TENNELEC

TC 947

DETECTOR BIAS SUPPLY

INSTRUCTION MANUAL


TENNELEC
TC 947
2KV BIAS
SUPPLY
OUTPUT POLARITY
POS.
NEG.
OUTPUT
VOLTAGE
0 to 2000V
OUTPUT VOLTAGE
IS 20× DIAL READING
H.V. ON
OFF
SERIAL
+24/15mA
+12/160mA
-24/80mA
-12/0mA

TC 947 DETECTOR BIAS SUPPLY

TABLE OF CONTENTS

FIGURES

1.0 INTRODUCTION

The TC 947 Detector Bias Supply simultaneously furnishes continuously adjustable voltages of 0 to ±2kV dc and 0 to ±200V dc. A single calibrated IO-turn control indicates the output voltage for both ranges.

The low-noise, less than 5mV peak-to-peak (p-p), and the low-current, 0 to 100µA, make the 0 to 2kV range ideal for applications using ion chambers, Germanium detectors, proportional counters or Si(Li) x-ray detectors, The less than 0.5mV p-p ripple in the 200V range allow the TC 947 to be used with surface barrier silicon detectors. The TC 947 was not intended to be used with scintillation detectors.

NOTE: THE TC 947 *PRODUCES HAZARDOUS* VOLTAGE. **DO NOT APPLY POWER UNLESS** PRECAUTIONS HAVE *BEEN TAKEN* TO AVOID ACCIDENTAL CONTACT *WITH* THE HIGH VOLTAGE.

2.0 SPECIFICATIONS

2kV Section

OUTPUT VOLTAGE: 0 to 2kV, continuously adjustable
OUTPUT POLARITY: Positive or negative-(reversible plug-in card)
MAXIMUM OUTPUT CURRENT: 100µA
NOISE AND RIPPLE: Less than 5mV p-p to 50 MHz
INTERNAL IMPEDANCE: Approximately 3MΩ
VOLTAGE STABILITY: 0.1%/hour
TEMPERATURE STABILITY: 0.02%/°C, 0°-50°C range
DIAL ACCURACY: ±1% of full scale
SHORT CIRCUIT CURRENT: 1mA maximum
DISABLE SIGNAL: Short circuit to ground, (1.5mA).

200V Section

OUTPUT VOLTAGE: 0 to 200V, continuously adjustable
OUTPUT POLARITY: Positive or negative, slaved to 2kV output
MAXIMUM OUTPUT CURRENT: 10µA
NOISE AND RIPPLE: Less than 0.5mV p-p to 50 MHz
INTERNAL IMPEDANCE: Approximately 7MΩ
VOLTAGE STABILITY: 0.1%/hour
TEMPERATURE STABILITY: 0.02%/°C, 0°-50°C range
DIAL ACCURACY: ±1% of full scale
SHORT CIRCUIT CURRENT: 40µA maximum
DISABLE SIGNAL: Short circuit to ground (1.5mA)

POWER REQUIREMENTS
+24V @ 15 mA
+12V @ 160 mA
-24V @ 80 mA

PACKAGING: No. 1 AEC NIM Standard Width.

NET WEIGHT: 1 lb. 6 oz. (0.63 kg)

SHIPPING WEIGHT: 3 lbs. 12 oz. (1.7 kg)

WARRANTY: One year

3.0 CONTROLS, CONNECTORS AND DISPLAYS

OFF/ON SWITCH: This toggle switch controls the high voltage output. When the front panel "HV" indicator lamp is lighted, the high voltage circuit is on.

OUTPUT VOLTAGE: A precision calibrated ten-turn potentiometer controls both the 2kV and 2DOV outputs. Both voltage outputs are available simultaneously through connectors at the rear panel.

OUTPUT POLARITY: These front panel lamps indicate the polarity of both the 2kV and 20DV outputs. The polarity is selected by a reversible card internally mounted.

OUTPUT CONNECTORS: Separate 2kV and 200V SHV connectors which are mounted on the rear panel.

