

DC VOLTAGE BRIDGE  
DATA

Bob Ross



**WILSON JONES**

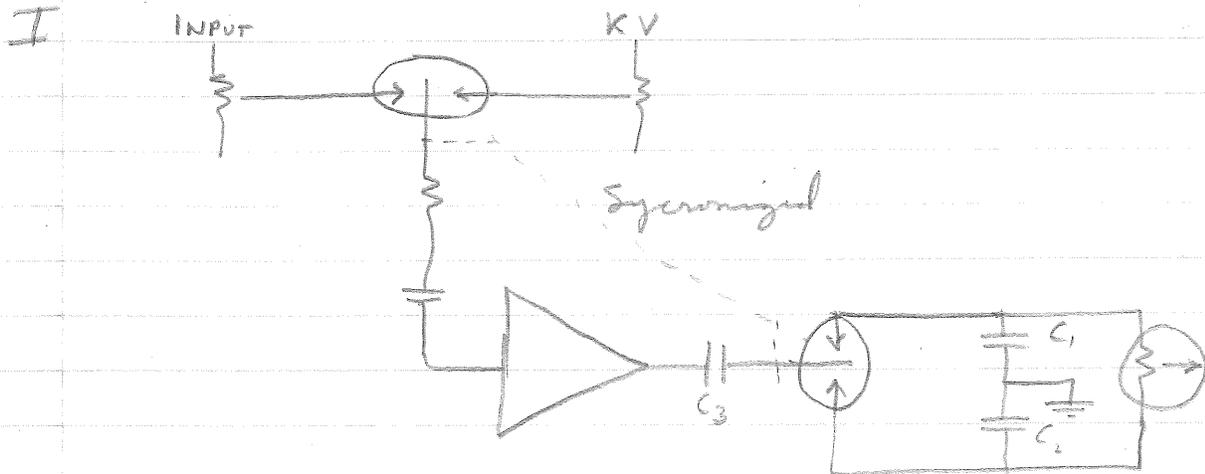
**REDI-COVER®**

**447-13B**

**GENUINE PRESSBOARD**

**MADE IN U. S. A.**

## Various Techniques for attaching meter to DCUB to observe null.



### Advantages

- (1) Signal from input & KV through same amplifier
- (2) effective infinite  $Z$  at input
- (3) Direction of unbalance indicated on meter.

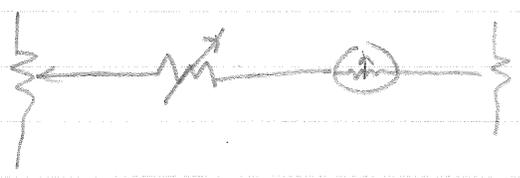
### Disadvantages

- (1)  $\omega$  choppers or equivalent
- (2)

### Problems

- (1)  $C_1, C_2$  large ( $\sim 1000\mu F$ ) in order to prevent discharge through small meter resistances ( $\sim 2k$ ) and therefore  $C_3$  must be large.

II



Advantages

- (1) Simplicity offsets cost of complex circuitry
- (2) Direction of imbalance indicated
- (3) Infinite  $Z$  at null
- (4) No choppers or power supplies

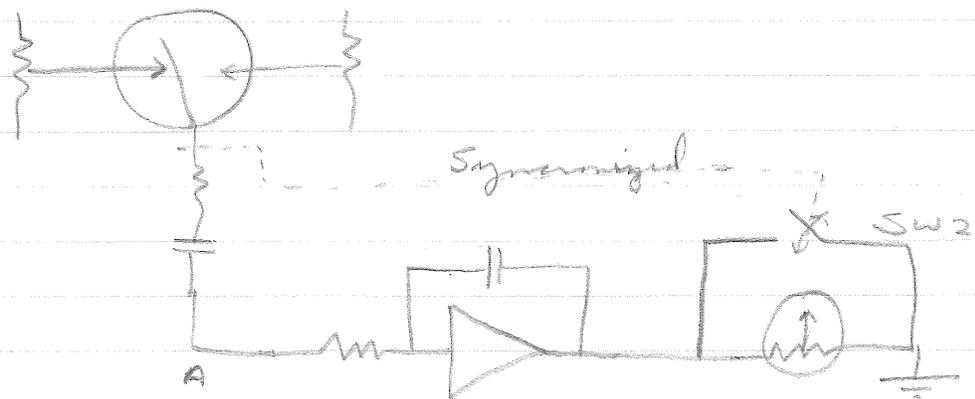
Disadvantages

- (1) Protection circuitry may be complicated and be source of error.

Problems

- (1) No compact, highly sensitive voltmeters found.

III



Theory

(1) When chopper swings to KV Voltage, output of integrator and meter is shorted setting A to proper level. When chopper swings to input attenuator, Voltage at A is changed and integrator output deflects null meter in proper direction.

Advantages

- (1) High effective gain with integrator
- (2) KV + Unknown Voltage through same Amplifier
- (3) SW2 could be transistor switch activated by 6.3V coil

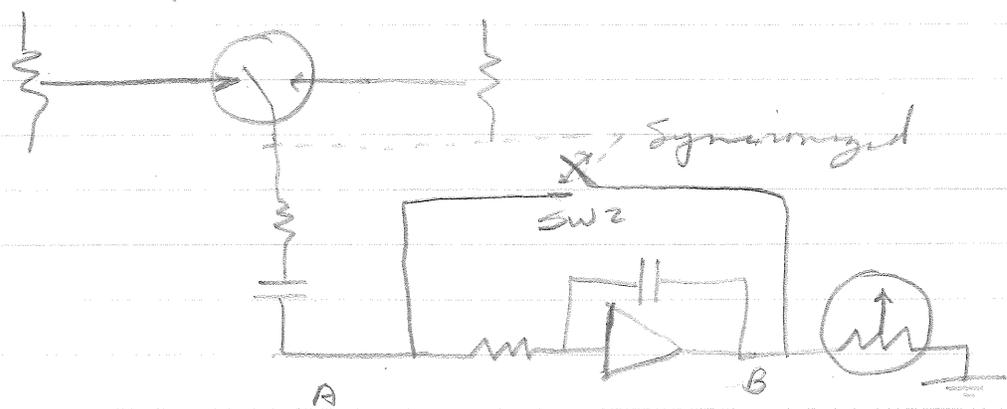
Disadvantages

- (1) 1 chopper, 1 read relay or equivalent
- (2)

Problems

- (1) Drift of Amplifier is a problem,
- (2) Impedance at A is low ?
- (3)

IV



Advantages

- (1) Negligible drift of meter
- (2) KV + Unknown Voltage through some Anglfuse.

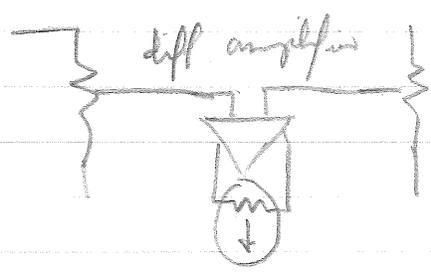
Disadvantages

- (1) SW 2 "floating"
- (2) 1 diode, 1 SW.2 required.

Problems

- (1) At null, output B is square wave instead of zero volts. Thus there is frequency dependence of null. Multis required.
- (2) Input Z at A is low due to Quisnt non zero levels.

I



Advantages

- (1) No chopper
- (2)

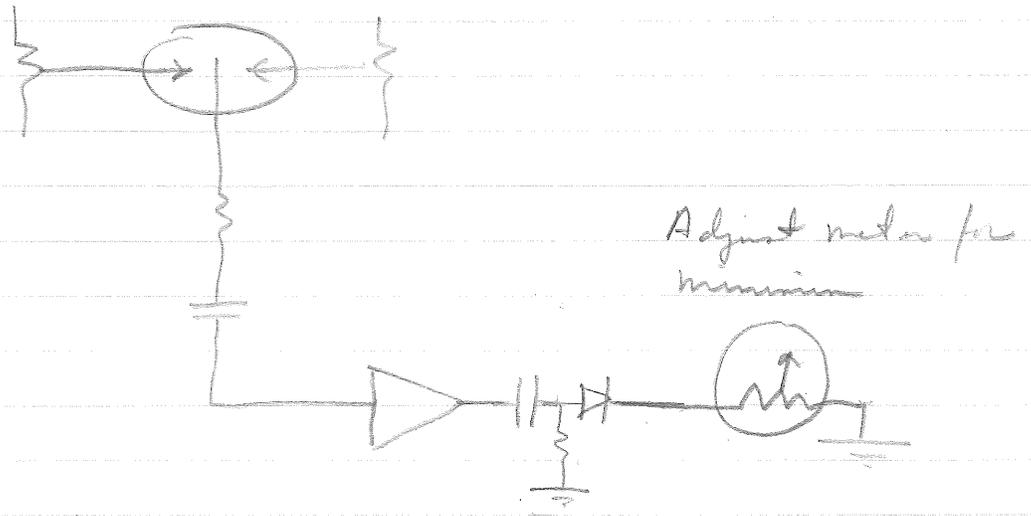
Disadvantages

- (1) Protection complicated
- (2) Probably need zero adjustment,
- (3)

Problems

- (1) Differential Amplifier Unbalance and drift critical because of high sensitivity of readings required.

VI



### Advantages

- (1) Simultaneous scope operation
- (2) Infinite  $Z$  at input at balance
- (3)  $kV$  + Input signal through same amplifier
- (4)

### Disadvantages

- (1) Direction of unbalance not indicated
- (2) Additional circuitry required if means for indicating direction of unbalance is required
- (3) Chopper required

### Problems

- (1) Chopper spikes may result in measured null different than actual null

## DC VOLTAGE BRIDGE

### Characteristics

1. Temperature Range for Stated Accuracy

15°C to 35°C (59°F to 95°F)

2. Line Voltage Range

105 to 125 vac

3. Measurement Accuracy

Voltage Range

Accuracy

0 to 1 v

± 1 mv

1 to 1100 v

± 0.1% of indicated voltage

High Voltage Input

1.1 to 4 kv

± % error = number of kv times ½

over 4 kv

± % error = number of kv minus 2

4. Input Resistance

Input Range

Input Resistance

11 v

≥ 100 megohms at null

110 v

≥ 1 megohm

1.1 kv

≥ 1 megohm

11 kv

≥ 100 megohms

## DC VOLTAGE BRIDGE

User Specifications:

### 3. Measurement Accuracy:

Input Voltage Range

Accuracy

0-1 volt

$\pm 1 \text{ mV}$

1-1100 volts

$\pm 0.1\%$  of indicated voltage

High Voltage Input:

1.1-4KV

% error ( $\pm$ ) = number of KV times  $\frac{1}{2}$

over 4KV

% error ( $\pm$ ) = number of KV minus 2

1. Temperature range for stated accuracy:

$15^{\circ}\text{C} - 35^{\circ}\text{C}$  ( $59^{\circ}\text{F} - 95^{\circ}\text{F}$ )

2. Line voltage range for stated accuracy:

105V - 125V

4. Input Resistance:

Input Range

Input Resistance

1V

$> 100 \text{ M}\Omega$  at null

110V

$1 \text{ M}\Omega$

1.1K

$1 \text{ M}\Omega$

11KV

$100 \text{ M}\Omega$

**RANGE**  
**POLARITY**  
 - OFF +  
 110V 1.1KV  
 (1MΩ) (1MΩ)

**INPUT VOLTAGE**  
 (SET FOR NULL)

11V  
 (R → ∞)

11 KV  
 (100 MΩ)

CAUTION

± HV INPUT

2385

CHOPPED  
 NULL SIGNAL

**DC VOLTAGE BRIDGE**

SERIAL

± INPUT

POWER  
 ON

NULL SIGNAL

OUTPUT

GND

RIPPLE CHECK



TEKTRONIX, INC., PORTLAND, OREGON, U.S.A.



PROOF.

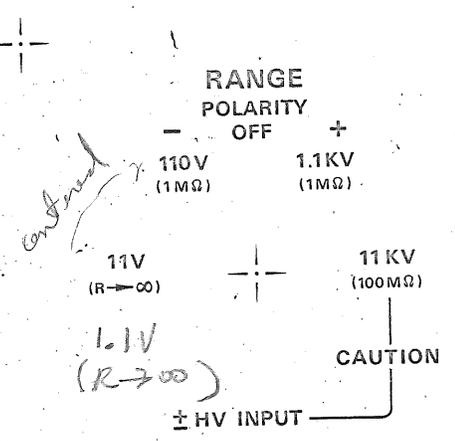
#2895

DC Voltage Bridge

14 brun.

