

# SpaceWire Electronic Ground Support Equipment (EGSE)

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#### STAR-Dundee Introduction

- What is the SpaceWire EGSE?
- How does it work?
  - Hardware
  - Software
- Scripting Language
- Capabilities/Benefits
- Examples

#### STAR-Dundee SpaceWire EGSE

- What it is: SpaceWire test and development unit developed by STAR-Dundee
- Purpose: Simulate instruments or other SpaceWire equipment in real time during testing and integration
- Generates user defined packets in pre-defined sequences at specific times and data rates

- i.e. packet 1 followed by packet 2 10ms later at 100Mbps

## STAR-Dundee SpaceWire EGSE Hardware



- 2 SpaceWire ports
- 4 External Triggers (3 IN, 1 OUT)
- Indicator LEDs
- 128MB Memory
- USB connection to host PC

## STAR-Dundee SpaceWire EGSE Software

## Compiler

Compiles scripts into EGSE configuration files

## Configurator

- Loads EGSE configuration files onto hardware
- Software API

Can be used to interact with EGSE whilst in operation

STAR-Dundee SpaceWire EGSE Scripting Language

- Packet Definition
- Variables
  - Used to define packets with dynamic data
- Packet Generation Schedules
- State Machines
  - Control current packet generation schedule
- Events
  - State machines reacts to events

Format

 Header, body, footer

packet myPkt hex(OA OB OC OD) eop end packet

Format

Header, body, footer

Data defined in hex or decimal

```
packet myPkt
hex(OA OB OC OD)
dec(1 2 3 4)
eep
end packet
```

Format

 Header, body, footer

 Data defined in hex or decimal
 EOP and EEP

control characters

```
packet myPkt
hex(OA OB OC OD)
dec(1 2 3 4)
eop
end packet
```

Format - Header, body, footer Data defined in hex or decimal EOP and EEP control characters CRC and checksum calculations

packet myPkt
start(crc8)
hex(OA OB OC OD)
dec(1 2 3 4)
stop(crc8)
eep
end packet

- Used to define packets with dynamic data
- Referenced in packet definition
- Types:
  - Increment

- Used to define packets with dynamic data
- Referenced in packet definition
- Types:
  - Increment
  - Decrement

variables myDecVar dec8 = 10 end variables packet myPkt hex(OA OB OC OD) myDecVar eop end packet

- Used to define packets with dynamic data
- Referenced in packet definition
- Types:
  - Increment
  - Decrement
  - Rotate Right

```
variables
    myRRVar ror8 = 1
end variables
packet myPkt
    hex(0A 0B 0C 0D)
    myRRVar
    eop
end packet
```

- Used to define packets with dynamic data
- Referenced in packet definition
- Types:
  - Increment
  - Decrement
  - Rotate Right
  - Rotate Left

```
variables
   myRLVar rol8 = 1
end variables
packet myPkt
   hex(OA OB OC OD)
   myRLVar
   eop
end packet
```

- Used to define packets with dynamic data
- Referenced in packet definition
- Types:
  - Increment
  - Decrement
  - Rotate Right
  - Rotate Left
  - Random

```
variables

myRandVar rnd = 0
end variables

packet myPkt

hex(OA OB OC OD)

myRandVar

eop
end packet
```

 Send pre-defined packets at specific times schedule mySchedule
 send myPkt1
 send myPkt2
end schedule

- Send pre-defined packets at specific times
- Specify the number of times to send packets

schedule mySchedule
 send myPkt1 \* 2
 send myPkt2
end schedule

- Send pre-defined packets at specific times
- Specify the number of times to send packets
- Timing
  - Relative to schedule start

```
packet myPkt1
hex(OA OB OC OD)
eop
end packet
```

•••

```
schedule mySchedule
    5ms send myPkt1
    send myPkt2
end schedule
```

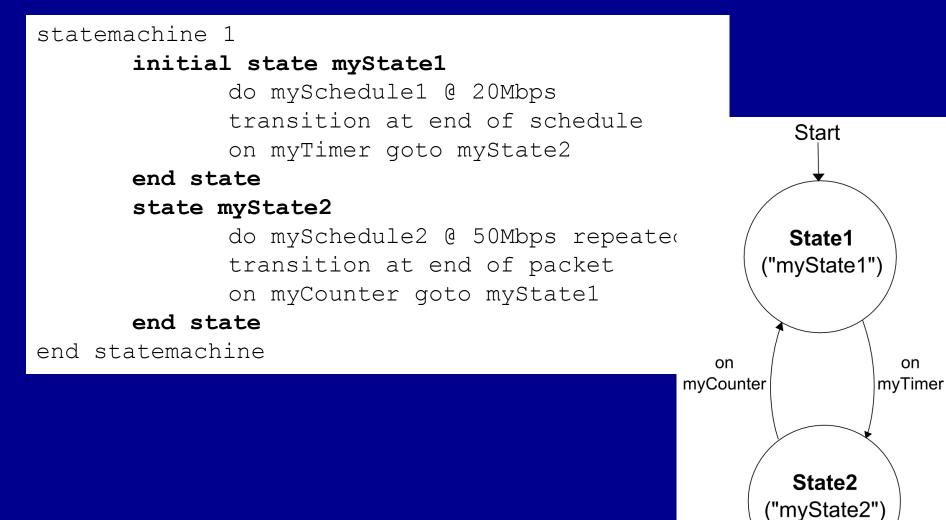
- Send pre-defined packets at specific times
- Specify the number of times to send packets
- Timing
  - Relative to schedule start
  - Relative to previous packet

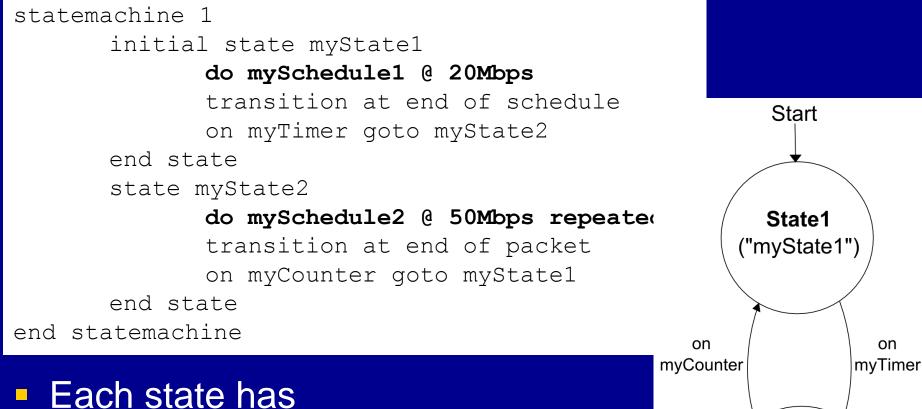
```
packet myPkt1
            hex(0A 0B 0C 0D)
            eop
end packet
...
```

```
schedule mySchedule
    5ms send myPkt1
    +5ms send myPkt2
end schedule
```

- Controls the EGSE state
- One state machine per SpaceWire interface
- Consists of state definitions

```
statemachine 1
initial state myState1
do mySchedule1 @ 20Mbps
transition at end of schedule
on myTimer goto myState2
end state
state myState2
do mySchedule2 @ 50Mbps repeatedly
transition at end of packet
on myCounter goto myState1
end state
end statemachine
```

