OPERATORS' MANUAL

DC Voltage and Current Standard

Model CR103
Serial No. _____

ELECTRONIC DEVELOPMENT CORPORATION
BOSTON, MASS
MADE IN U.S.A.

WARRANTY

The ELECTRONIC DEVELOPMENT CORPORATION (EDC) warrants to the original purchaser each instrument manufactured by them to be free from defects in material and workmanship. This warranty is limited to servicing, repairing and/or replacing any instrument or part thereof returned to the EDC factory for that purpose in accordance with the instructions set forth below; and furthermore to repair or replace all materials, except tubes, fuses, transitors and other semi-condutor devices which shall within one year of shipment to the original purchaser be returned to the EDC factory and upon examination be deemed defective.

EDC instruments may not be returned to the factory under the terms of this warranty without the prior authorization of the EDC Service Department. All instruments returned to EDC for service hereunder should be carefully packed and shipped. All transportation charges shall be paid by the purchaser.

EDC reserves the right to discontinue instruments without notice and to make changes to any instrument at any time without incurring any obligation to so modify instruments previously sold.

This warranty is expressly in lieu of all other obligations or liabilities on the part of EDC. No other person or persons is authorized to assume in the behalf of EDC any liability in the connection with the sale of its instruments.

CAUTION: The instrument you have purchased is a precision instrument manufactured under exacting standards. Any attempts to repair, modify or otherwise tamper with the instrument by anyone other than an EDC employee or authorized representative may result in this warranty becoming void.

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FACTORY SERVICE REQUEST
and
AUTHORIZATION

WARRANTY SERVICE

Instruments may be returned only on prior authorization. Please obtain a RETURN AUTHORIZATION NUMBER either directly from the factory or from an authorized E.D.C. Representative. (See General Instructions below.)

CHARGEABLE REPAIRS

If requested, an estimate of charges will be submitted prior to repairs. We suggest that you request a RETURN AUTHORIZATION NUMBER to facilitate handling.

GENERAL INFORMATION

A) Please provide the following information in order to expedite the repair:

   1) Indicate MODEL
   2) Serial Number
   3) Complete description of the trouble:
      Symptoms, measurements taken, equipment used, lash-up procedures, attempted repairs, suspected location of failure and any other pertinent information.

B) Freight Charges must be prepaid.

C) The RETURN AUTHORIZATION NUMBER should be noted on your documentation.

SECTION I

1.1.0 GENERAL DESCRIPTION

1.1.1 The Model CR103 is a versatile combination of a high accuracy DC current source, a high accuracy DC Voltage source and calibrator, combined in one instrument.

1.1.2 The unit is laboratory calibrated against a primary measuring system, having an absolute error of less than 10ppm. The saturated standard cells used are certified, and are traceable to the National Bureau of Standards, having a long history of documented Stability.

1.1.3 Current and voltage calibrator controls are obtained through front panel rotary and decade switches.

> No trims of adjustments required between Calibration Cycles. Adjustment settings are made at final calibration and are fully described under calibration procedures.

1.1.4 The circuitry is completely solid state packaged in discrete, hybrid and integrated circuit modules. These are proven circuits, using derated components to insure maximum reliability. Major discrete circuits are packaged on etched glass epoxy boards, so that the instrument can withstand abnormal environmental conditions. The instrument is also overload and short circuit protected.

SPECIFICATIONS

CURRENT MODE

All measurements are based on a Standard Resistor – 100 ohms

OUTPUT

100 mA Range	±111.111 0 mA
10 mA Range	±11.111 10 mA

RESOLUTION	1 ppm
100 mA Range	0.1 μa
10 mA Range	.01 μa

OUTPUT ACCURACY

(2 Methods) Relative to NBS standards

Calibration Accuracy: ±(0.005% of setting + 0.0005% of range)

The calibration accuracy is at Standard Reference Conditions at time of calibration. Nominal calibration temperature of 23°C ± 1°C at 70% Humidity. Nominal line voltage 117 Vac at constant external load.

Limit of Error Method: ±(0.01% of setting + 0.001% of range)

SPECIAL NOTE:

*Accuracy (Limit of Error or "Worst Case" Method). All peripheral, additive specs, i.e., error for line change, load change, temperature change, drift and noise are included in "Limit of Error" and are designated as *NON-ADDITIVE. Normal operating environment 65° to 85°F 70% R.H.

STABILITY* *(non-additive)*

1 hr.	±0.001%
8 hrs.	±0.003%
1 yr.	±0.005%

RIPPLE and NOISE, rms (0.1 Hz to 100kHz):
100 mA range: <2μA 10 mA range: <1μA

COMPLIANCE VOLTAGE

100 mA Range	0 to 60 VDC
10 mA Range	0 to 110 VDC

LOAD REGULATION *(non-additive) 0.001% for 100% compliance change. No load to full load.

OUTPUT CONDUCTANCE 0.1 micromho

VOLTAGE MODE

OUTPUT

10 V Range	±11.111 10 V
1 V Range	±1.111 110 V
100 mV Range	±111.111 0 mV

RESOLUTION	1 ppm
10 V Range	10μV
1 V Range	1μV
100 mV Range	.1μV

Calibration Accuracy: ±(0.003% of setting + 0.0005% of range or 5 μV).

At Standard Reference Conditions (See Current Mode for definitions).

Limit of Error Accuracy: ±(0.005% of setting + 0.00075% of range or 5 μV).

At Limit of Error or "Worst Case" conditions. (See Current Mode for definitions).

STABILITY *(non-additive)*

1 hr.	±0.00075%
8 hrs.	±0.001 %
1 yr.	±0.005 %

RIPPLE and NOISE, rms *(non-additive)* (0.1Hz to 100kHz)

10 V Range	50μV
1 V Range	40μV
100 mV Range	5μV

OUTPUT CURRENT

10 V and 1 V Range	50 milliamperes
100 mV Range	EMF into 100kΩ load. (See output impedance)

LOAD REGULATION *(non-additive)* ±0.0005% No load to full load.

OUTPUT IMPEDANCE

10 V & 1 V Range	0.03Ω
100 mV Range	3Ω (Constant)

LINE REGULATION *(non-additive)*
±0.0005% for 10% line change.

GENERAL SPECIFICATIONS:

TEMPERATURE

Calibration Temperature	23°C + 1°C
Ambient Temperature	20°C to 30°C
Operating Limit	-10°C to 50°C
Storage Temperatures	-40°C to 85°C

TEMPERATURE COEFFICIENT

Ambient	±0.0005% /°C
Operating Limit	±0.001% /°C

POWER REQUIREMENTS

30 watts, 50-400 Hz, 105-125 VAC
30 watts, 50-400 Hz, 220-240 VAC

DIMENSIONS

Bench – 5¼ X 17" X 10.9" (133.35 x 431.8 x 277 mm)

Rack Mounting (Option RK-02)
5¼ X 19" X 10.9" (133.35 x 482.6 x 277 mm)

WEIGHT 12 pounds (5.445 kg)

SHIPPING WEIGHT 18 pounds (8.16 kg)

CIRCUIT CONDITION INDICATOR

Front panel indicator illuminates for short circuit, overload, over-voltage condition, low-line voltage or malfunction.

PROTECTION

Short circuit, open circuit, and overload protection. Automatic recovery. Over-voltage protection up to 150 V.

PRICES: See PRICE LIST Section J.