6-1-65

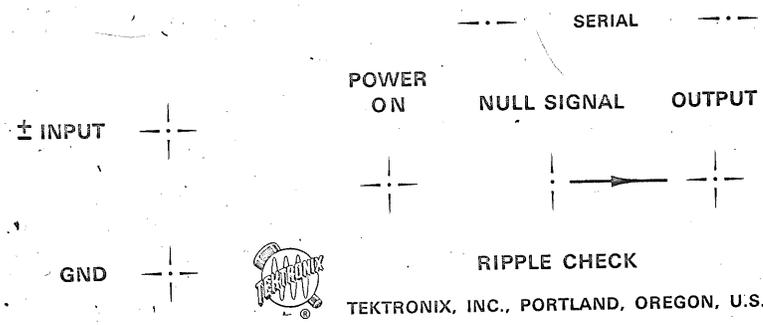
72008



INPUT VOLTAGE  
(SET FOR NULL)

3010

DC VOLTAGE BRIDGE

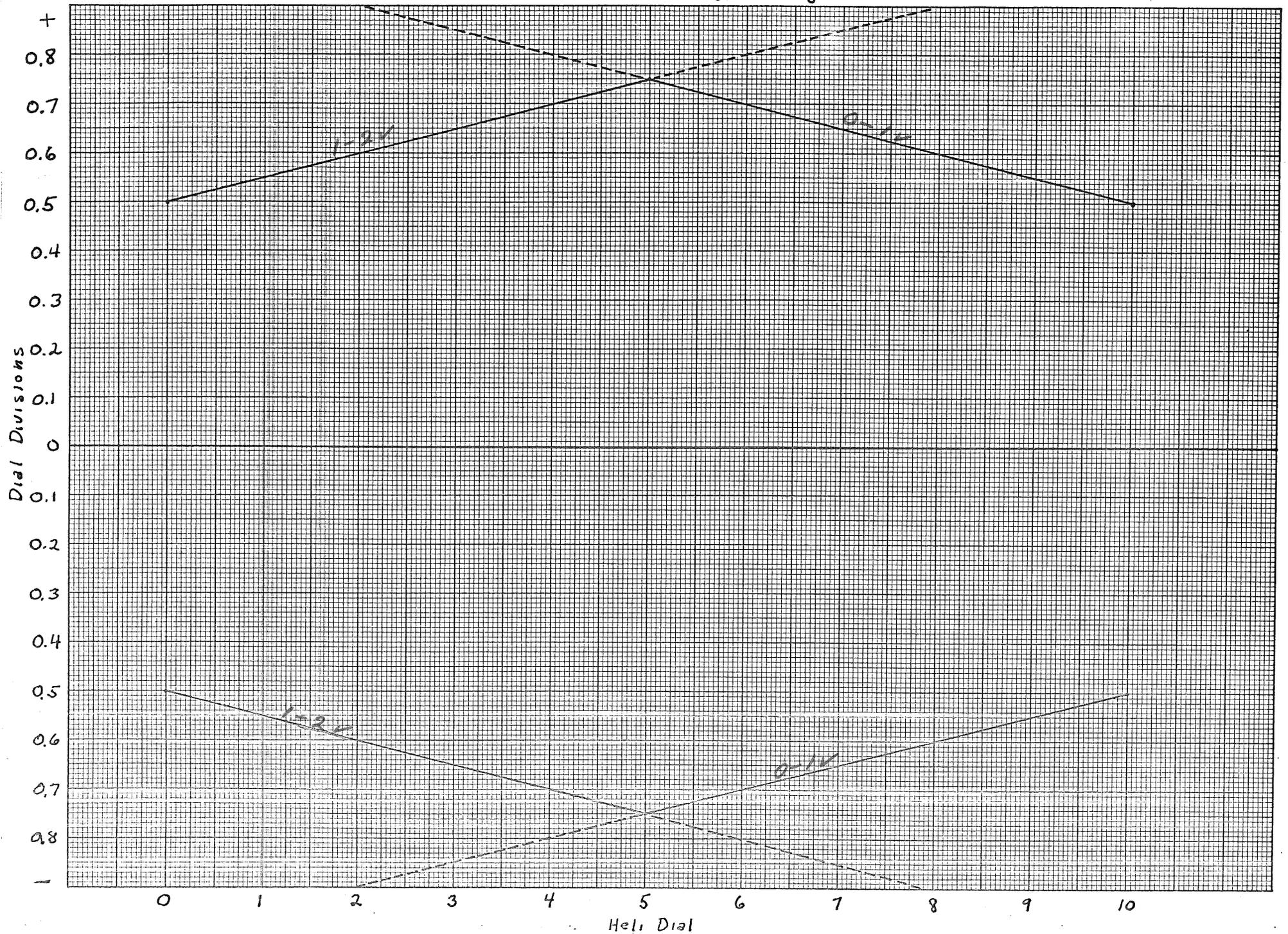


TEKTRONIX, INC., PORTLAND, OREGON, U.S.A.

#3010 D.C. Voltage Bridge

14 Brun  
30 Jun 65

# Helipot Linearity TEK DC Voltage Bridges



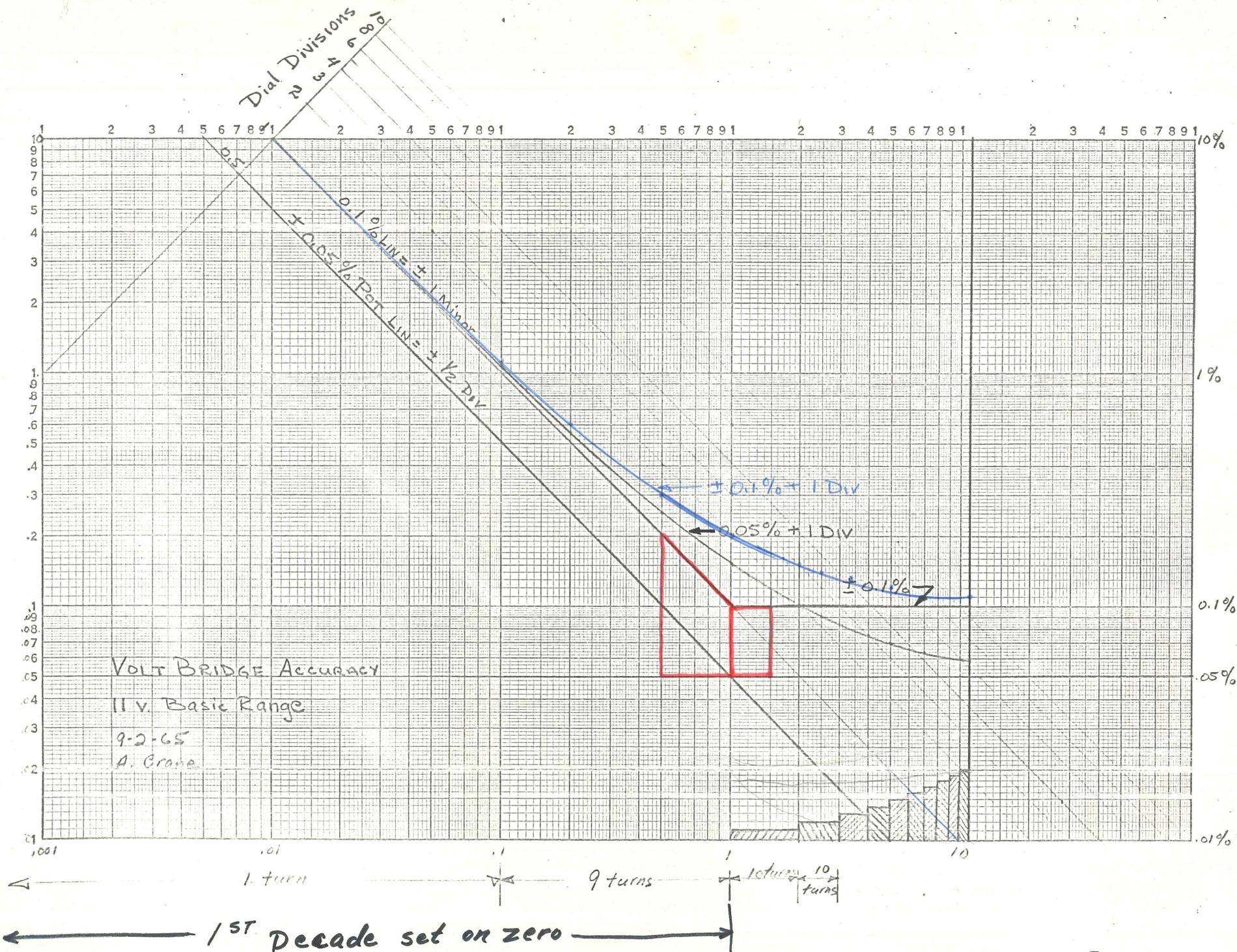
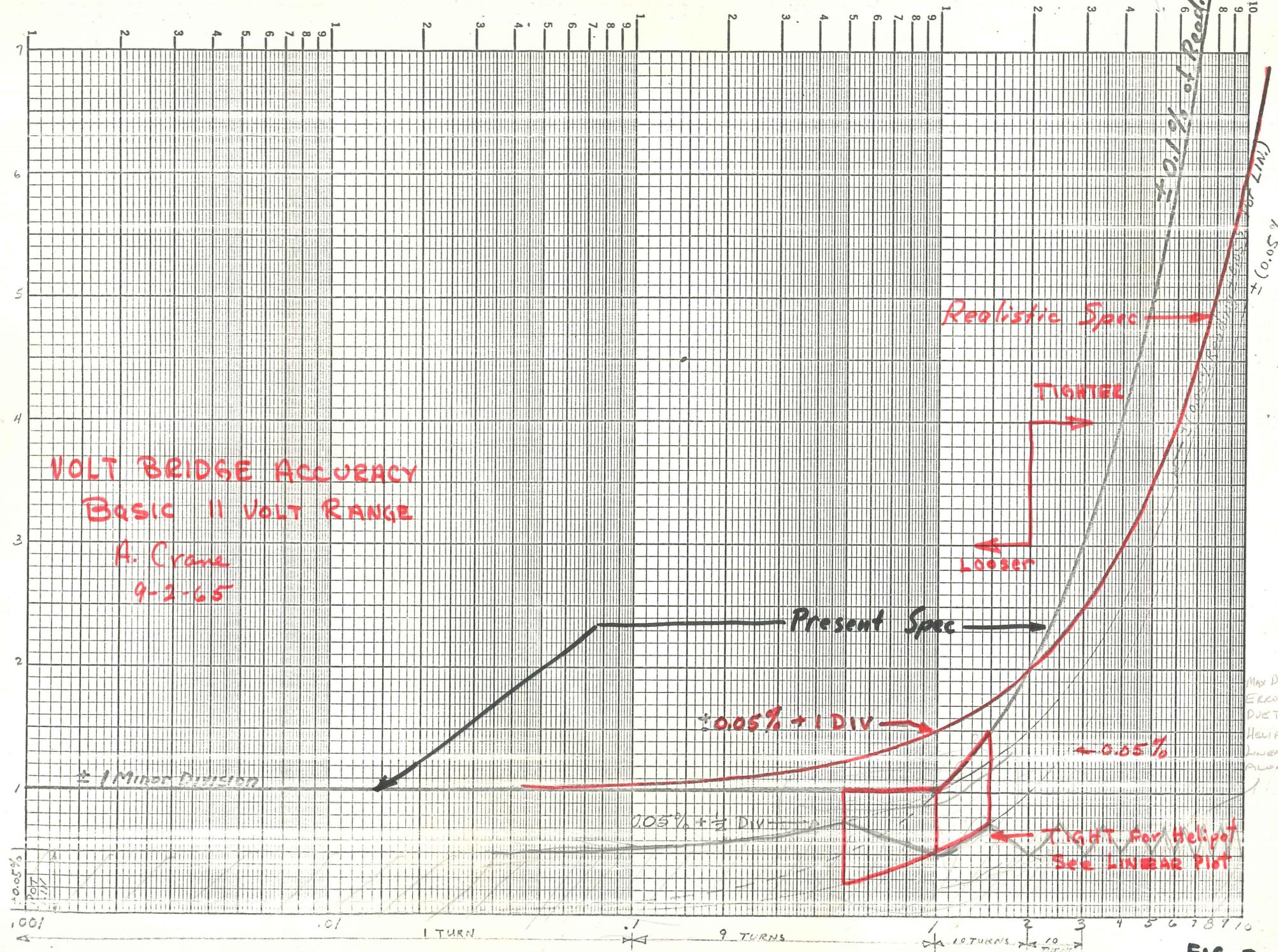


FIG 1

Minor Divisions

VOLT BRIDGE ACCURACY  
 BASIC 11 VOLT RANGE

A. Crane  
 9-2-65



MAX DIAL  
 ERROR  
 DUE TO  
 HELIPOT  
 LINEAR  
 ALONE

FIG 2

DC VB STICKER

Bob Ross X 305CORP No. 039700  
0410-20-621

## RANGE ACCURACY

VOLTAGE READING	MAXIMUM ERROR OF INDICATED VALUE
0 - 1100V	$\pm (0.05\% \text{ PLUS ONE MINOR DIVISION})$
1.1 - 4KV	$\pm 0.5\% \text{ FOR EACH KV}$
4 - 11KV	$\pm (1\% \text{ FOR EACH KV MINUS } 2\%)$

RANGE ACCURACY	
VOLTAGE READING	PER CENT ERROR OF INDICATED VALUE
.1-1100V	$\pm .1\%$
1.1-4KV	$\pm .5\% \text{ FOR EACH KV}$
4-11KV	$\pm (1\% \text{ FOR EACH KV MINUS } 2\%)$

RANGE ACCURACY	
VOLTAGE READING	MAX. ERROR OF INDICATED VALUE
0-1100V	$\pm (0.05\% \text{ PLUS ONE MINOR DIVISION})$
1.1-4KV	$\pm 0.5\% \text{ FOR EACH KV}$
4-11KV	$\pm (1\% \text{ FOR EACH KV MINUS } 2\%)$



