OPTRALITE

OPERATION & MAINTENANCE MANUAL

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

1.0 INTRODUCTION

The OPTRALITE™ Laser is a high performance component designed for use in critical measuring applications. This Helium\Neon laser has a stabilized Zeeman-split output which is well suited for interferometric applications in both system and laboratory settings. The laser is designed for use in highly precise metrology systems as well as being easily adapted for a variety of optical measurement techniques. The OPTRALITE™ Laser is completely self contained and will provide years of reliable service if properly cared for.

This owner's manual will explain how to install and operate your new laser. OPTRA's technical staff has years of experience in applying two-frequency lasers and interferometers to measurement applications. We encourage you to read this manual for a better understanding of the OPTRALITE Laser and its operation. For further details, please contact OPTRA, Inc., 461 Boston Street, Topsfield, MA 01983, (508) 887-6600.

CAUTION: The negligible use of controls or adjustments or the general misuse of this product may result in hazardous exposure to laser radiation.

2.0 INSTALLATION INFORMATION

2.1 Equipment

The OPTRALITE™ Laser has been packaged in a protective carton for shipping purposes. We suggest that you save this package for storing the laser or in the event that the product should need to be serviced or repaired at OPTRA's facility.

In addition to the OPTRALITE™ Laser, the following items have also been enclosed in the shipping package:

1. Operator's Manual
2. Power Cord
3. Spare Fuse
4. Output Aperture Cover
5. Rubber Benchtop Feet

2.2 Power Requirements

The OPTRALITE™ Laser is designed to operate on 115 VAC (60 Hz). Standard power dissipation is approximately 40 VA, however, during the initial warm up cycle power consumption may increase to 60 VA. The manufacturer can provide the option for operating the unit at 220 VAC (50 Hz).

CAUTION: Severe damage to the laser and possible injury to the operator will result if improper line voltage is used in this product.

2.3 Line Fuse

Your OPTRALITE Laser is equipped with a 3AG, 1 Amp, slow blow fuse. The laser must be unplugged when changing fuses.

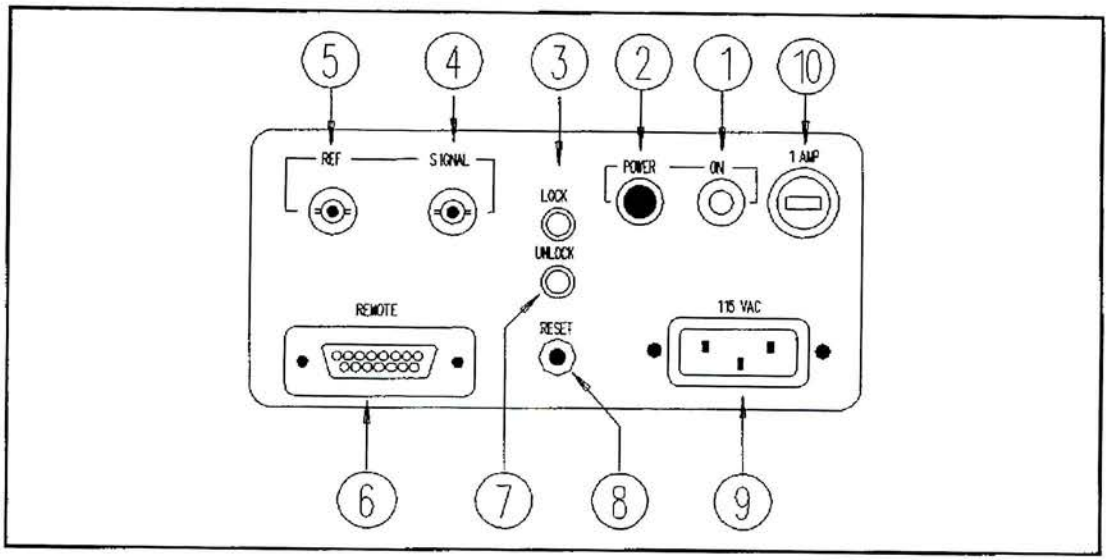
3.0 CONTROLS, CONNECTIONS, AND OUTPUTS

3.1 Rear Panel

Located on the rear panel of the OPTRALITE Laser are controls, indicators, and interfacing ports for operating the unit. A description of each of these features is included below:

Illustration #1.

Rear Panel Controls



1. **POWER SWITCH:** The switch will turn on the laser and activate all of the internal servo controls.

2. **POWER LED:** When the laser is switched on, this indicator will provide an amber glow to signal that power is reaching the internal power supplies.

3. **LOCK LED:** The presence of this green LED signals that the OPTRALITE Laser has stabilized the laser cavity and the output beam is ready for use.

4. **SIGNAL BNC:** The output for the optical detector/amplifier is located at the front plate of the laser, below the laser output aperture. For further information about this feature, please consult Section 4.4, Interfacing Considerations.

5. **LASER REFERENCE BNC:** The laser's output reference signal, is a 250 ± .001 kHz sine wave when the laser is stabilized. This signal is the difference, or beat, frequency of the laser. Further details on this port may be found under Section 4.4, Interfacing Considerations.

6. **REMOTE CONNECTOR:** This 15 pin female socket D-sub connector provides status information from the laser and servo system, while also enabling the user to remotely control the unit. A detailed description of this connection may be found in Section 4.4, Interfacing Considerations.

