TriQuint OPTOELECTRONICS, INC.

Data Sheet
May 2003

NetLight® NLP12 Small Form-Factor Pluggable (SFP) Gigabit Ethernet Laser Tranceivers

Available in a small form factor, LC Receptacle connector metal package, the NLP12 SFP Transceiver is a high-performance, cost-effective, optical transceiver for Gigabit Ethernet applications.

Features

- Multisource agreement (MSA) compliant SFP package
- LC duplex receptacle
- Metal package for superior EMI performance
- 1550 nm DFB laser transmitter with automatic output power control (1000BASE-LX, 80 km)
- 1310 nm DFB laser transmitter with automatic output power control (1000BASE-LX, 30 km)
- 1310 nm FP laser transmitter with automatic output power control (1000BASE-LX, 10 km)
- 850 nm VCSEL laser transmitter with automatic output power control (1000BASE-SX, 550 m)
- Transmitter disable input
- Hot-pluggable electrical interface
- Wide dynamic range GaAs PIN (1000BASE-SX) or InGaAs PIN (1000BASE-LX) receiver
- LVTTL loss-of-signal output
- Low power dissipation
- Single 3.3 V power supply
- ac-coupled data inputs and outputs
- Operating temperature range of –40 °C to +85 °C (10 km through 80 km versions with diagnostics)
- Serial identification (EEPROM)
- Diagnostic monitoring per SFF-8472 standard

Benefits

- Upgrade path:
  — OEMs can offer longer-reach and higher-speed solutions, as the end user needs upgrades.

Applications

- *IEEE*® 802.3z 1000BASE–SX to 550 m
- *IEEE* 802.3z 1000BASE-LX to 80 km

Description

The NLP12 is a line of high-speed, cost effective, small form-factor pluggable (SFP) optical transceivers intended for 1.25 Gb/s Gigabit Ethernet applications from 550 m to 80 km. The transceivers feature TriQuint Optoelectronics' optics and are packaged in a narrow-width metal housing with an LC duplex receptacle. The package outline and pinout conform to the multisource SFP transceiver agreement.

The transmitter features ac-coupled differential data inputs, and LVTTL logic level disable input and fault indicator output. The receiver features differential ac-coupled data outputs and an LVTTL logic level loss-of-signal output. Diagnostic monitoring is implemented per the SFF committee document SFF-8472.

Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operations sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

Parameter	Symbol	Min	Max	Unit
Storage Temperature Range	Tstg	–40	85	°C
Case Temperature Range	T_C	–40	85	°C
Supply Voltage	$V_{CCT, R}$	0	3.8	V

Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Case Temperature Range:	T_C				
NLP12-01-AA and NLP12-01-PA		0	—	70	°C
NLP12-10-AA		0	—	85	°C
NLP12-10-PA		–40	—	85	°C
NLP12-30-PA		–40	—	85	°C
NLP12-80-PA		–5	—	70	°C
Supply Voltage	$V_{CCT, R}$	3.135	—	3.465	V
Data Rate	—	—	1.25	—	Gb/s

Transceiver Timing Characteristics

Table 1. Transceiver Timing Characteristics (see Timing Diagrams, page 9)

Parameter	Symbol	Min	Max	Unit
Time to Initialize, Including Reset of Tx_Fault[1]	t_init	—	300	ms
Transmit Disable Assert Time[2]	t_off	—	10	µs
Transmit Disable Negate Time[3]	t_on	—	1	ms
Transmit Fault Assert Time[4]	t_fault	—	100	µs
Transmit Fault Reset Time[5]	t_reset	10	—	µs
Loss-of-signal Assert Time[6]	t_loss_on	—	100	µs
Loss-of-signal Deassert Time[7]	t_loss_off	—	100	µs
Serial ID Clock Rate	f-serial-clock	—	100	kHz

1. Condition: from power on or negation of Tx_Fault using Tx_Disable.
2. Time from rising edge of Tx_Disable to when the optical output falls below 10% of nominal.
3. Time from falling edge of Tx_Disable to when the modulated optical output rises above 90% of nominal.
4. Time from fault to Tx_Fault on.
5. Time Tx_Disable must be held high to reset Tx_Fault.
6. Time from LOS state to Rx LOS assert.
7. Time from non-LOS state to Rx LOS deassert.

Transceiver Optical and Electrical Characteristics, NLP12-01-AA

Table 2. Transmitter Optical and Electrical Characteristics (T_C = 0 °C to 70 °C, V_{CC} = 3.135 V—3.465 V)

Parameter	Symbol	Min	Max	Unit
Average Optical Output Power Average Optical Output Power (Tx Disabled)	P_O $P_{O\ DIS}$	–9.5 —	–3 –40	dBm dBm
Optical Wavelength	λ_C	830	850	nm
Spectral Width	$\Delta\lambda_{RMS}$	—	0.85	nm
Dynamic Extinction Ratio	EXT	9	—	dB
Optical Output Rise/Fall Time (20%–80%)	t_R/t_F	—	300	ps
Total Transmitter Jitter added at TP2[1]	T_J	—	227	ps
Relative Intensity Noise	RIN	—	–117	dB/Hz
Power Supply Current	I_{CCT}	—	150	mA
Input Data Voltage—Differential[2]	V_{INp-p}	300	1600	mVp-p
Transmit Disable Voltage[3]	V_D	V_{CC} – 1.3	V_{CC}	V
Transmit Enable Voltage[3]	V_{EN}	V_{EE}	V_{EE} + 0.8	V
Transmit Fault Output Voltage Level	V_{FAULTH} V_{FAULTL}	V_{CC} – 1.3 V_{EE}	V_{CC} V_{EE} + 0.8	V V

1. TP2 refers to compliance point specified in 802.3z, section 38.2.1.
2. Differential operation is necessary for optimum performance.
3. LVTTL compatible interface.

Table 3. Receiver Optical and Electrical Characteristics (T_C = 0 °C to 70 °C, V_{CC} = 3.135 V—3.465 V)

Parameter	Symbol	Min	Max	Unit
Average Sensitivity[1]	P_I	—	–17	dBm
Stressed Receiver Sensitivity:[2] 62.5 μm Fiber 50 μm Fiber	 P_{STRESS} P_{STRESS}	 — —	 –12.5 –13.5	 dBm dBm
Maximum Input Power[1] (Overload)	P_{MAX}	–3	—	dBm
Optical Return Loss	ORL	12	—	dB
Power Supply Current	I_{CCR}	—	150	mA
Power Supply Noise Rejection Ratio	PSNR	—	100	mV
Output Data—Differential[3]	V_{OUTp-p}	370	2000	mVp-p
Data Output Rise/Fall Time (20%—80%)	t_R/t_F	—	260	ps
Loss-of-Signal Voltage Level	V_{LOSH} V_{LOSL}	V_{CC} – 1.3 V_{EE}	V_{CC} V_{EE} + 0.8	V V
Loss-of-Signal Assert Deassert	 P_{LOSA} P_{LOSD}	 –34 –34	 –18 –17.5	 dBm dBm
LOS Hysteresis	P_{HYS}	0.5	6	dB

1. $2^7 - 1$ PRBS with a BER of 1×10^{-12}.
2. The stressed receiver sensitivity is measured using the conformance test signal defined in 802.3z, section 38.6.11.
3. Differential operation is necessary for optimum performance.

Transceiver Optical and Electrical Characteristics, NLP12-01-PA

Table 4. Transmitter Optical and Electrical Characteristics (T_C = 0 °C to 70 °C, V_{CC} = 3.135 V—3.465 V)

Parameter	Symbol	Min	Max	Unit
Average Optical Output Power Average Optical Output Power (Tx Disabled)	P_O $P_{O\ DIS}$	–9.5 —	–3 –40	dBm dBm
Optical Wavelength	λ_C	830	850	nm
Spectral Width	$\Delta\lambda_{RMS}$	—	0.85	nm
Dynamic Extinction Ratio	EXT	9	—	dB
Optical Output Rise/Fall Time (20%–80%)	t_R/t_F	—	260	ps
Total Transmitter Jitter added at TP2[1]	T_J	—	227	ps
Relative Intensity Noise	RIN	—	–117	dB/Hz
Power Supply Current	I_{CCT}	—	150	mA
Input Data Voltage—Differential[2]	V_{INp-p}	300	1600	mVp-p
Transmit Disable Voltage[3]	V_D	V_{CC} – 1.3	V_{CC}	V
Transmit Enable Voltage[3]	V_{EN}	V_{EE}	V_{EE} + 0.8	V
Transmit Fault Output Voltage Level	V_{FAULTH} V_{FAULTL}	V_{CC} – 1.3 V_{EE}	V_{CC} V_{EE} + 0.8	V V

1. TP2 refers to compliance point specified in 802.3z, section 38.2.1.
2. Differential operation is necessary for optimum performance.
3. LVTTL compatible interface.

