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LASER KIT ML801

INSTRUCTIONS

By Herbert H. Gottlieb

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## INTRODUCTION

This booklet contains instructions for building Metrologic Laser ML-801 using parts supplied in the kit. It is assumed that those building the kit have had some experience in wiring electronic circuits and in soldering components to printed circuit boards.

Because the electronic power supply generates high voltages and because the concentrated light output from this low powered (typically 0.5 mW) laser can be harmful to the eyes, it is especially important to follow instructions in the sequence given in this manual.

## NOTES, CAUTIONS, AND WARNINGS

As you work your way through this manual, you will see several paragraphs headed NOTES, CAUTIONS, and WARNINGS. Do not ignore them!

A "Note" gives additional background information, hints, and suggestions for building techniques that can save you time, trouble, and effort and result in a professionally built piece of equipment that will give you many years of service.

A "CAUTION" provides information that will help prevent damage to the equipment. Cautions must always be taken seriously and should never be ignored.

A "WARNING" is given whenever there is the likelihood that personal injury to the kit builder or others can occur. The necessity of heeding all warnings cannot be overemphasized.

## REQUIRED ITEMS NOT SUPPLIED WITH KIT

All of the necessary circuit elements, connecting leads, fasteners and other assembly parts are provided with the kit. In addition, you should have these items available:

Soldering iron - A low power (less than 50 watt) soldering iron or solder gun to mount circuit elements.

Long nose pliers - A pair of long nose pliers to bend and dress wire leads.

Diagonal pliers - Diagonal pliers, or a similar tool, to strip insulation and to trim leads when soldering.

Screwdrivers - One small Phillips head and one conventional.

Also, the following items, which are readily available in local hardware stores:

Roll of rosin core solder  
 Tube of Dow Corning Clear Sealant (or bathtub caulking)  
 A roll of plastic electric tape  
 A tube of DUCO (or similar fast drying cement)  
 Spray can, Krylon crystal clear, No. 1302

CAUTION - Acid flux or acid core solder is corrosive and should never be used for electronic circuits. The use of acid solder voids all guarantees provided by the manufacturer.

#### UNPACKING AND CHECKING PARTS

Before attempting to assemble the kit, identify and check off each part to be sure that the kit is complete.

#### Resistors

Symbol	Resistance (ohms)	Power (watts)	Color bands on resistor (See note below)	Part No.	Replace cost
R1	22 K	2	Red, Red, Orange	15001	\$ .50
R2	22 K	2	Red, Red, Orange	15001	.50
R3	4.7 Meg	0.5	Yellow, Purple, Green	13553	.20
R4	4.7 Meg	0.5	Yellow, Purple, Green	13553	.20
R5	15 K	1	Brown, Green, Orange	14507	.35
R6	1.0 Meg	0.5	Brown, Black, Green	13533	.20
R7	22 K	2	Red, Red, Orange	15001	.50
R8	22 ohms	0.5	Red, Red, Black	13542	.20
R9	560 ohms	0.5	Green, Blue, Brown	13537	.20
R10	100 K	0.5	Brown, Black, Yellow	13552	.20
R11	220 K	0.5	Red, Red, Yellow	13530	.20
R12	10 ohms	1	Brown, Black, Black	14513	.35
R13	20 ohms	0.5	Red, Black, Black	13545	.20

Notes: Gold banded resistors are +/- 5% tolerance  
 Silver banded resistors are +/- 10% tolerance

## Capacitors

Symbol	Capacitance	Type	Volts	Part No.	Replace cost
C1	50 pF	Disc	3 KV	21034	\$ .50
C2	50 pF	Disc	3 KV	21034	.50
C3	50 pF	Disc	3 KV	21034	.50
C4	50 pF	Disc	3 KV	21034	.50
C5	50 pF	Disc	3 KV	21034	.50
C6	.01 uF	Disc	3 KV	21005	.60
C7	.01 uF	Disc	3 KV	21005	.60
C8	.01 uF	Disc	3 KV	21005	.60
C9	50 pF	Disc	3 KV	21034	.50
C10	.001 uF	Disc	3 KV	21006	.50
C11	.1 uF	Tubular	100 V	22030	.60
C12	.001 uF	Tubular	1 KV	22037	.60
C13	47 uF	Electro.	250 V	20037	2.50

## DIODES

Symbol	Type	Comments	Part No.	Replace cost
D1-D6	3G3	Arrows printed on these six diodes indicate the negative (-) end.	23021	each \$1.50
D7,D8	XG6	Similar to the 3G3 above, but the XG6 diodes are larger.	23030	each 1.75
D9	1N5223B	Tiny blue diode with numbers 5223B printed on it. Black band shows negative (-) end.	23018	.60
D10-D13	1N4004	Silver band around one end indicates negative (-) end.	23020	each .25

## TRANSISTORS

Q1	TIP 50	Terminal at center is the collector. Metal tab mount.	24030	2.25
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## TRANSFORMERS

T1	2.0 mW 115V	The terminal that is closest to the groove in the base is terminal No. 1.	40023	\$8.00
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## LASER TUBE

