TLC5942EVM-248

This user's guide describes the characteristics, setup, and use of the TLC5942EVM-248 evaluation module (EVM). This EVM demonstrates the Texas Instruments TLC5942, 16-channel, constant-current LED driver. Included are setup instructions, a schematic diagram, a bill of materials, and printed-circuit board layout drawings for the evaluation module.

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1 Introduction

The Texas Instruments TLC5942 is a 16-channel, constant-current LED driver that can drive up to 50 mA per channel. The integrated circuit (IC) contains two separate input buses: one for 7-bit dot correction and one for 12-bit PWM dimming. The dot correction circuitry independently adjusts the dc current for each output channel to compensate for brightness differences between LEDs. Dot correction information is written into the TLC5942 internal registers. The 12-bit PWM dimming turns each output on and off within each frame refresh period. PWM dimming information is written into the TLC5942 internal registers. For more information on dot correction and PWM dimming, see the TLC5942 data sheet (SBVS096), a dot correction technical paper (SLYT225), and a PWM dimming technical paper (SLYT238) on the TI Web site. This EVM contains three TLC5942 ICs connected in series. The three ICs drive 16 light-emitting diodes (LEDs), each having a red, green, and blue LED in the same package.

1.1 Requirements

In order to operate this EVM, the following components must be connected and properly configured. All components, software, and connectors are supplied in the EVM except for the host computer and the DC power supply

1.1.1 Software

Texas Instruments provides a compact disk (CD) in the EVM kit that contains the software necessary to evaluate the TLC5942. Check the TLC5942 product folder on the TI Web site (www.ti.com) for updates to the software.

1.1.2 Host Computer

A personal computer (PC) with a USB port is required to operate this EVM. The TLC5942 software runs on the PC and communicates with the EVM via the PC’s USB port.

PC Requirements

- Windows™ 2000 or Windows™ XP operating system
- USB port
- Minimum of 30 MB of free hard disk space (100 MB recommended)
- Minimum of 256 MB of RAM

1.1.3 Power Supply Requirements

A dc power supply capable of delivering 5 V at 1 A is required to power the EVM.

1.1.4 Printed-Circuit Board Assemblies

The TLC5942EVM-248 EVM kit contains two printed-circuit boards (PCB): HPA248 (driver board) and HPA249 (LED board). The HPA248 PCB contains the TLC5942 ICs and their required external components. This board contains several jumpers and connectors that enable you to customize the board for specific operating conditions. The HPA249 contains 16 LEDs, each with three individual LED junctions in the same package: a red, a green, and a blue junction. The orderable part number for this PCB is RGBLEDEVM-249. Users can use the driver board to power the supplied LED board or to power their own custom LED board.

1.1.5 USB-TO-GPIO Interface Board

The USB-TO-GPIO Interface Adapter (http://focus.ti.com/docs/toolsw/folders/print/usb-to-gpio.html) is the link that allows the PC and the EVM to communicate. One end of the USB-TO-GPIO box connects to the PC with the supplied USB cable, and the other end connects to the TLC5942 driver board. When the user programs the EVM from the PC, the PC communicates with the USB-TO-GPIO via the USB interface. The USB-TO-GPIO converts the USB signal to a format that the EVM can use.

1.2 Related Documentation From Texas Instruments

1. *TLC5942, 16-Channel, 12-Bit PWM LED Driver With 7-Bit Dot Correction* data sheet (SBVS096)
2. *TPC5940 Dot Correction Compensates for Variations in LED Brightness* technical paper (SLYT225)
3. *TLC5940 PWM Dimming Provides Superior Color Quality in LED Video Displays* technical paper (SLYT238)

1.3 If You Need Assistance

Contact your local TI sales representative.

2 Setup

This section describes the jumpers and connectors on the EVM as well as how to properly connect, set up, and use the TLC5942EVM-248.

2.1 Input/Output Connector Descriptions

2.1.1 J1 – Communications Input Connector

This connects to the USB-TO-GPIO interface box with the supplied 10-pin ribbon cable.

2.1.2 J2 – LED Connector

This connector mates to the HPA249 LED board. The customer can also connect a custom board to this connector with a 30-pin ribbon cable. To minimize stray inductance and ringing on the output traces, make connections to this connector as short as possible.

2.1.3 J3 – LED Connector

This connector mates to the HPA249 LED board. The customer can also connect a custom board to this connector with a 30-pin ribbon cable. To minimize stray inductance and ringing on the output traces, make connections to this connector as short as possible

2.1.4 J4 – JTAG Connector

This connector can be used for JTAG communications to help debug user-generated software. This connector is not used with the standard EVM configuration.

2.1.5 J5 – Microprocessor RESET

Leave open. Short J5-1 and J5-2 together to manually reset the TMS320VC5509 microprocessor on the EVM.

2.1.6 J6 –VLED

This is the positive input supply to the EVM. The input voltage should be between 5 V and 17 V. To minimize power dissipation, ensure that the input voltage is as low as possible. Twist the leads to the input supply, and keep them as short as possible to minimize EMI transmission.

2.1.7 J7 –GND Connector

This is the return for the input supply to the EVM. Twist the leads to the input supply, and keep them as short as possible to minimize EMI transmission.

2.1.8 JP1 –Communications

This jumper connects the onboard TMS320VC5509 DSP to the TLC5942 LED drivers. This jumper comes preconfigured to connect the DSP control signals to the LED driver ICs. The GND pins on this jumper do not need shorting shunts because these pins are already grounded on the PCB. The user can remove all shorting shunts and connect their microprocessor control signals to this jumper to program the LED drivers.

CAUTION

Do not drive the outputs of the TMS320VC5509 DSP with external control signals.

2.1.9 JP2 – RED LED

This jumper must be shorted to connect the red LED driver's OUT15 pin to the red LED. This jumper can be opened to measure the current flowing into the OUT15 pin from the red LED.

2.1.10 JP3 –Green LED

This jumper must be shorted to connect the green LED driver's OUT15 pin to the green LED. This jumper can be opened to measure the current flowing into the OUT15 pin from the green LED.

2.1.11 JP4 – BLUE LED

This jumper must be shorted to connect the blue LED driver's OUT15 pin to the blue LED. This jumper can be opened to measure the current flowing into the OUT15 pin from the blue LED.

2.2 Software Setup

If installing from a CD, insert the CD and run Setup.exe. Follow all the prompts to allow the software to be installed.

If installing from the TI Web site, go to www.ti.com

Note: This installation page is best viewed with Microsoft™ Internet Explorer™ browser (It may not work correctly with other browsers)

Click on the install button; your PC gives you a security warning and asks if you want to install this application. Select Install to proceed.

With both types of installation, the software attempts to install the Microsoft Dot Net Framework 2.0 (if it is not already installed). This framework is required for the software to run.

After installation, the software should automatically run.

During future use of the software, it may prompt you to install a new version if it becomes available on the TI Web site.

Note: VeriSign™ code signing is used to prevent any malicious code from changing this application. If at any time in the future the binaries are modified, the code will no longer attempt to run.

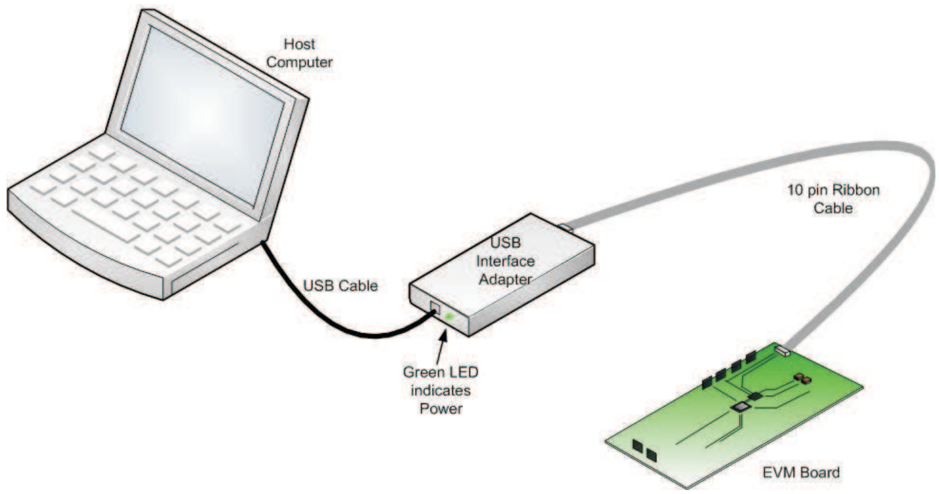
2.3 Hardware Setup

Ensure that the shorting shunts are installed on JP1, JP2, JP3, and JP4.

Connect the LED board (HPA249) to the LED driver board (HPA248).

Connect the USB-TO-GPIO interface board to the host computer using the supplied USB cable. Connect the TLC5942EVM board to the USB-TO-GPIO interface board using the supplied 10-pin ribbon cable. The connectors on the ribbon cable are keyed to prevent incorrect installation.

Quick Connection Diagram USB Interface Adapter



Connect an input voltage supply to the TLC5942EVM board. The TLC5942 uses an input voltage between 5 V and 17 V. Connect the positive input voltage to VLED on the LED driver board (J6), and connect the input voltage return (ground) connection to GND (J7).

CAUTION

Hot plugging the input supply with long leads can generate transients on the input supply bus that exceed the maximum ratings of the EVM. Connect the input supply before it is turned on.

Turn on the input supply voltage.

3 Operation

This section provides instructions on how to turn on the TLC5942EVM and operate the software.

The user can now run the host computer software and change the LED programming with the easy-to-use graphical interface.

3.1 Running the Software

Click on the icon on the host computer to start the software. If the host computer has no icon, then use the *start* button in the lower left corner of the screen to browse the program folders to find the software. Once started, the software checks the firmware in the USB-TO-GPIO interface box to ensure that it is compatible with the software. If the firmware is not compatible, the software gives the user instructions on how to reprogram it. Once the software is started and the communication channel is connected, the user can now use the graphical interface to program the LEDs. If the EVM is properly connected, the software screen looks like Figure 1 when first opened.

