

SBIR Topic Number:
AF063-003

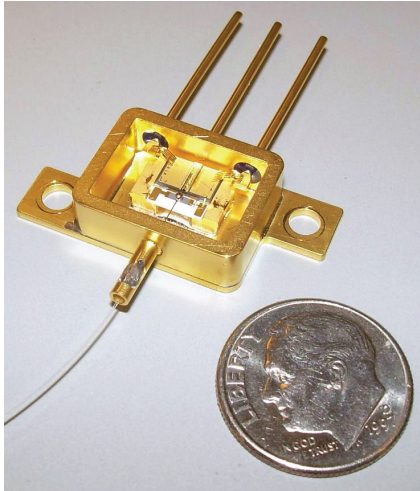
SBIR Title:
Pump Laser Diode Module

Contract Number:
FA8650-08-C-1325

SBIR Company Name:
nLIGHT Corporation,
Vancouver, WA

Technical Project Office:
AFRL Sensors Directorate,
Wright-Patterson AFB, OH

This Air Force SBIR/STTR Innovation Story is an example of Air Force supported SBIR/STTR technology that met topic requirements and has outstanding potential for Air Force and DoD.



Parameter	Min	Max	Unit
Wavelength	910	985	Nm
Power	5		W
Coupling Efficiency	90		%
Operating Temperature	-40	+85	° C
E to O Efficiency	40		%
Reliability @ 25° C (90 % confidence)		500	FIT
Radiation Resistance	500		kRad (Si)

Left: Space qualifiable, high-power, fiber-coupled pump laser prior to hermetic lid seal, shown with a dime for size comparison.
Right: Table of demonstrated design goals for pump laser module.

Space Qualifiable, High-Power, Fiber-Coupled Pump Laser for Telecommunication Applications

- The objective of this SBIR program was to develop designs, materials, and methods that lead to an enhanced pump laser module reliability
- nLIGHT Corporation produced a space qualifiable, high-power, single-emitter, fiber-coupled, 9XX nm laser diode module, which uses high thermal conductivity, expansion-matched materials in a low thermal resistance topology with high electrical conductivity to minimize laser diode junction heating
- The design builds on nLIGHT's proven stable and efficient optical coupling platform which, when combined with nLIGHT's proven 9XX nm laser diode efficiency, results in the lowest possible operating junction temperature, thus leading to a long high-temperature operating life
- Prospective customers include high-energy, laser weapon defense contractors; in addition, there are several potential clients for industrial fiber laser pumps

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Air Force Requirement

With satellite communications data rates anticipated to grow exponentially for the foreseeable future, the Air Force is interested in developing the capability for satellite based laser communications (SATCOM). Due to their lightweight and small size, diode pumped fiber amplifiers are highly suited for use in SATCOM laser communications applications. High power fiber amplifiers pumped by high power single emitters have demonstrated their advantages in terms of reliability as an optical source for laser communications.

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SBIR Technology

nLIGHT Corporation combined its proven design and production experience in high-reliability, single-emitter, fiber-coupled, laser diode module packaging with its proven experience in 9XX nm, high-power, wide-stripe, super-high-efficiency-diodes (SHEDs) to produce a space qualifiable, high-power, single-emitter, fiber-coupled, 9XX nm laser diode module. Existing space and telecommunications proven packaging processes have been modified for use with high-power (>5 W) wide stripe laser diodes.

The package design uses high thermal conductivity and expansion-matched materials in a low thermal resistance topology with high electrical conductivity to minimize laser diode junction heating. The design builds on nLIGHT's proven stable and efficient optical coupling platform which, when combined with nLIGHT's proven 9XX nm laser diode efficiency, results in the lowest possible operating junction temperature, thus leading to a long high-temperature operating life.

Potential Application

The foundation of the laser module is a highly reliable, highly efficient semiconductor laser diode mounted to a common sub-mount. A product such as this fundamentally advances the ability to create high power, directed energy class, fiber laser systems. There are no known competitors that have been able to match the combination of brightness, efficiency, and packaging size/weight that has been enabled by this work.

This program also focused on the development and transfer to manufacturing of the fiber-coupled single-emitter package. This package could go into manufacturing as a fiber laser pump source for directed energy, Laser Detection and Ranging (LADAR), target designation, and other potential Department of Defense applications.

The laser module is also able to be used directly for optical communications, multiple medical and materials processing applications. Other companies have demonstrated products of similar power, but none have released products with the combination of power, brightness, and efficiency that nLIGHT has demonstrated.

Company Impact

"In total, nLIGHT estimates the addressable merchant market for fiber laser pumps alone to be over \$30 million per year," states Dr. Geoff Fanning, Product Engineering Manager at nLIGHT. "Prospective customers include high-energy, laser weapon defense contractors. Moreover, potential clients for industrial fiber laser pumps are many and varied."

"nLIGHT has a history of design and production of Mini-DIL pump laser modules. These pump modules have been qualified to the stringent telecommunications requirements of Telcordia GR-468-CORE and produced by the thousands at nLIGHT's manufacturing facility. nLIGHT also has a decade of experience in the design and production of 1480 nm pump laser modules enabling fiber optic gyroscopes in inertial navigation systems. nLIGHT's laser modules are currently deployed in space and aerospace applications, including use on the National Aeronautics and Space Administration's Mars Rovers."



SBIR/STTR

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