Device Overview

The 89HPES22H16G2 is a member of the IDT PRECISE™ family of PCI Express® switching solutions. The PES22H16G2 is a 22-lane, 16-port system interconnect switch optimized for PCI Express Gen2 packet switching in high-performance applications, supporting multiple simultaneous peer-to-peer traffic flows. It provides connectivity and switching functions between a PCI Express upstream port and up to fifteen downstream ports and supports switching between downstream ports.

Features

- **High Performance Non-Blocking Switch Architecture**
  - Sixteen maximum switch ports
    - *Two x4 ports*
    - *Fourteen x1 ports*
  - Integrated SerDes supports 5.0 GT/s Gen2 and 2.5 GT/s Gen1 operation
  - Delivers 22 GBps (176 Gbps) of aggregate switching capacity
  - Supports up to 128 Bytes to 2 KB maximum payload size
  - Low latency cut-through architecture
  - Supports one virtual channel and eight traffic classes
- **Standards and Compatibility**
  - PCI Express Base Specification 2.0 compliant
  - Implements the following optional PCI Express features
    - *Advanced Error Reporting (AER) on all ports*
    - *End-to-End CRC (ECRC)*
    - *Access Control Services (ACS)*
    - *Power Budgeting Enhanced Capability*
    - *Device Serial Number Enhanced Capability*
    - *Sub-System ID and Sub-System Vendor ID Capability*
    - *Internal Error Reporting ECN*
    - *Multicast ECN*
    - *VGA and ISA enable*
    - *L0s and L1 ASPM*
    - *ARI ECN*
- **Port Configurability**
  - x4, x2, and x1 ports
    - *Ability to merge adjacent x4 ports to create a x8 port*
  - Automatic per port link width negotiation (x4 → x2 → x1)
  - Crosslink support
  - Automatic lane reversal
  - Autonomous and software managed link width and speed control
  - Per lane SerDes configuration
    - *De-emphasis*
    - *Receive equalization*
    - *Drive strength*
- **Switch Partitioning**
  - IDT proprietary feature that creates logically independent switches in the device
  - Supports up to 16 fully independent switch partitions
  - Configurable downstream port device numbering
  - Supports dynamic reconfiguration of switch partitions
    - *Dynamic port reconfiguration — downstream, upstream*
    - *Dynamic migration of ports between partitions*
    - *Movable upstream port within and between switch partitions*
- **Initialization / Configuration**
  - Supports Root (BIOS, OS, or driver), Serial EEPROM, or SMBus switch initialization
  - Common switch configurations are supported with pin strapping (no external components)
  - Supports in-system Serial EEPROM initialization/programming
- **Quality of Service (QoS)**
  - Port arbitration
    - *Round robin*
  - Request metering
    - *IDT proprietary feature that balances bandwidth among switch ports for maximum system throughput*
  - High performance switch core architecture
    - *Combined Input Output Queued (CIOQ) switch architecture with large buffers*
- **Multicast**
  - Compliant to the PCI-SIG multicast ECN
  - Supports arbitrary multicasting of Posted transactions
  - Supports 64 multicast groups
  - Multicast overlay mechanism support
  - ECRC regeneration support
- **Clocking**
  - Supports 100 MHz and 125 MHz reference clock frequencies
  - Flexible port clocking modes
    - *Common clock*
    - *Non-common clock*
    - *Local port clock with SSC and port reference clock input*
- **Hot-Plug and Hot Swap**
  - Hot-plug controller on all ports
    - *Hot-plug supported on all downstream switch ports*
  - All ports support hot-plug using low-cost external I^2C I/O expanders
  - Configurable presence detect supports card and cable applications

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- GPE output pin for hot-plug event notification
  - *Enables SCI/SMI generation for legacy operating system support*
- Hot swap capable I/O

◆ **Power Management**

- Supports D0, D3hot and D3 power management states
- Active State Power Management (ASPM)
  - *Supports L0, L0s, L1, L2/L3 Ready and L3 link states*
  - *Configurable L0s and L1 entry timers allow performance/ power-savings tuning*
- Supports PCI Express Power Budgeting Capability
- SerDes power savings
  - *Supports low swing / half-swing SerDes operation*
  - *SerDes optionally turned-off in D3hot*
  - *SerDes associated with unused ports are turned-off*
  - *SerDes associated with unused lanes are placed in a low power state*

◆ **54 General Purpose I/O**

◆ **Reliability, Availability and Serviceability (RAS)**

- ECRC support
- AER on all ports
- SECDED ECC protection on all internal RAMs
- End-to-end data path parity protection
- Checksum Serial EEPROM content protected
- Autonomous link reliability (preserves system operation in the presence of faulty links)
- Ability to generate an interrupt (INTx or MSI) on link up/down transitions

◆ **Test and Debug**

- On-chip link activity and status outputs available for Port 0 (upstream port)
- Per port link activity and status outputs available using external I^2C I/O expander for all other ports
- SerDes test modes
- Supports IEEE 1149.6 AC JTAG and IEEE 1149.1 JTAG

◆ **Power Supplies**

- Requires only two power supply voltages (1.0 V and 2.5 V). Note that a 3.3V is preferred for V_{DD}I/O
- No power sequencing requirements

◆ **Packaged in a 35mm x 35mm 1156-ball Flip Chip BGA with 1mm ball spacing**

Product Description

Utilizing standard PCI Express interconnect, the PES22H16G2 provides the most efficient I/O connectivity for applications requiring high throughput, low latency, and simple board layout with a minimum number of board layers. It provides 176 Gbps of aggregated, full-duplex switching capacity through 22 integrated serial lanes, using proven and robust IDT technology. Each lane provides 5 GT/s of bandwidth in both directions and is fully compliant with PCI Express Base Specification, Revision 2.0.

The PES22H16G2 is based on a flexible and efficient layered architecture. The PCI Express layer consists of SerDes, Physical, Data Link and Transaction layers in compliance with PCI Express Base specification Revision 2.0. The PES22H16G2 can operate either as a store and forward switch. It supports eight Traffic Classes (TCs) and one Virtual Channel (VC) with sophisticated resource management to enable efficient switching and I/O connectivity.

The PES22H16G2 is a *partitionable* PCIe switch. This means that in addition to operating as a standard PCI express switch, the PES22H16G2 ports may be partitioned into groups that logically operate as completely independent PCIe switches. Figure 2 illustrates a three partition PES22H16G2 configuration.

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Block Diagram

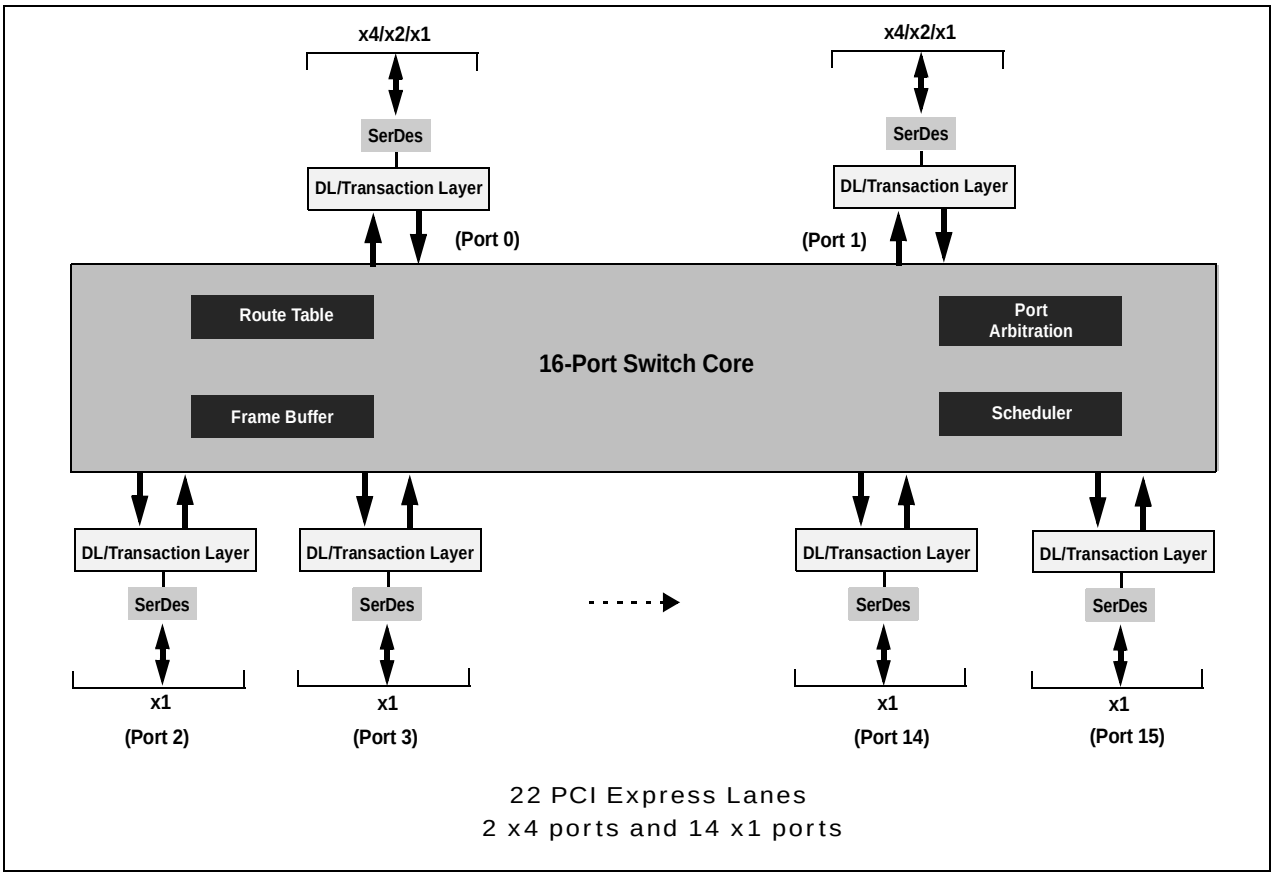


Figure 1 Internal Block Diagram

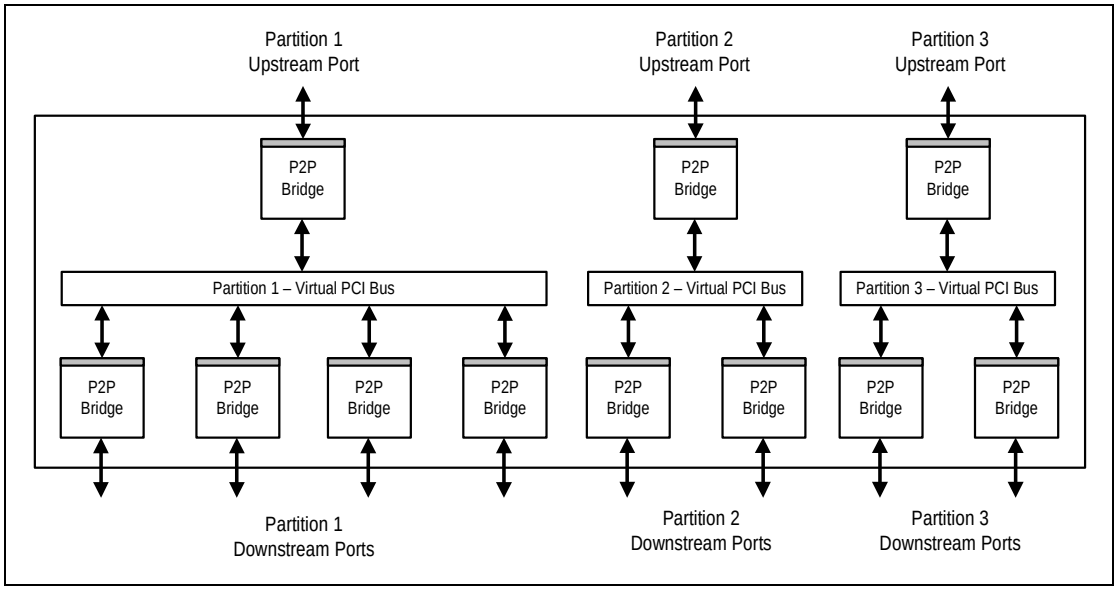


Figure 2 Example of Usage of Switch Partitioning

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SMBus Interface

The PES22H16G2 contains two SMBus interfaces. The slave interface provides full access to the configuration registers in the PES22H16G2, allowing every configuration register in the device to be read or written by an external agent. The master interface allows the default configuration register values of the PES22H16G2 to be overridden following a reset with values programmed in an external serial EEPROM. The master interface is also used by an external Hot-Plug I/O expander.

Each of the two SMBus interfaces contain an SMBus clock pin and an SMBus data pin. In addition, the slave SMBus has SSMBADDR1 and SSMBADDR2 pins. As shown in Figure 3, the master and slave SMBuses may only be used in a split configuration.

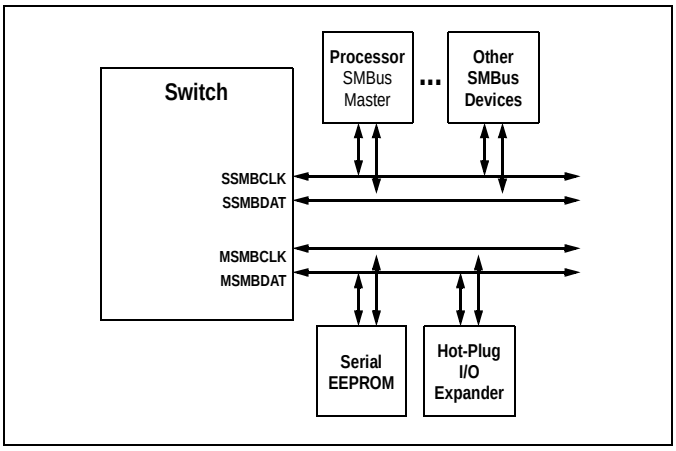


Figure 3 Split SMBus Interface Configuration

The switch's SMBus master interface does not support SMBus arbitration. As a result, the switch's SMBus master must be the only master in the SMBus lines that connect to the serial EEPROM and I/O expander slaves. In the split configuration, the master and slave SMBuses operate as two independent buses; thus, multi-master arbitration is not required.

Hot-Plug Interface

The PES22H16G2 supports PCI Express Hot-Plug on each downstream port (ports 1 through 15). To reduce the number of pins required on the device, the PES22H16G2 utilizes an external I/O expander, such as that used on PC motherboards, connected to the SMBus master interface. Following reset and configuration, whenever the state of a Hot-Plug output needs to be modified, the PES22H16G2 generates an SMBus transaction to the I/O expander with the new value of all of the outputs. Whenever a Hot-Plug input changes, the I/O expander generates an interrupt which is received on the IOEXPINTN input pin (alternate function of GPIO) of the PES22H16G2. In response to an I/O expander interrupt, the PES22H16G2 generates an SMBus transaction to read the state of all of the Hot-Plug inputs from the I/O expander.

General Purpose Input/Output

The PES22H16G2 provides 54 General Purpose I/O (GPIO) pins that may be individually configured as general purpose inputs, general purpose outputs, or alternate functions. Some GPIO pins are shared with other on-chip functions. These alternate functions may be enabled via software, SMBus slave interface, or serial configuration EEPROM.

Pin Description

The following tables list the functions of the pins provided on the PES22H16G2. Some of the functions listed may be multiplexed onto the same pin. The active polarity of a signal is defined using a suffix. Signals ending with an "N" are defined as being active, or asserted, when at a logic zero (low) level. All other signals (including clocks, buses, and select lines) will be interpreted as being active, or asserted, when at a logic one (high) level. Differential signals end with a suffix "N" or "P." The differential signal ending in "P" is the positive portion of the differential pair and the differential signal ending in "N" is the negative portion of the differential pair.

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Signal	Type	Name/Description
PE00RP[3:0] PE00RN[3:0]	I	**PCI Express Port 0 Serial Data Receive.** Differential PCI Express receive pairs for port 0.
PE00TP[3:0] PE00TN[3:0]	O	**PCI Express Port 0 Serial Data Transmit.** Differential PCI Express transmit pairs for port 0.
PE01RP[3:0] PE01RN[3:0]	I	**PCI Express Port 1 Serial Data Receive.** Differential PCI Express receive pairs for port 1. When port 0 is merged with port 1, these signals become port 0 receive pairs for lanes 4 through 7.
PE01TP[3:0] PE01TN[3:0]	O	**PCI Express Port 1 Serial Data Transmit.** Differential PCI Express transmit pairs for port 1. When port 0 is merged with port 1, these signals become port 0 transmit pairs for lanes 4 through 7.
PE02RP[0] PE02RN[0]	I	**PCI Express Port 2 Serial Data Receive.** Differential PCI Express receive pair for port 2.
PE02TP[0] PE02TN[0]	O	**PCI Express Port 2 Serial Data Transmit.** Differential PCI Express transmit pair for port 2.
PE03RP[0] PE03RN[0]	I	**PCI Express Port 3 Serial Data Receive.** Differential PCI Express receive pair for port 3.
PE03TP[0] PE03TN[0]	O	**PCI Express Port 3 Serial Data Transmit.** Differential PCI Express transmit pair for port 3.
PE04RP[0] PE04RN[0]	I	**PCI Express Port 4 Serial Data Receive.** Differential PCI Express receive pair for port 4.
PE04TP[0] PE04TN[0]	O	**PCI Express Port 4 Serial Data Transmit.** Differential PCI Express transmit pair for port 4.
PE05RP[0] PE05RN[0]	I	**PCI Express Port 5 Serial Data Receive.** Differential PCI Express receive pair for port 5.
PE05TP[0] PE05TN[0]	O	**PCI Express Port 5 Serial Data Transmit.** Differential PCI Express transmit pair for port 5.
PE06RP[0] PE06RN[0]	I	**PCI Express Port 6 Serial Data Receive.** Differential PCI Express receive pair for port 6.
PE06TP[0] PE06TN[0]	O	**PCI Express Port 6 Serial Data Transmit.** Differential PCI Express transmit pair for port 6.
PE07RP[0] PE07RN[0]	I	**PCI Express Port 7 Serial Data Receive.** Differential PCI Express receive pair for port 7.
PE07TP[0] PE07TN[0]	O	**PCI Express Port 7 Serial Data Transmit.** Differential PCI Express transmit pair for port 7.
PE08RP[0] PE08RN[0]	I	**PCI Express Port 8 Serial Data Receive.** Differential PCI Express receive pair for port 8.
PE08TP[0] PE08TN[0]	O	**PCI Express Port 8 Serial Data Transmit.** Differential PCI Express transmit pair for port 8.
PE09RP[0] PE09RN[0]	I	**PCI Express Port 9 Serial Data Receive.** Differential PCI Express receive pair for port 9.
PE09TP[0] PE09TN[0]	O	**PCI Express Port 9 Serial Data Transmit.** Differential PCI Express transmit pair for port 9.
PE10RP[0] PE10RN[0]	I	**PCI Express Port 10 Serial Data Receive.** Differential PCI Express receive pair for port 10.

