



**Professional high-speed optical transceiver**

**OPN-SL1513-60SC / OPN-SL1513-60SCI /  
OPN-SL1513-60LC / OPN-SL1513-60LCI**

**1550 nm TX / 1310 nm RX , 3.3V / 155 Mbps Digital Diagnostic Single-Fiber SFP Transceiver**

## **PRODUCT FEATURES**

- 1-Fiber Bi-Directional SFP Optical Transceiver
- Compliant with IEEE 802.3ah-2004 100BASE-BX
  - Simplex SC Connector: OPN-SL1513-60SC
  - Simplex LC Connector: OPN-SL1513-60LC
    - SFF-8472 Digital Diagnostic Function
      - 1550 nm DFB LD Transmitter
      - 1310 nm Receiver
      - Distance Up to 60 km
  - AC/AC Coupling according to MSA
    - Single +3.3 V Power Supply
    - RoHS Compliant
  - 0 to 70°C Operation: OPN-SL1513-60SC
  - -50 to 85°C Operation: OPN-SL1513-60SCI
- Class 1 Laser International Safety Standard IEC 60825Compliant

## **APPLICATIONS**

- WDM Fast Ethernet Links
- SONET/SDH Equipment Interconnect
  - Fibre Channel Links

## **PRODUCT DESCRIPTION**

The OPN-SL1513-60SC series are small form factor pluggable modules for IEEE 802.3ah 100BASE-BX and OC-3/STM-1 SONET/SDH single fiber communications by using 1550 nm transmitter and 1310 nm receiver. It is with the SFP 20-pin connector to allow hot plug capability. Digital diagnostic functions are available via an I<sup>2</sup>C. The transmittersection uses a multiple quantum well 1550 nm laser and is aclass 1 laser compliant according to International Safety Standard IEC 60825.

The receiver section uses an integrated1310 nm detector preamplifier (IDP) mounted in an optical header and a limiting post-amplifier IC.

## **ORDER INFORMATION**

| P/No.            | Bit Rate<br>(Mb/s) | Distance<br>(km) | TX<br>(nm) | RX<br>(nm) | Package         | Temp<br>(°C) | TX Power<br>(dBm) | RX Sens.<br>(dBm) | RoHS<br>Compliant |
|------------------|--------------------|------------------|------------|------------|-----------------|--------------|-------------------|-------------------|-------------------|
| OPN-SL1513-60SC  | 125/155            | 60               | 1550 DFB   | 1310       | SC SFP with DMI | 0 to 70      | 0 to -5           | -34               | Yes               |
| OPN-SL1513-60SCI | 125/155            | 60               | 1550 DFB   | 1310       | SC SFP with DMI | -50 to 85    | 0 to -5           | -34               | Yes               |
| OPN-SL1513-60LC  | 125/155            | 60               | 1550 DFB   | 1310       | LC SFP with DMI | 0 to 70      | 0 to -5           | -34               | Yes               |
| OPN-SL1513-60LCI | 125/155            | 60               | 1550 DFB   | 1310       | LC SFP with DMI | -50 to 85    | 0 to -5           | -34               | Yes               |

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| Absolute Maximum Ratings   |        |          |          |       |                                     |
|----------------------------|--------|----------|----------|-------|-------------------------------------|
| Parameter                  | Symbol | Min      | Max      | Units | Notes                               |
| Storage Temperature        | Tstg   | -50      | 85       | °C    |                                     |
| Operating Case Temperature | Topr   | 0<br>-50 | 70<br>85 | °C    | OPN-SL1513-60SC<br>OPN-SL1513-60SCI |
| Power Supply Voltage       | Vcc    | 0        | 3.6      | V     |                                     |
| Input Voltage              | ---    | GND      | Vcc      | V     |                                     |
| Output Current             | Iout   | 0        | 30       | mA    |                                     |

| Recommended Operating Conditions |                        |          |         |          |                                               |
|----------------------------------|------------------------|----------|---------|----------|-----------------------------------------------|
| Parameter                        | Symbol                 | Min      | Typ     | Max      | Units / Notes                                 |
| Power Supply Voltage             | Vcc                    | 3.1      | 3.3     | 3.5      | V                                             |
| Power Supply Current             | I <sub>CC(TX+RX)</sub> |          | 200     | 300      | mA                                            |
| Operating Case Temperature       | Topr                   | 0<br>-50 |         | 70<br>85 | °C / OPN-SL1513-60SC<br>°C / OPN-SL1513-60SCI |
| Data Rate                        |                        |          | 125/155 | 200      | Mb/s                                          |

