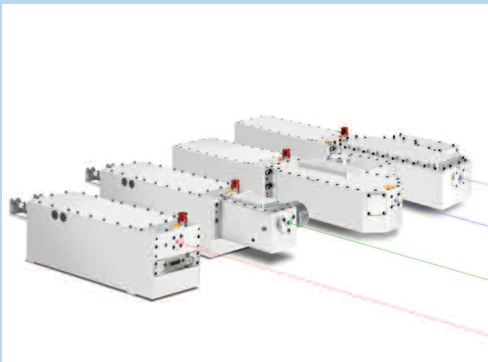
HIPPO™ Mid-Power Q-Switched Lasers

RUGGED DESIGN FOR HIGH UPTIME



The HIPPO Advantage

- OEM/Industrial design for 24/7 operation
- Single platform for 4 output wavelengths: 1064 nm, 532 nm, 355 nm, 266 nm
- High output power for fast throughput
- High peak power minimizes thermal damage to your parts
- Superior pulse-to-pulse stability for clean, consistent processing
- TEM_{00} beam characteristics for large depth of field
- Long life diodes mean low cost of operation and high uptime
- Modular design allows easy field replacement of key components
- Active Laser Purification System™ (ALPS) keeps laser running clean to extend laser life
- EternAlign™ - stable optical alignment over life of laser

The Spectra-Physics HIPPO lasers are a family of high power diode-pumped solid state (DPSS) Q-switched lasers with available outputs of 1064, 532, 355 and 266 nm wavelengths. They are used primarily in 24/7 industrial applications such as solar cell manufacturing, LED scribing and other microelectronics applications.

The HIPPO Q-switched laser has a strong track record and large installed base around the world. The laser's modular design allows easy field replacement of key components including diodes and fibers, laser output window, and the harmonic module without costly tool realignment. Rugged and proven, the HIPPO is the tool of choice in applications where uptime is critical.

EXCELLENT PERFORMANCE

HIPPO Q-switched lasers are characterized by extremely short pulse width (as low as <11 ns). High peak power and short pulse widths minimize undesirable thermal damage, such as heat affected zones, recast material, kerfs, and micro-cracking of the substrate.

All HIPPO Q-switched lasers have excellent TEM_{00} beam quality, which ensure a large depth of field and guarantee consistent and reliable scribing results over a wider range of material flatness, thickness, and surface variations.

HIPPO lasers have stable power, low pulse-to-pulse energy variation, and stable beam pointing over a wide range of operating conditions, including time, temperature, and pulse repetition rate.

HIGH RELIABILITY

HIPPO lasers have a number of unique design features that significantly increase both the laser life and uptime. Our diodes typically last twice the industry average. The HIPPO lasers' modular design isolates known wear components and key failure mechanisms into small components (such as diodes, fibers, output window, shutters, and harmonic modules) that are easy to change in the field without costly tool realignment. This lowers service inventory holding costs while shortening mean time to repair (MTTR).

Our proprietary optical alignment system (EternAlign™) and rugged laser housing virtually eliminate alignment failures that can occur with vibration and shock during shipping. The sealed laser resonator and unique filtration system (ALPS) significantly extends the life of the laser by keeping the air inside the laser clean, dry, and free of volatile organic compounds from out-gassing.

Spectra-Physics
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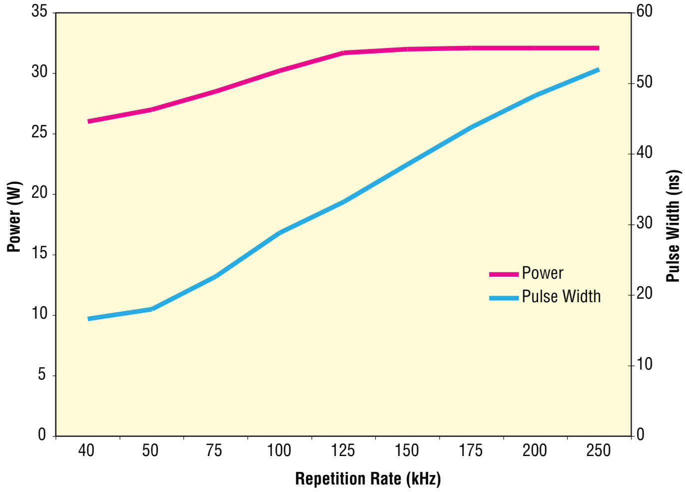
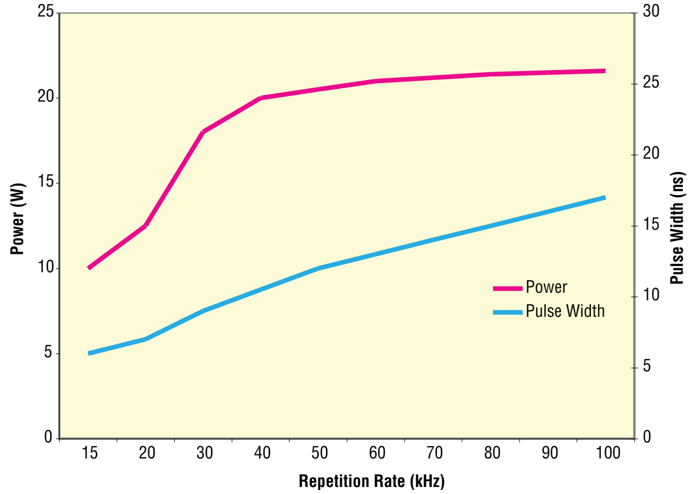
HIPPO™ Mid-Power Q-Switched Lasers

