

SpaceWire Brick Mk3

The SpaceWire Brick Mk3 is a USB 3.0 to SpaceWire interface device that is suitable for use in all stages of SpaceWire equipment development: initial SpaceWire evaluation, instrument simulation, control system simulation, unit testing, integration support, and EGSE.

The SpaceWire Brick Mk3 provides two SpaceWire interfaces, support for high speed data transfer, the capability to inject various types of errors on demand, the ability to transmit and receive time-codes and 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.

Expanding on the 10 years of knowledge and experience gained with the original SpaceWire-USB Brick and the Brick Mk2, the SpaceWire Brick Mk3 has new features to enhance its capability and supports STAR-Dundee's powerful software stack; STAR-System. This makes it simple to migrate from the Brick Mk2, which also supports STAR-System, to the Brick Mk3.

New features of the SpaceWire Brick Mk3

- USB 3.0, offering far higher throughput with the capability to transmit and receive on all links concurrently at the maximum rate.
- Additional independent channels allowing full data transfer on both links and configuration in parallel.
- Reduced latency and CPU usage.
- Full interface mode.
- FMECA protection for connected devices.
- Improved case design making it easier to interpret LEDs.
- New software tools for time-code control and scripting of RMAP operations.

Key Features

Two SpaceWire interfaces: Each fully compatible with the SpaceWire standard. Tri-colour LEDs for each link indicate status and packet transfer activity. The SpaceWire links have been tested running at 300 Mbit/s using a 2 metre STAR-Dundee lab cable, and at 200 Mbit/s using a 10 metre STAR-Dundee lab cable. Configurable transmit clock speeds allow the speed of each link to be set independently.

Improved hardware design: The new case design makes it easy to access the two SpaceWire ports and view the LEDs. The hardware is designed to prevent any single point of failure causing damage to equipment interfaced to the SpaceWire or Trigger ports. A FMECA report is available on request which provides further details on this protection.

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.

Operating modes: The SpaceWire Brick Mk3 operates in one of two modes:

- Interface mode
- Router mode

Interface mode: Interface Mode allows packets to be transmitted and received on each of the SpaceWire links concurrently. Traffic received on the SpaceWire links is automatically passed to software

through independent channels. Traffic is directly transmitted out of each SpaceWire link by software using its corresponding channel. No routing is required to transmit or receive in interface mode. Due to its simplicity, this mode can be very useful when first using SpaceWire. It can also be used to simulate equipment that does not require a router.

Router mode: In Router Mode the Brick Mk3 is able to route packets between SpaceWire ports and between those ports and the USB port. Path and logical addressing are supported along with a router configuration port, allowing SpaceWire routing technology to be explored. Port routing options mean that traffic from one port can be automatically routed to another. This combination of features, along with the comprehensive software provided, makes switching of SpaceWire traffic very simple and powerful using the Brick Mk3.

USB compatibility: The device is a standard USB 3.0 device. It can also be used in USB 2.0 or 1.1 ports.

USB powered: The Brick Mk3 is powered over the USB port, and requires no additional power source. This makes it very easy to connect to a laptop and debug problems in any location.

RMAP support: In addition to APIs for transmitting and receiving packets and configuring devices, the Brick Mk3 includes an API to build RMAP packets to be transmitted, and to interpret RMAP packets which have been received.



Included Software

The SpaceWire Brick Mk3 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, Brick Mk2 and Router Mk2S devices.

The release of the Brick Mk3 coincides with the release of version 3.0 of STAR-System, which includes a number of new features and improvements, while maintaining backwards compatibility.

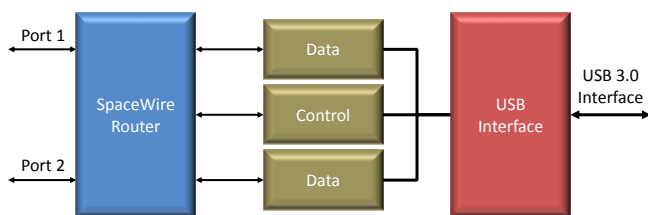
Extensive API: Developed after many years supporting users of SpaceWire interface devices, STAR-API provides a common API to all of STAR-Dundee's STAR-System products, enhancing reusability of the application software. The extensive functionality of the API makes it very easy to develop SpaceWire related application software. Example application programs further relieve the pressure on development schedules. The API provides access to all the functionality of the Brick Mk3, providing the high performance data transfer capabilities often needed for SpaceWire system simulation and testing purposes.

Software drivers: High performance drivers for the SpaceWire Brick Mk3 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 included, 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, the transmission and reception of packets and time-codes, and to inject errors. Version 3.0 of STAR-System also includes a new version of the CUBA Software, originally provided with the Brick Mk1.

Overview

A block diagram of the SpaceWire Brick Mk3 is shown below.



The two SpaceWire interfaces of the SpaceWire Brick Mk3 are each fully compliant to the SpaceWire standard. They are connected to a SpaceWire router so that packets from one SpaceWire port can be routed to the other SpaceWire port or into the host PC via the USB interface. There are two independent channels from the SpaceWire router to the USB interface, so traffic flowing over one 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 space of the Brick Mk3, regardless of the data flow.

The SpaceWire router contained in the Brick Mk3 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 links and monitoring their status.

The USB interface is compliant to the USB 3.0 standard, which provides lower latency and higher speed transfers than previous USB versions, allowing rapid transfer of data to and from host software to the SpaceWire Brick Mk3. The device can also be used in USB 2.0 and 1.1 ports. All power is provided by the USB port, and no additional power source is required. This makes it very easy to connect a Brick Mk3 to a laptop, and debug problems in the field.

The SpaceWire Brick Mk3 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 Brick Mk3 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.

An RMAP Packet Library is also included, which provides functions for creating Remote Memory Access Protocol (RMAP) packets to be transmitted, checking the validity of received RMAP packets, and obtaining the values of fields in an RMAP packet.

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 Brick Mk3 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 Brick Mk3 supports field upgradability of the board functionality. 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 with the SpaceWire Brick Mk3. 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).
- (See STAR-System details on website for latest language support.)

Software:

- Application software included.
- Source code examples provided.

Supported Platforms:

- Windows and Linux, 32 and 64-bit.
- (See STAR-System details on website for latest platform support.)

Size:

- 85 x 66 x 19 mm (approx.).

Power:

- Powered via USB cable.

SpaceWire Ports:

- Compliant to ECSS-E50-12A and ECSS-E-ST-50-12C.
- Number of SpaceWire Ports: 2.
- Maximum Speed: 300 Mbits/s tested using a 2 metre STAR-Dundee lab cable loopback between ports 1 and 2.
- Data-Strobe skew tolerance: tested on all units to ± 2 ns at a data rate of 200 Mbits/s.
- Connectors: 9-pin micro-miniature D-type.
- Signalling: LVDS.

USB Port:

- USB 3.0.
- Backwards compatible with USB 2.0 and 1.1.

EMC:

- CE/FCC certified.