

ELECTRONIC DEVELOPMENT CORPORATION

**INSTRUCTION AND MAINTENANCE
MANUAL**

PRECISION STANDARD

Model 2902 Serial # 6437

1977

ELECTRONIC DEVELOPMENT CORPORATION

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SECTION I

1.1.0 GENERAL DESCRIPTION

1.1.1 The Model 2901 is a versatile combination of a DC differential voltmeter, a multi-range DC voltmeter, 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 Meter and Calibrator controls are obtained through front panel push button and decade switches.

No trims of adjustments required between Calibration Cycles. Two adjustment settings are made at final calibration and are fully described under calibration procedure.

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.

1.2.0 APPLICATIONS

1.2.1 One of the major applications of the instrument as a DC calibrator is a system reference for electronic analog computers, digital converters, strain gages, and other peripheral equipment. Telemetry, data acquisition, control, and test facilities or electronic data handling systems using analog voltage inputs, either throughout or in part, will find the calibrator useful as a standard for systems calibration and checkout.

Other applications include the use of the instrument as a sophisticated ultrastable power supply providing an excellent source of bias current for operational amplifier and networks, semiconductor parameter tests, as well as for other experimental and breadboard circuitry.

Industrial checkout of power supplies, sensors, recorders, scopes, as well as analog, differential and digital voltmeters using the instrument as a DC voltage reference are other primary applications.

Colleges, universities and commercial research laboratories use the instrument in their physics and chemistry laboratories as a constant voltage source in calorimetric electrolytic and other applications.

1.2.2 The electronic meter system of the Model 2902 series includes two external measure modes:

- 1) TVM (transistor voltmeter) mode for measuring absolute voltages on a wide angle readout scale.
- 2) GALVO (differential Voltmeter) mode for accurately measuring an analog voltage differentially by nulling potentiometrically against the internal reference calibrator.

The full-scale sensitivities of both meter modes are the same ranging from 100μ Vdc and 10 00 Vdc. This makes the instrument valuable for precision measurements of high as well as extremely low voltages in production, quality control, and standard laboratories. The model 2902 series has found particular use in many applications common to manufacturing preliminary tests. This includes the check-out of transistors, transducers, operational amplifiers, the temperature cycling of zener diodes (and other semiconductors) as well as the balancing of differential amplifiers, calibration of logarithmic amplifiers, and the checking of static amplifier characteristics.

1.3.0. GENERAL SPECIFICATIONS

LINE REGULATIONS: .0005% for 10% line change

POWER REQUIREMENT: 115 VAC 50-400 Hz Change tap for
Approx. 20 watts/ 230V AC

STABILITY:

1 hr.	10ppm
8 hrs	20
1 month	40
6 months	50ppm

TEMPERATURE:

Calibration Temperature	23°C + 1°C
Ambient Operating Temp.	20°C - 30°C (68°F to 86°F)
Operating Limit	-10°C - 40°C (14°F to 104°F)
Storage Temperature	-40°C - 70°C (-40°F to 158°F)

ISOLATION: The output terminals may be floated 500 Vdc and the primary isolation is 1500 Vac RMS

OUTPUT TERMINALS: Floating output with case ground terminal.

REMOTE SENSING: 2 additional terminals are provided for sensing the IR drop across the connecting leads. Local Sensing is attained by a front panel links that connects the buss between the "output" and "remote" terminals.

POLARITY SWITCHING: plus (+), zero (0), minus (-).
(3 positions) The input and output terminals (floating) can be reversed with respect to each other.

The zero (0) setting of the polarity switch short circuits the output and open-circuits the input terminals. In effect this is a "standby" control as well as a positive "zero". In this position the Galvo may be used as a TVM

ELECTRICAL SPECIFICATIONS

Accuracy:	Line at nominal and with Sense at load or Links closed at terminals.	
a) CALIBRATION ACCURACY:	23°C ± 1°C at 70% RH	
100 V range:	±(0.002% of setting + 0.0005% of range)	
10 V range:	±(0.002% of setting + 0.0005% of range)	
1 V range:	±(0.002% of setting + 0.0005% of range)	
100mV range:	±(0.005% of setting + 3µV)	
b) LIMIT OF ERROR ACCURACY:	±(0.003% of setting + 0.001% of range)	
OUTPUT RANGES:	f.s.	Resolution
	100 V	100µV
	10V	10µV
	1V	1µV
	100mV	.1µV
OUTPUT CURRENT:	up to 100mA with remote sensing.	
OUTPUT IMPEDANCES:	Ranges	Output Impedance
	100 V @ 50mA	30 milliohms
	10 V @ 100mA	30 milliohms
	1 V @ 100mA	30 milliohms
	100mV	20 ohms
LOAD REGULATION:	± 0.0005% + 25 µV Not applicable on 100 mV range.	
NOISE & RIPPLE:	less than 100 µV <u>RMS</u> on all ranges in a band pass of 0.8 Hz to 100 kHz.	
WARM UP TIME:	30 seconds for calibrator. 1 hour for Calibration	
CIRCUIT CONDITION INDICATOR:	Front panel indication of short-circuit overload, overrange, low-line voltage or malfunction.	

DIFFERENTIAL VOLT METER MODE

ACCURACIES (2 methods)

a) CALIBRATION ACCURACIES

1000V range: $\pm(0.002\%$ of input $+0.0015\%$ of range). $+ 15\mu\text{V}$
100V range; $\pm(0.002\%$ of input $+0.0015\%$ of range)
10V range: $\pm(0.002\%$ of input $+0.001\%$ of range)
1V range: $\pm(0.002\%$ of input $+0.001\%$ of range.)

