

SPM-2500FWG

(RoHS Compliant)

32G FC / 100m / 850nm Digital Diagnostic SFP28 LC Multi-mode TRANSCEIVER

FEATURES

- Up to 28.05 Gb/s Bi-directional Data Links
- Complaint with SFF-8402 SFP28 MSA
- Compliant with Fibre Channel 3200-SN
- Compliant with 16G and 8G Fibre Channel
- Support OTN 27.85Gbps
- Support 25G Ethernet
- Built-in dual CDR
- Link Distance at 28.05 Gb/s
 - 100m links with OM4 MMF Cables
 - 70m links with OM3 MMF Cables
 - 20m links with OM2 MMF Cables
- SFF-8472 Digital Diagnostic Function
- AC/AC Coupling according to MSA
- Single +3.3 V Power Supply
- RoHS Compliant
- 0 to 70°C Operating
- Class 1 Laser International Safety Standard IEC-60825 Compliant
- Enhanced EWRAP, OWRAP, and CDR bypass operational features

DESCRIPTION

The SPM-2500FWG series multi-mode transceiver is a small form factor pluggable module for bi-directional serial optical data communications such as 32x/16x/8x Fibre Channel, OTN OTU4, and 25G Ethernet. It is with the SFP+ 20-pin connector to allow hot plug capability. Digital diagnostic functions are available via an I²C. 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 rate selection clock data recovery (CDR) 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.

APPLICATIONS

- Multi-rate 32x / 16x / 8x Fibre Channel
- OTN OTU4
- 25G Ethernet

ORDER INFORMATION

P/No.	Bit Rate (Gb/s)	FC	Distance (m)	Wavelength (nm)	Package	Case Temp (°C)	RoHS Compliant
SPM-2500FWG	Up to 28.05	32G/16G/8G	20/70/100*	850 VCSEL	SFP28 with DMI	0 to 70	Yes

*: 20m for OM2 MMF, 70m for OM3 MMF, and 100m for OM4 MMF. All tested at 28.05Gb/s.

Absolute Maximum Ratings						
Parameter	Symbol	Min	Max	Units	Notes	
Storage Temperature	Tstg	-40	85	°C		
Relative Humidity	RH	0	85	%	Non-condensing	
Operating Case Temperature	Topr	0	70	°C		
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
Relative Humidity	RH	0		85	% / Non-condensing
Power Supply Current	I _{CC(TX+RX)}		200	290	mA
Data Rate			25.78		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	PO, AVG	-6.2		2	dBm	1
Optical Modulation Amplitude	PO, OMA	-3.2			dBm	
Output Center Wavelength	λ_c	840		860	nm	
Output Spectrum Width	σ_λ			0.57	nm	RMS(σ)
Extinction Ratio	ER	2				
Relative Intensity Noise	RIN			-129	dB/Hz	

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

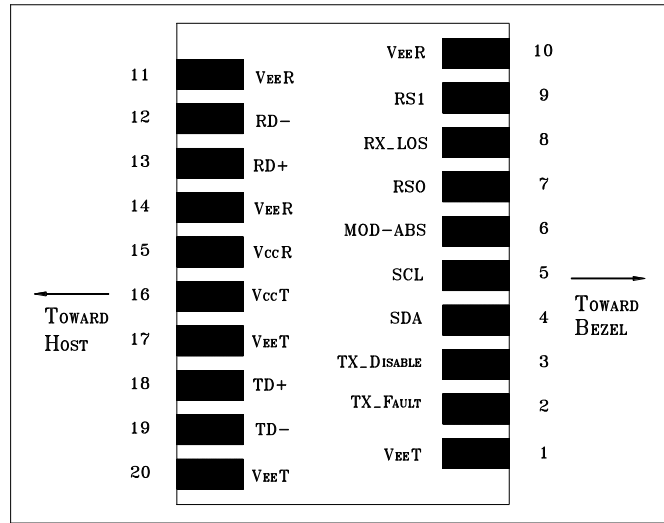
Receiver Optical Specifications (0°C < Topr < 70°C, 3.13V < Vcc < 3.47V)						
Parameter	Symbol	Min	Typ	Max	Units	Notes
Average Receiver Power	Sens1			2	dBm	2
Unstressed Sensitivity (OMA)	Sens2	-10.2	---		dBm	
Wavelength of Operation	λ_c	820		860	nm	
LOS – Deasserted	LOS _D	---	---	-13	dBm	Transition: low to high
LOS – Asserted	LOS _A	-30	---	---	dBm	Transition: high to low
Receiver Reflectance	ORL	12			dB	

