ISLRTG4DEMO1Z

Renesas Radiation Hardened Power Solution for RTG4 FPGA

Over the last decade satellites and spacecrafts have seen an exponential increase in the need for on-board data processing and storage demands. Additionally, major satellite manufacturers have recently announced their latest satellites to be modular, fully digital and capable of in-orbit reconfigurability. To meet these demands, satellite and payload manufacturers are using high-end FPGAs, ASICs and processors. Microsemi's RTG4 FPGA is a radiation hardened FPGA that has comparable performance to commercial counterparts in demanding computing applications. The RTG4 requires a complex power solution with multiple low voltage supply rails that can deliver high currents and a need for power supply sequencing to eliminate high inrush currents.

In collaboration with Microchip and Ibeos, Microsemi's RTG4 development board schematic and layout board were modified to replace the existing power solution that uses commercial grade products with Renesas Radiation Hardened power products as shown in Figure 1. An image of the ISLRTG4DEMO1Z reference board is shown in Figure 3. It has the same functionality as the Microchip RTG4 Development Kit but includes the space grade power solution from Renesas' Intersil family of power management ICs.

Related Literature

For a full list of related documents, visit our website:

- ISL70002SEH, ISL70003ASEH, ISL70005SEH, ISL75051ASEH, ISL70321SEH device pages
- RTG4 Radiation-Tolerant FPGAs Product Overview
- RTG4 FPGA Datasheet
- RTG4 FPGA Development Kit, UG0617 User Guide

Features

- Radiation hardened QMLV power solution (MIL-PRF-38535)
- RTG4 footprint compatibility with spaceflight version
- 2x1GB DDR3 SDRAM
- 2GB SPI flash memory
- PCI express Gen1 x1 interface
- PCIe x4 edge connector
- One pair of SMA connectors for testing of the full-duplex SERDES channel
- Two FMC connectors with HPC/LPC pinout for expansion
- RJ45 interface for 10/100/1000 Ethernet
- USB Micro-AB connector
- Headers for SPI and GPIOs
- FTDI programmer interface to program the SPI flash
- JTAG programming interface
- RVI header for application programming and debug
- FlashPro programming header
- Embedded Trace Macro (ETM) cell header for debug
- Dual In-Line Package (DIP) switches for user applications
- Push button switches and LEDs for demo purposes
- Current measurement test points

Specifications

- Power Supply Input using DC Jack: 12V ±10%

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1. Functional Description

The RTG4 development platform allow users to prototype and evaluate the performance of the FPGA in different applications. Figure 1 shows a block diagram of the development board. The board includes two 1GB Double Data Rate 3 (DDR3) memories and two 1GB SPI flash memories. The board also has several standard and advanced peripherals, such as PCIe x4 edge connector, two FMC connectors for using several off-the-shelf daughter cards, USB, Philips inter-integrated circuit (I^2C), gigabit Ethernet port, serial peripheral interface (SPI), and UART. Additionally, a FlashPro programmer is embedded on the board, which allows RTG4 FPGA programming through the JTAG interface.

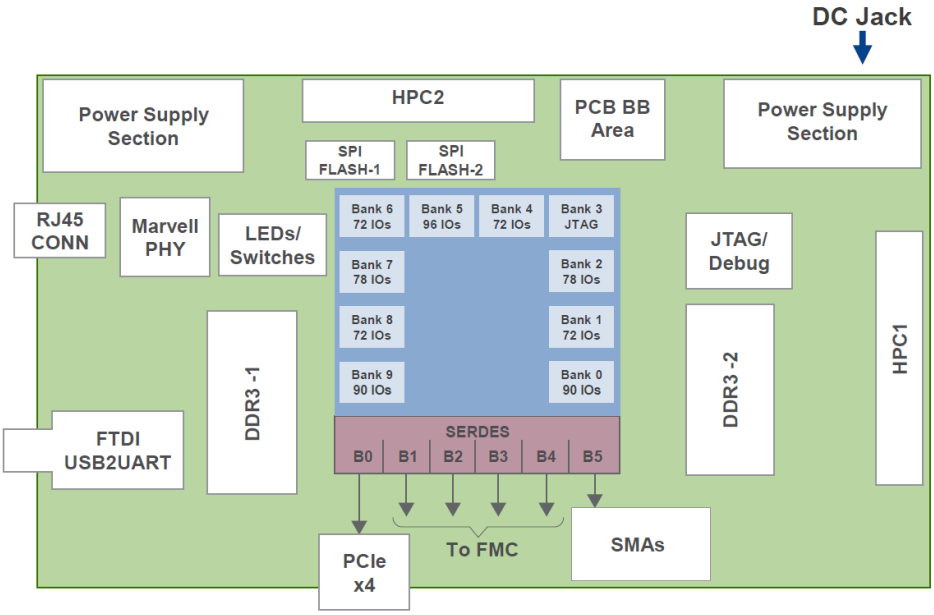


Figure 1. ISLRTG4DEMO1Z Block Diagram

1.1 Getting Started

Microchip provides demo platforms for evaluating various blocks of the Microsemi RTG4 FPGA. These platforms are published through their Demonstration Guides and can be found in the FPGA guide repository.

Example Demonstration Guides include:

- DG0622: RTG4 FPGA PCIe Data Plane Demo using Two Channel Fabric DMA
- DG0624: RTG4 FPGA SERDES EPCS Protocol Design
- DG0625: Interfacing RTG4 FPGA with External DDR3 Memory
- DG0630: RTG4 FPGA DSP FIR Filter Demo Guide

Download these Demonstration Guides and follow the instructions within the guides to evaluate the Renesas ISLRTG4DEMO1Z development board. The Demonstration Guides reference jumper settings for setting up the original Microsemi RTG4 Development Kit. The jumper reference designators for the Renesas ISLRTG4DEMO1Z are the same, with J16 as the only omission. J16 for the Microsemi RTG4 Development Kit programs the DC/DC regulator that provides the core voltage either for 1.0V or 1.2V. J16 is not available on ISLRTG4DEMO1Z as the DC/DC regulator for the core voltage is fixed at 1.2V.

More information on the Microsemi RTG4 Development Kit, including the user guide and board design files are located on the Microsemi website.

1.2 RTG4 Power Solution

Table 1 summarizes the Renesas part numbers, descriptions, and operating conditions of the Synchronous Buck Regulators and LDOs used in the space grade design.

Table 1. Radiation Hardened Power Management IC Configuration

Part Number	Description	Input Voltage (V)	Output Name	Output Voltage (V)	Output Current (A)
ISL70003ASEH	Radiation and SEE Tolerant 3V to 13.2V, 9A Buck Regulator	12	5V Intermediate Rail	5	9
ISL70002SEH	Radiation Hardened and SEE Hardened 22A Synchronous Buck Regulator with Current Sharing	5	VDD Core	1.2	16
ISL75051ASEH	Power for eight corner PLLs, PLLs in SerDes PCIe/PCS blocks, and FDDR PLL.	5	VDDPLL & VPP	3.3	1
ISL70005SEH	Radiation Hardened Dual Output Point-of-Load, Integrated Synchronous Buck and Low Dropout Regulator	5	DDR VDDQ	1.5	3
		1.5	DDR VTT	0.75	±1
ISL70002SEH	Radiation Hardened and SEE Hardened 22A Synchronous Buck Regulator with Current Sharing	5	3.3V Intermediate Rail	3.3	10
ISL75051ASEH	3A, Radiation Hardened, Positive, Ultra-Low Dropout Regulator.	3.3	SERDES_x_ Lyz_VDDAIO	1.2	3
ISL75051ASEH	3A, Radiation Hardened, Positive, Ultra-Low Dropout Regulator	3.3	SERDES_x_ Lyz_VDDAPLL	2.5	2

In addition to the power management ICs in Table 1, the ISL70321SEH quad power supply sequencer controls the power-up and power-down sequences of the power system. Figure 2 color codes the connections from the ISL70321SEH enable outputs to the enable inputs of the various power management ICs.

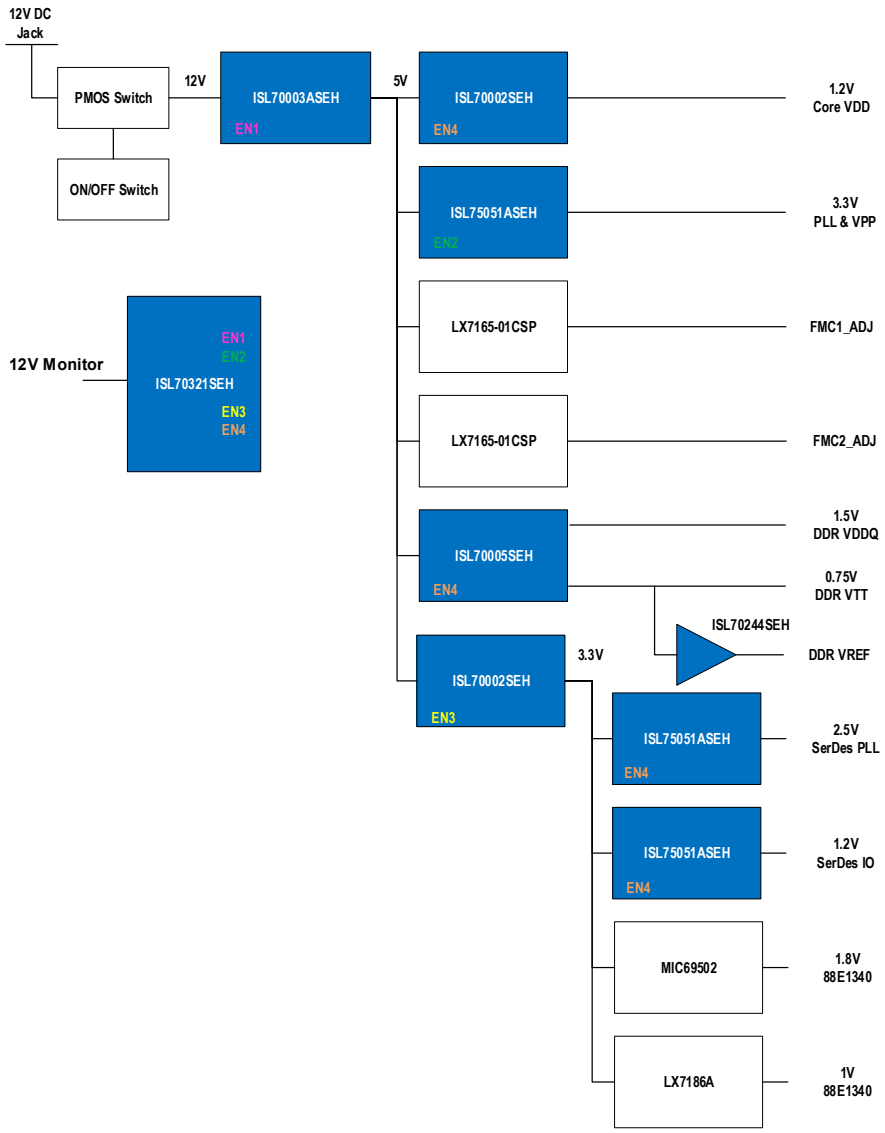


Figure 2. Renesas Space Grade Power Tree for the Microsemi RTG4

The following list summarizes the monitoring and control function of the ISL70321SEH:

- The 12V DC voltage is monitored by the ISL70321SEH and enables the ISL70003ASEH first when the voltage after the PMOS switch reaches 10V.
- When the 5V intermediate rail is up, the ISL75051ASEH is enabled to power the VPLL & VPP rail.
- When the VPLL & VPP rail is above the 3.1V, the ISL70002SEH is enabled to generate the 3.3V intermediate rail.
- When 3.3V is up, the regulators for the core VDD, DDR memory, and SerDes are enabled simultaneously.
- When the VDD rail is in proper regulation, the DONE signal from the ISL70321SEH is asserted high, which releases the RESET signal to the FPGA.

The final IC used in the power solution is the ISL70244SEH, a 19MHz radiation hardened 40V dual rail-to-rail input-output, low-power operational amplifier. The ISL70244SEH generates the DDR reference voltage in a buffer configuration with its input connected to the output of the LDO for the ISL70005SEH to achieve 50% tracking of the VDDQ rail. No changes have been made to the regulators for the FMC connectors or Ethernet PHY ICs.

Because there are no power-down requirements on the RTG4 FPGA, the reference board is set up to disable all regulators at the same time when the power switch is turned to the OFF state.

2. Board Design

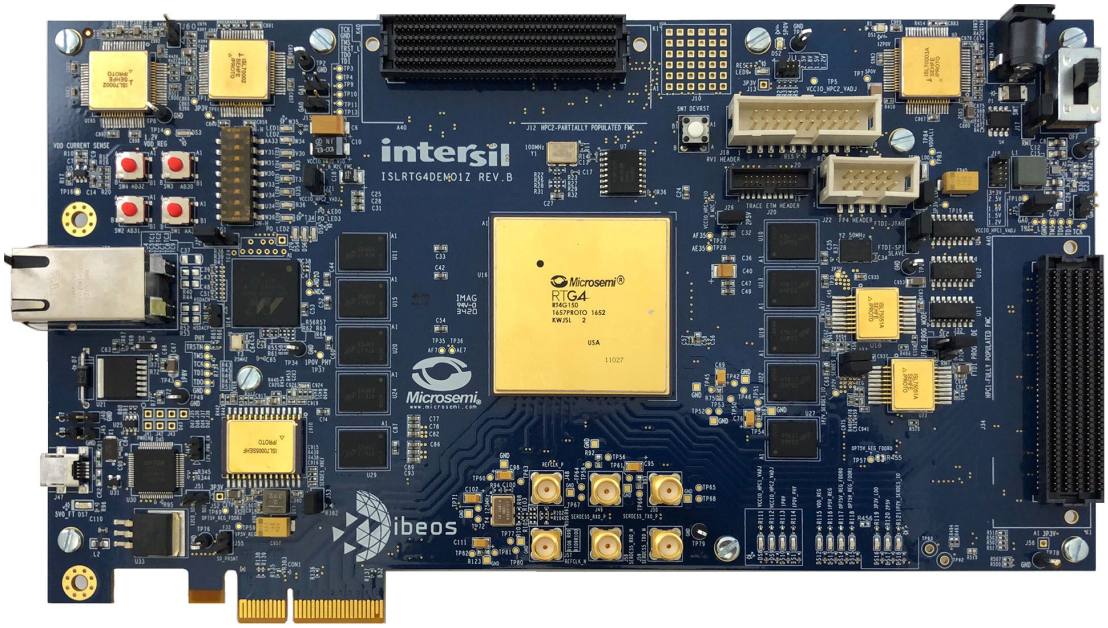


Figure 3. ISLRTG4DEMO1Z Reference Design (Top)

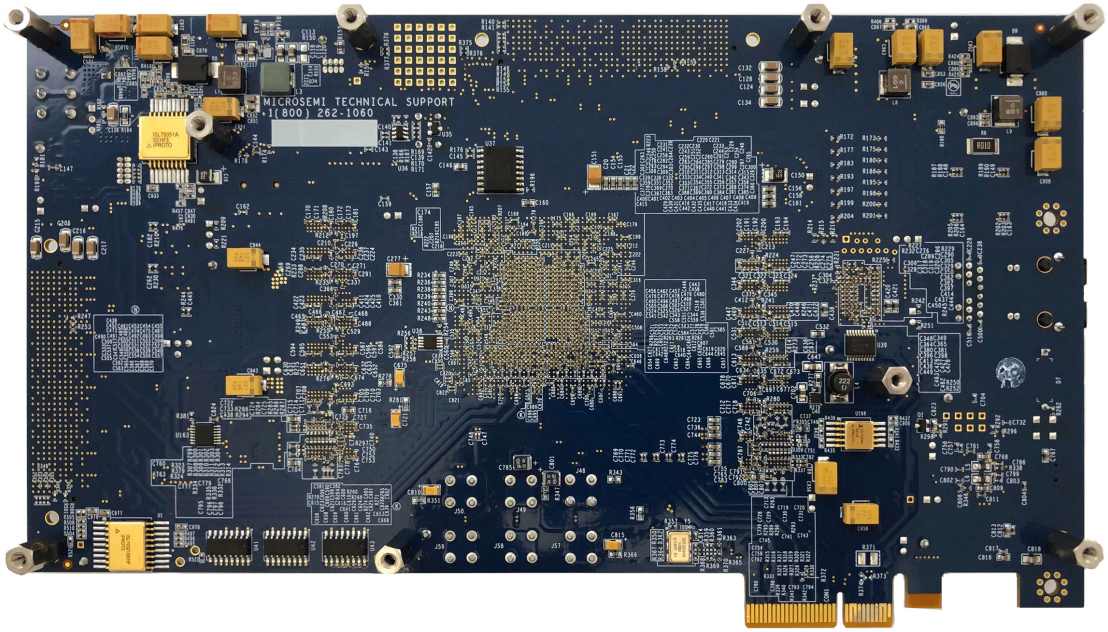


Figure 4. ISLRTG4DEMO1Z Reference Design (Bottom)

2.1 Layout Guidelines

Careful consideration must be taken with regards to the layout for the power management ICs for FPGA reference designs. The resulting current transitions from one power device to another can cause voltage spikes across the interconnecting impedances and parasitic circuit elements. These voltage spikes can degrade efficiency, radiate noise into the circuit, and lead to device overvoltage stress. Component layout and printed circuit design minimizes these voltage spikes. Here are some guidelines to follow:

- At least two layers should be dedicated for the ground plane, this reference design uses six layers dedicated to ground.
- Use the top and bottom layers primarily for signals. However, you can also use these to increase the VIN, VOUT, and GND planes as needed.
- Keep the signal and power grounds for each IC separate but have them tied together in a low noise area of the PCB. Be mindful that the noise generated from the power stage does not disrupt the signal ground.
- Place ceramic bypass capacitors directly at the power supply input pins of the PMIC. These capacitors are necessary to filter out any high frequency noise on those respective lines.
- Keep signal traces as short as possible.

