

# Spirit-NOPA®

Broadly Tunable Optical Parametric Amplifiers  
for 3-Photon Imaging in Neuroscience and  
Other Ultrafast Scientific Applications



The Spirit-NOPA is a family of automated non-collinear optical parametric amplifiers (NOPA) specifically built and optimized for the industry-proven Spirit® and Spirit® One™ ultrafast lasers. The turn-key, high repetition rate Spirit femtosecond laser combines with the Spirit-NOPA to create a powerful, user-friendly tunable, high repetition rate source of ultrashort pulses for in-vivo, deep tissue imaging in neuroscience, spectroscopy, and other ultrafast scientific applications.

## Spirit-NOPA-VISIR delivering unprecedented performance for 3-photon imaging:

In combination with our industry-proven Spirit platform, the Spirit-NOPA-VISIR provides an ideal platform for 3-photon excitation microscopy. Spirit-NOPA-VISIR comprises two amplification stages. The first amplification stage is non-collinear, which generates broad bandwidth, and the second amplification stage is collinear, which enables a broad tuning range.

Spirit-NOPA-VISIR provides a broadly tunable output of ultrashort pulses with a tuning range of 650 nm to 900 nm (signal) and 1200 nm to 2500 nm (idler), including key wavelengths for deep-tissue, 3-photon imaging. Optionally, the signal output can be compressed down to <70 fs using an external prism-based compressor unit, and the idler output down to <100 fs, using an integrated bulk compressor. When pumped by a Spirit ultrafast laser with up to 70 W and at a repetition rate of up to 4.3 MHz, the Spirit-NOPA-VISIR enables unprecedented performance for 3-photon imaging.

## Spirit-NOPA Advantage

### Spirit-NOPA-VISIR:

- Repetition rate up to 4.3 MHz
- Pump power up to 70 W
- High pulse energy for 3-photon imaging
- Broad tuning range: 650 nm to 900 nm (signal), 1200 nm to 2500 nm (idler)
- Optional pulse compression: <70 fs (signal), <100 fs (idler)
- Dual pulse length option to bridge the gap in the tuning range

### Spirit-NOPA (-2H, -3H, and -IR):

- High repetition rate, ultrashort pulses
- Wavelength range from UV to IR
- Integrated pulse compressor



### Applications

- 3-photon excitation microscopy
- Single molecules studies
- Nanomaterials science
- Ultrafast surface dynamics
- Multi-dimensional spectroscopy

# Spirit-NOPA

Spectra-Physics' Spirit-NOPA-VISIR pumped with up to 70 W provides sufficient peak power, even at high repetition rates, to compensate for losses in the microscope optics and other scattering effects in the sample, thereby enabling researchers to fully reap the benefits of 3P imaging.

The Spirit-NOPA-VISIR is fully computer controlled to enable user-friendly operation. To cover 2P excitation imaging and applications in optogenetics as well, the Spirit-NOPA-VISIR can be configured with a dual pulse length option. With this option, narrow bandwidth, uncompressed laser pulses are available over an extended tuning range of the Spirit-NOPA-VISIR, closing the gap between signal and idler. The dual pulse length option is ideally suited for photostimulation of neurons in optogenetics and excitation of fluorescent dyes in the 900 nm to 1200 nm spectral range.

## Spirit-NOPA-3H, Spirit-NOPA-2H, and Spirit-NOPA-IR for ultrashort pulses from UV to IR:

Spirit-NOPA-3H includes a built-in third harmonic generator and its output is tunable from 520 nm to 900 nm with a pulse width as short as sub-30 fs and an output energy up to  $>0.5 \mu\text{J}$ .

