

SpaceWire Router Mk2S

The SpaceWire Router Mk2S is a routing device that provides the essential capabilities now demanded of SpaceWire test and development equipment.

The SpaceWire Router Mk2S is suitable for all stages of SpaceWire equipment development: initial SpaceWire evaluation, instrument simulation, control system simulation, unit testing, integration support, and EGSE. It is functionally equivalent to the STAR-Dundee Router IP and the ESA radiation tolerant SpaceWire Router ASIC (AT7910E), available from Atmel.

The SpaceWire Router Mk2S provides eight SpaceWire interfaces, the ability to act as a time-code master, support for high speed data transfer, the capability to inject various types of errors on demand, and comes complete with highly optimised host software support for low latency transmission of SpaceWire packets directly to and from the host PC.

Expanding on the 10 years of knowledge and experience gained with the original SpaceWire Router-USB and Router Mk2, the SpaceWire Router Mk2S has new features to enhance its capability and has been migrated to support STAR-Dundee's powerful software stack; STAR-System.

New features of the SpaceWire Router Mk2S

- Improved interface mode.
- Independent data and configuration channels.
- On demand error injection.
- Link speed and state change event signalling.
- Support for STAR-System software stack.
- LabVIEW and C++ APIs.

Key Features

Eight 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 activity.

Device and link speed settings: The SpaceWire links can run at up to 200 Mbits/s with configurable transmit clock speeds allowing the speed of each link to be set independently. A precision transmit rate mode also allows the link speed to be configured to any value within the operating range of the Router, to a precision of greater than 0.1 Mbits/s.

Error injection: Parity errors, escape errors and credit errors can all be injected on demand, while transmitted packets can be terminated with an EEP.

Operating modes: The SpaceWire Router Mk2S operates in one of two modes:

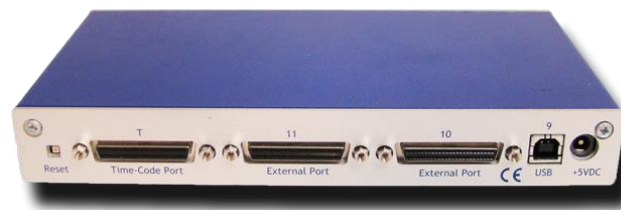
- Router mode
- Interface mode

Routing mode: the Router Mk2S incorporates STAR-Dundee's advanced SpaceWire routing technology to provide Routing Mode. In Routing Mode the Router Mk2S is able to route packets between SpaceWire ports and between those ports and the USB port and external FIFO ports. Path and logical addressing are supported along with a router configuration port. This allows SpaceWire routing technology to be explored using the Router Mk2S and makes switching of SpaceWire traffic very easy.

Interface mode: Interface Mode allows packets to be transmitted and received on each of the SpaceWire links. Traffic received on the SpaceWire links is automatically passed to software, with no routing required. Due to its simplicity, this mode can be very useful when first using SpaceWire.

RMAP support: In addition to APIs for transmitting and receiving packets and configuring devices, the Router Mk2S includes an API to build RMAP packets to be transmitted, and to interpret RMAP packets which have been received.

USB compatibility: The device is a standard USB 2.0 device, supporting transfers at up to 480 Mbits/s. It can also be used in USB 3.0 ports, or USB 1.1 ports at lower data rates.



Included Software

The SpaceWire Router Mk2S hardware is 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, including the STAR-Dundee PCI Mk2, cPCI Mk2, PCIe and Brick Mk2 devices.

Extensive API: Developed after many years supporting users of SpaceWire interface devices, STAR-API provides a common API to all of STAR-Dundee's STAR-System 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 further relieve the pressure on development schedules. The API provides access to all the functionality of the Router Mk2S, providing the high performance data transfer capabilities often needed for SpaceWire system simulation and testing purposes.

