Product Specification

4 Gigabit RoHS Compliant CWDM SFP Transceiver

FWLF1524P2yxx

PRODUCT FEATURES

- Up to 4.25Gb/s bi-directional data links
- Hot-pluggable SFP footprint
- Built-in digital diagnostic functions
- CWDM DFB laser transmitter
- Duplex LC connector
- RoHS compliant and Lead Free
- Up to 30 km on 9/125µm SMF at 4.25 Gb/s
- Metal enclosure, for lower EMI
- Single 3.3V power supply
- Commercial operating temperature range: -5°C to 75°C



APPLICATIONS

- Metro Access Rings and Point-to-Point networking for Gigabit Ethernet and Fibre Channel
- Link concatenation/aggregation

Finisar's FWLF1524P2yxx Small Form Factor Pluggable (SFP) transceiver is compatible with the Small Form Factor Pluggable Multi-Sourcing Agreement (MSA)[1]. The transceiver is designed for operation in Metro Access Rings and Point-to-Point networks using Fibre Channel[2] Gigabit Ethernet[3] networking equipment by selecting the appropriate line rate. The FWLF1524P2yxx is available in eight different CWDM wavelengths and is compliant per the RoHS Directive 2011/65/EU. See Finisar Application Note AN-2038 for more details.

PRODUCT SELECTION

FWLF1524P2yxx

y	L	Non Rate Selectable - 1x, 2x, 4x Fibre Channel
	V	Rate Selectable - 1x, 2x, 4x Fibre Channel and Gigabit Ethernet
xx		CWDM Wavelength (see table below)

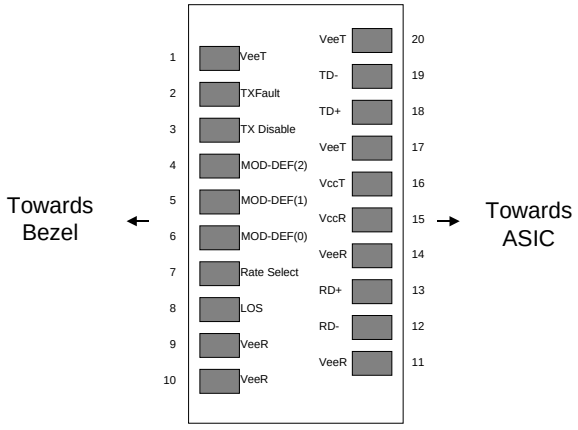
Wavelength	xx	Clasp Color Code	Wavelength	xx	Clasp Color Code
1471 nm	47	Gray	1551 nm	55	Yellow
1491 nm	49	Violet	1571 nm	57	Orange
1511 nm	51	Blue	1591 nm	59	Red
1531 nm	53	Green	1611 nm	61	Brown

I. Pin Descriptions

Pin	Symbol	Name/Description	Ref.
1	V_{EET}	Transmitter Ground (Common with Receiver Ground)	1
2	T_{FAULT}	Transmitter Fault. Not supported.	
3	T_{DIS}	Transmitter Disable. Laser output disabled on high or open.	2
4	MOD_DEF(2)	Module Definition 2. Data line for Serial ID.	3
5	MOD_DEF(1)	Module Definition 1. Clock line for Serial ID.	3
6	MOD_DEF(0)	Module Definition 0. Grounded within the module.	3
7	Rate Select	Open or Low = 1.063 Gb/s or 2.125 Gb/s Fibre Channel, 1.25 Gb/s Gigabit Ethernet (Low Bandwidth) High = 2.125 or 4.25 Gb/s Fibre Channel (High Bandwidth)	4
8	LOS	Loss of Signal indication. Logic 0 indicates normal operation.	5
9	V_{EER}	Receiver Ground (Common with Transmitter Ground)	1
10	V_{EER}	Receiver Ground (Common with Transmitter Ground)	1
11	V_{EER}	Receiver Ground (Common with Transmitter Ground)	1
12	RD-	Receiver Inverted DATA out. AC Coupled	
13	RD+	Receiver Non-inverted DATA out. AC Coupled	
14	V_{EER}	Receiver Ground (Common with Transmitter Ground)	1
15	V_{CCR}	Receiver Power Supply	
16	V_{CCT}	Transmitter Power Supply	
17	V_{EET}	Transmitter Ground (Common with Receiver Ground)	1
18	TD+	Transmitter Non-Inverted DATA in. AC Coupled.	
19	TD-	Transmitter Inverted DATA in. AC Coupled.	
20	V_{EET}	Transmitter Ground (Common with Receiver Ground)	1

