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CAUTION

Improper use of the Medlite controls or performance of procedures other than those specified in the Physician's Information Statement contained herein may result in hazardous radiation exposure.

Laser Safety Precautions

Continuum Biomedical's user information is in compliance with section 1040.10 of 21CFR Chapter 1, Subchapter J concerning Radiological Health published by the US Department of Health & Human Services, Center for Devices & Radiological Health, 1988.

The following safety precautions should be read and observed by anyone using the laser.

1. Always wear laser protective eye wear of sufficient optical density at the appropriate wavelength to protect the eyes from the maximum energy produced.
2. Never look directly into the laser beam or its reflection. Permanent damage to the eye can occur.
3. During laser operation, do not allow any non-essential personnel in the treatment room.
4. Remove all shiny reflective objects such as rings, watch bands and metallic

pencils from the patient and the operating physician.

5. Never depress the foot switch without first verifying the safe orientation of the articulated arm and the attached hand pieces.
6. Never leave the laser in a READY or EMISSION mode unattended. Turn laser off and remove the KEY when not in use.
7. Never allow untrained personnel to operate the laser system unless directly supervised by a trained, experienced physician.
8. Never attempt to remove the protective covers from the laser cabinet. Only allow a factory authorized service technician or representative to remove any of the protective covers.
9. Call Continuum Biomedical at 510-606-6118 for further information on any safety features of the Medlite Laser System.

Review the safety labels used on or in the Medlite Laser System. Refer to the diagrams for their location.

Physician Information Statement

Description:

The Medlite Laser System is a Q-Switched Nd:YAG laser. The fundamental wavelength is 1064nm. This wavelength is also frequency doubled to the shorter 532nm green wavelength. Refer to this Operators Manual for details on the Medlite Laser System.

Training Requirements:

The Medlite Laser System is intended for use only by physicians trained in the safe handling and use of the laser. Continuum and Continuum Biomedical, Inc. suggests that, in addition to laser safety training of all operating room or clinic personnel, the user/institution adopt a training and safety program as outlined in the latest revision of the ANSI standard Z136.3, the American National Standard for the Safe Use of Lasers in Health Care Facilities.

It is further suggested that each physician desiring privileges for laser use be approved by the appropriate credentialing body within their respective institutions.

Physicians should consider the following training avenues:

1. An accredited training course within the physician's specialty,
2. "Hands-on" training under the preceptorship of a qualified user.
3. Attendance at specialty specific courses presented during academy or college meetings.

Nurses and other allied health professionals handling lasers may also complete a training program which may include subjects such as basic laser physics, laser safety, tissue interaction, laser operating procedures, laser set-up procedures, potential hazards, and hands-on experience.

In Service training in the use of the Medlite Laser System will be provided by Continuum Biomedical during the system's installation. Clinical techniques described here are presented only as a reference based on clinical experience with the device and other laser devices reported in the public literature.

Continuum Biomedical, Inc., maintains a current listing of recommended training courses which are available to the user and allied health professionals. Contact Continuum Biomedical for further information at (800) 532-1064.

Indications:

The Medlite Series Laser System has been researched extensively in removing light and dark ink tattoos and lightening solar or senile lentigines.

In evaluating its effectiveness for removing tattoos, the following scale was used.

Quality of Response	Percentage Tattoo Removal
Excellent	> 75 %
Good	50-75 %
Fair	25-50 %
Poor	0-25 %

Uses:

The Medlite Laser System at 1064nm is intended for dark ink tattoo removal. The Medlite Laser System at 532nm is intended for light ink tattoo removal and lightening of solar or senile lentigines.

For dark ink tattoo removal, the recommended fluence levels are 2J/cm² to 12J/cm². For the treatment of solar or senile lentigines lesions of the body, the recommended fluence levels are 2J/cm² to 5J/cm². The recommended fluence levels for light ink tattoo removal is also 2J/cm² to 5J/cm².

CAUTION: Not indicated for FACIAL tattoos or lesions.

Contraindications:

There are no known contra-indications to laser tattoo removal or lentigines treatment with the Medlite Laser System. Patients who have had prior problems with laser therapy, however, should be carefully screened as potential candidates for treatment.

Warnings:

Observe all safety precautions described in the chapter on Safety in this Operators Manual.

The 1064nm mode is intended for lightening of dark ink tattoos; the 532nm mode is intended for the lightening of light ink tattoos and solar or senile lentigines.

CAUTION: Not indicated for FACIAL tattoos or lesions.

Precautions:

Begin treatment with the lowest energy possible. If more tissue reaction is desired, increase the energy level in small increments until the desired tissue effect is observed. In clinical trials, the Q-Switched Nd:YAG laser was well tolerated at fluences up to $12\text{J}/\text{cm}^2$ (Joules per square centimeter).

Complications/Adverse Effects:

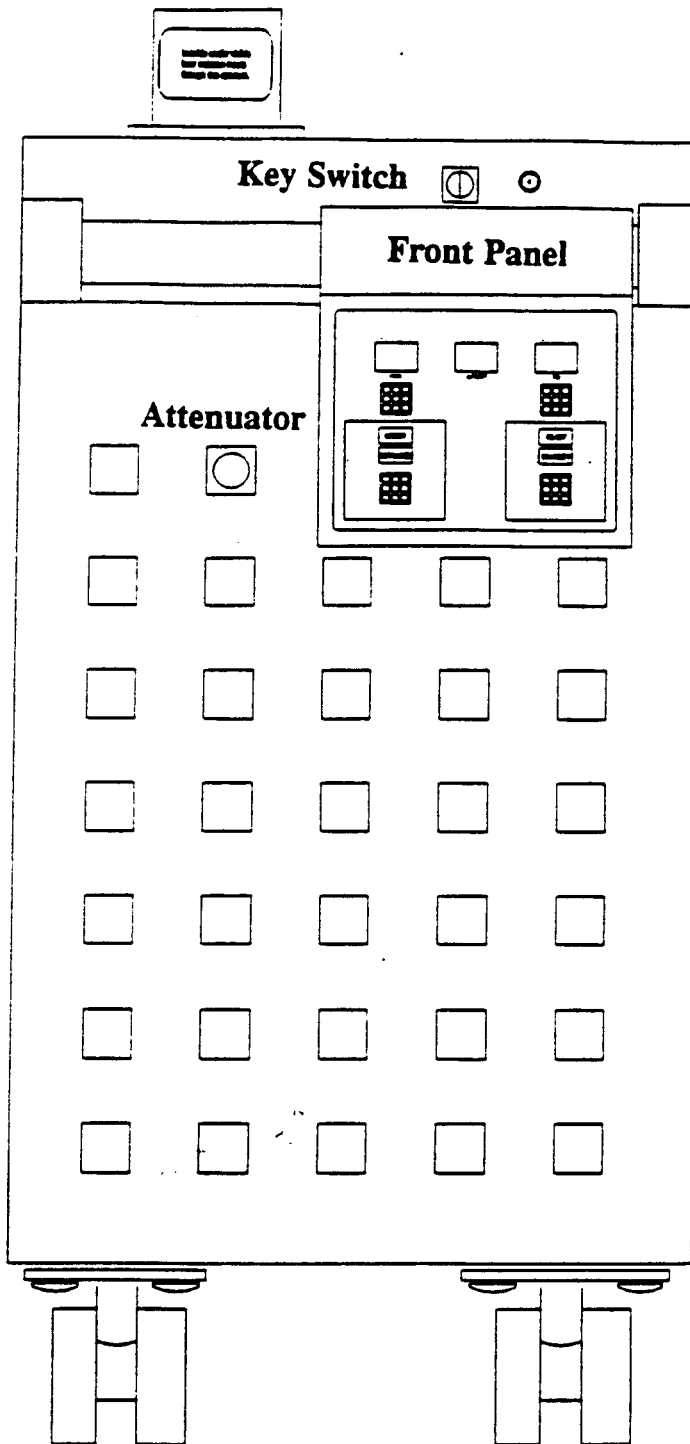
In clinical studies involving prototypes of the Medlite Laser System, complications were observed in less than 5% of patients treated. These complications included:

Scarring, keloid formation and indentation of the tissue may develop following laser therapy.

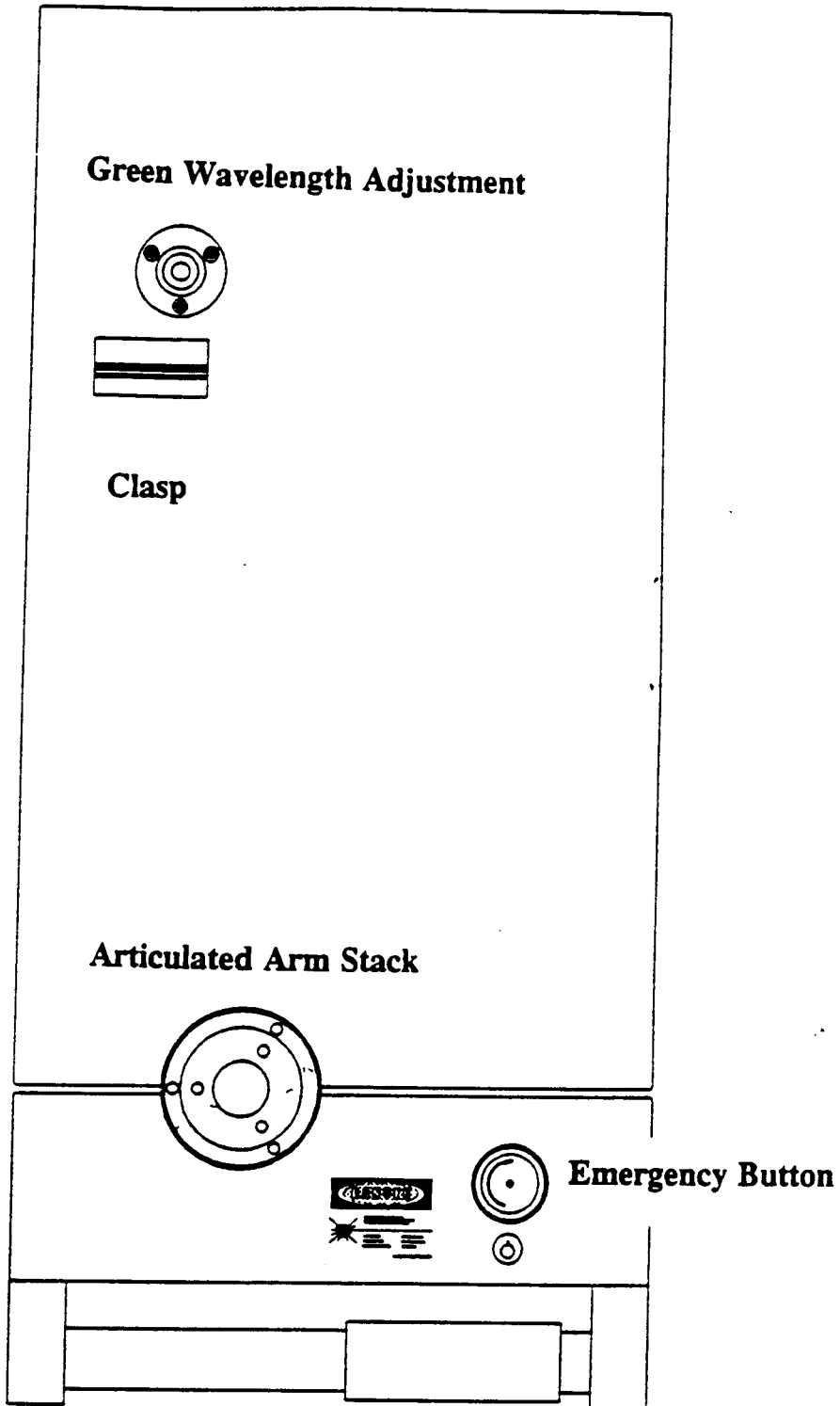
Postoperative erythema, edema, and pain may be experienced after laser treatment.

Hypo pigmentation or hyper pigmentation may occur.

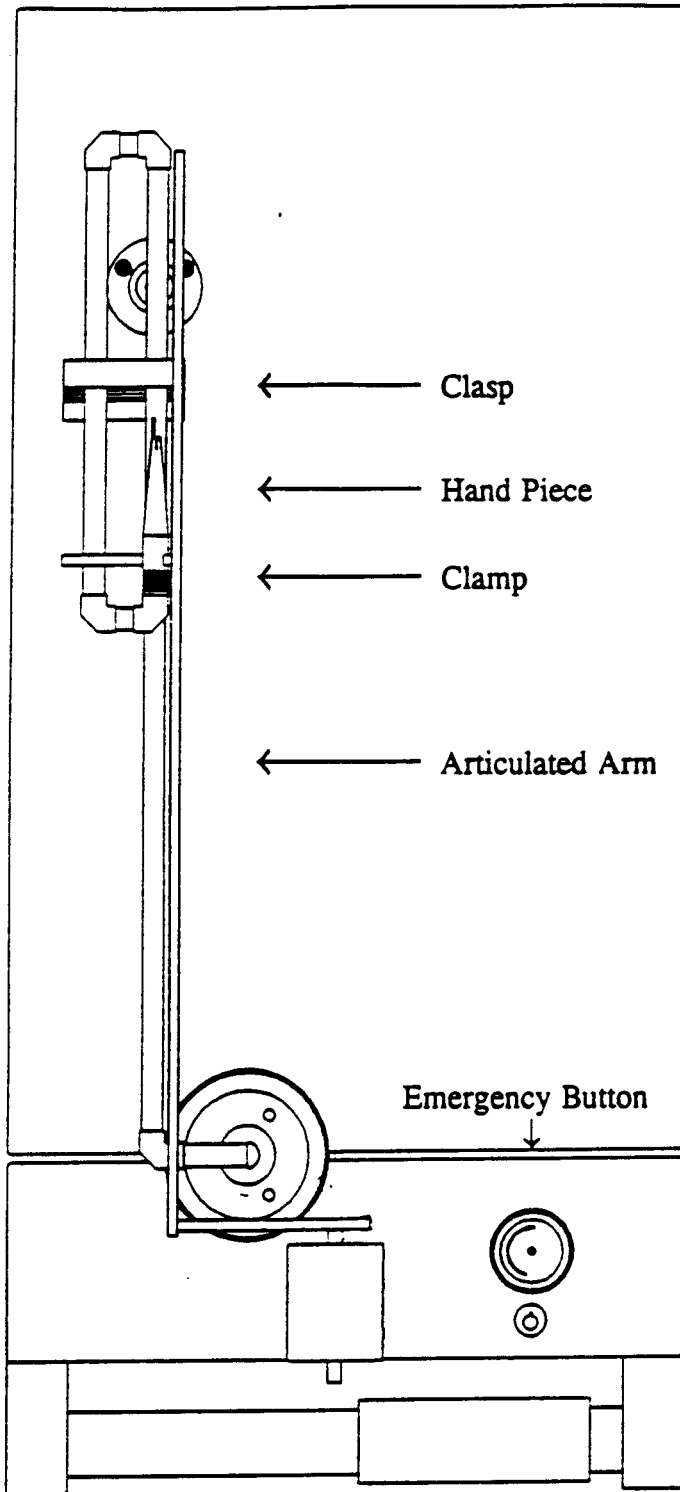
Drawings



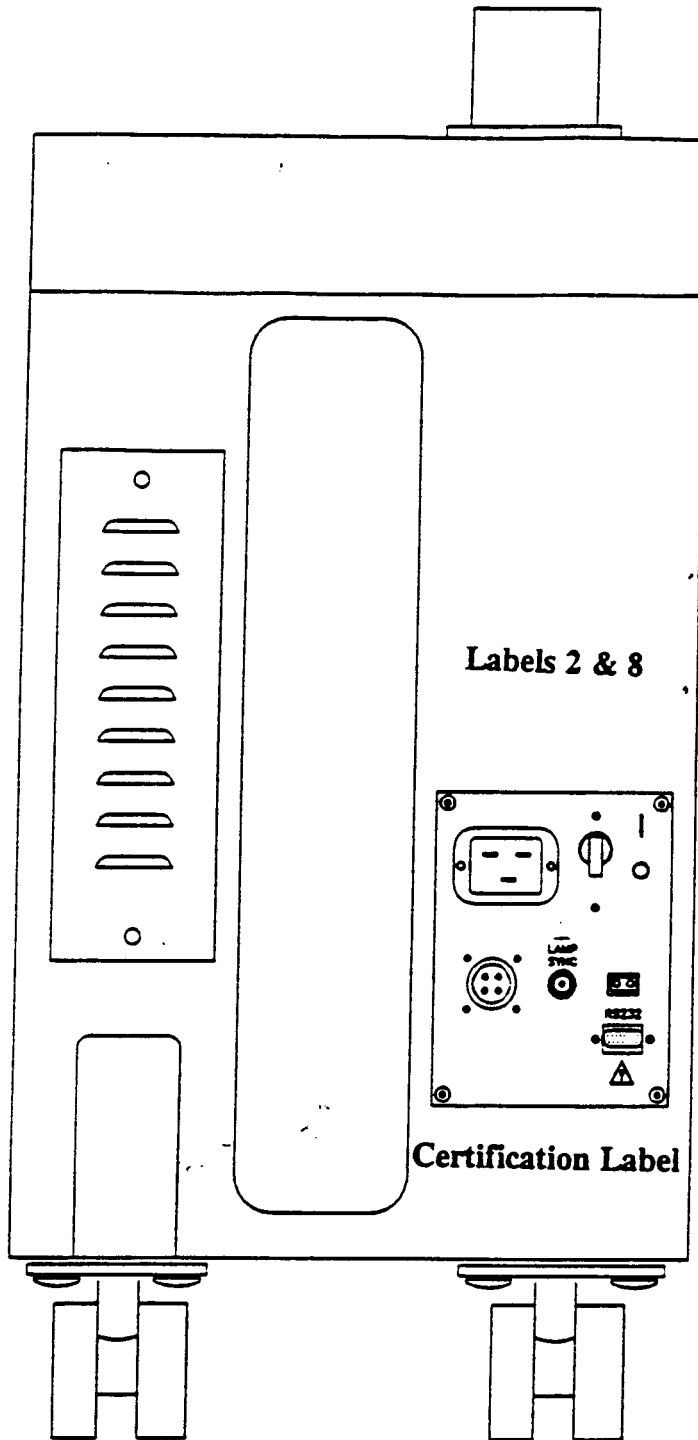
Medlite Front View
Figure 1



Medlite Top View
Figure 2
Page 7



**Medlite Top View
Figure 3**



**Medlite Rear View
Figure 4**

General Instructions

Continuum Biomedical considers itself responsible for the effects on safety, reliability and performance of the Medlite only if:

assembly operations, readjustments, modifications or repairs are carried out by persons authorized by the company.

the electrical installation of the relevant room complies with the appropriate requirements, and

the Medlite is used in accordance with the instructions for use.

I. Labels

Figures 5, 6 and 7 display the Medlite's labels. Figures 1, 2, 3, 4 and 16 may be used to find the locations of the various labels.

- Label 1. This is the Laser Warning Label indicating the Product is a class IV device. The label also lists the various laser parameters. It is located as shown in Figure 2 on the front top surface of the product.
- Label 2. This is a label indicating the product can only be sold to a medical facility, a physician or a physician's representative.
- Label 3. This the Manufacturer's Certification label. It indicates the manufacturer in the United States, the date of manufacturing and the serial number of the unit.
- Label 4. This is the label warning of laser output from an adjacent aperture.
- Label 5. This is the label warning of visible and invisible radiation enters the adjacent aperture. On the Medlite, this is located on the top surface next to the entrance to the articulated.
- Label 6. This is the label warning of visible and invisible radiation when an interior cover is removed.
- Label 7. This is the label warning of visible and invisible radiation when an interior cover is removed.
- Label 8. This is a warning concerning electrical power. It is located on the rear panel of the laser.
- Label 9. This is a warning concerning electrical power. It is located on the inside of the laser. Only authorized service individuals should have access to these areas.

DANGER

INVISIBLE AND/OR VISIBLE LASER
RADIATION-AVOID EYE OR SKIN EXPOSURE
TO DIRECT OR SCATTERED RADIATION

ENERGY/PULSE	2.0 Joule Maximum
PULSE DURATION	2 To 40 Nanoseconds
ND:YAG WAVELENGTHS	1084, 532 nm

CLASS IV LASER PRODUCT

Label 1

CAUTION

Federal law restricts this device
to sale by or on the order of a
physician.

Label 2

CONTINUUM
3150 Central Expwy., Santa Clara, CA 95051
MANUFACTURED

[Redacted]

Model [Redacted] S/N [Redacted]

This laser product conforms to the applicable
requirements of DHEW/BRH21 CFR Subchapter J
MADE IN U.S.A.

Label 3

**Medlite Labels
Figure 5**

LASER APERTURE.

Label 4

Invisible and/or visible
laser radiation inputs
through this aperture.

Label 5

Visible and /or invisible laser
radiation when open.
**AVOID EYE OR SKIN EXPOSURE TO
DIRECT OR SCATTERED
RADIATION**

Label 6

DANGER
Visible and invisible laser radiation
when open, and interlock defeated.
**AVOID EYE OR SKIN EXPOSURE
TO DIRECT OR SCATTERED
RADIATION**

Label 7

Medlite Labels
Figure 6

CAUTION

**HIGH VOLTAGE/HIGH
CAPACITANCE**

**UNIT CONTAINS POTENTIALLY
LETHAL ELECTRICAL CHARGE**

BEFORE WORKING ON UNIT:

- Disconnect All Cables Including
- Laser head Plug
- Wear Insulated Gloves
- Short Capacitors to Ground
(See Operating Manual)

Label 8

**CAUTION HIGH -VOLTAGE
BEFORE WORKING ON THIS UNIT
-SWITCH OFF POWER SUPPLY
-DISCONNECT ALL PLUGS**

Label 9

**Medlite Labels
Figure 7**

II. Set Up.

Note: If the Medlite has been left energized with electrical power for at least twenty minutes, go to step II.

- A. Plug power cord into socket at rear of laser. Plug power cord into wall power outlet. Verify External Interlock is connected properly.
- B. Switch on circuit breaker located on rear of laser. (See Figure 4)
- C. Release Emergency Button located on top of laser. (See Figure 2). All LED lamps should flash for one second.
- D. A 20 minute warm up of the Pockel Cell (Q-Switch) and the second harmonic generator (SHG) commences. This is indicated by a "Pd mm ss" in the display as shown below.

Location	Reading
Spot Size	Pd
Energy Density	19 (represents minutes)
Repetition Rate	59 (represents seconds)

- E. The numbers in the Energy Density indicator and the Repetition Rate count down from 20 minutes to 0 minutes. Following the count down, the machine displays "OFF" in the Energy Density and Repetition Rate indicators. The letter "O" is in the right digit of the Energy Density indicator and the letters "FF" are in the Repetition Rate indicator.
- F. A 20 minute period is required to heat the Pockel Cell and the second harmonic generator to the correct operating temperature. If the laser is left in the energized status, the Pockel Cell and the second harmonic generator are maintained at the correct operating temperature.
- G. This completes the application of electrical power to the system. To avoid the twenty minute warm up time, leave the Medlite plugged into the wall outlet, the circuit breaker turned on and the red emergency button released.

III. Start Up Sequence

A. Standby Mode

A. Make sure all individuals in the vicinity of the Medlite have the proper laser protection eye wear. See section XII for description of this eye wear.

B. The Front Panel should read "OFF" as described in section II. E.

C. Insert key and turn key switch one quarter turn clockwise. An initial delay of approximately 8 seconds follows to enable the microprocessor to complete a check of the various safety features and interlocks of the Medlite. During this period, the back lighting for the word "Standby" flashes.

D. Next the current date in the format "dd mm yy" displays on the front panel in the locations shown below. (This is an option. Not available on all units.)

Location	Reading
Spot Size	Number of the current day
Energy Density	Number of the current month
Repetition Rate	Number of the current year.

E. The installed software version flashes in the indicators for Energy Density and Repetition Rate. An example is the letters "Sr" in the energy Density indicator and the numbers "1.3" in the Repetition Rate indicator.

F. The cooling fans and water pump start and the letters "FLO" appear on the front panel. This indicates that the cooling water is starting to flow throughout the laser system and the flow switch is waiting to detect water flow.

G. The number 8 appears in the indicator for Repetition Rate. The numbers count down in one second intervals to 0.

H. After the countdown from 8 is completed, the front panel shows the following status.

- a. The word Standby is back lit.
- b. Infrared is back lit.
- c. The current repetition rate appears in the Repetition Rate Indicator.
- d. The current spot size appears in the Spot Size Indicator.

I. Set the desired treatment repetition rate by pressing the key pad under the repetition rate display on the front panel. Repetition rates of 1, 2, 5, and 10 pulses per second are available.

J. Set the desired treatment spot size by pressing the key pad under the spot size display on the front panel. Spot sizes of 2.0mm and 3.0mm are available. Check to determine if the hand piece on the output end of the articulated arm is the correct one for the set spot size. For information on changing the hand piece, please consult Section XII, Accessories and Hand Pieces. Consult Section XV for further information on the spot sizes.

Note: While in the Standby mode, laser light is not available from the articulated arm. Pressing the foot switch will not produce emission from the articulated arm.

B. Ready Mode.

The Medlite's status is changed between Standby mode to the Ready mode by pressing the Ready Standby key pad. See section V for further details.

1. Press the Standby/Ready key pad.
2. The "Ready" label flashes as the Medlite performs an internal calibration for five seconds after which the energy density in Joules /cm² will appear in the Energy Density Indicator. The "Ready" light will remain on and cease flashing.
3. If the Energy Density is improper for the scheduled treatment, adjust the power control knob until the desired energy density is displayed. For further information on the settings and stability of the energy density consult section VI.
4. Locate the foot switch in a comfortable place for the intended treatment.
5. Release the articulated arm by gently lifting the top portion of the clasp and rotating it counterclockwise. Also release the arm from the fold down clamp located on the long tube of the articulated arm.
6. Grasp the hand piece firmly, gently touch the area of skin with the end of the hand piece, and depress the foot switch to begin treatment.
7. When treatment is completed, release the foot switch and secure the articulated arm by placing it in its folded position and reinstall it in its clasp.
8. Press the Standby/Ready Key Pad. The system will return to Standby mode and printer will record the data from the treatment. **If the laser is turned off using the key switch or the Emergency Off button while in the Ready mode, the data is not be transmitted to the printer and is lost. See Printer Information for details of this output.**

IV. Shut Down Procedure

A. Rotate the key one quarter turn counterclockwise to turn off the Medlite. The letters OFF should appear on the front panel.

B. Remove the key and store in a safe and secured location.

C. If the laser will not be used for at least 24 hours, turn off the circuit breaker located on the rear panel of the Medlite.

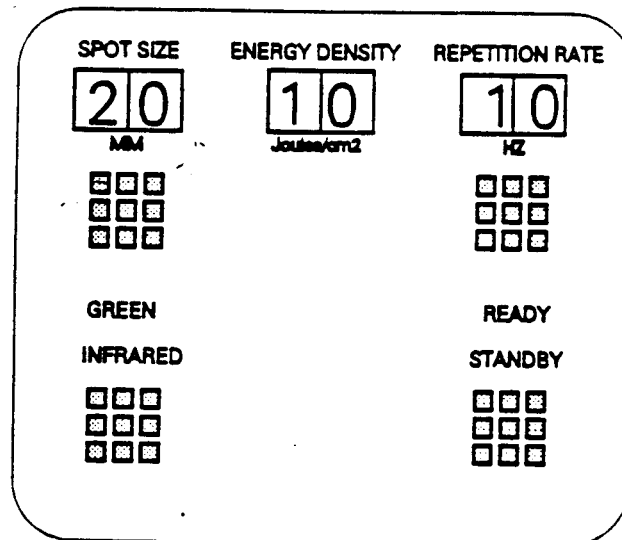
V. Medlite Front Panel Functions

The front panel of the Medlite is used primarily to display the parameters and status of the system while treating. In addition, various error codes may be displayed on the front panel indicating a fault has occurred somewhere in the system. For an explanation of these error codes, see section XVI.

Below is a description of the various indicators and key pads on the Front Panel.

- A. Standby/Ready Key Pad. This key pad is used to toggle between Ready and Standby mode. Laser output is available only when the system is in the Ready mode.
- B. Standby Indicator Light. When back lit, system is in the Standby mode.
- C. Ready Indicator Light. When back lit, systems in the Ready mode.
- D. Wavelength Key Pad. This key pad is used to select either Green output at 532nm or Infrared output at 1064nm.
- E. Infrared Indicator Light. When back lit, system is set to emit infrared laser output at 1064nm.
- F. Green Indicator Light. When back lit, system is set to emit green laser output at 532nm.
- G. Spot Size Indicator
 - A. Spot Size Indicator. This LED display indicates the approximate diameter of the treatment spot. The operator sets the spot size by using the spot size key pad. He or she should always verify the spot size indicator agrees with Spot Size label on the hand piece mounted on the output end of the articulated arm. The following spot sizes are available to the operator: 2.0mm. and 3.0mm.
- H. Spot Size Key Pad. This key pad is pressed to toggle through the various programmed spot sizes. The available spot sizes are 2.0mm and 3.0mm

- I. **Energy Density Indicator.** This LED display indicates the energy density in Joules/cm² at the output end of the hand piece. The energy density is calculated by the microprocessor using the energy per pulse and the true spot size. The energy density is the energy per pulse divided by the cross sectional area of the true spot size. See section XV for further information on the energy density.
- J. **Repetition Rate Indicator.** This LED display indicates the repetition rate set by the operator using the repetition rate key pad. The available repetition rates are 1, 2, 5, and 10 pulses per second (Hz).
- K. **Repetition Rate Key Pad.** This key pad is pressed to toggle through the various programmed repetition rates. The available repetition rates in the infrared are 1, 2, 5, 10 pulses per second (Hz). If the wavelength selector is on "Green", and the laser is in the "Ready" mode, the repetition rate key pad is also used as part of the optimization of the green output. By toggling through the various repetition rates, the letters "CA" will appear in the repetition rate indicator. When the letters "CA" are displayed, the green output can be optimized. For more information on this features, see Section IV.D. Continue to toggle through the repetition rates to escape from the "CA" mode.



**Medlite Front Panel
Figure 8**

VI. Medlite Power Measurement System

The Medlite utilizes a calibrated photo diode for monitoring the energy density during treatment. Continuum Biomedical recommends the system's calibration be checked every 90 days by a qualified service person. For more information on calibration, consult section XIV of this manual.

A. When the Medlite is changed from the Standby mode to the Ready mode, the system performs a calibration. During this three second period, the letters "CA" appear in the repetition rate indicator and the laser is operating internally at 10 Hertz. No laser emission is available from the articulated arm. When the calibration is complete, the energy density is displayed in the energy density indicator.

B. While in the Ready mode, if an operating parameter such as output power, spot size, or wavelength is changed, the Medlite will perform the same calibration procedure as described in section VI.A.

C. When the foot switch is pressed, laser pulses are emitted from the articulated arm. The photo diode is monitoring the power and updating the energy density on the Display Panel. If the energy density changes by $\pm 50\%$ during treatment, the output shutter will close and the system will re-calibrate. The foot switch must be released before laser emission is again available for treatment.

D. Optimizing Emission in the Green Mode.

If the Medlite has been set in the GREEN emission mode, The Repetition rate key pad may be pressed until the letters "CA" appear. The letters "Gr" will appear in the Spot Size indicator. Using the adjustment control on the top cover of the Medlite (see figure 2), the second harmonic generator (SHG) may be tuned and that the Energy Density indicator varies between 0 and 99 with angle of rotation. At 99, the SHG is tuned to its maximum output power. Note that this procedure may be performed only if the selected wavelength is in the "Green" position.

VII. Medlite Printer

A small thermal printer is attached to the side of the Medlite. This printer is used to record treatment statistics.

A. When the system is switched from the Standby mode to the Ready mode, the printer outputs the following lines.

Start Treatment
**Dr. _____ * Physicians Name*

B. When the foot switch is depressed and laser pulses are emitted from the articulated arm, various parameters are stored in the microprocessors memory. This data is transmitted to the printer when either a) a parameter such as energy density is changed or b) the system is switched from the "Ready" mode to the "Standby" mode. The printer displays the wavelength used, the repetition rate, the spot size, the energy density and the number of pulses emitted using these parameters. It also prints out a line for the patients name and another line for the date. Finally, the total number of treatment pulses is recorded. The last line is the total accumulated number of flashes on the flash lamp.

For example, the following information is added to the print out after treating the patient with the infrared light, using a 3 mm spot size, 5 Joules/cm², and a 10 Hertz repetition rate. Thirty seven (37) pulses were delivered through the articulated arm.

Start Treatment
**Dr. _____ **

****CALIBRATION ****
Infrared
Rep Rate (HZ) = 10
Spot (mm) = 3.0mm
J/cm² = 5
Shots = 37
Name _____
Date ____/____/____
Total Shots = 37
Flash # = 365890
End Treatment

C. When a parameter is changed, the stored data is transmitted to the printer. Additional treatments with the new parameters are subsequently added to the print out. Continuing with the above example, the patient is also treated with the green wavelength, using a 2.0mm spot and an energy density of 4 Joules/cm², a sample print out might be as shown below.

Start Treatment
**Dr. _____ **

****CALIBRATION ****
Infrared
Rep Rate (HZ) = 10-
Spot (mm) = 3.0mm
J/cm² = 5
Shots = 37
Green
Rep Rate (HZ) = 10-
Spot (mm) = 2.0mm
J/cm² = 4
Shots = 20
Name _____
Date ____/____/____
Total Shots = 57
Flash # = 365920
End Treatment

D. If the Medlite is turned off from the "Ready" mode using either the key switch, the emergency off button, or the circuit breaker on the rear panel, all treatment data stored in the microprocessor is lost. Be sure to return the system to the "Standby" mode and wait for the printer to complete its print out before turning off the laser.

E. Changing the Printers Paper

When the paper supply is low, a red line will appear on both edges of the print out. This is a good time to change the printer paper. When the printer paper roll is empty, a red light on the printer will flash.

The Medlite is supplied with an extra box of printer paper. The box contains five rolls. Additional rolls can be purchased from your local sales representative or my calling Continuum Biomedical directly.

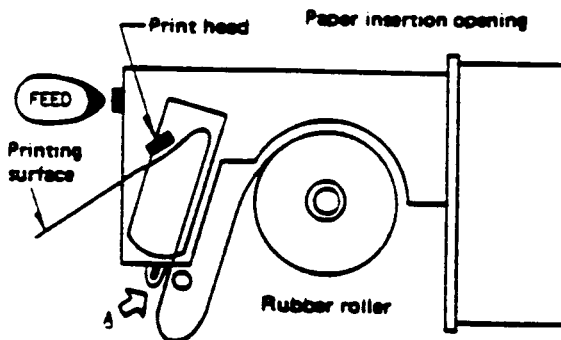
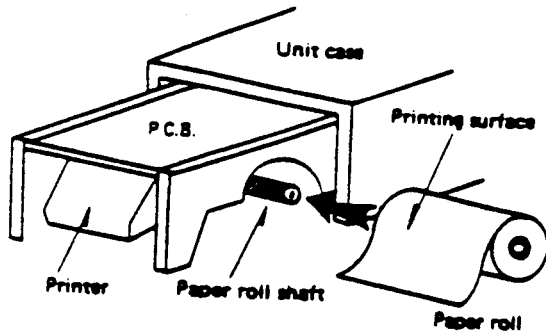
The paper roll is set inside the unit. To change the paper, turn off the key switch and gently press the hook for removing the front panel, remove the panel, and pull out the printer.

The outside and inside surfaces of the paper are different. The printing surface is the outside. Set the paper roll on the shaft as shown in Figure 9.

Gently push the paper face down into insertion opening A in Figure 9. Keep pressing the feed switch until the paper comes out from the print head.

When the paper from the print head has come out from the paper cutter, replace the front panel of the units.

If the paper is not pulled in by the rollers even when you press the feed switch, push the paper in the front cover of the printer. Slide the printer out, remove the cardboard roller. Next insert the new roll, unwrap a small piece of the new paper, insert it through the printer rollers. Turn on the key switch. The printer should automatically pull the paper through the rollers.



**Printer Paper Replacement
Figure 9**

VIII. Articulated Arm

A. Using the articulated arm.

Before using the articulated arm in a treatment, the arm must be unfolded. First release the arm from the clasp holding the arm to the laser cabinet. See figure 3 for the location of this clasp. The clasp is released by pulling upward and rotating the top portion approximately one quarter turn. Carefully lift the arm from the clasp.

Now the arm must be released from its clamp. The clamp is located on the arm and allows it fold up upon itself. the two supports on the clamp are labeled "Tube down" and tube Up". Gently remove the arm from the clamp. the arm is now ready for use.

The various accessories are easily screwed into the output end of the articulated arm. See section XII on the treatment of these accessories.

B. Mirror Inspection.

The articulated arm is used to transmit the laser pulses from the laser cabinet to the patient. It consists of a series of seven mirrors located at the various knuckles. these mirrors should be inspected by a qualified service technician every three months. Contact Continuum Biomedical for information on replacement mirrors.

C. Mirror Removal.

A 5/64" Allen key is needed to remove the two screws holding the mirrors to the arm. Using your thumb, press firmly on the back of the mirror holder. Release both retaining screws before releasing your thumb. Carefully pull the mirrors back from the arm and inspect the reflecting surface. Replace the mirror avoiding any touching of the reflective surface. There is no preferential orientation of the mirrors on the three outermost knuckles. The four mirrors on the inner knuckles have a required orientation. Note the orientation prior to removing the mirror, and replace the mirrors using the same orientation.

