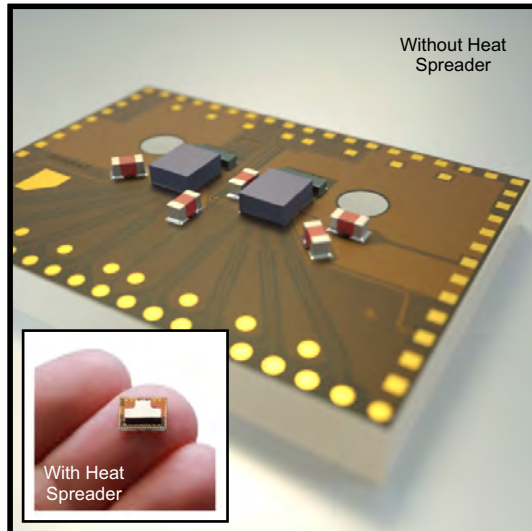# Fibre-Lyte 4x10G Transceiver Module

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.
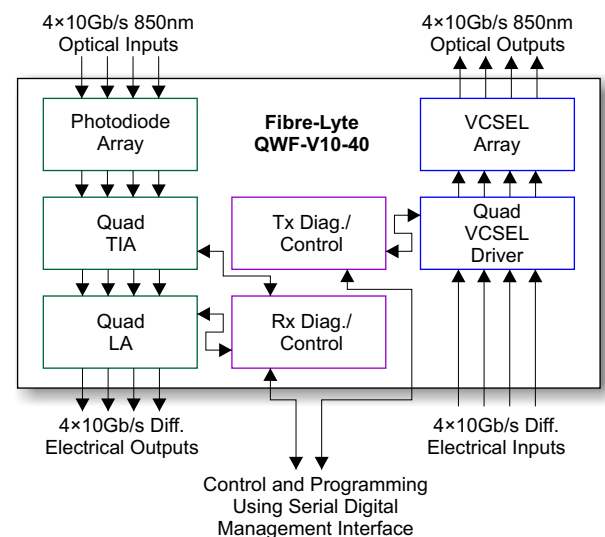- RoHS compliance.

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.

Without Heat Spreader

With Heat Spreader

Options

- 5G, 12.5G, 14G and 16G 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.
- Custom variants.

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

Functional Block Diagram

4×10Gb/s 850nm Optical Inputs

4×10Gb/s 850nm Optical Outputs

Photodiode Array

Fibre-Lyte QWF-V10-40

VCSEL Array

Quad TIA

Tx Diag./ Control

Quad VCSEL Driver

Quad LA

Rx Diag./ Control

4×10Gb/s Diff. Electrical Outputs

4×10Gb/s Diff. Electrical Inputs

Control and Programming Using Serial Digital Management Interface

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)		10	14	Gb/s	NRZ. Rated to 14G. 16G-18G possible at reduced sensitivity*.
Optical Link Budget		13.5		dB	VCSEL 1.5dBm, MT, BER 10^{-12}. -0.7dBm for 10^{-15} (extrapolated)*.
Power Consumption		500	674	mW	Total of all components (no CDR).
Differential Signal Return Loss			-20	dB	15GHz, module RF performance.
Differential Signal Insertion Loss			-0.35	dB	15GHz, module RF performance.
Near End Electrical Crosstalk			-38	dB	15GHz, module RF performance.
Far End Electrical Crosstalk			-48	dB	15GHz, module RF performance.
Differential to Common Mode Conversion			-46	dB	15GHz, module RF performance.

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* Detailed test results available on request (DOC-000295 R5).

Fibre-Lyte 4x10G Electrical Performance

Fibre-Lyte Configuration	Status	Type	Rev.	Manufacturer
1x4 SW ULMPIN-14-TT-N0104Y	Preliminary	PD	v02	Philips-ULM
1x4 SW ULM850-14-TT-N0104Y	Preliminary	VCSEL	v02	Philips-ULM
1x4 IPTA12G011	Production	TIA/LA	08	IPtronics
1x4 IPVD12G011	Production	Driver	09	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		200		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		30		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		20		µA p-p	BER 10^{-12}.
Low Frequency Cutoff		175		kHz	
Output Transistion Time		24	28	ps	
Deterministic Jitter			5.8	ps	
Random Jitter			1.6	ps	
Power Supply Voltage	3.15	3.3	3.45	V	RX_VDD pins.
Power Dissipation		276	401	mW	69mW per channel typ., includes load.
Differential Output Amplitude	0		739	mV p-p	Programmable, RX_DOx and RX_DONx.
Differential Output Pre-Emphasis	0		2×325	mV p-p	Programmable, add to RX_DOx and RX_DONx.
Termination Resistance	100	120	140	Ohms	Differential, RX_DOx and RX_DONx.
Differential Parameters <8.8GHz			-8.9	dB	RX_DOx and RX_DONx. S_{22}.
Differential Parameters >8.8GHz			Notes	dB	Formula: -10+(16.6×Log10(f/8.8)), with f in GHz. S_{22}.

