



## ABSTRACT

This user's guide describes the setup and use of the TPS929240EVM evaluation module (EVM). This EVM helps the user evaluate the features of the Texas Instruments TPS929240-Q1, which is an automotive 24-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.



### 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 TPS929240EVM kit (Figure 1-1) contains:

- USB2ANY
  - Ribbon cable
  - USB cable
- TPS929240EVM
- TPS929120CANEVM
- DB-09 cable

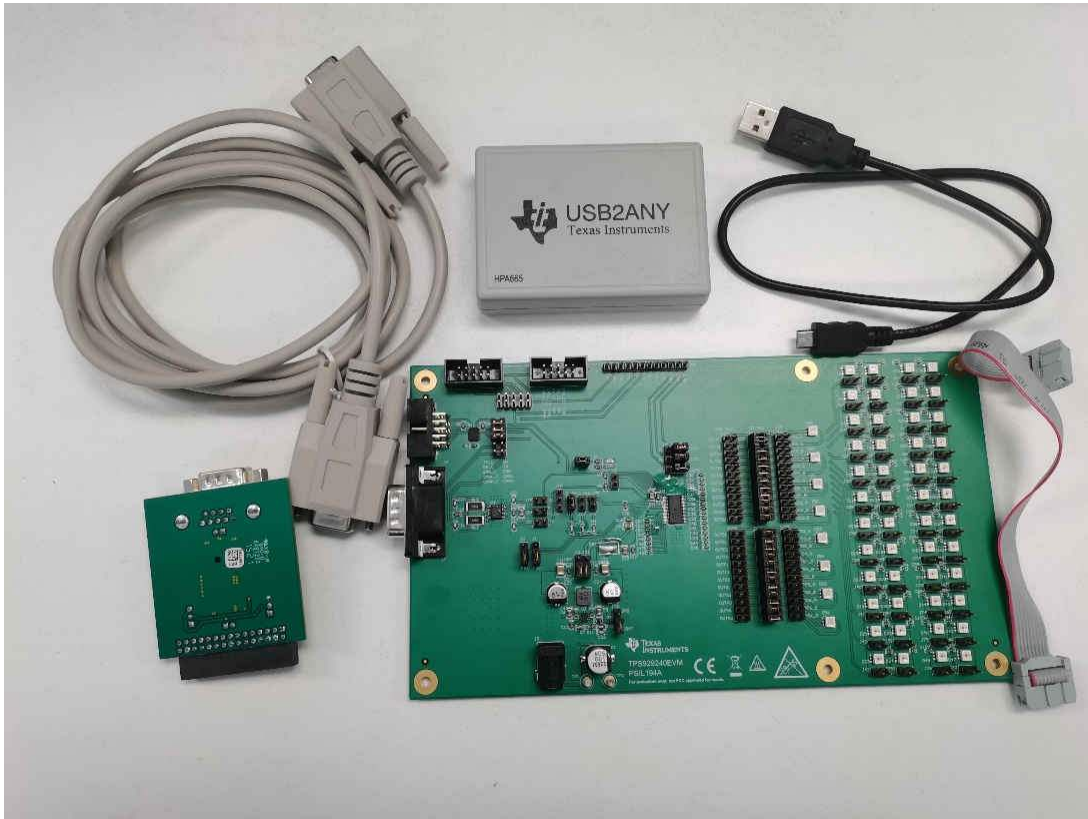


Figure 1-1. TPS929240EVM Kit

## 2 What You Need In Addition

The following additional items are required to run the TPS929240EVM:

- PC with TPS929240EVM GUI installed or to run the on-line TPS929240EVM GUI
- 12-V DC power supply

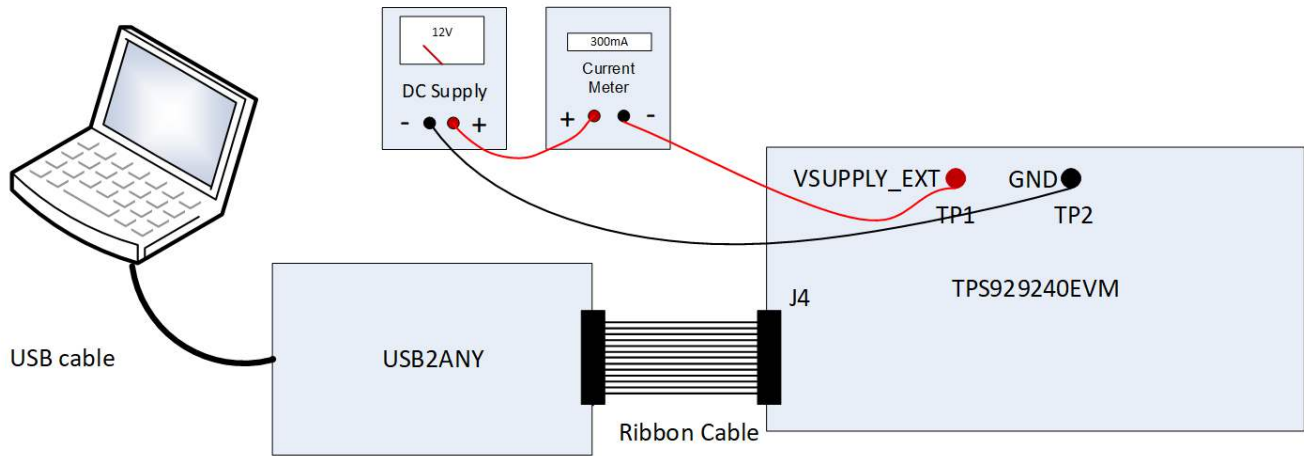
## 3 How to Get Started

### 3.1 Hardware Setup

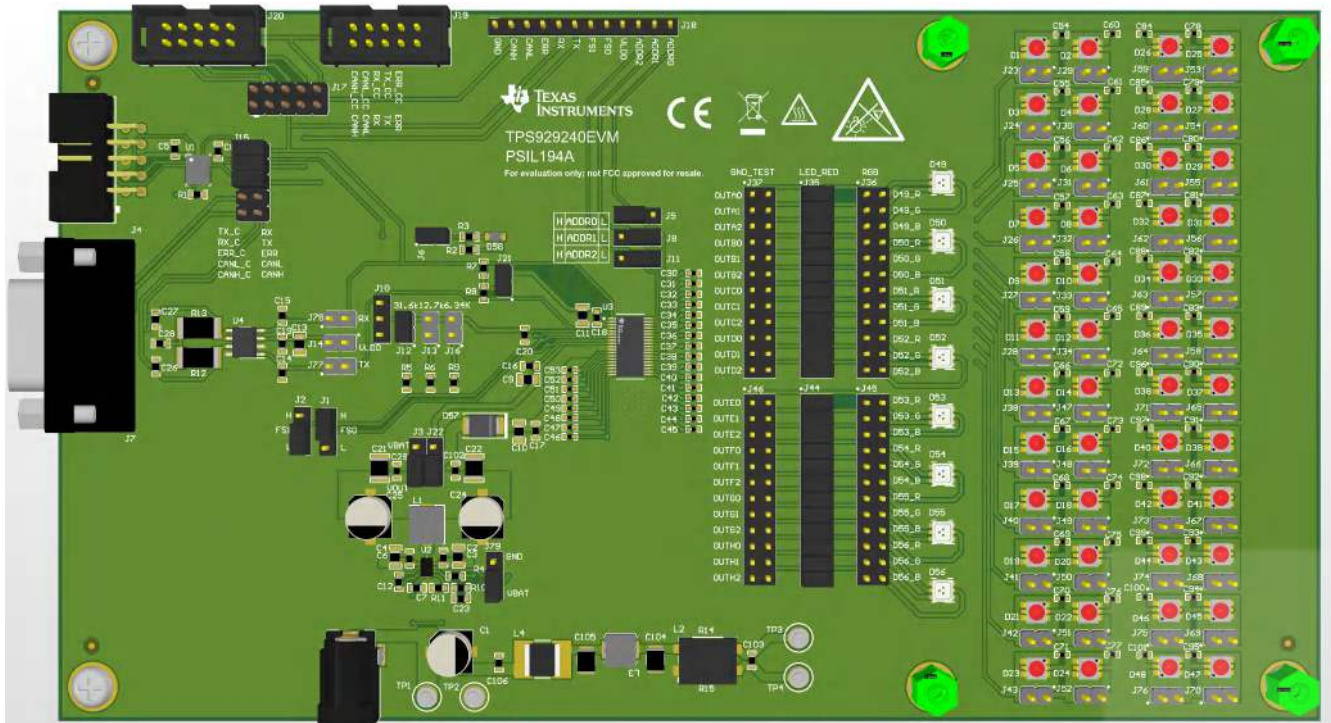
There are two hardware setups to simulate the communication between MCU and TPS929240-Q1 directly or through CAN transceiver. And TPS929240EVM contains a buck in the board. You can decide whether to use it by "J3", "J22", "J79."

