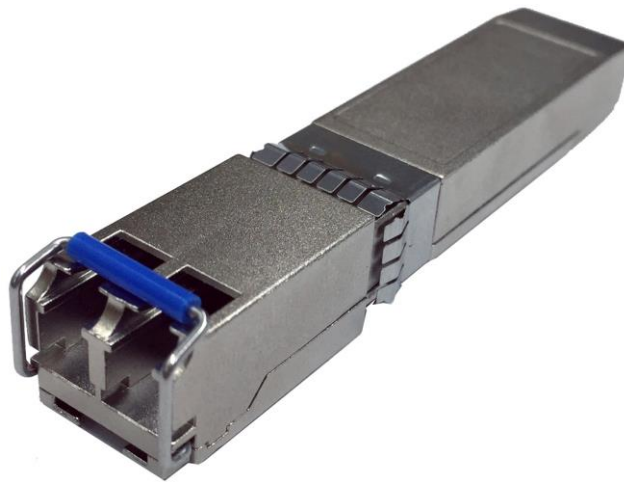


Product Specification

10.3 Gb/s 5km DWDM Tunable SFP Transceiver

P/N: BW10-www-10TxAx (See Ordering Information)



Bandwidth10's BW10-www-10TxAx transceivers are Enhanced Small Form Factor Pluggable Tunable SFP transceivers designed for use in multi-rate links up to 5 km of G.652 single mode fiber. Digital diagnostics functions are available via a 2-wire serial interface, as specified in SFF-8472. The optical transceiver is compliant per RoHS Directive 2011/65/EU.

The transceiver consists of two sections: The transmitter section incorporates a tunable single-mode VCSEL mounted on a TEC. The transmitter also consists of an optical isolator and a variable optical attenuator for dark tuning (TVAx part number only). The receiver section consists of an APD photodiode integrated with a TIA. All modules satisfy class I laser safety requirements. Bandwidth10's tunable SFP transceiver provides an enhanced monitoring interface, which allows real-time access to device operating parameters such as transceiver temperature, laser bias current, transmitted optical power, received optical power and transceiver supply voltage, laser temperature and TEC status.

PRODUCT FEATURES

- Hot-pluggable SFP formfactor
- Supports 10.3 Gb/s bit rate
- Up to 5 km link length (G.652/G.657 SMF) without dispersion compensation
- 100GHz ITU-based channel spacing (C-Band) without a wavelength locker
- AMCC (auxiliary management and control channel) command interface for remote wavelength tuning and stabilization
- APD photodiode receiver
- Duplex LC connector
- Power dissipation <1.5W
- Metal enclosure for lower EMI
- Built in digital diagnostic functions
- ROHS-6 compliant (lead-free)
- Laser Class 1 IEC/CDRH compliant

APPLICATIONS

- DWDM SONET/SDH
- Ethernet IEEE 802.3ae
- Fiber Channel

Absolute Maximum Ratings

Parameter	Symbol	Min	Typ	Max	Unit
Storage Temperature	T_s	-40		85	°C
Maximum Supply Voltage	V_{CC}	0		4	V
Relative Humidity	RH	5		95	%
Receiver Operating Damage Threshold	RX_{Damage}	-7			dBm
Case Operation Temperature: C-temp	$T_{CASE,C}$	-8		78	°C
E-temp	$T_{CASE,I}$	-20		85	°C
I-temp	$T_{CASE,E}$	-40		85	°C

Electrical Characteristics (Over Temperature, Voltage and Wavelength Range)

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage	V_{CC}	3.14		3.46	V
Supply Current	I_{CC}		300	450	mA
Module total power dissipation	P			1.5	W
Transmitter					
Input differential impedance	R_{in}	80	100	120	Ω
Differential data input swing	$V_{in,pp}$	200		700	mV
Transmit Disable Voltage	V_D	2.0		$V_{CC}+0.3$	V
Transmit Enable Voltage	V_{EN}	V_{EE}		$V_{EE}+0.8$	V
Receiver					
Output differential impedance	R_{out}	80	100	120	Ω
Differential data output swing	$V_{out,pp}$	200		800	mV
LOS asserted	V_{LOS_A}	2.0		$V_{CC}+0.3$	V
LOS de-asserted	V_{LOS_D}	V_{EE}		$V_{EE}+0.8$	V

Optical Characteristics (Over Temperature, Voltage and Wavelength Range)

