EVM User's Guide: DP83869EVM

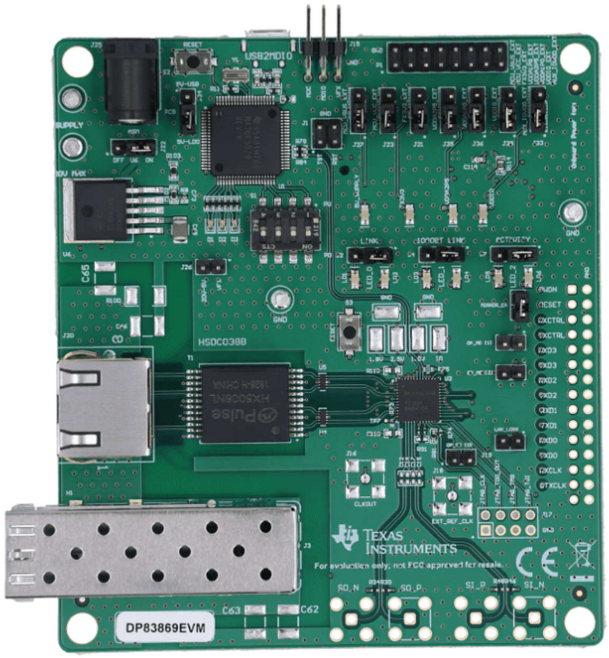
DP83869 Evaluation Module

Description

DP83869EVM is a PCB created to help for customers evaluate the DP83869HM for Ethernet applications. This user's guide details how to properly operate and configure the DP83869EVM. For best layout practices, schematic files, and Bill of Materials, see the associated support documents.

Features

- Multiple Operating Modes
  - Media Support: Copper and Fiber
  - Media Conversion: Copper to Fiber
  - Bridge Conversion: RGMII to SGMII, SGMII to RGMII
- RGMII and SGMII MAC Interfaces
- 1000Base-X, 100Base-T, 100Base-TX, 10Base-Te
- USB-2-MDIO Support Through Onboard MSP430 for Easy Register Access
- Onboard LDO and External Power Supply Options
- Status LEDs
  - Link
  - Activity
  - Power
- Bootstraps for Hardware Configuration



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1 Evaluation Module Overview

1.1 Introduction

The DP83869 is a low power, fully-featured Physical Layer transceiver with integrated PMD sublayers to support 10BASE-Te, 100BASE-TX, and 1000BASE-T Ethernet protocols. The DP83869 also supports Fiber protocols 1000BASE-X and 100BASE-FX. Optimized for ESD protection, the DP83869 exceeds 8-kV IEC 61000-4-2 (direct contact). This device interfaces to the MAC layer through Reduced GMI I (RGMII) and SGMII. Integrated Termination Impedance on RGMII helps reduce system BOM. The DP83869EVM demonstrates all features of DP83869. The EVM supports Copper Ethernet protocols, such as 10BASE-Te, 100BASE-TX, and 1000BASE-T. The EVM also supports Fiber protocols 1000BASE-X and 100BASE-FX. The EVM has connections to use the DP83869 MAC Interface in RGMII and SGMII mode. The EVM is also optimized to demonstrate the robust EMI, EMC, and ESD performance of the DP83869 device.

1.2 Kit Contents

The major components of the EVM are as below:

- The DP83869HM device
- RJ-45 Connecter
- DC power regulators
- MSP430 to program DP83869HM
- Micro USB Port for Power and Connection with MSP430
- External Supply Header
- Headers for configuring various TDP2004-Q1 features

1.3 Specification

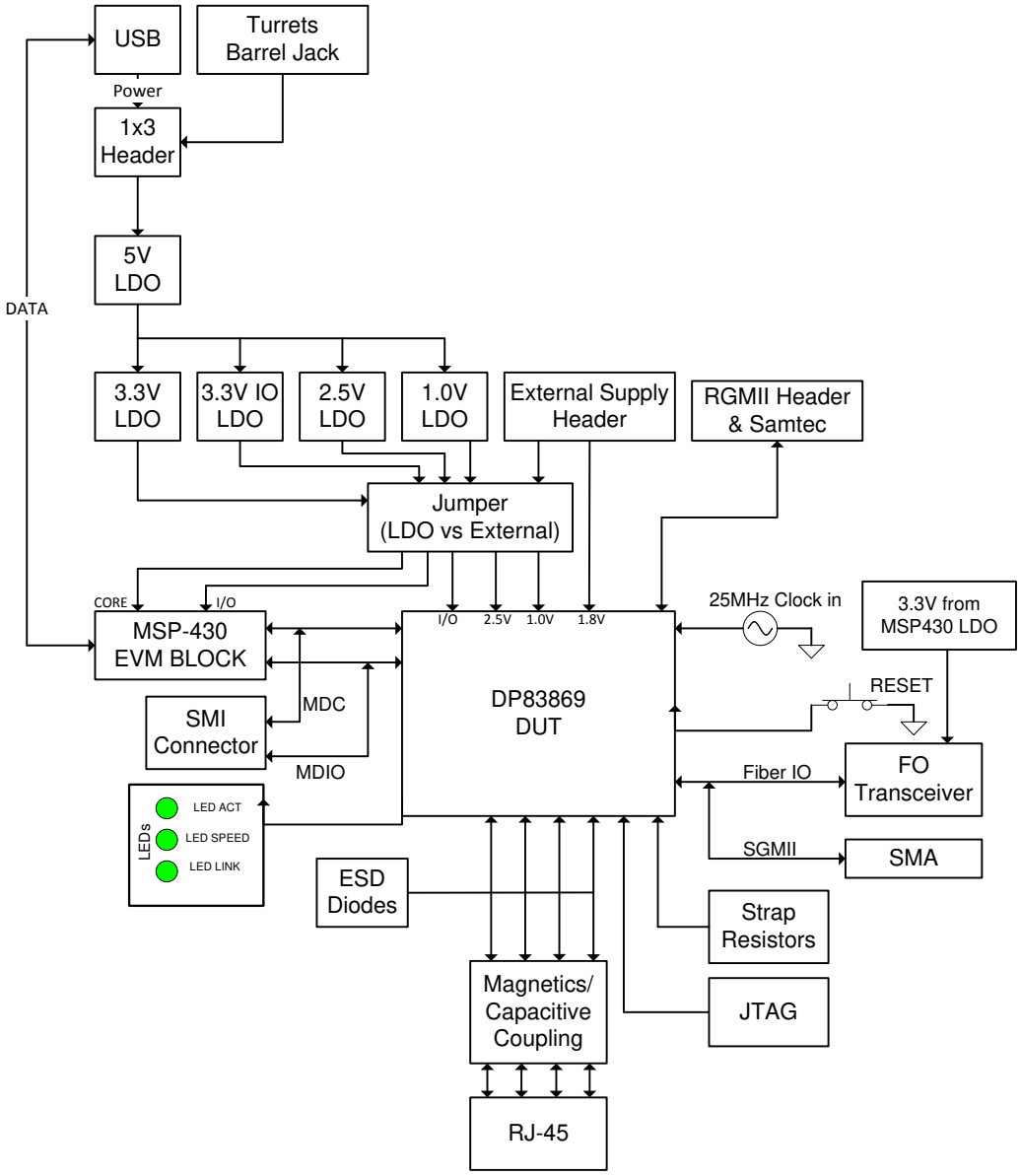

Figure 1-1. DP83869EVM Block Diagram

1.4 Device Information

The DP83869EVM is used to implement the DP83869HM. The DP83869HM device is a robust, fully-featured gigabit physical layer (PHY) transceiver with integrated PMD sublayers that supports 10BASE-Te, 100BASE-TX and 1000BASE-T Ethernet protocols. The DP83869 also supports 1000BASE-X and 100BASE-FX fiber protocols. The DP83869EVM is interfaced with RJ45 connector and SFP module. The DP83869EVM can be interacted by using USB-2-MDIO with on-board MSP430.

1.5 Quick Setup

1.5.1 Onboard Power Supply Operation

The EVM can be supplied power through multiple options. Single-supply operation uses onboard LDOs to generate the voltages required for operating various sections of the EVM (PHY, MSP430, FO transceiver, and so forth).

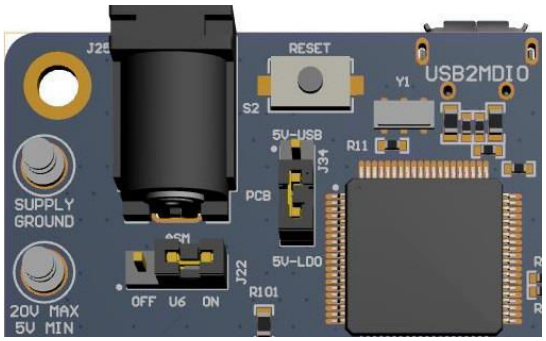

Figure 1-2. Onboard Power Supply Connection

The EVM can be supplied power by either a J25 barrel jack connector, power-supply turrets, or a USB

- For Barrel Jack and Turret, connect the jumper in the ON position to J22 and the jumper on 5V-LDO to J34.
- For USB power, connect the Jumper on 5V-USB position to J34. J22 is don't care.

1.5.2 External Power Supply Operation

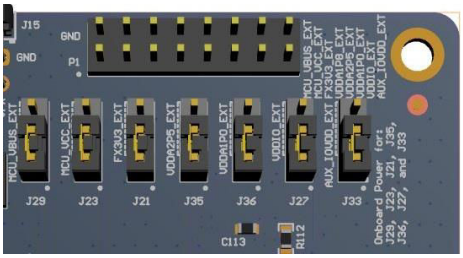

Figure 1-3. Jumper Placements for Onboard Power

The jumpers shown in Figure 1-3 can be used to choose whether a particular voltage rail is supplied through onboard LDOs or an external power supply. If an external power supply is desired on a voltage rail, then change the respective jumper from position 1-2 (LDO) to 2-3 (External). Then, connect the appropriate voltage on the corresponding pin to the P1 connector. For example, if the VDDA2P5 is to be supplied from an external supply, then change jumper position of J35 from 1-2 to 2-3. Then connect the 2.5-V external supply on pins 9-10 on the P1 connector. Note that pin 9 is supply and pin 10 is ground.