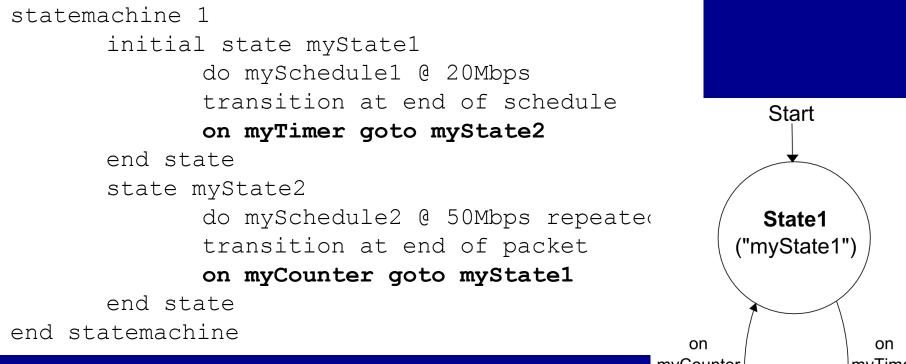




State2

("myState2")

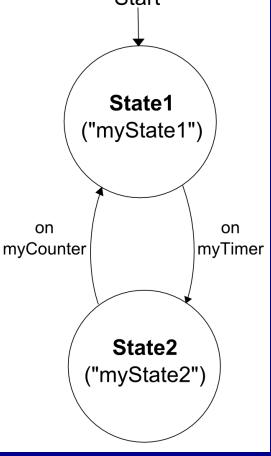
- - a schedule

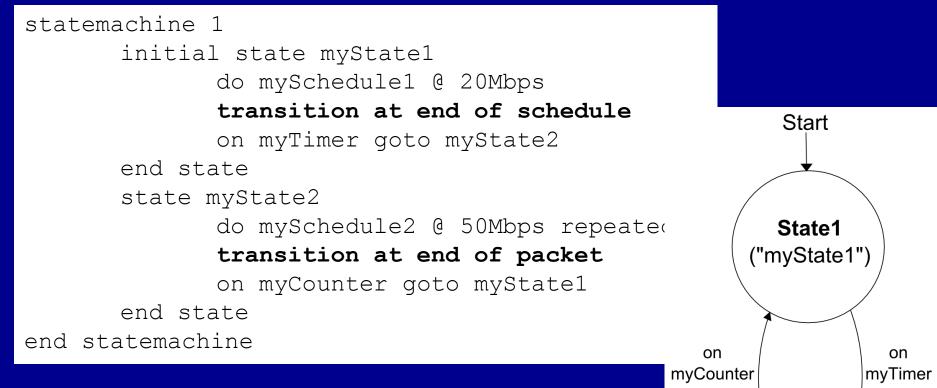


### Each state has

– a schedule

– conditions under which to change state





State2

("myState2")

### Each state has

- a schedule
- conditions under which to change state
- when to change state



- State machines react to events, changing state and therefore schedule
- Pre-defined events
  - Include: Link started, link errors, time-code received and packet generation events
- User defined events

- State machine reacts to events, changing state and therefore schedule
- Pre-defined events
  - Include: Link started, link errors, time-code received and packet generation events
- User defined events
  - Timers

```
timers
myTimer 10ms start on mySWEvent
end timers
```

- State machine reacts to events, changing state and therefore schedule
- Pre-defined events
  - Include: Link started, link errors, time-code received and packet generation events
- User defined events
  - Timers
  - Counters

counters myCounter 10 on myTrigIn1 end counters

- State machine reacts to events, changing state and therefore schedule
- Pre-defined events
  - Include: Link started, link errors, time-code received and packet generation events
- User defined events
  - Timers
  - Counters
  - Software

```
software
mySWEvent1 1
end software
```

- State machine reacts to events, changing state and therefore schedule
- Pre-defined events
  - Include: Link started, link errors, time-code received and packet generation events
- User defined events
  - Timers
  - Counters
  - Software

```
triggers
```

```
myTrigIn1 input 1 rising
output high on myTimer
end software
```

External triggers

## Requirements

 Simulate an instrument sending house keeping information, consisting of four pre-defined packets, every two seconds at 200Mbps.

#### SpaceWire Link Analyser Mk2 (Serial Number: 35100030) - [ ~~ Not Saved ~~ ]

<u>File View Find Settings Trigger H</u>elp 📾 🖪 🗙 🕨 🔳 👪 🌬?

| Time From            | n Trigger Ti                      | ime Delta End                         | A                | End A Delta | End B | End B Delta                           |
|----------------------|-----------------------------------|---------------------------------------|------------------|-------------|-------|---------------------------------------|
| 0 ns                 | 50.00                             | Header: 01                            | 50               |             |       | <b>^</b>                              |
| 50 ns                | 50 ns                             | Cargo Size: 10 bytes                  | 50 ns            |             |       |                                       |
| 520 ns               | 470 ns                            | EOP                                   | 470 ns           |             |       |                                       |
| 570 ns               | 50 ns                             | Header: 02                            | 50 ns            |             |       |                                       |
| 620 ns<br>1.090 µs   | 50 ns<br>470 ns                   | Cargo Size: 10 bytes<br>EOP           | 50 ns<br>470 ns  |             |       |                                       |
| 1.090 µs<br>1.140 µs | 470 hs<br>50 ns                   |                                       | 470 ns<br>50 ns  |             |       |                                       |
|                      | 50 hs                             | Header: 03                            |                  |             |       |                                       |
| 1.190 µs<br>1.660 µs | 470 ns                            | Cargo Size: 10 bytes                  | 50 ns<br>470 ns  |             |       |                                       |
| 1.710 µs             | 50 ns                             | EOP                                   | 470 hs<br>50 hs  |             |       | E                                     |
| 1.760 µs             | 50 hs                             | Header: 04                            | 50 ns            |             |       |                                       |
| 2.230 µs             | 470 ns                            | Cargo Size: 10 bytes<br>EOP           | 50 lis<br>470 ns |             |       |                                       |
| 1.99999683 s         | 1.9999946 s                       | Header: 01                            | 1.99999          | 16.0        |       |                                       |
| 1.99999688 s         | 50 ns                             | Cargo Size: 10 bytes                  | 50 ns            | +0 5        |       |                                       |
| 1.999999735 s        | 470 ns                            | EOP                                   | 470 ns           |             |       |                                       |
| 1.9999974 s          | 50 ns                             | Header: 02                            | 470 hs           |             |       |                                       |
| 1.99999745 s         | 50 ns                             |                                       |                  |             |       |                                       |
| 1.99999745 s         | 470 ns                            | Cargo Size: 10 bytes<br>EOP           | 50 ns<br>470 ns  |             |       |                                       |
| 1.99999792 s         | 50 ns                             |                                       | 470 hs<br>50 hs  |             |       |                                       |
| 1.999999802 s        | 50 hs                             | Header: 03                            | 50 lis           |             |       |                                       |
| 1.99999802 s         | 470 ns                            | Cargo Size: 10 bytes<br>EOP           | 50 lis<br>470 ns |             |       |                                       |
| 1.99999854 s         | 50 ns                             |                                       | 470 hs           |             |       |                                       |
| 1.99999854 s         | 50 hs                             | Header: 04<br>Cargo Size: 10 bytes    | 50 ns            |             |       |                                       |
| 1.99999906 s         | 470 ns                            | EOP                                   | 470 ns           |             |       |                                       |
| 3.99999367 s         | 1,99999461 s                      | Header: 01                            | 1.99999          | 161 c       |       |                                       |
| 3.99999372 s         | 50 ns                             | Cargo Size: 10 bytes                  | 50 ns            | +015        |       |                                       |
| 3.99999419 s         | 470 ns                            | EOP                                   | 470 ns           |             |       |                                       |
| 3.99999424 s         | 50 ns                             | Header: 02                            | 50 ns            |             |       |                                       |
| 3.99999429 s         | 50 ns                             | Cargo Size: 10 bytes                  | 50 ns            |             |       |                                       |
| 3.99999476 s         | 470 ns                            | EOP                                   | 470 ns           |             |       |                                       |
| 3.99999481 s         | 50 ns                             | Header: 03                            | 50 ns            |             |       |                                       |
| 3.99999486 s         | 50 ns                             | Cargo Size: 10 bytes                  | 50 ns            |             |       |                                       |
| 3.99999533 s         | 470 ns                            | EOP                                   | 470 ns           |             |       |                                       |
| 3.99999538 s         | 50 ns                             | Header: 04                            | 50 ns            |             |       |                                       |
| 3.99999543 s         | 50 ns                             | Cargo Size: 10 bytes                  | 50 ns            |             |       |                                       |
| 3.9999959 s          | 470 ns                            | EOP                                   | 470 ns           |             |       |                                       |
| 5.99999042 s         | 1.99999452 s                      | Header: 01                            | 1.99999          | 452 s       |       |                                       |
| 5.99999047 s         | 50 ns                             | Cargo Size: 10 bytes                  | 50 ns            |             |       |                                       |
| 5.99999094 s         | 470 ns                            | EOP                                   | 470 ns           |             |       |                                       |
| 5.99999099 s         | 50 ns                             | Header: 02                            | 50 ns            |             |       |                                       |
| 5.99999104 s         | 50 ns                             | Cargo Size: 10 bytes                  | 50 ns            |             |       |                                       |
| 5.99999151 s         | 470 ns                            | EOP                                   | 470 ns           |             |       |                                       |
| 5.99999156 s         | 50 ns                             | Header: 03                            | 50 ns            |             |       |                                       |
| 5.99999161 s         | 50 ns                             | Cargo Size: 10 bytes                  | 50 ns            |             |       | -                                     |
| 5.99999208 s         | 470 ns                            | EOP                                   | 470 ns           |             |       |                                       |
| 5.99999213 s         | 50 ns                             | Header: 04                            | 50 ns            |             |       |                                       |
| 5.99999218 s         | 50 ns                             | Cargo Size: 10 bytes                  | 50 ns            |             |       |                                       |
| 5.99999265 s         | 470 ns                            | EOP                                   | 470 ns           |             |       |                                       |
| 7.99998726 s         | 1.99999461 s                      | Header: 01                            | 1.99999          | 461 s       |       |                                       |
| ▲                    |                                   |                                       |                  |             |       |                                       |
| FC                   | Data View                         | Bit Width                             | Byte Settings    |             |       | -                                     |
| Expand All           |                                   |                                       |                  |             |       |                                       |
|                      | Data OASCII OInteger              | 8 Bit (Byte) 32 Bit (DWord) LSB First | Dates Des Deux   |             |       | -                                     |
| Collapse All         | Protocol   Hex                    | O 16 Bit (Word) O 64 Bit (OWord)      | Bytes Per Row 8  |             |       |                                       |
|                      | Protocol   Hex                    | 16 Bit (Word)                         |                  |             |       |                                       |
|                      |                                   |                                       |                  |             |       |                                       |
|                      | Packet Display Bit-Stream Display |                                       |                  |             |       |                                       |
| Complete             |                                   |                                       |                  |             |       | End A: 200.002 MHz End B: 200.002 MHz |

