

IceFyre®

Versatile UV, Green and IR Picosecond Lasers:
The New Standard for Picosecond Micromachining



IceFyre redefines picosecond micromachining lasers with a patent-pending design to achieve exceptional performance and unprecedented versatility at industry leading cost-performance. Based on Spectra-Physics' *It's in the Box™* design, IceFyre integrates laser and controller into the industry's smallest package.

Exceptional Performance and Unprecedented Versatility

The IceFyre UV50 is the highest performing UV ps laser on the market, providing >50 W of UV output power at 1.25 MHz (>40 μ J) with 100's μ J pulse energies in burst mode, and pulse widths of 10 ps. The IceFyre UV50 sets new standards in power and repetition rates from single shot to

10 MHz. The IceFyre UV30 offers >30 W of typical UV output power with pulse energy >60 μ J (greater pulse energies in burst mode) and delivers exceptional performance from single shot to 10 MHz. The IceFyre GR50 delivers >50 W of green output power at pulse energy >100 μ J at 500 kHz. The IceFyre IR50 outputs >50 W of IR power at 400 kHz single pulse and delivers exceptional performance from single shot to 10 MHz.

The IceFyre laser's unique design exploits fiber laser flexibility and Spectra-Physics' exclusive power amplifier capability to enable TimeShift™ ps programmable burst-mode technology for the highest versatility and performance in the industry. A standard set of waveforms is provided with each

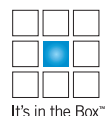
The IceFyre Advantage

- Highest power at high repetition rates UV, Green and IR models
- Industry-leading cost-performance
- Unprecedented pulse control
 - TimeShift ps technology
 - Adjustable number of pulses in burst
 - Programmable burst shape (envelope of burst)
 - Adjustable burst mode pulse separation
 - Full power available with burst mode adjustments
 - Widest adjustable repetition-rate range
 - Pulse-on-demand (POD) and position-synchronized output (PSO) triggering
 - Lowest timing jitter variability in pulse timing
- Most compact, *It's in the Box* laser
- 24/7 industrial reliability



Applications

- OLED processing
- 5G flexible printed circuits (FPC & MPI) cutting/drilling
- ITO drilling/scribing
- Semiconductor scribing and dicing
- PCB processing
- Ceramic cutting, drilling and scribing
- Solar cell scribing and drilling
- LED scribing, dicing and patterning
- Metal cutting, drilling and marking

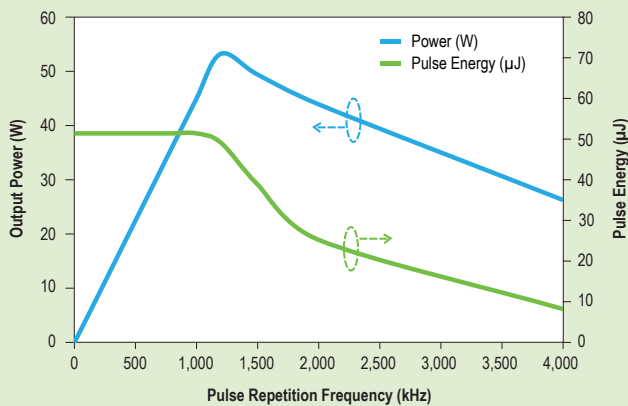


laser; an optional TimeShift ps GUI is available for creating custom waveforms. The laser design enables true pulse-on-demand (POD) and position-synchronized output (PSO) triggering with the lowest timing jitter in its class for high-quality processing at high scan speeds, e.g. when using a polygon scanner.

