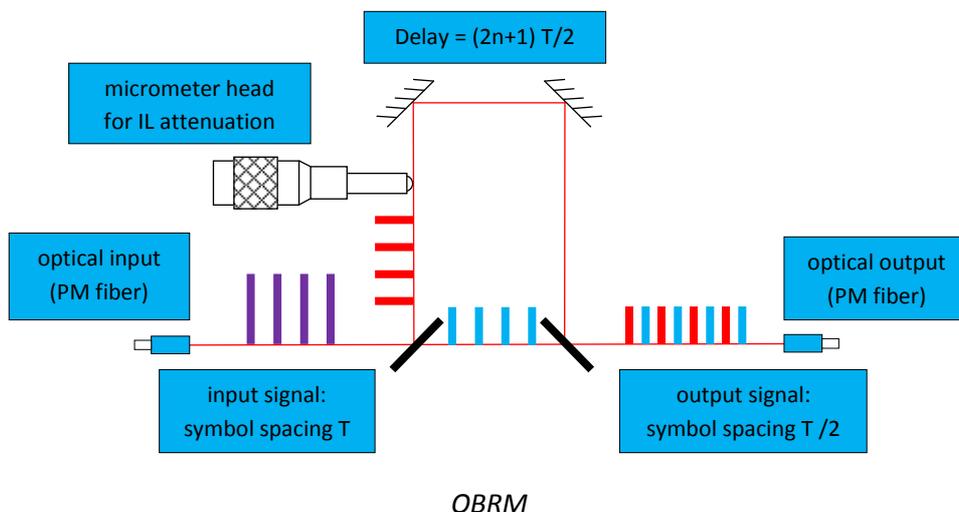


1 – Description

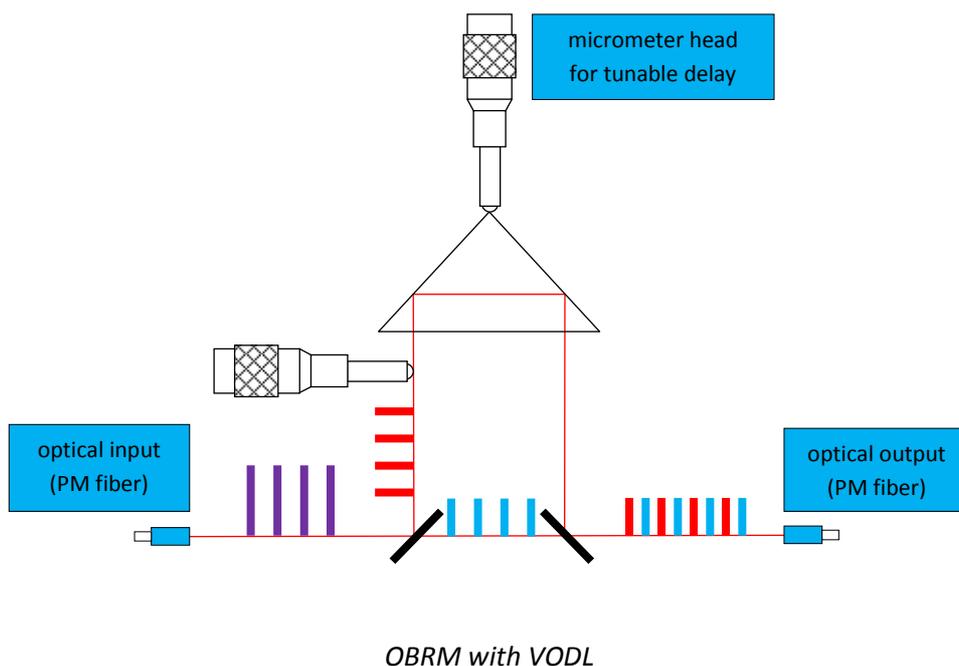
The Optical Bit Rate Multiplier (OBRM) is a device which increases the repetition rate of an input optical signal by 2 times. By cascading 2, 3 or 4 OBRM, the repetition rate will increase by 4, 8 or 16 times.

2 – Block diagram

The OBRM is an interferometer with a delay of $(2n+1) T/2$ between two free-space optical paths.



