SPS-6345W-DXXXG (RoHS Compliant)

16G FC / 50GHz DWDM / 40 km Digital Diagnostic SFP+ LC SINGLE-MODE TRANSCEIVER

FEATURES

- Up to 14.025 Gbps Bi-directional Data Links
- Complaint to SFP+ MSA
- Compliance with Fibre Channel 1600-SM-LC-L
- Maximum Link Length of 40 km
- Temperature-stabilized DWDM EML Transmitter
- 14 dB Power Budget at Least
- 50 GHz ITU Grid, C Band
- RX Rate Selection for 16G FC and 8G/4G FC
- Flexibility in RX data rate selection through either hardware or software control
- 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

APPLICATIONS

- Multi-rate 16x / 8x / 4x Fibre Channel
- 10G FCoE

DESCRIPTION

The SPS-6345W-DXXXG series single mode transceiver is a small form factor pluggable module for bi-directional serial optical data communications such as 16x/8x/4x 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 single mode fiber and operates at a nominal wavelength of 50GHz ITU Grid, C Band DWDM wavelength. A guaranteed minimum optical link budget of 14 dB is offered. The transmitter section uses temperature-stabilized DWDM 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 rate selection clock data recovery (CDR) 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.

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ORDER INFORMATION

P/No.	Bit Rate (Gb/s)	FC	Distance (km)	Spacing (GHz)	Wavelength (nm)	Package	Case Temp (°C)	RoHS Compliant
SPS-6345W-DXXXG	14.025	16G/8G/4G	40	50	DWDM*	SFP+ with DMI	0 to 70	Yes

*XXX: 50GHz ITU Grid wavelength (Please see below)

Channel #	Product code	Frequency (THz)	Center Wavelength (nm)	Label
190	SPS-6345W-D190G	191.90	1562.23	190
195	SPS-6345W-D195G	191.95	1561.83	195
200	SPS-6345W-D200G	192.00	1561.42	200
205	SPS-6345W-D205G	192.05	1561.01	205
210	SPS-6345W-D210G	192.10	1560.61	210
215	SPS-6345W-D215G	192.15	1560.20	215
220	SPS-6345W-D220G	192.20	1559.79	220
225	SPS-6345W-D225G	192.25	1559.39	225
230	SPS-6345W-D230G	192.30	1558.98	230
235	SPS-6345W-D235G	192.35	1558.58	235
240	SPS-6345W-D240G	192.40	1558.17	240
245	SPS-6345W-D245G	192.45	1557.77	245
250	SPS-6345W-D250G	192.50	1557.36	250
255	SPS-6345W-D255G	192.55	1556.96	255
260	SPS-6345W-D260G	192.60	1556.55	260
265	SPS-6345W-D265G	192.65	1556.15	265
270	SPS-6345W-D270G	192.70	1555.75	270
275	SPS-6345W-D275G	192.75	1555.34	275
280	SPS-6345W-D280G	192.80	1554.94	280
285	SPS-6345W-D285G	192.85	1554.54	285
290	SPS-6345W-D290G	192.90	1554.13	290
295	SPS-6345W-D295G	192.95	1553.73	295
300	SPS-6345W-D300G	193.00	1553.33	300
305	SPS-6345W-D305G	193.05	1552.93	305
310	SPS-6345W-D310G	193.10	1552.52	310
315	SPS-6345W-D315G	193.15	1552.12	315
320	SPS-6345W-D320G	193.20	1551.72	320
325	SPS-6345W-D325G	193.25	1551.32	325
330	SPS-6345W-D330G	193.30	1550.92	330
335	SPS-6345W-D335G	193.35	1550.52	335
340	SPS-6345W-D340G	193.40	1550.12	340
345	SPS-6345W-D345G	193.45	1549.72	345
350	SPS-6345W-D350G	193.50	1549.32	350
355	SPS-6345W-D355G	193.55	1548.91	355
360	SPS-6345W-D360G	193.60	1548.51	360
365	SPS-6345W-D365G	193.65	1548.11	365
370	SPS-6345W-D370G	193.70	1547.72	370
375	SPS-6345W-D375G	193.75	1547.32	375
380	SPS-6345W-D380G	193.80	1546.92	380
385	SPS-6345W-D385G	193.85	1546.52	385
390	SPS-6345W-D390G	193.90	1546.12	390
395	SPS-6345W-D395G	193.95	1545.72	395
400	SPS-6345W-D400G	194.00	1545.32	400
405	SPS-6345W-D405G	194.05	1544.92	405
410	SPS-6345W-D410G	194.10	1544.53	410
415	SPS-6345W-D415G	194.15	1544.13	415
420	SPS-6345W-D420G	194.20	1543.73	420
425	SPS-6345W-D425G	194.25	1543.33	425
430	SPS-6345W-D430G	194.30	1542.94	430
435	SPS-6345W-D435G	194.35	1542.54	435
440	SPS-6345W-D440G	194.40	1542.14	440
445	SPS-6345W-D445G	194.45	1541.75	445

