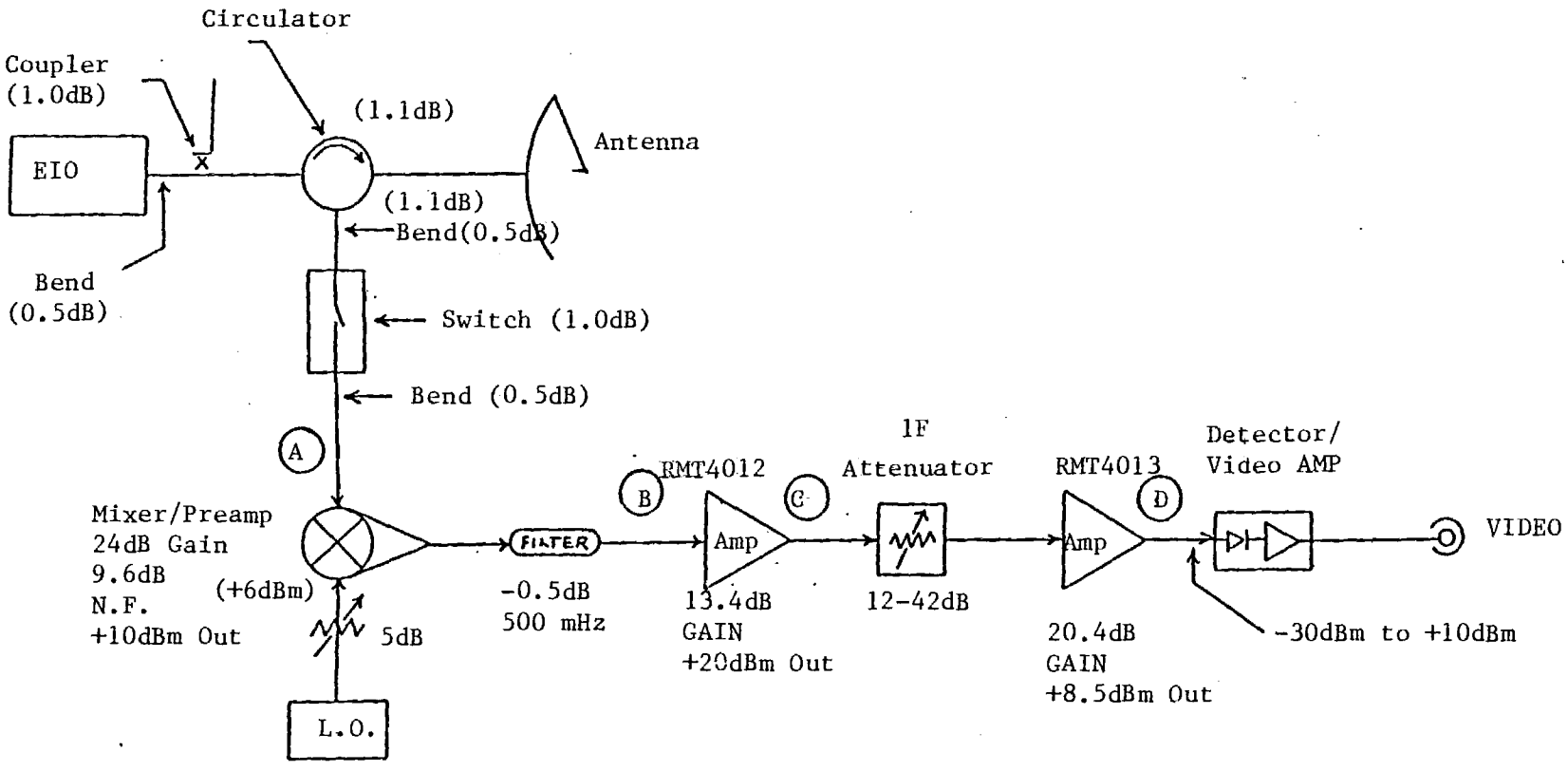


Figure 3. Receiver block diagram.

and lists the important characteristics of these components. The selection and design of these elements is such that a nearly optimum use of the receiver dynamic range is achieved. The system noise level is determined by the mixer/preamplifier noise figure (9.6 dB) and the receiver bandwidth (500 MHz).

$P_n = KTB_nF_n$ yields -77 dBm equivalent noise at the input to the mixer. The mixer/preamp has 24 dB gain, producing -53 dBm noise level out. The filter has a 0.5 dB loss and the first IF amp (AMT 4012) has 13.4 dB gain, providing -40.1 dBm noise. The PIN attenuator has 12 dB attenuation and the 2nd IF amplifier (AMT 4013) has 20.4 dB gain, providing a noise level of -31.7 dB into the detector. This is matched quite well to sensitivity of the detector.

Table 2 shows the signal level at various points in the receiver chain for various signal levels into the system, and for appropriate settings of IF attenuation. The system has an instantaneous dynamic range of 40 dB, limited by the dynamic range of the video detector, and an overall dynamic range of 60 dB, limited on the low end by the system noise level and on the high end by the mixer/preamp saturation point. For signal-to-noise ratios up to 40 dB, there is no need to employ IF attenuation. Under most cases, as shown in Figure 2, the signal-to-noise ratio will not exceed 40 dB so there will seldom be occasion to use the IF attenuator.

TABLE 2. RECEIVER SIGNAL LEVELS

Power at A (dBm)	Power at B (dBm)	Power at C (dBm)	Attenuator Setting (dBm)	Power at D (dBm)
-77 (noise)	-53.5	-40.1	12	-31.7
-67	-43.5	-30.1	12	-21.7
-57	-33.5	-20.1	12	-11.7
-47	-23.5	-10.1	12	-1.7
-37	-13.5	-0.1	12	+8.3*
-27	-3.5	9.9	22	8.3*
-17 (preamp)	+6.5	19.9*	32	8.3*
-14 (saturation)	+9.5*	22.9*	32	11.3*

* This point is at (or near) saturation.

SECTION 3
SYSTEM OPERATION

3.1 OVERVIEW

The 94 GHz radar system is operated via the switches located on the radar control panel, illustrated in Figure 4. The selectable functions on the control panel are POWER, STANDBY, RADIATE, PULSE WIDTH, and IF ATTENUATOR.

The system comprises three main units; the power supply, the control panel, and the radar transmitter/receiver unit. The radar system requires only single phase, 60 Hz, 115 Vac primary power applied to a connector on the power supply. All dc working voltages are generated within the unit for operation.

3.2 POWER SWITCH

Power to the radar system is controlled by the POWER double-pole, single-throw toggle switch located on the control panel. The POWER switch controls the power supplies that provide the dc voltages necessary for system operation. The power supply voltages used in the system are +28 Vdc, +15 Vdc, +8 Vdc, +5 Vdc and -15 Vdc. When the toggle switch is in the OFF position, all power supplies are disconnected from the radar unit. When the switch is in the ON position, all dc voltages are applied to the radar unit and the green power indicator lamp located above the switch is lit. The dc power supplies operate from 60 Hz, 115 Vac.

3.3 STANDBY AND RADIATE SWITCHES

The STANDBY and RADIATE switches are both push-button switches and control the on/off status of the transmitter. When power is first applied to the system by the POWER switch, the system is on and the ON light is illuminated, confirming that +28 V is applied to the system. After a nominal 2 minute warm-up period, the STANDBY light will come on, indicating that the system is ready for transmit mode. To turn the transmitter on,

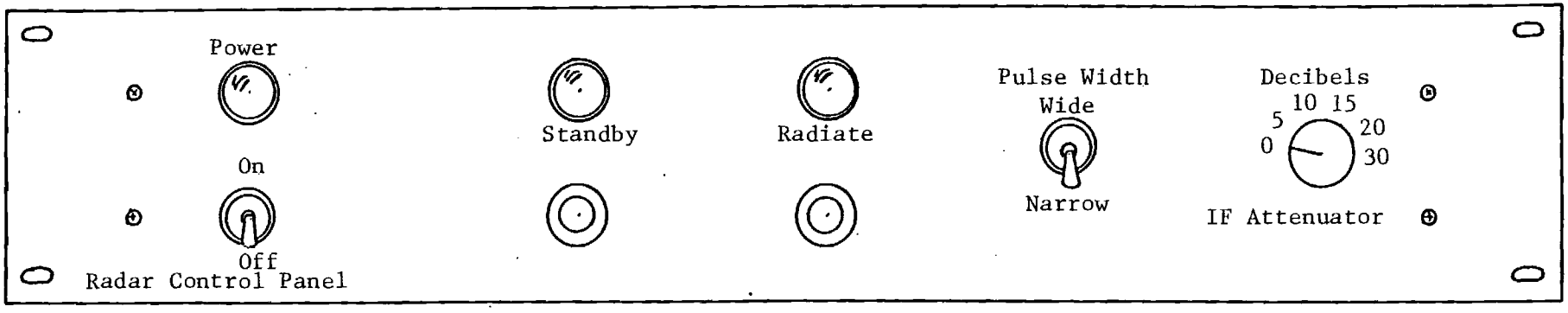


Figure 4. Control panel.

depress the RADIATE pushbutton switch. The yellow STANDBY indicator lamp will go off and the red RADIATE indicator lamp will light up. If power is supplied to the system, and the 2 minute warm-up period has expired, either the STANDBY or RADIATE indicator lamps should be lit.

3.4 PULSE WIDTH SWITCH

The PULSE WIDTH switch is a double-pole, double-throw switch that controls the transmitter pulse width. In the NARROW position, a pulse of 2 ns is transmitted. In the WIDE position, a pulse of 50 ns is transmitted. The pulses are transmitted at a PRF of 10.2 kHz when the radar is in the RADIATE mode.

3.5 IF ATTENUATOR SWITCH

The IF attenuator switch is a six-position rotary switch that sets the amount of attenuation at the input of the second IF amplifier (AMT4013). The purpose of the attenuator is to increase the overall dynamic range of the receiver by preventing the second IF amplifier from saturating at signal-to-noise ratios greater than 40 dB. The attenuation can be increased from 0 dB to 5 dB, 10 dB, 15 dB, 20 dB, or 30 dB. When set at maximum attenuation (30 dB), the attenuator provides approximately 20 dB more dynamic range to the system, allowing the detection of large targets with signal-to-noise ratios of 60 dB without saturating the receiver. Under normal conditions, however, the signal-to-noise ratio will be below 40 dB, so no IF attenuation should be necessary.

SECTION 4

SYSTEM, CABLE, AND SCHEMATIC DIAGRAMS

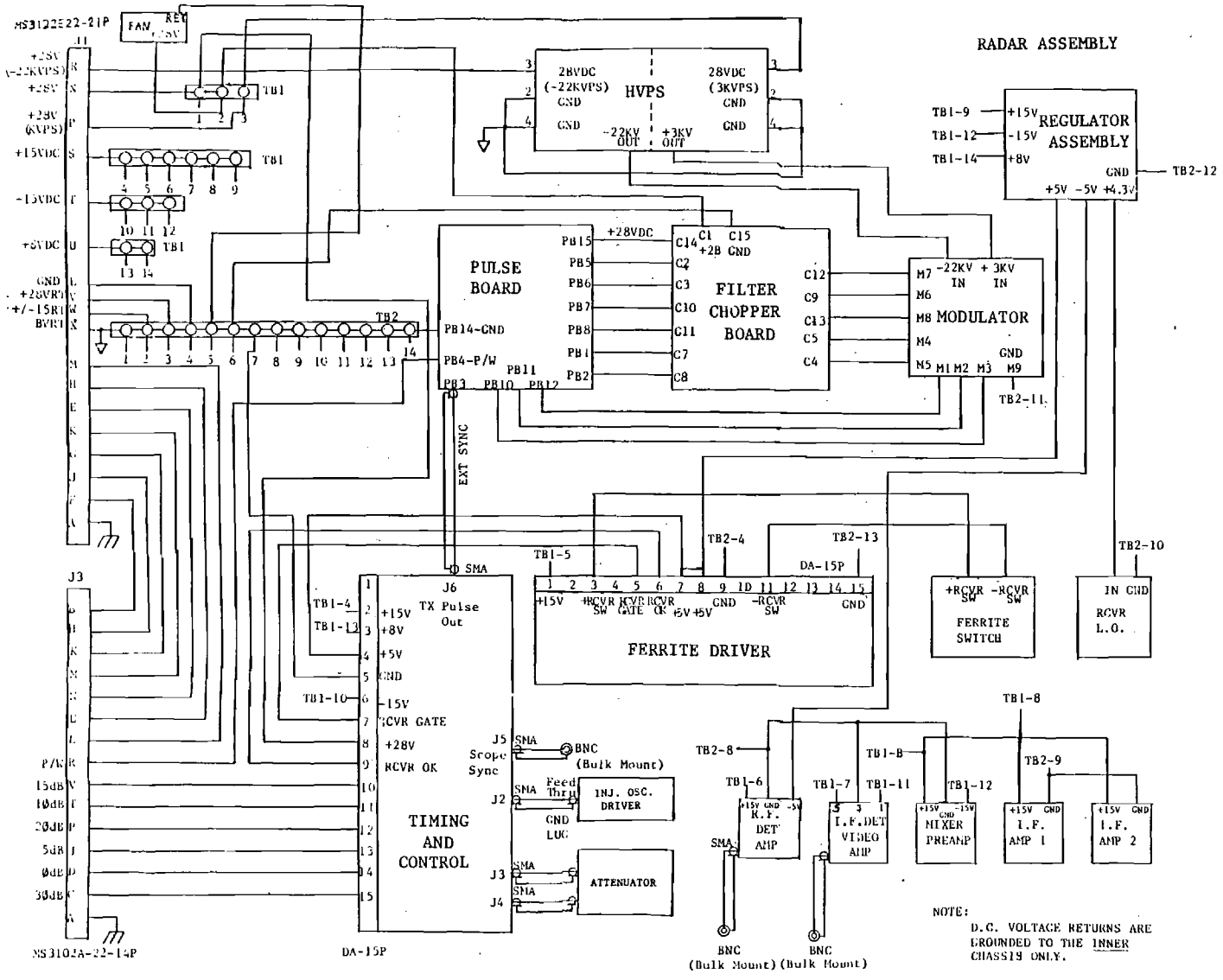


Figure 5. Radar system assembly.

