UCD90SEQ48EVM-560: 48-Pin Sequencer Development Board

This user's guide describes the 48-pin Sequencer Development Board – UCD90SEQ48EVM-560. This development board contains a 48-pin socket and interface circuitry to support the UCD9090 and UCD9090A.

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1 Description

The UCD90SEQ48EVM-560 allows the Texas Instruments UCD9090 and UCD9090A 48-pin sequencer to be installed into the onboard socket for evaluation. Access to all of the user input/output (I/O) is provided via strip connectors for integration into complex systems using clip-type jumper wires.

This development board also allows direct PMBus (power management bus) communication with the sequencer via an onboard USB interface. This interface allows direct control of and feedback from the sequencer when using the TI Fusion Digital Power Designer graphical user interface (GUI).

1.1 General Features

- USB port powered or power with single 5-V supply
- JTAG programming port for in-socket device configuration
- Serial port for advanced debugging
- Status LEDs on all GPIO
- Strip connector I/O access
- USB-PMBus interface for communication
- UCD9090/UCD9090A (in socket) and mini-USB cable provided

1.2 Sequencer Applications

- Industrial/ATE
- Telecommunications and networking equipment
- Servers and storage systems
- Any system requiring sequencing and monitoring of multiple power rails

2 Quick Start

2.1 Test Setup

Figure 1 shows a typical test setup for the UCD90SEQ48EVM-560. All that is required is a personal computer (PC) with a USB port and the TI Fusion Digital Power Designer GUI. The USB-EVM cable is provided with the evaluation module (EVM) and is used for EVM power.

When installing the UCD9090/UCD9090A sequence devices into XU1, ensure that the device pin 1 is oriented as shown in Figure 1.

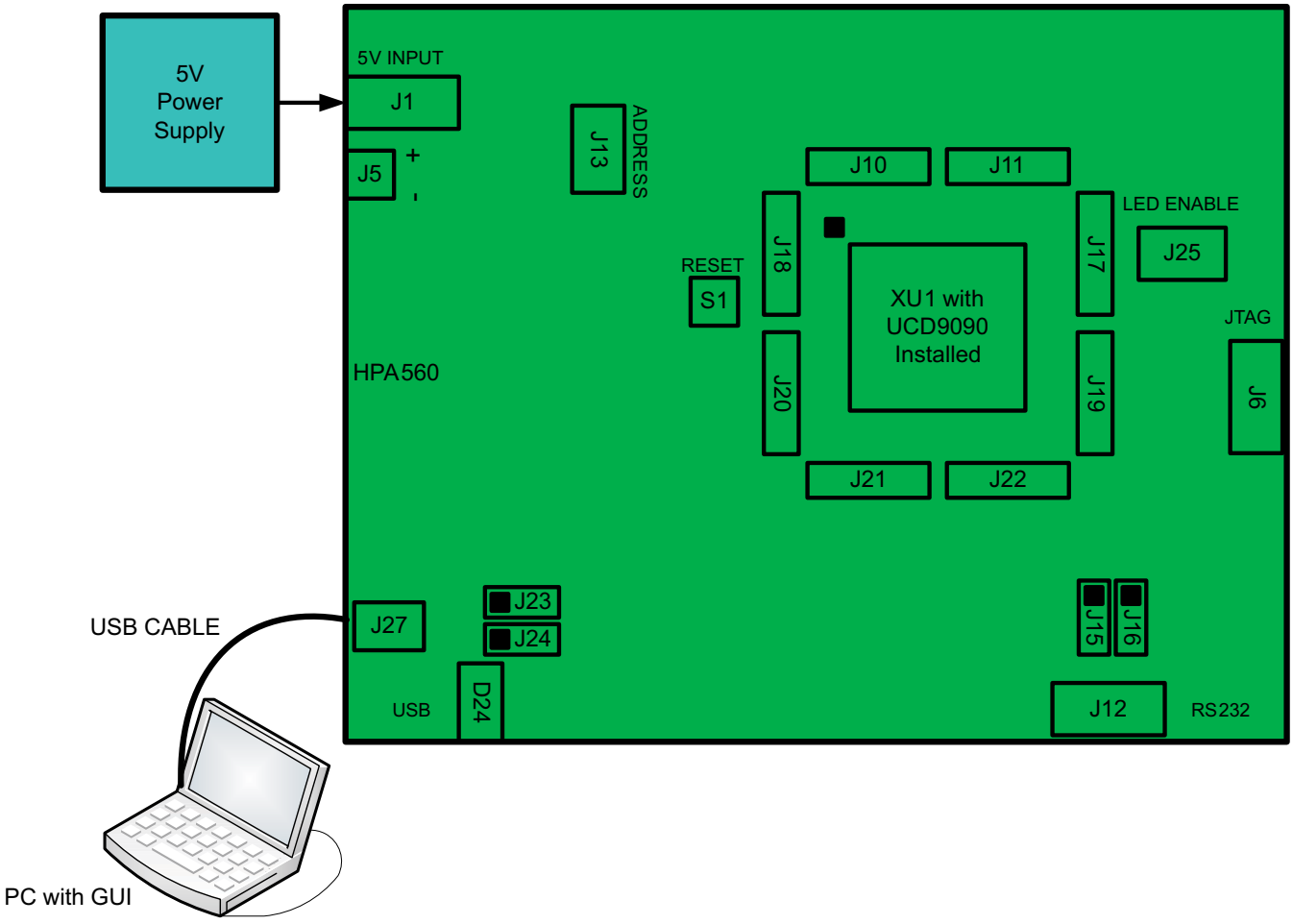


Figure 1. Typical Test Setup

3 UCD90SEQ48EVM-560 GUI Setup

3.1 UCD90SEQ48EVM-560 GUI Installation

The UCD90SEQ48EVM-560 uses the TI Fusion Digital Power Designer GUI which may be downloaded from the following Web site:

http://focus.ti.com/docs/toolsw/folders/print/fusion_digital_power_designer.html

Click the link for the official release for sequencers to start the download. Place the TI Fusion Digital Power Designer zip file in a known location on the PC. Unzip the TI Fusion Digital Power Designer zip file.

Double-click the unzipped TI Fusion Digital Power Designer .exe file. Proceed through the installation by accepting the installer prompts and the license agreement. Accept the GUI-suggested default PC installation locations to complete the install.

Once the GUI completes the installation, the program starts. The first time the GUI is launched on a particular PC, the user may be prompted to select a device. Choose UCD9xxx. Afterwards, the GUI may be closed.