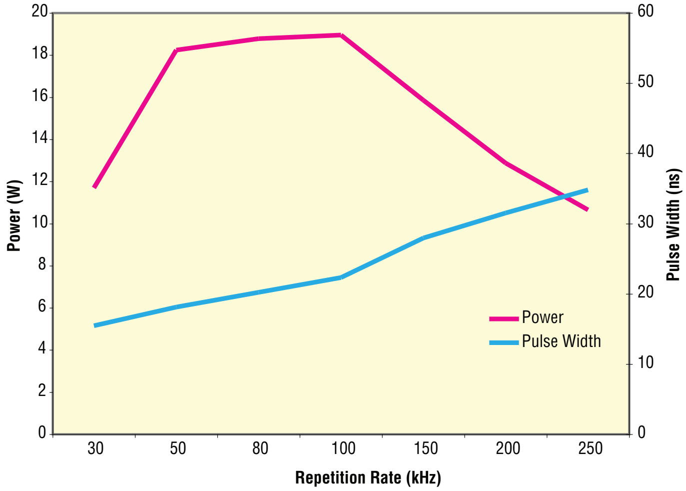
HIPPO 1064-27 Performance



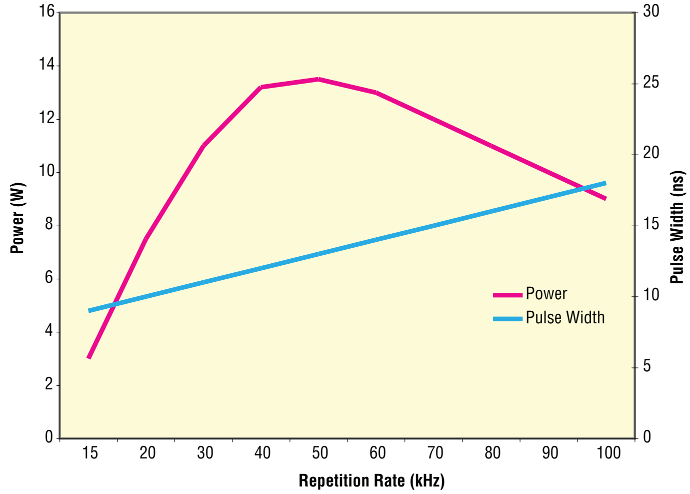
HIPPO 1064-17 Performance



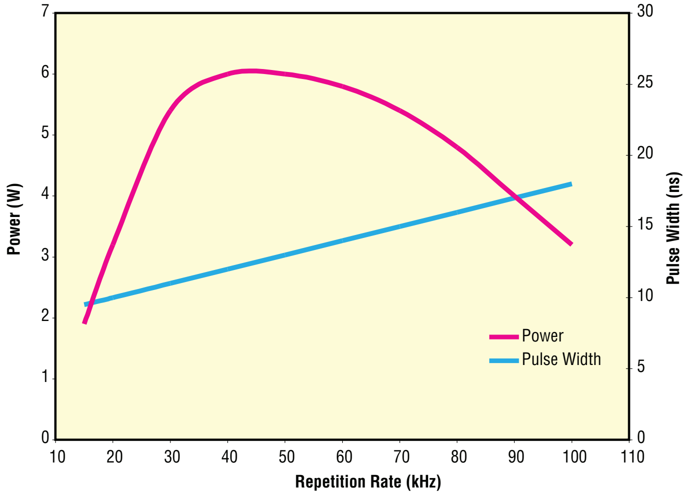
HIPPO 532-15 Performance



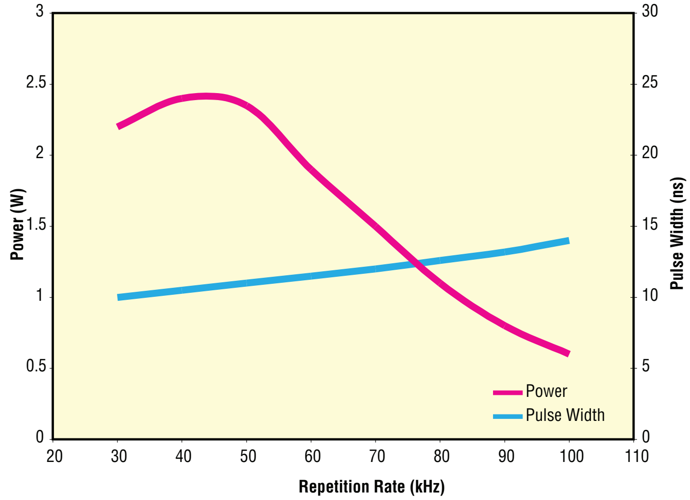
HIPPO 532-11 Performance



HIPPO 355-5 Performance



HIPPO Prime 266-2 Performance



APPLICATIONS

HIPPO 1064

- Laser scribing of P1 thin film solar cells
- c-Si solar cell edge isolation
- Laser deflashing electronics package leads
- Flexible circuit laser processing
- Laser marking on various metals and plastics
- Si wafer scribing

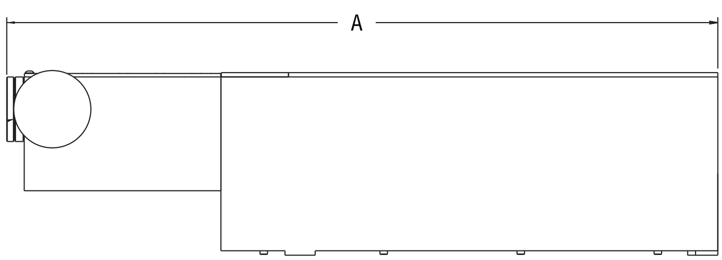
HIPPO 532

- Laser scribing of P2, P3 thin film solar cells
- c-Si solar cell edge isolation
- Laser glass cutting
- PCB laser structuring and laser singulation
- Si wafer laser marking

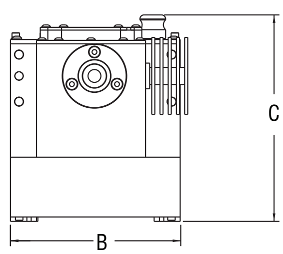
HIPPO 355/266

- c-Si solar cell edge isolation
- Flexible circuit laser processing
- Laser glass cutting
- Laser marking on various metals and plastics
- Laser ITO patterning
- Sapphire (LED) laser scribing
- LED laser lift-off
- Si wafer laser scribing
- Via hole drilling for flip chips, flexible circuits and PCBs

HIPPO Laser Dimensions



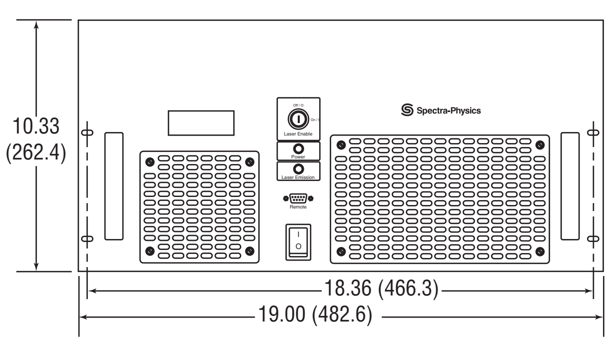
Side View



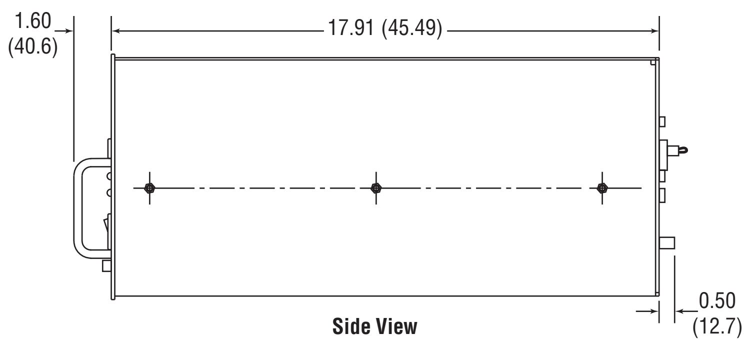
Front View

		HIPPO 1064-27 HIPPO 1064-17	HIPPO 532-15 HIPPO 532-11	HIPPO 355-5 HIPPO Prime 266-2
A	Length	14.6 in (371 mm)	20.8 in (528 mm)	28.5 in (724 mm)
B	Width	5.0 in (127 mm)	5.0 in (127 mm)	9.0 in (229 mm)
C	Height	6.0 in (152 mm)	6.0 in (152 mm)	6.0 in (152 mm)

