EVM User's Guide: LP-MSPM33C321A

LP-MSPM33C321A Evaluation Module

Description

The MSPM33C321A LaunchPad™ development kit is an easy-to-use evaluation module for the MSPM33C321A microcontroller (MCU). The LaunchPad kit contains everything needed to start development on the MSPM33C321x microcontroller platform, including an onboard debug probe for programming, debugging, and EnergyTrace™ technology. The board includes three buttons, two LEDs and one OLED display for quick integration of a simple user interface. The board also features external VREF, external OPA pads and ADC filtering pads for increased analog precision, and external FLASH for data storage.

Get Started

1. Order the LP-MSPM33C321A from ti.com.
2. Navigate to dev.ti.com to browse for code examples.
3. Plug LP-MSPM33C321A into a PC with USB cable.
4. Download code directly from the browser to the LP-MSPM33C321A with CCS Cloud.
5. Download CCS Theia for a desktop integrated development environment.
6. Download the MSPM33 SDK for desktop stored examples, demos, and software libraries.

Features

- Onboard XDS110 debug probe
- EnergyTrace technology available for ultra-low-power debugging
- Backchannel UART through USB to PC
- 80-pin BoosterPack™ headers, Mikrobus connector
- Hardware user interfaces: Two buttons, 1 RGB LED, 1 Red LED and 1 OLED display
- External REF6033 and external OPA365(unpopulated by default) for ADC(up to 9.4Msps) evaluation
- External NOR FLASH for external data storage
- External clock crystals
- Options for battery or super-capacitor

Applications

- Battery charging and management
- Power supplies and power delivery
- Personal electronics
- Building security and fire safety
- Connected peripherals and printers
- Grid infrastructure
- Smart metering
- Communication modules
- Medical and healthcare
- Lighting

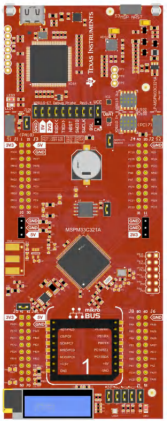

Figure 1-1. LP-MSPM33C321A

1 Evaluation Module Overview

1.1 Introduction

The MSPM33C321A is an Arm® Cortex® M33+ 32-bit CPU with memory protection unit and a frequency up to 160MHz. The device can be used in a variety of tasks from a IO-expander with the 100 pin variant to a full-application utilizing Dual-CAN interface, QSPI, and different security module to fulfill automotive applications. The easiest way to get started with the MSPM33C321A is with the LP-MSPM33C321A Launchpad. The LaunchPad has all the features to load code, debug, and prototype right out of the box.

The device features 1MB of dual-bank flash with 256kB of SRAM and 32kB of data flash memory. The device has Quad SPI (QSPI) for external memory, two digital audio interfaces supporting full duplex I2S and TDM, and two CANFD interfaces compliant to ISO 11898-1:2015. The device also has internal analog such as two internal ADCs, a voltage reference, and two comparators with 8-bit reference DACs.

Rapid prototyping is simplified by the 80-pin BoosterPack plug-in module headers, which support a wide range of available BoosterPack plug-in modules. Users can quickly add features like environmental sensing and much more. Design you own BoosterPack plug-in module or choose among many already available from TI and third-party developers.

To make prototyping easier, TI provides the MSPM33 software development kit (SDK), which has a variety of code examples to demonstrate how to use the internal peripherals.

Free software development tools are also available, such as TI's Code Composer Studio™ IDE. TI also supports 3rd party IDEs, such as IAR Embedded Workbench® IDE and Arm®Keil®µVision® IDE. Code Composer Studio IDE supports EnergyTrace technology with the MSPM33C321A LaunchPad development kit. More information about the LaunchPad development kit, the supported BoosterPack plug-in modules, and the available resources can be found at TI's LaunchPad development kit portal. To get started quickly and find available resources in the MSPM33 software development kit (SDK), visit the TI Developer Zone. The MSPM33 MCUs are also supported by extensive online collateral, training with MSPM33 Academy and online support through the TI E2E support forums.

1.2 Kit Contents

- LP-MSPM33C321A LaunchPad Development Kit
- USB cable
- Quick-start guide

1.3 Specification

LP-MSPM33C321A 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-MSPM33C321A 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

LP-MSPM33C321A uses the following devices from Texas Instruments.

Table 1-1. Device Information

Device Name	Description	Purpose
MSP432E401YTPDT	SimpleLink™ 32-bit ARM Cortex-M4F MCU with Ethernet™, CAN, 1MB Flash and 256kB RAM	XDS110 Host Device
MSP430G2452IRSA16R	Mixed-Signal Microcontroller with 16-bit RISC CPU, 8kB Flash, and 256B SRAM	DC/DC controller for EnergyTrace Technology
MSPM33C321ASPZR	Mixed-Signal Microcontroller with 160MHz Arm Cortex 32-bit-M33+ CPU, 1024kB flash, and 256kB SRAM	Evaluation device
TPS73533DRBT	500mA, adjustable, low quiescent current, low-noise, high-PSRR, single-output LDO regulator	3.3V power XDS110 and MSPM33C321A
TPD4E004DRYR	ESD-protection array for high-speed data interfaces, 4 channels	Protect LP-MSPM33C321A from ESD damage through USB connector
TPD6E004RSER	ESD-protection array for high-speed data interfaces, 6 channels	Protect LP-MSPM33C321A from ESD damage through debug connector
TPS2102DBVR	2.7V to 4V power mux, dual-input, single-output power switch	Switches XDS110 power
LM4040B25IDCKR	Precision micropower shunt voltage reference	Voltage reference for XDS110 debugger
REF6033IDGKR	High-Precision Voltage Reference with Integrated High-Bandwidth Buffer	Voltage reference for MSPM33