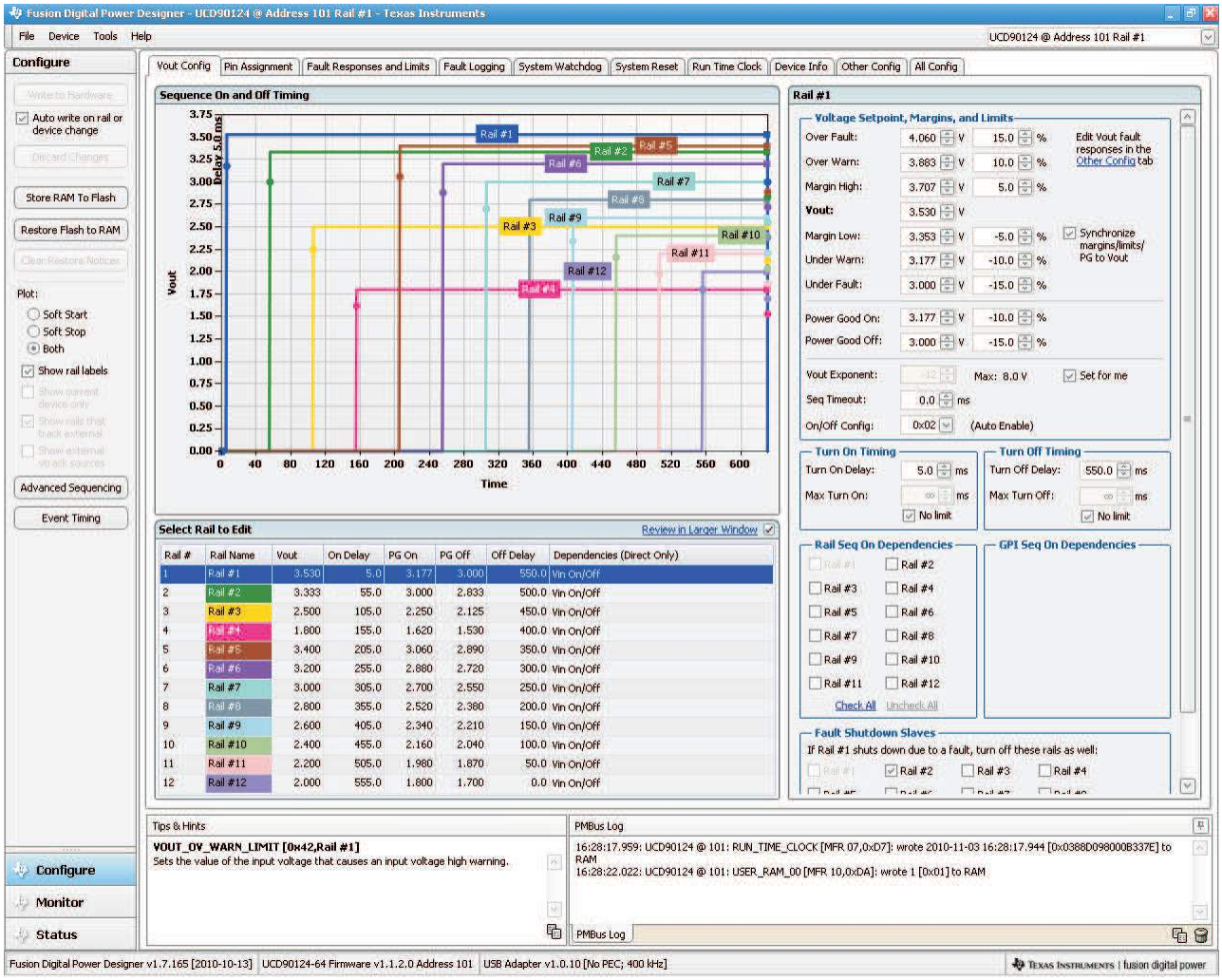
Note that the TI Fusion Digital Power Designer version 1.7.165 was used for the GUI figures in this document.

3.2 UCD90SEQ48EVM-560 GUI Operation

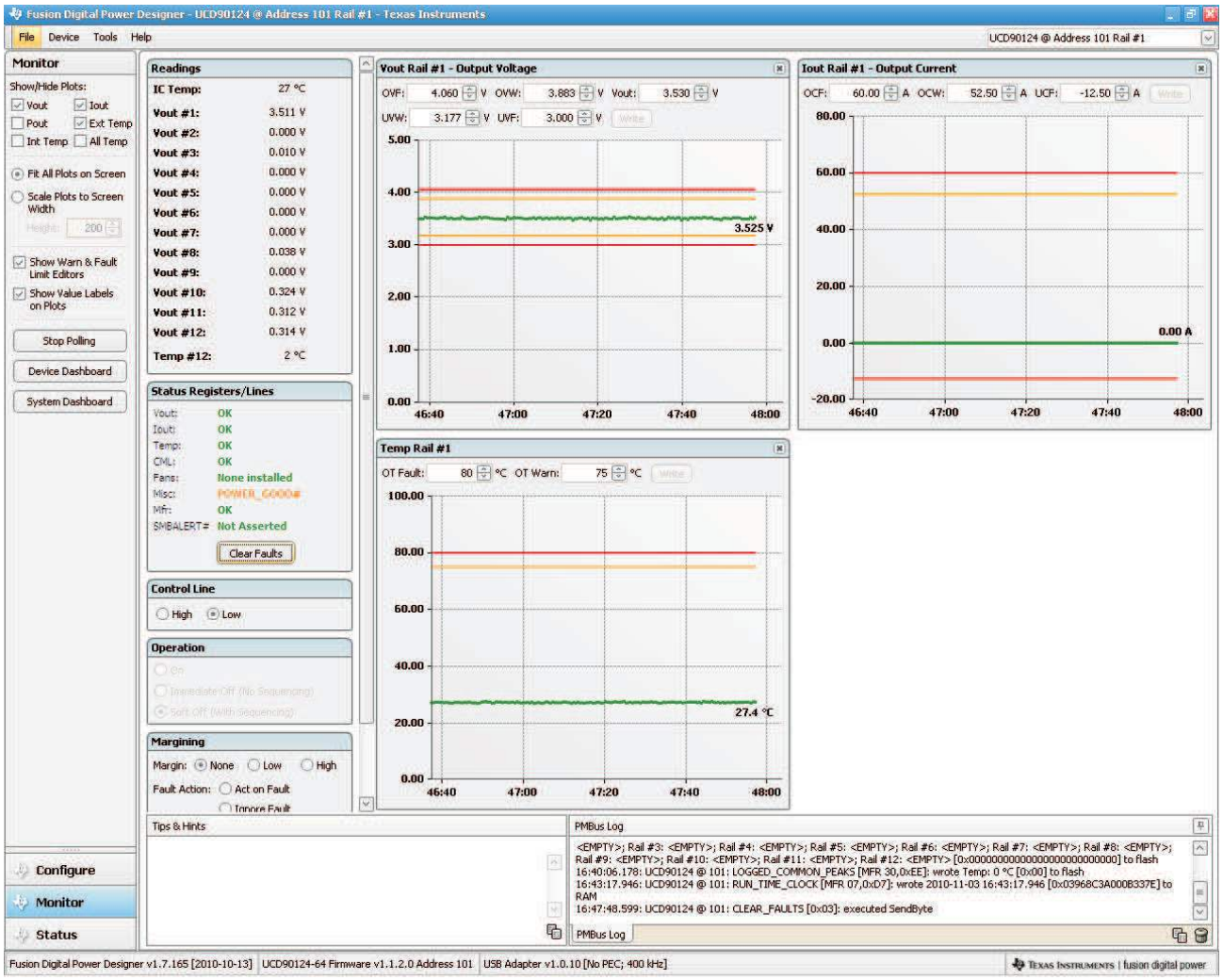
The EVM comes preloaded with a 10-rail default project that illuminates the onboard GPIO LEDs at power up. Export the default project to a file on the PC prior to making changes. To do this, go to the File menu and select *Save Project As …*, then select a project file name and location.

