

## Professional high-speed optical transceiver

### OPN-SLD55-160LC2 / OPN-SLD55-160LC2I

155Mbps / 160km / 100GHz DWDM Digital Diagnostic LC SFP SINGLE-MODE TRANSCEIVER

## PRODUCT FEATURES

- Hot-Pluggable SFP Footprint LC Optical Transceiver
- Small Form-Factor Pluggable (SFP) MSA compatible
  - Compliant with SONET OC-3 / SDH STM-1
    - Distance up to 160km
- Temperature-stabilized DWDM DML Transmitter
  - 37 dB Power Budget at Least
  - 100 GHz ITU Grid, C Band
- SFF-8472 Digital Diagnostic Function
- AC/AC Coupling according to MSA
  - Single +3.3 V Power Supply
    - RoHS Compliant
- 0 to 70°C Operation: OPN-SLD55-160LC2
- -50 to 85°C Operation : OPN-SLD55-160LC2I
- Class 1 Laser International Safety Standard IEC-60825Compliant

## APPLICATIONS

- ATM Switches and Routers
- SONET / SDH Switch Infrastructure
  - Fast Ethernet Applications

## PRODUCT DESCRIPTION

The OPN-SLD55-160LC2 series single mode transceiver is a small form factor pluggable module for bi-directional serial optical data communications such as SONET OC-3 /SDH STM-1 and Fast Ethernet. 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. This module is designed for single mode fiber and operates at a nominal wavelength of 100GHz ITU Grid, C Band DWDM wavelength. A guaranteed minimum optical link budget of 37 dB is offered. The transmitter section uses temperature-stabilized DWDM directly modulated laser (DML) and is class 1 laser compliant according to International Safety Standard IEC-60825. The receiver section uses an integrated InGaAs detector preamplifier (IDP) mounted in an optical header and a limiting post-amplifier IC.

## ORDER INFORMATION

| P/No.            | Bit Rate (Mb/s) | SONET /SDH | Distance (km) | Spacing (GHz) | Wavelength (nm) | Package         | Temp (°C) | RoHS Compliant |
|------------------|-----------------|------------|---------------|---------------|-----------------|-----------------|-----------|----------------|
| OPN-SLD55-160LC2 | 125 / 155       |            | 160           | 100           | DWDM*           | LC SFP with DMI | 0 to 70   | Yes            |
| OPN-SLD55-160LC2 | 125 / 155       |            | 160           | 100           | DWDM*           | LC SFP with DMI | -50 to 85 | Yes            |

\*: XX: 100GHz ITU Grid wavelength (Please see below)

| Channel # | Product code     | Frequency (THz) | Center Wavelength (nm) | Label |
|-----------|------------------|-----------------|------------------------|-------|
| 20        | OPN-SLD55-160LC2 | 192.0           | 1561.42                | D20   |
| 21        | OPN-SLD21-160LC2 | 192.1           | 1560.61                | D21   |
| 22        | OPN-SLD22-160LC2 | 192.2           | 1559.79                | D22   |
| 23        | OPN-SLD23-160LC2 | 192.3           | 1558.98                | D23   |
| 24        | OPN-SLD24-160LC2 | 192.4           | 1558.17                | D24   |
| 25        | OPN-SLD25-160LC2 | 192.5           | 1557.36                | D25   |
| 26        | OPN-SLD26-160LC2 | 192.6           | 1556.55                | D26   |
| 27        | OPN-SLD27-160LC2 | 192.7           | 1555.75                | D27   |
| 28        | OPN-SLD28-160LC2 | 192.8           | 1554.94                | D28   |
| 29        | OPN-SLD29-160LC2 | 192.9           | 1554.13                | D29   |
| 30        | OPN-SLD30-160LC2 | 193.0           | 1553.33                | D30   |
| 31        | OPN-SLD31-160LC2 | 193.1           | 1552.52                | D31   |
| 32        | OPN-SLD32-160LC2 | 193.2           | 1551.72                | D32   |
| 33        | OPN-SLD33-160LC2 | 193.3           | 1550.92                | D33   |
| 34        | OPN-SLD34-160LC2 | 193.4           | 1550.12                | D34   |

