

## Professional high-speed optical transceiver

### OPN-SFD32-80LC2 / OPN-SFD32-80LC2I

622Mbps / 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 SONET OC-12 / SDH STM-4
    - Distance up to 120km
- Temperature-stabilized DWDM DML Transmitter
  - 34 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-SFD32-120LC2
- -50 to 85°C Operation : OPN-SFD32-120LC2I
- Class 1 Laser International Safety Standard IEC-60825Compliant

## APPLICATIONS

- ATM Switches and Routers
- SONET / SDH Switch Infrastructure
  - XDSL Applications
  - Metro Edge Switching
- CPRI option 1: 614.4 Mbit/s

## PRODUCT DESCRIPTION

The OPN-SFD32-120LC2 series single mode transceiver is a small form factor pluggable module for bi-directional serial optical data communications such as SONET OC-12 / SDH STM-4 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 34 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<br>(Mb/s) | SONET<br>/SDH | Distance<br>(km) | Spacing<br>(GHz) | Wavelength<br>(nm) | Package         | Temp<br>(°C) | RoHS<br>Compliant |
|-------------------|--------------------|---------------|------------------|------------------|--------------------|-----------------|--------------|-------------------|
| OPN-SFD32-120LC2  | 622                |               | 120              | 100              | DWDM*              | LC SFP with DMI | 0 to 70      | Yes               |
| OPN-SFD32-120LC2I | 622                |               | 120              | 100              | DWDM*              | LC SFP with DMI | -50 to 85    | Yes               |

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

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| Channel # | Product code                         | Frequency (THz) | Center Wavelength (nm) | Label |
|-----------|--------------------------------------|-----------------|------------------------|-------|
| 20        | OPN-SFD20-120LC2 / OPN-SFD20-120LC2I | 192.0           | 1561.42                | D20   |
| 21        | OPN-SFD21-120LC2 / OPN-SFD21-120LC2I | 192.1           | 1560.61                | D21   |
| 22        | OPN-SFD22-120LC2 / OPN-SFD22-120LC2I | 192.2           | 1559.79                | D22   |
| 23        | OPN-SFD23-120LC2 / OPN-SFD23-120LC2I | 192.3           | 1558.98                | D23   |
| 24        | OPN-SFD24-120LC2 / OPN-SFD24-120LC2I | 192.4           | 1558.17                | D24   |
| 25        | OPN-SFD25-120LC2 / OPN-SFD25-120LC2I | 192.5           | 1557.36                | D25   |
| 26        | OPN-SFD26-120LC2 / OPN-SFD26-120LC2I | 192.6           | 1556.55                | D26   |
| 27        | OPN-SFD27-120LC2 / OPN-SFD27-120LC2I | 192.7           | 1555.75                | D27   |
| 28        | OPN-SFD28-120LC2 / OPN-SFD28-120LC2I | 192.8           | 1554.94                | D28   |
| 29        | OPN-SFD29-120LC2 / OPN-SFD29-120LC2I | 192.9           | 1554.13                | D29   |
| 30        | OPN-SFD30-120LC2 / OPN-SFD30-120LC2I | 193.0           | 1553.33                | D30   |
| 31        | OPN-SFD31-120LC2 / OPN-SFD31-120LC2I | 193.1           | 1552.52                | D31   |
| 32        | OPN-SFD32-120LC2 / OPN-SFD32-120LC2I | 193.2           | 1551.72                | D32   |
| 33        | OPN-SFD33-120LC2 / OPN-SFD33-120LC2I | 193.3           | 1550.92                | D33   |
| 34        | OPN-SFD34-120LC2 / OPN-SFD34-120LC2I | 193.4           | 1550.12                | D34   |
| 35        | OPN-SFD35-120LC2 / OPN-SFD35-120LC2I | 193.5           | 1549.32                | D35   |
| 36        | OPN-SFD36-120LC2 / OPN-SFD36-120LC2I | 193.6           | 1548.51                | D36   |
| 37        | OPN-SFD37-120LC2 / OPN-SFD37-120LC2I | 193.7           | 1547.72                | D37   |
| 38        | OPN-SFD38-120LC2 / OPN-SFD38-120LC2I | 193.8           | 1546.92                | D38   |
| 39        | OPN-SFD39-120LC2 / OPN-SFD39-120LC2I | 193.9           | 1546.12                | D39   |
| 40        | OPN-SFD40-120LC2 / OPN-SFD40-120LC2I | 194.0           | 1545.32                | D40   |
| 41        | OPN-SFD41-120LC2 / OPN-SFD41-120LC2I | 194.1           | 1544.53                | D41   |
| 42        | OPN-SFD42-120LC2 / OPN-SFD42-120LC2I | 194.2           | 1543.73                | D42   |
| 43        | OPN-SFD43-120LC2 / OPN-SFD43-120LC2I | 194.3           | 1542.94                | D43   |
| 44        | OPN-SFD44-120LC2 / OPN-SFD44-120LC2I | 194.4           | 1542.14                | D44   |
| 45        | OPN-SFD45-120LC2 / OPN-SFD45-120LC2I | 194.5           | 1541.35                | D45   |
| 46        | OPN-SFD46-120LC2 / OPN-SFD46-120LC2I | 194.6           | 1540.56                | D46   |
| 47        | OPN-SFD47-120LC2 / OPN-SFD47-120LC2I | 194.7           | 1539.77                | D47   |
| 48        | OPN-SFD48-120LC2 / OPN-SFD48-120LC2I | 194.8           | 1538.98                | D48   |
| 49        | OPN-SFD49-120LC2 / OPN-SFD49-120LC2I | 194.9           | 1538.19                | D49   |
| 50        | OPN-SFD50-120LC2 / OPN-SFD50-120LC2I | 195.0           | 1537.40                | D50   |
| 51        | OPN-SFD51-120LC2 / OPN-SFD51-120LC2I | 195.1           | 1536.61                | D51   |
| 52        | OPN-SFD52-120LC2 / OPN-SFD52-120LC2I | 195.2           | 1535.82                | D52   |
| 53        | OPN-SFD53-120LC2 / OPN-SFD53-120LC2I | 195.3           | 1535.04                | D53   |
| 54        | OPN-SFD54-120LC2 / OPN-SFD54-120LC2I | 195.4           | 1534.25                | D54   |
| 55        | OPN-SFD55-120LC2 / OPN-SFD55-120LC2I | 195.5           | 1533.47                | D55   |
| 56        | OPN-SFD56-120LC2 / OPN-SFD56-120LC2I | 195.6           | 1532.68                | D56   |
| 57        | OPN-SFD57-120LC2 / OPN-SFD57-120LC2I | 195.7           | 1531.90                | D57   |
| 58        | OPN-SFD58-120LC2 / OPN-SFD58-120LC2I | 195.8           | 1531.12                | D58   |
| 59        | OPN-SFD59-120LC2 / OPN-SFD59-120LC2I | 195.9           | 1530.33                | D59   |
| 60        | OPN-SFD60-120LC2 / OPN-SFD60-120LC2I | 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-SFD32-120LC2  |
|                            |        | -50  | 85  |       | OPN-SFD32-120LC2I |
| 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-SFD32-120LC2  |
|                            |                         | -50  |     | 85   | °C / OPN-SFD32-120LC2I |
| Relative Humidity          | RH                      | 5    |     | 85   | % / Non-condensing     |
| Power Supply Current       | I <sub>CC</sub> (TX+RX) |      |     | 430  | mA / OPN-SFD32-120LC2  |
|                            |                         |      |     | 600  | mA / OPN-SFD32-120LC2I |
| Data Rate                  |                         |      | 622 |      | Mb/s                   |

