TLC6C5712-Q1 Evaluation Module

1 Introduction

This document is the user's guide for the TLC6C5712-Q1 evaluation module (EVM) as a supplement to the TLC6C5712-Q1 data sheet. This user's guide describes the characteristics, operation, and use of the TLC6C5712-Q1 EVM. This EVM is designed to help the user evaluate and test the various operating modes of the TLC6C5712-Q1 device. This user's guide includes a detailed description of the graphical user interface (GUI) which can help customers easily use the GUI. The guide also contains the setup instructions for the hardware and software, a schematic diagram, a bill of materials (BOM), and PCB layout drawings for the evaluation module.

The TLC6C5712-Q1 device is a 12 channel, constant-current LED driver that is capable of driving up to 75 mA per channel. The device contains an integrated DOT-correction circuitry which can adjust the DC current for each output channel to compensate for a difference in brightness among the LEDs. The device also has integrated PWM mapping control to provide individual LED PWM dimming. The device has full LED diagnostics, such as LED open, LED short, output short to GND, over-temperature prewarning, over-temperature thermal shutdown, reference short and open, adjacent pin short, and others. This EVM can be used to evaluate a single device, but it can be also configured to drive two devices in a cascade configuration. By using the GUI, users can easily evaluate the device.

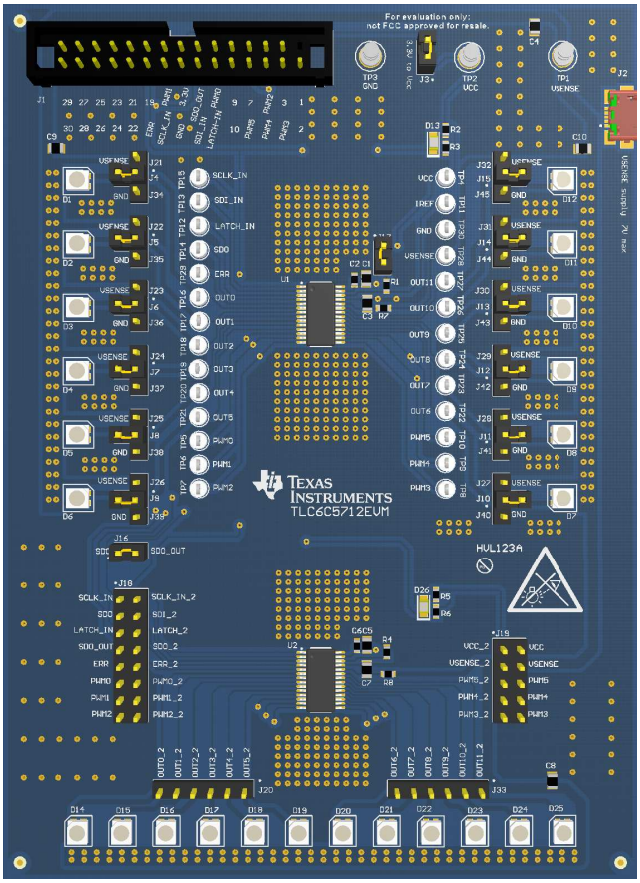


Figure 1. Top View of the TLC6C5712-Q1EVM PCB

2 Requirements

To operate this EVM, the software, power supply, and communication board must be connected and properly configured. This section provides more information on each component.

2.1 Software

Texas Instruments has provided the necessary software to evaluate this EVM. For the latest software revision, go to the TLC6C5712-Q1 product folder, www.ti.com/product/TLC6C5712-Q1,.

2.2 Power Supply Requirements

The EVM board can receive supply in one of two ways. The first way is suitable for evaluation in the lab which uses two DC power supplies. The first DC power supply is for V_{CC} and the other is for VSENSE. The second way is suitable for portable demonstration. In this case, only a 5-V micro-USB supply is required. The VSENSE pin can be powered through a USB cable directly and the V_{CC} pin can be directly supplied by the USB2ANY.

2.3 Communication Board

The USB2ANY is the interface between the PC and the TLC6C5712-Q1EVM. One end of the USB2ANY connects to the PC with the USB cable and the other end of the USB2ANY connects to the EVM with the ribbon cable. After installing the GUI, users can control the TLC6C5712-Q1EVM by sending commands through the USB2ANY.

3 Setup

The following sections describe how to setup the EVM hardware and software.

3.1 Hardware Setup

Figure 2 shows the hardware setup of the TLC6C5712-Q1EVM.

Step 1. Connect the 5-V power supply to the LED board between TP1 (VSENSE) and TP3 (GND). Users can also use the 5-V micro-USB supply connected to J2 to supply VSENSE.

Step 2. Put a shunt on J3 to connect the USB2ANY 3.3-V supply to V_{CC}. In this case, the user is not required to supply V_{CC} with another DC supply.

Step 3. Connect the host computer to USB2ANY board using the USB cable.

Step 4. Connect the ribbon cable between the USB2ANY board and the TLC6C5712-Q1 EVM board.

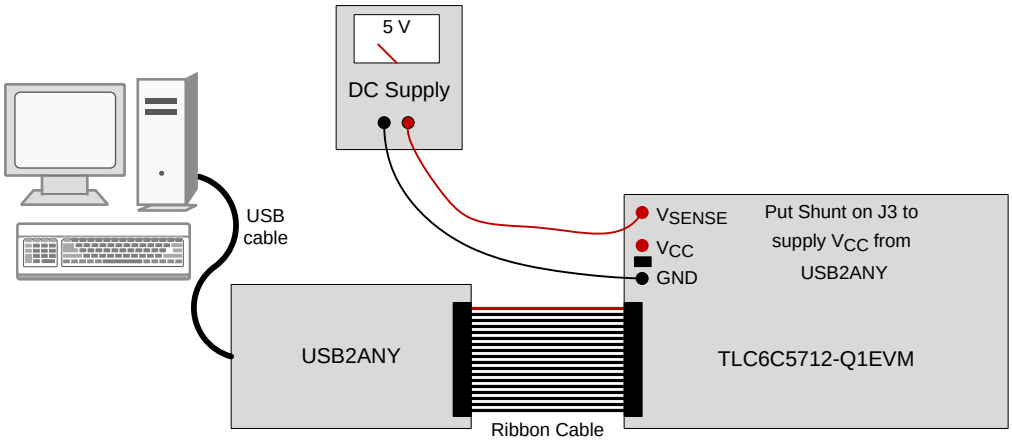


Figure 2. Hardware Setup for TLC6C5712-Q1EVM

3.2 Software Installation

Download the GUI software from www.ti.com. After downloading, install the TLC6C5712-Q1 EVM GUI on the PC. A shortcut to the GUI is found on the desktop. A shortcut can also be found in the startup menu under the *Texas Instruments* folder.