Table 5. Receiver Optical and Electrical Characteristics (T_C = 0 °C to 70 °C, V_{CC} = 3.135 V—3.465 V)

Parameter	Symbol	Min	Max	Unit
Average Sensitivity[1]	P_I	—	–17	dBm
Stressed Receiver Sensitivity:[2] 62.5 µm Fiber 50 µm Fiber	 P_{STRESS} P_{STRESS}	 — —	 –12.5 –13.5	 dBm dBm
Maximum Input Power[1] (Overload)	P_{MAX}	–3	—	dBm
Optical Return Loss	ORL	12	—	dB
Power Supply Current	I_{CCR}	—	150	mA
Power Supply Noise Rejection Ratio	PSNR	—	100	mV
Output Data—Differential[3]	V_{OUTp-p}	370	2000	mVp-p
Data Output Rise/Fall Time (20%—80%)	t_R/t_F	—	260	ps
Loss-of-Signal Voltage Level	V_{LOSH} V_{LOSL}	V_{CC} – 1.3 V_{EE}	V_{CC} V_{EE} + 0.8	V V
Loss-of-Signal Assert Deassert	 P_{LOSA} P_{LOSD}	 –34 –34	 –18 –17.5	 dBm dBm
LOS Hysteresis	P_{HYS}	0.5	6	dB

1. $2^7 – 1$ PRBS with a BER of 1×10^{-12}.
2. The stressed receiver sensitivity is measured using the conformance test signal defined in 802.3z, section 38.6.11.
3. Differential operation is necessary for optimum performance.

Transceiver Optical and Electrical Characteristics, NLP12-10-AA

Table 6. Transmitter Optical and Electrical Characteristics (T_C = 0 °C to 85 °C, V_{CC} = 3.135 V—3.465 V)

Parameter	Symbol	Min	Max	Unit
Average Optical Output Power Average Optical Output Power (Tx Disabled)	P_O $P_{O\ DIS}$	–9.5 —	–3 –40	dBm dBm
Optical Wavelength	λ_C	1270	1355	nm
Spectral Width	$\Delta\lambda_{RMS}$	—	2.8	nm
Dynamic Extinction Ratio	EXT	9	—	dB
Optical Output Rise/Fall Time (20%–80%)	t_R/t_F	—	260	ps
Total Transmitter Jitter added at TP2[1]	T_J	—	227	ps
Relative Intensity Noise	RIN	—	–120	dB/Hz
Power Supply Current	I_{CCT}	—	150	mA
Input Data Voltage—Differential[2]	V_{INp-p}	300	1600	mVp-p
Transmit Disable Voltage[3]	V_D	V_{CC} – 1.3	V_{CC}	V
Transmit Enable Voltage[3]	V_{EN}	V_{EE}	V_{EE} + 0.8	V
Transmit Fault Output Voltage Level	V_{FAULTH} V_{FAULTL}	V_{CC} – 1.3 V_{EE}	V_{CC} V_{EE} + 0.5	V V

1. TP2 refers to compliance point specified in 802.3z, section 38.2.1.
2. Differential operation is necessary for optimum performance.
3. LVTTL compatible interface.

Table 7. Receiver Optical and Electrical Characteristics (T_C = 0 °C to 85 °C, V_{CC} = 3.135 V—3.465 V)

Parameter	Symbol	Min	Max	Unit
Average Sensitivity[1]	P_I	—	–20	dBm
Stressed Receiver Sensitivity[2]	P_{STRESS}	—	–14.4	dBm
Maximum Input Power[1] (Overload)	P_{MAX}	–3	—	dBm
Optical Return Loss	ORL	12	—	dB
Power Supply Current	I_{CCR}	—	150	mA
Power Supply Noise Rejection Ratio	PSNR	—	100	mV
Output Data—Differential[3]	V_{OUTp-p}	400	1200	mVp-p
Data Output Rise/Fall Time (20%—80%)	t_R/t_F	—	260	ps
Loss-of-Signal Voltage Level	V_{LOSH} V_{LOSL}	V_{CC} – 1.3 V_{EE}	V_{CC} V_{EE} + 0.8	V V
Loss-of-Signal Assert Deassert	 P_{LOSA} P_{LOSD}	 –34 –34	 –21 –20.5	 dBm dBm
LOS Hysteresis	P_{HYS}	0.5	6	dB

1. 2^7 – 1 PRBS with a BER of 1 x 10^{-12}.
2. The stressed receiver sensitivity is measured using the conformance test signal defined in 802.3z, section 38.6.11.
3. Differential operation is necessary for optimum performance.

Transceiver Optical and Electrical Characteristics, NLP12-10-PA

Table 8. Transmitter Optical and Electrical Characteristics (T_C = –40 °C to 85 °C, V_{CC} = 3.135 V—3.465 V)

Parameter	Symbol	Min	Max	Unit
Average Optical Output Power Average Optical Output Power (Tx Disabled)	P_O $P_{O\ DIS}$	–9.5 —	–3 –40	dBm dBm
Optical Wavelength	λ_C	1270	1355	nm
Spectral Width	$\Delta\lambda_{RMS}$	—	2.8	nm
Dynamic Extinction Ratio	EXT	9	—	dB
Optical Output Rise/Fall Time (20%–80%)	t_R/t_F	—	260	ps
Total Transmitter Jitter added at TP2[1]	T_J	—	227	ps
Relative Intensity Noise	RIN	—	–120	dB/Hz
Power Supply Current	I_{CCT}	—	150	mA
Input Data Voltage—Differential[2]	V_{INp-p}	300	1600	mVp-p
Transmit Disable Voltage[3]	V_D	V_{CC} – 1.3	V_{CC}	V
Transmit Enable Voltage[3]	V_{EN}	V_{EE}	V_{EE} + 0.8	V
Transmit Fault Output Voltage Level	V_{FAULTH} V_{FAULTL}	V_{CC} – 1.3 V_{EE}	V_{CC} V_{EE} + 0.5	V V

1. TP2 refers to compliance point specified in 802.3z, section 38.2.1.
2. Differential operation is necessary for optimum performance.
3. LVTTL compatible interface.

Table 9. Receiver Optical and Electrical Characteristics (T_C = –40 °C to 85 °C, V_{CC} = 3.135 V—3.465 V)

Parameter	Symbol	Min	Max	Unit
Average Sensitivity[1]	P_I	—	–20	dBm
Stressed Receiver Sensitivity[2]	P_{STRESS}	—	–14.4	dBm
Maximum Input Power[1] (Overload)	P_{MAX}	–3	—	dBm
Optical Return Loss	ORL	12	—	dB
Power Supply Current	I_{CCR}	—	150	mA
Power Supply Noise Rejection Ratio	PSNR	—	100	mV
Output Data—Differential[3]	V_{OUTp-p}	400	1200	mVp-p
Data Output Rise/Fall Time (20%—80%)	t_R/t_F	—	260	ps
Loss-of-Signal Voltage Level	V_{LOSH} V_{LOSL}	V_{CC} – 1.3 V_{EE}	V_{CC} V_{EE} + 0.8	V V
Loss-of-Signal Assert Deassert	 P_{LOSA} P_{LOSD}	 –34 –34	 –21 –20.5	 dBm dBm
LOS Hysteresis	P_{HYS}	0.5	6	dB

1. 2^7 – 1 PRBS with a BER of 1 x 10^{-12}.
2. The stressed receiver sensitivity is measured using the conformance test signal defined in 802.3z, section 38.6.11.
3. Differential operation is necessary for optimum performance.

Transceiver Optical and Electrical Characteristics, NLP12-30-PA

Table 10. Transmitter Optical and Electrical Characteristics (T_C = –40 °C to 85 °C, V_{CC} = 3.135 V—3.465 V)

Parameter	Symbol	Min	Max	Unit
Average Optical Output Power Average Optical Output Power (Tx Disabled)	P_O $P_{O\ DIS}$	–5 —	0 –40	dBm dBm
Optical Wavelength	λ_C	1280	1355	nm
Spectral Width	$\Delta\lambda_{RMS}$	—	1	nm
Side Mode Suppression Ratio	SMSR	30	—	dB
Dynamic Extinction Ratio	EXT	9	—	dB
Optical Output Rise/Fall Time (20%–80%)	t_R/t_F	—	260	ps
Total Transmitter Jitter Added at TP2[1]	T_J	—	227	ps
Relative Intensity Noise	RIN	—	–120	dB/Hz
Power Supply Current	I_{CCT}	—	150	mA
Input Data Voltage—Differential[2]	V_{INp-p}	300	1600	mVp-p
Transmit Disable Voltage[3]	V_D	V_{CC} – 1.3	V_{CC}	V
Transmit Enable Voltage[3]	V_{EN}	V_{EE}	V_{EE} + 0.8	V
Transmit Fault Output Voltage Level	V_{FAULTH} V_{FAULTL}	V_{CC} – 1.3 V_{EE}	V_{CC} V_{EE} + 0.5	V V

1. TP2 refers to compliance point specified in 802.3z, section 38.2.1.
2. Differential operation is necessary for optimum performance.
3. LVTTL compatible interface.