| Transmitter Specifications (0°C < Topr < 70°C, 3.1V < Vcc < 3.5V) |                                                                  |      |     |         |       |                   |
|-------------------------------------------------------------------|------------------------------------------------------------------|------|-----|---------|-------|-------------------|
| Parameter                                                         | Symbol                                                           | Min  | Typ | Max     | Units | Notes             |
| <b>Optical</b>                                                    |                                                                  |      |     |         |       |                   |
| Optical Transmit Power                                            | P <sub>o</sub>                                                   | -5   |     | 0       | dBm   | 1                 |
| Output Center Wavelength                                          | λ                                                                | 1480 |     | 1580    | nm    |                   |
| Output Spectrum Width                                             | Δλ                                                               |      |     | 1       | nm    | -20 dB width      |
| Extinction Ratio                                                  | E <sub>R</sub>                                                   | 10   |     |         | dB    |                   |
| Output Eye                                                        | Compliant with Bellcore GR-253-CORE and ITU recommendation G.957 |      |     |         |       |                   |
| Optical Rise Time                                                 | t <sub>r</sub>                                                   |      |     | 2       | ns    | 10% to 90% Values |
| Optical Fall Time                                                 | t <sub>f</sub>                                                   |      |     | 2       | ns    | 10% to 90% Values |
| Relative Intensity Noise                                          | RIN                                                              |      |     | -116    | dB/Hz |                   |
| Total Jitter                                                      | TJ                                                               |      |     | 1.0     | ns    | 2                 |
| <b>Electrical</b>                                                 |                                                                  |      |     |         |       |                   |
| Data Input Current – Low                                          | I <sub>IL</sub>                                                  | -350 |     |         | μA    |                   |
| Data Input Current – High                                         | I <sub>IH</sub>                                                  |      |     | 350     | μA    |                   |
| Differential Input Voltage                                        | V <sub>IH</sub> - V <sub>IL</sub>                                | 0.5  |     | 2.4     | V     | Peak-to-Peak      |
| TX Disable Input Voltage – Low                                    | T <sub>DIS, L</sub>                                              | 0    |     | 0.5     | V     | 3                 |
| TX Disable Input Voltage – High                                   | T <sub>DIS, H</sub>                                              | 2.0  |     | Vcc     | V     | 3                 |
| TX Disable Assert Time                                            | T <sub>ASSERT</sub>                                              |      |     | 10      | μs    |                   |
| TX Disable Deassert Time                                          | T <sub>DEASSERT</sub>                                            |      |     | 1       | ms    |                   |
| TX Fault Output Voltage -- Low                                    | T <sub>FaultL</sub>                                              | 0    |     | 0.5     | V     | 4                 |
| TX Fault Output Voltage -- High                                   | T <sub>FaultH</sub>                                              | 2.0  |     | Vcc+0.3 | V     | 4                 |

Notes: 1. Output power is power coupled into a 9/125 μm single mode fiber.

