User's Guide
SLVUBE8–May 2018

TLC6946 Evaluation Module

This user's guide describes operational use of the TLC6946 evaluation module (BOOSTXL-TLC6946EVM) as a reference for engineering demonstration and evaluation of the TLC6946 16-channel, 32-multiplexing, 16-bit ES-PWM constant-current LED driver. Included in this user's guide are setup instructions, a schematic diagram, printed circuit board (PCB) layout, and a bill of materials (BOM).

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1 Introduction

1.1 Features

The TLC6946 device is a 16-channel, constant-current-sink LED driver. Each channel has an individually-adjustable 65 536 steps of PWM grayscale control. The maximum constant-current value of all 16 channels is set by a single external resistor with 7-bit (128 steps) global brightness control from 0.3 mA to 25 mA. The BOOSTXL-TLC6946EVM uses three TLC6946 devices to drive 16 RGB LEDs, each device controlling one color. Moreover, the EVM provides the function to verify the LED-Open Detection (LOD) and IREF Resistor Short Protection (ISP).

1.2 Applications

The BOOSTXL-TLC6946EVM can be used as a basic function evaluation module for the following applications:

- Mono-color, multi-color, full-color LED displays
- High-refresh-rate LED video displays
- High-density, fine-pitch LED matrix boards
- LED sign boards, message boards
- Variable message signs (VMS)

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2 Test Setup and Results

This section describes the BOOSTXL-TLC6946EVM connectors, test points, and jumpers.

2.1 BOOSTXL-TLC6946EVM Board

Figure 1 displays the EVM board.

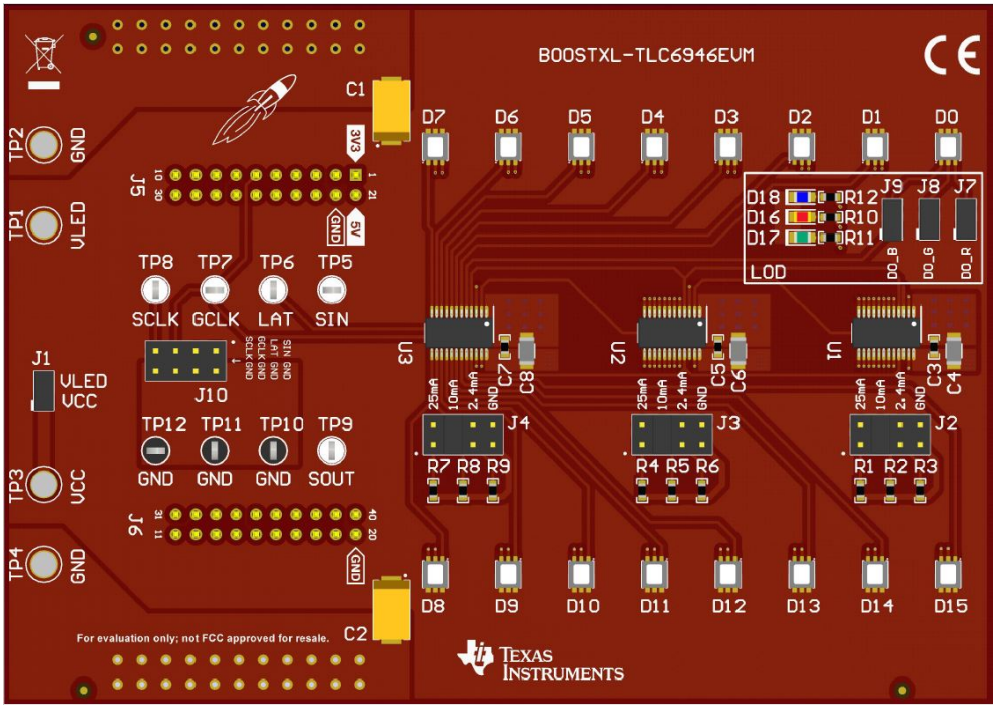


Figure 1. BOOSTXL-TLC6946EVM Board

2.2 Connectors

The EVM has the following connectors:

- TP1 (VLED): Input power supply for VLED
- TP3 (VCC): Input power supply for VCC
- TP2 or TP4 (GND): Supply ground

2.3 Test Points

All the signal pins on the TLC6946 device have test points on the EVM, helping users to observe the waveform on the pins, including SCLK, GCLK, LAT, SIN, and SOUT. The EVM also offers extra GND test points for connections.