3.2.1 Launch TI Fusion Digital Power Designer

Navigate to the location where the Fusion GUI is installed (Start → All Programs → Texas Instruments Fusion Digital Power Designer → Fusion Digital Power Designer), and start it. A window similar to the following illustration appears.



Most of the GUI control features are available from the Configure window. Monitor and Status information is available from the respective buttons on the GUI lower left. A typical Monitor window follows.



4 General-Use Features

4.1 EVM Input/Output Connectors and Switches

Connector/ Switch	Label	Description
J1	+5V POWER	5-Vdc jack
J5	+5V	5-V screw jack
J27	USB IN	USB input connector for communication and EVM power
J12	RS232	Serial debug connector
J6	JTAG	JTAG connector
XU1	XU1	Onboard socket for the 64-pin sequencer
S1	PBRESET	Pushbutton reset
J18		Sequencer I/O strip connector. Pin name silkscreened on EVM
J20		Sequencer I/O strip connector. Pin name silkscreened on EVM
J21		Sequencer I/O strip connector. Pin name silkscreened on EVM
J22		Sequencer I/O strip connector. Pin name silkscreened on EVM
J19		Sequencer I/O strip connector. Pin name silkscreened on EVM
J17		Sequencer I/O strip connector. Pin name silkscreened on EVM
J11		Sequencer I/O strip connector. Pin name silkscreened on EVM.
J10		Sequencer I/O strip connector. Pin name silkscreened on EVM.

4.2 EVM Test Jumpers

The EVM is equipped with shunts on the jumper positions identified in the Default Pin Position shown in the following table. Shunts can be moved and removed as required during use.

Jumper	Default Pin Position	Label	Description
J2	1-2	LDO 3.3V	LDO 3.3V. Install for complete EVM operation. Remove to allow power access to only the sequencer device.
J23	1-2	SCL	EEPROM SCL. For EVM manufacturing only.
J24	1-2	SDA	EEPROM SDA. For EVM manufacturing only.
J9	1-2	GPI1	General-purpose input #1. Install shunt to allow status LED operation.
J14	1-2	GPI2	General-purpose input #2. Install shunt to allow status LED operation.
J13	1-2,7-8	PM ADDR	PMBus address (default to 101). Remove shunts for JTAG operation at address 126.
J7		TCK	JTAG TCK. Install shunt when JTAG operation is desired.
J3		TDI	JTAG TDI. Install shunt when JTAG operation is desired.
J8		TDO	JTAG TDO. Install shunt when JTAG operation is desired.
J4		TMS	JTAG TMS. Install shunt when JTAG operation is desired.
J25	1-2	LEDEN	Status LED enable. Install to enable non-PWM GPIO status LEDs. Remove to disable status LED loading on the GPIOs.
J26	1-2, 3-4, 5-6, 7-8, 9-10, 11-12, 13-14, 15-16	LEDEN	Status LED enable for FPWMs (GPIO5-GPIO12). Install to enable FPWM GPIO status LEDs. Remove to disable status LED loading on the FPWM GPIOs.
J15		GPIO14/TX	Debug port TX (used for debug)
J16		GPIO15/RX	Debug port RX (not used during debug)

4.3 EVM Test Points

TP	Color	Label	Description
TP2	WHT	LDO 3.3V	LDO 3.3V. EVM 3.3V
TP1	WHT	V33D	V33D. Sequencer 3.3V.
TP5	WHT	ADDR0	ADDRSENS0. EVM PMBus address.
TP6	ORG	ADDR1	ADDRSENS1. EVM PMBus address.
TP3	WHT	RIN	Receive input from terminal device.
TP4	WHT	TOUT	Transmit output to terminal device.
TP7	SM-SLV	GND	Surface mount GND
TP8	SM-SLV	GND	Surface mount GND
TP9	SM-SLV	GND	Surface mount GND (bottom)
TP10	SM-SLV	GND	Surface mount GND
TP11	SM-SLV	GND	Surface mount GND
TP12	SM-SLV	GND	Surface mount GND (bottom)

4.4 EVM Status LEDs

LED	Color	Label	Description
D4	RED	5V ON	5VBUS ON indicator
D3	RED	V33D	Sequencer power ON
D10	RED	ALERT	PMBus Alert
D13	GREEN	CTRL	PMBus Control
D24	GREEN	USB ON	USB attached
D5	AMBER	GPI1	GPI1 input HIGH
D6	AMBER	GPI2	GPI2 input HIGH
D7	GREEN	GPIO1	GPIO1 HIGH
D8	GREEN	GPIO2	GPIO2 HIGH
D9	GREEN	GPIO3	GPIO3 HIGH
D11	GREEN	GPIO4	GPIO4 HIGH
D12	GREEN	GPIO13	GPIO13 HIGH
D14	GREEN	GPIO14/TX	GPIO14 HIGH
D15	GREEN	GPIO15/RX	GPIO15 HIGH
D16	GREEN	GPIO16	GPIO16 HIGH
D17	GREEN	GPIO17	GPIO17 HIGH
D18	GREEN	GPIO18	GPIO18 HIGH
D19	GREEN	GPIO19	GPIO19 HIGH
D20	GREEN	GPIO20	GPIO20 HIGH
D21	GREEN	GPIO21	GPIO21 HIGH
D22	AMBER	GPIO5	GPIO5 HIGH
D23	AMBER	GPIO6	GPIO6 HIGH
D25	AMBER	GPIO7	GPIO7 HIGH
D26	AMBER	GPIO8	GPIO8 HIGH
D27	AMBER	GPIO9	GPIO9 HIGH
D28	AMBER	GPIO10	GPIO10 HIGH
D30	AMBER	GPIO11	GPIO11 HIGH
D32	AMBER	GPIO12	GPIO12 HIGH

5 Description

The following paragraphs describe the UCD90SEQ48EVM-560 functionality and operation.

5.1 Communication Interface

Several communication interfaces to the sequencer are provided on the EVM.

5.1.1 USB Interface

An onboard USB-to-PMBus interface is provided through the USB Input (J27) connector. D24 provides USB attach status. The EVM can be fully operated from USB input power only.

