PEX 8509

Features

■ PEX 8509 General Features
- ○ 8-lane PCI Express switch
  - − PCIe Gen 1 (2.5Gbps) Integrated SerDes
- ○ Up to eight ports (x1, x2, x4)
- ○ 15mm x 15mm, 196-ball PBGA pkg.
- ○ Typical Power: 1.2 Watts

■ PEX 8509 Key Features
- ○ **Standards Compliant**
  - − PCI Express Base Specification, r1.1
  - − PCI Power Management Interface Specification r1.2
- ○ **High Performance**
  - − Cut-through with low packet latency
  - − Max Payload Size of 1024 Bytes
  - − Non-blocking switch fabric
  - − Full line rate on all ports
- ○ **Flexible Configuration**
  - − 8 flexible and configurable ports (x1, x2 or x4)
  - − Lane and polarity reversal
  - − Configurable through I^{2}C, Host software, EEPROM or strapping pins
- ○ **PCI Express Power Management**
  - − Link power management states: L0, L0s, L1, L2/L3 Ready, and L3
  - − Device states: D0 and D3hot
- ○ **Quality of Service (QoS)**
  - − One Virtual Channel per port
  - − Eight Traffic Classes per port
  - − Weighted Round-Robin Ingress Port Arbitration
- ○ **Reliability, Availability, Serviceability**
  - − 3 standard Hot-Plug controllers supporting PCI SHPC spec r1.0
  - − Transaction layer end-to-end CRC
  - − Poison bit support
  - − Basic and Advanced Error Reporting support
  - − Per port error diagnostics
    - • Bad DLLPs
    - • Bad TLPs
    - • CRC errors and more
  - − Fatal Error (FATAL_ERR#) signal (legacy SERR equivalent)
  - − INTA# signal
  - − Port status bits
  - − Eight software controllable General Purpose Output (GPO) signals
  - − JTAG boundary scan

Flexible & Versatile PCI Express® Switch

Low-Power 8-Lane, 8-Port *ExpressLane*™ PCIe Switch
The PEX 8509 device offers PCI Express switching capability conforming to the PCI Express Base specification revision 1.1. This device enables users to add scalable high bandwidth, non-blocking interconnects at the lowest cost to a wide variety of applications including communications platforms, consumer products, servers, storage systems, blade servers, industrial systems and embedded-control products. The PEX 8509 can be used as a **fan-out**, **aggregation**, or **peer-to-peer** switch, and is well-suited for **Control Plane Applications, Docking Stations, DVRs, Multi-Function Printers, Industrial Control Systems, Medical Imaging Systems, Embedded Systems** and **AMC** modules.

Port Configurations
The PEX 8509 offers eight lanes and up to eight ports supporting x1, x2 and x4 lane widths. The ports can be configured for **symmetric** (each port having the same lane width and traffic load) or **asymmetric** (ports having different lane widths). In the event of asymmetric traffic, the PEX 8509 features a **flexible central packet memory** that allocates a memory buffer for each port as required by the application or endpoint. This buffer allocation along with the device's **flexible packet flow control** minimizes bottlenecks when the upstream and aggregated downstream bandwidths do not match (are asymmetric).

High Performance
The PEX 8509 architecture supports packet **cut-thru with low latency (118ns).** This, combined with large packet memory **(up to 1024 byte maximum payload size)** and **non-blocking internal switch architecture**, provides **full line rate** on all ports for performance hungry applications such as docking stations, control planes, embedded systems and AMC modules.

End-to-End Packet Integrity
The PEX 8509 provides **end-to-end CRC** protection (ECRC) and **Poison-bit support** to enable designs that require **end-to-end data integrity**. These features are optional in the PCI Express specification, but PLX provides them across its entire *ExpressLane* switch product line.

Configuration Flexibility
The PEX 8509 provides several ways to configure its operations. The device can be configured through strapping pins, **I^{2}C interface**, CPU configuration cycles, or an optional serial EEPROM. This allows for easy debug during the development phase, performance monitoring during the operation phase, and driver or software upgrade.