2 Hardware

2.1 Board Setup Details

2.1.1 EVM High-Level Summary

The DP83869EVM supports SMI through J15 using pin 26 for MDIO and 28 for MDC. These pins can be connected to an MSP430 Launchpad, which can be used for USB-2-MDIO control.

Table 2-1. EVM Applications

NO.	DP83869 MODE	APPLICATIONS	HOW TO USE
1	RGMII to Copper	Run traffic between RGMII and Copper.	Connect to DP83867 RGMII EVM or MAC System using Header pins/Samtech connector.
		Perform IEEE and UNH compliance testing	Use onboard MSP430 to activate test mode waveform on DP83869.
		Run EMI/EMC Test on EVM	Use internal PRBS and loopback.
		Measure Power Dissipation	Connect external power supplies.
		External MAC loopback	Connect external MAC to headers/Samtech connector.
2	SGMII to Copper	Run traffic between SGMII and Copper.	Connect to DP83867 SGMII EVM or MAC System using SMA connector.
		Perform IEEE and UNH compliance testing	Use onboard MSP430 to activate test mode waveform on DP83869.
		Run EMI/EMC Test on EVM	Use internal PRBS and loopback.
		External SGMII loopback	Use SMA cable for Passive Loopback.
3	RGMII to Fiber Ethernet	Run traffic between RGMII and Fiber Ethernet.	Straps to enable Fiber Ethernet. Connect to DP83867 RGMII EVM or MAC System using Header/Samtech.
		Perform IEEE and UNH compliance testing	Use onboard MSP430 to activate test mode waveforms.
		Run EMI/EMC Test on EVM	Use internal PRBS and loopback.
		Measure Power Dissipation	Connect external power supplies.
4	100 M Media Convertor	Demonstrate 100 M functionality on EVM	Use SFP and RJ45 connector for fiber and copper ethernet. Straps are used for unmanaged mode and MDIO for managed mode.
		Demonstrate FAR End fault capability	
		Demonstrate unmanaged mode of Media convertor	
5	1000 M Media Convertor	Demonstrate 1000 M functionality on EVM	Use SFP and RJ45 connector for fiber and copper ethernet. Straps are used for unmanaged mode and MDIO for managed mode.
		Demonstrate Link Loss Pass Thru Capability	
		Demonstrate unmanaged mode of Media Convertor	
6	RGMII to SGMII bridge	Demonstrate SGMII as MAC able to link with SGMII i/f of Phy (DP83867)	Connect to DP83867 SGMII EVM over SMA connectors and monitor RGMII header on 869 EVM.
		Demonstrate SGMII link speed is reflected on RGMII	
		Demonstrate Complete Data path Use-case	Use DP83867 RGMII EVM and SGMII EVM with DP83869EVM.
7	SGMII to RGMII bridge	Demonstrate RGMII of DP83869 is able to link-up with RGMII of DP83867	Connect to DP83867 RGMII EVM over Samtech connectors and monitor SGMII SMA on 869 EVM.
		Demonstrate SGMII link speed is reflecting RGMII speed	
		Demonstrate Complete Data path Use-case	Use DP83867 RGMII EVM and SGMII EVM with DP83869EVM.

2.2 Configuration Options

2.2.1 Bootstrap Options

All straps are only two-level straps in DP83869 except PHYADD straps. EVM support one pullup and one pulldown resistor pad on RX_D0 and RX_D2 for PHY address straps. There is only one pullup resistor on all other strap pins with a jumper option to disconnect.

Table 2-2. 4 Level Straps

STRAP VALUE	MODE 0	MODE 1	MODE 2	MODE 3
Resistor PU (kΩ)	Open	10	5.76	2.49
Resistor PD (kΩ)	Open	2.49	2.49	Open

Table 2-3. 2 Level Straps

STRAP VALUE	MODE 0	MODE 1
Resistor PU (kΩ)	Open	2.49
Resistor PD (kΩ)	2.49	Open

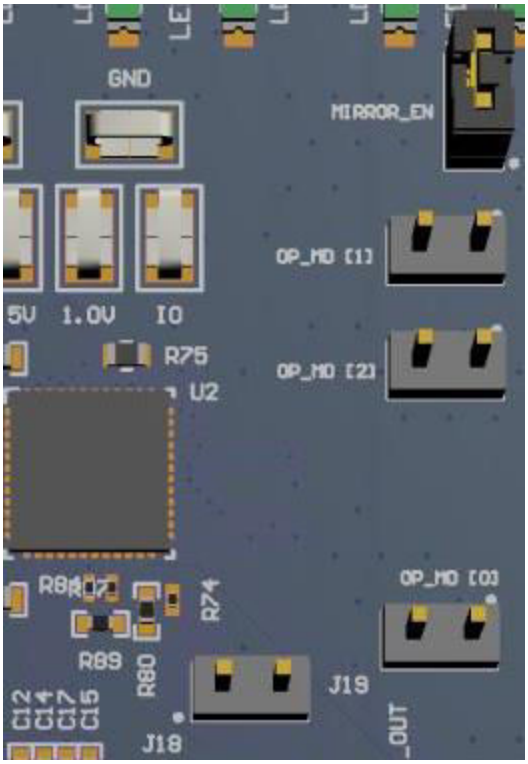

Figure 2-1. EVM Strap Jumpers

2.2.1.1 Straps for PHY Address

Table 2-4. PHY Strap Table

PIN NAME	STRAP NAME	PIN NO.	DEFAULT			
RX_D0	PHY_ADD[1:0]	33	00		PHY_ADD1	PHY_ADD0
				MODE 0	0	0
				MODE 1	0	1
				MODE 2	1	0
				MODE 3	1	1
RX_D1	PHY_ADD[3:2]	34	00		PHY_ADD3	PHY_ADD2
				MODE 0	0	0
				MODE 1	0	1
				MODE 2	1	0
				MODE 3	1	1

2.2.1.2 Strap for DP83869 Functional Mode Selection

Table 2-5. Functional Mode Strap Table

PIN NAME	STRAP NAME	PIN NO.	DEFAULT	OPMODE_2	OPMODE_1	OPMODE_0	FUNCTIONAL MODES
JTAG_TDO/ GPIO_1	OPMODE_0	22	0	0	0	0	RGMII to Copper(1000Base-T/ 100Base-TX/10Base-Te)
				0	0	1	RGMII to 1000Base-X
RX_D3	OPMODE_1	36	0	0	1	0	RGMII to 100Base-FX
				0	1	1	RGMII-SGMII Bridge Mode
				1	0	0	1000Base-T to 1000Base-X
				1	0	1	100Base-T to 100Base-FX
RX_D2	OPMODE_2	35	0	1	1	0	SGMII to Copper(1000Base-T/ 100Base-TX/10Base-Te)
				1	1	1	JTAG for boundary scan

2.2.1.3 Straps for RGMII/SGMII to Copper

Table 2-6. Copper Ethernet Strap Table

PIN NAME	STRAP NAME	PIN NO.	DEFAULT	ANEG_DIS	ANEGSEL_1	ANEGSEL_0	FUNCTION
LED_0	ANEG_DIS	47	0	0	0	0	Auto-negotiation, 1000/100/10 advertised, Auto MDI-X
				0	0	1	Auto-negotiation, 1000/100 advertised, Auto MDI-X
LED_1	ANEGSEL_0	46	0	0	1	0	Auto-negotiation, 100/10 advertised, Auto-MDI-X
				0	1	1	Reserved (JTAG for boundary scan)
				1	0	0	Forced 1000 M, master, MDI mode
LED_2	ANEGSEL_1	45	0	1	0	1	Forced 1000 M, slave, MDI mode
				1	1	0	Forced 100 M, full duplex, MDI mode
				1	1	1	Forced 100 M, full duplex, MDI-X mode
RX_CTRL	MIRROR_EN	38	0	0			Port Mirroring Disabled
				1			Port Mirroring Enabled

2.2.1.4 Straps for RGMII to 1000Base-X

Table 2-7. 1000Base-X Strap Table

PIN NAME	STRAP NAME	PIN #	DEFAULT		
LED_0	ANEG_DIS	47	0	0	Fiber Auto-negotiation ON
				1	Fiber Force mode
LED_1	ANEGSEL_0	46	0	0	Signal Detect disable on Pin 24
				1	Configure Pin 24 as Signal Detect Pin

2.2.1.5 Straps for RGMII to 100Base-FX

Table 2-8. 100Base-X Strap Table

PIN NAME	STRAP NAME	PIN #	DEFAULT		
LED_1	ANEGSEL_0	46	0	0	Signal Detect disable on Pin 24
				1	Configure Pin 24 as Signal Detect Pin

2.2.1.6 Straps for Bridge Mode (SGMII-RGMII)

Table 2-9. Bridge Mode Strap Table

PIN NAME	STRAP NAME	PIN #	DEFAULT		
RX_CTRL	MIRROR_EN	38	0	0	RGMII to SGMII (RGMII : MAC I/F, SGMII : Phy I/F)
				1	SGMII to RGMII (SGMII : MAC I/F, RGMII : Phy I/F)

2.2.1.7 Straps for 100 M Media Converter

Table 2-10. 100 M Media Converter Strap Table

PIN NAME	STRAP NAME	PIN #	DEFAULT			
LED_1	ANEGSEL_0	46	0	**ANEGSEL_1**	**ANEGSEL_0**	
LED_2	ANEGSEL_1	45	0	0	0	Copper : Auto-negotiation (100/10 Advertised), Auto MDIX
				1	1	Copper : Auto Negotiation (100 Advertised), Auto MDIX
RX_CTRL	MIRROR_EN	38	0	0		Copper: Mirror Disable
				1		Copper: Mirror Enable
RX_CLK	LINK_LOSS	32	0	0		Link Loss Pass Thru Enabled
				1		Link Loss Pass Thru Disabled

2.2.1.8 Straps for 1000 M Media Convertor

Table 2-11. 1000 M Media Strap Table

PIN NAME	STRAP NAME	PIN #	DEFAULT			
LED_0	ANEG_DIS	47	0	0		Fiber Auto Negotiation
				1		Fiber Force Mode
LED_1	ANEGSEL_0	46	0	ANEGSEL_1	ANEGSEL_0	
LED_2	ANEGSEL_1	45	0	0	0	Copper : Auto-negotiation (1000/100 Advertised), Auto MDIX
				1	1	Copper : Auto Negotiation (1000 Advertised), Auto MDIX

2.2.2 SGMII/Fiber Interface

SGMII Pins from the DUT are multipurpose pins functioning as SGMII and Fiber IO pins. By default, the EVM is configured for Fiber operation.

