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## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



## Product Specification

### 4.25 Gigabit RoHS Compliant CWDM SFP Transceiver

#### FWLF1625P2Lxx

#### PRODUCT FEATURES

- Up to 4.25 Gb/s bi-directional data links
- Hot-pluggable SFP footprint
- Built-in digital diagnostic functions
- CWDM DFB laser transmitter
- Duplex LC connector
- RoHS compliant
- Up to 80 km on 9/125µm SMF at 4.25 Gb/s with BER=1E-12
- 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 FWLF1625P2yxx Small Form Factor Pluggable (SFP) transceiver is compatible with the Small Form Factor Pluggable Multi-Sourcing Agreement (MSA)<sup>1</sup>. The transceiver is designed for operation in Metro Access Rings and Point-to-Point networks using Fibre Channel<sup>2</sup>, Gigabit Ethernet<sup>3</sup>, or SONET networking equipment by selecting the appropriate line rate. The FWLF1625P2yxx 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

#### FWLF1625P2Lxx

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

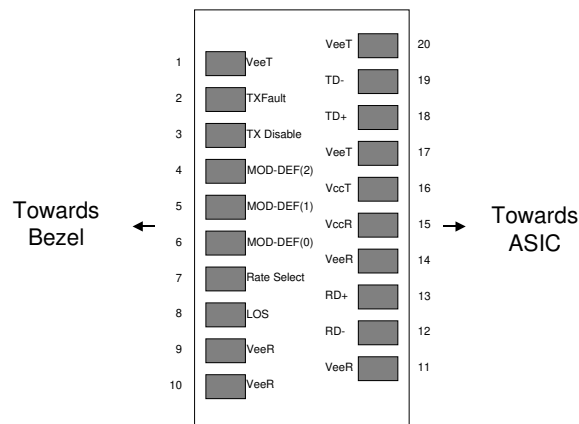
<b>Wavelength</b>	<b>xx</b>	<b>Clasp Color Code</b>	<b>Wavelength</b>	<b>xx</b>	<b>Clasp Color Code</b>
1471 nm	47	Gray	1551 nm	55	Yellow
1491 nm	49	Violet	1571 nm	57	Orange
1511 nm	51	Blue	1591 nm	59	Red
1531 nm	53	Green	1611 nm	61	Brown

## I. Pin Descriptions

Pin	Symbol	Name/Description	Ref.
1	V <sub>EET</sub>	Transmitter Ground (Common with Receiver Ground)	1
2	T <sub>FAULT</sub>	Transmitter Fault. Not supported.	
3	T <sub>DIS</sub>	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	Unused	4
8	LOS	Loss of Signal indication. Logic 0 indicates normal operation.	5
9	V <sub>EER</sub>	Receiver Ground (Common with Transmitter Ground)	1
10	V <sub>EER</sub>	Receiver Ground (Common with Transmitter Ground)	1
11	V <sub>EER</sub>	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 <sub>EER</sub>	Receiver Ground (Common with Transmitter Ground)	1
15	V <sub>CCR</sub>	Receiver Power Supply	
16	V <sub>CCT</sub>	Transmitter Power Supply	
17	V <sub>EET</sub>	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 <sub>EET</sub>	Transmitter Ground (Common with Receiver Ground)	1

### Notes:

- Circuit ground is internally isolated from chassis ground.
- Laser output disabled on T<sub>DIS</sub> >2.0V or open, enabled on T<sub>DIS</sub> <0.8V.
- 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.
- 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	V <sub>CC</sub>	-0.5		4.5	V	
Storage Temperature	T <sub>S</sub>	-40		85	°C	

Case Operating Temperature	T <sub>OP</sub>	-5		75	°C	
Relative Humidity	RH	0		85	%	1