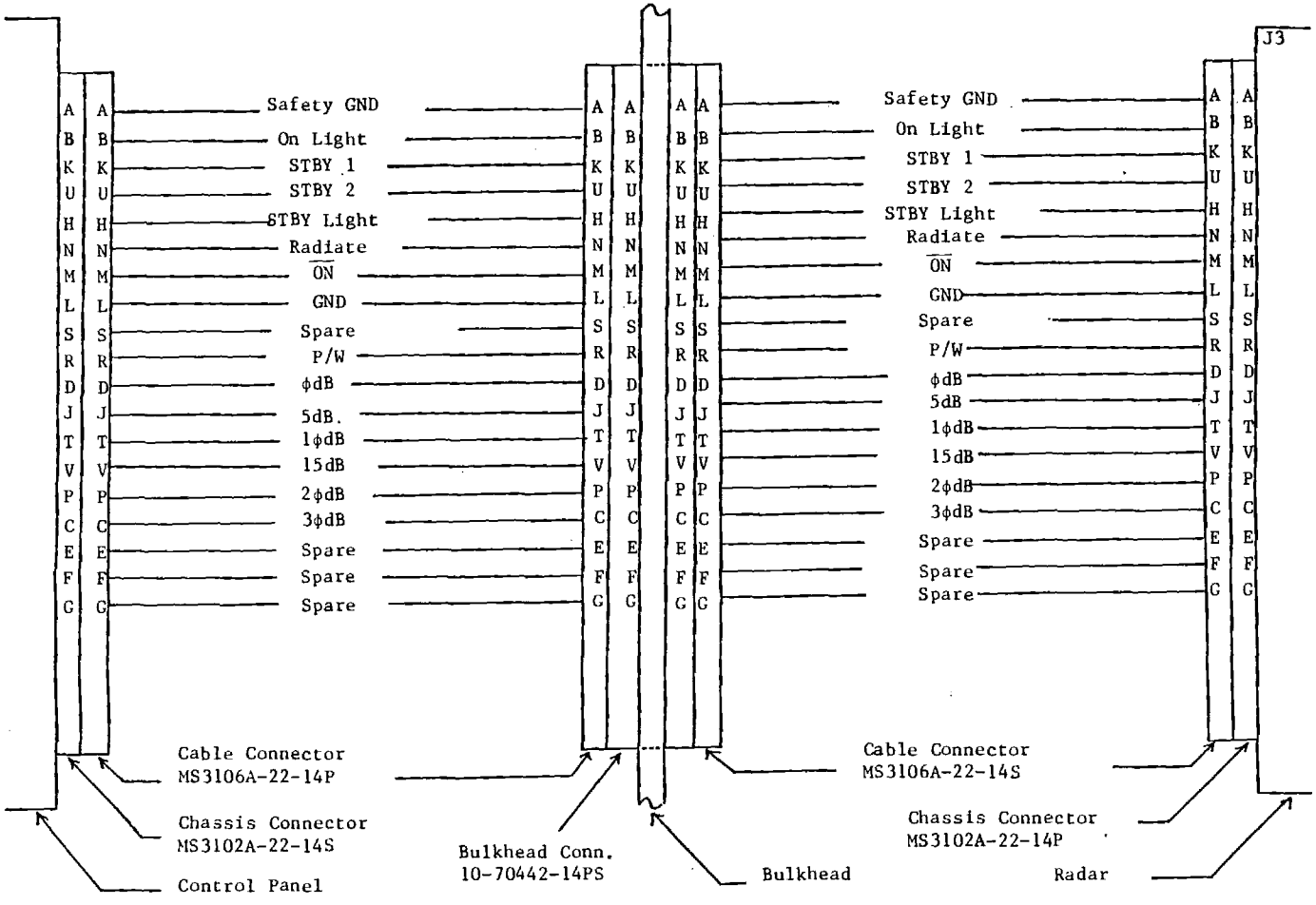


Figure 6. Control panel - to - radar cable.

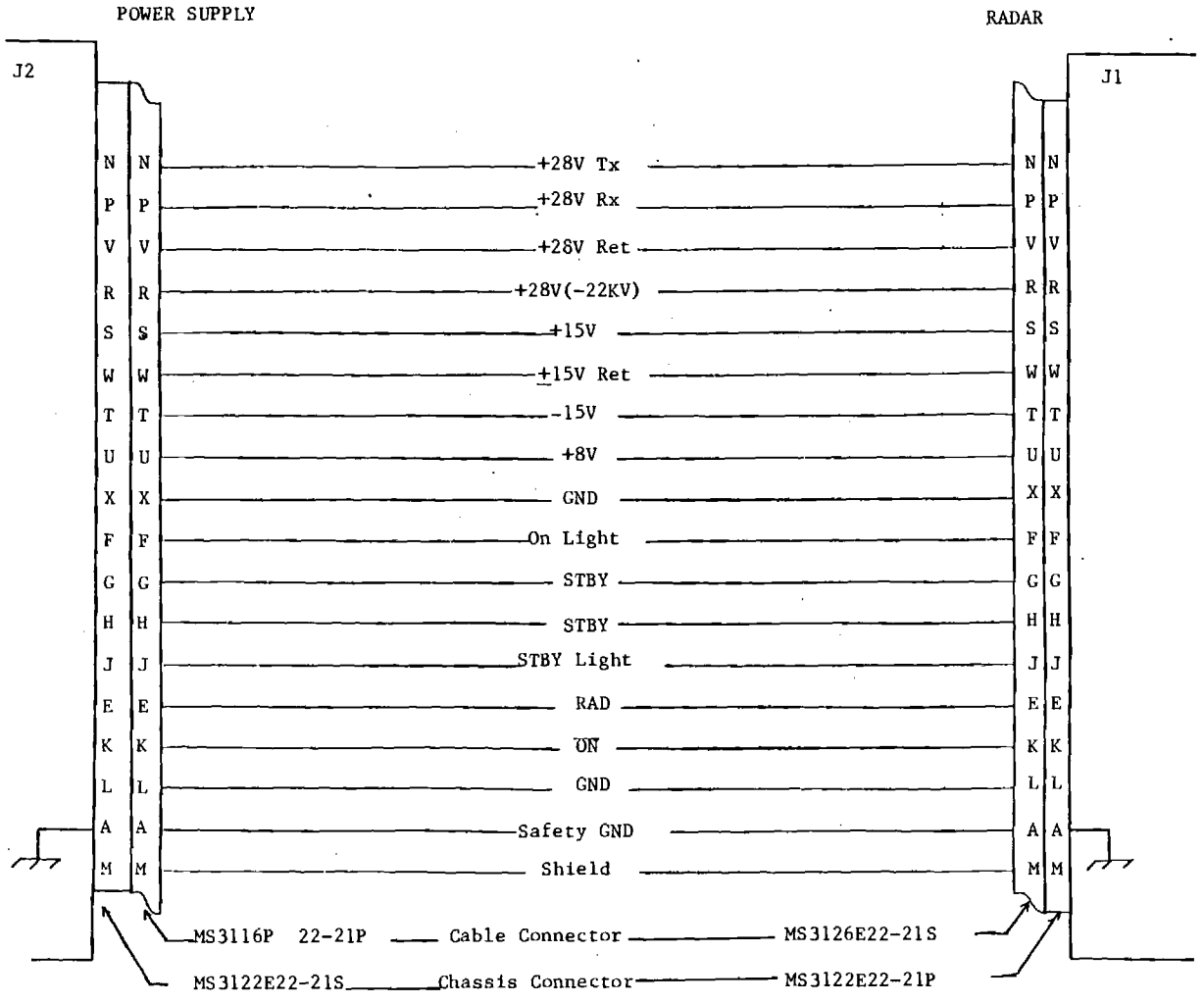


Figure 7. Power supply - to - radar cable.

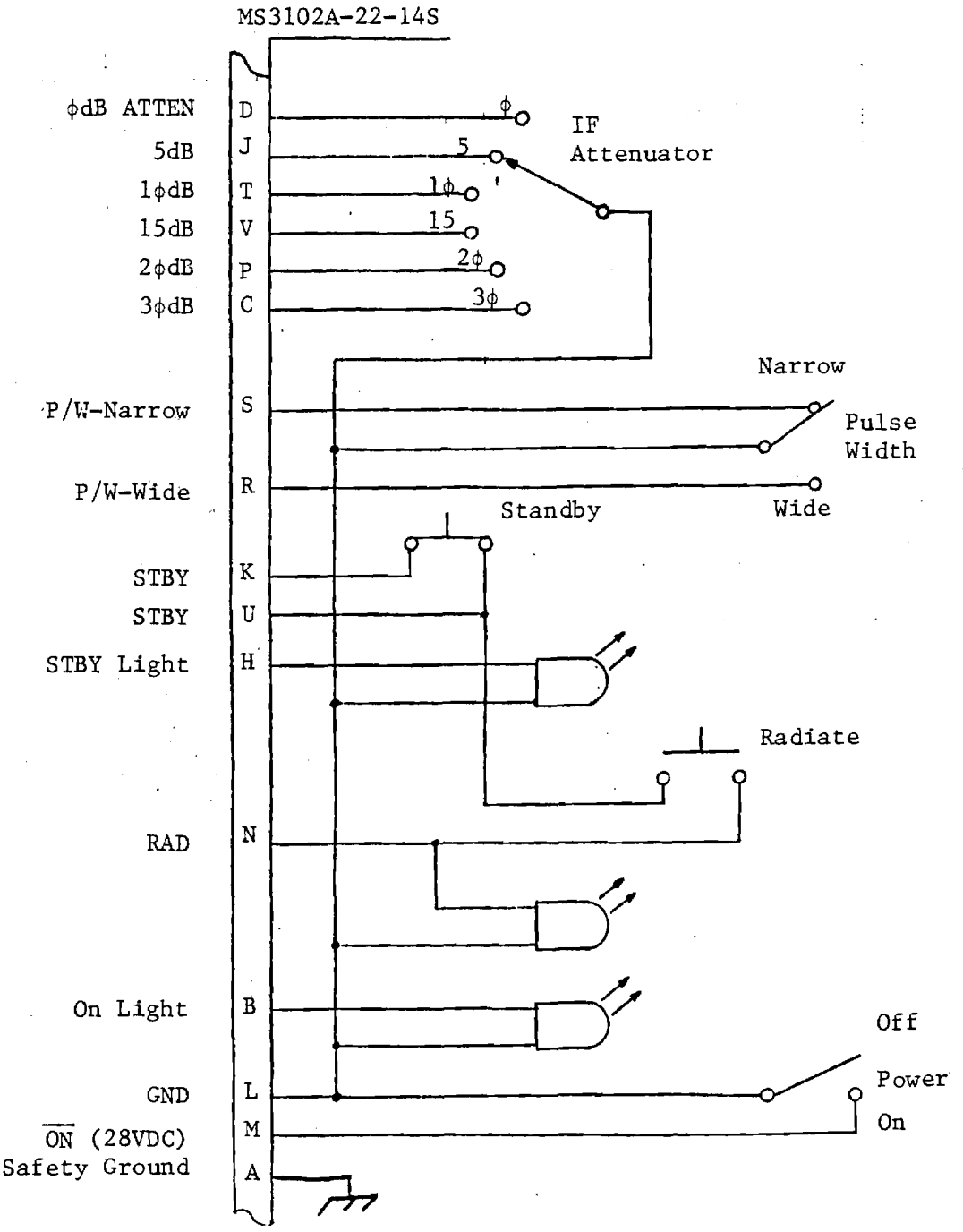


Figure 8. Control panel.