IX. Foot Switch

The foot switch, which plugs into the rear of the Medlite system has three positions.

A. The first position is the normal setting for the foot switch. The switch is not activated and no laser emission is available

B. The second position is used to emit a single pulse of laser light from the hand piece. The foot switch is depressed slightly (approximately half way between fully

opened and fully closed) to activate the second position, producing a single pulse of laser emission. If the foot switch is not released, a audible tones occurs. The tones cease when the foot switch is released.

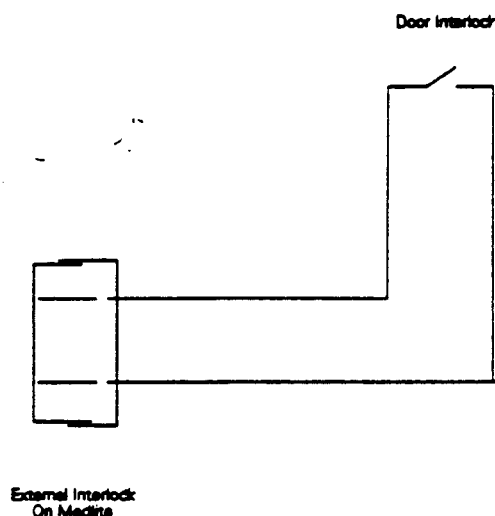
C. The third position is used to emit a continuous sequence of laser light pulses from the hand piece. The foot switch is fully depressed downward. If it is depressed to this third position and held down for less than 1 second, only a single laser pulse is emitted. If the foot switch continues to be held down, laser pulses are emitted from the hand piece in a continuous mode at the current repetition rate setting until released.

D. If the foot switch is depressed and the laser is switched from "Standby" mode to "Ready" mode, a fault is detected. The laser will emit a tone for five seconds. If the foot switch is not released during the tone, the laser will turn itself off and the appropriate error code will appear on the front panel. See section XVI for additional information on error codes.

X. External Interlock

The external interlock is located on the rear control panel. It is provided to enable the operator to connect an interlock on an entranceway to the Medlite. When opened, this interlock would turn off the power to the Medlite.

The external interlock on the Medlite consists of a two wire male pin connector. The pins are energized to 24 Volts DC. The two pins on the female mating connector which is installed on the laser are connected together by a short wire. The operator can either disconnect this short wire and used the provided female connector or Continuum Biomedical will provide an unwired female plug for this interlock upon request. Figure 10 shows the recommended connection procedure for this external interlock.



External Interlock
Figure 10

XI. Water Cooling System

The cooling system must be filled with de ionized water. Failure to use de ionized water may result in equipment failure and invalidate the warranty. The system may not be filled with any concentration of ethylene glycol. Only a qualified service technician should either fill or drain the water cooling system.

The cooling system must be drained if the Medlite is subjected to temperatures below the freezing point of water. The system can be drained by inserting a hose into the water cooling containment bottle located at the rear of the laser. The water is then siphoned into a container and discarded. Do not reuse this water in the Medlite. If the system is subjected to temperatures below the freezing the point of water, and the water has not been thoroughly drained from the system, the warranty is invalidated.

XII. Accessories

A. Laser Safety Eye Wear

The Medlite is supplied with four pair of laser safety eye wear manufactured by UVEX. These eye wear should remain with the laser at all times, and should be worn by everyone present during laser treatment. If laser safety eye wear provided by other manufacturers for their products are present with the Medlite, the user is strongly recommended to check the goggles prior to treatment to assure that no mixing of the eye wear has occurred.

1. L332CB. One of these goggles is provided with the system. The OD at 1064nm is 6+ and at 532nm is 7+. The goggle meets ANSI standards Z136.1. This goggle should be worn by the patient.

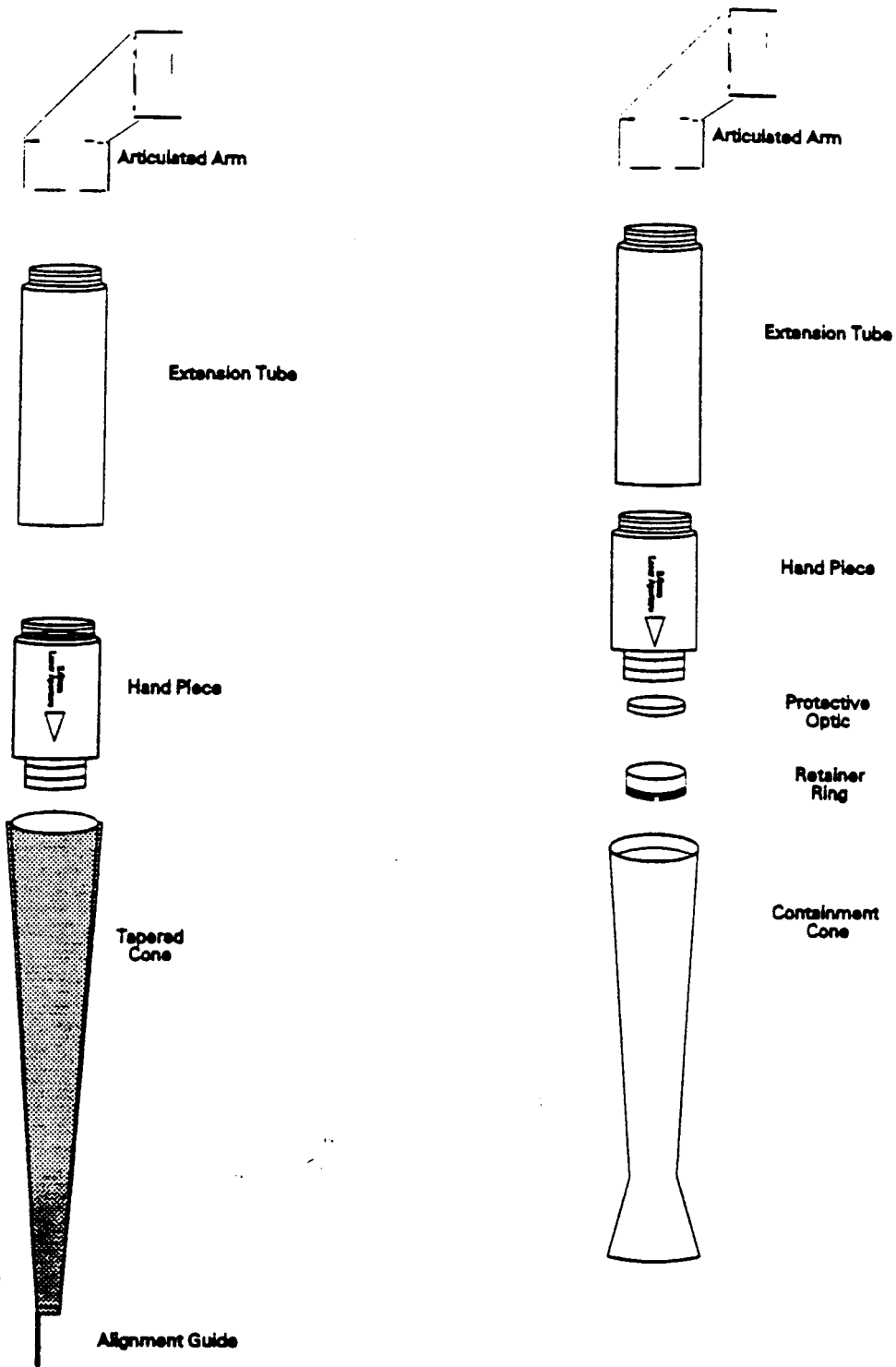
2. LPG-YAG/KTP.. Two of these goggles are provided with the system. The OD at 1064nm is 5+ and at 532nm is 4-5. The goggle meets ANSI standards Z136.1.2.3 This goggle should be worn by either the operator or anyone else present in the treatment room.

3. LPS-YAG/KTP. One of these spectacles is provided with the system. The OD at 1064nm is 5+ and at 532nm is 4-5. The goggle meets ANSI standards Z136.1.2.3 These spectacles should be worn by either the operator or anyone else present in the treatment room. Personnel who require vision corrective eye wear such as glasses should not wear these spectacles.

B. Hand Pieces. The hand pieces shown in figure 10 are used to focus the laser light onto the treatment tissue. Both a 2.0mm and a 3.0mm hand piece are provided as part of the Medlite. The size is engraved into each hand piece. One end of the hand piece screws into the articulated arm. The cone screws into the other end. Tissue from a treatment may collect on the lens of the hand piece. Consequently, the hand piece should be inspected after each patient. The lens can be cleaned using a cotton swab and normal lens cleaning solution.

C. Cones. There are two types of cones. One is the tapered cone and the other is the containment cone. They are shown in figure 10 mounted to the output end of the hand pieces. The extended tip on the end of the cones is designed to press against the patient. This insures the spatial diameter of the treatment pulse is true spot size for the hand piece. For more information on true spot size, see section XIV.

Since the containment cone and the tip of the tapered cone contacts the patient, the cones must be sterilized using an autoclaving procedure after every patient. Use the normal autoclaving cycle of 30 minutes at 125 °C followed by a 30 minute dry time.



Hand Pieces & Cones
Figure 11

Technical Description

Continuum Biomedical will make available on request circuit diagrams, component part lists, descriptions, calibration instructions, or any other information which will assist the User's appropriately qualified technical personnel to repair those parts of the Medlite which are designated by Continuum Biomedical as repairable.

XIII. Specifications

Laser Parameters

Laser Material:	Nd:YAG Rod; 6mm diameter; 4.5" long
Wavelengths:	1064nm & 532nm
Pulse Energy Density:	≤ 12 Joules/cm ² @1064nm with 2.0mm Hand Piece ≤ 8 Joules/cm ² @1064nm with 3.0mm Hand Piece. ≤ 5 Joules/cm ² @532nm with 3.0mm Hand Piece ≤ 5 Joules/cm ² @532nm with 2.0mm Hand Piece Measurements recorded at output end of articulated arm.
Repetition Rate:	1Hz, 2Hz, 5Hz, 10Hz, Single Shot
Spot Size (nominal):	2.0mm, 3.0mm
Pulse Duration	6 ±1 nsec.
Beam Delivery	Articulated Arm
Output Mode	Gaussian Distribution (Approximately)
Safety Goggles:	OD > 4.0 @ 532nm and 1064nm. Glass or Poly Carbonate

Physical Parameters

Dimensions:	Height: 34" (Not including Articulated Arm) Width: 16" Depth: 34" (Includes Handle)
Hand Piece Lens (fl):	200mm. fl: 2.0mm hand pieces. 250mm. fl : 3.0mm hand piece
Hand Piece Material	Anodized Aluminum or Plastic
Articulated Arm:	0.75" and 1.0" Diameter Mirrors. Total 7 Mirrors.
Articulated Arm:	Length fully extended > 4 feet.
Wheels:	4" diameter; Hard Rubber; All wheels swivel 360°.
Weight (approximate):	250 pounds
Operating Voltage:	120 Volts +/- 10% or 220 Volts +/- 10%
Operating Current:	12 Amps Max. @120V; 6 Amps Max. @ 220V
Operating Frequency:	50 or 60Hz.
Leakage current:	< 100 micro amperes
Operating Temperature:	50°F to 85°F
Operating Humidity:	10% to 95%

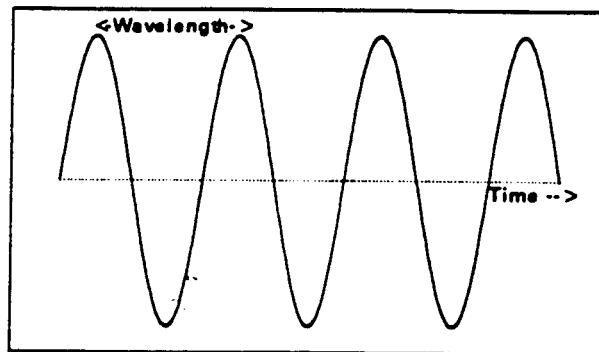
XIV. Physics of the Q-Switch NdYAG Laser

The operation of the Medlite Laser System has been designed for the maximum of safety and convenience for both the physician and the patient. This section is provided to assist the operator in better understanding the internal operations of the Medlite system.

The first part of this section explains the nature of laser pulses, discusses energy and power definitions and serves as a general physics lesson. The second part discusses the fundamentals of a Q-Switch Nd:YAG laser and its frequency doubling capabilities. The third section discusses the microprocessor and its software used to operate the Medlite Laser system and control its output parameters.

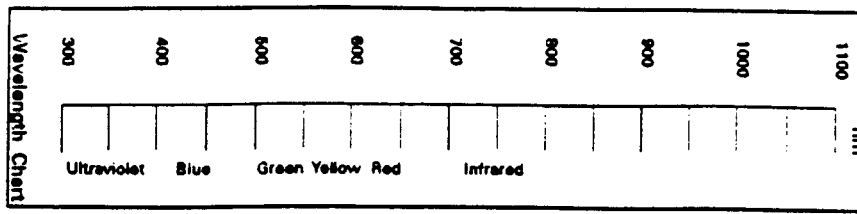
A. Fundamentals of Laser Light.

Lasers are categorized by the wavelength of their output and whether they are pulsed or continuous wave (cw). The wavelength of the light is the distance, measured in nanometers (nm), between the intensity peaks of the light as shown in Figure 12. A nanometer is 0.000,000,001 or 1×10^{-9} meters. The frequency of the light is the number of intensity peaks in one second. For green light the wavelength is approximately 500nm and the frequency is 60,000,000,000,000 or 6×10^{14} .



Waveform of Light
Figure 12

Figure 13 shows the relative wavelengths of various light colors. The wavelength of ultraviolet light is shorter than visible light while infrared light is longer. On a similar drawing showing frequency rather than wavelength, ultraviolet has a high frequency while infrared has a lower frequency.

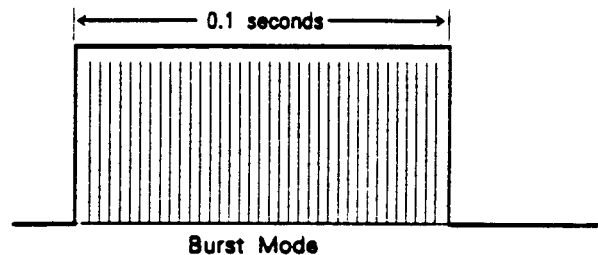


Wavelength Spectrum
Figure 13

The frequency of light multiplied by its wavelength is the speed of light, a constant number (3×10^8 meters per second.) Therefore doubling the frequency of the light, reduces the wavelength in half. The frequency doubler, called a second harmonic generator (SHG), used in the Q-Switched YAG laser reduces the infrared 1064nm light in half to 532nm.

In addition to wavelength, lasers are referred to as cw or pulsed. A cw laser produces a steady stream of light measured as average power in watts or kilowatts. A pulsed laser produces a burst of light followed by a period of no light. If repetitively pulsed, the burst repeats itself on a regular basis. The time between pulses is referred to as the interpulse period and the length of each pulse is called the pulse duration. The number of pulses per second is called the repetition rate.

The pulse duration is one for the main variables in pulsed laser. Long pulses generally last for a few milliseconds (10^{-3} seconds). Short pulses are measured in nanoseconds (10^{-9} seconds.) In between is the range of microsecond (10^{-6} seconds) pulses. Q-Switch pulses produced by the YAG laser are generally 5 to 7nsec. long.



Laser Burst Mode Operation
Figure 14

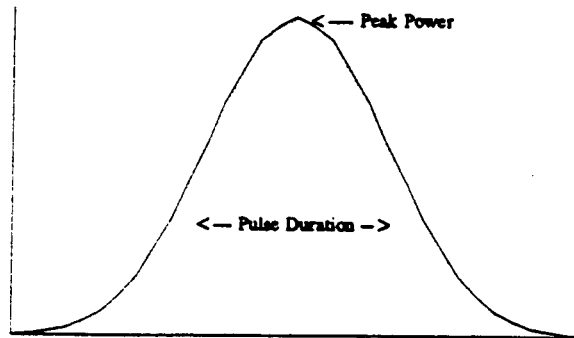
Sometimes lasers produce a burst of pulses. For example, a laser operating at 10kHz produces 10,000 pulses per second. If the laser is activated for 0.1 second, it will produce a burst of 1,000 pulses. This is referred to as operating the laser in a burst mode.

CW lasers are measured in terms of watts of output power. A watt is a measure of the "flow of energy" or power. The sum of this power over a period of time is the total energy measured in Joules. One Joule is one watt for one second. Since light can be represented as a stream of particles called photons. Each photon, depending upon the

wavelength of the light, has a specific energy. Photons with short wavelengths have more energy than photons of longer wavelength.

A watt is a measure of the number of photons multiplied by their energy striking a target at any one instant of time. A Joule is a measure of the total number of these photons striking the target over a period of time.

Figure 15 is a drawing of a laser pulse. The shaded area is the total energy or Joules contained in the pulse. The height of the pulse at any time is a measure of the instantaneous power measured in watts. For the YAG laser, the total of the shaded area is 0.1 to 0.5 Joules. The instantaneous power at the peak may be 30 Megawatts (MW).



Laser Pulse
Figure 15

The Medlite measures energy in a single pulse rather than the average power. At 10 pulses per second and a pulse energy of 0.3 Joules, the average power from the laser is 3 watts, the product of the pulse energy times the repetition rate. For a high repetition rate laser such as the KTP laser or the copper vapor laser, the pulse energy is approximately 0.0002 (much lower than the YAG laser). The repetition rate may be 15 kilohertz for an average power of 3 watts. When operated in a burst mode of 100 msec duration, the energy in each burst is the sum of the energies in each small pulse inside the burst envelope.

When the energy from a single pulse is focused to a circular spot, the energy density is often used to measure the output. This is the energy in a single pulse divided by the cross sectional area of the spot generated by the focusing lens. The unit of measure is the Joules/cm².

B. Nd:YAG Laser Fundamentals.

A Nd:YAG laser consists of three interconnected sections as shown in Figure 16. One is the power supply used to provide the proper voltage and current to the laser system. the second is the water cooling system used to remove heat from the power supply and the YAG rod located in the third section, the optical bench.. Figure 17 is a diagram of the optical bench consisting of the YAG rod and flash lamp, various mirrors, lenses, the frequency doubler and the articulated arm.

A high voltage electrical pulse from the power supply excites the flash lamp which emits a broad spectrum of light in the ultraviolet and visible. The YAG rod absorbs most of this light and releases the energy as laser light at 1064nm.

The light intensity builds up inside the laser cavity between the Gaussian output mirror and the high reflector. The Q-Switch and the polarizes act as valve preventing the light from leaving the cavity by controlling its polarization. In the absence of the Q-Switch the light would be emitted in a pulse matching the temporal profile of the flash lamp pulse.

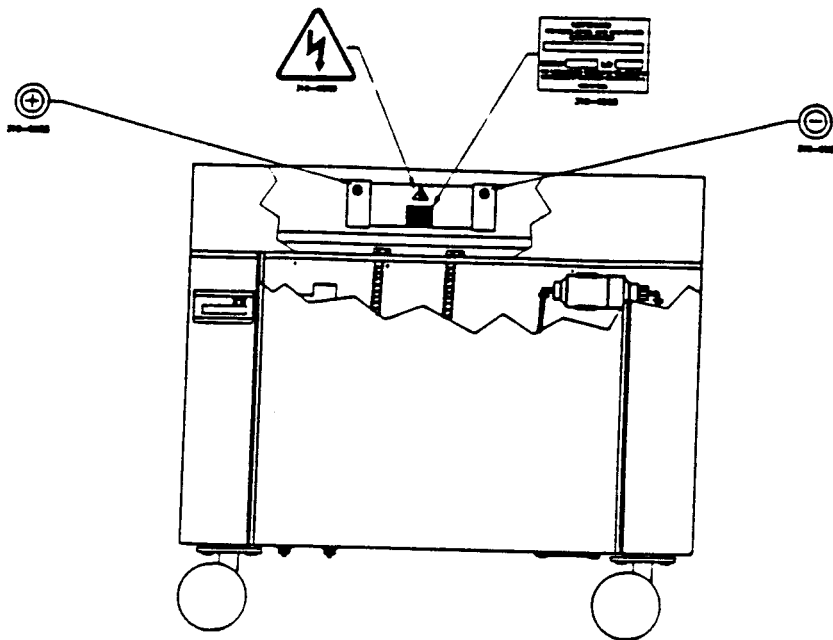
A short voltage pulse applied to the Q-Switch suddenly opens the cavity allowing the light pulse to escape in a length time equal to the time it takes light to make a few round trips inside the cavity. The resulting pulse is 8 to 10 nsec long and very intense.

The Q-Switch or Pockel Cell operates at slightly above room temperature. For best operation, the cell should be stabilized at its operating temperature. If power to the Medlite has been removed, a 20 minute warm up time is required to insure that the Pockel cell is stable at its operating temperature.

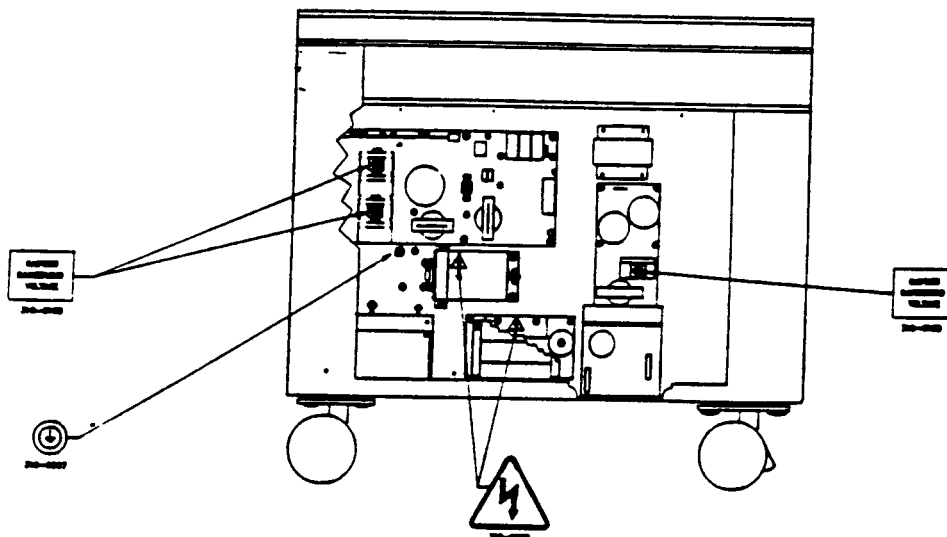
Following the release of the light pulse from the cavity, the Q-Switch is reset and the system awaits the next pulse from the power supply.

The YAG rod and cavity operate above room temperature as they are heated by the pulses. Ten to fifteen minutes of operation is required to stabilize these elements. These components remain at this steady state temperature since, in the Medlite Laser System, the flash lamp is always operating at 10 pulses per seconds or Hertz. The pulse rate does not vary with the repetition rate selected on the Display Panel. This ensures the temperature of the YAG rod and the cavity remain constant.

The repetition rate of the Q-Switch, however, is controlled by the Display Panel. It can be set to operate at 1, 2 ,5 or 10 pulses per second or in a "single shot mode. If the Q-Switch is not triggered during a flash lamp pulse, the light energy inside the laser cavity decays and no pulse is emitted. If the Q-Switch is triggered, a laser pulse is emitted.



COOLING GROUP VIEW



POWER SUPPLY VIEW

**Laser Subsystems
Figure 16**

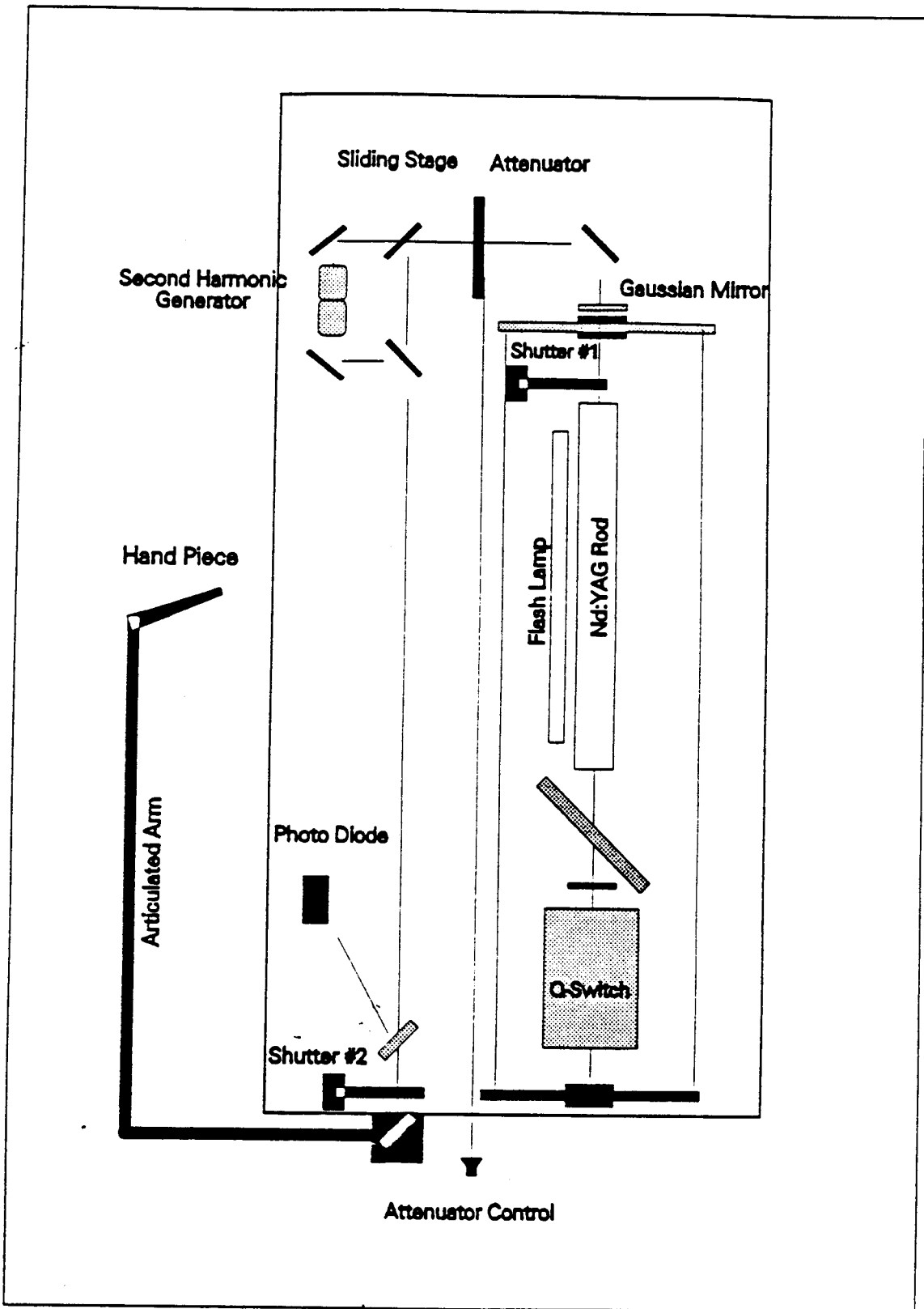
The pulse of light is directed at a right angle from the laser cavity to the color selection optics. When the Medlite is set for the RED mode, a steering mirror directs the beam to the articulated arm, bypassing the frequency doubling crystal or second harmonic generator (SHG). In the GREEN mode, however, the steering mirror is backed out of the beam path and the 1064nm light passes through the SHG and is converted to green light at 532nm. A different set of steering optics direct the green light to the articulated arm.

The second harmonic generator is a solid crystal operating at slightly above room temperature. Consequently, it contains a small electrical heater and requires eight to ten minutes to stabilize. Since the heater consumes almost no power, it is on all the time as long as the circuit breaker on the rear of the Medlite is in the on position.

The beam diameter is approximately 5mm corresponding to the diameter of the YAG rod. It is very collimated and should be directed through the articulated arm without blockage. The optics in the arm are coated for high reflectivity and low loss at both 532nm and 1064nm. Because of the high pulse intensity of the laser emission, any contamination on these optics will destroy the coatings reducing significantly the laser power. It is important to avoid getting dirt, lint or any other particles on these optics.

At the end of the arm, a lens in the hand piece focuses the beam to the desired spot size. Two hand pieces are provided. Both are for the 1064nm light and the 532nm light. The same lens can be used at both wavelengths although the light is focused to a slightly different size spot.

The cooling system in the YAG laser is used to remove heat from the power supply and the YAG rod enclosure. A heat sensor on the Rod enclosure protects the system in the event the cooling system fails.



Optical Bench
Figure 17

XV. Medlite Calibration

The Medlite utilizes a calibrated photo diode for determining the pulse energy density of the system. It is important that the calibration be correct and that it be checked on a periodic basis by a company trained service representative. Continuum Biomedical recommends testing the calibration of the Medlite every three months.

A. Spot Size

Before starting the calibration procedure, an understanding of the spot size is important. The spatial profile of the Medlite pulse is approximately Gaussian. consequently the true spot size used to calculate the energy density is less than the spot size shown on the front panel. The true spot size is the diameter of a hole through which 82% of the laser energy passes. The front panel spot size is the diameter of the beam measured using thermal burn paper.

The true spot size is recorded in the Medlite's microprocessor at the factory and is recorded on the Installation report presented in this manual.

The cross sectional area used to compute the energy density uses the true spot size. This area is πr^2 where r is the radius in centimeters of the true spot size. (10 millimeters equals 1 centimeter). The radius is the diameter divided by 2. The unit of the spot size is cm^2 .

B. Pulse Energy

The pulse energy measured in Joules is the average power divided by the repetition rate. For example, a 4.5 watt average power laser operating at 10 pulses per second produces 0.45 Joules or 450 milliJoules per pulse. At 5 pulses per second, the average power would be 2.25 watts for the same pulse energy.

C. Energy Density

The pulse energy density is computed by dividing the energy per pulse by the area of the true spot size. The microprocessor performs this calculation and displays the energy density on the front panel.

D. Calibration

To check the calibration of the Medlite, a laser power meter is required. Continuum Biomedical is prepared to recommend several makes and models of power meters. To check the calibration, follow this procedure. Remember laser safety goggles must be worn by everyone in the vicinity of the laser.

1. The Medlite should be in the Ready mode.

2. Remove the hand piece from the output end of the articulated arm.
3. Position the articulated arm and power meter such that the laser output from the arm impacts the absorbing surface of the power meter. The average power is measured by depressing the foot switch and operating the Medlite into the power for several seconds, allowing the power meter to stabilize. Record the average power and the energy density as displayed on the front panel. Using the chart on the following page, compare the energy density displayed on the front panel with the energy density shown in the chart. The two densities should be within $\pm 20\%$. If they are outside this range, either call your local service representative or follow the instructions on the articulated arm to check for any damage to the mirrors.
4. Rotate the power attenuator control and repeat step 3 for a variety of output energies.

Pulse Energy (mJoules)	100	125	150	175	200
Spot Size (mm)	Energy Density J/cm ²	Energy Density J/cm ²	Energy Density J/cm ²	Energy Density J/cm ²	Energy Density J/cm ²
1.7	4.4	5.5	6.6	7.7	8.8
1.8	3.9	4.9	5.9	6.9	7.9
1.9	3.5	4.4	5.3	6.2	7.1
2.0	3.2	4.0	4.8	5.6	6.4
2.1	2.9	3.6	4.3	5.1	5.8
2.2	2.6	3.3	3.9	4.6	5.3
2.3	2.4	3.0	3.6	4.2	4.8
2.4	2.2	2.8	3.3	3.9	4.4
2.5	2.0	2.5	3.1	3.6	4.1
2.6	1.9	2.4	2.8	3.3	3.8
2.7	1.7	2.2	2.6	3.1	3.5
2.8	1.6	2.0	2.4	2.8	3.2
2.9	1.5	1.9	2.3	2.6	3.0
3.0	1.4	1.8	2.1	2.5	2.8
3.1	1.3	1.7	2.0	2.3	2.6
3.2	1.2	1.6	1.9	2.2	2.5

Pulse Energy (mJoules)	250	300	350	400	450
Spot Size (mm)	Energy Density J/cm ²	Energy Density J/cm ²	Energy Density J/cm ²	Energy Density J/cm ²	Energy Density J/cm ²
1.7	11.0	13.2	15.4	17.6	19.8
1.8	9.8	11.8	13.7	15.7	17.7
1.9	8.8	10.6	12.3	14.1	15.9
2.0	8.0	9.5	11.1	12.7	14.3
2.1	7.2	8.7	10.1	11.5	13.0
2.2	6.6	7.9	9.2	10.5	11.8
2.3	6.0	7.2	8.4	9.6	10.8
2.4	5.5	6.6	7.7	8.8	9.9
2.5	5.1	6.1	7.1	8.1	9.2
2.6	4.7	5.6	6.6	7.5	8.5
2.7	4.4	5.2	6.1	7.0	7.9
2.8	4.1	4.9	5.7	6.5	7.3
2.9	3.8	4.5	5.3	6.1	6.8
3.0	3.5	4.2	4.9	5.7	6.4
3.1	3.3	4.0	4.6	5.3	6.0
3.2	3.1	3.7	4.4	5.0	5.6

XVI. Medlite Error Codes

This section describes the various error messages which may appear on the Front Panel in the event of a system fault. These messages appear as the letters "ER" in the Energy Density Indicator and a number of the repetition rate indicator. The numbers assist the service personnel in diagnosing the problem.

Er 01 Interlock not connected. The external interlock is not connected on the back of the unit.

Er 02 Coolant flow interrupted. Coolant flow switch detected lack of flow while the coolant pump was running.

Er 03 Coolant over temp. The temperature of the coolant has exceeded the maximum limit.

Er 04 Laser head interlock or fail. Laser head has exceeded the maximum temperature or the cavity cover interlock has been defeated.

Er 06 End of charge not detected. While firing the flash lamp the flash lamp supply has failed to recharge the flash lamp capacitors.

Er 07 Simmer supply not working correctly. Simmer supply has failed to keep the flash lamp simmered.

Er 08 Flow switch error. Flow switch was showing flow when the coolant pump was not on.

Er 09 Arm shutter not moved. The arm shutter feedback sensor has not detected a change in shutter position after the controller has told it to move.

Er 11 Sliding Stage Fault. The sensor has detected a faulty or incomplete move of the sliding stage.

Er 16 Serial port communications error. The Medlite controller has detected a bad data stream in the RS-232 serial communications port.

Er 17 Key board switch or foot switch error. A key is stuck on the keypad or the foot switch is held on in an illegal state.

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Date: April 15, 1993

Operation and Maintenance Manual Medlite Laser System

Continuum Biomedical, Inc.
547 Rhea Way
Livermore, CA 94550
800/532-1064 or 510/606-6118

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- I. Safety**
- II. Specifications**
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- IV. Detailed Operating Procedures**
- V. Installation**
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- VIII. Physician Information Statement**
- IX. Spare Parts**

I. Safety

CAUTION

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Laser Safety Precautions

Continuum's user information is in compliance with section 1040.10 of 21 CFR Chapter I, Subchapter J concerning Radiological Health published by U.S. Department of Health & Human Services Center for Devices & Radiological Health,, 1988.

The following safety precautions are to be read and observed by anyone working with the laser.

1. Wear laser protective eye wear of sufficient optical density and suitable wavelength to protect the eyes from the maximum energy produced.
2. Never look directly into a laser beam or its reflection. Permanent damage to the eye can occur.
3. Keep all unnecessary personnel out of the treatment room.
4. Remove all shiny reflective objects such as rings watch bands and metallic pencils from the patient and the operating physician.
4. Never depress the foot switch without verifying the safe orientation of the articulated arm and attached hand piece.

5. Never leave the laser in a **STANDBY** or **READY** mode unattended. Turn laser off and remove **KEY** when not in use.

6. Never allow any untrained individual to operate the Medlite Laser System unless directly supervised by a trained, experienced physician.

7. Never attempt to remove the protective covers of the laser cabinet. Allow only a factory authorized service technician or representative to remove any of the protective covers on the laser.

8. Call **Continuum Biomedical** at **1-800-532-1064** for further information on any safety features of the Medlite Laser system.

The following safety labels are used on or in the Medlite Laser Safety. Refer to the accompanying diagrams for their location.

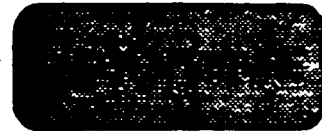
Visible and/or invisible laser radiation when open.
AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION.

Item 1

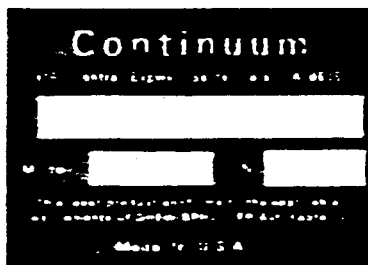
Found on side of bench under cover interlock switches.

Invisible and/or visible laser radiation inputs through this aperture.

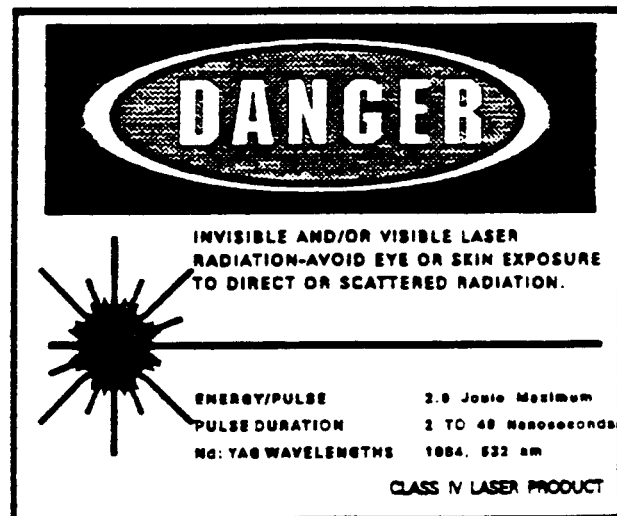
Item 2



Item 2b



Item 3



DANGER

INVISIBLE AND/OR VISIBLE LASER RADIATION-AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION.

