

POSSIBILITIES OF COMMUNICATION.
MADE EASY.

**For extremely high communications reliability
in radiation environments**

Serializer Deserializer

Industry challenges

The industry continues to increase requirements for faster and better data communications in space environments. From point-to-point sensor applications to networking an entire satellite, reliable communications with high bandwidth are imperative. Performance, with lower power consumption and 10 times faster than existing technology, fewer wires and less weight is also an expectation.

Honeywell's response

Honeywell responds to these challenges with our unsurpassed reliability for Gigabit Data Communications and Networks in Space Applications.

For both board level packaged parts and macrocells for Application Specific Integrated Circuits (ASICs), Honeywell Serializer Deserializers (SERDES) are designed for extremely high communications reliability in radiation environments. SERDES have proven compatibility with communication protocols including Serial Rapid IO, Gigabit Ethernet, and Fibre Channel. SERDES are also designed for direct point to point links and have been demonstrated to be compatible with other industry SERDES products and field-programmable gate array (FPGA) platforms. Serial communications with higher data rates reduce power, wires and weight over existing solutions.

SERDES Benefits

- **Internet data rates:** Rates of 1.0 to 3.125 Gb/s per channel supporting multiple standards
- **QML V Qualified:** First SERDES Qualified Manufacturers List (QML) V Qualified product in 2008
- **Reliable in radiation environments:** Low jitter phase-locked loop (PLL) and Transmitter, exceptional Receiver sensitivity, and a SERDES that continues to perform in SEE environments (no PLL unlock, no lanes down, no latchup)
- **Flexible:** SERDES are programmable for peak data throughput and the lowest power consumption

Standard Products

There are two standard products, the HXSRD01 and HXSRD02, which share a common SERDES physical layer but support slightly different applications, including communication protocols, and slightly different parallel interfaces. Below is a list of the key, unique features of the two products; Select the appropriate product that will meet your system requirements.

Feature	HXSRD01 Trivor	HXSRD02 Slider
Number of SERDES lanes	Quad Redundant SERDES (8 lanes)	4 Lanes
Communication Protocol	Gigabit Ethernet and Fibre Channel Protocol	Serial Rapid IO protocol and protocol bypass
Parallel Interface	8/10 bit parallel interface, 2.5V SSTL2	16/20 bit parallel interface, 2.5V SSTL2
Package (pin count)	468 CGA Package	467 CGA Package

The control and operation of the two parts share many common items, including control for optimizing performance:

- Data Rate of 1.0 to 3.125Gb/s
- 4 Lane XAUI capability for 10Gb/s operation
- 1.8V core power supply, 2.5V parallel interface power supply
- Independent Lane Control including on/off control for minimal power consumption
- Programmable Tx Output Amplitude and Pre-Emphasis
- Programmable Rx Equalization and Loss-of-Signal
- Integrated 8b10b encoder and decoder
- Integrated Clock and Data Recovery
- Package size and technology
- -55°C to +125°C

HX5000 ASICs and Structured Array with SERDES

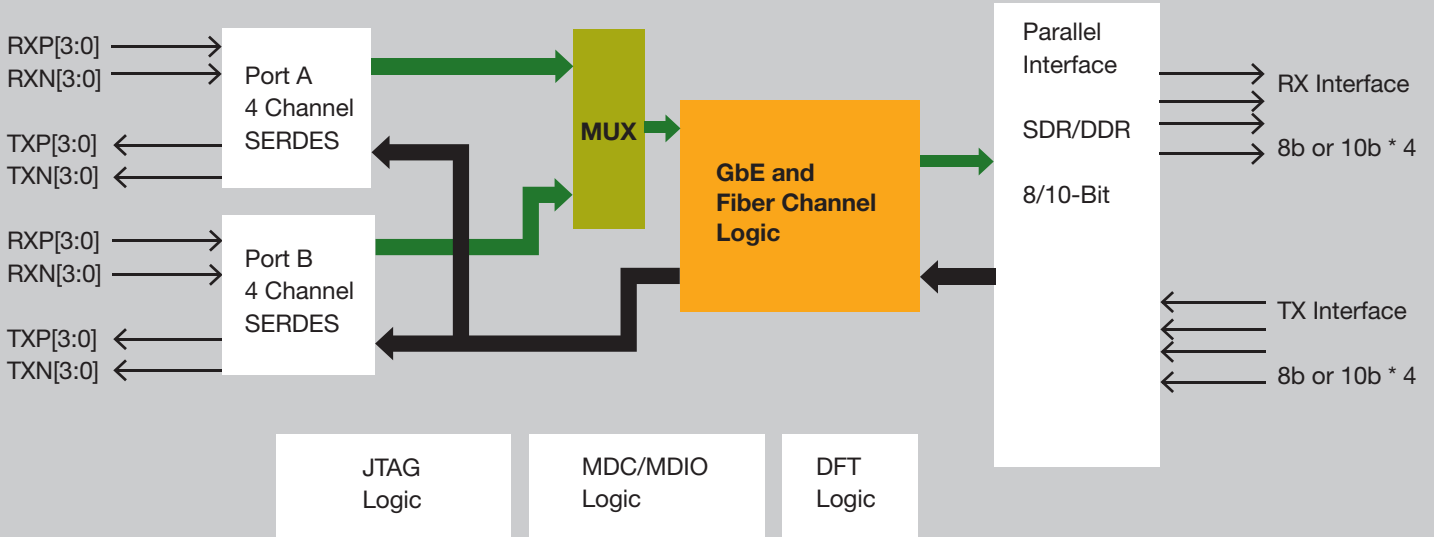
SERDES can be implemented in HX5000 Standard Cell ASICs and are integrated into the HX5SA13 Structured Array to enable a number of high bandwidth communication solutions. This can range from high speed point-to-point links, to the creation of networks with switches and endpoints.

