

Q1 series

FEATURES

Up to **40 mJ** pulse energy, up to **0.5 W** average output power

Up to **50 Hz** variable pulse repetition rate

Air cooled (**water-free**)

7 – 10 ns pulse duration

Weight **< 6 kg** incl. heatsink, controller & AC/DC adapter

> 2 G shot lifetime of pump diode

Built-in sync pulse generator for triggering of user equipment

Remote monitoring and control via built-in **Ethernet** interface

Optional attachable PC controlled motorized attenuator

Optional attachable pulse energy monitor

Optional fiber coupled output

Optional baseplate for mounting Q1 and H1 or Q1 and fiber coupler together

Optional stand-alone **2nd**, **3rd**, **4th** or **5th** harmonic generator

Stand-alone air-purging unit for long lifetime of UV optics

APPLICATIONS

Laser Induced Breakdown Spectroscopy (LIBS)

Laser ablation

Time-of-Flight Spectroscopy (TOFS)

Light Induced Fluorescence (LIF) Spectroscopy

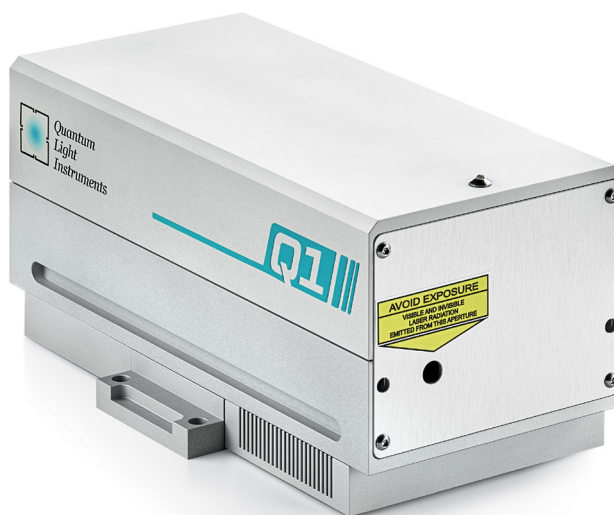
Non-linear laser spectroscopy

Flash photolysis

Photoacoustics

Metrology

DIODE PUMPED AIR-COOLED Q-SWITCHED LASER



Q1 is compact, energy-efficient, diode pumped, air-cooled, Q-switched laser designed for wide range of applications that require high peak power pulses.

Laser can produce up to 40 mJ at 10 Hz pulse repetition rate or up to 10 mJ at 50 Hz pulse repetition rate. Low divergence of laser beam allows efficient conversion to harmonic wavelengths using optional H1 series harmonic generator module.

The laser can be configured to emit 1053 nm or 1064 nm wavelength from Nd:YLF or Nd:YAG laser crystals respectively. Due to thermal properties of Nd:YLF crystal, at 1053 nm the laser can operate from single shot to maximum pulse repetition rate without significant changes in beam divergence or profile.

Innovative laser design resulted in user-friendly turnkey system that requires little maintenance. There are no chillers or bulky power supplies that one needs fit under the table. All laser electronics are integrated into Q1 housing and the only external modules are lightweight controller box that provides laser control interfaces and mains adapter that provides 12 VDC powering. Total weight of the laser is less than 5 kg.

Laser is monitored and controlled through Ethernet port via built-in web-server. Any computer or even cell phone with modern web-browser will be able to control Q1. API is provided for integration with user devices.

Low jitter triggering pulses for user equipment are available with up to 300 µs lead in internal triggering mode. In external triggering mode, laser pulsing can be externally triggered from delay generator.

Laser functionality can be further extended by wide selection of auxiliary equipment:

- Up to fifth harmonic output can be produced from our stand-alone H1 series harmonic generators.
- Lifetime of UV optics can be extended by stand-alone closed loop air-purging unit.
- Pulse energy can be adjusted with our motorized attenuator for fundamental wavelength beam.
- Pulse energy can be monitored by our attachable pulse energy monitor with analog and/or digital output.
- Fiber coupled output is available by request. Please inquire for detailed specifications.

