![Texas Instruments logo]

User's Guide

SLVU316 – October 2009

TLC5951EVM

This user's guide describes the characteristics, setup, and use of the TLC5951EVM evaluation module (EVM). This EVM helps the user to evaluate the features of the Texas Instruments TLC5951, which is a 24-channel, constant-current LED driver. This user's guide includes setup instructions, a schematic diagram, a bill of materials, printed-circuit board layout drawings, and software instructions.

Contents

List of Figures

List of Tables

controlCARD is a trademark of Texas Instruments.
Windows, Internet Explorer are trademarks of Microsoft Corporation.
VeriSign is a trademark of VeriSign, Inc.
ZigBee is a trademark of ZigBee Alliance.

1 Introduction

The Texas Instruments TLC5951 is a 24-channel, constant-current LED driver that is capable of driving up to 40 mA per channel. The TLC5951 has several features including 7-bit Dot Correction, 8-bit Global Brightness Control, user-selectable 8,10, or 12-bit grayscale PWM dimming, LED open and short failure detection, and overtemperature detection. For more information on PWM dimming, see the TLC5951 data sheet (SBVS127), a dot correction technical paper (SLYT225), and a PWM dimming technical paper (SLYT238) on the TI Web site. This EVM contains two TLC5951 integrated circuits (IC) connected in series. The two ICs drive 16 light-emitting diodes (LED), 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 the software necessary to evaluate the TLC5951EVM. Check the TLC5951 product folder on the TI Web site (www.ti.com) for updates to the software.

1.1.2 Host Computer

A computer with a USB port is required to operate this EVM. The TLC5951 software runs on the personal computer (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 TLC5951EVM-477 EVM kit contains two printed-circuit boards: HPA477 (Driver board) and TMDSCNCD2808 (DSP board).

Driver Board: The Driver board contains the TLC5951 ICs and their required external components. This board contains several jumpers and connectors that enable you to customize the board for specific operating conditions. This board interfaces directly to the host computer via a USB connector. The EVM GUI software communicates with the Driver board through a TUSB3410. The TUSB3410 communicates with the DSP board with an RS-232 protocol. The Driver board contains resistors R16-R27 that set a binary code to tell the DSP what EVM is connected. It contains all power supply circuitry. It also contains 16 LED packages, with three LEDs in each package: a red, a green, and a blue LED. Each TLC5951 IC drives 8 LED packages.

DSP Board: The DSP board contains a TMS320F2808 ('F2808) microcontroller that programs and controls the two TLC5951 ICs on the Driver board. The 'F2808 DSP decodes the information it receives from the LED Driver board and converts it into a form required by the TLC5951 ICs. The DSP board's orderable part number is TMDSCNCD2808. Figure 1 Figure 1 shows how these boards are connected.
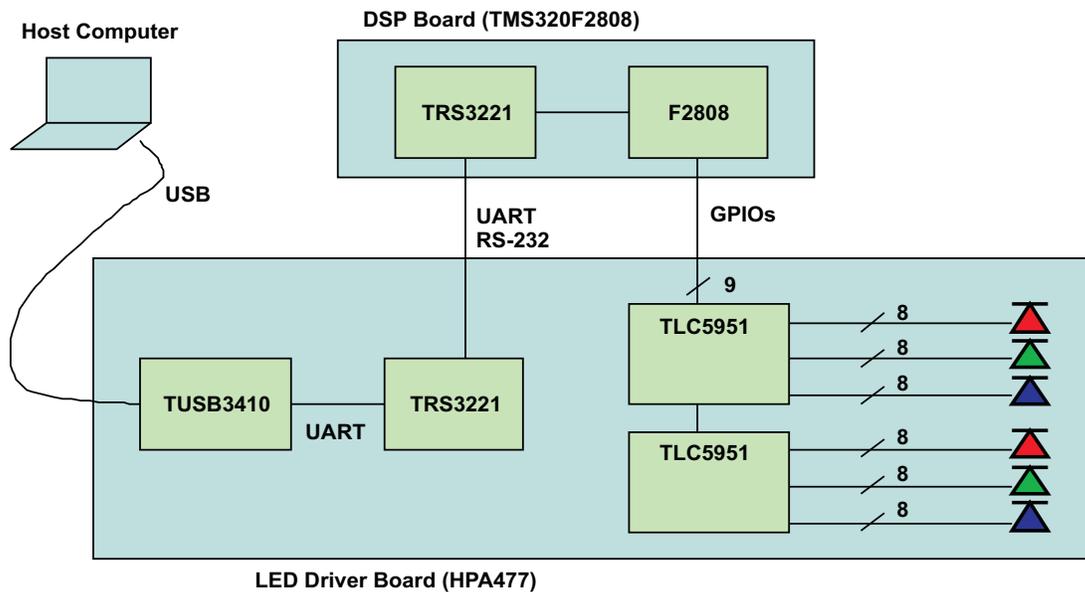
Figure 1. Board Connections

1.2   *Related Documentation From Texas Instruments*

1. *TLC5951, 24-Channel, 12-Bit PWM LED Driver With 7-Bit Dot Correction and 3 Group, 8-BIT Global Brightness Control* data sheet (SBVS112)
2. TLC5951 software (SLVC186)
3. TMDSCNCD2808 DSP controlCARD™ documents (SPRR101)

2   Setup

This section describes the jumpers and connectors on the EVM as well as how to properly connect, set up, and use the TLC5951EVM.

2.1   *Input/Output Connector Descriptions*

2.1.1   J1 – USB Input Connector

This mini-USB connector connects the EVM directly to the host PC's USB port.

2.1.2   J2 – ZigBee™ Input Connector

This connector allows the user to connect ZigBee devices such as the eZ430-RF2500. The user can write customized code to control the TLC5951EVM with a wireless ZigBee connection. J2 is not populated or used with the supplied EVM software.

2.1.3   J3 – RS-232 Input Connector

This connector allows the user to connect an RS-232 device. The user can write customized code to control the TLC5951EVM or to modify the DSP board's firmware. J3 is not populated or used with the supplied EVM software.

2.1.4 J4 – DSP Board Connector

The DSP board plugs into the J4 connector on the Driver board.

2.1.5 J5 – JTAG Input Connector

This connector can be used for JTAG communications to help debug user-generated software. J5 is not populated or used with the supplied EVM software.

2.1.6 J6 – VIN

This is the positive input supply to the EVM. The input voltage must be between 5 V and 15 V for normal operation with no multiplexing. When Row A and Row B are multiplexed by checking the Ghosting Demo button in the software, the maximum operating voltage is 10 V. The 10-V maximum voltage is limited by switching losses in the FETs on the LED board. The EVM can be operated with 15 V when multiplexing, if forced air cooling is used on the LED board. To minimize power dissipation, the input voltage must be as low as possible. The leads to the input supply must be twisted and kept as short as possible to minimize EMI transmission.

2.1.7 J7 – GND Connector

This connector is the return for the input supply to the EVM. The leads to the input supply must be twisted and kept as short as possible to minimize EMI transmission.

2.1.8 J8 – Input Power Connector

This is a right-angle miniature power jack with a 3,5-mm diameter connection. The user can use this connector to supply input power to the EVM from an ac-to-dc, plug-in adapter. The inner pin on the connector is connected directly to J6 (Vin). The outer pin on the connector is connected directly to J8 (GND). When using an ac-to-dc, plug-in adapter, ensure that the plug-in adapter's output voltage is stable and does not drop below 5 V when loaded.

