

## SPS-2341MW-CXX0G

**(RoHS Compliant)**

### 10G Multirate / CWDM / 40km Digital Diagnostic LC SFP+ SINGLE-MODE TRANSCEIVER

#### FEATURES

- | Support 9.95 Gbps to 11.1Gbps
- | Compliant to SFP+ MSA
- | Compliant to IEEE 802.3ae 10GBASE-ER
- | Compliant with OC-192 IR-2 / SDH STM S-64.2b
- | **Maximum Link Length of 40 km**
- | **Temperature-stabilized 8-Wavelength CWDM EML Transmitter: from 1470 nm to 1610 nm**
- | **15 dB Power Budget at Least**
- | 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 Operating
- | Class 1 Laser International Safety Standard IEC-60825 Compliant

#### APPLICATIONS

- | 10GBASE-ER/EW
- | OC-192 / STM-64 IR2
- | 40 km 10G Fibre Channel

#### DESCRIPTION

The SPS-2341MW-CXX0G series single mode transceiver is small form factor pluggable module for bi-directional serial optical data communications such as IEEE 802.3ae 10GBASE-ER/EW and OC-192 / STM-64 IR2. 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 CWDM wavelength. There are eight center wavelengths available from 1470 nm to 1610 nm, with each step 20 nm. A guaranteed minimum optical link budget of 15 dB is offered. The transmitter section uses a temperature-stabilized CWDM 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.

#### LASER SAFETY

This single 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) | 10G               | Power Budget (dB) | Wavelength (nm) | Package       | Temp. (°C) | RoHS Compliant |
|-------------------------|-----------------|-------------------|-------------------|-----------------|---------------|------------|----------------|
| <b>SPS-2341MW-CXX0G</b> | 9.95 – 11.1     | <b>Multirate*</b> | <b>&gt; 15</b>    | <b>CWDM*</b>    | SFP+ with DMI | 0 to 70    | Yes            |

\*: multirate for SONET OC-192 IR2, OC-192 IR-3, 10GBASE-ER/EW, 10G Fibre Channel, ITU-T G.709, 10GBASE-ER/EW + FEC

#### CWDM\* Wavelength (0 to 70°C)

| Central Wavelength | Min. (nm) | Typ. (nm) | Max. (nm) | Label      | Central Wavelength | Min. (nm) | Typ. (nm) | Max. (nm) | Label      |
|--------------------|-----------|-----------|-----------|------------|--------------------|-----------|-----------|-----------|------------|
| -C470              | 1464.5    | 1470      | 1477.5    | <b>C47</b> | -C550              | 1544.5    | 1550      | 1557.5    | <b>C55</b> |
| -C490              | 1484.5    | 1490      | 1497.5    | <b>C49</b> | -C570              | 1564.5    | 1570      | 1577.5    | <b>C57</b> |
| -C510              | 1504.5    | 1510      | 1517.5    | <b>C51</b> | -C590              | 1584.5    | 1590      | 1597.5    | <b>C59</b> |
| -C530              | 1524.5    | 1530      | 1537.5    | <b>C53</b> | -C610              | 1604.5    | 1610      | 1617.5    | <b>C61</b> |

CWDM\*: 8 Wavelengths from 1470 nm to 1610 nm, each step 20 nm.

**Absolute Maximum Ratings**

| Parameter                  | Symbol | Min  | Max | Units | Notes |
|----------------------------|--------|------|-----|-------|-------|
| Storage Temperature        | Tstg   | -40  | 85  | °C    |       |
| Operating Case Temperature | Topr   | 0    | 70  | °C    |       |
| 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            |
| Power Supply Current       | I <sub>CC(TX+RX)</sub> |      | 350     | 500  | mA            |
| Data Rate                  |                        | 9.95 | 10.3125 | 11.1 | Gb/s          |

