kylia

Design and assembly of free-space optical systems

PRODUCTS
CATALOGUE

Kylia Optical Assembly

Starting from customer's specifications (simple drawing or detailed specifications), we develop industrial optical products dedicated to be used as OEM's subsystems, or single-unit prototypes for reseach applications.
We can lead or be part in all the product development steps:

Design

- optical design
- packaging design
- selection of sub components suppliers and subcontractors

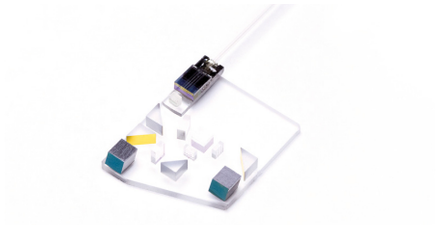
Prototype assembly

- prototype manufacturing using Kylia's assembly technology

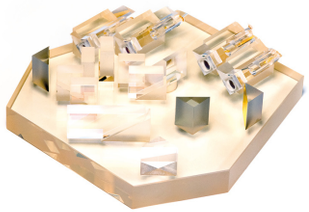
Product manufacturing

- process definition
- manufacturing capabilities up to 3 000 units per year

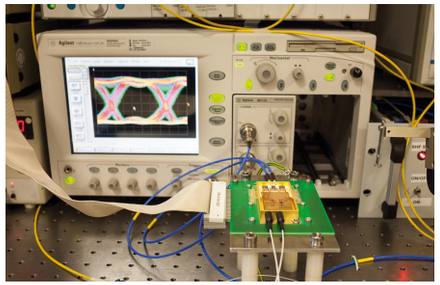
Kylia's technology is usually referred to as “free-space optics”.
It consists in the 6-axis nano-positioning of micro optical elements (lenses, prisms, diffraction gratings...) and their bonding onto a reference surface. Thanks to its know-how in assembly epoxies, Kylia can provide stable and robust devices, made to be used in extreme environment.



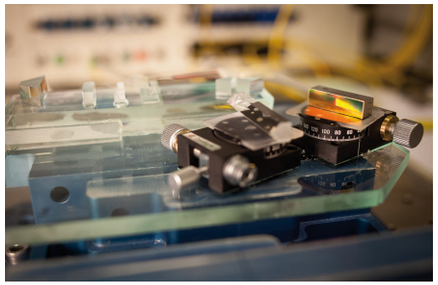
miniaturized PBS and Beam-Splitter for integrated coherent receivers



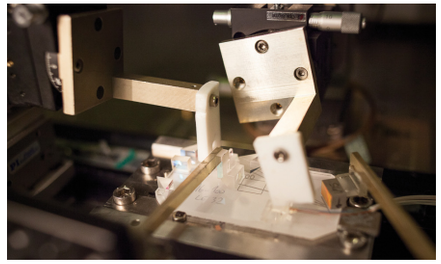
interferometers for spatial application (EADS, ESA)

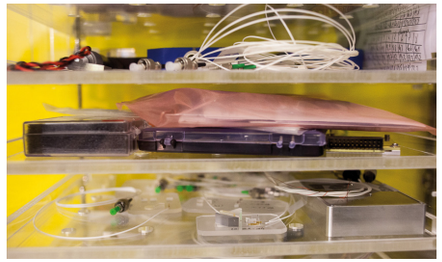


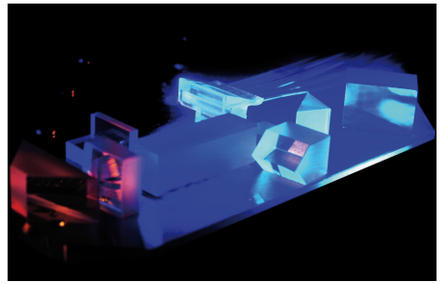
Delay Line Interferometer coupling into balanced photoreceiver for dual-polarization DPSK



integration of rotation stages on an optical breadbord for spacing and frequency tuning of a DWDM Mux/Demux





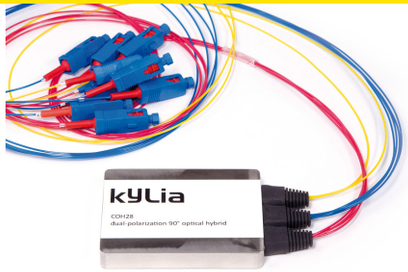


The wide scope of our technology and its flexibility enable low-cost and fast cutting edge components development.