2.1.9 J9 – Communications Connector

This connector contains shorting shunts that connect the 'F2808 DSP to the TLC5951 LED drivers. The shunts are preconfigured to properly connect the DSP's GPIO control signals to the LED driver ICs. The GND pins on this connector do not need shorting shunts because these pins are connected to the ground plane of the PCB. The user can remove all shorting shunts to disconnect the 'F2808 from the TLC5951 ICs. This allows the user to connect control signals from a separate microprocessor to this connector to program the LED drivers. The XERR signal does not need a shorting jumper because the user graphical interface (GUI) software does not use this signal.

CAUTION

Do not drive the outputs of the TMS320F2808 on the DSP board with external control signals.

2.1.10 J10 – LED Connector

This connector lets the user connect a custom LED board to the EVM though a standard 30-pin ribbon cable with 0.1-inch, pin-to-pin spacing. In order to minimize stray inductance and ringing on the output traces, connections to this connector must be as short as possible.

2.1.11 J11 – LED Connector

This connector lets the user connect a custom LED board to the EVM though a standard 30-pin ribbon cable with 0.1-inch, pin-to-pin spacing. In order to minimize stray inductance and ringing on the output traces, connections to this connector must be as short as possible.

2.1.12 J12 - VLED

This is a separate input supply to the LEDs. When the JP4 jumper is installed, power should not be applied to J12 because JP4 shorts VIN (J6) to VLED (J12). Removing JP4 allows the LEDs to be powered from a separate power supply from the rest of the EVM. The LED short detect can only be tested using a separate LED supply.

2.1.13 GND

Connect the VLED return lead to J13

2.1.14 JP1 – Default 'F2808 Boot Location

When a short is connected between pins 1-2, the 'F2808 boots up from the USB port connector, J1. When a short is connected between pins 2-3, the 'F2808 boots up from its internal flash EEPROM. The default boot location is the 'F2808 internal EEPROM. Firmware updates to the EEPROM require changes to the JP1 settings. The GUI software provides detailed instructions on how to update the firmware. If the user configures the EVM to communicate through the RS-232 or Zigbee connector, short JP1 pins 1 and 2 together so that the DSP boots from the RS-232 or Zigbee connector.

2.1.15 JP2 - SCL

This jumper is used to program the EEPROM, U1, at assembly. This jumper must be shorted to connect the TUSB3410 to the EEPROM for normal operation.

2.1.16 JP3 - SDA

This jumper is used to program the EEPROM, U1, at assembly. This jumper must be shorted to connect the TUSB3410 to the EEPROM for normal operation.

2.1.17 JP4 - VIN to VLED Shorting Jumper

This jumper shorts VIN to VLED. If using separate power for VIN and VLED, remove this jumper. The EVM default setting is for this jumper to be shorted so that both the EVM control circuitry and the LED power come from a single power supply.

2.1.18 JP5 – Green LED

This jumper must be shorted to connect the red LED, D7, to the LED driver. This jumper can be opened to measure the current flowing into the D7 LED.

2.1.19 JP6 – Green LED

This jumper must be shorted to connect the green LED, D7, to the LED driver. This jumper can be opened to measure the current flowing into the D7 LED.

2.1.20 JP7 – Blue LED

This jumper must be shorted to connect the blue LED, D7, to the LED driver. This jumper can be opened to measure the current flowing into the D7 LED.

2.1.21 JP5 – SCL

This jumper is used to program the EEPROM, U1, at assembly. This jumper must be shorted to connect the TUSB3410 to the EEPROM for normal operation.

2.1.22 JP6 – SDA

This jumper is used to program the EEPROM, U1, at assembly. This jumper must be shorted to connect the TUSB3410 to the EEPROM for normal operation.

2.1.23 S1 – Power Switch

This switch connects and disconnects input power from the EVM.

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 the URL 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 3.5 or later (if it is not already installed). This framework is required for the software to run.

After installation, the software automatically runs.

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

> **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 no longer attempts to run.

2.3 Hardware Setup

Ensure that S1 is in the OFF position.

Ensure that the shorting shunt is installed on JP1. The default for normal EVM operation is to short pins 2 and 3 together.

Ensure that the shorting shunts are installed on JP2 through JP7.

Connect the DSP board (TMDSCNCD2808) to the LED Driver board (HPA477). Ensure the DSP board is fully seated in J4 with the tabs positioned to lock the DSP board in place.

Connect the LED Driver board to the host computer using the supplied USB cable.

Using either the J6 and J7 input power connectors or the J8 power jack connector, connect an input voltage supply to the TLC5951EVM board. The TLC5951 requires an input voltage between 5 V and 15 V. The input supply must be capable of supplying at least 1.5 A. Note that some ac-to-dc, plug-in adapters do not provide clean power. Ensure that the input voltage is well regulated to avoid intermittent communication problems.

> **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. The input supply must be connected before it is turned on.

Turn on the input supply voltage.

Move S1 from OFF to ON.

The 16 LEDs now are displaying a default pattern.

3 Operation

This section provides instructions on how to turn on the TLC5951EVM and operate the software.

The user now can 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 TLC5951 EVM GUI icon on the host computer to start the software. If no icon appears on the host computer, then use the start button in the lower left corner of the screen to browse the program folders to find the software. The default directory for software installation is Program Files\Texas Instruments\TLC5951 EVM GUI Application. The executable file name is TLC5951WinFormView.exe. Once started, the software checks the firmware in the DSP board to ensure 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 communication is established between the GUI and the EVM, the user can use the graphical interface to program the LEDs. If the EVM is properly connected, the software screen looks like Figure 2 when first opened.
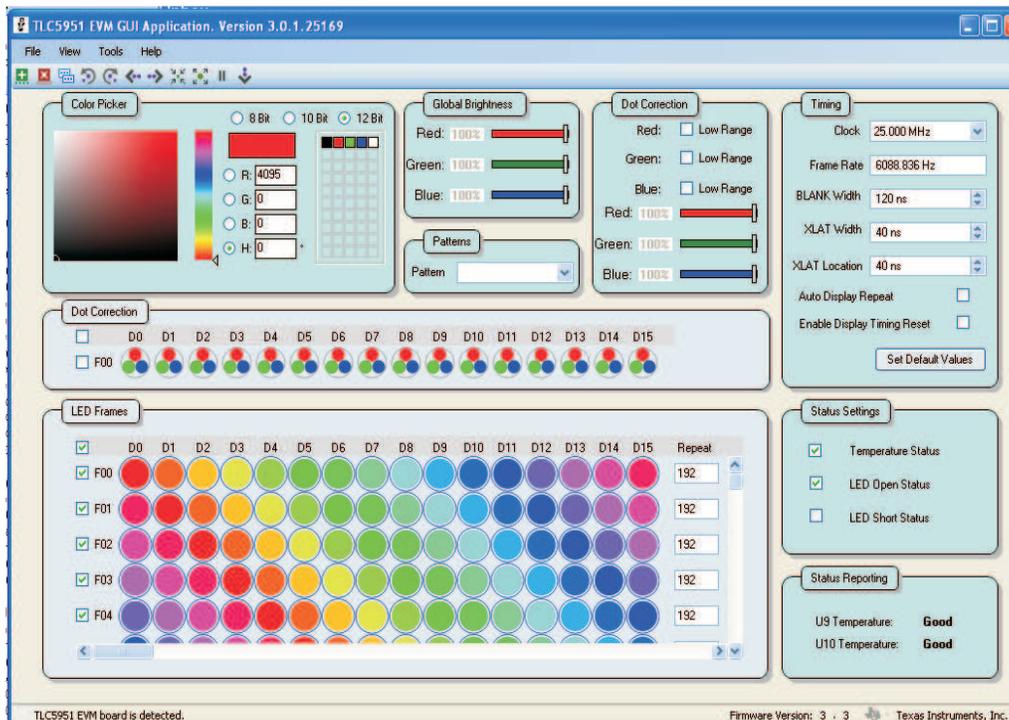
Figure 2. TLC5951EVM Software Start-Up Screen

3.2 Software Features

3.2.1 Color Picker

This window allows the user to choose the red, green, and blue PWM value for each LED. The software provides three options for choosing an LED's color. The user can manually enter the PWM values into the three text boxes, use the mouse to pick colors from the color bars, or use the mouse to click on a color from the custom color pallet. The color chosen in the Color Picker window is immediately displayed in the LEDs that are highlighted in the LED Frames window. The user can add custom colors to the pallet by dragging the current color to the custom color pallet. Custom colors can be deleted by right-clicking on the color to be removed. The TLC5951 is capable of displaying the full 2^{12}, or 4096 brightness levels per LED.

