



**User Manual for the  
4Links DSR  
Version 1.0**

2<sup>nd</sup> April 2019





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## 1 Introduction

The DSR product is a combined 2 port Diagnostics SpaceWire Interface (DSI) and a Single Link Recorder (SLR). It is housed in a 3U 8HP enclosure with an external 12V power-supply 'brick'. The functionality of the DSI and SLR are similar to the 1U DSI and 1U MSR respectively. The major difference between this product range and the 1U is the cross triggering support and the number of SpaceWire ports that are available.

On the front-panel of each board are two micro-D connectors (used for SpaceWire signals), a 1GbEthernet port for data transfer, a display that shows the status and activity for each of these SpaceWire connections, and a mini-USB connector for setting device operating parameters such as Ethernet IP address. The Mini-USB is also used for downloading software and firmware updates.

### 1.1 Product Features

Feature	Description	DSI	SLR
<b>SpaceWire</b>	SpaceWire Link rate (Mbps)	400Mbps	400Mbps
<b>Ethernet</b>	Ethernet Speed	1Gbps	1Gbps
<b>Ports</b>	Number of SpaceWire ports	1	1

The unit operates from a single 12V DC supply with a maximum power consumption of 15W.

### 1.2 Product Options

The following table shows the options for DSI and SLR compared to the 1U product. There are no upgrade options for this product.

Option	Description	DSI	SLR
<b>TT</b>	Time Tags	Standard	Standard
<b>ER</b>	Event/Error Reporting	Standard	Standard
<b>EI</b>	Event/Error Injection	Standard	No
<b>EW</b>	Event/Error Waveforms	Standard	Standard
<b>SO</b>	Synchronised Outputs	No	No
<b>CO</b>	Controlled Outputs	No	No
<b>OD</b>	Output Disable	No	No
<b>OE</b>	Output Enable	No	No

## 2 Getting Started

This section is aimed at getting the user to setup the DSR and run a set of tests to prove that the modules are functioning correctly. It uses a Windows environment for the example.



For experienced users of the 1U product then you can move to the Section

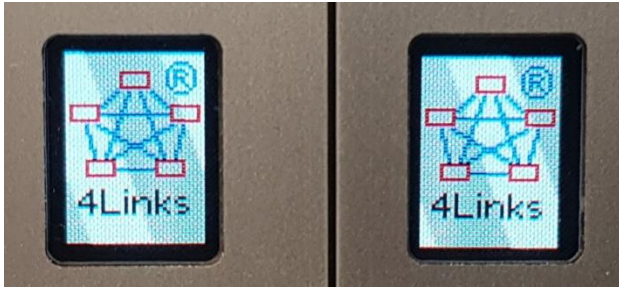


Module Configuration , to setup the modules. The configuration of the IP address is via a USB Flash Drive interface and not the front panel interface used on the 1U product.

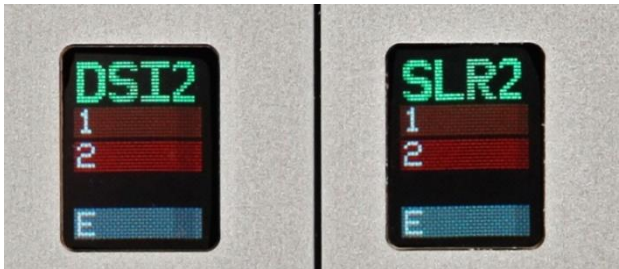
## 2.1 Powering up the DSR

When you unpack the DSR product you need to connect the power supply into the rear of the unit and then connect to a power socket. *Do not insert the Mini-USB cable yet.*

When you turn on the switch at the rear of the unit the displays on each module will show the 4Links Logo.



They will then continue to boot until the runtime display is shown.



## 2.2 Configuring the DSR

At this point you will need to connect the mini-USB cables (supplied) to each module and then connect them to the HOST PC. The HOST PC will then detect the module and install the device drivers. Each module is treated as a Flash Drive by the HOST PC.

Once the HOST PC has installed the device drivers you will be able to access each module as a Flash Drive. You will then need to go into each modules Flash Drive and modify the IP address stores in the 4Links-params file. The DSR does not support DHCP and you need to enter the IP address as a fixed location. The location of this file depends on the function of the module.

- For the DSI module the file is in \4Links-DSI2\4Links-params
- For the SLR module the file is in \4Links-SLR2\4Links-params

The file format is a Linux line ending extension and should be opened in an editor like Notepad++ or WordPad.

```
NAME=DSI2
LA=#44
IP=#0A0D375B
MAC=#0FF2
CNA=#2468
PRI=#01
VERS=#01
PWR=#01
EOF
```

Go to the line that references the IP= and modify the IP address. The IP address is stored as a set of hexadecimal numbers, so 0x0A = 10, 0x0D = 13, 0x37 = 55 and 0x5B = 91. This gives an IP address of 10.13.55.91. Modify this IP



address to match your network settings for each module. Ensure you do not use the same IP Address on both modules.

## 2.3 Connecting to the Ethernet network

Once you have set the IP addresses for the modules, you need to power cycle the DSR so the new values take effect. Once repowered connect the Ethernet ports on the SFP connectors (RJ45) to the network. You should then be able to ping each module to make sure it is working.

