

## Product Specification

### 125M-1.25Gbps Multi-Rate Smart SFP CWDM Transceiver

**FWL2519C1Cxx (xx = 47~61)**

#### PRODUCT FEATURES

- 125M-1.25Gbps Multi-rate Bi-directional Data Links
- Hot-pluggable SFP footprint
- Built-in Digital Diagnostics Functions Supporting Local DDMI
- Support Remote DDMI via Built-in Out-of-band, Non-intrusive Optical Communication Channel
- Optical “Dying Gasp”
- IEEE 802.3ah 1000Base-LX Ethernet
- 1.06Gbps Fiber Channel
- ITU-T CWDM DFB transmitter
- PIN photodiode receiver



#### APPLICATIONS

- Remote DDMI and Optical Link Management
- Optical-layer Demarcation

Finisar Smart SFPs are compatible with SFP Multi-Sourcing Agreement (MSA). In addition to local digital diagnostics functions via the 2-wire series bus specified in the SFP MSA, Smart SFPs also support remote digital diagnostics functions, i.e., when a pair of Finisar’s Smart SFPs are on the same optical link, each end is capable of reading digital diagnostics information from the other end. This function is accessed via a non-intrusive optical communication channel. Additionally, Finisar’s Smart SFPs offer optical Dying Gasp function. In order to utilize the remote DDMI and other advanced features equipment vendors only need to make a simple modification to their system software highlighted in the “Finisar Smart SFP host software interface specifications”, available upon request from Finisar Corporation.

**I. Absolute Maximum Ratings**

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Power Supply Voltage	V <sub>cc-Vee</sub>	-0.5		+3.6	V	
Storage Temperature	T <sub>S</sub>	-40		85	°C	

**II. Operating Environment**

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Power Supply Voltage	V <sub>cc</sub>	+3.15		+3.45	V	
Operating Case Temperature	T <sub>OP</sub>	0		70	°C	
Relative Humidity[Non-Condensing]	RH	5		95	%	

**III. Electrical Characteristics (Top, VCC = 3.15 to 3.45 Volts)\***

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Supply Voltage	V <sub>cc</sub>	3.15	3.3	3.45	V	
Supply Current	I <sub>cc</sub>			300	mA	
<b>Transmitter</b>						
Input Differential Impedance	R <sub>in</sub>		100		Ω	①
Data Input Swing Differential	V <sub>in</sub>	300			mV	①
Transmit Disable Voltage	V <sub>D</sub>	2.0		V <sub>cc</sub>	V	
Transmit Enable Voltage	V <sub>EN</sub>	0		0.8	V	
<b>Receiver</b>						
Data Output Swing Differential	V <sub>out</sub>	400		1000	mV	①
LOS Low	-	0		0.8	V	
LOS High	-	2.0		V <sub>cc</sub>	V	

\* All characteristics are tested with communication channel turned on.

**Note:**

①. Internally AC coupled;

**IV. Optical Characteristics (Top, VCC = 3.15 to 3.45 Volts)\***

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
<b>Transmitter</b>						
Center Wavelength (CW)	λ	λ <sub>C</sub> -7.5	λ	λ <sub>C</sub> +7.5	Nm	①
Spectral Width (RMS)	σλ			1	Nm	
Side Mode Suppression Ratio	SMSR	30			dB	
Average Launch Power	P <sub>OUT</sub>	0		4	dBm	②
Extinction Ratio	ER	9			dB	
Rise/Fall Time	TR/TF			0.26	Ns	③
<b>Receiver</b>						
Optical Center Wavelength	λ <sub>C</sub>	1460		1620	Nm	
Average Rx Sensitivity	R <sub>SENS</sub>			-25	dBm	④
Receiver Overload	P <sub>OVr</sub>	0			dBm	④

Optical Return Loss		24			dB	
LOS Asserted	-	-40			dBm	
LOS De-Asserted	-			-26	dBm	
LOS Hysteresis	-		2		dB	

\* All characteristics are tested with communication channel turned on.

## V. Communication Channel Characteristics\*\*

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Bit Rate			9600		Bit/s	
Link Budget		25			dB	

\*\* Communication channel is tested over 1.25G Ethernet link.