Table 11. Receiver Optical and Electrical Characteristics (T_C = –40 °C to 85 °C, V_{CC} = 3.135 V—3.465 V)

Parameter	Symbol	Min	Max	Unit
Average Sensitivity[1]	P_I	—	–21	dBm
Stressed Receiver Sensitivity[2]	P_{STRESS}	—	–14.4	dBm
Maximum Input Power[1] (Overload)	P_{MAX}	–3	—	dBm
Optical Return Loss	ORL	12	—	dB
Power Supply Current	I_{CCR}	—	150	mA
Power Supply Noise Rejection Ratio	PSNR	—	100	mV
Output Data—Differential[3]	V_{OUTp-p}	400	1200	mVp-p
Data Output Rise/Fall Time (20%—80%)	t_R/t_F	—	175	ps
Loss-of-Signal Voltage Level	V_{LOSH} V_{LOSL}	V_{CC} – 1.3 V_{EE}	V_{CC} V_{EE} + 0.8	V V
Loss-of-Signal Assert Deassert	 P_{LOSA} P_{LOSD}	 –34 –34	 –22 –21.5	 dBm dBm
LOS Hysteresis	P_{HYS}	0.5	6	dB

1. 2^7 – 1 PRBS with a BER of 1 x 10^{-12}.
2. The stressed receiver sensitivity is measured using the conformance test signal defined in 802.3z, section 38.6.11.
3. Differential operation is necessary for optimum performance.

Transceiver Optical and Electrical Characteristics, NLP12-80-PA

Table 12. Transmitter Optical and Electrical Characteristics (T_C = –40 °C to 85 °C, V_{CC} = 3.135 V—3.465 V)

Parameter	Symbol	Min	Max	Unit
Average Optical Output Power Average Optical Output Power (Tx Disabled)	P_O $P_{O\ DIS}$	0 —	4 –40	dBm dBm
Optical Wavelength	λ_C	1540	1570	nm
Spectral Width	$\Delta\lambda_{RMS}$	—	1	nm
Side Mode Suppression Ratio	SMSR	30	—	dB
Dynamic Extinction Ratio	EXT	9	—	dB
Optical Output Rise/Fall Time (20%–80%)	t_R/t_F	—	260	ps
Total Transmitter Jitter added at TP2[1]	T_J	—	227	ps
Relative Intensity Noise	RIN	—	–120	dB/Hz
Power Supply Current	I_{CCT}	—	150	mA
Input Data Voltage—Differential[2]	V_{INp-p}	300	1600	mVp-p
Transmit Disable Voltage[3]	V_D	V_{CC} – 1.3	V_{CC}	V
Transmit Enable Voltage[3]	V_{EN}	V_{EE}	V_{EE} + 0.8	V
Transmit Fault Output Voltage Level	V_{FAULTH} V_{FAULTL}	V_{CC} – 1.3 V_{EE}	V_{CC} V_{EE} + 0.5	V V

1. TP2 refers to compliance point specified in 802.3z, section 38.2.1.
2. Differential operation is necessary for optimum performance.
3. LVTTL compatible interface.

Table 13. Receiver Optical and Electrical Characteristics (T_C = –40 °C to 85 °C, V_{CC} = 3.135 V—3.465 V)

Parameter	Symbol	Min	Max	Unit
Average Sensitivity[1]	P_I	—	–24	dBm
Stressed Receiver Sensitivity[2]	P_{STRESS}	—	–14.4	dBm
Maximum Input Power[1] (Overload)	P_{MAX}	–3	—	dBm
Optical Return Loss	ORL	12	—	dB
Power Supply Current	I_{CCR}	—	150	mA
Power Supply Noise Rejection Ratio	PSNR	—	100	mV
Output Data—Differential[3]	V_{OUTp-p}	400	1200	mVp-p
Data Output Rise/Fall Time (20%—80%)	t_R/t_F	—	175	ps
Loss-of-Signal Voltage Level	V_{LOSH} V_{LOSL}	V_{CC} – 1.3 V_{EE}	V_{CC} V_{EE} + 0.8	V V
Loss-of-Signal Assert Deassert	 P_{LOSA} P_{LOSD}	 –34 –34	 –25 –24.5	 dBm dBm
LOS Hysteresis	P_{HYS}	0.5	6	dB

1. 2^7 – 1 PRBS with a BER of 1 x 10^{-12}.
2. The stressed receiver sensitivity is measured using the conformance test signal defined in 802.3z, section 38.6.11.
3. Differential operation is necessary for optimum performance.

Transceiver Timing Diagrams

Module installed except where noted.

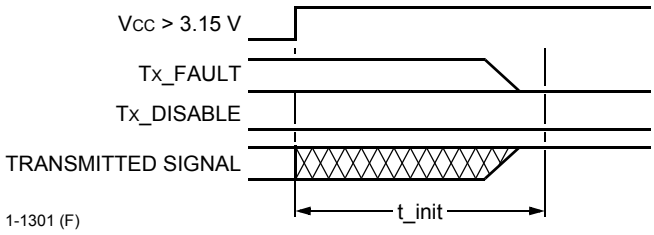


Figure 1. t_init: Tx_DISABLE Negated

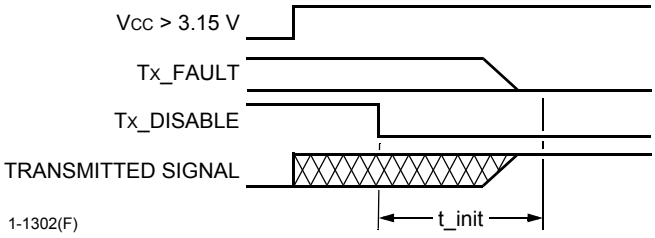


Figure 2. t_init: Tx_DISABLE Asserted

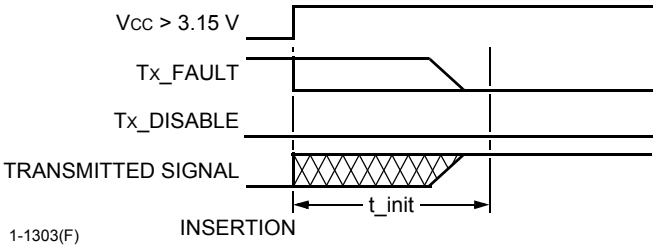


Figure 3. t_init: Tx_DISABLE Negated Module Hot Plugged

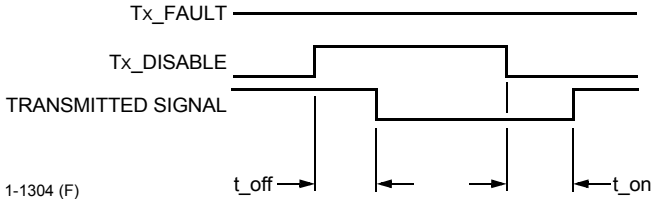


Figure 4. t_off and t_on: Tx_DISABLE Asserted Then Negated

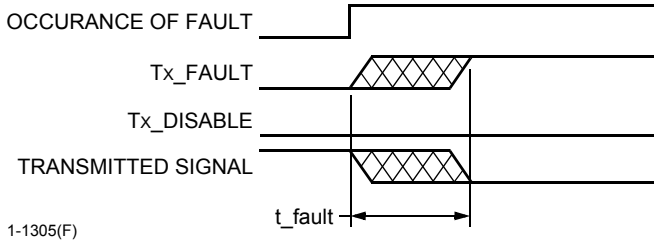
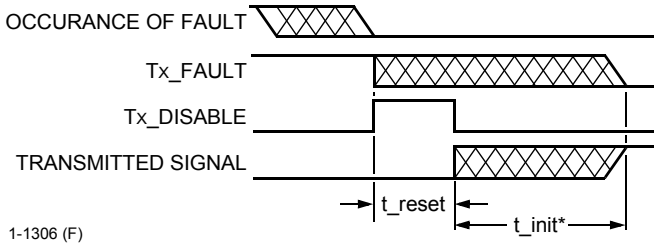
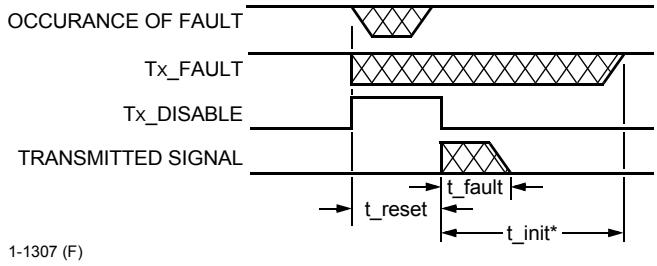


Figure 5. t_fault: Tx FAULT Asserted, Tx Signal Not Recovered



* SFP will clear Tx_FAULT IN <t_init if the failure is transient.

Figure 6. t_reset: Tx Disable Asserted Then Negated, Tx Signal Recovered



* SFP will clear Tx_FAULT IN <t_init if the failure is transient.

