User's Guide
MSPM0G3507 LaunchPad Development Kit (LP-MSPM0G3507)

TEXAS INSTRUMENTS

ABSTRACT

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.

The following figure shows the LP-MSPM0G3507 LaunchPad Development Kit.

MSPM0G3507 LaunchPad Development Kit

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1 Getting Started

1.1 Introduction

The MSPM0G3507 is Arm® 32-bit Cortex®-M0+ CPU with a memory protection unit and frequency up to 80 MHz. 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 Key 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 4 Msps) evaluation
- Onboard 32.768-kHz and 48-MHz crystals
- RC filter for ADC input (unpopulated by default)

1.3 What's Included

1.3.1 Kit Contents

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

1.3.2 Software Examples

- Out-of-Box Software Example
- SDK Examples

1.4 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.

1.4.1 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.

1.4.2 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.
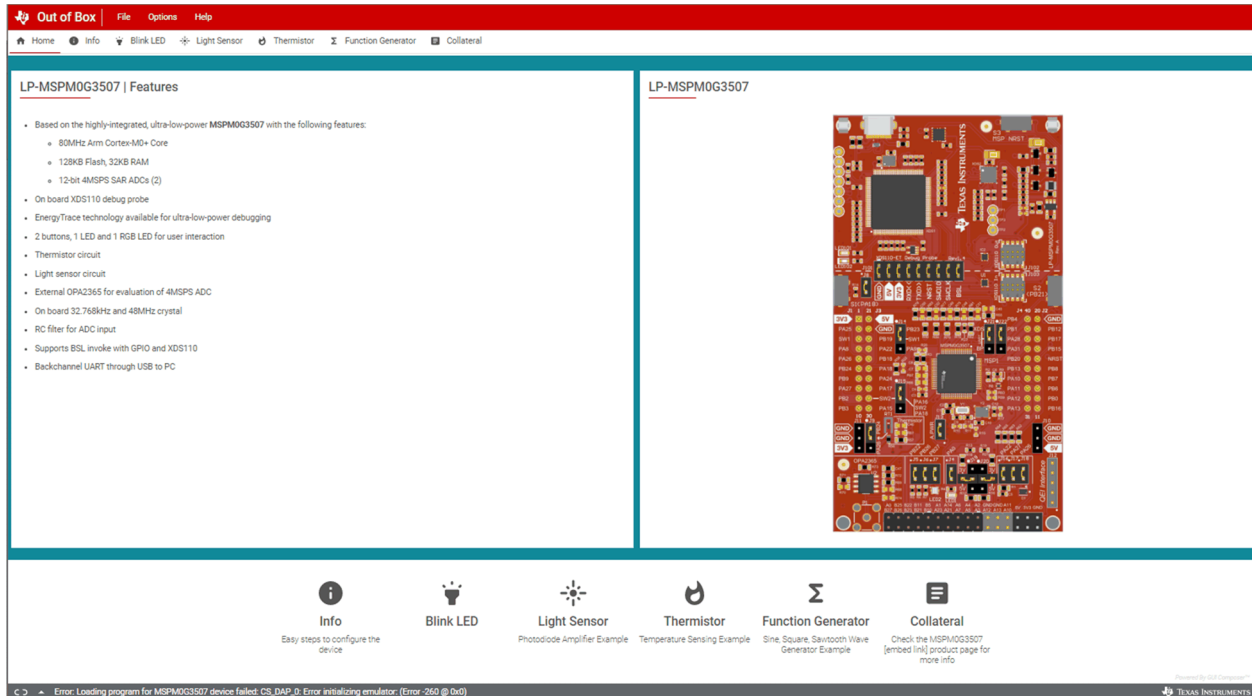

Figure 1-1. Out-of-Box Experience Welcome Screen

1.5 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 1.3.2 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.
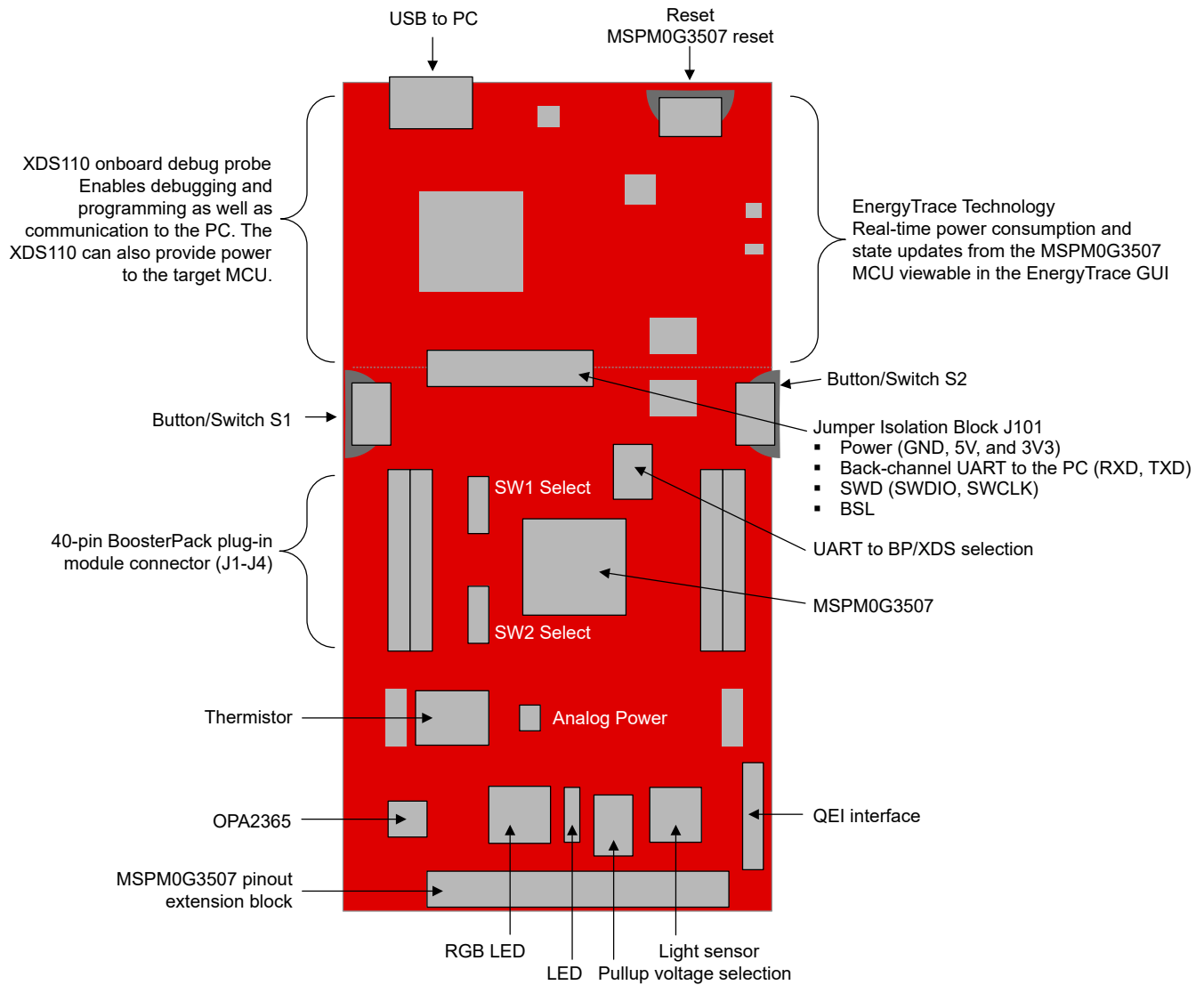
Figure 2-1. MSPM0G3507 LaunchPad Development Kit Hardware

