# SPM-4100WG / SPM-4100BWG / SPM-4100AWG (RoHS Compliant)

## 3.3V / 850 nm / 8.5 Gbps Digital Diagnostic SFP+ LC Multi-Mode TRANSCEIVER

## FEATURES

- Up to 8.5 Gb/s Bi-directional Data Link
- Complaint to SFP+ MSA
- Compliant with 8G FC 800-M5/M6/M5E-LC-I
- Compliant with 4G, 2G Fibre Channel
- Link Distance at 8.5 Gbd
  150 m links with OM3 MMF Cables
  50 m links with OM2 MMF Cables
  21 m links with OM1 MMF Cables
- SFF-8472 Digital Diagnostic Function
- AC/AC Coupling according to MSA
- Single +3.3 V Power Supply
- RoHS 6/6 Compliant
- 0 to 70°C Operation: SPM-4100WG
- -10 to 85°C Operation: SPM-4100BWG
- -40 to 85°C Operation: SPM-4100AWG
- Class 1 Laser International Safety Standard IEC 60825 Compliant

## APPLICATIONS

- Multi-rate 8x/4x/2x Fiber Channel

## DESCRIPTION

The SPM-4100WG series multi-mode transceivers is SFP+ module for bi-directional serial optical data communications such as 8x/4x/2x/1x Fibre Channel. It is with the SFP+ 20-pin connector to allow hot plug capability. Digital diagnostic functions are available via an $I^2C$. This module is designed for multi-mode fiber and operates at a nominal wavelength of 850 nm. The transmitter section uses a Vertical Cavity Surface Emitted Laser (VCSEL) and is a Class 1 laser compliant according to International Safety Standard IEC 60825. The receiver section uses an integrated GaAs detector preamplifier (IDP) mounted in an optical header and a limiting post-amplifier IC.

## LASER SAFETY

This multi-mode transceiver is a Class 1 laser product. It complies with IEC 60825 and FDA 21 CFR 1040.10 and 1040.11. The transceiver must be operated within the specified temperature and voltage limits. The optical ports of the module shall be terminated with an optical connector or with a dust plug.

## ORDER INFORMATION

| P/No. | Bit Rate (Gb/s) | FC-PI | Distance (m) | Wavelength (nm) | Package | Temp. (°C) | RoHS Compliant |
|---|---|---|---|---|---|---|---|
| SPM-4100WG | 8 / 4 / 2 | FC-PI-4 | 150 / 50 / 21* | 850 VCSEL | SFP+ with DMI | 0 to 70 | Yes |
| SPM-4100BWG | 8 / 4 / 2 | FC-PI-4 | 150 / 50 / 21* | 850 VCSEL | SFP+ with DMI | -10 to 85 | Yes |
| SPM-4100AWG | 8 / 4 / 2 | FC-PI-4 | 150 / 50 / 21* | 850 VCSEL | SFP+ with DMI | -40 to 85 | Yes |

*: 150m for OM3 MMF, 50m for OM2 MMF, and 21 m for OM1 MMF. All tested at 8.5Gb/s.

**Absolute Maximum Ratings**

| Parameter | Symbol | Min | Max | Units | Notes |
|---|---|---|---|---|---|
| Storage Temperature | Tstg | -40 | 85 | °C | |
| Operating Case Temperature | Topr | 0<br>-10<br>-40 | 70<br>85<br>85 | °C | SPM-4100WG<br>SPM-4100BWG<br>SPM-4100AWG |
| Operating Relative Humidity | RH | 5 | 95 | % | Non condensing |
| Power Supply Voltage | Vcc | 0 | 4 | V | |

