

# Optical CrossLinks, Inc.

## Preliminary Product Brief

### Optical Fiber Ribbon Doubler and Two Ribbon Mixer / Star Coupler

#### Product Summary

Optical CrossLinks' (OXL) custom configured optical fiber ribbon array doublers and two ribbon mixers are available in compact MT/MPO form factors. The doubler enables one fiber array ribbon to be easily doubled for each input channel into two ribbons with low insertion loss. Fiber ribbons with up to 12 fibers are doubled to two ribbon arrays with up to 12 each or 24 fibers in two 12 fiber ribbons. The close packed array of 1x2 splitters thus doubles each optical fiber channel. Optical excess insertion loss over the fundamental 3 dB split loss for each 1 to 2 channel is of the order 1dB for 850 and 1300nm range operation.

The star coupler mixer is an array of close spaced 2x2 star couplers that enables two input ribbons to mix signals. For the mixer, fiber #1 for example from each of two input ribbons is mixed into two outputs and this is done for up to 12 channels that make up the maximum in a standard MT connected ribbon fiber array. Thus two ribbon arrays with up to 12 fibers each are mixed fiber pair by pair into two ribbon outputs with the same fiber number or 12 channels.

Since the length of the mixer is 1.5 cm longer than for the doubler the excess losses are about 1.2 to 1.5 dB for 850nm and 1300nm respectively. In addition the mixer can be designed to operate as a bi-directional device, which would add about another 0.5 dB loss due a compromise to enable waveguide coupling in both directions into graded index optical fibers. For coupling the mixer input and output must have a 12 over 12 MT connector interface. This may require a jumper also sold by OXL for each end that converts two ribbons each in a linear up to 12 fiber MT format to a 12 over 12 format in one MT required to connect to the 2x2 mixer.

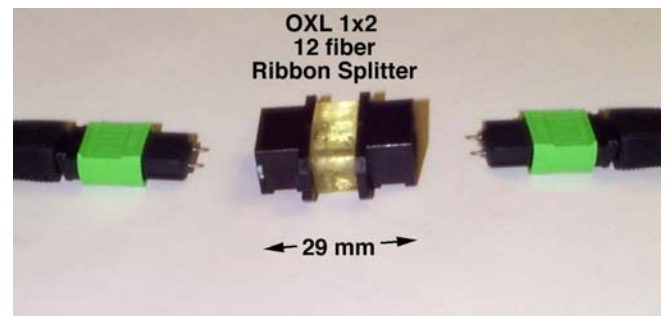
Designs for both doubler and mixers are typically optimized for standard multimode 62.5 micron graded index fiber cores. They can also be modified for custom core diameters and for square or step index profiles.

Total component footprint cross section is approximately that of a MPO bulkhead connector for both doublers and mixers. For the doubler a 1 cm waveguide section is in the center of a bulkhead connector (see Figure 1 and 2) making an approximately 3 cm long doubler component. MT/MPO fiber connectors go into the bulkhead connector as shown. For the mixer an additional 1.5 cm waveguide is needed to convert the 1x2 splitter into the 2x2 star coupler as noted. Doubler designs would need to be modified and optimized for operation as combiners to minimize the inherently larger

optical insertion loss due to mode combination losses in combining operations in addition to coupling losses into graded index optical fibers.

Packaging and connectorization is achieved using OXL's unique waveguide and connectorization technology to create an array of closely spaced 1x2's or 2x2's and precise alignment at the connector input and outputs. Optical path length differences between fiber channels are measured in the micron range over the array of 1x2's or 2x2's. Standard commercial MT style ferrules are typically hollowed out or equivalent footprint ferrules are made to contain the polymer guide splitters or star couplers in between the bulkhead connector halves.

Custom designs to handle larger numbers greater than 12 fibers per ribbon array are possible using custom molded ferrules, OXL precision alignment designs, similar MT style pin mating, and custom MPO equivalent latchable housings and/or expanded bulk head connectors for the mixers. Thus, versatile connectorization options with either MT standard or custom sized footprints and high density connectivity are achievable.



**Figure 1: Fiber Ribbon Array Doubler/Splitter** The ribbon splitter is a close packed array of 1x2 splitters up to 12 for a standard MT footprint located inside the bulkhead connector. Here two MT/MPO connected ribbons with 12 inputs go to a 12 over 12 output.

