

## Product Specification

### 1000BASE-T Copper GBIC Transceivers

#### FCL-8520/8521-3

#### Product Features

- Up to 1.25Gb/s bi-directional data links
- RoHS compliant and Lead Free
- Extended operating temperature range (0°C to +75°C)
- Hot-pluggable
- Fully metallic enclosure for low EMI
- Low power (1.5W typical)
- Access to physical layer IC via 2-wire serial bus



#### Applications

- 1.25 Gigabit Ethernet over Cat 5 cable

Finisar's FCL-8520/8521-3 1000BASE-T Copper GBIC transceivers are based on the GBIC Specification Revision 5.5<sup>1</sup>. They are compatible with the Gigabit Ethernet and 1000BASE-T standards as specified in IEEE Std 802.3z<sup>2</sup> and IEEE Std 802.3ab<sup>3</sup>.

The FCL-8520-3 uses the GBIC's RX\_LOS pin for link indication, and 1000BASE-X auto-negotiation must be disabled on the host system. The FCL-8521-3 is compatible with 1000BASE-X auto-negotiation, but does not have a link indication feature (RX\_LOS is internally grounded). See AN-2032, "Commonly Asked Questions Regarding Auto-negotiation on Finisar's 1000BASE-T GBICs"<sup>4</sup>, for a more complete explanation on the differences between the two models.

#### PRODUCT SELECTION

Part Number	Link Indicator on RX_LOS Pin	Compatible with 1000BASE-X Auto-negotiation
FCL-8520-3	Yes	No
FCL-8521-3	No	Yes

**I. GBIC to Host Connector Pin Out**

<b>Pin Name</b>	<b>Pin #</b>	<b>Sequence</b>
RX_LOS*	1	2
GND	2	2
GND	3	2
MOD_DEF(0)	4	2
MOD_DEF(1)	5	2
MOD_DEF(2)	6	2
TX_DISABLE	7	2
GND	8	2
GND	9	2
GND	10	2
GND	11	1
-RX_DAT	12	1
+RX_DAT	13	1
GND	14	1
V <sub>CC</sub>	15	2
V <sub>CC</sub>	16	2
GND	17	1
+TX_DAT	18	1
-TX_DAT	19	1
GND	20	1

Note: RX\_LOS is used for link indication on the FCL-8520-3, and is internally grounded on the FCL-8521-3

**Table 1. GBIC to host connector pin assignment**

“Sequence” indicates the order in which pins make contact when the device is hot plugged. For additional information, see “Table 3: Signal Definitions” in the GBIC Specification Revision 5.5.<sup>1</sup>

## II. +5V Volt Electrical Power Interface

The FCL-8520/8521-3 has an extended input voltage range of 4.5 to 5.5 V, compared to the GBIC standard of 4.25 to 5.25 V. The 6V maximum voltage is not allowed for continuous operation.

<b>+5 Volt Electrical Power Interface</b>						
<b>Parameter</b>	<b>Symbol</b>	<b>Min</b>	<b>Typ</b>	<b>Max</b>	<b>Units</b>	<b>Notes/Conditions</b>
Supply Current	$I_s$		310	375	mA	1.7W max power over full range of voltage and temperature. See Note 1.
Input Voltage	$V_{cc}$	4.5	5	5.5	V	Referenced to GND.
Maximum Voltage	$V_{max}$			6	V	
Surge Current	$I_{surge}$			450	mA	Hot plug. See Note 1.

**Table 2. +5 Volt electrical power interface**

### Note:

1. **Caution:** Power consumption and inrush current are higher than the specified values in the GBIC Specification Rev 5.5<sup>1</sup>.

## III. Low-Speed Signals

RX\_LOS is a TTL signals as described in Table 3 and 4. 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. For more detailed information, see sections 5.3.1 – 5.3.8 in the GBIC Specification Rev. 5.5<sup>1</sup>.

<b>Low-Speed Signals, Electronic Characteristics</b>						
<b>Parameter</b>	<b>Symbol</b>	<b>Min</b>	<b>Max</b>	<b>Units</b>	<b>Notes/Conditions</b>	
GBIC Output LOW	$V_{OL}$	0	0.5	V	4.7k to 10k pull-up to host_Vcc, measured at host side of connector	
GBIC 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	
GBIC Input LOW	$V_{IL}$	0	0.8	V	4.7k to 10k pull-up to Vcc, measured at GBIC side of connector	
GBIC Input HIGH	$V_{IH}$	2	Vcc + 0.3	V	4.7k to 10k pull-up to Vcc, measured at GBIC side of connector	

**Table 3. Low-speed signals, electronic characteristics**

<b>High-Speed Electrical Interface, Transmission Line-GBIC</b>						
Parameter	Symbol	Min	Typ	Max	Units	Notes/Conditions
Line Frequency	$f_L$		125		MHz	5-level encoding, per IEEE 802.3ab.
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-GBIC

#### IV. High-Speed Electrical Interface

All high-speed signals are AC-coupled internally.

