Using the TPS2459EVM

User's Guide

Literature Number: SLUU349
March 2009

TPS2459 Full-Featured AdvancedMC™ Slot Controller Evaluation Module

1 Introduction

The Full-Featured AdvancedMC™ Slot Controller Evaluation Module (EVM) is a PCB platform for users to learn about the features and operation of the TPS2459 integrated circuit (IC) from Texas Instruments (TI). The TPS2459 Full Featured AdvancedMC™ Slot Controller manages a single 12-V and single 3.3-V power rails, and features inrush and fault current limiting, FET OR'ing, input UVLO protection, logic-level enable inputs and an I^2C interface. Current control on the 12-V rail has a high degree of programmability, including independent current limit and fast trip thresholds. System level timing and other control parameters are accessed via the I^2C interface, along with readback of FET and output rail status. In addition, current sense and pass and block FET's for the 3.3-V channel are fully integrated into the device.

Power management applications based on the TPS2459 are easily configured to meet the requirements for 12-V and 3.3-V control of Advanced Mezzanine Card (AdvancedMC™) modules. Each device incorporated onto a Carrier Card provides full power control for an AdvancedMC™ slot according to the requirements of the Advanced Telecommunications Computing Architecture (ATCA™) specification, PICMG 3.0. In addition, the input supply FET OR'ing control for the 12-V rail facilitates efficient redundant supply implementations in Micro Telecommunications Computing Architecture (MicroTCA™) systems.

2 Description

2.1 Module Overview

The TPS2459EVM is a single-board evaluation platform consisting of two main sections. When oriented with the board nomenclature in a normal, upright reading position towards the user, the top approximately one-half of the board is the TPS2459 and related components. The bottom half contains a complete USB-to-I^2C interface adapter, allowing access to the device's internal I^2C registers directly from the USB port of any Windows-based host PC. Power connectors are organized with inputs along the left edge of the board, outputs along the right.

The main (upper) section of the board is comprised of the featured device, input and output banana jacks for connection of the user's supplies and test loads (if desired), and some on-board load capacitance. Numerous jumpers are provided throughout the circuit for maximum configuration flexibility. Test points are available for voltage and waveform monitoring.

The EVM kit includes a USB cable with the mating connector for the Type B-Mini connector on the EVM. The TPS2459 EVM GUI is available for download from the TPS2459 product folder on the TI website, www.TI.com . The GUI enables access to the control and status registers of the TPS2459 for quick set-up and operation of the EVM without having to write any code.

2.2 Typical Applications

The TPS2459EVM contains the necessary input connectors and external components to demonstrate the application of 12-V and 3.3-V supplies to an AdvancedMC™-like load (12-V and 3.3-V load rails). The module can be used independantly with just the on-board load capacitance, or the user's test loads can be attached to the output connectors. The EVM GUI provides easy access to the internal control bits to complete device configuration for the target application. This configuration provides a complete set-up for testing the TPS2459 power management of a single AdvancedMC™ slot in a non-redundant application.

If used in conjunction with a second EVM, with the two 12-V and two 3.3-V outputs connected together, the modules can be used to test and demonstrate operation in redundant systems. The EVM features two expansion ports and related jumpers needed to evaluate redundancy support. Setup details for this type of testing are provided below. Additional EVM modules for this purpose can be ordered directly from the TI website or by contacting your local TI representative.

As supplied from the factory, the EVM comes with current limits programmed for the requirements of Management Power and Payload Power control for AdvancedMC™ modules. However, limit thresholds on the 12-V channels are programmable by the user; instructions for modifying current limits are included below. This flexibility with the TPS2459 enables use in other, proprietary systems requiring 12-V and 3.3-V supply control.

2.3 Features

The TPS2459EVM includes the following features:

- One TPS2459 Full Featured AdvancedMC™ Slot Controller Device
- USB- to-I^2C Interface Adapter
- Programming and Sense Resistors (12-V)
- Low $R_{DS(on)}$ Pass and Block FET's (12-V)
- Input and Output Power Jacks for External Supply and Optional Load Connection
- Up to 880-µF (4 x 220 µF) Jumpered Load Capacitors for Simulated Payload Power Output Bulk Capacitance
- 150-µF Jumpered Load Capacitor for the Management Power Channel
- Address-Setting DIP Switch
- Slide Switch Actuation of Enable Inputs
- Expansion Port Headers
- Windows-Compatible EVM GUI

The use of these features is described in greater detail later in this document.

3 Electrical Specifications

3.1 Absolute Maximum Ratings

The absolute maximum ratings for the TPS2459EVM are given below in Table 1.

Table 1. Absolute Maximum Ratings(1)(2)

PARAMETER	RATING
Input voltage range, 12-V supply	-0.3 V to 13.8 V
Input voltage range, 3.3-V supply	-0.3 V to 4 V
Applied voltage, pins of J17, J18	-0.3 V to 5 V
SUMx	
Applied voltage, pins of J17, J18	-0.3 V to 3.5 V
SCL, SDA	
Output current, 12-V output	10A
Output current, 3.3-V output	Internally limited by device
Output current, SUMx	-5 mA
Output current, $\overline{\text{FLTx}}$, $\overline{\text{PGx}}$	5 mA
Storage temperature range	-55°C to 150 °C

(1) All voltages are with respect to the EVM GND node.
(2) Currents are positive into and negative out of the specified terminal.

3.2 Recommended Operating Conditions

The recommended operating conditions for the TPS2459EVM are given in Table 2.

Table 2. Recommended Operating Conditions, TPS2459EVM(1)(2)

PARAMETER	MIN	TYP	MAX	UNITS
Input supply voltage, 12 V	8.8	12	13.2	V
Input supply voltage, 12 V (for specified V_{OUT})	11.3	12	13.2	
Input supply voltage, 3.3 V	2.85	3.3	3.5	
Input supply voltage, 3.3 V (for specified V_{OUT})	3.235	3.3	3.465	
Load current, payload power out (SLOT_PWR)			-7.4	A
Load current, mgmt power out (SLOT_MP)			-165	mA

(1) All voltages are with respect to the EVM GND node.
(2) Currents are positive into and negative out of the specified terminal.

3.3 Electrical Characteristics

The electrical characteristics of the TPS2459EVM are as listed in Table 3.

Table 3. Electrical Characteristics, TPS2459EVM(1)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output voltage, payload power out (SLOT_PWR)	ENx = OREN = HI, $I_{LPWR} < I_{LPWR\_MAX}$	10.8		13.2	V
Output voltage, mgmt power out (SLOT_MP)	EN3 = HI, $I_{LMP} < I_{LMP\_MAX}$	3.135		3.465	
Current limit threshold, payload power		7.4	8.36	9.1	A
Current limit threshold, mgmt power		170	195	225	mA
Fast trip threshold, payload power				24.5	A
Fast trip threshold, mgmt power				400	mA
Output capacitance, payload power (CL_PWR)	All four load caps connected	704	880	1056	µF
Output capacitance, mgmt power (CL_MP)	Load cap connected	120	150	180	
Output ramp time, payload power	V_{IN} = 12 V - 13.2 V, V_O = 0 V to 98% x V_{IN}, R_{LOAD} = 1 kΩ, $C_{LOAD} = C_{L\_PWR}$		1.31	2.01	ms
Output ramp time, mgmt power	V_{IN} = 3.3 V - 3.465 V, V_O = 0 V to 98% V_{IN}, R_{LOAD} = 270, $C_{LOAD} = C_{L\_MP}$		2.57	3.74	ms

(1) All voltages are with respect to the EVM GND node.

4 Schematic Diagram

The schematic diagram for the TPS2459EVM is shown in Figure 1 and Figure 2.