## VI. Data rate

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Data Rate		125		1250	Mbps	

### Notes:

- ①. ITU-T G.694.2 CWDM wavelength from 1470 nm to 1610 nm, at increment of 20 nm
- ②. The measurement is made through a short patch cable
- ③. Unfiltered, 20%~80%. Complies with IEEE 802.3 and FC 1x eye mask when filtered
- ④. Measured with a PRBS  $2^7-1$  test pattern over all data rates specified in Section VI, ER=9dB, BER $\leq 1 \times 10^{-12}$

## **VII. Digital Diagnostic Functions**

Finisar Smart SFP support the 2-wire serial communication protocol as defined in the SFP MSA<sup>1</sup>.

Additionally, the Finisar Smart SFP provides a unique enhanced digital diagnostic monitoring interface, which allows real-time access to device operating parameters such as transceiver temperature, laser bias current, transmitted optical power, received optical power and transceiver supply voltage. It also defines a sophisticated system of alarm and warning flags, which alerts end-users when particular operating parameters are outside of a factory-set normal range.

The SFP MSA defines a 256-byte memory map in E2PROM that is accessible over a 2-wire serial interface at the 8 bit address 1010000X (A0h). The digital diagnostic monitoring interface makes use of the 8 bit address 1010001X (A2h), A0h stores static information including product and vendor IDs while A2h contains real-time diagnostic data.

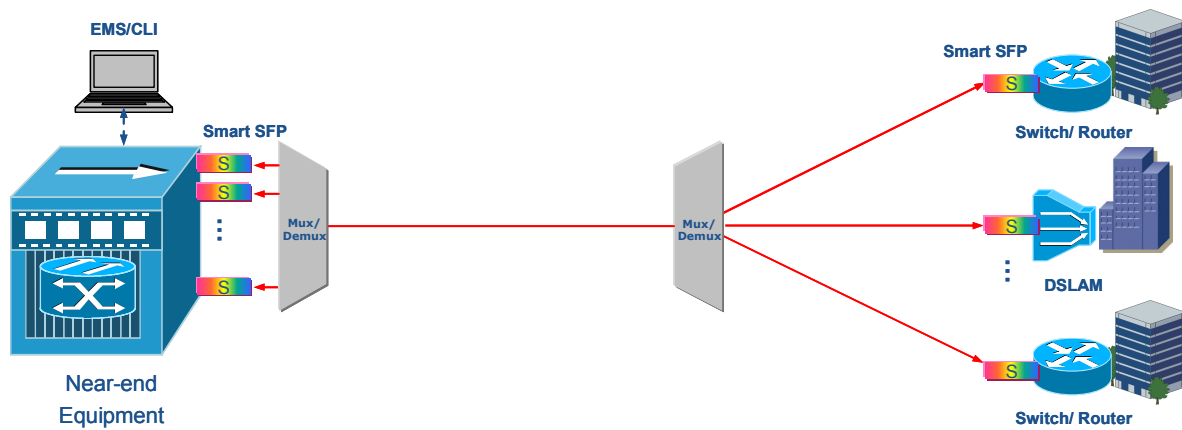
The operating and diagnostics information is monitored and reported by a Digital Diagnostics Transceiver Controller (DDTC) inside the transceiver, which is accessed through a 2-wire serial interface. When the serial protocol is activated, the serial clock signal (SCL) is generated by the host. The positive edge clocks data into the SFP transceiver into segments of the E2PROM that are not write-protected. The negative edge clocks data from the SFP transceiver. The serial data signal (SDA) is bi-directional for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The memories are organized as a series of 8-bit data words that can be addressed individually or sequentially.

For more information, please contact Finisar.

Digital diagnostics for the Smart SFP are internally calibrated by default.

## VIII. Enhanced Management and Diagnostic Capabilities

Finisar Smart SFP CWDM transceivers can be used in the typical network configuration shown below:



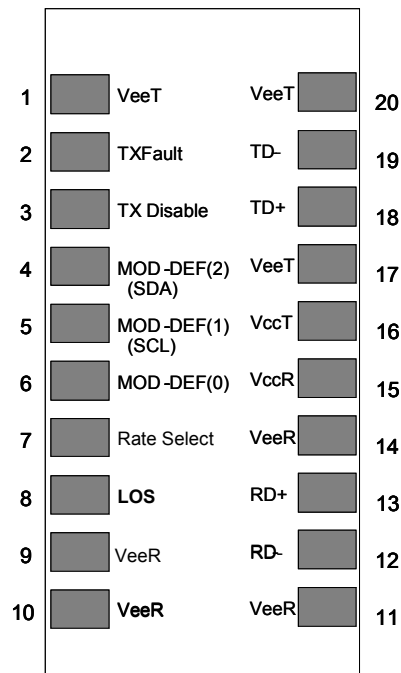
The Smart SFP's built-in non-intrusive optical communication channel enables remote monitoring and management. Through the I2C interface, the host equipment can manage not only the local Smart SFPs, but also the Smart SFPs located at the far end. These enhanced functions are available by following "Finisar Smart SFP Host Interface Specifications"

