

# Using MDIO in ONT CFP/CFP2 Modules

## MDIO History<sup>1</sup>

Management Data Input/Output, or MDIO, is a two-wire serial control bus used to manage physical-layer devices (PHYs) in media access controllers (MACs) inside Gigabit Ethernet equipment which requires accessing and modifying their various registers. MDIO is used for first- and second-generation carrier-frequency pulse modules (CFP and CFP2) (QSFP+ 40 G modules use I<sup>2</sup>C, which is another serial control bus).

MDIO was originally defined in Clause 22 of IEEE RFC802.3 as a single MDIO interface that could access up to 32 registers in 32 different PHY devices. These registers provide status and control information such as link status, speed ability and selection, power down for low-power consumption, duplex mode (full or half), auto-negotiation, fault signaling, and loopback.

MDIO was expanded to meet the needs of faster (10 G+) Ethernet devices as defined in Clause 45 of the 802.3ae specification which extended MDIO capabilities to include:

- Ability to access 65,536 registers in 32 different devices on 32 different ports
- Additional OP-code and ST-code for indirect address register access for 10 GE
- End-to-end fault signaling
- Multiple loopback points
- Low-voltage electrical specification (1.2 V bus).

## Theory of Operation

The MDIO bus has a management data clock (MDC) signal in addition to the MDIO signal. Other associated signals include module address pins A0, A1, and A2 which are used to set the module address.

MDIO uses specific terminology to define the various devices on the bus. The device driving the MDIO bus is identified as the station management entity (STA). The target devices that the MDC manages are known as MDIO manageable devices (MMD).

The STA initiates all communication in MDIO and drives the clock on the MDC which is specified to have a frequency of up to 4 MHz (updated from 2.5 MHz in the CFP MSA). When a CFP or CFP2 is inserted into the appropriate JDSU ONT, it then assumes the STA's role for as long as the CFP/CFP2 is the MMD.

Additional Clause 45 details can be found on the IEEE 802.3 workgroup website. <http://www.ieee802.org/3/ba/index.html>

1. Source: Total Phase, Inc., Knowledge Base - Article 10042: MDIO Background, 2012. <<http://www.totalphase.com/support/kb/10042/>>

## MDIO and the Viavi ONT

MDIO is required to control and monitor CFP/CFP2 modules and it also enables an ONT to read several important module parameters as shown in Figure 1, including:

- vendor name and ID
- module version and serial number
- module capabilities
- transmitted/received optical power
- module temperature
- module supply voltage.

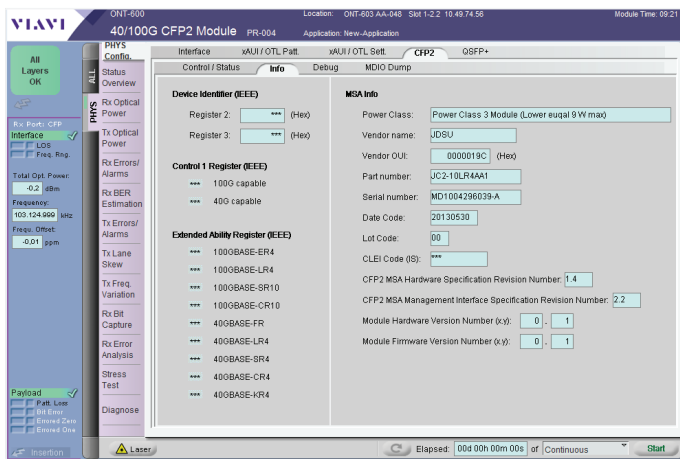


Figure 1. The ONT CFP2 overview screen displays key information provided by the module's MDIO.

Other MDIO registers may let you control and monitor important module elements as shown in Figure 2, such as lasers, CDRs, and receivers. It is possible to use a CFP/CFP2 without the MDIO (and instead using the control pins); however, it limits both the functionality and capabilities.

