



Professional high-speed optical transceiver

## OPN-SLD29-240LC2 / OPN-SLD29-240LC2I

155Mbps / 240km / 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 240km
- Temperature-stabilized DWDM DML Transmitter
  - 50 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-SLD29-240LC2
- -50 to 85°C Operation : OPN-SLD29-240LC2I
- Class 1 Laser International Safety Standard IEC-60825Compliant

### APPLICATIONS

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

### DESCRIPTION

The OPN-SLD29-240LC2I 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 50 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 Avalanche photodetector 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-SLD29-240LC2  | 125 / 155       |            | 240           | 100           | DWDM*           | LC SFP with DMI | 0 to 70   | Yes            |
| OPN-SLD29-240LC2I | 125 / 155       |            | 240           | 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-SLD29-240LC2 | 192.0           | 1561.42                | D20   |
| 21        | OPN-SLD21-240LC2 | 192.1           | 1560.61                | D21   |
| 22        | OPN-SLD22-240LC2 | 192.2           | 1559.79                | D22   |
| 23        | OPN-SLD23-240LC2 | 192.3           | 1558.98                | D23   |
| 24        | OPN-SLD24-240LC2 | 192.4           | 1558.17                | D24   |
| 25        | OPN-SLD25-240LC2 | 192.5           | 1557.36                | D25   |
| 26        | OPN-SLD26-240LC2 | 192.6           | 1556.55                | D26   |
| 27        | OPN-SLD27-240LC2 | 192.7           | 1555.75                | D27   |
| 28        | OPN-SLD28-240LC2 | 192.8           | 1554.94                | D28   |
| 29        | OPN-SLD29-240LC2 | 192.9           | 1554.13                | D29   |
| 30        | OPN-SLD30-240LC2 | 193.0           | 1553.33                | D30   |
| 31        | OPN-SLD31-240LC2 | 193.1           | 1552.52                | D31   |
| 32        | OPN-SLD32-240LC2 | 193.2           | 1551.72                | D32   |



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|    |                  |       |         |     |
|----|------------------|-------|---------|-----|
| 33 | OPN-SLD33-240LC2 | 193.3 | 1550.92 | D33 |
| 34 | OPN-SLD34-240LC2 | 193.4 | 1550.12 | D34 |
| 35 | OPN-SLD35-240LC2 | 193.5 | 1549.32 | D35 |
| 36 | OPN-SLD36-240LC2 | 193.6 | 1548.51 | D36 |
| 37 | OPN-SLD37-240LC2 | 193.7 | 1547.72 | D37 |
| 38 | OPN-SLD38-240LC2 | 193.8 | 1546.92 | D38 |
| 39 | OPN-SLD39-240LC2 | 193.9 | 1546.12 | D39 |
| 40 | OPN-SLD40-240LC2 | 194.0 | 1545.32 | D40 |
| 41 | OPN-SLD41-240LC2 | 194.1 | 1544.53 | D41 |
| 42 | OPN-SLD42-240LC2 | 194.2 | 1543.73 | D42 |
| 43 | OPN-SLD43-240LC2 | 194.3 | 1542.94 | D43 |
| 44 | OPN-SLD44-240LC2 | 194.4 | 1542.14 | D44 |
| 45 | OPN-SLD45-240LC2 | 194.5 | 1541.35 | D45 |
| 46 | OPN-SLD46-240LC2 | 194.6 | 1540.56 | D46 |
| 47 | OPN-SLD47-240LC2 | 194.7 | 1539.77 | D47 |
| 48 | OPN-SLD48-240LC2 | 194.8 | 1538.98 | D48 |
| 49 | OPN-SLD49-240LC2 | 194.9 | 1538.19 | D49 |
| 50 | OPN-SLD50-240LC2 | 195.0 | 1537.40 | D50 |
| 51 | OPN-SLD51-240LC2 | 195.1 | 1536.61 | D51 |
| 52 | OPN-SLD52-240LC2 | 195.2 | 1535.82 | D52 |
| 53 | OPN-SLD53-240LC2 | 195.3 | 1535.04 | D53 |
| 54 | OPN-SLD54-240LC2 | 195.4 | 1534.25 | D54 |
| 55 | OPN-SLD55-240LC2 | 195.5 | 1533.47 | D55 |
| 56 | OPN-SLD56-240LC2 | 195.6 | 1532.68 | D56 |
| 57 | OPN-SLD57-240LC2 | 195.7 | 1531.90 | D57 |
| 58 | OPN-SLD58-240LC2 | 195.8 | 1531.12 | D58 |
| 59 | OPN-SLD59-240LC2 | 195.9 | 1530.33 | D59 |
| 60 | OPN-SLD60-240LC2 | 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-SLD29-240LC2  |
|                            |        | -50  | 85  |       | OPN-SLD29-240LC2I |
| 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-SLD29-240LC2  |
|                            |                         | -50  |         | 85   | °C / OPN-SLD29-240LC2I |
| Relative Humidity          | RH                      | 5    |         | 85   | % / Non-condensing     |
| Power Supply Current       | I <sub>CC</sub> (TX+RX) |      |         | 430  | mA / OPN-SLD29-240LC2  |
|                            |                         |      |         | 600  | mA / OPN-SLD29-240LC2I |
| 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> | +5    | --- | +8    | dBm   | 1                 |
| Center Wavelength Spacing     |                     |       | 100 |       | GHz   | 2                 |
| Transmitter Center Wavelength | λ <sub>c</sub>      | X-100 | X   | X+100 | pm    | 3                 |
| -- over life time             |                     |       |     |       |       |                   |
| 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 |



