Novanta | PRECISION MANUFACTURING

WHITEPAPER

Monitoring CO_2 Laser Temperature

Ensure optimal performance of sealed tube CO_2 lasers

MONITORING CO_2 LASER TEMPERATURE

Ensure optimal performance of sealed tube CO_2 lasers

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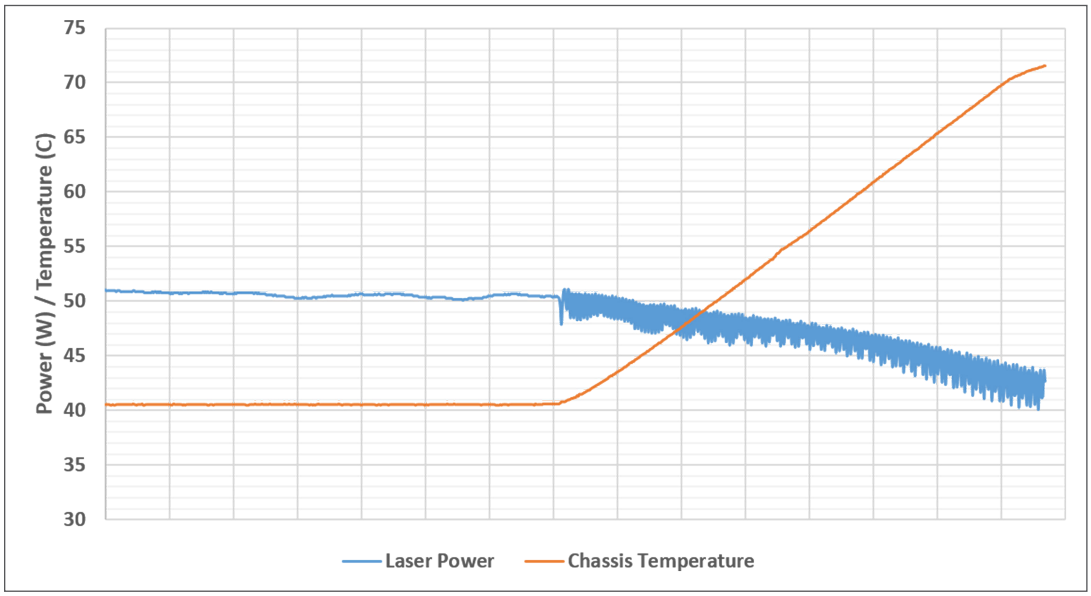
Managing the Tube Temperature is Critical for CO_2 Lasers

Avoiding unplanned downtime due to component failure within any integrated manufacturing or processing system is critical. Modern predictive maintenance systems provide operations managers with warnings when negative trends indicating potential shutdown are spotted. Many critical components within a manufacturing or processing system have unique performance indicators—for sealed CO_2 lasers, one critical performance metric is tube temperature, which has a direct impact on output power. When operated beyond specified temperature limits, CO_2 lasers can suffer a decrease in output power and correspondingly, power stability.

