LP5891-Q1 48 × 16 Common Cathode Matrix LED Display Driver Evaluation Module

TEXAS INSTRUMENTS

Description

The LP5891-Q1 evaluation module (EVM) is used to evaluate the characteristics, operation, and usage for matrix LED display driver LP5891-Q1. The LP5891-Q1 is a highly integrated, common cathode matrix LED display driver with 48 constant current sources and 16 scanning FETs. The LP5891-Q1 is AEC-Q100-qualified for automotive applications.

Features

- 48 current source channels from 0.2mA to 20mA
- 16 scan line switches with 190mΩ $R_{DS(ON)}$

- Ultra-low power consumption
- High-speed and low electromagnetic interference (EMI) continuous clock series interface (CCSI)

Applications

- Automotive free-form interactive signal display (FISD)
- Automotive ambient lighting
- Automotive head light and rear light with ultra-high-density pixels
- Automotive mini and micro-LED panels
- Automotive local dimming backlight
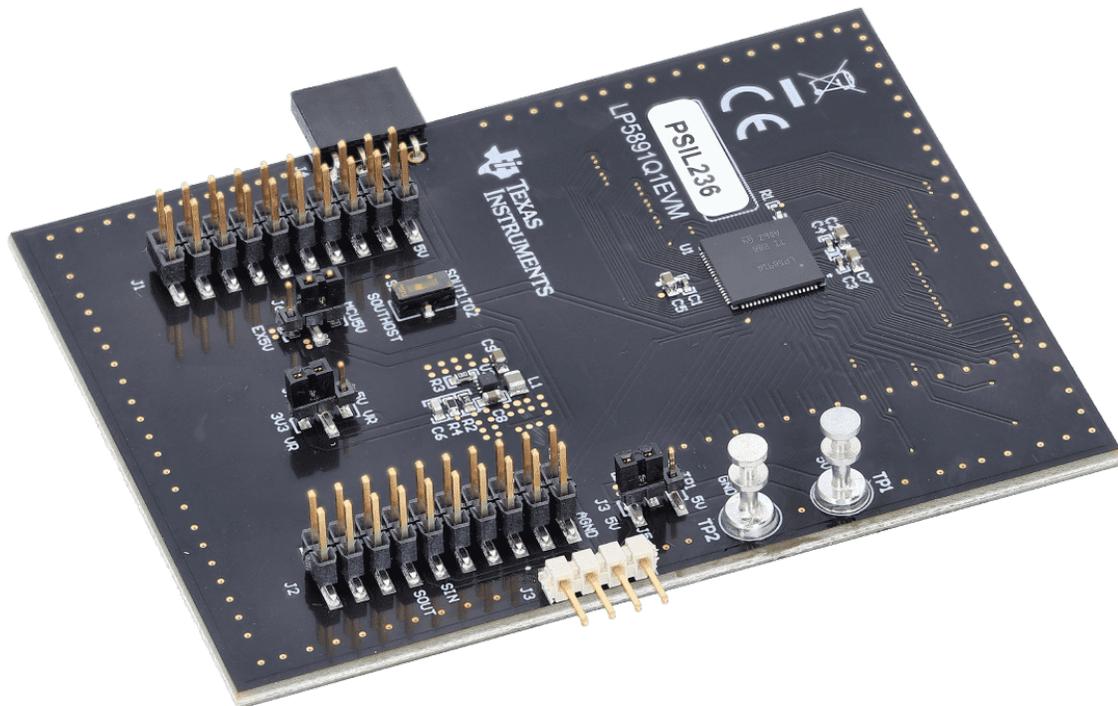
1 Evaluation Module Overview

1.1 Introduction

The LP5891-Q1 is a highly integrated, common cathode matrix LED display driver with 48 constant current sources and 16 scanning FETs. The LP5891-Q1 is AEC-Q100-qualified for automotive applications. One LP5891-Q1 is capable of driving 16 × 16 RGB LED pixels, while stacking two LP5891-Q1 can drive 32 × 32 RGB LED pixels, three LP5891-Q1 are capable of driving 48 × 48 RGB LED pixels, and stacking four LP5891-Q1 can drive 64 × 64 RGB LED pixels, which simplifies component placement and control. With the common cathode structure, the device supports separated power supplies for the red, green, and blue LEDs to achieve low power consumption. Furthermore, the operation power of the LP5891-Q1 is significantly reduced by ultra-low operation voltage range (Vcc down to 2.5V) and ultra-low operation current (Icc down to 3.6mA).

This user's guide describes the LP5891-Q1 evaluation module used as a reference for engineering demonstration and evaluation. Included in this user's guide are setup instructions, a schematic diagram, printed board (PCB) layout, and a bill of materials (BOM).

1.2 Kit Contents

• One LP5891Q1EVM board

Note that this EVM requires a controller (for example, MCU), which is not included.

1.3 Specification

The LP5891-Q1 device supports per-channel current from 0.2mA to 20mA, with typical 1% channel-to-channel current deviation and typical 1% device-to-device current deviation. The DC current value of all 48 channels is set by an external IREF resistor and can be adjusted by the 8-step global brightness control (BC) and the 256-step per-color group brightness control (CC_R/CC_G/CC_B).

1.4 Device Information

The LP5891-Q1 implements a high speed, rising-edge transmission interface to support up to 32 cascaded devices. The device supports up to 50MHz SCLK (external) and high refresh rate with maximum 160MHz GCLK (internal). Meanwhile, the device integrates enhanced circuits and intelligent algorithms to solve the various display challenges in Narrow Pixel Pitch (NPP) LED display applications and mini or micro-LED products: dim at the first scan line, upper and downside ghosting, non-uniformity in low grayscale, coupling, caterpillar caused by open or short LEDs, which make the LP5891-Q1 an excellent choice in such applications.

The LP5891-Q1 also implements LED open, weak short, short detection, and removal during operations and can also report the accurate fault position information out to the accompanying digital processor.