This window allows the user to program the TLC5951 to either 8-Bit, 10-Bit, or 12-Bit Dot Correction.

3.2.2 Global Brightness

This window allows the user to individually control the EVM's red, green, and blue Global Brightness values. Global Brightness values are only written to the EVM when one of the three values change.

3.2.3 Patterns

This window provides the user with several preprogrammed LED frame patterns. Choosing a pattern immediately programs the LED Frames window with the pattern and then displays the pattern with the LEDs.

3.2.4 Dot Correction

These two windows allow the user to individually control the EVM's red, green, and blue dot correction values. Each LED's Dot Correction value can be individually programmed. Dot Correction data is only written to the EVM when one of the three values change. To change an LED's dot correction value, select LEDs in the lower Dot Correction window. Select individual LEDs by clicking on each LED or select all LEDs by checking the box to the left of the LEDs. Then adjust the Dot Correction values in the upper Dot Correction window. The programmed Dot Correction value is used for all frames. Dot Correction values can not be changed from frame to frame. Checking the Low Range box programs the TLC5951 to use the low Dot Correction range. Clearing this box programs the high Dot Correction range.

3.2.5 Timing Control

The options in this window allow the user to modify the timing parameters of the signals written to the TLC5951 ICs. Note that all times and frequencies are approximate.

Clock: This drop-down menu allows the user to select the EVM's serial clock (SCLK) and grayscale (GSCLK) frequencies. The available clock frequencies are integral divisions of the 'F2808 clock frequency and cannot be modified.

Frame Rate: This shows the refresh rate for a single frame update. The Frame Rate is approximately 1/period, where period is the time to display all 2^{12} grayscale pulses at the chosen clock frequency plus the time the BLANK signal is high.

BLANK Width: This adjusts the width of the BLANK pulse.

XLAT Width: This adjusts the width of the XLAT pulse.

XLAT Location: This adjusts the rising edge of the XLAT pulse location. It is relative to the rising edge of the BLANK signal. A negative XLAT Location is shown when the XLAT signal rises before the BLANK signal.

Auto Display Repeat: This box enables or disables the Auto Display Repeat function

Enable Display Timing Reset: This box enables or disables the Display Timing Reset function

Set Default Values: This box resets all Timing Controls to their default values.

3.2.6 LED Frames

The LED tool bar provides many easy-to-use functions to facilitate the EVM's evaluation. Each button has a pop-up description, which makes each function self-explanatory.
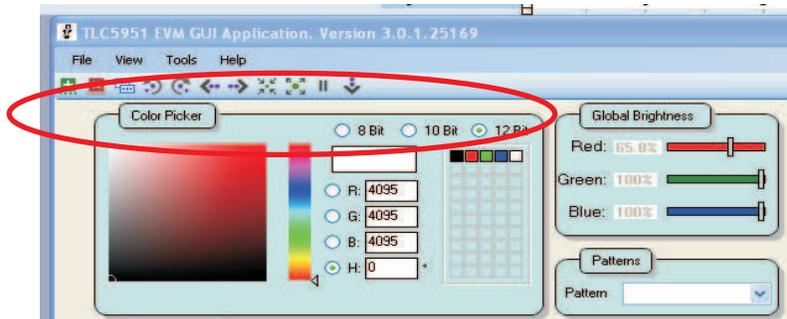
Figure 3. LED Toolbar

3.2.7 File – Save and Load

This tab allows the user to save and load custom frames. The file also saves all user-selectable settings such as operating frequency and Dot Correction settings.

3.2.8 View – Editing Radix

Changes the input format for the PWM Grayscale values in the Color Picker and Dot Correction Values between Hex, Percentage, and Absolute.

3.2.9 View – LED Display Mode

When Solid display mode is chosen, the pixel in the LED Frames window shows the LED pixels and their approximate color on the EVM. This color is generated by the mixing of the three individual LED colors. When RGB display mode is chosen, the pixel shows the relative intensity of each individual LED that makes up each pixel.

3.2.10 Tools – Update DSP Firmware

Clicking on this function provides step-by-step directions on how to update the EVM's DSP firmware.

3.2.11 Status Settings – Temperature Status

When checked, the Temperature Status box enables the GUI to report the temperature status of both TLC5951 ICs in the Status Reporting window. The TLC5951 ICs continually monitor and report their temperature status regardless of whether or not Temperature Status box is checked. Unchecking the box only disables status reporting in the GUI. The EVM firmware latches the TLC5951 overtemperature signals to ensure that the GUI is able to read and display the error signals. The GUI may show an error condition for 2 seconds longer than the condition actually exists on the hardware.

3.2.12 Status Settings– LED Open Status

When checked, the Temperature Status box enables the GUI to report the temperature status of both TLC5951 ICs in the Status Reporting window. The TLC5951 ICs continually monitor and report their temperature status regardless of whether or not Temperature Status box is checked. Unchecking the box only disables status reporting in the GUI. The EVM firmware latches the TLC5951 overtemperature signals to ensure that the GUI is able to read and display the error signals. The GUI may show an error condition for 2 seconds longer than the condition actually exists on the hardware

3.3 Hardware Features

3.3.1 EVM Binary Identification Code

Resistors R16-R27 set a binary code that is read by the DSP at start-up. The DSP communicates this code to the GUI so that it knows what version of the EVM is connected and can load the proper software version.

3.3.2 RS-232 Communication Frequency

Resistors R28-R31 set a binary code that sets the default RS-232 communication frequency. Table 1 shows the available settings. The default frequency is 115.2 kbps. The user can change this setting for custom software and communication protocol development.

Table 1. Available Settings

Default Frequency	GPIO 10	GPIO 9
9.6 kbps	0	0
57.6 kbps	0	1
115.2 kbps	1	0
Not used	1	1

3.3.3 Impedance Matching Termination Network

Each control line contains an RC impedance matching termination network. These are shown in the lower right corner on page 4 of the schematic. These networks are not installed and are not needed when using the DSP board to drive the LED drivers. If the user drives the LED drivers from an external source, these components may need to be installed to provide proper impedance matching of the PCB traces and the external drive circuitry. Excessive ringing caused by impedance mismatch can be interpreted as low-to-high logic level changes, causing erratic EVM behavior.

4   Schematics, Board Layouts, and Bill of Materials

4.1   Schematics

through provides the schematics for the TLC5951EVM-477.