HX5SA13 Structured Array with SERDES

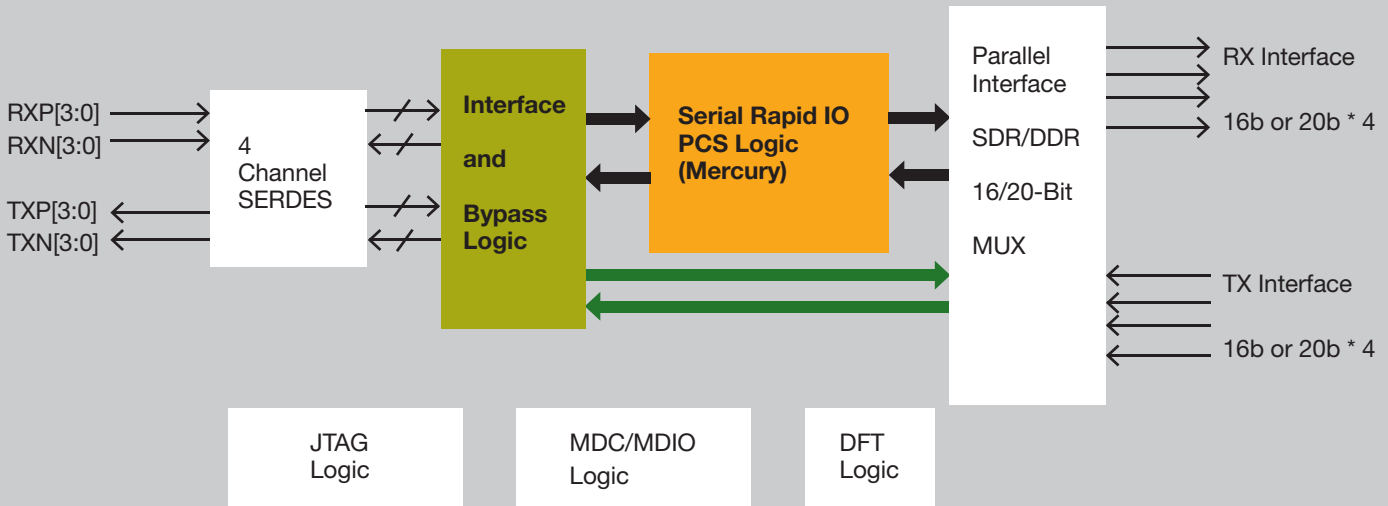
The HX5SA 13 Structured Array contains 16 lanes of SERDES. They are configured as two groups of 8 lanes so there are two separate PLLs and Clock Management Units (CMU).

