

multiLane 

# DATA CENTER TEST SOLUTIONS

## Development Kits



# TABLE OF CONTENTS

<b>INDEX</b> .....	<b>3</b>	<b>QSFP-DD</b> .....	<b>6</b>
<b>Module Testing Kits:</b> .....	<b>3</b>	<b>Module Testing:</b> .....	<b>6</b>
Module Compliance Boards		MLDCTS-QDD-Kit1: 400G .....	6
Adapters & Analyzers   Loopbacks		MLDCTS-QDD-Kit2: 800G .....	7
<b>Port Testing Kits:</b> .....	<b>4</b>	<b>Port Testing:</b> .....	<b>8</b>
Host Compliance Boards		MLDCTS-QDD-Kit3: 400G .....	8
Adapters & Analyzers   Loopbacks   Active		MLDCTS-QDD-Kit4: 800G .....	9
Loopbacks		<b>Compliance Testing:</b> .....	<b>10</b>
<b>Compliance Testing Kits:</b> .....	<b>5</b>	MLDCTS-Kit5: 800G .....	11
Module Compliance Boards			
Host Compliance Boards			
Adapters & Analyzers   Loopbacks			
<b>OSFP</b> .....	<b>12</b>	<b>QSFP</b> .....	<b>18</b>
<b>Module Testing:</b> .....	<b>13</b>	<b>Module Testing:</b> .....	<b>19</b>
MLDCTS-OSFP-Kit6: 400G .....	13	MLDCTS-QSFP-Kit11: 200G .....	19
MLDCTS-OSFP-Kit7: 800G .....	14	MLDCTS-QSFP-Kit12: 400G .....	20
<b>Port Testing:</b> .....	<b>15</b>	<b>Port Testing:</b>	<b>21</b>
MLDCTS-OSFP-Kit8: 400G .....	15	MLDCTS-QSFP-Kit13: 200G .....	21
MLDCTS-OSFP-Kit9: 800G .....	16	MLDCTS-QSFP-Kit14: 400G .....	22
<b>Compliance Testing:</b> .....	<b>17</b>	<b>Compliance Testing:</b>	<b>23</b>
MLDCTS-OSFP-Kit10: 800G .....	17	MLDCTS-QSFP-Kit15: 400G .....	23
<b>SFP</b> .....	<b>24</b>	<b>SFP-DD</b> .....	<b>30</b>
<b>Module Testing:</b>	<b>25</b>	<b>Module Testing:</b> .....	<b>31</b>
MLDCTS-SFP-Kit16: 50G .....	25	MLDCTS-SFPDD-Kit21: 100G .....	31
MLDCTS-SFP-Kit17: 100G .....	26	MLDCTS-SFPDD-Kit 22: 200G .....	32
<b>Port Testing:</b>	<b>27</b>	<b>Port Testing:</b> .....	<b>33</b>
MLDCTS-SFP-Kit18: 50G .....	27	MLDCTS-SFPDD-Kit23: 100G .....	33
MLDCTS-SFP-Kit19: 100G .....	28	MLDCTS-SFPDD-Kit24: 200G .....	34
<b>Compliance Testing:</b>	<b>29</b>	<b>Compliance Testing:</b> .....	<b>35</b>
MLDCTS-SFP-Kit20: 100G .....	29	MLDCTS-SFPDD-Kit25: 800G .....	35
<b>DSFP</b> .....	<b>36</b>		
<b>Compliance Testing:</b>	<b>37</b>		
MLDCTS-DSFP-Kit26: 100G .....	37		

## MODULE TESTING KITS:

MultiLane Module Testing Kits enable module vendors to validate their transceivers and passive/active cables, within a certain set of standards, with supporting speeds up to 400G and even 800G. Each module testing kit contains a Module Compliance Board, Analyzer, and loopbacks.

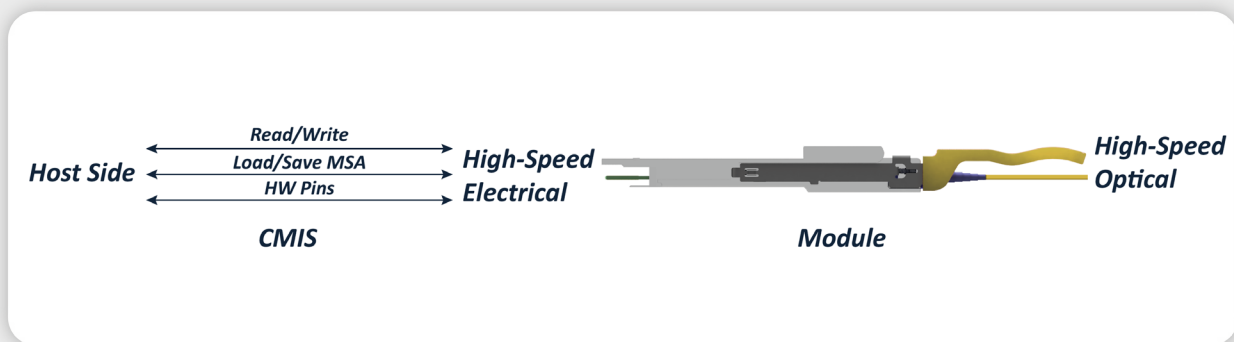
### Module Compliance Boards:

These boards are used with any form of pluggable in their respective form factor. They serve to validate the compliance, signal transmission, and any other feature the pluggable has. They are also used to test the thermal capability of modules, as well as stress testing them to evaluate their output.

The Module Compliance Boards are accompanied with a comprehensive user interface.

MultiLane has developed a CMIS interface for QSFP-DD and OSFP products, and SFP, SFP-DD and QSFP have their own specific user interface. The UI includes, but is not limited to:

- I2C Access and R/W
- Customizable memory maps and access to module EEPROM
- Temperature, voltage, and current monitoring



### Adapters and Analyzers: (ML4066 & ML4066-ANA)

Once the compliance of the module is validated, after making sure a clear input signal is followed by a clean output, and after confirming the I2C communication, the module vendor can take a closer look in analyzing the communication between their host, and module.

The adapter and analyzer are two boards which mate onto each other with a set of pin headers, and are accompanied with their own software, which:

- Analyzes I2C communication in 3 different modes
- Enables State Machine Testing
- Provides Access to the low speed and control signals
- Includes VCC monitoring
- Provides Access to module EEPROM, as well as customizable memory maps
- Monitors and visualizes I2C transactions and operations.

### Loopbacks:

A loopback will loop the TX port back to the RX port. It also emulates the thermal capability of a transceiver. Every loopback is equipped with temperature sensors, and power spots that dissipate a specific amount of power. Module vendors can use the loopback to validate their test setup and to prepare their environment before inserting in and testing their module.

# PORT TESTING KITS:

MultiLane Port Testing Kits enable system and host vendors to validate signal integrity and performance margin across all ports of their platforms, supporting speeds up to 400G and even 800G.

Port Testing Kits contain the following items: Host Compliance Boards, Adapters and Analyzers, and loopbacks.

## Host Compliance Boards:

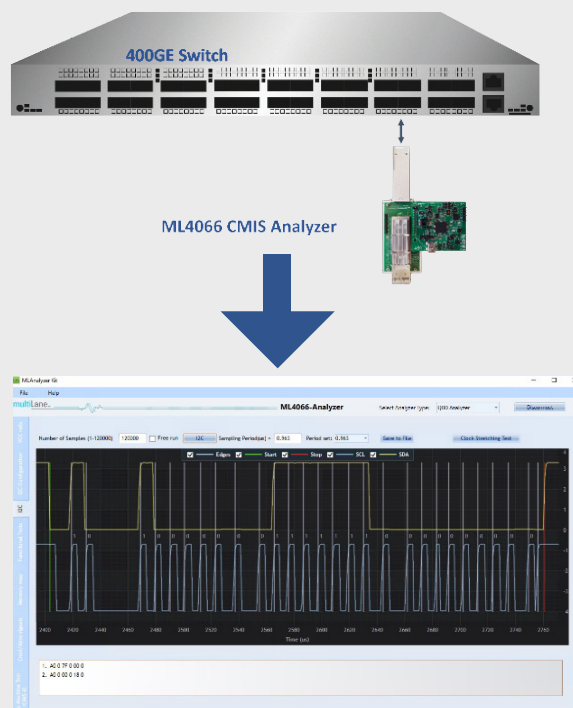
Host Compliance Boards or Breakout Boards, test the electrical paths of devices like switches, routers, or transponders. They ensure that the output signal of the host is clean enough.

## Adapters and Analyzers: (ML4066 & ML4066-ANA)

Once the electrical paths of the system host ports are validated, the host vendor can take a closer look in analyzing the communication between their host, and module.

The adapter and analyzer are two boards which mate onto each other with a set of pin headers, and are accompanied with their own software, with the objective to and abilities to:

- Analyze I2C communication in 3 different modes
- State Machine Testing
- Access to the low speed and control signals
- VCC monitoring
- Access to module EEPROM, as well as customizable memory maps
- Monitor and visualize I2C transactions and operations.