2 Hardware

2.1 Function Descriptions

This section describes the connectors, jumpers, and switches on the LP5891Q1EVM board.

Figure 2-1 shows the image of the driver IC side of the LP5891Q1EVM board.

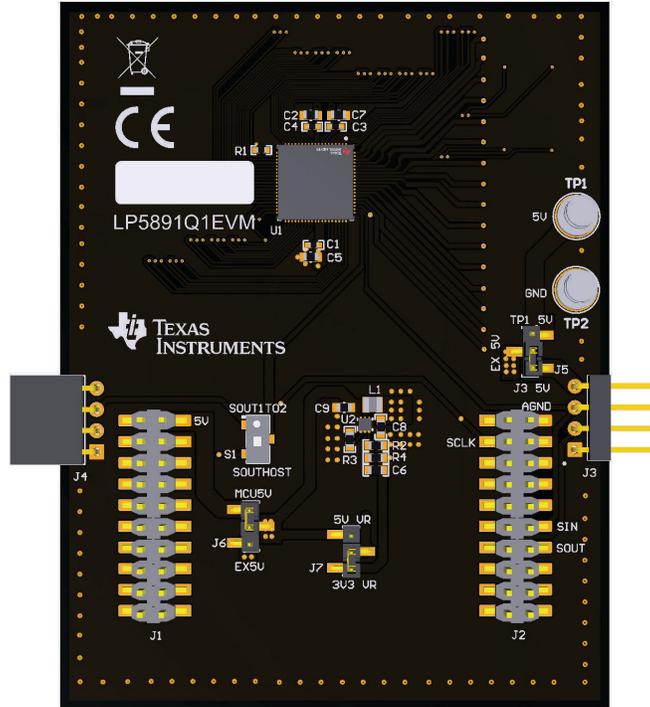Figure 2-2 shows the image of the LED side of the LP5891Q1EVM board.

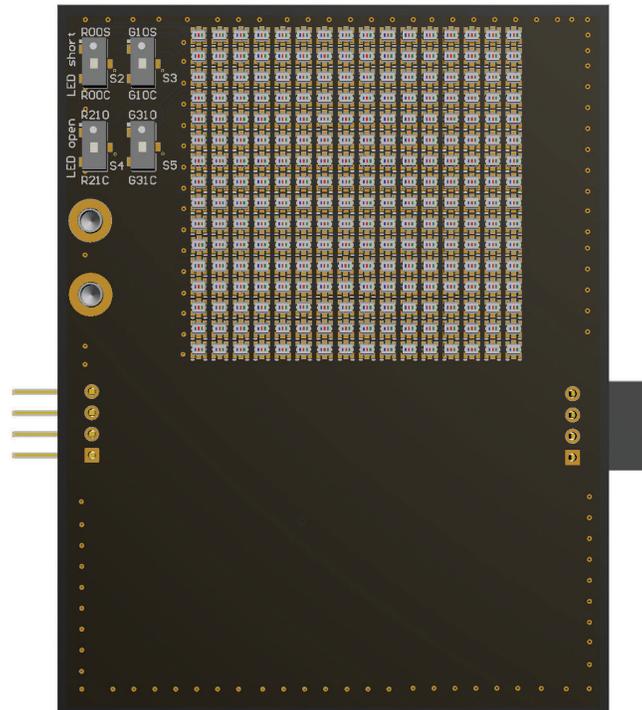**Figure 2-1. Driver IC Side of the LP5891Q1EVM Board**

Figure 2-2. LED Side of the LP5891Q1EVM Board

The LP5891Q1EVM works with a host controller, the TMS320F280039C LaunchPad™ for C2000™ real-time MCU. The LP5891Q1EVM is designed with connectors, jumpers, and switches to support device-to-device connection, device-to-host connection, and flexible power supply scheme. In addition, there are four switches on the LED side of the LP5891Q1EVM board that enables the evaluation of LED open and short detection and removal functions of the LP5891-Q1.

Table 2-1 lists the connectors of LP5891Q1EVM board and the descriptions.

Table 2-2 lists the jumpers of LP5891Q1EVM board and the descriptions.

Table 2-2 lists the switches of LP5891Q1EVM board and the descriptions.

Table 2-1. Connectors

Name	Description
J1, J2	Boosterpack connectors for connecting with the TMS320F280039C LaunchPad.
J3	Input board-to-board connectors between LP5891Q1EVM boards, including +5V, SIN (serial data input), SCLK (serial clock), and GND.
J4	Output board-to-board connectors between LP5891Q1EVM boards, including +5V, SOUT (serial data output), SCLK (serial clock), and GND.
TP1 (+5V)	External power supply that can be selected for VLEDG/VLEDB and DC/DC.
TP2 (GND)	Supply ground.

Table 2-2. Jumpers

Name	Description
J3	J3 is used to select external +5V power supply. • Put the jumper on *TP1 5V* and *EX 5V* to select the external power supply from TP1. • Put the jumper on *J3 5V* and *EX 5V* to select the external power supply from J3.
J6	J3 is used to select the +5V power supply that supplies VLEDG/VLEDB and DC/DC. • Put the jumper on *MCU5V* and the middle to select the +5V power supply from the host controller. • Put the jumper on *EX5V* and the middle to select the external +5V power supply, which is previously selected by J3.
J7	J7 is used to select the power supply that supplies VLEDR. • Put the jumper on *5V VR* and the middle to select +5V power supply for VLEDR. The +5V power supply is previously selected by J6. • Put the jumper on *3V3 VR* and the middle to select +3.3V power supply for VLEDR. The +3.3V power supply is generated by DC/DC.

