



**RoHS compliant**  
**850 nm Multi-mode Transceiver (1000BASE-SX)**  
**1×9, SC Duplex Connector, 3.3 V/5V**  
**1.0625Gbd Fiber Channel/1.25 Gigabit Ethernet**

No Shield

Forward Clipper

Backward Clipper



### Features

- Compliant with IEEE 802.3z Gigabit Ethernet standard
- Compliant with Fiber Channel standard
- Industry standard 1×9 footprint
- SC duplex connector
- Single power supply 3.3 V/5V
- Differential LVPECL/PECL inputs and outputs
- Compatible with solder and aqueous wash processes
- Class 1 laser product complies with EN 60825-1

### Ordering Information

LM22-CAS-TC-N

| PART NUMBER   | INPUT/OUTPUT | SIG | V        | CLIPPER  | TEMPERATURE  |
|---------------|--------------|-----|----------|----------|--------------|
| LM22-CAS-PC-N | DC/DC        | LV  | 5V       | ---      | 0°C to 70 °C |
| LM22-CAS-PC-B | DC/DC        | LV  | 5V       | Backward | 0°C to 70 °C |
| LM22-CAS-PC-F | DC/DC        | LV  | 5V       | Forward  | 0°C to 70 °C |
| LM22-CAS-TC-N | AC/AC        | TTL | 3.3 V/5V | ---      | 0°C to 70 °C |
| LM22-CAS-TC-B | AC/AC        | TTL | 3.3 V/5V | Backward | 0°C to 70 °C |
| LM22-CAS-TC-F | AC/AC        | TTL | 3.3 V/5V | Forward  | 0°C to 70 °C |

**Transmit distance: 300m (OM1:62.5/125 MM fiber)**  
**550m (OM2:50/125 MM fiber)**



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### Absolute Maximum Ratings

| PARAMETER             | SYMBOL     | MIN  | MAX      | UNITS | NOTE                |
|-----------------------|------------|------|----------|-------|---------------------|
| Storage Temperature   | $T_S$      | -40  | 85       | °C    |                     |
| Supply Voltage        | $V_{CC}$   | -0.5 | 6.0      | V     |                     |
| Input Voltage         | $V_{IN}$   | -0.5 | $V_{CC}$ | V     |                     |
| Output Current        | $I_o$      | ---  | 50       | mA    |                     |
| Operating Current     | $I_{OP}$   | ---  | 400      | mA    |                     |
| Soldering Temperature | $T_{SOLD}$ | ---  | 260      | °C    | 10 seconds on leads |

### Operating Environment

| PARAMETER                     | SYMBOL    | MIN | MAX  | UNITS | NOTE |
|-------------------------------|-----------|-----|------|-------|------|
| Ambient Operating Temperature | $T_{AMB}$ | 0   | 70   | °C    |      |
| Supply Voltage                | $V_{CC}$  | 3.1 | 5.25 | V     |      |



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### Transmitter Electro-optical Characteristics

$V_{CC} = 3.1 \text{ V to } 5.25 \text{ V}$ ,  $T_A = 0^\circ \text{C to } 70^\circ \text{C}$

| PARAMETER                                              | SYMBOL                    | MIN  | TYP. | MAX   | UNITS | NOTE    |
|--------------------------------------------------------|---------------------------|------|------|-------|-------|---------|
| Output Optical Power<br>62.5/125 $\mu\text{m}$ , fiber | $P_{out}$                 | -9.5 | ---  | -4    | dBm   | Average |
| Output Optical Power<br>50/125 $\mu\text{m}$ , fiber   | $P_{out}$                 | -9.5 | ---  | -4    | dBm   | Average |
| Extinction Ratio                                       | $ER$                      | 9    | ---  | ---   | dB    |         |
| Center Wavelength                                      | $\lambda_c$               | 830  | 850  | 860   | nm    |         |
| Spectral Width (RMS)                                   | $\Delta\lambda$           | ---  | ---  | 0.85  | nm    |         |
| Rise/Fall Time (20–80%)                                | $T_{r,f}$                 | ---  | ---  | 260   | ps    |         |
| Relative Intensity Noise                               | $RIN$                     | ---  | ---  | -117  | dB/Hz |         |
| Total Jitter                                           | $TJ$                      | ---  | ---  | 227   | ps    |         |
| Output Eye                                             | Compliant with IEEE802.3z |      |      |       |       |         |
| Power Supply Current                                   | $I_{CC}$                  | ---  | ---  | 120   | mA    | Note 1  |
| Transmitter Data Input Voltage-High                    | $V_{IH} - V_{CC}$         | -1.1 | ---  | -0.74 | V     | Note 2  |
| Transmitter Data Input Voltage-Low                     | $V_{IL} - V_{CC}$         | -2.0 | ---  | -1.58 | V     | Note 2  |
| Transmitter Data Input Differential Voltage            | $V_{DIFF}$                | 0.3  | ---  | 1.6   | V     | Note 2  |

