MODEL 2001

Air-cooled Argon Ion Laser Systems

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1·0 MODEL 2001 INTRODUCTION

Congratulations. You now own a rugged, compact, conservatively designed, and highly reliable Argon Ion Laser product.

It uses a metal-ceramic Plasma Tube with permanently aligned optics with vacuum-sealed mirror assemblies.

The Power Supply utilizes duty-cycle regulation, thus reducing power dissipation. Also, plug-in assemblies make it more efficient and smaller than conventional linear regulator power supplies. A full set of controls on the front panel allows the laser system to be easily operated. Complete facilities are provided also for remote operation.

The pages following in this Section deal with general information regarding the various laser components. Please take the time to familiarize yourself with this information material.

The Sales Brochure contained within this manual provides additional information including; output power, model number breakdown, features, and specifications.

1·1 Model 2001 Laser System

The Cyonics air-cooled Argon Ion Laser System consists of the following components.

- Model 2201 Laser Head
- Model 2101 Power Supply

1·2 Model 2201 Laser Head

The Laser Head houses the metal-ceramic Plasma Tube with its own self contained optics. A circulating fan draws cool air through opening vents located on one side of the Head enclosure case. This fan exhausts warm air vertically from the center of the top cover.

Key Features:

- Mirror assemblies are vacuum sealed directly to the Plasma Tube eliminating intracavity spaces, contaminated optics, and cleaning in the field.
- Metal-ceramic construction with a Beryllium Oxide bore provides extremely rigid stability and longer tube life.
- Brazed on Heat Sink fins gives better heat transfer and improved stability.

1·3 Model 2101 Power Supply

The Power Supply is a highly efficient, compact, FET, duty cycle switching regulator unit. A circulating fan draws cool air through the side panels and exhausts warm air from the center of the rear panel.

Key Features:

- Fully featured and protected control system provides safe and semi-automatic operation.
- Modular printed circuit design simplifies servicing. All active components are mounted on plug-in circuit boards. Service is achieved by plugging in a new board instead of spending time replacing individual components.
- Various L.E.D.'s are placed strategically throughout the circuit boards, thus aiding in any trouble shooting, should it occur.

1·4 System Operating Modes

When operating the laser in the LIGHT Control mode, the optical output power is held constant by the feedback circuit. This is the usual operating mode because the output power is highly stable over both long and short periods. As the Plasma Tube ages, the feedback circuit increases the tube current, but the output remains constant.

The laser may also be operated in the CURRENT control mode. In this mode, which is used for calibration and for assessing the performance of the Plasma Tube as it ages, the feedback circuit holds the Plasma Tube current constant. This mode only operates in REMOTE, see Section 3·7.

In LIGHT Control mode, desired output may be adjusted over a controlled range with the front panel PWR. ADJ. control. The output may also be set to the desired value with an external DC voltage source in both LIGHT and CURRENT control.

2-0 LASER SAFETY

The instructions in this manual include precautions to avoid possible exposure to laser and collateral radiation in excess of the applicable emission limits.

CAUTION

USE OF CONTROLS OR ADJUSTMENTS FOR PERFORMANCE OF PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN HAZARDOUS RADIATION EXPOSURE.

2-1 Laser Safety

Please read this Section of the manual carefully before installing or operating your laser.

The Cyonics 2000 Series Laser complies with Title 21, U.S. Government DHEW/BRH Performance Standards, Chapter I, Sub-chapter J, Section 1040, as applicable. This product falls into Class IIIb.

The protective housing of this laser product should always be in place during normal laser operation. Removal of the protective housing can expose the user unnecessarily to Class IIIb Argon laser power up to 250mW, and should be done only by trained service personnel and in accordance with specific instructions given in this manual.

The following instructions contained in this manual for proper installation and operation of your laser. Use of protective eyewear or other precautionary measures depends on the conditions of use and visual function required. Consult user standards as ANSI, ACGIH, or OSHA for guidance.

2-2 Optical Safety

The laser is a source of intense light having characteristics that are very different from the light emitted from conventional sources. The user must be aware of these characteristics of laser light and the proper safety precautions before attempting to operate the laser.

The energy level of the laser beam is high enough to cause serious damage to the eye with possible loss of vision if the beam were to pass directly into the eye.

Since the laser beam is collimated and coherent, the energy in the beam remains high and dangerous even at great distances from the laser.

2-3 Electrical Safety

The electrical safety hazards of ion laser systems should not be ignored, as they are as great as other electrical systems operating from AC power lines. The voltages involved and the current available have the potential to cause fatal electric shock. Although Cyonics 2000 Series conform to OSHA electrical requirements and additional safety features have been included in their design, the following safety precautions should be noted and observed:

1. Your laser is intended for operation only with the Laser Head and Power Supply covers in place.

2. Parts of the electrical circuitry that could be energized with the cover removed are insulated or insulated and covered with an additional safety shield.

3. For safety's sake, NEVER depend on any electrical safety device or interlock, but carefully make other determinations that all power is off and components de-energized before working on the electrical connections of the laser system.

4. Do not allow anyone to perform electrical maintenance on the laser, except those personnel who are familiar with Cyonics lasers and trained to service them.

WARNING - HIGH VOLTAGES

The Laser Head and Power Supply of this laser product contain electrical circuits operating at **HIGH VOLTAGE.**

Whenever access to the interior of the Laser Head or Power Supply is necessary, **TURN THE POWER SUPPLY OFF.**

When access to the interior of the Laser Head or Power Supply is necessary and laser operation is necessary:

EXERCISE EXTREME CAUTION TO AVOID CONTACT WITH HIGH VOLTAGES. THIS IS A LINE OPERATED POWER SUPPLY. IT IS NOT ISO-

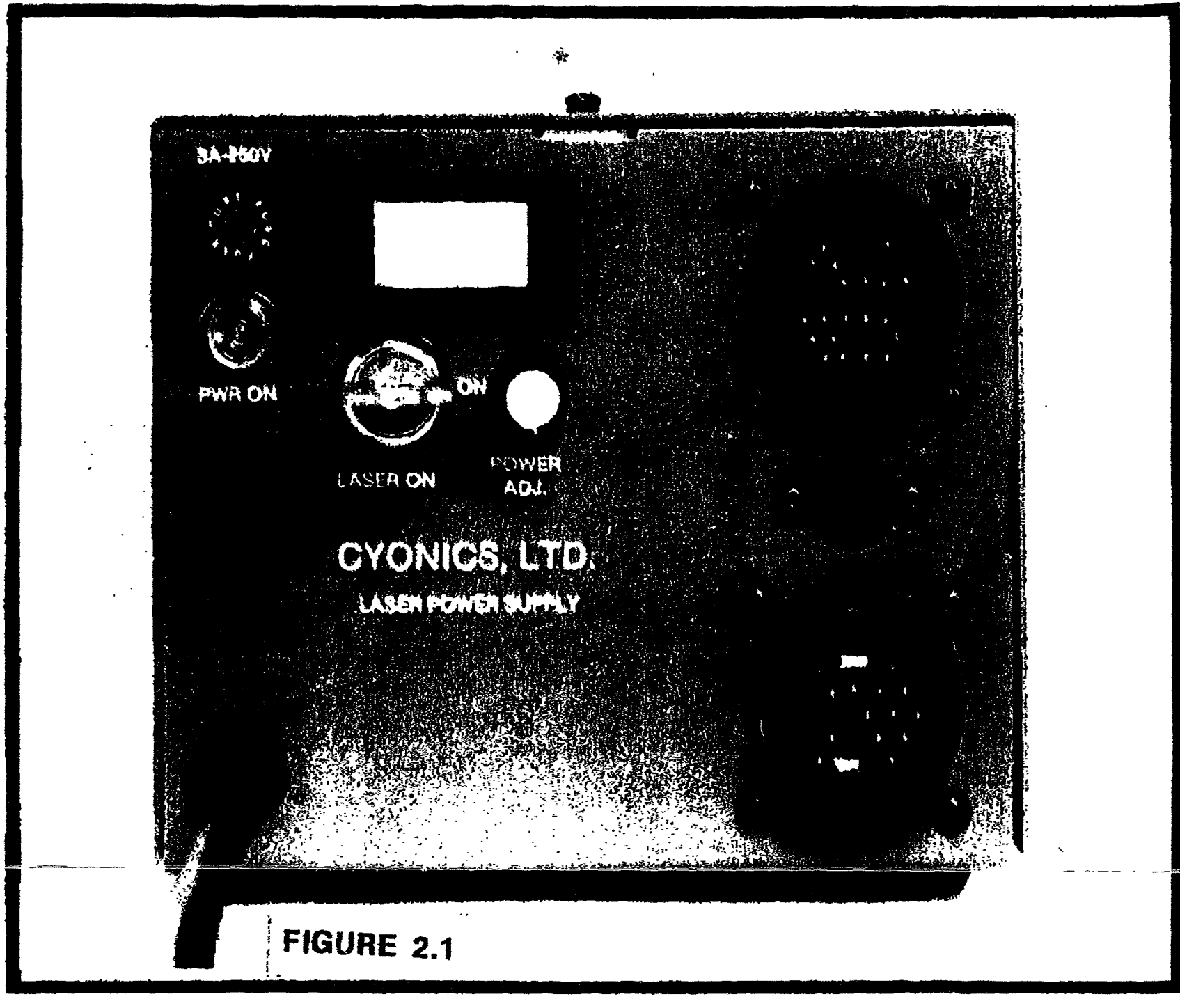


FIGURE 2.1

LATED FROM THE INPUT POWER LINE. THESE HIGH VOLTAGES ARE LETHAL.

Users of this laser product should be aware that operating the product without due regard to these precautions, or in a manner that is not in compliance with procedures recommended here, may cause an unsafe condition.

2-4 Safety Recommendations For Using The Laser

1. Always have the Power Supply cover and the Laser Head cover in place when the laser is energized.

2. Limit access to the laser to those familiar with the equipment. Keep the laser out of the hands of inexperienced and untrained personnel.

3. When the laser is on and the output beam is not being terminated in an experiment or optics system, the beam should be blocked.

4. **NEVER LOOK DIRECTLY INTO EITHER THE MAIN LASER BEAM. NEVER SIGHT DOWN A BEAM INTO ITS SOURCE.**

5. Do not allow reflective objects to be placed in the beam. Laser light scattered from a reflective surface can be as damaging as the original beam. Even objects such as rings, watchbands, and metal pencils can be hazardous.

6. Turn laser power down to a low level to minimize intensity of accidental stray reflections or refractions when aligning a chain of optical components in beam.

7. Set up experiments so the laser beam is **NOT** at eye level.

8. Post warning signs and limit access to the laser area when the laser is in operation.

9. Even when wearing laser safety glasses, there are two hazards that exist while operating CW (continuous-wave) ion lasers:

   - The glasses make the beam itself invisible, therefore, increasing the danger of skin burns.
   - Laser glasses may not afford enough protection if a very powerful beam is viewed directly.

An important reminder for laser servicing personnel and laser users in any area where laser maintenance is being performed:

NEVER LEAVE THE LASER ON, OPEN AND UNATTENDED!

2-5 Compliance Features

The following compliance features are incorporated into Cyonics 2000 Series Laser components. Location of these features is shown in Figure 2.1.

1. Protective Housing

   The housing of the Laser Head is designed to prevent collateral radiation in excess of admissible limits, as well as laser radiation in excess of the accessible emission limits of Class IIIb lasers (see beam attenuator).

2. REMOTE Control Connector

   A REMOTE control connector is provided on the front of the Power Supply. When this connector is removed, the Power Supply will not operate. This connector has Pins 36 & 37 shorted with a jumper wire.

   It is desirable in some working areas to employ a REMOTE switch. Remove the jumper connect Pins 36 & 37 to the REMOTE switch. Be aware that 24 VAC voltage is across these terminals when unshorted.

   The REMOTE connector also has Pins 12 & 13 shorted to permit LOCAL LIGHT control at the front panel. See Section 3-4 REMOTE Connector.

3. Key Control

   The Power Supply is activated when the key is turned to the "ON" position. A 30 second time delay occurs before the laser is activated. Note that the key cannot be removed when turned on the "ON" position.

4. Laser Radiation Emission Indicator

   The emission indicator lights immediately when the Circuit Breaker switch in the Power Supply is turned to the "ON" position. See front view picture of the Power Supply, Figure 2.1.