Figure 4. HPA477A Schematic 1
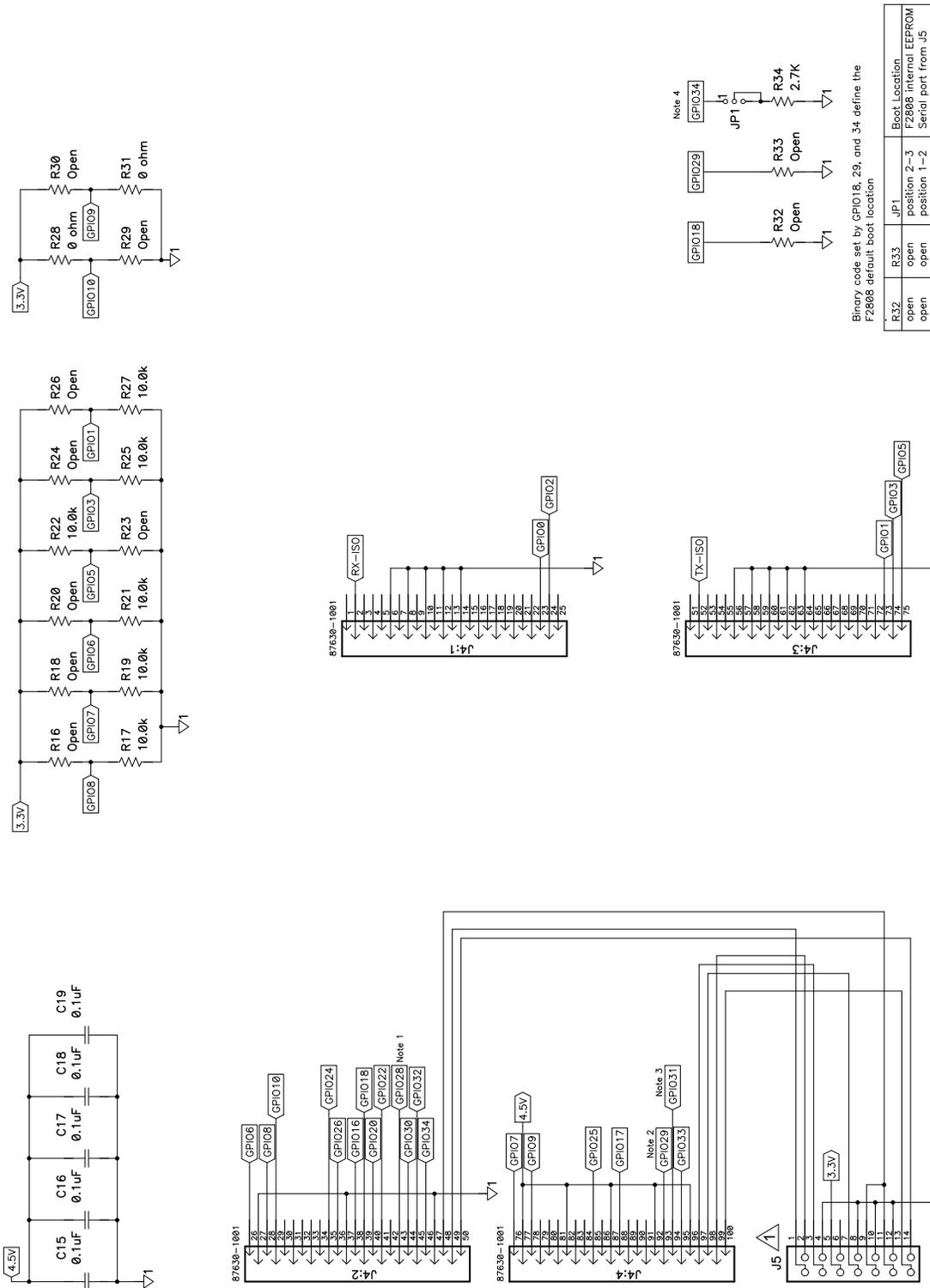
Figure 5. HPA477A Schematic 2
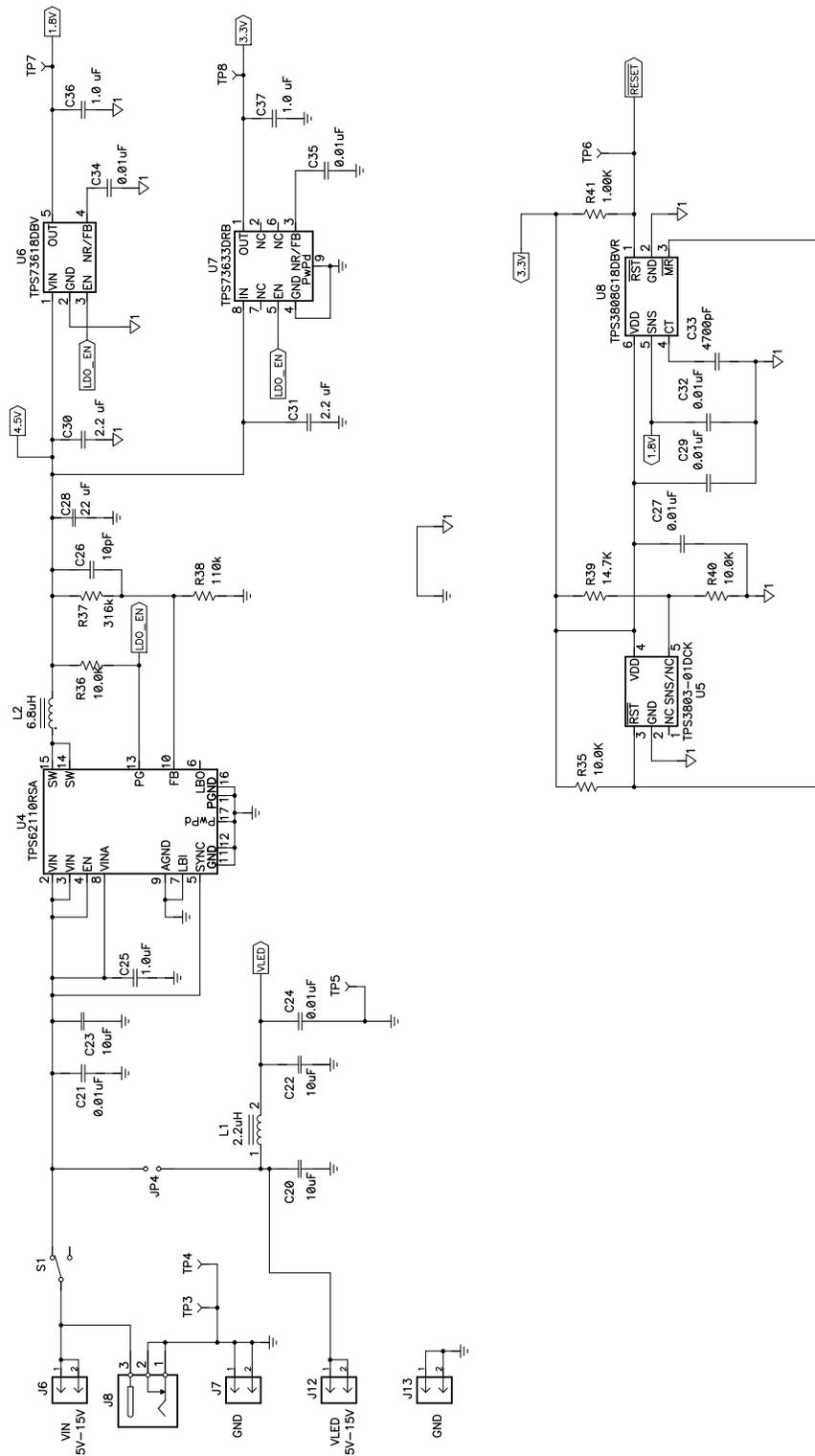
