

ML4066-ANA Manual





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1. Overview

The ML4066 is an Adaptor with diagnostic interface for the power, I2C and management interface control and alarm signals. The SFF analyzer board is connected to the ML4066 to enable live diagnosis for the transceiver and host.

2. SFF Analyzer

2.1 The SFF Analyzer features

- USB Interface
- Windows based GUI and API Library
- Detection and measurement of host pull up + pull down resistors on low speed signals
- Host VCC rails sampling measurement
- VCC spectral noise analysis
- I2C Analyzer
 - \circ Bus Speed
 - o ACK/ NACK Detection
 - Clock Stretching Analysis
 - Time Event Logging
- Functional tests
 - o Control signals
 - o Configuration registers
 - Ability to emulate optical module by loading identification registers with custom data
 - \circ $\$ I2C Terminated by microcontroller, I2C slave compliant with MSA
 - \circ $\;$ Implements MSA Memory map and programmable new pages
 - \circ $\;$ Memory map can be loaded to replicate optical module's identification registers
 - o Ability to control/monitor all low speed signals
 - Hot pluggable
- Alarm generation

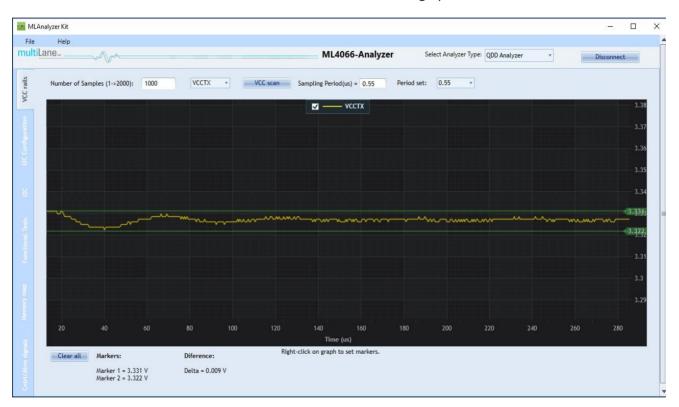


2.2 SFF Analyzer GUI

2.2.1 VCC tab

The VCC tab allows the measurement of the VCCTX, RX and VCC1. The user should select the number of samples that will be multiplied by the sampling period selected from the Combobox. The default value of this period is 0.55µs.

The user can add two markers to the graph using the mouse right-click. To add other markers the user shall Clear all markers and add others.



The values of the markers and their difference are shown under the graph.

Figure 1: VCC tab



2.2.2 I2C Configuration Tab

File	Help					
multiL	ane	ML4066-Analyzer	Select Analyzer Type:	QDD Analyzer	- Di	isconnect
	Select I2C Bus Direction: Bypass mode					
12C Configuration		I2C Master Configuration Enable Clock Stretching I2C Speed(10~400KHz) Max I2C Clock Stretching(0~3000us)				
		Get Apply Configuration				
		I2C Slave Configuration				-
		I2C Clock Stretching(0-225us) Get Apply Configuration				
Cntri//Atm signals						

This tab allows the user to manually configure the I2C bus direction, speed, and clock stretching.

When choosing **Internal Slave**, the user can Read/Write the Data of the Analyzer's EEPROM. **Internal Master** allows User to read/write on the Module.

Bypass mode makes the communication direct between the module and the host.

For the I2C Master configuration, use the Get button to retrieve the configuration. To change it, write the desired configuration then click "Apply Configuration". The max clock stretching corresponds to the maximum time that the Master waits for the slave's response. To set the max clock stretching the "Enable Clock Stretching" checkbox must be checked.

For I2C slave configuration, user can choose to enable/disable clock stretching, and can also set the clock stretching time that will be forced on SCL during I2C transactions

2.2.3 I2C tab

This tab analyzes the I2C packets. The graph will show the clock (SCL) and the data (SDA). The SCL rising edges are detected and the SDA values are shown at each rising edge (cf. image below). A vertical line is drawn at each rising edge and the SDA binary values are shown under the yellow SDA curve.



