

Product Specification

1000BASE-T RoHS Compliant Copper SFP Transceiver

FCLF8520P2BTL / FCLF8521P2BTL / FCLF8522P2BTL

Product Features

- Up to 1.25Gb/s bi-directional data links
- Hot-pluggable SFP footprint
- Extended case temperature range (-40°C to +85°C)
- Fully metallic enclosure for low EMI
- RoHS compliant and Lead Free
- Low power dissipation (1.05 W typical)
- Compact RJ-45 connector assembly
- Access to physical layer IC via 2-wire serial bus
- 10/100/1000 BASE-T operation in host systems with SGMII interface



Applications

- 1.25 Gigabit Ethernet over Cat 5 cable

Finisar's FCLF8520P2BTL, FCLF8521P2BTL and FCLF8522P2BTL 1000BASE-T Copper Small Form Pluggable (SFP) transceivers are based on the SFP Multi Source Agreement (MSA)¹. They are compatible with the Gigabit Ethernet and 1000BASE-T standards as specified in IEEE Std 802.3². They are RoHS compliant and lead-free per Directive 2002/95/EC³ and Finisar Application Note AN-2038. The 1000BASE-T physical layer IC (PHY) can be accessed via I2C, allowing access to all PHY settings and features.

The FCLF8520P2BTL uses the SFP's RX_LOS pin for link indication, and 1000BASE-X auto-negotiation should be disabled on the host system. The FCLF8521P2BTL is compatible with 1000BASE-X auto-negotiation, but does not have a link indication feature (RX_LOS is internally grounded). See AN-2036, "Frequently Asked Questions Regarding Finisar's 1000BASE-T SFPs", for a more complete explanation on the differences between the two models and details on applications issues for the products. The FCLF8522 shall support both RX_LOS pin for link indication and 1000BASE-X auto-negotiation.

PRODUCT SELECTION

| Part Number | Link Indicator on RX_LOS Pin | 1000BASE-X auto-negotiation enabled by default |
|---------------|------------------------------|--|
| FCLF8520P2BTL | Yes | No |
| FCLF8521P2BTL | No | Yes |
| FCLF8522P2BTL | Yes | Yes |

I. SFP to Host Connector Pin Out

| Pin | Symbol | Name/Description | Note |
|-----|--------------------|---|------|
| 1 | V _{EET} | Transmitter ground (common with receiver ground) | 1 |
| 2 | T _{FAULT} | Transmitter Fault. Not supported | |
| 3 | T _{DIS} | Transmitter Disable. PHY 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 | No connection required | |
| 8 | LOS | Loss of Signal indication. | 4 |
| 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 isolated from chassis ground
 2. PHY disabled on T_{DIS} > 2.0V or open, enabled on T_{DIS} < 0.8V
 3. Should be pulled up with 4.7k – 10k Ohms on host board to a voltage between 2.0 V and 3.6 V. MOD_DEF(0) pulls line low to indicate module is plugged in.
 4. LVTTTL compatible with a maximum voltage of 2.5V. Not supported on FCLF8521P2BTL.

Table 1. SFP to host connector pin assignments and descriptions

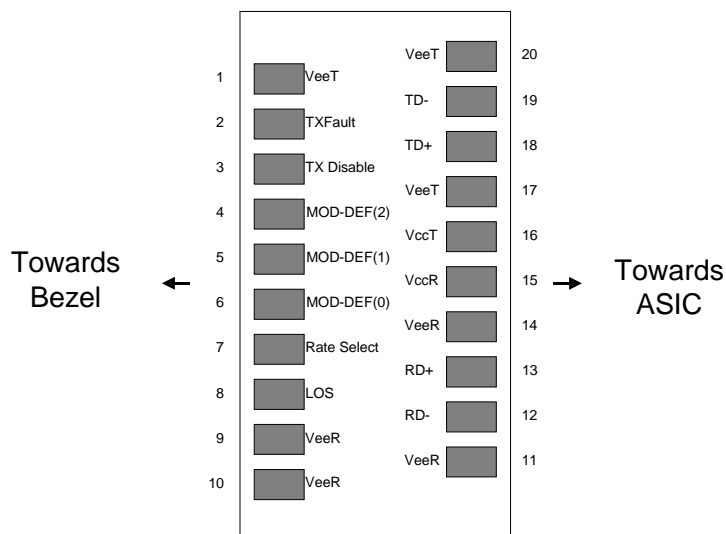


Figure 1. Diagram of host board connector block pin numbers and names

II. +3.3V Volt Electrical Power Interface

The FCLF8520P2BTL, FCLF8521P2BTL and FCLF8522P2BTL have an input voltage range of 3.3 V +/- 5%. The 4 V maximum voltage is not allowed for continuous operation.