## Loopbacks:

A loopback will loop the TX port back to the RX port. It also emulates the thermal capability of a transceiver. Every loopback is equipped with power spots, which dissipate a specific amount of power. They are also equipped with temperature sensors.

The loopback enables system vendors to validate the ports within their system. A loopback allows you to confirm the validity of a port, by looping back the signal to itself. It will also set up the host to the correct environment with its' power dissipation and monitoring capabilities.

## Active Loopbacks:

With the industry moving towards higher speeds, high loss ports require retiming to recover links. The Active Loopback is a DSP-based loopback module, supporting multiple chip vendors, which enables the retiming and equalization of host port signals. Its features include and are not limited to:

- PRBS Generator and Detector (BER Test)
- Validate port performance with an active device, equipped with better and improved performance.
- Advanced mode: TB
  - The Active Loopback supports our full BERT GUI (Bit Error Rate Tester GUI), for advanced BER, equalization and CMIS testing.





# COMPLIANCE TESTING KITS:

112G/ lane Compliance testing made easier with our ML Compliance testing Kits.

- Module Compliance Boards
- Host Compliance Boards
- Loopbacks

## Module Compliance Boards:

These boards are used with any form of pluggable in their respective form factor. They validate the compliance, signal transmission, and any other feature the pluggable has. They also test the thermal capability of modules and can stress test them to evaluate their output.

In compliance testing, MCBs are used to test transceivers against certain standards. MCBs can be connected to any instruments used in full compliance tests, like Bit Error Rate Testers (BERTs), or Digital Oscilloscopes (DSOs). They can be used to test the BER, provide an eye diagram, and perform any other tests as needed.

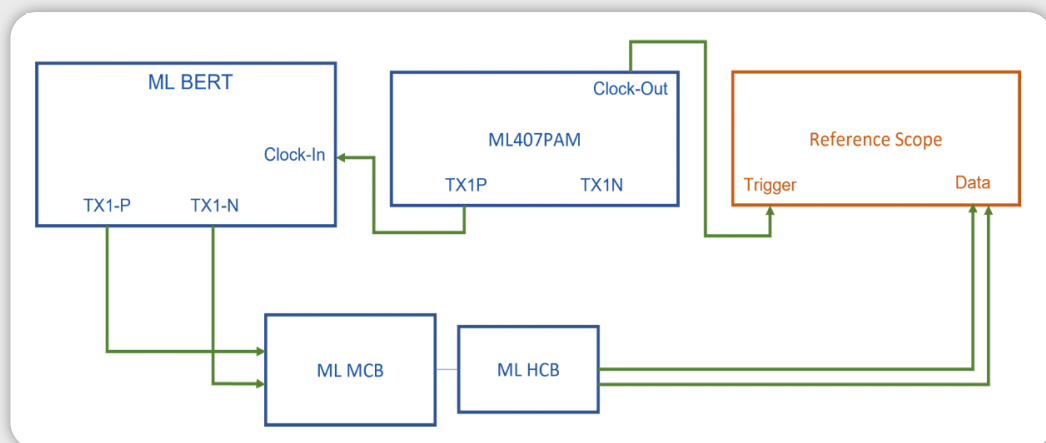
The MCB CMIS GUI is also used to read/write to the module EEPROM and configure the power settings, as well as validating the module's memory map compliance.

## Host Compliance Boards:

Host Compliance Boards or Breakout Boards, test the electrical paths of devices like switches, routers, or transponders. They ensure that the output signal of the host is clean enough.

In compliance testing, HCBs are used for calibration: before inserting a DUT and beginning a test, users calibrate the whole set up according to the appropriate standards.

HCBs are also used to validate the TX side of the port and allows users to drive a stressed input signal through to the RX side.



Calibration Test Setup

## Loopbacks:

A loopback loops the TX port back to the RX port. It also emulates the thermal capability of a transceiver. Every loopback is equipped with power spots, which dissipate a specific amount of power. They are also equipped with temperature sensors. A host vendor can use the loopback to validate their system and to prepare their environment before inserting in and testing other modules.

# QSFP-DD

## Module Testing



MLDCTS-QDD-Kit1: 400G



MLDCTS-QDD-Kit2: 800G

## Port Testing



MLDCTS-QDD-Kit3: 400G



MLDCTS-QDD-Kit4: 800G

## Compliance Testing

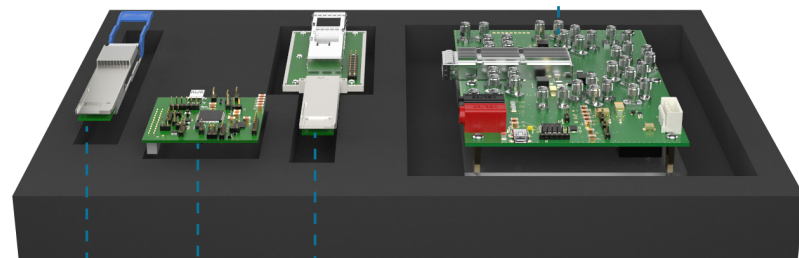


MLDCTS-QDD-Kit5: 800G

## MLDCTS-QDD-KIT1: 400G

### ML4062-MCB:

- Supports 8x28G NRZ and 8x56G PAM4
- All 8 channels come with matching trace length
- High performance signal integrity traces from 2.4-mm or 2.92-mm K connectors to QSFP-DD host connector
- On-board LEDs display MSA output alarm states
- On-board pin headers for MSA I/O control signals and I2C interface
- User friendly GUI, USB interface



### ML4062-TL2a:

- Loops back TX & RX with good performance signal integrity traces
- MSA Compliant shell and latching mechanism
- Ten power spots, dissipating up to 23.4W
- Four temperature sensors
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- CMIS compliant state machine

### ML4066-QDD-ANA:

- USB Interface
- Windows based GUI and API Library
- Detection and measurement of host pull-up + pull-down resistors on low-speed signals
- VCC spectral noise analysis
- I2C Analyzer
- Functional tests
- CMIS state machine test

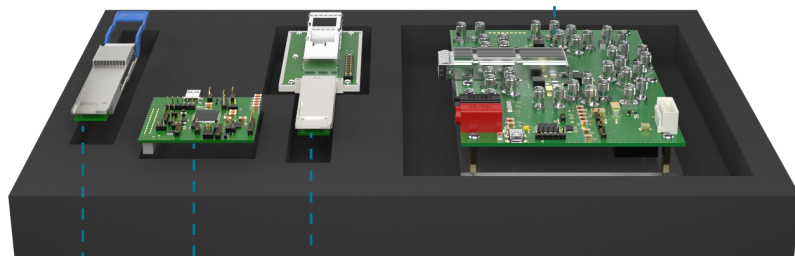
### ML4066-QDD:

- Low insertion loss PCB traces
- Power pins and low speed signals are accessible via pin headers
- Ability to drive I2C from external pin headers, or connect I2C packet analyzer
- Ability to drive 3.3 V from external source for power supply margining
- Ability to break 3.3 V power from Host to module allowing voltage and current measurement

## MLDCTS-QDD-KIT2: 800G

### ML4062-MCB-112:

- Supports 8x56G NRZ and 8x112G PAM4
- All 8 channels come with matching trace length
- High performance signal integrity traces from 2.4-mm or 1.85-mm connectors to QSFP-DD112 host connector.
- On-board LEDs display MSA output alarm states
- On-board pin headers for MSA I/O control signals and I2C interface
- User friendly GUI, USB interface



### ML4062-LB-112:

- Loops back TX & RX with good performance signal integrity traces
- MSA Compliant shell and latching mechanism
- Four power spots, dissipating up to 16W
- Four temperature sensors
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- CMIS compliant state machine

### ML4066-ANA-QDD:

- USB Interface
- Windows based GUI and API Library
- Detection and measurement of host pull-up + pull-down resistors on low-speed signals
- VCC spectral noise analysis
- I2C Analyzer
- Functional tests
- CMIS state machine test

### ML4066-QDD:

- Low insertion loss PCB traces
- Power pins and low speed signals are accessible via pin headers
- Ability to drive I2C from external pin headers, or connect I2C packet analyzer
- Ability to drive 3.3 V from external source for power supply margining
- Ability to break 3.3 V power from Host to module allowing voltage and current measurement