In the example above you would type at the Host PC command prompt

```
Ping 10.13.55.91
```

The command prompt should show responses for both Ethernet connections as below.

```
Command Prompt 4Links
c:\opt\4Links>ping 10.13.55.91

Pinging 10.13.55.91 with 32 bytes of data:
Reply from 10.13.55.91: bytes=32 time<1ms TTL=128
Reply from 10.13.55.91: bytes=32 time<1ms TTL=128
Reply from 10.13.55.91: bytes=32 time<1ms TTL=128
Reply from 10.13.55.91: bytes=32 time<1ms TTL=128

Ping statistics for 10.13.55.91:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

c:\opt\4Links>ping 10.13.55.92

Pinging 10.13.55.92 with 32 bytes of data:
Reply from 10.13.55.92: bytes=32 time<1ms TTL=128
Reply from 10.13.55.92: bytes=32 time<1ms TTL=128
Reply from 10.13.55.92: bytes=32 time<1ms TTL=128
Reply from 10.13.55.92: bytes=32 time<1ms TTL=128

Ping statistics for 10.13.55.92:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

If you get a response from each module you can then start to connect the SpaceWire cables and progress to system testing. If you don't get a response then you need to check the IP addresses are correct and that the cabling is working.

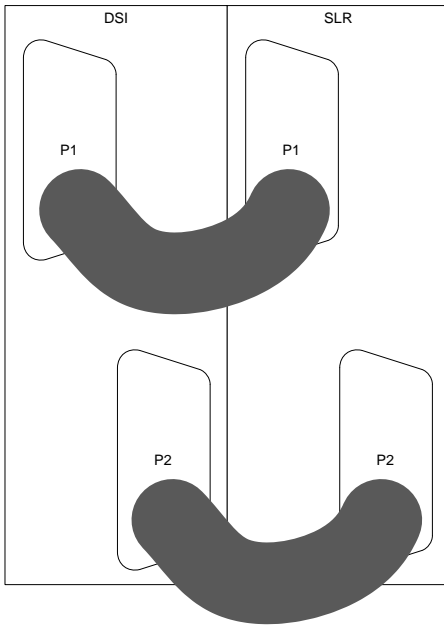
## 2.4 Installing the Host PC software

Using the supplied CD install the software for your specific Host PC operating system. The details on how to install this are on the readme.txt file of the CD.

## 2.5 Creating a test setup

Once the software is installed you can then connect up the SpaceWire cables (sold separately) as shown below between the two modules. This enables you to run a simple test to prove that both the DSI and SLR are working correctly.





## 2.6 Running the software

A simple test of the functionality can now be performed to prove that all the software and hardware are working together.

Open two command prompt windows on the Host PC. One will be used for the DSI and the other for the SLR. You need to change into the directory you installed the 4Links software and run the 4linksvars.bat file for each command prompt, to setup the operating parameters.

```
C:\opt\4Links>4linksvars.bat
```

In the DSI command prompt window (one of the windows) run the command with your IP address for the DSI (in the example below the IP address is 10.13.55.91);

```
C:\opt\4Links>spw 10.13.55.91 -l 12 -s 100
```

This will cause the DSI to send data between ports 1 and 2 at 100Mbps. The display output at the command prompt should show something like this.



```

Command Prompt 4Links
c:\opt\4Links>spw 10.13.55.91 -l 12 -s 100

SpW Windows x64 v33.5.1545340815 - SpaceWire test program
Copyright (c) 2007 - 2018 4Links Limited
4Links Limited DSI-3U (2 ports) Serial number A4076 at 00-50-C2-21-2F-EC

Start SpaceWire Link(s) 1 2
Transmit on SpaceWire Link(s) 1 2 at 100.0 Mb/s
Send continuous packets of 1000 bytes of checked data on each Transmit link.
Report every 1s

Waiting for SpaceWire link 1 to connect ... connected
Waiting for SpaceWire link 2 to connect ... connected

Received 14.438 MB in 997ms = 115.9 Mb/s; Total of 14.438 MB in 1s; 14.438 K packets, 0 with error
Received 14.732 MB in 1016ms = 116.0 Mb/s; Total of 29.170 MB in 2s; 29.170 K packets, 0 with error
Received 14.514 MB in 1000ms = 116.2 Mb/s; Total of 43.684 MB in 3s; 43.684 K packets, 0 with error
Received 14.506 MB in 1000ms = 116.1 Mb/s; Total of 58.190 MB in 4s; 58.190 K packets, 0 with error
Received 14.734 MB in 1015ms = 116.2 Mb/s; Total of 72.924 MB in 5s; 72.924 K packets, 0 with error
Received 14.526 MB in 1001ms = 116.1 Mb/s; Total of 87.450 MB in 6s; 87.450 K packets, 0 with error
Received 14.746 MB in 1016ms = 116.2 Mb/s; Total of 102.196 MB in 7s; 102.196 K packets, 0 with error
Received 14.726 MB in 1016ms = 116.0 Mb/s; Total of 116.922 MB in 8s; 116.922 K packets, 0 with error
Received 14.732 MB in 1015ms = 116.2 Mb/s; Total of 131.654 MB in 9s; 131.654 K packets, 0 with error
Received 14.559 MB in 1003ms = 116.2 Mb/s; Total of 146.213 MB in 10s; 146.213 K packets, 0 with error
Received 14.523 MB in 1001ms = 116.1 Mb/s; Total of 160.736 MB in 11s; 160.736 K packets, 0 with error
Received 14.504 MB in 1000ms = 116.1 Mb/s; Total of 175.240 MB in 12s; 175.240 K packets, 0 with error
Received 14.518 MB in 1001ms = 116.1 Mb/s; Total of 189.758 MB in 13s; 189.758 K packets, 0 with error
Received 14.544 MB in 1002ms = 116.2 Mb/s; Total of 204.302 MB in 14s; 204.302 K packets, 0 with error
Received 14.724 MB in 1015ms = 116.1 Mb/s; Total of 219.026 MB in 15s; 219.026 K packets, 0 with error

```

In the MSR command prompt window (the other window) run the following command with your IP address for the SLR (in the example below the IP address is 10.13.55.92);

