

EVM User's Guide: LP5813EVM LP5812EVM

LP5813-12 Evaluation Module



Description

The LP5813/12 Evaluation Module showcases all the features of the LP5813 and LP5812 4 × 3 matrix RGB LED driver with autonomous control. The difference between 2 devices is with or without synchronous boost function. Both LP5813 and LP5812 are placed on 1 board, please select the device which is needed to be evaluated by USB2ANY connector and jumper setting. And please select the right EVM version according to different package (WSON/WCSP). The graphical user interface or GUI called LP581x GUI is used to interface with USB to the EVM by the USB2ANY interface adapter.

Get Started

1. Request the LP5813-12 WCSP/WSON EVM from [ti.com](https://www.ti.com) according to the device package.
2. Request the LP5813 and LP5812 data sheet from [ti.com](https://www.ti.com).

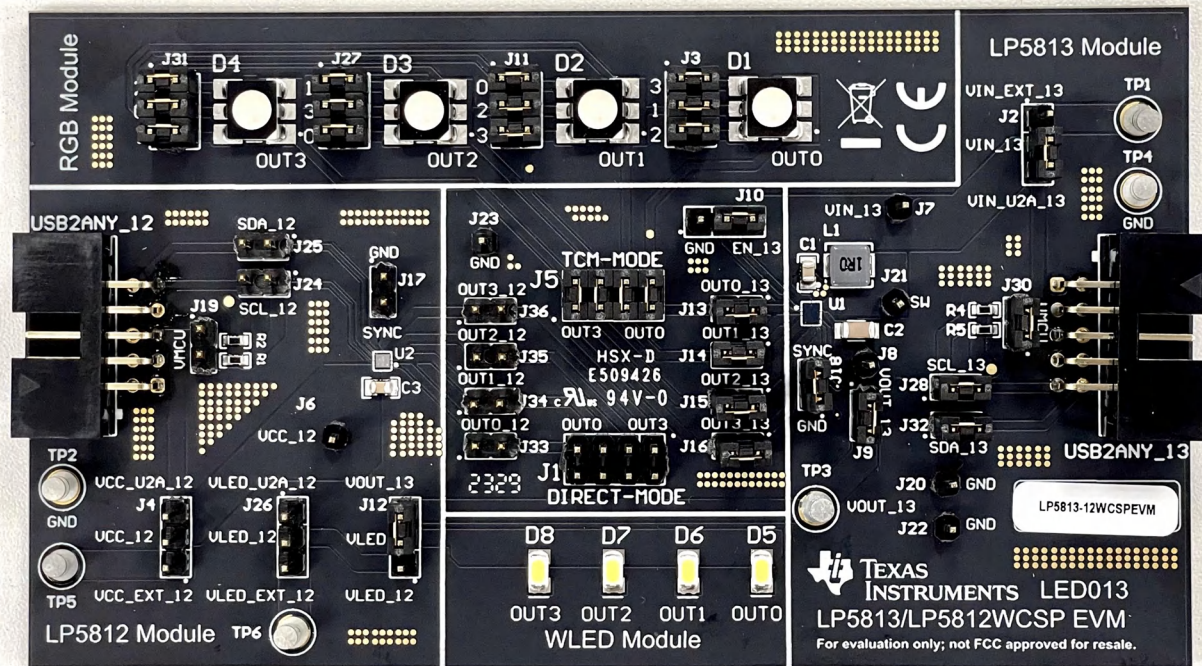
3. Download the LP581xGUI from [ti.com](https://www.ti.com).
4. Download the comprehensive reference design files.

Features

- LP5813 Synchronous Boost 4 × 3 Matrix RGB LED driver with autonomous control
- LP5812 4 × 3 Matrix RGB LED driver with autonomous control
- I2C input and power supply from USB2ANY interface adapter
- LP581x GUI is used to control the EVM

Applications

- **Portable and wearable electronics:** e-cigarette, earbuds and charging case
- **Gaming and home entertainment:** smart speaker, RGB mouse, video doorbell
- **Industrial HMI:** EV charger, factory automation



Hardware Image

1 Evaluation Module Overview

1.1 Introduction

The LP5813/LP5812EVM can be converted for testing the LP5811/LP5810, which are from the same device family, by removing the factory-installed device (U1/U2) and replacing with the LP5811/LP5810 counterpart. When testing the LP5811 device, select the direct mode jumper setting and corresponding tag from the menu on the GUI start page to start evaluation.

This user's guide describes the characteristics, setup, and usage of the LP5813/LP5812 evaluation module (EVM). The LP5813/LP5812EVM helps the user evaluate the features of the Texas Instruments LP5813 synchronous boost 4 × 3 matrix RGB LED driver and LP5812 4 × 3 matrix RGB LED driver, which integrate autonomous control.

This document covers following topics:

- Hardware setup instructions
- Graphical user interface (GUI) instructions
- Printed-circuit board (PCB) layout drawings
- Schematic diagram
- Bill of materials

1.2 Kit Contents

The LP5813/12EVM kit includes the following materials and is illustrated in [Figure 1-1](#).

- LP5813/LP5812 evaluation module
- USB2ANY interface adapter with ribbon cables and USB cable

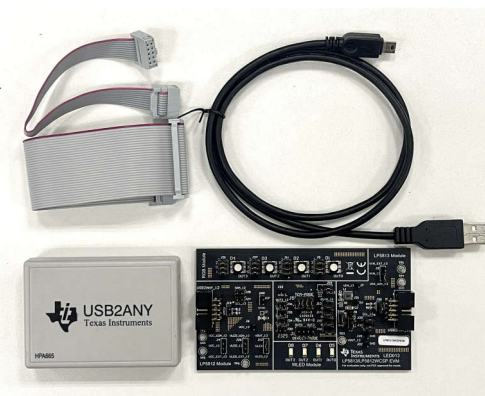


Figure 1-1. LP5813/12EVM Kit

1.3 Specification

The evaluation module provides several inputs. The inputs are I2C signal input and power supplies for Vin. Vin is provided by an external power supply or a USB2ANY interface adapter.

1.4 Device Information

The LP5813-12EVM is used to evaluate the characteristics, operation, and usage for LED driver LP5813/LP5812. The LP5813 device is a high-performance and small-size device, which integrates synchronous boost and autonomous engine, with time-cross-multiplexing (TCM) structure. LP5813 can drive up to 12 LED dots with only 4 output pins. The difference between LP5813 and LP5812 is that LP5812 does not have boost function. Typical application for LP5813 is shown in [Figure 1-2](#).

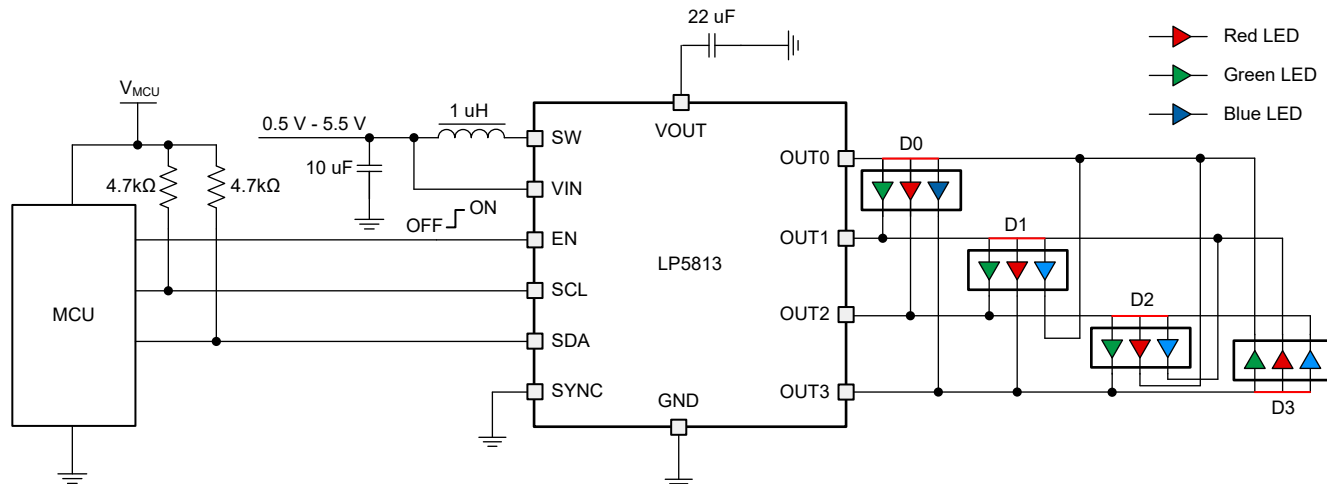


Figure 1-2. LP5813 Simplified Schematic

2 Hardware

2.1 Setup

This section describes how to set up the LP5813-12EVM properly. Items from the following list are required to begin evaluating the LP5813/LP5812:

- Computer
- LP5813-12EVM
- USB2ANY interface adapter

In the default jumper setting, the board can be evaluated by USB2ANY power directly and does not need an external power supply. Setup connection is demonstrated in [Figure 2-1](#). The setup procedure is as follows:

1. Connect the USB2ANY with the LP5813-12EVM using the ribbon cable.
2. Make sure all jumpers are properly set under the appropriate operating conditions. See more details in [Jumper Information](#).
3. Plug the USB cable into the USB port on the computer.

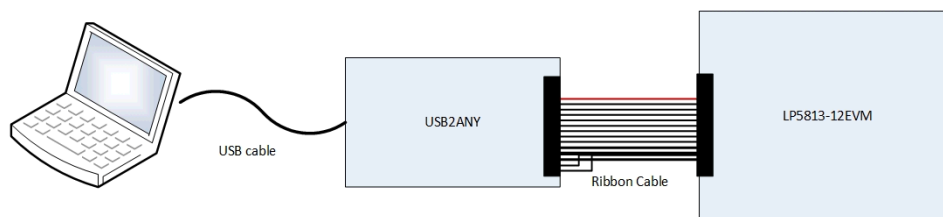


Figure 2-1. Hardware Connection

2.2 Jumper Information

Note

Only one device can be evaluated at a time. Select LP5813/LP5812 by the USB2ANY connector and jumper setting.