**Transmitter Optical Specifications (0°C < Topr < 70°C, 3.13V < Vcc < 3.47V)**

| Parameter   | Symbol              | Min                  | Typ            | Max                  | Units | Notes        |
|---|---------------------|----------------------|----------------|----------------------|-------|--------------|
| Average Launch Power                                      | P <sub>O, AVG</sub> | -1                   |                | 3                    | dBm   | 1            |
| Output Center Wavelength                                  | λ                   | λ <sub>c</sub> - 5.5 | λ <sub>c</sub> | λ <sub>c</sub> + 7.5 | nm    | 2            |
| Output Spectrum Width                                     | Δλ                  | ---                  |                | 1                    | nm    | -20 dB width |
| Extinction Ratio  | ER                  | 8.2                  |                |                      | dB    |              |
| Side Mode Suppression Ratio                               | SMSR                | 30                   |                |                      | dB    |              |
| Transmitter and Dispersion Penalty @ 800 ps/nm @ 10.3Gb/s | TDP                 |                      |                | 3                    | dB    |              |
| Relative Intensity Noise                                  | RIN                 |                      |                | -128                 | dB/Hz |              |
| Average Launch Power of OFF Transmitter                   |                     |                      |                | -30                  | dBm   |              |

- Output power is power coupled into a 9/125 μm single-mode fiber.
- ITU-T G.694.2 CWDM wavelength from 1470 nm to 1610 nm, each step 20 nm.

**Receiver Optical Specifications (0°C < Topr < 70°C, 3.13V < Vcc < 3.47V)**

| Parameter               | Symbol           | Min  | Typ | Max  | Units | Notes                   |
|-------------------------|------------------|------|-----|------|-------|-------------------------|
| Sensitivity             |                  |      |     | -16  | dBm   | 3 / Average power       |
| 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 | λ <sub>c</sub>   | 1260 |     | 1620 | nm    |                         |
| Optical Return Loss     | ORL              |      |     | -27  | dB    |                         |

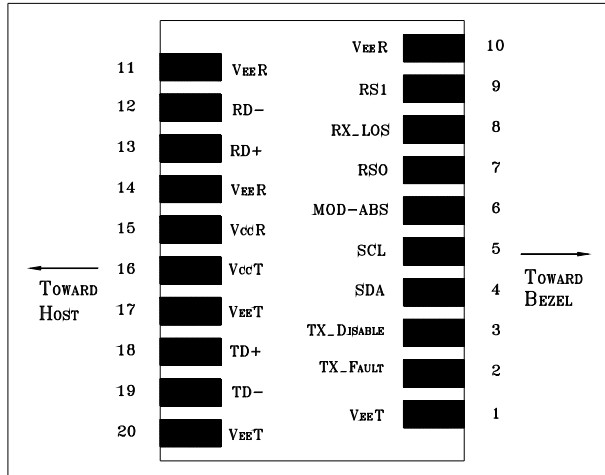
- Measured with average power; BER < 10<sup>-12</sup> and PRBS 2<sup>31</sup>-1.

**Electrical Characteristics**

| Parameter  | Symbol           | Min  | Typ     | Max                  | Units            | Notes                 |
|--|------------------|------|---------|----------------------|------------------|-----------------------|
| <b>High-Speed Signal (CML) Interface Specification</b>   |                  |      |         |                      |                  |                       |
| Input Data Rate  |                  | 9.95 | 10.3125 | 11.1                 | Gb/s             |                       |
| Differential Input Impedance                             | R <sub>in</sub>  |      | 100     |                      | Ω                |                       |
| Differential Data Input Amplitude                        |                  | 120  |         | 820                  | mV <sub>pp</sub> | Internally AC coupled |
| Output Data Rate   |                  | 9.95 | 10.3125 | 11.1                 | Gb/s             |                       |
| Differential Output Impedance                            | R <sub>out</sub> |      | 100     |                      | Ω                |                       |
| Differential Data Output Amplitude                       |                  | 350  | 600     | 850                  | mV <sub>pp</sub> | Internally AC coupled |
| <b>Low-Speed Signal (LVTTTL) Interface Specification</b> |                  |      |         |                      |                  |                       |
| Input High Voltage                                       |                  | 2.0  |         | V <sub>cc</sub> +0.3 | V                |                       |
| Input Low Voltage  |                  | GND  |         | 0.8                  | V                |                       |
| Output High Voltage                                      |                  | 2.4  |         | V <sub>cc</sub>      | V                |                       |
| Output Low Voltage                                       |                  | GND  |         | 0.5                  | V                |                       |