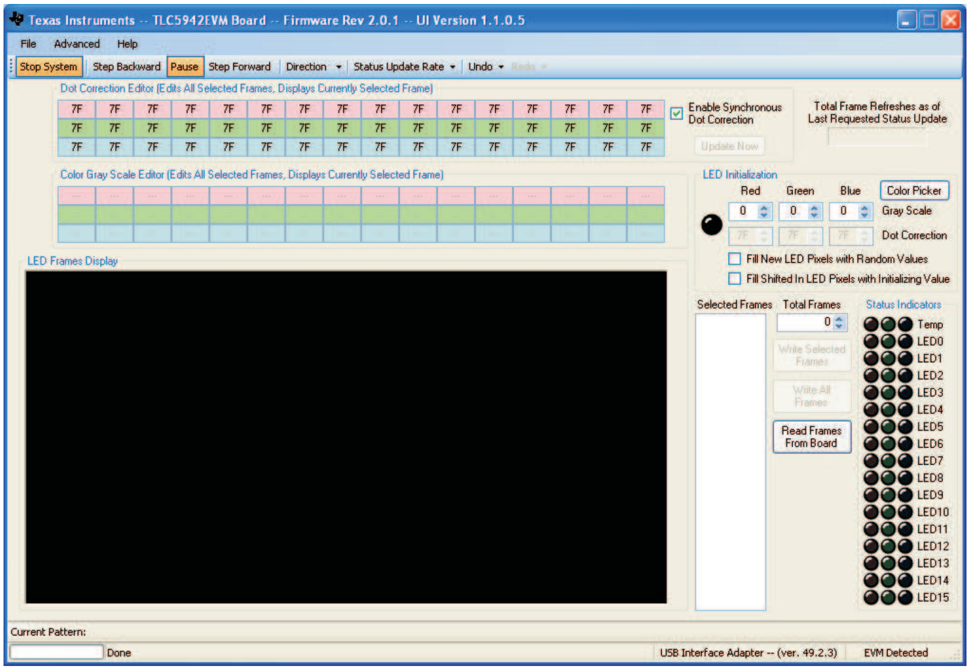


Figure 1. TLC5942 EVM Software Startup Screen

3.2 Software Features

3.2.1 Dot Correction Editor

This window displays the dot correction values of the frame that is currently selected in the *LED Frames Display*. The user can change the dot correction value between 00h and 7Fh.

The “Enable Synchronous Dot Correction” check box determines how often the dot correction values are updated. When this box is checked, each LED frame’s dot correction is updated at the beginning of its frame. When this box is not checked, all frames are initially displayed with frame 0’s dot correction. No additional dot correction values are programmed into the EVM. If the box is toggled from checked to unchecked, the LEDs are displayed with the last programmed dot correction values. When the box is unchecked, the dot correction values are not automatically updated. The user can change and then update dot correction values at any time by modifying the dot correction values in the Dot Correction Editor and clicking on the *Update Now* button.

3.2.2 Color Grayscale Editor

This window displays the PWM grayscale values of the frame that is currently selected in the *LED Frames Display*. The user can change the PWM grayscale to any value between 000h and FFFh.

3.2.3 LED Frames Display Window

This window displays the different *frames* to be programmed into the LED drivers. Add or remove frames from this window by increasing or decreasing the *Total Frames* counter just to the right of this window. Selecting and then right-clicking on any frame in this window brings up many useful options for manipulating the LED frames.

3.2.4 LED Initialization Window

This window allows the user to select the color (via the PWM grayscale and dot correction) of the LEDs that are added to the LED Frame Display Window. This window has several options. Clicking on the *Color Picker* button brings up a window that allows the user to select preset or custom colors. Note that the colors available in Windows™ have a 10-bit resolution whereas the TLC5942 is capable of 12-bit resolution. The TLC5942 software automatically converts the chosen color to the 12-bit resolution scale.

If the *Fill New LED Pixels with Random Values* button is not checked, the chosen LED color is shifted into the *Display Frames Window* when the *Total Frames* counter is increased. If this button is checked, the new LED frame contains random values. Note that the LED colors displayed in this window are only approximate to the actual LED color on the EVM.

3.2.5 Total Frames

This window allows the user to increase or decrease the number of frames in the LED Frames Display window. Frames are always added to and removed from the bottom of the LED Frames Display window.

3.2.6 Write Selected Frames

This button writes the PWM grayscale and dot correction values of the selected frame to the EVM.

3.2.7 Write All Frames

This button writes the PWM grayscale and dot correction values of every frame in the LED Frames Display window.

3.2.8 Read All Frames

This button reads the PWM grayscale and dot correction values from the EVM and displays them in the LED Frames Display window. All contents in the window are erased and then replaced with the frames that are read from the EVM.

3.2.9 Status Indicator Window

This window displays the TLC5942 LOD and overtemperature functions. It shows the status of each LED. The onboard DSP reads the GSOUT pin from U8 on the EVM and decodes the data. If all LEDs are properly connected, all indicators are turned off. If an LED becomes open during operation, its respective indicator light turns on. The *Status Update Rate* pulldown menu just above the *Dot Correction Editor* window allows the user to select the refresh rate of the Status Indicators.

3.2.10 Advanced Tab

This Advanced Tab contains several submenus.

Reset the Board resets the onboard DSP, causing the EVM to display the preprogrammed default frame sequence.

Write Firmware to EEPROM allows the user to manually rewrite the firmware to the onboard EEPROM in the event it becomes corrupted.

Enable Tool Tips enables and disables the popup dialog boxes that appear when you run your mouse over some of the software options.

Advanced Options… opens the window shown in Figure 2.

Run Test Pattern loads a default test mode pattern used during assembly. It cycles through the red, green, and then blue LEDs.

Copy as Comma-Separated Format When checked, a frame copied from the LED Frames Display can be pasted into a document in the Comma-Separated Format. When not checked, a frame copied from the LED Frames Display can be pasted into a document in the standard text format.

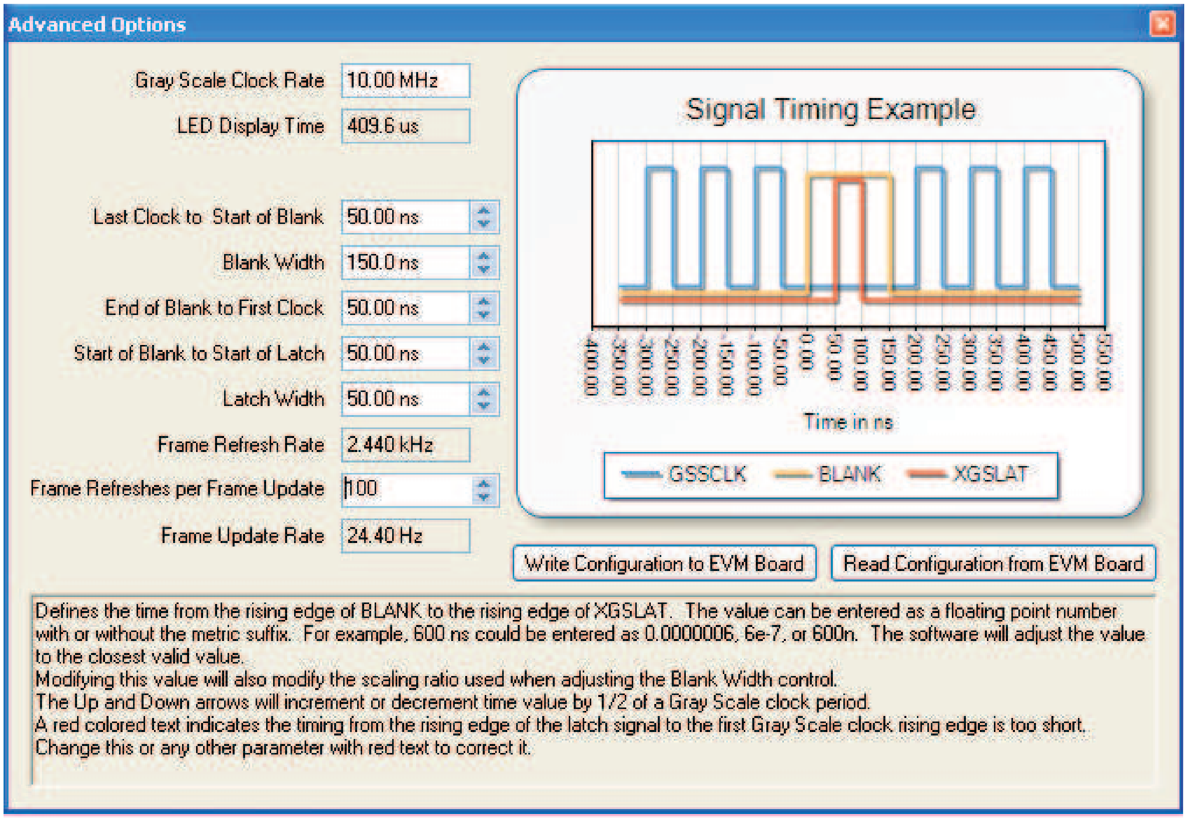


Figure 2. Advanced Options

The options in this window allow the user to modify the timing parameters of the signals written to the TLC5942 ICs. All options are explained in the lower portion of the window. Note that all times and frequencies are approximate.

3.2.11 System Controls

The system control tool bar, located just above the Dot Correction Editor, allows the user to start and stop the system, pause and play frames, change the direction of the frames being played, and modify the time delay between updates to the Status Indicators.

3.2.12 File – Save and Load

This tab allows the user to save and load custom frames. An example of the file format follows.