#### 3.1.1 Communication without CAN Transceiver

Figure 3-1 shows the hardware setup when TPS929120CANEVM is not used. Figure 3-2 shows the jumper configurations for the TPS929240EVM without TPS929120CANEVM connected. This jumper is the default jumper configuration shipped with the board.


**Figure 3-1. Hardware Setup without CAN Transceiver**

- Connect a 12-V power supply to TP1 (VSUPPLY\_EXT) and TP2 (GND).
- Connect USB2ANY tool to PC through the USB cable.
- Connect USB2ANY tool to the J4 connector of TPS929240EVM through ribbon cable.

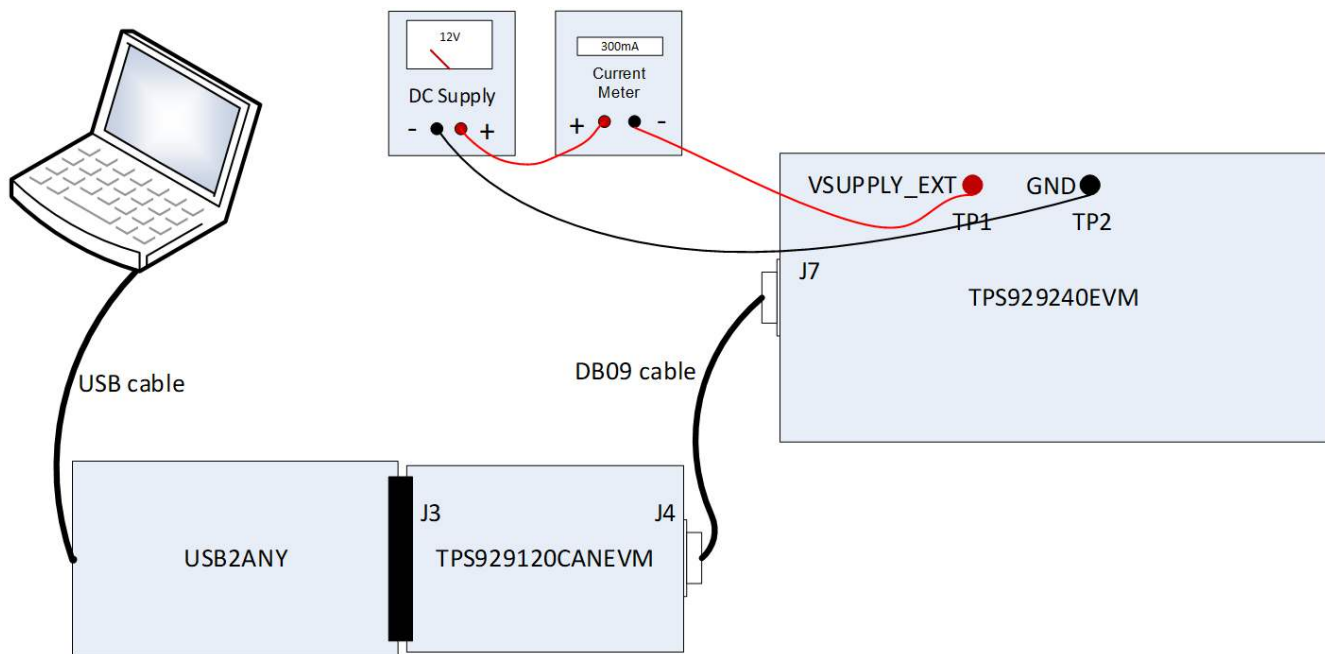

**Figure 3-2. TPS929240EVM Jumper Configurations without TPS929120CANEVM Connected**

**Table 3-1. TPS929240EVM Jumpers Setting without TPS929240CANEVM Connected**

| HEADER  | SETTING  |
|---|--|
| J6, J12, J21, J35, J44                                | Short  |
| J17, J10, J13, J16, J36, J37, J45, J46, J78, J77, J14 | Open   |
| J15   | Short "TX_C" to "RX", "RX_C" to "TX", "ERR_C" to "ERR" |
| J11   | Short "ADDR2" to "L"                                   |
| J8  | Short "ADDR1" to "L"                                   |
| J5  | Short "ADDR0" to "H"                                   |
| J1  | Short "FS0" to "H"                                     |
| J2  | Short "FS1" to "L"                                     |
| J3, J22   | Short to "VOUT"  |
| J79   | Short to "VBAT"  |
| All headers paralleled with LEDs                      | Open   |

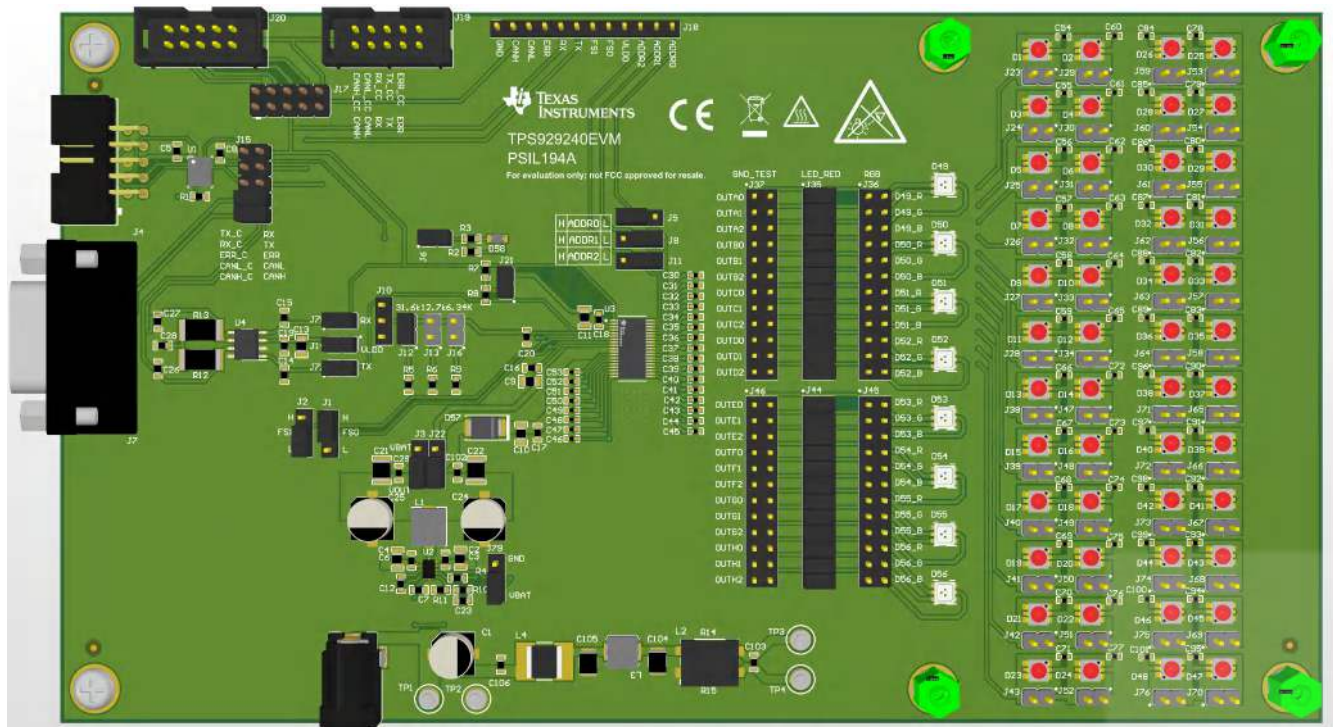
### 3.1.2 Communication with CAN Transceiver