\*\*\*\*\*  
**OPTOWAY TECHNOLOGY INC.** No.38, Kuang Fu S. Road, Hu Kou, Hsin Chu Industrial Park, Hsin Chu, Taiwan 303  
 Tel: 886-3-5979798 Fax: 886-3-5979737  
 E-mail: [sales@optoway.com.tw](mailto:sales@optoway.com.tw) [http:// www.optoway.com.tw](http://www.optoway.com.tw) 4/1/2010 V1.0

CONNECTION DIAGRAM



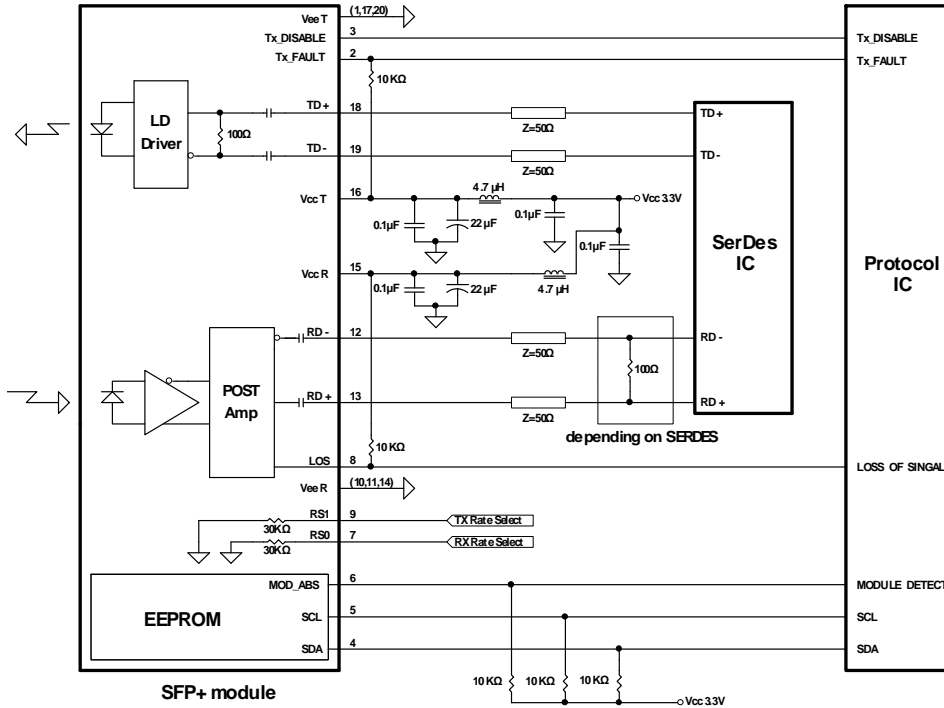
| PIN | Signal Name | Description   | PIN | Signal Name | Description                 |
|-----|-------------|---|-----|-------------|-----------------------------|
| 1   | VEET        | Transmitter Signal Ground   | 11  | VEER        | Receiver Signal Ground      |
| 2   | TX_Fault    | Transmitter Fault 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  | VEER        | Receiver Signal Ground      |
| 5   | SDL         | Modulation Definition 1 – Two wires serial ID Interface   | 15  | VccR        | Receiver Power – 3.3V±5%    |
| 6   | MOD-ABS     | Modulation Definition 0 – Ground in Module  | 16  | VccT        | 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  | VEET        | 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  | VEER        | Receiver Signal Ground  | 20  | VEET        | 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<sup>2</sup>PROM protocol of the ATMEL AT24C01A/02/04 family of components.

