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LN1000

NITROGEN LASER
OPERATING MANUAL

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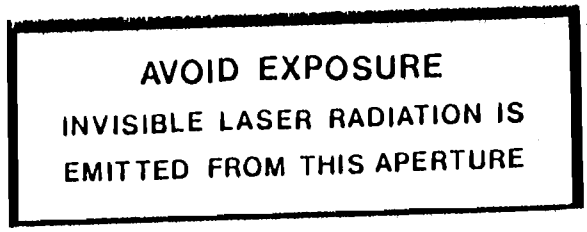
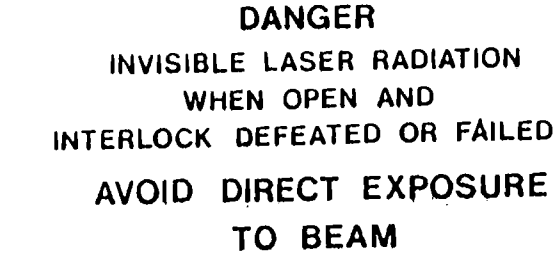
PRA®

CONTENTS

Below are examples of safety labelling and positions. Users are advised to familiarize themselves with areas/conditions of potential hazard, as indicated by these labels.



This is a legible reproduction of the warning label affixed on the front end plate of the laser, positioned near the laser beam aperture.



This is a legible reproduction of the warning label silkscreened on the outside of the front panel near the position of the safety interlock.

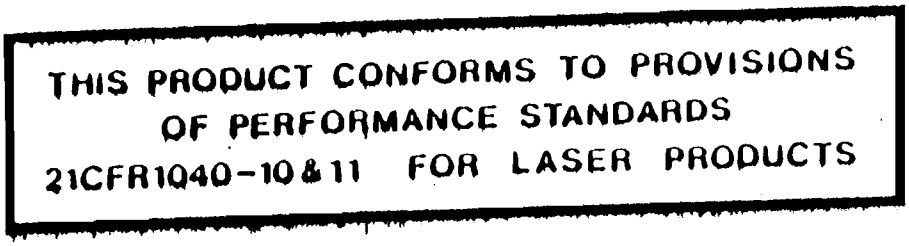
Located in the upper left hand corner of the front panel.

AVOID EXPOSURE
INVISIBLE LASER RADIATION IS EMITTED FROM THIS APERTURE

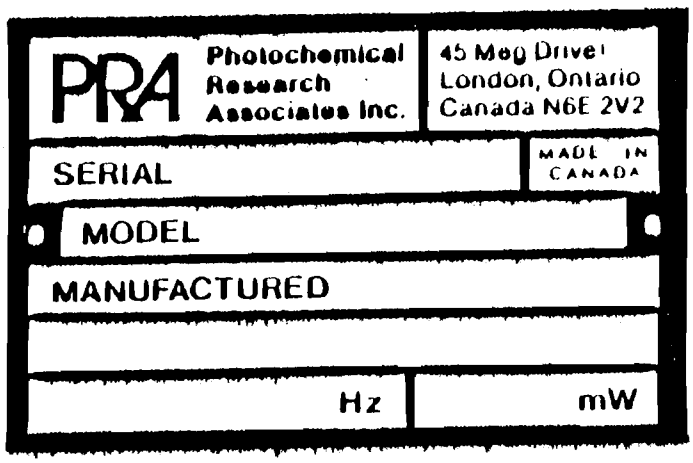
Located directly below the output aperture on the front end plate.

DANGER
INVISIBLE LASER RADIATION WHEN OPEN AND INTERLOCK DEFEATED OR FAILED
AVOID DIRECT EXPOSURE TO BEAM

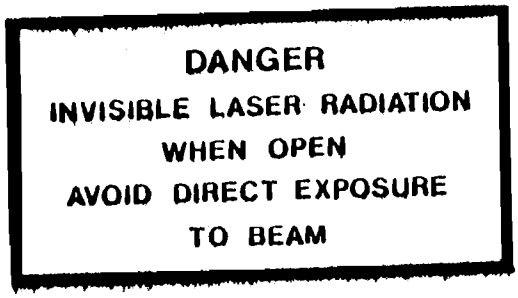
Silk screened on front panel.



This label is silk screened on the rear end plate of the laser.



This label is riveted to the rear end plate



Located on laser head cover and
also directly on laser head.

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

NITROGEN AND DYE LASERS

This is a legible reproduction of a warning logo type required to be affixed to the product described in the brochure.

QUALITY CONTROL LN1000

JOB NUMBER: 201770

LASER SERIAL NUMBER: 86030-LN10

OUTPUT ENERGY: @2Hz

Measured by Gen Tec ED200 Joulemeter

@ 17 kV 1.35 mJ

Pressure: Spark Gap 1 45psi

Spark Gap 2 80psi

Tested by: DS.

Date: Sept/86.

30 Jan 87 - DB

17kV 2Hz 1.2 mJ/pulse

17.5kV 10 Hz 1.1 mJ/pulse

$\frac{1.2 \times 10^{-3}}{7 \times 10^{-10}} = 1.7 \times 10^{6}$ W

Laser Photonics

407 - 281 - 4103

1.0 WARRANTY

1.1 General Information

The LN1000 laser head is warranted for 6 months, all other materials and workmanship for one year from date of shipment provided that the equipment has been used in the proper manner as detailed in the Instruction Manuals.

During the warranty period, repairs or replacement will be made at PRA's option. No instrument should be returned without informing PRA, either in writing or by telephone, of the nature of the fault, model number and serial number of the unit.

If PRA gives authorization for a return please REFER TO SHIPPING INSTRUCTIONS AT THE REAR OF THE MANUAL. These instructions are for a warranty return from the USA. An identical procedure must be followed when the return is made from any country, with the exception that notation for "US CUSTOMS CLEARANCE..." is deleted. An example with instructions of a CUSTOMS INVOICE is included as well as a blank invoice that can be used in the event of a warranty return. Follow the simple directions carefully in order to avoid delay and extra charges.

Instruments that are returned should be packed so they will withstand normal transit handling, and must be shipped PREPAID to PRA or a qualified distributor. Instruments that are damaged in transit due to inadequate packing will be repaired at the Sender's expense and it will be the Sender's responsibility to make claim with the shipper.

1.2 Expired Warranty

Instruments not under warranty shall be repaired at the standard charge. Customer Service will send a quotation for all non-warranty repairs. A Purchase Order must accompany the item to be returned.

1.3 Warranty on Equipment not Manufactured by PRA

PRA's basic one year warranty applies only to equipment manufactured by PRA. Although PRA may frequently supply, as part of a system, equipment manufactured by other companies, the only warranty that shall apply to such non-PRA equipment is that warranty offered by the original manufacturer.

1.4 On-Site Repair

The basic PRA warranty applies only to equipment manufactured by PRA which is returned to the factory. If equipment must be repaired at the customer's site, the actual repair labour and parts will be provided at no charge during the warranty period. However, travel expenses to and from the site as well as living expenses while on-site will be paid by the customer.

1.5 Damage in Transit

Shipments should be carefully examined when received for evidence of damage caused by shipping. If damage is found, notify PRA and the carrier immediately. Preserve all packages, cartons and documents. PRA will provide all possible assistance in damage claims.

2.0 CONTROL DESCRIPTIONS

Refer to Figure 1

1. Power cord connector for 120 V.
2. Fuse holders; the fuse is 120 V, 2.5 amps and 1/8 amp respectively.
3. Gas inlets.
4. The key switch turns the laser on and off. The key cannot be removed when turned to the on position.
5. White indicator light shows when the key switch is in the on position.
6. The red indicator light comes on when the laser can be fired.
7. The repetition rate control increases the repetition rate when turned in the clockwise direction.
8. The high voltage control adjusts the high voltage from 0 kV to 20 kV.
9. Panel meter indicates the voltage in kilovolts on the laser head.
10. Mode selection switch indicates whether the laser is being operated in either the internal or external mode.
11. Push button switch is used for manual single shot operation when the mode selection switch is set at external.
12. Electrode adjustments.
13. Gas purge 1 and 2.
14. 'Trigger in' is used to trigger the laser externally when the mode selection switch is in the external position.
15. 'Sync out' gives a 24 V pulse 1.5 μs wide 1 μs before lasing occurs.
16. Pins C&E on the remote connector must be shorted for the laser to operate.
17. The beam attenuator when pulled out blocks the laser beam from passing through the laser aperture.
18. Needle valve which controls gas flow to the laser head.

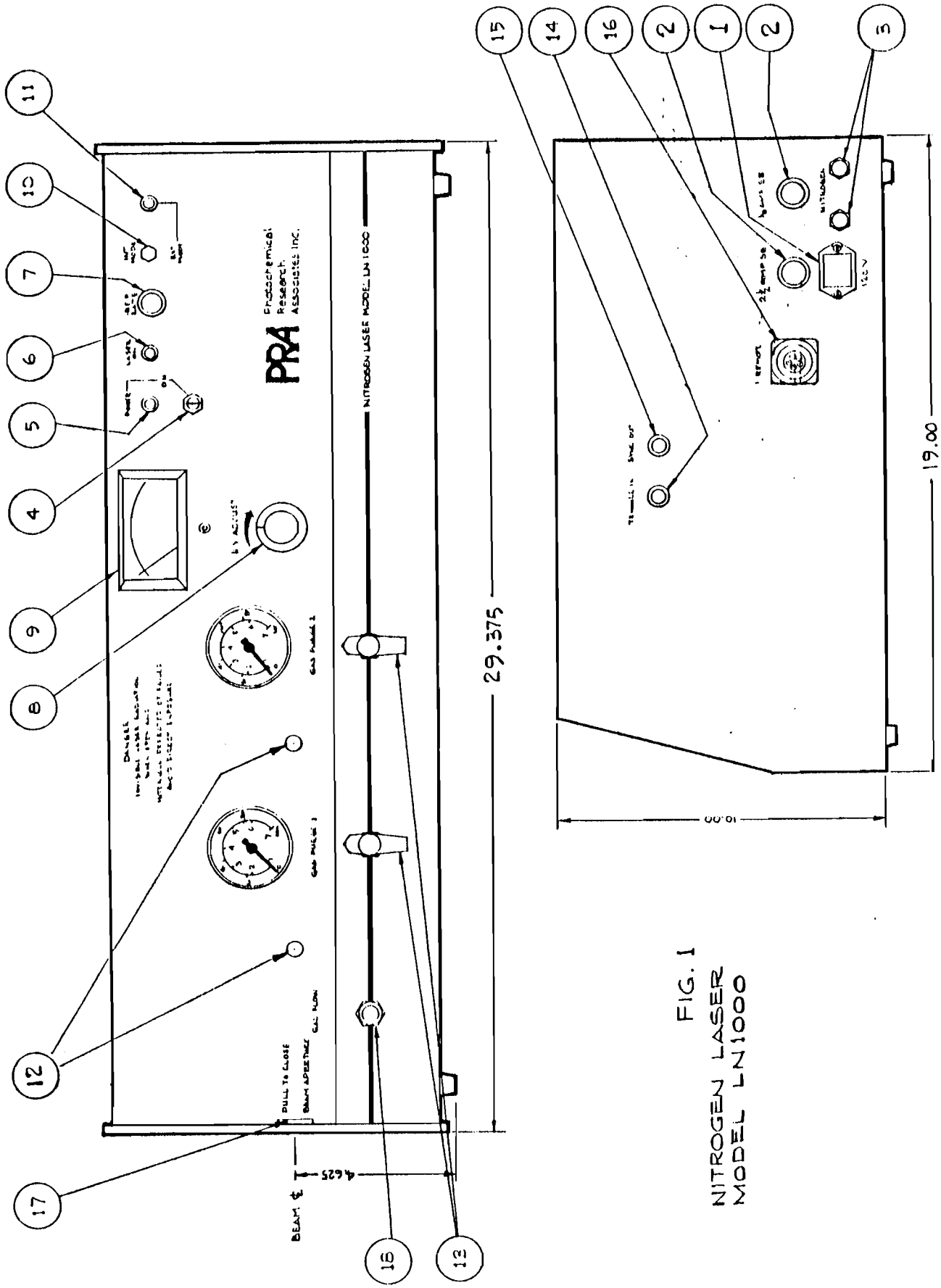
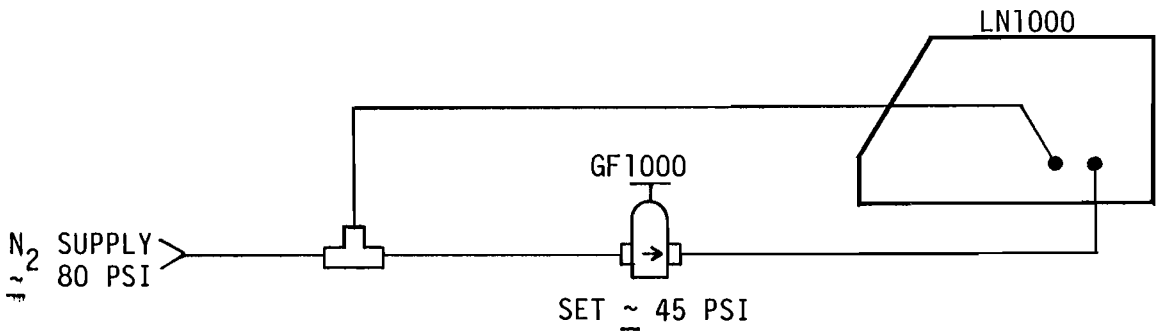


FIG. 1
NITROGEN LASER
MODEL LN1000

GAS FLOW CONTROLLER



NOTE: READ PRESSURES ON LN1000 GAUGES

Installation and Operation

1. Install regulator so that gas is in the direction of the arrow stamped on regulator. The regulator will operate in any position.