3.3 GUI Connection

After setting up the hardware, open the GUI. Figure 3 shows the overview of the TLC6C5712-Q1 EVM GUI. When the EVM is connected correctly, the status bar at the bottom right of the GUI will show a green *CONNECTED* status. A red *SIMULATION* status indicates that the device is not connected. Check the connection of the device to make sure that it is properly connected. If the SIMULATION status still appears, then uncheck the *Simulate Communication* box in the top right of the GUI to connect the device.

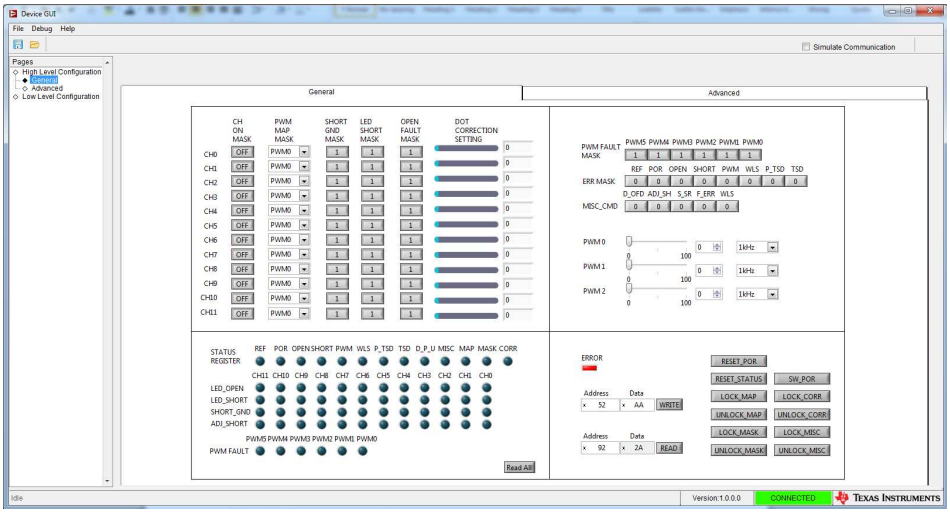


Figure 3. TLC6C5712-Q1 EVM GUI Overview

4 Input and Output Connector Descriptions

4.1 Power Supply Connector

Table 1 list the connector descriptions of the power supply.

Table 1. Power Supply Connectors

CONNECTOR	NAME	DESCRIPTION
TP1	VSENSE	This connector is the positive input of the load supply
J2	VSENSE Supply	The connector is a Micro-USB connector, it can be used to supply the load by an USB cable.
TP2	VCC	This connector is the positive input of the IC internal supply.
TP3	GND	This connector is the ground of the EVM.

4.2 SPI Interface Connectors

The J1 jumper is the SPI interface connector. Table 2 lists the detailed description of J1.

Table 2. SPI Interface Connector

PIN NO.	PIN SYMBOL	SIGNAL NAME	I/O	FUNCTION
1	—	—	—	—
2	—	—	—	—
3	—	—	—	—
4	PWM3	PWM3	Input	PWM input for PWM3 of U1
5	PWM2	PWM2	Input	PWM input for PWM2 of U1
6	PWM4	PWM4	Input	PWM input for PWM4 of U1
7	—	—	—	—
8	PWM5	PWM5	Input	PWM input for PWM5 of U1
9	—	—	—	—
10	—	—	—	—
11	PWM0	PWM0	Input	PWM input for PWM0 of U1
12	LATCH_IN	Serial data latch	Input	Rising edge latches data from shift registers into the device
13	SDO_OUT	Serial data output	Output	Serial data output for U1. This is also the serial data input in cascade mode.
14	SDI_IN	Serial data input	Input	Serial data input for U1
15	3.3 V	3.3-V supply	Power	3.3-V supply on USB2ANY
16	GND	Ground	Power	Signal ground
17	PWM1	PWM1	Input	PWM input for PWM1 of U1
18	SCLK_IN	Serial data clock	Input	Serial data input clock
19	—	—	—	—
20	ERR	Error output	Output	Error output for device
21	—	—	—	—
22	—	—	—	—
23	—	—	—	—
24	—	—	—	—
25	—	—	—	—
26	—	—	—	—
27	—	—	—	—
28	—	—	—	—
29	—	—	—	—
30	—	—	—	—

4.3 Test Points

Table 3 the test points of the EVM.

Table 3. Test points of the EVM

SYMBOL	NAME	FUNCTION
TP15	SCLK_IN	SPI clock input of U1
TP13	SDI_IN	SPI data input of U1
TP12	LATCH_IN	SPI latch input of U1
TP14	SDO	SPI data output of U1
TP29	ERR	ERR output of U1
TP16	OUT0	OUT0 of U1
TP17	OUT1	OUT0 of U1
TP18	OUT2	OUT0 of U1
TP19	OUT3	OUT0 of U1
TP20	OUT4	OUT0 of U1
TP21	OUT5	OUT0 of U1
TP5	PWM0	PWM0 of U1
TP6	PWM1	PWM0 of U1
TP7	PWM2	PWM0 of U1
TP4	V_{CC}	V_{CC} of U1
TP11	IREF	I_{ref} of U1
TP30	GND	GND
TP28	VSENSE	VSENSE of U1
TP27	OUT11	OUT0 of U1
TP26	OUT10	OUT0 of U1
TP25	OUT9	OUT0 of U1
TP24	OUT8	OUT0 of U1
TP23	OUT7	OUT0 of U1
TP22	OUT6	OUT0 of U1
TP10	PWM5	PWM0 of U1
TP9	PWM4	PWM0 of U1
TP8	PWM3	PWM0 of U1
J21, J22, J23, J24, J25, J26, J27, J28, J29, J30, J31, J32	VSENSE	VSENSE of U1
J34, J35, J36, J37, J38, J39, J40, J41, J42, J43, J44, J45	GND	GND

4.4 Jumpers

Table 4 lists shows the jumpers of the EVM.