Note

Fiber Transceiver is not a part of the EVM package. SFP cage and SFP connector need to be mounted.

For routing signals to Fiber Transceiver, populate R31, R38, R45, and R47. Remove C12, C14, C15, and C17.

For routing signals to SGMII SMAs, populate C12, C14, C15, and C17. Remove R31, R38, R45, and R47.

2.2.3 RGMII

RGMII signals are routed to standard 2.54-mm header connectors on J14. RGMII can be used both in Copper mode and Fiber mode.

2.2.4 Clock Output

The EVM has a SMB connector to output clock from the PHY. A 50-Ω Coax cable with a SMB connector needs to be used for accessing the clock output.

2.2.5 Clock Input

The EVM is configured for default crystal input clock operation. The EVM supports the option to provide clock from 25-MHz crystal, 25-MHz CMOS oscillator, and the External clock from the SMB connector. A 50-Ω Coax cable with a SMB connector needs to be used for providing clock input from external sources.

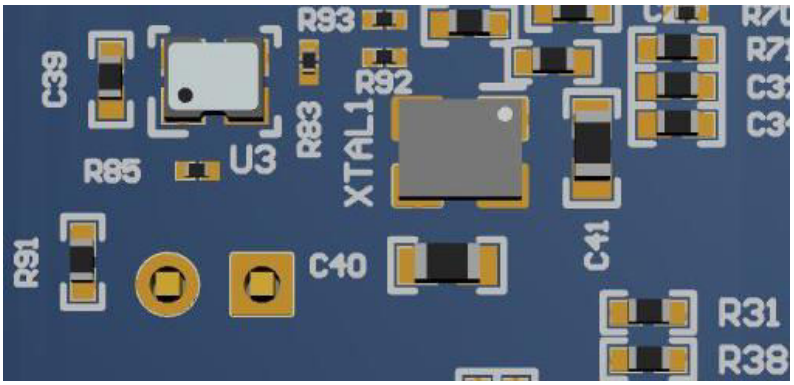

Figure 2-2. Onboard Clock

Figure 2-3. External Clock Input

2.2.6 Switch Configuration Options

The DP83869EVM includes a 4-pin dip switch (S1), which can be used for various test modes and feature displays. Some of the switch settings can also be used with the USB-2-MDIO GUI for additional control. Except for switch mode 15, all switch modes are hard-coded and can be used without USB-2-MDIO or any other serial com port. Refer to Table 2-12 for switch configurations and LED outputs. For each switch, PU is 1 and PD is 0.

Table 2-12. 4-Pin Dip Switch Modes

Mode	SW[4:1]	Feature	LED Description	LED D14	LED D15	LED D16	USB2MDIO
0	0000	Normal Operation	USB-2-MDIO Active (Flashes very briefly red during read and green during write)	Red Green	Off	Off	Yes
			Program failed to read PHY register	Red	Off	Off	No
			Program failed to write PHY register	Green	Off	Off	
1	0001	Test Mode 1 - Droop	Successfully entered Test Mode 1	Red Green	Off	Green	Yes
			Failed to enter Test Mode 1 (Flashing LEDs)	Red	Red	Red	No
2	0010	Test Mode 2 - Clock Frequency, Master Jitter	Successfully entered Test Mode 2	Red Green	Off	Red	Yes
			Failed to enter Test Mode 2 (Flashing LEDs)	Red	Red	Red	No
3	0011	Test Mode 3 - Slave Jitter	Successfully entered Test Mode 3	Red Green	Off	Red Green	Yes
			Failed to enter Test Mode 3 (Flashing LEDs)	Red	Red	Red	No
4	0100	Test Mode 4 - Distortion	Successfully entered Test Mode 4	Red Green	Green	Off	Yes
			Failed to enter Test Mode 4 (Flashing LEDs)	Red	Red	Red	No
5	0101	Test Mode 5	Successfully entered Test Mode 5	Red Green	Green	Green	Yes
			Failed to set Test Mode 5 (Flashing LEDs)	Red	Red	Red	No
6	0110	Force 100Mbps	Force 100-Mbps speed with force MDI	Red Green	Green	Red	Yes
			Program failed to program the PHY registers	Off	Green	Red	No
7	0111	Force 10Mbps	Force 10-Mbps speed with force MDI and PRBS on.	Off	Green	Red	No
			Program failed to program the PHY registers	Red	Red	Red	
8	1000	Reverse Loopback	Successfully entered Reverse Loopback	Red Green	Red	Off	Yes
			Failed to enter Reverse Loopback (Flashing LEDs)	Red	Red	Red	No
9	1001	xMII Loopback	Successfully entered xMII Loopback	Red Green	Red	Green	Yes
			Failed to enter xMII Loopback (Flashing LEDs)	Red	Red	Red	No
10	1010	Enable BIST	Enable BIST in Copper Ethernet Mode	Red	Green	Red Green	No
			Program failed to program the PHY registers	Red	Red	Red	
11 - 14	1011 - 1110	RESERVED	RESERVED	-	-	-	No

Table 2-12. 4-Pin Dip Switch Modes (continued)

Mode	SW[4:1]	Feature	LED Description	LED D14	LED D15	LED D16	USB2MDIO
15	1111	LOOP: Read data continuously from a list of registers loaded to the MC	To upload a list of registers to continuously read from with USB-2-MDIO: Write the hex value of the register you want to add to the list to the register address "LOAD"	Red Green	Red Green	Red Green	Yes(1)
			To begin reading data continuously with USB-2-MDIO: Read the register address "OPEN"				
			To stop reading data continuously with USB-2-MDIO: Read the register address "STOP"				

(1) During the loop for Mode 15, USB-2-MDIO is not operational. However, other serial port terminals (that is, PuTTY) can be used to view real-time data.

When running switch mode 15, data is constantly sent to the serial port. USB-2-MDIO is not capable of supporting the constant read feature. However, other serial port terminals, that is, PuTTY, can be used. When using a serial port terminal, copy and paste data. Do not enter in the data slowly, because the firmware executes as soon as the data is received.

To load a list of registers to read data from, follow this data format:

##LOADAAAAB/

- ## = Two digit PHY ID expressed in decimal form
- LOAD = the string 'LOAD' indicates to the MC to add a register to the list
- AAAA = Four character Register Address to read data from in hex form (that is, Read register 0x133h, set AAAA = 0133)
- B = use '*' for an extended access read and '=' for a direct access read
- / = end string with '/'

For example, to load register 0x462h with PHY_ID = 1 with extended access, copy and paste the following command into a serial com terminal: 01LOAD0462*/

To start reading data, continuously copy and paste the following into the serial com terminal: OPEN

To stop reading data, continuously copy and paste the following into the serial com terminal: STOP

Note

The *OPEN* and *STOP* commands are in no particular position, so the designer can copy *OPENSTOP* and paste into the serial com terminal once to start reading data and then paste again to stop reading data, for example.

Note

When the read loop is stopped, the list of registers to read is cleared.

3 Software

The onboard MSP430 comes pre-programmed and ready to use. When using this EVM for the first time on a Windows 7 (or above) PC, MSP430 drivers and USB2MDIO software utility has to be installed. The USB2MDIO software can be used for accessing registers.

3.1 MSP430 Driver

Install the latest MSP430 drive from this website: http://software-dl.ti.com/msp430/msp430_public_sw/mcu/msp430/MSP430_FET_Drivers/latest/index_FDS.html.

3.2 USB-2-MDIO Software

Download the software from http://www.ti.com/tool/usb-2-mdio. The Web page also contains a User's Guide for installing and using the software.

The MSP430 is on board the EVM, so the user does not have to purchase a separate MSP430 Launchpad kit and connect to the PHY using wires. The entire EVM can be powered and controlled through a USB connector. MSP430 and USB2MDIO utility can be used even when power is not supplied through a USB.

In case the onboard MSP430 cannot be used due to some reason, MDIO and MDC pins are also broken out on the J15 connector. Customers can connect a MSP430 launchpad or their own MDIO-MDC utility on J15 to access the PHY registers.

