MultiLane Active Cable Solutions

July, 2021

Outline

- Background
- Test Requirements
- MultiLane Solutions
- Appendix

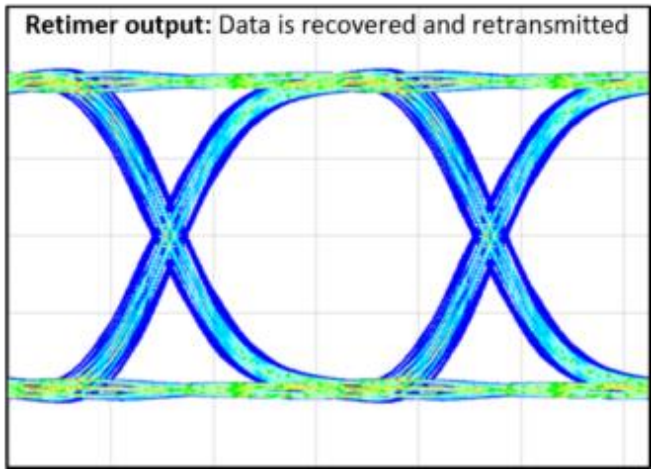
Background

Retimer – Active Electrical Cables (AEC)

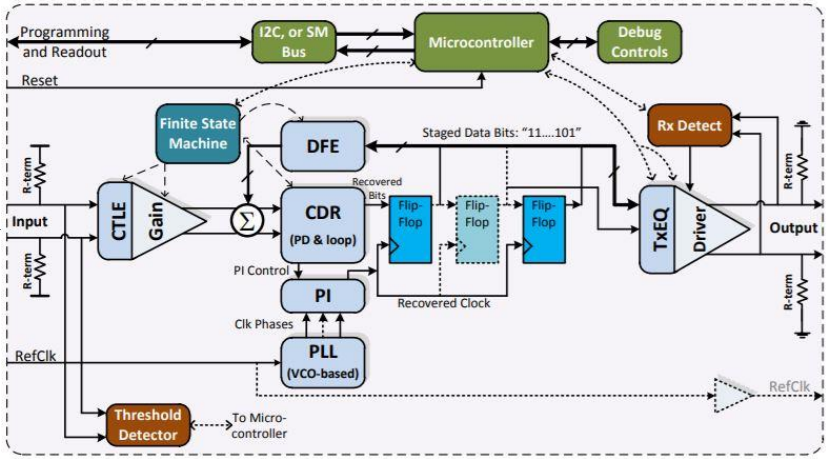
Active Cables

Active Electrical Cable

- Equalization + Gain + Retimer
- Clean eye



Standard interface (e.g.: QSFP-DD)



Source: https://www.intel.com/content/www/us/en/io/serial-bus-white-paper.html

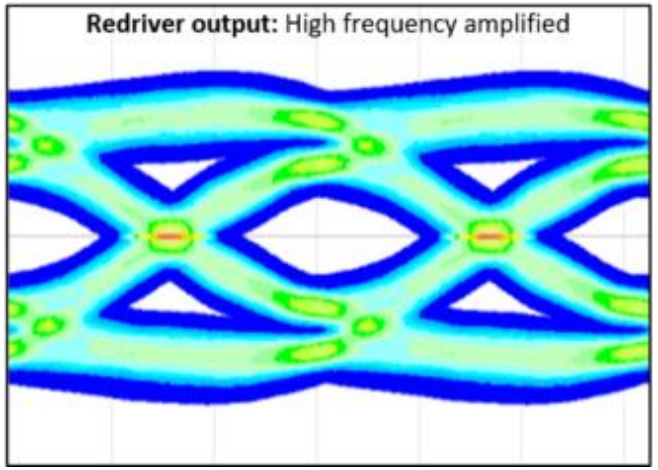
Redriver – Active Copper Cable (ACC)