Figure 6. HPA477A Schematic 3
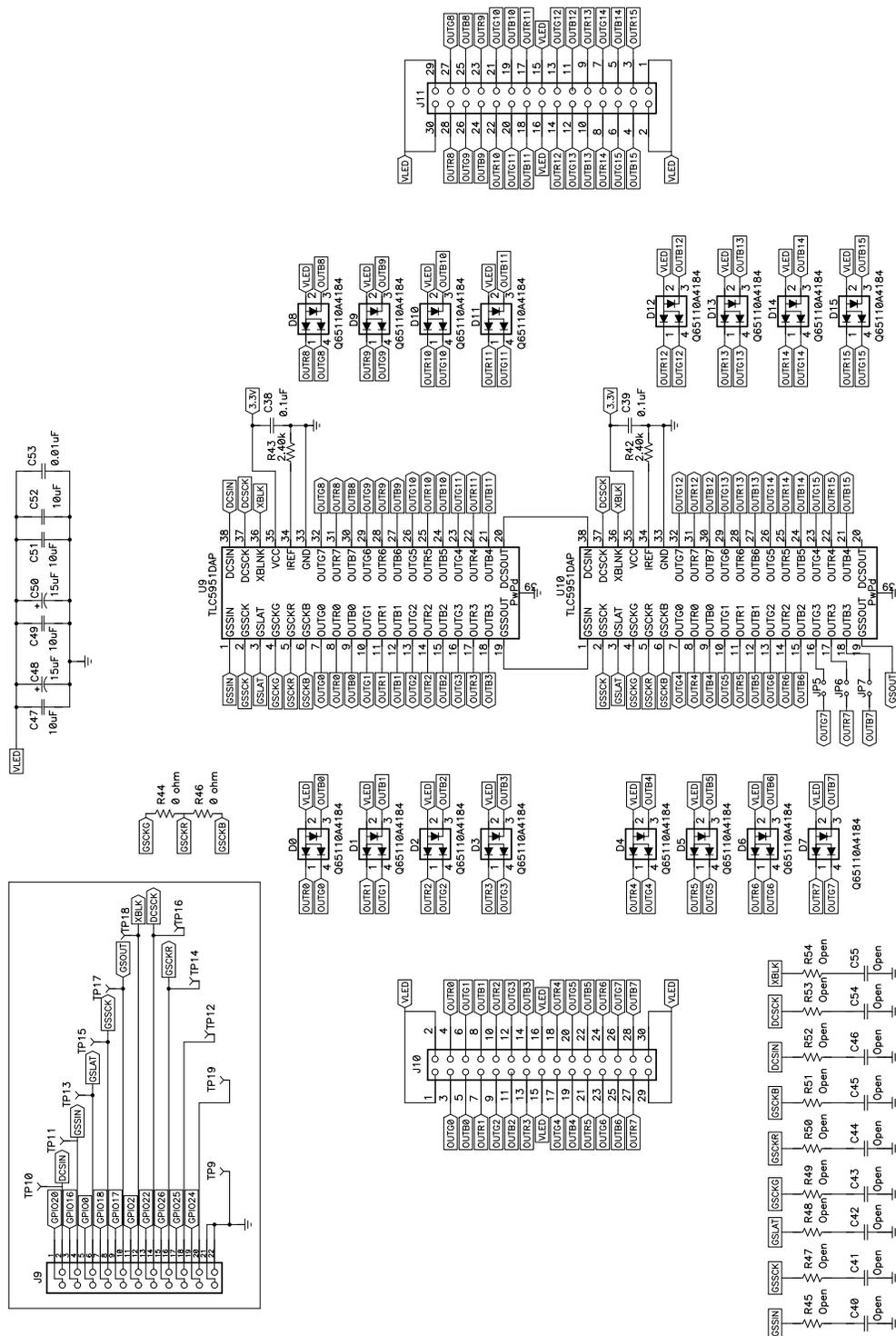
Figure 7. HPA477A Schematic 4