5.1.2 PMBus

Standard PMBus interface is provided to the sequencer from the onboard USB-PMBus circuitry. PMBus addressing is set using the J13 jumper block for ADDRSENS1 and ADDRSENS0, respectively. ADDRx = 8 and ADDRx = 5 positions for each are provided. The EVM comes with PMBus address set to 101 decimal.

PMBus Address (decimal) = 12 x ADDR1 + ADDR0 jumper block setting.

5.1.3 JTAG

Standard JTAG programming interface is provided to the sequencer through the J6 connector. The sequencer address must be set to 126 decimal to invoke sequencer JTAG operation. Install shunts at J3, J4, J7, and J8, and remove the shunts on J13 to use the JTAG interface.

5.1.4 RS232 Debug

A serial debug port is provided to the sequencer through the J12 connector. Install J15 when using the RS232 interface. For debug, the terminal listens only to the sequencer.

5.2 Input Power

The 5-Vdc EVM input power is provided through the USB interface. For stand-alone operation without a USB source, EVM input power can be provided at J1 (standard dc jack) or J5 (screw jack). A wall or laptop adapter with 200-mA capability and 2.5-mm I.D. × 5.5-mm O.D. × 9.5-mm dc jack can power the EVM.

5.3 Status LEDs

Visual status information for the GPI, GPIO, and PMBus signals (control and alert) is provided. Logic high at GPI1-4 or GPIO1-21 illuminates the associated LED. The GPIO status LEDs can be enabled (J25 shunt installed) or disabled (J25 shunt not installed) to prevent the LED bias from affecting the logic state of the GPIO signal during device reset. In addition, the sequencer PWM signals PWM1, PWM2, and FPWM1-FPWM8 can be disconnected from the status LEDs through the use of shunts when used for voltage margining.

5.4 Analog Monitor Inputs

The sequencer monitor inputs can be used to monitor offboard voltages. Each monitor input has a 4-kΩ resistor to ground. Ensure that the external source does not exceed 2.5 V.