SECTION II

2.0.0 The instrument is available in rack version, designed for mounting in standard 19" racks. It is completely enclosed in dust covers and therefore suitable for bench top use. Resilient feet and a folding tilt bale are supplied, Order for rack mounting if desired.

2.1.2 The overall size is 5 1/4" high x 19" wide x 12" back of the panel. It weighs 13 pounds. A standard 3 prong polarized plug and power cable is attached, and the unit is ready for use.

POWER REQUIREMENT = 30 WATTS
LINE VOLTAGE RANGE 115 or 230V 50/60Hz

The instrument has been designed to be easily transported from one location to another and will be in a stable and accurate operation condition in less than one minute from turn on time.

SECTION III

3.0.0 OPERATION OF INSTRUMENT

3.1.0 FRONT PANEL CONTROLS

3.1.1 Power Switch: Push button, line power, self illuminating.

3.1.2 Polarity Switch: this switch has 3 settings with the polarity switch on "+" the red output terminals are positive with respect to the black terminals. On "-" the red output terminals are negative with respect to the black terminals. On "0" a short circuit exists between the red and black voltage output terminals, the current terminals are open circuited.

3.1.3 Voltage Output and Sense Terminals: 4 terminals are provided for output and sense. The red terminals represent the polarity with respect to the black as the common terminals. The red terminals are indicated by the polarity switch.

If a high impedance or a low current load is connected, the output and sense terminals may be shorted with the sense links (provided) e.g. plus output to plus sense.

If drawing current is desired, the remote sense capability should be used. The advantage of remote sense is that you have a 4 wire output and the sense lines are brought directly to the load, thus eliminating the IR drop of the output lines. The metal terminal is case ground.

3.1.3.1 Current Output Terminals: A red and a black binding post are provided for the current source output. Polarity is the same as the voltage terminals.

With the range switch in a current position a load or a short should be placed across the current output terminals to prevent the full compliance voltage from appearing at these terminals.

3.1.4 Decade Switches: The decade switches are used to select the desired output.

3.1.5 Range Switch: The range switch is used to manually select one of the 5 range modes. In the two current ranges, the output and sense terminals at the right of the instrument are disconnected from the internal circuitry.

In the 3 voltage ranges the current terminals at the left of the instrument are shorted internally.

CR103 COMPLIANCE VOLTAGE SUPPLEMENT

This is an option ,not supplied.

3.1.6 This unit contains circuitry to limit the amount of compliance voltage available in the current ranges.

3.1.7 On the rear panel is a six position rotary switch.

3.1.8 The switch positions; 1-6, corresponds to 1.2V, 5.1V, 13.2V, 19.2V, 25.2V and the maximum compliance voltage

3.1.9 This control should be set prior to operating the instrument.

3.1.10 The accuracy specs are not degraded by the limiting of the compliance voltage.

NOTE: No "overload" indication will be present when a lower compliance voltage limit is exceeded.

3.2.0 OPERATION AS A VOLTAGE SOURCE

3.2.1 With power switch off, connect power cord to recommended power source, e.g. 115 VAC 60Hz or 220 VAC 50Hz

3.2.2 Connect the output terminals of the instrument to their respective loads as required, observing the sensing rules (see diagram below).

CAUTION: Do not place more than a 500 volt potential between the output terminals and chassis ground when using a floating output. In some applications it may be necessary to isolate chassis form line common. This practice is not recommended.

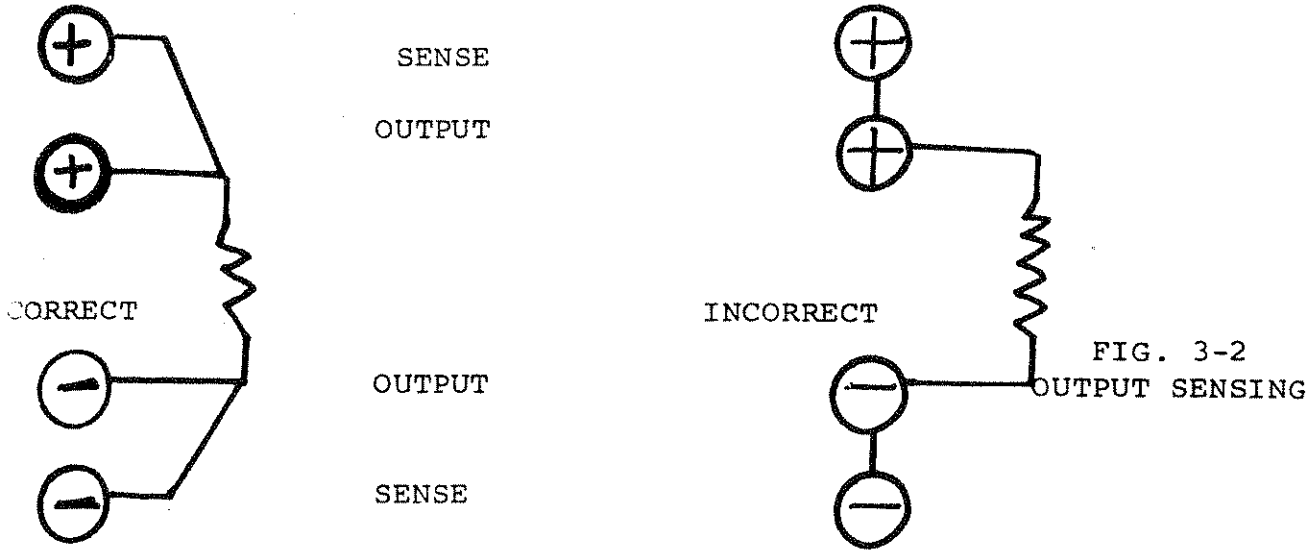


FIG. 3-2
OUTPUT SENSING

3.2.5 With polarity switch on "0" position, place power on switch to the "On" posistion. This procedure will prevent any possible turn on transient from appearing accross the output terminals.

3.2.6 Select the desired output voltage on the decade switches, set range switch to appropriate range, and switch the polarity switch to required polarity.

SECTION IV

4.0.0 THEORY OF OPERATION

4.1.0 The Basic Circuitry for Electronic Development Corporation's standards/sources are similar. The Basic circuitry is:

1. Power supply
2. Internal Precision reference
3. Chopper stabilized amplifier
4. Feedback circuitry
5. Output selector

4.2.0 Electronic chopper stabilization is utilized to automatically compensate for the DC drift of aging components and to provide stability of the output. The effects of warm-up drift are virtually none existant, and are confined to those components outside the feedback loop. Drift due to thermal gradients and self heating is minimized.

4.2.1 The Chopper stabilized amplifier utilized in EDC equipment is the synchronous amplitude modulated carrier type. The input signal to the main amplifier from the error point is fed into a modulator or switch. This modulates the voltage, converting it to a square wave which is AC coupled to the AC amplifier where it is amplified. The modulated output is AC coupled to the demodulator where it is filtered to a correcting DC voltage and fed to the plus or non-inverting input of the main amplifier.