7. **UNLOCK LED:** This Red LED will illuminate when the laser output is not stabilized. For further detailes read Section 4.0, Operation in its entirety.

8. **LASER RESET:** The RESET control is a one shot push button which will initiate a warm up cycle for the laser to stabilize. A complete description of this control and its proper use are detailed in Section 4.2, Laser Reset Cycle.

9. **INPUT POWER CONNECTION:** The power cord for the unit is connected at this port. More information on power requirements may be found in Section 2.2, Power Requirements.

10. **FUSE:** A slow blow fuse is placed between the AC line and the internal power supplies. The fuse is accessed by unscrewing the fuse cap.

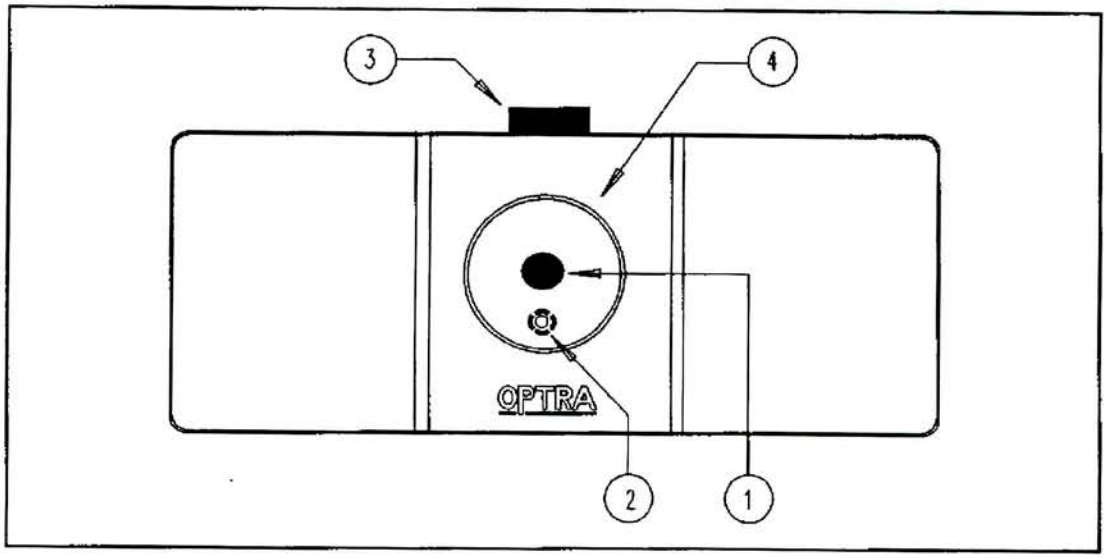
CAUTION: The laser must be unplugged when changing fuses to prevent injury or damage to the unit. Fuse requirements are discussed in Section 2.4, Line Fuse.

3.2 Front Panel

The front panel of your OPTRALITE Laser is illustrated below with a description of the key operating features.

Illustration #2

Front Panel Controls & Apertures



1. **OUTPUT APERTURE:** The beam from your OPTRALITE Laser emits from this opening. Under no circumstances should any object be inserted into the Output Aperture or the unit may be damaged.

   CAUTION: Do not look directly into this aperture, laser radiation is emitted and could result in personal injury.

2. **DETECTOR APERTURE:** The OPTRALITE Laser is equipped with a built in optical detector and amplifier stage which is located behind this aperture. A complete description of this feature and its operation is presented in Section 4.0, Operation.

3. **OUTPUT SHUTTER:** A sliding shutter enables the user to block off the output beam in the OFF position. The laser beam is emitted from the laser in either the OPEN or the OPEN/FDL position. The OPEN/FDL position, however, enables the user to take advantage of the internal detector by sliding a polarizer at 45° in front of the detector, thereby mixing the return signals for detection. This detector signal is output on the rear panel Signal

BNC. **The shutter should be placed in the OFF position whenever the laser is not in use to protect delicate internal optical elements.**

4. **NOSE PIECE MOUNTING:** Your OPTRALITE Laser is designed to be interfaced with other optical systems and a threaded collar may be used for securing attachments to the laser. The mechanical clearances are described in Section 8.0.

4.0 OPERATION

The OPTRALITE Laser emits a coherent beam of light which is comprised of two co-linear modes, separated in frequency by precisely 250 kHz. These two modes are linearly polarized, such that one frequency is represented by a wavefront moving in a vertical plane of polarization (relative to the base of the laser) while the other wavefront is moving in a horizontal plane (parallel to the base plate). The function of the laser is to produce these two modes and maintain a stable difference frequency of 250 kHz between them.

4.1 Initial Turn On

Your OPTRALITE Laser has been tested and inspected prior to shipping, however, we recommend that you check the unit for any shipping related damage. Place the laser on a firm level surface and attach the power cable. The routine starting sequence is listed below, which should be used each time the laser is turned on.

1. Move the shutter control to the CLOSED position.

   CAUTION: Care must be taken not to stare into the OUTPUT APERTURE or at bright reflections of the beam.

2. Turn on the POWER SWITCH and the POWER LED (amber light) will illuminate.

3. A few seconds later a red beam will emit from the Output Aperture.

4. During the next 3 to 5 minutes the unit's UNLOCK INDICATOR (red light) will flash on and off before the laser is stabilized as indicated by the illumination of the LOCK LED (green light).