| Parameter | Symbol | Min | Typ | Max | Units | Notes/Conditions |
|---|-------------|------|-----|------|-------|---|
| Supply Current | I_s | | 320 | 375 | mA | 1.2W max power over full range of voltage and temperature. See caution note below |
| Input Voltage | V_{cc} | 3.13 | 3.3 | 3.47 | V | Referenced to GND |
| Maximum Voltage | V_{max} | | | 4 | V | |
| Total Maximum Current including Surge Current | I_{surge} | | | 405 | mA | Hot plug above steady state current. See caution note below |

Caution: Power consumption and surge current are higher than the specific values in the SFP MSA

Table 2, +3.3 Volt electrical power interface

III. Low-Speed Signals

MOD_DEF(1) (SCL) and MOD_DEF(2) (SDA), are open drain CMOS signals (see section VII, “Serial Communication Protocol”). Both MOD_DEF(1) and MOD_DEF(2) must be pulled up to host_Vcc.

| Parameter | Symbol | Min | Max | Units | Notes/Conditions |
|-----------------|----------|----------------|----------------|-------|---|
| SFP Output LOW | V_{OL} | 0 | 0.5 | V | 4.7k to 10k pull-up to host_Vcc, measured at host side of connector |
| SFP Output HIGH | V_{OH} | host_Vcc - 0.5 | host_Vcc + 0.3 | V | 4.7k to 10k pull-up to host_Vcc, measured at host side of connector |
| SFP Input LOW | V_{IL} | 0 | 0.8 | V | 4.7k to 10k pull-up to Vcc, measured at SFP side of connector |
| SFP Input HIGH | V_{IH} | 2 | Vcc + 0.3 | V | 4.7k to 10k pull-up to Vcc, measured at SFP side of connector |

Table 3: Low-speed signals, electrical characteristics

IV. High-Speed Electrical Interface

All high-speed signals are AC-coupled internally.

High-Speed Electrical Interface, Transmission Line - SFP

| Parameter | Symbol | Min | Typ | Max | Units | Notes/Conditions |
|---------------------|--------------|-----|-----|-----|-------|---|
| Line Frequency | f_L | | 125 | | MHz | 5-level encoding, per IEEE 802.3 |
| Tx Output Impedance | $Z_{out,TX}$ | | 100 | | Ohm | Differential, for all frequencies between 1MHz and 125MHz |
| Rx Input Impedance | $Z_{in,RX}$ | | 100 | | Ohm | Differential, for all frequencies between 1MHz and 125MHz |

Table 4: High-speed electrical interface, transmission line-SFP

High-Speed Electrical Interface, Host-SFP

| Parameter | Symbol | Min | Typ | Max | Units | Notes/Conditions |
|--------------------------------|---------------|-----|-----|------|-------|--|
| Single ended data input swing | V_{insing} | 250 | | 1200 | mV | Single ended |
| Single ended data output swing | $V_{outsing}$ | 275 | | 800 | mV | Single ended, can be modified by writing to the PHY's internal registers. For more details, see Marvell datasheet ⁵ |
| Rise/Fall Time | T_r, T_f | | 175 | | psec | 20%-80% |
| Tx Input Impedance | Z_{in} | | 50 | | Ohm | Single ended |
| Rx Output Impedance | Z_{out} | | 50 | | Ohm | Single ended |

Table 5: High-Speed electrical interface, host-SFP

V. General Specifications

| Parameter | Symbol | Min | Typ | Max | Units | Notes/Conditions |
|--------------|--------|-----|-----|-------|--------|---|
| Data Rate | BR | 10 | | 1,000 | Mb/sec | IEEE 802.3 compatible. See Notes 2 through 4 below |
| Cable Length | L | | | 100 | m | Category 5 UTP. BER <10 ⁻¹² |

Table 6: General Specifications

Notes:

1. Clock tolerance is +/- 50 ppm
2. By default, the FCLF8520P2BTL, FCLF8521P2BTL and FCLF8522P2BTL are full duplex devices in preferred master mode
3. Automatic crossover detection is enabled. External crossover cable is not required
4. 10/100/1000 BASE-T operation requires the host system to have an SGMII interface with no clocks, and the module PHY to be configured per Application Note AN-2036. With a SERDES that does not support SGMII, the module will operate at 1000BASE-T only.

