

## Professional high-speed optical transceiver

### OPN-S1HD36-40LC2 / OPN-S1HD36-40LC2I

10.3 Gbps / 40 km /100GHz DWDM Digital Diagnostic LC SFP+ SINGLE-MODE TRANSCEIVER

## PRODUCT FEATURES

- Up to 10.5 Gb/s Bi-directional Data Links
  - Complaint to SFP+ MSA
- Compliant to IEEE 802.3ae 10GBASE-ER/EW
  - Maximum Link Length of 40 km
- Temperature-stabilized DWDM EML Transmitter
  - 14 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 Operating: OPN-S1HD36-40LC2
- -50 to 85°C Operating: OPN-S1HD36-40LC2I
- Class 1 Laser International Safety Standard IEC-60825Compliant

## APPLICATIONS

- 10GBASE-ER/EW
- OC-192 / STM-64 IR-2
- 40 km 10G Fibre Channel

## PRODUCT DESCRIPTION

The OPN-S1HD36-40LC2 series single mode transceiver is a small form factor pluggable module for bi-directional serial optical data communications such as IEEE 802.3ae 10GBASE-ER/EW. 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 14 dB is offered. The transmitter section uses temperature-stabilized DWDM electrical-modulated laser (EML) and is a 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 (Gb/s) | 10G     | Distance (km) | Spacing (GHz) | Wavelength (nm) | Package       | Case Temp (°C) | RoHS Compliant |
|-------------------|-----------------|---------|---------------|---------------|-----------------|---------------|----------------|----------------|
| OPN-S1HD36-40LC2  | 9.95 – 10.52    | ER / EW | 40            | 100           | DWDM*           | SFP+ with DMI | 0 to 70        | Yes            |
| OPN-S1HD36-40LC2I | 9.95 – 10.52    | ER / EW | 40            | 100           | DWDM*           | SFP+ with DMI | -50 to 85      | Yes            |

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

| Channel # | Product code     | Frequency (THz) | Center Wavelength (nm) | Label |
|-----------|------------------|-----------------|------------------------|-------|
| 19        | OPN-S1HD19-40LC2 | 191.9           | 1562.23                | D19   |
| 20        | OPN-S1HD20-40LC2 | 192.0           | 1561.42                | D20   |
| 21        | OPN-S1HD21-40LC2 | 192.1           | 1560.61                | D21   |
| 22        | OPN-S1HD22-40LC2 | 192.2           | 1559.79                | D22   |
| 23        | OPN-S1HD23-40LC2 | 192.3           | 1558.98                | D23   |
| 24        | OPN-S1HD24-40LC2 | 192.4           | 1558.17                | D24   |
| 25        | OPN-S1HD25-40LC2 | 192.5           | 1557.36                | D25   |
| 26        | OPN-S1HD26-40LC2 | 192.6           | 1556.55                | D26   |
| 27        | OPN-S1HD27-40LC2 | 192.7           | 1555.75                | D27   |
| 28        | OPN-S1HD28-40LC2 | 192.8           | 1554.94                | D28   |
| 29        | OPN-S1HD29-40LC2 | 192.9           | 1554.13                | D29   |
| 30        | OPN-S1HD30-40LC2 | 193.0           | 1553.33                | D30   |
| 31        | OPN-S1HD31-40LC2 | 193.1           | 1552.52                | D31   |
| 32        | OPN-S1HD32-40LC2 | 193.2           | 1551.72                | D32   |

## Professional high-speed optical transceiver

| Channel # | Product code     | Frequency (THz) | Center Wavelength (nm) | Label |
|-----------|------------------|-----------------|------------------------|-------|
| 33        | OPN-S1HD33-40LC2 | 193.3           | 1550.92                | D33   |
| 34        | OPN-S1HD34-40LC2 | 193.4           | 1550.12                | D34   |
| 35        | OPN-S1HD35-40LC2 | 193.5           | 1549.32                | D35   |
| 36        | OPN-S1HD36-40LC2 | 193.6           | 1548.51                | D36   |
| 37        | OPN-S1HD37-40LC2 | 193.7           | 1547.72                | D37   |
| 38        | OPN-S1HD38-40LC2 | 193.8           | 1546.92                | D38   |
| 39        | OPN-S1HD39-40LC2 | 193.9           | 1546.12                | D39   |
| 40        | OPN-S1HD40-40LC2 | 194.0           | 1545.32                | D40   |
| 41        | OPN-S1HD41-40LC2 | 194.1           | 1544.53                | D41   |
| 42        | OPN-S1HD42-40LC2 | 194.2           | 1543.73                | D42   |
| 43        | OPN-S1HD43-40LC2 | 194.3           | 1542.94                | D43   |
| 44        | OPN-S1HD44-40LC2 | 194.4           | 1542.14                | D44   |
| 45        | OPN-S1HD45-40LC2 | 194.5           | 1541.35                | D45   |
| 46        | OPN-S1HD46-40LC2 | 194.6           | 1540.56                | D46   |
| 47        | OPN-S1HD47-40LC2 | 194.7           | 1539.77                | D47   |
| 48        | OPN-S1HD48-40LC2 | 194.8           | 1538.98                | D48   |
| 49        | OPN-S1HD49-40LC2 | 194.9           | 1538.19                | D49   |
| 50        | OPN-S1HD50-40LC2 | 195.0           | 1537.40                | D50   |
| 51        | OPN-S1HD51-40LC2 | 195.1           | 1536.61                | D51   |
| 52        | OPN-S1HD52-40LC2 | 195.2           | 1535.82                | D52   |
| 53        | OPN-S1HD53-40LC2 | 195.3           | 1535.04                | D53   |
| 54        | OPN-S1HD54-40LC2 | 195.4           | 1534.25                | D54   |
| 55        | OPN-S1HD55-40LC2 | 195.5           | 1533.47                | D55   |
| 56        | OPN-S1HD56-40LC2 | 195.6           | 1532.68                | D56   |
| 57        | OPN-S1HD57-40LC2 | 195.7           | 1531.90                | D57   |
| 58        | OPN-S1HD58-40LC2 | 195.8           | 1531.12                | D58   |
| 59        | OPN-S1HD59-40LC2 | 195.9           | 1530.33                | D59   |
| 60        | OPN-S1HD60-40LC2 | 196.0           | 1529.55                | D60   |
| 61        | OPN-S1HD61-40LC2 | 196.1           | 1528.77                | D61   |