Table 2-3. Switches

Name	Description
S1	• If the switch is set towards *SOUTHOST*, then the serial data output from LP5891-Q1 chip is sent back to the host controller. • If the switch is set towards *SOUT1TO2*, then the serial data output from the first LP5891-Q1 chip is sent to J4 port, which is further sent to the second chip if several LP5891Q1EVM are cascaded.
S2	• If the switch is set towards *R00C*, then the red LED in row 0, column 0 is connected in normal state. • If the switch is set towards *R00S*, then the red LED in row 0, column 0 is shorted (the anode and the cathode of the LED are shorted).
S3	• If the switch is set towards *G10C*, then the green LED in row 1, column 0 is connected in normal state. • If the switch is set towards *G10S*, then the green LED in row 1, column 0 is shorted (the anode and the cathode of the LED are shorted).
S4	• If the switch is set towards *R21C*, then the red LED in row 2, column 1 is connected in normal state. • If the switch is set towards *R21O*, then the red LED in row 2, column 1 is opened (the anode of the LED is disconnected from the current source channel).

Table 2-3. Switches (continued)

Name	Description
S5	• If the switch is set towards *G31C*, then the green LED in row 3, column 1 is connected in normal state. • If the switch is set towards *G31O*, then the green LED in row 3, column 1 is opened (the anode of the LED is disconnected from the current source channel).

2.2 Test Setup

Table 2-4 shows the typical parameters for LP5891Q1EVM.

Table 2-4. LP5891Q1EVM Parameters

Parameter	Value
VCC Device supply voltage	2.5–5.5V
VLEDR/G/B supply voltage	2.5–5.5V
ICH Constant output source current	0.2–20mA

The LP5891Q1EVM can work with the TMS320F280039C LaunchPad for C2000 real-time MCU.

The LP5891Q1EVM is designed to work in two different modes:

- Single device
- Multiple cascaded devices in independent mode

For simplicity, the test setup for single device and dual devices are illustrated.

2.2.1 System/Tool Requirements

To perform the test, these hardware tools are required:

- LP5891Q1EVM × 1 (or more)
- TMS320F280039C LaunchPad development kit × 1
- Computer × 1
- (optional) DC power supply × 1
- (optional) DC power supply cables
- (optional) 1-pin female-to-female jumper wire × 1

To perform the test, please follow the software guidance provided in the sample code User's Guide which can be found at *LP589x(-Q1)/TLC698x Sample Code User's Guide*.

2.2.2 Hardware Setup for Single Device

The LP5891Q1EVM can be powered either by the TMS320F280039C LaunchPad with the USB power (when the current consumption is low) or an external power supply (the LP5891Q1EVM and the TMS320F280039C LaunchPad are powered separately). Single LP5891Q1EVM can be quickly set up and tested by following these steps:

1. USB Power supply from the TMS320F280039C LaunchPad
   a. Download the code to the TMS320F280039C LaunchPad with TI Code Composer Studio software.
   b. Put the J6 jumper on "MCU5V" and the middle, and set the switch S1 towards "SOUTHOST" , which are marked with red boxes in Figure 2-3.
   c. Connect BoosterPack connectors (J1, J2) on the LP5891Q1EVM with the TMS320F280039C LaunchPad, the connection method is shown in Figure 2-3.
   d. Power the TMS320F280039C LaunchPad through the USB cable.
2. External Power supply
   a. Download the code to the TMS320F280039C LaunchPad with TI Code Composer Studio software.
   b. Put the J5 jumper on *TP1 5V* and *EX 5V*. Then put the J6 jumper on *EX5V* and the middle. Set the switch S1 towards *SOUTHOST*.
   c. Connect BoosterPack connectors (J1, J2) on the LP5891Q1EVM with the TMS320F280039C LaunchPad, the connection method is shown in Figure 2-3.
   d. Power the TMS320F280039C LaunchPad through the USB cable.

LP5891-Q1 48 × 16 Common Cathode Matrix LED Display Driver Evaluation
Module
5

e. Connect TP1 and TP2 to 5V/GND power source.
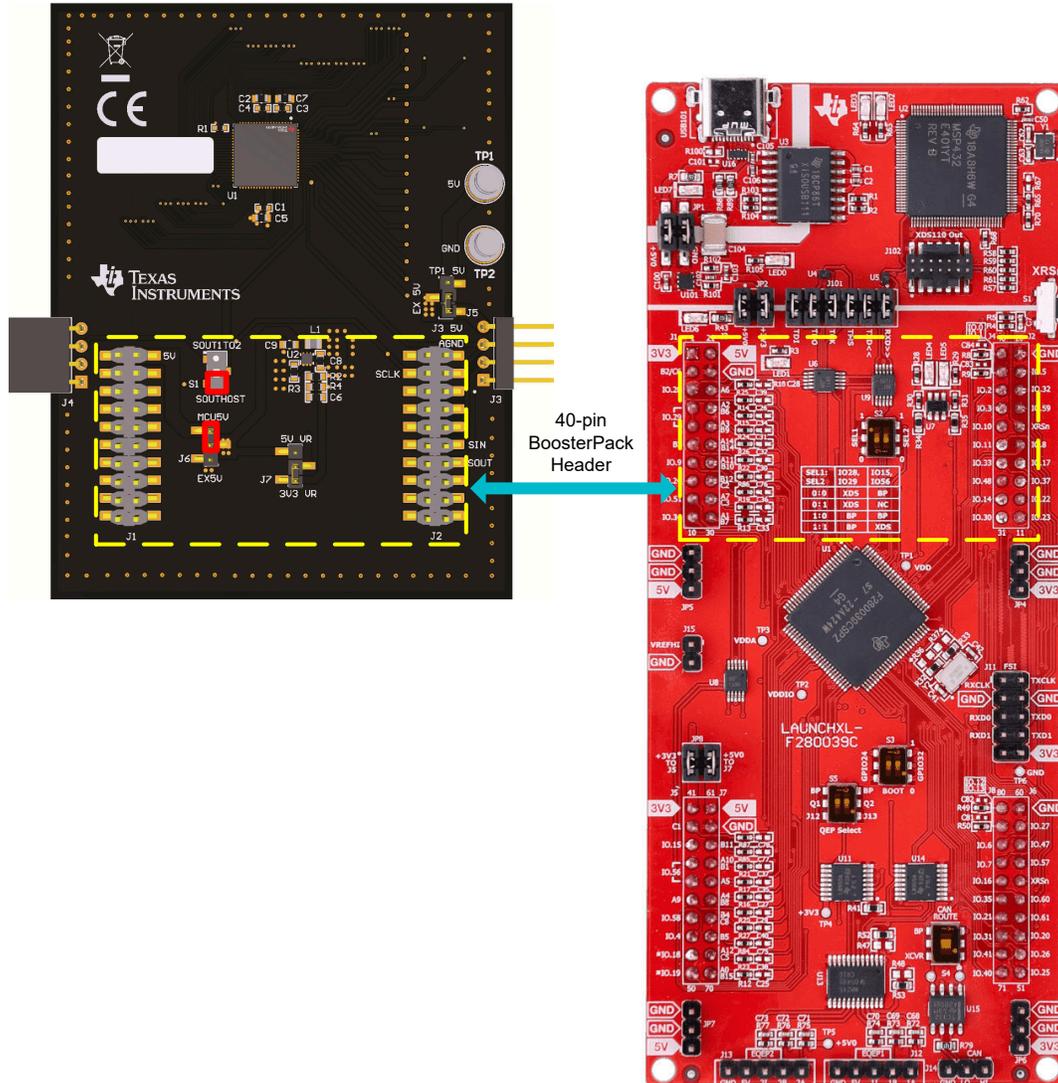f. Power on 5V/GND power supply.