Table 4. Jumpers of the EVM

JUMPER	DESCRIPTION
J3	Connect 3.3 V to V_{CC}
J17	Connect REF resister and GND
J16	Connect SDO to SDO_OUT, when controlling a single TLC6C5712-Q1 device, put a shunt on this jumper
J18	Cascade U1 with U2, when controlling U1 and U2 in series, remove shunt on J16, put shunt on J18 and J19
J19	Cascade U1 with U2, when controlling U1 and U2 in series, remove shunt on J16, put shunt on J18 and J19
J20	OUT0-5 of U2
J33	OUT6-11 of U2
J4	Connect D1 to OUT0 of U1
J5	Connect D2 to OUT1 of U1
J6	Connect D3 to OUT2 of U1
J7	Connect D4 to OUT3 of U1
J8	Connect D5 to OUT4 of U1
J9	Connect D6 to OUT5 of U1
J10	Connect D7 to OUT6 of U1
J11	Connect D8 to OUT7 of U1
J12	Connect D9 to OUT8 of U1
J13	Connect D10 to OUT9 of U1
J14	Connect D11 to OU10 of U1
J15	Connect D12 to OUT11 of U1

5 GUI Function

This section describes the details of the TLC6C5712-Q1 EVM GUI. The GUI has two configuration levels: one is a high-level configuration, the other is a low-level configuration. In the high-level configuration, two tabs are included which are for the general function and advanced function. Low-level configuration describes all the TLC6C5712-Q1 registers. The following sections introduce the details of the functions.

5.1 General

Figure 4 shows the general tab of TLC6C5712-Q1 EVM GUI. In this page, users can easily change the register values.

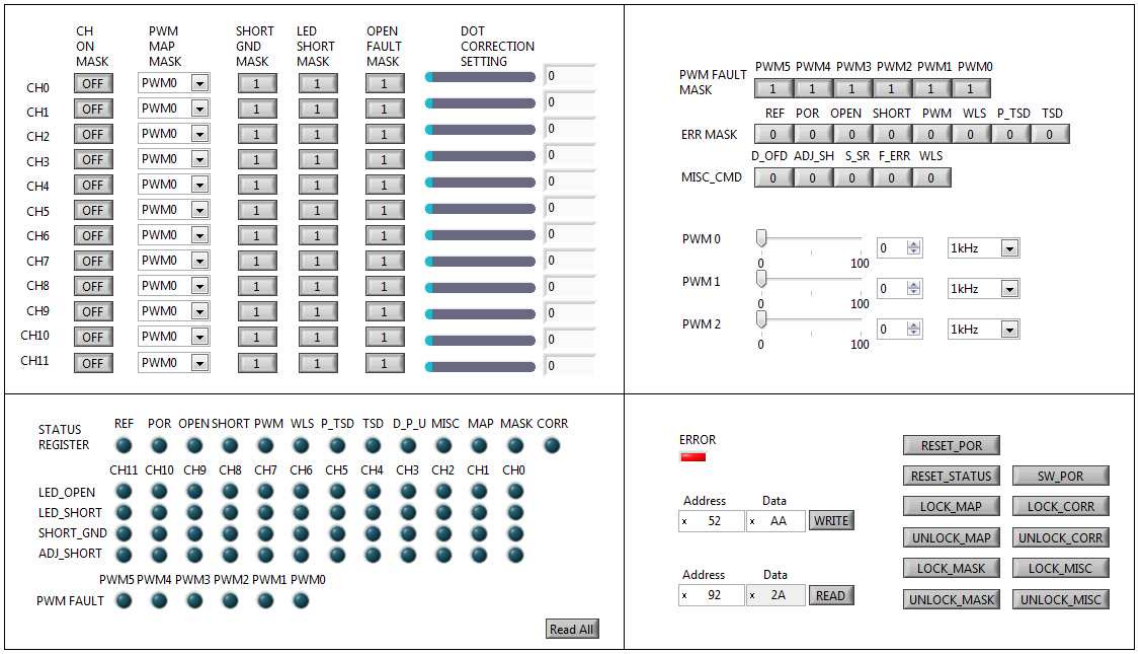


Figure 4. TLC6C5712-Q1 EVM GUI

The general tab is divided into four parts. Figure 5 shows the register control of CH ON MASK, PWM MAP MASK, SHORT GND MASK, LED SHORT MASK, OPEN FAULT MASK, and DOT CORRECTION SETTING.

The LEDs can be turned on by clicking the *CH ON MASK* button. The word on the button shows the value sent to the register. When the button displays *OFF*, the value of the CH ON MASK is 1 which means the LED is masked and the output is turned off. When the button displays *ON*, the value of the CH ON MASK is 0 which means the LED is not masked and the output is turned on.

The PWM MAP MASK is used to map the PWM control for each channel. When driving the EVM using the USB2ANY board, only three PWM outputs available: PWM0, PWM1, and PWM2. These outputs can be controlled by the sliders in Figure 6. The PWM3, PWM4 and PWM5 are connected to the GND of USB2ANY.

The SHORT GND MASK, LED SHORT MASK, and OPEN FAULT MASK are used to control the fault mask. A setting of 1 indicates that the fault is masked. A setting of 0 indicates that the fault is not masked. When the fault is unmasked, the fault will be reported to the open and short registers in the status register. SHORT GND MASK and LED SHORT MASK correspond with the status of the short register shown in Figure 7. OPEN FAULT MASK corresponds with the status of the open register shown in Figure 7.