| VCSEL Driver	Min.	Typ.	Max.	Units	Notes
Electrical Crosstalk			-29.4	dB	
Channel to Channel Skew		1	10	ps	
Deterministic Jitter			2.3	ps	To be tested in production.
Random Jitter			1.6	ps	To be tested in production.
Power Supply Voltage	3.15	3.3	3.45	V	TX_VDD pins.
Power Dissipation		224	273	mW	56mW per channel typ., includes VCSEL.
Differential Input Voltage	300		1200	mV p-p	TX_DIx and TX_DINx voltage limits.
Single Ended Input Voltage	60		600	mV p-p	TX_DIx and TX_DINx voltage limits.
Differential Termination Resistance	85	100	115	Ohms	
Differential Parameters <8.8GHz			-10	dB	TX_DIx and TX_DINx. S_{11}.
Differential Parameters >8.8GHz			Notes	dB	Formula: -10+(16.6×Log10(f/8.8)), with f in GHz. S_{11}.

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Fibre-Lyte 4x10G RF Performance

Differential Signal Return Loss
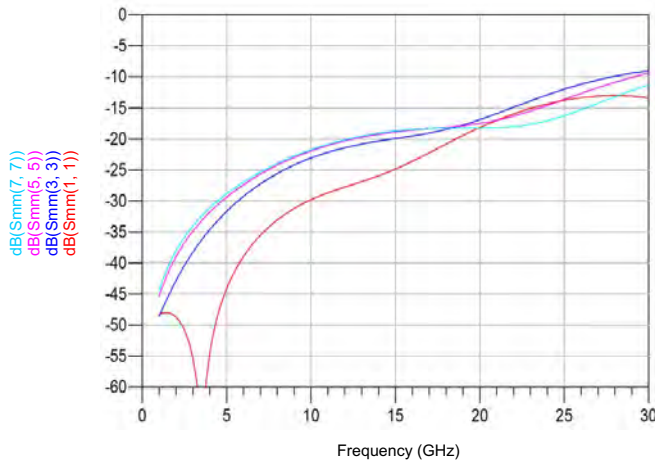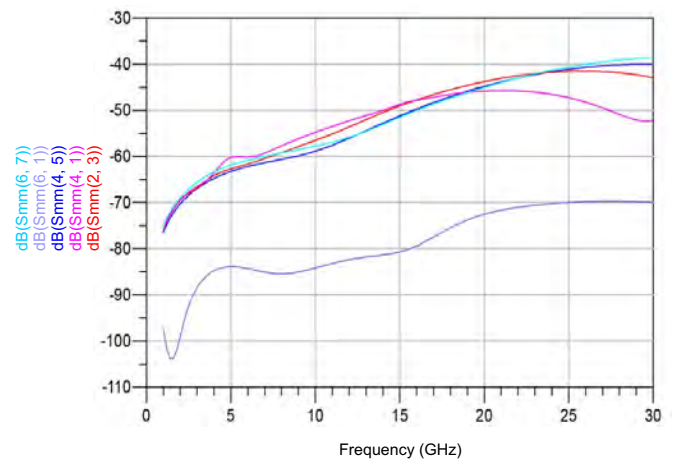

Differential Signal Insertion Loss
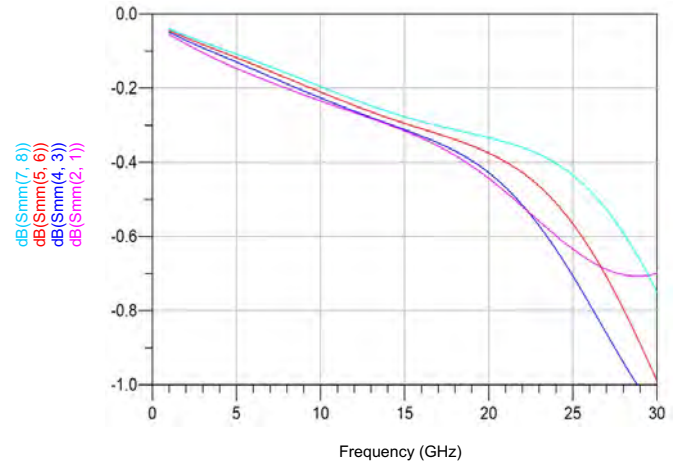
Near End Crosstalk
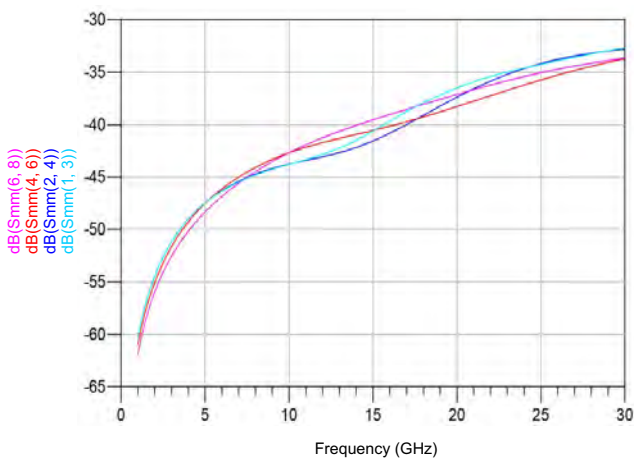
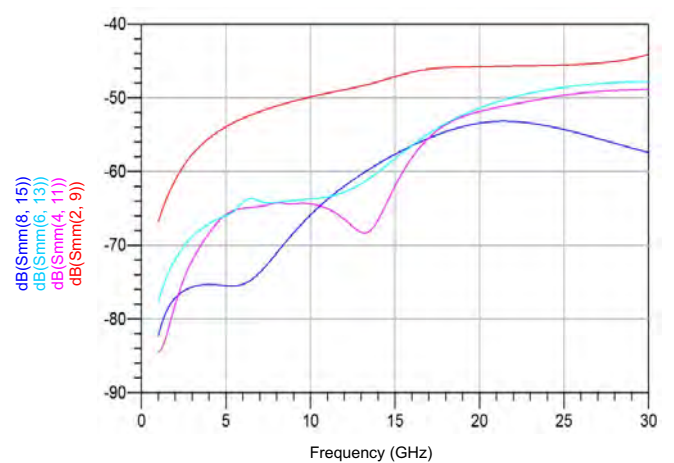## Far End Crosstalk