If LP5813 is under test, then please plug ribbon cable to USB2ANY_13 connector.

If LP5812 is under test, then please plug ribbon cable to USB2ANY_12 connector.

On the default jumper setting, users can evaluate LP5813 under the conditions below:

- Vin is provided by 3.3V from USB2ANY(Don't need external power supply).
- Synchronous boost is enabled.
- 4-SCAN TCM mode (Drive 12 LED dots with 4 outputs).

Figure 2-2 shows the default jumper settings.

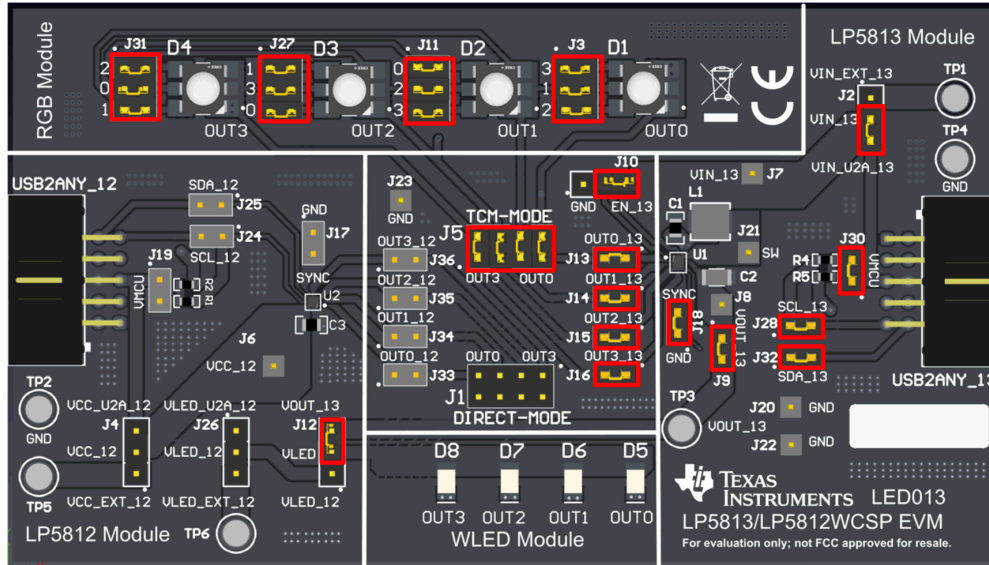


Figure 2-2. Default Jumper Setting

Users can follow the jumper setting instructions below to test the LP5813/LP5812 under different operating conditions.

Figure 2-3 shows the jumper setting for LP5813 in Direct mode and enable boost function without external power supply.

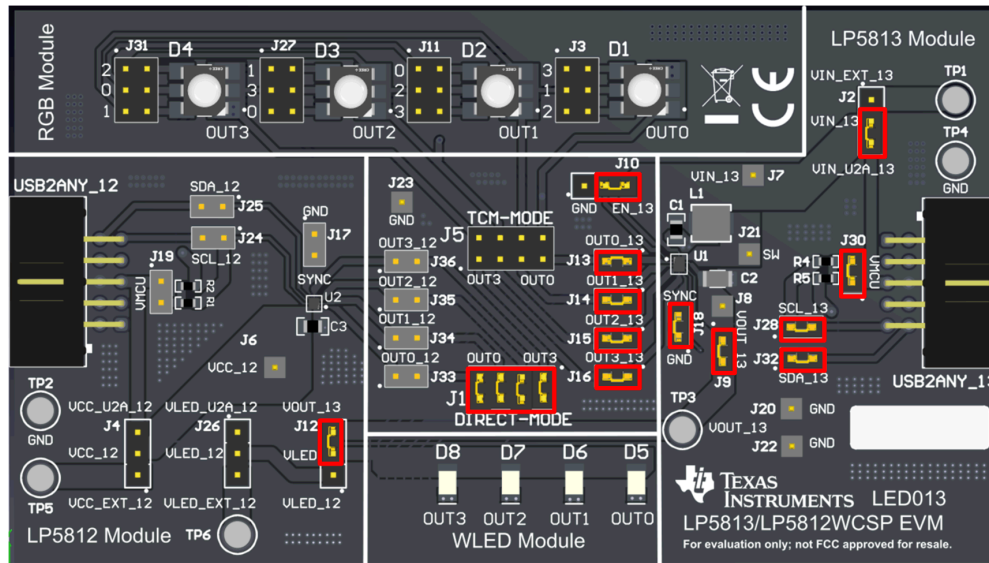


Figure 2-3. LP5813 Direct Mode and Enable Boost without External Power Supply

Figure 2-4 shows the jumper setting for LP5813 in TCM mode and disable boost function.

Under this condition, the device needs to be powered by Vout instead of Vin.

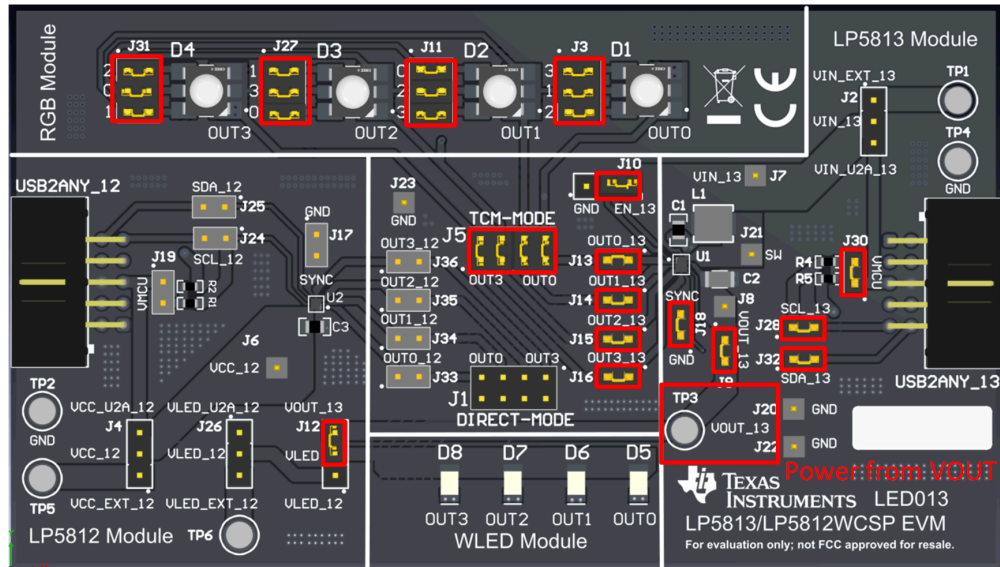


Figure 2-4. LP5813 4-SCAN TCM Mode and Disable Boost with External Power Supply

Figure 2-5 shows the jumper setting for LP5812 in TCM mode without external power supply.

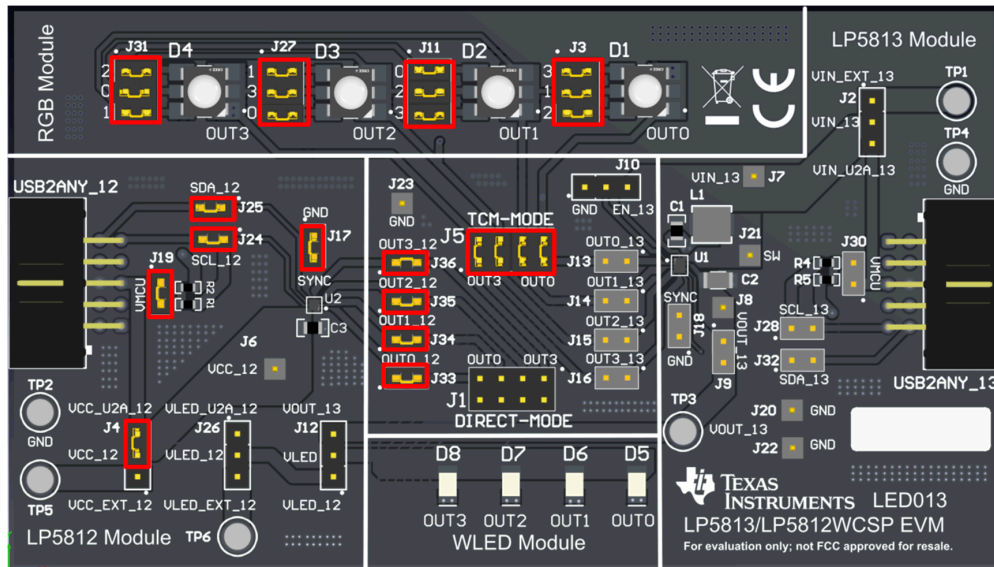


Figure 2-5. LP5812 4-SCAN TCM Mode without External Power Supply

Figure 2-6 shows the jumper setting for LP5812 in Direct mode without external power supply

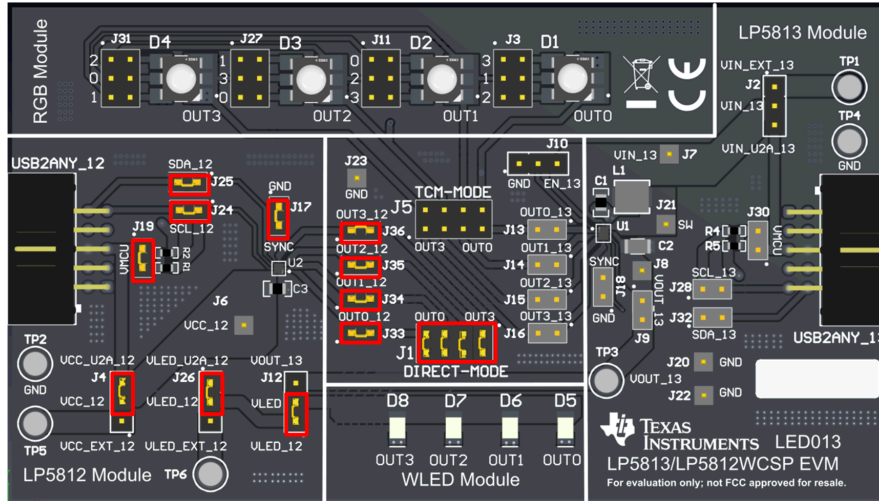


Figure 2-6. LP5812 Direct Mode without External Power Supply

Note

If the user wants to evaluate LP5813, then please connect J13-J16 and disconnect J33-J36. Each output from LP5813/LP5812 cannot be connected to both J5 and J1. For example, if the user wants to use Mix-Drive mode with 3-SCAN, and chose OUT3 as direct drive, then please connect OUT3 to J1 and OUT0/OUT1/OUT2 to J5. Please see Figure 2-7 for more details.