The DOT CORRECTION SETTING is used for setting the output current for each channel. Each channel has an internal 8-bit linear current DAC for individual dot correction control. Use Equation 1 to set the output current.

$$I_{OUT} = \frac{V_{REF} \times K_{OUT}}{R_{REF}} \times \frac{DC + 1}{256} \quad (1)$$

where

- V_{REF} is the reference voltage, 1.229 V
- K_{OUT} is the output current to I_{REF} current ratio, 500
- R_{REF} is the reference resistor
- DC is the DOT correction setting value

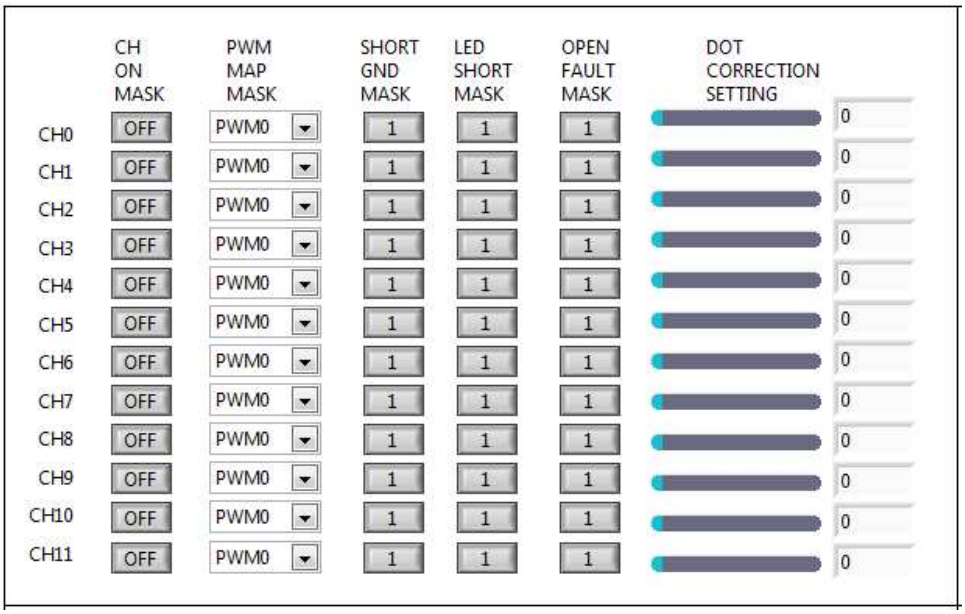


Figure 5. General Function I

PWM FAULT MASK is used to control the PWM fault mask. A setting of 1 indicates that the PWM fault is masked and therefore the fault will not be reported to the status register shown in Figure 7. A setting of 0 indicates that the PWM fault is unmasked and therefore when a PWM fault occurs, the fault will be reported to PWM status register.

The ERR MASK field is used to control the ERROR mask. A setting of 1 indicates that the error is masked and therefore the error is not reported to the ERROR indicator shown in Figure 8. A setting of 0 indicates that the error is unmasked and therefore, when an error occurs, the error is reported to the ERROR indicator. When users need the error indicator to report the fault, the fault mask for each channel (such as PWM fault mask, SHORT GND MASK, and so on) should not be masked. When D13 on the EVM is on, users can click the READ ALL to get the fault.

The MISC_CMD field contains fives commands. The D_OFD command disables the off state diagnostic. If the LED off-state diagnostic is not needed, change the register value to 1. The ADJ_SH command detects the adjacent pin short fault. Users can implement the detection by setting the register value to 1. Because the register value resets to 0 after the device finishes the detection, users must change the ADJ_SH value back to 0 after the detection is complete. The S_SR command is used to control the output slew rate. A setting of 1 indicates the slow slew rate. The F_ERR command forces the ERROR output state. When the register is 1, the ERR output is pulled low even the system has no error. The WLS command configures the weak-load supply-detection threshold. A setting of 1 indicates that the detection threshold is 2.77 V. A setting of 0 indicates that the detection threshold is 4.2 V.

The PWM0, PWM1, and PWM2 fields generate the PWM control signals for the TLC6C5712-Q1 EVM. PWM0, PWM1, and PWM2 corresponds with the PWM0, PWM1, and PWM2 inputs of the TLC6C5712-Q1 device. Users can select from the following 8 frequencies: 100 Hz, 200 Hz, 500 Hz, 1 KHz, 2 KHz, 5 KHz, 10 KHz, 20 KHz, 50 KHz, and 100 KHz. The duty cycles can also be changed from 0 to 100% respectively.

