TPS929120EVM User's Guide

This user's guide describes the setup and use of the TPS929120EVM evaluation module (EVM). This EVM helps the user evaluate the features of the Texas Instruments TPS929120-Q1, which is an automotive 12-channel LED driver with FlexWire interface, to address increasing needs of individual control of each LED string. This document includes hardware setup instructions, software instructions, a schematic diagram, a bill of materials and printed-circuit board layout drawings.

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WARNING

Hot surface! Contact may cause burns. Do not touch!

Some components may reach high temperatures >55°C when the board is powered on. The user must not touch the board at any point during operation or immediately after operating, as high temperatures may be present.

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1 What You Get

The TPS929120EVM kit (Figure 1) contains:

- USB2ANY
  - Ribbon cable
  - USB cable
- TPS929120EVM
- TPS929120CANEVM
- DB-09 cable

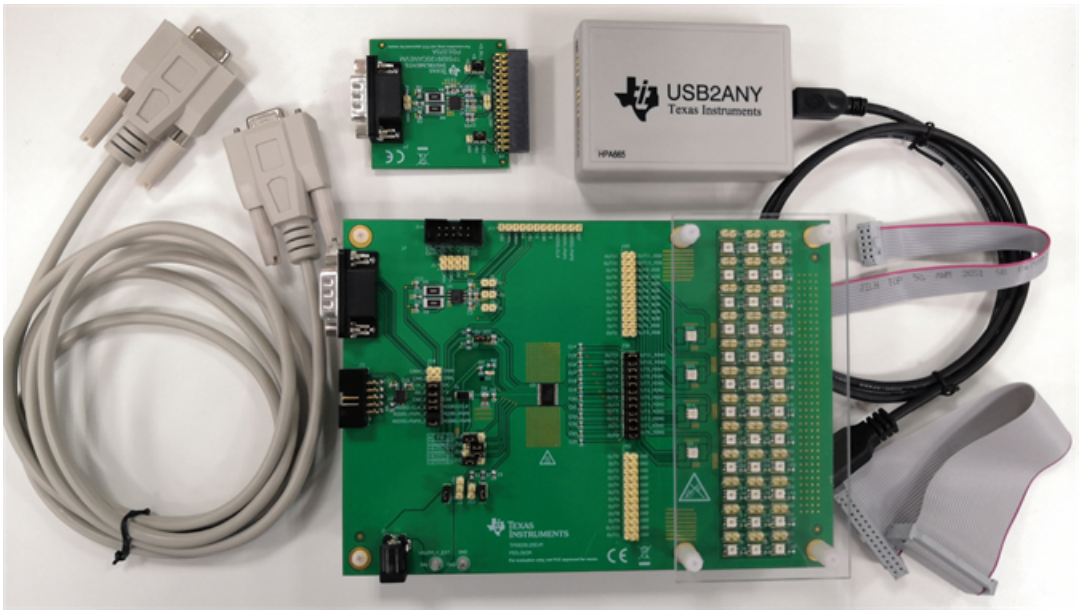


Figure 1. TPS929120EVM Kit

2 What You Need In Addition

The following additional items are required to run the TPS929120EVM:

- PC with TPS929120EVM GUI installed or to run the on-line TPS929120EVM GUI
- 12-V DC power supply

3 How to Get Started

3.1 Hardware Setup

There are two hardware setups to simulate the communication between MCU and TPS929120-Q1 directly or through CAN transceiver.

3.1.1 Communication Without CAN Transceiver

Figure 2 shows the hardware setup when TPS929120CANEVM is not used. Figure 3 shows the jumper configurations for the TPS929120EVM without TPS929120CANEVM connected. This is the default jumper configuration shipped with the board.

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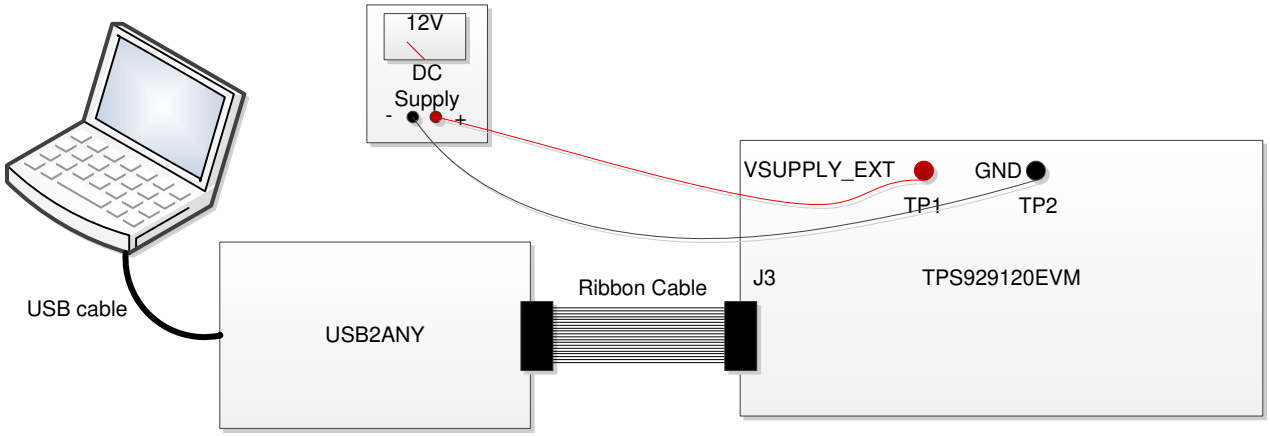


Figure 2. Hardware Setup Without CAN Transceiver

- Connect a 12-V power supply to TP1 (VSUPPLY_EXT) and TP1 (GND).
- Connect USB2ANY tool to PC through the USB cable.
- Connect USB2ANY tool to the J3 connector of TPS929120EVM through ribbon cable.

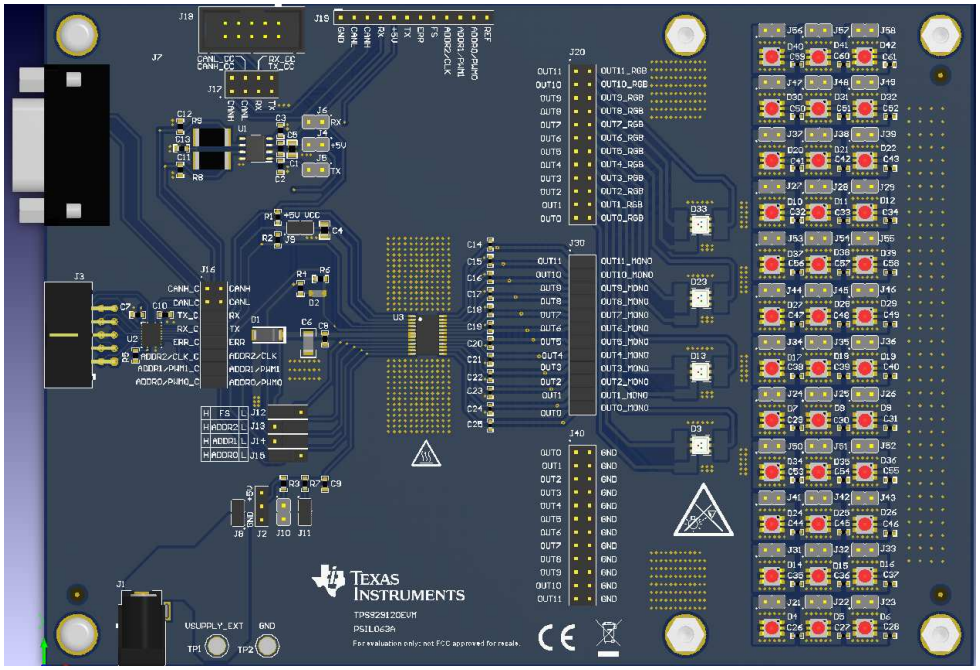


Figure 3. TPS929120EVM Jumper Configurations without TPS929120CANEVM Connected

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Table 1. TPS929120EVM Jumpers Setting without TPS929120CANEVM Connected

HEADER	SETTING
J2, J4, J5, J6, J10, J17, J19, J20, J40	Open
J8, J9, J11	Short
J12	Short “FS” to “H”
J13	Short “ADDR2” to “L”
J14	Short “ADDR1” to “L”
J15	Short “ADDR0” to “H”
J16	Short “TX_C” to “RX”, “RX_C” to “TX”, “ERR_C” to “ERR”, “ADDR2/CLK_C” to “ADDR2/CLK”, “ADDR1/CLK_C” to “ADDR1/CLK”, “ADDR0/CLK_C” to “ADDR0/CLK”
J30	Short “OUTx” to “OUTx_MONO”, where x=0 to 11
All headers paralleled with LEDs	Open

3.1.2 Communication with CAN Transceiver

Figure 4 shows the hardware setup when TPS929120CANEVM is used. Figure 5 shows the jumper configurations for TPS929120EVM with TPS929120CANEVM connected. With this setup, the clock and PWM signal terminals from the USB2ANY are disconnected to such signal terminals of the TPS929120-Q1 device on the TPS929120EVM. As a result, an extra instrument for generating the PWM or clock signal is required to simulate the external PWM or clock input to TPS929120EVM, because both signal outputs from USD2ANY board are not transmitted to TPS929120EVM if TPS929120CANEVM is connected.