The Calibration accuracies are at Standard Reference Conditions at time of calibration. Nominal calibration temperature $(23^{\circ}\text{C} \pm 1^{\circ}\text{C})$ at 70% relative humidity, Nominal line voltage 117 Vac at constant external load.

b) LIMIT OF ERROR ACCURACY: $\pm(0.003\%$ of input $+ 0.001\%$ of range)

The Limit of error Accuracy includes peripheral, additive specifications (ie. Error for line and load changes, ambient operating temperature changes and stability). Calibration cycle; 6 months.

INPUT VOLTAGE RANGES: 0 to ± 1100 Vdc on five (5) ranges. The Decade resolution is 1ppm plus differential meter resolution.

f.s. Range	Decade Switch Resolution (1ppm)
1000 Vdc	1mV
100 Vdc	100 μ V
10 Vdc	10 μ V
1 Vdc	1 μ V
.1 Vdc	.1 μ V
VM SENSITIVITY:	9 full scale levels; 10 μ V, 100 μ V, 1mV, 10mV, 100mV, 1V, 10V, 1000V

METER RESOLUTION: ± 50 parts + 20% overrange

INPUT IMPEDANCE

1000V range: 1 megohm at null; 1 megohm off null
100V range: 1 megohm at null; 1 megohm off null
10V range: True Galvo
1V range: True Galvo
.1V range : True Galvo

SECTION II

2.0.0 INSTALLATION

2.1.1 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 14" back of the panel. It weights 14 pounds. A standard 3 prong polarized plug and power cable is attached, and the unit is ready for use.

POWER REQUIREMENT = 20 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 terminal is positive with respect to the black terminal. On "-" the red output terminal is negative with respect to the black terminal. On "0" a short circuit exists between the red and black output terminals.

3.1.3 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.

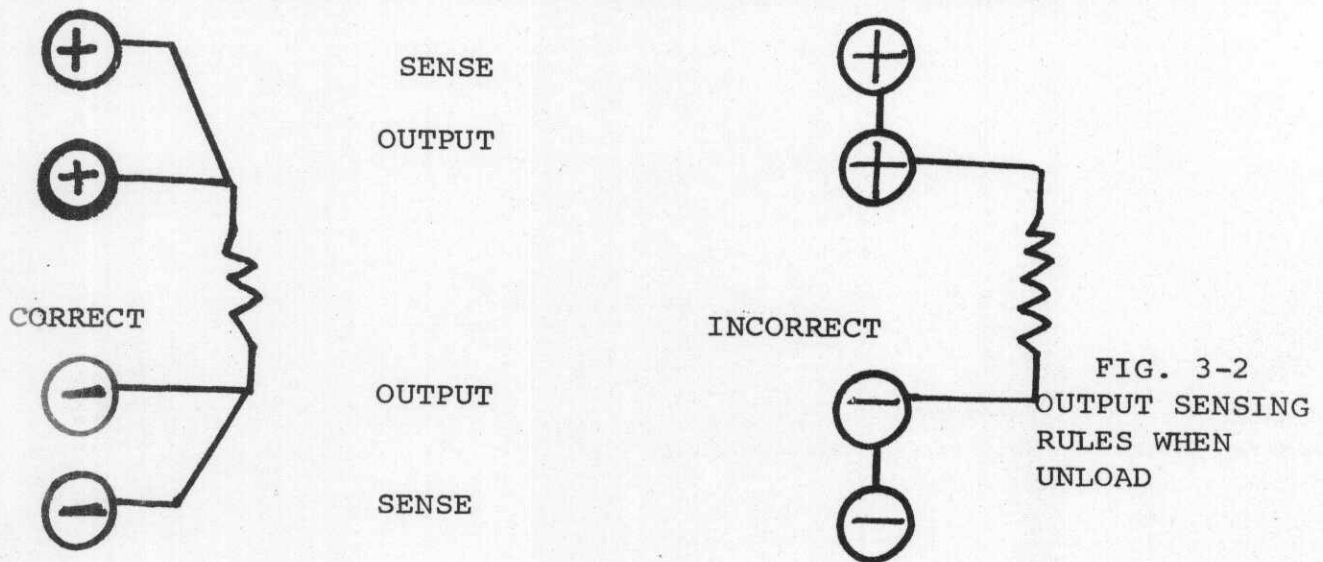
3.1.4 Decade Switches: The decade switches are used to select the desired output, and each switch is labeled with the multiple of the decimal it controls. Maximum settings of range are indicated by illuminated pushbutton lights, the decimal lights facilitate the reading of resolution.

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 from line common. This practice is not recommended.



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

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RANGE SWITCH:

A five (5) position rotary switch that selects four (4) output ranges and one (1) measurement only range. When the 1000V measure Range is selected the output terminals are disconnected from the internal output stages and the unit may be used only in 1000V measure mode; using the Galvo input terminals.

Galvo Sensitivity Switch:

A ten (10) position rotary switch that selects nine (9) levels of sensitivity ranges for Galvanometer measurements. The lowest level of measurement in the 10V, 1V, 100MV ranges are 10 μ V full scale enabling resolution of reading to less than 500 nanovolts. The 1000V and 100V ranges limit full scale sensitivity to 100 μ V and 1 MV Respectfully.

In the "off" position the unit is returned to the "source" mode of operation. Source and Galvo operation of the 2902 may not be used simultaneously.

Zero-Use Switch:

This permits zeroing of the Galvo. The Galvo may be checked for zero at any time during, before and after a measurement.