2. Plumb the nitrogen lines as in the diagram.

3. Set your main regulator so the gauge to the right of the control panel reads 80 psi.

4. To set the GF1000, pull out on the yellow locking cap and set the regulator so that the gauge to the left of the control panel reads 45 psi. Push yellow locking cap in to lock regulator.

5. After starting the laser it will be necessary to "fine-tune" both regulators to the specific settings noted on the set-up sheet in your manual.

3.0 OPERATING INSTRUCTIONS

3.1 Initial Set Up & Test

A. The power cord connector is for 120 V. If the input line voltage is other than 120 V, a stepdown transformer is required. (e.g. Europe or Asia).

B. Check the key switch to make sure it is on the off position.

C. Turn the high voltage control fully counterclockwise to set the laser initially at 0 V.

D. Set the mode selection switch to the internal position.

E. Ensure that the shorting connector is connected to the remote connector.

F. Set the repetition rate dial with the marker in the upright position.

G. Connect a nitrogen source to both gas inlets on the rear panel of the laser. Adjust the pressure on the dial above gas purge 1 between 40 - 50 psi and the pressure on the dial above the gas purge 2 to 80 psi. Open each gas purge valve for approx. 10 seconds, and shut them off. Open the needle valve marked gas flow completely and purge the head with nitrogen gas for a few seconds.

H. Push the beam attenuator in so that the aperture is open, then adjust the gas flow valve approximately 1/2 to 1 turn from its closed position.

I. Turn the key to the on position. The white power on light should light up.

J. In ten seconds, the red 'laser on' light should light up indicating that the laser is ready to lase.

K. Slowly turn up the high voltage. At about 10 kV noise will be heard from the laser. Adjust the repetition rate to 2 or 3 Hz. At about 16 kV the laser should be lasing. (if the laser happens to fire intermittently, open the valve purge 1 and purge the spark gap with nitrogen gas for a minute). The output can be easily seen on a piece of paper that fluoresces when exposed to UV light.

L. At higher repetition rates the gas flow to the laser head must be increased until the output energy is stable. Above 10 Hz it may be necessary to increase the voltage in order to obtain stable output.

3.2 External Operation of Laser

When the mode selection switch is turned to the external position, the laser can be fired manually or by using an external signal applied to the 'trigger in' connector on the rear end plate.

The laser is fired manually, one shot at a time by pressing the push button located on the front panel.

The laser can be triggered externally with a pulse having an amplitude >3 volts with a pulsewidth between 100 ns and 10 μs.

3.3 Trigger Out

A signal is provided at trigger out which comes approximately 1 μs before lasing takes place. The signal is about 25 volts with a duration of 1.5 μs.

4.0 CLEANING & ADJUSTMENT OF SPARK GAP 1

The spark gap is adjusted at the factory and further adjustment should not be necessary for many millions of shots. If the gap becomes very dirty after prolonged use the spark gap should be cleaned.

4.1 Cleaning Spark Gap 1

Shown in Fig. 3 is an exploded view of spark gap 1.

1. Unplug the laser from the line.
   Turn off the gas to the laser.

2. Remove the top cover of the laser.

3. Remove the metal enclosure over the laser head by undoing the four screws on the top of the enclosure.

4. Referring to Fig. 2 the small spark gap is marked number "1".

5. To disassemble the spark gap for cleaning remove the grid cap from the trigger electrode. Undo the four screws holding the plastic cap against the aluminum housing of the spark gap. The aluminum housing can then be removed exposing the interior of the spark gap. **DO NOT** remove the tubing to the gap.

6. The interior of the gap can then be cleaned using a Q-Tip and methanol. If the opposite electrode tip which is located in the teflon holder is very badly worn it may be necessary to readjust the opposite electrode or even replace it. If it is badly worn see section 4.2 on adjustment of the spark gap.

7. Reassemble the spark gap and replace the grid cap.

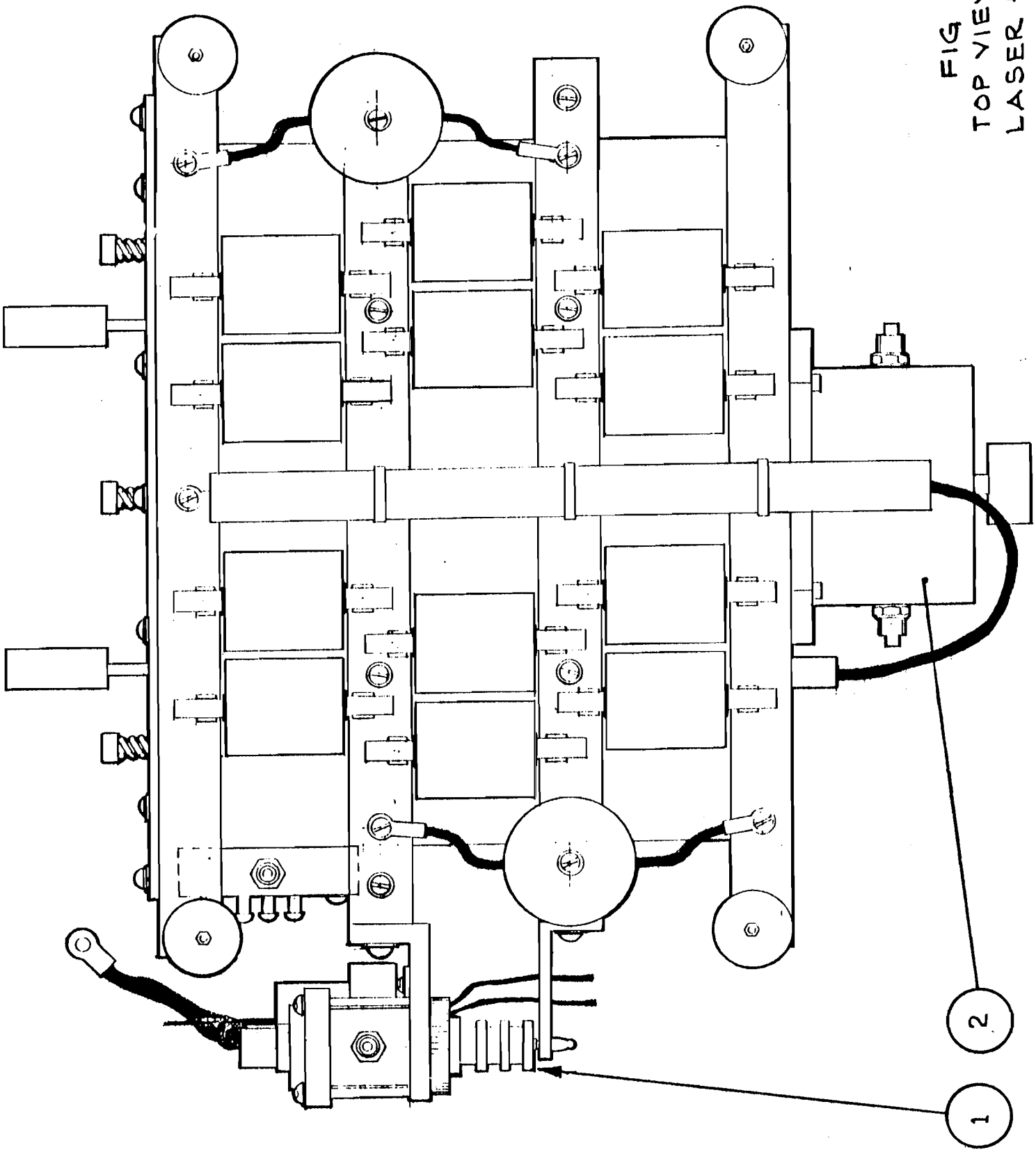


FIG 2
TOP VIEW OF
LASER HEAD

4.2 Adjustment of Spark Gap 1

Shown in Fig. 3 is an exploded view of the small spark gap.

In order to adjust the gap spacing first the gap must be disassembled as described in the preceding section. The gap spacing is altered by moving the opposite electrode contained in the white teflon holder marked "6" in the diagram.

The gap should be adjusted so that the spacing between the tip of the opposite electrode and the inner bottom surface of part 3 is 2 mm. This is marked in Fig. 3.

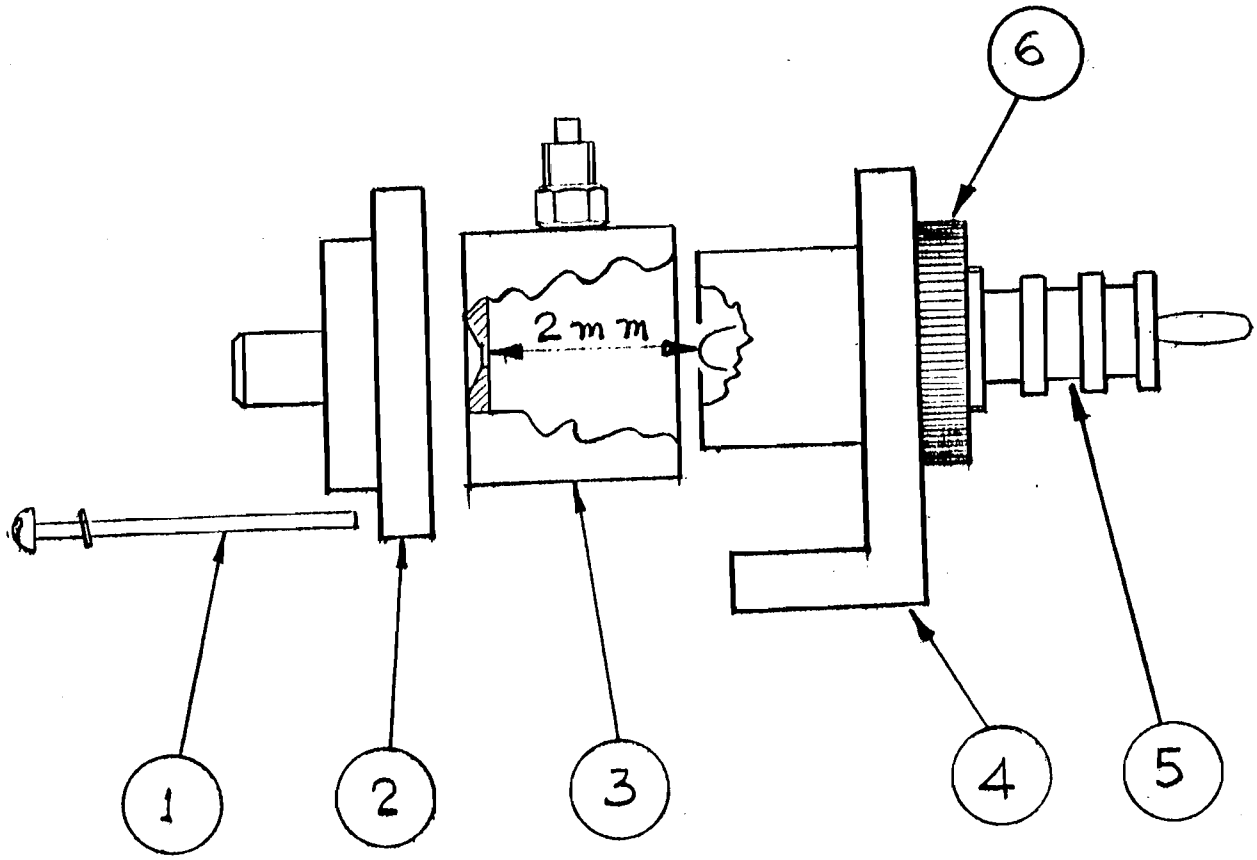
In order to move the opposite electrode, the white teflon opposite electrode holder 5 can be turned which causes the opposite electrode holder to move in and out. Move part 5 until the spark gap spacing will be 2 mm when part 3 is replaced. Then reassemble the spark gap as described previously.