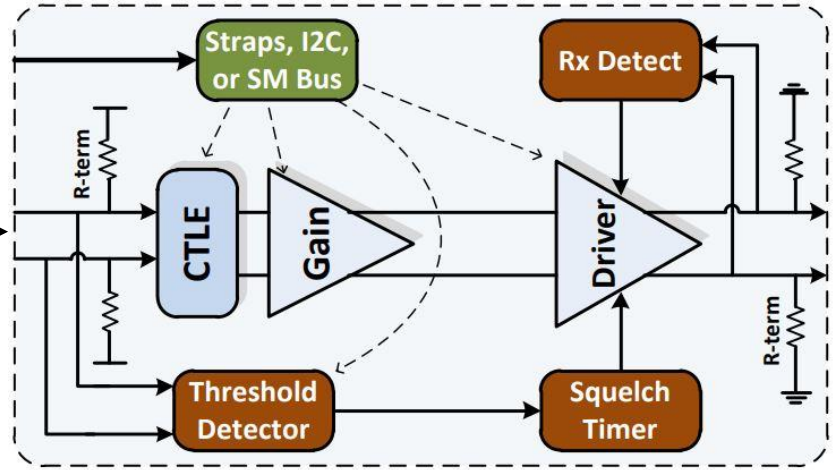
Active Cables

Active Copper Cable

- Equalization + Gain + Redriver
- Lossy eye

Standard interface (e.g.: QSFP-DD)





Source: https://www.intel.com/content/www/us/en/io/serial-bus-white-paper.html

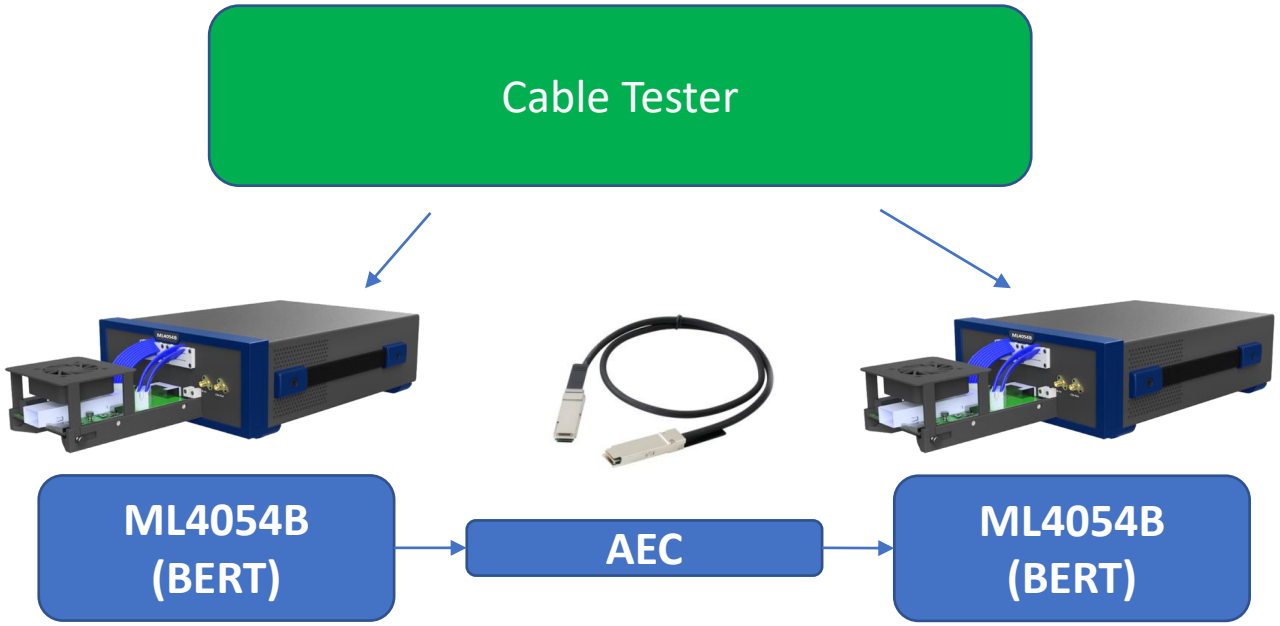
MultiLane Solutions

Solution 1 – Cable Tester

BER Based Solution

Cable tester (HiWire, etc.)