Bill Moursens

Bob Moulds

Byron Whit

~~Molds~~  
M

\$ 409

$\frac{1}{2}\%$

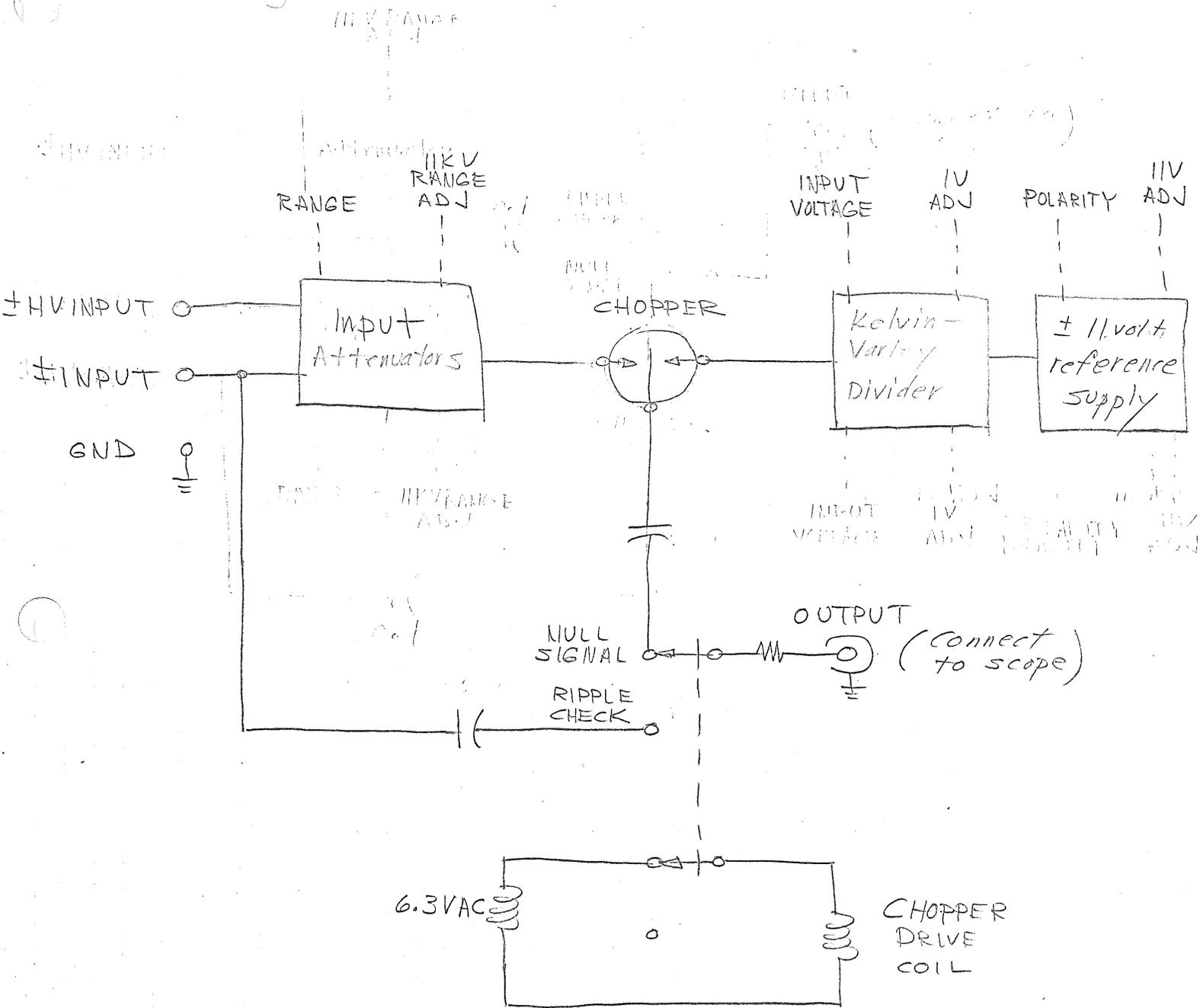
20 ppm/°C

0.75%

$\pm 20$  ppm

# DCV B

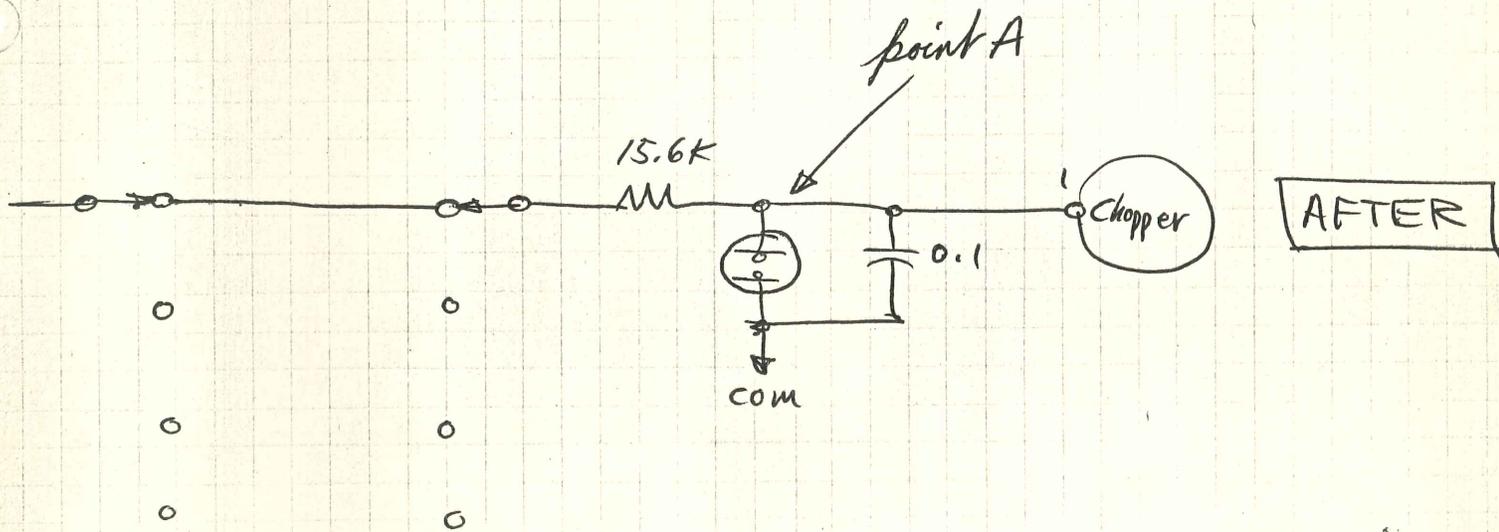
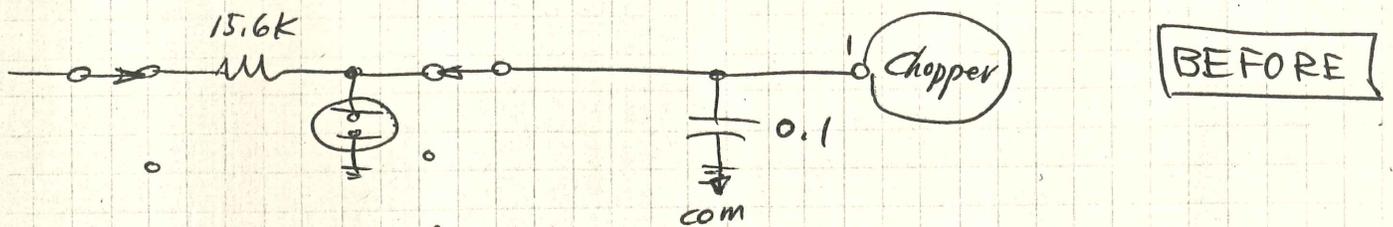
## Block Diagram



18 June 65  
The

Leon,  
~~Doug,~~

On the DC Voltage Bridge, the resistor (15.6K) on the Range switch is shorted by the switch contacts. Accordingly, we are changing the circuit.



In performing calibration, check the input attenuator to  $\pm 0.01\%$  taking into account possible leakage current through the neon. In other <sup>words</sup>, check the attenuator outputs at point A above. We have measured neon leakage currents at 11V and observed an equivalent resistance of more than  $3 \times 10^{10}$  ohms. This

would cause a worst case input attenuation error of 0.0003%. So, unless you get a leaky neon you shouldn't have any trouble.

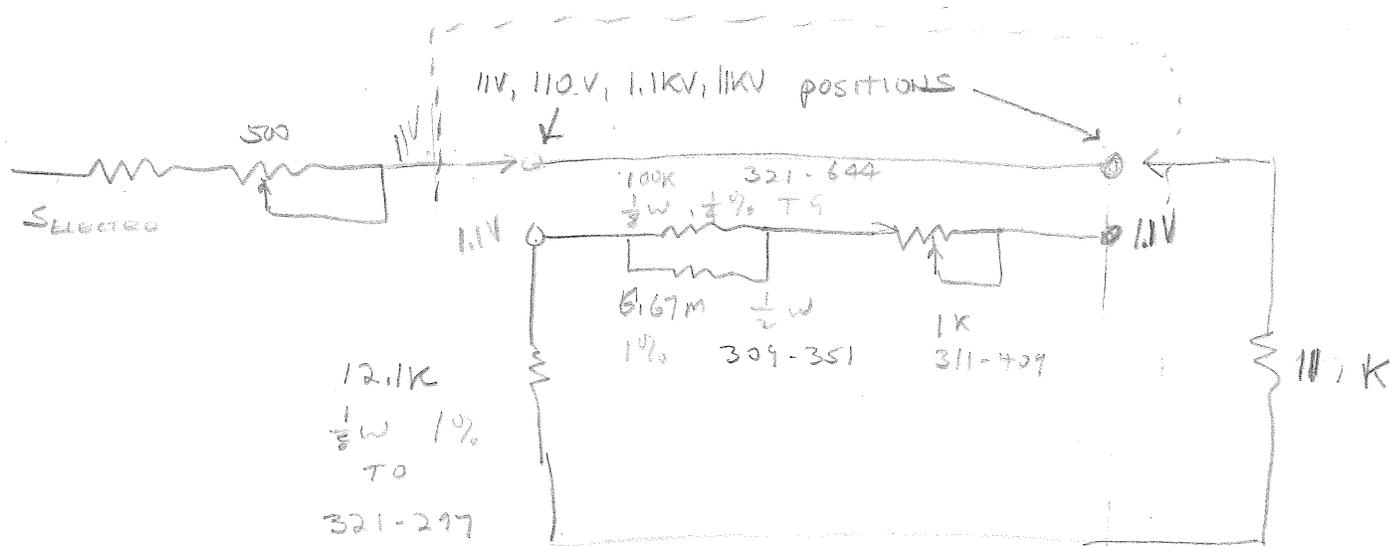
Tom C.

Note: if RT2-32-1A neons are used, they must be hand picked for less than 500  $\mu\text{pa}$  leakage at 10 volts. Many of the neons in stock go as high as 800  $\mu\text{pa}$  at 10.5 v.

We are waiting for some NE86's that are due July 9, 1965. These are coated inside and out for low leakage. We will test a handful of these when they come in. They are probably all below 100  $\mu\text{pa}$  at 10.5 volts.

John Carson  
July 1, 1965

# 1.1V SWITCH

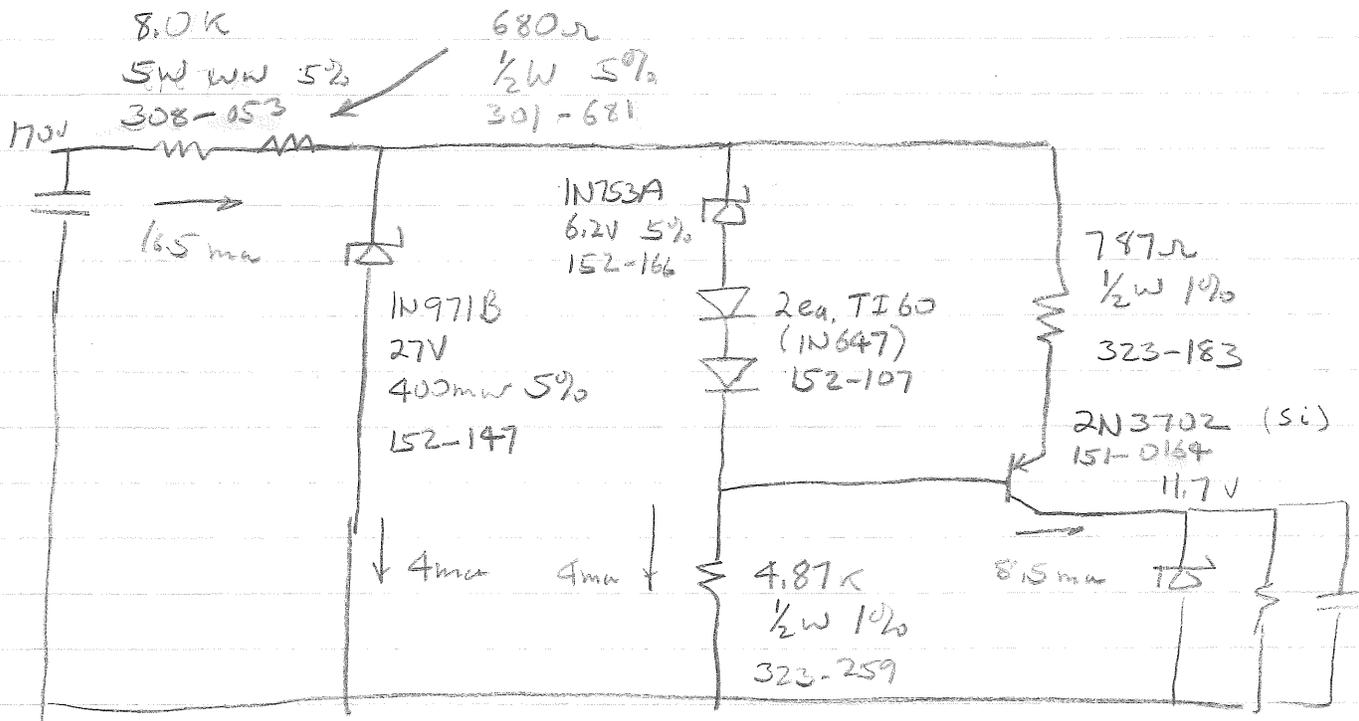


## ADDITIONAL PARTS

- |         |                                |         |
|---------|--------------------------------|---------|
| 12.1K   | $\frac{1}{8}W$ 10%             | 321-297 |
| 6.67M   | $\frac{1}{2}W$ 10%             | 309-351 |
| 100K    | $\frac{1}{8}W$ $\frac{1}{4}\%$ | 321-644 |
| 1K pot. |                                | 311-409 |

SWITCH

# PNP Regulator Using 27V Zener:



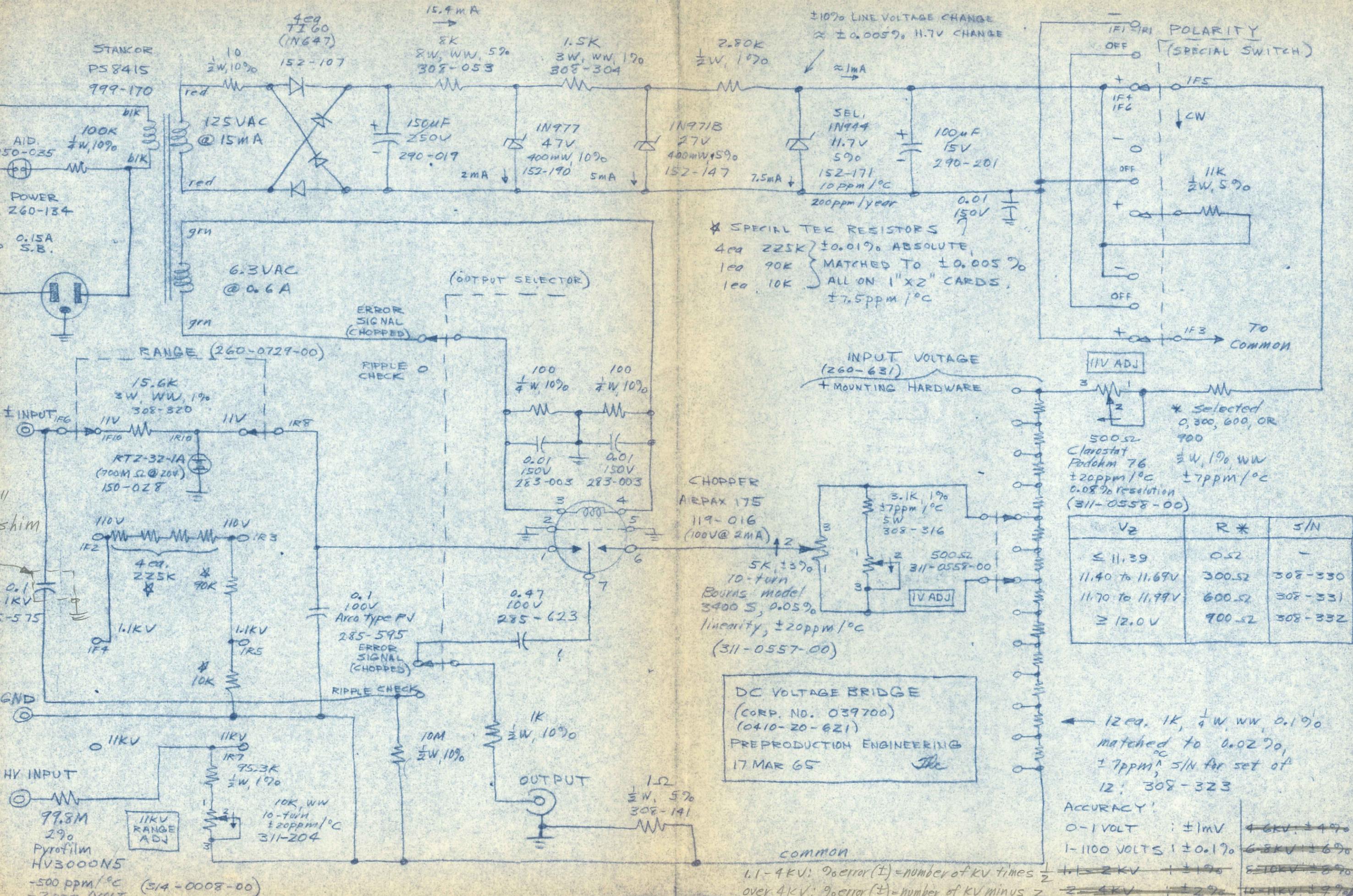
Regulation:

$$\approx \frac{50}{8.7} \times \frac{10}{4.9 \times 10^3} \times \frac{30}{790} = \underline{.45 \mu V}$$

Or  $\approx \underline{(7.6 \mu V / 10 \text{ V line change})}$

Worst case — no problem with 5% zener,

Temp dependent almost entirely on 11.7V zener.



