

Frequency Stabilized HeNe Laser

Models SL 02/1 and SL 02/2

Instruction Manual



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IMPORTANT NOTES:

Carefully read and observe those safety precautions stated below before using these frequency-stabilized HeNe lasers.

These lasers are is intended for use exclusively by trained personnel who are aware of the safety hazards that may arise when working with lasers and are familiar with those precautions needed for preventing them.

Carefully read this instruction manual through before commencing to use these lasers.

In particular, you should observe those precautions stated in Section 4 of this instruction manual at all times.

Although this instruction manual has been prepared with the utmost care, no liability is assumed for any errors or omissions. We also retain the right to alter products and their specifications in manners that may result in their differing from statements appearing in their instruction manuals at any time without prior notice.

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1 Major Features

Our models SL 02/1 and SL 02/2 frequency-stabilized HeNe lasers (cf. Figure 1, below) have the following major features:

- They incorporate frequency-stabilization systems based on the dual longitudinal-mode-offset method, which yields extremely accurate frequency stabilization.
- Laser emission in the red at a wavelength of approximately 633 nm
- Short warm-up times that are typically < 10 min
- Their laser head is incorporated in a compactly designed cylindrical housing and powered by a separate 13.5-VDC power supply supplied in a housing incorporating a line plug.



Figure 1: The model SL 02 frequency-stabilized HeNe laser.

- Available in two models having differing output-beam characteristics:
 - **Model SL 02/1**, which emits a single linearly polarized longitudinal mode.
 - Output power: ≥ 1 mW
 - **Model SL 02/2**, which emits a pair of linearly polarized longitudinal modes with mutually orthogonal planes of polarization.
 - Output power: ≥ 2 mW
 - Longitudinal mode spacing: 730 MHz
- The following options are available:
 - A frequency-output connector for slaving their frequency-stabilization circuitry to an iodine-cell-stabilized HeNe laser
 - A Faraday isolator
 - Markings indicating the orientation of their beam's plane(s) of polarization
 - User-specified output powers ranging from 0.7 mW to 1.3 mW
 - Modification for use at other operating temperatures
 - Output couplers equipped with alignment mechanisms for coupling them to monomode, multimode, polarization-preserving, or non-polarization-preserving optical fibers
 - A mode selector for switching between single-longitudinal-mode and dual-longitudinal-mode output (available on Model SL 02/2 only)
- Line adapter/power supply:
 - Accommodates European, UK, USA/Japanese, and Australian line voltages and frequencies and mates to various types of electrical outlets..

2 Items Included

Our models SL 02/1 and SL 02/2 frequency-stabilized HeNe lasers are supplied complete with the following items:

- a laser head of the type ordered (Model SL 02/1 or Model SL 02/2),
- a line adapter/power supply, and
- an instruction manual (this document).

3 Unpacking and Checking the Laser

Your laser has been thoroughly checked for mechanical and electrical integrity at our plant prior to shipment. Unpack the laser and check whether all those items listed above are present and whether there are any obvious signs of shipping damage. Report any shipping damage found to the carrier immediately, since failure to do so may result in your damage claim being rejected. Retain the original packaging for later use in the event that your laser must be returned for servicing or repair. We reserve the right to reject warranty claims in cases where lasers have been returned to us improperly packed or have been returned in other than their original packaging.

4 Notes on Using Your Laser

The laser's plasma tube is powered by a high-voltage DC power supply incorporated into the laser head's cylindrical metal housing. Since its metal housing is grounded to the ground terminal on its internal circuitry, electrical hazards due to high voltages are effectively precluded in the event of damage to the laser head or its internal components, such as breakage of its plasma tube due to impact or shock. The maximum output current of its high-voltage DC power supply is also too low to cause serious personal injuries.

The usual safety precautions that should be observed when installing or operating electrical equipment thus apply to these frequency-stabilized HeNe lasers and their power supplies as well, and are as follows:

- Its power supply may be plugged into any convenient, properly installed, correctly wired, electrical outlet. The electrical outlet involved need not have a ground contact, since the power supply's housing is fabricated from Class II electrically insulating material. To disconnect the laser from the electrical supply, simply unplug its power supply from the electrical outlet. Make certain that its power supply remains freely accessible at all times and is kept well away from damp locations and sources of water, such as sinks, water faucets, etc., including any sources of splash or spray, since the housing on its power supply is not water-proof.