Interoperability
The PEX 8509 is designed to be fully compliant with the PCI-SIG PCI Express base specification revision 1.1. Additionally, it supports **auto-negotiation**, **lane reversal**, and **polarity reversal**. The PEX 8509 also undergoes extensive Interoperability testing in PLX's **Interoperability Lab.**

Low Power with Granular SerDes Control
The PEX 8509 provides **low power capability** that is fully compliant with the PCI Express power management specification. For even lower power, the SerDes physical links can be programmed for desired power or turned off when unused.

Port Configurations

The lane width of each port can be individually configured through auto-negotiation, hardware strapping, host software configuration, I²C interface, or through an optional EEPROM.

The PEX 8509 supports 4 port configurations:
1) One x1 upstream port and seven x1 downstream ports
2) One x2 upstream port and six x1 downstream ports
3) One x2 upstream port and the downstream ports as one x2 and four x1
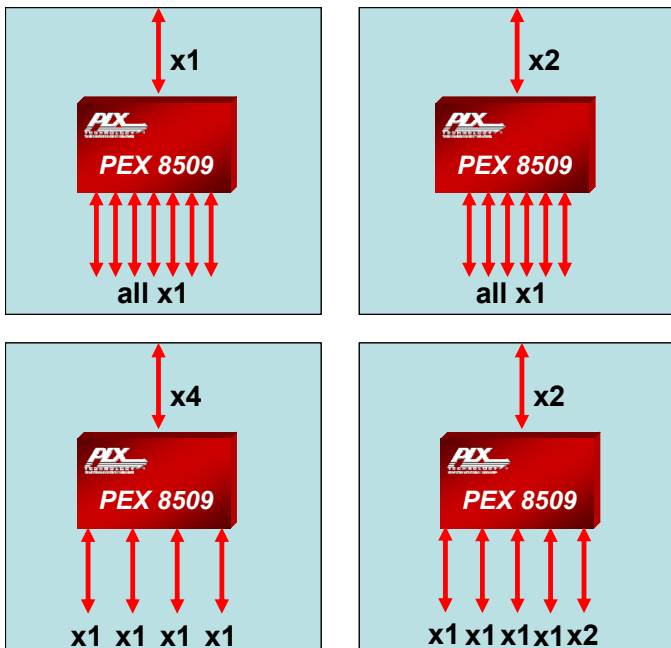4) One x4 upstream port and four x1 downstream ports

Figure 1. Port Configurations

For eight-lane configurations not shown in Figure 1, please use the PEX 8508 device which offers more configuration options in an 8-lane switch.

Hot Plug for High Availability

Hot Plug capability allows users to replace hardware modules and perform maintenance without powering down the system. The PEX 8509 **Hot Plug** capability and **Advanced Error Reporting** features make it suitable for **High Availability (HA) applications**. Ports 1, 2 & 3 include a **Standard Hot Plug Controller**. If the PEX 8509 is used in an application where one or more of its downstream ports connect to PCI Express slots, Hot Plug Controllers on the three downstream ports can be used to manage the hot plug event of its associated slot.

Fully Compliant Power Management

For applications that require power management, the ExpressLane PEX 8509 devices support both link (L0, L0s, L1, L2/L3 Ready, and L3) and device (D0 and D3hot) power management states, in compliance with the PCI Express power management specification.

SerDes Power and Signal Management

The ExpressLane PEX 8509 supports **software control** of the **SerDes outputs** to allow optimization of power and signal strength in a system. The PLX SerDes implementation supports four levels of power – off, low, typical, and high. The SerDes block also supports **loop-back modes** and **advanced reporting of error conditions**, which enables efficient debug and management of the entire system.

Port Arbitration

The PEX 8509 switch supports hardware fixed and **Weighted Round-Robin Ingress Port Arbitration**. This allows fine tuning of Quality of Service and efficient use of packet buffers and the system bandwidth.

Applications

Suitable for **docking stations, control plane applications, multi-function printers, DVRs, industrial control systems, medical imaging systems, embedded systems & AMC modules,** the PEX 8509 can be configured for a wide variety of form factors and applications.