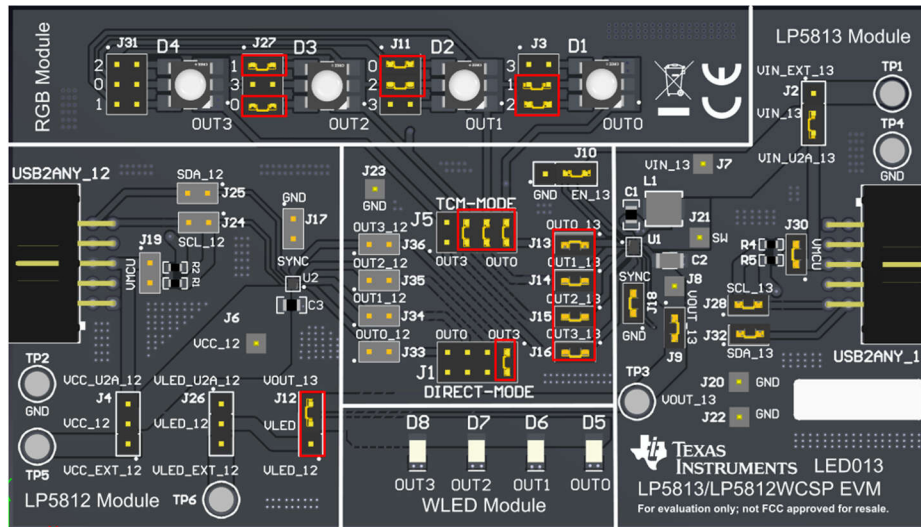


Figure 2-7. 3-SCAN Mix-Drive Mode

2.3 Power Supply

If the input current need to be measured, then an external VIN/VCC supply is recommended during evaluation.

1. Connect the USB2ANY to the LP5813-12EVM using the ribbon cable.
2. Connect a 1.8-5.5V external power supply to the VIN_EXT/VCC_EXT terminal (TP1 for LP5813/TP5 for LP5812) and connect the switching jumper (J2/J4) to VIN_EXT.
3. If the user wants to evaluate LP5813 but disable the boost function, then please provide power supply from Vout instead of VIN.
4. Plug the USB cable into the USB port on the computer.

3 Software

3.1 Software Description

The following sections describe how to set up the GUI properly. Items from the following list are required to begin evaluating the LP5813/LP5812:

- LP581XEVM-GUI software

3.2 GUI Installation

Users can install the LP581xGUI software from the link: [LP581xGUI](#).

After the Gallery page, click the *download* button to install the offline version to the user's computer. See [Figure 3-1](#).

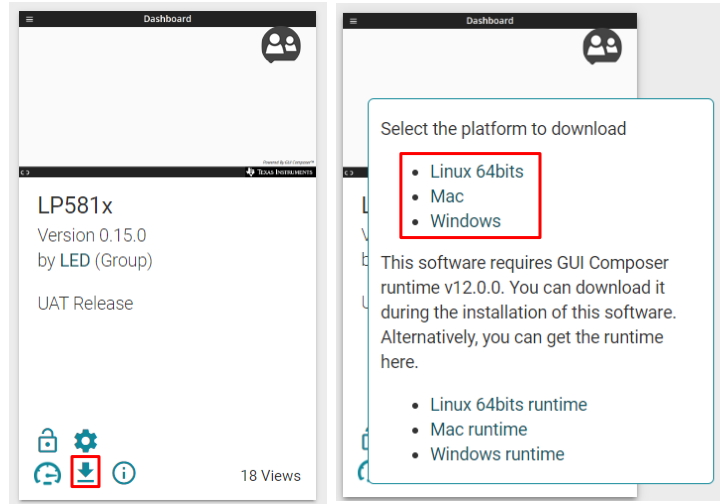


Figure 3-1. Gallery Page

Follow the setup wizard to install the LP581XEVM-GUI successfully. See [Figure 3-2](#).

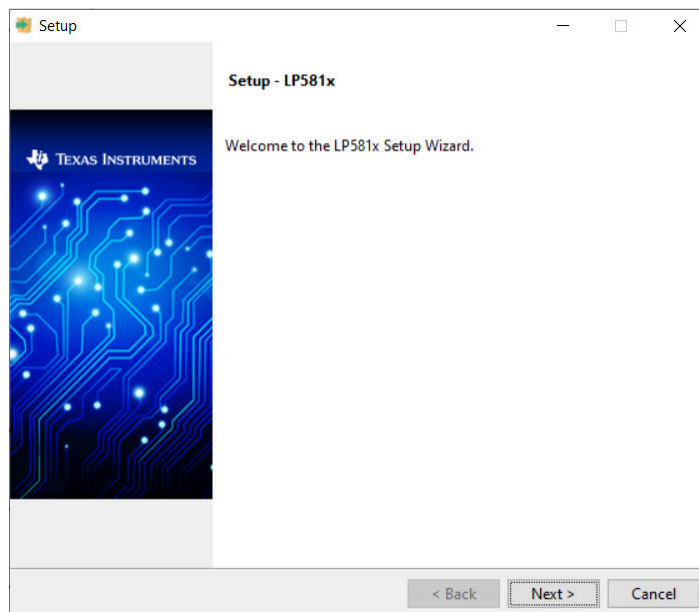


Figure 3-2. Setup Wizard

3.3 Graphical User Interface (GUI) Guidance

The LP581x GUI is a convenient tool to control and evaluate all functions of LP581x family. Open the LP581x.exe file and plug the USB cable into the USB port of the computer. The GUI automatically connects with the LP5813-12EVM. [Figure 3-3](#) illustrate the status bar showing the connection status at the bottom of GUI. *Hardware Connected* shows in the status and the indicator in the USB2ANY stops blinking when successfully connected. Click the *connection* button to connect or disconnect the LP5813-12EVM with the GUI.

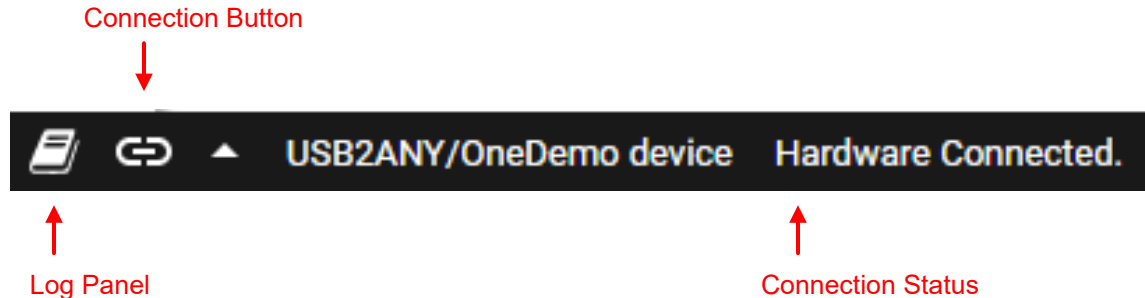


Figure 3-3. Status Bar

If the USB2ANY has been used to evaluate other EVMs and updated by other firmware version (such as, 2.8.2.0), then the correct firmware version must be updated into USB2ANY. Follow the instructions shown in the GUI when plugging in the USB cable to update the firmware successfully. See [Figure 3-4](#).



Figure 3-4. Firmware Update

If the USB2ANY has not been previously used to evaluate any EVM before, then an unknown version firmware is detected by GUI. When the update firmware notification shows up, follow these steps.

1. Unplug the USB cable (do not click the *UPDATE* button).
2. Press the BSL button inside USB2ANY, then plug in the USB cable.
3. Click *UPDATE* button.

Start Page

Different device variants in the LP581x family are selected from the *Start Page*. The default setting of EVM is for LP5813, so to begin evaluation, select the *LP5813* tab then click the *EXPLORE* button to begin evaluation. See [Figure 3-5](#).

After clicking *EXPLORE* button, the GUI helps navigate users to the *Hardware Set-up* page. Click *FINISH* button when the hardware has been set properly. See [Figure 3-6](#).