#### SpaceWire Link Analyser Mk2 (Serial Number: 35100030) - [ ~~ Not Saved ~~ ]

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| Time From Trigger  | Time Delta           | End A                    | End A Delta  | End B    | End B Delta                           |
|--|----------------------|--------------------------|--------------|----------|---------------------------------------|
| 0 ns   |                      | Header: 01               |              |          |                                       |
| 50 ns  | 50 ns                | Cargo Size: 10 bytes     | 50 ns        |          |                                       |
| 520 ns   | 470 ns               | EOP                      | 470 ns       |          |                                       |
| 570 ns   | 50 ns                | Header: 02               | 50 ns        |          |                                       |
| 620 ns   | 50 ns                | Cargo Size: 10 bytes     | 50 ns        |          |                                       |
| 1.090 µs   | 470 ns               | EOP                      | 470 ns       |          |                                       |
| 1.140 µs   | 50 ns                | Header: 03               | 50 ns        |          |                                       |
| 1.190 µs   | 50 ns                | Cargo Size: 10 bytes     | 50 ns        |          |                                       |
| 1.660 µs   | 470 ns               | EOP                      | 470 ns       |          |                                       |
| 1.710 µs   | 50 ns                | Header: 04               | 50 ns        |          |                                       |
| 1.760 µs   | 50 ns                | Cargo Size: 10 bytes     | 50 ns        |          |                                       |
| 2.230 µs   | 470 ns               | EOP                      | 470 ns       |          |                                       |
| 1.99999683 s   | 1.9999946 s          | Header: 01               | 1.9999946 s  |          |                                       |
| 1.99999688 s   | 50 ns                | Cargo Size: 10 bytes     | 50 ns        |          |                                       |
| 1.99999735 s   | 470 ns               | EOP                      | 470 ns       |          |                                       |
| 1.9999974 s  | 50 ns                | Header: 02               | 50 ns        |          |                                       |
| 1.99999745 s   | 50 ns                | Cargo Size: 10 bytes     | 50 ns        |          |                                       |
| 1.99999792 s   | 470 ns               | EOP                      | 470 ns       |          |                                       |
| 1.99999797 s   | 50 ns                | Header: 03               | 50 ns        |          |                                       |
| 1.99999802 s   | 50 ns                | Cargo Size: 10 bytes     | 50 ns        |          |                                       |
| 1.99999849 s   | 470 ns               | EOP                      | 470 ns       |          |                                       |
| 1.99999849 s<br>1.99999854 s   | 50 ns                | Header: 04               | 50 ns        |          |                                       |
| 1.99999859 s   | 50 ns                | Cargo Size: 10 bytes     | 50 ns        |          |                                       |
| 1.99999906 s   | 470 ns               |                          | 470 ns       |          |                                       |
|  |                      | EOP                      |              |          |                                       |
| 3.99999367 s   | 1.99999461 s         | Header: 01               | 1.99999461 s |          |                                       |
| 3.99999372 s   | 50 ns                | Cargo Size: 10 bytes     | 50 ns        |          |                                       |
| 3.99999419 s   | 470 ns               | EOP                      | 470 ns       |          |                                       |
| 3.99999424 s   | 50 ns                | Header: 02               | 50 ns        |          |                                       |
| 3.99999429 s   | 50 ns                | Cargo Size: 10 bytes     | 50 ns        |          |                                       |
| 3.99999476 s   | 470 ns               | EOP                      | 470 ns       |          |                                       |
| 3.99999481 s   | 50 ns                | Header: 03               | 50 ns        |          |                                       |
| 3.99999486 s   | 50 ns                | Cargo Size: 10 bytes     | 50 ns        |          |                                       |
| 3.99999533 s   | 470 ns               | EOP                      | 470 ns       |          |                                       |
| 3.99999538 s   | 50 ns                | Header: 04               | 50 ns        |          |                                       |
| 3.99999543 s   | 50 ns                | Cargo Size: 10 bytes     | 50 ns        |          |                                       |
| 3.9999959 s  | 470 ns               | EOP                      | 470 ns       |          |                                       |
| 5.99999042 s   | 1.99999452 s         | Header: 01               | 1.99999452 s |          |                                       |
| 5.99999047 s   | 50 ns                | Cargo Size: 10 bytes     | 50 ns        |          |                                       |
| 5.99999094 s   | 470 ns               | EOP                      | 470 ns       |          |                                       |
| 5.99999099 s   | 50 ns                | Header: 02               | 50 ns        | 200Mhz   |                                       |
| 5.99999104 s   | 50 ns                | Cargo Size: 10 bytes     | 50 ns        | 20010112 |                                       |
| 5.99999151 s   | 470 ns               | EOP                      | 470 ns       |          |                                       |
| 5.99999156 s   | 50 ns                | Header: 03               | 50 ns        |          |                                       |
| 5.99999161 s   | 50 ns                | Cargo Size: 10 bytes     | 50 ns        |          |                                       |
| 5.99999208 s   | 470 ns               | EOP                      | 470 ns       |          |                                       |
| 5.99999213 s   | 50 ns                | Header: 04               | 50 ns        |          |                                       |
| 5.99999218 s   | 50 ns                | Cargo Size: 10 bytes     | 50 ns        |          |                                       |
| 5.99999265 s   | 470 ns               | EOP                      | 470 ns       |          |                                       |
| 7.99998726 s   | 1.99999461 s         | Header: 01               | 1.99999461 s |          |                                       |
| **   | •                    |                          | -            |          |                                       |
| -Format Data   | View Bit Width       | Byte Settings            |              |          | -                                     |
| Expand All   |                      | 32 Bit (DWord) LSB First |              |          | -                                     |
|  |                      | Bytes Per Row 8          | <b>•</b>     |          |                                       |
| Protocol     Image: All O Protocol | ex O 16 Bit (Word) O | 04 DIL (QYV010)          |              |          |                                       |
| Character Display Packet Display Bit   | -Stream Display      |                          |              | _        |                                       |
| Complete   |                      |                          |              | ł        | End A: 200.002 MHz End B: 200.002 MHz |
|  |                      |                          |              |          |                                       |

