

# Spirit®

## High Power Femtosecond Lasers: The New Standard for High-Precision Micromachining

mks | Spectra-Physics®

The Spirit family sets new standards for femtosecond lasers in high-precision industrial manufacturing for micromachining of polymers, thin metals, sapphire, polycrystalline diamond, and many other materials. These lasers deliver high average power, high pulse energy, and high repetition rates for increased throughput. Customers benefit from the shortest industrially available pulse duration and superior beam quality that in turn enables machining complex and challenging parts with highest precision and quality with literally no heat affected zone (HAZ) at the highest throughput. Spirit lasers are designed for industrial use and offer reliable and robust 24/7 operation with lowest cost of ownership. The Spirit lasers also provide unprecedented performance for pumping of non-linear OPAs for 3-photon microscopy and spectroscopy applications.

### Highest-Precision Machining of the Finest Features with Highest Throughput

Our new additions to the industry-proven Spirit platform offers impressive versatility and performance, enabling a variety of applications. High average power (>140 W) and high pulse energy (>600  $\mu\text{J}$ ) combined with high repetition rates push femtosecond micromachining applications to highest levels of throughput at lowest cost-of-ownership. The user-configurable burst mode enables processing with increased ablation efficiency, and thus increased throughput and quality for certain materials. Pulse energy and repetition rate adjustability (single shot – 30 MHz) make the Spirit 1030-140 the ideal source for ablation and cutting. The integrated pulse picker offers full control of the laser output with single pulse selection and fast power control via an analog input signal.

### The Spirit Advantage

- High average power up to >140 W at 1030 nm and >50 W at 515 nm
- Same footprint for all Spirit models
- Adjustable repetition rate from single shot up to 30 MHz for processing at highest throughput
- <400 fs pulse duration for smallest heat affected zone (HAZ)
- User-configurable burst mode for processing with highest ablation efficiency
- Near diffraction-limited beam quality (typ.  $M^2 < 1.1$ ) for highest resolution and finest features
- Integrated pulse-picker for advanced triggering
- 24/7 industrial reliability
- Lowest cost-of-ownership



### Applications

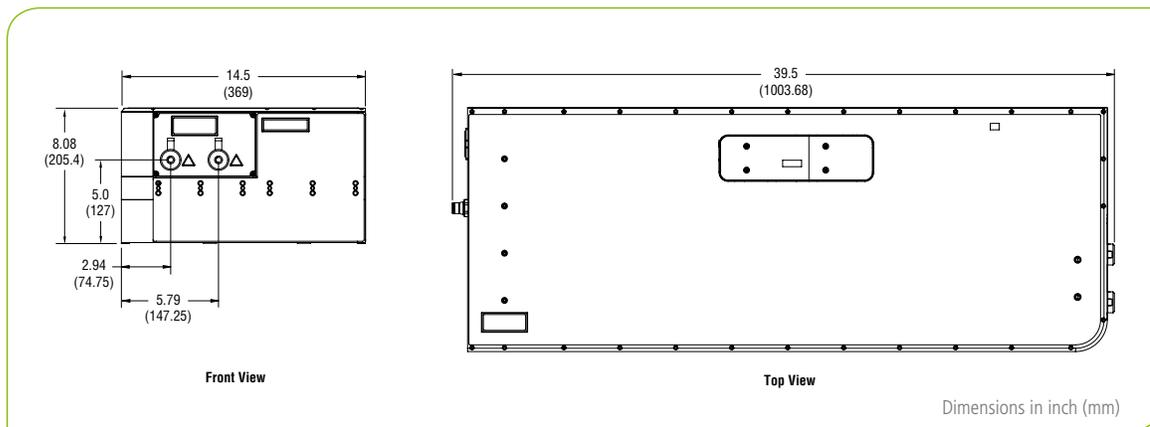
- OLED display manufacturing
- Semiconductor wafer dicing
- Polymer cutting
- Metal drilling and cutting
- Precision machining of hard and brittle materials
- Polycrystalline diamond (PCD) cutting and ablation
- Sapphire cutting and drilling
- 3-photon microscopy
- Optical parametric amplifier pumping