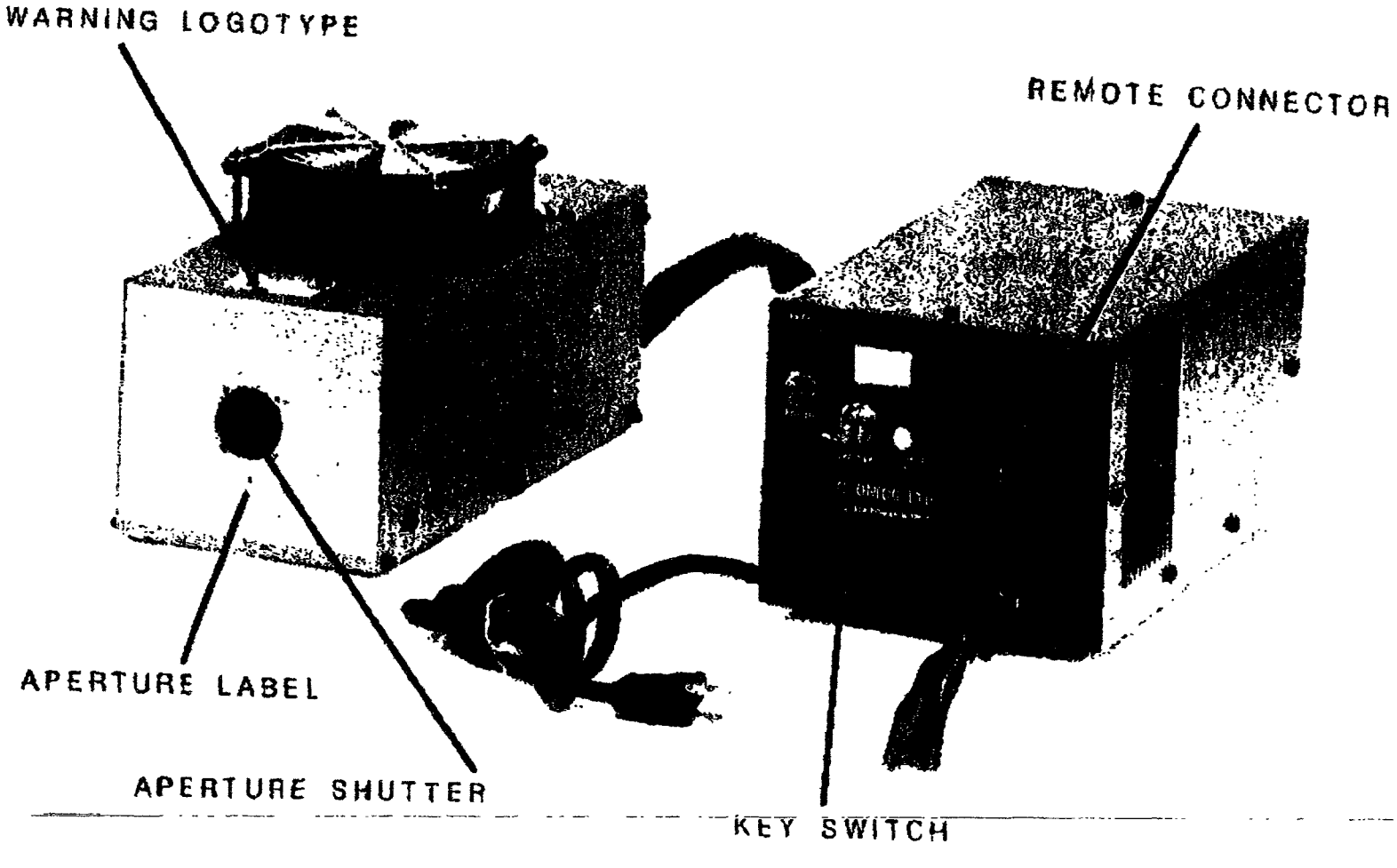

WARNING LOGOTYPE
REMOTE CONNECTOR
APERTURE LABEL
APERTURE SHUTTER
KEY SWITCH

FIGURE 2.2

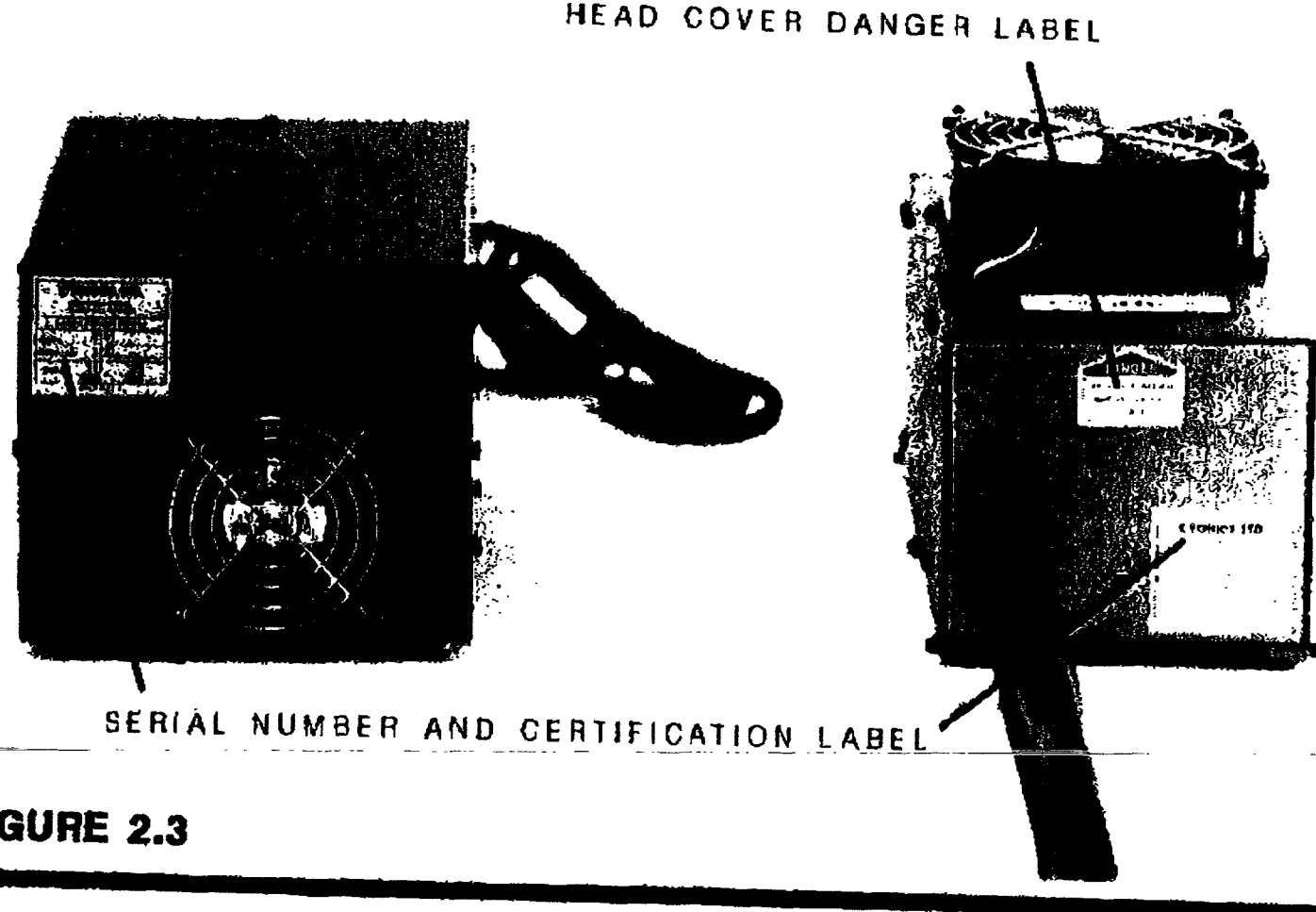

HEAD COVER DANGER LABEL
SERIAL NUMBER AND CERTIFICATION LABEL

FIGURE 2.3

5. Beam Attenuator

The attenuator, located on the output end of the Laser Head, is designed to prohibit laser radiation in excess of the accessible emission limits of Class IIIb lasers. Keep the attenuator in its closed position when not operating the laser.

6. Safety Labels

The location of the required safety labels for Class IIIb DHEW/BRH Standards are shown in Figure 2.2 and 2.3.

2.6 Maintenance Steps Necessary to Keep this Laser Product in Compliance

This laser product complies with Title 21 of The United States Code of Federal Regulations, Chapter I, Subchapter J, Parts 1040.10 and 1040.11, as applicable. To maintain compliance with these performance standards, once a year, or whenever the product has been subjected to adverse environmental conditions such as fire, flood, mechanical abrasion, solvent spillage, etc. Check to see that all features of the product listed on the radiation control drawing in this Section REMOTE control connector, emission indicator, beam attenuator and control Key Switch are functioning properly and all required labels are firmly in place and completely legible.