2. Measured with worst ER; BER < 1x10⁻⁶ and PRBS 2³¹-1.

Electrical Characteristics						
Parameter	Symbol	Min	Typ	Max	Units	Notes
High-Speed Signal (CML) Interface Specification						
Input Data Rate		8.5		28.05	Gb/s	
TX Clock Tolerance		-100		+100	ppm	3
Differential Input Impedance	Rin		100		Ω	
Differential Data Input Amplitude		150		1200	mVpp	Internally AC coupled
Output Data Rate		8.5		28.05	Gb/s	
RX Clock Tolerance		-100		+100	ppm	3
Differential Output Impedance	Rout		100		Ω	
Differential Data Output Amplitude		350	600	700	mVpp	Internally AC coupled
Low-Speed Signal (LVTTTL) 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	

3. Clock tolerance for 28.05Gb/s.

CONNECTION DIAGRAM



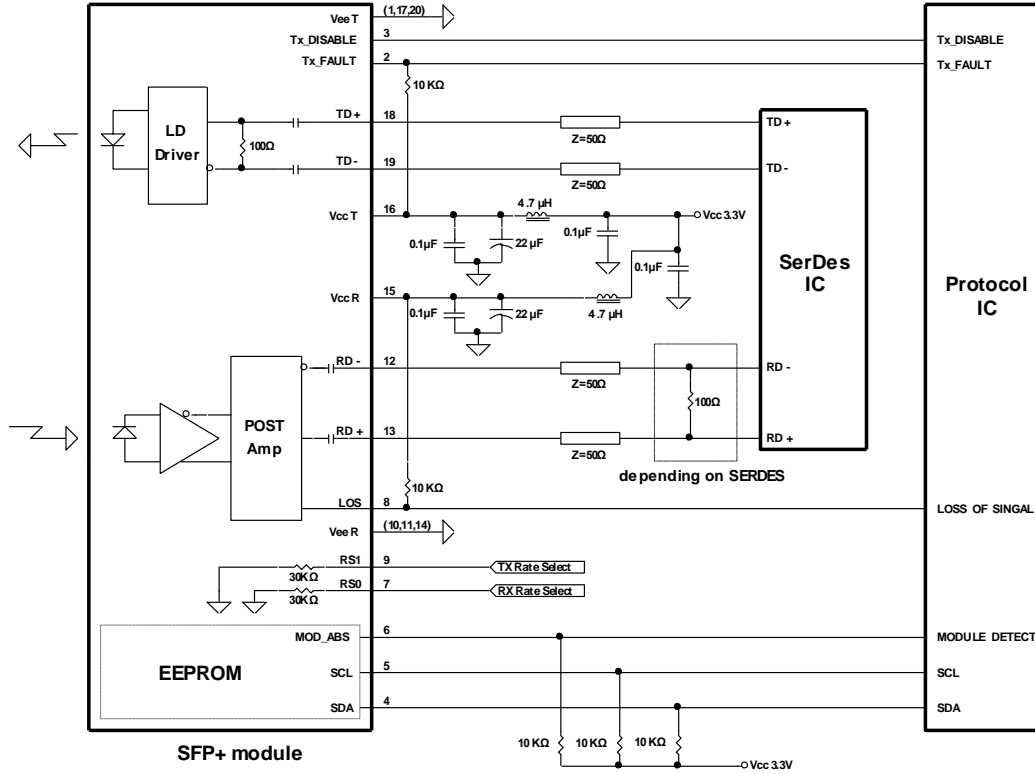
PIN	Signal Name	Description	PIN	Signal Name	Description
1	VEET	Transmitter Signal Ground	11	VEER	Receiver Signal Ground
2	TX_Fault	Transmitter Fault Indication. Logic "1" Output = Laser Fault. Logic "0" Output = Normal Operation	12	RD-	Inverse Receiver Data Out
3	TX_Disable	Logic "1" Input (or no connection) = 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	SCL	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: (See Rate Select Control) Open or Low: enable CDR for 16G or 8G FC. High: enable CDR for 32G FC or 25GE.	17	VEET	Transmitter Signal Ground
8	RX_LOS	Loss of Signal Out (OC).	18	TD+	Transmitter Data In
9	RS1	TX Rate Select: (See Rate Select Control) Open or Low: enable CDR for 16G or 8G FC. High: enable CDR for 32G FC or 25GE.	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