Power Plane Crosstalk
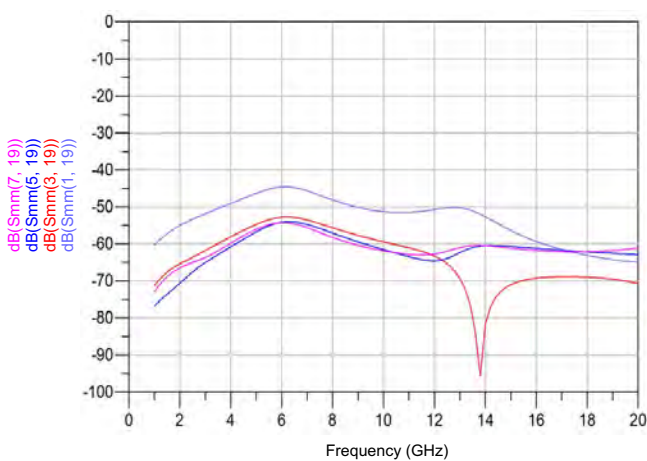
Mode Conversion

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Fibre-Lyte 4x10G Pinout

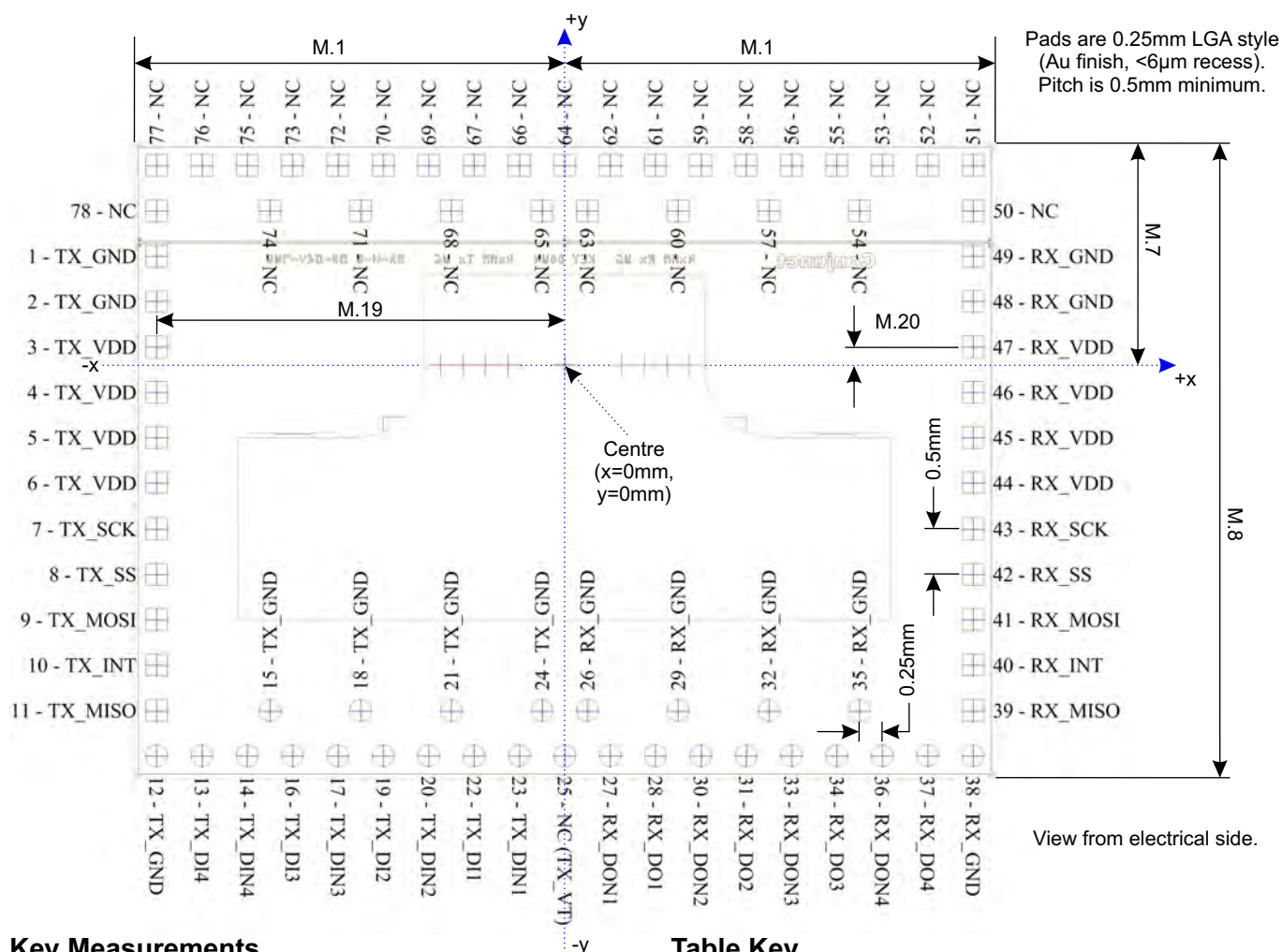| Pin	Name	x (mm)	y (mm)	IC Mapping	IC Pin	Notes
1	TX_GND	-4.5	1.2	IPtronics IPVD12G011	GND and GDS	Transmit ground plane.
2	TX_GND	-4.5	0.7	IPtronics IPVD12G011	GND and GDS	Transmit ground plane.
3	TX_VDD	-4.5	0.2	IPtronics IPVD12G011	VDD and VDS	Transmit power supply (+3.3V).
4	TX_VDD	-4.5	-0.3	IPtronics IPVD12G011	VDD and VDS	Transmit power supply (+3.3V).
5	TX_VDD	-4.5	-0.8	IPtronics IPVD12G011	VDD and VDS	Transmit power supply (+3.3V).
6	TX_VDD	-4.5	-1.3	IPtronics IPVD12G011	VDD and VDS	Transmit power supply (+3.3V).
7	TX_SCK	-4.5	-1.8	IPtronics IPVD12G011	SCK	Transmit device serial digital clock.
8	TX_SS	-4.5	-2.3	IPtronics IPVD12G011	SS	Transmit device chip select.
9	TX_MOSI	-4.5	-2.8	IPtronics IPVD12G011	MOSI	Serial digital programming input for transmitter.
10	TX_INT	-4.5	-3.3	IPtronics IPVD12G011	INT	Transmitter interrupt.
11	TX_MISO	-4.5	-3.8	IPtronics IPVD12G011	MISO	Serial digital programming output for transmitter.
12	TX_GND	-4.5	-4.3	IPtronics IPVD12G011	GND and GDS	Transmit ground plane.
13	TX_DI4	-4	-4.3	IPtronics IPVD12G011	DI4	Differential input data, transmit channel 4 positive.
14	TX_DIN4	-3.5	-4.3	IPtronics IPVD12G011	DIN4	Differential input data, transmit channel 4 negative.
15	TX_GND	-3.25	-3.8	IPtronics IPVD12G011	GND and GDS	Transmit ground plane.
16	TX_DI3	-3	-4.3	IPtronics IPVD12G011	DI3	Differential input data, transmit channel 3 positive.
17	TX_DIN3	-2.5	-4.3	IPtronics IPVD12G011	DIN3	Differential input data, transmit channel 3 negative.
18	TX_GND	-2.25	-3.8	IPtronics IPVD12G011	GND and GDS	Transmit ground plane.
19	TX_DI2	-2	-4.3	IPtronics IPVD12G011	DI2	Differential input data, transmit channel 2 positive.
20	TX_DIN2	-1.5	-4.3	IPtronics IPVD12G011	DIN2	Differential input data, transmit channel 2 negative.
21	TX_GND	-1.25	-3.8	IPtronics IPVD12G011	GND and GDS	Transmit ground plane.
22	TX_DI1	-1	-4.3	IPtronics IPVD12G011	DI1	Differential input data, transmit channel 1 positive.
23	TX_DIN1	-0.5	-4.3	IPtronics IPVD12G011	DIN1	Differential input data, transmit channel 1 negative.
24	TX_GND	-0.25	-3.8	IPtronics IPVD12G011	GND and GDS	Transmit ground plane.
25	NC (TX_VT)	0	-4.3	IPtronics IPVD12G011	VT	NC by default (AC coupling only). Contact factory for connection.
26	RX_GND	0.25	-3.8	IPtronics IPTA12G011	GND, GDS and GDx	Receive ground plane.
27	RX_DON1	0.5	-4.3	IPtronics IPTA12G011	DON1	Differential output data, receive channel 1 negative.
28	RX_DO1	1	-4.3	IPtronics IPTA12G011	DO1	Differential output data, receive channel 1 positive.