4 Hardware Design Files

4.1 Schematics

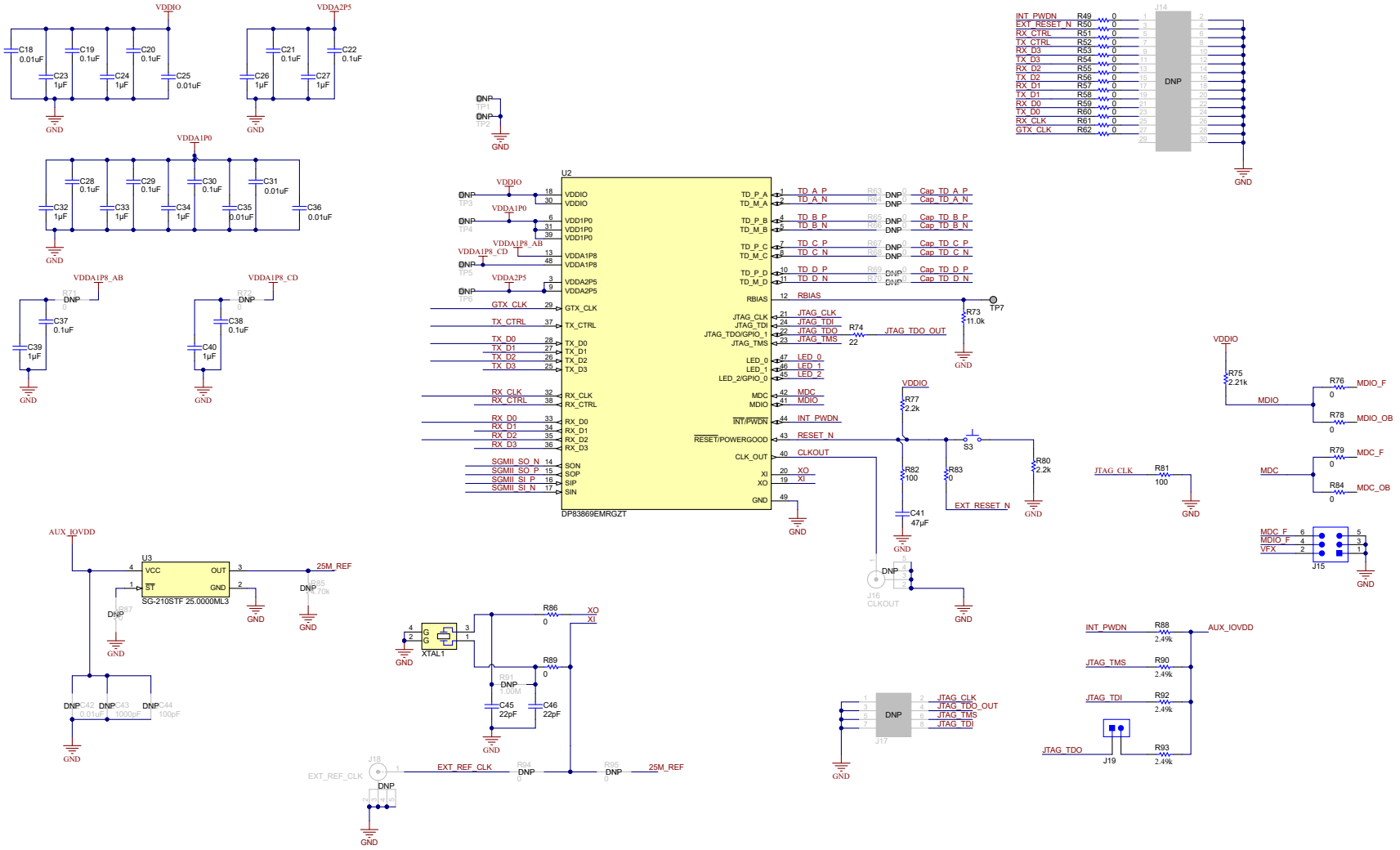

Figure 4-1. Schematic Page 1

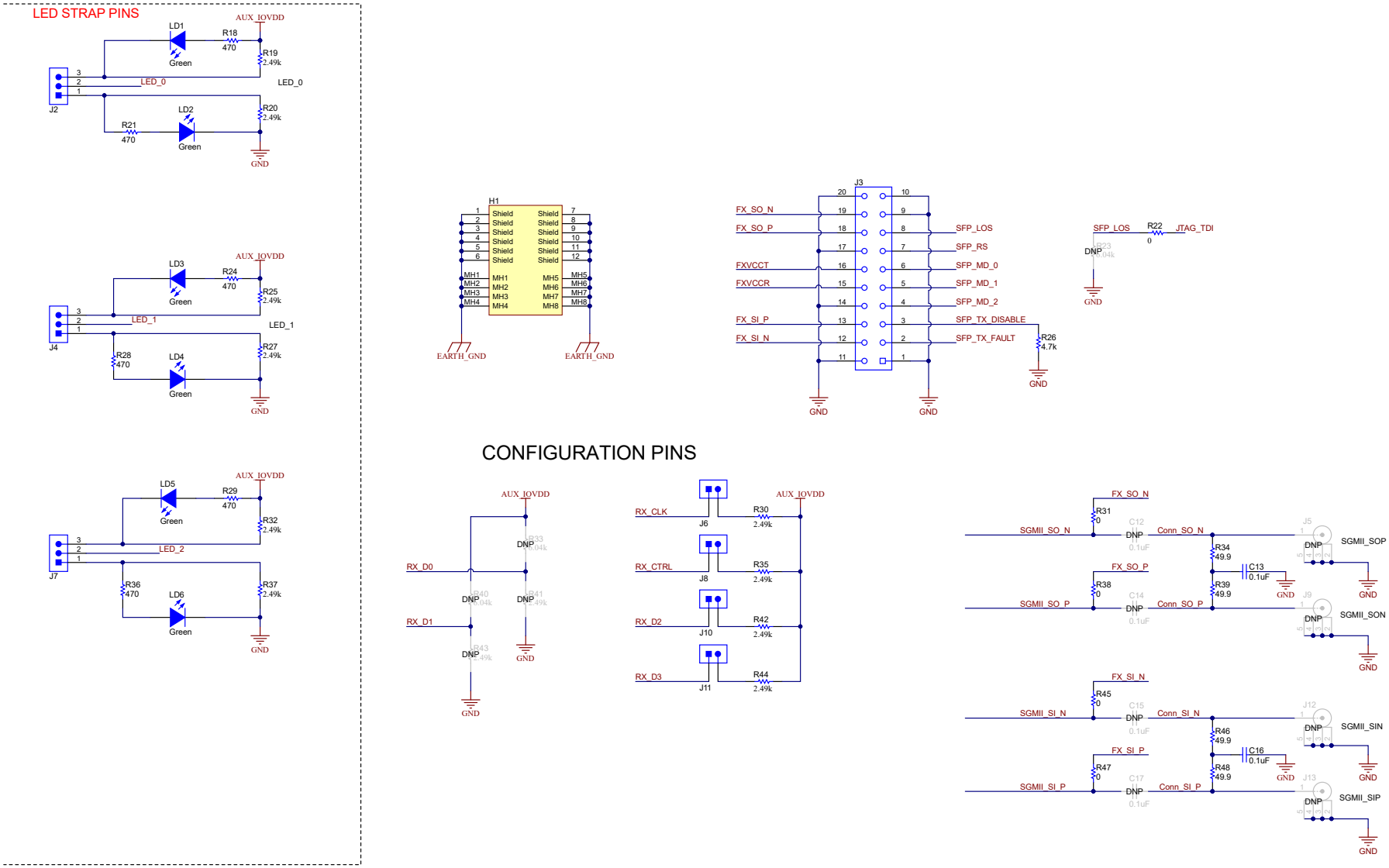

Figure 4-2. Schematic Page 2

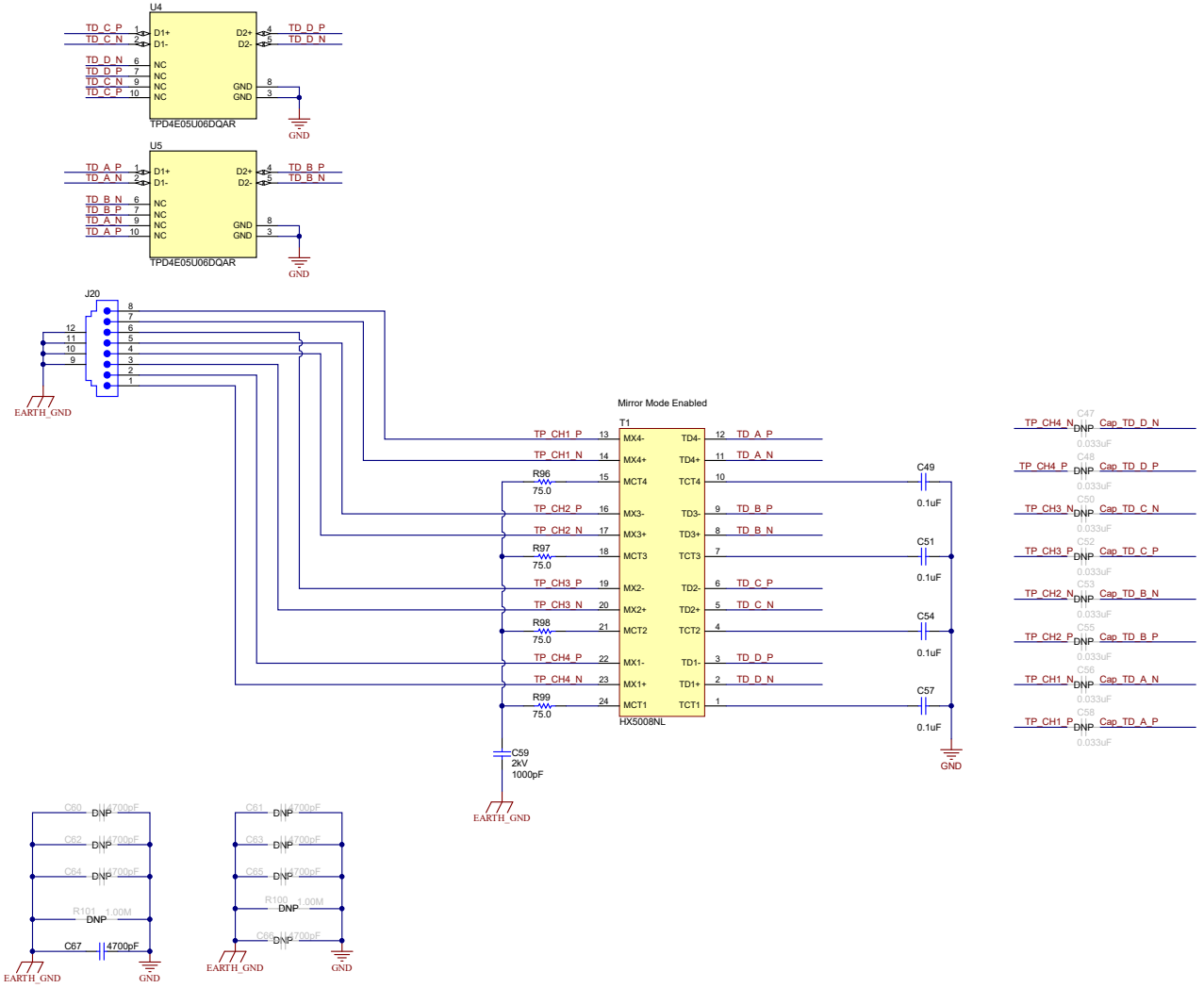

Figure 4-3. Schematic Page 3

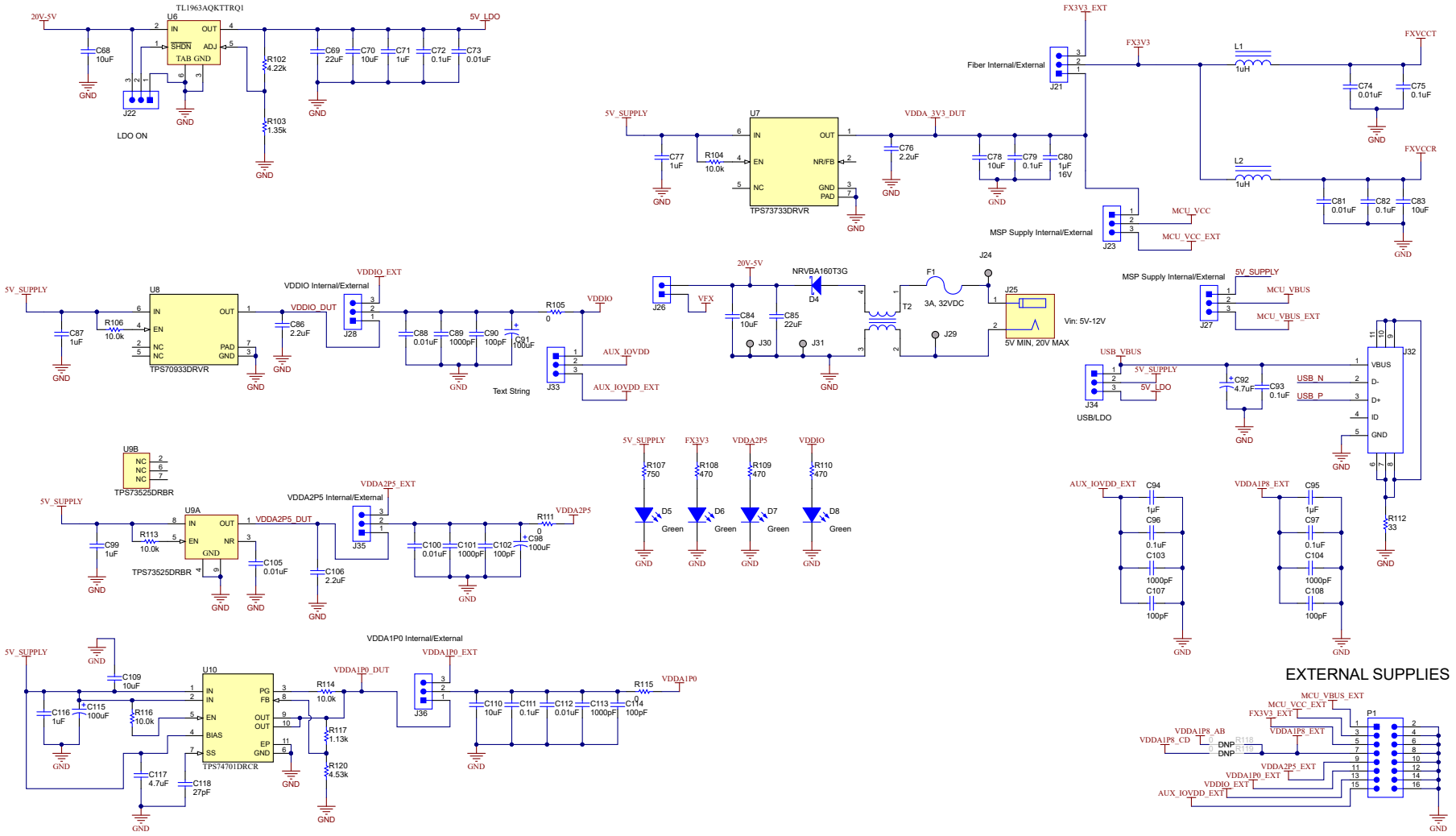

Figure 4-4. Schematic Page 4

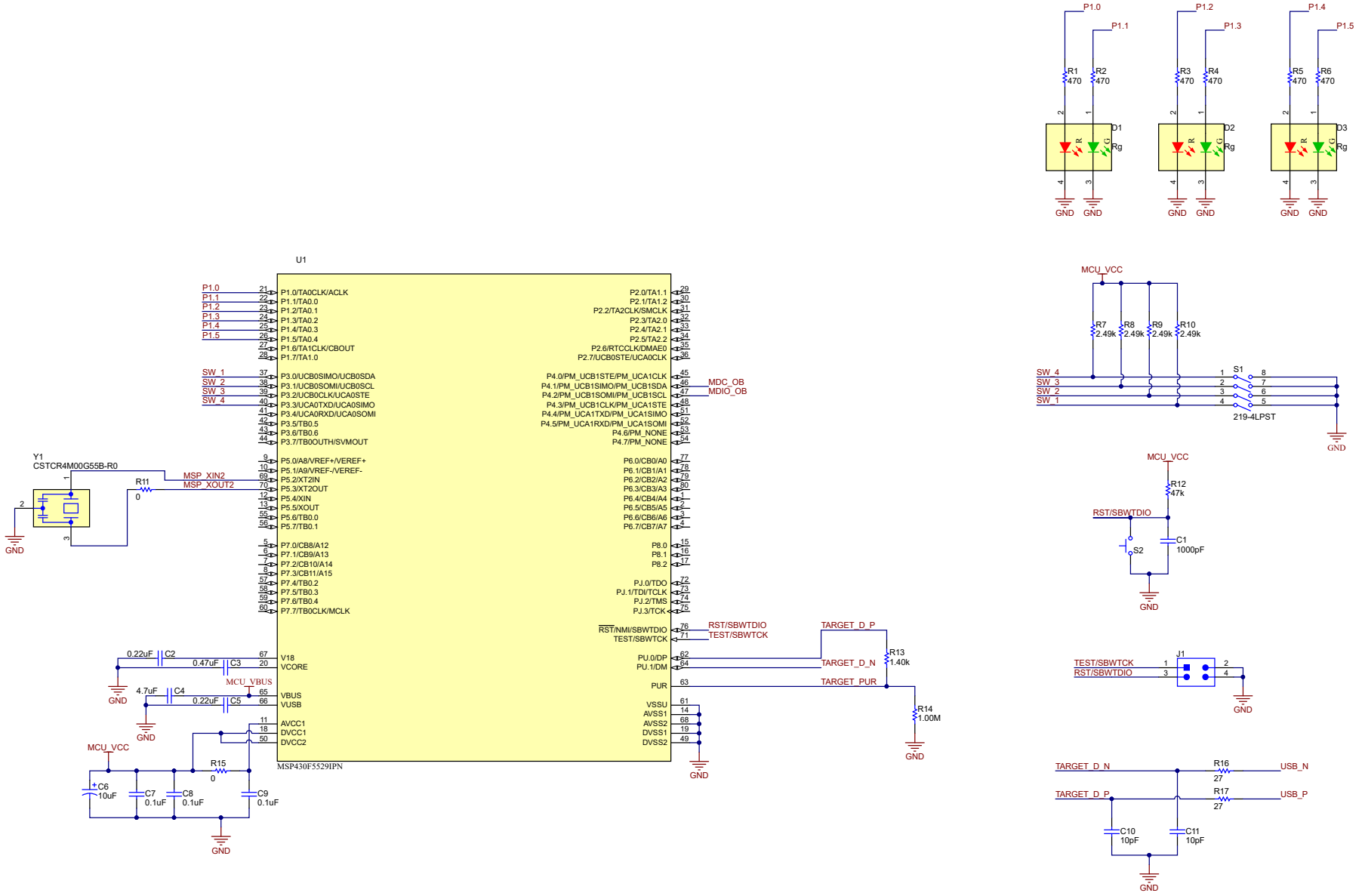

Figure 4-5. Schematic Page 5

4.2 Layout

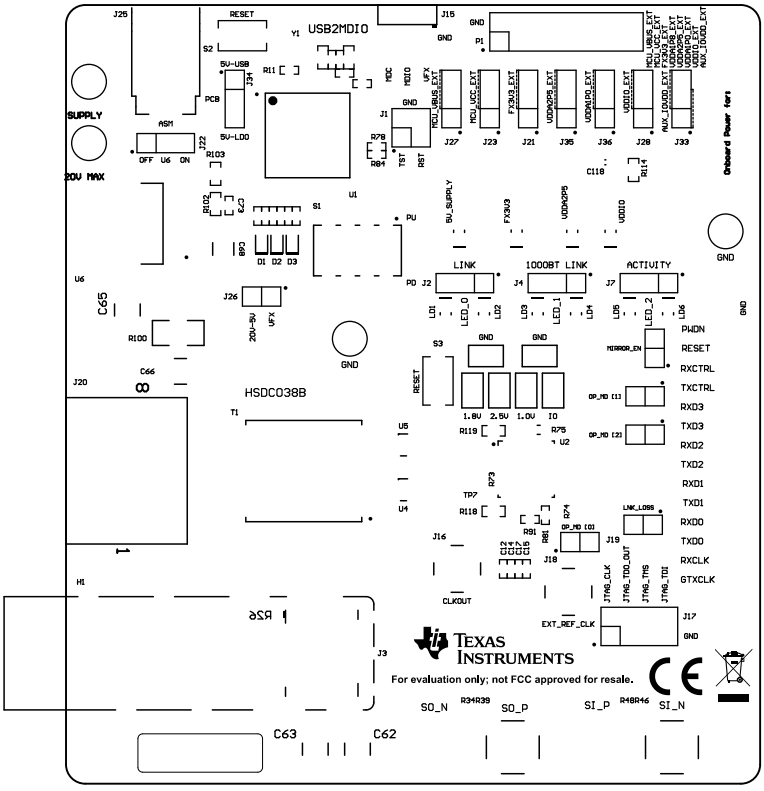

Figure 4-6. Top Overlay

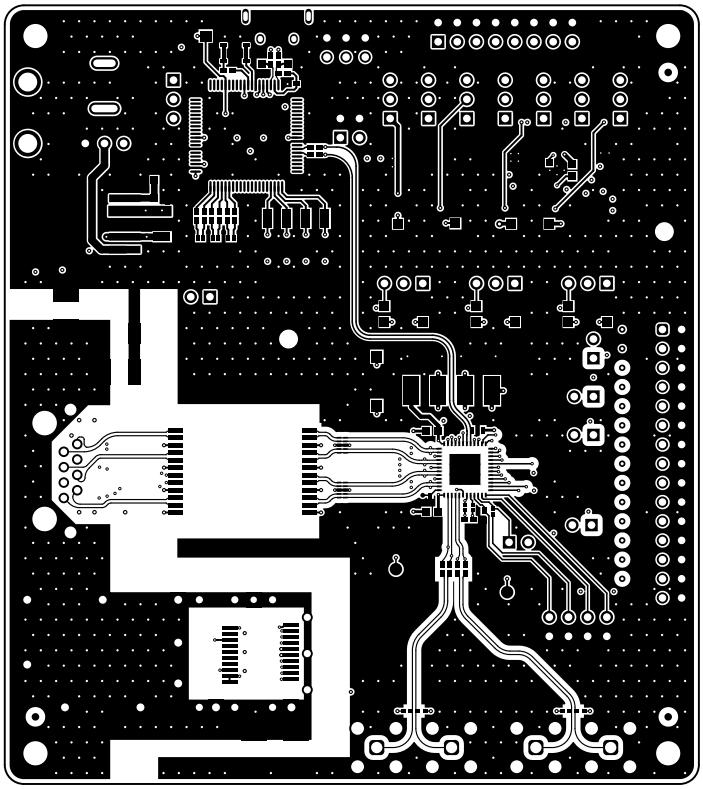

Figure 4-7. Top Layer

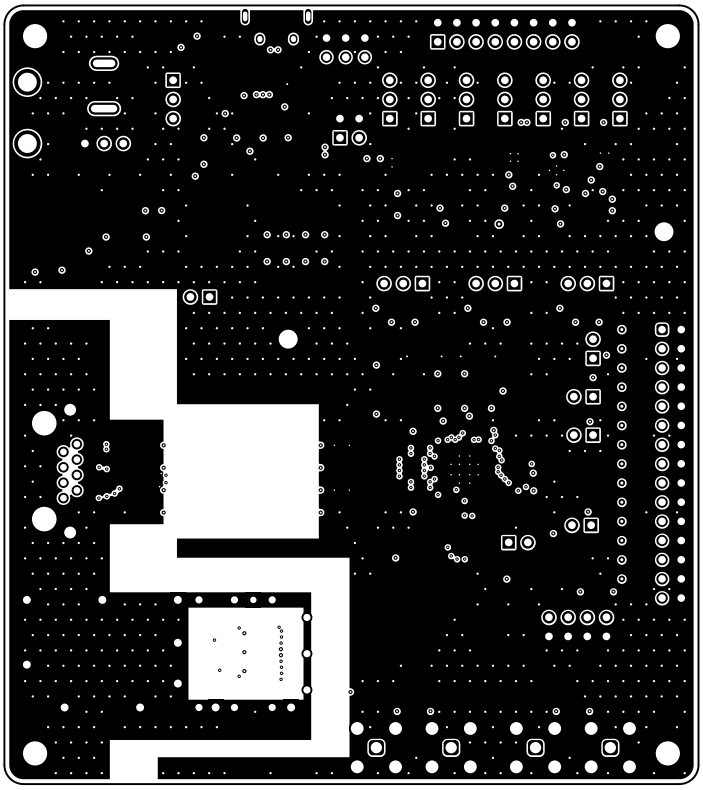

Figure 4-8. Signal Layer 1

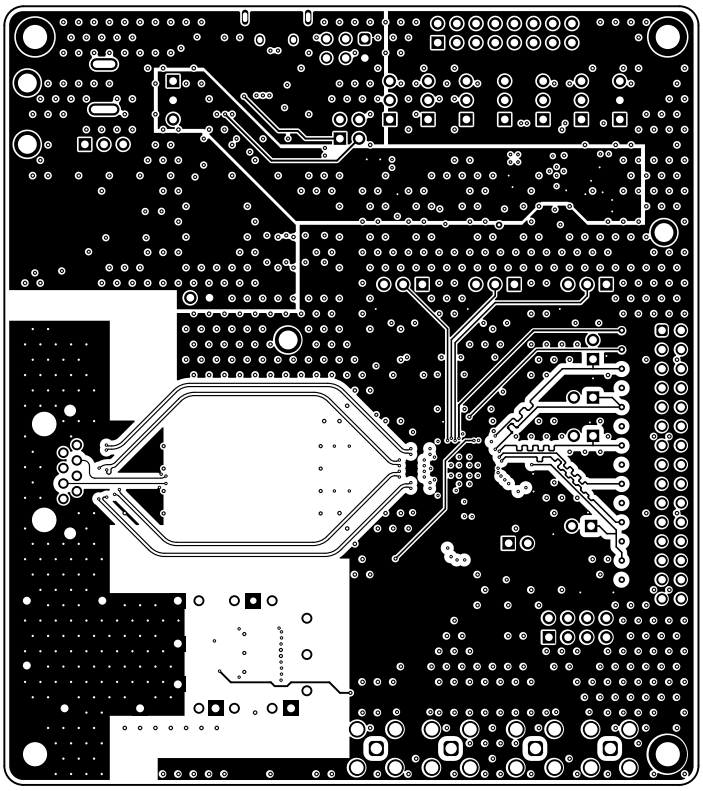

Figure 4-9. Signal Layer 2

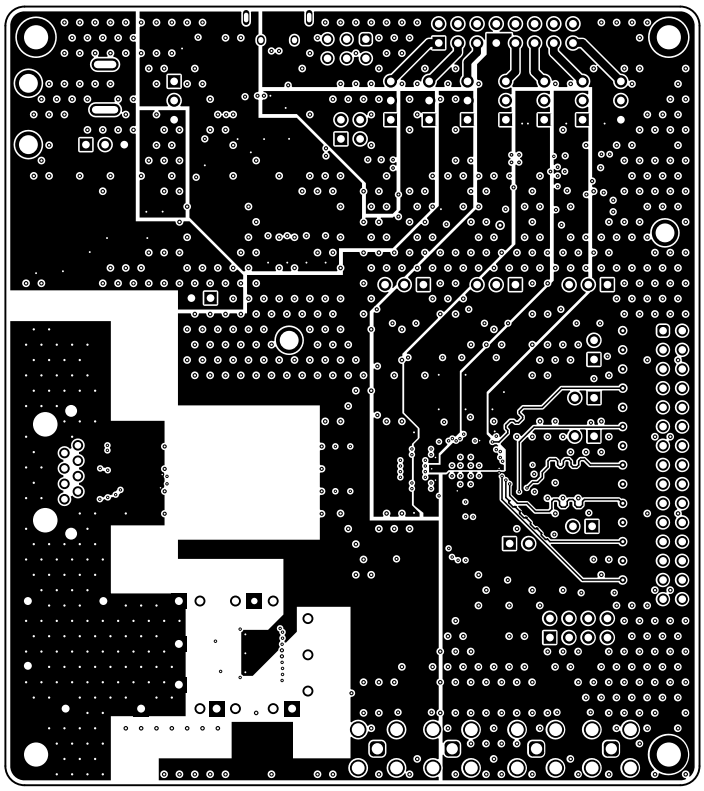

Figure 4-10. Signal Layer 3

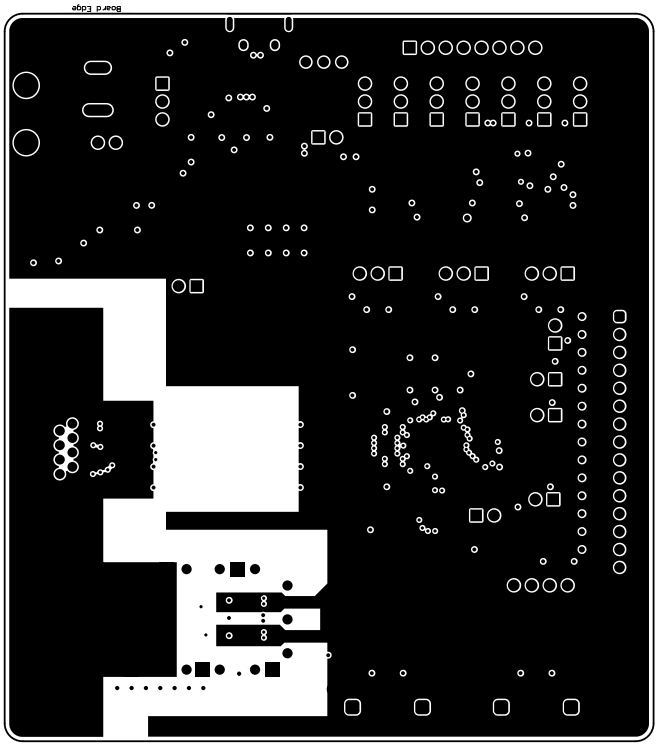

Figure 4-11. Signal Layer 4

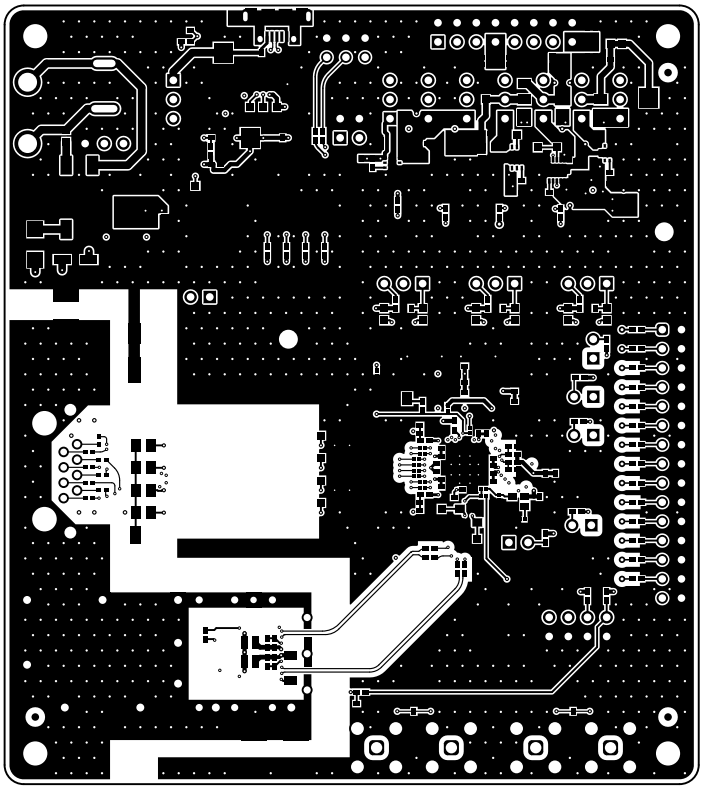

Figure 4-12. Bottom Layer

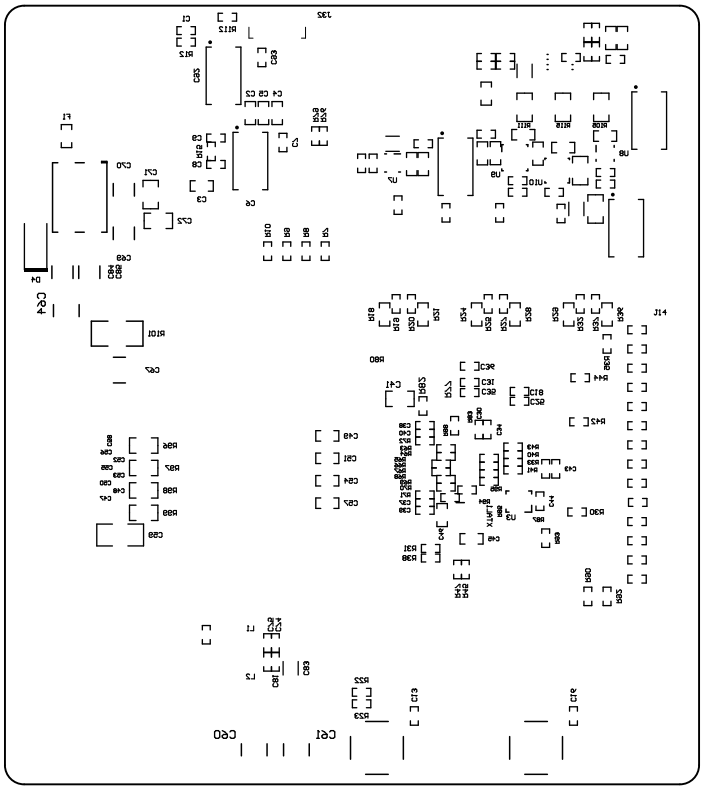

Figure 4-13. Bottom Overlay

4.3 Bill of Materials

Table 4-1. Bill of Materials

DESIGNATOR	QTY	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
C1	1	1000pF	CAP, CERM, 1000 pF, 50 V, +/- 5%, C0G/NP0, 0402	C1005NP01H102J050BA	TDK
C2, C5	2	0.22uF	CAP, CERM, 0.22 uF, 50 V, +/- 10%, X5R, 0603	C1608X5R1H224K080AB	TDK
C3	1	0.47uF	CAP, CERM, 0.47 uF, 50 V, +/- 10%, X6S, 0603	C1608X6S1H474K080AB	TDK
C4	1	4.7uF	CAP, CERM, 4.7 uF, 35 V, +/- 10%, X5R, 0603	C1608X5R1V475K080AC	TDK
C6	1	10uF	CAP, TA, 10 uF, 35 V, +/- 10%, 0.125 ohm, SMD	TPSD106K035R0125	AVX
