

EVM User's Guide: TXE81XXEVM

TXE81XX Evaluation Module



Description

The TXE81XXEVM allows the evaluation of the TXE81XX family of SPI I/O expanders. This EVM supports TXE8116, TXE8124, and TXE8148 (16-bit, 24-bit, and 48-bit, respectively) in the leaded package type DGS(24 and 32) and DGG (56). The EVM provides access to many test points and headers to accompany the extensive amount of I/O's provided by each expander. There are a mix of male and female header types which allow for easy shunt connections.

Get Started

1. Order the TXE81XXEVM.
2. Download the latest USB2ANY firmware.
3. Download the latest version of the GUI.

Features

- USB powered (5V and 3.3V options)
- Option for external power
- ICC current measurement header (for current consumption measurements)

- Various male and female connection headers + test points for quick testing
- On-board USB2ANY for minimal SPI driver setup
- On-board USB2ANY works with online GUI in the cloud or download to desktop
- LED's for visual feedback (port, /RESET, /INT)
- LED enable/disable header
- Additional test points and headers for SPI connections (SDI/SDO/SCLK/CS)
- Can be used with external drivers such as MSPM0, TP Aardvark, TP Cheetah, TP Promira, Arduino, ESP32
- Manual reset toggle switch to reset the SPI to I/O expander
- Daisy chain capable between multiple TXE81XXEVM's

Applications

- Extending the GPIO's of an MCU
- Sensor Control
- Driving LED's and arrays
- Keypad / Matrix Handling

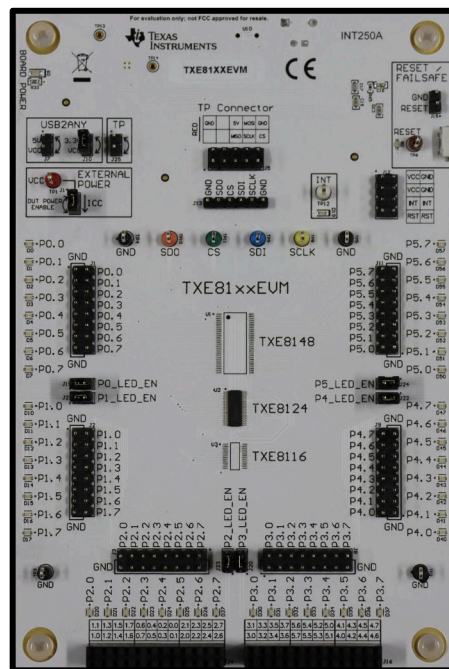


Figure 1-1. TXE81XXEVM

1 Evaluation Module Overview

1.1 Introduction

This guide helps to evaluate TI's family of serial peripheral interface (SPI) to general-purpose input/output (GPIO) expanders, which includes TXE8116 / TXE8124 / TXE8148 (16 bit / 24 bit / 48 bit). The information in this guide provides the details for flashing the on-board USB2ANY circuit, online TXE GUI access, utilizing the MSPM0 as an external SPI driver, and information for using a third party SPI driver with common platforms such as ESP32, Arduino, Total Phase SPI drivers, and so forth.

The TXE81XXEVM evaluation kit has multiple test points, male and female headers, and LED indicators to allow for intuitive bench testing of TXE81XX. The board is designed for ease of access to each GPIO, as well as many connections for the use of an oscilloscope. The board can be powered by an external power supply or by a USB connection from a standard PC.

1.2 Kit Contents

- TXE81XXEVM
- Mini USB Cable

1.3 Specification

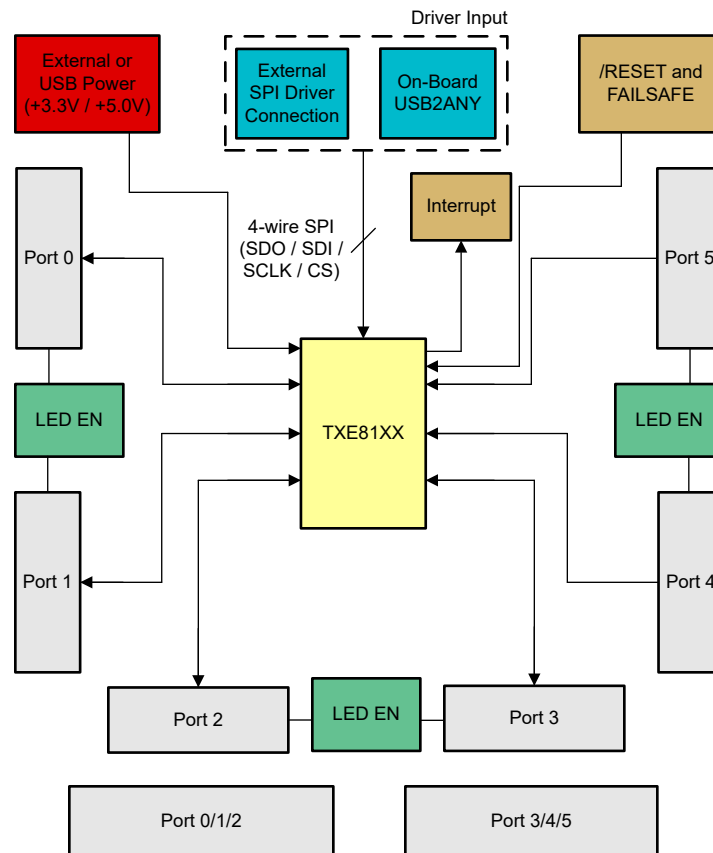


Figure 1-1. Simplified Block Diagram

1.4 Device Information

TXE81XX family includes 16-bit, 24-bit, and 48-bit GPIO expanders driven by the SPI protocol. The IC's are AEC-Q100 qualified for automotive applications, up to 10MHz SPI SCLK frequency, active-low reset input, configurable fail-safe I/O registers for redundancy, open-drain active-low interrupt pin, internal pull-up/pull-down resistors, open-drain vs. push-pull output, programmable drive strength, latchable-bus-holding inputs, and maskable interrupts. TXE81XX leaded package types DGS and DGG are used on this EVM for solderability purposes.

2 Hardware

2.1 Additional Images

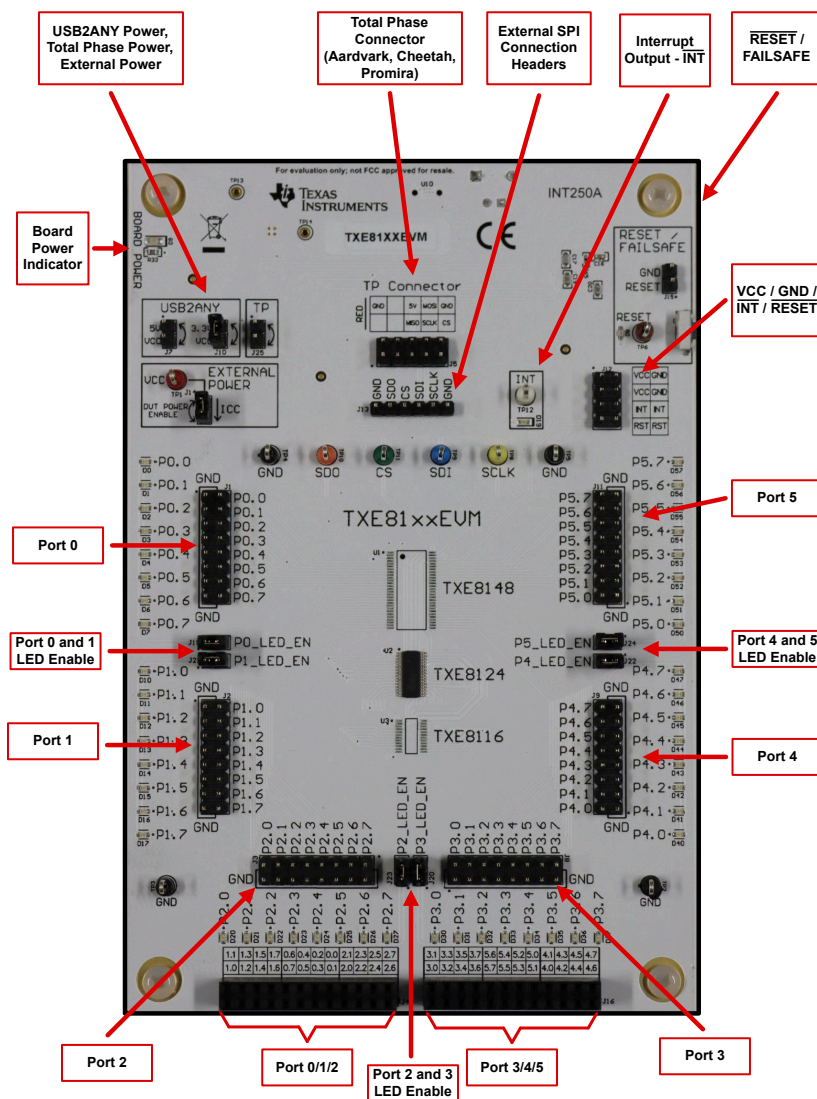


Figure 2-1. Top Side of Board

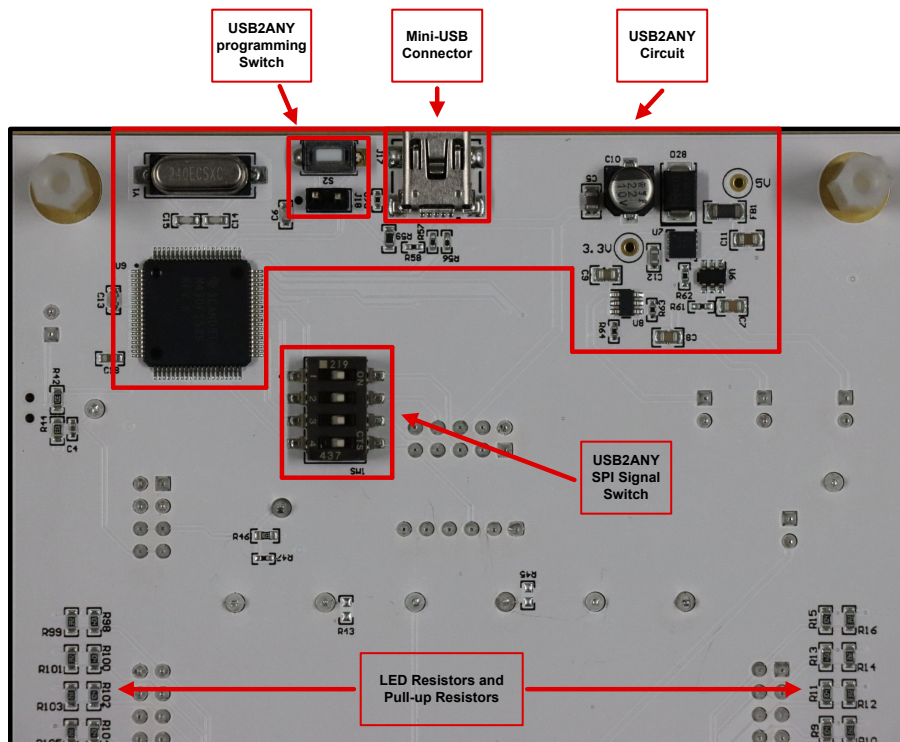


Figure 2-2. Bottom Side of Board

2.2 Power Requirements

TXE81XXEVM has a few different options for powering the board. When the TXE81XX is powered, the "BOARD POWER" indicator D9 lights up. This means that power is being applied to the board. This does not necessarily mean that the DUT is powered at this time. To confirm power at the DUT, J14 must be shorted. The board supports 5V and 3.3V USB power through the USB2ANY Explorer GUI. The Total Phase or "TP" jumper J25 connects the power from Total Phase products listed: SPI Aardvark, Cheetah SPI, Promira Serial Platform. TXE81XXEVM permits external power connection through a separate power source.

When jumping power connections, see guidelines in [Table 2-1](#). Only 1 power option can be shorted to VCC at a single time. This includes 3.3V USB2ANY, 5V USB2ANY, TP power, or and external power supply connection at the test point TP1.

Note

Only 1 jumper option can be enabled at a single time. 5V, 3.3V, or TP can be selected individually, never together. This also includes power coming from an external source on the VCC test point (TP1). Once the power connection is selected, short the power header J14 to enable power to the DUT.

