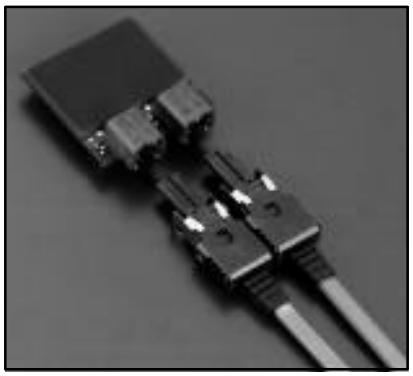
Advance Information

Optobus™ I Multichannel Optical Data Link

PC94DL0400

OPTOBUS



The PC94DL0400 OPTOBUS I multichannel optical data link is a 10–bit wide bidirectional point–to–point fiber optic link providing 4Gb/sec aggregate data transfer in each direction. This link has been designed using the latest advances in Vertical Cavity Surface Emitting Lasers diodes (VCSEL), optical fiber ribbon, and connectorization technologies. Motorola has combined these technologies with its existing experience in ICs, packaging, and low–cost manufacturing to provide a viable alternative to copper cabling and serial interconnects.

OPTOBUS I links are protocol–independent and are designed as part of the physical layer in a data communication system. They are used in short distance applications (up to 300 meters) where twisted pair or coaxial links were traditionally used, but where high bandwidth data transfer rates (up to 400 Mbits/sec/fiber) or signal integrity protection are required.

A complete OPTOBUS I features two 10–bit fiber ribbon cables, one for transmit and the other for receive, and two transceiver modules. The use of fiber optics is incidental in the design of OPTOBUS I and does not require the user to have knowledge in the use of fiber optics. The I/O of the modules utilizes Current Mode Logic (CML) with 250mV logic swings, which interfaces to most PECL I/O. If full PECL levels are required, Motorola recommends the MC10E416 differential line receiver.

The differential inputs of the input buffer IC can be driven by an NRZ data bit stream without having to incorporate a preamble bit prior to sending bursts of data. The laser diodes are VCSEL type laser arrays formed by an epitaxial process and have very low thresholds, making it very easy to drive from the differential buffer ICs. All 20 channels (10 Tx, 10 Rx) are asynchronous, independent data channels. A clock may be sent over any channel for system synchronization, but it is treated as a data signal. Clocks are neither required nor used by the link.

All of these features combine to provide maximum user flexibility. External interface circuitry can customize the link for a broad array of applications, including telecommunications switching, multimedia, high–end graphics, interactive video, workstations, multi–processing and parallel processing architectures.

FEATURES

- 10–bit Wide Bidirectional Optical Link
- 20 Channels (10 Transmit/10 Receive)
- Data Transfer Rate: 400 Mb/sec/fiber
- Aggregate Data Rate: 4 Gb/sec
- Distance: Up to 300 Meters
- Optical Expertise Not Required
- Clean Data Transfer
- Low Bit Error Rate
- Protocol–Independent
- Accepts Bursty Data
- Independent, Asynchronous Data Channels
- High Noise Immunity
- Lightweight and Compact
- Low Power
- Low Cost
- Performance Upgradeable
- Single 5V Supply
- Fully Differential ECL Compatible CML I/Os
- 196–pin PGA Footprint (101 pins actually being used)
- Security of data
- Resistance to EMI and RFI

APPLICATION EXAMPLES

- Telecommunications Switching/Processing
- High Performance PC's
- Workstations
- Multimedia Environments
- Massively Parallel Computers
- High–End Graphics/Video
- Interactive Video
- HDTV
- File Servers
- Multi–Gbit Networks
- High Performance Imaging/Visualization
- Data Storage

Evaluation Kit

An evaluation kit (94DL0400EB) is also available. The kit includes one Optobus I transceiver module, one 10–fiber connectorized ribbon, and one evaluation board.

General Notes

Interchannel relationship is asynchronous and independent.

All specifications assume the following conditions unless otherwise noted:

- Ambient operating temperature = 35°C, air flow = 500 lfm.
- Bit rate / Channel = 200 Mbit/s.
- Data pattern = PRBS of 2^{23}–1, all channels switching pseudo–randomly with respect to each other.
- Bit Error Rate = 10^{-14}.
- VCC = 5V