Figure 2-3. Single LP5891Q1EVM Connected with the TMS320F280039C LaunchPad

2.2.3 Hardware Setup for Dual Cascaded Devices

The LP5891Q1EVM can be cascaded in a daisy chain. In such case, each LP5891-Q1 works in the independent mode (compared to the stackable mode). The host TMS320F280039C LaunchPad sends the serial data to the first LP5891-Q1 through the 40-pin BoosterPack Header. Then the first LP5891-Q1 transmits the serial data through board-to-board connector (J3 and J4) to the second LP5891-Q1. The second LP5891-Q1 can transmit the serial data to the host with an additional 1-pin cable. The serial data are transmitted through the daisy chain, while the clock signal is shared between multiple devices.

When multiple LP5891Q1EVM are cascaded in a daisy chain, using an external power supply is recommended due to the large current consumption. Also, an additional digital buffer for SCLK can be needed if the drive strength of the controller is not enough.

Dual cascaded LP5891Q1EVM in independent mode can be quickly set up and tested by following these steps:

1. Download the code to the TMS320F280039C LaunchPad with TI Code Composer Studio software.
2. For the first LP5891Q1EVM, put the J5 jumper on *TP1 5V* and *EX 5V*. Then put the J6 jumper on *EX5V* and the middle. Set the switch S1 towards *SOUT1TO2*. These setups are marked with red boxes on the *First Device* in Figure 2-4.

3. For the second LP5891Q1EVM, put the J5 jumper on *J3 5V* and *EX 5V*. Then put the J6 jumper on *EX5V* and the middle. Set the switch S1 towards *SOUTHOST*. These setups are marked with red boxes on the *Second Device* in Figure 2-4.

4. Connect BoosterPack connectors (J1, J2) on the first LP5891Q1EVM with the TMS320F280039C LaunchPad, the connection method is shown in Figure 2-4.

5. Connect the J4 connector of the first LP5891Q1EVM to the J3 connector of the second LP5891Q1EVM. The direction is shown in Figure 2-4.

6. (Optional) Connect the SOUT pin of connector J2 on the second LP5891Q1EVM to the IO.17 pin of connector J2 on the TMS320F280039C LaunchPad through an additional 1-pin cable that is marked as the bottom blue line in Figure 2-4. This step enables LP5891Q1EVM to report LOD (LED Open Detection), and LSD (LED Short Detection) out to the host TMS320F280039C LaunchPad.

