

ML4050

MSA Compliant 100 G

CFP4 Electrical Passive Loopback Module



Revision 1.0

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ML4050 CFP4 4x25G Passive Loopback Module - Key Features

- ✓ Passive CFP4 loopback module, 4 TX & 4 RX Lanes operating up to 28 GB/s per lane.
- ✓ Compatible with both MSA v24 CFP4 and CFP4 ALT1 pinouts.
- ✓ Programmable Power Dissipation up to 6.5 W covering all CFP4 power classes
- ✓ Custom Memory Maps.
- ✓ Programmable TX_DIS, GLB_ALRMn and RX_LOS pins.
- ✓ High performance Signal Integrity traces.
- ✓ MSA compliant Digital Diagnostic and Monitoring Interface (DDMI).
- ✓ 3 Status LED indicators.
- ✓ Built with advanced PCB material.
- ✓ Temperature sensing.
- ✓ Cut-Off Temperature preventing module overheating.
- ✓ Hot Pluggable module.

LED Indicator

Green (Solid) - Signifies that the module is operating in high power mode.

Red (Solid) - Signifies the module is operating in low power mode.

Green/Red (Blinking) - Signifies that the module is overheated and the temperature high alarm is asserted.

Operating Conditions

Recommended Operation Conditions						
Parameter	Symbol	Notes/Conditions	Min	Typ	Max	Units
Operating Temperature	T_A		0		85	°C
Supply Voltage	VCC	Main Supply Voltage	3.00	3.3	3.60	V
Data Rate	R_b	Guaranteed to work at 28 Gbps per lane	0		100	Gbps
Input/Output Load Resistance	RL	AC-Coupled, Differential	90	100	110	Ω
Power Class		Programmable to Emulate all power classes	0		6.5	W

1. General Description

The ML4050 is a CFP4 passive electrical loopback module with a hot pluggable form factor designed for high speed testing applications for CFP4 host ports. The ML4050 is designed for 100 Gigabit Ethernet applications and provides 4x28G RX and TX lanes, a MDIO module management interface and all the CFP4 MSA hardware signals.

The ML4050 loops 4-lane of 28 Gb/s transmit data from the Host back to 4-lane of 28 GB/s receive data to the Host.

The ML4050 provides programmable power dissipation up to 6.5W allowing the module to emulate all the CFP4 power classes.

2. Functional Description

2.1 Management Data Interface - MDIO

The ML4050 supports the MDIO interface specified in IEEE802.3 Clause 45.

A dedicated MDIO logic block in the CFP4 module to handle the high rate MDIO data and a CFP register space that is divided into two register groups, the Non-Volatile Registers (NVR) and the Volatile Registers (VR). The NVRs are connected to a Non-Volatile Memory device (NVM) for ID/Configuration data storage. Over the internal bus system, the VRs are connected to a device that executes the Host control commands and reports various Digital Diagnostic Monitoring (DDM) data. Please Note that in the rest of this document, independently of implementation, CFP registers are also referred as NVRs or VRs.

The ML4050 specifications are the following:

- ✓ Supports MDC rates up to 4MHz.
- ✓ CFP Registers at MDIO Device Address 1 as specified by CFP MSA.
- ✓ Supports various Physical Addresses thus allowing communication with many modules plugged to the same Host with different Port Addresses (PRT_ADDR0-2) assigned.

CFP registers use fast memory to shadow the NVM data and the DDM data. The shadow registers decouple the Host-side timing requirements from the module's internal processing, timing, and hardware control circuit introduced latency.

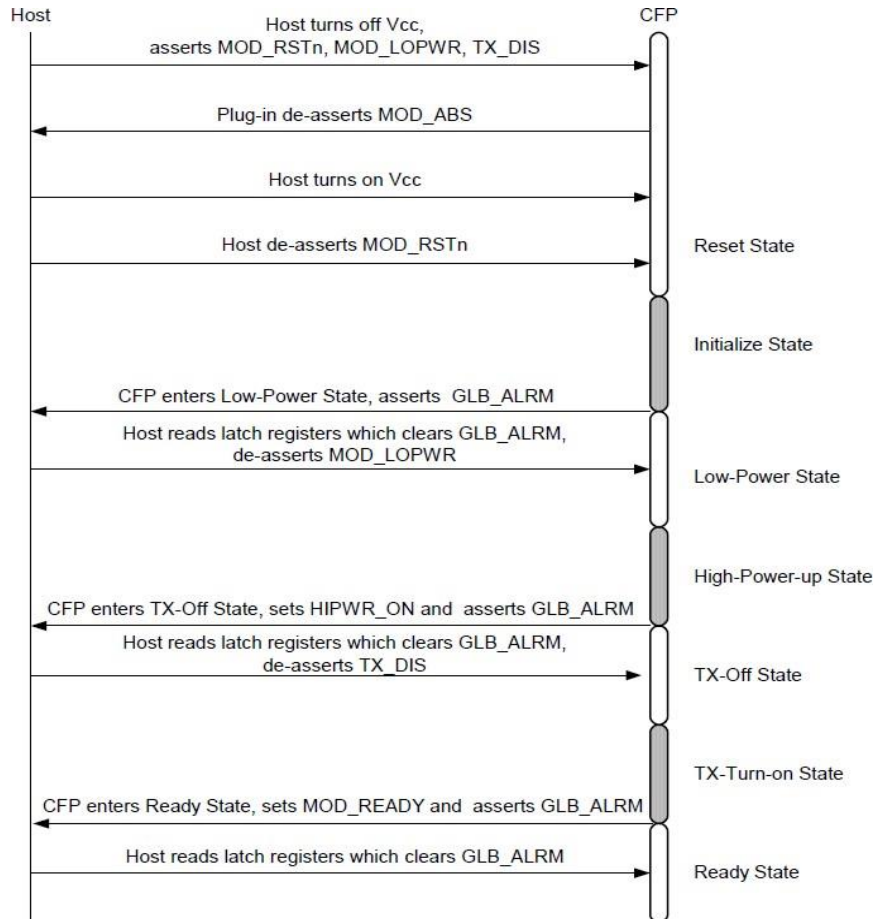
CFP shadow register set meets the following requirements:

- ✓ It supports dual access from the Host and from module internal operations such as NVM and DDM data transfers.