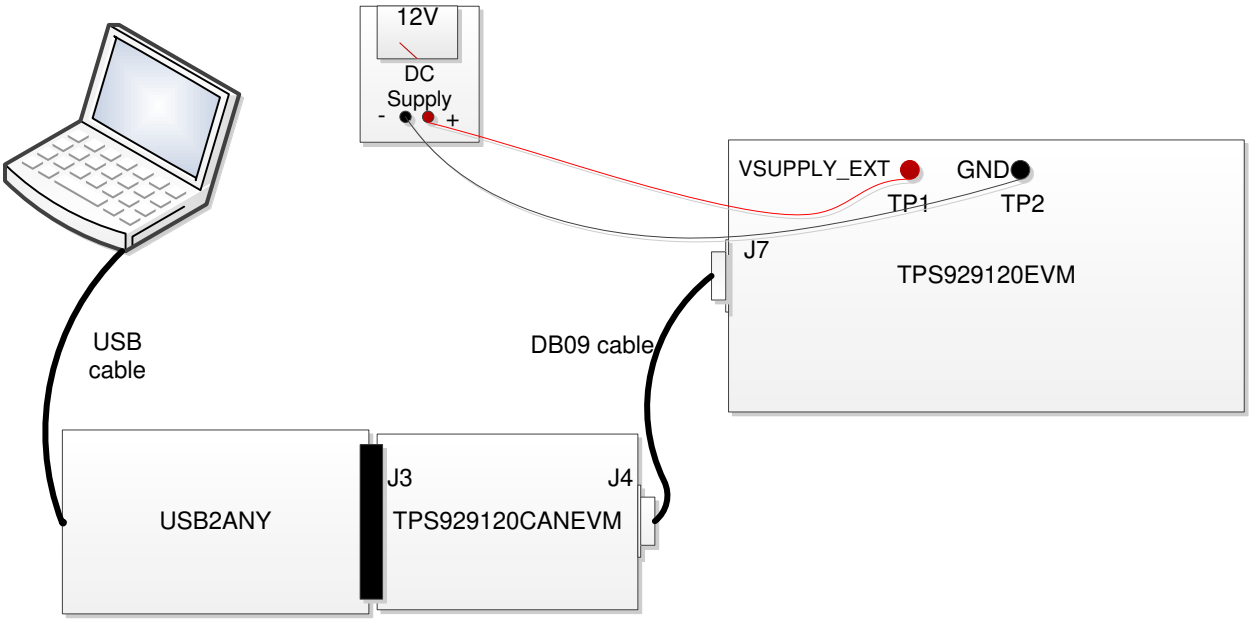


Figure 4. Hardware Setup with CAN Transceiver

- Connect a 12-V power supply to TP1 (VSUPPLY_EXT) and TP1 (GND).
- Connect USB2ANY tool to PC through USB cable.
- Plug TPS929120CANEVM to USB2ANY tool through the J3 header of TPS929120CANEVM.
- Connect TPS929120CANEVM to TPS929120EVM through the J4 connector of TPS929120CANEVM and the J7 connector of TPS929120EVM with DB-09 cable.

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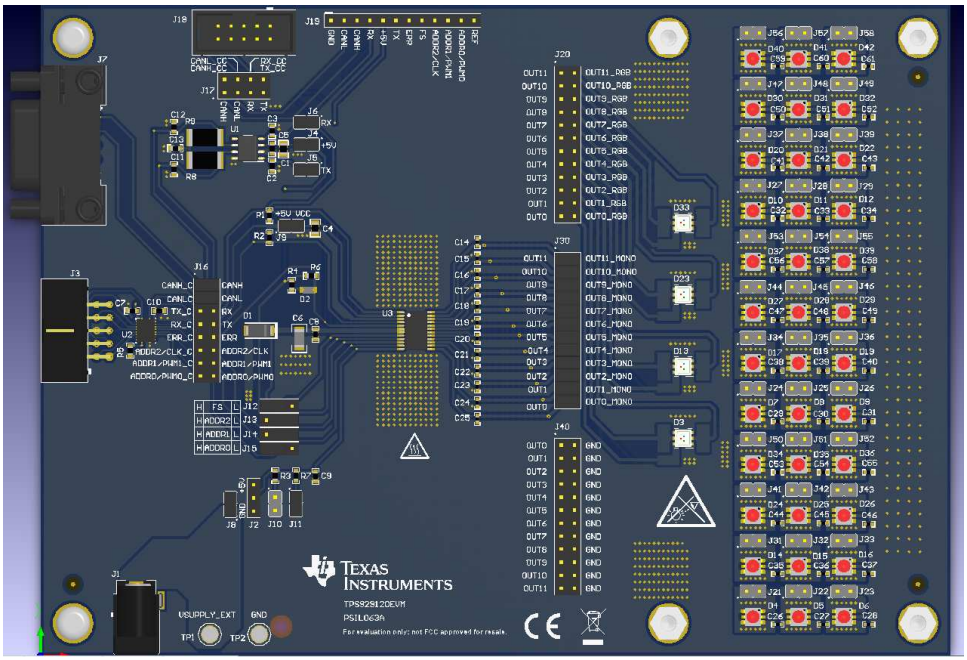


Figure 5. TPS929120EVM Jumper Configurations With TPS929120CANEVM Connected

Table 2. TPS929120EVM Jumpers Setting with TPS929120CANEVM Connected

HEADER	SETTING
J2, J10, J17, J19, J20, J40	Open
J4, J5, J6, J8, J9, J11	Short
J12	Short “FS” to “H”
J13	Short “ADDR2” to “L”
J14	Short “ADDR1” to “L”
J15	Short “ADDR0” to “H”
J16	Short “CANH_C” to “CANH”, “CANL_C” to “CANL”
J30	Short “OUTx” to “OUTx_MONO”, where x=0 to 11
All headers paralleled with LEDs	Open

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Figure 6 shows the jumper configurations for TPS929120CANEVM. For header J5, short "+5V" to "+5V_U2A". For header J6, short "+3.3V" to "+3.3V_U2A".

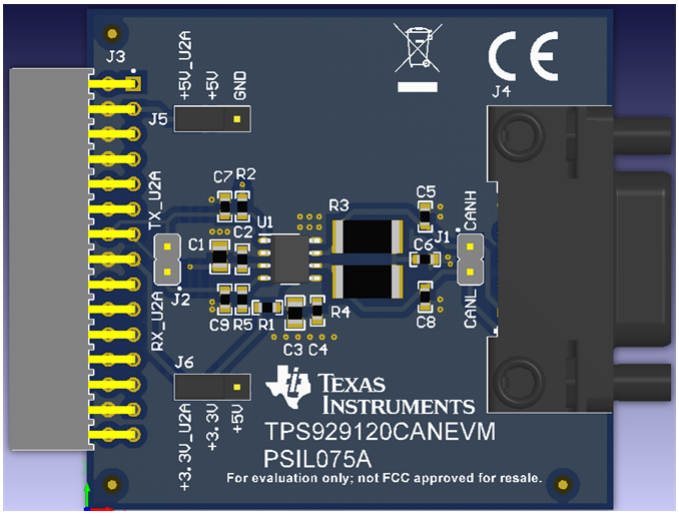


Figure 6. TPS929120CANEVM Jumper Configurations

3.2 Software Installation

There are two types of the GUI, online version and desktop version.