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

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

| Jumper	Description	Default setting	Connected Pin or Signal	Low Power Measurement Recommendation
J4	Red LED1	Installed	PAO 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) 3.3 V	PA0 to 3V3	OFF if pin initialized as output low or input with pullup/pulldown
J20	PA1 Open-drain IO pullup	(1) Short to (2) 3.3 V	PA1 to 3V3	OFF if pin initialized as output low or input with pullup/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
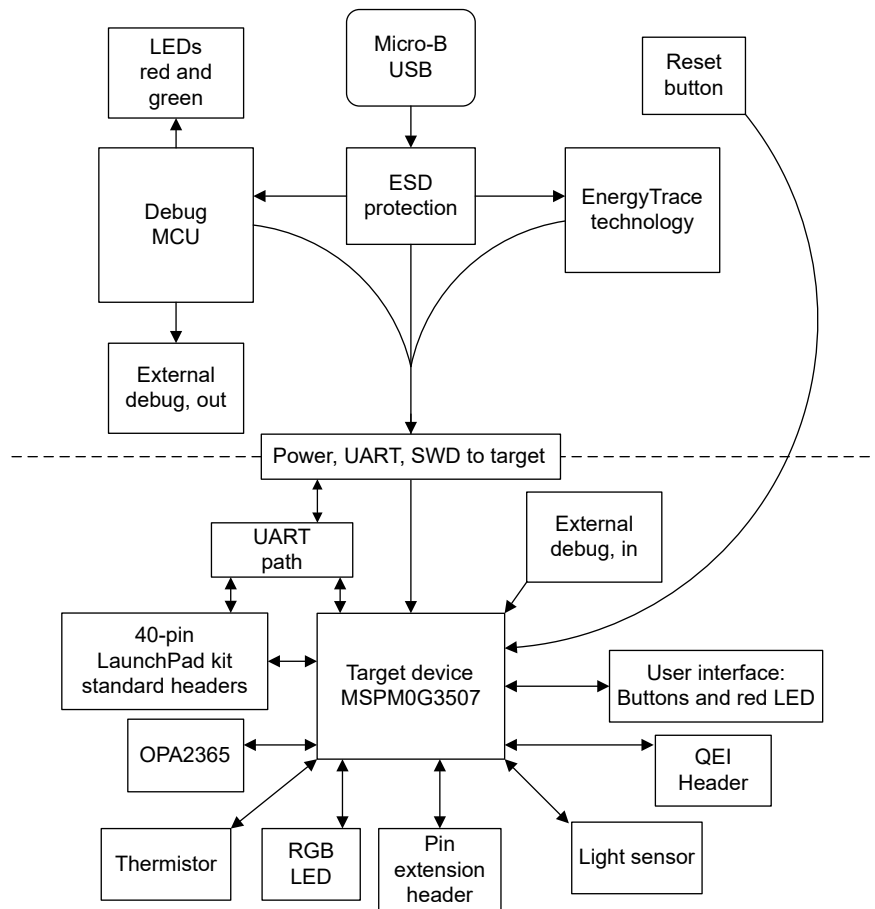
Figure 2-2. Block Diagram

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:

- 1.62-V to 3.6-V operation
- Arm 32-bit Cortex-M0+ with memory protection unit, up to 80 MHz
- 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
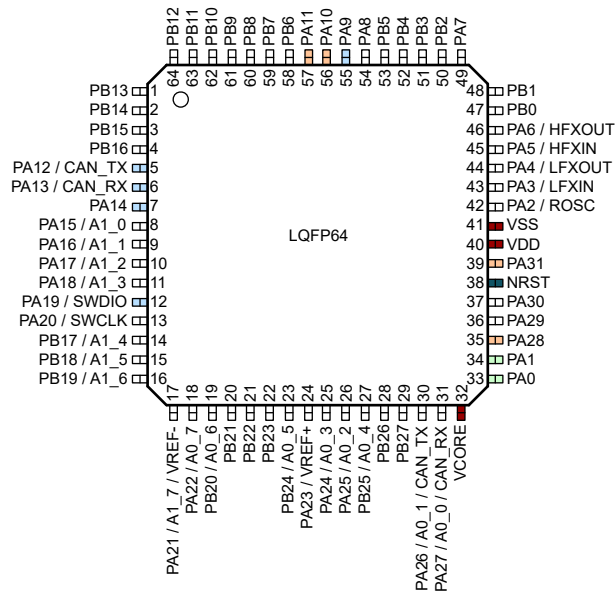- One 32-bit high-resolution time
- 60 GPIO

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.
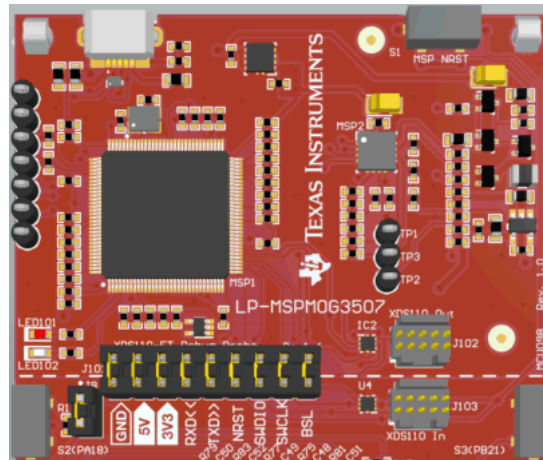
Figure 2-4. LP-MSPM0G3507 Debugger

