Optical CrossLinks Advanced Product Capabilities for:

● Dense optical multimode routing circuitry,
● Multimode multiplexer/demultiplexer devices, and
● Optical sensors and read heads

Optical CrossLinks' (OXL) proprietary polymeric optical waveguide process technology uniquely facilitates the formation of extremely high-density interconnectable waveguide arrays and lossless waveguide crossings. These process-enabled capabilities for dense imaged waveguides and crossovers are critical to construct complex optical interconnection circuitry, optical functionality, and novel add drop multiplexers and sensor devices. OXL has delivered prototype products for multimode chip and board level polymer array waveguide interconnects and stand alone stacked 2D waveguide interconnects all with MT style connector compatibility, connectorized low loss power splitters, and lossless waveguide crossovers configured as multimode add drop multiplexers with inserted dielectric filters and as sensor read head devices.

OXL's process does not depend on etching, embossing, or molding to form guides as do all other techniques for constructing polymer guides, but instead utilizes a proprietary light induced diffusion self development and light fixing process. This enables waveguides to be formed with micron spacing of essentially any size with internal lower index imaged regions in guides for waveguiding inside crossing regions all in stand-alone precise films. Based on this capability, dense array waveguide circuits with crossing guide for routing, multiplexers, and sensor devices have been created. Precise thickness precoated films in large rolls are used to form laminatable multilayer waveguide structures. Thus the process is amenable to producing large volumes of reproducible photomask imaged waveguides in large film sheets. The resulting reproducible precise thickness films have buried symmetrically placed waveguides, which are critical for construction of single or multi-guide layer MT style connectorization using laser micromachining to center the guides in the plane of the film. The films are stabilized with outer layers of low CTE and high Tg polymers providing stand-alone or substrate bondable applications withstanding industry requirements for assembly and operation. Precision micromachining of the imaged waveguide films creates in and out of plane reflective surfaces, slots for embedding filters, diode lasers or detector components precisely oriented in the waveguides.

Lossless waveguide crossovers in combination with our dense circuitry capability enable construction of complex routing for optical circuits, unique functionality for splitters/combiners, add drop multiplexers, and sensor or read head applications. The fundamental internal structure concept and the associated enhanced applications have all been included in initial patent action for proprietary protection. Each of these product applications will be described separately in greater detail. In addition, a generic description also provides understanding and the significance for guiding light through a crossing region thus the value for lossless crossovers in OXL's products.

BLB 11/20/03

Generic **Lossless Crossovers**

Crossing guides usually manifest decoupling and scatter loss as light propagates through a crossing region where the light is essentially unguided. This is depicted schematically in Fig. G1 and in an actual 200 micron guide in Fig. G2 where it is clear there is considerable scattered light that leaves the guide or could be coupled into the crossing guide. Thus a dense circuit with typical multiple waveguide crossovers can generate high unacceptable optical loss plus potential cross talk between propagating signals in the various guides