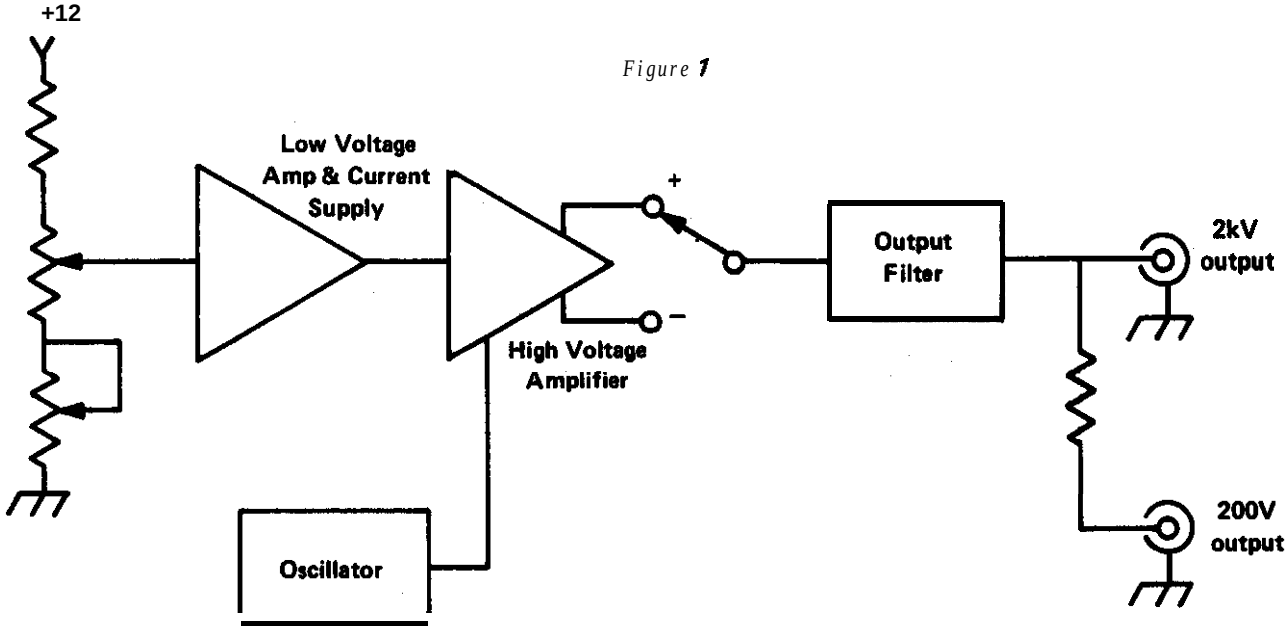
DISABLE CONNECTOR: A BNC connector mounted on the rear panel can be used to disable (turn-off) the high voltage output by short-circuiting the center pin to ground. Short-circuit current is approximately 1.5 mA.

4.0 CIRCUIT DESCRIPTION

The TC 947 is basically a dc-to-dc inverter (see Figure 1).

The step-up stage (labeled "High Voltage Amplifier") is driven at 33 kHz by the oscillator, and the dc output to the step-up stage is controlled by a low voltage amplifier and current supply. Detailed operation is as follows:

Figure 1



BLOCK DIAGRAM OF THE TC 947 POWER SUPPLY

Unijunction **Q4** generates 33kHz spikes which clock flip-flop **IC1A.** The outputs of **IC1A** are two 33kHz square waves **180°** out of phase. These square waves are applied to **Q6** and **Q8** which in turn drive **Q7, Q9,** and Transformer **T1.** Current is supplied to the center tap of **T1** from the emitter follower **Q3.** The output of the high voltage transformer, **T1,** is a square wave which is rectified by the voltage doubler made up of **D5, D6, C9** and, **C10.** The 200V output is tapped off from the 2kV supply through R22, R23, R24, and R25. R26 is a calibrating control for the 200V supply. The high voltage ON/OFF switch controls power to emitter follower **Q3** referred to above (also, in the OFF position. The J-K inputs of **IC1** are grounded). Output polarity is controlled by orientation of switching card **PC1.**

5.0 OPERATING INSTRUCTIONS

5.1 FIRST-TIME OPERATION

Every instrument from TENNELEC, Inc. is thoroughly checked before it leaves the plant. However, it is possible for damage to occur during shipping, and it is advised that a few tests be run before the instrument is put into actual operation. To test the indicated output voltage, follow the procedures outlined in Section 6.2

Visually check the Model TC 947 upon receipt for possible external damage. If it appears to be damaged, proceed according to the instructions given in the SHIPPING DAMAGE section of this manual.