Zero:

This is a potentiometer adjustment which "zeroes" the Galvo,

OPERATION OF GALVANOMETER

WHEN USING GALVO SENSE LINKS MUST BE IN

A. General

1. The high impedance Galvanometer Circuit installed in the 2902 enables the user to make differential and/or single ended measurements of voltage of less than 10 microvolts to 1100 volts.
2. In the differential mode the output of the voltage source is used to "buck" out the unknown voltage.
3. In the T V M or single measurement mode, the voltage source output decades must be set to Zero, or the output polarity switch must be set at Zero.
4. Input voltages above 100V are divided, and voltages on these ranges "look into" a fixed 1 megohm resistor. All other ranges are true galvo.

B. Mode Operation:

1. Balance of Galvo.

The Galvo may be balanced at any time during the measurement without removing the input voltage. The sensitivity need not be changed even at the 1000V level. The zero sensitivity will always be greater than the sensitivity set by the control.

2. Initial Zero Adjustment
 - a. Use Zero switch to zero position
 - b. SENSITIVITY switch off
 - c. Apply primary power to instrument
 - d. Check mechanical zero of meter
 - e. Adjusting the zero adj as required, increase sensitivity until the 10^μ V position is reached.

OPERATION OF GALVANOMETER

- Note: 1. This sets up the initial zero. Zero can be checked at any time by repeating steps "a" and "f".
2. The maximum sensitivity of the 100v and 1000v ranges are 100 microvolts and 1 millivolt respectively.

3. Voltage Measurement

A. Differential

1. Perform steps in paragraph 2
2. With polarity switch in zero select appropriate range and sensitivity. (if voltage is unknown select highest range).
3. Apply unknown voltage to input terminals.
4. With polarity switch in zero note meter deflection. If the meter deflects to the left set polarity switch to "+", if right then to "-".
5. Increase MSD until meter comes within one division of null, increase sensitivity one step repeat dial adjustment as before. Continue to adjust voltage and increase sensitivity until a null is achieved at the highest sensitivity available for the range.

Note: The range switch must not be set for a lower range than the actual input voltage.

B. TVM Measurement

1. Zero Galvo as in paragraph 2.
2. Select appropriate range, highest range if voltage is unknown.
3. Set Galvo sensitivity to the same range as "range" switch.
4. Set polarity to zero.
5. Read voltage direct.

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.