Note 1: Not including the terminations.

Note 2: These inputs are compatible with 10K, 10KH and 100K ECL and PECL input.



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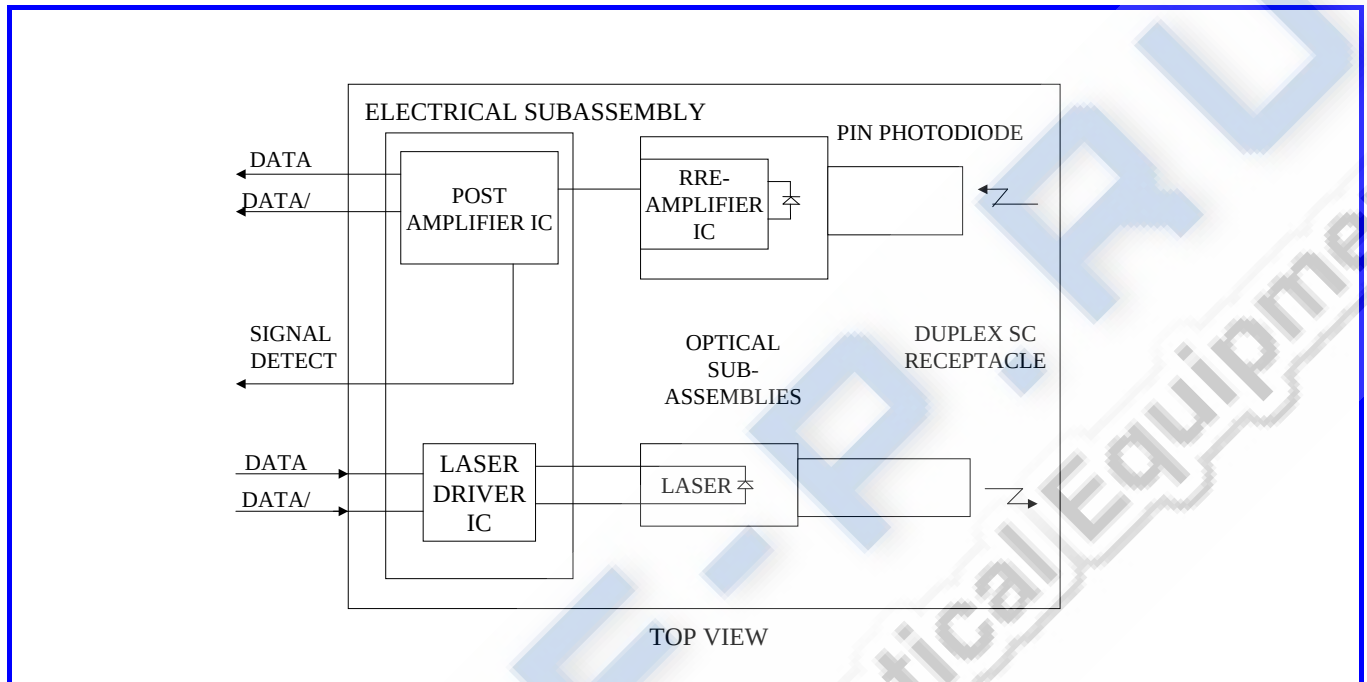
**Receiver electro-optical characteristics**