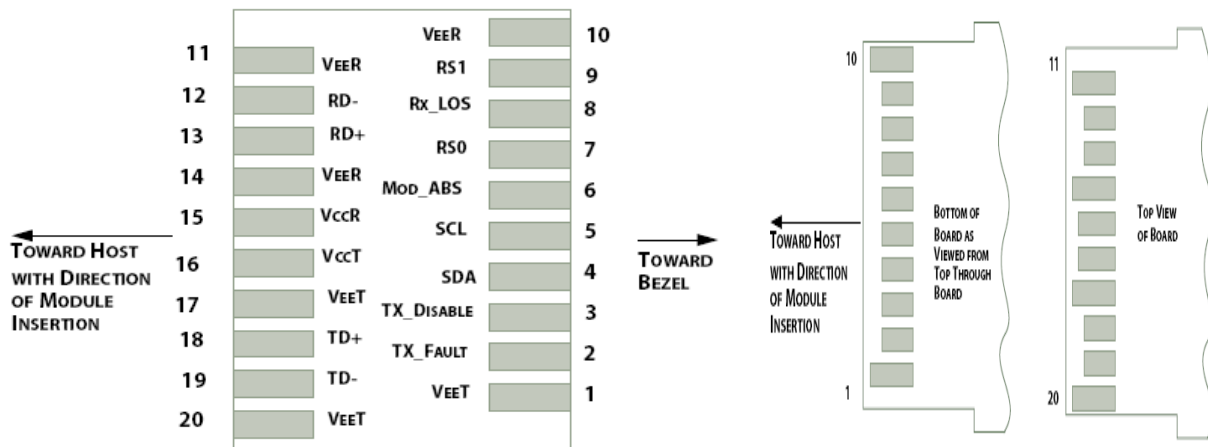
Parameter	Symbol	Min	Typ	Max	Unit
Transmitter					
Optical Wavelength	λ_C	As per ITU-T 694.1, 100GHz spacing			nm
Average Launch Power (AMCC ON)	P_{AVE}	-4		+3	dBm
Average Launch Power (AMCC ON) - 85°C	P_{AVE_85}	-4.5			dBm
Side-Mode Suppression Ratio	SMSR	30			dB
Optical Extinction Ratio	ER	3.5			dB
Average Launch power when TX is OFF	P_{OFF}			-30	dBm
Relative Intensity Noise	RIN		-140	-128	dB/Hz
Eye Mask	Compliant with IEEE802.3ae				
Spectral width, at -20dB, 0.03 nm RBW				0.22	nm
Receiver					
Receiver Sensitivity (APD) ¹	<1E-12	R_{SENS}		-18	dBm
Optical Input Power (APD) ²		$P_{SAT,IN}$	-25	-7	dBm
Link Budget C-temp version (informative)			14		dB
Optical Center Wavelength	λ_C	1531		1561	nm
LOS – Asserted	LOS_A	-35			dBm
LOS – De-Asserted	LOS_D			-20	dBm
LOS – Hysteresis	LOS_H	1			dB
AMCC dynamic range		-30		-7	dB

Notes:

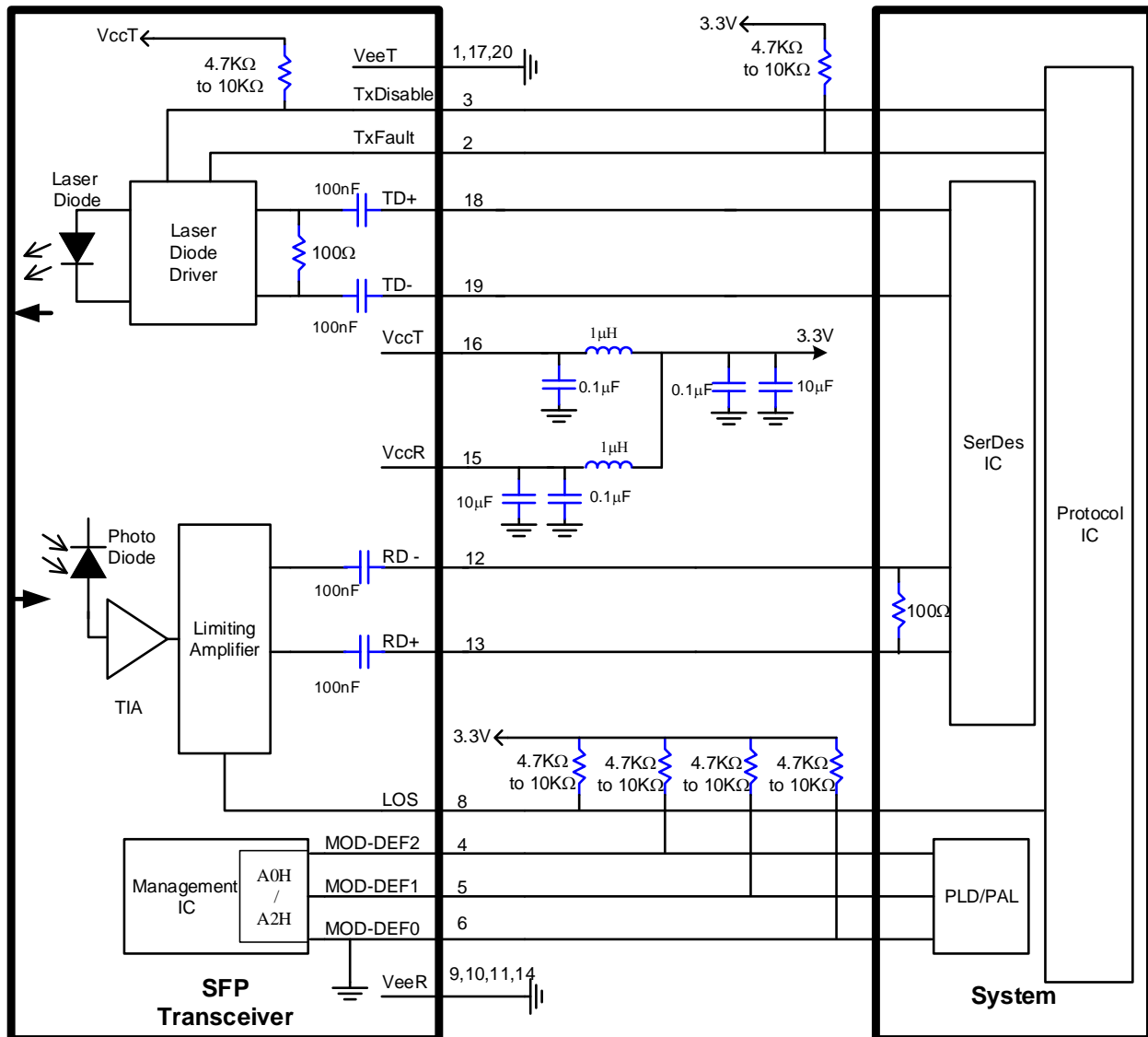
1 Receiver sensitivity is measured with a PRBS 2³¹-1 test signal for BER =1x 10⁻¹² including filter impairments.

2 Maximal input power limited by DDMI accuracy. Minimum saturation level for payload -7dBm.

***Warning:** Please do not connect Tx direct with Rx, and make sure add minimum 12dB attenuation in between. Otherwise the Rx APD would be damaged by overload.

Pin Definition and Descriptions


Pin	Name	Input-Output /Level	Description	Ref.
1	VEET	Power	Transmitter ground	
2	TXFault	Output	Laser failure indication (1=Laser Failure)	
3	Tx_DIS	Input/LVTTL	Transmitter Disable Control (1=Output Disable)	
4	MOD-DEF(2)	Input/Output	SDA, I2C communication data interface	
5	MOD-DEF(1)	Input	SCL, I2C communication clock interface	
6	MOD-DEF(0)	Output	Module present. Ground inside module.	
7	Rate Select 0	-	No connection.	
8	RxLOS	Output/LVTTL	Receiver loss of signal (1=Los of signal)	
9	Rate Select 1	-	No connection.	
10	VEER	Power	Receiver ground	
11	VEER	Power	Receiver ground	
12	RD-	Output/LVPECL	Inverted receiver data output	
13	RD+	Output/LVPECL	Non-inverted receiver data output	
14	VEER	Power	Receiver ground	
15	VCCR	Power	Receiver power supply	
16	VCCT	Power	Transmitter power supply	
17	VEET	Power	Transmitter ground	
18	TD+	Input/LVPECL	Transmitter non-inverted data input	
19	TD-	Input/LVPECL	Transmitter inverted data input	
20	VEET	Power	Transmitter ground	