2.2 Schematic Diagrams

2.2.1 Bank-0-FDDR0 Connection

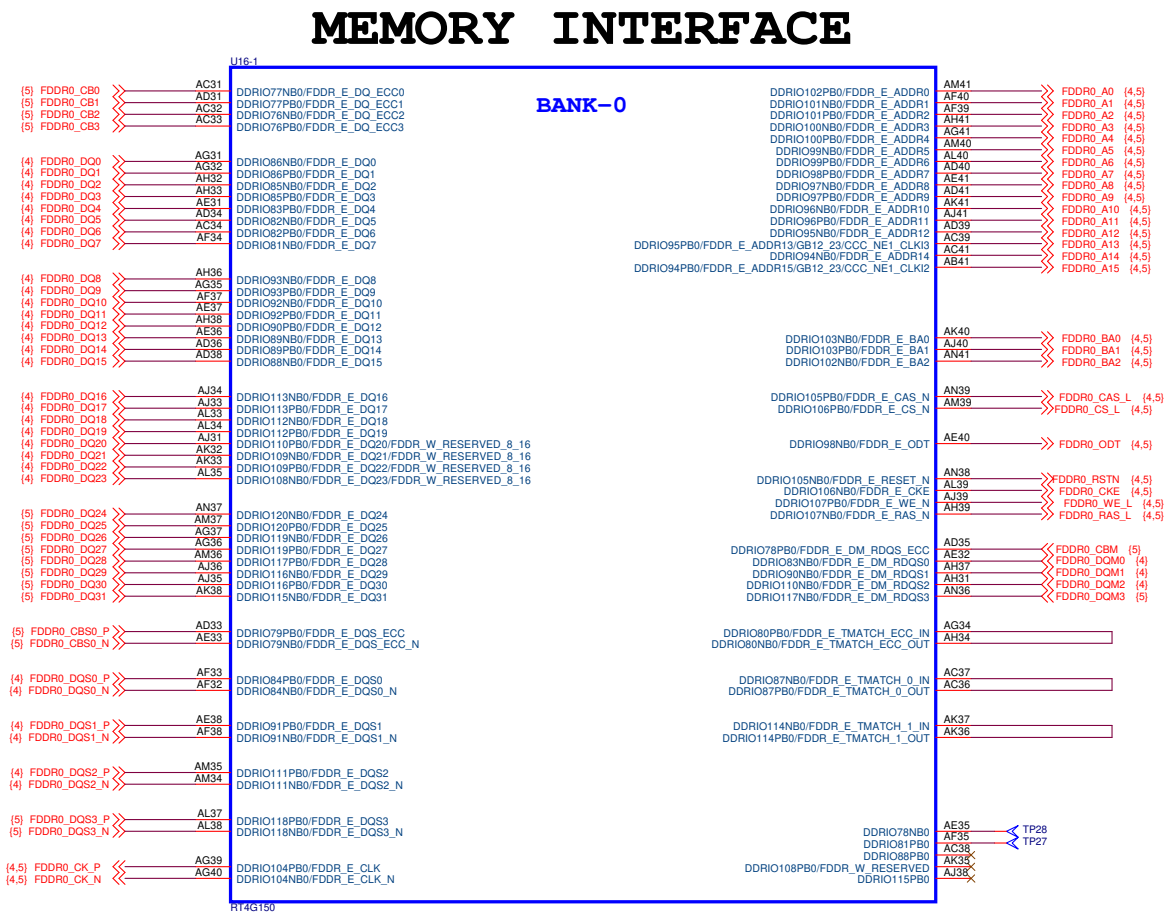


Figure 5. Schematic - Bank-0

2.2.2 DDR3-SDRAM Interface 1-FDDR0

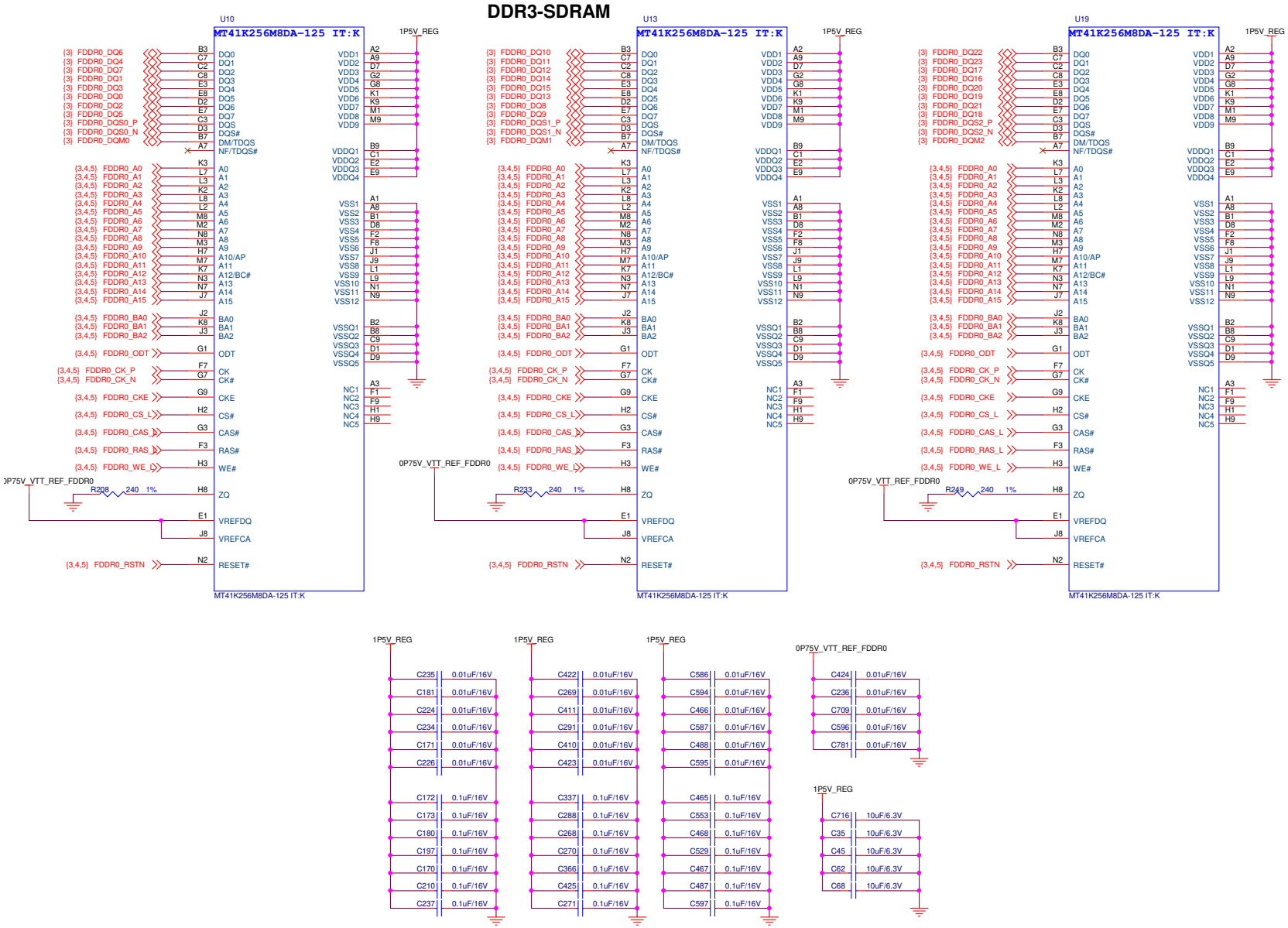


Figure 6. Schematic - DDR3-SDRAM Interface 1 - FDDR0

2.2.3 DDR3-SDRAM Interface 2-FDDR0

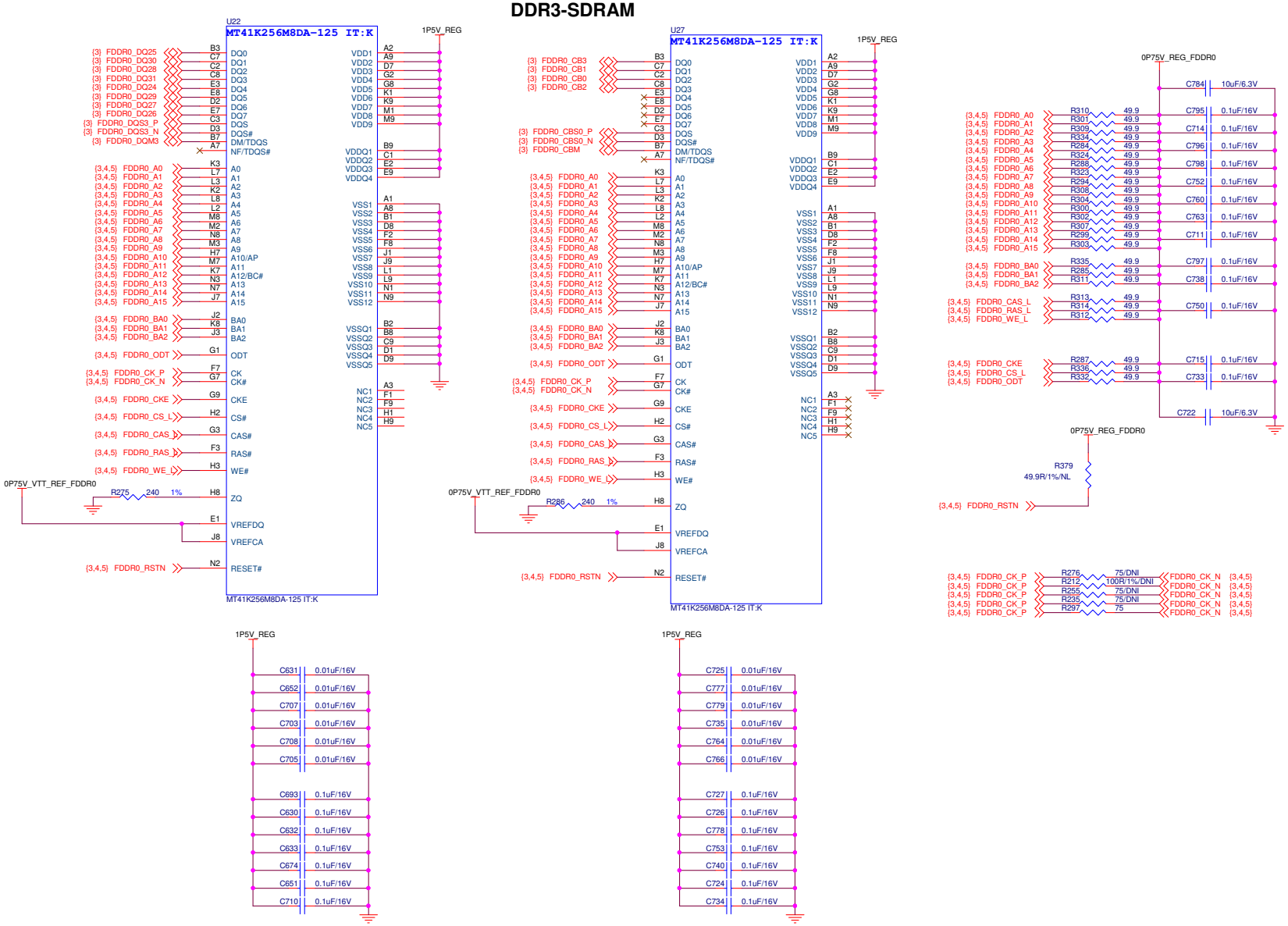


Figure 7. Schematic - DDR3-SDRAM Interface 2 - FDDR0

2.2.4 Bank-1 Connection

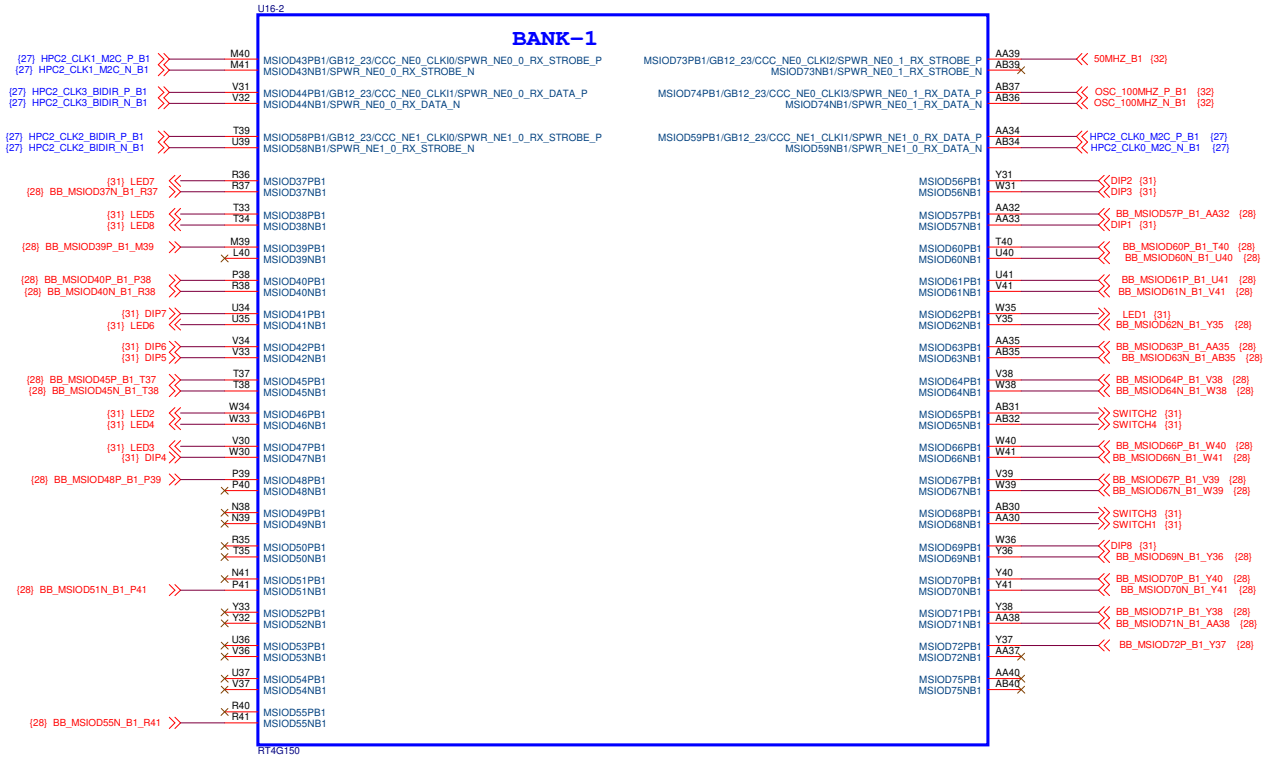


Figure 8. Schematic - Bank-1

2.2.5 Bank-2, Bank-3, and Miscellaneous Connection

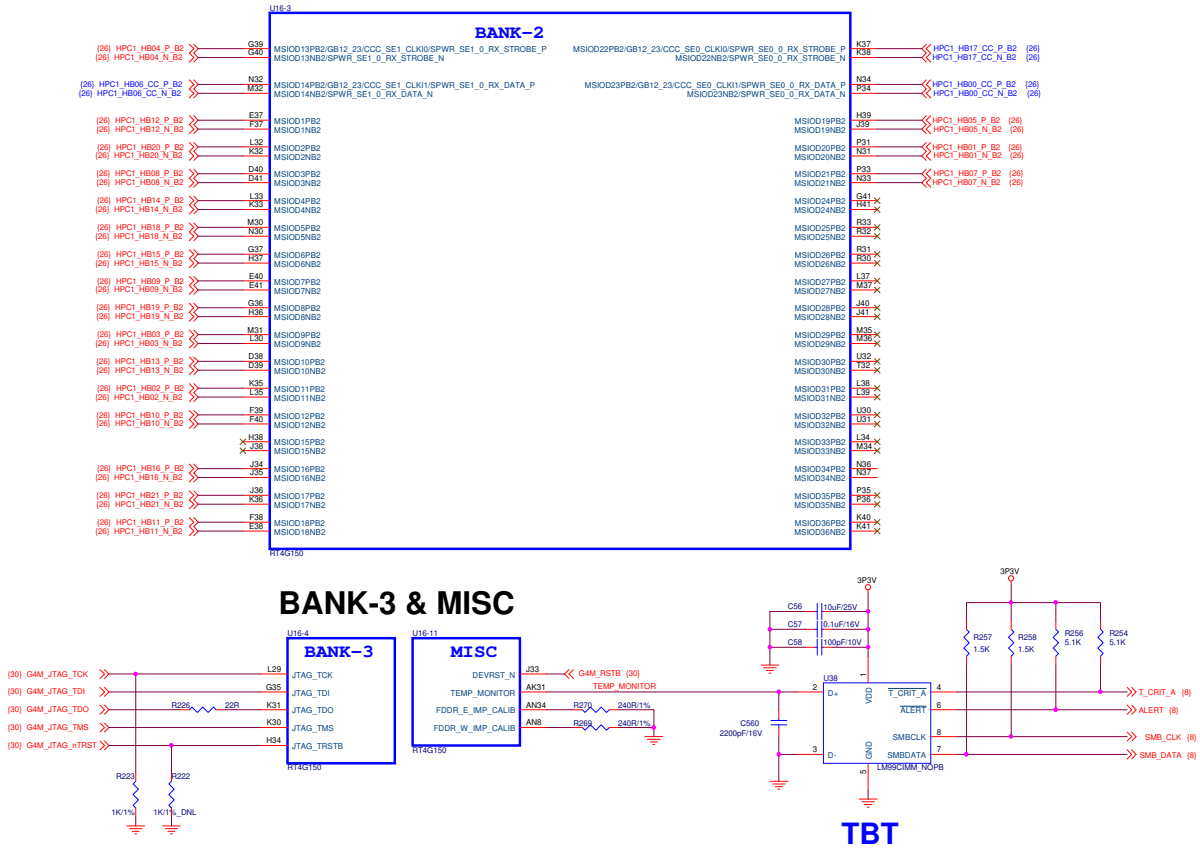


Figure 9. Schematic - Bank-2, Bank-3, and Miscellaneous

2.2.6 Bank-4 Connection

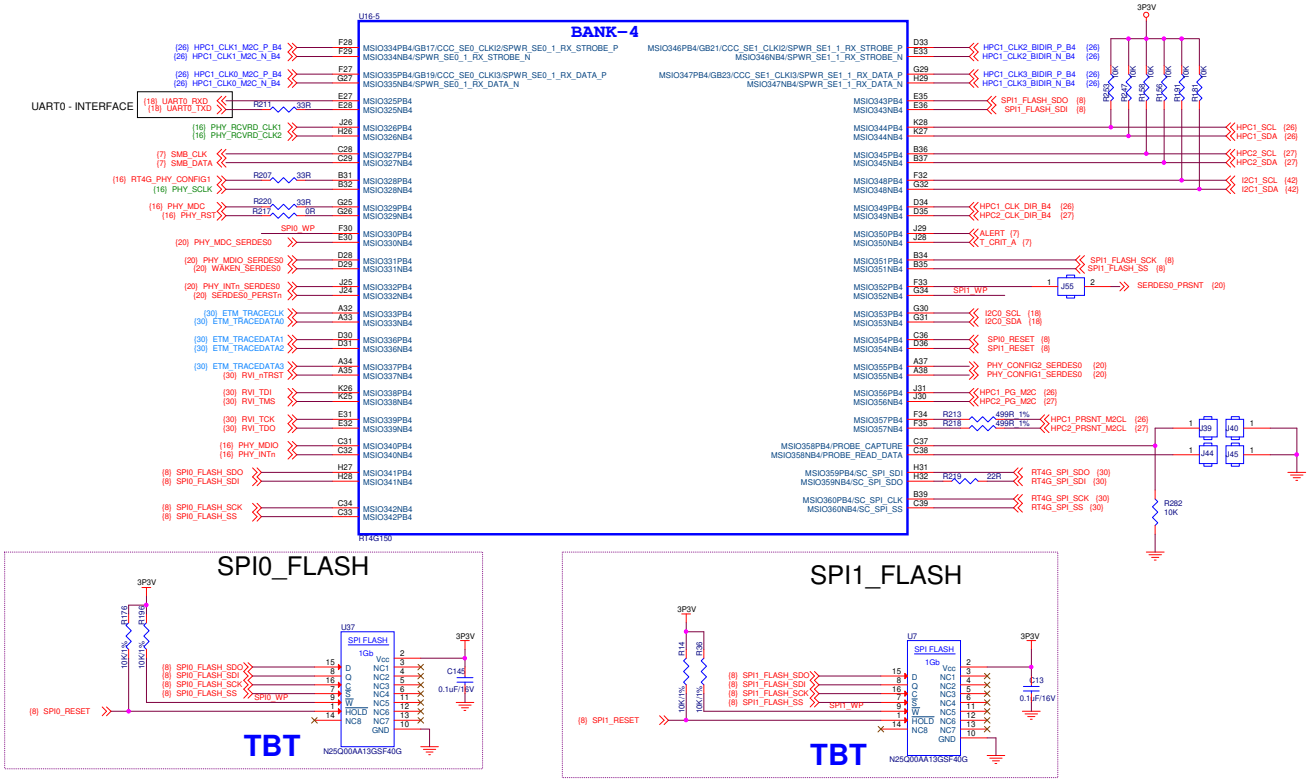


Figure 10. Schematic - Bank-4

2.2.7 Bank-5 Connection

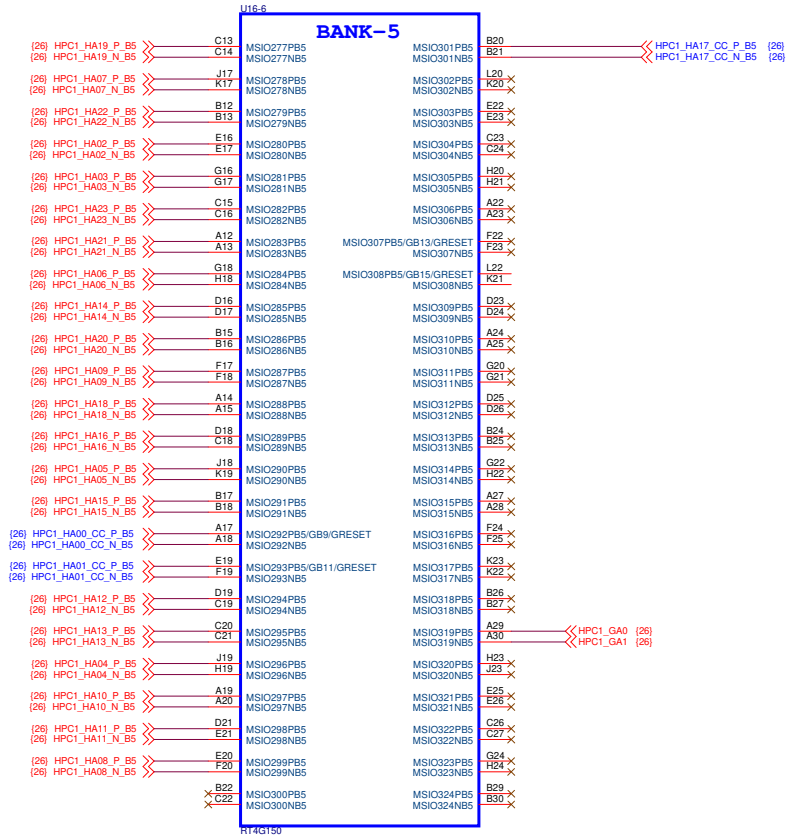


Figure 11. Schematic - Bank-5

2.2.8 Bank-6 Connection

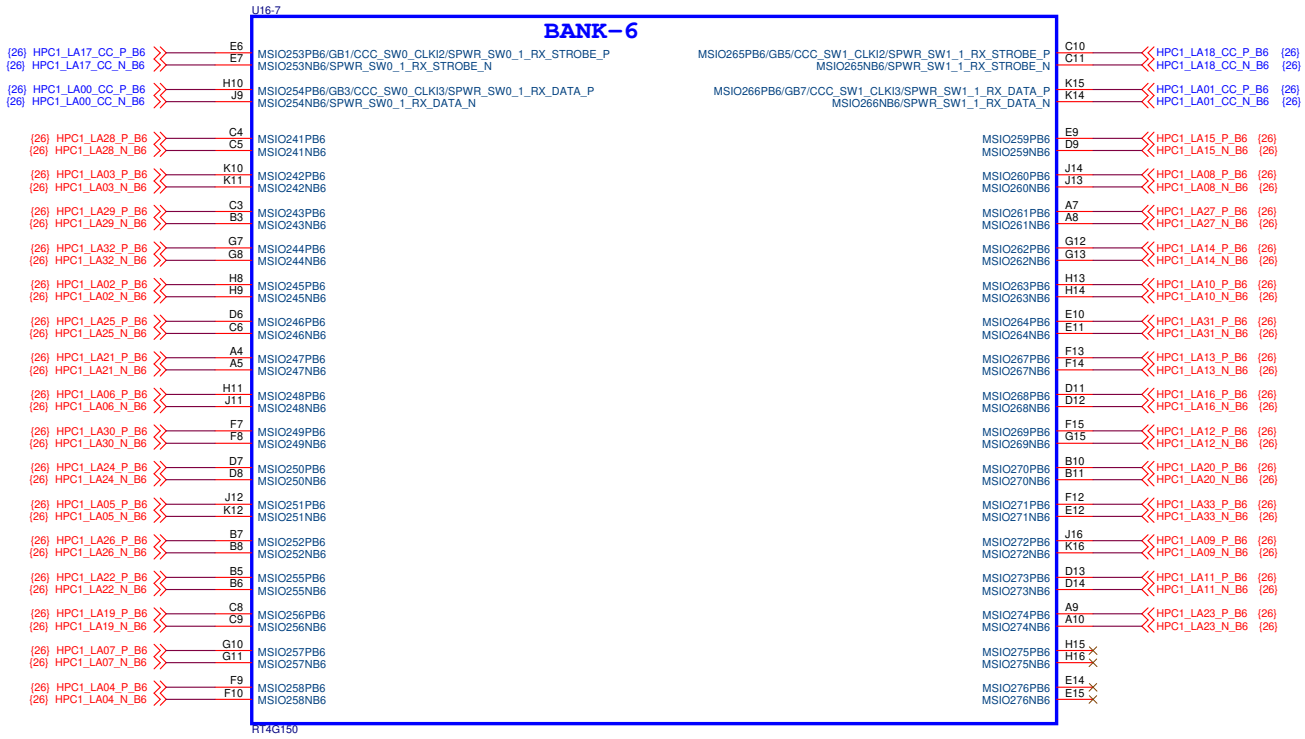


Figure 12. Schematic - Bank-6

2.2.9 Bank-7 Connection

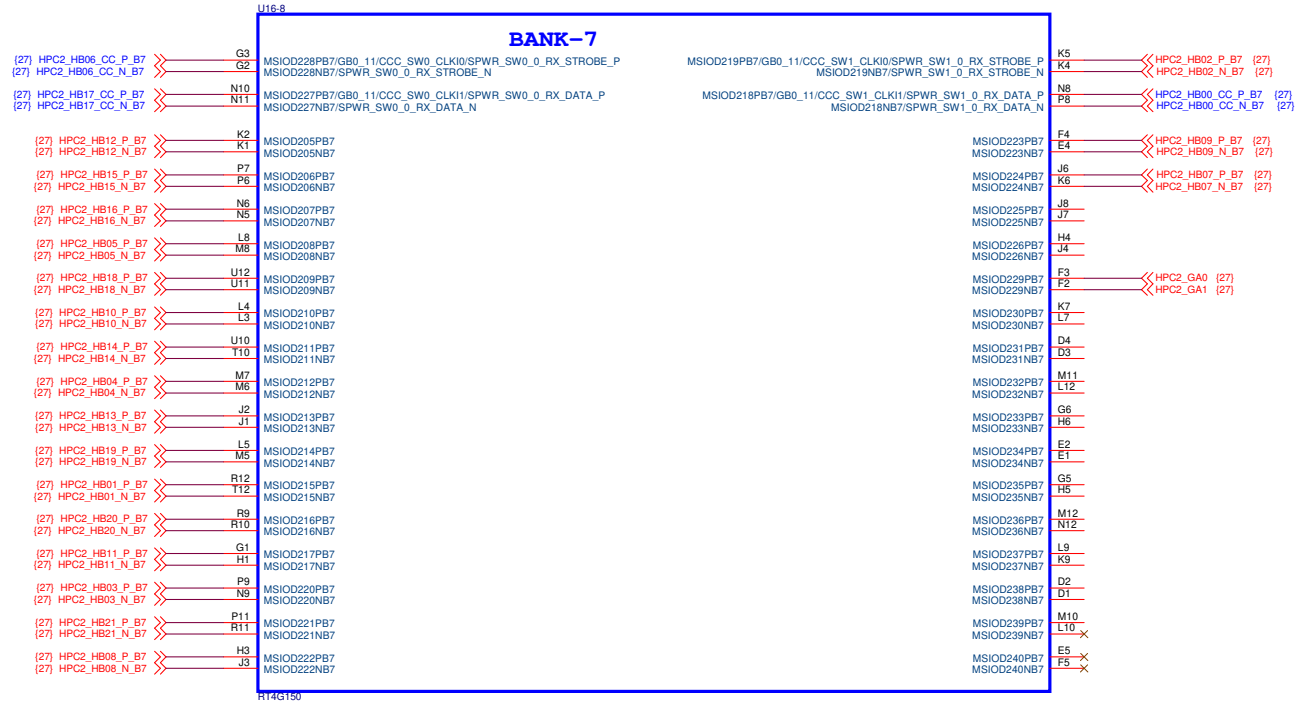


Figure 13. Schematic - Bank-7

2.2.10 Bank-8 Connection

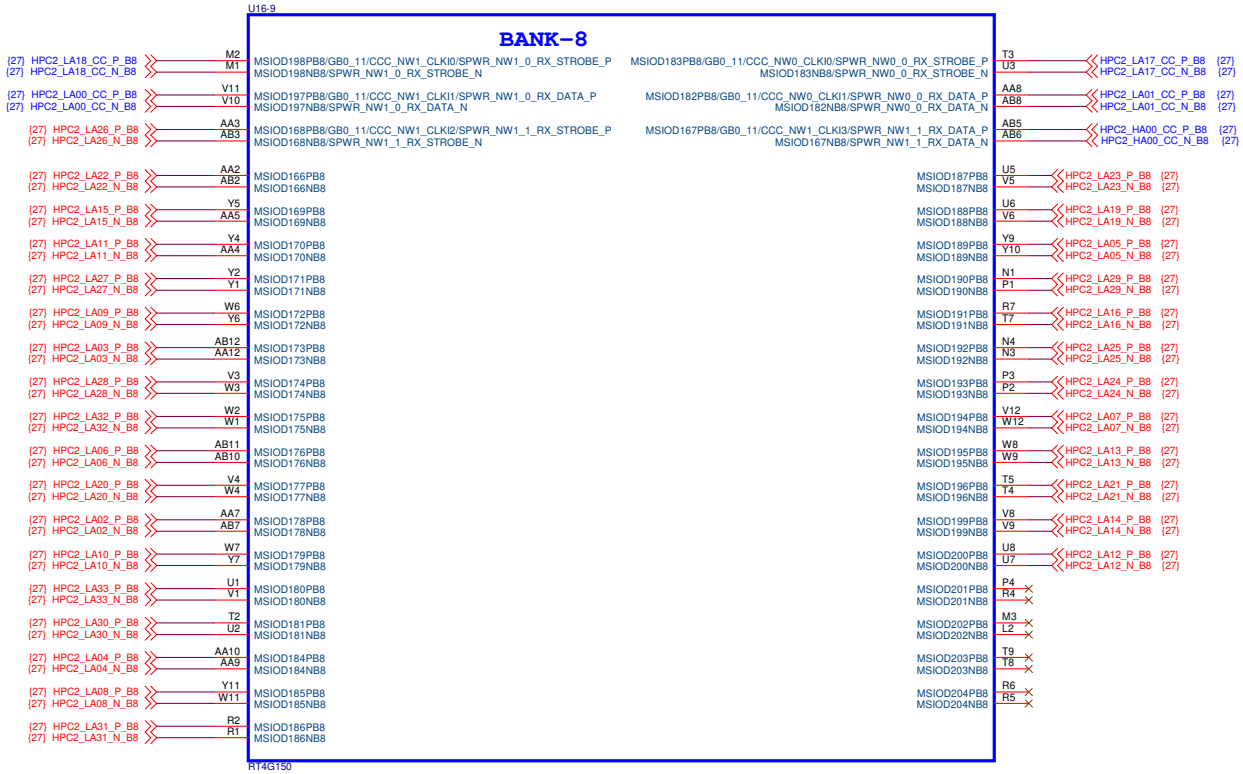


Figure 14. Schematic - Bank-6

2.2.11 Bank-9-FDDR1 Connection

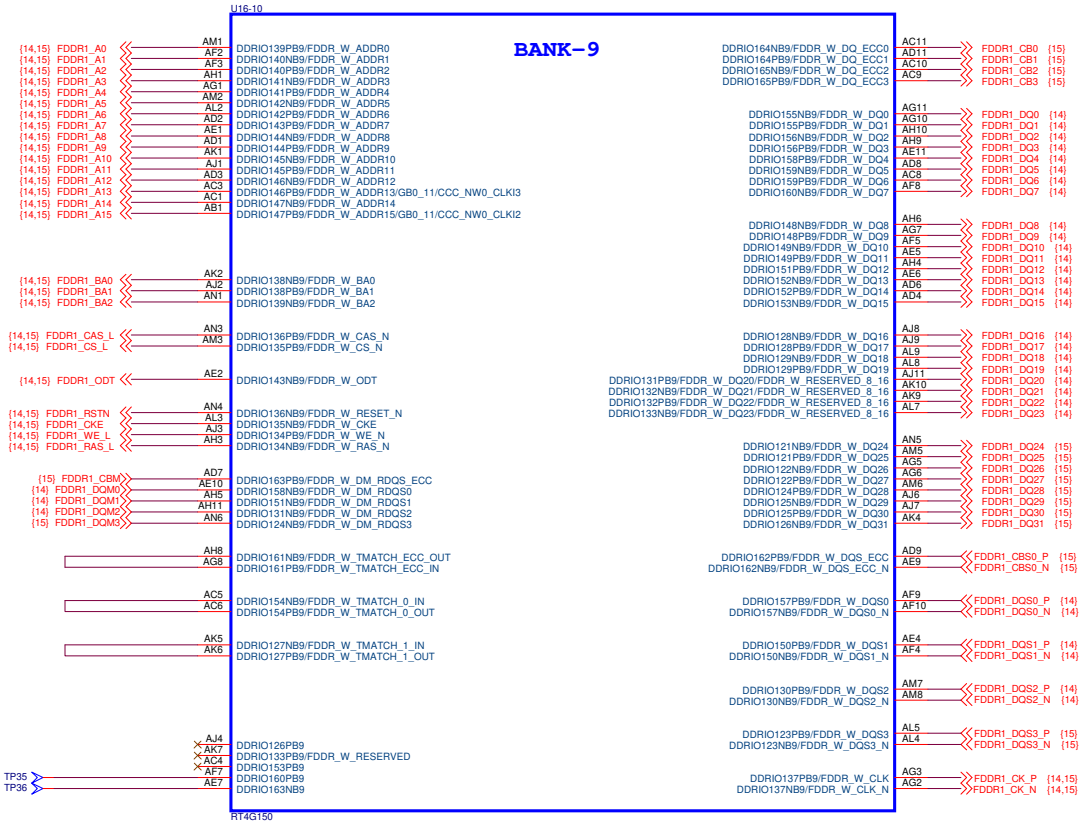


Figure 15. Schematic - Bank-9 FDDR Interface

2.2.12 DDR3-SDRAM Interface 1-FDDR1

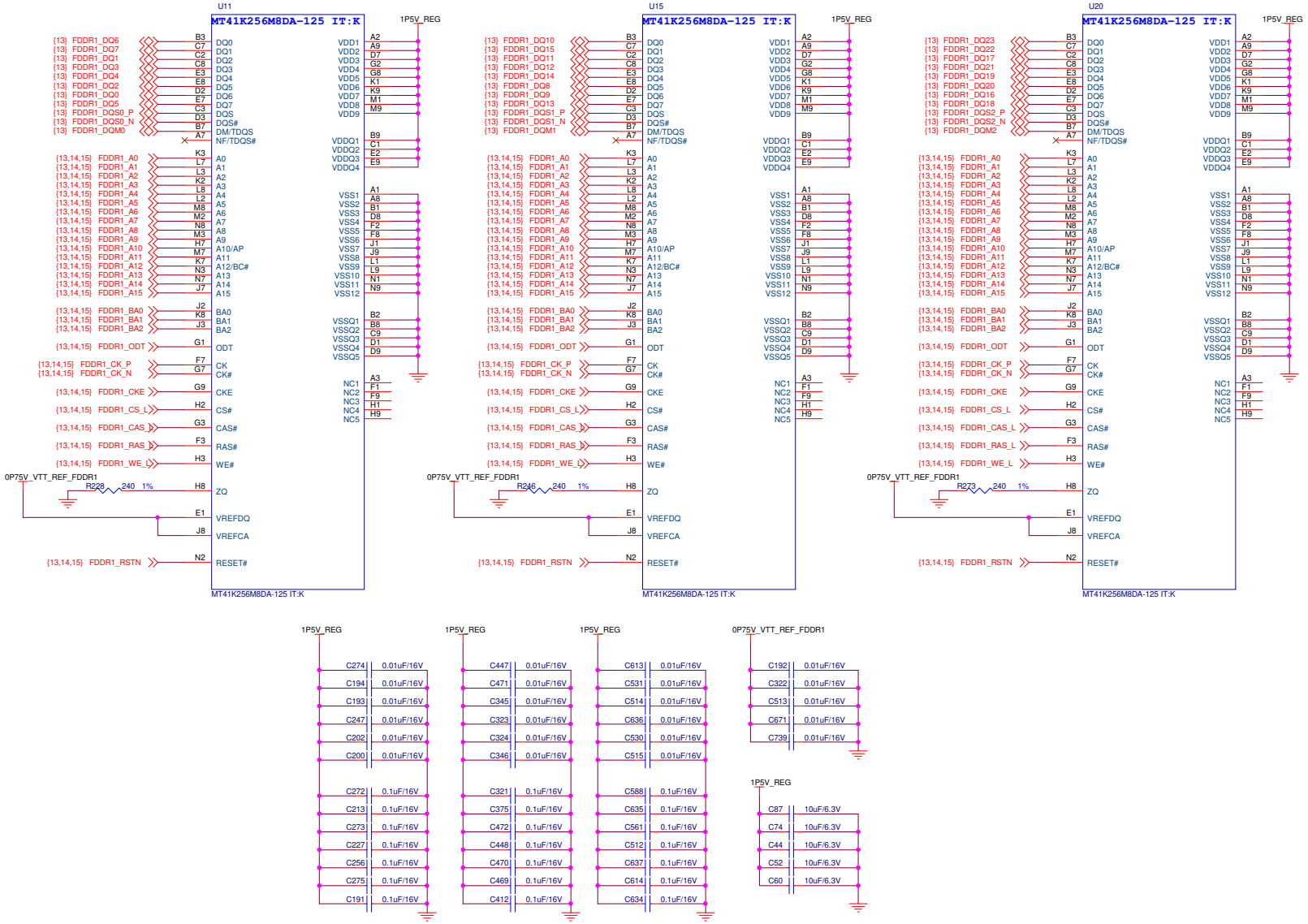


Figure 16. Schematic - DDR3-SDRAM Interface 1 - FDDR1