Channel #	Product code	Frequency (THz)	Center Wavelength (nm)	Label
450	SPS-6345W-D450G	194.50	1541.35	450
455	SPS-6345W-D455G	194.55	1540.95	455
460	SPS-6345W-D460G	194.60	1540.56	460
465	SPS-6345W-D465G	194.65	1540.16	465
470	SPS-6345W-D470G	194.70	1539.77	470
475	SPS-6345W-D475G	194.75	1539.37	475
480	SPS-6345W-D480G	194.80	1538.98	480
485	SPS-6345W-D485G	194.85	1538.58	485
490	SPS-6345W-D490G	194.90	1538.19	490
495	SPS-6345W-D495G	194.95	1537.79	495
500	SPS-6345W-D500G	195.00	1537.40	500
505	SPS-6345W-D505G	195.05	1537.00	505
510	SPS-6345W-D510G	195.10	1536.61	510
515	SPS-6345W-D515G	195.15	1536.22	515
520	SPS-6345W-D520G	195.20	1535.82	520
525	SPS-6345W-D525G	195.25	1535.43	525
530	SPS-6345W-D530G	195.30	1535.04	530
535	SPS-6345W-D535G	195.35	1534.64	535
540	SPS-6345W-D540G	195.40	1534.25	540
545	SPS-6345W-D545G	195.45	1533.86	545
550	SPS-6345W-D550G	195.50	1533.47	550
555	SPS-6345W-D555G	195.55	1533.07	555
560	SPS-6345W-D560G	195.60	1532.68	560
565	SPS-6345W-D565G	195.65	1532.29	565
570	SPS-6345W-D570G	195.70	1531.90	570
575	SPS-6345W-D575G	195.75	1531.51	575
580	SPS-6345W-D580G	195.80	1531.12	580
585	SPS-6345W-D585G	195.85	1530.72	585
590	SPS-6345W-D590G	195.90	1530.33	590
595	SPS-6345W-D595G	195.95	1529.94	595
600	SPS-6345W-D600G	196.00	1529.55	600
605	SPS-6345W-D605G	196.05	1529.16	605
610	SPS-6345W-D610G	196.10	1528.77	610

Absolute Maximum Ratings					
Parameter	**Symbol**	**Min**	**Max**	**Units**	**Notes**
Storage Temperature	Tstg	-40	85	°C	
Relative Humidity	RH	5	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	5		85	% / Non-condensing
Power Supply Current	$I_{CC\ (TX+RX)}$		350	550	mA
Data Rate		4.25	14.025		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	$Po_{,\ AVG}$	0		4	dBm	1
Extinction Ratio	ER	8.2			dB	
Center Wavelength Spacing			50		GHz	2
Transmitter Center Wavelength -- over life time	λc	X-60	X	X+60	pm	3
Output Spectrum Width	Δλ	---		1	nm	-20 dB width
Side Mode Suppression Ratio	SMSR	30			dB	
Transmitter and Dispersion Penalty @ 800 ps/nm	TDP			2	dB	
Relative Intensity Noise	RIN			-130	dB/Hz	
Average Launch Power of OFF Transmitter				-30	dBm	

1. Output power is power coupled into a 9/125 μm single-mode fiber.
2. Corresponds to approximately 0.8 nm.
3. X = specified ITU Grid wavelength.

