Typ:	Passive nonlinear SSFS module, 1030 nm	REV: 1.1
Date:	15.12.2021	MB
Modified:		

Photonics

Passive optical nonlinear module for spectral shifting of solitons, 1030-1500 nm

INTRODUCTION:

Nonlinear optical fiber modules for spectral shifting of femtosecond solitons utilize the phenomenon of soliton self-frequency shift (SSFS). They allow wavelength tuning of femtosecond lasers in the near-infrared range. Typically, a soliton from a fixed wavelength ytterbium femtosecond source can be tuned from the 1030 nm range up to 1500 nm wavelength. The output wavelength is easily tuned by changing the input optical power. Wavelength-shifted output signal maintains coherence and linear polarization. The modules are fully plug&play. They are passive and require only connecting to the laser source output port.

APPLICATIONS:

Extending capabilities of femtosecond lasers
Nonlinear microscopies, multiphoton microscopy
Nonlinear spectroscopies, e.g. CARS
Sensing, gas detection
Frequency and dual-frequency comb generation
Biomedical (e.g. deep-tissue imaging, virtual biopsy)
Laboratory experiments
Selective ablation

FEATURES AND ADVANTAGES:

Easily tunable output wavelength
Wide tunability range and continuous, no-gaps tuning
Preservation of input pulses state of polarization
Preservation of input pulses coherence
High conversion efficiency
Minimum chirp introduced
Low loss

TECHNICAL SPECIFICATION:

Parameter	Unit	Value
Input Wavelength Range	nm	1000-1500
Typ. Input Wavelength Range	nm	~1060
Typ. Input Pulse Duration	fs	<300[1]
Wavelength Shift Range	nm	up to 1500[2, 3]
Typ. Conversion Efficiency	%	40[2]
Min. Polarization Extinction Ratio	dB	18[2]

Fibrain Sp. z o.o., Zaczernie 190F, 36-062 Zaczernie, Poland tel:+48 17 866 08 00; email: photonics@fibrain.pl; web: www.fibrain.com

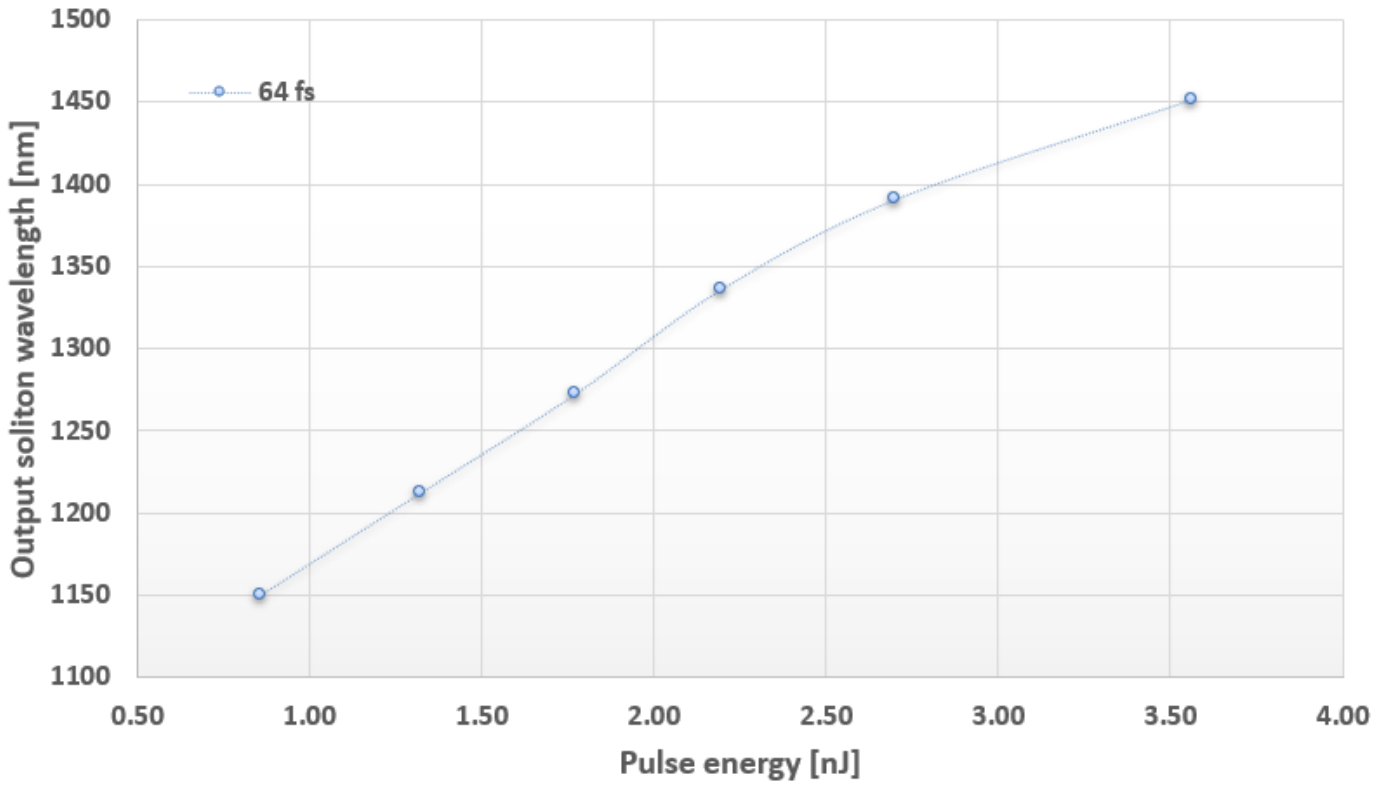
Min. Coherence	%	85[2]
Max. Linear Insertion Loss	dB	2.7
Default PM connector alignment		Slow axis[4]
Standard connector type		FC APC[4]
Operating Temperature	°C	-10/+65