- ✓ It supports continuous Host access (read and write) with fast access memory at maximum MDC rates of 4 MHz.
- ✓ It allows the uploading of NVM content into the CFP shadow register during module initialization. Data saving from CFP shadow register to NVM is supported.
- ✓ It supports the DDM data update periodically during the whole operation of the module. The maximum data refresh period is 1ms(real time temperature monitoring).
- ✓ It supports the whole CFP register set including all NVRs and VRs.
- ✓ Incomplete or otherwise corrupted MDIO bus transactions are purged from memory and disregarded.
- ✓ The port address is allowed to change on the fly without a module reset.

2.2 Initialization Sequence

The Startup sequence for the ML4050 is defined below:



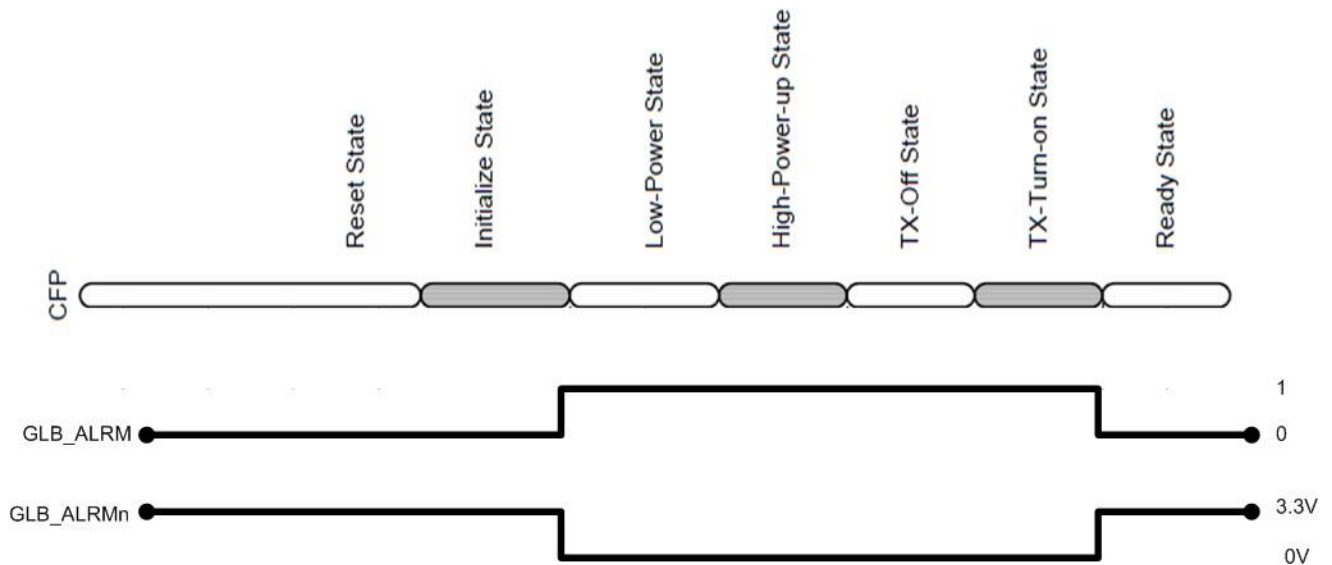
MOD_RSTs assertion drives CFP4 module to reset state, at this stage MDIO interface will be held at high impedance state, the Host will read 'FFFF'h, from any address, while host write operations will have no effect.

Upon the de-assertion of MOD_RSTs, CFP4 module exists to initialize state which is a transient state.

The Initialization time required is less than one second. When Initialization state is done, the CFP4 module will enter Low-Power state, at this point MDIO becomes available for R/W operations.

2.3 GLB_ALARM

Below is the flowchart for GLB_ALARM signal during CFP states transitions:



GLB_ALARM is de-asserted during Reset and Initialize state, it is asserted in Low-Power, High-Power-up, TX-Off and TX-Turn-on states, then de-asserted again when Ready state is reached. GLB_ALRMn is the hardware pin, and is the inverse of GLB_ALARM.

The below example can be run in order to check for correct module initialization and GLB_ALARM signal:

- Assert MOD_LOPWR and TX_DIS, Deassert MOD_RSTn : GLB_ALRMn should be HIGH (module in Reset state)
- Assert MOD_RSTn (module exits Reset state into Low Power state) : GLB_ALRMn should be LOW
- Deassert MOD_LOPWR (module exits Low Power into TX-Off state) : GLB_ALRMn should stay LOW
- Deassert TX_DIS (module enters Ready state) : GLB_ALRMn should go HIGH

2.4 MDIO Signals, Addressing and Frame Structure

Port Address (PRTADR)

As per the port address used, the module will work on any MDIO Physical port address which can be set by the HW input signals PRTADR [2:0]. So when using 2 or more CFP4 slots, each of them can be configured to a different Port Address.

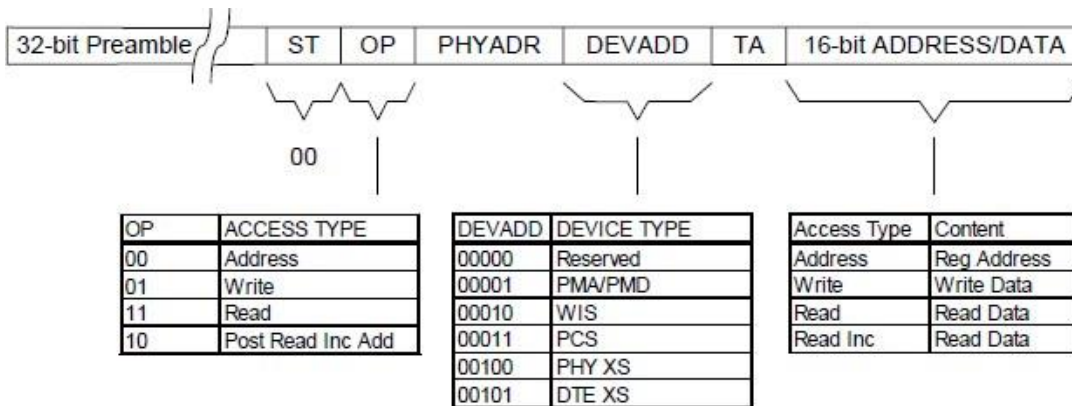
PRTADR0	MDIO Physical Port address bit 0	I	1.2V LVCMOS
PRTADR1	MDIO Physical Port address bit 1	I	1.2V LVCMOS
PRTADR2	MDIO Physical Port address bit 2	I	1.2V LVCMOS

Device Address (DEVADD)

MDIO Device Address consists of 5 bits that are sent in MDIO frames, CFP MSA specifies that CFP register Set should be addressed using Device Address = 1, Thus CFP register space is available in the ML4050 on D.A=1.