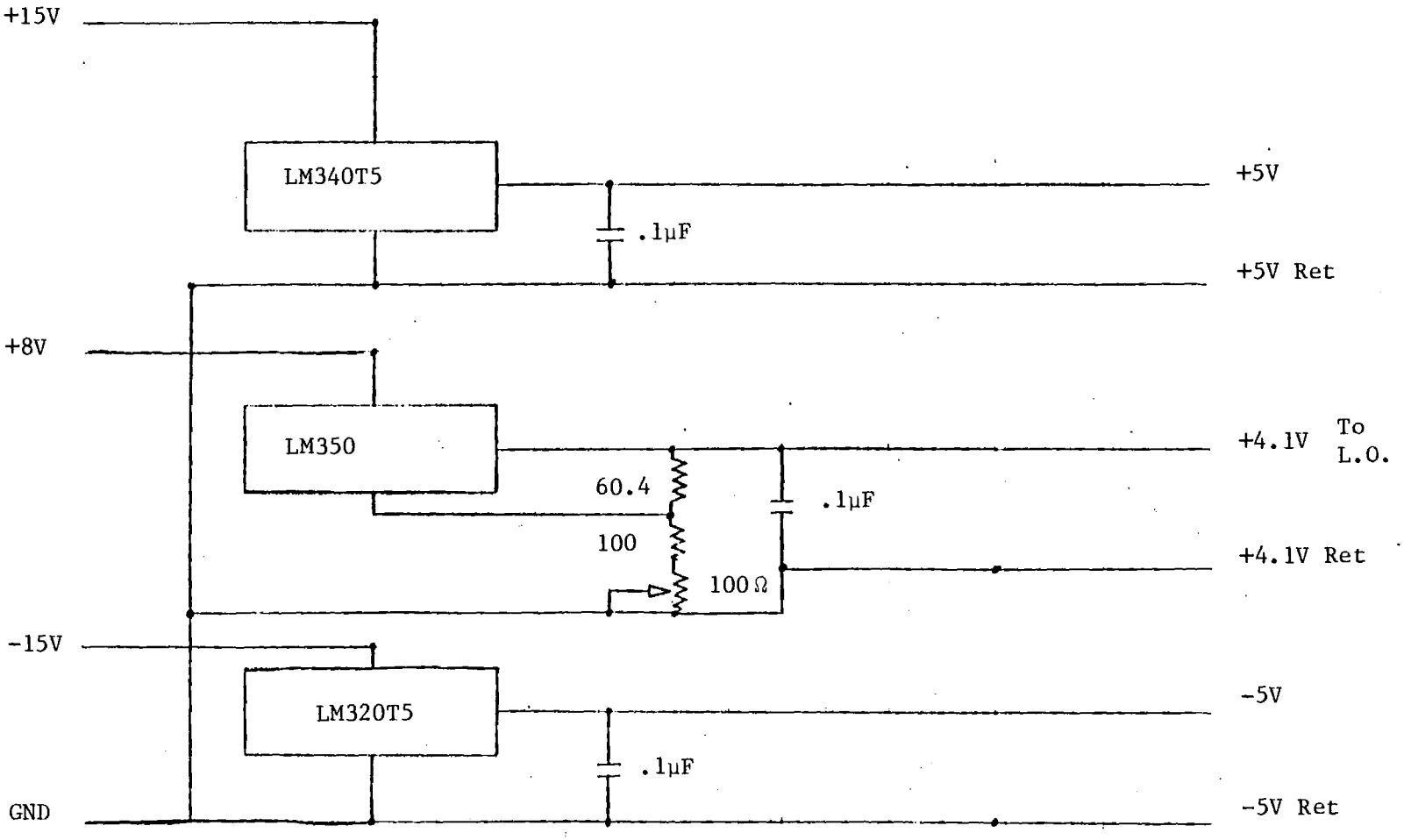


Figure 9. Voltage regulator assembly.

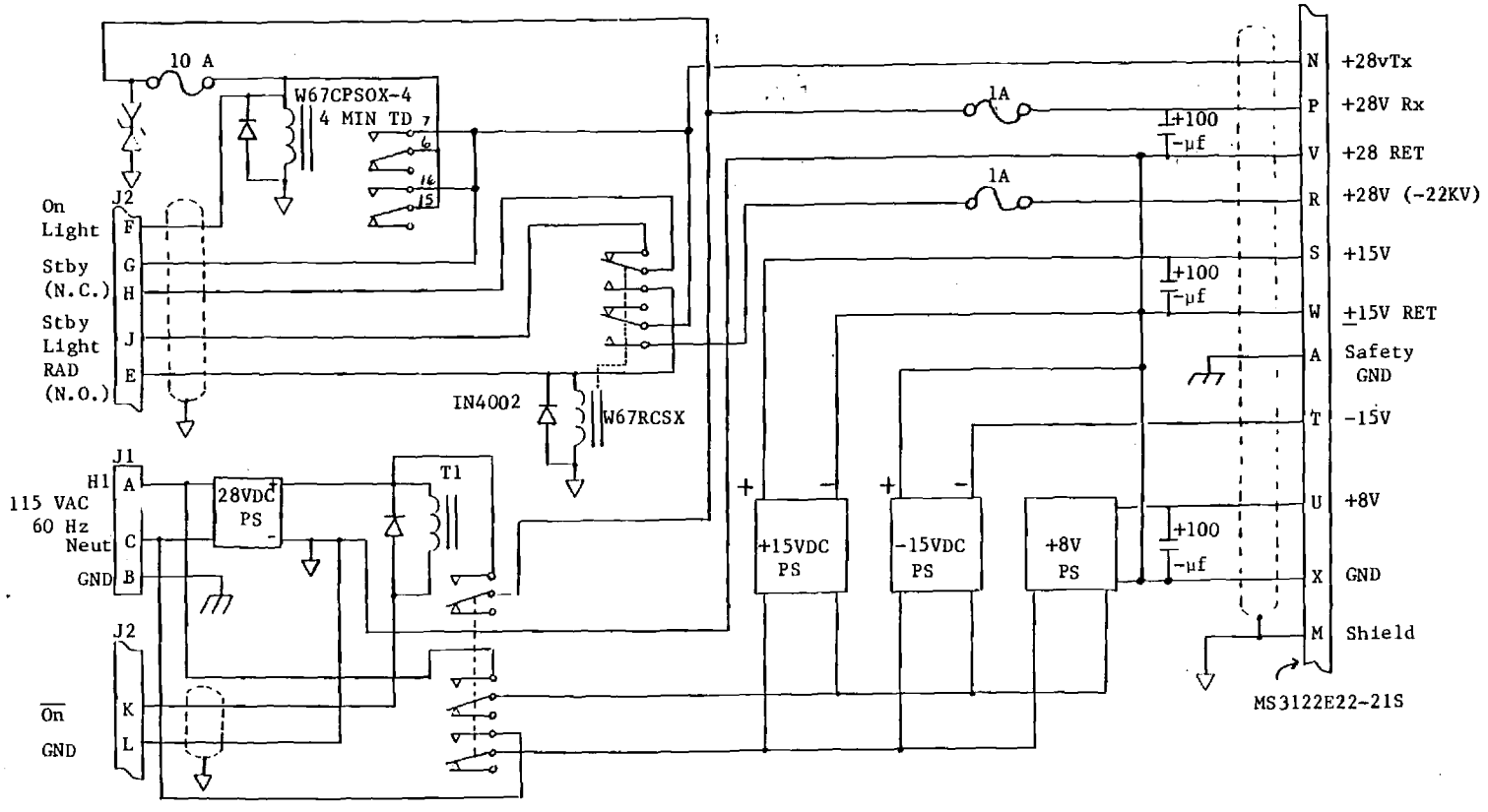


Figure 10. Power supply assembly.

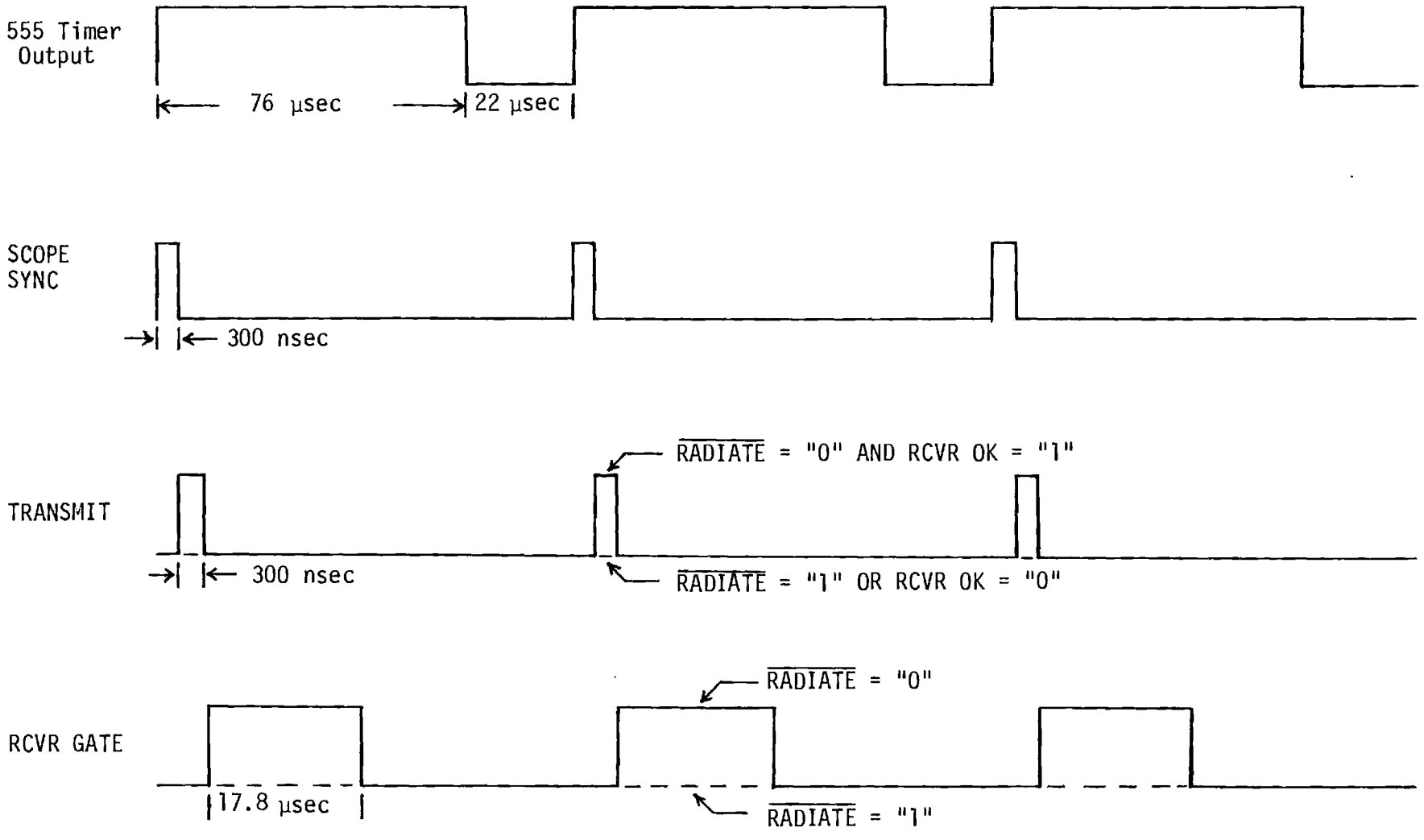


Figure 11. Timing diagram for timing and control circuitry.

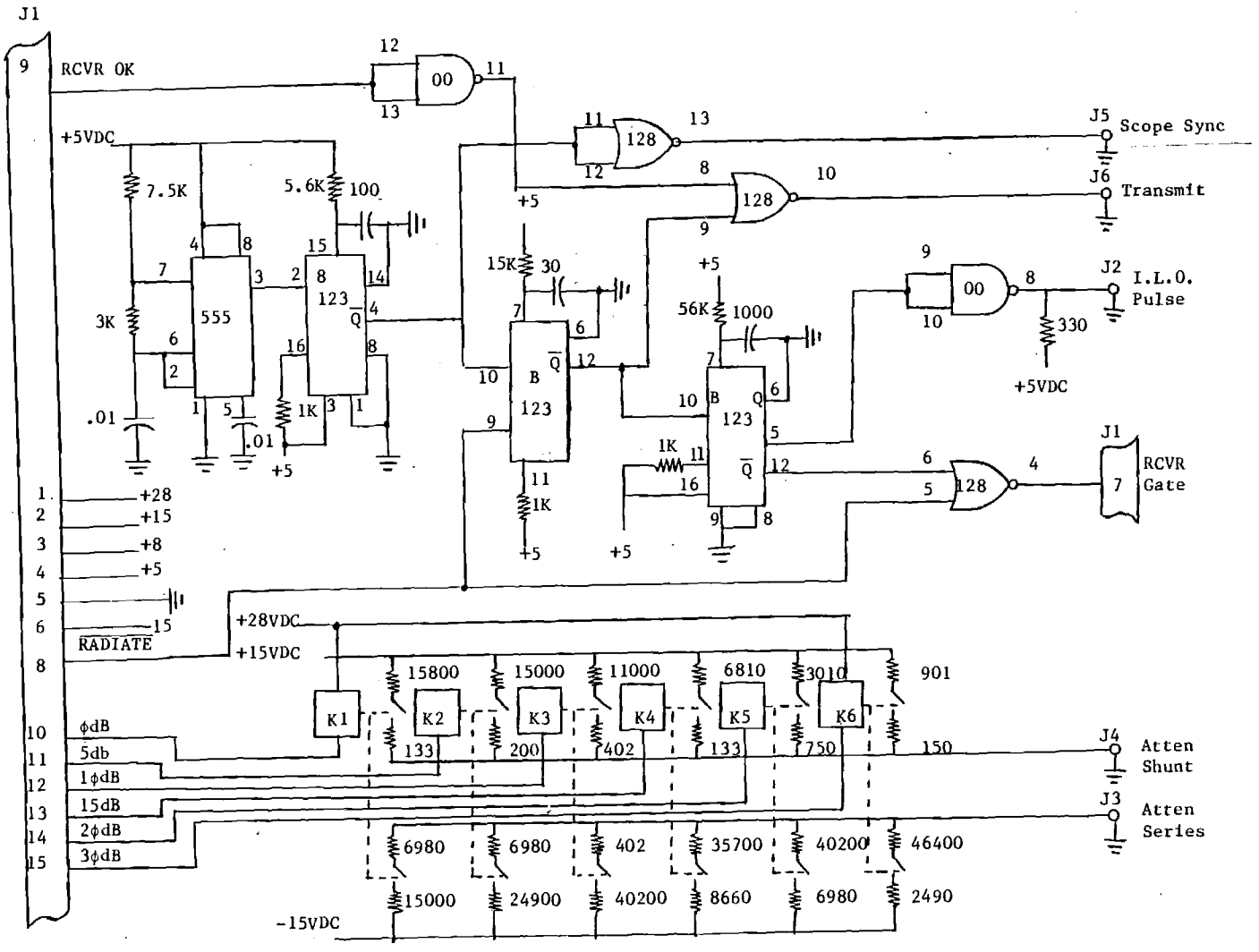


Figure 12. Timing and control assembly.