$V_{CC} = 3.1 \text{ V to } 5.25 \text{ V}, T_A = 0^\circ \text{C to } 70^\circ \text{C}$

| PARAMETER                                      | SYMBOL            | MIN            | TYP. | MAX      | UNITS   | NOTE             |
|------------------------------------------------|-------------------|----------------|------|----------|---------|------------------|
| Optical Input Power-maximum                    | $P_{IN}$          | 0              | ---  | ---      | dBm     | $BER < 10^{-12}$ |
| Optical Input Power-minimum<br>(Sensitivity)   | $P_{IN}$          | ---            | ---  | -18      | dBm     | $BER < 10^{-12}$ |
| Optical modulation amplitude (p-p)<br>-minimum | $OMA$             | ---            | ---  | 36       | $\mu W$ | $BER < 10^{-12}$ |
| Operating Center wavelength                    | $\lambda_C$       | 770            | ---  | 860      | nm      |                  |
| Optical Return Loss                            | $ORL$             | 12             | ---  | ---      | dB      |                  |
| Signal Detect-Asserted                         | $P_A$             | ---            | ---  | -18      | dBm     |                  |
| Signal Detect-Deasserted                       | $P_D$             | -35            | ---  | ---      | dBm     |                  |
| Signal Detect-Hysteresis                       | $P_A - P_D$       | 1.0            | ---  | ---      | dB      |                  |
| Stressed Receiver Sensitivity                  |                   | ---            | ---  | -13.5    | dBm     | 50 $\mu m$ MMF   |
|                                                |                   | ---            | ---  | -12.5    | dBm     | 62.5 $\mu m$ MMF |
| Signal Detect Voltage<br>(LVPECL/PECL) -High   | $V_{OH} - V_{CC}$ | -1.1           | ---  | -0.74    | V       | Note 1           |
| Signal Detect Voltage<br>(LVPECL/PECL) -Low    | $V_{OL} - V_{CC}$ | -2.0           | ---  | -1.58    | V       | Note 1           |
| Signal Detect Voltage (TTL)-High               | $V_{OH}$          | $V_{CC} - 0.8$ | ---  | $V_{CC}$ | V       |                  |
| Signal Detect Voltage (TTL)-Low                | $V_{OL}$          | 0              | ---  | 0.5      | V       |                  |
| Power Supply Current                           | $I_{CC}$          | ---            | ---  | 120      | mA      |                  |
| Data Output Rise, Fall Time<br>(20–80%)        | $T_{r,f}$         | ---            | ---  | 0.35     | ns      |                  |
| Data Output Voltage-High                       | $V_{OH} - V_{CC}$ | -1.1           | ---  | -0.74    | V       | Note 1           |
| Data Output Voltage-Low                        | $V_{OL} - V_{CC}$ | -2.0           | ---  | -1.58    | V       | Note 1           |
| Data Output Differential Voltage               | $V_{DIFF}$        | 0.3            | ---  | 1.6      | V       |                  |

Note 1: These outputs are compatible with 10K, 10KH and 100K ECL and PECL input.

### Block Diagram of Transceiver



#### Transmitter Section

The transmitter section consists of a 850 nm laser in an eye safe optical subassembly (OSA) which mates to the fiber cable. The laser OSA is driven by a LD driver IC which converts differential input LVPECL/PECL logic signals into an analog laser driving current.

#### Receiver Section

The receiver utilizes a MSM detector integrated with a trans-impedance preamplifier in an OSA. This OSA is connected to a circuit providing post-amplification quantization, and optical signal detection.

#### Receiver Signal Detect

Signal Detect is a basic fiber failure indicator. This is a single-ended LVPECL/PECL or TTL output. As the input optical power is decreased, Signal Detect will switch from high to low (deassert point) somewhere between sensitivity and the no light input level. As the input optical power is increased from very low levels, Signal Detect will switch back from low to high (assert point). The assert level will be at least 1.0 dB higher than the deassert level.