MDIO Frame

The Below Frame shows all segments of an MDIO Packet, PHYADR are the 5 bits Physical Address and DEVADD are the 5 bits Device Address.



ST = start bits (2 bits),
 OP = operation code (2 bits),
 PHYADR = physical port address (5 bits),
 DEVADD = MDIO device address (or called device type, 5 bits),
 TA = turn around bits (2 bits),
 16-bit ADDRESS/DATA is the payload.

2.5 CFP Register Set

All registers from 0x8000 to 0xA47F are supported in memory map (Refer to table below), the set of registers starting from 0x8000 to 0x9F00 are implemented as NVR registers, all these registers are always read from NVM during initialization and mapped to corresponding address.

All VR (Volatile Registers) from 0xA000 to 0xA47F are set to zero or MSA default value upon module initialization.

The NVR values are saved to NVM by calling the SAVE NVR function. The base ID registers are initially set, but user can change them if required.

CFP Register Allocation					
Starting Address in Hex	Ending Address in Hex	Access Type	Allocated Size	Data Bit Width	Table Name and Description
8000	807F	RO	128	8	CFP NVR 1. Basic ID registers.
8080	80FF	RO	128	8	CFP NVR 2. Extended ID registers.
8100	817F	RO	128	8	CFP NVR 3. Network lane specific registers.
8180	81FF	RO	128	8	CFP NVR 4.
8200	83FF	RO	4x128	N/A	MSA Reserved.
8400	847F	RO	128	8	Vendor NVR 1. Vendor data registers.
8480	84FF	RO	128	8	Vendor NVR 2. Vendor data registers.
8500	87FF	RO	6x128	N/A	Reserved by CFP MSA.
8800	887F	R/W	128	8	User NVR 1. User data registers.
8880	88FF	R/W	128	8	User NVR 2. User data registers.
8900	8EFF	RO	12x128	N/A	Reserved by CFP MSA.
8F00	8FFF	N/A	2x128	N/A	Reserved for User private use.
9000	9FFF	RO	4096	N/A	Reserved for vendor private use.
A000	A07F	R/W	128	16	CFP Module VR 1. CFP Module level control and DDM registers.
A080	A0FF	RO	128	16	Reserved by CFP MSA.
A100	A1FF	RO	2x128	N/A	Reserved by CFP MSA.
A200	A27F	R/W	128	16	Network Lane VR 1. Network lane specific registers.
A280	A2FF	R/W	128	16	Network Lane VR 2. Network lane specific registers.
A300	A3FF	RO	2x128	N/A	Reserved by CFP MSA.
A400	A47F	R/W	128	16	Host Lane VR 1. Host lane specific registers.

2.6 User NVR Restore and Save Function (0xA004)

To write permanently to User NVR registers (0x8000→ 0x9F00) Host shall use the “Save” function to store the shadowed NVR data into underlying NVM. The host only needs to perform a single Save operation to copy the entire User NVR shadow registers to the underlying NVM after finishing editing the data.

Upon power-up or reset the User NVR shadow registers are “Restored” with NVM values. Note that the Restore function will overwrite the NVR shadow registers, losing any host-written values in them that have occurred since the last Save to the underlying NVM.

The NVR Access Control Register (A004h) provides the Save function for Host to save the User NVRs content.

Bit 5 in NVR Access Control Register is designated for User NVR save command.

A “1” written to bit 5 in register A004h initiates a User NVR Save.

Hex Adr	Size	Access Type	Bit	Register Name Bit Field Name	Description	Init Value
A004	1			NVR Access Control		0000h
		WO	5	User Restore and Save command	1: Save the user NVR section	0

So to call the user NVR save command user can write 0x0020 into register 0xA004.

The Save NVR duration is around 0.5 seconds. When this function is called it should be followed by a 0.5 second time wait.

During this process user can't write or read CFP registers.

2.7 RX_LOS / PRG_ALARM

CFP4 defines one Alarm signal RX_LOS which could be optimally configurable as Programmable Alarm after Reset.

ML4050 initially implements RX_LOS to follow TX_DIS input, assuming that in a loopback module, when the host transmitters are disabled, no data should be received thus leading to RX_LOS condition.

For programmable feature, CFP bit "Soft RX_LOS" at register 0x9002 is dedicated for driving the RX_LOS output.

Hex Adr	Size	Access Type	Bit	Register Name Bit Field Name	Description	Init Value
9002	1			Custom Alarms		0000h
		RW	0	Prog RX_LOS	0: RX_LOS default operation (RX_LOS= TX_DIS) 1: Programmable RX_LOS (driven as per Soft RX_LOS bit)	0
		RW	1	Soft RX_LOS	0: RX_LOS HW signal set to LOW 1: RX_LOS HW signal set to High	0

2.8 Temperature Monitor

The alarms and warnings of the CFP4 Loopback are listed in the tables below. Alarms and Warnings are set in register 0xA01F in bits 8,9,10 and 11, and are continuously asserted and de-asserted when the corresponding alarms/warnings occur. addresses 0x8080, 0x8082, 0x8084, and 0x8086 are reference registers for temperature alarms and warnings, they contain the default values (HA:75, HW:65, LW:2 and LA:0) and can be changed when desired. The module is continuously reading the temperature and storing its value in Register 0x A02F.

When the temperature reaches the High Alarm values, the module front LED indicator will begin blinking.

