200Gb/s QSFP-DD LR4 10km Transceiver

LA-OT-200G-LR4

Description

This product is a 200Gb/s transceiver module designed for 10km optical communication applications. The design is compliant to IEEE802.3bs 200GBASE-LR4 standard. For 200GAUI-8 Electrical interface, the module converts 8 input channels(ch) of 25Gb/s electrical data to 4 channels of LWDM optical signals, and multiplexes them into a single channel for 200Gb/s (PAM4) optical transmission. Reversely, on the receiver side, the module optically de-multiplexes a 200Gb/s(PAM4) input into 4 LWDM channels of signals, and converts them to 8 channels output electrical data. For 200GAUI-4 Electrical interface, the module converts 4 input channels(ch) of 50Gb/s electrical data to 4 channels of LWDM optical signals, and multiplexes them into a single channel for 200Gb/s (PAM4) optical transmission. Reversely, on the receiver side, the module optically de-multiplexes a 200Gb/s(PAM4) input into 4 LWDM channels of signals, and converts them to 4 channels output electrical data. The central wavelengths of the 4 LWDM channels. It contains a duplex LC connector for the optical interface and a 76-pin connector for the electrical interface. To minimize the optical dispersion in the long-haul system, single-mode fiber (SMF) has to be applied in this module. Host FEC is required to support up to 10km fiber transmission. The product is designed with form factor, optical/electrical connection and digital diagnostic interface according to the QSFP-DD Multi-Source Agreement (MSA). It has been designed to meet the harshest external operating conditions including temperature, humidity and EMI interference.

Features

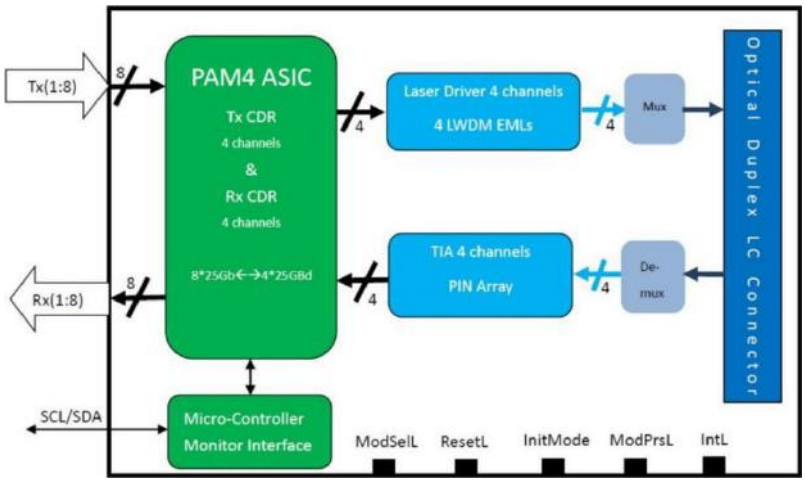
- IEEE802.3bs compliant
- QSFP-DD MSA compliant
- 4 LWDM lanes MUX/DEMUX design
- Supports 212.5Gb/s aggregate bit rate
- Up to 10km transmission on single mode fiber (SMF) with FEC
- Operating case temperature: 0 to 70oC
- 200GAUI-8 and 200GAUI-4 electrical interface
- Maximum power consumption 10.8W
- LC duplex connector
- RoHS compliant