It is recommended that the power supply of the bin be OFF when the module is inserted.

5.2 CHANGING THE OUTPUT POLARITY OF THE TC 947

To change the output polarity of both the 2kV and 200V sections, first turn off the power supply and the bin power, then remove the module. IF THE SUPPLY HAS BEEN ON, WAIT AT LEAST 30 SECONDS BEFORE OPENING THE TOP PANEL TO ALLOW THE CAPACITORS TO DISCHARGE. Now slide the top panel out, and remove the small card. Orient the card so that the desired polarity indication is on the bottom of the card with the arrows pointing down. Reinsert the card in the connector and close the top panel.

5.3 USING THE TC 947 WITH A ROOM TEMPERATURE SILICON SURFACE BARRIER DETECTOR

When the TC 947 power supply is used with a room-temperature silicon surface barrier detector, leakage current may be high enough to cause a voltage error since the internal impedance is 7MΩ. For example: if the supply is operating at an indicated 50V under a load of 1μA, the actual voltage will be 7 volts lower than shown on the dial, or at a 0.1μA load; the true voltage will be .7 volts lower than indicated.

6.0 SERVICING

6.1 GENERAL SERVICING INSTRUCTIONS

In the event of a component failure, replacement may be done in the field or the instrument may be returned to our plant for repair. There will be no charge for repairs that fall within the warranty.

6.2 OUTPUT VOLTAGE MEASUREMENT

The TC 947 is calibrated in TENNELEC's Quality Control Department with an electrostatic voltmeter. If an electrostatic voltmeter is not available, the next best method for checking or calibrating the TC 947 is as follows:

With the supply turned off, connect a 100 megohm, 5% resistor to the 2kV output in series with an ammeter (current) which will read at least 20 µamps full scale. Be sure to observe the proper polarity. With the voltage turned to zero, turn the supply ON. Slowly turn the voltage up and observe the ammeter. Because the output impedance of the TC 947 is approximately 3 megohms there will be an error in the meter reading at a dial setting of 2000V of approximately .60 µamps. Thus, an output current 19.40 µamps on the current meter will represent a true value of 2000V. Note that the 100 megohm resistor may be a source of error in the reading of a maximum of 5% or ±100V.

6.3 RECALIBRATION

When the TC 947 is shipped from the factory, it has been calibrated to a dial accuracy of ±1% of full scale. Over a period of time or in the event of a component failure, the dial setting may no longer represent the true output voltage. You will be able to recalibrate the TC 947 by following this procedure outlined below.

CAUTION: THE TC 947 PRODUCES HAZARDOUS VOLTAGE. IF YOU HAVE NOT HAD EXPERIENCE WITH HIGH VOLTAGE SUPPLIES, YOU MAY INJURE YOURSELF OR DAMAGE THE POWER SUPPLY. BETTER SAFE THAN SORRY!

Using an electrostatic voltmeter or the method outlined in 6.2 OUTPUT VOLTAGE MEASUREMENT, monitor the 2kV output.

Set the dial at 2000V and adiust R2 inside the module with a screwdriver until the meter gives a equivalent-to 2000V (see Fig. 2).