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 3.3-V and 5-V power.
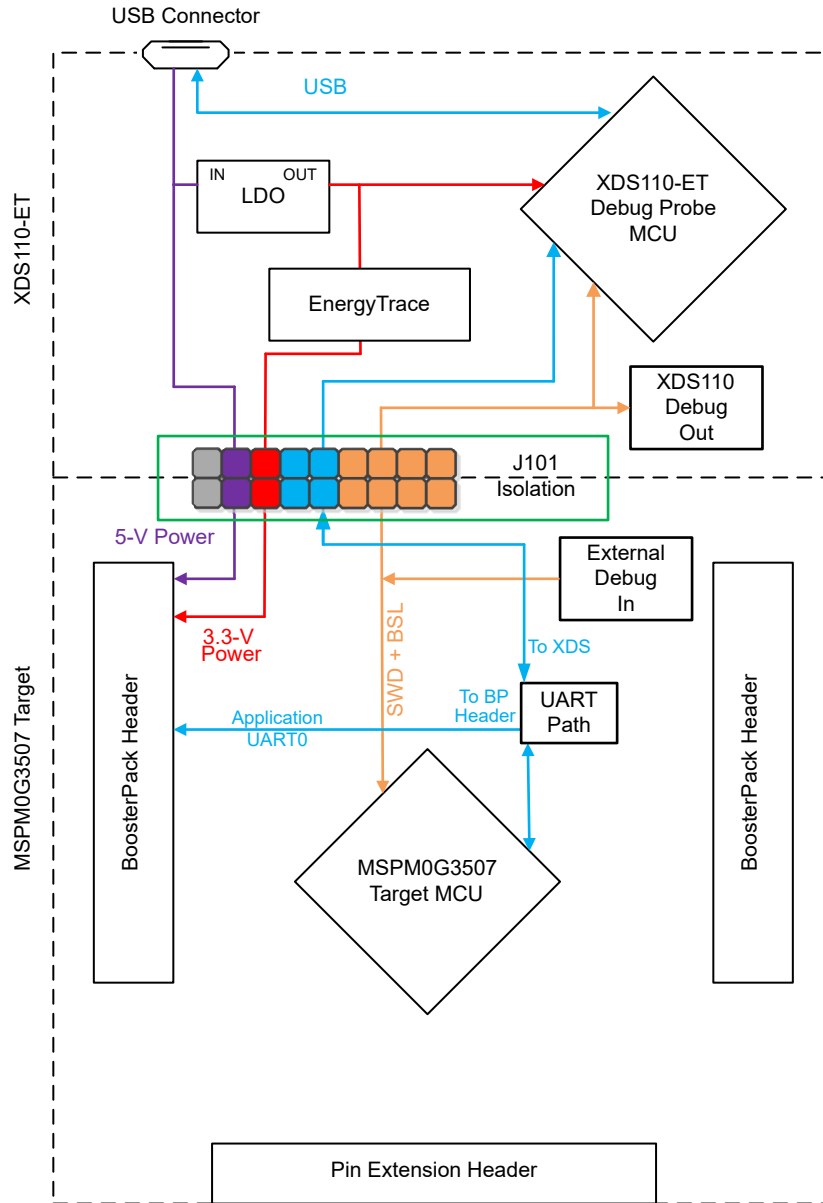
Figure 2-5. Isolation Jumper Block

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 3.3-V and 5-V 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 it can be used for devices other than the onboard MCU.

Jumper	Description
GND	Ground
5V	5-V VBUS from USB
3V3	3.3-V 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

Jumper	Description
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.
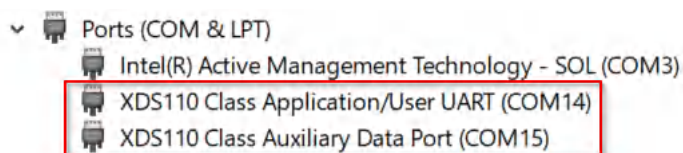

Figure 2-6. Application Backchannel UART in Device Manager

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 you identify the correct COM port, configure it in your host application according to its documentation. You can then open the port and begin communication to it 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, it is important that the PC application configures the baud rate to be the same as what is configured on the UART0.

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 3.3-V JTAG signals. If another voltage level is needed, the user must provide level shifters to translate the JTAG signal voltages. Additionally, 3.3 V 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 3.3 V 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 3.3 V 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 you 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, it 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.
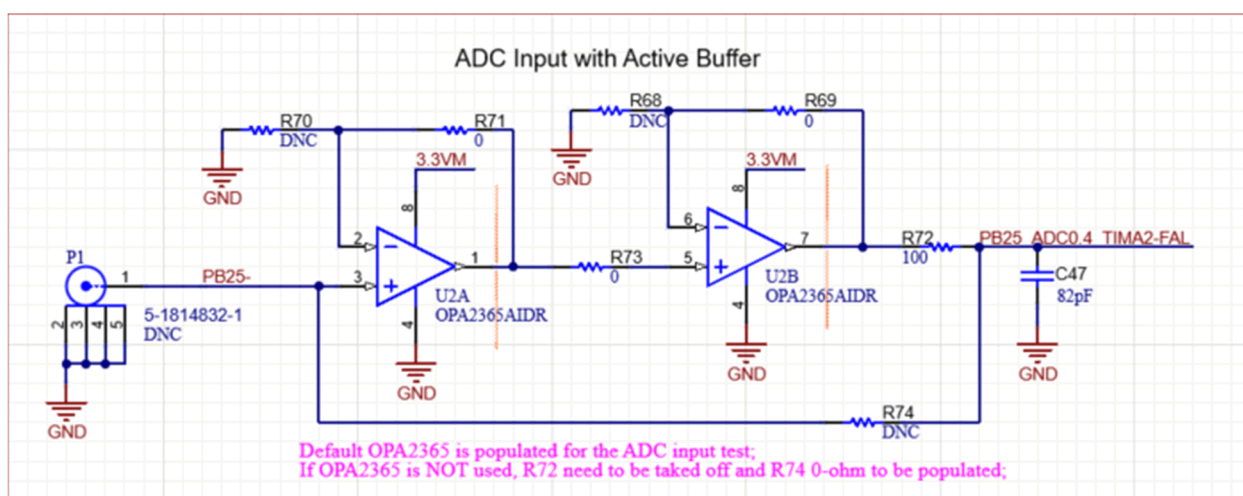
Figure 2-7. External OPA Circuit