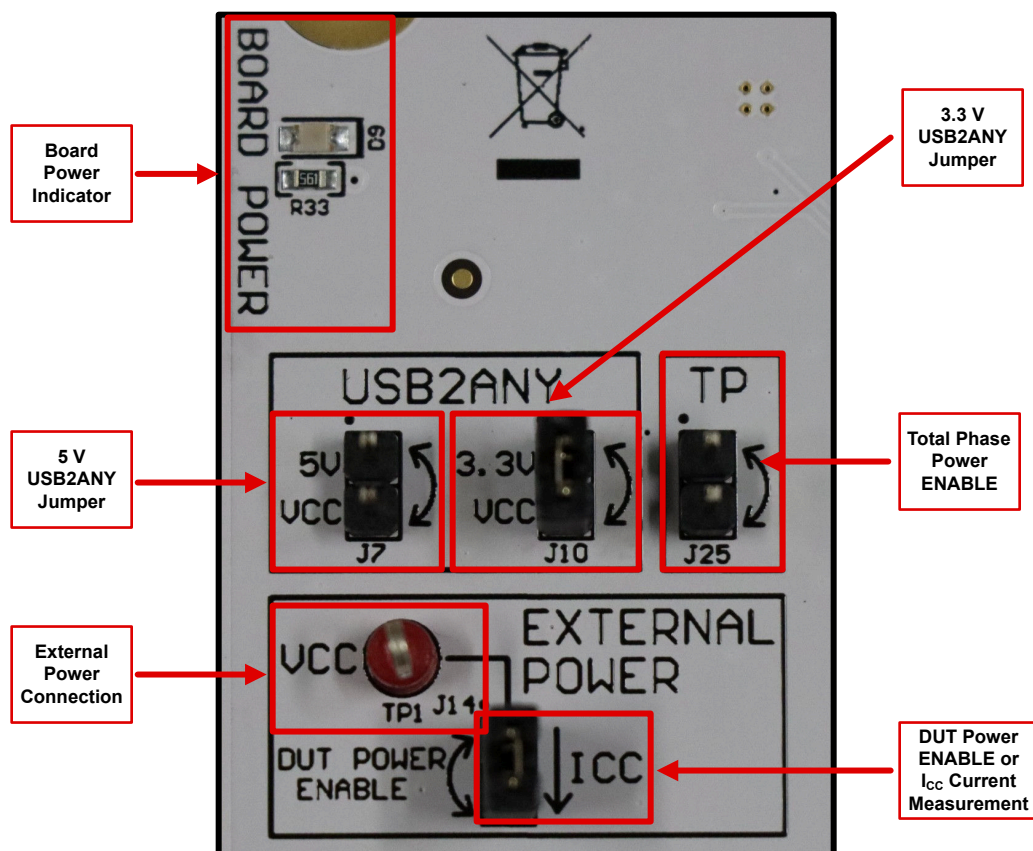


Figure 2-3. Power Options

Table 2-1. Power Jumper Connections

Designator	Description
J7	USB2ANY 5V to V _{CC} connection
J10	USB2ANY 3.3V to V _{CC} Connection
J25	Total Phase Power Connection (+ 3.3V)
J14	Connects power from USB2ANY, Total Phase product, or external power connection to the DUT. This header can be used to measure current flow to the TXE81xx.

2.3 Setup and Connecting the EVM

The TXE81XXEVM comes with a mini-usb cable. Connect the TXE81XXEVM to a computer or laptop through a USB 3.0 port.

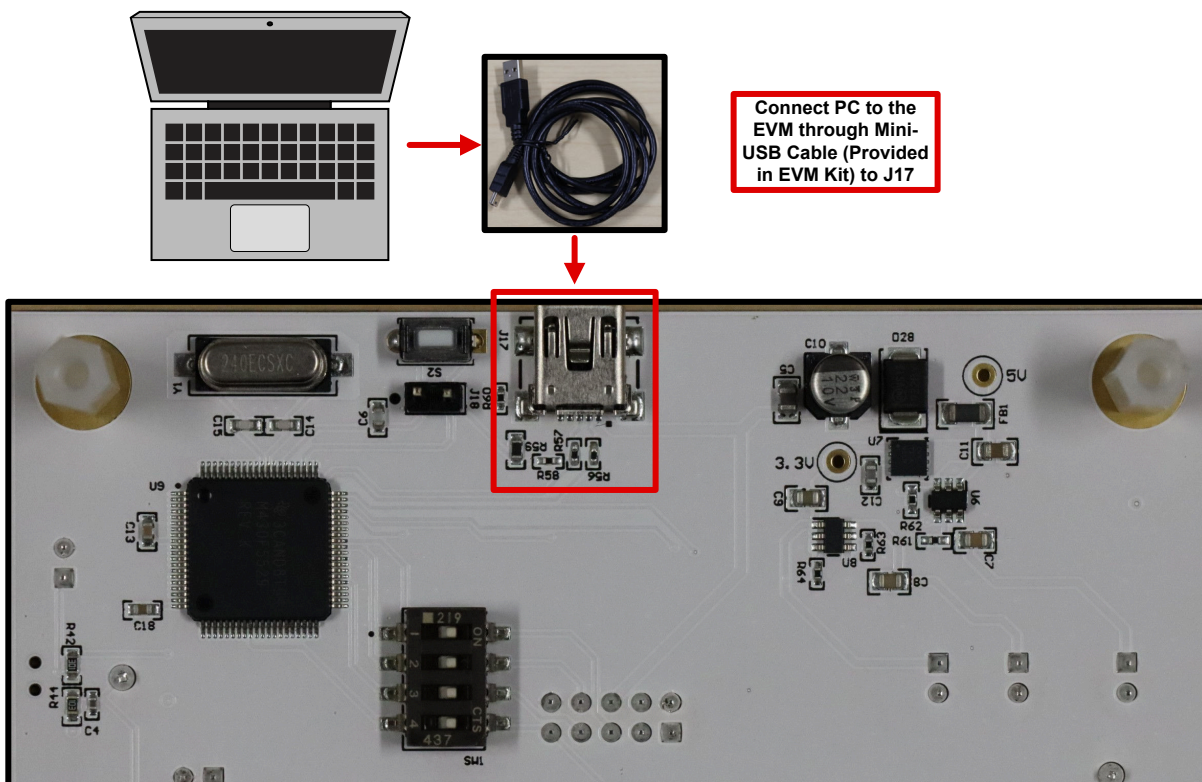


Figure 2-4. Connect to the TXE81XXEVM via Mini-USB to J17 on the Back of the EVM

Once connected, follow the steps in [Section 3.2.1](#).

2.4 Header and Jumper Information

The following section is a complete summary of the various headers and jumper connections on the TXE81XXEVM.

Figure 2-5 describes LED enable jumpers. If the header is left un-populated, the LED's for the specific port are disabled.

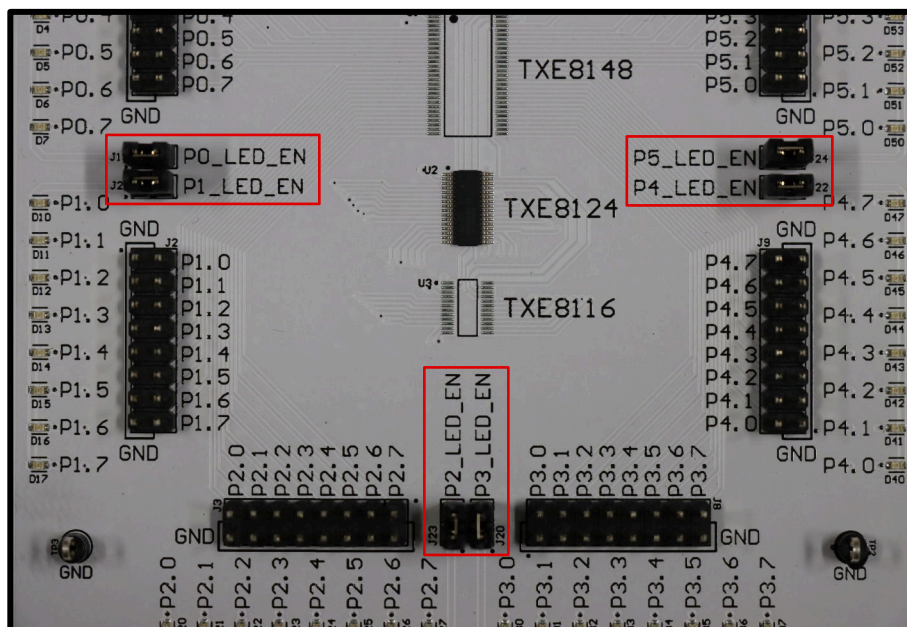


Figure 2-5. Port 0 - Port 5 LED Enable Jumper Locations

Table 2-2. LED Enables

Designator	Port #
J19	Port 0 - LED Enable
J21	Port 1- LED Enable
J23	Port 2- LED Enable
J20	Port 3- LED Enable
J22	Port 4- LED Enable
J24	Port 5- LED Enable

Header J18 is used for programming the on-board USB2ANY circuit. For more details, see [Figure 2-6](#).

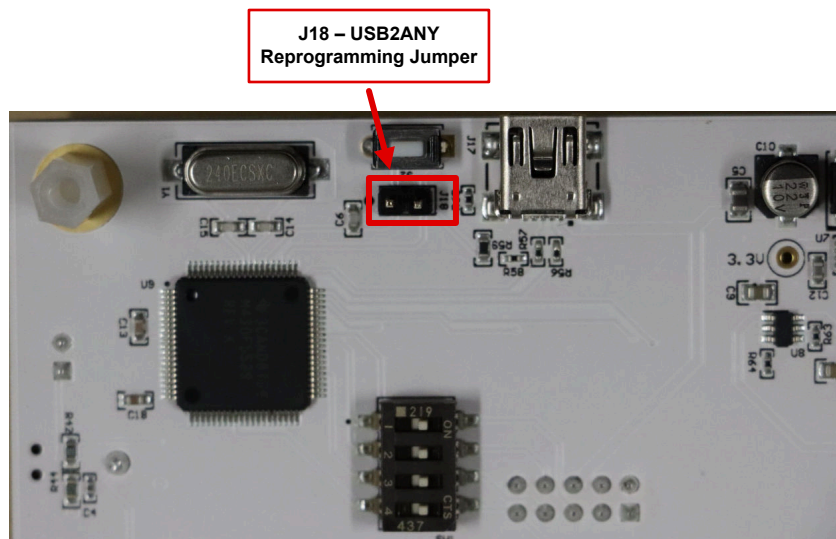


Figure 2-6. USB2ANY Circuit Programming Jumper (J18)

2.5 Push Buttons and Switches

This section covers the various button and switch locations on the EVM.

SW1 connects the USB2ANY driver SPI signals to the SDO / SDI / SCLK / CS on the EVM. The "ON" position for this switch is when the switch is in the right-most position.

When a Total Phase product or external SPI driver is connected, disable the 4 SPI signals on SW1.

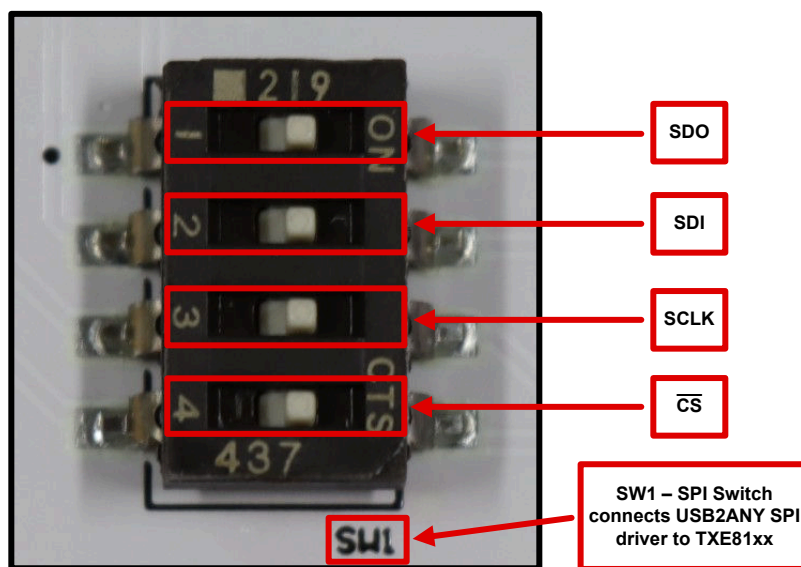


Figure 2-7. SPI Switch SW1

Push button S2 puts the USB2ANY circuit into programming mode when depressed while the TXE81XXEVM is being plugged in. This is an alternative method to programming the USB2ANY circuit. The easier method is to short J18 instead. If not programming the USB2ANY circuit, there is no further use case for S2.