3.2.1 Run Applications Through Online

Go to the TPS929120-Q1 EVM web page. Scroll down to the "Order Now" section and click the "Start Evaluation" button to reach to the TPS929120-Q1 gallery page. It might require to login user account privileges to open the gallery page. All GUI versions are shown ordered from left to right on the gallery page as shown in Figure 7. Left most application icon shows the latest version. Clicking the application icon to open the online version GUI. There may be prompt to download and install the browser extension and TI Cloud Agent for the first time. Follow the steps to install the browser extension and TI Cloud Agent Applications.

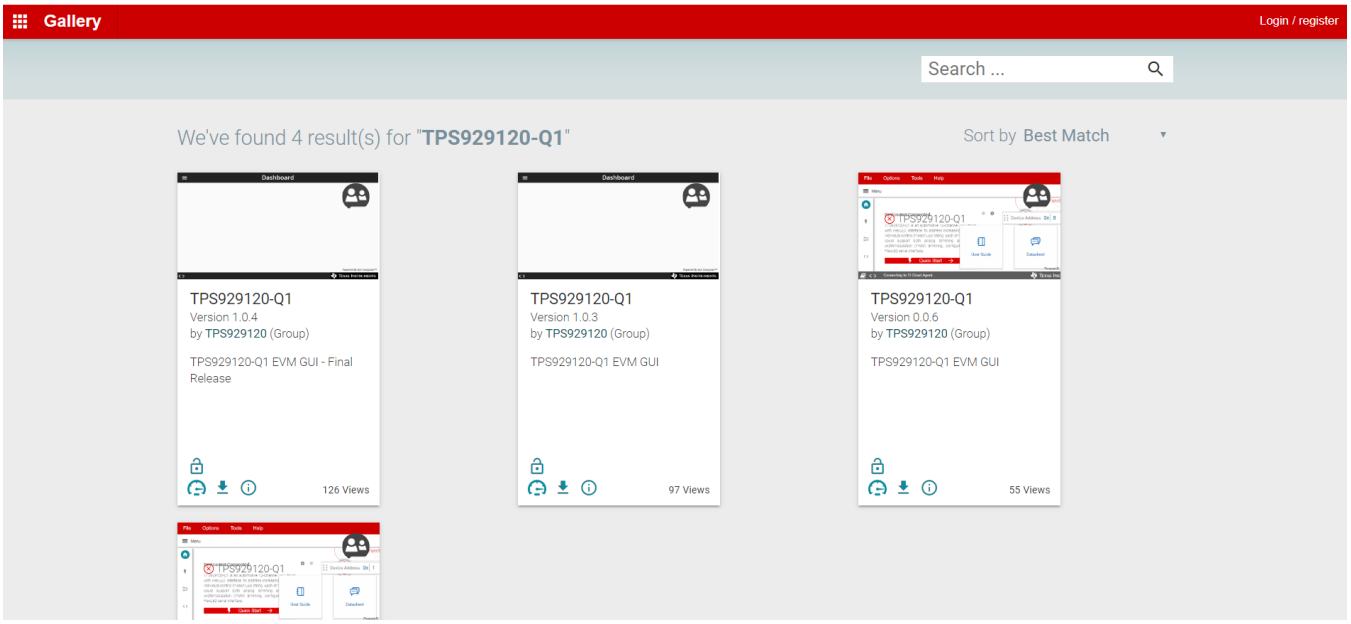


Figure 7. TPS929120-Q1 Gallery Page

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3.2.2 Run Applications on Desktop

Click the "Download" button under the "Order Now" section to download the TPS929120EVM GUI installation zip file to local computer, or you can download it from the application icon as showed in Figure 8 by hovering the cursor over the download button and selecting the appropriate platform. Then extract the zip folder and install the GUI using the exe - TPS929120-Q1-1.0.5.setup-win_7.3.0. Make sure the network is connected while installing the GUI.

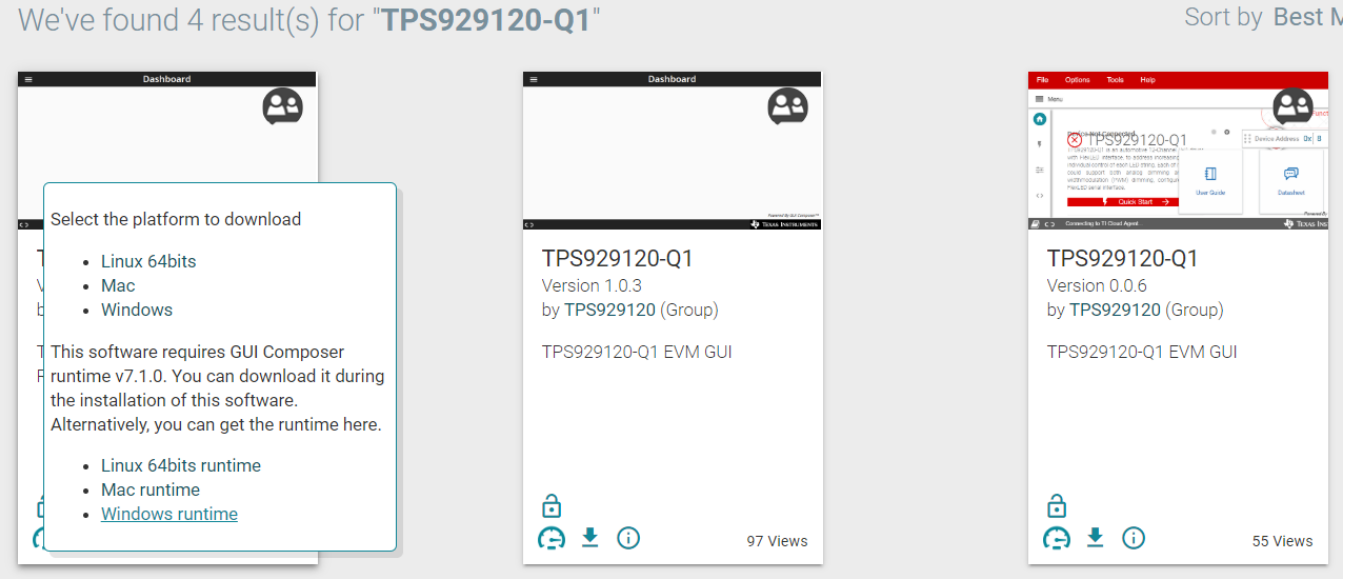


Figure 8. GUI and GUI Composer Download Page

Follow the on-screen instructions by clicking "Next" button to accept the license, default installation directory and to install the GUI Composer Runtime engine. You can either provide a location for the downloaded GUI Composer Installer, or choose to download from the web. The GUI Composer Installer can be downloaded from the gallery page as showed in Figure 8 by selecting the appropriate platform. Continue to click on the "Next" button to complete the GUI Composer Runtime installation.

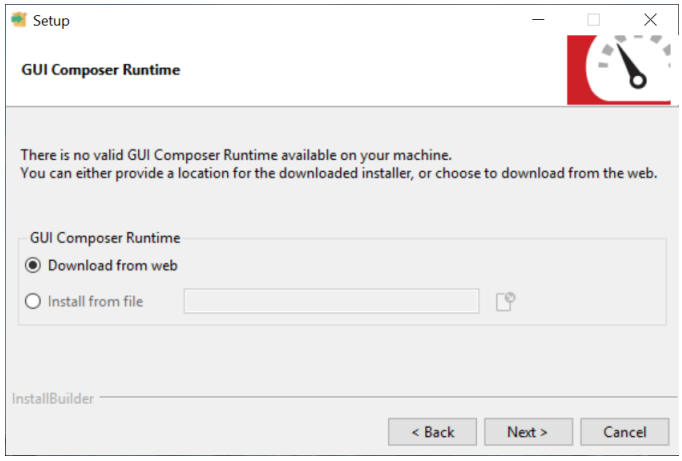


Figure 9. GUI Composer Runtime Installation

After the GUI Composer installation, it continues to install the TPS929120EVM GUI. Follow the on-screen instructions by clicking the "Next" button to finish the GUI installation. Once installed, a shortcut to the GUI is found on the desktop and also in the start-up menu under the Texas Instruments folder.