- Never operate the laser with its head or power supply opened. There is no point in operating the laser with its head opened, since it is incapable of proper operation in that condition due to the resultant lack of thermostating. Opening the laser head will also alter the alignment of its internal optics and void the laser's warranty, and should thus be avoided.
- If the laser head is incorporated into a system, its metal housing may be grounded to the system's case ground or ground line, if desired.

Caution: Since the power density in the laser beam is extremely high, you should never stare into the unattenuated beam or any specular beam reflections or directly view the beam or any specular beam reflections using any sort of optical instrument. The laser beam should be routed well above/below eye level wherever practicable. Unintended reflections should be precluded by taking proper precautions. The mechanical beam-blocking shutter on the laser head's beam-exit end may be closed in order to block the beam in the event that any work must be performed on the laser head, which will allow leaving the laser running with its frequency-stabilization system fully operational while work is being performed.

We recommend wearing suitable laser safety goggles whenever performing any alignment procedures.

Caution: Failure to observe this precaution may lead to severe eye injuries, including blinding. Safety regulations applying to both laser manufacturers and users are stated in European standard **EN 60825-1: 2007**, and should be observed at all times.

Our models SL 02/1 and SL 02/2 frequency-stabilized HeNe lasers are Class 3 R laser products and comply with all guidelines and regulations applicable to their design, their construction, and their component items.

All applicable national, state, and local safety and accident-prevention regulations (in Germany, the “Unfallverhütungsvorschriften der Berufsgenossenschaft der Feinmechanik und Elektrotechnik für Laserstrahlung (VBG 93)”) should be observed at all times when using these lasers.

Radiation-hazard warning labels and labels bearing laser-safety notices complying with currently applicable standards and regulations are affixed to the laser head's cylindrical housing. These labels are illustrated in Figure 2 and 3, below.



Figure 2: Warning labels affixed to Models SL 02/1 and SL 02/2 laser heads.

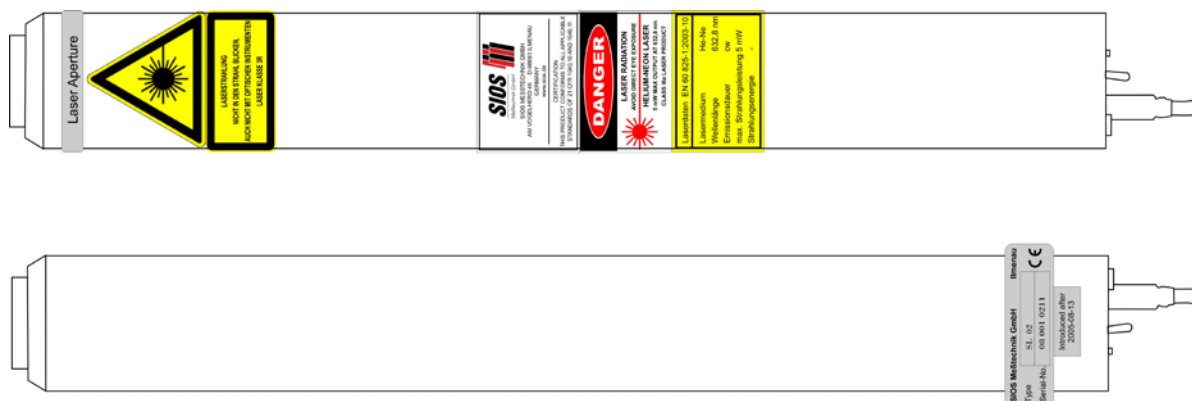


Figure 3: The warning labels and notices affixed to the laser head

5 Laser Operation/Maintaining Frequency-Stabilized Operation

The heads of these lasers have been designed for indoor use only and should be installed at locations where there are no large temperature variations that might adversely affect their frequency-stabilization systems. Their heads may be mounted in any orientation. Mounting hardware that grips their laser head's cylindrical housing is recommended for mounting.

Their power supply, which provides the 13.5-VDC, 2-A, needed for operating their laser head, incorporates input circuitry and a line transformer capable of covering the full range of standard AC line voltages, and is available in versions equipped with plugs mating to various types of electrical outlets commonly used around the world.