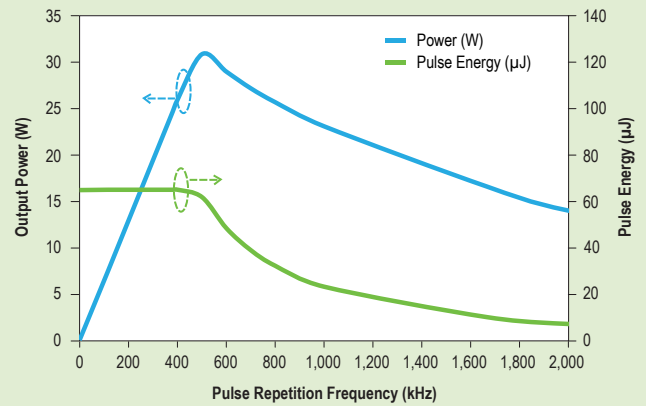
24/7 Industrial Reliability

IceFyre is designed, built, and tested to stringent quality standards for reliable continuous operation in demanding 24/7 manufacturing environments, resulting in high initial quality and low cost of ownership. IceFyre lasers' automatic data logging software monitors all key laser performance parameters over the life of the laser, providing a powerful service and preventative maintenance diagnostics feature and product reliability tool.

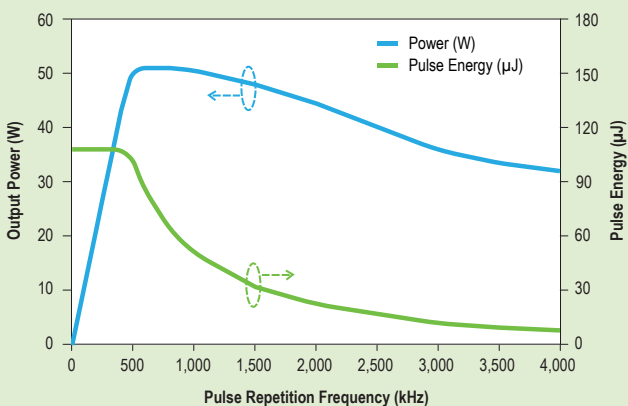
IceFyre UV50 Typical Power and Pulse Energy¹



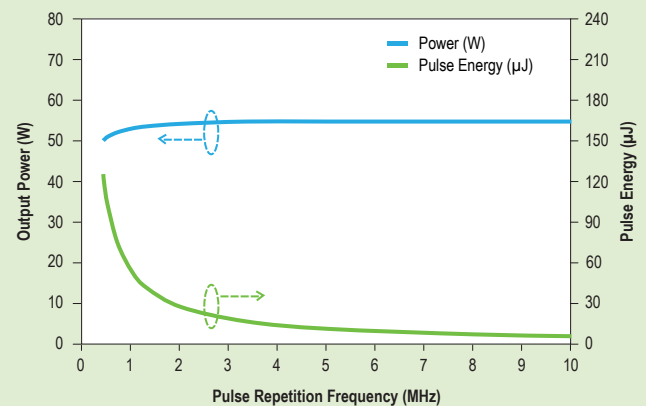
IceFyre UV30 Typical Power and Pulse Energy¹