```
C:\opt\4Links>msr 10.13.55.92 test.log!
```

The command prompt should show the something like this.

```

Command Prompt 4Links
c:\opt\4Links>msr 10.13.55.92 test.log!
msr Windows x64 v33.5.1545340815 - SpaceWire data recorder
Copyright (c) 2007 - 2018 4Links Limited
Product: SLR-3U Serial number: A4077 Ports: 2

[free running] Stored 15.532200 MB from 14564339 data bytes in 14564 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 31.489488 MB from 29522779 data bytes in 29524 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 47.253228 MB from 443111019 data bytes in 44312 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 63.210200 MB from 59277019 data bytes in 59278 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 79.178616 MB from 74249319 data bytes in 74250 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 94.897093 MB from 88992719 data bytes in 88994 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 110.636525 MB from 103754899 data bytes in 103756 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 126.378877 MB from 118518499 data bytes in 118519 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 142.347529 MB from 133492959 data bytes in 133494 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 158.067261 MB from 148234279 data bytes in 148234 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 173.792696 MB from 162980499 data bytes in 162981 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 189.762131 MB from 177957379 data bytes in 177958 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 205.527632 MB from 192743919 data bytes in 192744 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 221.482632 MB from 207705799 data bytes in 207706 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 237.415704 MB from 222647919 data bytes in 222648 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 253.193276 MB from 237444539 data bytes in 237444 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 268.902168 MB from 252171859 data bytes in 252172 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 284.627632 MB from 266917259 data bytes in 266918 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 300.589932 MB from 281893019 data bytes in 281894 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 316.795736 MB from 297090159 data bytes in 297090 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 332.793076 MB from 312085499 data bytes in 312086 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 348.490484 MB from 326811439 data bytes in 326812 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 364.476264 MB from 341803019 data bytes in 341804 EOP pkts 0 EEP pkts 0 errors 0 overruns
[free running] Stored 380.199320 MB from 356547859 data bytes in 356548 EOP pkts 0 EEP pkts 0 errors 0 overruns

```

The DSI is sending data between the two ports through the SLR. The log and display of the SLR will show the data being transferred.

If you can see data being transferred in both command prompt windows with zero errors, then the system is running correctly. The Displays on the DSR will also show activity and look something like the image below, with the bars representing the data activity in each direction on that interface.





### 3 Module Configuration

When you plug the mini-USB port on the module into a computer you will see it appear as a USB Flash drive. This enables the user to set operating parameters or change the modules function.

The module is configured using a number of files on its internal Flash drive. The configuration information for each function (such as a DSI, or SLR) is contained in a separate directory (or folder) on the drive. The top level file "4Linksconfig" contains the name of the currently-selected directory (and thus determines the function of the module). Editing this file, and re-booting the module, changes its function.

*Each module has a unique encrypted key, only images created for that module will work on it.*

#### 3.1 USB Flash Drive structure

An example Flash disk (for the module with serial number C4917) might be structured as follows:

```
\
|-4Links-config
|
|-4Links-DSI2\
| |-4Links-sw.C4917.DSI2.v0097.bin
| |-4Links-fw.C4917.DSI2.v0104.ebit
| |-4Links-params
|
|-4Links-SLR2\
| |-4Links-sw.C4917.SLR2.v0097.bin
| |-4Links-fw.C4917.SLR2.v0104.ebit
| |-4Links-params
```

In the above example, the file `4Links-config` contains one line, "4Links-DSI2" or "4Links-SLR2", which defines the function directory to be used for booting after the next power cycle. *Remember that these directory names are case-sensitive!*

Each function directory contains three files:

Filename	Purpose
<b>4Links-fw.Cnnnn.function.version.ebit</b>	Encrypted FPGA configuration image
<b>4Links-sw.Cnnnn.function.version.bin</b>	Embedded processor binary image
<b>4Links-params</b>	Configuration parameters for this directory

The Cnnnn is the serial number the images are encrypted for, the 'function' is used to identify the specific function and the 'version' shows the version number of the function.

*Be aware that all of these filenames are case-sensitive;* filename matching is performed using upper- and lower-case letters. In particular, notice that all of these filenames contain a capital 'L' in the "4Links" part.

The `4Links-fw...` and `4Links-sw...` files are supplied by 4Links and are specific to a particular PXIe-C module; the "Cnnnn" part of the filename is the serial number of the module. *They are encrypted and will not work on any other module.*

If more than one `4Links-fw...` or `4Links-sw...` files are in a function directory, then first one to be found will be used at boot time. Only a single `4Links-fw...` and `4Links-sw...` file should be included in each function directory for reliable operation.

The “4Links-params” file in each function directory contains operational parameters for that module and function.

## 3.2 Setting Module Parameters

The “4Links-params” file contains operational parameters for that module and function. This file is in Linux line ending format, if you edit it make sure to save in the same format otherwise the unit will not boot and return the error ‘16 20’. The Properties and values are shown below:

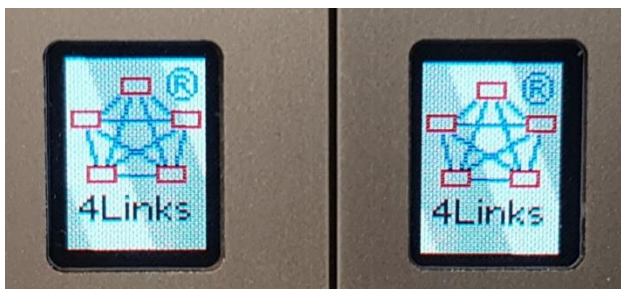
Property	Value	Description
<b>NAME=</b>	DSI2	Initial text for the display
<b>IP=</b>	#C0A80104	IP address as a hexadecimal number (0xC0.0xA8.0x01.0x04 = 192.168.1.4)
<b>LA=</b>	#44	Reserved
<b>CNA=</b>	#2468	Reserved
<b>PRI=</b>	#01	Reserved
<b>VERS=</b>	#01	Show version: 0=off; 1=version; 2=date
<b>PWR=</b>	#01	Initial power: 1=on; 0=off (DIR standby)
<b>EOF</b>		End of File marker

The format of the “4Links-params” file is a capitalised property name, followed by “=”, followed by a 2/4-character name/number (a “#” is used as a prefix for hexadecimal numbers).

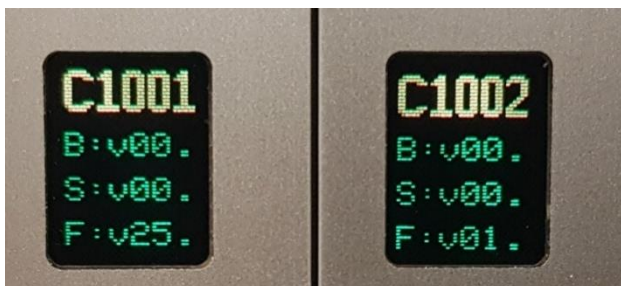
The only property that is required to be modified by the user is the ‘IP=’ as this sets the IP address of the module on the network.

## 3.3 Booting

On initial power up the 4Links Logo is displayed.



This is followed by the boot screen showing the module Serial Number, Bootstrap Version, Software Version and Firmware Version being loaded.



The v:XX. Values are the first two digits of the version number of the files being loaded (see below).

Once the module has booted the display then shows the modules configuration



The values are shown as a scrolling display.

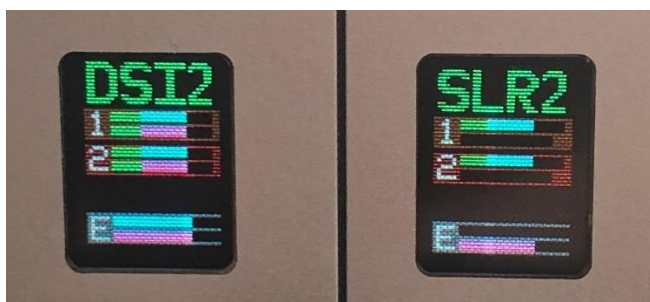
Once it has completed the boot process the display shows the SpaceWire port and Ethernet port activity as a horizontal bar graph



The bar graph display shows the following information

- The port number on the left;
  - 1 & 2 represent the SpaceWire Port
  - E represents the Ethernet interface
- A solid coloured bar indicates that the link is disconnected;

Once the software is communicating with the DSR and data transfers are in progress the display will show the activity on each links/port



A coloured border with black bars within is connected

- The upper black bar shows receive activity in magenta, with flashes for EOP (green) and EEP (red).
- The lower black bar shows transmit activity in cyan, with flashes for EOP (green) and EEP (red).
- The length of the coloured bar show the link transfer rate on a logarithmic scale.

### 3.3.1 Bootstrap Error Messages

When the DSR module is booting, a front-panel display might show error messages if the boot process is unsuccessful. These messages are:

Message	Indication
---------	------------



<b>1001</b>	USB Initialisation failed
<b>1002</b>	USB file system initialisation failed
<b>1101</b>	FPGA failed to power up successfully
<b>1201</b>	USB flash disk has bad format
<b>1301</b>	4Links-config configuration file not found
<b>1302</b>	4Links-params parameters file not found
<b>1401</b>	Function directory not found
<b>1402</b>	Function directory name is not a directory
<b>1501</b>	FPGA .ebit file not found
<b>1502</b>	FPGA .ebit load failed
<b>1503</b>	FPGA .ebit load checksum error
<b>1510</b>	FPGA .ebit header error in Design Name field
<b>1511</b>	FPGA .ebit header error in Part Name field
<b>1512</b>	FPGA .ebit header error in Date field
<b>1513</b>	FPGA .ebit header error in Time field
<b>1601</b>	Microcontroller .bin file not found
<b>1603</b>	Microcontroller .bin file load checksum error
<b>1610</b>	Internal UART link error
<b>1620</b>	4Links-params file corrupt (check

Faults with the FPGA and microcontroller files are likely due to corruption, or due to their attempted installation onto a 4Links PXIe-C module which has a different serial number from that which they are configured to boot. Try power cycling the modules and re-installing the files to the Flash Drive to rectify the problem. If this does not resolve the boot problem then contact 4Links for further support.

### 3.4 Configuration using Microsoft Windows

It is recommended that power is supplied to a module before connection to a HOST PC via USB as the 500mA limit on the USB power may not be sufficient to operate the module and potential flash drive corruption could occur. However if the module is connected to the USB the module containing the USB connection boots into “Safe Mode”, and the configuration disk may be opened using Windows Explorer.

Windows will automatically install the USB device driver, however this installation may take several seconds the first time that an SRS module is used with a particular HOST PC or if the USB port used is changed.

Once changes to the configuration file have been made, the Flash drive should be ejected using the ‘Eject’ option in File Explorer.

Should it be necessary to re-format the Flash disk on a board, use the command `format /q /a:4096 /v:4L-Cnnnn Z:` where “Cnnnn” is the serial number of the board and “Z:” is the disk letter reported by Windows Explorer. *Be careful to format the correct disk!*

### 3.5 Configuration using Linux

Linux by default requires a super-user (e.g. root) to install a USB device driver. Many Linux distributions auto-mount removable USB disks and make them available to the user who is logged-in to the console, creating a path under /media such as “/media/4L-C3306”.



If the Flash disk is not automatically mounted, one option is to force the device permissions using “udev” and then the mtools utilities:

- Set up the computer’s dynamic device manager, udev, to recognise 4Links PXIe-C boards by creating