Table 1 PCI Express Interface Pins (Part 1 of 2)

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Signal	Type	Name/Description
PE10TP[0] PE10TN[0]	O	**PCI Express Port 10 Serial Data Transmit.** Differential PCI Express transmit pair for port 10.
PE11RP[0] PE11RN[0]	I	**PCI Express Port 11 Serial Data Receive.** Differential PCI Express receive pair for port 11.
PE11TP[0] PE11TN[0]	O	**PCI Express Port 11 Serial Data Transmit.** Differential PCI Express transmit pair for port 11.
PE12RP[0] PE12RN[0]	I	**PCI Express Port 12 Serial Data Receive.** Differential PCI Express receive pair for port 12.
PE12TP[0] PE12TN[0]	O	**PCI Express Port 12 Serial Data Transmit.** Differential PCI Express transmit pair for port 12.
PE13RP[0] PE13RN[0]	I	**PCI Express Port 13 Serial Data Receive.** Differential PCI Express receive pair for port 13.
PE13TP[0] PE13TN[0]	O	**PCI Express Port 13 Serial Data Transmit.** Differential PCI Express transmit pair for port 13. W
PE14RP[0] PE14RN[0]	I	**PCI Express Port 14 Serial Data Receive.** Differential PCI Express receive pair for port 14.
PE14TP[0] PE14TN[0]	O	**PCI Express Port 14 Serial Data Transmit.** Differential PCI Express transmit pair for port 14.
PE15RP[0] PE15RN[0]	I	**PCI Express Port 15 Serial Data Receive.** Differential PCI Express receive pair for port 15.
PE15TP[0] PE15TN[0]	O	**PCI Express Port 15 Serial Data Transmit.** Differential PCI Express transmit pair for port 15.

Table 1 PCI Express Interface Pins (Part 2 of 2)

Signal	Type	Name/Description
GCLKN[1:0] GCLKP[1:0]	I	**Global Reference Clock.** Differential reference clock input pair. This clock is used as the reference clock by on-chip PLLs to generate the clocks required for the system logic. The frequency of the differential reference clock is determined by the GCLKFSEL signal.
P[15:0]CLKN P[15:0]CLKP	I	**Port Reference Clock**. Differential reference clock pair associated with ports 0 through 15.[1]

Table 2 Reference Clock Pins

1. Unused port clock pins should be connected to Vss on the board.

Signal	Type	Name/Description
MSMBADDR[4:1]	I	**Master SMBus Address.** These pins determine the SMBus address of the serial EEPROM from which configuration information is loaded.
MSMBCLK	I/O	**Master SMBus Clock.** This bidirectional signal is used to synchronize transfers on the master SMBus. It is active and generating the clock only when the EEPROM or I/O Expanders are being accessed.
MSMBDAT	I/O	**Master SMBus Data.** This bidirectional signal is used for data on the master SMBus.

Table 3 SMBus Interface Pins (Part 1 of 2)

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Signal	Type	Name/Description
SSMBADDR[5,3:1]	I	**Slave SMBus Address.** These pins determine the SMBus address to which the slave SMBus interface responds.
SSMBCLK	I/O	**Slave SMBus Clock.** This bidirectional signal is used to synchronize transfers on the slave SMBus.
SSMBDAT	I/O	**Slave SMBus Data.** This bidirectional signal is used for data on the slave SMBus.

Table 3 SMBus Interface Pins (Part 2 of 2)

Signal	Type	Name/Description
GPIO[0]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. Alternate function pin name: PART0PERSTN Alternate function pin type: Input Alternate function: Assertion of this signal initiated a partition fundamental reset in the corresponding partition.
GPIO[1]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. Alternate function pin name: PART1PERSTN Alternate function pin type: Input Alternate function: Assertion of this signal initiated a partition fundamental reset in the corresponding partition.
GPIO[2]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. Alternate function pin name: PART2PERSTN Alternate function pin type: Input Alternate function: Assertion of this signal initiated a partition fundamental reset in the corresponding partition.
GPIO[3]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. Alternate function pin name: PART3PERSTN Alternate function pin type: Input Alternate function: Assertion of this signal initiated a partition fundamental reset in the corresponding partition.
GPIO[4]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function — Reserved 2nd Alternate function pin name: P0LINKUPN 2nd Alternate function pin type: Output 2nd Alternate function: Port 0 Link Up Status output.
GPIO[5]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: GPEN 1st Alternate function pin type: Output 1st Alternate function: Hot-plug general purpose even output. 2nd Alternate function pin name: P0ACTIVEN 2nd Alternate function pin type: Output 2nd Alternate function: Port 0 Link Active Status Output.
GPIO[6]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin.
GPIO[7]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin.

Table 4 General Purpose I/O Pins (Part 1 of 8)

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Signal	Type	Name/Description
GPIO[8]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. Alternate function pin name: IOEXPINTN Alternate function pin type: Input Alternate function: IO expander interrupt.
GPIO[9]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. Alternate function pin name: HP0APN Alternate function pin type: Input Alternate function: Hot Plug Signal Group 0 Attention Push Button Input.
GPIO[10]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. Alternate function pin name: HP0PDN Alternate function pin type: Input Alternate function: Hot Plug Signal Group 0 Presence Detect Input.
GPIO[11]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. Alternate function pin name: HP0PFN Alternate function pin type: Input Alternate function: Hot Plug Signal Group 0 Power Fault Input.
GPIO[12]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. Alternate function pin name: HP0PWRGDN Alternate function pin type: Input Alternate function: Hot Plug Signal Group 0 Power Good Input.
GPIO[13]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. Alternate function pin name: HP0MRLN Alternate function pin type: Input Alternate function: Hot Plug Signal Group 0 Manually Operated Retention Latch Input.
GPIO[14]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. Alternate function pin name: HP0AIN Alternate function pin type: Output Alternate function: Hot Plug Signal Group 0 Attention Indicator Output.
GPIO[15]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. Alternate function pin name: HP0PIN Alternate function pin type: Output Alternate function: Hot Plug Signal Group 0 Power Indicator Output.
GPIO[16]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. Alternate function pin name: HP0PEP Alternate function pin type: Output Alternate function: Hot Plug Signal Group 0 Power Enable Output.
GPIO[17]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. Alternate function pin name: HP0RSTN Alternate function pin type: Output Alternate function: Hot Plug Signal Group 0 Reset Output.
GPIO[18]	I/O	General Purpose I/O. Alternate function pin name: HP1APN Alternate function pin type: Input Alternate function: Hot Plug Signal Group 1 Attention Push Button Input.

Table 4 General Purpose I/O Pins (Part 2 of 8)

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Signal	Type	Name/Description
GPIO[19]	I/O	General Purpose I/O. Alternate function pin name: HP1PDN Alternate function pin type: Input Alternate function: Hot Plug Signal Group 1 Presence Detect Input.
GPIO[20]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. Alternate function pin name: HP1PFN Alternate function pin type: Input Alternate function: Hot Plug Signal Group 1 Power Fault Input.
GPIO[21]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. Alternate function pin name: HP1PWRGDN Alternate function pin type: Input Alternate function: Hot Plug Signal Group 1 Power Enable Input.
GPIO[22]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP1MRLN 1st Alternate function pin type: Input 1st Alternate function: Hot Plug Signal Group 1 Manually Operated Retention Latch Input. 2nd Alternate function pin name: P1LINKUPN 2nd Alternate function pin type: Output 2nd Alternate function: Port 1 Link Up Status Output.
GPIO[23]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP1AIN 1st Alternate function pin type: Output 1st Alternate function: Hot Plug Signal Group 1 Attention Indicator Output. 2nd Alternate function pin name: P1ACTIVEN 2nd Alternate function pin type: Output 2nd Alternate function: Port 1 Link Active Status Output.
GPIO[24]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP1PIN 1st Alternate function pin type: Output 1st Alternate function: Hot Plug Signal Group 1 Power Indicator Output. 2nd Alternate function pin name: P2LINKUPN 2nd Alternate function pin type: Output 2nd Alternate function: Port 2 Link Up Status Output.
GPIO[25]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP1PEP 1st Alternate function pin type: Output 1st Alternate function: Hot Plug Signal Group 1 Power Enable Output. 2nd Alternate function pin name: P2ACTIVEN 2nd Alternate function pin type: Output 2nd Alternate function: Port 2 Link Active Status Output.
GPIO[26]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP1RSTN 1st Alternate function pin type: Output 1st Alternate function: Hot Plug Signal Group 1 Reset Output. 2nd Alternate function pin name: P3LINKUPN 2nd Alternate function pin type: Output 2nd Alternate function: Port 3 Link Up Status Output.

Table 4 General Purpose I/O Pins (Part 3 of 8)

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Signal	Type	Name/Description
GPIO[27]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP2APN 1st Alternate function pin type: Input 1st Alternate function: Hot Plug Signal Group 2 Attention Push Button Input. 2nd Alternate function pin name: P3ACTIVEN 2nd Alternate function pin type: Output 2nd Alternate function: Port 3 Link Active Status Output.
GPIO[28]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP2PDN 1st Alternate function pin type: Input 1st Alternate function: Hot Plug Signal Group 2 Presence Detect Input. 2nd Alternate function pin name: P4LINKUPN 2nd Alternate function pin type: Output 2nd Alternate function: Port 4 Link Up Status Output.
GPIO[29]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP2PFN 1st Alternate function pin type: Input 1st Alternate function: Hot Plug Signal Group 2 Power Fault Input. 2nd Alternate function pin name: P4ACTIVEN 2nd Alternate function pin type: Output 2nd Alternate function: Port 4 Link Active Status Output.
GPIO[30]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP2PWRGDN 1st Alternate function pin type: Input 1st Alternate function: Hot Plug Signal Group 2 Power Good Input. 2nd Alternate function pin name: P5LINKUPN 2nd Alternate function pin type: Output 2nd Alternate function: Port 5 Link Up Status Output.
GPIO[31]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP2MRLN 1st Alternate function pin type: Input 1st Alternate function: Hot Plug Signal Group 2 Manually Operated Retention Latch Input. 2nd Alternate function pin name: P5ACTIVEN 2nd Alternate function pin type: Output 2nd Alternate function: Port 5 Link Active Status Output.
GPIO[32]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP2AIN 1st Alternate function pin type: Output 1st Alternate function: Hot Plug Signal Group 2 Attention Indicator Output. 2nd Alternate function pin name: P6LINKUPN 2nd Alternate function pin type: Output 2nd Alternate function: Port 6 Link Up Status Output.

Table 4 General Purpose I/O Pins (Part 4 of 8)

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Signal	Type	Name/Description
GPIO[33]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP2PIN 1st Alternate function pin type: Output 1st Alternate function: Hot Plug Signal Group 2 Power Indicator Output. 2nd Alternate function pin name: P6ACTIVEN 2nd Alternate function pin type: Output 2nd Alternate function: Port 6 Link Active Status Output.
GPIO[34]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP2PEP 1st Alternate function pin type: Output 1st Alternate function: Hot Plug Signal Group 2 Power Enable Output. 2nd Alternate function pin name: P7LINKUPN 2nd Alternate function pin type: Output 2nd Alternate function: Port 7 Link Up Status Output.
GPIO[35]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP2RSTN 1st Alternate function pin type: Output 1st Alternate function: Hot Plug Signal Group 2 Reset Output. 2nd Alternate function pin name: P7ACTIVEN 2nd Alternate function pin type: Output 2nd Alternate function: Port 7 Link Active Status Output.
GPIO[36]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP3APN 1st Alternate function pin type: Input 1st Alternate function: Hot Plug Signal Group 3 Attention Push Button Input. 2nd Alternate function pin name: P8LINKUPN 2nd Alternate function pin type: Output 2nd Alternate function: Port 8 Link Up Status Output.
GPIO[37]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP3PDN 1st Alternate function pin type: Input 1st Alternate function: Hot Plug Signal Group 3 Presence Detect Input. 2nd Alternate function pin name: P8ACTIVEN 2nd Alternate function pin type: Output 2nd Alternate function: Port 8 Link Active Status Output.
GPIO[38]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP3PFN 1st Alternate function pin type: Input 1st Alternate function: Hot Plug Signal Group 3 Power Fault Input. 2nd Alternate function pin name: P9LINKUPN 2nd Alternate function pin type: Output 2nd Alternate function: Port 9 Link Up Status Output.
GPIO[39]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP3PWRGDN 1st Alternate function pin type: Input 1st Alternate function: Hot Plug Signal Group 3 Power Good Input. 2nd Alternate function pin name: P9ACTIVEN 2nd Alternate function pin type: Output 2nd Alternate function: Port 9 Link Active Status Output.

Table 4 General Purpose I/O Pins (Part 5 of 8)

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Signal	Type	Name/Description
GPIO[40]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP3MRLN 1st Alternate function pin type: Input 1st Alternate function: Hot Plug Signal Group 3 Manually Operated Retention Latch Input. 2nd Alternate function pin name: P10LINKUPN 2nd Alternate function pin type: Output 2nd Alternate function: Port 10 Link Up Status Output.
GPIO[41]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP3AIN 1st Alternate function pin type: Output 1st Alternate function: Hot Plug Signal Group 3 Attention Indicator Output. 2nd Alternate function pin name: P10ACTIVEN 2nd Alternate function pin type: Output 2nd Alternate function: Port 10 Link Active Status Output.
GPIO[42]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP3PIN 1st Alternate function pin type: Output 1st Alternate function: Hot Plug Signal Group 3 Power Indicator Output. 2nd Alternate function pin name: P11LINKUPN 2nd Alternate function pin type: Output 2nd Alternate function: Port 11 Link Up Status Output.
GPIO[43]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP3PEP 1st Alternate function pin type: Output 1st Alternate function: Hot Plug Signal Group 3 Power Enable Output. 2nd Alternate function pin name: P11ACTIVEN 2nd Alternate function pin type: Output 2nd Alternate function: Port 11 Link Active Status Output.
GPIO[44]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP3RSTN 1st Alternate function pin type: Output 1st Alternate function: Hot Plug Signal Group 3 Reset Output. 2nd Alternate function pin name: P12LINKUPN 2nd Alternate function pin type: Output 2nd Alternate function: Port 12 Link Up Status Output.
GPIO[45]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP4APN 1st Alternate function pin type: Input 1st Alternate function: Hot Plug Signal Group 4 Attention Push Button Input. 2nd Alternate function pin name: P12ACTIVEN 2nd Alternate function pin type: Output 2nd Alternate function: Port 12 Link Active Status Output.

Table 4 General Purpose I/O Pins (Part 6 of 8)

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Signal	Type	Name/Description
GPIO[46]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP4PDN 1st Alternate function pin type: Input 1st Alternate function: Hot Plug Signal Group 4 Presence Detect Input. 2nd Alternate function pin name: P13LINKUPN 2nd Alternate function pin type: Output 2nd Alternate function: Port 13 Link Up Status Output.
GPIO[47]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP4PFN 1st Alternate function pin type: Input 1st Alternate function: Hot Plug Signal Group 4 Power Fault Input. 2nd Alternate function pin name: P13ACTIVEN 2nd Alternate function pin type: Output 2nd Alternate function: Port 13 Link Active Status Output.
GPIO[48]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP4PWRGDN 1st Alternate function pin type: Input 1st Alternate function: Hot Plug Signal Group 4 Power Good Input. 2nd Alternate function pin name: P14LINKUPN 2nd Alternate function pin type: Output 2nd Alternate function: Port 14 Link Up Status Output.
GPIO[49]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP4MRLN 1st Alternate function pin type: Input 1st Alternate function: Hot Plug Signal Group 4 Manually Operated Retention Latch Input. 2nd Alternate function pin name: P14ACTIVEN 2nd Alternate function pin type: Output 2nd Alternate function: Port 14 Link Active Status Output.
GPIO[50]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP4AIN 1st Alternate function pin type: Output 1st Alternate function: Hot Plug Signal Group 4 Attention Indicator Output. 2nd Alternate function pin name: P15LINKUPN 2nd Alternate function pin type: Output 2nd Alternate function: Port 15 Link Up Status Output.

Table 4 General Purpose I/O Pins (Part 7 of 8)

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Signal	Type	Name/Description
GPIO[51]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. 1st Alternate function pin name: HP4PIN 1st Alternate function pin type: Output 1st Alternate function: Hot Plug Signal Group 4 Power Indicator Output. 2nd Alternate function pin name: P15ACTIVEN 2nd Alternate function pin type: Output 2nd Alternate function: Port 15 Link Active Status Output.
GPIO[52]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. Alternate function pin name: HP4PEP Alternate function pin type: Output Alternate function: Hot Plug Signal Group 4 Power Enable Output.
GPIO[53]	I/O	General Purpose I/O. This pin can be configured as a general purpose I/O pin. Alternate function pin name: HP4RSTN Alternate function pin type: Output Alternate function: Hot Plug Signal Group 4 Reset Output.