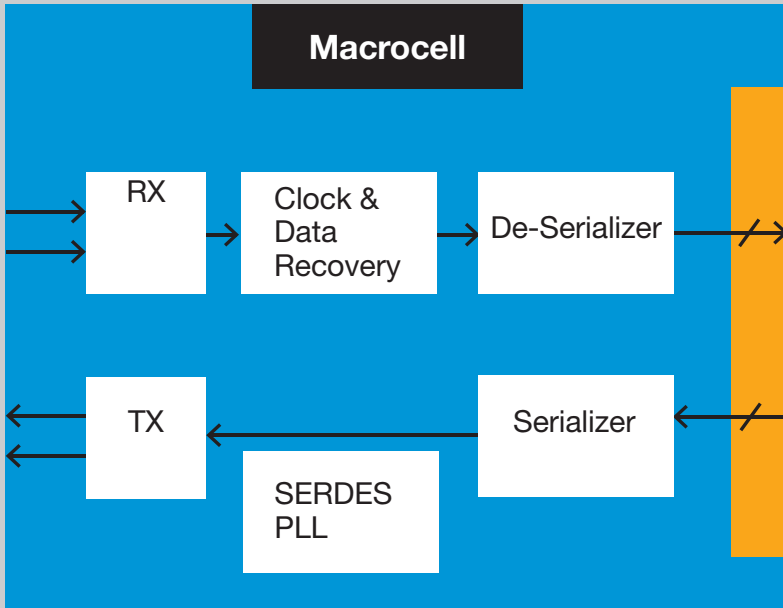


HXSRD01 Trivor Block Diagram



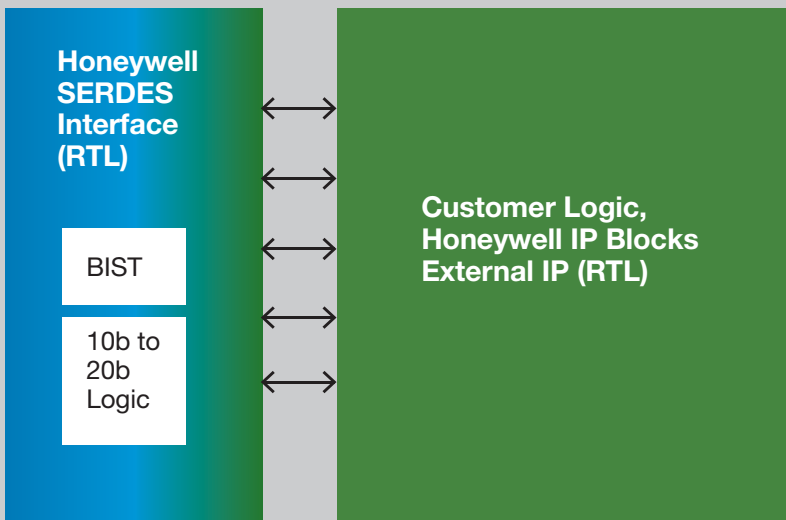
HXSRD02 Slider Block Diagram





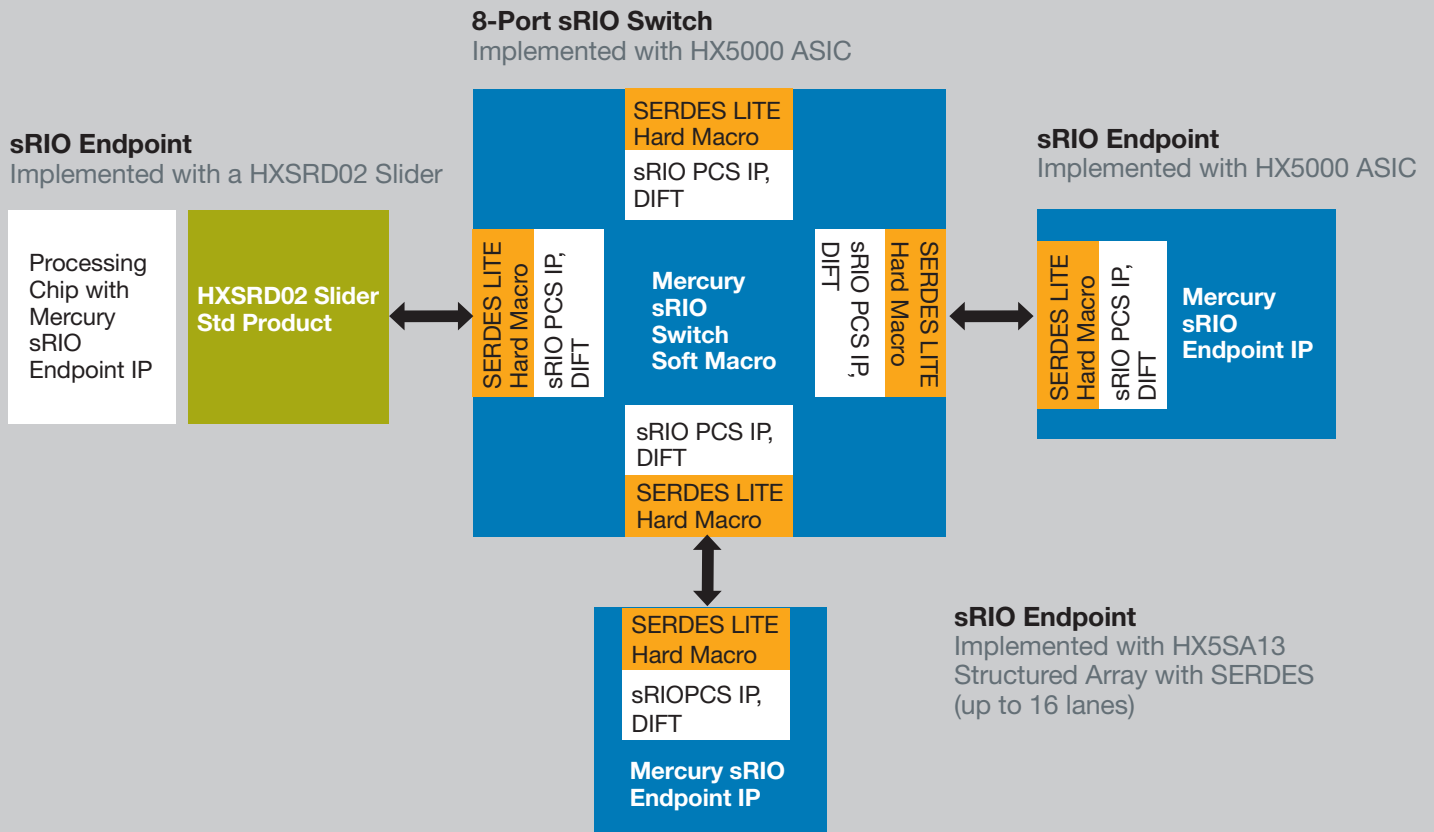
Both 4 lane and 8 lanes HX5000 SERDES macrocells can be instantiated with to create systems with 32 – 40 lanes (power dissipation can become a limiting factor). The interface to the core logic includes specialized high speed parallel interface logic and Built in Self-Test (BIST) logic.

An ASIC provides the flexibility for low overhead communication links like point to point. In these systems, a full communication networking protocol may not be necessary and the customer can implement their application specific protocol in the ASIC logic.



Possible Network Implementation

(for illustration purposes only)



