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# PEX 8509RDK
# Hardware Reference Manual

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# Hardware Reference Manual

**Version 1.1**

**June 2007**


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# PREFACE

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## ABOUT THIS MANUAL

This document describes the PLX PEX 8509RDK, a Rapid Development Kit, from a hardware perspective. It contains a description of all major functional circuit blocks on the board and also is a reference for the creation of software for this product. This manual also includes complete schematics and bill of materials.

## REVISION HISTORY

| Date | Version | Comments |
|---|---|---|
| April 2007 | 0.9 | Hardware Reference Manual initial release. |
| May 2007 | 1.0 | Incorporates feedback and minor updates. |
| June 2007 | 1.1 | Changed C58 value in BOM and schematic. |

# CONTENTS

## FIGURES



## TABLES

# 1. General Information

The PLX PEX 8509RDK is a Rapid Development Kit based on the PEX 8509, a 8-lane, 8-port PCI Express switch. The PEX 8509RDK provides a complete hardware and software development platform to facilitate getting designs up and running quickly, lowering risk and reducing time-to-market. This RDK allows the upstream port of the PEX 8509 to be directly plugged into a system board's x16/x8/x4 PCI Express connector, or plugged into an x1 PCI Express connector by using card edge adapters.

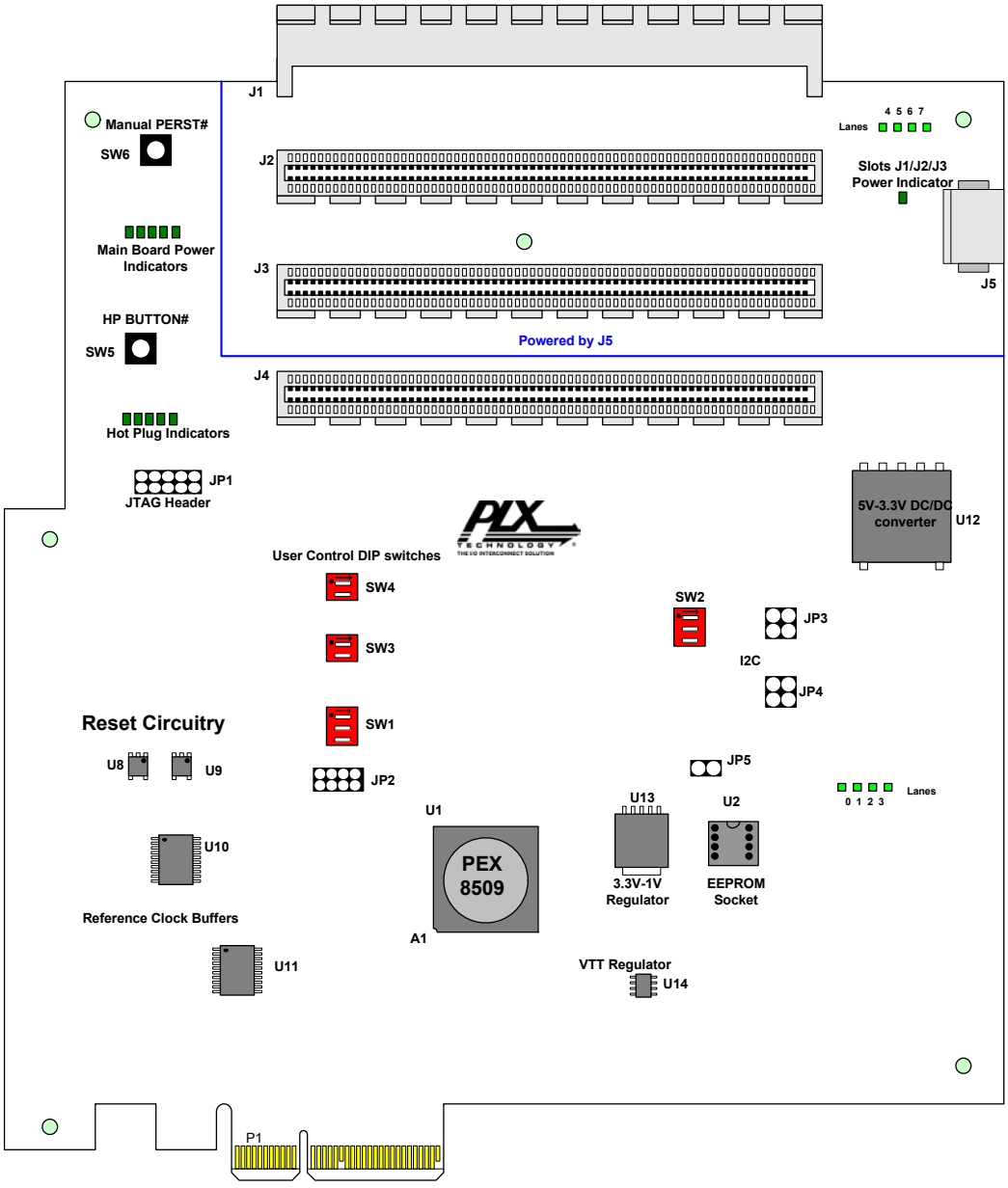


**Figure 1-1. PEX 8509RDK Component Side View**

## 1.1 PEX 8509 Features

- 8-lane, 8-port (maximum) PCI Express switch
- PCI Express Base Specification revision 1.1 and PCI Standard Hot-Plug Controller and Subsystem Specification, revision 1.0 compliance
- Eight PCI Express lanes provide 40 Gbps aggregate bandwidth
- Cut-thru Packet latency of 118ns (x4 to x1)
- Non-blocking internal crossbar architecture supports full wire speed
- Out of band communication/initialization interfaces (Serial EEPROM and I2C)
- Maximum Payload Size up to 1024 bytes
- Performance tuning
- Up to 8-ports (Up to 4 possible port configurations)
- PCI Express Standard Hot Plug Controller for three ports
- Assign x1, x2, or x4 lanes per port
- Allows any port to be designated as upstream port
- Configuration with strapping pins and/or EEPROM
- Sideband INTA# (PEX_INTA#) and FATAL ERROR (FATAL_ERR#) signaling
- Lane reversal

## 1.2 PEX 8509RDK Features

- PLX PEX 8509 PCI Express switch in a 196-ball PBGA package
- Form factor based on PCI Express Card Electromechanical (CEM) Specification 1.1
- Four downstream PCI Express Slot connectors
- DIP switches for hardware configuration of PEX 8509 and on-board clock circuitry
- Support for Spread Spectrum Clocking (SSC).
- One Hot Plug controllable slot
- Socketable Serial EEPROM (3.3V)
- Standard 0.1” headers to connect up to I2C
- Manual push-button PERST# capability
- Lane Status indicator LEDs for visual inspection of link status
- Auxiliary ATX Hard disk connector for supporting additional power requirements for add-in cards

## 1.3 RDK Port Expansion

An RDK Port Expansion Kit may be purchased separately, which will transform the PEX 8509RDK into a bench top platform that supports the full 8-port/8-lane configuration. When mated to the RDK Port Expander, the upstream port is connected to a PCI Express x1 Cable connector. The Expansion Kit includes a 1-meter cable and adapter card, which allows the PEX 8509’s upstream port to connect to any standard PC. See the RDK Port Expansion Kit Hardware Reference Manual for more details.

# 2. PEX 8509RDK Hardware Architecture

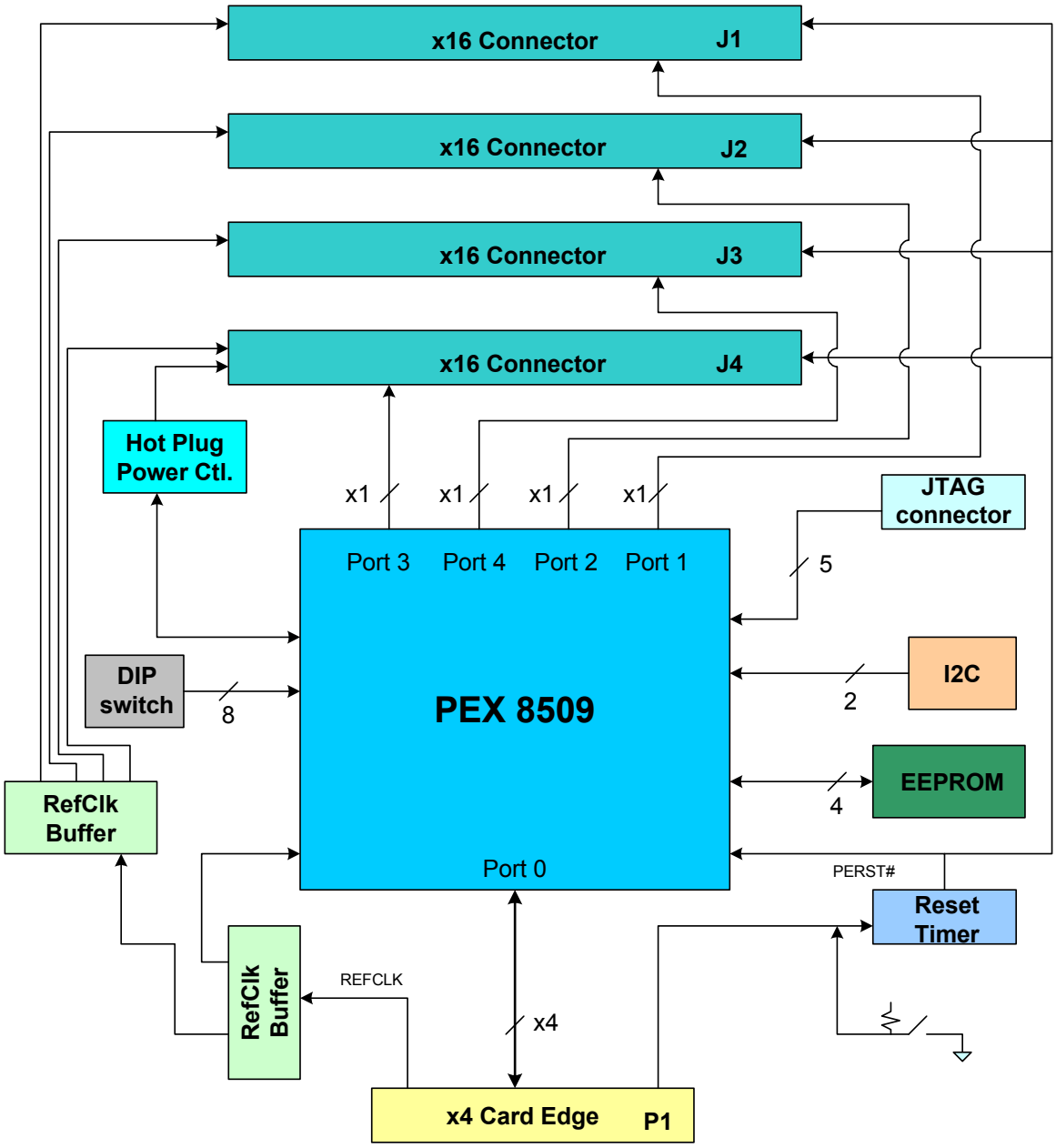


**Figure 2-1. PEX 8509RDK Hardware Architecture**

## 2.1 PEX 8509 PCI Express Switch

The PEX 8509 is a 8-lane, 8-port (maximum) PCI Express switch, which can be configured using strap pins or EEPROM. The RDK's onboard PEX 8509 is set up as a 5-port switch, with one x4 upstream port (Port 0) and four x1 downstream ports (Ports 1 - 4). Port 0 connects to the card edge (P1), while Ports 1, 2, 3, and 4 connect to x16-sized slot connectors (J1, J2, J3, and J4 respectively).