SPECIFICATIONS AT 10 Hz PULSE REPETITION RATE ¹⁾

MODEL	Q1			
	-B10	-C10	-D10	
Wavelength	1064 or 1053 nm		1064 nm	1053 nm
Pulse repetition rate ²⁾	single-shot to 10 Hz			
Pulse duration ³⁾	< 8 ns			
Pulse energy ⁴⁾				
1064 / 1053 nm	8 / 10 mJ	16 / 20 mJ	32 mJ	40 mJ
532 / 526.5 nm	4 / 5 mJ	8 / 10 mJ	16 mJ	20 mJ
355 / 351 nm	2.4 / 3 mJ	4.5 / 6 mJ	9 mJ	12 mJ
266 / 263 nm	1.2 / 1.5 mJ	2.4 / 3 mJ	5 mJ	6 mJ
213 / 211 nm	0.5 mJ	1 mJ	2 mJ	2.5 mJ
Pulse to pulse energy stability ⁵⁾				
1064 / 1053 nm	< 0.5 % RMS			
532 / 526.5 nm	< 2.5 % RMS			
355 / 351 nm	< 3.5 % RMS			
266 / 263 nm	< 4 % RMS			
213 / 211 nm	< 5 % RMS			
Power drift ⁶⁾	± 3.0 %			
Beam profile	bell-shaped, >75 % fit to Gaussian			
Beam divergence ⁷⁾	< 1.5 mrad	< 1 mrad		
Beam pointing stability ⁸⁾	< 10 μrad			
Polarization	linear, horizontal			
Typical beam diameter ⁹⁾	1.7 mm	2.5 mm	3.5 mm	
Jitter ¹⁰⁾	< 0.5 ns RMS			
OPTIONAL ATTENUATOR ¹¹⁾				
Transmission range	0.5 – 95 %			
DIMENSIONS				
Laser head (W×L×H)	110 × 231× 112 mm ³			
Controller unit (W×L×H)	108 × 191 × 59 mm ³			
Power adapter (W×L×H) ¹²⁾	50 × 125 × 31 mm ³			
Harmonic generator (W×L×H) ¹³⁾	110 × 242 × 112 mm ³			
OPERATING REQUIREMENTS				
Cooling requirements	air cooled			
Ambient temperature	15 – 30 °C			
Relative humidity	10 – 80 % (non-condensing)			
Mains voltage	90 – 230 VAC, single phase, 47 – 63 Hz ¹⁴⁾			
Average power consumption	15 W	25 W	30 W	

¹⁾ Due to continuous improvements all specifications are subject to change. Unless stated otherwise all specifications are measured at fundamental wavelength and maximum pulse repetition rate. The parameters marked typical are not specifications. They are indications of typical performance and will vary with each unit we manufacture.

²⁾ Factory-set pulse repetition rate is fixed at max repetition rate shown in the table. Smoothly variable pulse repetition rate is possible when laser is externally triggered. In internal triggering mode repetition rate can be divided by integer number down to f/2, f/3, f/4, ... 1 Hz.

³⁾ At FWHM level at fundamental wavelength, measured with 350 ps rise time photodiode.

⁴⁾ When pulse energy is presented in xx/yy format, first number is for 1064 nm wavelength version, second – for 1053 nm version. Pulse energies for harmonic wavelengths are maximum possible values available from H1 series harmonic generator module. See datasheets of H1 for details.

⁵⁾ Measured during 30 seconds operation after warm-up.

⁶⁾ Over 8 hour period after 20 minutes of warm-up when ambient temperature variation is less than ±2 °C.

⁷⁾ Full angle measured at the 4σ level.

⁸⁾ Peak to peak value, measured for 30 seconds of operation after laser warm-up.

⁹⁾ Beam diameter is measured 20 cm from laser output at the 4σ level.

¹⁰⁾ In respect to falling edge of pump diode triggering pulse.

¹¹⁾ Motorized attenuator intended to be attached to the laser housing. Transmission can be changed remotely through laser web-server control interface.

¹²⁾ Power adapter dimensions might differ from indicated here, depending on model.

¹³⁾ Q1 laser is compatible all models of stand-alone H1 harmonics generator. Please refer to harmonic generator datasheets for detailed specifications.

¹⁴⁾ Laser can be powered from appropriate 12 VDC power source. Please inquire for details.