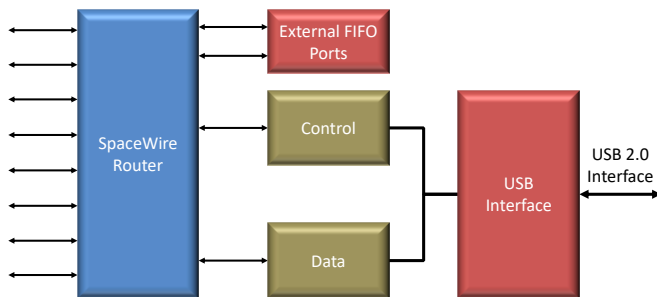
Software drivers: High performance drivers for the SpaceWire Router Mk2S are supplied for Windows and various versions of Linux operating systems.

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 using the Router Mk2S.



Overview

A block diagram of the SpaceWire Router Mk2S device is shown below.



SpaceWire Router Mk2S Block Diagram

The eight SpaceWire interfaces of the SpaceWire Router Mk2S are each fully compliant to the SpaceWire standard and operate at up to 200 Mbits/s. They are connected to a SpaceWire router so that packets from one SpaceWire port can be routed to the other SpaceWire ports, the external FIFO ports or into the host PC via the USB interface. There are two channels from the SpaceWire router to the USB interface. One channel is used to carry data, while the other is used as a control channel. This ensures that the host PC is always able to access the control, configuration and status space of the Router Mk2S, regardless of the data flow.

The SpaceWire router contained in the Router Mk2S has support for path and logical addressing, group adaptive routing, watch-dog timeouts and link management including power on request, and disable on silence. It includes a configuration port (port 0) for setting routing tables, configuring the SpaceWire links and monitoring their status. It is also functionally equivalent to the STAR-Dundee Router IP and the ESA radiation tolerant SpaceWire Router ASIC (AT7910E), available from Atmel.

The USB interface is compliant to the USB 2.0 standard, providing up to 480 Mbits/s data transfers, allowing rapid transfer of data to and from host software to the SpaceWire Router Mk2S. The device can also be used in older USB 1.1 ports, and the latest USB 3.0 ports. Power is provided by the supplied mains powered brick, so the device can be used without connecting the USB cable and can be configured over the SpaceWire network.

The SpaceWire Router Mk2S includes support for fault injection on each of the SpaceWire links. Parity errors, escape errors and various forms of credit errors can all be injected on demand, while transmitted packets can be terminated with an EEP.

Application Programming Interface

A full API is provided to allow all functions of the SpaceWire Router Mk2S to be controlled from user application software. A variety of programming languages are supported, while a version is also available for LabVIEW.

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 test software from one device to another and from one platform to another.

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. The API makes it simple to transmit packets terminated with an EEP, and to determine the end of packet marker of received packets. It simplifies the process of transmitting a stream of traffic (for example, from a file), and receiving a stream of traffic.

An RMAP Packet Library is also included, which provides functions for creating RMAP packets to be transmitted, checking the validity of received RMAP packets, and obtaining the values of the fields.

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 Router Mk2S is easy to use, enabling spacecraft system and software engineers to rapidly develop the simulation, test and EGSE equipment they need.

Field upgradability: The SpaceWire Router Mk2S supports field upgradability of the board functionality. 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 with the SpaceWire Router Mk2S. Support is provided directly from the team that developed the product allowing us to respond quickly with answers to customer questions, give assistance with application development, and resolve any problems quickly.

Specifications

API:

- C, C++, LabVIEW.
(See website for current list of supported languages).

Software:

- Application software included.
- Source code examples provided.

Supported Platforms:

- Windows (Windows 10, 8, 7, Vista, XP), 32 and 64-bit.
- Linux (3.x and 2.6 kernels).
(See website for current list of supported platforms.)

Size:

- 220 x 115 x 30 mm (approx.)

Power:

- +5V DC, mains powered brick supplied.

SpaceWire Ports:

- Compliant to ECSS-E50-12A and ECSS-E-ST-50-12C.
- Number of SpaceWire Ports: 8
- 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: Using Xilinx LVDS

USB Port:

- USB 2.0 (480 Mbits/s).

Other Ports:

- Two FIFO external ports.
- External time-code port.

EMC:

- CE/FCC certified.