## Connection Diagram

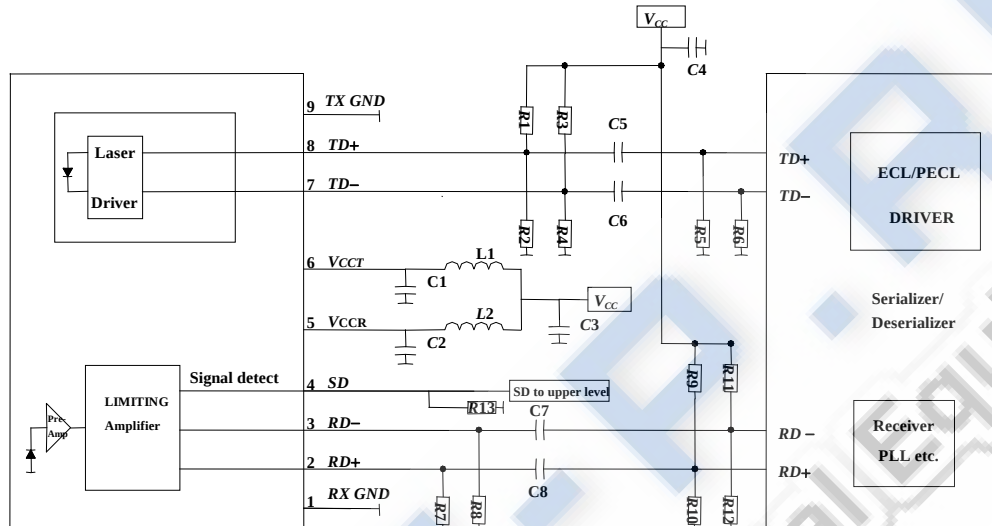
Pin-Out



| PIN | SYMBOL        | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | <i>RX GND</i> | Receiver Signal Ground.<br>Directly connect this pin to the receiver ground plane.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 2   | <i>RD+</i>    | <i>RD+</i> is an open-emitter output circuit.<br>Terminate this high-speed differential LVPECL/PECL output with standard LVPECL/PECL techniques at the follow-on device input pin. (See recommended circuit schematic)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 3   | <i>RD-</i>    | <i>RD-</i> is an open-emitter output circuit.<br>Terminate this high-speed differential LVPECL/PECL output with standard LVPECL/PECL techniques at the follow-on device input pin. (See recommended circuit schematic)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 4   | <i>SD</i>     | Signal Detect.<br>Normal optical input levels to the receiver result in a logic “1” output, $V_{OH}$ , asserted. Low input optical levels to the receiver result in a fault condition indicated by a logic “0” output $V_{OL}$ , deasserted. Signal Detect is a single-ended LVPECL/PECL or TTL output. <i>SD</i> can be terminated with LVPECL/PECL techniques via $50\ \Omega$ to $V_{CCR} - 2\text{ V}$ . Alternatively, <i>SD</i> can be loaded with a $180\ \Omega$ resistor to <i>RX GND</i> to conserve electrical power with small compromise to signal quality. If Signal Detect output is not used, leave it open-circuited. This Signal Detect output can be used to drive a LVPECL/PECL input on an upstream circuit, such as, Signal Detect input or Loss of Signal-bar. |
| 5   | <i>VCCR</i>   | Receiver Power Supply.<br>Provide +3.3 Vdc via the recommended receiver power supply filter circuit. Locate the power supply filter circuit as close as possible to the <i>VCCR</i> pin.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 6   | <i>V CCT</i>  | Transmitter Power Supply.<br>Provide +3.3 Vdc via the recommended transmitter power supply filter circuit. Locate the power supply filter circuit as close as possible to the <i>V CCT</i> pin.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 7   | <i>TD-</i>    | Transmitter Data In-Bar.<br>Terminate this high-speed differential LVPECL/PECL input with standard LVPECL/PECL techniques at the transmitter input pin. (See recommended circuit schematic)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 8   | <i>TD+</i>    | Transmitter Data In.<br>Terminate this high-speed differential LVPECL/PECL input with standard LVPECL/PECL techniques at the transmitter input pin. (See recommended circuit schematic)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 9   | <i>TX GND</i> | Transmitter Signal Ground.<br>Directly connect this pin to the transmitter signal ground plane. Directly connect this pin to the transmitter ground plane.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