5. The red beam emitted from the LASER OUTPUT APERTURE will be stabilized at this point.

At the completion of these conditions the OPTRALITE Laser is ready for use. A summary of the indicators and the conditions they represent are summarized in the following chart:

Table #1

Indicator Status & Conditions

Illuminated LED's	Laser Status
Amber	Power On, Laser in Warm-Up Mode
Amber, Green	Laser Output is Stabilized
Amber, Green, Red	Laser Reset is Necessary or Turn Off Laser for 5 Minutes to Cool Down and Begin Again
Amber, Red (Blinking) Green (Flickering)	Instability due to Optical Feedback, Heat or Localized Magnetic Fields
None	Laser Power is Off

If you have followed this sequence, and the laser has not stabilized (Green LED illuminated) please consult Appendix B, Trouble Shooting.

4.2 Laser Reset Cycle

The OPTRALITE Laser has an internal servo loop that maintains the proper laser cavity length to provide a stable difference frequency between the two output modes. The illumination of the green LOCK LED indicates that the laser servo has stabilized the laser cavity and the laser is ready for use. The servo loop inside the laser is both a thermal and magnetic field feedback controller. It is possible for the servo to lose control of the laser cavity length when either large magnetic fields are in the localized region on the laser or when the laser is extremely hot or cold.

If the laser is extremely hot, the red UNLOCK LED will illuminate along with the green LOCK LED on the rear panel of the laser. To correct this condition, press the RESET button the rear panel of the laser. If the green LOCK LED does not illuminate within three minutes, or both the UNLOCK and LOCK LED illuminate then the OPTRALITE is too hot internally to stabilize and should be turned off for five minutes to cool off.

The OPTRALITE is in a RESET condition when the laser is initially powered, the RESET button has been pushed or when the thermal or magnetic environment surrounding the laser tube have fallen out of an acceptable range for the servo loop

to stabilize. During the RESET condition the beat frequency or the difference frequency between the two modes scans a range between 10 and 300 kHz for one to five minutes as the tube is warmed with a heater blanket. When the tube temperature and magnetic field have reached the acceptable threshold for the servo loop to control, the scanning frequency will lock at 250.00 ± .001 kHz. The LOCK LED will illuminate. The laser is now stabilized and ready for use.

Since the RESET condition increases the internal temperature of the laser cavity, if RESET is activated too frequently the laser's cavity will become too hot to stabilize and should be turned off for five minutes to cool down.

4.3 Output Controls

The OPTRALITE laser is equipped with a sliding shutter which enables the user to block off the beam before it exits the laser. In addition to blocking the beam, the shutter also holds a polarizer that may be placed in front of the detector in the OPEN/FDL position. The polarizer is oriented at 45° to vertical and will mix the two incoming modes before they reach the detector. The following chart illustrates the various shutter settings:

Table #2

Shutter Control & Functions

Shutter Position	Output Status	Detector Status
OPEN	Beam Present	No Polarizer
CLOSED	Beam Blocked	No Polarizer
OPEN/FDL	Beam Present	Polarizer Between Detector and Front Plate

The detector, located below the output aperture, is useful in many measurement applications. The detector itself is centered in the DETECTOR APERTURE approximately one inch behind the front plate. The detector is always operational when the laser power is on. The signal is amplified with a preamp stage that is output on the Signal BNC located on the rear panel.

4.4 Interfacing Considerations

The two BNC connectors on the rear panel of the laser output a REFERENCE and a SIGNAL. The reference output is the detected and amplified beam emitting from the high reflectance mirror of the laser tube internal to the laser. This signal is

squared up and compared to a 250 kHz crystal oscillator to provide an error signal that feeds back to the servo loop to stabilize the laser. When locked, or stabilized, this output should be a stable 250.000 + .001 kHz sine wave with an amplitude between 1 and 5 volts peak to peak.

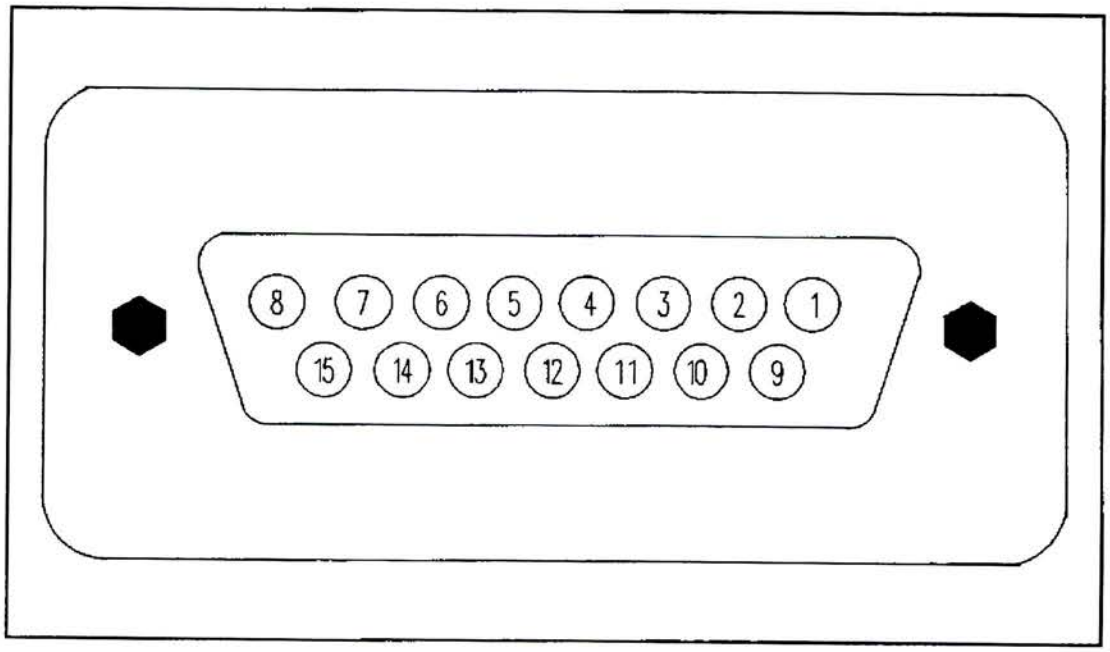
The signal BNC is the output of the detector located behind the front plate of the laser below the output aperture. A polarizer oriented at 45° to the vertical will be placed between the front plate and the detector when the shutter is in the OPEN/FDL position.