Link Performance Specifications

	Specification	Units	Min.	Typ.	Max.	Notes
A1	V_{CC} Supply Voltage	V	4.75	5.0	5.25	
A2	Allowable bit rate / Channel	Mbit/s	0	200	400	Final characterizations are required to gauge the impact of temperature, end of life, and/or distance on performance.
A3	Bit Error Rate			10^{-14}		
A4	Propagation Delay / Channel	ns		2.8		Delay through TX and RX paths of the modules in the link path. Add to per–meter fiber delay for total link delay.
A5	Duty Cycle	%	0		100	
A6	Random Jitter / Channel[1]	ps		50		Gaussian noise per channel with one channel switching on either a rising or falling edge, 1 sigma
A7	Pulse Width Distortion / Channel[1]	ps		500		Difference between rising and falling edges with one channel switching, 1 sigma
A8	Data Dependent Jitter[1]	ps		100		Jitter due to either previous states of one channel or noise from all channels switching, on either a rising or falling edge, 1 sigma
A9	Total Jitter[1]	ps		650		Sum of above 3 numbers. Assumes no jitter from fiber ribbon.
A10	Channel to Channel Skew[1]	ps		200		Assumes no skew from fiber ribbon. Add to length–dependent ribbon skew for total link value. 1 sigma
A11	Total Timing Inaccuracy	ps		850		Sum of jitter and skew. Assumes no impact from fiber ribbon.

1. Jitter and skew specifications are at 50% level measurement of crossing points in eye pattern.

Transmitter Electrical Specifications

	Specification	Units	Min.	Typ.	Max.	Notes
B1	Differential Input Voltage Swing	V	0.25		1.2	
B2	Input Common Mode Range	V	Vcc – 2.25		Vcc	Min Table value applies to low diff. level, max table value applies to upper diff. level.
B3	Transmitter Supply Current	mA		120		
B4	Electrical Input Signal Rise / Fall Time	ns			TBD	

Transmitter Optical Specifications

	Specification	Units	Min.	Typ.	Max.	Notes
C1	Optical Output Rise / Fall Time	ps		200		20–80% amplitude
C2	Center Wavelength	nm	835	850	860	
C3	Transmitted Optical Power / Channel, optical low	µW	0			Corresponds to TX input logic low. Note: RX output will also be a logic low
C4	Transmitted Optical Power / Channel, optical high	µW			800	Corresponds to TX input logic high: Note: RX output will also be a logic high

Receiver Electrical Specifications

	Specification	Units	Min.	Typ.	Max.	Notes
D1	Output Current / Channel	mA		5		
D2	Differential Output Voltage Swing / Channel	mV		250		Assumes 50Ω pull–up resistor on each of the differential outputs. Swing is directly proportional to the pull–up value.
D3	Pull – Up Voltage	V	3.00		5.25	Pull–up voltage must be the same on both differential outputs. Assumed 50Ω pullup resistors.
D4	Receiver Total Current	mA		150		
D5	Electrical Output Rise / Fall Time per Channel	ps		600		20% – 80% levels

Receiver Optical Specifications

	Specification	Units	Min.	Typ.	Max.	Notes
E1	Maximum Received Input Power	dBm		–1		
E2	Minimum Receiver Sensitivity	dBm		–13		
E3	Dynamic Range	dB		12		

Fiber Specifications

	Specification	Units	Min.	Typ.	Max.	Notes
F1	Connector Style			MT		Housing is based on MT ferrule
F2	TX Loss / Connector	dB		TBD		
F3	RX Loss / Connector	dB		TBD		
F4	Number of Connects / Disconnects			250		
F5	Fiber Loss	dB/km		3.75		
F6	Fiber Dispersion	ps/m		TBD		
F7	Bandwidth * Distance	MHz * km		160		3 dB loss point
F8	Fiber Delay / meter	ns/m		5		
F9	Ribbon Skew	ps/m		6		
F10	Distance Supported	m	0		300	Final characterizations are required to gauge the impact, if any, of bit rate on maximum distance.

1. All specifications are for 62.5/125 µm FDDI graded index fiber

Other Specifications:

	Specification	Units	Min.	Typ.	Max.	Notes
G1	Ambient Operating Temperature Range	° C	0	25	70	
G2	Storage Temperature Range	° C	–40		85	

Laser Safety

Optobus Laser Safety Compliance Information

The transceiver module contains ten laser diode output ports. The Optobus product is certified by Motorola to be a Class I Laser product to the requirements of DHHS Federal Product Performance Standard for Laser Products, 21 CFR Subchapter J, Part 1040.10.

The laser wavelength in nominally 850 nanometers. Maximum laser output from each port is 0.80 milliwatts. The output beam (without fiber ribbon cable) diverges in a large angle cone. Iti is the large angle of divergence that permits classifying the Optobus as a Class I laser product.

Class I levels of laser radiation are not considered to be hazardous. However, as a good general practice, never intentionally look into an active port or open cable connected to transmitter ports at the opposite end.