V <sub>2</sub>	R*	S/N
≤ 11.39	0.52	-
11.40 to 11.69V	300.52	308-330
11.70 to 11.99V	600.52	308-331
≥ 12.0V	900.52	308-332

← 12ea, 1K, 1/4W, WW, 0.1%  
 matched to 0.02%,  
 ±7ppm/°C, S/N for set of  
 12: 308-323

ACCURACY:

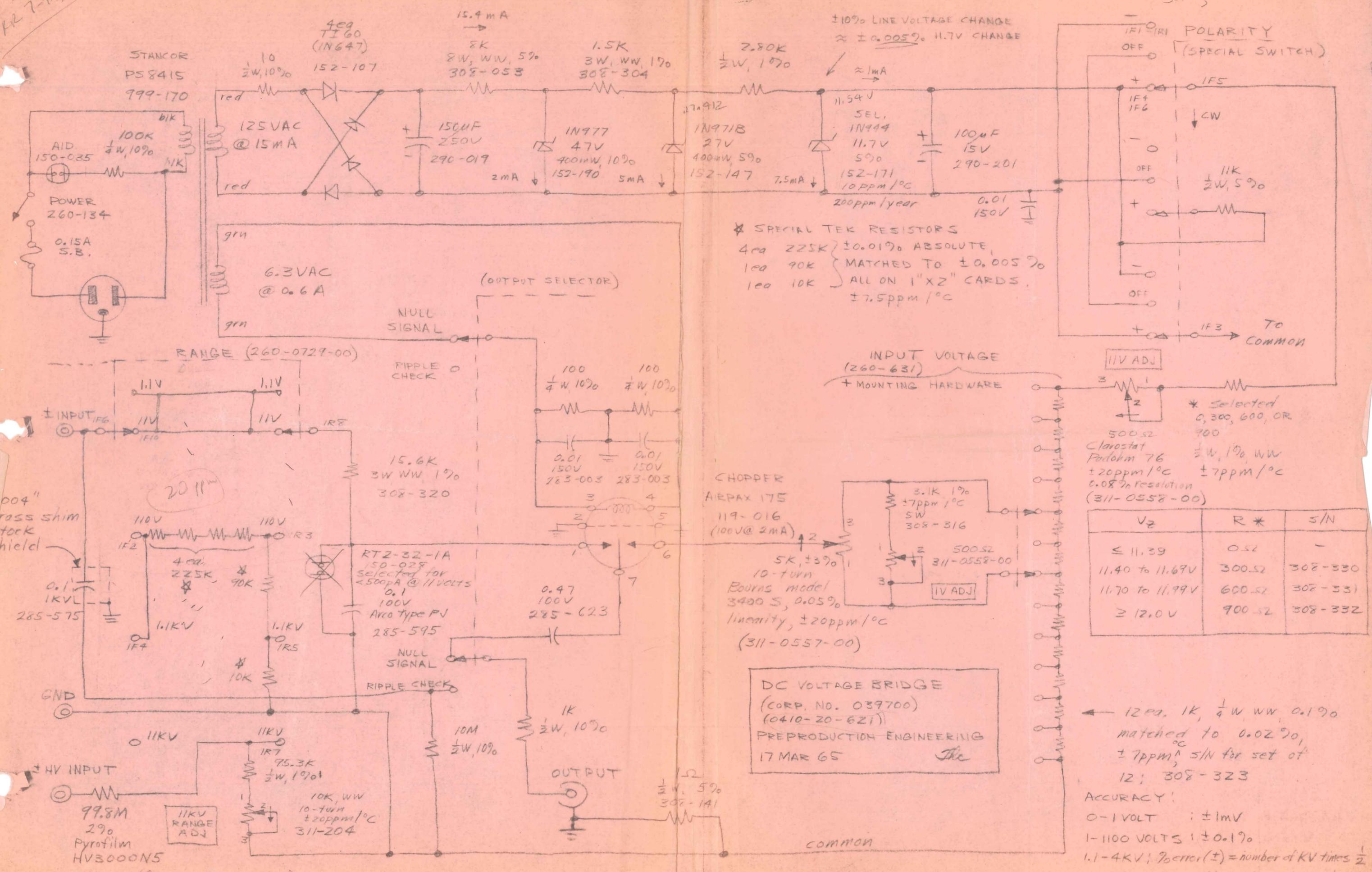
0-1 VOLT	±1mV	4.6KV ±4%
1-100 VOLTS	±0.1%	6.8KV ±6%
1-1KV	±1%	8.10KV ±8%
1-4KV	±2%	10-11KV ±7%

COMMON  
 1.1-4KV: %error(±) = number of KV times 1/2  
 over 4KV: %error(±) = number of KV minus 2



RR 7-14

301



004" brass shim lock shield

20 11V

0.1 1KV 285-575

HV INPUT 99.8M 2% Pyrofilm HV3000N5 -500 ppm/°C (314-0008-00)

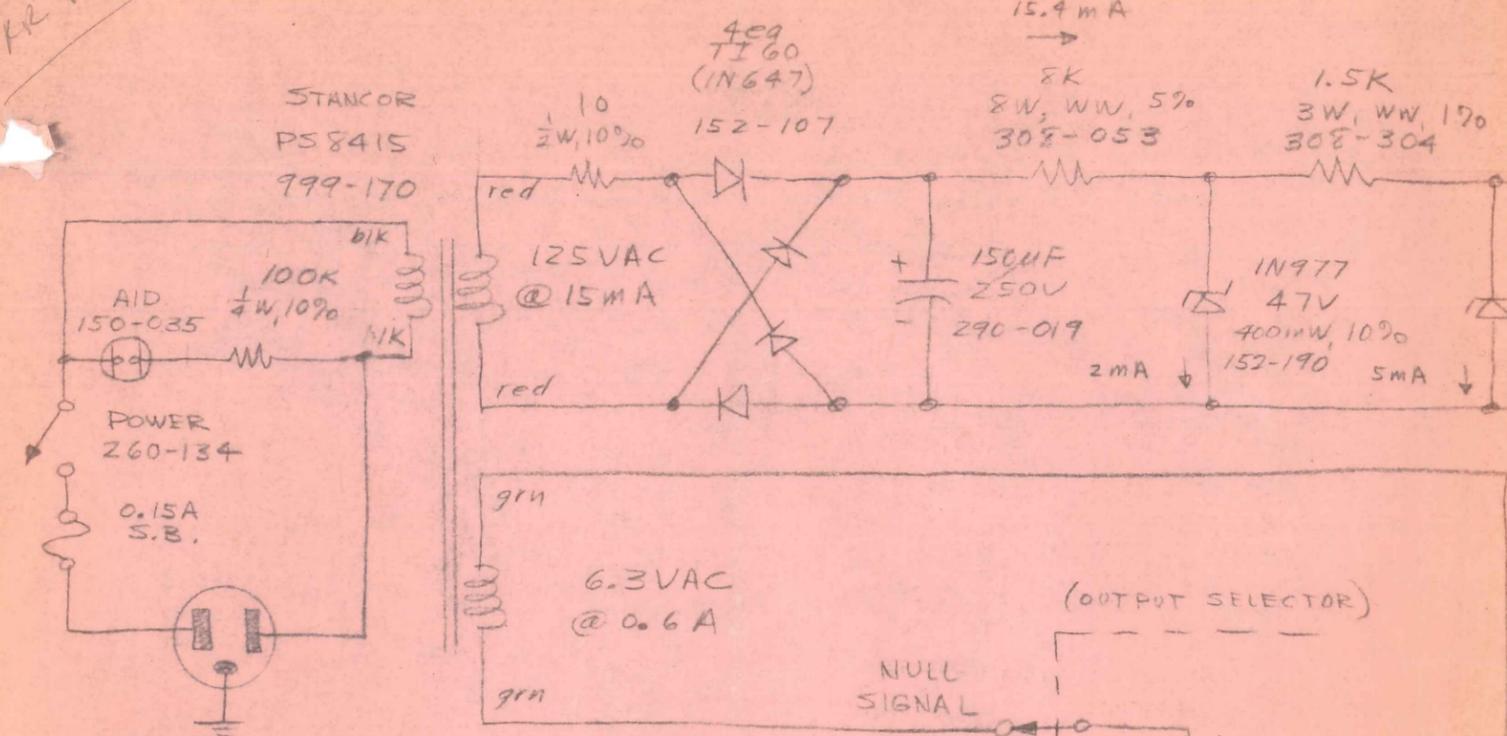
11KV RANGE ADJ

RT2-32-1A 150-028 selector for <500µA @ 11VOLTS 0.1 100V Arco type PV 285-595

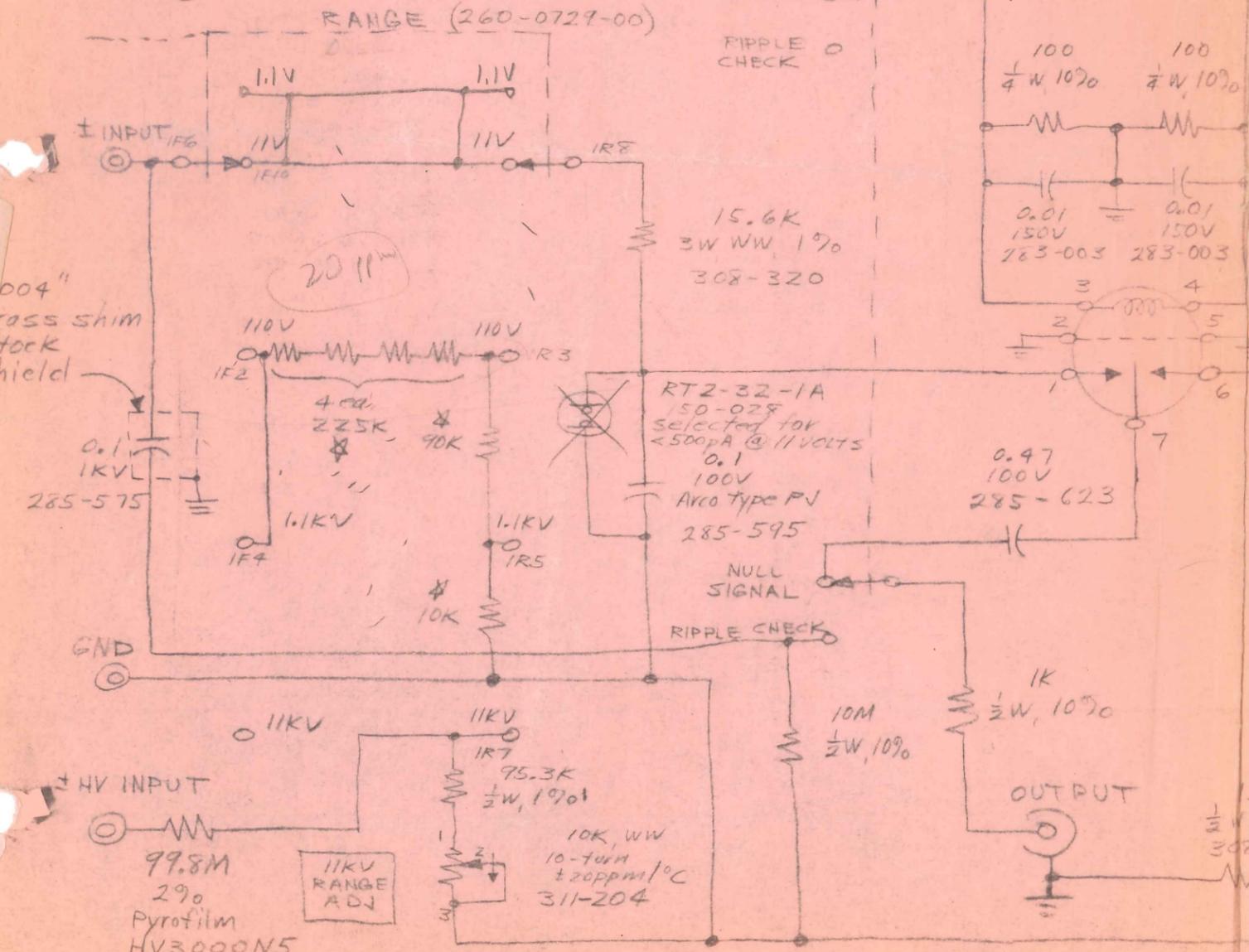
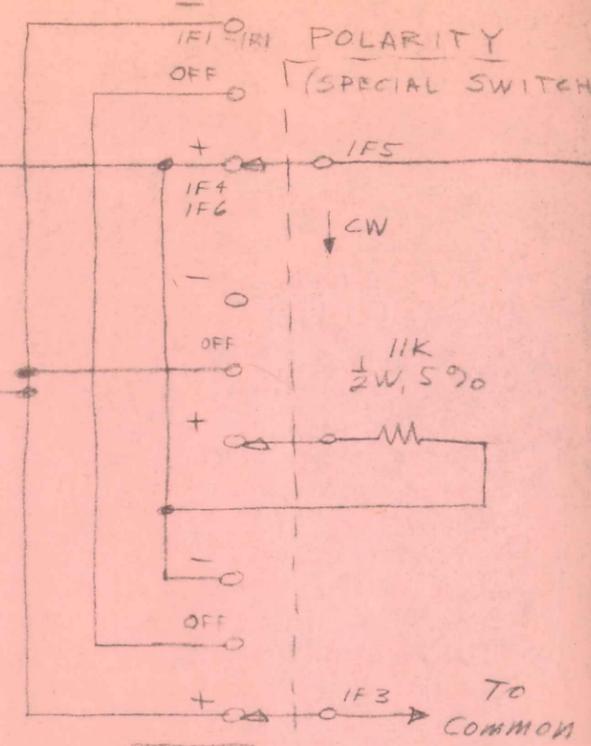
DC VOLTAGE BRIDGE (CORP. NO. 039700) (0410-20-621) PREPRODUCTION ENGINEERING 17 MAR 65

