on the JTAG signals on the J101 isolation block, including RST, TMS, TCK, TDO, and TDI.
2. Plug the 10-pin cable into J102, and connect to an external target. J102 follows the Arm Cortex Debug Connector standard outlined in Cortex-M Debug Connectors.
3. Plug USB power into the LaunchPad development kit, or power the kit externally. JTAG levels are 3.3V ONLY.

2.3.7 Special Features

2.3.7.1 Up to 4-Msps High-Speed Analog-to-Digital Converter

MSPM0 G-series device includes an up to 4-Msps high-speed ADC module. To help evaluate the best performance of the ADC, an external OPA is also included on the LaunchPad kit. This external OPA can be used as a buffer or to amplify the input signal. With the built-in ADC module, the device can achieve a maximum rate of 4 Msps.

The LaunchPad kit uses the OPA2365 in the ADC input channel in buffer mode by default (see Figure 2-7). The OPA2365 has 2 OPAs inside, and footprints for external passives are provided to allow users to customize the OPA configuration.

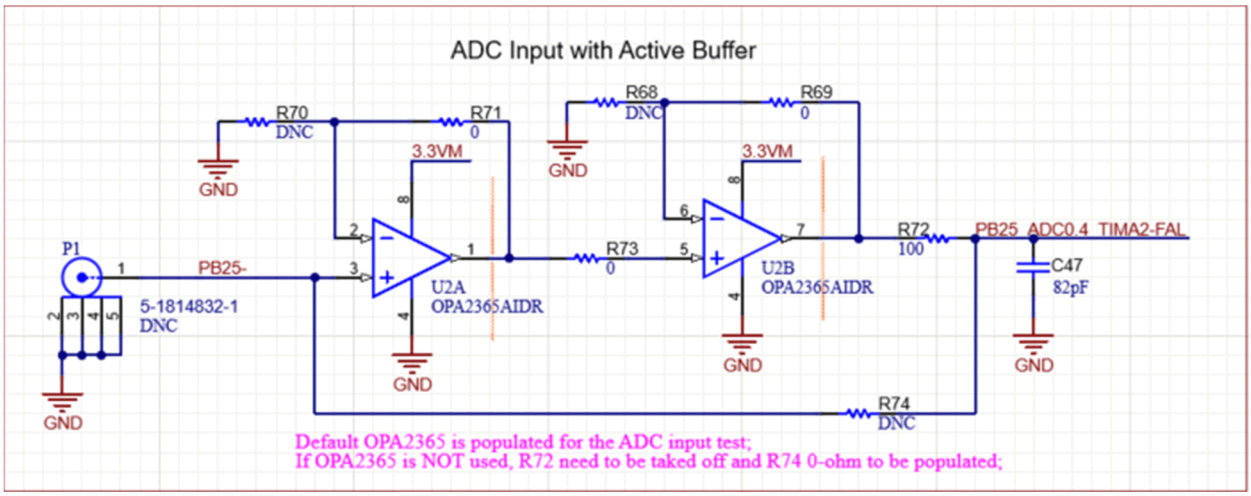


Figure 2-7. External OPA Circuit

For the signal input, a coaxial connector can be populated at P1 to reduce environmental noise. You can also access the OPA input through the pin extension header at the bottom of the board.

The OPA output connects to the ADC0.4 channel, and the example code helps to evaluate ADC performance quickly.

2.3.7.2 Thermistor

The LaunchPad kit includes a 10k linear thermistor (PTC), the TMP6131. Figure 2-8 shows the circuit. The PTC is in a low-side configuration with a 10kΩ 10ppm pullup resistor. The default position of the jumper in the header (1-2 position) connects this circuit directly to the ADC. In this mode, the output voltage is approximately 1.6V at room temperature.

The jumper can also be set to the 2-3 position to allow an OPA connection to the thermistor. The OPA output can be connected internally, through software, to the negative OPA terminal. This allows the OPA to be used as a buffer for the thermistor with an internal connection to an ADC channel for sampling. If an external connection or additional biasing or filtering is wanted, then the passives shown in Figure 2-8 need to be populated.

Note

The capacitor and resistor network associated with the OPA is not populated by default. This allows the user to populate with passive values to fit the specific application needs.

Note

When using the OPA and the passive network, be sure to check for conflicts with other pins on the LaunchPad kit because pins are multiplexed with several functions.

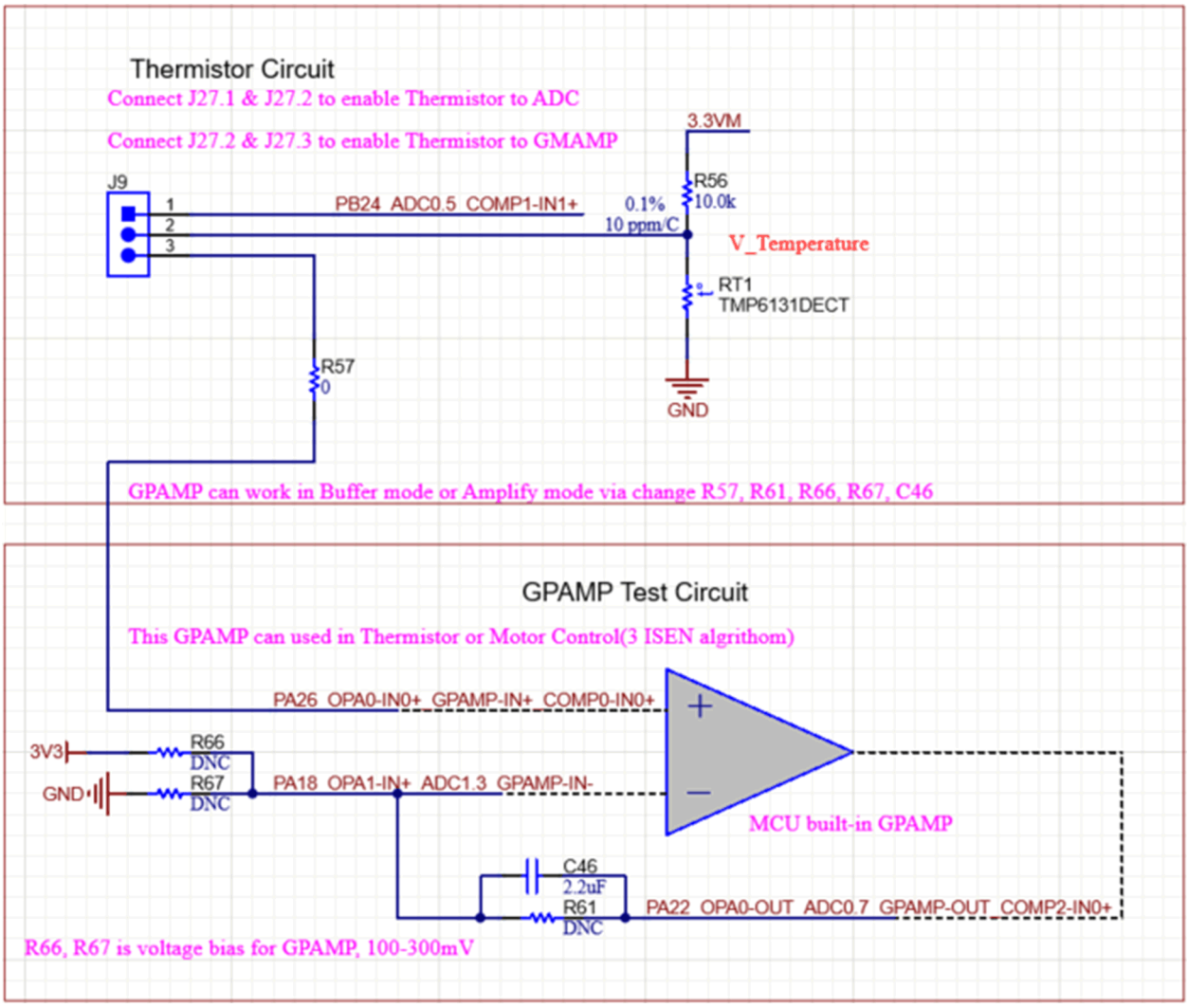


Figure 2-8. Thermistor Circuit

2.3.7.3 Light Sensor

A light sensor circuit is provided on the board using the photodiode in the configuration shown in Figure 2-9. The jumper connections between this circuit and the MSPM0 are populated by default so the photodiode is in circuit. The jumpers can be removed to place the photodiode out of circuit so the MSPM0 connections can be used for other evaluation purposes.