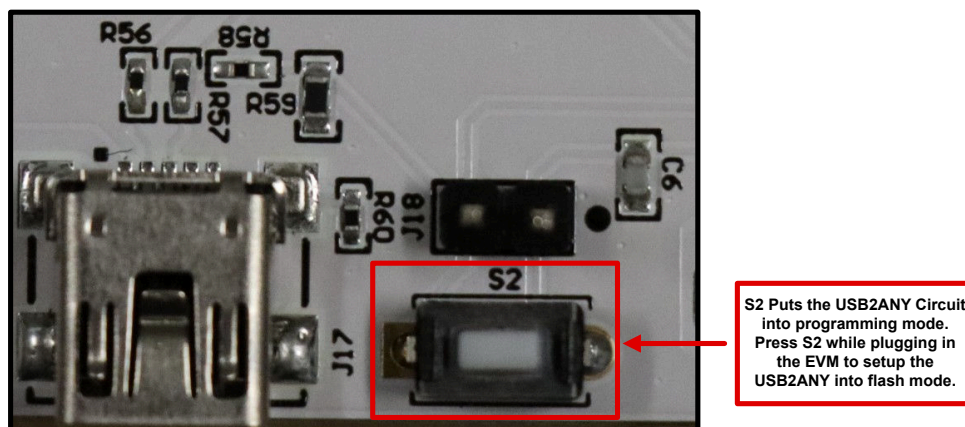


Figure 2-8. Programming Button S2

S1 is a side button used for manually resetting the TXE81XX. When S1 is pressed, it shorts RESET of the TXE81XX to GND. A pull-up resistor is used to bring the voltage on RESET back up to V_{CC} .

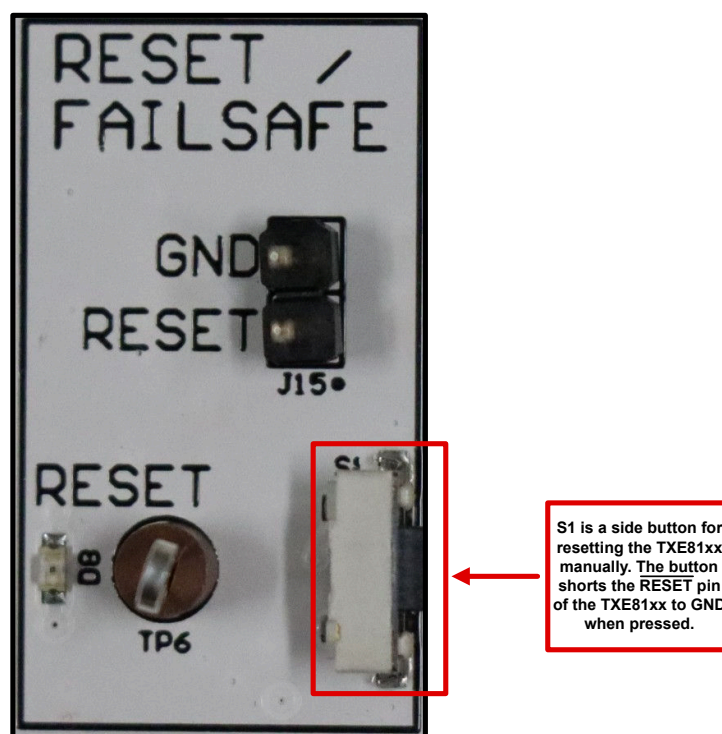


Figure 2-9. RESET Button S1

2.6 Driver Interfaces

The TXE81XXEVM can operate with SPI clock signals of up to 10MHz when V_{CC} is between 3.3V to 5.5V, or 5MHz when V_{CC} is between 1.65V to 5.5V.

The TXE81XXEVM has several options for SPI driver interfaces. The on-board USB2ANY circuit located on the bottom of the EVM, allows for quick access to a SPI driver that can communicate to the TXE81XX up to 8 MHz SPI.

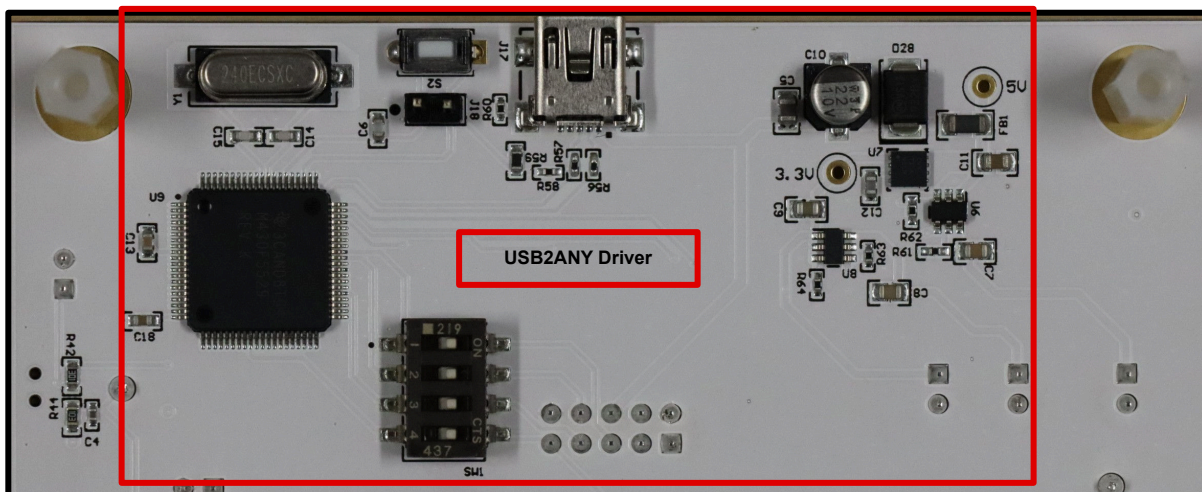


Figure 2-10. USB2ANY Driver

The EVM can be paired with an external MCU such as MSPM0 for programming the TXE81XX on the EVM. for more information, see [How to Program TXE81XX SPI I/O Expander Family](#).

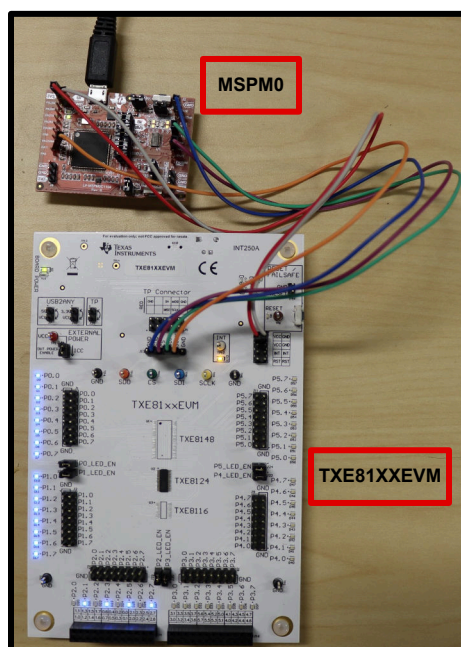


Figure 2-11. Using MSPM0 to Program the Device

The EVM also has a connector specific to third party tools such as [Total Phase Aardvark](#), [Total Phase SPI Cheetah](#), or [Total Phase Promira Serial Platform](#), through J5.

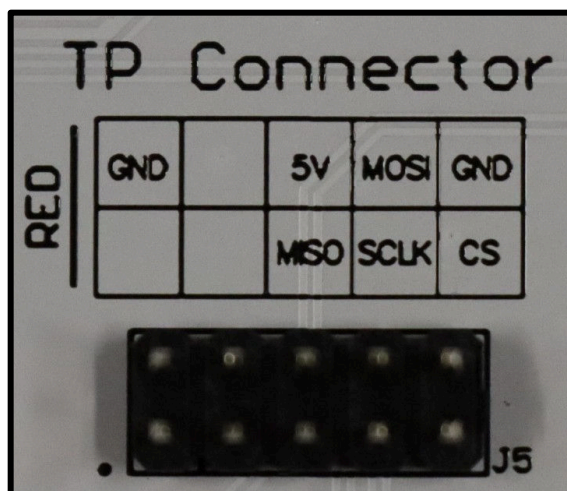


Figure 2-12. Total Phase Products Connect to J5 of the EVM

Common micro controller boards such as [Arduino](#) or [ESP32](#) can also be used via the external header connections for 4-wire SPI on J13.

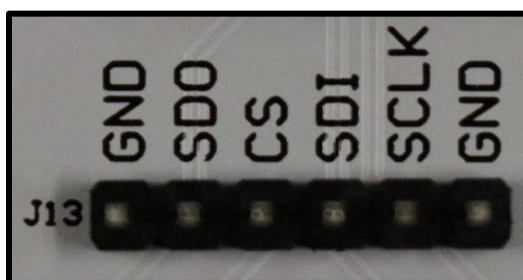


Figure 2-13. Common Dev Boards Such as Arduino and ESP32 Products are Compatible With the TXE81XXEVM Through SPI Headers

2.7 Test Points

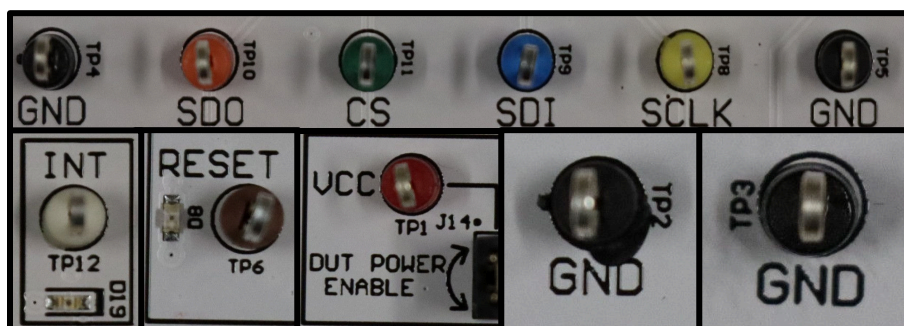


Figure 2-14. Test Points

Table 2-3 describes various test points throughout the EVM.

Table 2-3. Test Point Designator

Test Point Designator	Description
TP1	V _{CC} External Supply Voltage Input
TP2, TP3, TP4, TP5	GND
TP6	RESET
TP8	SCLK - clock
TP9	SDI - data input
TP10	SDO - data output
TP11	CS - chip select
TP12	INT - interrupt

3 Software

3.1 Software Description

For instructions on re-flashing the TXE81XXEVM with the correct firmware - [click here](#)

For instructions on using the USB2ANY Explorer GUI - [click here](#)

For instructions on using the full function TXE81XXEVM-GUI - [click here](#)

3.2 Software Installation

3.2.1 Downloading USB2ANY Firmware (For USB2ANY Explorer or TXE81XXEVM-GUI)

Downloading USB2ANY Firmware version 2.8.2.0 or higher is required for USB2ANY Explorer and TXE81XXEVM-GUI to work.

Note

The TXE81XXEVM is already flashed from the factory with the latest firmware version (2.8.2.0). If the EVM is not connecting to the USB2ANY Explorer, or is having connection issues with the full function GUI, then follow these steps to reflash the device:

To check if the EVM has the updated firmware, follow steps 1-4 below.

1. Download [USB2ANY Explorer Software](#) (SLVC695) from [ti.com](#).
2. Run "USB2ANY Explorer-2.8.2.0 Setup" Application File and install the explorer GUI.
3. Once the install is complete, open USB2ANY Explorer.
4. The USB2ANY Explorer GUI shows the type, serial #, and firmware version underneath the "Adapter Connection" in the GUI. The firmware version reads 2.8.2.0. If the "Firmware Version" shows 2.8.2.0, then the board is ready for use for either USB2ANY Explorer GUI or TXE81XXEVM GUI use. If it does not, follow step 5.