Figure 7. t_fault: Tx Disable Asserted Then Negated, Tx Signal Not Recovered

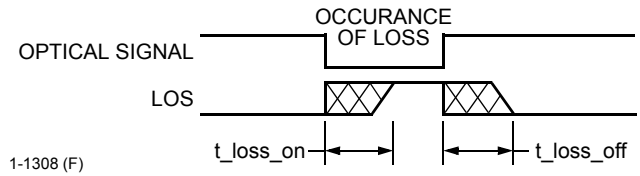


Figure 8. t_loss_on and t_loss-off

Power Supply Information

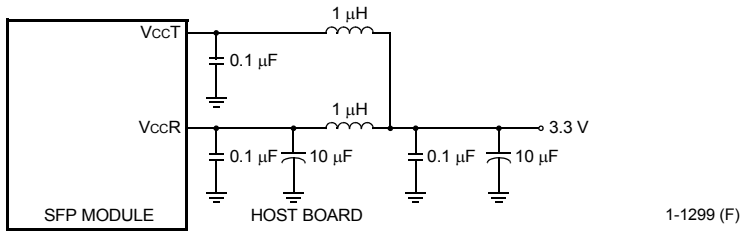


Figure 9. Power Supply Filtering of SFP Transceiver

Electrical Schematic

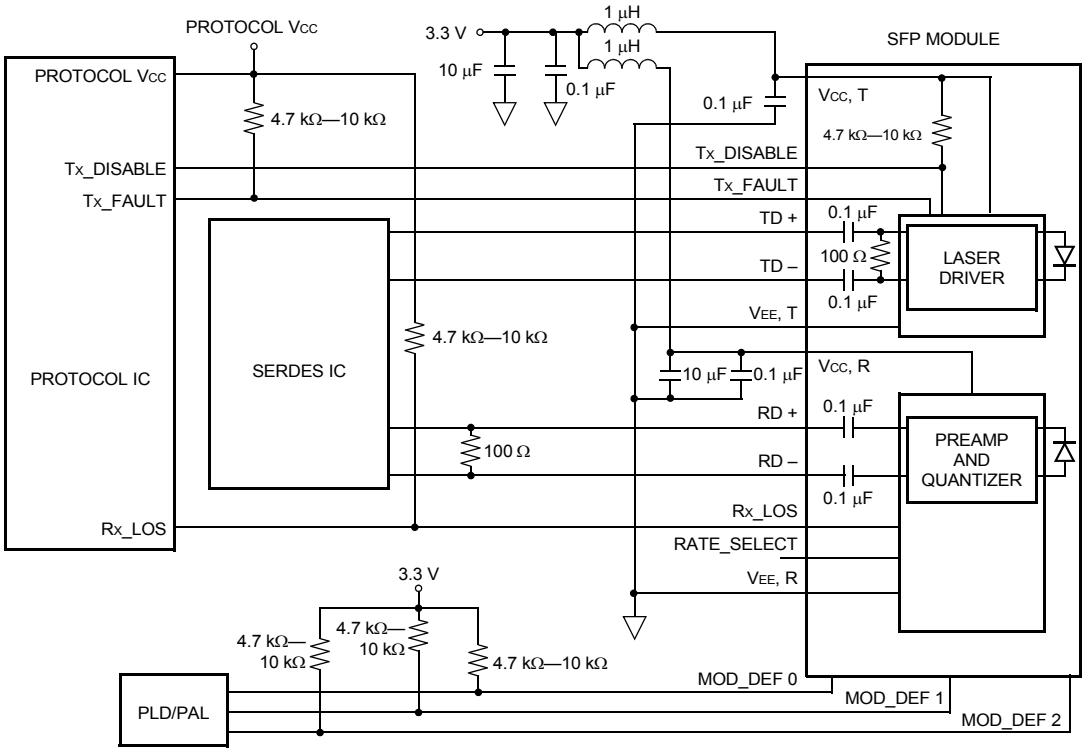


Figure 10. Example SFP Host Board Schematic

Pin Information

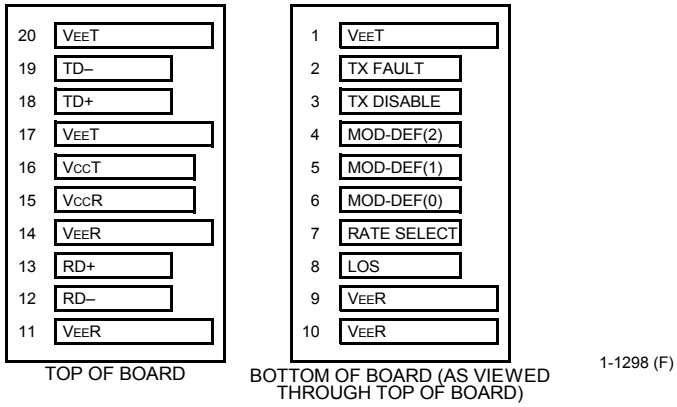


Figure 11. NLP25 SFP Transceiver, 20-Pin Configuration, Top View

Pin Information (continued)

Table 14. Transceiver Pin Descriptions

Pin Number	Symbol	Functional Description	Plug Sequence	Notes
1	$V_{EE}T$	Transmitter Ground	1	—
2	TX Fault	Transmitter Fault Indication	3	Note 1.
3	TX Disable	Transmitter Disable	3	Note 2, Module Disables on High or Open.
4	MOD-DEF2	Module Definition 2	3	Note 3, Two-Wire Serial ID Interface.
5	MOD-DEF1	Module Definition 1	3	Note 3, Two-Wire Serial ID Interface.
6	MOD-DEF0	Module Definition 0	3	Note 3, Grounded in Module.
7	Rate Select	Select Between Full or Reduced Receiver Bandwidth	3	Note 4.
8	LOS	Loss of Signal	3	Note 5.
9	$V_{EE}R$	Receiver Ground	1	Note 6.
10	$V_{EE}R$	Receiver Ground	1	Note 6.
11	$V_{EE}R$	Receiver Ground	1	Note 6.
12	RD–	Inv. Received Data Out	3	Note 7.
13	RD+	Received Data Out	3	Note 7.
14	$V_{EE}R$	Receiver Ground	1	Note 6.
15	$V_{CC}R$	Receiver Power	2	Note 8.
16	$V_{CC}T$	Transmitter Power	2	Note 8.
17	$V_{EE}T$	Transmitter Ground	1	Note 6.
18	TD+	Transmit Data In	3	Note 9.
19	TD–	Inv. Transmit Data In	3	Note 9.
20	$V_{EE}T$	Transmitter Ground	1	Note 6.

1. TX fault is an open collector/drain output, which should be pulled up with a 4.7 kΩ—10 kΩ resistor on the host board. Pull-up voltage between 2.0 V and VccT, R + 0.3 V. When high, output indicates a laser fault of some kind. Low indicates normal operation. In the low state, the output will be pulled to <0.8 V.
2. 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 kΩ—10 kΩ resistor. Its states are as follows:
   — Low (0 V—0.8 V): transmitter on; (>0.8 V, <2.0 V): undefined.
   — High (2.0 V—3.465 V): transmitter disabled.
   — Open: transmitter disabled.
3. MOD-DEF 0, 1, 2. These are the module definition pins. They should be pulled up with a 4.7 kΩ—10 kΩ resistor on the host board. The pull-up voltage shall be $V_{CC}T$ or $V_{CC}R$:
   — 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.
4. The rate-select option is not implemented. This pin should be left open on the host board.
5. LOS (loss of signal) is an open collector/drain output, which should be pulled up with a 4.7 kΩ—10 kΩ resistor. Pull-up voltage between 2.0 V and VccT, R + 0.3 V. 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 <0.8 V.
6. $V_{EE}R$ and $V_{EE}T$ may be internally connected within the SFP module.
7. RD–/+: These are the differential receiver outputs. They are ac-coupled 100 Ω differential lines, which should be terminated with 100 Ω (differential) at the user SERDES. The ac coupling is done inside the module and is thus not required on the host board.
8. $V_{CC}R$ and $V_{CC}T$ are the receiver and transmitter power supplies. Recommended host board power supply filtering is shown below. 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. $V_{CC}R$ and $V_{CC}T$ may be internally connected within the SFP transceiver module.
9. TD–/+: These are the differential transmitter inputs. They are ac-coupled, differential lines with 100 Ω differential termination inside the module. The ac coupling is done inside the module and is thus not required on the host board.