1. Verify that removing the REMOTE control or umbilical connector prevents laser operation.

2. Verify that the EMISSION key must be present before the laser will start. Also, verify that the laser is not operable when the key is removed.

3. Verify that the EMISSION indicator works properly; that is, it is lit up whenever laser is on.

4. Verify time delay between turn-on of EMISSION indicator and starting of plasma discharge; it must give enough warning to allow action to avoid exposure to laser radiation.

5. Verify that, when activated, the beam blocker (mechanical Shutter) actually blocks exposure to laser radiation.

WARNING

At all times during installation, operation, maintenance or service of your laser, avoid all unnecessary exposure to laser or collateral radiation in excess of the accessible emission limits listed in Performance Standards for Laser Products, 21CFR 1040.10 (d).

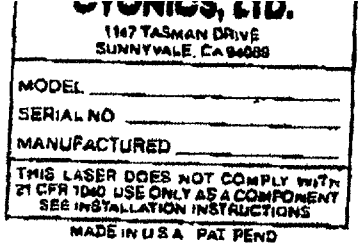
2.7 Additional Information Sources

Sources for additional information and assistance on laser safety are:

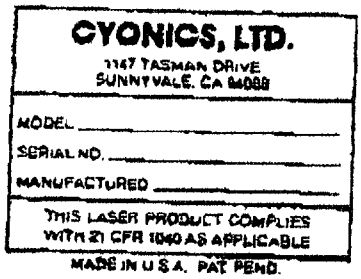
Director (HFX-400)
Division of Compliance
Bureau of Radiological Health
5600 Fishers Lane
Rockville, MD 20857
(Regulations & Requirements)

Laser Institute of America
4100 Executive Park Drive
Cincinnati, OH 45241
(Safety Guides)

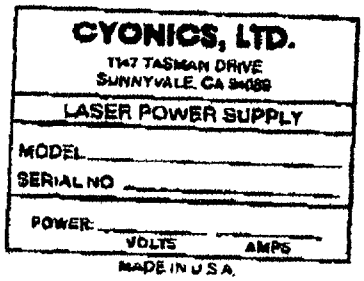
American Nat'l Standards Institute, Inc.
1430 Broadway
New York, NY 100118
(Safety Guides)



Certification Label for
Model 2000 Series



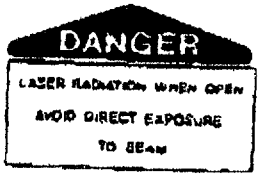
Certification Label for
Model 2000 Series



Certification Label for
Model 2000 Series

Warning Logotype for
Model 2000 Series

Aperature Label for
Model 2000 Series



Head Cover Danger Label
Model 2000 Series

LABELS REQUIRED FOR MODEL 2000 SERIES LASERS

3·0 INSTALLATION AND OPERATION

This Section deals with the installation and operation of the Model 2001 Argon Ion Laser System. Included will be the REMOTE control and monitoring features, and operation in CURRENT and LIGHT control modes. At the end of this Section is a chart showing the function and Pin numbers of the REMOTE plug found on front panel of Power Supply.

3·1 Mounting

Mount the Laser Head with base horizontal and fan facing upwards. Allow sufficient clearance from both the air intake vent on the side and the exhaust at the top. Place the Head unit so as to provide access to the mechanical shutter which is located on the front. The base plate has predrilled and tapped holes to allow convenient and secure mounting. These various holes can accommodate 6-32, 8-32, 10-32, 1/4-20, and M6 (metric) screws.

CAUTION

Select the proper length screw when mounting so as to prevent the screws or bolts from extending over 1.27 cm. (1/2 inch) into the Laser Head. This will prevent any inner damage to the Head unit. See the last page of the Sales Brochure for base plate hole location.

Mount the Power Supply in such a manner as to permit access to controls and connections on front panel. Either horizontal or vertical mounting is satisfactory. Provide at least 2.54 cm. (1 inch) clearance for air intake at sides, and air exhaust at rear. Rubber feet are mounted on base for convenient table top operation.

3·2 Connecting The Power Line

The Power Supply is equipped with its own AC power cord. Simply plug into any convenient AC outlet providing at least 20 Amp service. Most all AC outlets are equipped to handle this.

NOTE: Make sure to use a grounded outlet for safety.

3·3 Connecting The Umbilical Cable

Laser Head and Power Supply are joined electrically by an Umbilical Cable. This cable completes the interlock safety circuits of the laser system.

Each connector is "Keyed" to prevent improper insertion. One end of the cable is attached to the Laser Head, the other to the receptacle on Power Supply front panel. See Figure 2.1. Be sure all connector plugs are locked in place by rotating the knurled ring in a clock wise direction.

3·4 REMOTE Connector

A female REMOTE connector is supplied with the laser Power Supply. The connector has the interlock (Pins 36 & 37), and the LOCAL LIGHT control (Pins 12 & 13) jumpered to permit the Power Supply to be operated in LOCAL LIGHT control. See also Laser Safety Section 2·5·2.

Supplied also with the unit are 10 female Pins to insert into the REMOTE plug to permit other types of REMOTE functions. See Table 3.1 for Pin locations and functions. If more Pins are needed, they may be ordered. Cyonics part number 21-002-024 or Amp #66103-3, see Section 5·0 Spare Parts.

Wires are crimped to Pins with Amp tool #90277-1. Pins may be removed from plug by using Amp tool #305183R. These tools can be purchased at most electronics dealers.

3·5 Turning On The Laser

1. Set PWR. ADJ. knob and Key Switch on Power Supply completely counter clockwise. This is "idle" position for PWR. ADJ. knob and off position for Key Switch. With a flat blade screwdriver, open the Shutter on front bezel of laser by rotating the slotted Shutter control.

2. Next, turn on Rocker Switch, the orange light should turn on at this time. Turn the Key Switch clockwise to start system.

   NOTE: The laser should start after approximately a 30 second delay which allows Cathode to reach its operating temperature. During this 30 second delay make sure laser fan and Power Supply fan are operating.

3. Laser should now be on and operating at approximately 4.0 Amps. Set the PWR. ADJ.

knob on Power Supply to set laser power to desired level.

NOTE: At idle, (front panel knob fully counter-clockwise), the laser is at minimum current and is no longer in light regulation.

NOTE: A protection circuit is employed in the Power Supply. This protects laser against line surges and current over-loading, by shutting off the laser system. To reset system, simply turn off both the Key Switch and Rocker Switch. Re-start laser in the normal manner.

In the event AC line failure, laser with automatically restart after a 30 second delay.

The remaining paragraphs in this Section deal with three modes of operation, two methods of monitoring laser performance, and a paragraph dealing with interlocks and their function. See Table 3.1 for any assistance. The last paragraph briefly covers information about the timer found inside laser system.

