



PRESS RELEASE

October 22, 2018
Hamamatsu Photonics K. K.
Japan Science and Technology Agency (JST)
Cabinet Office Director General for Science, Technology and Innovation Policy

High-power high-repetition-rate laser system is now available in tabletop size.
It will increase laser processing productivity and open up new applications.

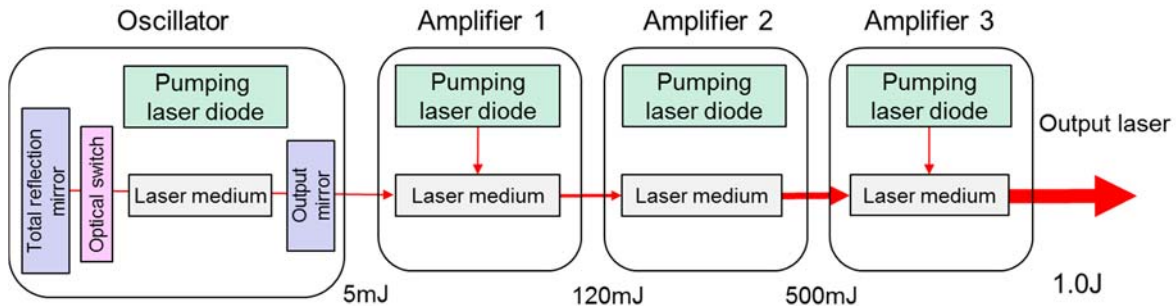
Hamamatsu Photonics (Hamamatsu, Japan - President and CEO: Akira Hiruma) has developed a compact tabletop size power laser system that emits high-power light pulses of 1 joule at a high repetition rate of 300 hertz by using laser diodes as pumping light sources that provide an output power boosted 3 times compared to ordinary pumping laser diodes. Increasing the output power of laser systems usually has an adverse effect on equipment size and repetition rate. This new power laser system solves that problem and delivers high output power and a high repetition rate despite its compact size.

This new power laser system improves production efficiency in laser machining processes such as laser cleaning for removing small debris and contaminants and will also find uses in new applications such as laser forming for fabricating metal materials by laser pulse shock and laser peening for extending lifetime of metal parts.

This new power laser system was developed by the team of Toshiyuki Kawashima, Deputy Director of the Industrial Development Center, Hamamatsu Photonics Central Research Laboratory. Part of this laser system's development relied on a R&D program called "Ubiquitous Power Laser for Achieving a Safe, Secure and Longevity Society" managed by Yuji Sano program manager under the ImPACT Program (**Imp**ulsing **Par**adigm **C**hange through **D**isruptive **T**echnologies) sponsored by the Japanese Cabinet Office Council for Science, Technology and Innovation. We intend to push ahead to develop this power laser system toward its successful commercialization. This newly developed power laser system will be on display at the Hamamatsu Photonics exhibition "PHOTON FAIR 2018" to be held at Act City Hamamatsu (Naka-ku, Hamamatsu City, Japan) for 3 days starting from November 1 (Thursday).

<About power laser system>

This power laser system mainly consists of an oscillator and amplifiers. The oscillator is made up of a pumping laser diode, laser medium, total reflection mirror, output mirror and optical switch. Each amplifier uses a pumping laser diodes and a laser medium. A laser beam emitted from the oscillator is supplied with energy from three laser media at a higher energy level (excited state) as it passes through the amplifiers and is finally output as a high power beam.



Schematic of power laser system

<Overview of power laser system>

This power laser system contains pumping laser diodes that we also newly developed, and emits high-power light pulses of 1 joule at a high repetition rate of 300 hertz despite its compact tabletop size.

Hamamatsu Photonics already produces and sells pumping laser diodes capable of a 100 watt output at a repetition rate of 300 Hz. We have boosted the output power of our currently available pumping laser diodes to the world's highest 300-watt class by using our unique in-house advanced crystal growth and coating technologies. At the same time, we adapted an efficient cooling design for the amplifiers by adjusting and optimizing the laser medium length and cross-sectional area. This eliminated the problem of thermal damage and destruction of the laser media and succeeded in extracting output power that is 3 times larger than present amplifiers.

Using laser diodes as pumping light sources increases electrical to optical energy conversion efficiency about 10-fold and extends the pumping light source service life about 100-fold compared to commercially available pulsed laser systems using flash lamp light sources. We also succeeded in improving the output stability, downsizing equipment, and cutting the cost by reducing the number of parts. Although increasing the output power of laser systems usually has an adverse effect on the equipment size and repetition rate, the power laser system we created delivers a high output power and high repetition rate despite its compact size.