Applications

- Data Center Interconnect
- 200G Ethernet
- Enterprise networking

Transceiver Block Diagram

For 200GAUI-8



For 200GAUI-4

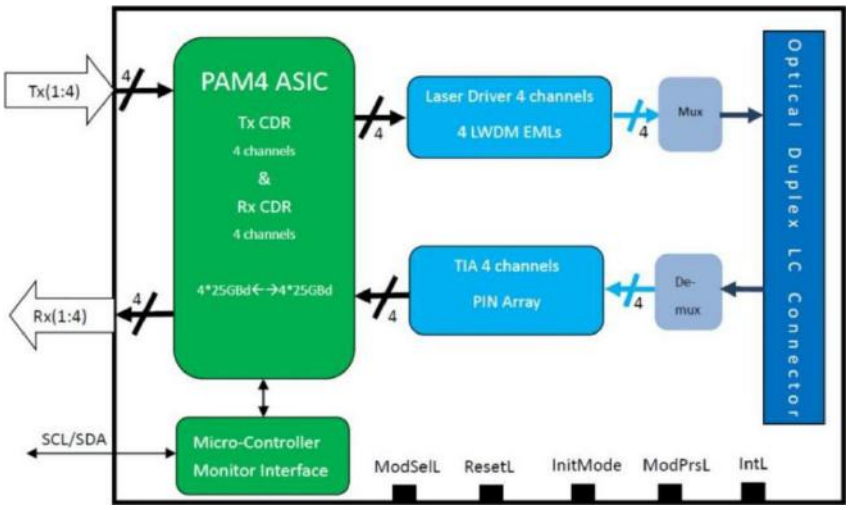


Figure 1. Transceiver Block Diagram

Pin Assignment and Description

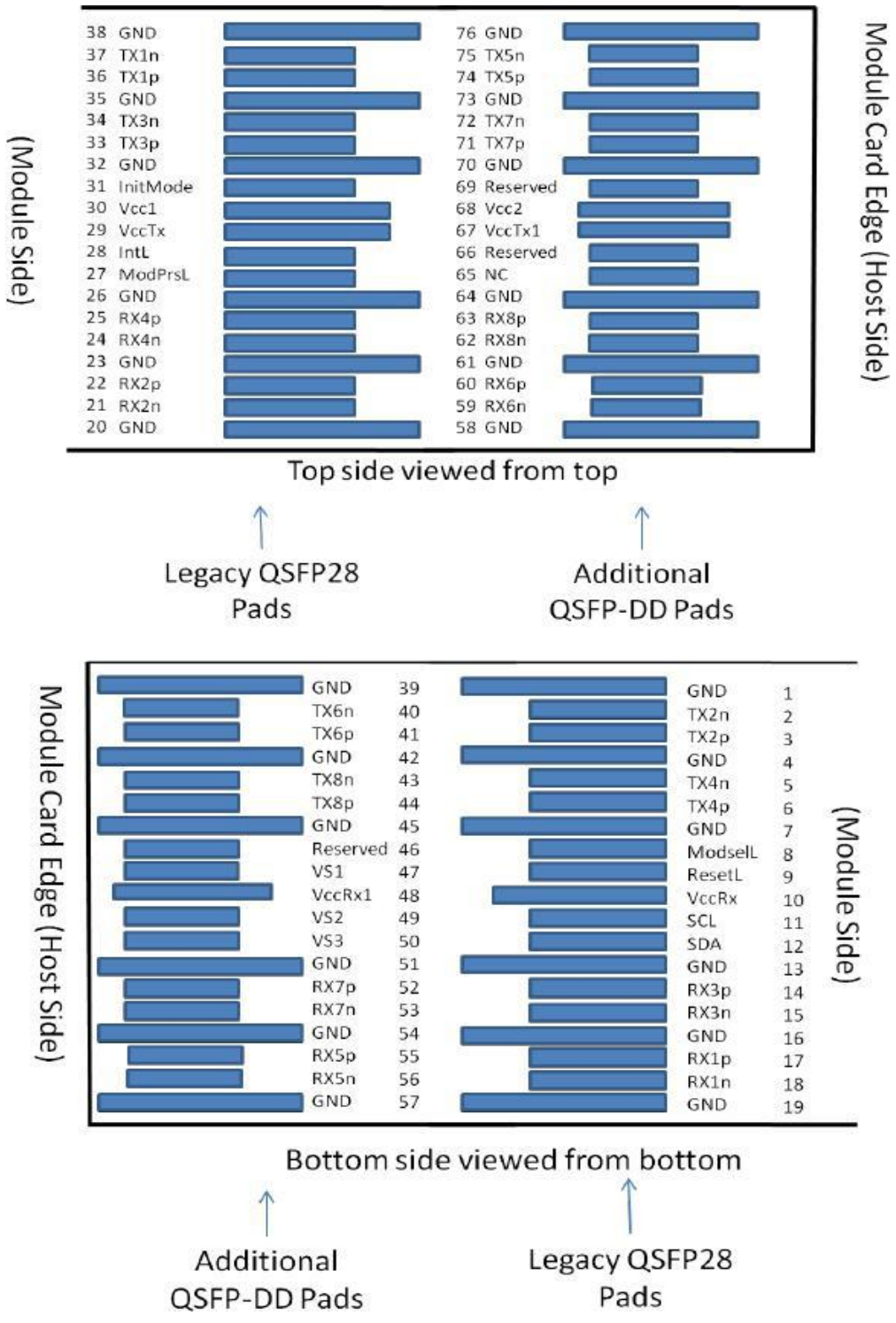


Figure 2. MSA compliant Connector

Pin Definition

Pin	Logic	Symbol	Description	Plug Sequence	Notes
1		GND	Ground	1B	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	3B	
3	CML-I	Tx2p	Transmitter Non-Inverted Data Input	3B	
4		GND	Ground	1B	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	3B	
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input	3B	
7		GND	Ground	1B	1
8	LVTTL-I	ModSelL	Module Select	3B	
9	LVTTL-I	ResetL	Module Reset	3B	
10		VccRx	+3.3V Power Supply Receiver	2B	2
11	LVCMOS-I/O	SCL	2-wire serial interface clock	3B	
12	LVCMOS-I/O	SDA	2-wire serial interface data	3B	
13		GND	Ground	1B	1
14	CML-O	Rx3p	Receiver Non-Inverted Data Output	3B	
15	CML-O	Rx3n	Receiver Inverted Data Output	3B	
16	GND	Ground	1B		1
17	CML-O	Rx1p	Receiver Non-Inverted Data Output	3B	
18	CML-O	Rx1n	Receiver Inverted Data Output	3B	
19		GND	Ground	1B	1
20		GND	Ground	1B	1
21	CML-O	Rx2n	Receiver Inverted Data Output	3B	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	3B	
23		GND	Ground	1B	1
24	CML-O	Rx4n	Receiver Inverted Data Output	3B	