### 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-S1HD36-40LC2  |
|                              |        | -50  | 85  |       | OPN-S1HD36-40LC2I |
| Power Supply Voltage         | Vcc    | -0.5 | 3.6 | V     |                   |
| Receiver Input Optical Power | Mip    |      | 3   | dBm   | Average power     |

### Recommended Operating Conditions

| Parameter                  | Symbol                 | Min   | Typ         | Max   | Units / Notes          |
|----------------------------|------------------------|-------|-------------|-------|------------------------|
| Power Supply Voltage       | Vcc                    | 3.135 | 3.3         | 3.465 | V                      |
| Operating Case Temperature | Topr                   | 0     |             | 70    | °C / OPN-S1HD36-40LC2  |
|                            |                        | -50   |             | 85    | °C / OPN-S1HD36-40LC2I |
| Relative Humidity          | RH                     | 5     | 85          | %     | Non-condensing         |
| Power Supply Current       | I <sub>CC(TX+RX)</sub> |       | 320         | 500   | mA/OPN-S1HD36-40LC2    |
|                            |                        |       | 320         | 650   | mA/OPN-S1HD36-40LC2I   |
| Data Rate                  |                        |       | 9.95 / 10.3 | 10.5  | Gb/s                   |

## Professional high-speed optical transceiver

| Transmitter Optical Specifications (0°C < Topr < 70°C, 3.13V < Vcc < 3.47V) |                 |       |     |       |       |              |
|-----------------------------------------------------------------------------|-----------------|-------|-----|-------|-------|--------------|
| Parameter                                                                   | Symbol          | Min   | Typ | Max   | Units | Notes        |
| Average Launch Power                                                        | Po, AVG         | -2    |     | 2     | dBm   | 1            |
| Optical Modulation Amplitude                                                | Po, OMA         | -1.7  |     |       |       | 1            |
| Extinction Ratio                                                            | ER              | 8.2   |     |       | dB    |              |
| 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    |              |
| Transmitter and Dispersion<br>Penalty @800 ps/nm @10.3Gb/s                  | TDP             |       |     | 2     | dB    |              |
| Relative Intensity Noise                                                    | RIN             |       |     | -128  | dB/Hz |              |
| Average Launch Power of OFF<br>Transmitter                                  |                 |       |     | -30   | dBm   |              |

1. Output power is power coupled into a 9/125  $\mu\text{m}$  single-mode fiber.
2. Corresponds to approximately 0.8 nm.
3. X = specified ITU Grid wavelength.

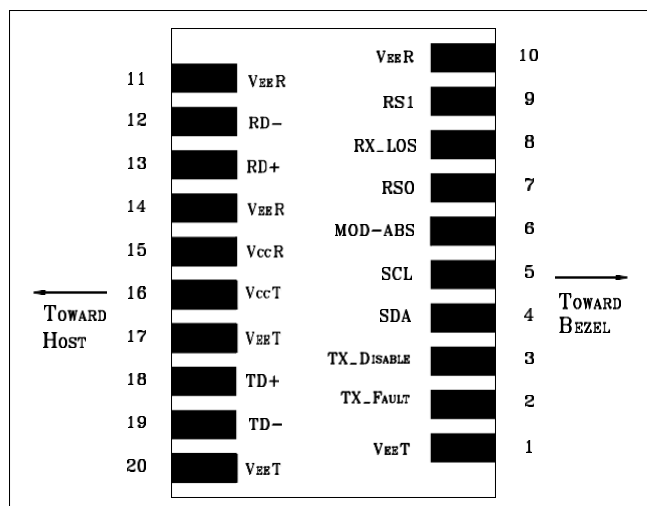
| Receiver Optical Specifications (0°C < Topr < 70°C, 3.13V < Vcc < 3.47V) |                  |      |     |       |       |                         |
|--------------------------------------------------------------------------|------------------|------|-----|-------|-------|-------------------------|
| Parameter                                                                | Symbol           | Min  | Typ | Max   | Units | Notes                   |
| Sensitivity                                                              |                  |      |     | -16   | dBm   | 4                       |
| Stressed Receiver Sensitivity,<br>OMA                                    |                  |      |     | -11.3 |       |                         |
| Receiver Overload                                                        | P <sub>MAX</sub> | -1   | --- |       | dBm   |                         |
| LOS -- Deasserted                                                        | LOS <sub>D</sub> | ---  | --- | -16   | dBm   | Transition: low to high |
| LOS -- Asserted                                                          | LOS <sub>A</sub> | -28  | --- | ---   | dBm   | Transition: high to low |
| Wavelength of Operation                                                  | $\lambda_c$      | 1480 |     | 1580  | nm    |                         |
| Optical Return Loss                                                      | ORL              |      |     | -27   | dB    |                         |