Hex Adr	Size	Access Type	Bit	Register Name Bit Field Name	Description	LSB Unit
8080	2	RW	7~0	Temp High Alarm Threshold	These thresholds are a signed 16-bit integer with LSB = 1/256 of a degree Celsius representing a range from -128 to + 127 255/256 degree C. MSA valid range is between -40 and +125C." MSB stored at low address, LSB stored at high address.	1/256 degC
8082	2	RW	7~0	Temp High Warning Threshold		
8084	2	RO	7~0	Temp Low Warning Threshold		
8086	2	RO	7~0	Temp Low Alarm Threshold		

Hex Adr	Size	Access Type	Bit	Register Name Bit Field Name	Description	Init Value
A01F	1	RO		Module Alarms and Warnings 1		0000h
			11	Mod Temp High Alarm	Mod temp high Alarm 0: Normal, 1: Asserted	0

			10	Mod Temp High Warning	Mod temp high Warning 0: Normal, 1: Asserted	0
			9	Mod Temp Low Warning	Mod temp high Warning 0: Normal, 1: Asserted	0
			8	Mod Temp Low Alarm	Mod temp Low Alarm 0: Normal, 1: Asserted	0

Hex Adr	Size	Access Type	Bit	Register Name Bit Field Name	Description	Init Value
A02F	1	RO		Module Temp Monitor A/D Value	Internally measured temperature in degrees Celsius, a 16-bit signed integer with LSB = 1/256 of a degree Celsius, representing a total range from -128 to + 127 255/256 degC. MSA valid range is between -40 and +125C. Accuracy shall be better than +/- 3 degC over the whole temperature range.	0000h

2.9 Insertion Counter

The Insertion counter contains the number of times the module was plugged in a host. The insertion counter is incremented every time the module goes in initializing sequence, as it is nonvolatile it is always saved, and can be read anytime from register 0x9010.

Hex Adr	Size	Access Type	Bit	Register Name Bit Field Name	Description	LSB Unit
9010	1			Insertion Counter		
		RO	0~7	Insertion Count	Number of times the modules was plugged in a host	1 insertion

2.10 Programmable Power Dissipation & Thermal Emulation

Register 0x9001 is used for PWM control over MDIO. It is an 8 bit data wide register.

The consumed power changes accordingly when the value in this register is changed (only when in high power mode). In Low power mode the module automatically turns off PWM.

The values written in this register can be stored by calling the Save NVR function, thus the user can permanently change the initial power consumed in high power mode when the module is powered up by setting the register value and calling the Save NVR function.

The PWM can also be used for module thermal emulation.

The module contains a thermal spot positioned where the optical transceivers usually are in an optical module that is heated relative to the related PWM register.

Note that the led starts blinking when the temperature high alarm is reached.

Hex Adr	Size	Access Type	Bit	Register Name Bit Field Name	Description	Init Value
9001	1			PWM		
		RW	0~7	PWM	0x00 to 0xFF corresponding to 0 to 6.5 W power consumption	0

2.11 Cut-Off Temperature

To avoid overheating the module, a Cut-Off Temperature is defined in Register 0x9008.

The module is continuously monitoring the temperature and checking its value against the Cut-Off temperature. A Temperature Cut-Off register is defined at address 0x9008. Once the module temperature reaches the cut-off temperature, the PWM will automatically turn off in order to prevent overheating. Once the temperature is 5 degrees below cut-off value, the PWM goes back to its previous value.

The Maximum allowed Cut-Off temperature for the ML4050 is 90 degC, so even if the value stored in register 0x9008 is higher than 90 the module will still Cut-Off power at 90 degC, in case the value stored in 0x9008 is lower than 90 then it will be adopted instead of the default value.

Hex Adr	Size	Access Type	Bit	Register Name Bit Field Name	Description	Default Value
9008	1			Temp Cut-Off		
		RW	0~7	Cut-Off Value	0x00 to 0x5A (0 to 90 degC)	0x50

2.12 Module Control and Status Registers

The below registers are implemented, and can be checked for module State and Control.

Hex Adr	Size	Access Type	Bit	Register Name Bit Field Name	Description	Init Value
A010	1			Module General Control		0000h
		RW	15	Soft Module Reset	Register bit for module reset function. Writing a 0 to this bit has no effect regardless it was 0 or 1 previously. 1: Module reset assert.	0
		RW	14	Soft Module Low Power	Register bit for module low power function. 1: Assert	0
		RW	13	Soft TX_Disable	Register bit for TX Disable function. 1: Assert.	0
		RO	12~10	Reserved		0
		RW	9	Soft GLB_ALRM	Command bit for software forced test signal. When this	0

			Test	bit is asserted it generates GLB_ALRM signal. 1: Assert.	
		RO	8~6	Reserved	0
		RO	5	TX_DIS Pin State Logical state of the TX_DIS pin. 1: Assert.	0
		RO	4	MOD_LOPWR Pin State Logical state of the MOD_LOPWR pin. 1: Assert.	0
		RO	3~0	Reserved	0

Hex Adr	Size	Access Type	Bit	Register Name Bit Field Name	Description	Init Value
A016	1			Module State		0000h
		RO	15~9	Reserved		0
			8	High-Power-down State	1: Corresponding state is active. Word value = 0100h.	0
			7	TX-Turn-off State	1: Corresponding state is active. Word value = 0080h.	0
			6	Fault State	1: Corresponding state is active. Word value = 0040h.	0
			5	Ready State	1: Corresponding state is active. Word value = 0020h.	0
			4	TX-Turn-on State	1: Corresponding state is active. Word value = 0010h.	0
			3	TX-Off State	1: Corresponding state is active. Word value = 0008h.	0
			2	High-Power-up State	1: Corresponding state is active. Word value = 0004h.	0
			1	Low-Power State	1: Corresponding state is active. Word value = 0002h.	0
			0	Initialize State	1: Corresponding state is active. Word value = 0001h.	0

Hex Adr	Size	Access Type	Bit	Register Name Bit Field Name	Description	Init Value
A01D	1			Module General Status		
		RO	1	HIPWR_ON	Status bit representing the condition of module in high power status. FAWS Type is not applicable. 0: Module is not in high power on status. 1: Module is in high powered on status.	0

