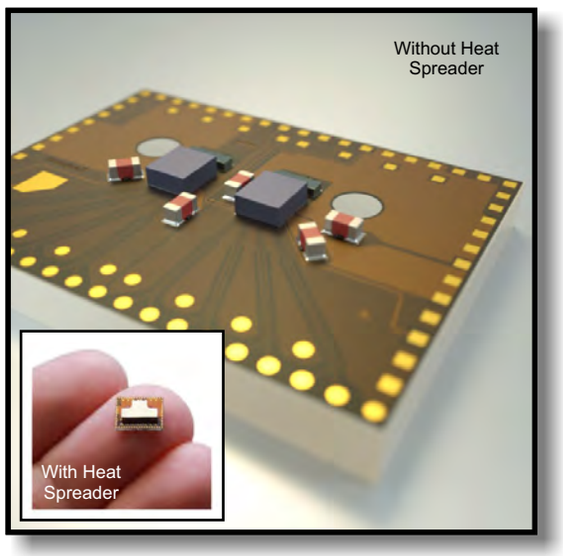
Fibre-Lyte 4x25G Transceiver Module

Features

- Highly integrated module with VCSELs, drivers, PDs and TIAs in an incredibly small **9.5x7.0x2.5mm**.
- Integrated optical waveguides.
- LGA pin out.
- Flexible mechanical interfacing.
- Low cost through wafer scale production processes.
- RoHS compliance.



Options

- 28G per channel operation.
- Long wavelength transmission.
- Passive MT/MPO alignment holes.
- Customer specified optical devices, drivers and TIAs.
- Reduced dimensions.
- Removable interconnects e.g. ACF or pin sockets.
- Available with CDR.
- Custom variants.

Dimensions	Typ.	Units
Length	9.5	mm
Breadth	7.0	mm
Height	2.5	mm

Applications

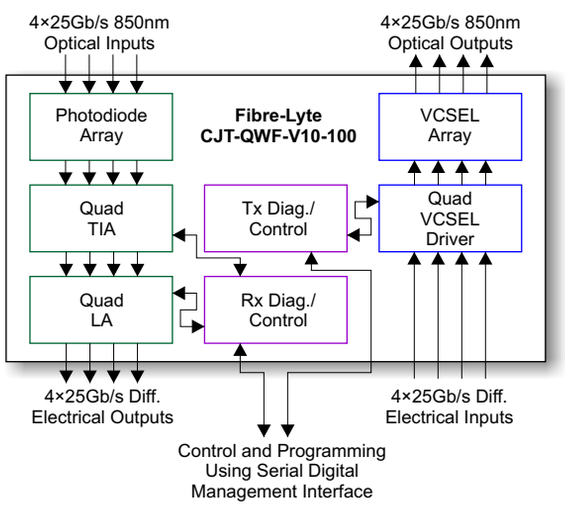
- Active optical cables (AOCs)
- Data storage and HPC I/O interfaces.
- ASIC/FPGA optical interfaces.
- Transceivers.

Overview

Conjunct's Fibre-Lyte transceiver is the world's smallest integrated transceiver module available today and is designed to interface with an external lens system or a range of proprietary connectors.

The module offers excellent electronic and optical performance and its small size allows it to be integrated into most platforms including PCBs. It is capable of being soldered, wire bonded, glued or flip chipped.

Functional Block Diagram



Performance

Fibre-Lyte Performance	Min.	Typ.	Max.	Units	Notes
Detection Wavelength	840		860	nm	
Emission Wavelength	840	850	860	nm	
Optical Crosstalk		0		dB	No BER impact with 2x aggressors. ±0.25dB equipment limited*.
Optical Coupling Efficiency		60		%	Underfilled components, no AR top surface.
Operational Temperature Range	0		85	°C	Assume +15°C over ambient in system.
Data Rate (Per Channel)		25	28	Gb/s	NRZ operation, RS-FEC. Determined by components.
Optical Link Budget		10.5		dB	VCSEL 3.5dBm, MT, -7dBm sensitivity at BER $1x10^{-5}$ *.
Power Consumption		810		mW	Total of all components. (With optional CDR 1.86W).
Differential Signal Return Loss			-16	dB	28GHz, module RF performance.
Differential Signal Insertion Loss			-0.8	dB	28GHz, module RF performance.
Near End Electrical Crosstalk			-32	dB	28GHz, module RF performance.
Far End Electrical Crosstalk			-40	dB	28GHz, module RF performance.
Differential to Common Mode Conversion			-25	dB	28GHz, module RF performance.

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* Detailed test results available on request (DOC-000295 R6).

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Fibre-Lyte 4x25G Electrical Performance

Fibre-Lyte Configuration	Status	Type	Rev.	Manufacturer
1x4 SW ULMPIN-25G-4CH	Prototype	PD	TBC	Philips-ULM
1x4 SW ULM850-25G-4CH	Prototype	VCSEL	TBC	Philips-ULM
1x4 IPTA28G4CPT	Prototype	TIA/LA	08	IPtronics
1x4 IPVD28G4CPT	Prototype	Driver	07	IPtronics

PD	Min.	Typ.	Max.	Units	Notes
Reverse Bias Voltage		-2	-20	V	
Photodetector Responsivity		0.6		A/W	
Variation of Responsivity		TBC		%	
Photodetector Dark Current		0.02	0.2	nA	At 25°C.
Capacitance		TBC		fF	