4. Measured with worst ER; BER < 10<sup>-12</sup> and PRBS 2<sup>31</sup>-1. Equivalent to -14.3 dBm OMA at ER=8.2 dB.

| Electrical Characteristics                               |        |     |             |         |          |                       |
|----------------------------------------------------------|--------|-----|-------------|---------|----------|-----------------------|
| Parameter                                                | Symbol | Min | Typ         | Max     | Units    | Notes                 |
| <b>High-Speed Signal (CML) Interface Specification</b>   |        |     |             |         |          |                       |
| Input Data Rate                                          |        |     | 9.95 / 10.3 | 10.5    | Gb/s     |                       |
| Differential Input Impedance                             | Rin    |     | 100         |         | $\Omega$ |                       |
| Differential Data Input Amplitude                        |        | 120 |             | 820     | mVpp     | Internally AC coupled |
| Output Data Rate                                         |        |     | 9.95 / 10.3 | 10.5    | Gb/s     |                       |
| Differential Output Impedance                            | Rout   |     | 100         |         | $\Omega$ |                       |
| Differential Data Output<br>Amplitude                    |        | 350 | 600         | 850     | mVpp     | Internally AC coupled |
| <b>Low-Speed Signal (LVTTTL) Interface Specification</b> |        |     |             |         |          |                       |
| Input High Voltage                                       |        | 2.0 |             | Vcc+0.3 | V        |                       |
| Input Low Voltage                                        |        | GND |             | 0.8     | V        |                       |
| Output High Voltage                                      |        | 2.4 |             | Vcc     | V        |                       |
| Output Low Voltage                                       |        | GND |             | 0.5     | V        |                       |

## Professional high-speed optical transceiver

### CONNECTION DIAGRAM



| PIN | Signal Name | Description                                                                                                                       | PIN | Signal Name | Description                 |
|-----|-------------|-----------------------------------------------------------------------------------------------------------------------------------|-----|-------------|-----------------------------|
| 1   | VEE T       | Transmitter Signal Ground                                                                                                         | 11  | VEE R       | Receiver Signal Ground      |
| 2   | TX_Fault    | Transmitter Fault Indication. Logic “1” Output = Laser Fault. Logic “0” Output = Normal Operation                                 | 12  | RD-         | Inverse Receiver Data Out   |
| 3   | TX_Disable  | Logic “1” Input (or no connection) = Laser off, Logic “0” = Laser on.                                                             | 13  | RD+         | Receiver Data Out           |
| 4   | SDA         | Modulation Definition 2 – Two wires serial ID Interface                                                                           | 14  | VEE R       | Receiver Signal Ground      |
| 5   | SCL         | Modulation Definition 1 – Two wires serial ID Interface                                                                           | 15  | VCC R       | Receiver Power – 3.3V±5%    |
| 6   | MOD-ABS     | Modulation Definition 0 – Ground in Module                                                                                        | 16  | VCC T       | Transmitter Power – 3.3V±5% |
| 7   | RS0         | RX Rate Select (LVTTL). This pin has an internal 30k pulldown to ground. A signal on this pin will not affect module performance. | 17  | VEE T       | Transmitter Signal Ground   |
| 8   | RX_LOS      | Loss of Signal Out (OC).                                                                                                          | 18  | TD+         | Transmitter Data In         |
| 9   | RS1         | TX Rate Select (LVTTL). This pin has an internal 30k pulldown to ground. A signal on this pin will not affect module performance. | 19  | TD-         | Inverse Transmitter Data In |
| 10  | VEE R       | Receiver Signal Ground                                                                                                            | 20  | VEE T       | Transmitter Signal Ground   |

### MODULE DEFINITION

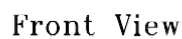
| Module Definition | PIN 4 | PIN 5 | PIN 6   | Interpretation by Host            |
|-------------------|-------|-------|---------|-----------------------------------|
| 4                 | SDA   | SCL   | MOD-ABS | Serial module definition protocol |

Module Definition 4 specifies a serial definition protocol. For this definition, upon power up, SDA and SCL appear as no connector (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

**Units in mm**

Top View



Bottom View

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