Thanks to this technology, we can design on-demand products including the following optical functionalities:

- optical interferometers
- splitting or combining of polarized beams
- wavelength multiplexing
- fiber coupling (laser output beam coupling into any fiber type, SM or PM)
- beam coupling into photoreceivers, SOA, PPLN waveguides...
- fiber-coupled AOM

90° optical hybrids



Kylia offers a complete range of 90° optical hybrids.

COH24 is a **single polarization 90° optical hybrid** that enables to extract phase and amplitude from a single polarization signal by performing four 90° phase stepped interferences between the signal and a Local Oscillator (LO).

COH28 is a **dual polarization 90° optical hybrid** that enable to extract phase, amplitude and polarization from a signal with any polarization.

COH24-X and **COH28-X** are a new generation of optical hybrids with improved performances: **wider operating wavelength range and better insertion losses uniformities.**
In order to perfectly adjust the 90° of the hybrid depending on the wavelength used, or to be able to evaluate the flaws on the transmission link induced by the phase shift, COH24-X and COH28-X can be offered with a **phase tunability option.**

Kylia also offers a **dual polarization 180° hybrid named COH22.**

Kylia's optical hybrid are **purely passive and athermal.**

Kylia's optical hybrids are also available with **PM output fibers.**

COH24-X and COH28-X are available for other operating wavelenghts, as **1030 nm, 1064 nm or 1310 nm.**
On the market since 2007, Kylia's optical hybrid are already integrated as **OEM components** into several customer's systems, and can be **customized** according user's requirements (for instance adding other optical functionnalities as tap coupler, circulator...).

	COH24 / COH28	COH24-X / COH28-X	COH-X Phase Tuning Option
Excess IL from Signal or LO	< 2.5dB		
IL uniformity	< 2.0 dB	< 1.0 dB	
IL dual uniformity	< 1.0 dB	< 0.5 dB	
Phase shift between I and Q	90° +/- 5°		± 20° phase tuning
Skew	< 1ps		
Packaging dimensions	70 x 52 x 10 mm^3	180 x 32 x 19.5 mm^3	175 x 60 x 24 mm^3

DWDM Mux/Demux

Thanks to its flexible bulk grating technology, Kylia is able to propose the market's most complete **DWDM Mux/Demux** component range :

- up to 48 channel
- **any spacing from 6.25 GHz up to 400 GHz**
- S+C+L+U band (1460nm to 1675nm)
- Flat Top shape or specific shape option
- **PM option**

All Kylia Mux/Demux products are **passively athermal.**
Since 1998, Kylia **MICS** product is deployed on the field by system vendors, for metro, long haul and submarine networks.
MICS is qualified to **TELCORDIA** 1209 and TELCORDIA 1221.

Spacing	GHz	6.25	12.5	25	33.33	50	100	200	400
Insertion Losses	dB	< 8.5	< 7.5	< 6.0	< 6.0	< 5.0	< 5.0	< 6.0	< 6.5
Polarization Dependent Losses	dB	< 0.4							
Channel Center	GHz	± 1.00	± 1.75	± 3.12	± 3.12	± 3.12	± 6.25	± 7.50	± 8.50
Bandwidth @-1dB	GHz	> 1.75	> 3.5	> 7	> 9.3	> 14	> 28	> 56	> 112
Bandwidth @-3dB	GHz	> 3	> 6	> 12	> 16	> 24	> 48	> 96	> 192
Adjacent Crosstalk	dB	> 25				> 30			
Packaging	mm^3	175 x 115 x 26.5	130 x 65 x 19.5			100 x 55 x 16		130 x 65 x 19.5	

Tunable Mux/Demux (TMICS) is a instrument for emulating any DWDM Mux/Demux by tuning the spacing and the frequency range.
TMICS is available in manual version (micrometer heads) and motorized version (piloted actuators). With the motorized option, spacing and frequencies are controlled using a user friendly software for active setup and fast tunability.