VCSEL	Min.	Typ.	Max.	Units	Notes
Threshold Current		0.7	1.5	mA	Typ. at 25°C, max at 85°C.
Slope Efficiency		0.4		W/A	
Roll-Off (P_{max})		TBC		mW	
Absolute Maximum Current			12	mA	
Signal Rise and Fall Time		TBC		ps	20% to 80%
Slope Efficiency Variation Over Temp.		-0.45		%/°C	0...85°C.
Wavelength Tuning Over Temperature		0.07		nm/K	

TIA/LA Amplifier	Min.	Typ.	Max.	Units	Notes
Input Sensitivity		50		µA p-p	BER 10^{-12}.
Low Frequency Cutoff		100		kHz	
Output Transistion Time		14	18	ps	20-80%.
Pattern Jitter		3	TBC	ps	
Random Jitter			TBC	ps	
Power Supply Voltage	3.13	3.3	3.47	V	RX_VDD pins.
Power Dissipation		440		mW	110mW per channel typ., includes load.
Differential Output Amplitude	0		TBC	mV p-p	Programmable, RX_DOx and RX_DONx.
Differential Output Pre-Emphasis	0		TBC	mV p-p	Programmable, add to RX_DOx and RX_DONx.
Termination Resistance	2×36	2×45	2×54	Ohms	Differential, RX_DOx and RX_DONx.
Differential Parameters <17.6GHz			-10	dB	90Ω, RX_DOx and RX_DONx. S_{22}.
Differential Parameters >17.6GHz			Notes	dB	Formula: -10+(16.6×Log10(f/17.6)), with f in GHz. S_{22}.

VCSEL Driver	Min.	Typ.	Max.	Units	Notes
Electrical Crosstalk			TBC	dB	
Channel to Channel Skew			TBC	ps	
Deterministic Jitter			2	ps	To be tested in production.
Random Jitter			0.5	ps	To be tested in production.
Power Supply Voltage	3.13	3.3	3.47	V	TX_VDD pins.
Power Supply Voltage	3.6	3.8	4	V	TX_VDD2 pins.
Power Dissipation		370		mW	92.5mW per channel typ., includes 5mA VCSEL.
Differential Input Voltage (AC Coupled)	2×30		2×400	V	TX_Dix and TX_DINx pins. No equalisation.
Differential Input Voltage (AC Coupled)	2×60		2×400	mV p-p	TX_Dix and TX_DINx pins. 6dB equalisation.
Differential Termination Resistance	72	90	108	Ohms	
Differential Reflection Coefficient			-15	dB	<17.6 GHz, 90Ω. To be tested in production. SDD_{11}.
Common Mode Reflection Coefficient		-0.15		dB	<17.6 GHz, 90Ω. To be tested in production. SCC_{11}.
Differential to Common Mode Reflection		-60		dB	<17.6 GHz, 90Ω. To be tested in production. SCD_{11}.
Common Mode to Differential Reflection		-70		dB	<17.6 GHz, 90Ω. To be tested in production. SDC_{11}.

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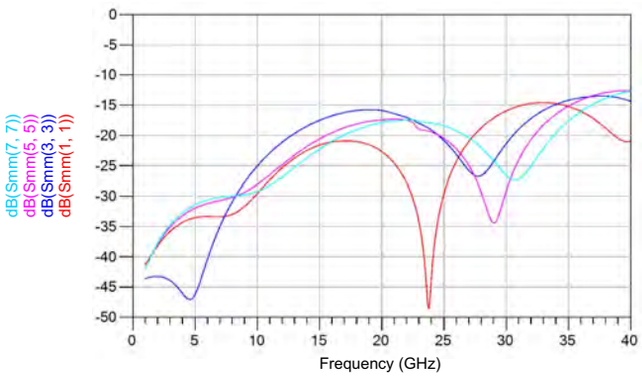
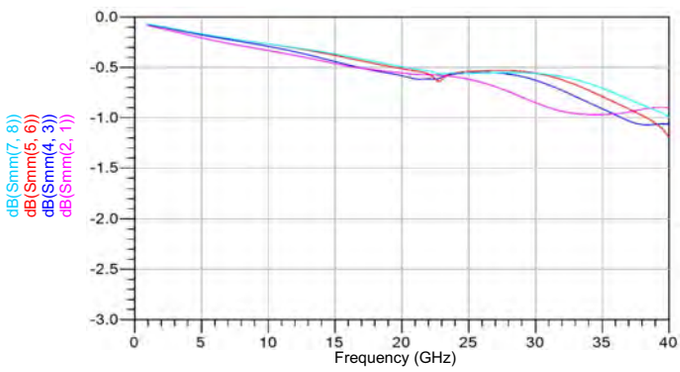
Fibre-Lyte 4x25G RF Performance