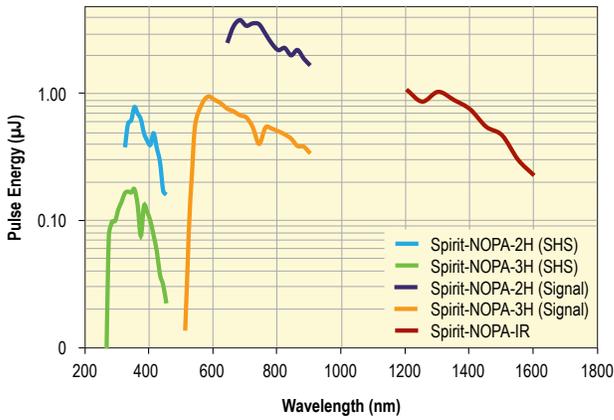
Spirit-NOPA-2H includes a built-in second harmonic generator, to convert the Spirit IR beam to 520 nm. The output of the Spirit-NOPA-2H is tunable from 650 nm to 900 nm with a pulse width as short as sub-30 fs and an output energy up to  $>3 \mu\text{J}$ .

Spirit-NOPA-IR includes a built-in second harmonic generator and its output is tunable from 1200 nm to 1600 nm with a pulse width as short as sub-80 fs and an output energy up to  $>0.6 \mu\text{J}$ .

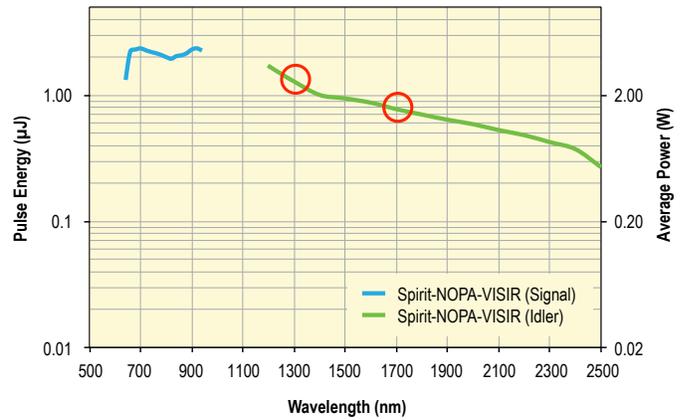
Spirit-NOPA (-3H, -2H, -IR) is fully computer controlled to allow for easy wavelength tunability. Its built-in bandwidth selector and integrated computer controlled compressor provide a pulse width agility unmatched by other ultrafast laser technologies.

# Spirit-NOPA

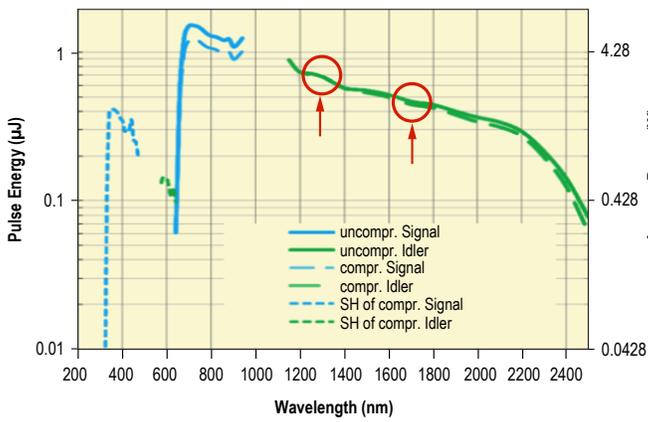
**Typical Spirit-NOPA Performance<sup>1</sup>**  
(Spirit pump pulse energy 40  $\mu$ J, Compressed Output)



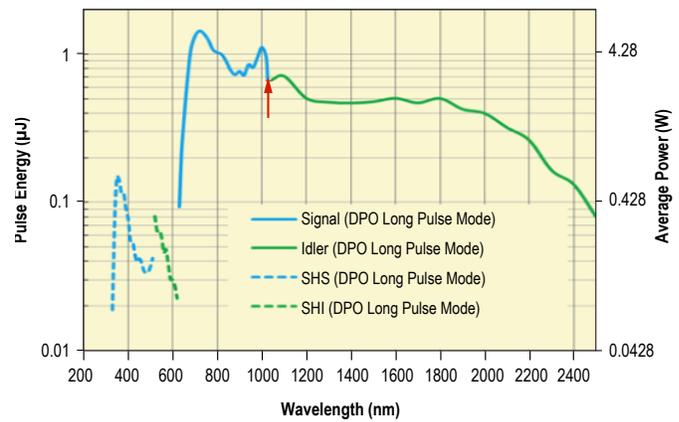
**Typical Spirit-NOPA-VISIR Performance<sup>1</sup>**  
(Pumped by a Spirit 1030-70 at 60 W and 2 MHz)



