

SpaceWire PXI

The SpaceWire PXI card is a versatile SpaceWire Interface, Router or RMAP target device. The card is designed to be an efficient host interface to a SpaceWire network by utilising a cPCI or PXI backplane. This makes the device suitable for use in all stages of SpaceWire equipment development including initial SpaceWire evaluation, instrument simulation, control system simulation, unit testing, integration support and EGSE.

The SpaceWire PXI utilises STAR-Dundee's efficient host software support for the rapid sending and receiving of SpaceWire packets straight into host PC memory. The card offers high speed data transfer, the capability to inject various types of errors on demand, the ability act as a time-code master, and comes complete with highly optimised host software for low latency transmission of SpaceWire packets directly to and from the host PC.

The SpaceWire PXI card is available in three formats; **SpaceWire Interface**, **SpaceWire Router** and **SpaceWire Interface with RMAP Target**. The SpaceWire Interface and RMAP cards are available in 4 or 8 HP (Horizontal Pitch) wide formats. All available options are listed below:

- **SpaceWire Interface:** 4 port SpaceWire Interface device. Available as 4 HP wide card or 8 HP wide card. The 8 HP card has 4 general purpose bi-directional triggers on the front panel.
- **SpaceWire Interface with RMAP Target:** 4 port SpaceWire Interface device with 4 embedded Remote Memory Access Protocol (RMAP) targets and 1GByte of DDR3 memory. Available as 4 HP wide card or 8 HP wide card. The 8 HP card has 4 general purpose bi-directional triggers on the front panel.
- **SpaceWire Router:** 12 port SpaceWire Interface/Router device available as an 8 HP wide card.



SpaceWire PXI Router and Interface (8 HP and 4 HP) cards

Key Features

Four or Twelve SpaceWire interfaces: Each fully compatible with the SpaceWire standard and able to operate at up to 200 Mbits/s. Tri-colour LEDs for each link indicate status and packet transfer activity.

PXI and cPCI slot design: The PXI Router, Interface and RMAP Target cards are compatible with standard PXI J1 slots, PXIe hybrid slots or

cPCI slots. The card includes a cPCI J1 connector which is a standard 32-bit capable cPCI interface.

Operating modes: The SpaceWire PXI Interface, RMAP Target and Router devices can operate in one of two modes: Interface mode or Router mode. In Router Mode the card is able to route packets between SpaceWire ports and between those ports and the host cPCI port. In Interface Mode the card allows packets to be transmitted and received on the SpaceWire links without the requirement for path or logical addressing.

Powerful SpaceWire routing capabilities: Incorporating STAR-Dundee's advanced SpaceWire routing technology, the SpaceWire PXI card is able to route packets between SpaceWire ports and the cPCI interface. Path and logical addressing are supported along with a router configuration port.

Hardware RMAP target: The SpaceWire Interface with RMAP Target option allows the card to act as a remote RMAP target which can be configured through a powerful API. The targets can be configured independently and support software/hardware authorisation, and memory access and event notification. In addition, software running on the host PC can directly access the RMAP target memory space through the PXI interface.

Triggering: The front panels of the 8 HP SpaceWire Interface and SpaceWire Interface with RMAP Target cards have four general purpose bi-directional SMB triggers which can be used for device synchronisation, triggering of SpaceWire packets and errors, or event signalling between cards or external equipment.

Device and link speed settings: Configurable transmit clock speeds allow the speed of each link to be set independently.

Error injection: Parity errors, escape errors and credit errors can all be injected on demand or in sequence with transmitted packets. Transmitted packets can also be terminated with an EEP and can have a parity or disconnect error injected at a user defined point in the packet.

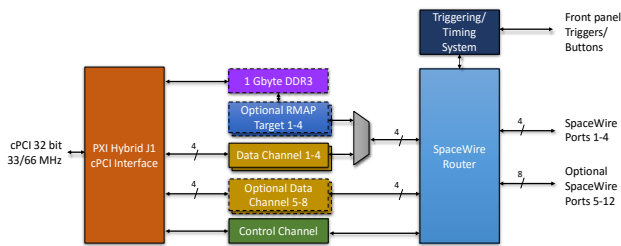
Extensive API: Developed after many years supporting users of SpaceWire interface boards, the API provides a common interface to all of STAR-Dundee's products, enhancing reusability of the application software. The extensive functionality of the API makes it very easy to develop SpaceWire related application software. Example application programs relieve further the pressure on development schedule. The API provides access to all the functionality of the SpaceWire PXI cards, supporting the high performance data transfer capabilities often needed for SpaceWire system simulation and testing purposes.