Figure 3-3 shows the hardware setup when TPS929120CANEVM is used. Figure 3-4 shows the jumper configurations for TPS929240EVM with TPS929120CANEVM connected.



**Figure 3-3. Hardware Setup with CAN Transceiver**

- Connect a 12-V power supply to TP1 (VSUPPLY\_EXT) and TP2 (GND).
- Connect USB2ANY tool to PC through USB cable.
- Plug TPS929120CANEVM to USB2ANY tool through the J3 header of TPS929240CANEVM.
- Connect TPS929120CANEVM to TPS929240EVM through the J4 connector of TPS929240CANEVM and the J7 connector of TPS929240EVM with DB-09 cable.

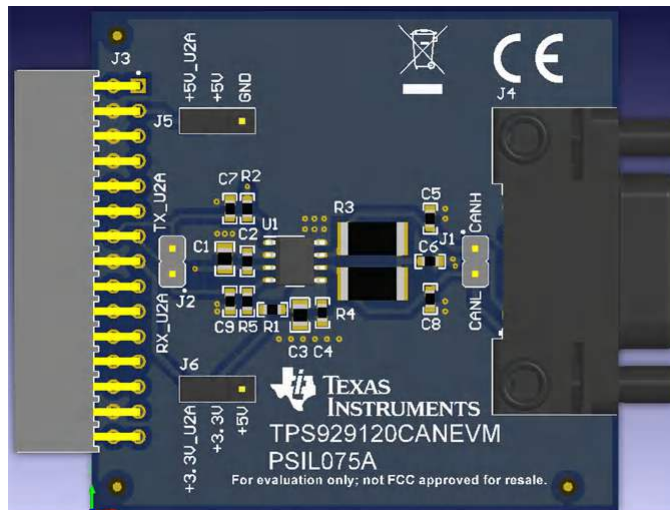


**Figure 3-4. TPS929240EVM Jumper Configurations with TPS929120CANEVM Connected**

**Table 3-2. TPS929240EVM Jumpers Setting with TPS929240CANEVM Connected**

| HEADER                                 | SETTING                                      |
|--|--|
| J6, J12, J14, J21, J77, J78, J35, J44  | Short  |
| J17, J10, J13, J16, J36, J37, J45, J46 | Open   |
| J15                                    | Short "CANH_C" to "CANH", "CANL_C" to "CANL" |
| J11                                    | Short "ADDR2" to "L"                         |
| J8                                     | Short "ADDR1" to "L"                         |
| J5                                     | Short "ADDR0" to "H"                         |
| J1                                     | Short "FS0" to "H"                           |
| J2                                     | Short "FS1" to "L"                           |
| J3, J22                                | Short to "VOUT"                              |
| J79                                    | Short to "VBAT"                              |
| All headers paralleled with LEDs       | Open   |

Figure 3-5 shows the jumper configurations for TPS929120CANEVM. For header J5, short "+ 5 V" to "+ 5 V\_U2A". For header J6, short "+ 3.3 V" to "+ 3.3 V\_U2A".



**Figure 3-5. 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 [TPS929240-Q1 EVM web page](#). Scroll down to the "Order Now" section and click the "Start Evaluation" button to reach to the TPS929240-Q1 gallery page. Login to user account privileges can be required to open the gallery page. All GUI versions are shown ordered from left to right on the gallery page as shown in [Figure 3-6](#). 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 3-6. TPS929240-Q1 Gallery Page**

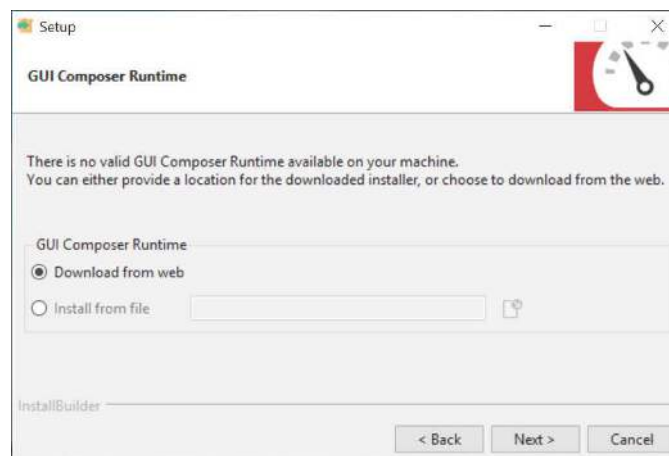
### 3.2.2 Run Applications on Desktop

Click the "Download" button under the "Order Now" section to download the TPS929240EVM GUI installation zip file to local computer, or you can download it from the application icon as showed in [Figure 3-7](#) 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 - TPS929240-Q1-1.0.5.setup-win\_7.3.0. Make sure the network is connected while installing the GUI.



**Figure 3-7. GUI and GUI Composer Download Page**

Follow the on-screen instructions by clicking the "Next" button to accept the license, default installation directory and to install the GUI Composer Runtime engine. 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 3-7](#) by selecting the appropriate platform. Continue to click on the "Next" button to complete the GUI Composer Runtime installation.



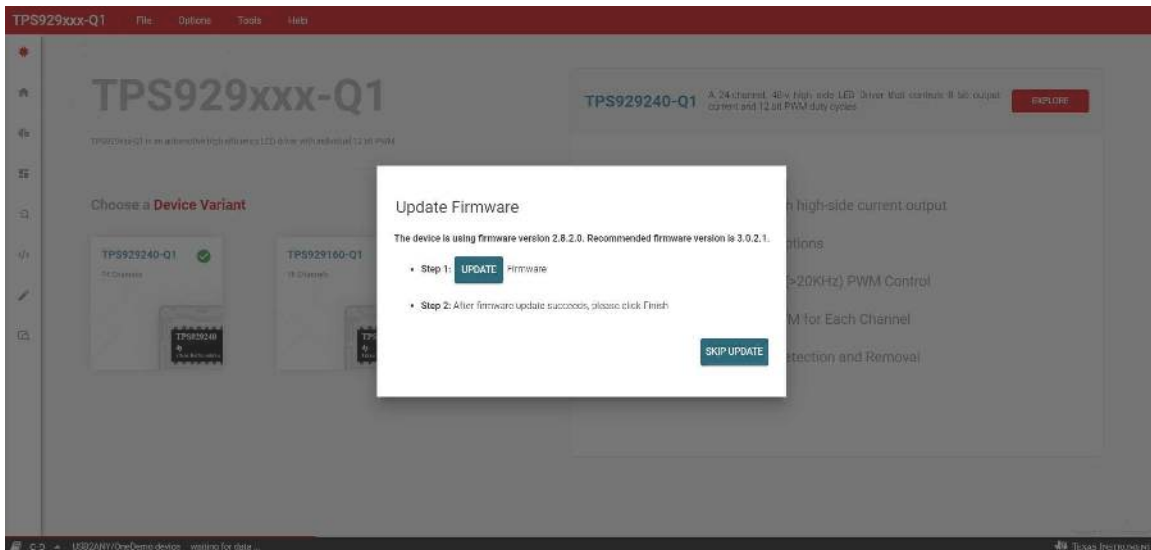
**Figure 3-8. GUI Composer Runtime Installation**

After the GUI Composer installation, it continues to install the TPS929240EVM GUI. Follow the on-screen instructions by clicking the "Next" button to finish the GUI installation. After installed, a shortcut to the GUI is found on the desktop and also in the start-up menu under the Texas Instruments folder.