C7, C8, C9, C13, C16, C75, C82, C93	8	0.1uF	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X7R, 0402	GRM155R71C104KA88D	MuRata
C10, C11	2	10pF	CAP, CERM, 10 pF, 50 V, +/- 5%, C0G/NP0, 0603	CGA3E2NP01H100D080AA	TDK
C18, C25, C31, C35, C36	5	0.01uF	CAP, CERM, 0.01 uF, 16 V, +/- 10%, X5R, 0402	GRM155R61C103KA01D	MuRata
C19, C20, C21, C22, C28, C29, C30, C37, C38, C96, C97	11	0.1uF	CAP, CERM, 0.1 uF, 10 V, +/- 10%, X5R, 0402	C1005X5R1A104K050BA	TDK
C23, C24, C26, C27, C32, C33, C34, C39, C40, C80, C94, C95	12	1uF	CAP, CERM, 1 µF, 16 V,+/- 20%, X5R, 0402	GRM155R61C105MA12D	MuRata
C41	1	47uF	CAP, CERM, 47 µF, 4 V,+/- 20%, X6S, 0805	GRM21BC80G476ME15L	MuRata
C45, C46	2	22pF	CAP, CERM, 22 pF, 50 V, +/- 5%, C0G/NP0, AEC-Q200 Grade 1, 0603	CGA3E2C0G1H220J080AA	TDK
C49, C51, C54, C57	4	0.1uF	CAP, CERM, 0.1 uF, 10 V, +/- 10%, X7R, 0603	C0603C104K8RACTU	Kemet
C59	1	1000pF	CAP, CERM, 1000 pF, 2000 V, +/- 10%, X7R, 1808	GR442QR73D102KW01L	MuRata
C67	1	4700pF	CAP, CERM, 4700 pF, 2000 V, +/- 10%, X7R, 1812	1812GC472KAT1A	AVX
C68, C70, C84	3	10uF	CAP, CERM, 10 uF, 25 V, +/- 20%, X7R, AEC-Q200 Grade 1, 1210	CGA6P1X7R1E106M250AC	TDK
C69, C85	2	22uF	CAP, CERM, 22 uF, 16 V, +/- 20%, X7R, AEC-Q200 Grade 1, 1210	CGA6P1X7R1C226M250AC	TDK
C71	1	1uF	CAP, CERM, 1 uF, 16 V, +/- 10%, X5R, 0805	GRM216R61C105KA88D	MuRata
C72	1	0.1uF	CAP, CERM, 0.1 uF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0805	GCM21BR71H104KA37K	MuRata
C73, C74, C81	3	0.01uF	CAP, CERM, 0.01 uF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	CGA2B3X7R1H103K050BB	TDK