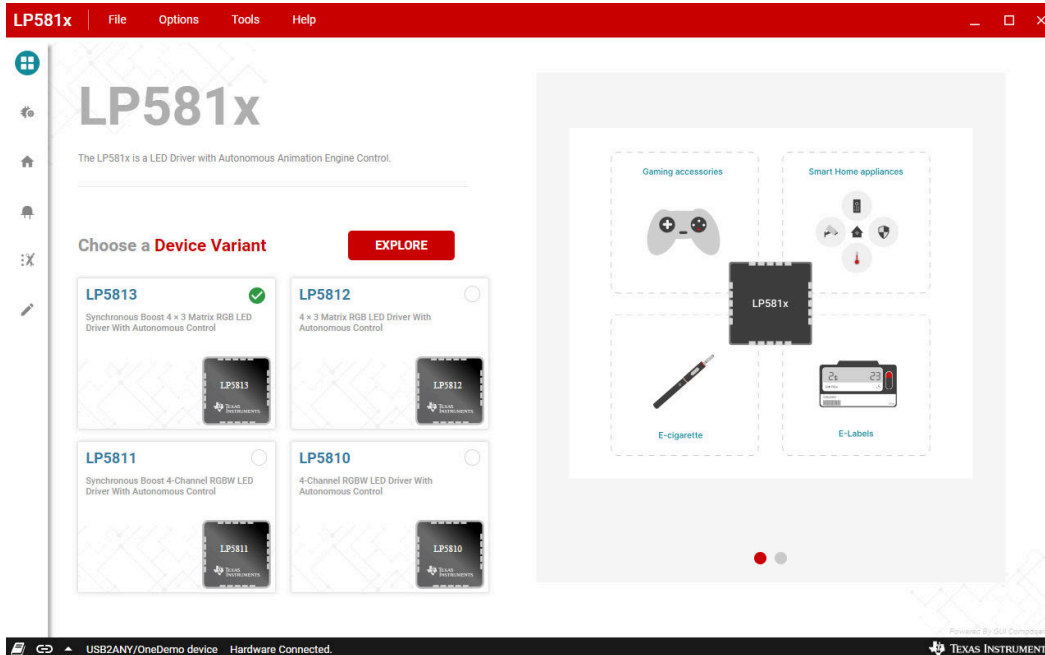


Figure 3-5. Start Page

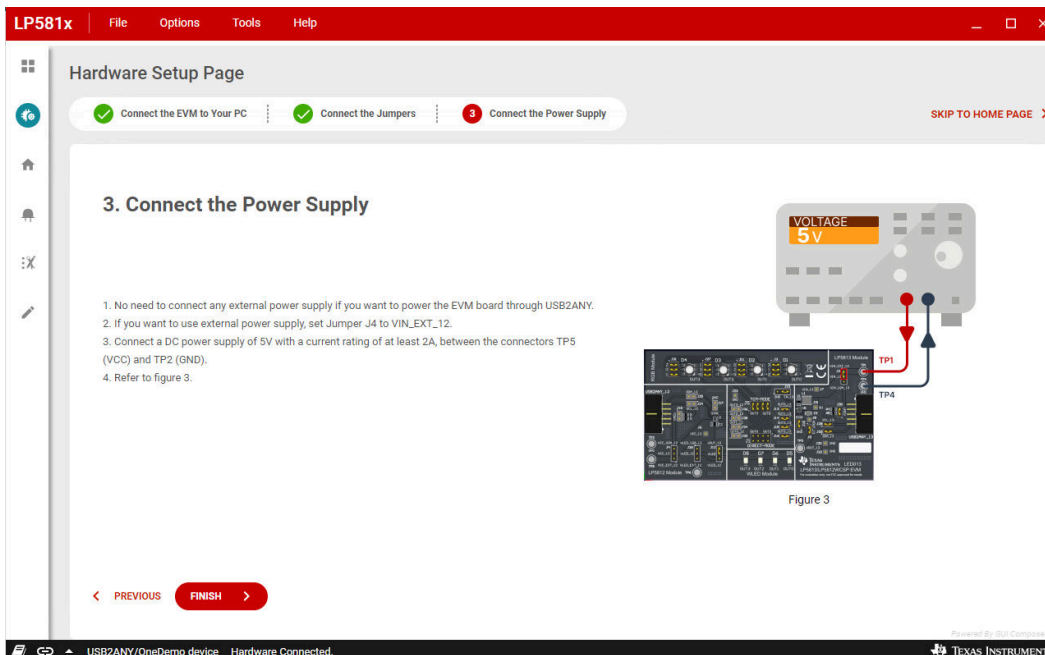


Figure 3-6. Hardware Setup Page

Home Page

Figure 3-7 shows the I2C address selected in the *Home* page. Click the *Configure & Connect* button to connect the USB2ANY with the LP5813-12EVM. The I2C protocol with broadcast chip address is the default. Users can also choose the I2C independent address depending on the IC which is under evaluation. For example, the default jumper setting is used for LP5813A, so choose 0x14 as the independent I2C address or use broadcast mode.

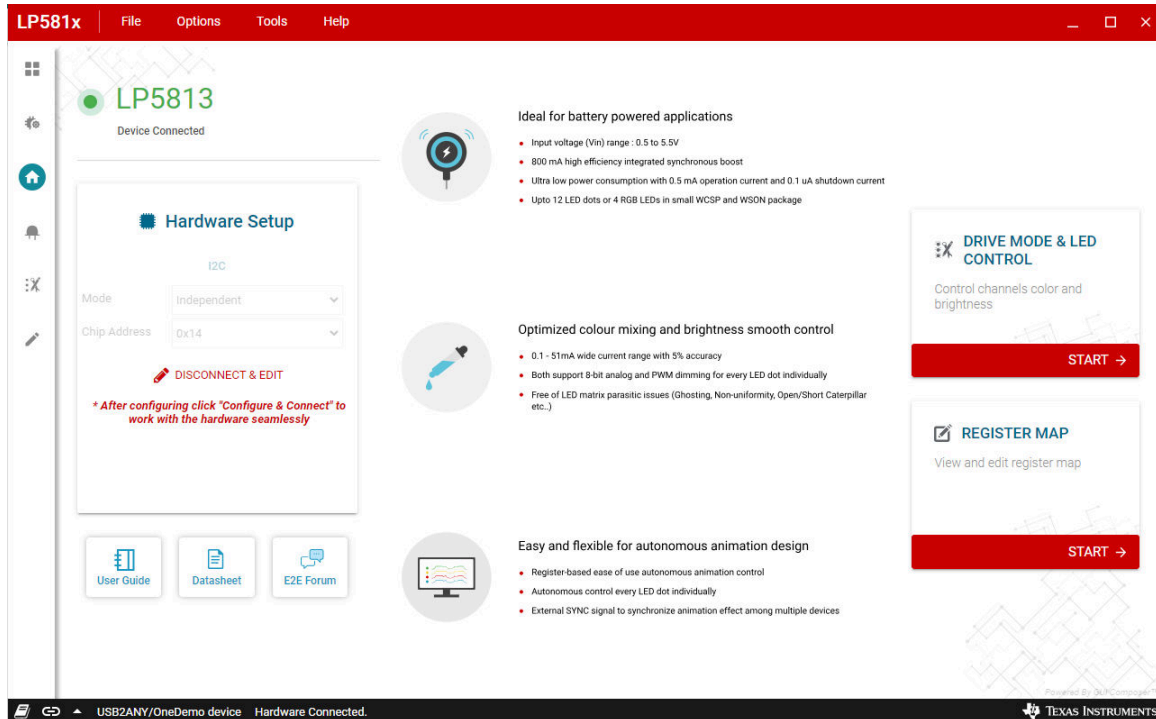


Figure 3-7. Home Page

Click the *START* button below the *DRIVE MODE & LED CONTROL* block to enter the Drive Mode Page while every individual register is configured in the *REGISTER MAP* page.

Drive Mode Page

In the Drive Mode page, users can configure the scan mode for LP5813/LP5812, and the jumper setting for the scan mode configuration is shown on the preview window. See [Figure 3-8](#).

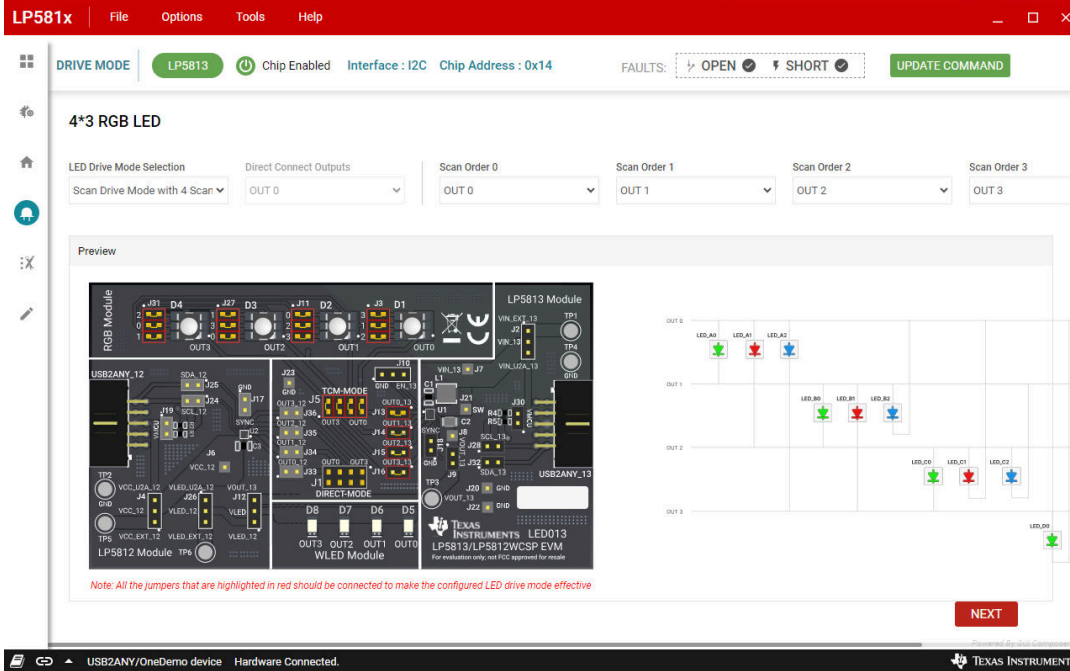


Figure 3-8. Drive Mode Page

Mode Select Page

Set the operation mode for every LED pixel in the LED mode select page. See the details in this page in [Figure 3-9](#).