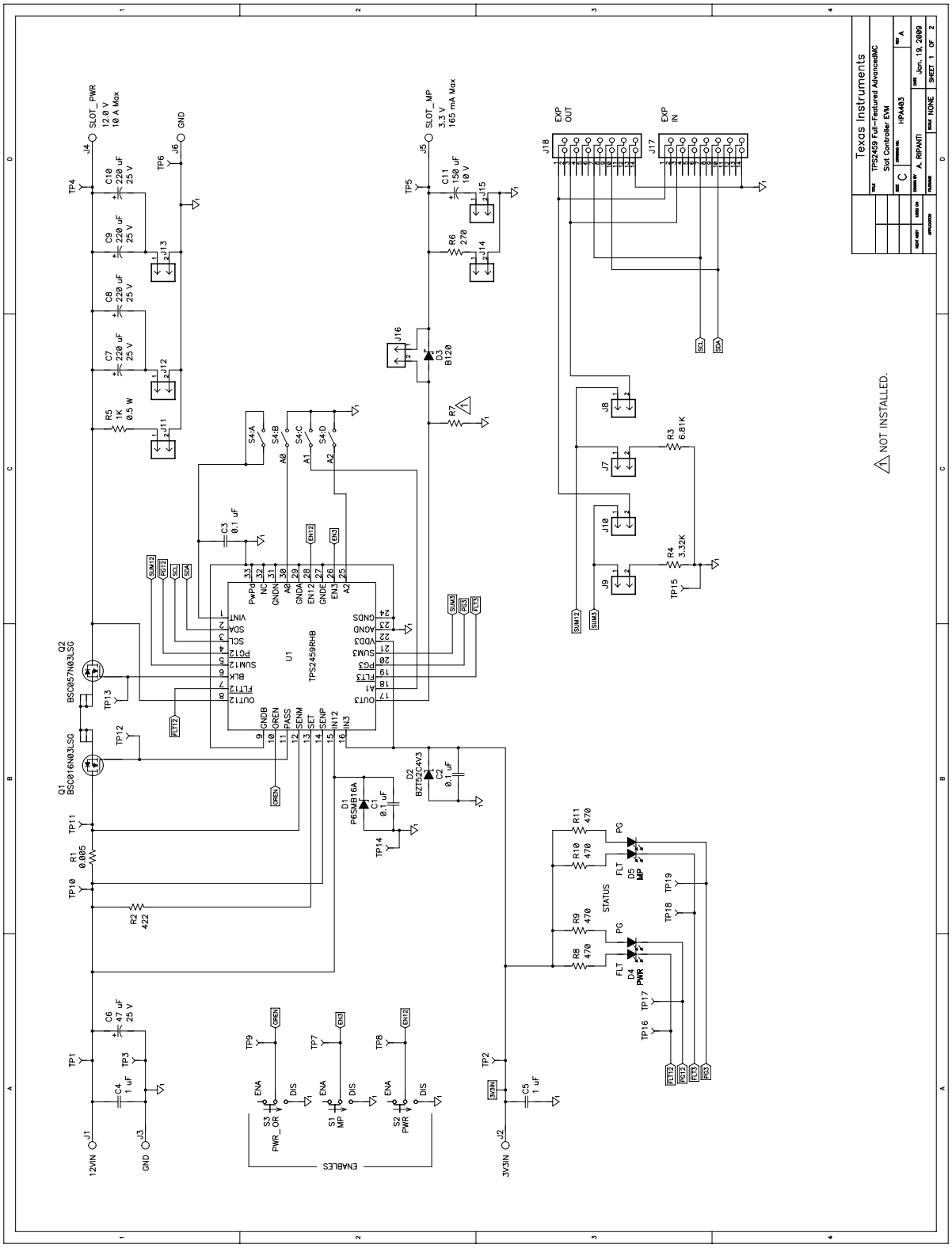

Figure 1. TPS2459 Evaluation Module Schematic Diagram

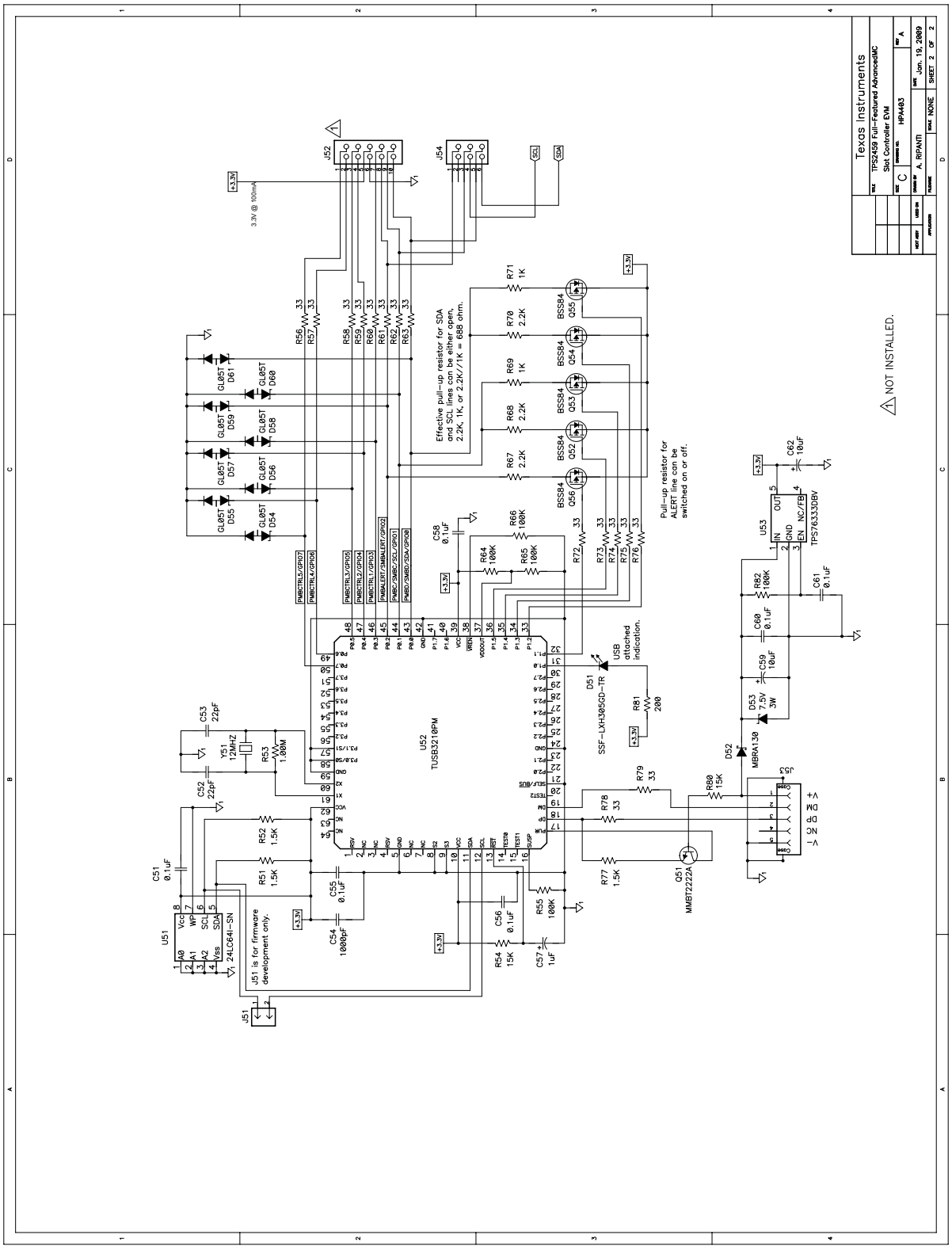

Figure 2. TPS2459 Evaluation Module Schematic Diagram

5 Test Set-up

5.1 Equipment Requirements

The following test and interface equipment (not supplied) is required to verify EVM module operation, and begin using the EVM.

- Power supply, 3.3 VDC, 500 mA minimum.
- Power supply, 12 VDC, 10 A minimum.
- Oscilloscope, 4 channel, with current probe.
- Personal computer, running Windows OS (95/98/2000/NT/XP), with USB port.

Connect the TPS2459EVM and test equipment as shown in Figure 3 for functional check-out of the board and a good starting point for user evaluation of device operation. Screen print labeling on the board employs a naming convention in keeping with the nomenclature of the target ATCA™ and MicroTCA™ applications. The input 3.3-V supply is connected to the 3V3IN jack, and the 12-V supply is connected to the 12VIN jack. A cross-reference of power rail labeling to standards naming is shown in Table 4.

Table 4. TPS2459EVM Output Net and Jack Naming

REF DES	CONNECTOR LABEL	DESCRIPTION
J5	SLOT MP	AdvancedMCTM slot Management Power
J4	SLOT PWR	AdvancedMCTM slot Payload Power
J6	GND	Common load return node

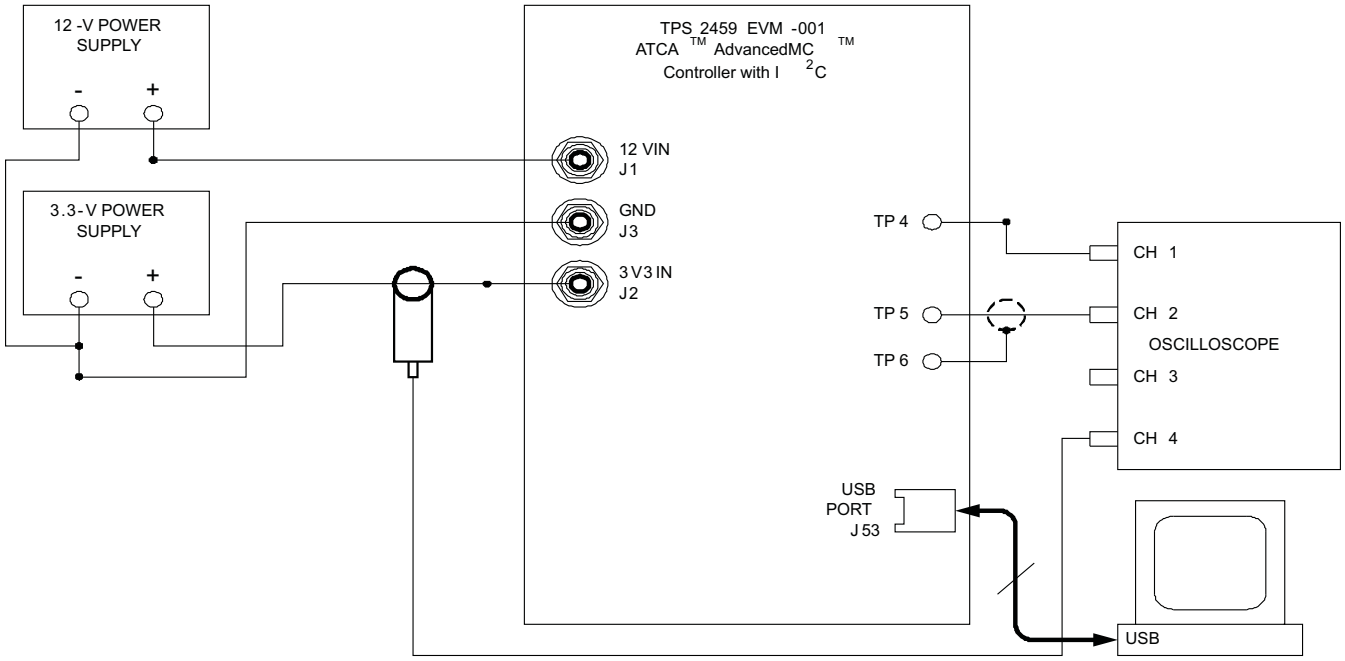

Figure 3. TPS2459EVM Set-up -- Non-Redundant System Connection

Note: Run separate leads from the GND jacks back to a common return point made near the power supply output terminals.