2.2.13 DDR3-SDRAM Interface 2-FDDR1

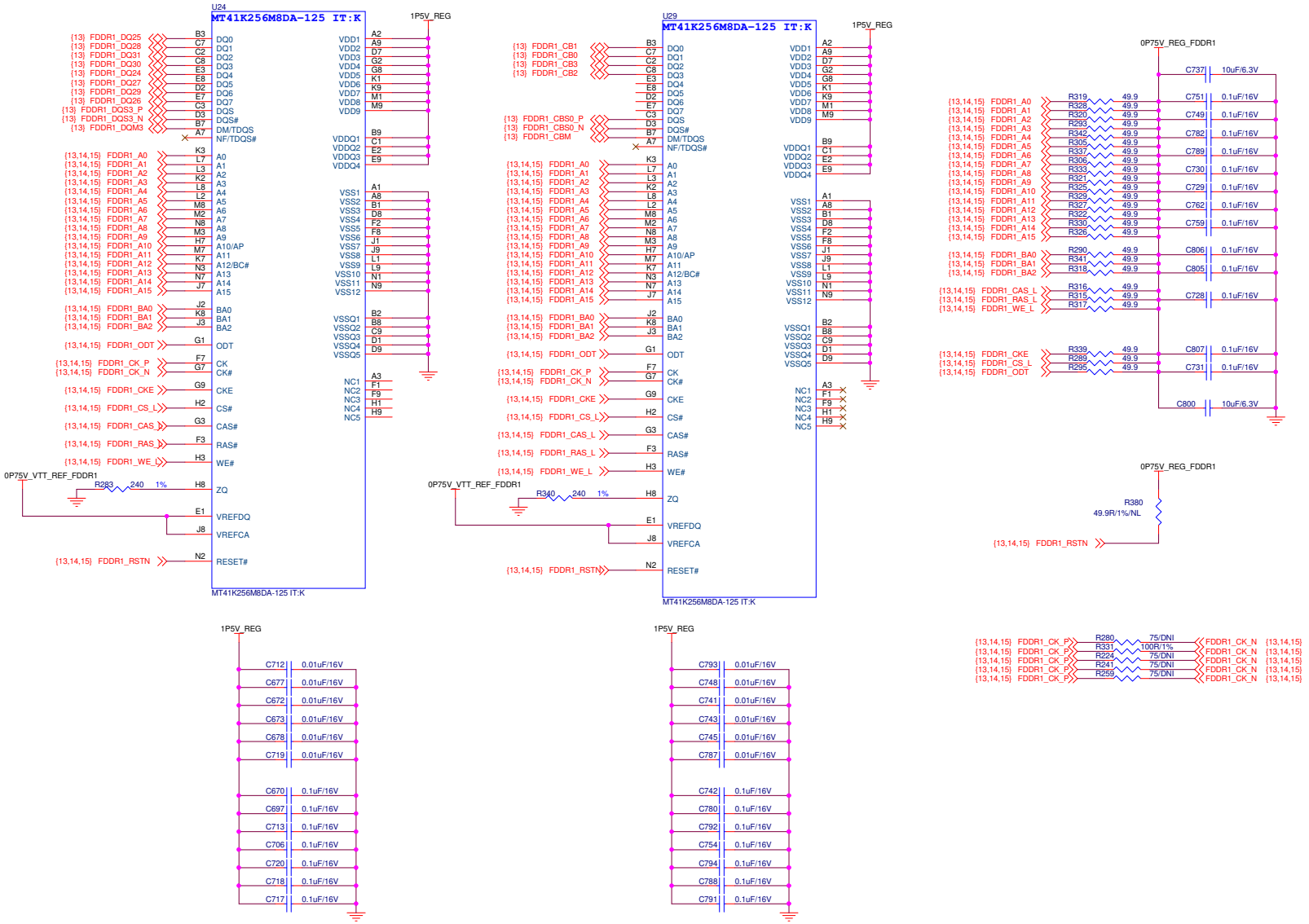


Figure 17. Schematic - DDR3-SDRAM Interface 2 - FDDR1

2.2.14 Marvell PHY-88E1340S

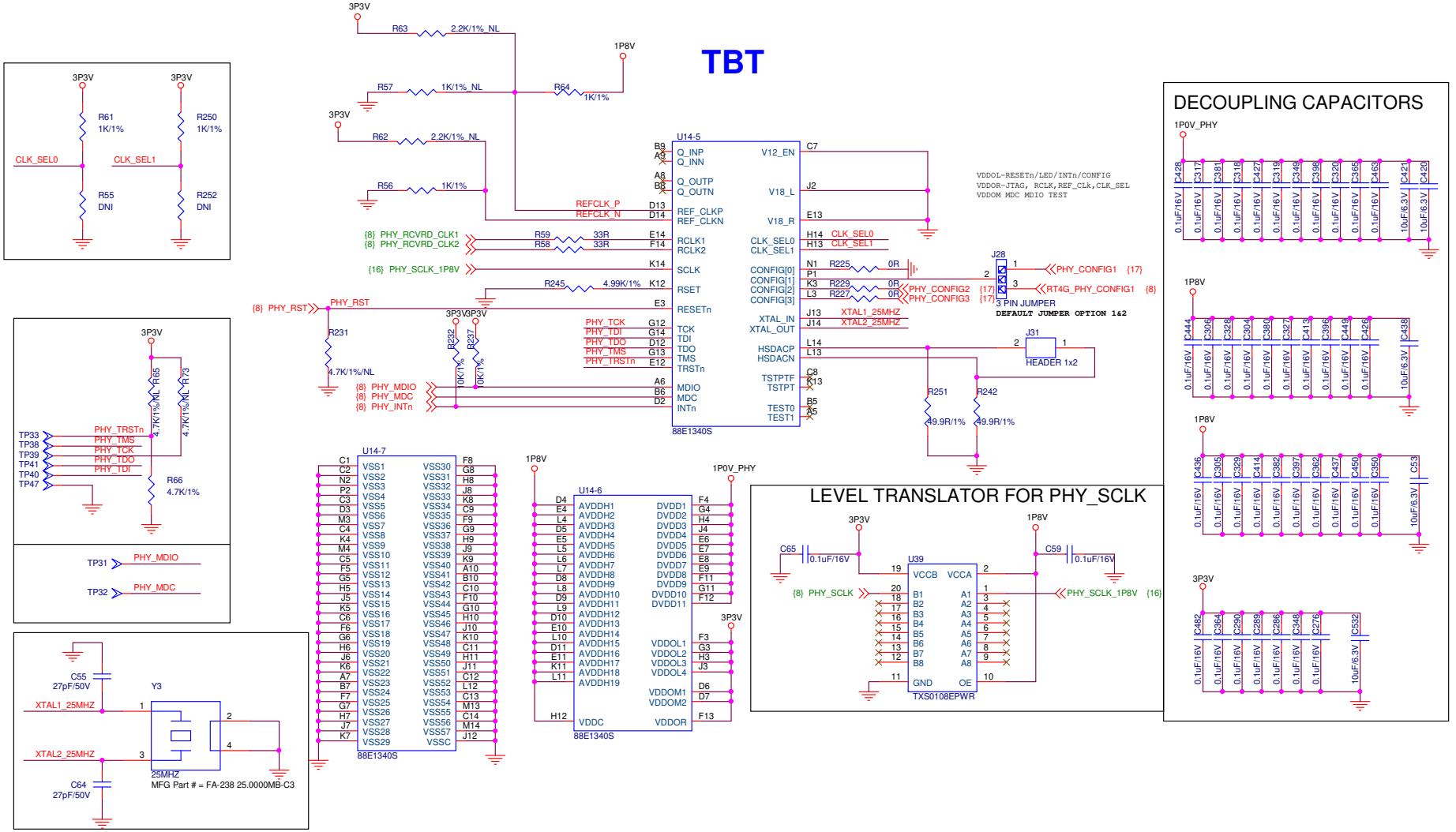


Figure 18. Schematic - Marvell PHY-88E1340S

2.2.15 Marvell PHY - RJ45 Interface

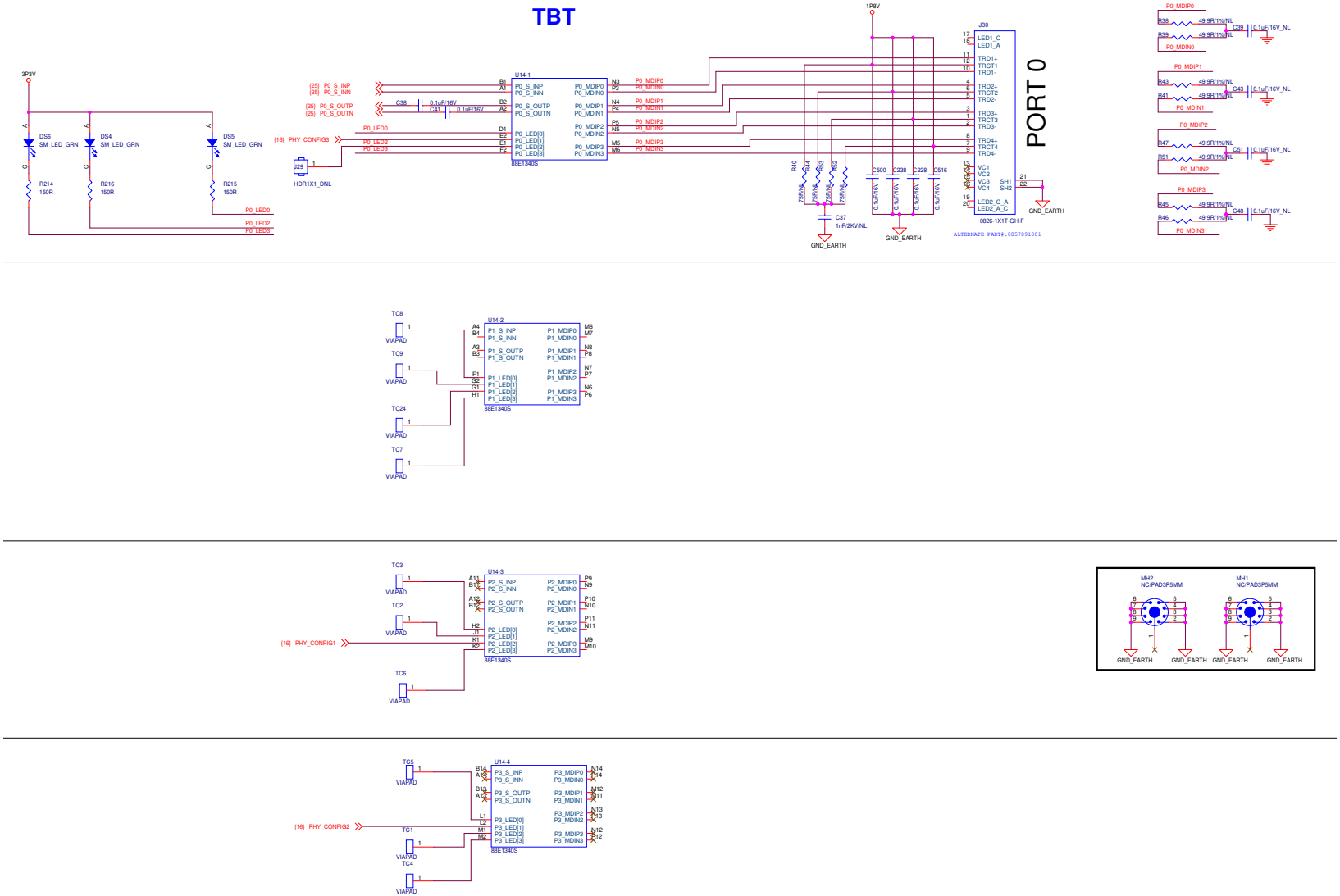


Figure 19. Schematic - Marvell PHY - RJ45 Interface

2.2.16 FT4232H Circuitry

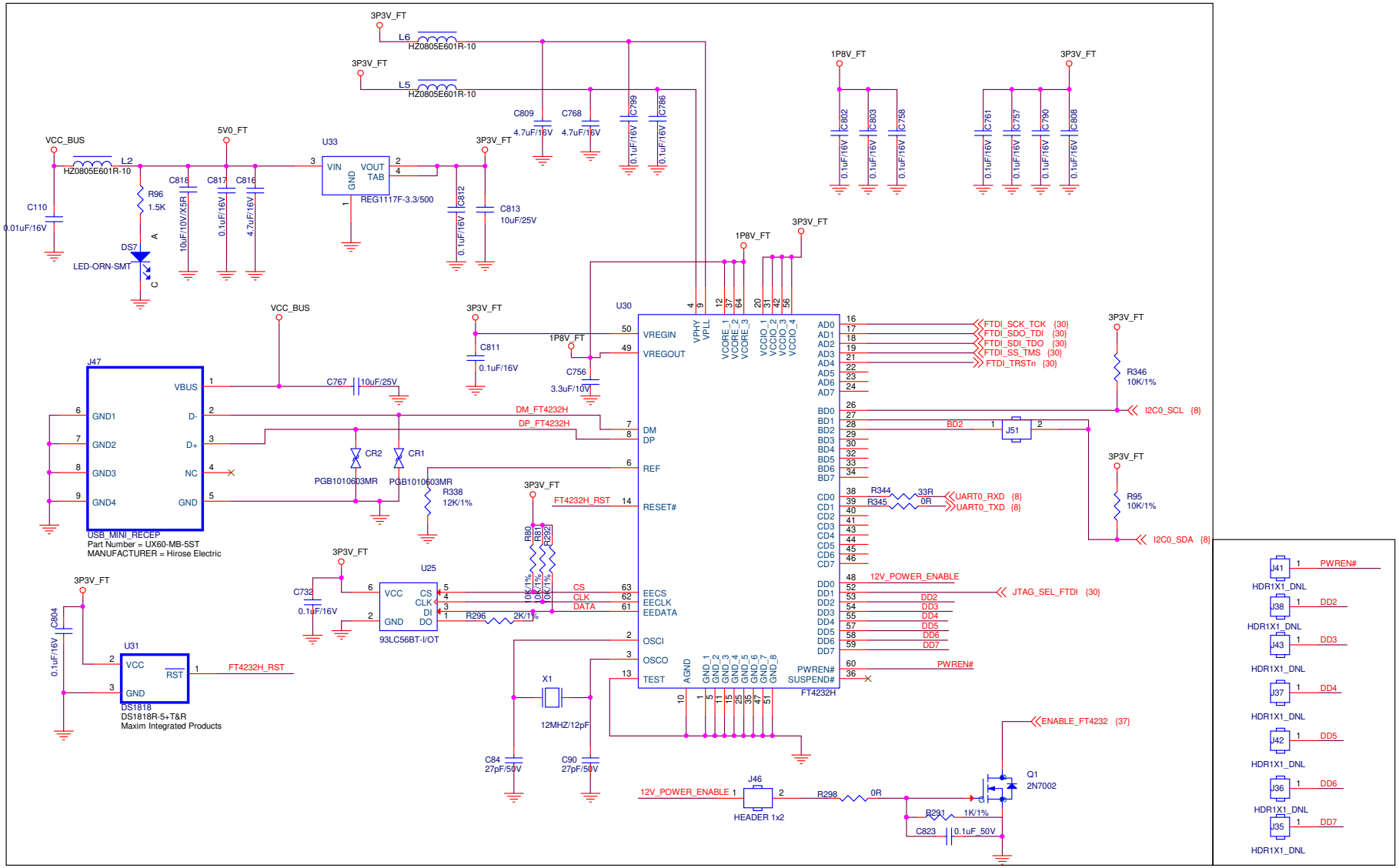


Figure 20. Schematic - FT4232H Circuitry

2.2.17 SerDes Block Diagram

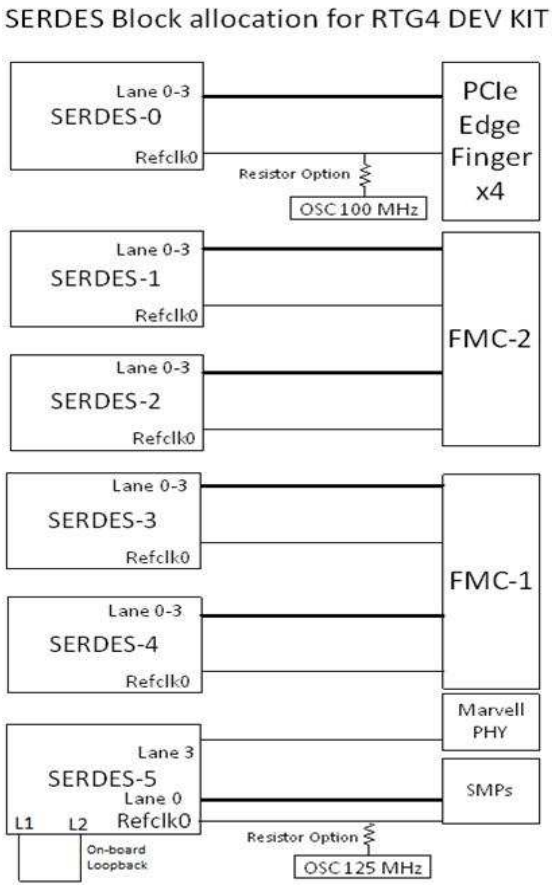


Figure 21. Schematic - SerDes Block Diagram

2.2.18 SerDes-0 Connection

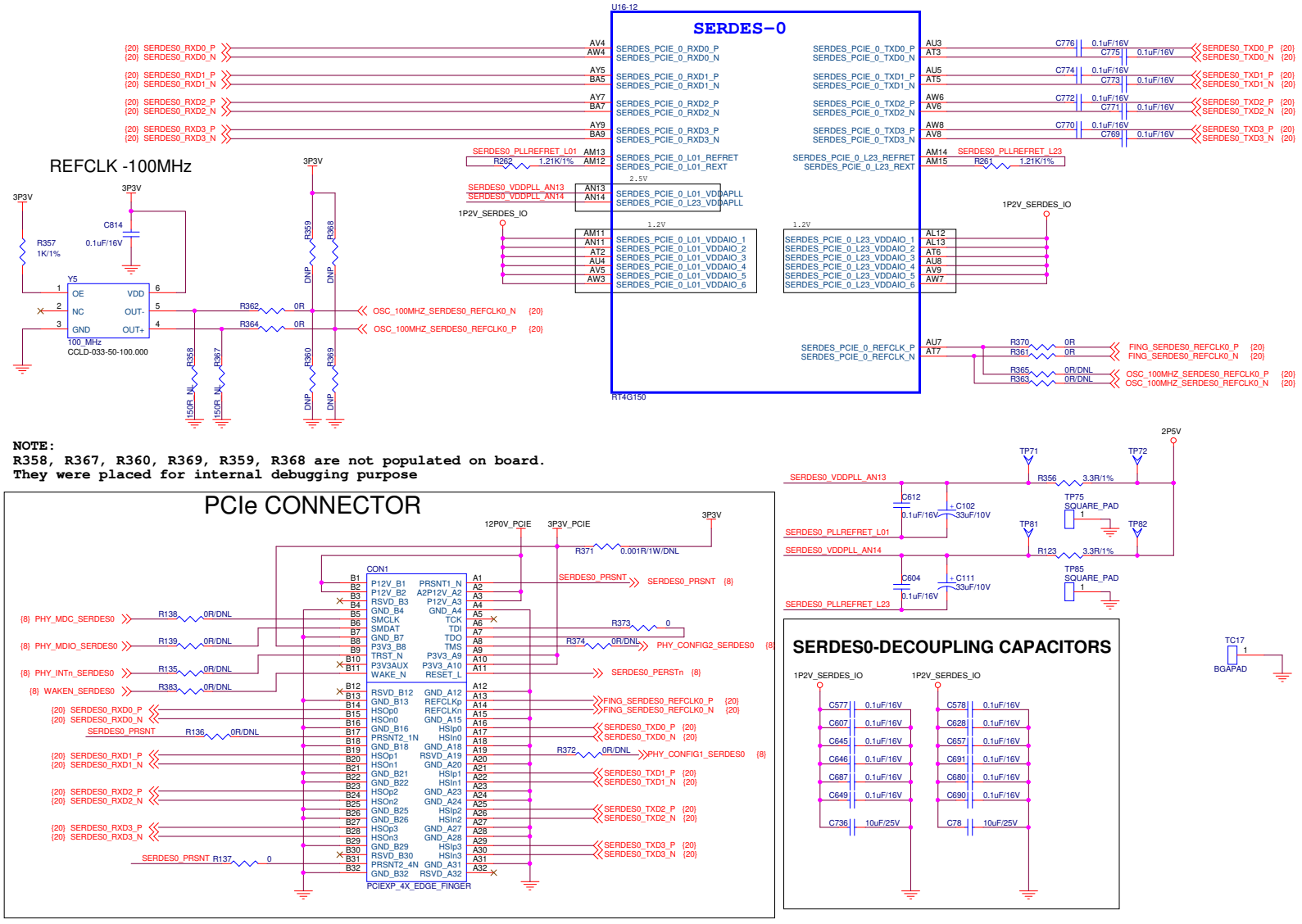


Figure 22. Schematic - SerDes-0 Connection

2.2.19 SerDes-1 Connection

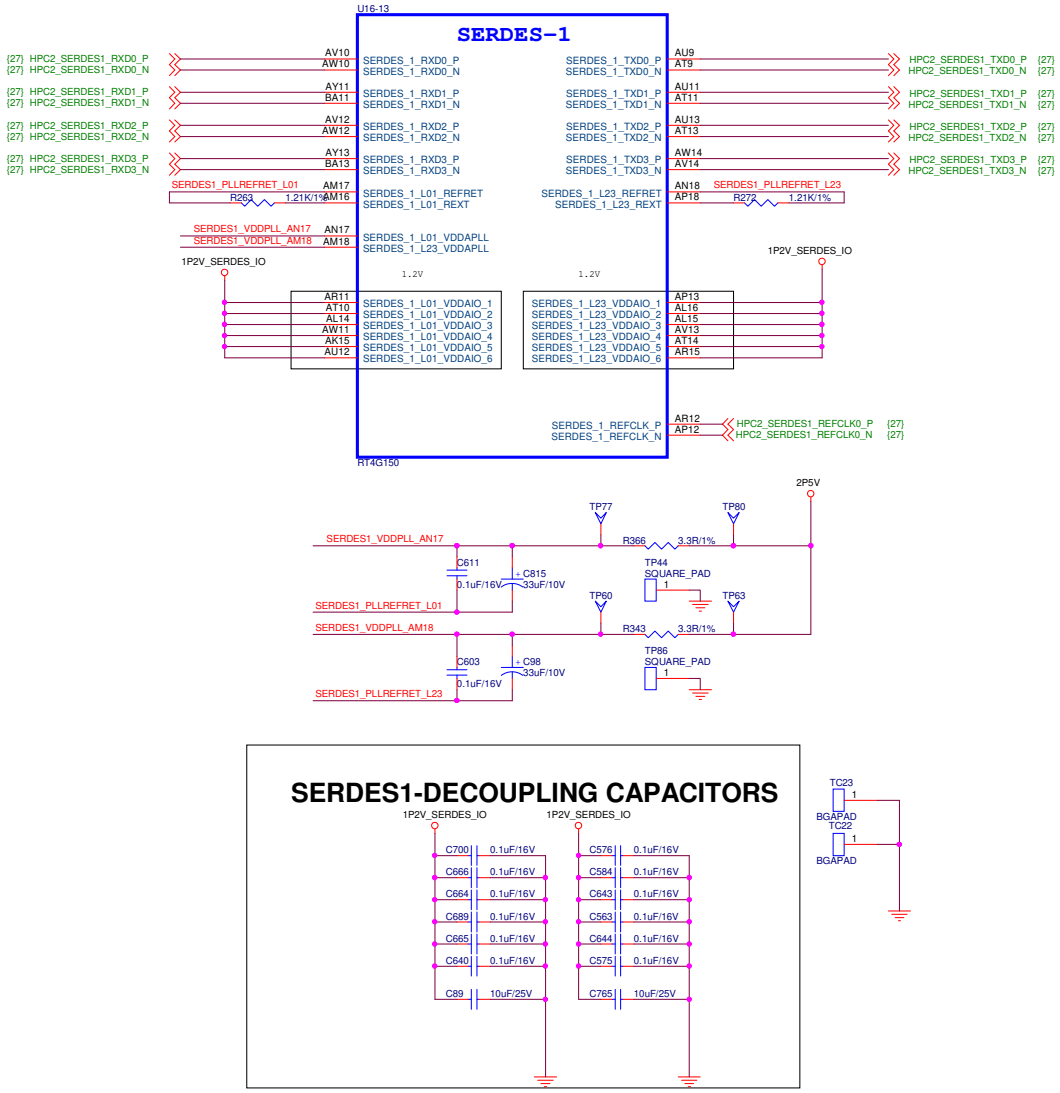


Figure 23. Schematic - SerDes-1 Connection

2.2.20 SerDes-2 Connection

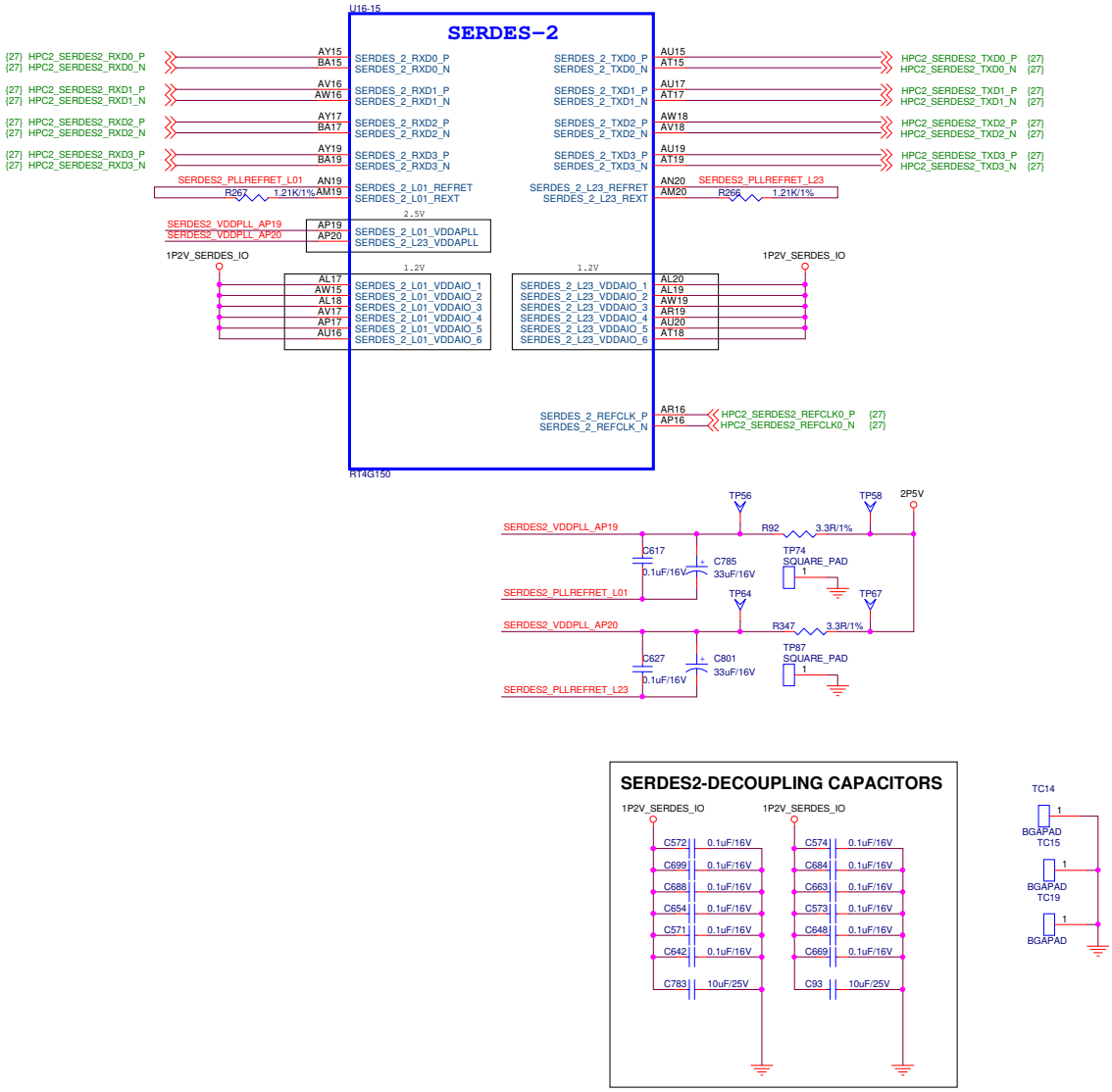


Figure 24. Schematic - SerDes-2 Connection

2.2.21 SerDes-3 Connection

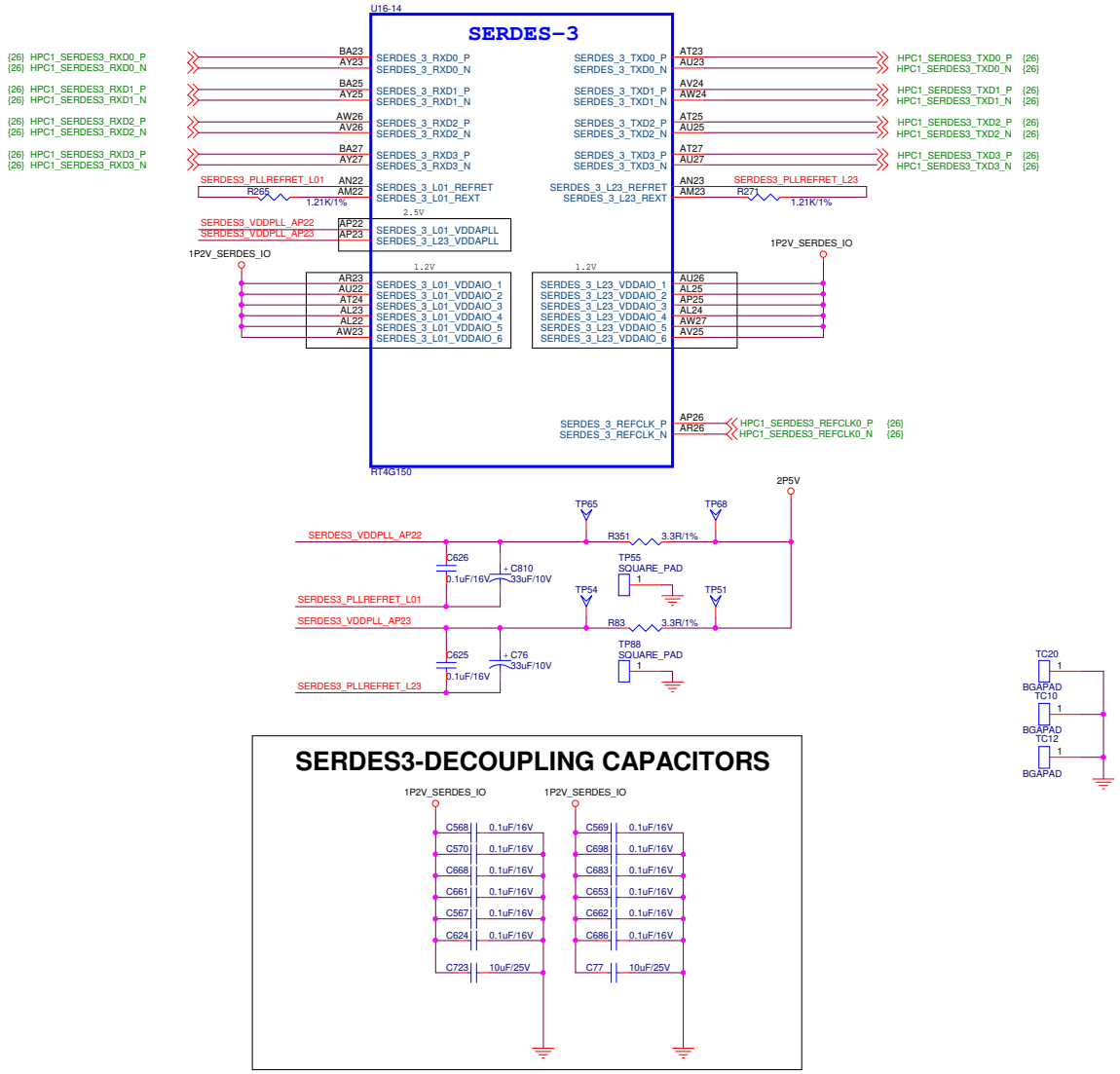


Figure 25. Schematic - SerDes-3 Connection

2.2.22 SerDes-4 Connection

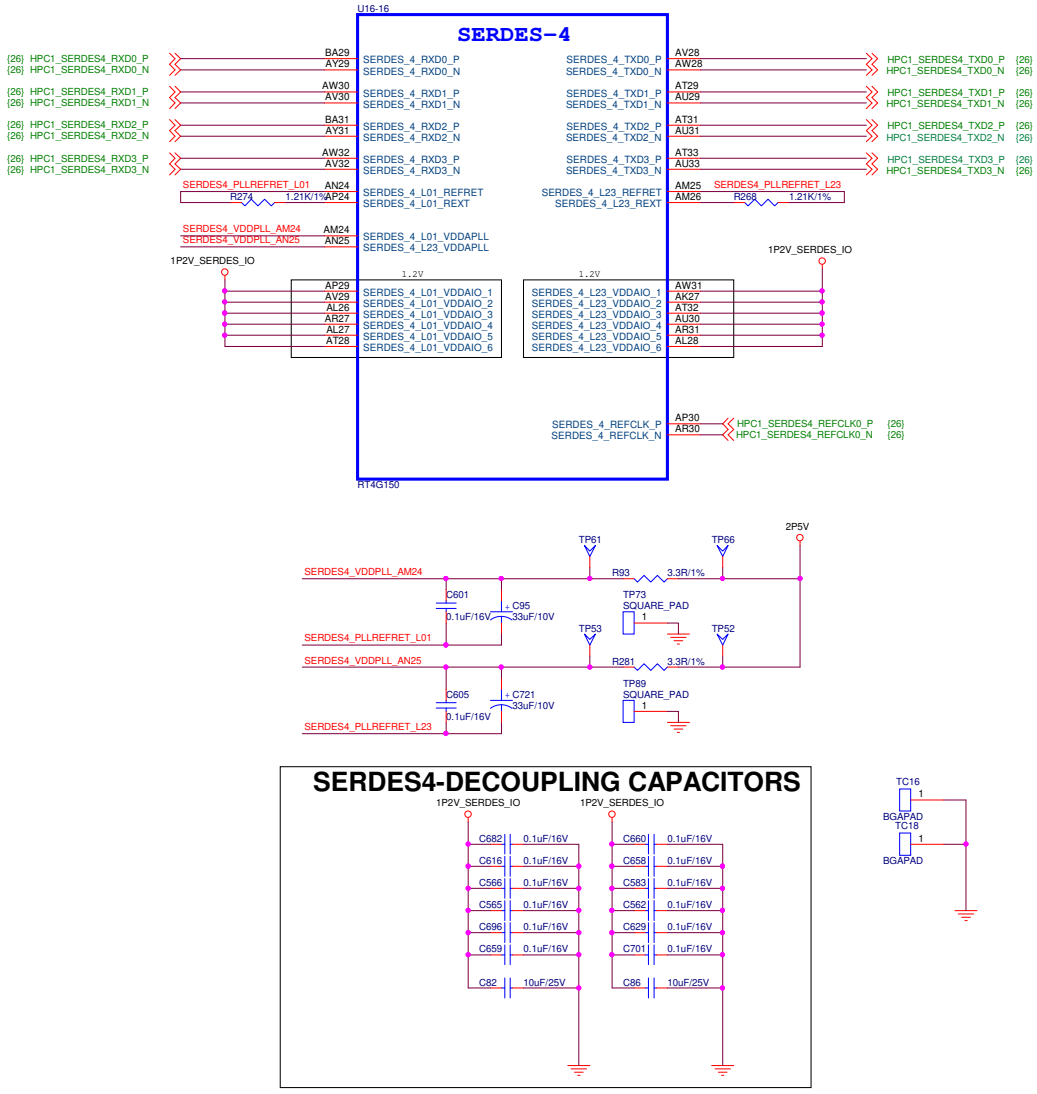


Figure 26. Schematic - SerDes-4 Connection

2.2.23 SerDes-5 Connection

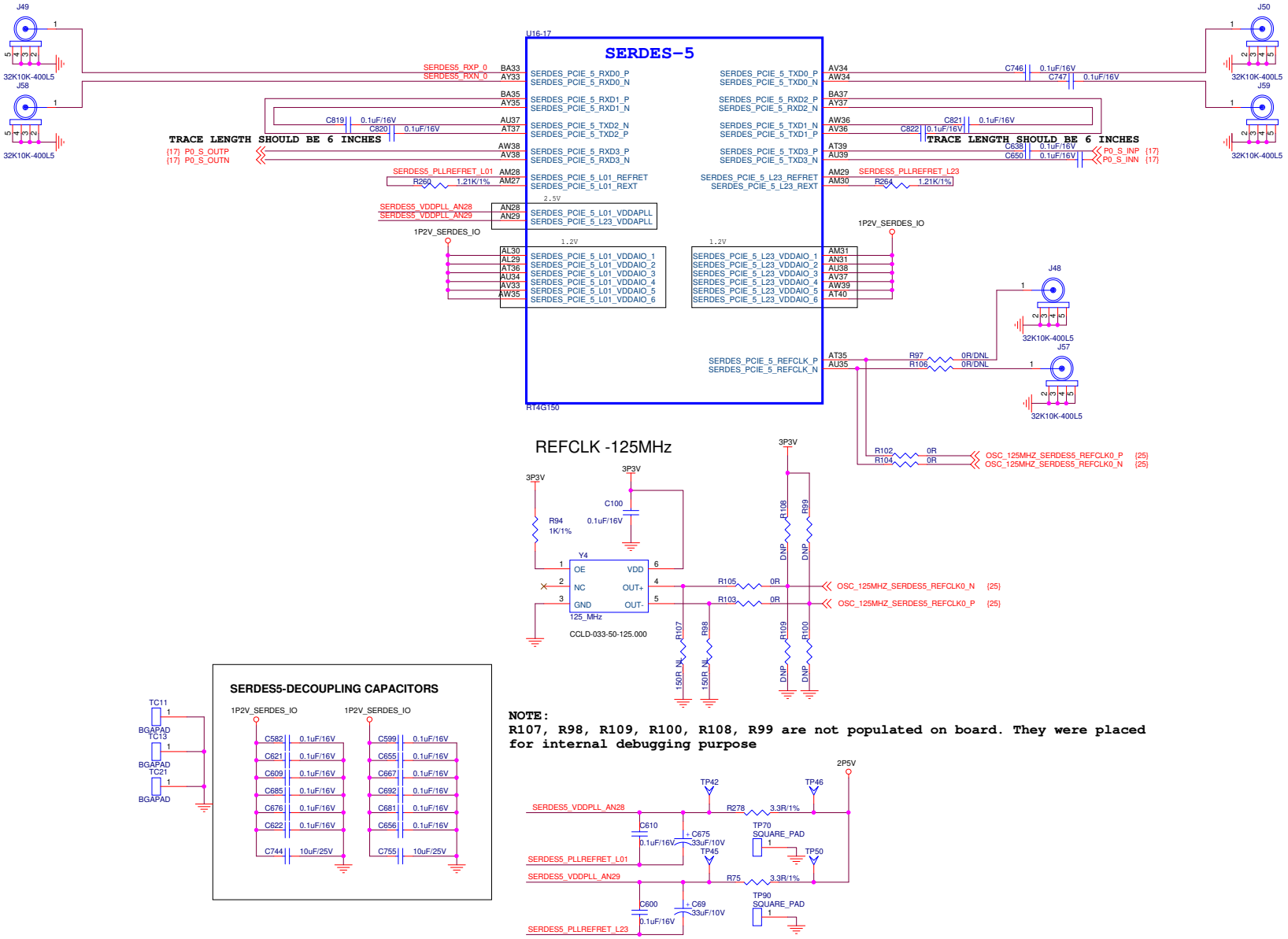
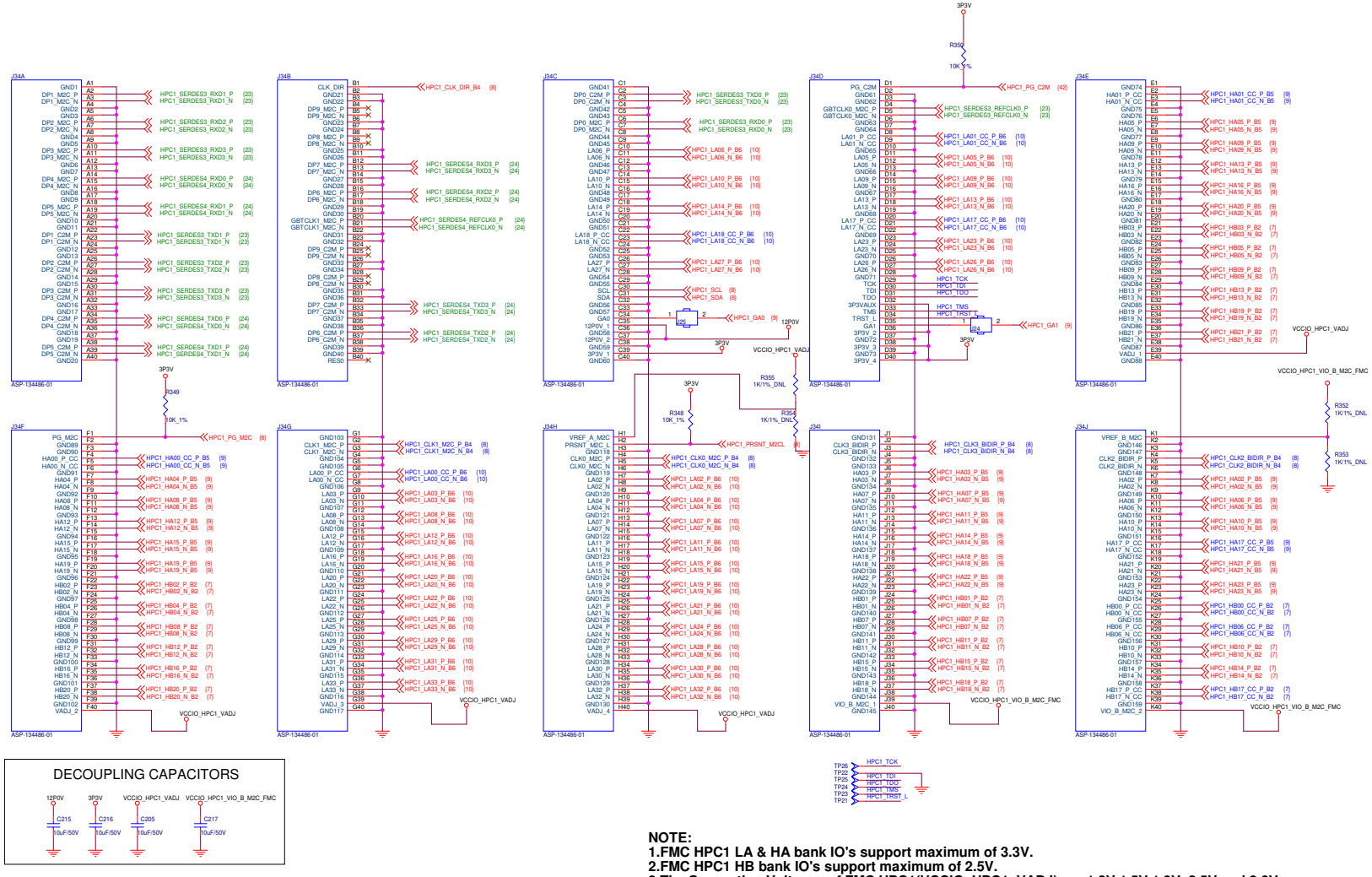


Figure 27. Schematic - SerDes-5 Connection

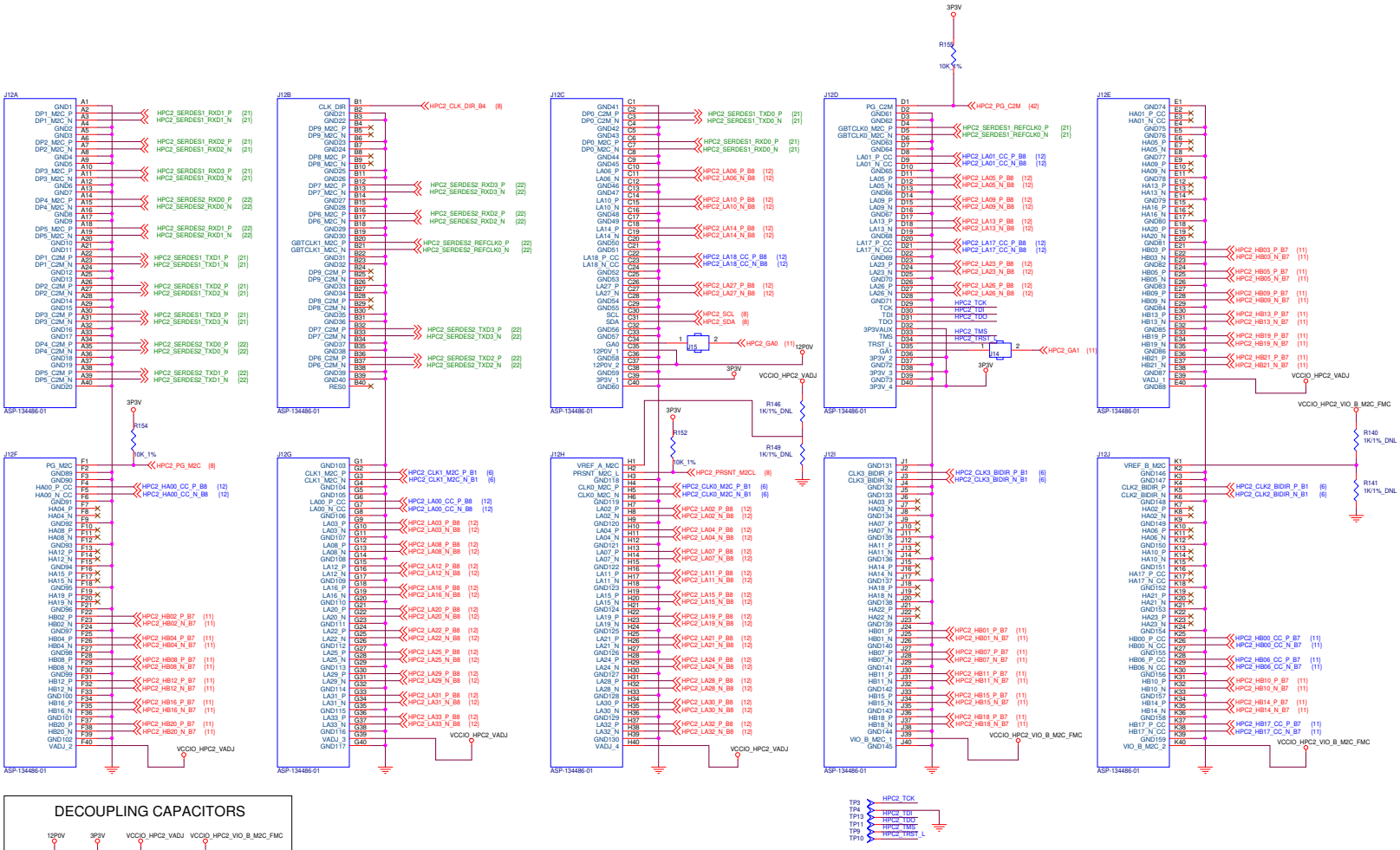
2.2.24 FMC Connector - HPC1



NOTE:
1.FMC HPC1 LA & HA bank IO's support maximum of 3.3V.
2.FMC HPC1 HB bank IO's support maximum of 2.5V.
3.The Supporting Voltages of FMC HPC1(VCCIO_HPC1_VADJ) are 1.2V,1.5V,1.8V, 2.5V and 3.3V.

Figure 28. Schematic - FMC Connector - HPC1

2.2.25 FMC Connector - HPC2



NOTE:
1.FMC HPC2 IO's support maximum of 2.5V
2.The Supporting Voltages of FMC HPC2(VCCIO_HPC2_VADJ) are 1.2V,1.5V,1.8V and 2.5V.

Figure 29. Schematic - FMC Connector - HPC2

2.2.26 Bread Board Connector

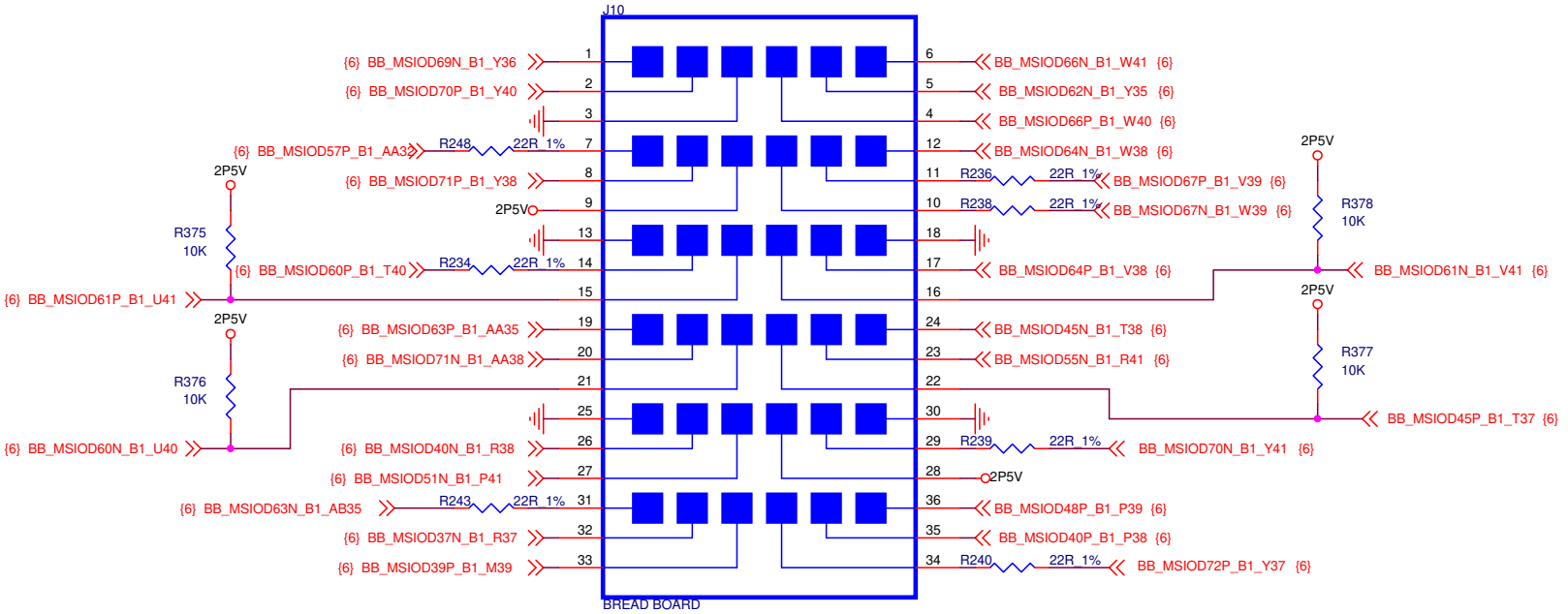


Figure 30. Schematic - Bread Board Connector

2.2.27 Programming Block Diagram

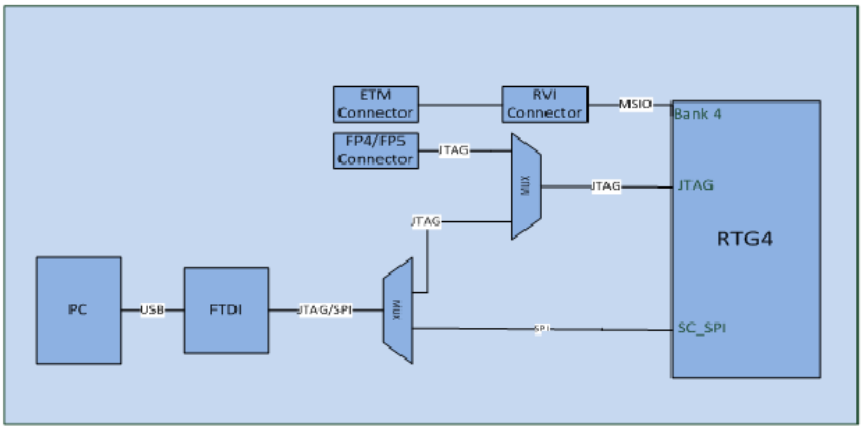


Figure 31. Schematic - Programming Block Diagram

2.2.28 Programming Circuitry

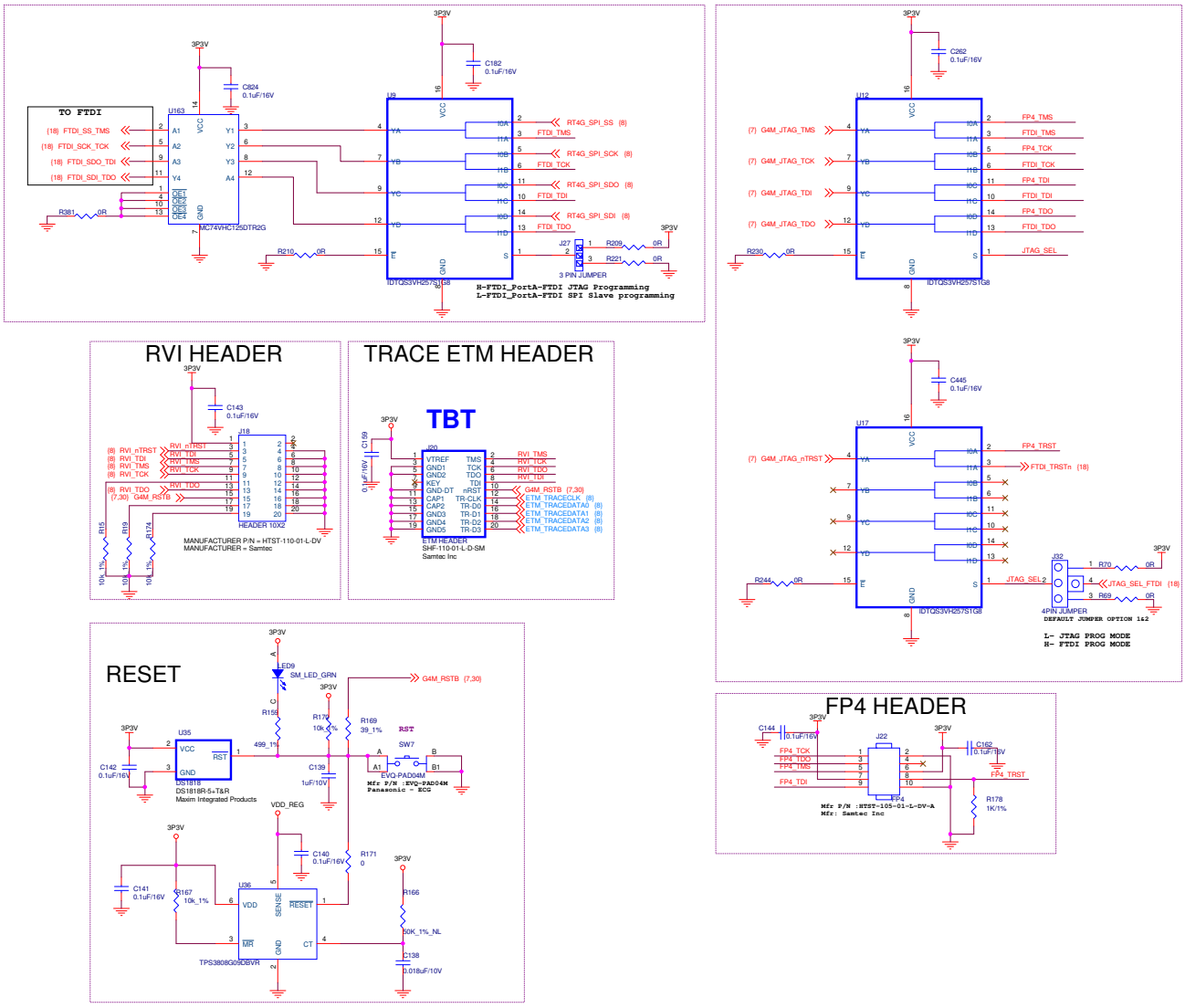
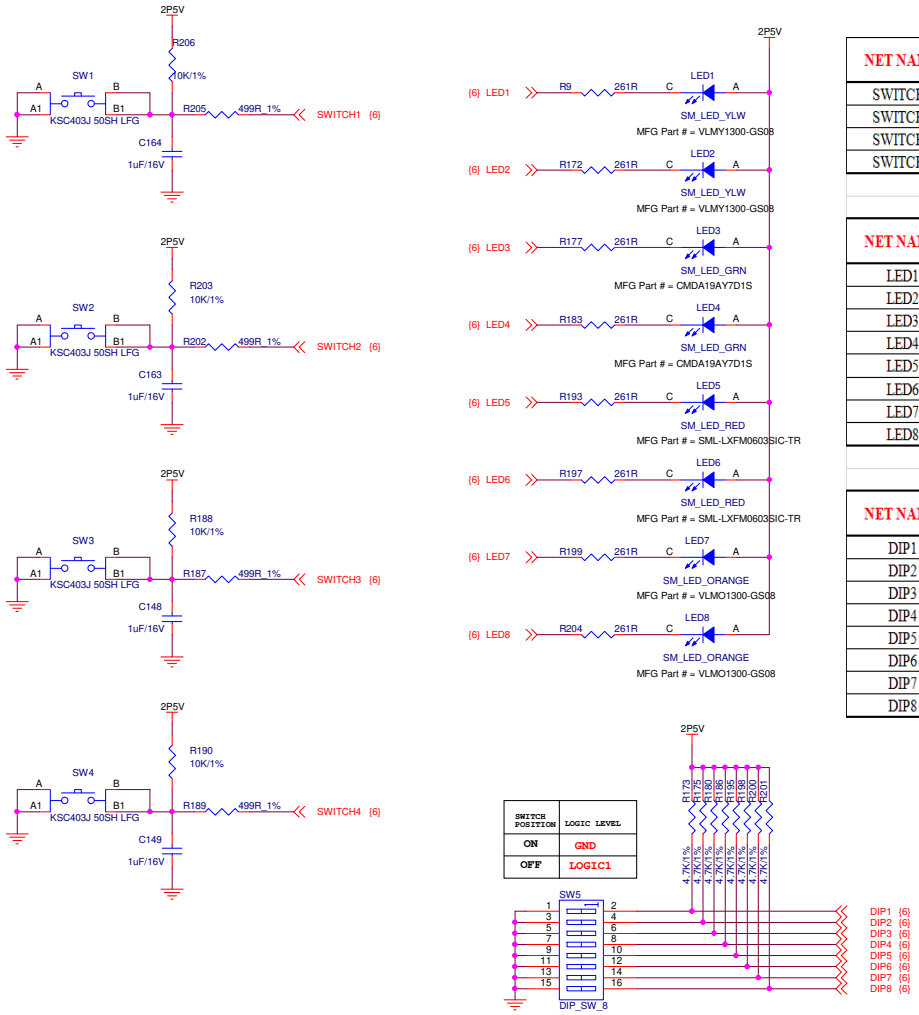


Figure 32. Schematic - Programming Circuitry

2.2.29 Debugging Circuitry



NET NAME	FPGA PIN NAME	FPGA PIN NO
SWITCH1	MSIOD68NB1	AA30
SWITCH2	MSIOD65PB1	AB31
SWITCH3	MSIOD68PB1	AB30
SWITCH4	MSIOD65NB1	AB32

NET NAME	FPGA PIN NAME	FPGA PIN NO
LED1	MSIOD62PB1	W35
LED2	MSIOD46PB1	W34
LED3	MSIOD47PB1	V30
LED4	MSIOD46NB1	W33
LED5	MSIOD38PB1	T33
LED6	MSIOD41NB1	U35
LED7	MSIOD37PB1	R36
LED8	MSIOD38NB1	T34

NET NAME	FPGA PIN NAME	FPGA PIN NO
DIP1	MSIOD57NB1	AA33
DIP2	MSIOD56PB1	Y31
DIP3	MSIOD56NB1	W31
DIP4	MSIOD47NB1	W30
DIP5	MSIOD42NB1	V33
DIP6	MSIOD42PB1	V34
DIP7	MSIOD41PB1	U34
DIP8	MSIOD69PB1	W36