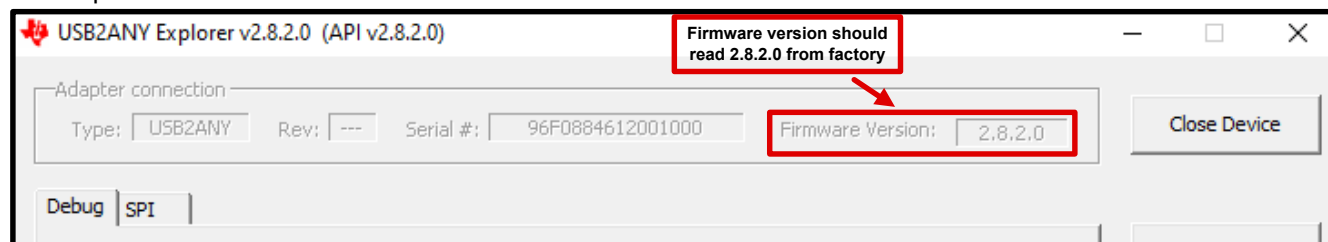


Figure 3-1. Checking Firmware Version of the Board - If Firmware is not up-to-date, follow step 5

5. Disconnect the TXE81XXEVM from the computer.

6. Short jumper **J18** on the bottom side of the EVM. This sets up the USB2ANY circuit into programming mode.

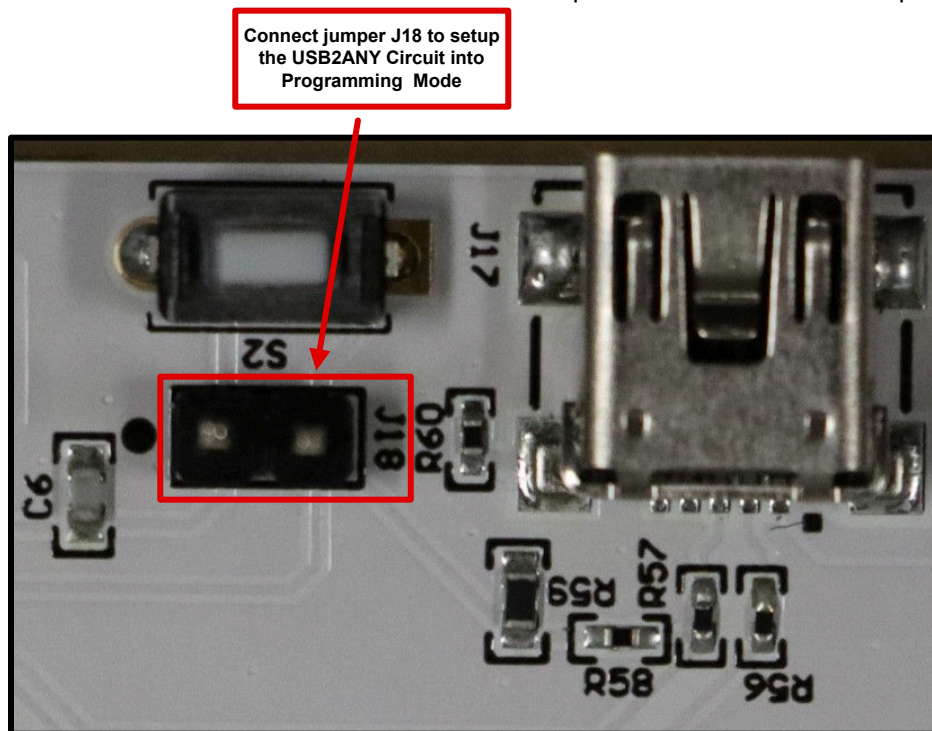


Figure 3-2. Setup the USB2ANY Circuit into Programming Mode by Shorting J18 with a Jumper

7. Re-connect the EVM.
8. Remove jumper on J18.
9. Select "Open Device" in the USB2ANY Explorer GUI and select "Yes".

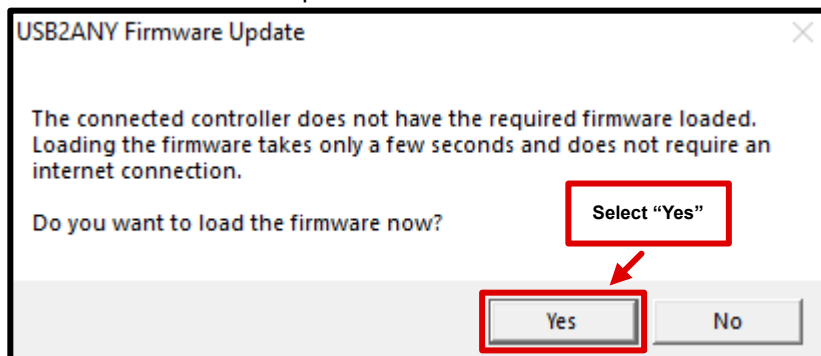


Figure 3-3. Select "Yes"

10. Select "Update Firmware".

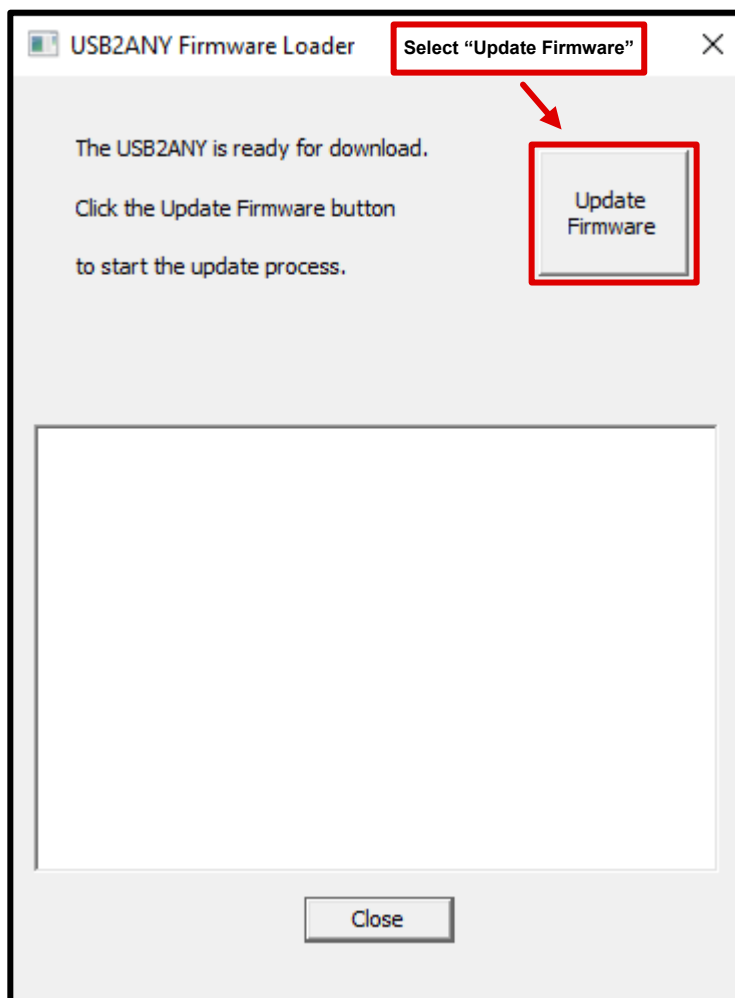


Figure 3-4. Select "Update Firmware"

11. Firmware is flashed when the final message says "Done!"

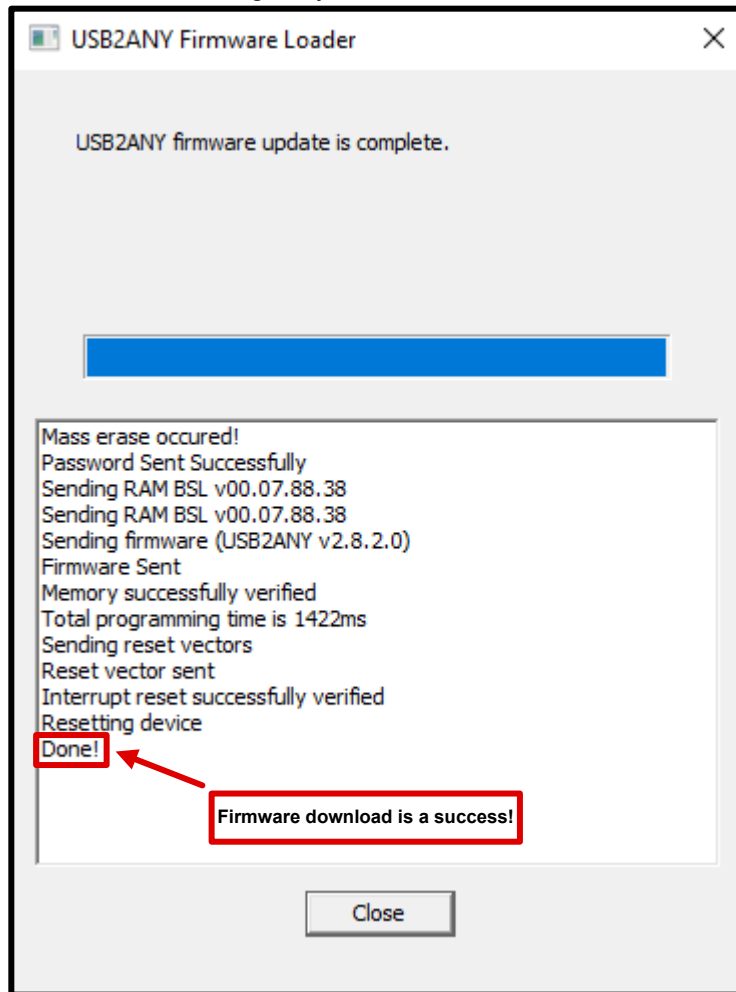


Figure 3-5. Firmware is Updated Successfully When the Console says "Done!"

12. The Firmware Version underneath "Adapter Connection" now reads 2.8.2.0. The USB2ANY circuit on the bottom side of the EVM is now correctly flashed and ready for use in the USB2ANY Explorer GUI or TXE81XXEVM GUI.

3.3 GUI Installation

3.3.1 USB2ANY Explorer GUI

Follow these steps to use the USB2ANY Explorer GUI to write and read SPI commands from the TXE81XX.

1. Connect the TXE81XXEVM to a computer/laptop with USB2ANY Explorer v2.8.2.0 installed.
2. Open USB2ANY Explorer v2.8.2.0 ([Follow steps 1-3 of "Downloading USB2ANY Firmware" for download instructions](#)).

- On the bottom of the TXE81XXEVM, make sure that the SPI switch for SDO/SDI/CS/SCLK is enabled.

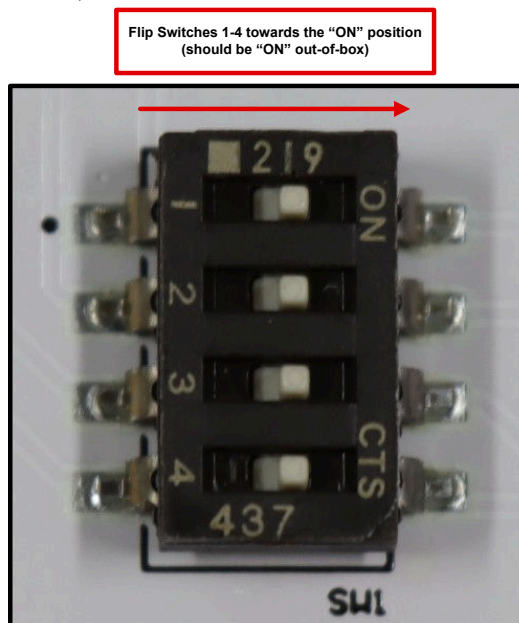


Figure 3-6. Make Sure That the SPI Switch (SW1) is in the "ON" Position

- Make sure that either 5V or 3.3V power jumper (J7 or J10, respectively) is shorted on the TXE81XXEVM. This matches the supply that is enabled in the USB2ANY Explorer GUI (in this case 5V).

