

Stand-alone automated harmonics generator



Automated harmonics generator H-SMART

H-SMART is a stand-alone, automated harmonic generator module designed for Q2 and Q2HE series lasers. It is mounted alongside the laser on a common optical table and enables hands-free operation using temperature-tuned nonlinear crystals and built-in pulse energy monitors. The system can be remotely monitored and controlled either through the laser's control panel or via the integrated Ethernet interface. H-SMART features up to three factory-configurable output ports supporting harmonic generation up to the 5th order, with custom configurations available upon request.

H-SMART flexible design and microprocessor controlled operation enabled to implement number of advanced features:

Single output port – motorized selection of required wavelength, emitted through the same exit aperture.

Self-tuning – automatic, microprocessor controlled tuning of nonlinear crystal temperatures for maximum pulse energy.

Monitoring – monitoring of pulse energy at fundamental or harmonic wavelength.

Bypass – laser fundamental beam can bypass H-SMART with minimal losses on internal optical components.

Attenuation – ability to attenuate output pulse energies without change of laser pump energy, helping to minimize changes to beam profile and pulse duration.

Enhanced spectral purity – improved to 99.9 % spectral purity of exit wavelengths.

“Advanced Features” table below summarizes features of each model and available extensions.

H SMART

FEATURES

- Stand-alone **2nd, 3rd, 4th or 5th** harmonic generator compatible with **Q2** and **Q2HE** series lasers
- **Microprocessor controlled** temperature tuned nonlinear crystals
- Factory-configurable up to **three exit ports**
- **Self-tuning** of crystals for maximum pulse energy
- Built-in **bypass** and/or **attenuator** of fundamental beam (for some models)
- **Remote monitoring** and control via common with laser or separate **Ethernet** interface

OPTIONAL EQUIPMENT

- **Enhanced spectral purity** of UV wavelengths
- Built-in or attachable **motorized attenuator** up to 5th harmonic beam
- Built-in or attachable pulse **energy monitor** with analog and/or digital output
- Mounting on common heatsink with Q2 series laser
- **Air-purging unit** for improved lifetime of UV harmonic crystals and optics
- **Fiber coupled** output

APPLICATIONS

- Laser wavelength conversion
- Laser pulse energy control
- Laser pulse energy monitoring

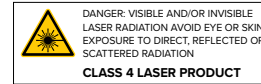
SPECIFICATIONS ¹⁾

Model	H-SMART
Conversion efficiency ²⁾	
Fundamental to second harmonic	> 50 %
Fundamental to third harmonic	> 30 %
Fundamental to fourth harmonic	> 15 %
Fundamental to fifth harmonic	> 6 %
Pulse to pulse energy stability ³⁾	
526.5/532 nm	< 2.5 % RMS
351/355 nm	< 3.5 % RMS
263/266 nm	< 4 % RMS
211/213 nm	< 5 % RMS
Spectral purity for Port #1 ⁴⁾	
Typical pulse duration	10–20 % shorter in each conversion stage
Typical beam diameter	10–30 % smaller than pump beam
Beam pointing stability	same as the pump beam

Dimensions	
Harmonic generator (W×L×H)	160 × 244 × 141 mm ³
Weight	< 5 kg

Operating requirements	
Ambient temperature	15–30 °C
Relative humidity	10–80 % (non-condensing)
Powering	12 VDC ⁵⁾
Average power consumption	< 20 W

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. Conversion efficiency presented here is for Port #1. Conversion efficiency at Port #2 or Port #3 depends on unit configuration and typically are lower than those presented here. Please inquire for details.
3. When unit is pumped by our Q2 or Q2HE series laser. Measured during 30 seconds operation after warm-up.
4. Spectral purity at Port #2 or Port #3 could not be specified for two-wavelength output configuration.
5. When supplied with Q2 or Q2HE laser, H-SMART is powered from laser controller.