The Remote Interface provides duplicating information found on the REFERENCE and the SIGNAL BNC's. This interface is most commonly used with the OPTRAMETER™ Measurement Module or an equivalent phase measuring system. The interface is designed for TTL logic where a Logic 0 level represents 0 volts DC and a Logic 1 level represents + 5 volts DC.

An illustration of the Remote Interface connector and the specific pin assignments follows.

Illustration #3

Remote Interface Connector



Remote Interface Pin Assignments

PIN #1 Reference Signal: The Laser Reference is identical to the Reference Output BNC. This output is an AC coupled Sine Wave with a frequency of 250 ± .001 kHz and an amplitude of 1 to 5 Volts (peak to peak).

PIN #2 Reference Signal Ground: Grounding Pin for PIN #1.

PIN #3 Laser Lock LED: Identical to the green Laser Lock LED. Logic 1 indicates the laser is locked and that the output is stabilized.

PIN #4 Laser Unlock LED: Identical to the red Laser Unlock LED. LED illuminates and instability occurs at any Logic 0 condition. During a laser reset cycle this level toggles between Logic 0 and 1. See Section 4.1 and 4.2 for more details.

PIN #5 Reset Control: Enables the Reset cycle for the servo system. A Logic 0 applied for at least 1 millisecond will initiate this cycle.

PIN #6 Diagnostic Status: Analog output for factory servicing. Maximum output voltage of 12 VDC.

PIN #7 Front End Detector Ground: Grounding pin for Pin #8.

PIN #8 Front End Detector Signal: Provides an analog signal from the Front End Detector. This AC coupled signal is amplified with a maximum ± 15 volts peak to peak.

PIN #9 Ground: Corresponding ground for pin #'s 3,4,5,6.

PIN #10-13 Unused Pins.

PIN #14 Unused Pins.

PIN #15 Unused Pins.

The following chart illustrates the various logic states for representing the operating status of the laser.

Table #3

Remote Indicator Status Logic States

Operating Status	PIN #4	PIN #5
Laser Locked (Normal Operation)	Logic 1	Logic 1
Laser Unlock (Warning)	Logic 0	Logic 1
Reset Cycle in Progress	Invalid	Logic 0

4.5 Long Term Operation

The OPTRALITE Laser is designed to be used over long periods. The servo mechanism will maintain the stability of the output as long as temperature fluctuations around the unit are minimized, large magnetic fields are not present and no excessive optical feedback is returning into the laser cavity. Ambient temperature changes of 5°C per hour will cause the laser to automatically initiate a reset cycle. In addition to ambient temperature changes, the laser may reset if the unit becomes too warm, as a result of poor thermal conductivity. We recommend that the base of the laser be mounted on a surface which will absorb heat.

5.0 LASER OUTPUT CHARACTERISTICS

5.1 Output Beam Characteristics

The OPTRALITE Laser emits a highly collimated He/Ne beam with a wavelength of 6328 Angstroms, at an optical frequency of about 4.736 x 10^{14} Hz. The output beam is comprised of two frequencies, or modes, that are separated by precisely 250 kHz, and stabilized to better than one part in 10^{7}. The output power of the laser is 1 milliwatt (each mode is about 0.5 milliwatt). The diameter of the beam is 0.64 mm with 1 milliradian divergence.

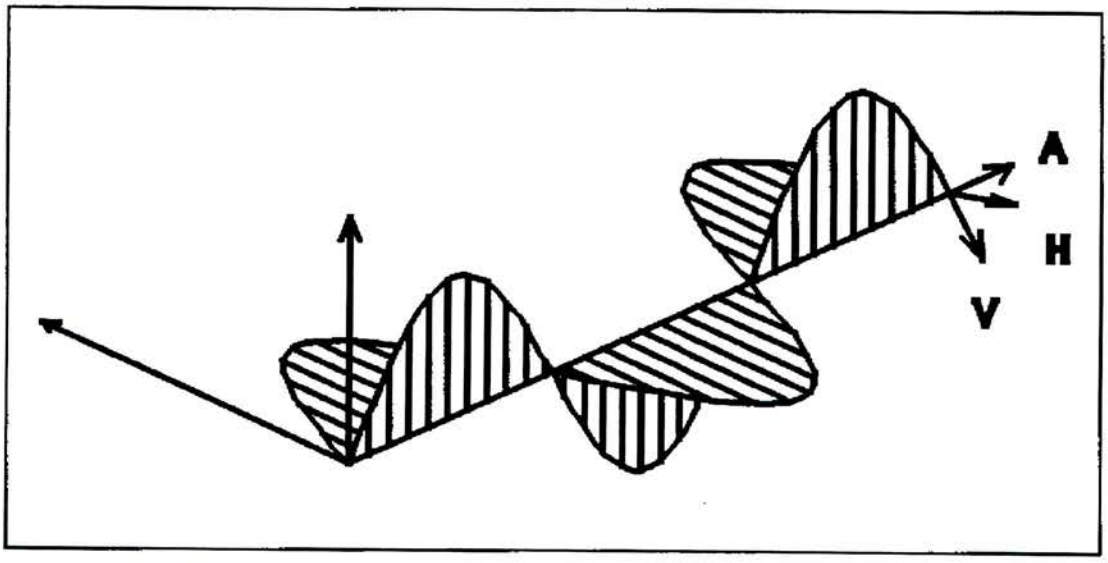
CAUTION: Care should be taken to avoid staring directly at the beam or bright reflections.