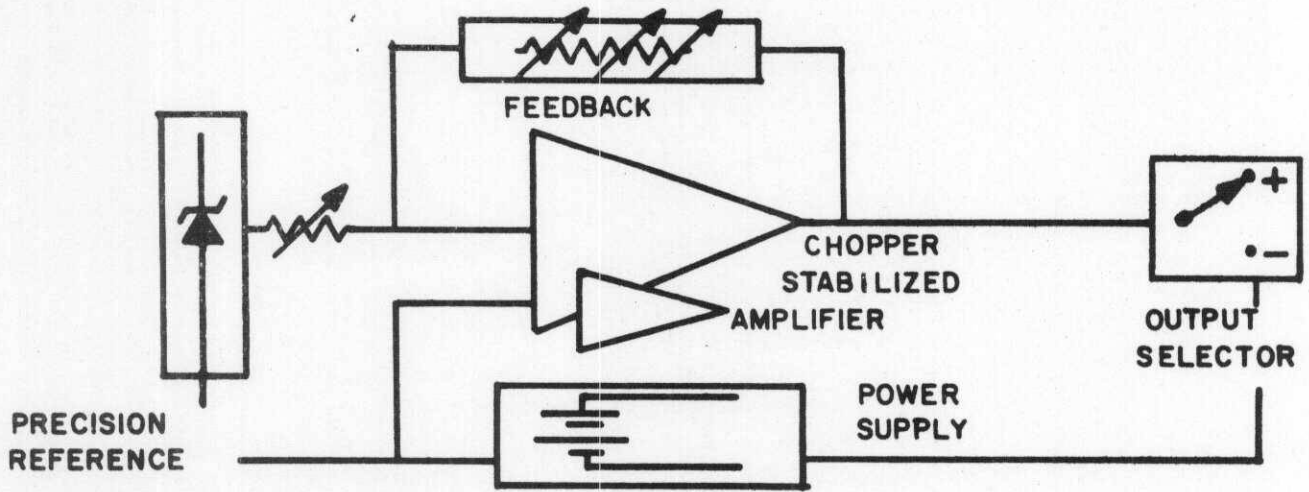


FIG. 4-1 BASIC CIRCUITRY

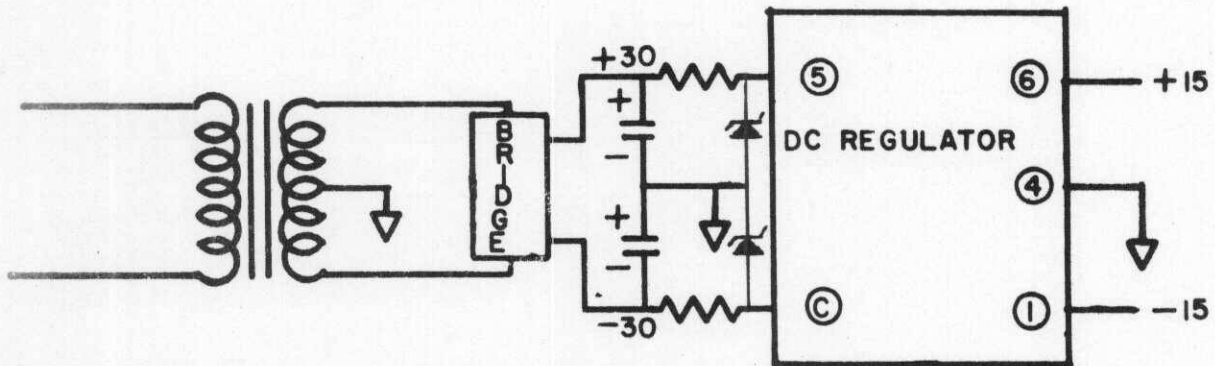


FIG. 4-2 POWER SUPPLY SIMPLIFIED

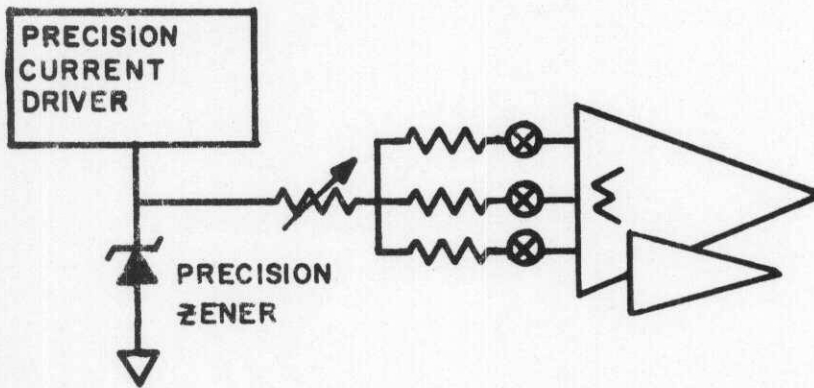
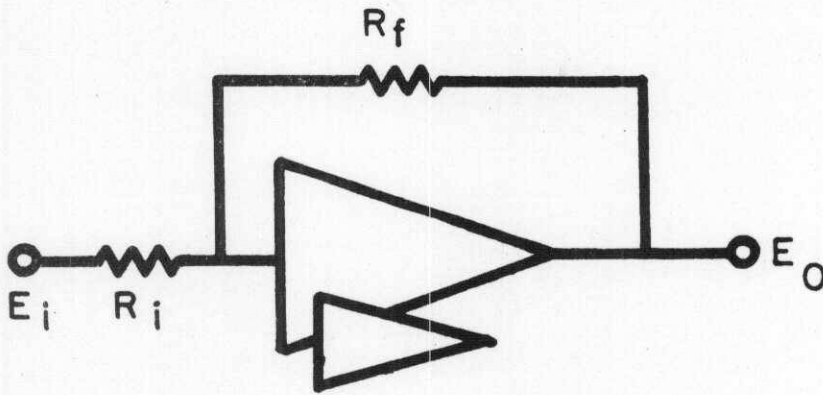


FIG. 4-3 PRECISION REFERENCE



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:

$$E_o = -IR_i R_f = -1 \text{ ma} \times 10K\Omega = -10V$$

CHOPPER STABILIZED AMP

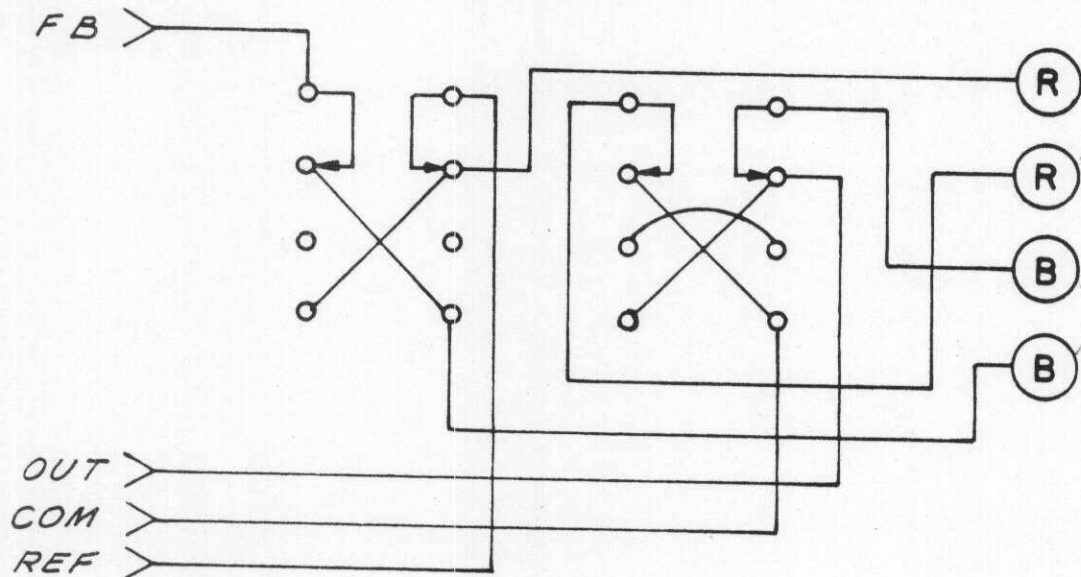


FIG. 4-5 OUTPUT SELECTOR

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

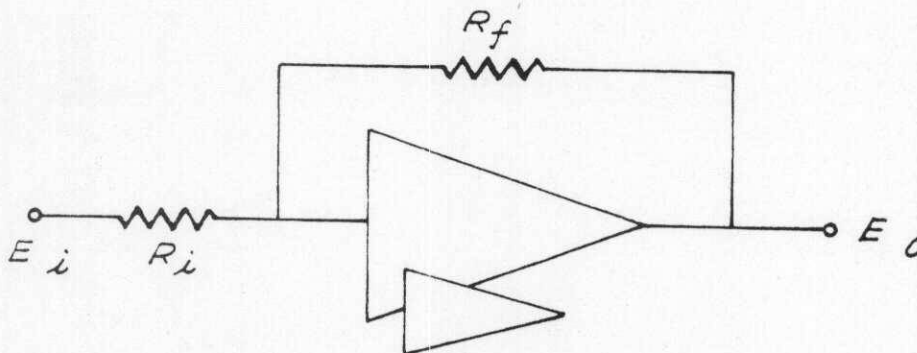


FIG. 4-6 OPERATIONAL AMPLIFIER

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:

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

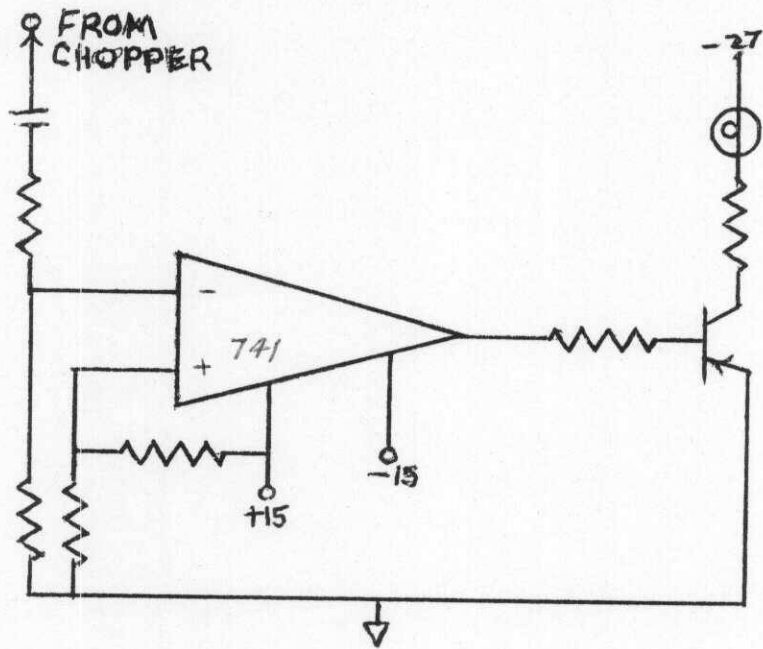


FIG. 4-7. OVERLOAD INDICATOR

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

MAINTENANCE

5.1.0 INTRODUCTION

5.1.1 In servicing the Model 2902 Series, it is recommended that malfunctions be treated in two categories - one producing gross errors, which can be isolated with general test equipment, will be covered in Section entitled "Troubleshooting". Correction of fine errors, requiring more specialized test equipment will be discussed in the Section entitled "Calibration". However, before any maintenance is attempted, the chapter on the "theory of Operation" should be read and thoroughly understood.

CAUTION

Care should be taken to prevent an internal short, while working on the unit, as this may cause the components to be damaged.

5.1.2 As the major circuits are all contained on printed circuit board modules, this section will discuss the isolation of any malfunctions to the Functional block diagrams.

NOTE: Dangerous high voltage is always present in the high voltage section.

5.2.0 DISASSEMBLY PRECEDURES

5.2.1 The cover can be removed to examine the Precision Voltage reference standard (calibrator). Remove the screws holding the top dust cover and lift the cover. This should suffice for physical inspection and electrical troubleshooting. If parts should have to be replaced, however, further disassembly may become necessary.

5.3.0 PREVENTIVE MAINTENANCE

5.3.1 Calibration: refer to calibration section for annual or semi-annual accuracy adjustment.

5.3.2 Switches: The only other type of preventive maintenance is the lubrication of the switches.

5.3.3 The decade and polarity (rotary) switches are lubricated at the factory. We recommended that these switches are not serviced during the first year.

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

The switch manufacturer claims a life of 50,000 revolutions which equals about 3 years (or 6000 Hrs.) average use.

The foregoing statement is intended as a guide and does not represent a direct or implied warranty of the switches beyond the stated instrument warranty.

5.3.4 CLEANING: DO NOT ARBITRARILY CLEAN THE SWITCHES .

In many instances, lubrication only may be all that is required. If a switch looks like it needs cleaning it is probably worn out and should be replaced if accuracy is to be maintained. BE CERTAIN TO RE-LUBRICATE AFTER CLEANING.

LUBRICATING: DO NOT USE OIL

Switch Contacts: Use: Rycon 2EP - Standard Oil of N.J. (Lubricant)
or: Beacon 325- Standard Oil of N.J. (Lubricant)
or: Oak 2008 - Oak Manufacturing (Lubricant)
or: May be ordered from Electronic Development
under EDC Part #2008.

Apply a small amount of one of the above products carefully to the switch contacts. Rotate switch several times to disperse the lubricant. DO NOT OVER LUBRICATE. DO NOT USE OIL. DO NOT ARBITRARILY CLEAN THE SWITCHES. In some instances, lubrication only may be all that is required.

SHAFT AND DETENTS: Use: Beacon 325 Standard Oil of N.J. (Lubricant). Apply sparingly at the recognised points of friction. Do not use ordinary grease. Oil and some greases have a tendency to migrate.

5.3.5 If soldering to the switch leads becomes necessary reasonable care must be used in the amount of heat applied. Excessive heat can significantly change the tension of the contacts and/or wiper and thus may change the contact resistance.

5.2.0 TROUBLE SHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
Output voltage not selectable, reads above full scale	Feedback string is open	check feedback string
No output at any setting, voltage very low, or lmv	Reference circuit malfunction	Examine reference circuit and repair as necessary
Low and unstable output voltage	+15 Volt supply overloaded	Check transistors in reference circuit and replace as necessary
Gross output error on low selected voltages	Output stage may be oscillating	Examine power stage and replace output transistor
Unit blows line fuse	component breakdown in power supply (regulator)	Examine power supply and repair as necessary (replace)
	Incorrect fuse installed	Install fuse of proper rating
Large AC signal observe from either output terminal to case	Interconnection of instruments are forming ground loops.	Examine connection and observe that the polarity of the ground buss connections is maintained to each of the instruments and cases are equal.