EEPROM Information

Table 15. EEPROM Serial ID Memory Contents, 1000BASE-SX Version (NLP12-01-AA)

Address	Hex	ASCII	Address	Hex	ASCII	Address	Hex	Address	Hex
0	3	—	34	20	—	68	Note 1	98	Note 4
1	4	—	35	20	—	69	Note 1	99	Note 4
2	7	—	36	0	—	70	Note 1	100	Note 4
3	0	—	37	0	—	71	Note 1	101	Note 4
4	0	—	38	0	—	72	Note 1	102	Note 4
5	0	—	39	0	—	73	Note 1	103	Note 4
6	1	—	40	4E	N	74	Note 1	104	Note 4
7	0	—	41	4C	L	75	Note 1	105	Note 4
8	0	—	42	50	P	76	Note 1	106	Note 4
9	0	—	43	31	1	77	Note 1	107	Note 4
10	0	—	44	32	2	78	Note 1	108	Note 4
11	1	—	45	2D	—	79	Note 1	109	Note 4
12	0D	—	46	30	0	80	Note 1	110	Note 4
13	0	—	47	31	1	81	Note 1	111	Note 4
14	0	—	48	2D	—	82	Note 1	112	Note 4
15	0	—	49	41	A	83	Note 1	113	Note 4
16	37	—	50	41	A	84	Note 2	114	Note 4
17	37	—	51	20	—	85	Note 2	115	Note 4
18	0	—	52	20	—	86	Note 2	116	Note 4
19	0	—	53	20	—	87	Note 2	117	Note 4
20	54	T	54	20	—	88	Note 2	118	Note 4
21	72	r	55	20	—	89	Note 2	119	Note 4
22	69	i	56	Note 5	—	90	20	120	Note 4
23	51	Q	57	Note 5	—	91	20	121	Note 4
24	75	u	58	Note 5	—	92	0	122	Note 4
25	69	i	59	Note 5	—	93	0	123	Note 4
26	6E	n	60	0	—	94	0	124	Note 4
27	74	t	61	0	—	95	Note 3	125	Note 4
28	20	—	62	0	—	96	Note 4	126	Note 4
29	4F	O	63	Note 3	—	97	Note 4	127	Note 4
30	50	P	64	0	—				
31	54	T	65	1A	—				
32	4F	O	66	0	—				
33	20	—	67	0	—				

1. Addresses 68—83 specify a unique device serial number.
2. Addresses 84—89 specify the date code in the form of two-digit year, two-digit month, and two-digit day of the month.
3. Addresses 63 and 95 are checksums. Address 63 is the checksum for bytes 0—62, and address 95 is the checksum for bytes 64—94.
4. MSA-defined, vendor-specific data, read only.
5. Addresses 56—59 specify module revision level.

EEPROM Information (continued)

Table 16. EEPROM Serial ID Memory Contents, 1000BASE-SX Version with Diagnostics (NLP12-01-PA)

Address	Hex	ASCII	Address	Hex	ASCII	Address	Hex	Address	Hex
0	3	—	34	20	—	68	Note 1	98	Note 4
1	4	—	35	20	—	69	Note 1	99	Note 4
2	7	—	36	0	—	70	Note 1	100	Note 4
3	0	—	37	0	—	71	Note 1	101	Note 4
4	0	—	38	0	—	72	Note 1	102	Note 4
5	0	—	39	0	—	73	Note 1	103	Note 4
6	1	—	40	4E	N	74	Note 1	104	Note 4
7	0	—	41	4C	L	75	Note 1	105	Note 4
8	0	—	42	50	P	76	Note 1	106	Note 4
9	0	—	43	31	1	77	Note 1	107	Note 4
10	0	—	44	32	2	78	Note 1	108	Note 4
11	1	—	45	2D	—	79	Note 1	109	Note 4
12	0D	—	46	30	0	80	Note 1	110	Note 4
13	0	—	47	31	1	81	Note 1	111	Note 4
14	0	—	48	2D	—	82	Note 1	112	Note 4
15	0	—	49	50	P	83	Note 1	113	Note 4
16	37	—	50	41	A	84	Note 2	114	Note 4
17	37	—	51	20	—	85	Note 2	115	Note 4
18	0	—	52	20	—	86	Note 2	116	Note 4
19	0	—	53	20	—	87	Note 2	117	Note 4
20	54	T	54	20	—	88	Note 2	118	Note 4
21	72	r	55	20	—	89	Note 2	119	Note 4
22	69	i	56	Note 5	—	90	20	120	Note 4
23	51	Q	57	Note 5	—	91	20	121	Note 4
24	75	u	58	Note 5	—	92	68	122	Note 4
25	69	i	59	Note 5	—	93	80	123	Note 4
26	6E	n	60	03	—	94	01	124	Note 4
27	74	t	61	52	—	95	Note 3	125	Note 4
28	20	—	62	0	—	96	Note 4	126	Note 4
29	4F	O	63	Note 3	—	97	Note 4	127	Note 4
30	50	P	64	0	—				
31	54	T	65	1A	—				
32	4F	O	66	0	—				
33	20	—	67	0	—				

1. Addresses 68—83 specify a unique device serial number.
2. Addresses 84—89 specify the date code in the form of two-digit year, two-digit month, and two-digit day of the month.
3. Addresses 63 and 95 are checksums. Address 63 is the checksum for bytes 0—62, and address 95 is the checksum for bytes 64—94.
4. MSA-defined, vendor-specific data, read only.
5. Addresses 56—59 specify module revision level.

EEPROM Information (continued)

Table 17. EEPROM Serial ID Memory Contents, 1000BASE-LX Version (NLP12-10-AA)

Address	Hex	ASCII	Address	Hex	ASCII	Address	Hex	Address	Hex
0	3	—	34	20	—	68	Note 1	98	Note 4
1	4	—	35	20	—	69	Note 1	99	Note 4
2	7	—	36	0	—	70	Note 1	100	Note 4
3	0	—	37	0	—	71	Note 1	101	Note 4
4	0	—	38	0	—	72	Note 1	102	Note 4
5	0	—	39	0	—	73	Note 1	103	Note 4
6	2	—	40	4E	N	74	Note 1	104	Note 4
7	0	—	41	4C	L	75	Note 1	105	Note 4
8	0	—	42	50	P	76	Note 1	106	Note 4
9	0	—	43	31	1	77	Note 1	107	Note 4
10	0	—	44	32	2	78	Note 1	108	Note 4
11	1	—	45	2D	—	79	Note 1	109	Note 4
12	0D	—	46	31	1	80	Note 1	110	Note 4
13	0	—	47	30	0	81	Note 1	111	Note 4
14	0A	—	48	2D	—	82	Note 1	112	Note 4
15	64	—	49	41	A	83	Note 1	113	Note 4
16	0	—	50	41	A	84	Note 2	114	Note 4
17	0	—	51	20	—	85	Note 2	115	Note 4
18	0	—	52	20	—	86	Note 2	116	Note 4
19	0	—	53	20	—	87	Note 2	117	Note 4
20	54	T	54	20	—	88	Note 2	118	Note 4
21	72	r	55	20	—	89	Note 2	119	Note 4
22	69	i	56	Note 5	—	90	20	120	Note 4
23	51	Q	57	Note 5	—	91	20	121	Note 4
24	75	u	58	Note 5	—	92	0	122	Note 4
25	69	i	59	Note 5	—	93	0	123	Note 4
26	6E	n	60	0	—	94	0	124	Note 4
27	74	t	61	0	—	95	Note 3	125	Note 4
28	20	—	62	0	—	96	Note 4	126	Note 4
29	4F	O	63	Note 3	—	97	Note 4	127	Note 4
30	50	P	64	0	—				
31	54	T	65	1A	—				
32	4F	O	66	0	—				
33	20	—	67	0	—				

1. Addresses 68—83 specify a unique device serial number.
2. Addresses 84—89 specify the date code in the form of two-digit year, two-digit month, and two-digit day of the month.
3. Addresses 63 and 95 are checksums. Address 63 is the checksum for bytes 0—62, and address 95 is the checksum for bytes 64—94.
4. MSA-defined, vendor-specific data, read only.
5. Addresses 56—59 specify module revision level.