**Recommended Operating Conditions**

| Parameter | Symbol | Min | Typ | Max | Units / Notes |
|---|---|---|---|---|---|
| Power Supply Voltage | Vcc | 3.14 | 3.3 | 3.46 | V |
| Operating Case Temperature | Topr | 0<br>-10<br>-40 | | 70<br>85<br>85 | °C / SPM-4100WG<br>°C / SPM-4100BWG<br>°C / SPM-4100AWG |
| Power Supply Current | $I_{CC\ (TX+RX)}$ | | 135 | 180 | mA |
| Data Rate | | 1 | 8.5 | | Gb/s |

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| Transmitter Optical Specifications (0°C < Topr < 70°C, 3.13V < Vcc < 3.47V) | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Min** | **Typ** | **Max** | **Units** | **Notes** |
| Average Launch Power | $Po_{,Avg}$ | -8.2 | | -1 | dBm | 1 |
| Optical Modulation Amplitude | $Po_{,OMA}$ | 0.302 | | | mW | |
| Output Center Wavelength | $\lambda c$ | 840 | 850 | 860 | nm | |
| Output Spectrum Width | $\sigma_\lambda$ | | | 0.6 | nm | RMS (σ) |
| Relative Intensity Noise | RIN | | | -128 | dB/Hz | |

1. Output power is power coupled into a 50/125 μm multi-mode fiber.

| Receiver Optical Specifications (0°C < Topr < 70°C, 3.13V < Vcc < 3.47V) | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Min** | **Typ** | **Max** | **Units** | **Notes** |
| Unstressed Sensitivity at 8.5 Gb/s | Sens | | | 0.076 | mWp-p | 2, OMA |
| | | | | -12.5 | dBm | 3, Average Power |
| Stress Sensitivity at 8.5 Gb/s | Sens | | --- | 0.155 | mWp-p | 2, OMA |
| Receiver Overload | $P_{MAX}$ | 0.5 | --- | | dBm | |
| LOS -- Deasserted | $LOS_D$ | --- | --- | -14 | dBm | Transition: low to high |
| LOS -- Asserted | $LOS_A$ | -25 | --- | --- | dBm | Transition: high to low |
| Wavelength of Operation | $\lambda c$ | 840 | | 860 | nm | |
| Optical Return Loss | ORL | | | -12 | dB | |

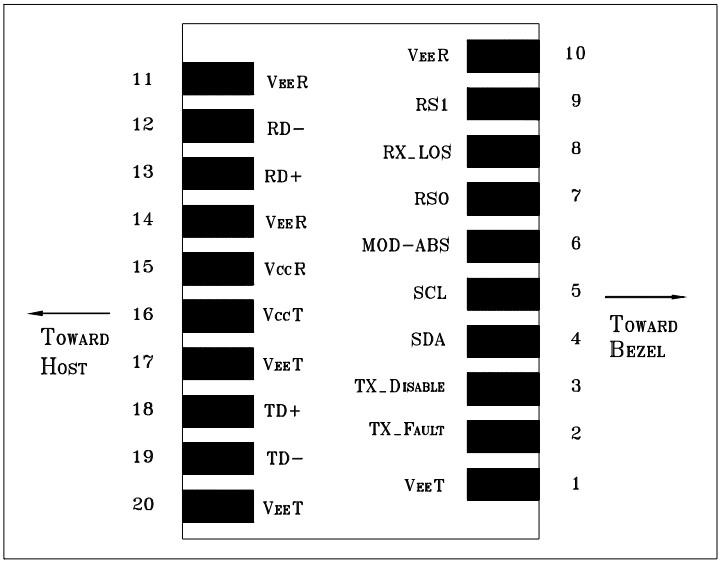
2. Measured with worst ER; BER < $10^{-12}$ and PRBS $2^7$-1.
3. Represents sensitivity based on OMA spec, as corrected to incoming Extinction Ratio of 7 dB. For example, an OMA of 0.076 mW is approximately equal to an average power of -12.5 dBm, average with an Extinction ratio of 7 dB.