### 3.3 Firmware Update

After opening the GUI, the GUI tries to connect the EVM board. At the moment, the GUI detects 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 3-9](#) to help user update the firmware in the USB2ANY. Click the update button to begin the firmware update process. After firmware update succeeds, click the finish button to close the prompt window. Then the GUI tries to connect the EVM board again with the defined device address. After it connects successfully, there is a 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.

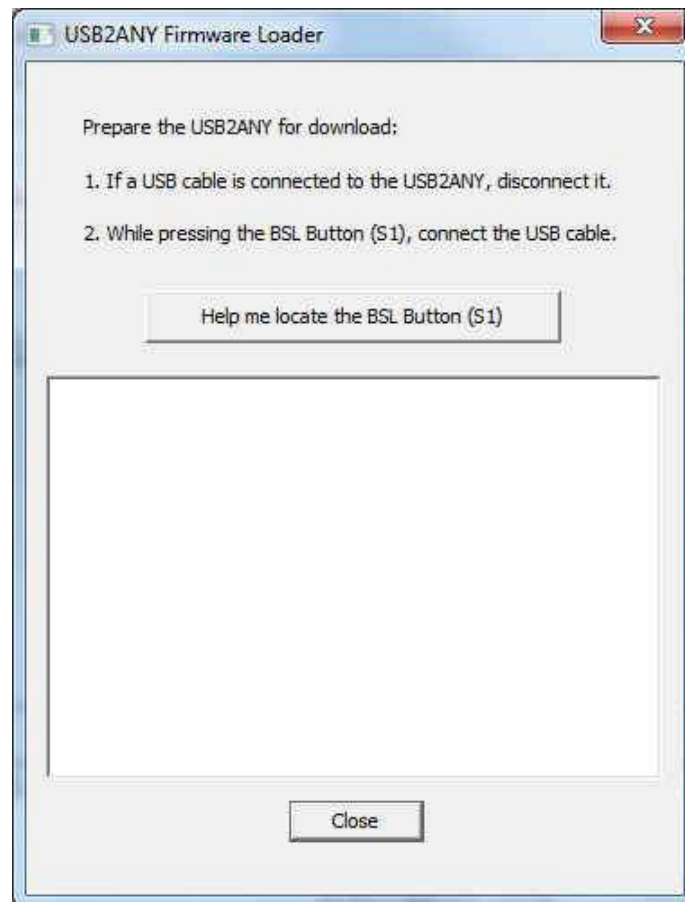




**Figure 3-9. Firmware Update Prompt Window**

If the firmware version of the USB2ANY tool is lower than 2.8.2.0 there is not firmware update prompt as showed in [Figure 3-9](#). 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. After the explorer is opened, there is a "USB2ANY Firmware Requirement" prompt. Click the "OK" button to continue. Follow the instructions on the "USB2ANY Firmware Loader" as showed in [Figure 3-10](#) to update the firmware.

After upgrading the USB2ANY firmware version to 2.8.2.0, close the USB2ANY Explorer and open the TPS929240EVM GUI again. While trying to connect the EVM board, the firmware upgrade window as showed in [Figure 3-9](#) appears.



**Figure 3-10. USB2ANY Firmware Loader**

### 3.4 GUI Function

This section provides instructions to run the TPS929240EVM using the TPS929240EVM 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 plugging it into the PC. Other operation orders may lead to the GUI working abnormally. After this action 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 must be checked. When the CAN board is not connected, leave 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. Check the connection status on the home page where there is a green check mark on the left side of the TPS929240-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. 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. Click the button to connect to hardware if hardware is not connected or to disconnect from hardware while hardware connected.

To connect the GUI to device successfully, set the correct device address on the GUI to map the real device address. See the [TPS929240-Q1 12-Channel Automotive 40-V High-Side LED Driver with FlexWire 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.

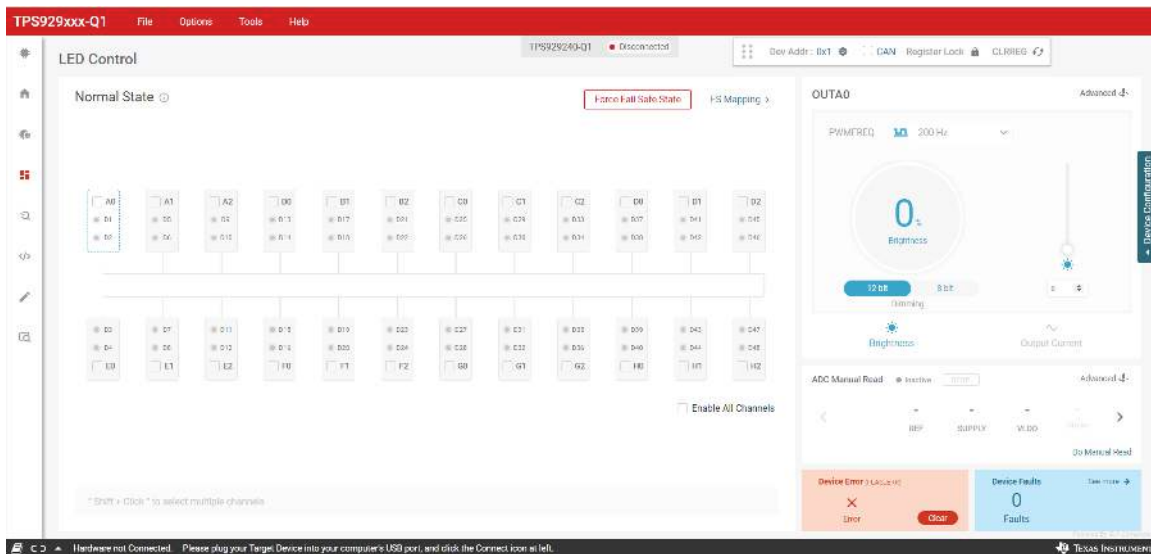
On the EVM board, the ADDR0, ADDR1 and ADDR2 can be configured as High or Low through "J5", "J8" and "J11" connectors. On the GUI page you can directly enter the specified value through the "Device Address" widget.