Table 4 General Purpose I/O Pins (Part 8 of 8)

Signal	Type	Name/Description
CLKMODE[2:0]		**Clock Mode.** These signals determine the port clocking mode used by ports of the device.
GCLKFSEL	I	**Global Clock Frequency Select.** These signals select the frequency of the GCLKP and GCLKN signals. 0x0 100 MHz 0x1 125 MHz
MSMBSMODE	I	**Master SMBus Slow Mode.** The assertion of this pin indicates that the master SMBus should operate at 100 KHz instead of 400 KHz. This value may not be overridden.
P01MERGEN	I	**Port 0 and 1 Merge.** P01MERGEN is an active low signal. It is pulled low internally. When this pin is low, port 0 is merged with port 1 to form a single x8 port. The Serdes lanes associated with port 1 become lanes 4 through 7 of port 0. When this pin is high, port 0 and port 1 are not merged, and each operates as a single x4 port.
PERSTN	I	**Global Reset.** Assertion of this signal resets all logic inside PES22H16G2.
RSTHALT	I	**Reset Halt.** When this signal is asserted during a PCI Express fundamental reset, PES22H16G2 executes the reset procedure and remains in a reset state with the Master and Slave SMBuses active. This allows software to read and write registers internal to the device before normal device operation begins. The device exits the reset state when the RSTHALT bit is cleared in the SWCTL register by an SMBus master.

Table 5 System Pins (Part 1 of 2)

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Signal	Type	Name/Description
SWMODE[3:0]	I	**Switch Mode.** These configuration pins determine the PES22H16G2 switch operating mode. **Note:** These pins should be static and not change following the negation of PERSTN. 0x0 - Single partition 0x1 - Single partition with Serial EEPROM initialization 0x2 through 0x7 - Reserved 0x8 - Single partition with port 0 selected as the upstream port (port 2 disabled) 0x9 - Single partition with port 2 selected as the upstream port (port 0 disabled) 0xA - Single partition with Serial EEPROM initialization and port 0 selected as the upstream port (port 2 disabled) 0xB - Single partition with Serial EEPROM initialization and port 2 selected as the upstream port (port 0 disabled) 0xC - Multi-partition 0xD - Multi-partition with Serial EEPROM initialization 0xE - Reserved 0xF - Reserved

Table 5 System Pins (Part 2 of 2)

Signal	Type	Name/Description
JTAG_TCK	I	**JTAG Clock**. This is an input test clock used to clock the shifting of data into or out of the boundary scan logic or JTAG Controller. JTAG_TCK is independent of the system clock with a nominal 50% duty cycle.
JTAG_TDI	I	**JTAG Data Input**. This is the serial data input to the boundary scan logic or JTAG Controller.
JTAG_TDO	O	**JTAG Data Output**. This is the serial data shifted out from the boundary scan logic or JTAG Controller. When no data is being shifted out, this signal is tri-stated.
JTAG_TMS	I	**JTAG Mode**. The value on this signal controls the test mode select of the boundary scan logic or JTAG Controller.
JTAG_TRST_N	I	**JTAG Reset**. This active low signal asynchronously resets the boundary scan logic and JTAG TAP Controller. An external pull-up on the board is recommended to meet the JTAG specification in cases where the tester can access this signal. However, for systems running in functional mode, one of the following should occur: 1) actively drive this signal low with control logic 2) statically drive this signal low with an external pull-down on the board

Table 6 Test Pins

Signal	Type	Name/Description
REFRES00	I/O	**External Reference Resistor.** Provides a reference for the SerDes bias currents and PLL calibration circuitry. A 3 kOhm +/- 1% resistor should be connected from this pin to ground.
REFRES01	I/O	**External Reference Resistor.** Provides a reference for the SerDes bias currents and PLL calibration circuitry. A 3 kOhm +/- 1% resistor should be connected from this pin to ground.
REFRES02	I/O	**External Reference Resistor.** Provides a reference for the SerDes bias currents and PLL calibration circuitry. A 3 kOhm +/- 1% resistor should be connected from this pin to ground.

Table 7 Power, Ground, and SerDes Resistor Pins (Part 1 of 3)

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Signal	Type	Name/Description
REFRES03	I/O	**External Reference Resistor.** Provides a reference for the SerDes bias currents and PLL calibration circuitry. A 3 kOhm +/- 1% resistor should be connected from this pin to ground.
REFRES04	I/O	**External Reference Resistor.** Provides a reference for the SerDes bias currents and PLL calibration circuitry. A 3 kOhm +/- 1% resistor should be connected from this pin to ground.
REFRES05	I/O	**External Reference Resistor.** Provides a reference for the SerDes bias currents and PLL calibration circuitry. A 3 kOhm +/- 1% resistor should be connected from this pin to ground.
REFRES06	I/O	**External Reference Resistor.** Provides a reference for the SerDes bias currents and PLL calibration circuitry. A 3 kOhm +/- 1% resistor should be connected from this pin to ground.
REFRES07	I/O	**External Reference Resistor.** Provides a reference for the SerDes bias currents and PLL calibration circuitry. A 3 kOhm +/- 1% resistor should be connected from this pin to ground.
REFRES08	I/O	**Port 8 External Reference Resistor.** Provides a reference for the Port 8 SerDes bias currents and PLL calibration circuitry. A 3 kOhm +/- 1% resistor should be connected from this pin to ground.
REFRES09	I/O	**Port 9 External Reference Resistor.** Provides a reference for the Port 9 SerDes bias currents and PLL calibration circuitry. A 3 kOhm +/- 1% resistor should be connected from this pin to ground.
REFRES10	I/O	**Port 10 External Reference Resistor.** Provides a reference for the Port 10 SerDes bias currents and PLL calibration circuitry. A 3 kOhm +/- 1% resistor should be connected from this pin to ground.
REFRES11	I/O	**Port 11 External Reference Resistor.** Provides a reference for the Port 11 SerDes bias currents and PLL calibration circuitry. A 3 kOhm +/- 1% resistor should be connected from this pin to ground.
REFRES12	I/O	**Port 12 External Reference Resistor.** Provides a reference for the Port 12 SerDes bias currents and PLL calibration circuitry. A 3 kOhm +/- 1% resistor should be connected from this pin to ground.
REFRES13	I/O	**Port 13 External Reference Resistor.** Provides a reference for the Port 13 SerDes bias currents and PLL calibration circuitry. A 3 kOhm +/- 1% resistor should be connected from this pin to ground.
REFRES14	I/O	**Port 14 External Reference Resistor.** Provides a reference for the Port 14 SerDes bias currents and PLL calibration circuitry. A 3 kOhm +/- 1% resistor should be connected from this pin to ground.
REFRES15	I/O	**Port 15 External Reference Resistor.** Provides a reference for the Port 15 SerDes bias currents and PLL calibration circuitry. A 3 kOhm +/- 1% resistor should be connected from this pin to ground.
REFRESPLL	I/O	**PLL External Reference Resistor.** Provides a reference for the PLL bias currents and PLL calibration circuitry. A 3K Ohm +/- 1% resistor should be connected from this pin to ground.
V_{DD}CORE	I	**Core V_{DD}.** Power supply for core logic (1.0V).
V_{DD}I/O	I	**I/O V_{DD}.** LVTTL I/O buffer power supply (2.5V or preferred 3.3V).
V_{DD}PEA	I	**PCI Express Analog Power.** Serdes analog power supply (1.0V).

Table 7 Power, Ground, and SerDes Resistor Pins (Part 2 of 3)

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Signal	Type	Name/Description
V_{DD}PEHA	I	**PCI Express Analog High Power.** Serdes analog power supply (2.5V).
V_{DD}PETA	I	**PCI Express Transmitter Analog Voltage.** Serdes transmitter analog power supply (1.0V).
V_{SS}	I	**Ground.**

Table 7 Power, Ground, and SerDes Resistor Pins (Part 3 of 3)

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Pin Characteristics

Note: Some input pads of the switch do not contain internal pull-ups or pull-downs. Unused SMBus and System inputs should be tied off to appropriate levels. This is especially critical for unused control signal inputs which, if left floating, could adversely affect operation. Also, floating pins can cause a slight increase in power consumption. Unused Serdes (Rx and Tx) pins should be left floating. Finally, No Connection pins should not be connected.

Function	Pin Name	Type	Buffer	I/O Type	Internal Resistor[1]	Notes
PCI Express Interface	PE00RN[3:0]	I	PCIe differential[2]	Serial Link		
	PE00RP[3:0]	I				
	PE00TN[3:0]	O				
	PE00TP[3:0]	O				
	PE01RN[3:0]	I				
	PE01RP[3:0]	I				
	PE01TN[3:0]	O				
	PE01TP[3:0]	O				
	PE02RN[0]	I				
	PE02RP[0]	I				
	PE02TN[0]	O				
	PE02TP[0]	O				
	PE03RN[0]	I				
	PE03RP[0]	I				
	PE03TN[0]	O				
	PE03TP[0]	O				
	PE04RN[0]	I				
	PE04RP[0]	I				
	PE04TN[0]	O				
	PE04TP[0]	O				
	PE05RN[0]	I				
	PE05RP[0]	I				
	PE05TN[0]	O				
	PE05TP[0]	O				
	PE06RN[0]	I				
	PE06RP[0]	I				
	PE06TN[0]	O				
	PE06TP[0]	O				
	PE07RN[0]	I				
	PE07RP[0]	I				
	PE07TN[0]	O				
	PE07TP[0]	O				
	PE08RN[0]	I				

Table 8 Pin Characteristics (Part 1 of 3)

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Function	Pin Name	Type	Buffer	I/O Type	Internal Resistor[1]	Notes
PCI Express Interface (cont.)	PE08RP[0]	I	PCIe differential	Serial Link		
	PE08TN[0]	O				
	PE08TP[0]	O				
	PE09RN[0]	I				
	PE09RP[0]	I				
	PE09TN[0]	O				
	PE09TP[0]	O				
	PE10RN[0]	I				
	PE10RP[0]	I				
	PE10TN[0]	O				
	PE10TP[0]	O				
	PE11RN[0]	I				
	PE11RP[0]	I				
	PE11TN[0]	O				
	PE11TP[0]	O				
	PE12RN[0]	I				
	PE12RP[0]	I				
	PE12TN[0]	O				
	PE12TP[0]	O				
	PE13RN[0]	I				
	PE13RP[0]	I				
	PE13TN[0]	O				
	PE13TP[0]	O				
	PE14RN[0]	I				
	PE14RP[0]	I				
	PE14TN[0]	O				
	PE14TP[0]	O				
	PE15RN[0]	I				
	PE15RP[0]	I				
	PE15TN[0]	O				
	PE15TP[0]	O				
	GCLKN[1:0]	I	HCSL	Diff. Clock Input		Refer to Table 9
	GCLKP[1:0]	I				
	P[15:0]CLKN	I				
	P[15:0]CLKP	I				

Table 8 Pin Characteristics (Part 2 of 3)

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Function	Pin Name	Type	Buffer	I/O Type	Internal Resistor[1]	Notes
SMBus	MSMBADDR[4:1]	I	LVTTL	Input	pull-down	
	MSMBCLK	I/O		STI[3]		
	MSMBDAT	I/O		STI		
	SSMBADDR[5,3:1]	I		Input	pull-up	
	SSMBCLK	I/O		STI		
	SSMBDAT	I/O		STI		
General Purpose I/O	GPIO[53:0]	I/O	LVTTL		pull-up	
System Pins	CLKMODE[1:0]	I	LVTTL	Input	pull-up	
	CLKMODE[2]	I			pull-down	
	GCLKFSEL	I			pull-down	
	MSMBSMODE	I			pull-down	
	P01MERGEN	I			pull-down	
	PERSTN	I		STI		
	RSTHALT	I		Input	pull-down	
	SWMODE[3:0]	I			pull-down	
EJTAG / JTAG	JTAG_TCK	I	LVTTL	STI	pull-up	
	JTAG_TDI	I		STI	pull-up	
	JTAG_TDO	O				
	JTAG_TMS	I		STI	pull-up	
	JTAG_TRST_N	I		STI	pull-up	External pull-down
SerDes Reference Resistors	REFRES[15:0]	I/O	Analog			
	REFRESPLL	I/O				

Table 8 Pin Characteristics (Part 3 of 3)

1. Internal resistor values under typical operating conditions are 92K Ω for pull-up and 91K Ω for pull-down.

2. All receiver pins set the DC common mode voltage to ground. All transmitters must be AC coupled to the media.

3. Schmitt Trigger Input (STI).

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Logic Diagram — PES22H16G2

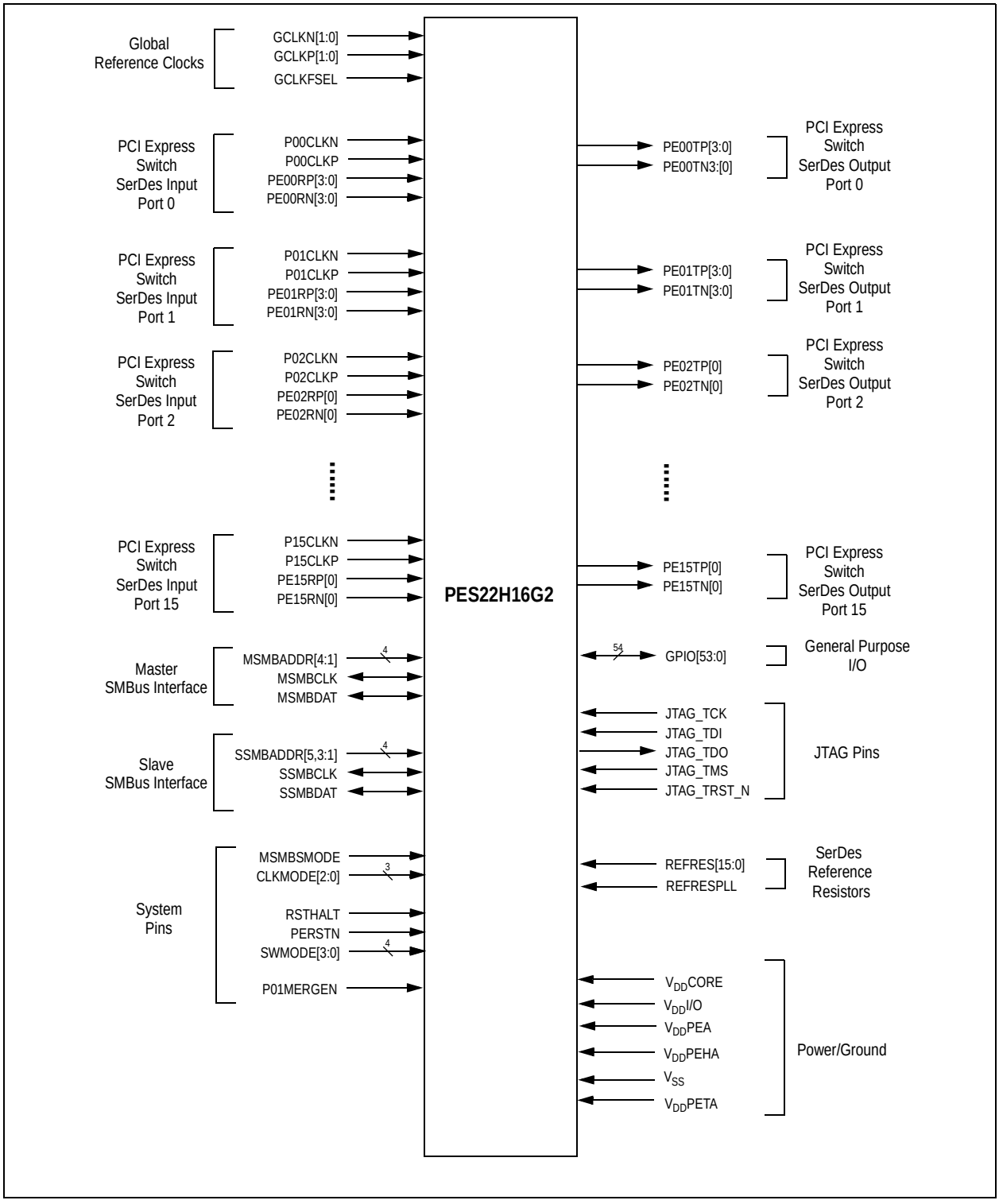


Figure 4 PES22H16G2 Logic Diagram

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System Clock Parameters

Values based on systems running at recommended supply voltages and operating temperatures, as shown in Tables 13 and 14.

Parameter	Description	Condition	Min	Typical	Max	Unit
$Refclk_{FREQ}$	Input reference clock frequency range		100		125[1]	MHz
T_{C-RISE}	Rising edge rate	Differential	0.6		4	V/ns
T_{C-FALL}	Falling edge rate	Differential	0.6		4	V/ns
V_{IH}	Differential input high voltage	Differential	+150			mV
V_{IL}	Differential input low voltage	Differential			-150	mV
V_{CROSS}	Absolute single-ended crossing point voltage	Single-ended	+250		+550	mV
$V_{CROSS-DELTA}$	Variation of V_{CROSS} over all rising clock edges	Single-ended			+140	mV
V_{RB}	Ring back voltage margin	Differential	-100		+100	mV
T_{STABLE}	Time before V_{RB} is allowed	Differential	500			ps
$T_{PERIOD-AVG}$	Average clock period accuracy		-300		2800	ppm
$T_{PERIOD-ABS}$	Absolute period, including spread-spectrum and jitter		9.847		10.203	ns
$T_{CC-JITTER}$	Cycle to cycle jitter				150	ps
V_{MAX}	Absolute maximum input voltage				+1.15	V
V_{MIN}	Absolute minimum input voltage		-0.3			V
Duty Cycle	Duty cycle		40		60	%
Rise/Fall Matching	Single ended rising Refclk edge rate versus falling Refclk edge rate			20		%
Z_{C-DC}	Clock source output DC impedance		40		60	Ω

Table 9 Input Clock Requirements

1. The input clock frequency will be either 100 or 125 MHz depending on signal GCLKFSEL.

AC Timing Characteristics

Parameter	Description	Gen 1			Gen 2			Units
		Min[1]	Typ[1]	Max[1]	Min[1]	Typ[1]	Max[1]	
PCIe Transmit								
UI	Unit Interval	399.88	400	400.12	199.94	200	200.06	ps
T_{TX-EYE}	Minimum Tx Eye Width	0.75			0.75			UI
$T_{TX-EYE-MEDIAN-to-MAX-JITTER}$	Maximum time between the jitter median and maximum deviation from the median			0.125				UI
$T_{TX-RISE}$, $T_{TX-FALL}$	TX Rise/Fall Time: 20% - 80%	0.125			0.15			UI
$T_{TX-IDLE-MIN}$	Minimum time in idle	20			20			UI
$T_{TX-IDLE-SET-TO-IDLE}$	Maximum time to transition to a valid Idle after sending an Idle ordered set			8			8	ns

Table 10 PCIe AC Timing Characteristics (Part 1 of 2)

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Parameter	Description	Gen 1			Gen 2			Units
		Min[1]	Typ[1]	Max[1]	Min[1]	Typ[1]	Max[1]	
$T_{TX-IDLE-TO-DIFF-DATA}$	Maximum time to transition from valid idle to diff data			8			8	ns
$T_{TX-SKEW}$	Transmitter data skew between any 2 lanes			1.3			1.3	ns
$T_{MIN-PULSED}$	Minimum Instantaneous Lone Pulse Width	NA			0.9			UI
$T_{TX-HF-DJ-DD}$	Transmitter Deterministic Jitter > 1.5MHz Bandwidth	NA					0.15	UI
$T_{RF-MISMATCH}$	Rise/Fall Time Differential Mismatch	NA					0.1	UI
PCIe Receive								
UI	Unit Interval	399.88	400	400.12	199.94		200.06	ps
$T_{RX-EYE (with jitter)}$	Minimum Receiver Eye Width (jitter tolerance)	0.4			0.4			UI
$T_{RX-EYE-MEDIUM TO MAX JITTER}$	Max time between jitter median & max deviation			0.3				UI
$T_{RX-SKEW}$	Lane to lane input skew			20			8	ns
$T_{RX-HF-RMS}$	1.5 — 100 MHz RMS jitter (common clock)	NA					3.4	ps
$T_{RX-HF-DJ-DD}$	Maximum tolerable DJ by the receiver (common clock)	NA					88	ps
$T_{RX-LF-RMS}$	10 KHz to 1.5 MHz RMS jitter (common clock)	NA					4.2	ps
$T_{RX-MIN-PULSE}$	Minimum receiver instantaneous eye width	NA			0.6			UI

Table 10 PCIe AC Timing Characteristics (Part 2 of 2)

1. Minimum, Typical, and Maximum values meet the requirements under PCI Specification 2.0

Signal	Symbol	Reference Edge	Min	Max	Unit	Timing Diagram Reference
GPIO						
GPIO[53:0][1]	Tpw_13b[2]	None	50	—	ns	See Figure 5.