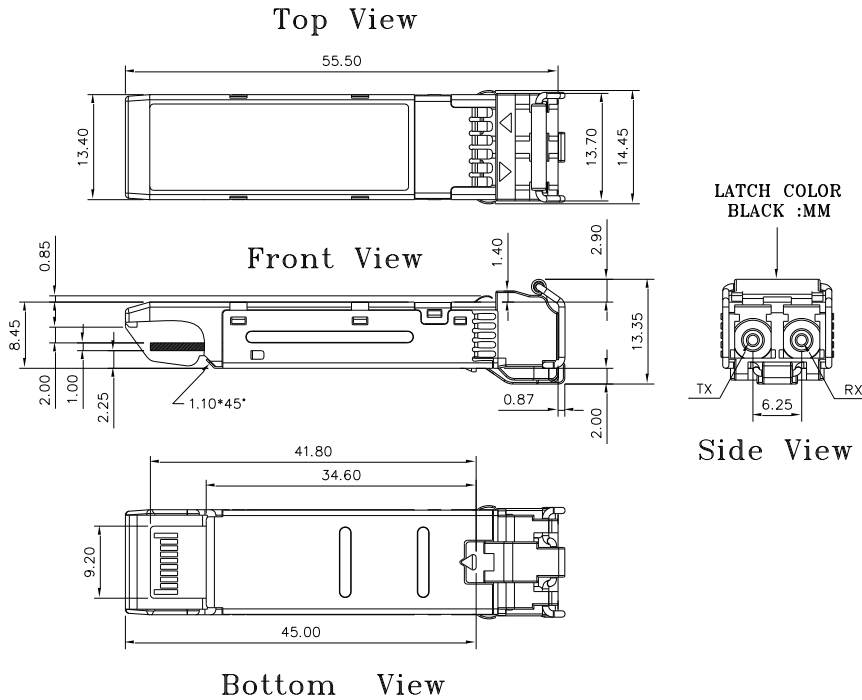
Module Definition 4 specifies a serial definition protocol. For this definition, upon power up, SDA and SCL appear as no connector (NC) and MOD-ABS is TTL LOW. When the host system detects this condition, it activates the serial protocol. The protocol uses the 2-wire serial CMOS E²PROM protocol of the ATMEL AT24C01A/02/04 family of components.

RECOMMENDED CIRCUIT SCHEMATIC



PACKAGE DIAGRAM

Units in mm



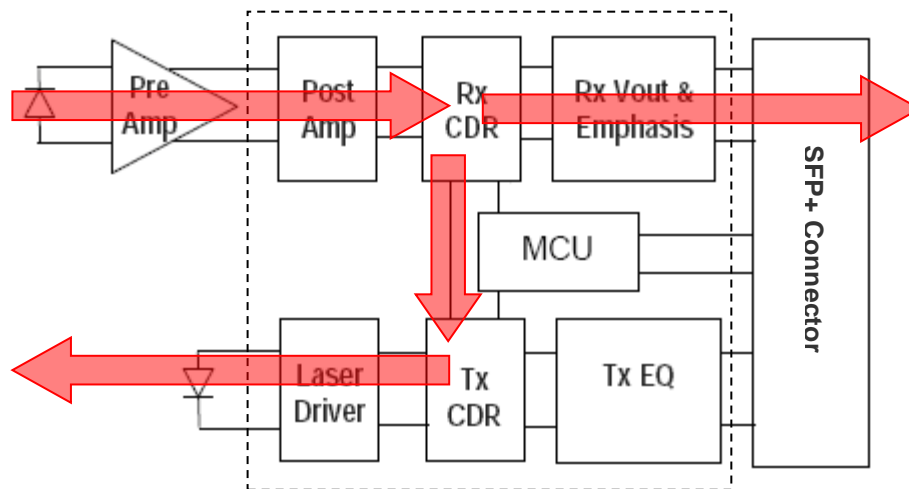
Note: Specifications subject to change without notice.