5.2 Output Polarization

The two modes emitted from the OPTRALITE Laser are orthogonal linear polarized light. These two linear polarized modes are best illustrated as two waves such that the two planes of polarization intersect at their zero crossings located in the center of the laser beam. The waves propagate orthogonal to one another. The amplitude vector is in a plane that is transverse and perpendicular to the axis of propagation.

Illustration #4

Linearly Polarized Output



Each of these two waves has a specific frequency such that their relative difference is 250 kHz.

In an ideal environment, these two polarizations should not contain any components in common. However, some mixing occurs such that the vertical polarization V, contains traces of the horizontal polarization H. Consequently, the horizontal polarization also contains traces of the vertical polarization. This results in a "polarization mix " or crosstalk between the two modes. Crosstalk is typically expressed as the percent of mixed signal amplitude divided by the overall signal amplitude. The OPTRALITE Laser may exhibit crosstalk no greater than 1.5%.

The two linear polarizations can be converted into circularly polarized light with the placement of a quarter wave plate for 632.8 nm after the output beam of the OPTRALITE. In this case the two modes still propagate along the axis of the beam, however, the amplitude vectors rotate about the propagation axis with a frequency that is equivalent to the wave period. The two polarizations maintain a difference frequency of 250 kHz.

The two polarizations emitted from the OPTRALITE Laser can be combined by inserting a linear polarizer perpendicular to the beam's axis. When the polarizer is oriented at 45° to the vertical plane of polarization, the two modes will be mixed resulting in a signal with a period of 250 kHz. The OPTRALITE Laser has a polarizer which can be positioned in the OPEN/FDL shutter position in front of the detector for mixing the two frequencies (See Section 4.3, Output Controls for optical detection). The optical detector collects the signal which is in turn amplified and output on the Signal BNC found on the rear panel.

Note 1: First surface reflecting optics should be used in order to minimize the relative phase shifts between the two polarizations when guiding the beam around. The angle of incidence for reflecting optics should be 45° to reduce this phase shifting effect.

Note 2: First surface reflections from uncoated optical components such as BK7 are as high as 5%, therefore, anti-reflection for 632.8 nm or "AR-V" coatings should be used on all optical elements in the beam path to reduce optical feedback.

6.0 INSTALLATION, ALIGNMENT AND ERROR SOURCES

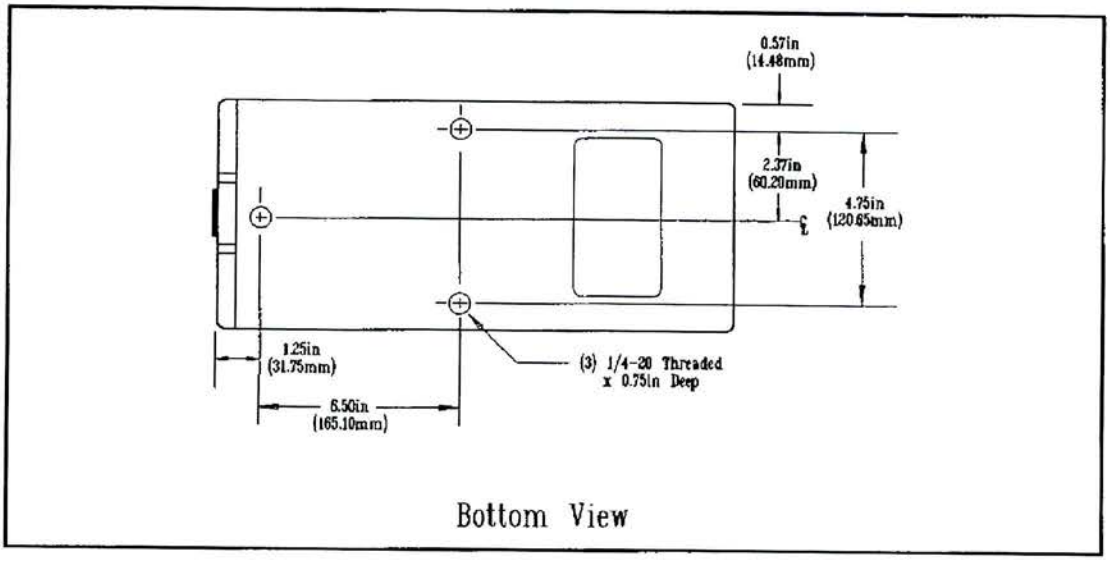
The OPTRALITE Laser package has been designed for easy integration into a variety of system applications. The laser has four stick-on rubber feet for general engineering and laboratory use. In many cases, the laser may need to be firmly attached to a lab bench or other surface. The provisions for installing the unit are described below.