<b>High-Speed Electrical Interface, Host-GBIC</b>						
Parameter	Symbol	Min	Typ	Max	Units	Notes/Conditions
Differential Input Voltage	$V_{indiff}$	0.50		2.00	V	Differential peak - peak
Differential Output Voltage	$V_{outdiff}$	0.37		2.00	V	Differential peak - peak
Rise/Fall Time	$T_r, T_f$		250		psec	20%-80% Differential
Tx Input Impedance	$Z_{in}$		75		Ohm	
Rx Output Impedance	$Z_{out}$		75		Ohm	

Table 5. High-speed electrical interface, host-GBIC

#### V. General Specifications

<b>General</b>						
Parameter	Symbol	Min	Typ	Max	Units	Notes/Conditions
Data Rate	BR			1.25	Gb/sec	IEEE 802.3 compatible. See Notes 1 and 2 below.
Cable Length	L			100	m	Category 5 UTP. BER $<10^{-10}$

Table 6. General specifications

#### Notes:

1. Clock tolerance is  $\pm 50$  ppm
2. The FCL-8520/8521-3 is a full-duplex device in the "Preferred Master" mode.
3. Automatic crossover detection is enabled. External crossover cable is not required

## VI. Environmental Specifications

The FCL-8520/8521-3 has an extended range from 0°C to +75°C case temperature as specified in Table 8.

<b>Environmental Specifications</b>						
<b>Parameter</b>	<b>Symbol</b>	<b>Min</b>	<b>Typ</b>	<b>Max</b>	<b>Units</b>	<b>Notes/Conditions</b>
Operating Temperature	T <sub>op</sub>	0		75	°C	Case temperature
Storage Temperature	T <sub>sto</sub>	-40		85	°C	Ambient temperature

**Table 7. Environmental specifications**

## VII. Serial Communication Protocol

All Finisar GBICs are ‘Module Definition “4”’ and support the 2-wire serial communication protocol outlined in the GBIC Specification<sup>1</sup>. These GBICs use an Atmel AT24C01A 128 byte E<sup>2</sup>PROM with an address of A0h. 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>5</sup>

The 1000BASE-T physical layer IC can also be accessed via the 2-wire serial bus at address A4h. For details interfacing with the PHY IC, see Marvell data sheet titled “Alaska Ultra 88E1011/88E1001S Integrated Gigabit Ethernet Transceiver”<sup>6</sup> (Marvell document number MV-5100281-00).

<b>Serial Bus Timing Requirements</b>						
<b>Parameter</b>	<b>Symbol</b>	<b>Min</b>	<b>Typ</b>	<b>Max</b>	<b>Units</b>	<b>Notes/Conditions</b>
I <sup>2</sup> C Clock Rate		0		100,000	Hz	

**Table 8. Serial bus timing requirements**



**IX. References**

1. “Gigabit Interface Converter (GBIC) Revision 5.5”. Sun Microsystems Computer Company et. al., September 27, 2000. <http://playground.sun.com/pub/OEmod/>
2. IEEE Std 802.3z. IEEE Standards Department, 2000.
3. “IEEE Std 802.3ab-1999 ‘Physical Layer Parameters and Specifications for 1000 Mb/s Operation Over 4-Pair of Category 5 Balanced Copper Cabling, Type 1000BASE-T’”. IEEE Standards Department, 1999.
4. “Application Note AN-XXXX: Commonly Asked Questions Regarding Auto-negotiation on Finisar’s 1000BASE-T GBICs”, Finisar Corporation, February 2003
5. “AT24C01A/02/04/08/16 2-Wire Serial CMOS E<sup>2</sup>PROM”. Atmel Corporation. [www.Atmel.com](http://www.Atmel.com)
6. “Alaska Ultra 88E1011/88E1001S Integrated 10/100/1000 Gigabit Ethernet Transceiver”. Marvell Corporation. [www.marvell.com](http://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](mailto:sales@finisar.com)  
[www.finisar.com](http://www.finisar.com)