

## ESP55X-60D(I)

10Gb/s SFP+ ZR 60km DDM Transceiver

### PRODUCT FEATURES

- Support data rate up to 11.3Gb/s
- Hot-Pluggable SFP Footprint and duplex LC connector
- Up to 60km reach for G.652 SMF
- EML laser and APD receiver
- Temperature Range:
  - Commercial: 0°C ~70°C
  - Extended: -20°C ~85°C
  - Industrial: -40°C ~85°C
- Low power consumption :<1.5W
- Compliant with SFP-8431
- Compliant with SFP-8432
- Compliant with SFP-8472
- Compliant with IEEE802.3ae
- RoHS 6 compliance
- Complies with EU Directive 2015/863/EU



### APPLICATIONS

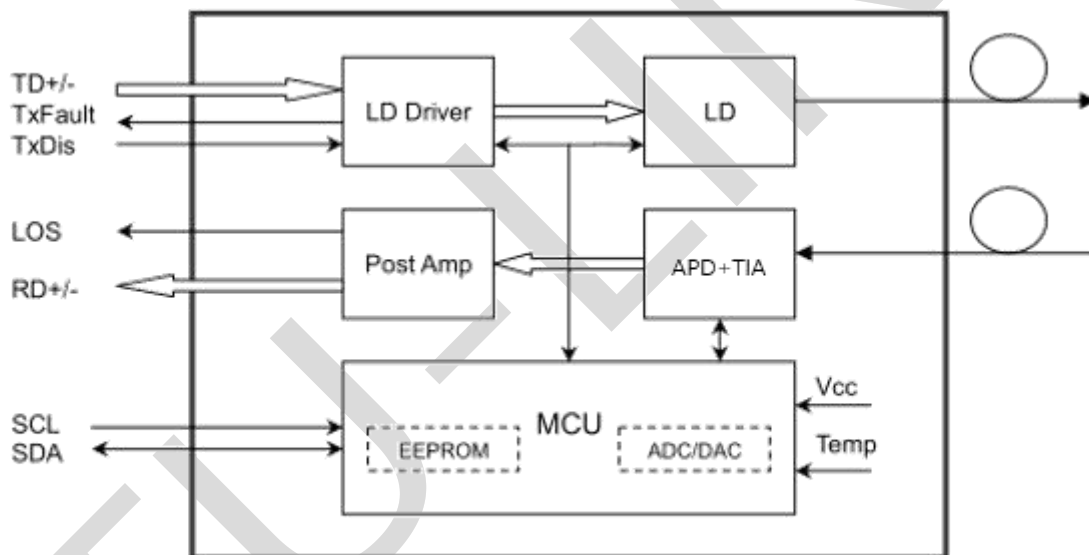
- 10G Ethernet
- OTU2/2e
- Other Optical Links

## DESCRIPTIONS

This 1550nm EML 10Gbps SFP+ transceiver is designed to transmit and receive optical data over single mode optical fiber for link length 60km.

The SFP+ 60km module electrical interface is compliant to SFI electrical specifications. The transmitter input and receiver output impedance is 100 Ohms differential. Data lines are internally AC coupled. The module provides differential termination and reduce differential to common mode conversion for quality signal termination and low EMI.

## Module Block Diagram



## Ordering Information

| Part No.    | Data Rate(optical) | Laser | Fiber Type | Distance | Optical Interface | Temp     | DDMI | Latch Color |
|-------------|--------------------|-------|------------|----------|-------------------|----------|------|-------------|
| ESP55X-60D  | 10.3125Gbps        | EML   | SMF        | 60km     | LC                | 0~70°C   | Y    | White       |
| ESP55X-60DE | 10.3125Gbps        | EML   | SMF        | 60km     | LC                | -20~85°C | Y    | White       |
| ESP55X-60DI | 10.3125Gbps        | EML   | SMF        | 60km     | LC                | -40~85°C | Y    | White       |