6.1 Mechanical Mounting

The OPTRALITE Laser has been equipped with three mounting holes located on the bottom side of the unit. Each of these mounting holes are threaded for 1/4-20 bolts.

Illustration #5

Mounting Hole Locations



The mounting holes are designed for bolts that extend 3/16" into the case. Bolts that extend further than 1/2" should not be used, or internal components for the unit may be damaged. When securing the laser to a base plate or surface, be careful not to use excessive force in tightening the bolts. The OPTRALITE Laser can be mounted in any position.

When aligning the laser to an optical system, such as an interferometer, the axis of horizontal rotation should be at the forward most mounting point. Vertical shifts in the laser's emitted beam, and the returning beam for the detector can be vertically shifted by rotating a point 1.75" above the forward mounting hole. The intersection of these two axes define the position of the laser beam and the first surface of the front end detector.

The dimensional drawings for the OPTRALITE Laser, and specific mounting holes can be found in Section 9.0, Specifications and Dimensions.

6.2 Thermal Considerations

The output stability of the OPTRALITE Laser depends on the consistency of the ambient temperature around the laser, as well as the thermal conductivity of the mounting surface. If the ambient temperature changes more than several degrees per hour, the laser will automatically re-stabilize the output. Similarly, if the mounting surface changes temperature the laser may automatically reset.

The OPTRALITE Laser dissipates 40 Watts of average power when operating. If the unit is mounted to an optical table or some thermally conducting frame, most of this power will be conducted away in the form of heat dissipation. In some applications this conducted heat may be a problem. If the mounting surface is temperature stabilized to minimize thermal expansion, the laser may be mounted on an insulating layer of material with low thermal conductivity such as G-10. When thermal insulation is used in mounting, the laser case may feel warmer to the touch.

6.3 Environmental Considerations

The output of the OPTRALITE Laser will be influenced by large localized magnetic fields. If the unit is to be used in close proximity to magnets, a large motor or high current carrying cables, please consult OPTRA, Inc. for information on shielding the unit.

As with all laser sources, considerations should be taken to avoid optical feedback reflecting off optical components into the laser cavity. Optical feedback will cause instability in the laser cavity length. A symptom of optical feedback is a blinking red unlock LED on the rear panel as well as ghosting and sporatic jumping on the REFERENCE output BNC signal.

The OPTRALITE Laser is a precision instrument and the unit should be fully protected when used in harsh environments. Care should be taken to avoid excessive vibration or impact during operation. Exposure to smoke or corrosive vapors will affect the operation of the unit and may result in permanent damage. OPTRA personnel have had years of experience in mounting the unit in adverse environments, and are always available to answer questions.

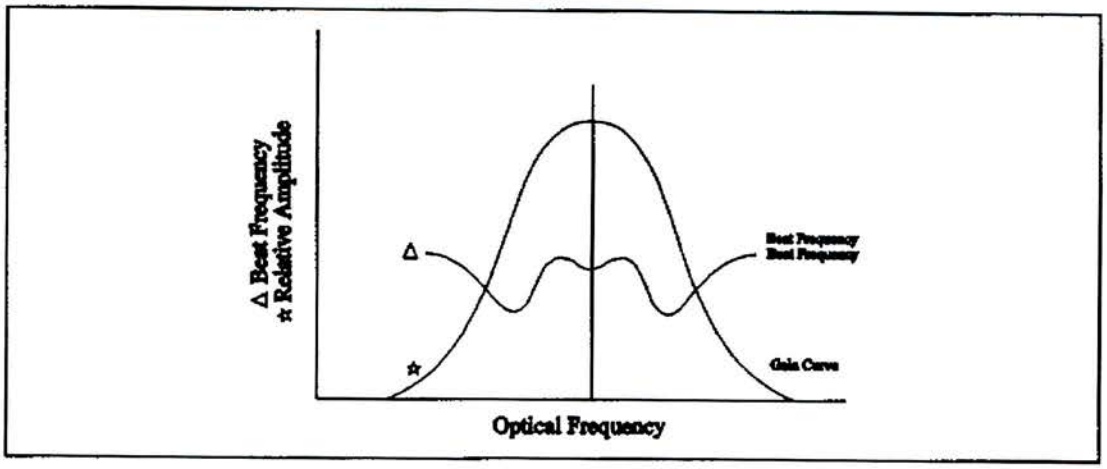
7.0 PRINCIPAL OF OPERATION

7.1 Optics Principles

The OPTRALITE Laser relies on the well-established use of an axial magnetic field to Zeeman-split the 6328A neon line of a HeNe laser. In a laser short enough to operate in a single axial mode, this results in a single beam laser output comprised of left handed and right handed circularly polarized components. These two modes differ in frequency depending on 1) the strength of the axial magnetic field, 2) the shape and magnitude of the laser gain and profile, and 3) the location of the oscillating mode within the gain profile (which in turn depends critically on the precise optical length of the laser resonator). The magnetic field is fixed so that the frequency difference between the two modes becomes dependent on their being tuned across the laser gain profile.