Notes:

1. Circuit ground is internally isolated from chassis ground.
2. Laser output disabled on T_{DIS} >2.0V or open, enabled on T_{DIS} <0.8V.
3. Should be pulled up with 4.7k - 10 kohms on host board to a voltage between 2.0V and 3.6V. MOD_DEF(0) pulls line low to indicate module is plugged in.
4. **Specific information when selecting line rate:** Rate selection is done in accordance with SFF Committee SFF-8079 Draft, Rev.1.6, Table 3. Note that rate select can also be set through 2-wire bus in accordance with SFF-8472[6] at Bit 3, Byte 110, Address A2h (note: writing '1' selects full bandwidth operation). Rate select is the logic OR of the input state of Rate Select Pin and 2-wire bus. Non Rate Selectable version can operate at 1x, 2x, 4x Fibre Channel independent of rate select pin setting.
5. LOS is open collector output. Should be pulled up with 4.7k – 10 kohms on host board to a voltage between 2.0V and 3.6V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.



Pinout of Connector Block on Host Board

II. Absolute Maximum Ratings

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Maximum Supply Voltage	Vcc	-0.5		4.5	V	
Storage Temperature	T_S	-40		85	°C	
Case Operating Temperature	T_{OP}	-5		75	°C	
Relative Humidity	RH	0		85	%	1

III. Electrical Characteristics (T_{OP} = -5 to 75 °C, V_{CC} = 3.1 to 3.5 Volts)

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Supply Voltage	Vcc	3.1		3.5	V	
Supply Current	Icc			300	mA	
Transmitter						
Input differential impedance	R_{in}		100		Ω	2
Single ended data input swing	Vin,pp	250		1200	mV	
Transmit Disable Voltage	V_D	Vcc – 1.3		Vcc	V	3
Transmit Enable Voltage	V_{EN}	Vee		Vee+ 0.8	V	
Transmit Disable Assert Time				10	us	
Receiver						
Single ended data output swing	Vout,pp	250		800	mV	4
Data output rise/fall time < 4.25 Gb/s	t_r, t_f			175	ps	5
Data output rise/fall time = 4.25 Gb/s	t_r, t_f			120	ps	5
LOS Fault	$V_{LOS\ fault}$	Vcc – 0.5		Vcc_{HOST}	V	6
LOS Normal	$V_{LOS\ norm}$	Vee		Vee+0.5	V	6
Power Supply Rejection	PSR	100			mVpp	7
Deterministic Jitter Contribution < 4.25 Gb/s	RX Δ DJ			51.7	ps	8
Total Jitter Contribution < 4.25 Gb/s	RX Δ TJ			122.4	ps	
Deterministic Jitter Contribution = 4.25 Gb/s	RX Δ DJ			25.9	ps	8
Total Jitter Contribution = 4.25 Gb/s	RX Δ TJ			61.2	ps	

Notes:
1. Non-condensing.
2. AC coupled.
3. Or open circuit.
4. Into 100 ohm differential termination.
5. 20 – 80 %
6. LOS is LVTTL. Logic 0 indicates normal operation; logic 1 indicates no signal detected.
7. All transceiver specifications are compliant with a power supply sinusoidal modulation of 20 Hz to 1.5 MHz up to specified value applied through the power supply filtering network shown on page 23 of the Small Form-factor Pluggable (SFP) Transceiver MultiSource Agreement (MSA)[1], September 14, 2000.
8. Measured with DJ-free data input signal. In actual application, output DJ will be the sum of input DJ and Δ DJ.