Power Supply Dimensions



Front View



Side View

All dimensions in inches (mm)

HIPPO™ Mid-Power Q-Switched Lasers

Specifications

General Characteristics	HIPPO 1064-27	HIPPO 1064-17	HIPPO 532-15	HIPPO 532-11	HIPPO 355-5	HIPPO Prime 266-2
Wavelength	1064 nm	1064 nm	532 nm	532 nm	355 nm	266 nm
Power	27 W at 100 kHz	17 W at 50 kHz	15 W at 100 kHz	11 W at 50 kHz	5 W at 50 kHz	2 W at 50 kHz
Repetition Rate	30–250 kHz	15–300 kHz	30–250 kHz	15–300 kHz	15–300 kHz	30–300 kHz
Pulse Width, nominal	<30 ns at 100 kHz	<15 ns at 50 kHz	<25 ns at 100 kHz	<13 ns at 90 kHz	<12 ns at 50 kHz	<12 ns at 50 kHz
Peak Power	~9 kW	~22.7 kW	~6 kW	~16.9 kW	~8.3 kW	~3.3 kW
Beam Characteristics						
Spatial Mode	TEM_{00}					
M^2	<1.2	<1.2	<1.3	<1.3	<1.3	<1.4
Polarization	>100:1, vertical	>100:1, vertical	>100:1, horizontal	>100:1, horizontal	>100:1, vertical	>100:1, vertical
Beam Diameter, at waist	0.6 mm nominal	0.6 mm nominal	0.8 mm nominal	1 mm nominal	1 mm nominal	2 mm nominal
Waist Location, nominal	-17 cm from output	-17 cm from output	at output	-30 cm from output	at output	at output
Beam Divergence, full angle	<3.0 mrad	<3.0 mrad	<1.2 mrad	<1.0 mrad	<0.65 mrad	<0.28 mrad
Beam Ellipticity	<10%	<10%	<10%	<10%	<10%	<20%
Beam Pointing Stability	<±50 µrad/°C					
Pulse-to-Pulse Stability	<2% rms	<2% rms	<4% rms	<5% rms	<5% rms	<8% rms
Operating Conditions						
Warm-up Time	<10 min	<10 min	<20 min	<20 min	<20 min	<30 min
Temperature Range	18–35 °C					
Altitude[3]	0–3,000 m					
Humidity	8–95%, non-condensing					
Water Cooling	Yes					
Water Temperature	20°C ±0.1°C					
Water Flow Rate	1.5 liter per minute at 3 psi					
Thermal Load	100 W					
Non-operating Conditions						
Temperature Range	0–50 °C					
Altitude, Non-operating	0–12,000 m					
Humidity, Non-operating	8–95%, non-condensing					
Physical Characteristics						
Dimensions (Laser Head) (L x W x H)	14.6 x 5.0 x 6.0 in (341 x 127 x 152 mm)	14.6 x 5.0 x 6.0 in (341 x 127 x 152 mm)	20.8 x 5.0 x 6.0 in (525 x 127 x 152 mm)	20.8 x 5.0 x 6.0 in (525 x 127 x 152 mm)	28.5 x 9.0 x 6.0 in (724 x 229 x 152 mm)	28.5 x 9.0 x 6.0 in (724 x 229 x 152 mm)
Weight (Laser Head)	17.6 lbs (8.0 kg)	16.8 lbs (7.6 kg)	21.9 lbs (9.9 kg)	20.9 lbs (9.5 kg)	33.1 lbs (15.0 kg)	35.0 lbs (15.9 kg)
Dimensions (Power Supply) (L x H x W)	19.0 x 10.3 x 17.9 in (482.6 x 262.3 x 455 mm)					
Weight (Power Supply)	55 lbs (24.9 kg)					

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www.newport.com/spectra-physics

3635 Peterson Way, Santa Clara, CA 95054, USA
PHONE: 1-800-775-5273 1-408-980-4300 FAX: 1-408-980-6923 EMAIL: sales@spectra-physics.com

	PHONE	EMAIL
Belgium	+32-(0)0800-11 257	belgium@newport.com
China	+86-10-6267-0065	china@newport.com
France	+33-(0)1-60-91-68-68	france@newport.com
Japan	+81-3-3794-5511	spectra-physics@splasers.co.jp
Taiwan	+886 -(0)2-2508-4977	sales@newport.com.tw
Irvine, CA, USA	+1-800-222-6440	sales@newport.com
Netherlands	+31-(0)30 6592111	netherlands@newport.com
United Kingdom	+44-1235-432-710	uk@newport.com
Germany / Austria / Switzerland	+49-(0)6151-708-0	germany@newport.com

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Newport Corporation, Global Headquarters
1791 Deere Avenue, Irvine, CA 92606, USA
PHONE: 1-800-222-6440 1-949-863-3144
EMAIL: sales@newport.com
Complete listings for all global office locations are available online at www.newport.com/contact

DS-021201

CHAPTER 1: Introduction

Figure 1-1 *Talon laser*

The Spectra-Physics *Talon*® systems bring more capability, greater process range, and better value to customers looking for uncompromising performance and reliability in lasers for micro-machining and other applications. By offering performance and features of much more expensive lasers and far exceeding the performance and reliability of similarly priced lasers, the *Talon* family of lasers bring an exceptionally favorable cost-of-ownership to a wide range of industrial laser applications.

Applications

The *Talon* systems were designed specifically to enable the applications demanding precision laser micro-machining to go faster, with higher quality, and at lower cost, with less downtime and lower maintenance costs. These applications include, among others:

- PCB via drilling
- PCB and FPCB cutting and depaneling
- Scribing/dicing
  - Si wafer + low K
  - Sapphire wafer scribing
  - Quartz
  - Ceramics
- Flat-panel display (FPD)
- ITO patterning and touch screen manufacturing
- IC package singulation
- Photovoltaics processing
- Medical device manufacturing

CHAPTER 3: Laser Description

Overview

The Spectra-Physics *Talon*® laser systems are solid-state, Q-switched OEM lasers that produce a superior quality, 532 nm green, or 355 nm UV, pulsed output beam over a wide range of repetition rates.

The *Talon* laser is capable of providing a stable pulse energy through the entire range of its repetition rate, as well as precise triggering or gating of pulsed output in response to user-provided signals.