The laser classification is based on a 5 Volt DC (±5%) supply to the module. The laser driver IC is voltage and temperature compensated to provide constant maximum optical output power. Failure to provide power to the module within Motorola upper voltage limit specification may result in excessive maximum optical output power, and if so, constitutes “modification” of the product. Modification of the product is construed to be “manufacturing” and requires the manufacturer who performs such modification to recertify and reidentify the product (21 CFR J, 1040.10 (i)).

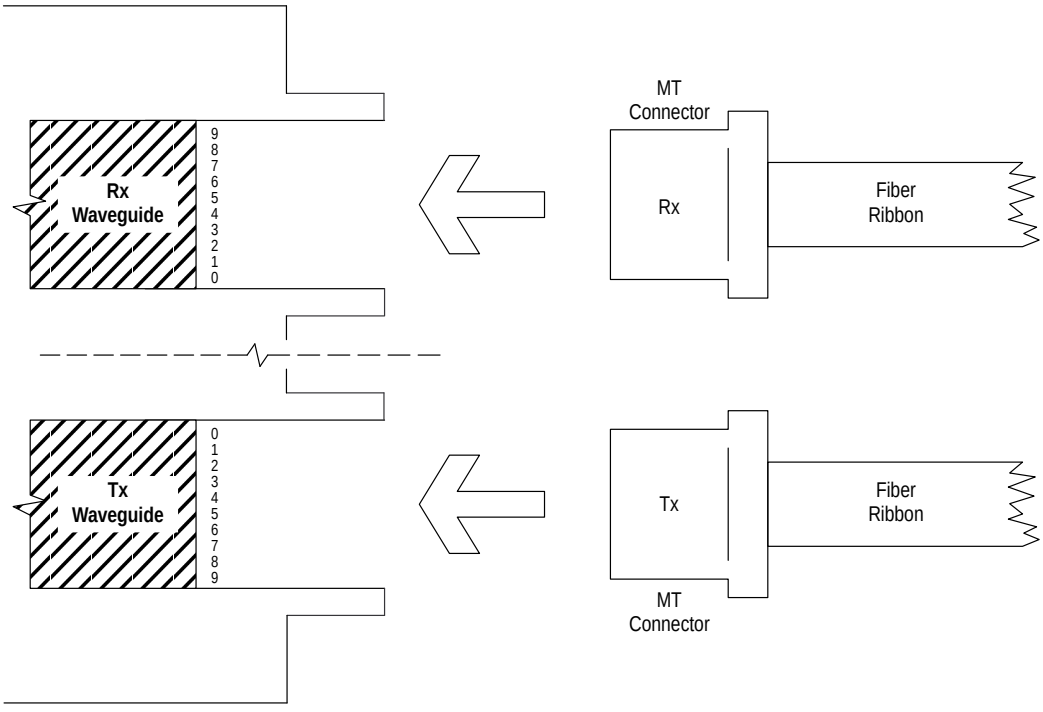


Figure 1. Channel Number Identification
(Top View of Module)