6 Test Procedure

The following procedure can be used to verify functional operation of the EVM assembly upon receipt.

6.1 GUI Installation

In an ATCA™ or µTCA™ application, the TPS2459 device may work in conjunction with an Intelligent Platform Management Controller (IPMC) device, which in turn is in communication with shelf management. The Shelf Management Controller (ShMC) configures slot power parameters, and enables and disables rails in response to a dynamically changing system configuration. With the EVM, this control function is realized with the TPS2459 EVM GUI, running on a Windows PC, via the on-board USB-to- I^2C interface.

The TPS2459 EVM GUI installation file is available in WinZip format as a free download from the TI website at www.ti.com. Alternatively, the GUI may be obtained on diskette or via e-mail by contacting your local authorized TI representative. Save the GUI .zip file to the desired directory on the local hard drive of the target PC. Open the .zip, and extract the installation executable. The installer filename will be of the form “TPS2459-EVM-GUI-1.0.x.y.exe”, where x and y are minor build revision numbers.

Launch the installer utility by double-clicking the name/icon in an Explorer window, or click on Start → Run … → Browse …, and navigate to the folder which the .exe was saved to. Select the .exe file, click Open, then click OK. The welcome window of the GUI Setup Wizard shown in Figure 3 will be displayed. Clicking Next will bring up the “License Agreement” window. Note that the I accept the agreement radial button must be selected in order to proceed.

Follow the installation instructions in this and subsequent Wizard windows, selecting the desired options, and clicking Next each time. At the “Ready to Install” screen, click Install if the displayed settings are O.K. The installer will verify system requirements, install GUI files, and create the selected icons and program groups. When the “Installation Complete” window of Figure 4 appears, click the Finish button to exit the Setup Wizard.

6.2 Jumper Installation

The TPS2459EVM makes use of various jumpers for quick change of functional configurations. Verify the module was supplied with jumpers installed across the following two-pin headers, or reconfigure settings as necessary.

Table 5. Initial Jumper Settings

JUMPER	STATUS/POSITION
J7, J9	Installed
J11, J12, J13	Installed
J14, J15	Installed
J16	Installed
J51	Installed
J54	Pin 3 - Pin 4
J54	Pin 5 - Pin 6

On the EVM board, place all three ENABLES slide switches (bottom left corner of PCB) to the ENA position.

6.3 Check-Out Steps

If not already done, connect the EVM and test equipment as shown in Figure 3. Once the EVM USB PORT is connected to the PC, the green LED D51 on the EVM should illuminate.

Turn on the 3.3-V power supply then turn on the 12.0-V supply. Verify all four STATUS LED's are off.

On the host PC, launch the EVM GUI from either the Start menu item or desktop icon. The GUI start-up screen of Figure 4 will appear. The TPS2459 EVM GUI auto-detects devices present on the I^2C bus. The address of the current device for all read and write transactions is displayed in the "at address:" field at the top of the GUI screen. The address of the TPS2459EVM is selectable using the four position DIP switch, S4, on the board.

In the GUI window, in the AMC STATUS panel, verify both the 12V PASS FET and BLK FET indicators display an OFF status (with red background). The 12V OUT>PG Threshold indicator should also be RED. In the AMC STATUS panel, verify the 3.3V PASS/BLK FET indicator displays an OFF status (with red background). The VOUT GOOD indicator should also be RED. In the 12V CONTROL panel, click on the FAULT TIME SET up arrow to maximize the displayed value at 15.5 mS. Click on the field with this value displayed (background color turns blue). Repeat this process for the 3.3V FAULT TIME field, being sure to click on the displayed 15.5 ms value.

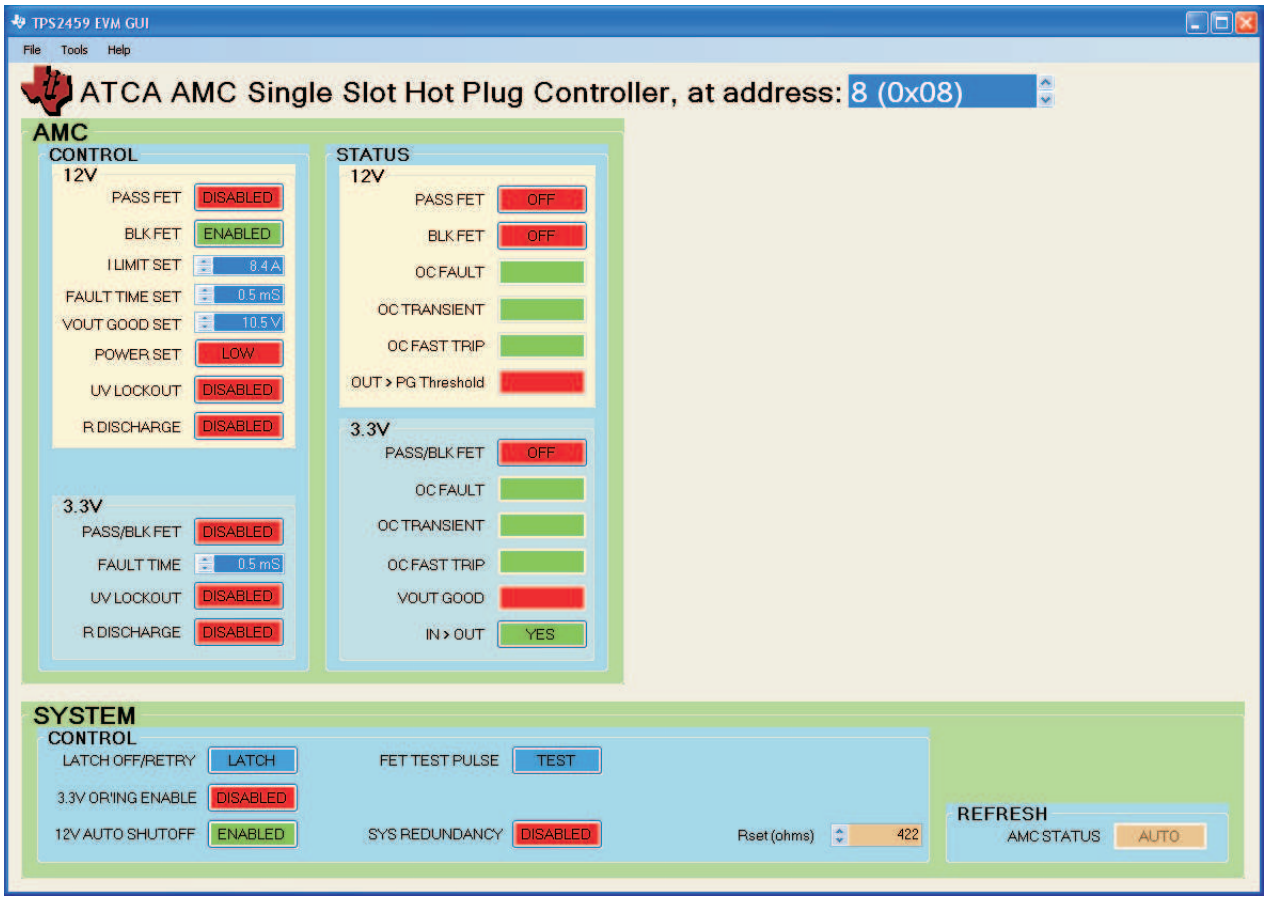

Figure 4. GUI Initial Control and Status Display at Launch

On the oscilloscope, set the Channel 1 amplifier scale to 2 V/div, and the Channel 2 amplifier to 5 V/div. Position the Channel 1 trace a couple divisions down from the top of the scope screen, and position the Channel 2 trace about a division below it. Set the current probe amplifier scale to 50 mA/div, and position that trace towards the bottom of the scope screen. Set the scope to trigger on the rising edge of Channel 1, at a threshold of about 1.5 V. Set the time base to 500 µs or 1 ms/div, and set the trigger mode to NORMAL.

In the GUI 3.3V CONTROL panel, click on the PASS/BLK FET button. In the STATUS panel, verify the 3.3V PASS/BLK FET and VOUT GOOD indicator colors change to GREEN. On the EVM board, the MP PGD green STATUS LED should be illuminated.

On the oscilloscope, verify a waveform was obtained similar to the one shown in Figure 5. The total ramp time of the Channel 1 waveform, from 0 V to about 3.2 V should be 2.6 0.6 ms. The peak amplitude of the current pulse on Channel 4 should be 195 25 mA. A DVM can be used to verify the voltage at TP5 (with respect to ground at TP6) is within 10 mV of the 3.3-V input supply voltage at 3V3IN (TP2).