**Typical Spirit-NOPA-VISIR Performance<sup>1</sup>**  
(Pumped by Spirit 1030-70 with 70 W at 4.3 MHz including optional compressors and SHS/SHI)



**Typical Spirit-NOPA-VISIR Performance<sup>1</sup>**  
(Pumped by Spirit 1030-70 with 70 W at 4.3 MHz including optional Dual Pulse Length Option and SHS/SHI)



1. Typically measured performance; not a guaranteed or warranted specification.

# Spirit-NOPA Specifications<sup>1</sup>

	Spirit-NOPA-3H	Spirit-NOPA-2H	Spirit-NOPA-IR
<b>Output Specifications</b>			
Tuning Range	520–900 nm	650–900 nm	1200–1600 nm
Pulse Energy <sup>2</sup>	0.5 µJ at 580 nm (peak); 0.25 µJ at 700 nm	3 µJ at 700 nm (peak); 1.2 µJ at 850 nm	0.6 µJ at 1300 nm; 0.3 µJ at 1500 nm
Pulse Width	<30 fs at 530–670 nm; <80 fs at 670–800 nm	<30 fs at 700–850 nm	<80 fs at 1200–1600 nm
<b>Optional SHG Output</b>			
Tuning Range	260–450 nm	325–450 nm	600–800 nm
Pulse Energy <sup>2</sup>	0.05 µJ at 290 nm (peak)	0.3 µJ at 350 nm (peak)	0.06 µJ at 650 nm
<b>Pump Requirements<sup>4</sup> from Spirit</b>			
Repetition Rate	Single shot to 1 MHz		
Wavelength	1030 nm or 1040 nm		
Pulse Energy <sup>5</sup>	12–120 µJ	10–120 µJ	10–120 µJ
Max. Input Power	8 W	8 W	16 W
<b>Spirit-NOPA-VISIR</b>			
<b>Output Specifications</b>			
Tuning Range	650–900 nm (signal) 1200–2500 nm (idler)		
Conversion Efficiency	>10% at peak, when pumped at >20 µJ (uncompressed signal + idler combined)		
Pulse Width <sup>3</sup>	<350 fs uncompressed <sup>2</sup> <70 fs at 650–900 nm with signal compressor; <100 fs at 1200–2000 nm with idler compressor		
Compressor Transmission	Signal prism compressor: >65% at 650–900 nm Idler bulk compressor: >80% at 1200–2000 nm		
<b>Optional SHG Output</b>			
Tuning Range	325–450 nm (SH of signal) 600–700 nm (SH of idler)		
Pulse Energy <sup>2</sup>	>10% of signal/idler at peak		
<b>Optional Dual Pulse Length Configuration</b>			
Tuning Range in Long Pulse Mode	650–1025 nm (signal) 1040–2500 nm (idler) Uncompressed output		
<b>Pump Requirements<sup>4</sup> from Spirit 1030-70 or Spirit 1030-100</b>			
Repetition Rate	Single shot to 4.3 ±0.3 MHz		
Wavelength	1030 nm		
Pulse Energy <sup>5</sup>	16–100 µJ		
Average Power	up to 70 W		