#### SpaceWire Link Analyser Mk2 (Serial Number: 35100030) - [ ~~ Not Saved ~~ ]

Eile View Eind Settings Irigger Help

| Time From Trip and               | Time Delta          | End A                      | End & Dolta  | End P      | End B Dalta                           |
|----------------------------------|---------------------|----------------------------|--------------|------------|---------------------------------------|
| Time From Trager<br>0 ns         | Time Delta          | End A<br>Header: 01        | End A Delta  | End B      | End B Delta                           |
| 50 ns                            | 50 ns               | Cargo Size: 10 Dytes       | 50.00        |            |                                       |
| 520 ns                           | 470 ns              | EOP                        | 470 ns       |            |                                       |
| 570 ns                           | 50 ns               | Header: 02                 | 50 ns        | 2 seconds  |                                       |
| 620 ns                           | 50 ns               | Cargo Size: 10 bytes       | 50 ns        | 4 35601103 |                                       |
| 1.090 µs                         | 470 ns              | EOP                        | 470 pc       |            |                                       |
| 1.140 µs                         | 50 ns               | Header: 03                 | 50 ns        |            |                                       |
| 1.190 µs                         | 50 ns               | Cargo Size: 10 butc        | 50 ns        |            |                                       |
| 1.660 µs                         | 470 ns              | POP                        | 470 ns       |            |                                       |
| 1.710 µs                         | 50 ns               | Header: 04                 | 50 ns        |            | =                                     |
| 1.760 µs                         | 50 ps               | Cargo Size: 10 bytes       | 50 ns        |            |                                       |
| 2.230 µs                         | 470 ns              | EOP                        | 470 ns       |            |                                       |
| 1.99999683 s                     | 1.9999946 s         | Header: 01                 | 1.9999946 s  |            |                                       |
| 1.99999688 s                     | 50 ns               | Cargo Size: 10 bytes       | 50 ns        |            |                                       |
| 1.99999735 s                     | 470 ns              | EOP                        | 470 ns       |            |                                       |
| 1.9999974 s                      | 50 ns               | Header: 02                 | 50 ns        |            |                                       |
| 1.99999745 s                     | 50 ns               | Cargo Size: 10 bytes       | 50 ns        |            |                                       |
| 1.99999792 s                     | 470 ns              | EOP                        | 470 ns       |            |                                       |
| 1.99999797 s                     | 50 ns               | Header: 03                 | 50 ns        |            |                                       |
| 1.99999802 s                     | 50 ns               | Cargo Size: 10 bytes       | 50 ns        |            |                                       |
| 1.99999849 s                     | 470 ns              | EOP                        | 470 ns       |            |                                       |
| 1.99999854 s                     | 50 ns               | Header: 04                 | 50 ns        |            |                                       |
| 1.99999859 s                     | 50 ns               | Cargo Size: 10 bytes       | 50 ns        |            |                                       |
| 1.99999906 s                     | 470 ns              | EOP                        | 470 ns       |            |                                       |
| 3.99999367 s                     | 1.99999461 s        | Header: 01                 | 1.99999461 s |            |                                       |
| 3.99999372 s                     | 50 ns               | Cargo Size: 10 bytes       | 50 ns        |            |                                       |
| 3.99999419 s                     | 470 ns              | EOP                        | 470 ns       |            |                                       |
| 3.99999424 s                     | 50 ns               | Header: 02                 | 50 ns        |            |                                       |
| 3.99999429 s                     | 50 ns               | Cargo Size: 10 bytes       | 50 ns        |            |                                       |
| 3.99999476 s                     | 470 ns              | EOP                        | 470 ns       |            |                                       |
| 3.99999481 s                     | 50 ns               | Header: 03                 | 50 ns        |            |                                       |
| 3.99999486 s                     | 50 ns               | Cargo Size: 10 bytes       | 50 ns        |            |                                       |
| 3.99999533 s                     | 470 ns              | EOP                        | 470 ns       |            |                                       |
| 3.99999538 s                     | 50 ns               | Header: 04                 | 50 ns        |            |                                       |
| 3.99999543 s                     | 50 ns               | Cargo Size: 10 bytes       | 50 ns        |            |                                       |
| 3.9999959 s                      | 470 ns              | EOP                        | 470 ns       |            |                                       |
| 5.99999042 s                     | 1.99999452 s        | Header: 01                 | 1.99999452 s |            |                                       |
| 5.99999047 s                     | 50 ns<br>470 ns     | Cargo Size: 10 bytes       | 50 ns        |            |                                       |
| 5.99999094 s                     |                     | EOP                        | 470 ns       |            |                                       |
| 5.99999099 s<br>5.99999104 s     | 50 ns               | Header: 02                 | 50 ns        | 200M       | <u> </u>                              |
| 5.99999104 s                     | 470 ns              | Cargo Size: 10 bytes       | 470 ns       |            |                                       |
| 5.99999151 s                     | 50 ns               | EOP<br>Header: 03          | 50 ns        | •          |                                       |
| 5.99999161 s                     | 50 ns               | Cargo Size: 10 bytes       | 50 ns        |            |                                       |
| 5.99999208 s                     | 470 ns              | EOP                        | 470 ns       |            |                                       |
| 5.99999213 s                     | 50 ns               | Header: 04                 | 50 ns        |            | · · · · · · · · · · · · · · · · · · · |
| 5.99999218 s                     | 50 ns               | Cargo Size: 10 bytes       | 50 ns        |            |                                       |
| 5.99999265 s                     | 470 ns              | EOP                        | 470 ns       |            |                                       |
| 7.99998726 s                     | 1.99999461 s        | Header: 01                 | 1.99999461 s |            |                                       |
| A.T.                             |                     |                            |              |            |                                       |
| -Format                          | Data View Bit Width | Byte Settings              |              |            | -                                     |
| Expand All                       | Data View Bit Width | Byte Settings              |              |            |                                       |
| Data                             | ○ ASCII ○ Integer   | 32 Bit (DWord) 📃 LSB First |              |            | -                                     |
|                                  |                     | Bytes Per Ro               | w 8 💌        |            |                                       |
| Collapse All O Protocol          | Hex                 | 64 Bit (QWord)             |              |            |                                       |
|                                  |                     |                            |              |            | - N                                   |
| Character Display Packet Display | Bit-Stream Display  |                            |              |            |                                       |
|                                  | ·                   |                            |              |            |                                       |
| Complete                         |                     |                            |              |            | End A: 200.002 MHz End B: 200.002 MHz |
|                                  |                     |                            |              |            |                                       |