This new power laser system will improve production efficiency in laser processes such as laser cleaning for removing small debris and contaminants adhering to parts and materials. This power laser system will also likely provide new pulsed laser applications in industrial fields such as laser forming that deforms and shapes metal materials for aircraft without using molds, and laser peening that extends the lifetime of metal parts.

We will continue our design and improvement work to successfully commercialize this power laser system by measures including further downsizing and streamlining maintenance.

<Background of development>

Lasers are widely used in machining and processing applications such as drilling, welding and cutting of metal materials. To improve production efficiency, unceasing efforts are being made to increase the output power of various lasers including fiber lasers and CO₂ lasers. Lasers are broadly classified into CW (continuous wave) lasers that continuously emit laser light of constant intensity and pulsed lasers that emit pulsed light repeatedly at very short time intervals. Laser processing applications mainly rely on CW lasers. Pulsed laser design, on the other hand, is directed toward new laser processing applications that differ from CW laser applications. Yet, high output power, high repetition rate laser-diode-pumped pulsed laser systems are seldom put to actual use due to the high cost of laser diodes. Consequently, most currently available joule-class pulsed laser systems use flash lamps as the pumping light source. In these pulsed laser systems, the lamps generate heat and large thermal effects that limit the repetition rate to around 10 hertz. These problems and the need to increase production efficiency in an even broader range of applications have led to an increasing demand for compact power laser systems that emit high-power pulsed light at a high repetition rate.

●Main specifications

Parameters	Power laser system	Units
Pulse energy	1	Joules per pulse
Repetition rate	300	Hz
Pulse width (FWHM)	30 to 40	ns
Wavelength	1.064	μm
Dimensions (W×L×H)	1.2×2.4×1.45	m

<Contract research information>

The development of this power laser system was achieved through the following program and R&D theme.



Toshiyuki Kawashima

Impulsing Paradigm Change through Disruptive Technologies Program (ImPACT) sponsored by the Cabinet Office of Japan

Program Manager: Yuji Sano

R&D Program: Ubiquitous Power Laser for Achieving a Safe, Secure and Longevity Society

R&D Theme: Development of high-output compact power laser

Principal Investigator: Toshiyuki Kawashima (Deputy Director of the Industrial Development Center, Hamamatsu Photonics Central Research Laboratory)

Research period: 2015 to 2018 fiscal year

In focusing on this R&D theme, we are making a major development effort to achieve a compact tabletop size power laser that emits high-power pulsed light at a high repetition rate yet is extremely stable during operation.

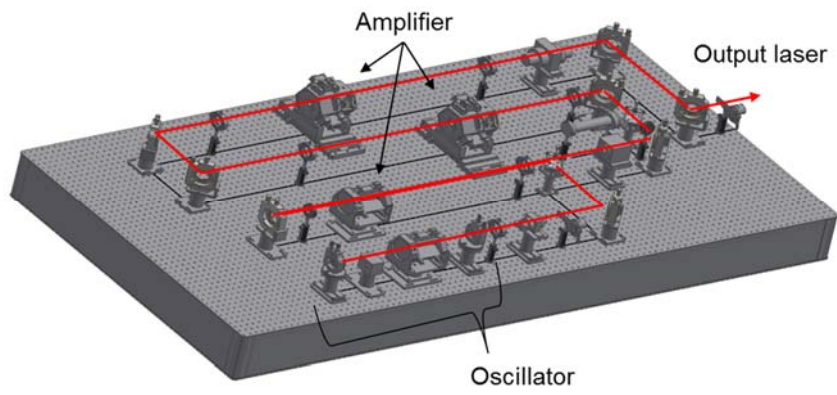
<Comment from Yuji Sano, ImPACT Program Manager>



In the “Ubiquitous Power Laser for Achieving a Safe, Secure and Longevity Society” program conducted as an ImPACT R&D program, we are working to downsize, simplify, and upgrade high-power pulsed laser systems that are essential for cutting-edge scientific research and industry as well as develop supportive basic technology and applied technology. Our goal is to contribute to industrial innovations by providing low-cost and highly stable lasers that can easily be used anywhere and anytime.

The Hamamatsu Photonics development group has currently succeeded in developing an innovative laser system that is both compact and low cost yet emits high-power pulsed light at a high repetition rate. They achieved this breakthrough by applying their advanced laser diodes manufactured in-house as the pumping light sources and by optimizing the laser system design.

We can expect this power laser system to be applied in a broad range of fields where power laser systems were not used up to now due to cost limitations and production efficiency issues.



Configuration of power laser system



External view of power laser system