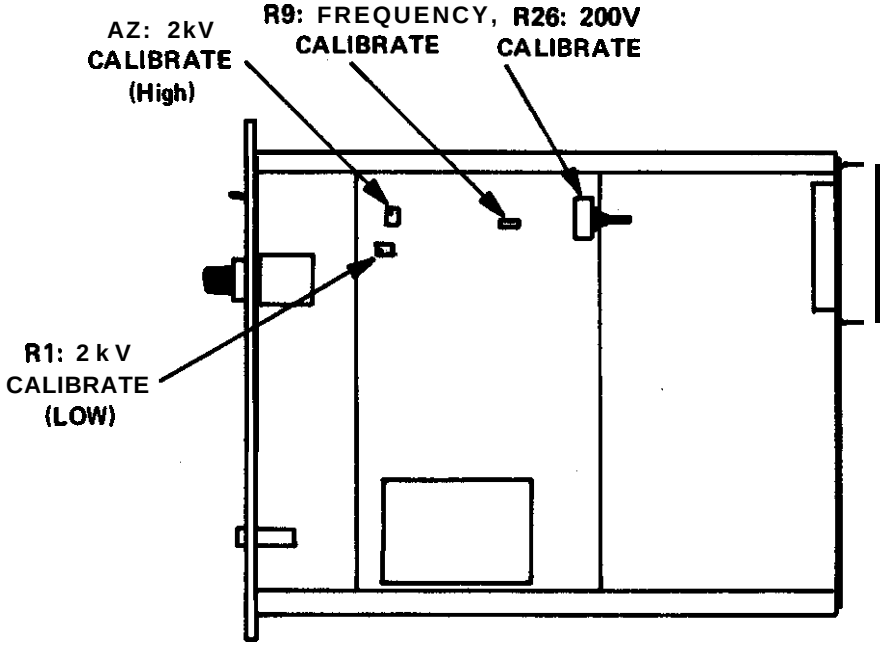


Figure2

Now set the dial to 100V and adjust RI until the meter indicates 100V. Because the R1 and R2 adjustments affect each other, it will be necessary to repeat the sequence a few times, The 200V output is slaved to the 2kV output. When the 2kV section has been properly calibrated, use a regular voltmeter (VTVM) to check the 200V output. Recalibration for the 200V output is via the R26 Pot in the output filter.

7.0 SHIPPING DAMAGE

Upon receipt of the instrument examine it for shipping damage. Damage claims should be filed with the carrier. The claims agent should receive a full report; a copy of that report should be sent to TENNELEC, Inc., P.D. Box D, Oak Ridge, Tennessee 31030. The model number and serial number of the instrument must be included in the report. Any remedial action taken by TENNELEC, Inc. will be based on the information contained in this report,

8.0 WARRANTY

In connection with TENNELEC's warranty (inside front cover), TENNELEC suggests that if a fault develops, the customer should immediately notify the TENNELEC Customer Service Manager. He may be able to prescribe repairs and to send replacement parts which will enable you to get the instrument operating sooner and at less expense than if you returned it.

Should return prove necessary, the TENNELEC Customer Service Manager must be informed either IN WRITING, BY CABLE or BY TWX of the nature of the fault and the model number and serial number of the instrument. Pack the instrument well and ship PREPAID and INSURED to TENNELEC, Inc., 601 Oak Ridge Turnpike, Oak Ridge, Tennessee 37830. As stated in the warranty, DAMAGE IN TRANSIT WILL BE REPAIRED AT THE SENDER'S EXPENSE as will damage that obviously resulted from abuse or misuse of the instrument.

Quotations for the repair of such damage will be sent for your approval before repair is undertaken.

10/74 - Engineering and component *improvements may* be made *after date of printing.*

TC 947 H.V. SUPPLY PARTS LIST

RESISTORS

Schematic No.	Description			TENNELEC Catalog No.
R1	200Ω Trim Pot			470X-UXIE-00201
R2	2k Trim Pot			470X-UXIE-00202
R3	1k	1/4W	CC	470X-BCOJ-00102
R4	1k	1/4W	CC	470X-BCOJ-00102
R5	47k	1/4W	CC	470X-BCOJ-00473
R6	4.7	1/4W	CC	470X-ACOJ-04R70
R7	4.7	1/4W	CC	470X-ACOJ-04R70
R8	47.5k	1/4W	MF	470X-CCOF-04751
R9	10k	1/2W	Ceramic	470X-TDOX-01002
R10	470	1/4W	5% cc	470X-BCOJ-00471
R11	47	1/4W	CC	470X-BCOJ-00470
R12	390	1/4W	CC	470X-BCOJ-00391
R13	6.2k	1/4W	cc	470X-BCOJ-00622
R14	390	1/4W	cc	470X-BCOJ-00391
R15	2.2k	1/4W	CC	470X-BCOJ-00222
R16	2.2k	1/4W	CC	470X-BCOJ-00222
R17	lk	1/4W	CC	470X-BCOJ-00102
R18	lk	1/4W	CC	470X-BCOJ-00102
R19	10k	1/4W	CC	470X-BCOJ-00103
R20	100k	1/2W	CC	470X-BDOJ-00104
R21	10k	1/2W	CC	470X-BDOJ-00103
R22	22 Meg	1W	DC	470X-AEOJ-00226
R23	22 Meg	1W	DC	470X-AEOJ-00226
R24	22 Meg	1W	DC	470X-AEOJ-00226
R25	6.8 Meg	1W	DC	470X-AEOJ-00685
R26	1 Meg Pot			470X-MXXX-00105
R27	22	1/2W	DC	470X-ADOJ-00220