Most of high performance birefringent crystals are hygroscopic, which might limit their lifetime in a humid environment. However, if they are continuously kept at higher than ambient temperatures, **the lifetime of crystals can be significantly extended** and can be even longer than laser system itself. **To keep crystals dry, H-SMART module needs to always remain connected to the power source. If power is not available, the module should be stored in dry environment.**

ADVANCED FEATURES

H-SMART-	No. of exits	Self-tuning	Monitoring	Bypass	Attenuation
SH	2	optional	optional	-	optional
SH-AT1	2	optional	optional	✓	✓
SH-AT2	2	optional	optional	-	✓
SH/SP	1	✓	✓	✓	optional
TH	2	optional	optional	-	optional
TH-2P	2	✓	✓	-	optional
TH-AT1	2	✓	optional	-	✓
TH-3P	3	✓	optional	✓	✓
TH/SP	1	✓	optional	-	✓
TH/OPO	2	✓	✓	✓	✓
FH	2	optional	optional	-	optional
FH-1P	1	✓	optional	-	optional
FH-2P	2	✓	✓	-	optional
FH-AT1	2	✓	✓	-	✓
FH-3P	3	✓	✓	✓	✓
FH/SP	1	✓	optional	-	✓
SH/TH/FH-3P	3	✓	✓	-	optional
SH/TH/FH-2P	2	✓	✓	-	optional
SH/TH/FH-UN	1	-	-	-	✓
FiH	1	✓	optional	-	optional
FiH/FH	1	✓	optional	-	-

EXIT PORT CONFIGURATION OPTIONS ¹⁾

H-SMART-	Port #1			Port #2	Port #3
	WL ²⁾	AT ³⁾	EM ⁴⁾	WL ²⁾	WL ²⁾
SH	532 nm	-AT2	-EM2	1064 nm ⁵⁾	N/A
SH-AT1	1064 nm	built-in	-EM1	532 nm ⁵⁾	
SH-AT2	532 nm	built-in	-EM2	1064 nm ⁵⁾	
SH/SP	532/1064 nm selectable	-AT	-EM/BB	N/A	
TH	355 nm	-AT3	-EM3	532 & 1064 nm ⁶⁾	
TH-2P	355 nm	-AT3	-EM3	532 & 1064 nm ⁶⁾	
TH-AT1	355 nm	-AT3	-EM3	532 nm ⁵⁾	
TH-3P	1064 nm	built-in	built-in	532 nm ⁵⁾	355 nm ⁵⁾
TH/SP	355/532/1064 nm selectable	built-in	-EM/BB	N/A	N/A
TH/OPO	355/1064 nm selectable	built-in	-EM/BB	532 nm ⁵⁾	
FH	266 nm	-AT4	-EM4	532 & 1064 nm ⁶⁾	
FH-1P	266 nm	-AT4	-EM4	N/A	
FH-2P	266 nm	-AT4	-EM4	532 & 1064 nm ⁶⁾	
FH-AT1	266 nm	-AT4	-EM4	532 nm ⁵⁾	
FH-3P	1064 nm	built-in	built-in	532 nm ⁵⁾	
FH/SP	266/532/1064 nm selectable	built-in	-EM/BB	N/A	N/A
SH/TH/FH-3P	355 nm	-AT3	-EM3	532 & 1064 nm ⁶⁾	266 nm
SH/TH/FH-2P	266/355 nm selectable	N/A	-EM/BB	532 & 1064 nm ⁶⁾	N/A
SH/TH/FH-UN	266 & 355 & 532 & 1064 nm	built-in	N/A	N/A	
FiH	213 nm ⁷⁾	-AT5	-EM5		
FiH/FH	213/266 nm selectable ⁷⁾	N/A	-EM/BB		

- See Figure 1 below for port number assignment.
- Wavelength is shown for 1064 nm pump wavelength. For 1053 nm pump wavelength recalculate wavelengths accordingly.
- Shows compatible attenuator model. This option is available only when H-SMART is supplied together with Q2 or Q2HE series laser.
- Shows compatible pulse energy monitor model. This option is available only when H-SMART is supplied together with Q2 or Q2HE series laser.
- Spectral purity is > 98 %.
- Both wavelengths exit Port #2, for separation external dichroic mirror is required.
- Spectral purity for this model is > 99.9 %.