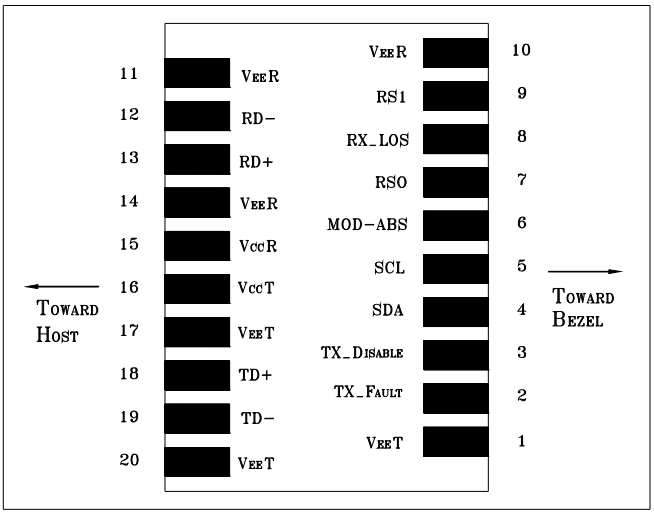
Receiver Optical Specifications (0°C < Topr < 70°C, 3.13V < Vcc < 3.47V)						
Parameter	**Symbol**	**Min**	**Typ**	**Max**	**Units**	**Notes**
Sensitivity				-14	dBm	4
Receiver Overload	P_{MAX}	1	---		dBm	
LOS – Deasserted	LOS_D	---	---	-14	dBm	Transition: low to high
LOS – Asserted	LOS_A	-24	---	---	dBm	Transition: high to low
Wavelength of Operation	λc	1480		1580	nm	
Optical Return Loss	ORL			-27	dB	

4. Measured with worst ER; BER < 10^{-12} and PRBS 2^{31}-1. Equivalent to -14.3 dBm OMA at ER=8.2 dB.

Electrical Characteristics						
Parameter	**Symbol**	**Min**	**Typ**	**Max**	**Units**	**Notes**
High-Speed Signal (CML) Interface Specification						
Input Data Rate		4.25	14.025		Gb/s	
TX Clock Tolerance		-100		+100	ppm	5
Differential Input Impedance	Rin		100		Ω	
Differential Data Input Amplitude		150		1200	mVpp	Internally AC coupled
Output Data Rate		4.25	14.025		Gb/s	
RX Clock Tolerance		-100		+100	ppm	5
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	

5. Clock tolerance for 14.025 Gb/s, 8.5Gb/s and 4.25 Gb/s.

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) = Laser off, Logic “0” = Laser on.	13	RD+	Receiver Data Out
4	SDA	Modulation Definition 2 – Two wires serial ID Interface	14	$V_{EE}R$	Receiver Signal Ground
5	SCL	Modulation Definition 1 – Two wires serial ID Interface	15	$V_{CC}R$	Receiver Power – 3.3V±5%
6	MOD-ABS	Modulation Definition 0 – Ground in Module	16	$V_{CC}T$	Transmitter Power – 3.3V±5%
7	RS0	RX Rate Select: Open or Low: 8.5 or 4.25 Gb/s FC. High: enable CDR for 16GFC.	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