3.2.12.1 Text File

The LED Frames Display data can be saved as a standard text file. The header in the text file should be *// TLC59xx Frame Data*. The frame information is broken up into pixels, with each pixel being broken up into a red, green, and blue LED. Each LED's information consists of its PWM value in hexadecimal and its dot correction value in hexadecimal. In the following sample text file, Frame 0 is a white pixel that is generated by programming each color of each LED with a PWM value of FFFh and a dot correction value of 7Fh. Frame 1 is a red pixel at half brightness that is generated by programming the red LEDs to their full PWM value of FFFh and to half of their dot correction value, 40h.

```
***************************
// TLC59xx Frame Data

{
Pixel  0 { Red { FFF, 7F } Green { FFF, 7F } Blue { FFF, 7F } }
Pixel  1 { Red { FFF, 7F } Green { FFF, 7F } Blue { FFF, 7F } }
Pixel  2 { Red { FFF, 7F } Green { FFF, 7F } Blue { FFF, 7F } }
Pixel  3 { Red { FFF, 7F } Green { FFF, 7F } Blue { FFF, 7F } }
Pixel  4 { Red { FFF, 7F } Green { FFF, 7F } Blue { FFF, 7F } }
Pixel  5 { Red { FFF, 7F } Green { FFF, 7F } Blue { FFF, 7F } }
Pixel  6 { Red { FFF, 7F } Green { FFF, 7F } Blue { FFF, 7F } }
Pixel  7 { Red { FFF, 7F } Green { FFF, 7F } Blue { FFF, 7F } }
Pixel  8 { Red { FFF, 7F } Green { FFF, 7F } Blue { FFF, 7F } }
Pixel  9 { Red { FFF, 7F } Green { FFF, 7F } Blue { FFF, 7F } }
Pixel 10 { Red { FFF, 7F } Green { FFF, 7F } Blue { FFF, 7F } }
Pixel 11 { Red { FFF, 7F } Green { FFF, 7F } Blue { FFF, 7F } }
Pixel 12 { Red { FFF, 7F } Green { FFF, 7F } Blue { FFF, 7F } }
Pixel 13 { Red { FFF, 7F } Green { FFF, 7F } Blue { FFF, 7F } }
Pixel 14 { Red { FFF, 7F } Green { FFF, 7F } Blue { FFF, 7F } }
Pixel 15 { Red { FFF, 7F } Green { FFF, 7F } Blue { FFF, 7F } }
}
Frame 1
{
Pixel  0 { Red { FFF, 40 } Green { 000, 00 } Blue { 000, 00 } }
Pixel  1 { Red { FFF, 40 } Green { 000, 00 } Blue { 000, 00 } }
Pixel  2 { Red { FFF, 40 } Green { 000, 00 } Blue { 000, 00 } }
Pixel  3 { Red { FFF, 40 } Green { 000, 00 } Blue { 000, 00 } }
Pixel  4 { Red { FFF, 40 } Green { 000, 00 } Blue { 000, 00 } }
Pixel  5 { Red { FFF, 40 } Green { 000, 00 } Blue { 000, 00 } }
Pixel  6 { Red { FFF, 40 } Green { 000, 00 } Blue { 000, 00 } }
Pixel  7 { Red { FFF, 40 } Green { 000, 00 } Blue { 000, 00 } }
Pixel  8 { Red { FFF, 40 } Green { 000, 00 } Blue { 000, 00 } }
Pixel  9 { Red { FFF, 40 } Green { 000, 00 } Blue { 000, 00 } }
Pixel 10 { Red { FFF, 40 } Green { 000, 00 } Blue { 000, 00 } }
Pixel 11 { Red { FFF, 40 } Green { 000, 00 } Blue { 000, 00 } }
Pixel 12 { Red { FFF, 40 } Green { 000, 00 } Blue { 000, 00 } }
Pixel 13 { Red { FFF, 40 } Green { 000, 00 } Blue { 000, 00 } }
Pixel 14 { Red { FFF, 40 } Green { 000, 00 } Blue { 000, 00 } }
Pixel 15 { Red { FFF, 40 } Green { 000, 00 } Blue { 000, 00 } }
}

***************************
```

3.2.12.2 CSV File

The program incorporates a comma-separated value file in order to facilitate ease of importing data generated by Excel™ and other programs into the software. The following file shows the same two frames saved in the .CSV format. Dot correction data is entered first. Dot correction information is preceded with a *D*. The dot correction data follows the following format: red pixel 0, red pixel 1, … , red pixel 15, green pixel 0, green pixel 1, …, green pixel 15, blue pixel 0, blue pixel 1, …, blue pixel 15. All frames following a dot correction entry keep that dot correction entry until a new dot correction entry is read in.

Grayscale data is preceded with a *G*. The grayscale data follows the following format: red pixel 0, red pixel 1, … , red pixel 15, green pixel 0, green pixel 1, …, green pixel 15, blue pixel 0, blue pixel 1, …, blue pixel 15.

```
**************
// TLC59xx Frame Data

#CSF
// Data in Comma Separated Format (CSF), Format = 16xRed, 16xGreen, 16xBlue

D, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F,
7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F,
7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F, 7F

G, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF,
FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF,
FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF,
FFF, FFF, FFF, FFF, FFF, FFF, FFF

D, 40, 40, 40, 40, 40, 40, 40, 40, 40, 40, 40, 40, 40, 40, 40, 40, 00, 00, 00,
00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00, 00, 00, 00, 00, 00

G, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF, FFF,
 FFF, FFF, FFF, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000,
000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000,
000, 000, 000, 000, 000, 000, 000
**********************
```

3.2.13 Measured Data

3.2.13.1 Refresh Rate vs Update Rate

Figure 3 through Figure 5 help illustrate the difference between the frame refresh and the frame update rate. Figure 3 shows the EVM programmed with two frames, one white and one black.