```
/etc/udev/rules.d/98-4links.rules to contain (all on one line)
KERNEL=="sd?", ACTION=="add|change", ENV{ID_VENDOR_ID}=="29e8",
  ENV{ID_MODEL_ID}=="0302", SYMLINK+="4Links PXIe-C",
  MODE="0660", GROUP="disk"
```

- Put the user requiring access in group “disk”
- Modify /etc/mtools.conf to add line(s) of the form `drive z:`  
`file="/dev/4Links PXIe-C"`
- Use mtools commands such as `mformat -T 16384 -s 64 -h 1 -H 0 -S 5`  
`-v 4L-C3306 z:`  
`mmdir z:`  
`mtype z:4Links-config mdel z:4Links-`  
`SRS8/4Links-params mcopy 4Links-`  
`fw.C3306.SRS8.bit z:4Links-SRS8`

On Linux systems that use the Selinux security scheme, be aware that a permissions failure might not be reported directly: look in the audit log for additional messages.



## 4 DSR Features

The DSR has as standard the following features shown in the table below

There are no options associated with the DSR. The table shows the options compared to the Classic 1U product range.

Option	Description	DSI	SLR
TT	Time Tags	Standard	Standard
ER	Event/Error Reporting	Standard	Standard
EI	Event/Error Injection	Standard	No
EW	Event/Error Waveforms	Standard	Standard

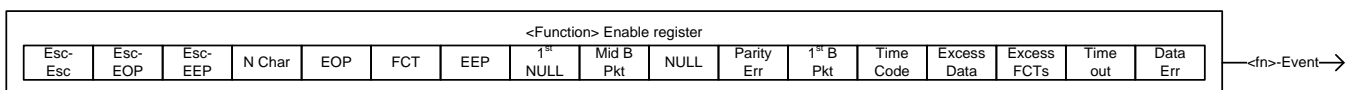
The functionality of the features is explained below.

### 4.1 Trigger Events

The following Events can cause trigger conditions for the DSI and SLR.

ID	Event	EI	ER	EW	TT	Description
a	Esc-Esc	Yes	Yes	Yes	Yes	Esc Esc has been received
b	Esc-EOP	Yes	Yes	Yes	Yes	Esc EOP has been received
c	Esc-EEP	Yes	Yes	Yes	Yes	Esc EEP has been received
d	Nchar	-	-	-	-	Data byte of value N in packet received
e	EOP	-	-	Yes	Yes	EOP has been received
f	FCT	-	Yes	Yes	Yes	FCT has been received
g	EEP	-	-	Yes	Yes	EEP has been received
i	1 <sup>st</sup> NULL	-	-	-	-	First Null received
m	Mid B Pkt	-	-	-	Yes	Middle Byte of Packet
n	NULL	-	Yes	-	Yes	Null has been received
p	Parity Err	Yes	Yes	Yes	Yes	SpaceWire Parity Error
s	1 <sup>st</sup> B Pkt	-	-	-	Yes	First byte of Packet
t	Time Code	-	Yes	Yes	Yes	Time Codes sent over SpaceWire
v	Excess Data	Yes	-	Yes	-	Monitors Data and FCT traffic, generates an event when more Data is received compared to the FCTs received
w	Excess FCTs	Yes	-	Yes	-	Monitors Data and FCT traffic, generates an event when more FCTs are received compared to the Data received
x	Time-out	Yes	Yes	Yes	Yes	Greater than the SpaceWire timeout period of 850ns.
~	Data Err	-	-	-	-	Inject a data error to cause a parity mis match

These events are set in a register for each feature. The diagram below is used in each section to show what events are available for that feature.

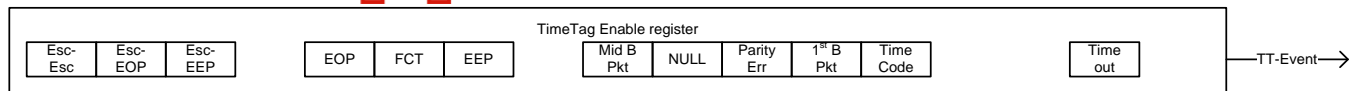


Any event that is not selectable for that feature is omitted from the register diagram.

### 4.2 TT Time Tags

This is applicable to the DSI and SLR products. Time Tags are used by 4Links hardware to tag events and send the time tag with the event over the Ethernet to the Host PC.

The highlighted blocks below show which events and errors can be Time Tagged



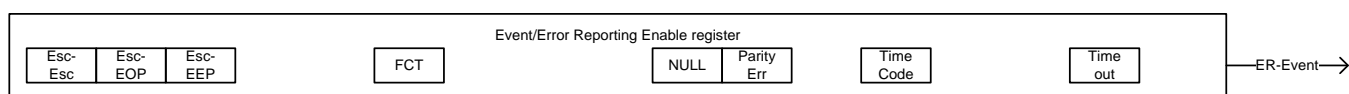
The hardware will give a resolution of 1.3ns for Time Tags.

The use of the TT feature is covered in the Software User Guide and C-API Programmers Guide.

## 4.3 ER Event/Error Reporting

This is applicable to the DSI and SLR products. For each SpaceWire port tokens defined as errors, that would normally be hidden (typically resulting in a link reset) and replaced by (at most) an EEP character, can be made visible to the user. Correct, but normally hidden tokens (such as flow-control tokens) can also be transferred to the user. When the reporting is enabled the Event/Error selected is passed over the Ethernet to the Host PC.