Recommended Circuit Diagram


Content in 2-Wire Address A0h

Address (DEC)	Address (HEX)	Name of Field	Value (HEX)	Description
00	00	Identifier	03	SFP+
01	01	Extended Identifier	04	SFP
02	02	Connector type	07	LC
03	03	10G Ethernet Compliance Codes	00	Not compliant
04	04	SONET Compliance Codes	00	Not compliant
05	05	SONET Compliance Codes	00	Not compliant
06	06	Ethernet Compliance Codes	00	Not compliant
07	07	Fiber Channel link length	00	Not compliant
08	08	Fiber Channel transmitter technology	00	Not compliant
09	09	Fiber Channel transmission media	00	Not compliant
10	0A	Fiber Channel speed	00	Not compliant
11	0B	Encoding codes	06	64B/66B
12	0C	Nominal Bit Rate (units of 100Mbps)	67	103*100Mbps
13	0D	Rate identifier	00	Unspecified
14	0E	Link length supported for 9um fiber	05	5 (units of km)
15	0F	Link length supported for 9um fiber	32	50 (units of 100m)
16	10	Link length supported for 50um, OM2	00	N/A (units of 10m)
17	11	Link length supported for 62.5um, OM1	00	N/A(units of 10m)
18	12	Link length supported for copper	00	N/A (units of 1m)
19	13	Link length supported for 50um, OM3	00	N/A (units of 10m)
20 ~ 35	14 ~ 23	Vendor Name	42,41,4E,44,57,49,44,54,48,31,30,20,20,20,20,20	BANDWIDTH10
36	24	Unallocated	00	
37 ~ 39	25 ~ 27	Vendor OUI	00,00,00	Unspecified
40 ~ 55	28 ~ 37	Part Number	42,57,31,30,2D,41,52,42,49,2D,31,30,54,47,41,43	See scheme i.e. BW10-ARBI-10TGAC
56 ~ 59	38 ~ 3B	Vendor Revision number	30,30,30,31	00 00 00 01
60 ~ 61	3C ~ 3D	Laser Wavelength	00,00	Tunable
62	3E	Unallocated	00	
63	3F	CC_BASE:		Checksum of byte 0~62
64	40	Options	14	Paging implemented, Cooled TRX
65	41	Options	5A	TX-DIS, TX_FAULT, RX-LOS, Tunable Tx
66	42	Bit Rate, max.	0A	+10% of nominal BR
67	43	Bit Rate, min.	0A	-10% of nominal BR
68 ~ 83	44 ~ 53	Serial Number	Serial Number	
84 ~ 89	54 ~ 59	Date Code	yy/mm/dd	
90 ~ 91	5A ~ 5B	Vendor specific lot code	20,20	Unspecified
92	5C	Diagnostic Monitoring Type	68	Internal calibration
93	5D	Enhanced Options (soft)	F0	Alarm/Warning flags, Soft TxDisable, Soft TxFault, Soft RxLOS implemented
94	5E	SFF-8472 Compliance	08	Rev12.3
95	5F	CC_EXT		Checksum of byte 64~94
96 ~ 122	60 ~ 7A	Vendor specific	undefined	
123-126	7B ~ 7E	Command register		
127	7F	Vendor specific	undefined	