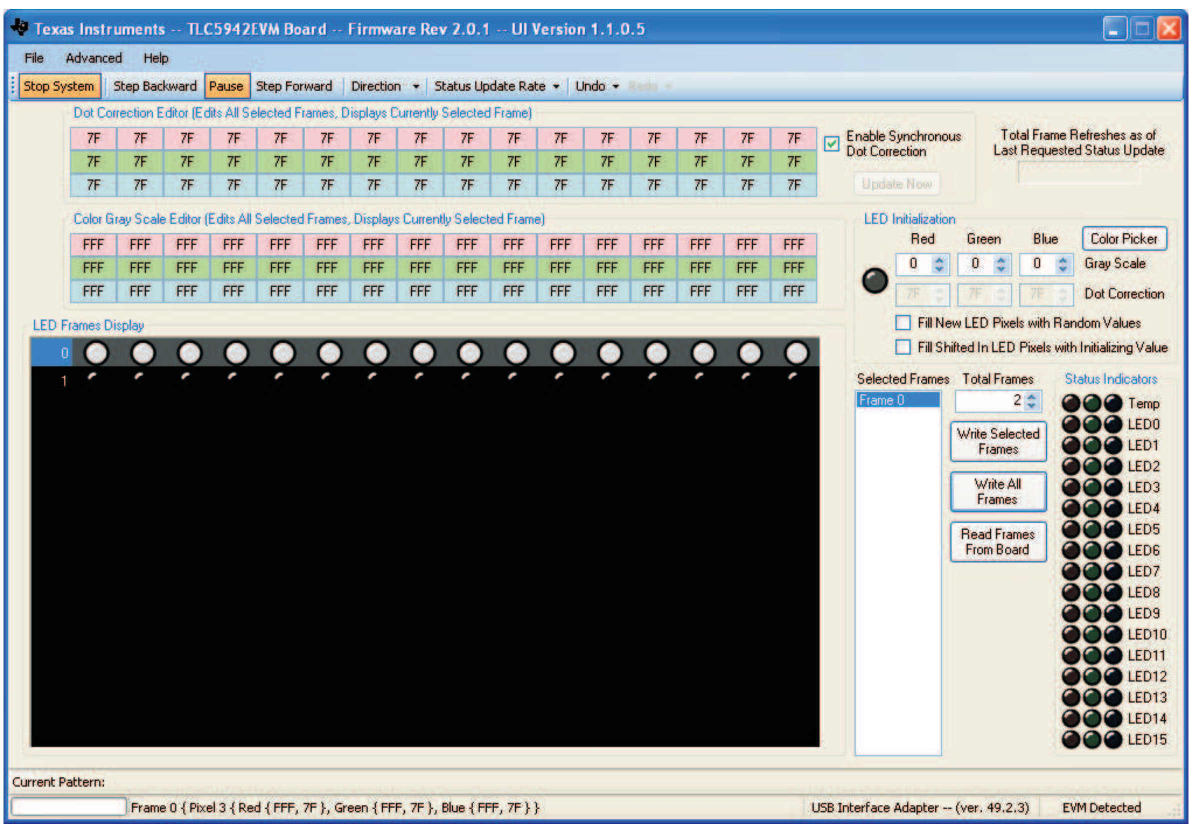


Figure 3. White and Black Frames

Figure 4 shows how the software is programmed to display these two frames

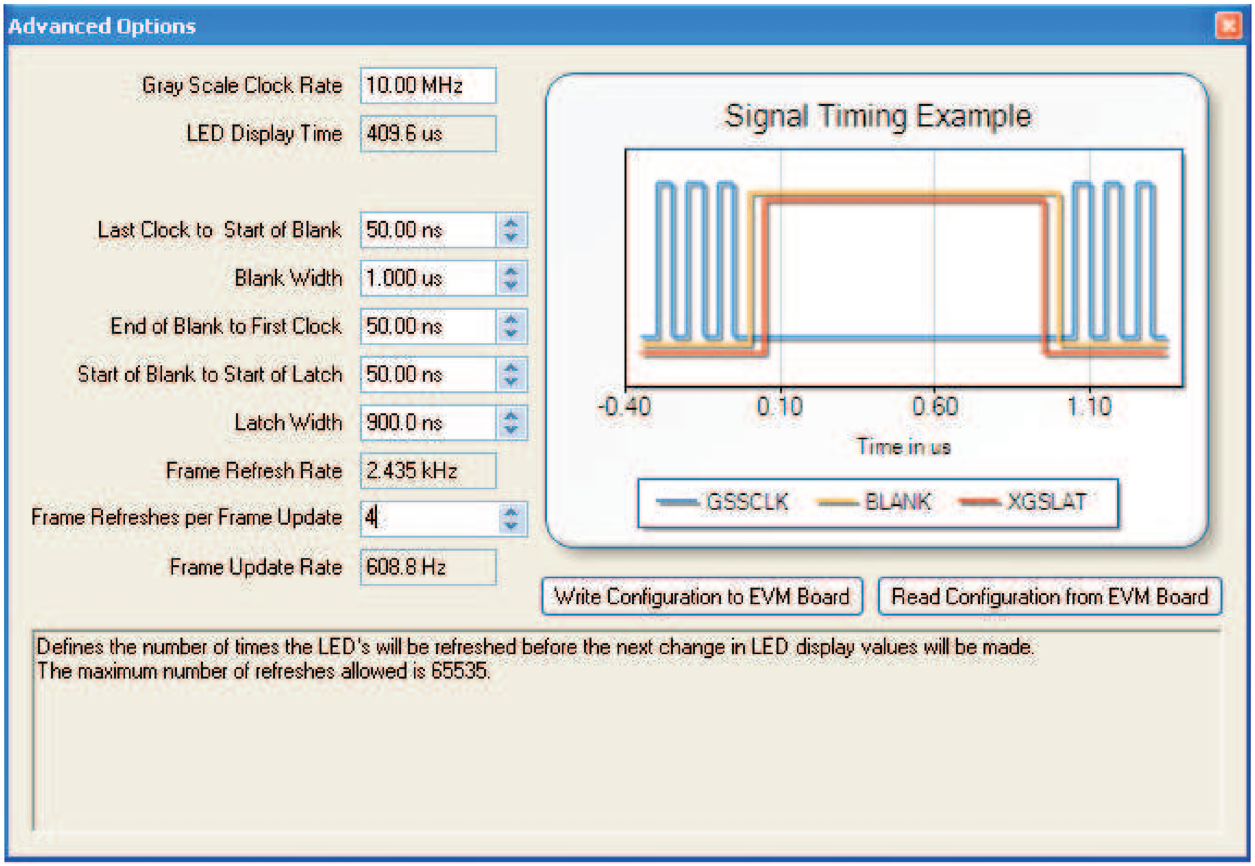


Figure 4. Advanced Window for White and Black Frames.

Figure 5 shows the resulting EVM waveforms. Trace 1 is the GSSIN data, trace 2 is BLANK, trace 3 is XLAT, and trace 4 is the current in an LED. When GSSIN goes high, the EVM is programming each LED with FFFh grayscale data (the white frame). This data is latched in when BLANK and XLAT both go high. Because the LED PWM grayscale register is programmed to FFFh, the LED turns on and remains on until the end of the PWM grayscale period. After the first grayscale period, BLANK goes high and then low to start another grayscale period. As programmed in the advanced window, the white frame is displayed, (or refreshed) four times. After four grayscale periods, the EVM programs and displays a black frame. The black frame is also displayed four times. As shown in both the oscilloscope plots and in the advanced window, the frame refresh rate is four times faster than the frame update rate.

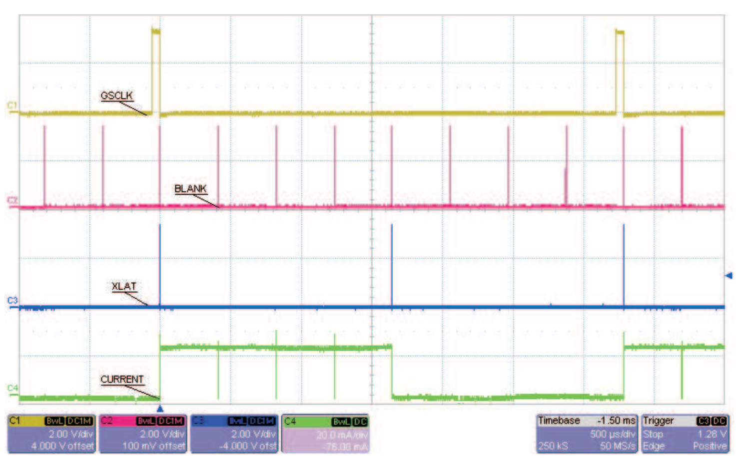


Figure 5. Displayed White and Black Frames

4 Board Layout

This section provides the TLC5942EVM-248 and RGBLEDEVM-249 board layouts and illustrations.

4.1 Layout

Figure 6 through Figure 10 show the board layout for the LED driver board, HPA248.