C76, C86, C106	3	2.2uF	CAP, CERM, 2.2 uF, 16 V, +/- 20%, X7S, AEC-Q200 Grade 1, 0603	CGA3E1X7S1C225M080AC	TDK
C77, C87, C99	3	1uF	CAP, CERM, 1 uF, 35 V, +/- 20%, X5R, 0402	GRM155R6YA105ME11D	MuRata
C78, C83, C109, C110	4	10uF	CAP, CERM, 10 uF, 35 V, +/- 20%, X7R, 1206_190	C3216X7R1V106M160AC	TDK
C79, C111	2	0.1uF	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X7R, 0603	CL10B104KO8NNNC	Samsung Electro-Mechanics
C88, C100, C105, C112	4	0.01uF	CAP, CERM, 0.01 uF, 50 V, +/- 5%, X7R, 0603	C0603C103J5RACTU	Kemet

Table 4-1. Bill of Materials (continued)

DESIGNATOR	QTY	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
C89, C101, C113	3	1000pF	CAP, CERM, 1000 pF, 50 V, +/- 10%, C0G/NP0, 0603	06035A102KAT2A	AVX
C90, C102, C107, C108, C114	5	100pF	CAP, CERM, 100 pF, 50 V, +/- 5%, C0G/NP0, 0402	CC0402JRNPO9BN101	Yageo America
C91, C98, C115	3	100uF	CAP, TA, 100 uF, 10 V, +/- 20%, 0.1 ohm, SMD	593D107X0010D2TE3	Vishay-Sprague
C92	1	4.7uF	CAP, TA, 4.7 uF, 35 V, +/- 10%, 1.3 ohm, SMD	293D475X9035D2TE3	Vishay-Sprague
C103, C104	2	1000pF	CAP, CERM, 1000 pF, 25 V, +/- 10%, X5R, 0402	GRM155R61E102KA01D	MuRata
C116	1	1uF	CAP, CERM, 1 uF, 16 V, +/- 10%, X5R, 0805	0805YD105KAT2A	AVX
C117	1	4.7uF	CAP, CERM, 4.7 uF, 10 V, +80/-20%, Y5V, 0805	CC0805ZRY5V6BB475	Yageo America
C118	1	27pF	CAP, CERM, 27 pF, 50 V, +/- 1%, C0G/NP0, 0603	CL10C270FB8NNNC	Samsung Electro-Mechanics
D1, D2, D3	3	Rg	LED, Rg, SMD	HSMF-C165	Avago
