SpaceWire PXI Mk2

The SpaceWire PXI Mk2 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 Mk2 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 Mk2 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 4HP or 8HP (Horizontal Pitch) wide formats. All available options are listed below:

- **SpaceWire Interface:** 4 port SpaceWire Interface device. Available as 4HP wide card or 8HP wide card. The 8HP 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 1 GB of DDR3 memory. Available as 4HP wide card or 8HP wide card. The 8HP card has 4 general purpose bi-directional triggers on the front panel.
- **SpaceWire Router:** 12 port SpaceWire Interface/Router device available as an 8HP wide card.

SpaceWire PXI Router and Interface (8HP and 4HP) Mk2 Cards

The PXI Mk2 card is the second generation of this card, and the boards are functionally equivalent to the PXI Mk1 cards but provide a number of improvements to single point of failure FMECA protection. A full FMECA guide for the PXI Mk2 boards is available on request.

Key Features

Four or Twelve SpaceWire interfaces: Each fully compatible with the SpaceWire standard and able to operate at up to 400 Mbit/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 Mk2 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 Mk2 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 ports without the requirement for path or logical addressing.

Powerful SpaceWire routing capabilities: Incorporating STAR-Dundee's advanced SpaceWire routing technology, the SpaceWire PXI Mk2 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 8HP 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.

Packet Timestamping: A start and end of packet timestamp can be recorded for each received packet at sub microsecond resolution. The elapsed time epoch is set using software and the timestamp seconds increment can be synchronised with a pulse input on one of the SMB triggers or by a hardware prescaler.

Device and link speed settings: Configurable transmit clock speeds allow the speed of each link to be set independently on Interface and Interface with RMAP Target boards, while the link speed of pairs of ports can be configured on Router boards.
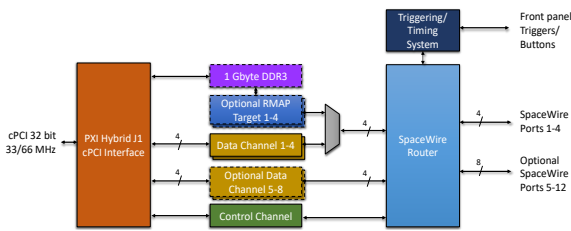
Error injection: Parity errors, escape errors and credit errors can all be injected on demand or in sequence with transmitted packets. Transmitted packets can be terminated with an EEP and disconnect or parity errors can be injected at user defined points in the packet.

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 application software. Example applications further relieve the pressure on development schedules. The API provides access to all the functionality of the PXI Mk2 cards, supporting high performance data transfer capabilities often needed for SpaceWire system simulation and testing.

In addition to APIs for transmitting and receiving packets and configuring devices, the PXI Mk2 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 PXI Mk2 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.

SpaceWire PXI Mk2 Hardware Overview

The SpaceWire interfaces of the PXI Mk2 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 ports or into the host PC via the PXI interface. There are 4 or 8 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 can 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 independently controlled and configured by a powerful software API. Up to 1 GB 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 33 or 66 MHz cPCI or PXI backplanes. Note that the front panel is connected to logic ground. The PXI Mk2 is not suitable when logic ground and chassis ground are to be isolated from one another.

Included Software

The SpaceWire PXI Mk2 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.

Software drivers: High performance drivers are supplied for Windows and Linux operating systems. These drivers are also available separately for QNX, RTEMS and VxWorks.

Software applications: Example command line applications are provided with source code to demonstrate common tasks, and to test a device's throughput and latency. GUI applications are also provided to configure devices, and to transmit and receive packets and time-codes using the SpaceWire PXI Mk2 cards.

Application Programming Interface

A full API is provided to allow all functions of the SpaceWire PXI Mk2 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 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 inject errors, 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 PXI Mk2 is easy to use, enabling engineers to rapidly develop the simulation, test and EGSE solutions they need.

Field upgradability: Field upgradeability of the board functionality is supported. Any upgrades 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

Part Number		
	SpW Interface Mk2 4HP	318a
	SpW Interface Mk2 8HP	318
	SpW Interface, RMAP Target Mk2 4HP	319a
	SpW Interface, RMAP Target Mk2 8HP	319
	SpW Router Mk2	320
Size	• Standard 3U PXI board approx. 100 x 160mm • Front Panel: 3U or 6U front panel	
Power	+3.3V supplied via cPCI or PXI backplane	
API	C, C++ (LabVIEW available separately)	
Software	• Application software included • Source code examples provided	
Platforms	• Windows (11, 10, 8 and 7) • Linux (6.x, 5.x, 4.x and 3.x kernels) • QNX, RTEMS and VxWorks drivers available separately (see website for current list of supported platforms)	
SpW Ports	• Compliant to ECSS-E50-12A, ECSS-E-ST-50-12C, ECSS-E-ST-50-12C Rev.1, and provides support for RMAP (ECSS-E-ST-50-52C) • Number of SpaceWire Ports: 4 or 12 • Maximum Speed: 400 Mbit/s • Data-Strobe skew tolerance: tested on all units to ±2 ns at data rate of 200 Mbit/s • Connectors: 9-pin micro-miniature D-type	
cPCI Interface	32-bit, 33/66 MHz	
SMB Ports	(Only available on 8HP SpW Interface and 8HP SpW 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	