## 2.2 PCI Express Card Edge P1

The RDK form factor is based on the PCI Express CEM 1.1 specification. The board can directly plug into any PCI Express x4, x8, or x16 connector. All four lanes from the card edge connect to the PEX 8509's Port 0. The default configuration of the PEX 8509RDK sets Port 0 to be the upstream port. The card edge provides the main source of +12V and +3.3V power, along with PERST# and REFCLK_P/N.

## 2.3 PCI Express Slot Connectors

The PEX 8509RDK contains four PCI Express slot connectors, which connect to the downstream ports of the PEX 8509. All four connectors are x16 sized connectors, although the PEX 8509 connects less than 16-lanes to each of these four connectors. The PCI Express Card Electromechanical Specification 1.1 refers to this as down-shifting, and in general is not allowed to be implemented. The RDK does this for testing purposes only; therefore, customers designing the PEX 8509 onto a platform board should size the slot connector to match the link width of the port routing to that connector (For example, an x4 should route to an x4 slot connector). Sizing all connectors to x16 allows any PCI Express CEM form factor card (x16, x8, x4 or x1) to directly plug into the RDK without the use of adapters. The link between the PEX 8509 port and the plug-in card's port will auto-negotiate to the highest common link width.

### *2.3.1 PCI Express Connector J1*

Connector J1 is a straddle-mount (SMT), x16 PCI Express connector. Cards plugging into this slot will be in-line with the RDK. Port 1 connects one lane (x1) to the lower four lanes of connector J1. The upper fifteen lanes are unconnected. Power is provided to connector J1 from the ATX hard disk connector J5.

### *2.3.2 PCI Express Connector J2*

Connector J2 is a vertical-mount (through-hole) x16 PCI Express connector. Cards plugging into this slot will be perpendicular to the RDK. Port 2 connects one lane (x1) to connector J2. The upper fifteen lanes are unconnected. Power is provided to connector J2 from the ATX hard disk connector J5.

### *2.3.3 PCI Express Connector J3*

Connector J1 is a vertical-mount (through-hole) x16 PCI Express connector. Cards plugging into this slot will be perpendicular to the RDK. Port 3 connects one lane (x1) to connector J3. The upper fifteen lanes are unconnected. Power is provided to connector J3 from the ATX hard disk connector J5.

### *2.3.4 PCI Express Connector J4*

Connector J4 is a vertical-mount (through-hole) x16 PCI Express connector. Cards plugging into this slot will be perpendicular to the RDK. Port 4 connects one lane (x1) to connector J4. The upper fifteen lanes are unconnected. Connector J4 is implemented as a Hot Plug controlled slot, via the PEX 8509 Hot Plug controller and Texas Intruments power controller (see section 2.6 for more details). Power for this slot is gated by two power FETs, which will only turn-on if a card is present in the slot (HP_PRSNT[3]# and HP_MRL[3]# asserted).

## 2.4 Reference Clock Circuitry

Two Cypress CY28400-2 1-to-4 PCI Express clock buffers (U10 and U11) provide on-board REFCLK distribution to the PEX 8509 and downstream slots (J1 – J4). The first CY28400-2 (U11) input is sourced by the card edge P1. U11 provides two differential CML (current mode logic) clock outputs. One pair drives the PEX 8509's PEX_REFCLKP/N input. This pair is AC-coupled (C74 and C75). This is required to block the DC information of the transmitter from the PEX 8509 clock receiver, which has on-chip biasing and termination circuitry. The other pair drives the input of a second CY28400-2 (U10), which is used for fan-out to the four downstream slots. The PEX 8509's port 3 Hot Plug controller can be used to control on the RefClk to slot J4.

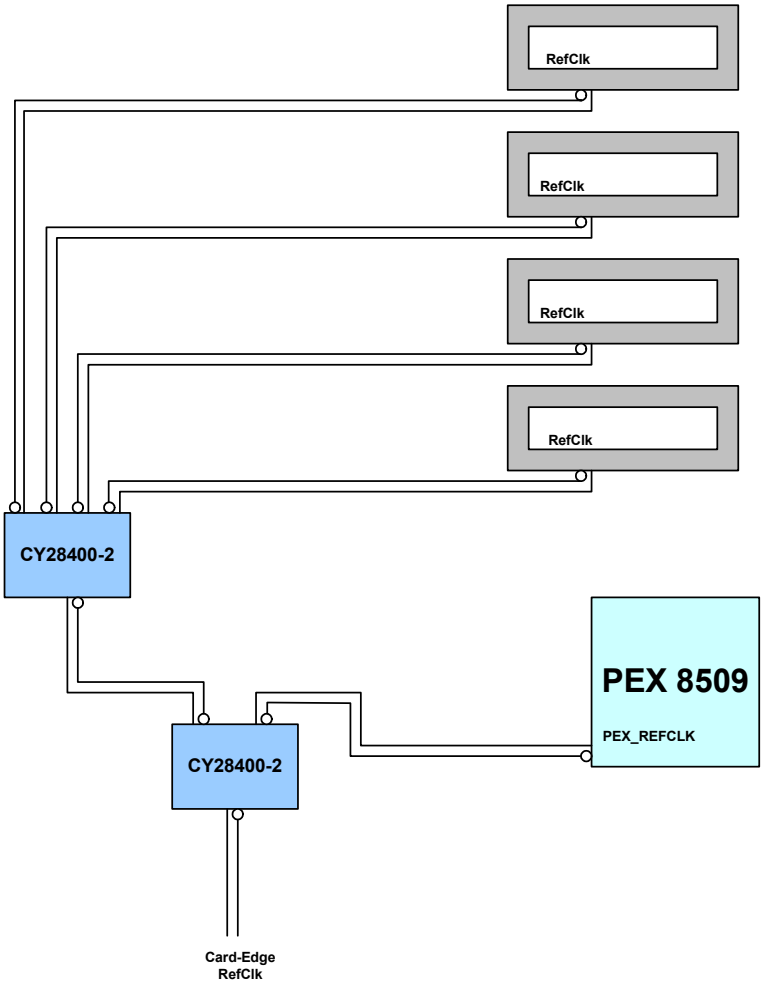


**Figure 2-2. PEX 8509RDK Reference Clock Circuit**

## 2.5 Reset Circuitry

The PEX 8509RDK reset circuitry includes a MAX6420 adjustable reset timer (U9) and manual reset push-button switch (SW6). The reset timer accepts PERST# from the card edge (P1) and from SW6 (logical-OR via U8). The MAX6420 has the capability of adjusting the reset timeout period by changing the value of C63 (0.001 µF ~= 3 ms).

## 2.6 Hot Plug Circuitry

Three PEX 8509 ports provide a 9-pin Hot Plug controller (HPC) interface. The RDK can be enabled (via switch SW3 position 1) to allow Port 3's HPC to provide full Hot Plug hardware functionality to slot J4.

Port 3's HPC interfaces to an Texas Instruments TP2310 Hot Plug power controller (U3), which is used to control and monitor +12V and +3.3V power to J4. The HPC provides an active-low power enable output (HP_PWREN[3]#), which directly enables the TP2310 to begin ramping up the gates of Q1 and Q2 (+12V and +3.3V respectively). After both power rails are stable, the TP2310 monitors the current being supplied on both rails via R43 and R48. If either rail exceeds its programmable current threshold (5A for both +12V and +3.3V) , the TP2310 will assert HP_PWRFLT[3]# to the PEX 8509's HPC, enter current regulation mode, and eventually drive the gates of Q1 and Q2 to 0V. HP_PWRFLT[3]# will remain asserted until HP_PWREN[3]# is de-asserted via software. The de-assertion of HP_PWREN[3]# will reset the TP2310.

Attention and power indicators (D13 and D12 respectively) provide visual status regarding the state of slot J4. The attention button (HP_BUTTON[3]#) is implemented as a push-button switch SW4. The manually-operated retention latch (HP_MRL[3]#) is implemented as a DIP switch controlled input to the HPC (SW4).

The PERST# signal supplied to J4 is directly controlled by the HPC (HP_PERST[3]#). By default, the Hot Plug control over slot J4 in not enabled. The user can enable Hot Plug control of power and reset to J4, by placing switch SW4, pin 1 to the OFF position.

## 2.7 Serial EEPROM

The PEX 8509RDK contains an 8-pin DIP socket for a serial EEPROM (U2). The board is populated with a blank Atmel AT25080A 8-Kbit device. To use the serial EEPROM, place a shunt between pins 1 and 2 of JP2 (see section 3.4 for more details). The AT25080A device can directly interface to the PEX8509.

## 2.8 I2C Interface

The PEX 8509 implements an I2C slave interface, which allows an external I2C master to read and write device registers through an out-of-band mechanism. The PEX 8509 I2C interface is accessible via a 7-bit address, at data rates up to 400kbits/sec. The RDK provides two cascaded 2x2, 0.1" pitch headers (JP3 and JP4), which interface to the PEX 8509's I2C port. This allows for cascading multiple RDKs together using standard ribbon cable, or connecting various 3rd party I2C test equipment such as the Total Phase Aardvark I2C controller.

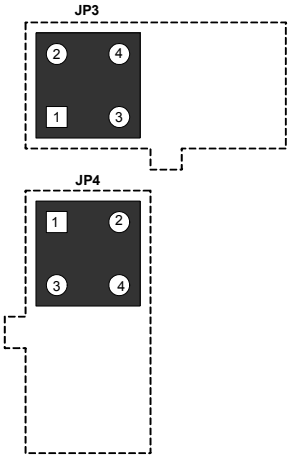


**Figure 2-3. I2C Connector Orientation for Aardvard I2C Controller**

## 2.9 Power Distribution

### *2.9.1 Power Generation/Conversion*

The PEX 8509RDK has two sources for DC power. The first source is the card edge connector (P1). The x4 connector provides up to 2.1A at +12V and 3.0A at +3.3V. Card edge power is intended to power only RDK board components and slot J4. Slots J1, J2 and J3 receive power via a 4-pin ATX hard disk connector (J5). Add-in cards that require more that 25W of power (such as graphics cards) should use slots J1, J2 and/or J3. These slots are power limited only by the ATX power supply that is used.

PEX8509 core and SerDes +1.0V supply is derived from the +3.3V rail through a Micrel MIC49150 LDO regulator (U13). The PEX 8509's +3.3V I/O supply receives power directly from the +3.3V card edge power rail. The VTT supply for the PEX8509 PCI Express transmitters, is regulated from the +3.3V card edge power via a Maxim MAX1806 adjustable LDO regulator (U14). The regulator output voltage is normally set to +1.50V, but can be adjusted by changing the values of R98 and R102.

The ATX 4-pin connector provides +12V and +5V DC power. The +5V is converted down to +3.3V for slots J1, J2 and J3 through a Bel S7AH-08B330/-08E1A0 non-isolated DC/DC converter (U12). The +12V power rail is used directly.