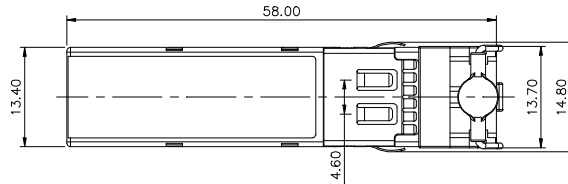
## RECOMMENDED CIRCUIT SCHEMATIC



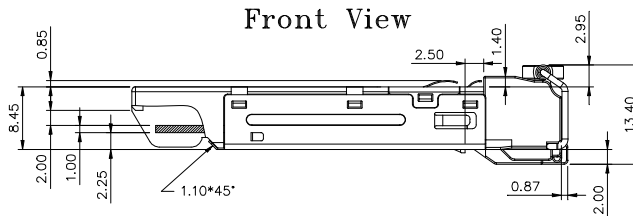
## PACKAGE DIAGRAM

Units in mm

### Top View

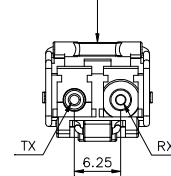


### Front View

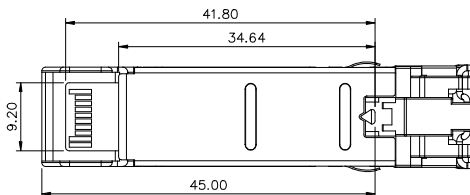


LATCH COLOR

Red



### Side View



### Bottom View

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

\*\*\*\*\*  
**OPTOWAY TECHNOLOGY INC.** No.38, Kuang Fu S. Road, Hu Kou, Hsin Chu Industrial Park, Hsin Chu, Taiwan 303

Tel: 886-3-5979798

Fax: 886-3-5979737

E-mail: [sales@optoway.com.tw](mailto:sales@optoway.com.tw)

<http://www.optoway.com.tw>

4/1/2010 V1.0

\*\*\*\*\*  
EEPROM Series ID Memory Contents (Address A0h)

| Addr. | Hex | ASCII | Note                  | Addr. | Hex | ASCII         | Note                          | Addr. | Hex | ASCII          | Note   | Addr.        | Hex | ASCII | Note                   |  |
|-------|-----|-------|-----------------------|-------|-----|---------------|-------------------------------|-------|-----|----------------|--|--------------|-----|-------|------------------------|--|
| 0     | 03  |       | SFP+                  | 32    | 20  |               |                               | 64    | 06  |                | Cooled Tx,   | 96           | 00  |       | Vendor specific EEPROM |  |
| 1     | 04  |       |                       | 33    | 20  |               |                               | 65    | 1A  |                | Power Level 2, Txdis, Txfault, LOS enable              | 97           | 00  |       |                        |  |
| 2     | 07  |       | LC                    | 34    | 20  |               |                               | 66    | 00  |                | Up bit rate  | 98           | 00  |       |                        |  |
| 3     | 80  |       | 10G Base-ER           | 35    | 20  |               |                               | 67    | 00  |                | Low bit rate   | 99           | 00  |       |                        |  |
| 4     | 08  |       | IR-2                  | 36    | 00  |               | NA                            | 68    |     |                | Serial number: each piece with different serial number | 100          | 00  |       |                        |  |
| 5     | 00  |       |                       | 37    | 00  |               | Vendor IEEE OUI               | 69    |     |                |  |              |     |       |                        |  |
| 6     | 00  |       |                       | 38    | 0E  |               |                               | 70    |     |                |  |              |     |       |                        |  |
| 7     | 10  |       | Long Distance (L)     | 39    | FA  |               |                               | 71    |     |                |  |              |     |       |                        |  |
| 8     | 10  |       | Longwave Laser (LL)   | 40    | 53  | S             | Part Number                   | 72    |     |                |  |              |     |       |                        |  |
| 9     | 01  |       | Single Mode (SM)      | 41    | 50  | P             |                               | 73    |     |                |  |              |     |       |                        |  |
| 10    | C0  |       | 1200 / 800 Mbytes/sec | 42    | 53  | S             |                               | 74    |     |                |  |              |     |       |                        |  |
| 11    | 06  |       | 64B/66B               | 43    | 2D  | -             |                               | 75    |     |                |  |              |     |       |                        |  |
| 12    | 6F  |       | 11.1Gbps              | 44    | 32  | 2             |                               | 76    |     |                |  |              |     |       |                        |  |