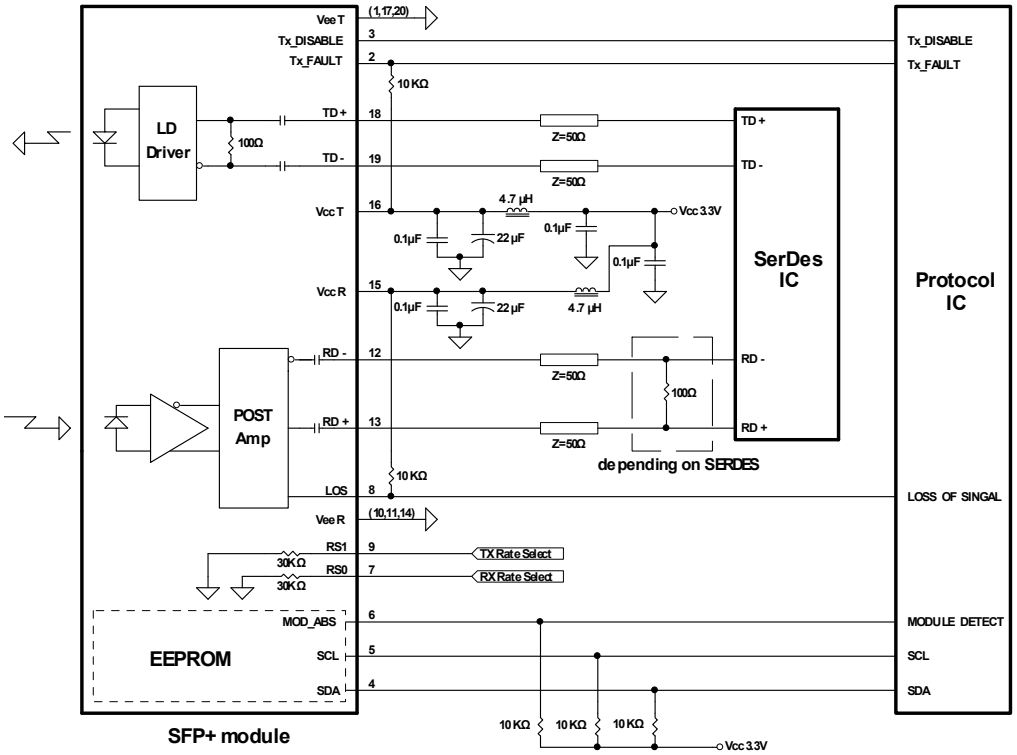
Module Definition 4 specifies a serial definition protocol. For this definition, upon power up, SDA and SCL appear as no connection (NC) and MOD-ABS is TTL LOW. When the host system detects this condition, it activates the serial protocol. The protocol uses the 2-wire serial CMOS E^2PROM protocol of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

RX Rate Select Control

RX rate can be independently controlled by either RS0 input pin (Hardware) or via register write to soft RS0 select bit (Software). RS0 input pin (pin 7) is used to select RX rate. Status of RS0 input pin logic level is reflected to register byte 110 bit 4 on address A2h. RX rate can also be controlled by register write to soft RS0 select bit (byte 110 bit 3 on address A2h). Power on default of soft RS0 select bit is logic low. Hardware and software control inputs are OR'd to allow flexible control. See following RX operation logic table:

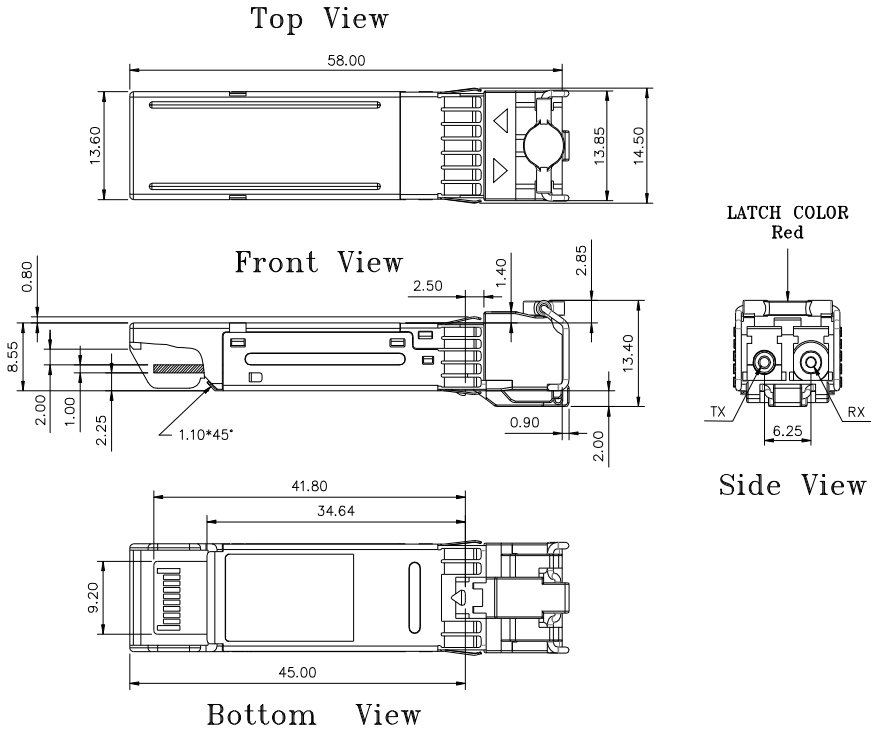
RS0 Control Input		RX Speed	RX CDR
RS0 Input Pin (Hardware: Pin 7)	Soft RS0 Select Bit (Software: Byte 110 Bit 3, A2h)		
0	0	4G/8G FC	Bypassed
0	1	16G FC	Enabled
1	0		
1	1		

RECOMMENDED CIRCUIT SCHEMATIC



PACKAGE DIAGRAM

Units in mm



Note: Specifications subject to change without notice.