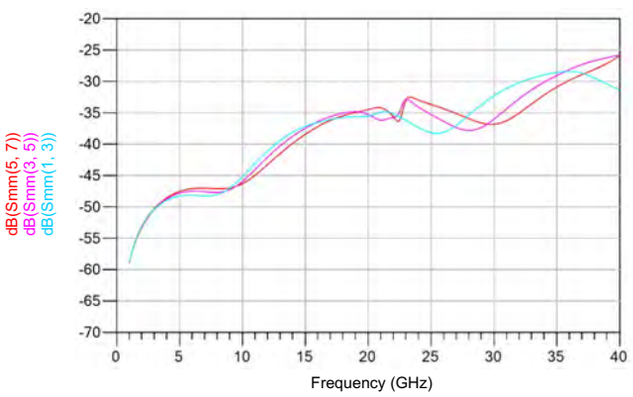
Differential Signal Return Loss



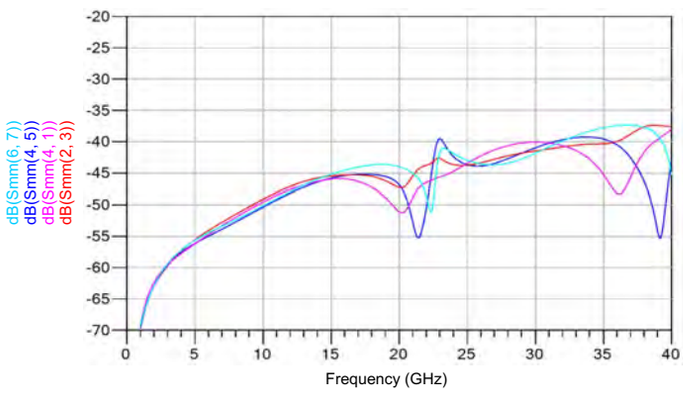
Differential Signal Insertion Loss



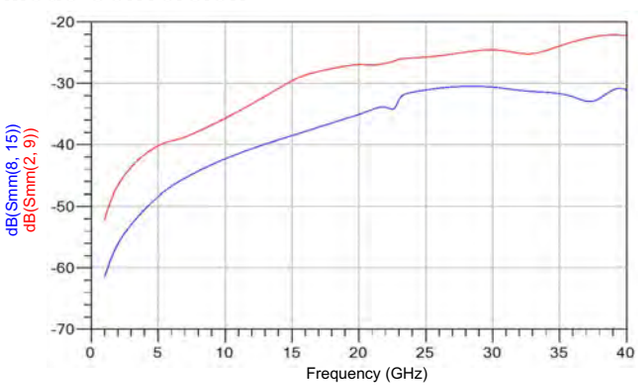
Near End Crosstalk



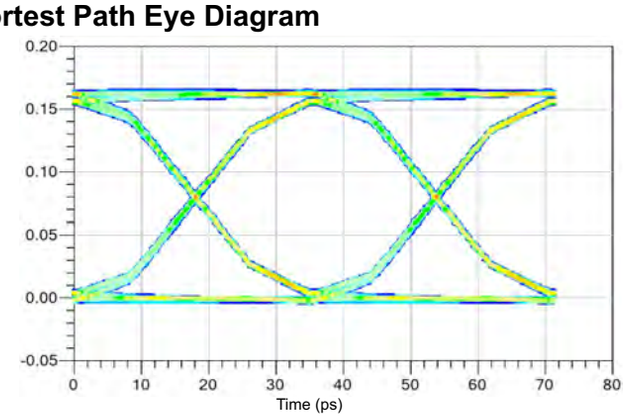
Far End Crosstalk



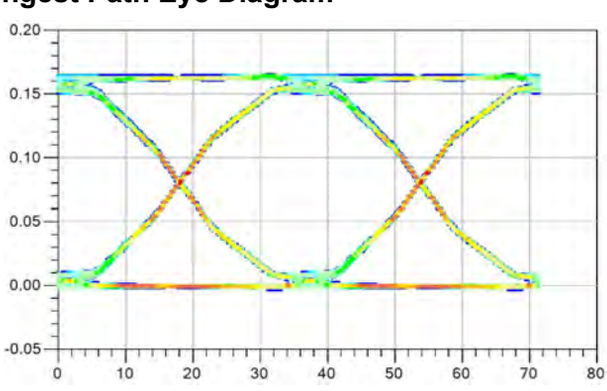
Mode Conversion



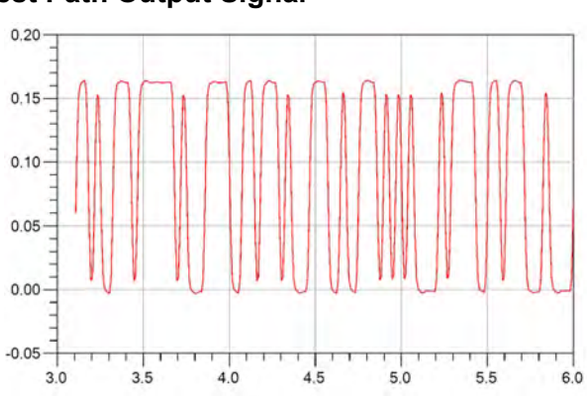
Shortest Path Eye Diagram



Longest Path Eye Diagram



Longest Path Output Signal



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Fibre-Lyte 4x25G Pinout

Pin	Name	x (mm)	y (mm)	IC Mapping	IC Pin	Notes
1	RX_GND	-4.5	1.2	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
2	RX_GND	-4.5	0.7	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
3	RX_GND	-4.5	0.2	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
4	RX_VDD	-4.5	-0.3	IPtronics IPTA28G4CPT	GND	Transmit ground plane.
5	RX_VDD	-4.5	-0.8	IPtronics IPTA28G4CPT	VDD, VDDX and VDDT	Receive power power supply (+3.3V).
6	RX_VDD	-4.5	-1.3	IPtronics IPTA28G4CPT	VDD, VDDX and VDDT	Receive power power supply (+3.3V).
7	RX_GND	-4.5	-1.8	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
8	RX_GND	-4.5	-2.3	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
9	RX_GPIO	-4.5	-2.8	IPtronics IPTA28G4CPT	GPIO	General purpose I/O for receiver.
10	RX_GND	-4.5	-3.3	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
11	RX_GND	-4.5	-3.8	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
12	RX_GND	-4.5	-4.3	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
13	RX_DO1	-4	-4.3	IPtronics IPTA28G4CPT	DO1	Differential output data, receive channel 1 positive.
14	RX_DON1	-3.5	-4.3	IPtronics IPTA28G4CPT	DON1	Differential output data, receive channel 1 negative.
15	RX_GND	-3.25	-3.8	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
16	RX_DO2	-3	-4.3	IPtronics IPTA28G4CPT	DO2	Differential output data, receive channel 2 positive.
17	RX_DON2	-2.5	-4.3	IPtronics IPTA28G4CPT	DON2	Differential output data, receive channel 2 negative.
18	RX_GND	-2.25	-3.8	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
19	RX_DO3	-2	-4.3	IPtronics IPTA28G4CPT	DO3	Differential output data, receive channel 3 positive.
20	RX_DON3	-1.5	-4.3	IPtronics IPTA28G4CPT	DON3	Differential output data, receive channel 3 negative.
21	RX_GND	-1.25	-3.8	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
22	RX_DO4	-1	-4.3	IPtronics IPTA28G4CPT	DO4	Differential output data, receive channel 4 positive.
23	RX_DON4	-0.5	-4.3	IPtronics IPTA28G4CPT	DON4	Differential output data, receive channel 4 negative.
24	RX_GND	-0.25	-3.8	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
25	RX_GND	0	-4.3	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
26	TX_GND	0.25	-3.8	IPtronics IPVD28G4CPT	GND	Transmit ground plane.
27	TX_DI1	0.5	-4.3	IPtronics IPVD28G4CPT	DI1	Differential input data, transmit channel 1 positive.
28	TX_DIN1	1	-4.3	IPtronics IPVD28G4CPT	DIN1	Differential input data, transmit channel 1 negative.
29	TX_GND	1.25	-3.8	IPtronics IPVD28G4CPT	GND	Transmit ground plane.
30	TX_DI2	1.5	-4.3	IPtronics IPVD28G4CPT	DI2	Differential input data, transmit channel 2 positive.
31	TX_DIN2	2	-4.3	IPtronics IPVD28G4CPT	DIN2	Differential input data, transmit channel 2 negative.
32	TX_GND	2.25	-3.8	IPtronics IPVD28G4CPT	GND	Transmit ground plane.
33	TX_DI3	2.5	-4.3	IPtronics IPVD28G4CPT	DI3	Differential input data, transmit channel 3 positive.
34	TX_DIN3	3	-4.3	IPtronics IPVD28G4CPT	DIN3	Differential input data, transmit channel 3 negative.