| 13    | 00  |       |                       | 45    | 33  | 3             |                               | 77    |     |                |  |              |     |       |                        |  |
| 14    | 28  |       | 40km                  | 46    | 34  | 4             |                               | 78    |     |                |  |              |     |       |                        |  |
| 15    | FF  |       | >25.4km               | 47    | 31  | 1             |                               | 79    |     |                |  |              |     |       |                        |  |
| 16    | 00  |       |                       | 48    | 4D  | M             |                               | 80    |     |                |  |              |     |       |                        |  |
| 17    | 00  |       |                       | 49    | 57  | W             |                               | 81    |     |                |  |              |     |       |                        |  |
| 18    | 00  |       |                       | 50    | 2D  | -             |                               | 82    |     |                |  |              |     |       |                        |  |
| 19    | 00  |       |                       | 51    | 43  | C             |                               | 83    |     |                |  |              |     |       |                        |  |
| 20    | 4F  | O     | Vendor name           | 52    | 3X  | X             |                               | 84    |     |                | Date Code  | 116          | 00  |       |                        |  |
| 21    | 50  | P     |                       | 53    | 3X  | X             |                               | 85    |     |                |  |              |     |       |                        |  |
| 22    | 54  | T     |                       | 54    | 30  | 0             |                               | 86    |     |                |  |              |     |       |                        |  |
| 23    | 4F  | O     |                       | 55    | 47  | G             |                               | 87    |     |                |  |              |     |       |                        |  |
| 24    | 57  | W     |                       | 56    | 30  | 0             | Revision, depended on version | 88    |     |                |  |              |     |       |                        |  |
| 25    | 41  | A     |                       | 57    | 30  | 0             |                               | 89    |     |                |  |              |     |       |                        |  |
| 26    | 59  | Y     |                       | 58    | 30  | 0             |                               | 90    |     |                |  |              |     |       |                        |  |
| 27    | 20  |       |                       | 59    | 30  | 1             |                               | 91    |     |                |  |              |     |       |                        |  |
| 28    | 20  |       |                       | 60    |     |               | 1XX0 nm                       | 92    | 68  |                |  | Monitoring   | 124 | 00    |                        |  |
| 29    | 20  |       |                       | 61    |     |               |                               | 93    | F0  |                |  | Soft Control | 125 | 00    |                        |  |
| 30    | 20  |       | 62                    | 00    |     | Reserved      | 94                            | 04    |     | SFF-8472V10.4  | 126  | 00           |     |       |                        |  |
| 31    | 20  |       | 63                    |       |     | Checksum 0-62 | 95                            |       |     | Checksum 64-94 | 127  | 00           |     |       |                        |  |