LT 1	0.5 mW output	Hard seal, HeNe, with attached prealigned end mirrors and collectors.	MT-500	\$145
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## MISCELLANEOUS PARTS

Laser case		Cast aluminum, 2.7 in. X 2.7 in. X 11 in. Threaded tripod mount at bottom.	30588	\$30
Laser cradle		Two strips of brown laminate each about 1 inch long. Mounts laser tube on circuit board.	30022	set .50
Cushion tape		Two lengths of 1/4 in. rubber each 11 in. long. Used to cushion bottom of laser case.	00155	set .50
Front end cap assembly		Aluminum plate with beam shutter mounted over central aperture.	44268	\$15
Printed circuit board		Phenolic. Laser tube mounts on foil side and all other parts mount on reverse side.	35105	\$10
End cap screws		Eight black screws, 1/2 in. 4-40 threads. Secure end caps to laser case.	18225	set .50
Stay wraps		Two plastic strips. Holds laser tube on PC board.	00035	set .25
Cathode lead		One 4-in. insulated wire.	19513	.50
Connector P1 (optional)		Furnished only if rear end cap assembled has mating plug for attachment to the PC board.	00390	.75

## HEAT SINK SUBASSEMBLY (See Figure 3.)

Heat sink	Aluminum U-block with drilled holes.	31141	1.00
Screw	Nylon 4-40 x 1 in. Mounts transistor on heat sink.	18222	.25
Washer	White beryllia. Provides heat conduction and electrical isolation for transistor tab.	00538	2.00
Washer	Nylon.	18800	.20
Nut	No. 4 hexagonal nut.	18291	.20
Lockwasher	No. 6 internal lock.	18389	.20
Screw	6-32 X 1/4 in. Phillips head flat screw. Fastens heat sink to bottom of laser case.	18346	.20
Screw	6-32 X 1/4 in Phillips head pan screw.	18316	.20
Thermal compound	White paste packed in tinfoil with spreading stick.	00801	.50

## REAR END CAP ASSEMBLY

Rear End Cap Assembly	Plug-in assembly. Contains switch, pilot lamp, fuse. and line cord. If plug P1 is not furnished, its 12-inch leads are soldered directly to the PC board.	44269	\$20
Instruction manual 45-801	Complete instructions for building Laser ML-801.	45801	\$5
Box	Useful for storing laser.	00001	\$5



## ASSEMBLY INSTRUCTIONS

The electronic components of the laser, including the laser tube, must all be mounted on printed circuit board PCI. Although this engineering provision is very handy when building, testing, and troubleshooting the laser, you should always be aware of the potential hazards of operating an electrical circuit without its protective case securely mounted in place. Exposed terminals on the rear end cap carry 110 volts from the ac power cord. Potentials high as 12,000 volts are available on the printed circuit board and at the terminals of the laser tube. Also, when the laser is operating, the ultra-violet light is emitted from the sides of the laser tube and a coherent laser beam radiates from both ends.

Accidents can be prevented by following the advice of professionals: NEVER APPLY POWER UNTIL YOU HAVE DOUBLE CHECKED ALL CONNECTIONS AND HAVE MADE CERTAIN THAT THE LASER IS POINTED AWAY FROM THE EYES OF ANYONE IN THE VICINITY OR FROM REFLECTING OBJECTS. Resist the urge to apply power and try the laser before the entire circuit has been completely wired and adequate safety precautions have been taken.

## MOUNTING DIODES

Follow the instructions below to mount the 13 diodes (D1 through D13) on the printed circuit board. Refer to the printed circuit assembly diagram (Fig. 1), for their correct positions.

1. With a pair of pliers, make a sharp right angle bend in each of the diode pigtailed so the diodes will exactly fit between the appropriate sets of prepunched holes on the circuit board.
2. Insert the leads of each diode into the printed circuit board making sure that the body of each diode is as close as possible to the board and that the negative (-) end of the diode is facing the correct direction. If any of the diodes are mounted backwards, the laser will not operate and further damage can result in the electronic circuit.
3. When you are certain that each of the diodes is on the circuit board and is facing the correct direction, apply a small amount of rosin core solder to the foil side of the PC board at the base of each lead.

CAUTION: Diodes are heat sensitive. Never use a large soldering iron, a high wattage solder gun, or apply heat longer than is necessary to melt the solder and fuse the leads to the printed circuit board.

4. Using a pair of diagonal cutting pliers, snip off the excess lengths of diode pigtailed as close as possible to the printed circuit board and discard them.

This completes the mounting of the diodes.

#### MOUNTING RESISTORS

There are 13 resistors to be mounted on the printed circuit board. Follow the instructions below and refer to Fig. 1 for the placement of the resistors.

1. Resistors R12 and R1 are mounted on the PC board standing up instead of lying down like the other resistors. Insert one of the leads of resistor R12 into the designated hole near the lower right corner of the PC board and push it all the way into the hole until the end of the resistor body touches the board. Holding it in this position, apply a small amount of solder to the resistor lead at the foil side of the board. When the solder has cooled, bend the other lead down, insert it into its designated hole at the lower right corner of the board, and solder it in place.