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 10-kΩ 10-ppm 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 1.6 V 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
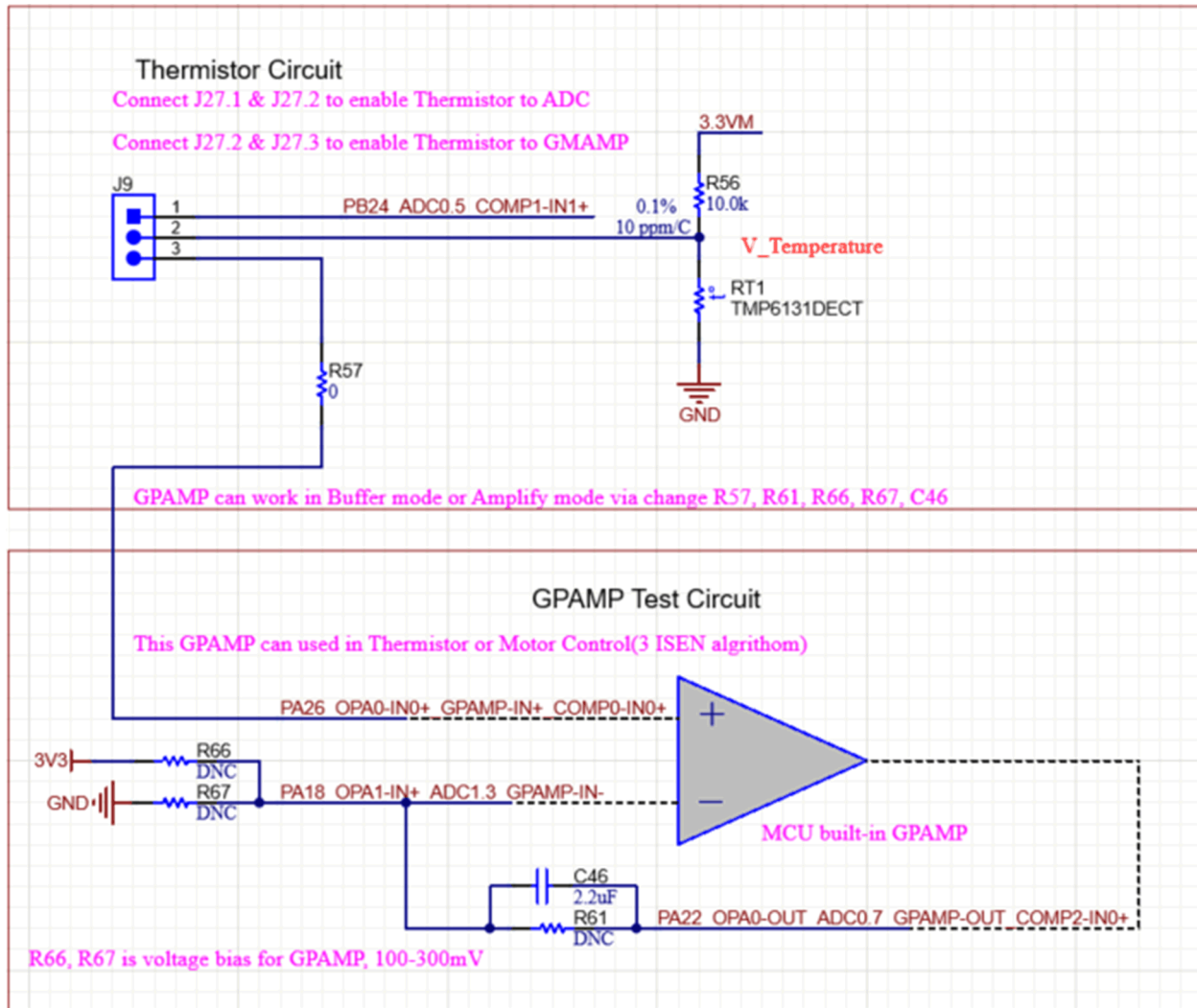
2.3.7.3 Light Sensor

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.
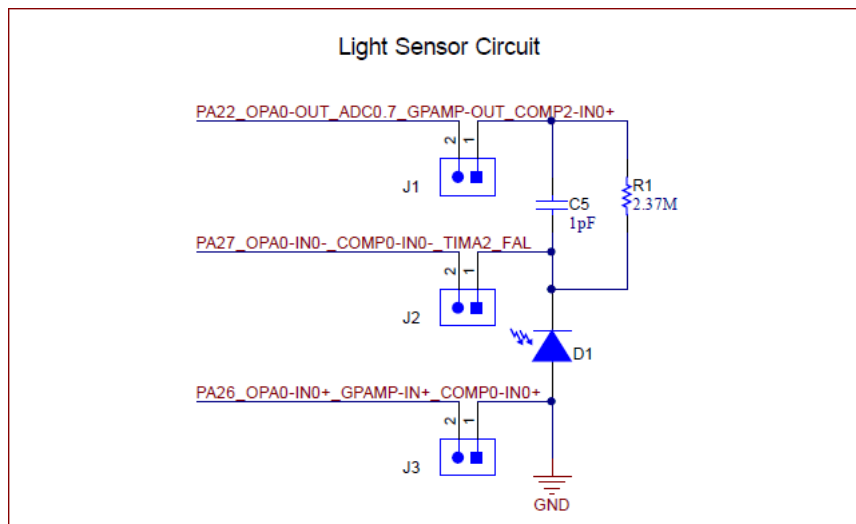
Figure 2-9. Light Sensor Circuit

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 5-V power from the USB and also regulates this power rail to 3.3 V for XDS110-ET operation and 3.3 V to the target side of the LaunchPad kit. Power from the XDS110-ET is controlled by jumper J101. For 3.3 V, 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. It is important to comply with the device voltage operation specifications when supplying external power. The MSPM0G3507 has an operating range of 1.62 V to 3.6 V. 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 may have on the current draw. Consider disconnecting these at the isolation jumper block, or at least consider their 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 should either be driven out or, if it is an input, should be 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, it may be difficult to get a stable measurement. It is easier to measure quiescent states.

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: 32.768-kHz 12.5-pF crystal
- Y2: 48-MHz 12.5-pF 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 32-MHz 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 80-MHz 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 ensure compatibility. Keep in mind that sometimes conflicts can be resolved by changing the MSPM0G3507 device pin function configuration in software.

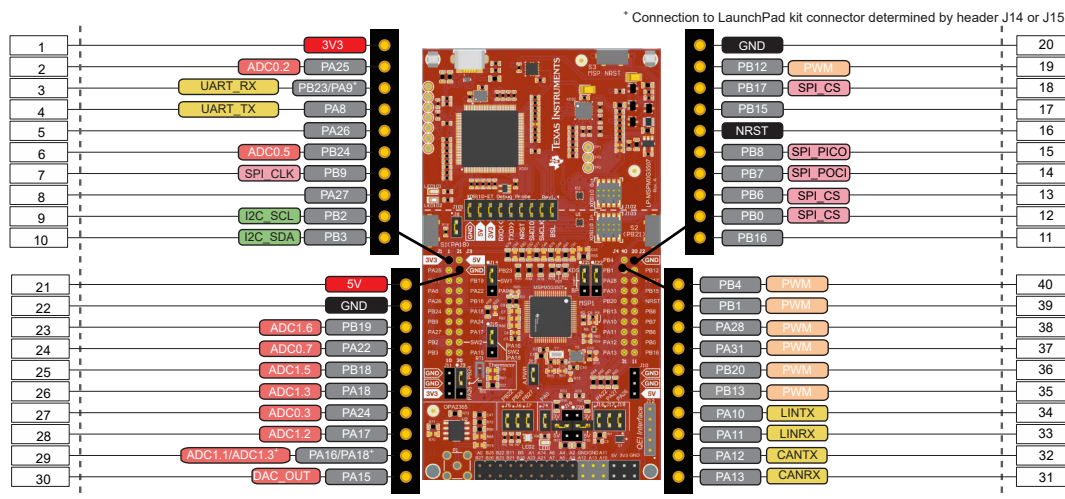**Figure 2-10. LaunchPad Development Kit to BoosterPack Plug-in Module Connector Pinout**

2.9 Design Files

Schematics can be found in Section 5. All design files including schematics, layout, bill of materials (BOM), Gerber files, and documentation are available on the LP-MSPM0L1306 Design File download page.