3. NVR Registers Content

Address	Hex	Decimal	ASCII	MSA Description
CFP NVR 1 32768(8000h)	0x12	18		Module Identifier
CFP NVR 1 32769(8001h)	0x20	32		Extended Identifier
CFP NVR 1 32770(8002h)	0x00	0		Connector Type Code
CFP NVR 1 32771(8003h)	0x00	0		Ethernet Application Code
CFP NVR 1 32772(8004h)	0x00	0		Fiber Channel Application Code
CFP NVR 1 32773(8005h)	0x00	0		Copper Link Application Code
CFP NVR 1 32774(8006h)	0x00	0		SONET/SDH Application Code
CFP NVR 1 32775(8007h)	0x00	0		OTN Application Code
CFP NVR 1 32776(8008h)	0x1F	31		Additional Capable Rates Supported
CFP NVR 1 32777(8009h)	0x44	68	D	Number of Lanes Supported
CFP NVR 1 32778(800Ah)	0xC4	196	?	Media Properties
CFP NVR 1 32779(800Bh)	0x00	0		Maximum Network Lane Bit Rate
CFP NVR 1 32780(800Ch)	0x8C	140	?	Maximum Host Lane Bit Rate
CFP NVR 1 32781(800Dh)	0x00	0		Maximum Single Mode Optical Fiber Length
CFP NVR 1 32782(800Eh)	0x00	0		Maximum Multi-Mode Optical Fiber Length
CFP NVR 1 32783(800Fh)	0x00	0		Maximum Copper Cable Length
CFP NVR 1 32784(8010h)	0x00	0		Transmitter Spectral Characteristics 1
CFP NVR 1 32785(8011h)	0x00	0		Transmitter Spectral Characteristics 2
CFP NVR 1 32786(8012h)	0x00	0		Minimum Wavelength per Active Fiber
CFP NVR 1 32787(8013h)	0x00	0		Minimum Wavelength per Active Fiber
CFP NVR 1 32788(8014h)	0x00	0		Maximum Wavelength per Active Fiber
CFP NVR 1 32789(8015h)	0x00	0		Maximum Wavelength per Active Fiber
CFP NVR 1 32790(8016h)	0x00	0		Maximum per Lane Optical Width
CFP NVR 1 32791(8017h)	0x00	0		Maximum per Lane Optical Width
CFP NVR 1 32792(8018h)	0x44	68	D	Device Technology 1
CFP NVR 1 32793(8019h)	0x00	0		Device Technology 2
CFP NVR 1 32794(801Ah)	0x00	0		Signal Code
CFP NVR 1 32795(801Bh)	0x00	0		Maximum Total Optical Output Power per Connector
CFP NVR 1 32796(801Ch)	0x00	0		Maximum Optical Input Power per Network Lane
CFP NVR 1 32797(801Dh)	0x21	33	!	Maximum Power Consumption
CFP NVR 1 32798(801Eh)	0x05	5		Maximum Power Consumption in Low Power Mode
CFP NVR 1 32799(801Fh)	0x50	80	P	Maximum Operating Case Temp Range
CFP NVR 1 32800(8020h)	0x00	0		Minimum Operating Case Temp Range
CFP NVR 1 32801(8021h)	0x4D	77	M	Vendor Name
CFP NVR 1 32802(8022h)	0x55	85	U	Vendor Name
CFP NVR 1 32803(8023h)	0x4C	76	L	Vendor Name
CFP NVR 1 32804(8024h)	0x54	84	T	Vendor Name
CFP NVR 1 32805(8025h)	0x49	73	I	Vendor Name
CFP NVR 1 32806(8026h)	0x4C	76	L	Vendor Name


CFP NVR 1 32807(8027h)	0x41	65	A	Vendor Name
CFP NVR 1 32808(8028h)	0x4E	78	N	Vendor Name
CFP NVR 1 32809(8029h)	0x45	69	E	Vendor Name
CFP NVR 1 32810(802Ah)	0x20	32		Vendor Name
CFP NVR 1 32811(802Bh)	0x53	83	S	Vendor Name
CFP NVR 1 32812(802Ch)	0x41	65	A	Vendor Name
CFP NVR 1 32813(802Dh)	0x4C	76	L	Vendor Name
CFP NVR 1 32814(802Eh)	0x20	32		Vendor Name
CFP NVR 1 32815(802Fh)	0x20	32		Vendor Name
CFP NVR 1 32816(8030h)	0x20	32		Vendor Name
CFP NVR 1 32817(8031h)	0x00	0		Vendor OUI
CFP NVR 1 32818(8032h)	0x00	0		Vendor OUI
CFP NVR 1 32819(8033h)	0x00	0		Vendor OUI
CFP NVR 1 32820(8034h)	0x4D	77	M	Vendor Part Number
CFP NVR 1 32821(8035h)	0x4C	76	L	Vendor Part Number
CFP NVR 1 32822(8036h)	0x34	52	4	Vendor Part Number
CFP NVR 1 32823(8037h)	0x30	48	0	Vendor Part Number
CFP NVR 1 32824(8038h)	0x35	53	5	Vendor Part Number
CFP NVR 1 32825(8039h)	0x30	48	0	Vendor Part Number
CFP NVR 1 32826(803Ah)	0x20	32		Vendor Part Number
CFP NVR 1 32827(803Bh)	0x20	32		Vendor Part Number
CFP NVR 1 32828(803Ch)	0x20	32		Vendor Part Number
CFP NVR 1 32829(803Dh)	0x20	32		Vendor Part Number
CFP NVR 1 32830(803Eh)	0x20	32		Vendor Part Number
CFP NVR 1 32831(803Fh)	0x20	32		Vendor Part Number
CFP NVR 1 32832(8040h)	0x20	32		Vendor Part Number
CFP NVR 1 32833(8041h)	0x20	32		Vendor Part Number
CFP NVR 1 32834(8042h)	0x20	32		Vendor Part Number
CFP NVR 1 32835(8043h)	0x20	32		Vendor Part Number
CFP NVR 1 32836(8044h)	0x4D	77	M	Vendor Serial Number
CFP NVR 1 32837(8045h)	0x4C	76	L	Vendor Serial Number
CFP NVR 1 32838(8046h)	0x34	52	4	Vendor Serial Number
CFP NVR 1 32839(8047h)	0x30	48	0	Vendor Serial Number
CFP NVR 1 32840(8048h)	0x35	53	5	Vendor Serial Number
CFP NVR 1 32841(8049h)	0x30	48	0	Vendor Serial Number
CFP NVR 1 32842(804Ah)	0x2D	45	-	Vendor Serial Number
CFP NVR 1 32843(804Bh)	0x31	49	1	Vendor Serial Number
CFP NVR 1 32844(804Ch)	0x2D	45	-	Vendor Serial Number
CFP NVR 1 32845(804Dh)	0x34	52	4	Vendor Serial Number
CFP NVR 1 32846(804Eh)	0x35	53	5	Vendor Serial Number
CFP NVR 1 32847(804Fh)	0x00	0		Vendor Serial Number
CFP NVR 1 32848(8050h)	0x00	0		Vendor Serial Number