Content in 2-Wire Address A2h

Address (DEC)	Address (HEX)	Name of Field	Value (HEX)	Description / Real Value
00-01	00-01	Temp High Alarm ¹	4E00 / 5500 / 5500	78 / 85 / 85 °C
02-03	02-03	Temp Low Alarm ¹	F800 / EC00 / D800	-8 / -20 / -40 °C
04-05	04-05	Temp High Warning ¹	4900 / 5200 / 5200	73 / 82 / 82 °C
06-07	06-07	Temp Low Warning ¹	FD00 / EF00 / DB00	-3 / -17 / -37 °C
08-09	08-09	Voltage High Alarm	88B8	3.50V
10-11	0A-0B	Voltage Low Alarm	7918	3.10V
12-13	0C-0D	Voltage High Warning	86C4	3.45V
14-15	0E-0F	Voltage Low Warning	7B0C	3.15V
16-17	10-11	Bias High Alarm	2AF8	22mA
18-19	12-13	Bias Low Alarm	00FA	0.5mA
20-21	14-15	Bias High Warning	2710	20mA
22-23	16-17	Bias Low Warning	01F4	1mA
24-25	18-19	TX Power High Alarm ²	4DF1	3dBm
26-27	1A-1B	TX Power Low Alarm ²	0003	-35dBm
28-29	1C-1D	TX Power High Warning ²	3DE9	2dBm
30-31	1E-1F	TX Power Low Warning ²	0004	-34dBm
32-33	20-21	RX Power High Alarm	03E8	-10dBm
34-35	22-23	RX Power Low Alarm	0028	-24dBm
36-37	24-25	RX Power High Warning	031A	-11dBm
38-39	26-27	RX Power Low Warning	0032	-23dBm
40-41	28-29	Laser Temp High Alarm	2E00	46°C
42-43	2A-2B	Laser Temp Low Alarm	0E00	14°C
44-45	2C-2D	Laser Temp High Warning	2D00	45°C
46-47	2E-2F	Laser Temp Low Warning	0F00	15°C
48-55	30-37	Reserved	00	-
56-59	38-3B	RX_PWR(4)	00000000	0
60-63	3C-3F	RX_PWR(3)	00000000	0
64-67	40-43	RX_PWR(2)	00000000	0
68-71	44-47	RX_PWR(1)	3F800000	1
72-75	48-4B	RX_PWR(0)	00000000	0
76-77	4C-4D	TX_I(Slope)	0100	1
78-79	4E-59	TX_I(Offset)	0000	0
80-81	50-51	TX_PWR(Slope)	0100	1
82-83	52-53	TX_PWR(Offset)	0000	0
84-85	54-55	T(Slope)	0100	1
86-87	56-57	T(Offset)	0000	0
88-89	58-59	V(Slope)	0100	1
90-91	5A-5B	V(Offset)	0000	0
92-94	5C-5D	Reserved	00	-
95	5F	Checksum		-
96-107	60-6B	Real time diagnostic		-
108-109	6C-6D	Reserved	00	-
110	6E	Optional Status/Control		Bit 6=1 disables the laser
111-119	6F-77	Reserved	00	-

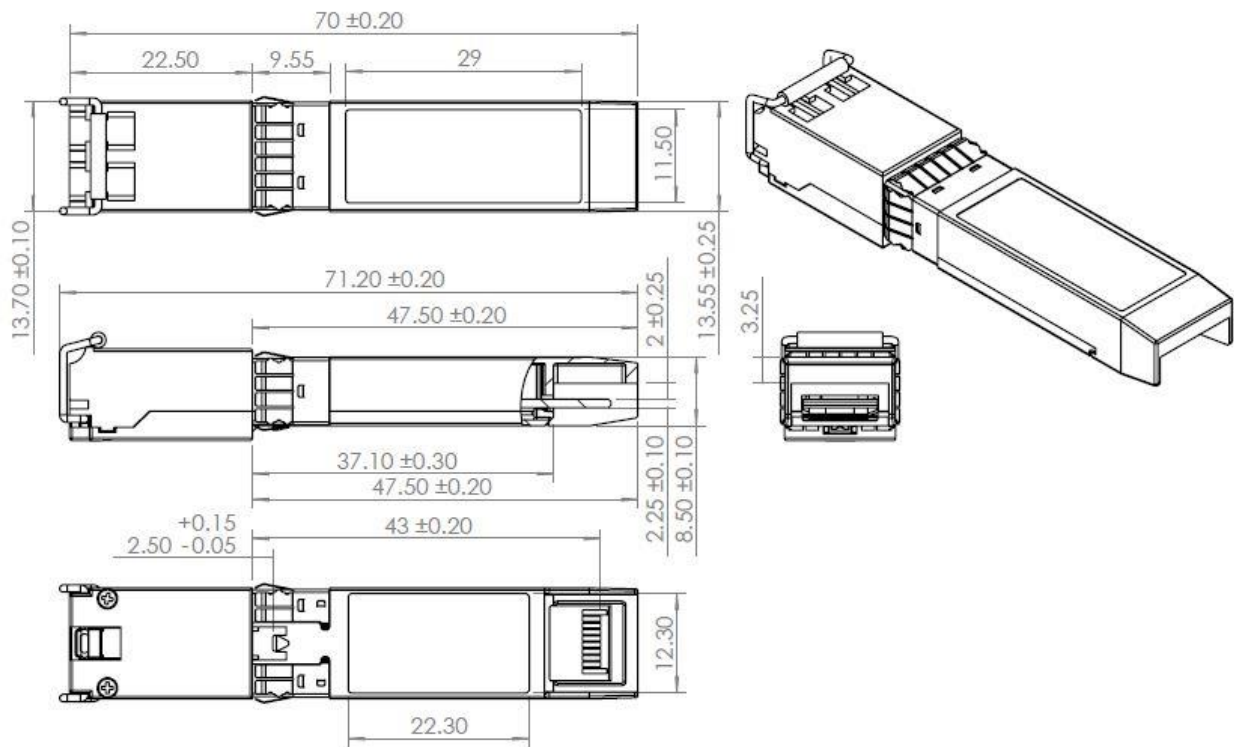
120-121	78-79	Firmware revision		
122-126	7A – 7E	Vendor specific	undefined	-
127	7F	Page select		-