## Absolute Maximum Ratings

| Parameter | Symbol | Min. | Typical | Max. | Unit | Notes |
|-----------|--------|------|---------|------|------|-------|
|-----------|--------|------|---------|------|------|-------|

|                               |                  |     |  |     |    |  |
|-------------------------------|------------------|-----|--|-----|----|--|
| Storage Temperature           | T <sub>stg</sub> | -40 |  | +85 | °C |  |
| Relative Humidity - Storage   | R <sub>HS</sub>  | 5   |  | 95  | %  |  |
| Relative Humidity - Operating | R <sub>HO</sub>  | 5   |  | 85  | %  |  |
| DC Supply Voltage             | V <sub>CC</sub>  | 0   |  | 3.6 | V  |  |

## Recommended Operating Conditions

| Parameter                  | Symbol          | Min. | Typical | Max. | Unit | Notes      |
|----------------------------|-----------------|------|---------|------|------|------------|
| Case Operating Temperature | Top             | 0    | -       | 70   | °C   | Commercial |
|                            |                 | -40  |         | 85   |      | Industrial |
| Power Supply Voltage       | V <sub>CC</sub> | 3.13 | 3.3     | 3.47 | V    |            |
| Transmission Distance      | TD              | -    | -       | 80   | km   | Over SMF   |

## Electrical Characteristics

High-Speed Signal: Compliant to CEI-11G-SR

Low-Speed Signal: Compliant to SFF-8419

| Parameter                                    | Symbol             | Min.            | Typical | Max.                 | Unit | Notes |
|----------------------------------------------|--------------------|-----------------|---------|----------------------|------|-------|
| <b>Transmitter (Module Input)</b>            |                    |                 |         |                      |      |       |
| Differential Input Resistance                | R <sub>Rdin</sub>  | 80              | 100     | 120                  | Ω    |       |
| Input Differential Voltage                   | R <sub>Vdiff</sub> | 110             | -       | 1050                 | mVpp |       |
| Tx_Disable                                   | Normal Operation   | V <sub>IL</sub> | -0.3    | 0.8                  | V    |       |
|                                              | Laser Disable      | V <sub>IH</sub> | 2.0     | V <sub>CC</sub> +0.3 | V    |       |
| <b>Receiver (Module Output)</b>              |                    |                 |         |                      |      |       |
| Differential Resistance                      | T <sub>Rd</sub>    | 80              | 100     | 120                  | Ohm  |       |
| Output Differential Voltage                  | T <sub>Vdiff</sub> | 360             | -       | 770                  | mVpp |       |
| Differential Termination Resistance Mismatch | T <sub>Rdm</sub>   | -               | -       | 5                    | %    |       |
| Rx los                                       | Normal Operation   | V <sub>OL</sub> | -0.3    | 0.4                  | V    |       |
|                                              | Loss Signal        | V <sub>OH</sub> | 2       | V <sub>CC</sub> HOST | V    |       |

## Optical and Characteristics

| Parameter                         | Symbol | Min. | Typical | Max. | Unit | Notes |
|-----------------------------------|--------|------|---------|------|------|-------|
| <b>Transmitter</b>                |        |      |         |      |      |       |
| Optical Modulation Amplitude(OMA) | POMA   | 0    |         | 6    | dBm  |       |
| Average Output Power              | POUT   | 1    |         | 6    | dBm  | 1     |
| Average Output Power(Laser Off)   | POFF   |      |         | -30  | dBm  |       |
| Wavelength                        | λ      | 1530 |         | 1565 | nm   |       |
| Spectrum Bandwidth @ -20dB        | Δλ     |      |         | 1    | nm   |       |
| Side mode suppression ratio(SMSR) | SMSR   | 30   |         |      | dB   |       |
| Extinction ratio                  | ER     | 8.2  |         |      | dB   |       |