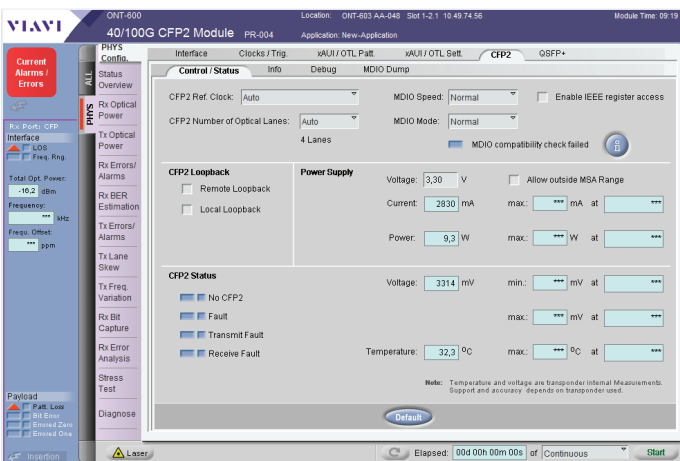


Figure 2. The ONT MDIO application lets you control the MDIO bus using two important parameters.

## MDIO Mode

The ONT supports these four MDIO operation modes:

1. Normal (bus runs at 1.25 MHz and 2 MHz for the CFP and CFP2, respectively) — Normal operation mode supports auto increment read, which is optimized for quick read/write. A checksum at 807F (CFP NVR1 checksum) is validated for correct value.
2. Relaxed (bus runs at 1.25 MHz and 2 MHz for the CFP and CFP2, respectively) — In Relaxed operation mode has a longer pause time (190 ns minimum) between address and read/write accesses. Also, auto increment is not used and checksum is ignored. It is also optimized for the most reliable operation.
3. External — For the CFP, the external mode allows external devices to fully control the MDIO bus within the instrument. The external device can completely control bus speed, timing, and other parameters. For the CFP2, the external MDIO application displays an MDIO control port via a connector on the front of the ONT CFP2 that is fully controlled by the ONT CFP2 MDIO application.
4. Disabled — No MDIO operation, therefore, the values displayed on the GUI should be considered invalid.

## MDIO Speed

The ONT CFP2 module supports three MDIO bus speeds:

1. Normal (bus runs at 2 MHz) — Normal is the default speed; however, the ONT CFP module runs the MDIO at a slower speed of 1.25 MHz.
2. Fast (bus runs at 4 MHz) — Fast is the fastest speed defined in the CFP Multi-Source Agreement (MSA).
3. Slow (bus runs at 500 kHz) — Slow is a very slow speed which helps to support debugging.

# MDIO Pinout on CFP and CFP2 Modules

## CFP Module

Figure 3 shows the pinout for the CFP module. The table that follows provides pinout details.

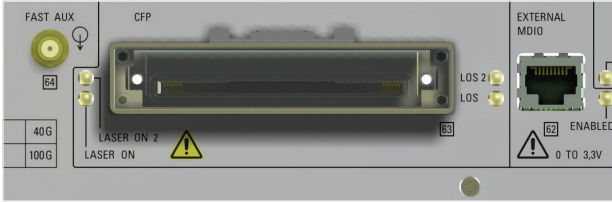


Figure 3. ONT CFP module pinout

Note: RJ45 pinning and electrical levels are **not** compatible with Ethernet. Avoid connecting the MDIO port to an Ethernet port.

## CFP2 Module

Figure 4 shows the pinout for the CFP2 module. The tables that follow list the pin assignments.

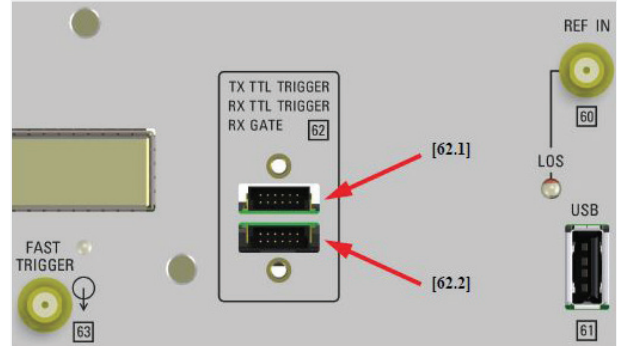


Figure 4. ONT CFP2 module pinout

## Pinout

Signal	Pin	IN/OUT	Level	"H"	"L"	Pull-Up/Down	Additional Information
MDIO	3	IN/OUT	1.2 V LVC MOS	—	—	Up (470 Ohm)	Management data
MDC	1	IN/OUT	1.2 V LVC MOS	—	—	Up (470 Ohm)	Management clock
MOD_RSTn	4	IN	3.3 V LVC MOS	Enable	Reset	Up (10k Ohm)	Module reset
MOD_LOPWR	8	IN	3.3 V LVC MOS	Deselect	Enable	Up (10k Ohm)	Module low-power mode
MOD_ABS	7	OUT	3.3 V LVC MOS	Absent	Present	Open drain	Module absent Use external pull up 4.7 to 10k Ohm
GLB_ALRM	5	OUT	3.3 V LVC MOS	Alarm	No alarm	N/A	Global alarm
GND	2	N/A	N/A	N/A	N/A	N/A	Ground
GND	6	N/A	N/A	N/A	N/A	N/A	Ground