SPECIFICATIONS AT 20 Hz PULSE REPETITION RATE ¹⁾

MODEL	Q1		
	-B20	-C20	-D20
Wavelength	1064 or 1053 nm		
Pulse repetition rate ²⁾	single-shot to 20 Hz		
Pulse duration ³⁾	< 8 ns		
Pulse energy ⁴⁾			
1064 / 1053 nm	10 mJ	15 mJ	25 mJ
532 / 526.5 nm	4 mJ	7.5 mJ	12.5 mJ
355 / 351 nm	2.5 mJ	5 mJ	7.5 mJ
266 / 263 nm	1 mJ	1.8 mJ	3 mJ
213 / 211 nm	0.4 mJ	0.7 mJ	1.2 mJ
Pulse to pulse energy stability ⁵⁾			
1064 / 1053 nm	< 0.5 % RMS		
532 / 526.5 nm	< 2.5 % RMS		
355 / 351 nm	< 3.5 % RMS		
266 / 263 nm	< 4 % RMS		
213 / 211 nm	< 5 % RMS		
Power drift ⁶⁾	± 3.0 %		
Beam profile	bell-shaped, >75 % fit to Gaussian		
Beam divergence ⁷⁾	< 1.5 mrad	< 1 mrad	
Beam pointing stability ⁸⁾	< 20 µrad		
Polarization	linear, horizontal		
Typical beam diameter ⁹⁾	1.7 mm	2.0 mm	2.5 mm
Jitter ¹⁰⁾	< 0.5 ns RMS		
OPTIONAL ATTENUATOR ¹¹⁾			
Transmission range	1 – 95 %		
DIMENSIONS			
Laser head (W×L×H)	110 × 231× 112 mm ³		
Controller unit (W×L×H)	108 × 191 × 59 mm ³		
Power adapter (W×L×H) ¹²⁾	50 × 125 × 31 mm ³		
Harmonic generator (W×L×H) ¹³⁾	110 × 242 × 112 mm ³		
OPERATING REQUIREMENTS			
Cooling requirements	air cooled		
Ambient temperature	15 – 30 °C		
Relative humidity	10 – 80 % (non-condensing)		
Mains voltage	90 – 230 VAC, single phase, 47 – 63 Hz ¹⁴⁾		
Average power consumption	30 W		

¹⁾ Due to continuous improvements all specifications are subject to change. Unless stated otherwise all specifications are measured at fundamental wavelength and maximum pulse repetition rate. The parameters marked typical are not specifications. They are indications of typical performance and will vary with each unit we manufacture.

²⁾ Factory-set pulse repetition rate is fixed at max repetition rate shown in the table. Smoothly variable pulse repetition rate is possible when laser is externally triggered. In internal triggering mode repetition rate can be divided by integer number down to f/2, f/3, f/4... 1 Hz.

³⁾ At FWHM level at fundamental wavelength, measured with 350 ps rise time photodiode.

⁴⁾ When pulse energy is presented in xx/yy format, first number is for 1064 nm wavelength version, second – for 1053 nm version. Pulse energies for harmonic wavelengths are maximum possible values available from H1 series harmonic generator module. See datasheets of H1 for details.

⁵⁾ Measured during 30 seconds operation after warm-up.

⁶⁾ Over 8 hour period after 20 minutes of warm-up when ambient temperature variation is less than ±2 °C.

⁷⁾ Full angle measured at the 4σ level.

⁸⁾ Peak to peak value, measured for 30 seconds of operation after laser warm-up.

⁹⁾ Beam diameter is measured 20 cm from laser output at the 4σ level.

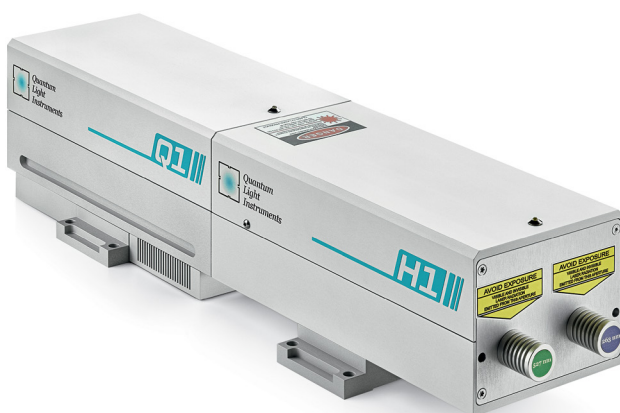
¹⁰⁾ In respect to falling edge of pump diode triggering pulse.

¹¹⁾ Motorized attenuator intended to be attached to the laser housing. Transmission can be changed remotely through laser web-server control interface.

¹²⁾ Power adapter dimensions might differ from indicated here, depending on model.

¹³⁾ Q1 laser is compatible all models of stand-alone H1 harmonics generator. Please refer to harmonic generator datasheets for detailed specifications.

¹⁴⁾ Laser can be powered from appropriate 12 VDC power source. Please inquire for details.