4.2 Board Layouts

This section provides the TLC5951EVM board layouts and illustrations.

through show the board layout for the LED driver board, HPA477.
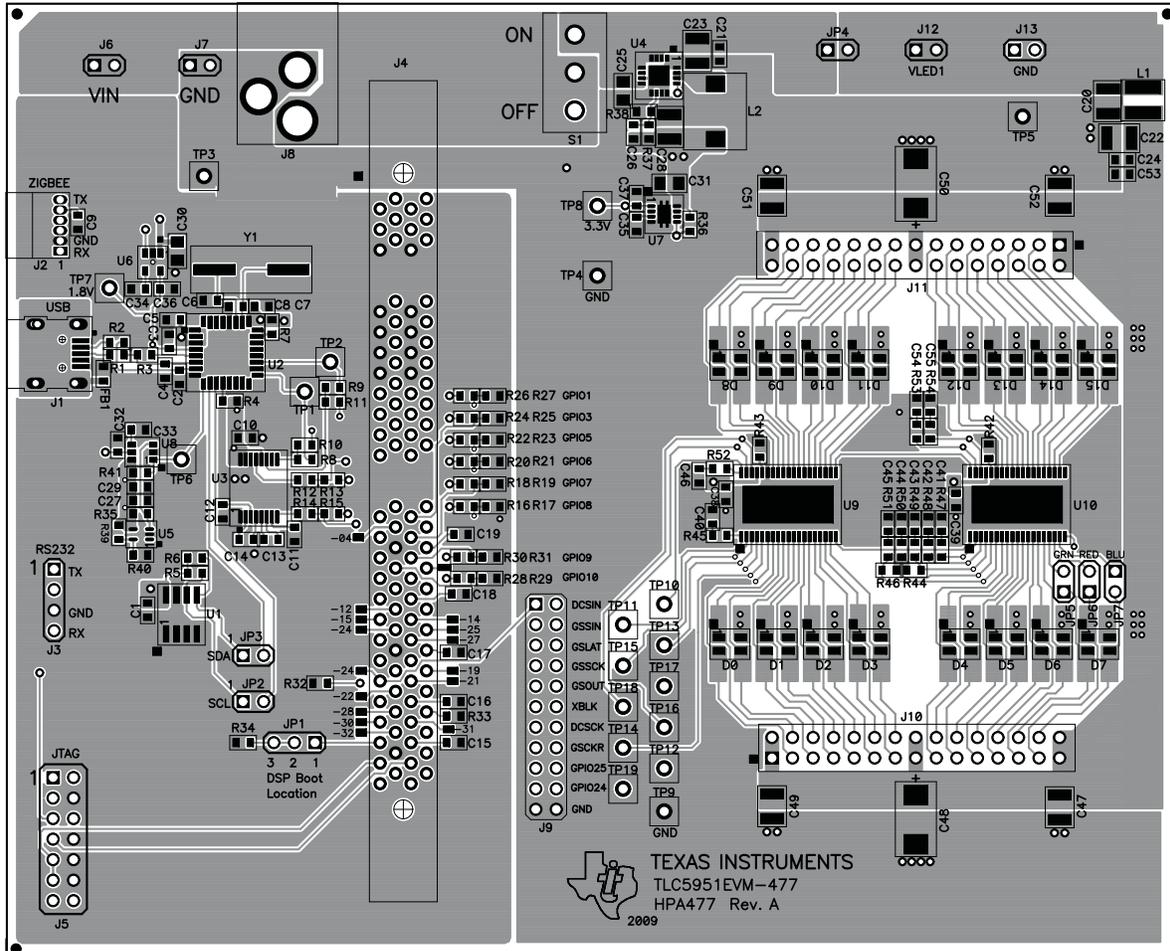
Figure 8. HPA477A Assembly Layer
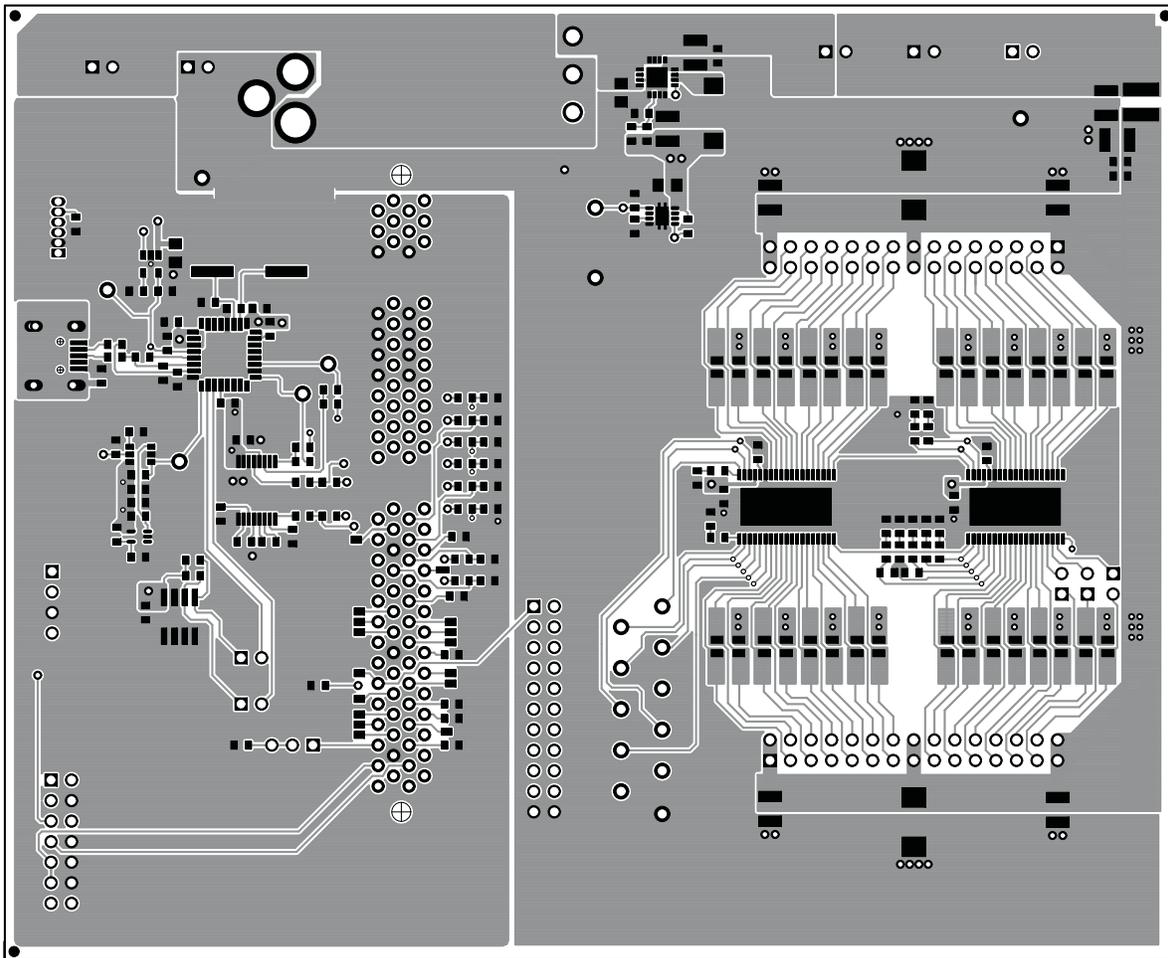