29	RX_GND	1.25	-3.8	IPtronics IPTA12G011	GND, GDS and GDx	Receive ground plane.
30	RX_DON2	1.5	-4.3	IPtronics IPTA12G011	DON2	Differential output data, receive channel 2 negative.
31	RX_DO2	2	-4.3	IPtronics IPTA12G011	DO2	Differential output data, receive channel 2 positive.
32	RX_GND	2.25	-3.8	IPtronics IPTA12G011	GND, GDS and GDx	Receive ground plane.
33	RX_DON3	2.5	-4.3	IPtronics IPTA12G011	DON3	Differential output data, receive channel 3 negative.
34	RX_DO3	3	-4.3	IPtronics IPTA12G011	DO3	Differential output data, receive channel 3 positive.
35	RX_GND	3.25	-3.8	IPtronics IPTA12G011	GND, GDS and GDx	Receive ground plane.
36	RX_DON4	3.5	-4.3	IPtronics IPTA12G011	DON4	Differential output data, receive channel 4 negative.
37	RX_DO4	4	-4.3	IPtronics IPTA12G011	DO4	Differential output data, receive channel 4 positive.
38	RX_GND	4.5	-4.3	IPtronics IPTA12G011	GND, GDS and GDx	Receive ground plane.
39	RX_MISO	4.5	-3.8	IPtronics IPTA12G011	MISO	Serial digital programming output for receiver.
40	RX_INT	4.5	-3.3	IPtronics IPTA12G011	INT	Receiver interrupt.
41	RX_MOSI	4.5	-2.8	IPtronics IPTA12G011	MOSI	Serial digital programming input for receiver.
42	RX_SS	4.5	-2.3	IPtronics IPTA12G011	SS	Receive device chip select.
43	RX_SCK	4.5	-1.8	IPtronics IPTA12G011	SCK	Receive device serial digital clock.
44	RX_VDD	4.5	-1.3	IPtronics IPTA12G011	VDD and VDS	Receive power supply (+3.3V).
45	RX_VDD	4.5	-0.8	IPtronics IPTA12G011	VDD and VDS	Receive power supply (+3.3V).
46	RX_VDD	4.5	-0.3	IPtronics IPTA12G011	VDD and VDS	Receive power supply (+3.3V).
47	RX_VDD	4.5	0.2	IPtronics IPTA12G011	VDD and VDS	Receive power supply (+3.3V).
48	RX_GND	4.5	0.7	IPtronics IPTA12G011	GND, GDS and GDx	Receive ground plane.
49	RX_GND	4.5	1.2	IPtronics IPTA12G011	GND, GDS and GDx	Receive ground plane.
50	NC	4.5	1.7	-	-	No connection.
51	NC	4.5	2.2	-	-	No connection.
52	NC	4	2.2	-	-	No connection.
53	NC	3.5	2.2	-	-	No connection.
54	NC	3.25	1.7	-	-	No connection.
55	NC	3	2.2	-	-	No connection.
56	NC	2.5	2.2	-	-	No connection.
57	NC	2.25	1.7	-	-	No connection.
58	NC	2	2.2	-	-	No connection.
59	NC	1.5	2.2	-	-	No connection.
60	NC	1.25	1.7	-	-	No connection.
61	NC	1	2.2	-	-	No connection.
62	NC	0.5	2.2	-	-	No connection.
63	NC	0.25	1.7	-	-	No connection.
64	NC	0	2.2	-	-	No connection.
65	NC	-0.25	1.7	-	-	No connection.
66	NC	-0.5	2.2	-	-	No connection.
67	NC	-1	2.2	-	-	No connection.
68	NC	-1.25	1.7	-	-	No connection.
69	NC	-1.5	2.2	-	-	No connection.
70	NC	-2	2.2	-	-	No connection.
71	NC	-2.25	1.7	-	-	No connection.
72	NC	-2.5	2.2	-	-	No connection.
73	NC	-3	2.2	-	-	No connection.
74	NC	-3.25	1.7	-	-	No connection.
75	NC	-3.5	2.2	-	-	No connection.
76	NC	-4	2.2	-	-	No connection.
77	NC	-4.5	2.2	-	-	No connection.
78	NC	-4.5	1.7	-	-	No connection.