#### SpaceWire Link Analyser Mk2 (Serial Number: 35100030) - [ ~~ Not Saved ~~ ]

Eile View Eind Settings Trigger Help

| One         One         Constrained         Constrained <thconstraine< th=""><th></th><th></th><th></th><th></th><th></th><th></th></thconstraine<>   |  |                |                      |              |           |                                       |
|---|--|----------------|----------------------|--------------|-----------|---------------------------------------|
| Area     Orgin     <  |  | Time Delta     |                      | End A Delta  | End B     | End B Delta                           |
| 28 5     57 58     77 58     2 seconds       37 50     67 58     2 seconds       37 50     67 58     77 58       37 50     67 58     77 58       37 50     67 58     77 58       37 50     67 58     77 58       37 50     67 58     77 58       37 50     67 58     77 58       37 50     77 58     77 58  | 0 ns                                   |                | Header: 01           |              |           | ▲                                     |
| Physic     Dirac     Bolker, Cl.     Dirac     Dirac <thdirac< th="">     Dirac     Dirac     Dirac<td>50 ns</td><td></td><td></td><td>50.00</td><td></td><td></td></thdirac<>  | 50 ns                                  |                |                      | 50.00        |           |                                       |
| Synth   | 520 ns                                 |                | EOP                  | 470 ns       |           |                                       |
| Synth   | 570 ns                                 |                | Header: 02           | 50 ns        | seconds   |                                       |
| 14000     Open     Node: 10     Open     Open     Open       14000     Open     Open     Open     Open     Open       71000     Open     Open     Open     Open <td>620 ns</td> <td>50 ns</td> <td>Cargo Size: 10 bytes</td> <td>50 ns</td> <td></td> <td></td>   | 620 ns                                 | 50 ns          | Cargo Size: 10 bytes | 50 ns        |           |                                       |
| Hours     Oran     Mark Status     Oran  | 1.090 µs                               | 470 ns         | EOP                  | 470 pe       |           |                                       |
| 1904     Do B     Chron Starty 10 August 2010     Do B     Do B     Chron Starty 10 August 2010     Do B     Do  | 1.140 µs                               | 50 ns          | Header: 03           | 50 ns        |           |                                       |
| Sepurt     Affan     Affan     Affan     Affan     Affan     Affan       Sepurt     Sepurt     Affan     Affan     Affan     Affan       220 Ja     Affan     Affan     Affan     Affan     Affan       200 Ja     Affan     Affan     A  | 1.190 µs                               |                |                      |              |           |                                       |
| 710 pr       Sone  |  |                | POP                  |              |           |                                       |
| Topic       Output base is between the space       Open         2000000000000000000000000000000000000   |  |                | Header: 04           |              |           | =                                     |
| 2222 j       0 </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>   |  |                |                      |              |           |                                       |
| segends s stand s   |  |                |                      |              |           |                                       |
| segenda i on a segen   |  |                |                      |              |           |                                       |
| segent s i dona de la construction de la constructi  |  |                | header: 01           |              |           |                                       |
| 999974 s       00 ns       Beder: 0.       00 ns       2 Seconds         999974 s       00 ns       00 ns       00 ns       0 ns         999974 s       00 ns       00 ns       00 ns       0 ns         999974 s       00 ns       00 ns       00 ns       0 ns         999974 s       00 ns       00 ns       00 ns       0 ns         999994 s       40 ns       00 ns       00 ns       00 ns         999994 s       40 ns       00 ns       00 ns       00 ns         999994 s       40 ns       00 ns       00 ns       00 ns         999994 s       40 ns       00 ns       00 ns       00 ns         999994 s       40 ns       00 ns       00 ns       00 ns         999994 s       40 ns       00 ns       00 ns       00 ns         999994 s       40 ns       00 ns       00 ns       00 ns         999994 s       00 ns       00 ns       00 ns       00 ns         999994 s       00 ns       00 ns       00 ns       00 ns         999994 s       00 ns       00 ns       00 ns       00 ns         999994 s       00 ns       00 ns       00 ns       00 ns <td></td> <td></td> <td>Cargo Sansta</td> <td></td> <td></td> <td></td>   |  |                | Cargo Sansta         |              |           |                                       |
| segent proses and a final process and a final   |  |                |                      | 470 ns       |           |                                       |
| segent proses and a final process and a final   |  |                |                      | 50 ns        | ' seconds |                                       |
| 9999977s       0 0 ms       Boder: 01       00 0 ms       00 ms   |  |                |                      |              |           |                                       |
| segende s<br>segende s<br>segend s<br>segende s<br>segende s<br>segende s<br>segende s<br>segende s |  |                |                      |              |           |                                       |
| 99999945 s       470 ns       470 ns       470 ns         9999995 s       50 ns       60 ns       60 ns         999995 s       50 ns       60 ns       2000M nz         999995 s       50 ns       2000M nz       60 ns         999995 s       50 ns       20 ns       20 ns         999995 s       50 ns       80 ns       60 ns  |  |                |                      |              |           |                                       |
| 99999845 s       Sons       Hader: 04       Sons       Internet       Sons   | 1.99999802 s                           | 50 ns          | Cargo Size: 10 butch | 50 ns        |           |                                       |
| 9999999 s       501       Corp Stars 10 Pyces       50 ns       100 ns       1  |  |                | POP                  | 470 ns       |           |                                       |
| 9999999 s       501       Corp Stars 10 Pyces       50 ns       100 ns       1  | 1.99999854 s                           | 50 ns          | Header: 04           | 50 ns        |           |                                       |
| 9000000 s       1000 s       DDr       470 ns       10000000 s       100000000 s       1000000000 s       1000000000 s       1000000000 s       1000000000000000 s       1000000000000000000000000000000000000  | 1.99999859 s                           |                |                      |              |           |                                       |
| 39999375       19999413       19999413       19999413         9999372       60 ns       Bodert 02       50 ns       2         9999419       470 ns       Bodert 02       50 ns       2         9999424       50 ns       Bodert 02       50 ns       2         9999424       50 ns       Bodert 02       50 ns       2       SecondS         99994245       50 ns       Caroo State 10 yrete       50 ns       2       SecondS         99994245       50 ns       Caroo State 10 yrete       50 ns       2       SecondS         9999535       50 ns       Bodert 04       50 ns       60 ns       60 ns         9999953       50 ns       Bodert 04       50 ns       60 ns       60 ns         9999953       50 ns       Bodert 04       50 ns       60 ns       60 ns         9999953       50 ns       Bodert 01       19994452 s       60 ns       2000M z       70 ns         9999955       50 ns       Bodert 03       Bodert 03       50 ns       2000M z       70 ns         99999055       50 ns       Bodert 03       50 ns       2000M z       70 ns       70 ns         99999055       50 ns       Bodert 03   |  | 1470 ns        |                      | 470 ns       |           |                                       |
