

V23832-T1231-M1

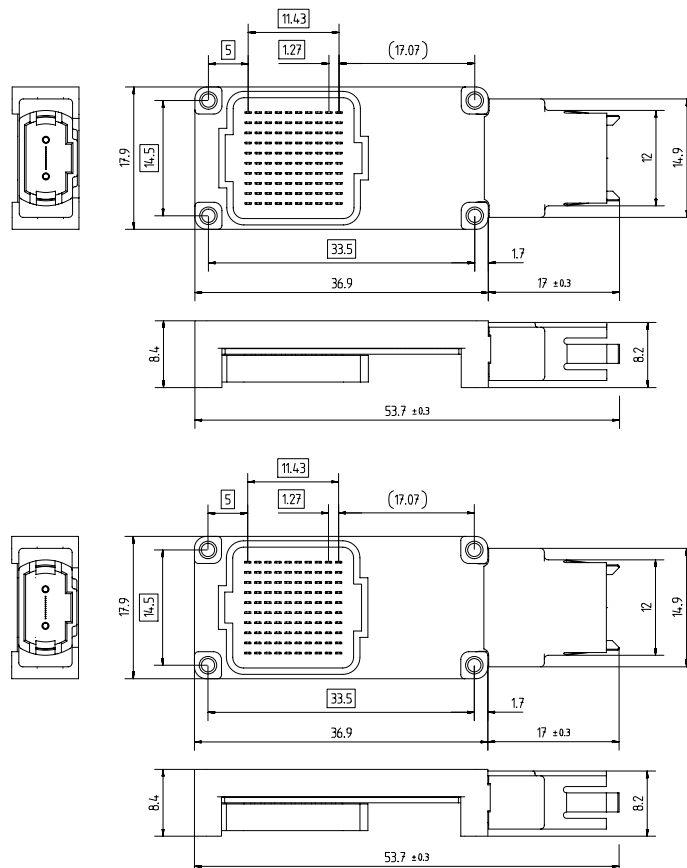
Parallel Optical Link Transmitter: PAROLI® 2T Tx AC, 2.5 Gbit/s

V23832-R221-M1

Parallel Optical Link Receiver: PAROLI® 2T Rx AC, 2.5 Gbit/s

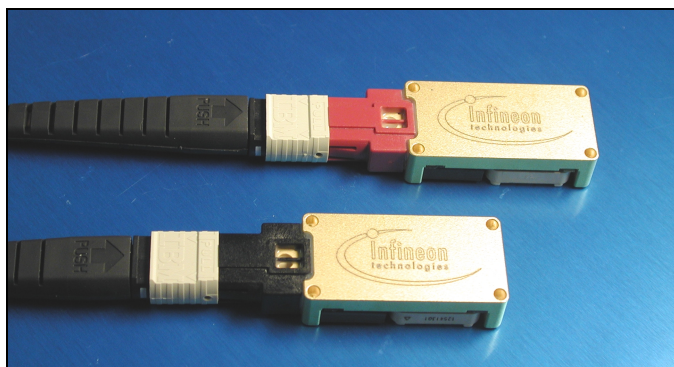
Preliminary

Dimensions in mm



PAROLI 2T Tx

PAROLI 2T Rx



FEATURES

- Power supply 3.3 V
- Transmitter with multistandard electrical interface
- Receiver with LVDS electrical interface
- 12 electrical data channels
- Asynchronous, AC-coupled optical link
- 12 optical data channels

- Transmission data rate of up to 2500 Mbit/s per channel, total link data rate up to 30 Gbit/s
- 850 nm VCSEL array technology
- PIN diode array technology
- 62.5 µm graded index multimode fiber ribbon
- MT based optical port (MPO connector)
- Plug-in module
- IEC Class 1 laser safety compliant
- SONET mask compliant
- Optional EMI-shielding available

APPLICATIONS

Telecommunication

- Switching equipment
- Access network

Data Communication

- Interframe (rack-to-rack)
- Intraframe (board-to-board)
- On board (optical backplane)

Absolute Maximum Ratings

Stress beyond the values stated below may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods of time may affect device reliability.