35	TX_GND	3.25	-3.8	IPtronics IPVD28G4CPT	GND	Transmit ground plane.
36	TX_DI4	3.5	-4.3	IPtronics IPVD28G4CPT	DI4	Differential input data, transmit channel 4 positive.
37	TX_DIN4	4	-4.3	IPtronics IPVD28G4CPT	DIN4	Differential input data, transmit channel 4 negative.
38	TX_GND	4.5	-4.3	IPtronics IPVD28G4CPT	GND	Transmit ground plane.
39	TX_GND	4.5	-3.8	IPtronics IPVD28G4CPT	GND	Transmit ground plane.
40	TX_GND	4.5	-3.3	IPtronics IPVD28G4CPT	GND	Transmit ground plane.
41	TX_LEN	4.5	-2.8	IPtronics IPVD28G4CPT	LEN	Pin for calibration of output driver currents on transmit channel.
42	TX_GND	4.5	-2.3	IPtronics IPVD28G4CPT	GND	Transmit ground plane.
43	TX_VDD	4.5	-1.8	IPtronics IPVD28G4CPT	VDD	Transmit power power supply (+3.3V).
44	TX_VDD	4.5	-1.3	IPtronics IPVD28G4CPT	VDD	Transmit power power supply (+3.3V).
45	TX_GND	4.5	-0.8	IPtronics IPVD28G4CPT	GND	Transmit ground plane.
46	TX_VDD2	4.5	-0.3	IPtronics IPVD28G4CPT	VDD2	Transmit power power supply for output buffers (+3.8V).
47	TX_VDD2	4.5	0.2	IPtronics IPVD28G4CPT	VDD2	Transmit power power supply for output buffers (+3.8V).
48	TX_VDD2	4.5	0.7	IPtronics IPVD28G4CPT	VDD2	Transmit power power supply for output buffers (+3.8V).
49	TX_GND	4.5	1.2	IPtronics IPVD28G4CPT	GND	Transmit ground plane.
50	TX_GND	4.5	1.7	IPtronics IPVD28G4CPT	GND	Transmit ground plane.
51	TX_GND	4.5	2.2	IPtronics IPVD28G4CPT	GND	Transmit ground plane.
52	TX_GND	4	2.2	IPtronics IPVD28G4CPT	GND	Transmit ground plane.
53	TX_GND	3.5	2.2	IPtronics IPVD28G4CPT	GND	Transmit ground plane.
54	TX_GND	3.25	1.7	IPtronics IPVD28G4CPT	GND	Transmit ground plane.
55	TX_VDD2	3	2.2	IPtronics IPVD28G4CPT	VDD2	Transmit power power supply for output buffers (+3.8V).
56	TX_VDD2	2.5	2.2	IPtronics IPVD28G4CPT	VDD2	Transmit power power supply for output buffers (+3.8V).
57	TX_GND	2.25	1.7	IPtronics IPVD28G4CPT	GND	Transmit ground plane.
58	TX_VDD2	2	2.2	IPtronics IPVD28G4CPT	VDD2	Transmit power power supply for output buffers (+3.8V).
59	TX_SDA	1.5	2.2	IPtronics IPVD28G4CPT	SDA	Serial data for I^2C transmit interface.
60	TX_GND	1.25	1.7	IPtronics IPVD28G4CPT	GND	Transmit ground plane.
61	TX_SCL	1	2.2	IPtronics IPVD28G4CPT	SCL	Clock signal for I^2C transmit interface.
62	TX_GPIO	0.5	2.2	IPtronics IPVD28G4CPT	GPIO	General purpose I/O for transmitter.
63	TX_GND	0.25	1.7	IPtronics IPVD28G4CPT	GND	Transmit ground plane.
64	RX_GND	0	2.2	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
65	RX_GND	-0.25	1.7	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
66	RX_SCL	-0.5	2.2	IPtronics IPTA28G4CPT	SCL	Clock signal for I^2C receiver interface.
67	RX_SDA	-1	2.2	IPtronics IPTA28G4CPT	SDA	Serial data for I^2C receiver interface.
68	RX_GND	-1.25	1.7	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
69	RX_VDD	-1.5	2.2	IPtronics IPTA28G4CPT	VDD, VDDX and VDDT	Receive power power supply (+3.3V).
70	RX_VDD	-2	2.2	IPtronics IPTA28G4CPT	VDD, VDDX and VDDT	Receive power power supply (+3.3V).
71	RX_GND	-2.25	1.7	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
72	RX_VDD	-2.5	2.2	IPtronics IPTA28G4CPT	VDD, VDDX and VDDT	Receive power power supply (+3.3V).
73	RX_GND	-3	2.2	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
74	RX_GND	-3.25	1.7	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
75	RX_GND	-3.5	2.2	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
76	RX_GND	-4	2.2	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
77	RX_GND	-4.5	2.2	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.
78	RX_GND	-4.5	1.7	IPtronics IPTA28G4CPT	GND and GNDT	Receive ground plane.