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3.3 Firmware Update

After opening the GUI, the GUI will try to connect the EVM board. At the moment, the GUI will detect the firmware version of the connected USB2ANY tool automatically. If the firmware version is not mapping with the recommended version for the GUI, there is a prompt as shown in Figure 10 to help user update the firmware in the USB2ANY. Click the update button to begin the firmware update process. After firmware update succeeds, click finish button to close the prompt window. Then the GUI will try to connect the EVM board again with the defined device address. Once it connects successfully there will be 3 confirmation sync-up prompt windows, the connected LEDs type (Monochrome or REG), Fail-Safe state (0 or 1) and EEPROM programming Mode (Chip select or External address). For each confirmation window, just click on the correct image mapping to the current EVM setup.

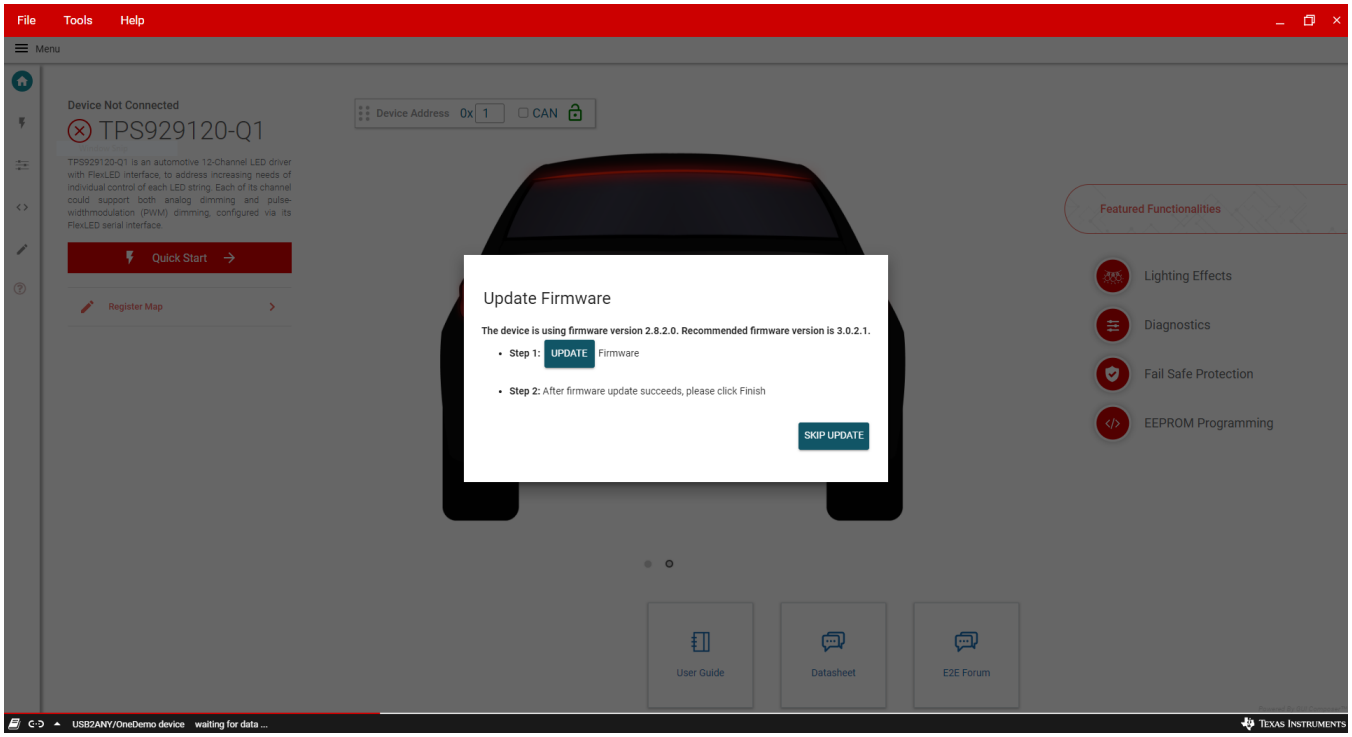


Figure 10. Firmware Update Prompt Window

If the firmware version of the USB2ANY tool is lower than 2.8.2.0 there will be not firmware update prompt as showed in Figure 10. We have to upgrade the firmware version to 2.8.2.0 manually. Go to USB2ANY Interface Adaptor web page, scroll down to "Key Document" section and click "USB2ANY Explorer Software" to download the installation file. Extract the zip file and install the USB2ANY Explorer using the "USB2ANY Explorer-2.8.2.0 Setup" exe file. After USB2ANY Explorer installation, open the software with USB2ANY tool connected to the computer. Please make sure that the GUI is closed while opening the USB2ANY Explorer. Once the explorer is opened, there will be a "USB2ANY Firmware Requirement" prompt. Click "OK" button to continue. Follow the instructions on the "USB2ANY Firmware Loader" as showed in Figure 11 to update the firmware.

After upgrading the USB2ANY firmware version to 2.8.2.0, close the USB2ANY Explorer and open the TPS929120EVM GUI again. While trying to connect the EVM board, the firmware upgrade window as showed in Figure 10 will appear.

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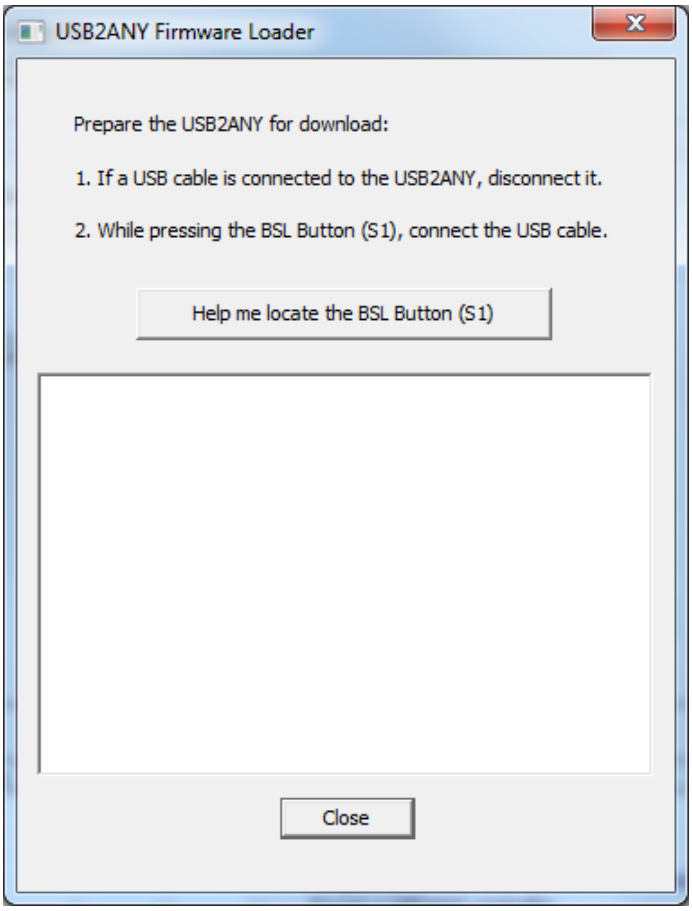


Figure 11. USB2ANY Firmware Loader

3.4 GUI Function

This section provides instructions to run the TPS929120EVM using the TPS929120EVM GUI.

3.4.1 Connection Status

Make sure to power up the EVM board and connect it to the PC through USB2ANY tool before opening the on-line version GUI or desktop version GUI. If the GUI has been opened but the USB2ANY has not been connected to the PC, make sure the USB2ANY has been connected to the powered-up EVM board when plug it into the PC. Other operation orders may lead to GUI working abnormally. Once it happens, please refresh the on-line version GUI or re-run the desktop version GUI.

The GUI supports both hardware setups with CAN board connected or not connected. When CAN board connected, the CAN checkbox on the "Device Address" widget should be checked. When CAN board is not connected, left the CAN checkbox unchecked. Before changing hardware setup, remove the USB2ANY cable plug from PC.

Before using the GUI, make sure the hardware is connected successfully. You can check the connection status on the home page where there is a green check mark on the left side of the TPS929120-Q1 body, which means the USB2ANY is connected to the computer successfully. If there is a red X mark, it means the hardware is not connected, you must reconnect the device.

After hardware is connected, either "Hardware Connected" or "Hardware not Connected" shows on the bottom left corner of the GUI. The button to connect or disconnect the GUI to hardware is also available there. You can click the button to connect to hardware if hardware is not connected or to disconnect from hardware while hardware connected.