2. Resistor R1 is the only resistor that is mounted on the foil side off the circuit board. Solder one lead to ground as shown in Figure 4. Do not connect the free end of resistor R1 at this time. Later it will be connected to the anode at the front of the laser tube.

3. With a pair of pliers, make sharp, right angle bends in each of the remaining resistor pigtailed so the resistors will exactly fit between the appropriate sets of prepunched holes on the circuit board.

4. Insert the leads of resistors R2, R5, and R7 in the designated holes at the left side of the board. Because these resistors become hot when the circuit is operating, the body of each of these resistors should not be mounted too close to the circuit board. Holding each of the resistors about a quarter to a half inch above the circuit board with the leads in the correct holes, apply a small amount of solder to the resistor leads at the foil side of the circuit board.

Note: Unlike diodes, the direction that a resistor faces in a circuit is unimportant. As long as a resistor is in the correct holes of the circuit board it will function correctly.

5. Insert the leads of the remaining eight resistors in the designated holes of the circuit board. With the bodies of these resistors as close as possible to the circuit board, apply solder at the foil side of the board.

6. Using a pair of diagonal cutting pliers, snip off the excess lengths of resistor pigtailed and discard them.

At this point all of the diodes and resistors have been mounted on the circuit board .

#### MOUNTING CAPACITORS

Refer to the assembly diagram (Fig. 1) and the instructions below to mount the 13 capacitors on the printed circuit board.

1. Place the leads of capacitor C13 in the of the printed circuit board making sure that the negative (-) end is toward the top of the board and the positive (+) end is down. If there are no + or - signs on the capacitor, look for arrows running along its length. The arrow head points to the negative (-) end.

CAUTION: Capacitor C13 is an electrolytic filter capacitor. If it is mounted backwards with the leads reversed, the capacitor and other electronic components will be permanently damaged when power is applied.

When you are sure that capacitor C13 leads are all the way in the correct holes, press the body of the capacitor against the board, apply a small amount of solder to the leads at the foil side, and snip off excess lead lengths.

2. Mount capacitors C1 through C12 in the designated holes of the PC board. Capacitors C1 through C10 are ceramic discs and capacitors C11 and C12 are tubular mylar types. Because these capacitors are not polarized, it is not important that they face any particular direction and the leads may be reversed without harm. Each of these capacitors should be held as closely as possible to the printed circuit board. Apply small amounts of solder to the leads at the foil side of the board and snip off excess lead lengths.

At this point all of the capacitors, diodes and resistors have been mounted.

#### MOUNTING TRANSFORMER T1

Refer to Fig. 1 and follow the instructions below to mount transformer T1 on the printed circuit board.

1. Hold transformer T1 so the base is down and the groove at the base (which identifies terminal 1) is at the lower right.
2. Insert the transformer in the printed circuit board so that all 12 terminals at the transformer base are firmly seated in the corresponding holes of the board.
3. Apply a small amount of solder at the foil side of the board to each of the transformer terminals.

Note: When soldering the terminals, be especially careful to avoid solder bridges between adjacent terminals. These can short out electronic circuits when power is applied.

#### MOUNTING TRANSISTOR Q1

Transistor Q1 is perhaps the most difficult component to mount on the printed circuit board because it must not only be mounted in the correct location but additional heat sinking precautions must be taken to avoid premature failure of this sensitive part. Refer to the exploded view of transistor Q1 and its heat sink mounting components in figure 3.

1. Hold transistor Q1 so its metal mounting tab is facing the aluminum u-block.

2. Mount the transistor to the u-block with a nylon screw and beryllia washer using plenty of heat sink compound between the washer and the aluminum u-block. Make the nut tight as possible without breaking the screw.

Note: Because the metal tab on the transistor is internally connected to the emitter, it must be electrically isolated from the heat sink. The beryllia washer provides both electric isolation and heat conduction.

3. Bend the transistor terminals so they fit into the three designated holes in the PC board.

4. Secure the aluminum heat sink to the board with a No.6 pan head screw and lockwasher.

Note: When tightening the pan head screw at the bottom of the heat sink, hold the aluminum u-block steady so it does not twist and break the leads of the transistor. It is imperative that the bottom of the aluminum u-block makes firm contact with the PC board.

Caution: Failure to make a tight connection or failure to use heat sink compound is likely to result in extensive damage to the transistor as well as several nearby diodes.

5. Apply a small amount of solder to the transistor leads at the foil side of the PC board.

6. Check to be sure that everything is sufficiently tight to provide heat sinking action when the circuit is operated.

Note: At this point we recommend an optional procedure to increase the laser longevity. Spray two or three thin coats of Krylon crystal clear No. 1302 on both sides of the PC board from the transformer to the anode/cathode end.

This completes the mounting of all components on the printed circuit board except the laser tube.

## MOUNTING THE LASER TUBE ON THE PC BOARD

Laser tube LT-1 is the only component that is mounted on the foil side of the circuit board. Follow the instructions below and refer to figure 4.

1. With the foil side up, cement the flat side of a laser cradle to the PC board between the holes located near diodes D2 and D3 using a thin coat of Duco (or similar) cement.