1. **Chip Enable** button: Click this button to enable device at the beginning of evaluation.
2. **Update Command**: Click this button to update all the Device Configuration Register values.
3. **LED Select**: Before setting operation mode for LEDs, one or multiple LEDs (Shift + select for multiple LED selections) must be selected first.
4. **Mode Selection**: This part includes LED enable/disable, LED operation mode (manual/auto), PWM dimming scale (linear/exponential), PWM phase align (forward/middle/backward).
5. **Device Configuration**: Click this button to navigate to the Device configuration page. See [Figure 3-10](#).

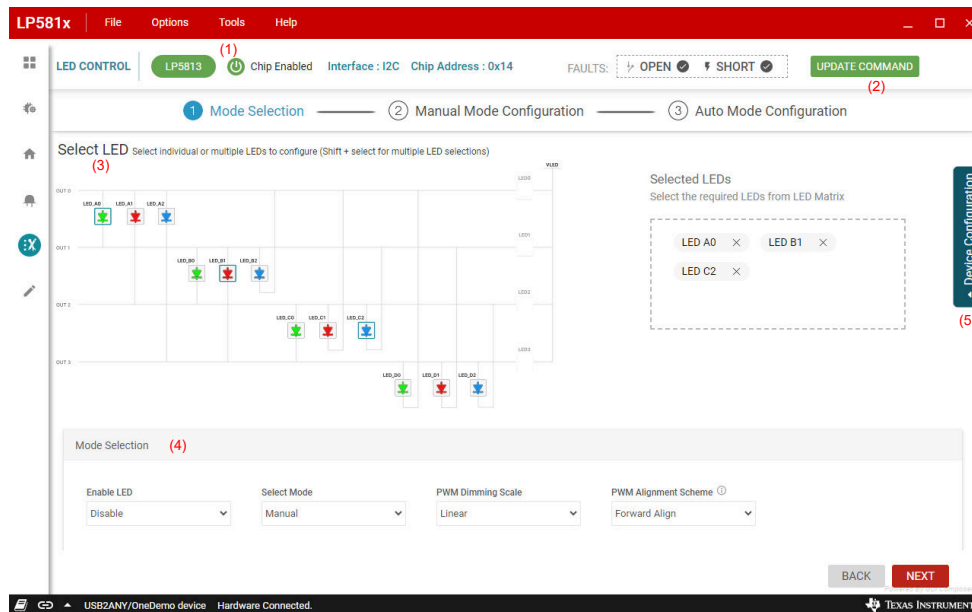


Figure 3-9. Mode Select Page

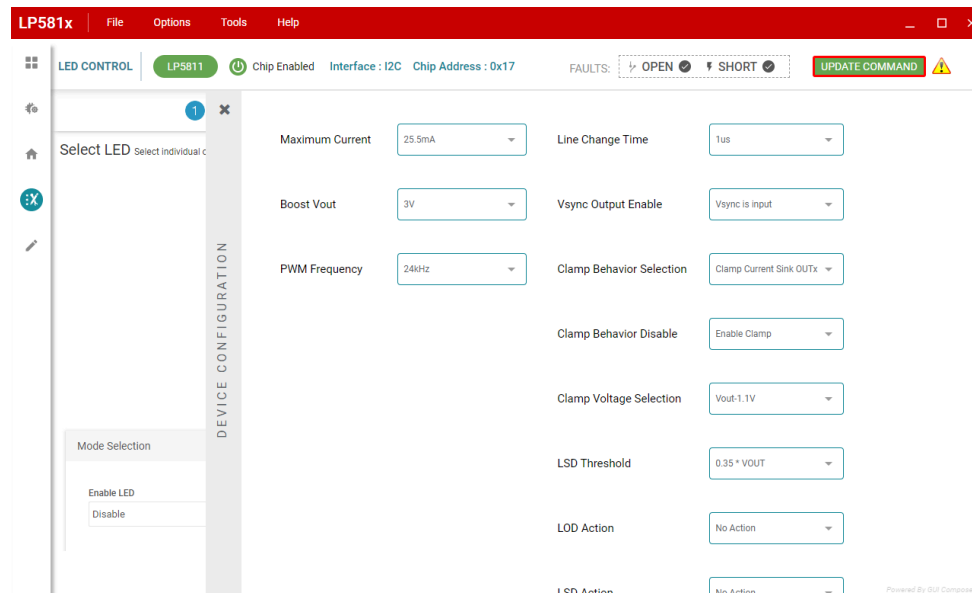


Figure 3-10. Device Configuration Page

After all the device configurations have been configured, click *NEXT* button to navigate to Manual Mode Configuration page.

Manual Mode Configuration Page

Set the analog dimming (dot current) and PWM dimming (manual PWM) value for every LED which is configure to manual mode. See [Figure 3-11](#).

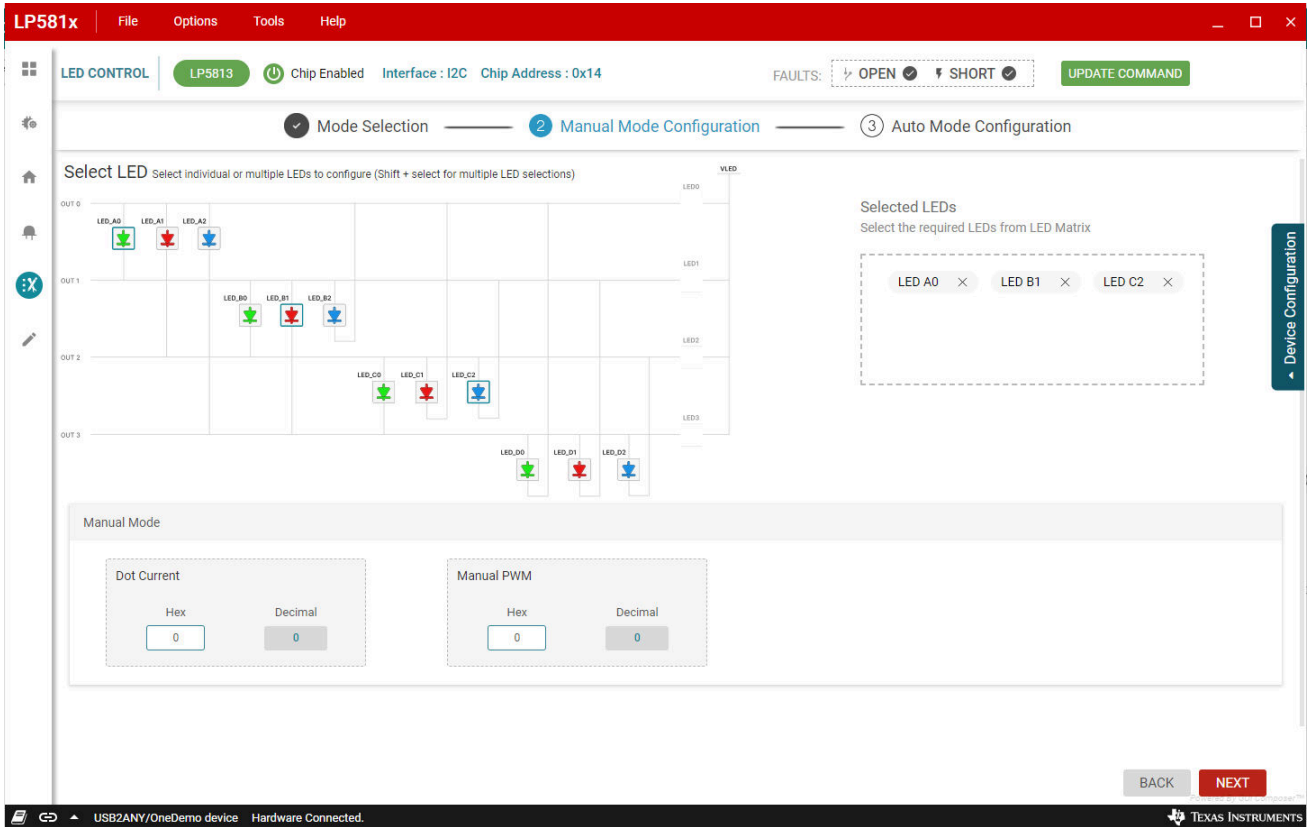


Figure 3-11. Manual Mode Configuration Page

After the manual mode LED brightness are configured, click *NEXT* button to navigate to Auto Mode Configuration page.

Auto Mode Configuration Page

This page is used to configure the animation engine of each device. One animation engine pattern is defined as shown in Figure 3-12. Three animation engine units (AEU) and two animation pause units (APU) compose the animation engine pattern. Users can also see more details about the animation engine in data sheet.

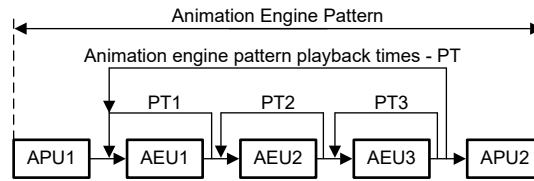


Figure 3-12. Animation Engine Pattern

All the parameters in the animation engine related register have random value when power up the device, so configure all the parameters before running the animation engine. Figure 3-13 shows the Auto Mode Configuration page.