Supply Voltage ($V_{CC}-V_{EE}$)	 -0.3 V to 4.5 V
Data/Control Input Levels (V_{IN}) ⁽¹⁾	 -0.5 V to $V_{CC}+0.5$ V
Data Input Differential Voltage ($ V_{ID} $) ⁽²⁾	 2.0 V
Operating Case Temperature (T_{CASE}) ⁽³⁾	 0°C to 80°C
Storage Ambient Temperature (T_{STG})	 -20°C to 100°C
Operating Moisture	 20% to 85%
Storage Moisture	 20% to 85%
ESD Resistance (all pins to V_{EE} , human body model) ⁽⁴⁾	 1 kV

Notes

1. At Data and LVCMOS inputs.
2. $|V_{ID}| = |(\text{input voltage of non-inverted input} - \text{input voltage of inverted input})|$.
3. Measured at case temperature reference point.
4. To avoid electrostatic damage, handling cautions similar to those used for MOS devices must be observed.

DESCRIPTION

PAROLI is a parallel optical link for high-speed data transmission. A complete PAROLI system consists of a transmitter module, a 12-channel fiber optic cable, and a receiver module. The transmitter supports LVDS, CML and LVPECL differential signals. The receiver module is described for the LVDS electrical output only. A specification for Infineons adjustable CML output can be provided separately.

Transmitter V23832-T1231-M1

The transmitter module converts parallel electrical input signals via a laser driver and a Vertical Cavity Surface Emitting Laser (VCSEL) diode array into parallel optical output signals. All input data signals are Multistandard Differential Signals (LVDS compatible; they also support LVPECL and CML because of the wide common input range). The electrical interface (LVDS, LVPECL or CML) is selected by the supply inputs V_{IN} . The data rate is up to 2500 Mbit/s for each channel. The transmitter module's min. data rate of 500 Mbit/s is specified for the CID⁽¹⁾ worst case pattern (disparity 72) or any pattern with a lower disparity.

A logic low level at $-\text{RESET}$ switches all laser outputs off. During power-up $-\text{RESET}$ must be used as a power-on reset which disables the laser driver and laser control until the power supply has reached a 3.135 V level.

The Laser Controller Up (LCU) output is low if a laser fault is detected or $-\text{RESET}$ is forced to low.

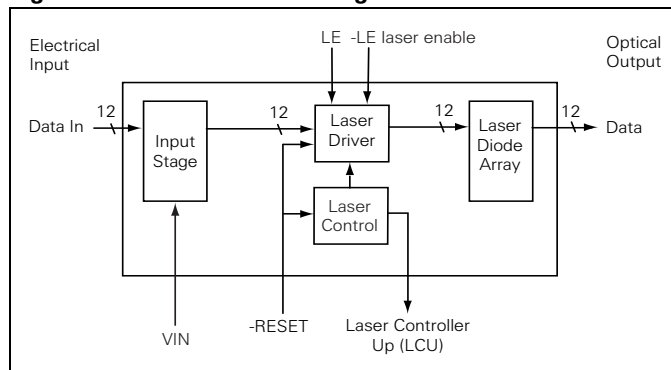
All non data signals have LVCMOS levels.

Transmission delay of the PAROLI system is ≤ 1 ns for the transmitter, ≤ 1 ns for the receiver and approximately 5 ns per meter for the fiber optic cable.

Note

1. Consecutive Identical Digit (CID) immunity test pattern for STM-N signals, ITU-T recommendation G.957 sec. II.

Figure 1. Transmitter block diagram



LASER SAFETY

The transmitter of the AC coupled Parallel Optical Link (PAROLI) is an IEC 60825-1 Amend. 2 Class 1 laser product. It complies with FDA performance standards (21 CFR 1040.10 and 1040.11) for laser products except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001. To avoid possible exposure to hazardous levels of invisible laser radiation, do not exceed maximum ratings.