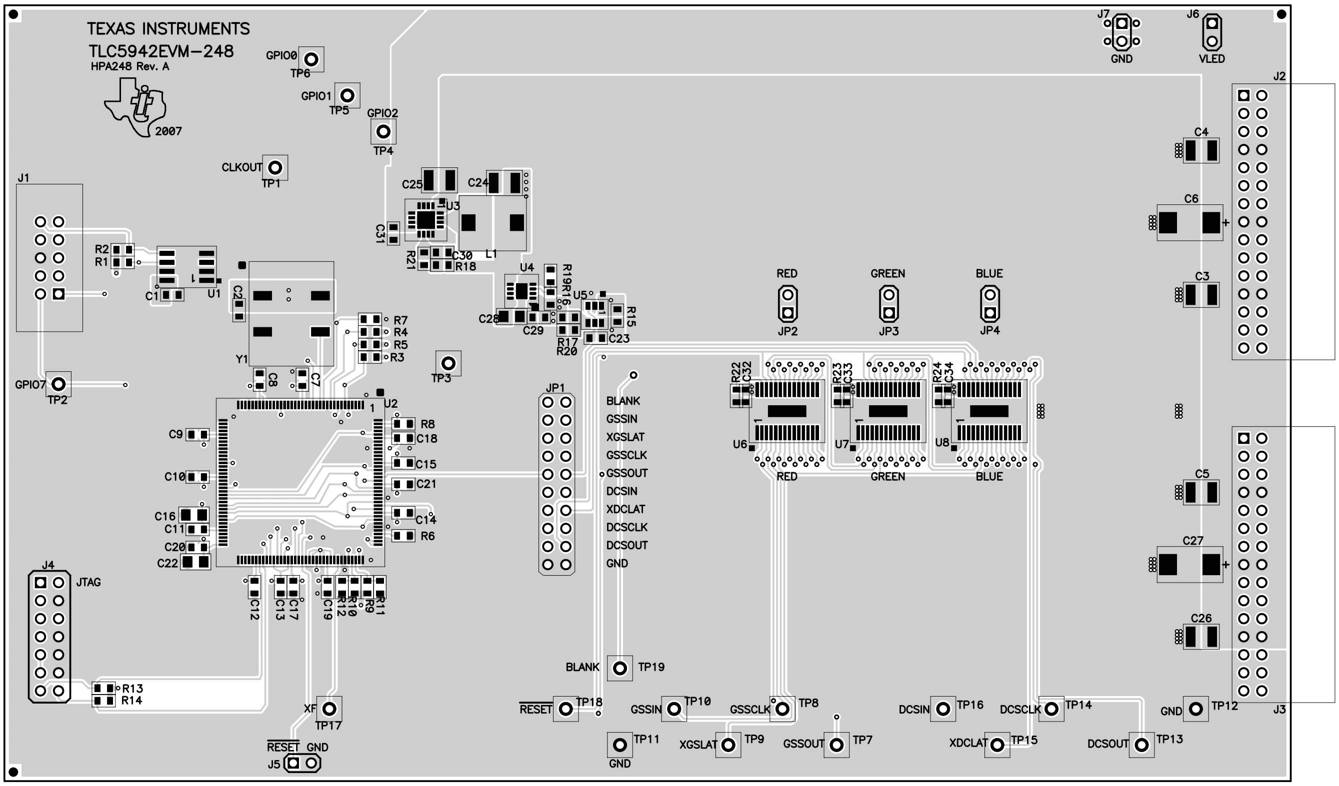


Figure 6. Assembly Layer

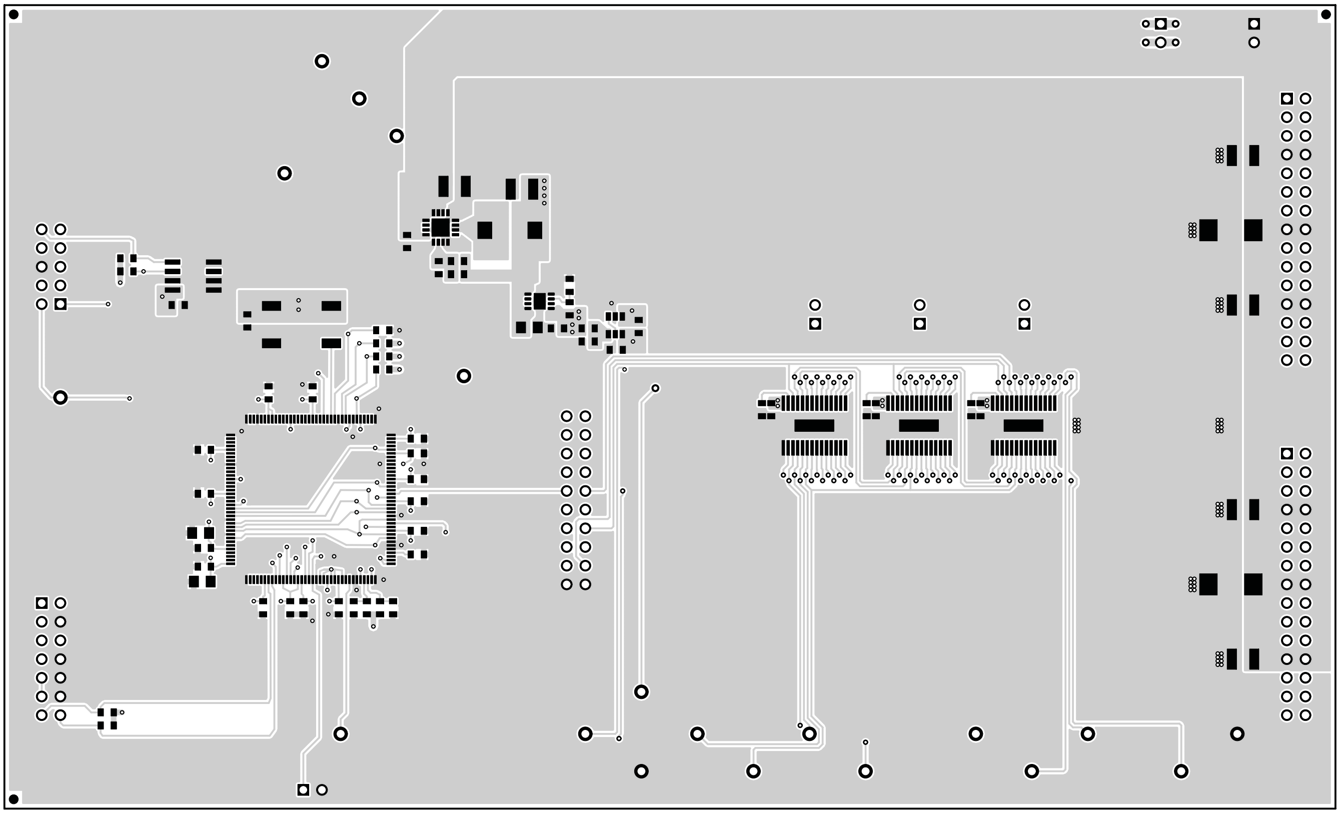


Figure 7. Top Layer

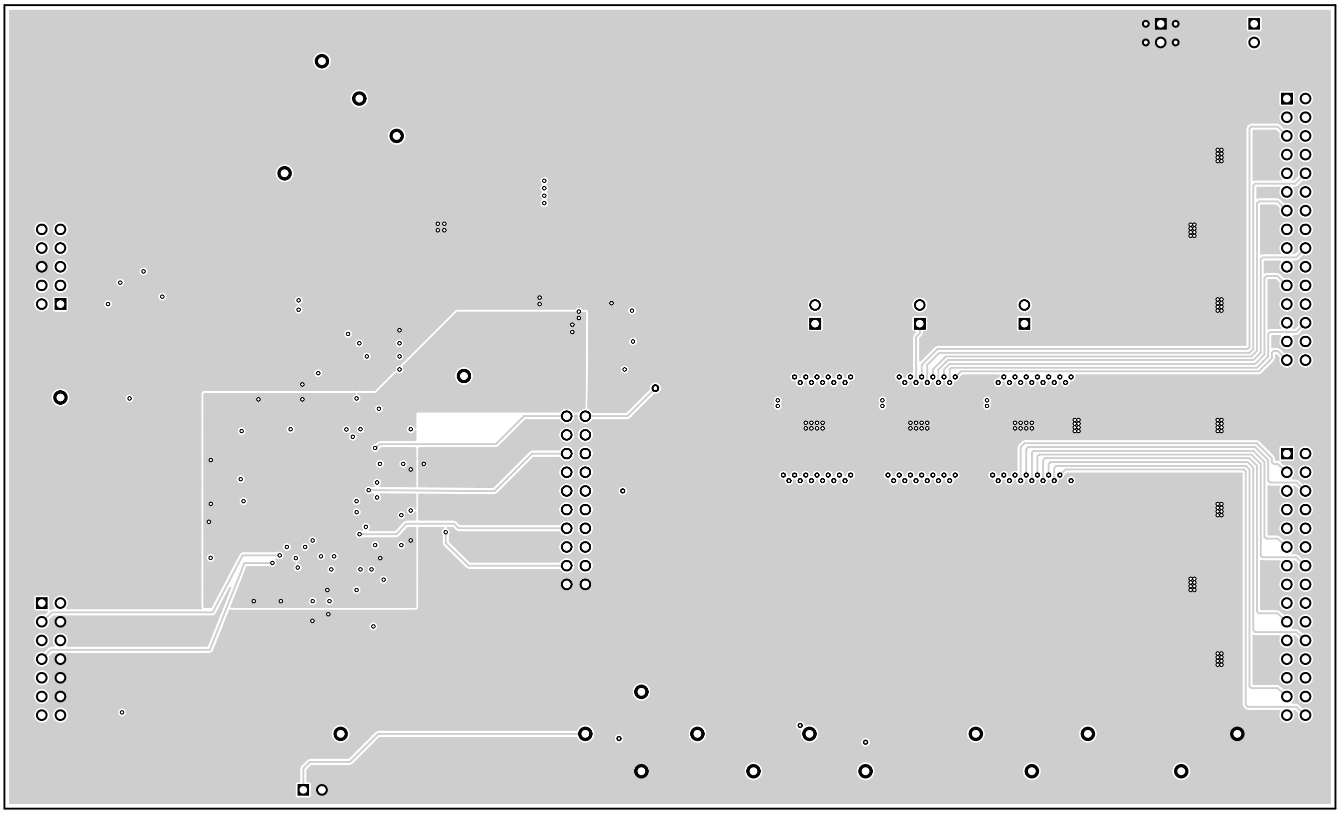


Figure 8. Layer 2