Delay Line Interferometers

MINT is a Delay Line Interferometer (DLI) that performs the interference between an incoming signal and itself delayed by one bit-time. Dedicated to **DPSK demodulation** it can be used in many other applications.

	MINT		
Free Spectral Range (FSR)	> 10 GHz	10 GHz > FSR > 2.5 GHz	< 2.5 GHz
FSR Accuracy	< 1% FSR		< 2% FSR
Insertion Losses (IL)	< 2.0 dB		
IL uniformity	< 0.5 dB		
Polarization Dependent Losses (PDL)	< 0.3 dB		< 0.5 dB
Polarization Dependant Frequency Shift (PDFS)	< 2 %FSR	< 4 %FSR	
Extinction Ratio	> 18 dB		> 15 dB
Skew	< 1 ps		
Packaging dimensions	100 x 55 x 16 mm^3 (custom smaller packaging on demand for FSR > 20 GHz)		130 x 65 x 19.5 mm^3

WT-MINT is a **FSR-tunable DLI** that enables to set the delay of the interferometer to the desired value. This can be done either with a micrometer head (manual option) or with a motorized translation stage (piloted version).

WT-MINT is available with several tunable delay ranges : 100 ps, 300 ps,... up to 12 ns.

	WT-MINT		
Free Spectral Range (FSR)	10 GHz to ∞	3.33 GHz to ∞	83 MHz to ∞ (for 12ns delay range)
Tunable delay range	100 ps	300 ps	3 ns to 12 ns
Insertion Losses (IL)	< 2.5 dB	< 4 dB	
IL uniformity	< 0.5 dB	< 1 dB	
Polarization Dependent Losses (PDL)	< 0.5 dB	< 0.8 dB	
Polarization Dependant Frequency Shift (PDFS)	< 3 %FSR	< 5 %FSR	
Extinction Ratio	> 18 dB	> 15 dB	
Skew	< 1 ps		
Packaging dimensions	216 x 92 x 40 mm^3		780 x 510 x 134 mm^3

Both MINT and WTMINT are phase-tunable to enable a precise matching of the carrier frequency. Two **phase tuning options** are available: the ultra-fast option (U), which exhibits very low tuning time constant (20µs), and the low voltage option (L), which needs only 3V to reach the tuning range of 360°.

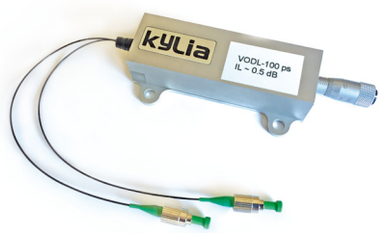
	L (thermal heater)	U (piezo)
Phase tuning range	1.5 FSR	
Phase tuning voltage	3 V	90 V
Phase tuning time constant	1 s	0.02 ms
Phase tuning power consumption	0.5 W	1 mW

MINT and WT-MINT are available with input and/or output **PM fibers.**

Kylia's DLI can be **customized** according user's requirements (tap coupler, wider phase tuning range...), and can be designed for other operating wavelengths, as **1310nm.**

For a dedicated application, Kylia's also designed and manufactured an **integrated DLI**, including the optical interferometer and the photoreceivers.

Variable Optical Delay Lines



Kylia offers a complete range of Variable Optical Delay Lines (VODL) with delay range from 100 ps to 12 ns.

The optical delay can be continuously tuned thanks to a micrometer head (manual version) or a motorized actuator (piloted version).