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|    |                  |       |         |     |
|----|------------------|-------|---------|-----|
| 35 | OPN-SLD35-160LC2 | 193.5 | 1549.32 | D35 |
| 36 | OPN-SLD36-160LC2 | 193.6 | 1548.51 | D36 |
| 37 | OPN-SLD37-160LC2 | 193.7 | 1547.72 | D37 |
| 38 | OPN-SLD38-160LC2 | 193.8 | 1546.92 | D38 |
| 39 | OPN-SLD39-160LC2 | 193.9 | 1546.12 | D39 |
| 40 | OPN-SLD40-160LC2 | 194.0 | 1545.32 | D40 |
| 41 | OPN-SLD41-160LC2 | 194.1 | 1544.53 | D41 |
| 42 | OPN-SLD42-160LC2 | 194.2 | 1543.73 | D42 |
| 43 | OPN-SLD43-160LC2 | 194.3 | 1542.94 | D43 |
| 44 | OPN-SLD44-160LC2 | 194.4 | 1542.14 | D44 |
| 45 | OPN-SLD45-160LC2 | 194.5 | 1541.35 | D45 |
| 46 | OPN-SLD46-160LC2 | 194.6 | 1540.56 | D46 |
| 47 | OPN-SLD47-160LC2 | 194.7 | 1539.77 | D47 |
| 48 | OPN-SLD48-160LC2 | 194.8 | 1538.98 | D48 |
| 49 | OPN-SLD49-160LC2 | 194.9 | 1538.19 | D49 |
| 50 | OPN-SLD50-160LC2 | 195.0 | 1537.40 | D50 |
| 51 | OPN-SLD51-160LC2 | 195.1 | 1536.61 | D51 |
| 52 | OPN-SLD52-160LC2 | 195.2 | 1535.82 | D52 |
| 53 | OPN-SLD53-160LC2 | 195.3 | 1535.04 | D53 |
| 54 | OPN-SLD54-160LC2 | 195.4 | 1534.25 | D54 |
| 55 | OPN-SLD55-160LC2 | 195.5 | 1533.47 | D55 |
| 56 | OPN-SLD56-160LC2 | 195.6 | 1532.68 | D56 |
| 57 | OPN-SLD57-160LC2 | 195.7 | 1531.90 | D57 |
| 58 | OPN-SLD58-160LC2 | 195.8 | 1531.12 | D58 |
| 59 | OPN-SLD59-160LC2 | 195.9 | 1530.33 | D59 |
| 60 | OPN-SLD60-160LC2 | 196.0 | 1529.55 | D60 |

### Absolute Maximum Ratings

| Parameter                  | Symbol | Min  | Max | Units | Notes             |
|----------------------------|--------|------|-----|-------|-------------------|
| Storage Temperature        | Tstg   | -50  | 85  | °C    |                   |
| Relative Humidity          | RH     | 5    | 85  | %     | Non-condensing    |
| Operating Case Temperature | Topr   | 0    | 70  | °C    | OPN-SLD55-160LC2  |
|                            |        | -50  | 85  |       | OPN-SLD55-160LC2I |
| Power Supply Voltage       | Vcc    | -0.5 | 3.6 | V     |                   |

### Recommended Operating Conditions

| Parameter                  | Symbol                  | Min  | Typ     | Max  | Units / Notes          |
|----------------------------|-------------------------|------|---------|------|------------------------|
| Power Supply Voltage       | Vcc                     | 3.13 | 3.3     | 3.47 | V                      |
| Operating Case Temperature | Topr                    | 0    |         | 70   | °C / OPN-SLD55-160LC2  |
|                            |                         | -50  |         | 85   | °C / OPN-SLD55-160LC2I |
| Relative Humidity          | RH                      | 5    |         | 85   | % / Non-condensing     |
| Power Supply Current       | I <sub>CC</sub> (TX+RX) |      |         | 430  | mA / OPN-SLD55-160LC2  |
|                            |                         |      |         | 600  | mA / OPN-SLD55-160LC2I |
| Data Rate                  |                         |      | 125/155 | 200  | Mb/s                   |