Figure 2: I2C tab

The image above refers to the I2C read command. The data packets are shown in a list under the graph.

The user can select the packet that he needs to visualize on the graph and it will show the range of that packet.

Each packet is delimited on the graph by the Start (marked in green) and Stop (marked in red) conditions (cf. image above).

Note that the user can show/hide any of the lines by clicking on the corresponding checkbox at the top of the graph.

The user can also change the sampling period using the combo box. This period will be multiplied by the number of samples chosen. Its default value is 0.963µs.

Note that for the reading process the user should select a higher number of samples so it can capture the whole packet.



Figure 3 - I2C Write

As for the description of the packet, each packet starts with the slave address A0 followed by the acknowledgment 0. The data afterword is the Data Word (7F is the page selection and 00 is the MemPage needed to write on). The second packet presents the writing process on the address 00(hex).

The free run checkbox is used to monitor the I2C bus. When checked, the monitoring function will start sampling directly after the I2C button is clicked.

When unchecked, the monitoring function will automatically detect I2C start frame.



2.2.4 Functional Tests tab

The functional tests tab gives access to the memory pages. The user can read/write on registers via I2C using this tab. To read/write from the module the user should select the "Internal Master" bus direction from the I2C configuration tab, or the "Internal Slave" to read/write from the EEPROM.

MLAnalyzer Kit		- 🗆 ×
File Help		<u>^</u>
multiLane	ML4066-Analyzer Select Analyzer Type: ODD Analyzer	- Disconnect
	I2C Read / Write	
	Memory Location	
	Upper Page 00 Upper Page 01 Upper Page 02 Upper Page 03	
	None of the above Please enter page number Set -	
	Single Byte	
	Address(decimal) Memory Content(Hex) Memory Content(binary)	
	20 00 0000000	
-	Read Write	-
Functional Tests	Multi-Byte Read	
ction	Starting Address (Dec) End Address (Dec) Address Hex Binary	
Fa	Starting Address (Dec) End Address (Dec) Address nex binary	
	0 50 000 0C 000011(▲	
	Read 001 28 0010100	
	002 06 0000011	
	Save to file 003 07 0000011	
	004 00 0000000	
	005 00 0000000	
	006 00 0000000	
	007 00 0000000	
	008 00 0000000.	
		*

Figure 4: Functional Tests tab

For the SFP-Analyzer, the functional tests tab adds the slave addresses corresponding to the SFP standards.

Figure 5-Functional Tests Tab for SFP-Analyzer



I2C Read/Write:

- 1. First, the user selects which page in the **Memory Location** he needs to perform a read or write operation on.
- 2. Then, he can use the **Single Byte** window to read/write one byte from the memory.
 - a. Address: The address to read/write from.
 - b. Memory Content: The data value to be read/written to the selected address (In Hex or in Binary)
- 3. Or, the user can use the **Multi-byte Read** to read/write multiple bytes between a Starting Address and an End Address that he specifies.

2.2.5 Memory Map tab

This tab gives access to the memory map of the module. It can be loaded to replicate optical module's identification registers.

