

## Professional high-speed optical transceiver

### OPN-S6F153-LC2 / OPN-S6F153E-LC2 / OPN-S6F153T-LC2 / OPN-S6F153ET-LC2

3.3V / CWDM / 622 Mbps RoHS Compliant 2X10 SFF LC 2X10 SINGLE-MODE TRANSCEIVER

## PRODUCT FEATURES

- Duplex LC Single Mode Transceiver
- SONET OC-12 LR / SDH STM-1 Compliant
- Small Form Factor, RJ-45 size, 2X10 pin Package
- 18-Wavelength CWDM DFB LD Transmitter from 1270 nm to 1610 nm with step 20 nm
  - 29 dB Link Power Budget at Least
    - Analog Monitor Function
      - Transmitter Laser Bias Current
      - Transmitter Laser Optical Power Monitor
      - Receiver Photo Detector Current
    - LVPECL Signal Input / Output
    - LVTTL Transmitter Disable Input
  - LVPECL Signal Detection Output: OPN-S6F153-LC2
  - LVTTL Signal Detection Output: OPN-S6F153T-LC2
    - Single +3.3 V Power Supply
    - 0 to 70°C Operation
- Wave Solderable and Aqueous Washable
- Class 1 Laser International Safety Standard IEC-60825 Compliant

## APPLICATIONS

- ATM 622 Mbps Links
- SONET / SDH Equipment Interconnect
- Fiber Channel 533 Mb/s Links

## PRODUCT DESCRIPTION

The OPN-S6F153T-LC2 series single mode transceivers are low power, high performance CWDM modules for bi-directional serial optical data communications such as long-reach SONET OC-12 LR / SDH STM-4 and Fast Ethernet. There are eighteen center wavelengths available from 1270 nm to 1610 nm, each step 20 nm. A guaranteed minimum optical link budget of 29 dB is offered. The transmitter section uses a multiple quantum well CWDM DFB laser 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. A PECL logic interface simplifies interface to external circuitry.

## ORDER INFORMATION

| P/No.           | Bit Rate<br>(Mb/s) | SONET<br>/SDH | Power<br>Budget<br>(dB) | Wavelength<br>(nm) | Package | Temp.<br>(°C) | TX Power<br>(dBm) | RX Sens.<br>(dBm) | RoHS<br>Compliant |
|-----------------|--------------------|---------------|-------------------------|--------------------|---------|---------------|-------------------|-------------------|-------------------|
| OPN-S6F153T-LC2 | 622                | LR            | > 29                    | CWDM*              | 2X10 LC | 0 to 70       | 5 to 0            | -29               | Yes               |

CWDM Wavelength (0 to 70°C)

| Central<br>Wavelength | Min.<br>(nm) | Typ.<br>(nm) | Max.<br>(nm) | Central<br>Wavelength | Min.<br>(nm) | Typ.<br>(nm) | Max.<br>(nm) |
|-----------------------|--------------|--------------|--------------|-----------------------|--------------|--------------|--------------|
| 127                   | 1264.5       | 1270         | 1277.5       | 145                   | 1444.5       | 1450         | 1457.5       |
| 129                   | 1284.5       | 1290         | 1297.5       | 147                   | 1464.5       | 1470         | 1477.5       |
| 131                   | 1304.5       | 1310         | 1317.5       | 149                   | 1484.5       | 1490         | 1497.5       |
| 133                   | 1324.5       | 1330         | 1337.5       | 151                   | 1504.5       | 1510         | 1517.5       |
| 135                   | 1344.5       | 1350         | 1357.5       | 153                   | 1524.5       | 1530         | 1537.5       |
| 137                   | 1364.5       | 1370         | 1377.5       | 155                   | 1544.5       | 1550         | 1557.5       |
| 139                   | 1384.5       | 1390         | 1397.5       | 157                   | 1564.5       | 1570         | 1577.5       |
| 141                   | 1404.5       | 1410         | 1417.5       | 159                   | 1584.5       | 1590         | 1597.5       |
| 143                   | 1424.5       | 1430         | 1437.5       | 161                   | 1604.5       | 1610         | 1617.5       |

CWDM\*: 18 Wavelengths from 1270 nm to 1610 nm, each step 20 nm.