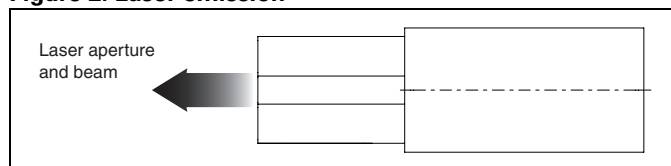
The PAROLI module must be operated under the specified operating conditions (supply voltage can be adjusted between 3.0 V and 3.6 V) under any circumstances to ensure laser safety.

Class 1 Laser Product

Note

Any modification of the module will be considered an act of "manufacturing", and will require, under law, recertification of the product under FDA (21 CFR 1040.10 (i)).

Figure 2. Laser emission



Laser safety design considerations

To ensure laser safety for all input data patterns each channel is controlled internally and will be switched off if the laser safety limits are exceeded.

A channel alerter switches the respective data channel output off if the input duty cycle permanently exceeds 57%. The alerter will not disable the channel below an input duty cycle of 57% under all circumstances.

The minimum alerter response time is 1 μ s with a constant high input, i.e. in the input pattern the time interval of excessive high input (e.g. '1's in excess of a 57% duty cycle, consecutive or non-consecutive) must not exceed 1 μ s, otherwise the respective channel will be switched off. The alerter switches the respective channel from off to on without the need of resetting the module if the input duty cycle is no longer violated.

All of the channel alerters operate independently, i.e. an alert within a channel does not affect the other channels. To decrease the power consumption of the module unused channel inputs can be tied to high input level. In this way a portion of the supply current in this channel is triggered to shut down by the corresponding alerter.

TECHNICAL DATA

The electro-optical characteristics described in the following tables are valid only for use under the recommended operating conditions.

Recommended Operating Conditions

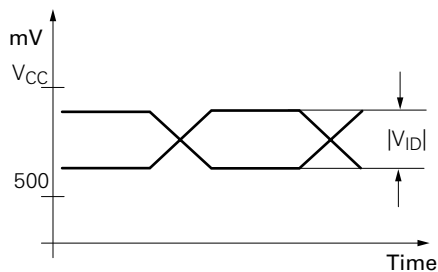
Parameter	Symbol	Min.	Max.	Units
Power Supply Voltage	V_{CC}	3.135	3.6	V
Noise on Power Supply ⁽¹⁾	N_{PS1}		50	mV
Noise on Power Supply ⁽²⁾	N_{PS2}		100	
Data Input Voltage Range ^(3,4)	V_{DATAI}	500	V_{CC}	
Data Input Differential Voltage ^(4,5)	$ V_{ID} $	80	1000	
Data Input Skew ⁽⁶⁾	t_{SPN}		$0.5 \times t_R, t_F$	ps
Data Input Rise/Fall Time ⁽⁷⁾	t_R, t_F	50	300	
LVC MOS Input High Voltage	$V_{LVC MOSIH}$	2.0	V_{CC}	V
LVC MOS Input Low Voltage	$V_{LVC MOSIL}$	V_{EE}	0.8	
LVC MOS Input Rise/Fall Time ⁽⁸⁾	t_R, t_F		20	ns

Notes

Voltages refer to $V_{EE}=0$ V.

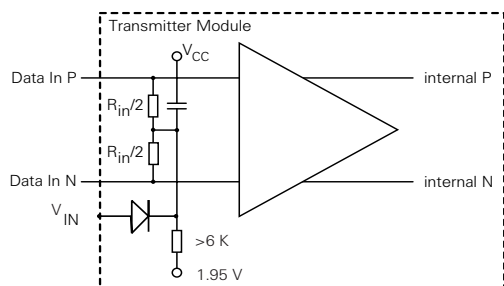
- Noise frequency is 1 kHz to 10 MHz. Voltage is peak-to-peak value.
- Noise frequency is > 10 MHz. Voltage is peak-to-peak value.
- This implies that the input stage can be AC coupled.
- Level diagram:

Figure 3. Input level diagram



- $|V_{ID}| = |(\text{input voltage of non-inverted input minus input voltage of inverted input})|$.
- Skew between positive and negative inputs measured at 50% level.
- 20%–80% level.
- Measured between 0.8 V and 2.0 V.