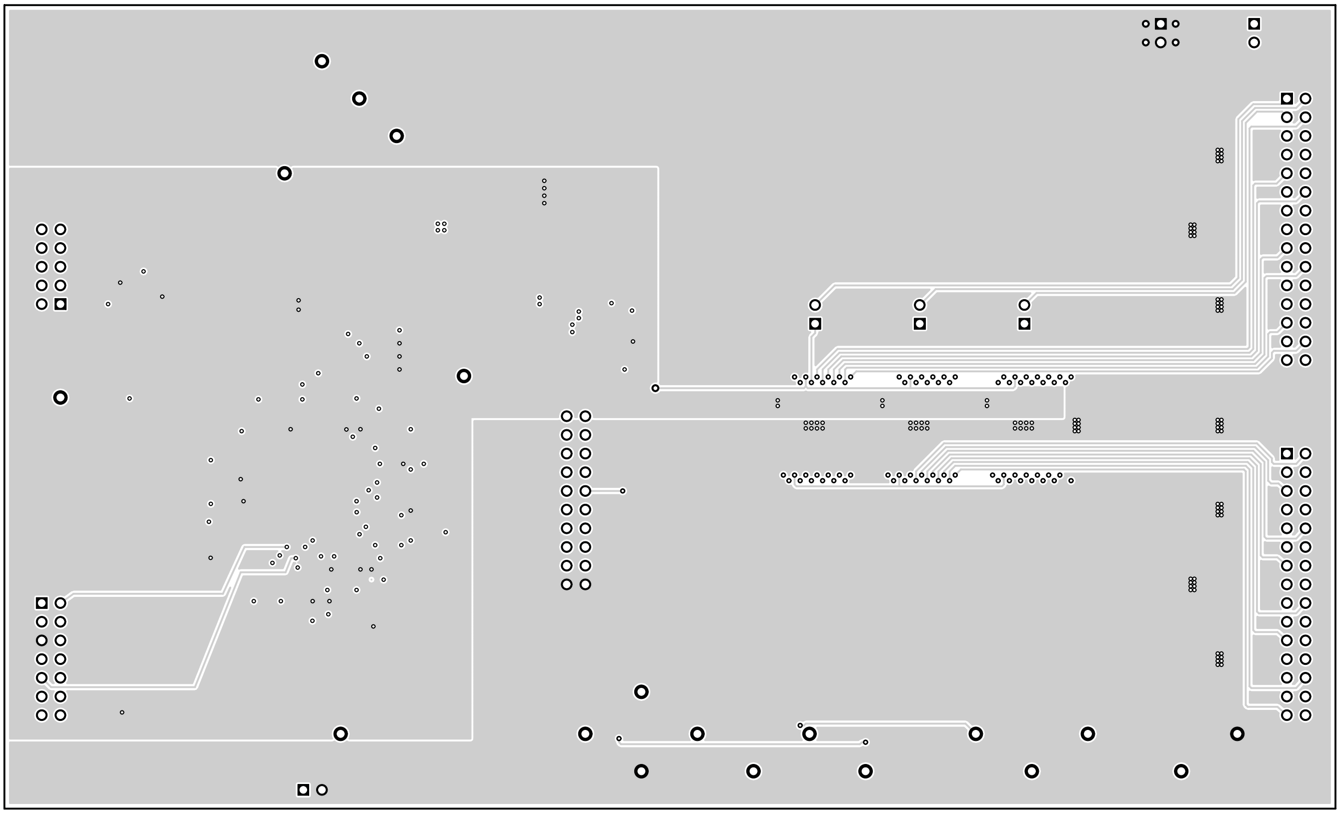


Figure 9. Layer 3

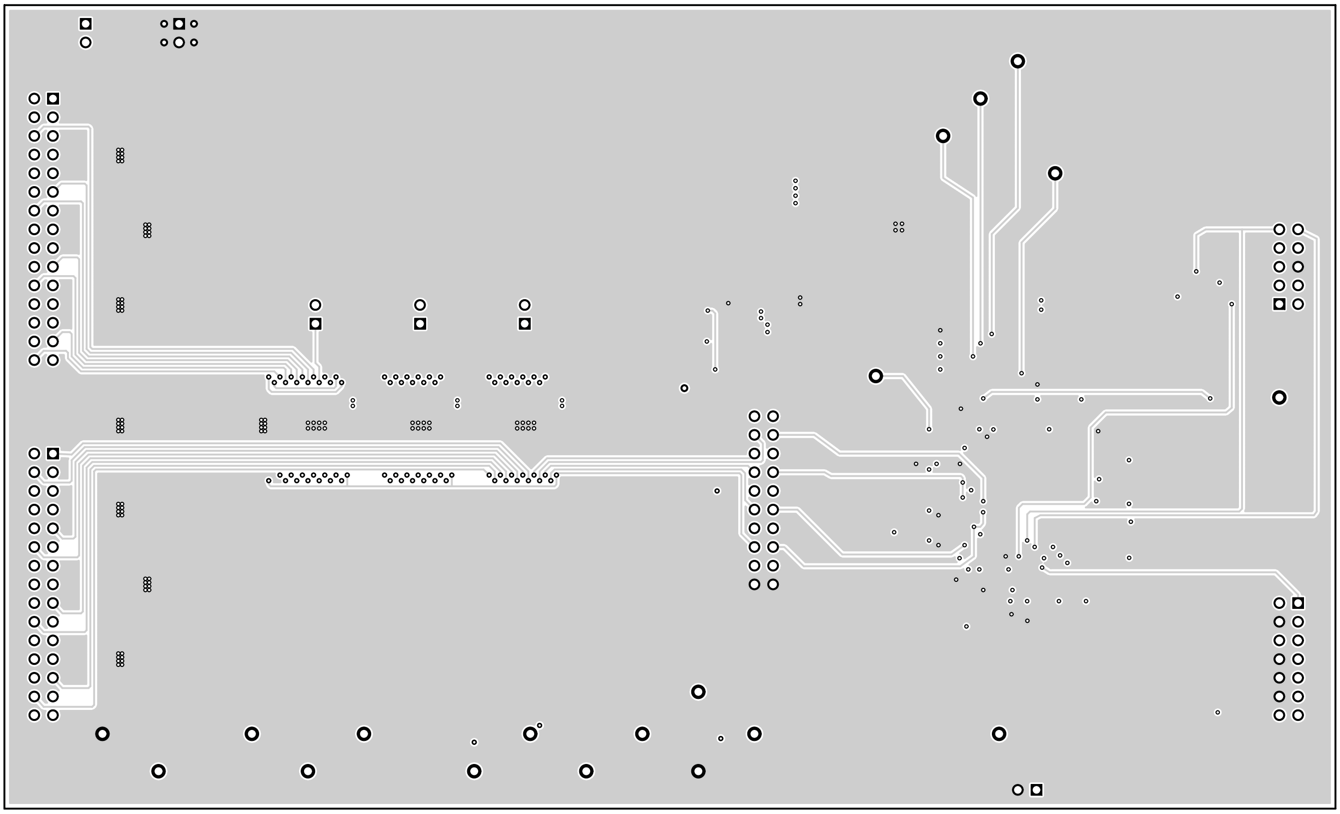


Figure 10. Bottom Layer

Figure 11 through Figure 13 show the board layout for the LED board, HPA249.