### Transmitter Specifications (0°C < Topr < 70°C, 3.13V < Vcc < 3.47V)

| Parameter                                          | Symbol              | Min   | Typ | Max   | Units | Notes             |
|----------------------------------------------------|---------------------|-------|-----|-------|-------|-------------------|
| <b>Optical</b>                                     |                     |       |     |       |       |                   |
| Average Launch Power                               | P <sub>o, AVG</sub> | +2    | --- | +5    | dBm   | 1                 |
| Center Wavelength Spacing                          |                     |       | 100 |       | GHz   | 2                 |
| Transmitter Center Wavelength<br>-- over life time | λ <sub>c</sub>      | X-100 | X   | X+100 | pm    | 3                 |
| Output Spectrum Width                              | Δλ                  | ---   |     | 1     | nm    | -20 dB width      |
| Side Mode Suppression Ratio                        | SMSR                | 30    |     |       | dB    |                   |
| Extinction Ratio                                   | E <sub>R</sub>      | 10    | --- | ---   | dB    |                   |
| 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                 |       |     | -120  | dB/Hz |                   |

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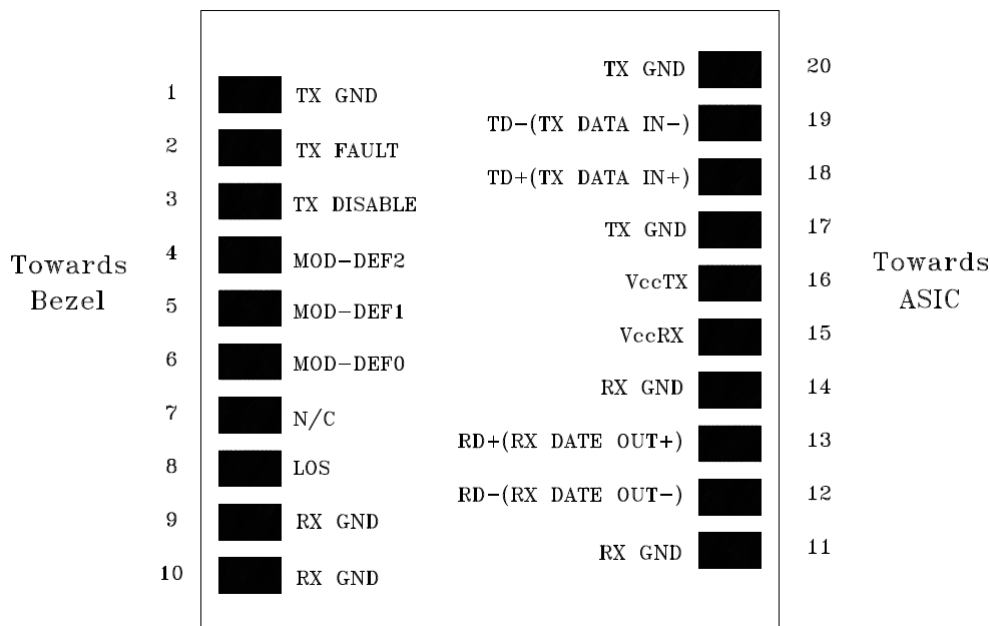
| Electrical                       |                   |      |  |              |         |              |
|----------------------------------|-------------------|------|--|--------------|---------|--------------|
| Data Input Current -- Low        | $I_{IL}$          | -350 |  |              | $\mu A$ |              |
| Data Input Current -- High       | $I_{IH}$          |      |  | 350          | $\mu A$ |              |
| Differential Input Voltage       | $V_{IH} - V_{IL}$ | 0.5  |  | 2.4          | V       | Peak-to-Peak |
| TX Disable Input Voltage -- Low  | $T_{DIS, L}$      | 0    |  | 0.5          | V       | 4            |
| TX Disable Input Voltage -- High | $T_{DIS, H}$      | 2.0  |  | $V_{CC}$     | V       | 4            |
| TX Disable Assert Time           | $T_{ASSERT}$      |      |  | 10           | $\mu s$ |              |
| TX Disable Deassert Time         | $T_{DEASSERT}$    |      |  | 1            | ms      |              |
| TX Fault Output Voltage -- Low   | $T_{FaultL}$      | 0    |  | 0.8          | V       | 5            |
| TX Fault Output Voltage -- High  | $T_{FaultH}$      | 2.0  |  | $V_{CC}+0.3$ | V       | 5            |