5.0 CLEANING & ADJUSTMENT OF SPARK GAP 2

Referring to Fig. 2 spark gap 2 is labelled number "2".

5.1 Cleaning Spark Gap 2

1. Unplug the laser from the line. Turn off the gas to the laser and bleed pressure off using the gas purge 2 valve.
2. Remove the top cover of the laser.
3. Remove the metal enclosure over the laser head by undoing the four screws on the top of the enclosure.
4. To disassemble the spark gap for cleaning remove the four screws from the aluminum housing. Slide the housing away from the laser head. Remove the six screws which mount the plastic cap to the aluminum housing and slide the plastic cap out to expose the interior of the spark gap. DO NOT remove the tubing to the gap.
5. The interior of the gap can then be cleaned using a Q-Tip and methanol. If the electrode is very badly worn it may be necessary to readjust the gap. See Section 5.2 on adjustment of the spark gap.
6. Reassemble the spark gap by reversing above.



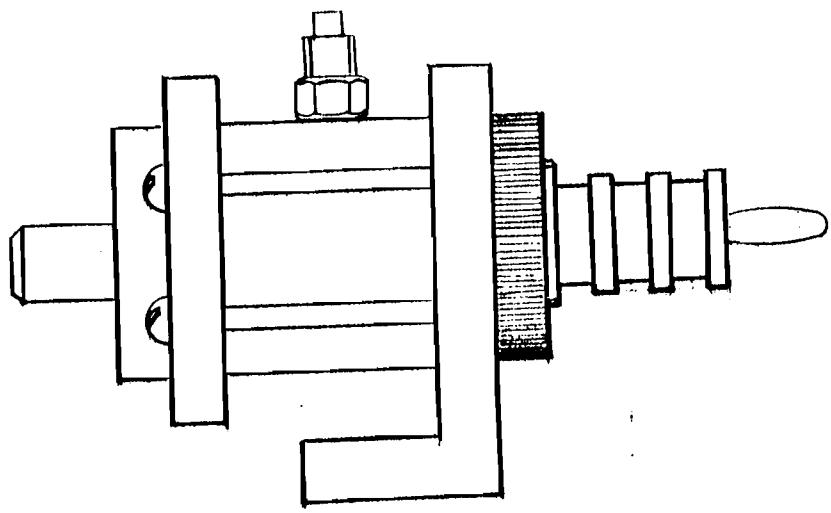


FIG 3

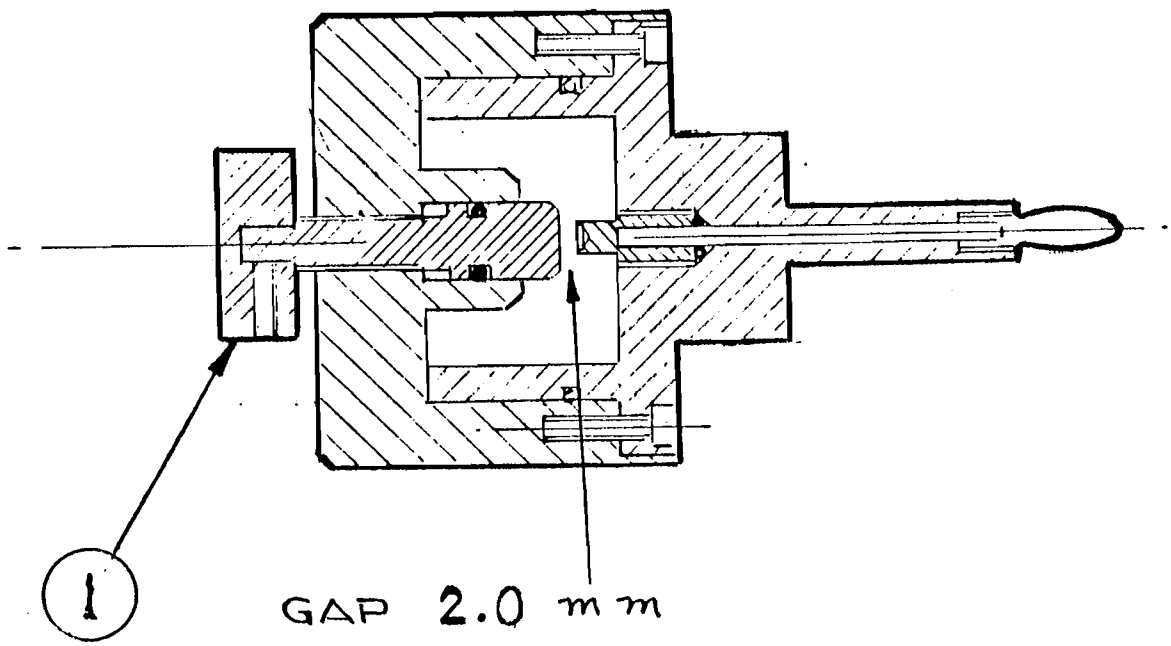


FIG. 4

5.2 Adjustment Spark 2

If it becomes necessary to adjust the gap the laser must be turned off and unplugged and the gas turned off and purged from the gaps.

The spark gap spacing can be changed by turning the black knurled knob as shown in Figure 4. One turn of the knob moves the electrode by ≅1 mm. The proper gap spacing is 2.0 turns from the closed position.

6.0 CLEANING & ADJUSTMENT OF LASER CHANNEL ELECTRODES

6.1 Cleaning of Laser Channel Electrodes

Ref. to Fig. 6 and 7
It may become necessary to clean the laser channel electrodes after many millions of shots.

1. Turn the laser OFF. Unplug from the line and turn off the gas supply.

2. Remove the top cover and the RF shield.

3. Remove the resistor end probe (1) from the laser head. Make sure in reassembly that the banana plug on this probe is properly seated.

4. Remove the ground strap (2) and the four screws (3) mounting the laser head to the standoffs.

5. Now tilt the front of the laser head upward and remove the six screws (4). Slide the electrode assembly (Fig. 7) out of the laser head.

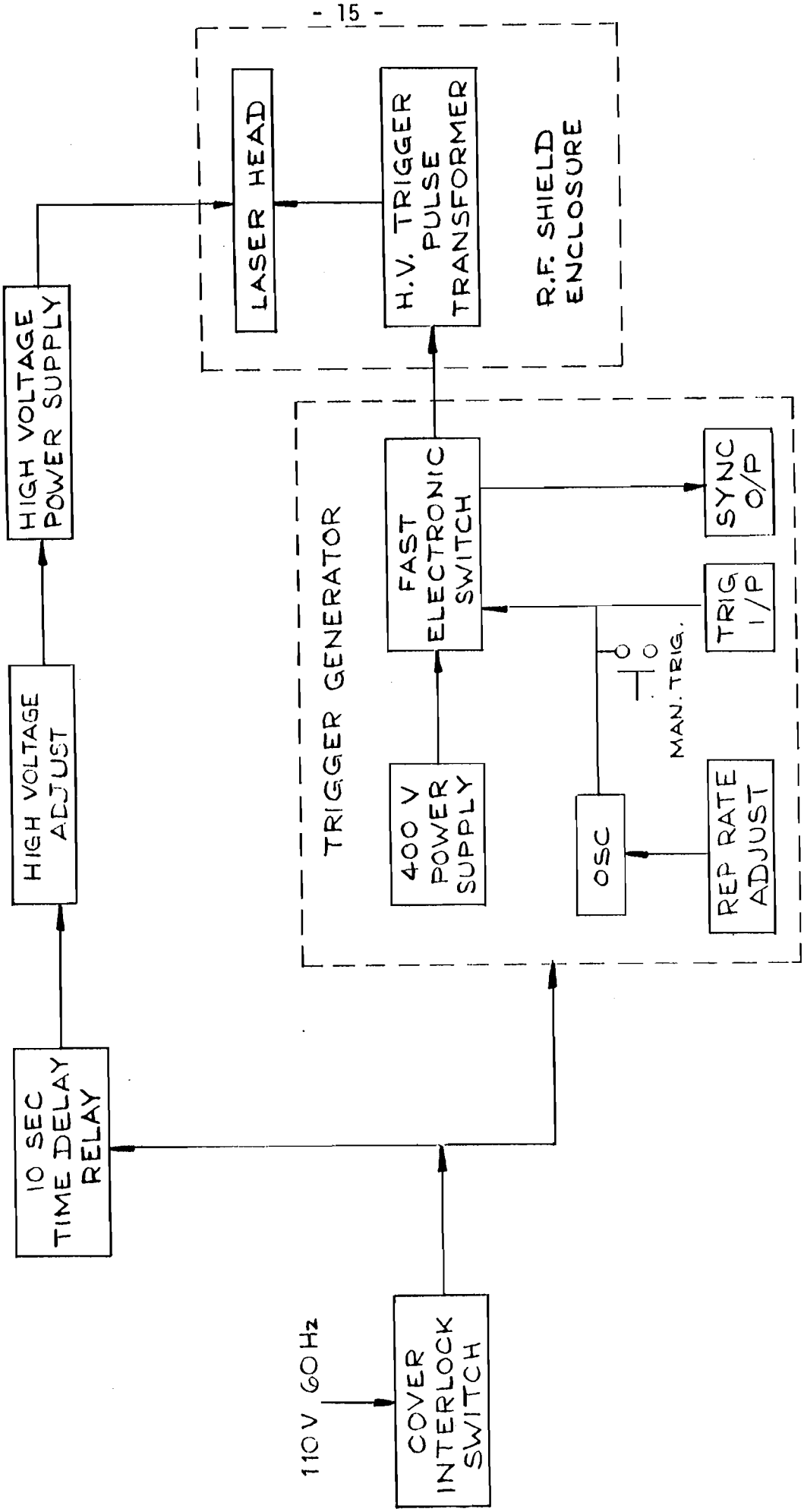
6. Remove the two plastic nuts (5) and the four screws (6) and remove the circuit board. The laser channel electrodes and the circuit boards can now be cleaned with a Q Tip and methanol.

7. The mirror (7) can also be cleaned using the same method.

8. Reassemble by reversing the above procedure. Some electrode adjustment may be necessary after reassembly.

6.2 Adjustment of Laser Channel Electrodes

The laser channel electrodes are aligned at PRA for optimum laser output. If for some reason the electrodes become misaligned they can be realigned using the electrode spacing gauge and the adjustment tool supplied with the laser. The electrode spacing gauge can be inserted inside the laser channel to give a reference electrode spacing of 6 mm. The adjustment tool can be inserted through the holes (marked "12" in Fig. 1) and fits into a hexagonal receptacle inside the laser head. With the laser turned off, insert the electrode spacing gauge between the electrodes at one end of the laser channel and at the same time turn the adjusting tool to make sure that the electrodes and the gauge are touching each other. Repeat the same procedure at the other end of the channel. If this is done, the spacing between the two electrodes should be 6 mm. With the laser turned on, its output can be optimized by adjusting the electrode spacing slightly (from 6 mm) while monitoring the output with an energy meter or a photodiode (with an appropriate attenuation on the laser beam). The channel formed by the electrode should be approximately 5.5 mm wide when the laser is optimized and the output beam will be approximately rectangular. The pulse to pulse reproducibility is also better when the electrode spacing is optimized.