Table 11 GPIO AC Timing Characteristics

1. GPIO signals must meet the setup and hold times if they are synchronous or the minimum pulse width if they are asynchronous.

2. The values for this symbol were determined by calculation, not by testing.

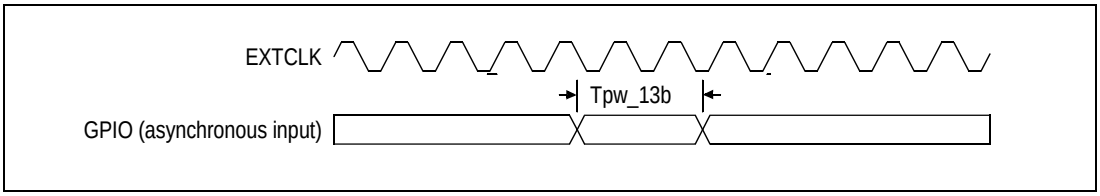


Figure 5 GPIO AC Timing Waveform

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Signal	Symbol	Reference Edge	Min	Max	Unit	Timing Diagram Reference
JTAG						
JTAG_TCK	Tper_16a	none	50.0	—	ns	See Figure 6.
	Thigh_16a, Tlow_16a		10.0	25.0	ns	
JTAG_TMS[1], JTAG_TDI	Tsu_16b	JTAG_TCK rising	2.4	—	ns	
	Thld_16b		1.0	—	ns	
JTAG_TDO	Tdo_16c	JTAG_TCK falling	—	20	ns	
	Tdz_16c[2]		—	20	ns	
JTAG_TRST_N	Tpw_16d[2]	none	25.0	—	ns	

Table 12 JTAG AC Timing Characteristics

1. The JTAG specification, IEEE 1149.1, recommends that JTAG_TMS should be held at 1 while the signal applied at JTAG_TRST_N changes from 0 to 1. Otherwise, a race may occur if JTAG_TRST_N is deasserted (going from low to high) on a rising edge of JTAG_TCK when JTAG_TMS is low, because the TAP controller might go to either the Run-Test/Idle state or stay in the Test-Logic-Reset state.

2. The values for this symbol were determined by calculation, not by testing.

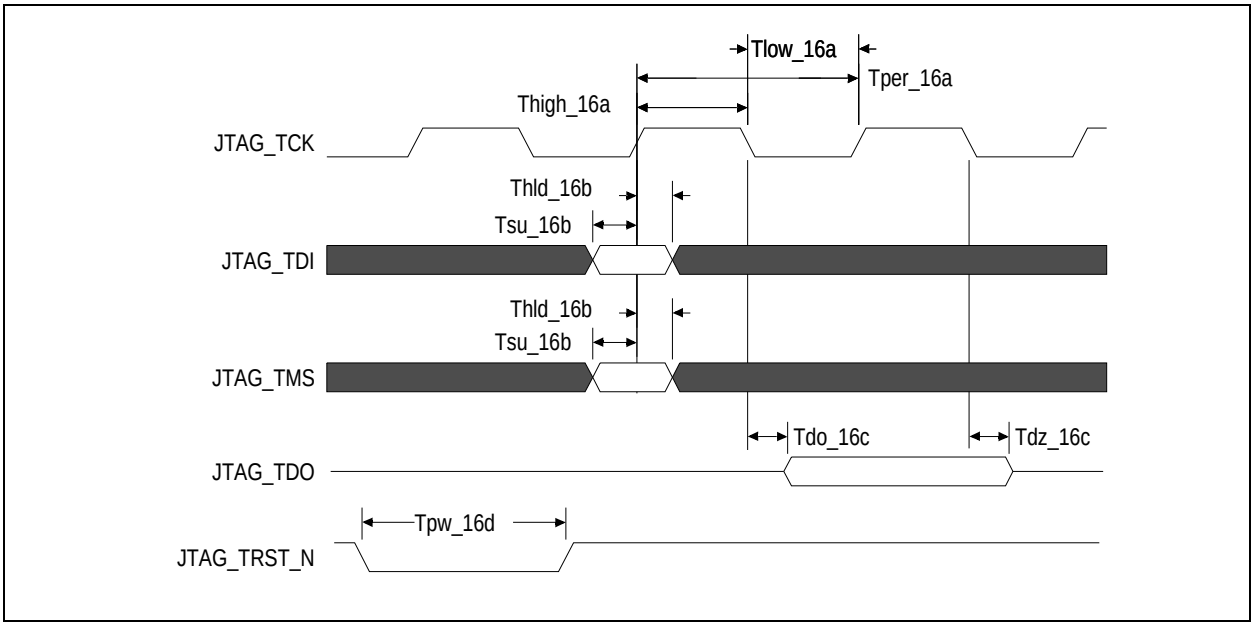


Figure 6 JTAG AC Timing Waveform

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Recommended Operating Supply Voltages

Symbol	Parameter	Minimum	Typical	Maximum	Unit
V_{DD}CORE	Internal logic supply	0.9	1.0	1.1	V
V_{DD}I/O	I/O supply except for SerDes	2.25	2.5	2.75	V
		3.125	3.3	3.465	V
V_{DD}PEA[1]	PCI Express Analog Power	0.95	1.0	1.1	V
V_{DD}PEHA[2]	PCI Express Analog High Power	2.25	2.5	2.75	V
V_{DD}PETA[1]	PCI Express Transmitter Analog Voltage	0.95	1.0	1.1	V
V_{SS}	Common ground	0	0	0	V

Table 13 PES22H16G2 Operating Voltages

1. V_{DD}PEA and V_{DD}PETA should have no more than 25m$V_{peak\text{-}peak}$ AC power supply noise superimposed on the 1.0V nominal DC value.
2. V_{DD}PEHA should have no more than 50m$V_{peak\text{-}peak}$ AC power supply noise superimposed on the 2.5V nominal DC value.

Power-Up Sequence

During power supply ramp-up, V_{DD}CORE must remain at least 1.0V below V_{DD}I/O at all times. There are no other power-up sequence requirements for the various operating supply voltages.

The power-down sequence can occur in any order.

Recommended Operating Temperature

Grade	Temperature
Commercial	0°C to +70°C Ambient
Industrial	-40°C to +85°C Ambient

Table 14 PES22H16G2 Operating Temperatures

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Power Consumption

Typical power is measured under the following conditions: 25°C Ambient, 35% total link usage on all ports, typical voltages defined in Table 13 (and also listed below).

Maximum power is measured under the following conditions: 70°C Ambient, 85% total link usage on all ports, maximum voltages defined in Table 13 (and also listed in the tables below).

Number of active Lanes per Port		Core Supply		PCIe Analog Supply		PCIe Analog High Supply		PCIe Transmitter Supply		I/O Supply		Total	
		Typ 1.0V	Max 1.1V	Typ 1.0V	Max 1.1V	Typ 2.5V	Max 2.75V	Typ 1.0V	Max 1.1V	Typ 2.5V	Max 2.75V	Typ Power	Max Power
One x8 and fourteen x1 (Full Swing)	**mA**	3240	5455	1600	2064	831	858	1100	1182	32	40		
	Watts	3.24	6.0	1.60	2.27	2.08	2.36	1.10	1.30	0.08	0.11	8.10	12.04
One x8 and fourteen x1 (Half Swing)	**mA**	3240	5455	1376	1775	831	858	572	615	32	40		
	Watts	3.24	6.0	1.38	1.95	2.08	2.36	0.57	0.68	0.08	0.11	7.35	11.10

Table 15 PES22H16G2 Power Consumption — 2.5V I/O

Number of active Lanes per Port		Core Supply		PCIe Analog Supply		PCIe Analog High Supply		PCIe Transmitter Supply		I/O Supply		Total	
		Typ 1.0V	Max 1.1V	Typ 1.0V	Max 1.1V	Typ 2.5V	Max 2.75V	Typ 1.0V	Max 1.1V	Typ 3.3V	Max 3.465V	Typ Power	Max Power
One x8 and fourteen x1 (Full Swing)	**mA**	3240	5455	1600	2064	831	858	1100	1182	36	46		
	Watts	3.24	6.0	1.60	2.27	2.08	2.36	1.10	1.30	0.12	0.16	8.14	12.09
One x8 and fourteen x1 (Half Swing)	**mA**	3240	5455	1376	1775	831	858	572	615	36	46		
	Watts	3.24	6.0	1.38	1.95	2.08	2.36	0.57	0.68	0.12	0.16	7.39	11.15

Table 16 PES22H16G2 Power Consumption — 3.3V I/O

Note 1: I/O supply of 3.3V is preferred.

Note 2: The above power consumption assumes that all ports are functioning at Gen2 (5.0 GT/S) speeds. Power consumption can be reduced by turning off unused ports through software or through boot EEPROM. Power savings will occur in V_{DD}PEA, V_{DD}PEHA, and V_{DD}PETA. Power savings can be estimated as directly proportional to the number of unused ports, since the power consumption of a turned-off port is close to zero. For example, if 3 ports out of 16 are turned off, then the power savings for each of the above three power rails can be calculated quite simply as 3/16 multiplied by the power consumption indicated in the above table.

Note 3: Using a port in Gen1 mode (2.5GT/S) results in approximately 18% power savings for each power rail: V_{DD}PEA, V_{DD}PEHA, and V_{DD}PETA.

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Thermal Considerations

This section describes thermal considerations for the PES22H16G2 (35mm^2 FCBGA1156 package package). The data in Table 17 below contains information that is relevant to the thermal performance of the PES22H16G2 switch.

Symbol	Parameter	Value	Units	Conditions
$T_{J(max)}$	Junction Temperature	125	^{0}C	Maximum
$T_{A(max)}$	Ambient Temperature	70	^{0}C	Maximum for commercial-rated products
		85	^{0}C	Maximum for industrial-rated products
$\theta_{JA(effective)}$	Effective Thermal Resistance, Junction-to-Ambient	13.0	^{0}C/W	Zero air flow
		6.8	^{0}C/W	1 m/S air flow
		5.8	^{0}C/W	2 m/S air flow
θ_{JB}	Thermal Resistance, Junction-to-Board	2.5	^{0}C/W	
θ_{JC}	Thermal Resistance, Junction-to-Case	0.15	^{0}C/W	
P	Power Dissipation of the Device	12.09	Watts	Maximum

Table 17 Thermal Specifications for PES22H16G2, 35x35 mm FCBGA1156 Package

Note: It is important for the reliability of this device in any user environment that the junction temperature not exceed the $T_{J(max)}$ value specified in Table 17. Consequently, the effective junction to ambient thermal resistance (θ_{JA}) for the worst case scenario must be maintained below the value determined by the formula:

$$\theta_{JA} = (T_{J(max)} - T_{A(max)})/P$$

Given that the values of $T_{J(max)}$, $T_{A(max)}$, and P are known, the value of desired θ_{JA} becomes a known entity to the system designer. How to achieve the desired θ_{JA} is left up to the board or system designer, but in general, it can be achieved by adding the effects of θ_{JC} (value provided in Table 17), thermal resistance of the chosen adhesive (θ_{CS}), that of the heat sink (θ_{SA}), amount of airflow, and properties of the circuit board (number of layers and size of the board). It is strongly recommended that users perform their own thermal analysis for their own board and system design scenarios.

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DC Electrical Characteristics

Values based on systems running at recommended supply voltages, as shown in Table 13.

Note: See Table 8, Pin Characteristics, for a complete I/O listing.

I/O Type	Parameter	Description	Gen1			Gen2			Unit	Conditions
			Min[1]	Typ[1]	Max[1]	Min[1]	Typ[1]	Max[1]		
Serial Link	PCIe Transmit									
	$V_{TX-DIFFp-p}$	Differential peak-to-peak output voltage	800		1200	800		1200	mV	
	$V_{TX-DIFFp-p-LOW}$	Low-Drive Differential Peak to Peak Output Voltage	400		1200	400		1200	mV	
	$V_{TX-DE-RATIO-3.5dB}$	De-emphasized differential output voltage	-3		-4	-3.0	-3.5	-4.0	dB	
	$V_{TX-DE-RATIO-6.0dB}$	De-emphasized differential output voltage	NA			-5.5	-6.0	-6.5	dB	
	$V_{TX-DC-CM}$	DC Common mode voltage	0		3.6	0		3.6	V	
	$V_{TX-CM-ACP}$	RMS AC peak common mode output voltage			20				mV	
	$V_{TX-CM-DC-active-idle-delta}$	Abs delta of DC common mode voltage between L0 and idle			100			100	mV	
	$V_{TX-CM-DC-line-delta}$	Abs delta of DC common mode voltage between D+ and D-			25			25	mV	
	$V_{TX-Idle-DiffP}$	Electrical idle diff peak output			20			20	mV	
	$RL_{TX-DIFF}$	Transmitter Differential Return loss	10					10	dB	0.05 - 1.25GHz
								8	dB	1.25 - 2.5GHz
	RL_{TX-CM}	Transmitter Common Mode Return loss	6					6	dB	
	$Z_{TX-DIFF-DC}$	DC Differential TX impedance	80	100	120			120	Ω	
	VTX-CM-ACpp	Peak-Peak AC Common	NA					100	mV	
	$V_{TX-DC-CM}$	Transmit Driver DC Common Mode Voltage	0		3.6	0		3.6	V	
	$V_{TX-RCV-DETECT}$	The amount of voltage change allowed during Receiver Detection			600			600	mV	
	$I_{TX-SHORT}$	Transmitter Short Circuit Current Limit	0		90				90	mA

Table 18 DC Electrical Characteristics (Part 1 of 2)

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I/O Type	Parameter	Description	Gen1			Gen2			Unit	Conditions
			Min[1]	Typ[1]	Max[1]	Min[1]	Typ[1]	Max[1]		
Serial Link (cont.)	PCIe Receive									
	$V_{RX-DIFFp-p}$	Differential input voltage (peak-to-peak)	175		1200	120		1200	mV	
	$RL_{RX-DIFF}$	Receiver Differential Return Loss	10					10	dB	0.05 - 1.25GHz
								8		1.25 - 2.5GHz
	RL_{RX-CM}	Receiver Common Mode Return Loss	6					6	dB	
	$Z_{RX-DIFF-DC}$	Differential input impedance (DC)	80	100	120	Refer to return loss spec			Ω	
	Z_{RX--DC}	DC common mode impedance	40	50	60	40		60	Ω	
	$Z_{RX-COMM-DC}$	Powered down input common mode impedance (DC)	200k	350k				50k	Ω	
	$Z_{RX-HIGH-IMP-DC-POS}$	DC input CM input impedance for V>0 during reset or power down			50k			50k	Ω	
	$Z_{RX-HIGH-IMP-DC-NEG}$	DC input CM input impedance for V<0 during reset or power down			1.0k			1.0k	Ω	
	$V_{RX-IDLE-DET-DIFFp-p}$	Electrical idle detect threshold	65		175	65		175	mV	
	$V_{RX-CM-ACp}$	Receiver AC common-mode peak voltage			150			150	mV	$V_{RX-CM-ACp}$
PCIe REFCLK										
	C_{IN}	Input Capacitance	1.5	—		1.5	—		pF	
Other I/Os										
LOW Drive Output	I_{OL}		—	2.5	—	—	2.5	—	mA	V_{OL} = 0.4v
	I_{OH}		—	-5.5	—	—	-5.5	—	mA	V_{OH} = 1.5V
High Drive Output	I_{OL}		—	12.0	—	—	12.0	—	mA	V_{OL} = 0.4v
	I_{OH}		—	-20.0	—	—	-20.0	—	mA	V_{OH} = 1.5V
Schmitt Trigger Input (STI)	V_{IL}		-0.3	—	0.8	-0.3	—	0.8	V	—
	V_{IH}		2.0	—	V_{DD}I/O + 0.5	2.0	—	V_{DD}I/O + 0.5	V	—
Input	V_{IL}		-0.3	—	0.8	-0.3	—	0.8	V	—
	V_{IH}		2.0	—	V_{DD}I/O + 0.5	2.0	—	V_{DD}I/O + 0.5	V	—
Capacitance	C_{IN}		—	—	8.5	—	—	8.5	pF	—
Leakage	Inputs		—	—	± 10	—	—	± 10	µA	V_{DD}I/O (max)
	$I/O_{LEAK\ W/O}$ Pull-ups/downs		—	—	± 10	—	—	± 10	µA	V_{DD}I/O (max)
	$I/O_{LEAK\ WITH}$ Pull-ups/downs		—	—	± 80	—	—	± 80	µA	V_{DD}I/O (max)

Table 18 DC Electrical Characteristics (Part 2 of 2)

1. Minimum, Typical, and Maximum values meet the requirements under PCI Specification 2.0.

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Absolute Maximum Voltage Rating

Core Supply	PCIe Analog Supply	PCIe Analog High Supply	PCIe Transmitter Supply	I/O Supply
1.5V	1.5V	4.6V	1.5V	4.6V

Table 19 PES22H16G2 Absolute Maximum Voltage Rating

Warning: For proper and reliable operation in adherence with this data sheet, the device should not exceed the recommended operating voltages in Table 13. The absolute maximum operating voltages in Table 19 are offered to provide guidelines for voltage excursions outside the recommended voltage ranges. Device functionality is not guaranteed at these conditions and sustained operation at these values or any exposure to voltages outside the maximum range may adversely affect device functionality and reliability.