nalyzer Kit Help							- 0
.ane					ML4066	-Analyzer Select Analyzer Type: QDD Analyzer	* Disconnect
	Refr	resh	Load MS	A from file	Save M	A to file Write MSA to HW	
	Add	ress	Data(Hex)	Data(Dec.)	Data(Ascii)	MSA Description	
	Low	Mem 0(00h)	0C	12	*	Identifier	
	Low	Mem 1(01h)	28	40	(Version Id	
	Low	Mem 2(02h)	06	6	0	CLEI code present	
	Low	Mem 3(03h)	07	7	0	Module State	
	Low	Mem 4(04h)	00	0		Bank 0	
	Low	Mem 5(05h)	00	0		Bank 1	
	Low	Mem 6(06h)	00	0		Bank 2	
	Low	Mem 7(07h)	00	0	1	Bank 3	
	Lowi	Mem 8(08h)	00	0		Module State changed flag	
	Low	Mem 9(09h)	00	0		Latched VCC3.3/Temp Alarm and Warning	
	Low	Mem 10(0Ah)	00	0		Latched AUX1/2 Alarm and Warning	
	Low	Mem 11(0Bh)	00	0		Latched Vendor Defined Alarm and Warning	
	Low	Mem 12(0Ch)	00	0		Reserved	
	Low	Mem 13(0Dh)	00	0		Custom	
	Lowi	Mem 14(0Eh)	18	24	0	Internally measured Temperature 1 MSB	
	Low	Mem 15(0Fh)	00	0		Internally measured Temperature 1 LSB	
	Lowi	Mem 16(10h)	82	130		Internally measured Supply 3.3v MSB	
	Low	Mem 17(11h)	35	53	5	Internally measured Supply 3.3v LSB	
	Lowi	Mem 18(12h)	00	0		Internally measured AUX1 MSB	
	Lowi	Mem 19(13h)	00	0		Internally measured AUX1 LSB	
	Low	Mem 20(14h)	00	0		Internally measured AUX2 MSB	
	Low	Mem 21(15h)	00	0		Internally measured AUX2 LSB	
		Mem 22(16h)	00	0		Internally measured AUX3 MSB	
	1 Loud	Mam 22/17b)	00	n		Internally maseured ALIV2_CD	

Figure 6: Memory Map tab

This screen allows User to Load or Save his custom MSA configuration.

Data is displayed according to the selected I2C Bus Direction in a grid showing: register address, hex value, Decimal Values, ASCII value, MSA description.

- **Refresh** button: Read MSA Registers, and refresh values.
- Write MSA to HW button: Write the current MSA configuration to OSFP module.

- Save MSA to file button: Saves the current MSA memory to a file using Comma separated values (CSV) format.
- Load MSA from file button: Loads MSA values from file and map it to MSA memory.

When choosing **Internal Slave**, the user can Read/Write the Data of the Analyzer's EEPROM. **Internal Master** allows User to read/write on the Module. **Bypass mode** makes the communication direct between the module and the host.

For the SFP-Analyzer, the user can choose which slave address he wants and from which page he wants

to read.