2 Hardware

2.1 Hardware Overview

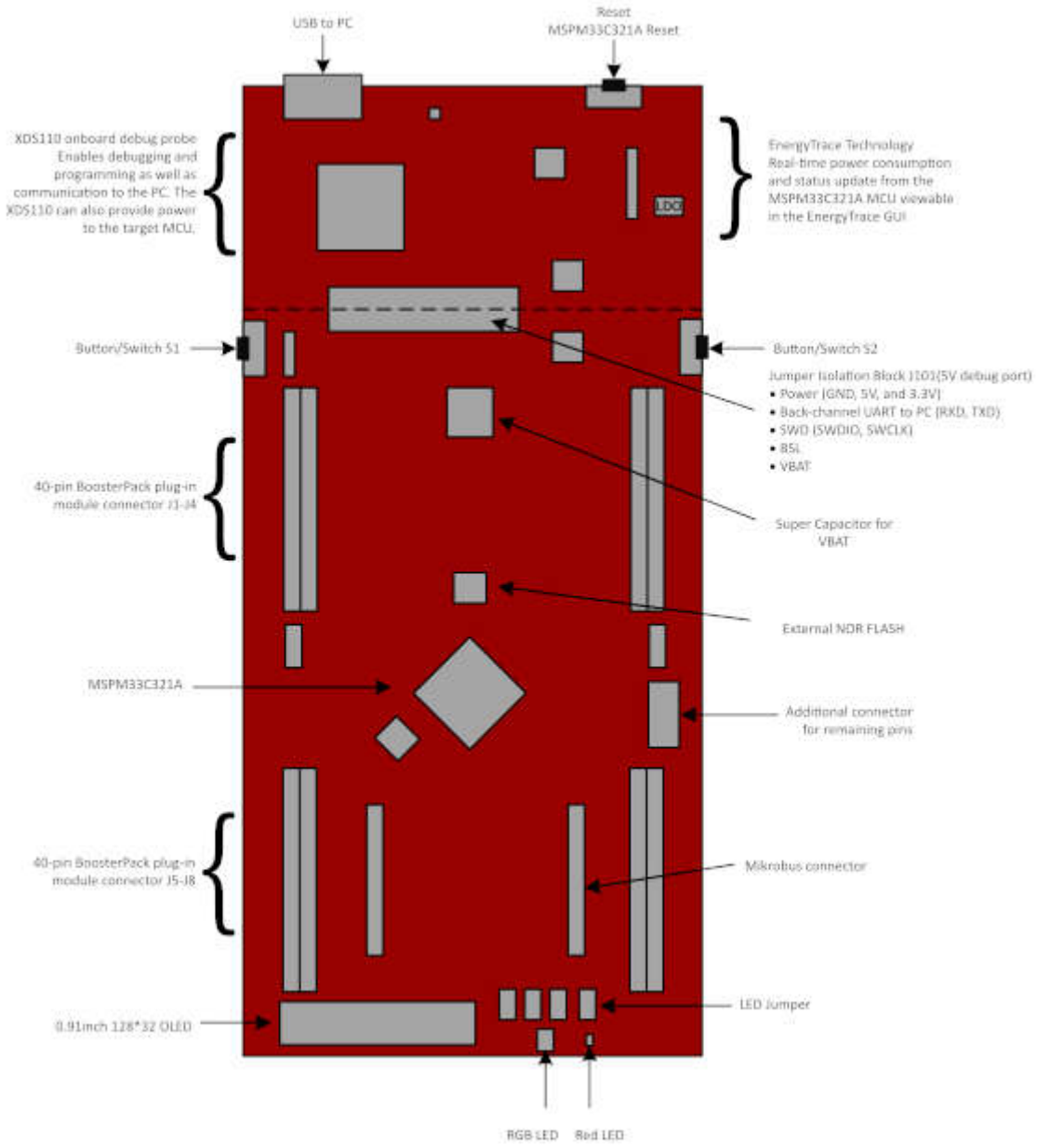

Figure 2-1. Diagram of LP-MSPM33C321A Jumpers and Connection

LP-MSPM33C321A has many hardware features, which allows the user full access to the MSPM33C321A pins, while still providing onboard connectivity for easy use. Shunt connections provide a way for the user to easily change LaunchPad configuration. The location of these shunts is shown in Figure 2-1. The connection of each shunt is described in Table 2-1. The default configuration is to have all shunts populated.

Table 2-1. Jumper Information

Jumper	Description	Default Setting	Connected Signal
J1 & J3	BoosterPack Header Block 1	Unpopulated	BoosterPack standard connection for pins 1-20
J2 & J4	BoosterPack Header Block 2	Unpopulated	BoosterPack standard connection for pins 21-40

Table 2-1. Jumper Information (continued)

Jumper	Description	Default Setting	Connected Signal
J5 & J7	BoosterPack Header Block 3	Unpopulated	BoosterPack standard connection for pins 41-60
J6 & J8	BoosterPack Header Block 4	Unpopulated	BoosterPack standard connection for pins 61-80
J1	OLED power supply	Populated	Connect 3.3V power supply for OLED
J3	BSL invoke	Populated	Connect PA18 to the S1 button
J4	Button S2	Populated	Connect PC17 to the S2 button
J5	External reference power supply	Populated	Connect 5V power supply for external reference
J6	Red LED	Populated	Connect PA0 to the Red LED
J7	RGB (Blue) LED	Populated	Connect PA2 to the RGB (Blue) LED
J8	RGB (Red) LED	Populated	Connect PC26 to the RGB (Red) LED
J9	RGB (Green) LED	Populated	Connect PC27 to the RGB (Green) LED
J11	Additional header for remaining pins	Un-assembly	Connection for the pins not output on BoosterPack or Mikrobus
J12	External NOR FLASH power supply	Populated	Connect 3.3V power supply for NOR FLASH
J16	5V Power Header	Unpopulated	Additional pin connections for GND and 5V
J17	3.3V Power Header	Unpopulated	Additional pin connections for GND and 3.3V
MIKROBUS 1	mikroBUS Host Socket	Populated	mikroBUS standard

2.2 Power Requirements

The LP-MSPM33C321A only needs the USB plugged in and debugger jumper block populated to power the device. With the onboard LDO, the 5V USB supply is converted to 3.3V with a supply of 500mA. The LaunchPad can also be powered by the 3.3V or 5V headers via an external supply. Do not exceed 3.3V on the 3.3V rail or 5V on the 5V rail. For operation of the Low-Frequency Subsystem Module (LFSS), the BAT jumper needs to be populated or powered with 1.65 - 3.3V.

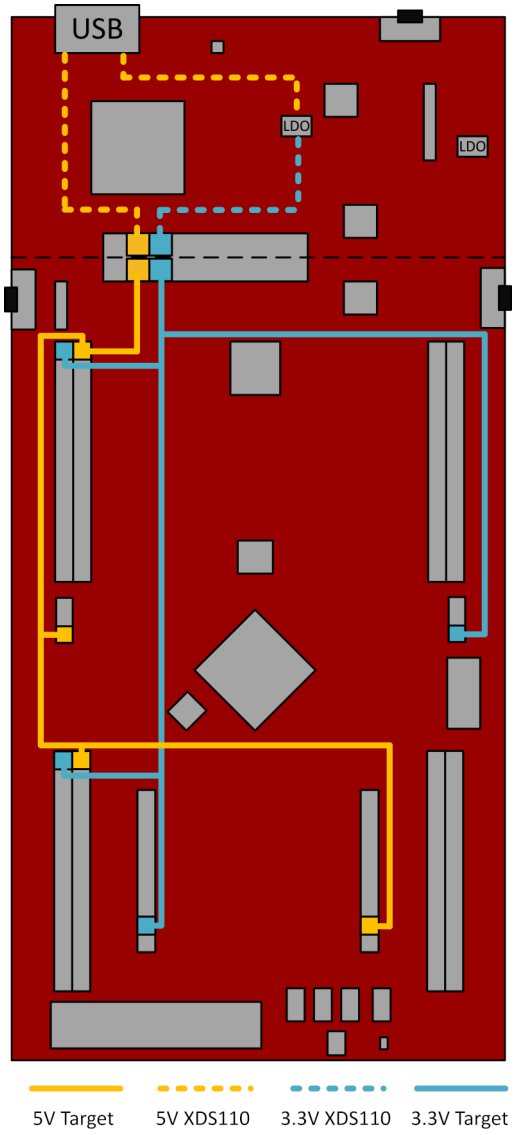

Figure 2-2. LP-MSPM33C321A Power Connections

2.3 XDS110 Debug Probe

LP-MSPM33C321A features an onboard debug probe to streamline prototyping. The debugger used on this LaunchPad is the XDS110 variant, which supports all MSPM33 device derivatives. The integrated XDS110 debug probe is separated from the rest of the MSPM33C321A circuitry, which is shown by the dashed silkscreen on the LaunchPad. The XDS110 is only connected through signals that pass through J101, in addition to a common ground.