|                                                    |                   |      |    |      |       |                         |
|----------------------------------------------------|-------------------|------|----|------|-------|-------------------------|
| Transmitter waveform and dispersion penalty (TWDP) |                   |      |    | 4.7  | dB    |                         |
| RIN20OMA                                           | RIN               |      |    | -128 | dB/Hz |                         |
| Optical return loss tolerance                      | ORLT              | 20   |    |      | dB    |                         |
| <b>Receiver</b>                                    |                   |      |    |      |       |                         |
| Wavelength                                         | $\lambda$         | 1260 |    | 1620 | nm    |                         |
| Received Sensitivity                               | $P_{IN}$          |      |    | -23  | dBm   | BER<1x10 <sup>-12</sup> |
| Optical Power Overload                             | $P_{IN}$<br>(SAT) | -5   |    |      | dBm   |                         |
| Damage threshold                                   |                   |      | -4 |      | dBm   | 2                       |
| Receiver Reflectance                               | RFL               |      |    | -12  | dB    |                         |
| Rx_LOS of Signal Assert                            | $P_A$             | -38  |    |      | dBm   |                         |
| Rx_LOS of Signal De-assert                         | $P_D$             |      |    | -23  | dBm   |                         |
| Rx_LOS of Signal Hysteresis                        | $P_{Hy}$          | 0.5  |    | 5    | dB    |                         |
| Optical Return Loss Tolerance                      | ORLT              | 20   |    |      | dB    |                         |

Notes:

1. The optical power is launched into SMF.
2. The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level. The receiver does not have to operate correctly at this input power.

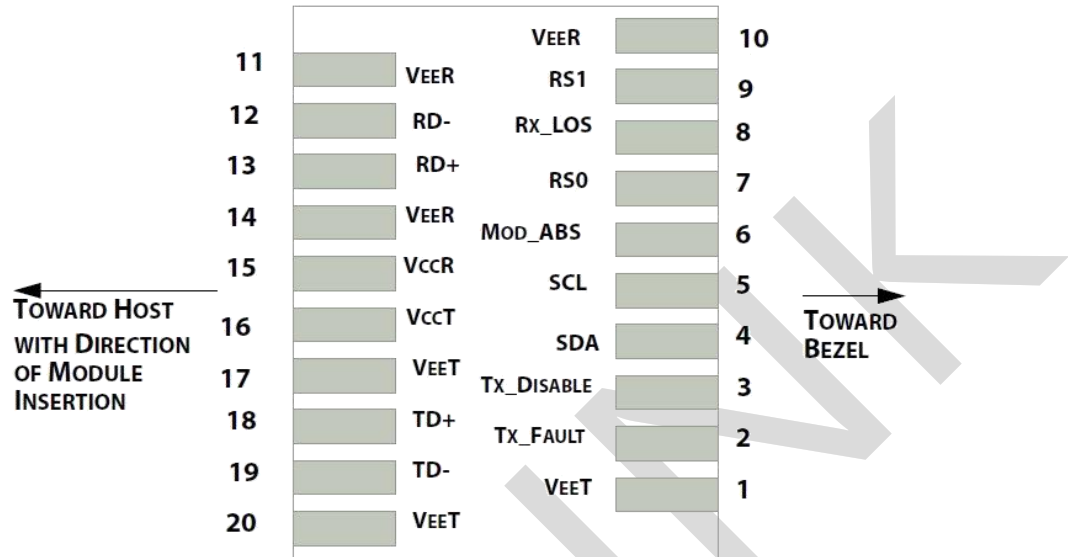
## Digital Diagnostics

| Parameter       | Range     | Accuracy | Unit | Calibration |
|-----------------|-----------|----------|------|-------------|
| Temperature     | -40 to 85 | ±3       | °C   | Internal    |
| Voltage         | 0 to Vcc  | ±3%      | V    | Internal    |
| Tx Bias Current | 0 to 100  | ±10%     | mA   | Internal    |
| Tx Output Power | 0 to 6    | ±3       | dB   | Internal    |
| Rx Input Power  | -24 to -5 | ±3       | dB   | Internal    |