WRAP AND BYPASS CDR OPERATION FUNCTIONS - SOFT CONTROL (Address A2h, Byte 111).

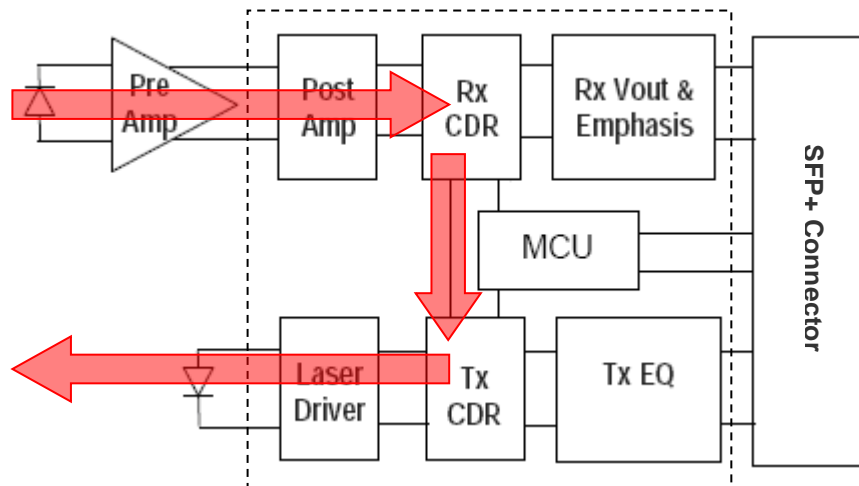
To assist with local host or remote diagnostic and optimization sequences, electrical and optical wrap functions can be enabled. Optical wrap (OWRAP) takes the received optical signal through CDRs and retransmits it optically out. Electrical wrap (EWRAP) takes the received electrical signal through CDRs and retransmits it electrically out. Optional forward functions can be transmitted outbound the wrapped information via i2c control.

Byte	Bit	Name	Description
111	7	TX CDR Bypass	When set, bypass the TX CDR.
	6	RX CDR Bypass	When set, bypass the RX CDR.
	4-5	Reserved	Reserved.
	3	OWRAP Forward Enable Bit	When set in combination with OWRAP Enable, OWRAP Forward routes incoming SFP+ Rx optical data to both the Tx optical output and the Rx electrical output. Enabling sets bit 2 and clears all other bits in byte 111.
	2	OWRAP Enable Bit	When set, OWRAP routes incoming SFP+ Rx optical data to the Tx optical output. Enabling clears all other bits in byte 111.
	1	EWRAP Forward Enable Bit	When set in combination with EWRAP Enable, EWRAP Forward routes incoming SFP+ Tx electrical data to both Rx electrical output and Tx optical output. Enabling sets bit 0 and clears all other bits in byte 111.
	0	EWRAP Enable Bit	When set, EWRAP Enable routes incoming SFP+ Tx electrical data to the Rx electrical output. Enabling clears all other bits in byte 111.

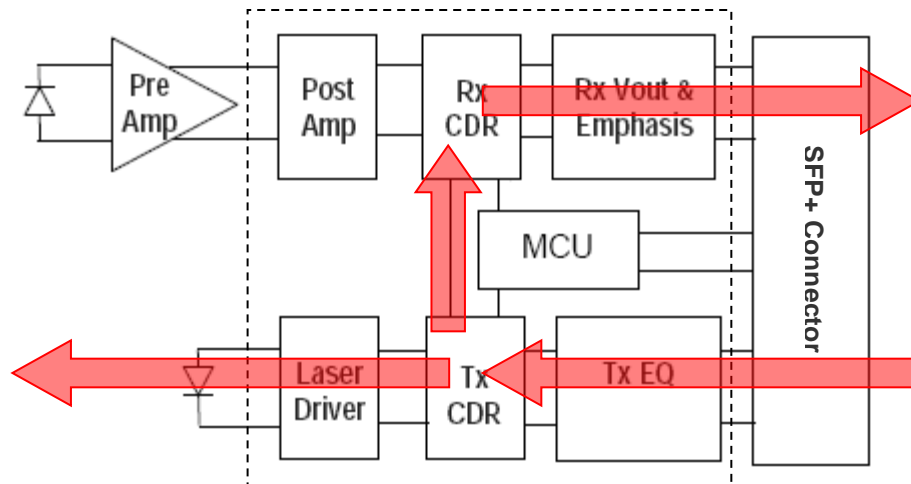
OWRAP FORWARD ENABLE MODE (I2C CONTROLLED)