Laser head Q1 with attached harmonic generator module H1



Laser head Q1 with controller unit

SPECIFICATIONS AT 50 Hz PULSE REPETITION RATE ¹⁾

MODEL	Q1		
	-50	-A50	-B50
Wavelength	1064 or 1053 nm		
Pulse repetition rate ²⁾	single-shot to 50 Hz		
Pulse duration ³⁾	< 10 ns	< 9 ns	< 8 ns
Pulse energy ⁴⁾			
1064 / 1053 nm	2.5 mJ	5 mJ	10 mJ
532 / 526.5 nm	1.2 mJ	2.5 mJ	5 mJ
355 / 351 nm	0.6 mJ	1.5 mJ	3 mJ
266 / 263 nm	0.3 mJ	0.7 mJ	1.5 mJ
213 / 211 nm	0.1 mJ	0.2 mJ	0.5 mJ
Pulse to pulse energy stability ⁵⁾			
1064 / 1053 nm	< 0.5 % RMS		
532 / 526.5 nm	< 2.5 % RMS		
355 / 351 nm	< 3.5 % RMS		
266 / 263 nm	< 4 % RMS		
213 / 211 nm	< 5 % RMS		
Power drift ⁶⁾	± 3.0 %		
Beam profile	nearly TEM ₀₀ , >80 % fit to Gaussian		
Beam divergence ⁷⁾	< 1.5 mrad		
Beam pointing stability ⁸⁾	< 20 μrad		
Polarization	linear, horizontal		
Typical beam diameter ⁹⁾	1.5 mm		
Jitter ¹⁰⁾	< 0.5 ns RMS		
OPTIONAL ATTENUATOR ¹¹⁾			
Transmission range	1 – 95 %		
DIMENSIONS			
Laser head (W×L×H)	110 × 231× 112 mm ³		
Controller unit (W×L×H)	108 × 191 × 59 mm ³		
Power adapter (W×L×H) ¹²⁾	50 × 125 × 31 mm ³		
Harmonic generator (W×L×H) ¹³⁾	110 × 242 × 112 mm ³		
OPERATING REQUIREMENTS			
Cooling requirements	air cooled		
Ambient temperature	15 – 30 °C		
Relative humidity	10 – 80 % (non-condensing)		
Mains voltage	90 – 230 VAC, single phase, 47 – 63 Hz ¹⁴⁾		
Average power consumption	<40 W		

- ¹⁾ Due to continuous improvements all specifications are subject to change. Unless stated otherwise all specifications are measured at fundamental wavelength and maximum pulse repetition rate. The parameters marked typical are not specifications. They are indications of typical performance and will vary with each unit we manufacture.
- ²⁾ Factory-set pulse repetition rate is fixed at max repetition rate shown in the table. Smoothly variable pulse repetition rate is possible when laser is externally triggered. In internal triggering mode repetition rate can be divided by integer number down to f/2, f/3, f/4,... 1 Hz.
- ³⁾ At FWHM level at fundamental wavelength, measured with 350 ps rise time photodiode.
- ⁴⁾ When pulse energy is presented in xx/yy format, first number is for 1064 nm wavelength version, second – for 1053 nm version. Pulse energies for harmonic wavelengths are maximum possible values available from H1 series harmonic generator module. See datasheets of H1 for details.
- ⁵⁾ Measured during 30 seconds operation after warm-up.
- ⁶⁾ Over 8 hour period after 20 minutes of warm-up when ambient temperature variation is less than ±2 °C.
- ⁷⁾ Full angle measured at the 4σ level.
- ⁸⁾ Peak to peak value, measured for 30 seconds of operation after laser warm-up.
- ⁹⁾ Beam diameter is measured 20 cm from laser output at the 4σ level.
- ¹⁰⁾ In respect to falling edge of pump diode triggering pulse.
- ¹¹⁾ Motorized attenuator intended to be attached to the laser housing. Transmission can be changed remotely through laser web-server control interface.
- ¹²⁾ Power adapter dimensions might differ from indicated here, depending on model.
- ¹³⁾ Q1 laser is compatible all models of stand-alone H1 harmonics generator. Please refer to harmonic generator datasheets for detailed specifications.
- ¹⁴⁾ Laser can be powered from appropriate 12 VDC power source. Please inquire for details.