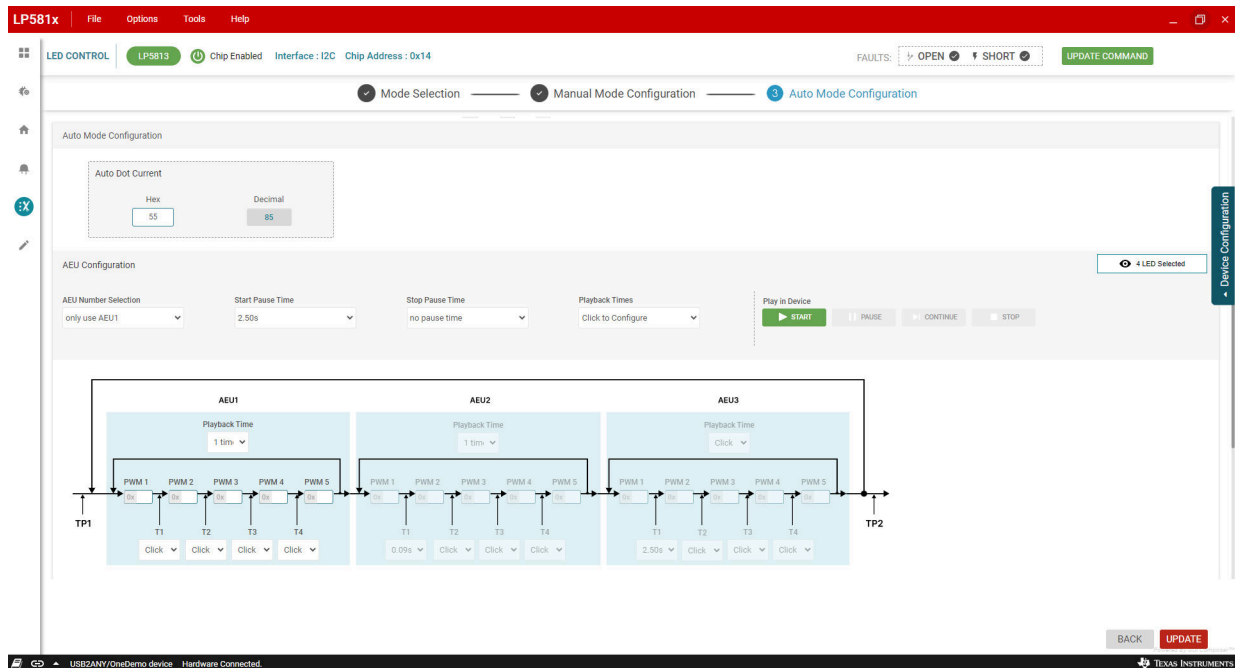


Figure 3-13. Auto Mode Configuration Page

Users can preview the LED animation pattern by enabling the Preview Mode and click the *SIMULATE* button. See [Figure 3-14](#).

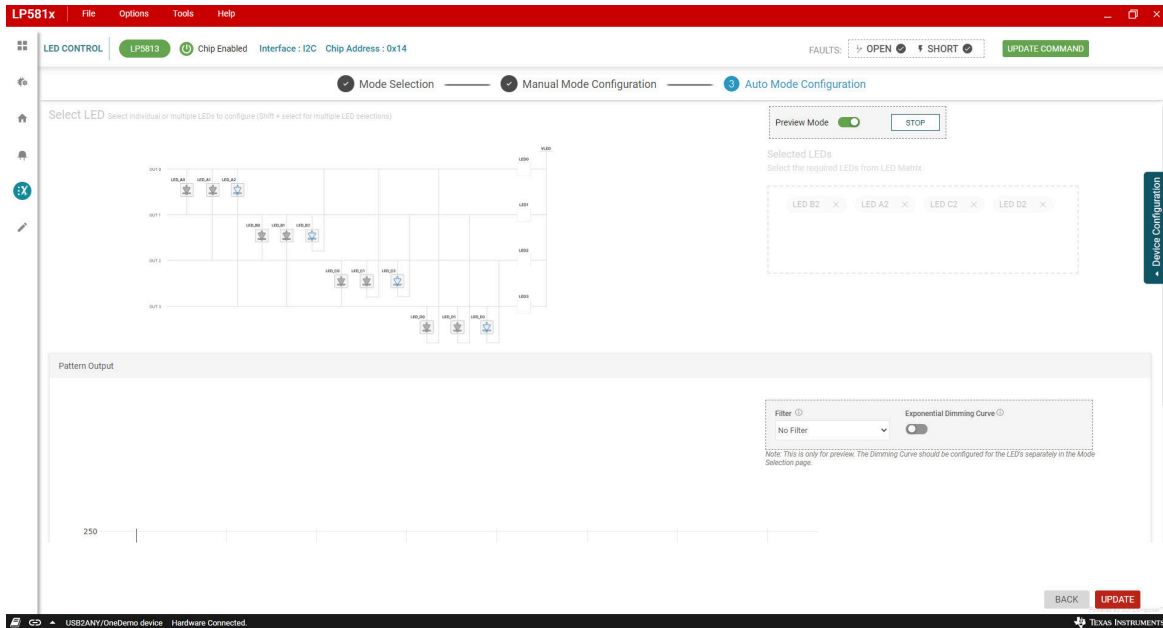


Figure 3-14. Preview Mode

The dimming curve is also shown under the configuration page. See [Figure 3-15](#).

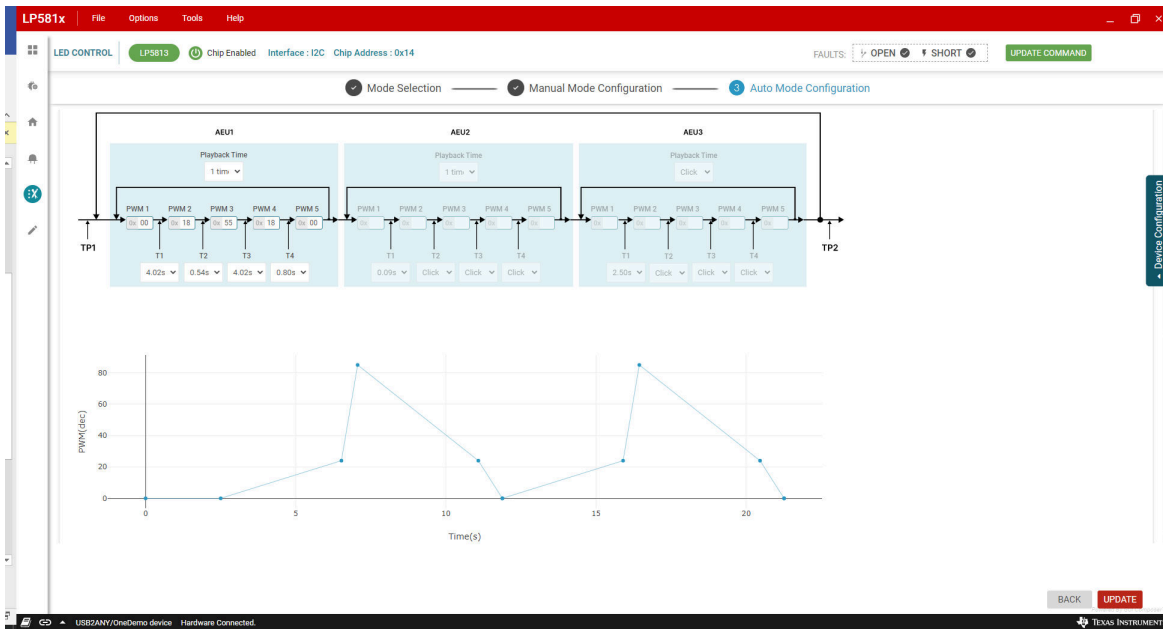


Figure 3-15. Dimming Curve Preview

After making sure all the configurations have been set properly, click the *START* button in the AEU configuration section. The device starts to generate the animation effect desired.

Fault Detection

The LP5813/LP5812 continually detects the status for every LED dot. Once an open or short failure is detected, the fault status is also be monitored on the GUI. Clicking the fault summary at the right-top of the GUI shows the summary for all fault status (see Figure 3-16). The *Clear Short LED* and *Clear open LED* buttons are used to clear related fault flags when the failures are removed.

To have precise detection results, the PWM must be set above 25.

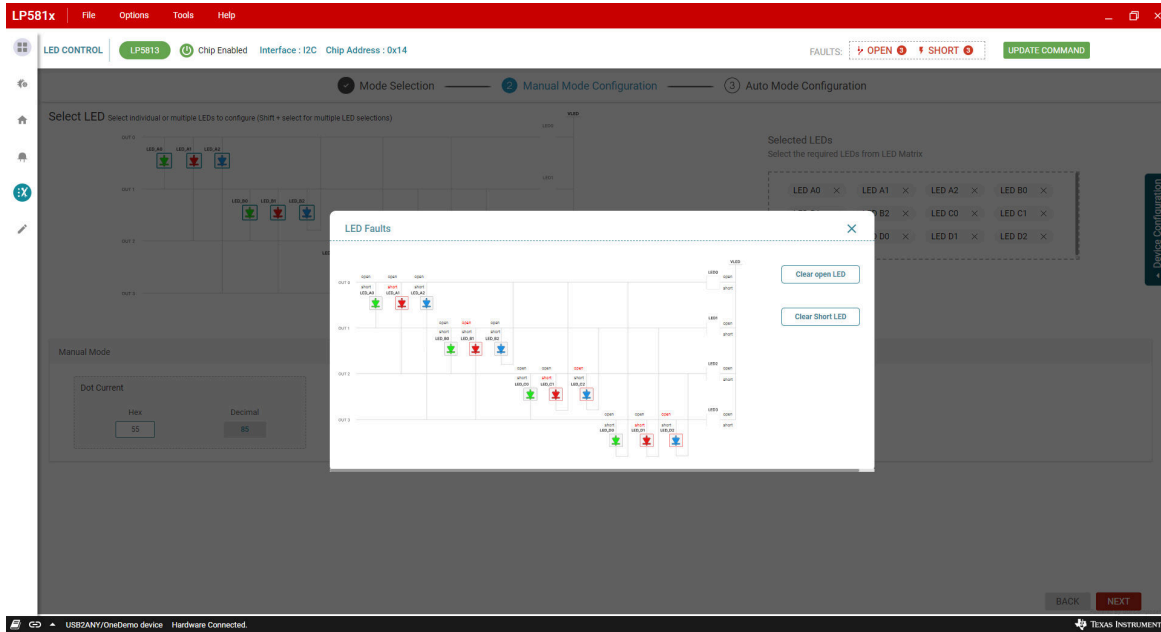


Figure 3-16. LED Fault Report

4 Hardware Design Files

4.1 Schematics

Figure 4-1 shows the schematic of LED driver module.