## MLDCTS-QDD-KIT3: 400G

### ML4066-QDD:

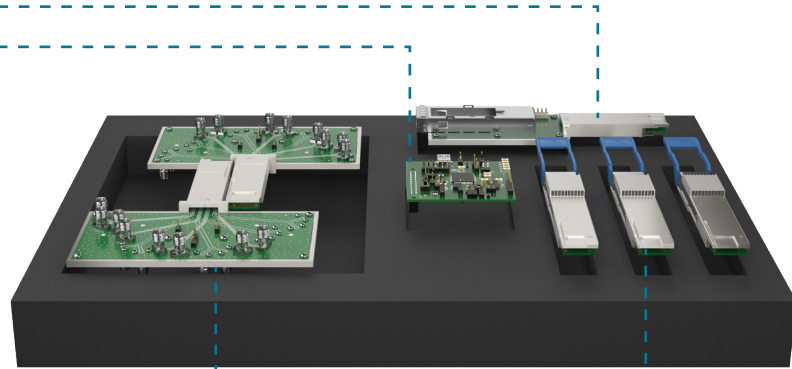
- Low insertion loss PCB traces
- Power pins and low speed signals are accessible via pin headers
- Ability to drive I2C from external pin headers, or connect I2C packet analyzer
- Ability to drive 3.3 V from external source for power supply margining
- Ability to break 3.3 V power from Host to module allowing voltage and current measurement

### ML4066-ANA-QDD:

- USB Interface
- Windows based GUI and API Library
- Detection and measurement of host pull-up + pull-down resistors on low-speed signals
- VCC spectral noise analysis
- I2C Analyzer
- Functional tests
- CMIS state machine test

### Optional: ML4062-ALB1-2A/B:

- Retiming and equalizing capabilities available
- MSA Compliant shell with latching mechanism
- Two temperature sensors
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- CMIS compliant state machine
- Advanced mode: ThunderBert
  - Advanced BER testing
  - Advanced equalization
  - Advanced CMIS testing



### ML4062-HCB1/2:

- Supports 4x28G NRZ and 4x56G PAM4
- High Performance signal integrity traces
- All channels come with matching trace length
- High speed signals accessible through 2.4-mm or 1.85-mm connectors
- 4 channels HCB1: Ch1, Ch2, Ch3, Ch4
- 4 channels HCB2: Ch5, Ch6, Ch7, Ch8

### ML4062-TL2a:

- Loops back TX & RX with good performance signal integrity traces
- MSA Compliant shell and latching mechanism
- Ten power spots, dissipating up to 23.4W
- Four temperature sensors
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- CMIS compliant state machine

## MLDCTS-QDD-KIT4: 800G

### ML4066-QDD:

- Low insertion loss PCB traces
- Power pins and low speed signals are accessible via pin headers
- Ability to drive I2C from external pin headers, or connect I2C packet analyzer
- Ability to drive 3.3 V from external source for power supply margining
- Ability to break 3.3 V power from Host to module allowing voltage and current measurement

### ML4066-ANA-QDD:

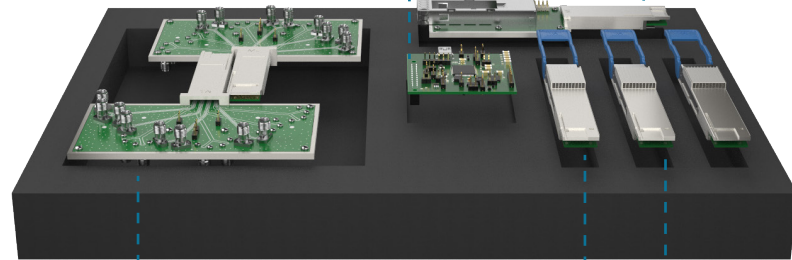
- USB Interface
- Windows based GUI and API Library
- Detection and measurement of host pull-up + pull-down resistors on low-speed signals
- VCC spectral noise analysis
- I2C Analyzer
- Functional tests
- CMIS state machine test

### ML4062-HCB1/2-112:

- Supports 4x56G NRZ and 4x112G PAM4
- High Performance signal integrity traces
- All channels come with matching trace length
- High speed signals accessible through 2.4-mm or 1.85-mm connectors
- 4 channels HCB1: Ch1, Ch2, Ch3, Ch4
- 4 channels HCB2: Ch5, Ch6, Ch7, Ch8

### Additional Loopback: ML4062-LB2a-6dB/9dB:

- Loops back TX to RX on all 8 ports
- Loss Target Loopbacks with 6 dB and 9 dB attenuation at 26 GHz to emulate specific DAC loss profiles
- Four thermal spots, dissipating up to 30W
- Four temperature sensors



### ML4062-LB-112:

- Loops back TX & RX with good performance signal integrity traces
- MSA Compliant shell and latching mechanism
- Four thermal spots, dissipating up to 16W
- Four temperature sensors
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- CMIS compliant state machine

### ML4062-ALB1-2A/B-112:

- Retiming and equalizing capabilities available
- MSA Compliant shell with latching mechanism
- Two temperature sensors
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- CMIS compliant state machine

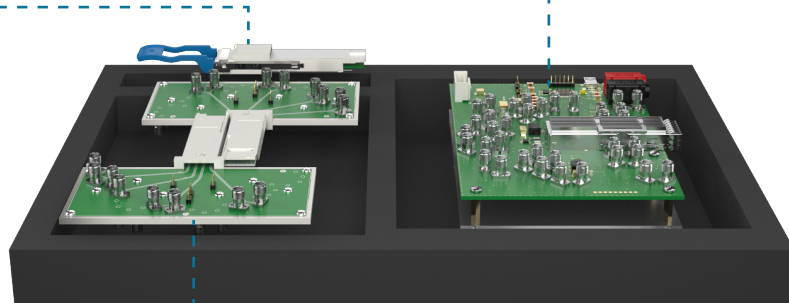
### Optional Feature

- Advanced mode: ThunderBert
  - Advanced BER testing
  - Advanced equalization
  - Advanced CMIS testing

## MLDCTS-QDD-KIT5: 800G

### ML4062-MCB-112:

- Supports 8x56G NRZ and 8x112G PAM4
- All 8 channels come with matching trace length
- High performance signal integrity traces from 2.4-mm or 1.85-mm connectors to QSFP-DD112 host connector
- On-board LEDs display MSA output alarm states
- On-board buttons/jumpers for MSA I/O control signals and I2C interface
- User friendly GUI, USB interface



### ML4062-LB-112:

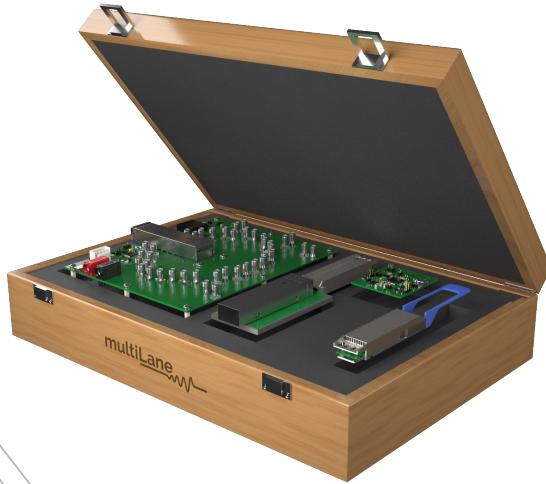
- Loops back TX & RX with good performance signal integrity traces
- MSA Compliant shell and latching mechanism
- Four thermal spots, dissipating up to 16W
- Four temperature sensors
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- CMIS compliant state machine

### ML4062-HCB1/2-112:

- Supports 4x56G NRZ and 4x112G PAM4
- High Performance signal integrity traces
- All channels come with matching trace length
- High speed signals accessible through 2.4-mm or 1.85-mm connectors
- 4 channels HCB1: Ch1, Ch2, Ch3, Ch4
- 4 channels HCB2: Ch5, Ch6, Ch7, Ch8

# OSFP

## Module Testing



MLDCTS-OSFP-Kit6: 400G



MLDCTS-OSFP-Kit7: 800G

## Port Testing



MLDCTS-OSFP-Kit8: 400G



MLDCTS-OSFP-Kit9: 800G

## Compliance Testing



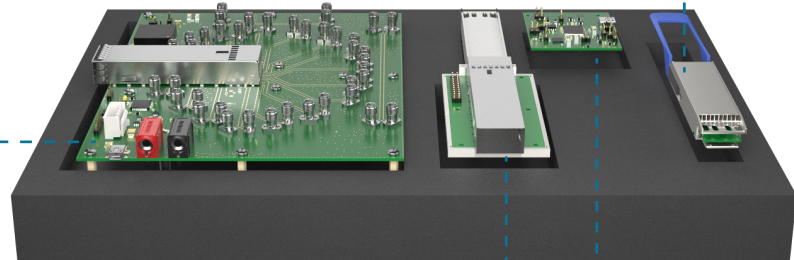
MLDCTS-OSFP-Kit10: 800G



## MLDCTS-OSFP-KIT6: 400G

### ML4064-LB:

- Loops back TX & RX with good performance signal integrity traces
- MSA Compliant shell with latching mechanism
- Nine thermal spots, dissipating up to 16W
- Two temperature sensors
- I2C Terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA Memory Map with programmable new pages
- CMIS compliant state machine



