Optical CrossLinks, Inc.

Preliminary Product Brief

Multi-mode Circuit Board Component Optical Interconnections

-----Custom Variations for coupling & connectorization interfaces

Product Summary

Optical CrossLinks (OXL) provides custom configured multi-mode clad waveguide arrays in films for optically interconnecting board-mounted components. Working with our customers, OXL designs waveguide arrays to assure optimum component coupling from VCSEL and diode laser sources to photodetectors with a broad range of options for chip-to-chip, chip-to-board edge and board-to-board connectivity.

Chip-to-chip component interconnections on boards can be designed with variable pitch, standard or extremely high density, and coupling either directly or with out-of-plane I/O mirrors.

Chip-to-board edge connectors in addition to the design features above provide connectivity either to off-board optical links or waveguide arrays on an underlying parallel supporting mother board, or couple to a backplane board at right angles. Versatile configurations as shown before board mounting in Figure 1 provide coupling for waveguide array

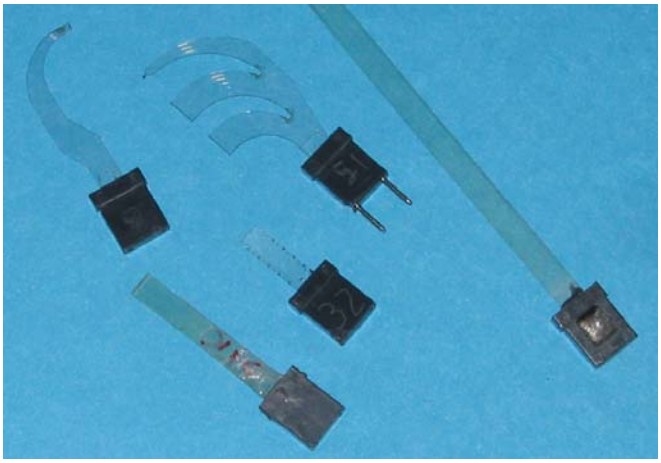

Figure 1. Precision machined waveguide strips with attached board edge connectors indicating diversity for routing waveguide arrays on boards

links going under, around or over board components. Figure 2 shows a board-mounted link with I/O mirror and edge connectors.

OXL's right angle board-to-board connectivity utilizes robust, bendable, and flexible waveguide films to create a small 5mm radius of curvature 90º junction as shown

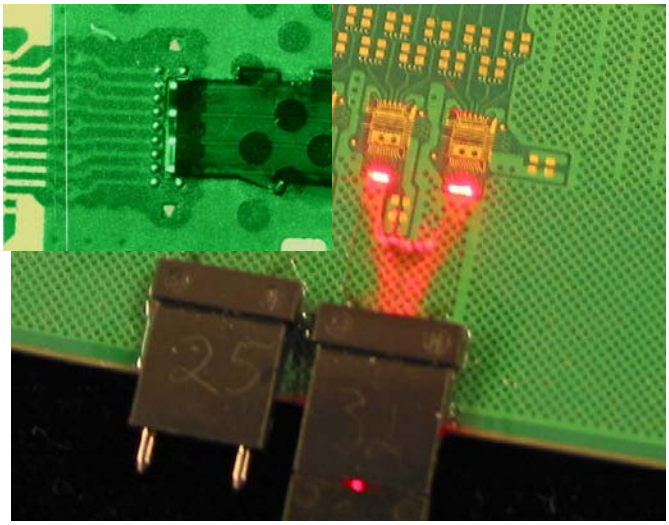

Figure 2. Board edge 8 guide connections on daughter board with 2 waveguide groups of 4 each with I/O mirrors. Inset shows magnified view of one I/O mirror output and the precise ± 5 micron alignment to solder ball defined positions plus the 4 up-deflected light spots

schematically in Figure 3. Located inside a backplane mounted housing ferrule the proprietary 90º connector design has a built in proprietary structure for flexible small