Note: The laser cradles provide the right amount of elevation for aligning the laser tube with the openings in the outer case. Check to be sure that there are no foreign materials or globs of solder on the foil side of the PC board in the vicinity of the laser cradles.

2. Cement the flat side of the second laser cradle to the foil side of the PC board between the holes near resistor R9 and capacitor C12.

3. With the printed circuit board foil side up, insert the pointed end of a plastic stay wrap through one of the large holes between diodes D2 and D3. The corrugated side of the stay wrap must face the middle of the PC board and the smooth side must be closest to the edge of the board. Now thread it back through the other hole as shown in figure 4 .

4. Repeat the above procedure and insert a second stay wrap through the holes between resistor R9 and capacitor C12.

5. Remove one quarter inch of insulation from each end of the 4-inch cathode wire that is supplied with the kit. Tin the wire, solder one side to the hole in the PC board that connects to resistor R7, and pass the wire through the large hole in the PC board so it is available for connection to the laser cathode.

6. Carefully place the laser tube on the circuit board in the position shown in figure 4.

CAUTION; Be very careful in handling the laser tube. It is fragile and the prealigned end mirrors can be damaged by dust or fingerprints.

To avoid short circuits, check that there is at least a quarter inch of space between the laser tube and the circuit board below it.

7. Pass the pointed end of each stay wrap through its end lock as shown in figure 4. Draw the stay wraps tightly against the laser tube and snip off the protruding ends of the wraps.

8. Solder the free end of the cathode lead to the terminal that can be seen protruding from the glass body at the front of the laser tube. This terminal that can be seen through glass is internally connected to the aluminum cathode.

9. Solder the free end of resistor R1 to either (a) the copper clip that is found on the metal collar at the very front of the laser tube or (b) to the terminal that can be seen protruding from the glass neck to the tube. This terminal is an anode and is internally connected to nothing.

This completes a temporary mounting of the laser tube on the PC board.

#### CONNECTING THE REAR END CAP TO THE PC BOARD

Solder connector P1 into the three holes at the right end of the PC board. (If connector P1 was not furnished with your laser kit, solder the three leads from the rear end cap assembly directly to the PC board as shown in Fig. 1) If the rear end cap assembly has the other half of connector P1 already installed, plug it into the PC board, making sure that the lips of the two connector halves are firmly mated.

This completes all of the electrical connections of the laser.

## VISUAL INSPECTION

Before the laser is mounted in its outer case, make a thorough check of the electrical components of the laser as follows:

CAUTION: Do not connect power to the laser until all of the preliminary checks are made and specific instructions are given to do so. The premature application of power can cause extensive damage.

1. Check that diodes, resistors, capacitors and other electrical parts are mounted in the correct positions of the printed circuit board. Refer both the assembly diagram and the schematic diagram while checking each part.
2. Wiggle each of the electrical components methodically while watching the printed circuit board for any movement that would indicate solder failure or a cold solder joint.
3. Scan the foil side of the printed circuit board looking for any solder bridges between circuits that will cause shorts.
4. Search for and remove any deposits of solder around the outer edge of the printed circuit board that might interfere with sliding the board into the outer case of the laser.
5. Inspect the mounting of the transistor and its heat sink to be sure that all of the mechanical connections are tight and there is a liberal amount of heat sink compound on both sides of the beryllia washer.
6. Make sure that the stay wraps on the laser tube are reasonably tight and the anode/cathode pin connectors are secure on the laser tube terminals.
7. Open the fuse holder at the rear end cap to be sure that the correct fuse (type 3AG, 3/4 ampere) is inside.
8. Operate the power switch on the rear end cap to the OFF position.
9. Place some books or boxes on the table at the ends of the laser tube to act as beam stoppers when the laser starts to operate.



10. Insert the plug into a 3 conductor GROUNDED wall outlet, 105-120 volts ac, 60 Hz.

WARNING - If the plug is inserted in an ungrounded outlet, dangerous voltages could appear on the laser case.

11. Operate the power switch on the rear end cap to the ON position. The pilot light in the rear end cap should go on, the inside of the laser tube should glow blue orange-red, and a strong laser beam should come out of the front end of the laser tube and a weaker beam should come out of the opposite end.

Note: If everything has been done correctly, the laser should be working properly. However, since individual laser tubes have slightly different operating characteristics you might wish to adjust the laser beam current for optimum operation in your particular laser. This optional procedure is described in the next section.

#### ADJUSTING LASER BEAM CURRENT

For optimal operation, the laser beam current should be between .4 and 5 milliamperes. Most lasers will operate properly with the correct beam current when assembled in accordance with the instructions given above. However, because there are small differences in the electrical characteristics of individual laser tubes, there is a small possibility that the the beam current in your laser does not fall within these specified limits. If the beam current is much too low, the laser will produce pulsating bursts of light rather than a steady beam. If the current is too high, the life of the tube may be shortened. To adjust the beam current, proceed as follows:

1. Remove all power from the laser and operate the switch on the rear end cap to OFF.
2. Slip off the red lead that is connected to the cathode terminal of the laser tube.