The highlighted blocks below show which events and errors can be reported.



The use of the ER feature is covered in the Software User Guide and C-API Programmers Guide.

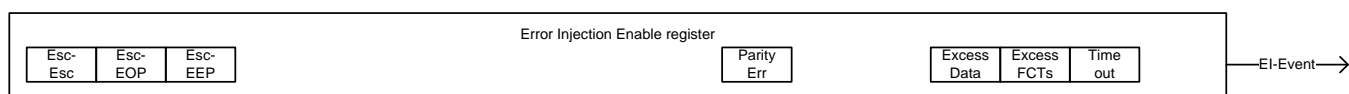
## 4.4 EI Event/Error Injection

This is applicable to the DSI only, as the SLR is a passive monitoring product. SpaceWire tokens that are not normally generated, because they are defined as errors, can be explicitly inserted into the data stream such as a SpaceWire Idle period - when D and S remain constant for an extended period (greater than the SpaceWire disconnect timeout, which is nominally 850 ns) should trigger a SpaceWire timeout response.

These error injection functions allow the user to observe the behaviour of SpaceWire components under controlled error conditions.

This feature enables the standard flow-control behaviour of the SpaceWire state-machine to be altered to provoke behaviour and errors relating to flow-control. For instance, flow-control tokens may be withheld, either partially or completely, to explore a device's handling of low flow-control credit. Alternatively, too many flow-control tokens can be issued, which should eventually result in a SpaceWire error condition.

The highlighted blocks below show which Error Injection events can be generated.

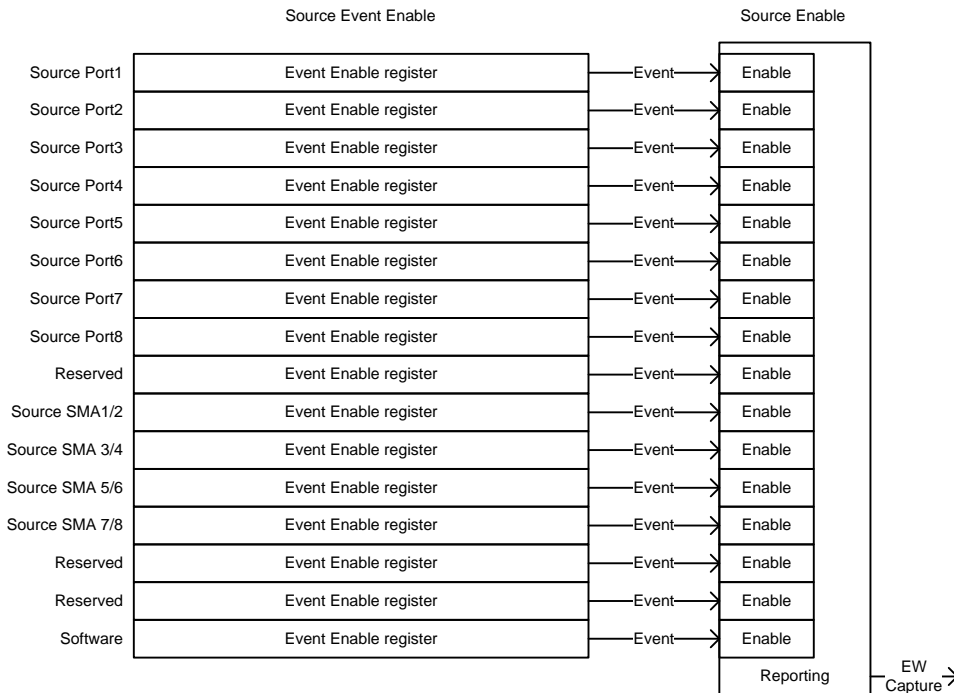


The use of the EI feature is covered in the Software User Guide and C-API Programmers Guide.

## 4.5 EW Event/Error Waveforms

Each SpaceWire port has an associated waveform store that captures transmit and receive wire signals for that port. Waveform captures can be triggered on a wide variety of events on that and/or other ports. It is possible, for example, to capture wire signals for all ports after a trigger signal on one port.

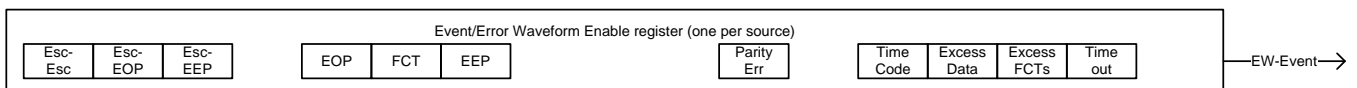
The diagram below shows how the triggering architecture is implemented for Event/Error Waveforms for all the 4Links products (with the EW option).



A Source Event Enable register for each source selects which events drive the combined event signal for that source. These event signals feed a Source Enable register which select which source event signals are used to drive the capture signal.

With this approach it is possible to select different Events per source and which sources are used to implement an Event/Error Waveform (EW) Capture.

For the DSI the first two ports are implemented and for the SLR only the first port is implemented. The highlighted blocks below show which error/events can be generated per source.



The use of the EW feature is covered in the Software User Guide and C-API Programmers Guide.

## 4.5.1 EW Sources

The DSI and SLR have the following trigger sources used for EW capture. The DSI only uses source 1&2 while the SLR only uses source 1. The remaining source IDs are shown for compatibility and reference with the Classic 1U product.

ID	Source	DSI	SLR	Description
1	SpW Port1	Yes	Yes	Event on SpW port 1
2	SpW Port2	Yes	-	Event on SpW port 2
3	SpW Port3	-	-	<i>Reserved</i>
4	SpW Port4	-	-	<i>Reserved</i>
5	SpW Port5	-	-	<i>Reserved</i>
6	SpW Port6	-	-	<i>Reserved</i>
7	SpW Port7	-	-	<i>Reserved</i>
8	SpW Port8	-	-	<i>Reserved</i>
9	<i>Reserved</i>	-	-	<i>Reserved</i>
A	SMA 1/2 Rising Edge	-	-	<i>Reserved</i>
B	SMA 3/4 Rising Edge	-	-	<i>Reserved</i>



<b>C</b>	SMA 5/6 Rising Edge	-	-	<i>Reserved</i>
<b>D</b>	SMA 7/8 Rising Edge	-	-	<i>Reserved</i>
<b>E</b>	<i>Reserved</i>	-	-	<i>Reserved</i>
