

## Professional high-speed optical transceiver

### OPN-SGD31-120LC2 / OPN-SGD31-120LC2I

1.25Gbps / 120km / 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 IEEE 802.3z Gigabit Ethernet
- Compliant with Fibre Channel FC-PI 100-SM-LL-V
  - Distance up to 120km
- Temperature-stabilized DWDM DML Transmitter
  - 32 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-SGD31-120LC2
  - -50 to 85°C Operation : OPN-SGD31-120LC2I
- Class 1 Laser International Safety Standard IEC-60825Compliant

## APPLICATIONS

- Gigabit Ethernet Switches and Routers
- Fibre Channel Switch Infrastructure
  - XDSL Applications
  - Metro Edge Switching
- CPRI option 2: 1228.8 Mbit/s
- CPRI option 1: 614.4 Mbit/s
  - OBSAI 768 MBaud

## PRODUCT DESCRIPTION

The OPN-SGD31-120LC2 series single mode transceiver is a small form factor pluggable module for bi-directional serial optical data communications such as Gigabit Ethernet 1000BASE-ZX and Fibre Channel FC-PI 100-SM-LL-V. It is with the SFP 20-pin connector to allow hot plug capability. Digital diagnostic functions are available via anI<sup>2</sup>C. This module is designed for single mode fiber and operates at a nominal wavelength of 100GHz ITU Grid, CBand DWDM wavelength. A guaranteed minimum optical link budget of 32 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 mounted in an optical header and a limiting post-amplifier IC.

## ORDER INFORMATION

| P/No.             | Bit Rate (Gb/s) | 1000BASE | Distance (km) | Spacing (GHz) | Wavelength (nm) | Package         | Temp (°C) | RoHS Compliant |
|-------------------|-----------------|----------|---------------|---------------|-----------------|-----------------|-----------|----------------|
| OPN-SGD31-120LC2  | 1.25            |          | 120           | 100           | DWDM*           | LC SFP with DMI | 0 to 70   | Yes            |
| OPN-SGD31-120LC2I | 1.25            |          | 120           | 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-SGD31-120LC2 | 192.0           | 1561.42                | D20   |
| 21        | OPN-SGD21-120LC2 | 192.1           | 1560.61                | D21   |
| 22        | OPN-SGD22-120LC2 | 192.2           | 1559.79                | D22   |
| 23        | OPN-SGD23-120LC2 | 192.3           | 1558.98                | D23   |
| 24        | OPN-SGD24-120LC2 | 192.4           | 1558.17                | D24   |
| 25        | OPN-SGD25-120LC2 | 192.5           | 1557.36                | D25   |
| 26        | OPN-SGD26-120LC2 | 192.6           | 1556.55                | D26   |
| 27        | OPN-SGD27-120LC2 | 192.7           | 1555.75                | D27   |

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|    |                  |       |         |     |
|----|------------------|-------|---------|-----|
| 28 | OPN-SGD28-120LC2 | 192.8 | 1554.94 | D28 |
| 29 | OPN-SGD29-120LC2 | 192.9 | 1554.13 | D29 |
| 30 | OPN-SGD30-120LC2 | 193.0 | 1553.33 | D30 |
| 31 | OPN-SGD31-120LC2 | 193.1 | 1552.52 | D31 |
| 32 | OPN-SGD32-120LC2 | 193.2 | 1551.72 | D32 |
| 33 | OPN-SGD33-120LC2 | 193.3 | 1550.92 | D33 |
| 34 | OPN-SGD34-120LC2 | 193.4 | 1550.12 | D34 |
| 35 | OPN-SGD35-120LC2 | 193.5 | 1549.32 | D35 |
| 36 | OPN-SGD36-120LC2 | 193.6 | 1548.51 | D36 |
| 37 | OPN-SGD37-120LC2 | 193.7 | 1547.72 | D37 |
| 38 | OPN-SGD38-120LC2 | 193.8 | 1546.92 | D38 |
| 39 | OPN-SGD39-120LC2 | 193.9 | 1546.12 | D39 |
| 40 | OPN-SGD40-120LC2 | 194.0 | 1545.32 | D40 |
| 41 | OPN-SGD41-120LC2 | 194.1 | 1544.53 | D41 |
| 42 | OPN-SGD42-120LC2 | 194.2 | 1543.73 | D42 |
| 43 | OPN-SGD43-120LC2 | 194.3 | 1542.94 | D43 |
| 44 | OPN-SGD44-120LC2 | 194.4 | 1542.14 | D44 |
| 45 | OPN-SGD45-120LC2 | 194.5 | 1541.35 | D45 |
| 46 | OPN-SGD46-120LC2 | 194.6 | 1540.56 | D46 |
| 47 | OPN-SGD47-120LC2 | 194.7 | 1539.77 | D47 |
| 48 | OPN-SGD48-120LC2 | 194.8 | 1538.98 | D48 |
| 49 | OPN-SGD49-120LC2 | 194.9 | 1538.19 | D49 |
| 50 | OPN-SGD50-120LC2 | 195.0 | 1537.40 | D50 |
| 51 | OPN-SGD51-120LC2 | 195.1 | 1536.61 | D51 |
| 52 | OPN-SGD52-120LC2 | 195.2 | 1535.82 | D52 |
| 53 | OPN-SGD53-120LC2 | 195.3 | 1535.04 | D53 |
| 54 | OPN-SGD54-120LC2 | 195.4 | 1534.25 | D54 |
| 55 | OPN-SGD55-120LC2 | 195.5 | 1533.47 | D55 |
| 56 | OPN-SGD56-120LC2 | 195.6 | 1532.68 | D56 |
| 57 | OPN-SGD57-120LC2 | 195.7 | 1531.90 | D57 |
| 58 | OPN-SGD58-120LC2 | 195.8 | 1531.12 | D58 |
| 59 | OPN-SGD59-120LC2 | 195.9 | 1530.33 | D59 |
| 60 | OPN-SGD60-120LC2 | 196.0 | 1529.55 | D60 |