The *Talon* laser system was specifically designed for applications requiring a Q-switched, high-quality beam with good mode quality in a cost-effective package. This laser is a rugged, sealed unit designed for simple hands-free operation and simple integration into an OEM host system.

The Utility Module contains a 48 Volt DC power supply and the ALPS air-supply system. The Utility Module has no communication capability with the laser head other than the direct connections of power and air, along with the AC power switch for the entire system.

The laser head contains all system electronics and optical components, along with microprocessors and memory for storing system parameters. The *Talon* system is designed for maximum reliability with minimum complexity. The laser head does not require any mechanical adjustments to operate, and is entirely controlled through the software.

The host system connects to the laser through the serial or USB port. External/TTL control signals via the ANALOG port can either be used or in combination with serial commands. Combining the two methods provides the greatest flexibility and control over the laser output. The ANALOG and serial controls are fully described in Chapter 4, “Controls, Indicators, and Connections,” and the commands are listed in Appendix A, “Programming Reference Guide.”

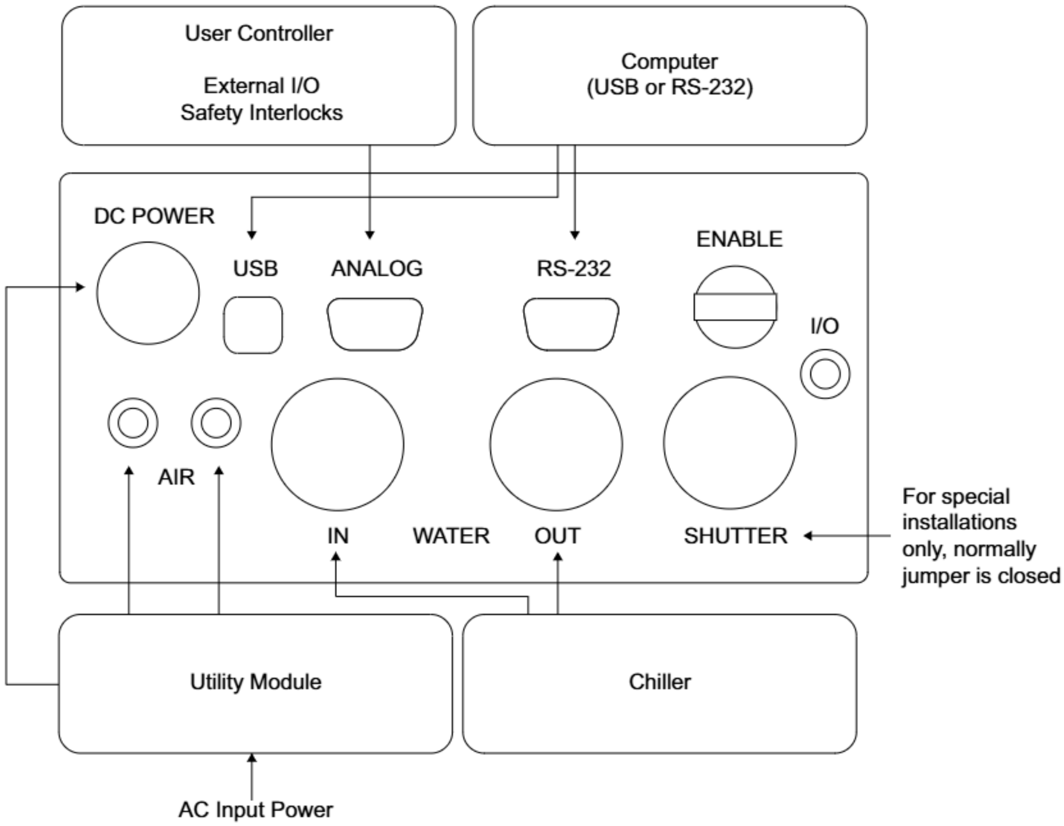


Figure 3-1 *System connection diagram*

Key Component Descriptions

The key system components are briefly described in this section to give an overall view of the *Talon* system to better understand the rest of this manual. Further details may be found in the later sections of this manual.

Laser Optical Elements

The internal optical elements are the primary components of the laser and are referenced in the commands used to control the laser.

Diode

The diode is the optical pump source for the *Talon* laser. The diode requires water cooling to remove waste heat. Exceeding temperature limits either by insufficient water flow or chiller cooling capacity causes the laser to shut the diode off. Diode life is not improved by turning off frequently or reducing current from operating current levels. Frequently turning the diode on and off and changing the current by large amounts can reduce the diode life. Refer to Chapter 6, “Operation,” for more information about diode use.

Gain Crystal

Controlling the gain crystal temperature is critical to maintaining laser efficiency. The chiller temperature control precision can determine the average power stability. The tower temperature, which is the temperature of the crystal and its mechanical support, is a critical monitoring parameter. An excessive tower temperature causes the laser to shut itself off.

Q-switch

The Q-switch device controls the laser parameters of pulse rate, intra-cavity energy build-up, first pulse suppression, and others. The primary inputs for Q-switch operations are trigger and gate inputs to the laser, along with the software controls for E-Pulse.

SHG Crystal

The second harmonic generator (SHG) crystal is temperature controlled internally to maintain efficiency. The temperature is set in terms of “counts.” Periodic optimization of the temperature counts may be required to maintain optimal performance due to age, temperature, and environmental changes. Refer to “Maintaining Optimal Laser Performance.”

THG Crystal (355 nm Units)

The third harmonic generator (THG) crystal is temperature controlled internally to maintain efficiency. The temperature is set in terms of “counts.” Periodic optimization of the temperature counts may be required to maintain optimal performance due to age, temperature, and environmental changes. Refer to “Maintaining Optimal Laser Performance.”

To further maintain optimal performance of the laser, the THG crystal can be translated to new spots. Keep movement between spots to a minimum. The system generates a warning and later a fault message when it is time to translate to a new spot. Refer to “System Event Codes.”

Internal Power Monitor

The internal power monitor tracks the average power of the laser over time and during processing. Accuracy may drift over time and over large repetition rate changes. True power should be judged using an external calibrated power detector. The internal power monitor can be calibrated to an external calibrated detector, see “Calibrating the Internal Power Monitor.”

Replaceable Output Window

Exposure to atmospheric contaminants or airborne particulate waste thrown off by material processing can find their way onto the output window of the laser. The high power incident there can cause these materials to stick to the window and cause the beam quality and power to become unacceptable over time. The output window on the *Talon* laser head is designed to be easily replaced in that event. Refer to "Replacing the User Replaceable Window" for instructions on when and how to do so.