Figure 4. Input stage



Transmitter Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units
Supply Current	I_{CC}		350	450	mA
Power Consumption	P		1.2	1.6	W
Data Rate per Channel	DR	500 ⁽¹⁾		2500	Mbit/s
LVC MOS Output Voltage Low	$V_{LVC MOSOL}$			0.4	V
LVC MOS Output Voltage High	$V_{LVC MOSOH}$	2.5			
LVC MOS Input Current High/Low	$I_{LVC MOSI}$	–500		500	μA
LVC MOS Output Current High ⁽²⁾	$I_{LVC MOSOH}$			0.5	mA
LVC MOS Output Current Low ⁽³⁾	$I_{LVC MOSOL}$			4.0	
Data Differential Input Impedance ⁽⁴⁾	R_{IN}	80		120	Ω
Data Input Differential Current	$ I_I $			5.5	mA

Notes

- Specified for CID worst case pattern (disparity 72) or any pattern with a smaller disparity.
- Source current.
- Sink current.
- Data input stage.

Transmitter Electro-Optical Characteristics

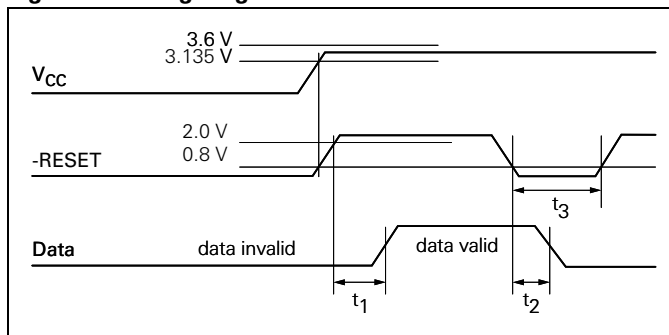
Parameter	Symbol	Min.	Typ.	Max.	Units
Optical Rise Time ⁽¹⁾	t_R			150	ps
Optical Fall Time ⁽¹⁾	t_F				
Total Jitter ⁽²⁾	J_T			0.35	UI
Deterministic Jitter	J_D			0.15	
Channel-to-channel skew ⁽³⁾	t_{CSK}			100	ps
Launched Average Power	P_{AVG}	–9.0	–5.0	–3.0	dBm
Launched Power Shutdown	P_{SD}			–30.0	
Center Wavelength	λ_C	830		860	nm
Spectral Width (FWHM)	$\Delta\lambda$			2	
Spectral Width (rms)	$\Delta\lambda$			0.85	
Relative Intensity Noise	RIN			–117	dB/Hz
Extinction Ratio (dynamic)	ER	6.0			
Optical Modulation Amplitude (OMA) ⁽⁴⁾	OMA	0.15 ⁽⁵⁾	0.46 ⁽⁶⁾		mW
Eye mask compliance		SONET ⁽⁷⁾			

Notes

Optical parameters valid for each channel.

1. 20%–80% level, non filtered values.
2. Measured using a filter ($f_r=1.875$ GHz) as defined in IEEE 802.3 (2000-edition) Gigabit Ethernet specification, section 38.6.5.
3. With input channel-to-channel skew 0 ps and a maximum data channel-to-channel average deviation and swing deviation of 5%.
4. Peak to peak values.
5. Corresponds to a minimum extinction ratio of 6 dB.
6. Corresponds to a typical extinction ratio of 8 dB.
7. Telcordia GR-253-CORE, Issue 3, Sept. 2000, sec. 4.2.4.4.