NOTE: CC: Carbon Composition DC-Deposited Carbon MF-Metal Film

CAPACITORS

C1	10µF/25V	T	150X-LCXL-00106
C2	220µF/10V	C	150X-FBXX-00227
C3	0.00047µF	MY	150X-B2CK-00471
C4	1.0µF	Hi-K C	150X-KBXX-00104
c5	220µF/10V	C	159X-FBXX-00227
C6	0.1µF	MY	150X-BICK-00104

CAPACITORS (Continued)

Schematic No.	Description		TENNELEC Catalog No.
c7	0.1µF	MY	150X-BICK-00104
C8	47µF/20V	T	150X-LCXL-00476
C9	.01µF/1kV	CD	150X-KHXL-00103
C10	.01µF/1kV	CD	150X-KHXL-00103
C11	0.1µF/2kV	F	150X-BKXX-00104
C12	.01µF	Hi-K C	150X-KDXX-00103
C13	.01µF	Hi-K C	150X-KDXX-00103

NOTE: T-Tantalum C-Ceramic My-Mylar CD-Ceramic Disc F-Film Cap

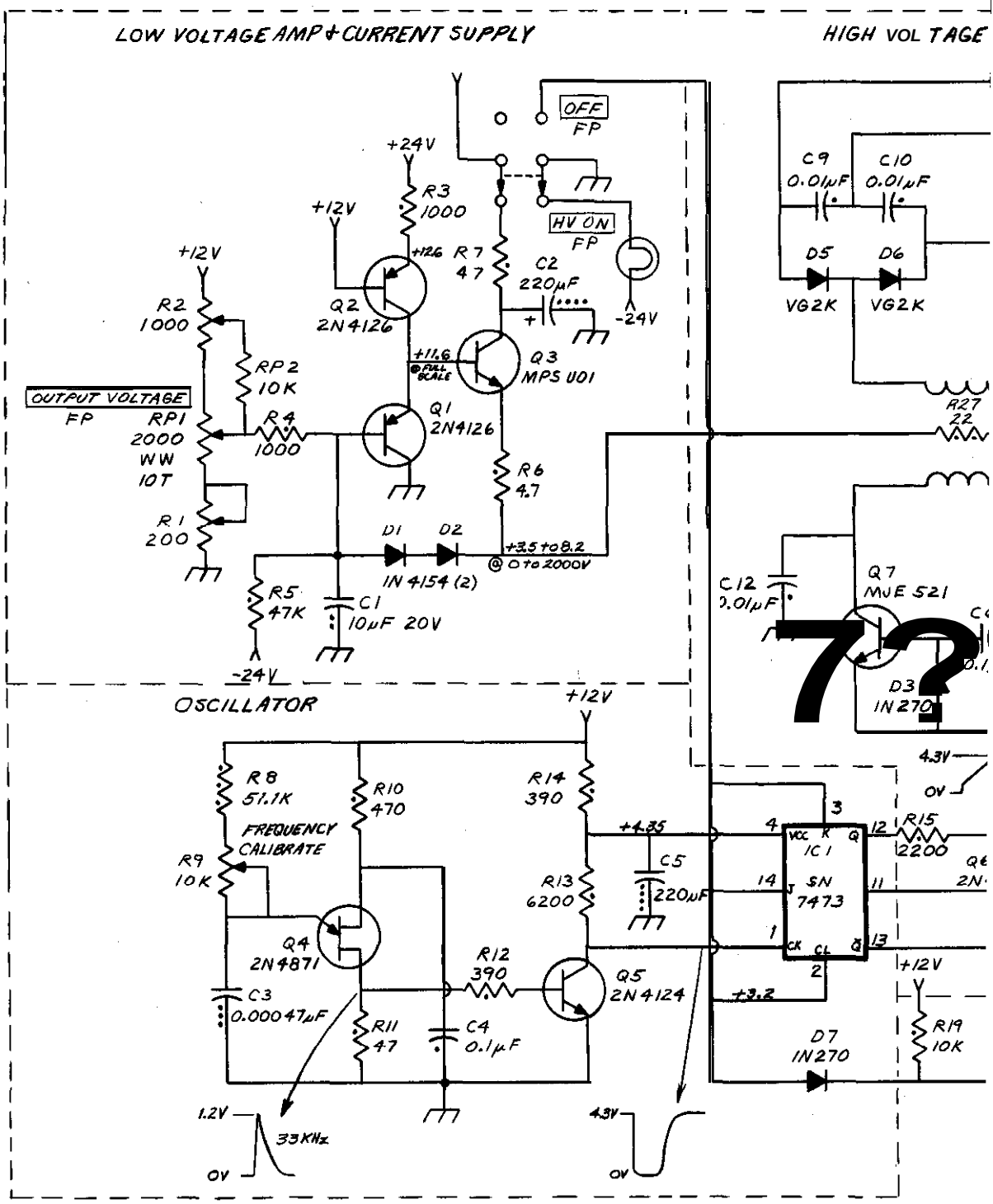
SEMI-CONDUCTORS

D1	IN4154	D	4800-IN4154
D2	IN4154	D	4800-IN4154
03	IN270	D	4800-IN270
D4	IN270	D	4800-IN270
D5	UG2K	D	4800-UG2K
D6	UG2K	D	4800-UG2K
D7	IN270	D	4800-IN270
Q1	2N4126	T	4800-2N4126
Q2	2N4126	T	4800-2N4126
Q3	MPSU01	T	4800-MPSU01
Q4	2N4871	T	4800-2N4871
Q5	2N4124	T	4800-2N4124
Q6	2N4124	T	4800-2N4124
Q7	MJE521	T	4800-MJE521
Q8	2N4124	T	4800-2N4124
Q9	MJE521	T	4800-MJE521
IC1	SN7473	IC	4800-SN7473

