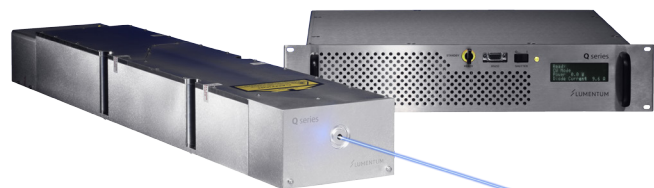


High-Power Q-Switched Diode-Pumped UV and Green Laser

Q Series



Lumentum Q Series lasers lead the market for high-power Q-switched diode-pumped UV and green lasers used for a wide variety of high-precision, micromachining applications. Whether for high-pulse-energy processing of materials such as ceramics, high-repetition-rate processing of materials such as sapphire or silicon, or patterning thin-film solar cells, the Q Series lasers deliver unsurpassed performance combined with industry-leading uptime.

Due to the self-stabilizing characteristics of intracavity UV harmonic generation, all Q Series lasers exhibit inherently high energy, high pulse-to-pulse stability and long-term output power stability. In addition, the excellent thermal management of the unique Nd: YAG-based direct-coupled pump (DCP) architecture achieves excellent beam quality over a wide range of operating conditions and maintains exceptionally stable beam position and profile, which is important for processes requiring accurate feature placement. These advantages enable Q series lasers to achieve the tightest possible process tolerances for micromachining and other materials-processing applications.

Key Features

- Highest commercially available pulse energy and peak power
- Tighter process control due to superior energy stability enabled by unique intracavity harmonic generation
- Capable of processing the widest range of materials due to large selection of pulse energies, pulse widths, and repetition rates
- High reliability due to low fluence in harmonic crystals and no cavity optic coatings exposed to UV
- 355 and 532 nm outputs available
- Customization available upon request

Applications

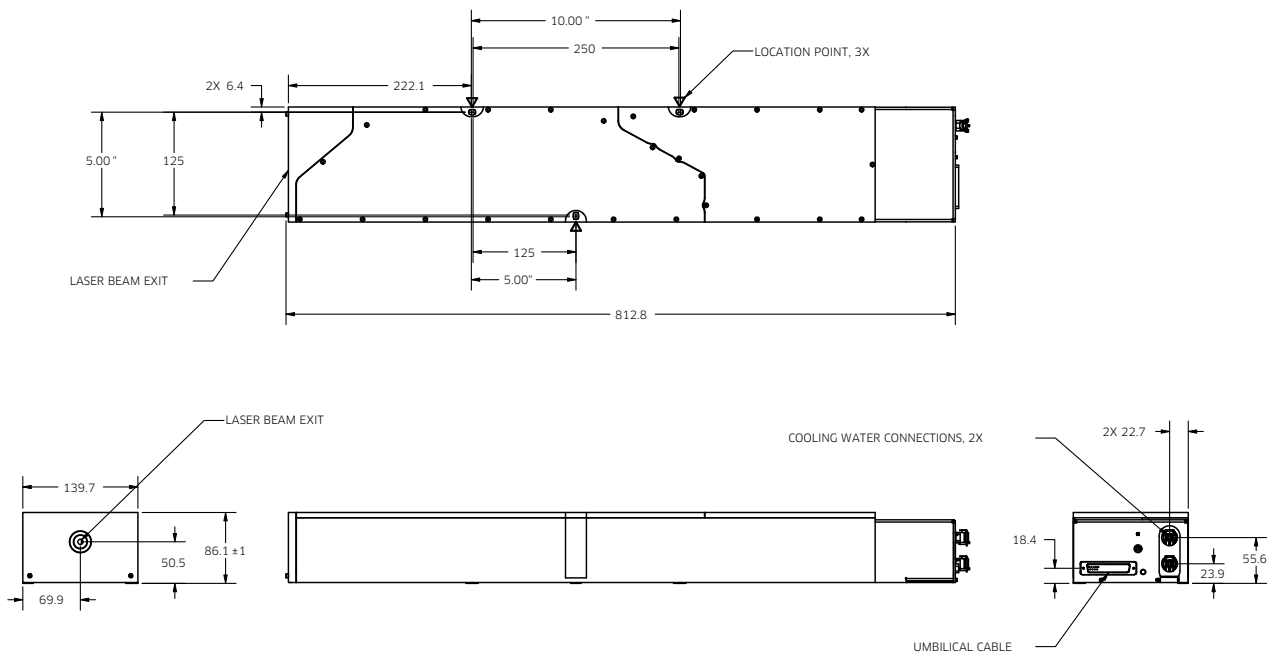
- Wafer scribing
- Full-cut wafer dicing
- Low-k dielectric grooving
- Micromachining of silicon, sapphire, ceramic, and metal
- Micro-via drilling
- PCB and flexboard cutting