ACCURACY:  
0-1 VOLT ±1mV  
1-1100 VOLTS ±0.1%  
1.1-4KV; %error(±) = number of KV times 1/2  
over 4KV; %error(±) = number of KV minus 3

FR 7-74

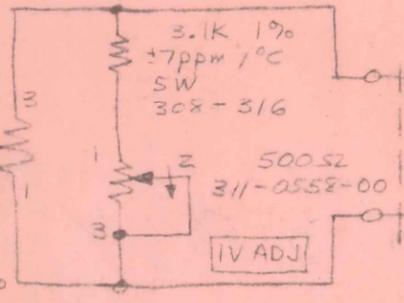


\* SPECIAL TEK RESISTORS  
 400 225K } ±0.01% ABSOLUTE  
 100 90K } MATCHED TO ±0.005%  
 100 10K } ALL ON 1"X2" CARDS.  
 ±7.5ppm/°C



INPUT VOLTAGE (260-631)  
 + MOUNTING HARDWARE

CHOPPER  
 ARPA 175  
 119-016  
 (100V @ 2MA)  
 5K, ±3%  
 10-TURN  
 Bouras model  
 3400 S, 0.05%  
 linearity, ±20ppm/°C  
 (311-0557-00)



\* Selected  
 0, 300, 600, OR  
 900  
 500Ω  
 Clavostat  
 Parlohm 76  
 ±20ppm/°C  
 0.08% Resolution  
 (311-0558-00)

V <sub>2</sub>	R*	S
≤ 11.39	0.5Ω	
11.40 to 11.69V	300.5Ω	308
11.70 to 11.99V	600.5Ω	308
≥ 12.0V	900.5Ω	308

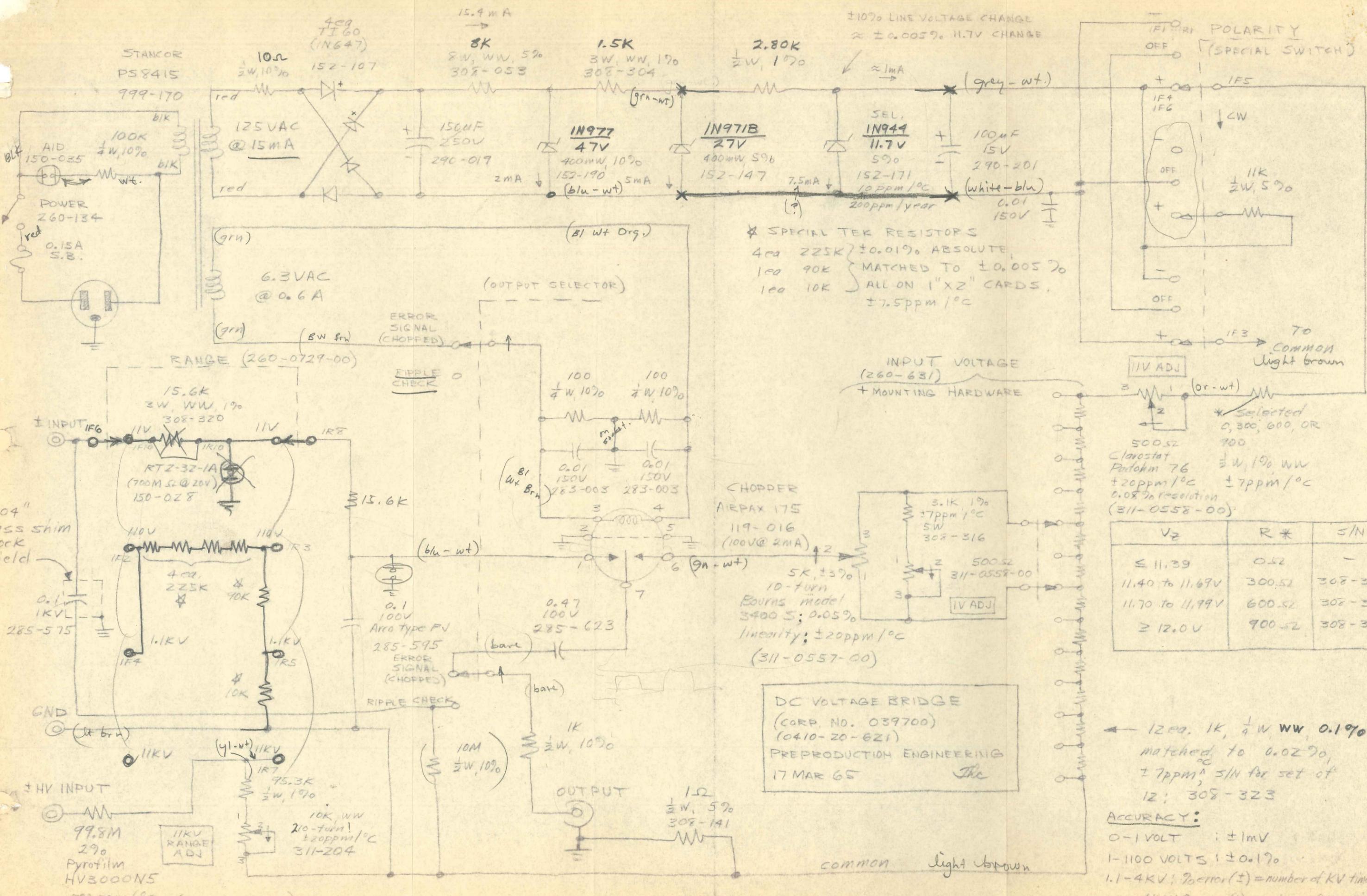
DC VOLTAGE BRIDGE  
 (CORP. NO. 039700)  
 (0410-20-621)  
 PREPRODUCTION ENGINEERING  
 17 MAR 65

← 120Ω, 1K, 1/4W, WW, 0.1%  
 matched to 0.02%,  
 ±7ppm/°C  
 5/1N for set of  
 12; 308-323

ACCURACY:  
 0-1 VOLT : ±1mV  
 1-1100 VOLTS : ±0.1%  
 1.1-4KV; %error(±) = number of KV  
 over 4KV; %error(±) = number of KV

004" brass shim stock shield

99.8M  
 2%  
 Pyrofilm  
 HV3000N5  
 -500 ppm/°C (514-0008-00)  
 -2ppm/VOLT



\* SPECIAL TEK RESISTORS  
 4Ω 225K ±0.01% ABSOLUTE  
 100 90K MATCHED TO ±0.005%  
 100 10K ALL ON 1"X2" CARDS,  
 ±7.5ppm/°C

V <sub>Z</sub>	R*	S/N
≤ 11.39	0.52	-
11.40 to 11.69V	300.52	308-330
11.70 to 11.99V	600.52	308-331
≥ 12.0V	900.52	308-332

← 12Ω, 1K, 1/4W, WW, 0.1%  
 matched to 0.02%,  
 ±7ppm/°C, S/N for set of  
 12: 308-323

ACCURACY:  
 0-1 VOLT ±1mV  
 1-1100 VOLTS ±0.1%  
 1.1-4KV: %error(±) = number of KV times 1/2  
 over 4KV: %error(±) = number of KV minus 3

DC VOLTAGE BRIDGE  
 (CORP. NO. 039700)  
 (0410-20-621)  
 PREPRODUCTION ENGINEERING  
 17 MAR 65

INPUT VOLTAGE  
 (260-631)  
 + MOUNTING HARDWARE

(OUTPUT SELECTOR)

RANGE (260-0729-00)

+ HV INPUT  
 99.8M  
 2%  
 Pyrofilm  
 HV3000N5  
 -500 ppm/°C  
 -2ppm/VOLT (314-0008-00)

ERROR SIGNAL  
 (CHOPPED)  
 RIPPLE CHECK

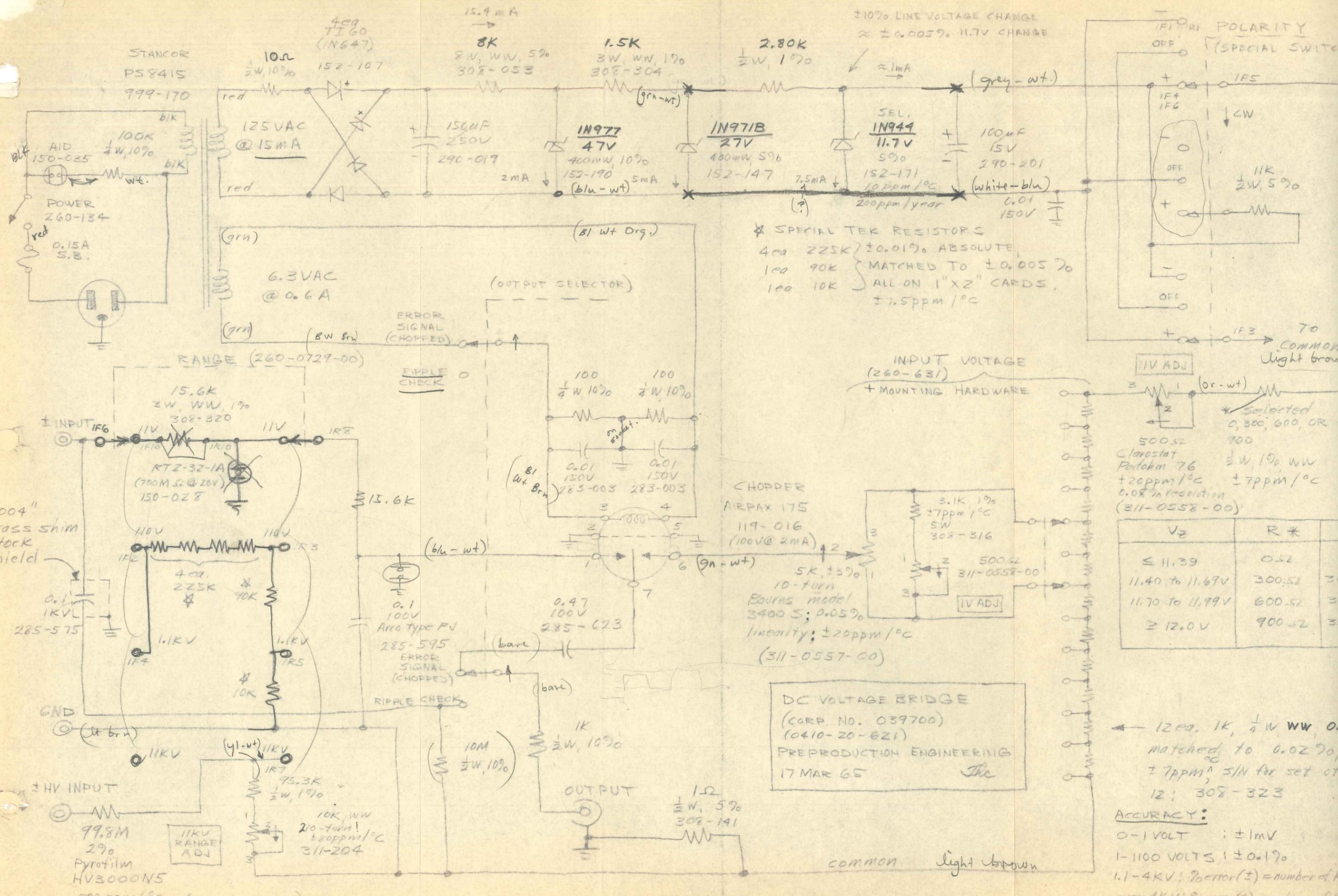
CHOPPER  
 AERMAX 175  
 119-016  
 (100V@2MA)  
 5K, ±3%  
 10-turn  
 Bourns model  
 3400 S; 0.05%  
 linearity; ±20ppm/°C  
 (311-0557-00)

11V ADJ

1V ADJ

OUTPUT

COMMON light brown



\* SPECIAL TEK RESISTORS  
 4ea 225K } ±0.01% ABSOLUTE  
 1ea 90K } MATCHED TO ±0.005%  
 1ea 10K } ALL ON 1" X 2" CARDS,  
 ±7.5ppm/°C

V <sub>2</sub>	R*	
≤ 11.39	0.52	
11.40 to 11.69V	300.52	302
11.70 to 11.99V	600.52	302
≥ 12.0V	900.52	302

← 12ea. 1K, 1/4 W WW, 0.1%  
 matched to 0.02%,  
 ±7ppm/°C, S/N for set of  
 12: 308-323

ACCURACY:  
 0-1 VOLT : ±1mV  
 1-1100 VOLTS : ±0.1%  
 1.1-4KV: %error(±) = number of KV  
 over 4KV: %error(±) = number of KV

DC VOLTAGE BRIDGE  
 (CORP. NO. 039700)  
 (0410-20-621)  
 PREPRODUCTION ENGINEERING  
 17 MAR 65  
 The

0.004" brass shim stock shield

±HV INPUT  
 99.8M 2%  
 Pyrofilm HV3000N5  
 -500 ppm/°C (3/4-0008-00)  
 -2ppm/VOLT

COMMON light brown

Bob Row

CALIBRATION PROCEDURE FOR  
TEKTRONIX DC VOLTAGE BRIDGE

1. Parameters Checked and Adjusted:

- 1.1 Helidial mechanical zero.
- 1.2 11V Reference voltage.
- 1.3 11V Reference voltage regulation.
- 1.4 1 volt adj.
- 1.5 Kelvin/Varley linearity.
- 1.6 Input Attenuation.