NOTE: When the malfunction is subtle, the overload light may not indicate an active chopper wave. A very low light or a low intensity flicker may indicate an oscillating unit, accompanied by an unstable output voltage.

SYMPTOM	PROBABLE CAUSE	REMEDY
Output exhibits gross, but selectable error	Defective 700352 amplifier 240	Replace amplifier
Output voltage constant regardless of setting	Output stage, driver, or amplifier stage malfunctioning	Examine output, at amplifier driver, stages and replace faulty component
Output voltage out of specification	Out of calibration	Recalibrate in accordance with the section on calibration.
Percentage error of part of range.	Defective resistor in feedback string	Locate defective resistor and replace
Poor Load regulation	Defect in output stage	Examine output and switch circuitry and replace faulty components.
	Incorrect use of sense terminals	Sense at load
On turn on: Output voltage rises to selected voltage the decays to zero voltage	Zener voltage = "0" or no input voltage at R_{in} or open R_{in} open Trim Pot	Check complete reference circuit, and repair measure R_{in} for approx. correct value Measure Trim Pot for correct value. Check for R as pot is adjusted
Voltage at "0" selected is larger than specs.	Zero trim pot has drifted, components have aged	adjust to "0" as described in calibration section.

TABLE MODEL 2902 CALIBRATION

Allow one hour of warm-up before attempting calibration. Refer to Fig. 5.2 for trimpot and zener reference location. MSD refers to most significant digit, 2SD refers to the second most significant digit, etc. See Galvo Calibration section for those adjustments for the Galvanometer.

STEP	RANGE SETTING	VOLTAGE SETTING	TEST POINT	ADJ	TEST VALUE	REMARKS
1.	1V	0	Reference Zener	R1	Voltage on tag	Zener adj.
2.	1V	0	Output terminals	R2	Minimal output	Zener offset adj.
3.	100V	10 on 2SD	Output Terminals	R3	10V	Set R4-R7 to mid-range before adjusting R3. R4 can be used as find adj.
4.	100V	10 on MSD	" "	R17		Rotate Galvo Sensitivity Switch between "off" and "100" position, adjust "R17" until the voltage seen on the "100V" position is one tenth the voltage seen on the "off" position, i.e., "off" =99.997; "100 V"=9.9997. Rotate between "off" and "100 V" several times as "R17" affects the voltage seen on both settings.
Adjustment of R4 in the "OFF" position may be made to adjust reading to 100V						
5.	100V	10 on 2nd		R4	10V	Galvo sensitivity "off"
6.	1000V	10 on 2nd MSD		R16	1V	
7)	10V	10 on 2SD	"	R5	1V	
8)	1 V	10 on 2SD	"	R6	100MV	
9)	100MV	10 on 2SD	"	R7	10MV	
10)	100V	2 on MSD	"	R10	20V	
11)	100V	1 on MSD	"	R15	10V	
12)	100V	4 on MSD	"	R11	40V	
13)	100V	6 on MSD	"	R12	60V	
14)	100V	8 on MSD	"	R13	80V	
15)	100V	10 on MSD	"	R14	100V	

GALVO CALIBRATION

A General

1. Calibration of the Galvo is done after the Voltage Source outputs have been calibrated. There are only two (2) adjustments necessary to complete the Galvo Calibration. These adjust the input divider for the 100V and 1000V ranges.
2. The Equipment Needed is:
 - a. 1000V DC Voltage Source , EDC Model 1030 .

B 1000V Input Divider

1. Check and adjust as necessary Galvo Zero
2. Set controls as for "1000V range, source" calibration
3. Apply 1000V to Galvo input terminals
4. Increase sensitivity towards maximum, (1mV) adjusting R 18 on Galvo Board for Null.

C 100V Input Divider

1. Check and adjust as necessary Galvo Zero
2. Set controls as for "100V range, source"
3. Set sensitivity switch to 100V
4. Apply 100V to Galvo input terminals
5. Increase sensitivity towards maximum, (100 μ Volts) adjusting R19 on Galvo Board for Null.

(2)

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GALVO CALIBRATION

D. 1000V input divider

1. Check and adjust as necessary "zero"
2. Set controls as for "1000V Range, Source" calibration
3. Apply 1000V to Galvo input terminals
4. Increase sensitivity towards maximum, (10MV) adjusting R 18 on Galvo Board for Null