IceFyre GR50 Typical Power and Pulse Energy¹



IceFyre IR50 Typical Power and Pulse Energy¹



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

IceFyre Specifications^{1, 2, 9}

	IceFyre UV50	IceFyre UV30	IceFyre GR50	IceFyre IR50
Output Characteristics				
Wavelength	355 nm		532 nm	1064 nm
Power ^{2, 3}	>50 W @ 1250 kHz	>30 W typical @ 500 kHz >25 W @ 800 kHz >20 W typical @ 1 MHz	>50 W @ 500 kHz	>50 W @ 400 kHz
Maximum Pulse Energy, typical (greater pulse energy per burst possible with TimeShift ps)	>40 μJ @ 1250 kHz	>60 μJ typical @ 500 kHz >31 μJ @ 800 kHz >20 μJ typical @ 1 MHz	>100 μJ @ 500 kHz	>200 μJ @ 200 kHz
Repetition Rate Range ⁶	Single shot to 10 MHz			
Pulse Width, FWHM ²	<12 ps (10 ps typical)		<15 ps (13 ps typical)	
TimeShift ps	yes			
Pulse-to-Pulse Energy Stability ²	<2.0%, 1 σ			<1.5%, 1 σ
Power Stability (after warm-up) ²	<1%, 1 σ, over 8 hours			
Beam Characteristics				
Spatial Mode ²	TEM ₀₀ (M ² <1.3)			
Polarization	>100:1, vertical		>100:1, horizontal	>100:1, vertical
Beam Diameter (D4σ) ²	5.0 ±0.5 mm	3.5 ±0.35 mm		3.0 ±0.3 mm
Beam Divergence, full angle ²	<0.20 mrad			<0.75 mrad
Beam Asymmetry ²	≤1.10 (≥90% circularity)			
Boresight Tolerance ²	±0.5 mm, ±5 mrad			
Beam Pointing Stability ²	<±25 μrad/°C			
Operating Conditions ⁸				
Warm-up Time, typical	45 min from warm start mode, <60 min from cold start ⁷			<15 min from warm start mode, <40 min from cold start ⁷
Temperature Range	15–30°C			
Altitude	0–2000 m			
Humidity ⁷	0–90% non-condensing, dew point <19°C			
Storage Conditions ⁸				
Temperature Range	0–50°C			
Altitude	0–10,000 m			
Humidity ⁷	0–90% non-condensing, dew point <22°C			
Electrical and Chiller Requirements ⁷				
Water Temperature (laser inlet)	20 ±1°C, stable to ±0.5°C			
Water Flow Rate (at laser head)	1.8 GPM (6.8 LPM)			
AC Input	200 VAC (180–260), 2000 W Max, 50/60 Hz, single phase	100–240 VAC, 1000 W Max, 50/60 Hz, single phase		
Heat Load (at laser head)	<1600 W	<800 W (600 W typical)		
Heat Load (at power supply)	300 W	<200 W		
Total Power Consumption	<2000 W	<1000 W		
Physical Characteristics ⁵				
Dimensions (Laser) (L x W x H) ⁴	42.14 x 19.88 x 7.63 in (1070.4 x 504.8 x 193.08 mm)	35.00 x 12.13 x 7.63 in (889.0 x 308.0 x 193.8 mm)		29.50 x 12.13 x 7.50 in (749.5 x 308.0 x 190.6 mm)
Weight (Laser)	215 lbs (97.5 kg)	108 lbs (49 kg)		95 lbs (43 kg)
Dimensions (Utility Module) (L x W x H)	21.16 x 18.98 x 3.47 in (537.5 x 482.1 x 88.1 mm)			
Weight (Utility Module)	24.70 lbs. (11.20 kg)	22.80 lbs. (10.34 kg)		15.00 lbs. (6.80 kg)
Features				
EU RoHS 2 Compliant, China RoHS 2, CE Compliant	Product compliant with restriction of hazardous substances			
Internal Power Monitor	May be calibrated against an external power meter			
Alignment Beam Mode	Lower power beam for installation and alignment in a tool (IR requires optional AOM)			
Replaceable Output Window	Customer replaceable to maintain power in harsh environments			
Data Log	Long- and short-term recording for diagnostics and equipment maintenance			
Optional Safety Shutter	Externally mounted for easy field service and customer replaceable			
Optional Output AOM	NA (Power attenuation by software control. Consult Spectra-Physics)			Provides power attenuation at constant power, used with trigger, gate and pulse on demand, use as a process shutter
Optional Timeshift ps GUI	Enables waveform customization			

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

2. IR specifications are at 400 kHz single pulse with the diode current set to achieve 51 W, unless otherwise noted. IceFyre UV30 specifications are at 800 kHz single pulse with the diode current set to achieve 25.5 W, unless otherwise noted. IceFyre UV50 specifications are at 1250 kHz single pulse with the diode current set to achieve >50 W, unless otherwise noted. IceFyre GR50 specifications are at 500 kHz single pulse with the diode current set to achieve >50 W, unless otherwise noted.