3. Connect the negative (-) milliammeter lead to the red cathode wire and the positive (+) milliammeter lead to the cathode terminal of the laser tube.

WARNING: HIGH VOLTAGE APPEARS AT THE LASER TUBE TERMINALS WHEN IT IS OPERATING. DO NOT TOUCH THE MILLIAMMETER, THE LASER TUBE, OR THE PRINTED CIRCUIT BOARD WHILE THE LASER IS PLUGGED INTO A WALL SOCKET.

4. When you are sure that the apparatus is positioned so that the meter can be observed without touching it, insert the plug into a wall socket and turn the power switch ON.

5. If the milliammeter indicates between 4 and 5 mA, skip the rest of this procedure. The beam current is within specified limits and no adjustment is necessary. In that case, turn off the power, remove the ammeter, and reconnect the red lead to the laser tube.

6. If the milliammeter indicates LESS THAN 4 mA, disconnect the power, unsolder resistor R13 from the printed circuit board, and replace it with an 18 ohm resistor. Reapply power. If the milliammeter still indicates less than 5mA, try replacing resistor R13 with a 15 ohm resistor. ALWAYS REMEMBER TO REMOVE POWER BEFORE TOUCHING THE LASER OR THE METER.

7. If the milliammeter indicates MORE THAN 5 mA, replace resistor R13 with a 22 ohm, 24 ohm or 27 ohm resistor) in turn until the beam current falls within the 4 to 5 mA range.

WARNING: REMEMBER TO TURN OFF THE POWER WHENEVER IT IS NECESSARY TO TOUCH THE LASER OR THE METER.

8. Once the beam current has been checked and adjusted, turn off the power, remove the meter, and reconnect the red anode lead to the laser tube terminal.

This completes the laser beam current adjustment.

## FINAL ASSEMBLY

The final assembly consists of placing all of the electronic parts inside the laser case and aligning the laser beam so it will emerge from the aperture in the front end plate. During this phase, it will be necessary to operate the laser with charged electronic components partially exposed, so once again exercise caution as you proceed.

1. With the power off, slide the printed circuit board all of the way into the laser case (Fig. 5). Without touching the end mirrors of the laser tube, slide the tube forward or backward on the PC board so the front and rear end caps can be assembled without contacting the ends of the laser tube. Also, the hole in the bottom of the case should be aligned with the tapped hole in the aluminum heat sink block.

2. With the laser aimed so it cannot strike any reflecting objects or the eyes of anyone in the vicinity, turn the power on. The pilot lamp should light, a strong beam should come out of the front of the laser and a much weaker beam should emerge from the rear.

3. Hold the front end plate in place over end of the laser case. With a non-metallic object, such as a comb, a piece of wood, or the plastic case of a ball point pen, push the laser tube to a central position inside the case so the beam emerges from the hole in the front end plate.

**WARNING:** There are high voltages at the laser terminals and the metallic ends of the laser tube are also charged. Do not use your fingers or any conducting object for aligning the laser beam.

If difficulty is experienced in getting the beam aligned with the front end plate, check for any irregularities or globs of solder under the laser cradles which might be tilting the laser tube. If found, the power should be turned off and the obstructions carefully removed.

4. When the laser tube has been aimed so the beam emerges as closely as possible from the center of the hole in the front end plate, shut off the power. Slide the printed circuit board most of the way out of the laser case being very careful not to misalign the laser tube. Squeeze out a liberal quantity of silicon cement (not furnished with the kit) and apply it between the sides of the laser tube and the foil side of the PC board near each laser cradle. Do not disturb the laser until the cement has cured.

5. When the cement is firm, slide the PC board back into its laser case. Make sure that there is a liberal amount of heat sink compound at the place where the heat sink contacts the laser case.

6. Insert the 6-32 1/4 inch screw through the bottom of the laser case into the threaded hole of the aluminum heat sink block.

7. Mount the front and rear end caps with the eight 4-40 X 1/2 inch screws that are furnished with the kit.

8. Cement the two thin rubber cushions into the grooves at the bottom of the laser case.

This completes the assembly and alignment of the entire laser. Congratulations!

## 90-DAY LIMITED WARRANTY

Your Metrologic Laser Kit ML-801 is warranted for 90 days from date of original purchase against defects in materials and workmanship by Metrologic Instruments Inc. During this period, such defects will be repaired or parts will be replaced, at Metrologic's option, without charge. This warranty only covers defects in material or workmanship performed by Metrologic, when the laser is in normal use and does not cover damages or losses resulting from accident, misuse, or abuse, lack of reasonable care, improper installation of parts or of the completed laser, the affixing of any attachment or modification not provided with the product, loss of parts, or other unreasonable use.

THIS WARRANTY DOES NOT COVER LASER TUBE FAILURE BECAUSE OF BROKEN GLASS OR TRANSISTOR AND DIODE BREAKDOWNS BECAUSE OF FAILURE TO PROVIDE ADEQUATE HEAT SINKING AS SPECIFIED IN THE KIT BUILDERS INSTRUCTIONS.