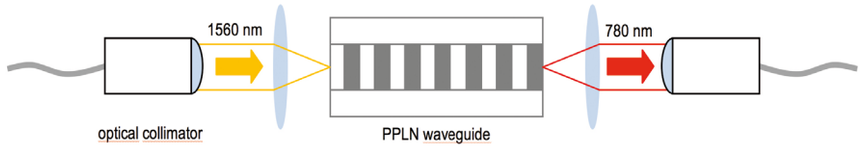
The following options are available on Kylia's VODL:

- PM fibers
- custom operating wavelengths as 780 nm, 1064 nm, 1310 nm...
- Optical reference path : this option enables to precisely control delay between the reference path and the tunable path and eventually take it down to zero.
- Variable Optical Attenuation

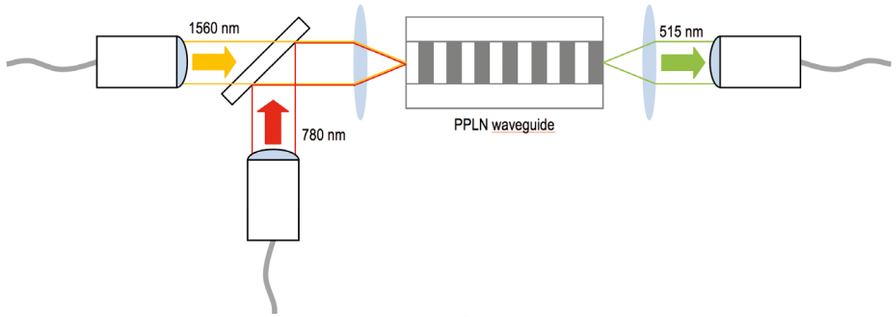
Optical Delay Range		100 ps	300 ps	600 ps	3 ns	12 ns
Insertion Losses (IL)	SM fiber	< 1 dB			< 2 dB	
	PM fiber	< 1.5 dB			< 2.5 dB	
Il uniformtity		< 0.5 dB				
Polarization Dependent Losses (PDL)		< 0.3 dB				
Manual VODL sensitivity		30 fs	15 fs	30 fs	NA	
Motorized VODL minimum incremental motion		NA	3 fs	6 fs	10 fs	40 fs
Motorized VODL relative accuracy		NA	150 fs	300 fs	250 fs	1000 fs
Packaging dimensions		100 x 32 x 25 mm^3	216 x 92 x 40 mm^3		780 x 510 x 134 mm^3	

PPLN modules

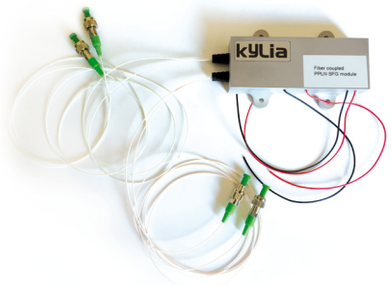
Thanks to its know-how in optical coupling into waveguides, Kylia designed **PPLN modules** based on PPLN waveguides. We can offer **SHG** (Second Harmonic Generation) modules, **SFG** (Sum Frequency Generation) or **DFG** (Difference Frequency Generation) modules, according to user's requirements.



example of a SHG module



example of a SFG module



Polarization Division Multiplexing Emulator

The **Polarization Division Multiplexing Emulator (PDME)** is a device that enables to control the delay between both polarizations. The PDME can be used to emulate **Polarization Division Multiplexing (PDM)** signal by launching a polarized signal with a given modulation format. At the output of the device the modulation format will be emulated on both polarizations. For example, if QPSK is launched at the input, PDM-QPSK will be emulated at the output. The PDME can also be used to emulate Polarization Mode Dispersion (PMD).

Several options are available on the PDME, such as **ON/OFF obturator, Variable Optical Attenuator, Variable Optical Delay Line** or **free space delay** (up to 20 ns).