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HWU Research Park, Edinburgh, EH14 4AP, UK, Tel: +44 (0)131 664 8122
Email sales@photronicsolutions.co.uk Web www.photronicsolutions.co.uk

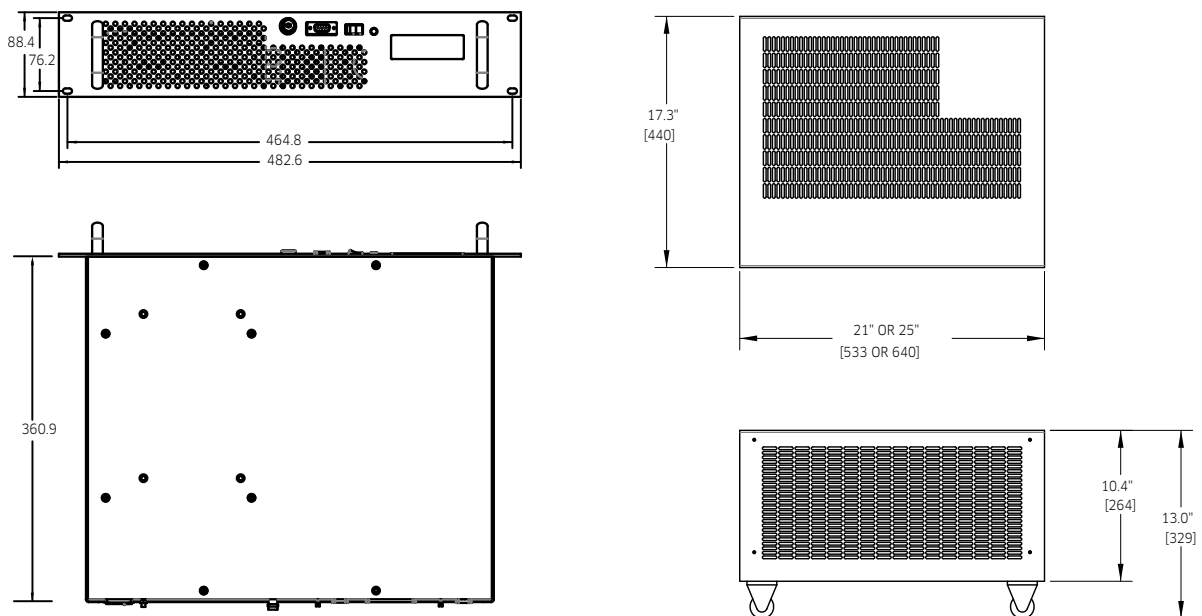
Q Series 355 nm Laser Head

(Specifications in millimeters unless otherwise noted. Dimensions include mounting pads.)



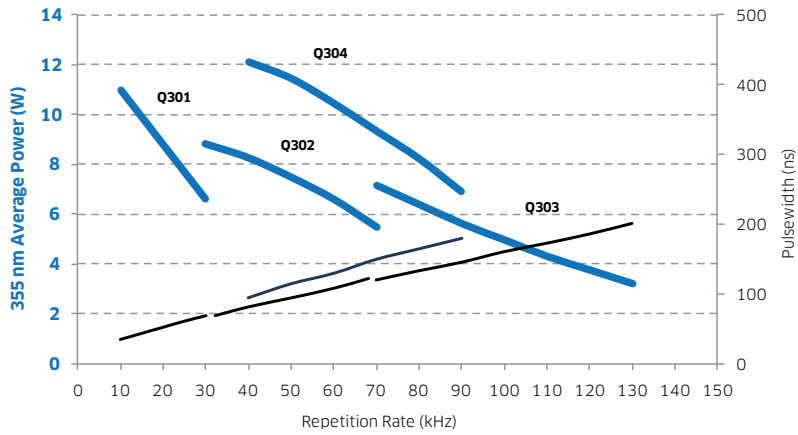
Power Supply and Chiller

(Specifications in millimeters unless otherwise noted.)