### ML4064-MCB:

- Supports 8x28G NRZ and 8x56G PAM4
- All 8 channels come with matching trace length
- High performance signal integrity traces from 2.92-mm or 2.4-mm K connectors to OSFP host connector
- On board LEDs display MSA output alarm states
- On board pin headers for MSA I/O control signals and I2C interface
- User friendly GUI, USB interface

### ML4066-OSFP:

- Low insertion loss PCB traces
- Power pins and low speed signals are accessible via pin headers
- Ability to drive I2C from external pin headers, or connect I2C packet analyzer
- Ability to drive 3.3 V from external source for power supply margining
- Ability to break 3.3 V power from Host to module allowing voltage and current measurement

### ML4066-ANA-OSFP:

- USB Interface
- Windows based GUI and API Library
- Detection and measurement of host pull-up + pull-down resistors on low-speed signals
- VCC spectral noise analysis
- I2C Analyzer
- Functional tests
- CMIS state machine test

## MLDCTS-OSFP-KIT7: 800G

### ML4064-LB-112:

- Loops back TX & RX with good performance SI Traces
- MSA Compliant Shell with latching mechanism
- Four thermal spots, dissipating up to 17.5W
- Two temperature sensors
- I2C Terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA Memory Map with programmable new pages
- CMIS compliant state machine

### ML4064-MCB-112:

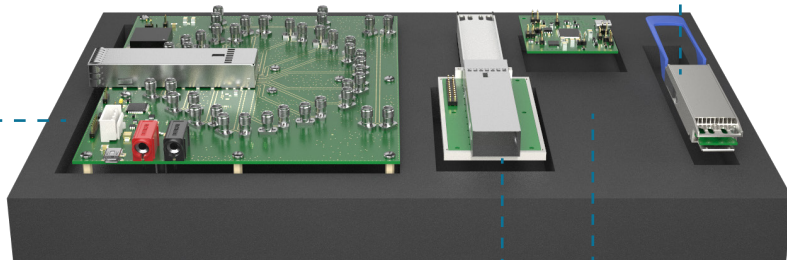
- Supports 8x56G NRZ and 8x112G PAM4
- All 8 channels come with matching trace length
- High performance signal integrity traces from 2.4-mm or 1.85-mm connectors to OSFP112 host connector
- On board LEDs display MSA output alarm states
- On board pin headers for MSA I/O control signals and I2C interface
- User friendly GUI, USB interface

### ML4066-OSFP:

- Low insertion loss PCB traces
- Power pins and low speed signals are accessible via pin headers
- Ability to drive I2C from external pin headers, or connect I2C packet analyzer
- Ability to drive 3.3 V from external source for power supply margining
- Ability to break 3.3 V power from Host to module allowing voltage and current measurement

### ML4066-ANA-OSFP:

- USB Interface
- Windows based GUI and API Library
- Detection and measurement of host pull-up + pull-down resistors on low-speed signals
- VCC spectral noise analysis
- I2C Analyzer
- Functional tests
- CMIS state machine test



## MLDCTS-OSFP-KIT8: 400G

### ML4066-OSFP:

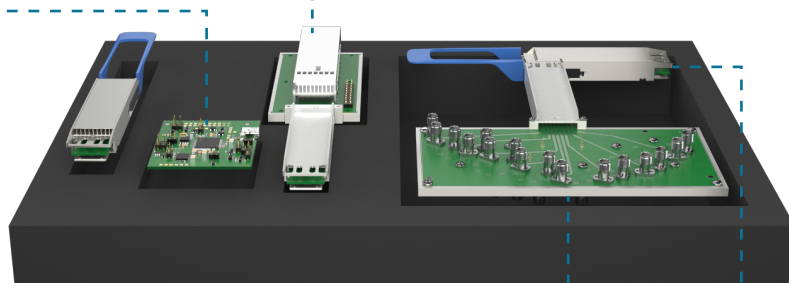
- Low insertion loss PCB traces
- Power pins and low speed signals are accessible via pin headers
- Ability to drive I2C and I<sup>s</sup> signals from external pin headers, or connect I2C packet analyzer
- Ability to drive 3.3 V from external source for power supply margining
- Ability to break 3.3 V power from Host to module allowing voltage and current measurement

### ML4066-ANA-OSFP:

- Windows based GUI and API Library, USB interface
- Detection and measurement of host pull-up + pull-down resistors on low-speed signals
- VCC measurement capability
- I2C Analyzer, I2C stressing
- Functional tests
- CMIS state machine test

### Optional: ML4064-ALB2-56:

- Retiming and equalizing capabilities available
- MSA Compliant shell with latching mechanism
- Two temperature sensors
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- CMIS compliant state machine
- Advanced mode: ThunderBert
  - Advanced BER testing
  - Advanced equalization
  - Advanced CMIS testing



### ML4064-HCB:

- Supports 8x28G NRZ and 8x56G PAM4
- High performance signal integrity traces
- All 8 channels come with matching trace length
- High speed signals accessible through 2.4-mm or 1.85-mm connectors
- 8 channels: 8 TX and the corresponding 8 RX

### ML4064-LB:

- Loops back TX & RX with good performance signal integrity traces
- MSA Compliant shell with latching mechanism
- Nine thermal spots, dissipating up to 16W
- Two temperature sensors
- I2C Terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA Memory Map with programmable new pages
- CMIS compliant state machine

## MLDCTS-OSFP-KIT9: 800G

### ML4066-OSFP:

- Low insertion loss PCB traces
- Power pins and low speed signals are accessible via pin headers
- Ability to drive I2C from external pin headers, or connect I2C packet analyzer
- Ability to drive 3.3 V from external source for power supply margining
- Ability to break 3.3 V power from Host to module allowing voltage and current measurement

### ML4066-ANA-OSFP:

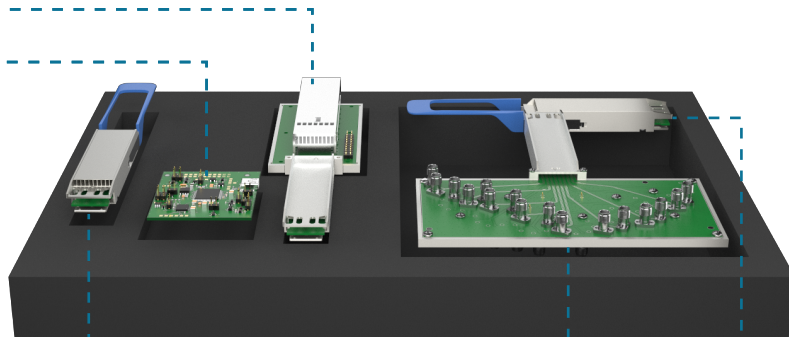
- USB Interface
- Windows based GUI and API Library
- Detection and measurement of host pull-up + pull-down resistors on low speed signals
- VCC spectral noise analysis
- I2C Analyzer
- Functional tests
- CMIS state machine test

### ML4064-ALB2-112:

- Retiming and equalizing capabilities available
- MSA Compliant shell with latching mechanism
- Two temperature sensors
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- CMIS compliant state machine

#### Optional Feature

- Advanced mode: ThunderBert
  - Advanced BER testing
  - Advanced equalization
  - Advanced CMIS testing



### ML4064-HCB-112:

- Supports 8x56G NRZ and 8x112G PAM4
- High performance signal integrity traces
- All 8 channels come with matching trace length
- High speed signals accessible through 2.4-mm or 1.85-mm connectors
- 8 channels: 8 TX and the corresponding 8 RX

### ML4064-LB-112:

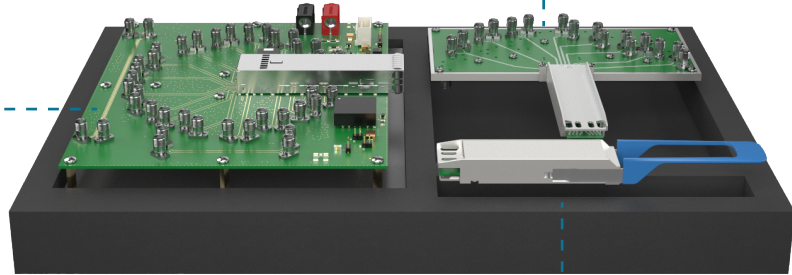
- Loops back TX & RX with good performance SI Traces
- MSA Compliant Shell with latching mechanism
- Four thermal spots, dissipating up to 17.5W
- Two temperature sensors
- I2C Terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA Memory Map with programmable new pages
- CMIS compliant state machine



## MLDCTS-OSFP-KIT10: 800G

### ML4064-HCB-112:

- Supports 8x112G
- High performance signal integrity traces
- All 8 channels come with matching trace length
- High speed signals accessible through 2.4-mm or 1.85-mm connectors
- 8 channels: 8 TX and the corresponding 8 RX



### ML4064-MCB-112:

- Supports 8x56G NRZ and 8x112G PAM4
- All 8 channels come with matching trace length
- High performance signal integrity traces from 2.4-mm or 1.85-mm connectors to OSFP112 host connector
- On board LEDs display MSA output alarm states
- On board pin headers for MSA I/O control signals and I2C interface
- User friendly GUI, USB interface