EEPROM Information (continued)

Table 18. EEPROM Serial ID Memory Contents, 1000BASE-LX Version with Diagnostics (NLP12-10-PA)

Address	Hex	ASCII	Address	Hex	ASCII	Address	Hex	Address	Hex
0	3	—	34	20	—	68	Note 1	98	Note 4
1	4	—	35	20	—	69	Note 1	99	Note 4
2	7	—	36	0	—	70	Note 1	100	Note 4
3	0	—	37	0	—	71	Note 1	101	Note 4
4	0	—	38	0	—	72	Note 1	102	Note 4
5	0	—	39	0	—	73	Note 1	103	Note 4
6	2	—	40	4E	N	74	Note 1	104	Note 4
7	0	—	41	4C	L	75	Note 1	105	Note 4
8	0	—	42	50	P	76	Note 1	106	Note 4
9	0	—	43	31	1	77	Note 1	107	Note 4
10	0	—	44	32	2	78	Note 1	108	Note 4
11	1	—	45	2D	—	79	Note 1	109	Note 4
12	0D	—	46	31	1	80	Note 1	110	Note 4
13	0	—	47	30	0	81	Note 1	111	Note 4
14	0A	—	48	2D	—	82	Note 1	112	Note 4
15	64	—	49	50	P	83	Note 1	113	Note 4
16	0	—	50	41	A	84	Note 2	114	Note 4
17	0	—	51	20	—	85	Note 2	115	Note 4
18	0	—	52	20	—	86	Note 2	116	Note 4
19	0	—	53	20	—	87	Note 2	117	Note 4
20	54	T	54	20	—	88	Note 2	118	Note 4
21	72	r	55	20	—	89	Note 2	119	Note 4
22	69	i	56	Note 5	—	90	20	120	Note 4
23	51	Q	57	Note 5	—	91	20	121	Note 4
24	75	u	58	Note 5	—	92	68	122	Note 4
25	69	i	59	Note 5	—	93	80	123	Note 4
26	6E	n	60	05	—	94	01	124	Note 4
27	74	t	61	1E	—	95	Note 3	125	Note 4
28	20	—	62	0	—	96	Note 4	126	Note 4
29	4F	O	63	Note 3	—	97	Note 4	127	Note 4
30	50	P	64	0	—				
31	54	T	65	1A	—				
32	4F	O	66	0	—				
33	20	—	67	0	—				

1. Addresses 68—83 specify a unique device serial number.
2. Addresses 84—89 specify the date code in the form of two-digit year, two-digit month, and two-digit day of the month.
3. Addresses 63 and 95 are checksums. Address 63 is the checksum for bytes 0—62, and address 95 is the checksum for bytes 64—94.
4. MSA-defined, vendor-specific data, read only.
5. Addresses 56—59 specify module revision level.

EEPROM Information (continued)

Table 19. EEPROM Serial ID Memory Contents, 30 km Version with Diagnostics (NLP12-30-PA)

Address	Hex	ASCII	Address	Hex	ASCII	Address	Hex	Address	Hex
0	3	—	34	20	—	68	Note 1	98	Note 4
1	4	—	35	20	—	69	Note 1	99	Note 4
2	7	—	36	0	—	70	Note 1	100	Note 4
3	0	—	37	0	—	71	Note 1	101	Note 4
4	0	—	38	0	—	72	Note 1	102	Note 4
5	0	—	39	0	—	73	Note 1	103	Note 4
6	2	—	40	4E	N	74	Note 1	104	Note 4
7	0	—	41	4C	L	75	Note 1	105	Note 4
8	0	—	42	50	P	76	Note 1	106	Note 4
9	0	—	43	31	1	77	Note 1	107	Note 4
10	0	—	44	32	2	78	Note 1	108	Note 4
11	1	—	45	2D	—	79	Note 1	109	Note 4
12	0D	—	46	33	3	80	Note 1	110	Note 4
13	0	—	47	30	0	81	Note 1	111	Note 4
14	1E	—	48	2D	—	82	Note 1	112	Note 4
15	FF	—	49	50	P	83	Note 1	113	Note 4
16	0	—	50	41	A	84	Note 2	114	Note 4
17	0	—	51	20	—	85	Note 2	115	Note 4
18	0	—	52	20	—	86	Note 2	116	Note 4
19	0	—	53	20	—	87	Note 2	117	Note 4
20	54	T	54	20	—	88	Note 2	118	Note 4
21	72	r	55	20	—	89	Note 2	119	Note 4
22	69	i	56	Note 5	—	90	20	120	Note 4
23	51	Q	57	Note 5	—	91	20	121	Note 4
24	75	u	58	Note 5	—	92	68	122	Note 4
25	69	i	59	Note 5	—	93	80	123	Note 4
26	6E	n	60	05	—	94	1	124	Note 4
27	74	t	61	1E	—	95	Note 3	125	Note 4
28	20	—	62	0	—	96	Note 4	126	Note 4
29	4F	O	63	Note 3	—	97	Note 4	127	Note 4
30	50	P	64	0	—				
31	54	T	65	1A	—				
32	4F	O	66	0	—				
33	20	—	67	0	—				

1. Addresses 68—83 specify a unique device serial number.
2. Addresses 84—89 specify the date code in the form of two-digit year, two-digit month, and two-digit day of the month.
3. Addresses 63 and 95 are checksums. Address 63 is the checksum for bytes 0—62, and address 95 is the checksum for bytes 64—94.
4. MSA-defined, vendor-specific data, read only.
5. Addresses 56—59 specify module revision level.

EEPROM Information (continued)

Table 20. EEPROM Serial ID Memory Contents, 80 km Version with Diagnostics (NLP12-80-PA)

Address	Hex	ASCII	Address	Hex	ASCII	Address	Hex	Address	Hex
0	3	—	34	20	—	68	Note 1	98	Note 4
1	4	—	35	20	—	69	Note 1	99	Note 4
2	7	—	36	0	—	70	Note 1	100	Note 4
3	0	—	37	0	—	71	Note 1	101	Note 4
4	0	—	38	0	—	72	Note 1	102	Note 4
5	0	—	39	0	—	73	Note 1	103	Note 4
6	2	—	40	4E	N	74	Note 1	104	Note 4
7	0	—	41	4C	L	75	Note 1	105	Note 4
8	0	—	42	50	P	76	Note 1	106	Note 4
9	0	—	43	31	1	77	Note 1	107	Note 4
10	0	—	44	32	2	78	Note 1	108	Note 4
11	1	—	45	2D	—	79	Note 1	109	Note 4
12	0D	—	46	383	8	80	Note 1	110	Note 4
13	0	—	47	30	0	81	Note 1	111	Note 4
14	50	—	48	2D	—	82	Note 1	112	Note 4
15	FF	—	49	50	P	83	Note 1	113	Note 4
16	0	—	50	41	A	84	Note 2	114	Note 4
17	0	—	51	20	—	85	Note 2	115	Note 4
18	0	—	52	20	—	86	Note 2	116	Note 4
19	0	—	53	20	—	87	Note 2	117	Note 4
20	54	T	54	20	—	88	Note 2	118	Note 4
21	72	r	55	20	—	89	Note 2	119	Note 4
22	69	i	56	Note 5	—	90	20	120	Note 4
23	51	Q	57	Note 5	—	91	20	121	Note 4
24	75	u	58	Note 5	—	92	68	122	Note 4
25	69	i	59	Note 5	—	93	80	123	Note 4
26	6E	n	60	06	—	94	1	124	Note 4
27	74	t	61	0E	—	95	Note 3	125	Note 4
28	20	—	62	0	—	96	Note 4	126	Note 4
29	4F	O	63	Note 3	—	97	Note 4	127	Note 4
30	50	P	64	0	—				
31	54	T	65	1A	—				
32	4F	O	66	0	—				
33	20	—	67	0	—				

1. Addresses 68—83 specify a unique device serial number.
2. Addresses 84—89 specify the date code in the form of two-digit year, two-digit month, and two-digit day of the month.
3. Addresses 63 and 95 are checksums. Address 63 is the checksum for bytes 0—62, and address 95 is the checksum for bytes 64—94.
4. MSA-defined, vendor-specific data, read only.
5. Addresses 56—59 specify module revision level.

Electrostatic Discharge

Caution: This device is susceptible to damage as a result of electrostatic discharge (ESD). Take proper precautions during both handling and testing. Follow *EIA*® Standard *EIA*-625.

Although protection circuitry is designed into the device, take proper precautions to avoid exposure to ESD.

TriQuint employs a human-body model (HBM) for ESD susceptibility testing and protection-design evaluation. ESD voltage thresholds are dependent on the critical parameters used to define the model. A standard HBM (resistance = 1.5 kΩ, capacitance = 100 pF) is widely used and, therefore, can be used for comparison purposes. The HBM ESD threshold established for the NLP12 is ±1000 V.

Qualification and Reliability

To help ensure high product reliability and customer satisfaction, TriQuint is committed to an intensive quality program that starts in the design phase and proceeds through the manufacturing process. Optoelectronic modules are qualified to TriQuint's internal standards as well as other appropriate industry standards using MIL-STD-883 test methods and procedures, and using sampling techniques consistent with *Telcordia Technologies* ™ requirements.

In addition, TriQuint has been certified to be in full compliance with the latest *ISO*® 9001 Quality System Standards.