All indicators, connectors, and operating controls are located on the laser head's rear face, as shown in Figure 4, below. To operate the laser, plug its power supply into a suitable electrical outlet, make certain that the ON/OFF-switch on the laser head is switched to its "O" (OFF) position, plug the connector on the free end of the cable on the power supply into the mating connector on the laser head, and switch the ON/OFF-switch on the laser head to its "I" (ON) position. Always switch the laser off before connecting/disconnecting the cable on the power supply to/from the laser head.

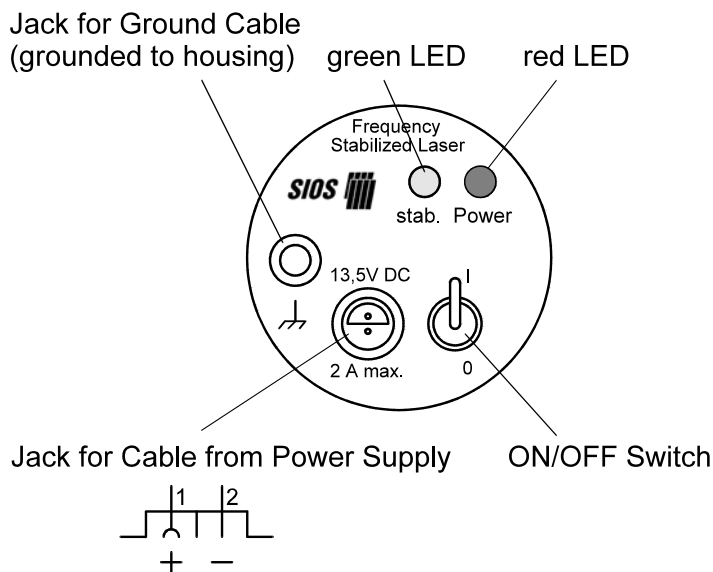


Figure 4: Indicators, connectors, and operating controls located on the rear faces of Models SL 02/1 and SL 02/2 laser heads.

The red “Power” LED will illuminate to indicate that the laser is operational. The gas discharge in the plasma tube will ignite within two seconds after the laser has been switched on. Open the beam-blocking shutter to allow the beam to exit. To block the beam, simply close the shutter. Laser heads equipped with fiberoptic couplers have no beam-blocking shutters.

Switching on the laser also switches on its frequency-stabilization circuitry. The laser's output power will fluctuate to indicate that it is warming up. The laser will be fully warmed up and ready for operation about 5 to 15 min (10 min is typical) after it has been switched on. The green “Stab.” LED will then illuminate to indicate that the laser's frequency has stabilized. Although the laser head's housing will become rather warm during operation, its temperature will remain below 50°C.

If this green LED flickers or remains extinguished for an extended period, then the laser's frequency is no longer stabilized due to:

- high levels of optical feedback from the external optical train,
- disturbing mechanical shocks or vibrations, and/or
- excessively high or low ambient temperatures.

If the green LED remains off for extended periods although the laser otherwise appears to be operating normally, then there is a component failure or malfunction somewhere in the laser head, in which case the laser will have to be sent in for repair.

Although the laser head requires no maintenance, it should be protected against ingress of excessive amounts of moisture or dust. A significant reduction in output power, accompanied by erratic ignition of the laser's plasma tube, indicates that the laser's plasma tube is nearing the end of its service life of approximately 15,000 operating hours, in which case, the entire laser head will have to be replaced.

The power supply is immune to both open-circuiting and short-circuiting, and may be left plugged in while the laser is switched off. Although leaving the power supply plugged in will not harm the laser head or power supply, it wastes electric power. To disconnect the laser from the electrical-supply line, simply switch it off and unplug its power supply.

6 Component Descriptions

6.1 The Laser Head

The laser head consists of a 50-mm-diameter, 410-mm-long, cylindrical metal housing (cf. Figure 5, below) housing an elastically, but rigidly, mounted, dual-longitudinal-mode HeNe laser tube with a rated output power of 2 mW, along with its high-voltage supply and frequency-stabilization electronics.