2. Measured with a 2<sup>23</sup>-1 PRBS

3. There is an internal 4.7K to 10K ohm pull-up resistor to VccTX.

4. Open collector compatible, 4.7K to 10K ohm pull-up to Vcc (Host Supply Voltage).

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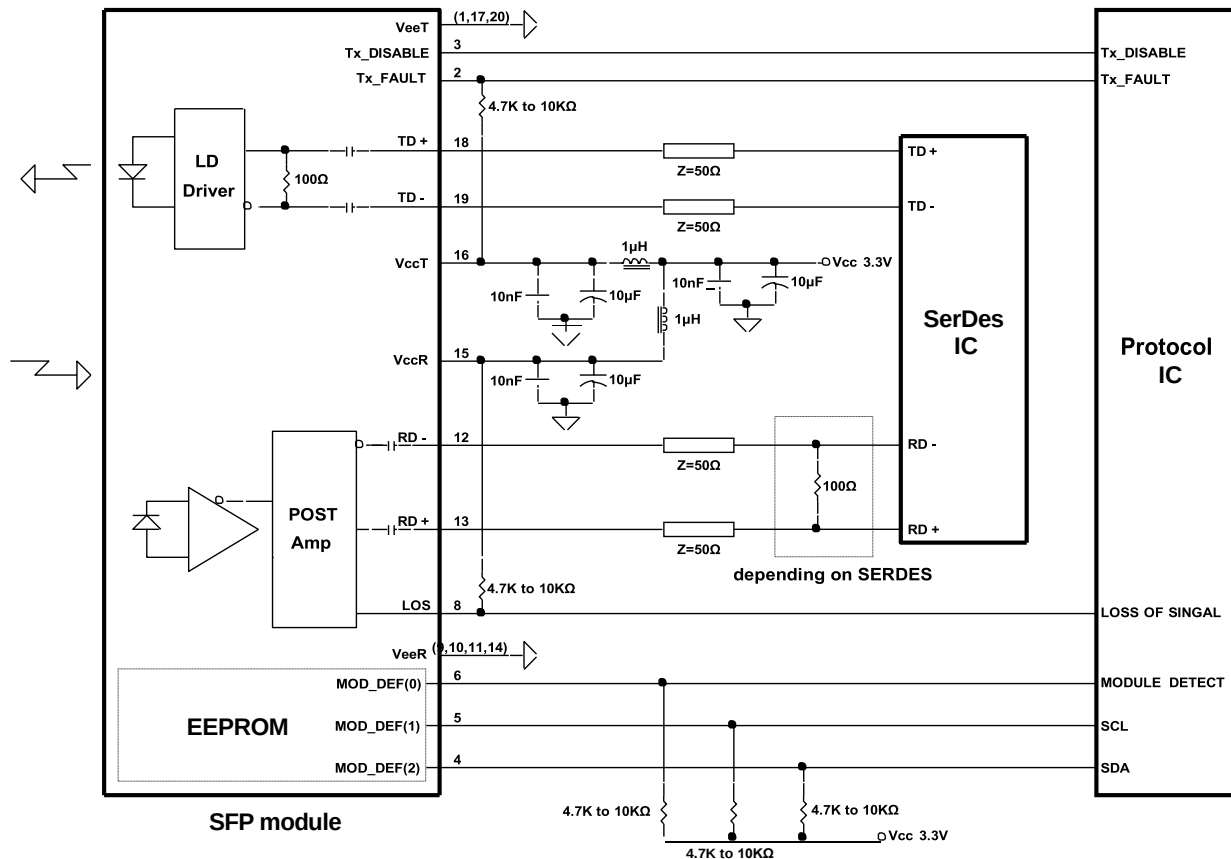
| Receiver Specifications (0°C < Topr < 70°C, 3.1 V < Vcc < 3.5V) |                   |      |     |              |       |                         |
|-----------------------------------------------------------------|-------------------|------|-----|--------------|-------|-------------------------|
| Parameter                                                       | Symbol            | Min  | Typ | Max          | Units | Notes                   |
| <b>Optical</b>                                                  |                   |      |     |              |       |                         |
| Sensitivity                                                     | ---               | ---  | --- | -34          | dBm   | 5                       |
| Maximum Input Power                                             | Pin               | -8   | --- | ---          | dBm   |                         |
| Signal Detect – Asserted                                        | Pa                | ---  | --- | -34          | dBm   | Transition: low to high |
| Signal Detect – Deasserted                                      | Pd                | -43  | --- | ---          | dBm   | Transition: high to low |
| Signal detect – Hysteresis                                      |                   | 1.0  | --- |              | dB    |                         |
| Wavelength of Operation                                         |                   | 1260 |     | 1360         | nm    | 6                       |
| Optical Return Loss                                             | ORL               | 14   |     |              | dB    |                         |
| <b>Electrical</b>                                               |                   |      |     |              |       |                         |
| Differential Output Voltage                                     | $V_{OH} - V_{OL}$ | 0.6  |     | 2.0          | V     |                         |
| Output LOS Voltage -- Low                                       | $V_{OL}$          | 0    |     | 0.5          | V     | 7                       |
| Output LOS Voltage – High                                       | $V_{OH}$          | 2.0  |     | $V_{CC}+0.3$ | V     | 7                       |
| Signal Detect Assert Time                                       | $AS_{MAX}$        |      |     | 100          | μs    | OFF to ON               |
| Signal Detect Deassert Time                                     | $ANS_{MAX}$       |      |     | 300          | μs    | ON to OFF               |

Notes: 5. Minimum sensitivity and saturation levels at BER 1E-10 for a 2<sup>23</sup>-1 PRBS.