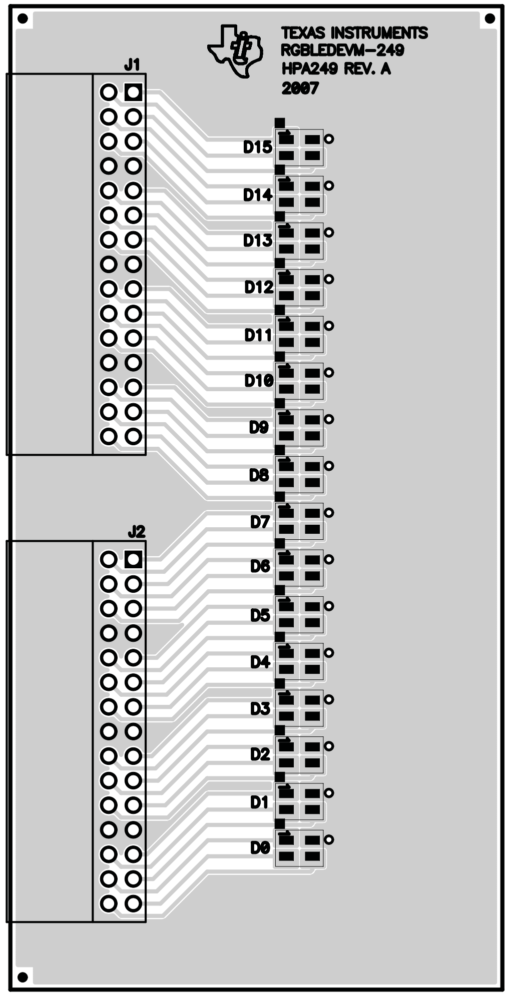


Figure 11. Assembly Layer

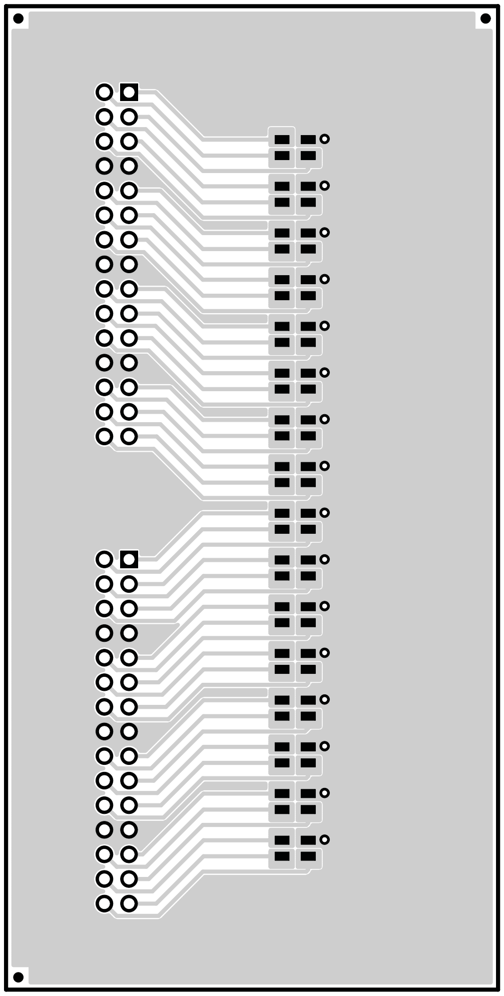


Figure 12. Top Layer

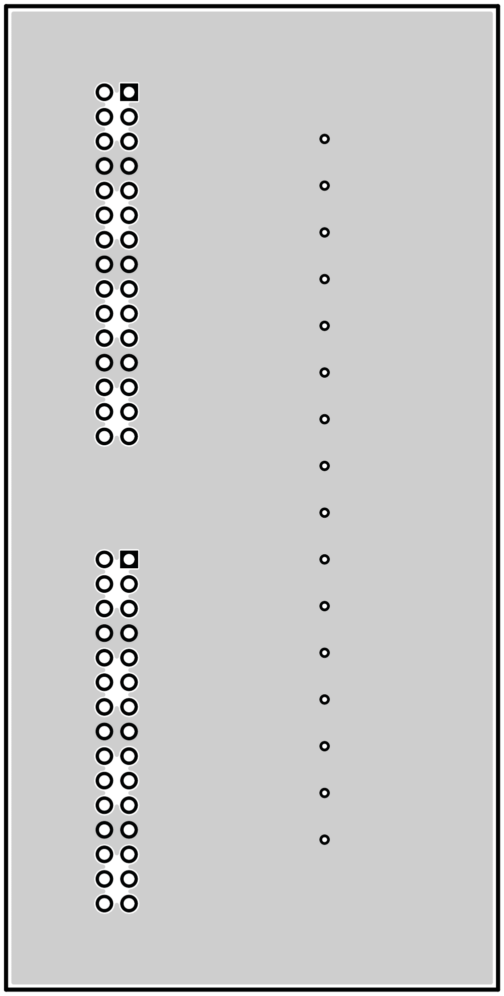


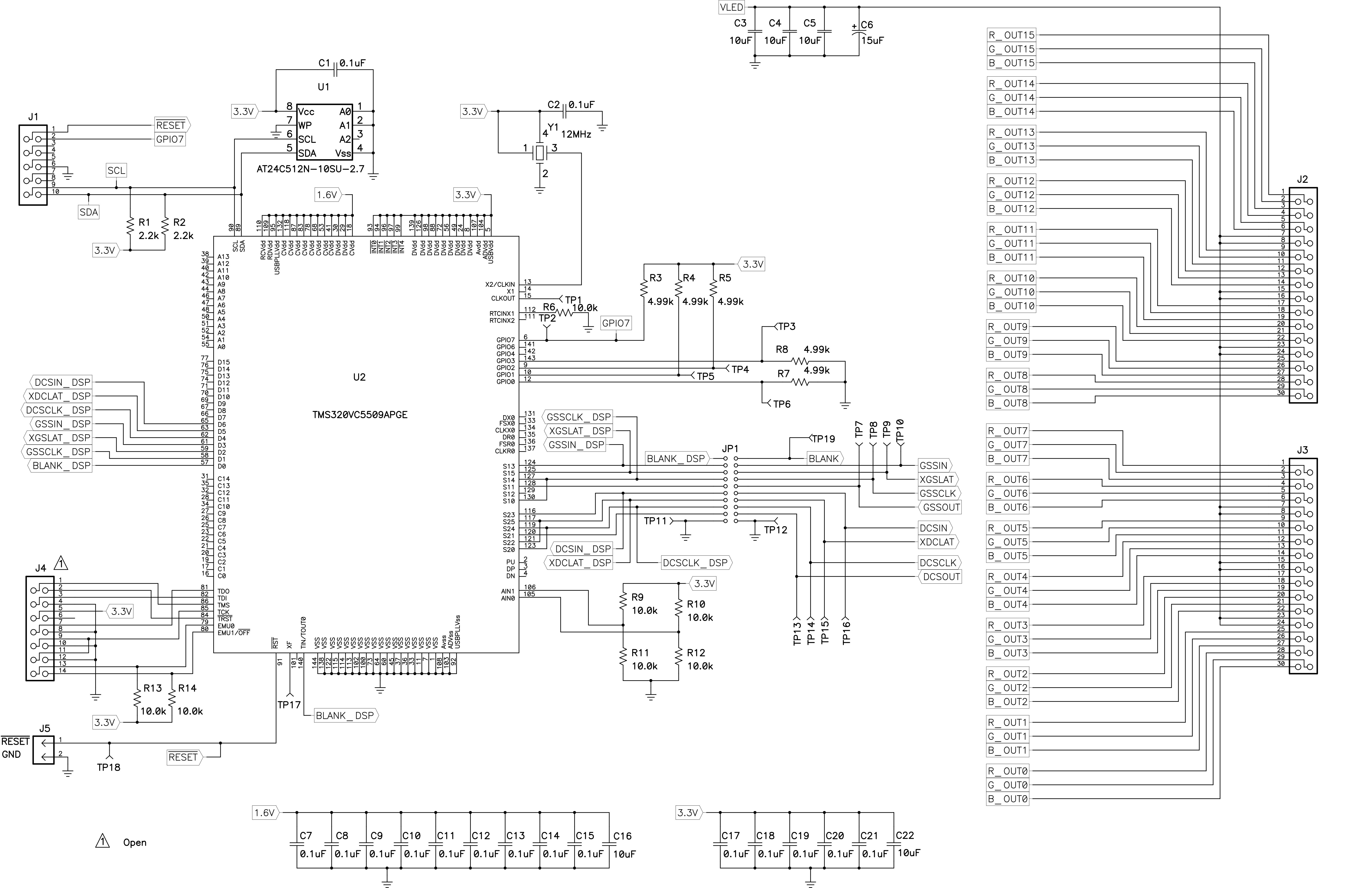
Figure 13. Bottom Layer

5 Schematic and Bill of Materials

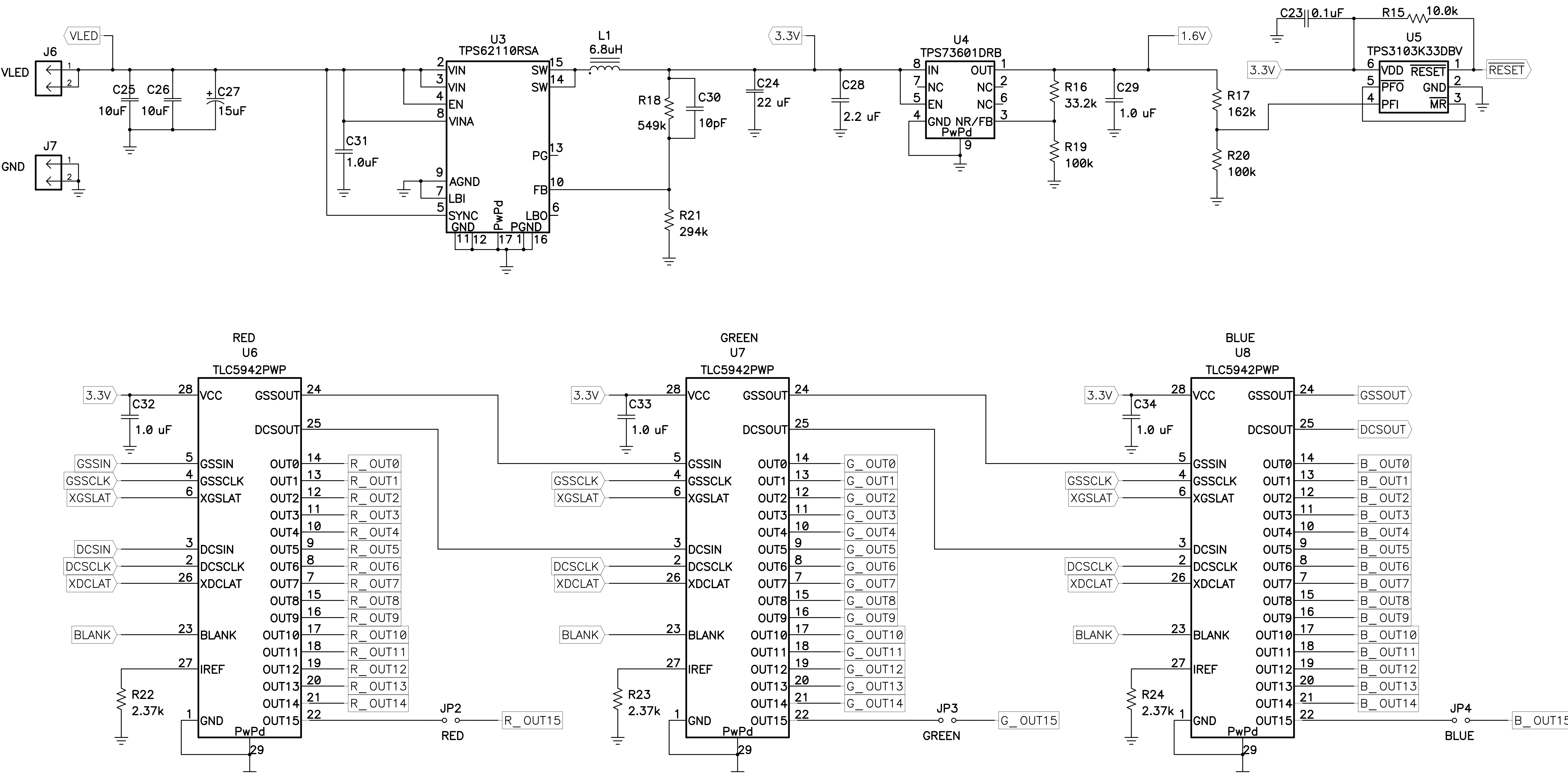
This section provides the TLC5942EVM-248 and RGBLEDEVM-249 schematics and bill of materials.

5.1 Schematic

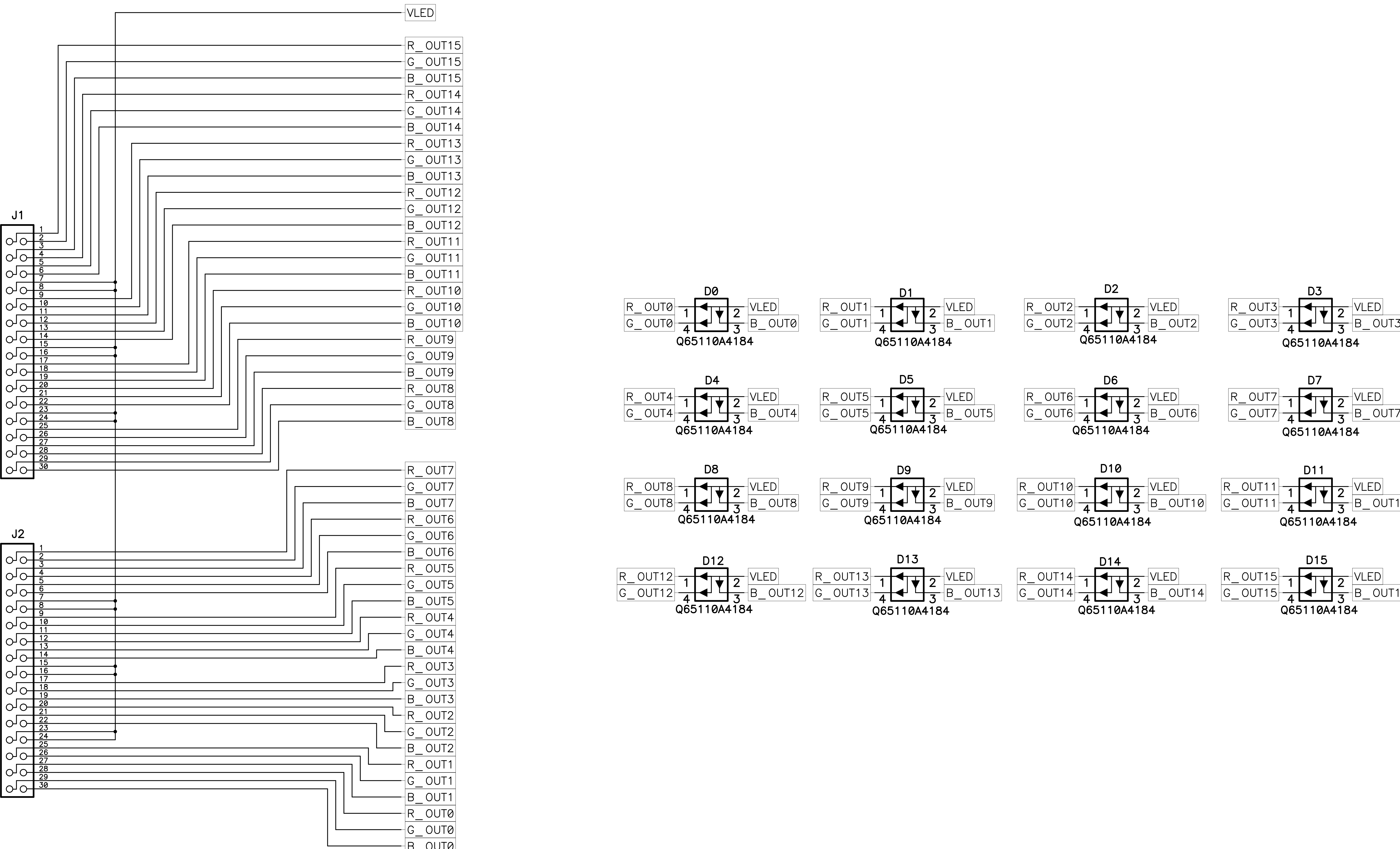
The schematics for the TLC5942EVM-248 and RGBLEDEVM-249 are affixed to this page.