### III. Electrical Characteristics (T<sub>OP</sub> = -5 to 75 °C, V<sub>CC</sub> = 3.1 to 3.5 Volts)

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Supply Voltage	V <sub>CC</sub>	3.135		3.465	V	
Supply Current	I <sub>CC</sub>			350	mA	
<b>Transmitter</b>						
Input differential impedance	R <sub>in</sub>		100		Ω	2
Single ended data input swing	V <sub>in,pp</sub>	125		800	mV	
Transmit Disable Voltage	V <sub>D</sub>	V <sub>CC</sub> - 1.3		V <sub>CC</sub>	V	3
Transmit Enable Voltage	V <sub>EN</sub>	V <sub>EE</sub>		V <sub>EE</sub> + 0.8	V	
Transmit Disable Assert Time				10	us	
<b>Receiver</b>						
Single ended data output swing	V <sub>out,pp</sub>	300		470	mV	4
Data output rise/fall time < 4.25 Gb/s	t <sub>r</sub> , t <sub>f</sub>			175	ps	5
Data output rise/fall time = 4.25 Gb/s	t <sub>r</sub> , t <sub>f</sub>			120	ps	5
LOS Fault	V <sub>LOS fault</sub>	V <sub>CC</sub> - 0.5		V <sub>CC</sub> <sub>HOST</sub>	V	6
LOS Normal	V <sub>LOS norm</sub>	V <sub>EE</sub>		V <sub>EE</sub> +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 LVTTTL. 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)<sup>1</sup>, 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.

#### IV. Optical Characteristics (T<sub>OP</sub> = -5 to 75 °C, V<sub>CC</sub> = 3.1 to 3.5 Volts)

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
<b>Transmitter</b>						
Output Opt. Power (Rate Select High)	P <sub>O,RH</sub>	+1		+5	dBm	1
Output Opt. Power (Rate Select Low)	P <sub>O,RL</sub>	+1		+5	dBm	2,3
Optical Wavelength	λ	X-6.5	X	X+6.5	nm	4
Spectral Width	σ			1	nm	
Optical Extinction Ratio	ER	4.5			dB	
RIN				-120	dB/Hz	
Deterministic Jitter Contribution = 4.25 Gb/s	TX Δ DJ			28.2	ps	5
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	5
Total Jitter Contribution ≤ 2.125 Gb/s	TX Δ TJ			119	ps	
<b>Receiver</b>						
Receiver Sensitivity = 4.25 Gb/s	R <sub>SENS4</sub>			5.6	uW	6
Average Received Power	R <sub>X,MAX</sub>			-8	dBm	
Optical Center Wavelength	λ <sub>C</sub>	1260		1620	nm	
Return Loss		12			dB	
LOS De-Assert	LOS <sub>D</sub>			-26	dBm	7
LOS Assert	LOS <sub>A</sub>	-42			dBm	8
LOS Hysteresis		0.5			dB	

##### Notes:

- High Bandwidth Mode. Class 1 Laser Safety per FDA/CDRH and EN (IEC) 60825 regulations.
- Low Bandwidth Mode. Class 1 Laser Safety per FDA/CDRH and EN (IEC) 60825 regulations.
- Applicable for rate selectable version only in low bandwidth mode.
- 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.
- Measured with DJ-free data input signal. In actual application, output DJ will be the sum of input DJ and Δ DJ.
- Measured with conformance signals defined in FC-PI-2 Rev. 10.0 specifications. Value in OMA. Measured with PRBS 2<sup>7</sup>-1 at 10<sup>-12</sup> BER.
- ER of Reference TX ≥ 6dB
- ER of Reference TX ≤ 6dB

#### V. General Specifications

Parameter	Symbol	Min	Typ	Max	Units	Ref.
Data Rate	BR	1062		4250	Mb/sec	1
Bit Error Rate	BER			10 <sup>-12</sup>		2
Dispersion Penalty at 4.25Gpbs, 80km 9/125um SMF	DP			3	dB	3

##### Notes:

- Gigabit Ethernet and 1x/2x/4x Fibre Channel compliant.
- Tested with a PRBS 2<sup>7</sup>-1 test pattern @4.25G
- With 80km SMF (1600ps/nm), @BER=1E-12, max case T=75°C

**VI. Environmental Specifications**

<b>Parameter</b>	<b>Symbol</b>	<b>Min</b>	<b>Typ</b>	<b>Max</b>	<b>Units</b>	<b>Ref.</b>
Case Operating Temperature for 4/5G	T <sub>op</sub>	-5		75	°C	
Storage Temperature	T <sub>sto</sub>	-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<sup>5</sup>. These SFPs use an Atmel AT24C01A 128 byte E<sup>2</sup>PROM with an address of A0h (see table below for E<sup>2</sup>PROM contents). For details on interfacing with the E<sup>2</sup>PROM, see the Atmel data sheet titled “AT24C01A/02/04/08/16 2-Wire Serial CMOS E<sup>2</sup>PROM.”<sup>6</sup>

Finisar’s CWDM SFPs also support extended diagnostic features as described in Finisar Applications Note AN-2030, “Digital Diagnostic Monitoring Interface for Optical Transceivers”<sup>7</sup>, and additional information is available in SFF standard titled: “Digital Diagnostic Monitoring Interface for Optical Transceivers”<sup>8</sup> (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.