We add a variable optical attenuation (VOA) in order to equilibrate the insertion losses in each path. A variable optical delay (VODL) can also be added:



3 – Absolute maximum ratings

Parameter	Symbol	Min	Typ.	Max	Unit	Remarks/Conditions
Maximal optical input power	OpIn			500	mW	
Storage temperature range	STR	-10		40	°C	
Humidity	RH	5		85	%	Non condensing

4 – Operating conditions

Parameter	Symbol	Min	Typ.	Max	Unit	Remarks/Conditions
Operating wavelength	OWR	1520		1625	nm	
Operating temperature range	OTR	10		35	°C	

5 – Specifications

Parameter	Symbol	Min	Typ.	Max	Unit	Remarks/Conditions
Insertion Losses ¹	OBRM x2	IL		5.0	dB	
	OBRM x4			9.0		
IL uniformity between both arms ¹	Δ IL		0.1	0.5	dB	
Variable Optical Attenuation accuracy ²				0.1	dB	
Optical Delay		0		400	ps	
Optical delay accuracy				0.1	ps	
Variable Optical Delay range ³	OBRM x2	150			ps	
	OBRM x4 stage #1	300				
	OBRM x4 stage #2	150				
IL variation over delay range ³				0.5	dB	
Phase tuning range ⁴		1.5			FSR	for
Phase tuning time constant ⁴				1	s	
Phase tuning voltage ⁴				4	V	
Optical Return Loss	ORL	35			dB	
Packaging size	standard	130 x 65 x 19.5			mm ³	
	VODL option ⁵	216 x 92 x 40				
Fiber Type		PANDA PM				

¹ measured over OTR and OWR

² for VOA option

³ for VODL option

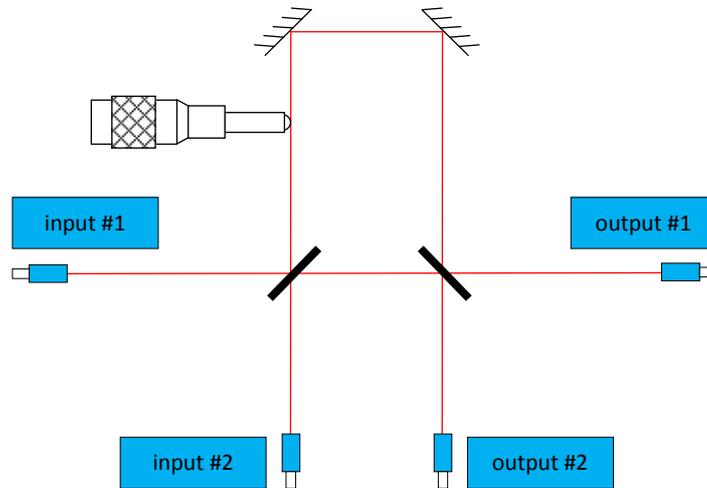
⁴ for phase tuning option

⁵ excluding micrometer head or piloted actuator

6 – Additional input or output

We can add a second input or/and a second output to our OBRM products.

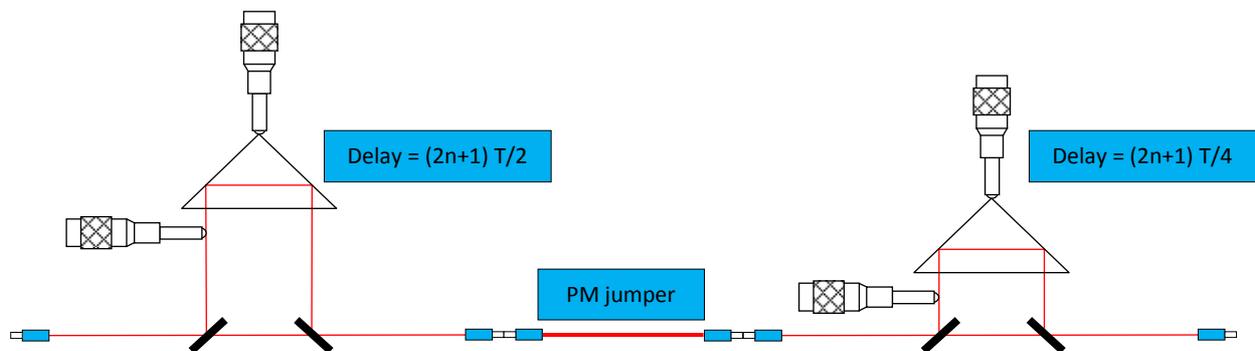
The second output can be used for the monitoring of the insertion losses equilibrate in each path.