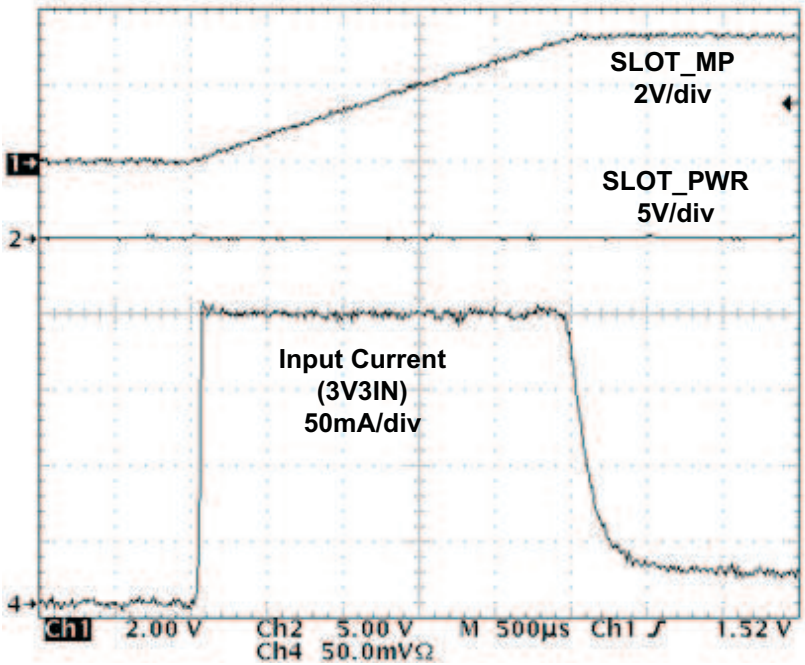

Figure 5. Output Ramp-Up waveforms - SLOT_MP Rail.

Remove the current probe from the 3.3-V supply lead, and clamp it across the 12VIN supply lead. Change the Channel 4 amplifier scale to 2 A/div. Set the scope to trigger on Channel 2, and adjust the scope trigger threshold to about 3 V.

In the GUI 12V CONTROL panel, click on the PASS FET button. In the STATUS panel, verify the 12V PASS FET, BLK FET, and OUT>PG Threshold indicators turn GREEN. On the EVM board, the PWR PGD green STATUS LED should be illuminated.

On the scope, verify a waveform was obtained similar to that shown in Figure 6. The total ramp time of the Channel 2 trace, from 0 V to about 11.8 V should be 1.3 0.3 ms. Note that the extent of variance of the 12-V supply setting from a nominal 12.0 V affects this timing result. The average amplitude of the current pulse (i.e., across the flattest part of the peak) on Channel 4 should be 7.9 0.8 A. A DVM can be used to verify the voltage at TP4 (with respect to ground at TP6) is essentially the same as the input supply potential at 12VIN.

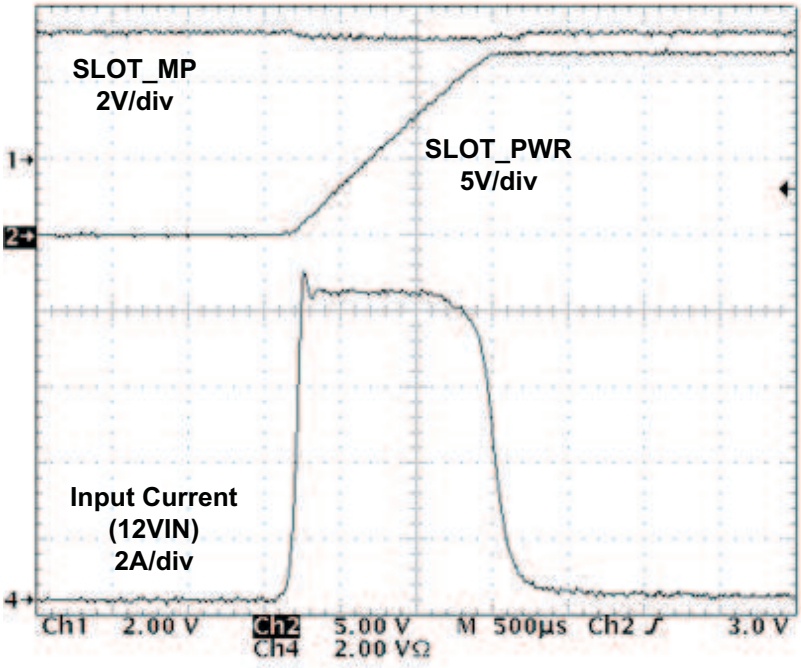

Figure 6. Output Ramp-Up Waveforms - SLOT_PWR Rail.

On the EVM board, set the PWR_OR enable slide switch to the DIS position. Use a DVM to verify the voltage at TP4 (SLOT_PWR), with respect to ground at TP6, drops to 11.4 0.6 V. Return the PWR_OR switch to the ENA position.

After completing the above steps, the TPS2459 EVM GUI display should appear as shown in Figure 7. Note that all the STATUS indicators are green.

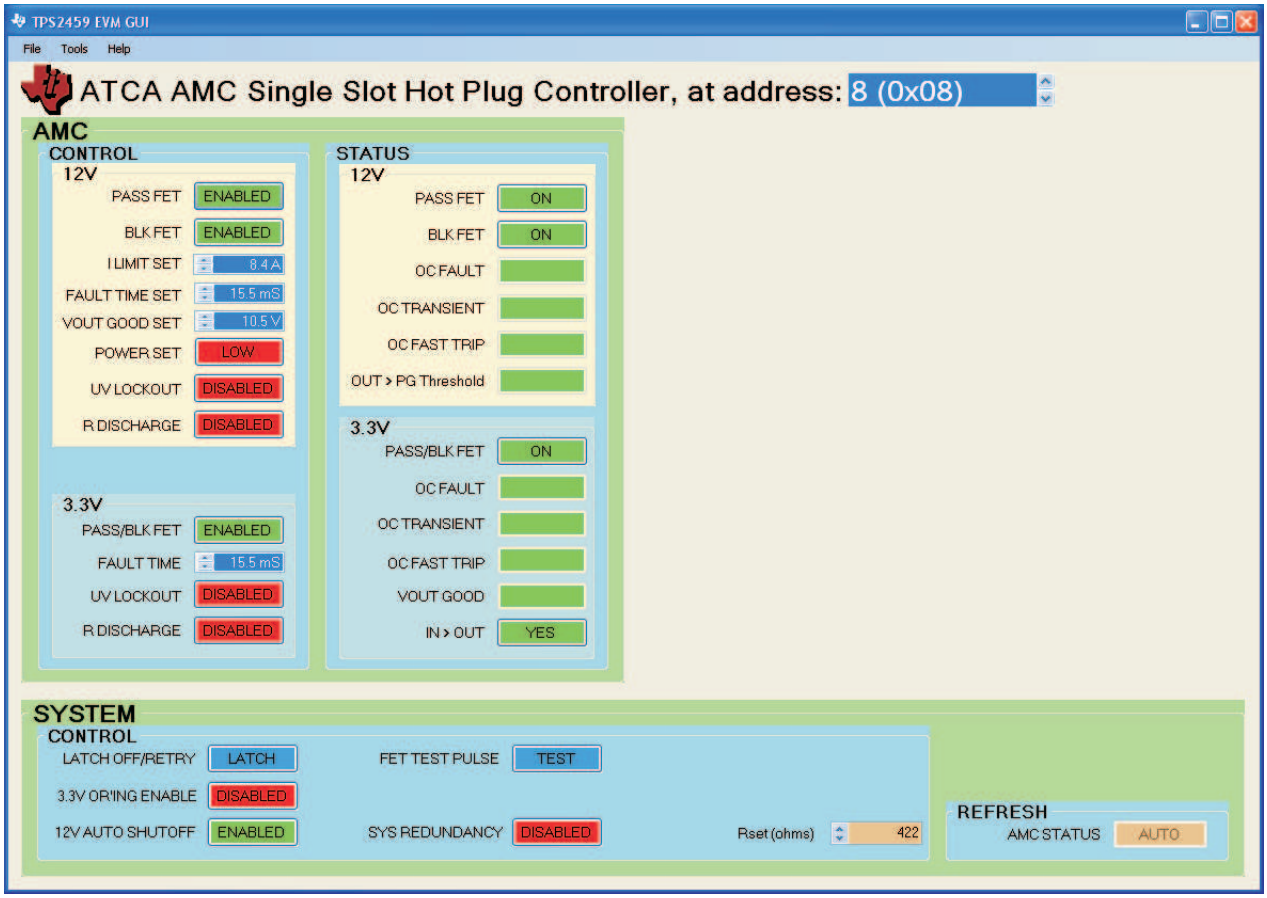

Figure 7. TPS2459 EVM GUI Display – Both Channels Successfully Powered

Set the scope trigger mode to AUTO to get a real-time display of the waveforms. On the EVM board, set both the PWR and MP enable switches to the DIS position. The STATUS LED's on the board should extinguish. On the scope, verify the output voltage waveforms decay towards 0 V. In the GUI screen, the 12V PASS FET and BLK FET, and the 3.3V PASS/BLK FET indicators should display OFF, with the indicator background color changing to red. Both PG indicators (12V and 3.3V) should change to RED.