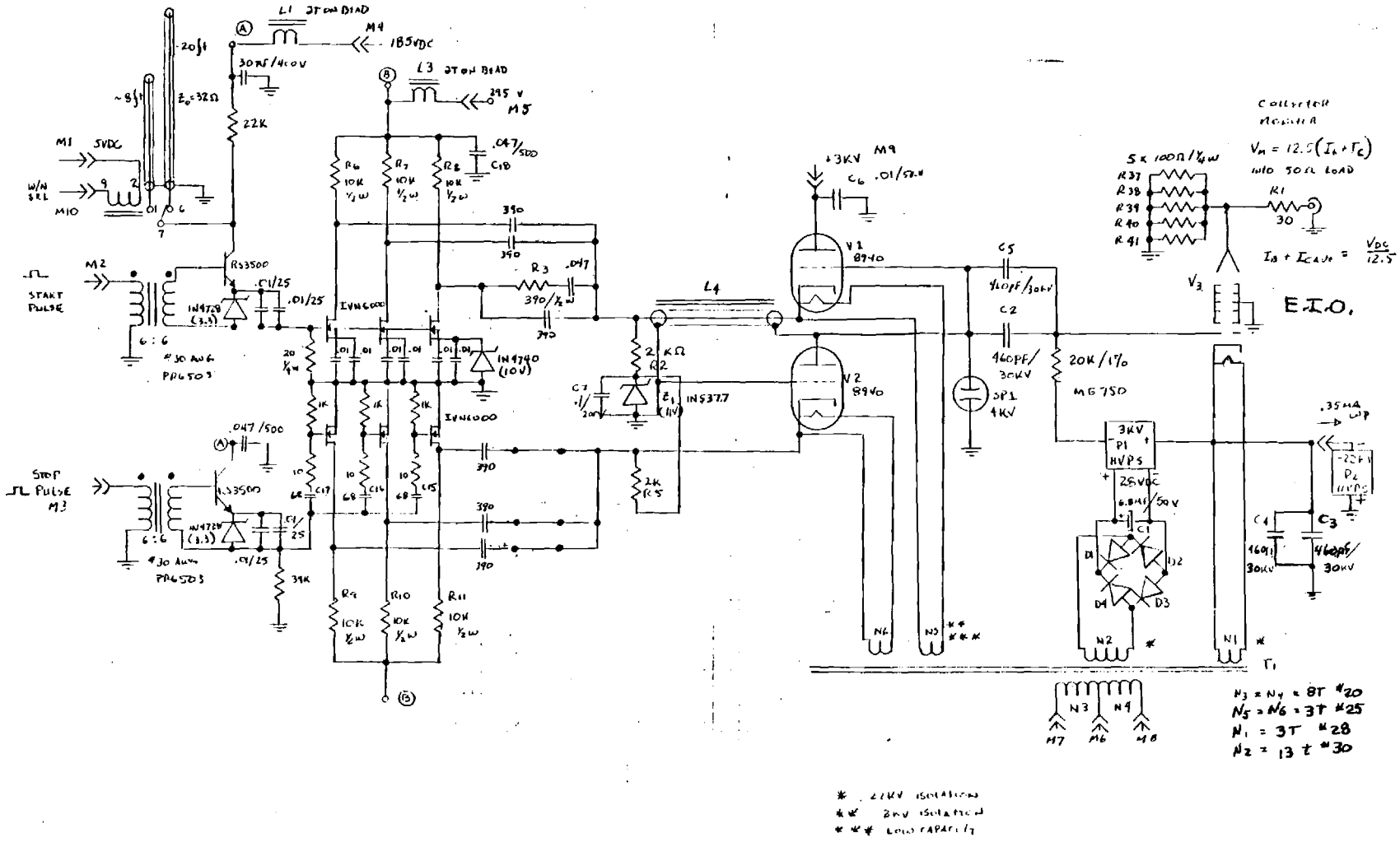


Figure 13. Modulator circuit.

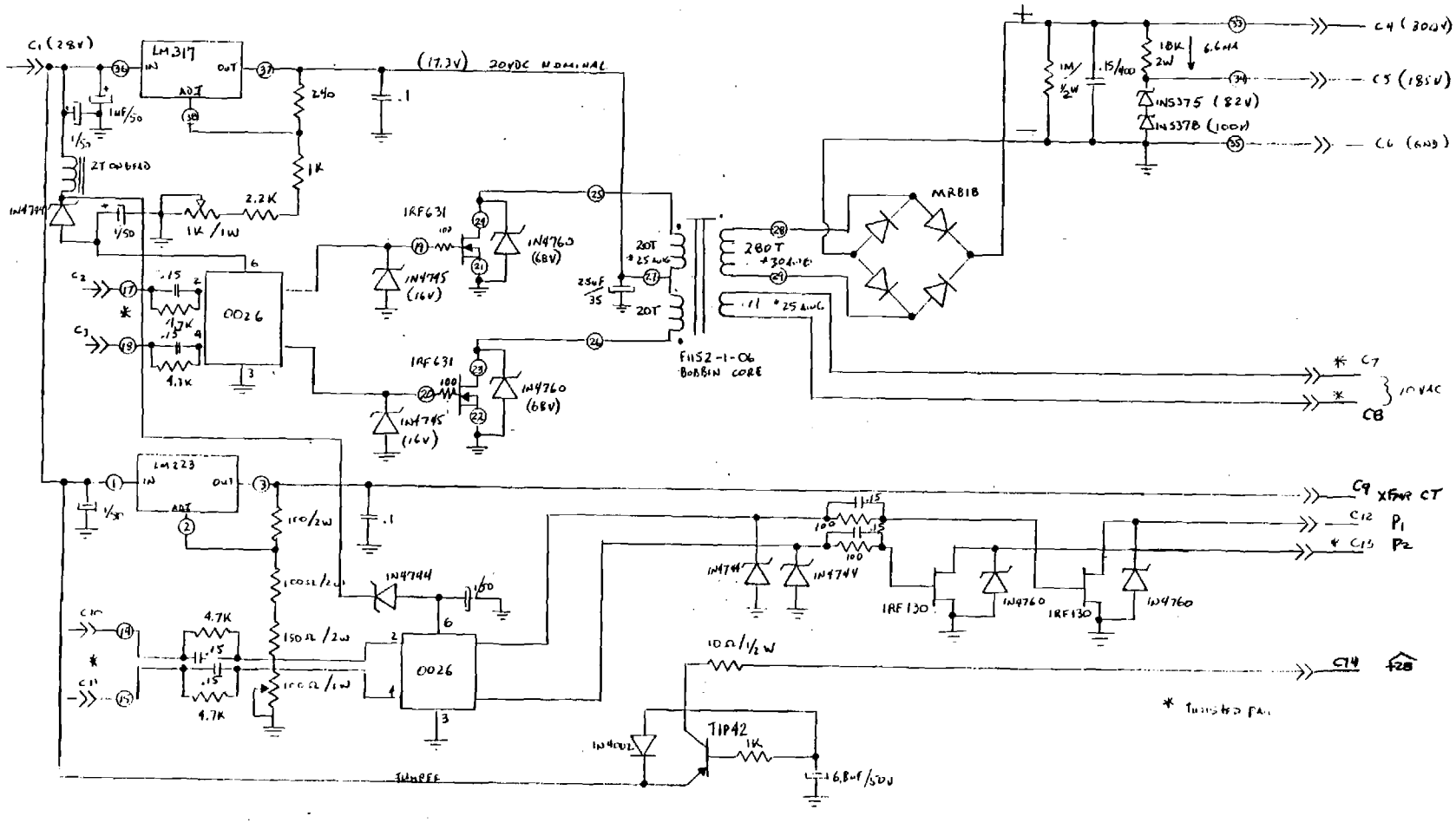


Figure 14. Filament chopper circuitry.

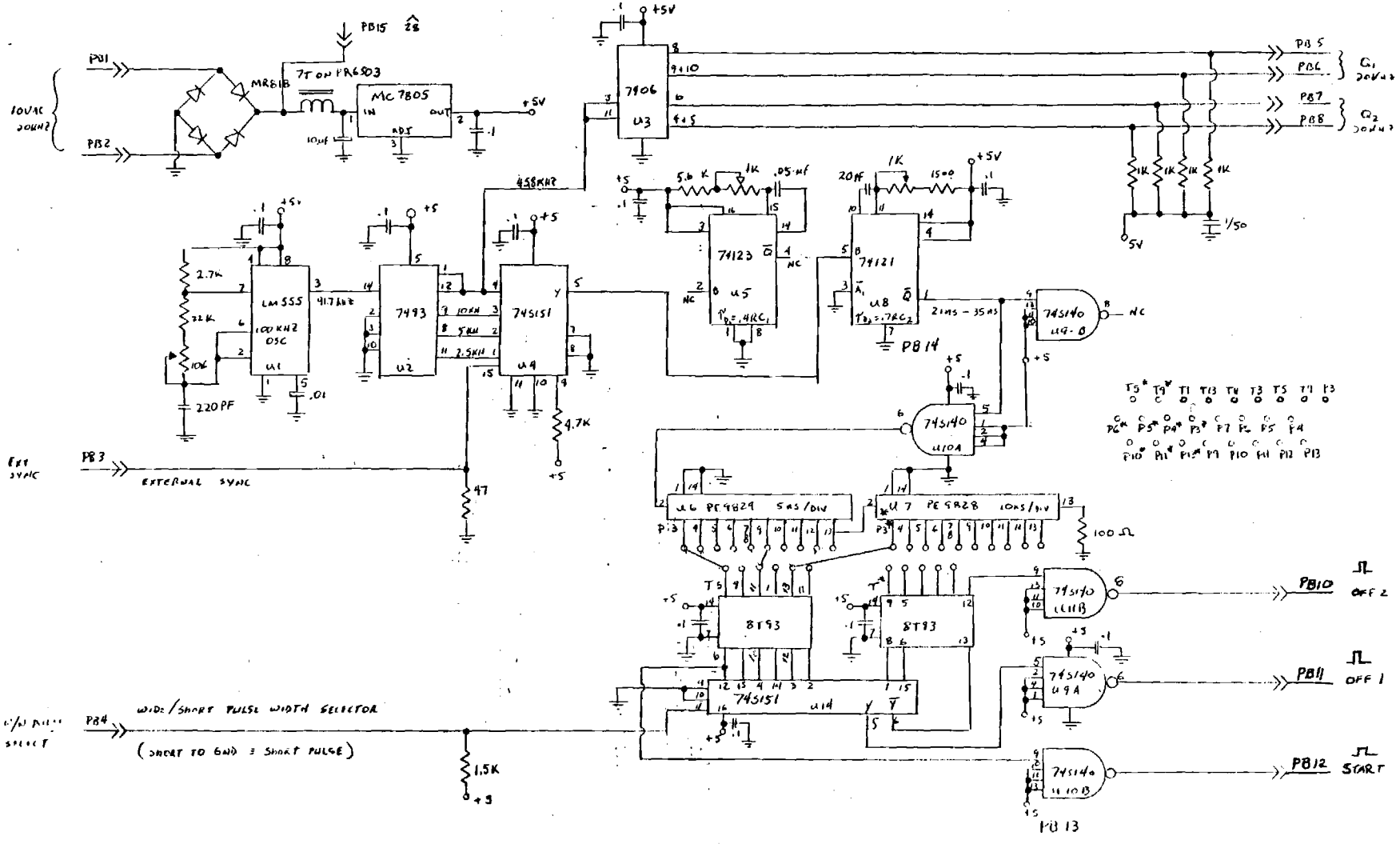


Figure 15. Pulse board.

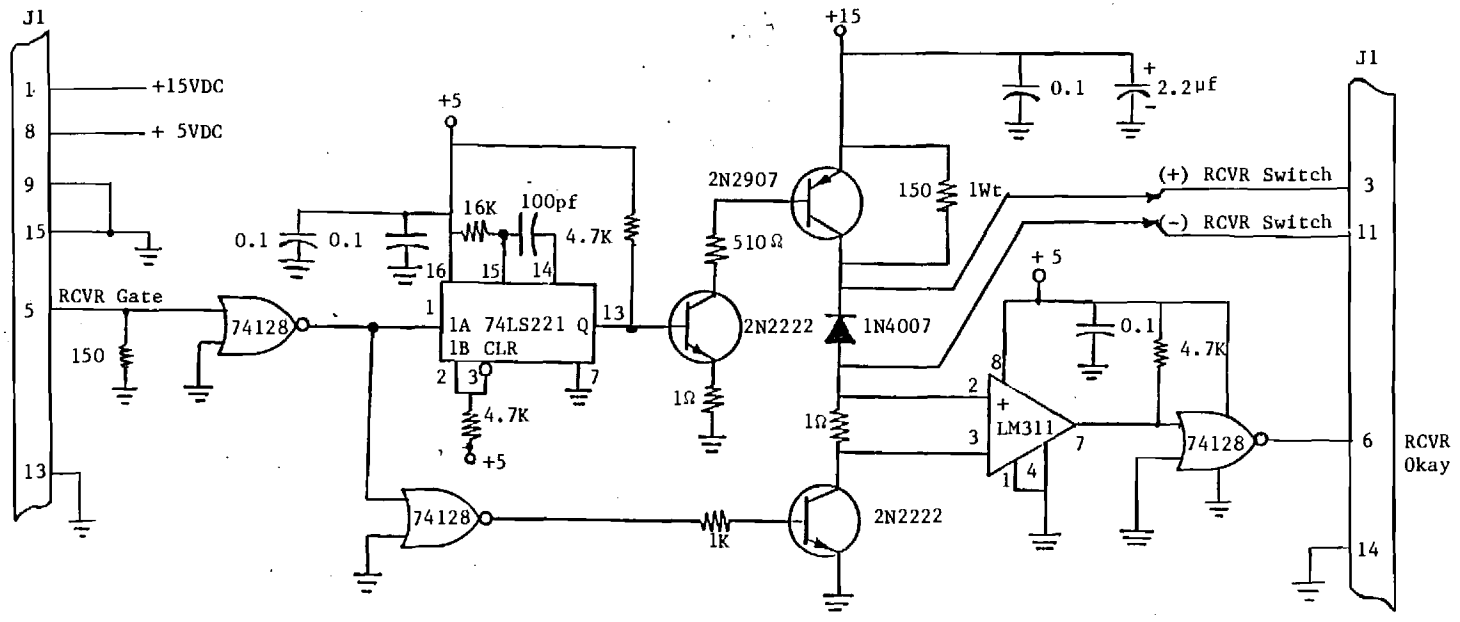


Figure 16. Ferrite switch driver.