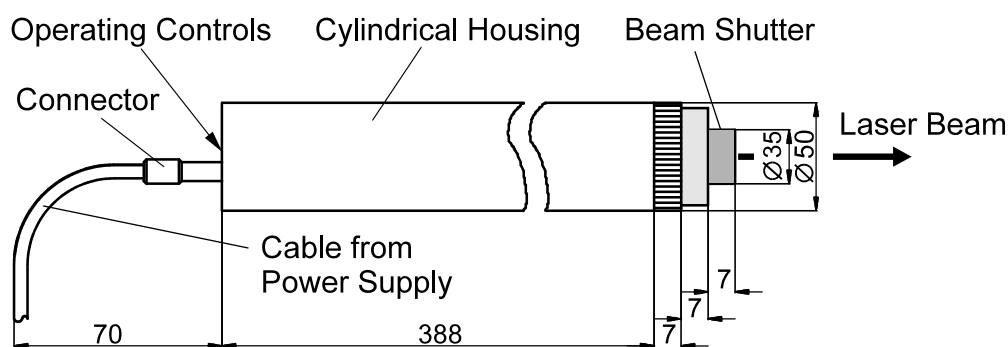


Figure 5: Dimensional drawing of a Model SL 02/1 / SL 02/2 laser head.

The connector on the free end of the cable on the power supply plugs into the mating connector on the rear face of the laser head, which also incorporates an ON/OFF switch, the red "Power" LED indicating that the electrical supply to the laser head has been switched on, the green "Stab." LED indicating that the laser's frequency has stabilized, and a jack for connecting a ground cable.

The laser head requires a stable supply voltage ranging from 12 VDC to 15 VDC. A supply voltage of 13.5 VDC has been chosen in order to provide the safety margin needed for reliable operation. The laser head's maximum current draw is 2 A.

A block schematic of the laser head's frequency-stabilization circuitry is shown in Figure 6, below. The negative conductor of the cable from the power supply is grounded to the laser head's housing. Since the power supply's housing is fabricated from insulating material, the laser head is electrically isolated from the line voltage and may thus be grounded to case ground or ground line of the system in which it is installed. A ground jack is provided on the rear face of the laser head for this purpose. The connector on the free end of the cable on the power supply cannot be incorrectly inserted into its mating connector on the laser head, which precludes problems due to reverse polarity.

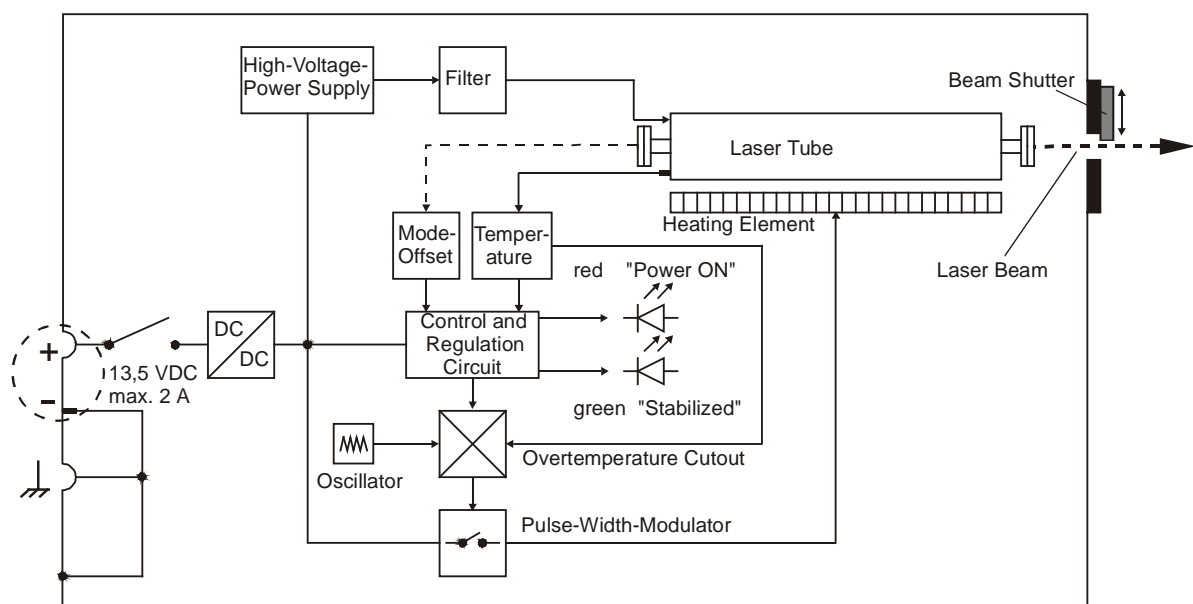


Figure 6: Block schematic of the stabilization circuitry incorporated into the head of our models SL 02/1 and SL 02/2 frequency-stabilized HeNe lasers.

