SpaceWire
Physical Layer Issues

Shaune Allen
September 10, 2004
SpaceWire Physical Layer Issues

- Shielding Configuration
  - Background and Rationale behind current configuration
  - Supporting Test Results

- Connector Specification
  - SpaceWire connectors have known issues
    - Not impedance matched to the cable
    - Handling (Mechanical) issues
  - Need space-qualified matched impedance connector
    - Efforts to identify an alternative or replacement space-qualified connector
SpaceWire Testing

- NASA has contracted or performed testing to evaluate the SpaceWire specifications
- Testing includes:
  - Differential Impedance
  - Insertion Loss
  - Return Loss
  - Skew
    - Pair to Pair
    - Within Pair
  - Eye Patterns
    - Conformance to LVDS Threshold Levels
    - Jitter
  - Bit Error Rate Measurement
  - Shielding Effectiveness
    - Wire Injection Method
  - Near End Crosstalk (NEXT)
  - Ground Bounce Susceptibility
  - LVDS Common Mode Range
  - Common Mode Rejection
  - Testing done with Data/Clock
    - Data/Strobe testing will be performed in the future
Cable Assembly Configurations Tested

- Conforming

- Inner shield tied together and to pin 3 of the connector on both ends of the cable assembly and isolated from outer shield that connects to the connector shell

- Inner shields tied together and to outer shield which is tied to the connector shell on both ends of the cable assembly

- Conforming with outer shield removed
What are the Requirements?

- **Cable Length:** ≤10m suggested (should vs. shall)
- **Wire Gauge of signal wires**
  - 28 AWG consisting of seven strands of 36 AWG wire (5.2.21)
- **Jitter** (not specified; recommended maximum 20% National Semiconductor AN-1088)
- **Bit Error Rate** (not specified; generally <1.0E-12)
- **Shielding Effectiveness** (not specified ESCC 3902-003 4.8.17)
- **Near End Crosstalk (NEXT)** (not specified)
- **Differential Impedance** 100 ± 6 Ω (5.2.3.11)
- **Insertion Loss** (not specified)
- **Return Loss** (not specified)
- **Skew**
  - Pair to Pair: <0.15ns/m (5.2.4.15)
  - Within Pair: <0.1ns/m (5.2.3.12, 5.2.4.15)
- **LVDS** (6.1)
  - LVDS Threshold Levels (± 100mV)
- **LVDS Common Mode Range** (not specified; generally ±1V)
NEXT on Connector with Adaptor

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Near End Crosstalk

Construction:

Lot no.:

Sample length (m): 20m

16.07.2004
M. Bluhm

Remark:
Space Wire
Cable Assembly
B (20m)

NEXT of Connector/Adaptor/Cable
NEXT of Connector/Adaptor/Cable

Near End Crosstalk

Construction:

Lot no.:

Sample length (m): 20m

16.07.2004

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Remark:

Space Wire
Cable Assembly B (20m)
Conforming PTP Cable Assembly

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Crosstalk

- SpaceWire cable not significant contributor
- Crosstalk due to connector (and connection)
- Is the SpaceWire connector good enough?
  - Dependant on pin configuration
- No SpaceWire NEXT Specification
  - Should one be defined???
- TIA/EIA-644-A specifies NEXT of 36.8dB at 50 MHz for four twisted pairs with an outer shield
- What is a good number??
  - Our results indicate <-30dB over the entire range (30MHz to 2 GHz)
Summary

- User community needs background on SpaceWire inner shield grounding configuration

- Although the SpaceWire connector is sufficient, a mechanically robust and matched impedance connector would improve performance and ease concerns

- Need a mechanism within the standard process for deviation
  - Alternative Connectors
  - Wire Gauge
  - Length (Jitter, Skew)

- Communication regarding available SpaceWire commercial products

- How do we proceed?