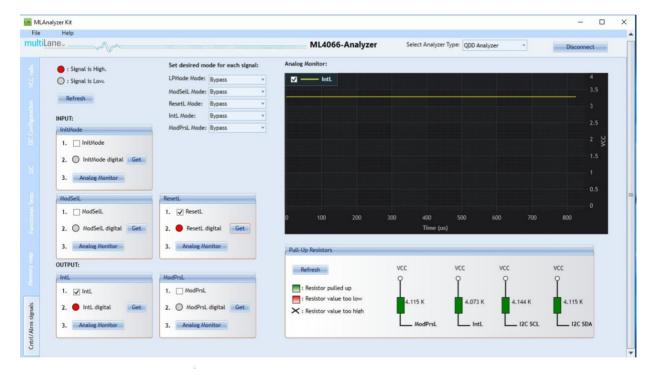
e	Help									
La	1e				ML40	66-Analyze	r Select Analyzer Type: SFP Analyzer	ter 🔹	Disconnect	
	Choose addresses to display	_	Refresh Load	WSA from file	Sav	e MSA to file	Write MSA to HW			
	Slave address A2 - Pagel 💌									
			Address	Data(Hex)	Data(Dec.)	Data(Ascii)	MSA Description			
		+	S.A. A2 Page00 Byte 0 (00h)	55	85	U	Alarm and Warning Thresholds			
			S.A. A2 Page00 Byte 1 (01h)	00	0		Alarm and Warning Thresholds			
			S.A. A2 Page00 Byte 2 (02h)	00	0		Alarm and Warning Thresholds			
			S.A. A2 Page00 Byte 3 (03h)	00	0		Alarm and Warning Thresholds			
			S.A. A2 Page00 Byte 4 (04h)	00	0		Alarm and Warning Thresholds			
			S.A. A2 Page00 Byte 5 (05h)	00	0		Alarm and Warning Thresholds			
			S.A. A2 Page00 Byte 6 (06h)	00	0		Alarm and Warning Thresholds			
		-	S.A. A2 Page00 Byte 7 (07h)	00	0		Alarm and Warning Thresholds			
			S.A. A2 Page00 Byte 8 (08h)	88	136		Alarm and Warning Thresholds			
			S.A. A2 Page00 Byte 9 (09h)	B8	184	5	Alarm and Warning Thresholds			
			S.A. A2 Page00 Byte 10 (0Ah)	75	117	u	Alarm and Warning Thresholds			
			S.A. A2 Page00 Byte 11 (0Bh)	30	48	0	Alarm and Warning Thresholds			
			S.A. A2 Page00 Byte 12 (0Ch)	00	0		Alarm and Warning Thresholds			
			S.A. A2 Page00 Byte 13 (0Dh)	00	0		Alarm and Warning Thresholds			
			S.A. A2 Page00 Byte 14 (0Eh)	00	0		Alarm and Warning Thresholds			
			S.A. A2 Page00 Byte 15 (0Fh)	00	0		Alarm and Warning Thresholds			
			S.A. A2 Page00 Byte 16 (10h)	00	0		Alarm and Warning Thresholds			
			S.A. A2 Page00 Byte 17 (11h)	00	0		Alarm and Warning Thresholds			
			S.A. A2 Page00 Byte 18 (12h)	00	0		Alarm and Warning Thresholds			
			S.A. A2 Page00 Byte 19 (13h)	00	0		Alarm and Warning Thresholds			
			S.A. A2 Page00 Byte 20 (14h)	00	0		Alarm and Warning Thresholds			
			S.A. A2 Page00 Byte 21 (15h)	00	0		Alarm and Warning Thresholds			
			S.A. A2 Page00 Byte 22 (16h)	00	0		Alarm and Warning Thresholds			

2.2.6 CNTRL/ALRM Signals tab

multiLane

This tab allows detection and measurement of host pull up resistors on low speed signals and the detection of their state (either digital or analog). The user can also drive these signals using the corresponding checkboxes.

- Pull-Up Resistors window: The analyzer detects if the pull-up resistor of each signal is missing or not and it calculates its value. The range between 1.3KΩ and 10KΩ is acceptable indicating that a pull-up resistor is present. Below 1.3KΩ the resistor value is too low and you risk to have a "Short circuit". Above 10KΩ you risk of an "open circuit" case. The marge of accuracy for the resistor's value is about 1KΩ.
- For each signal the desired mode "Drive", "Bypass" or "Analog Sampler" is chosen. The Analog Monitor button displays the voltage of the desired signal. To manually assert/de-assert the signals, the "Drive" option must be chosen to be able to toggle the signal's checkbox. Finally, if "Bypass" mode is selected, the user can control the module externally and gets its status when the Get button is clicked.



• The Refresh button gets the initial states of the signals in "Drive" mode.

Figure 7: Cntrl/Alrm signals tab



The SFP has different low speed control signals as shown in the figure below.



Figure 8- SFP-Analyzer Control signals

2.3 Application Notes

2.3.1 I2C Tab

- 1. Select "Bypass" mode from the "I2C Configuration" tab
- 2. In the I2C tab, select the number of samples for the I2C capture, for the I2C read it should be the maximum.
- 3. Without selecting the "free run" checkbox, click the I2C button to start monitoring, then using your host send an I2C command (read or write) and wait for the I2C Frame Capture.
- 4. If the "free run" checkbox is selected, the capturing will start immediately after the I2C button is clicked.