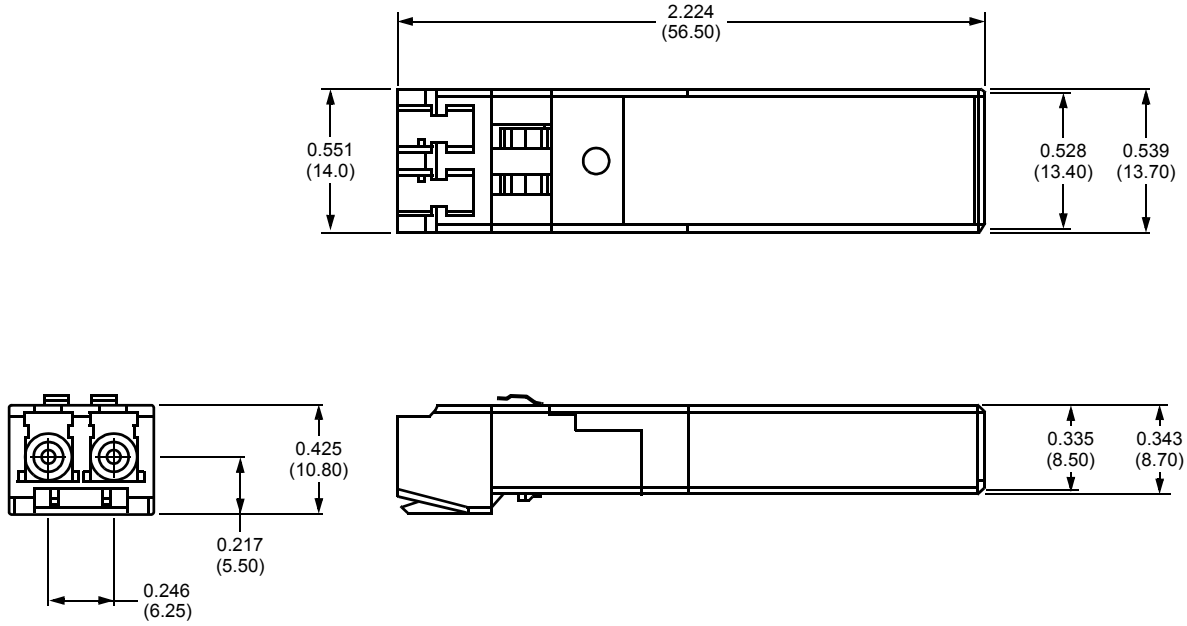
Table 21. Regulatory Compliance

Parameter	Test Method	Performance
Laser Eye Safety	U.S. 21 CFR (J) 1040.10 and 1040.11, *IEC*® 60825-1 1988, *IEC* 60825-2 1997	CDRH compliant and Class 1 laser safe. FDA Accession Number 0121593-02 (NLP12-10)
Electrostatic Discharge (ESD) to Electrical Pins	MIL-STD 883C, Method 3015.4	Class 1 (> 1000 V)
Electrostatic Discharge (ESD) to Optical Connector	*IEC* 61000-4-2; 1999	Withstand discharges of 15 kV using an air-discharge probe
Electromagnetic Interference (EMI)	FCC Part 15 Subpart J Class B, CISPR 22: 1997, EN 55022: 1998 Class B, VCCI Class I	Compliant with standards
Immunity	*IEC* 61000-4-3-1998	Less than 1 dB change in receiver sensitivity with field strength of 3 V/m RMS, from 10 MHz to 1 GHz.
Component	*UL*® 1950, *CSA*® C22.2 #950, *IEC* 60950: 1999	*UL* File No., *CSA* File No., TUV Certificate No.
Flammability	*UL* 94 V-0	—

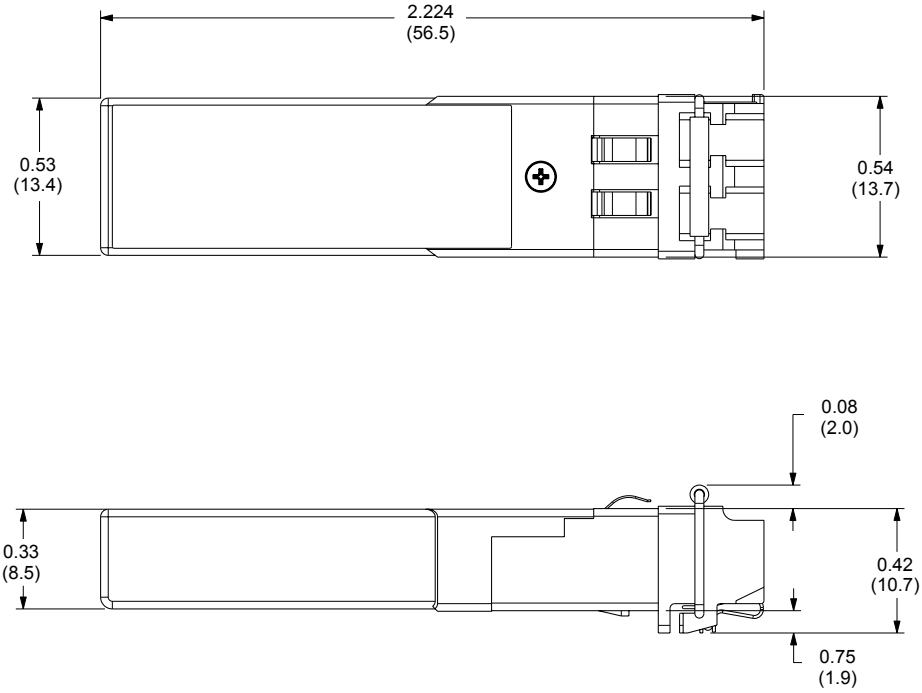
Outline Drawings

Dimensions are in inches and (millimeters).

Package Outline (standard latch)



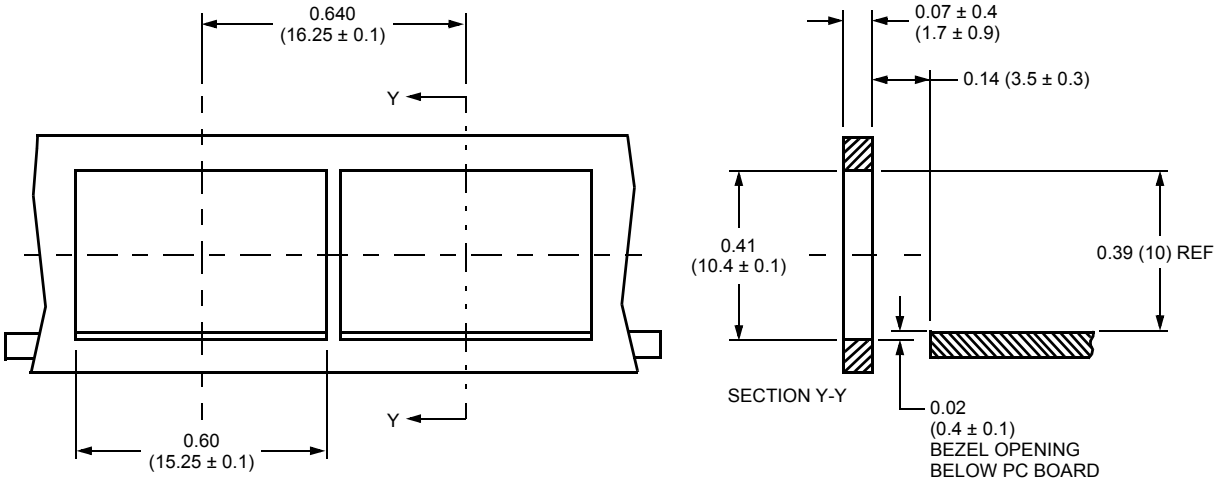
Package Outline (optional bail latch)



Outline Drawings (continued)

Dimensions are in inches and (millimeters).