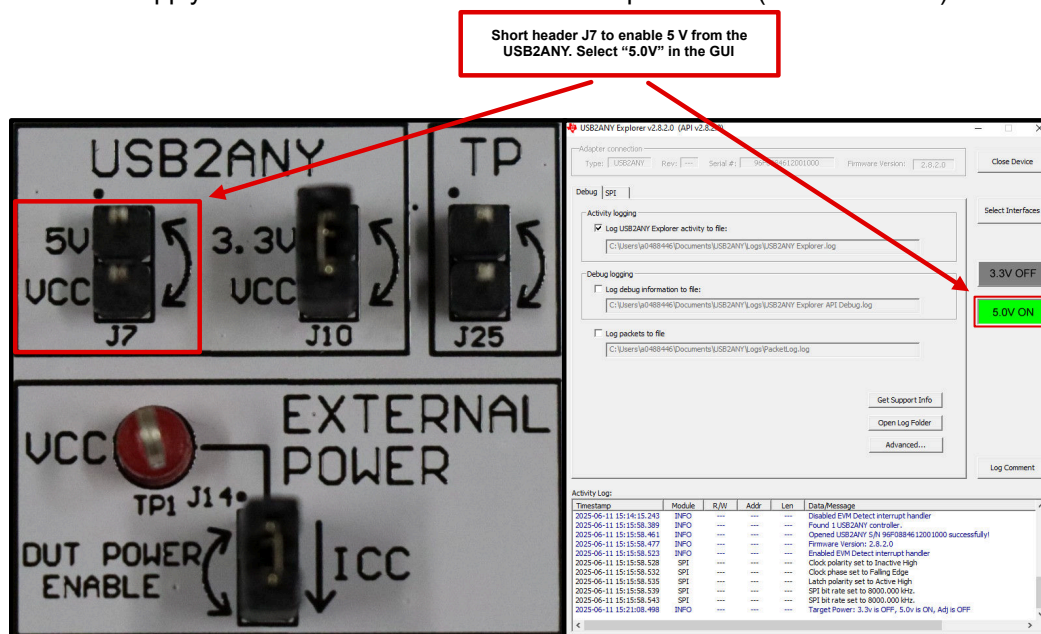


Figure 3-7. Match the Appropriate Header Jump With the Desired Voltage Level (3.3V or 5V)

Note

Do not short both J7 and J10 at the same time. This shorts the 5V supply to the 3.3V supply with potential to create an over-current event if both supplies are enabled in the USB2ANY Explorer GUI.

- Click "Select Interfaces", select "SPI", and hit "close".

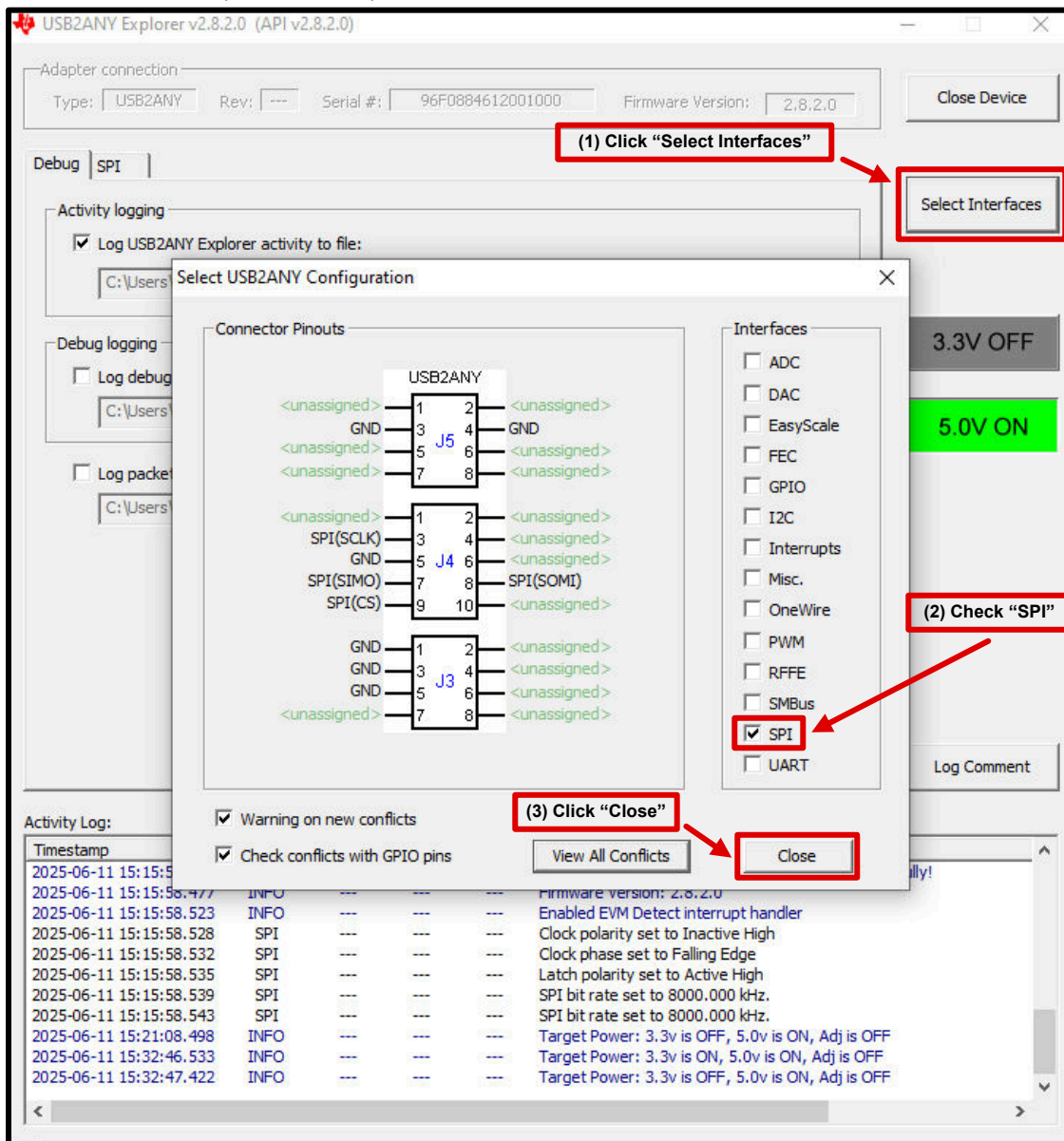


Figure 3-8. Select the "SPI" Interface

6. Open up the SPI tab and select the following configuration for SPI communication:
 - a. Clock Polarity = Inactive Low
 - b. Clock Phase = Leading Edge
 - c. CS Polarity = Active Low
 - d. Bit Direction = MSB First
 - e. Length = 8 bits
 - f. Bit Rate = user preference
 - g. Slave Device = 0
 - h. CS Type = per packet
 - i. # of Bytes = 3

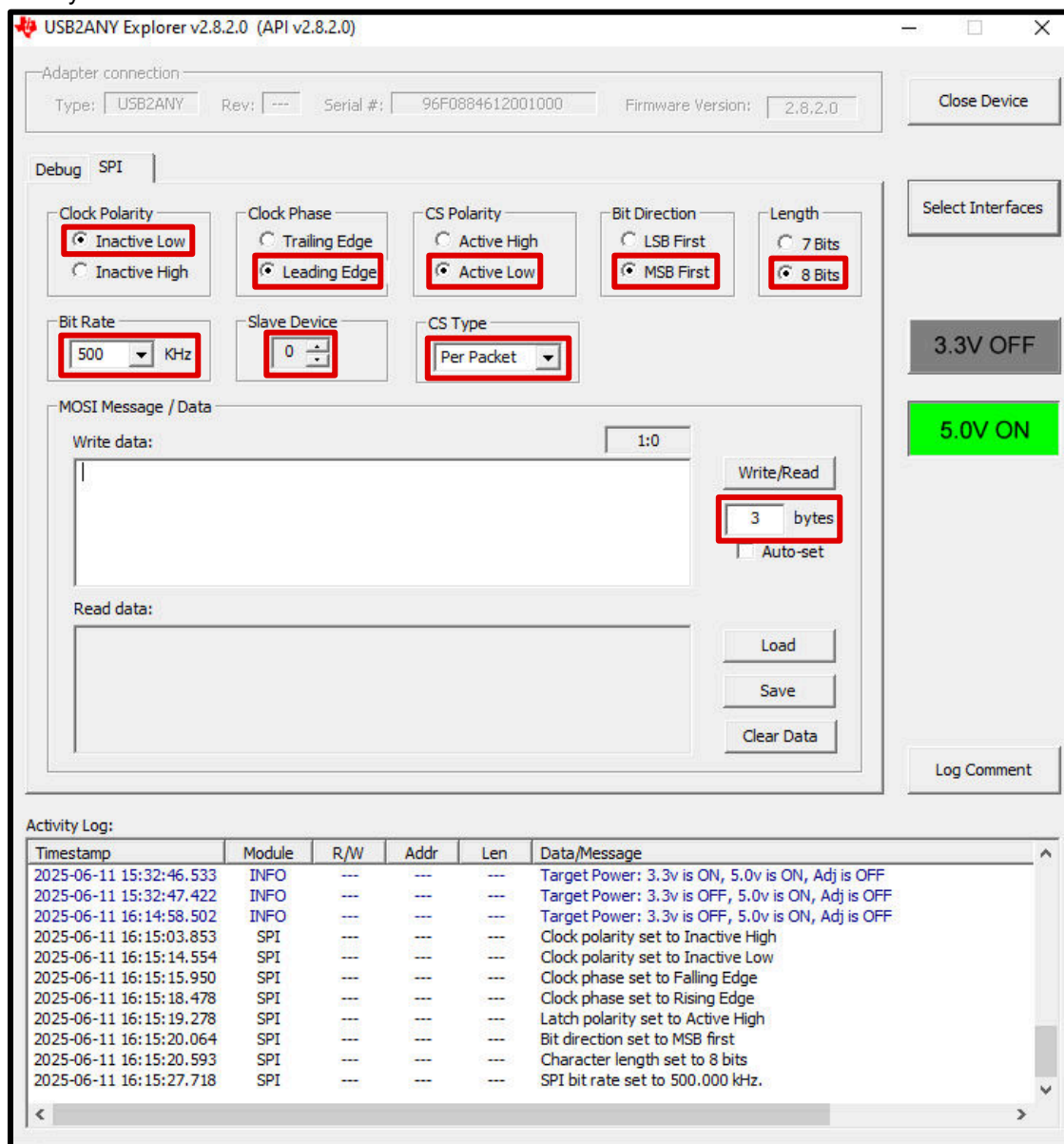


Figure 3-9. Select the Following Requirements in the SPI Window

7. Begin writing/reading SPI data.

- a. Example, set port 0 GPIO's to OUTPUT through the direction control register (0x04). Write data = 04 00 FF.

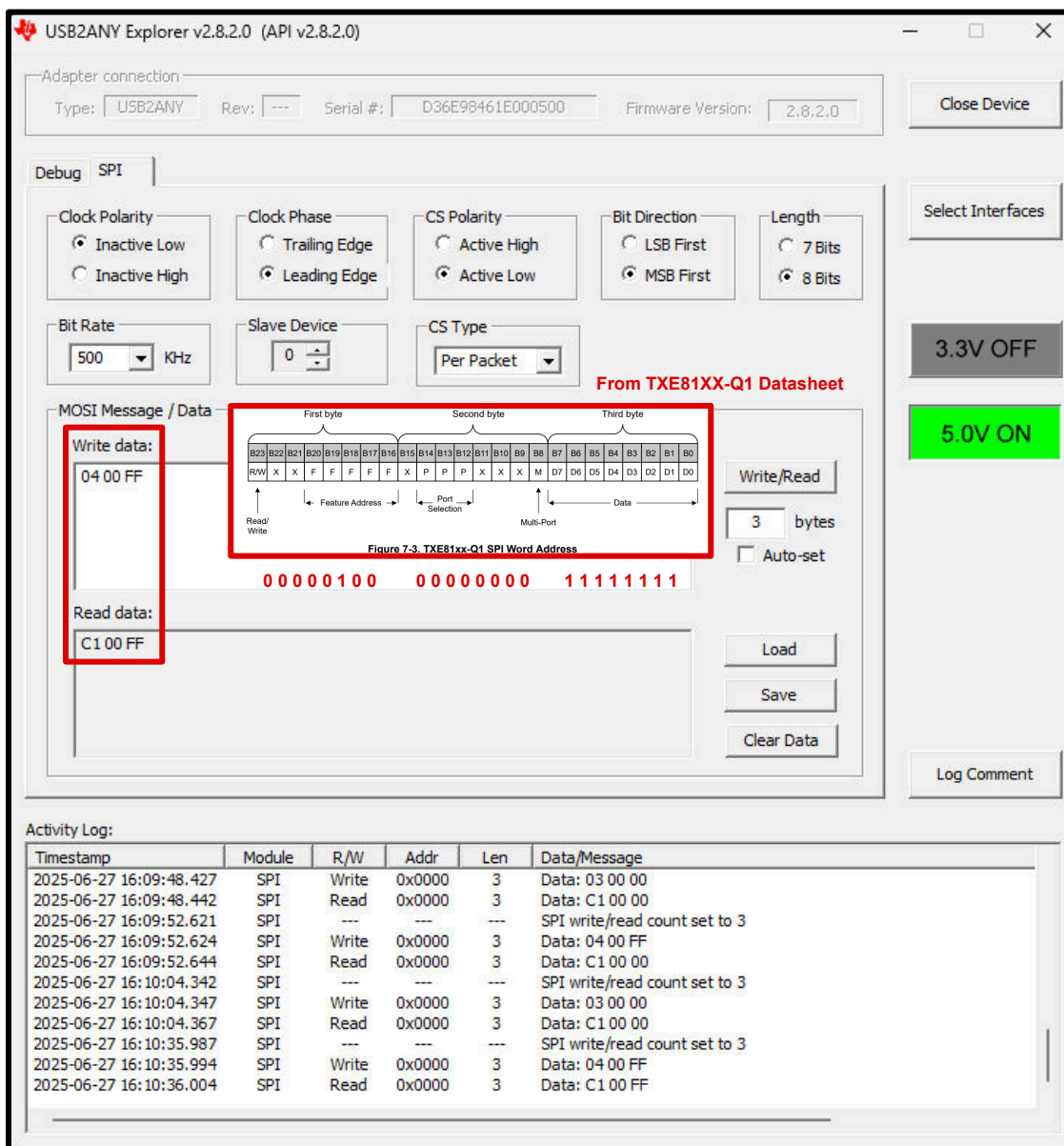


Figure 3-10. Write Data = 04 00 FF, to Set the GPIO's of Port 0 to "OUTPUT"