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In order to connect the GUI to device successfully, you must set the correct device address on the GUI to map the real device address. See the TPS929120-Q1 data sheet for instructions to set the device address. The default device address setting value of the GUI is 0x01 when you open the GUI.

On the EVM board, the ADDR0, ADDR1 and ADDR2 can be configured as High or Low through "J15", "J14" and "J13" connectors. On the GUI page you can directly enter the specified value through the "Device Address" widget.

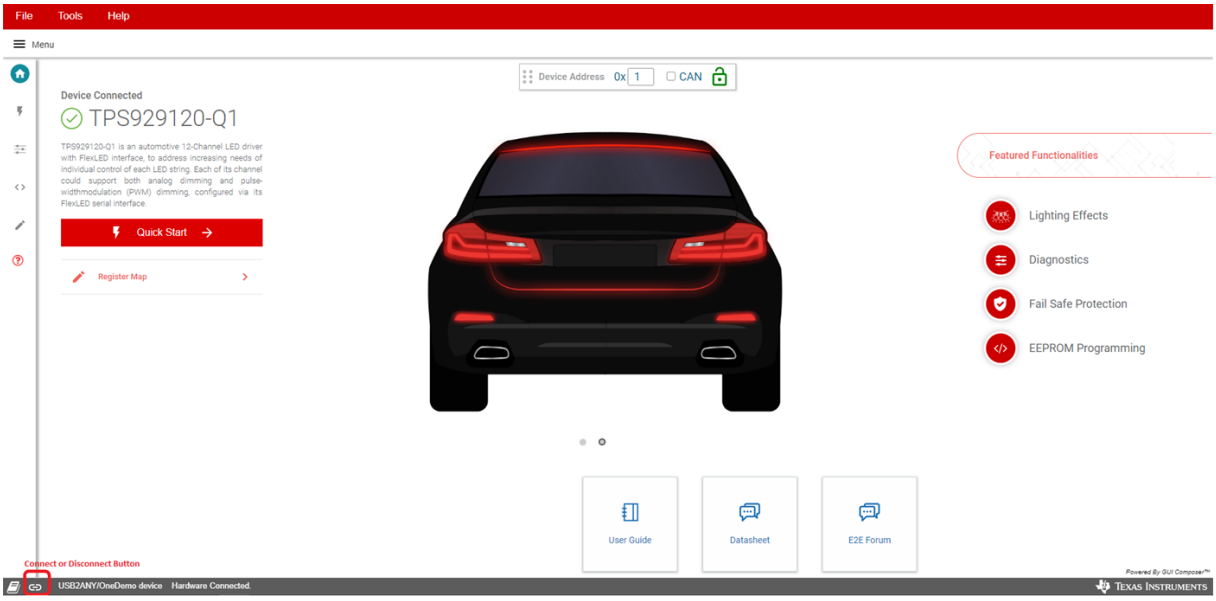


Figure 12. TPS929120EVM GUI Connection Status

3.4.2 Walkthrough Wizard Prompt

The GUI integrated walkthrough wizard prompts for each page to guide user through the GUI instructions. After selecting one page, clicking the question mark displays the walkthrough wizard that covers each control operation method on that page.

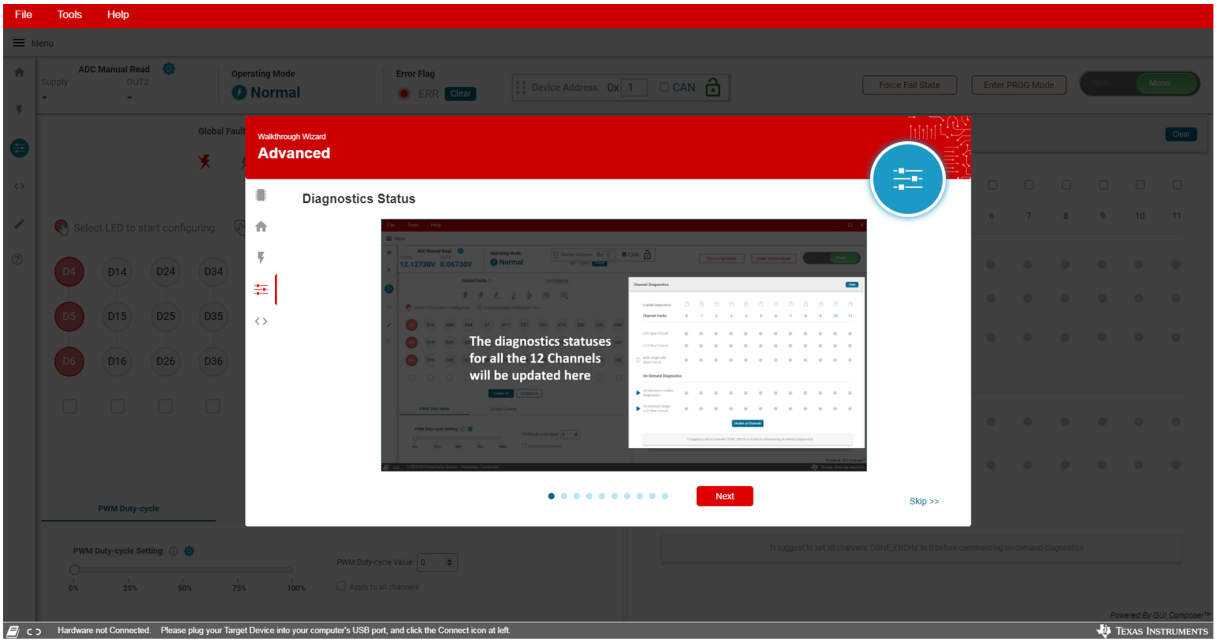


Figure 13. Walkthrough Wizard Prompt

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3.4.3 Quick Start Page

Current operation mode shows on the top left corner of the page. Error flag and global faults icons indicate the real-time status information of the device. There are two types of LEDs: monochrome LEDs and RGB LEDS. The LED strings can be controlled individually or simultaneously. For selected LEDs, the PWM duty-cycle and output current are all adjustable. Once a LED open, short or single LED short-circuit occurs, the related flag becomes red under the diagnostic details panel. For detailed operation instructions, see the walkthrough wizard of this page.

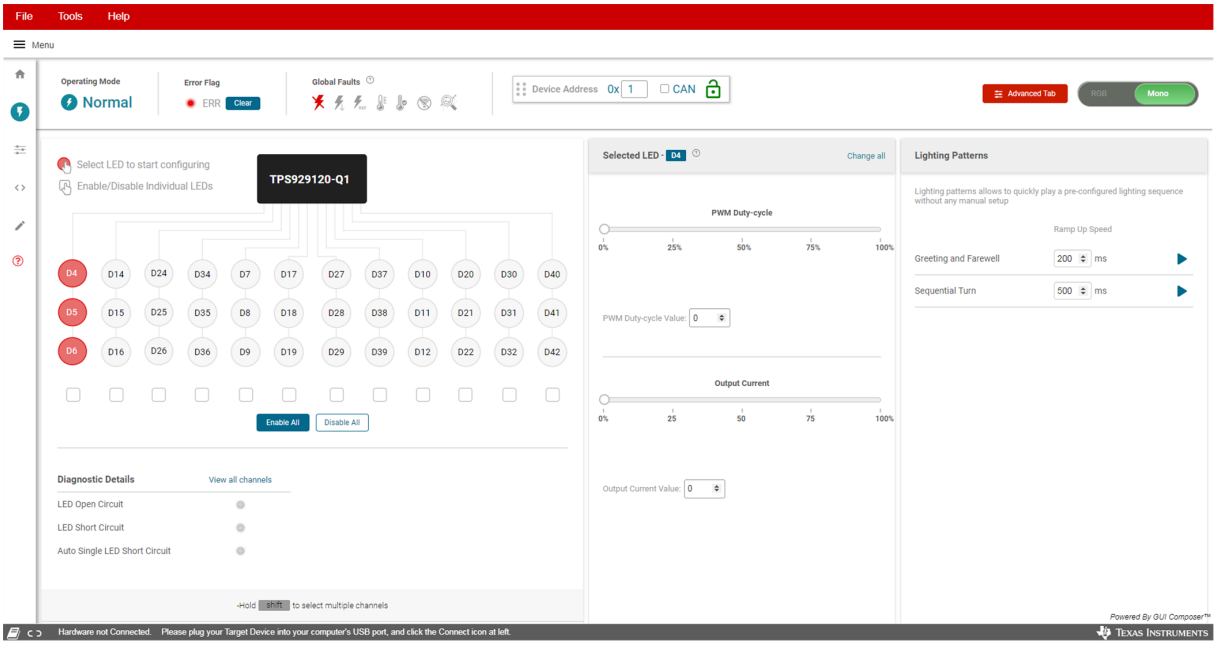


Figure 14. TPS929120EVM GUI Quick Start Page

3.4.4 Advanced Page

Figure 15 shows the advanced page where, compared to quick start page, more functions are provided. On the top left corner of the page, all ADC channel can be selected to update the reading value in real time. After clicking the "Force Fail Sate" button, the device enters the configured fail-safe state, and the operation mode changes from normal state to related fail-safe state automatically. Under the "Channel Diagnostics" panel, LED fault icon updates automatically once a corresponding fault happens. For detailed operation instructions, see the walkthrough wizard of this page.

