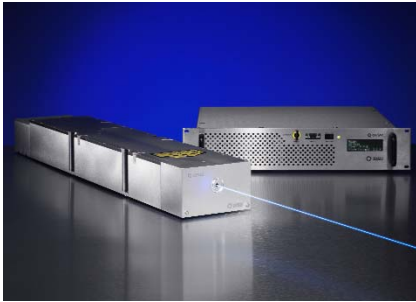


# High-Power Q-Switched Diode-Pumped UV Laser

## Q Series



### 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 widest range of materials due to wide range of pulse energies and repetition rates
- High reliability due to low fluence in harmonic crystals and no cavity optic coatings exposed to UV
- 355 or 532 nm outputs available

### Applications

- Solar cell processing
- Wafer scribing
- Full-cut thin wafer dicing
- Low-k dielectric grooving
- Micro via drilling
- Micromachining of silicon and metals

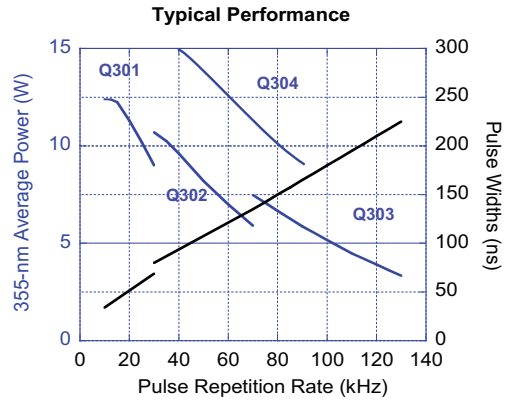
The JDSU Q Series lasers lead the market for high-power Q-switched diode-pumped UV lasers used for a wide variety of micromachining and solar cell processing applications. Whether for high pulse-energy processing of refractory materials such as silicon; high repetition rate processing of packaging materials such as Kapton; 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 pulse-to-pulse energy and long-term output power stability. In addition, the excellent thermal stability of the unique Nd:YAG-based direct-coupled pump (DCP) architecture 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.

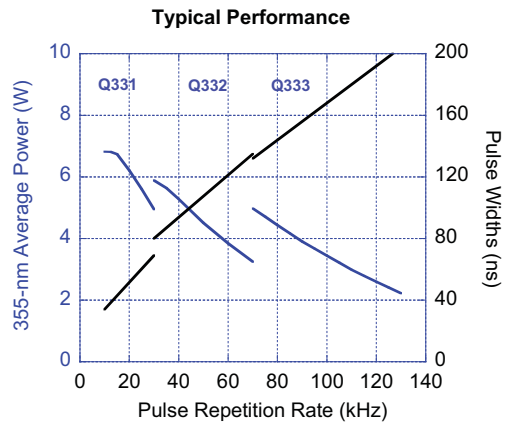


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**Q30X 355nm Models  
Typical Performance**