6. At least 30 dB optical isolation for the wavelength 1480 to 1580 nm.

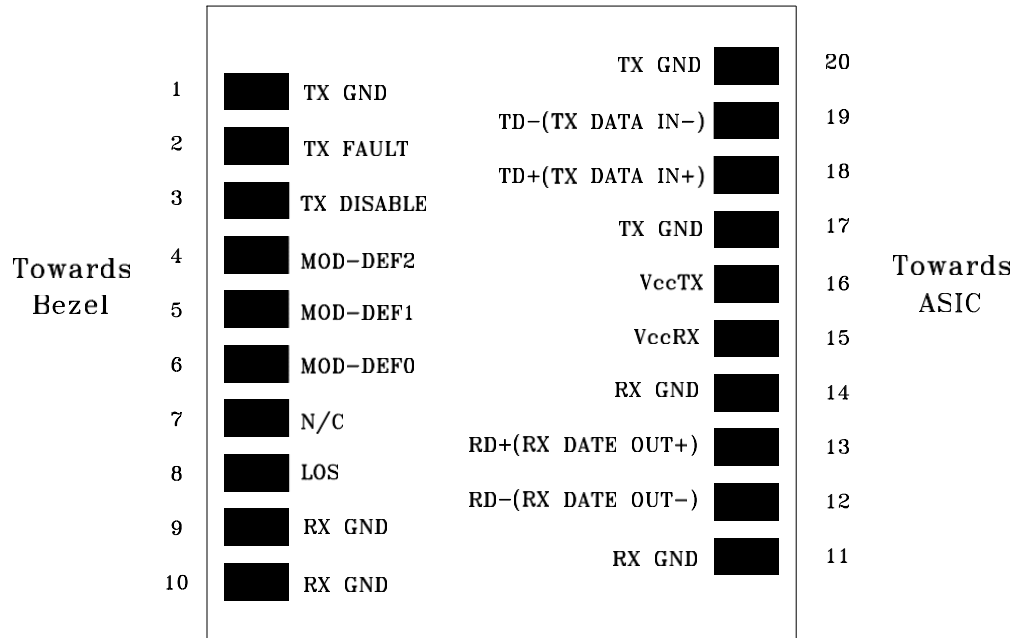
7. Open collector compatible, 4.7K to 10K ohm pull-up to Vcc (Host Supply Voltage).

## RECOMMENDED CIRCUIT SCHEMATIC



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### CONNECTION DIAGRAM



| PIN | Signal Name | Description                                             | PIN | Signal Name  | Description                 |
|-----|-------------|---------------------------------------------------------|-----|--------------|-----------------------------|
| 1   | TX GND      | Transmitter Ground                                      | 11  | RX GND       | Receiver Ground             |
| 2   | TX Fault    | Transmitter Fault Indication                            | 12  | RX DATA OUT- | Inverse Receiver Data Out   |
| 3   | TX Disable  | Transmitter Disable (Module disables on high or open)   | 13  | RX DATA OUT+ | Receiver Data Out           |
| 4   | MOD-DFE2    | Modulation Definition 2 – Two wires serial ID Interface | 14  | RX GND       | Receiver Ground             |
| 5   | MOD-DEF1    | Modulation Definition 1 – Two wires serial ID Interface | 15  | Vcc RX       | Receiver Power – 3.3V±5%    |
| 6   | MOD-DEF0    | Modulation Definition 0 – Ground in Module              | 16  | Vcc TX       | Transmitter Power – 3.3V±5% |
| 7   | N/C         | Not Connected                                           | 17  | TX GND       | Transmitter Ground          |
| 8   | LOS         | Loss of Signal                                          | 18  | TX DATA IN+  | Transmitter Data In         |
| 9   | RX GND      | Receiver Ground                                         | 19  | TX DATA IN-  | Inverse Transmitter Data In |
| 10  | RX GND      | Receiver Ground                                         | 20  | TX GND       | Transmitter Ground          |

### Module Definition

| Module Definition | MOD-DEF2<br>PIN 4 | MOD-DEF1<br>PIN 5 | MOD-DEF0<br>PIN 6 | Interpretation by Host            |
|-------------------|-------------------|-------------------|-------------------|-----------------------------------|
| 4                 | SDA               | SCL               | LV-TTL Low        | Serial module definition protocol |

