Data Center Test Solutions

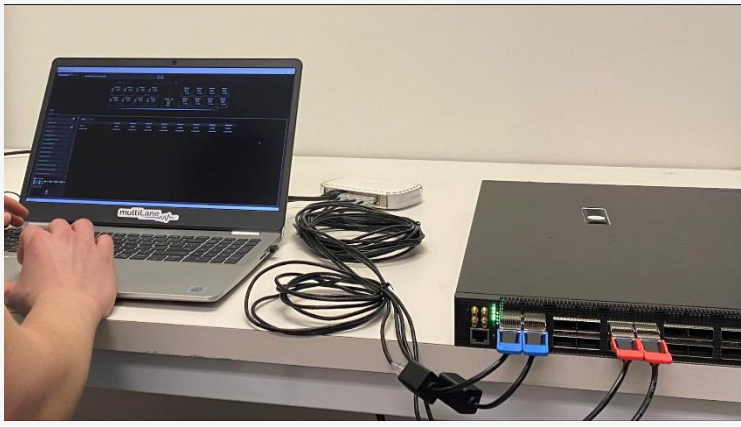
Active Loopbacks

CMIS 5.0 | 800G

Application Notes

MultiLane's Active Loopback provides a full testing suite from a DSP-based module that plugs directly into a host port. Equipped with a USB-c adapter that allows the module to plug into a laptop or tablet, the Active Loopbacks are CMIS 5.0 compliant, with the option to include MultiLane's powerful ThunderBERT software. When equipped with the latter, the module provides a complete set of BER diagnostic capabilities equivalent to an 800G BERT. Developed to account the complex equalization techniques required to characterize 800G port, MultiLane's Data Center Test Solutions (DCTS) team have pushed the technology into a first-of-its-kind complete testing solution useable at every stage of development, including postproduction.

MultiLane's Active Loopbacks are available in the QSFP-DD800 or OSFP800 form factors as the ML4062-ALB-112 or ML4064-ALB-112 respectively, with multivendor support for a truly interoperable experience.



The Active Loopback is a powerful module used in 800G systems to perform the following tests:

- Host port characterization
- BER/SNR diagnostics
- Taps
  - TX: 3 taps or 7 taps FIR
  - RX equalizer: 15 taps FFE
- PRBS generation
- Thermal management
- CMIS configuration

The following document gives an overview on how and where the ALB can be used to alleviate the many challenges we have faced within the industry while integrating 112G systems. From thermal management to CMIS compliance and ever more complicated SI, the active loopback module is equipped to perform the tests mentioned above, to cost effectively solve these issues.

MultiLane's Active Loopback comes in two versions:

- The default ALB
- The advanced ALB-TB which gives direct access to the MultiLane ThunderBERT GUI.

The following document shows how both operate to best alleviate 800G implementation challenges.

Figures 1 and 2 below represent equivalent setups

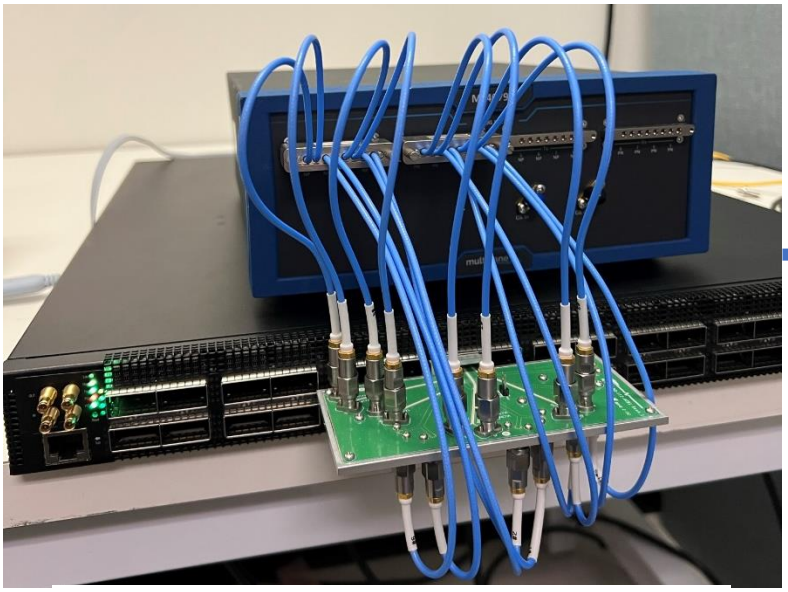


***Figure 1**: BERT, HCB plugged into a switch port for host port characterization*

The ALB aims to make host port characterization more efficient, while emulating transceiver thermal behavior, and giving access to CMIS low-speed and control signals, with writable registers and access to APIs.