### ML4064-LB-112:

- Loops back TX & RX with good performance SI Traces
- MSA Compliant Shell with latching mechanism
- Four thermal spots, dissipating up to 17.5W
- Two temperature sensors
- I2C Terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA Memory Map with programmable new pages
- CMIS compliant state machine

# QSFP

## Module Testing



MLDCTS-QSFP-Kit11: 200G



MLDCTS-QSFP-Kit12: 400G

## Port Testing



MLDCTS-QSFP-Kit13: 200G



MLDCTS-QSFP-Kit14: 400G

## Compliance Testing

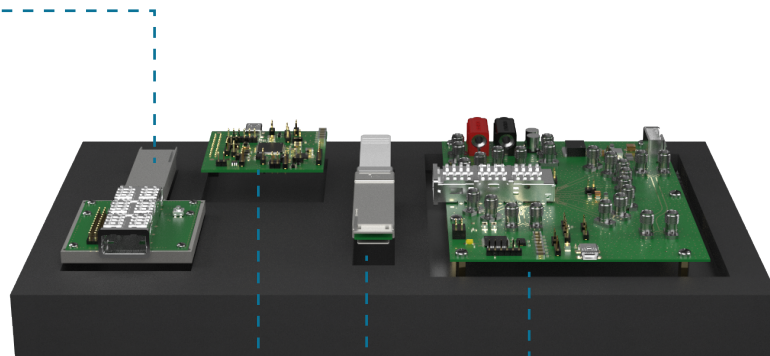


MLDCTS-QSFP-Kit15: 400G

## MLDCTS-QSFP-KIT11: 200G

### ML4066-QSFP:

- Low insertion loss PCB traces
- Power pins and low speed signals are accessible via pin headers
- Ability to drive I2C from external pin headers, or connect I2C packet analyzer
- Ability to drive 3.3 V from external source for power supply margining
- Ability to break 3.3 V power from Host to module allowing voltage and current measurement



### ML4066-ANA-QSFP:

- USB Interface
- Windows based GUI and API Library
- Detection and measurement of host pull-up + pull-down resistors on low-speed signals
- VCC spectral noise analysis
- I2C Analyzer
- Functional tests
- SFF/CMIS state machine test

### ML4002-56:

- Loops back TX & RX with good performance signal integrity traces
- MSA Compliant shell with latching mechanism
- Three power spots, dissipating up to 5 W
- One temperature sensor
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- SFF/CMIS Compliant state machine

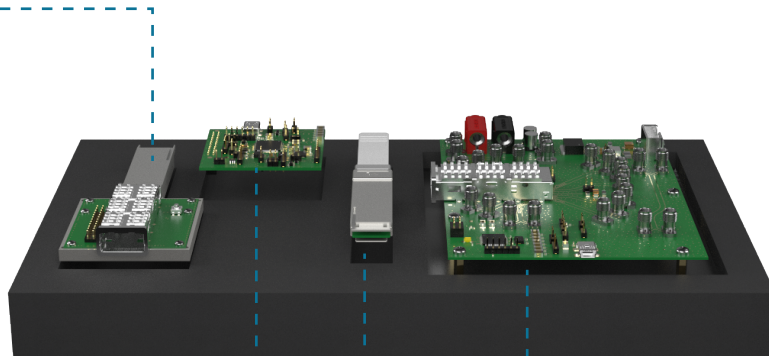
### ML4041K-MCB:

- Supports 4x28G NRZ and 4x56G PAM4
- All 4 channels come with matching trace length
- High performance signal integrity traces from 2.92-mm K connectors to QSFP host connector
- On board LEDs display MSA output alarm states
- On board pin headers for MSA I/O control signals and I2C interface
- User friendly GUI, USB interface

## MLDCTS-QSFP-KIT12: 400G

### ML4066-QSFP:

- Low insertion loss PCB traces
- Power pins and low speed signals are accessible via pin headers
- Ability to drive I2C from external pin headers, or connect I2C packet analyzer
- Ability to drive 3.3 V from external source for power supply margining
- Ability to break 3.3 V power from Host to module allowing voltage and current measurement



### ML4066-ANA-QSFP:

- USB Interface
- Windows based GUI and API Library
- Detection and measurement of host pull-up + pull-down resistors on low-speed signals
- VCC spectral noise analysis
- I2C Analyzer
- Functional tests
- SFF/CMIS state machine test

### ML4002-112:

- Loops back TX & RX with good performance signal integrity traces
- MSA Compliant shell with latching mechanism
- Three power spots, dissipating up to 7 W
- One temperature sensor
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- SFF/ CMIS Compliance

### ML4041-MCB-112:

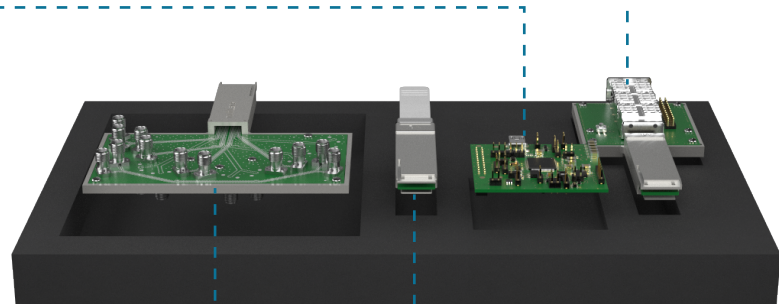
- Supports 4x56G NRZ and 4x112G PAM4
- All 4 channels come with matching trace length
- High performance signal integrity traces from 2.4-mm or 1.85-mm connectors to QSFP112 host connector
- On board LEDs display MSA output alarm states
- On board pin headers for MSA I/O control signals and I2C interface
- User friendly GUI, USB interface



## MLDCTS-QSFP-KIT13: 200G

### ML4066-QSFP:

- Low insertion loss PCB traces
- Power pins and low speed signals are accessible via pin headers
- Ability to drive I2C from external pin headers, or connect I2C packet analyzer
- Ability to drive 3.3 V from external source for power supply margining
- Ability to break 3.3 V power from Host to module allowing voltage and current measurement



### ML4066-ANA-QSFP:

- USB Interface
- Windows based GUI and API Library
- Detection and measurement of host pull-up + pull-down resistors on low-speed signals
- VCC spectral noise analysis
- I2C Analyzer
- Functional tests
- SFF/CMIS state machine test

### ML4020K-HCB:

- Supports 4x28G NRZ and 4x56G PAM4
- High performance signal integrity traces
- All channels come with matching trace length
- High speed signals accessible through 2.4-mm or 1.85-mm connectors
- 4 channels: 4 TX and the corresponding 4 RX

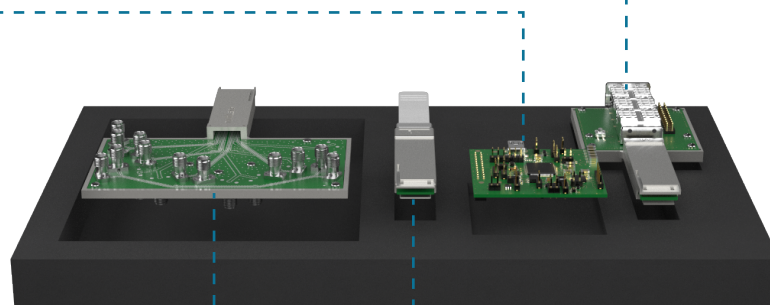
### ML4002-56:

- Loops back TX & RX with good performance signal integrity traces
- MSA Compliant shell with latching mechanism
- Three power spots, dissipating up to 5 W
- One temperature sensor
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- SFF/CMIS Compliant state machine

## MLDCTS-QSFP-KIT14: 400G

### ML4066-QSFP:

- Low insertion loss PCB traces
- Power pins and low speed signals are accessible via pin headers
- Ability to drive I2C from external pin headers, or connect I2C packet analyzer
- Ability to drive 3.3 V from external source for power supply margining
- Ability to break 3.3 V power from Host to module allowing voltage and current measurement



### ML4066-ANA-QSFP:

- USB Interface
- Windows based GUI and API Library
- Detection and measurement of host pull-up + pull-down resistors on low-speed signals
- VCC spectral noise analysis
- I2C Analyzer
- Functional tests
- SFF/CMIS state machine test

### ML4020-HCB-112:

- Supports 4x56G NRZ and 4x112G PAM4
- High performance signal integrity traces
- All channels come with matching trace length
- High speed signals accessible through 2.4-mm or 1.85-mm connectors
- 4 channels: 4 TX and the corresponding 4 RX