Isolation Jumper Block

The isolation jumper block J101 allows the user to connect or disconnect signals that cross from the XDS110 domain into the MSPM33C321A target domain. This includes XDS110 SWD signals, application UART signals, 3.3V and 5V power, reset, and a VBAT source.

Table 2-2. Isolation Jumper Block

Jumper	Description
5V	5V rail from the USB
3V3	3.3V rail from the LDO
RXD<<	Backchannel UART: The target MSPM33C321A receives data through this signal. The arrows indicate the direction of the signal.
TXD>>	Backchannel UART: The target MSPM33C321A sends data through this signal. The arrows indicate the direction of the signal.
NRST	Reset signal
SWDIO	Serial Wire Debug: SWDIO data signal
SWCLK	Serial wire debug: SWCLK clock signal
BSL	Invoke pin for bootstrap loader. Allows the XDS110 to invoke BSL.
BAT	VBAT selection between the LDO on the XDS110 side and 100mF super capacitor.

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

- To remove any and all influence from the XDS110 debug probe for high accuracy target power measurements.
- To control 3.3V and 5V power flow between the XDS110 and target domains.
- To expose the target MCU pins for other use than onboard debugging and application UART communication.
- To expose the programming and UART interface for the XDS110 so that the XDS110 can be used for devices other than the onboard MCU.
- To utilize other VBAT options.

Application (*Backchannel*) UART

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

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

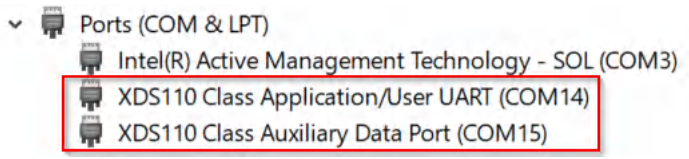

Figure 2-3. Application Backchannel UART in Device Manager

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

On the target MSPM33C321A side, the backchannel UART is connected to UART (PA10, PA11). The XDS110 has a configurable baud rate; therefore, the PC application configuring the baud rate needs to be the same baud rate.

2.4 Measure Current Draw of the MSPM33C321A

To measure the current draw of the MSPM33C321A MCU using a multimeter, use the 3V3 jumper on the J101 jumper isolation block. The current measured includes the target device, LaunchPad circuits, and any current drawn through the BoosterPack plug-in module headers. To measure ultra-low power, follow these steps:

1. Remove the 3V3 jumper in the J101 isolation block, and attach an ammeter across the 3V3 jumper.
2. Consider the effect that the backchannel UART and any circuitry attached to the MSPM33C321A can have on the current draw. Consider disconnecting the backchannel uart at the isolation jumper block, or at least consider the current sinking and sourcing capability in the final measurement.
3. Make sure there are no floating inputs or outputs (I/Os) on the MSPM33C321A. This causes unnecessary extra current draw. Every I/O is either driven or, if the I/O is an input, is pulled or driven to a high or low level.
4. Begin target execution.
5. For the most accurate current measurements, place the device in Free Run mode and disconnect programming signals between the MSPM33C321A and the debug portion of the board (header J101).
6. Measure the current. Remember that if the current levels are fluctuating, then getting a stable measurement can be difficult. Measuring the quiescent states is easier.

To measure the current draw of the VBAT domain:

- Remove the BAT jumper in the J101 isolation block, and attach an ammeter across the jumper.
- To isolate from other sources of current draw, TI recommends to power with a separate power source from VDD. To do this apply the voltage to the BAT pin on the MSP side of the board.
- Measure the current.

2.5 Clocking

The internal SYSOSC is 32MHz by default with an accuracy of 2.5%. The MCLK is sourced by the SYSOSC by default. The SYSPLL can be used to generate a clock signal up to 160MHz, which can be used to source MCLK. CPUCLK is sourced directly from MCLK in RUN mode and disabled in other modes. The low-power clock (ULPCLK) can be sourced by MCLK and active in RUN and SLEEP mode by configuration. The part also includes an internal 32kHz oscillator, LFOSC, which is the default low frequency source. Included on the LaunchPad are two clock crystal options, one high-frequency 40MHz crystal (HFXT), and one low-frequency 32.768kHz crystal (LFXT). The crystals can be selected during application programming as the clock source for the high frequency and low frequency clocks. For mre clock tree details, see the Clock Module (CKM) section of the MSPM33 C-Series Microcontrollers Technical Reference Manual.

2.6 BoosterPack Plug-in Module Pinout

The LaunchPad development kit adheres to the 80-pin LaunchPad development kit pinout standard, where pins are available. A standard was created to aid compatibility between LaunchPad development kits and BoosterPack plug-in modules across the TI ecosystem.

While most BoosterPack plug-in modules are compliant with the standard, some are not. If the reseller or owner of the BoosterPack plug-in module does not explicitly indicate compatibility with the MSPM33C321A LaunchPad development kit, then compare the schematic of the candidate BoosterPack plug-in module with the LaunchPad development kit to verify compatibility. Conflicts can be resolved by changing the MSPM33C321A device pin function configuration in software.

2.7 Mikrobus Module Pinout

The LaunchPad development kit contains a mikrobus socket with a pair of 1×8 female hearders.

- 3 groups of communications pins(SPI, UART, I2C)
- 6 additonal pins(PWM, Interrupt, Analog input, Reset and Chip select)
- 2 power groups(+3.3V, GND and +5V, GND)

With mikrobus socket, LaunchPad development kits are available with Mikrobus plug-in module. For more info about the mikrobus, please refer to www.mikroe.com.

2.8 External Storage

There is a 64Mbit external NOR FLASH on LP-MSPM33C321A to support external storage. QSPI is the interface with NOR FLASH. Table 2-3 shows the external NOR FLASH mapping.

To power external NOR FLASH, please populate J12 for the 3V3 power.

Table 2-3. NOR FLASH Mapping

NOR FLASH pin	Pin Function	LP Pin
1	CS	PC0
2	IO1	PA14
3	IO2	PA13
4	GND	-
5	IO0	PA12
6	SCLK	PB16
7	IO3	PB15
8	VCC	-

To evaluate QSPI with external connection, please solder J11 and 5 0-ohm resistors. 5 0ohm resistors are on the back of LP, which are un-soldered default to avoid noise on QSPI.

Table 2-4. 0-ohm resistors for QSPI

Resistor	LP Pin
R77	PA12 on J11
R78	PA13 on J11

Table 2-4. 0-ohm resistors for QSPI (continued)

Resistor	LP Pin
R79	PA14 on J11
R80	PB15 on J11
R81	PB16 on J11

2.9 OLED Display Module

Included in the LP-MSPM33C321A is an onboard 0.91 inch 128×32 OLED display with display driver SSD1316. The launchpad includes a 15-pin FPC connector and passive components to support OLED display. Table 2-5 shows the FPC connector mapping.

To power the display, please populate J1 for the 3V3 power.