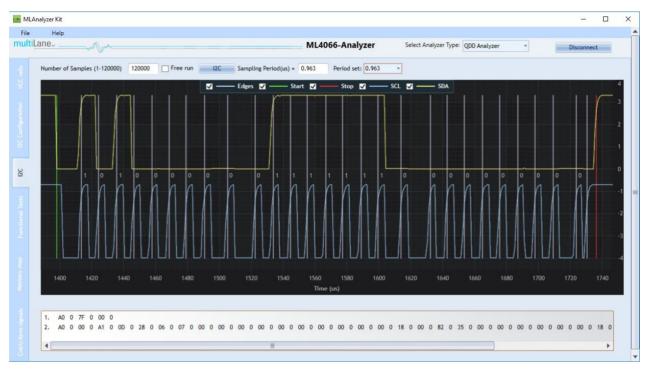


Figure 9: I2C Read

2.3.2 Functional Tests Tab

 Select "Bypass" mode, using your host try to read/write a value from the module. In the Analyzer GUI, the read/write won't work in this mode because the Host and module communicate directly without the interference of the Analyzer.

• • M	1LAnalyzer Kit		- 🗆 ×	(
File	e Help ItiLane	ML4066-Analyzer Select Analyzer Type: QDD Analyzer -	Disconnect	Î
VCC rails		I2C Read / Write Memory Location		
		Upper Page 00 Upper Page 01 Upper Page 02 Upper Page 03 None of the above Please enter page number Set		
		Single Byte Address(decimal) Memory Content(Hex) Memory Content(binary) 0		
sts I2C		Read Write		-
Functional Tests		Multi-Byte Read Starting Address (Dec) End Address (Dec) Address Hex Binary		
		Read Save to file		
				Ŧ

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2. Select "Internal Master" mode, read address 0 using the Analyzer GUI. This value refers to the one written on the module. The connection between the Host and the Analyzer is cut and using the Host to read will give you FF values.

Help					
tiLane	\mathbb{V}^{\wedge}	ML4066-Analyzer	Select Analyzer Type: QDD #	Analyzer +	Disconnect
	I2C Read / Write				
	Memory Location				
	Upper Page 00 Upper Page 01 Upper	Page 02 O Upper Page 03			
	None of the above Please enter page number	Set			
	Single Byte				
		lemory Content(binary)			
	20 00	0000000			
	Re	ad Write			
		ad Write			
	Re Multi-Byte Read	ad Write			
		ad Write Address Hex	Binary		
	Multi-Byte Read Starting Address (Dec) End Address (Dec)	Address Hex			
	Multi-Byte Read		Binary 000011(
	Multi-Byte Read Starting Address (Dec) End Address (Dec)	Address Hex 000 OC 001 28	000011(
	Multi-Byte Read Starting Address (Dec) End Address (Dec) 0 50 Read	Address Hex 000 0C 001 28 002 06	000011(▲ 001010(0000011		
	Multi-Byte Read Starting Address (Dec) End Address (Dec) 0 50	Address Hex 000 0C 001 28 002 06 003 07	000011(001010(0000011		
	Multi-Byte Read Starting Address (Dec) End Address (Dec) 0 50 Read	Address Hex 000 0C 001 28 002 06 003 07 004 00	000011(▲ 001010(0000011		
	Multi-Byte Read Starting Address (Dec) End Address (Dec) 0 50 Read	Address Hex 000 0C 001 28 002 06 003 07 004 00	0000111(001010(0000011 0000011 0000001		
	Multi-Byte Read Starting Address (Dec) End Address (Dec) 0 50 Read	Address Hex 000 OC 001 28 002 06 003 07 004 00 005 00	0000111(A 001010(0000011 00000011 0000000		

3. Select "Internal Slave" mode, the reading/writing command from the Analyzer or your Host will give the same value written in the EEPROM.