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	3B	
26		GND	Ground	1B	1
27	LVTTL-O	ModPrsL	Module Present	3B	
28	LVTTL-O	IntL	Interrupt	3B	

29		VccTx	+3.3V Power supply transmitter	2B	2
30		Vcc1	+3.3V Power supply	2B	2
31	LVTTL-I	InitMode	Initialization mode; In legacy QSFP applications, the InitMode pad is called LPMODE	3B	
32		GND	Ground	1B	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	3B	
34	CML-I	Tx3n	Transmitter Inverted Data Input	3B	
35		GND	Ground	1B	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	3B	
37	CML-I	Tx1n	Transmitter Inverted Data Input	3B	
38		GND	Ground	1B	1
39		GND	Ground	1A	1
40	CML-I	Tx6n	Transmitter Inverted Data Input	3A	
41	CML-I	Tx6p	Transmitter Non-Inverted Data Input	3A	
42		GND	Ground	1A	1
43	CML-I	Tx8n	Transmitter Inverted Data Input	3A	
44	CML-I	Tx8p	Transmitter Non-Inverted Data Input	3A	
45		GND	Ground	1A	1
46		Reserved	For future use	3A	3
47		VS1	Module Vendor Specific 1	3A	3
48		VccRx1	3.3V Power Supply	2A	2
49		VS2	Module Vendor Specific 2	3A	3
50		VS3	Module Vendor Specific 3	3A	3
51		GND	Ground	1A	1
52	CML-O	Rx7p	Receiver Non-Inverted Data Output	3A	
53	CML-O	Rx7n	Receiver Inverted Data Output	3A	
54		GND	Ground	1A	1
55	CML-O	Rx5p	Receiver Non-Inverted Data Output	3A	
56	CML-O	Rx5n	Receiver Inverted Data Output	3A	
57		GND	Ground	1A	1
58		GND	Ground	1A	1