#### Product Applications

Applications are for industrial, school, or central office systems; high-speed computers or routers; or for aerospace flight control and monitoring systems where there is a need to simply, rapidly and/or permanently double or mix fiber channels that are in ribbon arrays in optical data link interconnections and/or distribution link.

*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.*

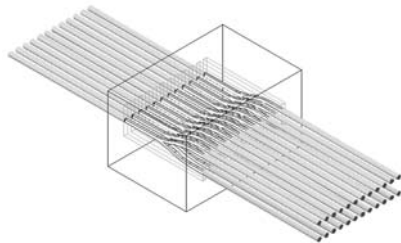
OXL's family of distribution link configurations is most amenable to a broad range of customer specific designs and packaging options for meeting diverse application requirements. Representative custom design options are summarized below.

**Key Customer Benefits**

- OXL's ribbon doubler is a small compact component easily inserted to couple one ribbon to two outgoing ribbons thus splitting up to 12 fibers per ribbon into two 12 fiber ribbons with a stacked array of small 1x2 splitters.
- OXL's two ribbon array mixer / star coupler is also small

**Figure 2. Stacked Waveguide Splitter Array**

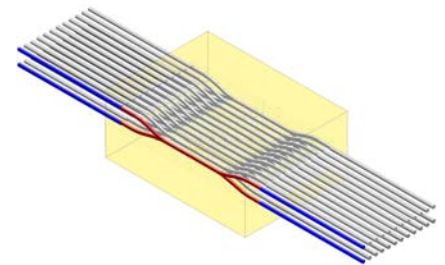
Schematic of OXL's close packed stacked array of polymeric optical 1x2 multimode waveguide splitters with up to 12 fitting into a standard MT connector format with larger numbers in custom ferrules upon request.



compact ready for insertion into a dual ribbon I/O system. In this case 12 over 12 MT ferrules are used for input and output. An adaptor transitioning two single ribbons going to a 12 over 12 MT format may be needed for both input and output as well.

- Custom or standard connectorization arrangements and connector ferrule housing footprints are available
- Broad range of custom options for fiber diameters and fiber number are available upon request.
- Robust packaging compatible with industry standards, cablized ribbons, and hermetic packaging is available upon request with slightly larger dimensions.

**Figure 3. Stacked 2x2 Mixer Array.** For the 2 fiber mixer the input and output ends are identical with two waveguides for each channel plus a double guide width mixing region in the middle. Up to 12 can fit into a MT standard ferrule.



**Specification Highlights for Fiber Ribbon Array Doublers/Mixers -----**

- Optical fiber ribbons with 2 to 12 fibers can be split to form a doubled output for each fiber in a standard MT/MPO size footprint with standard 125 micron OD fiber
- Similarly two ribbons connectorized with a 12 over 12 MT style connector can be mixed for each of up to 12 channels to form a 12 over 12 output MT interface each channel being 50% of the signal from each input
- Optical fiber ribbons with greater than 12 fibers can be handled on a custom basis with enlarged ferrules requiring complete custom designs for both ribbons connectors and doubling component

- Non-standard optical fiber diameters can be handled on a custom basis using OXL's ribbonization, connectivity designs and doubling component
- Custom multimode standard footprint MT style ferrules using OXL proprietary designs can be configured for non-typical large cores, and /or larger number or specialized arrangements
- Performance not impacted by shock or inertial issue
- Variable ratios for outputs for both doublers and mixers can be designed thus enabling add drop configurations.

**Distribution System Performance Enhancing Options**

For greater optical link versatility OXL's coupling components can be embedded into the fiber ribbon distribution links. For example, OXL components that can be incorporated, in addition to the fiber ribbon array doubler or mixers described in this product brief, include OXL's 1) compact polymeric small footprint 1 to up to 16 single input fiber link splitters, and 2) 4x4 to 32 x32 star couplers. (See separate OXL Product Briefs on Splitters, high port count Star Couplers and Distribution link ribbons, shuffles and wiring harnesses)

**Ordering Information:** Call or email the contacts below for pricing and/or 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](mailto:sales@opticalcrosslinks.com)-----see <http://www.opticalcrosslinks.com>

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