Table 2-5. FPC Connector Mapping

FPC connector pin	Pin Function	LP Pin
1	VCC	-
2	VCOMH	-
3	IREF	-
4	SDIN	PB17
5	SCLK	PB18
6	D/C	PA26
7	RES	PC15
8	CS	PA27
9	VDD	-
10	VSS	-
11	VBAT	-
12	C1N	-
13	C1P	-
14	C2N	-
15	C2P	-

3 Software

3.1 Software Development Options

There are multiple ways to prototype with LP-MSPM33C321A:

- Out-of-box GUI - Choose this option for an easy demo of the LP-MSPM33C321A.
- CCS Cloud - Choose this option to get started quickly with minimal installation.
- CCS Theia - Choose this option to work offline and have full access to debug features

3.2 Out-of-Box

Get started with the out-of-box example on LP-MSPM33C321A. After powering the board, LP-MSPM33C321A will show the TI logo image and some instruction information on the OLED display. By clicking the button S2, MSPM33C321A will read data from external NOR FLASH and display a short video on the OLED.

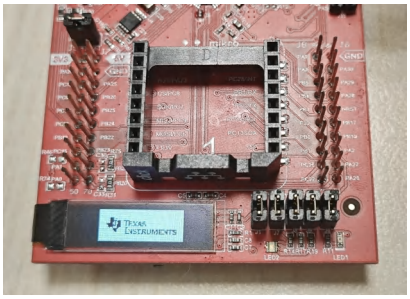

Figure 3-1. TI logo image on the display

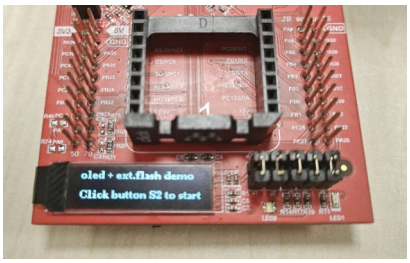

Figure 3-2. Instruction on the display

The OLED display is driven by MSPM33C321A via SPI. Display drive code is based on U8G2 library. For the display demo, please refer to the example in MSP M33 SDK .

The external display is driven by MSPM33C321A via QSPI. For the data storage demo, please refer to the example in MSP M33 SDK.

More information will be available after the full release and can be found on TI Developer Zone

3.3 CCS Cloud

1. Navigate to dev.ti.com. User are required to install CCS Cloud Agent. If CCS Cloud Agent is not installed yet, then follow the steps to complete this installation.
2. Plug LP-MSPM33C321A using a micro-USB cable. TI Developer Zone automatically detects that LP-MSPM33C321A has been plugged in.
3. Click Browse Software And Examples, which opens the MSPM33 SDK in a new window. In the left bar, navigate to Arm-based microcontrollers > Embedded Software > MSPM33 SDK > Examples > Development Tools > DriverLib > gpio_toggle_output > No RTOS > TI Clang Compiler > gpio_toggle_output.
4. Click the Import button at the top right corner of the screen. This action imports the project into CCS Cloud and open in a new window.
5. In CCS Cloud, click the debug icon in the left bar to open the debug view.
6. Click the *play* button to deploy the code to the device and open a debug session. By default, the debugger pauses the first line of code.
7. Click the blue *play* button to start the application.
8. The LED on LP-MSPM33C321A needs to be blinking.

Now, users are ready to begin prototyping by modifying the code or by importing a different example code