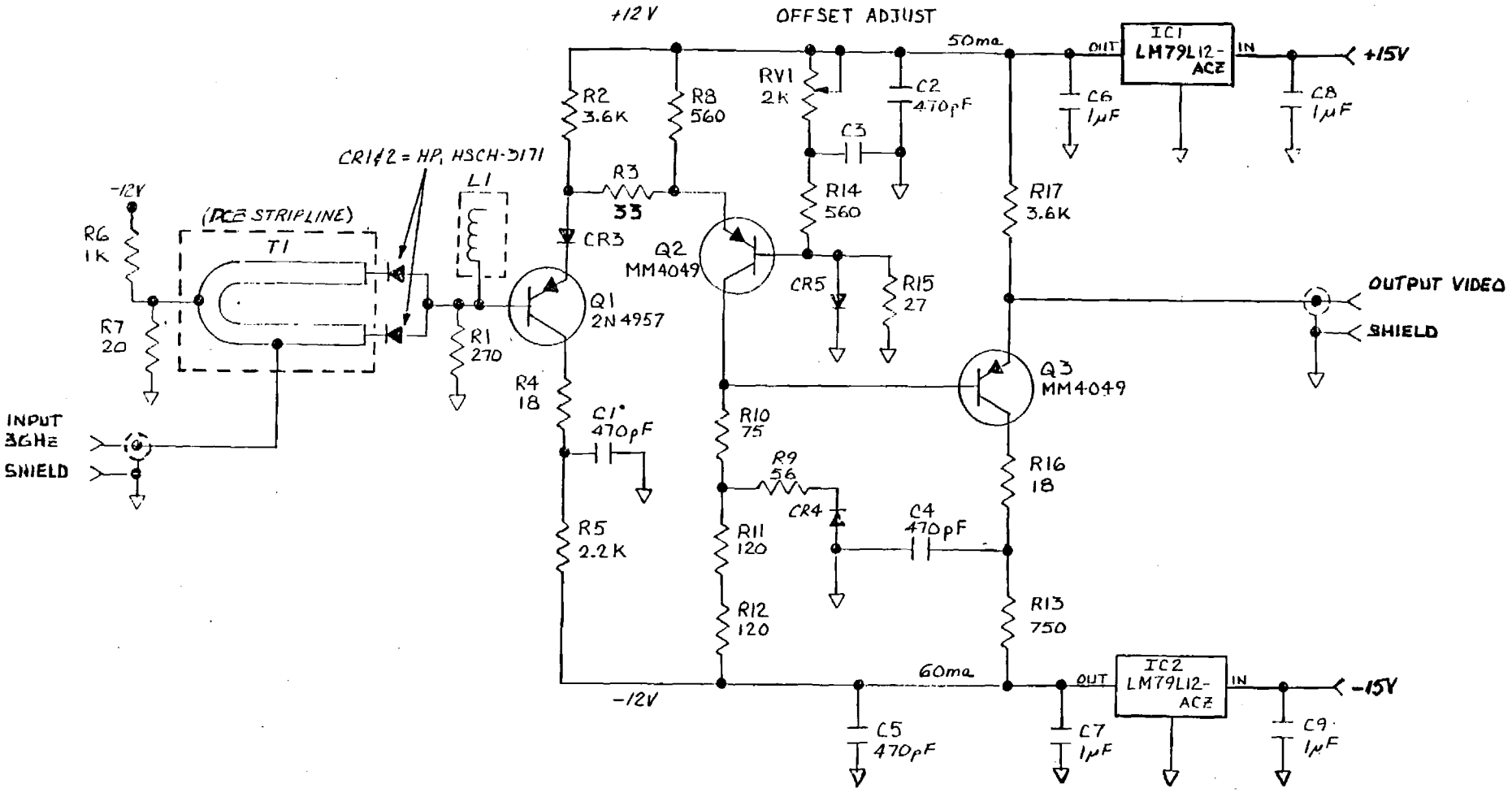


Figure 17. Video Detector/Amplifier

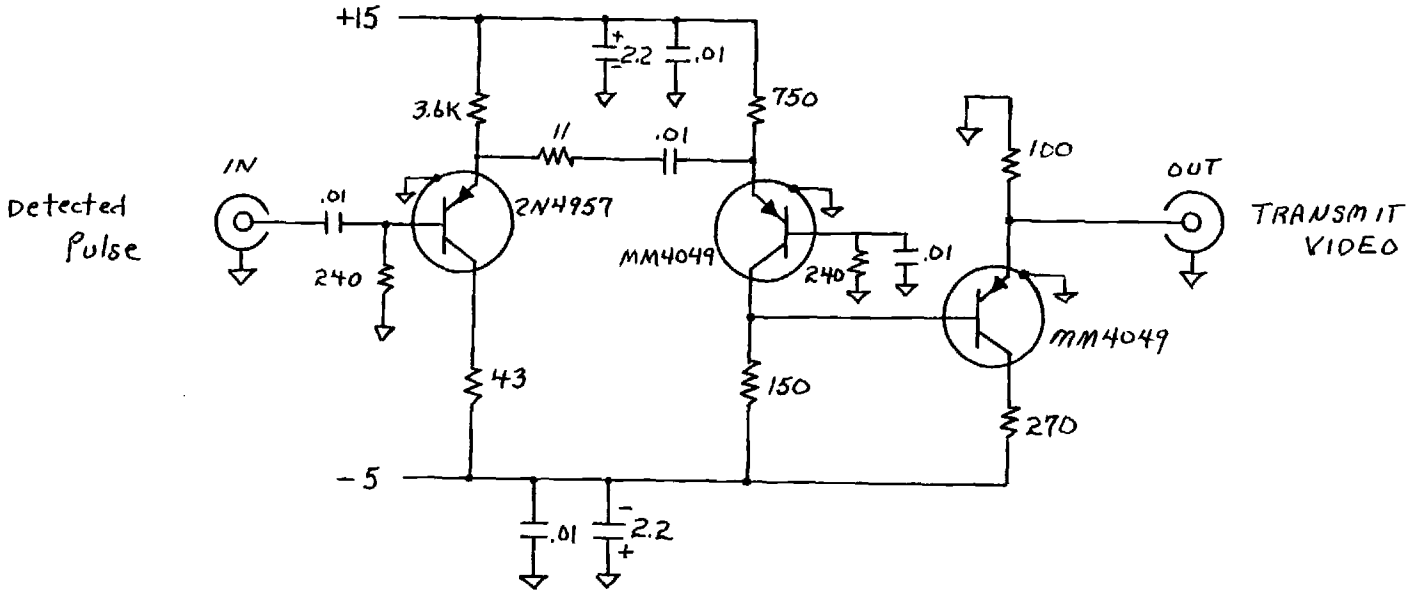


Figure 18. RF detector amplifier.

SECTION 5

ANTENNA PATTERNS

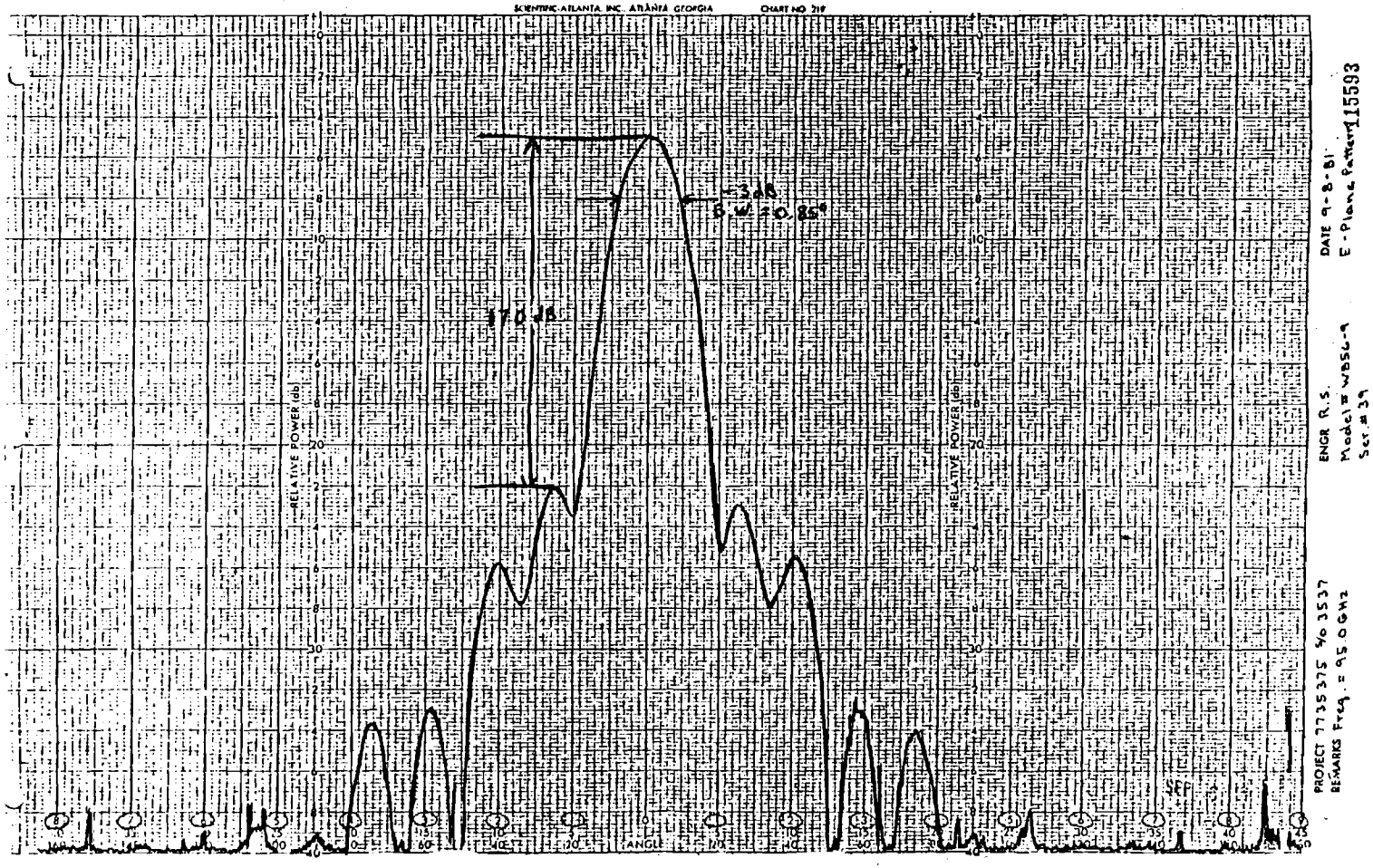


Figure 19. E-plane pattern.