#### Absolute Maximum Ratings

| Parameter                  | Symbol           | Min  | Max | Units | Notes             |
|----------------------------|------------------|------|-----|-------|-------------------|
| Storage Temperature        | T <sub>stg</sub> | -50  | 85  | °C    |                   |
| Relative Humidity          | RH               | 5    | 85  | %     | Non-condensing    |
| Operating Case Temperature | T <sub>opr</sub> | 0    | 70  | °C    | OPN-SGD31-120LC2  |
|                            |                  | -50  | 85  |       | OPN-SGD31-120LC2I |
| Power Supply Voltage       | V <sub>cc</sub>  | -0.5 | 3.6 | V     |                   |

#### Recommended Operating Conditions

| Parameter                  | Symbol                 | Min  | Typ  | Max  | Units / Notes          |
|----------------------------|------------------------|------|------|------|------------------------|
| Power Supply Voltage       | V <sub>cc</sub>        | 3.13 | 3.3  | 3.47 | V                      |
| Operating Case Temperature | T <sub>opr</sub>       | 0    |      | 70   | °C / OPN-SGD31-120LC2  |
|                            |                        | -50  |      | 85   | °C / OPN-SGD31-120LC2I |
| Relative Humidity          | RH                     | 5    |      | 85   | % / Non-condensing     |
| Power Supply Current       | I <sub>CC(TX+RX)</sub> |      |      | 430  | mA / OPN-SGD31-120LC2  |
|                            |                        |      |      | 600  | mA / OPN-SGD31-120LC2I |
| Data Rate                  |                        | 100  | 1250 |      | Mb/s                   |

#### Transmitter Specifications (0°C < T<sub>opr</sub> < 70°C, 3.13V < V<sub>cc</sub> < 3.47V)

| Parameter                     | Symbol              | Min   | Typ | Max   | Units | Notes |
|-------------------------------|---------------------|-------|-----|-------|-------|-------|
| <b>Optical</b>                |                     |       |     |       |       |       |
| Average Launch Power          | P <sub>o, AVG</sub> | 0     | --- | +5    | 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             |                     |       |     |       |       |       |

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|                                  |                   |      |     |         |         |                   |
|----------------------------------|-------------------|------|-----|---------|---------|-------------------|
| Output Spectrum Width            | $\Delta\lambda$   | ---  |     | 1       | nm      | -20 dB width      |
| Side Mode Suppression Ratio      | SMSR              | 30   |     |         | dB      |                   |
| Extinction Ratio                 | $E_R$             | 9    | --- | ---     | dB      |                   |
| Optical Rise Time                | $t_r$             |      |     | 260     | ps      | 20% to 80% Values |
| Optical Fall Time                | $t_f$             |      |     | 260     | ps      | 20% to 80% 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  |     | Vcc     | 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    |     | 0.5     | V       | 5                 |
| TX Fault Output Voltage -- High  | $T_{FaultH}$      | 2.0  |     | Vcc+0.3 | V       | 5                 |