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| Absolute Maximum Ratings |        |     |     |       |                          |
|--------------------------|--------|-----|-----|-------|--------------------------|
| Parameter                | Symbol | Min | Max | Units | Notes                    |
| Storage Temperature      | Tstg   | -50 | 85  | °C    |                          |
| Operating Temperature    | Topr   | 0   | 70  | °C    | With air flow 1m/sec     |
| Soldering Temperature    | ---    |     | 260 | °C    | 10 seconds on leads only |
| Power Supply Voltage     | Vcc    | 0   | 3.6 | V     |                          |
| Input Voltage            | ---    | GND | Vcc | V     |                          |
| Output Current           | Iout   | 0   | 30  | mA    |                          |

| Recommended Operating Conditions |        |      |     |      |                     |
|----------------------------------|--------|------|-----|------|---------------------|
| Parameter                        | Symbol | Min  | Typ | Max  | Units / Notes       |
| Power Supply Voltage             | Vcc    | 3.13 | 3.3 | 3.47 | V                   |
| Operating Temperature            | Topr   | 0    |     | 70   | °C /air flow 1m/sec |
| Data Rate                        |        | 50   | 622 |      | Mb/s                |
| Power Supply Current             | Icc    |      | 200 | 300  | mA                  |

| Transmitter Specifications (0°C < Topr < 70°C, 3.13V < Vcc < 3.47V) |                                                                  |                       |           |                 |       |                    |
|---------------------------------------------------------------------|------------------------------------------------------------------|-----------------------|-----------|-----------------|-------|--------------------|
| Parameter                                                           | Symbol                                                           | Min                   | Typ       | Max             | Units | Notes              |
| <b>Optical</b>                                                      |                                                                  |                       |           |                 |       |                    |
| Optical Transmit Power                                              | Po                                                               | 0                     | ---       | 5               | dBm   | 1                  |
| Output Center Wavelength                                            | $\lambda$                                                        | $\lambda-5.5$         | $\lambda$ | $\lambda+7.5$   | nm    | 2                  |
| Output Spectrum Width                                               | $\Delta\lambda$                                                  | ---                   | ---       | 1               | nm    | -20 dB width       |
| Side Mode Suppression Ratio                                         | SMSR                                                             | 30                    |           |                 | dB    |                    |
| Extinction Ratio                                                    | ER                                                               | 10                    | ---       | ---             | dB    |                    |
| Output Eye                                                          | Compliant with Bellcore GR-253-CORE and ITU recommendation G.957 |                       |           |                 |       |                    |
| 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 |                    |
| Total Jitter                                                        | TJ                                                               |                       |           | 0.55            | ns    | 3                  |
| <b>Electrical</b>                                                   |                                                                  |                       |           |                 |       |                    |
| Data Input Current – Low                                            | IIL                                                              | -350                  |           |                 | μA    |                    |
| Data Input Current – High                                           | IiH                                                              |                       |           | 350             | μA    |                    |
| Differential Input Voltage                                          | V <sub>IH</sub> - V <sub>IL</sub>                                | 300                   |           |                 | mV    |                    |
| Data Input Voltage – Low                                            | V <sub>IL</sub> - V <sub>CC</sub>                                | -2.0                  |           | -1.58           | V     | 4                  |
| Data Input Voltage -- High                                          | V <sub>IH</sub> - V <sub>CC</sub>                                | -1.1                  |           | -0.74           | V     | 4                  |
| Disable Input Voltage -- Low                                        | V <sub>TDIS,L</sub>                                              | 0                     |           | 0.5             | V     | TX Output Enabled  |
| Disable Input Voltage -- High                                       | V <sub>TDIS,H</sub>                                              | V <sub>CC</sub> - 1.3 |           | V <sub>CC</sub> | V     | TX Output Disabled |
| Shut Off Time for TxDis                                             | t <sub>DIS</sub>                                                 |                       |           | 1               | ms    |                    |

- Notes: 1. Output power is power coupled into a 9/125 μm single mode fiber.  
 2. ITU-T G.694.2 CWDM wavelength from 1270 nm to 1610 nm, each step 20 nm.  
 3. Measured with 2<sup>23</sup>-1 PRBS with 72 ones and 72 zeros  
 4. These inputs are compatible with 10K, 10KH and 100K ECL and PECL inputs.