© Finisar Corporation August 2015 Rev F

IV. Optical Characteristics (T_{OP} = -5 to 75 °C, V_{CC} = 3.1 to 3.5 Volts)

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Transmitter						
Output Opt. Power (Rate Select High)	$P_{O,RH}$	+1		+5	dBm	1
Output Opt. Power (Rate Select Low)	$P_{O,RL}$	+1		+5	dBm	2
Optical Wavelength	λ	X-6.5	X	X+6.5	nm	3
Spectral Width	σ			1	nm	3
Optical Modulation Amplitude	OMA	290			uW	4
Optical Extinction Ratio (Rate Select High)	ER	4			dB	
Optical Extinction Ratio (Rate Select Low)	ER	9			dB	
Optical Rise/Fall Time = 4.25 Gb/s	t_r/ t_f			105	ps	5
Optical Rise/Fall Time ≤ 2.125 Gb/s	t_r/ t_f			160	ps	6
RIN				-118	dB/Hz	
Deterministic Jitter Contribution = 4.25 Gb/s	TX Δ DJ			28.2	ps	7
Total Jitter Contribution = 4.25 Gb/s	TX Δ TJ			59.8	ps	
Deterministic Jitter Contribution ≤ 2.125 Gb/s	TX Δ DJ			56.5	ps	7
Total Jitter Contribution ≤ 2.125 Gb/s	TX Δ TJ			119	ps	
Receiver						
Receiver Sensitivity = 4.25 Gb/s	R_{SENS4}			29 -16.5	uW dBm	8 9
Receiver Sensitivity = 2.125 Gb/s	R_{SENS2}			15 -20.5	uW dBm	8 9
Receiver Sensitivity = 1.06 Gb/s	R_{SENS1}			15 -22.0	uW dBm	8 10
Receiver Sensitivity = 1.25 Gb/s	$R_{SENS-GE}$			-22	dBm	10
Stressed RX sens. = 1.25 Gb/s				-14.5	dBm	
Average Received Power	Rx_{MAX}			0	dBm	
Receiver Electrical 3dB cutoff freq.				1500	MHz	11
Receiver Electrical 3dB cutoff freq.				2500	MHz	12
Optical Center Wavelength	λ_C	1450		1620	nm	
Return Loss		12			dB	
LOS De-Assert	LOS_D			-19	dBm	
LOS Assert	LOS_A	-30			dBm	
LOS Hysteresis		0.5			dB	

Notes:

1. High Bandwidth Mode. Class 1 Laser Safety per FDA/CDRH and EN (IEC) 60825 regulations.
2. Low Bandwidth Mode. Class 1 Laser Safety per FDA/CDRH and EN (IEC) 60825 regulations.
3. Over case temperature of -5 to 75 °C. The Transmitter Center Wavelength "X" is as specified by the customer. The current available wavelengths are: 1471, 1491, 1511, 1531, 1551, 1571, 1591, and 1611 nm. Please see the "Product Selection" section on page 2.
4. Equivalent extinction ration specification for Fibre Channel. Allows smaller ER at higher average power
5. Unfiltered, 20-80% measured w/ a "00001111" pattern. Complies with FC 4x eye mask when filtered.
6. Unfiltered, 20-80% measured w/ a "00001111" pattern. Complies with IEEE 802.3 (Gig. E), FC 1x and 2x eye masks when filtered.
7. Measured with DJ-free data input signal. In actual application, output DJ will be the sum of input DJ and Δ DJ.
8. Measured with conformance signals defined in FC-PI-2 Rev. 10.0 specifications. Value in OMA. Measured with PRBS 2^7-1 at 10^{-12} BER.
9. Represents sensitivity at minimum Extinction Ratio with rate select high. Measured with PRBS 2^7-1 at 10^{-12} BER.

10. Represents sensitivity at minimum Extinction Ratio with rate select low. Measured with PRBS 2^7-1 at 10^{-12} BER
11. Rate Selectable version in low bandwidth mode.
12. Rate Selectable version in high bandwidth mode.