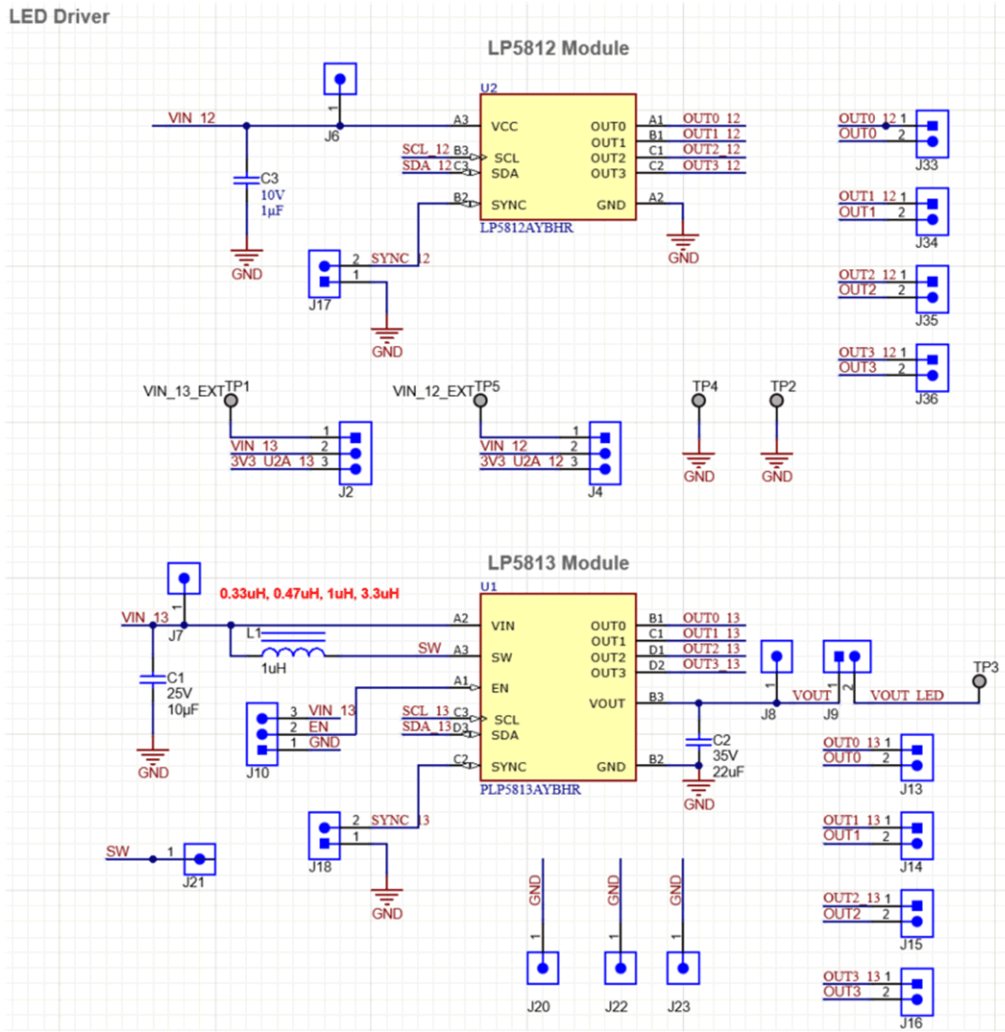


Figure 4-1. Schematic of LED Driver Module

Figure 4-2 shows the schematic of LED Load module.

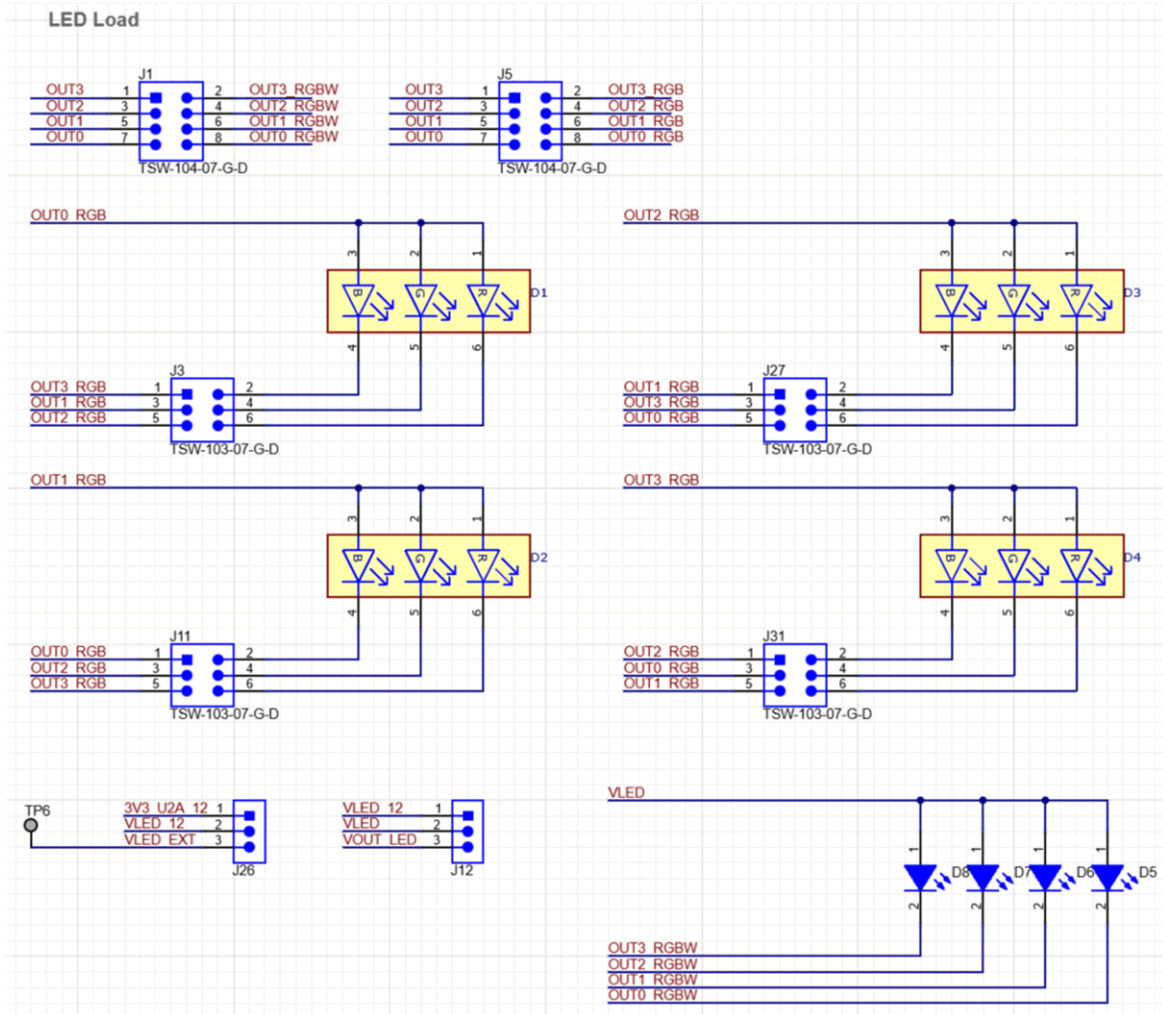


Figure 4-2. Schematic of LED Load Module

Figure 4-3 shows the schematic of USB2ANY connector.