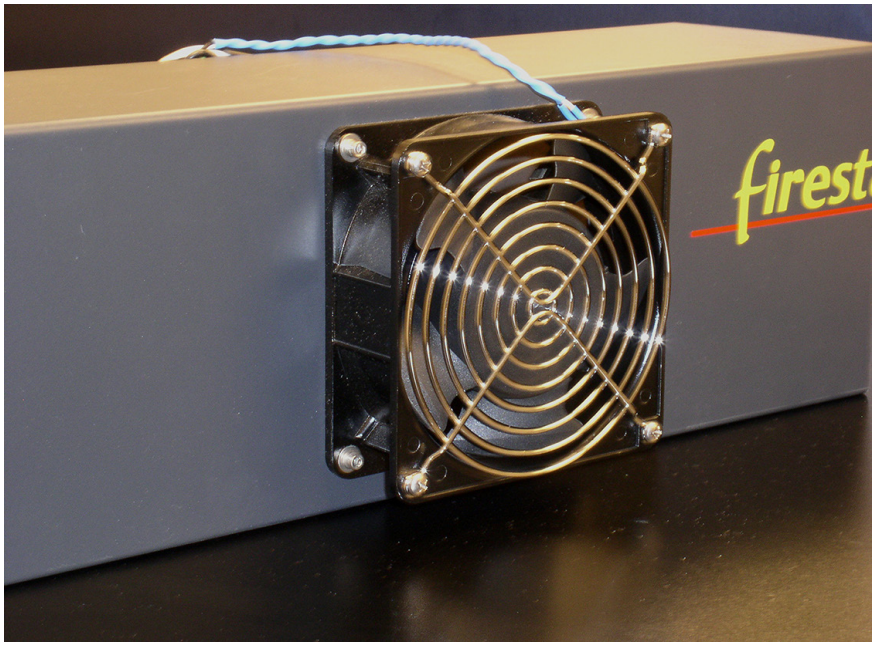


Changes in cooling system performance during steady state operation can cause power stability fluctuations and an overall drop in laser output power as shown in the chart above. The vi40 Temperature Broadcast feature can be used to sense changes in machine cooling performance and respond accordingly - before a change in application performance is noticed

Laser Performance and Tube Temperature

For sealed CO_2 lasers, higher tube temperatures can cause a decrease in the electrical to optical conversion efficiency, resulting in lower laser output power. Fluctuating temperatures can also impact output power stability. It is therefore critical to maintain the laser tube temperature within specified operational boundaries to ensure optimal performance. There are several factors that can affect the temperature of the laser tube:

- **Ambient conditions** – The ambient temperature of the operational environment will affect laser performance, causing an overall increase or decrease in the temperature of the laser tube, regardless of operational state.
- **Cooling systems** – Sealed CO_2 lasers are generally cooled with water or forced air (fans). In most cases these systems are sufficient, but a change in cooling system performance can have a drastic impact on laser power.

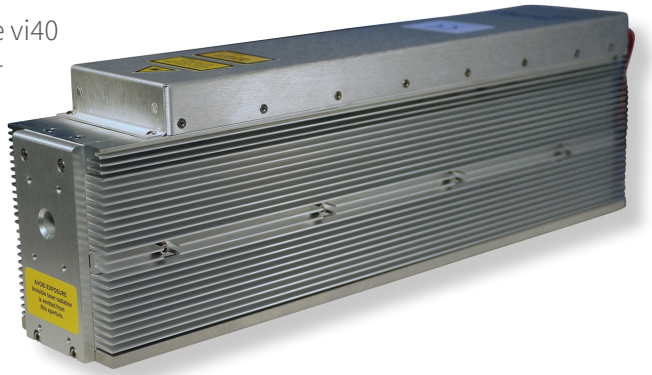


Maintaining the recommended operating temperatures for sealed CO_2 lasers is critical. The use of secondary cooling mechanisms like fans or flowing water systems are commonly added to assist cooling.

- **Laser operation** – The pulse width modulation (PWM) parameters of the laser also play a part in tube temperature. High duty cycle operation will drive increased laser tube temperatures.

By monitoring the laser temperature, control systems can analyze trends which may signal an issue with the machine cooling system and alert operators to take corrective action to prevent downtime. Integrating laser diagnostics into machine control systems can allow for smart control of cooling systems, with the benefit of reduced operational costs. This is especially true of fan-cooled lasers, where the fans can potentially be operated at reduced levels depending on environmental and operational parameters.

Novanta vi40 CO_2 Laser with Temperature Broadcast

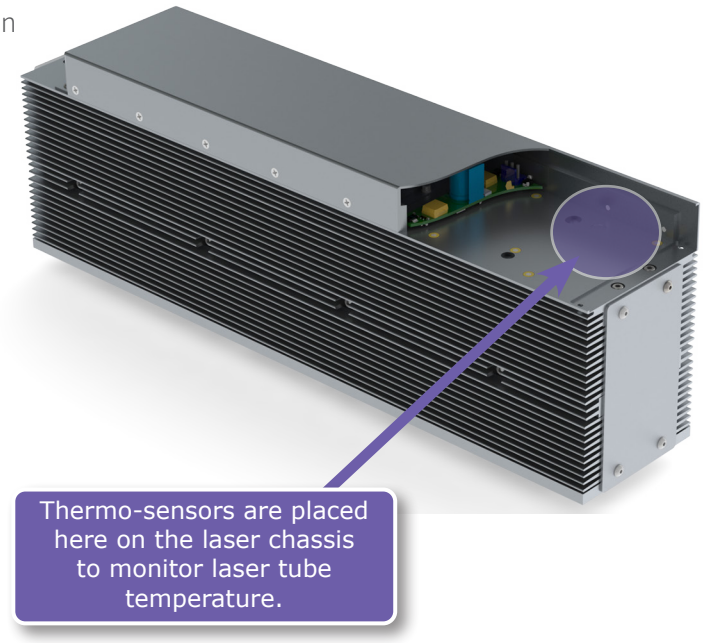


Novanta's next generation marking, coding, and engraving laser, the vi40 includes a Temperature Broadcast feature to provide real-time laser temperature information. The temperature data can be used for preventative maintenance, remote troubleshooting, performance optimization, and smart system design.