- Suitable for AECs, AOCs and ACCs
  - Type 1 – ML4054B
  - Type 2 – ML4079E-GB
- CMIS validation
- Link up time
- Pre- and post-FEC BER measurements
- No optimization required



Example: QSFF-DD 400G Solution

Parametric Tester

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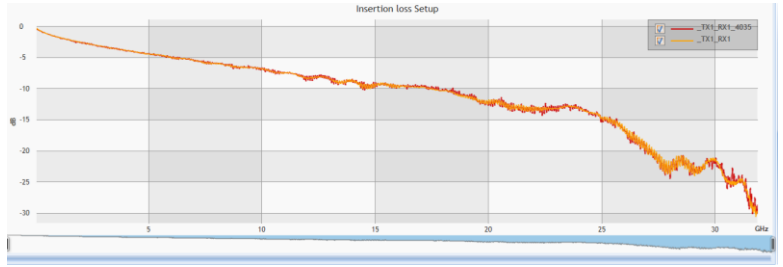
Solution 2 – Parametric Cable Tester

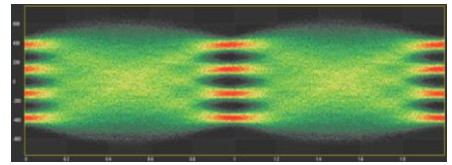
Parametric Based Solution



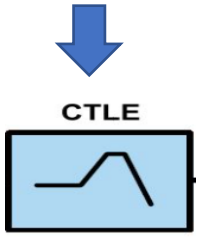
Insertion loss measurement

Parametric Cable tester

- Suitable for ACCs
- Measure eye diagram
  - Optimum CTLE, FFE settings derived
- Measure S-parameters
  - S21 – insertion loss



Eye diagram measurement



CTLE filter identification

ML4054B (PPG) → **ACC** → **ML4025 (DSO)**

Parametric Tester

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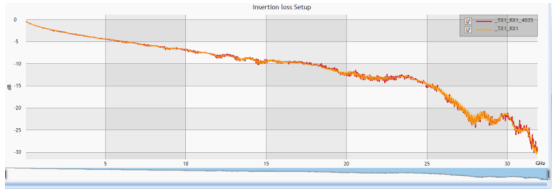
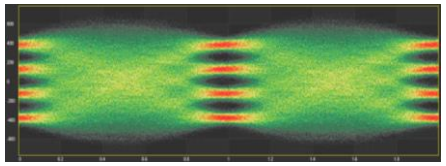
Solution 2 – Parametric Cable Tester