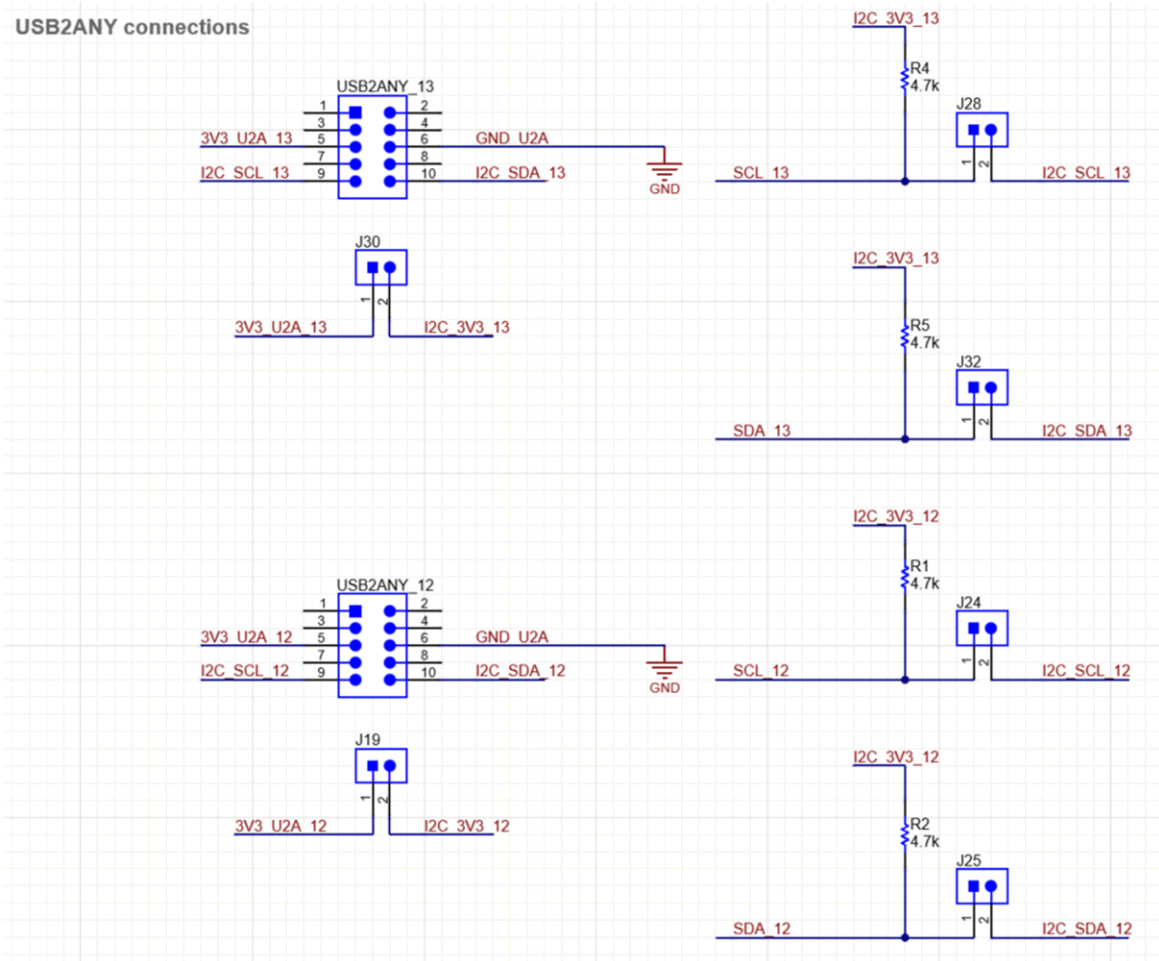


Figure 4-3. Schematic of USB2ANY Connector

4.2 PCB Layouts

Figure 4-4 and Figure 4-5 demonstrate the LP5813-12WCSP EVM layout images.

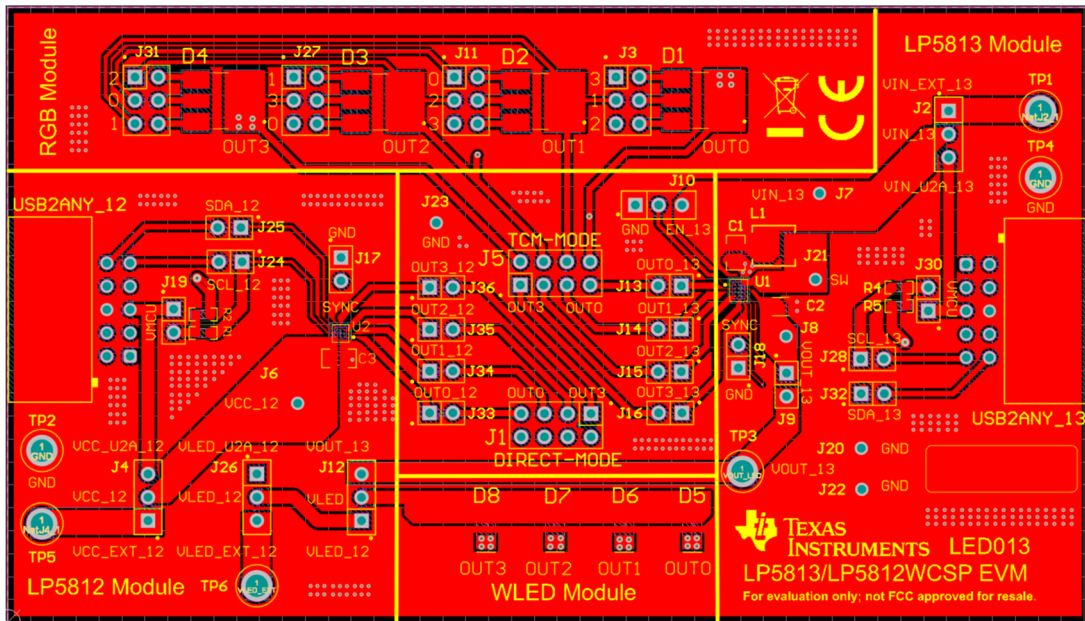


Figure 4-4. LP5813-12WCSP EVM Top Layer

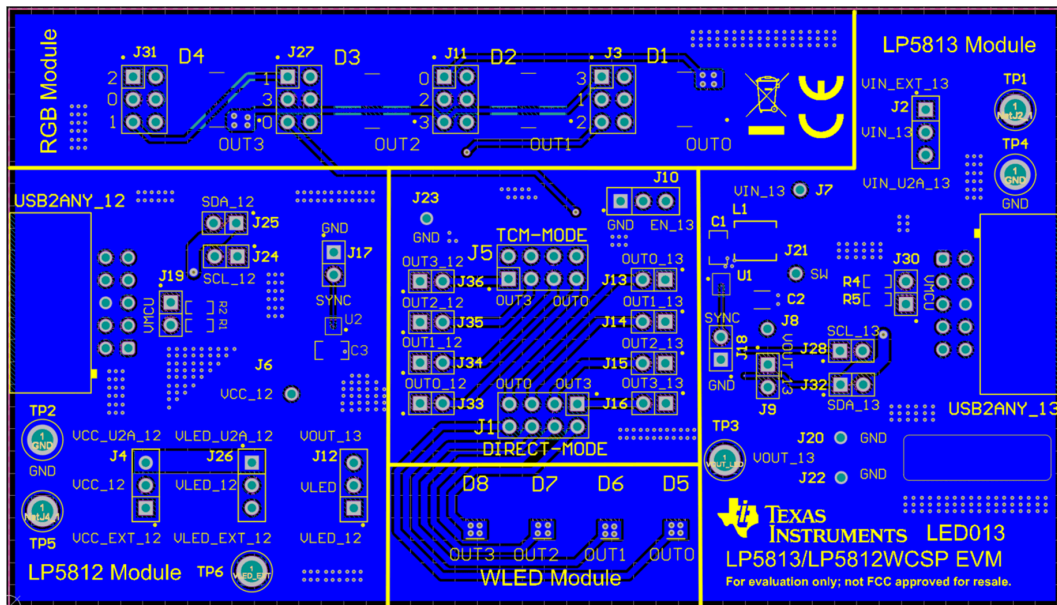


Figure 4-5. LP5813-12WCSP EVM Bottom Layer

4.3 Bill of Materials (BOM)

Table 4-1 displays the bill of materials (BOM). To download the BOM, see the design files at the [LP5813-12WCSPEVM](#) tools page.

Table 4-1. Bill of Materials

DESIGNATOR	QUANTITY	DESCRIPTION	MANUFACTURER	PART NUMBER
C1	1	CAP, CERM, 10µF, 25V,+/- 10%, X5R, 0805	Yageo	CC0805KKX5R8BB106
C2	1	CAP, CERM, 22uF, 35V, +/- 20%, X5R, 1206	TDK	C3216X5R1V226M160AC
C3	1	CAP, CERM, 1µF, 10V,+/- 5%, X8L, AEC-Q200 Grade 0, 0805	Kemet	C0805C105J8NACTU
D1, D2, D3, D4	4	Red, Green, Blue (RGB) 621.5nm Red, 530nm Green, 470nm Blue LED Indication - Discrete 2V Red, 3.2V Green, 3.2V Blue 6-SMD, J-Lead	Cree	CLP6C-FKB-CK1P1G1BB7R3R3
D5, D6, D7, D8	4	LED, Cool White, SMD	Cree	CLM3C-WKW-CWBYA453
J1, J5	2	Header, 100mil, 4x2, Gold, TH	Samtec	TSW-104-07-G-D
J2, J4, J10, J12, J26	5	Header, 100mil, 3x1, Gold, TH	Samtec	TSW-103-07-G-S
J3, J11, J27, J31	4	Header, 100mil, 3x2, Gold, TH	Samtec	TSW-103-07-G-D
J6, J7, J8, J20, J21, J22, J23	7	Header, 2.54mm, 1x1, Gold, TH	Samtec	TSW-101-08-G-S
J9, J13, J14, J15, J16, J17, J18, J19, J24, J25, J28, J30, J32, J33, J34, J35, J36	17	Header, 100mil, 2x1, Gold, TH	Samtec	HTSW-102-07-G-S
L1	1	Inductor, Shielded, Powdered Iron, 1uH, 5A, 0.027 ohm, SMD	Bourns	SRP4020TA-1R0M
R1, R2, R4, R5	4	RES, 4.7 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW06034K70JNEA
SH-J1 to SH-J28	28	Shunt, 100mil, Gold plated, Black	Samtec	SNT-100-BK-G
U1	1	12 LEDs Synchronous Boost RGB LED Driver With Autonomous Control	Texas Instruments	LP5813AYBHR
U2	1	12 LEDs RGB LED Driver With Autonomous Control	Texas Instruments	LP5812AYBHR
USB2ANY_12, USB2ANY_13	2	Header(shrouded), 2.54mm, 15x2, Gold with Tin tail, R/A, TH	Sullins Connector Solutions	SBH11-PBPC-D05-RA-BK

5 Additional Information

5.1 Trademarks

All trademarks are the property of their respective owners.

6 Revision History

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

Changes from Revision * (September 2023) to Revision A (April 2024)	Page
• Added <i>GUI Installation</i> and <i>GUI Guidance</i> sections.....	7

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.
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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:*
 - 2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
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 - 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 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。

<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html>

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。技術適合証明を受けていないものご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

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

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。日本テキサス・イ

ンスツルメンツ株式会社

東京都新宿区西新宿 6 丁目 2 4 番 1 号

西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page

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

3.4 European Union

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

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

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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.
 - 4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.
 5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.
 6. *Disclaimers:*
 - 6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.
 - 6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.
 7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.
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8. *Limitations on Damages and Liability:*

8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMNITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

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