## Communication Interface Timing Characteristics

| Parameter                                    | Symbol          | Min. | Typical | Max. | Unit | Notes |
|----------------------------------------------|-----------------|------|---------|------|------|-------|
| TX_Disable Assert Time                       | $t_{off}$       |      |         | 100  | us   |       |
| TX_Disable Negate Time                       | $t_{on}$        |      |         | 2    | ms   |       |
| Time to Initialize Include Reset of TX_FAULT | $t_{int}$       |      |         | 300  | ms   |       |
| TX_FAULT from Fault to Assertion             | $t_{fault}$     |      |         | 100  | us   |       |
| TX_Disable Time to Start Reset               | $t_{reset}$     | 10   |         |      | us   |       |
| Receiver Loss of Signal Assert Time          | $T_{A,RX\_LOS}$ |      |         | 100  | us   |       |
| Receiver Loss of Signal Deassert Time        | $T_{d,RX\_LOS}$ |      |         | 100  | us   |       |
| Rate-Select Chage Time                       | $t_{ratesel}$   |      |         | 10   | us   |       |

## Pin Diagram



## Pin Definitions

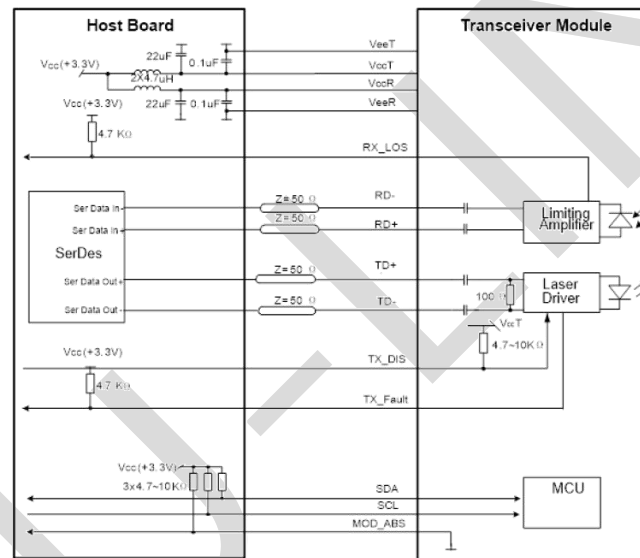
| PIN # | Name       | Function                                                                                                                    | Notes |
|-------|------------|-----------------------------------------------------------------------------------------------------------------------------|-------|
| 1     | VeeT       | Module transmitter ground                                                                                                   | 1     |
| 2     | Tx Fault   | Module transmitter fault                                                                                                    | 2     |
| 3     | Tx Disable | Transmitter Disable; Turns off transmitter laser output                                                                     | 3     |
| 4     | SDL        | 2 wire serial interface data input/output (SDA)                                                                             | 4     |
| 5     | SCL        | 2 wire serial interface clock input (SCL)                                                                                   | 4     |
| 6     | MOD-ABS    | Module Absent, connect to VeeR or VeeT in the module                                                                        | 4     |
| 7     | RS0        | Rate select0, optionally control SFP+ receiver. When high, input data rate >4.5Gb/s; when low, input data rate <=4.5Gb/s    | 5     |
| 8     | LOS        | Receiver Loss of Signal Indication                                                                                          | 6     |
| 9     | RS1        | Rate select0, optionally control SFP+ transmitter. When high, input data rate >4.5Gb/s; when low, input data rate <=4.5Gb/s | 1     |
| 10    | VeeR       | Module receiver ground                                                                                                      | 1     |
| 11    | VeeR       | Module receiver ground                                                                                                      | 1     |
| 12    | RD-        | Receiver inverted data output                                                                                               |       |
| 13    | RD+        | Receiver non-inverted data output                                                                                           |       |
| 14    | VeeR       | Module receiver ground                                                                                                      | 1     |
| 15    | VccR       | Module receiver 3.3V supply                                                                                                 |       |
| 16    | VccT       | Module transmitter 3.3V supply                                                                                              |       |
| 17    | VeeT       | Module transmitter ground                                                                                                   | 1     |
| 18    | TD+        | Transmitter inverted data output                                                                                            |       |

|    |      |                                      |   |
|----|------|--------------------------------------|---|
| 19 | TD-  | Transmitter non-inverted data output |   |
| 20 | VeeT | Module transmitter ground            | 1 |