Active Copper Cables



Insertion loss measurement

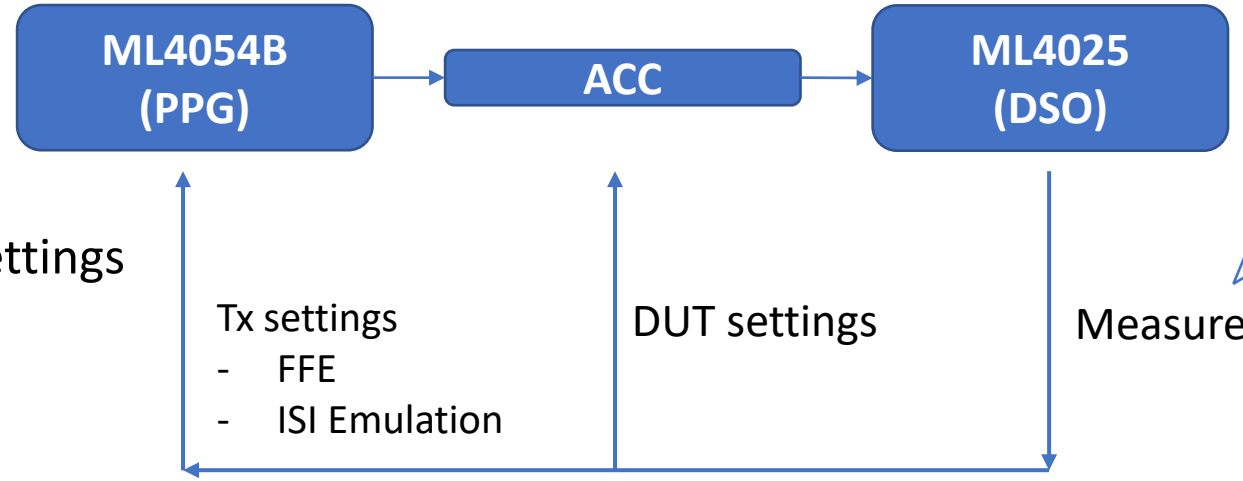


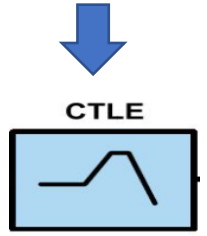
Eye diagram measurement

Two methods:

1 - Optimization routine
- Find ideal DUT settings

2 - Pass/fail tester
- CMIS
- Link up
- S-parameters/eye diagram





CTLE filter identification

Appendix

Multi-Corner Testing

Active Cables

Thermal Stream

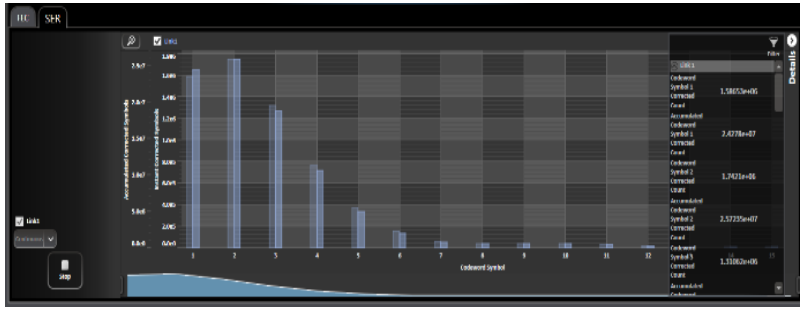
ML4054B

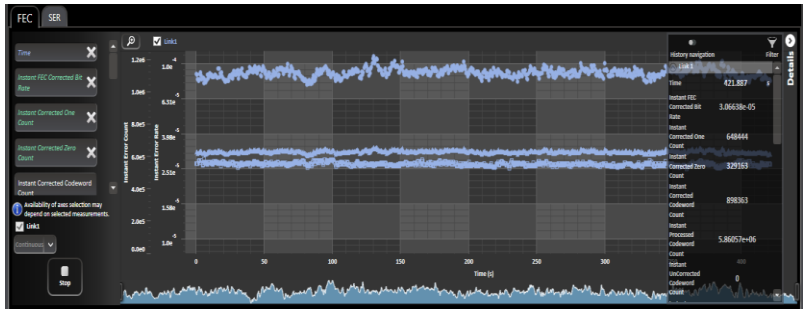
- Stress a DUT AEC by validating compliance at high/low operational corners of voltage and temperature
- The ML4054B includes an integrated host with **variable supply voltage control**
- To achieve desired temperatures two setups are available:
  - **ML4054B** with external mounted thermal stream
  - **ML4054B-LP** featuring same hardware inside a special enclosure that mounts on a custom door of a TestEquity temperature chamber

Active Electrical Cable (AEC) Type 1

ML4054B

- 8x26 GBd PAM4 BERT
- Dual QSFP56 MSA compliant adapter
- Real Hardware KP and KR FEC
- Instant BER and SER captures
- High-resolution TX Equalization (3-Tap/7-Tap)
- RX Equalization (CTLE, DFE, etc)
- Current and Voltage sensing
- CMIS Compliance test