1. Output power is power coupled into a 9/125  $\mu m$  single-mode fiber.
2. Corresponds to approximately 0.8 nm.
3. X = specified ITU Grid wavelength
4. There is an internal 4.7K to 10K ohm pull-up resister to  $V_{CC}TX$ .
5. Open collector compatible, 4.7K to 10K ohm pull-up to  $V_{CC}$  (Host Supply Voltage).

| Receiver Specifications (0°C < Topr < 70°C, 3.13V < Vcc < 3.47V) |                   |      |     |              |       |                         |
|------------------------------------------------------------------|-------------------|------|-----|--------------|-------|-------------------------|
| Parameter                                                        | Symbol            | Min  | Typ | Max          | Units | Notes                   |
| Optical                                                          |                   |      |     |              |       |                         |
| Sensitivity                                                      | Sens              |      |     | -35          | dBm   | 6                       |
| Maximum Input Power                                              | $P_{in}$          | -10  |     |              | dBm   | 6                       |
| Signal Detect -- Asserted                                        | $P_A$             | ---  |     | -35          | dBm   | Transition: low to high |
| Signal Detect -- Deasserted                                      | $P_D$             | -47  | --- | ---          | dBm   | Transition: high to low |
| Signal Detect -- Hysteresis                                      |                   | 1.0  | --- |              | dB    |                         |
| Wavelength of Operation                                          |                   | 1100 | --- | 1620         | nm    |                         |
| Electrical                                                       |                   |      |     |              |       |                         |
| Differential Output Voltage                                      | $V_{OH} - V_{OL}$ | 0.6  |     | 2.0          | V     |                         |
| Output LOS Voltage -- Low                                        | $V_{OL}$          | 0    |     | 0.8          | V     | 7                       |
| Output LOS Voltage -- High                                       | $V_{OH}$          | 2.0  |     | $V_{CC}+0.3$ | V     | 7                       |

6. Measured at PRBS 2<sup>23</sup>-1 at BER 1E-10.
7. Open collector compatible, 4.7K to 10K ohm pull-up to  $V_{CC}$  (Host Supply Voltage)