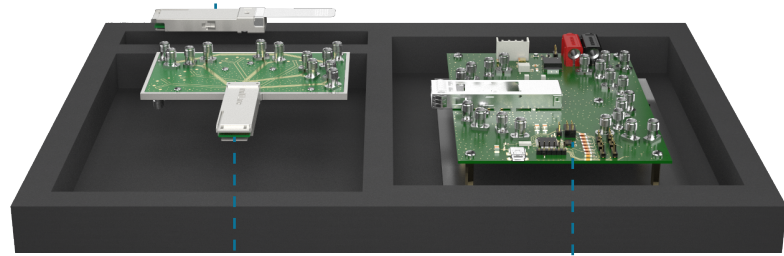
### ML4002-112:

- Loops back TX & RX with good performance signal integrity traces
- MSA Compliant shell with latching mechanism
- Three power spots, dissipating up to 7 W
- One temperature sensor
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- SFF/CMIS Compliant state machine

## MLDCTS-QSFP-KIT15: 400G

### ML4002-112:

- Loops back TX & RX with good performance signal integrity traces
- MSA Compliant shell with latching mechanism
- Three power spots, dissipating up to 7 W
- One temperature sensor
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- SFF/CMIS Compliant state machine



### ML4020-HCB-112:

- Supports 4x56G NRZ and 4x112G PAM4
- High performance signal integrity traces
- All channels come with matching trace length
- High speed signals accessible through 2.4-mm or 1.85-mm connectors
- 4 channels: 4 TX and the corresponding 4 RX

### ML4041-MCB-112:

- Supports 4x56G NRZ and 4x112G PAM4
- All 4 channels come with matching trace length
- High performance signal integrity traces from 2.4-mm or 1.85-mm connectors to QSFP112 host connector
- On board LEDs display MSA output alarm states
- On board pin headers for MSA I/O control signals and I2C interface
- User friendly GUI, USB interface

# SFP

## Module Testing



MLDCTS-SFP-Kit16: 50G



MLDCTS-SFP-Kit17: 100G

## Port Testing



MLDCTS-SFP-Kit18: 50G



MLDCTS-SFP-Kit19: 100G

## Compliance Testing



MLDCTS-SFP-Kit20: 100G

## MLDCTS-SFP-KIT16: 50G

### ML4024-MCB:

- Supports 28G NRZ
- Channel comes with matching trace length
- High performance signal integrity traces from 2.92-mm connector to SFP host connector
- On board LEDs display MSA output alarm states
- On board pin headers for MSA I/O control signals and I2C interface
- User friendly GUI, USB interface

### ML4026-28-0db:

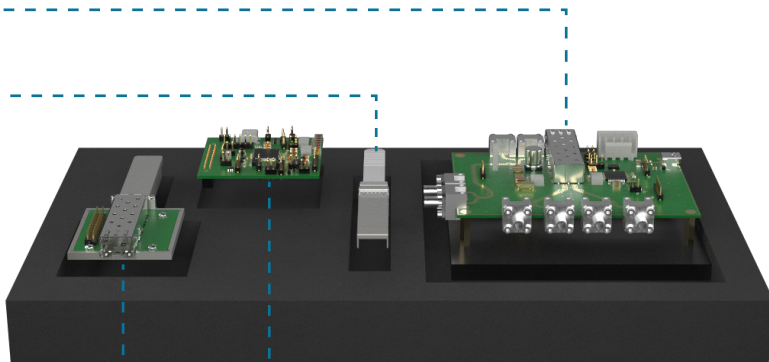
- Loops back TX & RX with good performance signal integrity traces
- MSA compliant shell with latching mechanism
- Six power spots, dissipating up to 2W
- One temperature sensor
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- SFF Compliant state machine

### ML4066-SFP:

- Low insertion loss PCB traces
- Power pins and low speed signals are accessible via pin headers
- Ability to drive I2C from external pin headers, or connect I2C packet analyzer
- Ability to drive 3.3 V from external source for power supply margining
- Ability to break 3.3 V power from Host to module allowing voltage and current measurement

### ML4066-ANA-SFP:

- USB Interface
- Windows based GUI and API Library
- Detection and measurement of host pull-up + pull-down resistors on low-speed signals
- VCC spectral noise analysis
- I2C Analyzer
- Functional tests
- SFF state machine test





## MLDCTS-SFP-KIT17: 100G

### ML4024-MCB-112:

- Supports 56G NRZ and 112G PAM4
- Channel comes with matching trace length
- High performance signal integrity traces from 1.85-mm or 2.92-mm connector to SFP112 host connector
- On board LEDs display MSA output alarm states
- On board pin headers for MSA I/O control signals and I2C interface
- User friendly GUI, USB interface

### ML4026-112:

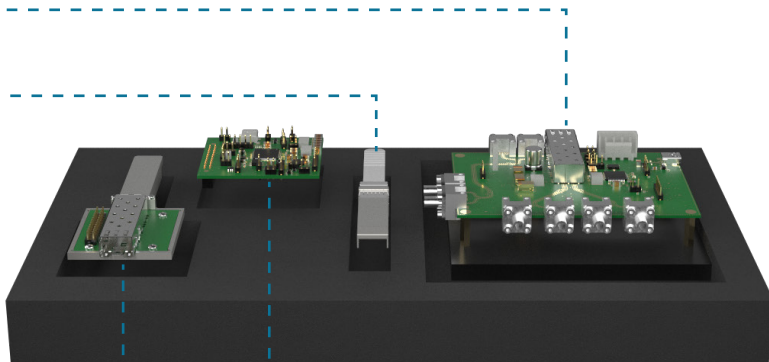
- Loops back TX & RX with good performance signal integrity traces
- MSA compliant shell with latching mechanism
- Two power spots, dissipating up to 2W
- One temperature sensor
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- SFF Compliant state machine

### ML4066-SFP:

- Low insertion loss PCB traces
- Power pins and low speed signals are accessible via pin headers
- Ability to drive I2C from external pin headers, or connect I2C packet analyzer
- Ability to drive 3.3 V from external source for power supply margining
- Ability to break 3.3 V power from Host to module allowing voltage and current measurement

### ML4066-ANA-SFP:

- USB Interface
- Windows based GUI and API Library
- Detection and measurement of host pull-up + pull-down resistors on low-speed signals
- VCC spectral noise analysis
- I2C Analyzer
- Functional tests
- SFF state machine test



## MLDCTS-SFP-KIT18: 50G

### ML4066-ANA-SFP:

- USB Interface
- Windows based GUI and API Library
- Detection and measurement of host pull-up + pull-down resistors on low-speed signals
- VCC spectral noise analysis
- I2C Analyzer
- Functional tests
- SFF state machine test

### ML4066-SFP:

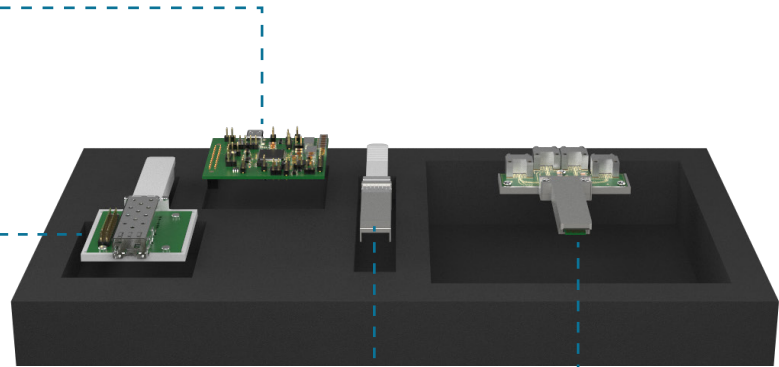
- Low insertion loss PCB traces
- Power pins and low speed signals are accessible via pin headers
- Ability to drive I2C from external pin headers, or connect I2C packet analyzer
- Ability to drive 3.3 V from external source for power supply margining
- Ability to break 3.3 V power from Host to module allowing voltage and current measurement

### ML4026-28-0db:

- Loops back TX & RX with good performance signal integrity traces
- MSA compliant shell with latching mechanism
- Six power spots, dissipating up to 2W
- One temperature sensor
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- SFF Compliant state machine

### ML4023-HCB:

- Supports 28G NRZ
- High Performance signal integrity traces
- Matching trace length
- High speed signals accessible through 2.92-mm K connectors
- 1 channel: TX and the corresponding RX



## MLDCTS-SFP-KIT19: 100G

### ML4066-ANA-SFP:

- USB Interface
- Windows based GUI and API Library
- Detection and measurement of host pull-up + pull-down resistors on low-speed signals
- VCC spectral noise analysis
- I2C Analyzer
- Functional tests
- SFF Compliance