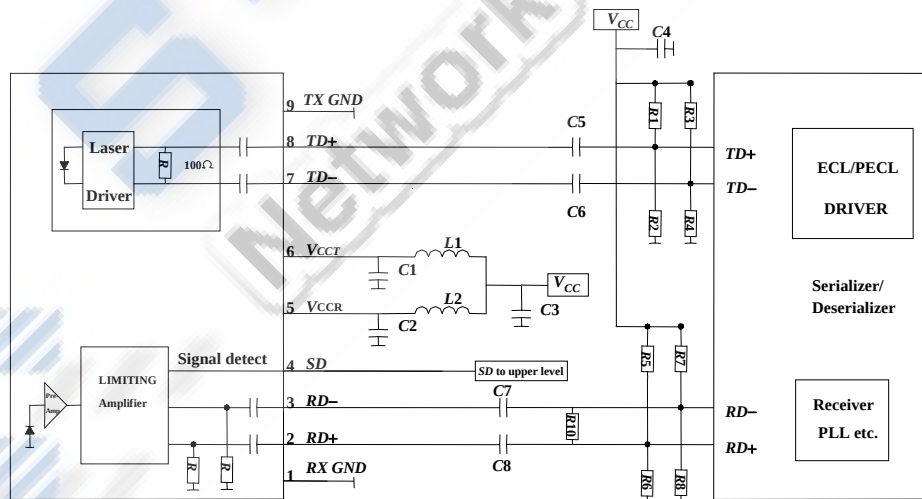
### Recommended Circuit Schematic

#### DC/DC Coupling



$C1/C2/C4/C5/C6/C7/C8 = 100 \text{ nF}$        $C3 = 4.7 \mu\text{F}$        $L1/L2 = 1 \mu\text{H}$   
 $R1/R3 = 82 \Omega$        $R2/R4 = 130 \Omega$        $R7/R8 = 180 \Omega$   
 $R13 = 180 \Omega \text{ (PECL)}$        $R5/R6/R9/R10/R11/R12$  Depend on SerDes

#### AC/AC Coupling



$C1/C2/C4/C5/C6/C7/C8 = 100 \text{ nF}$        $C3 = 4.7 \mu\text{F}$        $L1/L2 = 1 \mu\text{H}$   
 $R1/R2/R3/R4/R5/R6/R7/R8$  Depend on SerDes

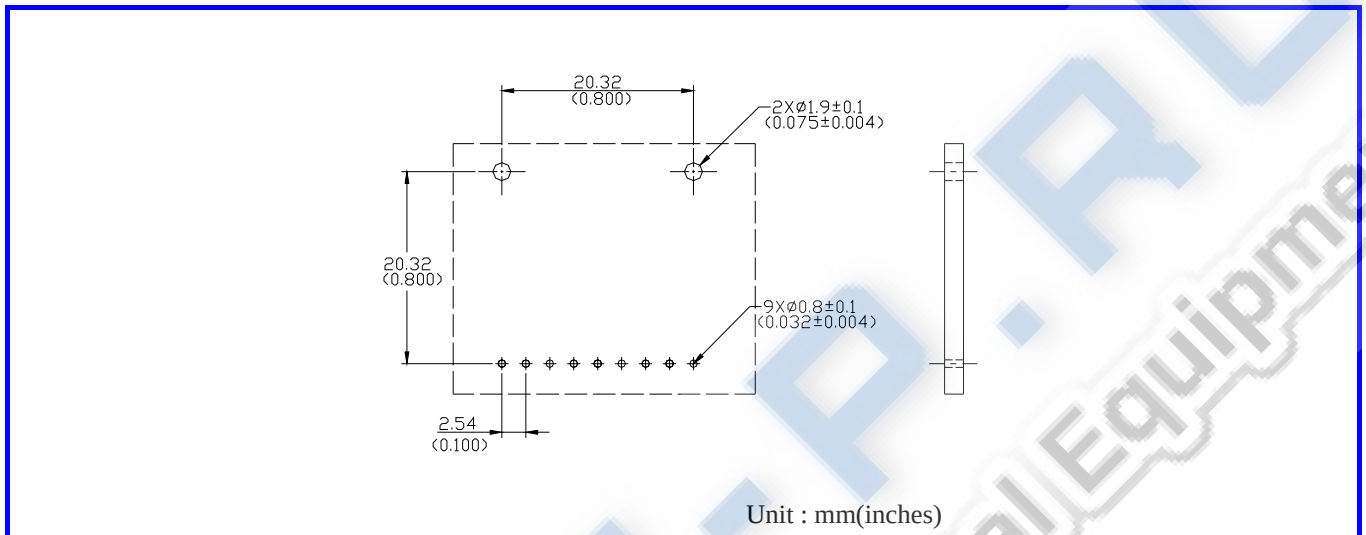
In order to get proper functionality, a recommended circuit is provided in above recommended circuit schematic.