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 they're 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. It 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 it 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

At some point, you will probably want more information about the MSPM0G3507 device. 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 80-MHz Microcontrollers Technical Reference Manual	Architectural information about the device, including all modules and peripherals such as clocks, timers, ADC, and so on

Table 4-1. Device Documentation (continued)

Document	For MSPM0L1306	Description
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 examples that 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 Schematics

Copyright © 2023 Texas Instruments Incorporated

BoosterPack Connectors

RC Filter for DAC Output

PA15_DAC-OUT   R55   PA15- _DAC-OUT
0
GND

Pin Selection for J1.pin3

VSENVM
1 PB23_TIMA0-FAL   PA25_OPA0-IN1+_ADC0.2   2
nFAULT
3 PA9_UART1-RX   PA8_UART1-TX
J14

3V3

nFAULT
PA26_OPA0-IN0+_GPAMP-IN+_COMP0-IN0+
PA24_ADC0.5_COMP1-IN1+
PB9_SPI1-SCK
PA27_OPA0-IN0-_COMP0-IN0-_TIMA2_FAL
PB2_I2C1-SCL
PB3_I2C1-SDA

3V3

J1/J3
+3.3V   1
Analog_In   2
LP_UART_RX   3
LP_UART_TX   4
GPIO !   5
Analog In   6
SPI_CLK   7
GPIO !   8
I2C_SCL   9
I2C_SDA   10
SSQ-110-03-T-D

+5V   21
GND   22
Analog_In   23
Analog_In   24
Analog_In   25
Analog_In   26
Analog_In/I2S_WS   27
Analog_In/I2S_SCLK   28
Analog_Out/I2S_SDout   29
Analog_Out/I2S_SDin   30

+5V
GND
PB19-_ADC1.6
PA22-_ADC0.7
PB18-_ADC1.5
PA18_OPA1-IN+_ADC1.3_GPAMP-IN-
PA17-_ADC0.3
PA17-_ADC1.2
PA15-_DAC-OUT
PA16_OPA1-OUT_ADC1.1

GND

Motor Phase Voltage
J15
Motor Phase Current
1/2/3 ISEN algorithm

Pin Selection for J3.pin29
J15 is to flexibly adopt 1 ISEN algorithm, 2 ISENs algorithm and 3 ISENs algorithm
Some DRV BP the ISENA/B/C is 26 27 28, some is 27 28 29

J2/J4
PB4_TIMA1-C0   40   PWM/GPIO !
PB1_TIMA1-C1   39   PWM/GPIO !
PA28_TIMA2_C0   38   PWM/GPIO !
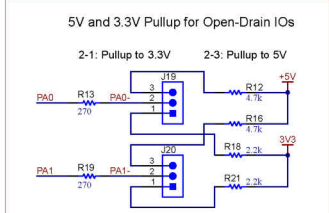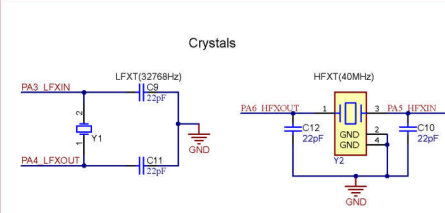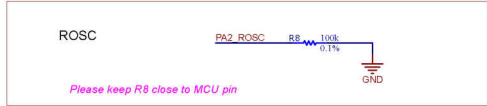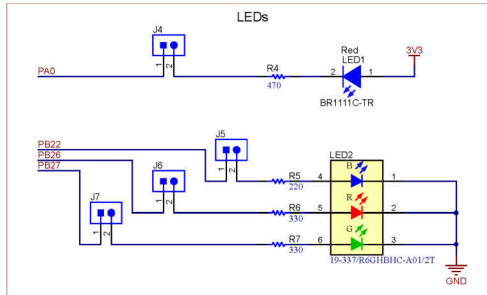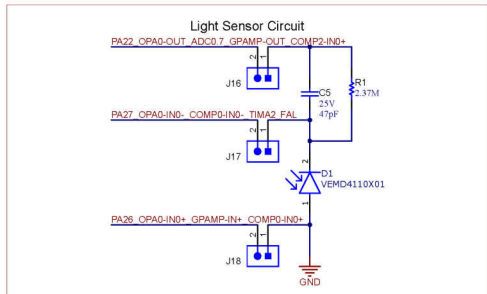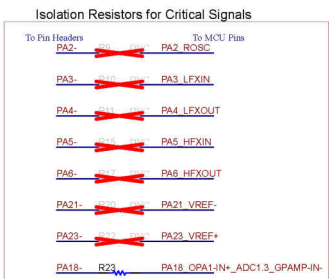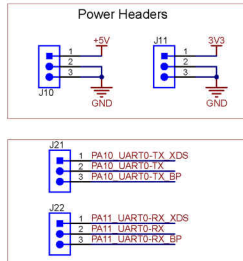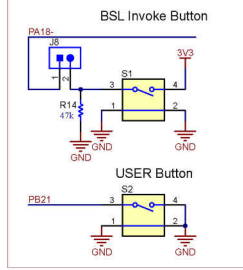PA31_TIMA2_C1   37   PWM/GPIO !
PB20_TIMA0-C2   36   Timer_Cap/GPIO !
PB13_TIMA0-C3   35   Timer_Cap/GPIO !
PB7_PA10_UART0-TX_BP 34 GPIO !
PB6_PA11_UART0-RX_BP 33 GPIO !
PA12_CAN-TX   32   GPIO !
PA13_CAN-RX   31   GPIO !
SSQ-110-03-T-D

6*PWM

CAN/LIN
LINTX
LINRX
CANTX
CANRX

R62
R63
R64
R65

GND   20
PWM/GPIO !   19
GPIO !   18
GPIO !   17
RST   16
SPI_MOSI   15
SPI_MISO   14
SPI_CS/GPIO !   13
SPI_CS/GPIO !   12
GPIO !   11

PB12_TIMA0-C2_TIMA1-FAL
PB17_ADC1.4_SPI1-CS1
PB15_UART2-TX_TIMG1-C0
RST
PB8_SPI1-PICO
PB7_SPI1-POCI
PB6_SPI1-CS0
PB0_SPI1-CS2
PB16_UART2-RX_TIMG1-C1

HALL-A or SPI
HALL-B or SPI
SPI
SPI
HALL-C or SPI
SPI

Thermistor Circuit
Connect J27.1 & J27.2 to enable Thermistor to ADC
Connect J27.2 & J27.3 to enable Thermistor to GMAMP

3.3VM
J9
1
2   PB24_ADC0.5_COMP1-IN1+
3
R56
0.1%
10.0k
10 ppm/C
V_Temperature
R57
0
RT1
TMP6131DECT
GND

GPAMP can work in Buffer mode or Amplify mode via change R57, R61, R66, R67, C46

GPAMP Test Circuit
This GPAMP can used in Thermistor or Motor Control(3 ISEN algrithom)