<b>F</b>	<i>Reserved</i>	-	-	<i>Reserved</i>
<b>0</b>	<i>Software</i>	-	-	<i>Reserved</i>

## 5 Electrical / Mechanical Characteristics

### 5.1 Environment

The system is for use only in environments having EU Pollution degree 2 or better (i.e. normally only non-conductive pollution; temporary condensation is allowable). This is expected to include offices, laboratories, test stations and clean-rooms.

Altitude: up to 2000 m

Humidity 0-90% non-condensing

Temperature: 5 to 35°C. Note: The ventilation holes on the sides of the module must not be obstructed.

### 5.2 Product Safety

Review the following safety precautions to avoid injury and prevent damage to this product or to any products connected to it.

To avoid potential hazards, use this product only as specified.

There are no user-serviceable parts inside this equipment.

- Do not remove covers.
- Do not operate with suspected failures. If you suspect that there is damage to this product, refer to 4Links for advice.
- Do not operate in wet or damp conditions.
- Do not operate in an explosive atmosphere.
- Keep product surfaces clean and dry.
- Provide proper ventilation. The air vents on the side panels must not be obstructed.

### 5.3 Enclosure Physical

#### 5.3.1 Dimensions

Overall size: 240 mm deep by 170 mm high by 65 mm wide.

Weight: 1125 g (DSI or SLR); 1250 g (DSR)

### 5.4 Power Supply Physical

The power requirements of the are less than 15W when the enclosure is fully populated and operational.

The power supply provided is a PowerSolve PSE16A-12-01 unit with a 12V DC output and rated at 15 W.

#### 5.4.1 Dimensions

Overall size: 91 mm by 36 mm by 36 mm

#### 5.4.1 Weight

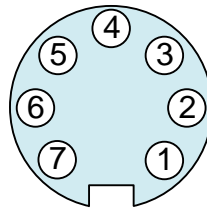
Weight: 165g

#### 5.4.2 Power Connector Pinout

A Binder 09 423 30 07 7-pin male chassis connector is mounted on the rear panel of the enclosure. The power supply carries a mating Binder 7-pin female cable connector, part number 99 0422 10 07.

The pinout of the male chassis connector (looking at the outside of the enclosure) is shown in the diagram below:

Pin	Signal
1	+12V
2	+12V
3	NC
4	0V
5	0V
6	0V
7	NC

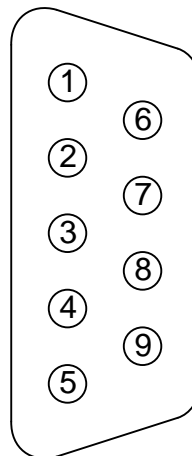


## 5.5 SpaceWire Connector Pinouts

Standard 9-way Micro-miniature D-type SpaceWire socket connectors are mounted on the front panel of the SRS routing switch modules.

The pinout of the SpaceWire socket connectors (looking at the outside of the SRS module) is shown in the diagram below:

Pin	Direction	Signal
1	Input	+Din
2	Input	+Sin
3		Ground
4	Output	+Sout
5	Output	-Dout
6	Input	-Din
7	Input	-Sin
8	Input	-Sout
9	Input	+Dout



## 5.6 Configuration Connector

The mini-USB connector on the front panel complies with USB2.0 and has the standard pinout.

## 6 Certificate of Conformity

The following information details the regulatory requirements and conformity of the products outlined below, according to ISO/IEC 17050-1:2004.

Manufacturer's Name: **4Links Limited**

Manufacturer's Address:

**Suite AL4, Bletchley Park,  
Sherwood Drive,  
Milton Keynes,  
MK3 6EB,  
United Kingdom.**

As originally delivered by 4Links Limited.

Product Name: **P-DSR, P-DSI, and P-SLR**

Product Model: **P-DSR, P-DSI2 and P-SLR2**

### 6.1 Electromagnetic Compatibility

The product was tested in a typical configuration as class A equipment.

Warning: This is a class A product. In a domestic environment, this product may cause radio interference, in which case the user may be required to take adequate measures.