1. Due to our continuous product improvement program, specifications are subject to change without notice.

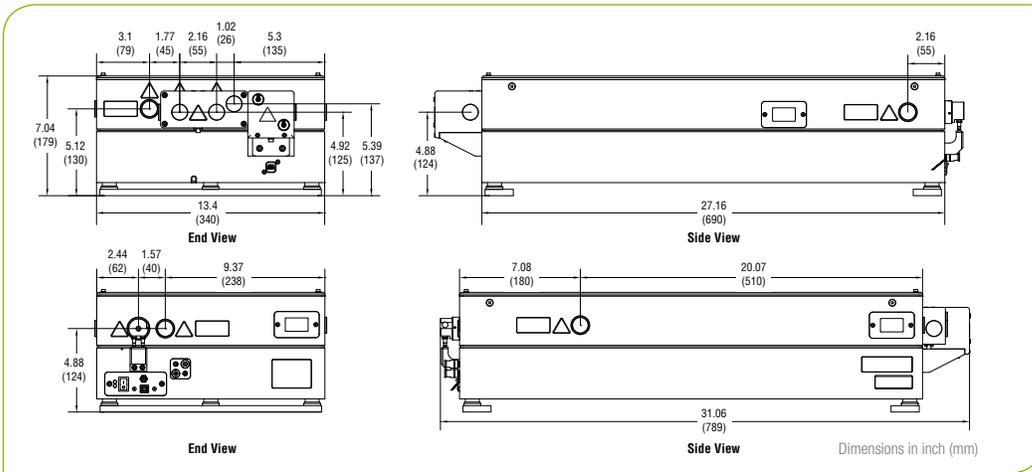
2. When pumped with 40 µJ at 1040 nm. For other pump levels, please contact Spectra-Physics.

3. Compressors for signal and/or idler are options.

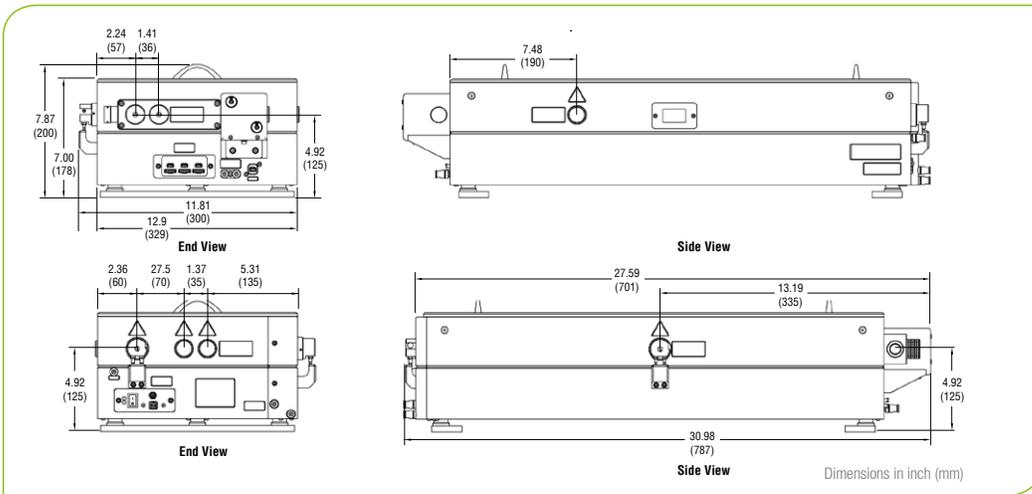
4. Spirit-NOPA pump parameters are determined at the time of order and are set at the factory.

5. Spirit-NOPA is factory optimized for one pump pulse energy only.

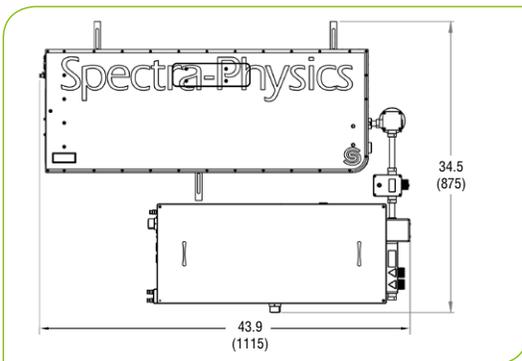
# Spirit-NOPA



Spirit-NOPA-2H, -3H, and -IR Dimensions



Spirit-NOPA-VISIR Dimensions



Spirit 1030-70/100 pumping Spirit-NOPA-VISIR Dimensions (without Signal compressor, top view)



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