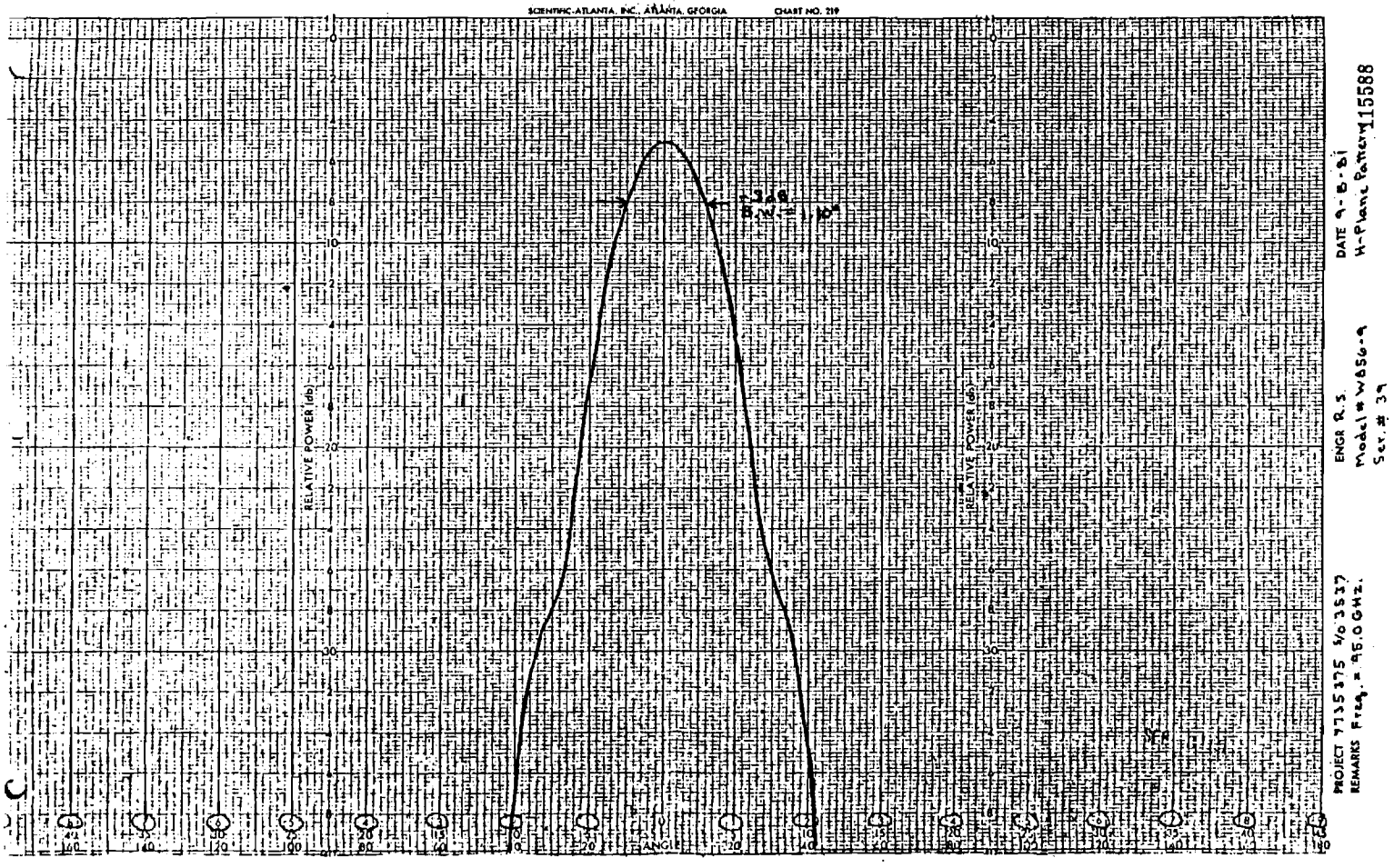


Figure 20. H-plane pattern.

SECTION 6

GRIDDED EXTENDED

INTERACTION OSCILLATOR

INSTRUCTION MANUAL

GRIDDED EXTENDED INTERACTION OSCILLATOR

OPERATING INSTRUCTIONS

VARIAN CANADA INC.
45 River Drive
Georgetown, Ontario, Canada

varian
canada

Tel: (416) 457-4130
TWX: 610-492-2641
Telex: 069-7502

GRIDDED EXTENDED INTERACTION OSCILLATOR OPERATING INSTRUCTIONS

INTRODUCTION:

These operating instructions provide basic information for installing and operating the Pulse Millimeter E.I.O.s. Additional information is given in the Engineering Specification and Test Performance Sheets. The Test Performance Sheet contains test results at specific frequencies for the individual tube. Requests for copies of this publication or additional information should be addressed:

Varian Canada Inc.
45 River Drive,
Georgetown, Ontario
Canada L7G 2J4

PROTECTIVE MEASURES:

Equipment in which these tubes are used should provide protection as described below. In addition, installation and operating precautions must be observed and absolute ratings must not be exceeded.

HIGH VOLTAGE:

Voltage required for the operation of this tube are extremely dangerous to personnel; equipment should be designed with protective interlock circuits which make accidental contact with these voltages impossible.

CURRENT LIMITING:

While every effort has been made to ensure that all electrode spacings within the tube are fully sufficient to withstand the applied voltages an occasional breakdown is not impossible. Since most power supplies use large capacitors for filtering purposes the energy dumped into the tube when a breakdown occurs can be sufficient to damage it beyond repair. It is strongly recommended therefore that a 1000 ohm resistor is used in series with the high voltage supplies unless the peak current is limited in some other way.

HEATER VOLTAGE:

The heater voltage must be supplied from an isolated transformer or DC supply which has adequate insulation. One side of the heater supply (the positive side if DC is used) must be connected to the cathode.

BODY:

The body is normally grounded, this connection includes the R.F. circuit and anode. Ground straps internally connect the body to the magnetic circuit assembly.

The body to cathode (beam) voltage determines both the beam current, when the tube is biased on, and the beam velocity through the R.F. circuit. The beam voltage has an optimum value which changes with frequency. Operation at other than optimum beam voltage will reduce the power output and provide some electronic tuning.

The body has very limited power handling abilities. The absolute ratings limit body dissipation by specifying average body current. However, because the beam is poorly focussed at conditions other than beam fully on, maximum values for pulse rise and fall times and beam cut-off current are also specified.

COLLECTOR:

A collector insulated from the body is provided in order that the body current may be monitored. The collector must always be operated at or close to body potential.

GRID:

This electrode is more correctly called an aperture grid. It provides a means whereby the cathode current may be controlled. However, the electron gun is correctly focussed only when the grid is at cathode potential.

When defocussed most of the cathode current will be intercepted by the body (the effect of this is discussed under the paragraph entitled BODY).

The value of negative grid voltage required to cut-off the beam current will increase as the beam voltage is increased. The minimum cut-off voltage at a particular beam voltage may be determined by reducing the grid bias voltage until 100 microamps beam current is drawn.

GRID -(contd)

The grid dissipates negligible* power unless it becomes positive with respect to the cathode. For normal operation the grid will either be at cathode potential or negative with respect to the cathode. If an attempt is made to use the (positive) grid current to clip the switching pulse it is important not to exceed the rating for grid power.

*. The energy involved here is less than a few milliwatts. When at/or very near cathode potential the grid may receive thermal electrons.

MICROWAVE RADIATION:

Precautions should be taken to prevent exposure of personnel to the microwave fields produced by this tube.

Refer to: American National Standard Safe Levels of Microwave Radiation, published by the I.E.E.E., 345 East 47th Street, New York, N.Y. 10017, entitled A.N.S.I. C95.1.

INTERLOCK SYSTEM:

Interlocks should be built into the system to remove or prevent the application of Beam Voltage if any of the absolute ratings are exceeded.

INSTALLATION INSTRUCTIONS:
HANDLING:

Magnetic materials, tools, etc. must be kept at least 2 inches away from the tube. The tube should be handled by its yoke (painted RED). Never handle the tube by the collector fins, electrical leads or tuner.

MOUNTING:

The E.I.O. may be mounted in any orientation using the 8-32 mounting and grounding holes. (See outline drawing).

Keep magnetic materials at least 2 inches away from the tube.

INSTALLATION INSTRUCTIONS (contd)

COOLING:

This tube is forced air cooled. Body temperature should be measured at the ground lug, collector temperature at the screw connector.

Maximum temperatures at these points are specified in the absolute ratings. It is the users responsibility to ensure that these figures are not exceeded. In order to monitor the temperature the lead must be removed, a thermocouple attached and lead replaced. However, 15CFM of air at 20°C and at sea level directed on the collector fins through a one square inch aperture from a distance of one inch, will normally provide sufficient cooling.

ELECTRICAL CONNECTIONS:

YELLOW	-	HEATER	BROWN (MOUNTING SCREWS)	-	BODY
WHITE	-	CATHODE	GREEN	-	GRID
BLUE	-	COLLECTOR			

The high voltage lead wires are not suitable for running adjacent to a ground plane. An air gap or increased insulation may be necessary to eliminate corona.

RF CONNECTIONS:

The tube is provided with a WR10 (.050" x .100") waveguide and a flange to mate with either:

1) UG 387/U modified
2) MIL-F-3922/67B-010
3) Ring alignment

IT IS ESSENTIAL THAT THE MATING FLANGE BE FLAT

This connection must be made with care in order to avoid gaps between the mating surfaces and to avoid overtightening the flange screws.

The method of flange connections are shown in Fig. 21 - 23.

The tube window is .001" thick, under no circumstances allow solid objects to enter the output waveguide.

Waveguide pressurization should not be needed however dust and small guide imperfections often cause electrical breakdown at power levels at little more than 1 KW so pressurization may be desirable. Refer to the absolute ratings for the maximum allowed waveguide pressure.

INSTALLATION INSTRUCTIONS (contd)

TUNER OPERATION:

The tuner is on the opposite face of the tube to the waveguide output flange. Clockwise rotation raises the frequency.

No attempt must be made to dismantle the tuning mechanism. Should the tuner appear to be malfunctioning, contact VARIAN CANADA, INC. for advice.

Mechanical stops are provided which normally allow the tube to be tuned somewhat beyond the specified frequency range. Damage could result if an attempt is made to tune beyond the range allowed by the stops. Unnecessary tuning should be avoided.

The trimmable tuner is designed to make up for mechanical tolerances in frequency sensitive components in the tube. It should therefore only be used to bring the tube on to the required frequency, and for occasional adjustments. The tuning diaphragm will survive several hundred complete tuning cycles but it does have a finite life. The only tool required to change frequency is a screwdriver.

OPERATING INSTRUCTIONS:

The tube is connected to the power supplies as shown in Fig. 24 and protected as discussed previously. This is similar to the circuit used at Varian. It is assumed that all power supplies are off and their controls set at zero before proceeding.

Under no circumstances exceed the maximum current specified in the individual tube operating instructions. This would be possible if the grid were to go positive WRT the cathode. The tube may also be connected to the power supplies as shown in Figure 25 and 26.

a) Before applying any voltages it is recommended that the following check list be covered:

   1) Collector connected to power supply positive (normally ground)
   2) Body connected to ground.
   3) Heater, cathode and grid leads connected to their respective supplies and adequately insulated.
   4) Forced air flow is adequate.
   5) Ensure, by the use of trips, adjustment stops,etc. that the absolute ratings will not be exceeded. (Note i)

OPERATING INSTRUCTIONS (contd)

Pay special attention to average power dissipation on the electrodes.

6) Personnel will not be subject to exposure from the microwave fields.

b) Switch on heater.

c) Switch on and increase the grid bias voltage to a value required to cut-off the cathode current at the proposed beam voltage. Note i and ii.

d) Switch on and increase beam voltage to a value appropriate to the desired frequency of operation. Note i and ii.

e) Switch on pulser. Note i, ii and iii.

f) Adjust the tuner until the tube oscillates at the desired frequency. If the beam voltage has been set correctly the tube should now be operating at the peak of the mode. i.e. the maximum power output. However in most cases it will be necessary to optimize the beam voltage if the maximum possible power is required. Since this results in some electronic tuning, a small tuner adjustment will be required to obtain a specific frequency. Working in this way, the maximum power output at a given frequency may be obtained.

NOTES

i) See absolute ratings page 39.

ii) See test data supplied with tube.

iii) The tube is on when the grid is at cathode potential i.e. the grid pulse amplitude should be equal to the bias voltage.
If the grid pulse is provided by an adjustable supply (as in circuit Fig. 25) the requirement that grid potential be equal to cathode potential may be set by adjusting the grid pulse for minimum body current. Do not exceed the maximum rating for body dissipation during this operation.

SHIPPING INSTRUCTIONS:

In the event of the tube being returned to the manufacturer or shipped to any other point by conventional carrier:

(1) Cover the W/G output.

(2) Place the E.I.O. in styrofoam cutouts, ensure that the collector fins and gun cover are clear, they must not take the weight of the tube.

(3) Fit the packaged E.I.O. into the foam lining inside the container.

(4) Seal the container.

(5) Identify the package as called for by your carrier.

If the original containers are not available, please contact Varian of Canada before shipping the tube. Tubes shipped without following these instructions will likely be damaged and could void the warranty.

ABSOLUTE RATINGS:

For tube: VKB2445T1 E0302J2

Note that a single rating may be the limitation and simultaneous operation at more than one rating may not be possible.

	MIN	MAX	UNITS
Cathode to Body (ground) voltage	-	22.0	KV
Cathode to Grid voltage	-	3.0	KV
Heater Voltage	6.1	6.5	VOLTS
Collector to body voltage	-	2000	VOLTS
Beam cut-off current	-	0.1	mA
Beam current	-	3.5	mA Ave.
Body current	-	0.5	mA Ave.
Grid power	-	0.5	watts
Pulse length	-	20	microsecs
Pulse rise time	-	5.0	microsecs
Pulse fall time	-	5.0	microsecs
Duty cycle	-	.005	
Waveguide pressurization	-	30	lbs./sq in
Cooling air flow (across the collector)	15	-	CFM
Heater warm up time	1	-	mins.
Collector temperature	-	150	°C
Body temperature	-	100	°C
Load VSWR (All Phases)	-	2:1	

VARIAN CANADA INC.

Test Data for Extended Interaction Oscillator

Model No. VKB 2445T1 Serial No. E0302J2

Test Frequency (GHz)	Power Output (W) Peak	Beam Voltage (kV) wrt cathode	Beam Current (mA) Peak	Body Current (mA) Peak	Grid Bias Voltage (kV) wrt cathode	Electron Tuning Range (MHz)
94.0	1230	+20.21	630	65	- 2.7	190
95.0	1030	+21.00	660	72	- 2.8	265
96.0	1200	+21.00	660	88	- 2.8	200

Average Test Data Calculated using: Ave Value = peak value x duty

Max Duty = .005

Average Beam Current = 3.3 mA

Average Body Current = 0.5 mA

Heater Current = 0.94 A @ 6.3 V	
Coolant Flow = 60 CFM of Air @ 12"	
Tested by: Ed Sokol	Date Tested: 31 August 82
Date Inspected:	Inspected by:
Customer: Georgia Institute of Technology	Sales Order No.: 5230 5762A
Date Shipped:	CM Number:

METHOD OF ASSEMBLY TO E.I.O. COMBINATION FLANGE.