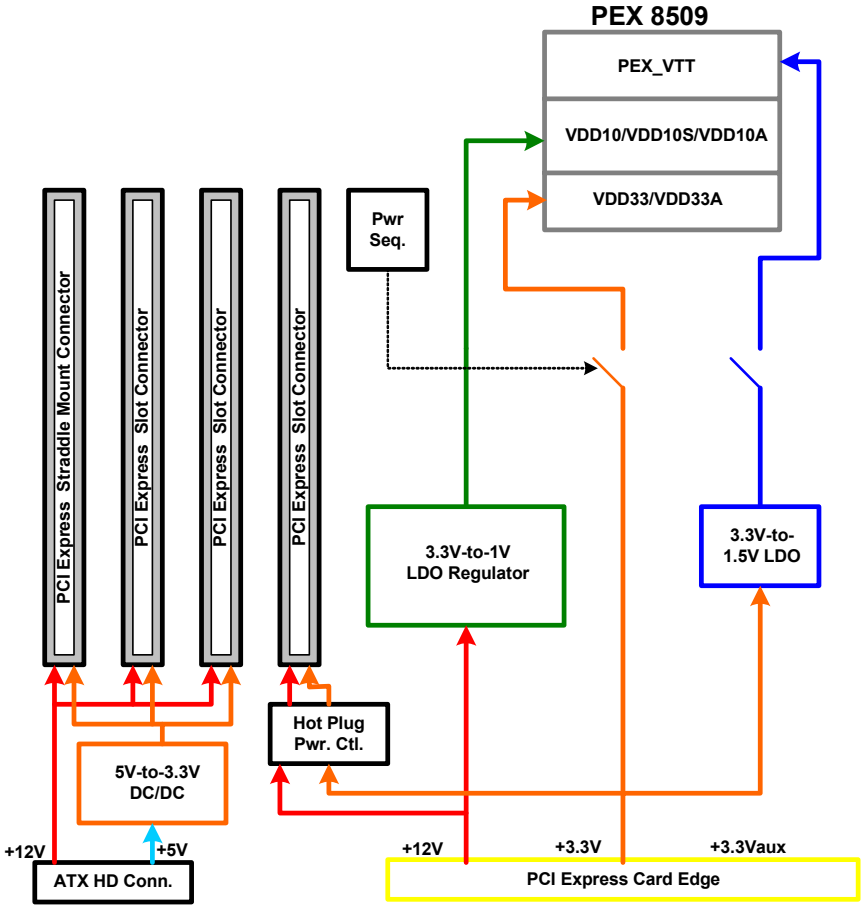


**Figure 2-4. PEX 8509RDK Power Subsystem**

### *2.9.2 Power Sequencing*

The PEX 8509 device requires that the 1.0V power rails are supplied before the 1.5V and 3.3V rails are powered. This power sequencing is accomplished via three bipolar transistors (Q3, Q4, Q6), biasing resistors and one power MOSFET (Q5).

## 2.10 LED Indicators

The PEX 8509RDK provides a number of LED indicators including power-on indication, PEX 8509 lane status indication, and Hot Plug status indication. Table 2-1 provides a quick explanation of the various board indicators.

**Table 2-1. PEX 8509RDK LED Indicator descriptions**

| Indicator Type | Locations | LED On | LED Off |
|---|---|---|---|
| Board Power indication | D16, D15, D17, D18 | 1.0V, 1.5V, 12V, 3.3V power on | 1.0V, 1.5V, 12V, 3.3V power off |
| Slot J1/J2/J3 Power Fault | D14 | +12V or +3.3V power to slots J1/J2/J3 had dropped below -15% on either supply. | +12V and +3.3V power to slots J1/J2/J3 is good. |
| J5 Power indication | D20 | ATX Hard disk connector is currently supplying power | ATX hard disk connector is not supplying power |

| Indicator Type | Locations | LED On | LED Off |
|---|---|---|---|
| Slot J4 Power indication | D10, D11 | Slot J4 +12V and +3.3V power on | Slot J4 +12V and +3.3V power off |
| PEX 8509 Port 0 Lane Status | D1, D4, D5, D8 | Port 0 link is up and lane n is active | If all LEDs off, Port 0 link is down |
| PEX 8509 Port 1 Lane Status | D2 | Port 1 link is up | If LED is off, Port 1 link is down |
| PEX 8509 Port 2 Lane Status | D6 | Port 2 link is up | If LED is off, Port 2 link is down |
| PEX 8509 Port 3 Lane Status | D3 | Port 3 link is up | If LED is off, Port 3 link is down |
| PEX 8509 Port 4 Lane Status | D7 | Port 4 link is up | If LED is off, Port 4 link is down |
| PEX 8509 Fatal Error Indication | D9 | PEX 8509 detected a fatal error. | No fatal errors reported |
| PEX 8509 INTA# | D19 | PEX 8509 has asserted sideband interrupt | Interrupt is not asserted |
| Hot Plug Attention indication | D13 | **On:** Operation problem<br>**Blinking:** Slot is being identified at user's request | Normal operation |
| Hot Plug Power indication | D12 | **On:** Slot is powered on<br>**Blinking:** Slot is being powered up or powered down | Slot power indication is off |

# 3. On-Board Connectors, Switches, and Jumpers

## 3.1 DIP Switches

The PEX 8509RDK contains four user controllable DIP switches (SW1, SW2, SW3 and SW4) for selecting various functionality. Each DIP switch position can be either ON (0b) or OFF (1b). The gray squares in Figures 3-1 through 3-4 indicate which way the switch position is connected.

### 3.1.1 Upstream Port Selection (SW1)

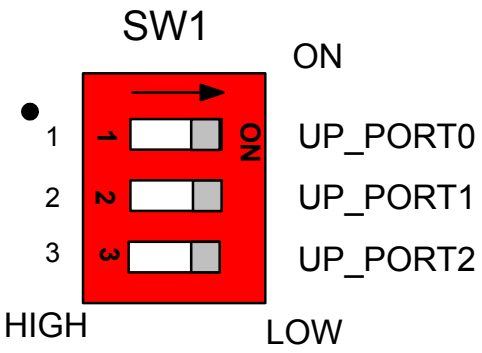


**Figure 3-1. Switch SW1 Default Settings**

**Table 3-1. Switch SW1 Description**

| SW1 Functional Description | Switch Position Settings |
|---|---|
| STRAP_UPSTRM_PORTSEL [2:0]<br>Selects the PEX 8509 Upstream Port.<br>**Default setting is 000b.** | 1: STRAP_UPSTRM_PORTSEL[0]<br>2: STRAP_UPSTRM_PORTSEL[1]<br>3: STRAP_UPSTRM_PORTSEL[2] |

| Bus Encodings [2:0] | Upstream Port |
|---|---|
| 000b | 0 |
| 001b | 1 |
| 010b | 2 |
| 011b | 3 |
| 100b | 4 |
| 101b | 5 |
| 110b | 6 |
| 111b | 7 |

### 3.1.2 PEX 8509 I2C Address Selection (SW2)

Switch SW2 is used to select the lower three address bits of the PEX 8509's I2C slave address.

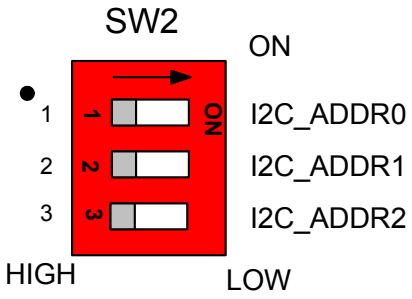


**Figure 3-2. Switch SW2 Default Settings**

**Table 3-2. Switch SW2 Description**

| SW2 Functional Description | Switch Position Settings |
|---|---|
| PEX 8509 I2C Address bits[2:0].<br>**Default setting is 111b.** | 1: I2C_ADDR[0]<br>2: I2C_ADDR[1]<br>3: I2C_ADDR[2] |

| Bus Encodings [1:0] | PEX 8509 I2C Slave Address |
|---|---|
| 000b | 38h |
| 001b | 39h |
| 010b | 3Ah |
| 011b | 3Bh |
| 100b | 3Ch |
| 101b | 3Dh |
| 110b | 3Eh |
| 111b | 3Fh |

### 3.1.3 Port Configuration (SW3)

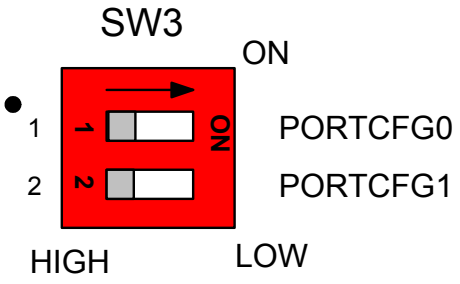


**Figure 3-3. Switch SW3 Default Settings**

**Table 3-3. Switch SW3 Description**

| SW3 Functional Description | Switch Position Settings |
|---|---|
| STRAP_PORTCFG[3:0]<br>Selects PEX 8509 Port Configuration<br>**Default Setting is 11b.**<br><br>**NOTE: When the RDK Plugs into the RDK Port Expansion Kit, SW3 setting should be 00b.** | 1: STRAP_STN_PORTCFG[0]<br>2: STRAP_STN_PORTCFG[1] |

| Bus Encodings [1:0] | Port Configuration |
|---|---|
| 00b | x1,x1,x1,x1,x1,x1,x1,x1 |
| 01b | x2,x1,x1,x1,x1,x1,x1 |
| 10b | x2,x2,x1,x1,x1,x1 |
| 11b | x4,x1,x1,x1,x1 |

### 3.1.4 J4 Slot control/Hot Plug Control (SW4)

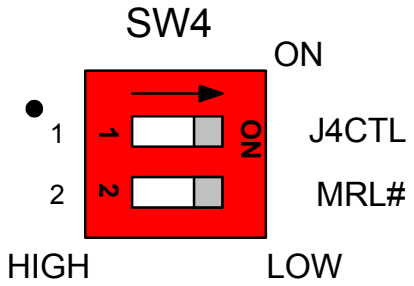


**Figure 3-4. Switch SW4 Default Settings**

**Table 3-4. Switch SW4 Description**

| SW4 Functional Description | Switch Position Settings |
|---|---|
| Slot J4 Hot Plug Control. Allows the user to select whether slot J4 is controlled via the PEX 8509 Hot Plug controller or normal board power-up sequencing.<br>**Default Setting is 0b.** | 1: J4CTL<br>**Value** / **Function**<br>0b – J4 is not Hot Plug controlled.<br>1b – J4 is controlled via Hot Plug |
| Hot Plug MRL[3]#. Used to simulate MRL sensor behavior.<br>**Default setting is 0b.** | 2: HP_MRL[3]#<br>**Value** / **Function**<br>0b – Latch closed<br>1b – Latch open |

## 3.2 Push-Button Switches

### *3.2.1 Hot Plug Attention Button# (SW5)*

Switch SW5 provides a push-button switch control for the PEX 8509 Hot Plug Controller's HP_BUTTON[3]# input pin. The PEX 8509 contains internal debounce circuitry for this input.

### *3.2.2 Manual Reset# (SW6)*

The PEX 8509 RDK provides a manual PERST# capability. Note that manual PERST# will only apply warm reset to the PEX 8509, and slots J1, J2, J3, and J4 (not P1).

## 3.3 EEPROM Enable Jumper (JP5)

JP5 is used to enable an EEPROM presence detection to the PEX 8509. Install a shunt between pins 1 - 2 to indicate a Serial EEPROM is present. Un-install the shunt to indicate a Serial EEPROM is not present.