ENERGY/PULSE	2.0 Joule Maximum
PULSE DURATION	2 TO 40 Nanoseconds
WAVELENGTHS	1064, 532 nm

CLASS IV LASER PRODUCT

Item 4

CAUTION - HIGH VOLTAGE
Before working on this unit
-Switch off power unit
-Disconnect all power plugs

Item 5
Found on rear panel

CAUTION
HIGH VOLTAGE

Item 6
Found inside Medlite on heat sinks,
capacitors & 24V power supplies.

CAUTION
**HIGH VOLTAGE/
HIGH CAPACITANCE**
Unit contains potentially
lethal electrical charge

BEFORE WORKING ON UNIT
-Disconnect unit from wall plug.
-Wear insulated gloves
-Short capacitors to ground
(see operating manual)

Item 7
Found on Rear panel

DANGER
Visible and invisible laser radiation
when open and interlock defeated.
**AVOID EYE OR SKIN EXPOSURE TO
DIRECT OR SCATTERED RADIATION**

Item 8

CAUTION
Federal law restricts this device to
sale by or on the order of a
physician.

Item 9

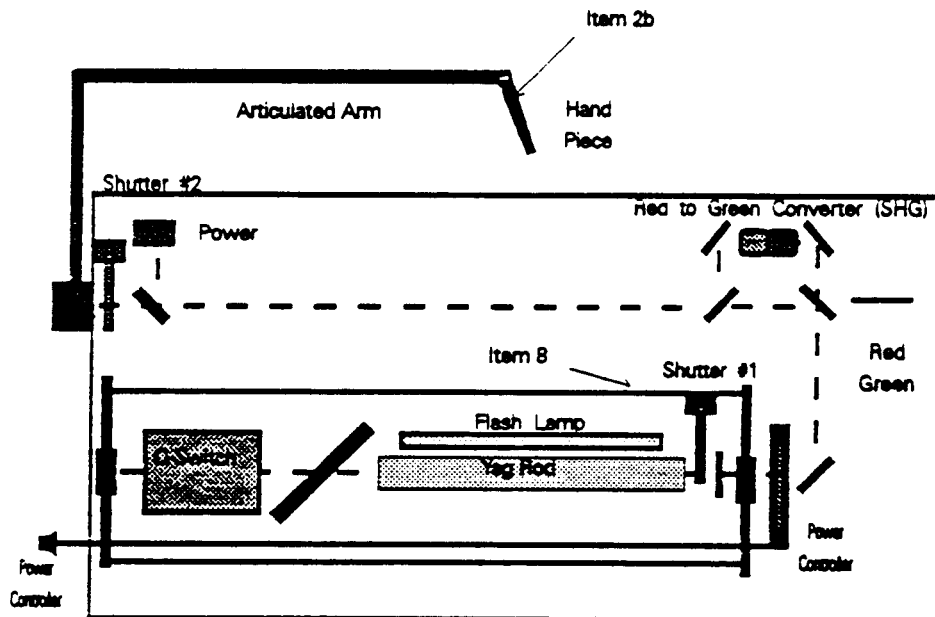
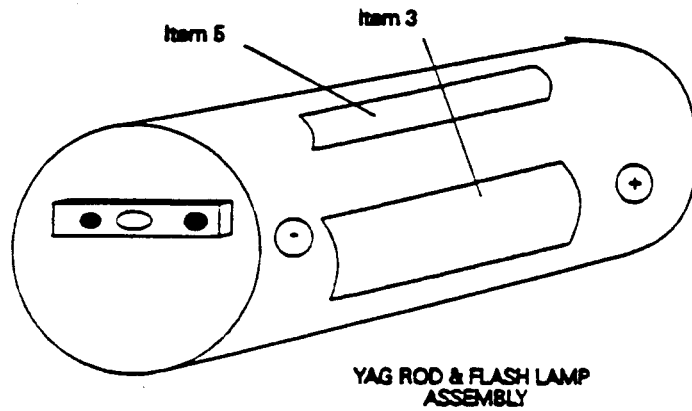
DANGER

INTERLOCK DEFEATED
Visible and/or invisible laser
radiation when open.
Avoid eye or skin exposure to
direct or scattered radiation.



INTERLOCK DEFEAT BRACKET

Figure 4b
Label Page 2



Overview of laser bench

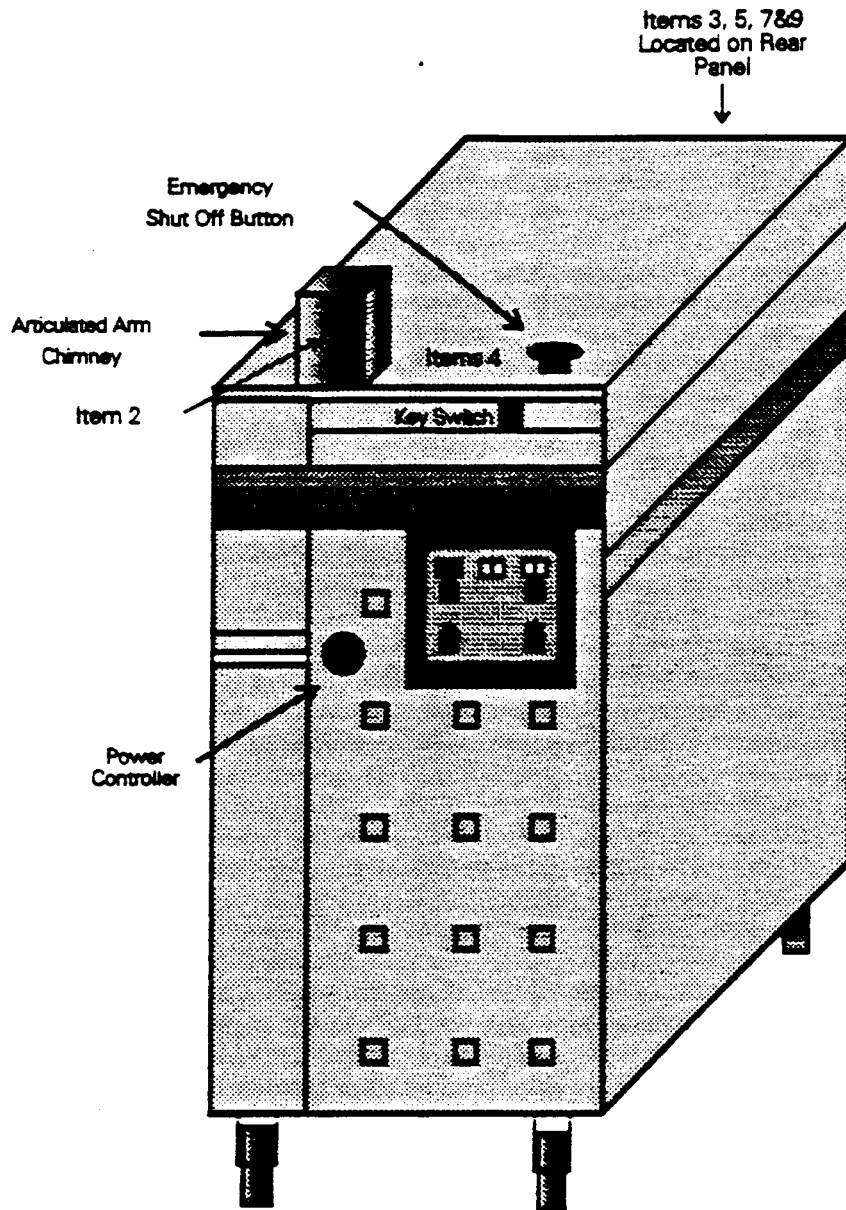


Figure 3
Label Location Guide
Medlite Unit

II. SPECIFICATIONS

Laser Parameters

Laser Material:	Nd:YAG Rod; 6mm diameter; 4.5" long
Excitation Source:	Flash lamp
Wavelengths:	1064nm & 532nm
Pulse Energy:	300mJ maximum @ 1064nm; 140mJ maximum @ 532nm. Measured at output of Articulated Arm.
Repetition Rate:	1Hz, 2Hz, 5Hz, 10Hz, Single Shot
Spot Size:	1.5mm, 2.0mm, 3.0mm
Safety Goggles:	OD > 4.0 @ 532nm and 1064nm. Glass or Poly Carbonate

Physical Parameters

Dimensions:	Height: 34" (Not including Articulated Arm)
	Width: 16"
	Depth: 34" (Includes Handle)
Hand Piece Lens (fl):	200mm. fl: 1.5mm & 2.0mm handpieces. 250mm. fl : 3.0mm handpiece
Hand Piece Material	Anodized Aluminum or Plastic
Articulated Arm:	0.75" and 1.0" Diameter Mirrors. Total 7 Mirrors.
Articulated Arm:	Length fully extended >4 feet.
Wheels:	4" diameter; Hard Rubber; All wheels swivel 360°.
Weight:	250 pounds
Operating Voltage:	120 Volts +/- 10% or 220 Volts +/- 10%
Operating Current:	12 Amps Max @120V; 6 Amps Max @ 220V
Operating Frequency:	50 or 60Hz.
Leakage current:	< 100 microamperes
Operating Temperature:	50°F to 85°F
Operating Humidity:	10% to 95%

III. STANDARD OPERATING PROCEDURE

Ensure that the proper Laser Safety Goggles are available for all personnel in the Treatment room.

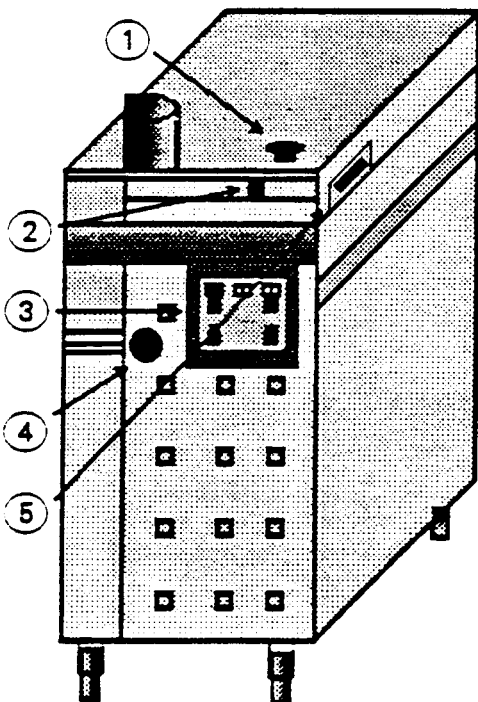
Note: Red Button on top of laser is for Emergency Shutdown.

Note: Red Button on top of laser should be released into "ON" position.

Note: Circuit Breaker on read off laser should be in "ON" Position.

Note: Letters "OFF" should be displayed on Front Panel.

Note: Put Laser Safety goggles on all personnel in treatment room.



MEDLITE FRONT PANEL FUNCTIONS

- 1. EMERGENCY SHUT OFF BUTTON.**
Pressing down on this button shuts off all power to the system. A slight twisting of the button is required to release it before system can be restarted.
- 2. KEY SWITCH.**
Using key, turn switch counterclockwise to start the laser. Turn key clockwise to turn laser off. Remove key and store in secure locations when Medlite not in use.
- 3. DISPLAY PANEL**
Functions on the DISPLAY PANEL are used to control the operating parameters of the Medlite laser system. Refer to section entitled "MEDLITE DISPLAY PANEL FUNCTIONS" for an explanation of each feature.
- 4. POWER ATTENUATOR**
Rotating this knob controls the laser power and the pulse energy. A clockwise rotation increases the power. A counterclockwise rotation decreases the power. This control knob is used to set the Energy Density to the desired level for the treatment.
- 5. PRINTER**
The printer records on thermal paper the patients name, the date, the total number of pulses used in the treatment at each energy density setting and the sum of pulses at all energy densities. See the section entitled "PRINTER FUNCTIONS" for more detail.

A. Daily Start-up Procedure

1.. Turn key switch clockwise to the ON position.

a. Installed software version is displayed on Front Panel. Versions "SR 1.1" and "SR 1.2" are currently available

b. Countdown from 8 to 1 begins on Front Panel.

c. "Standby" Light comes on.

d. Allow the system 8 to 10 minutes to stabilize.

2. Using the Display Panel.

a. Set desired laser emission wavelength by pressing keypad located below the GREEN and INFRARED indicators.

b. After a short delay, a flashing GREEN or INFRARED indicator will occur if the wavelength is changed.

c. Depending on selected wavelength, either GREEN or INFRARED indicator will be lit.

4. Begin Calibration Procedure.

a. Press Ready Button - "Ready" light will start flashing and the repetition rate will display "CA" to indicated calibration mode.

b. Using the Display Panel:

i. Input repetition rate by pressing blue key pad located below "Repetition Rate" indicator LED.

ii. Input spot size by pressing blue key pad located below "Spot Size" indicator LED.

Spot size should match handpiece spot size.

iii. "Energy Density" LED displays Pulse Energy Density.

iv. Using the Power Control Knob located on the front of the Medlite system, set the Pulse energy density to the desired level.

v. Steps i, ii and iv will force the Medlite to calibrate the energy display.

5. Listen for Short Beep sound.

a. Ready Light on steady.

b. Laser Light is available at hand piece when Footswitch is depressed.

c. When ready to treat patient, press and hold down foot switch. A single pulse is emitted if the foot switch is pressed half way closed. Pulses at the preset repetition rate are emitted if the foot switch is pressed entirely closed.

d. Release footswitch when treatment is completed.

B. Daily Shutdown Procedure

1. Turn key switch clockwise to OFF position.

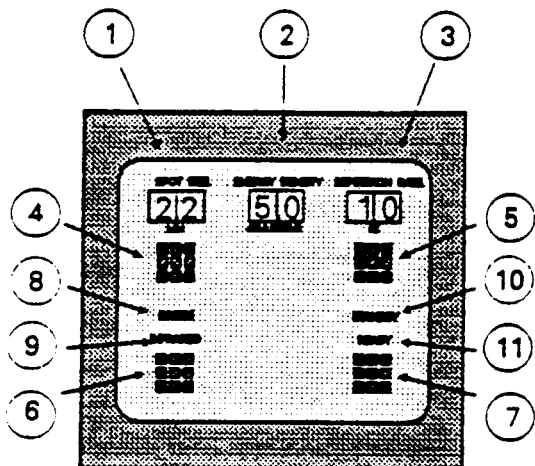
2. Secure Articulated Arm using Black holder located on top rear of the Medlite unit.

MEDLITE FRONT PANEL FUNCTIONS

1. SPOT SIZE DISPLAY

Indicates diameter of spot at output end of hand piece. Size is set by operator using press pad #4.

Operator should verify Spot Size on DISPLAY agrees with Spot Size label on hand piece. The following spot sizes can be set by the operator: 1.5mm and 2.0mm.



Medlite Front Panel

2. ENERGY DENSITY DISPLAY

Indicates energy density in Joules/cm² at end of hand piece.

Energy density is calculated by microprocessor based upon the energy per pulse and the spot size.

The energy density is the energy per pulse divided by the cross sectional area of the spot.

3. REPETITION RATE DISPLAY

Indicates the repetition rate set by the operator using the press pad #5.

The following repetition rates can be set: 1, 2, 5, 10 pulses per second (Hz).

4. SPOT SIZE PRESS PAD

Press this pad to toggle through the various programmed spot sizes.

The available spot sizes are 1.5mm and 2.0mm.

5. REPETITION RATE PRESS PAD

Press this pad to toggle through the various programmed repetition rates. The available repetition rates are 1, 2, 5, 10 pulses per second (Hz). In software version 1.2, a calibration mode is available for the green light. This appears in the repetition rate readout when the system is in "READY" mode and the wavelength selector is on GREEN.

6. WAVELENGTH SELECTOR PRESS PAD

PRESS PAD

Press this pad to select either Green output at 532nm or infrared output at 1064nm.

7. SYSTEM STATUS PRESS PAD

Press this pad to toggle between STANDBY and READY mode.

Laser output is available only when system is in READY mode.

8. GREEN INDICATOR LIGHT

When lit, system is set to emit green laser output at 532nm.

9. INFRARED INDICATOR LIGHT

When lit, system is set to emit infrared laser output at 1064nm.

10. STANDBY INDICATOR LIGHT

When lit, system is in the STANDBY mode.

11. READY INDICATOR LIGHT

When lit, systems in the READY mode.

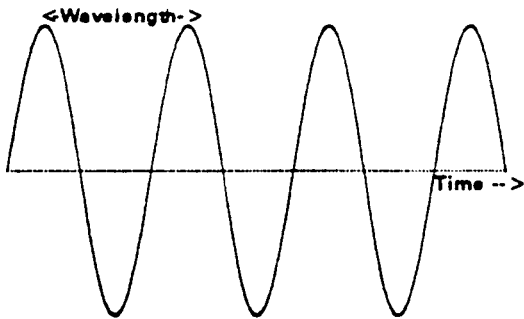
IV. DETAILED OPERATING PROCEDURES

The operation of the Medlite Laser System has been designed for the maximum of safety and convenience for both the physician and the patient. This section is provided to assist the operator in better understanding the internal operations of the Medlite system.

The first part of this section explains the nature of laser pulses, discusses energy and power definitions and serves as a general physics lesson. The second part discusses the fundamentals of a Q-switch Nd:YAG laser and its frequency doubling capabilities. The third section discusses the microprocessor and its software used to operate the Medlite Laser system and control its output parameters.

A. Fundamentals of Laser Light.

Lasers are categorized by the wavelength of their output and whether

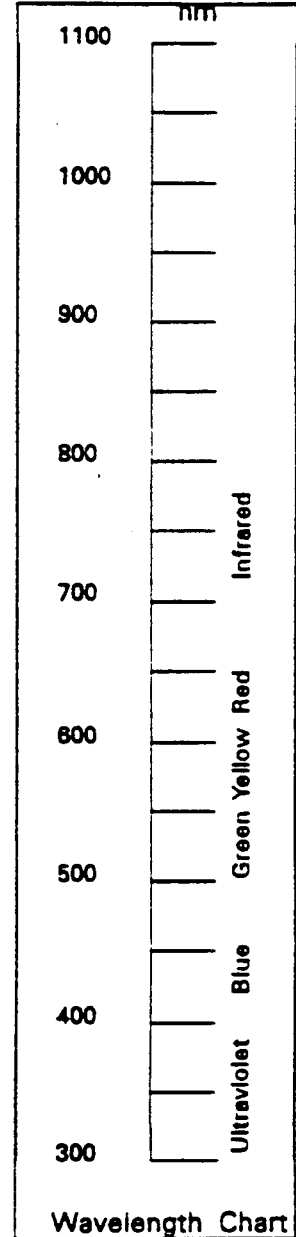


they are pulsed or continuous wave (cw). The wavelength of the light is the distance, measured in nanometers (nm), between the intensity peaks of the light as shown in the drawing. A nanometer is 0.000,000,001 or 1×10^{-9} meters. The frequency of the light is the number of intensity peaks in one

second. For green light the wavelength is approximately 500nm and the frequency is 60,000,000,000,000 or 6×10^{14} .

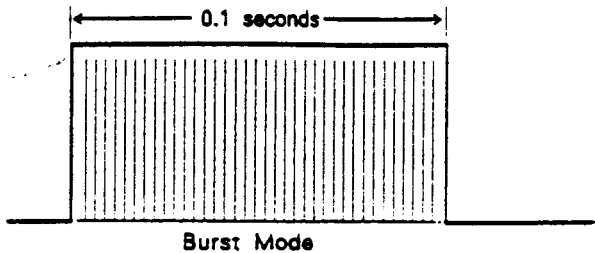
The drawing to the right shows the relative wavelengths of various light colors. The wavelength of ultraviolet light is shorter than visible light while infrared light is longer. On a similar drawing showing frequency rather than wavelength, ultraviolet has a high frequency while infrared has a lower frequency.

The frequency of light multiplied by its wavelength is the speed of light, a constant number (3×10^8 meters per second.) Therefore doubling the frequency of the light, reduces the wavelength in half. The frequency doubler, called a second harmonic generator (SHG), used in the Q-switched YAG laser reduces the infrared 1064nm light in half to 532nm.



In addition to wavelength, lasers are referred to as cw or pulsed. A cw laser produces a steady stream of light measured as average power in watts or kilowatts. A pulsed laser produces a

burst of light followed by a period of no light. If repetitively pulsed, the burst repeats itself on a regular basis. The time between pulses is referred to as the interpulse period and the length of each pulse is called the pulse duration. The number of pulses per



second is called the repetition rate.

The pulse duration is one of the main variables in pulsed laser. Long pulses generally last for a few milliseconds (10^{-3} seconds). Short pulses are measured in nanoseconds (10^{-9} seconds.) In between is the range of microsecond (10^{-6} seconds) pulses. Q-switch pulses produced by the YAG laser are generally 5 to 10 nsec long.

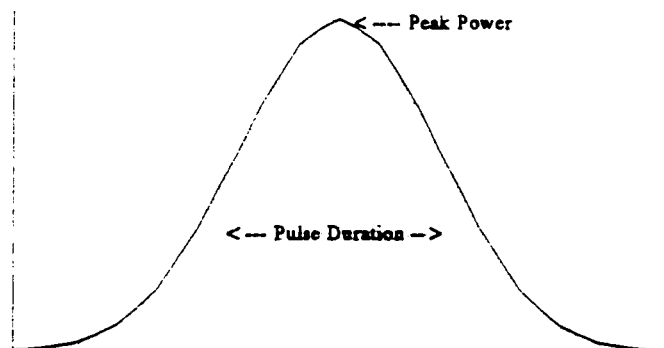
Sometimes lasers produce a burst of pulses. For example, a laser operating at 10 kHz produces 10,000 pulses per second. If the laser is activated for 0.1 second, it will produce a burst of 1,000 pulses. This is referred to as operating the laser in a burst mode.

CW lasers are measured in terms of watts of output power. A watt is a measure of the "flow of energy" or power. The sum of this power over a period of time is the total energy measured in Joules. One Joule is one watt for one second. Since light can be represented as a stream of particles called photons. Each photon,

depending upon the wavelength of the light, has a specific energy. Photons with short wavelengths have more energy than photons of longer wavelengths.

A watt is a measure of the number of photons multiplied by their energy striking a target at any one instant of time. A Joule is a measure of the total number of these photons striking the target over a period of time.

The figure below is a drawing of a laser pulse. The shaded area is the total energy or Joules contained in the pulse. The height of the pulse at any time is a measure of the instantaneous power measured in watts. For the YAG laser, the total of the shaded area is 0.1 to 0.5 Joules. The instantaneous power at the



peak may be 30 Megawatts (MW).

The Medlite measures energy in a single pulse rather than the average power. At 10 pulses per second and a pulse energy of 0.3 Joules, the average power from the laser is 3 watts, the product of the pulse energy times the repetition rate. For a high repetition rate laser such as the KTP laser or the copper vapor laser, the pulse energy is

approximately 0.0002 (much lower than the YAG laser). The repetition rate may be 15 kilohertz for an average power of 3 watts. When operated in a burst mode of 100 msec duration, the energy in each burst is the sum of the energies in each small pulse inside the burst envelope.

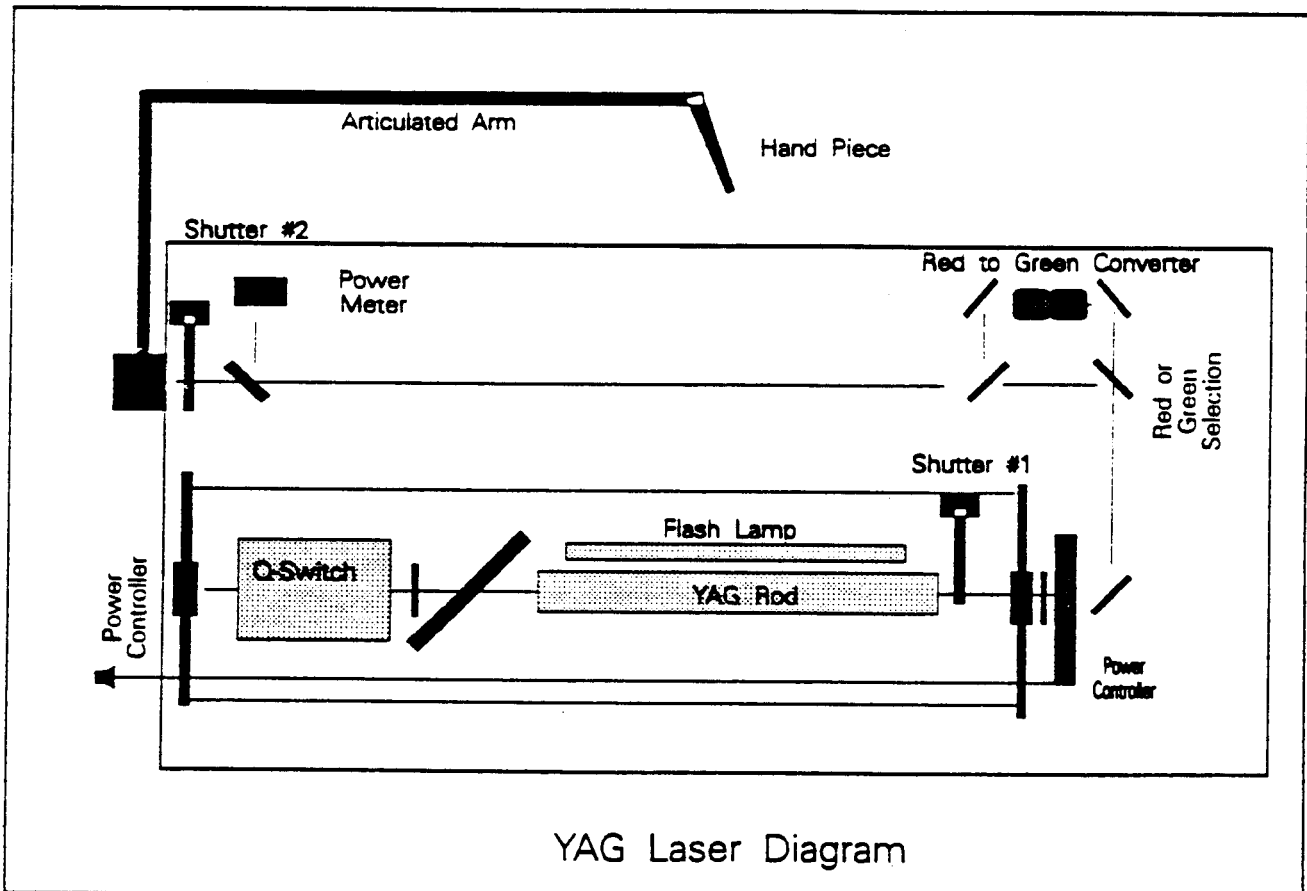
When the energy from a single pulse is focused to a circular spot, the energy density is often used to measure the output. This is the energy in a single pulse divided by the cross sectional area of the spot generated by the focusing lens. The unit of measure is the Joules/cm².

B. Fundamentals of a Nd:YAG Laser.

A Nd:YAG laser consists of three

interconnected sections. One is the power supply used to provide the proper voltage and current to the laser system. The second is the water cooling system used to remove heat from the power supply and the YAG rod located in the third section, the optical bench. Shown below is a diagram of the optical bench consisting of the YAG rod and flashlamp, various mirrors, lenses, the frequency doubler and the articulated arm.

A high voltage electrical pulse from the power supply excites the flash lamp which emits a broad spectrum of light in the ultraviolet and visible. The YAG rod absorbs most of this light and releases the energy as laser light at 1064nm.



The Q-Switch acts as an extremely high speed shutter. Its role in the cavity is to prevent the light from the "excited" Nd:YAG rod from reaching the rear mirror of the laser cavity until the Nd:YAG rod can store a large amount of energy.

A short voltage pulse applied to the Q-switch suddenly opens the cavity allowing the light pulse to escape in a length of time equal to the time it takes light to make a few round trips inside the cavity. The resulting pulse is 8 to 10 nsec long and extremely intense.

Following the release of the light pulse from the cavity, the Q-switch is reset and the system awaits the next pulse from the power supply.

The YAG rod and cavity operate above room temperature as they are heated by the pulses. Ten to fifteen minutes of operation is required to stabilize these elements. These components remain at this steady state temperature since, in the Medlite Laser System, the flash lamp is always operating at 10 pulses per seconds or Hertz. The pulse rate does not vary with the repetition rate selected on the DISPLAY PANEL. This ensures the temperature of the YAG rod and the cavity remain constant.

The repetition rate of the Q-switch, however, is controlled by the DISPLAY PANEL. It can be set to operate at 1, 2, 5 or 10 pulses per second or in a "single shot" mode. If the Q-switch is not triggered during a flash lamp pulse, the light energy inside the laser cavity decays and no pulse is

emitted. If the Q-switch is triggered, a laser pulse is emitted.

The pulse of light is directed at a right angle from the laser cavity to the color selection optics. When the Medlite is set for the RED mode, a steering mirror directs the beam to the articulated arm, bypassing the frequency doubling crystal or second harmonic generator (SHG). In the GREEN mode, however, the steering mirror is backed out of the beam path and the 1064nm light passes through the SHG and is converted to green light at 532nm. A different set of steering optics direct the green light to the articulated arm.

The second harmonic generator is a solid crystal operating at slightly above room temperature. Consequently, it contains a small electrical heater and requires eight to ten minutes to stabilize. Since the heater consumes almost no power, it is on all the time as long as the circuit breaker on the rear of the Medlite is in the ON position.

The beam diameter is approximately 5mm corresponding to the diameter of the YAG rod. It is very collimated and should be directed through the articulated arm without blockage. The optics in the arm are coated for high reflectivity and low loss at both 532nm and 1064nm. Because of the high pulse intensity of the laser emission, any contamination on these optics will destroy the coatings significantly reducing the laser power. It is important to avoid getting dirt, lint or any other particles on these optics.

At the end of the arm, a lens in the hand piece focuses the beam to the

desired spot size. Four hand pieces are provided. Two are for the 1064nm light and two are for the 532nm light. The same lens can not be used at both wavelengths as the light is focused to a different size spot.

The cooling system in the YAG laser is used to remove heat from the power supply and the YAG rod enclosure. A heat sensor on the Rod enclosure protects the system in the event the cooling system fails.

C. Fundamentals of the Medlite Software and Microprocessor

The Medlite control system consist of a microprocessor based controller and software. The microprocessor control system is capable of monitoring thirty IO (Input/Output) points with a 500 Hz loop time and detecting many fault conditions. This coupled with a real-time command kernel makes for a reliable and safe control system. A watch dog timer and power failure monitoring system provide a fail-safe system fault handling and de-couples the software from fast hardware fault detection.

1.0 Modes of Operation

There are four basic modes of system operation, they are:

A. Q-switch not switching, flash lamp not flashing
KEYSWITCH=OFF, Mode = OFF.

B. Q-switch not switching, flash lamp flashing
KEYSWITCH = ON, Mode = STANDBY.

C. Q-switch switching, flash lamp flashing
KEYSWITCH = ON, Mode = READY.

D. Beeper beeping. Display displays error message and Q-switch not switching, flash lamp not flashing.
Mode = ERROR.

1.1 Power on Sequence

The power on sequence begins when the power switch is placed in the ON position. The power on sequence starts a chain of events; they are:

A. Watchdog is reset, micro resets local logic.

B. Flash lamp and Q-switch logic are reset.

C. Trigger and simmer supply logic are reset.

E. 24V Interlock supply is turned off.

F. Pump and cooling fans are turned off.

G. The heater on the second harmonic generator turns on (SHG).

I. "OFF" is displayed on the front panel display.

1.2 KEYSWITCH ON/OFF Control

1.2.1 KEYSWITCH = ON

Rotating the keyswitch to the ON position begins a sequence of events, they are:

- A. Pump flow switch is checked to assure that it reads no flow.
- B. Setup and calibration parameters are read from the EEPROM.

C. Software revision "SR X.X" is displayed on the front panel and the beam steering hardware is steered to the selected (EEPROM stored values in this case) wavelength. A 3 second pause occurs while the beam steering equipment is moved. Simultaneously, shutter #S2 and #S1 are closed.

D. The cooling fans and pump flow is started and the message "FLO" is displayed while the pump flow switch begins to detect flow. The STANDBY lamp flashes.

E. The laser supply 24V interlock is turned on and the flash lamp begins flashing. An 8 second count down begins with the corresponding time out displayed on the front panel.

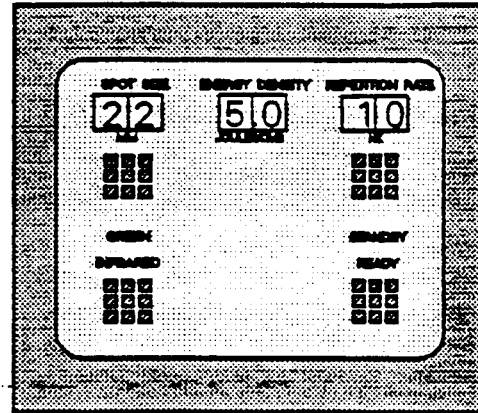
F. The control system now progresses to the STANDBY MODE (1.3.)

1.2.2 KEYSWITCH = OFF

- A. Micro resets local logic.
- B. 24V Interlock supply is turned off.
- C. Flash lamp and Q-switch logic are reset.
- D. Trigger and simmer supply logic are reset.

E. Pump and cooling fans are turned off.

F. "OFF" is displayed on the front panel display.



Medlite Display Panel

1.3 STANDBY Mode

The STANDBY mode indicates that the flash lamp is flashing at 10 Hz, and that the system is stable and prepared to enter the READY mode.

- A. Shutter #S1 and #S2 are closed. Q-switch is not switching.
- B. REPETITION RATE and SPOT SIZE displays the current Q-switch rate and hand piece spot sizes. The STANDBY lamp is ON and the READY light is OFF. The GREEN or INFRARED indicators are lit at the appropriate wavelength setting.

C. ENERGY DENSITY displays an energy of "0.0" indicating that laser is not lasing.

D. Interlocks pertinent to this current state are monitored at 500 Hz.

F. If the REPETITION RATE switch is activated, the REPETITION RATE display updates the REPETITION RATE to the next value.

G. If the SPOT SIZE switch is activated, the SPOT SIZE display updates the SPOT SIZE to the next value.

H. If the GREEN or INFRARED switch is activated, the GREEN or INFRARED lamp flashes for 3 seconds while the beam steering hardware is steered by the control system to the selected wavelength.

I. If the READY switch is activated, the control system moves to the READY mode (see 1.4).

J. The foot switch is ignored in STANDBY mode.

K. The printer is not queuing new data, but may be printing while in the STANDBY mode.

L. If the KEYSWITCH is moved to the OFF position then the control system moves to the KEYSWITCH=OFF mode.

1.4 READY Mode

The READY mode indicates that the laser system is prepared to fire the laser.

A. Shutter #S1 opens and #S2 closes.

B. The STANDBY indicator goes off and the READY lamp flashes. REPETITION RATE and SPOT SIZE display the current Q-switch rate and hand piece spot sizes. The GREEN or INFRARED indicators are lit at the appropriate wavelength setting.

C. The system begins a two second calibration by displaying "CA" and Q-switching the laser at 10 Hz. The photo diode power reading the current SPOT SIZE, wavelength settings and attenuator setting are used in the ENERGY DENSITY calculation. If a parameter change occurs within the two second calibration period, the controller stays within the calibration sub-mode until no parameters are changed. The ENERGY DENSITY display is constantly updated during calibration.

D. The system finishes calibration by updating the display REPETITION RATE and the current energy setting in the ENERGY DENSITY display.

E. Interlocks pertinent to the current mode are monitored at 500 Hz.

F. The foot switch has three positions. If the foot switch is pressed to the second position and then released a single shot will occur. If the foot switch is depressed to the third position and held down for less than 200 msec a single shot is fired. If the foot switch continues to be held down, shots are fired at the current REPETITION RATE setting until released.

G. If the REPETITION RATE switch is activated, the REPETITION RATE display updates the REPETITION RATE to the next value. Power calibration always occurs after this parameter change (see L.).

H. If the SPOT SIZE switch is activated, the SPOT SIZE display updates the SPOT SIZE to the next value. Power calibration always occurs after this parameter change (see L.).

I. If the GREEN or INFRARED switch is activated, the GREEN or INFRARED lamp flashes for 3 seconds while the beam steering hardware is steered by the control system to the selected wavelength. Power calibration always occurs after this parameter change (see L.).

J. If the READY switch is activated, the control system moves to the STANDBY mode (see 1.4).

K. Shutter #S1 opens and #S2 closes.

L. The system begins a two second calibration by displaying "CA" and Q-switching the laser at 10 Hz. The photo diode power reading the current SPOT SIZE, wavelength settings and attenuator setting are used in the ENERGY DENSITY calculation. If a power control change occurs within the two second calibration, the controller stays within the calibration sub-mode until no parameters are changed. The ENERGY DENSITY display is constantly updated during calibration.

M. The printer prints out the new calibration value and also prints out the current calibration statistics (see 1.5.).

N. If the KEYSWITCH is moved to the OFF position then the control system moves to the KEYSWITCH=OFF mode.

1.5 ERROR Mode

To prevent inadvertent injury, the control system has the capability to detect numerous error conditions.