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, Power Level 2, Txdis, Txfault, LOS enable, RX Rate Select	96	00		Vendor specific EEPROM
1	04			33	20			65	3A			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	00			36	00		NA	68			Serial number: each piece with different serial number	100	00		
5	00			37	00		Vendor IEEE OUI	69				101	00		
6	00			38	0E			70				102	00		
7	10		Long Distance (L)	39	FA			71				103	00		
8	10		Longwave Laser (LL)	40	53	S	Part Number	72				104	00		
9	01		Single Mode (SM)	41	50	P		73				105	00		
10	F0		1600/1200/ 800/400 Mbytes/sec	42	53	S		74				106	00		
11	06		64B/66B	43	2D	-		75				107	00		
12	8C		14.025Gbps	44	36	6		76				108	00		
13	08		Rx Rate_select only, High=16G, Low=10G/8G/4G	45	33	3		77				109	00		
14	28		40km	46	34	4		78				110	00		
15	FF		>25.4km	47	35	5		79				111	00		
16	00			48	57	W		80				112	00		
17	00			49	2D	-		81				113	00		
18	00			50	44	D		82				114	00		
19	00			51	3x	X		83				115	00		
20	4F	O	Vendor name	52	3x	X		84			Date Code	116	00		
21	50	P		53	3x	X		85				117	00		
22	54	T		54	47	G		86				118	00		
23	4F	O		55	20			87				119	00		
24	57	W		56	30	0	Revision, depended on version	88				120	00		
25	41	A		57	30	0		89				121	00		
26	59	Y		58	30	0		90				122	00		
27	20			59	31	1		91				123	00		
28	20			60			DWDM Wavelength	92	68		Monitoring	124	00		
29	20			61				93	FA		Soft Control and Monitoring	125	00		
30	20			62				94	05		SFF-8472V11.0	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	3D	Rx Power High Alarm (2dBm)	64	00	For External Cal.	96		Real Time Temp. MSB
1	00		33	E9		65	00	For External Cal.	97		Real Time Temp. LSB
2	FB	Temp. Low Alarm(-5°C)	34	00	Rx Power Low Alarm (-16dBm)	66	00	For External Cal.	98		Real Time Vcc MSB
3	00		35	FB		67	00	For External Cal.	99		Real Time Vcc LSB
4	49	Temp. High Warming(73°C)	36	31	Rx Power High Warming (1dBm)	68	3F	For External Cal.	100		Real Time Tx Bias MSB
5	00		37	2D		69	80	For External Cal.	101		Real Time Tx Bias LSB
6	00	Temp. Low Warming (0°C)	38	01	Rx Power Low Warming(-14dBm)	70	00	For External Cal.	102		Real Time Tx Pwr MSB
7	00		39	8E		71	00	For External Cal.	103		Real Time Tx Pwr LSB
8	8C	Voltage High Alarm (3.6V)	40	3C	LD Temp. High Alarm (60°C)	72	00	For External Cal.	104		Real Time Rx Pwr MSB
9	A0		41	00		73	00	For External Cal.	105		Real Time Rx Pwr LSB
10	75	Voltage Low Alarm(3.0V)	42	19	LD Temp. Low Alarm(25°C)	74	00	For External Cal.	106		Reserved
11	30		43	00		75	00	For External Cal.	107		Reserved
12	88	Voltage High Warming(3.5V)	44	37	LD Temp. High Warming(55°C)	76	01	For External Cal.	108		Reserved
13	B8		45	00		77	00	For External Cal.	109		Reserved
14	79	voltage Low Warming (3.1V)	46	1E	LD Temp. Low Warming (30°C)	78	00	For External Cal.	110		Tx Dis, RS(0), Tx Fault, Rx Los
15	18		47	00		79	00	For External Cal.	111		Reserved
16	FD	Tx Bias High Alarm(130mA)	48	27	ITEC High Alarm(1000mA)	80	01	For External Cal.	112		Alarm Flag
17	E8		49	10		81	00	For External Cal.	113		Alarm Flag/Reserved
18	13	Tx BiasLow Alarm(10mA)	50	D8	ITEC Low Alarm(-1000mA)	82	00	For External Cal.	114		Reserved
19	88		51	F0		83	00	For External Cal.	115		Reserved
20	EA	Tx Bias High Warming(120mA)	52	27	ITEC High Warming(1000mA)	84	01	For External Cal.	116		Warming Flag
21	60		53	10		85	00	For External Cal.	117		Warming Flag/Reserved
22	1D	Tx Bias Low Warming(15mA)	54	D8	ITEC Low Warming(-1000mA)	86	00	For External Cal.	118		Reserved
23	4C		55	F0		87	00	For External Cal.	119		Reserved
24	7B	Tx Power High Alarm (5dBm))	56	00	For External Cal.	88	01	For External Cal.	120		Vendor Specific
25	87		57	00	For External Cal.	89	00	For External Cal.	121		
26	1F	Tx Power Low Alarm(-1dBm)	58	00	For External Cal.	90	00	For External Cal.	122		
27	07		59	00	For External Cal.	91	00	For External Cal.	123		
28	62	Tx Power High Warming(4dBm)	60	00	For External Cal.	92	00	For External Cal.	124		
29	1F		61	00	For External Cal.	93	00	For External Cal.	125		
30	27	Tx Power Low Warming (0dBm)	62	00	For External Cal.	94	00	For External Cal.	126		
31	10		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	2011/1/1
2.0	The receiver saturation power level is changed from 0 dBm to +1 dBm.	2012/1/1
3.0	Change the TX wavelength stability to +/- 60 pm	2012/9/1
4.0	Revise package diagram	2013/7/1
5.0	Add 50GHz ITU Grid Channel # 190, 195, 605, and 610	2016/1/5