4.2.2 The basic amplifier has a very high open-loop gain in order to maintain the high accuracy.

THEORY OF OPERATION OF THE CHOPPER STABILIZED CURRENT AMPLIFIER

Part B, the chopper stabilized current amplifier is a conventional single ended power DC amplifier with a 100 Volt output swing and having 110 ma output capability. The theory pertaining to DC amplifiers previously described in the voltage reference section, applies also to the "Current Amplifier" of the instrument; the major difference being that the reference input voltage to the current amplifier is the selectable output of the voltage reference amplifier. This voltage is impressed across a precision input resistor connected to the summing point of the current amplifier. The terminals of the current amplifier, are the open circuit feed back points on amplifier #2.

This current amplifier output will support compliance voltages of approximately 100 VDC.

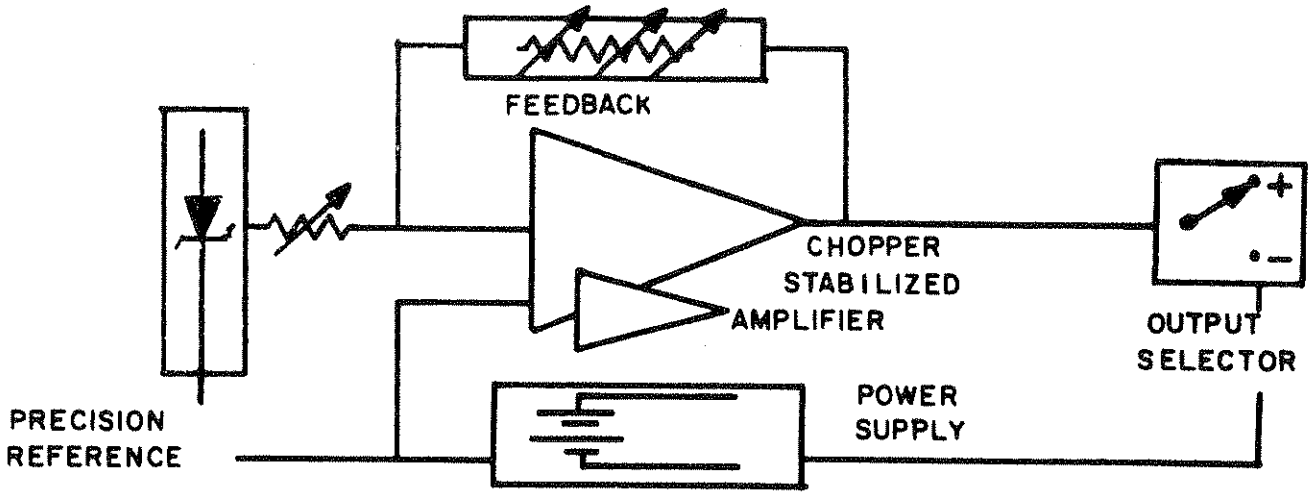


FIG. 4-1 BASIC CIRCUITRY

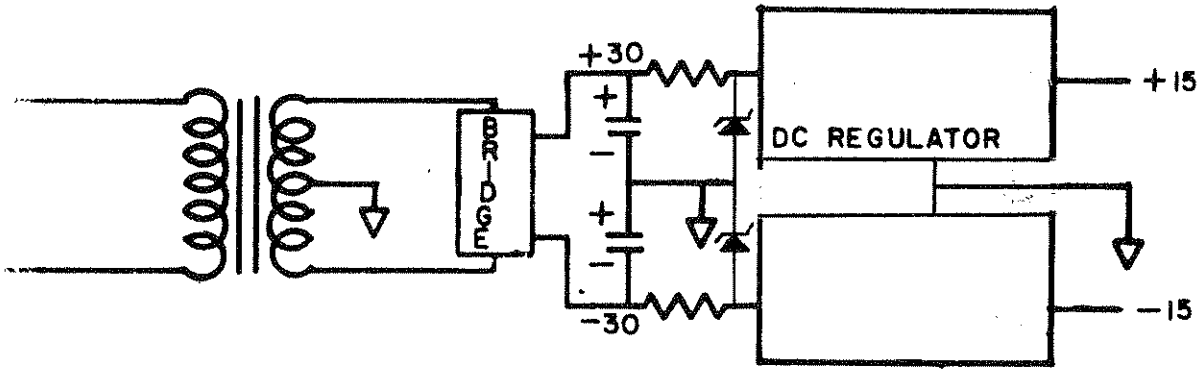


FIG. 4-2 POWER SUPPLY SIMPLIFIED

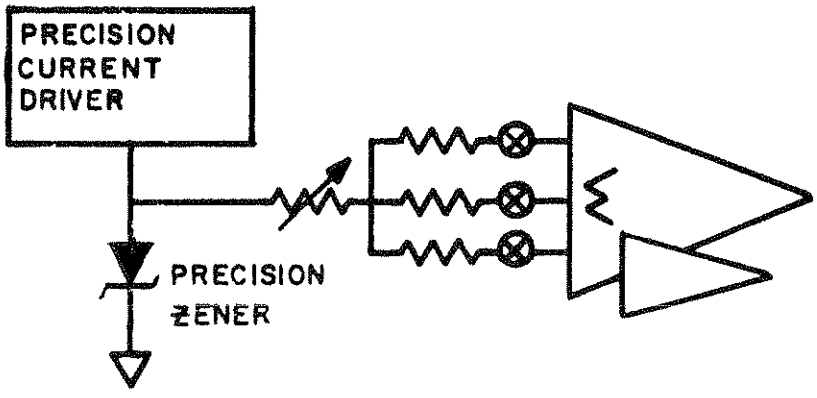
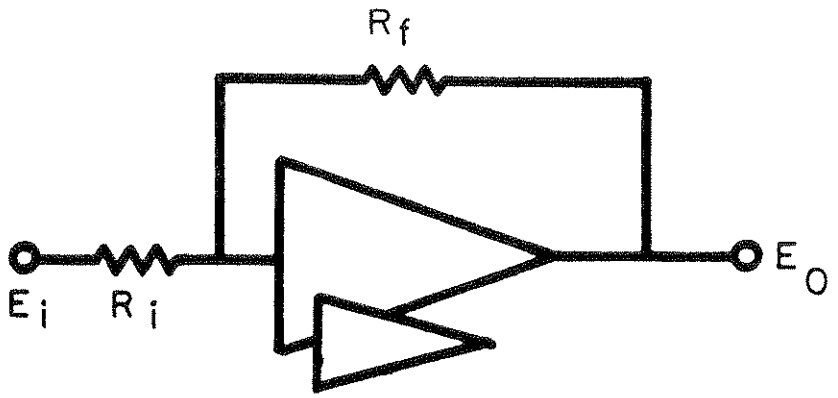


FIG. 4-3 PRECISION REFERENCE



4.3.0 Brief Mathematical Model of the Operation of a Voltage Reference Source:

4.3.1
An operational amplifier using negative feedback tries to drive the summing or error point to ground potential. This is useful in that the current flow into the error point through the (R_f) feedback string is equal to the current (IR_i) flowing through the input resistance (R_i), e.g. if $R_f = 6.3K\Omega$ then:

$$E_o = -E_i \frac{R_f}{R_i} = -6.3V \times \frac{6.3K}{6.3K} = -6.3V(1) = -6.3V$$