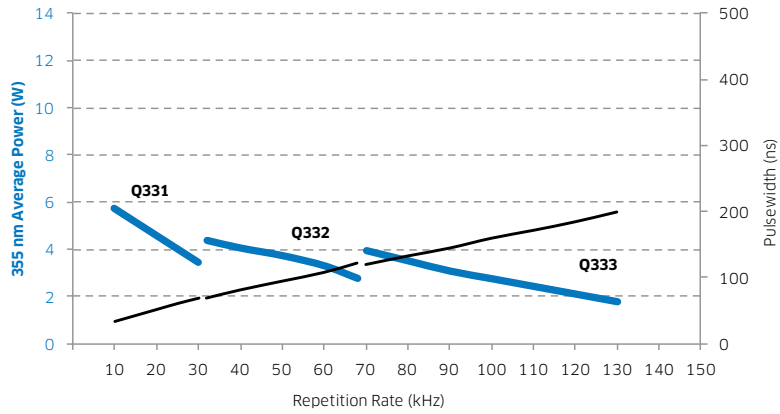
Q30X 355 nm Models

Typical Performance



Q33X Low Power 355 nm Models

Typical Performance



Q20X 532 nm Models

Typical Performance



Q Series Laser Head Specifications

Parameter	Q301-HD-1000R	Q302-HD-1000R	Q303-HD-1000R	Q304-HD-1000R
Wavelength	355 nm	355 nm	355 nm	355 nm
Polarization	>100:1, horizontal	>100:1, horizontal	>100:1, horizontal	>100:1, horizontal
Spatial mode	TEM ₀₀	TEM ₀₀	TEM ₀₀	TEM ₀₀
M-squared ¹	<1.2	<1.2	<1.2	<1.2
Waist location ¹ (internal, from beam exit)	42±0.4 cm	42±0.4 cm	42±0.4 cm	42±0.4 cm
Waist diameter ¹ : 1/e ²	0.26 mm nominal	0.26 mm nominal	0.26 mm nominal	0.25 mm nominal
Beam roundness	>85% circular	>85% circular	>85% circular	>85% circular
Beam divergence ¹ , full angle	1.8±0.35 mrad	1.8±0.35 mrad	1.8±0.35 mrad	2.0±0.35 mrad
Beam pointing drift, full angle	<10 μrad/°C	<10 μrad/°C	<10 μrad/°C	<10 μrad/°C
Pointing drift, over 8 hours, full angle ²	<50 μrad	<50 μrad	<50 μrad	<50 μrad
Beam position accuracy, unit to unit	<2.5 mm from nominal	<2.5 mm from nominal	<2.5 mm from nominal	<2.5 mm from nominal
Beam pointing accuracy, unit to unit	<1° from nominal	<1° from nominal	<1° from nominal	<1° from nominal
Controller repetition rate Internally triggered Externally triggered	1 kHz to 250 kHz 0 to 250 kHz	1 kHz to 250 kHz 0 to 250 kHz	1 kHz to 250 kHz 0 to 250 kHz	1 kHz to 250 kHz 0 to 250 kHz
Constant pulse energy range	<10 kHz	<30 kHz	<70 kHz	<40 kHz
Average output power ³ At 10, 20, and 30 kHz At 30, 50, and 70 kHz At 70, 100, and 130 kHz At 40, 60, and 90 kHz	≥10.0, 8.0 and 6.0 W - - -	- ≥8.0, 6.8, and 5.0 W - -	- - ≥6.5, 4.5, and 2.9 W -	- - - ≥11.0, 9.5, 6.3 W
Pulse width ⁴ At 10, 20, and 30 kHz At 30, 50, and 70 kHz At 70, 100, and 130 kHz At 40, 60, and 90 kHz	33±10, 49±15, 62±15 ns - - -	- 78±20, 107±25, 135±30 ns - -	- - 120±35, 160±45, 200±60 ns -	- - - 95±30, 130±35, 180±50 ns
Pulse energy fluctuations ⁵ At 10, 20, and 30 kHz At 30, 50, and 70 kHz At 70, 100, and 130 kHz At 40, 60, and 90 kHz	<1.0%, 10 – 30 kHz - - -	- <1.5%, 30 – 50 kHz - -	- - <1.5%, <2.0%, <2.5% -	- - - <1.5%, 40 – 90 kHz
Power drift over 8 hours ^{2,6}	<±2%	<±2%	<±2%	<±2%
Warm-up time From cold start From standby	<20 minutes <10 minutes	<20 minutes <10 minutes	<20 minutes <10 minutes	<20 minutes <10 minutes
Operating ambient temperature	15 to 35°C	15 to 35°C	15 to 35°C	15 to 35°C
Relative humidity, non-condensing	10 to 80%	10 to 80%	10 to 80%	10 to 80%
Weight	14.5 kg	14.5 kg	14.5 kg	14.5 kg