Recommended Panel Opening

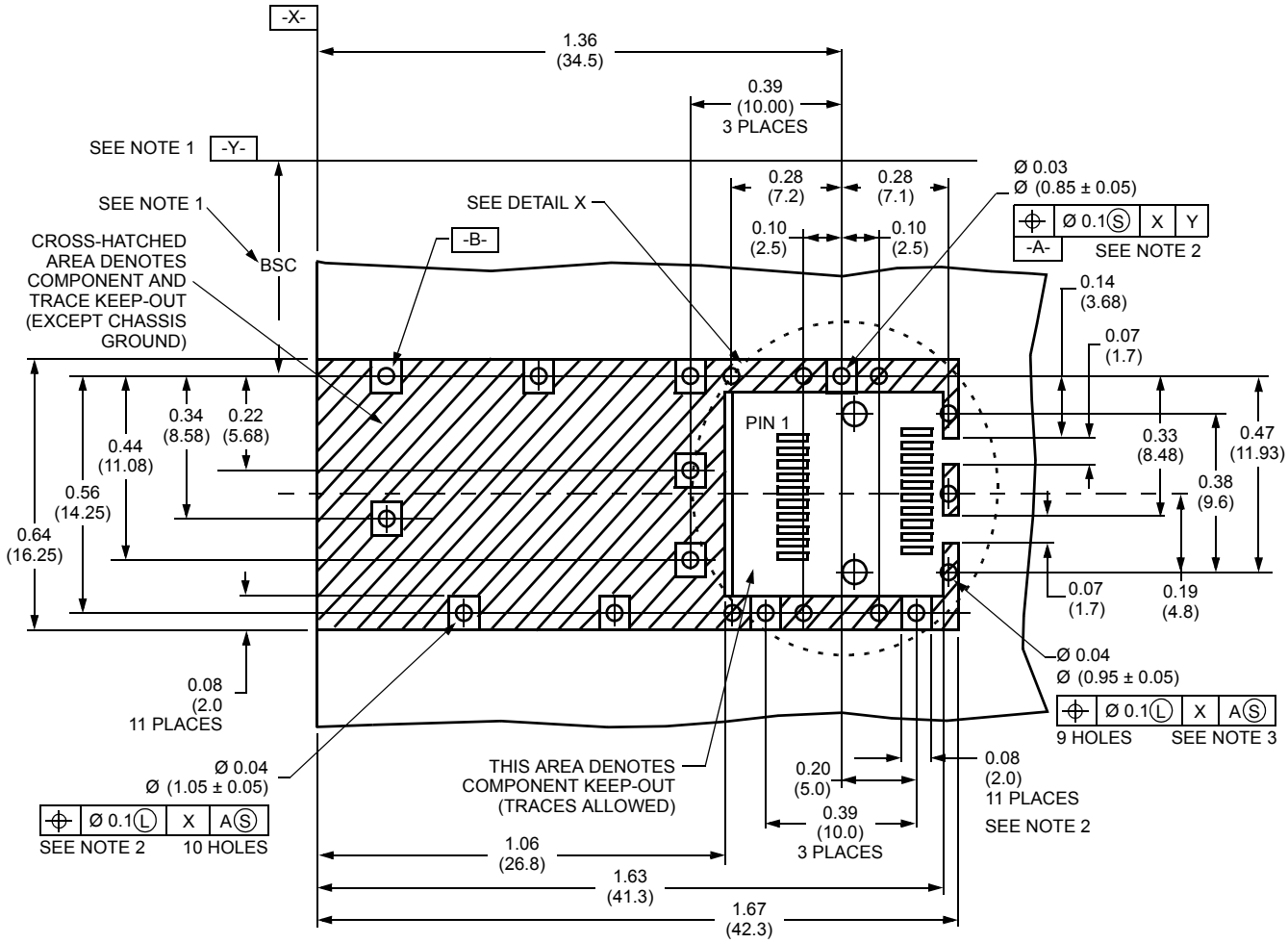


1-1309 (F)

Outline Drawings (continued)

Dimensions are in inches and (millimeters).

Printed Wiring Board Layout



1-1311F

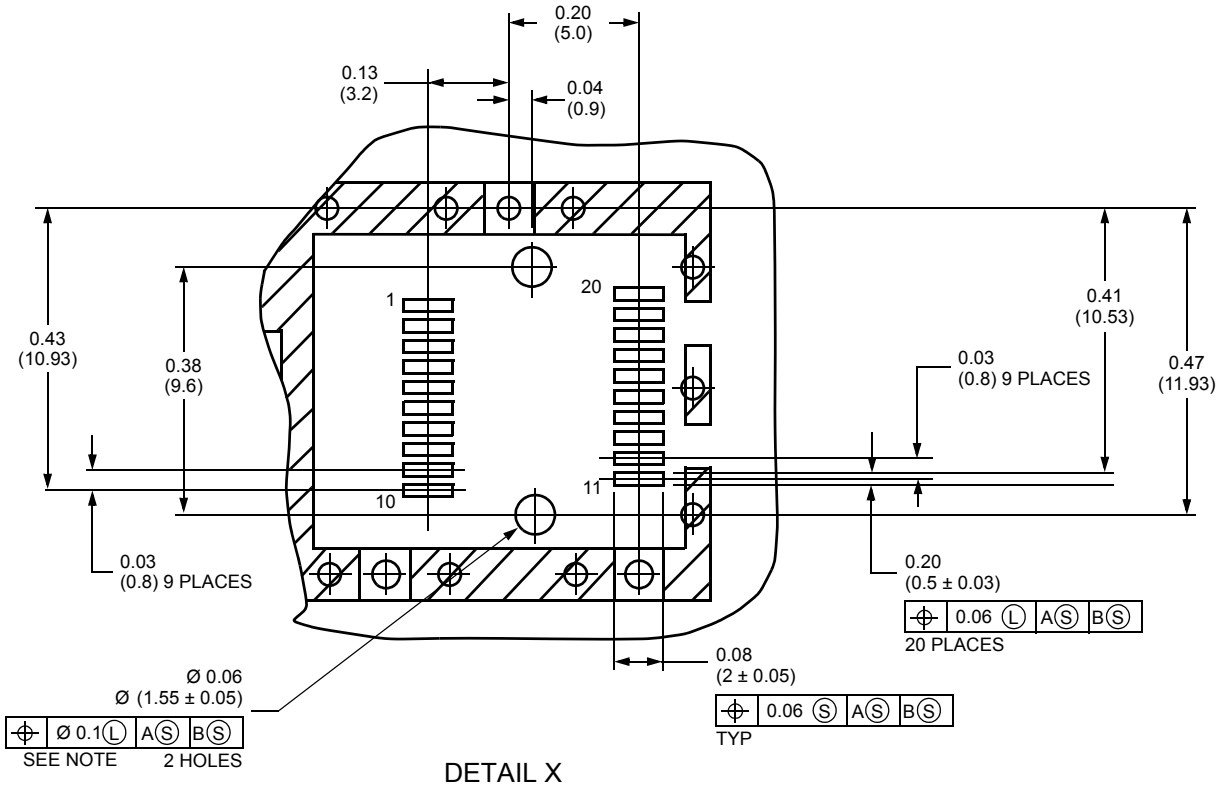
Notes:

1. Datum and basic dimensions established by customer.
2. Pads and vias are chassis ground.
3. Through holes, plating optional.

Outline Drawings (continued)

Dimensions are in inches and (millimeters).

Printed-Wiring Board Layout (continued)



1-1310F

Note: Through holes, plating optional.

Laser Safety Information

Class I Laser Product

All versions of the transceiver are Class I laser products per CDRH, 21 CFR 1040 Laser Safety requirements. All versions are Class I laser products per *IEC* 60825-1:1993. The transceiver will be classified with the FDA.

This product complies with 21 CFR 1040.10 and 1040.11.
Wavelength = 1550 nm (NLP12-80-PA)
Wavelength = 1310 nm (NLP12-10-AA, NLP12-10-PA, and NLP12-30-PA)
Wavelength = 850 nm (NLP12-01-AA and NLP12-01-PA)
Maximum power = 1.58 mW

Because of size constraints, laser safety labeling is not affixed to the module but is attached to the outside of the shipping carton.
Product is not shipped with power supply.

CAUTION: Use of controls, adjustments, and procedures other than those specified herein may result in hazardous laser radiation exposure.

NOTICE

Unterminated optical connectors can emit laser radiation.

Do not view with optical instruments.

Ordering Information

Table 22. Ordering Information

Description	Device Code	Comcode
SFP LC receptacle transceiver for 1.25 Gb/s, 550 m 1000BASE-SX Applications	NLP12-01-AA	700016894
SFP LC receptacle transceiver with bail latch for 1.25 Gb/s, 550 m 1000BASE-SX Applications	NLP12-01-AB	TBD
SFP LC receptacle transceiver with diagnostic monitors for 1.25 Gb/s, 550 m 1000BASE-SX Applications	NLP12-01-PA	TBD
SFP LC receptacle transceiver with bail latch and diagnostic monitors for 1.25 Gb/s, 550 m 1000BASE-SX Applications	NLP12-01-PB	TBD
SFP LC receptacle transceiver for 1.25 Gb/s, 10 km 1000BASE-LX Applications	NLP12-10-AA	700010638
SFP LC receptacle transceiver with bail latch for 1.25 Gb/s, 10 km 1000BASE-LX Applications	NLP12-10-AB	TBD
SFP LC receptacle transceiver with diagnostic monitors for 1.25 Gb/s, 10 km 1000BASE-LX Applications	NLP12-10-PA	700018957
SFP LC receptacle transceiver with bail latch and diagnostic monitors for 1.25 Gb/s, 10 km 1000BASE-LX Applications	NLP12-10-PB	TBD
SFP LC receptacle transceiver with diagnostic monitors for 1.25 Gb/s, 30 km 1000BASE-LX Applications	NLP12-30-PA	700018958
SFP LC receptacle transceiver with bail latch and diagnostic monitors for 1.25 Gb/s, 30 km 1000BASE-LX Applications	NLP12-30-PB	TBD
SFP LC receptacle transceiver with diagnostic monitors for 1.25 Gb/s, 80 km 1000BASE-LX Applications	NLP12-80-PA	700027914
SFP LC receptacle transceiver with bail latch and diagnostic monitors for 1.25 Gb/s, 80 km 1000BASE-LX Applications	NLP12-80-PB	TBD

Additional Information

For the latest specifications, additional product information, worldwide sales and distribution locations, and information about TriQuint:

Web: www.triquint.com **Tel: (503) 615-9000**

E-mail: info_opto@tqs.com **Fax: (503) 615-8902**

For technical questions and additional information on specific applications:

E-mail: info_opto@tqs.com

TriQuint OPTOELECTRONICS, INC.