Figure 5. Timing diagram



Parameter	Symbol	Min.	Max.	Units
–RESET on Delay Time	t_1		100	ms
–RESET off Delay Time	t_2		50	μ s
–RESET Low Duration ⁽¹⁾	t_3	10		

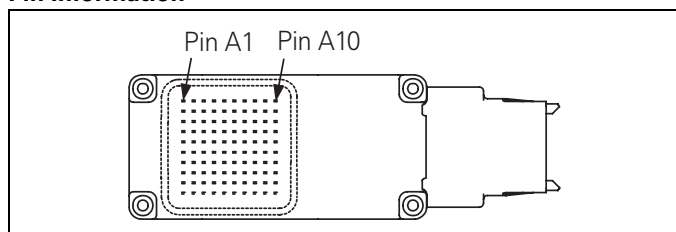
Note

1. Only when not used as power on reset. At any failure recovery, –RESET must be brought to low level for at least t_3 .

Numbering Conventions Transmitter (bottom view)

TX Customer Board Side										
	J	I	H	G	F	E	D	C	B	A
1	VEE	DI05N	DI05P	DI06N	DI06P	DI07N	DI07P	DI08N	DI08P	VEE
2	DI04P	VEE	VEE	VEE	VEE	VEE	VEE	VEE	VEE	DI09N
3	DI04N	VEE	Reserved	Reserved	t.b.i.o.	t.b.i.o.	Reserved	Reserved	VEE	DI09P
4	DI01P	VEE	Reserved	Reserved	t.b.i.o.	t.b.i.o.	Reserved	Reserved	VEE	DI012N
5	DI01N	VEE	VEE	VEE	t.b.i.o.	t.b.i.o.	VEE	VEE	VEE	DI012P
6	DI02P	VEE	VEE	VEE	t.b.i.o.	–LE	VEE	VEE	VEE	DI011N
7	DI02N	VEE	VEE	VEE	LCU	LE	VEE	VEE	VEE	DI011P
8	DI03P	VEE	VEE	VEE	VIN	–RESET	VEE	VEE	VEE	DI010N
9	DI03N	VEE	VEE	VEE	VCC	VCC	VEE	VEE	VEE	DI010P
10	VEE	VEE	VEE	VEE	VCC	VCC	VEE	VEE	VEE	VEE
Fiber Side										

Pin Information



Pin Description

Pin Name	Level/Logic	Description
VCC		Power supply voltage of laser driver
VIN		CML: V_{IN} =Reference supply (e.g. VCC) LVDS: $V_{IN}=V_{EE}$
VEE		Ground
LCU	LVC MOS Out	Laser Controller Up. High=normal operation Low=laser fault or RESET low.

Pin Name	Level/Logic	Description
DI0xN	Signal In	Data Input #x, inverted
DI0xP	Signal In	Data Input #x, non-inverted
–RESET	LVC MOS In	High=laser diode array is active. Low=switches laser diode array off. This input has an internal pull-down to ensure laser safety switch off in case of unconnected RESET input.
LE		Laser ENABLE. High active. High=laser array is on if LE is also active. Low=laser array is off. This input has an internal pull-up, therefore can be left open.
–LE		Laser ENABLE. Low active. Low=laser array is on if LE is also active. This input has an internal pull-down, therefore can be left open.

DESCRIPTION

Receiver V23832-R221-M1

The PAROLI receiver module converts parallel optical input signals into parallel electrical output signals. The optical signals received are converted into voltage signals by PIN diodes, transimpedance amplifiers, and gain amplifiers. There are two different modules available for LVDS and CML output. This description only refers to a module with LVDS output. A module description for Infineons adjustable CML output can be provided separately.

The data rate is up to 2500 Mbit/s for each channel. The receiver module's min. data rate of 500 Mbit/s is specified for the CID⁽¹⁾ worst case pattern (disparity 72) or any pattern with a lower disparity.