OBRM with additional input and output

7 – Cascaded OBRM

By connecting output of a first OBRM (delay $(2n+1) T/2$) to the input of a second OBRM (delay $(2n+1) T/4$), we increase the initial repetition rate by 4.



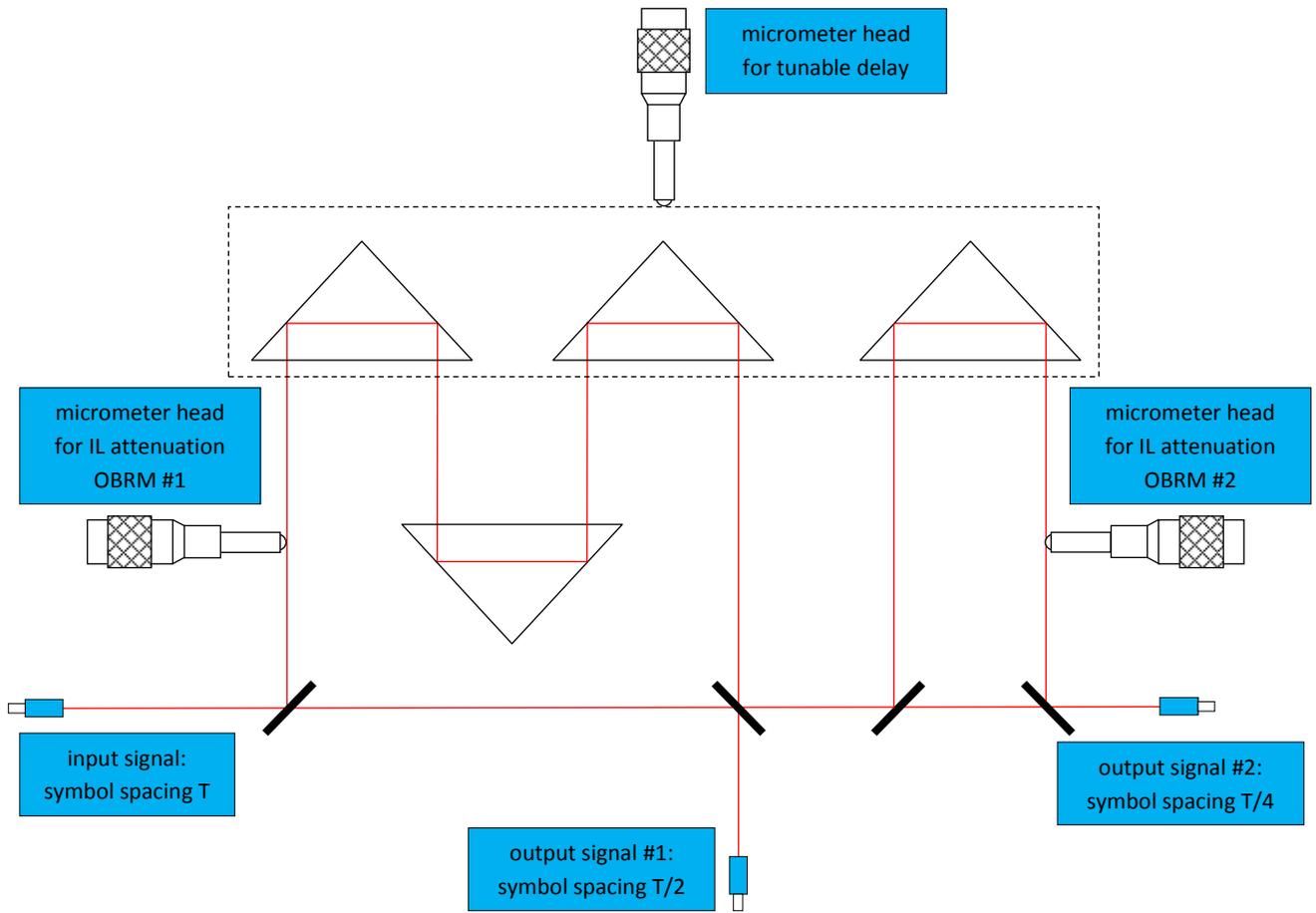
Cascaded OBRM in order to increase the repetition rate of the signal by 4

By cascading 3 or 4 OBRM, the repetition rate will increase by 8 or 16 times.