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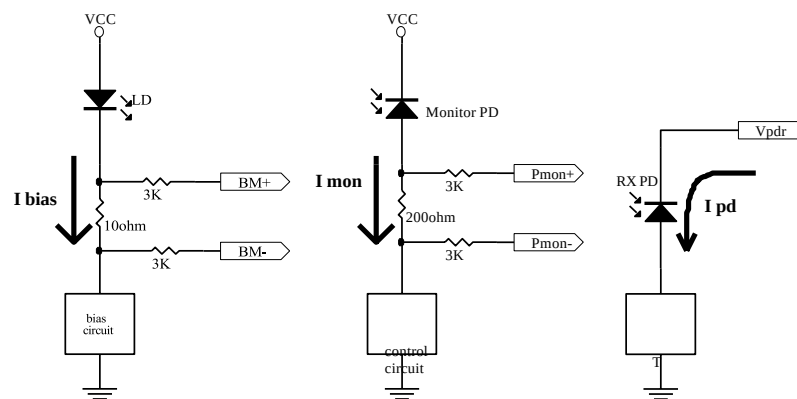
| Receiver Specifications (0°C < Topr < 70°C, 3.13V < Vcc < 3.47V) |                                   |      |     |       |       |                         |
|------------------------------------------------------------------|-----------------------------------|------|-----|-------|-------|-------------------------|
| Parameter                                                        | Symbol                            | Min  | Typ | Max   | Units | Notes                   |
| <b>Optical</b>                                                   |                                   |      |     |       |       |                         |
| Sensitivity                                                      | ---                               | ---  | --- | -29   | dBm   | 1                       |
| Maximum Input Power                                              | Pin                               | -5   |     | ---   | dBm   |                         |
| Signal Detect -- Asserted                                        | Pa                                | ---  | --- | -29   | dBm   | Transition: low to high |
| Signal Detect -- Deasserted                                      | Pd                                | -43  | --- | ---   | dBm   | Transition: high to low |
| Signal detect -- Hysteresis                                      |                                   | 1.0  | --- |       | dB    |                         |
| Wavelength of Operation                                          |                                   | 1100 | --- | 1620  | nm    |                         |
| <b>Electrical</b>                                                |                                   |      |     |       |       |                         |
| Data Output Voltage -- Low                                       | V <sub>OL</sub> - V <sub>CC</sub> | -2.0 |     | -1.58 | V     | 2                       |
| Data Output Voltage -- High                                      | V <sub>OH</sub> - V <sub>CC</sub> | -1.1 |     | -0.74 | V     | 2                       |
| Signal Detect Output Voltage -- Low                              | V <sub>OL</sub>                   | -2.0 |     | -1.58 | V     | OPN-S6F153-LC2          |
| Signal Detect Output Voltage -- High                             | V <sub>OH</sub>                   | -1.1 |     | -0.74 | V     |                         |
| Signal Detect Output Voltage -- Low                              | V <sub>OL</sub> - V <sub>CC</sub> |      |     | 0.5   | V     | OPN-S6F153T-LC2         |
| Signal Detect Output Voltage -- High                             | V <sub>OH</sub> - V <sub>CC</sub> | 2.0  |     |       | V     |                         |

Notes: 1. Minimum sensitivity and saturation levels at BER=1E-10 for a 2<sup>23</sup>-1 PRBS with 72 ones and 72 zeros.  
2. These outputs are compatible with 10K, 10KH and 100K ECL and PECL outputs.

## ANALOG DIAGNOSTICS FUNCTIONS

| Parameter                          | Symbol       | Min | Typ | Max | Units | Notes |
|------------------------------------|--------------|-----|-----|-----|-------|-------|
| <b>Transmitter</b>                 |              |     |     |     |       |       |
| Laser Bias Current Monitor         | Bmon+, Bmon- | 0   |     | Vcc | V     | 1     |
| Monitor Photodiode Current Monitor | Pmon+, Pmon- | 0   |     | Vcc | V     | 2     |
| <b>Receiver</b>                    |              |     |     |     |       |       |
| Received Photocurrent              | Rpd          | 0   |     | 1   | mA    | 3     |
| Photodiode Responsivity            | R            | 0.5 | 0.9 | 1.0 | A/W   |       |
| Applied Voltage at VpdR pin        | Vpd          | 2.4 |     | Vcc | V     | 3     |

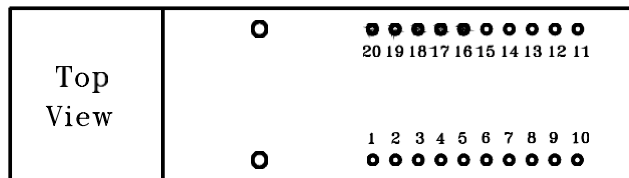
Notes: 1. PIN 17 and 18 provide an analog voltage output proportional to the laser bias current, based on the following formula:  $I_{bias} = V (Bmon+ - Bmon-) / 10 \Omega$ . See below the equivalent circuit.  
2. PIN 19 and 20 provide an analog voltage output proportional to the monitor photodiode current, based on the following formula:  $I_{mon} = V (Pmon+ - Pmon-) / 200 \Omega$ . See below the equivalent circuit.  
3. PIN 1 is used to monitor the received photocurrent. It must be connected to a positive voltage within the specified above. The received power is given by the photocurrent multiplied by the photodiode responsivity.