**Figure 3-11. TPS929240EVM GUI Connection Status**

### 3.4.2 LED Control Page

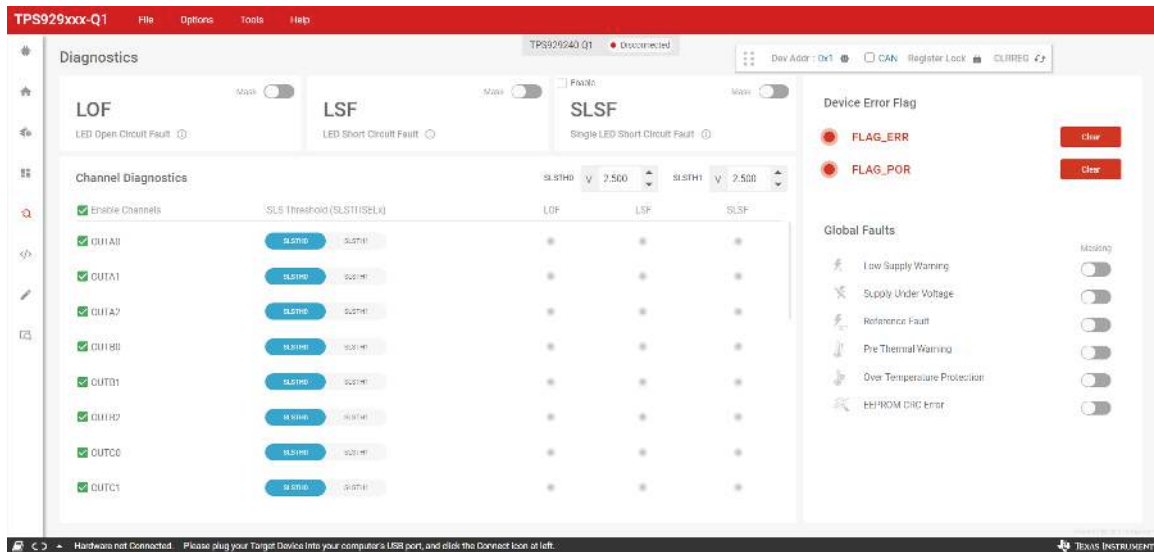
Figure 3-12 shows the registers page. On the left side, you can select one or more channels to control. On the right side, you can change the current and PWM of the selected channel. The ADC value and error flag is shown on the right. The green button called "Device Configuration" is used to make an advanced setup.



**Figure 3-12. TPS929240EVM GUI LED Control Page**

### 3.4.3 Diagnostics Page

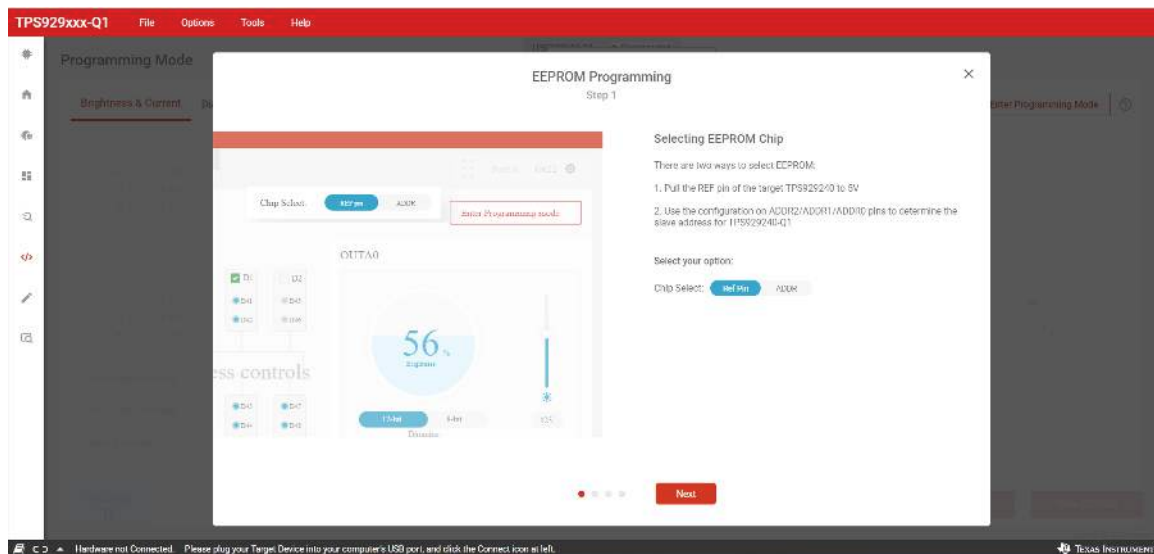
The diagnostics page monitors the status of each channel of the TPS929240EVM and shows the corresponding protection features.



**Figure 3-13. TPS929240EVM GUI Diagnostics Page**

### 3.4.4 EEPROM Programming Page

The device supports two programming modes for different applications: either with chip select or external address select. [Figure 3-14](#) shows the EEPROM programming page. Click "Enter Programming Mode" to enter the EEPROM mode and change the corresponding register value. "Read EEPROM" is used to get the value from the TPS929240EVM. After changing the value, click "Write EEPROM" button. Then the all the current configuration value really overwrites the corresponding EEPROM registers.



**Figure 3-14. TPS929240EVM GUI EEPROM Page**

### 3.4.5 Registers Page

[Figure 3-15](#) 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.

Jumping to other pages from the programming page or clicking "Exit PROG mode" button automatically forces the device exit EEPROM programming mode through clearing CONF\_STAYINEEP method, which means the newly modified EEPROM registers value do 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.

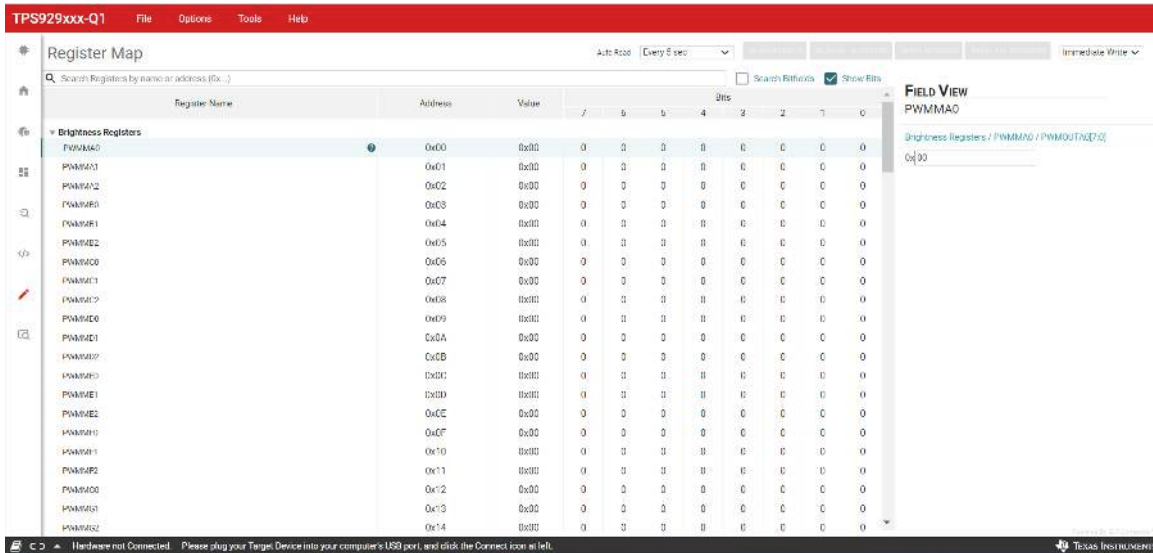


Figure 3-15. TPS929240EVM GUI Register Page

### 3.4.6 Debug Page

Figure 3-16 shows the debug function of the GUI. This function can calculate the corresponding CRC value based on the communication protocol of the TPS929240 and send the complete data. This page allows you to program and debug the TPS929240.