Multiport Switches and Endpoints are common in communication network applications and a more direct “transmitter to receiver” configuration is used for applications like image sensors data processing.

Tested Performance

Characterization and Qualification

The SERDES went through an extensive characterization and qualification process leading to being QML V qualified in 2008. A summary of key performance parameters is summarized below.

Independent Functional Verification

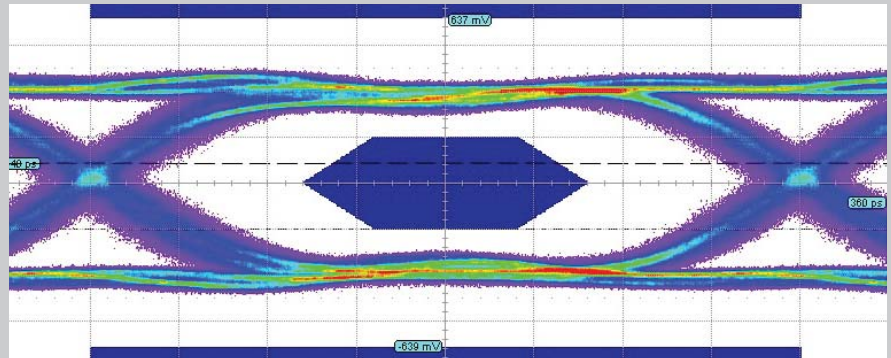
The HXSRD01 Trivor was functionality validated with the industry standards 1G Ethernet, XAUI 10G Ethernet, 1G and 2G and XAUI 10G Fibre Channel at the University of New Hampshire Inter-Operability Lab.

Bit Error Ratio and Jitter Testing

Verification of Bit Error Ratio (BER) and Jitter over temperature, voltage and data rate demonstrated BER much lower than $1E-12$ and a jitter tolerance of better than 0.7UI eye closure.