59	CML-O	Rx6n	Receiver Inverted Data Output	3A	
60	CML-O	Rx6p	Receiver Non-Inverted Data Output	3A	
61		GND	Ground	1A	1
62	CML-O	Rx8n	Receiver Inverted Data Output	3A	
63	CML-O	Rx8p	Receiver Non-Inverted Data Output	3A	
64		GND	Ground	1A	1
65		NC	No Connect	3A	3
66		Reserved	For future use	3A	3
67		VccTx1	3.3V Power Supply	2A	2
68		Vcc2	3.3V Power Supply	2A	2
69		Reserved	For Future Use	3A	3
70		GND	Ground	1A	1
71	CML-I	Tx7p	Transmitter Non-Inverted Data Input	3A	
72	CML-I	Tx7n	Transmitter Inverted Data Input	3A	
73		GND	Ground	1A	1
74	CML-I	Tx5p	Transmitter Non-Inverted Data Input	3A	
75	CML-I	Tx5n	Transmitter Inverted Data Input	3A	
76		GND	Ground	1A	1

Notes:

1. GND is the symbol for signal and supply (power) common for QSFP-DD modules. All are common within the QSFP-DD module and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal common ground plane.

2. VccRx, Vcc1 and VccTx are the receiving and transmission power suppliers and shall be applied concurrently. Recommended host board power supply filtering is shown in Figure 3 below. Vcc Rx, Vcc1 and Vcc Tx may be internally connected within the QSFP-DD transceiver module in any combination. The connector pins are each rated for a maximum current of 1000mA.

Recommended Power Supply Filter

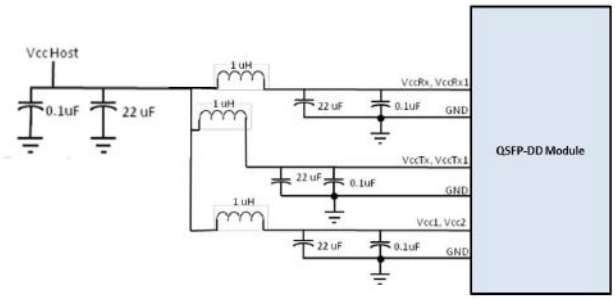


Figure 3. Recommended Power Supply Filter

Absolute Maximum Ratings

It has to be noted that the operation in excess of any individual absolute maximum ratings mightcause permanent damage to this module.

Parameter	Symbol	Min	Max	Units	Notes
Storage Temperature	TS	-40	85	degC	
Operating Case Temperature	TOP	0	70	degC	
Power Supply Voltage	VCC	-0.5	3.6	V	
Relative Humidity (non-condensation)	RH	0	85	%	
Damage Threshold, each Lane	THd	3.5		dBm	

Recommended Operating Conditions and Power Supply Requirements

Parameter	Symbol	Min	Typical	Max	Units	Notes
Operating Case Temperature	TOP	0		70	degC	
Power Supply Voltage	VCC	3.135	3.3	3.465	V	
Data Rate, each Lane			26.5625		GBd	
			53.125		Gb/s	
Data Rate Accuracy		-100		100	ppm	
Pre-FEC Bit Error Ratio				$2.4x10^{-4}$		
Post-FEC Bit Error Ratio				$1x10^{-12}$		1
Control Input Voltage High		2		Vcc	V	
Control Input Voltage Low		0		0.8	V	
Link Distance with G.652	D	0.002		10	km	2

Notes:

1. FEC provided by host system.

2. FEC required on host system to support maximum distance.

Electrical Characteristics

The following electrical characteristics are defined over the Recommended Operating Environment unless otherwise specified.