VI. Environmental Specifications

The FCLF8520P2BTL, FCLF8521P2BTL and FCLF8522P2BTL have an industrial temperature ranges from -40°C to +85°C case temperature as specified in Table 8.

| Parameter | Symbol | Min | Typ | Max | Units | Notes/Conditions |
|-----------------------|------------------|-----|-----|-----|-------|---------------------|
| Operating Temperature | T _{op} | -40 | | 85 | °C | Case temperature |
| Storage Temperature | T _{sto} | -40 | | 85 | °C | Ambient temperature |

Table 7: Environment specifications

VII. Serial Communication Protocol

All Finisar SFPs support the 2-wire serial communication protocol outlined in the SFP MSA¹. These SFPs use an Atmel AT24C01A 128 byte E²PROM with an address of A0h. For details on interfacing with the E²PROM, see the Atmel data sheet titled “AT24C01A/02/04/08/16 2-Wire Serial CMOS E²PROM.”⁴

The 1000BASE-T physical layer IC can also be accessed via the 2-wire serial bus at address ACh. For details interfacing with the PHY IC, see Marvell data sheet titled “Alaska Ultra 88E1111 Integrated Gigabit Ethernet Transceiver”⁵ (Marvell document number MV-S100649-00).

| Parameter | Symbol | Min | Typ | Max | Units | Notes/Conditions |
|----------------------------------|--------|----------|-----|----------------|-----------|------------------|
| I²C Clock Rate | | 0 | | 100,000 | Hz | |

Table 8: Serial bus timing requirements

VIII. Mechanical Specifications

The host-side of the FCLF8520P2BTL, FCLF8521P2BTL and FCLF8522P2BTL conforms to the mechanical specifications outlined in the SFP MSA¹. The front portion of the SFP (part extending beyond the face plate of the host) is larger to accommodate the RJ-45 connector. See Figure 2 below for details.

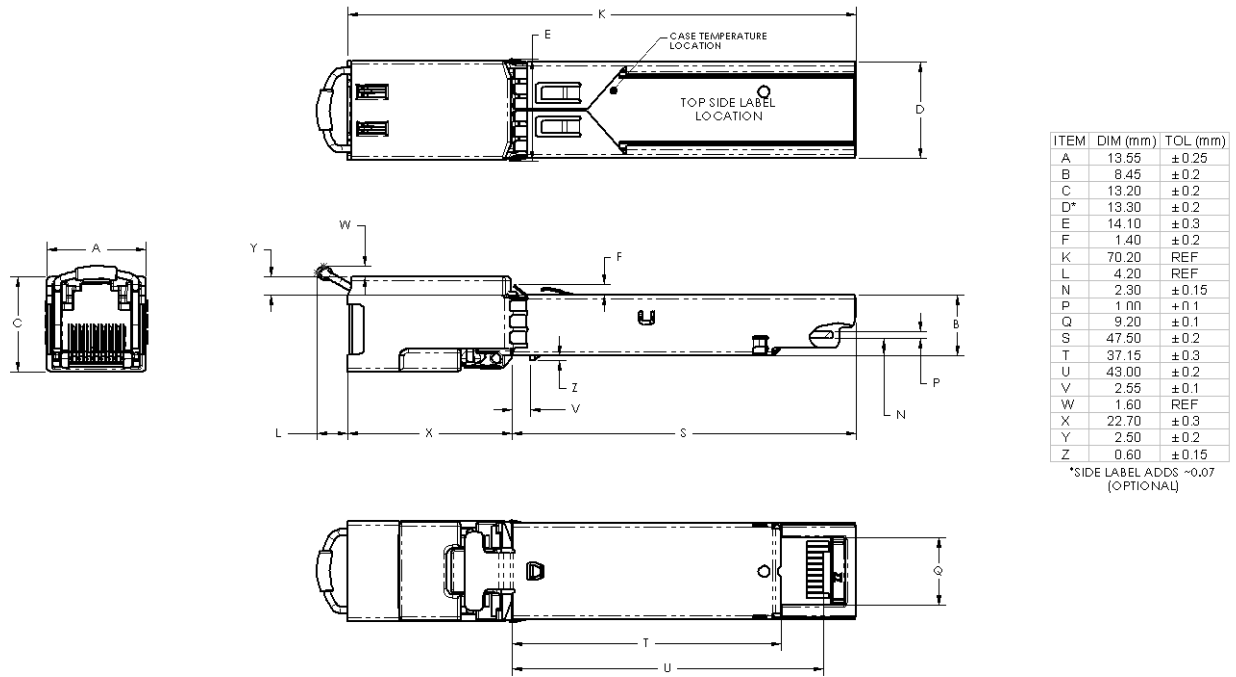


Figure 2. FCLF8520P2BTL, FCLF8521P2BTL and FCLF8522P2BTL mechanical dimensions

IX. References

1. Small Form Factor Pluggable (SFP) Transceiver Multi-Source Agreement (MSA), September 2000. Documentation is currently available at Finisar upon request.
2. IEEE Std 802.3, 2002 Edition. IEEE Standards Department, 2002
3. Directive 2002/95/EC of the European Council Parliament and of the Council, “on the restriction of the use of certain hazardous substances in electrical and electronic equipment.” January 27, 2003.
4. “AT24C01A/02/04/08/16 2-Wire Serial CMOS E²PROM”, Atmel Corporation. www.Atmel.com
5. “Alaska Ultra 88E1111 Integrated 10/100/1000 Gigabit Ethernet Transceiver”, Marvell Corporation. www.marvell.com

X. 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