CFP NVR 1 32849(8051h)	0x00	0		Vendor Serial Number
CFP NVR 1 32850(8052h)	0x00	0		Vendor Serial Number
CFP NVR 1 32851(8053h)	0x00	0		Vendor Serial Number
CFP NVR 1 32852(8054h)	0x32	50	2	Date Code
CFP NVR 1 32853(8055h)	0x30	48	0	Date Code
CFP NVR 1 32854(8056h)	0x31	49	1	Date Code
CFP NVR 1 32855(8057h)	0x34	52	4	Date Code
CFP NVR 1 32856(8058h)	0x30	48	0	Date Code
CFP NVR 1 32857(8059h)	0x35	53	5	Date Code
CFP NVR 1 32858(805Ah)	0x33	51	3	Date Code
CFP NVR 1 32859(805Bh)	0x30	48	0	Date Code
CFP NVR 1 32860(805Ch)	0x00	0		Lot Code
CFP NVR 1 32861(805Dh)	0x00	0		Lot Code
CFP NVR 1 32862(805Eh)	0x00	0		CLEI Code
CFP NVR 1 32863(805Fh)	0x00	0		CLEI Code
CFP NVR 1 32864(8060h)	0x00	0		CLEI Code
CFP NVR 1 32865(8061h)	0x00	0		CLEI Code
CFP NVR 1 32866(8062h)	0x00	0		CLEI Code
CFP NVR 1 32867(8063h)	0x00	0		CLEI Code
CFP NVR 1 32868(8064h)	0x00	0		CLEI Code
CFP NVR 1 32869(8065h)	0x00	0		CLEI Code
CFP NVR 1 32870(8066h)	0x00	0		CLEI Code
CFP NVR 1 32871(8067h)	0x00	0		CLEI Code
CFP NVR 1 32872(8068h)	0x0E	14		CFP MSA Hardware Specification Revision Number
CFP NVR 1 32873(8069h)	0x16	22		CFP MSA Management Interface Specification Revision
CFP NVR 1 32874(806Ah)	0x01	1		Module Hardware Version Number
CFP NVR 1 32875(806Bh)	0x00	0		Module Hardware Version Number
CFP NVR 1 32876(806Ch)	0x00	0		Module Firmware Version Number
CFP NVR 1 32877(806Dh)	0x03	3		Module Firmware Version Number
CFP NVR 1 32878(806Eh)	0x00	0		Digital Diagnostic Monitoring Type
CFP NVR 1 32879(806Fh)	0x01	1		Digital Diagnostic Monitoring Capability 1
CFP NVR 1 32880(8070h)	0x00	0		Digital Diagnostic Monitoring Capability 2
CFP NVR 1 32881(8071h)	0x80	128	?	Module Enhanced Options
CFP NVR 1 32882(8072h)	0x01	1		Maximum High-Power-up Time
CFP NVR 1 32883(8073h)	0x01	1		Maximum TX-Turn-on Time
CFP NVR 1 32884(8074h)	0x00	0		Host Lane Signal Spec
CFP NVR 1 32885(8075h)	0x00	0		Heat Sink Type
CFP NVR 1 32886(8076h)	0x01	1		Maximum TX-Turn-off Time
CFP NVR 1 32887(8077h)	0x01	1		Maximum High-Power-down Time
CFP NVR 1 32888(8078h)	0x00	0		Module Enhanced Options 2
CFP NVR 1 32889(8079h)	0xA3	163	?	Transmitter Monitor Clock Options
CFP NVR 1 32890(807Ah)	0xA3	163	?	Receiver Monitor Clock Options

CFP NVR 1 32891(807Bh)	0x00	0		Reserved
CFP NVR 1 32892(807Ch)	0x00	0		Reserved
CFP NVR 1 32893(807Dh)	0x00	0		Reserved
CFP NVR 1 32894(807Eh)	0x00	0		Reserved
CFP NVR 1 32895(807Fh)	0x24	36	\$	CFP NVR 1 Checksum
CFP NVR 2 32896(8080h)	0x41	65	A	Transceiver Temp High Alarm Threshold
CFP NVR 2 32897(8081h)	0x00	0		Transceiver Temp High Alarm Threshold
CFP NVR 2 32898(8082h)	0x3C	60	<	Transceiver Temp High Warning Threshold
CFP NVR 2 32899(8083h)	0x00	0		Transceiver Temp High Warning Threshold
CFP NVR 2 32900(8084h)	0x02	2		Transceiver Temp Low Warning Threshold
CFP NVR 2 32901(8085h)	0x00	0		Transceiver Temp Low Warning Threshold
CFP NVR 2 32902(8086h)	0x00	0		Transceiver Temp Low Alarm Threshold
CFP NVR 2 32903(8087h)	0x00	0		Transceiver Temp Low Alarm Threshold
CFP NVR 2 32904(8088h)	0x00	0		VCC High Alarm Threshold
CFP NVR 2 32905(8089h)	0x00	0		VCC High Alarm Threshold
CFP NVR 2 32906(808Ah)	0x00	0		VCC High Warning Threshold
CFP NVR 2 32907(808Bh)	0x00	0		VCC High Warning Threshold
CFP NVR 2 32908(808Ch)	0x00	0		VCC Low Warning Threshold
CFP NVR 2 32909(808Dh)	0x00	0		VCC Low Warning Threshold
CFP NVR 2 32910(808Eh)	0x00	0		VCC Low Alarm Threshold
CFP NVR 2 32911(808Fh)	0x00	0		VCC Low Alarm Threshold
CFP NVR 2 32912(8090h)	0x00	0		SOA Bias Current High Alarm Threshold
CFP NVR 2 32913(8091h)	0x00	0		SOA Bias Current High Alarm Threshold
CFP NVR 2 32914(8092h)	0x00	0		SOA Bias Current High Warning Threshold
CFP NVR 2 32915(8093h)	0x00	0		SOA Bias Current High Warning Threshold
CFP NVR 2 32916(8094h)	0x00	0		SOA Bias Current Low Warning Threshold
CFP NVR 2 32917(8095h)	0x00	0		SOA Bias Current Low Warning Threshold
CFP NVR 2 32918(8096h)	0x00	0		SOA Bias Current Low Alarm Threshold
CFP NVR 2 32919(8097h)	0x00	0		SOA Bias Current Low Alarm Threshold
CFP NVR 2 32920(8098h)	0x00	0		Auxiliary 1 Monitor High Alarm Threshold
CFP NVR 2 32921(8099h)	0x00	0		Auxiliary 1 Monitor High Alarm Threshold
CFP NVR 2 32922(809Ah)	0x00	0		Auxiliary 1 Monitor High Warning Threshold
CFP NVR 2 32923(809Bh)	0x00	0		Auxiliary 1 Monitor High Warning Threshold
CFP NVR 2 32924(809Ch)	0x00	0		Auxiliary 1 Monitor Low Warning Threshold
CFP NVR 2 32925(809Dh)	0x00	0		Auxiliary 1 Monitor Low Warning Threshold
CFP NVR 2 32926(809Eh)	0x00	0		Auxiliary 1 Monitor Low Alarm Threshold
CFP NVR 2 32927(809Fh)	0x00	0		Auxiliary 1 Monitor Low Alarm Threshold
CFP NVR 2 32928(80A0h)	0x00	0		Auxiliary 2 Monitor High Alarm Threshold
CFP NVR 2 32929(80A1h)	0x00	0		Auxiliary 2 Monitor High Alarm Threshold
CFP NVR 2 32930(80A2h)	0x00	0		Auxiliary 2 Monitor High Warning Threshold
CFP NVR 2 32931(80A3h)	0x00	0		Auxiliary 2 Monitor High Warning Threshold
CFP NVR 2 32932(80A4h)	0x00	0		Auxiliary 2 Monitor Low Warning Threshold