| 9999972 s       01 s       00 s       00 s       00 s       00 s         9999972 s       00 s       00 s       00 s       00 s       00 s         9999972 s       00 s       00 s       00 s       00 s       00 s         9999972 s       00 s       00 s       00 s       00 s       00 s         9999978 s       470 ns       80 s       00 s       00 s       00 s         9999978 s       60 ns       00 s       00 s       00 s       00 s         9999978 s       60 ns       00 s       00 s       00 s       00 s         9999978 s       60 ns       00 s       00 s       00 s       00 s       00 s         9999978 s       60 ns       00 s       00 s       00 s       00 s       00 s       00 s         9999978 s       60 ns       00 s       00 s </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>   |  |                |                      |              |           |                                       |
| 99999419s 470 ns BOP 170 s<br>99999428s 50 ns Carpo State 10 bytes 50 ns 2 seconds<br>9999428s 50 ns Carpo State 10 bytes 50 ns 2 seconds<br>999948ts 50 ns Carpo State 10 bytes 50 ns 470 ns 50   |  |                |                      |              |           |                                       |
| 99999424 6       90 ns       2 seconds         99999425 5       50 ns       Cargo State 10 bytes       50 ns       2 seconds         99999475 5       470 ns       20 ms       2 seconds       1         99999475 5       50 ns       Cargo State 10 bytes       50 ns       1         99999475 5       50 ns       Cargo State 10 bytes       50 ns       1         99999475 5       50 ns       Cargo State 10 bytes       50 ns       1         9999953 5       50 ns       Cargo State 10 bytes       50 ns       1         9999953 5       10 ns       Cargo State 10 bytes       50 ns       1         9999953 5       10 ns       Cargo State 10 bytes       50 ns       1         9999947 5       50 ns       Cargo State 10 bytes       50 ns       2000Miz         9999947 5       50 ns       Cargo State 10 bytes       50 ns       2000Miz         9999947 5       50 ns       Cargo State 10 bytes       50 ns       2000Miz         9999947 5       50 ns       Cargo State 10 bytes       50 ns       2000Miz         9999947 5       50 ns       Cargo State 10 bytes       50 ns       2000Miz         9999915 s       50 ns       Cargo State 10 bytes       50  |  |                | FUD                  |              |           |                                       |
| 99999475 6 470 ns BCP 470 ns 670 ns 640er 10 50 ns 670 ns   |  |                |                      | 50 ns        |           |                                       |
| 99999475 6 470 ns BCP 470 ns 670 ns 640er 10 50 ns 670 ns   |  |                |                      | 50 ns        | seconds   |                                       |
| 99999481s 50 ns 6 cryo Size: 10 byree 60 ns 1 19999482 s<br>9999953s 470 ns Cryo Size: 10 byree 60 ns 1 19999482 s<br>9999953s 50 ns 6 cryo Size: 10 byree 70 ns 1 19999482 s<br>9999950s 50 ns 6 cryo Size: 10 byree 60 ns 1 19999482 s<br>9999904 s 470 ns 6 cryo Size: 10 byree 60 ns 1 19999482 s<br>9999904 s 470 ns 6 cryo Size: 10 byree 60 ns 1 19999482 s<br>9999904 s 470 ns 6 cryo Size: 10 byree 60 ns 1 19999482 s<br>999904 s 470 ns 6 cryo Size: 10 byree 60 ns 1 19999482 s<br>999904 s 470 ns 6 cryo Size: 10 byree 60 ns 1 19999482 s<br>999904 s 470 ns 6 cryo Size: 10 byree 60 ns 1 19999482 s<br>999904 s 470 ns 6 cryo Size: 10 byree 60 ns 1 19999482 s<br>999904 s 50 ns 6 cryo Size: 10 byree 60 ns 1 19999482 s<br>999904 s 50 ns 6 cryo Size: 10 byree 60 ns 1 19999482 s<br>999905 s 50 ns 6 cryo Size: 10 byree 60 ns 1 19999482 s<br>999915 s 50 ns 6 cryo Size: 10 byree 60 ns 1 10 10 10 10 10 10 10 10 10 10 10 10 1  |  |                |                      | 30 IIS       | 00001100  |                                       |
| 99999486 s 50 ns 6 20 ns 70 ns 800 470 ns 800 470 ns 90 ns 1 1 1 1999942 5 50 ns 1 1 1 1999942 5 5 1 1 1 1 1 1999942 5 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1  |  |                |                      |              |           |                                       |
| 99999533 s       470 ns       800       470 ns       470 ns         99999533 s       50 ns       Carpo Size: 10 bytes       50 ns       50 ns         9999953 s       90 ns       60 ns       50 ns       50 ns         9999953 s       90 ns       60 ns       50 ns       50 ns         99999543 s       50 ns       50 ns       50 ns       50 ns         99999042 s       19999452 s       Beader: 01       19999452 s         9999904 s       470 ns       2000Mbz       50 ns         9999904 s       50 ns       800 ms       60 ns         9999915 s       50 ns       800 ms       60 ns         9999916 s       50 ns       2000Mbz       50 ns         9999915 s       50 ns       60 ns       800 ms         9999915 s       50 ns       60 ns       90 ms         999915 s       50 ns       60 ns       90 ms         999915 s       50 ns       60 ns       90 ms         999915 s       50 ns       60 ns       90 ms         9999201 s       50 ns       60 ns       90 ms         9999201 s       50 ns       90 ms       90 ms         9999201 s       50 ns       60 ns   |  |                |                      |              |           |                                       |
| 99999538 s       50 ns       50 ns       50 ns       50 ns         9999954 s       50 ns       20P       470 ns       50 ns         9999942 s       19999425 s       19999425 s       19999425 s       19999425 s         9999954 s       50 ns       64 ns       50 ns       67 ns       19999425 s         9999942 s       50 ns       64 ns       50 ns       67 ns       19999425 s         9999943 s       50 ns       64 ns       50 ns       67 ns       67 ns         9999945 s       50 ns       64 ns       50 ns       67 ns       67 ns         9999945 s       50 ns       64 ns       50 ns       67 ns       50 ns       67 ns         9999945 s       50 ns       60 ns       60 ns       50 ns       60 ns       60 ns         9999945 s       50 ns       60 ns       60 ns       50 ns       60 ns       60 ns         9999945 s       50 ns       60 ns       60 ns       60 ns       60 ns       60 ns         9999945 s       50 ns       60 ns   |  |                |                      |              |           |                                       |
| 98999543 s       50 ns       Cargo Size: 10 bytes       50 ns       470 ns         9899959 s       1999942 s       Header: 01       1999942 s       1999942 s         9899904 s       50 ns       Cargo Size: 10 bytes       50 ns       200         9899904 s       50 ns       Cargo Size: 10 bytes       50 ns       200         9899904 s       50 ns       Cargo Size: 10 bytes       50 ns       200         9899904 s       50 ns       Cargo Size: 10 bytes       50 ns       200         9899915 s       470 ns       20P       470 ns       200         9899915 s       50 ns       Cargo Size: 10 bytes       50 ns       200         9899915 s       470 ns       20P       470 ns       20         9899915 s       50 ns       Cargo Size: 10 bytes       50 ns       30 ns         9899915 s       50 ns       Cargo Size: 10 bytes       50 ns       30 ns       30 ns         9899915 s       50 ns       Bader: 03       50 ns       30 ns       30 ns       30 ns         98999213 s       50 ns       Bader: 04       50 ns       30 ns       30 ns       30 ns       30 ns       30 ns         98999221 s       19999461 s       Bader: 01  |  |                | EOP                  |              |           |                                       |
| 3999999 s       10015       002       470 ns       11       19999425 s       11       19999425 s       11       19999425 s       11  |  |                |                      |              |           |                                       |
| 19999942s       1999942s       1999942s       1999942s       1999942s         9999947s       50 ns       Cargo Size: 10 bytes       60 ns       2000Mnz       19999945         999994s       470 ns       2000Mnz       50 ns       2000Mnz       1999945         9999916s       50 ns       Cargo Size: 10 bytes       50 ns       2000Mnz       19999461         9999916s       50 ns       Cargo Size: 10 bytes       50 ns       2000Mnz       19999461         9999916s       50 ns       Cargo Size: 10 bytes       60 ns       19999461       19999461         9999916s       50 ns       Bader: 03       50 ns       19999213       50 ns       19999213         9999920s       470 ns       BDP       470 ns       19999461 s       90 ns       19999451 s         9999921s       50 ns       Bader: 04       50 ns       19999461 s       1   |  | 50 ns          | Cargo Size: 10 bytes |              |           |                                       |