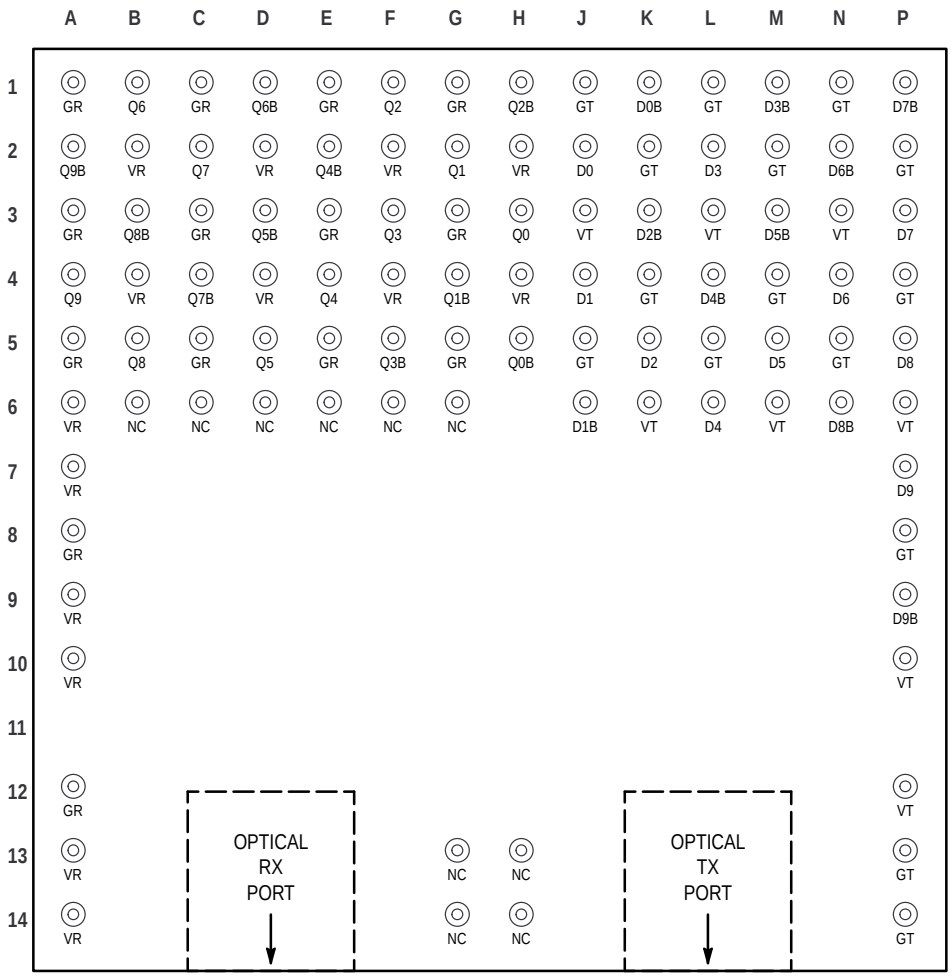


Figure 2. OPTOBUS 1 Electrical Pinout
(Bottom View)

Notes on electrical pinout changes since the initial prototypes:
(1) Pins B6, C6, D6, E6, F6, G6, and G13 have been added.
(2) Pins A11 and P11 have been removed.
(3) The polarity of both the input and output differential signals has been inverted. This was done so that a logic “0” input corresponds to laser “off” and vice versa. Because both the inputs and the outputs were inverted, functionality from electrical input to electrical output remains non–inverting.
(4) NC = “No User Connect” These pins must be left floating.

Optobus I Pin Descriptions

Pin Location	Description	Pin Location	Description	Pin Location	Description	Pin Location	Description
A1	Receiver GND	D1	Output 6 Bar	G14	NC	L6	Data 4
A2	Output 9 Bar	D2	Receiver V_{CC}	H1	Output 2 Bar	M1	Data 3 Bar
A3	Receiver GND	D3	Output 5 Bar	H2	Receiver V_{CC}	M2	Transmitter GND
A4	Output 9	D4	Receiver V_{CC}	H3	Output 0	M3	Data 5 Bar
A5	Receiver GND	D5	Output 5	H4	Receiver V_{CC}	M4	Transmitter GND
A6	Receiver V_{CC}	D6	NC	H5	Output 0 Bar	M5	Data 5
A7	Receiver V_{CC}	E1	Receiver GND	H13	NC	M6	Transmitter V_{CC}
A8	Receiver GND	E2	Output 4 Bar	H14	NC	N1	Transmitter GND
A9	Receiver V_{CC}	E3	Receiver GND	J1	Transmitter GND	N2	Data 6 Bar
A10	Receiver V_{CC}	E4	Output 4	J2	Data 0	N3	Transmitter V_{CC}
A12	Receiver GND	E5	Receiver GND	J3	Transmitter V_{CC}	N4	Data 6
A13	Receiver V_{CC}	E6	NC	J4	Data 1	N5	Transmitter GND
A14	Receiver V_{CC}	F1	Output 2	J5	Transmitter GND	N6	Data 8 Bar
B1	Output 6	F2	Receiver V_{CC}	J6	Data 1 Bar	P1	Data 7 Bar
B2	Receiver V_{CC}	F3	Output 3	K1	Data 0 Bar	P2	Transmitter GND
B3	Output 8 Bar	F4	Receiver V_{CC}	K2	Transmitter GND	P3	Data 7
B4	Receiver V_{CC}	F5	Output 3 Bar	K3	Data 2 Bar	P4	Transmitter GND
B5	Output 8	F6	NC	K4	Transmitter GND	P5	Data 8
B6	NC	G1	Receiver GND	K5	Data 2	P6	Transmitter V_{CC}
C1	Receiver GND	G2	Output 1	K6	Transmitter V_{CC}	P7	Data 9
C2	Output 7	G3	Receiver GND	L1	Transmitter GND	P8	Transmitter GND
C3	Receiver GND	G4	Output 1 Bar	L2	Data 3	P9	Data 9 Bar
C4	Output 7 Bar	G5	Receiver GND	L3	Transmitter V_{CC}	P10	Transmitter V_{CC}
C5	Receiver GND	G6	NC	L4	Data 4 Bar	P12	Transmitter V_{CC}
C6	NC	G13	NC	L5	Transmitter GND	P13	Transmitter GND
						P14	Transmitter GND

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