**Table 3-5. Jumper JP2 settings**

| JP5 Setting | EEPROM Status |
|---|---|
| Shunt installed (Default) | Serial EEPROM present |
| Shunt not installed | Serial EEPROM not present |

## 3.4 JTAG Header (JP1)

Header JP1 provides a direct connection to the PEX 8509 JTAG interface. The 10-pin connector is designed to allow a direct interface to 3rd party JTAG controllers, such as the Corelis USB-1149.1/E controller.

## 3.5 PCI Express Fatal Error Indication (D9)

The PEX 8509 provides an output status pin (FATAL_ERR#), which reports the event of a PCI Express fatal error condition. The RDK connects this output to D9, which is lit when a fatal error is detected. Examples of fatal error conditions are data link layer protocol errors, receiver overflow, malformed TLPs, etc… The PCI Express Base specification provides a complete listing of fatal error conditions.

## 3.6 PEX INTA# (D19)

PEX 8509 provides a side-band interrupt pin for signaling various programmable events.

## 3.7 Slots J1/J2/J3 Power Fault Indication (D20)

Slots J1, J2, and J3 are power by the ATX 4-pin hard disk connector and a DC/DC converter (U12). No circuitry is provided to current limit the power consumed by those three slots; however, a voltage supervisor is provided to monitor under-voltage conditions on the +12V and +3.3V supply rails going to those slots. If either rail drops below 15% of its nominal supply voltage, the power good signal from U3 is used to clear a D-flip flop (U15), which will in turn light a red indicator LED (D14). Once the LED is lit, it remains lit until board power is cycled.

# 4. Serial EEPROM Registers

## 4.1 Serial EEPROM Contents

The PEX 8509RDK is shipped with a programmed AT25080A EEPROM. PLX Technology provides the necessary binary image files and software tools required to program the EEPROM. Install a jumper between JP2 pins 1 and 2, before applying power to the RDK.

# 5. FAQ/Troubleshooting

## 5.1 Frequently Asked Questions

**Q1) I have purchased an RDK Port Expansion Kit to enable my PEX 8509RDK to work as an 8-port/8-lane switch. What steps must I take to get my RDK working behind the RDK Port Expander?**

A1) The RDK Port Expansion Kit has a separate Hardware Reference Manual, which provides of a list of steps that should be taken prior to plugging the RDK into the RDK Port Expander. In general, since the RDK Port Expansion Kit is intended to operate as a bench-top platform, the PCI Express bracket should be removed, nylon stand-offs must be mounted onto to RDK, the PEX 8509's Port Configuration should be changed from x4x1x1x1x1 to x1x1x1x1x1x1x1x1 by changing SW3 from 11b to 00b.

**Q2) Since the RDK Port Expansion Kit may use a different power than my host PC, is there a power-up ordering requirement?**

A2) Yes. The RDK Port Expander/PEX 8509RDK must have power applied before the PC is powered on. This will ensure than the PC BIOS enumeration will see the PEX 8509 and it's downstream components.

# 6. Bill of Materials/ Schematics

| Item # | Qty | Man | Man's Part # | Des | Package Type | Comp Des(s) | Subcon. Part # |
|---|---|---|---|---|---|---|---|
| **SURFACE MOUNT COMPONENTS** | | | | | | | |
| 1 | 1 | PLX Technology | PEX8509-AA25BI | IC, 8-lane, 8-port, PCI Express switch | SMT, 196-pin PBGA | U1 | |
| 2 | 1 | Intersil | ISL6536IB | IC, Four Channel Supervisor | SMT, 8-pin SOIC | U3 | |
| 3 | 1 | TI | TPS2310IPW | IC, Dual-power Hot Plug Controller | SMT, 20-lead TSSOP | U4 | |
| 4 | 3 | TI | SN74LVC1G3157DCKR | 1-bit, SPDT Analog switch | SMT, 6-pin SC-70 | U5, U6, U7 | Digikey P/N: 296-14909-1-ND |
| 5 | 1 | Fairchild | NC7S08M5X | IC, Tiny Logic 2-input AND gate | SMT, 5-pin SOT-23 | U8 | Digikey P/N: NC7S08M5XCT-ND |
| 6 | 1 | Maxim | MAX6420UK29-T | IC, Reset controller, Adj. reset timeout | SMT, SOT23-5 | U9 | |
| 7 | 2 | Cypress | CY28400OXC-2 | IC, 100MHz Differential Clock Buffer | SMT, 28-pin SSOP | U10, U11 | |
| 8 | 1 | Belfuse | S7AH-08E1A0 | Non-iso DC/DC converter, 5V-to-3.3V @ 8A | SMT, 7-pin | U12 | |
| 9 | 1 | Micrel | MIC49150WR | LDO Regulator, 1.5A, Adj output | SPAK-5 | U13 | Digikey P/N: 576-1227-ND |
| 10 | 1 | Maxim | MAX1806EUA15 | LDO regulator, 500mA adjustable | SMT, 8-pin uMax | U14 | |
| 11 | 1 | TI | SN74LVC2G74DCTR | IC, Single Positive Edge D Flip flop | SMT, 8-pin SSOP | U15 | Digikey P/N: 296-13273-1-ND |
| 12 | 1 | Fairchild | NC7S04M5X | IC, Tiny Logic Inverter | SMT, 5-pin SOT-23 | U17 | Digikey P/N: NC7S04M5XCT-ND |
| 13 | 1 | Adex | CONN-PCIEXP-16X-SM | PCI Express x16 straddle-mount connector | SMT, 164-pin | J1 | See second source for alternatives |
| 14 | 1 | Fairchild Semiconductor | FDN359BN | IC, N-Channel MOSFET | SMT, Super SOT-3 | Q5 | Digikey P/N: FDN359BNCT-ND |
| 15 | 2 | International Rectifier | IRF7470 | IC, N-Channel MOSFET | SMT, 8-pin, SO-8 | Q1, Q2 | Digikey P/N: IRF7470-ND |
| 16 | 5 | On Semiconductor | MMBT3904LT1 | IC, Bipolar Transistor | SMT, SOT-23 | Q3, Q4, Q6, Q7, Q8 | Digikey P/N: MMBT3904 |

| Item # | Qty | Man | Man's Part # | Des | Package Type | Comp Des(s) | Subcon. Part # |
|---|---|---|---|---|---|---|---|
| | | | | | | | LT1OSCT-ND |
| 17 | 1 | Lumex | SML-LXT0805YW-TR | LED, Yellow | SMT, 0805 | D13 | Digikey P/N: 67-1554-1-ND |
| 18 | 8 | Lumex | SML-LXT0805GW-TR | LED, Green | SMT, 0805 | D10, D11, D12, D15, D16, D17, D18, D20 | Digikey P/N: 67-1553-1-ND |
| 19 | 2 | Lumex | SML-LX0603IW-TR | LED, Red | SMT, 0603 | D9, D14 | Digikey P/N: 67-1548-1-ND |
| 21 | 2 | ITTCANNON | SDA02H1SKD | Dip Switch, 2-pos, half pitch, tape seal | SMT | SW3, SW4 | Digikey P/N: CKN1286-ND |
| 22 | 2 | ITTCANNON | SDA03H1SKD | Dip Switch, 3-pos, half pitch, tape seal | SMT | SW1, SW2 | Digikey P/N: CKN1287-ND |
| 23 | 2 | Omron | B3S1002 | Switch, Push Button | SMT | SW5, SW6 | Digikey P/N: SW416-ND |
| 24 | 6 | CTS | 742C083512J | Chip Res. Array, 5.1K ohm, 4R isolated | SMT | RN1, RN2, RN3, RN4, RN5, RN6 | Digikey P/N: 742C083512JCT-ND |
| 25 | 15 | Panasonic | ERJ-3GEY0R00V | Res. 1/10W, zero ohm 5% | SMT, 0603 | R1, R2, R11, R13, R14, R15, R16, R17, R46, R53, R59, R61, R102, R119, R120 | Digikey P/N: P0.0GCT-ND |
| 26 | 2 | TTelectronics | LRF2512-LF-R020-F | Res. 2W, 0.02 ohm 1% | SMT, 2512 | R42, R48 | Mouser P/N: 66-LRF2512-LF-R020-F |
| 27 | 2 | Panasonic | ERJ-3GEYJ4R7V | Res. 1/10W, 4.7 ohm 5% | SMT, 0603 | R62, R63 | Digikey P/N: P4.7GCT-ND |
| 28 | 13 | Panasonic | ERJ-2GEJ330X | Res. 1/16W, 33 ohm 5% | SMT, 0402 | R18, R64, R65, R68, R69, R70, R72, R77, R79, R80, R83, R88, R89 | Digikey P/N: P33JCT-ND |
| 29 | 12 | Panasonic | ERJ-2RKF49R9X | Res. 1/16W, 49.9 ohm 1% | SMT, 0402 | R66, R67, R71, R73, R74, R75, R81, R82, R86, R87, R90, R91 | Digikey P/N: P49.9LCT-ND |
| 30 | 17 | Panasonic | ERJ-3GEYJ151V | Res. 1/10W, 150 ohm 5% | SMT, 0603 | R3, R4, R5, R6, R7, R8, R9, R10, R25, R41, R51, R52, R107, R108, R109, R114, R122 | Digikey P/N: P150GCT-ND |

| Item # | Qty | Man | Man's Part # | Des | Package Type | Comp Des(s) | Subcon. Part # |
|---|---|---|---|---|---|---|---|
| 31 | 2 | Panasonic | ERJ-3EKF4750V | Res. 1/16W, 475 ohm 1% | SMT, 0603 | R84, R85 | Digikey P/N: P475HCT-ND |
| 32 | 5 | Panasonic | ERJ-3EKF1001V | Res. 1/16W, 1K ohm 1% | SMT, 0603 | R40, R99, R105, R113, R120 | Digikey P/N: P1.00KHCT-ND |
| 33 | 1 | IRC | PFC-W0805R-03-1301-B | Res. 1/10W, 1.30K ohm 1% | SMT, 0805 | R96 | Mouser: 66-PFC08C1.3K-B |
| 34 | 2 | Panasonic | ERJ-3EKF2001V | Res. 1/10W, 2.0K ohm, 1% | SMT, 0603 | R43, R44 | Digikey P/N: P2.00KHCT-ND |
| 35 | 3 | Panasonic | ERJ-3EKF2261V | Res. 1/16W, 2.26K ohm 1% | SMT, 0603 | R36, R37, R38 | Digikey P/N: P2.26KHCT-ND |
| 36 | 1 | Panasonic | ERJ-3EKF2741V | Res. 1/16W, 2.74K ohm 1% | SMT, 0603 | R117 | Digikey P/N: P2.74KHCT-ND |
| 37 | 21 | Yageo America | 9C06031A5101FKHFT | Res. 1/10W, 5.1K ohm 1% | SMT, 0603 | R19, R20, R21, R26, R27, R33, R35, R39, R47, R49, R50, R54, R56, R58, R76, R78, R94, R103, R104, R106, R121 | Digikey P/N: 331-5.10KHCT-ND |
| 38 | 1 | Panasonic | ERJ-3EKF7681V | Res. 1/16W, 7.68K ohm 1% | SMT, 0603 | R112 | Digikey P/N: P7.68KHCT-ND |
| 39 | 2 | Panasonic | ERJ-3EKF8251V | Res. 1/10W, 8.25K ohm 1% | SMT, 0603 | R100, R118 | Digikey P/N: P8.25KHCT-ND |
| 40 | 4 | Panasonic | ERJ-3GEYJ103V | Res. 1/10W, 10K ohm 5% | SMT, 0603 | R12, R57, R110, R115 | Digikey P/N: P10KGCT-ND |
| 41 | 2 | Panasonic | ERJ-3GEYJ513V | Res. 1/10W, 51K ohm 5% | SMT, 0603 | R45, R60 | Digikey P/N: P51KGCT-ND |
| 42 | 1 | Yaego America | 9C06031A7502FKHFT | Res. 1/10W, 75K ohm 1% | SMT, 0603 | R111 | Digikey P/N: 311-75.0KHCT-ND |