6 EVM Schematic, Assembly Drawings, Layout Guidelines, and Bill of Materials

6.1 Schematic

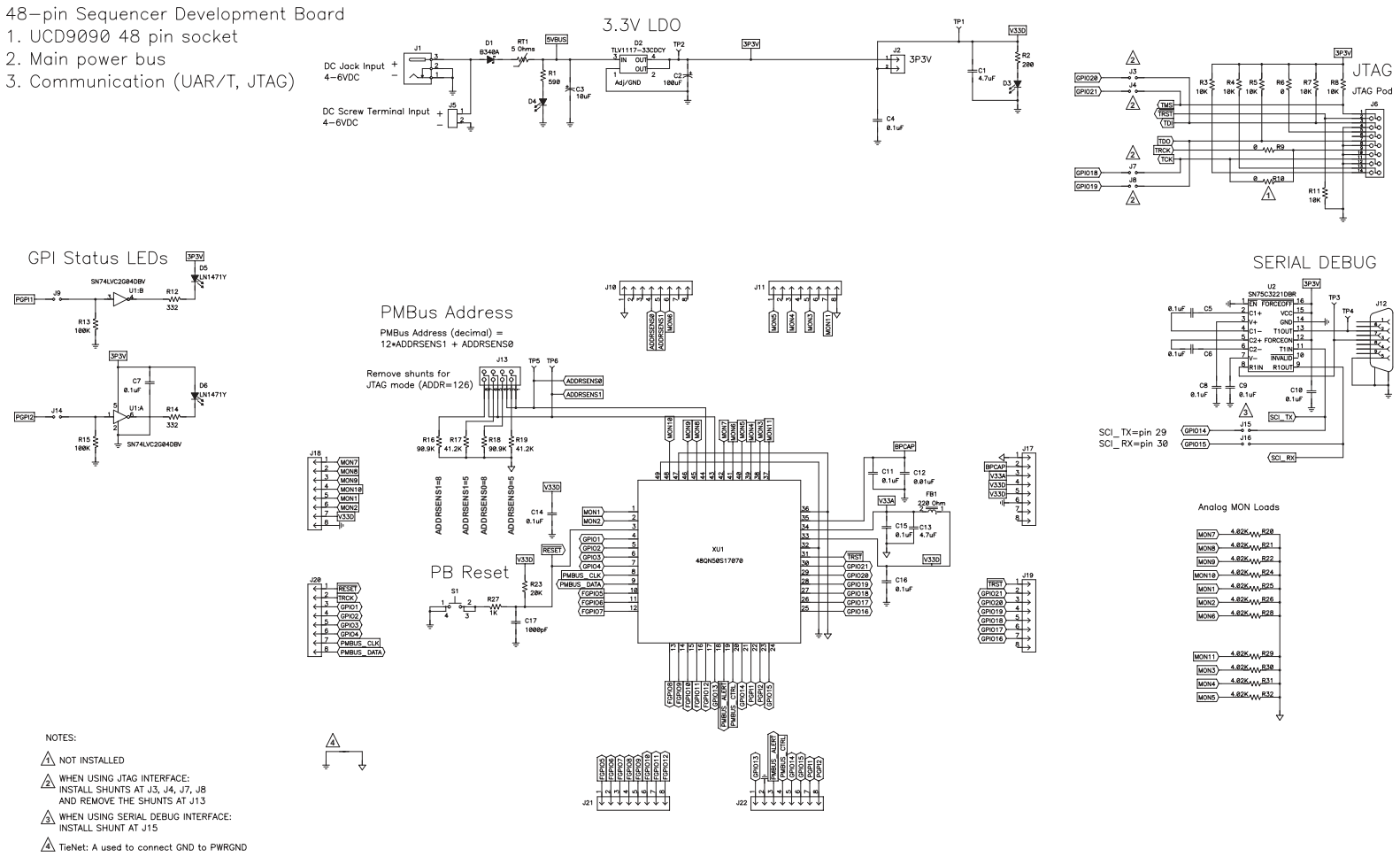


Figure 2. UCD90SEQ48EVM-560 Schematic, Sheet 1 of 2

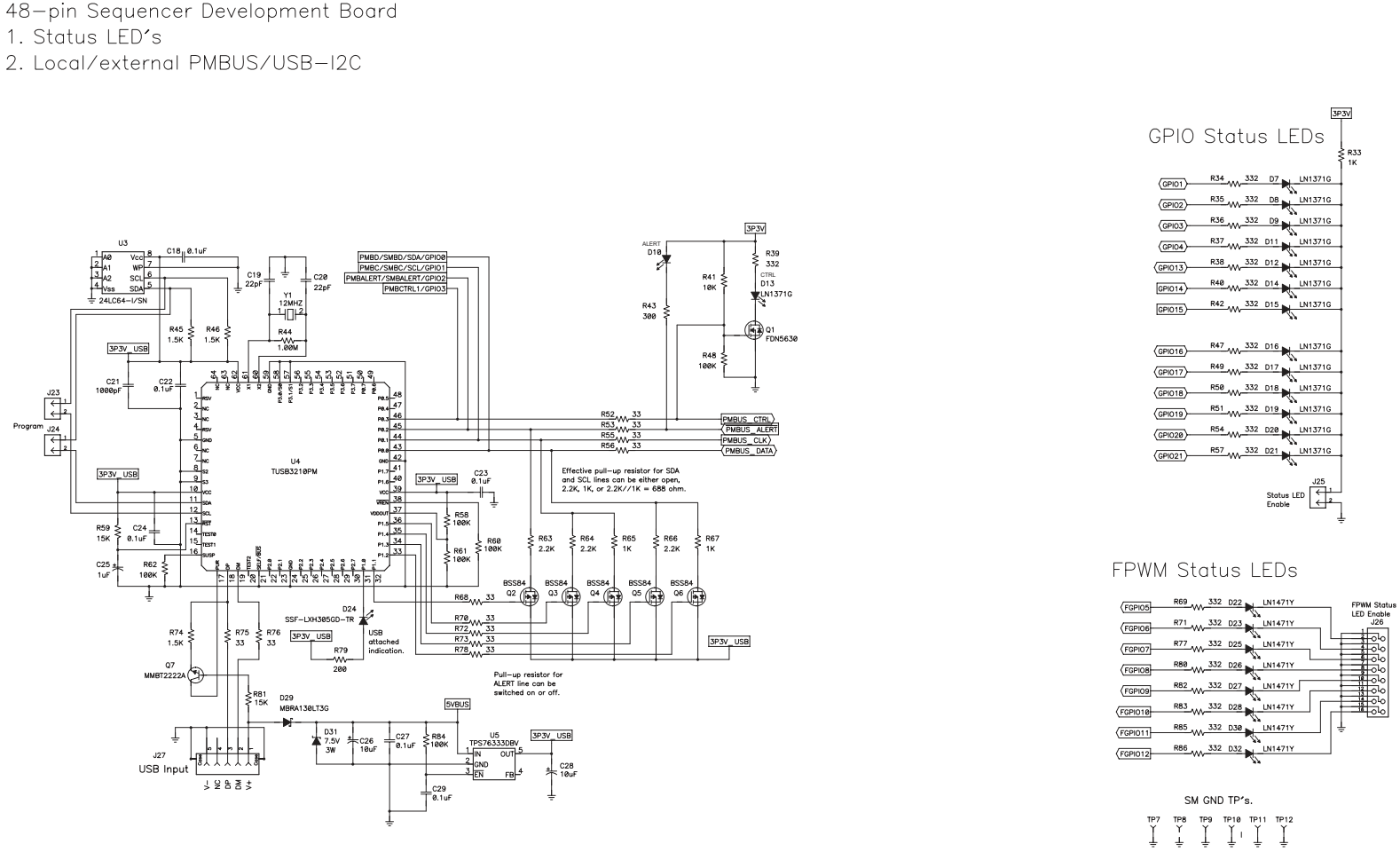


Figure 3. UCD90SEQ48EVM-560 Schematic, Sheet 2 of 2

6.2 Printed-Circuit Board Drawings

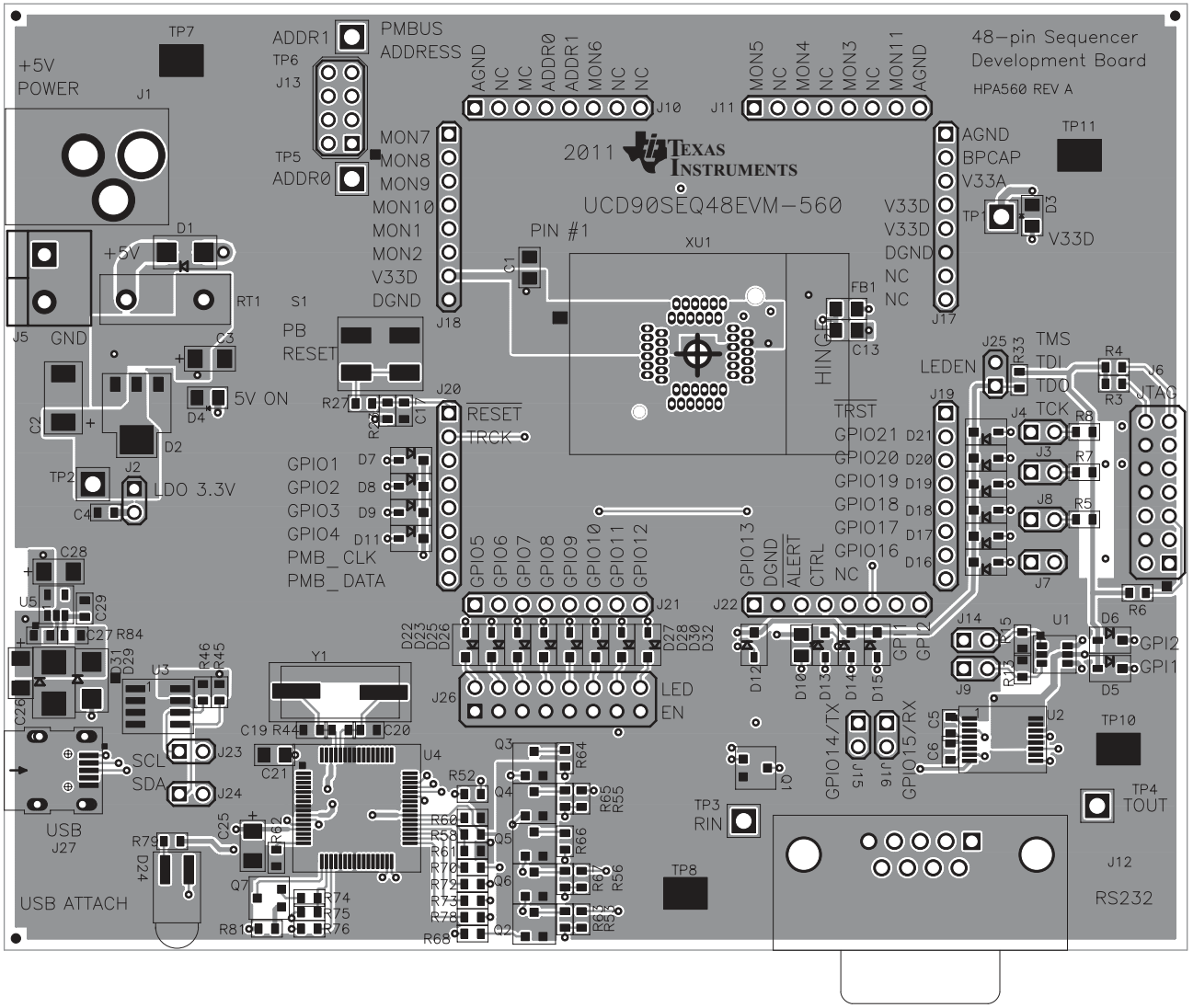


Figure 4. Top-Side Layout/Routing

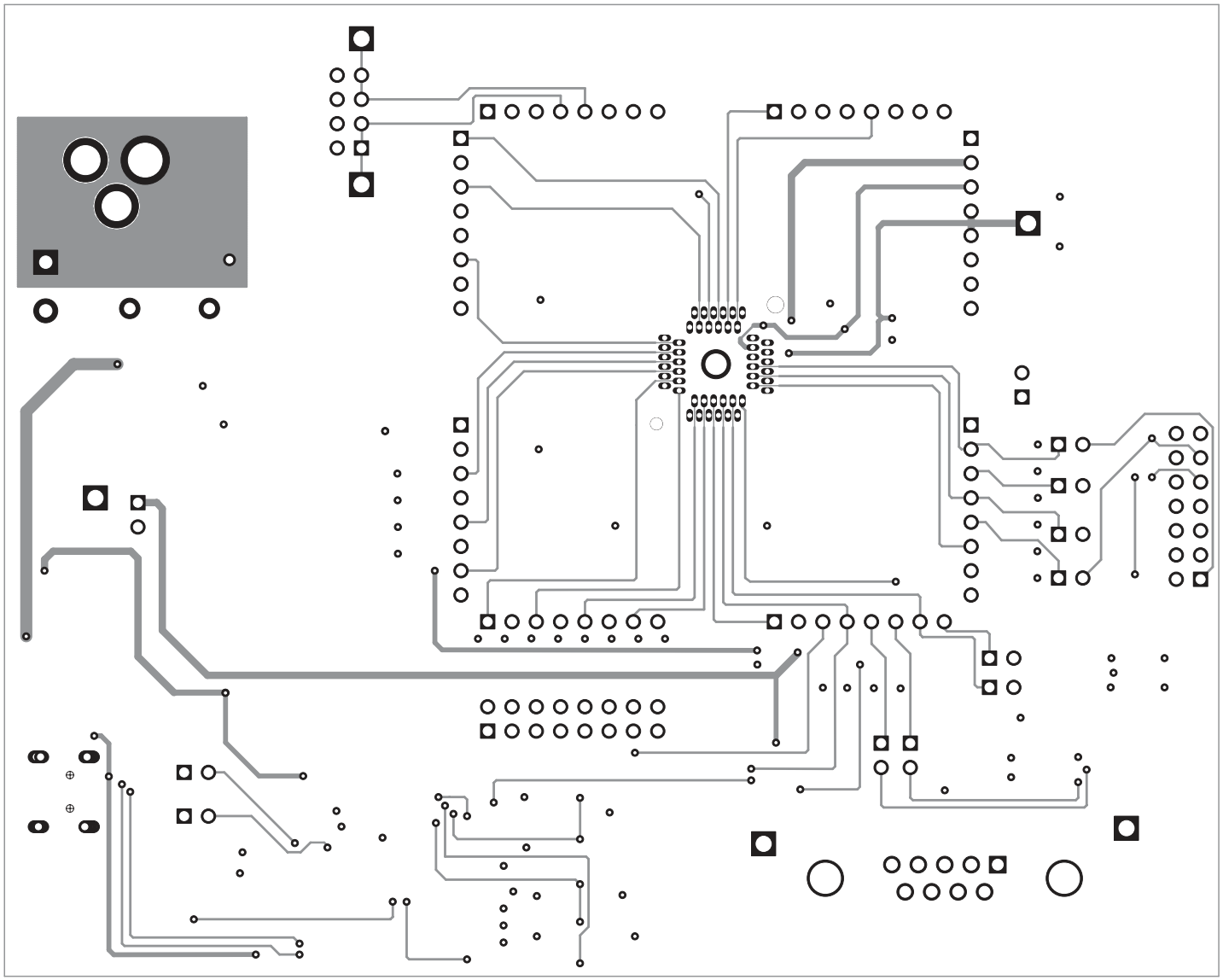


Figure 5. Layer-2 Routing

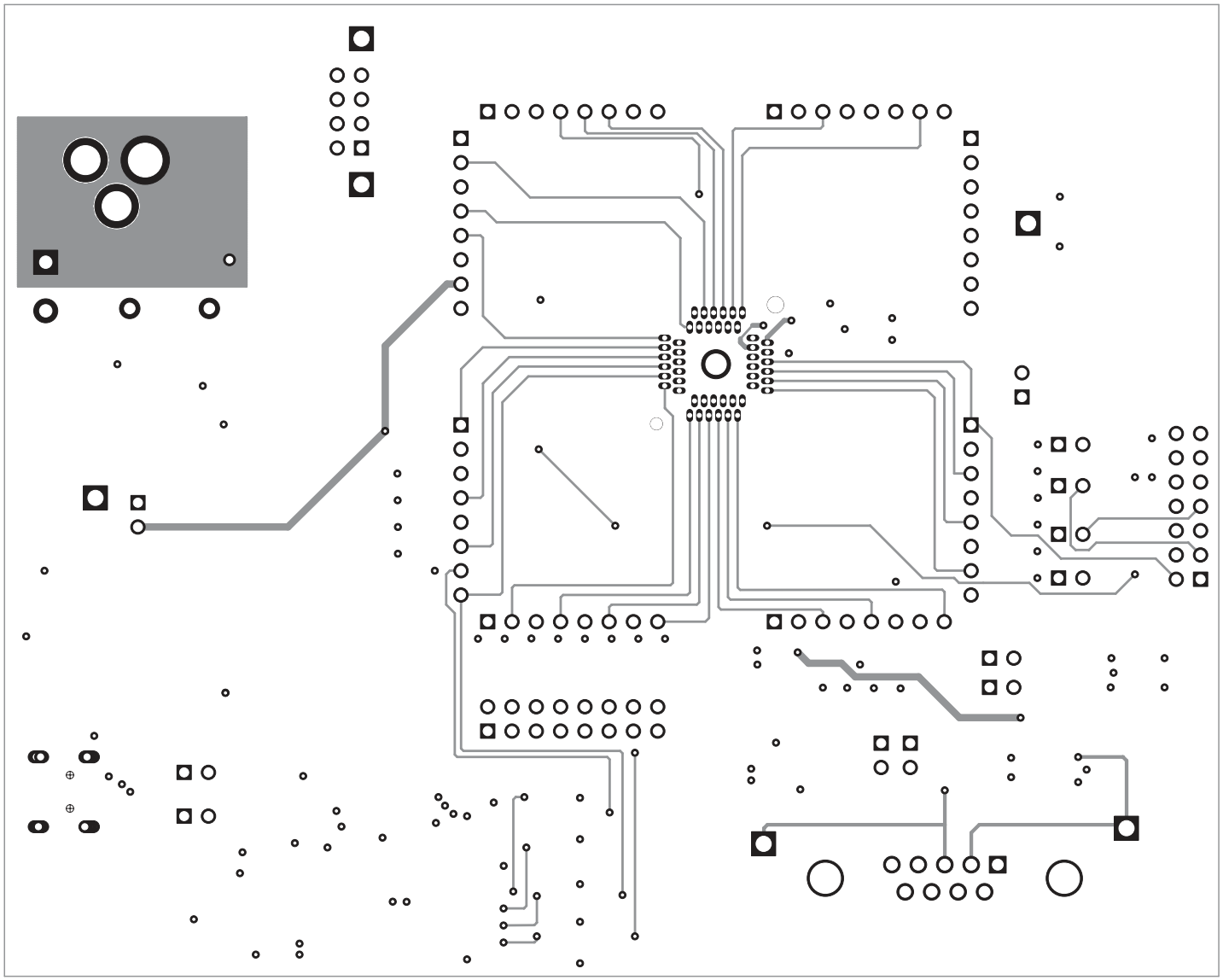


Figure 6. Layer-3 Routing

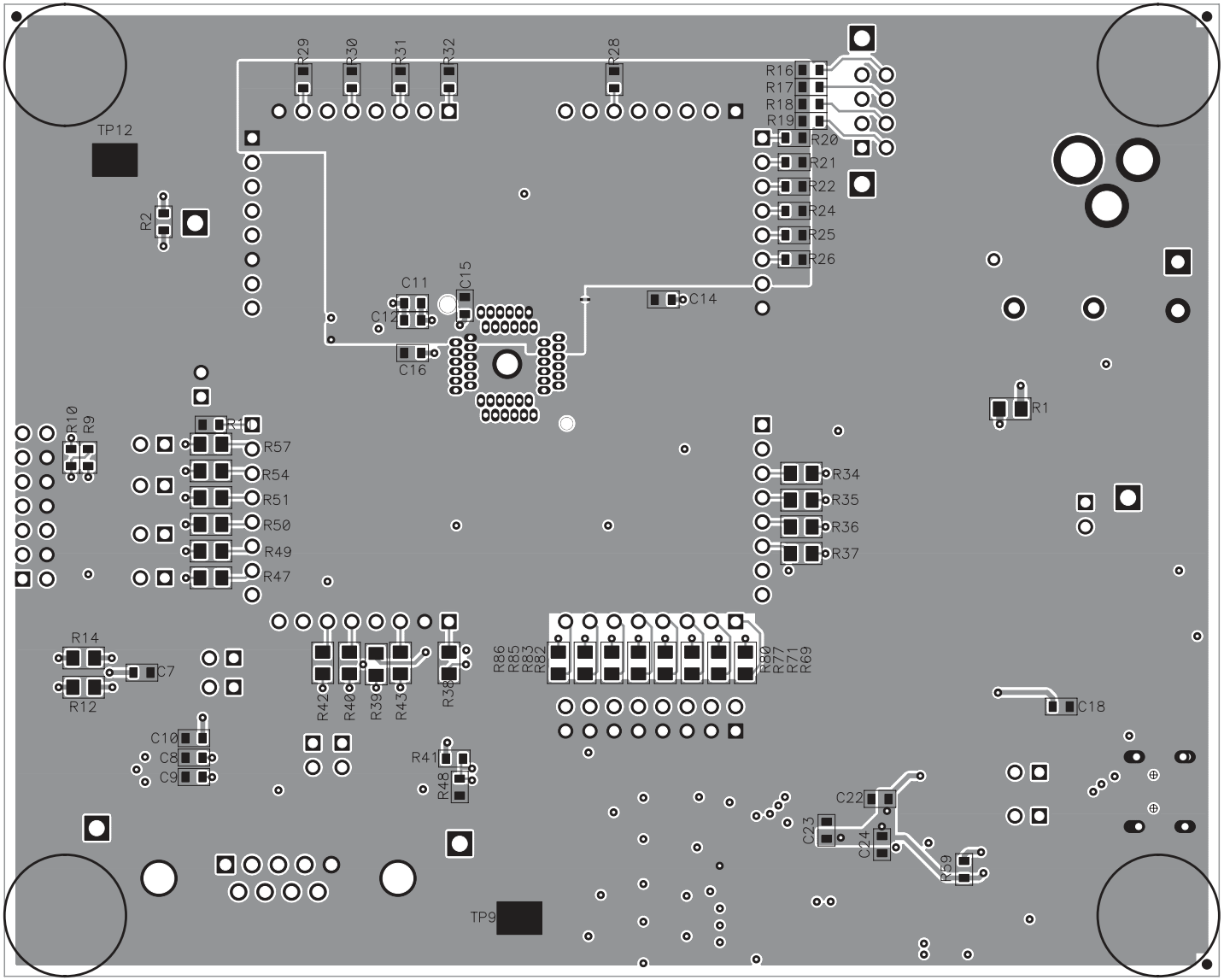


Figure 7. Bottom-Side Placement/Routing

6.3 Bill of Materials

Table 1. HPA560A Bill of Materials

Count	RefDes	Value	Description	Size	Part Number
2	C1, C13	4.7 µF	Capacitor, Ceramic, 10V, X5R, 20%	0805	Std
1	C12	0.01 µF	Capacitor, Ceramic, 50V, X7R, 10%	0603	Std
1	C17	1000 pF	Capacitor, Ceramic, X7R, 16V, 10%	0603	Std
2	C19, C20	22 pF	Capacitor, Ceramic, 50V, C0G, 10%	0603	Std.
1	C2	100 µF	Capacitor, Tantalum, 10V, 10%	6032	TAJC107K010R