7. Power the TMS320F280039C LaunchPad through the USB cable.

8. Connect TP1 and TP2 on the first LP5891Q1EVM to 5V/GND power source.
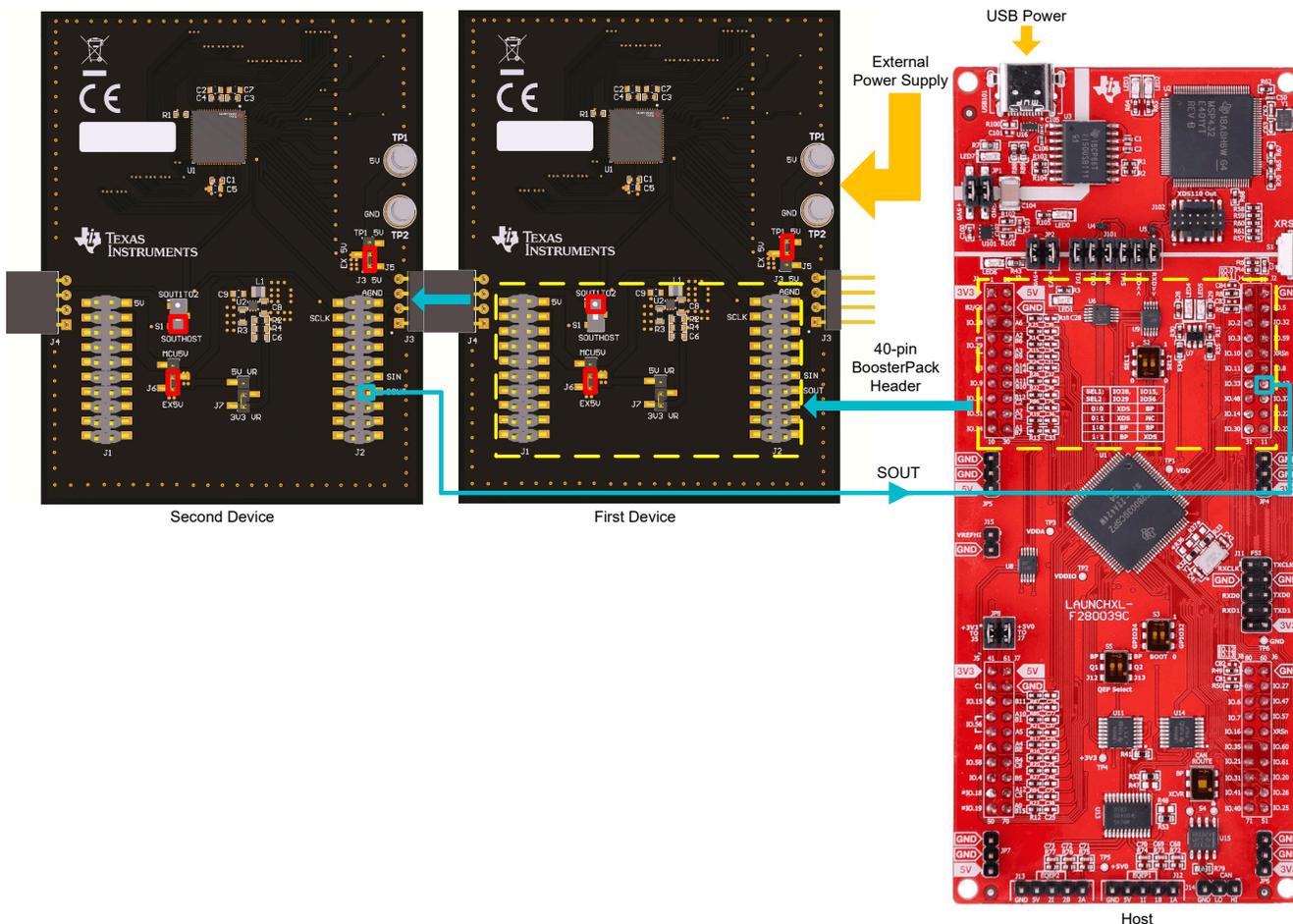
9. Power on 5V/GND power supply.

Figure 2-4. Dual Cascaded LP5891Q1EVM Connected with the TMS320F280039C LaunchPad

3 Software

3.1 Software Setup

To set up the software for the TMS320F280039C LaunchPad, please follow the steps documented in the sample code User's Guide which can be downloaded from *LP589x(-Q1)/TLC698x Sample Code User's Guide*. This User's Guide also provides guidance on software setup for LED fault diagnostics, multiple CCSI buses, cascading devices, and animation control.

4 Hardware Design Files

4.1 Schematic

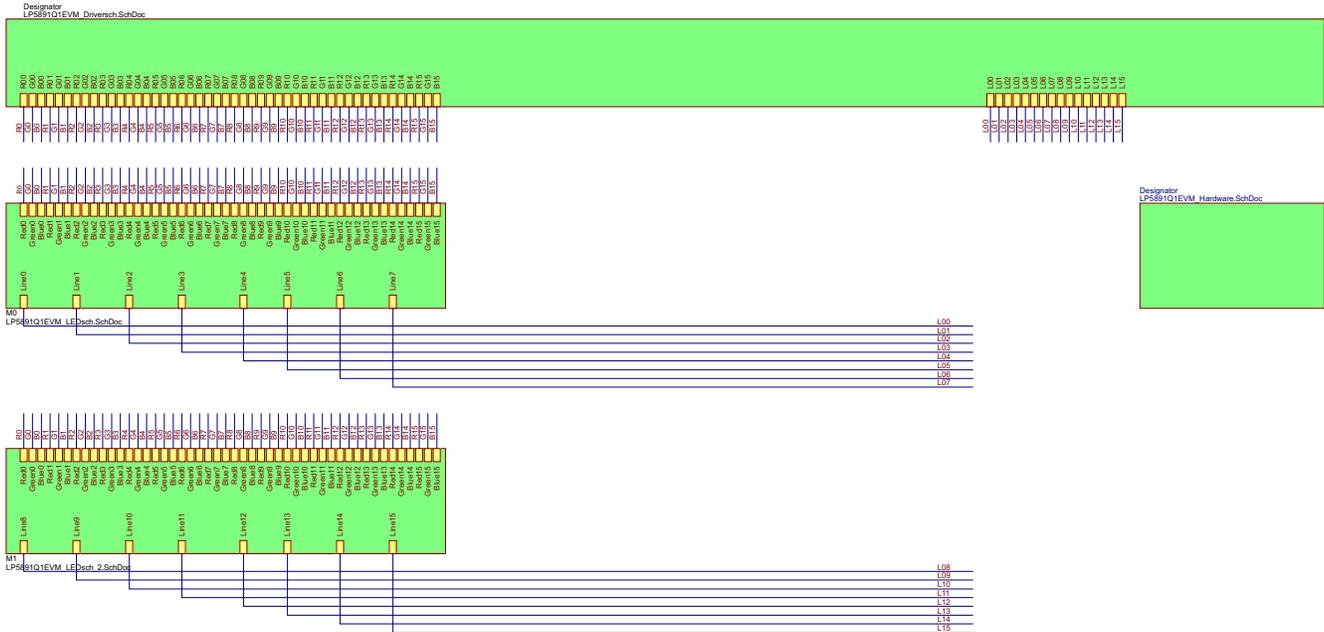The schematic of the EVM is shown below.