When designing the circuit interface, there are a few fundamental guidelines to follow.

- (1) The differential data lines should be treated as 50  $\Omega$  Micro strip or strip line transmission lines. This will help to minimize the parasitic inductance and capacitance effects. Locate termination at the received signal end of the transmission line. The length of these lines should be kept short and of equal length.
- (2) For the high speed signal lines, differential signals should be used, not single-ended signals, and these differential signals need to be loaded symmetrically to prevent unbalanced currents which will cause distortion in the signal.
- (3) Multi layer plane PCB is best for distribution of  $V_{CC}$ , returning ground currents, forming transmission lines and shielding. Also, it is important to suppress noise from influencing the fiber-optic transceiver performance, especially the receiver circuit.
- (4) A separate proper power supply filter circuits shown in Figure for the transmitter and receiver sections. These filter circuits suppress  $V_{CC}$  noise over a broad frequency range, this prevents receiver sensitivity degradation due to  $V_{CC}$  noise.
- (5) Surface-mount components are recommended. Use ceramic bypass capacitors for the 0.1  $\mu\text{F}$  capacitors and a surface-mount coil inductor for 1  $\mu\text{H}$  inductor. Ferrite beads can be used to replace the coil inductors when using quieter  $V_{CC}$  supplies, but a coil inductor is recommended over a ferrite bead. All power supply components need to be placed physically next to the  $V_{CC}$  pins of the receiver and transmitter.
- (6) Use a good, uniform ground plane with a minimum number of holes to provide a low-inductance ground current return for the power supply currents.



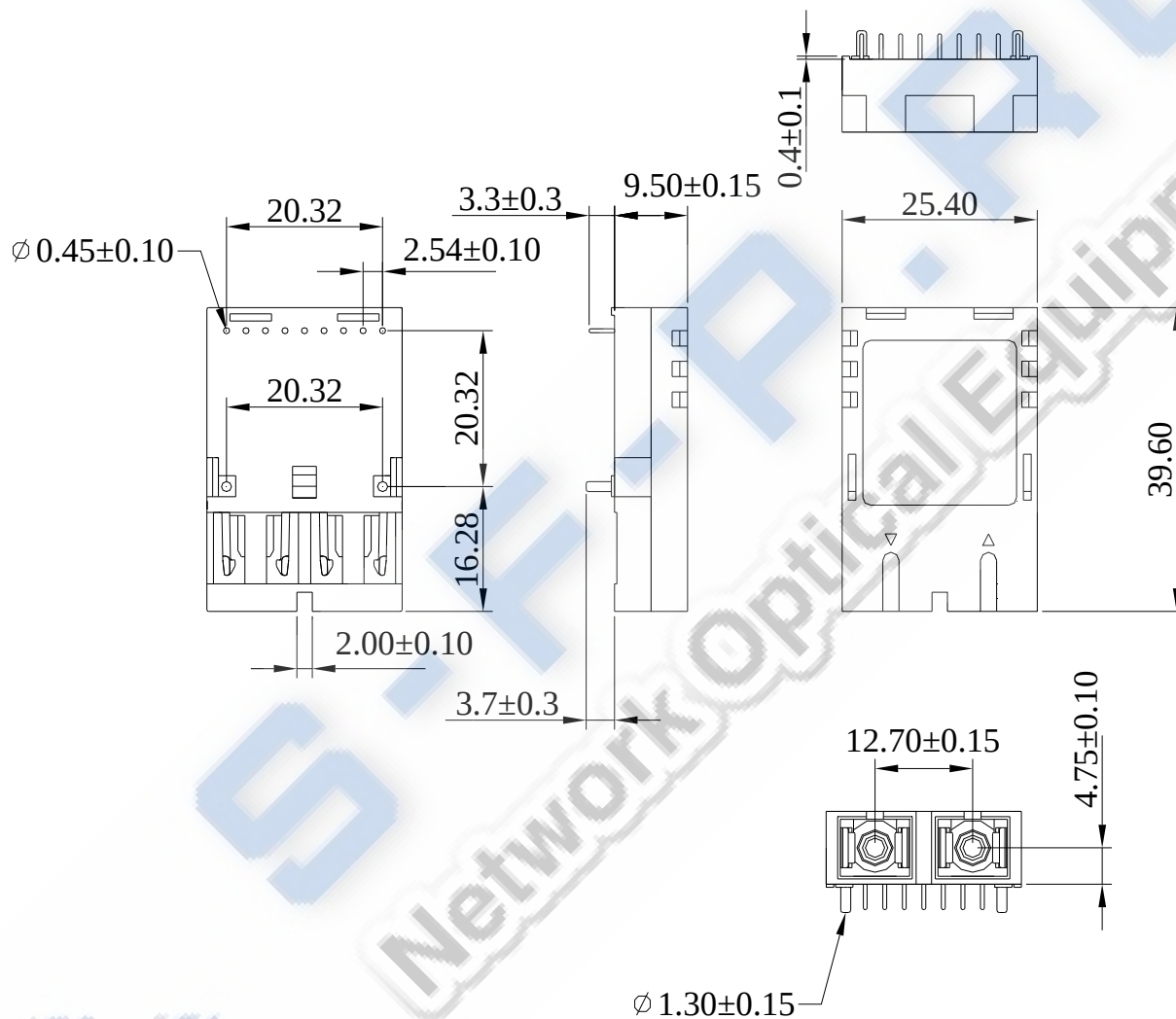
### Recommended Board Layout Hole Pattern