V. General Specifications

Parameter	Symbol	Min	Typ	Max	Units	Ref.
Data Rate	BR	1062		4250	Mb/sec	1
Bit Error Rate	BER			10^{-12}		2
Max. Supported Link Length on 9/125 µm SMF @ 4X Fibre Channel	L_{MAX1}		30		km	3
Max. Supported Link Length on 9/125µm SMF @ 1X and 2X Fibre Channel	L_{MAX2}		50		km	3
Max. Supported Link Length on 9/125µm SMF @ Gigabit Ethernet	L_{MAX3}		50		km	3

Notes:
1. Gigabit Ethernet and 1x/2x/4x Fibre Channel compliant.
2. Tested with a PRBS 2^7-1 test pattern.
3. A 3 dB penalty is included for dispersion on data rates >2Gb/s amd 2dB penalty is included for data rates <2Gb/s. Distances are indicative only. Please refer to the Optical Specifications in Table IV to calculate a more accurate link budget based on specific conditions in your application

VI. Environmental Specifications

Parameter	Symbol	Min	Typ	Max	Units	Ref.
Case Operating Temperature	T_{op}	-5		75	°C	
Storage Temperature	T_{sto}	-40		85	°C	

VII. Regulatory Compliance

Finisar transceivers are Class 1 Laser Products and comply with US FDA regulations. These products are certified by TÜV and CSA to meet the Class 1 eye safety requirements of EN (IEC) 60825 and the electrical safety requirements of EN (IEC) 60950. Copies of certificates are available at Finisar Corporation upon request.

VIII. Digital Diagnostic Functions

All Finisar SFPs support the 2-wire serial communication protocol outlined in the SFP MSA[5]. These SFPs use an Atmel AT24C01A 128 byte E^2PROM with an address of A0h (see table below for E^2PROM contents). For details on interfacing with the E^2PROM, see the Atmel data sheet titled "AT24C01A/02/04/08/16 2-Wire Serial CMOS E^2PROM."[6]

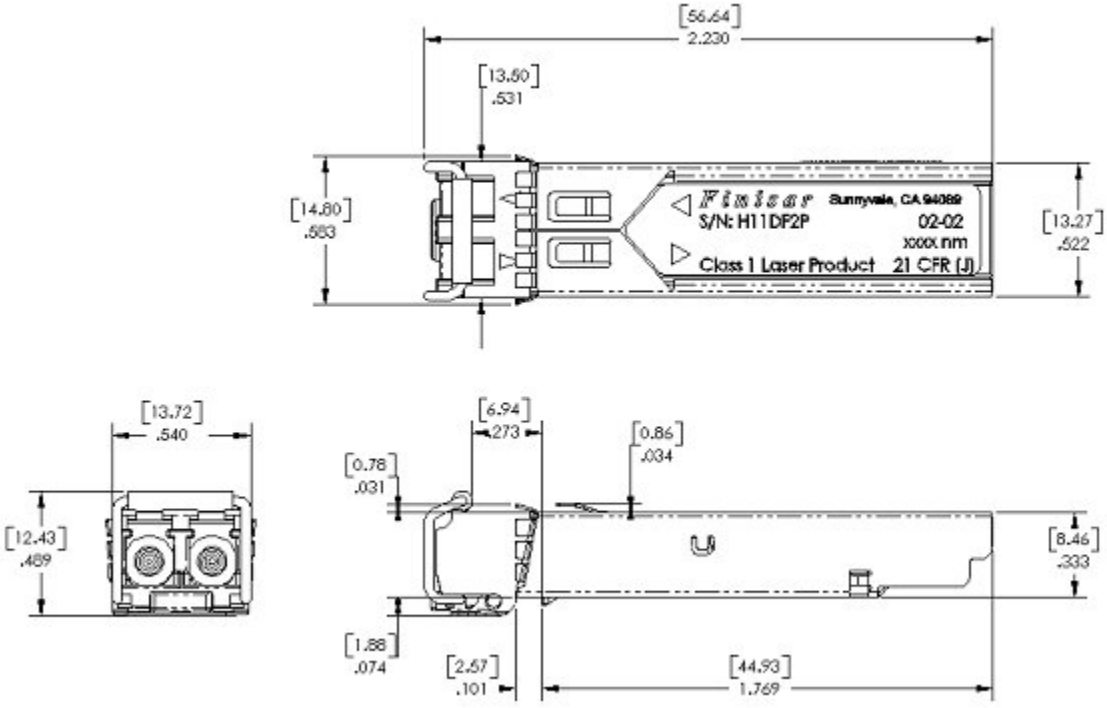
Finisar's CWDM SFPs also support extended diagnostic features as described in Finisar Applications Note AN-2030, "Digital Diagnostic Monitoring Interface for Optical Transceivers"[7], and additional information is available in SFF standard titled: "Digital Diagnostic Monitoring Interface for Optical Transceivers[8] (SFF-8472 rev9.3). A controller IC that monitors system parameters such as laser current, module temperature, transmitter power, and received power is accessible at address A2H.