PA26_OPA0-IN0+_GPAMP-IN+_COMP0-IN0+

3V3
GND
PA18_OPA1-IN+_ADC1.3_GPAMP-IN-
MCU built-in GPAMP
PA22_OPA0-OUT_ADC0.7_GPAMP-OUT_COMP2-IN0+

R66, R67 is voltage bias for GPAMP, 100-300mV

3V3

Pin headers at the Low Side of the Board

QEI Interface
3V3
PA29_TIMG10_C0   J12
PA30_TIMG10_C1   1
PB14_TIMG10_IDX   2
                  3
                  4
                  5
HTSW-105-07-G-S
GND

PA19, PA20 are SWDIO, SWDCLK for debug/programming interface. They are on J101.pin14, pin16

PB5
PB11_TIMG0-C1
PB22
PB25-
PA0-
J27
61301021121

PA2-
PA4-
PA6-
PA14_TIMH0-C0
PA1-
J28
61301021121

LINRX
GND
J26
PBC03DAAN

J23 +5V
J25 3V3 J24

90120-0122 90120-0122 90120-0122
GND

PB27
PB26
PB23_TIMA0-FAL
PB21
PB10_TIMG0-C0

PA23-
PA21-
PA7_CLK-OUT
PA5-
PA3-

CANTX
CANRX
LINTX

ADC Input with Active Buffer

R71
R69
3.3VM   3.3VM
GND   GND
U2A
OPA2365AIDR
PB25-
R73   R72 PB25_ADC0.4_TIMA2-FAL
100
U2B
OPA2365AIDR
C47
82pF
GND   GND   GND
GND
5-1814832-1

Default OPA2365 is populated for the ADC input test;
If OPA2365 is NOT used, R72 need to be taked off and R74 0-ohm to be populated;

RC Filter for ADC Input

PB18-_ADC1.5 R75   R76 PB18_ADC1.5   PB19-_ADC1.6 R77   R78 PB19_OPA1-IN+_ADC1.6
GND   GND

PA24-_ADC0.3 R79   R80 PA24_OPA0-IN1-_ADC0.3   PA17-_ADC1.2 R81   R82 PA17_OPA1-IN-_ADC1.2
GND   GND

PA22-_ADC0.7 R83   R84 PA22_OPA0-OUT_ADC0.7_GPAMP-OUT_COMP2-IN0+
GND

Orderable: LP-MSPM0G3507	Designed for: Public Release Mod. Date: 12/9/2022
TID #: N/A	Project Title: LP-MSPM0G3507
Number: MCU098 Rev: A	Sheet Title: BoosterPack Connectors
SVN Rev:	Assembly Variant: Variant 1
Drawn By: Johnson He	File: MCU098_02_BoosterPack_Connectors.SchDoc Size: B Sheet: 2 of 7
Engineer: Johnson He	Contact: http://www.ti.com/support

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Software-controlled DCDC converter

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

XDS110-ET <<---->> LaunchPad

J101
PEC09DAAN

+5V   3V3
GND

XDS_VBUS	1 2
XDS_VCCTARGET	3 4
XDS_TXD	5 6
XDS_RXD	7 8 PA11_UART0-RX_XDS
	9 10 PA10_UART0-TX_XDS
	11 12 RST
XDS_TMS_SWDIO	13 14 PA19_SWDIO
XDS_TCK_SWDCLK	15 16 PA20_SWCLK
XDS_TDO_SWO	17 18 PA18-
XDS_TDI	

BSL_INVOKE

XDS_VCC

R85
3.30k

XDS_RESET_OUT

XDS_GND

XDS_VCC

J102
FTSH-105-01-L-DV-K

1	2
3	4
5	6
7	8
9	10

XDS_GND

CNT-M127-2*5-GS-3.05/2.5-250

3V3

J103
FTSH-105-01-L-DV-K

1	2
3	4
5	6
7	8
9	10

GND

CNT-M127-2*5-GS-3.05/2.5-250

IC2
TPD6E004RSER

1	IO1	IO4	5
2	IO2	IO5	6
3	IO3	IO6	7
8	VCC	GND	4

XDS_GND

U1
TPD6E004RSER

1	IO1	IO4	5
2	IO2	IO5	6
3	IO3	IO6	7
8	VCC	GND	4

GND

Orderable: LP-MSPM0G3507	Designed for: Public Release	Mod. Date: 8/17/2022
TID #: N/A	Project Title: LP-MSPM0G3507	
Number: MCU098 Rev: A	Sheet Title: XDS110-ET Interface	
SVN Rev:	Assembly Variant: Variant 1	
Drawn By: Johnson He	File: MCU098_05_XDS110_Target_Interface.SchDoc Size: B	Sheet:5 of 7
Engineer: Johnson He	Contact: http://www.ti.com/support	