LN1000 NITROGEN LASER BLOCK DIAGRAM

FIG. 5

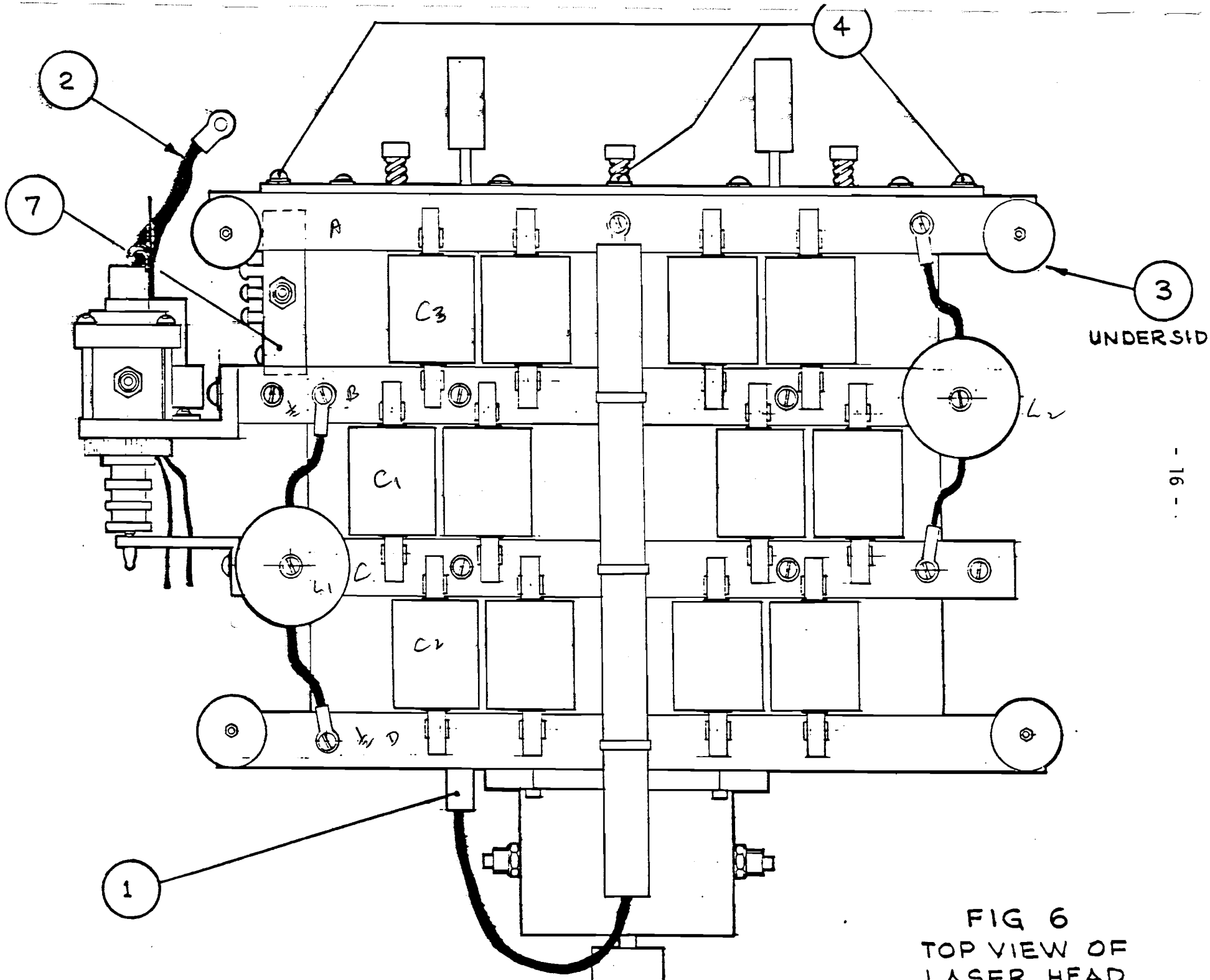


FIG 6
TOP VIEW OF
LASER HEAD

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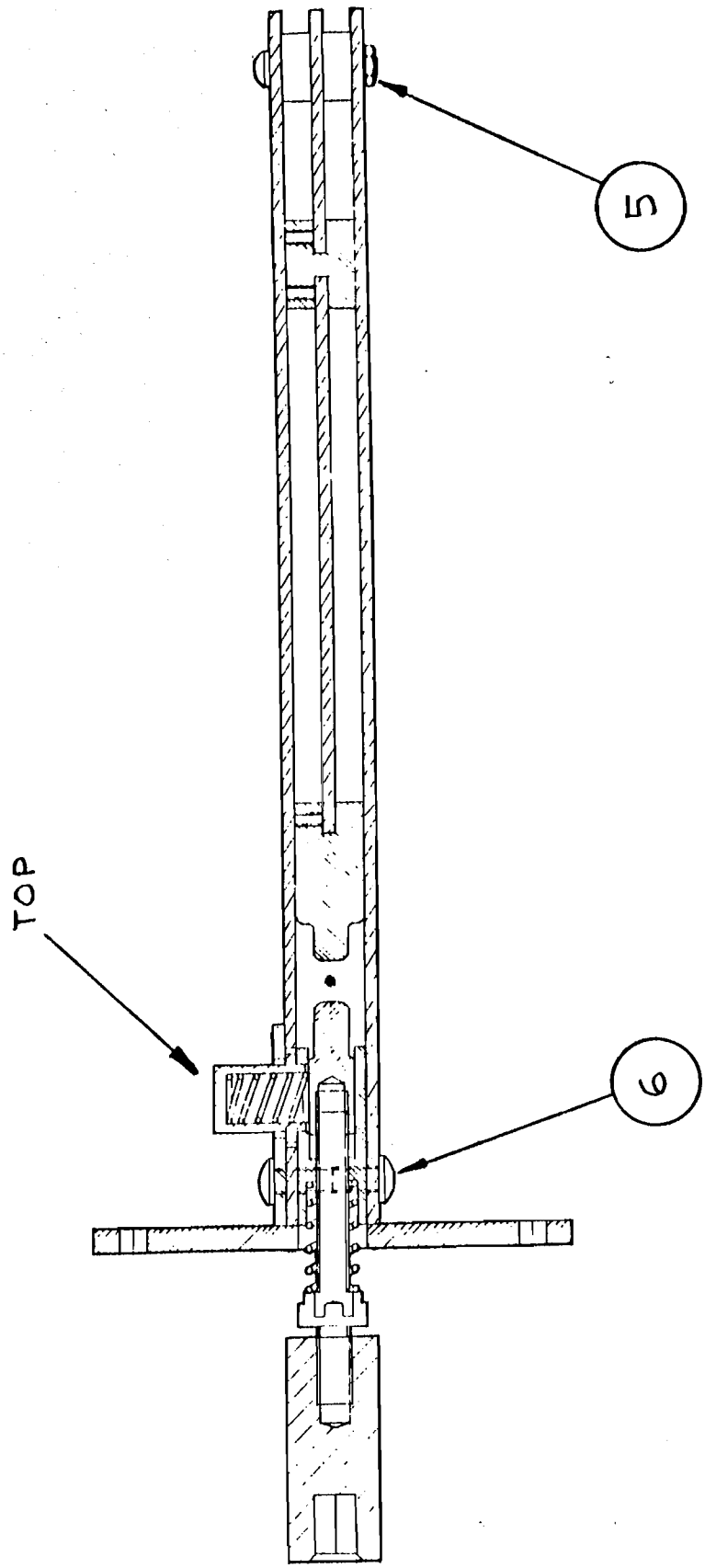
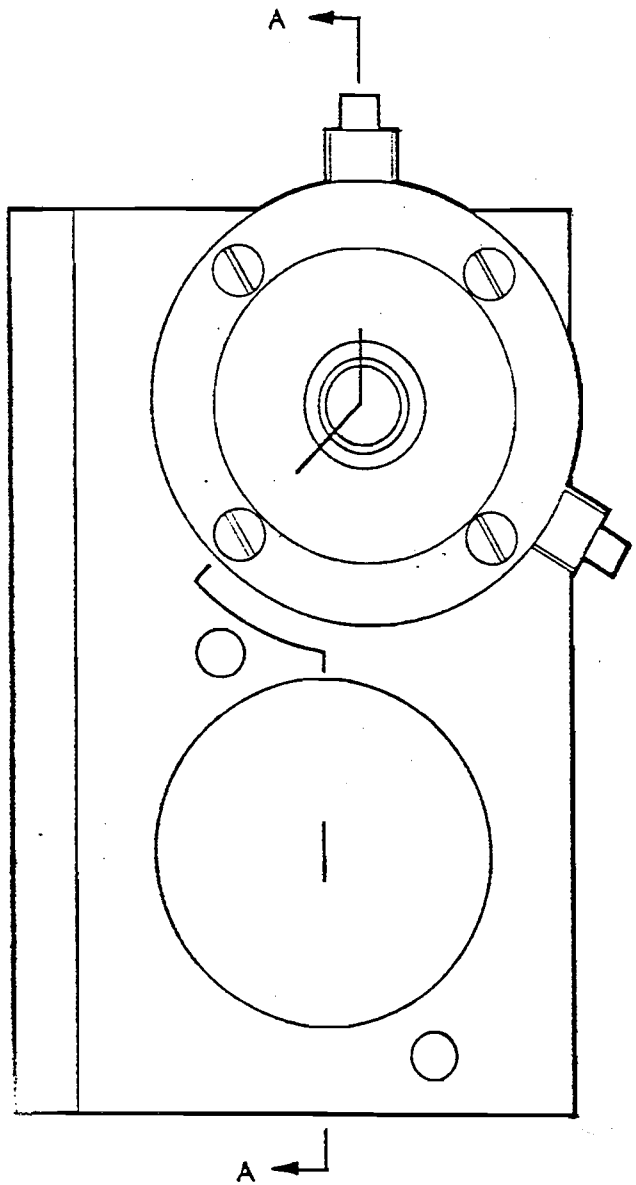