1. Specifications hold over different repetition rate ranges, depending on the laser model, as follows:
Q301 from 10 to 30 kHz, for Q302 from 30 to 70 kHz, for Q303 from 70 to 130 kHz, and Q304 from 40 to 90 kHz.

2. Ambient temperature constant ±2°C.

3. Averaged for 1 hour after >80 minutes of continuous operation.

4. FWHM pulse duration measured according to method detailed in Lumentum application note titled "Optical Pulse Width Measurement Techniques for Q-Series Lasers."

5. Pulse Energy Fluctuations = $\sigma / \mu \times 100\%$, σ = standard deviation, μ = average pulse energy.

6. Measured after more than 80 minutes of continuous operation.

Q Series Laser Head Specifications (Continued)

Parameter	Q331-HD-1000R	Q332-HD-1000R	Q333-HD-1000R
Wavelength	355 nm	355 nm	355 nm
Polarization	>100:1, horizontal	>100:1, horizontal	>100:1, horizontal
Spatial mode	TEM ₀₀	TEM ₀₀	TEM ₀₀
M-squared ¹	<1.2	<1.2	<1.2
Waist location ¹ (internal, from beam exit)	42±0.4 cm	42±0.4 cm	42±0.4 cm
Waist diameter ¹ , 1/e ²	0.26 mm nominal	0.26 mm nominal	0.26 mm nominal
Beam roundness	>85% circular	>85% circular	>85% circular
Beam divergence ¹ , full angle	1.8±0.35 mrad	1.8±0.35 mrad	1.8±0.35 mrad
Beam pointing drift, full angle	<10 μrad/°C	<10 μrad/°C	<10 μrad/°C
Pointing drift, over 8 hours, full angle ²	<50 μrad	<50 μrad	<50 μrad
Beam position accuracy, unit to unit	<2.5 mm from nominal	<2.5 mm from nominal	<2.5 mm from nominal
Beam pointing accuracy, unit to unit	<1° from nominal	<1° from nominal	<1° from nominal
Controller repetition rate Internally triggered Externally triggered	1 kHz to 250 kHz 0 to 250 kHz	1 kHz to 250 kHz 0 to 250 kHz	1 kHz to 250 kHz 0 to 250 kHz
Constant pulse energy range	<10 kHz	<30 kHz	<70 kHz
Average output power ³ At 10, 20, and 30 kHz At 30, 50, and 70 kHz At 70, 100, and 130 kHz	≥5.0, 4.0 and 3.0 W - -	- ≥4.0, 3.4, and 2.5 W -	- - ≥3.6, 2.5, and 1.6 W
Pulse width ⁴ At 10, 20, and 30 kHz At 30, 50, and 70 kHz At 70, 100, and 130 kHz	34±10, 52±15, 69±15 ns - -	- 69±20, 94±25, 121±34 ns -	- - 120±35, 160±45, 200±60 ns
Pulse energy fluctuations ⁵ At 10, 20, and 30 kHz At 30, 50, and 70 kHz At 70, 100, and 130 kHz	<2.0%, 10 – 30 kHz - -	- <3%, 30 – 70 kHz -	- - <3%, 70 - 130 kHz
Power drift over 8 hours ^{2,6}	<±2%	<±2%	<±2%
Warm-up time From cold start From standby	<20 minutes <10 minutes	<20 minutes <10 minutes	<20 minutes <10 minutes
Operating ambient temperature	15 to 35°C	15 to 35°C	15 to 35°C
Relative humidity, non-condensing	10 to 80%	10 to 80%	10 to 80%
Weight	14.5 kg	14.5 kg	14.5 kg

1. Specification holds over different repetition rate ranges, depending on the laser model, as follows:
Q331 from 10 to 30 kHz, for Q332 from 30 to 70 kHz, for Q333 from 70 to 130 kHz.