This transceiver is compatible with industry standard wave or hand solder processes. After wash process, all moisture must be completely remove from the module. The transceiver is supplied with a process plug to prevent contamination during wave solder and aqueous rinse as well as during handling, shipping or storage.

Solder fluxes should be water-soluble, organic solder fluxes. Recommended cleaning and degreasing chemicals for these transceivers are alcohol's (methyl, isopropyl, isobutyl), aliphatics (hexane, heptane) and other chemicals, such as soap solution or naphtha. Do not use partially halogenated hydrocarbons for cleaning/degreasing.

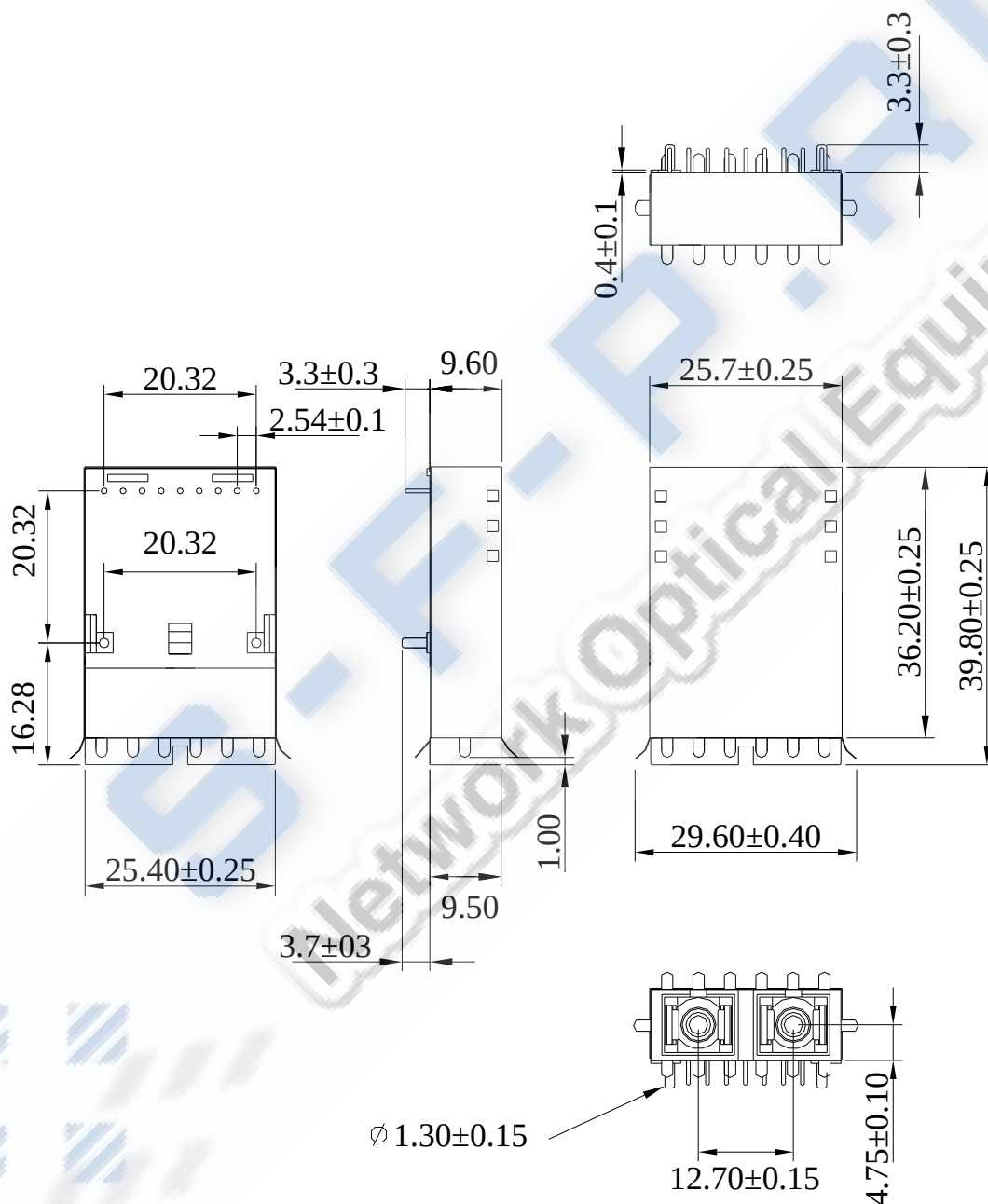
Drawing Dimensions- No Shield



ALL DIMENSIONS ARE±0.20mm UNLESS OTHERWISE SPECIFIED

Unit: mm

### Drawing Dimensions- Forward Shield



ALL DIMENSIONS ARE  $\pm 0.2$  mm UNLESS OTHERWISE SPECIFIED

Unit: mm

Technical drawing of a 10G SFP+ module showing three views: top, side, and front. The drawing includes various dimensions in millimeters with tolerances.

**Top View Dimensions:**

- Overall width:  $25.40 \pm 0.25$
- Overall height:  $20.32$
- Pin pitch:  $2.54 \pm 0.10$
- Mounting hole diameter:  $\varnothing 0.45 \pm 0.10$
- Distance from top edge to pin center:  $3.3 \pm 0.3$
