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 according to the device package.
2. Request the LP5813 and LP5812 data sheet from ti.com.
3. Download the LP581xGUI from 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 & wearable electronics: E-Cigarette, Earbud & Charging case
• Gaming & home entertainment: Smart speaker, RGB mouse, Video doorbell
• Industrial HMI: EV charger, Factory automation
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

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](image)

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.

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

Figure 2-4. LP5813 4-SCAN TCM Mode and Disable Boost with 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](image)

**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](image)

### 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

LP581xGUI information will be updated after RTM.
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 LP5813-12 WCSPEVM layout images.

Figure 4-4. LP5813-12 WCSPEVM Top Layer

Figure 4-5. LP5813-12 WCSPEVM 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>
<thead>
<tr>
<th>DESIGNATOR</th>
<th>QUANTITY</th>
<th>DESCRIPTION</th>
<th>MANUFACTURER</th>
<th>PART NUMBER</th>
</tr>
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<tr>
<td>C1</td>
<td>1</td>
<td>CAP, CERM, 10 µF, 25 V, +/- 10%, X5R, 0805</td>
<td>Yageo</td>
<td>CC0805KXX5R8BB106</td>
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<td>TDK</td>
<td>C3216X5R1V226M160AC</td>
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<td>C3</td>
<td>1</td>
<td>CAP, CERM, 1 µF, 10 V, +/- 5%, X8L, AEC-Q200 Grade 0, 0805</td>
<td>Kemet</td>
<td>C0805C105J8NACTU</td>
</tr>
<tr>
<td>D1, D2, D3, D4</td>
<td>4</td>
<td>Red, Green, Blue (RGB) 621.5nm Red, 530 nm Green, 470 nm Blue LED Indication - Discrete 2 V Red, 3.2 V Green, 3.2 V Blue 6-SMD, J-Lead</td>
<td>Cree</td>
<td>CLP6C-FKB-CK1P1G1BB7R3R3</td>
</tr>
<tr>
<td>D5, D6, D7, D8</td>
<td>4</td>
<td>LED, Cool White, SMD</td>
<td>Cree</td>
<td>CLM3C-WKW-CWBYA453</td>
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<td>J1, J5</td>
<td>2</td>
<td>Header, 100mil, 4x2, Gold, TH</td>
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<td>TSW-104-07-G-D</td>
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<td>Samtec</td>
<td>TSW-103-07-G-S</td>
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<td>J3, J11, J27, J31</td>
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<td>Samtec</td>
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<td>J6, J7, J8, J20, J21, J22, J23</td>
<td>7</td>
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<td>Samtec</td>
<td>TSW-101-08-G-S</td>
</tr>
<tr>
<td>J9, J13, J14, J15, J16, J17, J18, J19, J24, J25, J28, J30, J32, J33, J34, J35, J36</td>
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<td>Samtec</td>
<td>HTSW-102-07-G-S</td>
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<tr>
<td>R1, R2, R4, R5</td>
<td>4</td>
<td>RES, 4.7 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603</td>
<td>Vishay-Dale</td>
<td>CRCW06034K70JNEA</td>
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<td>SH-J1 to SH-J28</td>
<td>28</td>
<td>Shunt, 100mil, Gold plated, Black</td>
<td>Samtec</td>
<td>SNT-100-BK-G</td>
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<td>U1</td>
<td>1</td>
<td>12 LEDs Synchronous Boost RGB LED Driver With Autonomous Control</td>
<td>Texas Instruments</td>
<td>LP5813AYBHR</td>
</tr>
<tr>
<td>U2</td>
<td>1</td>
<td>12 LEDs RGB LED Driver With Autonomous Control</td>
<td>Texas Instruments</td>
<td>LP5812AYBHR</td>
</tr>
<tr>
<td>USB2ANY_12, USB2ANY_13</td>
<td>2</td>
<td>Header(shrouded), 2.54mm, 15x2, Gold with Tin tail, R/A, TH</td>
<td>Sullins Connector Solutions</td>
<td>SBH11-PBPC-D05-RA-BK</td>
</tr>
</tbody>
</table>

### 5 Additional Information

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User shall operate the Evaluation Kit within TI’s recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI’s recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI’s instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:
EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.
3 Regulatory Notices:

3.1 United States

3.1.1 Notice applicable to EVMs not FCC-Approved:

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:

CAUTION
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices
NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, 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 détaçables

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.

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3.3.1 Notice for EVMs delivered in Japan: Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。


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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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https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html

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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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4.1 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 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 proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. Accuracy of Information: To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

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