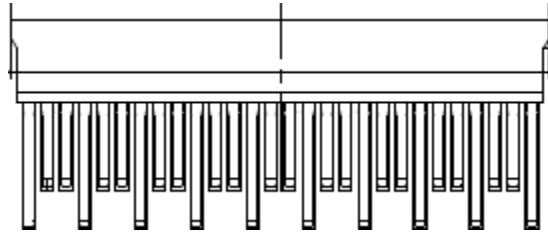
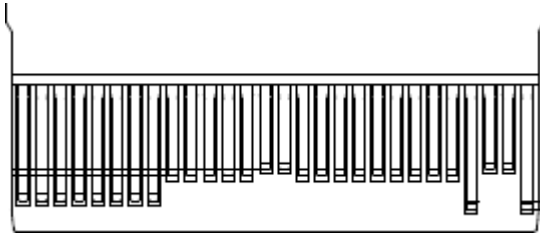
CFP NVR 2 32933(80A5h)	0x00	0	Auxiliary 2 Monitor Low Warning Threshold
CFP NVR 2 32934(80A6h)	0x00	0	Auxiliary 2 Monitor Low Alarm Threshold
CFP NVR 2 32935(80A7h)	0x00	0	Auxiliary 2 Monitor Low Alarm Threshold
CFP NVR 2 32936(80A8h)	0x00	0	Laser Bias Current High Alarm Threshold
CFP NVR 2 32937(80A9h)	0x00	0	Laser Bias Current High Alarm Threshold
CFP NVR 2 32938(80AAh)	0x00	0	Laser Bias Current High Warning Threshold
CFP NVR 2 32939(80ABh)	0x00	0	Laser Bias Current High Warning Threshold
CFP NVR 2 32940(80ACh)	0x00	0	Laser Bias Current Low WarningThreshold
CFP NVR 2 32941(80ADh)	0x00	0	Laser Bias Current Low WarningThreshold
CFP NVR 2 32942(80AEh)	0x00	0	Laser Bias Current Low Alarm Threshold
CFP NVR 2 32943(80AFh)	0x00	0	Laser Bias Current Low Alarm Threshold
CFP NVR 2 32944(80B0h)	0x00	0	Laser Output Power High Alarm Threshold
CFP NVR 2 32945(80B1h)	0x00	0	Laser Output Power High Alarm Threshold
CFP NVR 2 32946(80B2h)	0x00	0	Laser Output Power High Warning Threshold
CFP NVR 2 32947(80B3h)	0x00	0	Laser Output Power High Warning Threshold
CFP NVR 2 32948(80B4h)	0x00	0	Laser Output Power Low Warning Threshold
CFP NVR 2 32949(80B5h)	0x00	0	Laser Output Power Low Warning Threshold
CFP NVR 2 32950(80B6h)	0x00	0	Laser Output Power Low Alarm Threshold
CFP NVR 2 32951(80B7h)	0x00	0	Laser Output Power Low Alarm Threshold
CFP NVR 2 32952(80B8h)	0x00	0	Laser Temperature High Alarm Threshold
CFP NVR 2 32953(80B9h)	0x00	0	Laser Temperature High Alarm Threshold
CFP NVR 2 32954(80BAh)	0x00	0	Laser Temperature High WarningThreshold
CFP NVR 2 32955(80BBh)	0x00	0	Laser Temperature High Warning Threshold
CFP NVR 2 32956(80BCh)	0x00	0	Laser Temperature Low Warning Threshold
CFP NVR 2 32957(80BDh)	0x00	0	Laser Temperature Low Warning Threshold
CFP NVR 2 32958(80BEh)	0x00	0	Laser Temperature Low Alarm Threshold
CFP NVR 2 32959(80BFh)	0x00	0	Laser Temperature Low Alarm Threshold
CFP NVR 2 32960(80C0h)	0x00	0	Receive Optical Power High Alarm Threshold
CFP NVR 2 32961(80C1h)	0x00	0	Receive Optical Power High Alarm Threshold
CFP NVR 2 32962(80C2h)	0x00	0	Receive Optical Power High Warning Threshold
CFP NVR 2 32963(80C3h)	0x00	0	Receive Optical Power High Warning Threshold
CFP NVR 2 32964(80C4h)	0x00	0	Receive Optical Power Low Warning Threshold
CFP NVR 2 32965(80C5h)	0x00	0	Receive Optical Power Low Warning Threshold
CFP NVR 2 32966(80C6h)	0x00	0	Receive Optical Power Low Alarm Threshold
CFP NVR 2 32967(80C7h)	0x00	0	Receive Optical Power Low Alarm Threshold
CFP NVR 2 32968(80C8h)	0x00	0	Reserved
CFP NVR 2 32969(80C9h)	0x00	0	Reserved
CFP NVR 2 32970(80CAh)	0x00	0	Reserved
CFP NVR 2 32971(80CBh)	0x00	0	Reserved
CFP NVR 2 32972(80CCh)	0x00	0	Reserved
CFP NVR 2 32973(80CDh)	0x00	0	Reserved
CFP NVR 2 32974(80CEh)	0x00	0	Reserved