Figure 33. Schematic - Debugging Circuitry

2.2.30 Clock Circuitry

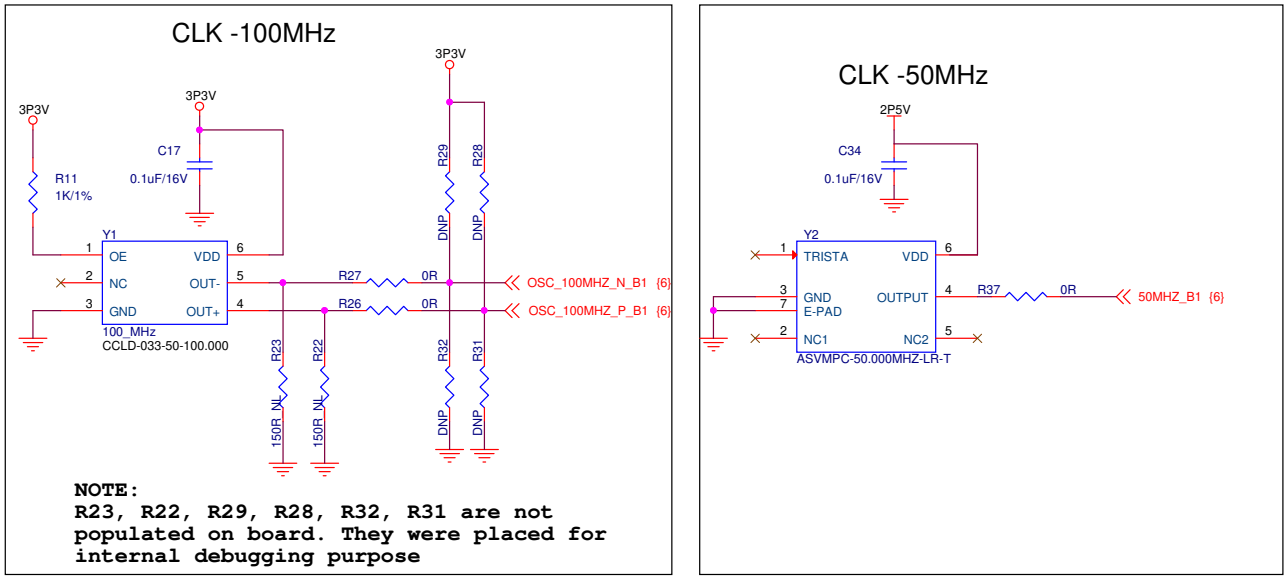


Figure 34. Schematic - Clock Circuitry

2.2.31 Power Connection

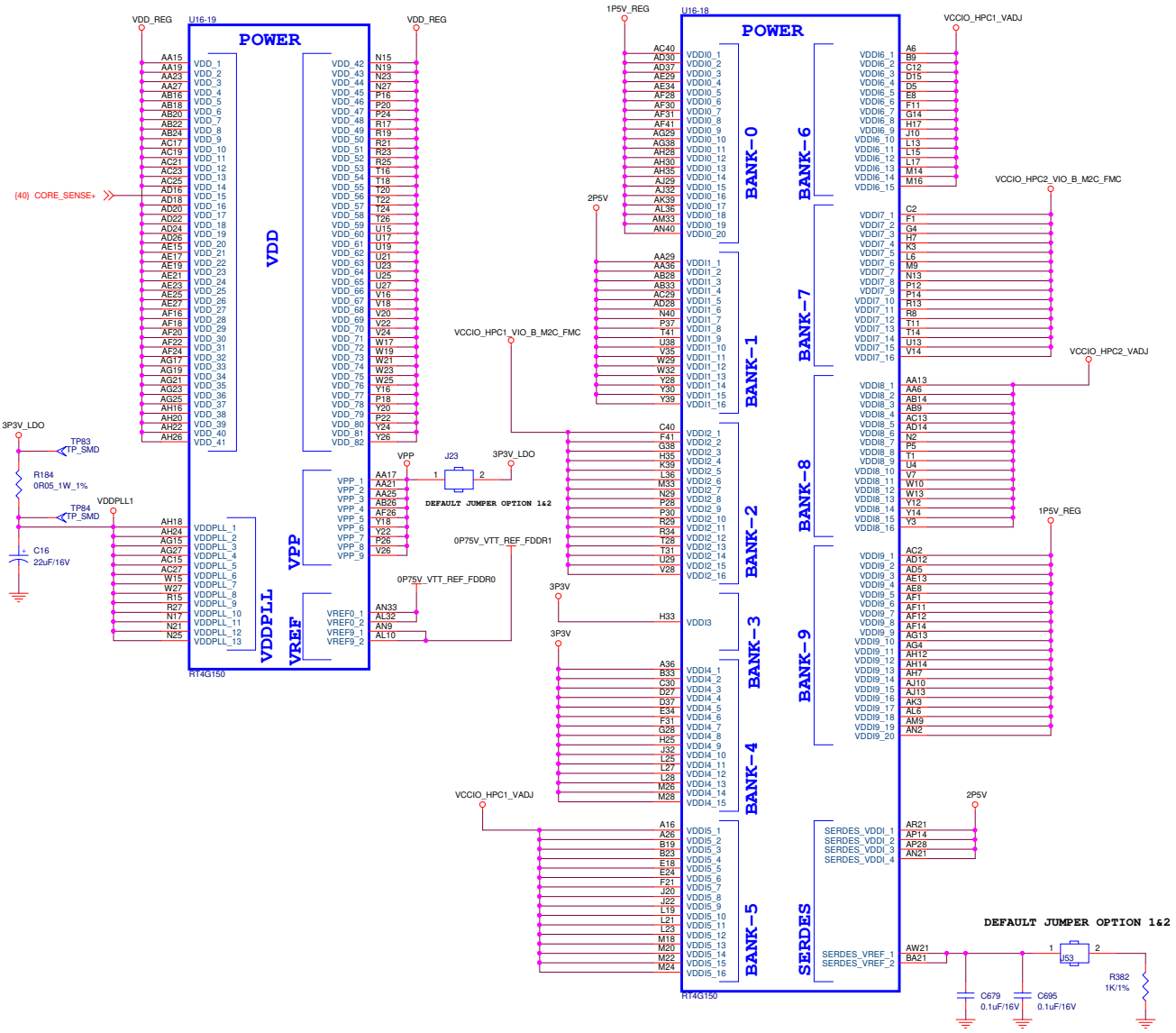


Figure 35. Schematic - Power Connection

2.2.32 Ground and NC Connections

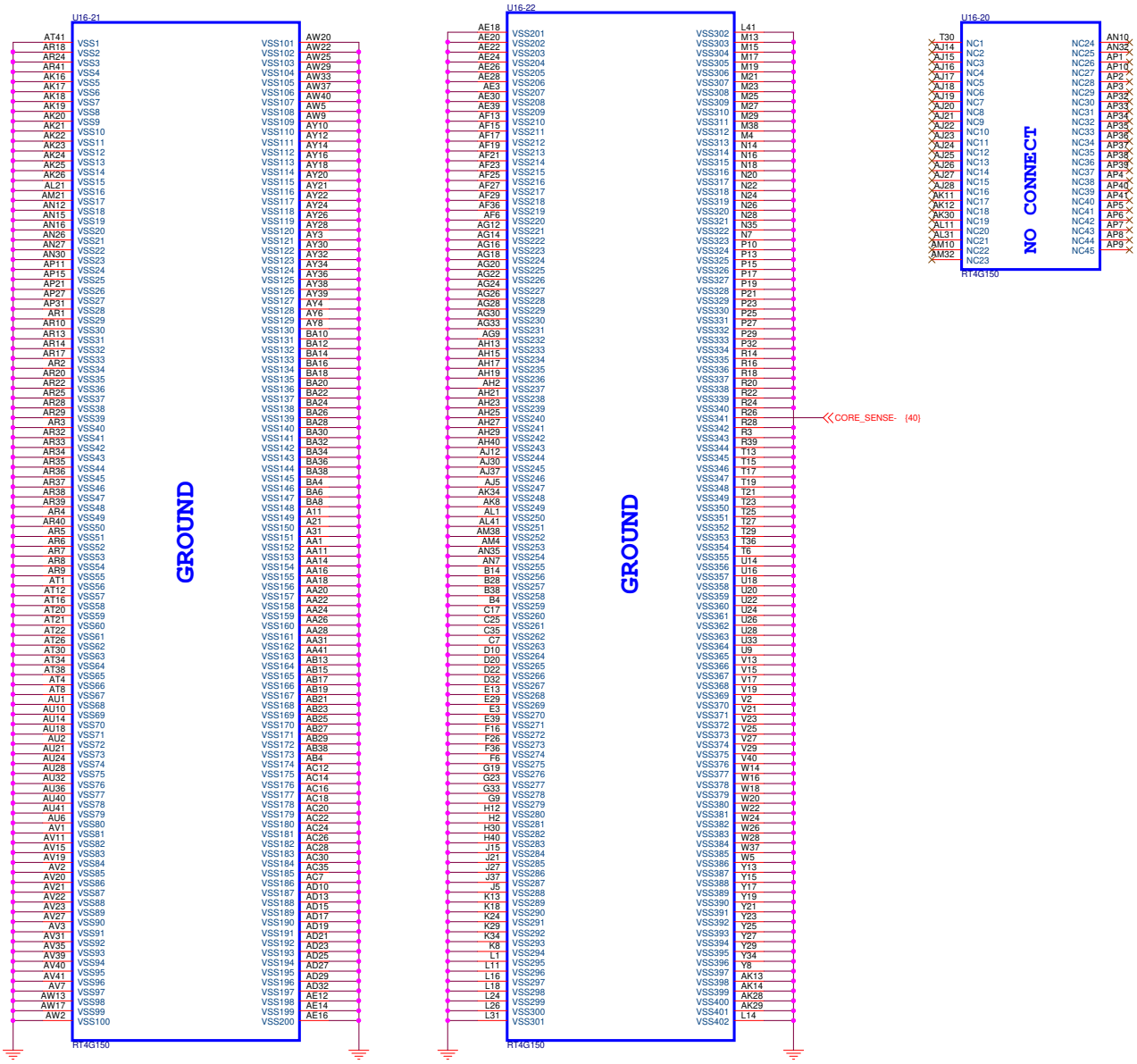


Figure 36. Schematic - Ground and NC Connections

2.2.33 Decoupling Capacitor Connection

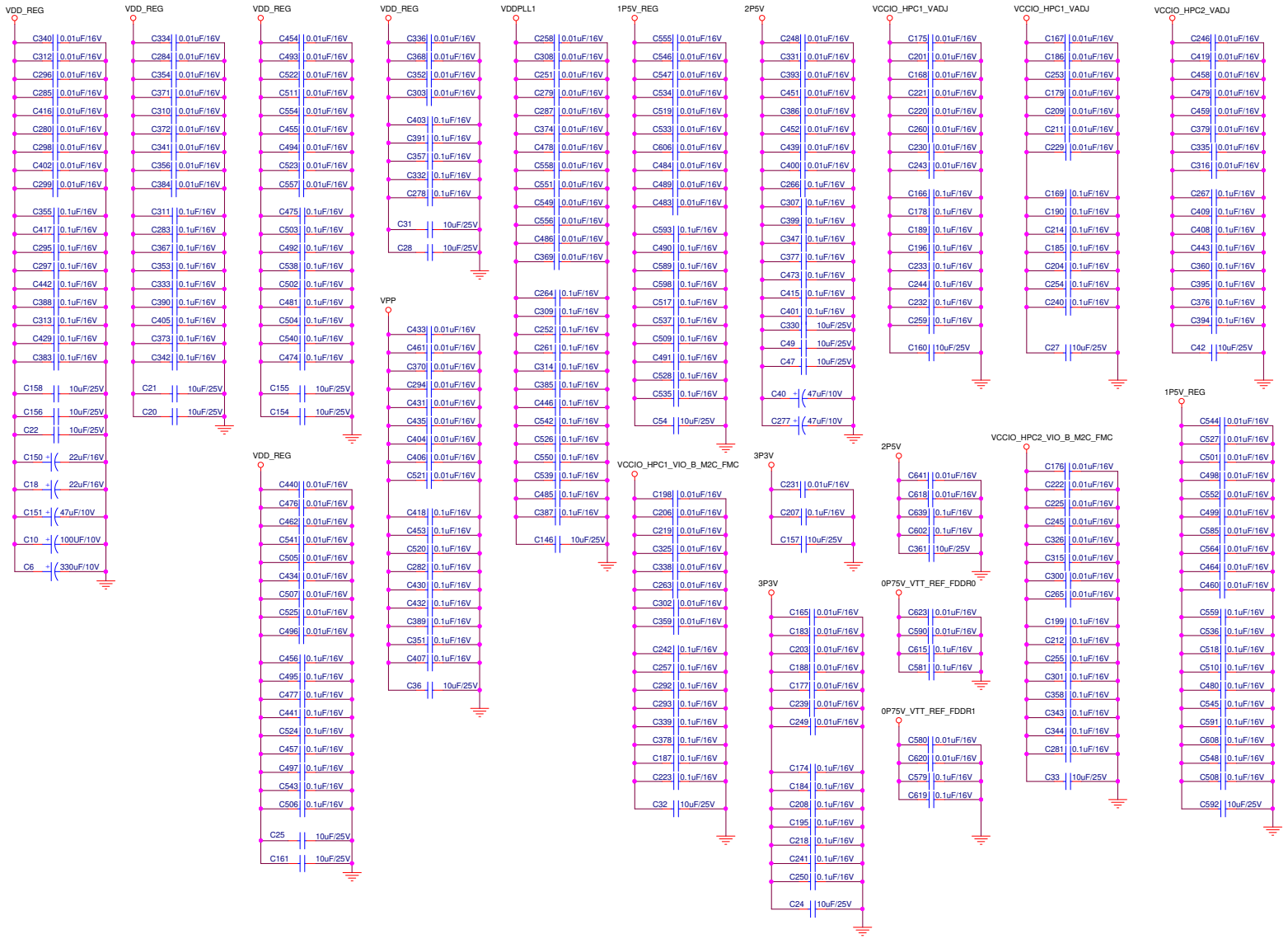


Figure 37. Schematic - Decoupling Capacitor Connection

2.2.34 12V Power Supply Connection

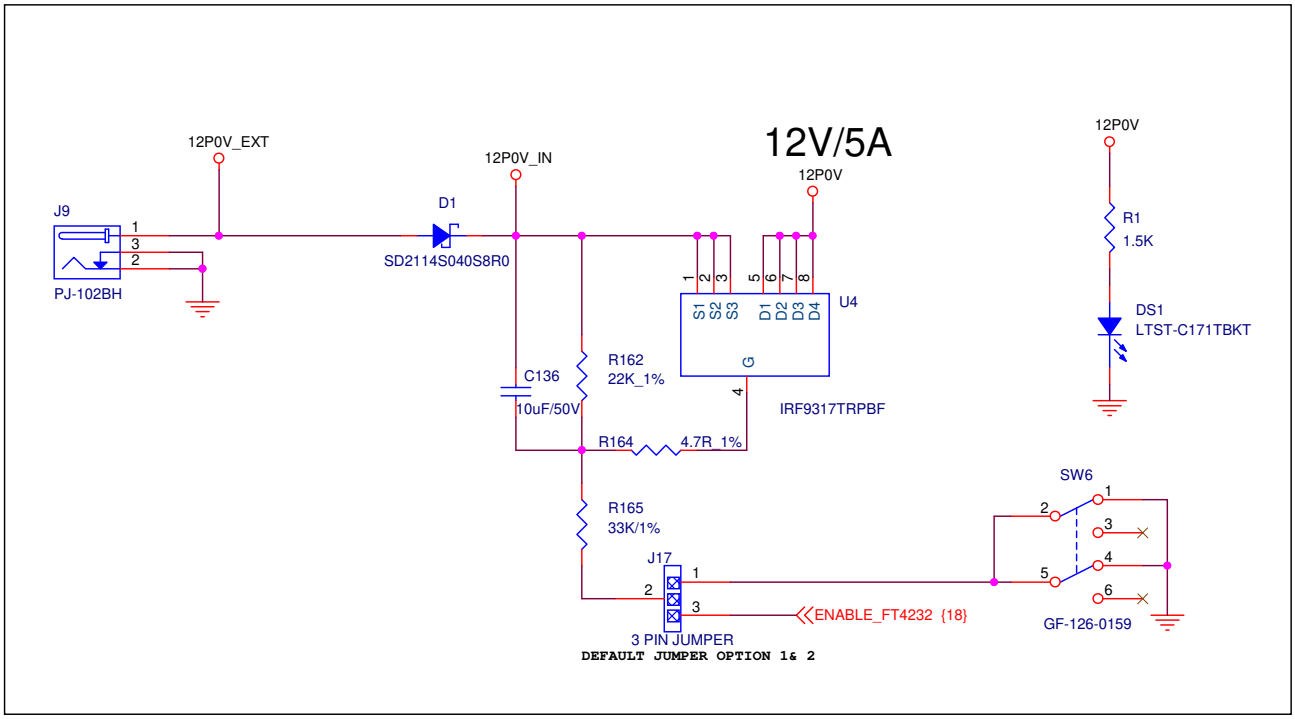
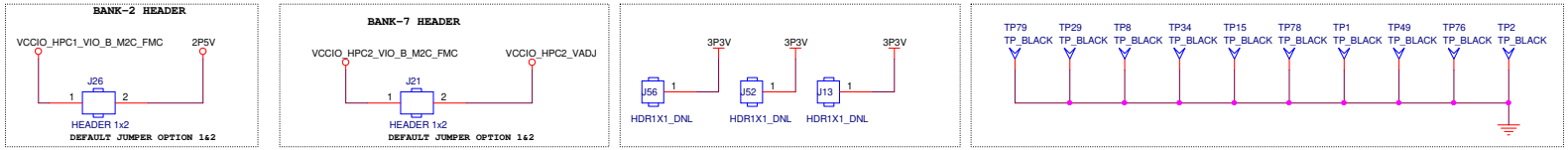
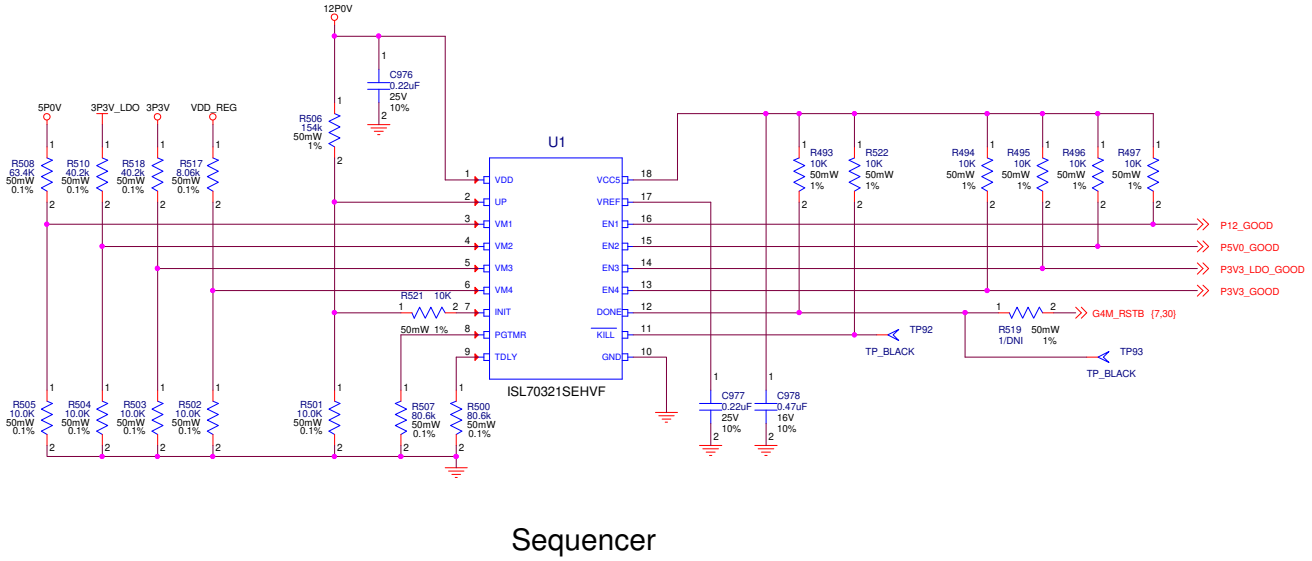