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|                                  |                   |      |  |              |         |                   |
|----------------------------------|-------------------|------|--|--------------|---------|-------------------|
| Optical Fall Time                | $t_f$             |      |  | 2            | ns      | 10% to 90% Values |
| Relative Intensity Noise         | RIN               |      |  | -120         | dB/Hz   |                   |
| <b>Electrical</b>                |                   |      |  |              |         |                   |
| 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                 |

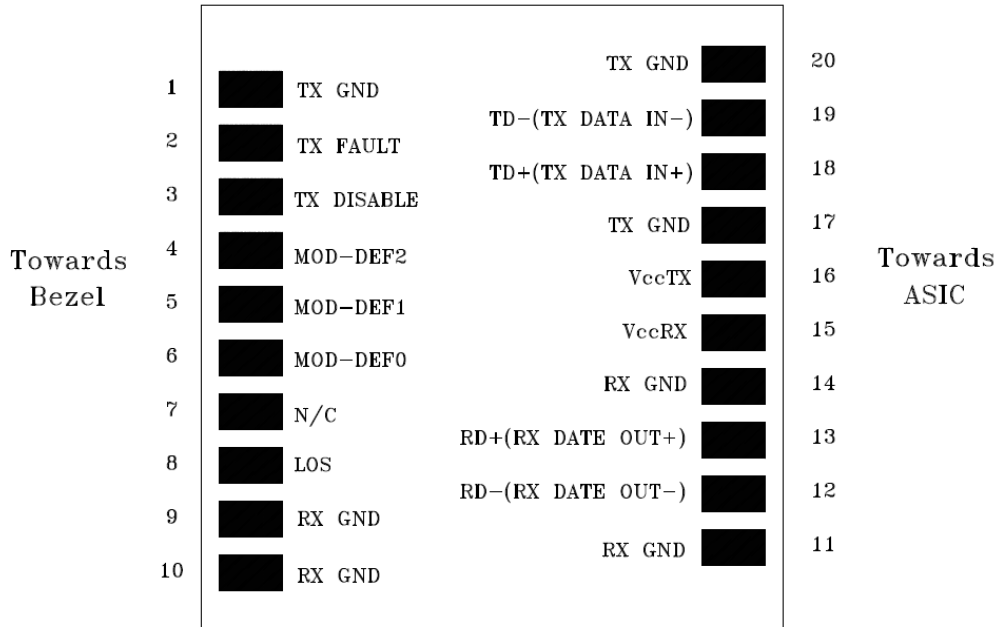
- Output power is power coupled into a 9/125  $\mu m$  single-mode fiber.
- Corresponds to approximately 0.8 nm.
- X = specified ITU Grid wavelength
- There is an internal 4.7K to 10K ohm pull-up resistor to  $V_{CCTX}$ .
- Open collector compatible, 4.7K to 10K ohm pull-up to  $V_{CC}$  (Host Supply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