| Item # | Qty | Man | Man's Part # | Des | Package Type | Comp Des(s) | Subcon. Part # |
|---|---|---|---|---|---|---|---|
| 43 | 1 | Panasonic | ERJ-3GEYJ104V | Res. 1/10W, 100K ohm 5% | SMT, 0603 | R101 | Digikey P/N: P100KGCT-ND |
| 44 | 1 | Littlefuse | 0429 007.WRM | Fuse, Very fast acting, 7A | SMT, 1206 | F1 | Digikey P/N: F1276CT-ND |
| 45 | 1 | Kemet | C0603C102J5RACTU | Cap. Ceramic, 0.001uF, X7R, 50V 5% | SMT, 0603 | C63 | Digikey P/N: 399-1083-1-ND |
| 46 | 10 | Kemet | C0402C103K3RACTU | Cap. Ceramic, 0.01uF, X7R, 25V 10% | SMT, 0402 | C35, C36, C37, C38, C64, C65, C67, C68, C71, C73 | Digikey P/N: 399-1278-1-ND |
| 47 | 3 | Kemet | C0603C103K5RACTU | Cap. Ceramic, 0.01uF, X7R, 50V 20% | SMT, 0603 | C74, C75, C89 | Digikey P/N: 399-1091-1-ND |
| 48 | 4 | AVX Corporation | 0402YC223KAT2A | Cap. Ceramic, 0.022uF, X7R, 16V 10% | SMT, 0402 | C39, C40, C41, C42 | Digikey P/N: 478-1118-1-ND |
| 49 | 30 | Kemet | C0402C104K8PACTU | Cap. Ceramic, 0.1uF, X5R, 10V 10% | SMT, 0402 | C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C26, C27, C28, C29, C31, C32, C33, C34, C44, C45, C46, C47, C48 | Digikey P/N: 399-3027-1-ND |
| 50 | 7 | Kemet | C0603C104K3RACTU | Cap. Ceramic, 0.1uF, X7R, 25V 10% | SMT, 0603 | C57, C58, C59, C60, C62, C86, C92 | Digikey P/N: 399-1281-1-ND |
| 51 | 2 | Panasonic | ECJ-1VB1C105K | Cap. Ceramic, 1uF, X5R, 16V 10% | SMT, 0603 | C24, C25 | Digikey P/N: PCC2224CT-ND |
| 51 | 8 | Kemet | C0805C105K4RACTU | Cap. Ceramic, 1uF, X7R, 16V 20% | SMT, 0805 | C78,C80, C81, C83, C84, C87, C88, C91 | Digikey P/N: 399-1284-1-ND |
| 53 | 1 | Panasonic | ECJ-1VB0J106M | Cap. Ceramic, 10uF, X5R, 6.3V 20% | SMT, 0603 | C79 | Digikey P/N: PCC2395TR-ND |
| 53 | 12 | Panasonic | ECJ-3YB1C106M | Cap. MLCC , 10uF, X5R, 16V 20% | SMT, 1206 | C20, C21, C22, C23, C30, C43, C66, C69, C70, C72, C85, C90 | Digikey P/N: PCC2227TR-ND |
| 54 | 12 | AVX Corporation | TAJB226K020R | Cap. Tantalum, 22uF, 20V 20% | SMT, B-case | C1, C2, C49, C50, C51, C52, C53, C54, C55, C56, C76, C82 | Digikey P/N: 478-1683-1-ND |
| **THROUGH-HOLE COMPONENTS** | | | | | | | |
| 100 | 3 | Molex | 87715- | PCI Express x16 | TH, 164- | J2, J3, J4 | 100 |

| Item # | Qty | Man | Man's Part # | Des | Package Type | Comp Des(s) | Subcon. Part # |
|---|---|---|---|---|---|---|---|
| | | | 3302 | Through-hole connector | pin | | |
| 101 | 1 | Molex | 53113-0410 | Connector, ATX Hard Disk, 4-pin | TH, 4-pin | J5 | 101 |
| 102 | 1 | AMP | 103240-5 | Header, 2x5, 100mil | TH, 10-pin | JP1 | 102 |
| 103 | 1 | AMP | 103185-2 | Header, 1x2, 100mil | TH, 2-pin | JP5 | 103 |
| 104 | 2 | AMP | 103240-2 | Header, 2x2, 100mil | TH, 4-pin | JP3, JP4 | 104 |
| 105 | 1 | Samtec | ICA-308-S-TT | Socket, 8-pin DIP, 300 mil | TH, 8-pin DIP | U2 | 105 |
| 106 | 1 | Vishay | 94SP187X0016EBP | Cap. Oscon, 180uF, 16V | TH, 2-pin | C77 | 106 |
| **MANUALLY INSERTED COMPONENTS** | | | | | | | |
| 200 | 1 | Atmel | AT25080A-10PU-2.7 | SPI Serial EEPROM | 8-lead PDIP | U2 | Digikey P/N: AT25080A-10PU-2.7-ND |
| 201 | 1 | Keystone Electronics | 9203 | PCI bracket w/ two tabs | | | Mouser P/N: 534-9203 |
| 202 | 2 | Building Fasteners | PMSSS 440 0025 PH | Phillips Panhead screw, 4-40 thread, 0.25" | | | Digikey P/N: H703-ND |
| 201 | 1 | Amp/Tyco | 382811-6 | Jumpers | | JP5 | Digikey P/N: A26227-ND |
| **MISCELLANEOUS COMPONENTS** | | | | | | | |
| 300 | 1 | PLX | 90-0071-000-A | PEX8509RDK Bare Board rev 000 | | | |
| **PART THAT SHOULD NOT BE ASSEMBLED** | | | | | | | |
| | 1 | Yageo America | 9C06031A5101FKHFT | Res. 1/10W, 5.1K ohm 1% | SMT, 0603 | R55 | |
| | 11 | Panasonic | ERJ-3GEY0R00V | Res. 1/10W, zero ohm 5% | SMT, 0603 | R22, R23, R24, R28, R29, R30, R31, R32, R34, R92, R93 | |
| | 1 | Panasonic | ERJ-3GEYJ103V | Res. 1/10W, 10K ohm 5% | SMT, 0603 | R116 | |
| | 1 | | | Resistor, Value not specified | SMT, 0805 | R95 | |
| | 2 | | | Resistor, Value not specified | SMT, 0603 | R98, R124 | |
| | 1 | AMP | 103240-4 | Header, 2x4, 100mil | TH, 8-pin | JP2 | |
| **SECOND SOURCE / ALTERNATIVE PARTS** | | | | | | | |
| | | TwinHunter | TW-164PL | PCI Express x16 straddle-mount connector | SMT, 164-pin | | |
| | | ST | STS12NH3 | IC, N-Channel | SMT, 8- | | |

| Item # | Qty | Man | Man's Part # | Des | Package Type | Comp Des(s) | Subcon. Part # |
|---|---|---|---|---|---|---|---|
| | | Microelectronics | LL | MOSFET | pin, SO-8 | | |
| | | Infineon Tech. | SMBT3904 E6327 | IC, Bipolar Transistor | SMT, SOT-23 | | Digikey P/N: SMBT3904INCT-ND |
| | | Littlefuse | 0433 005 | Fuse, Very fast acting, 5A | SMT, 1206 | | |
| | | Molex | 87715-0123 | PCI Express x16 Through-hole connector | TH, 164-pin | | |
| | | | | | | | |
| | | | | | | | |
| **PLX Part #: 91-0071-004-A** | | | | | | | |
| **Product Name: PEX8509RDK** | | | | | | | |

# PEX 8509RDK

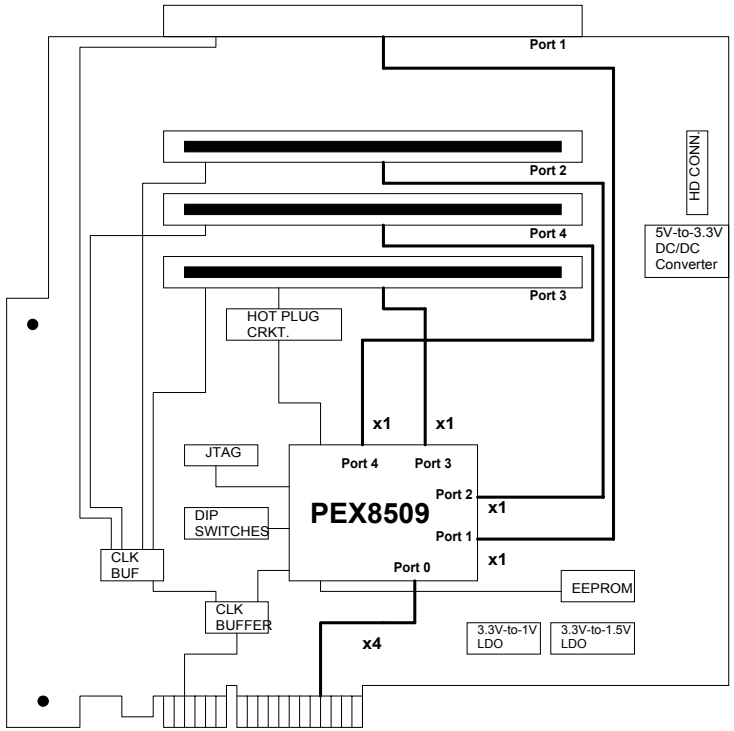


**TABLE OF CONTENTS**



NOTE: NL INDICATES COMPONENT NOT LOADED

**Revision History**

| Rev# | Date | Changes from last revision |
|---|---|---|
| 000 | 12/01/2006 | Initial Revision |
| 001 | 01/09/2007 | Feedback from design review |
| 002 | 04/05/2007 | Re-designed Hot Plug circuit, cost reduction. |
| 003 | 04/25/2007 | Various BOM updates/fixes |
| 004 | 06/14/2007 | Changed C58 value from 0.001uF to 0.1uF |