### ML4066-SFP:

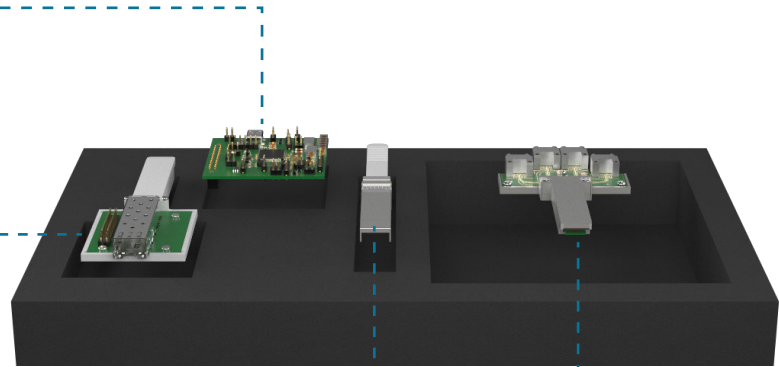
- Low insertion loss PCB traces
- Power pins and low speed signals are accessible via pin headers
- Ability to drive I2C from external pin headers, or connect I2C packet analyzer
- Ability to drive 3.3 V from external source for power supply margining
- Ability to break 3.3 V power from Host to module allowing voltage and current measurement

### ML4026-112:

- Loops back TX & RX with good performance signal integrity traces
- MSA compliant shell with latching mechanism
- Two power spots, dissipating up to 2W
- One temperature sensor
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- SFF Compliant state machine

### ML4023-HCB-112:

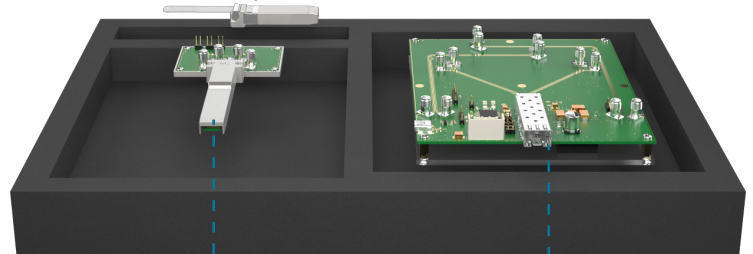
- Supports 56G NRZ and 112G PAM4
- High performance signal integrity trace
- Matching trace length
- High speed signals accessible through 2.4-mm or 1.85-mm connectors to SFP112 host connector
- 1 channel: TX and the corresponding RX



## MLDCTS-SFP-KIT20: 100G

### ML4026-112:

- Loops back TX & RX with good performance signal integrity traces
- MSA compliant shell with latching mechanism
- Two power spots, dissipating up to 2W
- One temperature sensor
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- SFF Compliant state machine



### ML4023-HCB-112:

- Supports 56G NRZ and 112G PAM4
- High performance signal integrity trace
- Matching trace length
- High speed signals accessible through 2.4-mm or 1.85-mm connectors
- 1 channel: TX and the corresponding RX

### ML4024-MCB-112:

- Supports 56G NRZ and 112G PAM4
- TX and RX channel comes with matching trace length
- High speed signals accessible through 1.85-mm or 2.92-mm connectors to SFP112 host connector
- On board LEDs display MSA output alarm states
- On board pin headers for MSA I/O control signals and I2C interface
- User friendly GUI, USB interface

# SFP-DD

## Module Testing



MLDCTS-SFPDD-Kit21: 100G



MLDCTS-SFPDD-Kit22: 200G

## Port Testing



MLDCTS-SFPDD-Kit23: 100G



MLDCTS-SFPDD-Kit24: 200G

## Compliance Testing



MLDCTS-SFPDD-Kit25: 200G



## MLDCTS-SFPDD-KIT21: 100G

### ML4066-ANA-SFPDD:

- USB Interface
- Windows based GUI and API Library
- Detection and measurement of host pull-up + pull-down resistors on low-speed signals
- VCC spectral noise analysis
- I2C Analyzer
- Functional tests
- MIS/CMIS state machine test

### ML4066-SFPDD:

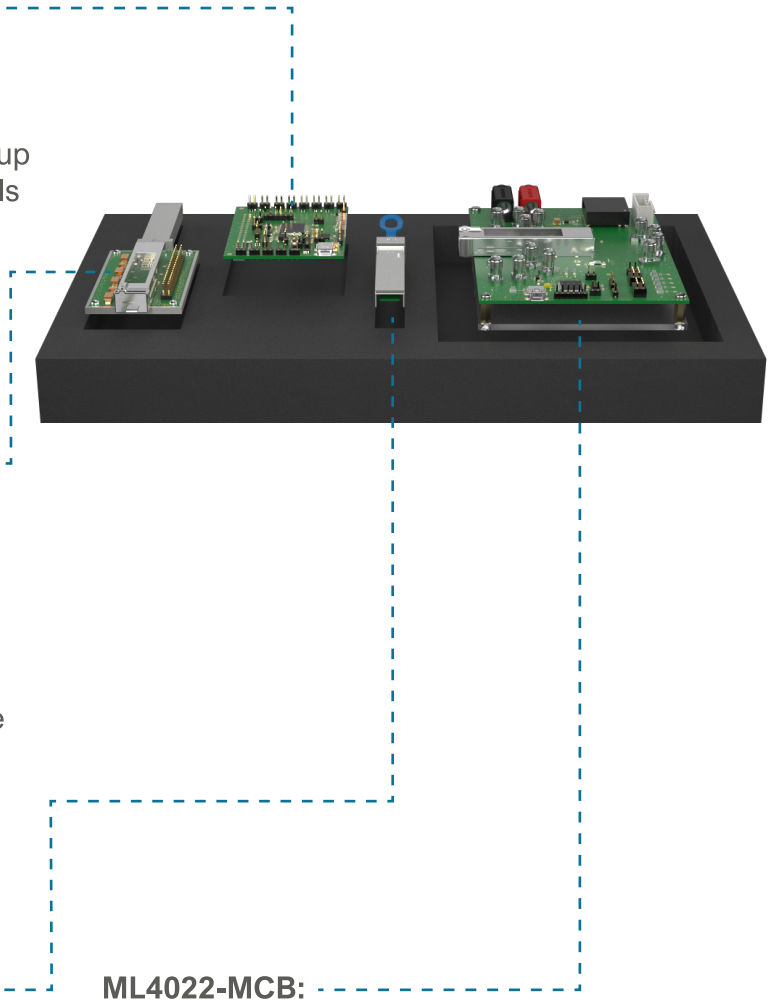
- Low insertion loss PCB traces
- Power pins and low speed signals are accessible via pin headers
- Ability to drive I2C from external pin headers, or connect I2C packet analyzer
- Ability to drive 3.3 V from external source for power supply margining
- Ability to break 3.3 V power from Host to module allowing voltage and current measurement

### ML4022-LB:

- Loops back TX & RX with good performance signal integrity traces
- MSA compliant shell with latching mechanism
- Four power spots, dissipating up to 4.96 W
- One temperature sensor
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- MIS/CMIS Compliant state machine

### ML4022-MCB:

- Supports 2x28G NRZ and 2x56G PAM4
- All channels come with matching trace length
- High speed signals accessible through 1.85-mm or 2.92-mm connectors to SFP-DD host connector
- On board LEDs display MSA output alarm states
- On board pin headers for MSA I/O control signals and I2C interface
- User Friendly GUI and USB interface



## MLDCTS-SFPDD-KIT22: 200G

### ML4066-ANA-SFPDD:

- USB Interface
- Windows based GUI and API Library
- Detection and measurement of host pull-up + pull-down resistors on low-speed signals
- VCC spectral noise analysis
- I2C Analyzer
- Functional tests
- MIS/CMIS state machine test

### ML4066-SFPDD:

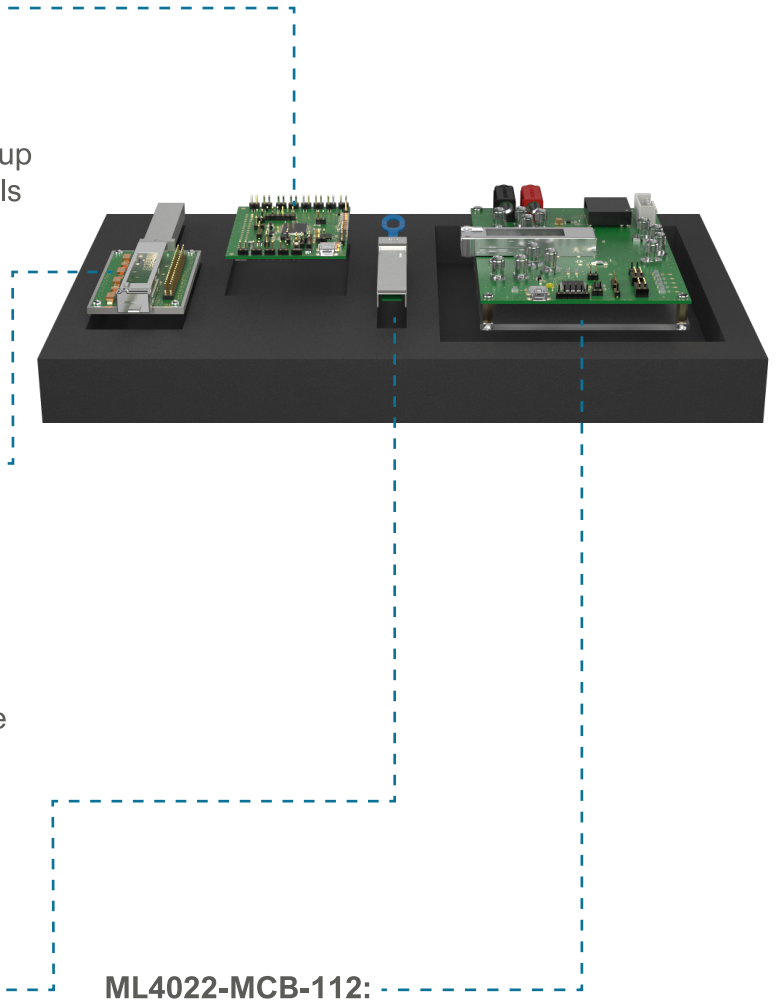
- Low insertion loss PCB traces
- Power pins and low speed signals are accessible via pin headers
- Ability to drive I2C from external pin headers, or connect I2C packet analyzer
- Ability to drive 3.3 V from external source for power supply margining
- Ability to break 3.3 V power from Host to module allowing voltage and current measurement