| Receiver Specifications (0°C < Topr < 70°C, 3.13V < Vcc < 3.47V) |                   |      |     |              |       |                         |
|------------------------------------------------------------------|-------------------|------|-----|--------------|-------|-------------------------|
| Parameter                                                        | Symbol            | Min  | Typ | Max          | Units | Notes                   |
| <b>Optical</b>                                                   |                   |      |     |              |       |                         |
| Sensitivity                                                      | Sens              |      |     | -45          | dBm   | 6                       |
| Maximum Input Power                                              | $P_{in}$          | -10  |     |              | dBm   | 6                       |
| Signal Detect -- Asserted                                        | $P_A$             | ---  |     | -45          | dBm   | Transition: low to high |
| Signal Detect -- Deasserted                                      | $P_D$             | -55  | --- | ---          | dBm   | Transition: high to low |
| Signal Detect -- Hysteresis                                      |                   | 1.0  | --- |              | dB    |                         |
| Wavelength of Operation                                          |                   | 1100 | --- | 1620         | nm    |                         |
| <b>Electrical</b>                                                |                   |      |     |              |       |                         |
| 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                       |

- Measured at PRBS 2<sup>23</sup>-1 at BER 1E-10. Receiver sensitivity is better than -45dBm at 155 Mbps and 125 Mbps. However, due to the resolution limitation of Digital Diagnostic Monitoring, the effect readout range for the RX received power at EEPROM A2 is from -10 to -34 dBm.
- Open collector compatible, 4.7K to 10K ohm pull-up to  $V_{CC}$  (Host Supply Voltage)

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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          |