It is assumed that the same reasonable care will be given to the laser as one gives to any electronic device. Store in a dust-free atmosphere and avoid extremes of temperature and humidity. However, the ML-801 is a hard-seal laser and unlike previous lasers, continuous or periodic operation is NOT REQUIRED to ensure a long life.

Metrologic shall have no responsibility for the installation or maintenance of the product or for any personal injury, property damage or any special incidental, contingent or consequential damages or losses of any kind resulting from defects of the product or failure of the product to perform, or failure of the kit builder to heed the warnings in this manual.

Implied warranties (if any) including but not limited to implied warranties of fitness for a particular purpose and merchantability, are limited in duration to a period of 90 days from the date of original purchase. The exclusive remedy for breach of the limited warranty contained herein is the repair or replacement of the defective product or the return of the purchase price at Metrologic's option. In no case shall Metrologic's liability under any other remedy prescribed by law exceed the purchase price.

Any kit that has been built in accordance with the instructions given in this manual, that proves defective in normal use, will be repaired or replaced at Metrologic's option without charge for either parts or labor provided the defective product is shipped within the 90-day warranty period, prepaid and insured to Customer Service Division, Metrologic Instruments Inc., 143 Harding Avenue, Bellmawr, New Jersey 08031. Please mark the package FRAGILE and pack it accordingly. Also, enclose a note explaining the nature of the difficulty together with proof of your purchase.

The Metrologic company does not assume any responsibility for defects that have been caused by the failure of a purchaser to follow the kit building instructions in this booklet. However, as a service to the purchaser, the Metrologic company will repair such damages and replace damaged parts (except for an abused laser tube) at an additional cost that shall not exceed sixty dollars (\$60) if the entire laser kit is returned to the above address insured and prepaid within the 90 day warranty period.

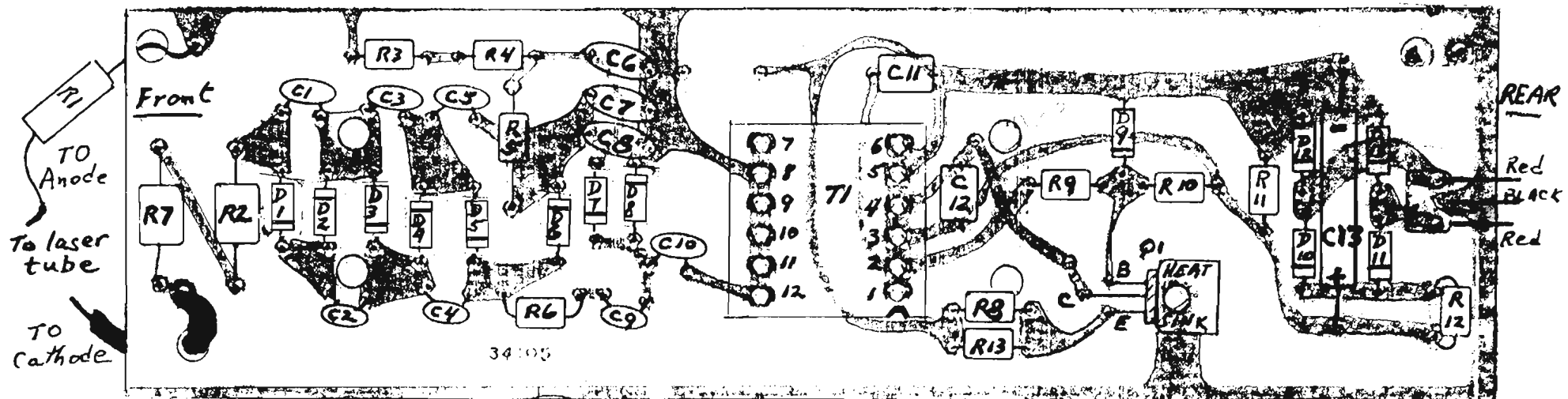
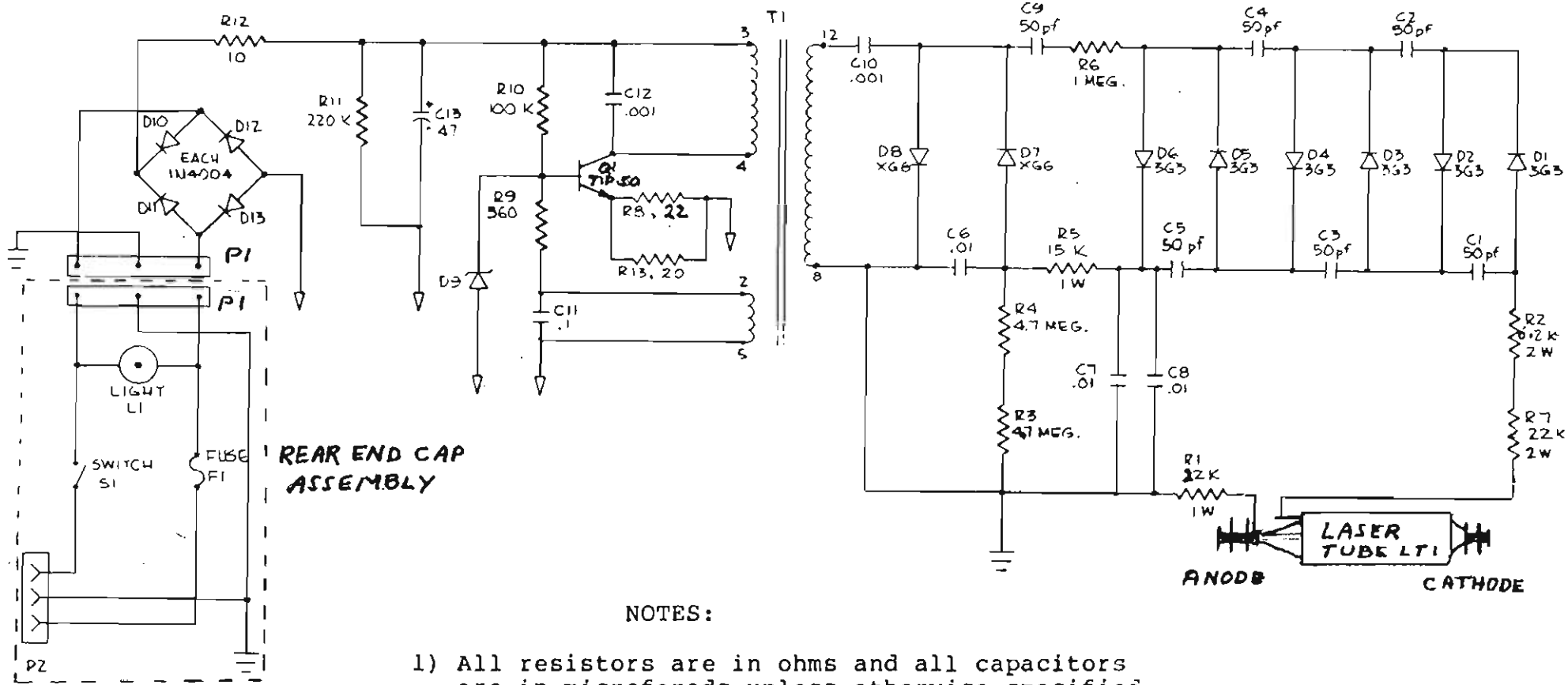