Docking Station

The PEX 8509 is the most cost-effective PCI Express switch that can be used in a docking station application. Figure 2 shows four x1 downstream ports connecting two PCIe end-points, a Network Card and an ExpressCard to a single x4 upstream port. The PEX 8509's Hot-Plug feature is extremely useful for the plugging/un-plugging of ExpressCards.
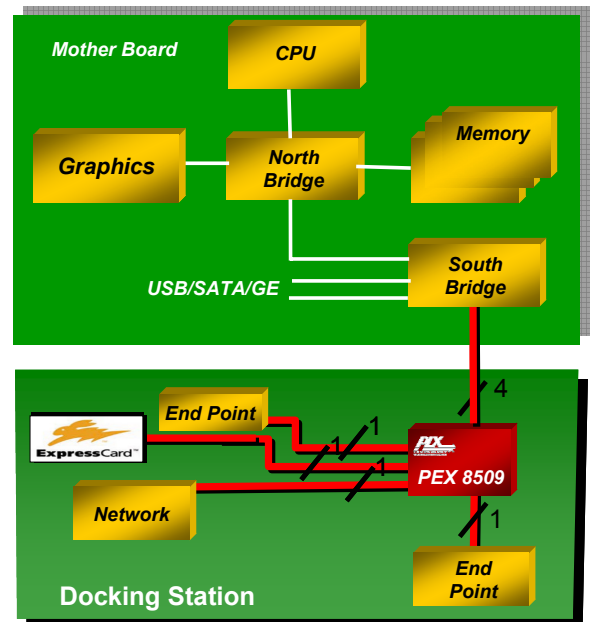

Figure 2. Docking Station

Adapter Card Aggregation

The number and variety of PCI Express native-mode devices is growing quickly. As these devices become mainstream, it will be necessary to create multi-function and multi-port adapter cards with PCI Express capability.

The PEX 8509 can be used to create an adapter or mezzanine card that aggregates the PCI Express devices into a single port that can be plugged into a backplane or a motherboard. Figure 3 shows the PEX 8509 in this application.
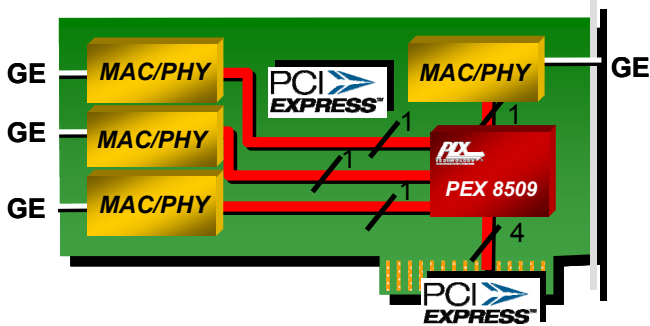

Figure 3. Aggregation Adapter Card

Control Plane Application

The PEX 8509 is ideal for migrating existing PCI control planes in routers to high-speed PCI Express interface to meet increased packet processing needs. Figure 4 shows a controller card with a PEX 8509 connecting the Control Processor to as many as seven line cards each via a x1 port. This usage model provides connectivity to multiple line cards giving the processor control over a large number of line cards in mid-range routers.
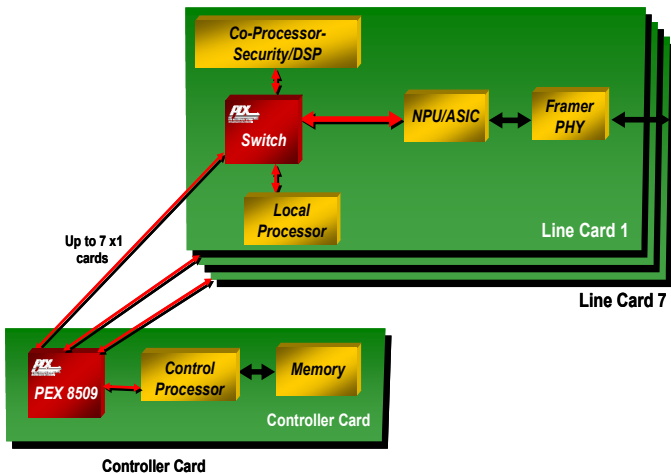