Figure 38. Schematic - 12V Power Supply Connection

2.2.35 Power Header Connection

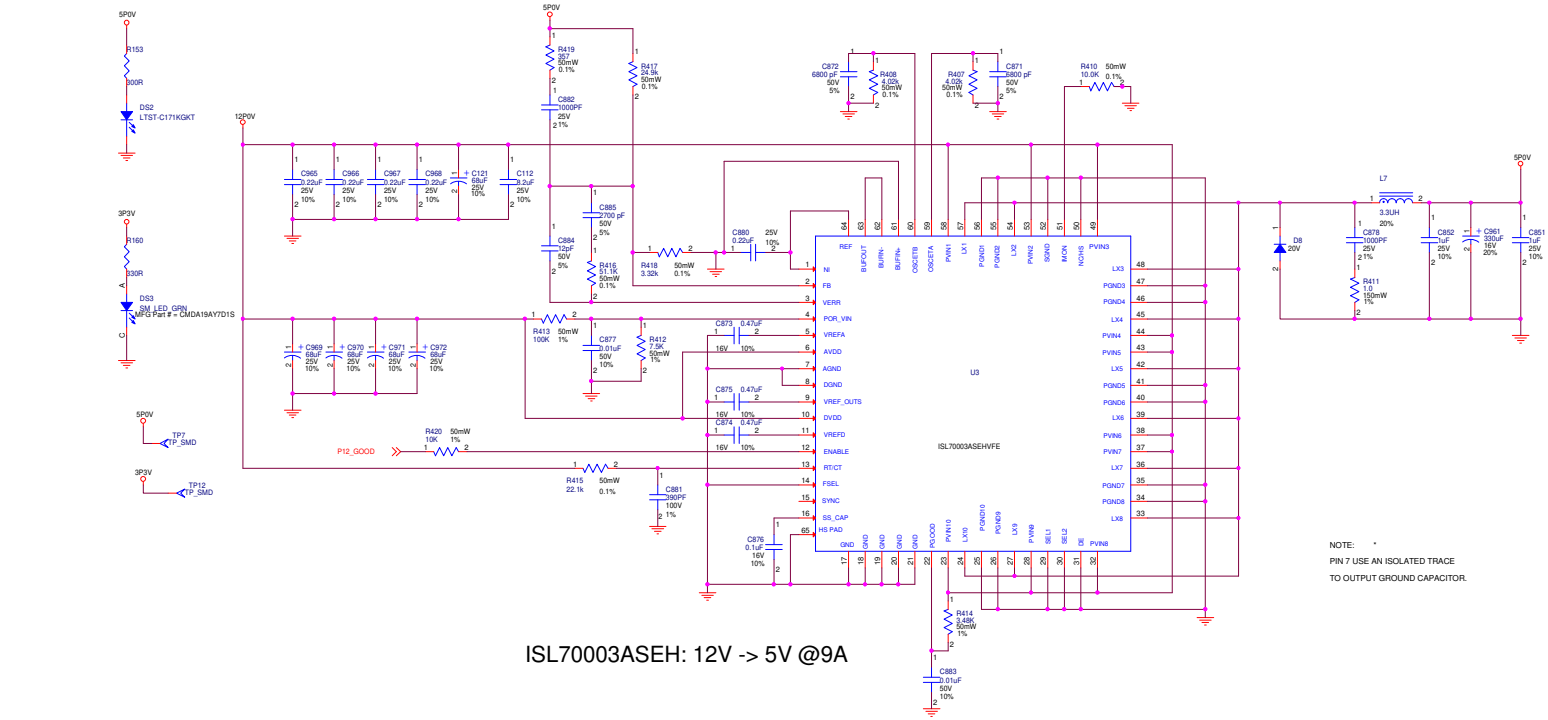




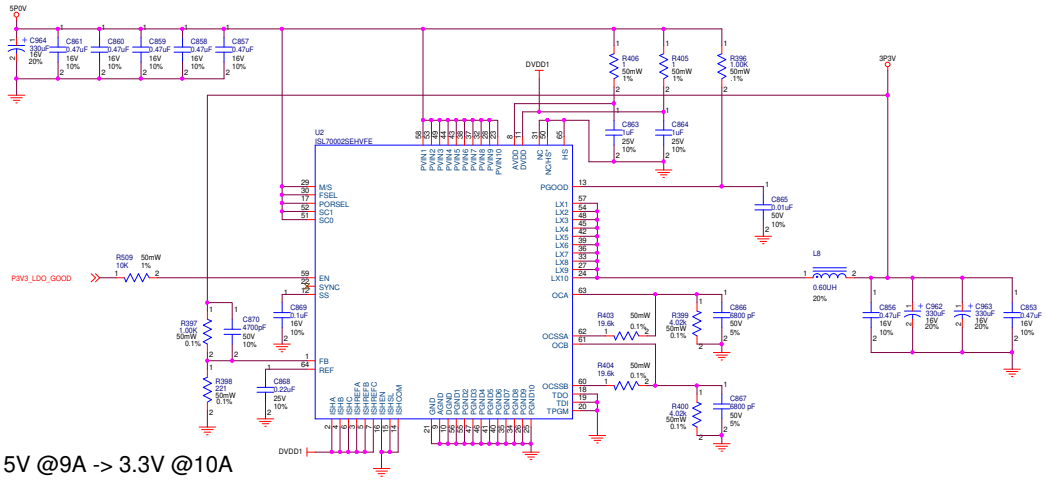
Sequencer

Figure 39. Schematic - Power Header Connection

2.2.36 Power Supplies-1



ISL70003ASEH: 12V -> 5V @9A



ISL70002SEH: 5V @9A -> 3.3V @10A

Figure 40. Schematic - Power Supplies-1

2.2.37 Power Supplies-2

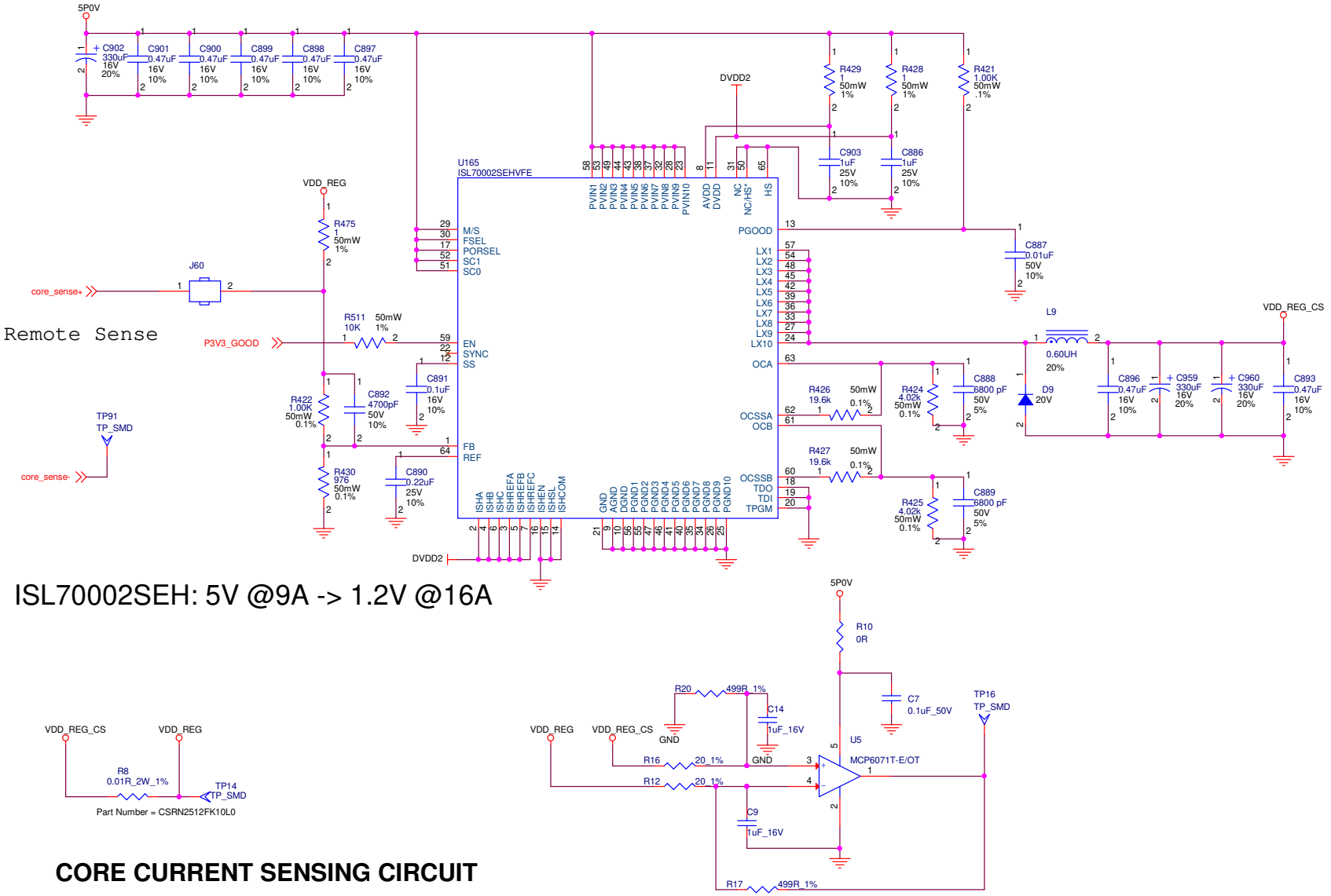


Figure 41. Schematic - Power Supplies-2

2.2.38 Power Supplies-3

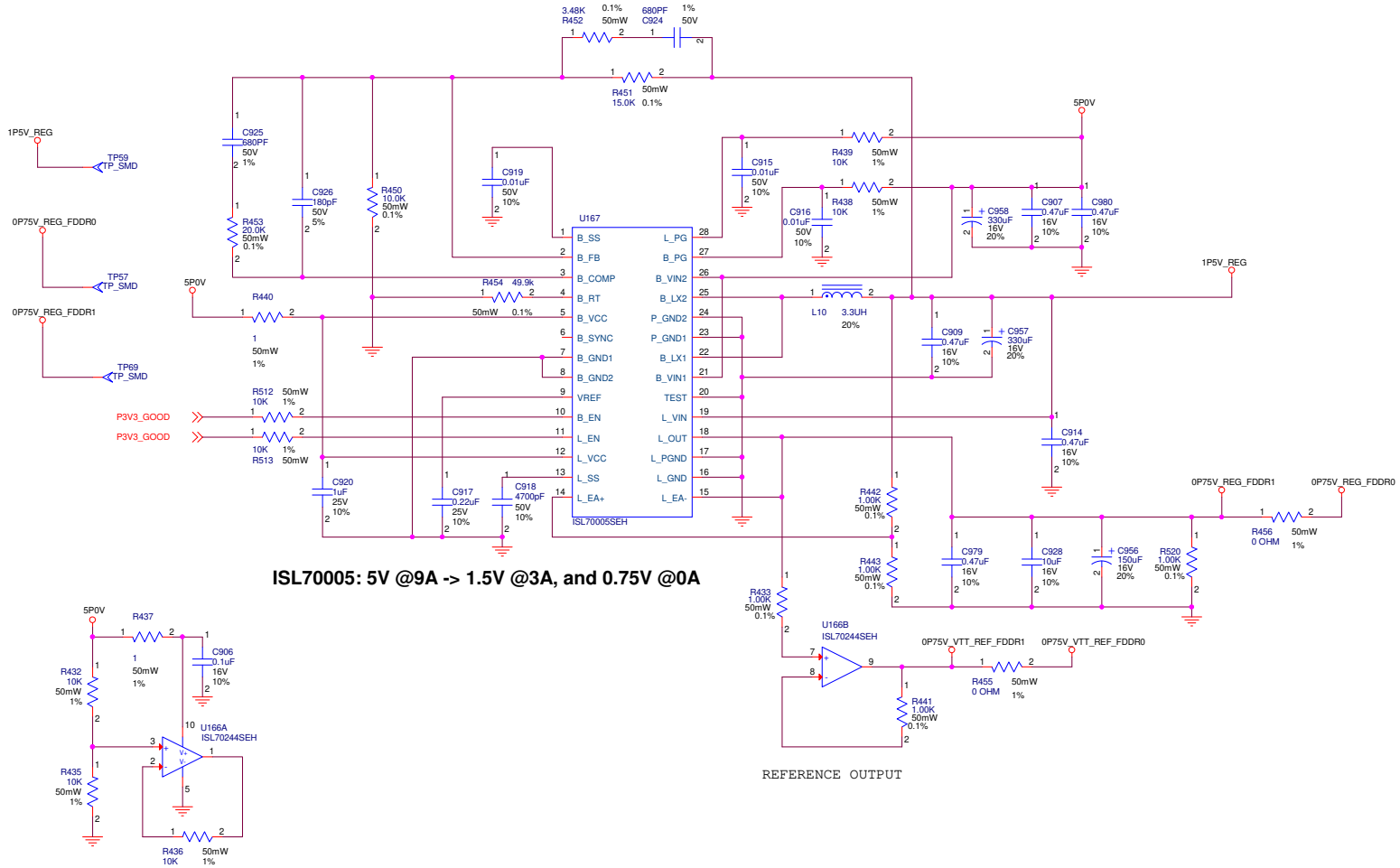


Figure 42. Schematic - Power Supplies-3

2.2.39 Power Supplies-4

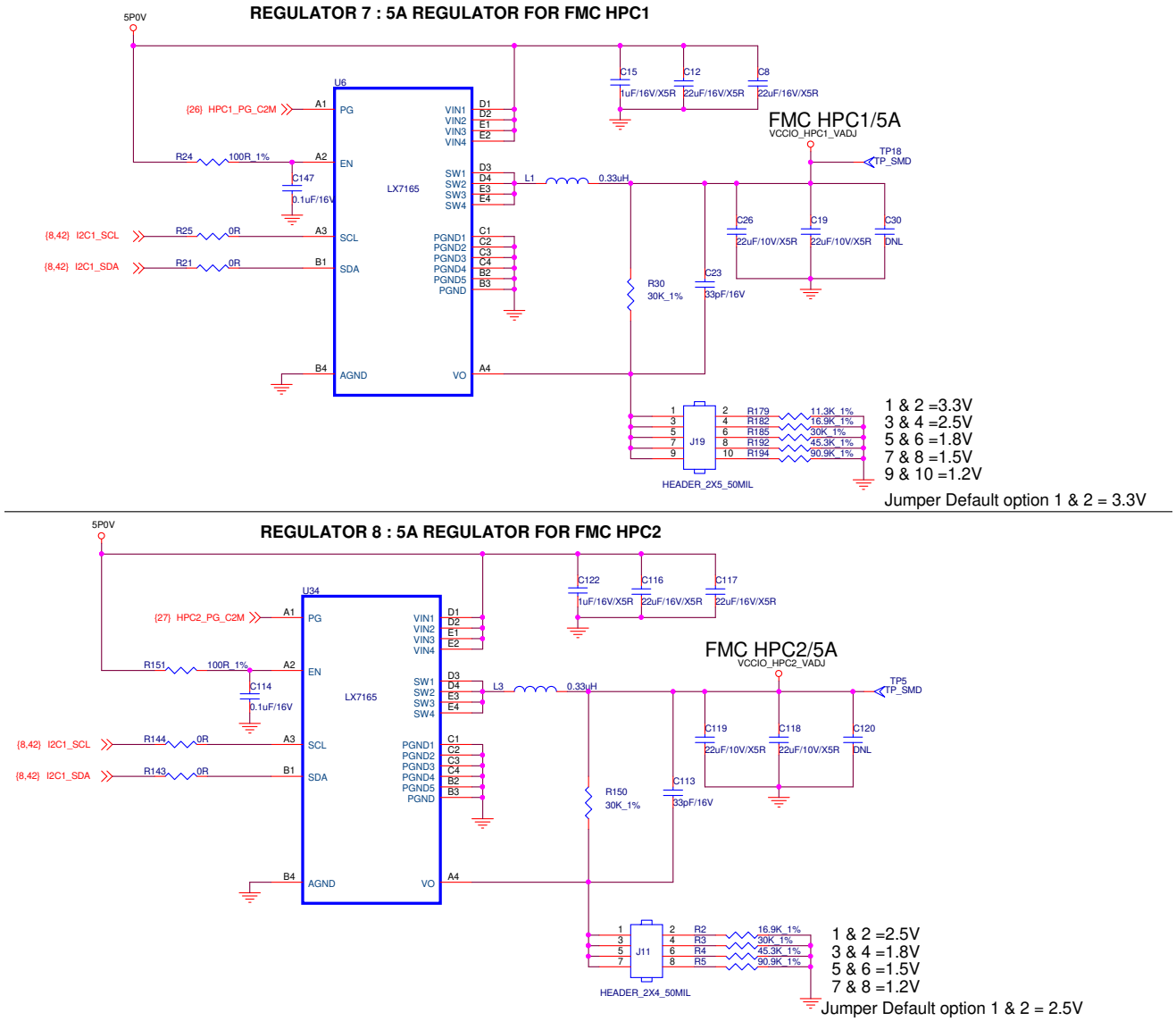


Figure 43. Schematic - Power Supplies-4

2.2.40 Power Supplies-5

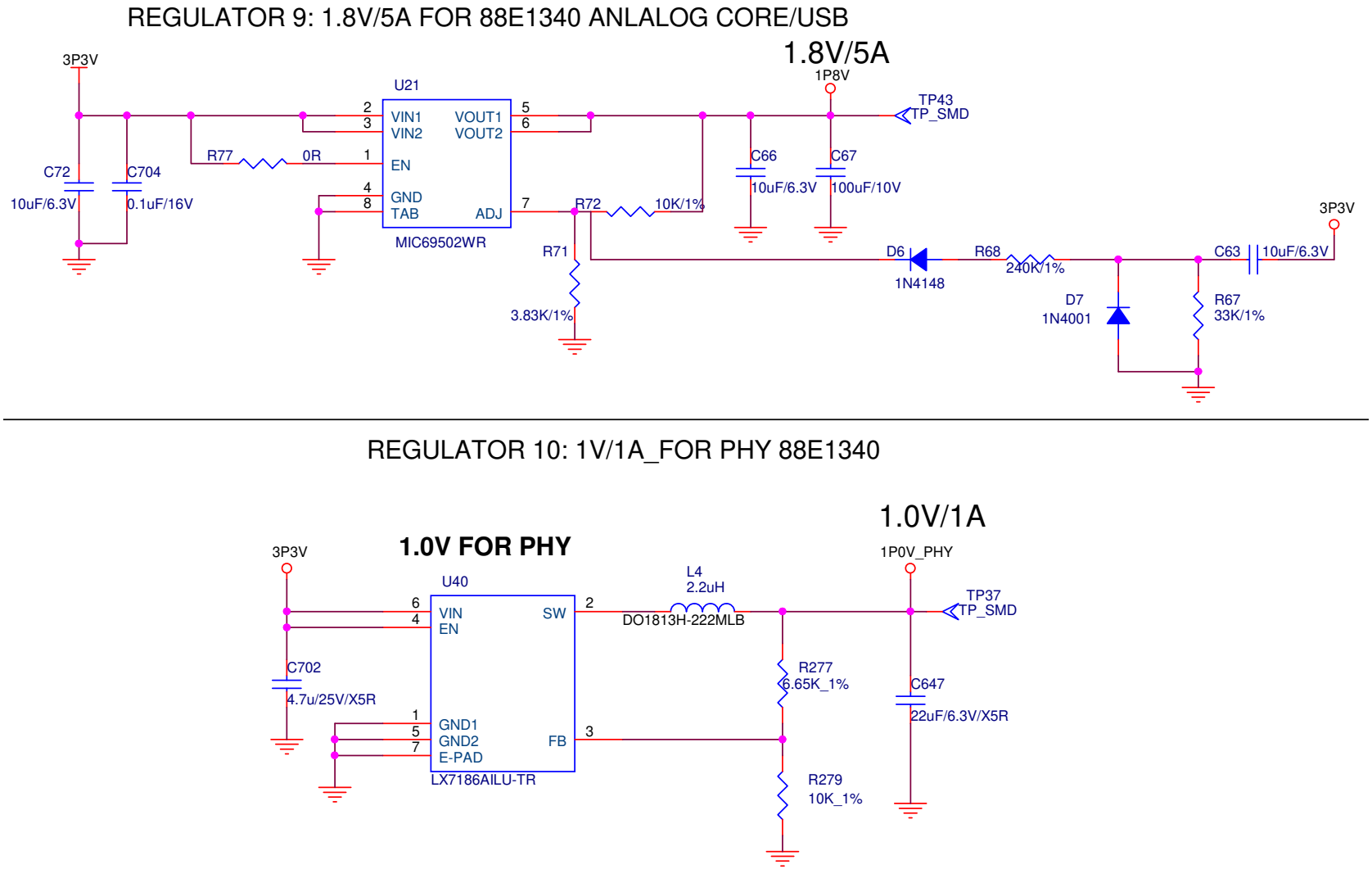


Figure 44. Schematic - Power Supplies-5

2.2.41 Power Supplies-6

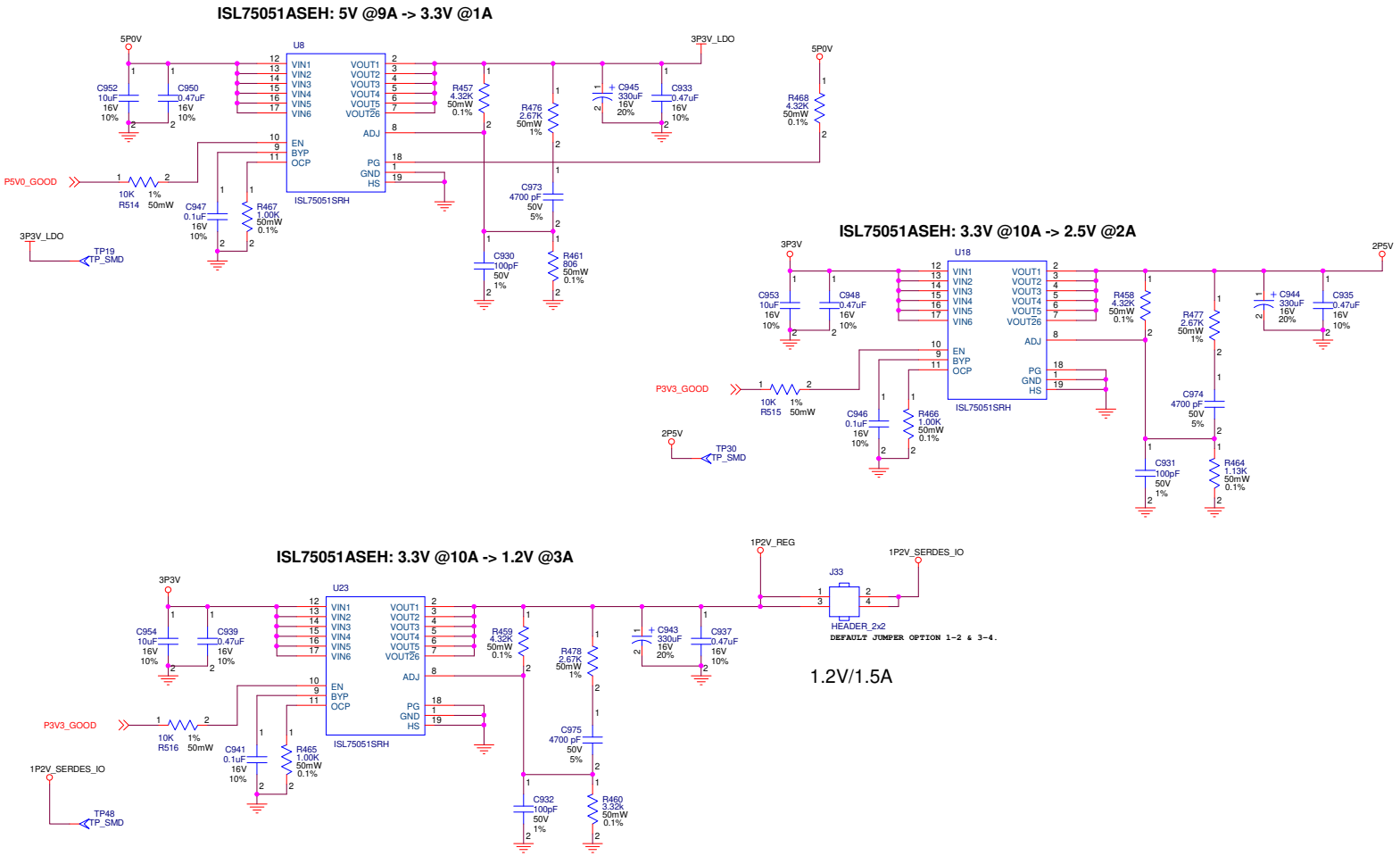


Figure 45. Schematic - Power Supplies-6

2.2.42 Power LEDs

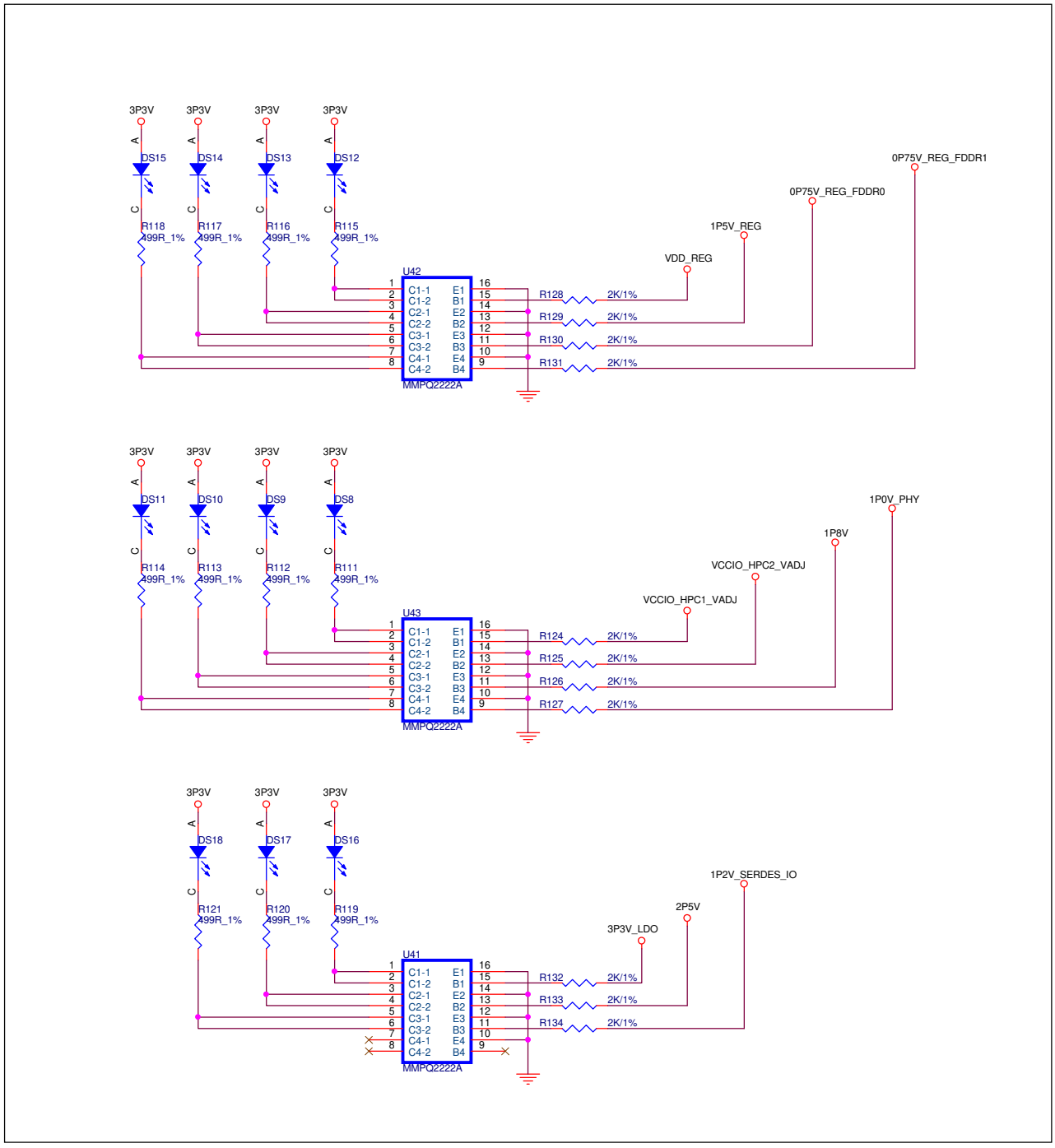


Figure 46. Schematic - Power LEDs

2.3 Bill of Materials

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
1		PWB-PCB, ISLRTG4DEMO1Z, REVB, ROHS	Gorilla Circuits Inc.	ISLRTG4DEMO1ZREVBPCB
2	C23, C113	CAP, SMD, 0603, 33pF, 16V, 5%, X7R, ROHS	AVX	0603YC330JAT2A
1	C10	CAP-TANT, SMD, 7.3x4.3, 100µF, 10V, 10%, 600mΩ, -55+125C, ROHS	Vishay/Sprague	293D107X9010D2TE3
3	C930, C931, C932	CAP-AEC-Q200, SMD, 0402, 100pF, 50V, 1%, C0G/NP0, ROHS	Kemet	C0402C101F5GACAUTO
7	C865, C877, C883, C887, C915, C916, C919	CAP-AEC-Q200, SMD, 0402, 0.01µF, 50V, 10%, X7R, ROHS	Kemet	C0402C103K5RACAUTO
7	C869, C876, C891, C906, C941, C946, C947	CAP-AEC-Q200, SMD, 0402, 0.1µF, 16V, 10%, X7R, ROHS	Kemet	C0402C104K4RACAUTO
1	C884	CAP-AEC-Q200, SMD, 0402, 12pF, 50V, 5%, C0G/NP0, ROHS	Kemet	C0402C120J5GACAUTO
1	C926	CAP-AEC-Q200, SMD, 0402, 180pF, 50V, 5%, C0G/NP0, ROHS	Kemet	C0402C181J5GACAUTO
1	C138	CAP, SMD, 0402, 0.018µF, 10V, 10%, X7R, ROHS	Kemet	C0402C183K8RACTU
2	C878, C882	CAP-AEC-Q200, SMD, 0603, 1000pF, 50V, 5%, C0G/NP0, ROHS	Kemet	C0603C102J5GACAUTO
10	C868, C880, C890, C917, C965, C966, C967, C968, C976, C977	CAP-AEC-Q200, SMD, 0603, 0.22µF, 25V, 10%, X7R, ROHS	Kemet	C0603C224K3RACAUTO
1	C885	CAP-AEC-Q200, SMD, 0603, 2700pF, 50V, 5%, C0G/NP0, ROHS	Kemet	C0603C272J5GACAUTO
1	C881	CAP-AEC-Q200, SMD, 0603, 390pF, 50V, 5%, C0G/NP0, ROHS	Kemet	C0603C391J5GACAUTO
6	C870, C892, C918, C973, C974, C975	CAP-AEC-Q200, SMD, 0603, 4700pF, 50V, 5%, C0G/NP0, ROHS	Kemet	C0603C472J5GACAUTO
29	C853, C856, C857, C858, C859, C860, C861, C873, C874, C875, C893, C896, C897, C898, C899, C900, C901, C907, C909, C914, C933, C935, C937, C939, C948, C950, C978, C979, C980	CAP-AEC-Q200, SMD, 0603, 0.47µF, 16V, 10%, X7R, ROHS	Kemet	C0603C474K4RACAUTO
2	C924, C925	CAP-AEC-Q200, SMD, 0603, 680pF, 50V, 5%, C0G/NP0, ROHS	Kemet	C0603C681J5GACAUTO

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
6	C866, C867, C871, C872, C888, C889	CAP-AEC-Q200, SMD, 0603, 6800pF, 50V, 5%, C0G/NP0, ROHS	Kemet	C0603C682J5GACAUTO
7	C851, C852, C863, C864, C886, C903, C920	CAP-AEC-Q200, SMD, 0805, 1µF, 25V, 10%, X7R, ROHS	Kemet	C0805C105K3RACAUTO
1	C756	CAP, SMD, 0402, 3.3µF, 10V, 10%, X5R, ROHS	TDK	C1005X5R1A335K050BC
5	C122, C148, C149, C163, C164	CAP-LOW ESL, SMD, 0402, 1µF, 16V, 10%, X5R, ROHS	TDK	C1005X5R1C105K050BC
1	C139	CAP, SMD, 0402, 1µF, 10V, 10%, X7S, ROHS	TDK	C1005X7S1A105K050BC
4	C928, C952, C953, C954	CAP-AEC-Q200, SMD, 1206, 10µF, 16V, 10%, X7R, ROHS	Kemet	C1206C106K4RACAUTO
1	C112	CAP-BOARDFLEX, SMD, 1210, 8.2µF, 25V, 10%, X7R, ROHS	Kemet	C1210X825K3RAC7800
3	C768, C809, C816	CAP, SMD, 0603, 4.7µF, 16V, 10%, X6S, ROHS	TDK	C1608X6S1C475K080AC
2	C9, C14	CAP, SMD, 0603, 1.0µF, 16V, 10%, X7R, ROHS	TDK	C1608X7R1C105K
2	C7, C823	CAP, SMD, 0603, 0.1µF, 50V, 10%, X7R, SOFT TERM., ROHS	TDK	C1608X7R1H104K080AE
22	C35, C44, C45, C52, C53, C60, C62, C63, C66, C68, C72, C74, C87, C420, C421, C438, C532, C716, C722, C737, C784, C800	CAP-LOW ESL, SMD, 0603, 10µF, 6.3V, 20%, X7S, ROHS	TDK	C1608X7S0J106M080AC
4	C19, C26, C118, C119	CAP-LOW ESL, SMD, 0805, 22µF, 10V, 10%, X5R, ROHS	TDK	C2012X5R1A226K125AB
4	C8, C12, C116, C117	CAP, SMD, 0805, 22µF, 16V, 10%, X5R, ROHS	TDK	C2012X5R1C226K125AC
1	C702	CAP, SMD, 0805, 4.7µF, 25V, 10%, X5R, ROHS	TDK	C2012X5R1E475K125AB
1	C67	CAP, SMD, 1206, 100µF, 10V, 20%, X5R, ROHS	TDK	C3216X5R1A107M160AC
1	C58	CAP-HI Q, LOW ESR, SMD, 0402, 100pF, 25V, 1%, C0G/NP0, ROHS	Kemet	CBR04C101F3GAC
1	C818	CAP-AEQ-200, SMD, 0805, 10µF, 10V, 10%, X5R, ROHS	TDK	CGA4J3X5R1A106K125AB

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
41	C20, C21, C22, C24, C25, C27, C28, C31, C32, C33, C36, C42, C47, C49, C54, C56, C77, C78, C82, C86, C89, C93, C146, C154, C155, C156, C157, C158, C160, C161, C330, C361, C592, C723, C736, C744, C755, C765, C767, C783, C813	CAP, SMD, 0603, 10µF, 25V, 20%, X5R, ROHS	Samsung	CL10A106MA8NRNC
9	C124, C128, C132, C134, C136, C205, C215, C216, C217	CAP, SMD, 1206, 10µF, 50V, 10%, X5R, ROHS	Samsung	CL31A106KBHNNNE
3	C16, C18, C150	CAP-TANT, SMD, 3.5x2.8mm, 22µF, 16V, 20%, 1.9Ω, ROHS	AVX	F931C226MBA
4	C55, C64, C84, C90	CAP, SMD, 0402, 27pF, 50V, 5%, C0G/NP0, ROHS	Murata	GRM1555C1H270JA01D

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
214	C110, C165, C167, C168, C171, C175, C176, C177, C179, C181, C183, C186, C188, C192, C193, C194, C198, C200, C201, C202, C203, C206, C209, C211, C219, C220, C221, C222, C224, C225, C226, C229, C230, C231, C234, C235, C236, C239, C243, C245, C246, C247, C248, C249, C251, C253, C258, C260, C263, C265, C269, C274, C279, C280, C284, C285, C287, C291, C294, C296, C298, C299, C300, C302, C303, C308, C310, C312, C315, C316, C322, C323, C324, C325, C326, C331, C334, C335, C336, C338, C340, C341, C345, C346, C352, C354, C356, C359, C368, C369, C370, C371, C372, C374, C379, C384, C386, C393, C400, C402, C404, C406, C410, C411, C416, C419, C422, C423, C424, C431, C433, C434, C435, C439, C440, C447, C451, C452, C454, C455, C458, C459, C460, C461, C462, C464, C466, C471, C476, C478, C479, C483, C484, C486, C488, C489, C493, C494, C496, C498, C499, C501, C505, C507, C511, C513, C514, C515, C519, C521, C522, C523, C525, C527, C530, C531, C533, C534, C541, C544, C546, C547, C549, C551, C552, C554, C555, C556, C557, C558, C564, C580, C585, C590, C586, C587, C594, C595, C596, C606, C613, C618, C620, C623, C631, C636, C641, C652, C671, C672, C673, C677, C678, C703, C705, C707, C708, C709, C712, C719, C725, C735, C739, C741, C743, C745, C748, C764, C766, C777, C779, C781, C787, C793	CAP, SMD, 0402, 0.01µF, 16V, 10%, X7R, ROHS	Murata	GRM155R71C103KA01D

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
427	C13, C17, C34, C38, C39, C41, C43, C48, C51, C57, C59, C65, C100, C114, C140, C141, C142,C143, C144, C145, C147, C159, C162, C166, C169, C170, C172, C173, C174, C178, C180, C182, C184, C185, C187, C189, C190, C191, C195, C196, C197, C199, C204, C207, C208, C210, C212, C213, C214, C218, C223, C227, C228, C232, C233, C237, C238, C240, C241, C242, C244, C250, C252, C254, C255, C256, C257, C259, C261, C262, C264, C266, C267, C268, C270, C271, C272, C273, C275, C276, C278, C281, C282, C283, C286, C288, C289, C290, C292, C293, C295, C297, C301, C304, C305, C306, C307, C309, C311, C313, C314, C317, C318, C319, C320, C321, C327, C328, C329, C332, C333, C337, C339, C342, C343, C344, C347, C348, C349, C350, C351, C353, C355, C357, C358, C360, C362, C364, C365, C366, C367, C373, C375, C376, C377, C378, C380, C381, C382, C383, C385, C387, C388, C389, C390, C391, C394, C395, C396, C397, C398, C399, C401, C403, C405, C407, C408, C409, C412, C413, C414, C415, C417, C418, C425, C426, C427, C428, C429, C430, C432, C436, C437, C441, C442, C443, C444, C445, C446, C448, C449, C450, C453, C456, C457,	CAP, SMD, 0402, 0.1µF, 16V, 10%, X7R, ROHS	Murata	GRM155R71C104KA88D

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
	C463, C465, C467, C468, C469, C470, C472, C473, C474, C475, C477, C480, C481, C482, C485, C487, C490, C491, C492, C495, C497, C500, C502, C503, C504, C506, C508, C509, C510, C512, C516, C517, C518, C520, C524, C526, C528, C529, C535, C536, C537, C538, C539, C540, C542, C543, C545, C548, C550, C553, C559, C561, C562, C563, C565, C566, C567, C568, C569, C570, C571, C572, C573, C574, C575, C576, C577, C578, C579, C581, C582, C583, C584, C588, C589, C591, C593, C597, C598, C599, C600, C601, C602, C603,C604, C605, C607, C608, C609, C610, C611, C612, C614, C615, C616, C617, C619, C621, C622, C624, C625, C626, C627, C628, C629, C630, C632, C633, C634, C635, C637, C638, C639, C640, C642, C643, C644, C645, C646, C648, C649, C650, C651, C653, C654, C655, C656, C657, C658, C659, C660, C661, C662, C663, C664, C665, C666, C667, C668, C669, C670, C674, C676, C679, C680, C681, C682, C683, C684, C685, C686, C687, C688, C689, C690, C691, C692, C693, C695, C696, C697, C698, C699, C700, C701, C704, C706, C710, C711, C713, C714, C715, C717, C718, C720, C724, C726, C727, C728, C729, C730, C731, C732, C733, C734, C738, C740, C742, C746, C747, C749, C750, C751, C752, C753, C754, C757, C758, C759, C760, C761, C762, C763, C769, C770, C771, C772, C773, C774, C775, C776, C778, C780, C782, C786, C788, C789, C790, C791, C792, C794, C795, C796, C797, C798, C799, C802, C803, C804, C805, C806, C807, C808, C811, C812, C814, C817, C819, C820, C821, C822, C824	CAP, SMD, 0402, 0.1µF, 16V, 10%, X7R, ROHS	Murata	GRM155R71C104KA88D

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
1	C560	CAP, SMD, 0402, 2200pF, 16V, 10%, X7R, ROHS	Murata	GRM155R71C222KA01D
1	C647	CAP, SMD, 0805, 22µF, 6.3V, 10%, X5R, ROHS	Taiyo Yuden	JMK212BJ226KG-T
3	C40, C151, C277	CAP-TANT, SMD, 3.5x2.8mm, 47µF, 10V, 10%, 1Ω, ROHS	Kemet	T491B476K010AT
5	C121, C969, C970, C971, C972	CAP-TANT, SMD, 7.3x4.3, 68µF, 20V, 10%, 150mΩESR, ROHS	Kemet	T493X686K020BH6420
1	C6	CAP-TANT, SMD, 7.3x4.3mm, 330uf, 10V, 10%, 150mΩ, -55+125C, ROHS	Kemet	T495D337K010ATE150
1	C956	CAP-TANT, SMD, 7.3x4.3, 150µF, 16V, 20%, 40mΩESR, ROHS	Kemet	T541X157M016AH6710
12	C902, C943, C944, C945, C957, C958, C959, C960, C961, C962, C963, C964	CAP-TANT, SMD, 7.3x4.3, 330µF, 16V, 20%, 20mΩESR, ROHS	Kemet	T541X337M016AH6720
10	C69, C76, C95, C98, C102, C111, C675, C721, C810, C815	CAP-TANT, SMD, 1206, 33µF, 10V, 10%, 700mΩ, ROHS	Avx	TPSA336K010R0700
2	C785, C801	CAP-TANT, SMD, B, 33µF, 16V, 10%, 350mΩ, ROHS	Vishay/Sprague	TR3B336K016C0350
2	L1, L3	COIL-PWR INDUCTOR, SMD, 7.3X6.8, 0.33µH, 20%, 18A, ROHS	Abracon Corp.	ASPI-7318-R33M
1	L4	COIL-PWR INDUCT, SMD, 8.9x6mm, 2.2µH, 20%, 3.5A, 35mΩ, ROHS	Coilcraft	DO1813H-222MLB
2	L10, L7	COIL-PWR INDUCTOR, SMD, 5.2x5.4mm, 3.3µH, 20%, 8.7A, 21.2mΩ, ROHS	Coilcraft	XAL5030-332MEB
2	L8, L9	COIL-PWR INDUCTOR, SMD, 5.2x5.4mm, 0.6µH, 20%, 19.8A, 4.1mΩ, ROHS	Coilcraft	XAL5030-601MEB
1	J30	CONN-MAG JACK, 1 PORT, TH, RJ45, R/A, 10/100/1000 Base-T, ROHS	Bel Fuse Inc.	0826-1X1T-GH-F
6	J48, J49, J50, J57, J58, J59	CONN-RF, SMA JACK, TH, STRAIGHT, PCB MNT, ROHS	Rosenberger	32K10K-400L5
10	TP1, TP2, TP8, TP15, TP29, TP34, TP49, TP76, TP78, TP79	CONN-MULTI-PURPOSE TEST PT, BLK, ROHS	Keystone	5011
1	J33	CONN-HEADER, 2x2, BRKAWY 2X36, 2.54mm, VERTICAL, ROHS	Berg/FCI	67996-272HLF
4	J39, J40, J44, J45	CONN-HEADER, 1x1, BREAKAWAY 1x36, 2.54mm, ROHS	Berg/FCI	68000-236HLF

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
13	J14, J15, J21, J23, J24, J25, J26, J31, J46, J51, J53, J55, J60	CONN-HEADER, 1x2, BRKAWY 1X36, 2.54mm, ROHS	Berg/FCI	68000-236HLF
3	J17, J27, J28	CONN-HEADER, 1x3, BREAKAWY 1x36, 2.54mm, ROHS	Berg/FCI	68000-236HLF
1	J32	CONN-HEADER, TH, 1x4, 2.54mmPITCH, 6.75x2.9, ROHS	Molex	901200124
2	J12, J34	CONN-SOCKET ARRAY, TH, 400P, 0.05 PITCH, CUSTOM, ROHS	Samtec	ASP-134486-01
1	J11	CONN-HEADER, TH, 2x4, 1, 27mmPITCH, 3x2.3mm, ROHS	Sullins	GRPB042VWVN-RC
1	J19	CONN-HEADER, TH, 2x5, 1, 27mmPITCH, 3x2.3mm, ROHS	Sullins	GRPB052VWVN-RC
1	J22	CONN-IDC HEADER, HI TEMP, SHROUDED, SMD, 2x5, ROHS	Samtec	HTST-105-01-L-DV-A
1	J18	CONN-IDC HEADER, HI TEMP, SHROUDED, SMD, 2x10, ROHS	Samtec	HTST-110-01-L-DV
2	J11-Pins 1-2, J19-Pins 1-2	CONN-JUMPER, SHORTING, 2P, 1.27mm PITCH, BLK, 3mm LENGTH, ROHS	Harwin Inc	M50-1900005
1	J9	CONN-PWR JACK, TH, 2.5x5.5mm, BLACK, R/A, ROHS	CUI, Inc	PJ-102BH
1	J20 (*Remove pin 7 before assy)	CONN-IDC HEADER, SHROUDED, SMD, 2x5, ROHS	Samtec	SHF-110-01-L-D-SM
10	a) Pins 1-2 on: J17, J21, J23, J26,	CONN-JUMPER, SHUNT, 2P, 2.54mm PITCH, BLK, 6mm, OPEN, ROHS	Sullins	SPC02SYAN
0	b) Pins 1-2 on: J27, J28, J32, J53	CONN-JUMPER, SHUNT, 2P, 2.54mm PITCH, BLK, 6mm, OPEN, ROHS	Sullins	SPC02SYAN
0	c) J33-Pins 1-2&3-4	CONN-JUMPER, SHUNT, 2P, 2.54mm PITCH, BLK, 6mm, OPEN, ROHS	Sullins	SPC02SYAN
1	J47	CONN-RECEPTACLE, SMD, MINI USB 2.0, 5POS, R/A, ROHS	Hirose Electric	UX60-MB-5ST
1	D7	DIODE-RECTIFIER, AXIAL, DO-41, 50V, 1A, ROHS	Diodes, Inc.	1N4001

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1	D6	DIODE-RECTIFIER, SMD, SOD-123, 100V, 400mW, 150mA, ROHS	Diodes Inc.	1N4148W-7-F
2	D8, D9	DIODE-RECTIFIER, SMD, SMC, 2P, 20V, 3A, ROHS	On Semiconductor	MBRS320T3G
2	CR1, CR2	DIODE-TVS, ZENER, SMD, 0603, 24V, 150V VOLT CLAMPING, ROHS	Littelfuse	PGB1010603MR
1	D1	DIODE-SHOTTKY, SMD, 2P, DO-214AA, 40V, 8A, ROHS	AVX	SD2114S040S8R0
1	DS7	LED, SMD, 0805, ORANGE/CLEAR, 2V, 20mA, 110mcd, 605nm, ROHS	Dialight	598-8130-107F
18	LED3, LED4, LED9, DS3, DS4, DS5, DS6, DS8, DS9, DS10, DS11, DS12, DS13, DS14, DS15, DS16, DS17, DS18	LED, SMD, 0603, GREEN/DIFFUSED, 2.2V, 20mA, 15mcd, 570nm, ROHS	Visual Communications Co.	CMDA19AY7D1S
1	DS2	LED, SMD, 0805, GREEN/CLEAR, 2V, 20mA, 35mcd, 571nm, ROHS	Liteon/Vishay	LTST-C171KGKT
1	DS1	LED, SMD, 0805, BLUE/CLEAR, 3.4V, 20mA, 468nm, 30mcd, ROHS	Liteon/Vishay	LTST-C171TBKT
2	LED5, LED6	LED, SMD, 0603, RED/CLEAR, 2V, 20mA, 150mcd, 636nm, ROHS	Lumex	SML-LXFM0603SIC-TR
2	LED7, LED8	LED, SMD, 0603, ORANGE, 2V, 20mA, 90mcd, 605nm, ROHS	Vishay	VLMO1300-GS08
2	LED1, LED2	LED, SMD, 0603, YELLOW, 2.4V, 20mA, 180mcd, 597nm, ROHS	Vishay	VLMY1300-GS08
3	L2, L5, L6	FERRITE EMI CHIP BEAD, SMD, 0805, 600Ω, 500mA, ROHS	Laird Technologies	HZ0805E601R-10
1	U25	IC-EEPROM, 2Kb, 128x16 SPI, 2MHz, SMD, SOT-23-6, ROHS	Microchip Technology	93LC56BT-I/OT
2	U31, U35	IC-3V SUPERVISOR, 1 CHANNEL, SMD, 3P, SOT-23-3, ROHS	Maxim	DS1818R-5+T&R
1	U30	IC-USB BRIDGE, USB 2.0-UART INTERFACE, 64P, LQFP, ROHS	Future Technology Devices	FT4232HL-REEL
2	U165, U2	IC-12A SYNC BUCK REGULAT, 64P, CQFP, W/HEATSINK, ROHS	Renesas Electronics America	ISL70002SEHFE/PROTO

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1	U3	IC-RAD-HARD12A BUCK REGULATOR, 64P, CQFP, ROHS	Renesas Electronics America	ISL70003ASEHFE/PROTO
1	U167	IC-RAD HARD LDO REGULATOR, SMD, 28P, CFP, ROHS	Renesas Electronics America	ISL70005SEHF/PROTO
1	U166	IC-19MHz RAD HARD R/R OP AMP, 10P, FP, ROHS	Renesas Electronics America	ISL70244SEHF/PROTO
1	U1	IC-RADHARD QUAD SEQUENCER, 18P, FLATPAK, ROHS	Renesas Electronics America	ISL70321SEHF/PROTO
3	U18, U23, U8	IC-RADHARD, CMOS 3A LDO REGULATOR, 18P, CFP, ROHS	Renesas Electronics America	ISL75051ASEHFE/PROTO
2	U6, U34	IC-3.3-5V, 5A BUCK REGULATOR, 20BUMP, WLCSP, ROHS	Microchip Technology	LX7165-01CSP-TR
1	U40	IC-ADJ.BUCK REGULATOR, 0.6V, 1A, 6P, UDFN, ROHS	Microchip Technology	LX7186AILU-TR
1	U5	IC-OP AMP, 1 CIRCUIT RAIL-RAIL, SMD, 5P, SOT-23-5, ROHS	Microchip Technology	MCP6071T-E/OT
1	U21	IC-LINEAR ADJ.VOLTAGE REGULATOR, SMD, SPAK-7, ROHS	Microchip Technology	MIC69502WR
10	U10, U11, U13, U15, U19, U20, U22, U24, U27, U29	IC-SDRAM, DDR3, 2G 256Mx8, 800MHz, 78BUMP, FBGA, ROHS	Micron Semiconductor	MT41K256M8DA-125IT:K
2	U7, U37	IC-MEMORY, FLASH NOR, 1Gb (256M x 4) SPI, 16P, SOP, ROHS	Micron Semiconductor	N25Q00AA13GSF40G
3	U9, U12, U17	IC-BUS SWITCH, MUX/DEMUX QUAD 2.1, 16P, SOIC, ROHS	IDT	QS3VH257S1G8
1	U33	IC-3.3V VOLTAGE REGULATOR, SMD, D2PAK, 800mA, ROHS	Texas Instruments	REG1117F-3.3/500
1	U36	IC-SUPERVISOR, 1 CHANNEL, SMD, SOT-23-6, ROHS	Texas Instruments	TPS3808G09DBVR
1	U39	IC-TRANSLATOR, BIDIRECTIONAL, 60Mbps, 20P, TSSOP, ROHS	Texas Instruments	TXS0108EPWR
1	Q1	TRANSISTOR, N-CHANNEL, 3LD, SOT-23, 60V, 115mA, ROHS	Diodes, Inc.	2N7002-7-F
1	U4	TRANSISTOR-MOS, P-CHANNEL, SMD, 8P, SOIC, -30V, -16A, ROHS	Infineon Technology	IRF9317TRPBF