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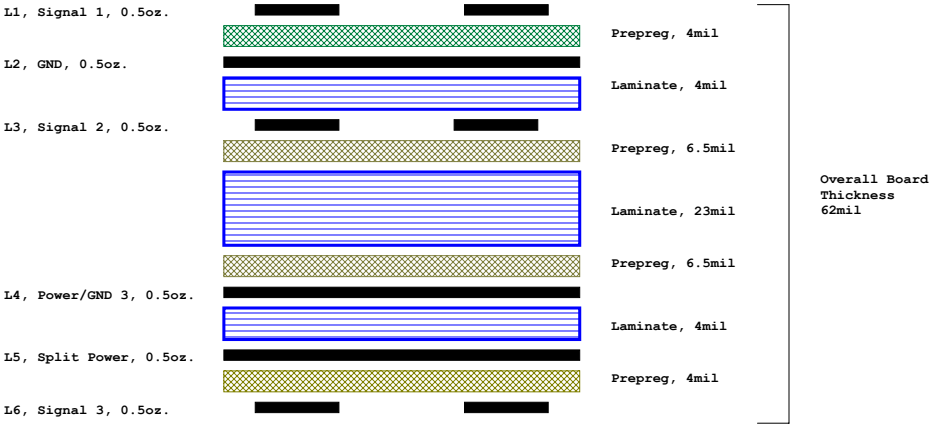
Title: PEX8509RDK - Functional Block Diagram

| Size | Document Number | Rev |
|---|---|---|
| C | 91-0071-004-A | 004 |

Date: Thursday, June 14, 2007 Sheet 1 of 9




| Material | Thickness | Dielectric Constant | Layer# | Description | Weight/Thickness |
|---|---|---|---|---|---|
| FR4 | 0.004 | 4.3 | 1 | TOP - SIGNAL + COMPONENTS | 1/2 oz, .0022 |
| FR4 | 0.004 | 4.3 | 2 | GROUND PLANE | 1/2 oz, .0007 |
| FR4 | 0.0065 | 4.3 | 3 | SIGNAL | 1/2 oz, .0007 |
| FR4 | 0.023 | 4.3 | | | |
| FR4 | 0.0065 | 4.3 | 4 | POWER/GROUND PLANE | 1/2 oz, .0007 |
| FR4 | 0.004 | 4.3 | 5 | SPLIT POWER PLANE | 1/2 oz, .0007 |
| FR4 | 0.004 | 4.3 | 6 | BOTTOM - SIGNAL + COMPONENTS | 1/2 oz, .0022 |

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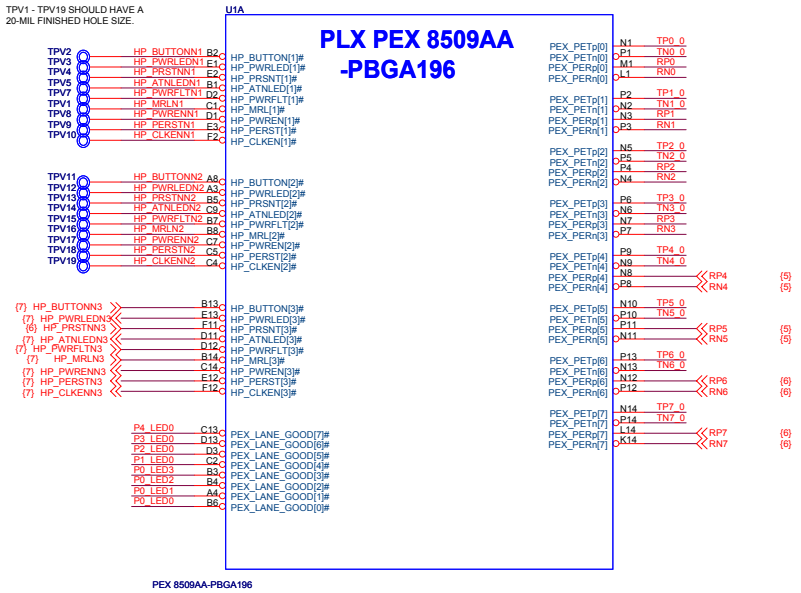
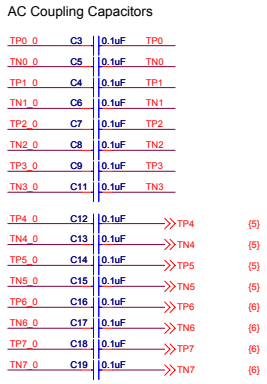
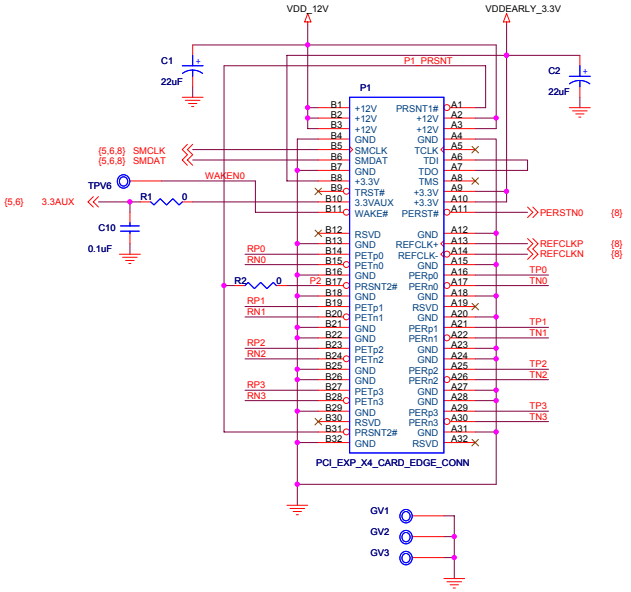
Title: PEX8509RDK - Board Layout Information

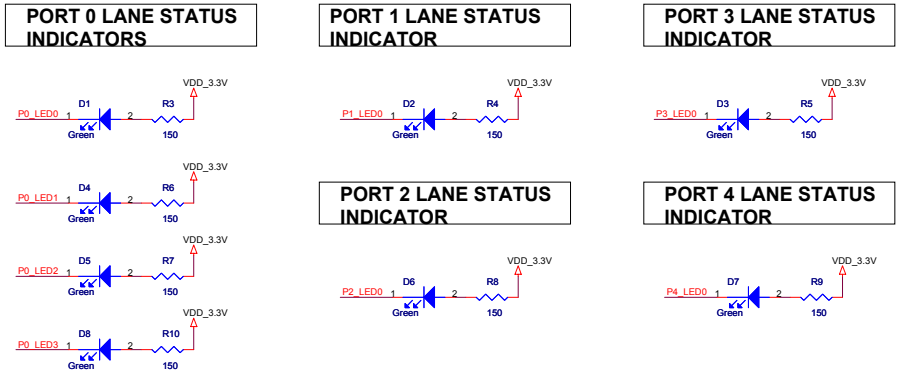
Size: C | Document Number: 91-0071-004-A | Rev: 004

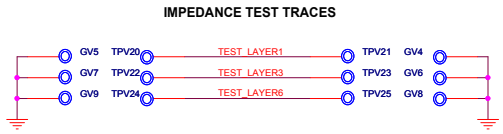
Date: Thursday, June 14, 2007 | Sheet 2 of 9




IMPEDANCE TEST TRACES SHOULD BE 8" IN LENGTH.
GROUND VIAS SHOULD BE SPACED 0.1" FROM THE
CORRESPONDING TEST POINT VIA. TVP20-TVP27 AND
GV4-GV11 DIAMETERS ARE 30-MIL

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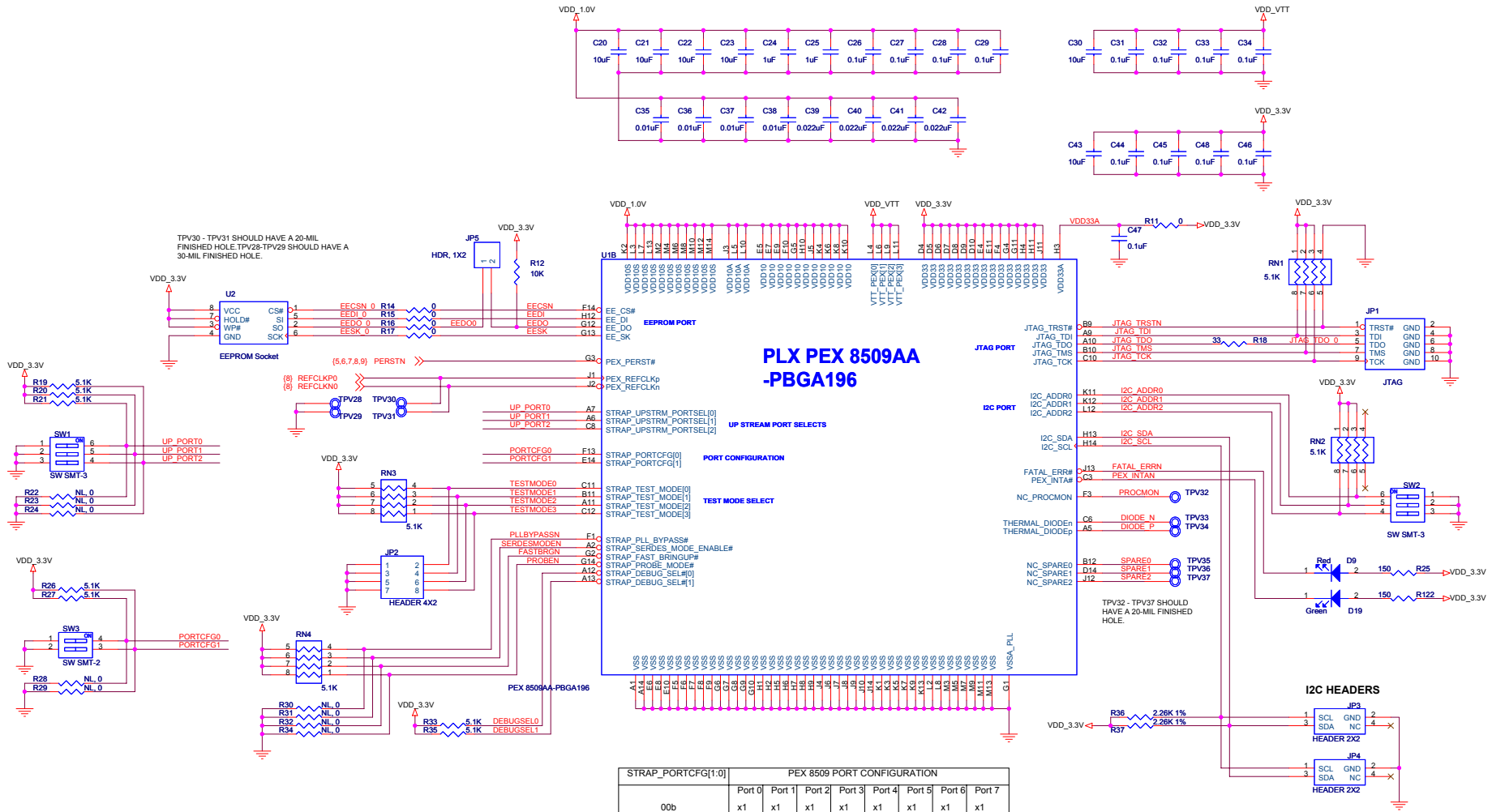
Title: PEX8509RDK - PEX8509 PEX Interface

| Size | Document Number | Rev |
|---|---|---|
| C | 91-0071-004-A | 004 |

Date: Thursday, June 14, 2007 Sheet 3 of 9




| STRAP_PORTCFG[1:0] | PEX 8509 PORT CONFIGURATION | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Port 0 | Port 1 | Port 2 | Port 3 | Port 4 | Port 5 | Port 6 | Port 7 |
| 00b | x1 | x1 | x1 | x1 | x1 | x1 | x1 | x1 |
| 01b | x2 | x1 | x1 | x1 | x1 | x1 | x1 | |
| 10b | x2 | x2 | x1 | x1 | x1 | x1 | | |
| 11b | x4 | x1 | x1 | x1 | x1 | | | |

NOTE: RDK default setting is 11b.

| STRAP_UPSTREAM_PORT_SEL[2:0] | |
|---|---|
| 000b | Port 0 |
| 001b | Port 1 |
| 010b | Port 2 |
| 011b | Port 3 |
| 100b | Port 4 |
| 101b | Port 5 |
| 110b | Port 6 |
| 111b | Port 7 |

NOTE: RDK default setting is 000b.