4.3.2
It is interesting to note that R_f times the input current (IR_i) is the same output voltage therefore:

$$E_o = -IR_iR_f = -1 \text{ max } 10K\Omega = -10V$$

CHOPPER STABILIZED AMPLIFIER

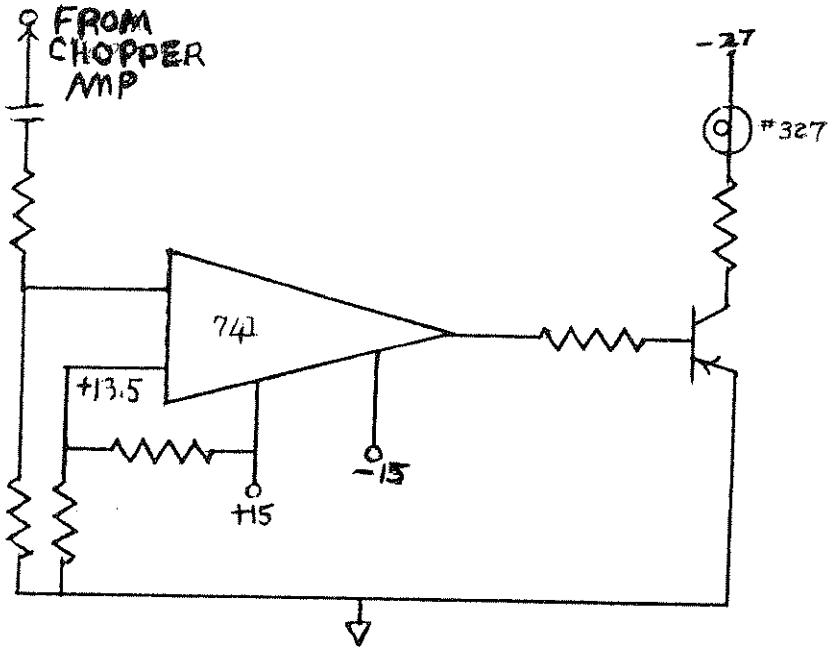


FIG. 4-7 OVERLOAD INDICATOR

4.4.0 Overload protection is provided by a current limiting resistor in the output stage. In the event of an overload or short circuit, the chopper amplifier is saturated and the excess voltage is stored in the demodulator filter capacitor until the condition is corrected. The recovery from this condition after removing the overload or short is a function of the discharge of this circuit.

4.5.0 Overload Indicator Light, basically, shows the condition of the output of the chopper circuit. Any or all of the following conditions can cause the indicator to light.

1) Chopper amplifier is correcting output voltage
2) Low Line Voltage
3) Load is drawing more than rated current
4) Short circuit
5) Sense loops not complete

SECTION V

5.0.0 MAINTENANCE

5.1.0 PREVENTIVE MAINTENANCE

5.1.1 The decade and polarity (rotary) switches are lubricated at the factory. We recommend that these switches are NOT serviced during the first year.

NOTE: Over-zealous, arbitrary, or unnecessary cleaning may damage the switches.

CLEANING: DO NOT ARBITRARILY CLEAN THE SWITCHES

5.1.2 In many instances, lubrication may be all that is required.

RELUBRICATE AFTER CLEANING!

THE USE OF A CLEANER WITHOUT LUBRICATING WILL SHORTEN THE LIFE OF THE SWITCHES TO ABOUT TWO MONTHS.

LUBRICATING - DO NOT USE OIL

5.2.0 NOISE MEASUREMENTS

5.2.1 EDC uses the following procedure to measure the noise levels on the voltage calibrators. Techniques are employed to minimize external ground loops and radiation paths which may introduce improper data into the desired measurements.

5.2.2 "RULE OF THUMB": If the measurement indicates more than 1 millivolt p.p. of noise on <u>any</u> EDC instrument, the operator should recheck his equipment and lash-up.

5.2.3 Because noise may appear in many forms, EDC recommends the use of an oscilloscope to make the noise measurements.

5.2.4 A high gain 50 μV/CM or better, <u>differential</u> pre-amp is well suited for this application.

5.2.5 In an environment with excessive EMI levels, these tests should be performed in a screen room. A comparison test in the normal environment will permit calibration for radiated noise pick-up on the test measurements.

5.2.6 The noise test should not be made simultaneously with regulation and voltage accuracy test. The "pump back" currents from some measuring devices will seriously disturb noise measurements.

5.2.7 Differential input measurements are the most reliable. They will cancel out common mode, due to slight errors in lash-up.

5.2.8 The scope and the EDC Calibrator under test should be connected to adjacent power outlets on the same phase. A three wire ground is required. In the event the line does not have a ground, the scope and unit under test should have a separate, heavy wire chassis-to-chassis connection separate from the shield of the differential input leads.

5.2.9 The lead used between the scope input and the source output should be a shield, twisted pair with the shield connected to the frame of the scope, and, to the ground lug adjacent to the output terminals of the EDC source.

5.2.10 <u>Do not</u> use the shield of the input cable as the chassis-to-chassis connection in place of line system ground. Use additional separate heavy wire.

5.2.11 If the EDC instrument has remote sensing, be sure that the "output" and "sense" terminals are bussed.

TIP 48	MJE 340K	SAGER	TR112	1	
MC 7815CT		SAGER	TR122	2	
MC 7915CT		SAGER	TR123	2	
2N2905A	MOTOROLA	AVNET	TR131	1	
2N 5086	FC	ARROW	TR132	1	
2N 5088	FC	ARROW	TR133	1	
DTS 710	SDTS	GREEN	TR142	1	
MJE 3740	TIP 32A	SAGER	TR148	1	
CAP 68PF	DM15	GERBE	CP114	1	
CAP 100PF	DM15	GERBE	CP115	1	
CAP 1000PF	DM15	GERBE	CP124	2	
.01 /400	4PS-S10	SAGER	CP131	4	
.01 /3KV	Z5U.01M	SAGER	CP132	1	
.1 /35V	ETP1	KITCH	CP141	2	
.1 /100	MKC 1860	KITCH	CP142	2	
.1 /400	MKC 1860	KITCH	CP143	2	
.1 1000	10PS-P10	SAGER	CP144	1	
.22 /400	MKT1813	KITCH	CP146	1	
1 / 35V	ETP1 TANT	KITCH	CP213	2	
1 /100V	MKC 1860	KITCH	CP214	3	
5/450V	500D	SAGER	CP222	1	
6.8/35V	NDF68K35S	SAGER	CP223	5	
90/450V	TVLU1555	SAGER	CP230	2	
100/63V	EB40 ERO	KITCH	CP231	1	
470/40V	EB ERO	KITCH	CP232	7	
IN825	REF DT1061	COMPD	DI112	2	
IN914B	HS DIODE	ARROW	DI113	13	1
IN4005	500V RECT	ARROW	DI114	3	
IN5335B	3.9V SEMI	GREEN	DI119	1	
IN4741	11V	ARROW	DI121	1	
IN5359B	24V SEMI	ARROW	DI127	4	
MDA202	B442-20 200V	EDALI	DI131	1	