Safety Shutter (Optional)

The shutter is used as a safe means of blocking the laser beam without shutting off the laser diode. If an optional safety shutter has been installed on the *Talon* system, it may be operated via serial commands, or through the shutter interlock pins on the ANALOG connector. The optional safety shutter is not intended for high duty-cycle operation and thus is not to be used as a process shutter. Its function is for safety only, to protect personnel from accidental or potential exposure to the laser beam. If the operation of a shutter on the laser beam can be predicted in advance, as part of the known operational sequence of loading work pieces on and off the tool, or within the process steps of manufacturing, it is being used as a process shutter. Although extremely reliable, the safety shutter generally should not be cycled more than approximately 10 times daily (10,000 times over the life of the laser).

Software and System Control

As a component in an OEM system, the *Talon* laser is controlled using the serial command language or external control signals, or a combination of both. The serial and ANALOG ports are located on the rear of the laser head. The most common methods of operating the laser are described in Chapter 6, "Operation."

Software

The *Talon* system is supplied with a graphical user interface (GUI) for using a computer as a control panel for the laser, sending commands and queries for information. The GUI also contains a command window that allows programmers to verify commands and queries for custom software development.

Serial Inputs

Two serial inputs, a USB port and an RS-232 port, are provided. While the laser may be controlled using either, the strong recommendation is to use the RS-232 port for laser commands and control, and the USB port only for retrieving data logs from the laser. The RS-232 port is more suitable for industrial control purposes, with better protection and isolation from potential noise and interference on the control lines.

Data Log

Data log software produces system activity logs. The log data is extremely useful for the service engineer in identifying the root cause of a failure, formulating corrective actions, and for remote diagnostics. Refer to Appendix B, "Data Log Access," for information on downloading the data log.

Utility Module

Figure 3-2 *Utility Module*

The Utility Module provides DC power and clean and filtered air to the laser head, and receives exhaust air from the laser head. The only control available on the Utility Module is the ON/OFF power switch. Other than providing DC power and air, the Utility Module does not communicate with the laser head or any other instrument. When the Utility Module is ON, power is provided to the laser head and air is being circulated through the purge lines to and from the laser head.

Active Laser Purification System (ALPS)

Located inside the Utility Module, the Active Laser Purification System (ALPS) module provides a constant flow of clean, dry air to maintain a clean environment inside the laser to protect and extend the life of the laser optics. When the laser is installed, it is recommended that the Utility Module remain ON for the ALPS to continue supplying clean air to the laser head. The ALPS module needs to be changed on a regular basis to maintain performance and keep the laser warranty valid.

Chiller

The *Talon* laser requires fluid cooling to carry off the heat generated internally. This is typically done using a closed-loop recirculating water chiller (purchased separately) that provides a flow of water at a regulated temperature. Chiller requirements are given in Chapter 5, “Equipment Installation.” When the laser head is ON, a flow of water is required for component cooling, even if no laser beam is being emitted. Water flow direction is important, and the laser head water connections are marked WATER IN (with female connector) and WATER OUT (with male connector).

A chiller purchased from Spectra-Physics ships with a 5 micron filter on the return line of the chiller. If you did not order a chiller from Spectra-Physics, ensure that the coolant is filtered through at least a 20 to 50 micron filter on the return side of the chiller and that the filter and coolant are replaced regularly. To avoid galvanic corrosion, all wetted metal surfaces need to be stainless steel, copper, or nickel; do not use an aluminum-based chiller.

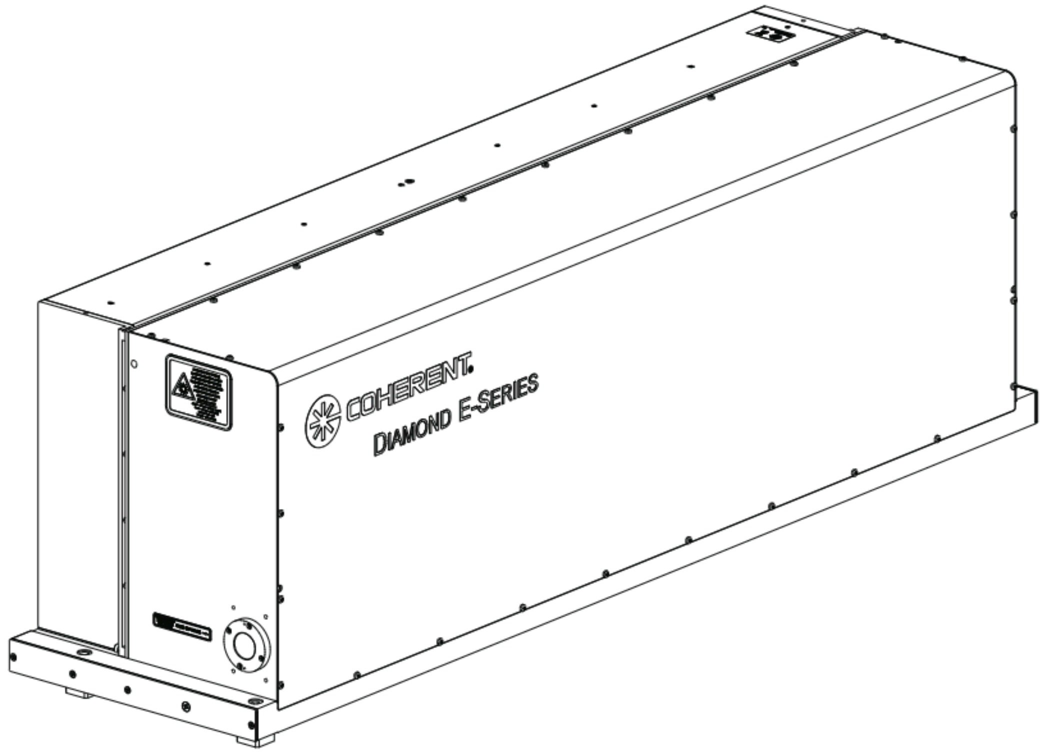
Note *Nalco and distilled water are the only approved coolants for use with the Talon laser. Do NOT use tap or deionized (DI) water.*