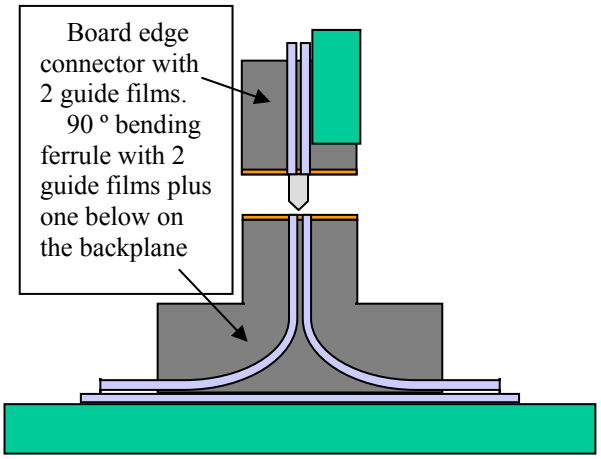

Figure 3. Schematic for daughter board to backplane connectivity

vertical ferrule displacement (not shown) within a customer sensitive support housing. This avoids rigidity and assures compatibility relative to other electrical pin or optical connectors on the inserted daughter board. The backplane mounted 90º bend ferrule and housing has the same vertical offset as adjoining electrical pin connector and is surface mounted with no required backplane thru holes.

OXL's backplane to daughter board coupling enables bi-directionality by using stacked waveguides in the 90º ferrule optical interface to the daughter board. At the base of the 90º ferrule the two waveguide array films go in both directions on the backplane away from the 90º ferrule as shown in both Figure 3 and Figure 4. The daughter board edge connector has a mating set of two waveguide film arrays to complete the optical coupling. The dual waveguide interface enables board-to-board interconnections from both directions on the backplane and allows connectivity for multiple boards across the backplane.

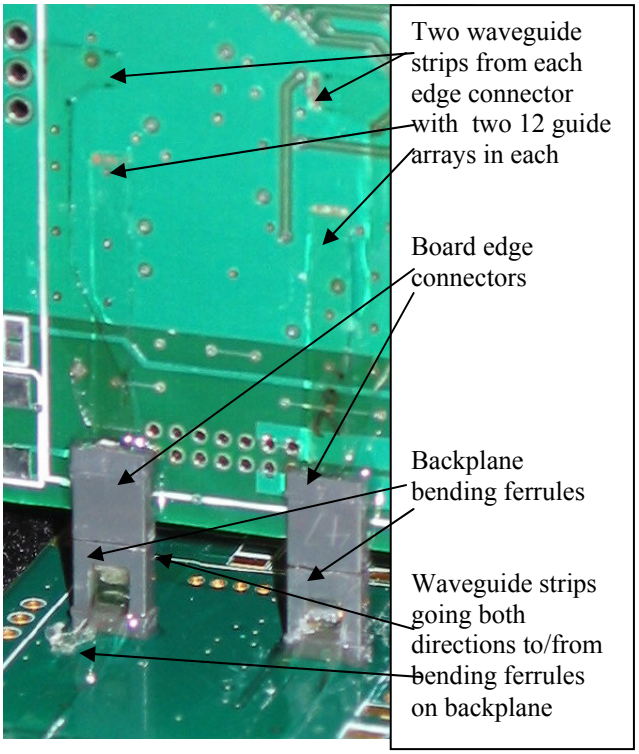

Figure 4. Backplane to Daughter Board Interconnection for 24 waveguides

OXL's Manufacturing Advantage

OXL's process assures high quality optical link performance before board mounting. Robust self-supporting waveguide containing films are first created and precision micromachined to form all coupling and aligning features. All connecting ferrules are attached and optical surfaces completed before being aligned and mounted on boards as depicted in Figure 1. Verification that all specifications are met before permanent bonding on high value boards eliminates potential expensive yield loss.

OXL's precision micromachining provides alignment structures in the waveguide array films enabling precise positioning on boards to within several microns to fiducials or solder balls as shown in Figure 4.