Figure 4-1. LP5891Q1EVM Schematic (1 of 4)

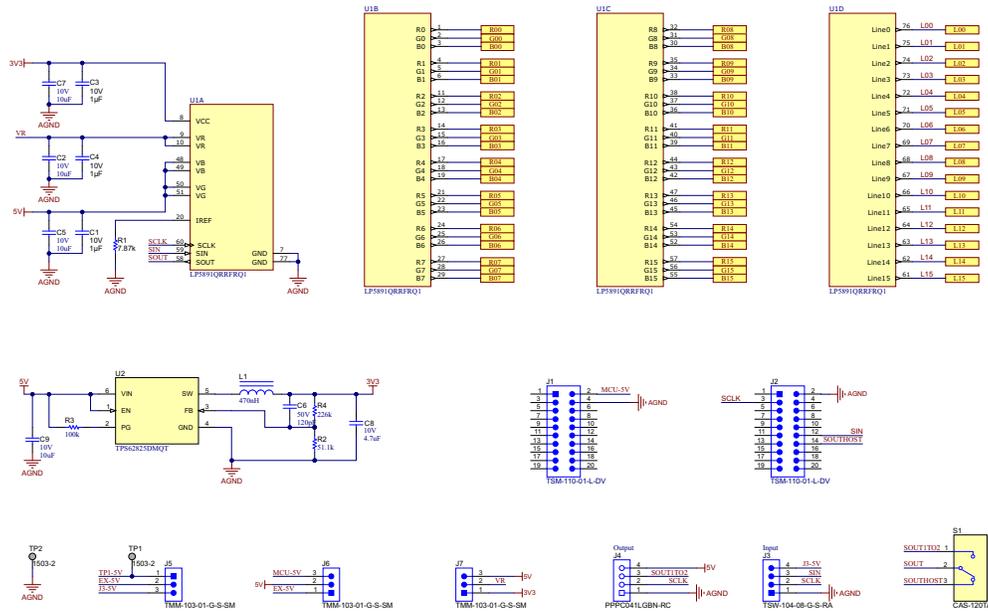**Figure 4-2. LP5891Q1EVM Schematic (2 of 4)**