| 99999047 s       50 ns       64rop Sizer 10 bytes       50 ns       60 ns       200Mhz       -         99999045 s       50 ns       60 ns       200Mhz       -  | 3.9999959 s                            | +/ U NS        | EOP                  | 470 ns       |           |                                       |
| 39999094 s       470 ns       Bod       470 ns       200Mhz         39999094 s       50 ns       Beader: 02       50 ns       200Mhz         39999151 s       470 ns       BDP       470 ns       30 ns         39999151 s       50 ns       Beader: 03       50 ns       50 ns         39999216 s       50 ns       Bader: 04       50 ns       50 ns         39999216 s       50 ns       BDP       470 ns       90 ns         39999216 s       50 ns       BDP       470 ns       90 ns         39999216 s       50 ns       BDP       470 ns       90 ns         39999216 s       470 ns       50 ns       90 ns       90 ns         39999216 s       470 ns       BDP       470 ns       90 ns         39999216 s       470 ns       19999461 s       90 ns       90 ns         3999270 s       19999461 s       19999461 s       19999461 s       90 ns         Collapse All       Protocol   | 5.99999042 s                           | 1.99999452 s   | Header: 01           | 1.99999452 s |           |                                       |
| 39999009 s       50 ns       Header: 02       50 ns       200VADZ       -         19999104 s       50 ns       Cargo Size: 10 bytes       50 ns       60 ns       -         9999915 s       470 ns       BDP       470 ns       -       -         9999915 s       50 ns       Header: 03       50 ns       -       -         9999915 s       50 ns       Cargo Size: 10 bytes       50 ns       -       -         9999913 s       50 ns       Cargo Size: 10 bytes       50 ns       -       -         9999913 s       50 ns       Cargo Size: 10 bytes       50 ns       -       -         9999921 s       50 ns       Cargo Size: 10 bytes       50 ns       -       -         9999921 s       50 ns       Cargo Size: 10 bytes       50 ns       -       -         9999272 s       19999461 s       Beader: 01       19999461 s       -       -         9999272 s       19999461 s       Beader: 01       19999461 s       -       -       -         9999273 s       0 ns       Beader: 01       19999461 s       -       -       -       -         9999278 s       19999461 s       Beader: 01       19999461 s       -   | 5.99999047 s                           | 50 ns          | Cargo Size: 10 bytes | 50 ns        |           |                                       |
| 39999104 s       50 ns       Cargo Size: 10 bytes       50 ns       90 ns   | 5.99999094 s                           | 470 ns         |                      | 470 ns       | 00014     |                                       |
| 39999104 s       50 ns       Cargo Size: 10 bytes       50 ns       90 ns   | 5.99999099 s                           |                |                      |              | 200M/h    | 7                                     |
| 39999151s       470 ns       BDP       470 ns       -         39999151s       50 ns       60 ns       60 ns       -         39999208 s       470 ns       BDP       470 ns       -         39999208 s       470 ns       BDP       470 ns       -         39999208 s       470 ns       BDP       470 ns       -         39999208 s       50 ns       BDP       470 ns       -         39999208 s       50 ns       Cargo Size: 10 bytes       50 ns       -         39999208 s       50 ns       Bader: 04       50 ns       -         39999208 s       470 ns       BDP       470 ns       -         39999208 s       470 ns       Bop       -       -         3999926 s       19999941 s       Beder: 01       19999941 s       -         Collapse All       ASCII       Integer       Bit Wdth       Sit (BWord)  |  |                |                      |              |           |                                       |
| 39999156 s       50 ns       60 ns       60 ns       60 ns       60 ns         99999161 s       50 ns       Cargo Size: 10 bytes       50 ns       60 ns       60 ns       60 ns         99999208 s       470 ns       BDP       470 ns       50 ns       60 ns   |  |                |                      |              |           |                                       |
| 39999161 s       50 ns       50 ns       50 ns       9099208 s       470 ns       BDP       470 ns       9099208 s       470 ns       9099208 s       50 ns       9099208 s       50 ns       9099218 s       50 ns       9099218 s       50 ns       90992218 s       50 ns       9099226 s       90 ns       90 ns       9099226 s       90 ns       9099226 s       90 ns       9099226 s       90 ns       90 ns <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>  |  |                |                      |              |           |                                       |
| 39999208 s       470 ns       BOP       470 ns       9999213 s       50 ns       9999213 s       50 ns       9099213 s       909 ns       909221 s       909 ns       909221 s       909221 s       90 ns       909221 s       900 s       909221 s       9001 s       909221 s       9001 s       909221 s       9001 s  |  |                |                      |              |           |                                       |
| i99999213 s       50 ns       60 ns       60 ns       9999218 s       50 ns       9999218 s       60 ns       9999218 s       60 ns       9999218 s       60 ns       9999218 s       60 ns       9999218 s       90 ns   |  |                |                      |              |           |                                       |
| 39999218 s       50 ns       Cargo Size: 10 bytes       50 ns       9099265 s       470 ns       BDP       470 ns       9099265 s       470 ns       9099265 s       470 ns       9099265 s       19999265 s <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>   |  |                |                      |              |           |                                       |
| 39999265 s       470 ns       20P       470 ns       9998265 s       19999461 s       19999461 s       19999461 s       -         9998265 s       1.9999461 s       Beader: 01       1.9999461 s       - <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td></t<>  |  |                |                      |              |           |                                       |
| 1.99998726 s       1.9999461 s       1.9999461 s       Image: second s  |  |                |                      |              |           |                                       |
| Expand All       Format       Data       Data       Bit Width       Bit Width       Bytes Settings         Collapse All       Protocol       Hex       16 Bit (Word)       LSB First       Bytes Per Row       Bytes Per Row         Character Display       Packet Display       Bit-Stream Display       Bit-Stream Display       Bit-Stream Display  |  |                |                      |              |           |                                       |
| Expand All       Format       Data View       Bit Width       Bit Width       Bit Width       Byte Settings         Collapse All       Protocol       Hex       16 Bit (Word)       64 Bit (QWord)       LSB First       Bytes Per Row       Bytes Per Row       Image: Character Display       Bit-Stream Display       Bit-Stream Display       Bit-Stream Display       Image: Character Display       Bit-Stream Display       Image: Character Display   |  | 1.999994015    | neader: 01           | 1.999994015  |           | <b>_</b> −                            |
| Expand All   © Data   O Data   O Protocol     Hex     16 Bit (Word)     Bit Stream Display     Bit-Stream Display   Bytes Per Row 8   |  |                |                      |              |           |                                       |
| Collapse All        • Protocol       • Hex       • 16 Bit (Word)       • 64 Bit (QWord)       • 64 Bit (QWo  | Expand All                             |                |                      |              |           |                                       |
| Character Display Packet Display Bit-Stream Display   |  |                | Bytes Per Row 8      | -            |           |                                       |
|   |  |                |                      |              |           |                                       |
| Complete End A: 200.002 MHz End B: 200.002 MHz  | Character Display Packet Display Bit-S | Stream Display |                      |              |           |                                       |
|   | Complete                               |                |                      |              |           | End A: 200.002 MHz End B: 200.002 MHz |