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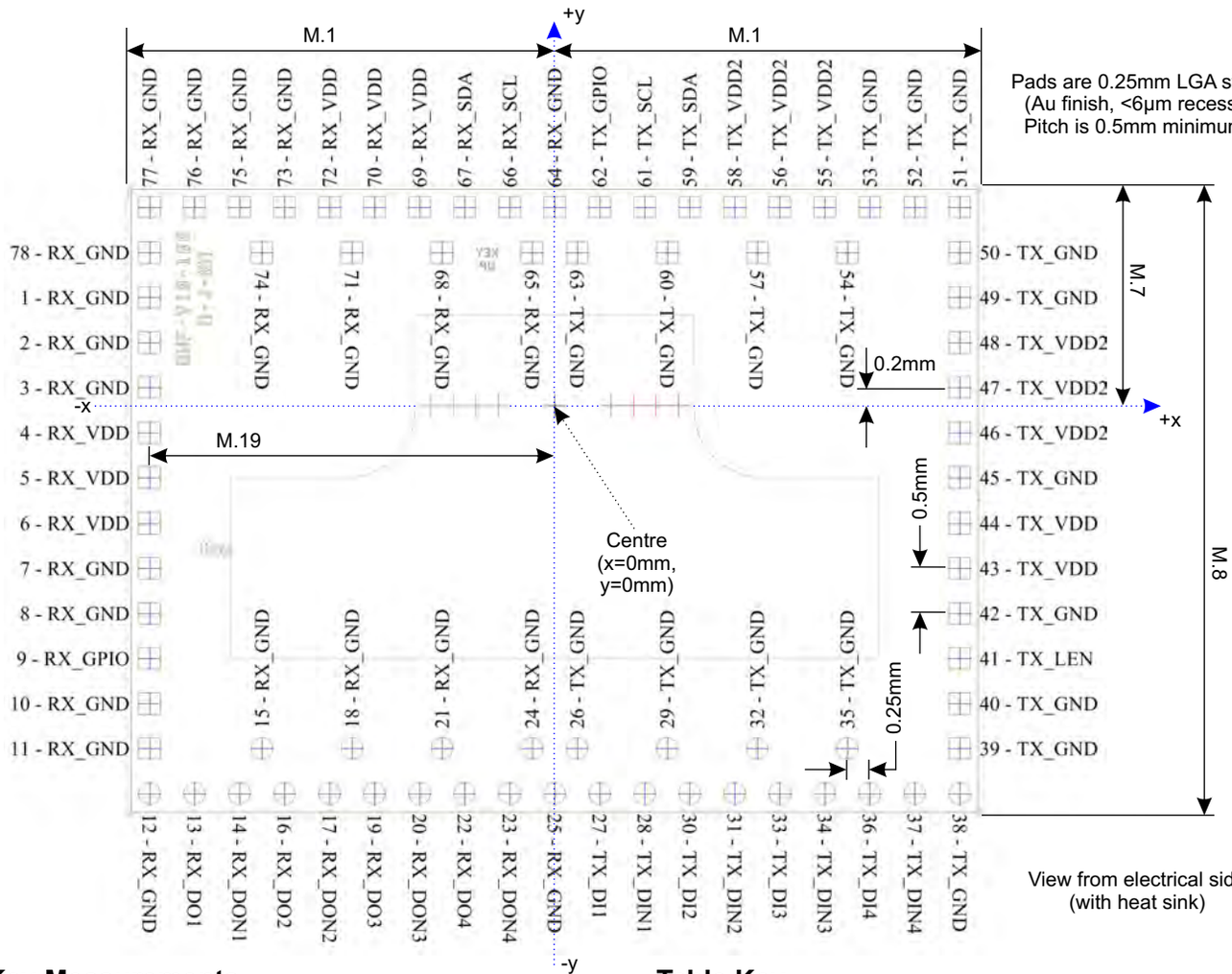
Fibre-Lyte 4x25G Pinout



Pads are 0.25mm LGA style (Au finish, <6µm recess). Pitch is 0.5mm minimum.