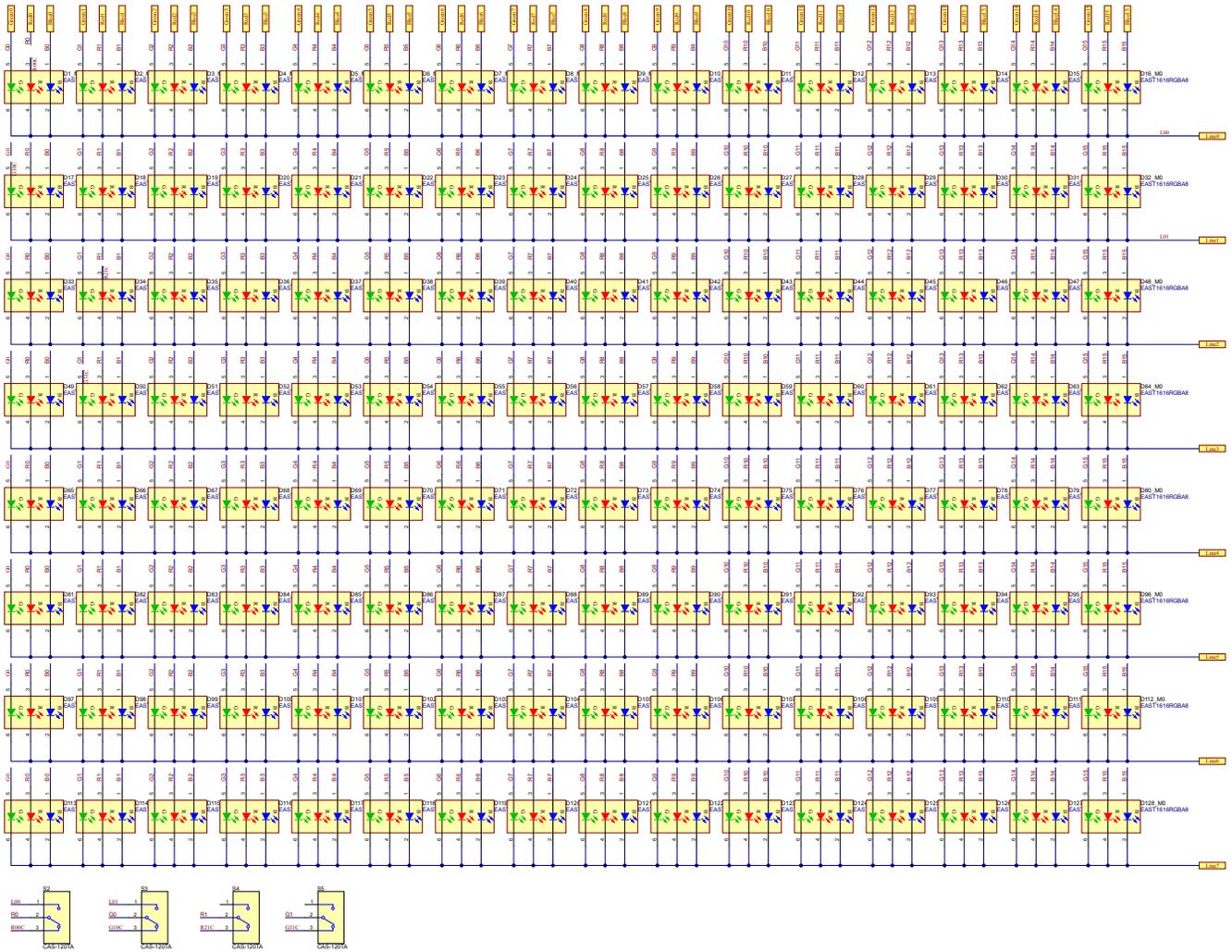
Figure 4-3. LP5891Q1EVM Schematic (3 of 4)
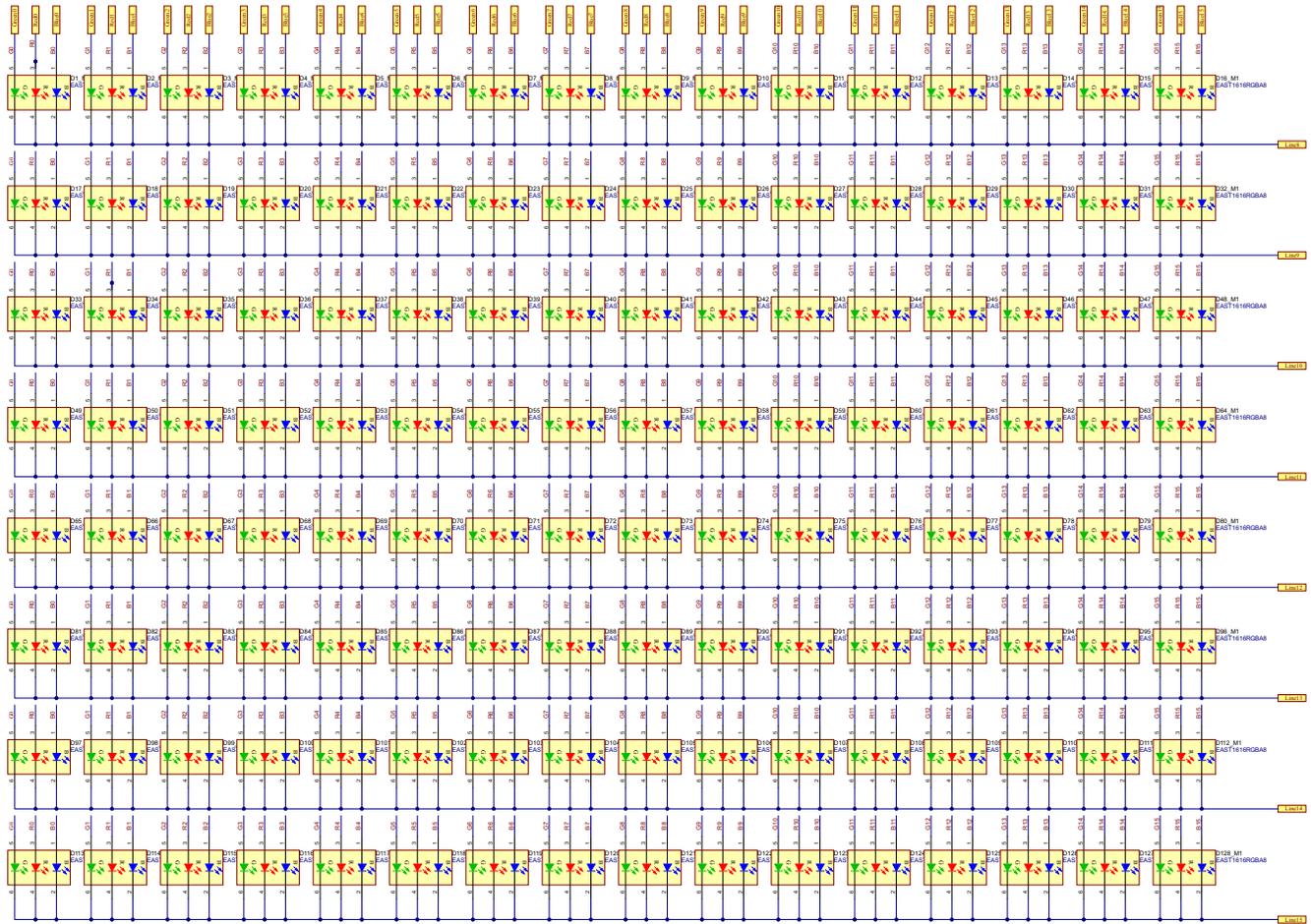
Figure 4-4. LP5891Q1EVM Schematic (4 of 4)