1	C21	1000 pF	Capacitor, Ceramic, 100V, C0G, 5%	0805	Std.
1	C25	1 µF	Capacitor, Tantalum, 16V, 20%	3216	293D105X0016A2T
3	C3, C26, C28	10 µF	Capacitor, Tantalum, 10V, 20%	3216	293D106X0010A2T
17	C4, C5, C6, C7, C8, C9, C10, C11, C14, C15, C16, C18, C22, C23, C24, C27, C29	0.1 µF	Capacitor, Ceramic, X7R, 16V, 10%	0603	Std
1	D1	B340A	Diode, Schottky, 3A, 40V	SMA	B340A-13-F
1	D2	TLV1117-33CDCY	IC, 3.3 V, 800mA LDO Voltage Regulator	SOT-223	TLV1117-33CDCY
1	D24	SSF-LXH305GD-TR	Diode, LED, Green, 20 mA, 30 mcd	SMD	SSF-LXH305GD-TR
1	D29	MBRA130LT3G	Diode, Schottky, 1A, 30V	SMA	MBRA130LT3G
3	D3, D4, D10	SML-LXT0805SRW-TR	Diode, LED, Red, 100 mA	0805	SML-LXT0805SRW-TR
1	D31	7.5V	Diode, Zener, 7.5V, 3W	SMB	1SMB5922BT3G
10	D5, D6, D22, D23, D25, D26, D27, D28, D30, D32	LN1471Y	Diode, LED, Amber, 20-mA, 0.4-mcd	0.114 X 0.049 inch	LN1471YTR
14	D7, D8, D9, D11, D12, D13, D14, D15, D16, D17, D18, D19, D20, D21	LN1371G	Diode, LED, Green, 20-mA, 0.9-mcd	SMD	LN1371G
1	FB1	220 Ohm	Ferrite Bead, 2A, 0.050 m-ohm	0805	BLM21PG221SN