SMBus Characterization

Symbol	Parameter	SMBus 2.0 Char. Data[1]			Unit
		3V	3.3V	3.6V	
DC Parameter for SDA Pin					
V_{IL}	Input Low	1.16	1.26	1.35	V
V_{IH}	Input High	1.56	1.67	1.78	V
$V_{OL@350uA}$	Output Low	15	15	15	mV
$I_{OL@0.4V}$		23	24	25	mA
I_{Pullup}	Current Source	—	—	—	µA
I_{IL_Leak}	Input Low Leakage	0	0	0	µA
I_{IH_Leak}	Input High Leakage	0	0	0	µA
DC Parameter for SCL Pin					
$V_{IL\ (V)}$	Input Low	1.11	1.2	1.31	V
$V_{IH\ (V)}$	Input High	1.54	1.65	1.76	V
I_{IL_Leak}	Input Low Leakage	0	0	0	µA
I_{IH_Leak}	Input High Leakage	0	0	0	µA

Table 20 SMBus DC Characterization Data

1. Data at room and hot temperature.

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Symbol	Parameter	SMBus @3.3V ±10%[1]		Unit
		Min	Max	
F_{SCL}	Clock frequency	5	600	KHz
T_{BUF}	Bus free time between Stop and Start	3.5	—	µs
$T_{HD:STA}$	Start condition hold time	1	—	µs
$T_{SU:STA}$	Start condition setup time	1	—	µs
$T_{SU:STO}$	Stop condition setup time	1	—	µs
$T_{HD:DAT}$	Data hold time	1	—	ns
$T_{SU:DAT}$	Data setup time	1	—	ns
$T_{TIMEOUT}$	Detect clock low time out	—	74.7	ms
T_{LOW}	Clock low period	3.7	—	µs
T_{HIGH}	Clock high period	3.7	—	µs
T_F	Clock/Data fall time	—	72.2	ns
T_R	Clock/Data rise time	—	68.3	ns
$T_{POR@10kHz}$	Time which a device must be operational after power-on reset	20	—	ms

Table 21 SMBus AC Timing Data

1. Data at room and hot temperature.

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Package Pinout — 1156-BGA Signal Pinout for PES22H16G2

The following table lists the pin numbers and signal names for the PES22H16G2 device.

Pin	Function	Alt	Pin	Function	Alt	Pin	Function	Alt	Pin	Function	Alt
A1	V_{SS}		B1	V_{SS}		C1	GPIO_29	2	D1	GPIO_28	2
A2	V_{SS}		B2	V_{DD}I/O		C2	GPIO_27	2	D2	GPIO_26	2
A3	GPIO_19	1	B3	GPIO_18	1	C3	GPIO_21	1	D3	V_{DD}I/O	
A4	VDDIO		B4	GPIO_17	1	C4	GPIO_16	1	D4	GPIO_23	2
A5	V_{SS}		B5	V_{SS}		C5	V_{SS}		D5	V_{SS}	
A6	NC		B6	NC		C6	V_{SS}		D6	NC	
A7	NC		B7	NC		C7	V_{SS}		D7	NC	
A8	V_{SS}		B8	V_{SS}		C8	V_{SS}		D8	V_{SS}	
A9	NC		B9	NC		C9	V_{SS}		D9	NC	
A10	PE09TP0		B10	PE09TN0		C10	V_{SS}		D10	PE09RN0	
A11	V_{SS}		B11	V_{SS}		C11	V_{SS}		D11	V_{SS}	
A12	NC		B12	NC		C12	V_{SS}		D12	NC	
A13	NC		B13	NC		C13	V_{SS}		D13	NC	
A14	V_{SS}		B14	V_{SS}		C14	V_{SS}		D14	V_{SS}	
A15	NC		B15	NC		C15	V_{SS}		D15	NC	
A16	PE08TP0		B16	PE08TN0		C16	V_{SS}		D16	PE08RN0	
A17	V_{SS}		B17	V_{SS}		C17	V_{SS}		D17	V_{SS}	
A18	NC		B18	NC		C18	V_{SS}		D18	NC	
A19	NC		B19	NC		C19	V_{SS}		D19	NC	
A20	V_{SS}		B20	V_{SS}		C20	V_{SS}		D20	V_{SS}	
A21	NC		B21	NC		C21	V_{SS}		D21	NC	
A22	PE03TP0		B22	PE03TN0		C22	V_{SS}		D22	PE03RN0	
A23	V_{SS}		B23	V_{SS}		C23	V_{SS}		D23	V_{SS}	
A24	NC		B24	NC		C24	V_{SS}		D24	NC	
A25	NC		B25	NC		C25	V_{SS}		D25	NC	
A26	V_{SS}		B26	V_{SS}		C26	V_{SS}		D26	V_{SS}	
A27	NC		B27	NC		C27	V_{SS}		D27	NC	
A28	PE02TP0		B28	PE02TN0		C28	V_{SS}		D28	PE02RN0	
A29	V_{SS}		B29	V_{SS}		C29	V_{SS}		D29	V_{SS}	
A30	VDDIO		B30	MSMBADDR3		C30	MSMBADDR4		D30	JTAG_TMS	
A31	MSMBADDR1		B31	MSMBADDR2		C31	JTAG_TDI		D31	V_{DD}I/O	
A32	MSMBSMODE		B32	PERSTN		C32	JTAG_TRST_N		D32	SSMBADDR5	
A33	V_{SS}		B33	V_{DD}I/O		C33	SSMBADDR2		D33	SSMBADDR3	
A34	V_{SS}		B34	V_{SS}		C34	SSMBADDR1		D34	V_{DD}I/O	

Table 22 PES22H16G2 1156-pin Signal Pin-Out (Part 1 of 9)

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Pin	Function	Alt	Pin	Function	Alt	Pin	Function	Alt	Pin	Function	Alt
E1	V_{DD}I/O		F1	V_{SS}		G1	PE10TP0		H1	NC	
E2	GPIO_30	2	F2	V_{SS}		G2	PE10TN0		H2	NC	
E3	GPIO_31	2	F3	V_{SS}		G3	V_{SS}		H3	V_{SS}	
E4	GPIO_24	2	F4	V_{SS}		G4	PE10RN0		H4	NC	
E5	V_{SS}		F5	V_{SS}		G5	PE10RP0		H5	NC	
E6	NC		F6	V_{SS}		G6	V_{SS}		H6	V_{SS}	
E7	NC		F7	V_{SS}		G7	GPIO_46	2	H7	GPIO_48	2
E8	V_{SS}		F8	V_{SS}		G8	GPIO_45	2	H8	GPIO_20	1
E9	NC		F9	V_{SS}		G9	V_{SS}		H9	V_{DD}I/O	
E10	PE09RP0		F10	REFRES09		G10	V_{SS}		H10	GPIO_47	2
E11	V_{SS}		F11	P09CLKP		G11	P09CLKN		H11	V_{SS}	
E12	NC		F12	V_{SS}		G12	NC		H12	V_{SS}	
E13	NC		F13	V_{SS}		G13	V_{SS}		H13	V_{DD}PEHA	
E14	V_{SS}		F14	P08CLKP		G14	P08CLKN		H14	V_{SS}	
E15	NC		F15	V_{SS}		G15	NC		H15	V_{DD}PETA	
E16	PE08RP0		F16	V_{SS}		G16	V_{SS}		H16	V_{SS}	
E17	V_{SS}		F17	REFRESPLL		G17	GCLKN0		H17	V_{SS}	
E18	NC		F18	V_{SS}		G18	GCLKP0		H18	V_{SS}	
E19	NC		F19	REFRES03		G19	NC		H19	V_{SS}	
E20	V_{SS}		F20	P03CLKP		G20	P03CLKN		H20	V_{DD}PETA	
E21	NC		F21	V_{SS}		G21	V_{SS}		H21	REFRES02	
E22	PE03RP0		F22	V_{SS}		G22	NC		H22	V_{DD}PEHA	
E23	V_{SS}		F23	P02CLKP		G23	P02CLKN		H23	V_{SS}	
E24	NC		F24	V_{SS}		G24	V_{SS}		H24	V_{SS}	
E25	NC		F25	V_{SS}		G25	V_{SS}		H25	V_{SS}	
E26	V_{SS}		F26	V_{SS}		G26	GPIO_33	2	H26	MSMBDAT	
E27	NC		F27	V_{SS}		G27	MSMBCLK		H27	V_{DD}I/O	
E28	PE02RP0		F28	V_{SS}		G28	GPIO_32	2	H28	SSMBCLK	
E29	V_{SS}		F29	V_{SS}		G29	V_{SS}		H29	V_{SS}	
E30	V_{SS}		F30	PE01RP3		G30	PE01RP2		H30	V_{SS}	
E31	V_{SS}		F31	PE01RN3		G31	PE01RN2		H31	V_{SS}	
E32	V_{SS}		F32	V_{SS}		G32	V_{SS}		H32	V_{SS}	
E33	V_{SS}		F33	PE01TN3		G33	PE01TN2		H33	V_{SS}	
E34	V_{SS}		F34	PE01TP3		G34	PE01TP2		H34	V_{SS}	

Table 22 PES22H16G2 1156-pin Signal Pin-Out (Part 2 of 9)

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Pin	Function	Alt	Pin	Function	Alt	Pin	Function	Alt	Pin	Function	Alt
J1	V_{SS}		K1	NC		L1	NC		M1	V_{SS}	
J2	V_{SS}		K2	NC		L2	NC		M2	V_{SS}	
J3	V_{SS}		K3	V_{SS}		L3	V_{SS}		M3	V_{SS}	
J4	V_{SS}		K4	NC		L4	NC		M4	V_{SS}	
J5	V_{SS}		K5	NC		L5	NC		M5	V_{SS}	
J6	GPIO_50	2	K6	V_{SS}		L6	V_{SS}		M6	V_{SS}	
J7	GPIO_51	2	K7	GPIO_53	1	L7	V_{SS}		M7	V_{SS}	
J8	V_{SS}		K8	GPIO_52	1	L8	V_{SS}		M8	V_{SS}	
J9	GPIO_25	2	K9	V_{DD}I/O		L9	V_{SS}		M9	V_{SS}	
J10	GPIO_49	2	K10	GPIO_22	2	L10	V_{SS}		M10	V_{SS}	
J11	V_{SS}		K11	V_{SS}		L11	V_{SS}		M11	V_{SS}	
J12	V_{SS}		K12	V_{SS}		L12	V_{SS}		M12	V_{SS}	
J13	V_{SS}		K13	V_{DD}PEHA		L13	V_{DD}PEA		M13	V_{DD}PEA	
J14	V_{DD}PEA		K14	V_{SS}		L14	V_{DD}PEA		M14	V_{SS}	
J15	REFRES08		K15	V_{DD}PETA		L15	V_{DD}PEA		M15	V_{DD}PEA	
J16	V_{SS}		K16	V_{SS}		L16	V_{SS}		M16	V_{SS}	
J17	V_{DD}PEHA		K17	V_{DD}PEHA		L17	V_{DD}PEA		M17	V_{DD}PEA	
J18	V_{DD}PEHA		K18	V_{DD}PEHA		L18	V_{DD}PEA		M18	V_{DD}PEA	
J19	V_{SS}		K19	V_{SS}		L19	V_{SS}		M19	V_{SS}	
J20	V_{SS}		K20	V_{DD}PETA		L20	V_{DD}PEA		M20	V_{DD}PEA	
J21	V_{DD}PEA		K21	V_{SS}		L21	V_{DD}PEA		M21	V_{SS}	
J22	V_{SS}		K22	V_{DD}PEHA		L22	V_{DD}PEA		M22	V_{DD}PEA	
J23	V_{SS}		K23	V_{SS}		L23	V_{SS}		M23	V_{SS}	
J24	V_{SS}		K24	V_{SS}		L24	V_{SS}		M24	V_{SS}	
J25	JTAG_TDO		K25	CLKMODE1		L25	V_{SS}		M25	V_{SS}	
J26	V_{DD}I/O		K26	JTAG_TCK		L26	V_{SS}		M26	V_{SS}	
J27	SSMBDAT		K27	GPIO_36	2	L27	V_{SS}		M27	V_{SS}	
J28	GPIO_34	2	K28	GPIO_35	2	L28	V_{SS}		M28	REFRES01	
J29	V_{SS}		K29	V_{SS}		L29	V_{SS}		M29	V_{SS}	
J30	PE01RP1		K30	PE01RP0		L30	V_{SS}		M30	PE00RP3	
J31	PE01RN1		K31	PE01RN0		L31	V_{SS}		M31	PE00RN3	
J32	V_{SS}		K32	V_{SS}		L32	V_{SS}		M32	V_{SS}	
J33	PE01TN1		K33	PE01TN0		L33	V_{SS}		M33	PE00TN3	
J34	PE01TP1		K34	PE01TP0		L34	V_{SS}		M34	PE00TP3	

Table 22 PES22H16G2 1156-pin Signal Pin-Out (Part 3 of 9)

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Pin	Function	Alt	Pin	Function	Alt	Pin	Function	Alt	Pin	Function	Alt
N1	PE11TP0		P1	NC		R1	V_{SS}		T1	NC	
N2	PE11TN0		P2	NC		R2	V_{SS}		T2	NC	
N3	V_{SS}		P3	V_{SS}		R3	V_{SS}		T3	V_{SS}	
N4	PE11RN0		P4	NC		R4	V_{SS}		T4	NC	
N5	PE11RP0		P5	NC		R5	V_{SS}		T5	NC	
N6	V_{SS}		P6	V_{SS}		R6	V_{SS}		T6	NC	
N7	NC		P7	P10CLKP		R7	REFRES10		T7	P11CLKP	
N8	V_{DD}PEHA		P8	P10CLKN		R8	V_{DD}PETA		T8	P11CLKN	
N9	V_{SS}		P9	V_{DD}PEA		R9	V_{SS}		T9	REFRES11	
N10	V_{DD}PEHA		P10	V_{SS}		R10	V_{DD}PETA		T10	V_{SS}	
N11	V_{DD}PEA		P11	V_{DD}PEA		R11	V_{DD}PEA		T11	V_{SS}	
N12	V_{DD}PEA		P12	V_{SS}		R12	V_{DD}PEA		T12	V_{SS}	
N13	V_{DD}CORE		P13	V_{DD}CORE		R13	V_{DD}CORE		T13	V_{SS}	
N14	V_{DD}CORE		P14	V_{SS}		R14	V_{DD}CORE		T14	V_{SS}	
N15	V_{DD}CORE		P15	V_{DD}CORE		R15	V_{SS}		T15	V_{DD}CORE	
N16	V_{SS}		P16	V_{SS}		R16	V_{DD}CORE		T16	V_{SS}	
N17	V_{DD}CORE		P17	V_{DD}CORE		R17	V_{SS}		T17	V_{DD}CORE	
N18	V_{SS}		P18	V_{SS}		R18	V_{DD}CORE		T18	V_{SS}	
N19	V_{DD}CORE		P19	V_{DD}CORE		R19	V_{SS}		T19	V_{DD}CORE	
N20	V_{DD}CORE		P20	V_{SS}		R20	V_{DD}CORE		T20	V_{SS}	
N21	V_{DD}CORE		P21	V_{DD}CORE		R21	V_{SS}		T21	V_{DD}CORE	
N22	V_{DD}CORE		P22	V_{DD}CORE		R22	V_{DD}CORE		T22	V_{DD}CORE	
N23	V_{DD}PEA		P23	V_{SS}		R23	V_{DD}PEA		T23	V_{SS}	
N24	V_{DD}PEA		P24	V_{DD}PEA		R24	V_{DD}PEA		T24	V_{SS}	
N25	V_{DD}PEHA		P25	V_{SS}		R25	V_{DD}PETA		T25	V_{SS}	
N26	V_{SS}		P26	V_{DD}PEA		R26	V_{SS}		T26	V_{SS}	
N27	V_{DD}PEHA		P27	P01CLKN		R27	V_{DD}PETA		T27	P00CLKN	
N28	NC		P28	P01CLKP		R28	V_{SS}		T28	P00CLKP	
N29	V_{SS}		P29	V_{SS}		R29	REFRES00		T29	NC	
N30	PE00RP2		P30	V_{SS}		R30	PE00RP1		T30	PE00RP0	
N31	PE00RN2		P31	V_{SS}		R31	PE00RN1		T31	PE00RN0	
N32	V_{SS}		P32	V_{SS}		R32	V_{SS}		T32	V_{SS}	
N33	PE00TN2		P33	V_{SS}		R33	PE00TN1		T33	PE00TN0	
N34	PE00TP2		P34	V_{SS}		R34	PE00TP1		T34	PE00TP0	

Table 22 PES22H16G2 1156-pin Signal Pin-Out (Part 4 of 9)