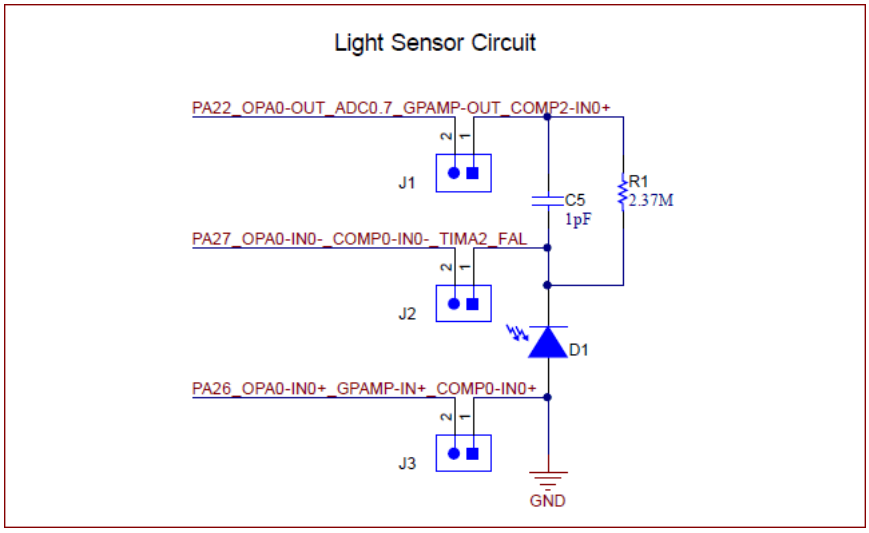


Figure 2-9. Light Sensor Circuit

This circuit is intended to be used with the internal OPA of the MSPM0 in an transimpedance configuration to drive the circuit. The OPA output is internally set to an ADC channel for sampling.

2.4 Power

The board accommodates various powering methods, including through the onboard XDS110-ET as well as external or BoosterPack plug-in module power.

2.4.1 XDS110-ET USB Power

The most common power-supply scenario is from USB through the XDS110-ET debugger. This provides 5V power from the USB and also regulates this power rail to 3.3V for XDS110-ET operation and 3.3V to the target side of the LaunchPad kit. Power from the XDS110-ET is controlled by jumper J101. For 3.3V, make sure that a jumper is connected across the J101 3V3 terminal.

2.5 External Power Supply and BoosterPack Plug-in Module

Header J11 is present on the board to supply external power directly. The importance is to comply with the device voltage operation specifications when supplying external power. The MSPM0G3507 has an operating range of 1.62V to 3.6V. More information can be found in the MSPM0G3507 data sheet.

2.6 Measure Current Draw of the MSPM0 MCU

To measure the current draw of the MSP430FR2355 MCU using a multimeter, use the 3V3 jumper on the

J101 jumper isolation block. The current measured includes the target device 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 this jumper.
2. Consider the effect that the backchannel UART and any circuitry attached to the MSPM0G3507 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.
   a. Disconnect unnecessary jumpers as outlined in the jumper map of Table 2-1. In particular, Analog Power jumper J13 must be removed if not using the thermistor or OPA2365 circuits.
3. Make sure there are no floating inputs or outputs on the MSPM0G3507. This causes unnecessary extra current draw. Every I/O is either driven out or, if there is an input, then the I/O is pulled or driven to a high or low level.
4. Begin target execution.
5. Measure the current. Keep in mind that if the current levels are fluctuating, then getting a stable measurement is difficult. Measuring quiescent states is easier.

EnergyTrace technology can also be used to compare various current profiles and better optimize your energy performance.

2.7 Clocking

The MSPM0G3507 provides external clocks in addition to the internal clocks in the device.

- Y1: 32.768kHz 12.5pF crystal
- Y2: 40MHz 12.5pF crystal

The internal SYSOSC is 32 MHz by default at an accuracy of 2.5%. For higher accuracy, connect a 0.1% resistor at ROSC pin. 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. For more clock tree details, see Section 2.3 *Clock Module (CKM)* in the *MSPM0 G-Series 80MHz Microcontrollers Technical Reference Manual*.

2.8 BoosterPack Plug-in Module Pinout

The LaunchPad development kit adheres to the 40-pin LaunchPad development kit pinout standard. 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. The MSPM0G3507 LaunchPad development kit is compatible with all 40-pin BoosterPack plug-in modules that are compliant with the standard. If the reseller or owner of the BoosterPack plug-in module does not explicitly indicate compatibility with the MSPM0G3507 LaunchPad development kit, compare the schematic of the candidate BoosterPack plug-in module with the LaunchPad development kit to verify compatibility. Keep in mind that sometimes conflicts can be resolved by changing the MSPM0G3507 device pin function configuration in software.

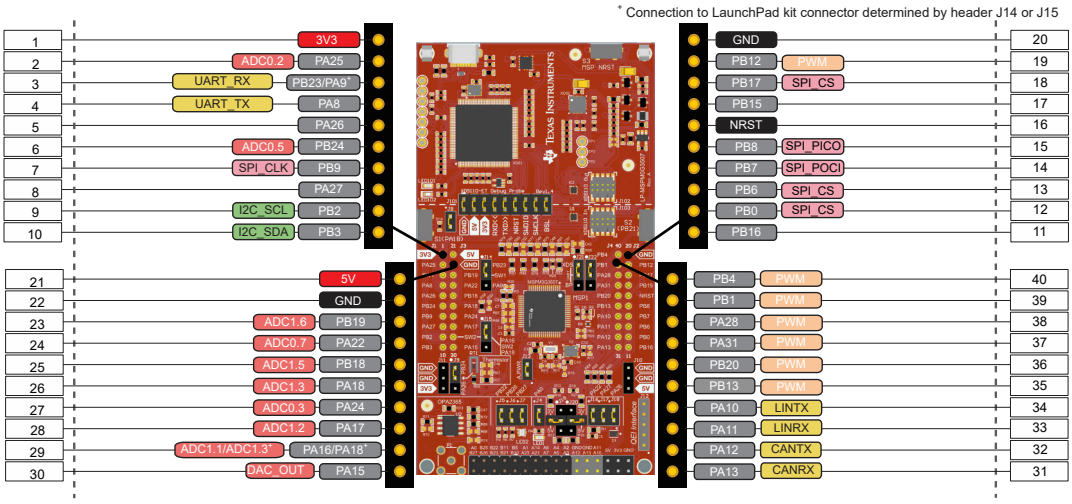


Figure 2-10. LaunchPad Development Kit to BoosterPack Plug-in Module Connector Pinout

3 Software Examples

See the MSPM0 SDK documentation for more details about available software.

4 Resources

4.1 Integrated Development Environments

Although the source files can be viewed with any text editor, more can be done with the projects if the source files are opened with a development environment like Code Composer Studio IDE (CCS) or IAR Embedded Workbench IDE.

4.1.1 TI Cloud Development Tools

TI's Cloud-based software development tools provide instant access to MSPM0_SDK content and a web-based IDE.

4.1.2 TI Resource Explorer Cloud

TI Resource Explorer Cloud provides a web interface for browsing examples, libraries and documentation found in MSPWare without having to download files to your local drive. Visit TI Resource Explorer Cloud now at dev.ti.com.

4.1.3 Code Composer Studio Cloud

Code Composer Studio Cloud (CCS Cloud) is a web-based IDE that lets you quickly create, edit, build ,and debug applications for the LaunchPad development kit. No need to download and install large software packages, simply connect your LaunchPad development kit and begin. Choose from a large variety of examples in MSPWare software and Energia or develop your own application. CCS Cloud supports debug features such as execution control, breakpoints, and viewing variables.

For more information, see the full comparison between CCS Cloud and CCS Desktop.

Explore Code Composer Studio Cloud now at dev.ti.com.

4.1.4 Code Composer Studio IDE

Code Composer Studio Desktop is a professional integrated development environment that supports TI's Microcontroller and Embedded Processors portfolio. Code Composer Studio comprises a suite of tools used to develop and debug embedded applications. Code Composer Studio includes an optimizing C/C++ compiler, source code editor, project build environment, debugger, profiler, and many other features.

To learn more about CCS and view user’s guides, visit the CCS tool page.

CCS v11.1 or higher is required. When CCS has been launched, and a workspace directory chosen, use Project>Import Existing CCS Eclipse Project. Direct to the desired demo project directory that contains main.c.

4.2 MSPM0 SDK and TI Resource Explorer

TI Resource Explorer is a tool integrated into CCS that allows you to browse through available design resources. TI Resource Explorer helps you quickly find what you need inside packages. TI Resource Explorer is well organized to find everything that you need quickly, and you can import software projects into your workspace in one click!

TI Resource Explorer Cloud is one of the TI Cloud Development tools, and is tightly integrated with CCS Cloud. See Section 4.1.2 for more information.

4.3 MSPM0G3507 MCU

4.3.1 Device Documentation

More information about the MSPM0G3507 device is available. For every MSP device, the documentation is organized as shown in Table 4-1.