ITEM			CODE	QTY
342004L	FUSE POST	SAGER	OD116	1
102071	FUSE CLIP	SAGER	OD119	2
40008-10	14" BAIL	BUCKE	OD125	1
FUSE 2/10 AMP	3AG	SAGER	OD132	1
FUSE 1 AMP	MDL	SAGER	OD135	1
68WR20	BECKMAN	MARSH	PT110	1
68WR200	BECKMAN	MARSH	PT112	2
68WR 1K	BECKMAN	MARSH	PT114	1
68WR50K	BECKMAN	MARSH	PT117	2
68XR 20	BECKMAN	MARSH	PT120	11
SA1 .2 30PPM 2.0 %		TEL	PR110	6
SA1 2 30PPM .25%		TEL	PR112	6
SA1 20 15PPM .02%		TEL	PR116	6
SA1 200 5PPM .005%		TEL	PR120	6
500 - 900 TRIM .10%		TEL	PR124	1
SA1 770 5PPM .10%		TEL	PR128	1
SA1 990 5PPM .10%		TEL	PR129	1
SA2 1000 5PPM .01%		TEL	PR130	1
SA2 2000 5PPM .005%		TEL	PR132	6
SA2 10K 5PPM .01%		TEL	PR142	2
SA2 19990 5PPM .02%		TEL	PR143	6
SA2 24400 5PPM .02%		TEL	PR146	1
SA2 100K 5PPM .01%		TEL	PR220	1
A3550 3 OHM DIVIDER		TEL	PR224	1
IC 741	FC TI	ARROW	IC112	2
10 OHM 3W		VC3E SAGER	PW112	1
15 OHM 3W		VC3D SAGER	PW113	2
100 OHM 3W		VC3D SAGER	PW116	2
30 OHM 5W		VC5E SAGER	PW121	1
100 OHM 50W 850F100		SAGER	PW132	4

ITEM		CODE	QTY
C 2967-6	BASIC CHS METAL	CH111	1
5250 17-1100 C3008	BUCKE	CH121	1
C2789-1 CR103	RAW BUCKE	PN129	0
C2790-A CR103	FIN APPLD	PN130	1
C3009-2	BASIC RAW BUCKE	PN310	1
A2933A CR103	MYDEM	XF110	1
P2654	RANGE SW CIRCS	PC110	1
P3560	MSD BD AUTOC	PC115	1
P2648K	CR'S 330 AUTOC	PC116	1
P3579 BASIC BD -/+	AUTOC	PC216	1
BP30BC BLK TERMINAL	SAGER	CT134	3
BP30RC RED TERMINAL	SAGER	CT135	3
208 SMITH GND TERM	SAGER	CT138	1
P10018 GRY PWR CORD	PACER	CT139	1
RB67-1-BM	PTR ROGAN	KN110	2
RB67-2A-CSK-10M BLK	ROGAN	KN112	6
A2983 5-17132623F1X	OAK	SW110	6
A2989 4-25653898FX	OAK	SW111	1
A3150 5-24332631F1X	OAK	SW113	1
A3382 5-41182611 CR	OAK	SW115	1
399039FC INDEX 1-2	IMPAC	SW120	1
SC2CK-P1-9295 PWR	SAGER	SW138	1
46206LFR 115/230 SL	SAGER	SW142	1
387-LONG LIFE 28V	SAGER	LT110	1
101-8430-0933-201	SAGER	LT111	1
54-BA-5-CAO PCLEADS	VALUE	LT131	3
B3563 103 HEAT	METAL	HS112	1
PA1-1CB HEAT SINK	STERL	HS114	2
LAT03B4B TO3 LARGE	STERL	HS115	1
Z33J AMP 4225 B	ANALO	AM110	1
1703 AMP 700723 D	TELED	AM115	1

VOLTAGE MODE CALIBRATION

STEP	RANGE SETTING	DECADE SETTING	TEST POINT	SET ADJ	MEASURED VOLTAGE	REMARKS
1	1 V	All zeros	Ref	R1	Voltage on tag	Normal factory adj. +200 μV
2A	1V	All zeros	Between Black output terminals	R2A	1 mV	remove sense link
2	1 V	All zeros	output terminals	R2	"0" +15 μV	Output zero adj. Check zero on 100 mV and 10 V range
3	10 V	"10" on 2nd decade	output terminals (Voltage)	R3	1 V	Course adj.
4	10 V	"2" on MSD	" "	R7	2 V	MSD Calibration
5	10 V	"1" on MSD	" "	R8	1 V	" "
6	10 V	"4" on MSD	" "	R9	4 V	" "
7	10 V	"6" on MSD	" "	R10	6 V	" "
8	10 V	"8" on MSD	" "	R11	8 V	" "
9	10 V	"10" on MSD	" "	R12	10 V	" "
9A	10 V	"10" on MSD	" "	R5	10 V	Fine 10 V range adj.
10	1 V	"10" on MSD	" "	R4	1 V	Fine 1 V range adj.
11	100 mV	" "	" "	R6	100 mV	Fine 100 mV range adj.

CURRENT MODE CALIBRATION

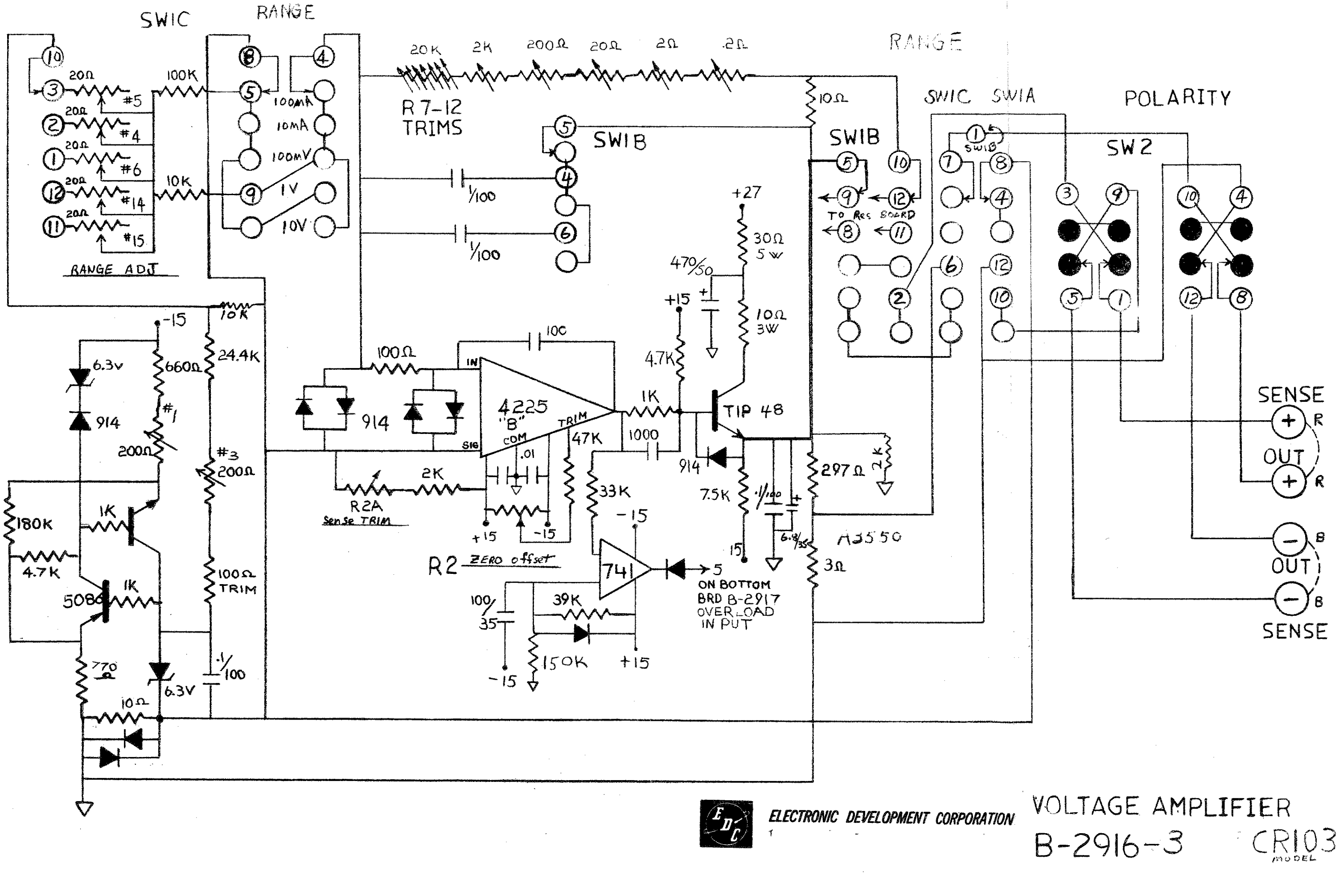
Set output selector to zero, connect precision load resistor to current terminals. Connect digital to load, at the resistor.