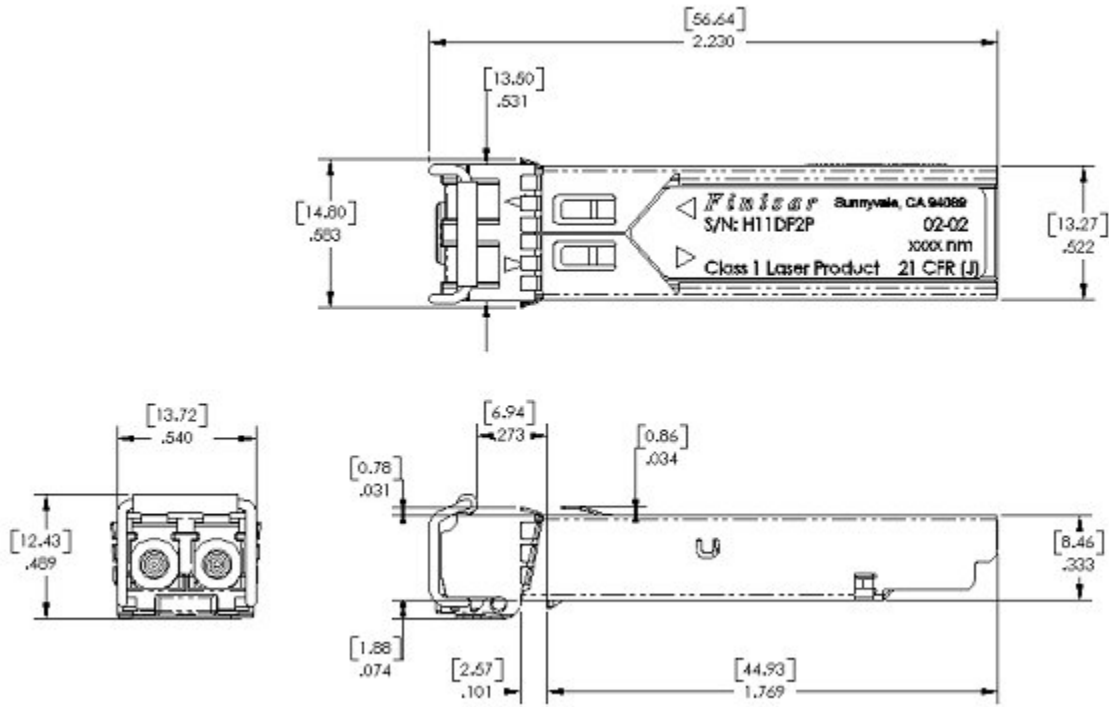
I2C clock speed, digital diagnostic accuracy and digital diagnostic range can be found in the table below. Values in the table represent the worst-case values over temperature, voltage, and life.

Parameter	Symbol	Min	Typ	Max	Units	Notes/Conditions
I <sup>2</sup> C Clock Speed		0		100,000	Hz	Bus can be driven blind
<b>Accuracy</b>						
Transceiver Temperature	DD <sub>Temperature</sub>	-5		+5	°C	Case temperature
Transceiver Supply Voltage	DD <sub>Voltage</sub>	-3		+3	%	
Tx Bias Current	DD <sub>Bias</sub>	-10		+10	%	
Tx Output Power	DD <sub>TxPower</sub>	-3		+3	dB	
Received Average Power	DD <sub>RxPower</sub>	-3		+3	dB	
<b>Range</b>						
Transceiver Temperature	DD <sub>Temperature</sub>	-10		80	°C	
Transceiver Supply Voltage	DD <sub>Voltage</sub>	3.0		4.0	V	
Tx Bias Current	DD <sub>Bias</sub>	0		100	mA	
Tx Output Power	DD <sub>TxPower</sub>	-10		+7	dBm	
Received Average Power	DD <sub>RxPower</sub>	-28		-7	dBm	