SECTION ONE: DESCRIPTION AND SPECIFICATIONS

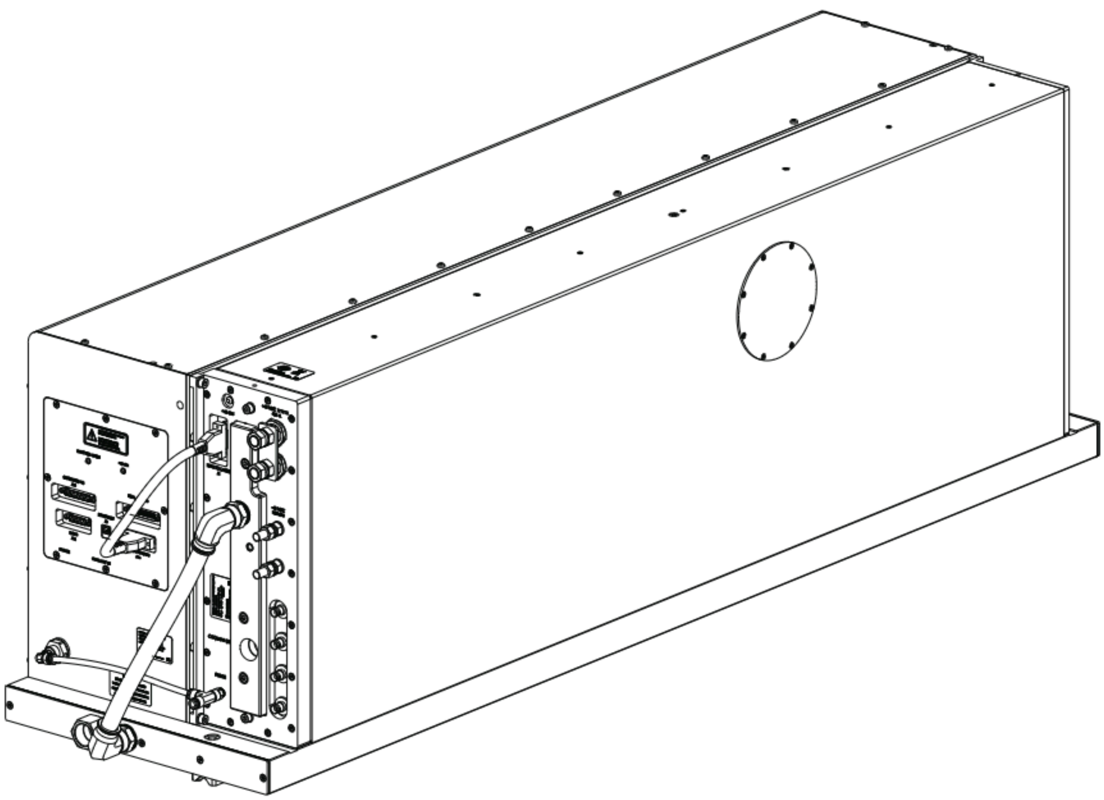
Introduction

The DIAMOND™ E-1000 Series laser systems (Figure 1-1 and Figure 1-2) are integrated, RF excited, liquid-cooled, sealed-tube, pulsed industrial CO_2 lasers and consist of an integrated laser head and RF power supply. These integrated systems operate on 48 VDC at high currents; therefore a DC power supply is required. To remove heat from the laser system (and from the liquid-cooled DC power supply, if used), external liquid cooling is essential. A continuous supply of purge gas to the laser system is needed to prevent condensation and reduce contamination on optical surfaces. Internal control electronics act on external signals to vary pulse frequency and duty cycle while monitoring laser performance and safety circuits. A simplified laser system block diagram is shown in Figure 1-3 on page 1-3.

Figure 1-1. DIAMOND E-1000 Series OEM Laser



a. Output End Isometric View



b. Interface End Isometric View

Figure 1-2. E-1000 Series OEM Laser

Purpose of This Manual

This manual is designed to assist the Original Equipment Manufacturer (OEM) during the integration of any DIAMOND E-1000 Series laser. It contains information on the performance and operation of the laser as well as installation and control methods. This OEM manual is intended to be used by trained staff during the process of integration into a laser tool.

E-1000 Series Lasers

DIAMOND E-1000 Series lasers operate in either a pulsed or quasi-continuous wave modes, and can be operated via several control and communication methods to generate many pulse formats. This allows the user complete control of the output beam and power output.

All E-1000 Series lasers are equipped with a powerful embedded control system that is useful in providing onboard diagnostics (setup and troubleshooting) as well as fault isolation. Laser data are accessible using a standard LAN connection via HTML protocol. A detailed description of the embedded control is available in Appendix A: Embedded Control and Diagnostics. A simplified laser system block diagram is shown in Figure 1-3.

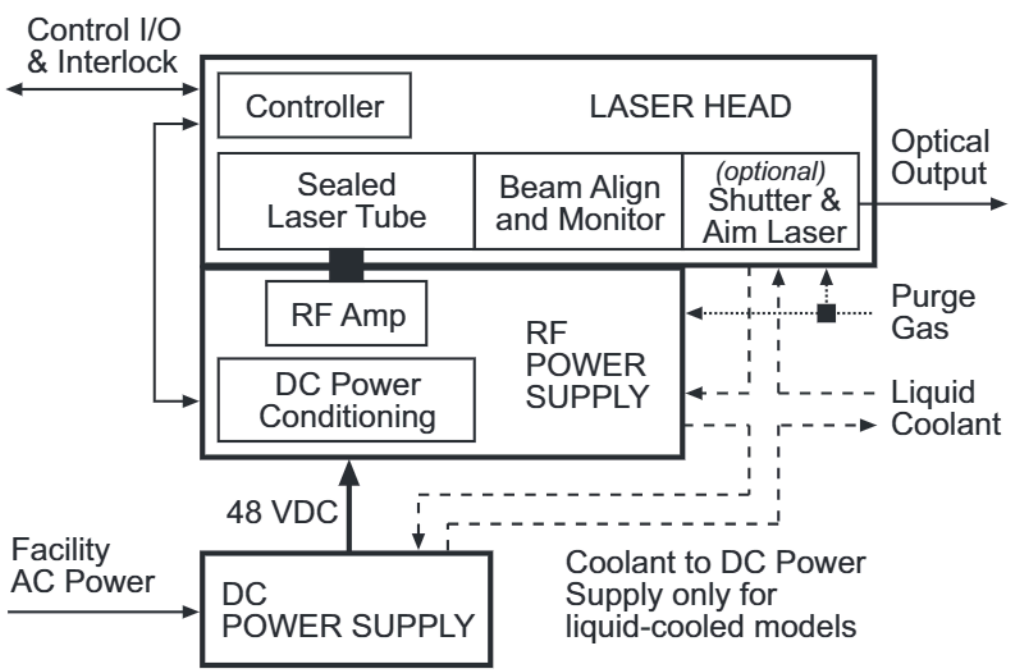


Figure 1-3. Simplified System Block Diagram

Laser System Components

DIAMOND E-1000 Series lasers contain the laser head (tube) with beam conditioning optics, (optional) shutter and RF matching network, simmer circuit, control electronics, coolant temperature and internal monitors, and the RF power supply (Figure 1-4).