2.4 Jumpers

2.4.1 VCC and VLED Connection Jumpers – J1

Jumper J1 is used to connect VCC and VLED. With a shunt, the EVM uses the same power supply for VCC and VLED.

2.4.2 IREF Set Jumpers - J2, J3, and J4

Jumpers J2, J3, and J4 are used to select different maximum constant-output sink current or ISP function verification. Table 1 contains the definitions for jumpers J2–J4.

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Table 1. Jumpers J2–J4

Jumper Position	With Shunt Function
25 mA	Set maximum constant-output sink current to 25 mA
10 mA	Set maximum constant-output sink current to 10 mA
2.4 mA	Set maximum constant-output sink current to 2.4 mA
GND	Connect IREF with GND to verify IREF Resistor Short Protection (ISP)

2.4.3 Signal Input Jumpers - J5, J6, and J10

This BOOSTXL-TLC6946EVM provides BoosterPack connector J5 and J6 to connect with the MSP-EXP432P401R LaunchPad™ for a quick software start.

To use other controllers or data generator, the signals can be input through J10.

2.4.4 LOD Function Verification Jumpers – J7, J8, and J9

Jumpers J7–J9 are used to verify the LED-Open Detection (LOD) function. Using the MSP-EXP432P401R LaunchPad to drive the EVM, D16–D18 can work as indicators for LOD. If using other controllers or data generator, the LOD data can be read from SOUT (TP9). Table 2 contains the definitions for jumpers J7–J9.

Table 2. Jumpers J7–J9

Designator	Attached Function	Without Shunt Result
J7	LOD for LED D0 Red	LED D0 red is open and D16 turns ON if using MSP-EXP432P401R LaunchPad configuration
J8	LOD for LED D0 Green	LED D0 green is open and D17 turns ON if using MSP-EXP432P401R LaunchPad configuration
J9	LOD for LED D0 Blue	LED D0 blue is open and D18 turns ON if using MSP-EXP432P401R LaunchPad configuration

3 Test Setup

Table 3 shows the typical parameters for the BOOSTXL-TLC6946EVM. Table 3 contains the BOOSTXL-TLC6946EVM parameters.

Table 3. BOOSTXL-TLC6946EVM Parameters

Parameter	Value
Input voltage for VCC	3 V to 5.5 V
Input voltage for VLED	17 V Maximum
Input Current for VLED	1.2-A Maximum

Follow these steps for the EVM test setup:

1. Using J1 to select whether using the same power supply for VCC, VLED. Set the voltage of the DC power supply for VCC and VLED and set the current limit to 1.5 A.
2. Connect the positive and negative outputs of the power supply to connectors VCC, VLED and GND on the EVM board.
3. Select the positions of J2–J4 and make sure J7–J9 have shunts.
4. Connect the MSP-EXP432P401R LaunchPad with the EVM through J5 and J6.
5. Power up the VCC, VLED and send the signal to change LED status and check LOD and ISP functions.

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4 Board Layout

Figure 2 illustrates the EVM board layout.