2. Specifications:

- 2.1 Helidial mechanical zero ---  $\pm 0.1$  minor division.
- 2.2 11V Reference voltage (at 115VAC input) ---  $\pm 0.001\%$ .
- 2.3 11V Reference voltage regulation (115  $\pm 10$  VAC) ---  $\pm 1\text{mv}$ .
- 2.4 1.1 volt setting (at 115 VAC input) ---  $\pm 0.001\%$ .
- 2.5 Helipot linearity ---  $\pm 0.04\%$  ( $\pm 0.4$  div).
- 2.6 Decade ratio accuracy ---  $\pm 0.02\%$ .
- 2.7 110V and 1.1KV input attenuation ---  $\pm 0.01\%$ .
- 2.8 11KV input attenuation (at 1KV input) ---  $\pm 0.05\%$ .

3. Equipment Required:

- 3.1 Fluke Power Supply; type 301E.
- 3.2 Tektronix Fluke Calibrator.
- 3.3 L & N Potentiometer; type K-3.
- 3.4 ESI Resistors; type SR1010; 1K/Step, 10K/Step, 100K/Step.
- ✓ 3.5 Tektronix Oscilloscope; type D Plug-in.
- ✓ 3.6 Tektronix Variac; type 76 TU.
- 3.7 Auxiliary Helipot; 1K $\Omega$ , 10 turn.

4. Helidial Mechanical Zero:

- 4.1 Check that Decade switch and Helipot mounting hardware are tight.
- 4.2 Check Helidial index for less than 0.1 minor division play. This may be reduced by removing Helidial and carefully spreading Helidial alignment bracket.
- 4.3 Set Helipot fully counter-clockwise and tighten Helidial with dial set to 0.000  $\pm 0.1$  minor division.

## CALIBRATION PROCEDURE FOR TEKTRONIX DC VOLTAGE BRIDGE

### 5. 11V Reference and 1.1V Adjust:

- 5.1 Set line voltage to 115 VAC.
- 5.2 Set RANGE to 11V, POLARITY to (+), OUTPUT SELECTOR to 10.X (10.X is Decade switch set to 10 and Helipot set to 1.000).
- 5.3 Connect Fluke calibrator from pin 2 of Helipot to COMMON.
- 5.4 Set 11V ADJ. for 11 volts,  $\pm 0.001\%$ .
- 5.5 Reset Decade switch to 0 (leave Helipot set to 1.000).
- 5.6 Set 1V ADJ. for 1 volt,  $\pm 0.001\%$  between pin 2 of Helipot and COMMON.

NOTE: 11V ADJ. and 1V ADJ. interact slightly. It may be necessary to repeat steps 5.2 thru 5.6 several times.

### 6. 11V Reference Voltage Regulation:

- 6.1 Set INPUT VOLTAGE to 10.X.
- 6.2 Vary input voltage from 105VAC to 125VAC.
- 6.3 11V Reference should not change more than  $\pm 1\text{mv}$ .
- 6.4 Reset input voltage to 115VAC, and leave for remainder of calibration.
- 6.5 Connect Fluke calibrator to junction of 11V ADJ. pot. and divider.
- 6.6 Measure this voltage (slightly higher than 11 volt).
- 6.7 Rotate Decade switch from 0 thru 10 and note any change in voltage observed in step 6.6. This change should be less than  $\pm 0.1\text{mv}$ . Record maximum positive and maximum negative change.
- 6.8 Reverse Fluke calibrator connections and set POLARITY switch to (-) and note any change in voltage observed in step 6.6. This change should be less than  $0.1\text{mv}$ .
- 6.9 Reset POLARITY to (+).

### 7. Helipot Linearity:

- 7.1 Connect Fluke Power Supply, SR1010, 1K/Step, K-3 and auxiliary potentiometer as in figure 1.

CALIBRATION PROCEDURE FOR TEKTRONIX DC VOLTAGE BRIDGE

7. Helipot Linearity: (continued)

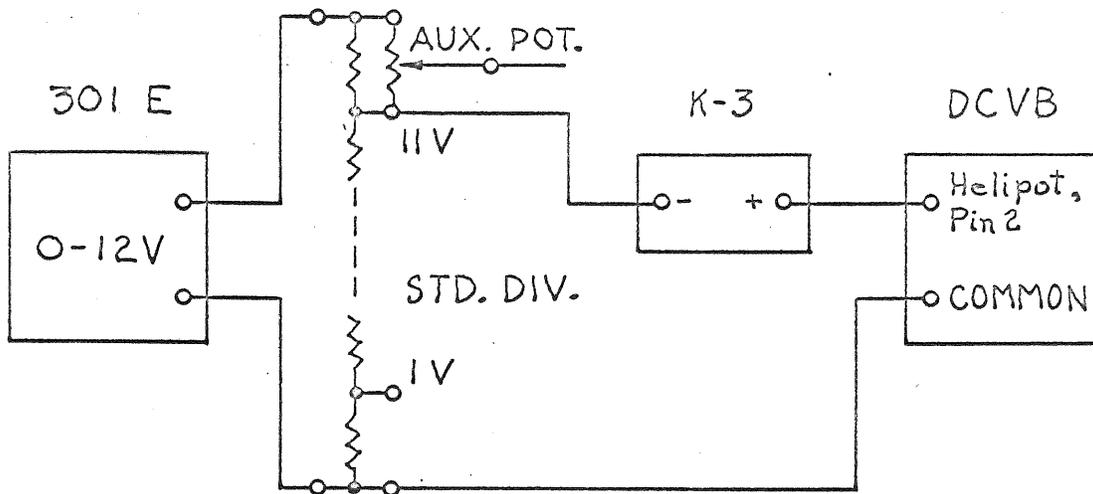


Figure 1

- 7.2 Set INPUT VOLTAGE to 10.X.
- 7.3 Set Fluke 301E power supply so that pin 2 of Helipot and 11V tap of standard divider are at same potential.
- 7.4 Connect center tap of auxiliary potentiometer to junction of 11V ADJ. pot and divider.
- 7.5 Adjust auxiliary pot. so that pin 2 and 11V tap are again at the same potential. Do not disturb auxiliary pot. during remainder of linearity test.
- 7.6 Connect K-3 potentiometer, (-) terminal to COMMON and set INPUT VOLTAGE to 0.000.
- 7.7 Measure voltage at pin 2 at cardinal points of Helipot and record voltage deviation from nominal. Error should be less than 0.4mv (0.4 minor division).

NOTE: It may be necessary to reset 1V ADJ. so that all cardinal point errors are less than 0.4mv.

## CALIBRATION PROCEDURE FOR TEKTRONIX DC VOLTAGE BRIDGE

### 8. Kelvin Varley Ratio Accuracy:

- 8.1 Set INPUT VOLTAGE to 1.000, and connect K-3 (-) terminal to 1V tap on standard divider.
- 8.2 Measure and record difference between pin 2 and standard divider. This error voltage should be less than  $\pm 0.02\%$  of nominal, i.e., 0.2mv at 1V, etc.
- 8.3 Repeat step 8.2 for all Decade switch positions.
- 8.4 Reset INPUT VOLTAGE to 0.X, 1.X, etc., and repeat step 8.2 for all Decade switch positions.

### 9. 110V and 1.1KV Divider:

- 9.1 Connect circuit as shown in figure 2.

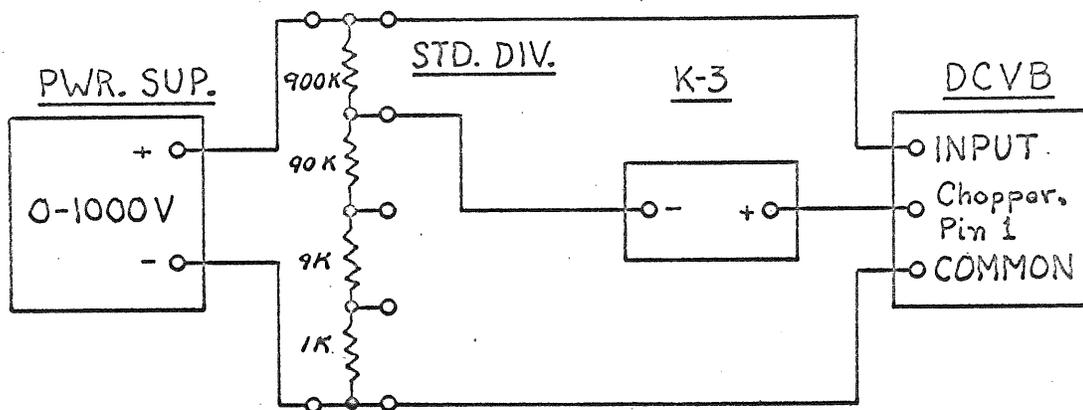


Figure 2

- 9.2 Set RANGE to 110V, POLARITY to (+) and OUTPUT SELECTOR to RIPPLE CHECK.
- 9.3 ADJUST Power Supply to 100 volt,  $\pm 5\%$ , and connect K-3 (-) terminal to junction of 900K and 90K of standard divider.
- 9.4 Measure and record voltage difference. It should be less than  $\pm 1\text{mv}$ .

CALIBRATION PROCEDURE FOR TEKTRONIX DC VOLTAGE BRIDGE

9. 110V and 1.1KV Divider: (continued)

- 9.5 Set RANGE to 1.1KV.
- 9.6 Adjust Power Supply to 1000 volt,  $\pm 5\%$ , and connect K-3 (-) terminal to junction of 90K and 9K of standard divider.
- 9.7 Measure and record voltage difference. It should be less than  $\pm 1\text{mv}$ .

10. 11KV Divider:

- 10.1 Connect circuit as shown in figure 2, using HV INPUT jack.
- 10.2 Set RANGE to 11KV.
- 10.3 Adjust Power Supply to 1000 volt,  $\pm 5\%$  and connect K-3 (-) terminal to junction of 9K and 1K of standard divider.
- 10.4 Adjust 11KV RANGE ADJ. for K-3 voltage difference of less than  $\pm 0.5\text{mv}$ .

11. Functional Check:

- 11.1 Connect Tektronix oscilloscope and plug-in of  $1\text{mv/cm}$  vertical sensitivity to OUTPUT.
- 11.2 Set OUTPUT SELECTOR to ERROR SIGNAL.
- 11.3 Apply various known voltages (plus and minus) for each range and insure that DCVB indicates within the following tolerance:

<u>INPUT VOLTAGE</u>	<u>TOLERANCE</u>
0 - 1V	$\pm 1\text{mv}$
1 - 1.1KV	$\pm 0.1\%$ of indicated voltage
1.1 - 4KV	$\pm \left(\frac{\text{KV}}{2}\right)\%$
4KV - 11KV	$\pm (\text{KV}-2)\%$

## Cal. Procedure for DC Voltage Bridge

Page 1

Sandy Lincoln  
Test Plant 3

## Pre-checks:

1. 0.15 Slow Blow fuse.
2. Insulation over front end of 99.8 Meg resistor should extend  $\frac{1}{4}$ " to  $\frac{3}{8}$ " from end of resistor and should cover mounting nut.
3. Check for no sharp point at connection of the 99.8 Meg resistor to solder lug. If sharp point exists, re-solder connection.  
Note: Do not touch 99.8 Meg res. with bare fingers. Oil from fingers will affect electrical operation of resistor.
4. Wires adjacent to 99.8 Meg. res. should be dressed away from res. body at least  $\frac{1}{2}$ ".
5. Zero Duodial & check heli-pot for binding. If binding occurs, check to see that key on switch plate is in key-way. Also loosen heli-pot or mounting plate nuts & re-position.

- Measure with negative <sup>voltage</sup> ~~lead~~ grounded.   
 (the V-Ω-A lead on Triplet multimeters, the neg. lead on Simpson multimeters)
- a. Check Power Supply resistances to ground,
    - a. Resistance at positive terminal of 150  $\mu$ f 250V cap should be approx. 2.3 K $\Omega$
    - b. Resistance at cathode of 47V Zener should be approx. 15 K $\Omega$
    - c. Resistance at cathode of 27V Zener should be approx. 13 K $\Omega$
    - d. Resistance at cathode of 11.7V Zener should be approx. 11 K $\Omega$
  - ~~e. Check resistance across 150  $\mu$ f cap. + diameter lead to + side of cap. Resistance should be approx. 2 K $\Omega$ .~~
  - ~~f. Check that the 6K (8w ww), 1.5K (3w, ww) & 2.80K (1/2w ww 1%) resistors are wired in correctly.~~

Measure by connecting the probe ground clip to the anode and the probe tip to the cathode.

# Calibration

Caution: Select proper range before applying voltage to input.

~~Over loading may cause 15.6K res. at input to burn up.~~

1. Check DC voltages on Pwr. Supply.
  - a. Voltage at positive terminal of 150 $\mu$ f-250V cap should be 170 V ( $\pm 20V$ )
  - b. Voltage at cathode of 47V Zener should be 47V ( $\pm 5V$ )
  - c. Voltage at cathode of 27V Zener should be 27V ( $\pm 1.5V$ )

2. Check Ripple.
  - a. Check positive terminal of 150 $\mu$ f-250V cap for 120 cps. Approx 0.5V peak-to-peak
  - b. Ripple at cathode of 11.7V Zener should be less than 1mv peak-to-peak. <sup>①</sup>

3. Select resistor in series with 11V Adj Pot.
  - a. Measure voltage ( $V_Z$ ) at cathode of the 11.7 Volt Zener, using Fluke or DCVB.
  - b. Select proper series resistor from table below:
  - c.  $V_Z$  should read 11.7V  $\pm 0.6V$

$V_Z$	R	P/N
$\leq 11.39V$	0 $\Omega$	—
11.40 to 11.69V	300 $\Omega$	308-330
11.70 to 11.99V	600 $\Omega$	308-331
$\geq 12.0V$	900 $\Omega$	308-332

Note: The selected resistor should be installed in notches #1 & #4 of the 4-notch ceramic strip located forward of chopper.

4. Set 11V ADJ. using DCVB or Fluke.
  - a. Set dial on instrument under test to 11V. (Dial & outer dial knob set to 10.0)
  - b. Set voltage on rear contact of heli-pot to 11V by adjusting ~~front~~ screw on front pot mounted on back of Polarity Switch.