LP5891-Q1 48 × 16 Common Cathode Matrix LED Display Driver Evaluation Module

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4.2 PCB Layout

The PCB layout of the EVM is shown below.

Figure 4-5. LP5891Q1EVM Top Layer

Figure 4-6. LP5891Q1EVM Signal Layer 1

Figure 4-7. LP5891Q1EVM Signal Layer 2

Figure 4-8. LP5891Q1EVM Bottom Layer

4.3 Bill of Materials

Table 4-1 lists the bill of materials for LP5891Q1EVM.

Table 4-1. Bill of Materials
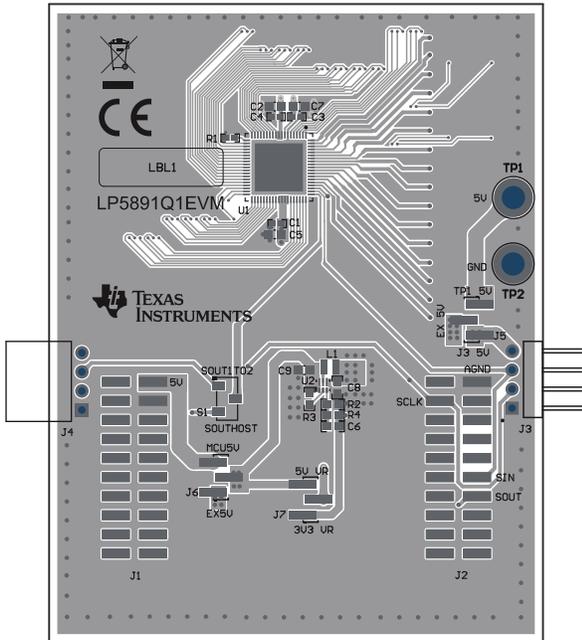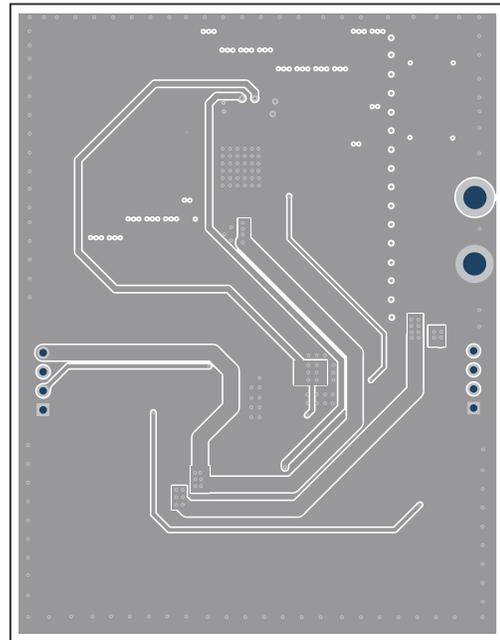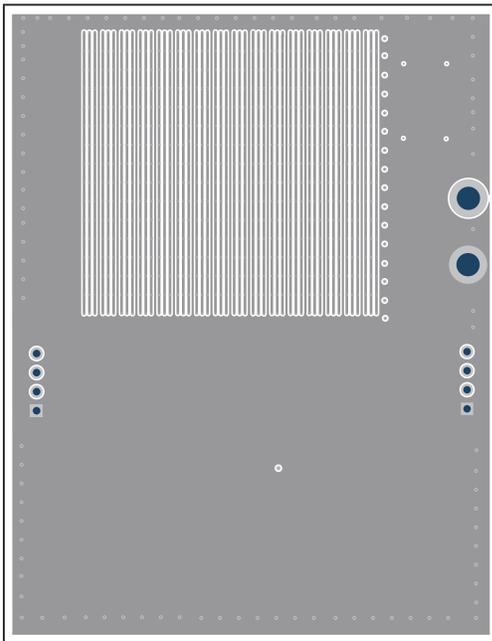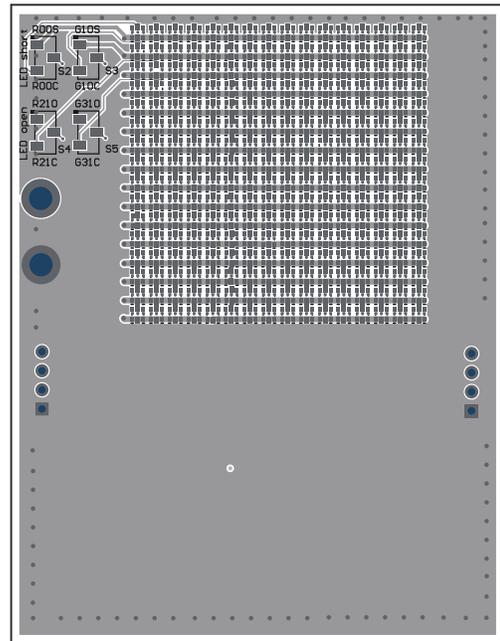
Designator	Qty.	Description	Part Number	Manufacturer
C1, C3, C4	3	CAP, CERM, 1µF, 10V,±20%, X5R, 0402	CC0402MRX5R6BB105	Yageo America
C2, C5, C7, C9	4	CAP, CERM, 10uF, 10V, ±10%, X7T, 0603	ZRB18AD71A106KE01L	MuRata
C6	1	CAP, CERM, 120pF, 50V, ±1%, C0G/NP0, 0603	VJ0603A121FXACW1BC	Vishay-Sprague
C8	1	CAP, CERM, 4.7uF, 10V, ±10%, X5R, 0603	CGB3B1X5R1A475K055AC	TDK
D1_M0... D128_M1	256	LED, RGB, SMD	EAST1616RGBA8	Everlight
J1, J2	2	Header, 2.54mm, 10x2, Gold, SMT	TSM-110-01-L-DV	Samtec
J3	1	Header, 100mil, 4x1, Gold, R/A, TH	TSW-104-08-G-S-RA	Samtec
J4	1	Receptacle, 100mil, 4x1, Gold, R/A, TH	PPPC041LGBN-RC	Sullins Connector Solutions
J5, J6, J7	3	Header, 2mm, 3x1, Gold, SMT	TMM-103-01-G-S-SM	Samtec
L1	1	Inductor, Shielded, Metal Composite, 470nH, 3.6A, 0.032 ohm, SMD	DFE201610E-R47M=P2	MuRata
LBL1	1	Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	THT-14-423-10	Brady
R1	1	RES, 7.87 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW04027K87FKED	Vishay-Dale
R2	1	RES, 51.1 k, 0.1%, 0.1 W, 0603	RT0603BRD0751K1L	Yageo America
R3	1	RES, 100 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW0603100KFKEA	Vishay-Dale
R4	1	RES, 226 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW0603226KFKEA	Vishay-Dale
S1, S2, S3, S4, S5	5	Switch, Slide, SPDT 100mA, SMT	CAS-120TA	Copal Electronics
SH-J1, SH-J2, SH-J3	3	Shunt, 2mm, Gold plated, Black	2SN-BK-G	Samtec
TP1, TP2	2	Terminal, Turret, TH, Double	1503-2	Keystone
U1	1	48 Current Sources, 64 Scans, Common Cathode Matrix LED Display Driver	LP5891QRRFRQ1	Texas Instruments
U2	1	2A High Efficiency Synchronous Buck Converter, DMQ0006A (VSON-HR-6)	TPS62825DMQT	Texas Instruments

5 Additional Information

5.1 Additional Resources

More information about the LP5891-Q1 can be found at:

- LP5891-Q1 data sheet, product information and support | TI.com
- LP5891Q1EVM Evaluation board | TI.com
- [FAQ] How to master LP589x / TLC698x devices with LED display applications within five minutes? - Power management forum - Power management - TI E2E support forums

5.2 Trademarks

LaunchPad™ and C2000™ are trademarks of Texas Instruments.
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 * (March 2023) to Revision A (April 2024)	Page
• Deleted software instructions and added a link to the software user's guide... 7	

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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 DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

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   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/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。

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２４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/lsds/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.

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.

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.

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