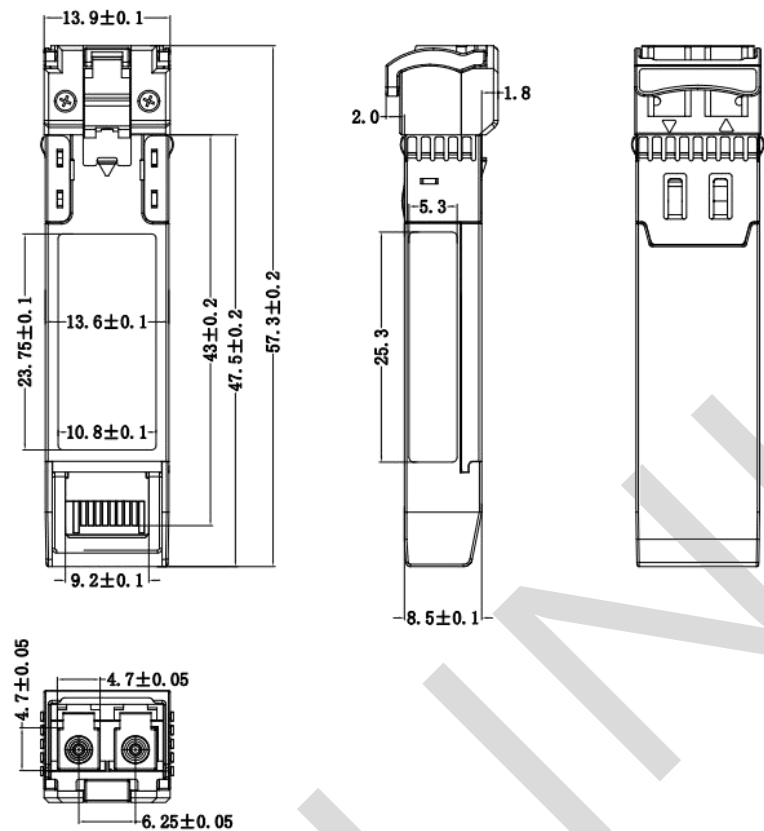
Notes:

1. Circuit ground is internally isolated from chassis ground
2. Tx FAULT is an open collector/drain output, which should be pulled up with a 4.7k – 10k Ohms resistor on the host board if intended for use. Pull up voltage should be between 2.0V to Vcc + 0.3V. A high output indicates a transmitter fault caused by either the TX bias current or the TX output power exceeding the preset alarm thresholds. A low output indicates normal operation. In the low state, the output is pulled to <0.8V.
3. Laser output disabled on Tx DIS >2.0V or open, enabled on Tx DIS <0.8V.
4. Should be pulled up with 4.7kΩ- 10kΩ host board to a voltage between 2.0V and 3.6V. MOD\_ABS pulls line low to indicate module is plugged in.
5. Internally pulled down per SFF-8431 Rev 4.1.
6. LOS is open collector output. It should be pulled up with 4.7kΩ – 10kΩ on host board to a voltage between 2.0V and 3.6V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.

## Recommended Interface Circuit



## Mechanical Diagram



Revision History

| Version No. | Date             | Description           |
|-------------|------------------|-----------------------|
| 1.0         | February 8, 2016 | Preliminary datasheet |
| 2.0         | October 11, 2023 | Product upgrades      |
| 3.0         | July 26, 2024    | Format change         |

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