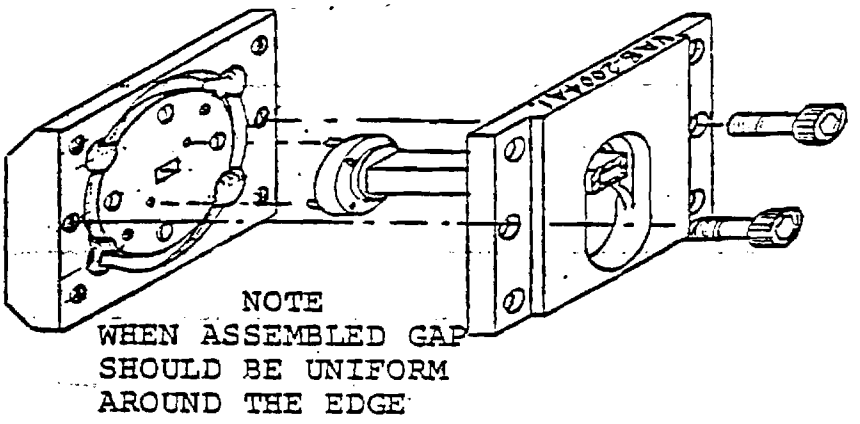


Figure 21. Submillimeter contact flange (FXR type).

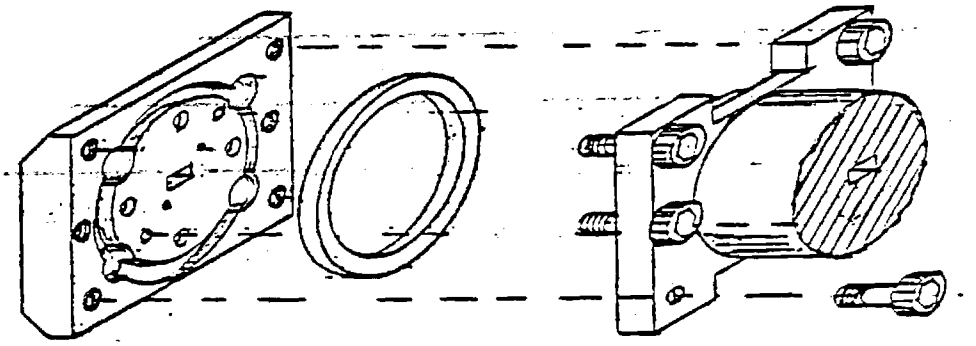


Figure 22. Ring alignment flange.

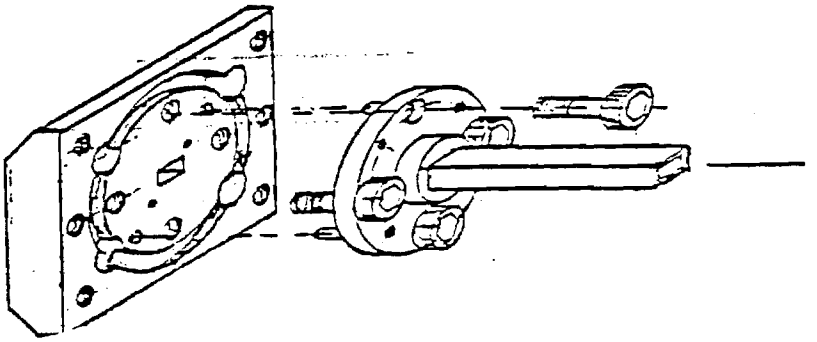
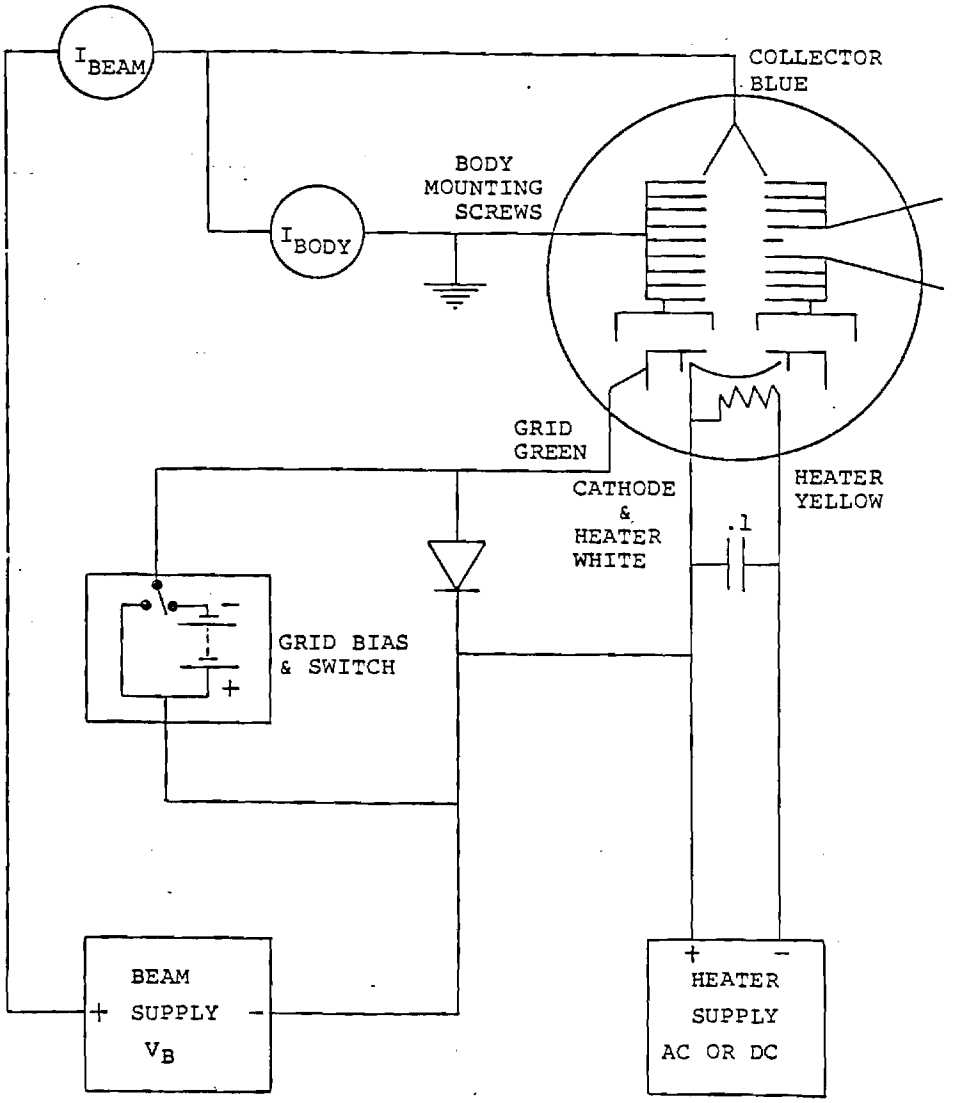


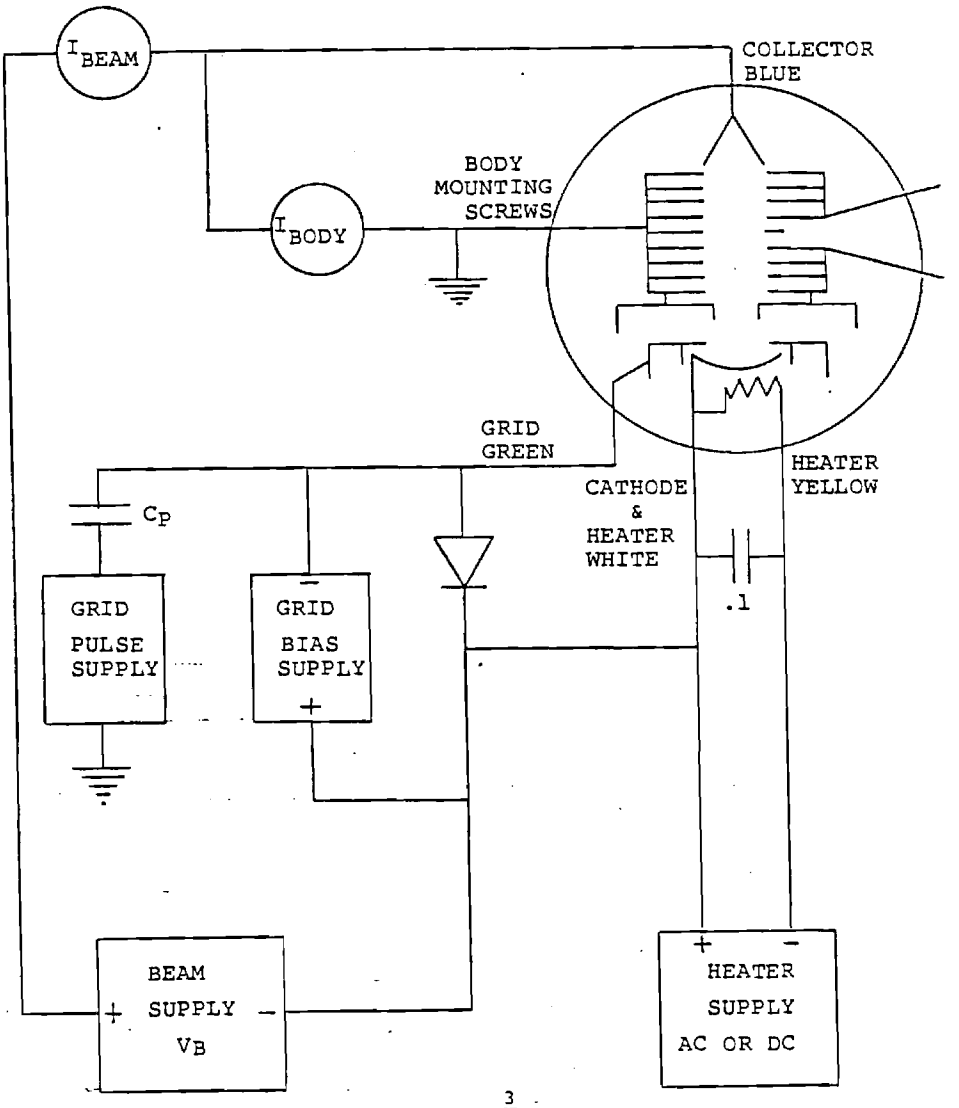
Figure 23. Millimeter contact flange (UG 385/U type).



1) BEAM CURRENT = $.2 \times 10^{-6} V_B^{\frac{3}{2}}$ AMPS APPROX

2) DIODE PREVENTS GRID FROM BECOMING POSITIVE W.R.T. CATHODE

Figure 24. Typical circuit for switched grid bias supply for a gridded EIO.



1) BEAM CURRENT = $.2 \times 10^{-6} V_B^{\frac{3}{2}}$ AMPS APPROX

2) CAPACITANCE C_P CHOOSEN ACCORDING TO REQUIRED PULSE LENGTH VOLTAGE RATING IS THE SUM OF BEAM PLUS BIAS VOLTAGE.

3) DIODE PREVENTS GRID FROM BECOMING POSITIVE W.R.T. CATHODE.

Figure 25. Typical circuit for a capacitor coupled grid pulsed EIO.

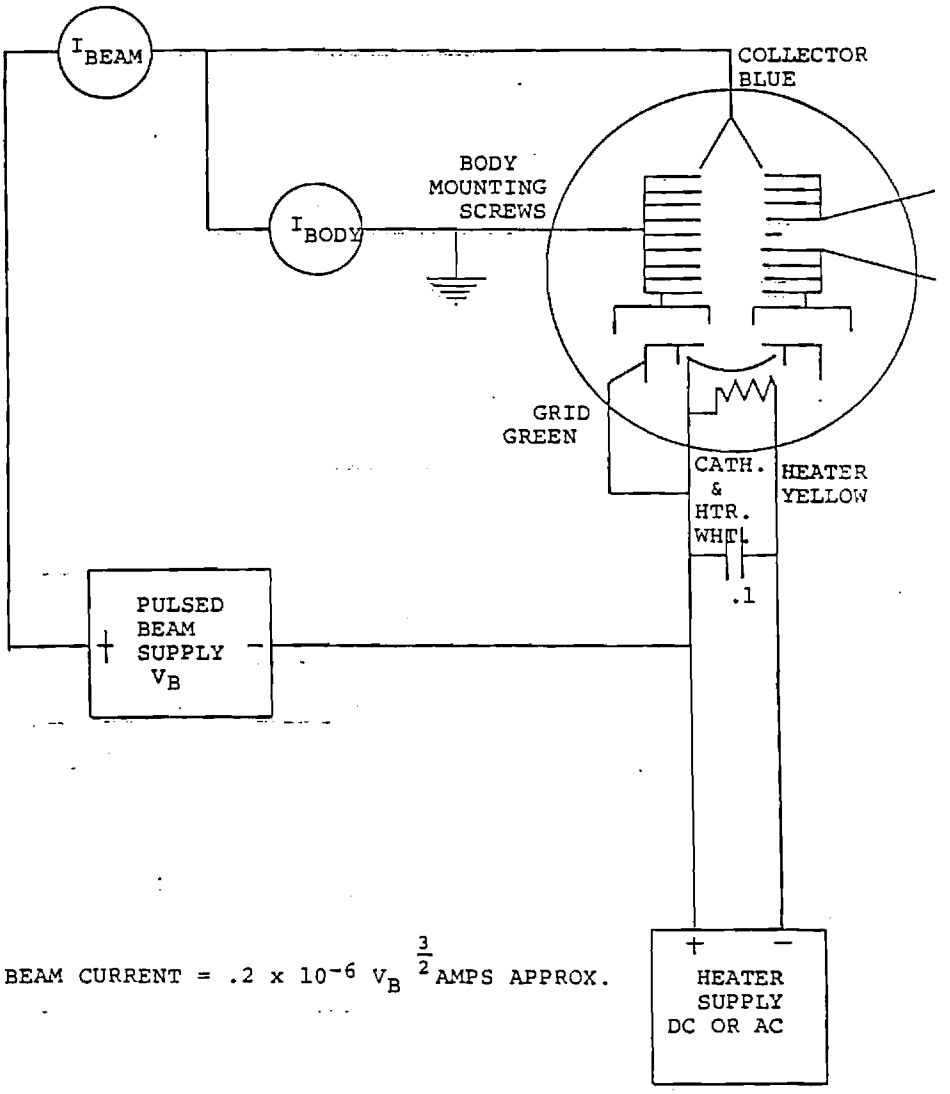


Figure 26. Typical circuit for a gridded EIO operated from a single power supply.

varian

OPERATING HAZARDS

READ THE FOLLOWING INSTRUCTIONS AND TAKE ALL NECESSARY PRECAUTIONS

OPERATING INSTRUCTIONS

This information is provided to help you establish safe operating conditions for both you and your Varian microwave tube.