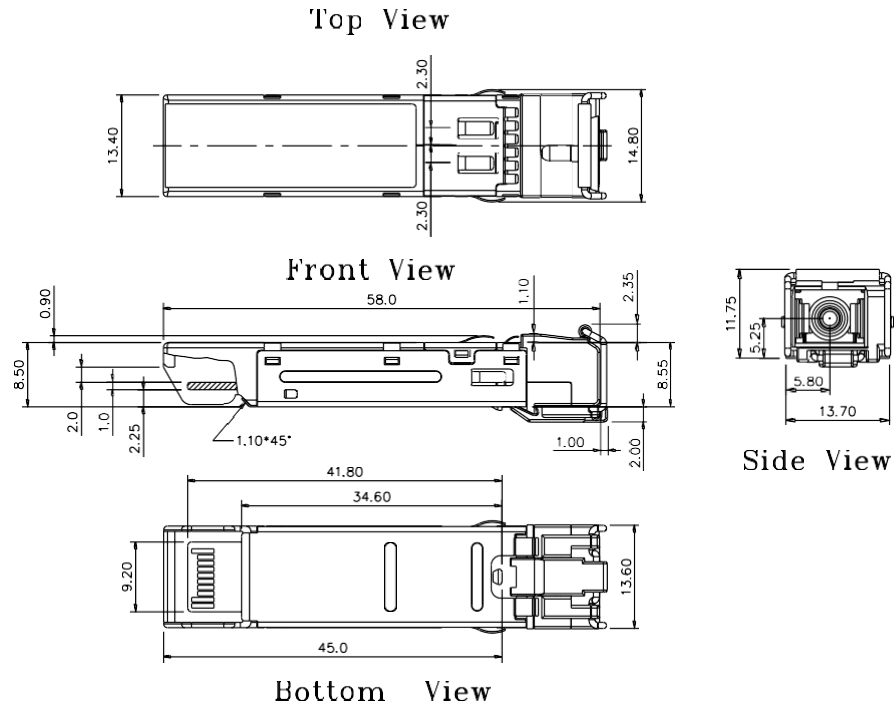
Module Definition 4 specifies a serial definition protocol. For this definition, upon power up, MOD-DEF(1:2) appear as no connector (NC) and MOD-DEF(0) is TTL LOW. When the host system detects this condition, it activates the serial protocol. The protocol uses the 2-wire serial CMOS E<sup>2</sup>PROM protocol of the ATMEL AT24C01A/02/04 family of components.

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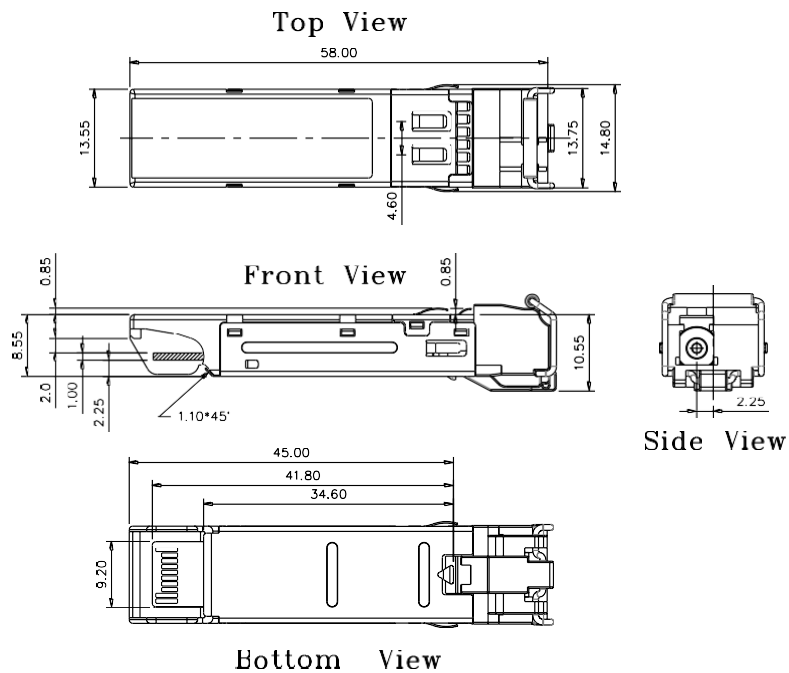
### PACKAGE DIAGRAM

Units in mm

#### A) SC SFP



#### B) LC SFP



Note: Specifications subject to change without notice.