D4	1	60V	Diode, Schottky, 60 V, 1 A, AEC-Q101, SMA	NRVBA160T3G	ON Semiconductor
D5, D6, D7, D8, LD1, LD2, LD3, LD4, LD5, LD6	10	Green	LED, Green, SMD	QTLP630C4TR	Everlight
F1	1		Fuse, 3 A, 32 VDC, SMD	F0603E3R00FSTR	AVX
H1	1		SFP Single Cage	U77-A1118-200T	Amphenol Canada
J1	1		Header, 100mil, 2x2, Gold, TH	TSW-102-07-G-D	Samtec
J2, J4, J7, J21, J22, J23, J27, J28, J33, J34, J35, J36	12		Header, 100mil, 3x1, Gold, TH	HTSW-103-07-G-S	Samtec
J3	1		Receptacle, 0.8mm, 10x2, Gold, R/A, SMT	1367073-1	TE Connectivity
J6, J8, J10, J11, J19, J26	6		Header, 100mil, 2x1, Gold, TH	HTSW-102-07-G-S	Samtec
J15	1		Header, 2.54mm, 3x2, Gold, R/A, TH	90122-0763	Molex
J20	1		RJ45, No LED, tab up, R/A, TH	1-406541-1	TE Connectivity
J24, J29, J30, J31	4		Terminal, Turret, TH, Double	1502-2	Keystone
J25	1		Power Jack, 2mm, R/A, TH	PJ-037AH	CUI Inc.
J32	1		Connector, Receptacle, Micro-USB Type AB, R/A, Bottom Mount SMT	475890001	Molex
L1, L2	2	1uH	Inductor, Shielded, Ferrite, 1 uH, 1.6 A, 0.115 ohm, SMD	IFSC0806AZER1R0M01	Vishay-Dale
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	THT-14-423-10	Brady
P1	1		Header, 100mil, 8x2, Gold, TH	TSW-108-07-G-D	Samtec
R1, R2, R3, R4, R5, R6, R108, R109, R110	9	470	RES, 470, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW0402470RJNED	Vishay-Dale
R7, R8, R9, R10, R19, R20, R25, R27, R30, R32, R35, R37, R42, R44, R88, R90, R92, R93	18	2.49k	RES, 2.49 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW04022K49FKED	Vishay-Dale

Table 4-1. Bill of Materials (continued)