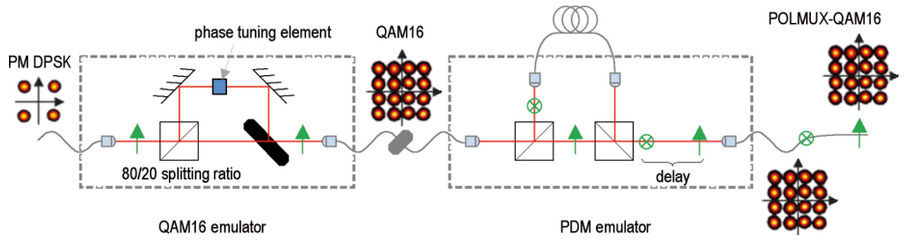
Delayed arm		PM fiber	free space
Insertion Losses		< 3 dB	< 4 dB
IL variation between both arms		< 1 dB	
Optical delay		10 ns (typ.)	< 20 ns
Variable delay range (VODL option)		330 ps	
Packaging dimensions	standard	100 x 55 x 16 mm	
	VODL option	216 x 92 x 40 mm	
Input fiber		PANDA PM	
Output fiber		SMF-28	

Quadrature Amplitude Modulator

The QAM16 emulator is a device that enables to emulate a **QAM16 signal from a QPSK signal.** The device has one PM input by which a QPSK signal is launched. First the signal is split in a very precise 80/20 ratio. One part is delayed by 1ns in order to de-correlate both parts of the signal. Then the two parts are combined to make them interfere and thus emulate a QAM16 signal which is injected in the PM output fiber.

The QAM64 emulator is a device that enables to emulate a **QAM16 or QAM64 signal** from a QPSK signal. The device has one PM input by which a QPSK signal is launched. It is then split twice thanks to tunable couplers and the three parts are finally recombined together after one has been delayed by 500ps and another by 1ns. The interference of these three signals emulatesvv a QAM64 signal injected in the PM output of the device.

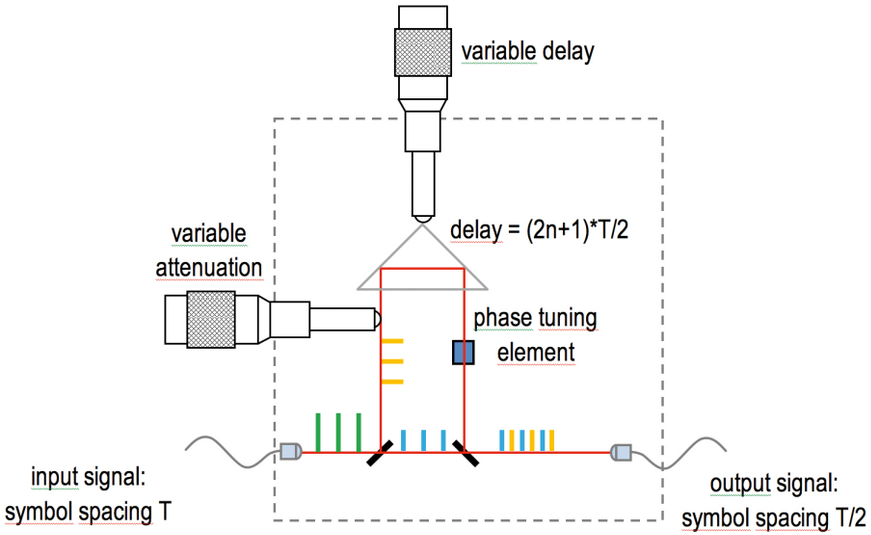
Phase tuning elements enable to precisely adjust the delay between the several arms depending on the wavelength used.