4 Hardware Design Files

4.1 Schematics

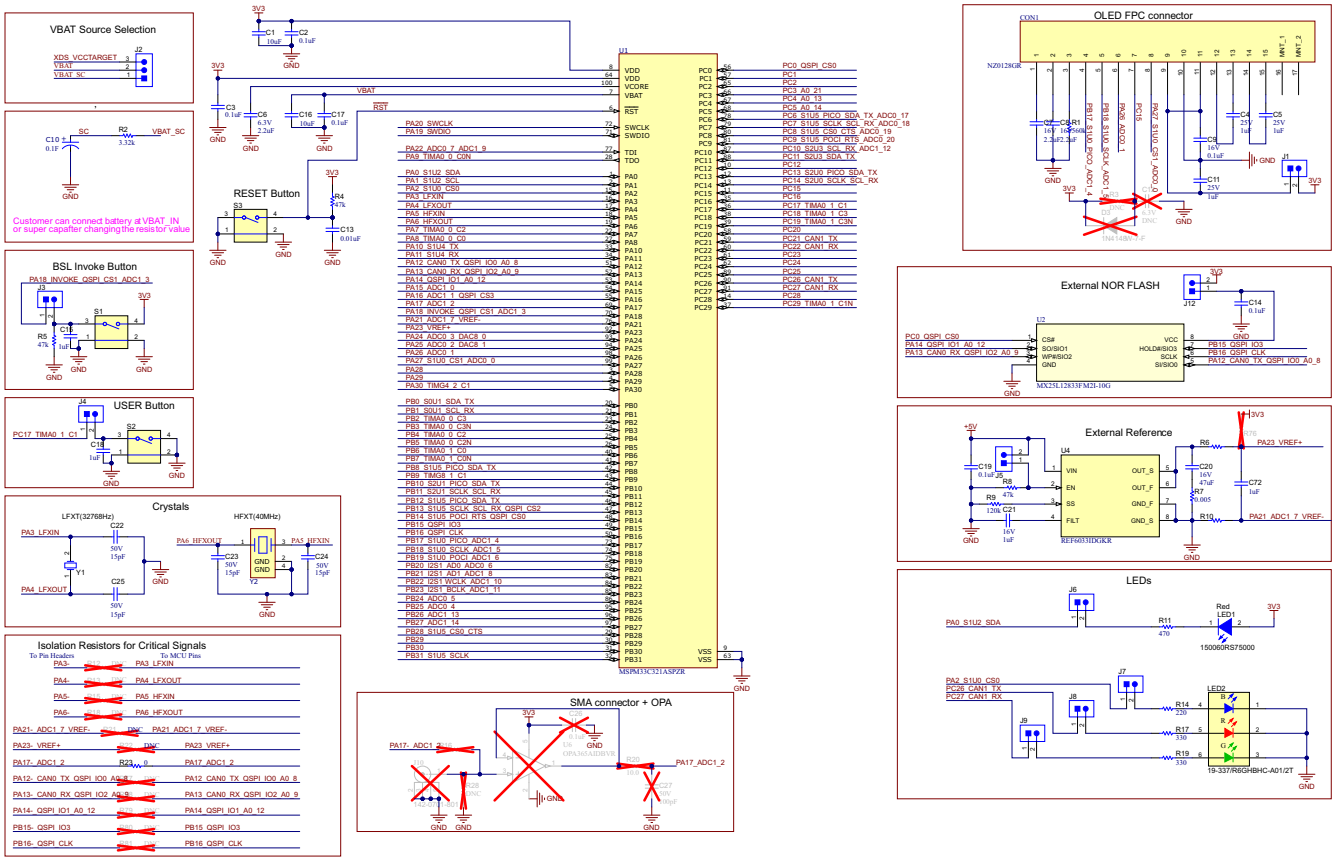

Figure 4-1. LP-MSPM33C321A Target Device Schematic

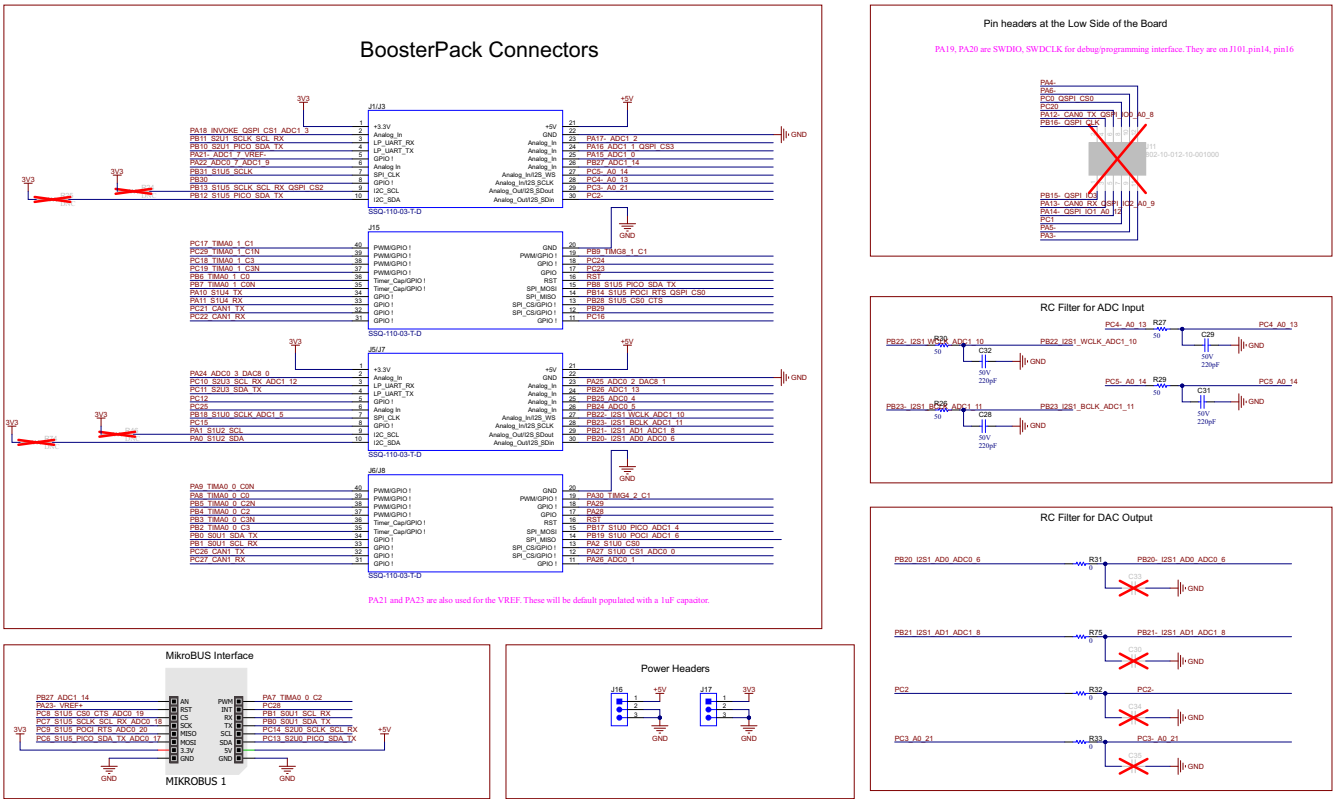

Figure 4-2. BoosterPack Connectors

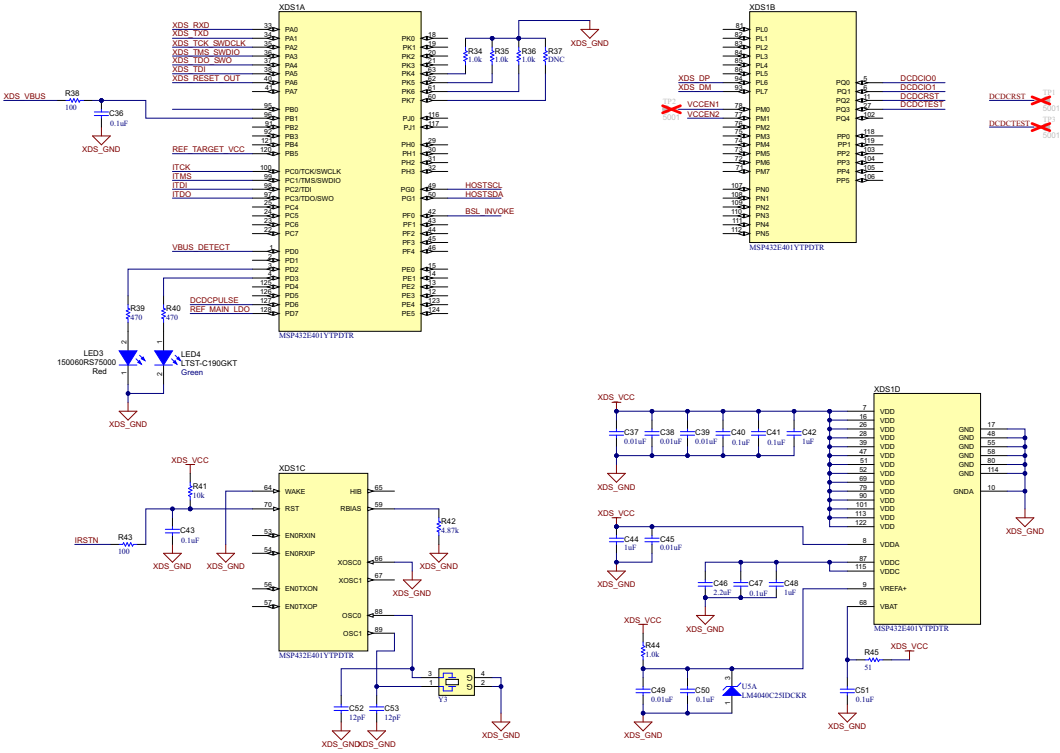

Figure 4-3. XDS110 Debug Probe Emulator Schematic

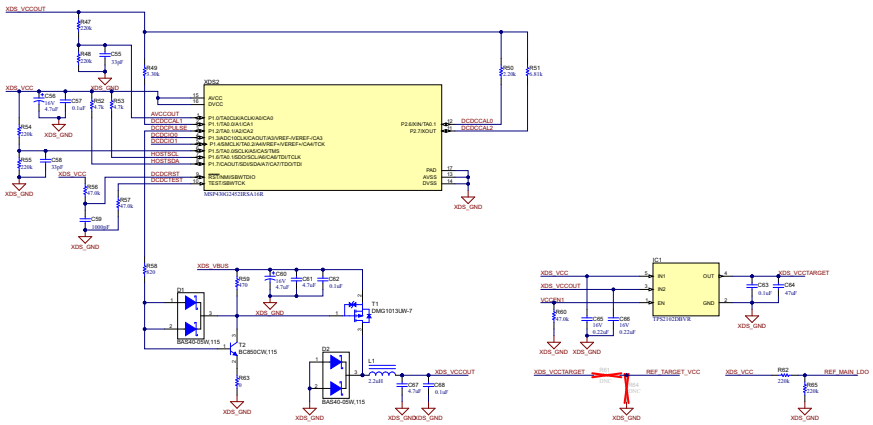

Figure 4-4. XDS110 EnergyTrace Schematic

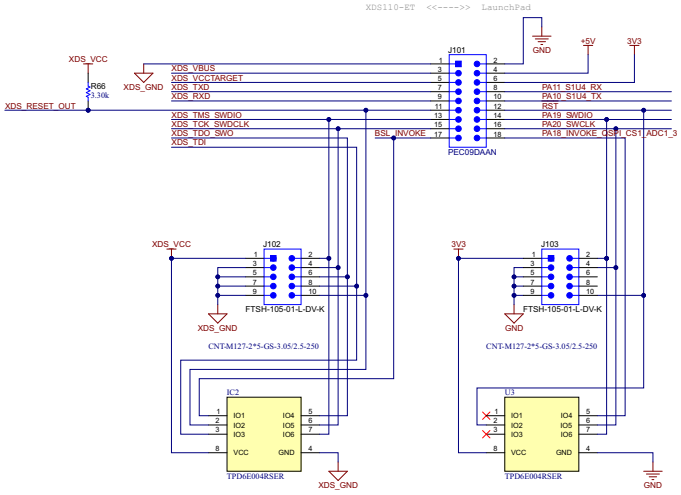

Figure 4-5. XDS110 Target Interface Schematic