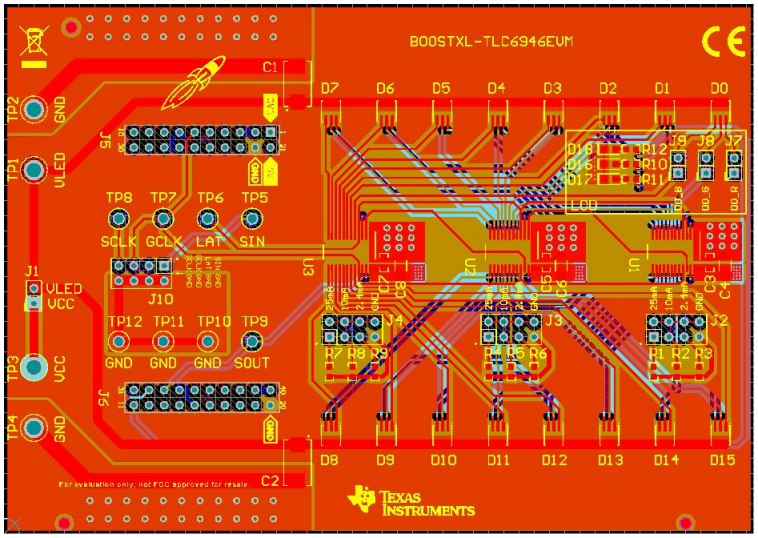


Figure 2. BOOSTXL-TLC6946EVM Layout

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5 Schematic and Bill of Materials

5.1 Schematic

Figure 3 shows the EVM schematic.

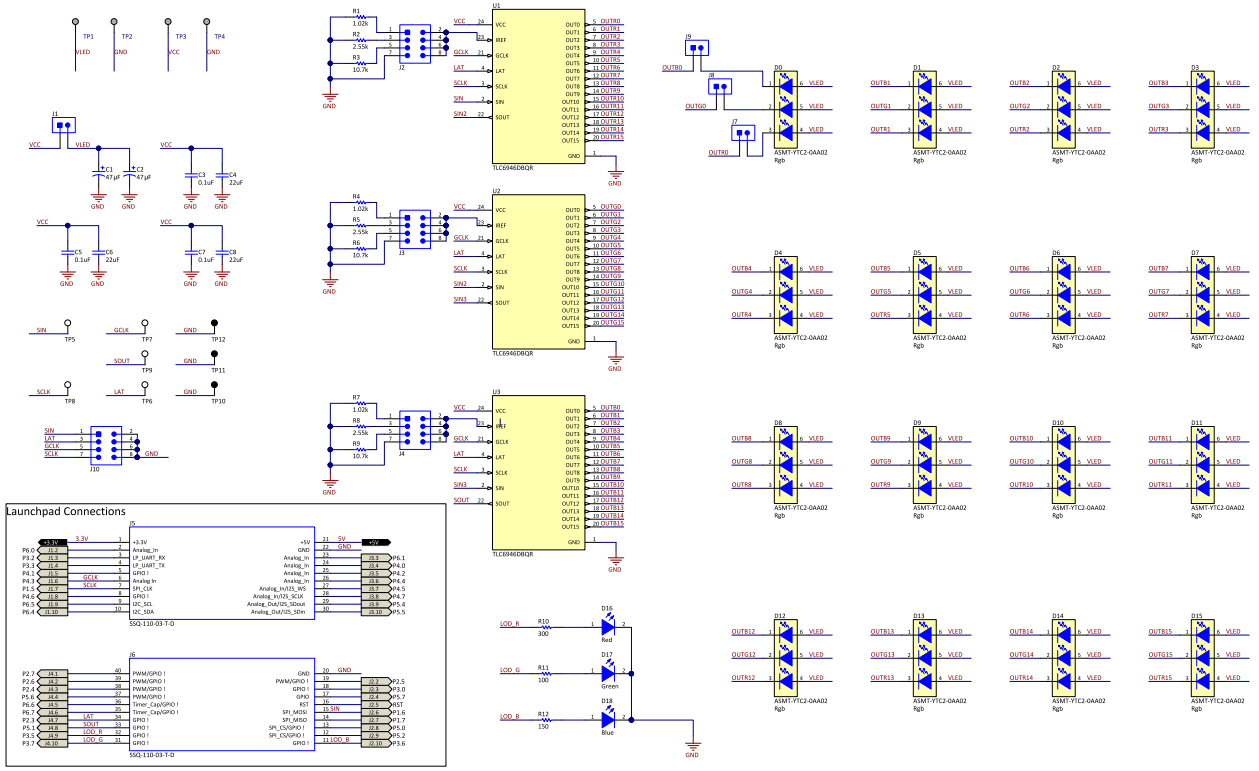


Figure 3. BOOSTXL-TLC6946EVM Schematic

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5.2 Bill of Materials

Table 4 lists the BOOSTXL-TLC6946EVM BOM.