In order to avoid having two separate products connected via a PM jumper, we propose full free-space x4 OBRM, available with or without VODL option.

In this configuration, the IL between the input and the output #2 will be less than 9 dB.

The variable optical delay range will be 300ps for OBRM #1 and 150ps for the OBRM #2.



OBRM x4 with VODL and VOA options



OBRM with VODL option packaging

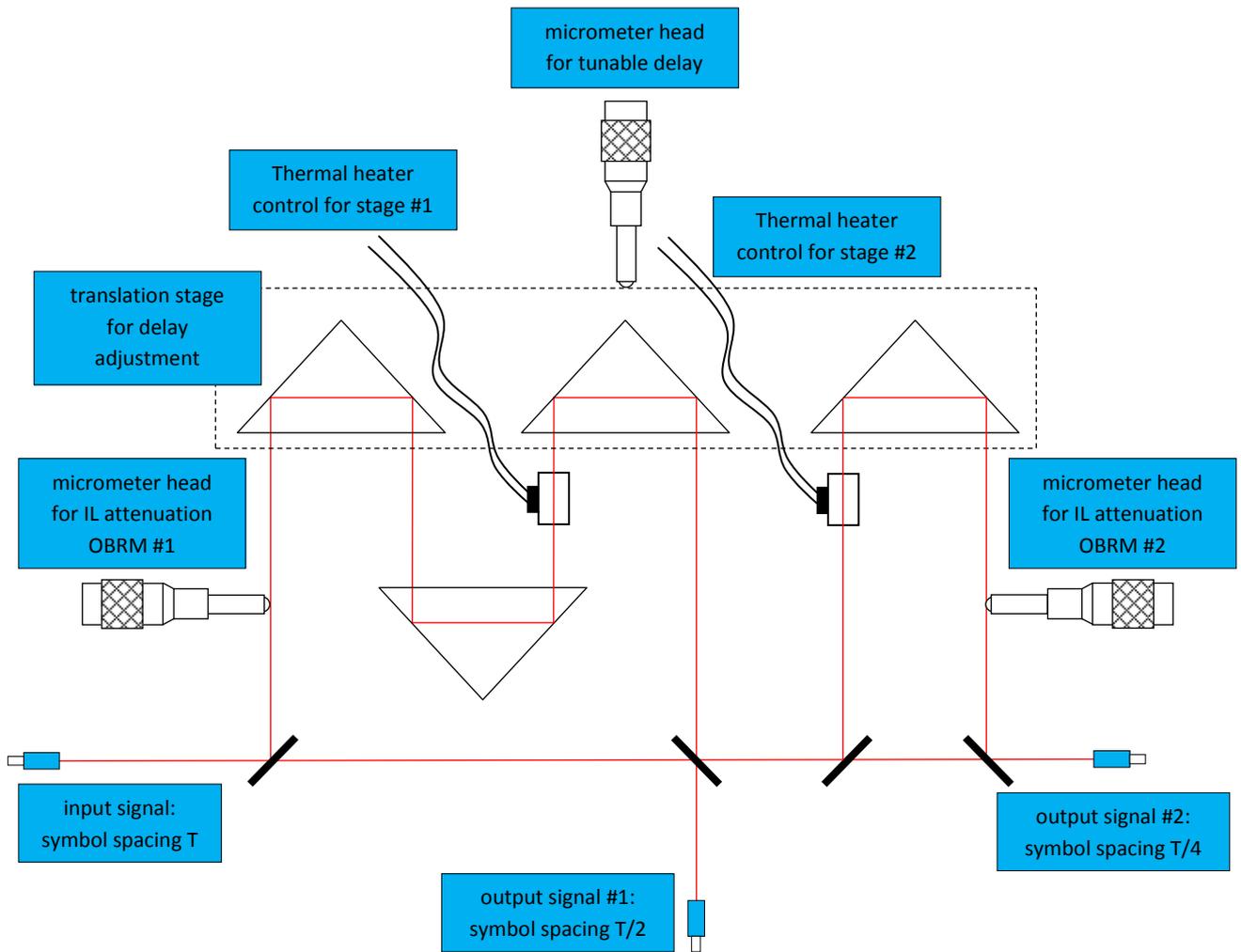
We propose this product with two outputs:

- OBRM #1 output to collect the x2 repetition rate. This output will help the user to equilibrate the both paths insertion losses of the OBRM #1
- OBRM #2 output to collect the x4 repetition rate.

In case of VODL option, the delay control is the same for both OBRM in order to propose an easy-use product (a delay shift of 1ps for the OBRM #1 corresponds to a delay shift of 0.5ps for the OBRM #2).

8 – Phase tuning option

We also add two phase tuning control on both interferometers. We control the phase by slightly changing the delay of the interferometer via a thermal heater fixed on an optical window placed on the optical path.



OBRM x4 with VODL, VOA and phase tuning options

9 – Fiber type and connectors

The OBRM is made using PM PANDA fiber.

The devices can be proposed with any kind of connectors (FP/UPC, FC/APC, SC/PC, SC/APC, LC/PC, E2000/PC, E2000/APC).

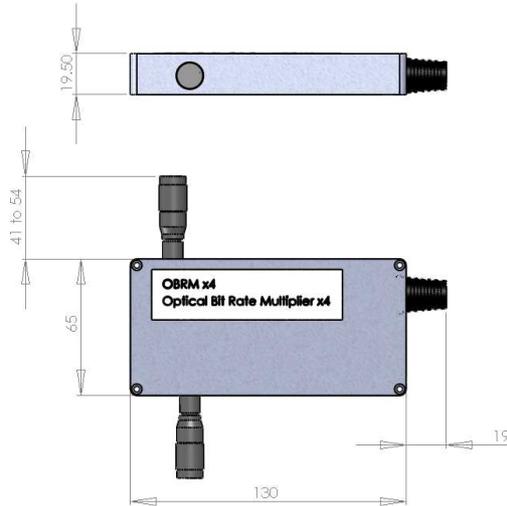
10 – Wavelength range

The OBRM can be proposed at different wavelength range, from the visible to the IR. The device will be operational on a wavelength range of a tens of nanometers centered on the wavelength required by customer.

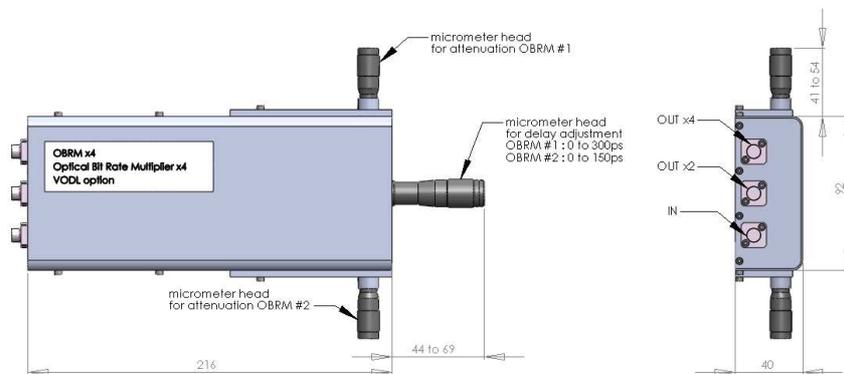
11 – Custom product

Thanks to our free-space technology we can easily customize most of our product and so it is for the OBRM. Customer can feel free to ask for any customization they need. We will examine the request and do our best to have a positive answer.

12 – Package layout



OBRM x4 packaging



OBRM x4 with VODL option packaging

13 – Revision

date	version	Object
April 26, 2013	OBRM V1.0	Creation
June 2 nd , 2014	OBRM V1.1	Added phase tuning option