1) Alarms given for: C-temp / E-temp / I-temp version 2) Not supported

Content in 2-Wire Address A2h upper page 02h

Write on page A2h register 7Fh value 02h to access upper page 02h

Address (DEC)	Address (HEX)	Name of Field	Value (HEX)	Description / Real Value
128	80	transceiver description encoding	01	Tunable DWDM / selection in 50pm steps supported
129-131	81-83	Reserved		
132-133	84-85	LFL1 Lasers First Frequency	See p/n	(THz)
134-135	86-87	LFL2 Lasers First Frequency	See p/n	(GHz*10)
136-137	88-89	LFH1 Lasers Last Frequency	See p/n	(THz)
138-139	8A-8B	LFH2 Lasers Last Frequency	See p/n	(GHz*10)
140-141	8C-8D	LGrid Laser's minimum supported grid spacing	03E8	1000
142-143	8E-8F	Reserved		
144-145	90-91	Channel Number Set User input of wavelength channel # integer 1 to N (N=Number of channels)		Not supported Please use BW10 commands to select channels
146-147	92-93	Wavelength Set User input of Wavelength setpoint. (Units of 0.05 nm)		Supported
148-150	94-96	Reserved		
151	97	Tx Dither		Not supported
152-153	98-99	Reported Frequency error		Not supported
154-155	9A-9B	Reported Wavelength error		Not supported
156-167	9C-A7	Reserved	00	
168	A8	Current Status	00	Bit 6 =1: indicates TEC Fault
169-172	A9-AB	Reserved	00	
172	AC	Latched Status	00	Bit 6=1: indicates Latched TEC Fault
173-247	AD-F7	Reserved	00	
248-255	F8-FF	Vendor Specific	00	

Mechanical Outlines (units: mm)


Regulatory and Safety Compliance

Parameter	Standard	Note
<i>Product Safety</i>	UL 60950-1 CSA C22.2 No. 60950-1	
<i>Laser Safety</i>	EN 60825-1, EN 60825-2 IEC 60825-2 U.S. 21CFR 1040.10	Class 1 Laser
<i>Radiated Emission</i>	EMC Directive 2004/108/EC FCC rules 47 CFR Part 15 CISPR 22 AS/NZS CISPR22 EN 55022 ICES-003, Issue 5 VCCI V-3	Class B
<i>Immunity</i>	EMC Directive 2004/108/EC CISPR 24 EN 55024	
<i>Radiated Immunity</i>	IEC/EN 61000-4-3	
<i>RoHS</i>	EU Directive 2002/95/EC + EU Directive 2011/65/EU	ROHS 6

Ordering Information:
Part Number

BW10	-	www	-	ss	T	S	A	C
		Wavelength (see below)		Bitrate 10= 10.3 Gb/s	Tunable	Feature S: Standard G: AMCC V: with VOA for dark tuning and AMCC	Receiver Type A: APD	Temp. Ranges C: 0~70 °C E: -20 ~ 85 °C I: -40 ~ 85 °C

Wavelength Description:

www	Frequency (THz)	Note
ARBI	Not specified	Supports 9 arbitrary channels on 100GHz grid
2028	192.0- 192.8	9 Channels on 100GHz ITU-T G.694.1 grid
2836	192.8- 193.6	9 Channels on 100GHz ITU-T G.694.1 grid
3644	193.6- 194.4	9 Channels on 100GHz ITU-T G.694.1 grid
4452	194.4- 195.2	9 Channels on 100GHz ITU-T G.694.1 grid
5260	195.2- 196.0	9 Channels on 100GHz ITU-T G.694.1 grid
ABCD	19A.B-19C.D	Customized part number supporting all channels from 19A.B THz to 19C.D THz on a 100GHz grid. One transceiver can support up to 9 channels. Please contact your local sales for additional information