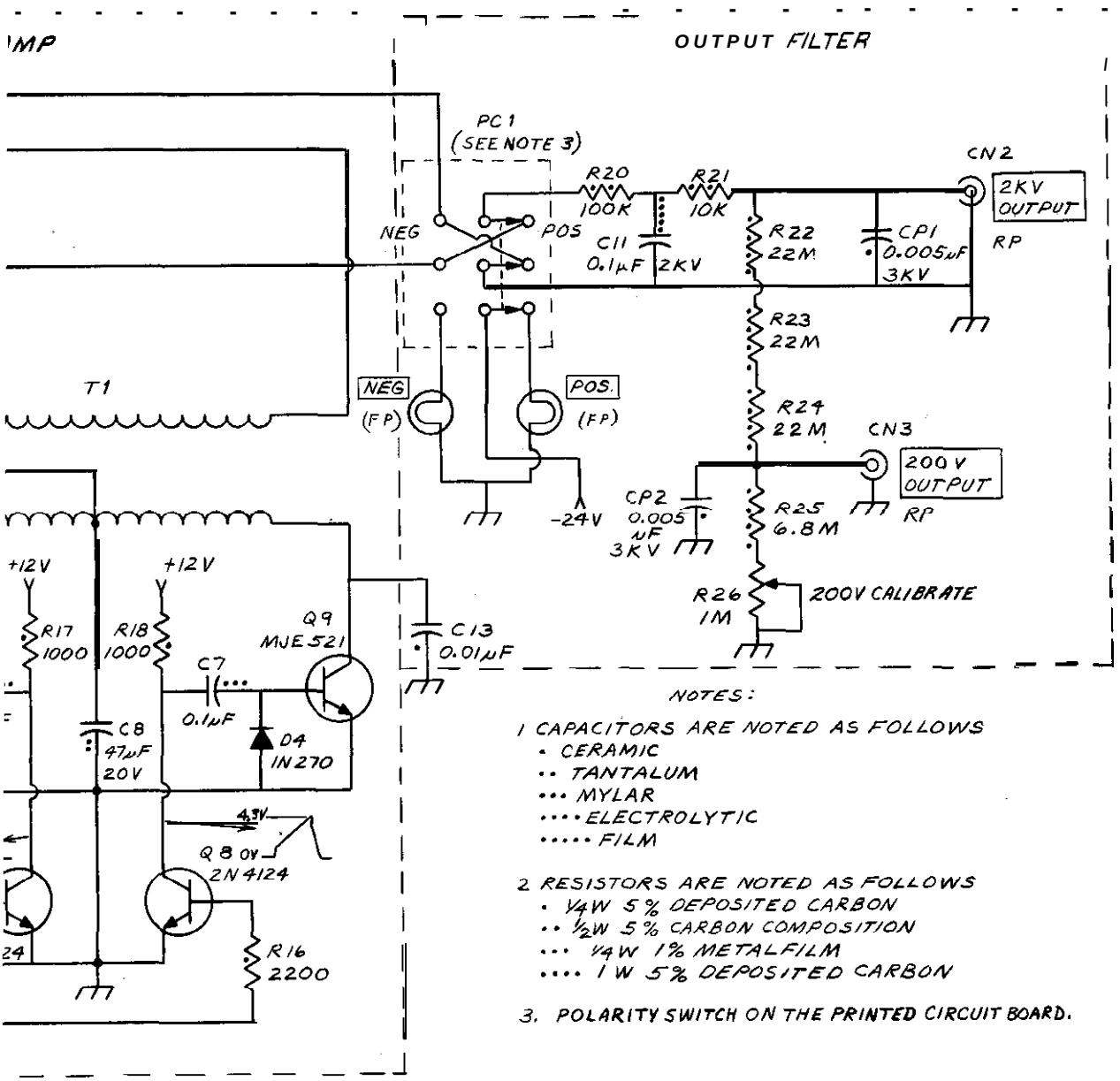
NOTE: D-Diode T-Transistor IC-Integrated Circuit

MISCELLEANOUS

T1	Transformer FEC P/N W-3014	5600-0085



2	ICN 74-138 (ADD C14)	1-14-74	JW
1	CURRENT + VOLTAGES	10-3-74	R.C.S.
REV.	ECN NO.	DATE	BY
REVISIONS			

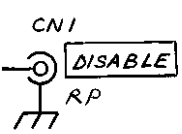


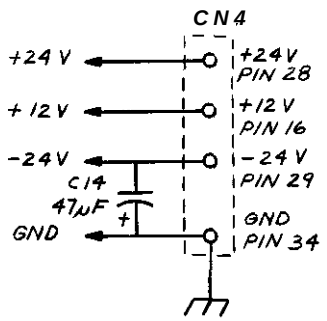
NOTES:

1 CAPACITORS ARE NOTED AS FOLLOWS
- • CERAMIC
- •• TANTALUM
- ••• MYLAR
- •••• ELECTROLYTIC
- ••••• FILM

2 RESISTORS ARE NOTED AS FOLLOWS
- • ¼W 5% DEPOSITED CARBON
- •• ½W 5% CARBON COMPOSITION
- ••• ¼W 1% METALFILM
- •••• 1W 5% DEPOSITED CARBON

3. POLARITY SWITCH ON THE PRINTED CIRCUIT BOARD.





TENNELEC

P. O. BOX D, OAK RIDGE, TENNESSEE 37830

TITLE: TC 947 2KV BIAS SUPPLY
CIRCUIT DIAGRAM

ENGINEER	DATE	ENG. APPROVAL	DATE	PART NO.
P. PFLASTERER	3/73			
DRAFTSMAN	DATE	DRAFTING APPROVAL	DATE	DRAWING NO.
JW	5-1-73			TC947-10
SCALE		RELEASED BY	DATE	