FIG 7
ELECTRODE ASS'Y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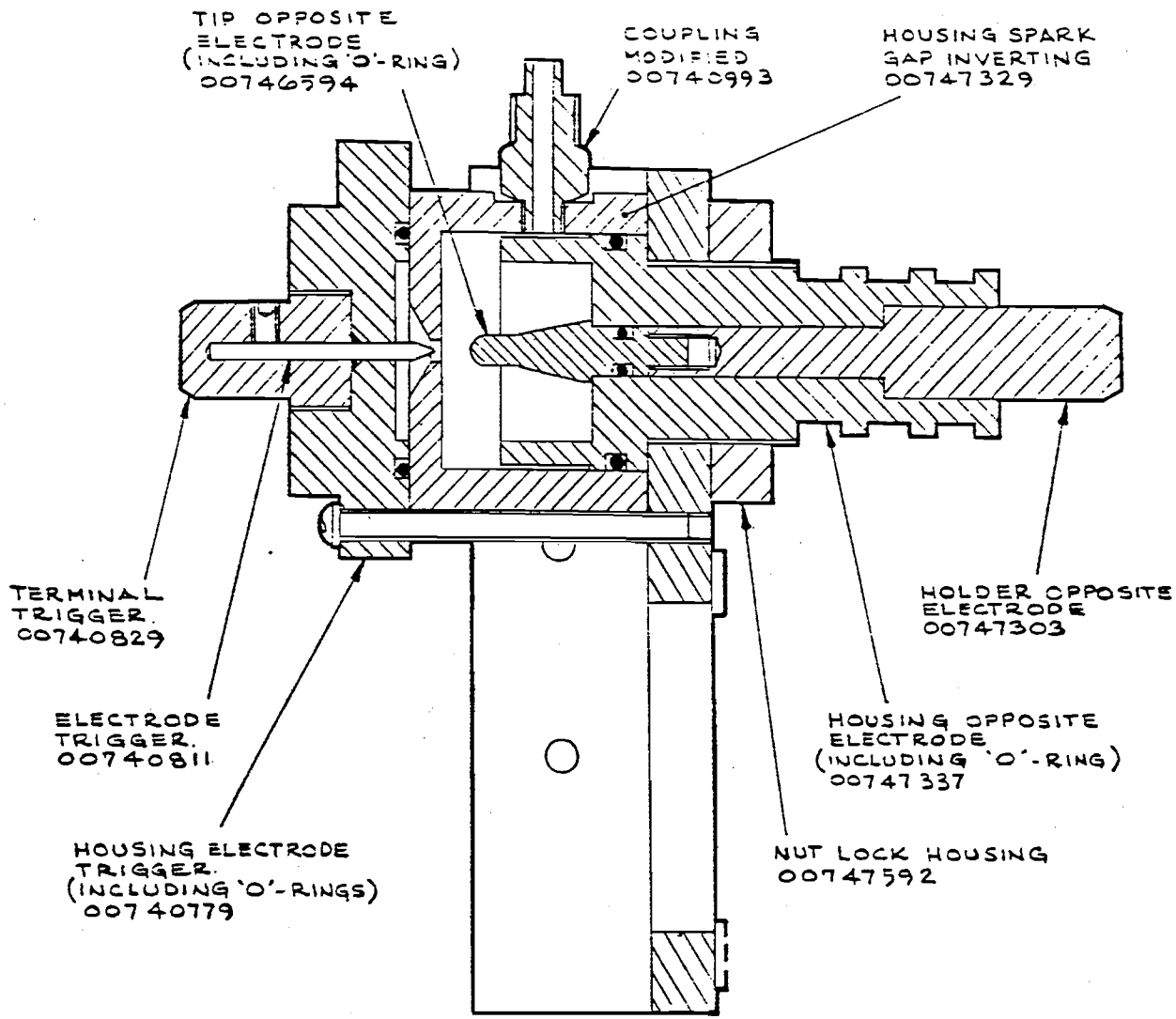
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ELECTRODE TRIGGER. 00740811
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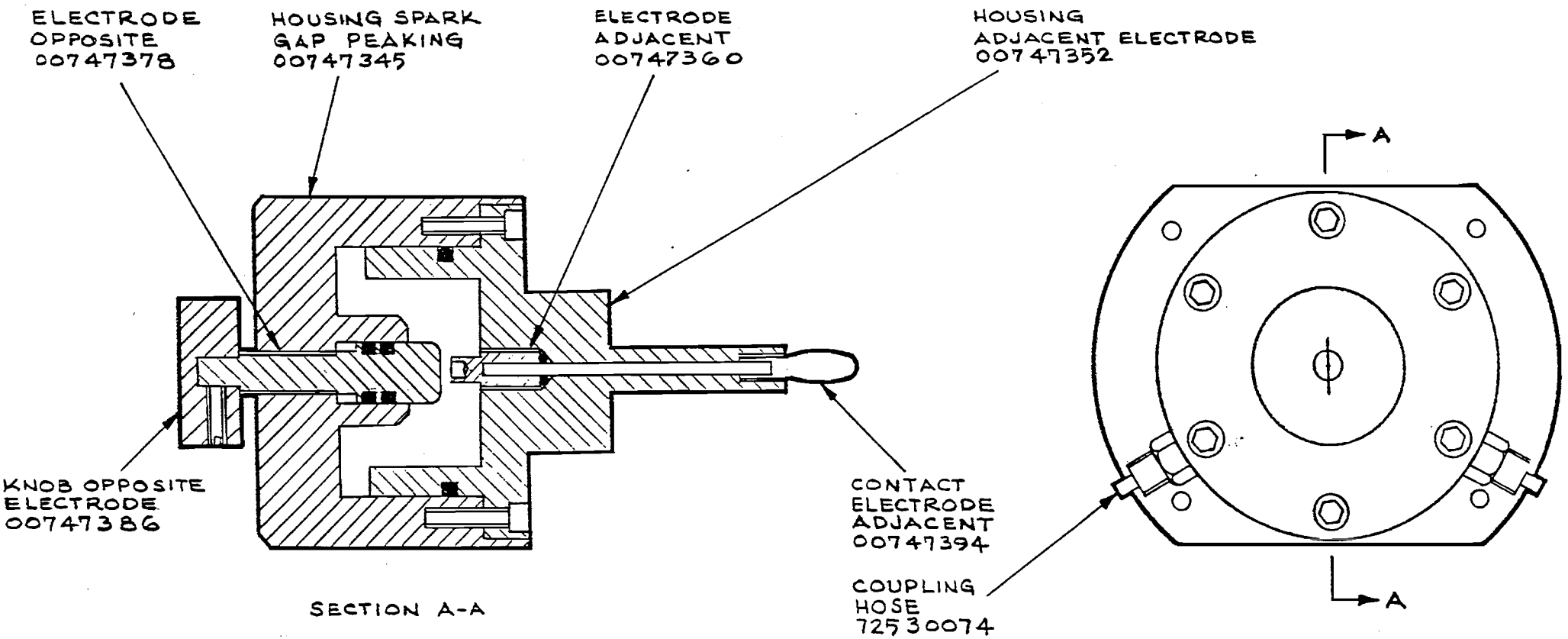
SECTION A-A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CONTACT ELECTRODE ADJACENT 00747394
COUPLING HOSE 72530074
A

SECTION A-A

N_2 LASER REFERENCES

1. "Pulsed UV Nitrogen laser: dynamical behaviour", P. Richter et al, Appl. Optics, Vol. 15, No. 3, March 1976, p756.

2. "Cascade Population mechanism in nitrogen lasers", L. Scaffardi et al, L.E.S. Mathias and J.T. Parker, Appl. Optics, Vol. 24, No. 1, Jan. 1985, p22.

3. "Stimulated Emission in the Band Spectrum of Nitrogen", Appl. Phys. Lett., Vol. 3, p16 (1963).

4. "Pulsed Molecular Nitrogen Laser Theory", E.T. Gerry, Appl. Phys. Lett., Vol. 7, p6-8, July, 1965.

5. "UV TEA laser with 760-Torr N_2", E.E. Bergmann, Appl. Phys. Lett., Vol. 28, No. 2, 15 Jan. 1976, p84.

6. "Ultraviolet Gas Laser at Room Temperature", H.G. Heard, Nature (London) 200, p667, 1963.

RETURN AUTHORIZATION (R/A) NUMBER IS REQUIRED BEFORE RETURNING ANY ITEM TO PRA. CONTACT CUSTOMS AND TRAFFIC FOR R/A NO. AND FOLLOW THE SHIPPING INSTRUCTIONS FOR RETURN PROCEDURES AS LISTED BELOW:

SHIPPING INSTRUCTIONS

WHEN SHIPPING BY TRUCK, BUS OR COURIER:

1. Canadian Customs Invoices, in quadruplicate, must accompany the shipment. Attach Customs form to a copy of the Bill of Lading.

2. Canadian Customs Invoices and Bill of Lading SHOULD CLEARLY BE MARKED AS FOLLOWS:

   U.S. CUSTOMS CLEARANCE CONTACT: J.V. CARR, 560 Delaware Ave., Buffalo, N.Y. 14201 or J.V. CARR & SON INC., 1600 W Lafayette Detroit, MI 48232 for T.I.B. BOND.

   FOR CANADIAN CUSTOMS CLEARANCE: CONTACT INTERNATIONAL CUSTOM BROKERS LTD.

3. Mail two extra copies of Canadian Customs Invoice, the Original Bill of Lading, and your commercial invoice or purchase order on date of shipment to PRA.

WHEN SHIPPING BY AIR FREIGHT OR AIR CARGO:

1. Canadian Customs Invoices, in quadruplicate, must accompany the shipment. Attach to the Air Way Bill and CLEARLY MARK:

   U.S. CUSTOMS CLEARANCE TO ISSUE TIB BOND, PRIOR TO DEPARTING THE U.S.

   AND ALSO:

   AIRPORT CUSTOMS CLEARANCE FOR CANADIAN CUSTOMS CONTACT: INTERNATIONAL CUSTOM BROKERS LIMITED.

2. Air Way Bills must be identically marked as above.

3. Air Mail two extra copies of Canadian Customs invoice, the original Air Way Bill and you commercial invoice or purchase order to PRA the day the shipment leaves.

SHIPPING INSTRUCTIONS CONTINUED

WHEN SHIPPING BY MAIL OR PARCEL POST:

1. Canadian Customs invoice, in quadruplicate, must be mailed direct to:

   PRA INTERNATIONAL INC.
   45 MEG DRIVE
   LONDON, ONTARIO
   CANADA N6E 2V2 Phone No.: (519) 686-2950

2. Mail two extra copies of the Canadian Customs Invoice, and your commercial invoice or purchase order to PRA, on date of shipment.

   PLEASE NOTE: If goods are not registered with U.S. Customs as leaving the U.S. to be going to Canada for repair or replacement, there will be lengthy delays, and it may be necessary for additional charges to be incurred for proper Customs clearance.

   PRA is entitled to refuse to accept any returns that do not have proper Customs documentation, once the customer has been advised of proper procedure regarding returns.

   If any questions arise concerning the foregoing procedure, please contact:

   PRA INTERNATIONAL INC.
   45 MEG DRIVE
   LONDON, ONTARIO
   CANADA N6E 2V2

   Phone No.: (519) 686-2950 Attention: Traffic Department


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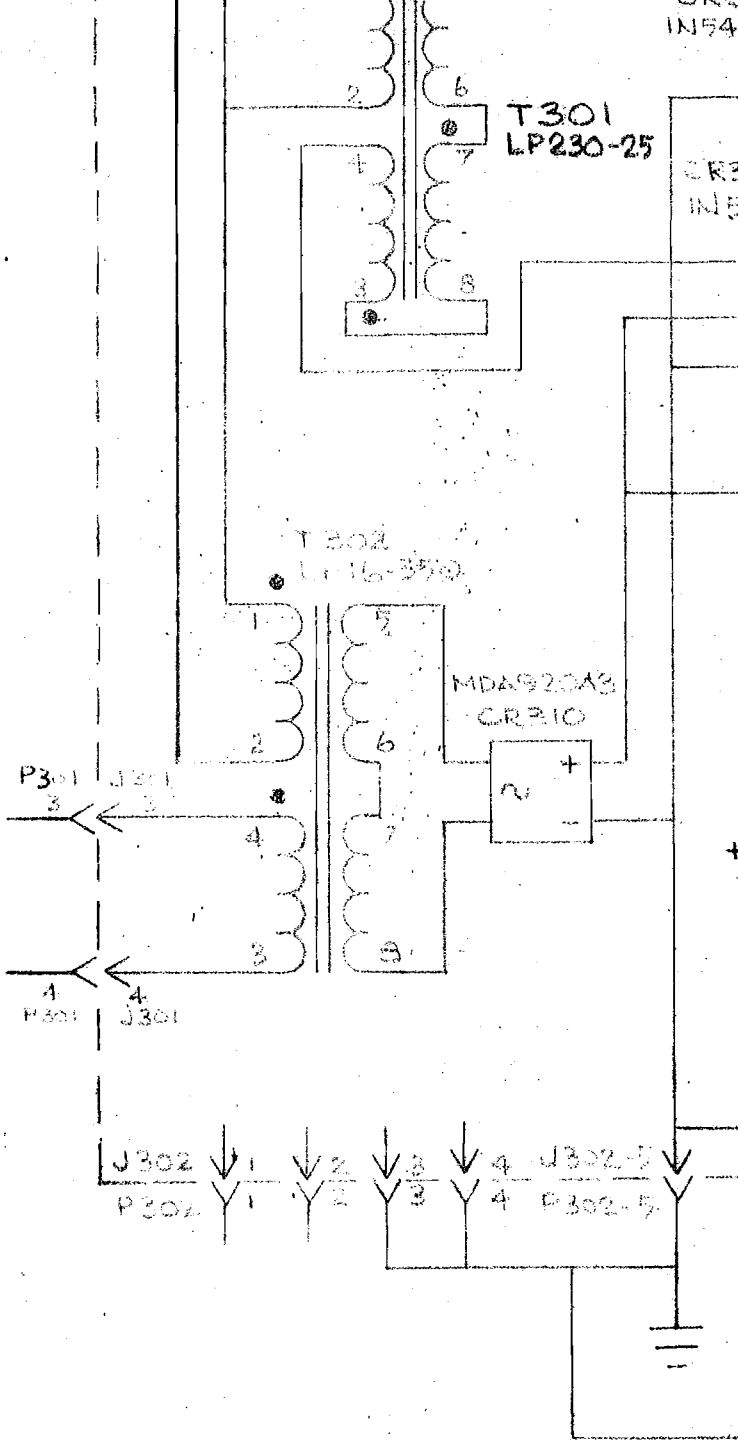
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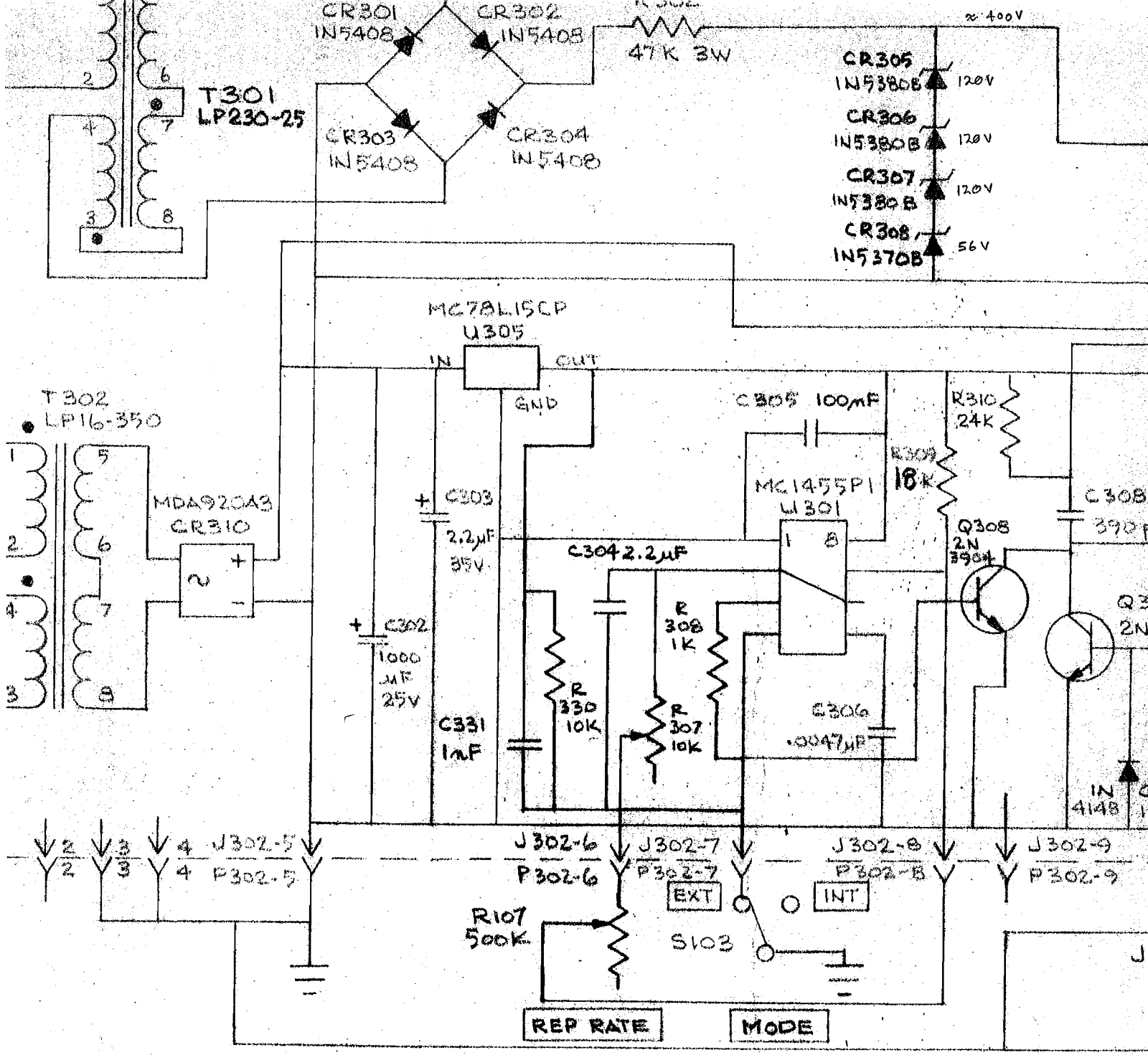
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MC78L15CP U305
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T302 LP16-350
MDA920A3 CR310
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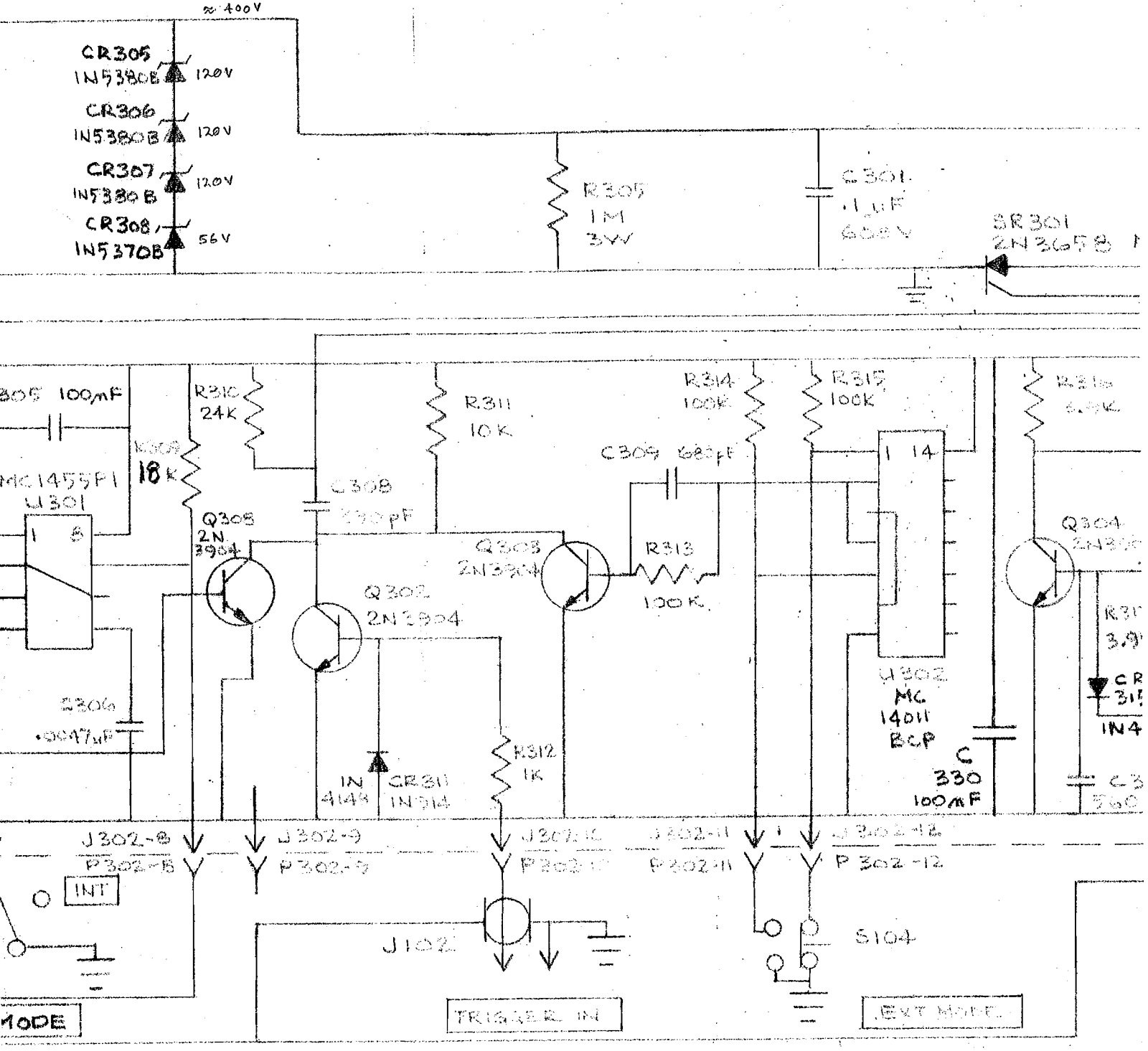