DESIGNATOR	QTY	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
R11, R15	2	0	RES, 0, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW04020000Z0ED	Vishay-Dale
R12	1	47k	RES, 47 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW040247K0JNED	Vishay-Dale
R13	1	1.40k	RES, 1.40 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW04021K40FKED	Vishay-Dale
R14	1	1.00Meg	RES, 1.00 M, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW04021M00FKED	Vishay-Dale
R16, R17	2	27	RES, 27, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW040227R0JNED	Vishay-Dale
R18, R21, R24, R28, R29, R36	6	470	RES, 470, 1%, 0.1 W, 0603	RC0603FR-07470RL	Yageo America
R22	1	0	RES, 0, 5%, 0.063 W, 0402	ERJ-2GE0R00X	Panasonic
R26	1	4.7k	RES, 4.7 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW04024K70JNED	Vishay-Dale
R31, R38, R45, R47	4	0	RES, 0, 5%, 0.063 W, 0402	MCR01MZPJ000	Rohm
R34, R39, R46, R48	4	49.9	RES, 49.9, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW040249R9FKED	Vishay-Dale
R49, R50, R51, R52, R53, R54, R55, R56, R57, R58, R59, R60, R61, R62, R76, R78, R79, R84	18	0	RES, 0, 5%, 0.063 W, 0402	RC0402JR-070RL	Yageo America
R73	1	11.0k	RES, 11.0 k, 1%, 0.05 W, 0201	CRCW020111K0FKED	Vishay-Dale
R74	1	22	RES, 22, 5%, 0.05 W, AEC-Q200 Grade 1, 0201	ERJ-1GNJ220C	Panasonic
R75	1	2.21k	RES, 2.21 k, 0.1%, 0.1 W, AEC-Q200 Grade 0, 0603	TNPW06032K21BEEA	Vishay-Dale
R77, R80	2	2.2k	RES, 2.2 k, 5%, 0.05 W, 0201	CRCW02012K20JNED	Vishay-Dale
R81	1	100	RES, 100, 1%, 0.1 W, 0402	ERJ-2RKF1000X	Panasonic
R82	1	100	RES, 100, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	ERJ-2GEJ101X	Panasonic
R83, R86, R89	3	0	RES, 0, 5%, .05 W, AEC-Q200 Grade 0, 0201	ERJ-1GN0R00C	Panasonic
R96, R97, R98, R99	4	75.0	RES, 75.0, 1%, 0.125 W, 0805	CRCW080575R0FKEA	Vishay-Dale
R102	1	4.22k	RES, 4.22 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW06034K22FKEA	Vishay-Dale
R103	1	1.35k	RES, 1.35 k, 0.1%, 0.1 W, 0603	RT0603BRD071K35L	Yageo America
R104, R106, R113, R116	4	10.0k	RES, 10.0 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW040210K0FKED	Vishay-Dale
R105, R111, R115	3	0	RES, 0, 5%, 0.125 W, 0805	ERJ-6GEY0R00V	Panasonic
R107	1	750	RES, 750, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW0402750RJNED	Vishay-Dale
R112	1	33	RES, 33, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW040233R0JNED	Vishay-Dale
R114	1	10.0k	RES, 10.0 k, 1%, 0.1 W, 0603	RC0603FR-0710KL	Yageo America
R117	1	1.13k	RES, 1.13 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW06031K13FKEA	Vishay-Dale
R120	1	4.53k	RES, 4.53 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW06034K53FKEA	Vishay-Dale
S1	1		Switch, SPST 4 Pos, Top Actuated, SMT	219-4LPST	CTS Electrocomponents
S2, S3	2		Switch, Normally open, 2.3N force, 200k operations, SMD	KSR221GLFS	C&K Components

Table 4-1. Bill of Materials (continued)

DESIGNATOR	QTY	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
SH1, SH2, SH3, SH4, SH5, SH6, SH7, SH8, SH9, SH10, SH11, SH12, SH13	13	1x2	Shunt, 100mil, Gold plated, Black	969102-0000-DA	3M
T1	1	325uH	Transformer, 325 uH, SMT	HX5008NL	Pulse Engineering
T2	1		Coupled inductor, 5 A, 0.01 ohm, SMD	ACM9070-701-2PL-TL01	TDK
U1	1		25 MHz Mixed Signal Microcontroller with 128 KB Flash, 8192 B SRAM and 63 GPIOs, -40 to 85 degC, 80-pin QFP (PN), Green (RoHS & no Sb/Br)	MSP430F5529IPN	Texas Instruments
U2	1		Robust, High Immunity 10/100/1000 Ethernet Physical Layer Transceiver, RGZ0048B (VQFN-48)	DP83869EMRGZT	Texas Instruments
U3	1		Oscillator, 25 MHz, SMD	SG-210STF 25.0000ML3	Epson
U4, U5	2		4-Channel Ultra-Low-Capacitance IEC ESD Protection Diode, DQA0010A (USON-10)	TPD4E05U06DQAR	Texas Instruments
U6	1		Single Output Fast Transient Response LDO, 1.5 A, Adjustable 1.21 to 20 V Output, 2.1 to 20 V Input, 5-pin DDPAK (KTT), -40 to 125 degC, Green (RoHS & no Sb/Br)	TL1963AQKTTRQ1	Texas Instruments
U7	1		Single Output LDO, 1A, Adj. (1.2 to 5.0V), Reverse Current Protection, DRV0006A (WSON-6)	TPS73733DRVR	Texas Instruments
U8	1		150-mA, 30-V, Ultra-Low IQ, Wide Input Low-Dropout Regulator with Reverse Current Protection, DRV0006A (WSON-6)	TPS70933DRVR	Texas Instruments
U9	1		Single Output High PSRR LDO, 500 mA, Fixed 2.5 V Output, 2.7 to 6.5 V Input, with Low IQ, 8-pin SON (DRB), -40 to 125 degC, Green (RoHS & no Sb/Br)	TPS73525DRBR	Texas Instruments
U10	1		Single Output LDO, 500 mA, Adjustable 0.8 to 3.6 V Output, 0.8 to 5.5 V Input, with Programmable Soft Start, 10-pin SON (DRC), -40 to 125 degC, Green (RoHS & no Sb/Br)	TPS74701DRCR	Texas Instruments
XTAL1	1		Crystal, 25 MHz, 20 ppm, AEC-Q200 Grade 1, SMD	ECS-250-12-33Q-JES-TR	ECS Inc.
Y1	1		Resonator, 4 MHz, 39 pF, AEC-Q200 Grade 1, SMD	CSTCR4M00G55B-R0	MuRata
C12, C14, C15, C17	0	0.1uF	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X5R, 0402	160R07X104KV4T	Johanson Technology
C42	0	0.01uF	CAP, CERM, 0.01 uF, 50 V, +/- 5%, X7R, 0402	C0402C103J5RACTU	Kemet
C43	0	1000pF	CAP, CERM, 1000 pF, 25 V, +/- 5%, X7R, 0402	C0402C102J3RACTU	Kemet
C44	0	100pF	CAP, CERM, 100 pF, 50 V, +/- 5%, C0G/NP0, 0402	CC0402JRNPO9BN101	Yageo America
C47, C48, C50, C52, C53, C55, C56, C58	0	0.033uF	CAP, CERM, 0.033 uF, 10 V, +/- 10%, X5R, 0402	GRM155R61A333KA01D	MuRata
C60, C61, C62, C63, C64, C65, C66	0	4700pF	CAP, CERM, 4700 pF, 2000 V, +/- 10%, X7R, 1812	1812GC472KAT1A	AVX
J5, J9, J12, J13	0		JACK, SMA, 50 Ohm, Gold, R/A, TH	901-143-6RFX	Amphenol RF

Table 4-1. Bill of Materials (continued)

DESIGNATOR	QTY	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
J14	0		Header, 2.54mm, 15x2, Gold, TH	PRPC015DAAN-RC	Sullins Connector Solutions
J16, J18	0		Mini-RFCable Connector 50 Ohm	MCX?J?P?H?ST?SM1	Samtec
J17	0		Header, 100mil, 4x2, Gold, TH	TSW-104-07-G-D	Samtec
R23, R33, R40	0	6.04k	RES, 6.04 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW04026K04FKED	Vishay-Dale
R41, R43	0	2.49k	RES, 2.49 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW04022K49FKED	Vishay-Dale
R63, R64, R65, R66, R67, R68, R69, R70, R87, R94, R95	0	0	RES, 0, 5%, .05 W, AEC-Q200 Grade 0, 0201	ERJ-1GN0R00C	Panasonic
R71, R72	0	0	RES, 0, 5%, 0.063 W, 0402	MCR01MZPJ000	Rohm
R85	0	4.70k	RES, 4.70 k, 1%, 0.05 W, 0201	CRCW02014K70FKED	Vishay-Dale
R91	0	1.00Meg	RES, 1.00 M, 1%, 0.063 W, 0402	RC0402FR-071ML	Yageo America
R100, R101	0	1.00Meg	RES, 1.00 M, 1%, 1 W, 2010	HVCB2010FKC1M00	Stackpole Electronics Inc
R118, R119	0	0	RES, 0, 5%, 0.1 W, 0603	RC0603JR-070RL	Yageo America
TP1, TP2, TP3, TP4, TP5, TP6	0		Test Point, Miniature, SMT	5019	Keystone

5 Additional Information

5.1 Definitions

Table 5-1. Terminology

ACRONYM	DEFINITION
PHY	Physical Layer Transceiver
MAC	Media Access Controller
SMI	Serial Management Interface
MDIO	Management Data I/O
MDC	Management Data Clock
MII	Media Independent Interface
RMII	Reduced Media Independent Interface
RGMII	Reduced Gigabit Media Independent Interface
SGMII	Serial Gigabit Media Independent Interface
VDDA	Analog Core Supply Rail
VDDIO	Digital Supply Rail
PD	Pulldown
PU	Pullup

Trademarks

6 Revision History

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

Changes from Revision A (January 2024) to Revision B (July 2025) **Page**

- Added the Features Section 1
- Added the Kit Contents Section 3
- Updated Schematics. 15
- Added the Layout Section 20
- Added the Bill of Materials Section 24

Changes from Revision * (April 2018) to Revision A (January 2024) **Page**

- Changed jumper number from *J26* to *J25* and jumper number *J35* to *J34* 5
- Changed jumper number from *J36* to *J35* 5
- Updated note in *SGMII/Fiber Interface* section 10
- Changed switch from *S3* to *S1* 11

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