1	J1	RAPC712X	Connector, DC Jack, Pin dia.2.5mm, Shell dia 5.5mm	0.57 x 0.35 inch	RAPC712X
8	J10, J11, J17, J18, J19, J20, J21, J22	PEC08SAAN	Header, Male 8-pin, 100mil spacing,	0.100 inch x 8	PEC08SAAN
1	J12	182-009-213R171	Connector, 9-pin D, Right Angle, Female	1.213 x 0.510	182-009-213R171
1	J13	PEC04DAAN	Header, Male 2x4-pin, 100mil spacing	0.20 x 0.40 inch	PEC04DAAN
12	J2, J3, J4, J7, J8, J9, J14, J15, J16, J23, J24, J25	PEC02SAAN	Header, Male 2-pin, 100mil spacing,	0.100 inch x 2	PEC02SAAN
1	J26	PEC08DAAN	Header, Male 2x8 pin, 100mil spacing	0.100 inch X2X8	PEC08DAAN
1	J27	UX60-MB-5ST	Connector, Recpt, USB-B, Mini, 5-pins, SMT	0.354in. x 0.303in.	UX60-MB-5S8
1	J5	ED120/2DS	Terminal Block, 2-pin, 15-A, 5.1mm	0.40 x 0.35 inch	ED120/2DS
1	J6	PEC07DAAN	Header, Male 2x7 pin, 100mil spacing	0.100 inch x 2X7	PEC07DAAN
1	Q1	FDN5630	MOSFET, N-ch, 60-V,1.7-A, 100-milliohm	SSOT3	FDN5630
5	Q2, Q3, Q4, Q5, Q6	BSS84	Transistor, PFET, -50 V, 130 mA, Rds(ON) < 10 ohm at V(gs) = 5 V	SOT-23	BSS84