## Pin Assignment List of ERNI SMC Connector (Top)



Signal	Pin	IN/OUT	Level	"H"	"L"	Pull-Up/Down	Additional Information
PRG_ALARM 1	1	IN	3.3 V LVC MOS	Alarm	No alarm	Up (10k Ohm)	Programmable alarm 1
PRG_ALARM 2	2	IN	3.3 V LVC MOS	Alarm	No alarm	Up (10k Ohm)	Programmable alarm 2
PRG_ALARM 3	3	IN	3.3 V LVC MOS	Alarm	No alarm	Up (10k Ohm)	Programmable alarm 3
RX_LOS	4	IN	3.3 V LVC MOS	Loss of signal	OK	Up (10k Ohm)	Loss of receiver signal
GLB_ALRMn	5	OUT	3.3 V LVC MOS	Alarm	No alarm	Up (10k Ohm)	Global alarm
MOD_ABS	6	IN	3.3 V LVC MOS	Absent	Present	Up (10k Ohm)	Module absent
GND	9	N/A	N/A	N/A	N/A	N/A	Ground
GND	12	N/A	N/A	N/A	N/A	N/A	Ground

### Pin Assignment List of ERNI SMC Connector (Bottom)

Pin 2	Pin 4	Pin 6	Pin 8	Pin 10	Pin 12
PRG_CNTL2	TX_DIS	MOD_RSTn	not used	MDC	GND
Pin 1	Pin 3	Pin 5	Pin 7	Pin 9	Pin 11
PRG_CNTL1	PRG_CNTL3	MOD_LOPWR	not used	GND	MDIO

Signal	Pin	IN/OUT	Level	"H"	"L"	Pull-Up/Down	Additional Information
PRG_CNTL 1	1	OUT	3.3 V LVCMOS	—	—	N/A	Programmable control 1
PRG_CNTL 2	2	OUT	3.3 V LVCMOS	—	—	N/A	Programmable control 2
PRG_CNTL 3	3	OUT	3.3 V LVCMOS	—	—	N/A	Programmable control 3
TX_DIS	4	OUT	3.3 V LVCMOS	Disable	Enable	N/A	Transmitter disable
MOD_LOPWR	5	OUT	3.3 V LVCMOS	Deselect	Enable	—	Module low-power mode
MOD_RSTn	6	OUT	3.3 V LVCMOS	Enable	Reset	—	Module reset
GND	9	N/A	N/A	N/A	N/A	N/A	Ground
MDC	10	IN/OUT	1.2 V LVCMOS	—	—	Up (470 Ohm)	Management clock
MDIO	11	IN/OUT	1.2 V LVCMOS	—	—	Up (470 Ohm)	Management data
GND	12	N/A	N/A	N/A	N/A	N/A	Ground

The MDIO address pins are hard wired in the ONT, where A0=1, A1=0, and A2=0.

## Conclusion

The ONT MDIO compatibility check is not simply a pass/fail test. Rather, it provides additional information to help support R&D to develop and debug CFP and CFP2 modules. The robust ONT MDIO support works under most conditions and is not intended for use as an MDIO compliance test.

Check the following if the ONT indicates an MDIO compatibility check failure:

- Checksum at 807F (CFP NVR1 checksum)
- Module support for auto increment read
- Address 0x8000 module identifier

The module can operate via MDIO relaxed mode without serious issues if required (ignoring checksum and without auto increment).

Remember that the compatibility check provides useful information; however, avoid relying on it as simply a definitive module pass/fail test.



Contact Us **+1 844 GO VIAVI**  
(+1 844 468 4284)

To reach the Viavi office nearest you,  
visit [viavisolutions.com/contacts](http://viavisolutions.com/contacts).

© 2015 Viavi Solutions Inc.  
Product specifications and descriptions in this  
document are subject to change without notice.  
mdio-an-opt-tm-ae  
30175755 900 0813