Module operation as indicated in the above steps, along with obtaining the indicated GUI responses, is a good indication of a fully functional board and correct set-up. This is also a good starting point for further test and user evaluation of the device. Note that the two power channels must be reset by setting the PASS FET and PASS/BLK FET CONTROL buttons to DISABLED (and returning the ENABLES switches to the HI position), in order to enable subsequent power-up events.

7 EVM Feature Details

7.1 Test Points

The TPS2459EVM contains numerous test points throughout the circuit for monitoring waveforms and voltage measurement. Table 6 lists the module test points and the signal available at each one. The EVM PCB layout connects all ground nodes and supply returns to a common GND node, via several power plane areas. However, due to potentially high loading conditions on the Payload Power output (SLOT_PWR), multiple ground test points are provided to mitigate the measurement impact of return current drops. Therefore, where appropriate, certain test points are paired in the table with the pertinent reference point for meter return connections.

Table 6. Module Test Points

TEST POINT	REF POINT	SIGNAL	DESCRIPTION
TP1	TP3	12VIN	Input 12-V supply
TP2		3V3IN	Input 3.3-V supply
TP4	TP6	SLOT_PWR	AdvancedMC™ slot Payload Power, 12-V output
TP5		SLOT_MP	AdvancedMC™ slot Management Power, 3.3 V output
TP7	TP14 or TP15	EN3	Active-high enable input to TPS2459 for the 3.3-V output rail
TP8		EN12	Active-high enable input to TPS2459 for the 12-V output rail
TP9		OREN	Active high enable of the 12-V (POWER) supply OR'ing function
TP10	TP11		AdvancedMC™ slot 12-V load current sense voltage
TP12	TP14	PASS	TPS2459 12-V pass FET gate drive output
TP13		BLK	TPS4359 12-V block/OR'ing FET gate drive output
TP16	TP14	$\overline{\text{FLT12}}$	TPS2459 active-low payload power (12 V) fault output
TP17		$\overline{\text{PG12}}$	TPS2459 active-low payload power (12 V) powergood signal
TP18		$\overline{\text{FLT3}}$	TPS2459 active-low mgmt power (3.3 V) fault output
TP19		$\overline{\text{PG3}}$	TPS2459 active-low mgmt power (3.3 V) powergood signal

7.2 Connecting Loads to the TPS2459EVM

Both output power rails of the TPS2459EVM are supplied with some amount of load capacitance in the form of discrete electrolytics. The capacitors can be connected to or disconnected from their associated output nodes using 100-mil, 2-pin shunt jumpers across the on-board PCB headers. These capacitors are intended to simulate input bulk capacitance which may be encountered at the front ends of AdvancedMC™ modules plugged into the card slots of the target application. The AdvancedMC™ standard specifies the maximum allowable input capacitance on both Management and Payload Power rails. The TPS2459EVM provides up to 150 µF capacitance on the Management power output, in accordance with the AdvancedMC™ maximum limit. The EVM also provides up to 880 µF of capacitance on the Payload Power rail, to approximate the 800-µF limit of the standard. In addition, low-level (mA) load resistors can be jumpered in across each output and return. These limited load resistors are intended primarily as reset devices between output ramp events, particularly when loaded with significant capacitance.

Table 7 lists the EVM module's output voltage nodes, and for each one indicates the associated jumper reference designators, and the resultant load value with jumper installed.

Table 7. EVM On-Board Loads

OUTPUT RAIL	JUMPER	DEVICE	VALUE
SLOT_MP	J15	C11	150 F
	J14	R6	270 Ω
SLOT_PWR	J12	C7, C8	440 F
	J13	C9, C10	440 F
	J11	R5	1 kΩ

Banana jacks are provided along the right-hand edge of the board for connection of the user's optional test loads. The output banana jack reference designators are listed in Table 4 along with the voltage rail available at each one. Also, the net names are screen printed on the PCB, adjacent to their respective jacks.

7.3 I²C Address Selection

Three input pins on the TPS2459 are assigned for setting the device I²C address: A2, A1 and A0. These pins are tri-level inputs, allowing the device to be assigned any one of 27 unique address values. These pins can be tied to ground potential to generate a logic low (L), pulled up to the VINT pin to generate a logic high (H), or left open to float to a mid-range, no-connect (NC) level. On the EVM, address selection is performed using switch S4. However, S4 is a common 4-position, 2-throw DIP switch. The switch is wired into the circuit to pull the corresponding input pin to ground (L) when its DIP position is closed. When a DIP position is open (O), the corresponding pin floats. Therefore, the address space for the EVM is limited to an 8-value subset of the addresses recognized by the TPS2459. Table 8 specifies the valid address space of the TPS2459EVM. Note that switch position S4-4 is not connected to any of the device pins.

Table 8. TPS2459EVM Valid I²C Addresses

S3 Position			Device Address	
A2	A1	A0	Ternary	Decimal
L	L	L	0003 + 223	0 + 8 = 8
L	L	O	0013 + 223	1 + 8 = 9
L	O	L	0103 + 223	3 + 8 = 11
L	O	O	0113 + 223	4 + 8 = 12
O	L	L	1003 + 223	9 + 8 = 17
O	L	O	1013 + 223	10 + 8 = 18
O	O	L	1103 + 223	12 + 8 = 20
O	O	O	1113 + 223	13 + 8 = 21

7.4 Using the EVM GUI

The TPS2459 EVM GUI comes packaged in an installer script/license agreement utility. Follow the instruction in Section 6.1 GUI Installation to Install the GUI to the target PC/laptop.

7.4.1 General GUI Information

Once installed, and depending on the install options selected by the user, the GUI can be launced either from the TPS2459 EVM GUI program group in the Windows Start menu, or from the desk-top icon. At start-up, the GUI automatically scans the legitimate address space of the TPS2459 for any devices on the bus. If one or more addreses are discovered, the numerically lowest address is displayed in the “at address:” field at the top of the GUI screen. This device becomes the current device for all I^2C read and write transactions. the GUI then polls the entire register set of this device, and populates the fields with the current contents.

The GUI is divided into two main panels of information display, AMC and SYSTEM. AMC isaplays and modifies rail-specific information of the AMC slot being contolled. It is in turn divided into two sub-panels: CONTROL, user access to register control bits and fields of the selected device, and STATUS, status information from the read-only registers of the TPS2459. Note that these settings and values are specific to the 12-V or 3.3-V channel. The SYSTEM panel at the bottom of the GUI display provides access to “higher level” functions, in that they apply to both channels of the device, or control GUI operation.

With a few exceptions, the GUI generally uses a two-color coding scheme to provide quick visual feedback to the user of control and status information. A red button background color is used to indicate DISABLED, in the case of control, or OFF or FAULT, in the case of status information. A green background is used to signal ENABLED, ON or GOOD (i.e., no fault). Fields which do not have a binary value set are coded with either a blue or grey button background. All the control and some status buttons also feature a text label reflecting the current setting.

The GUI has two status update modes, automatic and manual. The current mode is indicated in the REFRESH block in the lower-right corner of the SYSTEM panel. By default, the GUI starts up in AUTO mode. To change to manual mode, check the "Manual Refresh" option under the Tools pull-down menu at the top of the GUI window. Un-checking the "Manual Refresh" option will enter automatic mode. In manual refresh mode, the REFRESH, AMC STATUS button displays UPDATE. Click the UPDATE button to obtain a status read of the of the device whose address is displayed at the top of the window. Regardless of mode, REFRESH only polls the three status registers of the device, registers 7, 8 and 9. A status read action decodes the returned information from the TPS2459, and populates the GUI fields accordingly. AUTO REFRESH polls the device at about a 1-Hz rate.

Write transactions to the current device are only triggered by a GUI button or field mouse click. Binary slot (e.g., “AMC”) and SYSTEM control buttons (e.g., 12V PASS FET, 3.3V PASS/BLK FET) are click to toggle. Numeric fields are click to send the displayed field contents. When a control button or field is clicked on, the new register contents are formed from the value(s) currently displayed on the GUI screen, and the new value is written to the correspond device register.

7.4.2 GUI Control Fields and Buttons

Table 9 lists the primary controls for turning the output rails on and off, in the AMC CONTROL panel.

Table 9. Output Rails Primary Controls

GUI BUTTON	DEVICE BIT (Register[Bit])	OPERATION
12V PASS FET	R4[5]	Enable/disable 12-V pass (and block) FET’s.
12V BLK FET	R3[7]	Enable/disable 12-V block (i.e, OR’ing) FET
3.3V PASS/BLK FET	R5[5]	Enable/disable internal 3.3-V FET.

8 Assembly Drawing and PCB Layout

The top assembly drawing and individual PCB layers for the TPS2459EVM are shown in Figure 8 through Figure 12.