3·6 Output Power Control

Laser power can be adjusted from an external 0-10 VDC input on Pins 1 & 5, Pin 1 return, Pin 5 positive (calibration is 0.1 Volts/mW).

NOTE: The LOCAL LIGHT control shunt (Pins 12 & 13) must be removed before applying voltage to Pins 1 & 5.

NOTE: The external power supplies should produce at least a 100mA current draw in order to properly operate laser system.

3·7 Laser Current Control

Laser discharge current is adjusted from an external 0-10 VDC input source on Pins 1 & 6, Pin 1 return, Pin 6 positive (calibration is 0.5 V/A).

NOTE: The LOCAL LIGHT control shunt (Pins 12 & 13) must be removed and the CURRENT control shunt (Pins 14 & 15) must be installed before applying voltage to Pins 1 & 6.

NOTE: CURRENT control can only be operated in the REMOTE function.

3·8 Laser Output Power Monitor

Pins 29 & 30 may be used to monitor laser output power. Calibration = 0.1/mW. Accuracy is ±5%.

3·9 Laser Current Monitor

Pins 26 & 27 may be used to monitor laser discharge current - calibration = 0.1V/Amp.

NOTE: These output monitors have a 10 OHM source impedance. A Digital Volt Meter of 1000 OHMs or higher is recommended.

3·10 Laser Standby - Discharge On

In order to prolong laser tube lifetime, the laser may be operated in a low current (4 Amps) standby mode by shorting Pins 34 & 35. Removing the short will return the laser power to its present level.

3·11 Interlocks

Several electrical safety interlocks are incorporated into the 2001 Laser System. They are wired in series and the opening of any one of these connections will cause the laser discharge to shut off. These interlocks are as follows:

a. Over temperature protect switch on laser tube.

b. Umbilical interconnect cable.

c. REMOTE connector Pins 36 & 37 on Power Supply.

d. Fan interface connector.

A detailed schematic diagram Figure 3.1, outlines the entire interlock circuit of the Cyonics laser system.

3·12 Laser Shutdown

A shutdown feature is incorporated into the Power Supply. See Table 3.1 for details.

3·13 Timer

The Laser Heads are fitted with a timer an electro mechanical register that is operated from the AC power line to indicate the number of hours of operation.

The timer operates on both 60Hz and 50Hz. To read the timer correctly do the following:

At 60Hz Read Direct
At 50Hz multiply reading by 1.2.

Example:
If your AC frequency is 50Hz and the timer reads 500, the Laser Head has operated 500 X 1.2 = 600 hours.

TABLE 3-1

FUNCTION	PIN #	COMMENTS
Laser Output Power Control	Pin 5 Source + Pin 1 Source -	Source = 0-10 VDC Calibration = 0.1V/mW Both the Current control Shunt and Local control shunt must be removed in order to externally control the laser output power.
Laser Current Control	Pin 6 Source + Pin 1 Source -	Source = 0-10VDC Calibration = 0.5V/A
Laser Output Power Monitor	Pin 29 + Pin 30 -	Calibration = .1V/mW
Laser Current Monitor	Pin 26 + Pin 27 -	Calibration = .1V/A
Local Control Shunt	Pin 13 + Pin 12 -	This shunt enables front potentiometer. (The laser operates in light mode.) Jumpered at shipment.
Current Control Shunt	Pin 15 + Pin 14 -	This shunt enables the laser current control.
Laser Standby Discharge on	Pin 34 + Pin 35 -	This shunt allows the laser to only operate at idle current (4A).
Interlock	Pin 36 + Pin 37	See Section 3-12 Interlocks Jumpered at shipment.
Laser Shutdown	Pin 33 + Pin 35 -	This shunt disables the laser discharge but allows the cathode to remain on.
External Power Supplies	Pin 25 + 15 VDC Pin 24 - 15 VDC Pin 23 Return	Source + 15 VDC -15V measured into infinite impedance.
Power Ground	Pin 4	

CYONICS-2000 SERIES INTERLOCK CIRCUIT

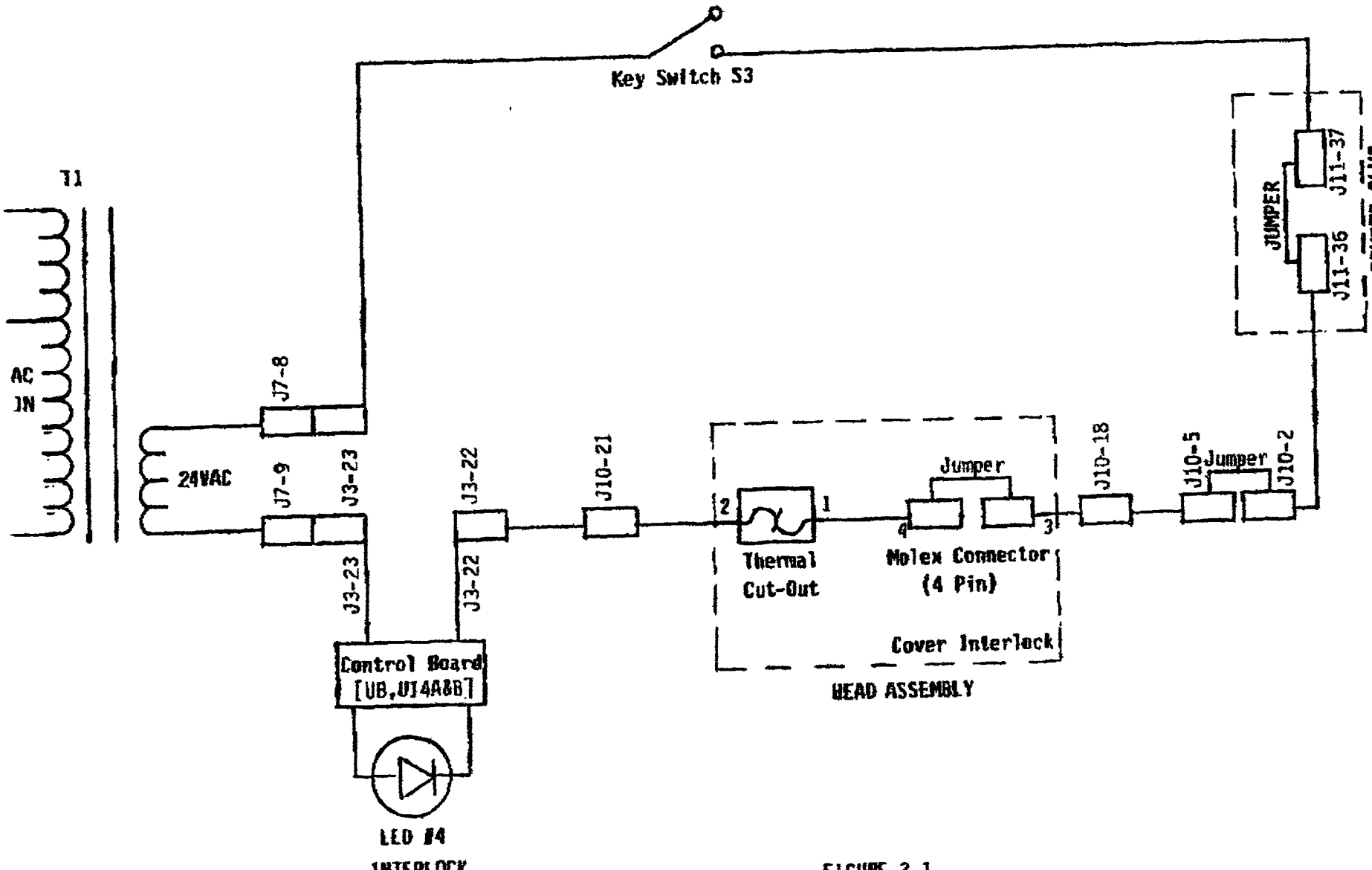


FIGURE 3.1

4.0 MODEL 2001 MAINTENANCE & TROUBLE SHOOTING

This Section has been provided to aid the user maintaining and trouble shooting the Cyonics 2000 Series laser system. This Section, should answer or solve most any service question or problem that should occur. Information provided in this Section include:

- Optical Cleaning
- Recommended Service Equipment
- Calibration Procedures
- Trouble Shooting Flow Chart

Before attempting any maintenance to any laser component, please review this Section first. If any further assistance is required, contact:

4.1 Cleaning Recommendation and Precautions

Instructions for cleaning optics in this Section are provided only in those cases involving a loss in laser output power which has been positively diagnosed due to contaminated or filmy optical components.

To achieve optimum success with cleaning optical components, here are some helpful items.

- Optics cleaning should be done only in a clean laboratory atmosphere whenever possible.
- Always use optical reagent-grade solvents for optics cleaning.

  Always wash hands before handling or cleaning any optical components. This removes excess skin oil and minimizes the possibility of contamination.
- Methanol removes skin oil from optics; acetone will not.
- Acetone is preferred for the final wipe of an optical component because it evaporates very rapidly.
- Always use a new sheet of lens tissue for each wipe of an optical component.
- Avoid touching tissue that will be in contact with an optical surface with the fingers.

It is recommended also, that "Q" tips not be used when cleaning optical surfaces. Stray fibers may remain on an optical surface, and also those same fibers perhaps might dislodge or misalign a strategically placed optical component. Therefore, lens tissue is highly recommended to clean laser optics.

Here are some helpful suggestions when using lens tissue:

- Fold the lens tissue in such a fashion as to form a soft padded surface for cleaning. This will also help eliminate scratching delicate optical surfaces. Figure 4.1.
- Apply one of the solvents (methanol for first wipe, acetone for last) to the tissue pad with an eyedropper, **NEVER DIP THE TISSUE INTO THE BOTTLE, SINCE SKIN OIL FROM THE TISSUE CAN CONTAMINATE THE SOLVENT.** Thoroughly saturate the tissue, keeping the folded part of the tissue upward. This is the part of the pad which will touch the optical surface.
- To judge how effectively an optical component was cleaned, it is suggested a power reading be taken before and after cleaning.

4.2 Recommended Service Equipment

Although Cyonics laser products require a very minimum amount of service or attention, the following list of basic tools and equipment would greatly facilitate any servicing, should it prove necessary.

Standard Blade Screw Driver

#1 Philips Screw Driver

#2 Philips Screw Driver
Trimpot Adjuster

Diagonal Cutters

Needle-Nose Pliers

Soldering Iron (small)