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120V
CR308
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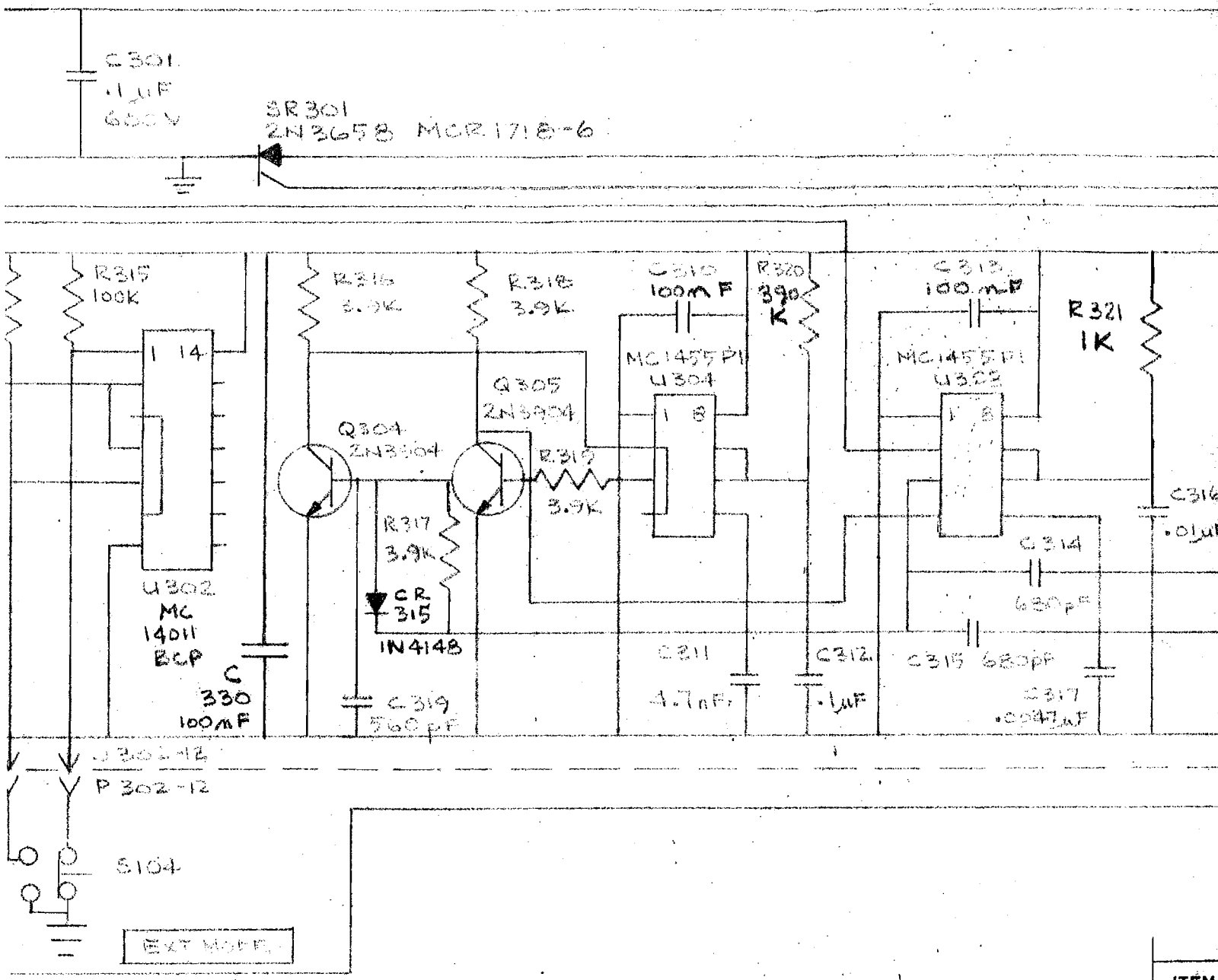
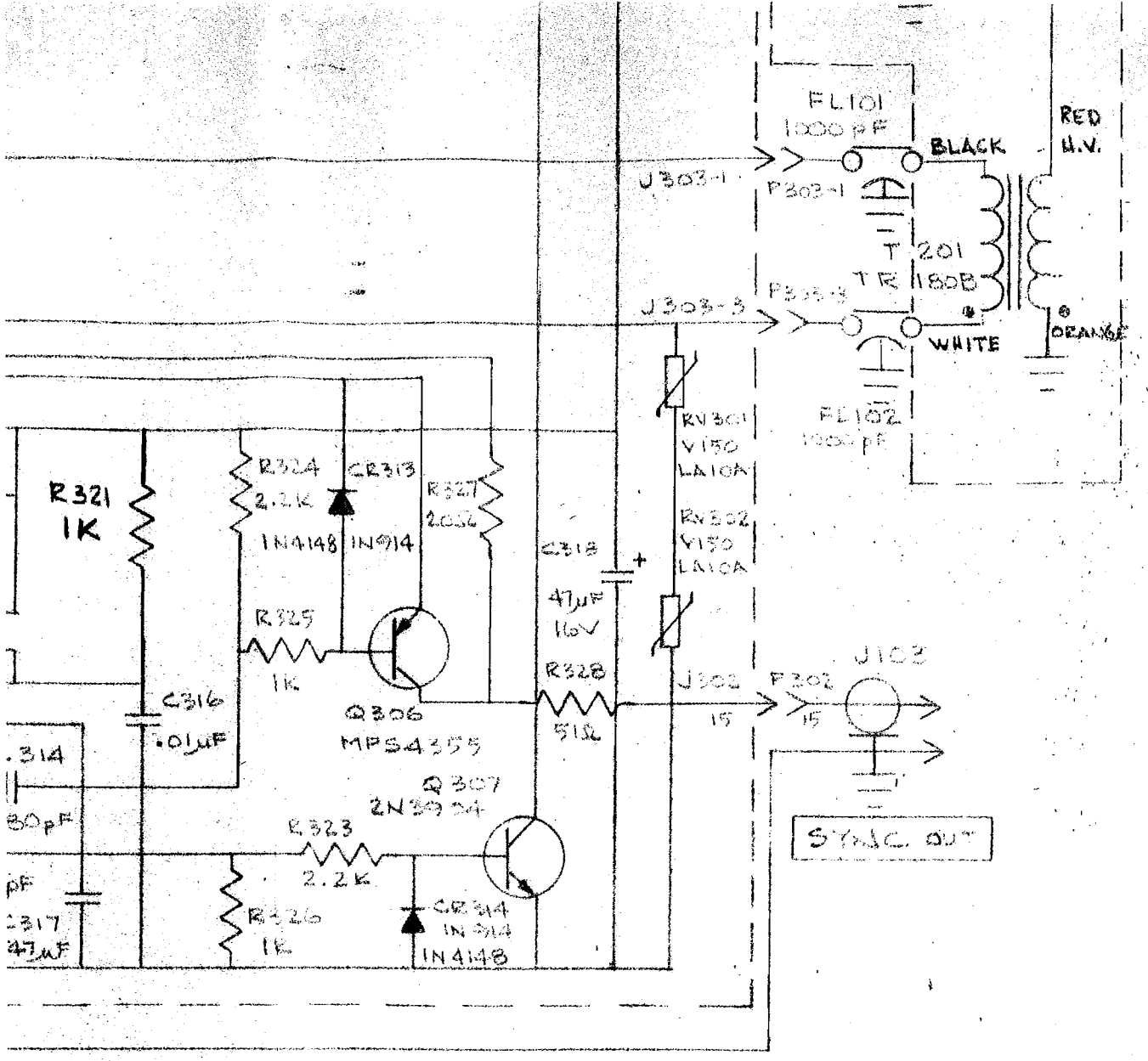
1M
3W
C301
.1 μF
630V
SR301
2N3669B
100mF
R310
24K
R309
18K
MC1455P1
U301
Q308
2N
3904
C308
R311
10K
R314
100K
R315
100K
C309 68pF
R313
100K
Q303
2N3904
Q302
2N3904
C306
.0047μF
CR311
IN
4148
R312
1K
U302
MC
14011
BCP
C
330
100mF
Q304
J302-8
P302-8
J302-9
P302-9
J302-11
P302-11
J302-12
P302-12
INT
MODE
J102
TRIGGER IN
S104
EXT MODE