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Fibre-Lyte 4x10G Pinout

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

77 - NC, 76 - NC, 75 - NC, 73 - NC, 72 - NC, 70 - NC, 69 - NC, 67 - NC, 66 - NC, 64 - NC, 62 - NC, 61 - NC, 59 - NC, 58 - NC, 56 - NC, 55 - NC, 53 - NC, 52 - NC, 51 - NC

78 - NC, 74 - NC, 71 - NC, 68 - NC, 65 - NC, 63 - NC, 60 - NC, 57 - NC, 54 - NC, 50 - NC

1 - TX_GND
2 - TX_GND
3 - TX_VDD
4 - TX_VDD
5 - TX_VDD
6 - TX_VDD
7 - TX_SCK
8 - TX_SS
9 - TX_MOSI
10 - TX_INT
11 - TX_MISO

49 - RX_GND
48 - RX_GND
47 - RX_VDD
46 - RX_VDD
45 - RX_VDD
44 - RX_VDD
43 - RX_SCK
42 - RX_SS
41 - RX_MOSI
40 - RX_INT
39 - RX_MISO

Centre
(x=0mm,
y=0mm)

15 - TX_GND, 18 - TX_GND, 21 - TX_GND, 24 - TX_GND, 26 - RX_GND, 29 - RX_GND, 32 - RX_GND, 35 - RX_GND

0.5mm
0.25mm

12 - TX_GND, 13 - TX_DI4, 14 - TX_DIN4, 16 - TX_DI3, 17 - TX_DIN3, 19 - TX_DI2, 20 - TX_DIN2, 22 - TX_DI1, 23 - TX_DIN1, 25 - NC (TX_VT), 27 - RX_DON1, 28 - RX_DO1, 30 - RX_DON2, 31 - RX_DO2, 33 - RX_DON3, 34 - RX_DO3, 36 - RX_DON4, 37 - RX_DO4, 38 - RX_GND

View from electrical side.