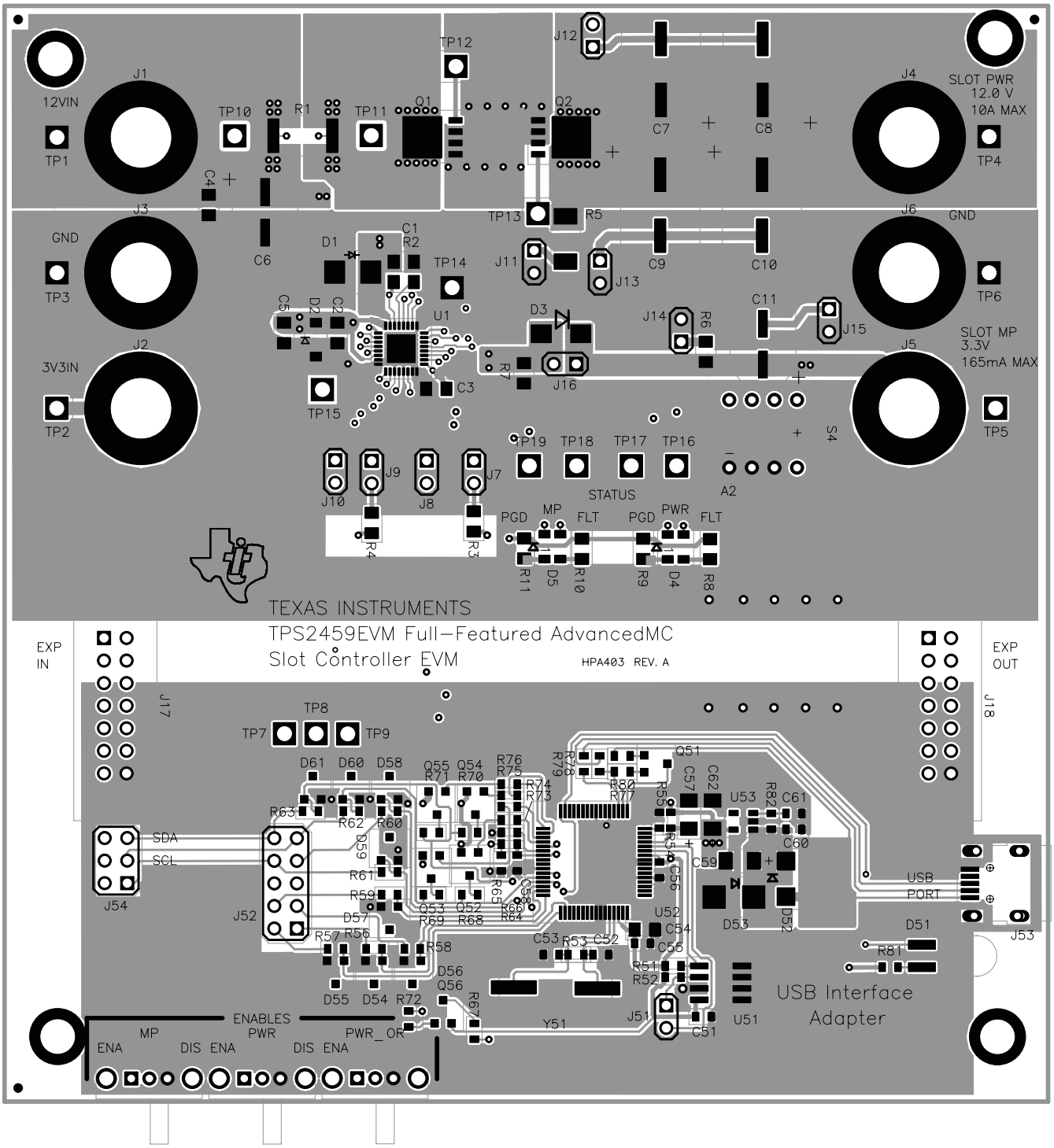

Figure 8. Top Assembly

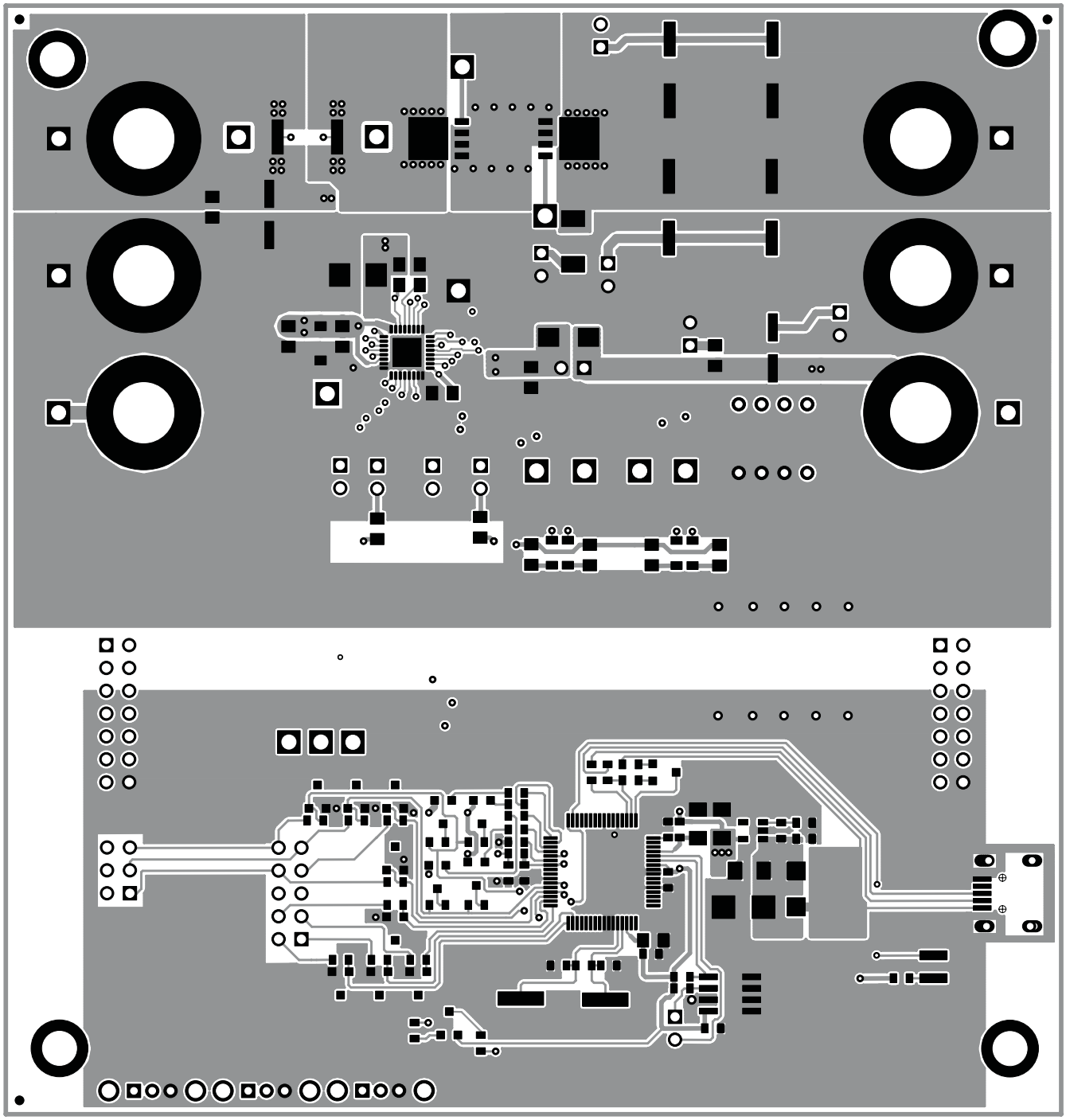

Figure 9. Top Layer Routing

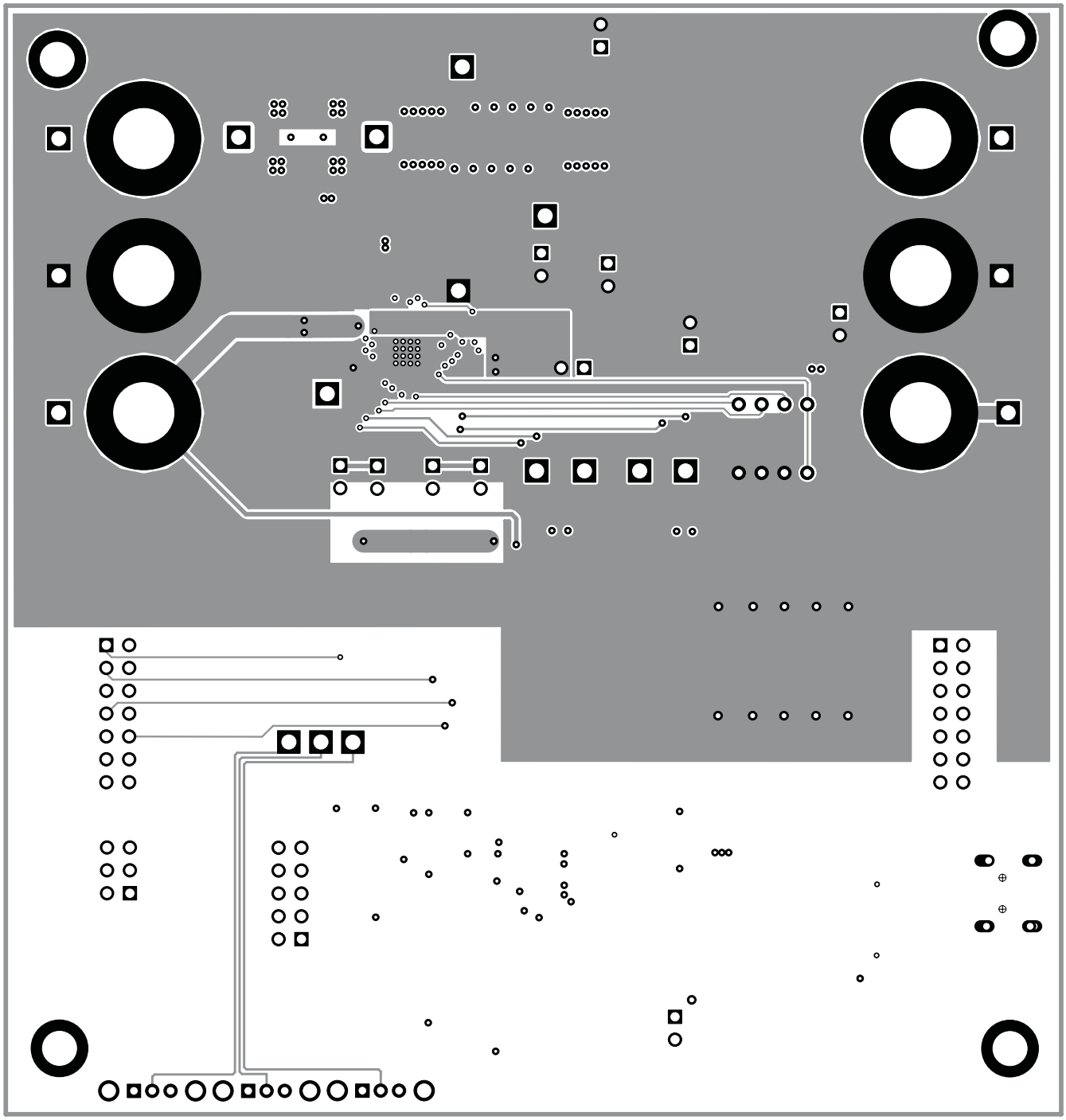

Figure 10. Layer 2 Routing