View from electrical side (with heat sink)

Key Measurements

Code	Dimension	Tolerance	Notes
M.1	4.75mm	+/-15um	RIE->Metal->Dice
M.2	9.5mm	+/-5um	Dice->Dice
M.7	2.45mm	+/-15um	RIE->Metal->Dice
M.8	7.0mm	+/-5um	Dice->Dice
M.9	1.55mm	+/-60um	RIE->HS
M.10	3.1mm	+/-100um	HS->HS
M.11	1.0mm	+/-60um	RIE->HS
M.12	3.8mm	+/-100um	HS->HS
M.13	0.75mm	+/-50um	HS arc at -0.05mm y.
M.14	3.6mm	+/-60um	RIE->HS
M.15	7.2mm	+/-100um	HS->HS
M.16	2.0mm	+/-100um	HS->HS
M.17	1.5mm	+/-150um	HS->HS->Epoxy
M.18	1.0mm	+/-25um	Wafer thickness.
M.19	4.5mm	+/-10um	RIE->Metal
M.20	0.2mm	+/-10um	RIE->Metal
M.22	Not Shown	+/-50nm	WG->WG

Table Key

- Part centre defined by reactive ion etch (*RIE*).
- *Metal:* Metallised layer and pads.
- *WG*: Waveguide.
- *Dice*: Dicing lines where separated from wafer.
- *HS*: Heat sink, assumes milled part.
- *Epoxy*: HS attach.

Feature Placement (Electrical Side)

Feature	Colour	x (mm)	y (mm)
RX1 Waveguide	Violet	-1.375	0
RX2 Waveguide	Violet	-1.125	0
RX3 Waveguide	Violet	-0.875	0
RX4 Waveguide	Violet	-0.625	0
Centre	Black	0	0
TX1 Waveguide	Red	0.625	0
TX2 Waveguide	Red	0.875	0
TX3 Waveguide	Red	1.125	0
TX4 Waveguide	Red	1.375	0