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)

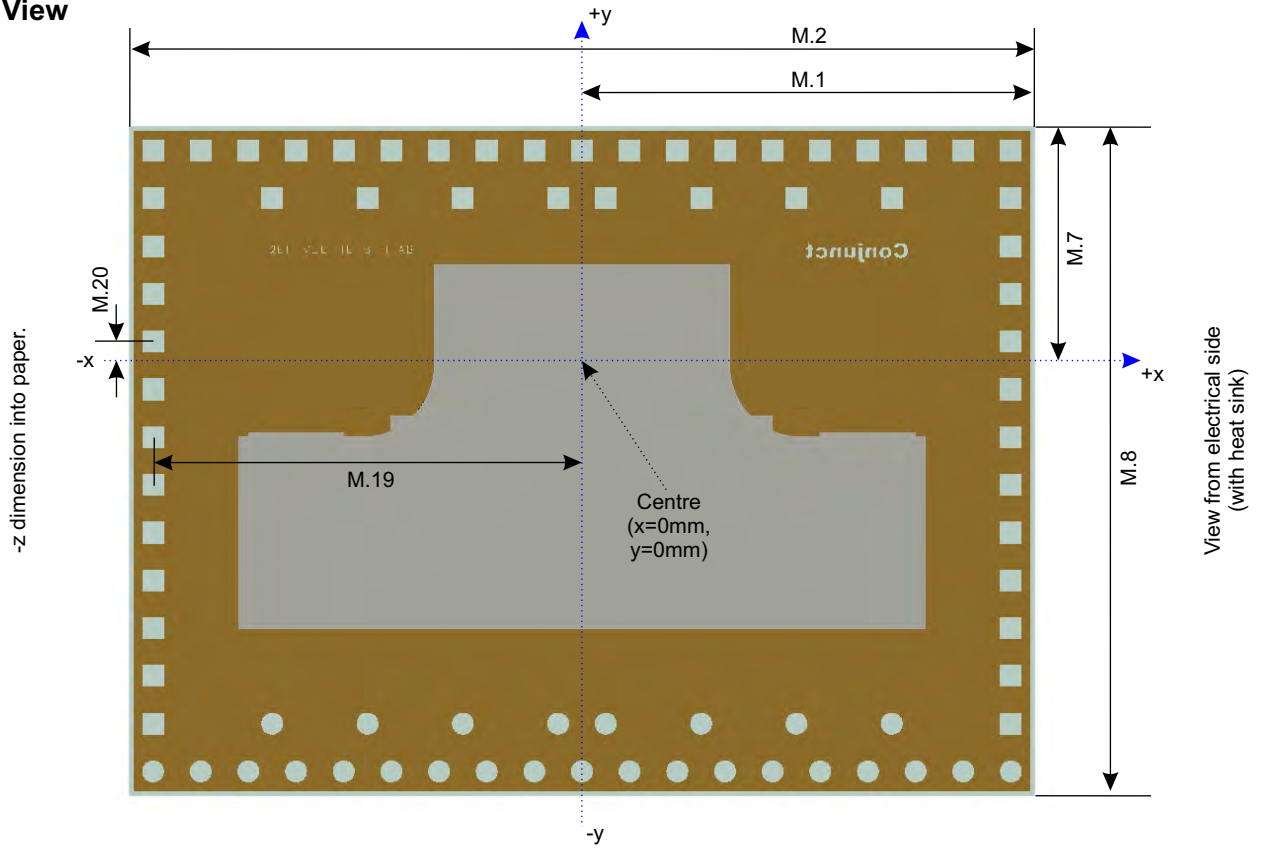| Feature	Colour	x (mm)	y (mm)
TX4 Waveguide	Red	-1.375	0
TX3 Waveguide	Red	-1.125	0
TX2 Waveguide	Red	-0.875	0
TX1 Waveguide	Red	-0.625	0
Centre	Black	0	0
RX1 Waveguide	Violet	0.625	0
RX2 Waveguide	Violet	0.875	0
RX3 Waveguide	Violet	1.125	0
RX4 Waveguide	Violet	1.375	0