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1	U163	IC-BUFFER, NON-INVERTING, 4-ELEMENT, 14P, TSSOP, ROHS	On Semiconductor	MC74VHC125DTR2G
3	U41, U42, U43	IC-TRANSISTOR-4 NPN, 40V, 0.5A, 16P, SOIC, ROHS	On Semiconductor	MMPQ2222A
1	Y2	OSC-MEMS CLOCK, CMOS, 50MHz, 6-SMD, 7x5mm, ROHS	Abracon Corp.	ASVMPC-50.000MHZ-LR
2	Y1, Y5	OSC-CRYSTAL, CLOCK, 100MHz, 3.3V, 50ppm, LVDS, 6-SMD, 7x5mm, ROHS	Crystek	CCLD-033-50-100.000
1	Y4	OSC-CRYSTAL, CLOCK, 125MHz, 3.3V, 50ppm, LVDS, 6-SMD, 7x5mm, ROHS	Crystek	CCLD-033-50-125.000
1	X1	OSC-CRYSTAL, 12MHz, 12pF, 150Ωs, SMD, 2P, 5x3.2mm, ROHS	Kyocera	CX5032GB12000H0PESZZ
1	Y3	OSC-CRYSTAL, 25MHz, 50Ω, 18pf LOAD, 4-SMD, 3.2x2.5mm, ROHS	Epson Crystals	FA-238-25.0000MB-C3
1	R8	RES-CURR.SENSE, SMD, 2512, 0.01Ω, 2W, 1%, TF, ROHS	Stackpole	CSRN2512FK10L0
12	R396, R397, R421, R422, R433, R441, R442, R443, R465, R466, R467, R520	RES-AEC-Q200, SMD, 0402, 1k, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB102X
7	R410, R450, R501, R502, R503, R504, R505	RES-AEC-Q200, SMD, 0402, 10k, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB103X
1	R464	RES-AEC-Q200, SMD, 0402, 1.13k, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB1131X
1	R451	RES-AEC-Q200, SMD, 0402, 15k, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB153X
4	R403, R404, R426, R427	RES-AEC-Q200, SMD, 0402, 19.6k, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB1962X
1	R453	RES-AEC-Q200, SMD, 0402, 20k, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB203X
1	R398	RES-AEC-Q200, SMD, 0402, 221Ω, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB2210X
1	R415	RES-AEC-Q200, SMD, 0402, 22.1k, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB2212X
1	R417	RES-AEC-Q200, SMD, 0402, 24.9k, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB2492X
2	R418, R460	RES-AEC-Q200, SMD, 0402, 3.32k, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB3321X

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
2	R414, R452	RES-AEC-Q200, SMD, 0402, 3.48k, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB3481X
1	R419	RES-AEC-Q200, SMD, 0402, 357Ω, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB3570X
6	R399, R400, R407, R408, R424, R425	RES-AEC-Q200, SMD, 0402, 4.02k, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB4021X
2	R510, R518	RES-AEC-Q200, SMD, 0402, 40.2k, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB4022X
4	R457, R458, R459, R468	RES-AEC-Q200, SMD, 0402, 4.32k, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB4321X
1	R454	RES-AEC-Q200, SMD, 0402, 49.9k, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB4992X
1	R416	RES-AEC-Q200, SMD, 0402, 51.1k, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB5112X
1	R508	RES-AEC-Q200, SMD, 0402, 63.4k, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB6342X
1	R461	RES-AEC-Q200, SMD, 0402, 806Ω, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB8060X
1	R517	RES-AEC-Q200, SMD, 0402, 8.06k, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB8061X-T
2	R500, R507	RES-AEC-Q200, SMD, 0402, 80.6k, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB8062X-T
1	R430	RES-AEC-Q200, SMD, 0402, 976Ω, 1/16W, 0.1%, TF, ROHS	Panasonic	ERA-2AEB9760X
7	R405, R406, R428, R429, R437, R440, R475	RES-AEC-Q200, SMD, 0402, 1Ω, 1/16W, 1%, TF, ROHS	Panasonic	ERJ-2BQF1R0X
2	R455, R456	RES-AEC-Q200, SMD, 0402, 0Ω, 1/10W, ROHS	Panasonic	ERJ-2GE0R00X
20	R420, R432, R435, R436, R438, R439, R493, R494, R495, R496, R497, R509, R511, R512, R513, R514, R515, R516, R521, R522	RES-AEC-Q200, SMD, 0402, 10k, 1/10W, 1%, TF, ROHS	Panasonic	ERJ-2RKF1002X
1	R413	RES-AEC-Q200, SMD, 0402, 100k, 1/10W, 1%, TF, ROHS	Panasonic	ERJ-2RKF1003X
1	R411	RES-AEC-Q200, SMD, 0805, 1Ω, 1/4W, 1%, TF, ROHS	Panasonic	ERJ-U6QF1R0V
1	R153	RES-AEC-Q200, SMD, 0603, 300Ω, 1/4W, 5%, ANTI-SURGE, TF, ROHS	Rohm	ESR03EZPJ301
1	R160	RES-AEC-Q200, SMD, 0603, 330Ω, 1/4W, 5%, ANTI-SURGE, TF, ROHS	Rohm	ESR03EZPJ331

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
2	R219, R226	RES, SMD, 0402, 22Ω, 1/16W, 1%, TF, ROHS	Panasonic	ERJ-2RKF22R0X
6	R58, R59, R207, R211, R220, R344	RES, SMD, 0402, 33Ω, 1/16W, 1%, TF, ROHS	Yageo	RC0402FR-0733RL
1	R169	RES, SMD, 0402, 39Ω, 1/16W, 1%, TF, ROHS	Stackpole	RMCF0402FT39R0
1	R297	RES, SMD, 0402, 75Ω, 1/16W, 1%, TF, ROHS	Panasonic	ERJ-2RKF75R0X
29	R26, R27, R37, R69, R70, R77, R102, R103, R104, R105, R137, R171, R209, R210, R217, R221, R225, R227, R229, R230, R244, R298, R345, R361, R362, R364, R370, R373, R381	RES, SMD, 0402, 0Ω, 1/16W, 5%, TF, ROHS	Venkel	CR0402-16W-00T
3	R24, R151, R331	RES, SMD, 0402, 100Ω, 1/16W, 1%, TF, ROHS	Venkel	CR0402-16W-1000FT
11	R11, R56, R61, R64, R94, R178, R223, R250, R291, R357, R382	RES, SMD, 0402, 1k, 1/16W, 1%, TF, ROHS	Venkel	CR0402-16W-1001FT
39	R14, R15, R19, R36, R72, R80, R81, R95, R152, R154, R155, R156, R158, R167, R170, R174, R176, R181, R188, R190, R191, R196, R203, R206, R232, R237, R247, R253, R279, R282, R292, R346, R348, R349, R350, R375, R376, R377, R378	RES, SMD, 0402, 10k, 1/16W, 1%, TF, ROHS	Panasonic	ERJ-2RKF1002X
1	R179	RES, SMD, 0402, 11.3k, 1/16W, 1%, TF, ROHS	Yageo	RC0402FR-0711K3L
1	R338	RES, SMD, 0402, 12k, 1/16W, 1%, TF, ROHS	Venkel	CR0402-16W-1202FT
12	R260, R261, R262, R263, R264, R265, R266, R267, R268, R271, R272, R274	RES, SMD, 0402, 1.21k, 1/16W, 1%, ROHS	Yageo	RC0402FR-071K21P
3	R214, R215, R216	RES, SMD, 0402, 150Ω, 1/16W, 1%, TF, ROHS	Venkel	CR0402-16W-1500FT
4	R1, R96, R257, R258	RES, SMD, 0402, 1.5k, 1/16W, 1%, TF, ROHS	Venkel	CR0402-16W-1501FT
1	R506	RES, SMD, 0402, 154k, 1/16W, 1%, TF, ROHS	Vishay/dale	CRCW0402154KFKED
2	R2, R182	RES, SMD, 0402, 16.9k, 1/16W, 1%, TF, ROHS	Panasonic	ERJ-2RKF1692X
12	R124, R125, R126, R127, R128, R129, R130, R131, R132, R133, R134, R296	RES, SMD, 0402, 2k, 1/16W, 1%, TF, ROHS	Panasonic	ERJ-2RKF2001
1	R162	RES, SMD, 0402, 22k, 1/16W, 1%, TF, ROHS	Venkel	CR0402-16W-223JT

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
12	R208, R228, R233, R246, R249, R269, R270, R273, R275, R283, R286, R340	RES, SMD, 0402, 240Ω, 1/16W, 1%, TF, ROHS	Stackpole	RMCF0402FT240R
1	R68	RES, SMD, 0402, 240k, 1/16W, 1%, TF, ROHS	Stackpole	RMCF0402FT240K
8	R9, R172, R177, R183, R193, R197, R199, R204	RES, SMD, 0402, 261Ω, 1/16W, 1%, TF, ROHS	Bourns	CR0402-FX-2610GLF
3	R476, R477, R478	RES, SMD, 0402, 2.67k, 1/16W, 1%, TF, ROHS	Yageo	RC0402FR-072K67L
4	R3, R30, R150, R185	RES, SMD, 0402, 30k, 1/16W, 1%, TF, ROHS	Yageo	RC0402FR-0730KL
2	R67, R165	RES, SMD, 0402, 33k, 1/16W, 1%, TF, ROHS	Panasonic	ERJ-2RKF3302X
1	R71	RES, SMD, 0402, 3.83k, 1/16W, 1%, TF, ROHS	Venkel	CR0402-16W-3831FT
2	R4, R192	RES, SMD, 0402, 45.3k, 1/16W, 1%, TF, ROHS	Venkel	CR0402-16W-4532FT
9	R66, R173, R175, R180, R186, R195, R198, R200, R201	RES, SMD, 0402, 4.7k, 1/16W, 1%, TF, ROHS	Venkel	CR0402-16W-4701FT
18	R111, R112, R113, R114, R115, R116, R117, R118, R119, R120, R121, R159, R187, R189, R202, R205, R213, R218	RES, SMD, 0402, 499Ω, 1/16W, 1%, TF, ROHS	Venkel	CR0402-16W-4990FT
1	R245	RES, SMD, 0402, 4.99k, 1/16W, 1%, TF, ROHS	KDA	RK73H1E4991F
52	R242, R251, R284, R285, R287, R288, R289, R290, R293, R294, R295, R299, R300, R301, R302, R303, R304, R305, R306, R307, R308, R309, R310, R311, R312, R313, R314, R315, R316, R317, R318, R319, R320, R321, R322, R323, R324, R325, R326, R327, R328, R329, R330, R332, R333, R334, R335, R336, R337, R339, R341, R342	RES, SMD, 0402, 49.9Ω, 1/16W, 1%, TF, ROHS	Panasonic	ERJ-2RKF49R9X
2	R254, R256	RES, SMD, 0402, 5.1k, 1/16W, 1%, TF, ROHS	Multicomp	MC0402WGF5101TCE-TR
1	R412	RES, SMD, 0402, 7.5k, 1/16W, 1%, TF, ROHS	Pansonic	ERJ-2RKF7501
2	R5, R194	RES, SMD, 0402, 90.9k, 1/16W, 1%, TF, ROHS	Vishay/Dale	CRCW040290K9FKED
0	R28, R29, R31, R32, R55, R99, R100, R108, R109, R252, R359, R360, R368, R369	RES, SMD, 0402, DNP, DNP, DNP, TF, ROHS		
2	R12, R16	RES, SMD, 0603, 20Ω, 1/10W, 1%, TF, ROHS	Panasonic	ERJ-3EKF20R0V

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
7	R234, R236, R238, R239, R240, R243, R248	RES, SMD, 0603, 22Ω, 1/10W, 1%, TF, ROHS	Yageo	RC0603FR-0722RL
12	R75, R83, R92, R93, R123, R278, R281, R343, R347, R351, R356, R366	RES, SMD, 0603, 3.3Ω, 1/10W, 1%, TF, ROHS	Panasonic	ERJ-3RQF3R3V
5	R10, R21, R25, R143, R144	RES, SMD, 0603, 0Ω, 1/10W, TF, ROHS	Venkel	CR0603-10W-000T
2	R17, R20	RES, SMD, 0603, 499Ω, 1/10W, 1%, TF, ROHS	Venkel	CR0603-10W-4990FT
1	R277	RES, SMD, 0603, 6.65k, 1/10W, 1%, TF, ROHS	Yageo	RC0603FR-076K65L
1	R164	RES, SMD, 0805, 4.7Ω, 1/8W, 1%, TF, ROHS	Yageo	RC0805FR-074R7L
1	R184	RES-AEC-Q200, SMD, 1206W, 1Ω, 1W, 1%, CURR.SENSE, TF, ROHS	Rohm	LTR18EZPFL1R00
1	SW5	SWITCH, SMD, LOW PROFILE, 8P, SLIDE, SPST, ROHS	CTS	219-8LPSTP
1	SW7	SWITCH-PUSH, TH, 6MM, 1P, PUSHB MOM-SPST	Panasonic	EVQ-PAD04M
1	SW6	SWITCH-SLIDE, TH, 6P, DPDT, 3A, 125V, ROHS	CW Industries	GF-126-0159
4	SW1, SW2, SW3, SW4	SWITCH-TACTILE, SMD, 6.2mm, SPST-NO, TOP ACTUATE, ROHS	C&K Components	KSC403J50SHLFG
9	Perimeter & Center PCB	STANDOFF-METRIC, M3x0.5mm, FEMALE, 6mmHEX, 13mmLENGTH, SS, ROHS	McMaster-Carr	94868A008
9	Perimeter & Center PCB	SCREW-METRIC, M3x0.5mm, PANHEAD, SLOTTED, 8mmLENGTH, SS, ROHS	McMaster-Carr	90353A143
1	U14	IC-PHY TRANSCEIVER, ETHERNET, QUAD PORT, 196P, TFBGA, ROHS	Marvell	88E1340SA0-BAM2I000
0	C30, C120	DO NOT POPULATE OR PURCHASE		
0	C37 (C1206C102MGRACTU)	DO NOT POPULATE OR PURCHASE		
0	CON1	DO NOT POPULATE OR PURCHASE		
0	MH1, MH2	DO NOT POPULATE OR PURCHASE		
0	R166 (CRCW040249K9FKED)	DO NOT POPULATE OR PURCHASE		
0	R212 (CRCW0402100RFKED)	DO NOT POPULATE OR PURCHASE		

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
0	R22, R23, R98, R107, R358, R367	DO NOT POPULATE OR PURCHASE		
0	R222 (CRCW04021K00FKED)	DO NOT POPULATE OR PURCHASE		
0	R371 (PMR25HZPJV1L0)	DO NOT POPULATE OR PURCHASE		
0	R40, R44, R52, R53 (CRCW080575R0FKEA)	DO NOT POPULATE OR PURCHASE		
0	R519 (ERJ-2BQF1R0X)	DO NOT POPULATE OR PURCHASE		
0	R57 (CRCW04021K00FKED)	DO NOT POPULATE OR PURCHASE		
0	R62, R63 (CRCW04022K20FKED)	DO NOT POPULATE OR PURCHASE		
0	R65, R73, R231 (CRCW04024K70FKED)	DO NOT POPULATE OR PURCHASE		
0	R97, R106, R363, R365 (MCR01MRTJ000)	DO NOT POPULATE OR PURCHASE		
0	TC1-TC24	DO NOT POPULATE OR PURCHASE		
0	J13, J29, J35, J36, J37, J38, J41, J42, J43, J52, J56	DO NOT POPULATE OR PURCHASE		
0	R38, R39, R41, R43, R45, R46, R47, R51, R135, R136, R138, R139, R140, R141, R146, R149, R224, R235, R241, R255, R259, R352, R353, R372,	DO NOT POPULATE OR PURCHASE		
0	TP3, TP4, TP5, TP7, TP9-TP14, TP16, TP18, TP19, TP21-TP28, TP30, TP31, TP32, TP33, TP35-TP48, TP50-TP61, TP63-TP75, TP77, TP80-TP91	DO NOT POPULATE OR PURCHASE		
0	R276, R280 (ERJ-2RKF75R0X)	DO NOT POPULATE OR PURCHASE		
0	R354, R355 (CRCW04021K00FKED)	DO NOT POPULATE OR PURCHASE		
0	R374, R383 (MCR01MRTJ000)	DO NOT POPULATE OR PURCHASE		
0	R379, R380 (CRCW040249R9FKED)	DO NOT POPULATE OR PURCHASE		
1	U38	IC-TEMPERATURE SENSOR, DIGITAL, 8P, TSSOP, ROHS	Texas Instruments	LM99CIMM/NOPB
1	U16 (Non-Rohs)	IC-SERDES TRANSCEIVER, RAD HARD FPGA, 1657P, CBGA	Microsemi	RT4G150-CB1657PROTO