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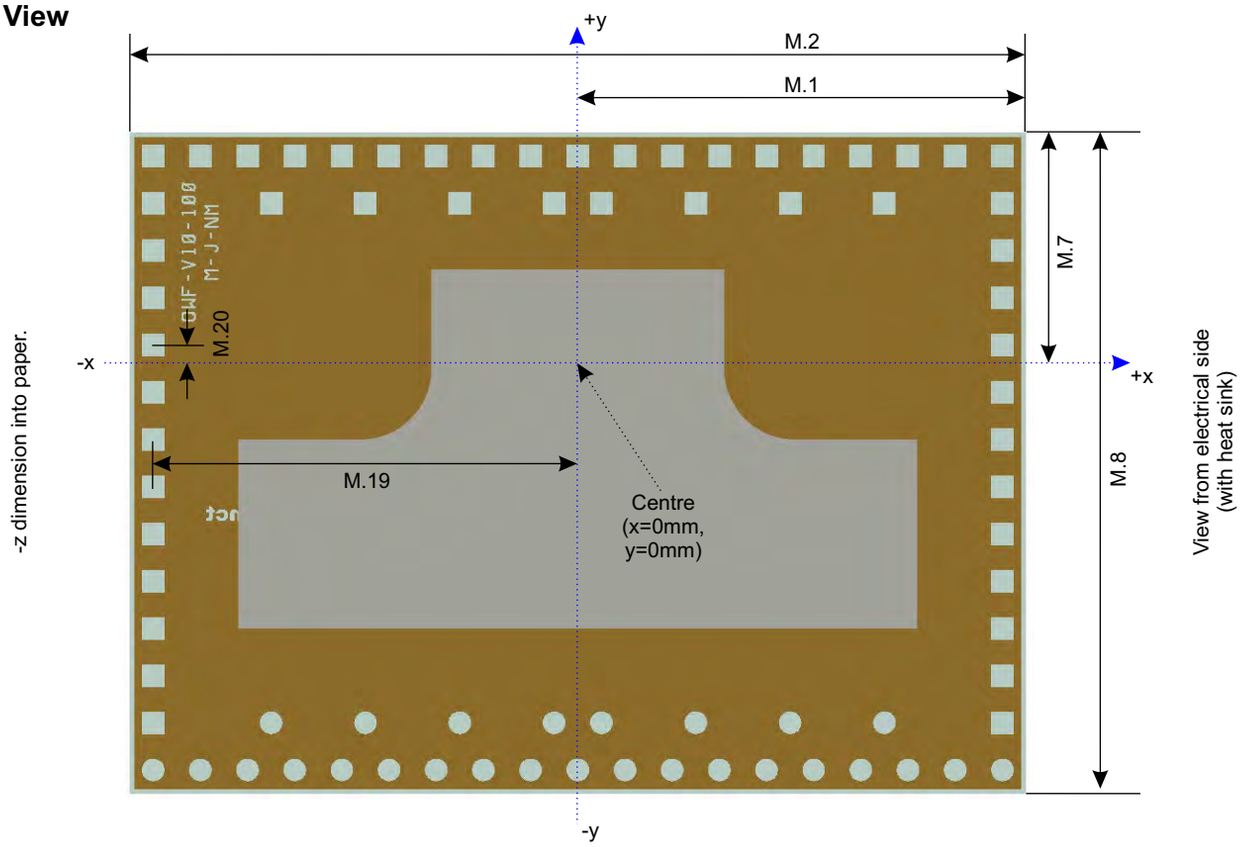
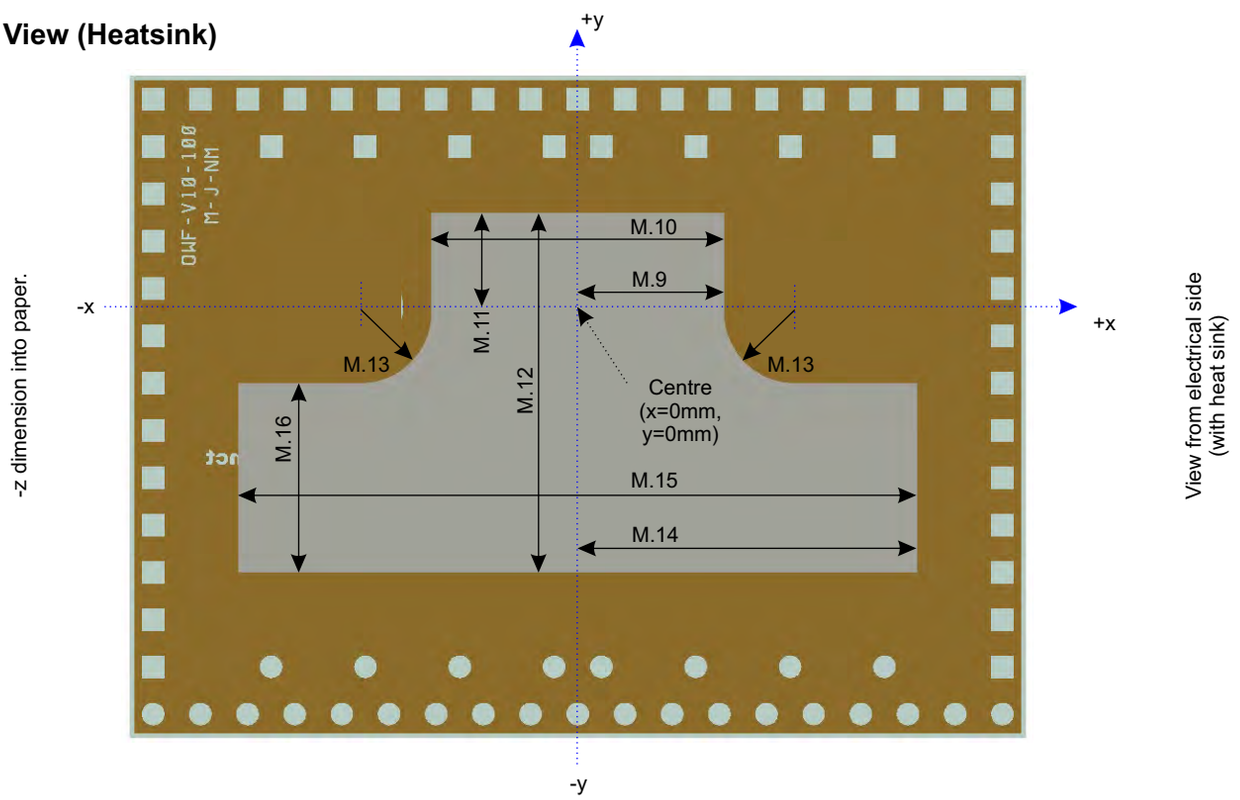
Fibre-Lyte 4x25G Mechanical Details

Top View



Top View (Heatsink)