Additional Signal Detect outputs (SD1 active high / -SD12 active low) show whether an optical AC input signal is present at data input 1 and/or 12. The signal detect circuit can be disabled with a logic low at ENSD. The disabled signal detect circuit will permanently generate an active level at Signal Detect outputs, even if there is insufficient signal input. This could be used for test purposes.

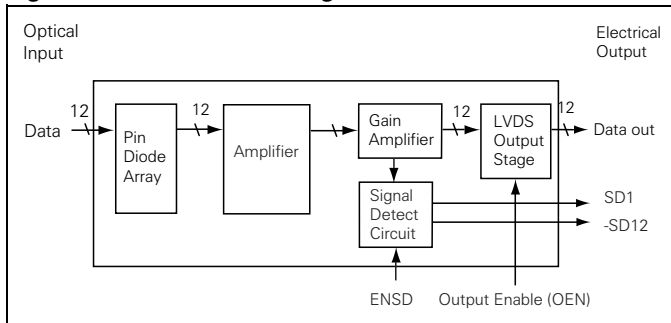
A logic low at LVDS Output Enable (OEN) sets all data outputs to logic low. SD outputs will not be effected.

All non data signals have LVCMOS levels. Transmission delay of the PAROLI system is at a maximum 1 ns for the transmitter, 1 ns for the receiver and approximately 5 ns per meter for the fiber optic cable.

Note

1. Consecutive Identical Digit (CID) immunity test pattern for STM-N signals, ITU-T recommendation G.957 sec. II.

Figure 6. Receiver block diagram



TECHNICAL DATA

Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Units
Power Supply Voltage	V_{CC}, V_{CCO}	3.0	3.6	V
Noise on Power Supply ⁽¹⁾	N_{PS1}		50	mV
Noise on Power Supply ⁽²⁾	N_{PS2}		100	
Differential LVDS Termination Impedance	R_t	80	120	Ω
LVCMOS Input High Voltage	$V_{LVCMOSIH}$	2.0	V_{CC}	V
LVCMOS Input Low Voltage	$V_{LVCMOSIL}$	V_{EE}	0.8	
LVCMOS Input Rise/Fall Time ⁽³⁾	t_R, t_F		20	ns
Optical Input Rise/Fall Time ⁽⁴⁾	t_R, t_F		200	ps
Input Extinction Ratio	ER	6.0		dB
Input Center Wavelength	λ_C	830	860	nm

Notes

Voltages refer to $V_{EE}=0$ V.

1. Noise frequency is 1 kHz to 10 MHz. Voltage is peak-to-peak value.
2. Noise frequency is > 10 MHz. Voltage is peak-to-peak value.
3. Measured between 0.8 V and 2.0 V.
4. 20%–80% level. Non filtered values.

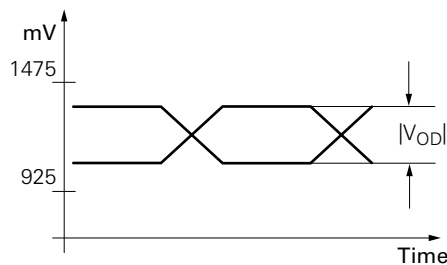
Receiver Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units
Supply Current	I_{CC}		250	350	mA
Power Consumption	P		0.8	1.3	
LVDS Output Low Voltage ^(1,2)	V_{LVDSOL}	925			mV
LVDS Output High Voltage ^(1,2)	V_{LVDSOH}			1475	
LVDS Output Differential Voltage ^(1,2,3)	$ V_{OD} $	250		400	
LVDS Output Offset Voltage ^(1,2,4)	V_{OS}	1125		1275	
LVDS Rise/Fall Time ⁽⁵⁾	t_R, t_F			300	ps
LVCMOS Output Voltage Low	$V_{LVCMOSOL}$			400	
LVCMOS Output Voltage High	$V_{LVCMOSOH}$	2500			
LVCMOS Input Current High/Low	$I_{LVCMOSI}$	-500		500	μA
LVCMOS Output ⁽⁶⁾ Current High	$I_{LVCMOSOH}$			0.5	mA
LVCMOS Output ⁽⁷⁾ Current Low	$I_{LVCMOSOL}$			4.0	
Total Jitter ^(8,9)	J_T			0.39	UI
Deterministic Jitter ⁽⁸⁾	J_D			0.15	
Channel-to-channel skew ⁽¹⁰⁾	t_{CSK}			100	ps