MLAnalyzer Kit	- 0
File Help multiLane	ML4066-Analyzer Select Analyzer Type: QDD Analyzer * Disconnect
	I2C Read / Write Memory Location • Upper Page 00 • Upper Page 01 • Upper Page 02 • Upper Page 03 • Upper P
	O None of the above Please enter page number Set Single Byte Address(decimal) Memory Content(Hex) Memory Content(binary)
88 20	0 20 00100000 Read Write
Functional Tests	Multi-Byte Read Starting Address (Dec) End Address (Dec) Address Hex Binary
	Read Save to file

In the "Memory Map" tab, the grid when clicking "Refresh" displays all data written in the registers and it follows the rules above.

Analyzer Kit Help						- 0
Lane				ML4066	-Analyzer Select Analyzer Type: QDD Analyzer	* Disconnect
	Refresh	- Load A	ISA from file	Save M	5A to file Write MSA to HW	
	Address	Data(Hex)	Data(Dec.)	Data(Ascii)	MSA Description	
	LowMem 0(00	h) 0D	13		Identifier	
	LowMem 1(01	h) 28	40	(Version Id	
	LowMem 2(02	h) 06	6	0	CLEI code present	
	LowMem 3(03	h) 07	7	0	Module State	
	LowMem 4(04	h) 00	0		Bank 0	
	LowMem 5(05	h) 00	0		Bank 1	
	LowMem 6(0	h) 00	0		Bank 2	
	LowMem 7(0)	h) 00	0		Bank 3	
	LowMem 8(08	h) 00	0		Module State changed flag	
	LowMem 9(09	h) 00	0		Latched VCC3.3/Temp Alarm and Warning	
	LowMem 10(Ah) 00	0		Latched AUX1/2 Alarm and Warning	
	LowMem 11(Bh) 00	0		Latched Vendor Defined Alarm and Warning	
	LowMem 12(Ch) 00	0		Reserved	
	LowMem 13(Dh) 00	0		Custom	
	LowMem 14(Eh) 18	24	۵	Internally measured Temperature 1 MSB	
	LowMem 15(Fh) 00	0		Internally measured Temperature 1 LSB	
	LowMem 16(1	0h) 82	130		Internally measured Supply 3.3v MSB	
	LowMem 17(1	1h) 35	53	5	Internally measured Supply 3.3v LSB	
	LowMem 18(1		0		Internally measured AUX1 MSB	
	LowMem 19(1	3h) 00	0		Internally measured AUX1 LSB	
	LowMem 20(1	4h) 00	0		Internally measured AUX2 MSB	
	LowMem 21(1	5h) 00	0		Internally measured AUX2 LSB	
	LowMem 22(1	6h) 00	0		Internally measured AUX3 MSB	