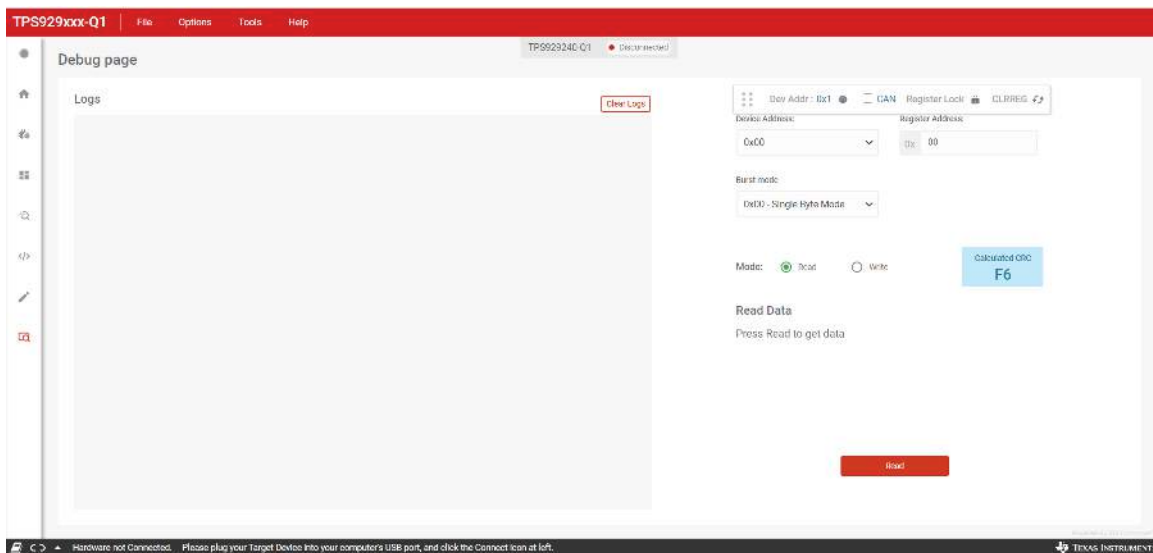


Figure 3-16. TPS929240EVM GUI Debug Page

## 4 Board Layout

Figure 4-1 and Figure 4-2 show the PCB layout of TPS929240EVM.

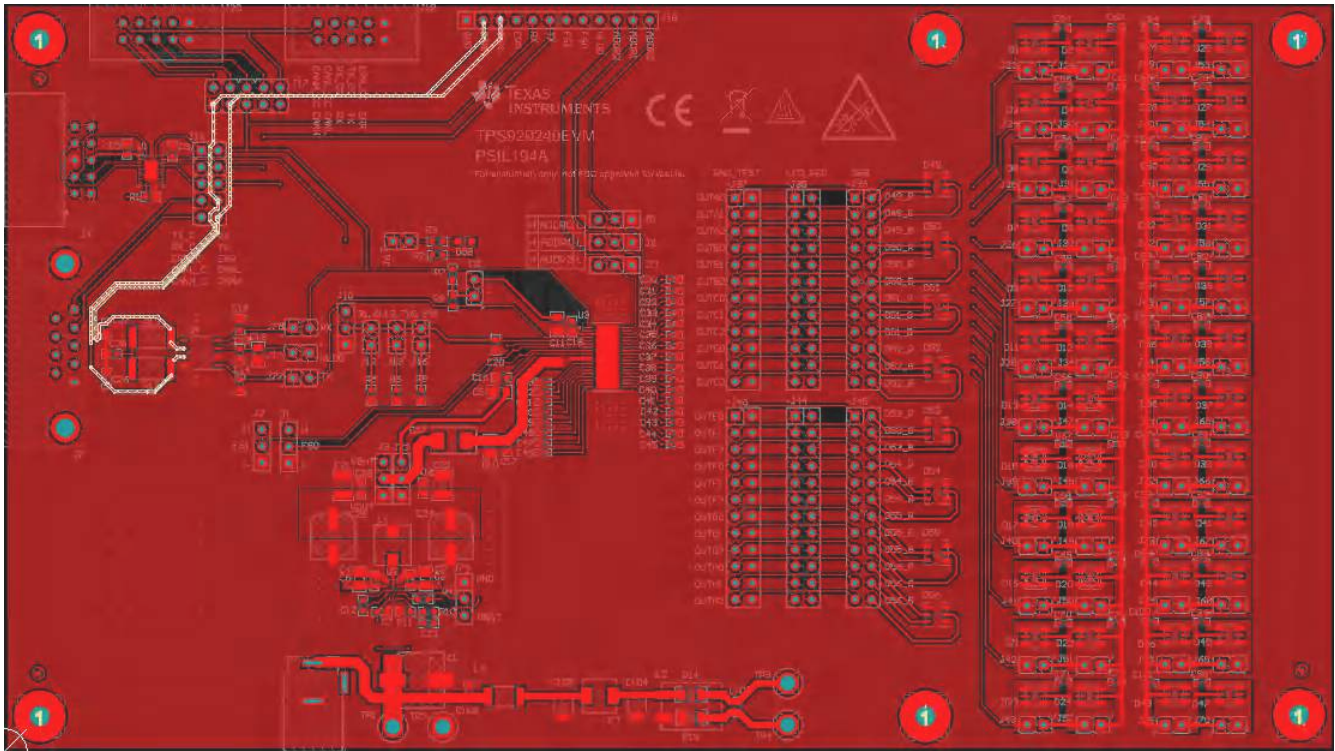


Figure 4-1. Top Layer Routing

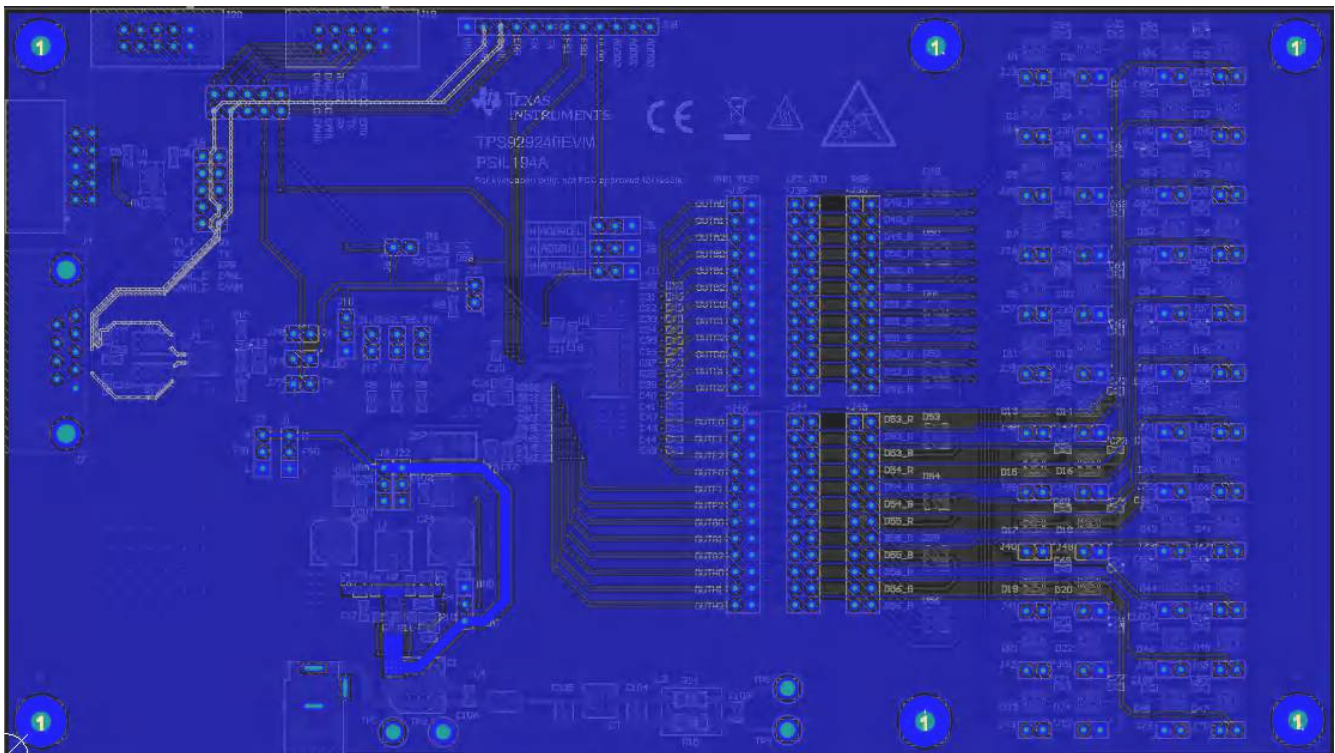


Figure 4-2. Bottom Layer Routing (Mirrored)

## 4.1 Schematic

Figure 4-3 is the TPS929240EVM schematic.