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| 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                                                | Po, AVG                           | 0     | --- | +5      | dBm     | 1                 |
| Center Wavelength Spacing                                           |                                   |       | 100 |         | GHz     | 2                 |
| Transmitter Center Wavelength<br>-- over life time                  | $\lambda_c$                       | X-100 | X   | X+100   | pm      | 3                 |
| Output Spectrum Width                                               | $\Delta\lambda$                   | ---   |     | 1       | nm      | -20 dB width      |
| Side Mode Suppression Ratio                                         | SMSR                              | 30    |     |         | dB      |                   |
| Extinction Ratio                                                    | ER                                | 10    | --- | ---     | dB      |                   |
| Optical Rise Time                                                   | tr                                |       |     | 1.2     | ns      | 10% to 90% Values |
| Optical Fall Time                                                   | tf                                |       |     | 1.2     | ns      | 10% to 90% Values |
| Relative Intensity Noise                                            | RIN                               |       |     | -120    | dB/Hz   |                   |
| <b>Electrical</b>                                                   |                                   |       |     |         |         |                   |
| Data Input Current -- Low                                           | IIL                               | -350  |     |         | $\mu$ A |                   |
| Data Input Current -- High                                          | I <sub>IH</sub>                   |       |     | 350     | $\mu$ A |                   |
| 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       | 4                 |
| TX Disable Input Voltage -- High                                    | T <sub>DIS, H</sub>               | 2.0   |     | Vcc     | V       | 4                 |
| TX Disable Assert Time                                              | T <sub>ASSERT</sub>               |       |     | 10      | $\mu$ s |                   |
| TX Disable Deassert Time                                            | T <sub>DEASSERT</sub>             |       |     | 1       | ms      |                   |
| TX Fault Output Voltage -- Low                                      | T <sub>FaultL</sub>               | 0     |     | 0.5     | V       | 5                 |
| TX Fault Output Voltage -- High                                     | T <sub>FaultH</sub>               | 2.0   |     | Vcc+0.3 | V       | 5                 |