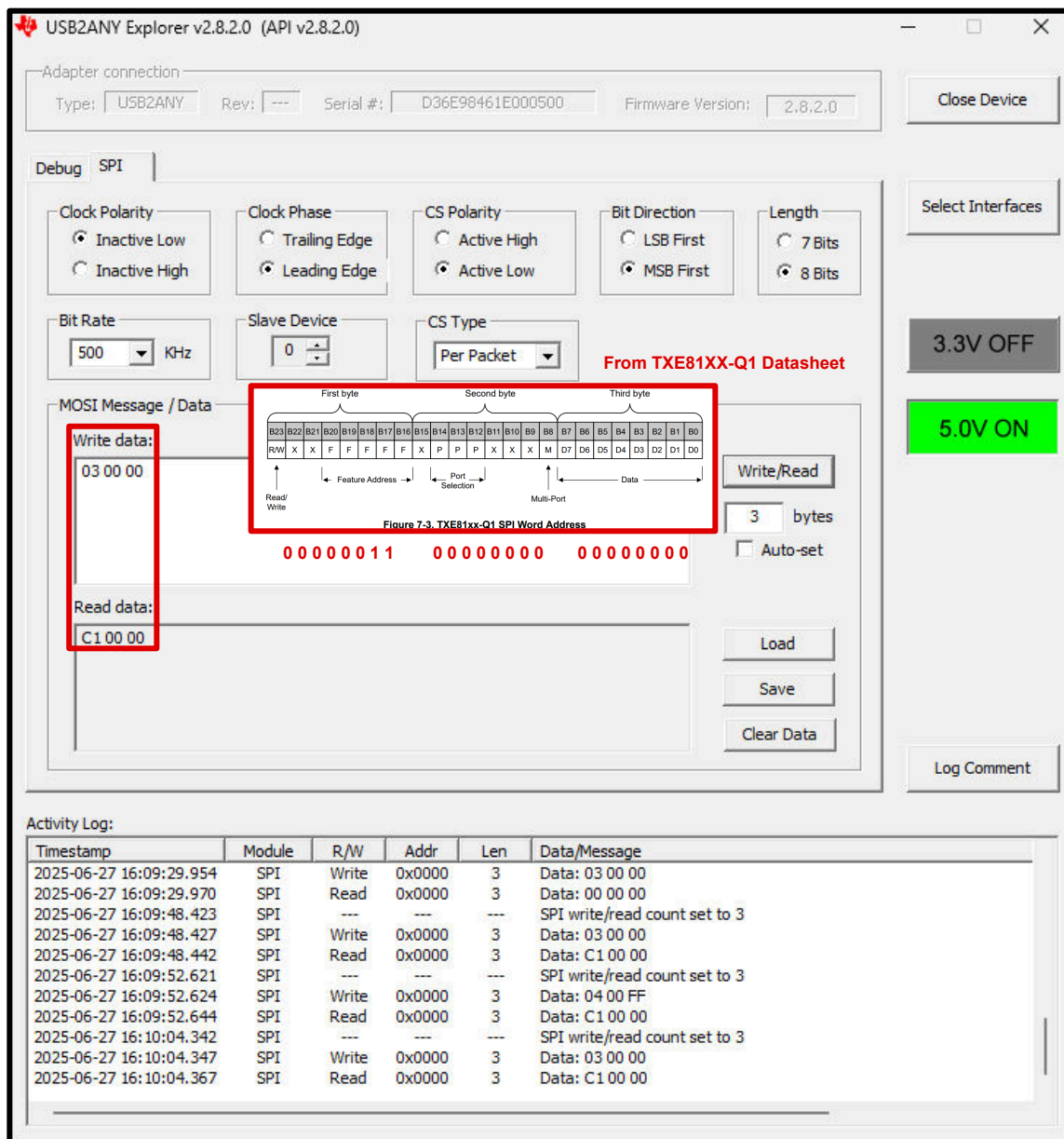


Figure 3-11. Write Data = 03 00 00, to Set the Outputs of Port 0 to "LOW"

3.3.2 TXE81XXEVM-GUI

In the case that the EVM is not loaded with the most up-to-date firmware, follow steps 1-3 of the previous section "[Downloading USB2ANY Firmware.](#)"

Follow the steps to use the full function TXE81XXEVM GUI through GUI Composer

1. Make sure that the USB2ANY Explorer GUI is closed.
2. Using Google Chrome, download the [Cloud Agent here](#).
3. Make sure that USB 3.0 is being used for the TXE81XXEVM.
4. The TXE81XXEVM-GUI can be accessed through the link [here](#).