200GAUI-8 Electrical Characteristics

Parameter	Symbol	Min	Typical	Max	Units	Notes
Power Consumption				10.8	W	
Supply Current	Icc			3258	mA	
Transmitter (each Lane)						
Signaling rate per lane(200GBASE-LR4)		26.5625±100ppm			GBd	
Peak-to-peak differential output voltage				900	mv	
AC common-mode output voltage		17.5 mV RMS with respect to signal ground			mV	
Differential output returnloss		Meets Equation (120D-2) constraints				
Reference impedance for output return loss		100			Ω	
Common to differential mode conversion	Zin	Meets Equation (83E–3) constraints				
Differential termination mismatch		Less than 10%				
Transition time		Greater than or equal to 12ps				
Eye width		0.57			UI	
Eye height		228			mV	
Crosstalk source		Asynchronous crosstalk source using Pattern 5, Pattern 3, or valid 200GBASE-R signal				
Vertical eye closure				5.5	dB	
Receiver (each Lane)						
Single-ended Output Voltage		-0.4		3.3	V	Referredto signal common
Differential pk-pk input voltage tolerance		900			mV	
		Equati				

Differential input return loss		on (83E–5)				
Differential to common-mode input returnloss		Equation on (83E–6)				
Termination Mismatch at 1MHz				10	%	
Module stressed input test		See 83E.3.4.1				
DC common mode voltage		-350		2850	mv	
Eye width		0.46			UI	
Eye height		95			mV	

200GAUI-4 Electrical Characteristics

Parameter	Symbol	Min	Typical	Max	Units	Notes
Power Consumption				10.8	W	
Supply Current	Icc			3258	mA	
Transmitter (each Lane)						
Signaling rate per lane(200GBASE-LR4)		26.5625±100ppm			GBd	
Peak-to-peak differential output voltage				900	mv	
AC common-mode output voltage				17.5	mV	
Differential output return loss		Equation (83E-2)				

Common to differential mode conversion	Zin	Equation (83E–3)				
Differential termination mismatch				10	%	
Transition time（20% to 80%）		9.5			ps	
DC common mode voltage		-350		2850	mV	
Receiver (each Lane)						
Single-ended Output Voltage		-0.4		3.3	V	Referred to signal common
Differential pk-pk input voltage tolerance		900			mV	
Differential input return loss		Equati on (83E–5)				
Differential to common- mode input returnloss		Equati on (83E–				

Optical Characteristics

Parameter	Symbol	Min	Typical	Max	Units	Notes
Wavelength Assignment	L0	1294.53	1295.56	1296.59	nm	
	L1	1299.02	1300.05	1301.09	nm	
	L2	1303.54	1304.58	1305.63	nm	
	L3	1308.09	1309.14	1310.19	nm	
Transmitter						
Data Rate, each Lane		26.5625 ± 100 ppm			GBd	
Modulation Format		PAM4				
Side-mode Suppression Ratio	SMSR	30			dB	Modulated
Total Average Launch Power	P_T			11.3	dBm	
Average Launch Power, each Lane	P_{AVG}	-3.4		5.3	dBm	1
Outer Optical Modulation Amplitude (OMA_{outer}), each Lane	POMA	-0.4		5.1	dBm	2
Launch Power in OMA_{outer} minus TDECQ, each Lane		-1.8			dB	For ER ≥4.5dB
		-1.7			dB	For ER <4.5dB
Transmitter and Dispersion Eye Clouser for PAM4, each Lane	TDECQ			3.4	dB	
Extinction Ratio	ER	3.5			dB	
Difference in Launch Power between any Two Lanes (OMA_{outer})				4	dB	
$RIN_{16.5}OMA$	RIN			-132	dB/Hz	
Optical Return Loss Tolerance	TOL			15.1	dB	

Transmitter Reflectance	T_R			-26	dB	
Average Launch Power of OFF Transmitter, each Lane	P_{off}			-30	dBm	
Receiver						
Data Rate, each Lane		26.5625 ± 100 ppm	GBd			
Modulation Format		PAM4				
Damage Threshold, each Lane	TH_d	6.3			dBm	3
Average Receive Power, eachLane		-9.7		5.3	dBm	4
Receive Power (OMA_{outer}), each Lane				5.1	dBm	
Difference in Receiver Power between any Two Lanes (OMA_{outer})				4.2	dB	
Receiver Sensitivity (OMA_{outer}),each Lane	SEN			-7.7	dBm	For BER of 2.4E-4
Stressed Receiver Sensitivity (OMA_{outer}), each Lane	SRS			-5.2	dBm	5
Receiver Reflectance	RR			-26	dB	
LOS Assert	LOSA	-25.7			dBm	
LOS De-assert	LOSD			-11.7	dBm	
LOS Hysteresis	LOSH	0.5			dB	