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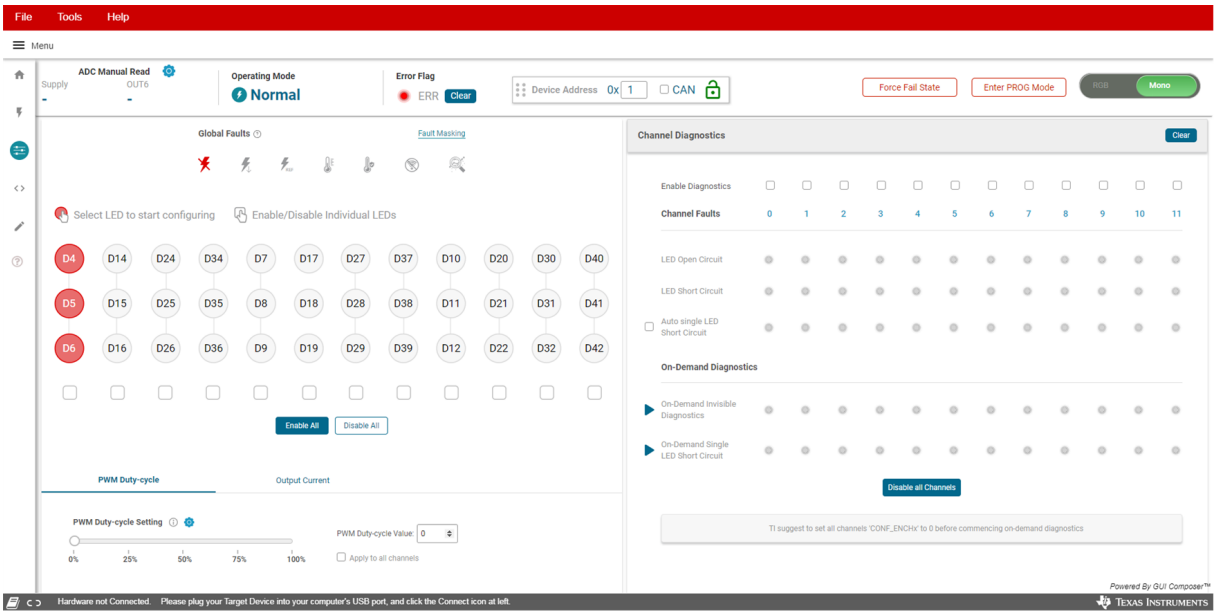


Figure 15. TPS929120EVM GUI Advanced Page

3.4.5 EEPROM Programming Page

The device supports two programming modes for different applications: either with chip select or external address select. Figure 16 shows the EEPROM programming page. The programming mode is set as the method you have configured during sync-up process, which can also be toggled through clicking one of the programming buttons. All EEPROM registers value can be set on this page. All the configured values are copied to corresponding shadow registers firstly. After clicking "Start Programming" button, all the shadow registers values overwrites all related EEPROM registers, which means that only after clicking "Start Programming" button all the current configuration value really overwrites the corresponding EEPROM registers. Clicking "Load Default" button sets all current registers with default value as showed in datasheet. The current register configuration can be saved for future reuse.

Jumping to other pages from the programming page or clicking "Exit PROG mode" button will automatically force the device exit EEPROM programming mode through clearing CONF_STAYINEEP method, which means the newly modified EEPROM registers value will not update to corresponding configuration registers after exiting EEPROM programming mode. CLR_REG can be set through register map page to update configuration registers with the latest EEPROM registers value immediately. For other detailed operation instructions, see the walkthrough wizard of this page.

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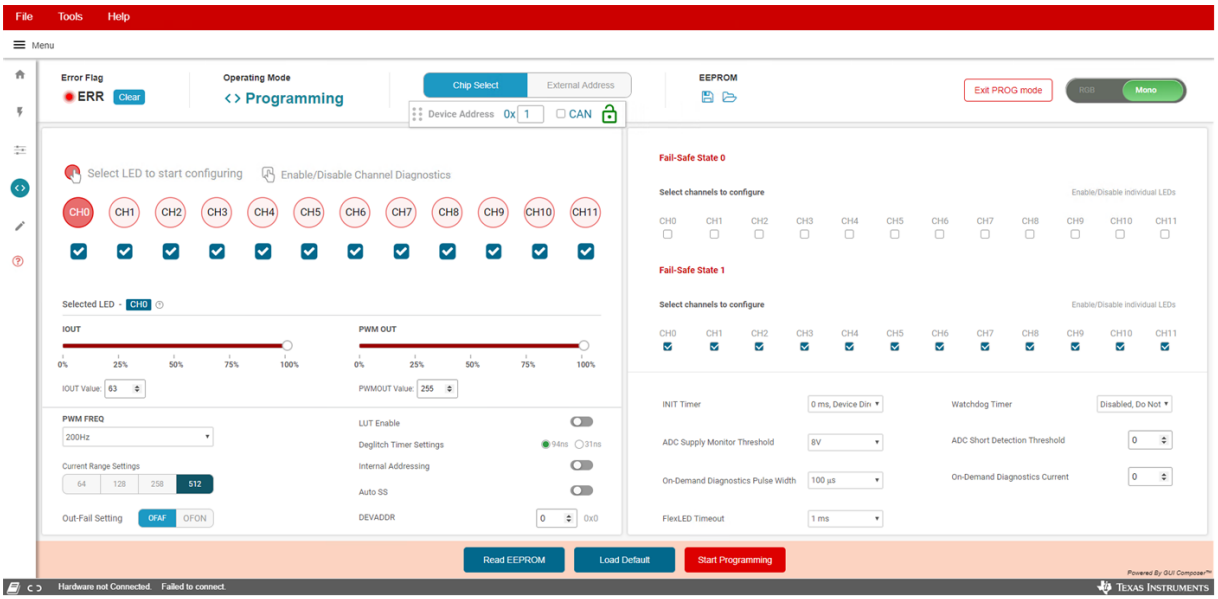


Figure 16. TPS929120EVM GUI EEPROM Programming Page

3.4.6 Registers Page

Figure 17 shows the registers page. All the configuration and EEPROM registers are available on this page. Clicking on the row of the register automatically updates the corresponding field view on the right side of the page. The register value can be modified through clicking the "Value" column or double clicking the "Bits" column. The modified value is effective immediately if "Immediate" function is selected on the top right corner. The modified value does not take effect until you click "WRITE REGISTER" button with "Deferred" function selected. Click "READ REGISTER" button only reads the selected register. All registers' value can be read back or set one time through clicking "READ ALL REGISTERS" or "WRITE ALL REGISTERS".

Modifying the EEPROM registers' value on the register map page does not overwrite the real EEPROM registers' value. Real EEPROM registers' value can be modified only through EEPROM programming page.