5. Set 1 V ADJ using DCVB or Fluke.
- Set dial on instrument under test to 1 V. (Leave duodial at 10.0 & set outer dial knob to 0.)
  - Set voltage on rear contact of heli-pot to 1 V by adjusting ~~rear~~ screw <sup>rear</sup> w/pot mounted on back of Polarity Switch
  - Re-check 11 V and 1 V adjustments to correct changes due to interaction.
6. Check Chopped Waveform Error Signal
- With switch in Chopped mode, Polarity switch to 0, ground input & check wave form. Positive & negative portions of the signal should be symmetrical & approx. equal in amplitude.
7. Check 11 V Range
- Apply +10 V from Standard Amplitude Calibrator to Input. Connect cable from Output to test scope input.
  - Set dial on instrument under test to 10 V, Polarity Sw. to positive.
  - Set duodial for null signal on test scope. ~~by fine adjusting the Duodial.~~
  - Voltage reading on dial should be  $10V \pm 0.5\%$  (50 minor divisions on dial or 50 mv.)
  - Switch polarity on bridge & SAC to negative & check for no change of amplitude of error signal on test scope.
  - Sw. Polarity of bridge to Zero & check for approx. 10 V square wave on test scope.

e. Check overload neon at Input by applying 100V momentarily to Input with Range Sw. to 11V. Neon mounted on under side of Polarity Sw. should light.

8. Check 110V Range

- a. Switch range to 110V
- b. Set dial to 100V & apply +100V SAC to Input; Polarity Sw. to positive
- c. Check accuracy to  $\pm 0.5\%$  (500mv or 50 minor div. on dial.)
- d. Switch to negative polarity and check as in step 7c.

9. Check 1.1KV Range.

- a. Switch range to 1.1KV
- b. Set dial to 100V & apply +100V SAC to Input; Polarity Sw. to positive
- c. Check accuracy to  $\pm 0.5\%$  ( $\pm 500$ mv or  $\pm 5$  minor div. on dial)
- d. Switch to negative polarity & check as in step 7c.

e. Switch mode to "Ripple Check". Ripple should be visible on test scope. Return mode to "Chopped Error Signal".

② and chopper should turn off.

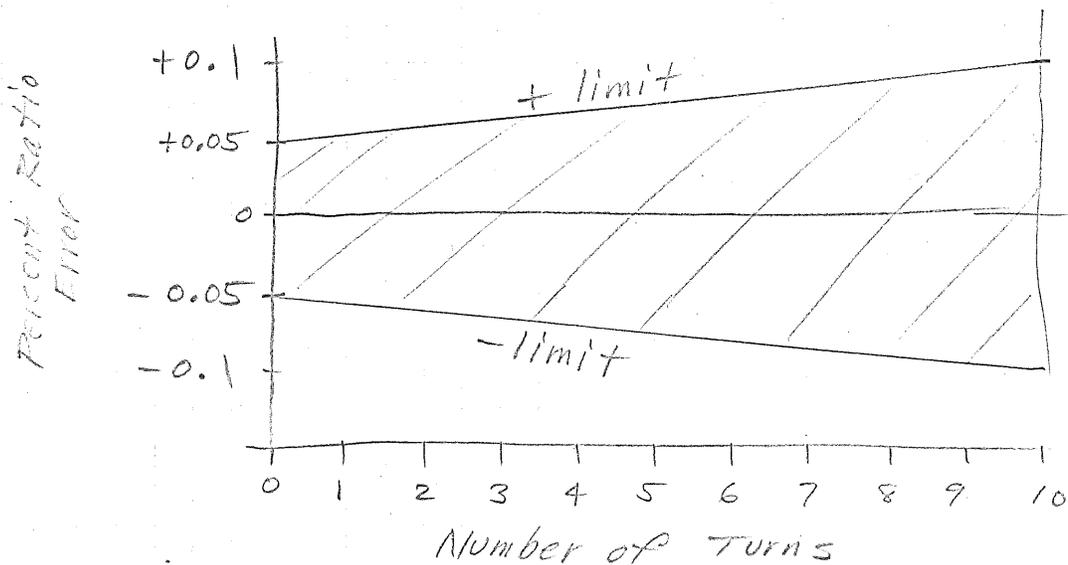
10. Set 11KV Range Adj.

- a. Switch range to 11KV & apply +100V SAC signal to "11KV Input" with Polarity sw. to positive.
- b. Set dial to 100V & adjust 11KV Range Adj pot for null signal on test scope (Pot is located on upper left side of chassis below the 99.8 Meg resistor)
- c. Sw. to negative polarity & check as in 7c

# Outline of Calibration Procedure DC Voltage Range

There are the steps to be performed by the MQA Standards Lab. The following is an outline only; the Standards Lab. has a detailed procedure

- A. Set AC line voltage to 115V. at mechanical zero
- B. Adjust Voltages. 1. Set 10-turn dial to read 000 ( $\pm 0.2$  minor division).
- 2. Set INPUT VOLTAGE knob at 10, 10-turn dial at 100. between
- adjust the 11V ADJ pot for 11 volts ( $\pm 0.001\%$ ) between the wiper of the 10-turn pot and COMMON. ~~(OVER)~~ (A)
- 3. Set INPUT VOLTAGE knob at 0. Adjust the 1V ADJ pot for 1 volt ( $\pm 0.001\%$ ) between the wiper of the 10-turn pot and COMMON.
- 4. The 11 volt and 1 volt adjustments will interact so that several settings of each may be necessary.
- 5. Check that changing POLARITY from + to - doesn't affect
- C. Measure linearity of 10-turn pot, accuracy of the 11 volt
  - 1. Measure ratio accuracy at 10 points.
  - 2. Plot results on a graph as in Fig. 1.



(A)

Check regulation:

a. Set  $V_{LINE} = 105V$ ; the 11V should decrease  $\approx 1mV$  from its value at  $V_{LINE} = 115V$ .

b. Set  $V_{LINE} = 125V$ ; the 11V should increase  $\approx 1mV$  from its value at  $V_{LINE} = 115V$ .

3. If necessary, increase or decrease the Volt across the pot in order to keep all plotted points within the shaded area of Fig. 1. However, if an increase or decrease of more than 1 millivolt is necessary, replace the pot.
- D. Check the Kelvin-Varley divider for a ratio accuracy of  $\pm 0.02\%$ .
- E. Check the input attenuators on the 110V and 1.1KV ranges for a ratio accuracy of  $\pm 0.01\%$ .
- F. Apply 1000 volts to the  $\pm$  HV INPUT jack and adjust the 11KV RANGE ADJ for proper attenuation ( $\pm 0.05\%$ ).
- G. Perform appropriate functional checks.

initially + and - POLARITY

note - to zero the  $\mu$ ammeter, first  
open S1, then zero the meter with  
open circuit (no neon in clips)  
avoid W-metal contacts

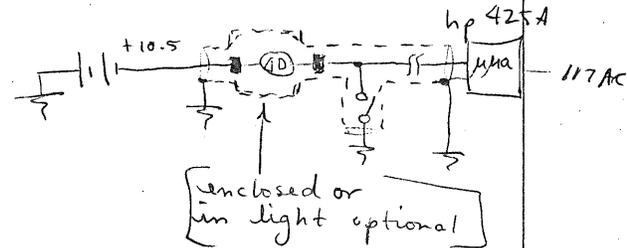
John Carson

June 4, 1964

RT2-32-1A

neon bulb leakage check at 10.5 volts.

using hp 425A  $\mu$ ammeter.



- (A)  $\left\{ \begin{array}{l} 59 \mu\text{a} \text{ initial in dark} \\ 80 \mu\text{a} \text{ initial in light} \end{array} \right.$
- 115  $\mu\text{a}$  in dark immediately after 30 sec of 7 ma current  
75  $\mu\text{a}$  in dark after waiting  $\approx$  10 minutes  
125  $\mu\text{a}$  in light after 30 sec of 7 milliampr
- (B)  $\left\{ \begin{array}{l} 1350 \mu\text{a} \text{ initial in dark} \\ 1365 \mu\text{a} \text{ initial in light} \end{array} \right.$
- 3000  $\mu\text{a}$  (dark) after 30 sec of 7 ma current  
1500  $\mu\text{a}$  (dark) after waiting  $\approx$  2 minutes (de ionization)
- (C)  $\left\{ \begin{array}{l} 3 \mu\text{a} \text{ initial in dark} \\ 46 \mu\text{a} \text{ initial in light} \end{array} \right.$
- 10  $\mu\text{a}$  (dark) after 30 sec @ 7 ma.  
60  $\mu\text{a}$  (light) after " " "
- 25  $\mu\text{a}$  (dark) after 90 sec additional at 7 ma  
11  $\mu\text{a}$  (dark) after waiting for  $\approx$  4 minutes
- (D)  $\left\{ \begin{array}{l} 3000 \mu\text{a} \text{ initial in dark} \\ \approx 3015 \mu\text{a} \text{ initial in light} \\ 8000 \mu\text{a} \text{ after 30 sec @ 7 ma (back down to 4000 } \mu\text{a)} \end{array} \right.$
- (E)  $\left\{ \begin{array}{l} 465 \mu\text{a} \text{ initial in dark} \\ 480 \mu\text{a} \text{ initial in light} \\ 1700 \mu\text{a} \text{ after 30 sec at 7 ma (dark)} \rightarrow 620 \text{ after 10 minutes} \\ 2500 \mu\text{a} \text{ after 2 minutes at 7 ma (dark)} \rightarrow 520 \text{ after 2 minutes} \end{array} \right.$
- (F)  $\left\{ \begin{array}{l} 6000 \mu\text{a} \text{ initial in dark} \\ 15000 \mu\text{a} \text{ after 30 sec at 7 ma (dark)} \\ \text{back down to } 2000 \mu\text{a} \text{ in } \approx 60 \text{ seconds} \end{array} \right.$
- evaluation - handpick or use NE86 instead



# MEMO

DATE: Aug 17, 1965

TO: Bob Ross DEPT: PEM

FROM: John Carson DEPT: PEM

SUBJECT: NE86 to replace RT2-32-1A Neon Lamp  
in the DC Voltage Bridge

The RT2 Neons used to protect the chopper were found to be leaky way beyond the minimum allowable. Tom Charles figured the min. to be 1 namp at 11 volts. Many have gone to 6 namps

The NE86 is coated inside and out with a silicone dri-film. The leakage of about 14 NE86's tested (100 in stock) were consistently less than 2 p. amps in dark and less than 20 pa in light.

NE86 test for effects of current:

unit	initial		after 2 intervals of 5sec at about 70 ma	
	dark	light	dark	light
1	< 2 pa	< 20 pa	< 2 pa	230 pa § 110 pa
2	< 2 pa	< 20 pa	< 2 pa	70 pa § 18 pa above depends on polarity
3	< 2 pa	< 20 pa	< 2 pa	225 pa § 160 pa
4	< 2 pa	< 20 pa	< 2 pa	50 pa § 20 pa depending on polarity

NE86 recommended to replace RT2 neon. Many RT2's have already been removed by people in calibration.

#3 and 4 after 3 intervals at 120 ma until electrodes were red hot

John Carson



# MEMO

000-125

Leon

Department PEXM

Date 27 Oct 65

Subject DCVB

Attached is Byron Witts' report on the 99.8M resistor (314-008) used in the DC Voltage Bridge.

It looks like we have no long term worries about its stability.

Name Tom Chartier

Dept. Sampling

PREPRODUCTION ENGINEERING PROJECT REPORT

Resistors

File Topic



PE Report No.

750128

Corporate No.

Title Load-Life Test

Report By <u>Byron M. Witt</u>	Requested By <u>Tom Charters</u>
Department <u>CMA <i>BR</i></u>	Department <u>Sampling</u>
Date: Received <u>6-21-65</u>	Delivery Station <u>81-679</u>
Tent. Comp. <u>7-21-65</u>	Account Number _____
Actual Comp. <u>9-24-65</u>	Subject: (Inst. Type, P/N, etc.)
Additional Routing:  Warren Collier Glenn Pelikan Bill Sedig Bill Walker	Pyrofilm HV3000N5 99.8M, 2% carbon film resistors.  <u>314-0008-00</u>

PROBLEM/OBJECT:

Perform load-life test under the following conditions: 11,000 VDC, at room temperature for 1000 hours.

CONCLUSION:

The greatest change in resistance was 0.4%. Manufacturer's specification is 0.5%. In the intended application we should experience no difficulty.

DETAILS OF PROCEDURE:

Four units were tested. 11,000 volts DC was applied to the units at room temperature for 1000 hours. The resistors were measured on the ESI model 231 bridge before and after the test. The usual buildup of dust occurred on the negative end of each resistor.

*Byron M. Witt*

Byron M. Witt  
Component and Material Application

MANUFACTURING QUALITY ASSURANCE  
Measurement Standards Laboratory

TEST REPORT

TO: Engineering

Device: DC Voltage Bridge  
Ser # 100

This device has been tested in our laboratory with instruments and standards traceable to the National Bureau of Standards. The recorded values are for the device at the time of measurement and under specified laboratory conditions. No specification of stability is made and accuracy under other conditions should not be assumed.

① 10-1 & 100-1 Divider For 110V & 1100V range  
has 90K & 10K Resistors installed in interchanged  
position.

② Helipot Bad

DATE: 14 July 65

Ambient Temperature \_\_\_\_\_

Relative Humidity \_\_\_\_\_

Reported by K. Jacobs

MANUFACTURING QUALITY ASSURANCE  
Measurement Standards Laboratory

# TEST REPORT

TO: Engineering

Device: DC. Voltage Bridge  
Ser # 101

This device has been tested in our laboratory with instruments and standards traceable to the National Bureau of Standards. The recorded values are for the device at the time of measurement and under specified laboratory conditions. No specification of stability is made and accuracy under other conditions should not be assumed.

① 10-1 & 100-1 Divider out of tolerance

② Bad Helipot

DATE: 14 July 65

Ambient Temperature \_\_\_\_\_

Relative Humidity \_\_\_\_\_

Reported by K. Jacobs







MANUFACTURING QUALITY ASSURANCE  
Measurement Standards Laboratory

# TEST REPORT

TO: Engineering

Device: D.C. Voltage Bridge  
Ser # 108

This device has been tested in our laboratory with instruments and standards traceable to the National Bureau of Standards. The recorded values are for the device at the time of measurement and under specified laboratory conditions. No specification of stability is made and accuracy under other conditions should not be assumed.