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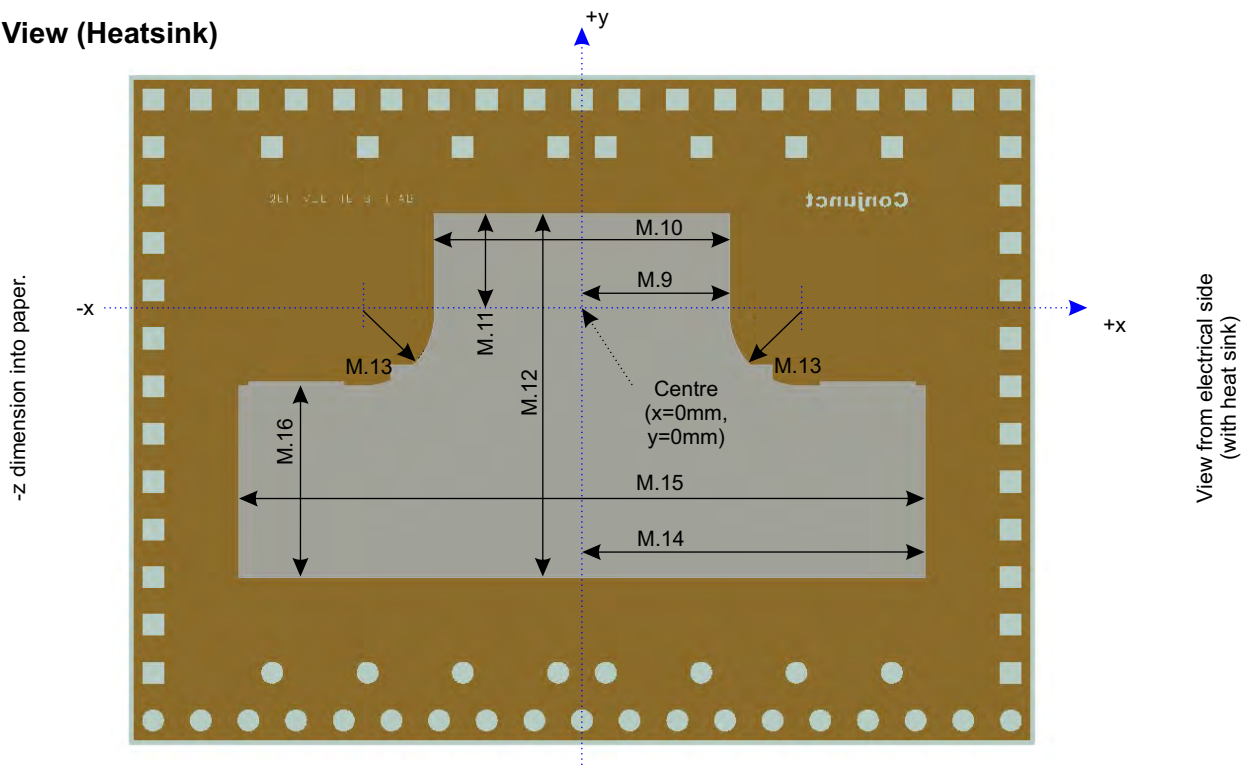
http://www.conjunct.co.uk
e: ken.allstaff@conjunct.co.uk

Fibre-Lyte 4x10G Mechanical Details

Top View

+y

M.2

M.1

M.7

-z dimension into paper.

M.20

-x

+x

M.8

View from electrical side (with heat sink)

M.19

Centre
(x=0mm,
y=0mm)

Conjunct

-y

Top View (Heatsink)

+y

-z dimension into paper.

-x

+x

View from electrical side (with heat sink)

M.10

M.9

M.11

M.13

M.13

M.12

Centre
(x=0mm,
y=0mm)

M.16

M.15

M.14

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Conjunct

Fibre-Lyte 4x10G Mechanical Details

Side View

+x dimension into paper.

+z

M.12

M.16

M.11

M.17

M.7

+y

-y

Centre
(y=0mm,
z=0mm)

M.18

-z   M.8

Front View

+y dimension into paper.

+z

M.15

M.14

M.17

+x

Centre
(x=0mm,
z=0mm)