The OXL family of chip and board level optical interconnection offers considerable diversity for a broad range of customer specific applications capable of satisfying associated packaging and connectorization requirements. Applications include board level optical data link interconnections and distribution, such as for industrial, home, school, or central office systems; high-speed computers; or for aerospace control or monitoring systems where board space saving and high performance considerations are paramount.

Key Customer Benefits

- Quality system performance with pre assembly and evaluation of multi-guide links with connector ferrules and I/O mirrors before board mounting
- Compatible with electronic connectors

Specification Highlights

● Standard 250 micron or custom high-density pitch with as small as 10 micron separation available .

● Board to board interconnects using standard MT footprint is either a 12 linear guide array or stacked 24 or 12 over 12 for bi- directional backplane connectivity

●MT ferrules are typically used for board edge or backplane interconnections due to compatibility with standard practice, however, custom larger or smaller ferrules can be made for all connections to waveguides or fibers

● MT ferrules on the board/substrate edge are inserted or modified with latchable blind mate housings for coupling

● System optical loss is uniform and balanced across waveguide arrays for all interconnections

● System losses are typically one dB for transmission and about 2 dB for receiving modes at the 800 to 850nm range including losses for waveguides (0.08dB/cm), component coupling (0.2dB), I/O mirrors (~0.4dB), and MT aligning positioning ((0.5dB) in ferrules and graded index fiber interfaces (0.5 to 1.0dB).

● Precision waveguide alignment to solder balls or fiducials for component coupling within ± 5 microns or better over a 12 guide linear array with less than 3 micron runout

● Stable thermal cycling from –45 C to 95 C

● Stable performance when subjected to 300^{o} C IR solder reflow thermal spike for 30 seconds

● In addition to metalizing mirrors for high NA reflectivity, metalized electronic runs can also be deposited on the films

● Homogeneous polymer MM guides are polarization independent; thus no polarization loss has been measured to date at least to 3 orders of magnitude

● Waveguide films are typically mounted on a board surface, however they can be embedded between board/substrate layers using a flex link or optical lense /via coupling to the surface

● Substrate materials can be FR4, semiconductor wafers, ceramics etc.

● Chip to chip lengths on board rage from millimeter to 10's of centimeters with guides under, over or navigating around chips

● Chip to board edge connection one centimeter to 10's of centimeter lengths and versatile guide arrangements with stacked or single layers

● Board to board 90 º connections with 5 mm ROC guide film and stacked arrays for bi directional board interconnectivity

● Guide array arrangement include straight, curved, variable pitch, crossovers, splitters, star-couplers and off board guide regions (for top access to components)

● Extreme high densities are allowed where the nominal 40 micron MM guides are spaced 10 microns apart in large arrays

● Standard coupling either waveguide to waveguide or for off board is to 62.5 micron core fibers,

● Alternative fiber core size interfaces can be accommodated for optimum coupling

● Input / output guide design variations to optimize for single direction devices and optimize fiber-coupling for custom applications

OXL's board and chip level interconnectivity enables a fully optically interconnected package. The family of board level interconnection products and variations enables a broad range of customer specific designs and packaging options for meeting diverse application requirements. Point to point links and other OXL waveguide functionality combined with versatile shapes or configurations broadens the scope for board related applications compatible with board component arrangements

Ordering Information: The generic custom part number for ordering is OXL-BdIC-C. Call or email the contacts below for pricing and discussion on specific modifications or custom developments.

Contact regarding orders or for more information:

Optical CrossLinks, Inc., 206 Gale Lane, Kennett Square, PA, 19348: 610 444 9469 or sales@opticalcrosslinks.com -----see http://www.opticalcrosslinks.com

Optical CrossLinks develops and produces custom optical interconnection point to point links, distribution links or waveguide devices using proprietary polymer waveguide technology, materials and custom fiber ribbonization. All are fully connectorized with standard or custom proprietary approaches as needed for self-supporting or board level interconnections.

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