- A. Micro resets local logic.
- B. 24V Interlock supply is turned off.
- C. Flash lamp and Q-switch logic are reset.
- D. Trigger and simmer supply logic are reset.
- E. Pump and cooling fans are turned off.
- F. System beeps and "ERR XX" is displayed on the front panel display. See section VII. Troubleshooting for an explanation of the various error messages.

2.0 Printer

A small thermal printer is attached to the side of the Medlite. This printer is used to print out treatment statistics.

- A. The printer prints the following when READY mode is entered:

Start Treatment
Indicates start

Dr. "Physicians Name"

- B. The printer prints the following when READY mode is exited:

Total Shots = xxx
 Treatment shots
 Name: Patients Name
 Date ___ / ___ / ___
 Flash # = xxxxx
 Total flash lamp Flashes
 End Treatment
 Indicates end

C. If the foot switch was depressed and shots were taken, the printout will indicate how many shots were taken and at the current wavelength, SPOTS SIZE and REPETITION RATE, and ENERGY DENSITY:

** CALIBRATION **
 Infra Red Laser
 Wavelength
 Rep Rate (HZ) = x-
 REPETITION RATE
 Energy (J/cm²) = xx
 Energy density
 # Shots = xx
 Total shots taken

D. If any of the parameters were changed during treatment forcing the controller to recalculate, the printout will indicate how many shots were taken and at the current wavelength, SPOTS SIZE and REPETITION RATE, and ENERGY DENSITY:

*** CALIBRATION ***
 Green Laser
 Wavelength
 Rep Rate (HZ) = x
 REPETITION RATE
 Energy (J/cm²) = xx-
 Energy density
 # Shots = xx
 Total shots taken

3.0 Switches and Functions

3.1 KEYSWITCH Switch

When the key switch is moved to the OFF position, the controller immediately stop lasing and shuts off the laser power supply.

When the key switch is moved to the ON position, the controller immediately enters the STANDBY mode.

3.2 STANDBY/READY Switch

If the Key switch is in the ON position, the STANDBY/READY switch toggles between the STANDBY and READY modes.

3.3 GREEN/INFRA RED Wavelength Switch

If the Key switch is in the ON position, and the mode is STANDBY or READY, pressing the GREEN/INFRARED switch switches the wavelength.

3.4 REPETITION RATE, ENERGY DENSITY and SPOT SIZE Displays

If the Key switch is in the ON position, and the mode is READY the ENERGY DENSITY display displays the current energy density.

If the Key switch is in the ON position, and the mode is STANDBY, the ENERGY DENSITY display displays an energy density of "0.0".

If the key switch is in the ON position, and the mode is STANDBY or READY, the REPETITION RATE and SPOT SIZE displays display the current values.

3.5 Attenuator Power Controller

If the Key switch is in the ON position, and the mode is READY, turning the attenuator knob CW increases the laser power output. Turning the attenuator knob CCW decreases the laser power output.

Turning the attenuator knob causes the controller to calibrate the power meter before allowing treatment to continue.

V. INSTALLATION

The Medlite laser system must be installed by a factory authorized service representative. Any unauthorized attempt to install the laser system may void the warranty.

A. Pre-Installation Requirements

1. The Medlite Laser system is shipped in a crate designed to protect the device when subject to normal shipping and handling procedures.

a. Inspect the crate to insure it has not been unreasonably damaged during shipment and delivery.

b. Move the crate to the treatment room in which the laser will be installed.

c. The crate may be opened to remove the Laser Safety goggles and any accessories.

d. Do not attempt to remove the Medlite Laser system from the crate.

2. Verify the location of a 110 Volt 15 amp wall plug within 10 feet of the rear of the Medlite Laser System.

3. Call Continuum Biomedical at 1-800-532-1064 and request a factory authorized service representative be sent to complete the installation.

B. Installation Requirements

The initial installation of the Medlite Laser System must be performed by a factory authorized service

representative. The following Installation procedure is provided in the event the Medlite System is moved to a facility other than the original installation site.

1. Water Cooling system

a. The water cooling system is opened on the top. Consequently, water must be drained from the system if it is to be transported by motorized vehicle.

b. The water cooling system must be refilled following draining. Approximately 4 gallons of distilled water will be needed.

c. Open the service door located at the right rear corner of the Medlite system. Fill the Water Cooling System reservoir with distilled water. Reservoir should be approximately 75% full.

d. Close the service door.

2. ARTICULATED ARM

a. The articulated arm should be removed from the pedestal if the Medlite Laser System is being transported by motorized vehicle.

b. Reinstall Arm using 1/4-20 bolts provided in the installation packet.

3. ENERGY DENSITY CALIBRATION

- a. Start up laser system
- b. Set Repetition Rate to 10 Hertz.
Set spot size to 2.0mm
- c. Set Laser emission to INFRARED.
- d. Use a Calibrated Power Meter approved by Continuum Biomedical. Meters from the factory are available on a loan basis for a limited time at no charge.
- e. Put on Laser Safety goggles.
- f. Remove lens barrel and position end of arm at volume absorbing surface of power meter.
- g. Press foot switch and read power on power meter.
- h. Calculate energy density by dividing the average power by 10, the repetition rate. Using the energy density chart on the following page, verify the calibration. For 2.0mm spot, the true spot size is 1.7 or 1.8mm. Confirm Energy Density reading on front panel agrees within $\pm 20\%$. Repeat this for several settings of the attenuator.
- i. Set emission to GREEN
- g. Press foot switch and read power on power meter.
- h. Calculate energy density by dividing the average power by 10, the repetition rate. Using the energy density chart on the following page, verify the calibration. For 2.0mm spot, the true spot size is 1.6 or 1.7mm. Confirm Energy Density reading on front panel agrees within $\pm 20\%$. Repeat this for several settings of the attenuator.
- j. If the Energy Density displayed on the Front Panel is in error, contact the factory for a service representative.

Energy Density Chart

Power	Spot Size 2mm J/cm2	Spot Size 1.9mm J/cm2	Spot Size 1.8mm J/cm2	Spot Size 1.7mm J/cm2
1.0	3.2	3.5	3.9	4.4
1.2	3.8	4.2	4.7	5.3
1.4	4.5	4.9	5.5	6.2
1.6	5.1	5.6	6.3	7.0
1.8	5.7	6.3	7.1	7.9
2.0	6.4	7.1	7.9	8.8
2.2	7.0	7.8	8.6	9.7
2.4	7.6	8.5	9.4	10.6
2.6	8.3	9.2	10.2	11.5
2.8	8.9	9.9	11.0	12.3
3.0	9.5	10.6	11.8	13.2
3.2	10.2	11.3	12.6	14.1
3.4	10.8	12.0	13.4	15.0

Power	Spot Size 1.6mm J/cm2	Spot Size 1.5mm J/cm2	Spot Size 1.4mm J/cm2	Spot Size 1.3mm J/cm2
1.0	5.0	5.7	6.5	7.5
1.2	6.0	6.8	7.8	9.0
1.4	7.0	7.9	9.1	10.5
1.6	8.0	9.1	10.4	12.0
1.8	8.9	10.2	11.7	13.6
2.0	9.9	11.3	13.0	15.1
2.2	10.9	12.4	14.3	16.6
2.4	11.9	13.6	15.6	18.1
2.6	12.9	14.7	16.9	19.6
2.8	13.9	15.8	18.2	21.1
3.0	14.9	17.0	19.5	22.6
3.2	15.9	18.1	20.8	24.1
3.4	16.9	19.2	22.1	25.6

VI. Maintenance

A. Cleaning Optics

Equipment Needed:

- reagent grade (or better) methanol
 - hemostat (surgical pliers)
 - finger cots or surgical gloves
 - cotton swabs
 - eyedropper
 - lens tissue
-

Unmounted Optics

1. Always wash your hands first in order to remove all dirt and oil residues and put on finger cots or gloves.

Hold one sheet of lens tissue over optic to be cleaned

Using eyedropper, place a few drops of good quality methanol on top of lens tissue.

Drag the lens tissue across the optic once only.

5. If a residue of solvent is left on the optic, repeat the procedure using less solvent and a new tissue until no residue remains.

Mounted Optics and Rods

1. Wrap lens tissue on a cotton tipped applicator.

2. apply a few drops of methanol directly on lens tissue and shake off excess.

3. Swab optic gently with the applicator starting at center and working towards the edge.

4. Repeat step 3, using a dry swab to remove residue.

Caution

When cleaning glued optics use solvent sparingly. Excessive solvent will dissolve the glue and your cleaning action may drag the residue onto mirror surface.

B. Flashlamp Replacement

Equipment needed:

- new flashlamp (PN#203-0019)
 - exploded head drawing
 - 2.5mm Allen wrench
 - lens tissue
 - cotton swabs
 - approximately 50ml distilled water
 - safety glasses
-

1. Study exploded head drawing
2. Turn off laser using breaker on rear panel of the Medlite
3. Unplug main ac power cord at wall socket
4. Remove top panel from Medlite.
5. Remove inner top cover over laser head.
6. Disconnect the two leads that run to the thermal switch located on top of the laser head. The leads can be disconnected by pulling firmly in the horizontal direction on the two crimped connectors.
7. Use your fingers to gently pull the lamp connectors from the lamp electrodes. Pull only on connector, not the wire.
8. Release the laser head from its base cradle plate by screwing the thumbwheel clockwise. The thumbwheel is located below the laser

head. Note orientation of head as you remove it. Anode end of head faces output coupler.

9. Remove the laser head from the bench and place it on a solid, flat, level work area.

10. Put on safety glasses.

11. Use a 2.5mm Allen wrench to remove the Allen bolts holding the white plastic lamp retainers at each end of the laser head.

12. With a cotton swab wet each end of the exposed flashlamp electrode with water, and then using a gentle twisting motion, remove the white plastic lamp retainers.

13. Pull firmly on either flashlamp electrode and push on the other to remove the lamp.

14. DO NOT touch the glass barrel of the new lamp. Hold the lamp by the metal electrodes. Inspect glass barrel and clean with lens tissue and methanol if necessary. Note anode/cathode orientation of new lamp and insert lamp into head according to "+" and "-" stickers on side of head.

15. Slide the new lamp into the laser head and install the Teflon backing ring and then the black "O" ring over the ends of the lamp electrodes.

Note:

Wet all parts before reinserting

16. Press black lamp "O" rings flush to laser head end plates before installing nylon lamp retainers.

17. Wet the exposed electrode and then replace the white plastic lamp retainers. Use a gentle pushing twisting motion.

18. Once the lamp retainers have been slipped over the lamp electrodes check to make sure the lamp is centered in the head and then bolt the lamp retainers in

place. tighten screws fir snug fit. do not over tighten.

19. Place the laser head in base cradle while checking orientation once again and begin to screw the thumbwheel counter clockwise to reattach the laser head to its cradle. Gently rock the laser head as you tighten the thumbwheel. The head should mate firmly against the cooling water "O" rings.

Caution

Base cradle screw threads are aluminum and can be stripped if over tightened. a snug fit is adequate.

20. Reattach lamp connectors at each end. Make sure lamp electrodes are dry before sliding lamp connectors over lamp ends.

21. Reattach the two leads to the thermal switch.

22. Replace laser head cover.

23. Replace top panel of Medlite.

24. Plug laser back into mains.

25. Turn on breaker on rear panel of Medlite.

26. Turn key switch to on.

C. Replacing DI Water Filter

Equipment Needed:

- New DI filter (PN#313-0099)
 - 3 gallons distilled water
 - Drain Pan
 - Phillips screwdriver
 - Small lab jack
-

1. Turn off main ac circuit breaker on rear panel of laser.

2. Disconnect power cord from wall socket.

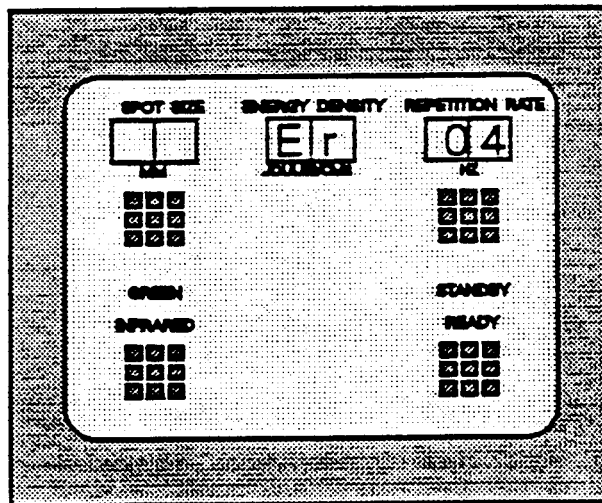
3. Remove the rear corner panel.

4.. Reach behind water storage reservoir and pull DI filter out of laser.

5. Using Phillips screwdriver, remove hose clamps
- 6.. Remove filter, reinstall new filter, and reinstall hose clamps.
- 7.. Push DI filter back into laser behind water storage reservoir.
8. Replace rear corner panel.
9. Reconnect power cord into wall plug and turn on main circuit breaker on back of laser.

VII. TROUBLE SHOOTING

This section describes the various error messages which may appear on the DISPLAY PANEL in the event of a system fault. As shown below, these messages appear as the letters ER followed by two numbers. The numbers assist the service personnel in diagnosing the problem.



Medlite Display Panel

List of Errors

Er 01	Interlock not connected	Er 10	Not used
Er 02	Coolant flow interrupted	Er 11	Sliding Stage Fault
Er 03	Coolant over temp	Er 12	Software error
Er 04	Laser head interlock or fail	Er 13	Not used
Er 05	Not used	Er 14	Not used
Er 06	End of charge not detected	Er 15	Power meter error
Er 07	Simmer supply fault	Er 16	Serial port error
Er 08	Flow switch error	Er 17	Key board or foot switch error
Er 09	Arm shutter not moved		

Error Description

- Er 01 Interlock not connected**
The external interlock is not connected on the back of the unit.
- Er 02 Coolant flow interrupted**
Coolant flow switch detected lack of flow while the coolant pump was running.
- Er 03 Coolant over temp**
The temperature of the coolant has exceeded the maximum limit.
- Er 04 Laser head interlock or fail**
Laser head has exceeded the maximum temperature or the cavity cover interlock has been defeated.
- Er 06 End of charge not detected**
While firing the flash lamp the flash lamp supply has failed to recharge the flash lamp capacitors.
- Er 07 Simmer supply not working correctly**
Simmer supply has failed to keep the flash lamp simmered.
- Er 08 Flow switch error**
Flow switch was showing flow when the coolant pump was not on.
- Er 09 Arm shutter not moved**
The arm shutter feedback sensor has not detected a change in shutter position after the controller has told it to move.
- Er 11 Sliding Stage Fault**
The sensor has detected a faulty or incomplete move of the sliding stage.
- Er 12 Software error**
An illegal op code was detected by the Medlite controller.
- Er 15 Power meter error**
While firing the laser, the Medlite controller has detected a discrepancy between the attenuator position and laser power output at that attenuator setting.
- Er 16 Serial port communications error**
The Medlite controller has detected a bad data stream in the RS-232 serial communications port.
- Er 17 Key board switch or foot switch error**
A key is stuck on the keypad or the foot switch is held on in an illegal state.

Status/Interlock List

There are four basic modes of system operation, they are:

- A. KEYSWITCH=OFF, Mode = OFF.
Q-switch not switching, flash lamp not flashing
- B. KEYSWITCH = ON, Mode = STANDBY.
Q-switch not switching, flash lamp flashing
- C. KEYSWITCH = ON, Mode = READY.
Q-switch switching, flash lamp flashing
- D. Mode = ERROR.
Beeper beeping. Display Panel shows error message and Q-switch not switching, flash lamp not flashing.

Maintenance and Calibration

The Maintenance Mode uses a PC and the RS-232 Port on the rear panel of the Medlite Laser System. Only Continuum Biomedical authorized service personnel should enter data through this port. All tuning, factory initialization and maintenance mode parameters are entered through the RS-232 serial port. The communication parameters are:

Baud rate: 19200
Parity: None
Stop bits: 1
Data bits: 8

The electrical interface is a null Modem 9-pin female to 9-pin female PC-AT compatible. A serial Null_modem cable is recommended.

PC-Serial Port	Medlite Port
Pin 2	Pin 3
Pin 3	Pin 2
Pin 5	Pin 5

Using a Communication software package such as Procomm, access the laser by striking the enter key on a commuter keyboard. Using all capital letters, type the word HELP. The current system parameters should be displayed on the computer screen.. If they are not displayed, the computer is not communicating properly with the laser. Shown on the following two pages is a representation of the computer screen for the two current software versions.

Maintenance Interface Software Version SR 1.1

From the prompt, type HELP:

CONTINUUM> HELP

Displaying help

PASSWORD Password =

VOLTS Enter power supply voltage (volts) = 1500

Q-DELAY Q-switch delay (microseconds) = 164

FLASH Flash lamp rate (HZ) = 10

IFR IFR only installed (Y/N)? N

PRINT Printer on (Y/N) ? Y

SERIAL Serial dump on (Y/N)? N

HELP Displaying help ...

S_GRN (mm) Enter hand piece spot size (GREEN) Current = 1.2 1.7 2.6

S_IFR (mm) Enter hand piece spot size (RED) Current = 1.3 1.8 2.7

S_DSP (mm) 'R' to reset, Hand piece spot size Current = 1.5 2.0 3.0

RATES (HZ) 'R' to reset, Enter Q-switch rate, Current = 10 5 2 1

SHOTS Reset shot counter (Y/N) ?, Current count is

LABEL Enter new label, Current label is

POT Read energy pot (Y/N) ?

DIODE Read photo diode (Y/N) ?

G-MIN Enter Green minimum power (mJ) = 1

G-MAX Enter Green maximum power (mJ) = 120

I-MIN Enter Infra Red minimum power (mJ) = 1

I-MAX Enter Infra Red maximum power (mJ) = 300

Maintenance Interface Software Version SR 1.2

From the prompt, type HELP:

CONTINUUM> HELP

Displaying help

PASSWORD Password =

VOLTS Enter power supply voltage (volts) = 1500

Q-DELAY Q-switch delay (microseconds) = 164

FLASH Flash lamp rate (HZ) = 10

IFR IFR only installed (Y/N)? N

GRN CA Flash Green PPS (Y/N) ? Y

SERIAL Serial dump on (Y/N)? N

HELP Displaying help ...

S_GRN (mm) Enter hand piece spot size (GREEN) Current = 1.2 1.7 2.6

S_IFR (mm) Enter hand piece spot size (RED) Current = 1.3 1.8 2.7

S_DSP (mm) 'R' to reset, Hand piece spot size Current = 1.5 2.0 3.0

RATES (HZ) 'R' to reset, Enter Q-switch rate, Current = 10 5 2 1

SHOTS Reset shot counter (Y/N) ?, Current count is

LABEL Enter new label, Current label is

POT Read energy pot (Y/N) ?

DIODE Read photo diode (Y/N) ?

G-MIN Enter Green minimum power (mJ) = 1

G-MAX Enter Green maximum power (mJ) = 120

I-MIN Enter Infra Red minimum power (mJ) = 1

I-MAX Enter Infra Red maximum power (mJ) = 300

These are the Medlite maintenance mode commands. Entering the command at the prompt will bring up the relevant command and entry if the password is properly entered.

4.2.1 PASSWORD

```
CONTINUUM> PASSWORD  
Password = LASER
```

The password keeps unauthorized users from disturbing system parameters.

4.2.2 VOLTS

```
CONTINUUM> VOLTS  
Enter power supply voltage (volts) = 1500 (Typical) Must be 100 volts below free  
running voltage.
```

This power supply voltage value is stored in EEPROM on the system. When the system reboots, this value is written to the charging supply. Default value is 900 volts.

4.2.3 Q-DELAY

```
CONTINUUM> Q-DELAY  
Q-switch delay (microseconds) = 165 (Typical)
```

This Q switch delay is stored in EEPROM on the system. When the system reboots, this value is written to the charging supply. Default value is 130.

4.2.4 PRINT

```
CONTINUUM> PRINT  
Printer on (Y/N) ? Y
```

If a small thermal printer is installed in the system, turning the printer on will dump patient treatment data statistics and store the printer installed setting to EEPROM. Default value is no printer installed.

4.2.5 SERIAL

```
CONTINUUM> SERIAL  
Serial dump on (Y/N) ? N
```

If a small thermal printer is not installed on the system, turning the SERIAL dump on will dump patient treatment data statistics to the serial port and store the printer installed setting to EEPROM. Default value is no serial dump installed.

4.2.6 S_DSP Setting the Hand piece Spot Sizes

Setting the Hand piece Spot sizes is easily accomplished by entering the spot sizes through the system serial port:

```
CONTINUUM> S_DSP (mm) 'R' to reset,  
Enter spot size "R"
```

```
CONTINUUM> S_DSP (mm) 'R' to reset,  
Enter spot size 1.5
```

```
CONTINUUM> S_GRN Enter spot size 1  
Enter 1.2
```

```
CONTINUUM> S_IFR Enter spot size 1  
Enter 1.3
```

```
CONTINUUM> S_DSP (mm) 'R' to reset,  
Enter spot size 2.0
```

```
CONTINUUM> S_GRN Enter spot size 1  
Enter 1.7
```

```
CONTINUUM> S_IFR Enter spot size 1  
Enter 1.8
```

```
CONTINUUM> S_DSP (mm) 'R' to reset,  
Enter spot size 3.0
```

```
CONTINUUM> S_GRN Enter spot size 1  
Enter 2.7
```

```
CONTINUUM> S_IFR Enter spot size 1  
Enter 2.7
```

The entered spot sizes 1.5, 2.0 and 3.0 are then permanently stored in EEPROM.

4.2.7 RATES Setting the Q-switch Rep Rates

```
CONTINUUM> RATES (HZ) 'R' to reset  
Enter Q-switch rate R
```

```
CONTINUUM> RATES (HZ) 'R' to reset  
Enter Q-switch rate 10
```

```
CONTINUUM> RATES (HZ) 'R' to reset  
Enter Q-switch rate 5
```

```
CONTINUUM> RATES (HZ) 'R' to reset  
Enter Q-switch rate 2
```

```
CONTINUUM> RATES (HZ) 'R' to reset  
Enter Q-switch rate 1
```

The entered Q-switch repetition rates; 10, 5, 2 and 1 are then permanently stored in EEPROM.

4.2.8 LABEL - Setting the Location Label

The location label is set and stored in EEPROM via the serial port:

```
CONTINUUM > LABEL
Enter new label, Current label is
'* CONTINUUM',
New is: "Enter Desired Name."
```

The new name will then appear on the location label in the printout.

4.2.9 POT - Displaying the Attenuator Setting

POT displays the current Attenuator setting.

```
CONTINUUM > POT
Read energy pot (Y/N) ?Y
Energy pot is set to 19
```

4.2.10 DIODE - Displaying the Power Meter Reading

```
CONTINUUM > DIODE
Read photo diode (Y/N) ?Y
Diode value is at 180
Note: A diode reading of 255 indicates saturation and may produce a non-linear result.
```

4.2.11 IFR - Setting Wavelength Options

```
CONTINUUM > IFR
IFR only installed (Y/N) ?Y
```

A "Y" implies that INFRA-RED only is installed on the system. This parameter is installed in EEPROM. The default is INFRA-RED only.

4.3 Setup Calibration and Initialization: Use a calibrated power meter, and measure all powers at end of articulated arm with lens barrel removed.

Step 1. Set repetition rate to 10 Hertz. Adjust the attenuator to allow maximum power (2.8 to 3.0 Watts) in the infrared. If power is low, adjust the power supply voltage and Q-Switch delay so that a maximum power of 2.8W is obtained at the output of the articulated arm.. Raised the voltage 100 volts and check for free running using an IR Detection card. System should not be free running.

Step 2. While in READY mode, enter I-MAX. Depressed foot switch and while infrared light is emitted from the articulated arm, enter output pulse energy (280 to 300mJ) using the laptop. Release foot switch.

Step 3. Adjust attenuator to minimize output energy, and enter I-MIN. Depressed foot switch and while infrared light is emitted from the articulated arm, enter output pulse energy (1mJ) using the laptop. Release foot switch.

Step 4. Change the emission wavelength to GREEN and adjust attenuator to allow maximum power.

Step 5. In systems not containing an external adjustment knob, remove the top cover. Adjust the alignment of the second harmonic generator by inserting an Allen key into the hole on the top inner black cover. Depress the foot switch. While green light is emitted from the articulated arm, maximize the output power as measured by the power meter by turning slightly the Allen key. A minimum of 1.20 Watts is required.

Step 6. In systems containing an external adjustment knob, adjust the alignment of the second harmonic generator by depressing and rotating the external adjustment knob located on the top cover of the laser. Depress the foot switch. While green light is emitted from the articulated arm, maximize the output power as measured by the power meter by turning slightly the adjustment knob. A minimum of 1.20 Watts is required.

Step 7. While in READY mode, enter G-MAX. Depressed foot switch and while green light is emitted from the articulated arm, enter output pulse energy (120mJoules or higher) using the laptop.

Step 8. Adjust attenuator to minimize output energy and enter G-MIN. Depressed foot switch and while green light is emitted from the articulated arm, enter output pulse energy (1mJ) using the laptop. Release foot switch.

The ENERGY DENSITY power meter reading will now adjust to the new calibration standards.

Reset the system to the STANDBY mode and turn the KEYSWITCH to the off position.

Step 5. In systems not containing an external adjustment knob, remove the top cover. Adjust the alignment of the second harmonic generator by inserting an Allen key into the hole on the top inner black cover. Depress the foot switch. While green light is emitted from the articulated arm, maximize the output power as measured by the power meter by turning slightly the Allen key. A minimum of 1.20 Watts is required.

Step 6. In systems containing an external adjustment knob, adjust the alignment of the second harmonic generator by depressing and rotating the external adjustment knob located on the top cover of the laser. Depress the foot switch. While green light is emitted from the articulated arm, maximize the output power as measured by the power meter by turning slightly the adjustment knob. A minimum of 1.20 Watts is required.

Step 7. While in READY mode, enter G-MAX. Depressed foot switch and while green light is emitted from the articulated arm, enter output pulse energy (120mJoules or higher) using the laptop.

Step 8. Adjust attenuator to minimize output energy and enter G-MIN. Depressed foot switch and while green light is emitted from the articulated arm, enter output pulse energy (1mJ) using the laptop. Release foot switch.

The ENERGY DENSITY power meter reading will now adjust to the new calibration standards.

Reset the system to the STANDBY mode and turn the KEYSWITCH to the off position.

**VIII. Physician Information Statement
for Continuum Biomedical, Inc.
Medlite Laser System**

Description:

The Medlite Laser System is a Q-Switched Nd:Yag laser. The fundamental wavelength is 1064nm. This wavelength is also frequency doubled to the shorter 532nm green wavelength. Refer to this Operators Manual for details on the Medlite Laser System.

Training Requirements:

The Medlite Laser System is intended for use only by physicians trained in the safe handling and use of the laser. Continuum and Continuum Biomedical, Inc. suggests that, in addition to laser safety training of all operating room or clinic personnel, the user/institution adopt a training and safety program as outlined in the latest revision of the ANSI standard Z136.3, the American National Standard for the Safe Use of Lasers in Health Care Facilities.

It is further suggested that each physician desiring privileges for laser use be approved by the appropriate credentialing body within their respective institutions.

Physicians should consider the following training avenues:

1. An accredited training course within the physician's specialty,
2. "Hands-on" training under the preceptorship of a qualified user.
3. Attendance at specialty specific courses presented during academy or college meetings.

Nurses and other allied health professionals handling lasers may also complete a training program which may include subjects such as basic laser physics, laser safety, tissue interaction, laser operating procedures, laser set-up procedures, potential hazards, and hands-on experience.

In Service training in the use of the Medlite Laser System will be provided by Continuum Biomedical during the system's installation. Clinical techniques described here are presented only as a reference based on clinical experience with the device and other laser devices reported in the public literature.

Continuum Biomedical, Inc., maintains a current listing of recommended training courses which are available to the user and allied health professionals. Contact Continuum Biomedical for further information at (800) 532-1064.

Indications:

The Medlite Series Laser System has been researched extensively in removing light and dark ink tattoos and lightening solar or senile lentigines.

In evaluating its effectiveness for removing tattoos, the following scale was used.

Quality of Response	Percentage Tattoo Removal
Excellent	> 75%
Good	50-75%
Fair	25-50%
Poor	0-25%

Uses:

The Medlite Laser System at 1064nm is intended for dark ink tattoo removal. The Medlite Laser System at 532nm is intended for light ink tattoo removal and lightening of solar or senile lentigines.

For dark ink tattoo removal, the recommended fluence levels are 2J/cm² to 12J/cm². For the treatment of solar or senile lentigines lesions of the body, the recommended fluence levels are 2J/cm² to 5J/cm². The recommended fluence levels for light ink tattoo removal is also 2J/cm² to 5J/cm².

CAUTION: Not indicated for FACIAL tattoos or lesions.

Contraindications:

There are no known contra-indications to laser tattoo removal or lentigines treatment with the Medlite Laser System.. Patients who have had prior problems with laser therapy, however, should be carefully screened as potential candidates for treatment.

Warnings:

Observe all safety precautions described in the chapter on Safety in this Operators Manual.

The 1064nm mode is intended for lightening of dark ink tattoos; the 532nm mode is intended for the lightening of light ink tattoos and solar or senile lentigines.

CAUTION: Not indicated for FACIAL tattoos or lesions.

Precautions:

Begin treatment with the lowest energy possible. If more tissue reaction is desired, increase the energy level in small increments until the desired tissue effect is observed. In clinical trials, the Q-switched Nd:YAG laser was well tolerated at fluences upto $12\text{J}/\text{cm}^2$ (Joules per square centimeter).

Complications/Adverse Effects:

In clinical studies involving prototypes of the Medlite Laser System, complications were observed in less than 5% of patients treated. These complications included:

Scarring, keloid formation and indentation of the tissue may develop following laser therapy.

Postoperative erythema, edema, and pain may be experienced after laser treatment.

Hypopigmentation or hyperpigmentation may occur.

IX. SPARE PARTS

The following is a list of spare parts for the Medlite Laser System.

Assembly	Part Number	Description
Articulated Arm	105-0116	Mirror, 0.75" Diameter
Articulated Arm	105-0117	Mirror, 1.00" Diameter
Articulated Arm	3120246	Articulated Arm
Articulated Arm	624-1200	Hand Piece 1.5mm
Articulated Arm	624-1300	Hand Piece 2.0mm
Articulated Arm	624-3000	Hand Piece 3.0mm

Cabinet	312-0283	Caster, 4" Swivel
Cabinet	312-0288	Caster, 4" Locking
Cabinet	429-0109	Keys <i>159.20</i>
Cabinet	429-0111	Mushroom Button
Cabinet	624-0019	Foot Switch
Cabinet	624-1800	Control Panel

Cooling	313-0099	DI Filter
Cooling	313-0230	Pressure Switch
Cooling	315-0093	Heat Exchanger
Cooling	402-0140	Water Reservoir
Cooling	423-0011	Cooling Fan 32 CFM
Cooling	423-0015	Cooling Fan 106 CFM
Cooling	424-0002	Water Cooling Pump
Cooling	426-0025	Thermistor

Electronics	421-0096	Transformer Isolation
Electronics	425-0029	5V, 12V, 24V Power Supply 304.00
Electronics	429-0083	Circuit Breaker
Electronics	504-3100	Assembly Marx Bank
Electronics	504-3200	PCB PS 750 Volts
Electronics	504-6600	Assembly, SCR
Electronics	505-1100	Assembly, PCB Temp Control
Electronics	619-0400	Photo diode Assembly
Electronics	619-5300	Power Board
Electronics	619-5400	Power Control PCB
Electronics	624-2600	Power Control PCB & Microprocessor

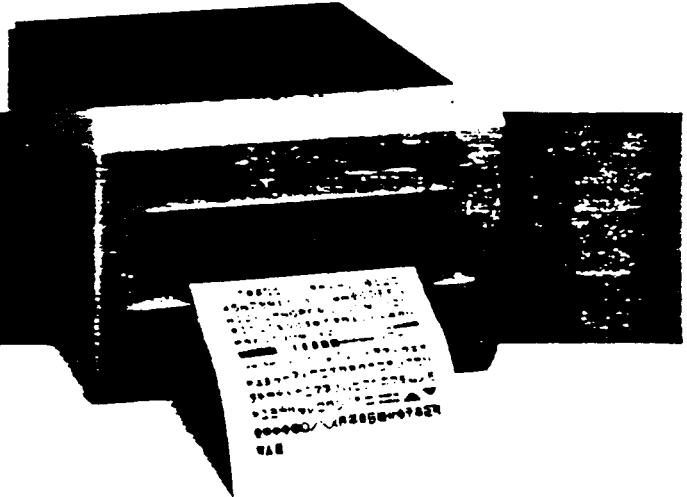
Laser Head	104-0026	Rear Mirror 4M curvature
Laser Head	104-0030	Gaussian Mirror
Laser Head	108-0001	Wave Plate Qtr AR106
Laser Head	201-0056	Nd:YAG Rod
Laser Head	202-0001	Crystal Pockel Cell
Laser Head	203-0019	Flash lamp FL611-06
Laser Head	426-0028	Thermostat

Optics Bench	105-0002	Steering Mirror IFR Only
Optics Bench	105-0022	IFR/GRN Mirrors
Optics Bench	105-0123	Steering Mirror Green Only
Optics Bench	108-0004	Wave Plate Half AR106 (Attenuator)
Optics Bench	110-0005	Photo diode Mirror
Optics Bench	624-0500	Sliding Stage
Optics Bench	624-1500	Second Harmonic Generator
Optics Bench	624-3100	Shutter Assembly
Optics Bench	624-3100	Shutter Assembly

Printer	312-0292	Printer
Printer	624-1610	Printer Paper

INSTRUCTION MANUAL

DATA PRINT UNIT
DPU-20
• DPU-20-20 CF
• DPU-20-24 CF



Please read this manual carefully before using DPU-20.

Seiko Instruments Inc.

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1. HANDLING PRECAUTIONS

- Install the printer in the horizontal to vertical range.
- Use only a 5 VDC \pm 1V power supply. Any other voltages may cause a failure. Ensure that no excess noise is allowed to enter the power supply line.
- Do not print without paper.
- Do not pull out the thermal paper roll from the paper insertion opening.
- Use only the 58-mm wide thermal paper rolls specified below.

Product No. : TP058-18C
Width : 58mm
Outer diameter : 28mm
Roll length : 18m

2. NOMENCLATURE

The diagram below shows the DPU20 parts. When removing the DPU 20 from its packing, check that all the components shown in the diagram below are there.

<Components>

- 1 x main unit
- 1 x paper roll (inside unit)
- 1 x main unit fitting
- 2 x main unit fitting screw (3 x 10)

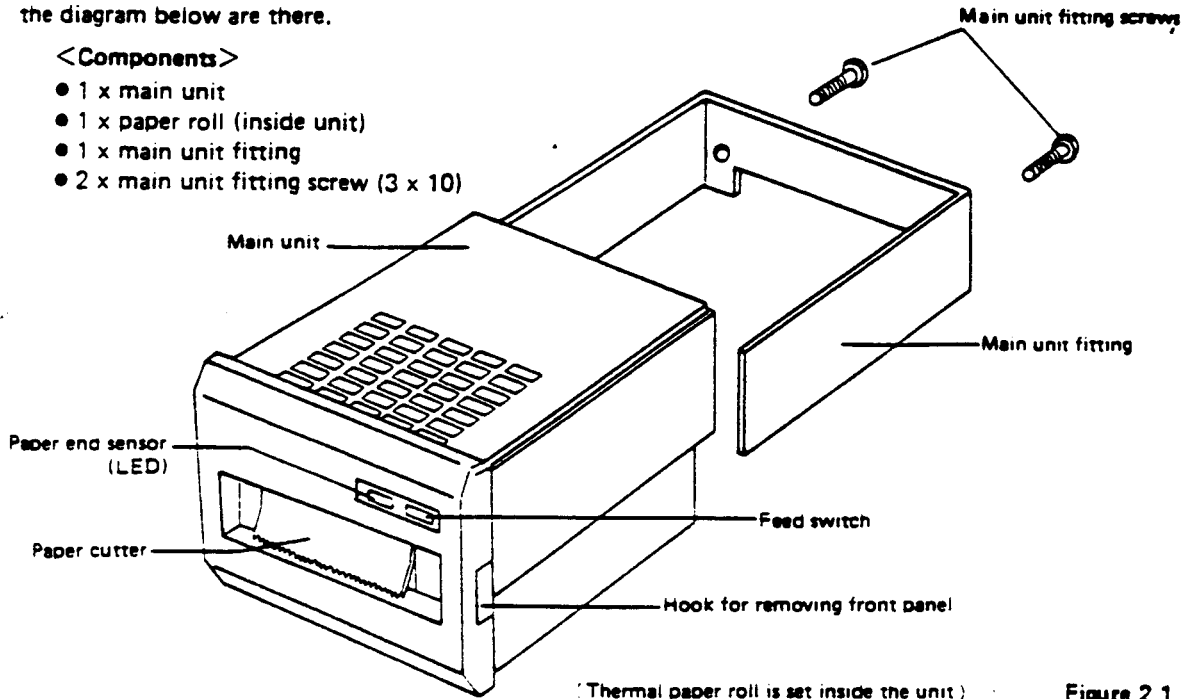


Figure 2.1

3. CONNECTOR CABLE

The I/O terminal at the rear of the DPU-20 is 4234-0001 LCSC (3M). Use the HIF3BA-34D-2.54R (Hirose) or equivalent connector.