Table 4. BOOSTXL-TLC6946EVM Bill of Materials

Item No.	Designator	QTY	Value	Part Number	Manufacturer	Description	Package Reference
1	C1, C2	2	47uF	593D476X9020E2TE3	Vishay-Sprague	CAP, TA, 47 µF, 20 V, +/- 10%, 0.15 ohm, SMD	7343-43
2	C3, C6, C8	3	22uF	1206YD226MAT2A	AVX	CAP, CERM, 22 µF, 16 V,+/- 20%, X5R, 1206	1206
3	C4, C5, C7	3	0.1uF	0603ZC104KAT2A	AVX	CAP, CERM, 0.1 µF, 10 V,+/- 10%, X7R, 0603	0603
4	D0, D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12, D13, D14, D15	16	Rgb	ASMT-YTC2-0AA02	Avago	LED, RGB, SMD	LED, 3x2x3.6 mm
5	D16	1	Red	LTST-C170KRKT	Lite-On	LED, Red, SMD	Red 0805 LED
6	D17	1	Green	LTST-C170KGKT	Lite-On	LED, Green, SMD	LED_0805
7	D18	1	Blue	LTST-C170TBKT	Lite-On	LED, Blue, SMD	LED_0805
8	J1, J7, J8, J9	4		TSW-102-07-G-S	Samtec	Header, 100mil, 2x1, Gold, TH	2x1 Header
9	J2, J3, J4, J10	4		TSW-104-07-G-D	Samtec	Header, 100mil, 4x2, Gold, TH	4x2 Header
10	J5, J6	2		SSQ-110-03-T-D	Samtec	Receptacle, 2.54mm, 10x2, Tin, TH	10x2 Receptacle
11	R1, R4, R7	3	1.02k	RT0603DRE071K02L	Yageo America	RES, 1.02 k, 0.5%, 0.1 W, 0603	0603
12	R2, R5, R8	3	2.55k	RT0603BRD072K55L	Yageo America	RES, 2.55 k, 0.1%, 0.1 W, 0603	0603
13	R3, R6, R9	3	10.7k	RT0603BRD0710K7L	Yageo America	RES, 10.7 k, 0.1%, 0.1 W, 0603	0603
14	R10	1	300	CRCW0603300RJNEA	Vishay-Dale	RES, 300, 5%, 0.1 W, 0603	0603
15	R11	1	100	CRCW0603100RFKEA	Vishay-Dale	RES, 100, 1%, 0.1 W, 0603	0603
16	R12	1	150	CRCW0603150RJNEA	Vishay-Dale	RES, 150, 5%, 0.1 W, 0603	0603
17	SH-J1, SH-J2, SH-J3, SH-J4, SH-J7, SH-J8, SH-J9	7	1x2	SPC02SYAN	Sullins Connector Solutions	Shunt, 100mil, Flash Gold, Black	Closed Top 100mil Shunt
18	TP1, TP2, TP3, TP4	4	Double	1502-2	Keystone	Terminal, Turret, TH, Double	Keystone1502-2
19	TP5, TP6, TP7, TP8, TP9	5		5012	Keystone	Test Point, Multipurpose, White, TH	White Multipurpose Testpoint
20	TP10, TP11, TP12	3		5011	Keystone	Test Point, Multipurpose, Black, TH	Black Multipurpose Testpoint
21	U1, U2, U3	3		TLC6946DBQR	Texas Instruments	16-Channel 32-Multiplexing 16-Bit ES-PWM Constant-Current LED Driver, DBQ0024A (SSOP-24)	DBQ0024A

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FCC Interference Statement for Class B EVM devices

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- *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*

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(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.

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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.

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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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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,
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