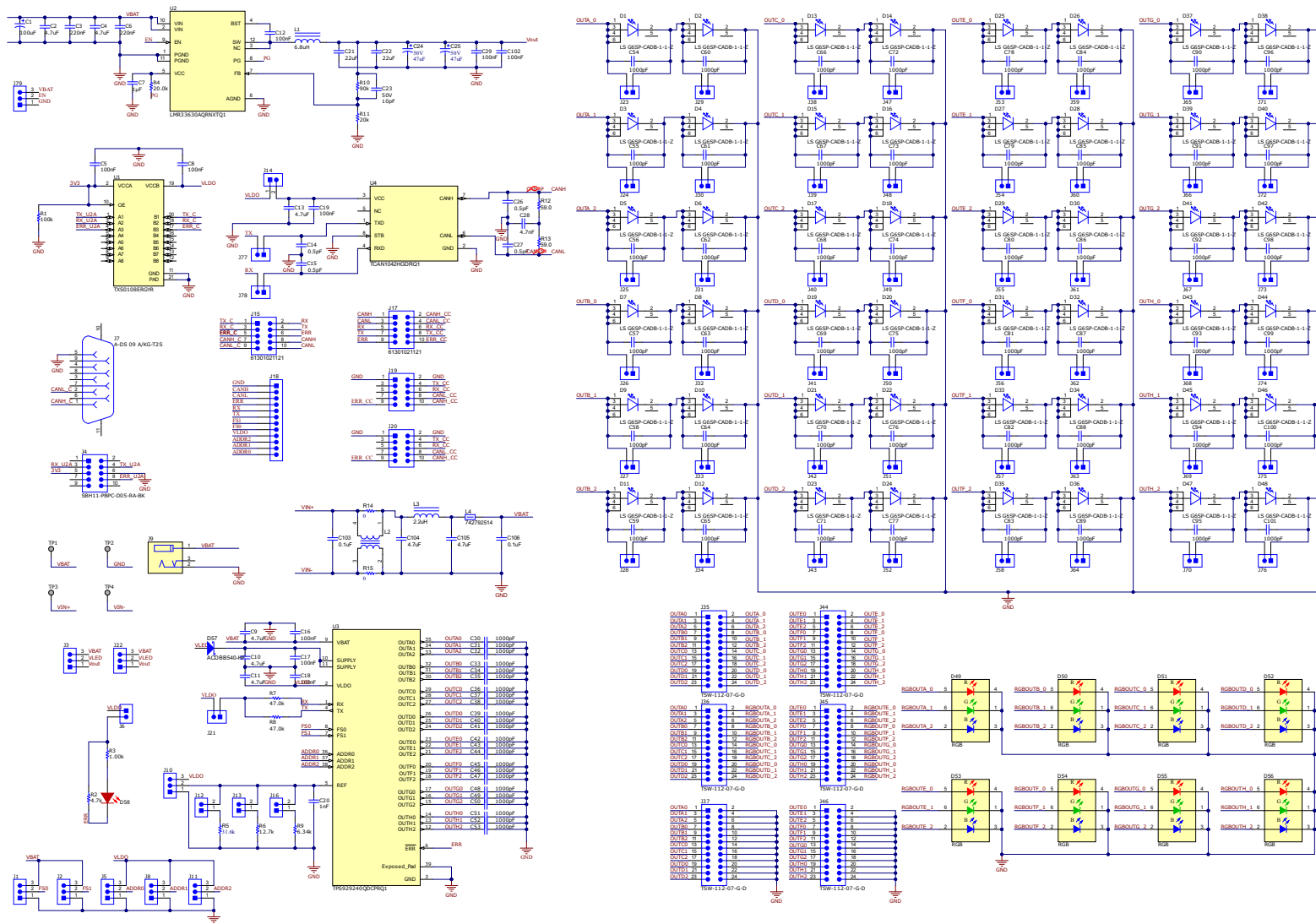


Figure 4-3. TPS929240EVM Schematic Diagram

## 4.2 BOM

Table 4-1 lists the TPS929240EVM BOM.

**Table 4-1. Bill of Materials (BOM)**

| DESIGNATOR   | DESCRIPTION   | MANUFACTURER              | PART NUMBER                       | QTY |
|--|---|---------------------------|-----------------------------------|-----|
| C1   | CAP, AL, 100 uF, 50 V, +/- 20%, SMD                             | Chemi-Con                 | EMVA500ADA101MHA0G                | 1   |
| C2, C4, C9, C10, C11, C13  | CAP, CERM, 4.7 uF, 50 V, +/- 10%, X5R, 0805                     | TDK                       | C2012X5R1H475K125AB               | 6   |
| C3, C6   | CAP, CERM, 0.22 uF, 50 V, +/- 10%, X7R, 0603                    | TDK                       | C1608X7R1H224K080AB               | 2   |
| C5, C8, C12, C16, C17, C18, C19, C29, C102   | CAP, CERM, 0.1 uF, 25 V, +/- 10%, X7R, 0603                     | AVX                       | 06033C104KAT2A                    | 9   |
| C7   | CAP, CERM, 1 uF, 25 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603     | TDK                       | CGA3E1X7R1E105K080AD              | 1   |
| C14, C15, C26, C27   | CAP, CERM, 0.5 pF, 50 V, +/- 50%, C0G/NP0, 0603                 | Kemet                     | C0603C508C5GACTU                  | 4   |
| C20  | CAP, CERM, 1000 pF, 50 V, +/- 5%, X7R, AEC-Q200 Grade 1, 0603   | Kemet                     | C0603C102J5RACAUTO                | 1   |
| C21, C22   | CAP, CERM, 22 uF, 25 V, +/- 10%, X5R, 1210                      | Samsung Electro-Mechanics | CL32A226KAJNNNE                   | 2   |
| C23  | CAP, CERM, 10 pF, 50 V, +/- 5%, C0G/NP0, 0603                   | MuRata                    | GRM1885C1H100JA01D                | 1   |
| C24, C25   | CAP, AL, 47 uF, 50 V, +/- 20%, 0.68 ohm, SMD                    | Nichicon                  | UUD1H470MCL1GS                    | 2   |
| C28  | CAP, CERM, 4700 pF, 100 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603 | TDK                       | CGA3E2X7R2A472K080AA              | 1   |
| 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, C62, C63, C64, C65, C66, C67, C68, C69, C70, C71, C72, C73, C74, C75, C76, C77, C78, C79, C80, C81, C82, C83, C84, C85, C86, C87, C88, C89, C90, C91, C92, C93, C94, C95, C96, C97, C98, C99, C100, C101 | CAP, CERM, 1000 pF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402  | TDK                       | CGA2B2X7R1H102K050BA              | 72  |
| C103, C106   | CAP, CERM, 0.1 uF, 16 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603   | TDK                       | CGJ3E2X7R1C104K080AA              | 2   |
| C104, C105   | CAP, CERM, 4.7 uF, 50 V, +/- 20%, X7R, AEC-Q200 Grade 1, 1210   | TDK                       | CGA6P3X7R1H475M250AB              | 2   |
| D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12, D13, D14, D15, D16, D17, D18, D19, D20, D21, D22, D23, D24, D25, D26, D27, D28, D29, D30, D31, D32, D33, D34, D35, D36, D37, D38, D39, D40, D41, D42, D43, D44, D45, D46, D47, D48  | LED, Super Red, SMD   | OSRAM                     | LS G6SP-CADB-1-1-Z                | 48  |
| D49, D50, D51, D52, D53, D54, D55, D56   | LED, RGB, SMD   | OSRAM                     | LRTB GVSG-UEVE-24+AMAQ-29+SCUC-HR | 8   |
| D57  | Diode, Schottky, 40 V, 5 A, AEC-Q101, SMB                       | Comchip Technology        | ACDDB540-HF                       | 1   |
| D58  | LED, Red, SMD   | OSRAM                     | LS R976-NR-1                      | 1   |