Figure 10: Internal Master

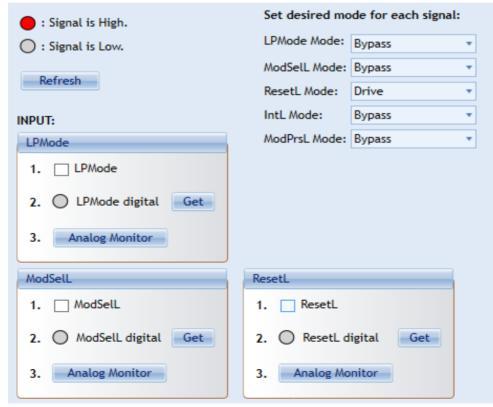
2.3.3 Cntrl/Alrm Tab

multiLane

1. The refresh button gets the Status of the signals at the "Drive" mode and the checkboxes reflect its condition.

multiLane								
	raits	: Signal is High.	Set desired mode for each signal: LPMode Mode: Bypass					
		C : Signal is Low.	ModSelL Mode: Bypass *					
		INPUT:	ResetL Mode: Bypass IntL Mode: Bypass					
		LPMode 1. LPMode 2. LPMode digital Get 3. Analog Monitor	ModPrsL Mode: Bypass 🔹					
		ModSelL 1. ModSelL	ResetL 1. ResetL					
		2. O ModSelL digital Get	2. O ResetL digital Get					
	ignals	3. Analog Monitor	3. Analog Monitor					
	Cntrl/Alrm signals	OUTPUT:	ModPrsL					
	Cntrl	1. 🗹 IntL	1. 🗌 ModPrsL					
		2. O IntL digital Get	2. O ModPrsL digital Get					
		3. Analog Monitor	3. Analog Monitor					

2. Select "Drive" mode for ResetL and toggle the checkbox, the ResetL signal of the module will be activated or deactivated.





3. Select "Bypass" mode, from you Host try to trigger the ResetL signal. In the analyzer GUI get its status by clicking on "Get" button.

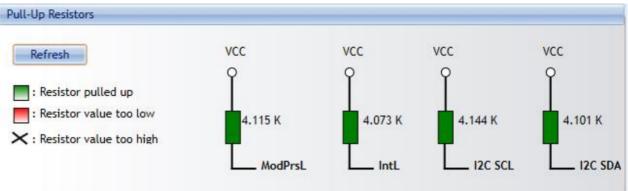
: Signal is High. Set desired mode for each sign			
🔵 : Signal is Low.	LPMode Mode: Bypass		
Refresh	ModSelL Mode: Bypass		
Nerresit	ResetL Mode: Bypass 🔹		
INPUT:	IntL Mode: Bypass 🔹		
LPMode	ModPrsL Mode: Bypass		
1. 🗌 LPMode			
2. O LPMode digital Get			
3. Analog Monitor			
ModSelL ResetL			
1. 🗌 ModSelL	1. 🗌 ResetL		
2. O ModSelL digital Get	2. 🔴 ResetL digital 🛛 🕞 Get		
3. Analog Monitor	3. Analog Monitor		

4. Select "Analog Monitor" mode and click on the "Analog Monitor" button of ResetL. The graph displays its DC voltage level from the Host side.





5. In the "Pull-Up Resistors" Groupbox, click "Refresh" button, the values displayed are the values of the pullup resistors at the Host. See section 3.2.5 for more details about the values description.



3. CMIS State Machine Test

This analyzer test works for all QSFP and QDD modules that are **<u>CMIS 4.0</u>** compliant.

The Module State Machine is engaged after module insertion and power on, and thus the test can be started. During the test, different state transitions can be shown and tested by toggling the desired destination state. The Module State Machine is different for devices implementing a paged memory map and those implementing a flat (non-paged) memory map.

File	Help		
multi	Lane	ML4066-Analyzer Select Analyzer Type: QSFP Analyzer	- Connect
12C Configuration			-
		Throughout this test, the analyzer will be operating in drive mode for all control signals. It will switch to its previously set mode when the test is stopped.	
		Initialize Test	-
State Machine Test (CMIS 4)			
100			¥



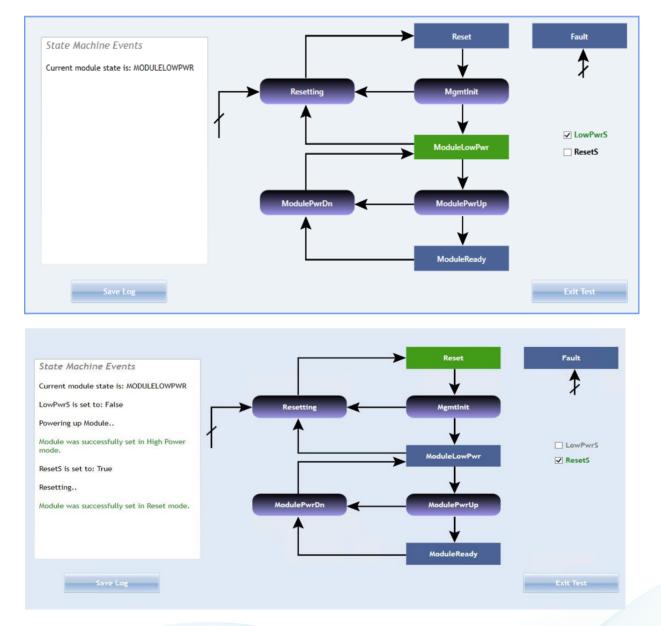
Upon test initialization, the CMIS compliance version is verified and module type is detected. If the latter was not feasible the test would not start normally.