Table 4-1. Device Documentation

Document	For MSPM0L1306	Description
Device family TRM	*MSPM0 G-Series 80MHz Microcontrollers Technical Reference Manual*	Architectural information about the device, including all modules and peripherals such as clocks, timers, ADC, and so on
Device-specific data sheet	*MSPM0G350x Mixed-Signal Microcontrollers With CAN-FD Interface* *MSPM0G310x Mixed-Signal Microcontrollers With CAN-FD Interface* *MSPM0G150x Mixed-Signal Microcontrollers* *MSPM0G110x Mixed-Signal Microcontrollers*	Device-specific information and all parametric information for this device

4.3.2 MSPM0G3507 Code Examples

MSPM0_SDK has a set of simple C examplesthat demonstrate how to use the entire set of peripherals on the MSPM0G3507 MCU. Every MSP derivative has a set of these code examples. When starting a new project or adding a new peripheral, these examples serve as a great starting point.

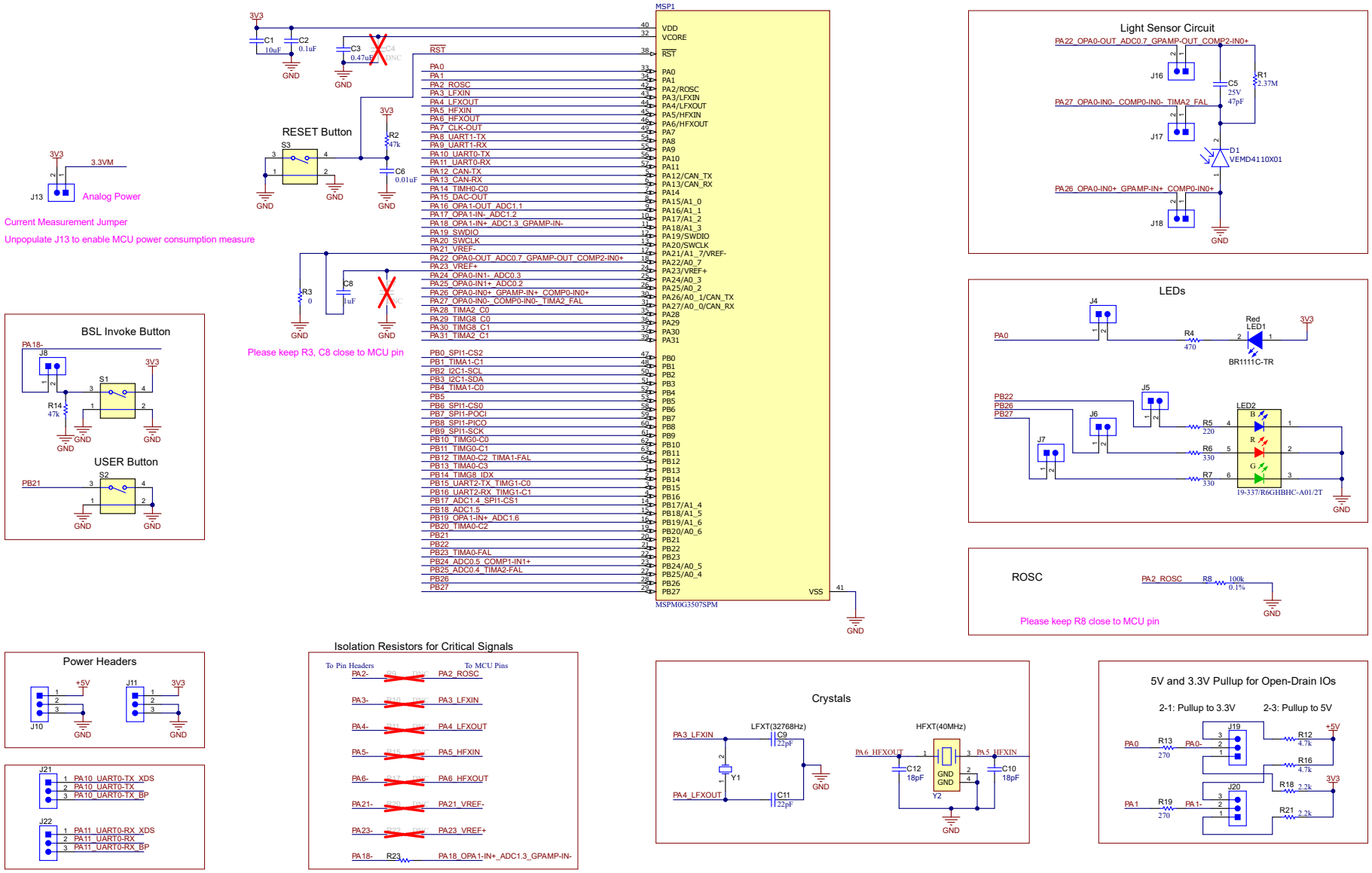
4.4 Community Resources

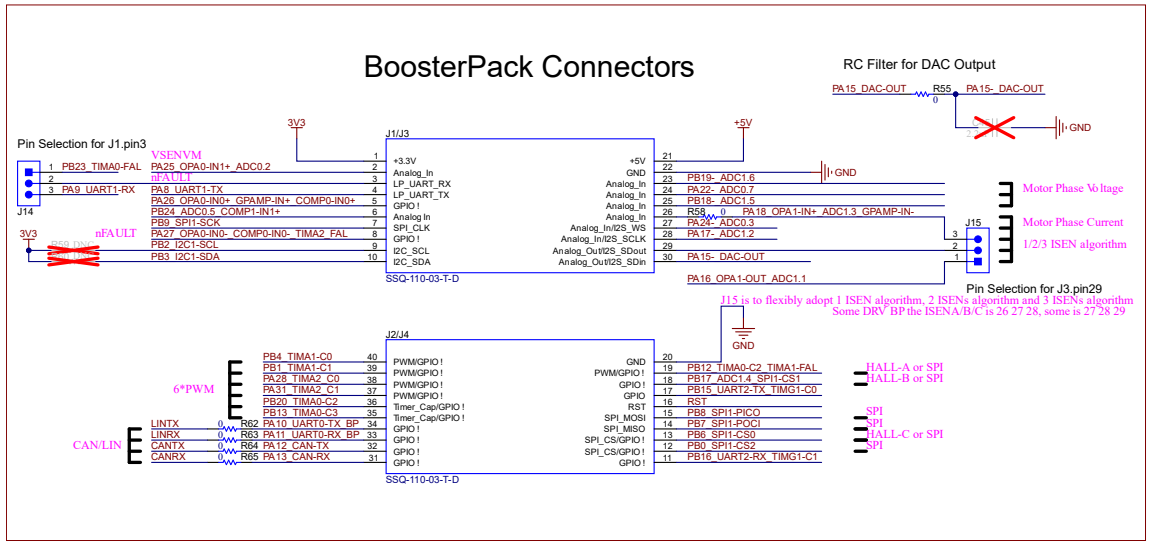
4.4.1 TI E2E™ Forums

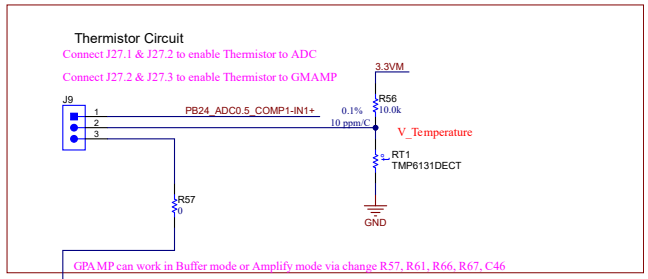
Search the forums at e2e.ti.com. If you cannot find your answer, post your question to the community!