I2C clock speed, digital diagnostic accuracy and digital diagnostic range can be found in the table below. Values in the table represent the worst-case values over temperature, voltage, and life.

Parameter	Symbol	Min	Typ	Max	Units	Notes/Conditions
I^2C Clock Speed		0		100,000	Hz	Bus can be driven blind
Accuracy						
Transceiver Temperature	$DD_{Temperature}$	-5		+5	°C	Case temperature
Transceiver Supply Voltage	$DD_{Voltage}$	-3		+3	%	
Tx Bias Curent	DD_{Bias}	-10		+10	%	
Tx Output Power	$DD_{TxPower}$	-3		+3	dB	100% tested in production over temp to ±2 dB
Received Average Power	$DD_{RxPower}$	-3		+3	dB	100% tested in production over temp to ±2 dB
Range						
Transceiver Temperature	$DD_{Temperature}$	-10		80	°C	
Transceiver Supply Voltage	$DD_{Voltage}$	3.0		4.0	V	
Tx Bias Current	DD_{Bias}	0		100	mA	
Tx Output Power	$DD_{TxPower}$	-10		+5	dBm	
Received Average Power	$DD_{RxPower}$	-25		+1	dBm	

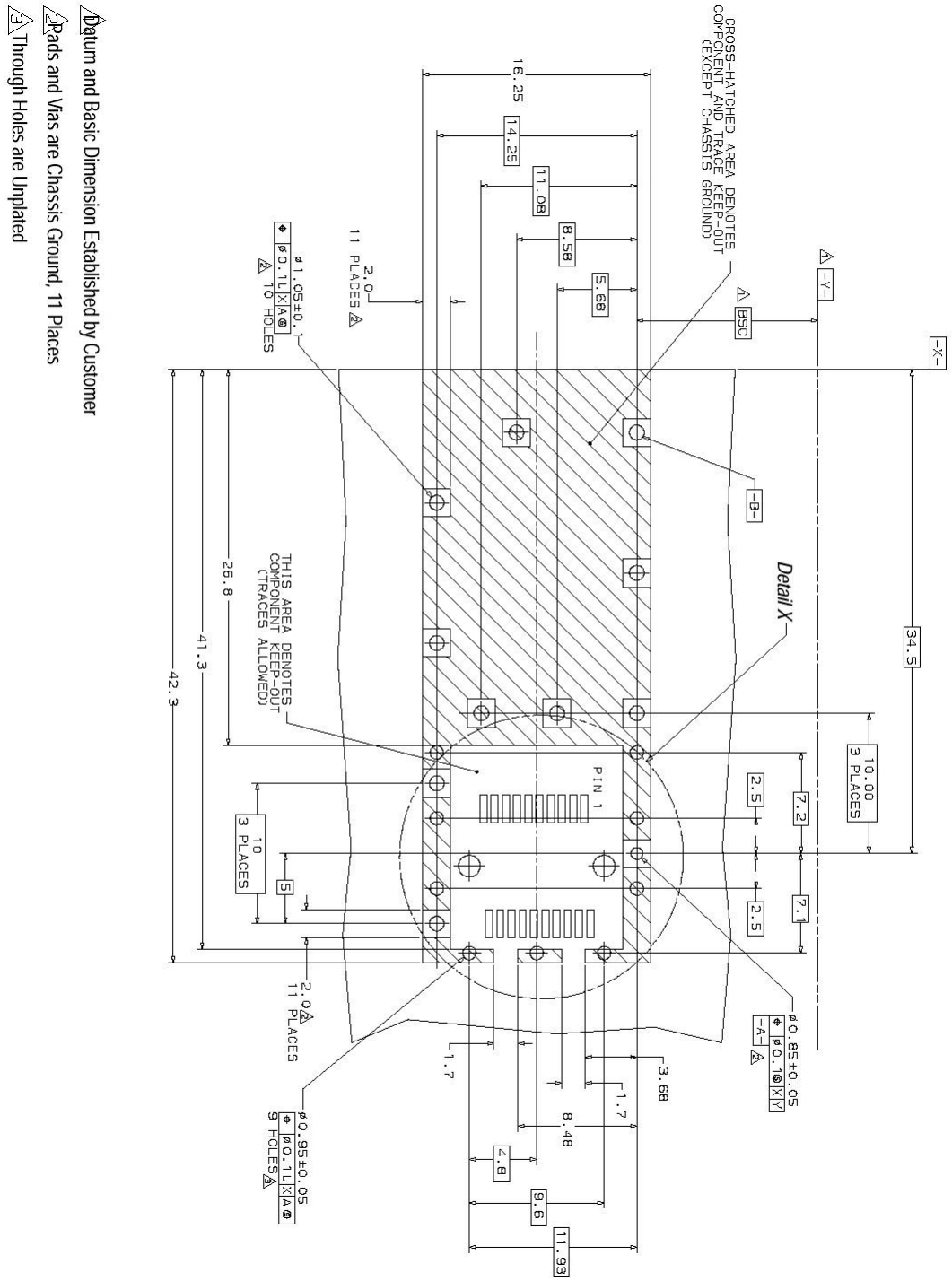
IX. Mechanical Specifications

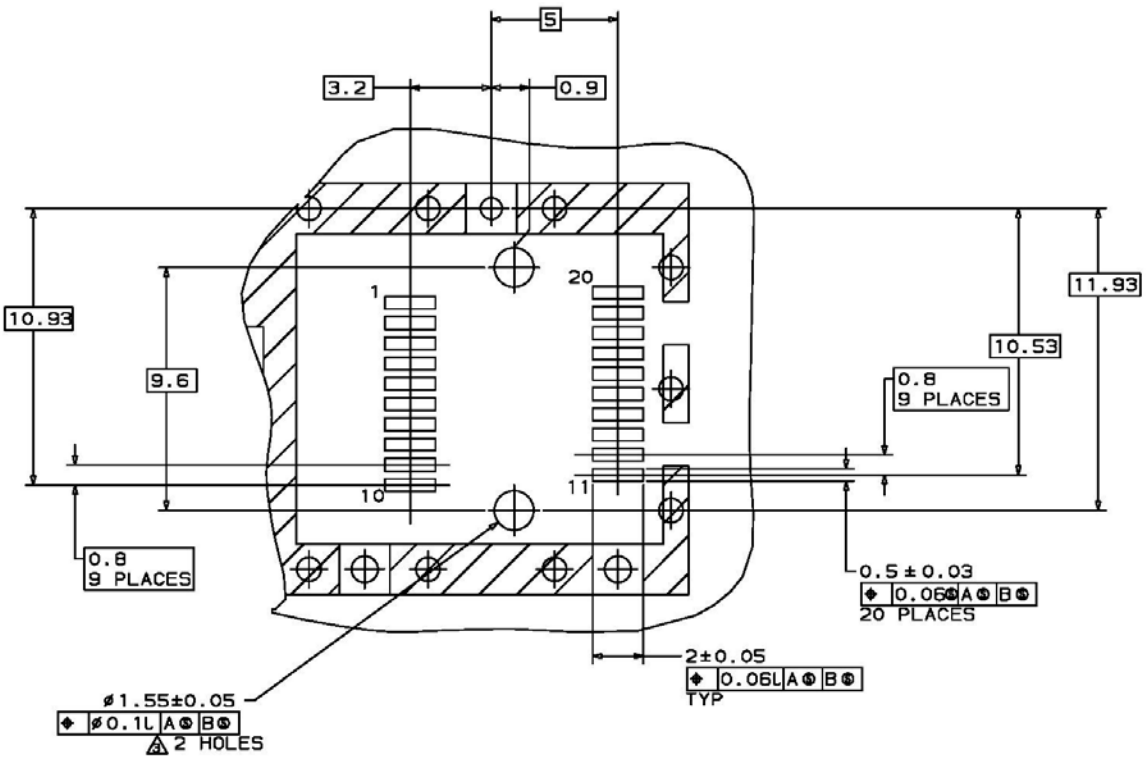
Finisar's Small Form Factor Pluggable (SFP) transceivers are compatible with the dimensions defined by the SFP Multi-Sourcing Agreement (MSA)[1].