3.1 Paged Memory Modules

If the detected module implements a paged memory map, the below diagram appears showing the current state of the module and the transition signals.

The user can switch to another steady state (Reset, ModuleLowPwr, ModuleReady) by toggling it. State and transition signal changes will appear and events will be logged in the logging box. The logged events can then be saved to a text file possessing the module serial number and the time the test was done.

If an error occurs while transitioning, the module will be thrown into a **Fault** state. This state can be exited only by resetting the module.



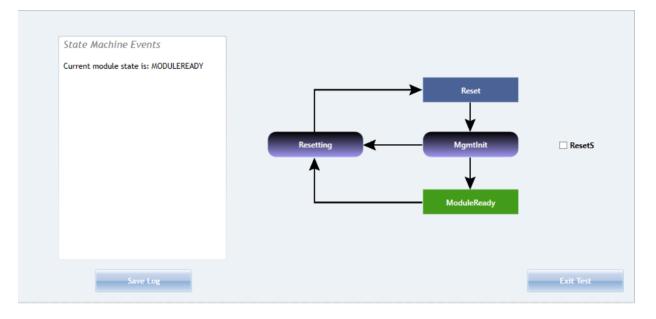


3.2 Flat Memory Modules

If the detected module implements a flat (non-paged) memory map, the below diagram appears showing the current state of the module and the transition signal.

The user can switch between the steady states (Reset or ModuleReady) by toggling any of them. State and transition signal changes will appear and events will be logged in the logging box. The logged events can then be saved to a text file possessing the module serial number and the time the test was done.

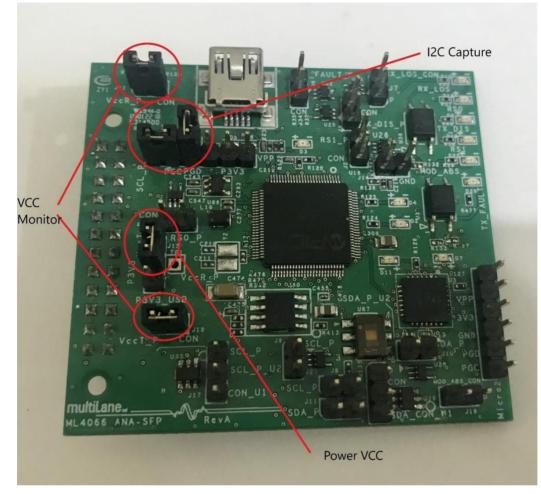
If an error occurs while transitioning, the module will be stuck in the transition state until resetting the module or re-initializing the test.





Appendix

• SFP Analyzer jumpers' placement



Revision Information

Revision number	Description	Date
1.0	 Preliminary revision 	2017/11/27
1.1	 Updated parag 3.2 to match version 1.0 of the GUI 	2017/12/13
1.2	 Adding period selection 	2018/1/4
1.3	 Adding Resistor pullup and Refresh button in cntrl Tab 	2018/4/26
1.4	 Adding application notes 	2018/5/3
1.5	 Update parag 3.3.1 	2018/6/4
1.6	 Add Appendix 	2019/9/4
1.7	 Add CMIS 4.0 State Machine Test 	2020/3/2



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