Illustration #6

Laser Gain & Beat Frequency



The beat frequency between the laser's two circularly polarized oscillation modes[1], is caused by the difference in optical path lengths for each of the two polarizations in the laser resonator. The difference in optical path length is due to the different indices of refraction for each polarization which is caused by the Zeeman splitting of the atomic states of neon.

[1] The two circular polarizations pass through a 1/4 plate which converts the output into two linearly polarized modes. The orientation of this optical element has been carefully positioned to convert the polarization and minimize the crosstalk between signals.

The beat frequency of the OPTRALITE Laser is stabilized at a specific value slightly displaced from the center of the gain curve.

7.2 Electronic Principles

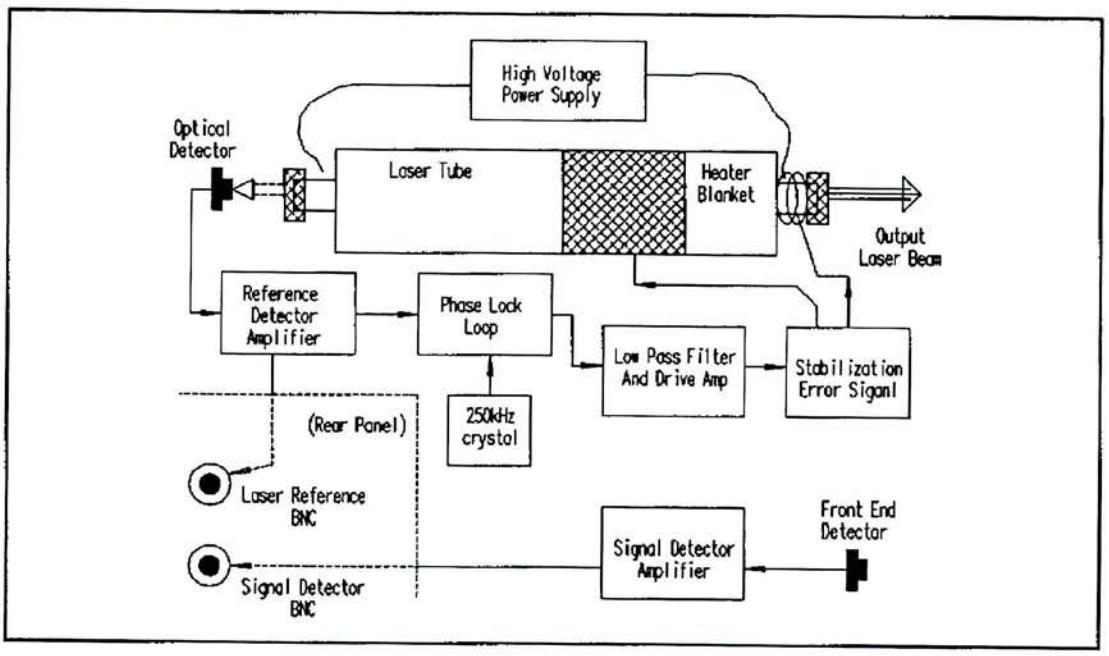
The OPTRALITE Laser is controlled with a thermal and magnetic servo loop. The laser beam emitted from the HR mirror internal to the laser is collected and amplified as the laser REFERENCE signal. The stabilized reference is squared up and compared to a 250 kHz crystal oscillator signal producing an error signal that is fed back to a heater and a magnetic field generator used to stabilize the laser tube Zeeman Split. A network of comparitors and logic gates are used in this carefully balanced servo loop.

The red UNLOCK LED will illuminate when the servo loop is having difficulty stabilizing the laser. See Section 4.0 for details on laser lock and unlock conditions.

The following schematic diagram illustrates the primary components of the laser servo system and the front end detector.

Illustration #7

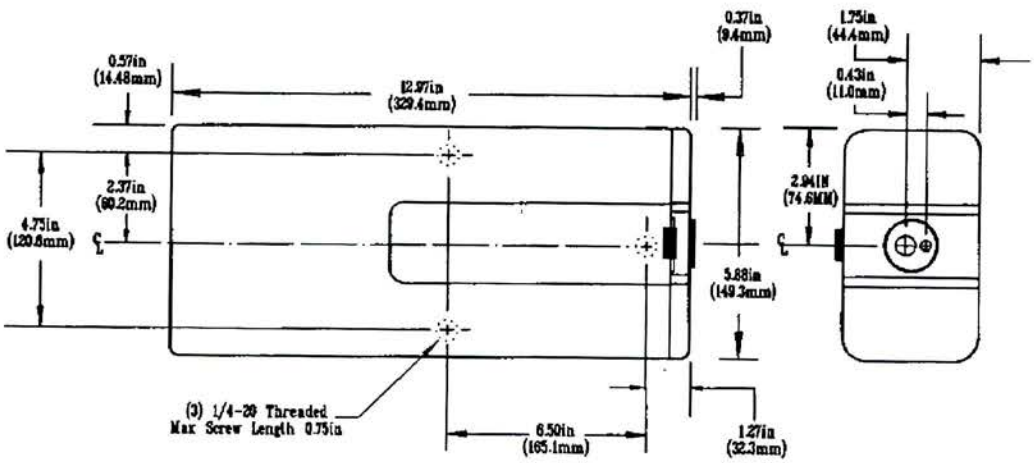
OPTRALITE Electronic Schematic



7.3 Mechanical Principles

The OPTRALITE Laser is built on a 0.25" aluminum, anodized cast base with two supporting mounts that hold the tube firmly in place. A third mounting block is located in front of the tube to support several optical elements as well as the front end detector. The power supplies and circuit board are attached to the laser base, and the unit is enclosed with a sturdy aluminum cover.