3. IR power shown is without optional AOM.

4. Dimensions noted do not include the removable lift handles.

5. AC to DC converter module included with standard system.

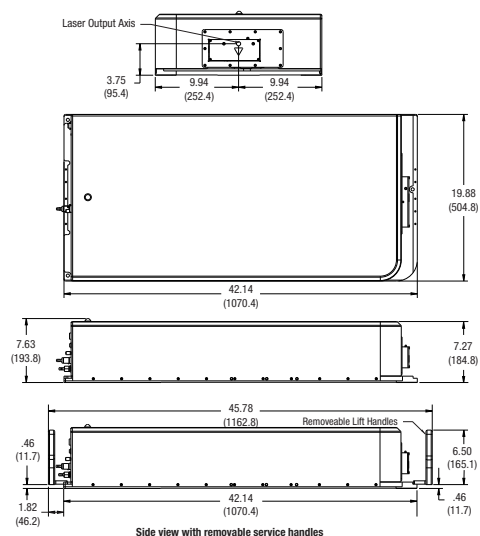
6. Please consult factory for IR operation below 400 kHz without output AOM option.

7. Warm start: AC, chiller and GUI on, all diodes off.

8. High temperature, high humidity operation limited to dew point <19°C; high temperature, high humidity storage limited to dew point <22°C.

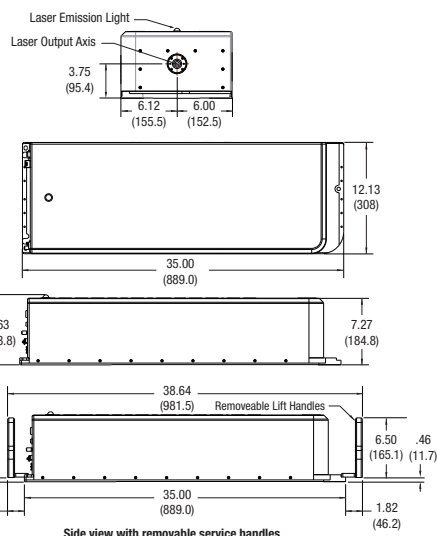
9. IceFyre is a Class IV – High-Power Laser, whose beam is, by definition, a safety and fire hazard. Take precautions to prevent exposure to direct and reflected beams. Diffuse as well as specular reflections can cause severe skin or eye damage.

IceFyre Dimensional Drawings



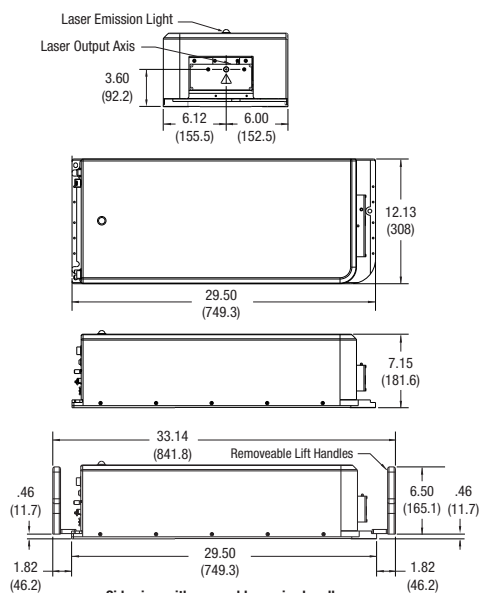
Dimensions in inch (mm)

IceFyre UV50 Laser Dimensions



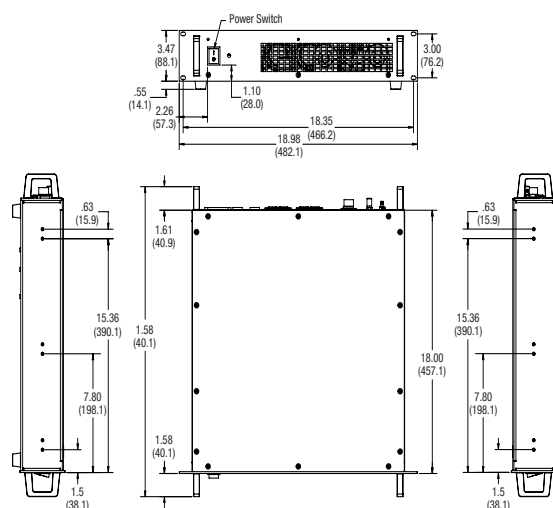
Dimensions in inch (mm)

IceFyre UV30 and GR50 Laser Dimensions



Dimensions in inch (mm)

IceFyre IR50 Laser Dimensions



Dimensions in inch (mm)

Utility Module Dimensions