- Distance from side edge to pin center:  $9.60$
- Distance from bottom edge to pin center:  $3.7 \pm 0.3$
- Distance from side edge to mounting hole center:  $9.50$

**Side View Dimensions:**

- Total height:  $39.80 \pm 0.25$
- Top flange height:  $3.30 \pm 0.30$
- Body height:  $3.50$

**Front View Dimensions:**

- Width:  $29.50 \pm 0.40$
- Height:  $4.75 \pm 0.10$
- Pin pitch:  $12.70 \pm 0.15$
- Pin diameter:  $\varnothing 1.30 \pm 0.15$

ALL DIMENSIONS ARE  $\pm 0.20\text{mm}$  UNLESS OTHERWISE SPECIFIED

Unit: mm



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### Eye Safety Mark

The LM2 series Multi-mode transceiver is a class 1 laser product. It complies with EN 60825-1 and FDA 21 CFR 1040.10 and 1040.11. In order to meet laser safety requirements the transceiver shall be operated within the Absolute Maximum Ratings.

#### Caution

All adjustments have been done at the factory before the shipment of the devices. No maintenance and user serviceable part is required. Tampering with and modifying the performance of the device will result in voided product warranty.

#### Required Mark

Class 1 Laser Product  
Complies with  
21 CFR 1040.10 and 1040.11

Note : All information contained in this document is subject to change without notice.