## Requirements

 Simulate an instrument continuously sending packets in both directions over a SpaceWire link at 350Mbps.

#### SpaceWire Link Analyser Mk2 (Serial Number: 35100030) - [ ~~ Not Saved ~~ ]

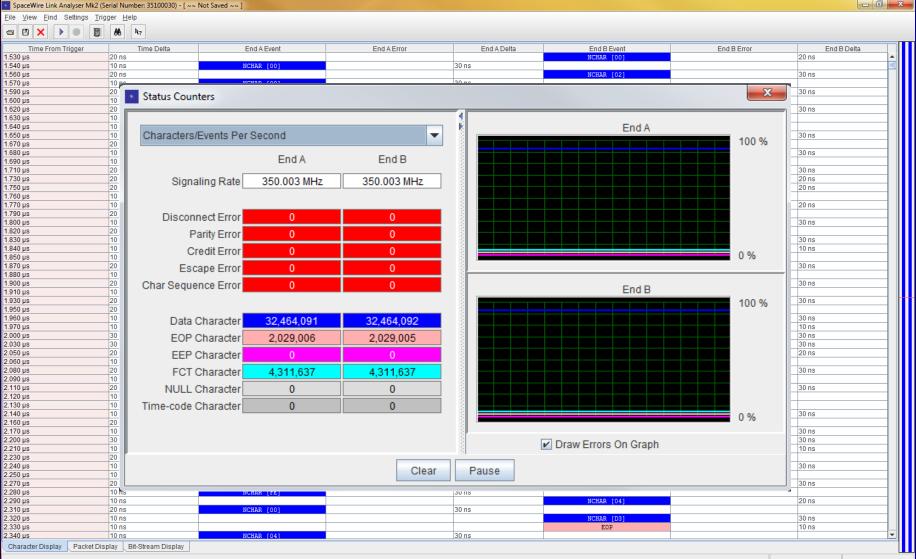
View Find Cottings Trigger Hole

| _ | _ |   |  | s Ing |    |            |  |
|---|---|---|--|-------|----|------------|--|
| - | 8 | × |  | 1     | 88 | <b>A</b> ? |  |

| Time From Trigger                     | Time Delta             | End A Event | End A Error | End A Delta | End B Event | End B Error | End B Delta |
|---------------------------------------|------------------------|-------------|-------------|-------------|-------------|-------------|-------------|
|                                       | 20 ns                  |             |             |             | NCHAR [00]  |             | 20 ns       |
|                                       | 10 ns                  | NCHAR [00]  |             | 30 ns       |             |             | <u> </u>    |
|                                       | 20 ns                  |             |             |             | NCHAR [02]  |             | 30 ns       |
|                                       | 10 ns                  | NCHAR [00]  |             | 30 ns       |             |             |             |
|                                       | 20 ns                  |             |             |             | NCHAR [00]  |             | 30 ns       |
|                                       | 10 ns                  | NCHAR [04]  |             | 30 ns       |             |             |             |
|                                       | 20 ns                  |             |             |             | NCHAR [00]  |             | 30 ns       |
|                                       | 10 ns                  | NCHAR [FF]  |             | 30 ns       |             |             |             |
|                                       | 10 ns                  | EOP         |             | 10 ns       |             |             |             |
|                                       | 10 ns                  |             |             |             | NCHAR [00]  |             | 30 ns       |
|                                       | 20 ns                  | NCHAR [FE]  |             | 30 ns       |             |             |             |
| 1.680 µs                              | 10 ns                  |             |             |             | NCHAR [00]  |             | 30 ns       |
| 1.690 µs                              | 10 ns                  | NCHAR [01]  |             | 20 ns       |             |             |             |
| 1.710 µs                              | 20 ns                  | FCT         |             | 20 ns       | NCHAR [00]  |             | 30 ns       |
| 1.730 µs                              | 20 ns                  | NCHAR [48]  |             | 20 ns       | NCHAR [00]  |             | 20 ns       |
| 1.750 µs                              | 20 ns                  |             |             |             | FCT         |             | 20 ns       |
| 1.760 µs                              | 10 ns                  | NCHAR [20]  |             | 30 ns       |             |             |             |
|                                       | 10 ns                  |             |             |             | NCHAR [00]  |             | 20 ns       |
| 1.790 µs                              | 20 ns                  | NCHAR [FE]  |             | 30 ns       |             |             |             |
| 1.800 µs                              | 10 ns                  |             |             |             | NCHAR [04]  |             | 30 ns       |
| 1.820 µs                              | 20 ns                  | NCHAR [00]  |             | 30 ns       |             |             |             |
| 1.830 µs                              | 10 ns                  |             |             |             | NCHAR [FF]  |             | 30 ns       |
| 1.840 µs                              | 10 ns                  |             |             |             | EOP         |             | 10 ns       |
|                                       | 10 ns                  | NCHAR [03]  |             | 30 ns       |             |             |             |
|                                       | 20 ns                  |             |             |             | NCHAR [FE]  |             | 30 ns       |
|                                       | 10 ns                  | NCHAR [00]  |             | 30 ns       |             |             |             |
|                                       | 20 ns                  |             |             |             | NCHAR [01]  |             | 30 ns       |
|                                       | 10 ns                  | NCHAR [00]  |             | 30 ns       |             |             |             |
|                                       | 20 ns                  | NCHAR [00]  |             | 20 ns       | NCHAR [48]  |             | 30 ns       |
|                                       | 20 ns                  | FCT         |             | 20 ns       |             |             |             |
|                                       | 10 ns                  |             |             |             | NCHAR [20]  |             | 30 ns       |
|                                       | 10 ns                  | NCHAR [00]  |             | 20 ns       | FCT         |             | 10 ns       |
|                                       | 30 ns                  | NCHAR [00]  |             | 30 ns       | NCHAR [FE]  |             | 30 ns       |
|                                       | 30 ns                  | NCHAR [00]  |             | 30 ns       | NCHAR [00]  |             | 30 ns       |
|                                       | 20 ns                  |             |             |             | NCHAR [03]  |             | 20 ns       |
|                                       | 10 ns                  | NCHAR [00]  |             | 30 ns       |             |             |             |
|                                       | 20 ns                  |             |             |             | NCHAR [00]  |             | 30 ns       |
|                                       | 10 ns                  | NCHAR [04]  |             | 30 ns       |             |             |             |
|                                       | 20 ns                  |             |             |             | NCHAR [00]  |             | 30 ns       |
|                                       | 10 ns                  | NCHAR [D3]  |             | 30 ns       |             |             |             |
|                                       | 10 ns                  | EOP         |             | 10 ns       |             |             |             |
|                                       | 10 ns                  |             |             |             | NCHAR [00]  |             | 30 ns       |
|                                       | 20 ns                  | NCHAR [FE]  |             | 30 ns       |             |             |             |
|                                       | 10 ns                  | FCT         |             | 10 ns       | NCHAR [00]  |             | 30 ns       |
|                                       | 30 ns                  | NCHAR [01]  |             | 30 ns       | NCHAR [00]  |             | 30 ns       |
|                                       | 10 ns                  |             |             |             | FCT         |             | 10 ns       |
|                                       | 20 ns                  | NCHAR [48]  |             | 30 ns       |             |             |             |
|                                       | 10 ns                  |             |             |             | NCHAR [00]  |             | 30 ns       |
|                                       | 10 ns                  | NCHAR [20]  |             | 20 ns       |             |             |             |
|                                       | 20 ns                  |             |             |             | NCHAR [00]  |             | 30 ns       |
|                                       | 10 ns                  | NCHAR [FE]  |             | 30 ns       |             |             |             |
|                                       | 10 ns                  |             |             | -           | NCHAR [04]  |             | 20 ns       |
|                                       | 20 ns                  | NCHAR [00]  |             | 30 ns       |             |             |             |
|                                       | 10 ns                  |             |             |             | NCHAR [D3]  |             | 30 ns       |
|                                       | 10 ns                  |             |             |             | EOP         |             | 10 ns       |
|                                       | 10 ns                  | NCHAR [04]  |             | 30 ns       | 201         |             | <b>▼</b>    |
| · · · · · · · · · · · · · · · · · · · |                        |             |             |             | ·           |             | ·           |
| Character Display Packet Disp         | lay Bit-Stream Display |             |             |             |             |             |             |

Complete

End A: 350.003 MHz End B: 350.003 MHz



Complete

**STAR-Dundee** SpaceWire EGSE Capabilities

- Detailed packet definitions
  - Via raw data, variables, automatic CRC and checksum calculation
- Precise packet generation scheduling at specific data rates.
- Packet generation control
  - Via state machines and events

## STAR-Dundee SpaceWire EGSE Key Benefits

- Mimic real-time behaviour of SpaceWire units
- Integrate with equipment via external triggers
- Minimal development time

## STAR-Dundee SpaceWire EGSE Conclusion

- Hardware
- Software
- Scripting Language
- Capabilities and Benefits
- Release date: Q1 2012