4.1 Schematics

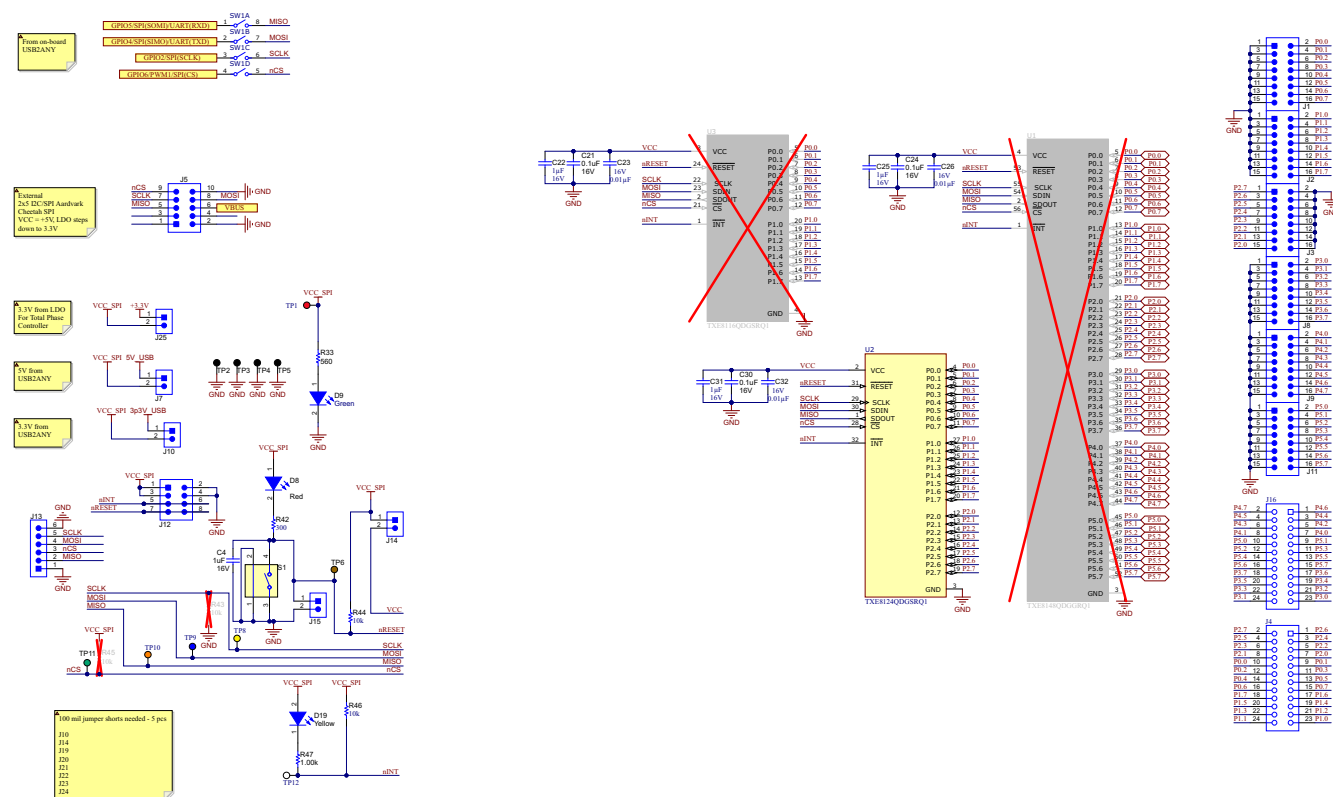


Figure 4-1. Schematic Page 1 - TXE81XX Interface

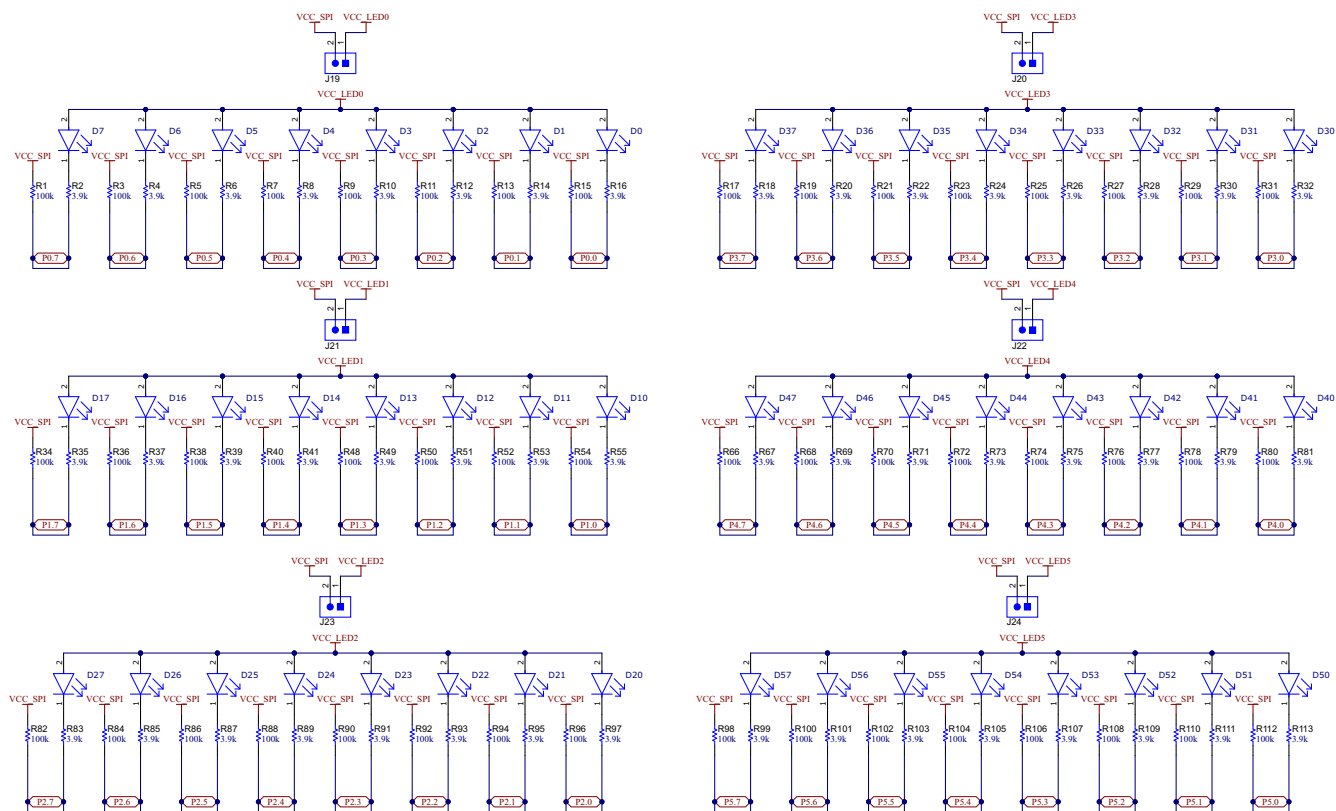


Figure 4-2. Schematic Page 2 - LED Banks



4.2 PCB Layouts

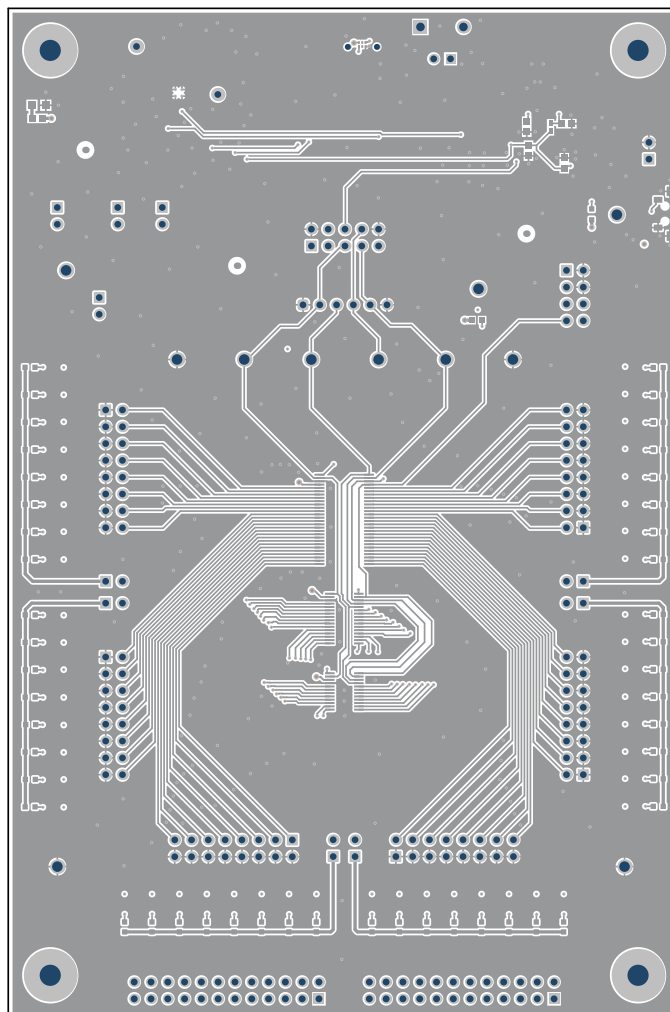


Figure 4-4. Top Layer

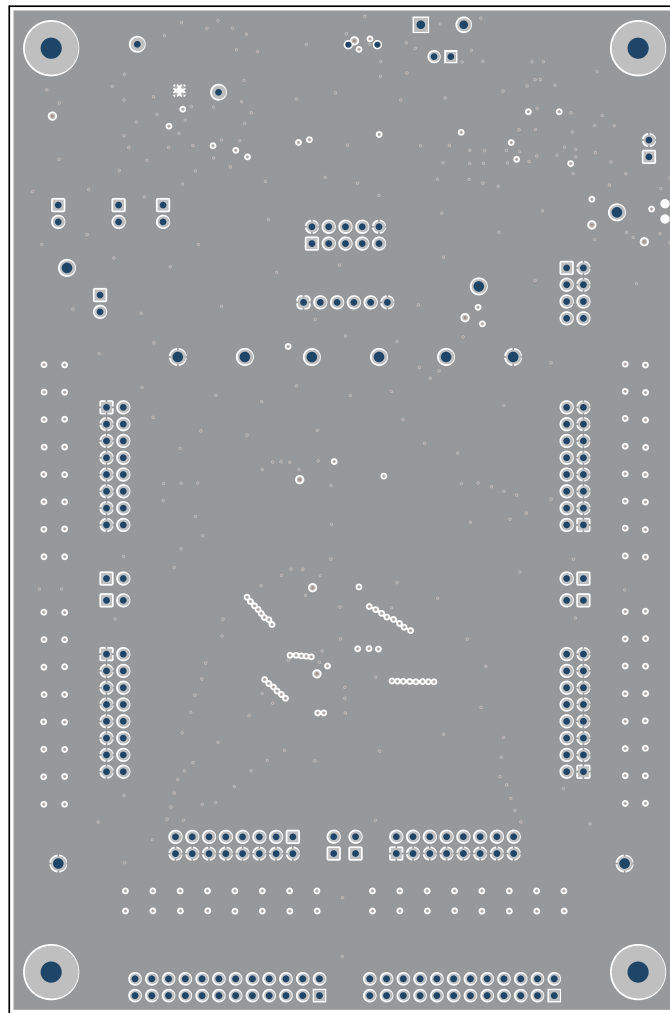


Figure 4-5. Layer 2 - GND

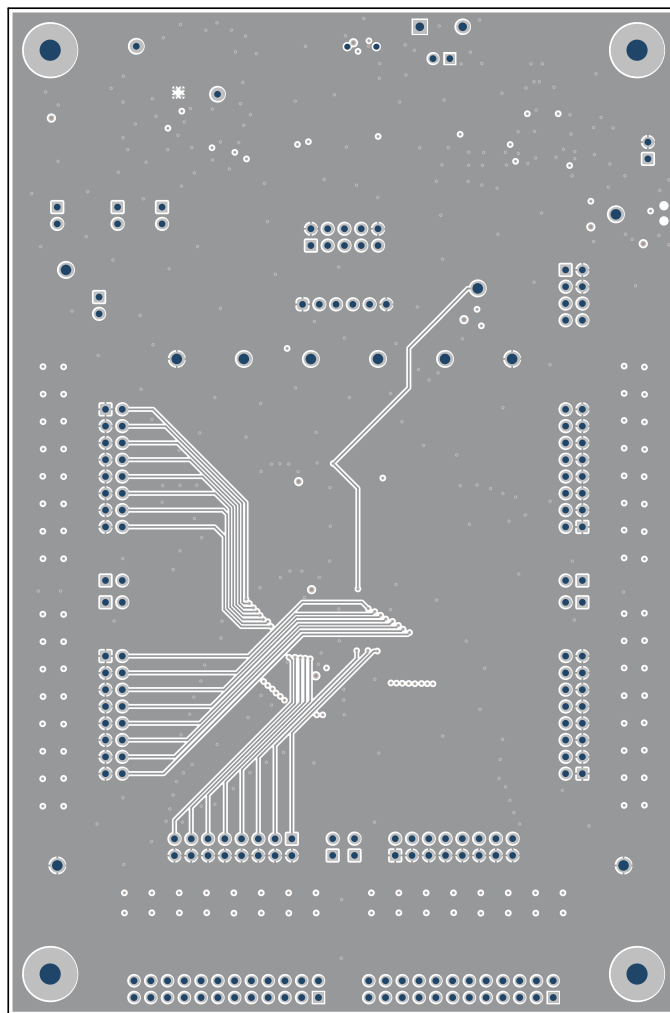


Figure 4-6. Layer 3 - Signal

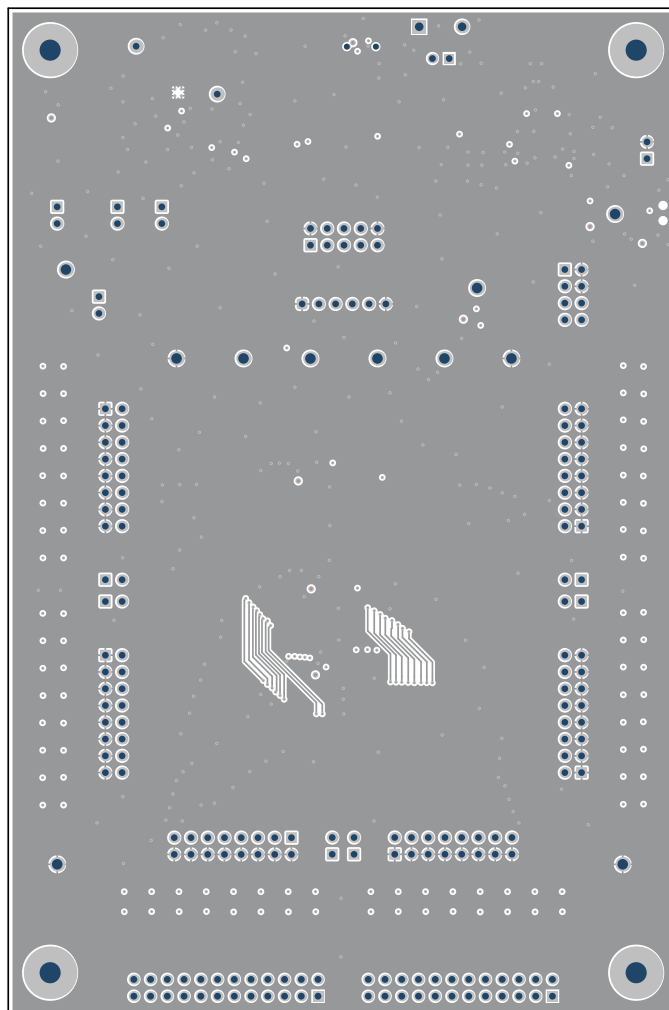


Figure 4-7. Layer 4 - Signal

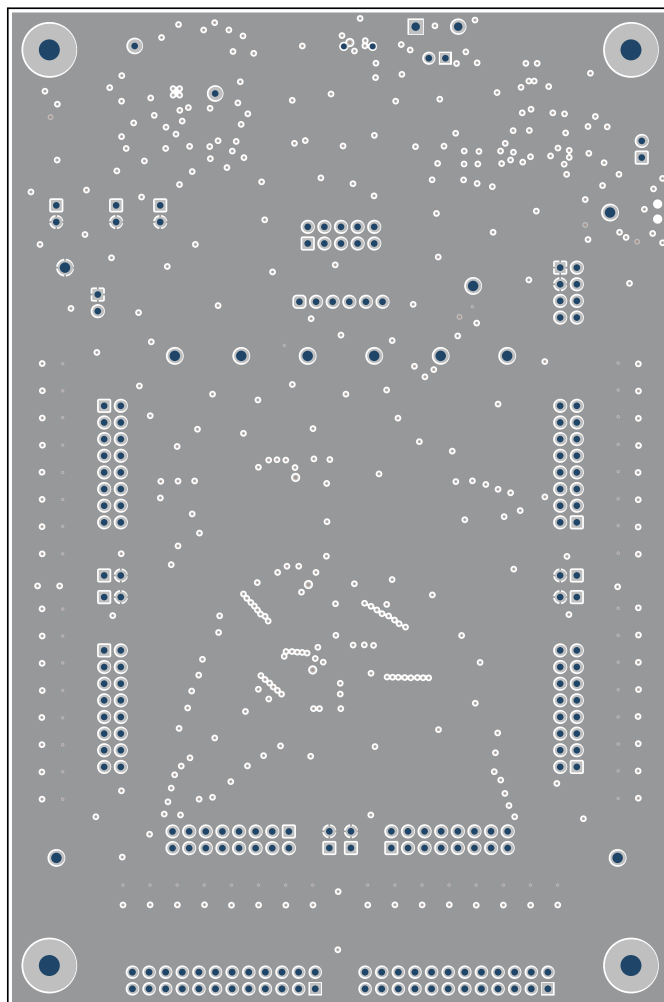


Figure 4-8. Layer 5 - V_{CC}

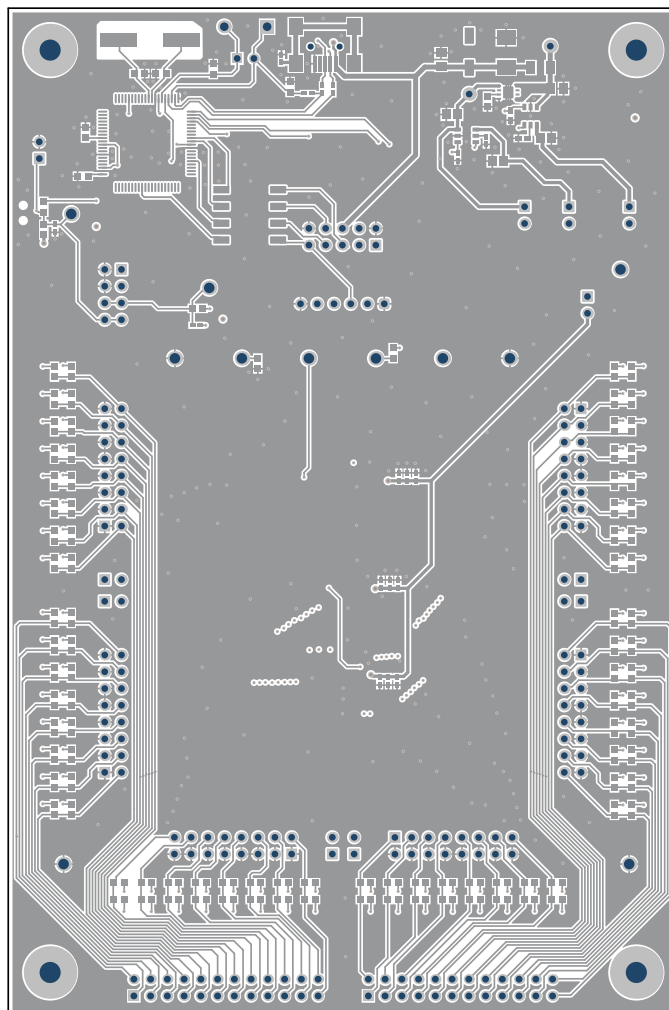


Figure 4-9. Bottom Layer

4.3 Bill of Materials (BOM)

Table 4-1. Bill of Material (BOM)