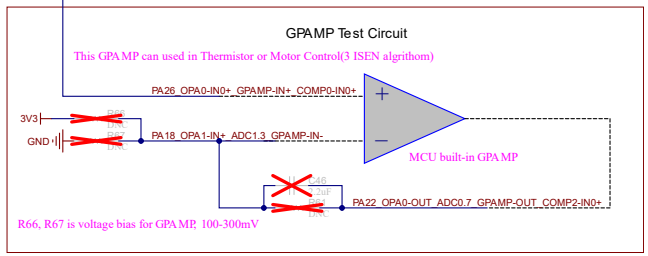
5 Hardware Design Files

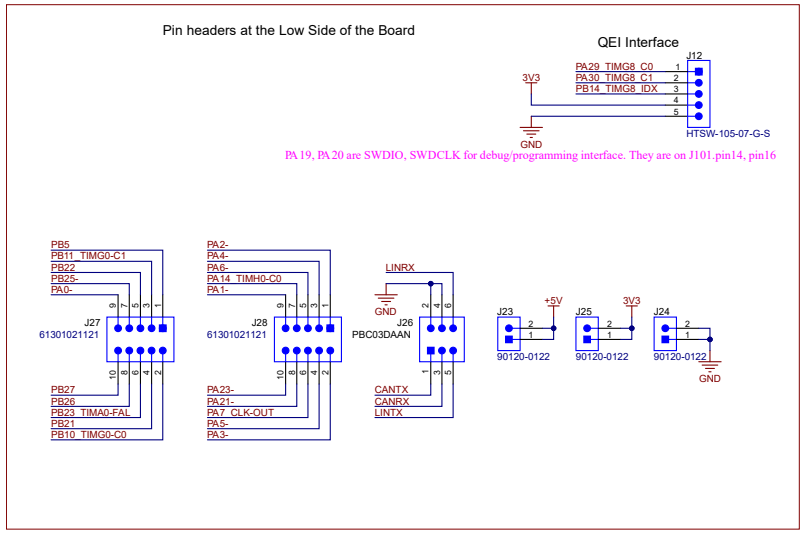
5.1 Schematics

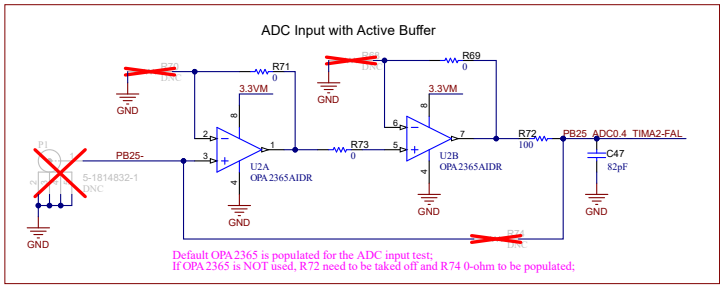


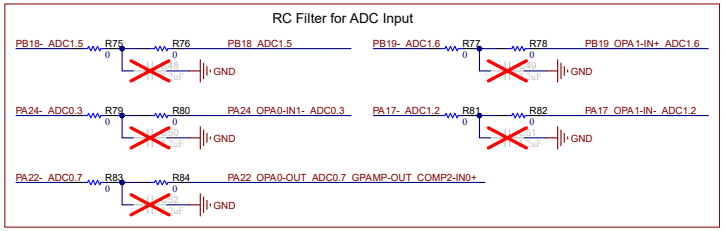


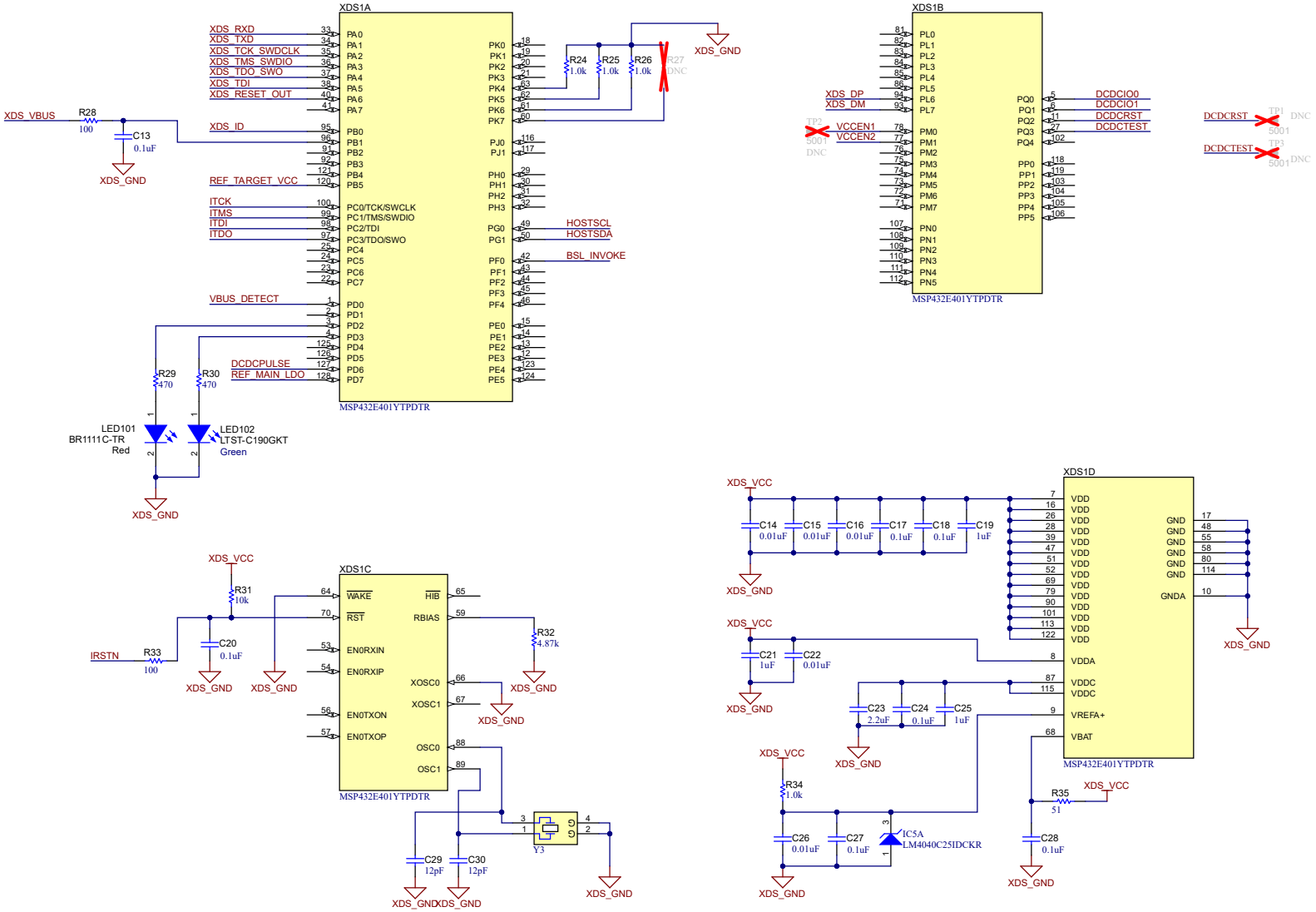






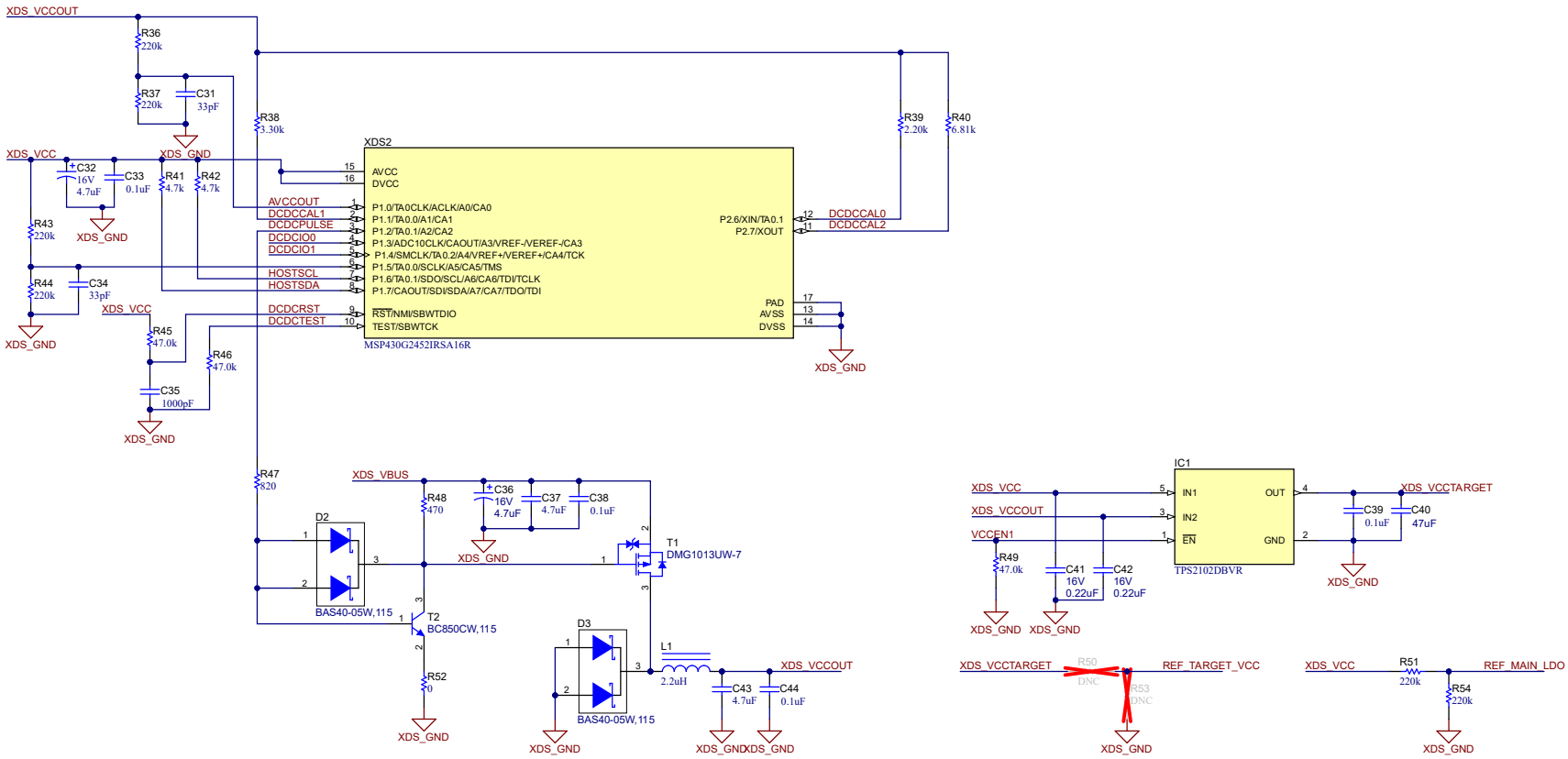


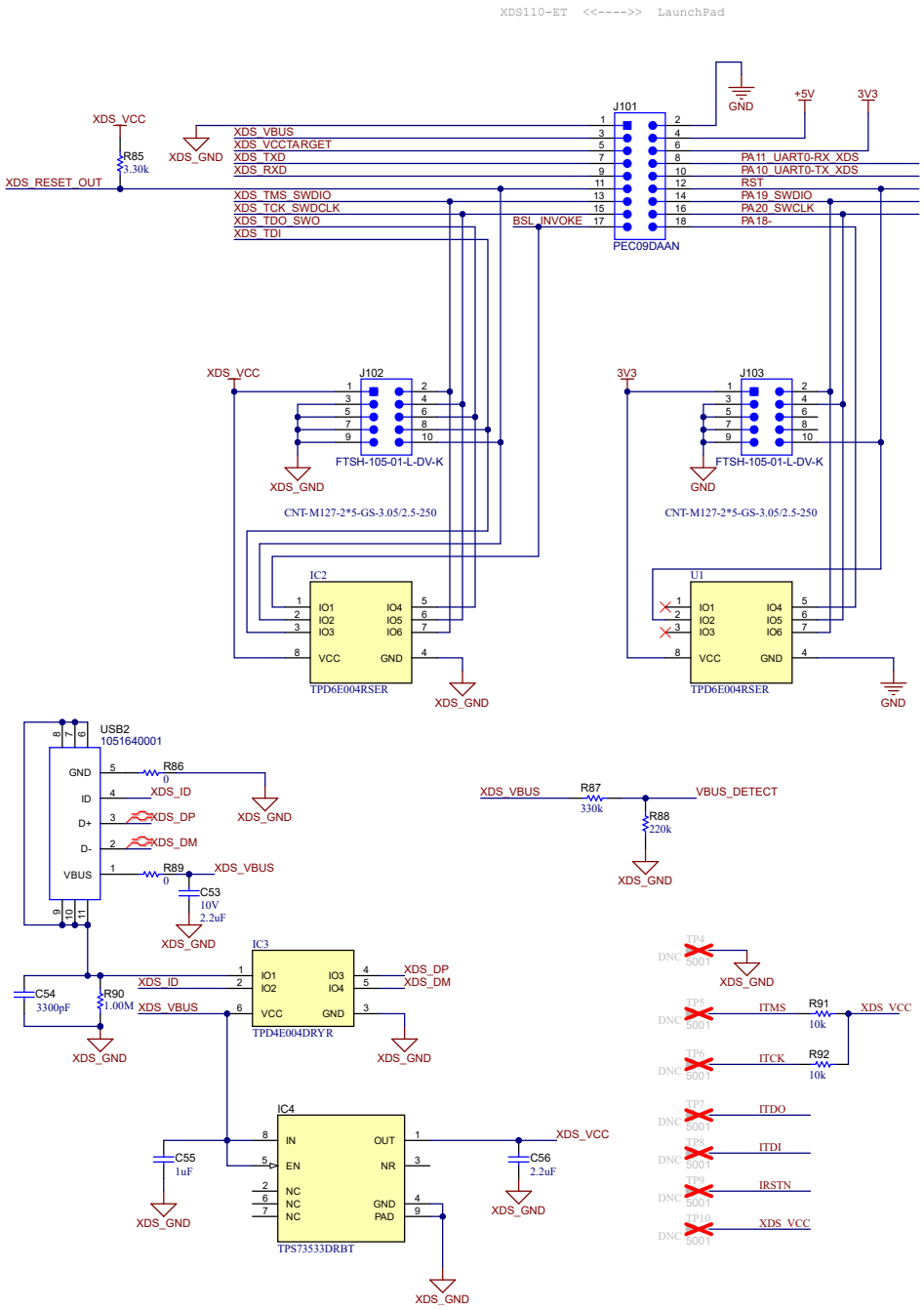




Software-controlled DCDC converter

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





5.2 PCB Layouts

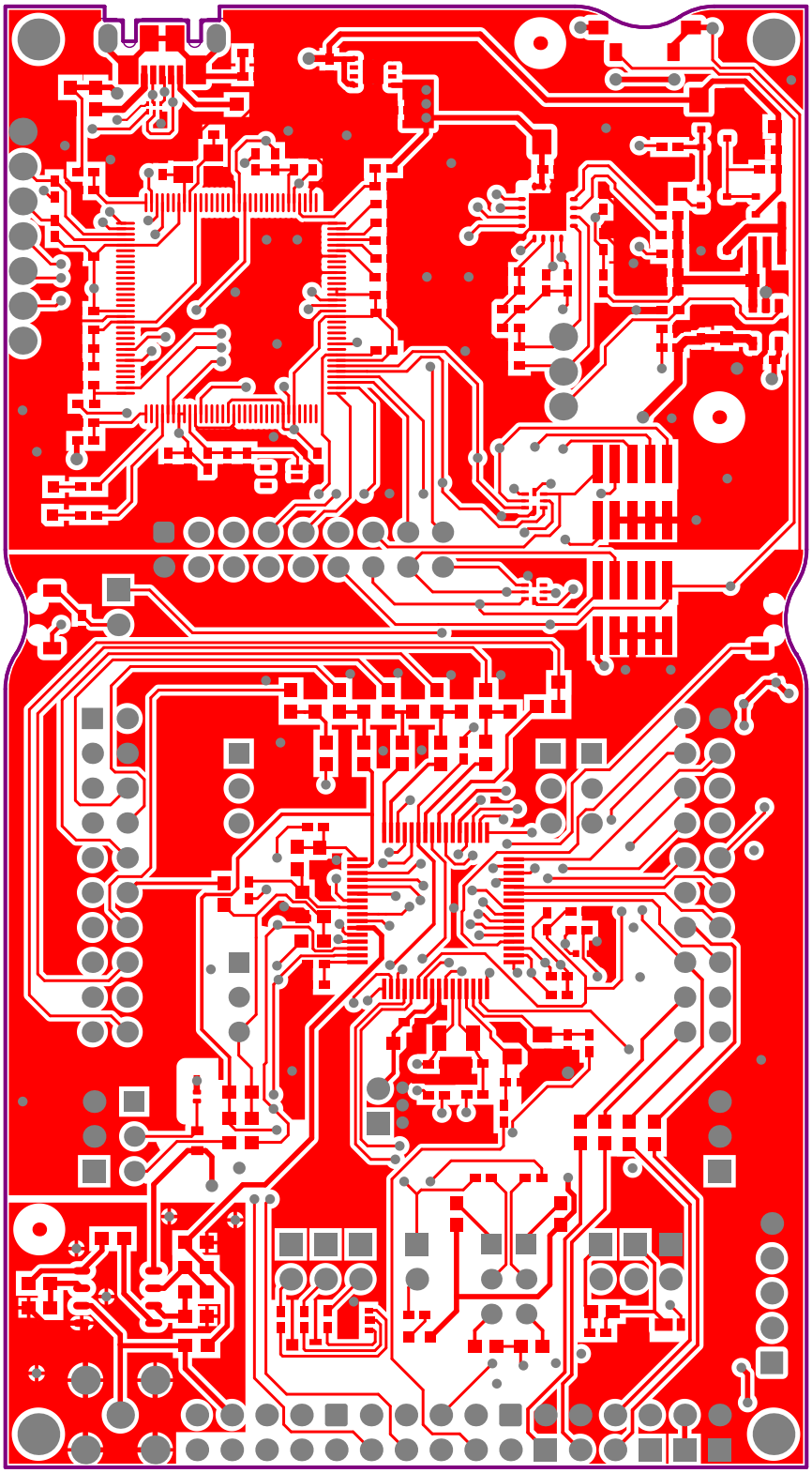


Figure 5-1. Top Layer

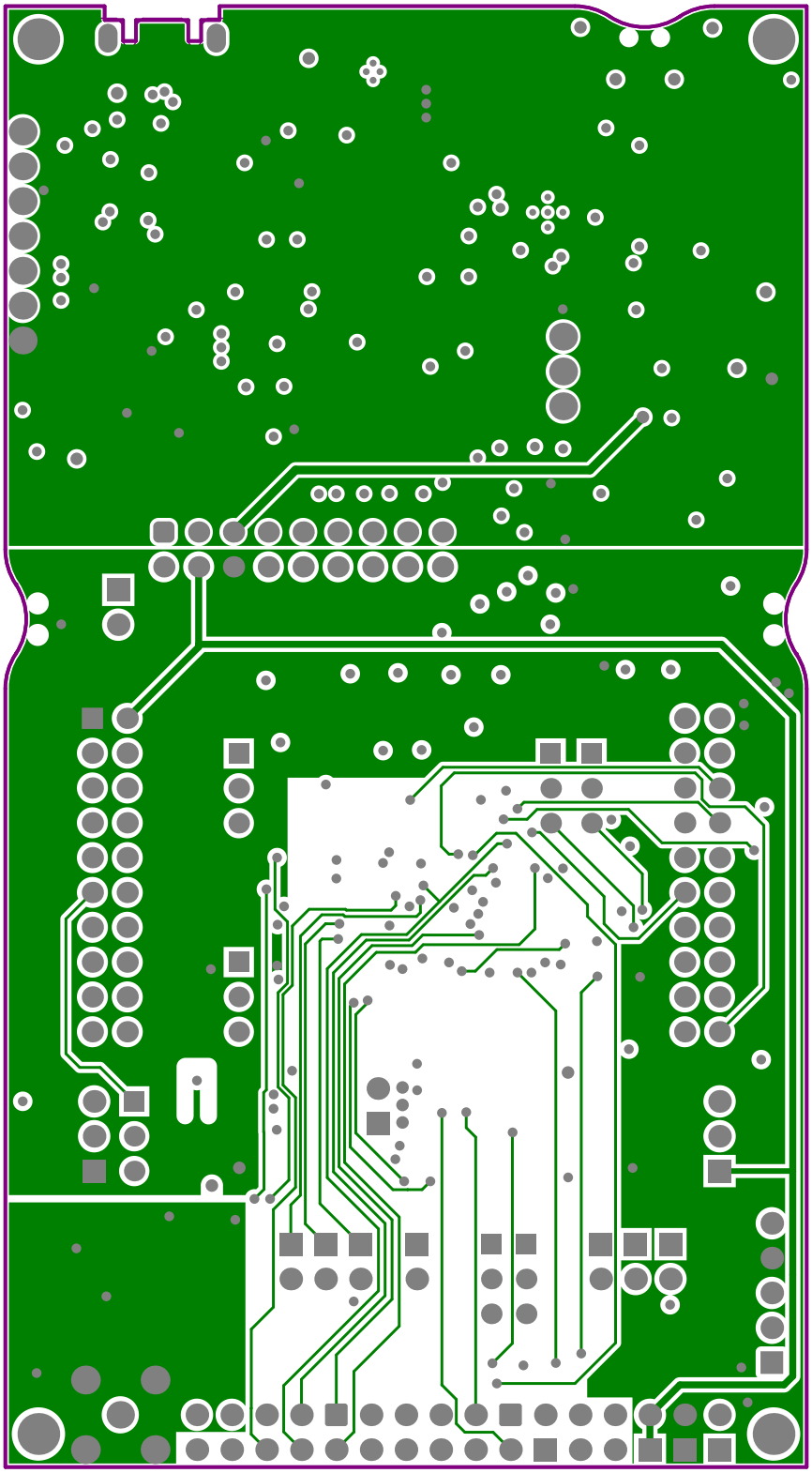


Figure 5-2. VCC Layer

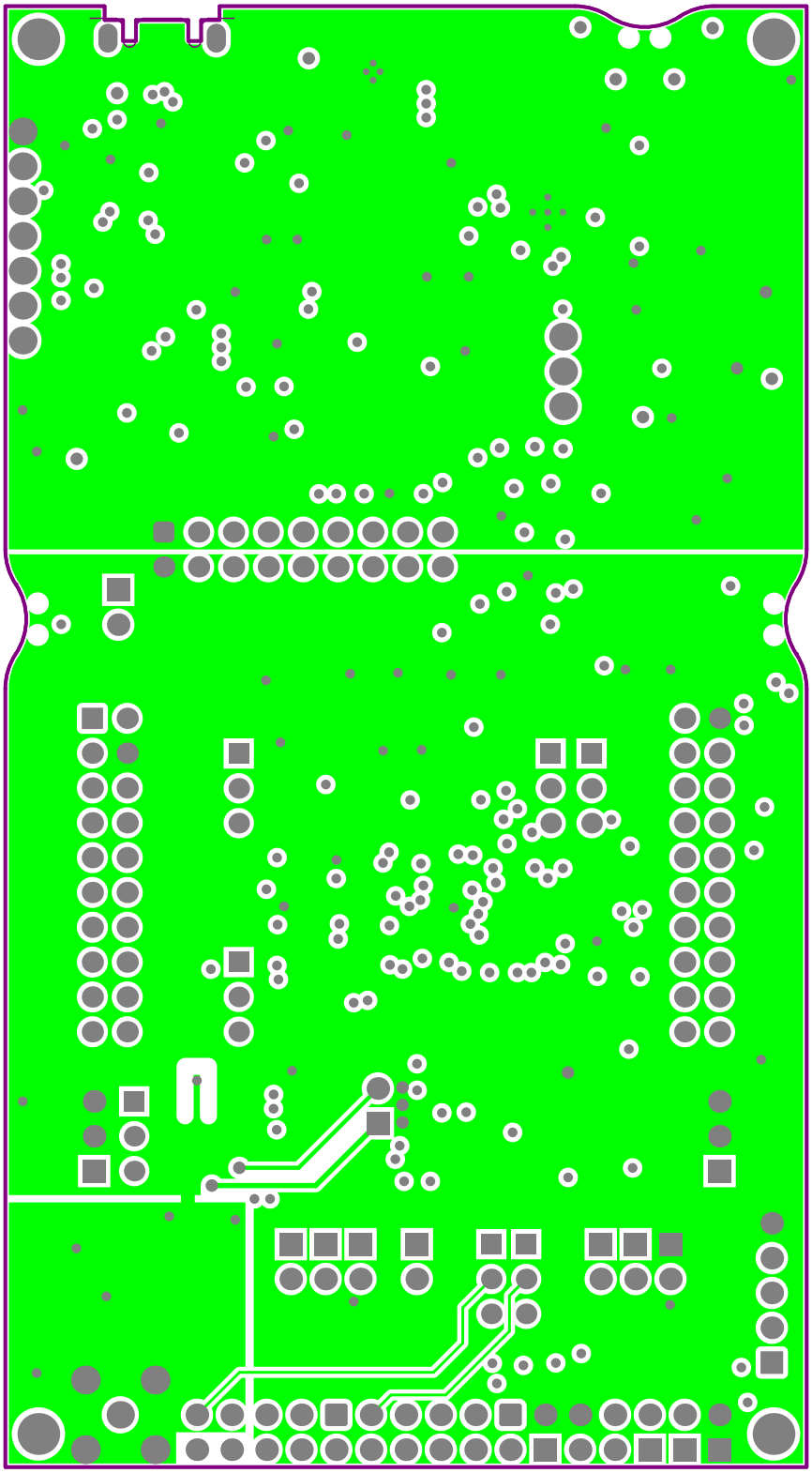


Figure 5-3. GND Layer

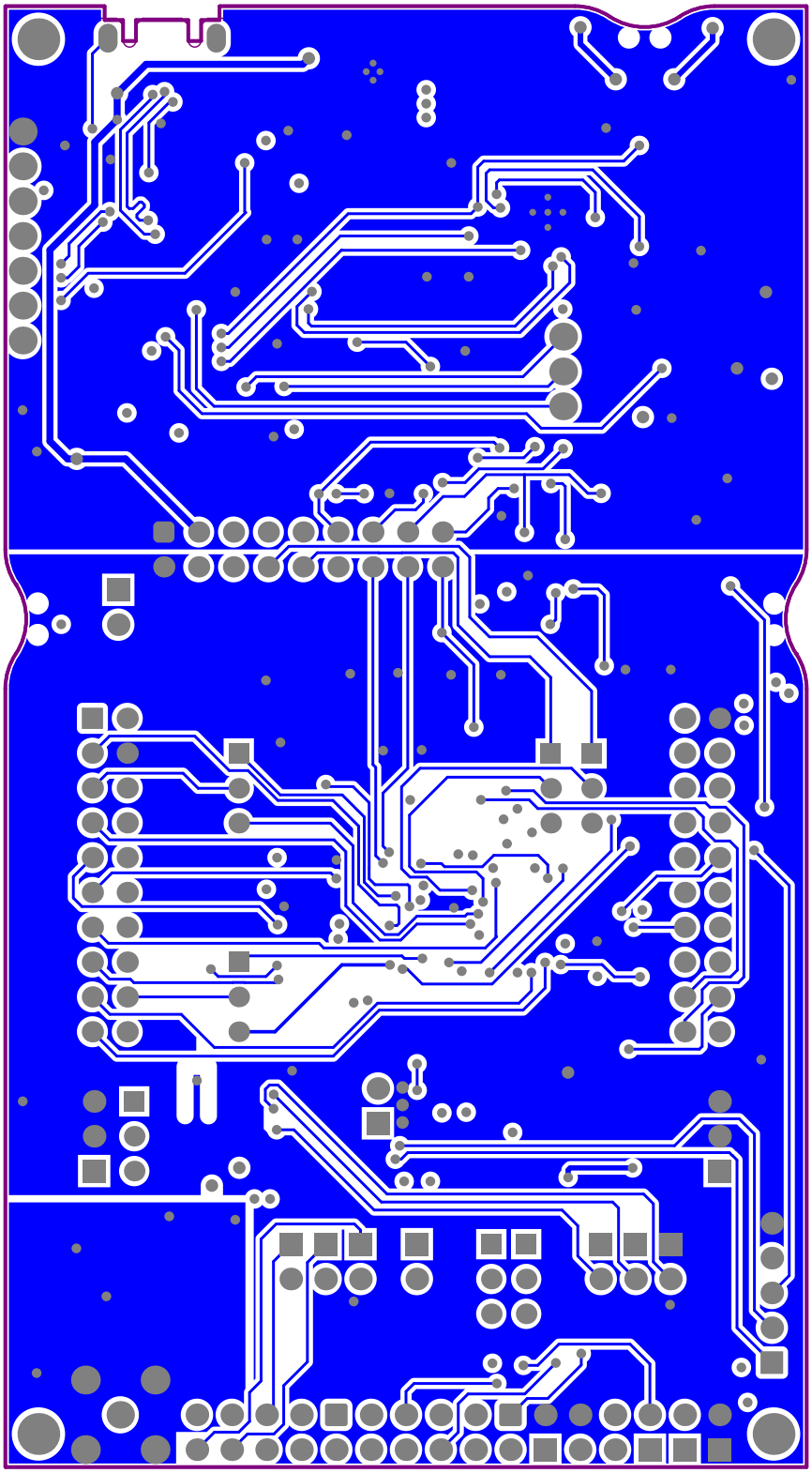


Figure 5-4. Bottom Layer

5.3 Bill of Materials (BOM)

Designator	Quantity	Value	Description	PartNumber	Manufacturer
!PCB1	1		Printed Circuit Board	MCU098	Any
C1	1	10uF	CAP, CERM, 10 uF, 6.3 V, +/- 20%, X5R, 0603	GRM188R60J106ME84	MuRata