**Table 4-1. Bill of Materials (BOM) (continued)**

| DESIGNATOR  | DESCRIPTION  | MANUFACTURER                | PART NUMBER          | QTY |
|---|--|-----------------------------|----------------------|-----|
| H1, H2, H3, H4, H13, H16  | Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead                  | B&F Fastener Supply         | NY PMS 440 0025 PH   | 6   |
| H5, H6, H7, H8, H12, H15  | Standoff, Hex, 0.5"L #4-40 Nylon   | Keystone                    | 1902C                | 6   |
| H9, H10, H11, H14   | Standoff, Hex, Male/Female, 4-40, Nylon, 1/2"                              | Keystone                    | 4802                 | 4   |
| J1, J2, J3, J5, J8, J10, J11, J22, J79  | Header, 100mil, 3x1, Gold, TH  | Sullins Connector Solutions | PBC03SAAN            | 9   |
| J4  | Header(shrouded), 2.54mm, 5x2, Gold, R/A, TH                               | Sullins Connector Solutions | SBH11-PBPC-D05-RA-BK | 1   |
| J6, J12, J13, J14, J16, J21, J23, J24, J25, J26, J27, J28, J29, J30, J31, J32, J33, J34, J38, J39, J40, J41, J42, J43, J47, J48, J49, J50, J51, J52, J53, J54, J55, J56, J57, J58, J59, J60, J61, J62, J63, J64, J65, J66, J67, J68, J69, J70, J71, J72, J73, J74, J75, J76, J77, J78 | Header, 100mil, 2x1, Gold, TH  | Sullins Connector Solutions | PBC02SAAN            | 56  |
| J7  | D-Sub, 2.77mm, 9 Pos, Tin, R/A, TH   | Assman WSW                  | A-DS 09 A/KG-T2S     | 1   |
| J9  | WR-DC DC Power Jack, R/A, TH   | Würth Elektronik            | 694106301002         | 1   |
| J15, J17  | Header, 2.54 mm, 5x2, Gold, TH   | Würth Elektronik            | 61301021121          | 2   |
| J18   | Header, 100mil, 12x1, Gold, TH   | Samtec                      | TSW-112-07-G-S       | 1   |
| J19, J20  | Header(shrouded), 2.54mm, 5x2, Gold, TH                                    | Sullins Connector Solutions | SBH11-PBPC-D05-ST-BK | 2   |
| J35, J36, J37, J44, J45, J46  | Header, 100mil, 12x2, Gold, TH   | Samtec                      | TSW-112-07-G-D       | 6   |
| L1  | Inductor, Shielded, Ferrite, 6.8 uH, 4 A, 0.0762 ohm, SMD                  | Bourns                      | SRP5030T-6R8M        | 1   |
| L2  | Coupled inductor, 5 A, 0.01 ohm, SMD                                       | TDK                         | ACM9070-701-2PL-TL01 | 1   |
| L3  | Inductor, Shielded Drum Core, Powdered Iron, 2.2 uH, 5.5 A, 0.025 ohm, SMD | Vishay-Dale                 | IHLP2020CZER2R2M11   | 1   |
| L4  | Ferrite Bead, 600 ohm @ 100 MHz, 3 A, 1812                                 | Würth Elektronik            | 742792514            | 1   |
| R1  | RES, 100 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603                              | Vishay-Dale                 | CRCW0603100KFKEA     | 1   |
| R2  | RES, 4.7 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603                              | Panasonic                   | ERJ-3GEYJ472V        | 1   |
| R3  | RES, 1.00 k, 1%, 0.1 W, 0603   | Panasonic                   | ERJ-3EKF1001V        | 1   |
| R4  | RES, 20.0 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603                             | Vishay-Dale                 | CRCW060320K0FKEA     | 1   |
| R5  | RES, 31.6 k, 1%, 0.1 W, 0603   | Vishay-Dale                 | CRCW060331K6FKEA     | 1   |
| R6  | RES, 12.7 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603                             | Vishay-Dale                 | CRCW060312K7FKEA     | 1   |
| R7, R8  | RES, 47.0 k, 1%, 0.1 W, 0603   | Yageo                       | RC0603FR-0747KL      | 2   |
| R9  | RES, 6.34 k, 1%, 0.1 W, 0603   | Yageo                       | RC0603FR-076K34L     | 1   |
| R10   | RES, 100 k, 1%, 0.1 W, 0603  | Yageo                       | RC0603FR-07100KL     | 1   |
| R11   | RES, 24.9 k, 1%, 0.1 W, 0603   | Yageo                       | RC0603FR-0724K9L     | 1   |
| R12, R13  | RES, 59.0, 1%, 1 W, AEC-Q200 Grade 0, 2512                                 | Stackpole Electronics Inc   | RMCF2512FT59R0       | 2   |
| R14, R15  | RES, 0, 5%, 0.25 W, AEC-Q200 Grade 0, 1206                                 | Vishay-Dale                 | CRCW12060000Z0EA     | 2   |

**Table 4-1. Bill of Materials (BOM) (continued)**

| DESIGNATOR  | DESCRIPTION  | MANUFACTURER                | PART NUMBER      | QTY |
|---|--|-----------------------------|------------------|-----|
| 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, SH-J26, SH-J27, SH-J28, SH-J29, SH-J30, SH-J31, SH-J32, SH-J33, SH-J34, SH-J35, SH-J36, SH-J37, SH-J38 | Shunt, 100mil, Flash Gold, Black   | Sullins Connector Solutions | SPC02SYAN        | 38  |
| TP1, TP2, TP3, TP4  | Terminal, Turret, TH, Double   | Keystone                    | 1502-2           | 4   |
| U1  | 8-Bit Bidirectional Voltage-Level Shifter For Open-Drain And Push-Pull Application, RGY0020A (VQFN-20) | Texas Instruments           | TXS0108ERGYR     | 1   |
| U2  | Automotive 3.8-V to 36-V 3-A Synchronous Step-Down Voltage Regulator, RNX0012B (VQFN-HR-12)            | Texas Instruments           | LMR33630AQRNXTQ1 | 1   |
| U3  | 24-Channel Automotive 40-V High-Side (O)LED Driver   | Texas Instruments           | TPS929240QDCPRQ1 | 1   |
| U4  | Automotive Fault Protected CAN Transceiver With Flexible Data-Rate, D0008A (SOIC-8)                    | Texas Instruments           | TCAN1042HGDRQ1   | 1   |

## STANDARD TERMS FOR EVALUATION MODULES

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  - 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:*
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  - 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 DEGRADATION 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/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/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。  
[http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page)

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.

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#### 3.4 European Union

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

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

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#### 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.

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