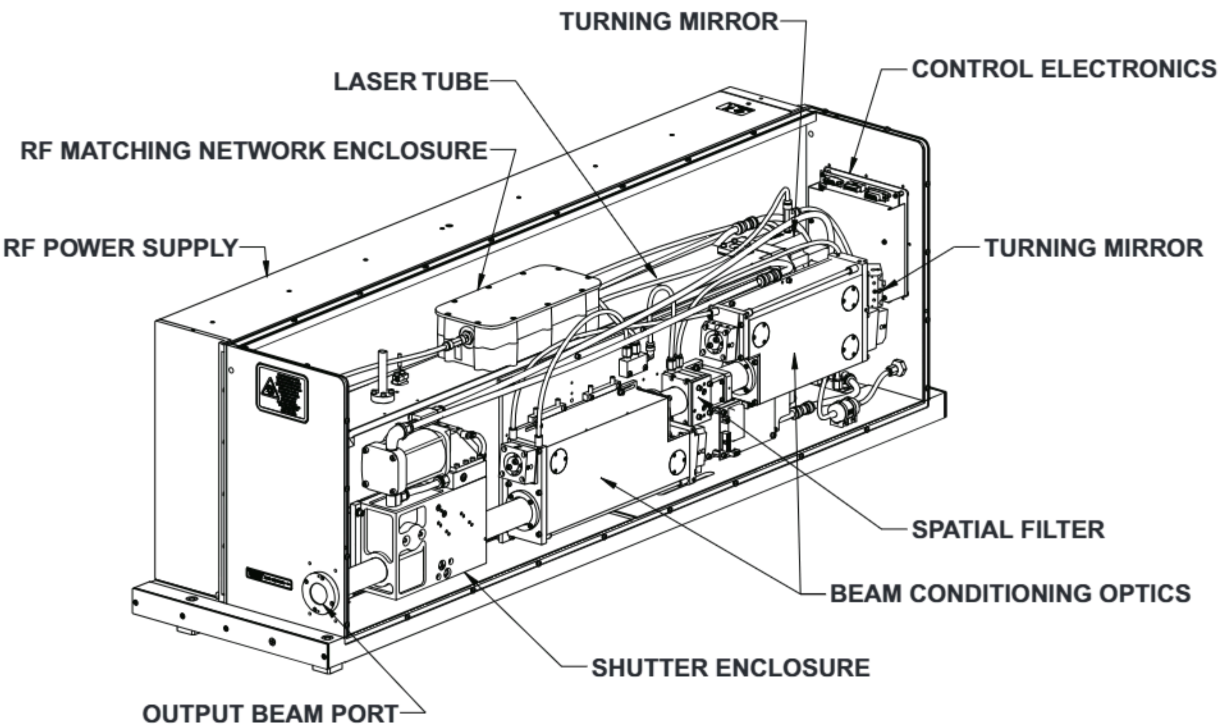


Figure 1-4. E-1000 Series Component Location Diagram

The laser system incorporates a sealed laser tube, which by design requires no gas exchange or periodic refill for operation.

The all metal construction of the laser head provides high thermal stability and resistance to damage due to shock and/or vibration.

Tube

The laser tube consists of a two mirror optical cavity with fluid-cooled rectangular shaped (slab design) electrodes extending the length of the tube. An RF matching network is mounted on top of the tube and coils within the tube are positioned to create a uniform distribution of RF energy across the electrodes (see Figure 1-5).

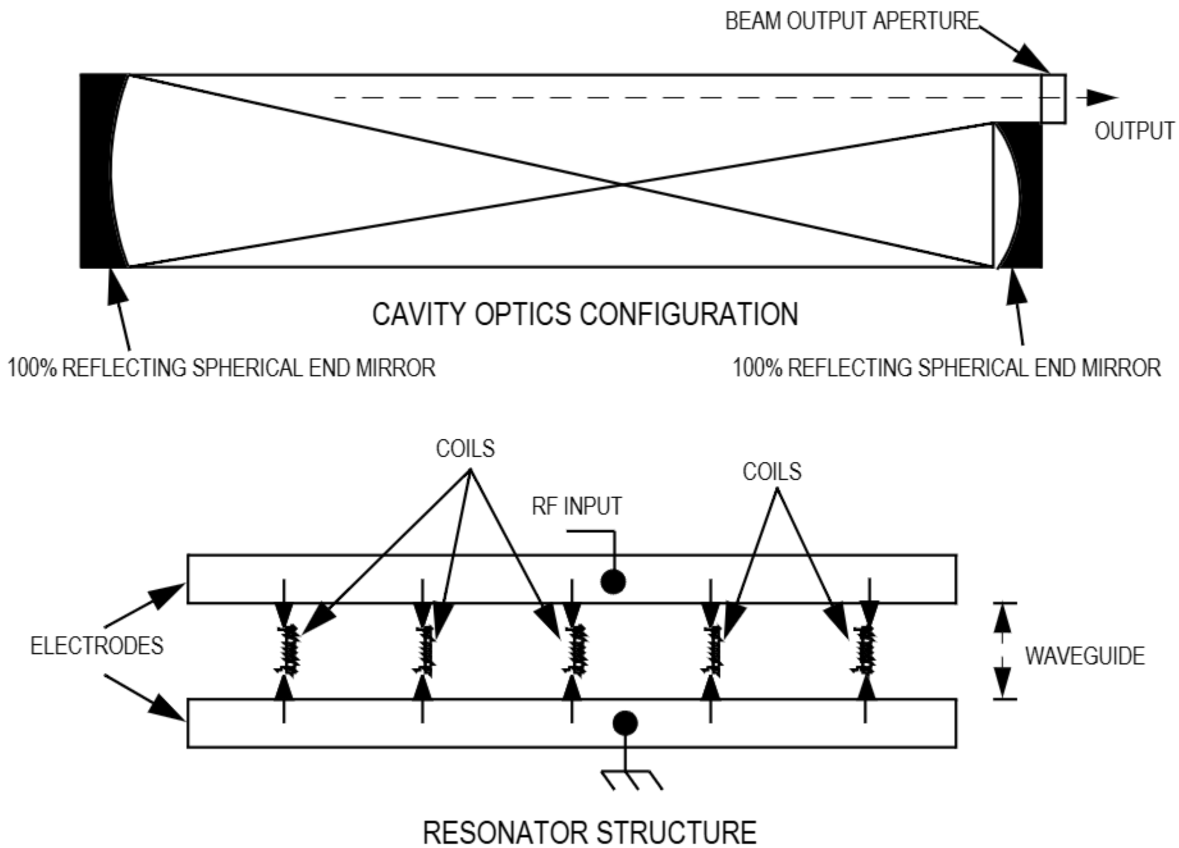


Figure 1-5. Laser Tube

One of the 100% reflecting end mirrors partially covers the electrode area. The gap at the end of the mirror forms the output path for the laser beam. The beam exiting in this gap passes through a zinc selenide sealing window at the output end of the tube.