## CONNECTION DIAGRAM



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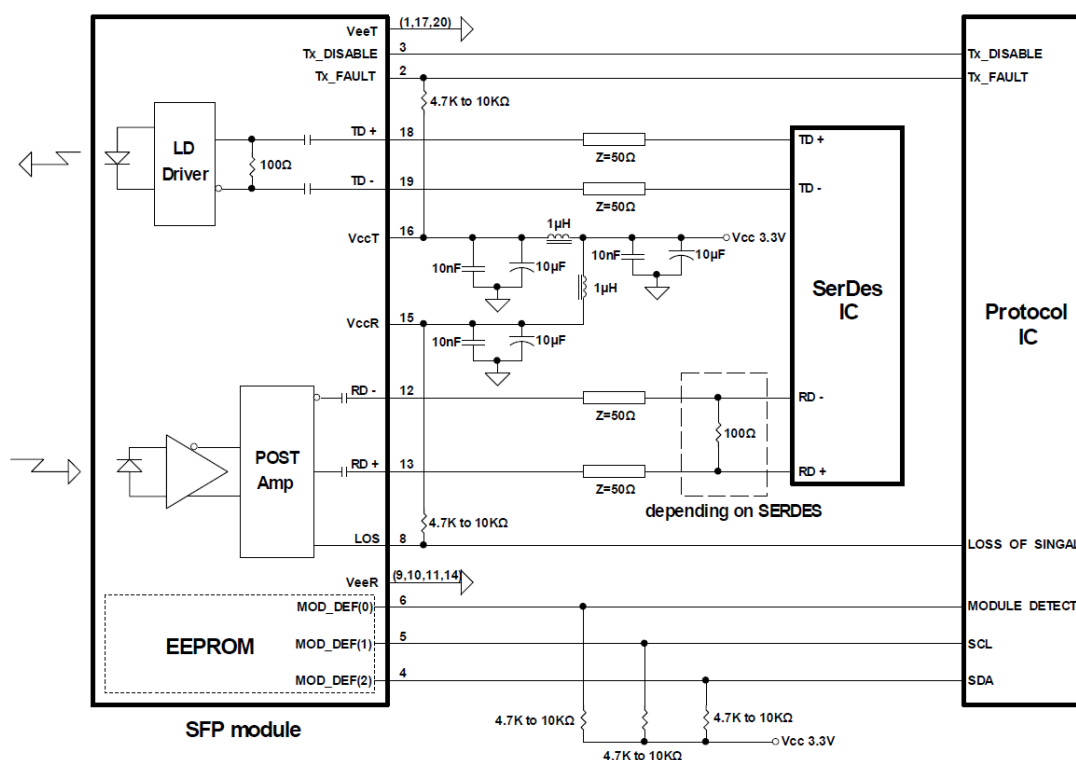
| PIN | Signal Name | Description                                             | PIN | Signal Name  | Description                 |
|-----|-------------|---------------------------------------------------------|-----|--------------|-----------------------------|
| 1   | TX GND      | Transmitter Ground                                      | 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, SDA and SCL appear as no connection (NC) and MOD-ABS 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.

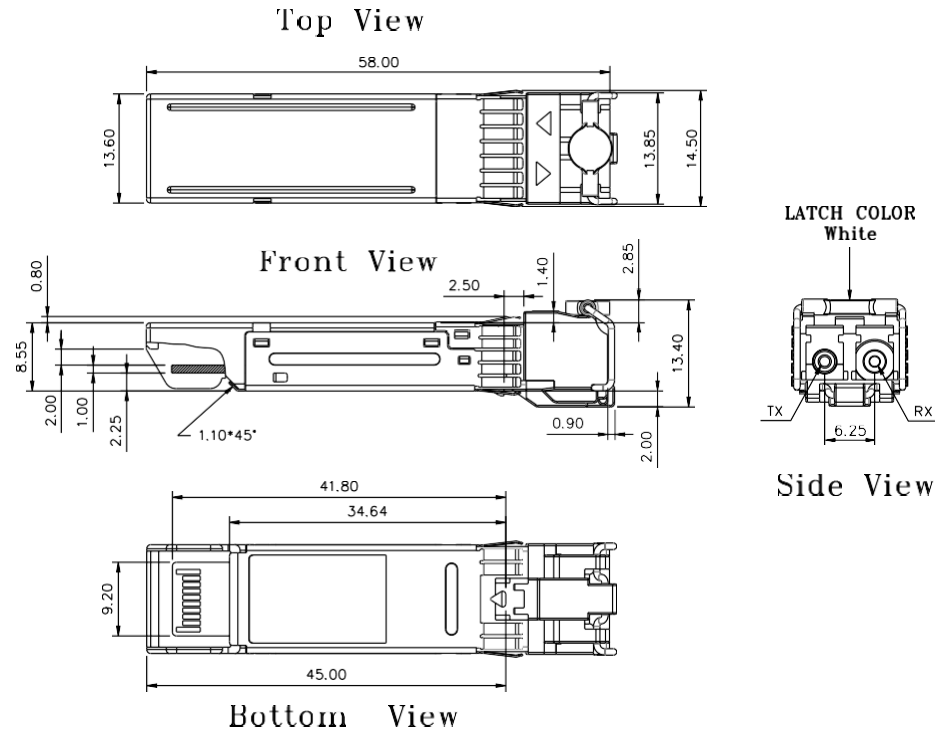
## RECOMMENDED CIRCUIT SCHEMATIC



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### PACKAGE DIAGRAM

Units in mm



**Note:** Specifications subject to change without notice.