Stressed Conditions for Stress Receiver Sensitivity (Note 6)						
Stressed Eye Closure for PAM4 (SECQ), Lane under Test				3.4	dB	
OMAouter of each Aggressor Lane			-1		dBm	

Notes:

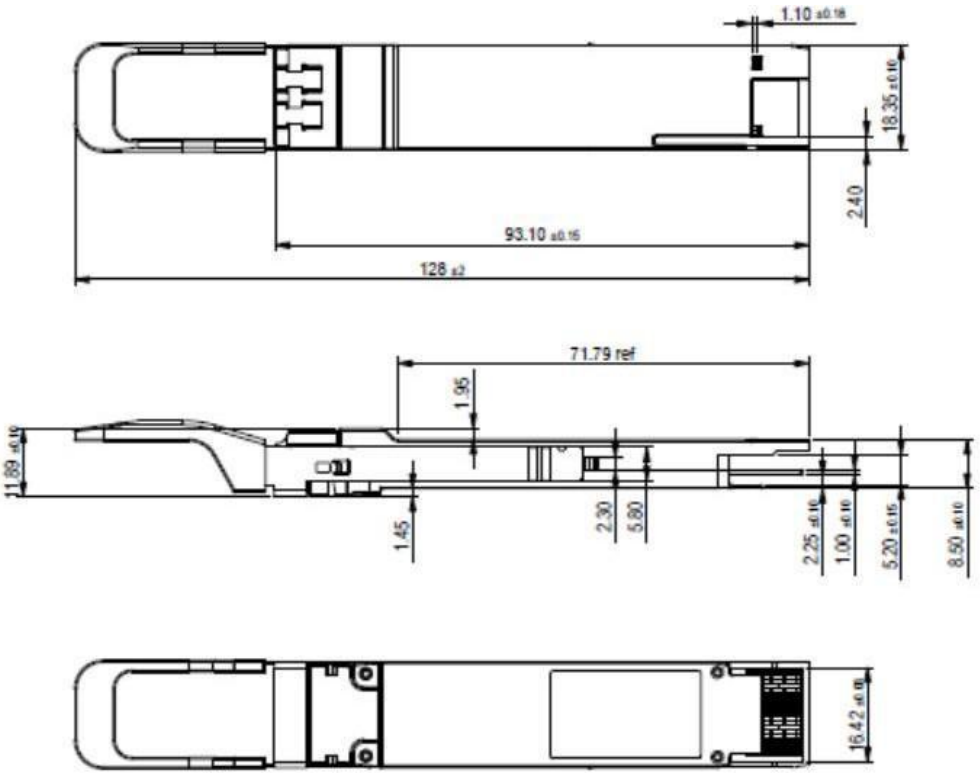
1. Average launch power, each lane (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.
2. Even if the TDECQ < 1.4 dB for an extinction ratio of ≥ 4.5 dB or TDECQ < 1.3 dB for an extinction ratio of < 4.5 dB, the OMAouter (min) must exceed the minimum value specified here.
The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level.
3. Average receive power, each lane (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.
4. Measured with conformance test signal for BER = 2.4x10-4.
5. These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

Digital Diagnostic Functions

The following digital diagnostic characteristics are defined over the normal operating conditions unless otherwise specified.

Parameter	Symbol	Min	Max	Units	Notes
Temperature monitors absolute error	DMI_Temp	-3	3	degC	Over operating temperature range
Supply voltage monitor absolute error	DMI _VCC	-0.1	0.1	V	Over full operating range
Channel RX power monitor absolute error	DMI_RX_Ch	-3	3	dB	
Channel Bias current monitor	DMI_Ibias_Ch	-10%	10%	mA	
Channel TX power monitor absolute error	DMI_TX_Ch	-3	3	dB	

Outline Drawing (mm)



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