Figure 1. Printed Circuit Board  
Assembly Diagram

ML-801  
Rev. Jan 1956



NOTES:

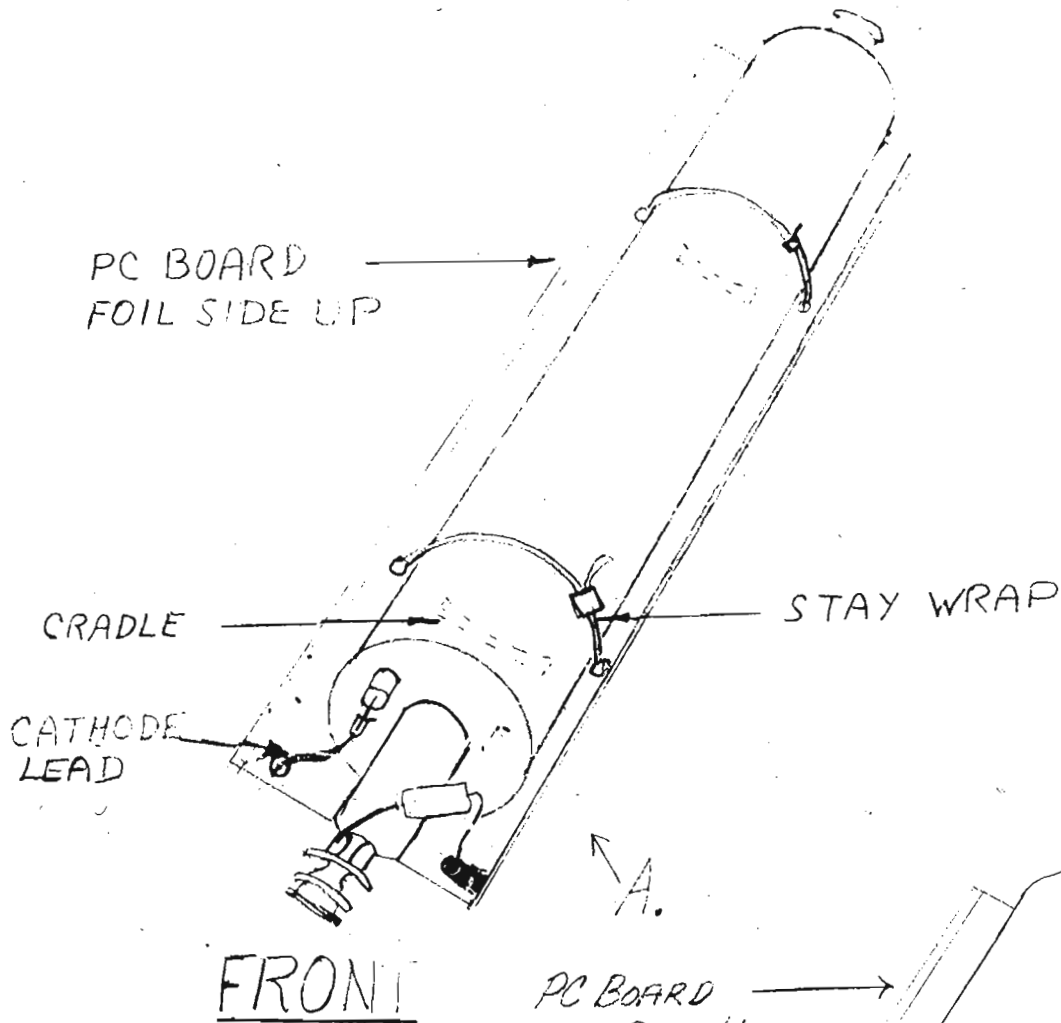
- 1) All resistors are in ohms and all capacitors are in microfarads unless otherwise specified.
- 2) In some kits, connector P1 may be omitted.
- 3) Anode of Laser tube MT-500 is **NEGATIVE** with respect to its cathode.