4. INSERTING THE THERMAL PAPER ROLL

- (1) The paper roll is set inside the unit. Gently press the hook for removing the front panel, remove the panel, and pull out the printer.
- (2) The outside and inside surfaces of the paper are different. The printing surface is the outside. Set the paper roll on the shaft. (See Figure 4.1.)
- (3) Gently push the paper face down into insertion opening A in Figure 4.2. Keep pressing the feed switch until the paper comes out from the print head.
- (4) When the paper from the print head has come out from the paper cutter, replace the front panel of the unit.

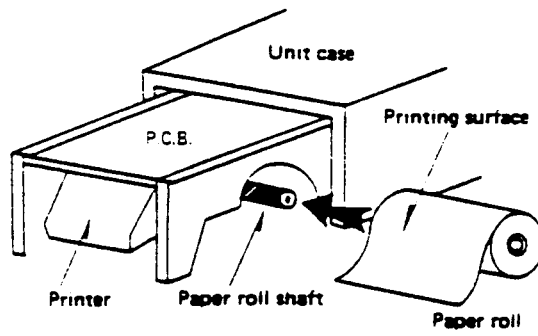


Figure 4.1

Note: If the paper is not pulled in by the rollers even when you press the feed switch, push the paper in.

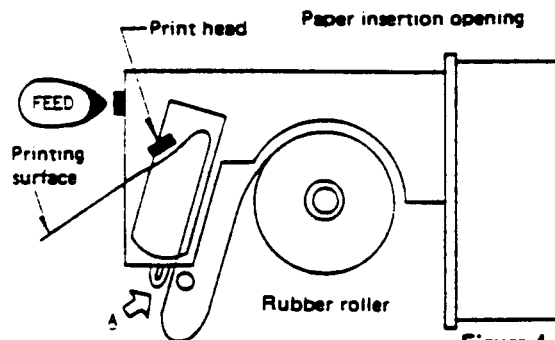


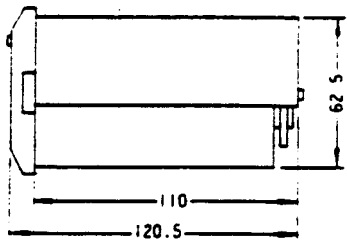
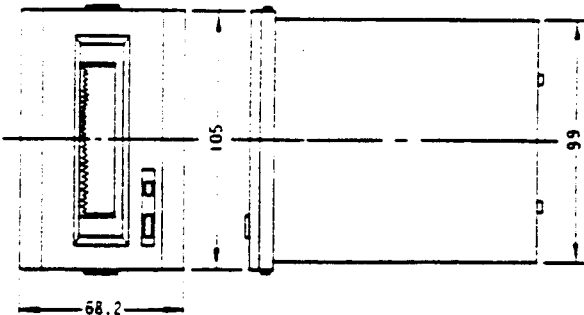
Figure 4.2

5. GENERAL SPECIFICATIONS

5.1 Printer Specifications

Item	Model	DPU-20-20CF	DPU-20-24CF
Printing system		Thermal serial dot	
Printing direction		Left to right in relation to paper feeding	
Printing timing		Tacogenerator synchronous system	
Home position detection system		Mechanical switch	
Printing speed (normal temperature, 5.0 V)		Approx. 0.9 lines/s	Approx. 0.8 lines/s
Number of columns		20 (2-dot space)	24 (2-dot space)
Character dimensions (W x D)		2.4 mm x 1.5 mm	2.4 mm x 1.3 mm
Character matrix		7 x 5 dot matrix	
Input character code		JIS 8-bit code (See Section 12, Data Code Table.)	
Data input system		8-bit parallel (conforms to Centronics) Handshaking with the <u>STROBE</u> and <u>READY/BUSY</u> lines (See Section 6.3, Data Timing.)	
Service life		500,000 lines (5.0 V rated energy, normal temperature, printing "8")	
Operating voltage		+5V DC ± 5%	
Current consumption		Operation: 3.0 A max. Standby: 250 mA max.	
Operating temperature		0°C to +50°C	
Storage temperature		-40°C to +60°C	
Thermal paper		Width: 58 ⁺⁰ ₋₁ mm Thickness: 60 μm ± 5 μm	

5.2 Dimensions



Unit: mm

* Rectangular mounting hole: 99.3^{+0.5}₋₀ mm x 62.7^{+0.5}₋₀ mm

6. INTERFACE SPECIFICATIONS

6.1 Basic Specifications

- (1) Eight-bit data from the host is input by STROBE and READY/BUSY handshaking.
- (2) Eight-bit data is stored in the built-in data memory. When one line of data or a CR or LF code has been input, a line is printed.
- (3) Characters are printed by conversion of the input data code to dot patterns by the built-in character generator.

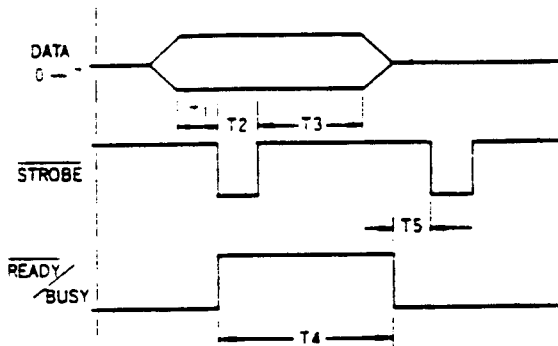
6.2 I/O Signals

- (1) Strobe input (STROBE)
STROBE input is the data read command signal. Data is latched when the signal goes low. The printer starts data input processing when this signal is received.
- (2) Data 0 to 7 input (DATA)
Data 0 to 7 is an 8-bit parallel data input signal. It is high when data is 1, and low when data is 0.
- (3) Ready/Busy output (READY/BUSY)
READY/BUSY checks whether data can be received. When the signal is low, data can be input.

- (4) Paper end signal detection (PE)
When the paper runs out, the PE terminal is high, and "PAPER" lights on the front panel (optical detection by a photo interrupter).
- (5) Paper feed (FEED)
The feed switch is on the front panel of the main unit. When the paper is set, hold the feed switch down to feed the paper. The signal is ignored, however, if one or more characters are received or if printing is in progress. The I/O connector also has a FEED pin, enabling control from the host. When the print head is at the home position, and the signal is low for more than 100 μ s, the paper is fed one line.
- (6) Error signal output (ERROR)
When paper jams or other error occurs during printing or paper feed, all output to the printing mechanism is OFF. Data cannot be received if the Error signal output changes to low and the READY/BUSY output changes to high. To cancel the error state, turn the reset signal to low or turn the power off, then on again (power reset).
- (7) Reset (RESET)
The reset signal initializes the printer the same way as a power-on reset. When the signal is low, all input data is cleared, and the paper is

fed one line. The signal is received when the printer is at the home position and when there is an error. Reset is not effective during printing. (The I/O connector has a RESET terminal.)

6.3 Data Timing

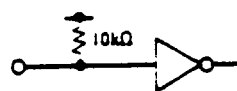


T1-T3	0 μ s min. (minus not possible)
T2	0.5 μ s min.
T4	214 μ s to 1004 μ s
T5	6 μ s min.

6.4 Electrical Conditions

(1) Input signal conditions

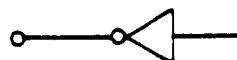
The DATA, RESET, and STROBE input signals are pulled up at the CMOS level and the input pins at 10k Ω .



ICs
DATA: 40HC273
STROBE: 40HC04
RESET: 40HC08

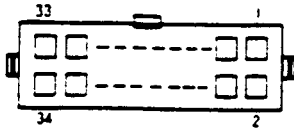
(2) Output signal conditions

The READY/BUSY output and PE output signals are at the CMOS level.



ICs
READY/BUSY: 40HC04
PE: 40HC04

6.5 Connector Pins



*DPU-20: 4234-0001 LCSC (3M)
Connector: HIF38A-34D-2.54R (Hirose) or equivalent

Note: Connectors are not supplied with the unit.

(XXX is active low.)

Pin no.	Signal	I/O	Description
1	<u>STROBE</u>	Input	Reads 8-bit data. Printer starts processing data on receiving this signal.
3	DATA 0	Input	8-bit parallel data signal. High when data is 1 and low when data is 0.
5	DATA 1		
7	DATA 2		
9	DATA 3		
11	DATA 4		
13	DATA 5		
15	DATA 6		
17	DATA 7		
19	NC	Not used	
21	<u>READY/</u> <u>BUSY</u>	Output	Shows whether data can be received. Data can be received when signal is low. (Receives data when <u>STROBE</u> signal goes low, then becomes active.)
23	PE	Output	Paper end signal
25	ERROR	Output	Error signal
27	VCC	Input	+5.0 VDC operating power supply
29	GND	Input	Power supply GND
31	GND	Input	Power supply GND
33	VCC	Input	+5.0 VDC operating power supply

Pin no.	Signal	I/O	Description
2			
4	Return GND		GND
6			
8			
10			
12			
14			
16			
18			
20	NC	Not used	
22	NC	Not used	
24	<u>FEED</u>	Input	Paper feed signal
26	<u>RESET</u>	Input	Initialization signal
28	VCC	Input	+5.0 VDC operating power supply
30	GND	Input	Power supply GND
32	GND	Input	Power supply GND
34	VCC	Input	+5.0 VDC operating power supply

7. POWER SPECIFICATIONS

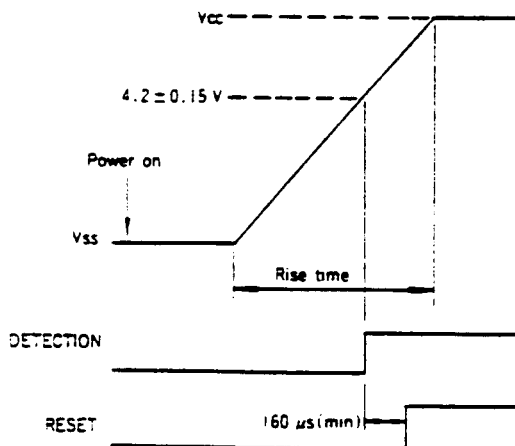
Operating voltage: +5.0 VDC \pm 5%

Current consumption: Operation: 3.0 A max. (momentary current during printing)

Standby: 250 mA max.

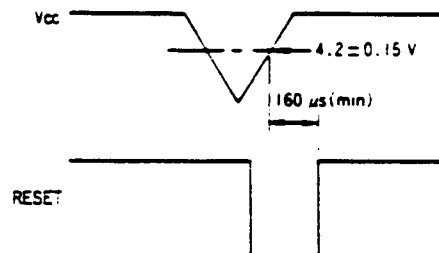
To handle the maximum momentary current of 3.0A during printing, a power supply with a high electrical capacitance should be used. When using the same power supply as the host system, ensure that the system does not run away during momentary voltage drops.

- (1) Conditions for internal circuit power on
The voltage level is checked when power is turned on, and the circuit is initialized under the conditions shown below.



- (2) Reset conditions after abnormal voltage drops during operation

When abnormal voltage drops as shown below, the circuit is reset the same way as for a power-on reset.



(7) ESC code (1B₁₆) + C (63₁₆)

When ESC C is input, F9₁₆ to FD₁₆ are changed as shown in the following table. Pressing ESC C again resets the mode. Since this change remains in effect on a line basis, ̄ and Σ, and ̄ and μ cannot be used in the same line. The <CAN> code is not effective.

Code	F9H	FAH	FBH	FBH	FDH
Character at initialization	̄	̄	̄	̄	̄
ESC "C"	Σ	μ	Ω	π	τ

(8) ESC + R

ESC R is used to set the character set of different countries. ESC code (1B₁₆) + R (52₁₆) + n (0₁₆ to 6₁₆) selects the characters shown in the table below. The selected character remains in effect until a change command is input. The <CAN> code is not effective.

HEX	20H	24H	40H	50H	54H	58H	5EH	60H	70H	74H	78H
JAPAN	*	5	3	1	0	2	7	0	0	0	0
FRANCE	*	5	3	1	0	2	7	0	0	0	0
GERMANY	*	5	3	1	0	2	7	0	0	0	0
U.K.	*	5	3	1	0	2	7	0	0	0	0
SWEDEN	*	5	3	1	0	2	7	0	0	0	0
ITALY	*	5	3	1	0	2	7	0	0	0	0
U.S.A.	*	5	3	1	0	2	7	0	0	0	0

The character set for Japan is set at initialization.

*Supplementary cancelling commands

(1) When the <CAN> code is input, everything in the print buffer is cleared. This includes the <SO>, <SI>, and ESC S commands. The ESC C and ESC R commands are flagged. Since the <CAN> code does not enter the print buffer, it has no effect.

(2) Codes other than S, C, and R used after ESC are invalid.

For example, A, B, ESC F, and G (41₁₆, 42₁₆, 1B₁₆, 46₁₆, and 47₁₆) are input, ESC F is not a command, so the data is only A, B, and G.

10. SOFTWARE GRAPHICS MODE

The DPU-20 normally uses character printing, but when it receives data conforming to the protocol determined by the specified control code, it can print bit image graphics and mixed characters and bit image graphics. Because the DPU-20 has a print head for printing only characters, the DO dot section in graphics is not available, and therefore cannot be printed with the character print head. As a result, space is left between lines when using the character print head.

10.1 Input Method

Software graphics is input with ESC (1B₁₆) + S (53₁₆) and four following integers. This also sets the length of the bit image graphics data. After the set data is received, the graphics mode is cancelled.

Form: ESC + S + n₁ + n₂ + n₃ + n₄

Example: When sending 192-bit image data

1B₁₆, 53₁₆, 0192, 31₁₆, 39₁₆, 32₁₆ ...
 ESC S 0192 31 39 32
 four integers 192 data items

n₁, n₂, n₃, and n₄ must form a four-digit integer. Data that is not in the correct form is ignored.

Correct examples	Incorrect examples
0 0 1 2	0 0 A B ... Data is not integers
0 1 9 0	0 2 4 ... Only three digits

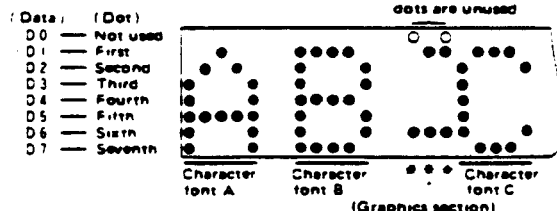
10.2 Relationship between Data Bits and Print Head Dots

The examples below show the relationship between data bits and print head dots.

Example: Data

41H, 42H, 1BH, 53H, 30H, 30H, 30H, 33H,
 (A) (B) (ESC) (S) (0) (0) (0) (3)

41H, 42H, 43H, 43H
 (A) (B) (C) (C)

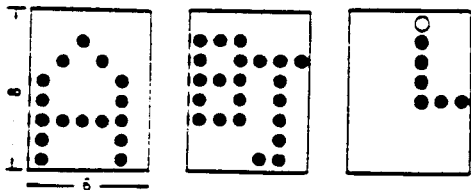


Data that exceeds the line length in the software graphics mode is printed on the following line. Character codes other than ESC S or the wrong codes used instead of n₁ to n₄ are invalid. Subsequent graphics data will be printed as character codes.

11. CHARACTER FONT

11.1 Normal Size Characters

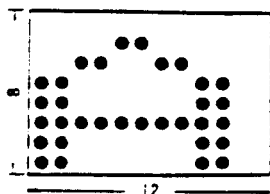
Normal size characters use an 8 x 6 dot matrix, but since the DPU20 uses a character printer, the top row does not print.



Examples (○ does not print)

11.2 Double-width Characters

Double-width characters use an 8 x 12 dot matrix. Each dot of the character pattern is printed twice, doubling the size of the character. As with normal size characters, the top row does not print.



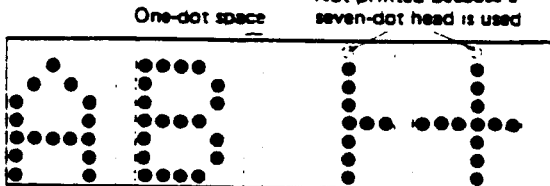
Example

11.3 Space between Characters

The DPU20 prints a one-dot space between characters.

Print example

Character printing
Not printed because a
seven-dot head is used



12. DATA CODE TABLE

The table below shows the 8-bit codes for all characters and control codes.

Lower bit	higher bit	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
		0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0	0000		SP	0	n	P		p		-	-	SP	-	タ	ミ	-	×
1	0001		!	1	A	Q	a	q		-	-	。	ア	キ	ム	-	田
2	0010		"	2	B	R	b	r		-	-	フ	イ	ツ	ノ	-	車
3	0011		#	3	C	S	c	s		■	ト	リ	ワ	テ	モ	-	月
4	0100		\$	4	D	T	d	t		■	-	、	エ	ト	ヤ	▲	日
5	0101		%	5	E	U	e	u		■	-	。	オ	ナ	ニ	▲	晴
6	0110		&	6	F	V	f	v		■	|	ヲ	カ	ニ	ヨ	▼	分
7	0111		'	7	G	W	g	w		■	|	ア	キ	ヌ	ラ	▼	秒
8	1000	CAN	(	8	H	X	h	x		■	レ	イ	ク	ネ	リ	◆	千
9	1001		)	9	I	Y	i	y		■	レ	ウ	ケ	ノ	ル	♥	市
A	1010	LF	[	:	J	Z	j	z		■	レ	エ	コ	ハ	レ	◆	区
B	1011	ESC	+	:	K	[	k	]		■	レ	ウ	サ	ヒ	コ	♣	町
C	1100		,	<	L	¥	l	:		■	レ	ウ	シ	フ	フ	●	村
D	1101	CR	-	=	M	]	m	]		■	レ	ウ	ス	ヘ	シ	○	人
E	1110	SO	.	>	N	^	n	-		■	レ	ウ	セ	ホ	-	△	ノ
F	1111	SI	/	?	O	_	o	-		■	レ	ウ	ソ	マ	。	△	ノ

Undefined codes are ignored. Codes enclosed by heavy lines are control codes.

13. CHARACTER PATTERNS

*O does not print

11	21	31	41	51	61	71	81	91	01
21	30	40	50	60	70	80	90	00	10
12	22	32	42	52	62	72	82	92	02
23	33	43	53	63	73	83	93	03	13
14	24	34	44	54	64	74	84	94	04

*O does not print

52	62	72	82	92	02	12	22	32	42
53	63	73	83	93	03	13	23	33	43
54	64	74	84	94	04	14	24	34	44
55	65	75	85	95	05	15	25	35	45
56	66	76	86	96	06	16	26	36	46

• ○ does not print

A4	A5	A6	A7	A8	A9	A1	A7	AC	A1
A5	AA	AF	A4	A9	AE	A1	A8	AD	A2
A6	AB	A8	A3	A6	AF	A1	A9	AE	A7
A7	AC	A1	A6	A9	AB	A1	AA	AF	A4
A8	AD	A2	A7	AC	A1	AA	AB	AA	A5

• ○ does not print

B4	B5	C9	C5	CA	C7	D4	D9	D7	E1
B7	BC	C1	C6	C2	D6	D1	DA	D7	E4
B8	BD	C7	C7	CC	D1	D6	DB	E0	E3
B9	BE	C3	C8	CD	D2	D7	DC	E1	E5
BA	BF	C4	C9	CE	D3	D8	DD	E2	E7

* O does not print.

EE EP P2 P7 EC I E C I P8

E3 EE P1 P4 PD I I I I PA

EA EP P4 P5 PE E I I I P3

E2 P6 P3 P4 I P U I PC

EC P1 P4 P3 I I I I P3



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(Specifications are subject to change without notice.)
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Introduction

This manual contains information on service and maintenance necessary to maintain safe and proper operation of the Medlite Laser System. Some of these areas may already be covered in the Operation Manual supplied with the laser. The purpose of this manual is to supply more detailed information to a factory trained or laser qualified technician or engineer on service and maintenance procedures.

Any service performed should be done in accordance with this manual or by the direction of the Service Department. If the laser is under warranty no service other than normal required maintenance should be performed without express consent from Continuum Biomedical Inc. **FAILURE TO COMPLY COULD RESULT IN VOIDING OF THE LASER WARRANTY.**

If problems or questions arise that are not covered in this manual, please contact the Continuum Biomedical Service Department.

Service Department Phone #	800/524-5571
International Phone #	209/239-6400
Fax #	209/239-6407

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I. Tools and Equipment

The Medlite Laser System is simple to service and maintain. It does not require many expensive special tools or equipment to do normal maintenance or service. However the tools and equipment listed here will be necessary to perform the service and maintenance described in this manual.

Required tools:

- Standard Allen wrench set
- Metric Allen wrench set
- Screw Drivers (blade and Phillips)
- Pliers and cutters
- Assorted wrenches
- Hemostat
- Laser safety glasses
- Factory supplied alignment jigs (apertures)

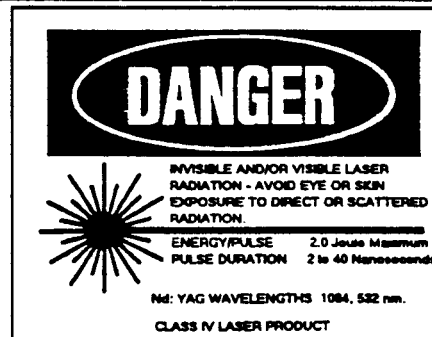
Required equipment:

- Oscilloscope (optional)
- Photo Diode (optional)
- IR phosphor card (Kodak Catalogue number 174 2048)
- Laptop Computer with communication software and 9 pin serial to serial null modem cable
- Burn paper (Kodak Linagraph Direct Print Paper, Catalogue number 198 6108)
- Solvent (reagent grade or better methanol)
- Lens tissue
- Cotton swabs

A basic tool kit and optics cleaning supplies should be enough to do most all of the maintenance. The oscilloscope and photo diode are not necessary if an IR card is available. Burn paper is used to quickly determine if optics are damaged by evaluating the beam burn pattern. It is not essential but is extremely helpful.

Caution

Service performed on the Medlite Laser System should be done in accordance with established laser safety procedures. Safety glasses should be worn at all times. Exercise caution when working in the high voltage section of the laser. Failure to abide by safety procedures could result in injury.



II. Subassembly and Module Descriptions

Section 1. Optics Bench Layout

This section shows the top part of the laser system, the optics bench. Refer to figure 1-1 for a simplified layout diagram. This can be used to quickly locate an area or part in question.

1-A. Laser Head

General Description

The Medlite Laser System uses a model 711-06 laser head, P/N 504-6900, manufactured by Continuum.

The head is a modular design incorporating a rod, flashlamp and coupling medium (see figure 1-2 and pg.8 for exploded view). It has a linear flashlamp that is in a close coupled configuration surrounded by a high brilliance magnesium oxide diffuser. This results in a high pumping efficiency that minimizes thermal loading and reduces power consumption. These features combine to create the excellent pumping homogeneity required for producing high gain and superior quality beams. The 711-06 head is designed for a beam height of 43mm.

1-B. Rods

The head is designed to pump Nd⁺³ doped YAG. The doping levels vary from 0.9 to 1.4%. The YAG rod ends have hard dielectric anti reflective coating (AR). The rod length of the head is 115mm measured along the optical axis. The diameter of the 711-06 rod is 6mm, P/N 201-0056.

1-C. Flashlamps

The head is pumped by a linear flashlamp P/N 203-0019. The lamp has a voltage polarity that must be observed. The flashlamp anode can be identified by a red marking on the electrode whereas the cathode has no marking. The discharge system of the flashlamp uses a negative critically damped pulse (-1.8kV max.) with a duration of 200 microseconds full width half max. (FWHM). The gas in the flashlamp is xenon with a pressure of 1-3 atmospheres. See figure 1-3.

1-D. Cooling

The laser head, (flashlamps and laser rod) must be cooled by distilled, deionized water. The resistivity of the cooling water should not fall below 500 kohms/cm. Do not mix any chemical products with the distilled water.

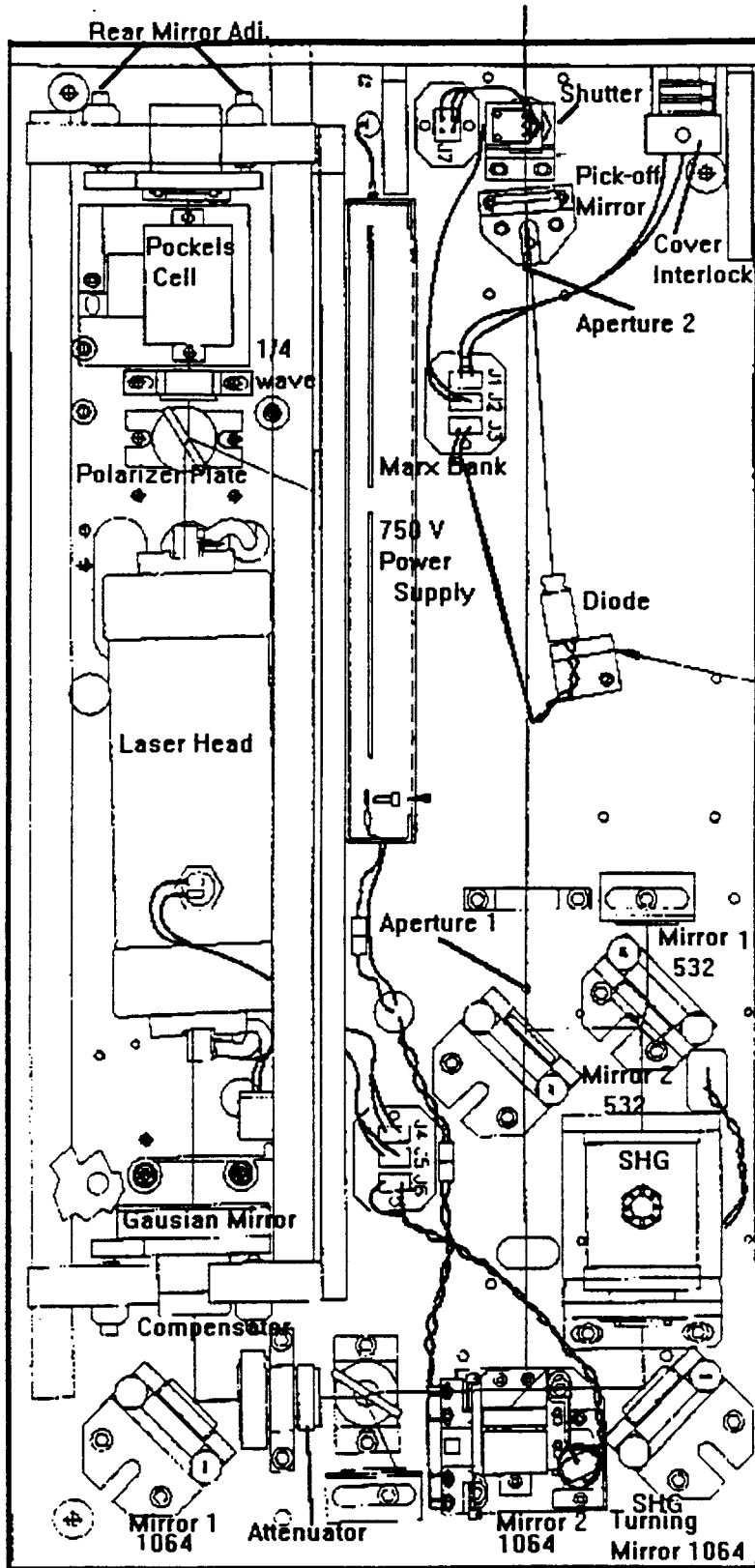
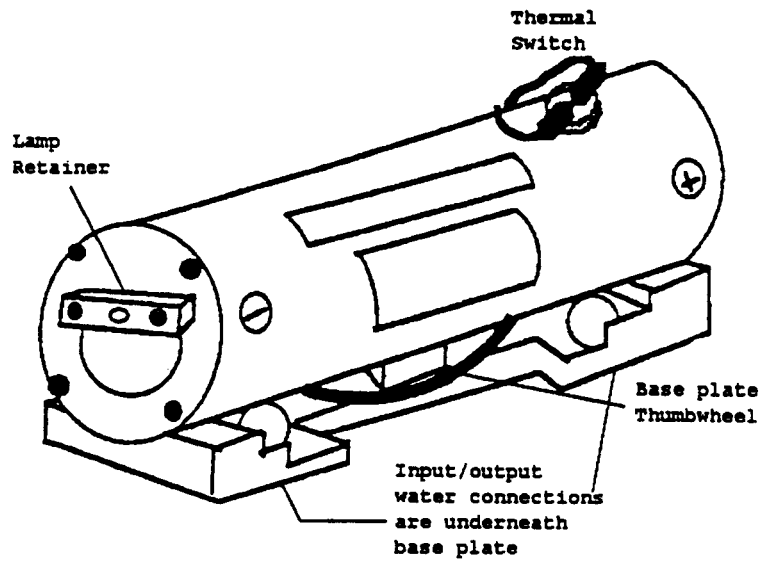


Figure 1-1



711-06 laser head

Figure 1-2

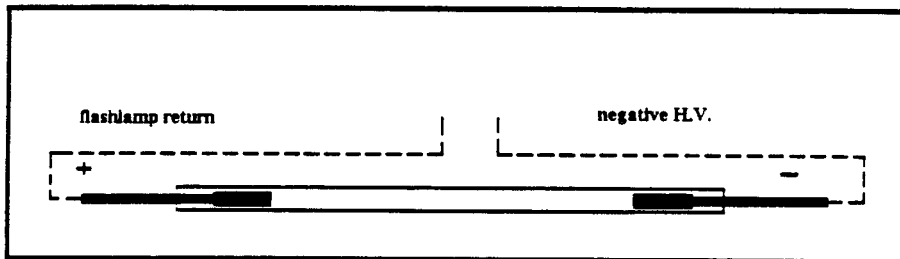
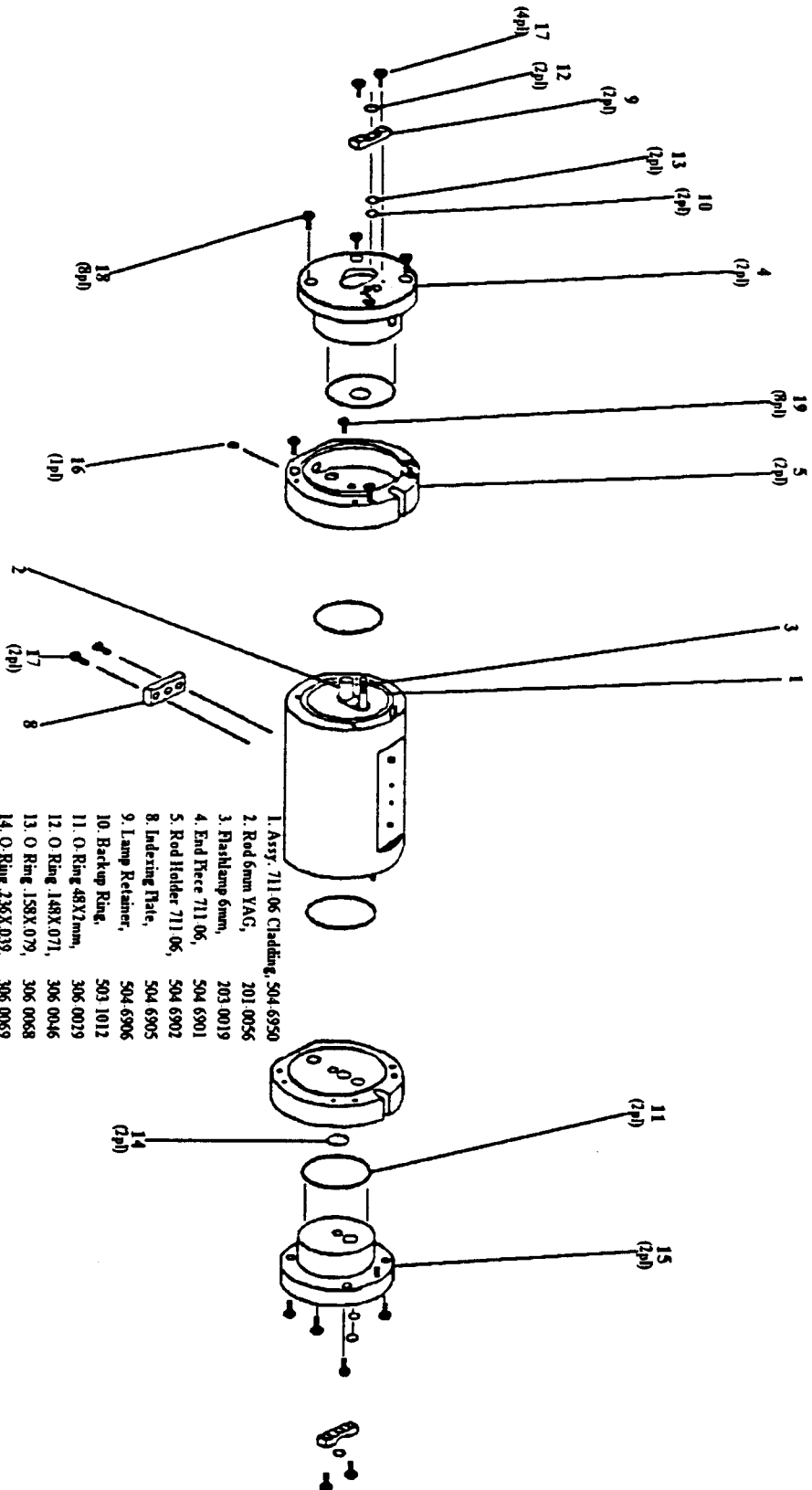


Figure 1-3



- 1. Assy. 711 06 Cladding, 504 6950
- 2. Rod 6mm YAG, 201 0056
- 3. Flashlamp 6mm, 203 0019
- 4. End Piece 711 06, 504 6901
- 5. Rod Holder 711 06, 504 6902
- 8. Indexing Plate, 504 6905
- 9. Lamp Retainer, 504 6906
- 10. Backup Ring, 503 1012
- 11. O-Ring 48X2mm, 306 0029
- 12. O Ring 148X.071, 306 0046
- 13. O Ring 158X.079, 306 0068
- 14. O-Ring 236X.039, 306 0069
- 15. Dowel Pin, 313 0119
- 16. Dowel Pin, 312 0190
- 17. Screw M3X6mm SHCS
- 18. Screw M3X12mm SHCS
- 19. Screw M3X25mm SHCS
- 20. Screw M4X6mm SHCS

Exploded view of 711-06 laser head

1-E. Active Q-switch

Principle of Operation

The Q-switch consists of the following:

Optical

- a) Pockels cell
- b) plate polarizing element
- c) quarter-wave plate

Electrical

- a) timed pulse generated by micro board
- b) Marx bank
- c) 750 volt power supply

Pockels cell

The Pockels cell, P/N 202-0001, has a longitudinal field KD*P crystal with a 15mm clear aperture mounted at 43mm beam height. A voltage of ~3600 results in a quarter wave of rotation for photons at 1064nm passing in either direction. A voltage of 0 results in no rotation, and no lasing occurs.

Plate polarizer

The thin film multi-layer dielectric polarizer, P/N 199-0055, has an angle of incidence of ~57 degrees. In its standard orientation, the polarizer is highly transparent (>95%) to horizontal while being highly reflective (>99%) too vertical. The contrast/extinction ratio is >500:1

Quarter-wave plate

The 1/4 wave plate, P/N 108-0001, used introduces a quarter wave rotation to photons at 1064nm as they pass in either direction through the plate. The plate has a clear aperture of 15mm and is mounted at a beam height of 43mm.

Timed pulse generated by micro board

The micro board tracks the firing of the flashlamp in the laser head and then at a pre-selected delay of ~160 microseconds triggers the Marx bank with a +15vdc pulse. The signal is normally set to fire at the peak of the gain curve of the oscillator YAG rod. The delay can be changed or set in the service mode. See Laser Service Mode with Laptop, Q-DELAY.

Marx bank

This board charges 7 capacitors in parallel and then discharges them through fast switching transistors in series so that the voltage on each capacitor is summed. This generates a ~4kV pulse with a rise time of 20ns. P/N 504-3100

750 volt power board

This board generates the dc voltage necessary to power the Marx bank. The dc voltage can be adjusted if necessary by adjusting the pot clockwise to increase the voltage. This

board and the Marx bank are located in a metal enclosure adjacent to the Pockels cell.
P/N 504-3200

Cavity closed

The beam propagating within the oscillator cavity makes a double pass through the Pockels cell and the quarter-wave plate. At 0 volts on the Pockels cell it adds no rotation while the quarter-wave adds 45° with each pass, giving a total rotation of 90°. Thus the horizontal beam that transmitted through the plate polarizer is rotated too vertical and is rejected by the polarizer and no oscillation (lasing) occurs. See figure 1-4.

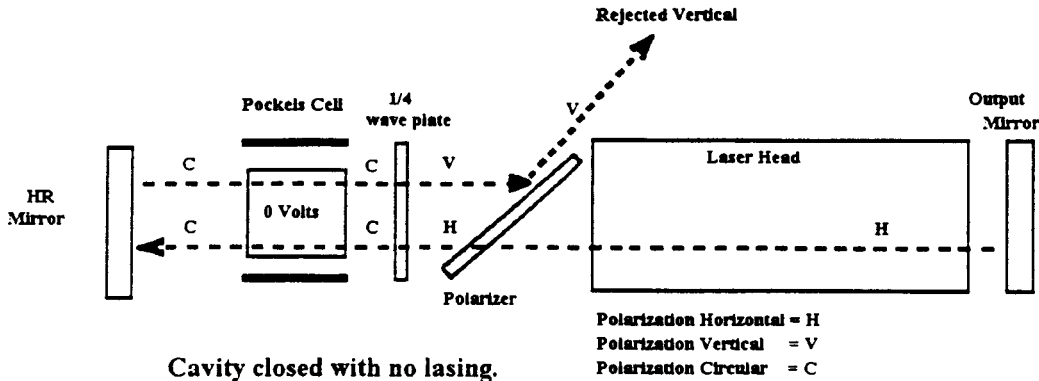


Figure 1-4

Cavity open

The beam propagating within the oscillator cavity makes a double pass through the Pockels cell and quarter-wave plate. At 3600 volts on the Pockels cell it adds 45° rotation and the quarter-wave adds 45° with each pass, giving a total rotation of 180°. Thus the horizontal beam that transmitted through the plate polarizer is rotated to vertical and back to horizontal so that it is transmitted by the polarizer allowing oscillation (lasing) to occur. See figure 1-5.