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Pin	Function	Alt	Pin	Function	Alt	Pin	Function	Alt	Pin	Function	Alt
U1	NC		V1	V_{SS}		W1	PE04TP0		Y1	NC	
U2	NC		V2	V_{SS}		W2	PE04TN0		Y2	NC	
U3	V_{SS}		V3	V_{SS}		W3	V_{SS}		Y3	V_{SS}	
U4	NC		V4	V_{SS}		W4	PE04RN0		Y4	NC	
U5	NC		V5	V_{SS}		W5	PE04RP0		Y5	NC	
U6	V_{SS}		V6	V_{SS}		W6	V_{SS}		Y6	NC	
U7	NC		V7	NC		W7	P04CLKP		Y7	REFRES04	
U8	V_{SS}		V8	V_{SS}		W8	P04CLKN		Y8	V_{DD}PETA	
U9	V_{DD}PEHA		V9	V_{DD}PEHA		W9	V_{SS}		Y9	V_{SS}	
U10	V_{DD}PEHA		V10	V_{DD}PEHA		W10	V_{SS}		Y10	V_{DD}PETA	
U11	V_{DD}PEA		V11	V_{DD}PEA		W11	V_{SS}		Y11	V_{DD}PEA	
U12	V_{DD}PEA		V12	V_{DD}PEA		W12	V_{SS}		Y12	V_{DD}PEA	
U13	V_{DD}CORE		V13	V_{SS}		W13	V_{DD}CORE		Y13	V_{DD}CORE	
U14	V_{DD}CORE		V14	V_{SS}		W14	V_{DD}CORE		Y14	V_{SS}	
U15	V_{SS}		V15	V_{DD}CORE		W15	V_{SS}		Y15	V_{DD}CORE	
U16	V_{DD}CORE		V16	V_{SS}		W16	V_{DD}CORE		Y16	V_{SS}	
U17	V_{SS}		V17	V_{DD}CORE		W17	V_{SS}		Y17	V_{DD}CORE	
U18	V_{DD}CORE		V18	V_{SS}		W18	V_{DD}CORE		Y18	V_{SS}	
U19	V_{SS}		V19	V_{DD}CORE		W19	V_{SS}		Y19	V_{DD}CORE	
U20	V_{DD}CORE		V20	V_{SS}		W20	V_{DD}CORE		Y20	V_{SS}	
U21	V_{SS}		V21	V_{DD}CORE		W21	V_{SS}		Y21	V_{DD}CORE	
U22	V_{SS}		V22	V_{DD}CORE		W22	V_{SS}		Y22	V_{DD}CORE	
U23	V_{DD}PEA		V23	V_{DD}PEA		W23	V_{SS}		Y23	V_{DD}PEA	
U24	V_{DD}PEA		V24	V_{DD}PEA		W24	V_{SS}		Y24	V_{DD}PEA	
U25	V_{DD}PEHA		V25	V_{DD}PEHA		W25	V_{SS}		Y25	V_{DD}PETA	
U26	V_{DD}PEHA		V26	V_{DD}PEHA		W26	NC		Y26	V_{SS}	
U27	V_{SS}		V27	V_{SS}		W27	P15CLKN		Y27	V_{DD}PETA	
U28	NC		V28	NC		W28	P15CLKP		Y28	V_{SS}	
U29	V_{SS}		V29	V_{SS}		W29	REFRES15		Y29	NC	
U30	V_{SS}		V30	NC		W30	NC		Y30	V_{SS}	
U31	V_{SS}		V31	NC		W31	NC		Y31	V_{SS}	
U32	V_{SS}		V32	V_{SS}		W32	V_{SS}		Y32	V_{SS}	
U33	V_{SS}		V33	NC		W33	NC		Y33	V_{SS}	
U34	V_{SS}		V34	NC		W34	NC		Y34	V_{SS}	

Table 22 PES22H16G2 1156-pin Signal Pin-Out (Part 5 of 9)

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Pin	Function	Alt	Pin	Function	Alt	Pin	Function	Alt	Pin	Function	Alt
AA1	V_{SS}		AB1	NC		AC1	NC		AD1	V_{SS}	
AA2	V_{SS}		AB2	NC		AC2	NC		AD2	V_{SS}	
AA3	V_{SS}		AB3	V_{SS}		AC3	V_{SS}		AD3	V_{SS}	
AA4	V_{SS}		AB4	NC		AC4	NC		AD4	V_{SS}	
AA5	V_{SS}		AB5	NC		AC5	NC		AD5	V_{SS}	
AA6	V_{SS}		AB6	REFRES05		AC6	V_{SS}		AD6	V_{SS}	
AA7	P05CLKP		AB7	NC		AC7	V_{SS}		AD7	V_{SS}	
AA8	P05CLKN		AB8	V_{DD}PEHA		AC8	V_{SS}		AD8	V_{SS}	
AA9	V_{DD}PEA		AB9	V_{SS}		AC9	V_{SS}		AD9	NC	
AA10	V_{SS}		AB10	V_{DD}PEHA		AC10	V_{SS}		AD10	NC	
AA11	V_{DD}PEA		AB11	V_{DD}PEA		AC11	V_{SS}		AD11	V_{SS}	
AA12	V_{SS}		AB12	V_{DD}PEA		AC12	V_{SS}		AD12	V_{SS}	
AA13	V_{DD}CORE		AB13	V_{DD}CORE		AC13	V_{DD}PEA		AD13	V_{DD}PEA	
AA14	V_{DD}CORE		AB14	V_{DD}CORE		AC14	V_{SS}		AD14	V_{DD}PEA	
AA15	V_{SS}		AB15	V_{DD}CORE		AC15	V_{DD}PEA		AD15	V_{DD}PEA	
AA16	V_{DD}CORE		AB16	V_{DD}CORE		AC16	V_{SS}		AD16	V_{SS}	
AA17	V_{SS}		AB17	V_{SS}		AC17	V_{DD}PEA		AD17	V_{DD}PEA	
AA18	V_{DD}CORE		AB18	V_{DD}CORE		AC18	V_{DD}PEA		AD18	V_{DD}PEA	
AA19	V_{SS}		AB19	V_{SS}		AC19	V_{SS}		AD19	V_{SS}	
AA20	V_{DD}CORE		AB20	V_{DD}CORE		AC20	V_{DD}PEA		AD20	V_{DD}PEA	
AA21	V_{SS}		AB21	V_{DD}CORE		AC21	V_{SS}		AD21	V_{DD}PEA	
AA22	V_{DD}CORE		AB22	V_{DD}CORE		AC22	V_{DD}PEA		AD22	V_{DD}PEA	
AA23	V_{SS}		AB23	V_{DD}PEA		AC23	V_{SS}		AD23	V_{SS}	
AA24	V_{DD}PEA		AB24	V_{DD}PEA		AC24	V_{SS}		AD24	V_{SS}	
AA25	V_{SS}		AB25	V_{DD}PEHA		AC25	V_{SS}		AD25	GPIO_39	2
AA26	V_{DD}PEA		AB26	V_{SS}		AC26	V_{SS}		AD26	GPIO_38	2
AA27	P14CLKN		AB27	V_{DD}PEHA		AC27	V_{SS}		AD27	GPIO_37	2
AA28	P14CLKP		AB28	V_{SS}		AC28	V_{SS}		AD28	V_{SS}	
AA29	REFRES14		AB29	V_{SS}		AC29	V_{SS}		AD29	V_{SS}	
AA30	NC		AB30	PE15RP0		AC30	V_{SS}		AD30	NC	
AA31	NC		AB31	PE15RN0		AC31	V_{SS}		AD31	NC	
AA32	V_{SS}		AB32	V_{SS}		AC32	V_{SS}		AD32	V_{SS}	
AA33	NC		AB33	PE15TN0		AC33	V_{SS}		AD33	NC	
AA34	NC		AB34	PE15TP0		AC34	V_{SS}		AD34	NC	

Table 22 PES22H16G2 1156-pin Signal Pin-Out (Part 6 of 9)

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Pin	Function	Alt	Pin	Function	Alt	Pin	Function	Alt	Pin	Function	Alt
AE1	PE05TP0		AF1	NC		AG1	V_{SS}		AH1	NC	
AE2	PE05TN0		AF2	NC		AG2	V_{SS}		AH2	NC	
AE3	V_{SS}		AF3	V_{SS}		AG3	V_{SS}		AH3	V_{SS}	
AE4	PE05RN0		AF4	NC		AG4	V_{SS}		AH4	NC	
AE5	PE05RP0		AF5	NC		AG5	V_{SS}		AH5	NC	
AE6	V_{SS}		AF6	V_{SS}		AG6	V_{SS}		AH6	V_{SS}	
AE7	V_{SS}		AF7	V_{SS}		AG7	CLKMODE0		AH7	CLKMODE2	
AE8	V_{DD}I/O		AF8	V_{SS}		AG8	V_{DD}I/O		AH8	GCLKFSEL	
AE9	V_{DD}I/O		AF9	V_{DD}I/O		AG9	V_{SS}		AH9	V_{SS}	
AE10	V_{DD}I/O		AF10	V_{SS}		AG10	V_{SS}		AH10	V_{SS}	
AE11	V_{SS}		AF11	V_{SS}		AG11	V_{SS}		AH11	V_{SS}	
AE12	V_{SS}		AF12	V_{SS}		AG12	V_{SS}		AH12	P06CLKN	
AE13	V_{DD}PEHA		AF13	V_{SS}		AG13	V_{DD}PEHA		AH13	V_{SS}	
AE14	V_{SS}		AF14	V_{DD}PEA		AG14	V_{SS}		AH14	REFRES06	
AE15	V_{DD}PETA		AF15	V_{SS}		AG15	V_{DD}PETA		AH15	P07CLKN	
AE16	V_{SS}		AF16	V_{SS}		AG16	V_{SS}		AH16	NC	
AE17	V_{DD}PEHA		AF17	V_{DD}PEHA		AG17	V_{SS}		AH17	GCLKP1	
AE18	V_{DD}PEHA		AF18	V_{DD}PEHA		AG18	V_{SS}		AH18	GCLKN1	
AE19	V_{SS}		AF19	V_{SS}		AG19	V_{SS}		AH19	V_{SS}	
AE20	V_{DD}PETA		AF20	V_{SS}		AG20	V_{DD}PETA		AH20	REFRES12	
AE21	V_{SS}		AF21	V_{DD}PEA		AG21	NC		AH21	P12CLKN	
AE22	V_{DD}PEHA		AF22	V_{SS}		AG22	V_{DD}PEHA		AH22	NC	
AE23	V_{SS}		AF23	V_{SS}		AG23	V_{SS}		AH23	REFRES13	
AE24	V_{SS}		AF24	V_{SS}		AG24	V_{SS}		AH24	P13CLKN	
AE25	GPIO_06		AF25	GPIO_42	2	AG25	GPIO_44	2	AH25	V_{SS}	
AE26	V_{DD}I/O		AF26	GPIO_09	1	AG26	V_{DD}I/O		AH26	V_{SS}	
AE27	GPIO_40	2	AF27	GPIO_41	2	AG27	GPIO_04	1	AH27	V_{SS}	
AE28	V_{SS}		AF28	V_{SS}		AG28	GPIO_43	2	AH28	V_{SS}	
AE29	V_{SS}		AF29	V_{SS}		AG29	V_{SS}		AH29	V_{SS}	
AE30	NC		AF30	V_{SS}		AG30	NC		AH30	PE14RP0	
AE31	NC		AF31	V_{SS}		AG31	NC		AH31	PE14RN0	
AE32	V_{SS}		AF32	V_{SS}		AG32	V_{SS}		AH32	V_{SS}	
AE33	NC		AF33	V_{SS}		AG33	NC		AH33	PE14TN0	
AE34	NC		AF34	V_{SS}		AG34	NC		AH34	PE14TP0	

Table 22 PES22H16G2 1156-pin Signal Pin-Out (Part 7 of 9)

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Pin	Function	Alt	Pin	Function	Alt	Pin	Function	Alt	Pin	Function	Alt
AJ1	NC		AK1	V_{SS}		AL1	V_{DD}I/O		AM1	V_{DD}I/O	
AJ2	NC		AK2	V_{SS}		AL2	P01MERGEN		AM2	V_{DD}I/O	
AJ3	V_{SS}		AK3	V_{SS}		AL3	V_{DD}I/O		AM3	V_{DD}I/O	
AJ4	NC		AK4	V_{SS}		AL4	V_{DD}I/O		AM4	V_{DD}I/O	
AJ5	NC		AK5	V_{SS}		AL5	V_{DD}I/O		AM5	SWMODE3	
AJ6	V_{SS}		AK6	V_{SS}		AL6	V_{SS}		AM6	V_{SS}	
AJ7	V_{SS}		AK7	PE06RP0		AL7	PE06RN0		AM7	V_{SS}	
AJ8	V_{SS}		AK8	NC		AL8	NC		AM8	V_{SS}	
AJ9	V_{SS}		AK9	V_{SS}		AL9	V_{SS}		AM9	V_{SS}	
AJ10	V_{SS}		AK10	NC		AL10	NC		AM10	V_{SS}	
AJ11	V_{SS}		AK11	NC		AL11	NC		AM11	V_{SS}	
AJ12	P06CLKP		AK12	V_{SS}		AL12	V_{SS}		AM12	V_{SS}	
AJ13	V_{SS}		AK13	PE07RP0		AL13	PE07RN0		AM13	V_{SS}	
AJ14	NC		AK14	NC		AL14	NC		AM14	V_{SS}	
AJ15	P07CLKP		AK15	V_{SS}		AL15	V_{SS}		AM15	V_{SS}	
AJ16	REFRES07		AK16	NC		AL16	NC		AM16	V_{SS}	
AJ17	V_{SS}		AK17	NC		AL17	NC		AM17	V_{SS}	
AJ18	V_{SS}		AK18	V_{SS}		AL18	V_{SS}		AM18	V_{SS}	
AJ19	V_{SS}		AK19	PE12RP0		AL19	PE12RN0		AM19	V_{SS}	
AJ20	V_{SS}		AK20	NC		AL20	NC		AM20	V_{SS}	
AJ21	P12CLKP		AK21	V_{SS}		AL21	V_{SS}		AM21	V_{SS}	
AJ22	V_{SS}		AK22	NC		AL22	NC		AM22	V_{SS}	
AJ23	V_{SS}		AK23	NC		AL23	NC		AM23	V_{SS}	
AJ24	P13CLKP		AK24	V_{SS}		AL24	V_{SS}		AM24	V_{SS}	
AJ25	V_{SS}		AK25	PE13RP0		AL25	PE13RN0		AM25	V_{SS}	
AJ26	V_{SS}		AK26	NC		AL26	NC		AM26	V_{SS}	
AJ27	V_{SS}		AK27	V_{SS}		AL27	V_{SS}		AM27	V_{SS}	
AJ28	V_{SS}		AK28	NC		AL28	NC		AM28	V_{SS}	
AJ29	V_{SS}		AK29	NC		AL29	NC		AM29	V_{SS}	
AJ30	V_{SS}		AK30	V_{SS}		AL30	V_{SS}		AM30	V_{SS}	
AJ31	V_{SS}		AK31	GPIO_08	1	AL31	GPIO_07		AM31	GPIO_00	1
AJ32	V_{SS}		AK32	GPIO_15	1	AL32	V_{DD}I/O		AM32	GPIO_05	2
AJ33	V_{SS}		AK33	GPIO_14	1	AL33	GPIO_10	1	AM33	GPIO_11	1
AJ34	V_{SS}		AK34	V_{DD}I/O		AL34	GPIO_12	1	AM34	GPIO_13	1

Table 22 PES22H16G2 1156-pin Signal Pin-Out (Part 8 of 9)

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Pin	Function	Alt	Pin	Function	Alt	Pin	Function	Alt	Pin	Function	Alt
AN1	V_{SS}		AN18	V_{SS}		AP1	V_{SS}		AP18	V_{SS}	
AN2	V_{DD}I/O		AN19	PE12TN0		AP2	V_{SS}		AP19	PE12TP0	
AN3	V_{DD}I/O		AN20	NC		AP3	RSTHALT		AP20	NC	
AN4	SWMODE0		AN21	V_{SS}		AP4	SWMODE1		AP21	V_{SS}	
AN5	SWMODE2		AN22	NC		AP5	V_{DD}I/O		AP22	NC	
AN6	V_{SS}		AN23	NC		AP6	V_{SS}		AP23	NC	
AN7	PE06TN0		AN24	V_{SS}		AP7	PE06TP0		AP24	V_{SS}	
AN8	NC		AN25	PE13TN0		AP8	NC		AP25	PE13TP0	
AN9	V_{SS}		AN26	NC		AP9	V_{SS}		AP26	NC	
AN10	NC		AN27	V_{SS}		AP10	NC		AP27	V_{SS}	
AN11	NC		AN28	NC		AP11	NC		AP28	NC	
AN12	V_{SS}		AN29	NC		AP12	V_{SS}		AP29	NC	
AN13	PE07TN0		AN30	V_{SS}		AP13	PE07TP0		AP30	V_{SS}	
AN14	NC		AN31	GPIO_01	1	AP14	NC		AP31	V_{DD}I/O	
AN15	V_{SS}		AN32	GPIO_02	1	AP15	V_{SS}		AP32	GPIO_03	1
AN16	NC		AN33	V_{DD}I/O		AP16	NC		AP33	V_{SS}	
AN17	NC		AN34	V_{SS}		AP17	NC		AP34	V_{SS}	

Table 22 PES22H16G2 1156-pin Signal Pin-Out (Part 9 of 9)