Figure 4. Control Plane

Control Planes For Larger Systems

For larger systems that need more than 8 ports, two PEX 8509 devices can be linked together to provide up to 14 ports. Figure 5 shows such an application. The two PEX 8509 devices together provide connectivity for up to 13 line cards each via an x1 link. The Control Processor connected to a PEX 8509 via an x1 port on the controller card in this example can control up to 13 different line cards.
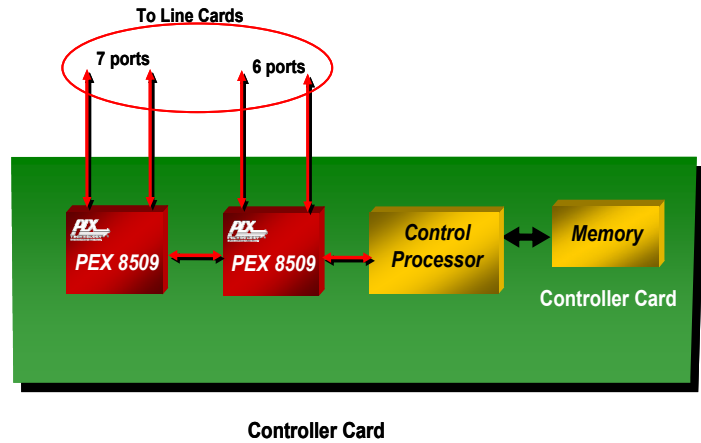

Figure 5. Control Plane for Large Systems

Redundant Control Plane Applications

For those systems that need redundant control planes, the PEX 8509 can be used in conjunction with the PEX 8508 which supports Non-Transparent bridging. With the NT port, the PEX 8508 can connect to a redundant control card providing fail-over support. An added benefit of the PEX 8509 & PEX 8508 combination design is the increased fan-out capability – it is now possible to connect a total of 9 line cards to the controller card.
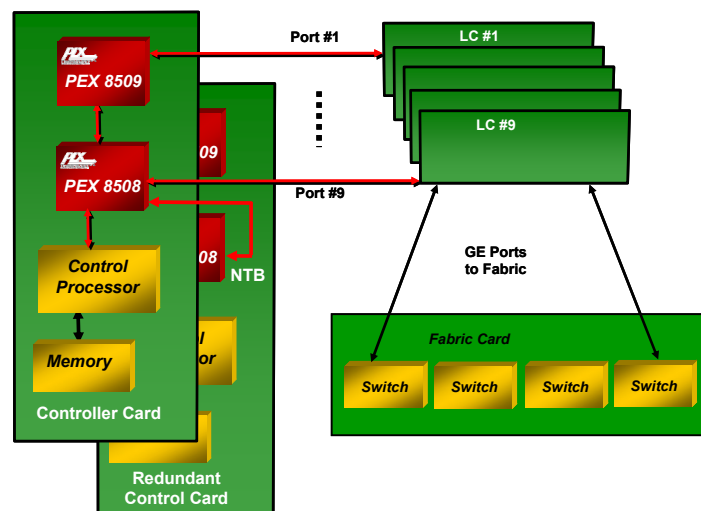

Figure 6. Redundant Control Plane

Software Usage Model

From a system model viewpoint, each PCI Express port is a virtual PCI to PCI bridge device with its own set of PCI Express configuration registers. It is through the upstream port that the BIOS or host can configure the other ports using standard PCI enumeration. The virtual PCI to PCI bridges within the PEX 8509 are compliant to the PCI and PCI Express system models. The Configuration Space Registers (CSRs) in a virtual primary/secondary PCI to PCI Bridge are accessible by type 0 configuration cycles through the virtual primary bus interface (matching bus number, device number, and function number).