| Electrical Characteristics | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Min** | **Typ** | **Max** | **Units** | **Notes** |
| **High-Speed Signal (CML) Interface Specification** | | | | | | |
| Input Data Rate | | 1 | 8.5 | | Gb/s | |
| Differential Input Impedance | Rin | | 100 | | Ω | |
| Differential Data Input Amplitude | | 150 | | 700 | mVpp | Internally AC coupled |
| Output Data Rate | | 1 | 8.5 | | Gb/s | |
| Differential Output Impedance | Rout | | 100 | | Ω | |
| Differential Data Output Amplitude | | 350 | 600 | 700 | mVpp | Internally AC coupled |
| **Low-Speed Signal (LVTTL) Interface Specification** | | | | | | |
| 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 | |

## LINK LENGTH

| Data Rate / Standard | Fiber Type | Model Bandwidth @ 850nm (MHz-km) | Distance Range (m) |
|---|---|---|---|
| 8.5 GBd | 62.5/125 μm MMF (OM1) | 200 | 0.5 to 21 |
| | 50 / 125 μm MMF (OM2) | 500 | 0.5 to 50 |
| | 50 / 125 μm MMF | 900 | 0.5 to 90 |
| | 50 / 125 μm MMF | 1500 | 0.5 to 120 |
| | 50 / 125 μm MMF (OM3) | 2000 | 0.5 to 150 |