Analogue Monitoring Function Connections

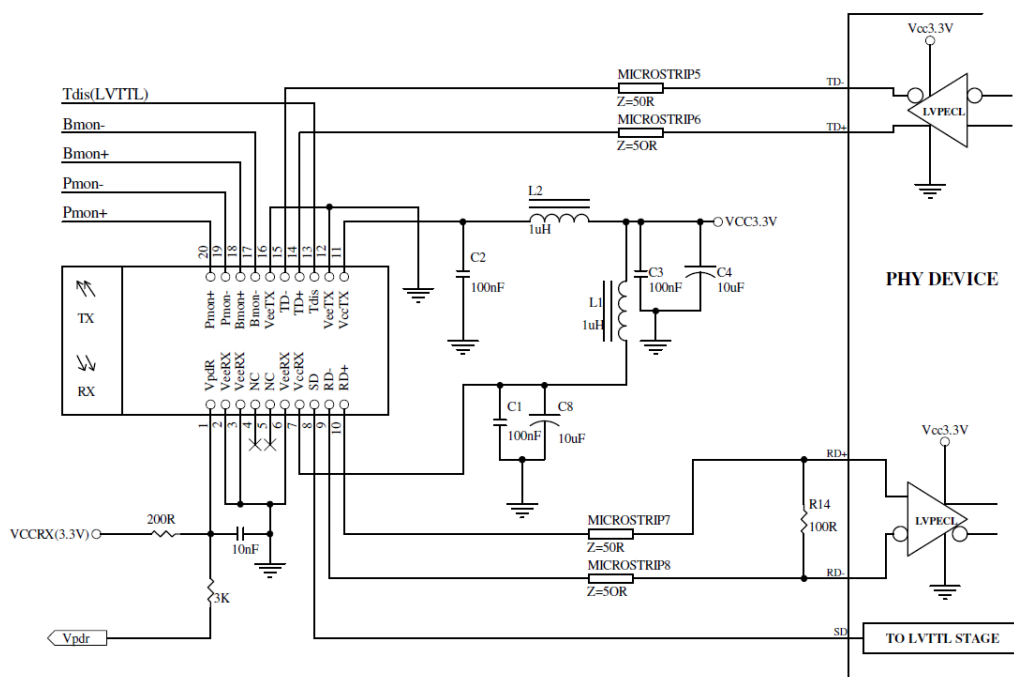
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### CONNECTION DIAGRAM



| PIN | Symbol | Notes                                                                                                                                                                                 | PIN | Symbol | Notes                                                                                                           |
|-----|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------|-----------------------------------------------------------------------------------------------------------------|
| 1   | VpdR   | Receiver power monitor. This pin must be connected to a positive power supply (Vcc), preferably via a small resistor. Supplier photocurrent and maybe used to monitor receiver power. | 11  | VccT   | +3.3V dc transmitter power supply                                                                               |
| 2   | VeeR   | Receiver ground.                                                                                                                                                                      | 12  | VeeT   | Transmitter ground.                                                                                             |
| 3   | VeeR   | Receiver ground.                                                                                                                                                                      | 13  | T Dis  | Transmitter Disable. Connect this pin to logic "1" to disable module. To enable module connect to logic low "0" |
| 4   | NC     | No connected                                                                                                                                                                          | 14  | TD +   | Transmitter Data In                                                                                             |
| 5   | NC     | No connected                                                                                                                                                                          | 15  | TD -   | Transmitter Data In Bar                                                                                         |
| 6   | VeeR   | Receiver ground.                                                                                                                                                                      | 16  | VeeT   | Transmitter ground.                                                                                             |
| 7   | VccR   | +3.3V dc receiver power supply                                                                                                                                                        | 17  | Bmon-  | Laser Bias Monitoring -- Negative End                                                                           |
| 8   | SD     | Signal detect. Logic 1 indicate a normal operation.                                                                                                                                   | 18  | Bmon+  | Laser Bias Monitoring -- Positive End (Bmon+ - Bmon-) = 10 Ω X laser bias current                               |
| 9   | RD-    | Receiver Dataout Bar                                                                                                                                                                  | 19  | Pmon-  | Laser Power Monitoring -- Negative end                                                                          |
| 10  | RD+    | Receiver Dataout                                                                                                                                                                      | 20  | Pmon+  | Laser Power Monitoring -- Positive end (Pmon+ - Pmon-) = 200 Ω X monitor photodiode current                     |
| MS  | MS     | Mounting Studs. Connect to Chassis Ground                                                                                                                                             |     |        |                                                                                                                 |