In addition to APIs for transmitting and receiving packets and configuring devices, the PXI cards include a software API to build RMAP packets to be transmitted, and to interpret RMAP packets which have been received.

Hardware Overview

A block diagram of the SpaceWire PXI card is shown in the figure below. Data channels 5-8 and SpaceWire ports 5-12 are available in

the 12 port SpaceWire Router configuration. The RMAP target is available in the SpaceWire Interface with RMAP Target card configuration.



PXI hardware overview

The SpaceWire interfaces of the SpaceWire PXI card are each fully compliant to the SpaceWire standard. The ports are connected to a SpaceWire router so that packets from one SpaceWire port can be routed to the other SpaceWire ports or into the host PC via the PXI interface.

There are four or eight independent channels from the SpaceWire router to the PXI interface, so traffic flowing over one SpaceWire port cannot block traffic for another port. In addition there is a separate control channel, so that the host PC is always able to access the control, configuration and status information of the device.

The RMAP Target card has an option to connect up to 4 RMAP targets directly to the SpaceWire ports so the card can act as a remote RMAP target. Each target can be controlled and configured independently by a powerful software API. Up to 1 GByte of DDR3 memory is available for RMAP access, and each target can have exclusive access to a configurable memory space or share the space with other targets.

The cPCI interface is compliant to the cPCI standard, and can be used in a 33 or 66 MHz cPCI or PXI backplane.

Included Software

The SpaceWire PXI cards are supported by STAR-Dundee's software stack, STAR-System, providing a consistent programming interface for accessing all STAR-Dundee's most recent, and future, router and interface devices

The release of the SpaceWire PXI Router coincided with the release of version 3.0 of STAR-System, which includes many new features and improvements, while maintaining backwards compatibility.

Software drivers: High performance drivers are supplied for Windows and Linux operating systems. Version 3.0 of STAR-System includes improved performance, increasing throughput and decreasing latency and CPU usage.

Software applications: Example command line applications are provided with source code to demonstrate common tasks, and to test the throughput and latency of a device. GUI applications are also provided to support the configuration of devices, and the transmission and reception of packets and time-codes using the SpaceWire PXI cards.

Application Programming Interface

A full API is provided to allow all functions of the SpaceWire PXI cards to be controlled from user application software. A variety of programming languages are supported, while a version is also available for LabVIEW separately.

The API is common across several STAR-Dundee products, and is consistent for each programming language and supported platform.

This simplifies software development and allows migration of software from one device to another and from one platform to another, improving software reuse and reducing the risk of schedule delays.

A key feature of the API is that it not only provides functionality to transmit and receive packets, but also functions required when testing equipment. For example, the API makes it simple to transmit packets terminated with an EEP, and to determine the end of packet marker of received packets.

All APIs are provided with extensive documentation and examples, which can be used as a basis for new applications.

Usability

Ease of use: The SpaceWire PXI hardware and software is easy to use, enabling spacecraft system and software engineers to rapidly develop the simulation, test and EGSE equipment they need.

Field upgradability: Field upgradeability of the board functionality is supported. Any upgrades or requested customisations can be downloaded from the STAR-Dundee website and installed quickly and efficiently.

First class support: As with all of STAR-Dundee's products, a year's support and maintenance is included. Support is provided directly from the team that developed the product allowing us to respond quickly with answers to technical questions, give assistance with application development, and resolve any problems quickly.

Specifications

API:

- C, C++.
(LabVIEW available separately.)

Software:

- Application software included.
- Source code examples provided.

Supported Platforms:

- Windows drivers (Windows 10, 8, 7, Vista, XP).
- Linux (4.x, 3.x and 2.6 Kernels).
- QNX, RTEMS and VxWorks drivers available separately.
(See website for current list of supported platforms.)

cPCI Interface:

- 32-bit, 33 MHz.

Size:

- Standard 3U PXI board approx. 100mm by 160mm.
- Front Panel: 3U or 6U front panel.

SpaceWire Ports:

- Compliant to ECSS-E50-12A and ECSS-E-ST-50-12C.
- Number of SpaceWire Ports: 4 or 12.
- Maximum Speed: 200 Mbits/s.
- Data-Strobe skew tolerance: tested on all units to ± 2 ns at data rate of 200 Mbits/s.
- Connectors: 9-pin micro-miniature D-type.
- LVDS signalling: Standard LVDS

SMB Ports (Only available on the 8 HP SpaceWire Interface and SpaceWire Interface with RMAP Target panels):

- 5V tolerant level or edge triggered input buffer.
- 3.3V output buffer with active high/low and programmable pulse width options.

EMC:

- The SpaceWire PXI card is sold as a component for inclusion in a computer unit. EMC certification is the responsibility of the user.