C2	1	0.1uF	CAP, CERM, 0.1 uF, 50 V, +/- 20%, X5R, 0402	GRM155R61H104ME14D	MuRata
C3	1	0.47uF	CAP, CERM, 0.47 uF, 6.3 V, +/- 10%, X5R, 0402	GRM155R60J474KE19D	MuRata
C5	1	47pF	CAP, CERM, 47 pF, 25 V, +/- 5%, C0G/NP0, 0402	GRM1555C1E470JA01D	MuRata
C6	1	0.01uF	CAP, CERM, 0.01 uF, 16 V, +/- 10%, X5R, 0402	GRM155R61C103KA01D	MuRata
C8	1	1uF	CAP, CERM, 1 uF, 25 V, +/- 10%, X5R, 0603	C1608X5R1E105K080AC	TDK
C9, C11	2	22pF	CAP, CERM, 22 pF, 50 V, +/- 5%, C0G/NP0, 0402	GRM1555C1H220JA01D	MuRata
C10, C12	2	18pF	CAP, CERM, 18 pF, 50 V, +/- 5%, C0G/NP0, 0402	GRM1555C1H180JA01D	MuRata
C13, C17, C18, C20, C24, C27, C28, C33, C38, C39, C44	11	0.1uF	CAP, CERM, 0.1 uF, 6.3 V, +/- 10%, X7R, 0402	GRM155R70J104KA01D	MuRata
C14, C15, C16, C22, C26	5	0.01uF	CAP, CERM, 0.01 uF, 25 V, +/- 10%, X7R, 0402	GRM155R71E103KA01D	MuRata
C19, C21, C25, C55	4	1uF	CAP, CERM, 1 uF, 25 V, +/- 10%, X5R, 0402	C1005X5R1E105K050BC	TDK
C23, C56	2	2.2uF	CAP, CERM, 2.2 uF, 6.3 V, +/- 10%, X5R, 0402	GRM155R60J225KE95D	MuRata