#### 6.1.1 EU Certification

Complies with the essential requirements of the following applicable European Directive and carries the CE marking accordingly:

**EMC Directive 2014/30/EU**

and conforms with the following test specifications:

<b>EN 55032:2015</b>	<b>EN 55024:2010 + A1:2015</b>
<b>EN 55016-1-2:2014</b>	<b>EN 55016-1-4:2010 + A1:2012</b>
<b>EN 61000-3-2:2014</b>	<b>EN 61000-3-3:2013</b>
<b>EN 61000-4-2:2009</b>	<b>EN 61000-4-3:2006 + A2:2010</b>
<b>EN 61000-4-4:2012</b>	<b>EN 61000-4-5:2015</b>
<b>EN 61000-4-6:2014</b>	<b>EN 61000-4-11:2004</b>

#### 6.1.2 USA Certification

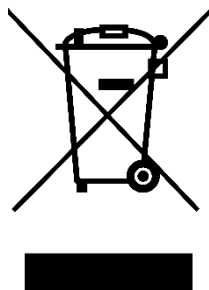
The products were tested and the emissions are within the limits of

**FCC CFR 47: Part 15.B:2015 for Class A equipment.**

## 6.2 Waste Electrical & Electronic Equipment (WEEE)

The symbol shown below indicates that this product complies with the European Union's requirements according to EU Directive **2012/19/EU** on waste electrical and electronic equipment (WEEE).

The black bar beneath the crossed out wheeled bin denotes that the product was put onto the market on August 13th 2005 or later, and thus falls under the WEEE directive.



## 6.3 Restriction of Hazardous Substances (RoHS)

Restriction of Hazardous Substances: This product has been classified as Monitoring and Control equipment and complies to the **2011/65/EU** RoHS Directive.

This Declaration of Conformity applies to products placed on the EU market after December 2018.

## 6.4 Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)

We hereby confirm that all products supplied by 4Links Limited are in conformity with European Regulations **1907/2006** REACH and that the following substances of very high concern (SVHC) as published by the European Chemicals Agency ([http://echa.europa.eu/chem\\_data/candidate\\_list\\_table\\_en.asp](http://echa.europa.eu/chem_data/candidate_list_table_en.asp)) have not been intentionally added nor believe to be contained in any of the materials used for production of any 4Links Limited products or may only be present below the accepted limit of 0.1%:

The equipment has been designed to comply with the relevant sections of the above referenced specifications. The equipment complies with all applicable Essential Requirements of the Directive.

This Declaration of Conformity applies to products placed on the EU market after December 2018.

Signed

Date



Spencer Saunders  
General Manager

31<sup>st</sup> December 2018



## 7 Statement of Volatility

The module contains memory presented as a USB Mass Storage Device (Flash drive). The size of this Flash drive is 64MB

This Flash drive is used for configuration data and support programs only, no data or information is logged to the Flash drive with 4Links software or firmware. However as it is a Flash Drive when seen from a HOST PC it is possible for users to write files to it.

To erase the Flash Drive the user can connect it to a HOST PC and use their preferred software to wipe the contents.

Once the Flash disk is erased all original files and functionality will be removed - along with any other files added by users.

Functionality can be restored by writing appropriate files to the module. Customers may take a reference copy of the files when the module is first used or obtain a reference set from 4Links. Note: some of the files are encrypted for the specific module and will not work if moved between devices.

## 8 FMECA

Subject to having a non-disclosure agreement (NDA) in place, a Failure Mode, Effects and Criticality Analysis (FMECA) is available on request.