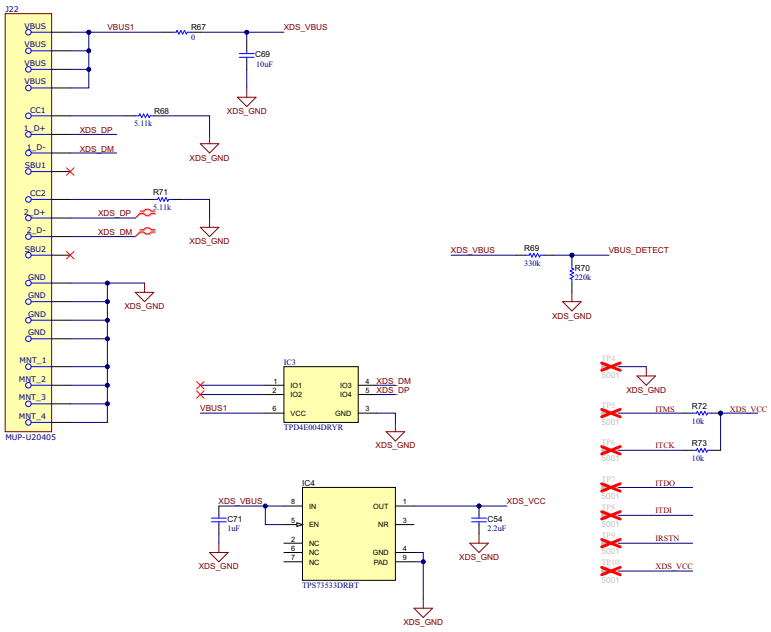

Figure 4-6. XDS110 USB Power Schematic

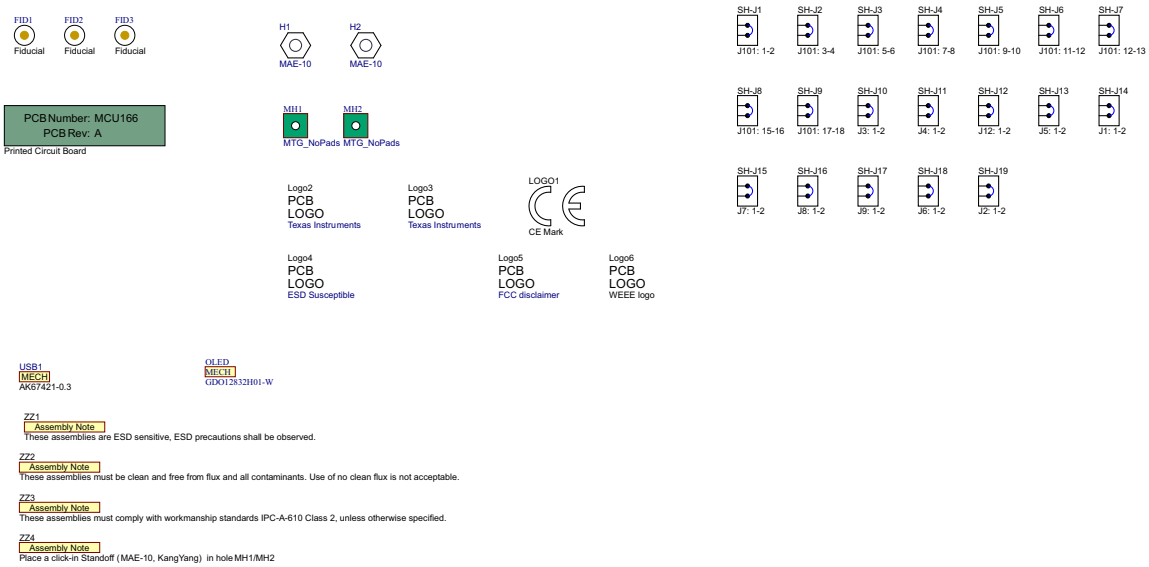

Figure 4-7. Jumpers and Standoffs

4.2 PCB Layouts

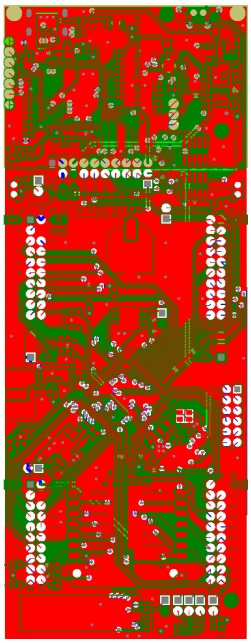

Figure 4-8. Top Layer and Overlay (1st Layer)

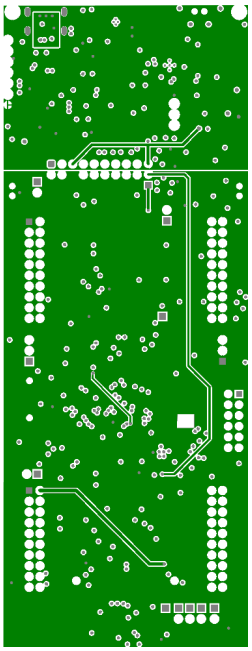

Figure 4-9. VCC Plane (2nd Layer)

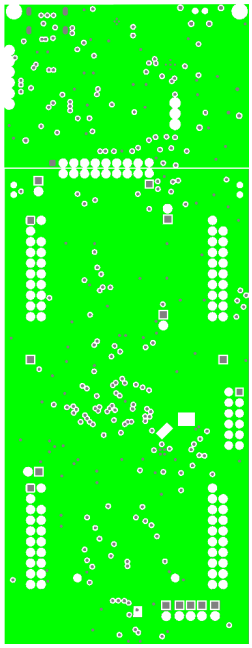

Figure 4-10. Ground Plane (3rd Layer)

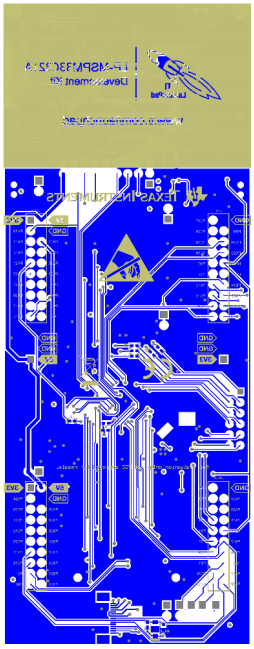

Figure 4-11. Bottom Layer and Overlay (4th Layer)