C301
.1 μF
SR301
2N3658 MCR 1718-6
R315
10K
R316
3.9K
R318
3.9K
C310
100mF
R320
390
K
C313
100mF
R321
1K
MC1455P1
U304
MC1455P1
U322
Q305
2N3904
Q304
2N3904
R319
3.9K
R317
3.9K
CR
315
IN4148
U302
MC
14011
BCP
C
330
100mF
C319
560pF
C311
.47nF
C312
.1μF
C314
680pF
C315 680pF
C317
.047μF
C316
.01μF
P302-12
S104
EXT MODE



ITEM	QTY	DESCRIPTION	PART NO.

PARTS LIST

MATERIAL

FINISH

EQUIPMENT
NITROGEN LASER
MODEL LN 1000

PRA Photochemical Research Associates Inc.

TOLERANCES
UNLESS OTHERWISE STATED
3 PLACE DEC. ± .005
2 PLACE DEC. ± .010
FRACTION ± 1/64

DRAWN DATE: JUNE 9/83

CHECKED DATE: 29 FEB 84

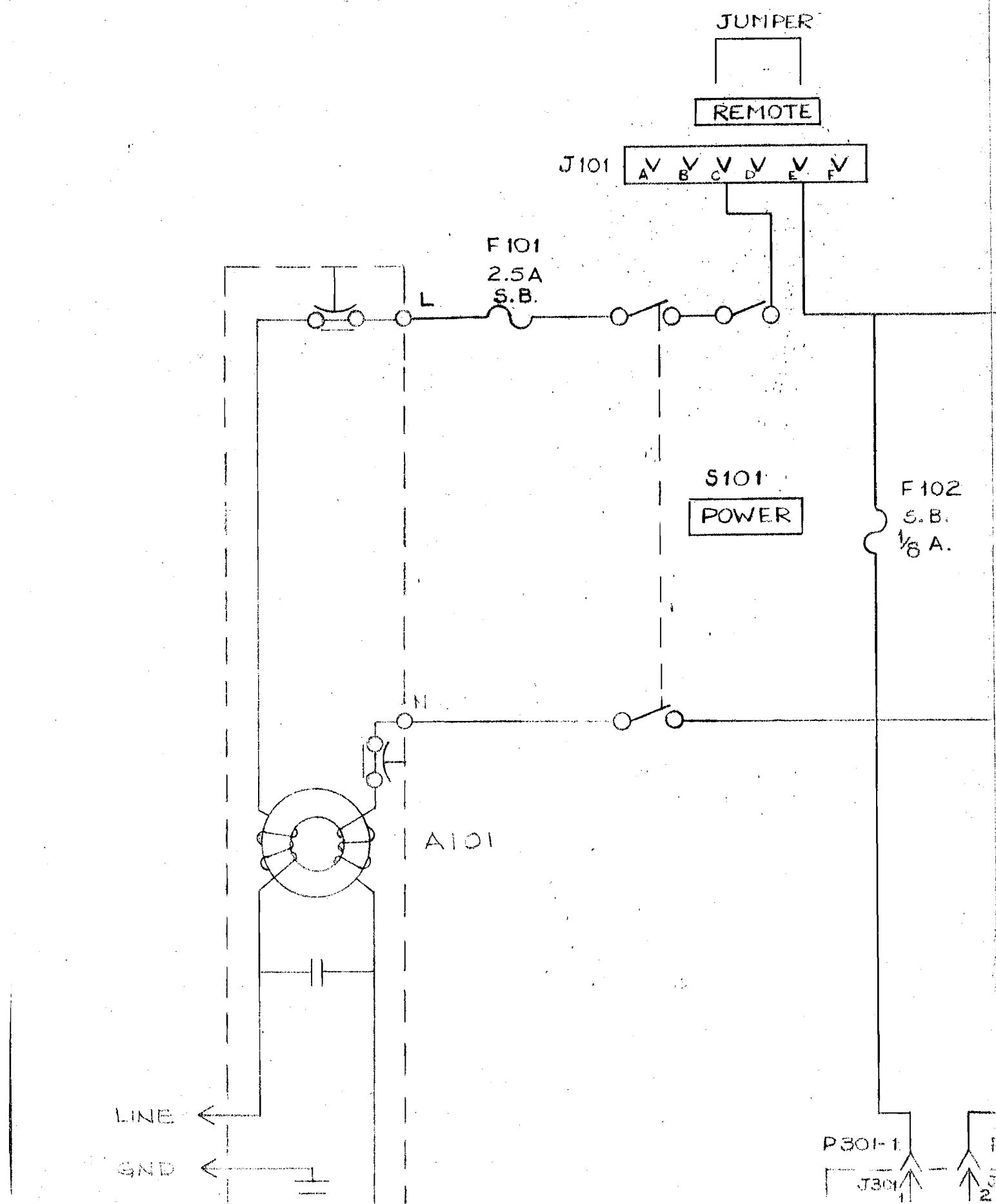
APPROVED DATE: 29 Feb 84

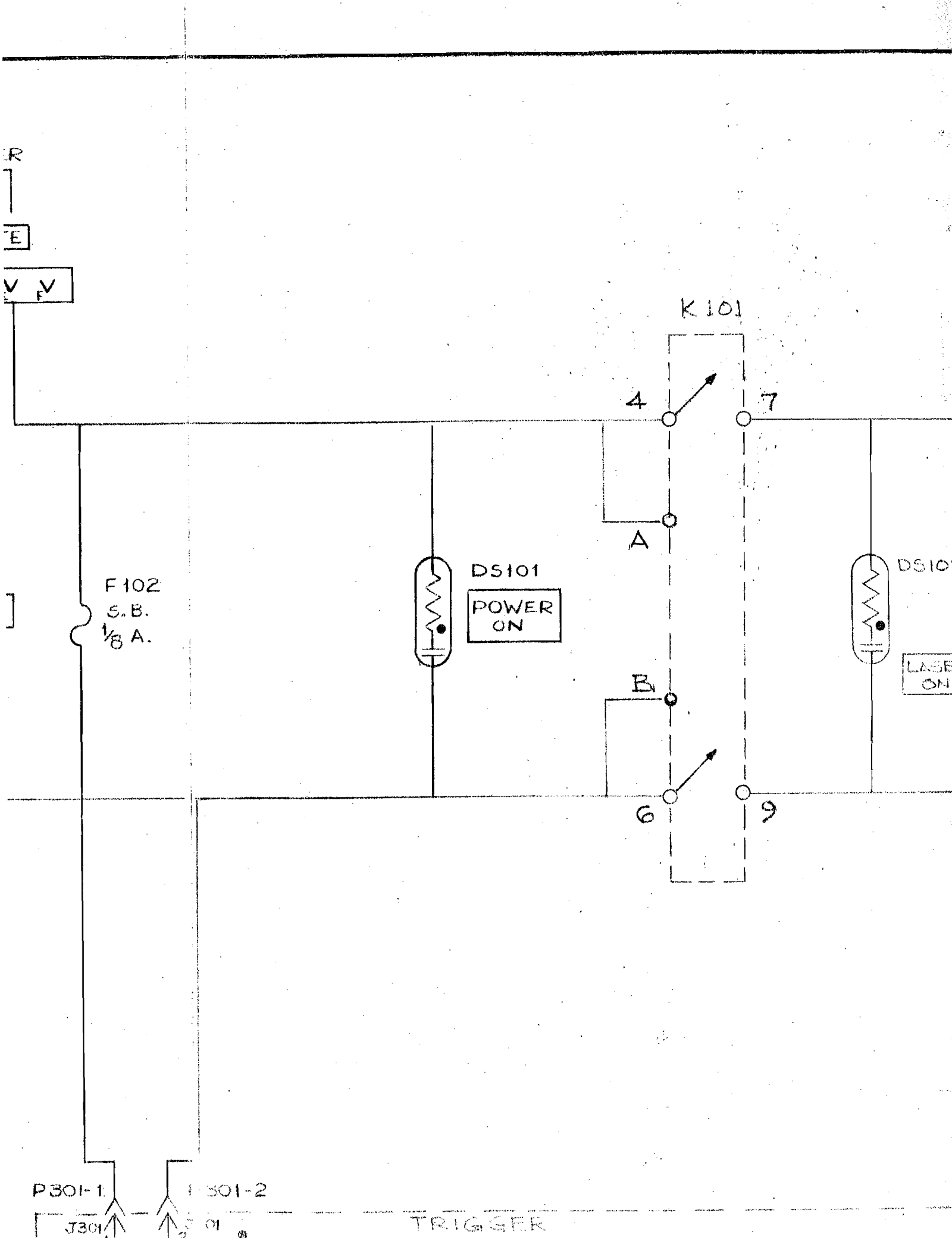
TITLE
SCHEMATIC

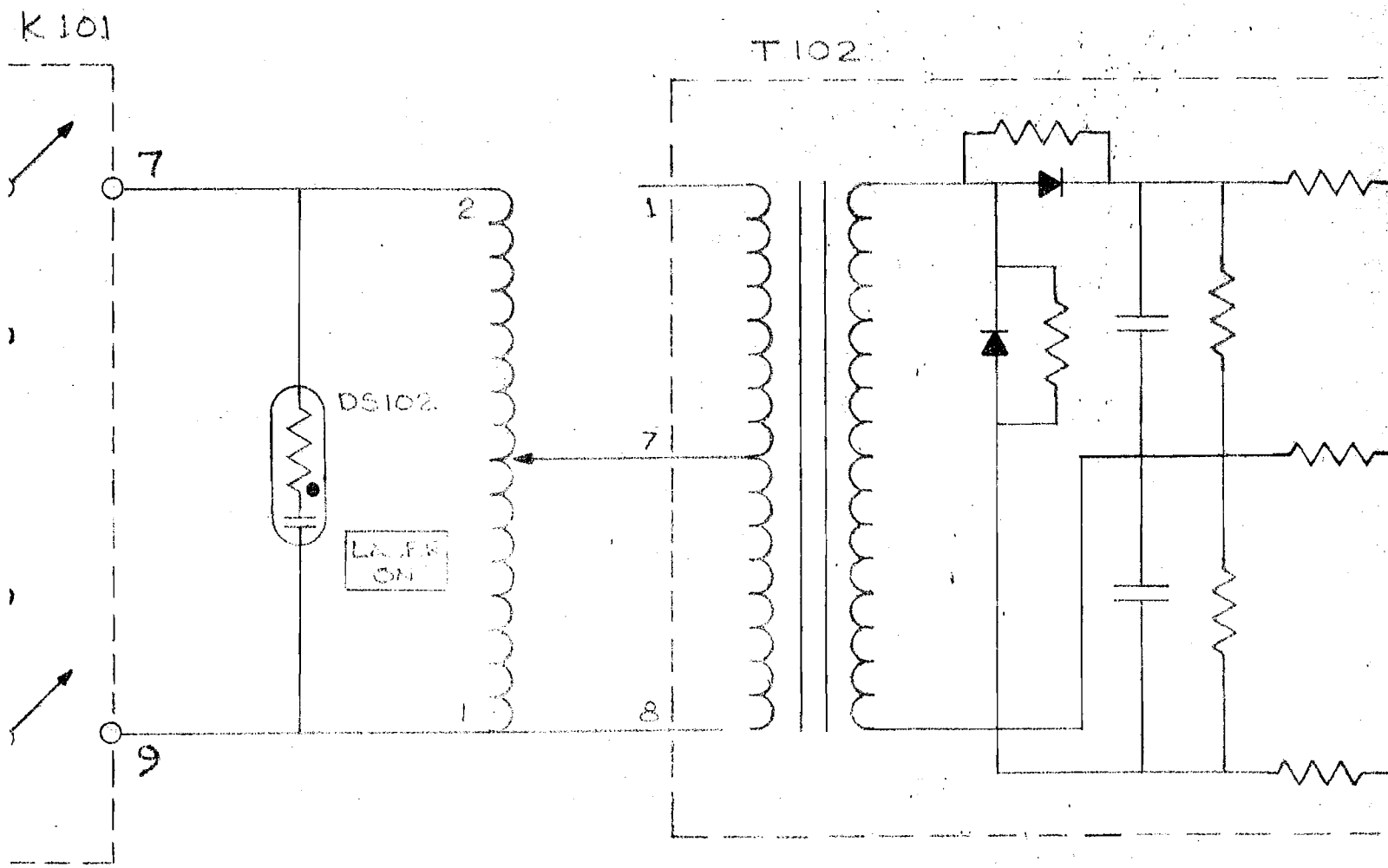
DWG SIZE: D

DWG. No.: 2757062

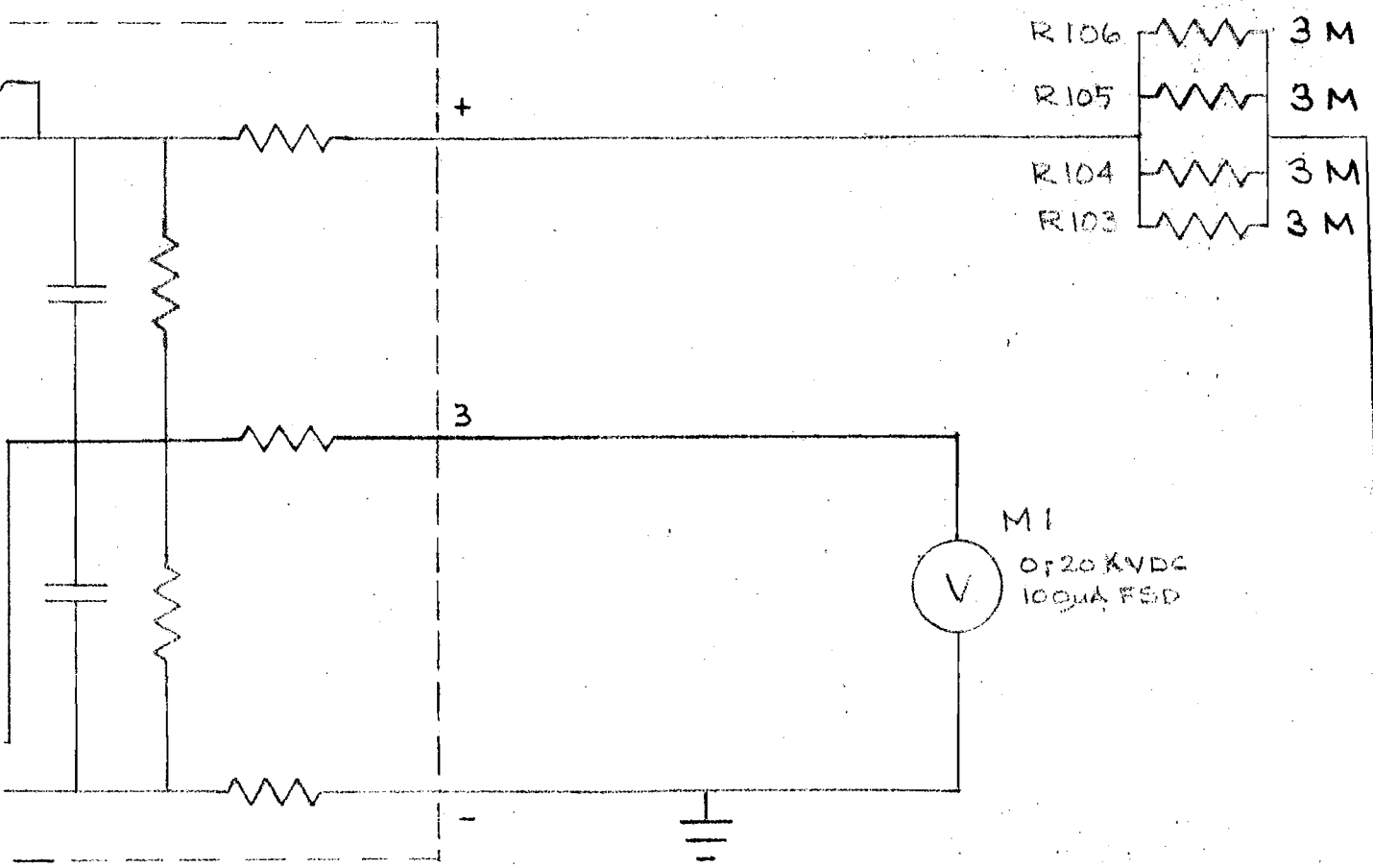
REV.


JUMPER
REMOTE
J101
A
B
C
D
E
F
F 101
2.5A
S.B.
L
S101
POWER
F 102
S.B.
1/8 A.
N
A101
LINE
GND
P301-1
J301


K 101
4
7
A
B
6
9
DS101
POWER ON
F 102
S. B.
1/8 A.
P301-1
J301
TRIGGER


K 101
7
9
DS 102
T 102
2
1
1
7
8

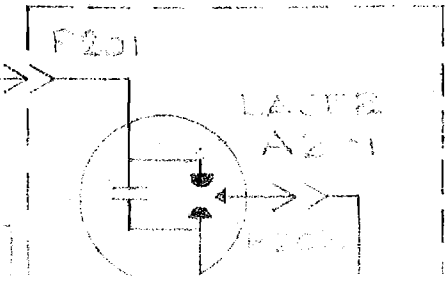
REV	CN
—	RN
A	07
B	09
C	10
D	10



REVISIONS

REV	CN No.	DESCRIPTION	DATE	APPR
—	RN C314	RELEASED	28 FEB 84	
A	0742	C320 ADDED	19 MAR 84	
B	0947	R322 REMOVED, WIRE COLOURS ADDED TO T201	29 OCT 85	
C	1025	R321 1K WAS 22K, C305, C310, C313 .100MF WERE .022μF, C330 100MF ADDED, R320 390K WAS 82K, R308 1K WAS 10K, C304 2.2μF WAS 4.7μF C331 1MF ADDED, R330 10K ADDED, CR308 IN5370B WAS IN5380, R309 18K WAS 3.9K R301, R304, Q301, CR309 DELETED.	26 APR 86.	
D	1053	R101, R102 DELETED (NOW INSIDE T102)	3 JUNE 86	

3 M
3 M
3 M
3 M



1425

CUSTOMER PARTS & LABOR QUOTE FORM

Company UNIVERSITY OF TENNA	Date Quoted 10/12/92
Contact JAMES PARKES	Person Quoted JAMES DEPARTMENT OF PHYSI
Address	Phone #
City & State	
Phone # (615) 974-8950	Fax # (615) 974-8289

PART #	QTY	DESCRIPTION	COST
0301-2036	2	MOD TRANSMISSION BOARD	$190.0
0074-7071	2	RETAINER ELECTRODE ADJUSTMENT	$53.00
			486.00
		PRA S/# 86030-LN10	
		FOR LN 1000 N2 LASER	
		MASS Acct # R01-1062-50	

FAXed 2-2-93

ESTIMATED LABOR & TRAVEL EXPENSES		
Travel: hrs. @ $ per hour = $		Labor: hrs. @ $ per hour = $
Air Fare $	Ground Transportation $	Lodging $
Meals $	Parking/Tolls $	Misc. $

Customer Request Shipping Data:	
Part Availability: IN STOCK	
Schedule Next Field Service Visit:	Approval:

A confirming purchase order is required before goods or services can be provided. Fax purchase orders are acceptable if followed by an original.

This quotation is valid for 30 days. F.O.B. Factory, Orlando, Florida

Terms: Net 30 days with approved credit. All price quoted in U.S. dollars.