AUXILIARY EQUIPMENT

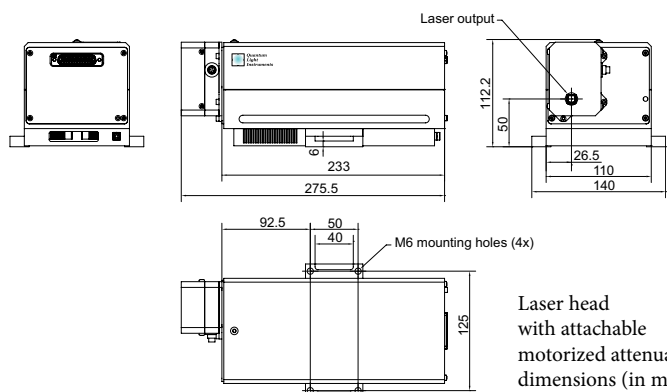
Stand-alone H1 series harmonic generators for down to 211 nm output

Attachable motorized attenuator for fundamental wavelength beam

Attachable pulse energy monitor with analog and/or digital output

Baseplate for mounting Q1 and H1 or Q1 and fiber coupler together

Stand-alone air-purging unit for long lifetime of UV optics



Laser head with attachable motorized attenuator dimensions (in mm)

MOTORIZED ATTENUATORS & PULSE ENERGY MONITORS

ATTENUATOR FEATURES

Drop-in attachable to the laser body attenuators for **1st, 2nd, 3rd, 4th or 5th** harmonics of Nd:YAG or Nd:YLF lasers

Up to **98%** maximum transmission

Precise transmission control by stepper motor in microstepping mode (12800 steps/rotation)

Transmission adjustment resolution **<0.15 %**

Remote control via common with laser **Ethernet** interface

Optional stand-alone version for mounting on optical table

Optional side port transforms attenuator to variable beam splitter

PULSE ENERGY MONITOR FEATURES

Drop-in laser pulse energy or power monitoring (up to **100 samples/second**)

Less than **2 %** insertion losses

12-bit resolution

Average pulse energy and pulse-to-pulse stability calculation

Sample&Hold analog output from BNC socket on the rear panel of laser controller

Digital readout through laser **Ethernet** interface

Optional broadband version for 210 – 2300 nm range

ATTENUATOR SPECIFICATIONS ¹⁾

MODEL	ATTENUATORS				
	AT1	AT2	AT3	AT4	AT5
Design wavelength	1064 nm	532 nm	355 nm	266 nm	213 nm
Typical max transmission ²⁾	98 %	95 %	90 %	75 %	65 %
Typical min transmission ²⁾	1 %			0.5 %	
Output polarization ³⁾	linear, horizontal			linear, rotating	
Resolution	< 0.15 %				
Accuracy	± 0.5 %				
Clear aperture	6 mm				
Stepper motor	12800 steps / 360 deg, 4-phase, 1A				
Dimensions (W×L×H)	42 × 54 × 77 mm ³				
Weight	< 0.4 kg				

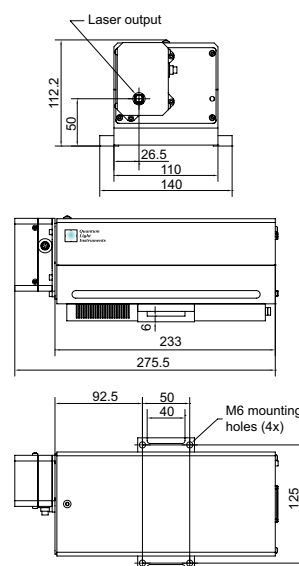
PULSE ENERGY MONITOR SPECIFICATIONS ¹⁾

MODEL	PULSE ENERGY MONITOR					
	EM1	EM2	EM3	EM4	EM5	EM/BB
Design wavelength	1064 nm	532 nm	355 nm	266 nm	213 nm	210 – 2600 nm
Insertion loss	< 2 %					
Detector type	photodiode					pyroelectric
Resolution	12 bit					
Accuracy	± 3 %					
Clear aperture	6 mm					
Dimensions (W×L×H)	24 × 28 × 48 mm ³					
Weight	< 0.1 kg					

¹⁾ Due to continuous improvements all specifications are subject to change. The parameters marked typical are not specifications. They are indications of typical performance and will vary with each unit we manufacture.

²⁾ Depends on polarization state of laser. Depolarization of laser beam might affect values provided here.

³⁾ For some models polarization plane depends on angular position of polarizer.



Dimensions (in mm) of Q1 laser with attenuator attached



Attenuator and pulse energy monitor attached to the laser head