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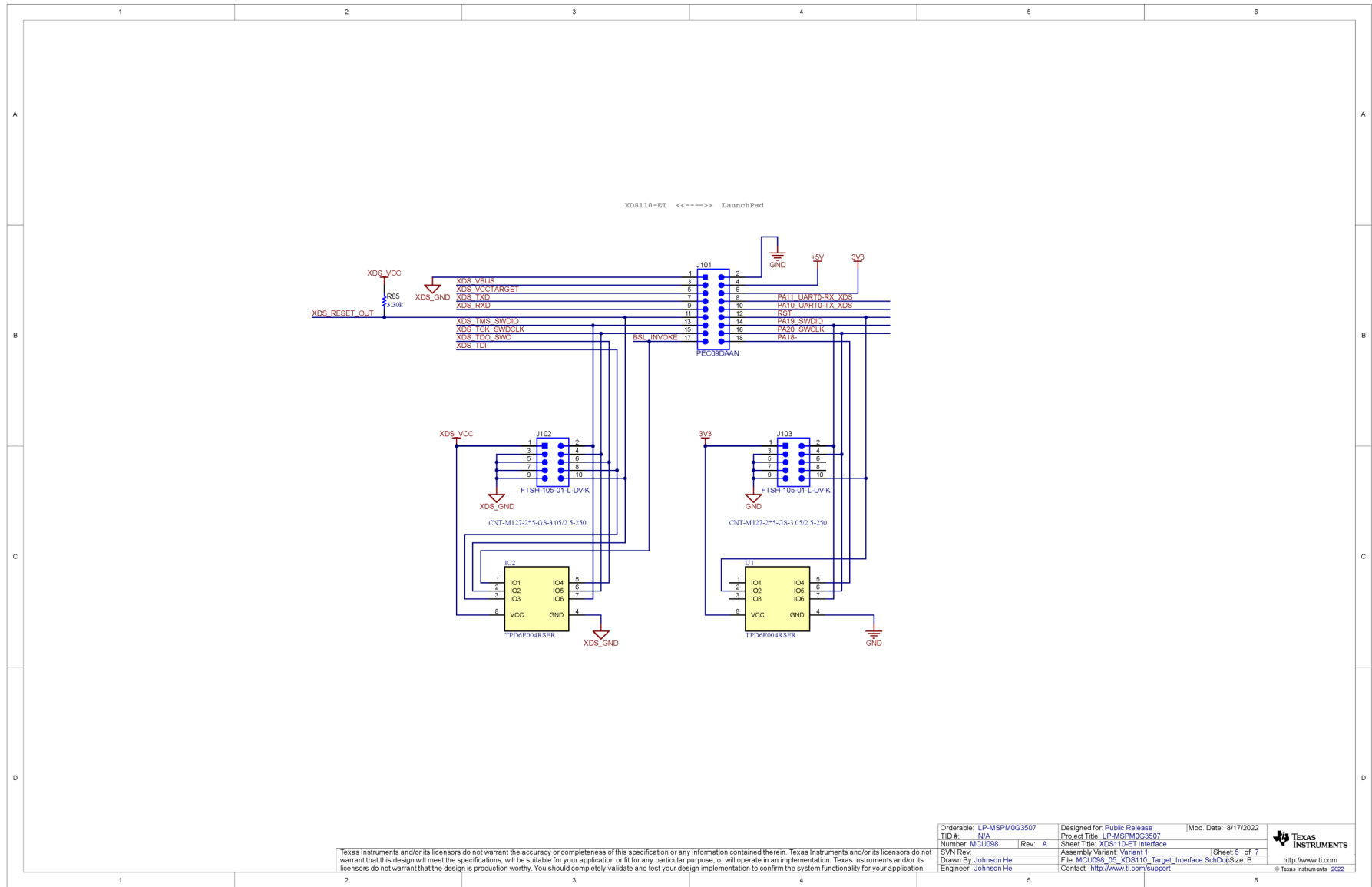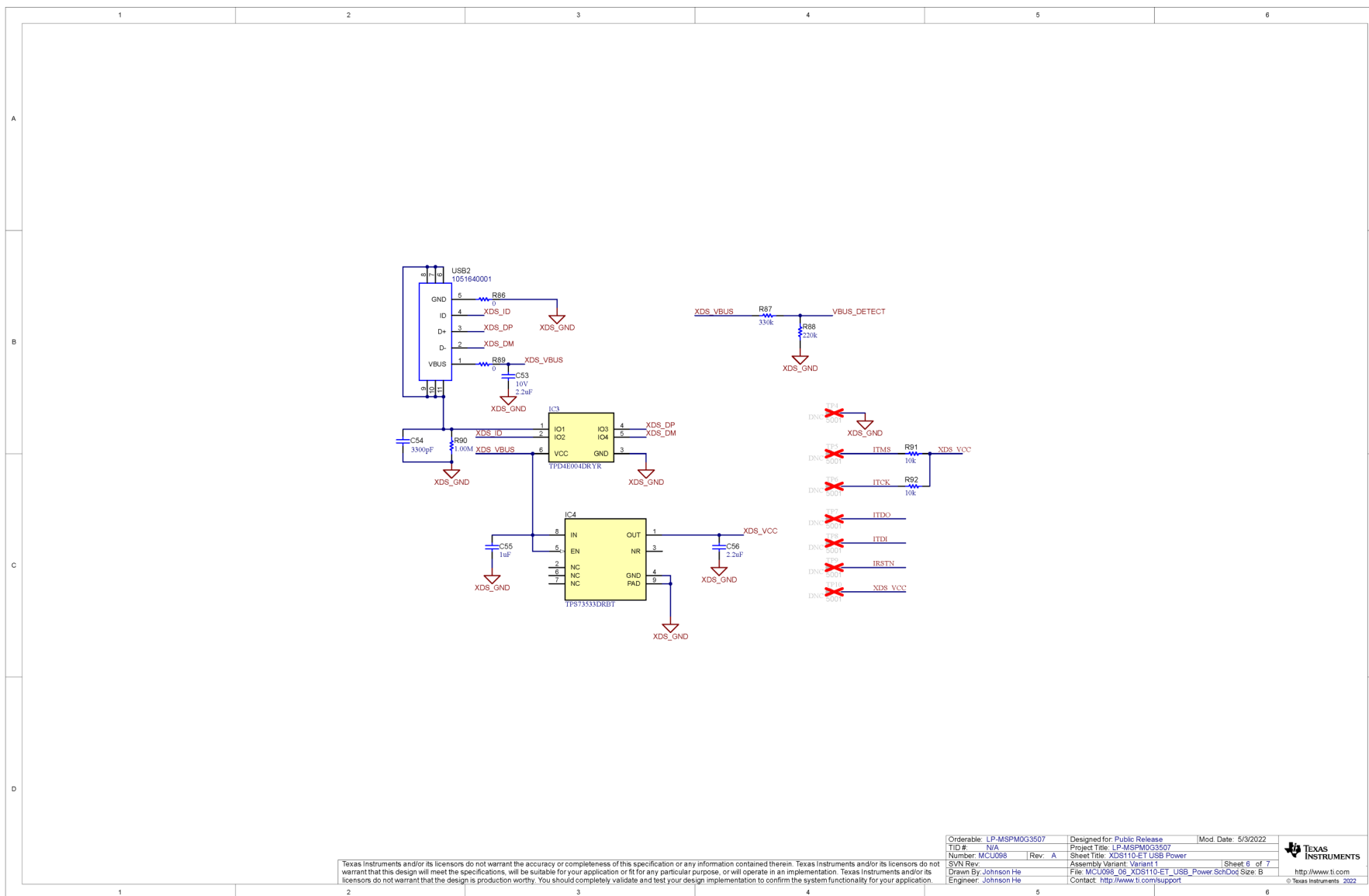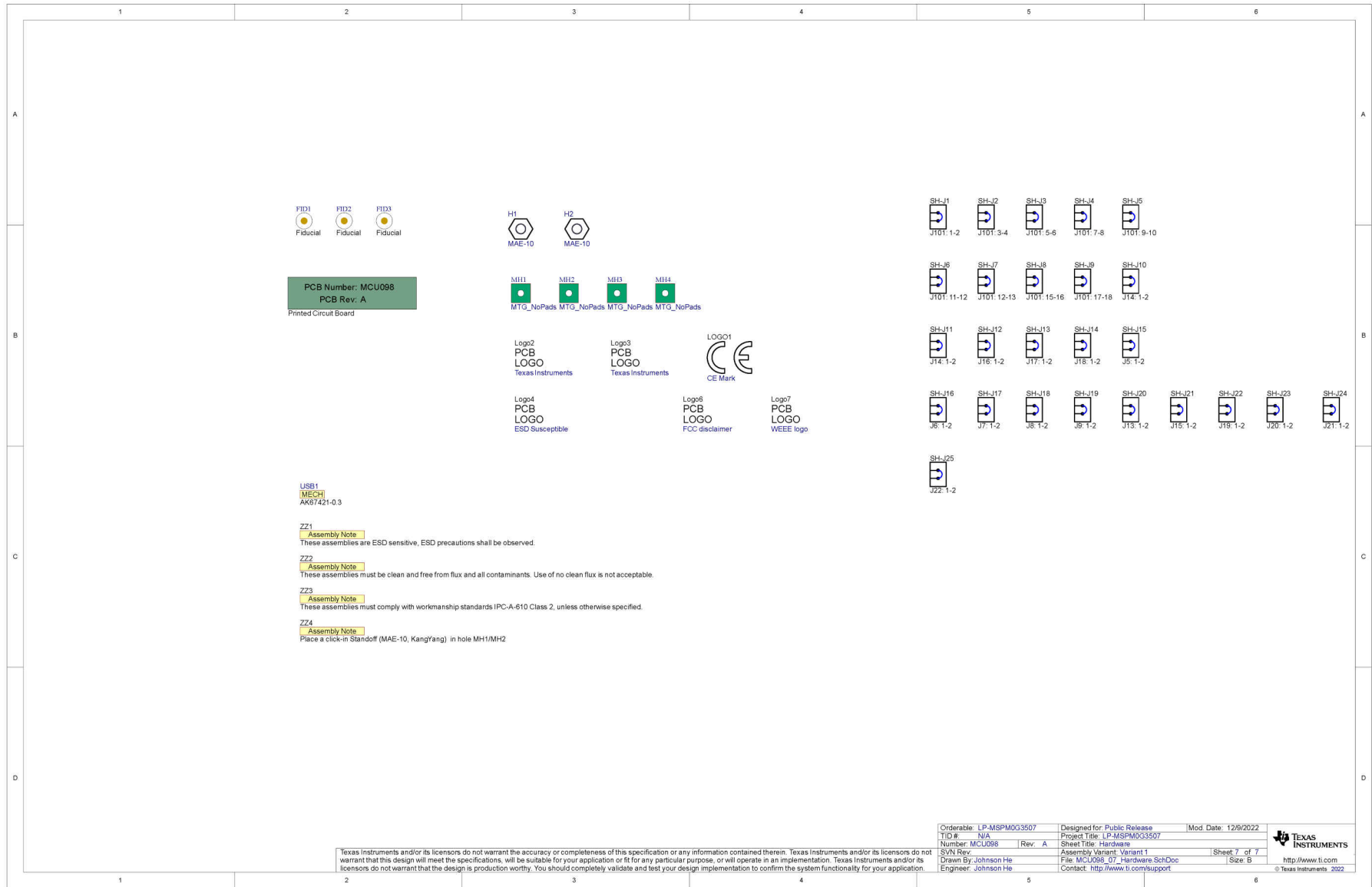
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USB2
1051640001