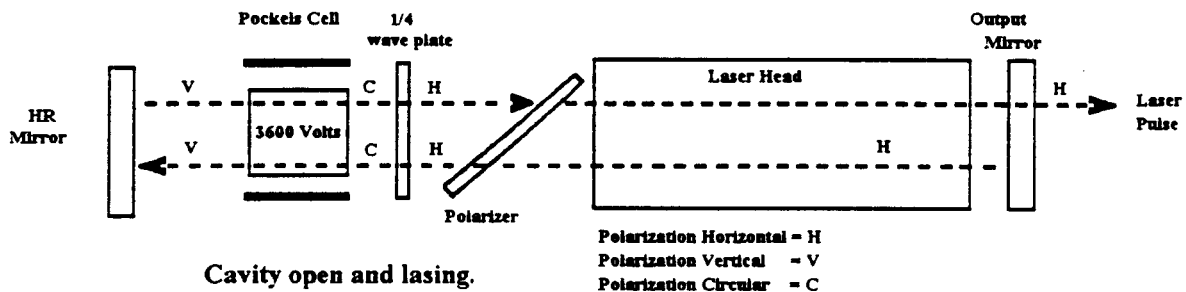


Figure 1-5

1-F. Harmonic Generators

The Medlite laser can generate laser light at the Nd:YAG fundamental wavelength (1064nm) or its second harmonic (532nm). This is achieved by passing the fundamental beam through a second harmonic generating (SHG) crystal. The crystal used is KD*P.

The SHG, P/N 624-1500, is located 180° from the output of the YAG cavity. The beam is delivered by two 45° turning mirrors. The SHG assembly is heated even when the laser is off to maintain temperature stability and maximum performance of the SHG crystal. It is heated by 24vdc that is supplied by the crystal heater PCB, P/N 624-0800.

1-G. Wavelength Separation

A set of dichroic mirrors, P/N's 105-0123(thick one) and 105-0022(thin one), isolates the 532nm beam and steers it to the articulated arm while the remaining 1064nm light passes through and is safely sent to a beam block.

1-H. Sliding Stage

The sliding stage, P/N 624-0500, contains a prism turning mirror and is electrically operated by pressing the wavelength select button on the control panel. The stage slides forward and reflects the 1064nm light to the articulated arm. Selecting Green causes the stage to slide back allowing the beam to be steered to the SHG and producing 532nm light.

1-J. Articulated Arm

Due to the pulse and energy characteristics of the Medlite laser, use of an articulated arm to deliver the laser light to the patient is necessary. Due to the high peak power and short pulse duration, mirrors from time to time may be damaged due to contamination or misalignment. Replacement or cleaning may be necessary to achieve good beam quality as well as sufficient treatment power. Since the arm is factory aligned, no field alignment is needed. However, improper installation of the mirrors or damage to the arm by hitting a wall will affect the alignment. The arm, P/N 312-0246, uses two different size diameter mirrors which are coated to reflect both wavelengths at 45°. There are five 1" optics, P/N 105-0117, and three 3/4" optics, P/N 105-0116, used.

II. Subassembly and Module Descriptions

Section 2. Control, Power Group and Cooling Groups

2-A. Micro Board

The Medlite laser is operated by the use of a micro processor to control functions directed by the operator as well as monitoring the laser for proper operation. The micro board is able to detect faults through sensors, shut the laser down if necessary and display a fault code corresponding to the problem. The micro board consists of two separate PCBs. The main or mother board 624-1000 is the interface for the microprocessor (made by Micromint, P/N RTC 180) which is commercially available. It is mounted to the rear of 624-1000. The completed assembly becomes P/N 624-2600, loosely called the "micro board".

This system is capable of monitoring up to 30 IO points with a 500 Hz loop time and detecting the many possible fault conditions. This coupled with a real time command kernel makes for a reliable and safe control system. A watch dog timer and power failure monitoring system provide a fail-safe system fault handling and de-couples the software from fast hardware fault detection.

2-B. Laser Control Panel

The micro board during normal operation receives its commands and displays its information such as spot size, power, rep rate, etc., and error codes through the laser control panel P/N 624-1100.

2-C. Power Group

The power group consists of several separate boards located in the lower left half of the cabinet. See figure 2-1. The main board is the power supply board, P/N 619-5300. This supplies the pulsed voltage to the flashlamp via the SCR board, P/N 504-6600. It is controlled by the power control board, P/N 619-5400. The other board important to proper operation is the current source board, P/N 504-6400, or sometimes called the simmer supply, it supplies the simmer current for the flashlamp. A separate power supply MAP 55-4401, P/N 425-0029, has four separate outputs that supply DC voltages to different systems. The outputs are Pin 1 = +12V, Pin 2 = -12V, Pin 3 = +24V, Pin 4 = GND, Pin 5 = +5V.

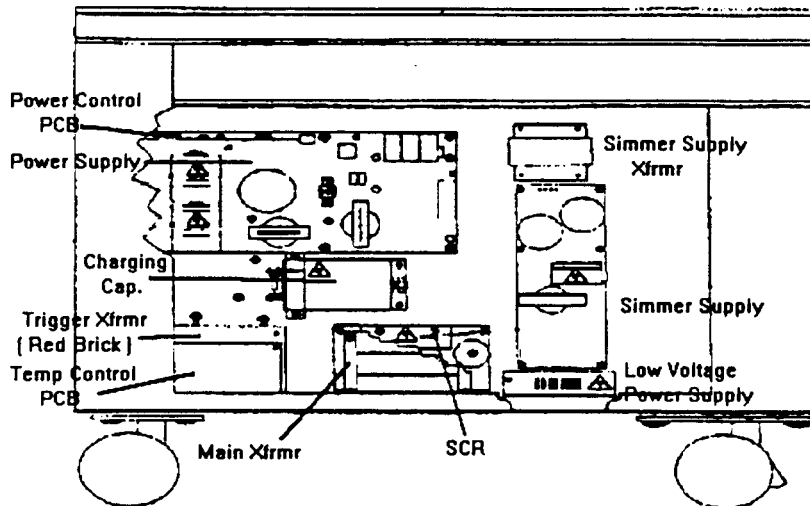


Figure 2-1

2-D. Temperature Control Board

Temperature stability is important to maximum output power from the laser. A temperature control board, P/N 505-1100, monitors the water temperature and adjusts the cooling fan speed accordingly to maintain a flat temperature profile. This PCB is located in the power group side of the cabinet. The input is 240 VAC, the output is phase controlled 240VAC to the cooling fan.

2-E. Cooling Group

The cooling group is important for reliable and stable operation of the Medlite laser. As mentioned earlier, DI water must be used with a resistivity not less than 500 kohms/cm. The cooling group is located in the lower right half of the cabinet. It consists of several components.

The major components that make up this group are, the pump, P/N 424-0002, water reservoir, P/N 309-0180, heat exchanger, P/N 315-0093, cooling fan, P/N 423-0015, pressure switch, P/N 313-0230, temperature sensor, P/N 426-0025 and DI filter, P/N 313-0099.

III. Service and Maintenance Procedures

This section will describe the major service and maintenance procedures necessary to maintain safe and reliable operation of the unit.

3-A. Cleaning Optics

Cleaning of the optics is probably the most common and most frequently performed maintenance on the system. The environment the laser is in will determine how often the optics may need to be cleaned. Low output power may be due to dirty or damaged optics. Check and determine if cleaning or replacement is needed. The laser head is protected by a dust cover, so frequent cleaning should not be necessary. Check and clean these optics as necessary. Pulsed air may be used to remove dust. If contamination remains then cleaning with a solvent is necessary.

Caution

When cleaning glued or mounted optics use solvent sparingly. Excessive solvent may dissolve the glue and your cleaning action may drag residue over the optical surface.

Use established methods for cleaning any optics. Contamination, streaks, or improper cleaning may result in damaged optics after operation.

Bench Optics

The bench optics may be cleaned in place to preserve the alignment. Care should be taken not to put too much pressure where the alignment may be affected.

Arm Optics

The arm has eight dual coated mirrors. These optics must be removed to clean them. There are five 1" optics, four mounted in caps and attached to the arm, these are orientation sensitive and proper mounting should be noted, and the fifth is in the arm stack. There are three 3/4" dual coated optics nearer the handpiece. These optics require more frequent cleaning to maintain good arm output power and are not orientation sensitive. The handpiece contains a focusing lens and should be cleaned frequently.

If replacement is necessary the mirror may be removed easily by heating the cap with a heat gun to soften the double-side sticky pad that holds the optic in place. This double-side sticky pad is only used to keep the optic in place, in the cap. There is a spring type washer that must be placed behind the optic. There is no alignment to perform so the optic must be mounted properly or the beam will not make it out the end.

3-B. Flashlamp Replacement

The flashlamp used is good for many millions of shots (10^7). Flashlamp replacement is quick and easy.

Equipment needed:

- new flashlamp P/N203-0019
- 2.5mm Allen wrench
- lens tissue
- cotton swabs
- small amount of distilled water
- safety glasses

1. Study exploded head drawing on page 8.
2. Turn off laser power using main breaker switch located on the lower rear panel.
3. Unplug main AC power cord from wall.
4. Remove top white sliding cover and remove inner dust cover.
5. Disconnect the two leads that run to the thermal sensor mounted on the laser head.
6. Use your fingers to gently pull the lamp connectors leads from the lamp electrodes. Pull only the connector, not the wires.
7. Release the laser head from its base cradle plate by screwing the thumbwheel clockwise (see figure 1-2). Note the orientation of the laser head as you remove it; anode end (+) of the head faces the output coupler.
8. Remove the laser head from the optics bench and place it on a solid, flat work area.
9. Put on safety glasses.
10. Use the 2.5mm Allen wrench to remove the screws holding the white plastic lamp retainers at each end of the laser head.
11. With a cotton swab wet each end of the exposed flashlamp electrodes with the DI water, and then using a gentle twisting motion, remove the lamp retainers. Be careful not to lose the O-rings or Teflon backing rings.
12. Pull firmly on either electrode while pushing on the other to remove the flashlamp.
13. **DO NOT** touch the glass barrel of the new lamp. Handle the new lamp by the electrode ends only. Inspect the glass barrel and clean with methanol if necessary.

Note: Wet all parts except the lamp before inserting.

14. Note the anode/cathode orientation of the new lamp and insert the lamp into the head according to "+" and "-" stickers on the head. Slide the new lamp into the laser head with the red marked electrode of the lamp to the anode end (+) and install the Teflon backing ring then the black O-ring over the ends of the lamp electrodes.
15. Press the black lamp O-rings flush to the laser head end plates before installing the lamp retainers.
16. Wet the exposed electrodes and then replace the lamp retainers. Use a gentle pushing twisting motion.

17. Once the lamp retainers have been slipped over the electrodes check to make sure the lamp is centered in the head and then bolt the lamp retainers in place. Tighten screws for a snug fit. **DO NOT** over tighten.

18. Place the laser head in the base cradle while checking orientation once again and begin to screw the thumbwheel counter clockwise to reattach the laser head to its cradle. The laser head should mate firmly against the cooling water O-rings of the cradle.

Caution

The base cradle screw threads are aluminum and can be stripped if over tightened or cross threaded. A snug fit is adequate

19. Reattach the lamp connectors at each end. Make sure the electrodes are dry before sliding the connectors over the ends.

20. Reattach the two leads for the thermal sensor.

21. Check for water leaks by running the laser. Fix any leaks and re-test until no leaks are present.

22. Replace laser head dust cover and sliding cover.

Note: If lamp voltage was raised to compensate for aging, the voltage should be lowered to its original value. Check output power from the laser and adjust as necessary. The lowest voltage possible to meet spec. power should be used to get maximum life from the flashlamp. See Flashlamp Voltage Adjustment.

3-C. Replacing the DI Water Filter

The water along with the filter should be changed once a year or if contamination is present. Contaminated water can adversely affect the performance and reliability of the laser.

Equipment needed:

- new DI filter P/N 313-0099
- 1 gallon of distilled water
- drain pan
- Phillips screwdriver
- pliers

Note: If contamination is present see Cooling Group Contamination before proceeding.

1. Turn off main circuit breaker on lower rear panel.

2. Disconnect power cord from wall socket.

3. Remove top sliding cover, right side cooling group panel and rear water panel access door.

4. Either siphon water from reservoir or pick lowest hose in cooling group to drain water.

5. Remove DI filter from behind reservoir noting flow direction (towards bottle).

6. Install new filter.
7. Refill with new distilled water.
8. Turn on laser and check for leaks.
9. If no leaks are present reinstall covers and panels.

3-D. Cooling Group Contamination

The purpose of this section is to describe the procedure for flushing the cooling group in the event that it becomes contaminated. As mentioned earlier the water should have a resistivity of not less than 500 kohms/cm and should appear clear with no color. If the water has a green tint, floating debris or laser does not seem to operate to spec. proceed with this section.

Equipment needed:

- 1 pint (~500ml) 30% hydrogen peroxide
- 12 gallons distilled water
- drain pan
- Phillips screwdriver
- pliers

1. Turn off main breaker and unplug the power cord from the wall.
2. Remove top sliding panel, cooling group side panel and rear water access panel.
3. Drain contaminated water and refill with new distilled water.
4. Add 1/2 pint (~250ml) of the hydrogen peroxide to the reservoir.
5. Circulate for 1 hour.
6. Drain water.
7. Refill with new distilled water and circulate for 15 minutes then drain.
8. Refill and inspect for contamination. If contamination is still present repeat above steps.
9. Install new DI filter and refill with distilled water.
10. Plug in power and turn on main breaker.
11. Turn on laser and check for leaks.
12. Reinstall cooling group panel, top sliding cover and rear water access panel.

3-E. Oscillator Alignment Optimization

This section will describe the procedures for optimizing the oscillator performance. This should only be done if beam quality has changed or misalignment is suspected.

Equipment needed:

- power meter with VOLUME absorbing head
- Allen key set
- Phillips screwdriver
- laser safety glasses

Caution
Never attempt to adjust the output coupler.

Danger

The inner protective cover must be removed and the safety interlock defeated to perform this operation. Extreme caution should be used. Wear safety glasses and keep room secure from unprotected personnel.

1. Remove top sliding cover and inner dust cover.
2. Defeat interlock.
3. Check for contamination or damaged optics before proceeding.
4. Put on laser safety glasses and start laser.
5. Measure output power after beam aperture before arm exit. Make sure entire beam is going through the aperture and is not being clipped. If it is clipped, a cavity optimization may not be necessary. An optical realignment may be needed first.
6. Locate and identify the horizontal and vertical adjustments at the rear of the oscillator.
7. Loosen the adjustment locks and lightly tweak the adjustments for maximum power.
8. Once maximum power has been achieved tighten adjustment locks. Check optical alignment to and through arm.
9. If optical alignment is good restore interlock to normal operation and reinstall covers.

Note: Make sure system is not free-running after alignment. If system is free-running see Eliminating Free-running before operating.

3-F. Flashlamp Voltage Adjustment

It is common for a flashlamp to last 20-30 million shots or more. During that time the efficiency of the lamps may decline. It is possible initially to compensate for the decline by increasing the pump voltage. However, after a certain point the thermal loading of the YAG rod will adversely affect the beam quality. This section will describe the procedure for increasing the lamp voltage.

Equipment needed:

- power meter with VOLUME absorbing head
- IR card
- burn paper
- laptop computer with terminal emulation
- laser safety glasses

1. Before increasing the pump voltage to bring the laser output power back to spec., make sure that the lower power is not due to cavity misalignment, optical damage or contamination.
2. Verify energy specs by reviewing QA data sheet or last service report.
3. Position the power meter after aperture to measure power.
4. Increase the pump voltage by 10 or 20 volts at a time using a laptop computer as described in the Laser Communication section.
5. Measure output power.

6. If power is still below spec. repeat steps 3 through 5.

Note: If the total voltage increases exceed the installed voltage by more than 100 volts, then the flashlamps should be changed or there may be some other undetected problem.

7. Check the free-running buffer. It needs to be at least 100 volts. See the procedure on Eliminating Free-running.

8. If the power is back to spec. level, record the new values for future reference.

3-G. Eliminating Free-running

Free-running is a term used to describe the condition of a Q-switched oscillator actually lasing before the Q-switch is open. This effect can be damaging to optics and result in power fluctuations and reduced second harmonic conversion efficiency.

There are generally three ways in which free-running can occur:

- ◆ **Misalignment** - If the polarization optics, especially the 1/4 wave plate and the Pockels cell become misaligned, then the polarization in the cavity becomes slightly undefined. This means that the dielectric polarizer does not receive linearly polarized light. Therefore, when the polarizer is supposed to be rejecting light out of the cavity, a certain amount "leaks" through. That "leakage" energy then builds up and becomes lasing. Since this lasing occurs before the Q-switch is opened, it is called free-running.
- ◆ **Increased pump voltage** - If the flashlamp voltage is increased, the oscillator will reach a level at which, due to the increased gain, it begins to lase. This occurs because the polarization optics cannot reject enough energy out of the cavity.
- ◆ **Optical feedback** - Optical feedback from an external reflective surface can increase the amount of energy in the oscillator cavity. This increased energy, just as with turning up the pump voltage can exceed the polarization optics ability to reject enough energy out of the cavity to prevent free-running.

During normal operation free-running will manifest itself in the form of shot-to-shot instability or even a snapping sound coming from the laser (not the breakdown from the handpiece focusing lens). If this occurs, stop the Q-switching immediately. Then follow the procedure below to check for and eliminate free-running.

Equipment needed:

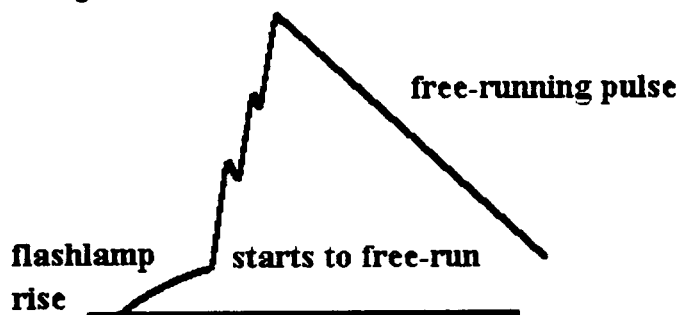
- IR card
- Oscilloscope with 1 megohm input (optional)
- Photodiode with ~ 1ns rise time (optional)
- Styrofoam high density beam block
- Allen wrench set
- laptop computer
- laser safety gasses

Note: The following procedure is done without Q-switching the laser. Do not step on the footswitch or put in calibration mode. Also, if using the IR card be aware that the card is not capable of high energy impacts as in Q-switching or high energy free-running.

1. Place the beam block in the beam path of the laser output.
2. Place the photodiode so that it monitors the light scattered off the beam block.
3. Set up an oscilloscope
 - a.) Connect the photodiode to the 1 meg input.
 - b.) Run a trigger BNC cable from the flashlamp sync BNC connector (located on lower breaker panel and labeled flashlamp sync.) to the external trigger input of the scope.
4. Start the laser (flashlamps firing only) and ensure that the flashlamp voltage is at normal operating value as shown on the computer.
5. Adjust the photo diode so that it detects a small amount of the flashlamp light and the scope displays a lamp discharge curve.



6. Now open the interactive shutter and check the scope display for any change in wave form. The wave form previously on the scope should be unchanged. If you are using an IR card you must place it so that the output light is striking the card at this time.
7. If the wave form starts with a gentle slope then abruptly increases to a jagged peak, the laser is free-running. If you are using an IR card, orange fluorescence will be noticed. If the scope display remains as above or no fluorescence from the card is noticed then the laser is not free-running.



8. If no free-running is noticed go to step 13, if the laser is free-running adjustments to the polarization optics are necessary.
9. At this time start making very small adjustments to the vertical axis of the Pockels cell through the access hole located at the top of the cell mount. The two locking screws directly under and facing outward will have to be loosened.

10. Note the vertical amplitude of the scope display or orange fluorescence. If the peak becomes less or the fluorescence becomes more faint the adjustment was made in the right direction.
11. Continue with the vertical adjustment until the free-running is minimized or eliminated. If the free running stops go to step 13.
12. Once minimum free-running has been achieved but not eliminated check the horizontal adjustment. Loosen the lock down screw. Make adjustments as before to eliminate the free-running.
13. Increase the pump voltage until the laser is free-running.

Warning

Do not exceed 1.8kV unless instructed to do so by a Continuum Biomedical representative.

14. If the laser is in a free-running state, repeat above steps to eliminate it.
15. Once the "buffer" voltage is ~100 volts, return the pump voltage to its normal level while maintaining spec. output power.
16. Tighten all lock down screws. Double check to make sure the laser is not free-running at normal input power.

Note: Once the oscillator optics are properly adjusted, passive free-running should not occur until the pump voltage has exceeded 100 volts above the normal operating level. In many cases this voltage "buffer" will be even greater than 100 volts.

3-H. Beam Alignment

A beam alignment may be necessary after a cavity alignment, if the laser was moved or bumped hard. Both wavelengths must be aligned co-linear to each other and produce complete, unclipped spots from the hand piece. As this procedure is harder to explain than do, only a brief description is provided here. Training by the factory or prior experience is most helpful and fully recommended. Refer to Figure 1-1 on page 6 for aperture and mirror locations.

Equipment needed:

- power meter
 - Allen wrench set
 - 2 factory supplied apertures with orange paper on one side and white paper on the other
 - burn paper
 - laser safety glasses
1. Have the laser running, select IR and ready mode.
 2. Take a back burn at full power, adjust oscillator if necessary, see Section 3-E.
 3. Lower power to 50 % or less and place apertures in alignment holes 1 and 2 with orange paper towards the beam.

3. Starting with the IR beam, check alignment on aperture 1, adjust IR mirror 1 to center beam. Remove aperture 1 and check alignment on aperture 2, adjust IR mirror 2 (sliding prism) to center beam. Insert aperture 1 and check alignment, adjust IR mirror 1 as necessary. Continue until beam is centered on both apertures.
4. Rotate aperture to white side and go to Green wavelength. Use the same procedure outlined above, adjusting Green mirror 1 while checking beam alignment on aperture 1 and adjusting Green mirror 2 while checking beam alignment on aperture 2. The Green beam should be co-linear with the IR beam at this point.
5. Remove alignment aperture 1. Check Green beam placement on aperture 2, it should be centered.
6. Shine arm output with lens attached away to a far wall, lower safety glasses to see faint spot and fringe pattern from alignment aperture. **USE EXTREME CAUTION. LIMIT ACCESS AND PERSONNEL TO ROOM.**
7. If spot and fringe pattern are not centered, adjustment to the stack mirror is necessary. This mirror adjustment is located above the micro board.
8. Check at 90° angles to see if alignment stays within limits.
9. Tighten lock down screws and recheck alignment.
10. Remove last alignment aperture. Setup target and shoot with aligned Green beam. Note spot. Without moving anything, change wavelengths and take one shot with IR. It should be very close to or on top of Green beam spot. If not make necessary adjustments to prism, IR mirror 2 only.

Note: Insure all adjustment lock down screws are tight.

11. Make burn spots of both wavelengths and check for clipping.
12. Measure output at optics deck, measure output from arm. There should be no more than a 50mj drop. If there is a significant drop alignment or optics should be checked.
13. Re calibrate panel display, see next section.

3-J. Panel Display Calibration

The front panel handset is used to control functions such as spot size, rep rate and wavelength. It also displays the settings of those functions as well as treatment power setting in joules/cm². It is important that the calibration be correct. Anytime the alignment or some other laser parameter is changed, check the calibration to insure it is correct.

Equipment needed:

- power meter
- laptop computer

1. Check calibration in IR and green wavelengths. Measure output power from arm output with no lens. Calculate area based on spot size indicated on laptop, then multiply by average power in millijoules. Use formula πr^2 for area, converting mm to cm. Measure output power in watts, divide by 10Hz for millijoules (mj) then by 100 for joules (J). Example: 1.7mm spot, 130mj. $1.7\text{mm} \div 2 \div 10 = .085\text{cm}$, $.085^2 \times \pi = .022698006 \times 1/x = 44.05673165 \times .130 \text{ joules} = 5.7 \text{ J/cm}^2$.

2. If calculated power and display power agree within 20% or less for both wavelengths no calibration is necessary. If one or both wavelengths do not agree within 20% or less proceed with calibration.
3. Reduce power adjust to minimum. Measure output. While the laser is Q-switching (foot on footswitch) and the laser in service mode (see Laser Service Mode with Laptop 3-K) enter measured value at **I-MIN** or **G-MIN** command line.
4. Increase power adjust to maximum. Measure output. Again enter value while laser is Q-switching at command line **I-MAX** or **G-MAX**. This procedure is exactly the same for both wavelengths except for command line.

Note: Check diode reading on laptop by typing HELP while lasing. It should be below 255 while at max. power. If not, move pick off mirror slightly. Check diode reading again. If calibration was completed with diode at 255 the calibration procedure will have to be repeated.

5. Check calibration again. If calibration is not acceptable repeat above steps.
6. Once calibration is acceptable turn keyswitch to OFF position to lock in new values.

3-K. Micro Board Replacement

The micro board is the brains that operate the laser based on input from the user or service person in service mode. The users input are do via the handset and footswitch. Inputs by the service person might be spot size information, min. and max. output power (as described above) or the doctors name. If the micro board fails, the new board must be re-calibrated and reprogrammed with the original system parameters.

Equipment needed:

- Phillips screwdriver
- Allen wrench set
- laptop computer

1. If the original micro parameters are not recorded you must access it from the old board, if possible, before removing. If you cannot find the information or access it call Continuum Biomedical Service Department to get the information. Have the laser serial number available.
2. Once the information has been saved, unplug laser.
3. Remove cover under push handle.
4. Note connector locations and orientations. Unplug connections.
5. Remove micro board.
6. Install new micro board. Make all connections. Plug in power cord.

CAUTION: Improper connections could result in board failure.

7. While laser is running enter original voltage and Q-Delay values to bring laser back to normal operating parameters. Enter spot sizes and label.
8. Check calibration by: having at least 300mj output at arm at 1064, verify that the diode is not saturated by checking **TP1** on the micro board with a DVM. It should be at

least 5vdc and no higher than 9vdc. If the dc voltage is too low the calibration will be unstable. if it dc voltage is too high it means the diode is optically saturated and will not produce a linear calibration.

9. Check **TP2**, adjust pot R26 (marked "CAL") until DVM reads 5vdc +0% / -2%. If 5vdc is not reached adjust to maximum.

Note: TP3 is the ground point.

10. Verify that the diode reading on the laptop is 240 ± 10 while the laser is lasing. If not, adjust the pick off mirror diode to attain the proper reading. The light from the pick off mirror should be full face on the diode to produce the most stable readings. Recheck **TP1** and 2 and diode reading on laptop and adjust pot R26 or pick off mirror until all values are met.

11. Enter MIN. and MAX. values for both wavelengths.

12. Turn key switch to OFF position to lock in all entered parameters.

13. Verify calibration at 100% and 50%.

3-L. Laser Service Mode with Laptop Computer

As mentioned previously the laser is controlled by a micro processor. The use of a laptop or desk computer to communicate with the laser is done through the use of some type of communication software such as Procomm, Qmodem or even Windows Terminal. Setup is important not only for the software but also the COM port on your computer.

You will need the following to communicate with the laser computer:

Computer with terminal emulation software and 9-pin female PC-AT compatible port.

Software setup should be:

Baud Rate - 19200

Parity - None

Stop bits - 1

Data bits - 8

Select the appropriate COM port to access the 9-pin serial port.

The interface cable is a **null modem** 9-pin female to 9-pin female PC-AT compatible.

Cable pin-out should be:

PC port	Medlite port
Pin 2	Pin 3
Pin 3	Pin 2
Pin 5	Pin 5

Once hardware and software are setup and the laser is on and running plug cable in the 9-pin serial port of the computer to RS-232 port of the laser. The laser must be in the ON position to communicate. From the flashing cursor, tap the ENTER key twice, the word CONTINUUM> will appear. At this prompt type HELP. **NOTE:** Your computer must be in **CAPS LOCK** mode to communicate with the laser. The following screen will appear for 1.1 version software.

```

CONTINUUM> HELP
PASSWORD Password =
VOLTS Enter power supply voltage (volts) = XXXX
Q-DELAY Q-switch delay (microseconds) = XXX
FLASH Flash lamp rate (HZ) = 10
IFR IFR only installed (Y/N) ?
PRINT Printer on (Y/N) ?
SERIAL Serial dump on (Y/N) ?
HELP Displaying help ...
S_GRN (mm) Enter hand piece spot size (GREEN) Current = 1.4 1.7 2.6
S_IFR (mm) Enter hand piece spot size ( RED ) Current = 1.5 1.8 2.9
S_DSP (mm) 'R' to reset, Hand-piece spot size Current = 1.5 2 3
RATES (HZ) 'R' to reset, Enter Q-switch rate Current = 1 2 5 10
SHOTS Reset shot counter (Y/N) ?, Current count is XXXXXX
LABEL Enter new label, Current label is ( 19 characters or spaces)
POT Read energy pot (Y/N) ? XXX
DIODE Read photo diode (Y/N) ? XXX
G-MIN Enter Green minimum power (mj) = X
G-MAX Enter Green maximum power (mj) = XXX
I-MIN Enter Infra Red minimum power (mj) = X
I-MAX Enter Infra Red maximum Power (mj) = XXX
CONTINUUM>

```

Note the first word of each line, these are the commands for the functions described after the word. The following will give a more detailed description of command and function for each line for software version 1.1.

1. Type '**PASSWORD**' hit **ENTER**, **Password =**, will appear, Type '**LASER**' hit **ENTER** to enter SERVICE MODE. This command must be used to change or enter values or functions to the laser.
2. Type '**VOLTS**' hit **ENTER**, **Enter power supply voltage (volts) =**, will appear, enter desired voltage at =, example:1490, hit **ENTER**.
3. Type '**Q-DELAY**' hit **ENTER**, **Q-switch delay (microseconds) =**, will appear, enter desired Q-switch delay at =, hit **ENTER**.
4. Type '**FLASH**' hit **ENTER**, **Flash lamp rate (HZ) = 10**, will appear. Lamp rate should always be at **10** unless instructed otherwise.
5. Type '**IFR**' hit **ENTER**, **IFR only installed (Y/N) ?**, will appear. By entering '**N**' you will be able to select "Green" or "Infrared" from handset control. Selecting '**Y**' allows only Infrared operation.

6. Type **'PRINT'** hit **ENTER**, **Printer on (Y/N) ?**, will appear. By entering **'Y'** you will activate the printer, allowing patient data to be printed. Selecting **'N'** will deactivate the printer from printing data. However, the data will be stored and can be printed out unless completely powered down or unplugged.
7. Type **'SERIAL'** hit **ENTER**, **Serial dump on (Y/N) ?**, will appear. By entering **'N'** data will not go to the serial dump but to the printer. Selecting **'Y'** will allow the data to be transferred out the RS-232 of the laser to the laptop screen where it can be saved to disk and edited in word processing program.
8. Type **'HELP'** hit **ENTER**, Full real-time HELP menu is displayed. This can be used instead of **'POT'** or **'DIODE'** commands for real-time readout of values.

NOTE: Changing the spot sizes is easy if the following is known. To change other than the last entered spot size or enter an addition spot size you must first clear all entered spot sizes by using the 'S_DSP' command (see line 11 instructions). The sequence used is as follows: Line 11, line 9, line 10. Repeat 11, 9,10 sequence until all spot sizes are entered. Only one spot size per command can be entered.

9. Type **'S_GRN'** hit **ENTER**, **Enter hand piece spot size (GREEN) Current =**, will appear. If not cleared spot size values will be shown. Type **'spot size value'**, hit **ENTER**. This value is the actual spot size at hand piece tip.
10. Type **'S_IFR'** hit **ENTER**, **Enter hand piece spot size (RED) Current =**, will appear. If not cleared spot size values will be shown. Type **'spot size value'**, hit **ENTER**. This value is the actual spot size at hand piece tip.
11. Type **'S_DSP'** hit **ENTER**, **'R' to reset, Hand piece spot size Current =**, will appear. If not cleared, spot size values will be shown. Type **'R'** hit **ENTER** to clear all current entries for GRN, IFR and DSP spot size values. Type **'spot size value'**, hit **ENTER**. This value is the indicated or displayed spot size shown on the Control Panel readout.
12. Type **'RATES'**, hit **ENTER**, **'R' to reset, Enter Q-switch rate Current = 1 2 5 10**, will appear. Enter **'R'**, hit **ENTER** to clear current values. Type **'RATES'** hit **ENTER**, **'R' to reset, Enter Q-switch rate Current =**, will appear. Enter **'1'**, hit **ENTER**. Repeat sequence for 2,5 and 10 rates. **NOTE: Q-SWITCH RATES MUST BE MULTIPLES OF 10 AND UP TO 10 ONLY.**
13. Type **'SHOTS'**, hit **ENTER**, **Reset shot counter (Y/N) ?**, will appear. Enter **'Y'**, hit **ENTER**, to clear. This is used when changing the flashlamp.
14. Type **'LABEL'**, hit **ENTER**, **Enter new label, Current label is '**, will appear. Enter new label up to 16 characters, including spaces.
15. Type **'POT'**, hit **ENTER**, **Read energy pot (Y/N) ?**, will appear. Enter **'Y'**, hit **ENTER**. This will give a real-time readout of the energy pot position.
16. Type **'DIODE'**, hit **ENTER**, **Read photo diode (Y/N) ?**, will appear. Enter **'Y'**, hit **ENTER**. This will give a real-time readout of the diode value while lasing.
17. Type **'G-MIN'**, hit **ENTER**, **Enter Green minimum power (mj) =**, will appear. Enter value **WHILE LASING**, hit **ENTER**. Insure power adjust knob is at minimum.
18. Type **'G-MAX'**, hit **ENTER**, **Enter Green maximum power (mj) =**, will appear. Enter value **WHILE LASING**, hit **ENTER**. Insure power adjust knob is at maximum.

19. Type 'I-MIN', hit ENTER, **Enter Infra Red minimum power (mj) =**, will appear. Enter value *WHILE LASING*, hit ENTER. Insure power adjust knob is at minimum.
20. Type 'I-MAX', hit ENTER, **Enter Infra Red maximum power (mj) =**, will appear. Enter value *WHILE LASING*, hit ENTER. Insure power adjust knob is at maximum.

1.2 version software

```

CONTINUUM> HELP
Displaying help ...
PASSWORD Password =
VOLTS Enter power supply voltage (volts) = XXXX
Q-DELAY Q-switch delay (microseconds) = XXX
FLASH Flash lamp rate (HZ) = 10
GRN CA Flash on Green PPS (Y/N) ? N (turns green calibrate mode on and off)
SERIAL Serial dump on (Y/N) ? N ( turns printer on and off or print to laptop)
HELP Displaying help ...
S_GRN (mm) Enter hand piece spot size (GREEN) Current = 1.3 1.7 2.7
S_IFR (mm) Enter hand piece spot size ( RED ) Current = 1.3 1.8 2.8
S_DSP (mm) 'R' to reset, Hand-piece spot size Current = 1.5 2 3
RATES (HZ) 'R' to reset, Enter Q-switch rate Current = 1 2 5 10
SHOTS Reset shot counter (Y/N) ?, Current count is XXXXXX
LABEL Enter new label, Current label is ' CONBIO
POT Read energy pot (Y/N) ? XXX
DIODE Read photo diode (Y/N) ? XXX
G-MIN Enter Green minimum power (mj) = X
G-MAX Enter Green maximum power (mj) = XXX
I-MIN Enter Infra Red minimum power (mj) = XX
I-MAX Enter Infra Red maximum power (mj) = XXX
CONTINUUM>

```

1.3 version software

```

CONTINUUM> HELP
Displaying help ...
PASSWORD Password =
VOLTS Enter power supply voltage (volts) = XXXX
Q-DELAY Q-switch delay (microseconds) = XXX
FLASH Flash lamp rate (HZ) = 10
SERIAL Serial dump on (Y/N) ? N (turns printer on and off or print to laptop)
HELP Displaying help ...
S_GRN (mm) Enter hand piece spot size (GREEN) Current = 1.3 1.7 2.7
S_IFR (mm) Enter hand piece spot size ( RED ) Current = 1.3 1.9 2.9
S_DSP (mm) 'R' to reset, Hand-piece spot size Current = 1.5 2 3
RATES (HZ) 'R' to reset, Enter Q-switch rate Current = 10 5 2 1
SHOTS Reset shot counter (Y/N) ?, Current count is XXXXXXXX
LABEL Enter new label, Current label is ' CONBIO

```

POT Read energy pot (Y/N) ? XXX
DIODE Read photo diode (Y/N) ? XXX
G-MIN Enter Green minimum power (mj) = X
G-MAX Enter Green maximum power (mj) = XXX
I-MIN Enter Infra Red minimum power (mj) = X
I-MAX Enter Infra Red maximum power (mj) = XXX
CONTINUUM>

3.1 version software

Displaying help ...