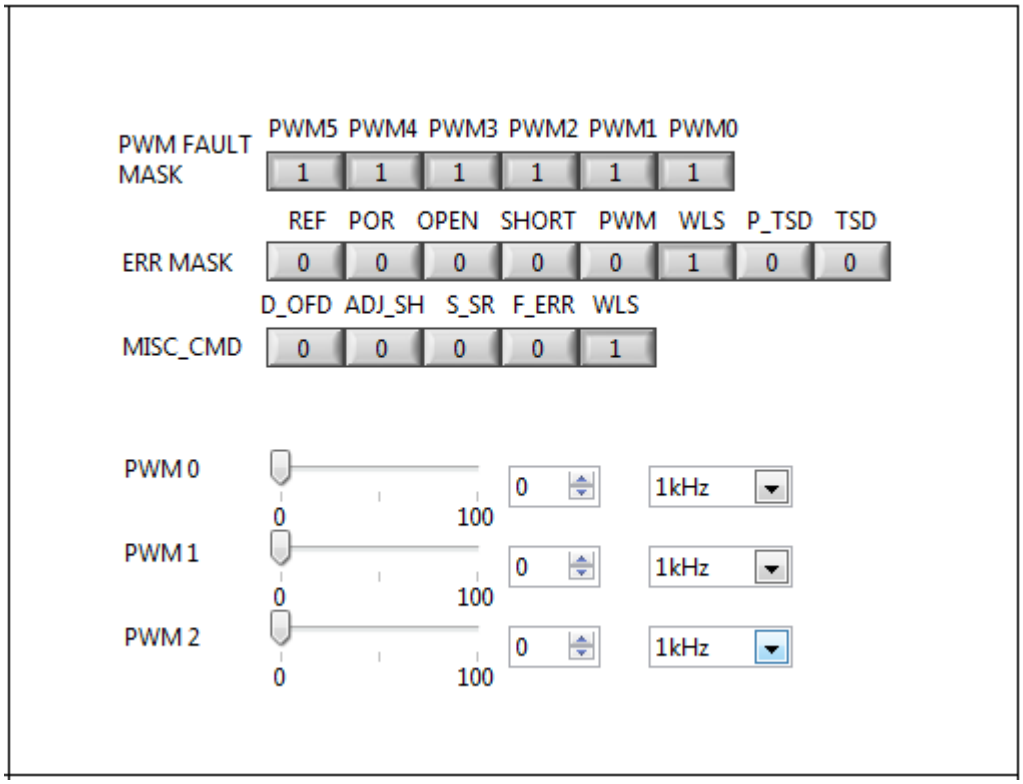


Figure 6. General Function II

Figure 7 shows the status registers and fault registers of the TLC6C5712-Q1 device. By clicking the *Read All* button, the information of these registers is read out. A red indicator color indicates a fault.

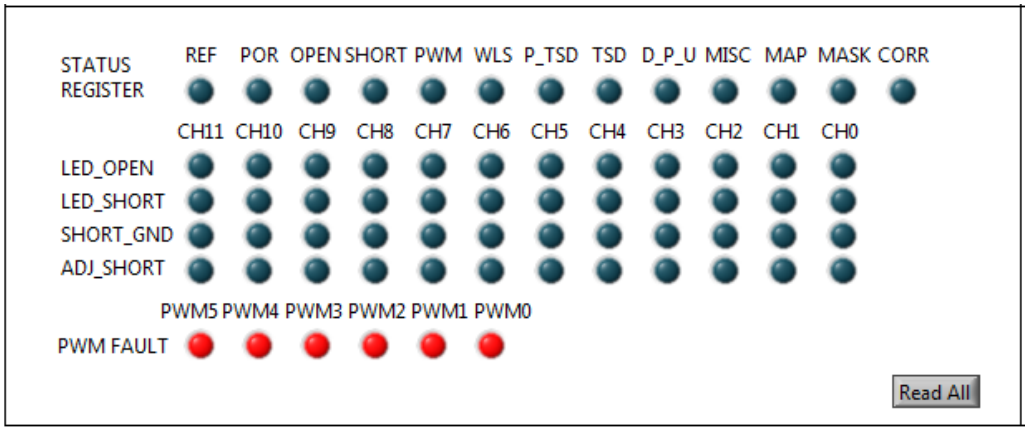


Figure 7. General Function III

Figure 8 contains registers with simple read and write functions. Users can write and read registers by input address and data value. The ERROR indicator shows the ERR pin state. If the error pin is pulled low, the ERROR indicator displays red. The left side of Figure 8 shows several special commands of TLC6C5712-Q1 device which can be found in the datasheet (SLVSCO9).

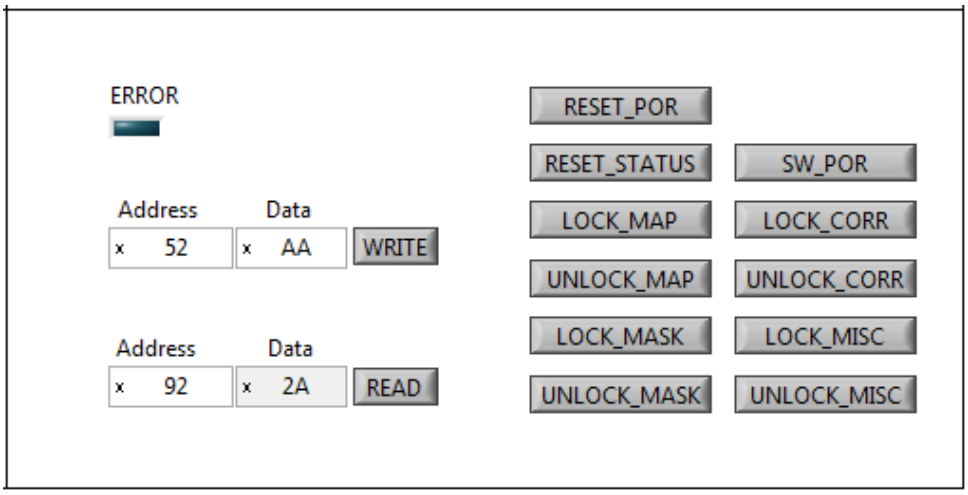


Figure 8. General Function IV

5.2 Advanced Commands

Figure 9 shows the advanced command functions. Users can write command sequences in the *Codes to Send* field. Users must follow the specific format when inputting the commands. The standard format for comments is *// comments* which is optional. The GUI identifies the *//* symbol and ignores the content following this symbol. The text following the symbol can be in either uppercase or lowercase. The delay function is only used for general delay as the delay time does not contain the software operate delay.

```
Address Data // comments
0x61 0x69 // power on reset
0x62 0x66
PWM(1,2,50) //PWM(Channel,Index,DutyCycle)
Delay 100 // Delay N, delay N ms
0x52 0x00 //Turn on CH0-CH5
0x53 0x00 //Turn on CH6-CH11
0x46 0xff   //CH0 Dot Correction value = 255
.........
```

For the PWM command, the channel value should range from 0 to 2. A value of 0 corresponds with PWM0, a value of 1 corresponds with PWM1, and a value of 2 corresponds with PWM2. The index value should range from 0 to 9. This value corresponds with a frequency from 100 Hz to 100 kHz. Table 5 lists the relationship between the channel and PWM control. Table 6 lists the relationship between the index value and frequency.

Table 5. Channel and PWM Control

CHANNEL	0	1	2
PWM CONTROL	PWM0	PWM1	PWM2

Table 6. Index and Frequency

INDEX	0	1	2	3	4	5	6	7	8	9
FREQUENCY	100 Hz	200 Hz	500 Hz	1 kHz	2 kHz	5 kHz	10 kHz	20 kHz	50 kHz	100 kHz

The GUI can distinguish read commands from write commands. When the command is a read command, the read-back data is displayed in the *Codes Received* field.

Selecting the *Loop the Codes* box sends the codes repeatedly. The *Binary to Hex to Hexadecimal to Decimal Converter* can help users easily convert the data scale.