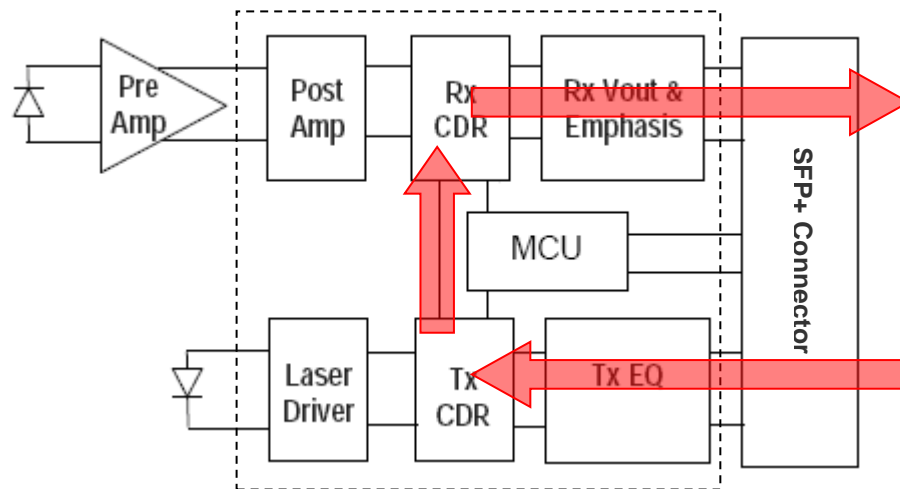
OWRAP ENABLE MODE (I2C CONTROLLED)



EWRAP FORWARD ENABLE MODE (I2C CONTROLLED)



EWRAP ENABLE MODE (I2C CONTROLLED)



RATE SELECT CONTROL

RX / TX rate can be independently controlled by RS0 / RS1 input pin (Hardware). RS0 / RS1 input pins (pin 7 / 9) are used to select RX / TX rate. Status of RS0 / RS1 input pin logic level is reflected to register byte 110 bit 4 / 5 on address A2h. RS0 / RS1 input pin must be “High” for 32GFC or 25GE transmission and “Low” for 16GFC or 8GFC transmission. To have flexible transmission data rate other than 32G/16G/8G FC and 25GE, user may assert TX and/or RX CDR Bypass bits (A2h, Byte 111, [7:6]) to bypass the CDR if required.