PASSWORD Password =

VOLTS Enter power supply voltage (volts) = XXXX

Q-DELAY Q-switch delay (microseconds) = XXX

SERIAL Serial dump on (Y/N) ? N (turns printer on and off or print to laptop)

WRM 20 Minute Doubler Warmup (Y/N) ? Y (turns optics heaters on and off)

HELP Displaying help ...

S_GRN (mm) Enter hand piece spot size (GREEN) Current = 1.8 2.1

S_IFR (mm) Enter hand piece spot size (RED) Current = 2.2 2.7

S_DSP (mm) 'R' to reset, Hand-piece spot size Current = 2 3

SHOTS Reset shot counter (Y/N) ?, Current count is XXXX (counts flash lamp shots)

FIRE Reset fire counter (Y/N) ? XXXX (counts q-switch pulses)

LABEL Enter new label, Current label is ' CONTINUUM

POT Read energy pot (Y/N) ? XXX

DIODE Read photo diode (Y/N) ? XXX

G-MIN Enter Green minimum power (mj) = XX

G-MAX Enter Green maximum power (mj) = XXX

I-MIN Enter Infra Red minimum power (mj) = XX

I-MAX Enter Infra Red maximum power (mj) = XXX

YEAR Year exp. = 99 (sets year to shut down)

MONTH Month exp. = 2 (sets month to shut down)

DAY Day exp. = 28 (sets day to shut down)

CONTINUUM>

For software version 1.2 and above follow the same sequence as outlined above, type the command word (first word) then hit enter it will be followed by the action item. Note that the print command has been eliminated from these versions. To turn the printer on and off you turn the serial dump on or off.

Version 3.1 has a feature to set a date and time for the patient print out and a time out date to shut the laser down. When the expiration (exp) dates meet the dates set on the hand set the laser voltage drops to 900VDC and cannot be changed until the handset date or the exp date are set apart.

To set the date and time for the patient print out do the following:

- 1.) Push the red emergency stop button down.
- 2.) Holding the Spot Size and Standby / Ready buttons on the handset release the red stop button. When the software version is displayed release the panel buttons quickly. With no buttons held you will be in the time mode.
- 3.) To set the hour use the Wavelength select button (bottom left), to change the minutes use the Spot Size button.
- 4.) To change the date hold the Standby / Ready button, then use the Wavelength select to change the day, the Spot Size button to change the month and the Rep Rate button to change the year. Note the date is as follows: day/month/year.
- 5.) When the date and time are set correctly depress the red stop button.
- 6.) Release the red stop button. To bypass the twenty minute warm-up hold the Spot Size and Wavelength select buttons while releasing the red button

IV. Troubleshooting

This section will describe the error messages that may appear on the front panel in the event of a system fault.

The laser may display up to 17 different error messages that may account for up to 20 or more actual faults. As with any computer erroneous faults or indications may occur. The first step for any error code indication is to turn the key switch to the OFF position, leave off for 30 sec. to 1 min. Turn system back on and see if error code is still displayed. If the error code is still displayed you may try turning off the main power or unplugging it for a short time. Try again, if error code still persists the fault may be real.

4-A. List, Description and Solutions of Error Code Messages

Er01 Medlite in Maintenance Mode

The external interlock on the lower back panel is not connected.

Solution: Check interlock jumper.

Er02 Coolant flow interrupted

Coolant flow switch detected a lack of flow while the coolant pump was running.

Solution: Check coolant level, remove any air bubbles from sensor tube.

Verify pump is running. Adjust the pressure switch, CW for less sensitivity.

Er03 Coolant over temp

The temperature of the coolant has exceeded the maximum limit.

Solution: Check coolant temperature, it should be below 180°F. Check cooling fan for operation, check heat exchange grill. Wall voltage may be slightly low.

Er04 Laser head cover interlock open or head temp sensor over limit

The laser cover interlock has failed or is not defeated or laser head over temp. These sensors are in series.

Solution: Check cover interlock, check laser head temp. sensor. Check cooling fan for operation, check heat exchange grill. Check wall voltage, it may be slightly low.

Er05 Not used

Er06 End of charge not detected

While firing the flashlamp the flashlamp supply has failed to recharge the flashlamp capacitors.

Solution: Check wall voltage, check simmer current, check or replace Power Control PCB, check or replace flashlamp.

Er07 Simmer supply not working correctly

Simmer supply has failed to keep the flashlamp simmering.

Solution: Check simmer current, look to see if lamp is simmering, replace flashlamp or simmer supply.

Er08 Flow switch error

Flow switch has detected flow when the coolant pump was not on.

Solution: Check for air bubbles or pressure buildup in sensor tubing. Sensor may have failed.

Er09 Arm shutter not moved

The shutter sensor has not detected a change in the shutter position after the controller has told it to move.

Solution: Adjust top sensor mount, rotate arm shutter(plunger style), replace shutter and sensor assembly.

Er10 Not used

Er11 Sliding stage fault

A sensor has detected a faulty or incomplete move of the sliding stage.

Solution: Check movement of the sliding stage. Tightening or loosening of motor screws may be necessary.

Er12 Software error

An illegal opcode was detected by the Medlite controller.

Solution: Turn key switch to OFF and restart.

Er13 Printer time out

There is a problem with the printer.

Solution: Check that printer is not jammed. Replace printer.

Er14 Not used

Er15 Not used

Er 16 Serial port communications error

The Medlite controller has detected a bad data stream in the RS-232 serial communications port.

Solution: Turn laser to OFF, reboot computer and communication software. Check communications baud rate setup.

Er17 Handset or footswitch error, a keypad button or footswitch held in an illegal position.

Solution: Release keypad or footswitch if alarm is sounded. Check footswitch for proper operation (not a stuck micro switch). Replace, footswitch, handset keypad or micro board.

4-B. Non-Error Code faults and Solutions

Other problems or faults may occur that are not detected by the Medlite controller. See below for a description of the problem and possible solution.

NOTE: These are the most likely problems that may be encountered. Problems encountered that are not covered here should be directed to the Continuum Biomedical Service Department for evaluation and determination.

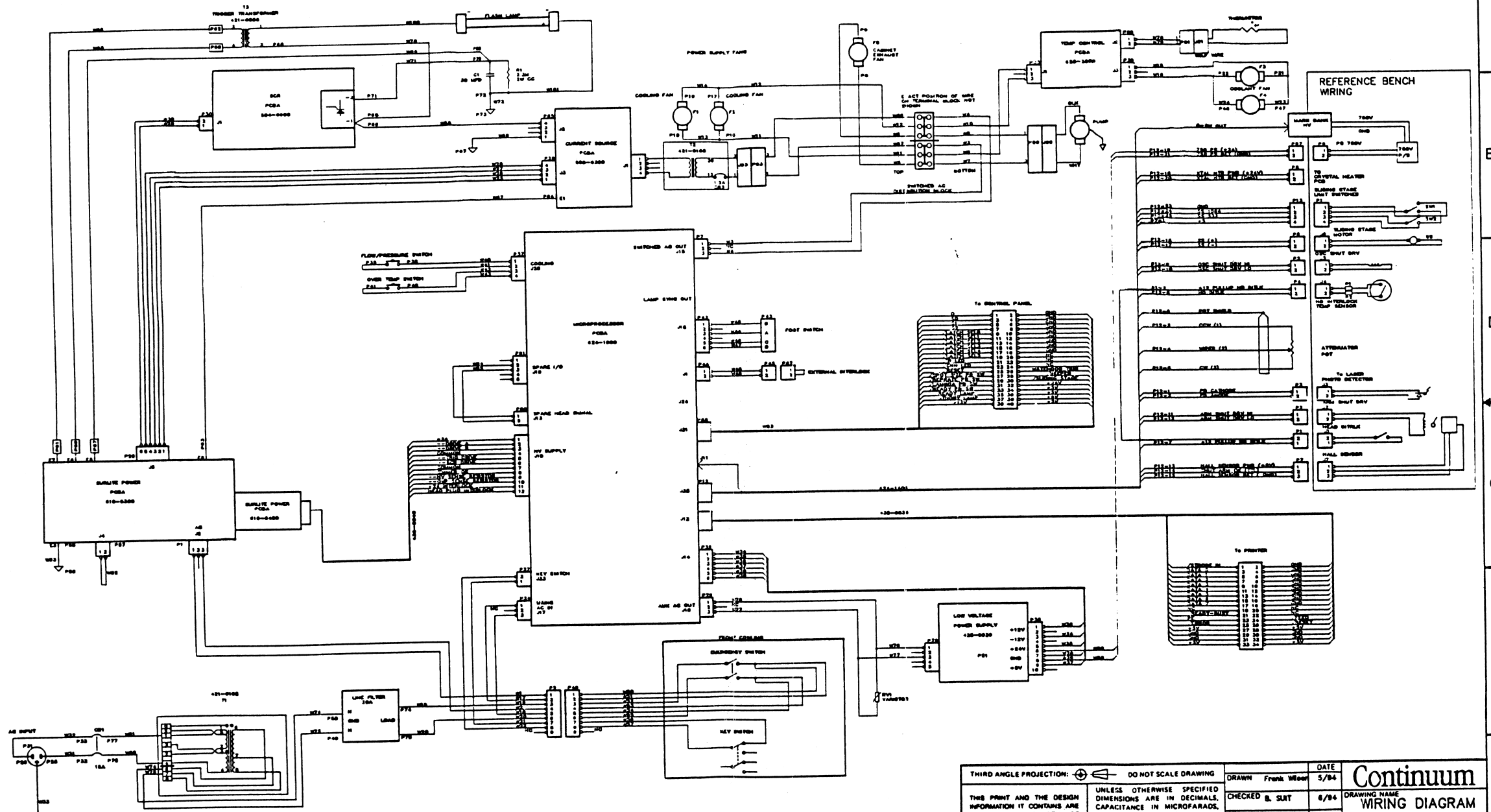
Low output power: This may be due one of several factors. Cavity alignment, flashlamp voltage increase or replacement. One or all of these may be needed. See Service and Maintenance Procedures.

Incorrect power display: If the laser was realigned, output power changed or some other parameter changed, the laser may require a recalibration. See Panel Display Calibration 3-H.

Incorrect or no spot size or rep rate display: No function or display is indicated for spot size or rep rate. Controller may have suffered a memory loss. A reentry of all data may be necessary.

Correct power displayed but poor tissue response: The optics in the arm or focusing lens may have become dirty or damaged. Check and replace optics. Check arm output calibration, it should be within 20% accuracy.

REVISIONS					
REV	ZONE	DESCRIPTION	ECO#	DATE	APPROVED
A		PRODUCTION RELEASE	4543	6/84	B.SUT
B		BOM CHANGE	4608	11/84	J.L.
C		WIRES REMOVED LINE 11,1201 REWIRE	4825	3/85	B.SUT
D		CLARIFY DWG	5027	5/85	B.SUT



INPUT LINE VOLTAGE	OHM FUSE	AMP	AB IN	AB OUT
115 VAC	15 A	1-1.5-0.0	4.6	0.7
115 VAC	15 A	1-1.5-0.0	4.6	0.7
230 VAC	7.5 A	1-1.5-0.0	4.6	0.7
230 VAC	7.5 A	1-1.5-0.0	4.6	0.7
FOR AN ADDITIONAL ICE OUT 0.8				

THIRD ANGLE PROJECTION: DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN DECIMALS, CAPACITANCE IN MICROFARADS, RESISTANCE IN OHMS, SR, SW

SURFACES DECIMALS
 .XX
 .XXX
 .XXXs

BREAK SHARP EDGES .06"

DATE	DATE	DATE
5/84	6/84	6/84

DRAWN Frank Wiser
 CHECKED B. SUT
 APPROVED J.L.

APPROVED

MATERIAL

FINISH

SCALE

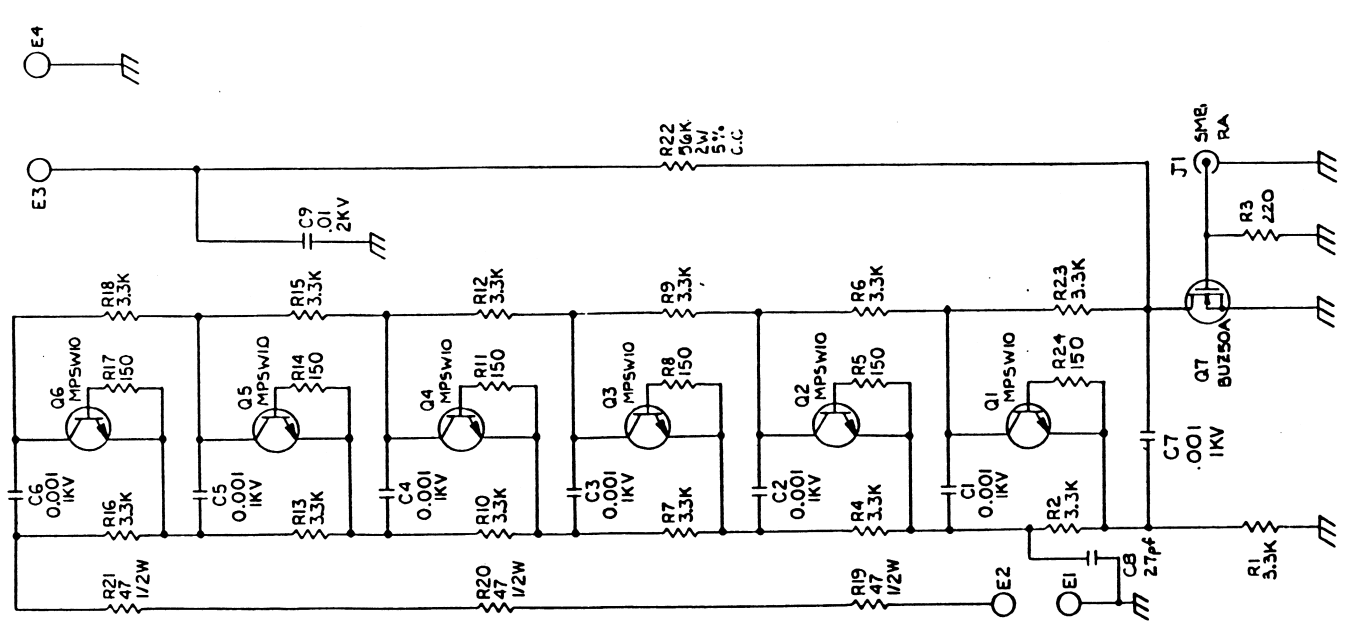
Continuum
 DRAWING NAME
WIRING DIAGRAM
MEDLITE, DOMESTIC

DRAWING NO.
624-0225P-4

Q.A. REFERENCE

REV. D

REV	ZONE	DESCRIPTION	ECOD	DATE	APPROVED
2		RID RELEASE		2/89	J. HENDEEN
A		PRODUCTION RELEASE			
B		PC REDESIGN	2051	7/2/85	
C		HARDWARE CHANGE ONLY	3439	5/4/83	

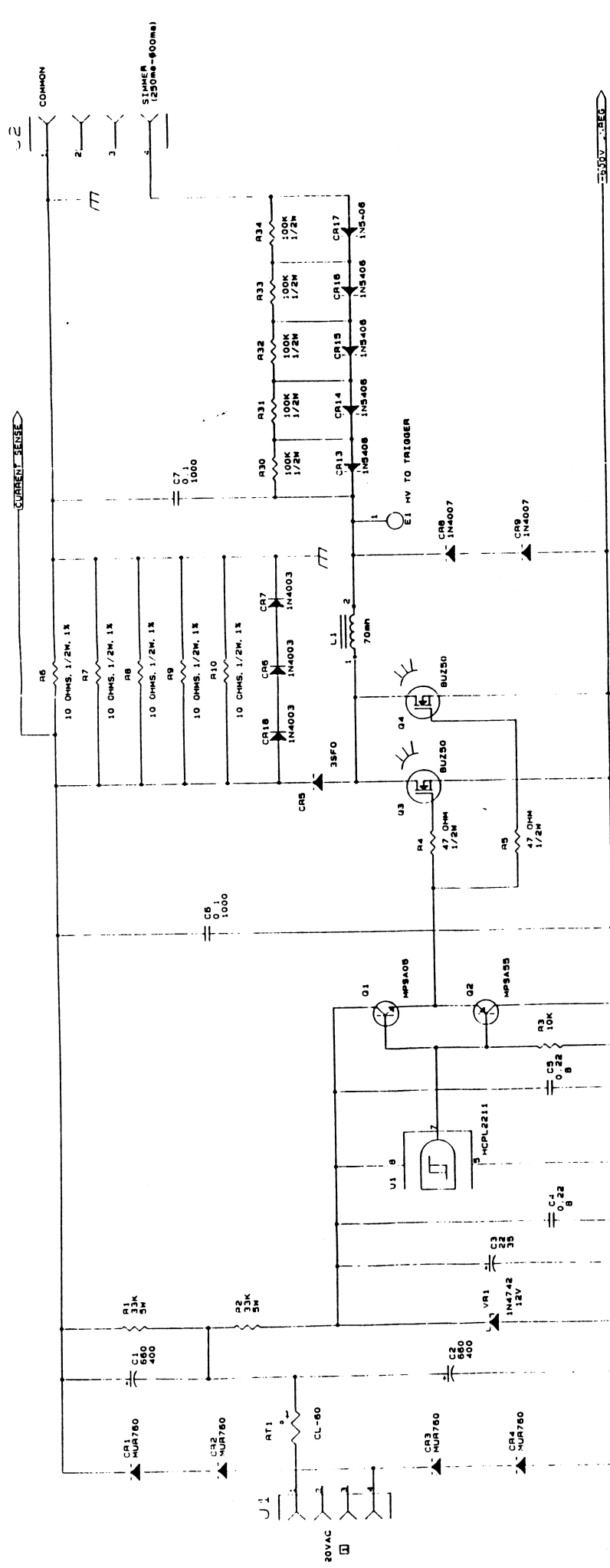


ITEM	PART NUMBER	DATE	QTY
DRAWN	BSUIT	2/89	
CHECKED			
APPROVED			
CONTRACT NO.			
MATERIAL			
FINISH			
SCALE	NONE		

THIRD ANGLE PROJECTION: DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED. DIMENSIONS ARE IN DECIMALS. CAPACITANCE IN MICROFARADS. RESISTANCE IN OHMS, 5%, 1W. SURFACES: DECIMALS .X1, .X2, .X3, .X4, .X5, .X6, .X7, .X8, .X9, .XX1, .XX2, .XX3, .XX4, .XX5, .XX6, .XX7, .XX8, .XX9. BREAK SHARP EDGES 200°.

DESCRIPTION	Quantel International
DRAWING NAME	SCHEMATIC
DRAWING NO.	MARX BANK
DRAWING NO.	504-3100-2
D.A. REFERENCE	
REV.	C

REVISIONS		
REV. NO.	DESCRIPTION	DATE
3	ADD WORK RELS. 401.0015	3/5/92

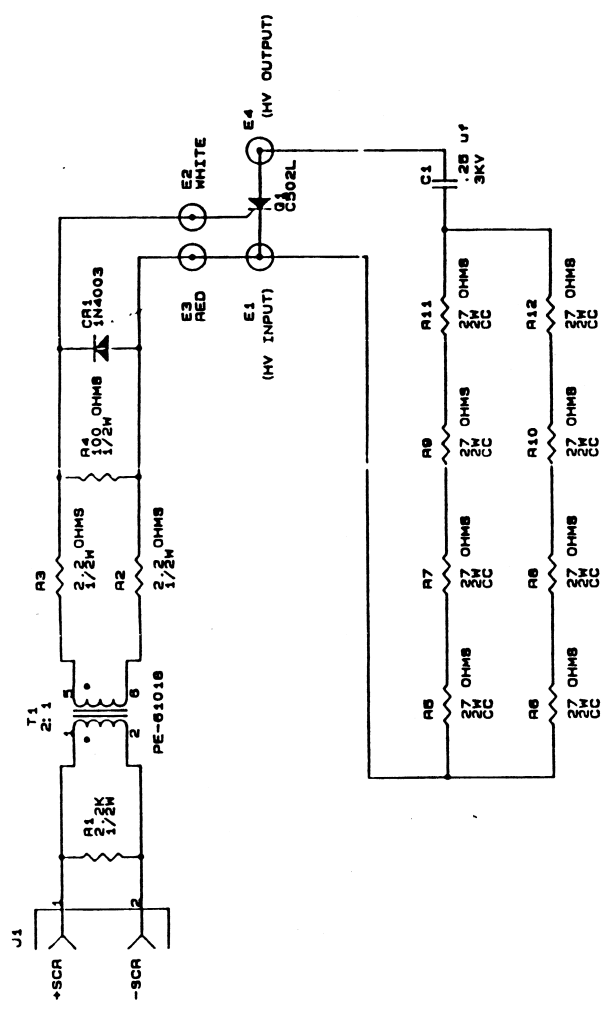


NOTES: 1. 220VAC MUST BE FROM ISOLATED XFMR WINDING ONLY.

THIRD ANGLE PROJECTION:		DO NOT SCALE DRAWING	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN DECIMALS		DATE	5/92
THIS PRINT AND THE DESIGN INFORMATION IT CONTAINS ARE THE SOLE PROPERTY OF CONTINUUM AND MAY NOT BE REPRODUCED OR COPIED IN ANY MANNER WITHOUT PERMISSION IN WRITING FROM CONTINUUM. THIS DRAWING MUST BE RETURNED TO CONTINUUM UPON COMPLETION OF THE PROJECT OR ORDER.		DRAWN	DOMONIC Q.
SURFACES DECIMALS		CHECKED	Bjt
.XXI		APPROVED	5/92
.XXXI		APPROVED	5/92
BREAK SHARP EDGES 90°		MATERIAL	
ANGLES:		FINISH	
		SCALE	1:1

Continuum
 SCH CURRENT SOURCE PCB
 DRAWING NO. 504-6400-2
 Q.A. REFERENCE REV. B

REVISIONS					
REV	ZONE	DESCRIPTION	ECO#	DATE	APPROVED
A		PRODUCTION RELEASE			Y
B		BOM CHANGE ONLY (1)	3347	2-5-01	Y



ITEM	PART NUMBER	DATE	DESCRIPTION	QTY
	DRAWN 5/8	11/14/80	Quantel International	
	CHECKED 5/11	1/21	DRAWING NAME	
	APPROVED Y	1/85	SCHEMATIC	
	CONTRACT NO.		SCR PCB	
	MATERIAL		DRAWING NO.	
	FINISH		504-6600-2	
	SCALE		Q.A. REFERENCE	
			REV. B	
			SIZE	
			SHEET	

THIRD ANGLE PROJECTION: DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN DECIMALS, CAPACITANCE IN MICROFARADS, RESISTANCE IN OHMS, 5%, 1/2W

SURFACES DECIMALS .X± .XX± .XXX±

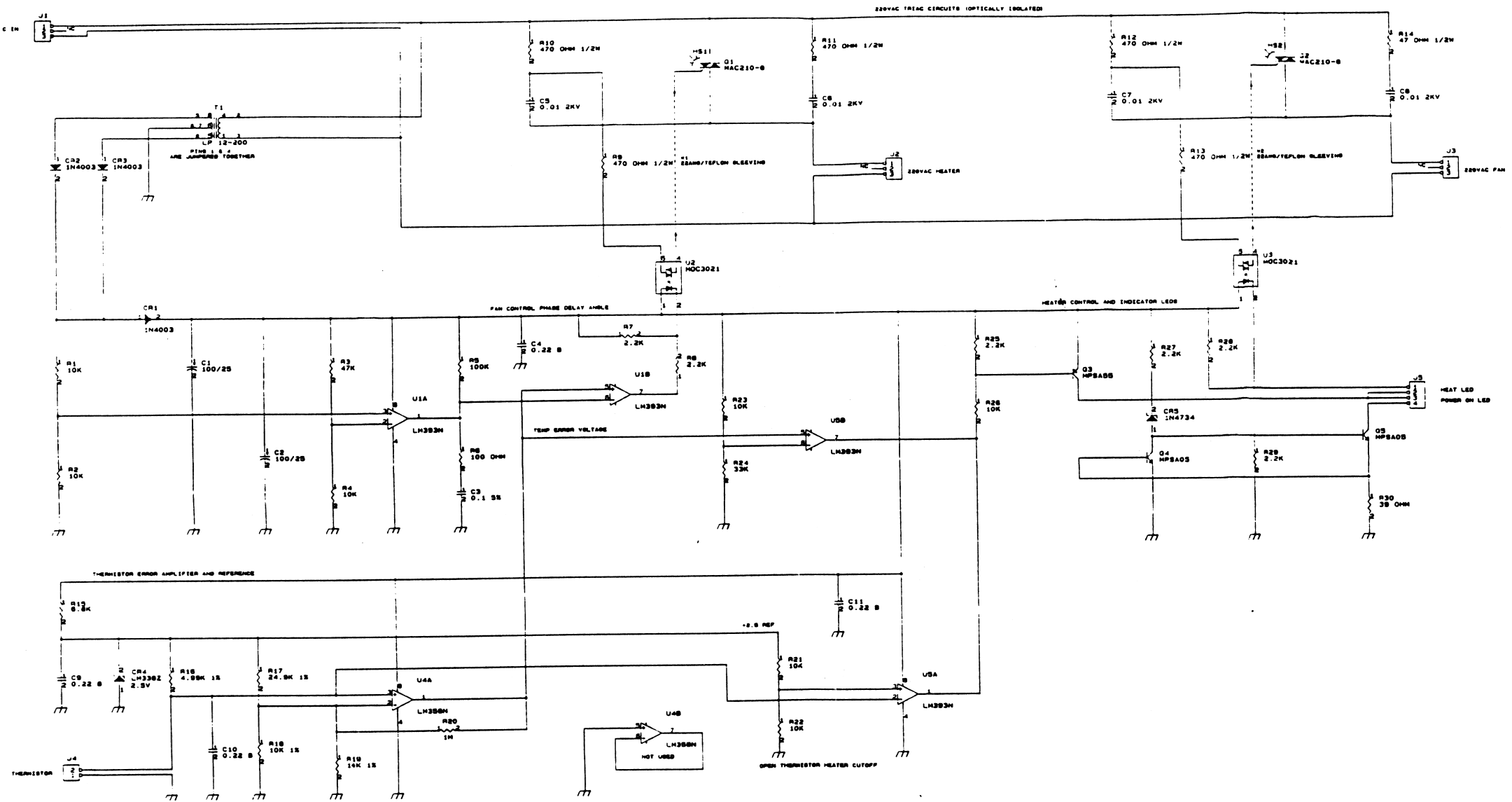
BREAK SHARP EDGES 005°

ANGLES ±

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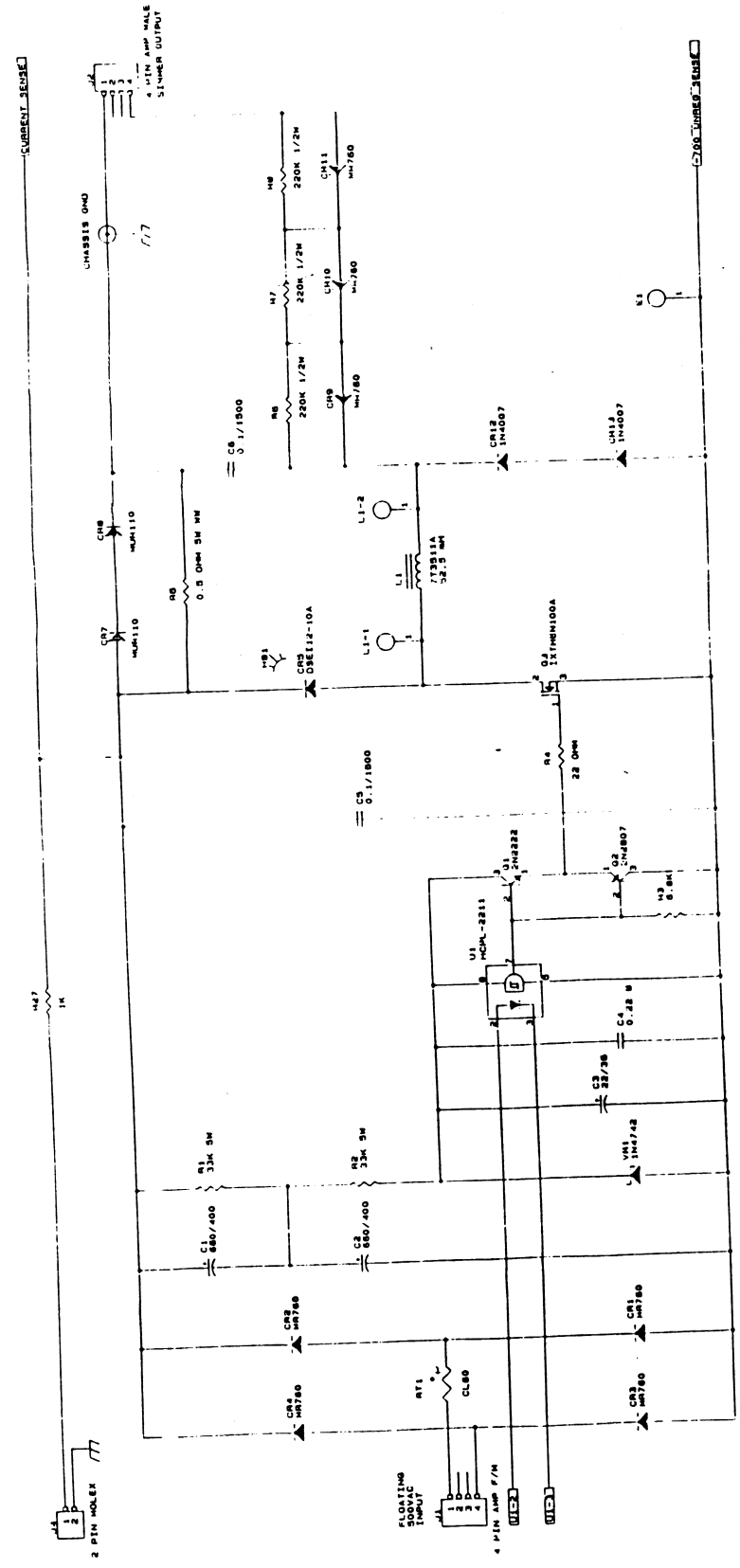
NOTE: 1, E1 AND E4 ARE ON Q1, SCR MOUNTING BRACKET.

REVISIONS					
REV	ZONE	DESCRIPTION	ECO#	DATE	APPROVED
B		C5-B CHG TO 2KV, R19 TO 15K	3233	1-3-92	J.J.
C		R19 CHG TO 14K	3310	1-27-92	J.J.



THIRD ANGLE PROJECTION:	DO NOT SCALE DRAWING	DATE	9-D-90
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	SURFACES DECIMALS —/— .X1 —/— .XX1 —/— .XXX1	CHECKED	B. SUIIT
		APPROVED	J.J.
		APPROVED	D-11-90
	BREAK SHARP EDGES 008"	MATERIAL	
		FINISH	
		SCALE	
		DRAWING NAME	Continuum
		DRAWING NO.	SCHMATIC, TEMP CONTROL PCB
		Q.A. REFERENCE	505-1100-2
		REV.	C

REV. ZONE	DESCRIPTION	ECO#	DATE	APPROVED
C	ALD 21 R27 DEL CRG, W/S	3697	10/92	J.J.
D	SCM CHANGE ONLY	3796	1/93	J.J.
E	ADD 22B & C2G	3825	3/95	J.J.
F	LABEL CHANGE ONLY	4306	1/94	J.J.



- NOTES:
1. CAUTION--DANGEROUS VOLTAGES
 2. 500 VAC INPUT MUST BE FROM FLOATING SOURCE ONLY.

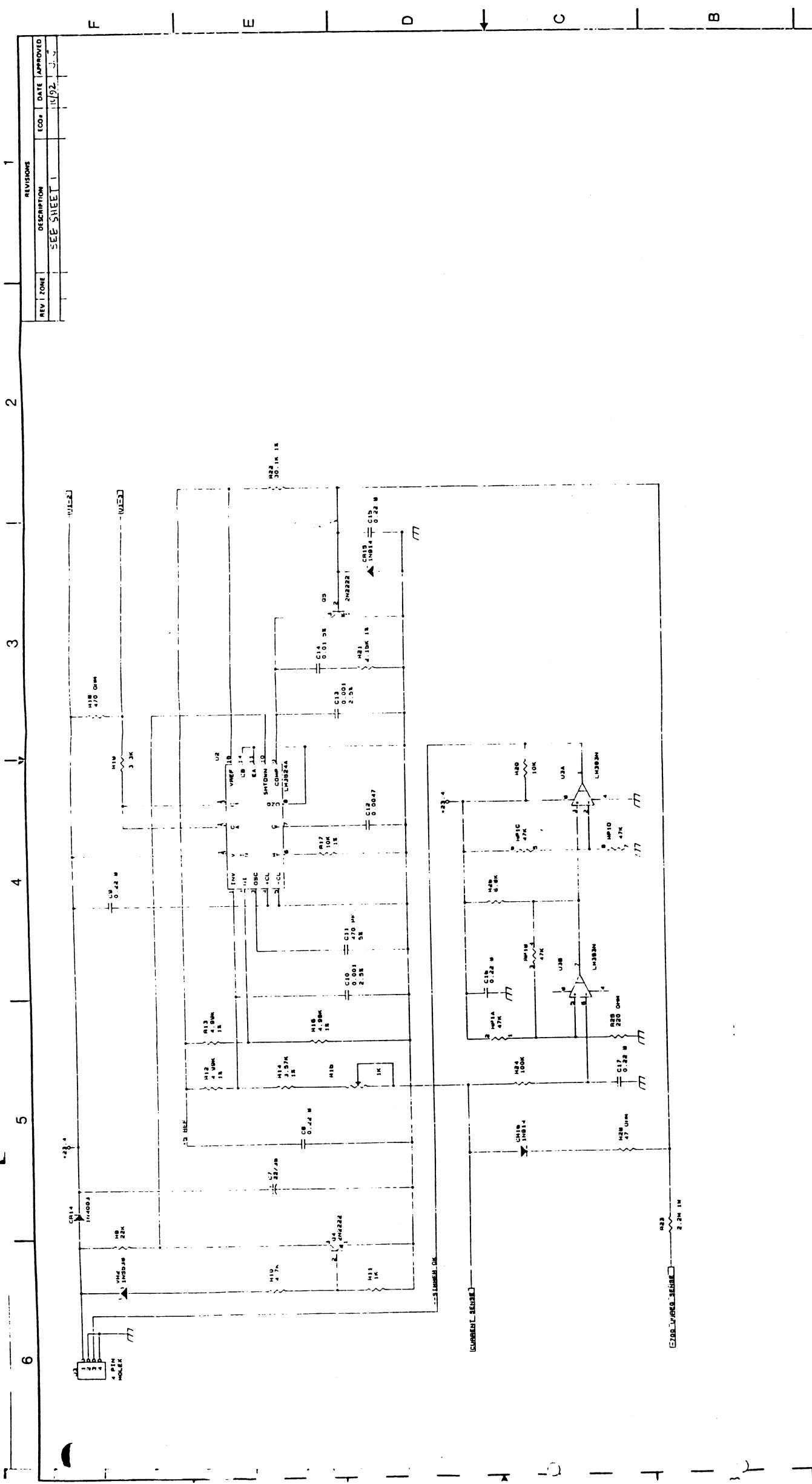
REV. ZONE	DESCRIPTION	ECO#	DATE	APPROVED
C	ALD 21 R27 DEL CRG, W/S	3697	10/92	J.J.
D	SCM CHANGE ONLY	3796	1/93	J.J.
E	ADD 22B & C2G	3825	3/95	J.J.
F	LABEL CHANGE ONLY	4306	1/94	J.J.

REV. ZONE	DESCRIPTION	ECO#	DATE	APPROVED
C	ALD 21 R27 DEL CRG, W/S	3697	10/92	J.J.
D	SCM CHANGE ONLY	3796	1/93	J.J.
E	ADD 22B & C2G	3825	3/95	J.J.
F	LABEL CHANGE ONLY	4306	1/94	J.J.

REV. ZONE	DESCRIPTION	ECO#	DATE	APPROVED
C	ALD 21 R27 DEL CRG, W/S	3697	10/92	J.J.
D	SCM CHANGE ONLY	3796	1/93	J.J.
E	ADD 22B & C2G	3825	3/95	J.J.
F	LABEL CHANGE ONLY	4306	1/94	J.J.

REV. ZONE	DESCRIPTION	ECO#	DATE	APPROVED
C	ALD 21 R27 DEL CRG, W/S	3697	10/92	J.J.
D	SCM CHANGE ONLY	3796	1/93	J.J.
E	ADD 22B & C2G	3825	3/95	J.J.
F	LABEL CHANGE ONLY	4306	1/94	J.J.

REV. ZONE	DESCRIPTION	ECO#	DATE	APPROVED
C	ALD 21 R27 DEL CRG, W/S	3697	10/92	J.J.
D	SCM CHANGE ONLY	3796	1/93	J.J.
E	ADD 22B & C2G	3825	3/95	J.J.
F	LABEL CHANGE ONLY	4306	1/94	J.J.



REV	ZONE	DESCRIPTION	ECO#	DATE	APPROVED
1		SEE SHEET 1		10/02	J.S.