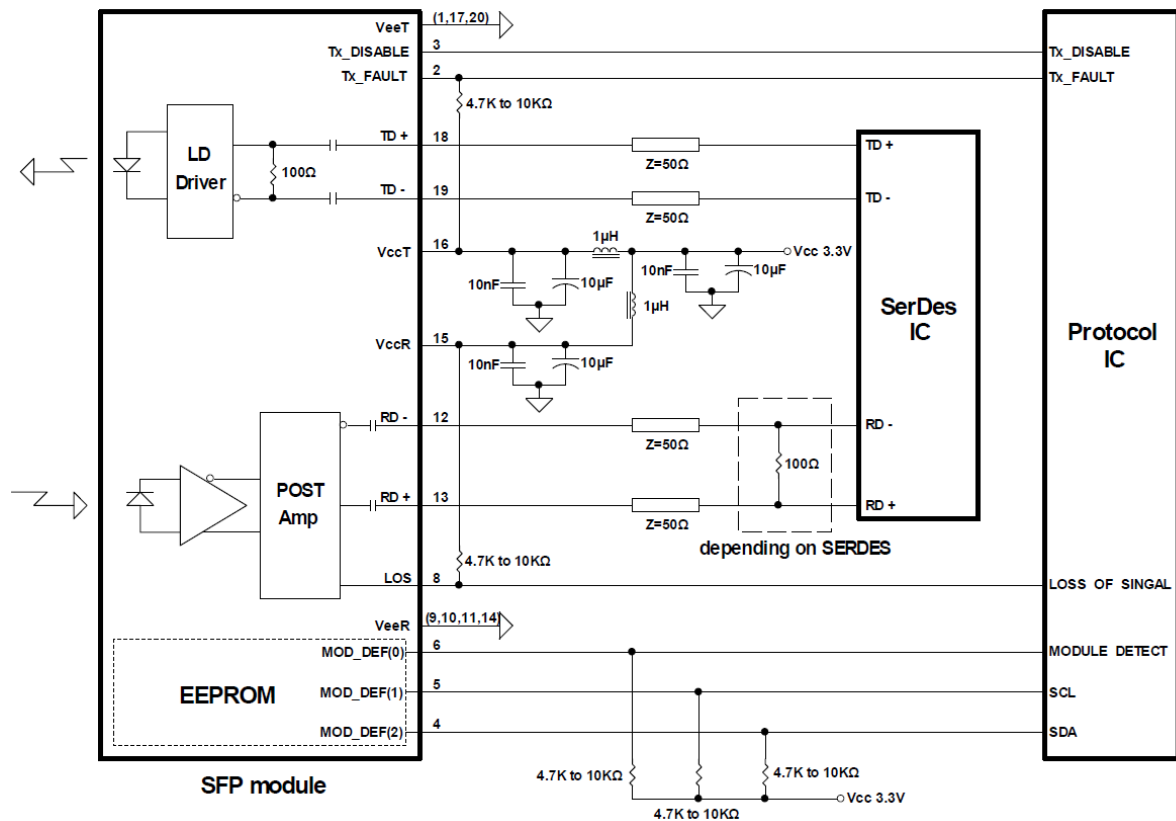
### MODULE DEFINITION

| 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, 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.

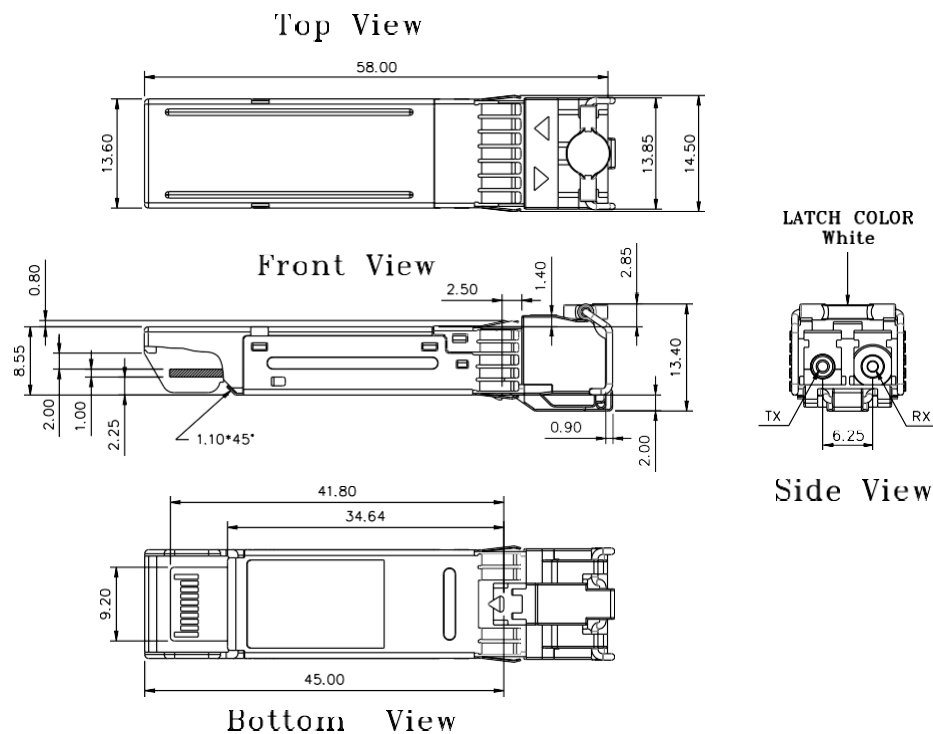
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### RECOMMENDED CIRCUIT SCHEMATIC



### PACKAGE DIAGRAM

Units in mm



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