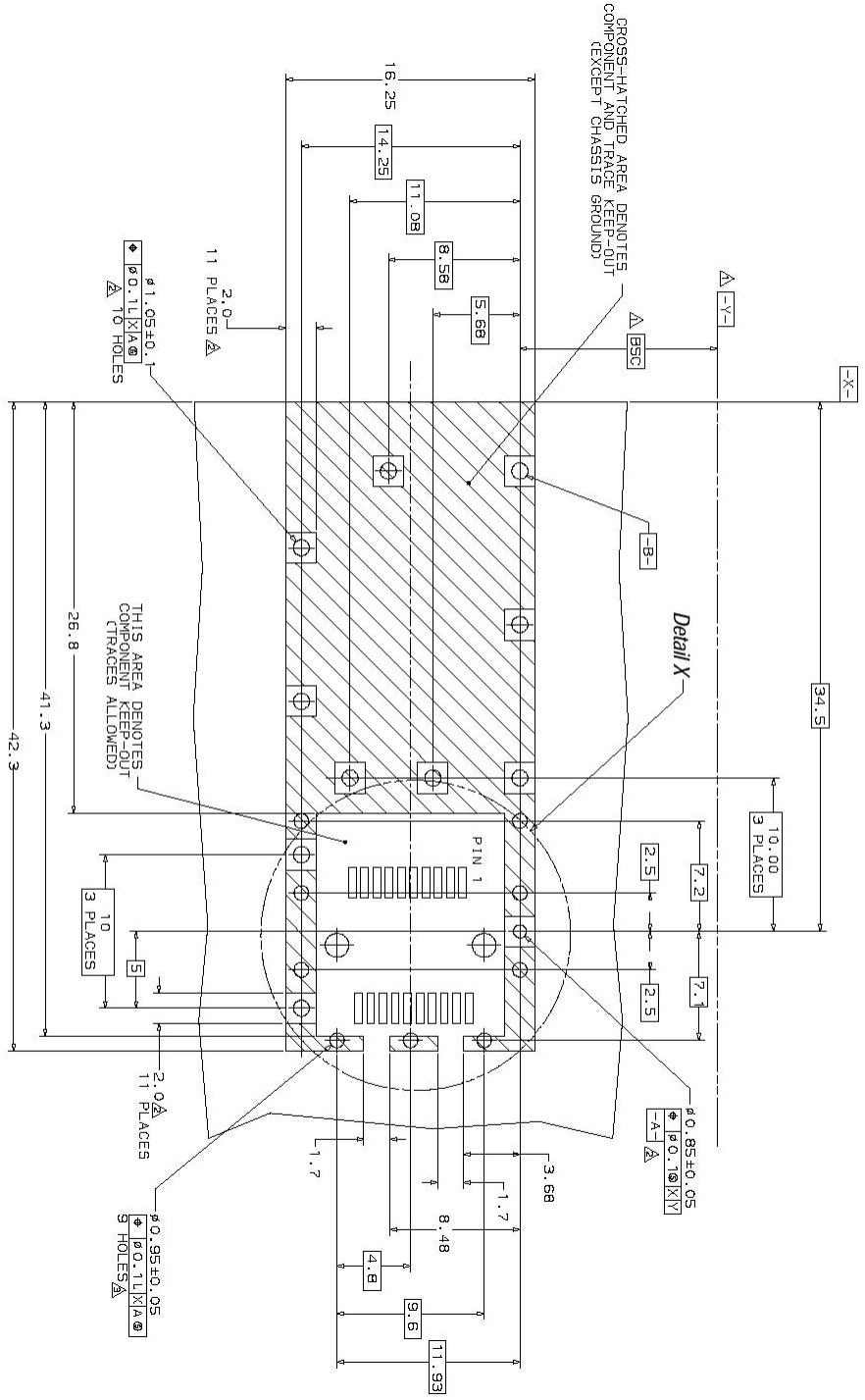
## IX. Mechanical Specifications

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

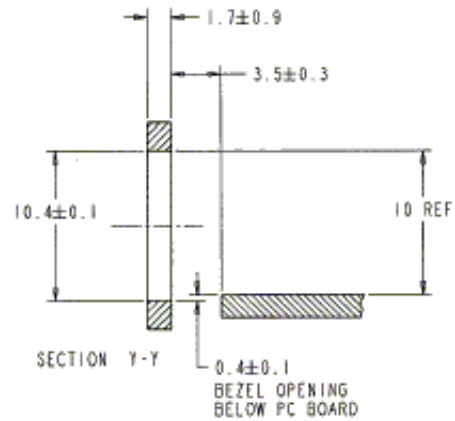
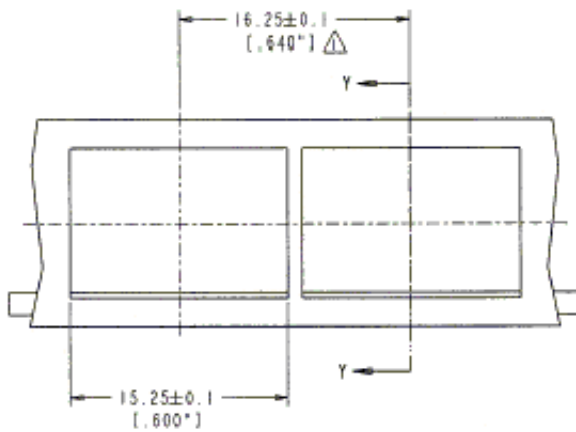
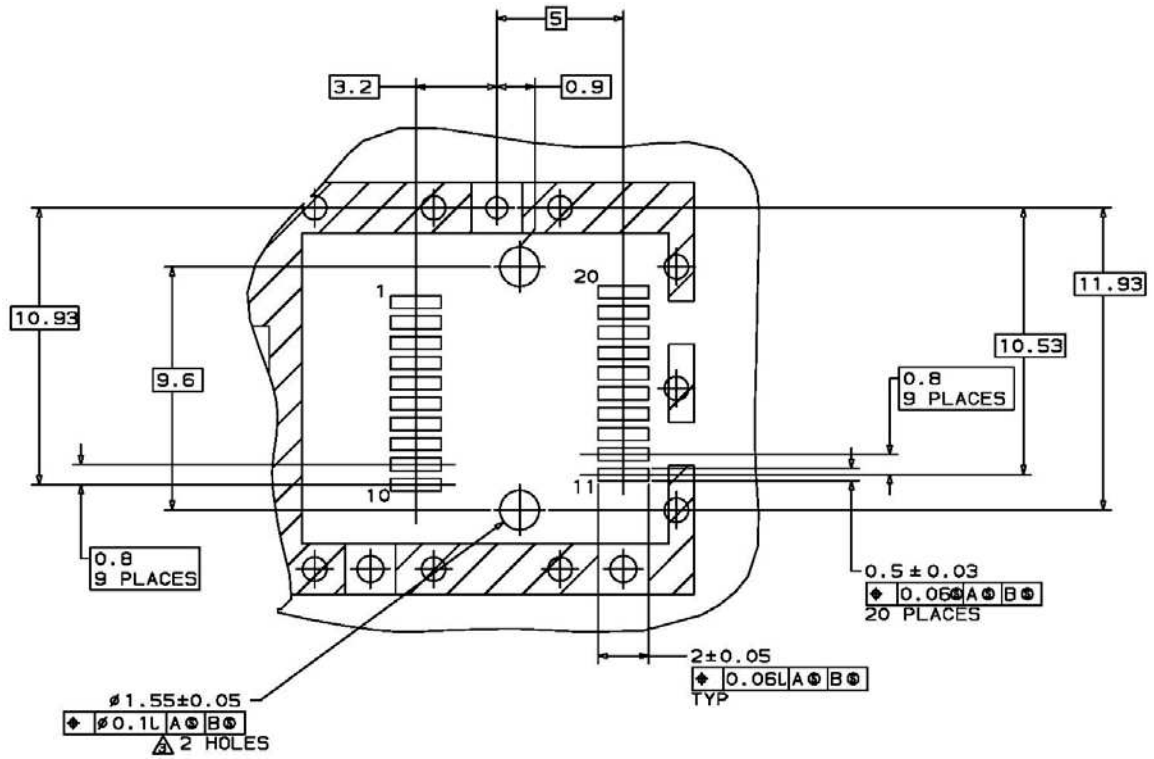


**FWLF1625P2yxx Outline Drawing**

### X. PCB Layout and Bezel Recommendations



- Datum and Basic Dimension Established by Customer
- Plates and Vias are Chassis Ground, 11 Places
- Through Holes are Unplated



NOTES:

△ 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<sup>2</sup>PROM”, Atmel Corporation. [www.Atmel.com](http://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](mailto:sales@finisar.com)  
[www.finisar.com](http://www.finisar.com)