Use the Test Performance Sheet and Operating Instructions with the information given in this sheet to help you operate this tube in a safe and efficient manner. The Test Performance Sheet is an individual record of the test conditions and test results obtained at the factory. The Operating Instructions give special considerations and precautions to be followed to obtain best performance.

Do not operate this tube except in accordance with proper operating instructions, these precautions, and any additional information provided by Varian Tube Division representatives. Address any questions regarding the safe and proper use of this tube to:

Varian Canada, Inc.
45 River Drive
Georgetown, Ontario, Canada

WARNING – SERIOUS HAZARDS EXIST IN THE OPERATION OF ALL MICROWAVE TUBES

The operation of all microwave tubes involves the follow hazards.

a. HIGH VOLTAGE – Normal operating voltages can be deadly.

b. MICROWAVE RADIATION – Microwave radiation can cause serious personal injury which can be fatal.

c. X-RAY RADIATION – High voltage tubes can produce dangerous X-rays.

Read the following instructions and take all necessary precautions. Varian as a component supplier can assume no responsibility for any damage or injury resulting from the operation of Varian microwave tubes.

HIGH VOLTAGE

Operating voltages for microwave tubes range from about 200 volts to over 150 kilovolts. Since these voltages can be deadly, the equipment must be designed properly and operating precautions must be followed. Design equipment so the operator cannot come in contact with high voltages. Enclose high voltage circuits and terminals and provide interlocking switch circuits to open the primary circuits of the power supply and discharge high voltage condensers whenever access is required.

MICROWAVE RADIATION

Exposure of the human body to microwave radiation in excess of 10 milliwatts per square centimeter is unsafe, and the output of many microwave tubes exceeds this level. For this reason, the rf energy must be contained properly by waveguides and shielding. Arrangements should be made to prevent exposure of personnel to strong rf fields in the vicinity of microwave tubes and in front of antenna systems. (Ref: Proc. IRE, Vol. 49, No. 2, pp. 427 - 477, Feb. 1961.)

X-RAY RADIATION

Electronic tubes operating at voltages higher than 15 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. Therefore, many high power microwave tubes are potential X-ray hazards. Provide adequate X-ray shielding on all sides of these tubes, as well as the modulator and pulse transformer tanks. Make periodic checks on the X-ray levels and never operate high voltage tubes without adequate X-ray shielding being in place. (Ref: "Medical X-ray Protection up to Three Million Volts," National Bureau of Standards Handbook 76. Available from Superintendent of Documents, Washington D.C., 20402, Price: 25 cents.)

DANGER – BERYLLIUM OXIDE CERAMICS AVOID BREATHING DUST OR FUMES

Some Varian high power microwave tubes contain Beryllium Oxide Ceramics. Avoid performing any operation on the ceramic parts of these tubes which produce dust or fumes. In particular, avoid operations such as grinding, grit blasting, and acid cleaning. BERYLLIUM OXIDE DUST AND FUMES ARE HIGHLY TOXIC AND BREATHING THEM CAN RESULT IN SERIOUS PERSONAL INJURY OR DEATH. If a tube fails and a broken window is suspected, the tube should be carefully removed from the mating waveguide and the output flange of the tube should be sealed with tape.

Disposal of used tubes containing Beryllium Oxide must be done in a manner which will ensure that personnel in the disposal operation will be safeguarded and that personnel in any possible salvage operation will be fully warned. If proper disposal presents a problem, Varian is prepared to offer disposal service for tubes containing this material. Tubes should be returned prepaid with a written authorization to Varian to dispose of the tubes.

Although Varian tubes containing Beryllium Oxide Ceramics are marked with a warning label at Varian, because of the possibility of an obliterated or missing label, we strongly urge that Varian be contacted prior to performing any work on the ceramic portions of any Varian high power microwave tubes.

3126 12/79

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WARRANTY

MICROWAVE TUBES, EQUIPMENT AND COMPONENTS
VARIAN CANADA, INC.

WARRANTY

Microwave Tubes, Equipment and Components ("Products") sold by Varian Canada, Inc., are warranted against defects in workmanship and material when used under normal operating conditions within the respective Varian specified ratings and in accordance with Varian operating instructions. The applicable Microwave Tube warranty period shall commence on the date of shipment from Varian Canada, Inc. and extend for a specified number of hours of operation of the filament or heater, or for a specified number of months following the date of shipment thereof, whichever first occurs. The applicable number of hours of operation of the filament or heater included in the warranty for a Microwave Tube depends upon the type of tube. The most common periods of warranty are listed below:

CODES		
Warranty Code	Warranted Filament or Heater Operation (hours)	Maximum Adjustment Period (months)
WM	Unlimited	12
B	100	6
E	200	12
G	500	12
K	1000	12
L	2000	12
S	5000	12
V	7500	18
W	7500	24

Equipment and passive Components (including electromagnets, solenoids, filters, loads, circulators, couplers, waveguide windows, diplexers, and other passive devices) are warranted for unlimited hours of operation during the one year period following date of shipment thereof.

ADJUSTMENTS

Repair, or at Varian's option, replacement of the Product or defective parts therein shall be the sole and exclusive remedy under valid warranty claims; provided that Varian may, as an alternative for Microwave Tubes, elect to refund an equitable portion of the purchase price of the Product in accordance with the following adjustment criteria.

If a Microwave Tube fails from causes covered by this warranty within the warranted hours of operation and maximum adjustment period, a pro rata adjustment, based on the selling price, will be made as follows:

$$\text{Adjustment} = (\text{Applicable Selling Price}) \times \left[\frac{(\text{Warranted Hours} - \text{Hours of Operation at Failure})}{\text{Warranted Hours}}\right]$$

No adjustment will be made for failure beyond the warranted hours of operation or beyond the maximum adjustment period. In all cases failure shall be deemed to have occurred no more than seven days before the first date on which notice of failure is received by Varian.

Varian shall have no obligations under this warranty unless the applicable warranty period (number of hours of operation of the filament or heater, and/or number of months from date of shipment) is specified on Varian's quotation, or is otherwise agreed to in writing by Varian. In the event Customers and/or users of any Microwave Tube subject to warranty claim fail to keep accurate records of the number of hours of operation of the filament or heater, Varian, in its sole discretion, may reject any such claim or determine probable usage of the Product.

This warranty is expressly in lieu of and excludes all warranties of any kind express or implied, including warranties of merchantability and of fitness for particular purpose, use or application, and all other obligations or liabilities on the part of Varian, unless such other warranties, obligations or liabilities are expressly agreed to in writing by Varian.

LIABILITIES

Varian's aggregate liability for damages shall not exceed the payment, if any, received by Varian for the unit of Product or service furnished or to be furnished, as the case may be, which is the subject of claim or dispute. In no event shall Varian be liable for incidental, consequential or special damages, howsoever caused. No action, regardless of form, arising out of, or in any way connected with Products or services furnished by Varian, may be brought by Customer more than one (1) year after the cause of action has accrued. All patent liability of Varian shall be determined solely in accordance with the standard Terms and Conditions of Sale, Electron Device Group, Varian Associates, Inc.

3897 11/79 Printed in U.S.A.

RETURN PROCEDURES

WARRANTY CLAIM

All claims under warranty must be made promptly after occurrence of circumstances giving rise to the claim and must be received within the applicable warranty period by Varian or its authorized representative. Varian reserves the right to reject any warranty claim not promptly reported. After expiration of the applicable warranty period, Microwave Tubes, Power Supplies and Components are not subject to adjustment.

Unnecessary expense and loss of time often can be avoided by calling the local Varian Field Office before returning a Product to the factory. Returned Products are frequently found to be within performance specifications required of new Products. The Varian representative may be able to determine the trouble and obtain satisfactory performance from the Product. This may save shipping time and expense and minimize equipment down time.

WARRANTY CLAIM FORM

Before any Product is returned for repair and/or adjustment, written authorization from Varian for the return and instructions as to how and where the Product should be shipped must be obtained. The Product type and serial numbers and a full description of the circumstances giving rise to the warranty claim should be included. Such information will help establish the cause of failure and expedite adjustment or repair. For this purpose, a Warranty Claim Form is shipped with each Product.

IMPORTANT

If goods are to be returned from outside Canada, the customer must first contact Varian Canada, Inc. for special instructions regarding customs. Otherwise costly duty charges may be incurred and charged to the customer.

Any Product returned without a completed claim form will be considered to have met all contractual requirements. Both the Product and the completed claim form must be submitted to Varian prior to expiration of the applicable warranty period.

TRANSPORTATION AND PACKAGING

Any Product returned to Varian for examination must be sent prepaid via the means of transportation indicated as acceptable by Varian. Varian reserves the right to reject any warranty claim on any item that has been altered or has been shipped by nonacceptable means of transportation. Returned Products should be carefully packed in the original container, and unless otherwise indicated, shipped to:

VARIAN CANADA, INC.
45 River Drive
Georgetown, Ontario,
Canada

Attn: Returned Products

AUTHORIZATION FOR EVALUATION

When any Product is returned for examination and inspection, or for any other reason, Customer and its shipping agency shall be responsible for all damage resulting from improper packing or handling, and for loss in transit, notwithstanding any defect or nonconformity in the Product. By returning a Product, the owner grants Varian permission to open and disassemble the Product as required for evaluation. In all cases Varian has sole responsibility for determining the cause and nature of failure, and Varian's determination with regard thereto shall be final.

If it is found that Varian's Product has been returned without cause and is still serviceable, the Customer will be notified and the Product returned at its expense; in addition, a charge for testing and examination may, at Varian's sole discretion, be made on Products so returned.

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WARRANTY CLAIM FORM
FOR
MICROWAVE TUBES, EQUIPMENT AND COMPONENTS

Varian Canada, Inc.

PROPER COMPLETION OF THIS FORM IS VITALLY IMPORTANT TO THE PROMPT AND EFFICIENT HANDLING OF PRODUCT WARRANTY CLAIMS.

I. This claim form, properly completed, must accompany any returned Product and be received by Varian Canada, Inc. prior to expiration of the adjustment period. Compliance with this requirement assures the user of the most prompt and thorough service possible. A Product returned within the adjustment period, but without the completed Warranty Claim Form, will be treated as out of warranty.

II. Complete the following information regarding the Product being returned:

A. Product Type: Varian Part No._____ Serial No._____

Customer Part No._____

B. Customer Purchase Order No._____

Date of Purchase Order _____

C. Control Specification Number _____ Dated _____

(Check one) Document of VA ☐ your company ☐

D. Contract Warranty (either Varian Warranty code or specification paragraph)

_____

Filament Hours _____ Warranty Adjustment Began_____

Adjustment Time _____ (months) Expires_____

III. Claim is made against warranty based on the following:

A. Specification(s) not met by the Product (list by specification and paragraph number):

3442 11/79 Printed in U.S.A.

PLEASE FILL IN FOR FAILED PRODUCTS

(Place an "X" in the appropriate box to show what variance from normal was seen at the time of tube failure.)

Product Serial No. / Type No.	Date Installed	Date Failed	Filament Hours	Radiate Hours	Filament Current		Beam Current		Helix or Body Current		Hi Voltage Arcs		W/G Arcs		Coolant Flow		Mech. Problems		Electro-Magnet Current	
					Lo	Hi	Lo	Hi	Nml	Hi	No	Yes	No	Yes	Nml	Lo	No	Yes	Nml	Lo

*It is necessary to have the Product serial number rather than the system serial number.

B. Describe the circumstances and/or sequence of events under which the Product failed. Include remarks relating to installation problems, system anomalies, etc.

IV. System used in _____

Serial No. _____

V. Purchaser's Name _____

Address _____

_____

Claim made by: _____

Person to contact for additional information:

Name _____

Telephone _____

VI. Repair or Replacement to be sent to:

Name _____

Address _____

_____

(Signature)

_____

(Date)

Return completed form promptly, with Product, to:

Varian Canada, Inc.
45 River Drive
Georgetown, Ontario
Canada

Telephone: (416) 457-4130
TWX: 610-492-2641
TELEX: 069-7502

Attn: Returned Products