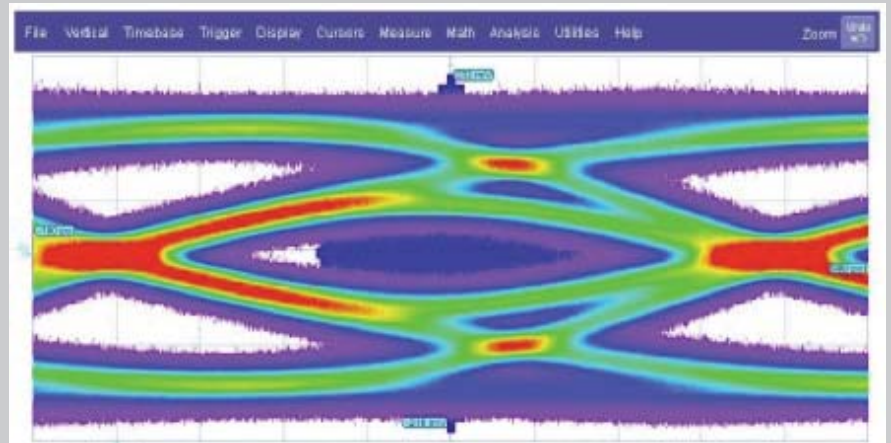
Robust Performance

One benefit of the Silicon on Insulator Complementary metal-oxide-semiconductor (SOI CMOS) technology is the low noise process. The transistors are isolated from the bulk silicon substrate which minimizes cross-circuit signal coupling. This leads to a SERDES Transmitter with very low jitter. Shown below is the transmitter output at 3.125Gb/s, 1.7V, 125C, and 100 foot coaxial cable.



High Sensitivity SERDES Receiver

The Receiver is capable of receiving data and delivering a Bit Error Ratio (BER) that is better than $1E-12$ BER @ 3.125 Gb/s with an eye that is ~85% closed (shown below).





Radiation Performance Summary

Designed for the space applications, the SERDES communication is reliable even in strong heavy ion and proton environments.

Parameter	Limites	Units	Conditions
Total Dose	$\geq 1 \times 10^6$	rads(Si)	
Transient Dose Rate Upset	$\geq 1 \times 10^{10}$	rads(Si)/s	Pulse width = 20 ns
Transient Dose Rate Survivability	$\geq 1 \times 10^{12}$	rads(Si)/s	Pulse width = 20 ns
Bit Error Rate (s)	Heavy Ion Proton	$\geq 1 \times 10^{-12}$ $\geq 1 \times 10^{-12}$	Bit Upsets/ Bits Sent
			Geosynchronous orbit during solar minimum non-flare conditons behind 100mil Aluminum shield
Neutron Fluence	$\geq 1 \times 10^6$	N/cm ²	1MeV equivalent energy, Unbiased, T _A =25°C

1. Device will not latch up due to any of the specific radiation exposure conditions.
 2. The Bit Error Ratio (BER) is defined as the number of but errors per bits sent due to ion-induced single event upsets.



The SERDES will continue to perform in single event effects environments.

- No phase-locked loop unlock
- No lanes down
- No latchup

Our History

Honeywell has a long history of building highly reliable products for the space industry. A focus has always been on the performance of the parts under radiation conditions. This starts with the design of the basic cells up through the completed integrated circuit. This philosophy was further enhanced with the introduction of the SERDES products with QML V qualification in 2008.

Why Honeywell?

- Radiation hard “by process” with Silicon On Insulator (SOI) CMOS Technology
- Fully qualified space products since early 1990’s
- SERDES products QML V Qualified in 2008
- Trusted Foundry includes Design, Assembly and Test in addition the wafer fabrication
- Foundry, Product and Support longevity, continue to maintain multiple technology nodes

Global Network of Support Services

Honeywell’s comprehensive support network, spanning the Americas, Europe, Middle East, Africa, Asia and the South Pacific, delivers fully integrated service solutions and 24/7/365 support to meet the needs of the aerospace industry. As a world leader of aviation aftermarket services, Honeywell provides the knowledge and resources to take care of all your service needs – whenever and wherever you require maintenance and repair services.

Our comprehensive global services provide industry recognized service support including repair, overhaul, and asset logistics with unmatched turn-time and quality performance supported by the Honeywell Operating System (HOS).

Find out more

For general information on Honeywell’s Microelectronics, please visit aerospace.honeywell.com/microelectronics or email us at Microelectronics@honeywell.com.

For more technical inquiries, please contact us at MicroelectronicsTechnicalInquiries@honeywell.com.

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