C29, C30	2	12pF	CAP, CERM, 12 pF, 50 V, +/- 5%, C0G/NP0, 0402	GRM1555C1H120JA01D	MuRata
C31, C34	2	33pF	CAP, CERM, 33 pF, 50 V, +/- 5%, C0G/NP0, 0402	GRM1555C1H330JA01D	MuRata
C32, C36	2	4.7uF	CAP, TA, 4.7 uF, 16 V, +/- 10%, 4 ohm, SMD	TAJA475K016RNJ	AVX
C35	1	1000pF	CAP, CERM, 1000 pF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	GCM155R71H102KA37D	MuRata
C37, C43	2	4.7uF	CAP, CERM, 4.7 uF, 16 V, +/- 10%, X5R, 0603	GRM188R61C475KAAJ	MuRata
C40	1	47uF	CAP, CERM, 47 uF, 6.3 V, +/- 20%, X5R, 0603	GRM188R60J476ME15D	MuRata

Designator	Quantity	Value	Description	PartNumber	Manufacturer
C41, C42	2	0.22uF	CAP, CERM, 0.22 uF, 16 V, +/- 10%, X7R, 0402	GRM155R71C224KA12D	MuRata
C47	1	82pF	CAP, CERM, 82 pF, 50 V, +/- 10%, C0G/NP0, 0603	C0603C820K5GACTU	Kemet
C53	1	2.2uF	CAP, CERM, 2.2 uF, 10 V, +/- 10%, X5R, 0603	C0603C225K8PACTU	Kemet
C54	1	3300pF	CAP, CERM, 3300 pF, 50 V, +/- 10%, X7R, 0402	GRM155R71H332KA01D	MuRata
D1	1		Photodiode PIN Chip 910nm Automotive 2-Pin Case 0805(2012Metric) T/R	VEMD4110X01	Vishay
D2, D3	2	40V	Diode, Schottky, 40 V, 0.12 A, AEC-Q101, SOT-323	BAS40-05W,115	Nexperia
FID1, FID2, FID3	3		Fiducial mark. There is nothing to buy or mount.	N/A	N/A
H1, H2	2		Spacer Support, Nylon 66	MAE-10	Kang Yang
IC1	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)	TPS2102DBVR	Texas Instruments
IC2, U1	2		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
IC3	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
IC4	1		500mA, Adjustable, Low Quiescent Current, Low-Noise, High-PSRR, Single-Output LDO Regulator, DRB0008A (VSON-8)	TPS73533DRBT	Texas Instruments
IC5	1		Precision Micropower Shunt Voltage Reference, 0.5% accuracy, 2.5 V, 15 ppm / degC, 15 mA, -40 to 85 degC, 5-pin SC70 (DCK), Green (RoHS & no Sb/Br)	LM4040C25IDCKR	Texas Instruments
J1/J3, J2/J4	2		Receptacle, 2.54mm, 10x2, Tin, TH	SSQ-110-03-T-D	Samtec