Optics

The resonator optics are within the sealed head and require no maintenance or alignment. Upon exiting the laser cavity, the asymmetrical laser beam (wide in one transverse beam axis and narrow in the orthogonal beam axis) propagates through an output window and on through a series of precision aligned optical components. These components serve to create a circular symmetrical propagating optical beam. As the beam is corrected for symmetry, it is also focused through a narrow set of knife edges. These knife edges are set wide enough to allow the main lobe of radiation to pass, but also strip off unwanted side-lobe energy. Finally, the beam reflects off of a spherical mirror which nominally collimates the beam for minimum divergence, then to an (optional) internal shutter assembly before it exits the laser head aperture.

Simmer Circuit

The simmer circuit generates short duration RF pulses at 1,000 us intervals (1 kHz rate) to the tube gas in order to promote rapid starting after periods of being turned off. The simmer pulse is automatic to ensure instant-on operation but is not powerful enough to cause laser action. When commanded to modulate, the simmer circuit is disabled.

Control Electronics

The E-1000 Series Control Electronics provide control, diagnostics and fault management for the system. Primary control and diagnostics are provided through dedicated signal connections on the interface panel. The hardware interface circuitry is highly similar to the other DIAMOND OEM products. See Section Four: Control Interfaces for a detailed interface description.

A secondary ethernet interface is provided for remote control, diagnostics and troubleshooting. See Appendix A: Embedded Control and Diagnostics for more information.

All E-1000 Series lasers are equipped with a main controller as well as distributed microcontrollers located throughout the system. Fault management is accomplished by the main controller using data from the distributed microcontrollers. The main controller also polls the distributed microcontrollers for status information and system warnings.

Coolant Temperature Monitor

All E-1000 Series lasers require water with a corrosion inhibitor additive as the cooling medium to remove heat from the laser head and RF power supply. Temperature probes and circuits within the laser head and RF power supply continuously monitor the coolant temperature whenever the laser is on. If the internal coolant temperature falls outside pre-set limits, the laser will not operate and will indicate a temperature fault condition. To prevent temperature faults, the customer must maintain proper coolant temperature and flow as specified in the utility requirements.

Failure to provide proper coolant temperature and flow to this laser will result in intermittent or halted operation of this laser.

Internal Power Monitor

E-1000 Series lasers are equipped with an internal power monitor. The final mirror allows a small percentage of the output beam to strike a thermopile sensor located behind it. This sensor generates an output voltage proportional to laser output power. An analog signal is available at the extended interface signal connector, with a conversion factor of 1.5 mV per watt. The internal power meter is calibrated against an external power meter calibrated and traceable to NIST calibration standards.

RF Power Supply

The RF power supply (RFPS) provides pulsed RF power to the laser head to energize the laser gas mixture in the tube. The laser output pulse (width and frequency) is based on an input modulation signal to the RF power supply.

The RF power supply should always be physically and electrically connected to the laser head (load). Although protection is built into the unit, operating the RF power supply with no load could cause damage.

The RF power supply control circuitry also has the following features:

- Provides protection from duty cycles exceeding 60%.
- Limits the pulse width to less than 1 msec.
- Monitors forward and reflected RF power to and from the laser head.
- Contains a factory set VSWR limit that limits duty cycle in case the laser fails to start.
- The RFPS contains embedded control sensors which supports fault isolation. Further description of this capability is found in Appendix A: Embedded Control and Diagnostics.

DC Power Supply

A high-current 48 VDC power supply is the required power source for the E-1000 Series laser systems.

Note that the laser presents a pulsed dynamic load to the DC power supply. Using an oscilloscope, laser modulation-induced variation across the RF power supply DC input terminals will be observed.

Coherent has qualified both air and liquid-cooled DC power supplies for use with the E-1000 Series laser system (see Appendix C: Accessories and Options). Whichever model is used, refer to the installation instructions provided by the DC power supply manufacturer to determine the correct mounting, AC input power cord/wiring specifications, cooling requirements, connections and controls.

It is the responsibility of the system integrator to provide AC input power wiring (electrical disconnect, circuit breaker/fusing, power cord, receptacles and mating plugs). Consult a qualified electrician to select and install the appropriate components that meet local electric codes.

The DC power supply output cables are a critical part of the overall system. Coherent can provide the DC output cables required to handle the high current requirement.

Laser System Specifications

The E-1000 Series laser system's physical characteristics and utility requirements common to all E-1000 Series models are given in Table 1-1 and Table 1-2. Laser performance specifications for a specific E-1000 Series laser model are provided in its datasheet available on-line at **www.coherent.com** and in the test report provided with each laser system.

Table 1-1. Laser Physical Characteristics

PARAMETER	VALUE
LASER PHYSICAL CHARACTERISTICS	
Weight	173 kg (381 lbs.)
Dimensions (L x W x H)	1497 x 384 x 471 mm (58.9 x 15.1 x 18.5 in.)

Table 1-2. Utility Requirements

PARAMETER	VALUE
ENVIRONMENT (OPERATING)	
Altitude	<2,000 m (<6,500 ft.)
Relative Humidity(1)	<95% non-condensing for inlet fluid temperature
Ambient Temperature	5 to 45°C (41 to 113°F)
Shock & Vibration	1G static acceleration 0.2G RMS vibration
ELECTRICAL	
DC Input Voltage	48 VDC ± 1.0%

Table 1-2. Utility Requirements (Continued)

PARAMETER	**VALUE**
Ripple Voltage	<±1% of peak
Maximum Voltage Sag During Peak Current	≤2.4V from Starting Voltage
Line Regulation	≤±1%
Load Regulation	≤±1%
DC Continuous Current[2]	≤425A
Dynamic Peak Current	<628A peak for 1 ms
RECOMMENDED DC POWER CABLES (4, 2 RED AND 2 BLK)	
DC Cable Length (each)	3 m (10 ft.)
DC Cable Wire Gauge (each, 2+ and 2– are used)	85 mm^2 (3/0)
LIQUID COOLING	
Composition	Distilled or de-ionized water plus corrosion inhibitor
Flow Rate	25 lpm (6.5 gpm)
Heat Load [3]	<22 kW (<75 kBtu/hr)
Maximum Static Pressure	827 kPa (120 psi)
Pressure Differential [4]	344 kPa (50 psi) @ 25 lpm (6.5 gpm)
Set Temperature Range (at laser head coolant inlet)	21 to 25°C (69.8 to 77°F)
Temperature Variation about Set Temperature	<±1°C (±1.8°F)
Particulate Size	≤30 microns in diameter
LASER PURGE GAS	
Composition	N_2 or CDA
Flow Rate	2.8 lpm

The above specifications subject to change without notice.

(1) Do not operate at or below dew point.

(2) Current rating may vary with specific model.

(3) If a closed-loop system is used, it must have sufficient capacity to handle this heat load in addition to meeting the other fluid requirements listed in this table. If the liquid-cooled DC power supply option is chosen, the cooling system must also account for an additional 2 kW heat load (see Table C-2).

(4) Measured from system inlet to outlet ports and does not include the pressure drop from chiller fittings or the supply and return hose.