**Q33X Lower Coast 355nm Models  
Typical Performance**



## 4

## Q Series Laser Head Specifications

Parameter	Q301-HD	Q302-HD	Q303-HD	Q304-HD
Wavelength	355 nm	355 nm	355 nm	355 nm
Spatial mode	TEM <sub>00</sub>	TEM <sub>00</sub>	TEM <sub>00</sub>	TEM <sub>00</sub>
M-squared <sup>1</sup>	<1.2	<1.2	<1.2	<1.2
Waist location <sup>1</sup> (internal, from beam exit)	42±0.4 cm	42±0.4 cm	42±0.4 cm	42±0.4 cm
Waist diameter <sup>1</sup> , 1/e <sup>2</sup>	0.26 mm nominal	0.26 mm nominal	0.26 mm nominal	0.25 mm nominal
Beam divergence <sup>1</sup> , 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 <sup>2</sup>	<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
Repetition rate				
Internally triggered	5 to 250 kHz	5 to 250 kHz	5 to 250 kHz	5 to 250 kHz
Externally triggered	0 to 250 kHz	0 to 250 kHz	0 to 250 kHz	0 to 250 kHz
Constant pulse energy range	<10 kHz	<30 kHz	<50 kHz	<40 kHz
Average output power <sup>3</sup>				
At 10, 20, and 30 kHz	≥10.0, 8.0 and 6.0 W	-	-	-
At 30, 50, and 70 kHz	-	≥8.0, 6.8, and 5.0 W	-	-
At 70, 100, and 130 kHz	-	-	≥6.5, 4.5, and 2.9 W	-
At 40, 60, and 90 kHz	-	-	-	≥11.0, 9.5, 6.3 W
Pulse width <sup>4</sup>				
At 10, 20, and 30 kHz	34±10, 52±15, 69±15 ns	-	-	-
At 30, 50, and 70 kHz	-	78±20, 107±20, 135±30 ns	-	-
At 70, 100, and 130 kHz	-	-	135±35, 180±45, 225±60 ns	-
At 40, 60, and 90 kHz	-	-	-	95±30, 130±35, 180±50 ns
Pulse energy fluctuations <sup>5</sup>				
At 10, 20, and 30 kHz	<1.0%, 10 – 30 kHz	-	-	-
At 30, 50, and 70 kHz	-	<1.5%, 30 – 50 kHz	-	-
At 70, 100, and 130 kHz	-	-	<1.5%, <2.0%, <2.5%	-
At 40, 60, and 90 kHz	-	-	-	<1.5%, 40 – 90 kHz
Power drift over 8 hours <sup>2,6</sup>	<±2%	<±2%	<±2%	<±2%
Beam roundness	>85% circular	>85% circular	>85% circular	>85% circular
Polarization	>100:1, horizontal	>100:1, horizontal	>100:1, horizontal	>100:1, horizontal
Warm-up time				
From cold start	<20 minutes	<20 minutes	<20 minutes	<20 minutes
From standby	<10 minutes	<10 minutes	<10 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. Pulse duration measured according to method detailed in JDSU application note titled "Optical Pulse Width Measurement Techniques for Q-Series Lasers."

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

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

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Q Series Laser Head Specifications	Continued		
Parameter	Q331-HD	Q332-HD	Q333-HD
Wavelength	355 nm	355 nm	355 nm
Spatial mode	TEM <sub>00</sub>	TEM <sub>00</sub>	TEM <sub>00</sub>
M-squared <sup>1</sup>	<1.2	<1.2	<1.2
Waist location <sup>1</sup> (internal, from beam exit)	42±0.4 cm	42±0.4 cm	42±0.4 cm
Waist diameter <sup>1</sup> , 1/e <sup>2</sup>	0.26 mm nominal	0.26 mm nominal	0.26 mm nominal
Beam divergence <sup>1</sup> , 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 <sup>2</sup>	<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
Repetition rate			
Internally triggered	5 to 250 kHz	5 to 250 kHz	5 to 250 kHz
Externally triggered	0 to 250 kHz	0 to 250 kHz	0 to 250 kHz
Constant pulse energy range	<10 kJ	<30 kJ	<50 kJ
Average output power <sup>3</sup>			
At 10, 20, and 30 kHz	≥5.0, 4.0 and 3.0 W	-	-
At 30, 50, and 70 kHz	-	≥4.0, 3.4, and 2.5 W	-
At 70, 100, and 130 kHz	-	-	≥3.6, 2.5, and 1.6 W
Pulse width <sup>4</sup>			
At 10, 20, and 30 kHz	34±10, 52±15, 69±15 ns	-	-
At 30, 50, and 70 kHz	-	78±20, 107±20, 135±30 ns	-
At 70, 100, and 130 kHz	-	-	132±30, 168±40, 204±55 ns
Pulse energy fluctuations <sup>5</sup>			
At 10, 20, and 30 kHz	<2.0%, 10 – 30 kHz	-	-
At 30, 50, and 70 kHz	-	<3%, 30 – 50 kHz	-
At 70, 100, and 130 kHz	-	-	<3%, <2.0%, <2.5%
Power drift over 8 hours <sup>2,6</sup>	<±2%	<±2%	<±2%
Beam roundness	>85% circular	>85% circular	>85% circular
Polarization	>100:1, horizontal	>100:1, horizontal	>100:1, horizontal
Warm-up time			
From cold start	<20 minutes	<20 minutes	<20 minutes
From standby	<10 minutes	<10 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. Pulse duration measured according to method detailed in JDSU application note titled “Optical Pulse Width Measurement Techniques for Q-Series Lasers.”