# Spirit

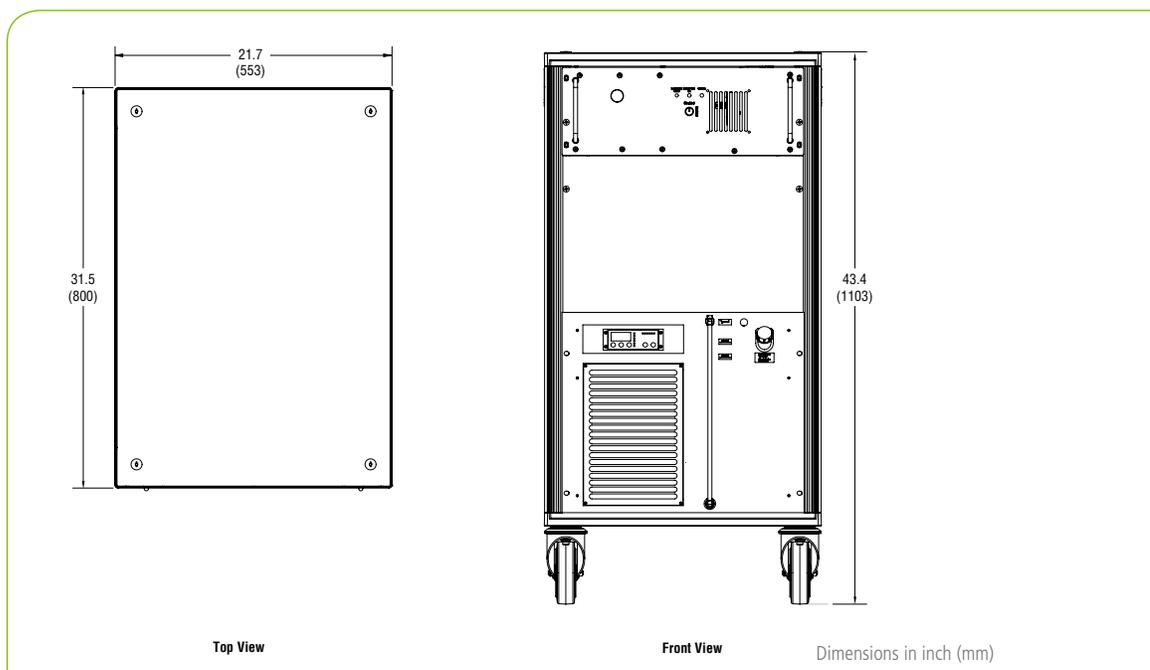
Spirit 515-50 offers an output power of >50 W and a typical pulse width of <300 fs at a wavelength of 515 nm. At this shorter wavelength, machining of the finest features is possible, depending on the material, at equal or even higher speeds compared to those obtained with other technologies.

## 24/7 Industrial Reliability

The Spirit lasers are designed and tested to rigorous quality standards for reliable 24/7 operation. The built-in data logging and analysis capability allows monitoring of all relevant laser parameters over the life time of the system. As such, this represents an indispensable diagnostics tool for service and preventive maintenance which significantly enhances uptime and thus productivity of the tool.



Spirit Laser Dimensions



Spirit Laser Rack with Power Supply and Chiller Dimensions

# Spirit Specifications<sup>1, 7</sup>

	Spirit 1030-140	Spirit 1030-100	Spirit 1030-70	Spirit 515-50
<b>Output Characteristics</b>				
Wavelength	1030 nm ±5 nm			515 nm ±3 nm
Output Power	>140 W	>100 W	>70 W	>50 W <sup>3</sup>
Pulse Energy	>600 μJ <sup>2</sup>	>100 μJ	>70 μJ	>50 μJ <sup>3</sup>
Repetition Rates <sup>4</sup>	0.1–30 MHz	1–30 MHz		
Pulse Selection	Single shot to 2 MHz using Integrated Pulse Picker (AOM)			
Pulse Width	<400 fs			
Power Stability	<1% rms over 100 hours			
Pulse-to-Pulse Stability	<2% rms			
Spatial Mode	TEM <sub>00</sub> (M <sup>2</sup> <1.2)			
Beam Diameter	2.5 mm ±0.5 mm			
Beam Divergence, full angle	<1 mrad			<0.5 mrad
Burst Mode <sup>5,6</sup>	>600 μJ/burst	>100 μJ/burst	>70 μJ/burst	N/A
Pre-Pulse Contrast Ratio	>250:1			
Polarization	Horizontal			
Cold Start Time	<30 min.			
Warm Start Time	<15 min.			
<b>Environmental specifications</b>				
Operating Temperature	15–35°C (59–95°F)			
Relative Humidity	<65%, non-condensing			
<b>Cooling Requirements</b>				
Laser Head	Water cooled			
Power Supply	Water cooled			
<b>Utility Requirements</b>				
Voltage	208–230 V, 50/60 Hz			
Current	<16 A			
<b>Laser Head Physical Characteristics</b>				
Dimensions (L x W x H)	39.5 x 14.5 x 8.1 in (1003 x 369 x 205 mm)			
Weight	155 lbs (70 kg)			
<b>Rack with Power Supply and Chiller Physical Characteristics</b>				
Dimensions (L x W x H)	31.5 x 21.8 x 43.4 in ( 800 x 553 x 1102 mm)			
Weight	220 lbs (100 kg)			

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

2. Pulse energy of >600μJ at 100 kHz

3. Maximum conversion efficiency for SHG at 1 MHz.

4. Specific pre-calibrated repetition rates are available; please contact Spectra-Physics.

5. Burst mode operation is optional; if implemented the number of pulses per burst (<12 pulses) can be selected in GUI.

6. Repetition rates are limited to ≤2 MHz for Spirit 1030 lasers with the burst mode option.

7. Spirit lasers are Class IV - High Power Lasers, whose beam are, by definition, a safety and fire hazard. Take precautions to prevent exposure to the direct and reflected beams. Diffuse as well as specular reflections can cause severe skin or eye damage.



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