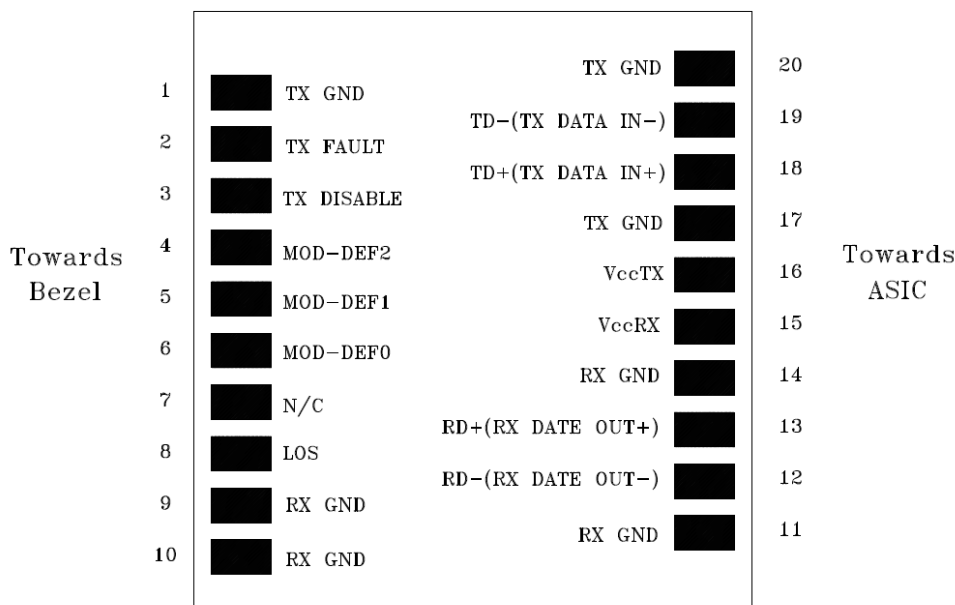
1. Output power is power coupled into a 9/125  $\mu$ m single-mode fiber.
2. Corresponds to approximately 0.8 nm.
3. X = specified ITU Grid wavelength
4. There is an internal 4.7K to 10K ohm pull-up resistor to VccTX.
5. Open collector compatible, 4.7K to 10K ohm pull-up to Vcc (Host Supply Voltage).

| Receiver Specifications (0°C < Topr < 70°C, 3.13V < Vcc < 3.47V) |                                   |      |     |         |       |                         |
|------------------------------------------------------------------|-----------------------------------|------|-----|---------|-------|-------------------------|
| Parameter                                                        | Symbol                            | Min  | Typ | Max     | Units | Notes                   |
| <b>Optical</b>                                                   |                                   |      |     |         |       |                         |
| Sensitivity                                                      | Sens                              |      |     | -34     | dBm   | 6                       |
| Maximum Input Power                                              | P <sub>in</sub>                   | -9   |     |         | dBm   | 6                       |
| Signal Detect -- Asserted                                        | P <sub>A</sub>                    | ---  |     | -34     | dBm   | Transition: low to high |
| Signal Detect -- Deasserted                                      | P <sub>D</sub>                    | -47  | --- | ---     | dBm   | Transition: high to low |
| Signal Detect -- Hysteresis                                      |                                   | 1.0  | --- |         | dB    |                         |
| Wavelength of Operation                                          |                                   | 1100 | --- | 1620    | nm    |                         |
| <b>Electrical</b>                                                |                                   |      |     |         |       |                         |
| Differential Output Voltage                                      | V <sub>OH</sub> - V <sub>OL</sub> | 0.6  |     | 2.0     | V     |                         |
| Output LOS Voltage -- Low                                        | V <sub>OL</sub>                   | 0    |     | 0.5     | V     | 7                       |
| Output LOS Voltage -- High                                       | V <sub>OH</sub>                   | 2.0  |     | Vcc+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 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-DEF2    | 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          |