2. Ambient temperature constant ±2°C.

3. Averaged for 1 hour after >80 minutes of continuous operation.

4. FWHM pulse duration measured according to method detailed in Lumentum application note titled "Optical Pulse Width Measurement Techniques for Q-Series Lasers."

5. Pulse Energy Fluctuations = $\sigma / \mu \times 100\%$, σ = standard deviation, μ = average pulse energy.

6. Measured after more than 80 minutes of continuous operation.

Q Series Laser Head Specifications (Continued)

Parameter	Q201-HD-1000R	Q202-HD-1000R
Wavelength	532 nm	532 nm
Polarization	>100:1, vertical	>100:1, vertical
Spatial mode	TEM ₀₀	TEM ₀₀
M-squared	<1.3	<1.3
Waist location (internal, from beam exit)	50±5 cm	50±5 cm
Waist diameter, 1/e ²	0.35 mm nominal	0.35 mm nominal
Beam roundness	>85% circular	>85% circular
Beam divergence, full angle	2.2 mrad	2.2 mrad
Pointing drift, over 8 hours, full angle ²	<50 μrad	<50 μrad
Beam position accuracy, unit to unit	<1.0 mm from nominal	<1.0 mm from nominal
Beam pointing accuracy, unit to unit	<1.0° from nominal	<1.0° from nominal
Controller repetition rate Internally triggered ¹ Externally triggered ²	1 kHz to 250 kHz 0 to 250 kHz	1 kHz to 250 kHz 0 to 250 kHz
Frequency of pulse equalization (FPE) ^{1,2}	5 kHz	15 kHz
Average output power At 5, 10, 15 kHz At 15, 20, 30, 40, 50, 60 kHz	≥12.0, 14.5, 15.0 W -	- >12, 13, 14, 14.5, 14 W
Pulse width At 5, 10, 15 kHz At 15, 20, 30, 40, 50, 60 kHz	18±10, 29±15, 40±20 ns -	- 55±20, 65±25, 85±35, 110±45, 135±55, 160±65 ns
Pulse energy fluctuations ⁴ At 5, 10, 15 kHz At 15, 20, 30, 40, 50, 60 kHz	<2.0% -	- <2.5%
Power drift over 8 hours	<±2%	<±2%
Warm-up time From cold start From standby	<20 minutes <10 minutes	<20 minutes <10 minutes
Operating ambient temperature	15 to 35°C	15 to 35°C
Relative humidity, non-condensing	10 to 80%	10 to 80%
Weight	14.5 kg	14.5 kg

1. Specification holds over different repetition rate ranges, depending on the laser model, as follows:
Q201 from 5-15 kHz, for Q202 from 15 to 60 kHz.

2. Ambient temperature constant ±2°C.

3. Averaged for 1 hour after >80 minutes of continuous operation.

4. FWHM pulse duration measured according to method detailed in Lumentum application note titled "Optical Pulse Width Measurement Techniques for Q-Series Lasers."

5. Pulse Energy Fluctuations = $\sigma / \mu \times 100\%$, σ = standard deviation, μ = average pulse energy.

6. Measured after more than 80 minutes of continuous operation.

Q-PS-1000R Power Supply

Parameter	Specification
Front panel/display	Power on/off key Shutter open/closed switch (status LED) Status display (4 line x 20 character vacuum fluorescent) RS232 serial port connector (9-pin D-sub)
Rear panel	RS232 serial port connector (Identical to front panel) Interlock connector (2-pin, 0.1" spacing) Q switch RF connector (SMA connector) Umbilical connector (multi-pin D-shaped) Chiller communication port (9-pin D-sub) Emission indicator connector (2-pin, 0.1" spacing) External control port (10-pin 3M-style) Slot for optional standard or custom interface board (standard with 3 BNC connectors) Ground pin Fuse holder Power switch Power-cord connector
Weight	20.5 lbs (9.3 kg)
Umbilical cable length	10 ft. (3 m), 16.4 ft. (5 m), 23.3 ft. (7 m), 33.3 ft. (10 m). Other lengths available on request.
Frequency	100 to 240 V AC, 50 - 60 Hz
Power	<550 W (400 W typical)
Input and Ambient	
Voltage, frequency	100 to 240 V AC, 50 - 60 Hz
Power	<550 W (400 W typical)
Operating ambient temperature	15 to 35°C
Relative humidity, non-condensing	10 - 80%
Storage temperature	-20 to 55°C