**VOLTAGE MEASUREMENT POINTS**

VDD_1.0V TPV38 GV16
VDD_VTT TPV39 GV17
VDD_3.3V TPV40 GV18

CLEARLY LABEL, AND PLACE CLOSE TO U1.

TPV38-40 AND GV16-18 SHOULD BE PLACED CLOSE TO U1. FINISHED HOLE SIZE SHOULD BE 34-MIL

**GROUND POST HOLES**

GV12 GV13 GV14 GV15

GV12-15 SHOULD BE 60-MIL PAD/34-MIL FINISHED HOLE. PROVIDE SILKSCREEN LABELS FOR THESE VIAS.

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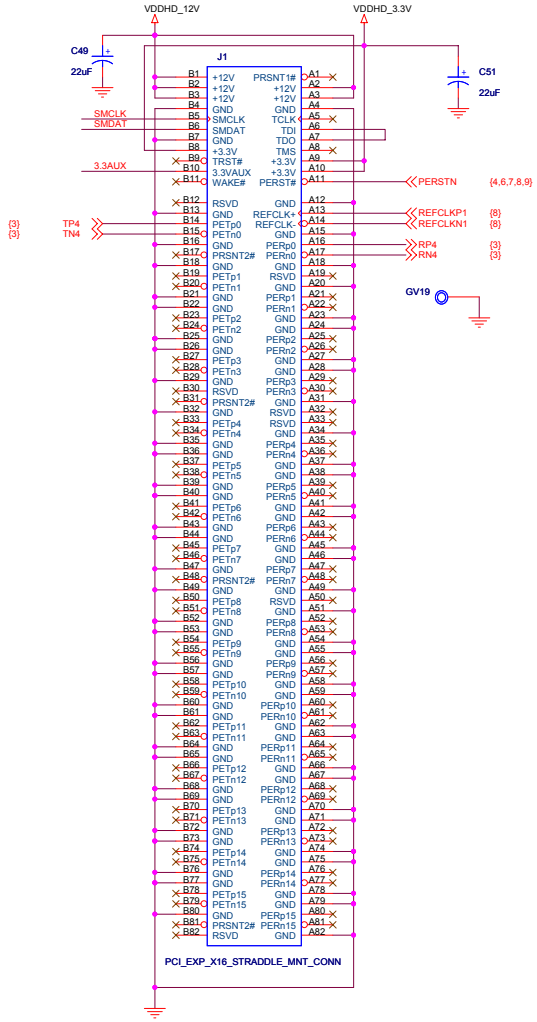
Title: PEX8509RDK - PEX8509 Power, Misc.

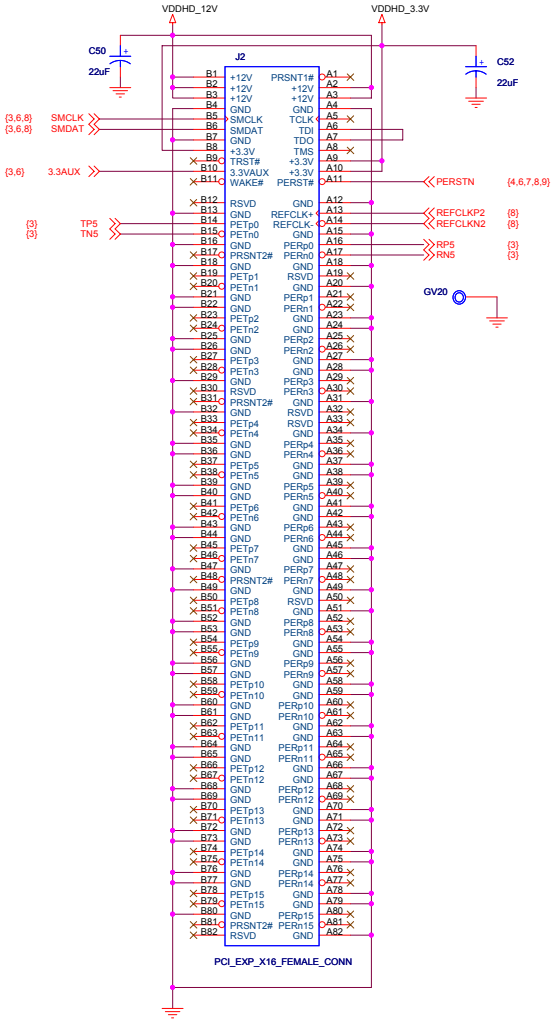
| Size | Document Number | Rev |
|---|---|---|
| C | 91-0071-004-A | 004 |

Date: Thursday, June 14, 2007 Sheet 4 of 9

## PORT 1 SLOT CONNECTOR




## PORT 2 SLOT CONNECTOR

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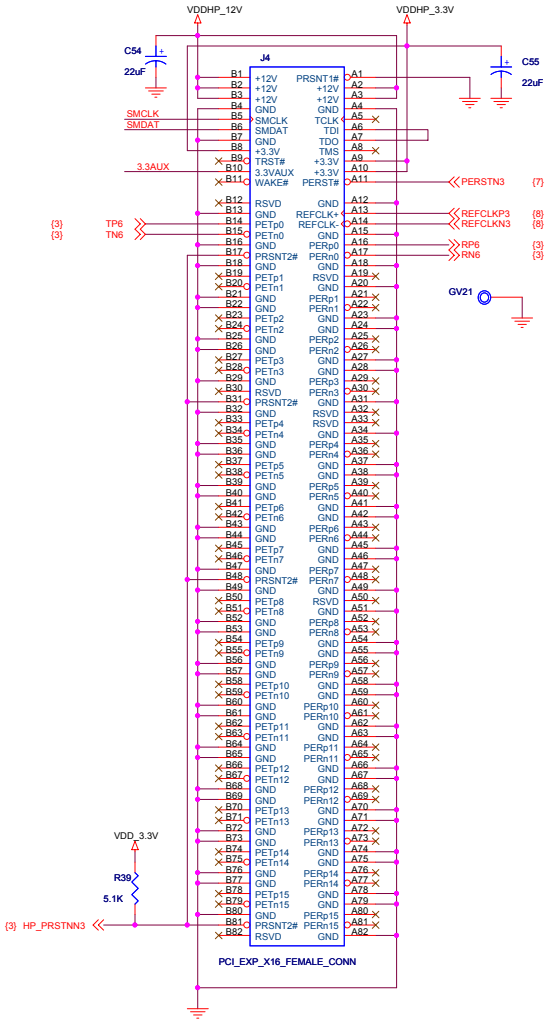
Title: PEX8509RDK - PCI Express Slot Connectors 1

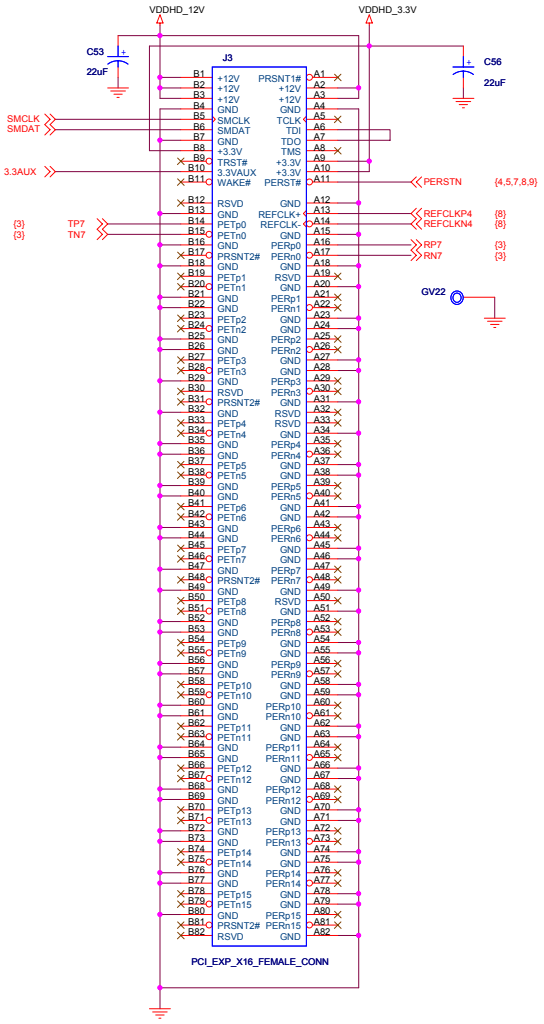
| Size | Document Number | Rev |
|---|---|---|
| C | 91-0071-004-A | 004 |

Date: Thursday, June 14, 2007 Sheet 5 of 9

## PORT 3 SLOT CONNECTOR




## PORT 4 SLOT CONNECTOR

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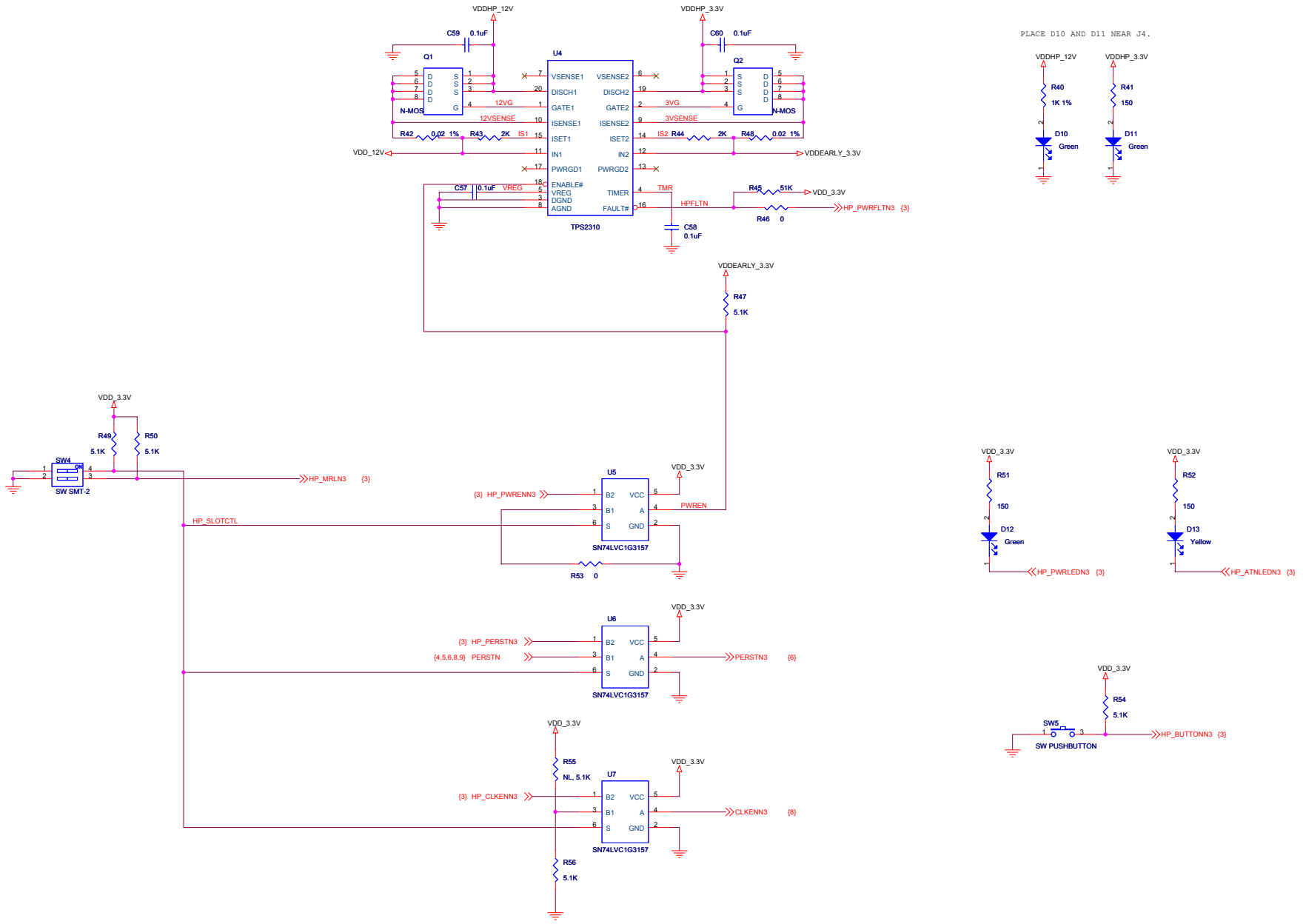
Title: PEX8509RDK - PCI Express Slot Connectors 2