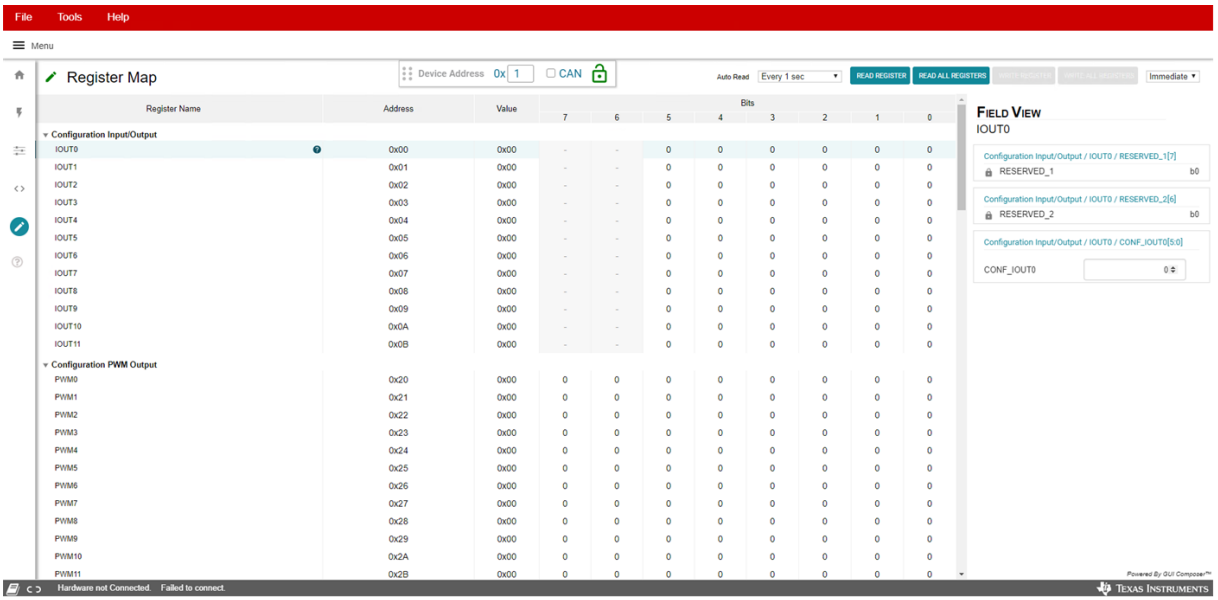


Figure 17. TPS929120EVM GUI Registers Page

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4 Board Layout

Figure 18 and Figure 19 show the PCB layout of TPS929120EVM.

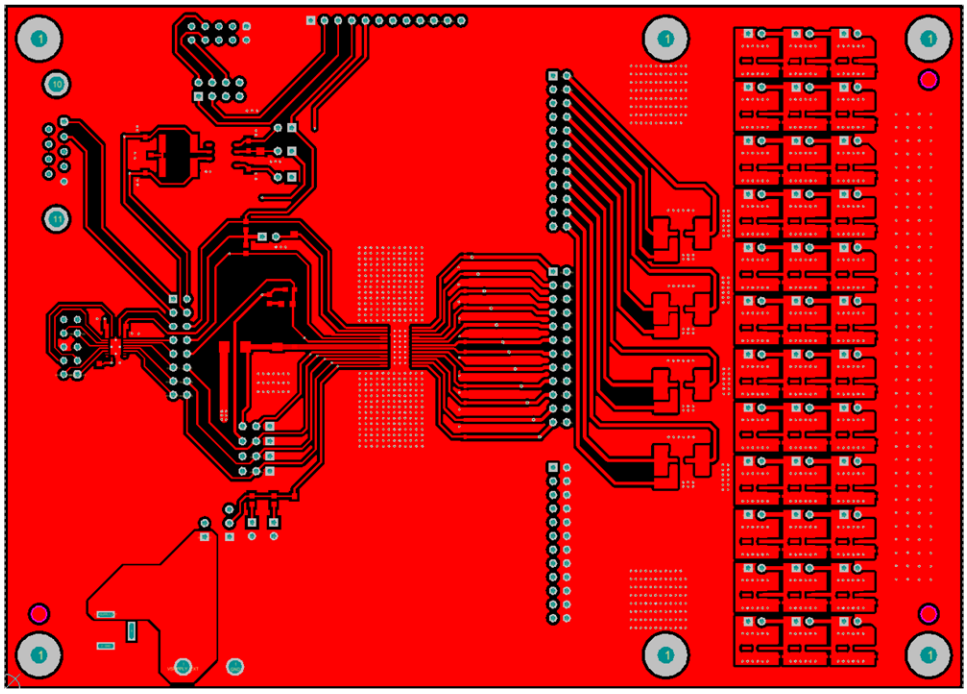


Figure 18. Top Layer Routing

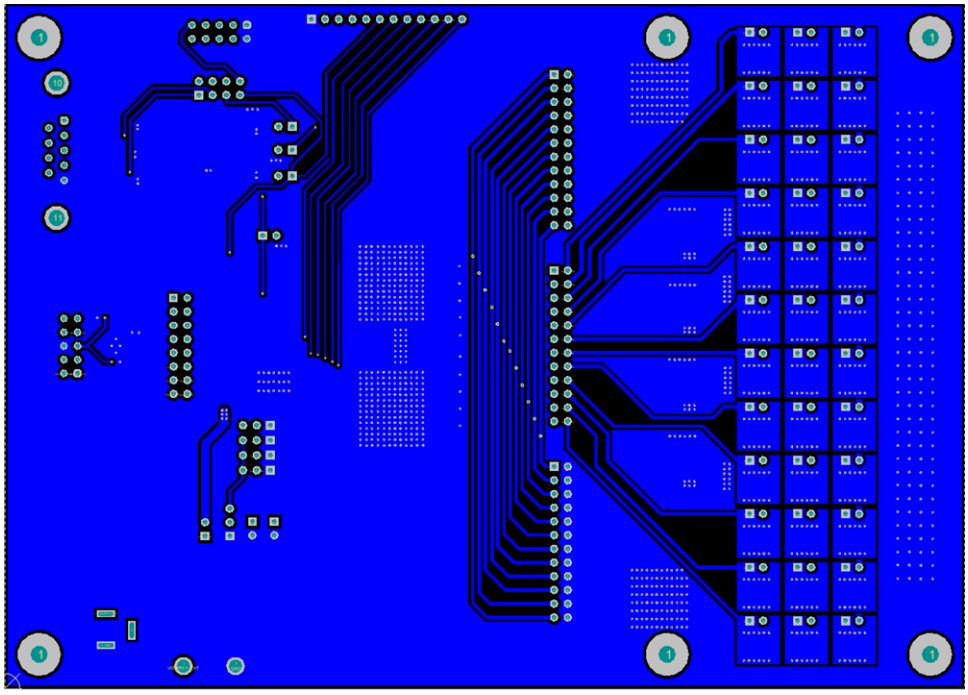


Figure 19. Bottom Layer Routing (Mirrored)

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4.1 Schematic

Figure 20 is the TPS929120EVM schematic.

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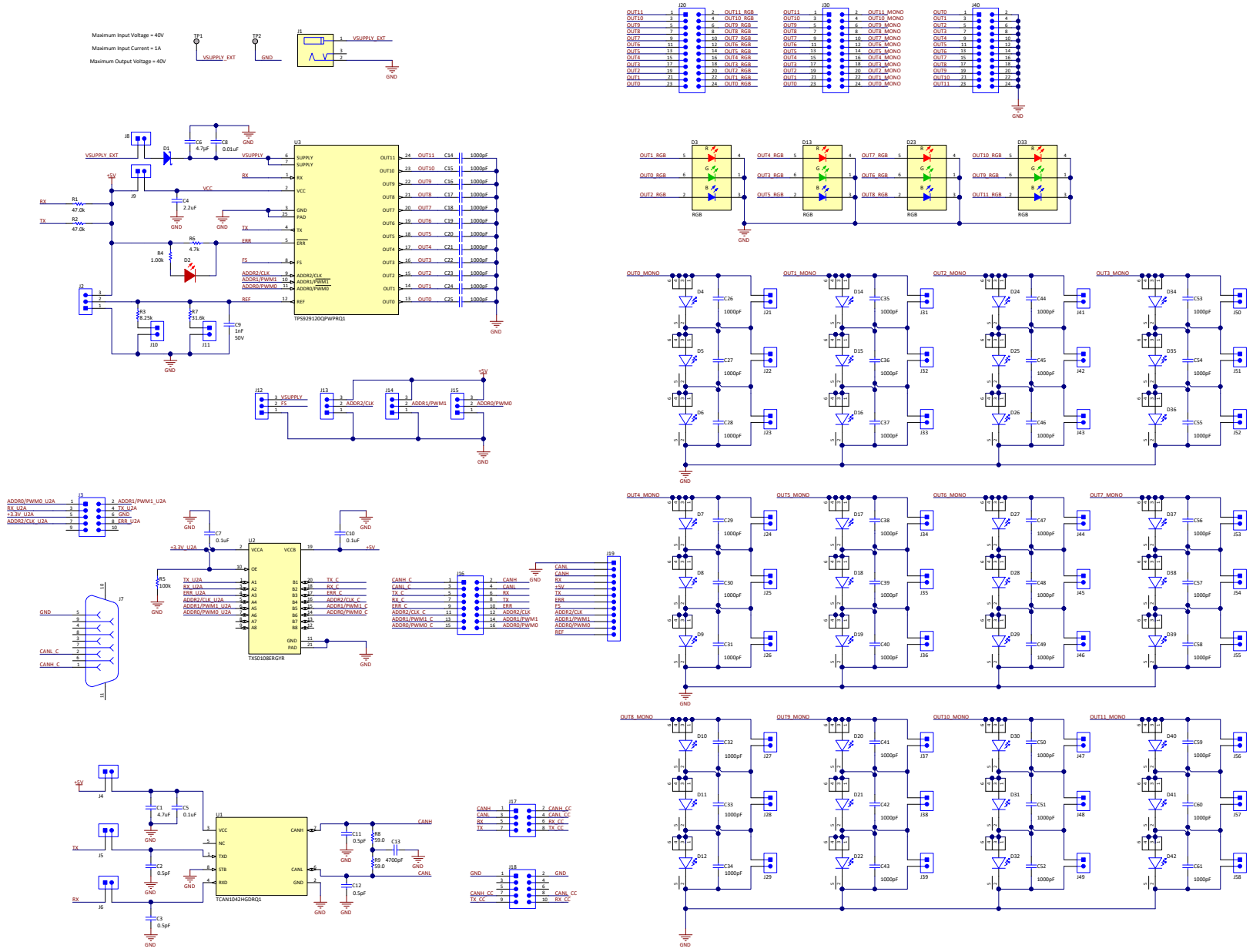