The laser beam exits the opposite end of the laser head, concentric with the connector mating to that on the free end of the cable from the power supply. The laser beam may be blocked using the beam-blocking shutter provided, which complies with applicable safety regulations, whenever necessary, except on units equipped with the optional fiberoptic coupler, since the fiberoptic coupler replaces their beam-blocking shutter.

The DC power supply incorporated into their laser head provides the high voltage needed to ignite their plasma tube and automatically supplies the current needed to maintain the gas discharge once it has been ignited. A low-pass filter prevents disturbing high-frequency modulation of the laser beam, thereby reducing beam amplitude noise.

The red “Power” LED will illuminate to indicate that the laser has been switched on. A mode-offset signal regulates the plasma tube's temperature such that the frequency of the laser beam remains stable. The stabilized condition will be indicated by illumination of the green “Stab” LED.

Employing the maximum available heater power to preheat the cold plasma tube accelerates warmup. A thermal cutout precludes overheating of the plasma tube. Power dissipation of the laser head may be as much as 27 W during warmup, but will drop to about 20 W once the laser's frequency has stabilized.

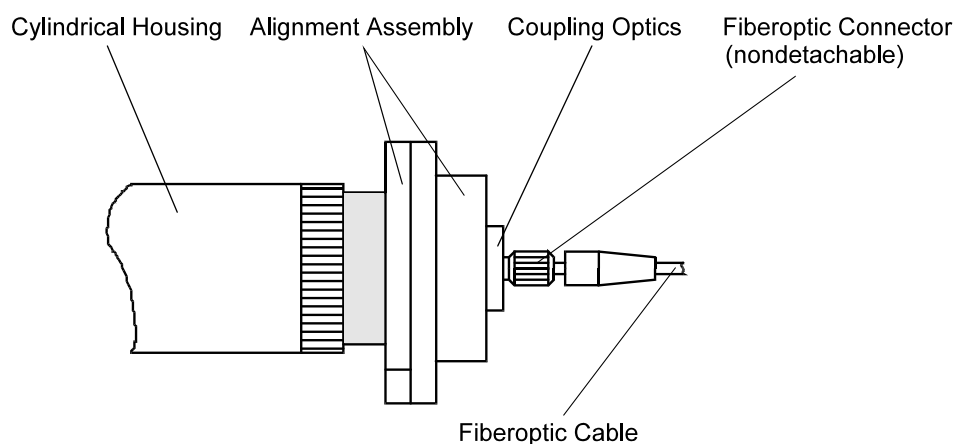


Figure 7: The optional fiberoptic coupler used on our models SL 02/1 and SL 02/2 frequency-stabilized HeNe lasers.

The optional fiberoptic coupler has pairs of factory-preset lateral-translation and tilt adjustments for coupling to monomode or multimode optical fibers and screws into the threaded mount on the beam-exit end of the laser head (cf. Figure 7, above). The power exiting the free end of these output couplers' approximately 3-m length of monomode fiberoptic cable will be approximately 1.2 mW when the laser is running in the frequency-stabilized condition. Diamond D-4108.6 or E-2000 monomode DIN-type connectors and fiber-pigtail connectors are optionally available for installing on the free end of this length of monomode fiberoptic cable.

Caution: This monomode fiberoptic cable will have to be realigned whenever it has been removed from its holder on the fiberoptic coupler. This operation should thus be performed by personnel authorized by SIOS Meßtechnik GmbH to perform such tasks only.
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6.2 The Power Supply

A standard, commercially available, primary-switched-mode, switching power supply equipped with input circuitry accommodating a wide range of line voltages incorporated into a Class II insulating housing and available in versions equipped with line plugs mating to various types of electrical outlets commonly encountered around the world is supplied with these lasers. A permanently attached cable approximately 1.5 m long equipped with a LEMOSA FFA.OS.302-connector on its free end provides the necessary electrical connections to the laser head.