Figure G1. Schematic showing typical crossing guide structure

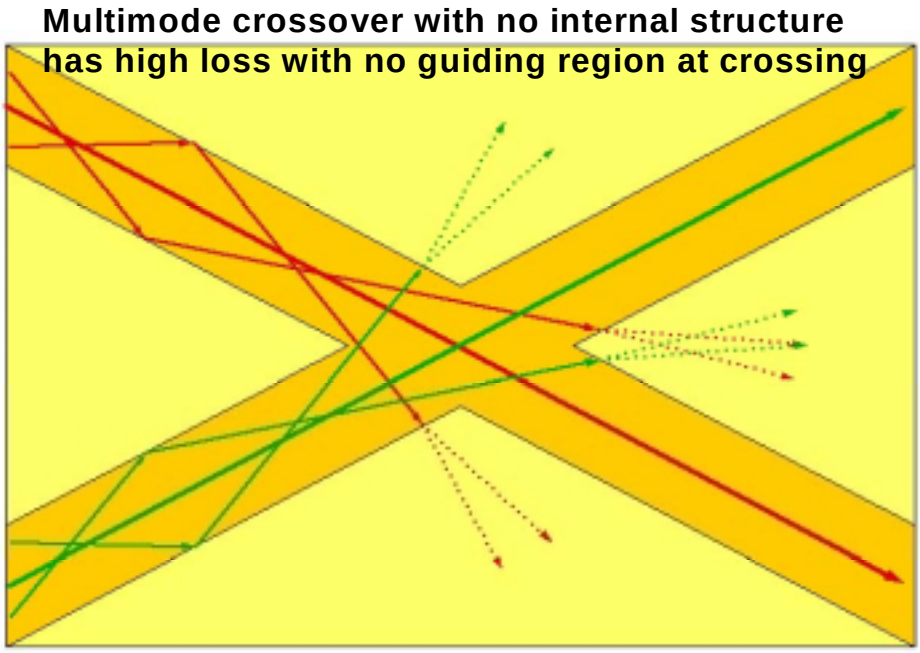
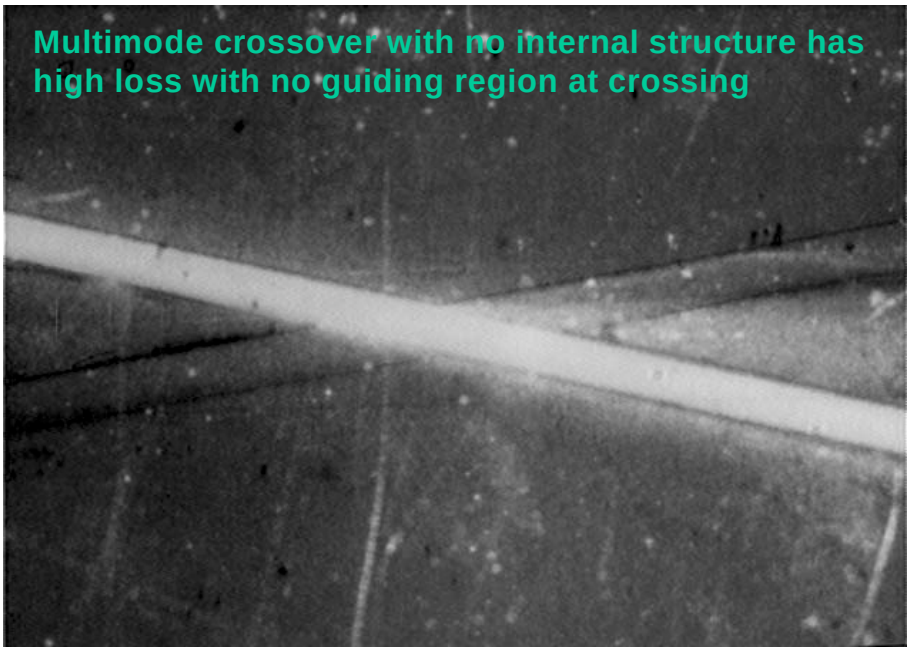


Figure G2. Photo showing guided light in typical crossover



By photo imaging waveguides with a small few micron unexposed region around the crossover area we provide for guiding in the crossing region. Schematically this is shown in Fig. G3 and in an actual 200 micron wide guide in Fig. G4. It is clear that there is essentially no scatter out of

Figure G3. Schematic showing OXL's guiding crossovers that are formed with OXL's self developing waveguide forming process that allows small regions to be imaged and formed by diffusing monomers

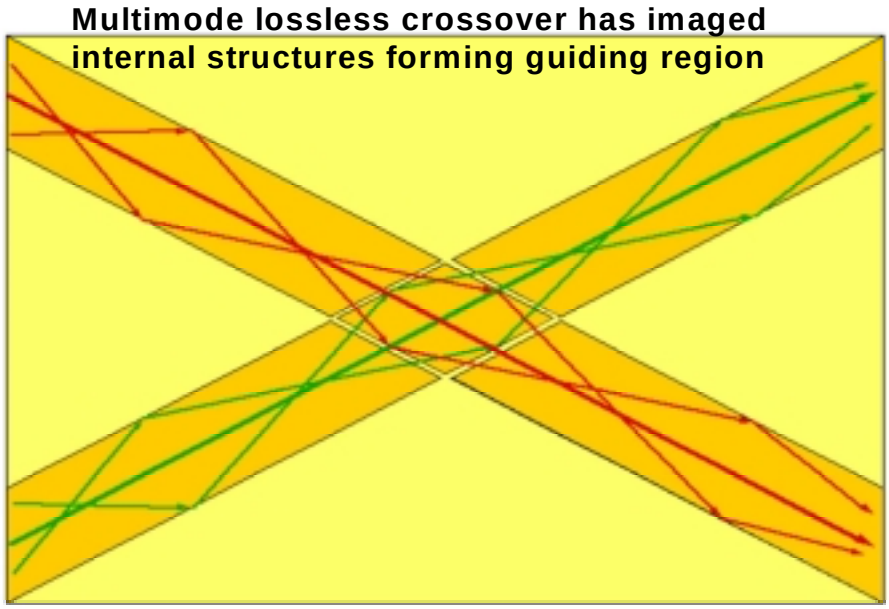


Figure G4. OXL's actual waveguiding crossovers with internal guiding structures providing for essentially no light leakage, crosstalk or additional loss

the guide in the cross over region. Any losses from the crossover are from the 4 micron lower index unexposed lines, which in this example are also 35 microns deep (guide dimensions 35 by 200 microns), which are observable in the figure. The losses were below the threshold of our measurement apparatus, or at least –30dB. We have begun to utilize these lossless crossover structures for dense multimode circuit routing, multimode add drop multiplexer devices, and sensor / read heads. Specific details to date are provided separately for chip and board optical waveguide applications, sensors, and multiplexers. 11/20/03