8.2 Dimensions



OPTRALITE MOUNTING DIMENSIONS

APPENDIX A

WARRANTY STATEMENT

OPTRA, Inc., warrants the OPTRALITE™ laser against defects in workmanship or materials for a period of one year from the date of shipment. This warranty covers the repair or replacement of the product provided that the unit has not been electrically or physically abused, including internal tampering (opening the enclosure) as determined by OPTRA. The manufacturer in no way guarantees the suitability of this product to the customer's final application. OPTRA is in no way liable for damages that occur to property, equipment, and/or personnel as a result of the use or misuse of this product.

Product Return Policy

Upon approval by OPTRA, the unit may be shipped (prepaid) back to the factory, with a statement of the problem, for evaluation and repair. If the unit is still under warranty, as is determined by OPTRA, the unit will be repaired or replaced, free of charge, and returned (prepaid) to the customer. If the unit is determined to be out of warranty, OPTRA will immediately notify the customer. If the customer chooses not to have the product repaired, the unit will be promptly shipped back (prepaid).

Non-Warranty Repair

The OPTRALITE™ laser which is not under warranty may be returned (prepaid) to the factory for evaluation. The unit will be tested and the customer notified of the repair cost and return date. Should the customer decide not to have the unit repaired it will be promptly returned (prepaid) to the customer. Should the customer require a laser during the repair period, OPTRA may provide a replacement unit for a daily charge.

Warranty subject to change without notice.

Return Procedure

Approval from OPTRA must be obtained before the unit is returned for testing and servicing. A written statement of the problem and application should be enclosed with the unit.

The unit should be wrapped in a plastic enclosure, and packed in suitable material to prevent damage during shipment. The original carton, or one of similar size, is recommended by the manufacturer for shipping this product. The unit should be insured, and properly labeled. OPTRA will not accept returned units that are not prepaid.

APPENDIX B

TROUBLE SHOOTING

The OPTRALITE Laser is not user serviceable. However, if you suspect a problem with the unit, please review this section before contacting OPTRA. The following list presents specific conditions and corrective action.

1. Power LED does not illuminate
   a) Check the power cord to insure that the laser is plugged in.
   b) Check to see the fuse has not blown.

2. Power LED illuminates, but no beam is emitted
   a) Verify that the shutter is open (Section 4.3).

3. Green LOCK LED does not illuminate
   a) Allow at least four minutes for laser to warm up.
   b) Avoid direct reflections back into the laser output aperture.
   c) Check that ambient environmental conditions (temperature) are met (See Section 4.0).
   d) Check that no large localized magnetic fields are present. If so, contact OPTRA for shielding advice.

4. Red UNLOCK LED is blinking or continously illuminated
   a) Reset or cool down may be necessary (See Section 4.2).
   b) Avoid direct reflections back into the Laser output aperture.
   c) Investigate and remove any possible magnetic fields in close proximity to the laser.
   d) Avoid subjecting the laser to vibration.

5. Laser Case feels very warm

   a) If "LOCK" LED is exclusively illuminated do not be concerned. If LOCK and UNLOCK LED's are both illuminated, read Section 4.2 in its entirety.

6. Beat Frequency will not lock at 250 kHz

   a) Investigate and remove any possible magnetic fields that could exist around the laser.
   b) Eliminate optical feedback
   c) Turn laser off or five minutes to cool down (Read Section 4.0 in its entirety)

APPENDIX C

ACCESSORIES

Accessories to meet certain needs are available from OPTRA. The list of accessories is changing in response to customer needs; check with OPTRA for the most up-to-date list.

1. Single Frequency Attachment (Part #1103)

The single frequency attachment is designed for situations where a single linear source with polarization is required. The attachment is easily secured on the nose piece mount, with no tools required. The output is a horizontal linear polarized beam.

2. Laboratory Mounting Brackets

Three Brackets are available and are specifically designed to mount the OPTRALITE to optical tables, or other surfaces. Each bracket is made of solid aluminum and is equipped with mounting holes. The height of the output beam is 1.75" $\pm$ .030.

BRACKET #	THICKNESS	BEAM HEIGHT
1301	0.25"	2.00"
1302	0.75"	2.50"
1305	H" [2]	1.75" + H

[2] Bracket # 1305 can be built to a specific thickness. Please consult OPTRA for further details.

APPENDIX D

CAUTIONARY STATEMENTS

The OPTRALITE Laser is a class IIIa laser product and emits a 1-2 milliwatts, Helium/Neon beam. Extreme care should be taken to avoid staring into the laser radiation or bright reflections.

The OPTRALITE Laser has no user serviceable parts inside. High voltages and stored charges are present in the unit which may result in personal injury if tampered with. Severe damage to the laser unit and possibly to the end user may result if improper line voltage is used in this product. The OPTRALITE Laser is grounded, however, care should be exercised to avoid shorting other devices to the laser which could damage sensitive internal components. The laser should never be operated in or near water.

OPTRA, Inc. certifies that this product conforms to all applicable provisions of CDRH regulations 21 CFR 1040.10 and 1040.11 as required by 21 CFR 10101 in effect as of the date of manufacture.