Host port characterization previously required a BERT and a Host Compliance Board (Figure 1), making up a heavy, and costly setup. In comparison to having these same capabilities in just one module, plugged into a switch port, and connected to a laptop. (Figure 2)

The capabilities included in the ALB, in addition to it behaving as a standalone loopback, makes future host port characterization tests lighter, faster, and cost effective.

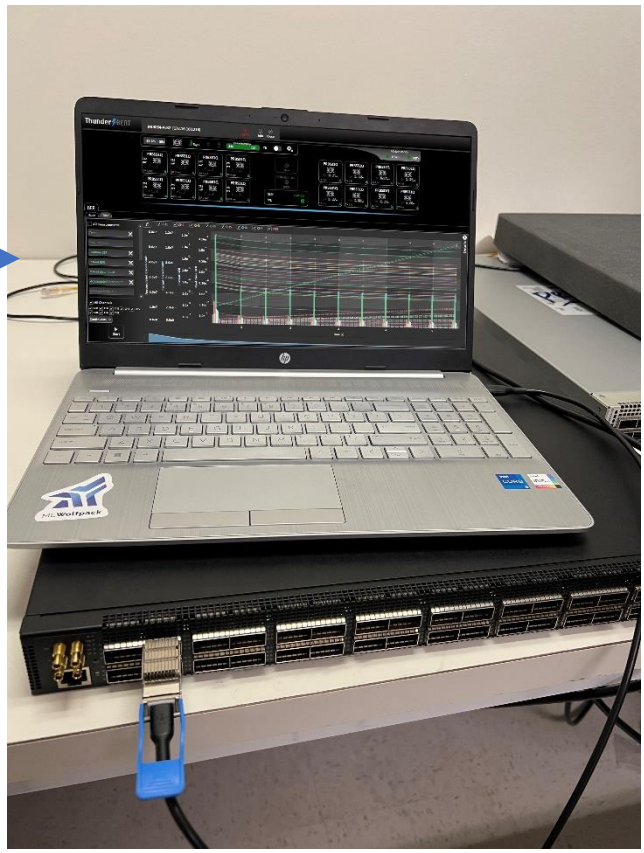


***Figure 2**: The module above is the ALB-TB, giving direct access to the MultiLane ThunderBERT GUI through the Ethernet Interface.*

Host Port Characterization

As the industry adopts 800G systems, the characterization of 800G ports has become exponentially challenging.

At 112G per lane, the retiming and equalizing of host port signals is a necessity.

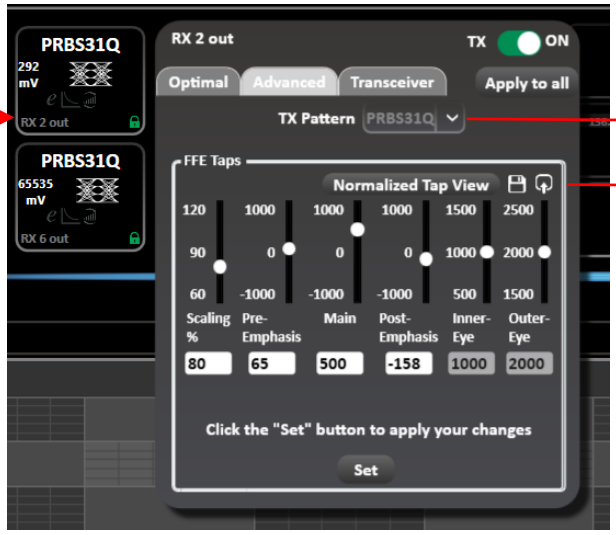
DSP based modules have become an undeniable component of host port characterization as they include retiming and equalizing capabilities.

Multilane's Active Loopback goes a step further, with capabilities to analyze the signal on the TX side as well as the RX side.

Below we list the features accessible through the ALB-TB after performing a link test on your host port:

- To validate the host TX, use the RX checker by running full BER/SNR diagnostics:

- To validate the RX side of the host signal, use the PRBS generator on the ThunderBERT GUI, which you can see in the image above.
- Below is a closer look on the PRBS and tuning settings:



Change PRBS

Use FFE Taps for TX equalization, pre, post and main emphasis.

User has the option between 3 taps and 7 taps for better equalization.