Notes

1. Level Diagram:

Figure 7. Output level diagram



- LVDS output must be terminated differentially with R_t .
- $|V_{ODI}|$ = [output voltage of non-inverted output minus output voltage of inverted output].
- $V_{OS} = 1/2$ (output voltage of inverted output + output voltage of non-inverted output).
- Measured between 20% and 80% level with a maximum capacitive load of 3 pF.
- Source current.
- Sink current.
- With no optical input jitter.
- At sensitivity limit of 0.05 mW OMA.
- With input channel-to-channel skew 0 ps.

Receiver Electro-Optical Characteristics

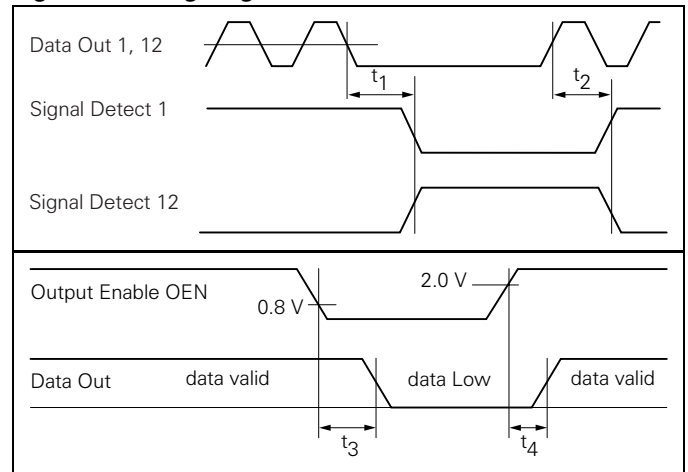
Parameter	Symbol	Min.	Max.	Units
Data Rate Per Channel	DR	500 ⁽¹⁾	2500	Mbit/s
Sensitivity (Average Power) ⁽²⁾	P _{IN}		-16.0	dBm
Optical Modulation Amplitude (OMA) ⁽³⁾	OMA	0.05 ⁽⁴⁾		mW
Saturation (Average Power)	P _{SAT}	-3.0		dBm
Signal Detect Assert Level ⁽⁵⁾	P _{SDA}		-17.0	
Signal Detect Deassert Level ⁽⁵⁾	P _{SDD}	-29		
Signal Detect Hysteresis ⁽⁵⁾	P _{SDA} - P _{SDD}	1.0	4.0	dB
Return Loss of Receiver	A _{RL}	12		

Notes

Optical parameters valid for each channel.

- Specified for CID worst case pattern (disparity 72) or any pattern with a smaller disparity
- BER=10⁻¹², Extinction ratio=infinite, Specified for CID worst case pattern (disparity 72) or any pattern with a smaller disparity.
- Peak to peak value.
- Corresponds to an maximum sensitivity (average power) of -16.0 dBm at an infinite extinction ratio.
- Extinction ratio=infinite,
P_{SDA}: Average optical power when SD switches from inactive to active.
P_{SDD}: Average optical power when SD switches from active to inactive.