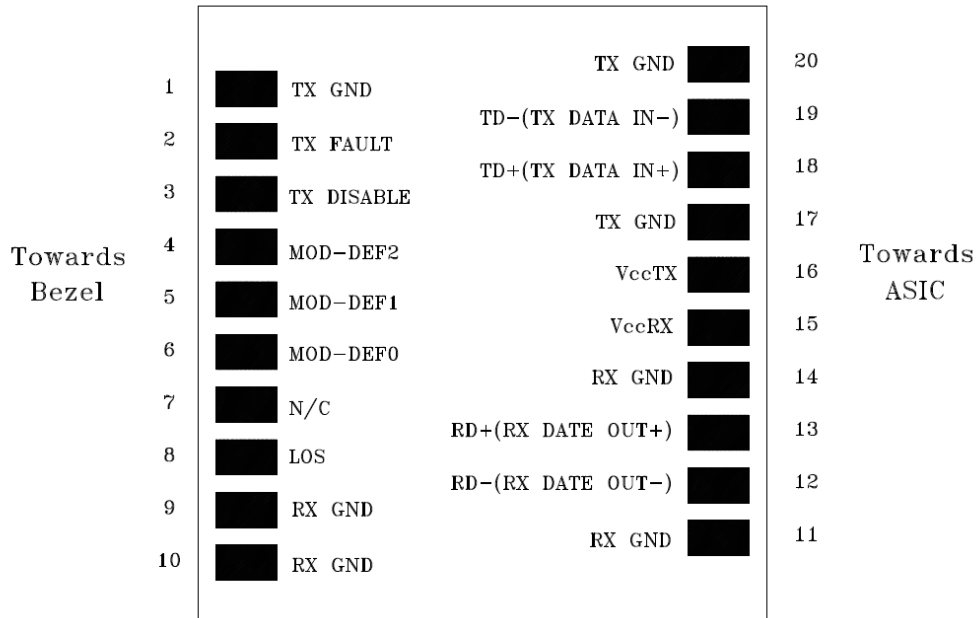
1. Output power is power coupled into a 9/125  $\mu$ m single-mode fiber.
2. Corresponds to approximately 0.8 nm.
3. X = specified ITU Grid wavelength
4. There is an internal 4.7K to 10K ohm pull-up resistor to VccTX.
5. Open collector compatible, 4.7K to 10K ohm pull-up to Vcc (Host Supply Voltage).

| Receiver Specifications (0°C < Topr < 70°C, 3.13V < Vcc < 3.47V) |                   |      |     |         |       |                         |
|--|-------------------|------|-----|---------|-------|-------------------------|
| Parameter  | Symbol            | Min  | Typ | Max     | Units | Notes                   |
| <b>Optical</b>   |                   |      |     |         |       |                         |
| Sensitivity  | Sens              |      |     | -32     | dBm   | 6                       |
| Maximum Input Power  | $P_{in}$          | -9   |     |         | dBm   | 6                       |
| Signal Detect -- Asserted  | $P_A$             | ---  |     | -32     | dBm   | Transition: low to high |
| Signal Detect -- Deasserted                                      | $P_D$             | -45  | --- | ---     | 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    |     | 0.5     | V     | 7                       |
| Output LOS Voltage -- High                                       | $V_{OH}$          | 2.0  |     | Vcc+0.3 | V     | 7                       |

6. Measured at PRBS 2<sup>7</sup>-1 at BER 1E-12.
7. Open collector compatible, 4.7K to 10K ohm pull-up to Vcc (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.

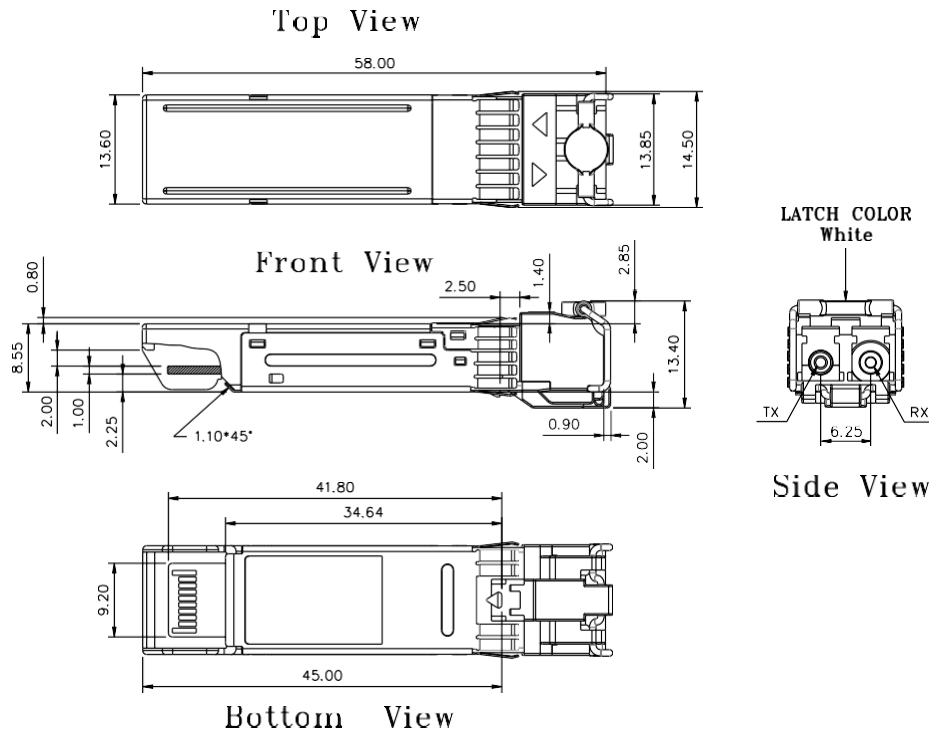
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### RECOMMENDED CIRCUIT SCHEMATIC



### PACKAGE DIAGRAM

Units in mm



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