Employment of this power supply will provide that the technical data stated in Section 7 of this instruction manual will be met, although, at least in principle, any other power supply meeting those specifications stated below could be employed. However, we will not warrant that our Models SL 02/1 or SL 02/2 frequency-stabilized HeNe lasers will meet their specifications in cases where power supplies other than those supplied with them are employed. Customers who insist on using some other power supply for supplying the DC-voltage required by their laser head due to the fact that, e.g., they are to be incorporated into a system, should contact us regarding their choice of power supply before proceeding.

7 Single-Longitudinal-Mode Output on the Model SL 02/2

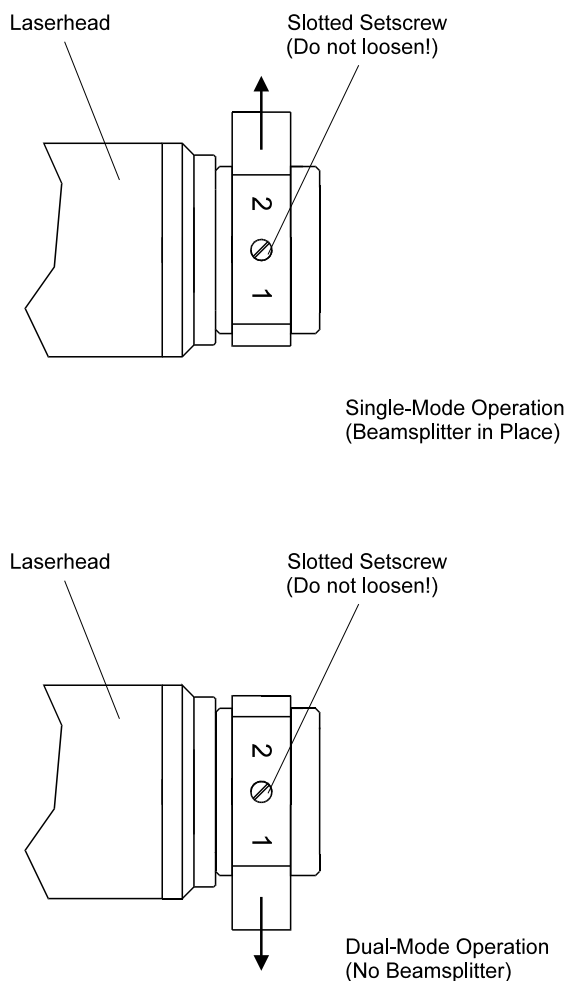


Figure 8: The mode selector for switching between single-longitudinal-mode and dual-longitudinal mode output on the Model SL 02/2.

The optional mode selector shown in Figure 8, above, allows switching between single-longitudinal-mode and dual-longitudinal-mode output on our Model SL 02/2. Either single-longitudinal-mode or dual-longitudinal-mode output may be selected at any time merely by pivoting its polarization beamsplitter into, or out of, the laser beam, respectively. Beam polarization will be better than 500:1 when single-longitudinal-mode output is selected. The mode selector is permanently installed on the laser head, which provides long-term, fixed, alignments of the plane(s) of polarization of its output beam relative to its plasma tube. The mode selector is equipped with a mechanical beam-blocking shutter.