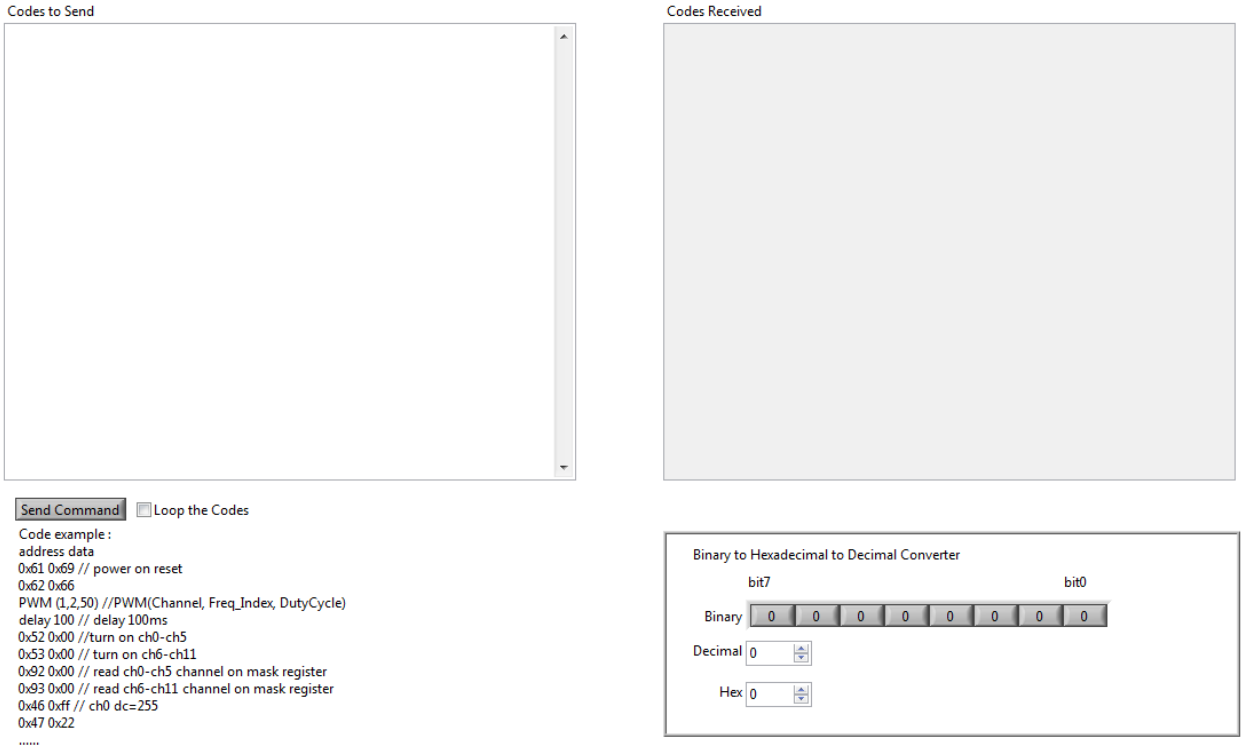
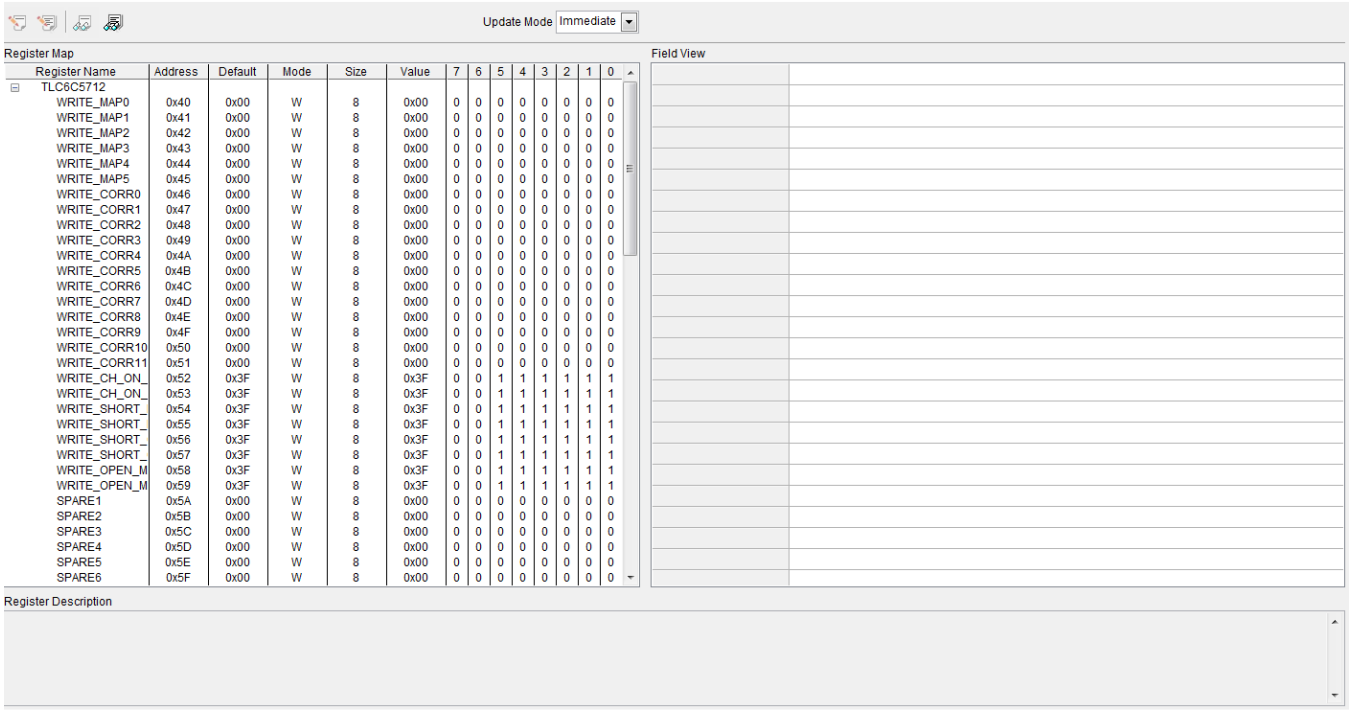


Figure 9. Advanced Commands

5.3 Register Map

In the low-level configuration, users can change the register bits by directly clicking the bit value. If the immediate update mode is selected, the register value is updated immediately when the value is changed. If manual update mode is selected, the register value is not updated unless the *Write Selected* or *Write Modified* button is clicked.