| Size | Document Number | Rev |
|---|---|---|
| C | 91-0071-004-A | 004 |

Date: Thursday, June 14, 2007 Sheet 6 of 9

# HOT PLUG CIRCUIT





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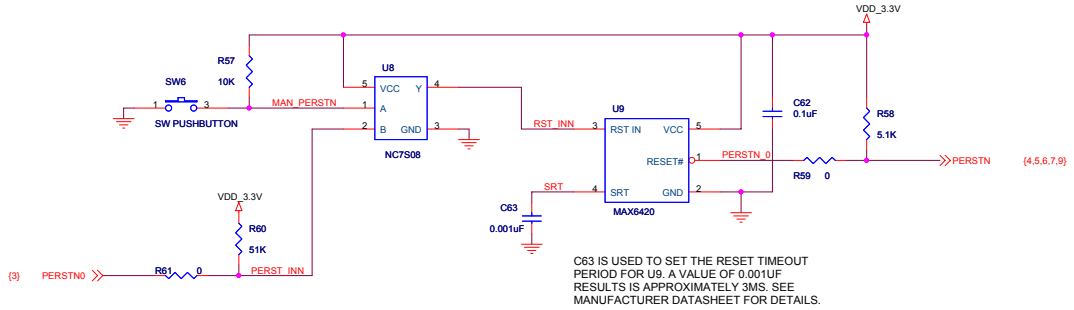
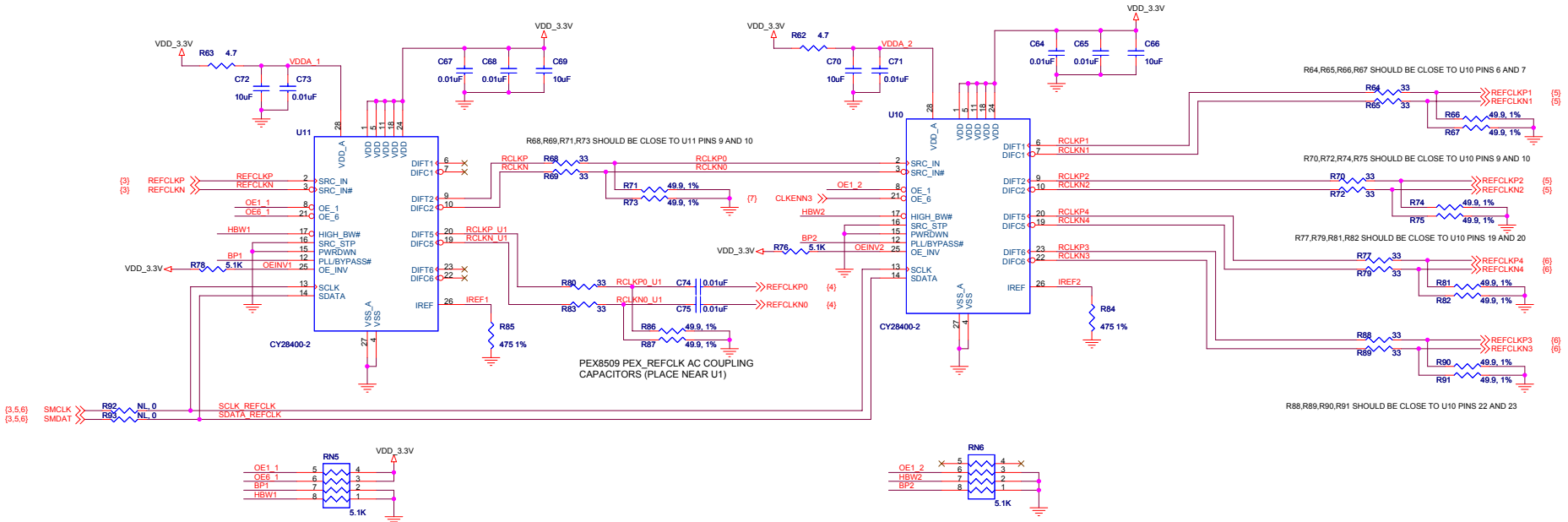
| | | |
|---|---|---|
| Title | PEX8509RDK - Hot Plug Circuitry | |
| Size C | Document Number 91-0071-004-A | Rev 004 |
| Date: Thursday, June 14, 2007 | Sheet 7 of 9 | |

# RESET CIRCUIT




C63 IS USED TO SET THE RESET TIMEOUT PERIOD FOR U9. A VALUE OF 0.001UF RESULTS IS APPROXIMATELY 3MS. SEE MANUFACTURER DATASHEET FOR DETAILS.

# REFCLK CIRCUIT





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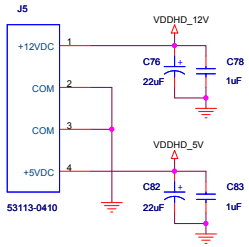
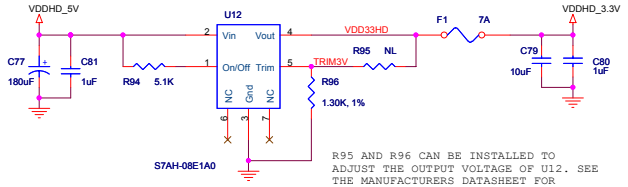
# J1/J2/J3 SLOT POWER

## ATX 4-PIN HARD DISK CONNECTOR




NOTE: THE PCI EXPRESS CEM 1.1 SPEC DOES NOT ALLOCATE ENOUGH POWER FOR ADD-IN CARDS TO USE ON FANOUT SLOTS. J5 IS USED TO GENERATE POWER FOR THE SLOT CONNECTORS J1, J2, AND J3. THE +12V IS USED DIRECTLY, WHILE THE +5V IS CONVERTED TO +3.3V VIA U12.

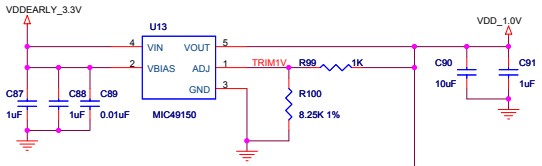
## 5V-TO-3.3V DC/DC CONVERTER




R95 AND R96 CAN BE INSTALLED TO ADJUST THE OUTPUT VOLTAGE OF U12. SEE THE MANUFACTURERS DATASHEET FOR DETAILS.

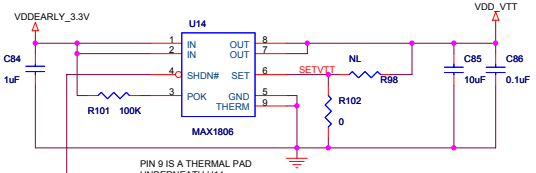
# PEX 8509 POWER

## 1.0V REGULATOR

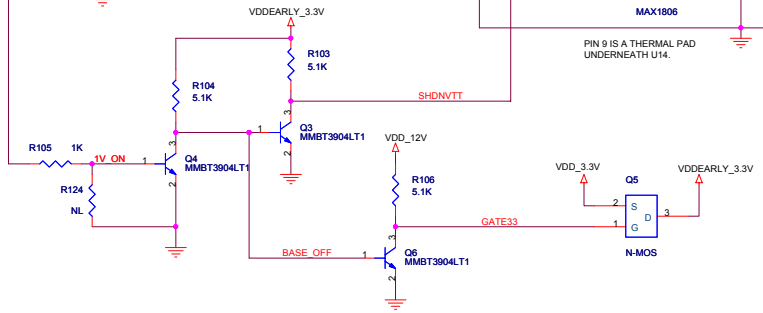



U13 VOUT CAN RANGE FROM 2.8V TO 0.9V, BY VARING R99 AND R100.

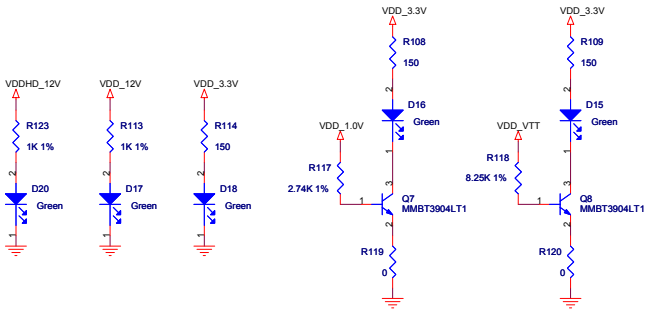
## VTT REGULATOR



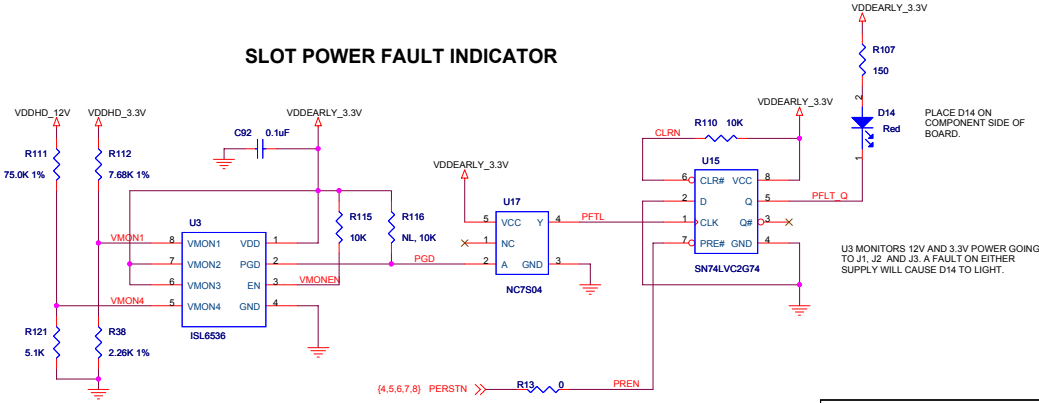

PIN 9 IS A THERMAL PAD UNDERNEATH U14.




## BOARD POWER ON INDICATOR LEDS




## SLOT POWER FAULT INDICATOR




PLACE D14 ON COMPONENT SIDE OF BOARD.

U3 MONITORS 12V AND 3.3V POWER GOING TO J1, J2 AND J3. A FAULT ON EITHER SUPPLY WILL CAUSE D14 TO LIGHT.

PLACE U3, U15 AND U17 ON SOLDER SIDE.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