8 Technical Data

Laser Head

Nominal output wavelength:	632.9914 nm \pm 0.0003 nm
Output power (Models SL 02/1 / SL 02/2):	\geq 1 mW / \geq 2 mW
Amplitude noise (30 Hz – 10 MHz, Models SL 02/1 / SL 02/2):	< 0.2 % / < 0.3 %
Amplitude modulation (39 kHz, Models SL 02/1 / SL 02/2):	< 0.2 % / < 0.3 %
Amplitude stability over 24 h / 1 min:	< 5 % / < 0.5 %
Beam diameter (TEM ₀₀):	0.63 mm
Beam divergence (TEM ₀₀):	1.3 mrad
Beam polarization:	
Model SL 02/1	Single, linearly polarized, longitudinal mode
Model SL 02/2	Two mutually orthogonal, linearly polarized, longitudinal modes
Mode spacing (Model SL 02/2):	730 MHz
Warmup time:	< 10 min
Frequency drift:	
Max. thermal frequency drift	\pm 4 MHz/°C
Max. frequency excursions	\pm 25 MHz
Frequency stability after 1 min / 1 h / 24 h:	\pm 2 x 10 ⁻⁹ / \pm 1 x 10 ⁻⁸ / \pm 2 x 10 ⁻⁸
Max. tolerated optical feedback:	1 x 10 ⁻⁵
Max. tolerated magnetic-field strengths at the laser head:	
Magnetodynamic fields	10 ⁻⁶ T
Magnetostatic fields	< 10 ⁻⁴ T
Operating temperature:	+ 15°C to + 30°C
Storage temperature:	- 20°C to + 50°C
Typical service life:	15,000 h
Power dissipation when stabilized:	Approx. 20 W
Laser-head dimensions:	50 mm dia. x 410 mm long
Internal thread at beam exit:	
Standard	1.279“-32
Optional	1.000“-32
Length of cable connecting laser head and power supply:	1.5 m

Weight:	900 g
Laser safety class according to DIN EN 60825-1:	3 R
Laser safety class according to ANSI Z136.1 (CDRH):	III a
Altitude, non operational:	0 - 7,000 m
Altitude during operation:	0 - 3,000 m
Shock loading of laser head (for 11 ms)	10 g

Power Supply

- Input voltage: 90 VAC - 264 VAC, 47 Hz - 63 Hz
- Available with line plugs for use in: Europe, UK, USA/Japan, and Australia
- Output voltage: 13.5 VDC \pm 5 %, open-circuit/short-circuit protected
- Ripple: < 100 mVp-p
- Max. output power: 30 W
- Operating temperature: 0°C to +40°C
- Storage temperature: - 40°C to +70°C
- Weight: 350 g
- Dimensions: 105 mm x 68 mm x 39 mm (L x W x H)

Testing and Certifications:

- EMC: EN 50081-1 3/93
EN 50082-2 2/96
- Safety: EN 60950 9/94
- Certifications: VDE, UL, JETL (others, e.g., VDE-ENEC, have been applied for)
- CE-symbol in compliance with:
EU-guidelines 2006/95/EG and 2004/108/EG

Options

Output coupler equipped with a monomode optical fiber:

Input power to fiber Approx. 1.2 mW

Connector on fiber output end Diamond D-4108.66 or E-2000 DIN-connector

Fiber length 3 m (lengths up to 25 m are optionally available)

Mode selector for switching between dual-longitudinal-mode and single-longitudinal-mode output on Model SL 02/2 only: Polarization ratio better than 500:1

9 Maintenance and Servicing

These lasers require no maintenance. Refer to the instructions appearing in Section 5 of this instruction manual in the event of a malfunction.

10 Warranty Terms

These lasers are warranted for twelve (12) months from invoice date. Unauthorized opening or improper handling of these lasers or using them for other than their intended purposes will void their warranty.

***Manufacturer's Certification of Compliance
with Applicable EU-Guidelines***

CE - Seal of Approval

Per EU-Guideline 2006/95/EC regarding low-voltage devices
and EU-Guideline 2004/108/EC regarding electromagnetic compatibility.

We herewith certify that the design and construction of the products listed below and the form in which they have been brought into commercial traffic are in compliance with applicable basic safety and health provisions of said EU-Guidelines.

Product group: ***Frequency-Stabilized HeNe Laser SL- Series***

Applicable standards

Safety:

EN 60825-1: 2007	Safety of Laser-Products
EN 61010-1: 2001	Safety requirements for electrical equipment for measurement, control and laboratory use

Emission:

EN 61000-6-4: 2007	Emission standard for industrial environments
EN 55011: 2007	Conducted emission of power line (class B) Radiated emission (class B)

Immunity:

EN 61000-6-2: 2005	Immunity for industrial environments
61000-4-2	Electrostatic discharge
61000-4-3	Electromagnetic field
61000-4-4	Fast transient (Burst)
61000-4-5	Surge
61000-4-6	Conducted disturbance
61000-4-11	Voltage dips, short interruptions and Voltage variations

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Ilmenau, 01 February 2009



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Managing Director