### ML4022-LB:

- Loops back TX & RX with good performance signal integrity traces
- MSA compliant shell with latching mechanism
- Four power spots, dissipating up to 4.96 W
- One temperature sensor
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- MIS/CMIS Compliant state machine

### ML4022-MCB-112:

- Supports 2x56G NRZ and 2x112G PAM4
- All channels come with matching trace length
- High performance signal integrity traces from 2.4-mm connectors to SFP-DD112 host connector
- On board LEDs display MSA output alarm states
- On board pin headers for MSA I/O control signals and I2C interface
- User Friendly GUI and USB interface



## MLDCTS-SFPDD-KIT23: 100G

### ML4022-LB:

- Loops back TX & RX with good performance signal integrity traces
- MSA compliant shell with latching mechanism
- Four power spots, dissipating up to 4.96 W
- One temperature sensor
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- MIS/CMIS Compliant state machine

### ML4022-HCB:

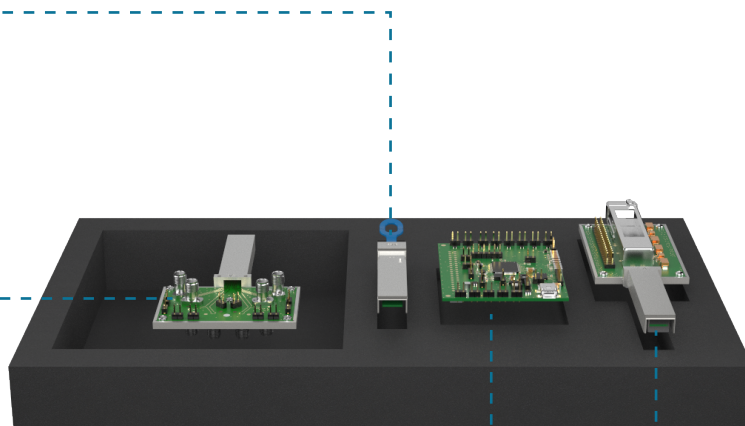
- Supports 2x28G NRZ and 2x56G PAM4
- High Performance signal integrity traces
- High-speed signals accessible through 2.92-mm K connectors
- 2 channels: 2 TX and the corresponding 2 RX

### ML4066-ANA-SFPDD:

- USB Interface
- Windows based GUI and API Library
- Detection and measurement of host pull-up + pull-down resistors on low-speed signals
- VCC spectral noise analysis
- I2C Analyzer
- Functional tests
- MIS/CMIS state machine test

### ML4066-SFPDD:

- Low insertion loss PCB traces
- Power pins and low speed signals are accessible via pin headers
- Ability to drive I2C from external pin headers, or connect I2C packet analyzer
- Ability to drive 3.3 V from external source for power supply margining
- Ability to break 3.3 V power from Host to module allowing voltage and current measurement



## MLDCTS-SFPDD-KIT24: 200G

### ML4022-LB:

- Loops back TX & RX with good performance signal integrity traces
- MSA compliant shell with latching mechanism
- Four power spots, dissipating up to 4.96 W
- One temperature sensor
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- MIS/CMIS Compliant state machine

### ML4022-HCB-112:

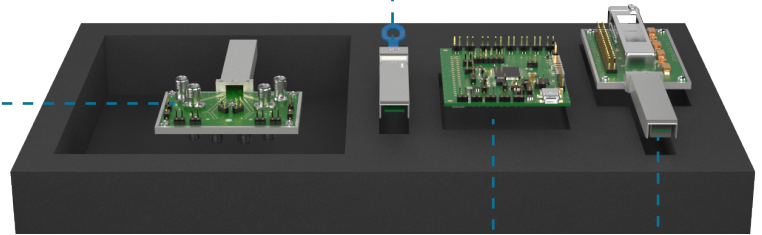
- Supports 2x56G NRZ and 2x112G PAM4
- High Performance signal integrity traces
- High-speed signals accessible through 2.92-mm K connectors
- 2 channels: 2 TX and the corresponding 2 RX

### ML4066-ANA-SFPDD:

- USB Interface
- Windows based GUI and API Library
- Detection and measurement of host pull-up + pull-down resistors on low-speed signals
- VCC spectral noise analysis
- I2C Analyzer
- Functional tests
- MIS/CMIS state machine test

### ML4066-SFPDD:

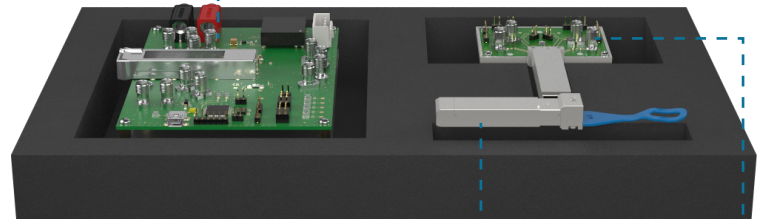
- Low insertion loss PCB traces
- Power pins and low speed signals are accessible via pin headers
- Ability to drive I2C from external pin headers, or connect I2C packet analyzer
- Ability to drive 3.3 V from external source for power supply margining
- Ability to break 3.3 V power from Host to module allowing voltage and current measurement



## MLDCTS-SFPDD-KIT25: 200G

### ML4022-MCB-112:

- Supports 2x56G NRZ and 2x112G PAM4
- All channels come with matching trace length
- High performance signal integrity traces from 2.4-mm connectors to SFP-DD112 host connector
- On board LEDs display MSA output alarm states
- On board pin headers for MSA I/O control signals and I2C interface
- User Friendly GUI and USB interface



### ML4022-LB:

- Loops back TX & RX with good performance signal integrity traces
- MSA compliant shell with latching mechanism
- Four power spots, dissipating up to 4.96 W
- One temperature sensor
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- MIS/CMIS state machine test

### ML4022-HCB-112:

- Supports 2x56G NRZ and 2x112G PAM4
- High Performance signal integrity traces
- High-speed signals accessible through 2.92-mm K connectors
- 2 channels: 2 TX and the corresponding 2 RX



# DSFP

**Compliance  
Testing**

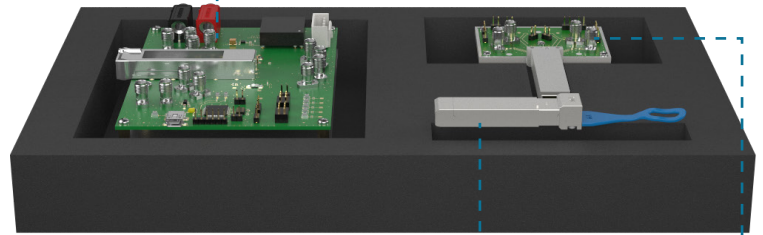


MLDCS-DSFP-Kit26: 100G

## MLDCTS-DSFP-KIT26: 200G

### ML4019-MCB:

- Supports 2x28G NRZ and 2x56G PAM4
- All channels come with matching trace length
- High performance signal integrity traces from 2.92-mm K connectors to DSFP host connector
- On board LEDs display MSA output alarm states
- On board pin headers for MSA I/O control signals and I2C interface
- User Friendly GUI and USB interface



### ML4019-LB-56-3.5W:

- Loops back TX & RX with good performance signal integrity traces
- MSA compliant shell with latching mechanism
- Four power spots, dissipating up to 3.5 W
- Two temperature sensors
- I2C terminated by microcontroller, I2C slave compliant with MSA
- Implements MSA memory maps with programmable new pages
- CMIS state machine test

### ML4019-HCB:

- Supports 2x28G NRZ and 2x56G PAM4
- High Performance signal integrity traces
- High-speed signals accessible through 2.92-mm K connectors
- 2 channels: 2 TX and the corresponding 2 RX

# multiLane



Innovation for the Next Generation



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