Figure 9. HPA477A Top Layer
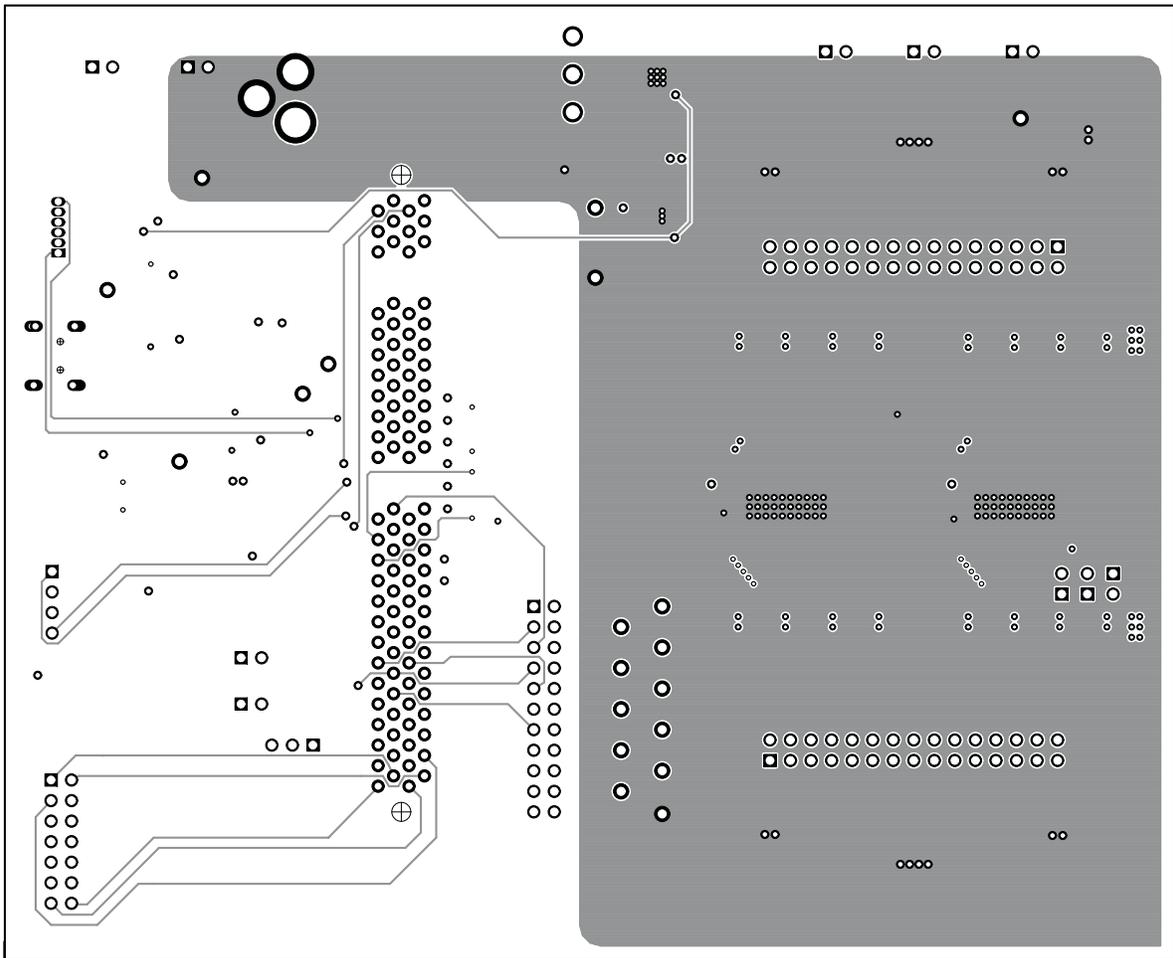
Figure 10. HPA477A Layer 2
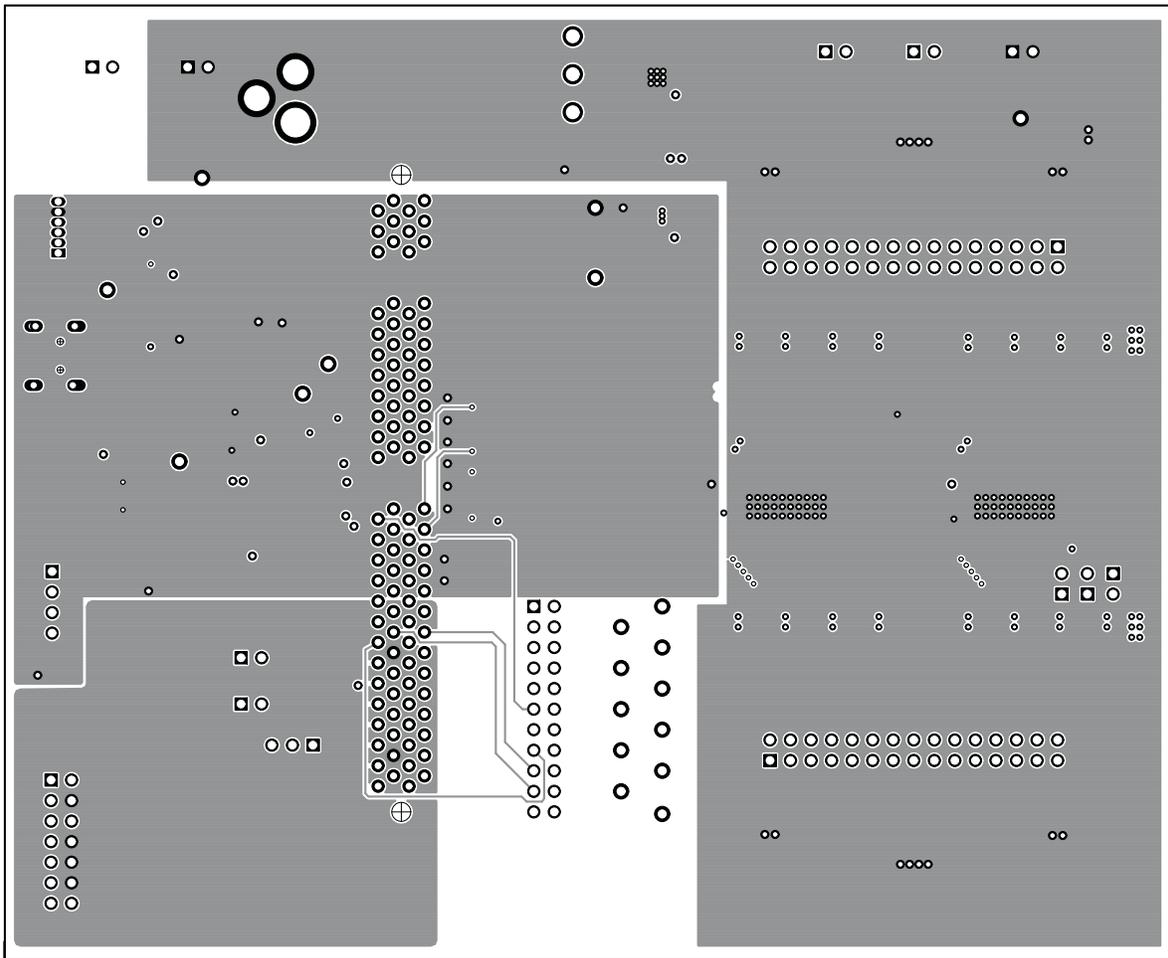
Figure 11. HPA477A Layer 3 (replace picture)
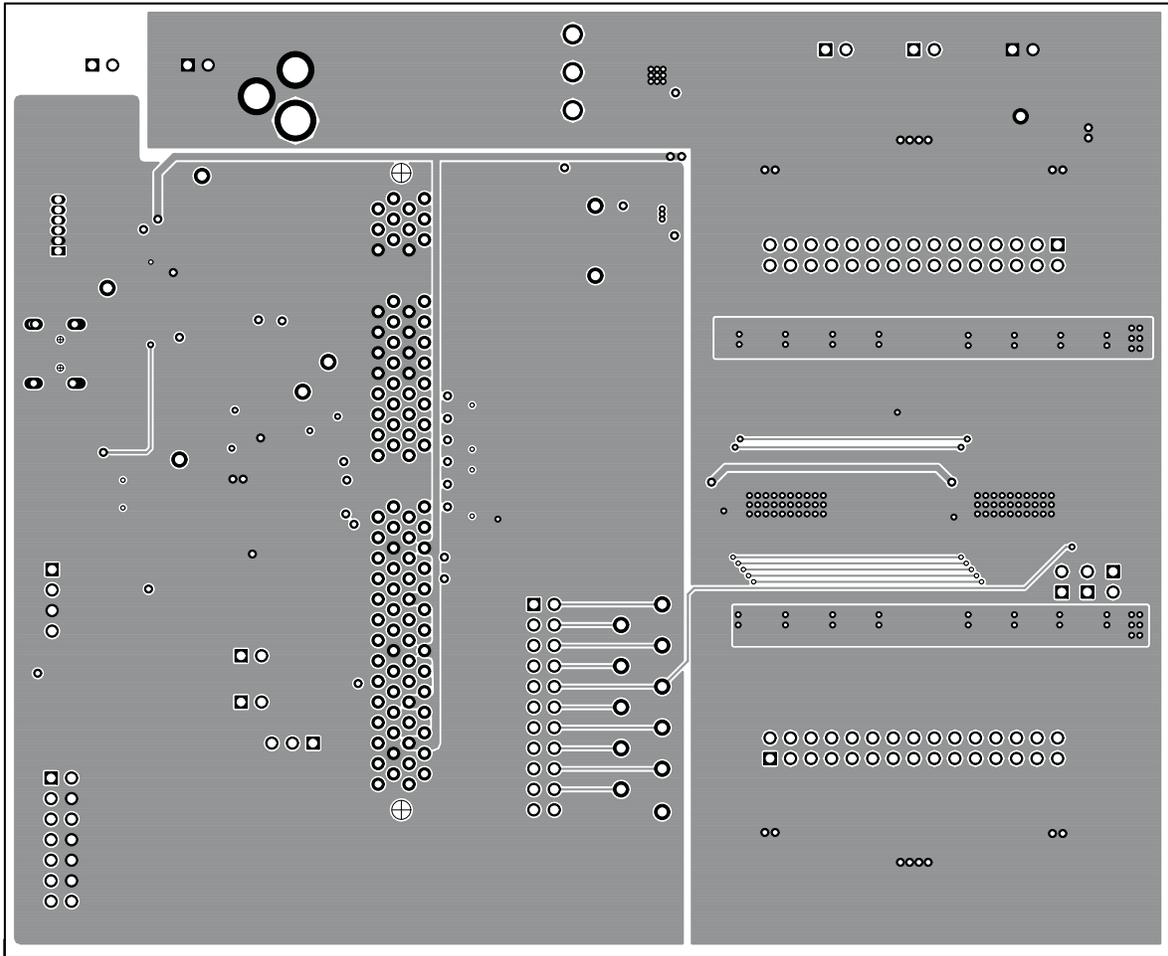
Figure 12. HPA477 Bottom Layer Routing