4.3 Bill of Materials (BOM)

Table 4-1. Bill of Material

Designator	Quantity	Value	Description	Part Number	Package Reference	Designator
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8, SH-J9, SH-J10, SH-J11, SH-J12, SH-J13, SH-J14, SH-J15, SH-J16, SH-J17, SH-J18, SH-J19	19	J101: 1-2, J101: 3-4, J101: 5-6, J101: 7-8, J101: 9-10, J101: 11-12, J101: 12-13, J101: 15-16, J101: 17-18, J3: 1-2, J4: 1-2, J12: 1-2, J5: 1-2, J1: 1-2, J7: 1-2, J8: 1-2, J9: 1-2, J6: 1-2, J2: 1-2	Shunt, 100mil, Gold plated, Black	2228CG	SNT-100-BK-G	Nextron
C36, C40, C41, C43, C47, C50, C51, C57, C62, C63, C68	11	0.1uF	CAP, CERM, 0.1 uF, 6.3 V, +/- 10%, X7R, 0402	CC0402KRX7R5BB104	0402	Yageo
J1, J3, J4, J5, J6, J7, J8, J9, J12	9		Header, 100mil, 2x1, Tin, TH	NS-201-SH0386-201S-1*2P(F)	CONN_90120-0122	Nstech
C4, C5, C11, C42, C44, C48, C71	7	1uF	CAP, CERM, 1 uF, 25 V, +/- 10%, X5R, 0402	CC0402KRX5R8BB105	0402	Yageo
R47, R48, R54, R55, R62, R65, R70	7	220k	RES, 220 k, 1%, 0.0625 W, 0402	RC0402FR-07220KL	0402	Yageo America
R31, R32, R33, R63, R67, R75	6	0	RES, 0, 5%, 0.1 W, 0603	RC0603JR-070RL	0603	Yageo
C2, C3, C14, C17, C19	5	0.1uF	CAP, CERM, 0.1 uF, 50 V, +/- 20%, X5R, 0402	CC0402KRX5R9BB104	0402	Yageo
C37, C38, C39, C45, C49	5	0.01uF	CAP, CERM, 0.01 uF, 25 V, +/- 10%, X7R, 0402	CC0402KRX7R8BB103	0402	Yageo
C28, C29, C31, C32	4	220pF	CAP, CERM, 220 pF, 50 V,+/- 5%, C0G/NP0, AEC-Q200 Grade 1, 0402	AC0402JRNPO9BN221	0402	Yageo
R34, R35, R36, R44	4	1.0k	RES, 1.0 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	AC0402JR-071KL	0402	Yageo
R26, R27, R29, R30	4	50	RES, 50, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW060350R0FKEA	0603	Vishay-Dale
R11, R39, R40, R59	4	470	RES, 470, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	AC0402JR-07470RL	0402	Yageo
C22, C23, C24, C25	4	15pF	CAP, CERM, 15 pF, 50 V, +/- 5%, C0G/NP0, 0402	CC0402JRNPO9BN150	0402	Yageo
S1, S2, S3	3		Switch, SPST, 0.05 A, 12 VDC, SMD	THBM02-LAB	SW_1188E	HONGJU
C15, C18, C72	3	1uF	CAP, CERM, 1 uF, 25 V, +/- 10%, X5R, 0603	CC0603KRX5R8BB105	0603	Yageo
R41, R72, R73	3	10k	RES, 10 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	AC0402JR-0710KL	0402	Yageo

Table 4-1. Bill of Material (continued)

Designator	Quantity	Value	Description	Part Number	Package Reference	Designator
R4, R5, R8	3	47k	RES, 47 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	AC0402JR-0747KL	0402	Yageo
C1, C16, C69	3	10uF	CAP, CERM, 10 uF, 6.3 V, +/- 20%, X5R, 0603	CC0603MRX5R5BB106	0603	Yageo
R56, R57, R60	3	47.0k	RES, 47.0 k, 1%, 0.0625 W, 0402	RC0402FR-0747KL	0402	Yageo America
R6, R10, R23	3	0	RES, 0, 5%, 0.063 W, 0402	RC0402JR-070RL	0402	Yageo America
LED1, LED3	2	Red	LED, Red, SMD	150060RS75000	WL-SMCW_RED	Wurth Elektronik
D1, D2	2	40V	Diode, Schottky, 40 V, 0.12 A, AEC-Q101, SOT-323	BAS40-05W,115	SOT-323	Nexperia
R52, R53	2	4.7k	RES, 4.7 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	AC0402JR-074K7L	0402	Yageo
R68, R71	2	5.11k	RES, 5.11 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	AC0402FR-075K11L	0402	Yageo
R38, R43	2	100	RES, 100, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	AC0402JR-07100RL	0402	Yageo
R17, R19	2	330	RES, 330, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	AC0402JR-07330RL	0402	Yageo
R49, R66	2	3.30k	RES, 3.30 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0402	AC0402FR-073K3L	0402	Yageo
J102, J103	2		Header(Shrouded), 1.27mm, 5x2, Gold, SMT	FTSH-105-01-L-DV-K	Samtec_FTSH-105-01-x-DV-K	Samtec
C46, C54	2	2.2uF	CAP, CERM, 2.2 uF, 6.3 V, +/- 10%, X5R, 0402	CC0402KRX5R5BB225	0402	Yageo
C7, C8	2	2.2uF	CAP, CERM, 2.2 uF, 16 V, +/- 10%, X5R, 0402	CC0402KRX5R7BB225	0402	Yageo
C65, C66	2	0.22uF	CAP, CERM, 0.22 uF, 16 V, +/- 10%, X7R, 0402	CC0402KRX7R7BB224	0402	Yageo
C61, C67	2	4.7uF	CAP, CERM, 4.7 uF, 16 V, +/- 10%, X5R, 0603	CC0603KRX5R7BB475	0603	Yageo
C52, C53	2	12pF	CAP, CERM, 12 pF, 50 V, +/- 5%, C0G/NP0, 0402	CC0402JRNPO9BN120	0402	Yageo
C55, C58	2	33pF	CAP, CERM, 33 pF, 50 V, +/- 5%, C0G/NP0, 0402	CC0402JRNPO9BN330	0402	Yageo
H1, H2	2		Spacer Support, Nylon 66	MAE-10	KY_MAE-10	Kang Yang
J1/J3, J5/J7	2		Receptacle, 2.54mm, 10x2, Tin, TH	NS-203-SH0135-203S-Y-2*10P(F)	BoosterPack_40pin_J1J3	Nstech

Table 4-1. Bill of Material (continued)