PART NUMBERS

H-SMART-FH-2P-AT4

Model

Output wavelength configuration	Number of exit ports
SH → second harmonic	1P → single exit port
TH → third harmonic	2P → two exit ports
FiH → fifth harmonic	3P → three exit ports
FH → fourth harmonic	
SH/TH/FH → 2 nd , 3 rd and 4 th harmonic	
FiH/FH → 5 th and 4 th harmonics	
UN → unseparated wavelengths	

See datasheet for all available options

Optional items

AT1/AT2/AT3/AT4/AT5	→ motorized attenuator
EM1/EM2/EM3/EM4/EM5	→ pulse energy monitor
BSP2	→ baseplate for mounting with Q2 laser baseplate for mounting with Q2HE laser
FC/UV	→ fiber coupler for UV range
FC/VIS	→ fiber coupler for VIS range
APU2	→ air-purging unit
SP	→ Single port output

OPTIONAL ITEMS

WF	Stand-alone wireless router for wireless laser control
RS	Stand-alone adapter for laser control via RS-232 port
PC	Laptop computer for laser control
EXP	Stand-alone pulse generator for variable repetition rate
CT19	19" mounted controller with integrated AC/DC power supply
CTA19	19" mounted controller with air-purging unit
CTBR	Front/rear panel with brackets for standard controller
PS19	19" form factor AC/DC power supply
APU2	Stand-alone air-purging unit with integrated AC/DC power supply
CST	Custom model

IMAGES



Harmonics generator H-SMART.
Front view



Harmonics generator H-SMART.
Rear view



Harmonics generator H-SMART.
Side view

OPTIONAL EXTENSIONS



Laser controller with air-purging unit CTA19



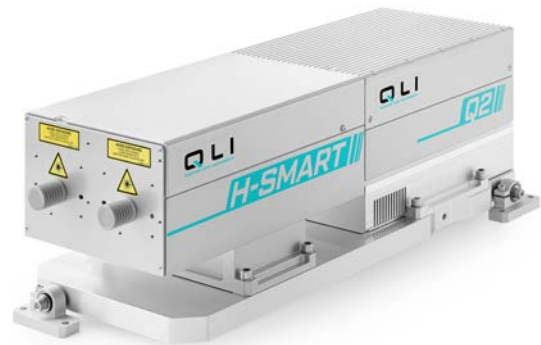
Front view of CTA19



Rear view of CTA19

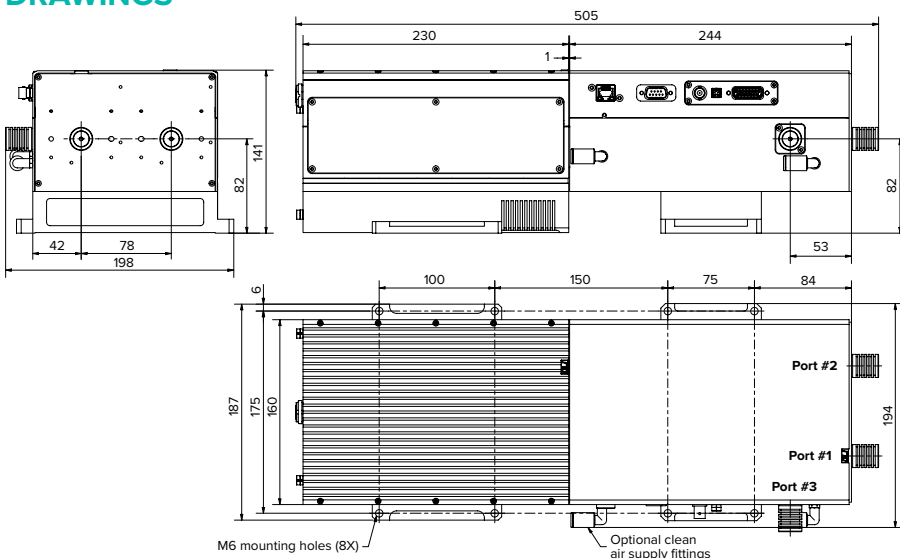


H-SMART harmonics generator with fiber coupler FC



H-SMART harmonics generator attached to Q2 laser
on BSP2 base plate

DRAWINGS



Outline drawings of H-SMART harmonics generator attached to Q2 laser head
(dimension in mm)



Fiber coupler FC



Attenuator AT1 and pulse
energy monitor EM1