## CONNECTION DIAGRAM



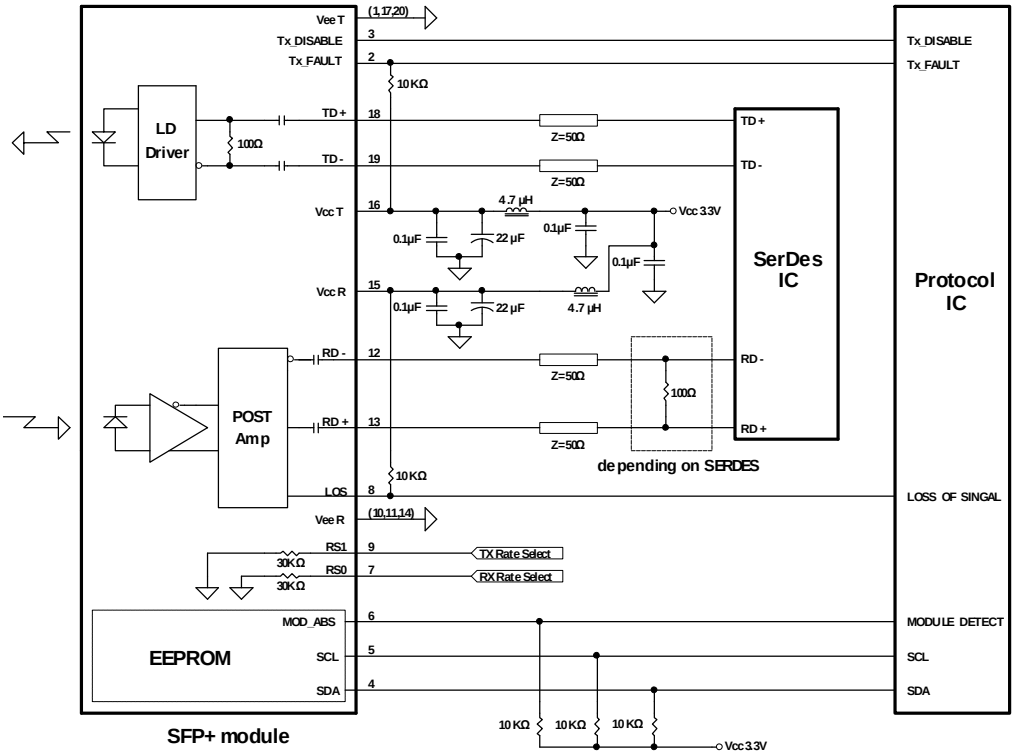

| PIN | Signal Name | Description | PIN | Signal Name | Description |
|---|---|---|---|---|---|
| 1 | $V_{EE}T$ | Transmitter Signal Ground | 11 | $V_{EE}R$ | Receiver Signal Ground |
| 2 | TX_Fault | Transmitter Fault Indication. Logic "1" Output = Laser Fault. Logic "0" Output = Normal Operation | 12 | RD- | Inverse Receiver Data Out |
| 3 | TX_Disable | Logic "1" Input (or no connection) = TX off, Logic "0" = TX on. | 13 | RD+ | Receiver Data Out |
| 4 | SDA | Modulation Definition 2 – Two wires serial ID Interface | 14 | $V_{EE}R$ | Receiver Signal Ground |
| 5 | SDL | Modulation Definition 1 – Two wires serial ID Interface | 15 | $V_{CC}R$ | Receiver Power – 3.3V±5% |
| 6 | MOD-ABS | Modulation Absent, connected to $V_{EE}T$ or $V_{EE}R$ in the module. | 16 | $V_{CC}T$ | 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 | $V_{EE}T$ | 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 | $V_{EE}R$ | Receiver Signal Ground | 20 | $V_{EE}T$ | 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 |

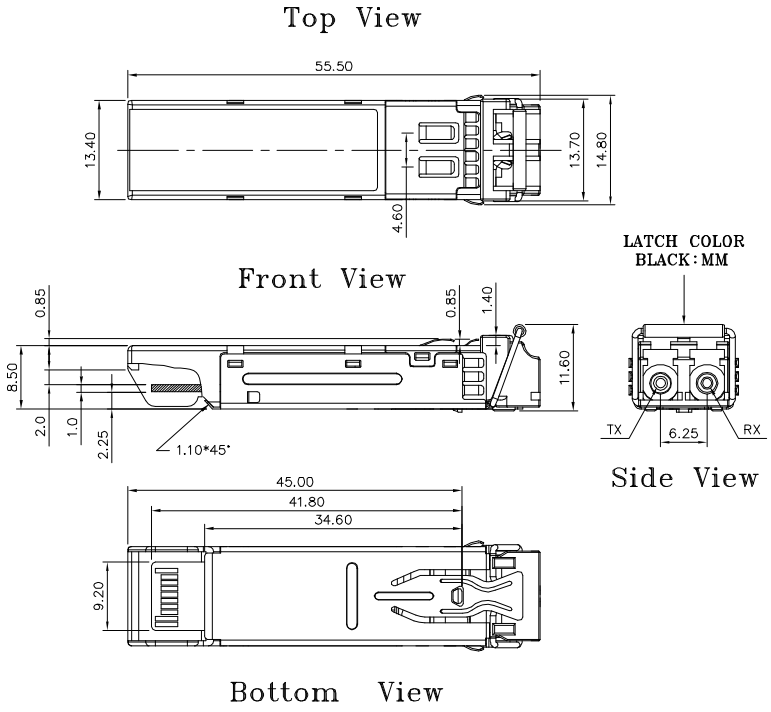
Module Definition 4 specifies a serial definition protocol. For this definition, upon power up, SDA and SDL appear as no connector (NC) and MOD-ABS is TTL LOW. When the host system detects this condition, it activates the serial protocol. The protocol uses the 2-wire serial CMOS $E^2$PROM protocol of the ATMEL AT24C01A/02/04 family of components.

## RECOMMENDED CIRCUIT SCHEMATIC




## PACKAGE DIAGRAM

**Units in mm**




Note: Specifications subject to change without notice.

REVISION HISTORY

| Version | Subject | Release Date |
|---|---|---|
| 1.0 | Initial datasheet | 2007/7/1 |
| 2.0 | Add SPM-4100BWG, -10 to 85°C | 2007/12/1 |
| 3.0 | Add SPM-4100AWG, -40 to 85°C | 2008/2/1 |
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| | | |