STEP	RANGE SETTING	DECADE SETTING	TEST POINT	SET ADJ	TEST VALUE	REMARKS
12	100 mA	All zeros	Load terminals current	R13	Minimum voltage	output zero adj. check zero on 10 mA range
13	100 mA	"10" on	" "	R14	10 V	100 mA range adj.
14	10 mA	" "	" "	R15	1 V	10 mA range adj.

NOTE:

All current adjustments are made by Precision Calculations of the voltage, measured across a 100 ohm precision resistor of the necessary wattage and accuracy.

This Resistor can be assembled from 10 of 1000 Ω .005% in parallel and immersed oil for heat sink. Precaution must be exercised so that self heating in the resistors does not occur, causing the absolute value of Resistor to change. Should a resistor of doubtful value be used at this point in the set up and checking, the resulting output may be observed as drift.

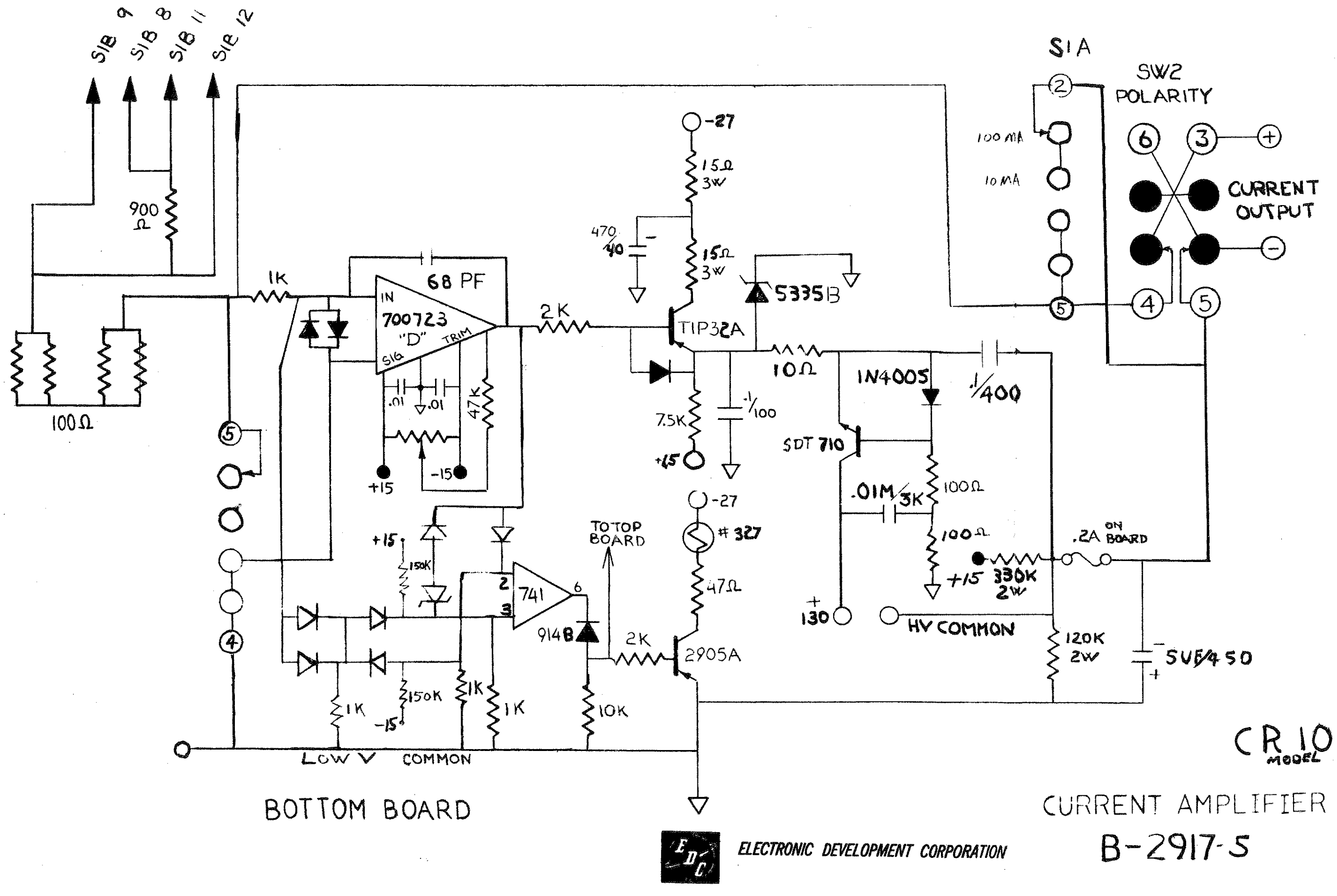


ELECTRONIC DEVELOPMENT CORPORATION

VOLTAGE AMPLIFIER

B-2916-3 CR103 MODEL

10-10-83



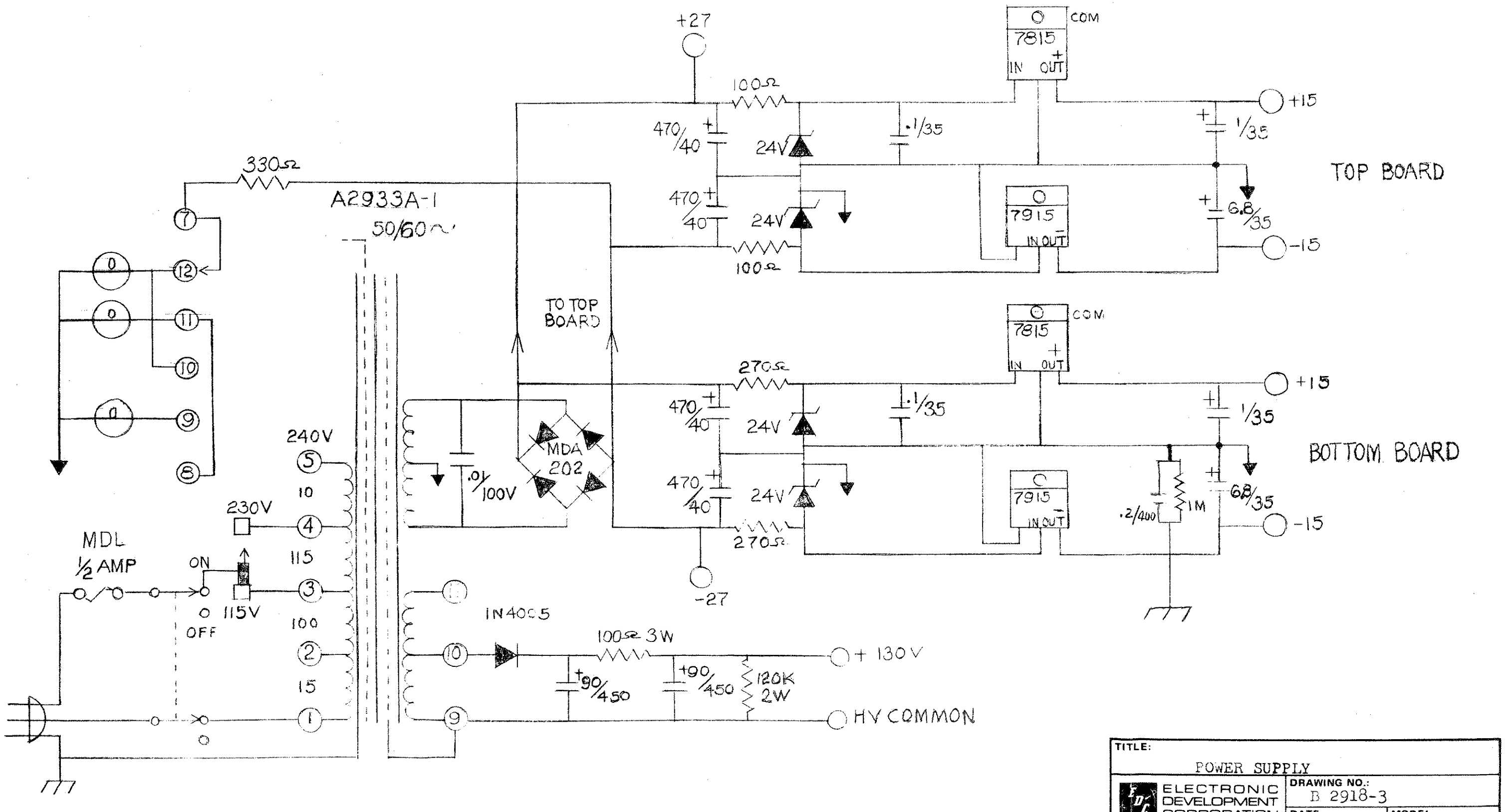
BOTTOM BOARD

CR 103 MODEL

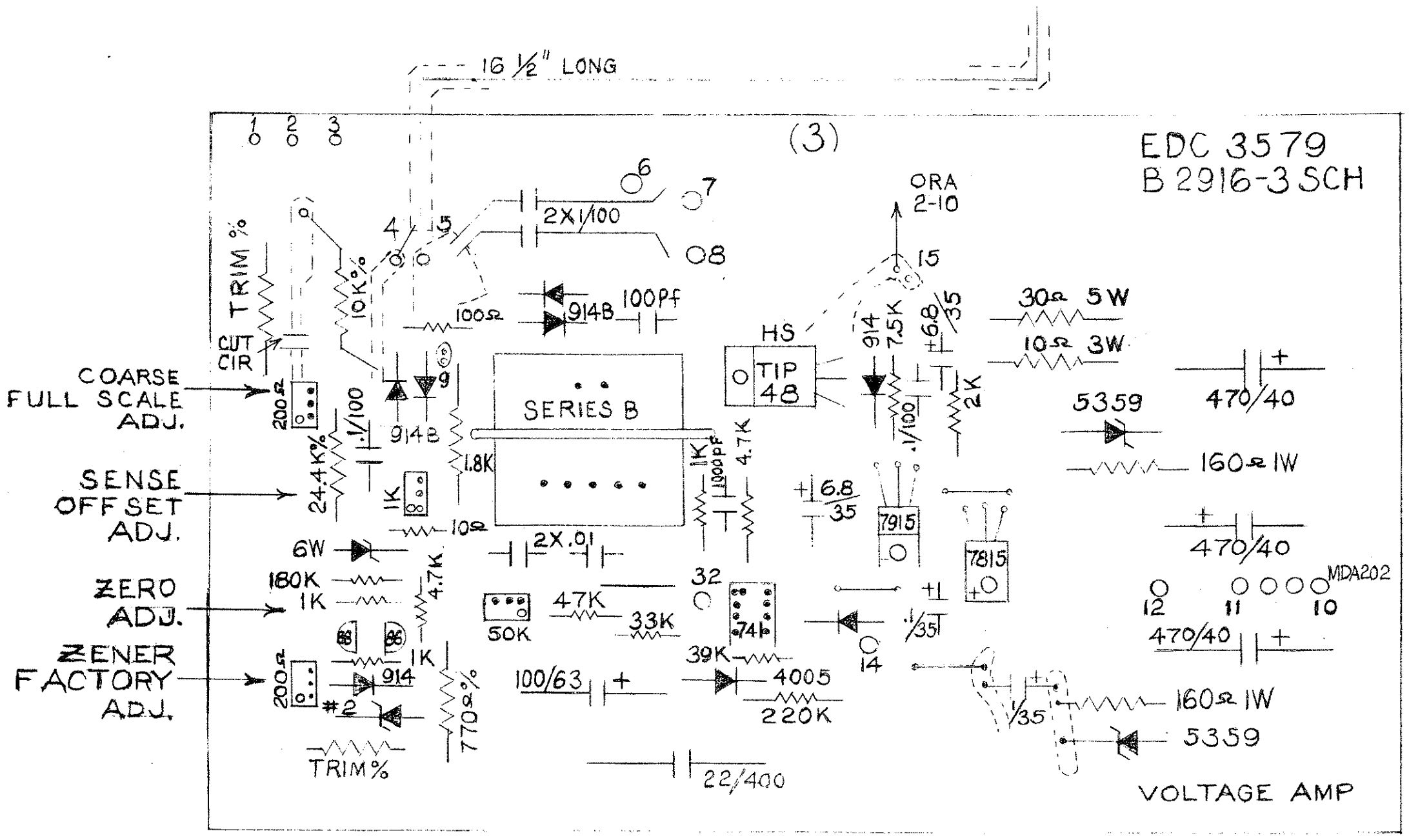
CURRENT AMPLIFIER

B-2917-5