VLED
C3 10uF
C4 10uF
C5 10uF
C6 15uF
C1 0.1uF
U1
AT24C512N−10SU−2.7
Vcc
WP
SCL
SDA
A0
A1
A2
Vss
3.3V
C2 0.1uF
Y1 12MHz
J1
RESET
GPIO7
SCL
SDA
R1 2.2k
R2 2.2k
1.6V
U2
TMS320VC5509APGE
X2/CLKIN
X1
CLKOUT
RTCINX1
RTCINX2
TP1
R6 10.0k
TP2
GPIO7
R3 4.99k
R4 4.99k
R5 4.99k
TP3
R8 4.99k
TP4
TP5
R7 4.99k
TP6
DCSIN_DSP
XDCLAT_DSP
DCSCLK_DSP
GSSIN_DSP
XGSLAT_DSP
GSSCLK_DSP
BLANK_DSP
JP1
BLANK
TP19
TP7
TP8
TP9
TP10
GSSIN
XGSLAT
GSSCLK
GSSOUT
DCSIN
XDCLAT
DCSCLK
DCSOUT
TP11
TP12
TP13
TP14
TP15
TP16
R9 10.0k
R10 10.0k
R11 10.0k
R12 10.0k
J4
TDO
TDI
TMS
TCK
TRST
EMU0
EMU1/OFF
R13 10.0k
R14 10.0k
TP17
J5
RESET
GND
TP18
J2
J3
R_OUT15
G_OUT15
B_OUT15
R_OUT14
G_OUT14
B_OUT14
R_OUT13
G_OUT13
B_OUT13
R_OUT12
G_OUT12
B_OUT12
R_OUT11
G_OUT11
B_OUT11
R_OUT10
G_OUT10
B_OUT10
R_OUT9
G_OUT9
B_OUT9
R_OUT8
G_OUT8
B_OUT8
R_OUT7
G_OUT7
B_OUT7
R_OUT6
G_OUT6
B_OUT6
R_OUT5
G_OUT5
B_OUT5
R_OUT4
G_OUT4
B_OUT4
R_OUT3
G_OUT3
B_OUT3
R_OUT2
G_OUT2
B_OUT2
R_OUT1
G_OUT1
B_OUT1
R_OUT0
G_OUT0
B_OUT0
C7 0.1uF
C8 0.1uF
C9 0.1uF
C10 0.1uF
C11 0.1uF
C12 0.1uF
C13 0.1uF
C14 0.1uF
C15 0.1uF
C16 10uF
C17 0.1uF
C18 0.1uF
C19 0.1uF
C20 0.1uF
C21 0.1uF
C22 10uF
Open



VLED
J6
GND
J7
C25 10uF
C26 10uF
C27 15uF
U3
TPS62110RSA
VIN
VIN
EN
VINA
AGND
LBI
SYNC
GND
PwPd
PGND
SW
SW
PG
FB
LBO
C31 1.0uF
L1
6.8uH
R18 549k
C30 10pF
R21 294k
3.3V
C24 22 uF
C28 2.2 uF
U4
TPS73601DRB
IN
NC
EN
GND
OUT
NC
NC
NR/FB
PwPd
R16 33.2k
R19 100k
C29 1.0 uF
1.6V
R17 162k
R20 100k
C23 0.1uF
R15 10.0k
U5
TPS3103K33DBV
VDD
PFO
PFI
RESET
GND
MR
RESET
RED
U6
TLC5942PWP
GREEN
U7
TLC5942PWP
BLUE
U8
TLC5942PWP
VCC
GSSIN
GSSCLK
XGSLAT
DCSIN
DCSCLK
XDCLAT
BLANK
IREF
GND
PwPd
GSSOUT
DCSOUT
OUT0
OUT1
OUT2
OUT3
OUT4
OUT5
OUT6
OUT7
OUT8
OUT9
OUT10
OUT11
OUT12
OUT13
OUT14
OUT15
C32 1.0 uF
C33 1.0 uF
C34 1.0 uF
R22 2.37k
R23 2.37k
R24 2.37k
R_OUT0 … R_OUT14
G_OUT0 … G_OUT14
B_OUT0 … B_OUT14
JP2 RED R_OUT15
JP3 GREEN G_OUT15
JP4 BLUE B_OUT15



J1
J2
VLED
R_OUT15
G_OUT15
B_OUT15
R_OUT14
G_OUT14
B_OUT14
R_OUT13
G_OUT13
B_OUT13
R_OUT12
G_OUT12
B_OUT12
R_OUT11
G_OUT11
B_OUT11
R_OUT10
G_OUT10
B_OUT10
R_OUT9
G_OUT9
B_OUT9
R_OUT8
G_OUT8
B_OUT8
R_OUT7
G_OUT7
B_OUT7
R_OUT6
G_OUT6
B_OUT6
R_OUT5
G_OUT5
B_OUT5
R_OUT4
G_OUT4
B_OUT4
R_OUT3
G_OUT3
B_OUT3
R_OUT2
G_OUT2
B_OUT2
R_OUT1
G_OUT1
B_OUT1
R_OUT0
G_OUT0
B_OUT0
D0 D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11 D12 D13 D14 D15
Q65110A4184

5.2 Bill of Materials

Table 1. HPA248A Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
17	C1, C2, C7–C21, C23	0.1 µF	Capacitor, Ceramic, 50V, X7R, 10%	0603	C1608X7R1H104K	TDK
2	C16, C22	10 µF	Capacitor, Ceramic, 6.3V, X5R, 10%	0805	GRM219R60J106KE19D	Murata
1	C24	22 µF	Capacitor, Ceramic, 16V, X7R, 20%	1210	C3225X7R1C226M	TDK
1	C28	2.2 µF	Capacitor, Ceramic, 6.3V, X5R, 10%	0805	C2012X5R0J225KT	TDK
4	C29, C32–C34	1.0 µF	Capacitor, Ceramic, 6.3V, X5R, 10%	0603	C3216X5R0J105KT	TDK
5	C3–C5, C25, C26	10 µF	Capacitor, Ceramic, 25V, X5R, 10%	1210	GRM31CR61E106KA12L	Murata
1	C30	10 pF	Capacitor, Ceramic, 50V, C0G, 5%	0603	C1608C0G1H100DB	TDK
1	C31	1.0 µF	Capacitor, Ceramic, 25V, X7R, 10%	0603	C1608X7R1E105K	TDK
2	C6, C27	15 µF	Capacitor, POSCAP, 25V, 90mΩ, [temp], 20%	7343(D)	25TQC15MV	Sanyo
1	J1	2510-6002UB	Connector, Male Straight 2×5 pin, 100mil spacing, 4 Wall	0.338 × 0.788 in	2510-6002UB	3M
2	J2, J3	PTC30DBAN	Header, Male 2×15-pin, 100mil spacing (36-pin strip), Right-Angle	0.100 in × 15 × 2	PEC30DBAN	Sullins
1	J4		Header, 2×7 pin, 100mil spacing (36 pin strip)	0.100 in × 2X7		
3	J5–J7	PTC36SAAN	Header, 2-pin, 100mil spacing, (36-pin strip)	0.100 in × 2	PTC36SAAN	Sullins
1	JP1	PTC36SAAN	Header, 10 pin, 100mil spacing, (36-pin strip)	0.100 in × 2 × 10	PTC36SAAN	Sullins
3	JP2–JP4	PTC36SAAN	Header, 2-pin, 100mil spacing, (36-pin strip)	0.100 in × 2	PTC36SAAN	Sullins
1	L1	6.8 µH	Inductor, SMT, 1.6A, 49.2mΩ	0.276 sq	SLF7032T-6R8M1R6	TDK
2	R1, R2	2.2k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R16	33.2k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R17	162k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R18	549k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
2	R19, R20	100k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R21	294k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
3	R22–R24	2.37k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
5	R3–R5, R7, R8	4.99k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
8	R6, R9–R15	10.0k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
17	TP1–TP10, TP13–TP19		Test Point, Red, Thru hole color keyed	0.100 × 0.100 in	5000	Keystone
2	TP11, TP12		Test Point, Black, Thru hole color keyed	0.100 × 0.100 in	5001	Keystone
1	U1	AT24C512N-10SU-2.7	IC, 512K, Serial EEPROM	SO-8	AT24C512N-10SU-2.7	Atmel
1	U2	TMS320VC5509APGE	IC, Digital Signal Processor	LQFP-144	TMS320VC5509APGE	TI
1	U3	TPS62110RSA	IC, Synchronous Step-Down Converter, 17V, 1.5A	QFN-16	TPS62110RSA	TI
1	U4	TPS73601DRB	IC, Cap-Free, NMOS, 400mA LDO regulator with reverse current protection	QFN-8	TPS73601DRB	TI
1	U5	TPS3103K33DBV	IC, Ultra Low Current/Supply, Voltage Supervisor	SOT23-6	TPS3103K33DBV	TI
3	U6–U8	TLC5942PWP	IC, 16 Chan LED Driver With Dot Correction/Grayscale PWM Control	TSSOP-28	TLC5942PWP	TI
1	Y1	12MHz	Clock Oscillator, SMD	0.386 × 0.547 inch	CMX-309FBC12.000M-UT	Citizen
1	--		PCB, 7.125 In × 4.3 In × 0.062 In		HPA248	Any
12	—		Shunt, 100-mil, Black	0.100	929950-00	3M
1			PCB Assembly		HPA249	TI

Table 2. HPA249A Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
16	D0–D15	Q65110A4184	Diode, LED, 20mA, Common Anode (LATBT66B)	0.118 × 0.134	Q65110A4184	Osram
2	J1, J2	PPTC152LJBN-RC	Header, female, 2×5-pin, .100 inch, RA	0.500 × 1.520 inch	PPTC152LJBN-RC	Sullins
1	—		PCB, 2 In × 4 In × 0.062 In		HPA248	Any

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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 3.6 V to 17 V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's 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, some circuit components may have case temperatures greater than 60°C. The EVM is designed to operate properly with certain components above 60° C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265