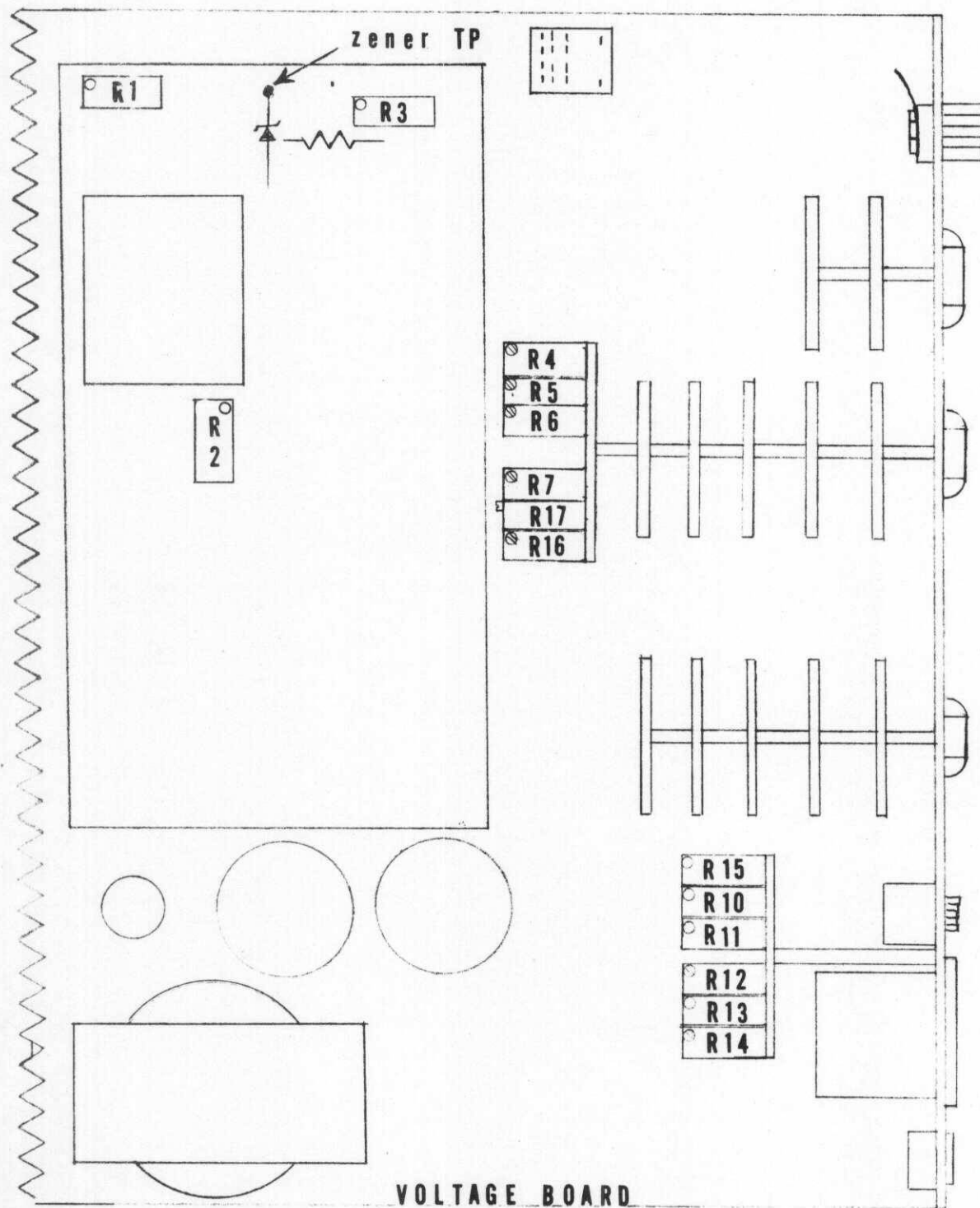
E. 100V Input Divider

1. Check and adjust as necessary "Zero"
2. Set controls as for "100V Range, source",
3. Set sensitivity switch to 100V
4. Apply 100V to Galvo input terminals
5. Increase sensitivity towards max (1 MV), adjusting R19 on Galvo Board for Null.

BASIS FOR EDC ACCURACY STATEMENT

VOLTAGE POINTS	1000V	100V	10V	1V
MODEL 1045AI POTENTIOMETER	0.2	0.2	0.2	2
MODEL 1045AI MULTIPLIER VOLTBOX	4	2	0	0
MODEL 1045AI WORKING VOLTAGE	2	2	2	2
MODEL 1045AI MEASUREMENT DETECTOR	0.2	0.2	0.2	0.2
MODEL 1045AI MONITOR DETECTOR	2	2	2	2
MODEL 1045AI STANDARD REFERENCE VOLTAGE DIVIDER	2	2	2	2
MODEL 1045AI THERMO ELECTRIC VOLTAGE	0.01	0.01	0.01	0.1
MODEL 1045AI END ERROR	0.01	0.01	0.01	0.1
MODEL 1045AI POWER COEFFICIENT	10.5	0.7	0.5	0.5
MODEL 1045AI SHORT TERM STABILITY	0.5	0.5	0.5	0.5
SATURATED CELL EPPLY MODEL	10.0	10.0	10.0	10.0
R.S.S. OF TOLERANCE CAL. ACCURACY IN PPM	15.4	10.8	10.6	11.5