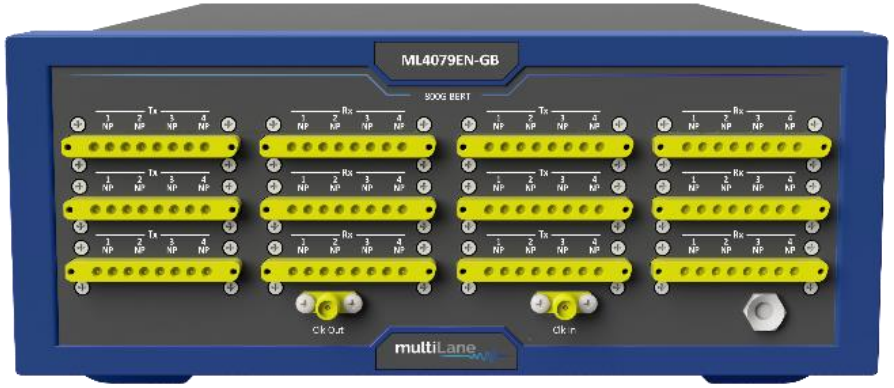




Active Electrical Cable (AEC) Type 2

ML4079EN-GB

- Line side: NRZ & PAM4 8x 23 – 29 GBd and 46 – 58 GBd with max amplitude of 2000 mVpp
- Host side: NRZ & PAM4 16x 23 – 29 GBd with max amplitude of 800 mVpp
- Full FEC (KP4 & KR4) and Gray coding
- Gearbox: MUX & de-MUX
- 3 types of noise generation:
  - Random noise (bounded uncorrelated noise BUN, spectrum 0.5 to 20 GHz)
  - Burst Noise (140 MHz to 5 GHz repetitive, 20 GHz spectrum)
  - Single shot noise (5 ms or slower per incident)

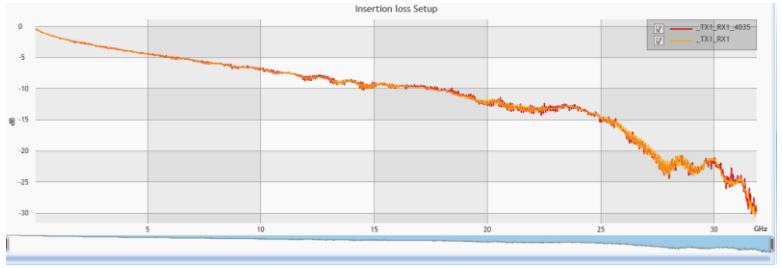


A SIDE			B SIDE		
SPEED	CONNECTOR	MODE	SPEED	CONNECTOR	MODE
400G			**400G**		
8X50G	QSFP-DD	PAM4	8X50G	QSFP-DD	PAM4
8X50G	OSFP	PAM4	8X50G	OSFP	PAM4
400G			**100G**		
8X50G	QQSFP-DD	PAM4	4X25G	QSFP28	NRZ
8X50G	OSFP	PAM4	4X25G	QSFP28	NRZ
200G			**200G**		
4x50G	QSFP56	PAM4	4x50G	QSFP56	PAM4
200G			**100G**		
4x50G	QSFP56	PAM4	4X25G	QSFP28	NRZ
4x50G	QSFP56	PAM4	2X50G	DSFP / SFP56-DD	PAM4
4x50G	QSFP56	PAM4	2X50G	QSFP56	PAM4
100G			**100G**		
2x50G	DSFP / SFP56-DD	PAM4	4X25G	QSFP28	NRZ
2x50G	DSFP / SFP56-DD	PAM4	2x50G	DSFP / SFP56-DD	PAM4

Active Copper Cable (ACC)

ML4054B, ML4025

- 8x26 GBd PAM4 BERT
- 4x35 GHz Electrical Sampling Scope
- Full eye measurements (TDECQ, EH, EW, etc.)
- Insertion loss and return loss
- Post-processing CTLE filter determination for ideal equalization

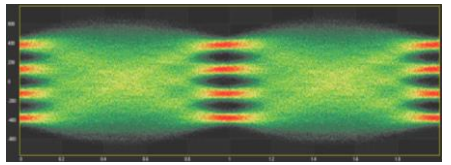


Insertion loss measurement

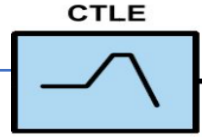
ML4054B (PPG) → **ACC** → **ML4025 (DSO)**

Optimized CTLE filter

Eye measurement



CTLE filter identification



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THANK YOU

Innovation for the next generation

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