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Alternate Signal Functions

Pin	GPIO	1st Alternate	2nd Alternate	Pin	GPIO	1st Alternate	2nd Alternate
AM31	GPIO_00	PART0PERSTN	—	D1	GPIO_28	HP2PDN	P4LINKUPN
AN31	GPIO_01	PART1PERSTN	—	C1	GPIO_29	HP2PFN	P4ACTIVEN
AN32	GPIO_02	PART2PERSTN	—	E2	GPIO_30	HP2PWRGDN	P5LINKUPN
AP32	GPIO_03	PART3PERSTN		E3	GPIO_31	HP2MRLN	P5ACTIVEN
AG27	GPIO_04	—	P0LINKUPN	G28	GPIO_32	HP2AIN	P6LINKUPN
AM32	GPIO_05	GPEN	P0ACTIVEN	G26	GPIO_33	HP2PIN	P6ACTIVEN
AK31	GPIO_08	IOEXPINTN	—	J28	GPIO_34	HP2PEP	P7LINKUPN
AF26	GPIO_09	HP0APN	—	K28	GPIO_35	HP2RSTN	P7ACTIVEN
AL33	GPIO_10	HP0PDN	—	K27	GPIO_36	HP3APN	P8LINKUPN
AM33	GPIO_11	HP0PFN	—	AD27	GPIO_37	HP3PDN	P8ACTIVEN
AL34	GPIO_12	HP0PWRGDN	—	AD26	GPIO_38	HP3PFN	P9LINKUPN
AM34	GPIO_13	HP0MRLN	—	AD25	GPIO_39	HP3PWRGDN	P9ACTIVEN
AK33	GPIO_14	HP0AIN	—	AE27	GPIO_40	HP3MRLN	P10LINKUPN
AK32	GPIO_15	HP0PIN	—	AF27	GPIO_41	HP3AIN	P10ACTIVEN
C4	GPIO_16	HP0PEP	—	AF25	GPIO_42	HP3PIN	P11LINKUPN
B4	GPIO_17	HP0RSTN	—	AG28	GPIO_43	HP3PEP	P11ACTIVEN
B3	GPIO_18	HP1APN	—	AG25	GPIO_44	HP3RSTN	P12LINKUPN
A3	GPIO_19	HP1PDN	—	G8	GPIO_45	HP4APN	P12ACTIVEN
H8	GPIO_20	HP1PFN	—	G7	GPIO_46	HP4PDN	P13LINKUPN
C3	GPIO_21	HP1PWRGDN	—	H10	GPIO_47	HP4PFN	P13ACTIVEN
K10	GPIO_22	HP1MRLN	P1LINKUPN	H7	GPIO_48	HP4PWRGDN	P14LINKUPN
D4	GPIO_23	HP1AIN	P1ACTIVEN	J10	GPIO_49	HP4MRLN	P14ACTIVEN
E4	GPIO_24	HP1PIN	P2LINKUPN	J6	GPIO_50	HP4AIN	P15LINKUPN
J9	GPIO_25	HP1PEP	P2ACTIVEN	J7	GPIO_51	HP4PIN	P15ACTIVEN
D2	GPIO_26	HP1RSTN	P3LINKUPN	K8	GPIO_52	HP4PEP	—
C2	GPIO_27	HP2APN	P3ACTIVEN	K7	GPIO_53	HP4RSTN	—

Table 23 PES22H16G2 Alternate Signal Functions

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No Connection Pins

NC									
A6	B19	E9	K2	U1	Y4	AD30	AH4	AK28	AN17
A7	B21	E12	K4	U2	Y5	AD31	AH5	AK29	AN20
A9	B24	E13	K5	U4	Y6	AD33	AH16	AL8	AN22
A12	B25	E15	L1	U5	Y29	AD34	AH22	AL10	AN23
A13	B27	E18	L2	U7	AA30	AE30	AJ1	AL11	AN26
A15	D6	E19	L4	U28	AA31	AE31	AJ2	AL14	AN28
A18	D7	E21	L5	V7	AA33	AE33	AJ4	AL16	AN29
A19	D9	E24	N7	V28	AA34	AE34	AJ5	AL17	AP8
A21	D12	E25	N28	V30	AB1	AF1	AJ14	AL20	AP10
A24	D13	E27	P1	V31	AB2	AF2	AK8	AL22	AP11
A25	D15	G12	P2	V33	AB4	AF4	AK10	AL23	AP14
A27	D18	G15	P4	V34	AB5	AF5	AK11	AL26	AP16
B6	D19	G19	P5	W26	AB7	AG21	AK14	AL28	AP17
B7	D21	G22	T1	W30	AC1	AG30	AK16	AL29	AP20
B9	D24	H1	T2	W31	AC2	AG31	AK17	AN8	AP22
B12	D25	H2	T4	W33	AC4	AG33	AK20	AN10	AP23
B13	D27	H4	T5	W34	AC5	AG34	AK22	AN11	AP26
B15	E6	H5	T6	Y1	AD9	AH1	AK23	AN14	AP28
B18	E7	K1	T29	Y2	AD10	AH2	AK26	AN16	AP29

Table 24 PES22H16G2 No Connection

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Power Pins

V_{DD}Core	V_{DD}Core	V_{DD}I/O	V_{DD}I/O	V_{DD}PEA	V_{DD}PEA	V_{DD}PEHA	V_{DD}PETA
N13	V15	A4	AG8	J14	V11	H13	H15
N14	V17	A30	AG26	J21	V12	H22	H20
N15	V19	B2	AK34	L13	V23	J17	K15
N17	V21	B33	AL1	L14	V24	J18	K20
N19	V22	D3	AL3	L15	Y11	K13	R8
N20	W13	D31	AL4	L17	Y12	K17	R10
N21	W14	D34	AL5	L18	Y23	K18	R25
N22	W16	E1	AL32	L20	Y24	K22	R27
P13	W18	H9	AM1	L21	AA9	N8	Y8
P15	W20	H27	AM2	L22	AA11	N10	Y10
P17	Y13	J26	AM3	M13	AA24	N25	Y25
P19	Y15	K9	AM4	M15	AA26	N27	Y27
P21	Y17	AE8	AN2	M17	AB11	U9	AE15
P22	Y19	AE9	AN3	M18	AB12	U10	AE20
R13	Y21	AE10	AN33	M20	AB23	U25	AG15
R14	Y22	AE26	AP5	M22	AB24	U26	AG20
R16	AA13	AF9	AP31	N11	AC13	V9	
R18	AA14			N12	AC15	V10	
R20	AA16			N23	AC17	V25	
R22	AA18			N24	AC18	V26	
T15	AA20			P9	AC20	AB8	
T17	AA22			P11	AC22	AB10	
T19	AB13			P24	AD13	AB25	
T21	AB14			P26	AD14	AB27	
T22	AB15			R11	AD15	AE13	
U13	AB16			R12	AD17	AE17	
U14	AB18			R23	AD18	AE18	
U16	AB20			R24	AD20	AE22	
U18	AB21			U11	AD21	AF17	
U20	AB22			U12	AD22	AF18	
				U23	AF14	AG13	
				U24	AF21	AG22	

Table 25 PES22H16G2 Power Pins

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Ground Pins

V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}
A1	C16	E33	G32	J32	M1	P14
A2	C17	E34	H3	K3	M2	P16
A5	C18	F1	H6	K6	M3	P18
A8	C19	F2	H11	K11	M4	P20
A11	C20	F3	H12	K12	M5	P23
A14	C21	F4	H14	K14	M6	P25
A17	C22	F5	H16	K16	M7	P29
A20	C23	F6	H17	K19	M8	P30
A23	C24	F7	H18	K21	M9	P31
A26	C25	F8	H19	K23	M10	P32
A29	C26	F9	H23	K24	M11	P33
A33	C27	F12	H24	K29	M12	P34
A34	C28	F13	H25	K32	M14	R1
B1	C29	F15	H29	L3	M16	R2
B5	D5	F16	H30	L6	M19	R3
B8	D8	F18	H31	L7	M21	R4
B11	D11	F21	H32	L8	M23	R5
B14	D14	F22	H33	L9	M24	R6
B17	D17	F24	H34	L10	M25	R9
B20	D20	F25	J1	L11	M26	R15
B23	D23	F26	J2	L12	M27	R17
B26	D26	F27	J3	L16	M29	R19
B29	D29	F28	J4	L19	M32	R21
B34	E5	F29	J5	L23	N3	R26
C5	E8	F32	J8	L24	N6	R28
C6	E11	G3	J11	L25	N9	R32
C7	E14	G6	J12	L26	N16	T3
C8	E17	G9	J13	L27	N18	T10
C9	E20	G10	J16	L28	N26	T11
C10	E23	G13	J19	L29	N29	T12
C11	E26	G16	J20	L30	N32	T13
C12	E29	G21	J22	L31	P3	T14
C13	E30	G24	J23	L32	P6	T16
C14	E31	G25	J24	L33	P10	T18
C15	E32	G29	J29	L34	P12	T20

Table 26 PES22H16G2 Ground Pins (Part 1 of 3)

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V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}
T23	W9	AA21	AD2	AF13	AH10	AK4
T24	W10	AA23	AD3	AF15	AH11	AK5
T25	W11	AA25	AD4	AF16	AH13	AK6
T26	W12	AA32	AD5	AF19	AH19	AK9
T32	W15	AB3	AD6	AF20	AH25	AK12
U3	W17	AB9	AD7	AF22	AH26	AK15
U6	W19	AB17	AD8	AF23	AH27	AK18
U8	W21	AB19	AD11	AF24	AH28	AK21
U15	W22	AB26	AD12	AF28	AH29	AK24
U17	W23	AB28	AD16	AF29	AH32	AK27
U19	W24	AB29	AD19	AF30	AJ3	AK30
U21	W25	AB32	AD23	AF31	AJ6	AL6
U22	W32	AC3	AD24	AF32	AJ7	AL9
U27	Y3	AC6	AD28	AF33	AJ8	AL12
U29	Y9	AC7	AD29	AF34	AJ9	AL15
U30	Y14	AC8	AD32	AG1	AJ10	AL18
U31	Y16	AC9	AE3	AG2	AJ11	AL21
U32	Y18	AC10	AE6	AG3	AJ13	AL24
U33	Y20	AC11	AE7	AG4	AJ17	AL27
U34	Y26	AC12	AE11	AG5	AJ18	AL30
V1	Y28	AC14	AE12	AG6	AJ19	AM6
V2	Y30	AC16	AE14	AG9	AJ20	AM7
V3	Y31	AC19	AE16	AG10	AJ22	AM8
V4	Y32	AC21	AE19	AG11	AJ23	AM9
V5	Y33	AC23	AE21	AG12	AJ25	AM10
V6	Y34	AC24	AE23	AG14	AJ26	AM11
V8	AA1	AC25	AE24	AG16	AJ27	AM12
V13	AA2	AC26	AE28	AG17	AJ28	AM13
V14	AA3	AC27	AE29	AG18	AJ29	AM14
V16	AA4	AC28	AE32	AG19	AJ30	AM15
V18	AA5	AC29	AF3	AG23	AJ31	AM16
V20	AA6	AC30	AF6	AG24	AJ32	AM17
V27	AA10	AC31	AF7	AG29	AJ33	AM18
V29	AA12	AC32	AF8	AG32	AJ34	AM19
V32	AA15	AC33	AF10	AH3	AK1	AM20
W3	AA17	AC34	AF11	AH6	AK2	AM21
W6	AA19	AD1	AF12	AH9	AK3	AM22

Table 26 PES22H16G2 Ground Pins (Part 2 of 3)

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V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}
AM23	AM28	AN9	AN24	AP2	AP18	AP33
AM24	AM29	AN12	AN27	AP6	AP21	AP34
AM25	AM30	AN15	AN30	AP9	AP24	
AM26	AN1	AN18	AN34	AP12	AP27	
AM27	AN6	AN21	AP1	AP15	AP30	

Table 26 PES22H16G2 Ground Pins (Part 3 of 3)

Signals Listed Alphabetically

Signal Name	I/O Type	Location	Signal Category
CLKMODE0	I	AG7	System
CLKMODE1	I	K25	
CLKMODE2	I	AH7	
GCLKFSEL	I	AH8	
GCLKN0	I	G17	
GCLKN1	I	AH18	
GCLKP0	I	G18	
GCLKP1	I	AH17	
GPIO_00	I/O	AM31	General Purpose I/O
GPIO_01	I/O	AN31	
GPIO_02	I/O	AN32	
GPIO_03	I/O	AP32	
GPIO_04	I/O	AG27	
GPIO_05	I/O	AM32	
GPIO_06	I/O	AE25	
GPIO_07	I/O	AL31	
GPIO_08	I/O	AK31	
GPIO_09	I/O	AF26	
GPIO_10	I/O	AL33	
GPIO_11	I/O	AM33	
GPIO_12	I/O	AL34	
GPIO_13	I/O	AM34	
GPIO_14	I/O	AK33	
GPIO_15	I/O	AK32	
GPIO_16	I/O	C4	
GPIO_17	I/O	B4	

Table 27 89PES22H16G2 Alphabetical Signal List (Part 1 of 7)

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Signal Name	I/O Type	Location	Signal Category
GPIO_18	I/O	B3	General Purpose I/O (cont.)
GPIO_19	I/O	A3	
GPIO_20	I/O	H8	
GPIO_21	I/O	C3	
GPIO_22	I/O	K10	
GPIO_23	I/O	D4	
GPIO_24	I/O	E4	
GPIO_25	I/O	J9	
GPIO_26	I/O	D2	
GPIO_27	I/O	C2	
GPIO_28	I/O	D1	
GPIO_29	I/O	C1	
GPIO_30	I/O	E2	
GPIO_31	I/O	E3	
GPIO_32	I/O	G28	
GPIO_33	I/O	G26	
GPIO_34	I/O	J28	
GPIO_35	I/O	K28	
GPIO_36	I/O	K27	
GPIO_37	I/O	AD27	
GPIO_38	I/O	AD26	
GPIO_39	I/O	AD25	
GPIO_40	I/O	AE27	
GPIO_41	I/O	AF27	
GPIO_42	I/O	AF25	
GPIO_43	I/O	AG28	
GPIO_44	I/O	AG25	
GPIO_45	I/O	G8	
GPIO_46	I/O	G7	
GPIO_47	I/O	H10	
GPIO_48	I/O	H7	
GPIO_49	I/O	J10	
GPIO_50	I/O	J6	
GPIO_51	I/O	J7	
GPIO_52	I/O	K8	
GPIO_53	I/O	K7	

Table 27 89PES22H16G2 Alphabetical Signal List (Part 2 of 7)

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Signal Name	I/O Type	Location	Signal Category
JTAG_TCK	I	K26	Test
JTAG_TDI	I	C31	
JTAG_TDO	O	J25	
JTAG_TMS	I	D30	
JTAG_TRST_N	I	C32	
MSMBADDR_1	I	A31	SMBus Interface
MSMBADDR_2	I	B31	
MSMBADDR_3	I	B30	
MSMBADDR_4	I	C30	
MSMBCLK	I/O	G27	
MSMBDAT	I/O	H26	
MSMBSMODE	I	A32	System
NO CONNECTION	See Table 24 for a listing of No Connect pins.		
P00CLKN	I	T27	PCI Express
P01CLKN	I	P27	
P02CLKN	I	G23	
P03CLKN	I	G20	
P04CLKN	I	W8	
P05CLKN	I	AA8	
P06CLKN	I	AH12	
P07CLKN	I	AH15	
P08CLKN	I	G14	
P09CLKN	I	G11	
P10CLKN	I	P8	
P11CLKN	I	T8	
P12CLKN	I	AH21	
P13CLKN	I	AH24	
P14CLKN	I	AA27	
P15CLKN	I	W27	
P00CLKP	I	T28	
P01CLKP	I	P28	
P02CLKP	I	F23	
P03CLKP	I	F20	
P04CLKP	I	W7	
P05CLKP	I	AA7	
P06CLKP	I	AJ12	

Table 27 89PES22H16G2 Alphabetical Signal List (Part 3 of 7)

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Signal Name	I/O Type	Location	Signal Category
P07CLKP	I	AJ15	PCI Express (cont.)
P08CLKP	I	F14	
P09CLKP	I	F11	
P10CLKP	I	P7	
P11CLKP	I	T7	
P12CLKP	I	AJ21	
P13CLKP	I	AJ24	
P14CLKP	I	AA28	
P15CLKP	I	W28	
P01MERGEN	I	AL2	System
PE00RN0	I	T31	PCI Express
PE00RN1	I	R31	
PE00RN2	I	N31	
PE00RN3	I	M31	
PE00RP0	I	T30	
PE00RP1	I	R30	
PE00RP2	I	N30	
PE00RP3	I	M30	
PE00TN0	O	T33	
PE00TN1	O	R33	
PE00TN2	O	N33	
PE00TN3	O	M33	
PE00TP0	O	T34	
PE00TP1	O	R34	
PE00TP2	O	N34	
PE00TP3	O	M34	
PE00RN0	I	K31	
PE01RN1	I	J31	
PE01RN2	I	G31	
PE01RN3	I	F31	
PE01RP0	I	K30	
PE01RP1	I	J30	
PE01RP2	I	G30	
PE01RP3	I	F30	
PE01TN0	O	K33	
PE01TN1	O	J33	

Table 27 89PES22H16G2 Alphabetical Signal List (Part 4 of 7)

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Signal Name	I/O Type	Location	Signal Category
PE01TN2	O	G33	PCI Express (cont.)
PE01TN3	O	F33	
PE01TP0	O	K34	
PE01TP1	O	J34	
PE01TP2	O	G34	
PE01TP3	O	F34	
PE02RN0	I	D28	
PE02RP0	I	E28	
PE02TN0	O	B28	
PE02TP0	O	A28	
PE03RN0	I	D22	
PE03RP0	I	E22	
PE03TN0	O	B22	
PE03TP0	O	A22	
PE04RN0	I	W4	
PE04RP0	I	W5	
PE04TN0	O	W2	
PE04TP0	O	W1	
PE05RN0	I	AE4	
PE05RP0	I	AE5	
PE05TN0	O	AE2	
PE05TP0	O	AE1	
PE06RN0	I	AL7	
PE06RP0	I	AK7	
PE06TN0	O	AN7	
PE06TP0	O	AP7	
PE07RN0	I	AL13	
PE07RP0	I	AK13	
PE07TN0	O	AN13	
PE07TP0	O	AP13	
PE08RN0	I	D16	
PE08RP0	I	E16	
PE08TN0	O	B16	
PE08TP0	O	A16	
PE09RN0	I	D10	
PE09RP0	I	E10	

Table 27 89PES22H16G2 Alphabetical Signal List (Part 5 of 7)