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

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

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**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	Standard: 10 ft. (3.0 m); optional: 16.4 ft. (5.0 m)
Frequency	100 to 240 V AC, 50 – 60 Hz
Power	<550 W (400 W typical)
<b>Input and Ambient</b>	
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 or tap water
Reservoir volume	<1 gal (3.8 l)
Coolant flow rate	<0.4 gpm at 6 psi (1.5 lpm at 0.4 atm)
Weight, reservoir empty	121 lbs (55 kg)
Hose length	Standard: 9.5 ft (2.9 m); optional: 16 ft (4.9 m)
Control cable length	10 ft (3.0 m)
<b>Input and Ambient</b>	
Voltage, frequency <sup>1</sup>	90 to 110 and 180 to 220 V AC, 50 Hz 105 to 125 and 210 to 250 V AC, 60 Hz
Power	<1000 W (700 W typical)
Operating ambient temperature	15 to 35°C
Relative humidity, non-condensing	10 to 80%
Storage temperature	-20 to 55°C
Orientation	Upright position only

1. For 200/230 VAC version, the model number is QA-CH-E.

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**Ordering Information**

For more information on this or other products and their availability, please contact your local JDSU account manager or JDSU directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide, or via e-mail at [customer.service@jdsu.com](mailto:customer.service@jdsu.com).

**Sample: Q331-HD (355 nm, 10 to 30 kHz laser head), Q-PS-1000R (power supply), Q-PS-A30R (3 meter flex umb cable set), QA-CH (standard voltage configuration chiller), and QA-CH-A11 (3 m hose, straight/straight couplings)**

**Laser Head**

Product Code	Description
Q331-HD	355 nm, 5 W class, 10 to 30 kHz
Q332-HD	355 nm, 5 W class, 30 to 70 kHz
Q333-HD	355 nm, 5 W class, 70 to 130 kHz
Q301-HD	355 nm, 10 W class, 10 to 30 kHz
Q302-HD	355 nm, 10 W class, 30 to 70 kHz
Q303-HD	355 nm, 10 W class, 70 to 130 kHz
Q304-HD	355 nm, 11 W class, 40 to 90 kHz

**Power Supply**

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

**Umbilical Cable**

Product Code	Description
Q-PS-A30R	3 meter flex umbilical cable set
Q-PS-A50R	5 meter flex umbilical cable set
Q-PS-A70R	7 meter flex umbilical cable set
Q-PS-A100R	10 meter molded umb cable set

**Chiller**

Product Code	Description
QA-CH	Chiller with standard voltage configuration
QA-CH-E	Chiller with European voltage configuration

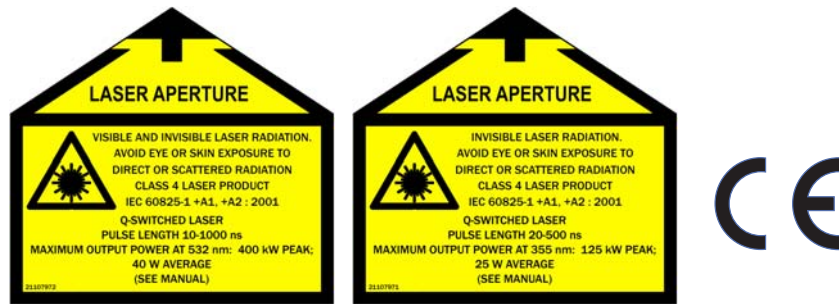
**Hose Kit**

Product Code	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 (non-OEM) versions of JDSU 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). JDSU recommends that laser users obtain and follow the procedures described in this ANSI Standard.


**Warranty**

JDSU diode-pumped Q Series laser systems are warranted to be free of defects in materials and workmanship for thirteen months from the date of shipment or for 5,000 operating hours, whichever occurs first.

**Patent Information**

The products described in this data sheet are based on JDSU 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 JDSU's laser products and associated technologies. For further information contact the JDSU Legal Department.