Users now have access to the laser tube temperature to verify the effectiveness of cooling systems and monitor system health and performance in real time. The data can also be used to predict laser safety shutdown due to overheating, allowing corrective action to prevent potential delays in production. During the design process, system engineers can also determine the most effective and cost-efficient methods for cooling by measuring temperature more easily and accurately using Temperature Broadcast.

The Temperature Broadcast system utilizes a temperature sensing device in contact with the laser chassis and mounted to the control board. The data is captured and transmitted at 250 millisecond intervals on a user output line, accessible on the laser DB-9 I/O connector. The laser chassis and laser tube temperatures are directly proportional, and in turn have a direct impact on laser output power and stability.

Maintaining a constant laser tube temperature during operation can also improve long term power stability. Drifts in laser temperature due to cooling systems or ambient conditions can cause fluctuations in laser output power. The vi40 Temperature Broadcast feature can be integrated into machine cooling control systems to provide a feedback signal for laser temperature regulation for better long term power stability.



Temperature Broadcast has many benefits and can lead to improvements in:

- **Performance** – By closely monitoring and maintaining the laser's temperature, users can ensure optimal laser power output and long term stability.
- **Cost Savings** – Reduced downtime via early warning and preventative maintenance. Smart control of cooling systems can also reduce operational costs.
- **Environmental Conditions** – Accurate control of cooling systems is increasingly critical in more demanding environments, allowing the vi40 to be safely integrated and operate in tougher conditions.
- **System Monitoring** – Real-time laser temperature data can be correlated to system health and performance and allow remote troubleshooting.

Novanta delivers high quality solutions to real world applications where reliability and uptime are critical. The vi40 Temperature Broadcast feature is designed to allow users to harness the power of diagnostic data to take control of laser system performance and maximize productivity.

Novanta vi40 CO_2 Laser

Next gen laser engineered for seamless integration onto modern high-speed, high-volume processing equipment.

- Gen2 tube design efficiently manages thermal resistance and power to deliver a stable, accurate beam for precise image control
- Real-time condition monitoring with an industry first Temperature Broadcast feature to avoid unexpected downtime and costly system repairs
- Up to 100 kHz max pulse frequency enables high speed engraving, marking, and coding applications for high-volume manufacturers and processors
- 40W continuous power for faster throughput
- Industry best maximum operating environment temperature ensures reliable operation in a wide range of conditions
- Compact, lightest 40W CO_2 laser available, easily fits into tight spaces and onto weight sensitive systems

Output Specifications		
Wavelength, µm		10.57 - 10.63
Power Output, continuous[1]		40W
Power Stability[2]		± 5%/± 3%
Mode Quality (M^2)		≤ 1.2
Beam Waist Diameter, mm (at $1/e^2$)[3]		2.5 ± 0.5
Beam Divergence, full angle, mrad		< 7.0
Ellipticity		<1.2
Polarization		Linear, horizontal
Rise Time		<100 µs
Input Specifications		
Power Supply Voltage		48 VDC ± 2.0 VDC
Power Supply Maximum Current[4]		15A
Input Signals	**Tickle Signal**	**PWM Command Signal**
Voltage (5V Nominal)	+3.5 to 6.7 VDC	+3.5 to 6.7 VDC
Current	10 mA @ +6.7 VDC	10 mA @ +6.7 VDC
Frequency	5 KHz (1 µs duration)	DC - 100 - kHz
Cooling Specifications		
Maximum Heat Load		680 Watts
Maximum Chassis Operating Temperature		70° C
Minimum Flow Rate		190 CFM per fan (2 required)
Environmental Specifications		
Operating Ambient Temperature Range[5]		15° C - 45° C
Humidity		0 - 95%, non-condensing
Physical Specifications		
Length		16.8 in. (427 mm)
Width		3.5 in. (89 mm)
Height		5.45 in. (138 mm)
Weight		13.00 lbs. (5.9 kg)

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