Register Name	Address	Default	Mode	Size	Value	7	6	5	4	3	2	1	0
TLC6C5712													
WRITE_MAP0	0x40	0x00	W	8	0x00	0	0	0	0	0	0	0	0
WRITE_MAP1	0x41	0x00	W	8	0x00	0	0	0	0	0	0	0	0
WRITE_MAP2	0x42	0x00	W	8	0x00	0	0	0	0	0	0	0	0
WRITE_MAP3	0x43	0x00	W	8	0x00	0	0	0	0	0	0	0	0
WRITE_MAP4	0x44	0x00	W	8	0x00	0	0	0	0	0	0	0	0
WRITE_MAP5	0x45	0x00	W	8	0x00	0	0	0	0	0	0	0	0
WRITE_CORR0	0x46	0x00	W	8	0x00	0	0	0	0	0	0	0	0
WRITE_CORR1	0x47	0x00	W	8	0x00	0	0	0	0	0	0	0	0
WRITE_CORR2	0x48	0x00	W	8	0x00	0	0	0	0	0	0	0	0
WRITE_CORR3	0x49	0x00	W	8	0x00	0	0	0	0	0	0	0	0
WRITE_CORR4	0x4A	0x00	W	8	0x00	0	0	0	0	0	0	0	0
WRITE_CORR5	0x4B	0x00	W	8	0x00	0	0	0	0	0	0	0	0
WRITE_CORR6	0x4C	0x00	W	8	0x00	0	0	0	0	0	0	0	0
WRITE_CORR7	0x4D	0x00	W	8	0x00	0	0	0	0	0	0	0	0
WRITE_CORR8	0x4E	0x00	W	8	0x00	0	0	0	0	0	0	0	0
WRITE_CORR9	0x4F	0x00	W	8	0x00	0	0	0	0	0	0	0	0
WRITE_CORR10	0x50	0x00	W	8	0x00	0	0	0	0	0	0	0	0
WRITE_CORR11	0x51	0x00	W	8	0x00	0	0	0	0	0	0	0	0
WRITE_CH_ON_	0x52	0x3F	W	8	0x3F	0	0	1	1	1	1	1	1
WRITE_CH_ON_	0x53	0x3F	W	8	0x3F	0	0	1	1	1	1	1	1
WRITE_SHORT_	0x54	0x3F	W	8	0x3F	0	0	1	1	1	1	1	1
WRITE_SHORT_	0x55	0x3F	W	8	0x3F	0	0	1	1	1	1	1	1
WRITE_SHORT_	0x56	0x3F	W	8	0x3F	0	0	1	1	1	1	1	1
WRITE_SHORT_	0x57	0x3F	W	8	0x3F	0	0	1	1	1	1	1	1
WRITE_OPEN_M	0x58	0x3F	W	8	0x3F	0	0	1	1	1	1	1	1
WRITE_OPEN_M	0x59	0x3F	W	8	0x3F	0	0	1	1	1	1	1	1
SPARE1	0x5A	0x00	W	8	0x00	0	0	0	0	0	0	0	0
SPARE2	0x5B	0x00	W	8	0x00	0	0	0	0	0	0	0	0
SPARE3	0x5C	0x00	W	8	0x00	0	0	0	0	0	0	0	0
SPARE4	0x5D	0x00	W	8	0x00	0	0	0	0	0	0	0	0
SPARE5	0x5E	0x00	W	8	0x00	0	0	0	0	0	0	0	0
SPARE6	0x5F	0x00	W	8	0x00	0	0	0	0	0	0	0	0

Figure 10. Register Map

Users can save the register configuration by clicking the *Saving Configuration* button. When opening the configuration file, all of the saved registers value are reloaded into the device.

6 Bill of Materials and Schematic

Table 7 lists the bill of materials (BOM) for the TLC6C5712EVM.

Table 7. TLC6C5712-Q1 BOM

DESIGNATOR	QUANTITY	VALUE	DESCRIPTION	PARTNUMBER	MANUFACTURER
C1, C5	2	4.7 µF	Capacitor, ceramic 4.7 µF, 16 V, ±10%, X5R, 0805	GRM21BR61C475KA88L	MuRata
C2, C6	2	0.1 µF	Capacitor, ceramic 0.1 µF, 16 V, ±5%, X7R, 0603	0603YC104JAT2A	AVX
C3, C7, C9, C10	4	4.7 µF	Capacitor, ceramic 4.7 µF, 16 V, ±10%, X5R, 0805	EMK212BJ475KG-T	Taiyo Yuden
C8	1	10 µF	Capacitor, ceramic 10 µF, 16 V, ±10%, X6S, 0805	C2012X6S1C106MT	TDK
D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12	12	White	LED, White, SMD	LW-E6SG	OSRAM
D13, D26	2	Red	LED, Red, SMD	LTST-C170KRKT	Lite-On
D14, D17, D20, D23	4	Red	LED, Red, SMD	LR-E6SF	OSRAM
D15, D18, D21, D24	4	Green	LED, Green, SMD	LT-E6SG	OSRAM
D16, D19, D22, D25	4	Blue	LED, Blue, SMD	LB-E6SG	OSRAM
J1	1		Connector, 15x2, 3A 300V STRT DIP, TH	XG4C-3031	Omron Electronic Components
J2	1		Receptacle, 0.65 mm, 5x1, Gold, R/A, SMT	10118192-0001LF	FCI
J3, J4, J5, J6, J7, J8, J9, J10, J11, J12, J13, J14, J15, J16, J17	15		Header, 100mil, 2x1, Gold, TH	TSW-102-07-G-S	Samtec
J18	1		Header, 100mil, 8x2, Gold, TH	TSW-108-07-G-D	Samtec
J19	1		Header, 100mil, 5x2, Gold, TH	TSW-105-07-G-D	Samtec
J20, J33	2		Header, 100mil, 6x1, Gold, TH	TSW-106-07-G-S	Samtec
J21, J22, J23, J24, J25, J26, J27, J28, J29, J30, J31, J32, J34, J35, J36, J37, J38, J39, J40, J41, J42, J43, J44, J45	24		Header, 100mil, 1pos, Gold, TH	TSW-101-07-G-S	Samtec
R1, R4	2	12.1 kΩ	Resistor, 12.1 kΩ, 1%, 0.1 W, 0603	CRCW060312K1FKEA	Vishay-Dale
R2, R5	2	1 kΩ	Resistor, 1 kΩ, 5%, 0.1 W, 0603	CRCW06031K00JNEA	Vishay-Dale
R3, R6	2	3.3 kΩ	Resistor,, 3.3 kΩ, 5%, 0.1 W, 0603	CRCW06033K30JNEA	Vishay-Dale
R7, R8	2	0	Resistor, 0, 5%, 0.1 W, 0603	ERJ-3GEY0R00V	Panasonic
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8, SH-J9, SH-J10, SH-J11, SH-J12, SH-J13, SH-J14, SH-J15	15	1x2	Shunt, 100mil, Gold plated, Black	969102-0000-DA	3M
TP1, TP2, TP3	3	Double	Terminal, Turret, TH, Double	1502-2	Keystone
TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP18, TP19, TP20, TP21, TP22, TP23, TP24, TP25, TP26, TP27, TP28, TP29, TP30	27	White	Test Point, Miniature, White, TH	5002	Keystone
U1	1		Constant Current Sink LED Driver, PWP0028H	TLC6C5712QPWPRQ1	Texas Instruments