4.3 Bill of Materials

Table 2. HPA477A Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
10	C1, C7, C21, C24, C27, C29, C32, C34, C35, C53	0.01uF	Capacitor, Ceramic, 50V, X7R, 20%	0603	GRM188R71H103MA	Murata
2	C2, C4	22pF	Capacitor, Ceramic, 50V, COG, 5%	0603	GRM1885C1H220JA	Murata
15	C3, C5, C9, C10–C19, C38, C39	0.1uF	Capacitor, Ceramic, 6.3V, X7R, 10%	0603	GRM188R70J104KA	Murata
2	C6, C8	33pF	Capacitor, Ceramic, 6.3V, X7R, 10%	0603	Std	Std
7	C20, C22, C23, C47, C49, C51, C52	10uF	Capacitor, Ceramic, 25V, X5R, 10%	1210	GRM32DR71E106KA12L	Murata
1	C25	1.0uF	Capacitor, Ceramic, 25V, X5R, 10%	0805	GRM216R61E105KA	Murata
1	C26	10pF	Capacitor, Ceramic, 50V, C0G, 5%	0603	C1608C0G1H100DB	TDK
1	C28	22 uF	Capacitor, Ceramic, 16V, X7R, 20%	1210	C3225X7R1C226M	TDK
2	C30, C31	2.2 uF	Capacitor, Ceramic, 6.3V, X5R, 10%	0805	C2012X5R0J225KT	TDK
1	C33	4700pF	Capacitor, Ceramic, 16V, X7R, 10%	0603	GRM188R71C472KA	Murata
2	C36, C37	1.0 uF	Capacitor, Ceramic, 6.3V, X5R, 10%	0603	C1608X5R0J105K	TDK
0	C40–C46, C54, C55	Open	Capacitor, Ceramic, 6.3V, X7R, 10%	0603	Std	Std
2	C48, C50	15uF	Capacitor, POSCAP, 25V, 90mΩ, 20%	7343(D)	25TQC15M	Sanyo
16	D0–D15	Q65110A4184	Diode, RGB LED, 20-mA, Common Anode	0.118 × 0.134 inch	Q65110A4184	Osram
1	FB1	74279266	Bead, SMD Ferrite, 100 MHz Max. 200mA , ±25%	0603	74279266	WE
1	J1	UX60-MB-5S8	Connector, Recpt, USB-B, Mini, 5-pins, SMT	0.354 × 0.303 Inches	UX60-MB-5S8	Hirose
0	J2	Open	Header, 1×6-pin, 50mil spacing	1.000 × 0.085 inch	850-106-10-S-RA	Millmax
0	J3	Open	Header, Male 4-pin, 100mil spacing	0.100 inch × 4	PEC04SAAN	Sullins
1	J4	87630-1001	Connector, PCI Card, 100-pin 1.27 mm pitch	0.300 × 3.850 inch	87630-1001	Molex
0	J5	Open	Header, 2×7 pin, 100mil spacing	0.100 inch × 2 × 7	PEC07DAAN	Sullins
4	J6, J7, J12, J13	PEC02SAAN	Header, 2-pin, 100mil spacing	0.100 inch × 2	PEC02SAAN	Sullins
1	J8	RAPC 712	Connector, Pin dia. 2.5mm, DC Jack,	0.57 × 0.35 inch	RAPC 712	Switchcraft
1	J9	PEC11DAAN	Header, Male 2×11-pin, 100mil spacing	0.100 inch × 11 × 2	PEC11DAAN	Sullins
2	J10, J11	PEC15DAAN	Header, Male 2x15-pin, 100mil spacing	0.100 inch x 15 × 2	PEC15DAAN	Sullins
1	JP1	PEC03SAAN	Header, 3-pin, 100mil spacing	0.100 inch × 3	PEC03SAAN	Sullins
6	JP2–JP7	PEC02SAAN	Header, 2-pin, 100mil spacing	0.100 inch × 2	PEC02SAAN	Sullins
1	L1	2.2uH	Inductor, SMT, 3.4A, 70mΩ	0.153 × 0.153 inch	LPS4018-222ML	Coilcraft
1	L2	6.8uH	Inductor, SMT, 1.6A, 49.2mΩ	0.276 sq	SLF7032T-6R8M1R6	TDK
2	R1, R2	33	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R3	1.50K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
5	R4, R7, R35, R36, R40	10.0K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
3	R5, R6, R41	1.00K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
8	R8, R9, R12, R14, R28, R31, R44, R46	0 ohm	Resistor, Chip, 1/16W, 1%	0603	Std	Std
0	R10, R11, R13, R15, R16, R18, R20, R23, R24, R26, R29, R30, R32, R33, R45, R47–R54	Open	Resistor, Chip, 1/16W, 1%	0603	Std	Std
6	R17, R19, R21, R22, R25, R27	10.0k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R34	2.70K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R37	316k	Resistor, Chip, 1/16W, 1%	0603	Std	Std

Table 2. HPA477A Bill of Materials (continued)

Count	RefDes	Value	Description	Size	Part Number	MFR
1	R38	110k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R39	14.7K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
2	R42, R43	2.40k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	S1	CS12ANW03	Switch, SPDT, Miniature Slide, 3A 125VAC	0.276 × 0.551 inch	CS12ANW03	NKK
14	TP1, TP2, TP6–TP8, TP10–TP18	5000	Test Point, Red, Thru Hole Color Keyed	0.100 x 0.100 inch	5000	Keystone
5	TP3–TP5, TP9, TP19	5001	Test Point, Black, Thru Hole Color Keyed	0.100 × 0.100 inch	5001	Keystone
1	U1	AT24C512BN-SH25-T	IC, 512K, Serial EEPROM	SO-8	AT24C512BN-SH25-T	Atmel
1	U2	TUSB3410IVF	IC, USB to Serial Port Controller	PQFP32	TUSB3410IVF	TI
1	U3	TRS3221ECDBR	IC, RS-232 Transceivers with AutoShutdown	SSOP-16	TRS3221ECDBR	TI
1	U4	TPS62110RSA	IC, Synchronous Step-Down Converter, 17V, 1.2A	QFN-16	TPS62110RSA	TI
1	U5	TPS3803-01DCK	IC, Voltage Supervisor	SOP-5 (DCK)	TPS3803-01DCK	TI
1	U6	TPS73618DBV	IC, Cap-Free, NMOS, 400mA LDO Regulator with Reverse Current Protection.	SOT23-5	TPS73618DBV	TI
1	U7	TPS73633DRB	IC, Cap-Free, NMOS, 400mA LDO Regulator With Reverse Current Protection	QFN-8	TPS73633DRB	TI
1	U8	TPS3808G18DBVR	IC, SVS, Low Quiescent Current, Programmable 1.8V, Delay Time: 1.25ms to 10s	SOT23-6	TPS3808G18DBVR	TI
2	U9, U10	TLC5951DAP	IC, 24-Chan, 12-Bit PWM LED Driver with 7-Bit Dot Correction and 3-Group, 8-Bit Global Brightness Control	HTSSOP-38	TLC5951DAP	TI
1	Y1	ABLS-12.000Mhz-B2	Crystal, Controlled Oscillators	0.150 × 0.528 inch	ABLS-12.000Mhz-B2	ABRACON
1	–		PCB, 4.65 In × 5.7 In × 0.0062 In		HPA477	Any
18	–		Shunt, 100-mil, Black	0.100		Any
4	See Note 5	2566	Bumper, rubber		2566	SPC Tech
1	See Notes 5, 6		F2808 DSP Control Card		TMDSCNCD2808	TI

EVALUATION BOARD/KIT IMPORTANT NOTICE

FCC Warning

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.

IMPORTANT NOTICE