CFP NVR 2 32975(80CFh)	0x00	0	Reserved
CFP NVR 2 32976(80D0h)	0x00	0	Reserved
CFP NVR 2 32977(80D1h)	0x00	0	Reserved
CFP NVR 2 32978(80D2h)	0x00	0	Reserved
CFP NVR 2 32979(80D3h)	0x00	0	Reserved
CFP NVR 2 32980(80D4h)	0x00	0	Reserved
CFP NVR 2 32981(80D5h)	0x00	0	Reserved
CFP NVR 2 32982(80D6h)	0x00	0	Reserved
CFP NVR 2 32983(80D7h)	0x00	0	Reserved
CFP NVR 2 32984(80D8h)	0x00	0	Reserved
CFP NVR 2 32985(80D9h)	0x00	0	Reserved
CFP NVR 2 32986(80DAh)	0x00	0	Reserved
CFP NVR 2 32987(80DBh)	0x00	0	Reserved
CFP NVR 2 32988(80DCh)	0x00	0	Reserved
CFP NVR 2 32989(80DDh)	0x00	0	Reserved
CFP NVR 2 32990(80DEh)	0x00	0	Reserved
CFP NVR 2 32991(80DFh)	0x00	0	Reserved
CFP NVR 2 32992(80E0h)	0x00	0	Reserved
CFP NVR 2 32993(80E1h)	0x00	0	Reserved
CFP NVR 2 32994(80E2h)	0x00	0	Reserved
CFP NVR 2 32995(80E3h)	0x00	0	Reserved
CFP NVR 2 32996(80E4h)	0x00	0	Reserved
CFP NVR 2 32997(80E5h)	0x00	0	Reserved
CFP NVR 2 32998(80E6h)	0x00	0	Reserved
CFP NVR 2 32999(80E7h)	0x00	0	Reserved
CFP NVR 2 33000(80E8h)	0x00	0	Reserved
CFP NVR 2 33001(80E9h)	0x00	0	Reserved
CFP NVR 2 33002(80EAh)	0x00	0	Reserved
CFP NVR 2 33003(80EBh)	0x00	0	Reserved
CFP NVR 2 33004(80ECh)	0x00	0	Reserved
CFP NVR 2 33005(80EDh)	0x00	0	Reserved
CFP NVR 2 33006(80EEh)	0x00	0	Reserved
CFP NVR 2 33007(80EFh)	0x00	0	Reserved
CFP NVR 2 33008(80F0h)	0x00	0	Reserved
CFP NVR 2 33009(80F1h)	0x00	0	Reserved
CFP NVR 2 33010(80F2h)	0x00	0	Reserved
CFP NVR 2 33011(80F3h)	0x00	0	Reserved
CFP NVR 2 33012(80F4h)	0x00	0	Reserved
CFP NVR 2 33013(80F5h)	0x00	0	Reserved
CFP NVR 2 33014(80F6h)	0x00	0	Reserved
CFP NVR 2 33015(80F7h)	0x00	0	Reserved
CFP NVR 2 33016(80F8h)	0x00	0	Reserved

CFP NVR 2 33017(80F9h)	0x00	0	Reserved
CFP NVR 2 33018(80FAh)	0x00	0	Reserved
CFP NVR 2 33019(80FBh)	0x00	0	Reserved
CFP NVR 2 33020(80FCh)	0x00	0	Reserved
CFP NVR 2 33021(80FDh)	0x00	0	Reserved
CFP NVR 2 33022(80FEh)	0x00	0	Reserved
CFP NVR 2 33023(80FFh)	0x7F	127 	CFP NVR 2 Checksum

4. CFP4 Pin Allocation

CFP4 Baseline pin allocation defined in MSA CFP4_Pin_Allocation_ver_24 is adopted for the ML4050.



CFP4	
Bottom	
1	3.3V_GND
2	3.3V_GND
3	3.3V
4	3.3V
5	3.3V
6	3.3V
7	3.3V_GND
8	3.3V_GND
9	VND_IO_A
10	VND_IO_B
11	TX_DIS (PRG_CNTL)
12	RX_LOS (PRG_ALRM)
13	GLB_ALRMn
14	MOD_LOPW
15	MOD_ABS
16	MOD_RSTn
17	MDC
18	MDIO
19	PRTADR0
20	PRTADR1
21	PRTADR2
22	VND_IO_C
23	VND_IO_D
24	VND_IO_E
25	GND
26	(MCLKn)
27	(MCLKp)
28	GND

CFP4	
Top	
56	GND
55	TX3n
54	TX3p
53	GND
52	TX2n
51	TX2p
50	GND
49	TX1n
48	TX1p
47	GND
46	TX0n
45	TX0p
44	GND
43	(REFCLKn)
42	(REFCLKp)
41	GND
40	RX3n
39	RX3p
38	GND
37	RX2n
36	RX2p
35	GND
34	RX1n
33	RX1p
32	GND
31	RX0n
30	RX0p
29	GND

4.1 High Speed Signals

High speed signals are electrically lopped back from TX side to RX side of the module, all differential TX pairs are connected to the corresponding RX pairs; the signals are AC coupled as specified by CFP MSA HW specs.

The Passive traces connecting TX to RX pairs are designed to support a data rate up to 28Gbps.

REFCLKn/p is also connected to MCLKn/p, AC coupling capacitor exists in between.

Revision history

Revision	Description	Date
0.1	<ul style="list-style-type: none"> ▪ Preliminary Revision 	24/01/2014
0.2	<ul style="list-style-type: none"> ▪ Added Section 3 ▪ Adjusted maximum power consumption to be 6.5 W instead of 6 W 	13/02/2014
0.3	<ul style="list-style-type: none"> ▪ Specified register Address 0x9002 of programmable RX_LOS ▪ Adjusted default values for Temperature Alarms and Warnings as well as default cut-off value, this is applicable for FW V0.3 ▪ Temperature Cut-Off register was moved from Address 0x9080 to 0x9008 	27/06/2014
1.0	<ul style="list-style-type: none"> ▪ Fixed the default value of temp cut-off to 0x50 ▪ Added photo ▪ Defined init time ▪ Red not amber (LED colors) ▪ Fixed default values of temp monitor ▪ Updated bit 15 of A010 ▪ Added NVR registers 	6/12/2015

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