Table 1. HPA560A Bill of Materials (continued)

Count	RefDes	Value	Description	Size	Part Number
1	Q7	MMBT2222A	Transistor, NPN, 40 V, 500 mA	SOT-23	MMBT2222A
1	R1	590	Resistor, Chip, 1/10W, 1%	0805	Std
24	R12, R14, R34, R35, R36, R37, R38, R39, R40, R42, R47, R49, R50, R51, R54, R57, R69, R71, R77, R80, R82, R83, R85, R86	332	Resistor, Chip, 1/10W, 1%	0805	Std
8	R13, R15, R48, R58, R60, R61, R62, R84	100K	Resistor, Chip, 1/16W, 1%	0603	Std
2	R16, R18	90.9K	Resistor, Chip, 1/16W, 1%	0603	Std
2	R17, R19	41.2K	Resistor, Chip, 1/16W, 1%	0603	Std
2	R2, R79	200	Resistor, Chip, 1/16W, 5%	0603	Std
11	R20, R21, R22, R24, R25, R26, R28, R29, R30, R31, R32	4.02K	Resistor, Chip, 1/16W, 1%	0603	Std
1	R23	20K	Resistor, Chip, 1/16W, 1%	0603	Std
4	R27, R33, R65, R67	1K	Resistor, Chip, 1/16W, 1%	0603	Std
7	R3, R4, R5, R7, R8, R11, R41	10K	Resistor, Chip, 1/16W, 1%	0603	Std
1	R43	300	Resistor, Chip, 1/10W, 1%	0805	Std
1	R44	1.00M	Resistor, Chip, 1/16 W, 1%	0603	Std.
3	R45, R46, R74	1.5K	Resistor, Chip, 1/16 W, 5%	0603	Std
11	R52, R53, R55, R56, R68, R70, R72, R73, R75, R76, R78	33	Resistor, Chip, 1/16W, 5%	0603	Std
2	R59, R81	15K	Resistor, Chip, 1/16 W, 5%	0603	Std.
2	R6, R9	0	Resistor, Chip, 1/16W, 1%	0603	Std
0	R10	0	Resistor, Chip, 1/16W, 1%	0603	Std
3	R63, R64, R66	2.2K	Resistor, Chip, 1/16 W, 5%	0603	Std.
1	RT1	5 Ohms	Inrush current limiter, 4.7A, 0.11 ohms	0.180 X 0.550	CL-150
1	S1	KT11P2JM34LFS	Switch, SPST, PB Momentary, Sealed Washable	0.245 X 0.251	KT11P2JM34LFS
5	TP1, TP2, TP3, TP4, TP5	5012	Test Point, White, Thru Hole	0.125 x 0.125 inch	5012
1	TP6	5013	Test Point, Orange, Thru Hole	0.125 x 0.125 inch	5013
6	TP7, TP8, TP9, TP10, TP11, TP12	5016	Test Point, SM, 0.150 x 0.090""	0.185 x 0.135	5016
1	U1	SN74LVC2G04DBV	IC, Dual Schmitt-Trigger Inverter	SOT23-6	SN74LVC2G04DBV
1	U2	SN75C3221DBR	IC, RS-232 Transceivers with AutoShutdown	SSOP-16	SN75C3221DBR
1	U3	24LC64-I/SN	IC, Serial EEPROM, 64K, 2.5-5.5V, 400 kHz Max.	SO-8	24LC64-I/SN
1	U4	TUSB3210PM	IC, USB, General Purpose Device Controller	PQFP-64	TUSB3210PM**
1	U5	TPS76333DBV	IC, Micro-Power 100 mA LDO Regulator	SOT23-5	TPS76333DBV

Table 1. HPA560A Bill of Materials (continued)

Count	RefDes	Value	Description	Size	Part Number
1	XU1	48QN50S17070	Socket, 48 pin TH, QFN Pack, Clam-shell	1.08 x 0.800 inch	48QN50S17070
1	Y1	12MHZ	Crystal, 12-MHz, 20 pF, ±50 PPM@25C	0.185 x 0.532	CY12BPSMD
1	NA	UCD9090ARGZ	IC, Digital PWM System Controller	PFC-48	UCD9090ARGZ
4		SJ-5003	BUMPON HEMISPHERE .44X.20 BLACK		SJ-5003
16			Shunt, Black	100-mil	929950-00
1	--		PCB, 5 In x 4 In x 0.062 In		HPA560
1	N/A		USB Cable, 5-pin, B-Mini Male to Type A Male, 2m		AK672M/2-2-R

Revision History

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

Changes from Original (July 2011) to A Revision	Page
• Added device number to include UCD9090A throughout	2
• Changed "UCD9090RGZ" to ""UCD9090ARGZ" in Table 1	18

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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 0 V to 5.5 V and the output voltage range of 0 V to 3.8 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 40°C. The EVM is designed to operate properly with certain components above 70°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.

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