[1] Efficiency of SSFS depends significantly on the pulse width
[2] Dependent on specifics of the input pulse
[3] Dependent on nonlinear fiber length, less for shorter modules
[4] Other types on request

EXPERIMENTAL DATA:

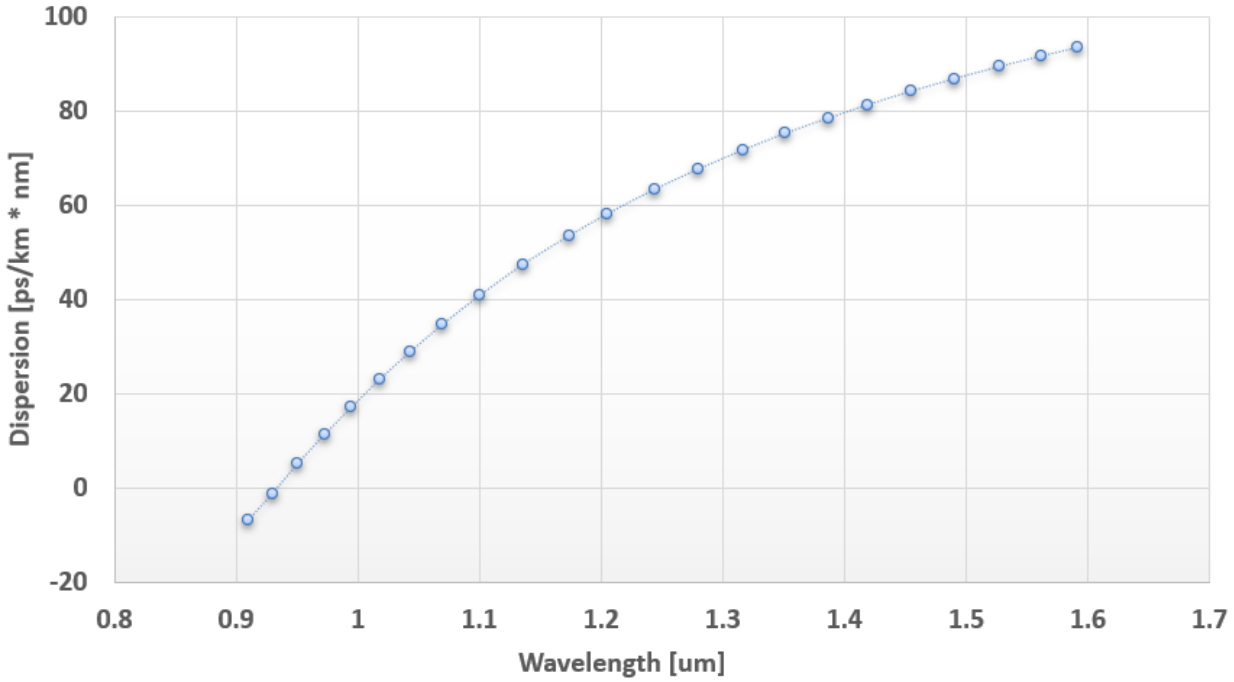
The efficiency of the SSFS depends on a number of characteristics of the input pulses, chiefly among them on the pulse duration and energy. There are however also other characteristics, for example pulse shape, coherence, polarization state and polarization stability or chirp which may impact on the observable wavelength-shifting efficiency. Therefore the below data has been measured for a given seed laser configuration. Although the results are representative, the exact performance with other light sources has to been experimentally determined.

Typical wavelength-tuning characteristics, dependence on the input pulse energy, 64 fs input pulses, for module length of one meter:



Photonics

Chromatic dispersion characteristics of nonlinear fiber, dependence on wavelength:



REFERENCE SYSTEM:

Series	Input fiber type	Input fiber length	Seed wavelength	Nonlinear fiber length	Output fiber type	Output fiber length	Cable type	Packaging options	Input connector	Output connector
SSFS-G0	06 - PM 980	10 - 10 cm	10 - 1030 nm	050 - 50 cm	10 - PM 1310	10 - 10 cm	25 - 250 um	P - patchcord	XX - no con	XX - no con
	08 - PM 1060	20 - 20 cm	15 - 1550 nm	100 - 100 cm	11 - PM 1550	20 - 20 cm	90 - 900 um	2 - ABS 100x80x10 mm	FC3 - FCA slow axis	FC3 - FCA slow axis
	11 - PM 1550	…			15 - PM 1950		20 - 2.0 mm	3 - ABS 120x80x18 mm	FC4 - FCA fast axis	FC4 - FCA fast axis

Ordering example:
SSFS-G0-06-20-10-200-11-30-20-P-XX-FC3: Nonlinear SSFS module, for 1030nm seed, input pigtail PM980 nm, 20 cm, no connector, nonlinear fiber length 200 cm, output pigtail Panda 1550 nm, 30 cm, FC APC slow axis alignment, 2.0 mm patchcord-type