2.4 Board Layout

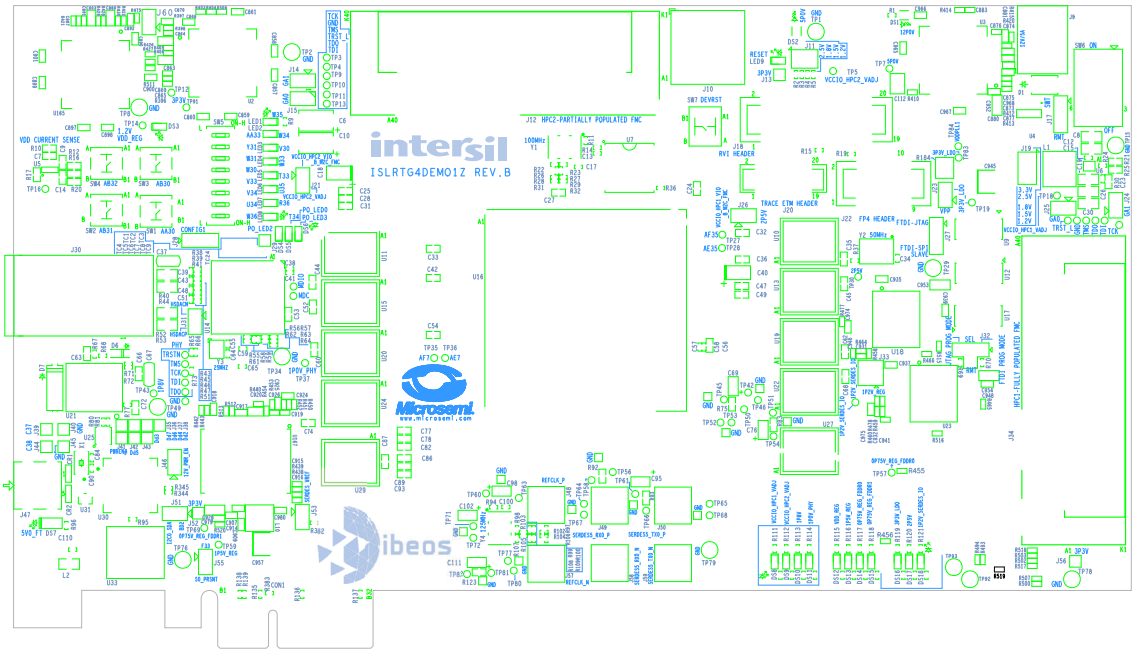

Figure 47. Silkscreen Top

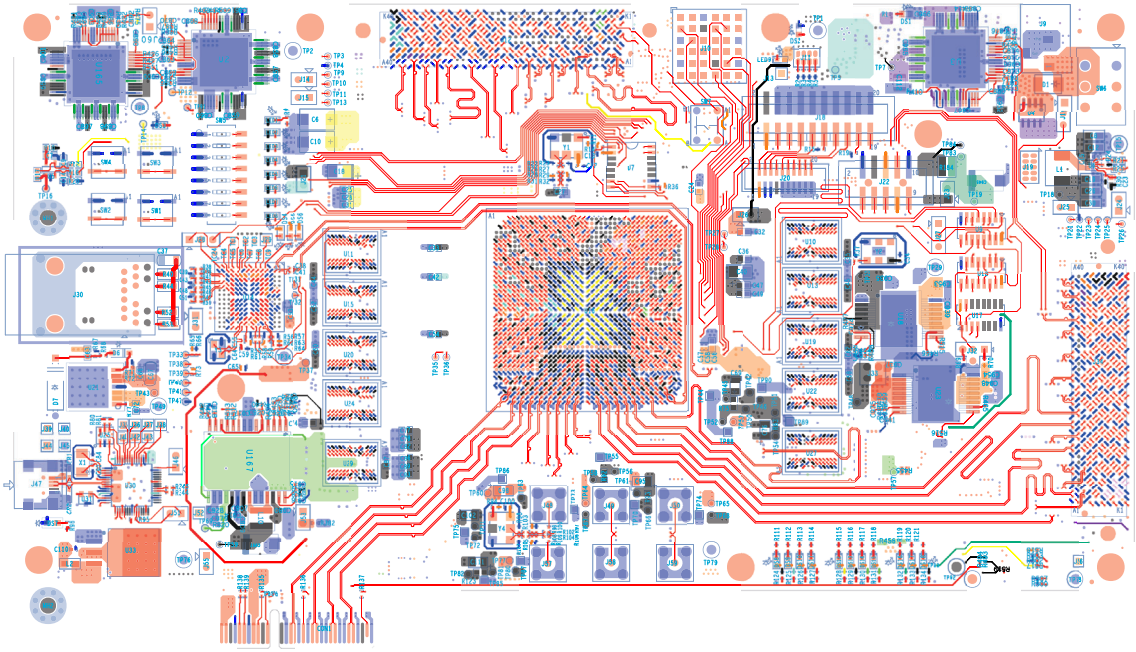

Figure 48. Top Layer

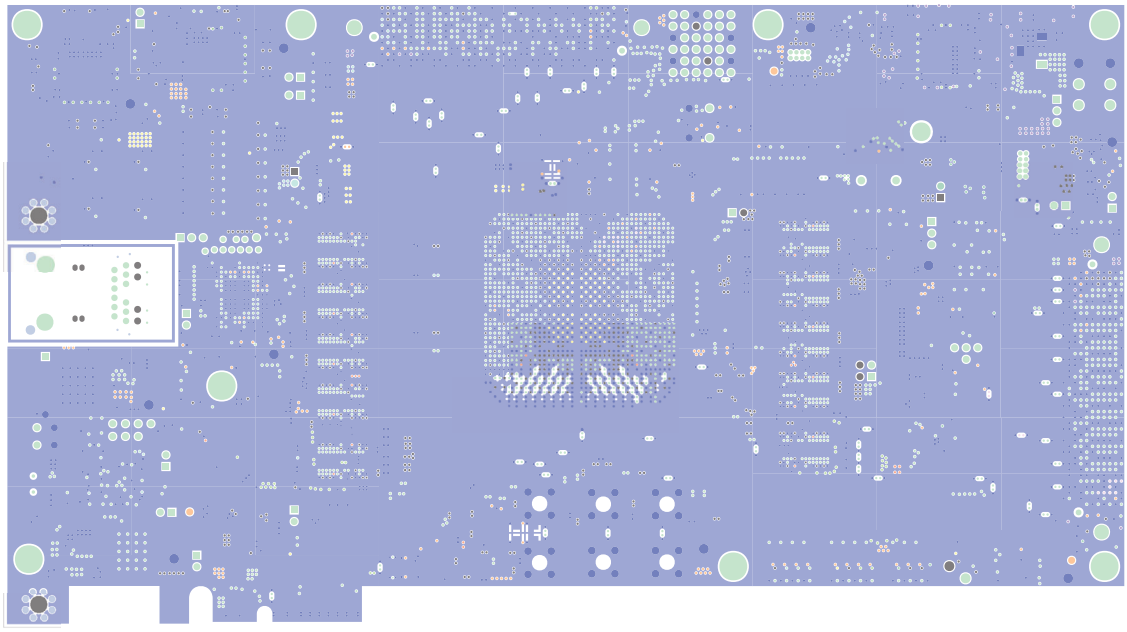

Figure 49. Layer 2

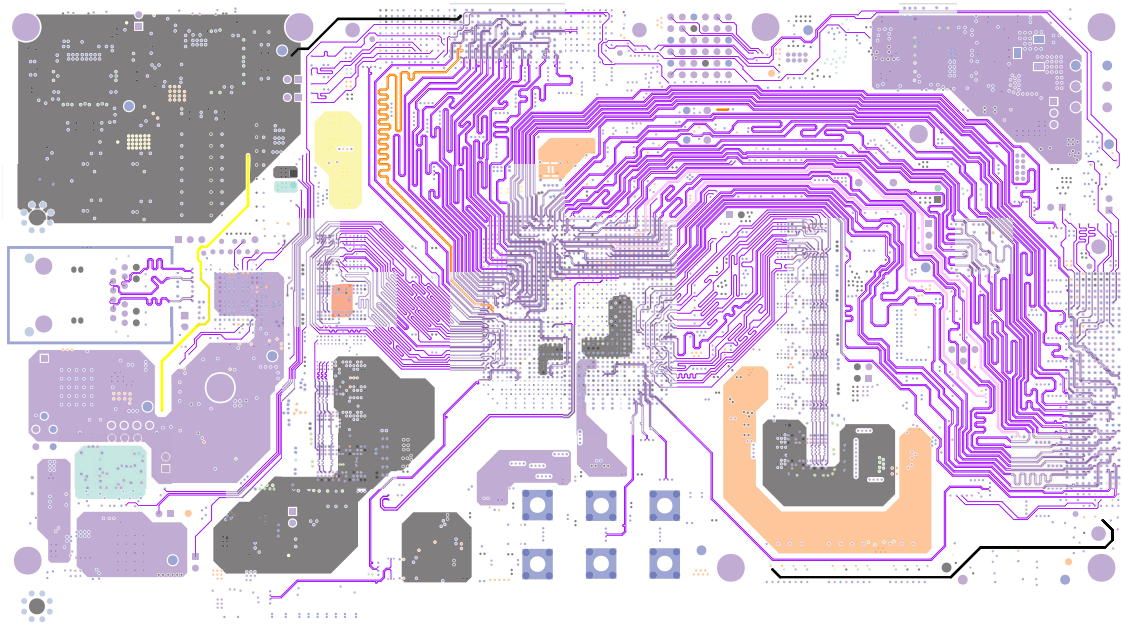

Figure 50. Layer 3

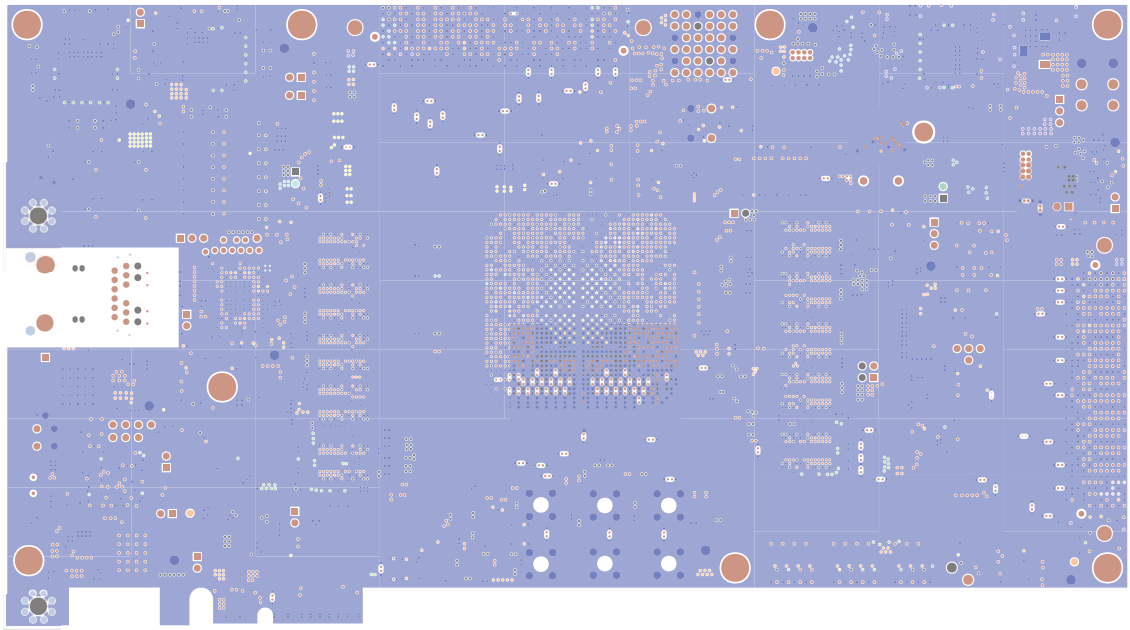

Figure 51. Layer 4

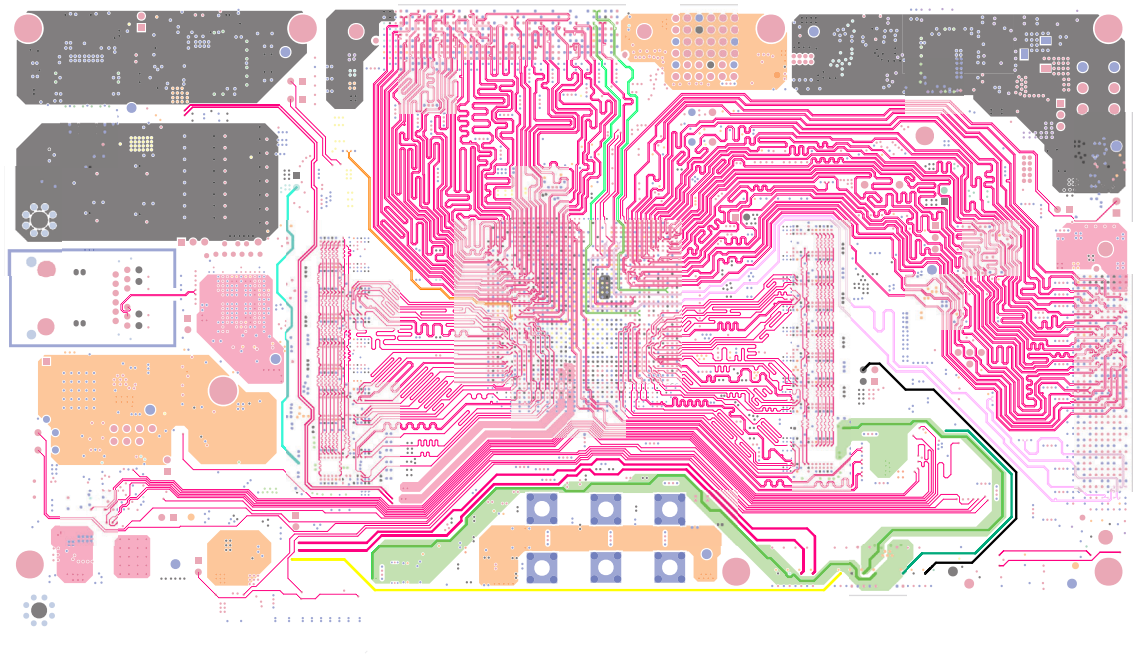

Figure 52. Layer 5

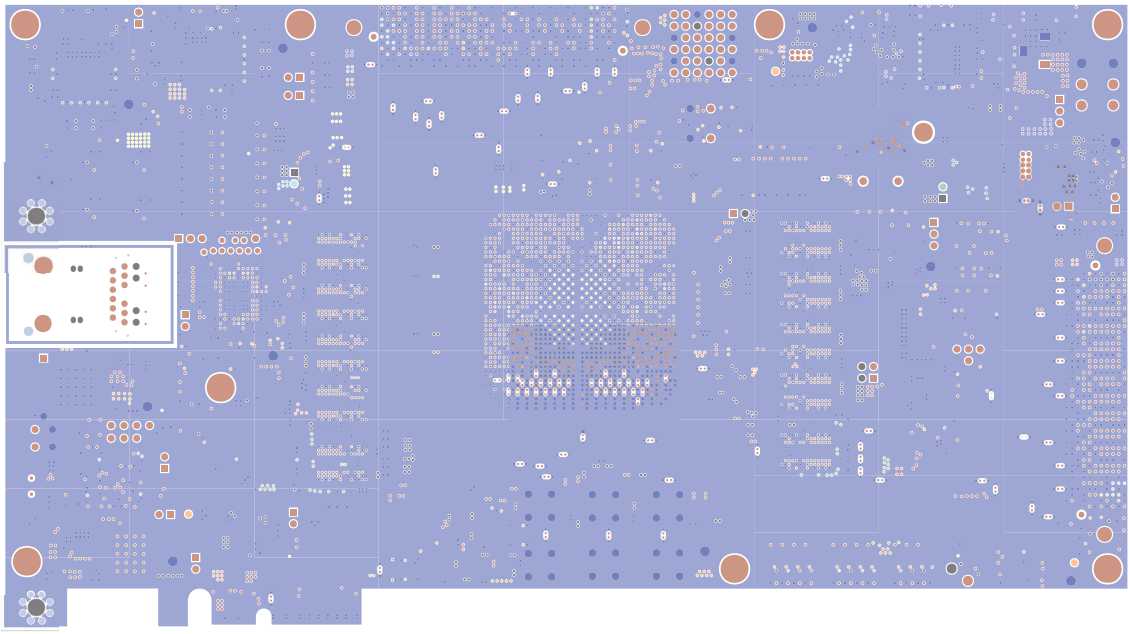

Figure 53. Layer 6

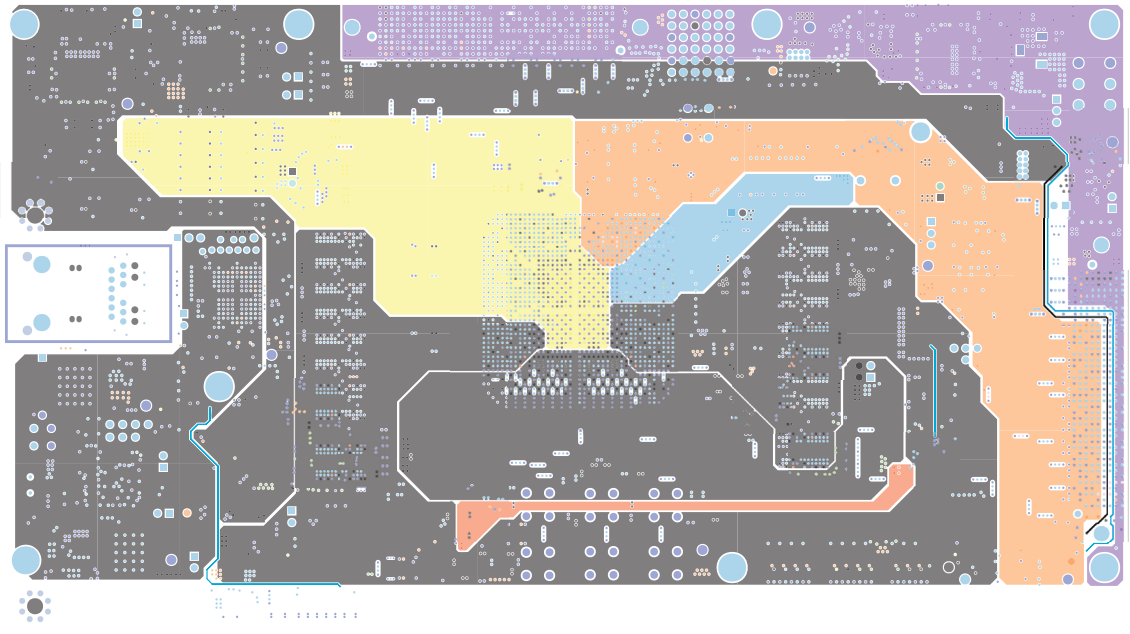

Figure 54. Layer 7

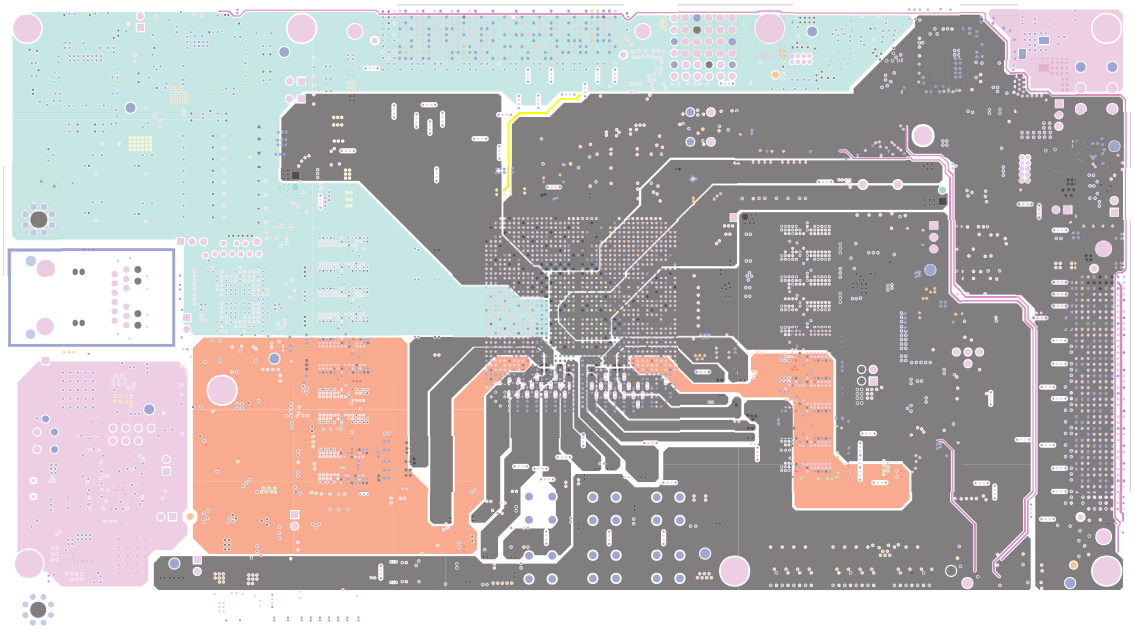

Figure 55. Layer 8

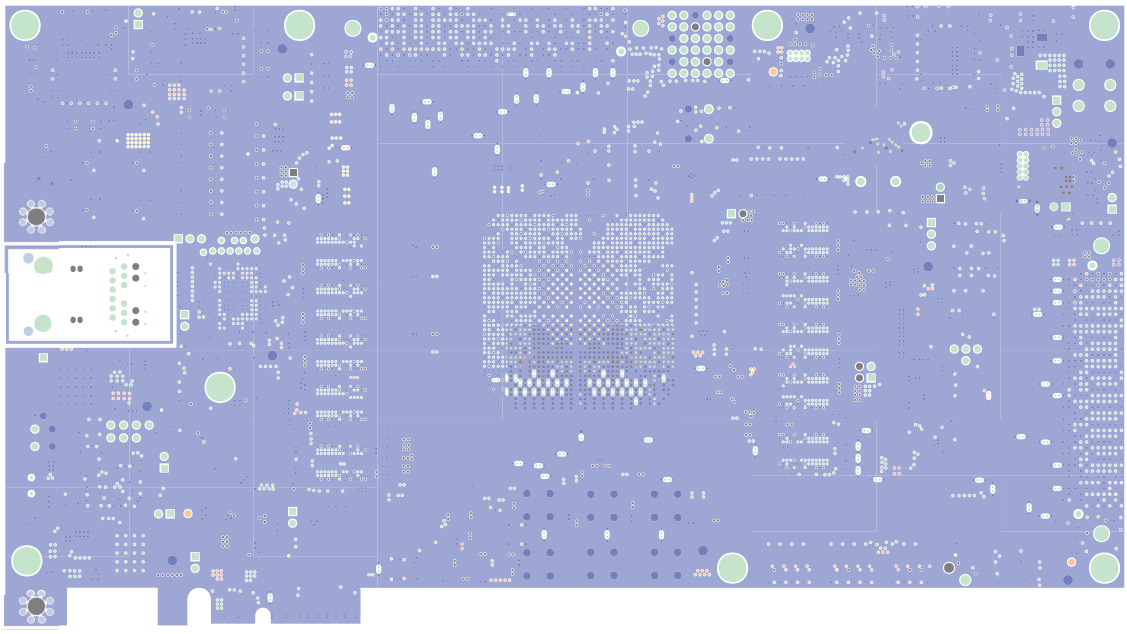

Figure 56. Layer 9

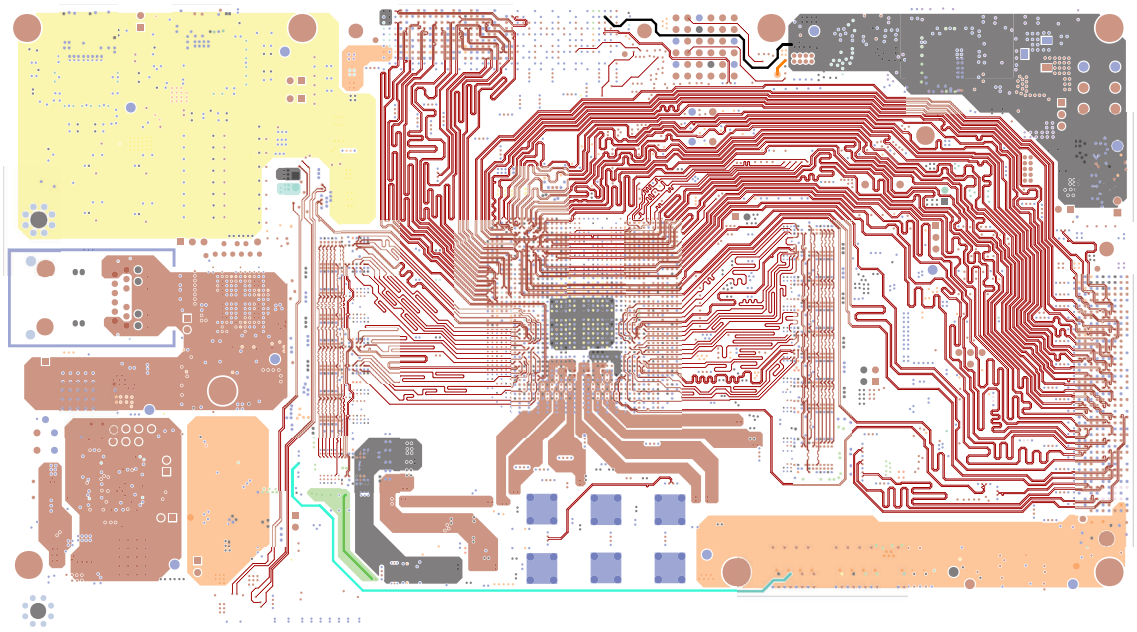

Figure 57. Layer 10

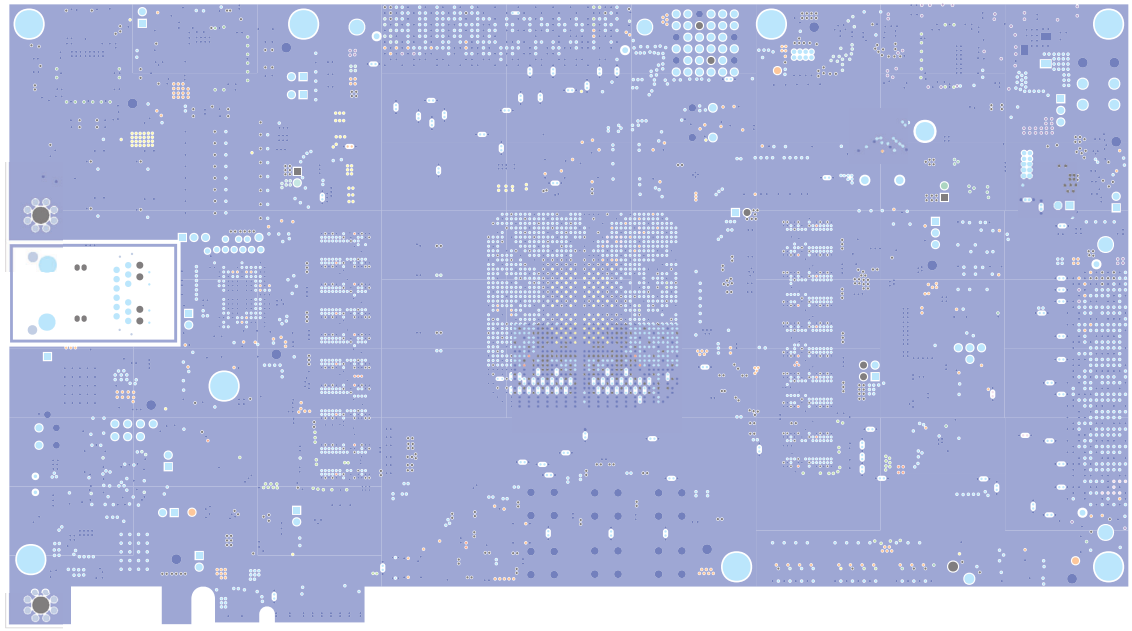

Figure 58. Layer 11

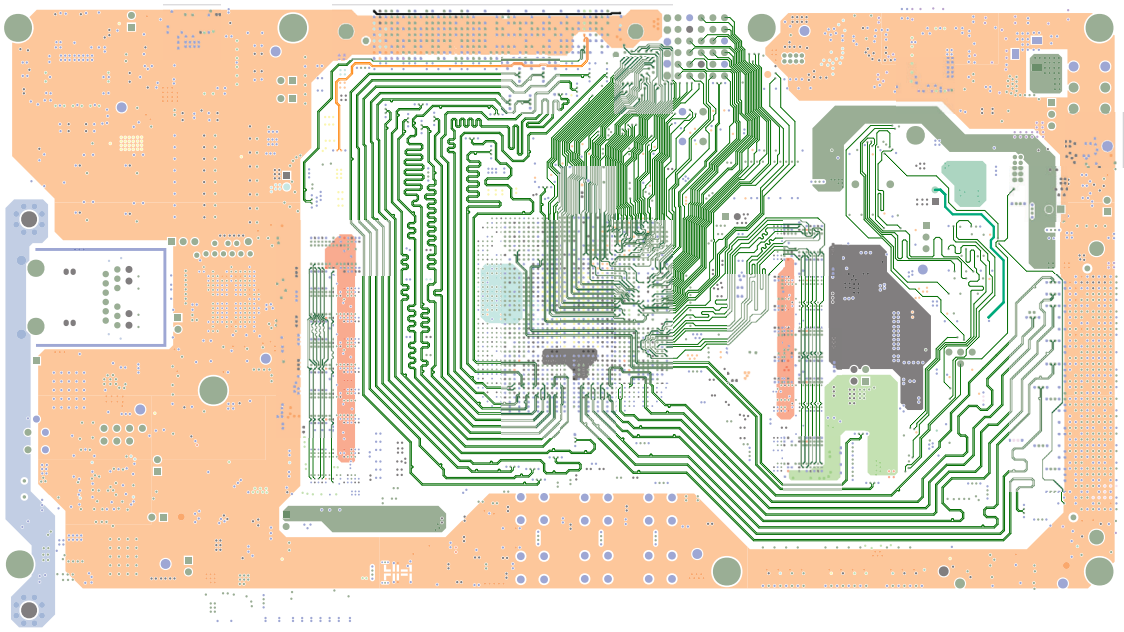

Figure 59. Layer 12

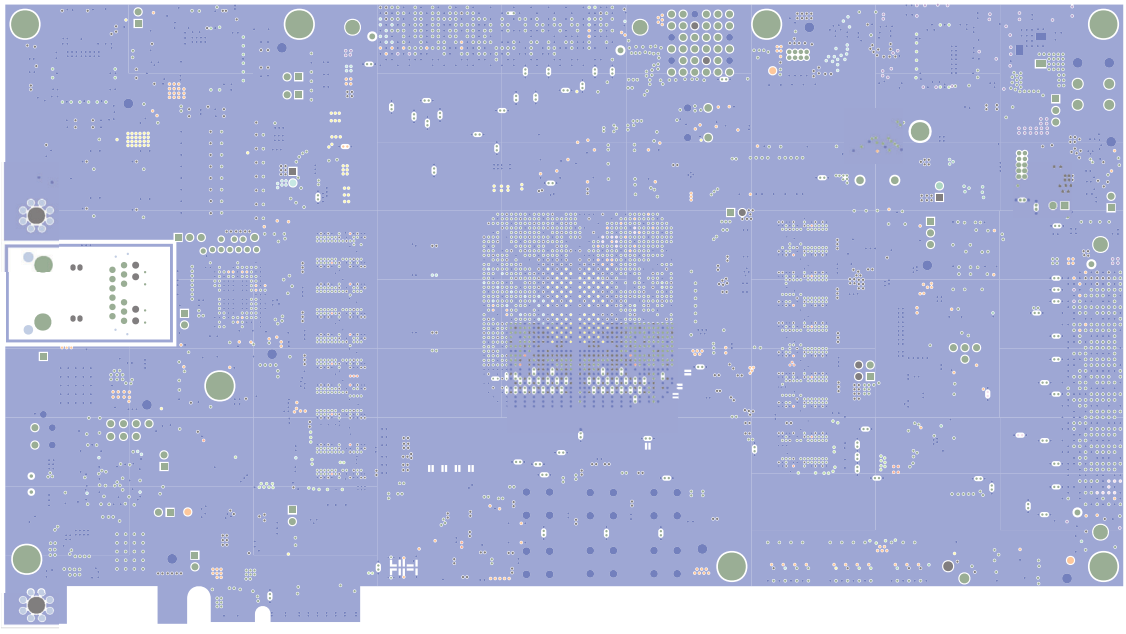

Figure 60. Layer 13

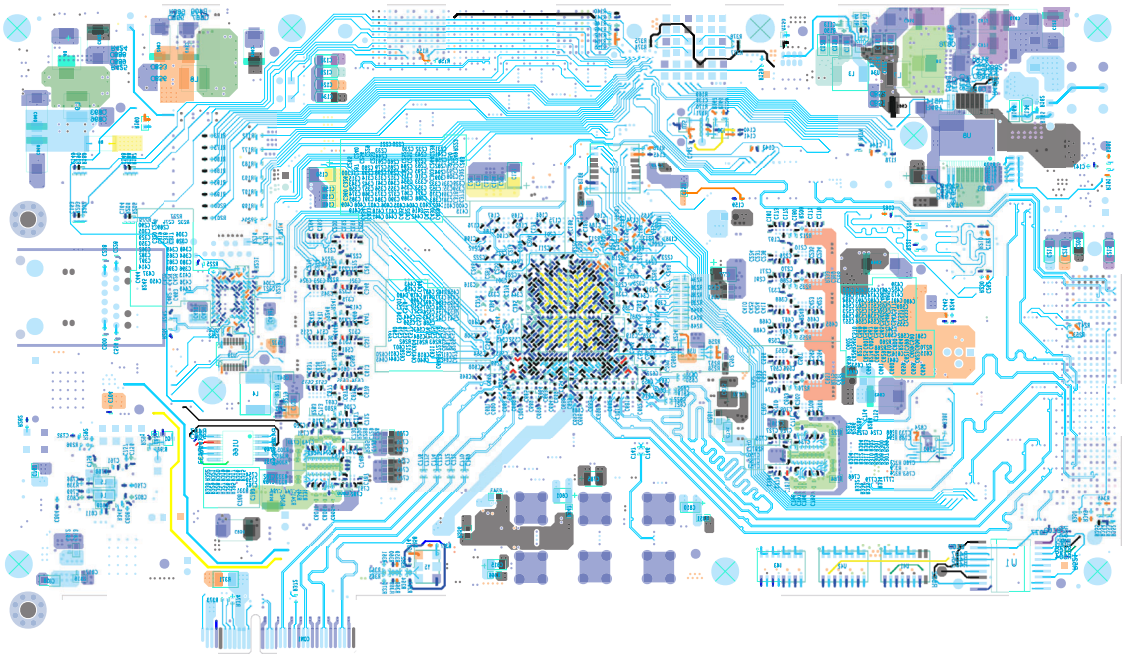

Figure 61. Bottom Layer

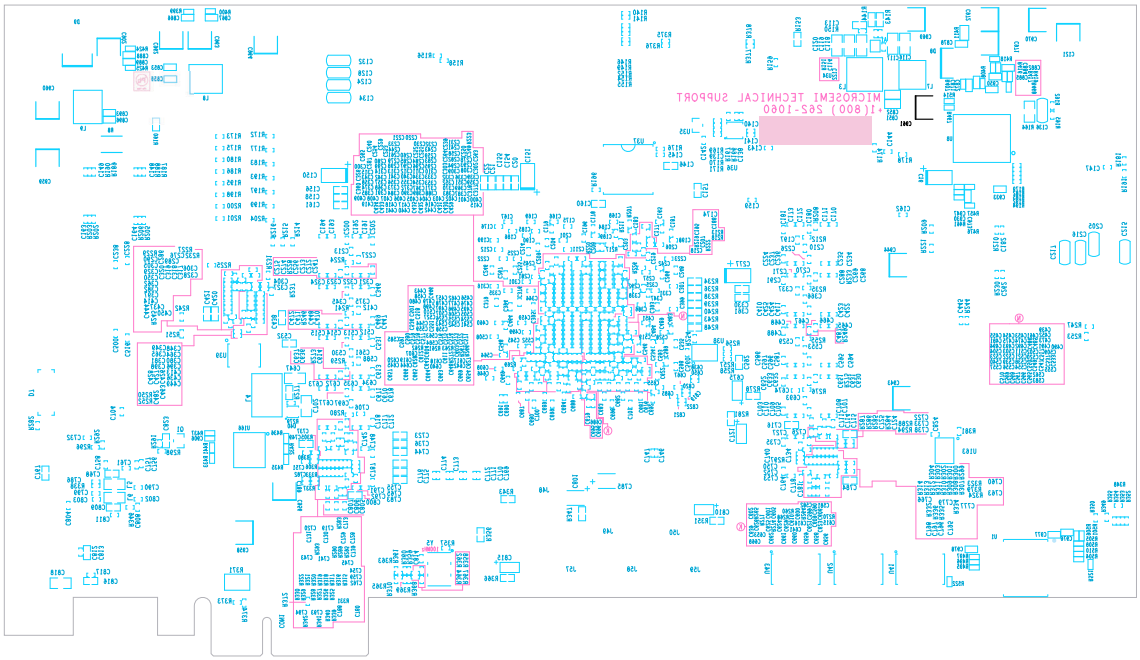

Figure 62. Silkscreen Bottom

3. Typical Performance Graphs

Typical performance curves for Figure 63 through Figure 68 are derived from the datasheet of the associated part. Actual performance on the ISLRTG4DEMO1Z will be different because of the test conditions.

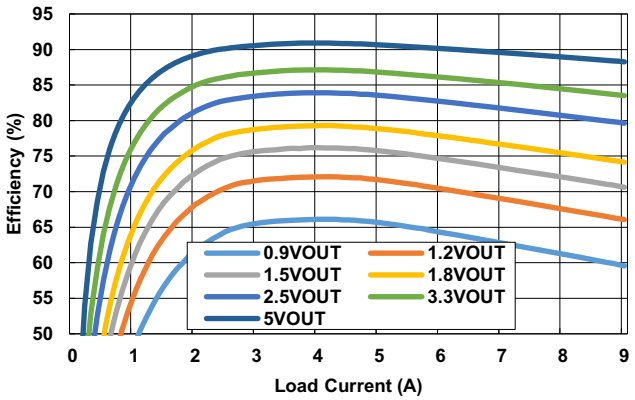

Figure 63. ISL70003ASEH Efficiency, V_{IN} = 12V, 500kHz

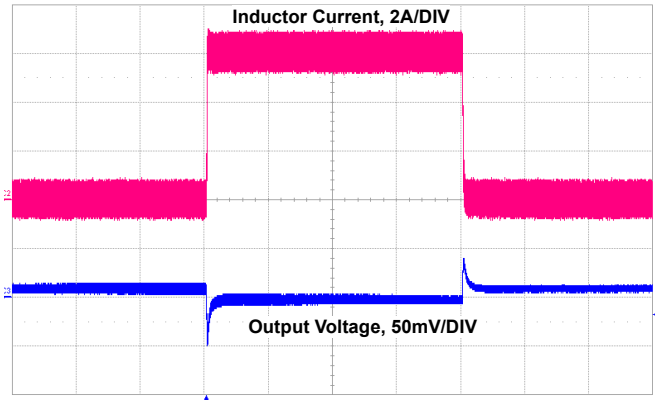

Figure 64. ISL70003ASEH 6A Load Transient Response

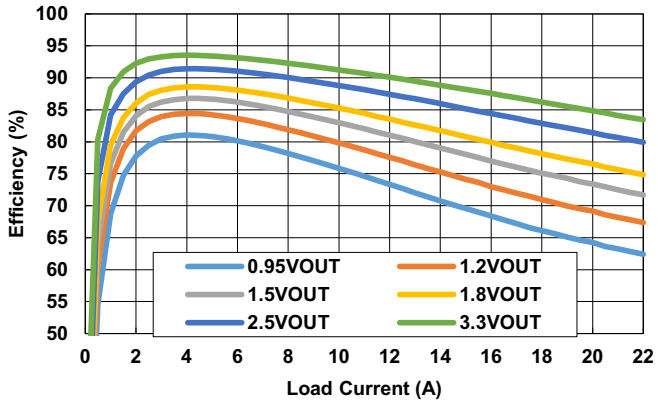

Figure 65. ISL70002SEH Efficiency, V_{IN} = 5V, 500kHz

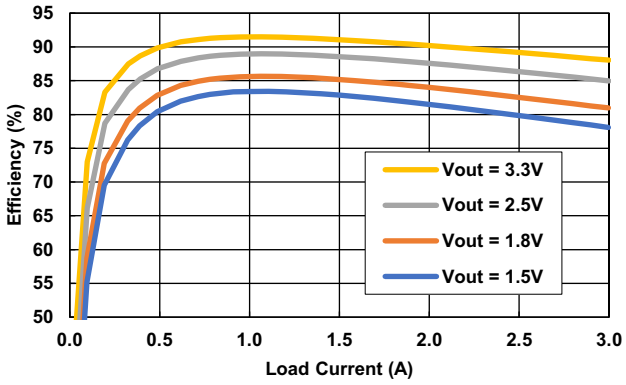

Figure 66. ISL70005SEH Buck Efficiency, V_{IN} = 5V, 1MHz

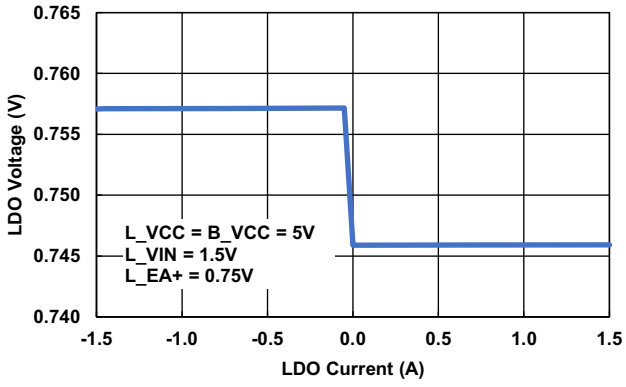

Figure 67. ISL70005SEH LDO Load Regulation

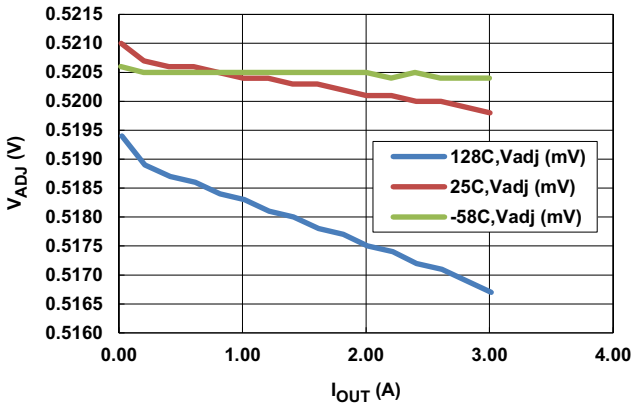

Figure 68. ISL75051ASEH Load Regulation, VADJ vs I_{OUT}

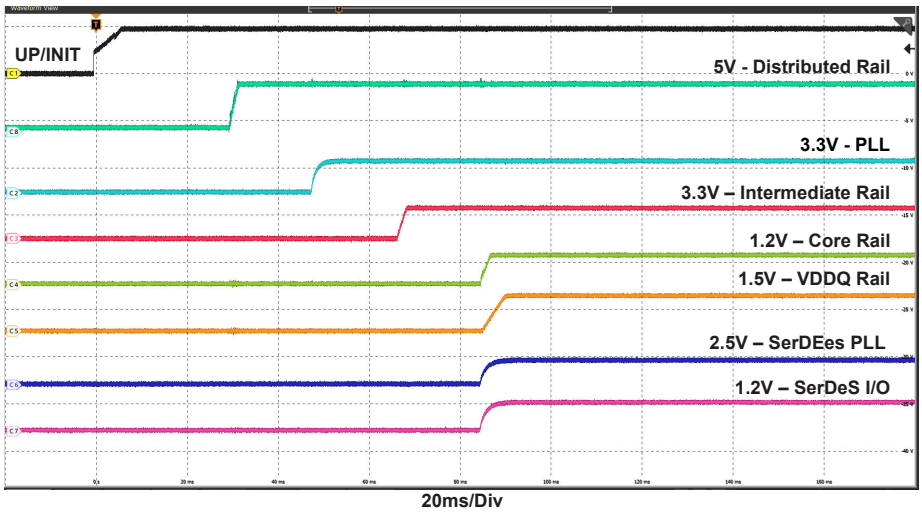

Figure 69. Up Sequence for the ISLRTG4DEMO1Z

4. Ordering Information

Part Number	Description
ISLRTG4DEMO1Z	RTG4 Development Kit with QMLV Power Supply Reference Design

5. Revision History

Rev.	Date	Description
1.0	Feb 25, 2021	Initial release

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(Rev.1.0 Mar 2020)

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