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Signal Name	I/O Type	Location	Signal Category
PE09TN0	O	B10	PCI Express (cont.)
PE09TP0	O	A10	
PE10RN0	I	G4	
PE10RP0	I	G5	
PE10TN0	O	G2	
PE10TP0	O	G1	
PE11RN0	I	N4	
PE11RP0	I	N5	
PE11TN0	O	N2	
PE11TP0	O	N1	
PE12RN0	I	AL19	
PE12RP0	I	AK19	
PE12TN0	O	AN19	
PE12TP0	O	AP19	
PE13RN0	I	AL25	
PE13RP0	I	AK25	
PE13TN0	O	AN25	
PE13TP0	O	AP25	
PE14RN0	I	AH31	
PE14RP0	I	AH30	
PE14TN0	O	AH33	
PE14TP0	O	AH34	
PE15RN0	I	AB31	
PE15RP0	I	AB30	
PE15TN0	O	AB33	
PE15TP0	O	AB34	
PERSTN	I	B32	System
REFRES00	I/O	R29	SerDes Reference Resistors
REFRES01	I/O	M28	
REFRES02	I/O	H21	
REFRES03	I/O	F19	
REFRES04	I/O	Y7	
REFRES05	I/O	AB6	
REFRES06	I/O	AH14	
REFRES07	I/O	AJ16	
REFRES08	I/O	J15	

Table 27 89PES22H16G2 Alphabetical Signal List (Part 6 of 7)

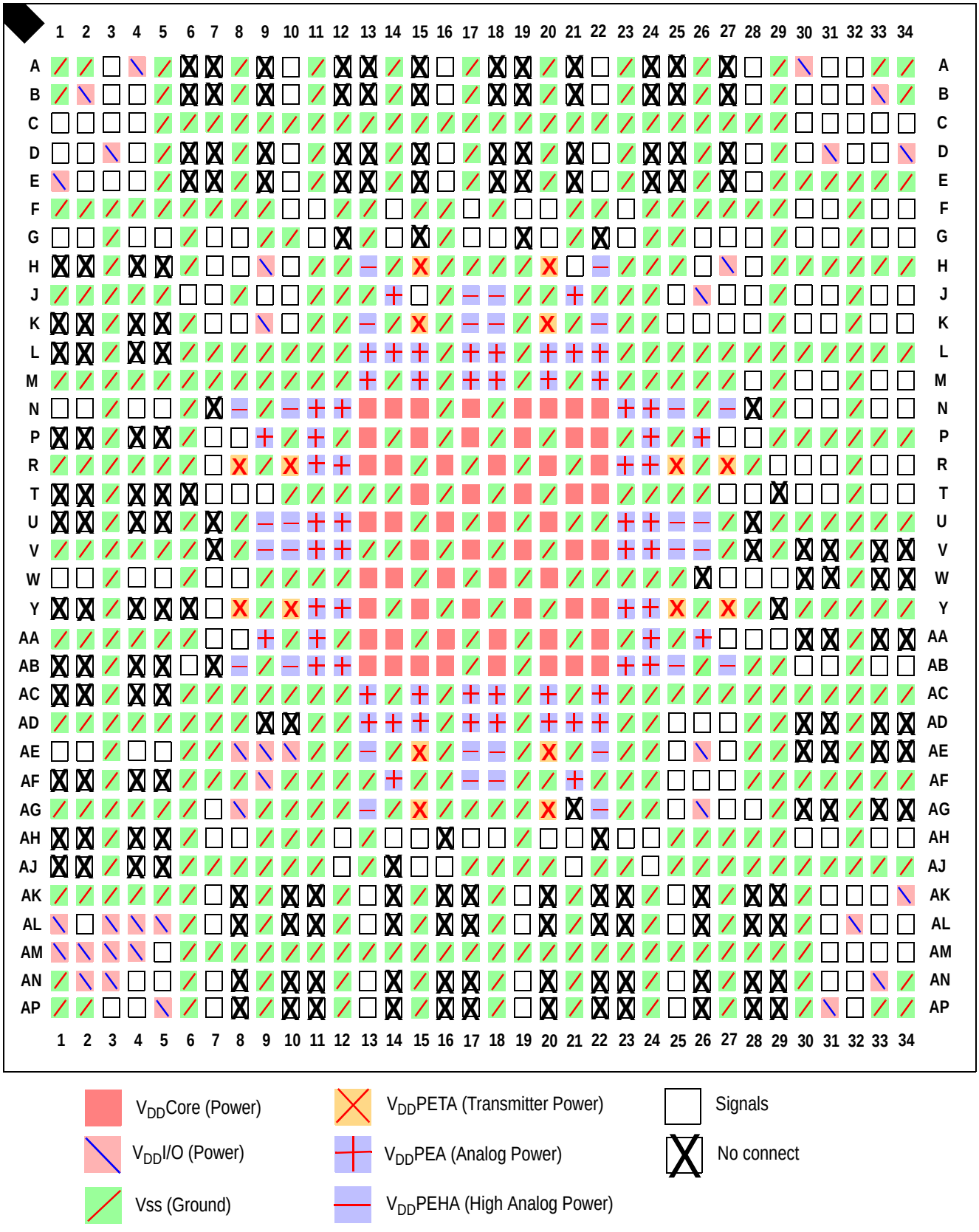
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Signal Name	I/O Type	Location	Signal Category
REFRES09	I/O	F10	SerDes Reference Resistors (cont.)
REFRES10	I/O	R7	
REFRES11	I/O	T9	
REFRES12	I/O	AH20	
REFRES13	I/O	AH23	
REFRES14	I/O	AA29	
REFRES15	I/O	W29	
REFRESPLL	I/O	F17	
RSTHALT	I	AP3	System
SSMBADDR_1	I	C34	SMBus Interface
SSMBADDR_2	I	C33	
SSMBADDR_3	I	D33	
SSMBADDR_5	I	D32	
SSMBCLK	I/O	H28	
SSMBDAT	I/O	J27	
SWMODE_0	I	AN4	System
SWMODE_1	I	AP4	
SWMODE_2	I	AN5	
SWMODE_3	I	AM5	
V_{DD}CORE, V_{DD}I/O, V_{DD}PEA, V_{DD}PEHA, V_{DD}PETA	See Table 25 for a listing of power pins.		
V_{SS}	See Table 26 for a listing of ground pins.		

Table 27 89PES22H16G2 Alphabetical Signal List (Part 7 of 7)

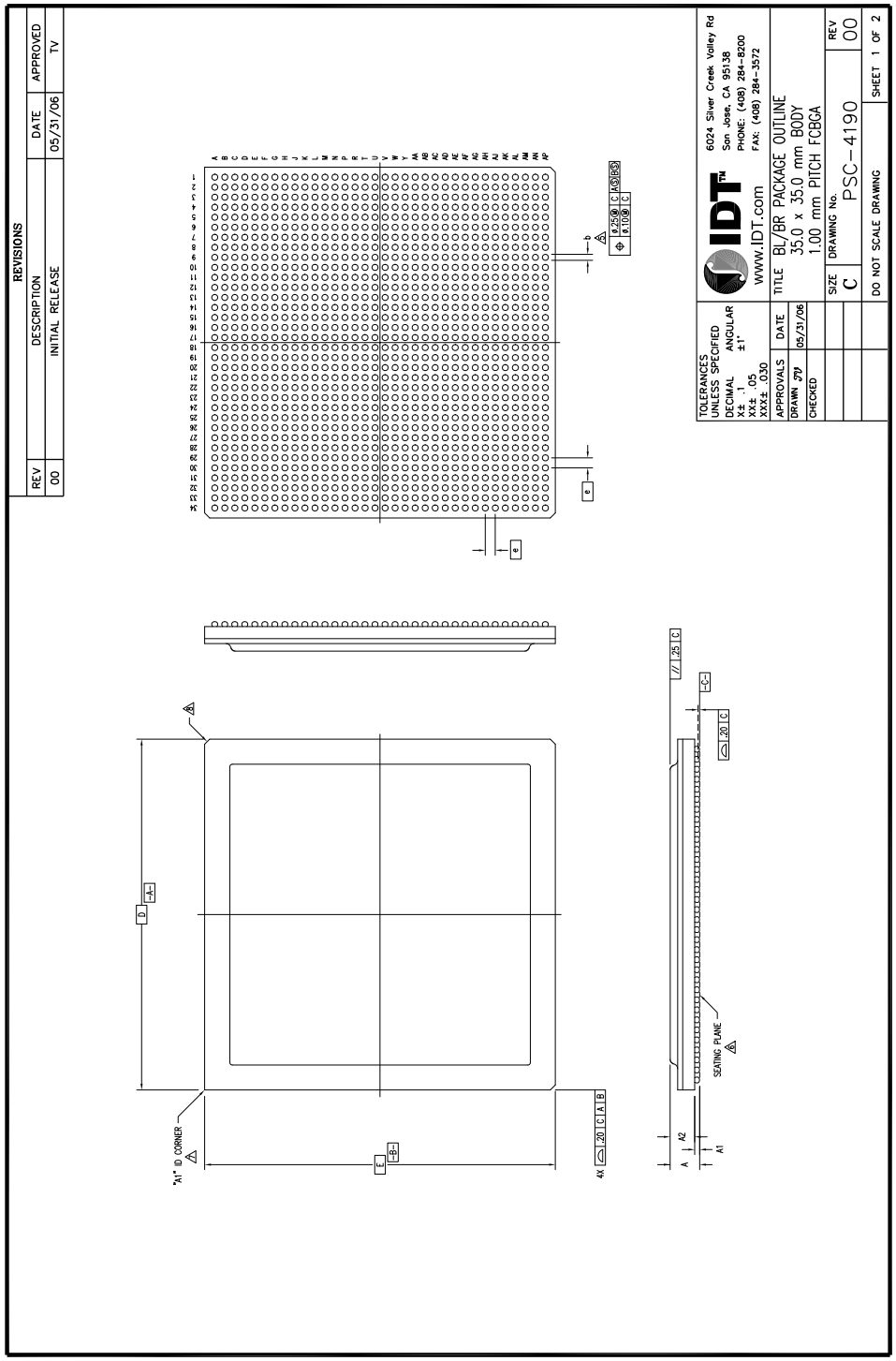
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PES22H16G2 Pinout — Top View



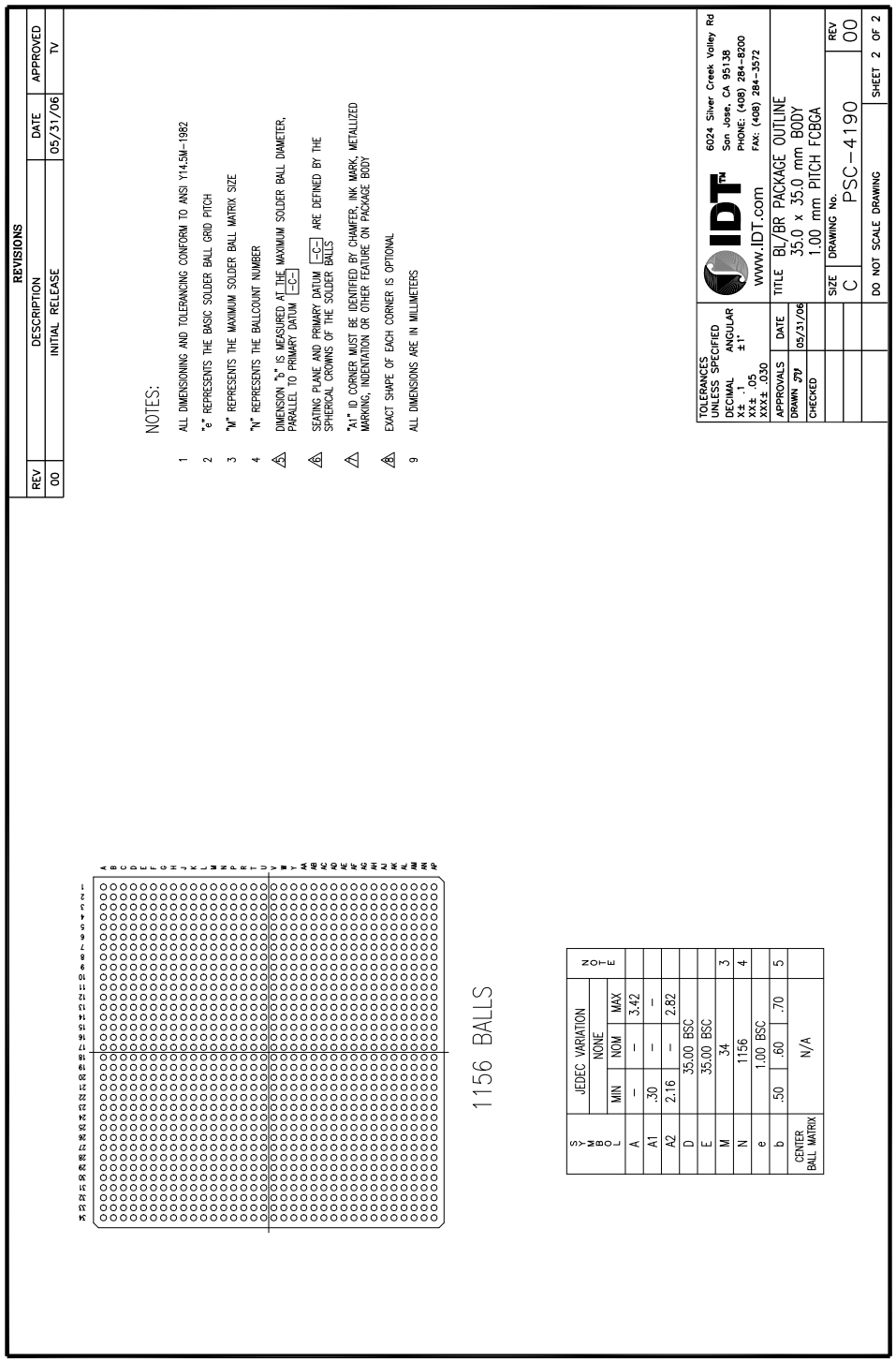
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PES22H16G2 Package Drawing — 1156-Pin BL1156/BR1156



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PES22H16G2 Package Drawing — Page Two



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Revision History

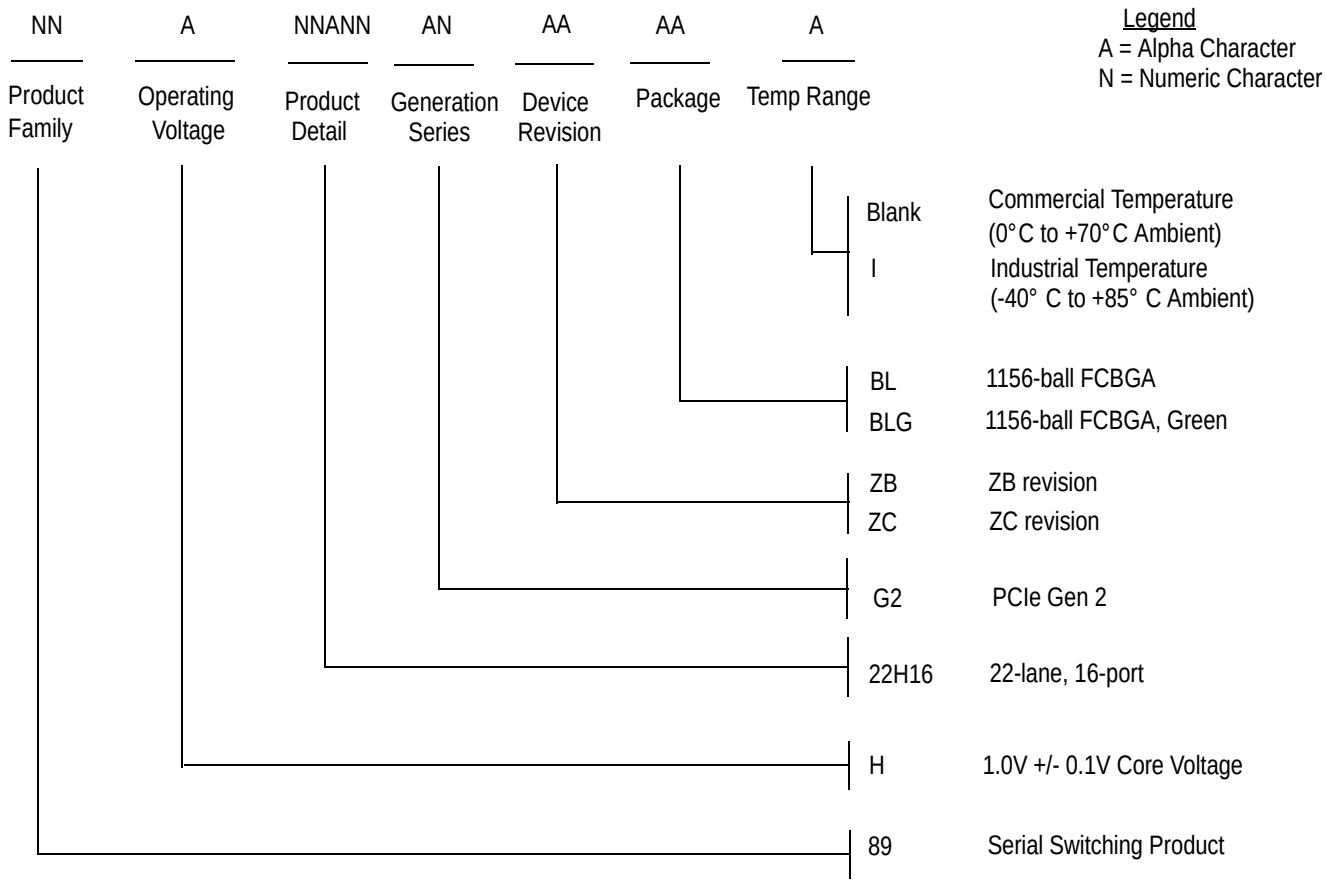
January 21, 2010: Publication of Final data sheet.

March 30, 2011: In Table 13, added V_{DD}PETA to footnote #1.

November 28, 2011: Added new Tables 20 and 21, SMBus Characterization and Timing.

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Ordering Information



Valid Combinations

89H22H16G2ZBBL	1156-ball FCBGA package, Commercial Temperature
89H22H16G2ZBBLG	1156-ball Green FCBGA package, Commercial Temperature
89H22H16G2ZBBLI	1156-ball FCBGA package, Industrial Temperature
89H22H16G2ZBBLGI	1156-ball Green FCBGA package, Industrial Temperature
89H22H16G2ZCBL	1156-ball FCBGA package, Commercial Temperature
89H22H16G2ZCBLG	1156-ball Green FCBGA package, Commercial Temperature
89H22H16G2ZCBLI	1156-ball FCBGA package, Industrial Temperature
89H22H16G2ZCBLGI	1156-ball Green FCBGA package, Industrial Temperature

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Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

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