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		SFP28	32	20			64	18		Power Level 1,	96	00		Vendor specific EEPROM
1	04			33	20			65	3A		w/ CDR,	97	00		
2	07		LC	34	20			66	70		Uncooled Tx,	98	00		
3	00			35	20			67	00		Rate Select,	99	00		
4	00			36	02		25GBASE-SR	68			Txdis, Txfault,	100	00		
5	00			37	00		Vendor IEEE	69			LOS	101	00		
6	00			38	0E		OUI	70			Serial number:	102	00		
7	20		Intermediate distance (I)	39	FA			71			each piece with	103	00		
8	40		Shortwave laser w/o OFC (SN)	40	53	S	Part Number	72			different serial	104	00		
9	04		M5, M5E	41	50	P		73			number	105	00		
10	68		3200/1600/ 800 Mbytes/sec	42	4D	M		74				106	00		
11	06		64B/66B	43	2D	-		75				107	00		
12	FF		> 25.4 Gb/s	44	32	2		76				108	00		
13	0C		FC-PI-6 (32/16/ 8G Independent Rx, Tx Rate_ Select) High= 32G only, Low = 16G/8G	45	35	5		77				109	00		
14	00			46	30	0		78				110	00		
15	00			47	30	0		79				111	00		
16	02		OM2 50/125um MMF, 20m	48	46	F		80				112	00		
17	00			49	57	W		81				113	00		
18	0A		OM4 50/125um MMF, 100m	50	47	G		82				114	00		
19	07		OM3 50/125um MMF, 70m	51	20			83				115	00		
20	4F	O	Vendor name	52	20			84		Y	Date Code	116	00		
21	50	P		53	20			85		Y		117	00		
22	54	T		54	20			86		M		118	00		
23	4F	O		55	20			87		M		119	00		
24	57	W		56	30	0	Revision,	88		D		120	00		
25	41	A		57	30	0	depended on	89		D		121	00		
26	59	Y		58	30	0	version	90	20			122	00		
27	20			59	31	1		91	20			123	00		
28	20			60	03		850 nm	92	68		Monitoring	124	00		
29	20			61	52			93	F8		Soft Control and Monitoring	125	00		
30	20		62	00		Reserved	94	08		SFF-8472 V12.3	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	4D	Rx Power High Alarm (3dBm)	64	00	For External Cal.	96		Real Time Temp. MSB
1	00		33	F1		65	00	For External Cal.	97		Real Time Temp. LSB
2	FB	Temp. Low Alarm(-5°C)	34	02	Rx Power Low Alarm (-12.2dBm)	66	00	For External Cal.	98		Real Time Vcc MSB
3	00		35	5B		67	00	For External Cal.	99		Real Time Vcc LSB
4	49	Temp. High Warming(73°C)	36	3D	Rx Power High Warming (2dBm)	68	3F	For External Cal.	100		Real Time Tx Bias MSB
5	00		37	E9		69	80	For External Cal.	101		Real Time Tx Bias LSB
6	00	Temp. Low Warming (0°C)	38	03	Rx Power Low Warming(-10.2dBm)	70	00	For External Cal.	102		Real Time Tx Pwr MSB
7	00		39	BB		71	00	For External Cal.	103		Real Time Tx Pwr LSB
8	8C	Voltage High Alarm (3.6V)	40	7F	Reserved	72	00	For External Cal.	104		Real Time Rx Pwr MSB
9	A0		41	FF	Reserved	73	00	For External Cal.	105		Real Time Rx Pwr LSB
10	75	Voltage Low Alarm(3.0V)	42	80	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	7F	Reserved	76	01	For External Cal.	108		Reserved
13	B8		45	FF	Reserved	77	00	For External Cal.	109		Reserved
14	79	Voltage Low Warming (3.1V)	46	80	Reserved	78	00	For External Cal.	110		Tx Dis, Tx Fault, Rx Los
15	18		47	00	Reserved	79	00	For External Cal.	111		CDR Bypass, OWRAP, EWRAP
16	27	Tx Bias High Alarm(20mA)	48	7F	Reserved	80	01	For External Cal.	112		Alarm Flag
17	10		49	FF	Reserved	81	00	For External Cal.	113		Alarm Flag/Reserved
18	01	Tx Bias Low Alarm(1mA)	50	80	Reserved	82	00	For External Cal.	114		Reserved
19	F4		51	00	Reserved	83	00	For External Cal.	115		Reserved
20	1D	Tx Bias High Warming(15mA)	52	7F	Reserved	84	01	For External Cal.	116		Warming Flag
21	4C		53	FF	Reserved	85	00	For External Cal.	117		Warming Flag/Reserved
22	03	Tx Bias Low Warming(2mA)	54	80	Reserved	86	00	For External Cal.	118		RS1 Select
23	E8		55	00	Reserved	87	00	For External Cal.	119		Reserved
24	4D	Tx Power High Alarm (3dBm)	56	00	For External Cal.	88	01	For External Cal.	120		Vendor Specific
25	F1		57	00	For External Cal.	89	00	For External Cal.	121		
26	07	Tx Power Low Alarm(-7.2dBm)	58	00	For External Cal.	90	00	For External Cal.	122		
27	71		59	00	For External Cal.	91	00	For External Cal.	123		
28	3D	Tx Power High Warming(2dBm)	60	00	For External Cal.	92	00	For External Cal.	124		
29	E9		61	00	For External Cal.	93	00	For External Cal.	125		
30	09	Tx Power Low Warming (-6.2dBm)	62	00	For External Cal.	94	00	For External Cal.	126		
31	5F		63	00	For External Cal.	95		Check Sum	127		

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

REVISION HISTORY

Version	Subject	Release Date
1.0	Initial datasheet	2019/2/20
1.1	Revise EEPROM A0h content	2020/4/27