EEPROM Series ID Memory Contents (Address A2h)

| Addr. | Hex | Note                         | Addr. | Hex | Note                          | Addr. | Hex | Note              | Addr. | Hex | Note                     |
|-------|-----|------------------------------|-------|-----|-------------------------------|-------|-----|-------------------|-------|-----|--------------------------|
| 0     | 4B  | Temp. High Alarm (75°C)      | 32    | 27  | Rx Power High Alarm (0dBm)    | 64    | 00  | For External Cal. | 96    |     | Real Time Temp. MSB      |
| 1     | 00  |                              | 33    | 10  |                               | 65    | 00  | For External Cal. | 97    |     | Real Time Temp. LSB      |
| 2     | FB  | Temp. Low Alarm(-5°C)        | 34    | 00  | Rx Power Low Alarm (-18dBm)   | 66    | 00  | For External Cal. | 98    |     | Real Time Vcc MSB        |
| 3     | 00  |                              | 35    | 9E  |                               | 67    | 00  | For External Cal. | 99    |     | Real Time Vcc LSB        |
| 4     | 46  | Temp. High Warming(70°C)     | 36    | 1F  | Rx Power High Warming (-1dBm) | 68    | 3F  | For External Cal. | 100   |     | Real Time Tx Bias MSB    |
| 5     | 00  |                              | 37    | 07  |                               | 69    | 80  | For External Cal. | 101   |     | Real Time Tx Bias LSB    |
| 6     | 00  | Temp. Low Warming (0°C)      | 38    | 00  | Rx Power Low Warming(-16dBm)  | 70    | 00  | For External Cal. | 102   |     | Real Time Tx Pwr MSB     |
| 7     | 00  |                              | 39    | FB  |                               | 71    | 00  | For External Cal. | 103   |     | Real Time Tx Pwr LSB     |
| 8     | 8C  | Voltage High Alarm (3.6V)    | 40    | 00  | Reserved                      | 72    | 00  | For External Cal. | 104   |     | Real Time Rx Pwr MSB     |
| 9     | A0  |                              | 41    | 00  | Reserved                      | 73    | 00  | For External Cal. | 105   |     | Real Time Rx Pwr LSB     |
| 10    | 75  | Voltage Low Alarm(3.0V)      | 42    | 00  | Reserved                      | 74    | 00  | For External Cal. | 106   |     | Reserved                 |
| 11    | 30  |                              | 43    | 00  | Reserved                      | 75    | 00  | For External Cal. | 107   |     | Reserved                 |
| 12    | 88  | Voltage High Warming(3.5V)   | 44    | 00  | Reserved                      | 76    | 01  | For External Cal. | 108   |     | Reserved                 |
| 13    | B8  |                              | 45    | 00  | Reserved                      | 77    | 00  | For External Cal. | 109   |     | Reserved                 |
| 14    | 79  | voltage Low Warming (3.1V)   | 46    | 00  | Reserved                      | 78    | 00  | For External Cal. | 110   |     | Tx Dis, Tx Fault, Rx Los |
| 15    | 18  |                              | 47    | 00  | Reserved                      | 79    | 00  | For External Cal. | 111   |     | Reserved                 |
| 16    | EA  | Tx Bias High Alarm(120mA)    | 48    | 00  | Reserved                      | 80    | 01  | For External Cal. | 112   |     | Alarm Flag               |
| 17    | 60  |                              | 49    | 00  | Reserved                      | 81    | 00  | For External Cal. | 113   |     | Alarm Flag/Reserved      |
| 18    | 27  | Tx BiasLow Alarm(20mA)       | 50    | 00  | Reserved                      | 82    | 00  | For External Cal. | 114   |     | Reserved                 |
| 19    | 10  |                              | 51    | 00  | Reserved                      | 83    | 00  | For External Cal. | 115   |     | Reserved                 |
| 20    | D6  | Tx Bias High Warming(110mA)  | 52    | 00  | Reserved                      | 84    | 01  | For External Cal. | 116   |     | Warming Flag             |
| 21    | D8  |                              | 53    | 00  | Reserved                      | 85    | 00  | For External Cal. | 117   |     | Warming Flag/Reserved    |
| 22    | 3A  | Tx Bias Low Warming(30mA)    | 54    | 00  | Reserved                      | 86    | 00  | For External Cal. | 118   |     | Reserved                 |
| 23    | 98  |                              | 55    | 00  | Reserved                      | 87    | 00  | For External Cal. | 119   |     | Reserved                 |
| 24    | 62  | Tx Power High Alarm (4dBm))  | 56    | 00  | For External Cal.             | 88    | 01  | For External Cal. | 120   |     | Vendor Specific          |
| 25    | 1F  |                              | 57    | 00  | For External Cal.             | 89    | 00  | For External Cal. | 121   |     |                          |
| 26    | 18  | Tx Power Low Alarm(-2dBm)    | 58    | 00  | For External Cal.             | 90    | 00  | For External Cal. | 122   |     |                          |
| 27    | A6  |                              | 59    | 00  | For External Cal.             | 91    | 00  | For External Cal. | 123   |     |                          |
| 28    | 4D  | Tx Power High Warming(3dBm)  | 60    | 00  | For External Cal.             | 92    | 00  | For External Cal. | 124   |     |                          |
| 29    | F1  |                              | 61    | 00  | For External Cal.             | 93    | 00  | For External Cal. | 125   |     |                          |
| 30    | 1F  | Tx Power Low Warming (-1dBm) | 62    | 00  | For External Cal.             | 94    | 00  | For External Cal. | 126   |     |                          |
| 31    | 07  |                              | 63    | 00  | For External Cal.             | 95    |     | Check Sum         | 127   |     |                          |

Note: Address 128 – 247: customer R/W eeprom. Address 248 – 255: Vendor Specific.

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

\*\*\*\*\*  
REVISION HISTORY

| Version | Subject           | Release Date |
|---------|-------------------|--------------|
| 1.0     | Initial datasheet | 2010/4/1     |
|         |                   |              |
|         |                   |              |

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