The above host port characterization demonstrated using the ALB-TB, can be done with the default ALB, using a pre-defined set of registers, to which the user will have access to with the provided APIs, and a CMIS compliant host. The default ALB operates in two modes:

- Retimed loopback mode (default)
- PRBS mode

The module is also equipped with a set of registers which the user can write to or read from:

- To change modes
- Set the desired PRBS sequence and taps
- Gather BER/SNR Diagnostics

For example, should a user want to get the BER of channels 5 to 8 with 53.125 GBaud, PAM4, PRBS7:

The user will have to access registers 183 from page 13h to set the ALB to PRBS mode. Registers 166 and 167 from page 13h will be used to choose the PRBS, and the channels required, respectively. While register 128 from page B8h will be accessed to set the Gbaud rate, and PAM4. To check the lock status, the user will read from register 138, page 14h.

Loopback Capabilities

- The ALB also acts as a regular loopback:
  - Performs basic link tests:
    - 800G ports require retiming and equalizing capabilities provided by DSP based modules.
  - CMIS configuration
  - CMIS low-speed signals
    - ModselL
    - ResetL
    - LPMode
    - IntL
    - ModPrstL
  - CMIS control and alarm thresholds
  - Supports I2C interface
    - Reading and writing operations
  - Thermal Management
    - Programmable power dissipation
    - Temperature monitor
- Thermal Management has particularly become more challenging as the ever-increasing data rates are dissipating more heat than ever before, and the need for strong, equipped cooling systems remains a constant of the industry.

ALB Features:

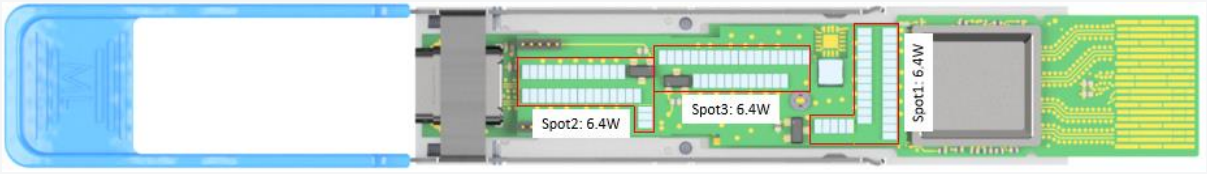
- Separate daughter card for configurable power spots, dissipating up to 19W
- DSP dissipates 10W
- Module overall dissipates up to 30W
- Two temperature sensors, one voltage sensor

One of the challenges of 112G implementation is the increasing heat dissipation: optical modules are now required to dissipate more heat, and with that, more efficient cooling systems are required.

The ALB allows the user to emulate transceiver behavior with several power spots dissipating heat, leaving the user the choice to make the power combinations that their setup requires.

The power spots and temperature sensors are accessed by registers compliant with MSA.

Below is the QDD800 ALB, ML4062-ALB1-2A/B-112, power spots distribution and temperature sensors:



Module Power spots accessed through 3 MSA Registers

Module Temperature sensors accessed through 4 MSA registers

Yellow pads represent the module thermal pads

- With provided API files, the above can be accessed through the user's host, with predefined registers to set the desired power dissipation, read and monitor the temperature, and perform tests to emulate transceiver behavior and configure the respective cooling system.

Ordering Options

Form Factor	Part Number	Features	Availability
QSFPDD800	ML4062-ALB1-2A/B-112	CMIS 5.0 Support, shell type 2A or 2B, chipset is optical DSP	Now
	ML4062-ALB1-2A/B-112-TB	CMIS 5.0 Support, full ThunderBERT GUI Support, shell type 2A or 2B, chipset is optical DSP	Now
	ML4062-ALB2-2A/B-112	CMIS 5.0 Support, shell type 2A or 2B, chipset is optical DSP	Now
	ML4062-ALB2-2A/B-112-TB	CMIS 5.0 Support, ThunderBERT GUI Support, shell type 2A or 2B, chipset is optical DSP	Now
OSFP800	ML4064-ALB2-112	CMIS 5.0 Support, chipset is optical DSP	Q2 2023
	ML4064-ALB2-112-TB	CMIS 5.0 Support, ThunderBERT GUI Support, chipset is optical DSP	Q1 2023
	ML4064-ALB4- 112	CMIS 5.0 Support, chipset is retimer only	Q3 2023

Note: ALB1, ALB2, and ALB4 point to the different DSP chips supported.