### RECOMMENDED CIRCUIT SCHEMATIC



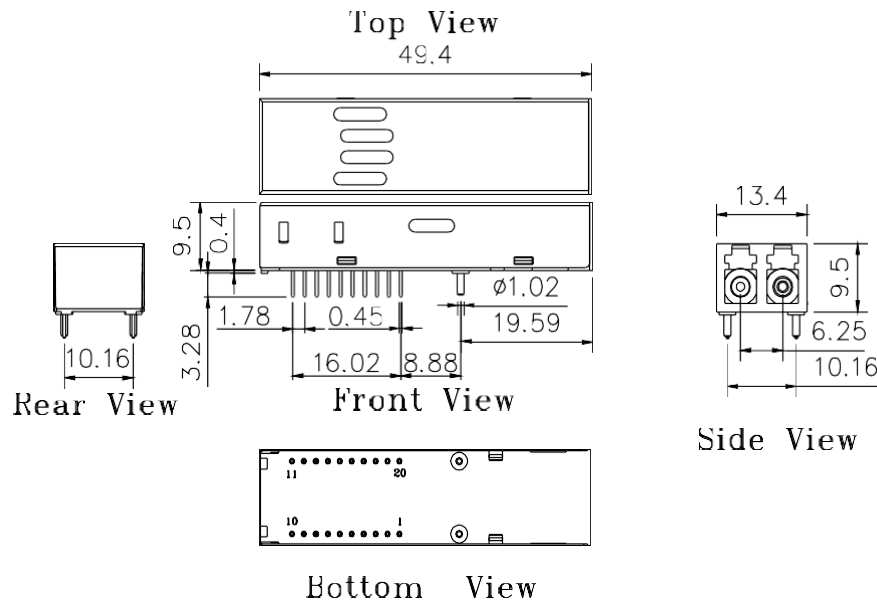
- Note: 1. TX input is terminated inside the module.  
 2. VeeR and VeeT are not internally connected to each other.  
 3. 50 Ω line pattern and component placements on TD+/TD- and RD+/RD- lines shall be symmetrical for better impedance matching.

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### PACKAGE DIAGRAM

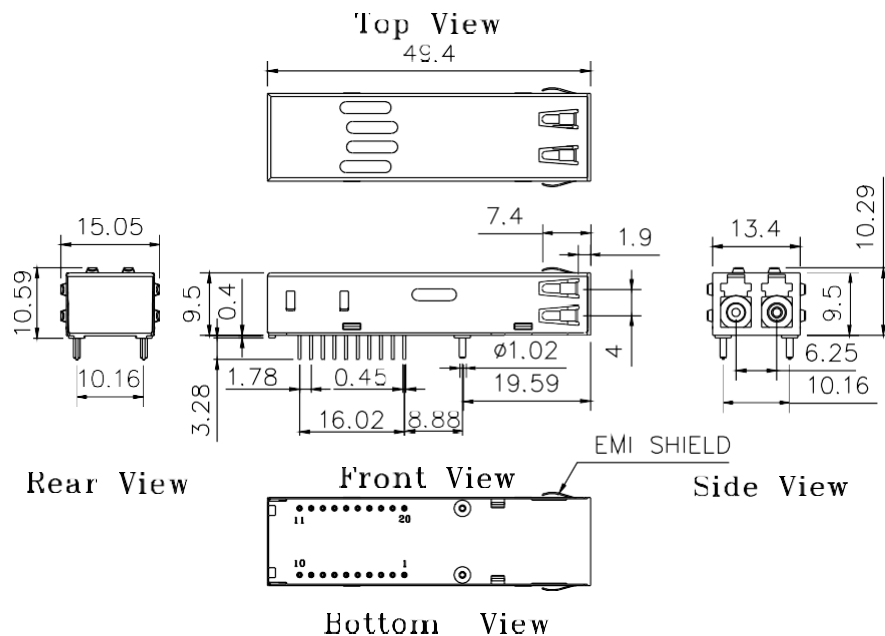
Units in mm

#### 1) Standard Case



OPN-S6F153-LC2 / OPN-S6F153T-LC2

#### 2) Extended Case



OPN-S6F153E-LC2 / OPN-S6F153ET-LC2

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