Figure 20. TPS929120EVM Schematic Diagram

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4.2 BOM

Table 3 lists the TPS929120EVM BOM.

Table 3. Bill of Materials (BOM)

DESIGNATOR	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
C1	CAP, CERM, 4.7 uF, 16 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0805	MuRata	GCM21BR71C475KA73K	1
C2, C3, C11, C12	CAP, CERM, 0.5 pF, 50 V, +/- 50%, C0G/NP0, 0603	Kemet	C0603C508C5GACTU	4
C4	CAP, CERM, 2.2 uF, 10 V, +/- 10%, X5R, 0805	AVX	0805ZD225KAT2A	1
C5, C7, C10	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X7R, 0603	Kemet	C0603C104K4RACTU	3
C6	CAP, CERM, 4.7 µF, 50 V,+/- 10%, X7R, AEC-Q200 Grade 1, 1206	TDK	CGA5L3X7R1H475K160AE	1
C8	CAP, CERM, 0.01 uF, 50 V, +/- 10%, X7R, 0603	Kemet	C0603C103K5RACTU	1
C9	CAP, CERM, 1000 pF, 50 V, +/- 5%, X7R, AEC-Q200 Grade 1, 0603	Kemet	C0603C102J5RACAUTO	1
C13	CAP, CERM, 4700 pF, 100 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	TDK	CGA3E2X7R2A472K080AA	1
C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25, C26, C27, C28, C29, C30, C31, C32, C33, C34, C35, C36, C37, C38, C39, C40, C41, C42, C43, C44, C45, C46, C47, C48, C49, C50, C51, C52, C53, C54, C55, C56, C57, C58, C59, C60, C61	CAP, CERM, 1000 pF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	TDK	CGA2B2X7R1H102K050BA	48
D1	DIODE, SCHOTTKY, 60V, 3A, DO214AC	Micro Commercial Co	SK36A-LTPMSCT-ND	1
D2	LED, Red, SMD	OSRAM	LS R976-NR-1	1
D3, D13, D23, D33	LED, RGB, SMD	OSRAM	LRTB GVSG-UEVE-24+AMAQ-29+SCUC-HR	4
D4, D5, D6, D7, D8, D9, D10, D11, D12, D14, D15, D16, D17, D18, D19, D20, D21, D22, D24, D25, D26, D27, D28, D29, D30, D31, D32, D34, D35, D36, D37, D38, D39, D40, D41, D42	LED, Super Red, SMD	OSRAM	LS G6SP-CADB-1-1-Z	36
H1, H3, H5, H7, H9, H11	HEX STANDOFF 4-40 ALUMINUM 3/4"	Keystone	2204	6
H2, H4, H6, H8, H10, H12	Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	B&F Fastener Supply	NY PMS 440 0025 PH	6
H13, H14, H15, H16	Standoff, Hex, Male/Female, 4-40, Nylon, 1/2"	Keystone	4802	4
H17	CABLE ASSY DB09 SHLD BEIGE 2M	Assmann WSW Components	AK152-2	1
H18	LED Diffuser Panel (2.42" X 5" X 0.125" UL 94V0 polycarbonate transparent gray or bronze material. Must meet or exceed UL94-V0 Lexan 9600 or Makrolon FI or equivalent	ANY	MCH044	1
J1	WR-DC DC Power Jack, R/A, TH	Wurth Elektronik	694106301002	1
J2, J12, J13, J14, J15	Header, 100mil, 3x1, Gold, TH	Sullins Connector Solutions	PBC03SAAN	5
J3	Header(shrouded), 2.54mm, 5x2, Gold, R/A, TH	Sullins Connector Solutions	SBH11-PBPC-D05-RA-BK	1

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Table 3. Bill of Materials (BOM) (continued)

DESIGNATOR	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
J4, J5, J6, J8, J9, J10, J11, J21, J22, J23, J24, J25, J26, J27, J28, J29, J31, J32, J33, J34, J35, J36, J37, J38, J39, J41, J42, J43, J44, J45, J46, J47, J48, J49, J50, J51, J52, J53, J54, J55, J56, J57, J58	Header, 100mil, 2x1, Gold, TH	Sullins Connector Solutions	PBC02SAAN	43
J7	D-Sub, 2.77mm, 9 Pos, Tin, R/A, TH	Assman WSW	A-DS 09 A/KG-T2S	1
J16	Header, 100mil, 8x2, Gold, TH	Samtec	TSW-108-07-G-D	1
J17	Header, 100mil, 4x2, Gold, TH	Samtec	TSW-104-07-G-D	1
J18	Header(shrouded), 2.54mm, 5x2, Gold, TH	Sullins Connector Solutions	SBH11-PBPC-D05-ST-BK	1
J19	Header, 100mil, 12x1, Gold, TH	Samtec	TSW-112-07-G-S	1
J20, J30, J40	Header, 100mil, 12x2, Gold, TH	Samtec	TSW-112-07-G-D	3
R1, R2	RES, 47.0 k, 1%, 0.1 W, 0603	Yageo	RC0603FR-0747KL	2
R3	RES, 8.25 k, 1%, 0.1 W, 0603	Yageo	RC0603FR-078K25L	0
R4	RES, 1.00 k, 1%, 0.1 W, 0603	Panasonic	ERJ-3EKF1001V	1
R5	RES, 100 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	Panasonic	ERJ-3GEYJ104V	1
R6	RES, 4.7 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	Panasonic	ERJ-3GEYJ472V	1
R7	RES, 31.6 k, 1%, 0.1 W, 0603	Yageo	RC0603FR-0731K6L	1
R8, R9	RES, 59.0, 1%, 1 W, AEC-Q200 Grade 0, 2512	Stackpole Electronics Inc	RMCF2512FT59R0	2
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, SH-J20, SH-J21, SH-J22, SH-J23, SH-J24, SH-J25	Shunt, 100mil, Flash Gold, Black	Sullins Connector Solutions	SPC02SYAN	25
TP1, TP2	Terminal, Turret, TH, Double	Keystone	1502-2	2
U1	Automotive Fault Protected CAN Transceiver With Flexible Data-Rate, D0008A (SOIC-8)	Texas Instruments	TCAN1042HGDRQ1	1
U2	8-Bit Bidirectional Voltage-Level Shifter For Open-Drain And Push-Pull Application, RGY0020A (VQFN-20)	Texas Instruments	TXS0108ERGYR	1
U3	12-Channel Automotive FlexWire Driver, PWP0024P (HTSSOP-24)	Texas Instruments	TPS929120QPWPRQ1	1

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Revision History

Changes from A Revision (May 2019) to B Revision **Page**

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- Updated Section 3.3 9
- Updated Figure 20 16

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