GND 5
ID 4
D+ 3
D- 2
VBUS 1

R86
0
R89
0

XDS_ID
XDS_DP
XDS_DM
XDS_VBUS
XDS_GND

C53
10V
2.2uF
XDS_GND

XDS_VBUS   R87
330k

R88
220k
XDS_GND

VBUS_DETECT

C54
3300pF
R90
1.00M

XDS_ID
XDS_VBUS
XDS_GND

IC3
IO1 IO3 4 XDS_DP
IO2 IO4 5 XDS_DM
VCC GND 3
TPD4E004DRYR
XDS_GND

TP4
DNC DO01
TP5
ITMS R91 10k XDS_VCC
DNC DO01
TP6
ITCK R92 10k
DNC DO01
TP7
ITDO
DNC DO01
TP8
ITDI
DNC DO01
TP9
IRSTN
DNC DO01
TP10
XDS_VCC
DNC DO01

XDS_GND

IC4
IN 8   OUT 1   XDS_VCC
EN 5   NR 3
NC 2
NC 6   GND 4
NC 7   PAD 9
TPS73533DRBT

C55
1uF
XDS_GND

C56
2.2uF
XDS_GND

XDS_GND

Orderable: LP-MSPM0G3507	Designed for: Public Release	Mod. Date: 5/3/2022
TID #: N/A	Project Title: LP-MSPM0G3507	
Number: MCU098 Rev: A	Sheet Title: XDS110-ET USB Power	
SVN Rev:	Assembly Variant: Variant 1	Sheet: 6 of 7
Drawn By: Johnson He	File: MCU098_06_XDS110-ET_USB_Power.SchDoc Size: B	
Engineer: Johnson He	Contact: http://www.ti.com/support	

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FID1 Fiducial
FID2 Fiducial
FID3 Fiducial

H1 MAE-10
H2 MAE-10

PCB Number: MCU098
PCB Rev: A
Printed Circuit Board

MH1 MTG_NoPads
MH2 MTG_NoPads
MH3 MTG_NoPads
MH4 MTG_NoPads

Logo2 PCB LOGO
Texas Instruments

Logo3 PCB LOGO
Texas Instruments

LOGO1
CE Mark

Logo4 PCB LOGO
ESD Susceptible

Logo6 PCB LOGO
FCC disclaimer

Logo7 PCB LOGO
WEEE logo

USB1 MECH
AK67421-0.3

ZZ1 Assembly Note
These assemblies are ESD sensitive, ESD precautions shall be observed.

ZZ2 Assembly Note
These assemblies must be clean and free from flux and all contaminants. Use of no clean flux is not acceptable.

ZZ3 Assembly Note
These assemblies must comply with workmanship standards IPC-A-610 Class 2, unless otherwise specified.

ZZ4 Assembly Note
Place a click-in Standoff (MAE-10, KangYang) in hole MH1/MH2

SH-J1 J101: 1-2
SH-J2 J101: 3-4
SH-J3 J101: 5-6
SH-J4 J101: 7-8
SH-J5 J101: 9-10

SH-J6 J101: 11-12
SH-J7 J101: 12-13
SH-J8 J101: 15-16
SH-J9 J101: 17-18
SH-J10 J14: 1-2

SH-J11 J14: 1-2
SH-J12 J16: 1-2
SH-J13 J17: 1-2
SH-J14 J18: 1-2
SH-J15 J5: 1-2

SH-J16 J6: 1-2
SH-J17 J7: 1-2
SH-J18 J8: 1-2
SH-J19 J9: 1-2
SH-J20 J13: 1-2
SH-J21 J15: 1-2
SH-J22 J19: 1-2
SH-J23 J20: 1-2
SH-J24 J21: 1-2

SH-J25 J22: 1-2

Orderable: LP-MSPM0G3507	Designed for: Public Release	Mod. Date: 12/9/2022
TID #: N/A	Project Title: LP-MSPM0G3507	
Number: MCU098 Rev: A	Sheet Title: Hardware	
SVN Rev:	Assembly Variant: Variant 1	Sheet: 7 of 7
Drawn By: Johnson He	File: MCU098_07_Hardware.SchDoc	Size: B
Engineer: Johnson He	Contact: http://www.ti.com/support	© Texas Instruments 2022

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6 Revision History

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

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