Designator	Quantity	Value	Description	Part Number	Package Reference	Designator
J6/J8, J15	2		Receptacle, 2.54mm, 10x2, Tin, TH	NS-203-SH0135-203S-Y-2*10P(F)	BoosterPack_40pin_J2J4	Nstech
C56, C60	2	4.7uF	CAP, TA, 4.7 uF, 16 V, +/- 10%, 4 ohm, SMD	TAJA475K016RNJ	3216-18	AVX
IC2, U3	2		Low-Capacitance 6-Channel +/-15 kV ESD Protection Array for High-Speed Data Interfaces, RSE0008A (UQFN-8)	TPD6E004RSER	RSE0008A	Texas Instruments
LED2	1	RGB	LED, RGB, TH	19-337/R6GHBHC-A01/2T	19-337_RGB	Everlight
USB1	1		Cable, USB-A to micro USB-B, 0.3 m	A006ZX060		Zanxin
T2	1	45 V	Transistor, NPN, 45 V, 0.1 A, SOT-323	BC850CW,115	SOT-323	NXP Semiconductor
C21	1	1uF	CAP, CERM, 1 uF, 16 V, +/- 10%, X6S, 0402	CC0402KRX6S7BB105	0402	Yageo
C20	1	47uF	CAP, CERM, 47 uF, 16 V, +/- 15%, X5R, 1206	C3216X5R1C476MTJ00N	1206	TDK
L1	1	2.2uH	Inductor, Wirewound, Ceramic, 2.2 uH, 0.89 A, 0.13 ohm, SMD	CBC2518T2R2M	CBC2518	Taiyo Yuden
R50	1	2.20k	RES, 2.20 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	RMCF0402FT2K20	0402	Stackpole
R42	1	4.87k	RES, 4.87 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	AC0402FR-074K87L	0402	Yageo
R51	1	6.81k	RES, 6.81 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	AC0402FR-076K81L	0402	Yageo
R45	1	51	RES, 51, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	AC0402JR-0751RL	0402	Yageo
R9	1	120k	RES, 120 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	RC0402FR-07120KL	0402	Yageo
R14	1	220	RES, 220, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	AC0402JR-07220RL	0402	Yageo
R1	1	560k	RES, 560 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	AC0402JR-07560KL	0402	Yageo
T1	1	-20V	MOSFET, P-CH, -20 V, -0.82 A, SOT-323	DMG1013UW-7	SOT-323	Diodes Inc.

Table 4-1. Bill of Material (continued)

Designator	Quantity	Value	Description	Part Number	Package Reference	Designator
R7	1	0.005	RES, 0.005, 1%, 0.25 W, AEC-Q200 Grade 1, 0603	ERJ3LWFR005V	0603	Panasonic
C10	1	100mF	100 mF (EDLC) Supercapacitor 5.5 V Radial, Can - SMD 25Ohm @ 1kHz	FC0H104ZFTBR24	FP-FC0H104ZFTBR24_RADIAL_SMT-MFG	KEMET
Y1	1		Crystal, 32.768 KHz, 12.5 pF, SMD	9CAA32768122TF70QT	Epson_FC-135	INTERQUIP
C59	1	1000pF	CAP, CERM, 1000 pF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	AC0402KRX7R9BB102	0402	Yageo
OLED	1		0.87inch 128*32 OLED display	GDO12832H01-W		Xiamen Ocular Optics
C6	1	2.2uF	CAP, CERM, 2.2 uF, 6.3 V, +/- 20%, X5R, 0402	CC0402MRX5R5BB225	0402	Yageo
C13	1	0.01uF	CAP, CERM, 0.01 uF, 16 V, +/- 10%, X5R, 0402	CC0402KRX7R7BB103	0402	Yageo
C9	1	0.1uF	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X5R, 0402	CC0402KRX5R7BB104	0402	Yageo
C64	1	47uF	CAP, CERM, 47 uF, 6.3 V, +/- 20%, X5R, 0603	CL10A476MQ8QRNC	0603	Samsung
U5	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	DCK0005A_N	Texas Instruments
LED4	1	Green	LED, Green, SMD	LTST-C190GKT	LED_LTST-C190	Lite-On
MIKROBUS 1	1		mikroBUS Host Socket	MIKROE 4248	MIKROBUS HOST CONN. SMD	MikroElektronika
XDS2	1		MSP430G2x52, MSP430G2x12 Mixed Signal Microcontroller, RSA0016B (VQFN-16)	MSP430G2452IRSA16R	RSA0016B	Texas Instruments
XDS1	1		MSP432E401YTPDT, PDT0128A (TQFP-128)	MSP432E401YTPDTR	PDT0128A	Texas Instruments
U1	1		Mixed-Signal Microcontroller With CAN-FD Interface, LQFP100	MSPM33C321ASPZR	PZ0100A-MFG	Texas Instruments

Table 4-1. Bill of Material (continued)

Designator	Quantity	Value	Description	Part Number	Package Reference	Designator
J22	1		16PIN USB C connectors in chargers TOP mount type CH 1.63 & L=6.9 USB Type C connectors	MUP-U20405	FP-MUP-U20405_USB_CONN-MFG	MUP
U2	1		No Description Available	MX25L12833FM2I-10G	SOP8_200MIL_MAC	Macronix
Y3	1		Crystal, 16 MHz, 8pF, SMD	5YAA16000082TF80Q3	NDK_NX3225GA	INTERQUIP
CON1	1		15pin FPC 0.5mm	CFAD189-1522A002C2AD	PCBComponent_1	Greenconn
J2	1		Header, 100mil, 3x1, Tin, TH	NS-201-SH0385-201S-1*3P(F)	CONN_PEC03SAAN	Nstech
J16	1		Header, 100mil, 3x1, Tin, TH	NS-201-SH0385-201S-1*3P(F)	PEC03SAAN_Launchpad_5V0	Nstech
J17	1		Header, 100mil, 3x1, Tin, TH	NS-201-SH0385-201S-1*3P(F)	PEC03SAAN_Launchpad_3V3	Nstech
J101	1		Header, 2.54mm, 9x2, Tin, TH	NS-201-SH0384-201S-2*9P(F)	Sullins_PxC09DAAN	Nstech
R69	1	330k	RES, 330 k, 1%, 0.0625 W, 0402	RC0402FR-07330KL	0402	Yageo America
R58	1	820	RES, 820, 1%, 0.063 W, 0402	RC0402FR-07820RL	0402	Yageo America
R2	1	3.32k	RES, 3.32 k, 1%, 0.1 W, 0603	RC0603FR-073K32L	0603	Yageo
U4	1		5ppm/C High-Precision Voltage Reference with Integrated High-Bandwidth Buffer, DGK0008A (VSSOP-8)	REF6033IDGKR	DGK0008A_N	Texas Instruments
IC3	1		4-Channel ESD Protection Array for High-Speed Data Interfaces, DRY0006A (USON-6)	TPD4E004DRYR	DRY0006A	Texas Instruments
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	DBV0005A_N	Texas Instruments

Table 4-1. Bill of Material (continued)

Designator	Quantity	Value	Description	Part Number	Package Reference	Designator
IC4	1		500mA, Adjustable, Low Quiescent Current, Low-Noise, High-PSRR, Single-Output LDO Regulator, DRB0008A (VSON-8)	TPS73533DRBT	DRB0008A	Texas Instruments
Y2	1		Crystal 40MHz ±10ppm (Tol) ±20ppm (Stability) 12pF FUND 40Ohm 4-Pin Mini-CSMD T/R	5YAA40000121TF30Q2	FP-X1E0000210179_TSX-3225-MFG	INTERQUIP

5 Compliance Information

5.1 Compliance and Certifications

LP-MSPM33C321A EU Declaration of Conformity (DoC)

6 Additional Information

6.1 Trademarks

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7 Related Documentation

7.1 Supplemental Content

The following items are important learning materials to get started with MSPM33.

- MSPM33 Academies
- MSPM33-SDK Code examples
- TI Precision Labs

8 Revision History

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

DATE	REVISION	NOTES
December 2025	*	Initial Release

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。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・インスツルメンツ株式会社

東京都新宿区西新宿 6 丁目 2 4 番 1 号

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

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

3.4 *European Union*

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

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

4 *EVM Use Restrictions and Warnings:*

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

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

4.3 *Safety-Related Warnings and Restrictions:*

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

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

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.

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