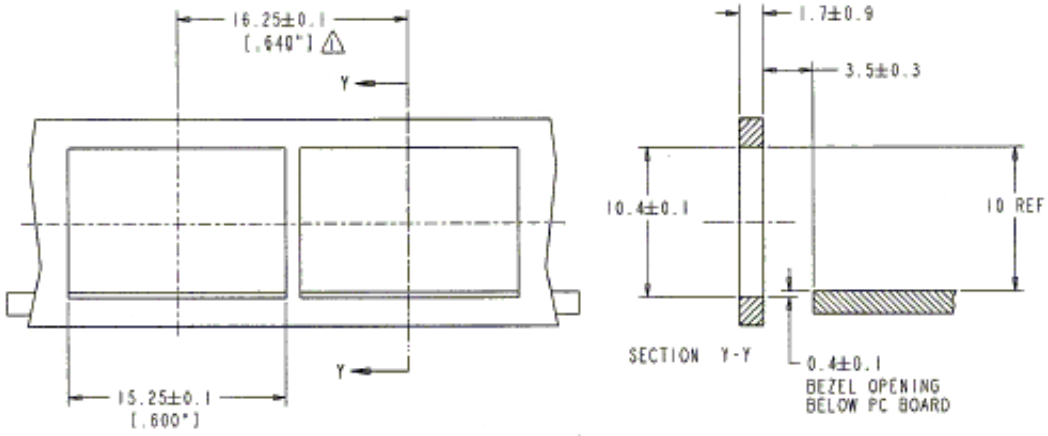


FWLF1524P2Vxx Outline Drawing

X. PCB Layout and Bezel Recommendations







NOTES:

1. MINIMUM PITCH ILLUSTRATED, ENGLISH DIMENSIONS ARE FOR REFERENCE ONLY
2. NOT RECOMMENDED FOR PCI EXPANSION CARD APPLICATIONS

XI. References

1. Small Form-factor Pluggable (SFP) Transceiver Multi-source Agreement (MSA), September 14, 2000.

2. "Fibre Channel Draft Physical Interface Specification (FC-PI-2 Rev. 10.0)". American National Standard for Information Systems.

3. IEEE Std 802.3, 2002 Edition, Clause 38, PMD Type 1000BASE-LX. IEEE Standards Department, 2002.

4. Directive 2011/65/EU of the European Council Parliament and of the Council, "on the restriction of the use of certain hazardous substances in electrical and electronic equipment". Certain products may use one or more exemptions as allowed by the Directive.

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

6. "AT24C01A/02/04/08/16 2-Wire Serial CMOS E^2PROM", Atmel Corporation. www.Atmel.com

7. "Application Note AN-2030: Digital Diagnostic Monitoring Interface for Optical Transceivers", Finisar Corporation, April 2002.

8. "Digital Diagnostic Monitoring Interface For Optical Transceivers Rev 9.3". SFF Document No. SFF-8472.

XII. For More Information

Finisar Corporation
1389 Moffett Park Drive
Sunnyvale, CA 94089-1133
Tel. 1-408-548-1000
Fax 1-408-541-6138
sales@finisar.com
www.finisar.com