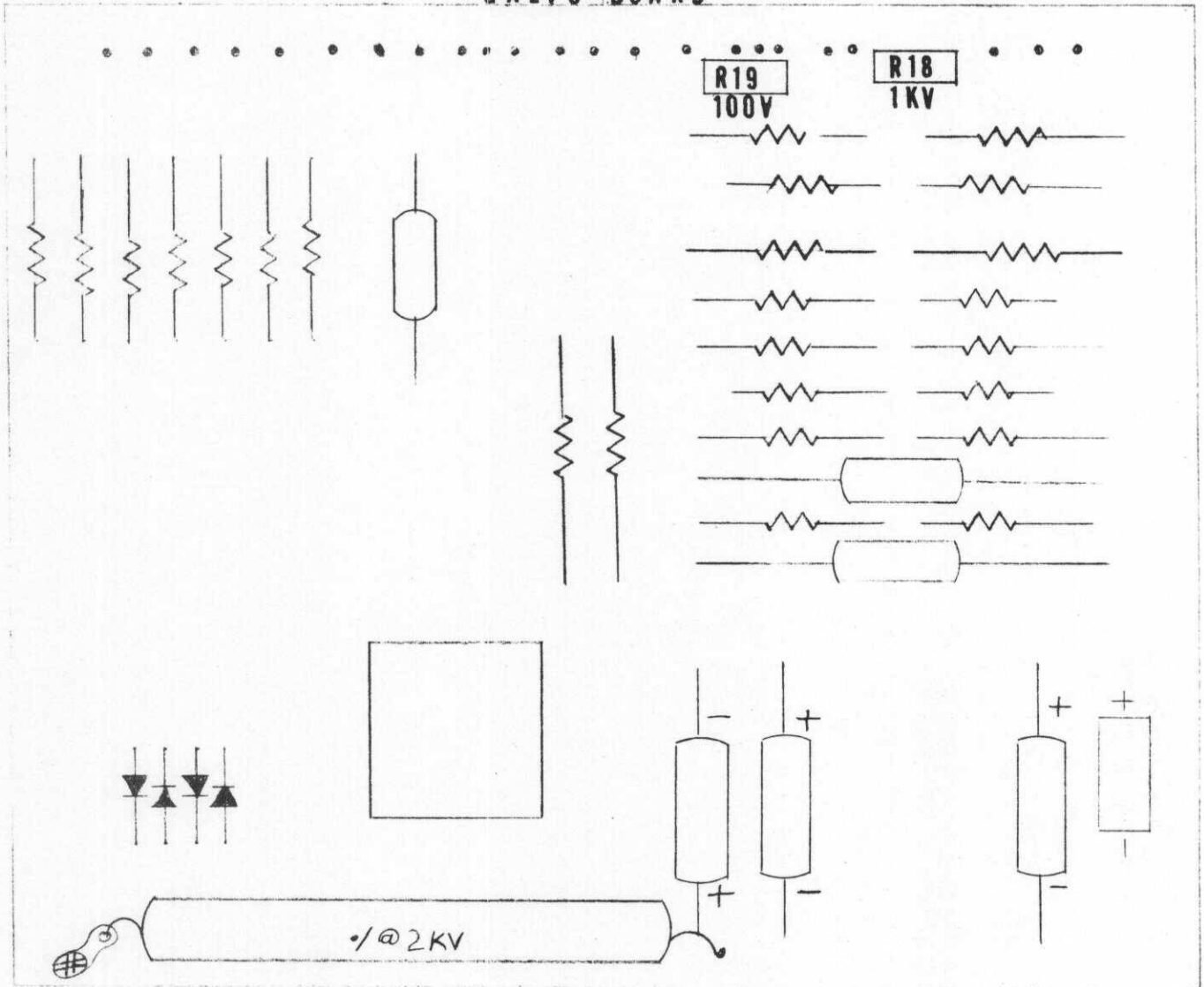
FIGURE 5-4



MODEL 2902 CALIBRATION ADJUSTMENTS

FIG. 6.2

GALVO BOARD



GALVO INPUT ADJUSTMENTS

FIG. 6.2A

MODEL 2902
PARTS LIST

<u>DESCRIPTION</u>	<u>MFG</u>	<u>PART NO</u>	<u>QTY</u>
Line Cord 18/3			1
Transformer	EDC	A - 2635	1
Power Switch	C. H.	SC2CKP192-92-95	1
Fuse Holder	LITTLE	357001	1
Fuse 1 1/2 MDL	LITTLE		1
Binding Post	SUPER	257-R	2
Binding Post	SUPER	257-B	2
Binding Post	H. SMITH	208	1
Decimal LT 650	GEN IL	10 HM 553	3
Range SW Index	CRL	PA 301	1
Range Deck Wafer	CRL	PA 11	1
Polarity SW	CRL	PA 2031	1
Overload Light	DRAKE	5131-038	1
SW Decade	OAK		6
PC Board SW Res	EDC	P 2654	1
Range Deck Wafer	CRL	PA 5	3
.2 Ω 5%	RCL	7010	6
2 Ω .25%	RCL	7010	6
20 Ω .02%	RCL	7010	6
200 Ω .005%	RCL/DAVEN	7010/1250	6
2000 Ω .005%	RCL/DAVEN	7010 /1250	6
19990 Ω .05%	RCL/DAVEN	7020/1195	6
100 ohm pot	BckMan	68XP100 ohm	2
20 Ω pot	BckMan	68XP20 ohm	9
Knobs 0-10	EDC		6
Pointers Knobs (blk)	ROGAN		3
MSD Resistor Module	EDC	A-2711	2
Capacitors 100/25V	SPRAG		2
Divider 100 -1	DAVEN	NR 1374 -1	1
Pot 500 Ω	BEKMN	68W500	1
Pot 200 Ω	BEKMN	68W200	2
Pot 500K ohm	BEKMN	68W500K	1
Amplifier (chopper)	EDC		1
100 K ohm .01% 5/20	DAVEN	1195	1
200 Ω .01% 10/60	RCL	7010	1
490 Ω .1% 10/60	RCL	7010	1
1 K .25% 5/20		7010	1
23.696K .01% 5/20	EDC	1195	1
81.818K .01% 5/20	EDC	1195	1

MODEL 2902
PARTS LIST

<u>DESCRIPTION</u>	<u>MFG</u>	<u>PARTS NO</u>	<u>QTY</u>
6.000K .01% 5/20	RCL/DAVEN	1250	1
10.000K .01% 5/20	RCL/DAVEN	1195	3
DIODE	MOT	MR818	1
DIODE IN 706	EDC		1
DIODE IN 3499	EDC		1
Regulator	Rayth	RC4194D	1
71.5K 1%	CORN	RN60C	1
37.5K 1%	CORN	RN60C	1
Transistor E3740	MOTOROLA		1
Transistor 2N5086	MOTOROLA		1
Transistor 2N5088	MOTOROLA		1
Transistor 2N2905A	MOTOROLA		1
DIODE IN 4005	TRANS		3
Amplifier	EDC	GALVO MODULE	1
Amplifier	EDC	741	1