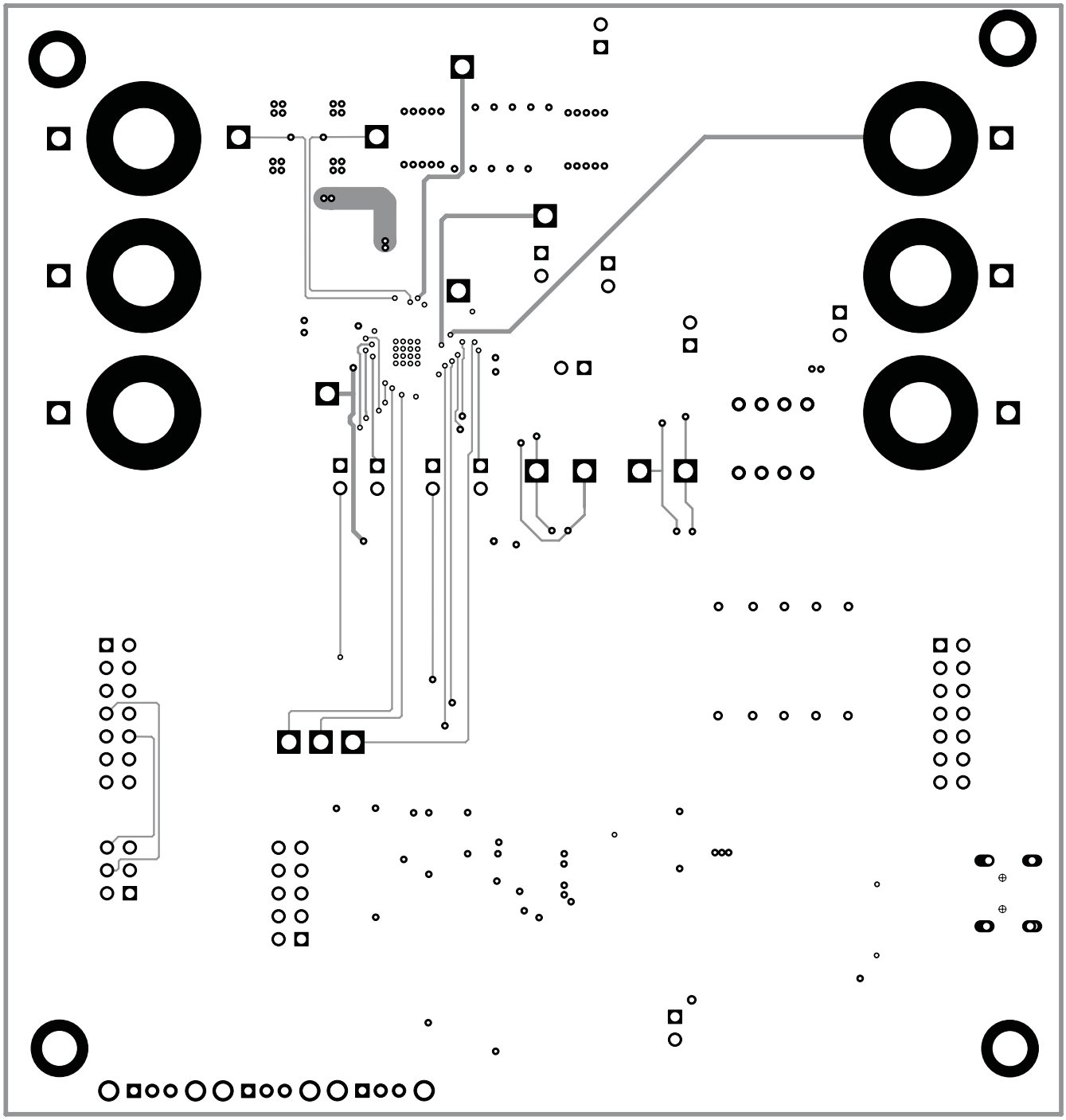

Figure 11. Layer 3 Routing

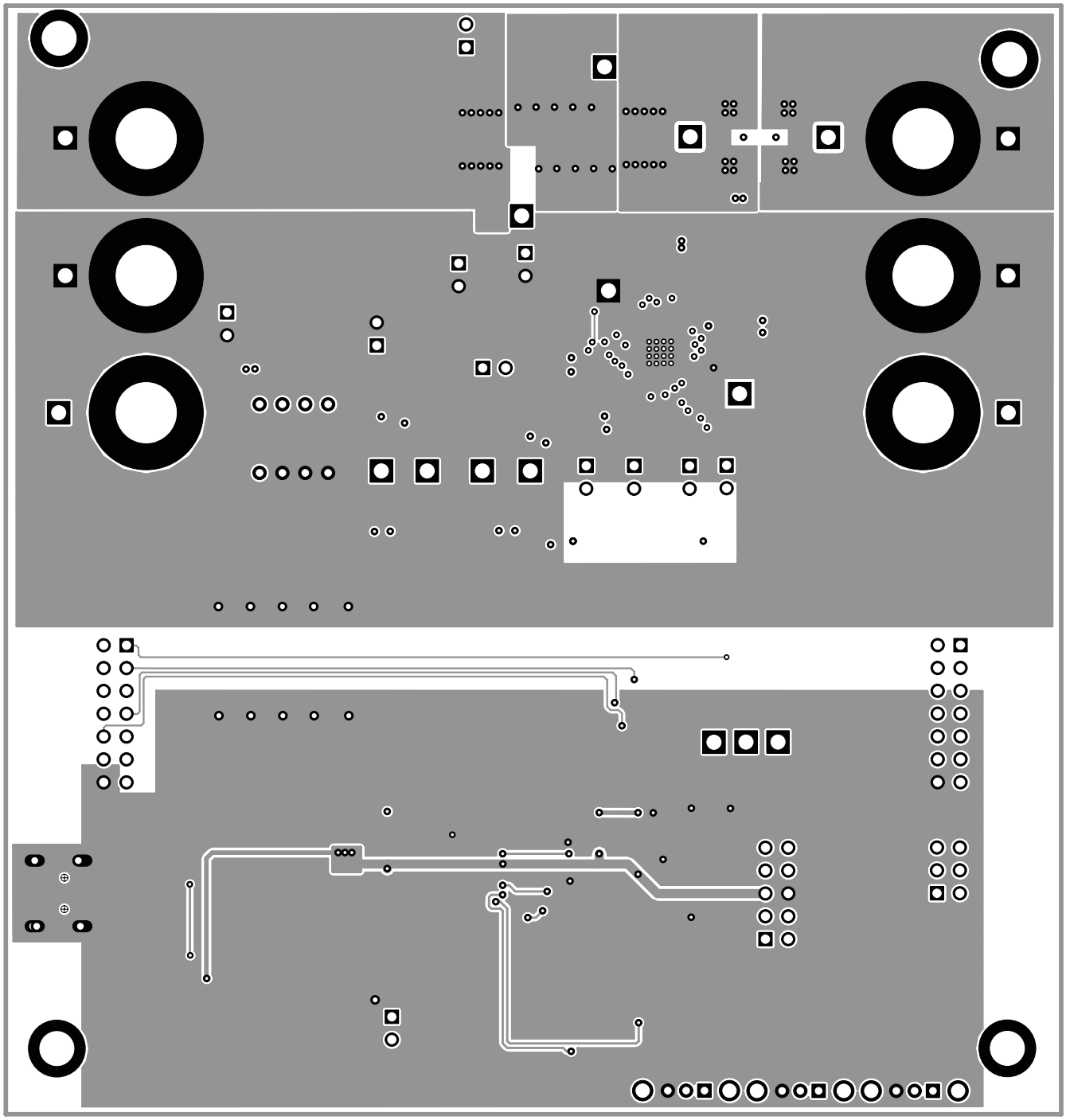

Figure 12. Bottom Layer Routing

9 List of Materials

Table 10. TPS2459EVM List of Materials(1)(2)(3)(4)(5)(6)(7)(8)(9)