Designator	Quantity	Value	Description	PartNumber	Manufacturer
J4, J5, J6, J7, J8, J13, J16, J17, J18	9		Header, 100mil, 2x1, Tin, TH	90120-0122	Molex
J9, J10, J11, J14, J15, J19, J20, J21, J22	9		Header, 100mil, 3x1, Tin, TH	PEC03SAAN	Sullins Connector Solutions
J101	1		Header, 2.54mm, 9x2, Tin, TH	PEC09DAAN	Sullins Connector Solutions
J102, J103	2		Header(Shrouded), 1.27mm, 5x2, Gold, SMT	FTSH-105-01-L-DV-K	Samtec
L1	1	2.2uH	Inductor, Wirewound, Ceramic, 2.2 uH, 0.89 A, 0.13 ohm, SMD	CBC2518T2R2M	Taiyo Yuden
LED1, LED101	2	Red	LED, Red, SMD	BR1111C-TR	Stanley Electric Co., LTD
LED2	1	Rgb	LED, RGB, SMD	19-337/R6GHBHC-A01/2T	Everlight
LED102	1	Green	LED, Green, SMD	LTST-C190GKT	Lite-On
MSP1	1		Mixed-Signal Microcontrollers With CAN-FD Interface LQFP64	MSPM0G3507SPM	Texas Instruments
R1	1	2.37Meg	RES, 2.37 M, 1%, 0.1 W, 0603	CRCW06032M37FKEA	Vishay-Dale
R2, R14	2	47k	RES, 47 k, 5%, 0.063 W, 0402	CRCW040247K0JNED	Vishay-Dale
R3, R52, R55, R57, R58, R62, R63, R64, R65, R69, R71, R73, R75, R76, R77, R78, R79, R80, R81, R82, R83, R84, R86, R89	24	0	RES, 0, 5%, 0.1 W, 0603	RC0603JR-070RL	Yageo
R4, R29, R30, R48	4	470	RES, 470, 5%, 0.063 W, 0402	CRCW0402470RJNED	Vishay-Dale
R5	1	220	RES, 220, 5%, 0.063 W, 0402	CRCW0402220RJNED	Vishay-Dale
R6, R7	2	330	RES, 330, 5%, 0.063 W, 0402	CRCW0402330RJNED	Vishay-Dale
R8	1		Res Thin Film 0402 100K Ohm 0.1% 1/16W ±25ppm/°C Molded SMD SMD Punched Carrier T/R	ERA-2AEB104X	Panasonic
R12, R16	2	4.7k	RES, 4.7 k, 5%, 0.1 W, 0603	RC0603JR-074K7L	Yageo
R13, R19	2	270	RES, 270, 5%, 0.063 W, 0402	CRCW0402270RJNED	Vishay-Dale
R18, R21	2	2.2k	RES, 2.2 k, 5%, 0.1 W, 0603	RC0603JR-072K2L	Yageo
R23	1	0	RES, 0, 5%, 0.063 W, 0402	RC0402JR-070RL	Yageo America
R24, R25, R26, R34	4	1.0k	RES, 1.0 k, 5%, 0.063 W, 0402	CRCW04021K00JNED	Vishay-Dale
R28	1	100	RES, 100, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW0402100RJNED	Vishay-Dale
R31, R91, R92	3	10k	RES, 10 k, 5%, 0.063 W, 0402	CRCW040210K0JNED	Vishay-Dale

Designator	Quantity	Value	Description	PartNumber	Manufacturer
R32	1	4.87k	RES, 4.87 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW04024K87FKED	Vishay-Dale
R33	1	100	RES, 100, 5%, 0.063 W, 0402	CRCW0402100RJNED	Vishay-Dale
R35	1	51	RES, 51, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW040251R0JNED	Vishay-Dale
R36, R37, R43, R44, R51, R54, R88	7	220k	RES, 220 k, 1%, 0.0625 W, 0402	RC0402FR-07220KL	Yageo America
R38, R85	2	3.30k	RES, 3.30 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0402	ERJ-2RKF3301X	Panasonic
R39	1	2.20k	RES, 2.20 k, 1%, 0.063 W, 0402	CRCW04022K20FKED	Vishay-Dale
R40	1	6.81k	RES, 6.81 k, 1%, 0.063 W, 0402	CRCW04026K81FKED	Vishay-Dale
R41, R42	2	4.7k	RES, 4.7 k, 5%, 0.063 W, 0402	CRCW04024K70JNED	Vishay-Dale
R45, R46, R49	3	47.0k	RES, 47.0 k, 1%, 0.0625 W, 0402	RC0402FR-0747KL	Yageo America
R47	1	820	RES, 820, 1%, 0.063 W, 0402	RC0402FR-07820RL	Yageo America
R56	1	10.0k	RES, 10.0 k, 0.1%, 0.1 W, AEC-Q200 Grade 0, 1.6x0.8mm	ERA3ARB103V	Panasonic
R72	1	100	RES, 100, 1%, 0.1 W, 0603	RC0603FR-07100RL	Yageo
R87	1	330k	RES, 330 k, 1%, 0.0625 W, 0402	RC0402FR-07330KL	Yageo America
R90	1	1.00Meg	RES, 1.00 M, 1%, 0.063 W, 0402	CRCW04021M00FKED	Vishay-Dale
RT1	1		Thermistor, DEC0002A (X1SON-2)	TMP6131DECT	Texas Instruments
S1, S2, S3	3		Switch, SPST, 0.05 A, 12 VDC, SMD	1188E-1K2-V-TR	Diptronics
SH-J1	1	J101: 1-2	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J2	1	J101: 3-4	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J3	1	J101: 5-6	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J4	1	J101: 7-8	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J5	1	J101: 9-10	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec

Designator	Quantity	Value	Description	PartNumber	Manufacturer
SH-J6	1	J101: 11-12	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J7	1	J101: 12-13	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J8	1	J101: 15-16	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J9	1	J101: 17-18	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J10, SH-J11	2	J14: 1-2	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J12	1	J16: 1-2	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J13	1	J17: 1-2	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J14	1	J18: 1-2	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J15	1	J5: 1-2	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J16	1	J6: 1-2	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J17	1	J7: 1-2	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J18	1	J8: 1-2	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J19	1	J9: 1-2	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J20	1	J13: 1-2	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J21	1	J15: 1-2	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J22	1	J19: 1-2	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J23	1	J20: 1-2	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J24	1	J21: 1-2	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
SH-J25	1	J22: 1-2	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
T1	1	-20V	MOSFET, P-CH, -20 V, -0.82 A, SOT-323	DMG1013UW-7	Diodes Inc.

Designator	Quantity	Value	Description	PartNumber	Manufacturer
T2	1	45 V	Transistor, NPN, 45 V, 0.1 A, SOT-323	BC850CW,115	NXP Semiconductor
U2	1		50 MHz, Low-Noise Single-Supply Rail-to-Rail Operational Amplifier, 2.2 to 5.5 V, -40 to 125 degC, 8-pin SOIC (D8), Green (RoHS & no Sb/Br)	OPA2365AIDR	Texas Instruments
USB1	1		Cable, USB-A to micro USB-B, 0.3 m	AK67421-0.3	Assman WSW
USB2	1		Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT	1051640001	Molex
XDS1	1		MSP432E401YTPDT, PDT0128A (TQFP-128)	MSP432E401YTPDTR	Texas Instruments
XDS2	1		MSP430G2x52, MSP430G2x12 Mixed Signal Microcontroller, RSA0016B (VQFN-16)	MSP430G2452IRSA16R	Texas Instruments
Y1	1		Crystal, 32.768 KHz, 12.5 pF, SMD	X1A0001410014	Epson
Y2	1		Crystal 40MHz ±10ppm (Tol) ±20ppm (Stability) 12pF FUND 40Ohm 4-Pin Mini-CSMD T/R	X1E0000210179	Seiko Epson
Y3	1		Crystal, 16 MHz, 8pF, SMD	NX3225GA-16.000M-STD-CRG-1	NDK

6 Additional Information

Trademarks

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7 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision D (October 2024) to Revision E (September 2026)	Page
• Added *Description* section	1
• Deleted *Abstract* section and moved content to *Description* section	1
• Added *Features* section	1
• Moved content from deleted *Key Features* section to *Features*	1
• Added *Hardware Image* section	1
• Moved MSPM0G3507 LaunchPad Development Kit figure from deleted *Abstract* to *Hardware Image* section	1
• Changed section title from *Getting Started* to *Evaluation Module Overview*	2
• Deleted *Key Features* section	2
• Added *Specification* section	2
• Added *Device Information* section	2
• Added *Hardware Design Files* section	19
• Updated all images in *Schematics* section	19
• Added *PCB Layouts* section	24
• Added *Bill of Materials (BOM)* section	28
• Added *Additional Information* section	34

Changes from November 1, 2023 to October 31, 2024 (from Revision C (November 2023) to Revision D (October 2024))	Page
• Updated C10 and C12 from 22pF to 18pF	19

Changes from Revision B (March 2023) to Revision C (November 2023)	Page
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STANDARD TERMS FOR EVALUATION MODULES

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

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

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

2 *Limited Warranty and Related Remedies/Disclaimers*:

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

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

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

WARNING

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

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

NOTE:

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

3 *Regulatory Notices:*

3.1 *United States*

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

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

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

CAUTION

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

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

FCC Interference Statement for Class A EVM devices

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

FCC Interference Statement for Class B EVM devices

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

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

3.2 *Canada*

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

Concerning EVMs Including Radio Transmitters:

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

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

Concernant les EVMs avec appareils radio:

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

Concerning EVMs Including Detachable Antennas:

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

Concernant les EVMs avec antennes détachables

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

3.3 *Japan*

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

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

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

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

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

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

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

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西新宿三井ビル

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

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3.4 *European Union*

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

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

4 *EVM Use Restrictions and Warnings:*

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

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

4.3 *Safety-Related Warnings and Restrictions:*

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

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

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

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

6. *Disclaimers:*

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.

6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

   8.1 *General Limitations*. IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

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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