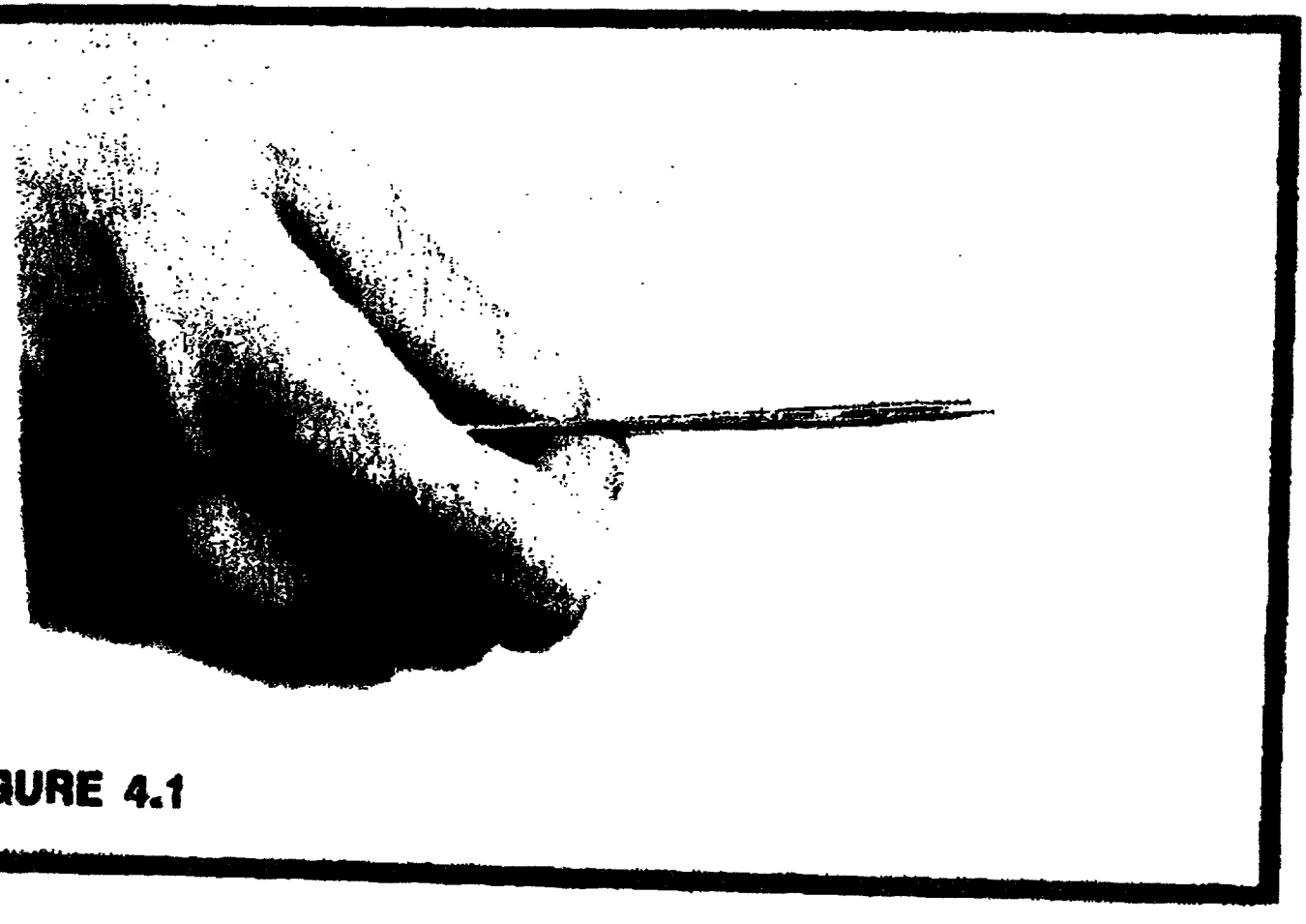


FIGURE 4.1

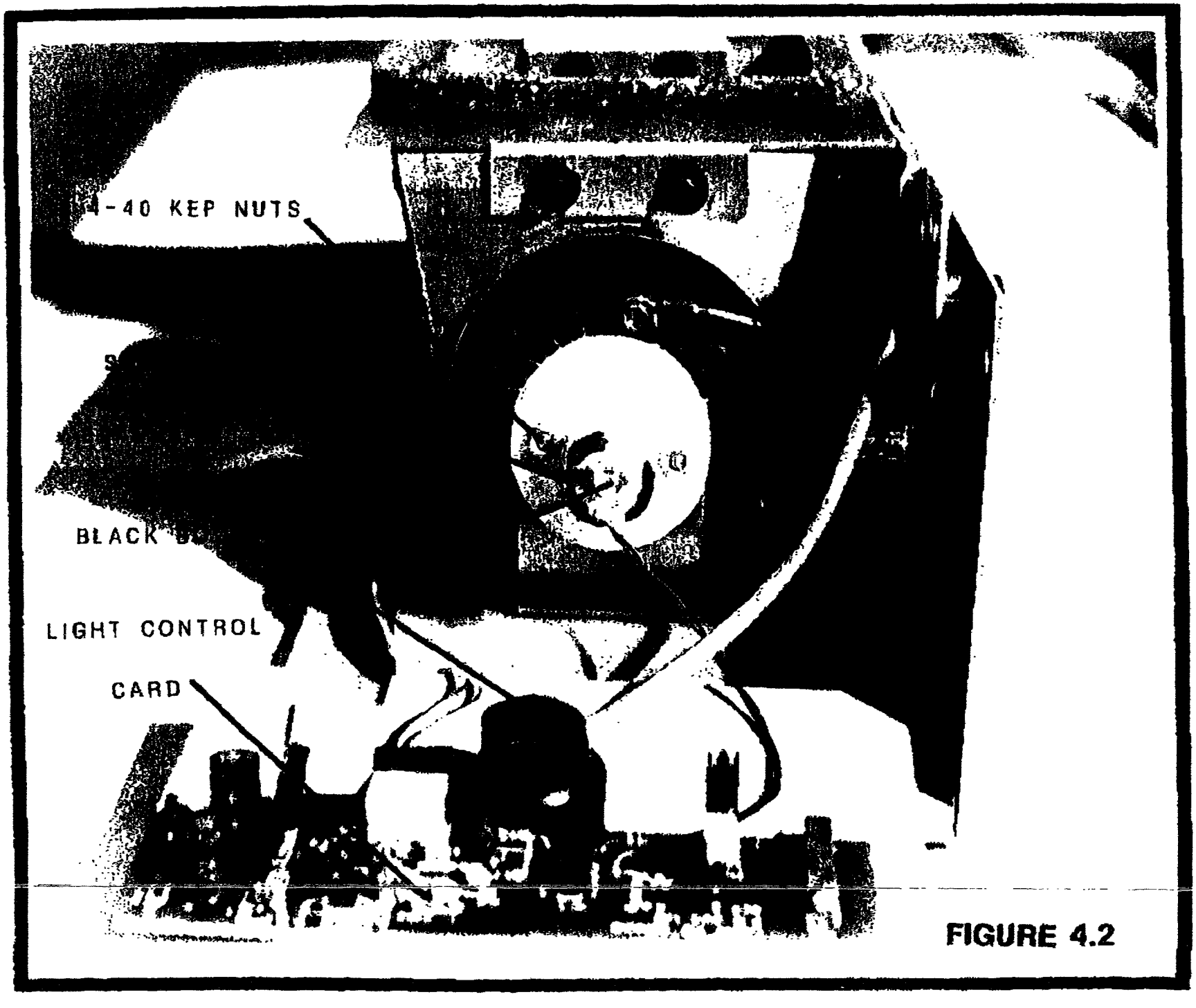


FIGURE 4.2

Solder-Wik (for removing solder)

Solder (60/40 resin core)

Tweezers (small)

REMOTE Pins (female) Amp #66103-3

REMOTE Pin Crimping Tool Amp #90277-1

REMOTE Pin Removal Tool Amp #305183-R

Hex Drivers, 7/64" and 3/32"

Hex Driver 1/4"

Laser Power Meter

4·3 Model 2001 Beam Splitter Cleaning

The Beam Splitter should only, on very rare occasions, need cleaning or attention. Should the need for cleaning ever arise, follow these important steps so as not to damage this assembly.

1. Remove the seven (7) black Philips head screws holding the fan cover to Laser Head. Leave fan attached to cover.

2. With the front end of the Laser Head extending 9.0 cm. (approx. 3.5 inch) over the edge of a table, remove the two (2) 3-32 Allen hex screws which holds the front bezel to the base plate. Remove the remaining Philips screws holding front bezel to side plate, very gently pull bezel forward to clear the white nylon Beam Splitter Housing.

3. Carefully unplug the wires J5 & J6 which attach to the light PC board. Remove the bezel.

4. Study Section 4·1, Cleaning Recommendation and Precautions, then clean outer surface of Beam Splitter.

Most of the cleaning that is needed for the Beam Splitter should only be necessary on the outside surface. The optic itself is mounted on the aluminum disk next to the Solar Cell. (See Figure 4.2).

If after cleaning the Beam Splitter, the laser still exhibits low power with all operational parameters normal, proceed with Section 4·4 Beam Splitter Housing Removal.

4·4 Beam Splitter Housing Removal

Again, make note of the power output level before proceeding. This disassembly step is only if it has been determined that low power might be caused from the inner parts of the Beam Splitter Housing. The aid of an external Power Meter is needed to determine any output level differences. Refer to Figure 4.2.

Remove the two 4-40 keep-nuts holding the housing onto the Plasma Tube. Carefully slide assembly off, leaving the rubber diaphragm in place. With laser energized, note any increase of power output. On the single-line (SL) lasers, a power increase will always happen since a line filter is installed in the Beam Splitter Assembly.

On the multi-line (ML) lasers a very slight increase of power output should be noted.

Apply the cleaning techniques of Section 4·1 Cleaning Recommendation and Precautions, and clean outer surface of Front Mirror. Again with an External Power Meter, note any increase of power output. If there is no increase of power output, optical components inside housing might be contaminated. The inside components of the Beam Splitter Assembly cannot be cleaned in the field. Contact Cyonics for further servicing instructions of this assembly.

The laser still may be operated with the assembly removed. However, the laser will not operate in the LIGHT control mode. Switch to REMOTE CURRENT control.

4·5 Transmitter Mirror Servicing

Since the mirror is enclosed in a dust free cavity unit, little or no cleaning of this mirror should be necessary. If it is absolutely certain the outer mirror surface needs attention, follow the procedure outlined in Section 4·3. Refer also to Section 4·1.