Designator	Quantity	Value	Part Number	Manufacturer	Description
C4	1	1uF	EMK105BJ105KVHF	Taiyo Yuden	CAP, CERM, 1uF, 16V, ±10%, X5R, 0402
C5	1	10uF	CC0805MKX5R7BB106	YAGEO	CAP, CERM, 10uF, 16V, ±20%, X5R, 080
C6, C17	2	220pF	CC0603FRNPO9BN221	YAGEO	CAP, CERM, 220pF, 50V, ±1%, C0G/NP0, 060
C7, C8	2	1uF	CC0805KRX5R7BB105	YAGEO	CAP, CERM, 1uF, 16V, ±10%, X5R, 0805
C9	1	2.2uF	CC0805KRX5R7BB225	YAGEO	CAP, CERM, 2.2uF, 16V, ±10%, X5R, 0805
C10	1	22uF	EDH226M025S9DAA	KEMET	CAP, AL, 22uF, 25V, ±20%, SMD
C11	1	1uF	CC0805KKX7R7BB105	YAGEO	CAP, CERM, 1uF, 16V, ±10%, X7R, 0805
C12	1	0.0uF	CC0603JRNPO9BN103	YAGEO	CAP, CERM, 0.01uF, 50V, ±5%, C0G/NP0, 0603
C13, C19, C20	3	0.1uF	CC0603JRX7R7BB104	YAGEO	CAP, CERM, 0.1uF, 16V, ±5%, X7R, 0603

Table 4-1. Bill of Material (BOM) (continued)

Designator	Quantity	Value	Part Number	Manufacturer	Description
C14, C15	2	30pF	CC0603JRNPO9BN300	YAGEO	CAP, CERM, 30pF, 50V, ±5%, C0G/NP0, 0603
C16	1	2200pF	CC0603KRX7R9BB222	YAGEO	CAP, CERM, 2200pF, 50V, ±10%, X7R, 0603
C18	1	0.47uF	CC0603KRX7R6BB474	YAGEO	CAP, CERM, 0.47uF, 10V, ±10%, X7R, 0603
C21, C24, C30	3	0.1uF	CC0402JRX7R7BB104	YAGEO	CAP, CERM, 0.1uF, 16V, ±5%, X7R, 0402
C22, C25, C31	3	1uF	GRM155R61C105MA12D	MuRata	CAP, CERM, 1 uF, 16V, ±20%, X5R, 0402
C23, C26, C32	3	0.01uF	CC0402KRX7R7BB103	YAGEO	CAP, CERM, 0.01uF, 16V, ±10%, X7R, 0402
D0, D1, D2, D3, D4, D5, D6, D7, D10, D11, D12, D13, D14, D15, D16, D17, D20, D21, D22, D23, D24, D25, D26, D27, D30, D31, D32, D33, D34, D35, D36, D37, D40, D41, D42, D43, D44, D45, D46, D47, D50, D51, D52, D53, D54, D55, D56, D57	48		LTST-C190TBKT	Lite-On	LED Uni-Color Blue 468nm 2-Pin Chip LED T/R
D8	1	Red	LTST-C190KRKT	Lite-On	LED, Red, SMD
D9	1	Green	LG R971-KN-1	OSRAM	LED, Green, SMD
D19	1	Yellow	150060YS75000	Würth Elektronik	LED, Yellow, SMD
D28	1	7.5V	1SMB5922BT3G	ON Semiconductor	Diode, Zener, 7.5V, 550mW, SMB
FB1	1	90Ω	MI1206K900R-10	Laird-Signal Integrity Products	Ferrite Bead, 90Ω @ 100MHz, 1.5 A, 1206
H1, H2, H3, H4	4		CPF-306A	WEICHIMEI	Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead
H5, H6, H7, H8	4		0239 BTH-312	WEICHIMEI	Standoff, Hex, 0.5"L #4-40 Nylon
J1, J2, J3, J8, J9, J11	6		NS-201-SH0384-201S-2*8P(F)	NS-TECH	Header, 100mil, 8x2, Gold, TH
J4, J16	2		NS-203-SH0002-203S-Y-2x12P(F)	NS-TECH	Receptacle, 12x2, 2.54mm, Gold, TH
J5	1		NS-201-SH0384-201S-2*5P(F)	NS-TECH	Header, 100mil, 5x2, Gold, TH
J7, J10, J14, J15, J19, J20, J21, J22, J23, J24, J25	11		NS-201-SH0385-201S-1*2P(F)	NS-TECH	Header, 100mil, 2x1, Gold, TH

Table 4-1. Bill of Material (BOM) (continued)

Designator	Quantity	Value	Part Number	Manufacturer	Description
J12	1		NS-201-SH0384-201S-2*4P(F)	NS-TECH	Header, 100mil, 4x2, Gold, TH
J13	1		NS-201-SH0385-201S-1*6P(F)	NS-TECH	Header, 100mil, 6x1, Gold, TH
J17	1		1734035-2	TE Connectivity	Connector, Receptacle, Mini-USB Type B, R/A, Top Mount SMT
J18	1		NS-201-SH0385-201S-1*2P(F)	NS-TECH	Header, 100mil, 2x1, Gold, TH
R1, R3, R5, R7, R9, R11, R13, R15, R17, R19, R21, R23, R25, R27, R29, R31, R34, R36, R38, R40, R48, R50, R52, R54, R66, R68, R70, R72, R74, R76, R78, R80, R82, R84, R86, R88, R90, R92, R94, R96, R98, R100, R102, R104, R106, R108, R110, R112	48	100k	AC0603JR-07100KL	YAGEO	RES, 100 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603
R2, R4, R6, R8, R10, R12, R14, R16, R18, R20, R22, R24, R26, R28, R30, R32, R35, R37, R39, R41, R49, R51, R53, R55, R67, R69, R71, R73, R75, R77, R79, R81, R83, R85, R87, R89, R91, R93, R95, R97, R99, R101, R103, R105, R107, R109, R111, R113	48	3.9k	AC0603JR-073K9L	YAGEO	RES, 3.9 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603
R33	1	560	AC0603JR-07560RL	YAGEO	RES, 560, 5%, 0.1W, 0603
R42	1	300	RC0603JR-07300RL	Yageo	RES, 300, 5%, 0.1W, 0603
R44, R46	2	10k	AC0603JR-0710KL	YAGEO	RES, 10 k, 5%, 0.1W, AEC-Q200 Grade 0, 0603
R47	1	1.00k	RC0402FR-071KL	Yageo America	RES, 1.00k, 1%, 0.0625 W, 0402

Table 4-1. Bill of Material (BOM) (continued)

Designator	Quantity	Value	Part Number	Manufacturer	Description
R56, R57	2	33	AC0402JR-0733RL	YAGEO	RES, 33, 5%, 0.063W, AEC-Q200 Grade 0, 0402
R58	1	1.5k	AC0402JR-071K5L	YAGEO	RES, 1.5k, 5%, 0.063W, AEC-Q200 Grade 0, 0402
R59	1	1.07Meg	AC0603FR-071M07L	YAGEO	RES, 1.07M, 1%, 0.1W, AEC-Q200 Grade 0, 0603
R60, R65	2	33k	AC0402JR-0733KL	YAGEO	RES, 33k, 5%, 0.063W, AEC-Q200 Grade 0, 0402
R61	1	130k	AC0402JR-07130KL	YAGEO	RES, 130k, 5%, 0.063W, AEC-Q200 Grade 0, 0402
R62, R64	2	100k	AC0402JR-07100KL	YAGEO	RES, 100k, 5%, 0.063W, AEC-Q200 Grade 0, 0402
R63	1	160k	AC0402JR-07160KL	YAGEO	RES, 160k, 5%, 0.063W, AEC-Q200 Grade 0, 0402
S1	1		THBM02-LAB	宏聚	Switch, SPST, 0.05A, 12VDC, SMD
S2	1		FSMH	TE Connectivity ALCOSWITCH Switches	Switch, Tactile, SPST-NO, 0.05A, 12V, TH
SW1	1		219-4MSTR	CTS Electrocomponents	Dip Switch SPST 4 Position Surface Mount Slide (Standard) Actuator 100mA 20VDC
TP1	1		Test Point-1P-DIP-H8.1-Φ3.2-Red	FuZhou XiXiang	Test Point, Multipurpose, Red, TH
TP2, TP3, TP4, TP5	4		Test Point-1P-DIP-H8.1-Φ3.2-BLACK	FuZhou XiXiang	Test Point, Multipurpose, Black, TH
TP6	1		5125	Keystone Electronics	Test Point, Multipurpose, Brown, TH
TP8	1		Test Point-1P-DIP-H8.1-Φ3.2-Yellow	FuZhou XiXiang	Test Point, Multipurpose, Yellow, TH
TP9	1		5127	Keystone	Test Point, Multipurpose, Blue, TH
TP10	1		Test Point-1P-DIP-H8.1-Φ3.2-Orange	FuZhou XiXiang	Test Point, Multipurpose, Orange, TH
TP11	1		5126	Keystone	Test Point, Multipurpose, Green, TH
TP12	1		Test Point-1P-DIP-H8.1-Φ3.2-White	FuZhou XiXiang	Test Point, Multipurpose, White, TH
U2	1		TXE8124QDGSRQ1	Texas Instruments	TXE8124QDGSRQ1
U6, U8	2		TPS2553DBVT-1	Texas Instruments	Adjustable, Active High, Latch-off, Current-Limited Power-Distribution Switch, 0.075 to 1.7A Current Limit, -40° to 85°C, 6-pin SOT-23 (DBV), Green (RoHS & no Sb/Br)
U7	1		TPS73533DRBT	Texas Instruments	Single Output High PSRR LDO, 500mA, Fixed 3.3V Output, 2.7 to 6.5V Input, with Low IQ, 8-pin SON (DRB), -40° to 125°C, Green (RoHS & no Sb/Br)

Table 4-1. Bill of Material (BOM) (continued)

Designator	Quantity	Value	Part Number	Manufacturer	Description
U9	1		MSP430F5529IPNR	Texas Instruments	25MHz Mixed Signal Microcontroller with 128 KB Flash, 8192 B SRAM and 63 GPIOs, -40° to 85°C, 80-pin QFP (PN), Green (RoHS & no Sb/Br)
Y1	1		ECS-240-20-5PX-TR	ECS Inc.	Crystal, 24.000MHz, 20pF, SMD
R43, R45	0	10k	CRCW060310K0JNEA	Vishay-Dale	RES, 10 k, 5%, 0.1W, AEC-Q200 Grade 0, 0603
TP13, TP14	0		5000	Keystone	Test Point, Miniature, Red, TH
U1	0		TXE8148QDGGRQ1	Texas Instruments	TXE8148QDGGRQ1
U3	0		TXE8116QDGSRQ1	Texas Instruments	TXE8116QDGSRQ1
U10	0		TPD4E004DRYR	Texas Instruments	4-Channel ESD Protection Array for High-Speed Data Interfaces, DRY0006A (USON-6)

5 Additional Information

5.1 Trademarks

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5.2 Terminology

SPI terminology changes

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