- Fig. 2 ML-801 Schematic Diagram -

100-100-100







PC BOARD  
FOIL SIDE UP

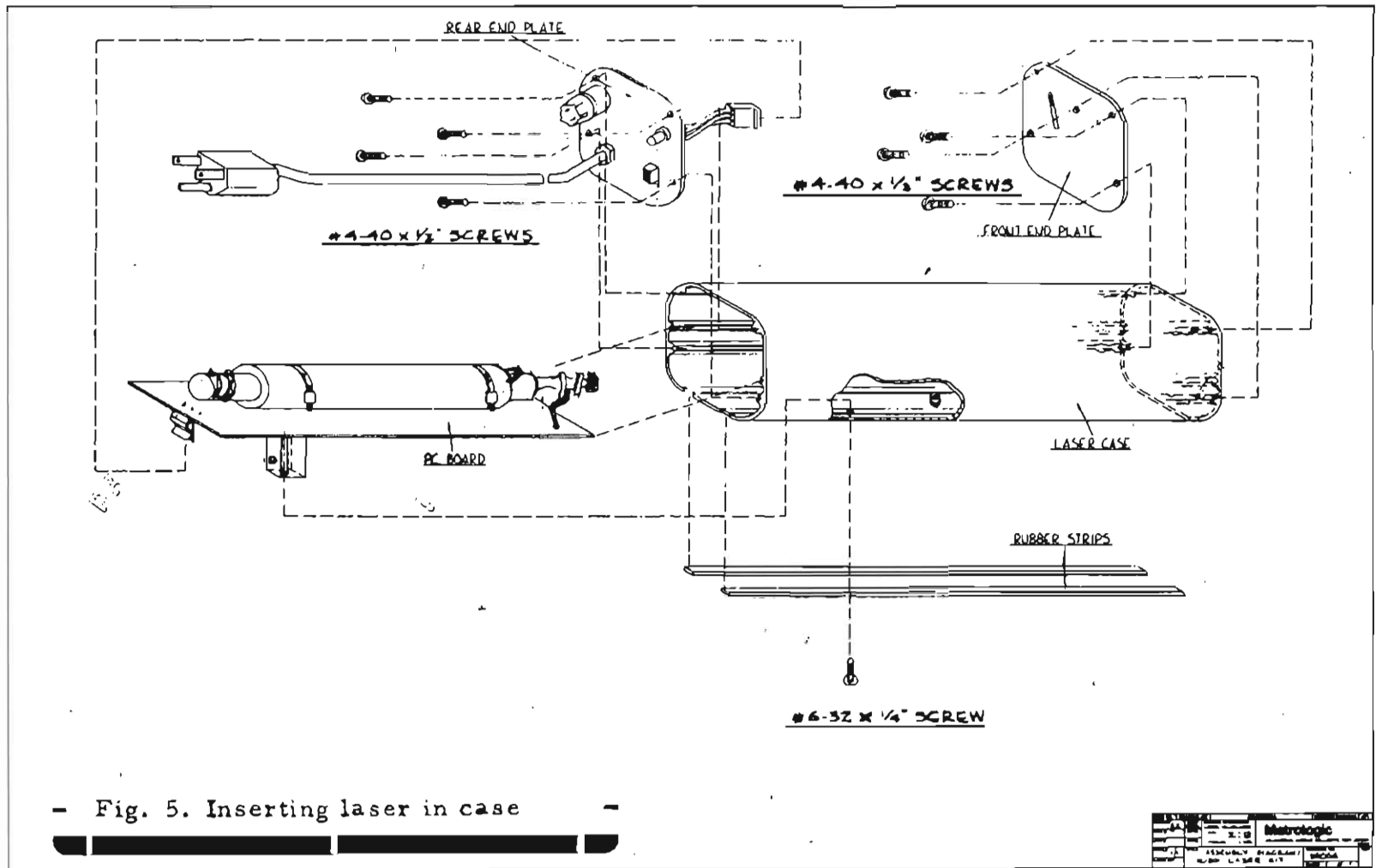
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Fig 4. Laser Tube Mounting Diagram

RED  
HIGH  
VOLTAGE  
WIRE

STAY WRAP

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