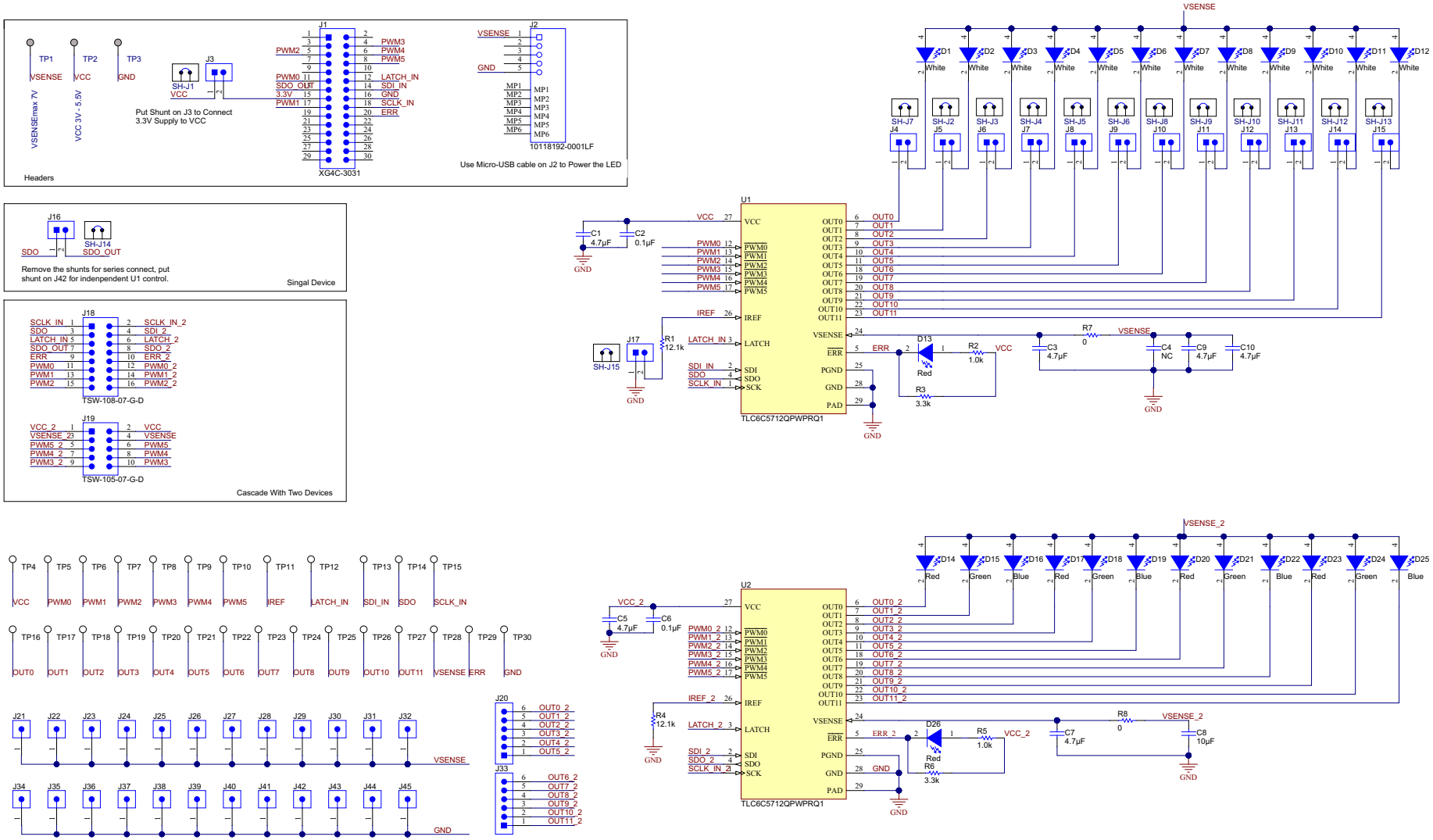


Figure 11. TLC6C5712EVM Schematic

Revision History

Changes from Original (January 2015) to A Revision **Page**

- Changed the communication board from a LaunchPad to USB2ANY and updated connectors and layout 1
- Added additional capacitors to VSENSE in the schematic 14

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

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      3.1.1 *Notice applicable to EVMs not FCC-Approved:*

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      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

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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.*

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3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210*

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This device complies with Industry Canada license-exempt RSS standard(s). 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

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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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