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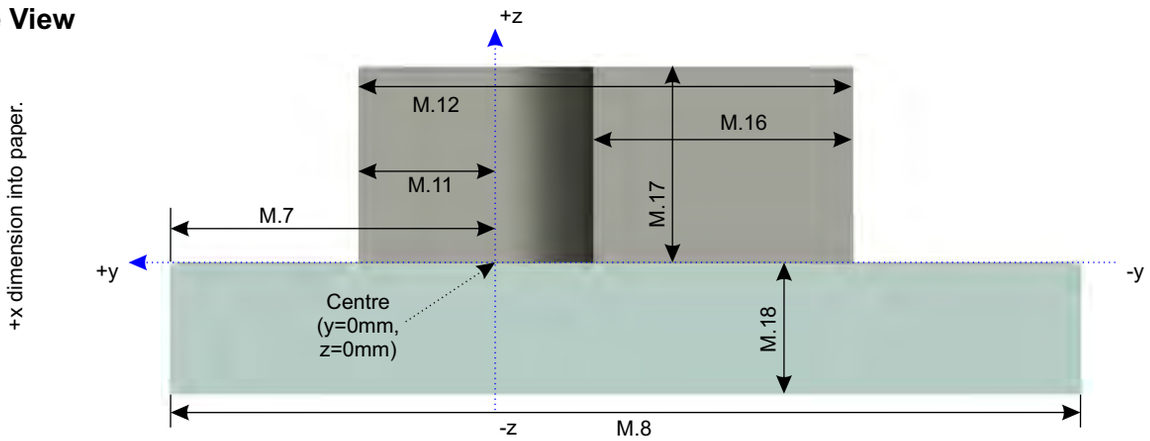
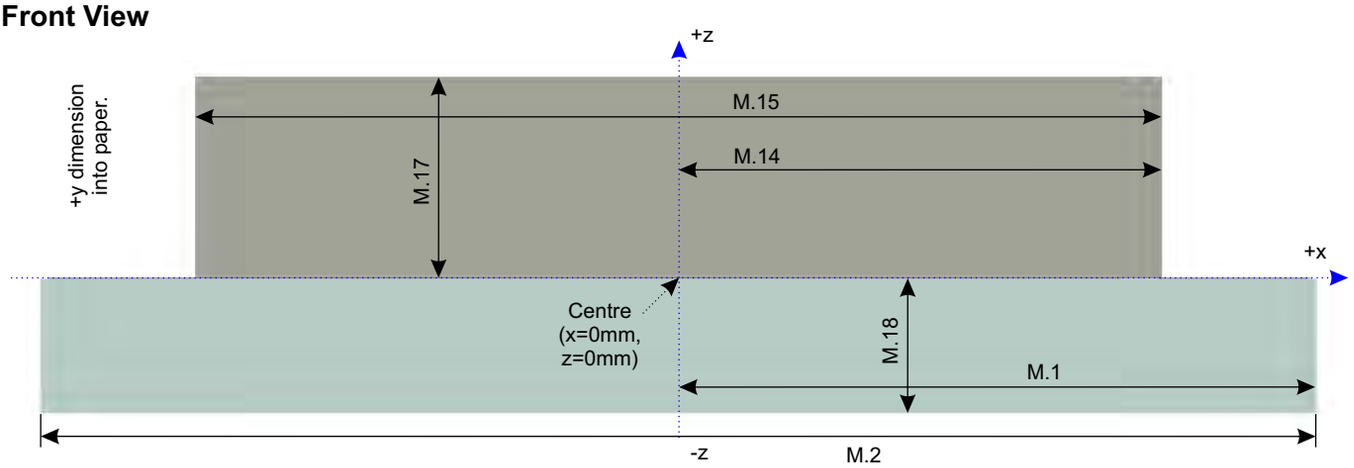
Fibre-Lyte 4x25G Mechanical Details

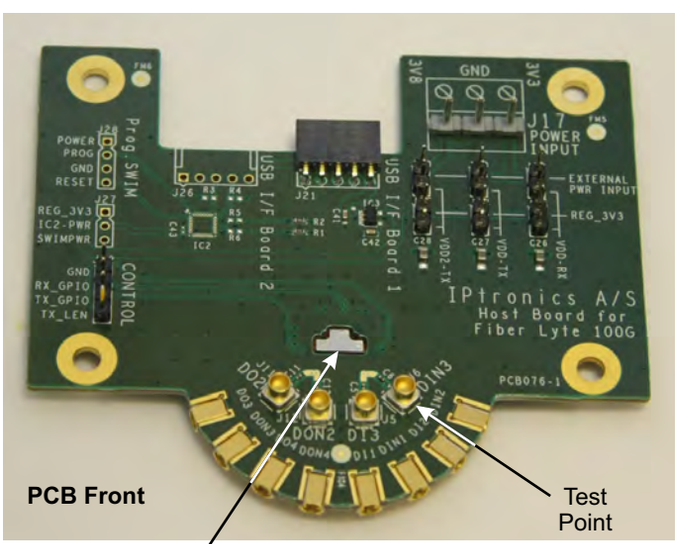
Side View

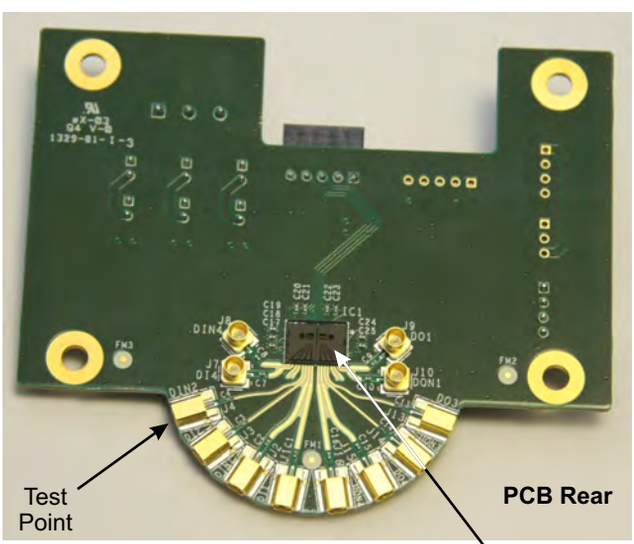


Front View



Fibre-Lyte 4x25G Evaluation PCB





- 100G Fibre-Lyte pre-mounted on a PCB.
- Diff. electrical interface (4 Tx & 4 Rx pairs, mini SMP).
- Requires active optical align to 1x12 MPO or cleaved OM3/4 for testing (butt coupled).
- Can be supplied with pre-aligned pig-tail on request.
- Requires 3.3V/3.8V power and a USB<->I2C programmer.

Conjunct

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