With Finisar's Smart SFPs, equipment vendors can achieve the following advanced management and diagnostic capabilities:

- Remote Smart SFP digital diagnostics
- Optical link monitoring
- Optical dying gasp for fault isolation. With optical dying gasp when power failure is imminent, the far-end Smart SFP will quickly generate a dying gasp signal to the near-end Smart SFP on the other end. The near-end equipment can thereby distinguish between far-end power failure and optical cable cut.

**IX. Pin Descriptions**

Pin	Symbol	Name/Description	Notes
1	VEET	Transmitter Ground (Common with Receiver Ground)	
2	TFAULT	Transmitter Fault.	Note 1
3	TDIS	Transmitter Disable.	Note 2, Module disables on high or open
4	MOD_DEF(2) (SDA)	Module Definition 2.	Note 3, 2 wire serial ID interface
5	MOD_DEF(1) (SCL)	Module Definition 1.	Note 3, 2 wire serial ID interface
6	MOD_DEF(0)	Module Definition 0.	Note 3, Grounded within the Module
7	Rate Select	Not Connected	-
8	LOS	LOS of Signal	Note 4
9	VEER	Receiver Ground (Common with Transmitter Ground)	Note 5
10	VEER	Receiver Ground (Common with Transmitter Ground)	Note 5
11	VEER	Receiver Ground (Common with Transmitter Ground)	Note 5
12	RD-	Receiver Inverted DATA out.	Note 6
13	RD+	Receiver Non-inverted DATA out.	Note 6
14	VEER	Receiver Ground (Common with Transmitter Ground)	Note 5
15	VCCR	Receiver Power Supply	Note 7, 3.3V±5%
16	VCCT	Transmitter Power Supply	Note 7, 3.3V±5%
17	VEET	Transmitter Ground (Common with Receiver Ground)	Note 5
18	TD+	Transmitter Non-Inverted DATA in.	Note 8
19	TD-	Transmitter Inverted DATA in.	Note 8
20	VEET	Transmitter Ground (Common with Receiver Ground)	Note 5



#### Pinout of Connector Block on Host equipment

##### Notes:

- TX Fault is an open collector/drain output, which should be pulled up with a 4.7K–10K $\Omega$  resistor on the host board. Pull up voltage between 2.0V and VccT, R+0.3V. When high, output indicates a laser fault of some kind. Low indicates normal operation. In the low state, the output will be pulled to < 0.8V.
- TX disable is an input that is used to shut down the transmitter optical output. It is pulled up within the module with a 4.7–10 K $\Omega$  resistor. Its states are:
 