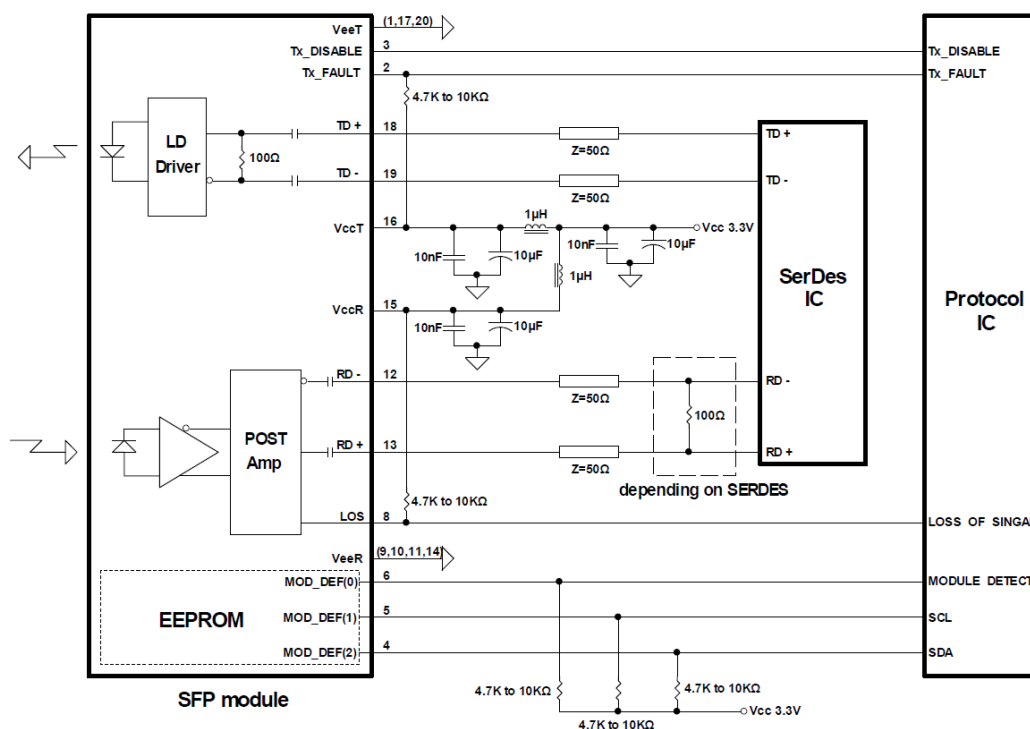
### MODULE DEFINITION

| 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.

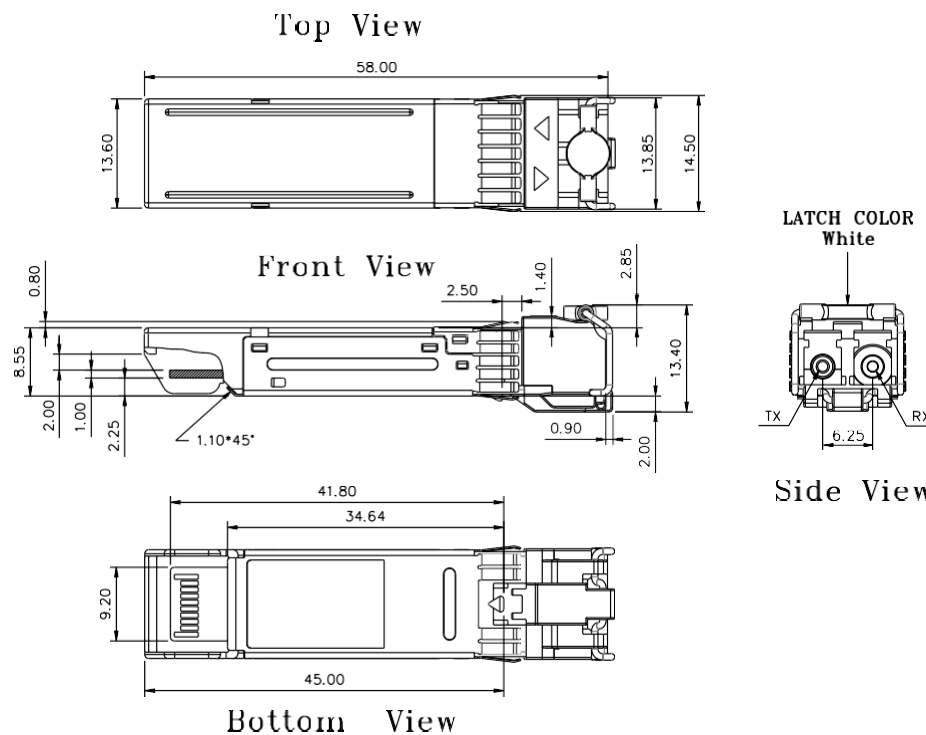
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### RECOMMENDED CIRCUIT SCHEMATIC



### PACKAGE DIAGRAM

Units in mm



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