The coating side of the mirror is hard sealed to the Plasma Tube itself. A defective mirror requires a replacement of the entire Plasma Tube.

4·6 High Reflector (HR) Mirror Servicing

The Rear Mirror is capped and needs absolutely no attention other than tuning; only if required.

4.7 Model 2001 Laser Output Calibration (R3)

1. Place system to be calibrated in REMOTE LIGHT control using an external DC power source. Refer to Section 3.0 Operation and Installation. Place the leads from a DVM on TP1 & TP2, (positive lead on TP2), on the Light Amplifier board found inside the Laser Head. Refer to Figure 4.2. Allow at least a five (5) minute warmup time before proceeding.

2. Using the example below, adjust the voltage at the DC source, so that it reads 1.0 Volts DC across TP1 and TP2. This is the calibration voltage for a 10mW laser, 1.5 Volts would be for a 15mW laser, and so on. Example:

2001 - 10 SL ("SPEC" power is 10mW)
Voltage Factor = 0.1V/mW or
0.1 X 10 = 1.0 Volts DC

3. Place an external Power Meter in front of the laser beam. Adjust R3 on the light amplifier board so that the power level indicated on the Power Meter agrees with the voltage level as in Step #2.

4. Finally check calibration of laser output on Pins 29 & 30 of the REMOTE Plug. Laser output on Power Meter should agree to the voltage factor found on Table 3.1, Laser Output Power Monitor.

TABLE 4.1 TROUBLE-SHOOTING FLOW CHART

PROBLEM	POSSIBLE CAUSE	CORRECTING ACTION
Laser will not start, Emission Indicator is off, key switch is on.	- Rocker Switch off - Fuse (F1) blown - Not plugged in - No AC power at source	- Turn on Rocker Switch - Replace Fuse - Connect to AC source - Connect to active AC source
Laser will not start, has AC power, Emission Indicator is on. L.E.D. #4 not on	- Control/Logic Board defective - Key Switch off - Remote Plug (J11) not inserted - Umbilical Cable (J10) loose - Thermal Cut-Out (Head) open - No 24 VAC on interlock chain	- Replace U8 or U10 or Board - Turn Key Switch on - Plug in, Pins 36 & 37 shunted - Plug in, Pins 2 & 5 shunted - Allow to cool. Replace if bad - Check transformer (T1), replace*
Laser will not start, has AC power, Emission Indicator is on, interlock chain O.K.	- Defective Tube - Too low filament voltage & current - No tube voltage - Defective Power, Control/ Logic Boards	- Replace* - Check Fil. Transformer taps - Check Power Board - Replace defective board(s)*.
Laser emission will "blink" on & off while starting.	- Tube - Negative start pulse from Start Board - Regulator F.E.T. circuit defective - Idle current (R33) set too low - Too high capacitance in P/S output filter	- Replace tube* - Replace board* - Replace Power Board - Adjust R33, - Replace Power Board, or capacitors in filter network*
Laser starts, power output low with current setting at Maximum.	- Film on output mirror - Shutter "clipping" beam - Dirty Beam Splitter (if equipped) - Misaligned Mirrors	- Clean output surface - Open Shutter fully - Clean optical surfaces - Realign*

TABLE 4.2 TROUBLE-SHOOTING FLOW CHART

PROBLEM	POSSIBLE CAUSE	CORRECTING ACTION
Laser current high and cannot be adjusted or regulated in Light control.	- Light Control Amp. (Logic Board) defective	- Replace Board*
	- Misaligned Tube Mirrors	- Realign*
	- Misaligned Beam Splitter	- Replace B/S housing*
	- Defective Solar Cell	- Replace B/S housing*
	- Light Control Board defective	- Replace Board*
	- Saturated input voltage to Remote Light	- Adjust external voltage
	- Light Control Board out of calibration	- Calibrate*
Laser current cannot be adjusted in either Light or Current control, stays high.	- Defective F.E.T. (switching) network	- Replace Power Board*
	- F.E.T. Driver defective	- Replace U5, or Pwr. Board*
	- Pwr. Adj. control pot defective	- Replace with new part
	- Too low AC line voltage, out of regulation	- Adjust AC line or taps on Low Voltage Transformer*
No laser output, tube starts, power supply normal, current can be regulated normally.	- Shutter closed	- Open shutter
	- Tube Mirrors misaligned	- Realign
	- Defective light board	- Replace
Laser output in Light control unstable.	- Improper air-flow	- Increase air-flow
	- Laser set at idle	- Adjust to higher current
	- Loose Beam Splitter	- Attach with epoxy*
	- Defective F.E.T. Driver	- Replace U5 on Pwr. Board
	- Fluctuating Light Control external input voltage	- Stabilize external voltage
Laser Beam-Pointing unstable, power output stable in Light control.	- Improper air-flow	- Increase air-flow
	- Anode or Cathode leads too stiff	- Correct
	- Mounting Leaf Springs stressed	- Factory replacement
	- Cooling Shroud not isolated properly from Start Coil on Start Board, or Fan PC Board excessive pressure on Tube.	- Factory adjustment only

***Contact Cyonics Service Department or Qualified Service Personnel familiar with Cyonics Lasers for any corrective action.**

5·0 SPARE PARTS, HEAD AND POWER SUPPLY

MODEL 2201 HEAD

Beam Splitter Assembly	005-129
Fan (small), (specify model), Pamotor #4606X 120 C.F.M.	26-002-001
Fan (large), (specify model), Pamotor #7606 240 C.F.M.	26-002-002
Fan PC Board (converts to 70 Hz)	005-216
Light Control PC Board	005-217
Mirror Line Filter Assembly (specify wave length & model)	005-130
Start PC Board	005-318
Themo Cut-out, Elmwood Sensor #3450 RC	53-001-002

MODEL 2101 POWER SUPPLY

Amphenol Pins, (for Remote Connector) male, 20-24 gauge	21-002-023
Amphenol Pins, (for Remote Connector) male, 16-18 gauge	21-002-024
Amphenol Pins, (for Remote Connector) female, 20-24 gauge	21-003-006
Amphenol Pins, (for Remote Connector) female, 16-18 gauge	21-003-007
Fuse	51-003-003
Fuse Holder, Bussman #HKP-CC	51-004-001
Fan, Pamotor #8500D	26-002-003
Key Switch, C&K #Y101-13-0-C203 NQA	51-001-006
Knob, Front Panel	28-019-001
Logic/Control PC Board Assembly	005-261
Opto-isolater #4N35 (U8, U10)	31-002-005
Pilot Light, Radon #51N 2513	24-005-001
Power Adjust Potentiometer, Bournes #12F9985	47-005-001
Power PC Board & Heat Sink Assembly, (specify model)	005-269
Rocker Switch, (Circuit Breaker), 16 amp Weber #WT22-551	51-001-007
Remote Plug, (spare) amp #206151-1, no pins	60-009-004
Switch F.E.T., I.R. #IRF-741	56-001-002
Transformer, (Low Voltage), HBR #6-003	56-001-002
Transformer, (Filiment), (specify model), HBR #10-027	005-309
Umbilical Extension Cable, (J10), (specify model)	