THIRD ANGLE PROJECTION	DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN DECIMALS. CAPACITANCE IN MICROFARADS. RESISTANCE IN OHMS 5% .3W	SURFACES	DECIMALS	ANGLES
1	1		1	.1	XXI
2	1		2	.01	XXXI
3	1		3	.001	XXXXI
4	1		4	.0001	XXXXXI
5	1		5	.00001	XXXXXXI
6	1		6	.000001	XXXXXXXI

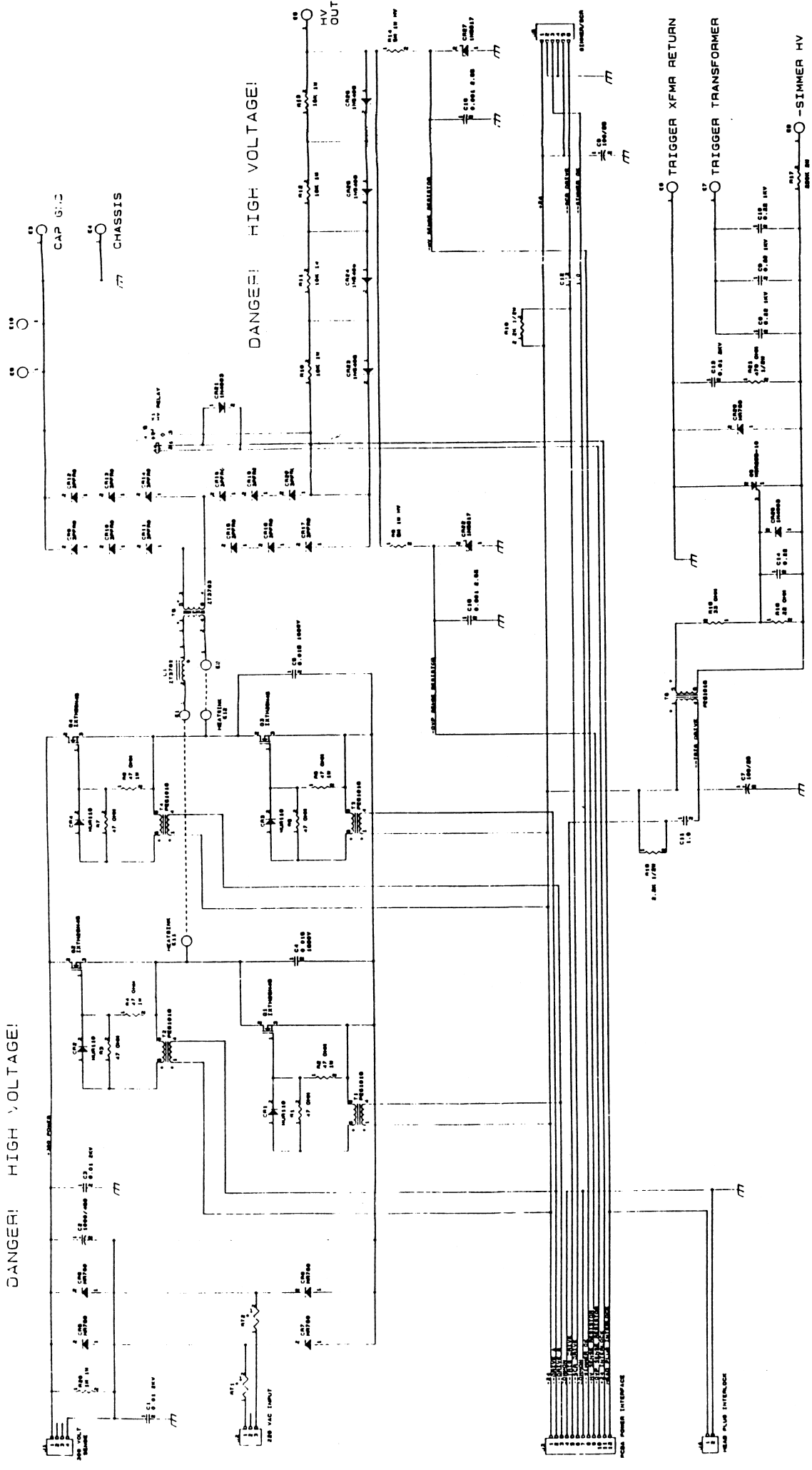
DATE	DRAWN	CHECKED	APPROVED	APPROVED	MATERIAL	FINISH
3/1/93	V. CASANOVA					

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Continuum
 DRAWING NAME SCHEMATIC
 CURRENT SOURCE
 .71.4A PCB
 DRAWING NO. 505-9300-2
 O.A. REFERENCE REV.

REVISIONS					
REV	ZONE	DESCRIPTION	ECN#	DATE	APPROVED
D		ADD C14 - C16, CHG RIG 33A	3345	3-2-92	YCY

DANGER! HIGH VOLTAGE!



DANGER! HIGH VOLTAGE!

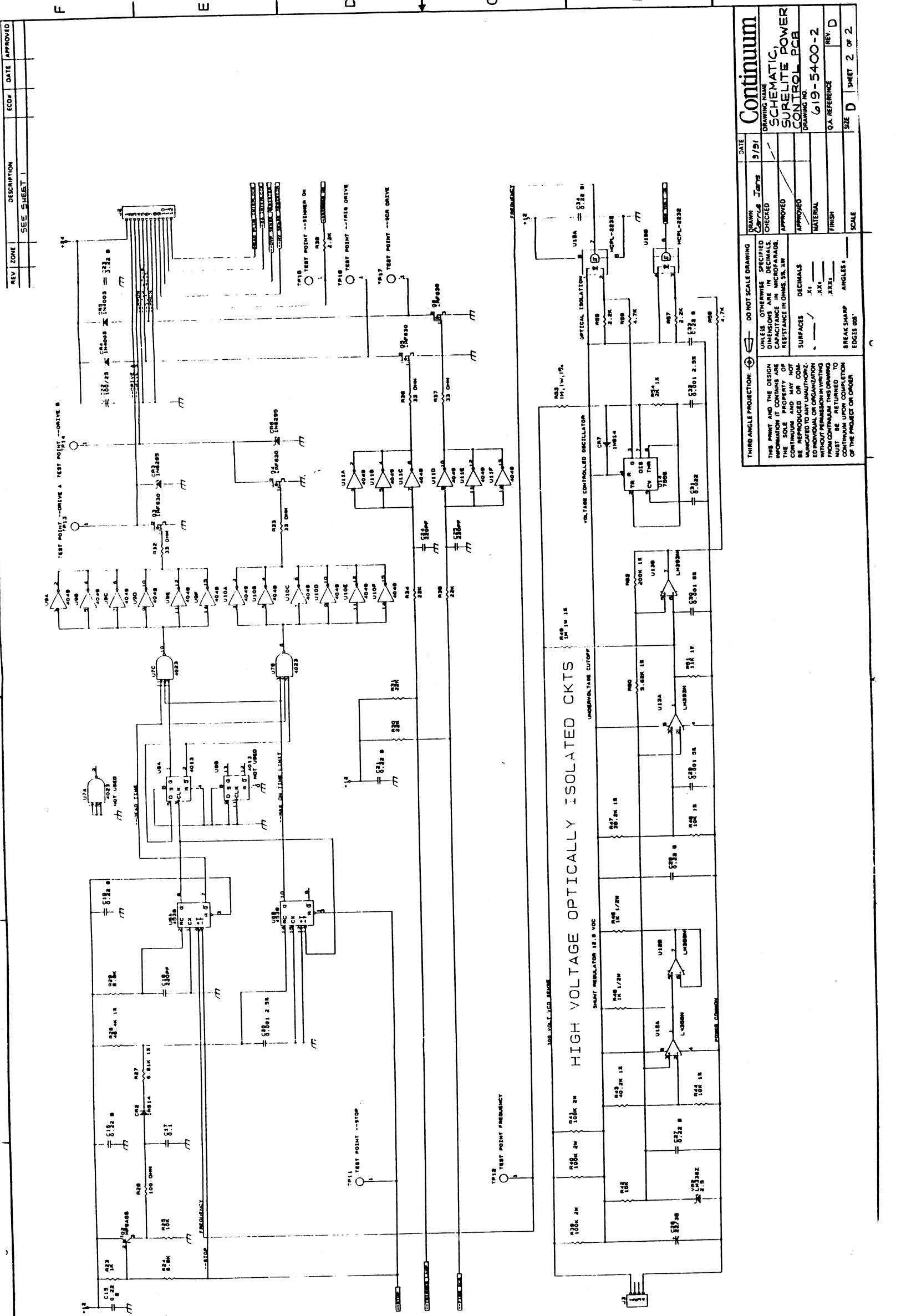
DANGER! HIGH VOLTAGE!

DATE	DATE	DATE
3-2-92	3-2-92	3-2-92

DRAWN: *YCY*
 CHECKED: *YCY*
 APPROVED: _____
 APPROVED: _____
 MATERIAL: _____
 FINISH: _____
 SCALE: _____

Continuum
 DRAWING NAME: SCHEMATIC
 SURELITE POWER PCB
 DRAWING NO.: 619-5300-2
 O.A. REFERENCE: REV. D

THIRD ANGLE PROJECTION: \oplus DO NOT SCALE DRAWING
 UNLESS OTHERWISE SPECIFIED
 DIMENSIONS ARE IN DECIMALS.
 CAPACITANCE IN MICROFARADS.
 RESISTANCE IN OHMS, $\% \text{ } \Omega$
 SURFACES DECIMALS
 .X1
 .X2
 .X3
 .X4
 .X5
 .X6
 .X7
 .X8
 .X9
 .X0
 BREAK SHARP EDGES 00°



THIRD ANGLE PROJECTION:	DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED IN MICROINCHES. SURFACE FINISH IS UNLESS OTHERWISE SPECIFIED.	
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DRAWN <i>John J. Jones</i>	DATE 3/91
CHECKED	APPROVED
MATERIAL	FINISH
SCALE	SCALE

Continuum DRAWING NAME SCHEMATIC, SURELITE POWER CONTROL PCB DRAWING NO. 619-5400-2 Q.A. REFERENCE REV. D SIZE D SHEET 2 OF 2	
---	--

TO SERVICE PANEL

TO PRINTER
SEIKO OPU-20-24 CF

REVISIONS				
REV	ZONE	DESCRIPTION	ECO#	DATE APPROVED
1		CABLE FROM STR TO RA	345	3/83
2		EOM CHANGE	1361	3/83

SPARE HEAD SIGNALS

TO LASER BENCH

TO LV DC
POWER SUPPLY
PWR1 MAP55-4001

SWITCHED
AC OUT
AUX.
AC OUT
MAINS
AC IN

FOOT SWITCH
CONTROLS

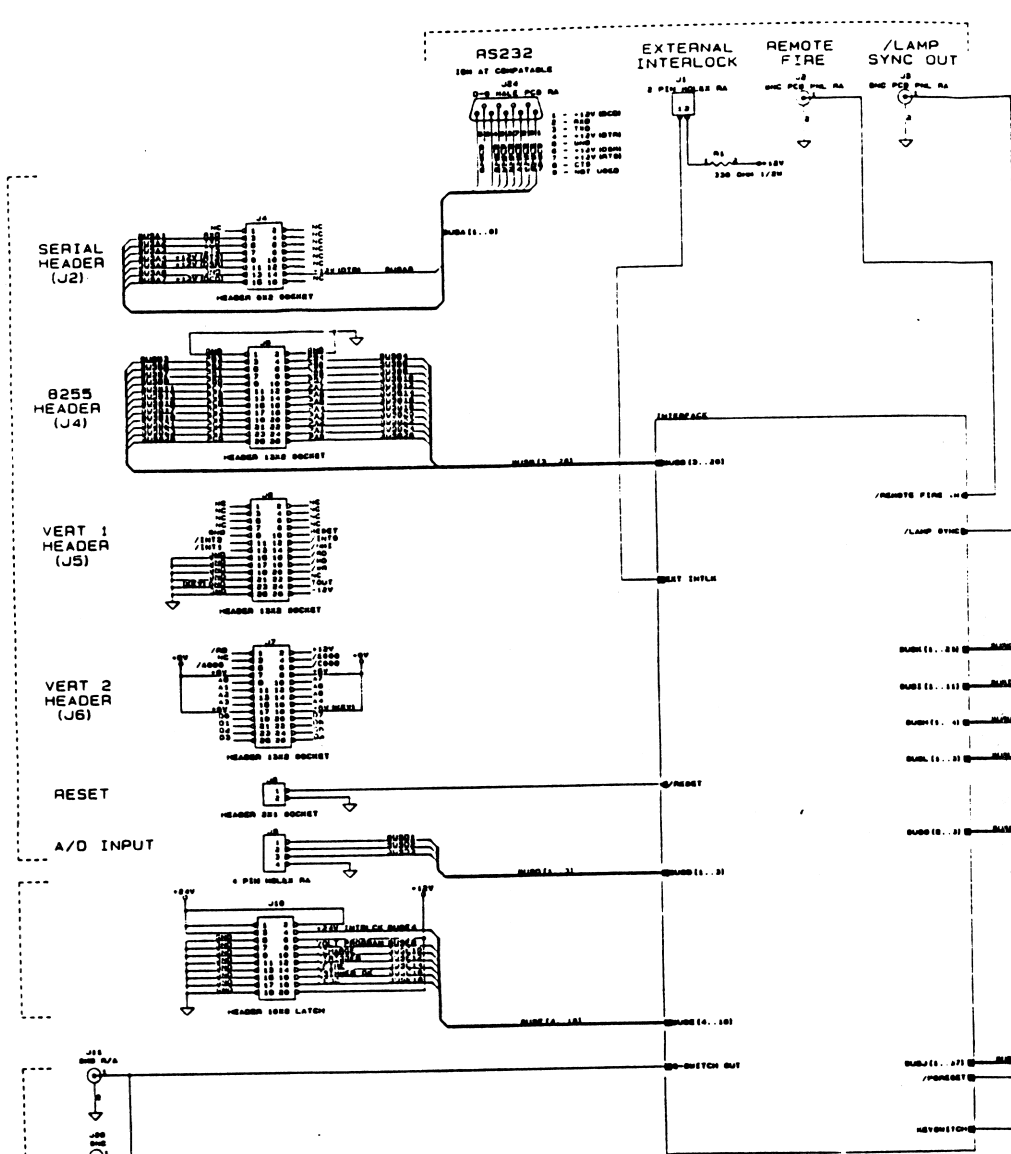
SPARE
INPUTS

TO COOLING

TO CONTROL
PANEL

PUSH BUTTON
RESET

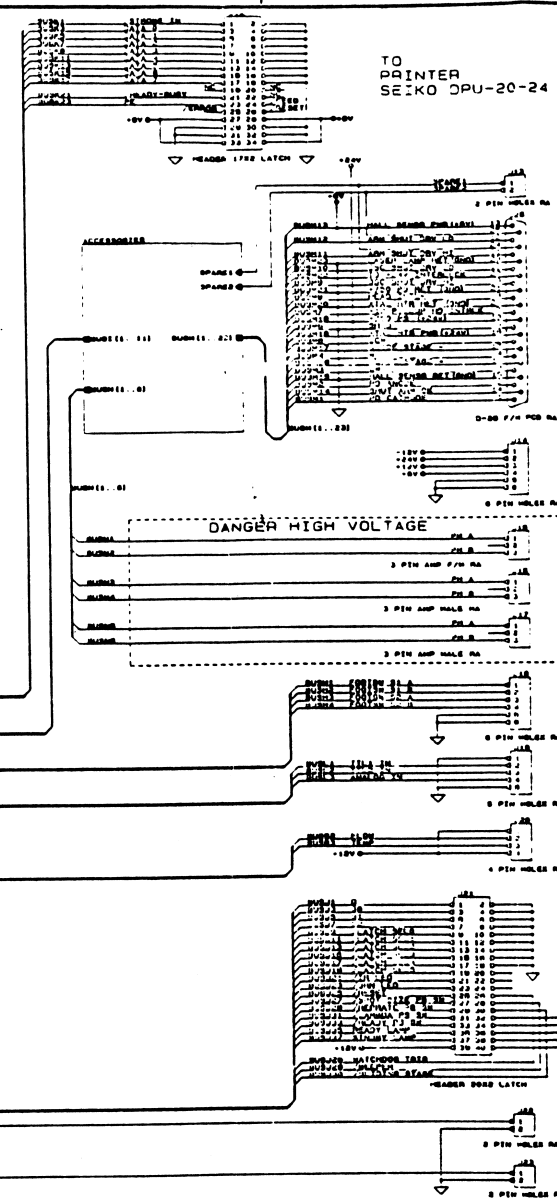
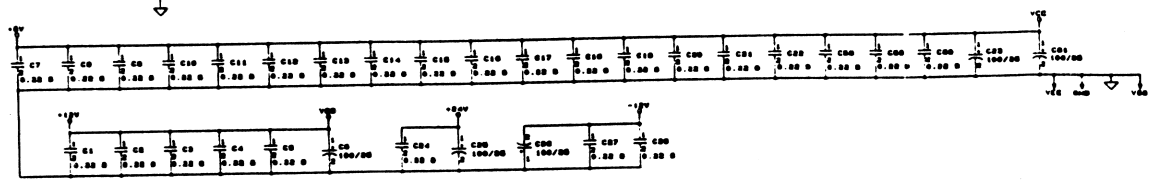
KEYSWITCH



TO
RTC180
COMPUTER

TO HV
POWER
SUPPLY

TO MARK
BANK



THIRD ANGLE PROJECTION:		DO NOT SCALE DRAWING		DATE	
DRAWN VAL CASHION		3/82		Continuum	
CHK'CD S. SUIT		3/82		DRAWING NAME	
APPROVED J.J.		3/82		SCHEMATIC MECHANICAL MICROPROCESSOR	
APPROVED				DRAWING NO.	
MATERIAL				624-1000-2	
FIN SH				IQA REFERENCE	

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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN DECIMALS. CAPACITANCE IN MICROFARADS. RESISTANCE IN OHMS. 5% TOL.

SURFACES DECIMALS
 X1 _____
 .XX1 _____
 .XXX1 _____

BREAK SHARP ANGLES

F
E
D
C
B
A

6

5

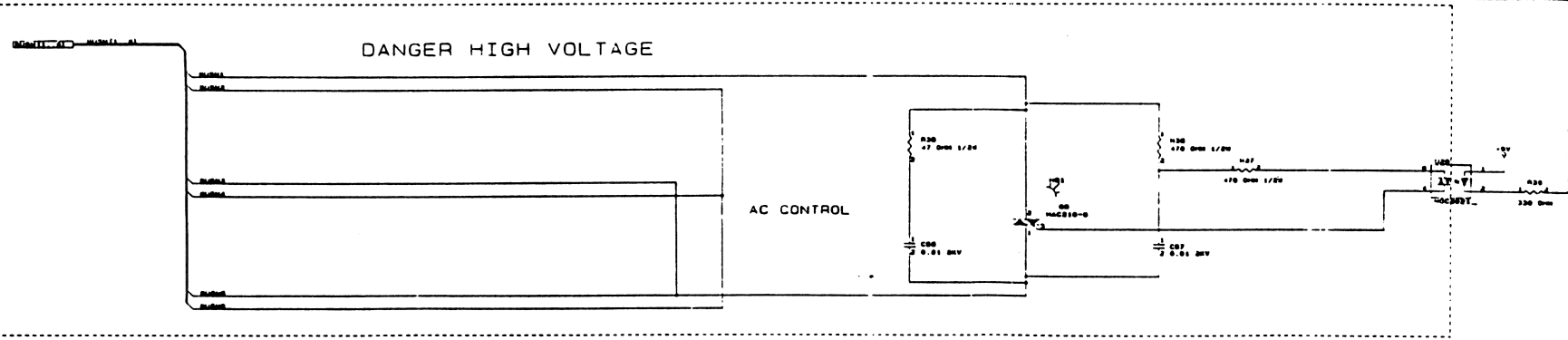
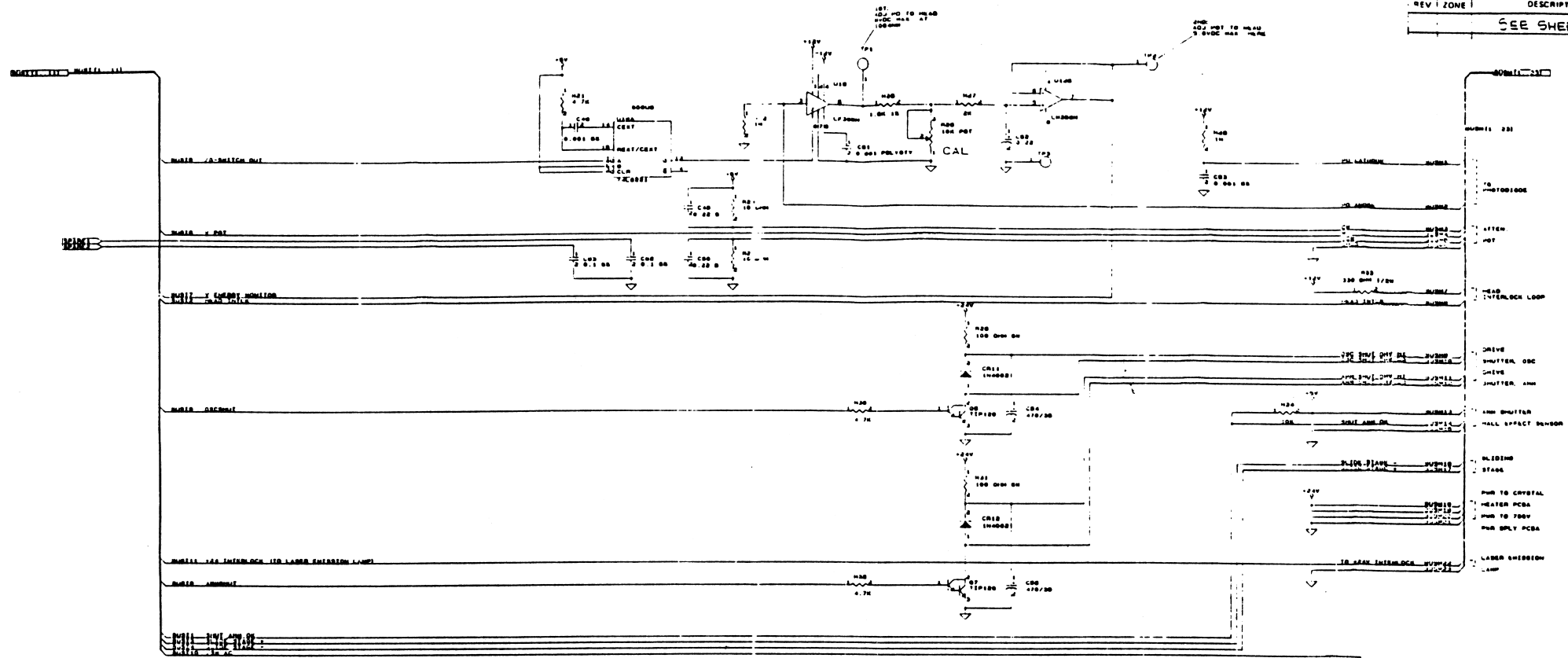
4

3

2

1

REVISIONS					
REV	ZONE	DESCRIPTION	ECO#	DATE	APPROVED
SEE SHEET 1					



MEDLASER
ACCESSORIES

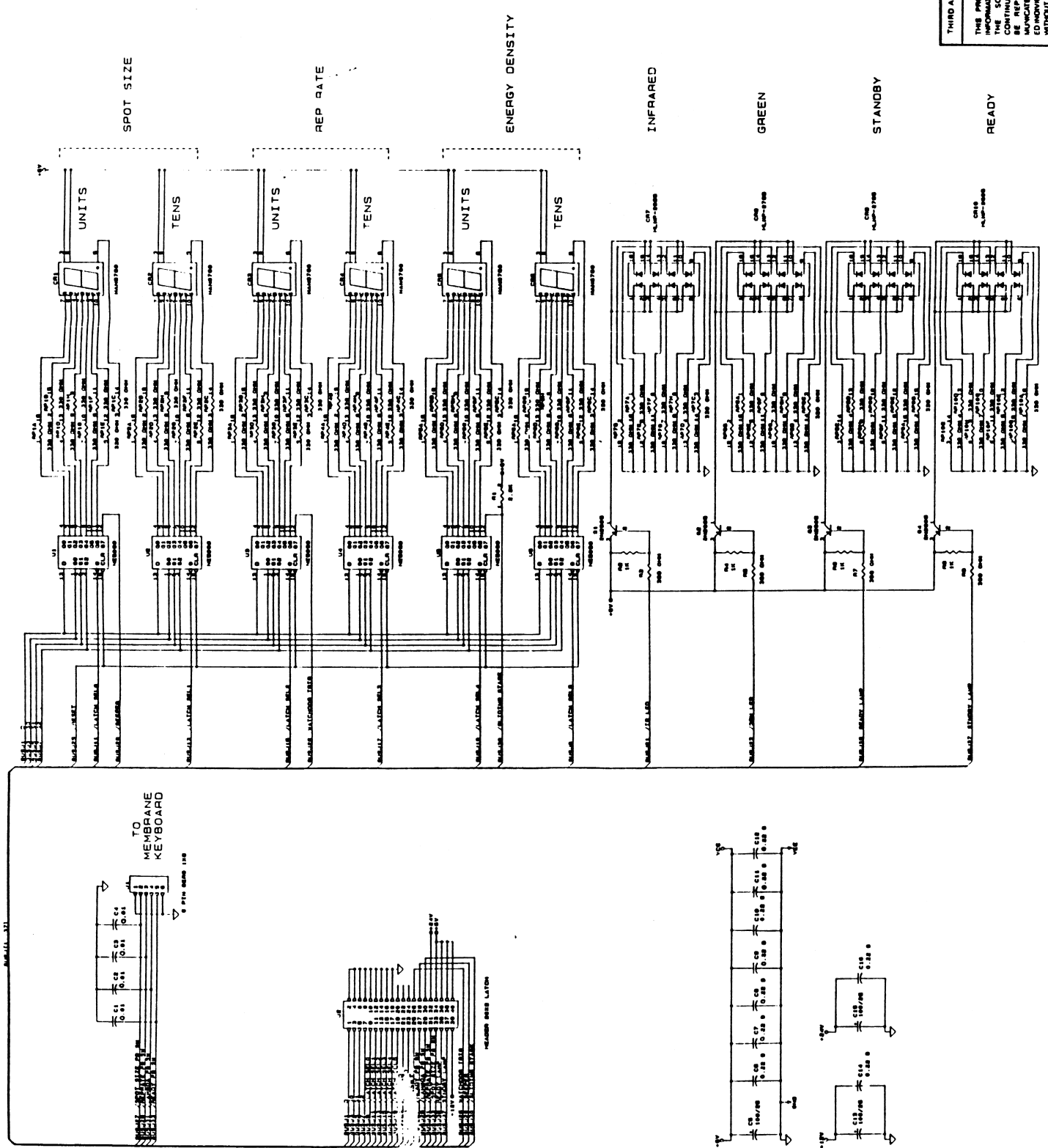
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SURFACES		DECIMALS	DATE
— /		X1	8/12
		.XX	8/12
		.XXX	8/12
BREAK SHARP EDGES 100°		ANGLES	

DRAWN	JML	DATE	8/12
CHECKED	JML		
APPROVED	J.S.		
APPROVED	J.S.		
MATERIAL			
FINISH			
Q.A. REFERENCE			

Continuum	
DRAWING NAME	
SC4, MEDLASER	
DRAWING NO	
624-1000-2	
Q.A. REFERENCE	

REVISIONS					
REV	ZONE	DESCRIPTION	ECOP	DATE	APPROVED
B		CIRCUIT CHGS, DELETE J3	3376	3-4-52	JCS
C		LOCATE LOCATION OF CRB (CR)	3477		

1
2
3
4
5
0



THIRD ANGLE PROJECTION: \odot — DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN DECIMALS. DIMENSIONS IN PARENTHESES ARE RESISTANCE IN OHMS, Ω , $k\Omega$, $M\Omega$.

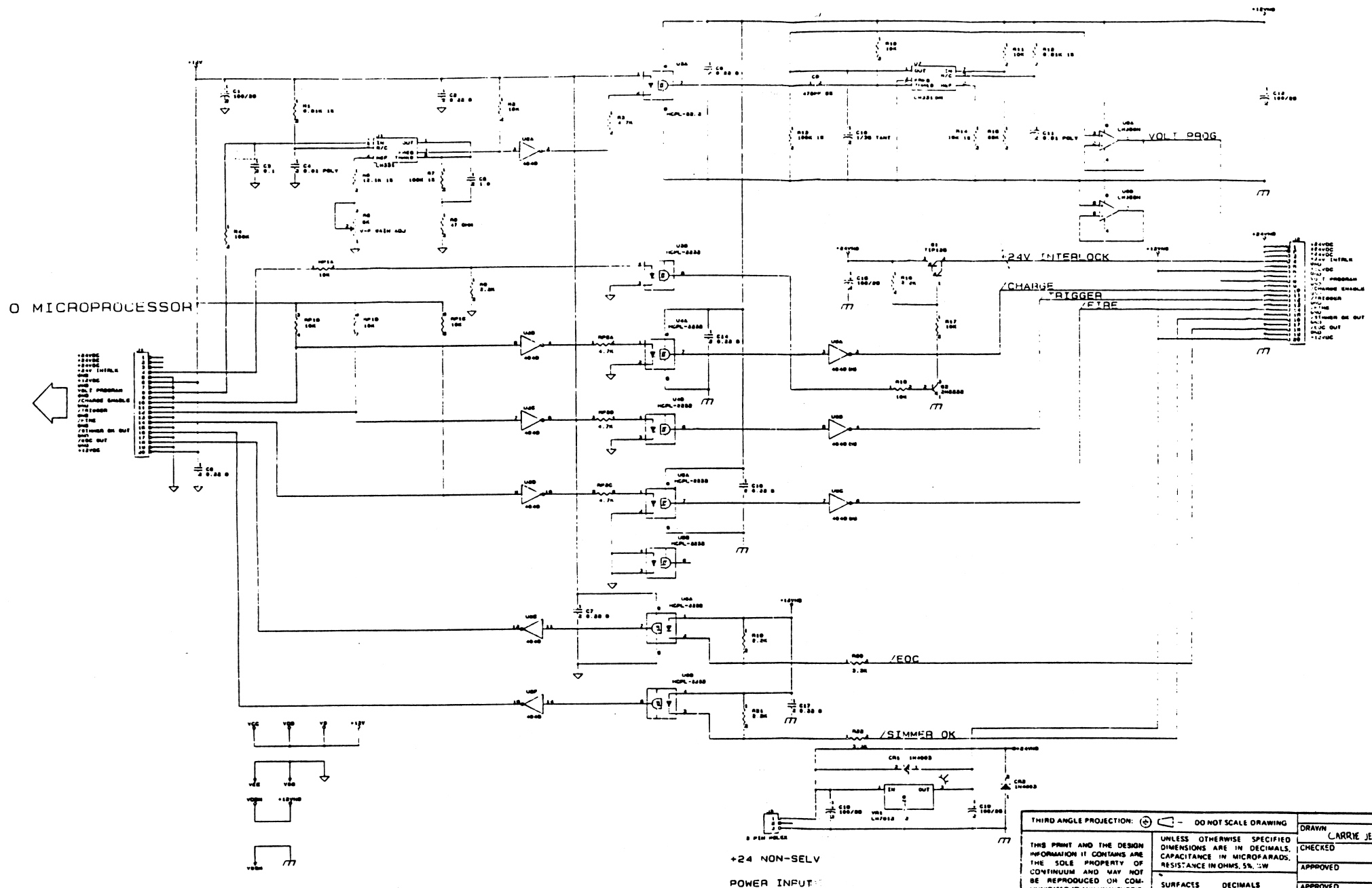
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DRAWN	DATE
CP726-227S	3-4-52
CHECKED	DRAWING NAME
JCS	3/52 SCHEMATIC, MED-
APPROVED	1/72 LASER CONTROL
APPROVED	PANEL PCB
MATERIAL	DRAWING NO.
	624-1100-2
FINISH	

SURFACES: DECIMALS: X1, X2, X3, X4, X5, X6, X7, X8, X9, X10, X11, X12, X13, X14, X15, X16, X17, X18, X19, X20, X21, X22, X23, X24, X25, X26, X27, X28, X29, X30, X31, X32, X33, X34, X35, X36, X37, X38, X39, X40, X41, X42, X43, X44, X45, X46, X47, X48, X49, X50, X51, X52, X53, X54, X55, X56, X57, X58, X59, X60, X61, X62, X63, X64, X65, X66, X67, X68, X69, X70, X71, X72, X73, X74, X75, X76, X77, X78, X79, X80, X81, X82, X83, X84, X85, X86, X87, X88, X89, X90, X91, X92, X93, X94, X95, X96, X97, X98, X99, X100, X101, X102, X103, X104, X105, X106, X107, X108, X109, X110, X111, X112, X113, X114, X115, X116, X117, X118, X119, X120, X121, X122, X123, X124, X125, X126, X127, X128, X129, X130, X131, X132, X133, X134, X135, X136, X137, X138, X139, X140, X141, X142, X143, X144, X145, X146, X147, X148, X149, X150, X151, X152, X153, X154, X155, X156, X157, X158, X159, X160, X161, X162, X163, X164, X165, X166, X167, X168, X169, X170, X171, X172, X173, X174, X175, X176, X177, X178, X179, X180, X181, 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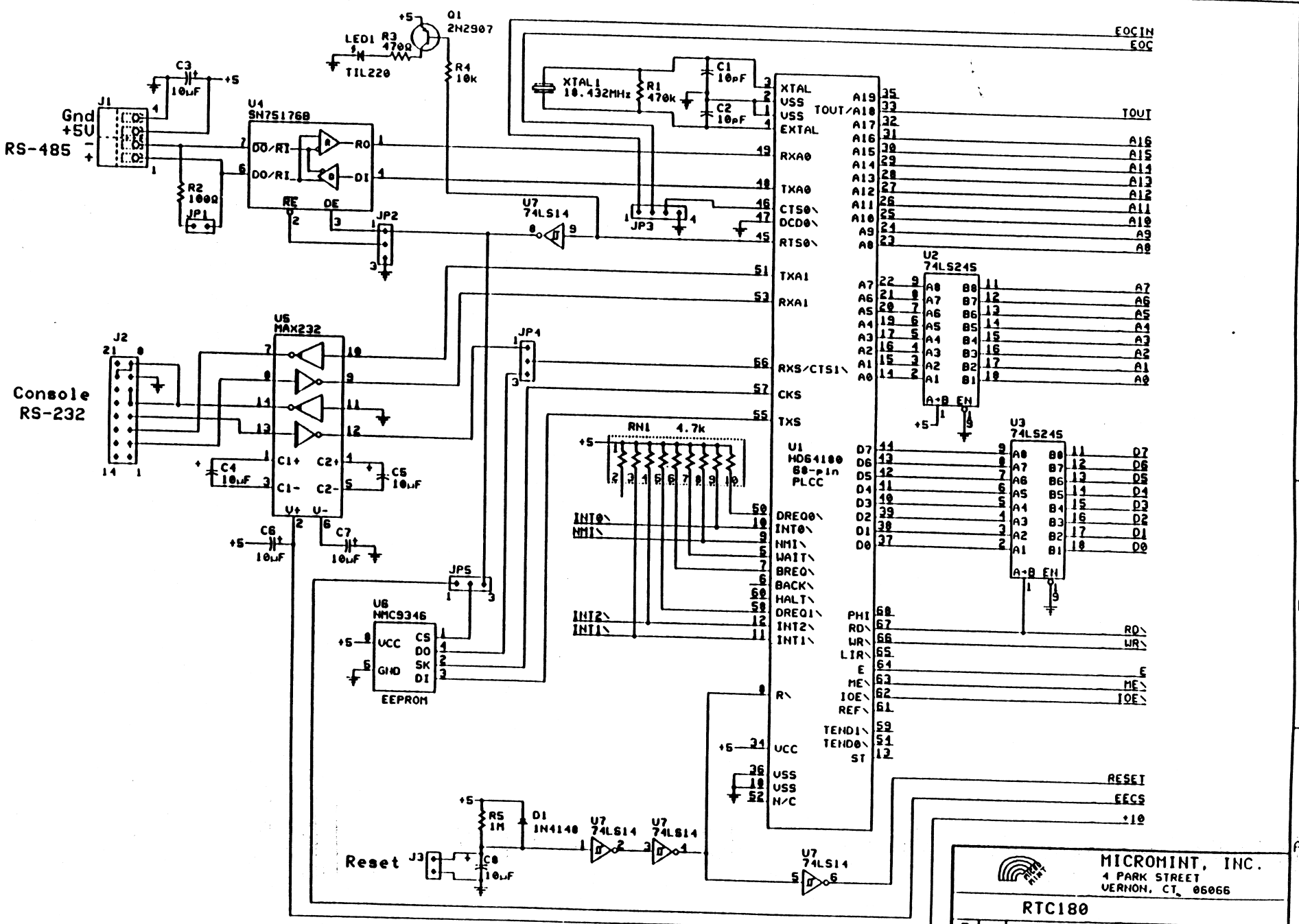
REVISIONS				
REV. ZONE	DESCRIPTION	ECOP	DATE	APPROVED
3	ADDED HUB, INCREASE SLOTS U3	4240	11/04	


BMM SPACING



+24 NON-SELV
POWER INPUT

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		CHECKED		DRAWING NAME	
		APPROVED		SCH. DWG, OPTO INTERFACE PCB	
		APPROVED		DRAWING NO.	
SURFACES		DECIMALS	MATERIAL		
— ✓		.X1	FINISH		
—		.XX1	DRAWING NO. 624-3800-2		
—		.XXX1	DRAWING NO. 624-3800-2		
BREAK SHARP		ANGLES	DRAWING NO. 624-3800-2		



 MICROMINT, INC. 4 PARK STREET VERNON, CT, 06066	
RTC180	
B	KEN DAVIDSON REV 1.1
DATE: 4/23/90	SHEET 1 OF 2