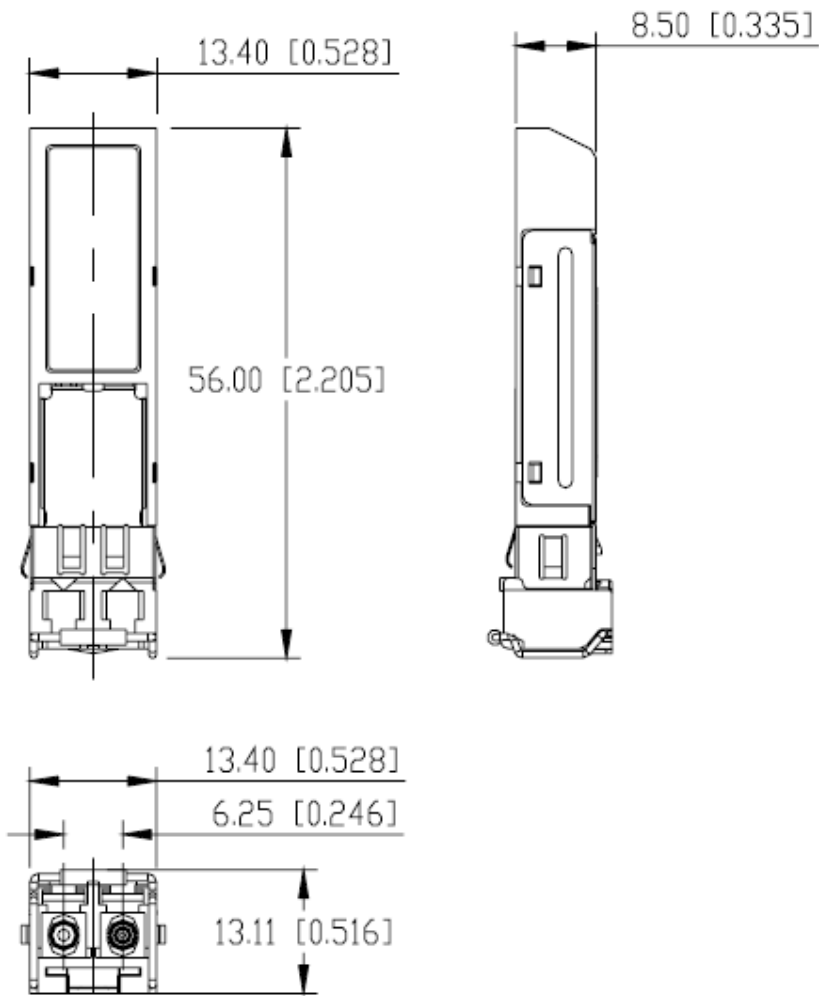
Low (0 – 0.8V):	Transmitter on
(>0.8, < 2.0V):	Undefined
High (2.0 – 3.465V):	Transmitter Disabled
Open:	Transmitter Disabled.
- Mod-Def 0,1,2. These are the module definition pins. They should be pulled up with a 4.7K – 10K $\Omega$  resistor on the host board. The pull-up voltage shall be VccT or VccR.
  - Mod-Def 0 is grounded by the module to indicate that the module is present
  - Mod-Def 1 is the clock line of two wire serial interface for serial ID
  - Mod-Def 2 is the data line of two wire serial interface for serial ID.
- LOS (Loss of Signal) is an open collector/drain output, which should be pulled up with a 4.7K – 10K $\Omega$  resistor. Pull up voltage between 2.0V and VccT, R+0.3V. When high, this output indicates the received optical power is below the worst-case receiver sensitivity (as defined by the standard in use). Low indicates normal operation. In the low state, the output will be pulled to < 0.8V.
- VeeR and VeeT may be internally connected within the SFP module.
- RD-/+ : These are the differential receiver outputs. They are AC coupled 100 $\Omega$

differential lines which should be terminated with 100 $\Omega$  (differential) at the user SERDES. The AC coupling is done inside the module and is thus not required on the host board.

7. VccR and VccT are the receiver and transmitter power supplies. They are defined as 3.3V  $\pm$ 5% at the SFP connector pin. Maximum supply current is 300mA. Recommended host board power supply filtering is shown below. Inductors with DC resistance of less than 1 $\Omega$  should be used in order to maintain the required voltage at the SFP input pin with 3.3V supply voltage. When the recommended supply filtering network is used, hot plugging of the SFP transceiver module will result in an inrush current of no more than 30 mA greater than the steady state value. VccR and VccT may be internally connected within the SFP transceiver module.
8. TD-/+: These are the differential transmitter inputs. They are AC-coupled, differential lines with 100 $\Omega$  differential termination inside the module. The AC coupling is done inside the module and is thus not required on the host board.



**X. Mechanical Specifications**



(Unit : mm [inch])

**Smart SFP**

**XI. References**

1. Small Form Factor Pluggable (SFP) Transceiver Multi-Source Agreement (MSA), September 2000. Documentation is currently available at Finisar upon request.

**XII. Ordering Information**

Part Number	Case Temperature	Note
FWLF2519C1Cxx (xx = 47~61)	0~70°C	

Where “xx” refers to CWDM wavelength channels. “xx” can be a number of 47, 49, 51, 53, 55, 57, 59 and 61, with corresponding central wavelengths of 1470nm, 1490nm, 1510nm, 1530nm, 1550nm, 1570nm, 1590nm and 1610nm respectively.

**XIII. For More Information**

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