Interrupt Sources/Events

The ExpressLane PEX 8509 switch supports the INTx interrupt message type (compatible with the PCI 2.3 Interrupt signals) or Message Signaled Interrupts (MSI) when enabled. Interrupts/messages are generated by the PEX 8509 for hot plug events, baseline error reporting, and advanced error reporting.

Development Tools

PLX offers the PEX 8509RDK which includes hardware and software tools to enable rapid customer design activity. These tools consist of a hardware module, hardware documentation and a Software Development Kit (SDK).

ExpressLane™ PEX 8509RDK

The RDK hardware module includes the PEX 8509 with one upstream x4 port and four downstream x1 ports.

The PEX 8509RDK hardware module can be installed in a motherboard, used as a riser card, or configured as a bench-top board.

The PEX 8509RDK can be used to test and validate customer software. Additionally, it can be used as an evaluation vehicle for the PEX 8509 features and benefits.

SDK

The SDK tool set includes:
- Linux and Windows drivers
- C/C++ Source code, Objects, libraries
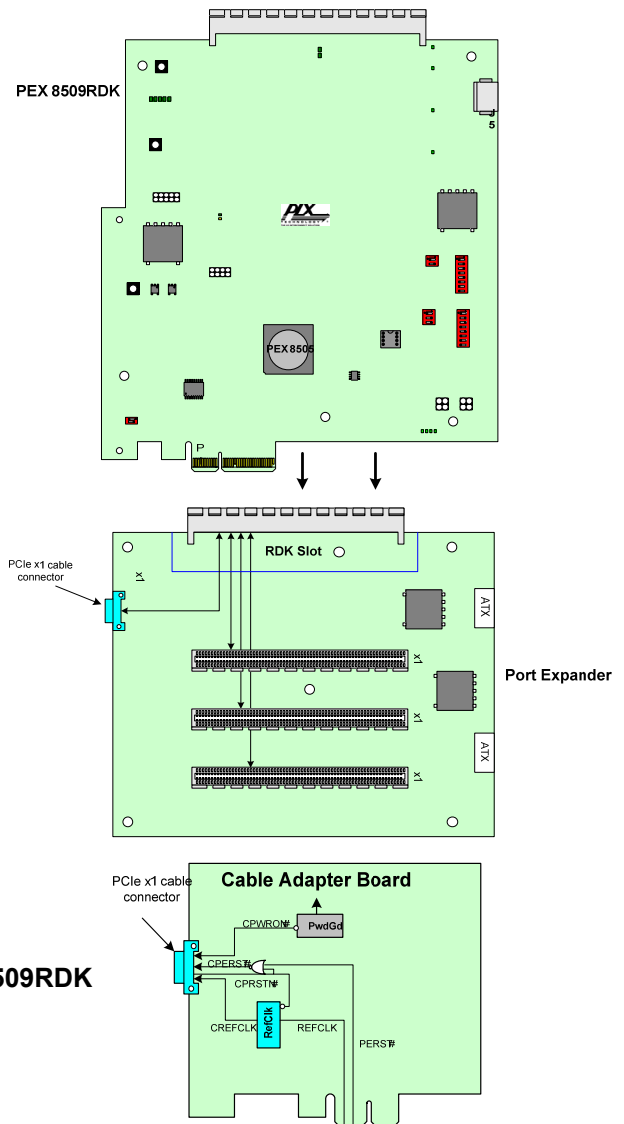- User's Guides, Application examples, Tutorial

Figure 7. PEX 8509RDK

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Product Ordering Information

Part Number	Description
PEX 8509-AA25BI	8-Lane, 8-port PCI Express Switch
PEX 8509-AA25BI G	8-Lane, 8-port PCI Express Switch Pb-Free
PEX 8509RDK-4	PEX 8509 Rapid Development Kit with x4 connector (5 ports)
PEX 8509RDK-1	PEX 8509 Rapid Development Kit with port expander (8 ports)

Please visit the PLX Web site at www.plxtech.com or contact PLX sales at 408-774-9060 for sampling.