M.18

M.1

-z   M.2
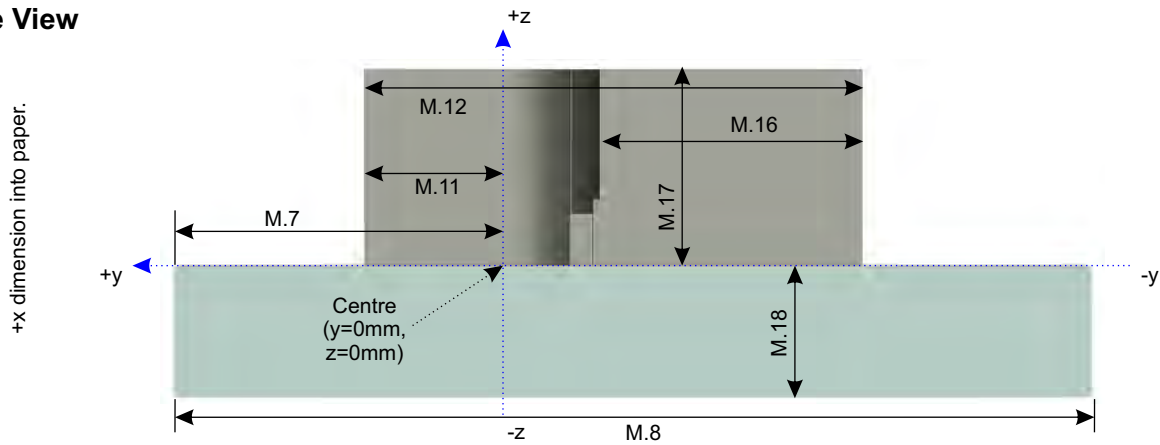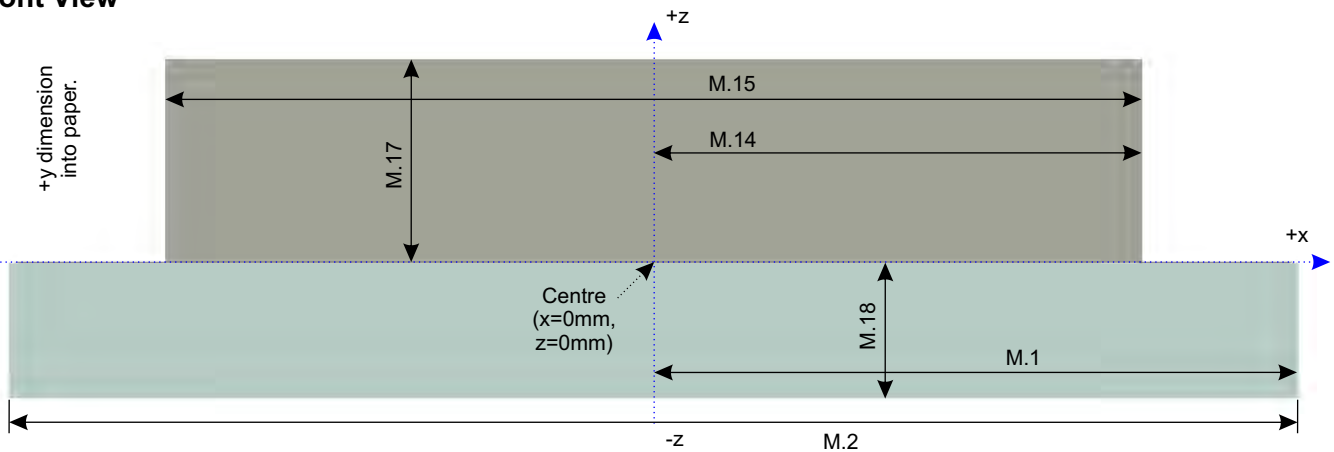
Fibre-Lyte 4x10G Evaluation PCB

PCB Front

Test Point

Test Point

PCB Rear
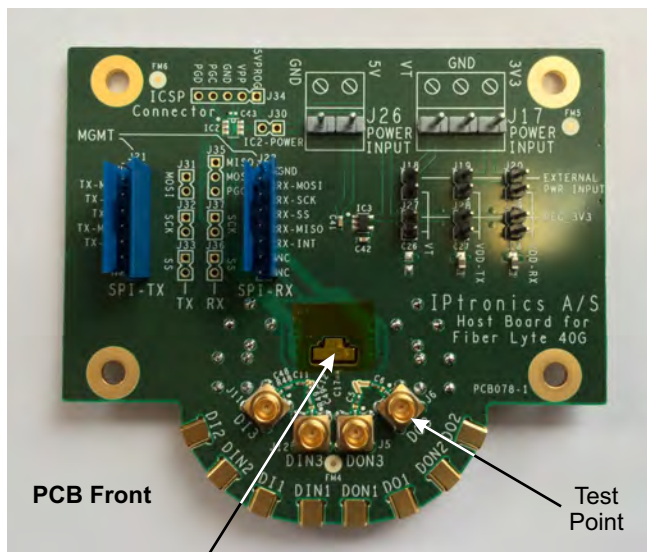
Fibre-Lyte Rear
(Heat Sink Side)
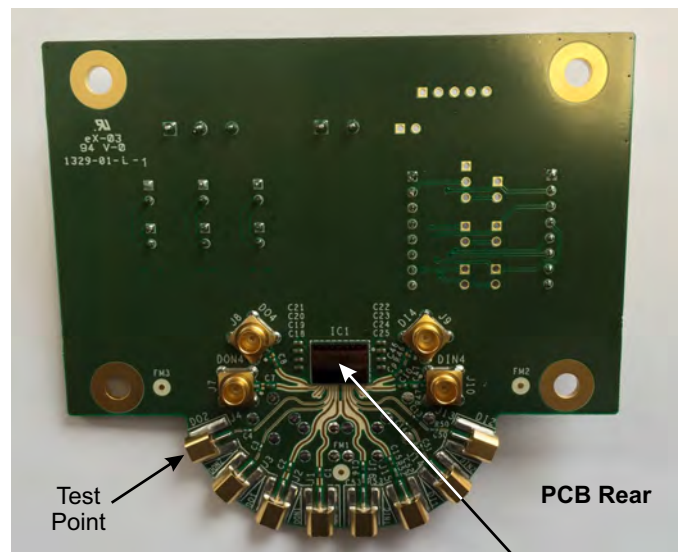
Fibre-Lyte Front
(Optical Connector Side)

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http://www.conjunct.co.uk
e: ken.allstaff@conjunct.co.uk

- 40G Fibre-Lyte pre-mounted on a PCB.
- Diff. electrical interface (4 Tx & 4 Rx pairs, 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 power and a USB<->SPI programmer.