ELECTRONIC DEVELOPMENT CORPORATION



TITLE: POWER SUPPLY	
ELECTRONIC DEVELOPMENT CORPORATION	DRAWING NO.: B 2918-3
	DATE:
	MODEL: CR-103



TITLE: TOP BOARD		
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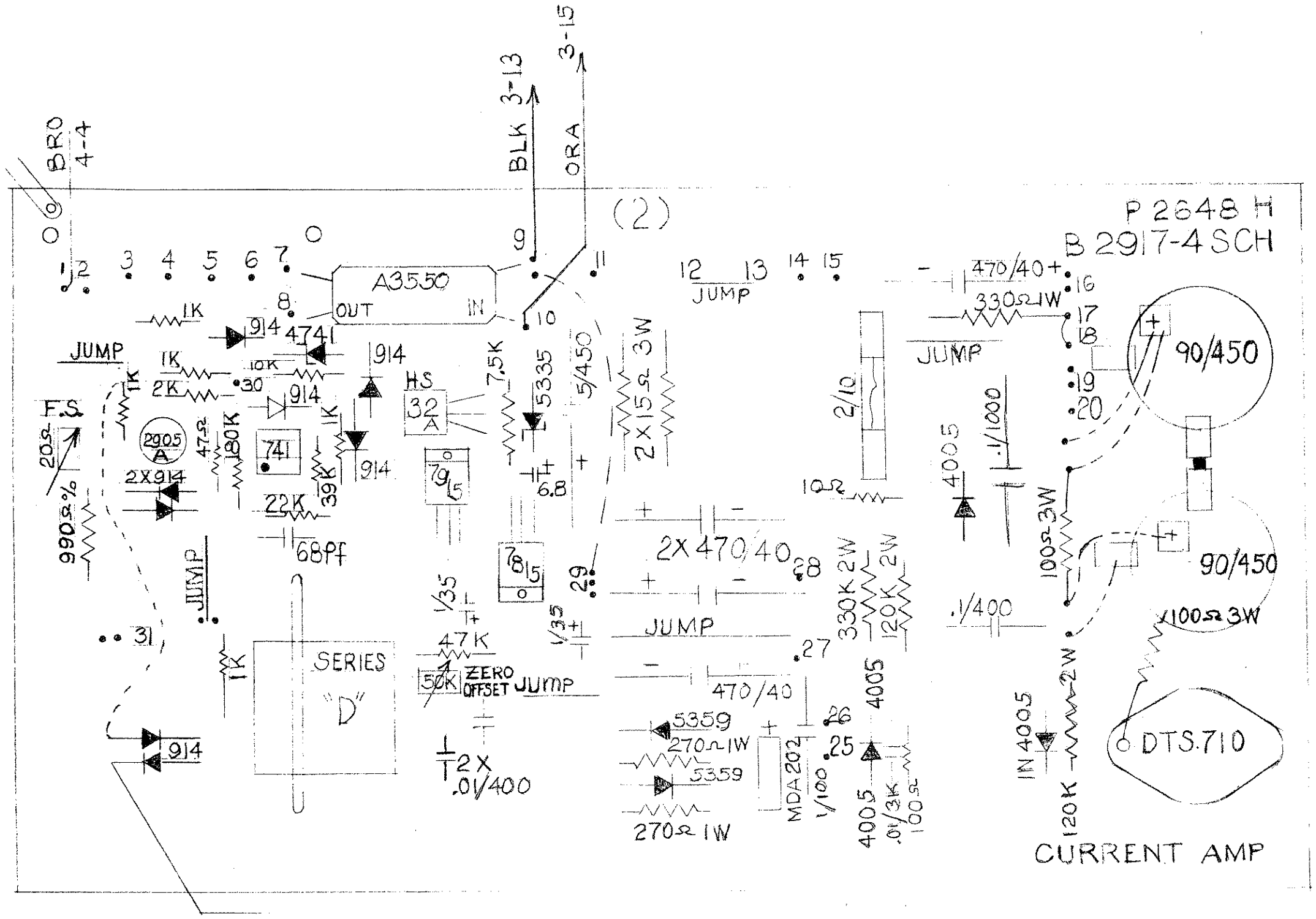

TITLE: BOTTOM BOARD		
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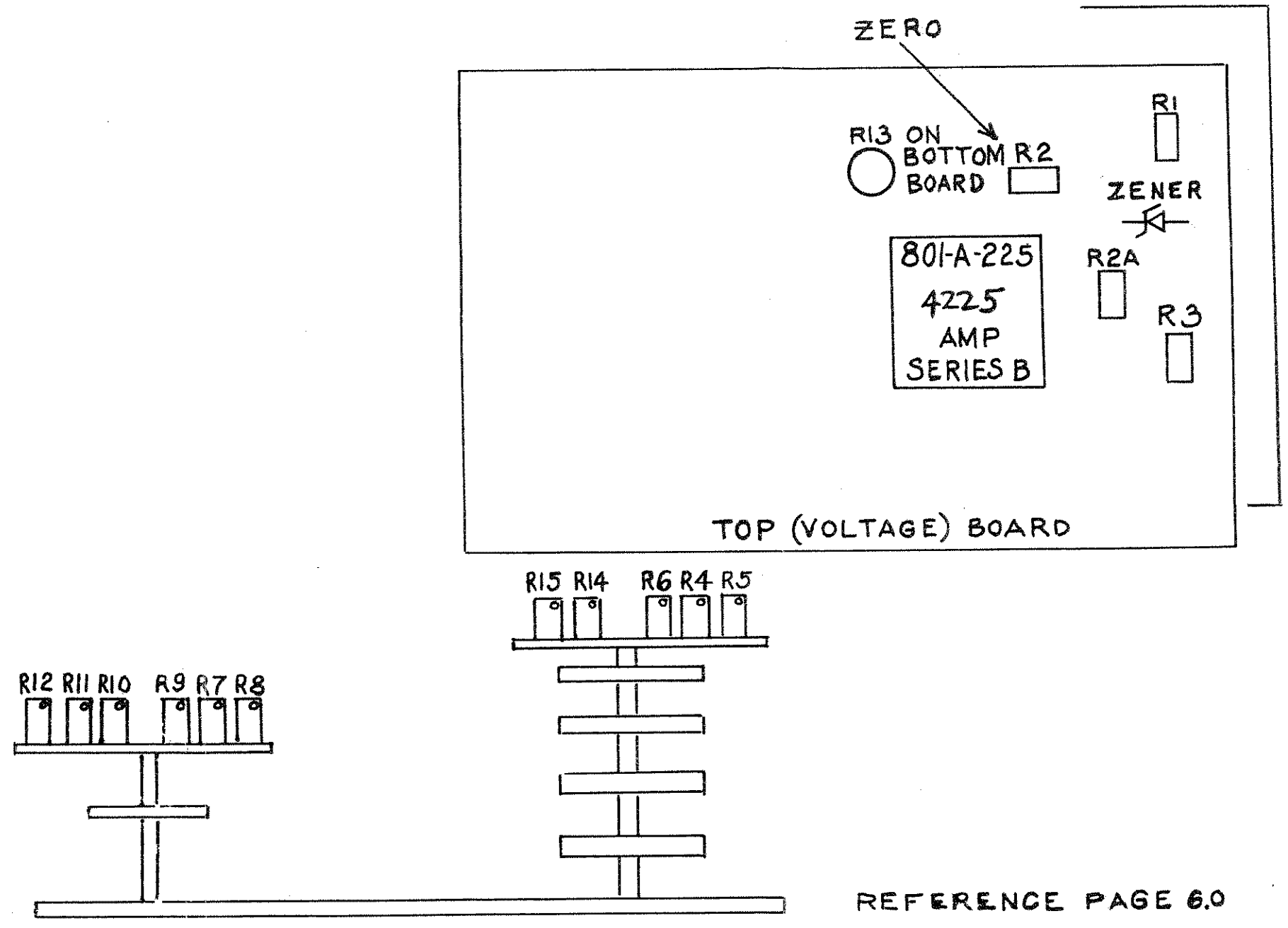

REFERENCE PAGE 6.0

TITLE: CALIBRATION ADJUSTMENTS		
ELECTRONIC DEVELOPMENT CORPORATION	DRAWING NO.: B3820	
	DATE: 4-15-79	MODEL: CR 103

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