COUNT	REF DES	DESCRIPTION	PART NUMBER	MFR
3	C1, C2, C3	Capacitor, ceramic, 25V, X7R, 20%, 0.1 uF, 0805	Std.	Std.
1	C11	Capacitor, aluminum, SM, 10V, 20%, 150 uF, Case D	EEV-FK1A151P	Panasonic
2	C4, C5	Capacitor, ceramic, 25V, X7R, 20%, 1 uF, 0805	Std.	Std.
6	C51, C55, C56, C58, C60, C61	Capacitor, ceramic, 25V, X7R, 20%, 0.1uF, 0603	Std.	Std.
2	C52, C53	Capacitor, ceramic, 50V, C0G, 10%, 22pF, 0603	Std.	Std.
1	C54	Capacitor, ceramic, 100V, C0G, 5%, 1000pF, 0805	Std.	Std.
1	C57	Capacitor, tantalum, 16V, 20%, 1uF, 3216	293D105X0016A2T	Vishay
2	C59, C62	Capacitor, tantalum, 10V, 20%, 10uF, 3216	293D106X0010A2T	Vishay
1	C6	Capacitor, aluminum, SM, 25V, 20%, 47 uF, Case D	EEV-FK1E470P	Panasonic
4	C7, C8, C9, C10	Capacitor, aluminum, SM, 25V, 20%, 220 uF, Case F	EEV-FK1E221P	Panasonic
1	D1	Diode, TVS, V(RWM) = 13.6 V, 600 W Pk., SMB	P6SMB16A	"ON Semior Vishayor Littelfuse"
1	D2	Diode, Zener, 4.3 V, 500 mW max., SOD-123	BZT52C4V3	Diodes
1	D3	Diode, Schottky, 1A, 20V, SMA	B120	Diodes
2	D4, D5	Diode, LED, red/green, 1210, 45/35 mcd @ 20 mA, 0.126 x 0.106in.	LTST-C155KGJRKT	Lite-On
1	D51	Diode, LED, green, 20 mA, 30 mcd, SMD	SSF-LXH305GD-TR	Lumex
1	D52	Diode, Schottky, 1A, 30V, SMA	MBRA130	IR
1	D53	Diode, Zener, 7.5V, 3W, SMB	1SMB5922BT3	On Semi
8	D54, D55, D56, D57, D58, D59, D60, D61	Diode, TVS, low cap., V(RM) = 5 V, 300 W Pk., SOT-23	GL05T	Vishay
6	J1, J2, J3, J4, J5, J6	Jack, banana, non-ins., PC mount, TH	3267	Pomona
2	J17, J18	Header, PCB mnt., vert., 2 x 7, 100 mil spacing, 0.100 in. x 2 x 7	2514-6002UB	3M
0	J52	Header, 2 x 5-pin, 100-mil spacing, 0.100 in. x 2 x 5	PEC36DAAN	Sullins
1	J53	Connector, recpt, USB-B, mini, 5-pins, SMT, 0.354in. x 0.303in.	UX60-MB-5S8	Hirose
1	J54	Header, 2 x 3-pin, 100-mil spacing, 0.100 in. x 2 x 3	PEC36DAAN	Sullins

(1) These assemblies are ESD sensitive, ESD precautions shall be observed.
(2) These assemblies must be clean and free from flux and all contaminants. Use of no clean flux is not acceptable.
(3) These assemblies must comply with workmanship standards IPC-A-610 Class 2.
(4) "TH" package designation indicates "thru-hole" (leaded) component.
(5) Part number information is for reference only to further illustrate component characteristics; substitution of other mfgrs' part of equal or better specification is permissible. Substitution NOT allowed on part numbers marked with double asterisk (**).
(6) Double pound sign ('##') after part number indicates preferred device. Acceptable substitutes are listed afterwards, in decreasing order of preference.
(7) If banana jacks (J1 - J6) are supplied with solder lugs, dispose of lugs prior to installation on PCB. Solder lugs are NOT to be installed on assembly.
(8) Spacers to be installed at each of the thru-holes at the four corners of the PCB assembly, using nylon screws.
(9) Shunts installed in accordance with manufacturing test procedure during test.

Table 10. TPS2459EVM List of Materials (continued)

COUNT	REF DES	DESCRIPTION	PART NUMBER	MFR
11	J7, J8, J9, J10, J11, J12, J13, J14, J15, J16, J51	Header, 2-pin, 100-mil spacing, 0.100 in. x 2	PEC36SAAN	Sullins
1	Q1	Transistor, NFET, 30V, 100A, Rds(ON) < 5 mohm, TDSON-8	"BSC016N03LSG## or BSC022N03SG"	Infineon
1	Q2	Transistor, NFET, 30V, Rds(ON) < 20 mohm, TDSON-8	"BSC057N03LSG## or BSC050N03LSGor BSC042N03LSGor BSC022N03SGor BSC016N03LSG"	Infineon
1	Q51	Transistor, NPN, 40 V, 500 mA, SOT-23	MMBT2222A	Fairchild
5	Q52, Q53, Q54, Q55, Q56	Transistor, PFET, -50 V, 130 mA, Rds(ON) < 10 ohm @V(gs) = 5 V, SOT-23	BSS84	Fairchild
1	R1	Resistor, metal strip, 1 W, 1%, 0.005, 2512	WSL2512-5L000FEA	Vishay-Dale
1	R2	Resistor, chip, 1/10 W, 1%, 422, 0805	Std	Std
1	R3	Resistor, chip, 1/10 W, 1%, 6.81K, 0805	Std	Std
1	R4	Resistor, chip, 1/10 W, 1%, 3.32K, 0805	Std	Std
1	R5	Resistor, chip, 1/2 W, 5%, 1K, 2010	Std	Std
3	R51, R52, R77	Resistor, chip, 1/16 W, 5%, 1.5K, 0603	Std.	Std.
1	R53	Resistor, chip, 1/16 W, 1%, 1.00M, 0603	Std.	Std.
2	R54, R80	Resistor, chip, 1/16 W, 5%, 15K, 0603	Std.	Std.
5	R55, R64, R65, R66, R82	Resistor, chip, 1/16 W, 5%, 100K, 0603	Std.	Std.
15	R56, R57, R58, R59, R60, R61, R62, R63, R72, R73, R74, R75, R76, R78, R79	Resistor, chip, 1/16 W, 5%, 33, 0603	Std.	Std.
1	R6	Resistor, chip, 1/10 W, 5%, 270, 0805	Std	Std
3	R67, R68, R70	Resistor, chip, 1/16 W, 5%, 2.2K, 0603	Std.	Std.
2	R69, R71	Resistor, chip, 1/16 W, 5%, 1K, 0603	Std.	Std.
0	R7	Resistor, chip, 1/10 W, 5%, 0805	Std	Std
4	R8, R9, R10, R11	Resistor, chip, 1/10 W, 5%, 470, 0805	Std.	Std.
1	R81	Resistor, chip, 1/16 W, 5%, 200, 0603	Std.	Std.
3	S1, S2, S3	Switch, slide, SPDT, Rt. angle, 200-mA, TH	EG1213**	E-Switch
1	S4	Switch, DIP, 4 pos., raised rocker, 0.38 x 0.48 inch	"76SB04S(T)or BD04"	"Grayhillor C&K Switch"

Table 10. TPS2459EVM List of Materials (continued)

COUNT	REF DES	DESCRIPTION	PART NUMBER	MFR
15	TP1, TP2, TP4, TP5, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP16, TP17, TP18, TP19	Test point, white, 0.062 in. Hole, 5012, TH	5012	Keystone
4	TP3, TP6, TP14, TP15	Test point, black, 0.062 in. hole, 5011, TH	5011	Keystone
1	U1	Full-Featured AdvancedMC Slot Controller, QFN-32	TPS2459RHB**	Texas Instruments
1	U51	Serial EEPROM, 64K, 2.5-5.5V, 400 kHz Max., SO-8	24LC64I-SN	Microchip
1	U52	USB, General Purpose Device Controller , PQFP-64	TUSB3210PM**	Texas Instruments
1	U53	Micro-Power 150 mA LDO Regulator, 3.3 V, SOT-23-5	TPS76333DBV**	Texas Instruments
1	Y51	Crystal, 12-MHz, 20 pF, +/- 50 PPM@25C, 12MHZ, 0.185 x 0.532	CY12BPSMD	Crystek
1	N/A	PCB, FR-4, 4-layer, SMOBC, 4.63" x 4.85" x .062"	HPA403**	Any
11	N/A	Shunt, open-top	151-8000	Kobiconn
4	N/A	SPACER, nylon, hex, #6-32, 0.625"	14HTSP020	Eagle
4	N/A	SCREW, nylon, rnd hd, #6-32, 0.25"	010632R025	Eagle
1	N/A	USB cable, 5-pin, b-mini male to type A male, 2m	AK672M/2-2	Assman

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