QA-CH Chiller

Parameter	Specification
Cooling capacity	>300 W
Refrigerant	R134a
Coolant	Distilled water
Reservoir volume	<1 gal (3.8 l)
Coolant flow rate	<0.5 gpm at 14 psi (2 lpm at 1 bar)
Weight, reservoir empty	<121 lbs (55 kg)
Hose length	9.5 ft (2.9 m) or 16 ft (4.9 m). Other lengths on request
Chiller control cable length	10 ft (3.0 m)
Input and Ambient	
Voltage, frequency	110/115/208/220VAC ±10% 50 - 60Hz (16A at 100V)
Power	<1100 W (700 W typical)
Operating ambient temperature	15 to 35°C
Relative humidity, non-condensing	10 to 80%
Storage temperature	5 to 75°C
Orientation	Upright position only

Ordering Information

For more information on this or other products and their availability, please contact your local Lumentum account manager or Lumentum directly at customer.service@lumentum.com.

Example for complete system:

Q331-HD-1000R (355 nm, 10 to 30 kHz laser head)

Q-PS-1000R (power supply)

Q-PS-A30R (3 meter flex umbilical cable)

QA-CH (standard voltage configuration chiller)

QA-CH-A11 (3 m hose set, straight/straight couplings)

Laser Head

Product Code	Description
Q331-HD-1000R	355 nm, 5 W class, 10 to 30 kHz
Q332-HD-1000R	355 nm, 5 W class, 30 to 70 kHz
Q333-HD-1000R	355 nm, 5 W class, 70 to 130 kHz
Q301-HD-1000R	355 nm, 10 W class, 10 to 30 kHz
Q302-HD-1000R	355 nm, 10 W class, 30 to 70 kHz
Q303-HD-1000R	355 nm, 10 W class, 70 to 130 kHz
Q304-HD-1000R	355 nm, 11 W class, 40 to 90 kHz
Q201-HD-1000R	532 nm, 15 W class, 5 to 15 kHz
Q202-HD-1000R	532 nm, 15 W class, 15 to 60 kHz

Note: Lumentum Q-Series portfolio covers a wide range of repetition rate from single shot up to 200kHz. Custom models are available upon request.

Accessories

Product Code	Power Supply Description
Q-PS-1000R	Standard power supply

Product Code	Umbilical Cable Description
Q-PS-A30R	3 meter flex umbilical cable
Q-PS-A50R	5 meter flex umbilical cable
Q-PS-A70R	7 meter flex umbilical cable
Q-PS-A100R	10 meter flex umbilical cable

Product Code	Chiller Description
QA-CH	Standard with 110 VAC
QA-CH-E	European with 220 VAC

Product Code	Hose Kit Description
QA-CH-A11	Pair of 3 m hoses, straight/straight couplings
QA-CH-A12	Pair of 5 m hoses, straight/straight couplings
QA-CH-A21	Pair of 3 m hoses, right-angle/straight couplings
QA-CH-A22	Pair of 5 m hoses, right-angle/straight couplings
QA-CH-A31	Pair of 3 m hoses, right-angle/right-angle couplings
QA-CH-A32	Pair of 5 m hoses, right-angle/right-angle couplings

Compliance with Regulatory Requirements

These laser sources are generic versions of Lumentum diode-pumped, Q-switched laser systems. The lasers are Class IV lasers as defined by the Federal Register 21 CFR 1040.10 Laser Safety Standard. The Standard requires that certain performance features and laser safety labels be provided on the product.

The American National Standards Institute publishes a laser safety standard for users entitled American National Standard for the Safe Use of Lasers (ANSI Z136.1). Lumentum recommends that laser users obtain and follow the procedures described in this ANSI Standard.



Warranty

Lumentum diode-pumped Q Series laser systems are warranted to be free of defects in materials and workmanship. Multiple warranty options available.

Patent Information

The products described in this data sheet are based on Lumentum Intellectual Property which includes more than 1,800 United States and foreign registered patents. These patents are relevant to an extensive set of products and/or technology applications including Lumentum's laser products and associated technologies. For further information contact the Lumentum Legal Department.



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