Figure 8. Timing diagrams

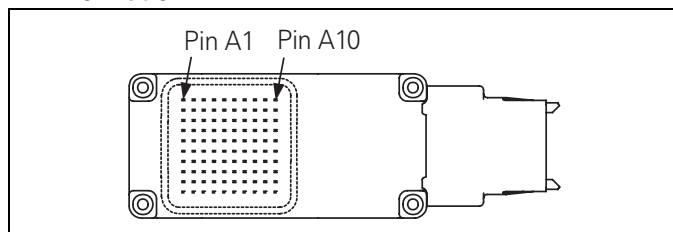


Parameter	Symbol	Max.	Units
Signal Detect Deassert Time	t ₁	10	μs
Signal Detect Assert Time	t ₂		
LVDS Output Enable off Delay Time	t ₃	20	ns
LVDS Output Enable on Delay Time	t ₄		

Numbering Conventions Receiver (bottom view)

RX Customer Board Side										
	J	I	H	G	F	E	D	C	B	A
1	VEE	DO05P	DO05N	DO06P	DO06N	DO07P	DO07N	DO08P	DO08N	VEE
2	DO04N	VEE	VEE	VEE	VEE	VEE	VEE	VEE	VEE	DO09P
3	DO04P	VEE	Reserved	Reserved	t.b.l.o.	t.b.l.o.	Reserved	Reserved	VEE	DO09N
4	DO01N	VEE	Reserved	Reserved	OEN	ENSD	Reserved	Reserved	VEE	DO012P
5	DO01P	VEE	VEE	VEE	SD01	-SD12	VEE	VEE	VEE	DO012N
6	DO02N	VEE	VEE	VEE	Reserved	REFR	VEE	VEE	VEE	DO011P
7	DO02P	VEE	VEE	VEE	VCCO	VCCO	VEE	VEE	VEE	DO011N
8	DO03N	VEE	VEE	VEE	VCCO	VCCO	VEE	VEE	VEE	DO010P
9	DO03P	VEE	VEE	VEE	VCC	VCC	VEE	VEE	VEE	DO010N
10	VEE	VEE	VEE	VEE	VCC	VCC	VEE	VEE	VEE	VEE
Fiber Side										

Pin Information



Pin Description

Pin Name	Level/Logic	Description
V _{CC}		Power supply voltage of pre amplifier and analog circuitry
V _{CCO}		Power supply voltage of output stages
REFR		LVDS=t.b.l.o.
V _{EE}		Ground
OEN	LVC MOS In	Output Enable High=normal operation. Low=sets all Data Outputs to low. This input has an internal pull-up which pulls to high level when this input is left open.
ENSD		High=SD1 and -SD12 function enabled. Low=SD1 and -SD12 are set to permanent active. This input has an internal pull-up which pulls to high level when this input is left open.
SD1	LVC MOS Out	Signal Detect on fiber #1. High=signal of sufficient AC power is present on fiber #1. Low=signal on fiber #1 is insufficient.
-SD12	LVC MOS Out low active	Signal Detect on fiber #12. Low=signal of sufficient AC power is present on fiber #12. High=signal on fiber #12 is insufficient.
DO0xP	LVDS Out	Data Output #x, non-inverted
DO0xN		Data Output #x, inverted

Optical Port

- Designed for the 12 fiber MT Connector (MPO)
- Alignment pins fixed in module port
- Integrated mechanical keying

Features of the MT Connector (MPO)

(as part of optional PAROLI fiber optic cables)

- Uses standardized MT ferrule
- MT compatible fiber spacing (250 µm) and alignment pin spacing (4600 µm)
- Push-pull mechanism
- Ferrule bearing spring loaded

Features of the PAROLI 2T electrical connector⁽¹⁾

- Module side: FCI-MEG-Array[®] -Plug (part no. 84512-202)
- PCB side: FCI MEG-Array[®] -Receptacle (part no. 84513-201)
- 100 pin positions
- Pluggable version using BGA socket
- 4 mm stack height in mated conditions
- Plug and receptacle are provided with pick-up cap
- Standard BGA process for socket assembly
- Contact area plating made from gold over nickel

Note

1. The PAROLI 2T module needs to be screwed to the customer board by using the provided holes in the module frame (see page 1) in order to provide long term reliability.

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