example of emulation of a POLMUX-QAM16 signal from a PM-DQPSK signal

Optical Bit Rate Multiplier

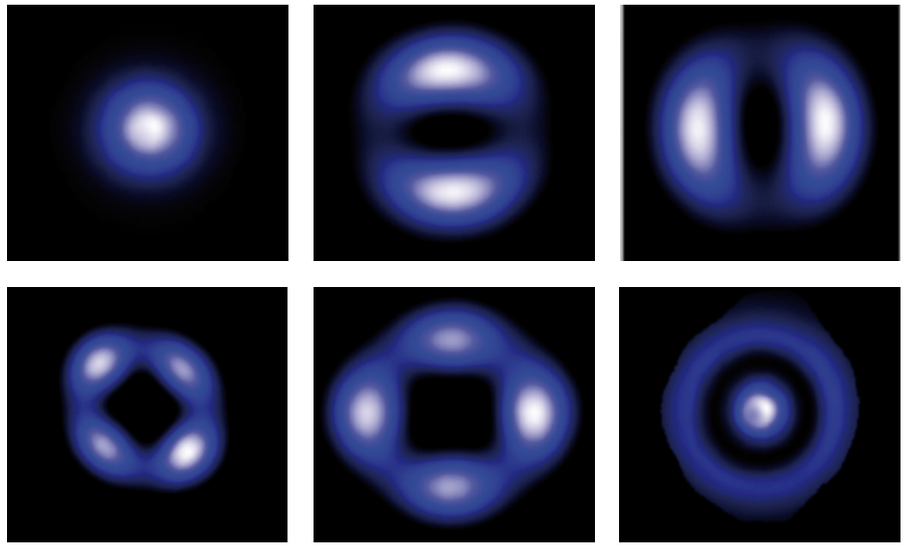
Kylia's Optical Bit Rate Multiplier (OBRM) is a device which increases the repetition rate of an input optical signal by 2 times. By cascading 2, 3 or 4 OBRM, the repetition rate will increase by 4, 8 or 16 times.
ORBM is an interferometer with a delay of (2n+1)*T/2 between two free-space optical paths. A variable optical delay helps to adjust the delay, a variable optical attenuation helps to equilibrate the insertions losses in both paths, and a phase tuning element helps to control the phase of the interferometer.



Modal Mux/Demux

Kylia offers a complete range of Modal Mux/Demux that enable to inject/recover 3, 5 or 6 different signals coming from 3, 5 or 6 different fibers in a single Few Mode Fiber (FMF):

- 3-modes Mux/Demux called M3 : the 3 carried modes are **LP01, LP11a** and **LP11b.**
- 5-modes Mux/Demux called M5 : the 5 carried modes are **LP01, LP11a, LP11b, LP21a** and **LP21b.**
- 6 modes Mux/Demux called M6 : the 6 carried modes are **LP01, LP11a, LP11b, LP21a, LP21b** and **LP02.**



The FMF is supplied either by Kylia or by customer. In latter case, an analysis of the fiber will be conducted in order to check the compatibility of the fiber. This **FMF analysis** is based on Modes field diameters, cladding dimensions, and then a spectrally and spatially resolved analysis of the modes is performed. This analysis will give the number of modes carried by the fiber, their shape, and their crosstalk.

Kylia also offers to design and make other components (**splitter, circulator**...) with FMF.

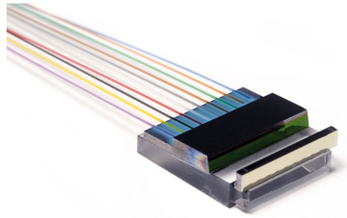
Optical Switches

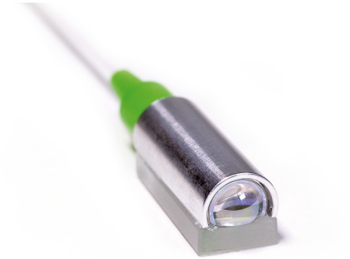
Kylia's offers a **manual optical switch** for applications that do not require an electrical control. This switch is available at 1550 nm in SM or PM version but can be designed for others operating wavelengths.

	SM fibers	PM fibers
# of outputs fibers	8	
Insertion Losses	< 1 dB	< 1.5 dB
PDL	< 0.3 dB	NA
PER	NA	> 20 dB
Crosstalk	> 40 dB	

Kylia also offers **electrically controlled PM optical switches** based on **Magneto-Optical** elements (Faraday Rotators).

Collimators & Collimators arrays





By assembling an optical fiber and a lens, or a fiber array and a microlenses array, Kylia can design and make any collimator or collimator array based on customer requirements.
Kylia provides customized **collimators** and **collimators arrays** dedicated to be used in industrial optical systems or in research laboratories, according to our customers requirement:

- operating wavelength
- fiber type
- working distance
- beam diameter

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