① 10-1 & 100-1 Divider for 110V & 1100V Range  
out of tolerance

② Helipot out of tolerance

DATE: 14 July 65

Ambient Temperature \_\_\_\_\_

Relative Humidity \_\_\_\_\_

Reported by K. Jacobs



# Bourmes Helipad

RJR  
10-21-65

F.S. = 1000 divisions

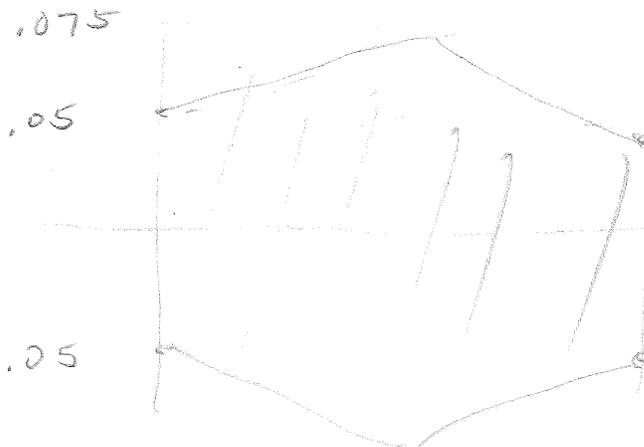
.1% = 1 div

.05% = .5 div

## Manufacturer Spec

.05% Indep Tolerance

## Our Spec



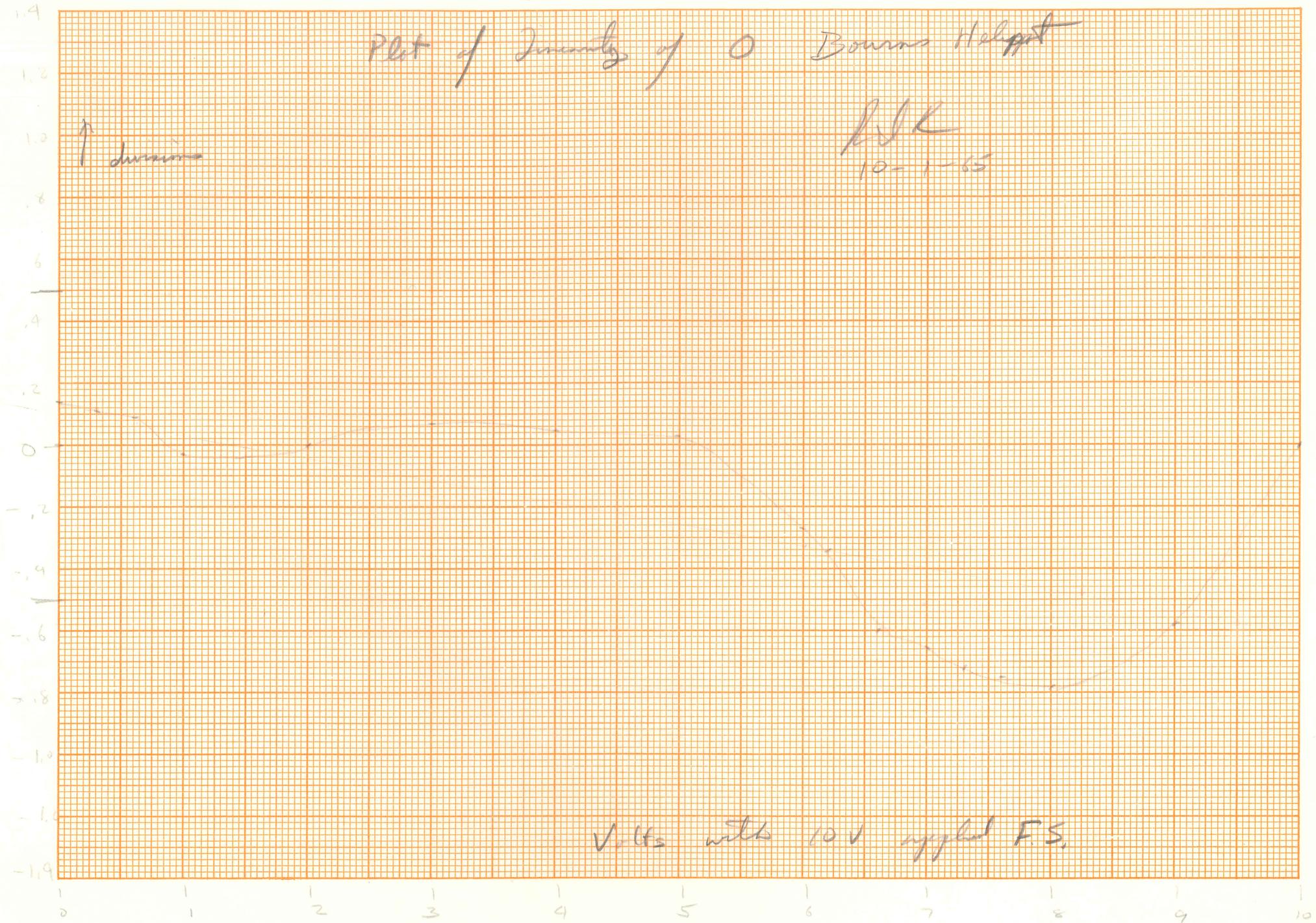


0

Plot of Intensity of 0 Bourman Helipot

↑ Intensity

RJK  
10-1-65



Volts with 10V applied FS.

TEST RECORD

1000 turn  
1 turn = 102  
15 turn = 15000

INSTRUMENT Bourne Helipot

SERIAL NO. \_\_\_\_\_  
LOCATION \_\_\_\_\_  
DATE \_\_\_\_\_  
WEEK DUE \_\_\_\_\_  
STANDARDS \_\_\_\_\_

CAL. FREQ. DC  
CERT. ISSUED \_\_\_\_\_  
RATED ACCURACY \_\_\_\_\_  
CALIBRATOR John Carson  
July 19, 1965

peak deviation is starred \*

	<sup>.69 mm</sup> shift down A	<sup>.18</sup> OK B	<sup>.55</sup> OK C	<sup>1.10</sup> FOOBY D	<sup>.40</sup> OK E	<sup>OK</sup> F	
0.0	.15	.17	<del>.26</del>	.47	+ .01	< .01	
0.3	.28	.02	-.43	.74	-.13	-.17	
0.6	.34	.10	-.53 *	.85	-.08	-.26	
1.0	.29	.06	-.44	.87	+ .02	-.30	
1.3	.43	.12	-.38	+ 1.10 *	-.06		
1.6	.43	.18 *	-.49	<u>          </u>	-.14		
2.0	.30	-.06	-.46		-.05	-.37 *	
2.3	.49	.00	-.53		-.19		
2.6	.59	.10	-.55 *		-.21		
3.0	.40	.01	-.46		-.18	-.26	
3.3	<u>.69 *</u>	.13	-.35		-.28		
3.6	.64	.10	-.36		-.40 *		
4.0	.46	.00	-.45		-.38	-.16	
4.3	.69 *	.00	-.29		-.33		
4.6	.58	.03	-.38		-.40		
5.0	.44	-.08	-.35		-.18	-.06	
5.3	.58	-.07	-.41		-.22		
5.6	.58	-.13	-.35		-.20	+ .13	
6.0	.37	-.10	-.33		-.08	-.20	
6.3	.62	-.03	-.21		-.10		
6.6	.55	-.03	-.27		-.10		
7.0	.37	-.03	-.23		+ .02	+ .01	
7.3	.56	-.02	-.12				
7.6	.50	.05	-.10				
8.0	.35	-.02	-.16		+ .03	+ .01	
8.3	.48	.07	+ .04				
8.6	.38	.16	-.03				
9.0	.19	.00	-.12		-.02	-.12	
9.5	.39	.15	+ .03		-.17		
10.0	set 0.00	set 00	set -	set -	set -	set	

TEST RECORD

INSTRUMENT \_\_\_\_\_  
 SERIAL NO. \_\_\_\_\_  
 LOCATION \_\_\_\_\_  
 DATE \_\_\_\_\_  
 WEEK DUE \_\_\_\_\_  
 STANDARDS \_\_\_\_\_

CAL. FREQ. DC  
 CERT. ISSUED \_\_\_\_\_  
 RATED ACCURACY \_\_\_\_\_  
 CALIBRATOR John Carson - PEM

July 20, 1965

peak deviation is starred \*

	.66 ? <i>OK G</i>	.54 ? <i>OK H</i>	.48 ? <i>OK I</i>	.60 ? <i>OK J</i>	.57 ? <i>OK K</i>	.58 ? <i>OK L</i>	
0.0	.27	.01	.15	.01	.15	.01	
0.3	.27	.05	.07	.08	.26	.03	
0.6	.09	-.02	.06	-.04	.11	-.05	
1.0	-.14	-.04	-.23	-.02	-.05	-.30	
1.3	-.15						
1.6	-.30		-.26				
2.0	-.40	-.06	-.48 *	+0.05	-.20	-.09	
2.3	-.29		-.46				
2.6	-.45		-.47		-.18		
3.0	-.48	-.15	-.31	+0.04	-.33	-.25	
3.3	-.42				-.18		
3.6	-.66 *	-.38			-.28		
4.0	-.54	-.43	-.12	-.07	-.37	-.14	
4.3	-.41	-.43			-.31		
4.6	-.54	-.50		-.26	-.44		
5.0	-.47	-.54 *	-.18	-.35	-.36	+0.20	
5.3	-.41	-.45		-.48	-.47	+0.40	
5.6	-.49	-.51		-.43	-.47	+0.47	
6.0	-.40	-.50	-.22	-.60 *	-.48	+0.48	
6.3	-.18	-.40		-.45	-.48	+0.52	
6.6		-.30		-.45	-.44	+0.37	
7.0	-.16	-.35	-.14	-.48	-.57 *	+0.43	
7.3				-.31	-.40	+0.58 *	
7.6				-.35	-.49	+0.52	
8.0	-.12	-.04	+0.04	-.25	-.40	+0.25	
8.3				-.17	-.39	.33	
8.6					-.40		
9.0	+0.05	+0.05	.00	-.04	-.29	.05	
9.5					-.10		
10.0	set —	set —	set —	set —		set —	

# TEST RECORD

INSTRUMENT \_\_\_\_\_  
 SERIAL NO. \_\_\_\_\_  
 LOCATION \_\_\_\_\_  
 DATE \_\_\_\_\_  
 WEEK DUE \_\_\_\_\_  
 STANDARDS \_\_\_\_\_

CAL. FREQ. DC  
 CERT. ISSUED \_\_\_\_\_  
 RATED ACCURACY \_\_\_\_\_  
 CALIBRATOR John Carson

( July 21, 1965 )

*peak deviation started \**

	<i>.57 at 0.3 ?</i> <b>M</b>	<i>.29 at 4.0 OK</i> <b>N</b>	<i>.78 at 8.0 NO</i> <b>O</b>	<i>.50 div at 8.0 OK</i> <b>P</b>	<i>at 6.6 OK</i> <b>Q</b>	<i>.24 max OK!</i> <b>R</b>	
0.0	.48	.17	.14	.15	.02	.01	
0.3	<b>.57 *</b>	.17	.11	.24	-.10	.24 *	
0.6	.53	.14	.09	.20	-.02	-.05	
<del>0.9</del> 1.0	.39	.06	-.03	.16	-.18	-.03	
1.3	.45						
1.6	.47						
2.0	.40	-.15	.00	.00	-.20	+.16	
2.3	.42						
2.6	.41						
3.0	.34	-.26	.07	-.07	-.18	+.09	
3.3							
3.6							
4.0	.23	-.39 *	.05	-.27	-.31	+.05	
4.3		-.35					
4.6					-.17		
5.0	-.03	-.19	.03	-.17	-.24	+.10	
5.3							
5.6				-.41			
6.0	-.29	+.19	-.27	-.42	-.37	+.04	
6.3			-.34	-.38	-.35		
6.6			-.60	-.30	-.48 *		
7.0	-.34	+.30	-.66	-.41	-.43	+.08	
7.3			-.72		-.35		
7.6			-.75	-.42	-.43		
8.0	-.35	+.17	<b>-.78 *</b>	-.50 *	-.30	+.08	
8.3				-.38	-.17		
8.6	-	+.02			-		
9.0	-.20	+.05	-.58	-.36	-.21	-.11	
9.5							
10.0	set	set	set	set	set ✓	set ✓	

INSTRUMENT TYPE Boumes SK helipot  
 SERIAL NUMBER  
 CALIBRATION DATE  
 LOCATION standards lab  
 CALIBRATOR  
~~CERTIFICATE ISSUED~~ (\* = max deviation)

July 22, 1965  
 by John Carson PEM  
 TEMPERATURE  
 REL. HUMIDITY

Setting	.37 div max S	.51 div max T	.48 div max U	.62 div at 60set V	.77 div at 6.6set W	.23 max X
	OK	OK	OK	OK	NO	OK!
0.0	.04	.14	.01	.35	.05	.01
0.3	.12	.31	-.11	.36	-.06	-.02
0.6	.20	.24	-.12	.25	-.06	-.16
1.0	.08	.14	-.19	.18	-.05	-.08
1.3						
1.6						
2.0	.25	.10	-.35	.03	-.14	+.13
2.3			-.21			
2.6			-.42			
3.0	.31	.02	-.45	-.12	-.23	+.23 *
3.3			-.30			
3.6			-.46			
4.0	.18	-.07	-.48 *	-.27	-.25	+.20
4.3			-.30	-.30		
4.6			-.36	-.43		
5.0	.04	-.16	-.31	-.51	-.39	+.16
5.3				-.45	-.30	
5.6		-.25		-.47	-.61	
6.0	-.10	-.38	-.38	-.62 *	-.56	+.16
6.3		-.40		-.53	-.54	
6.6		-.50		-.64	-.77 *	
7.0	-.16	-.51 *	-.34	-.54	-.65	+.14
7.3		-.49		-.46	-.65	
7.6	-.18	-.36		-.56	-.66	
8.0	-.35	-.46	-.25	-.48	-.62	+.20
8.3	-.37 *	-.31			-.50	
8.6	-.12	-.29				
9.0	-.34	-.26	-.04	-.31	-.37	+.20
9.5	-.15	-.02				
10.0	set ✓	set ✓	set ✓	set ✓	set ✓	set ✓

STANDARDS USED:

Dekaver  
 10 K- RV622  
 .0010% linear

INSTRUMENT TYPE Bourne 5K helipot

SERIAL NUMBER

CALIBRATION DATE July 22 1965

LOCATION standards lab

CALIBRATOR John Carson

TEMPERATURE

~~CERTIFICATE ISSUED~~ (\* = max deviation)

REL. HUMIDITY

setting	.40 max dev.	.26 div max	.27 div max	.41 div max	.62 div at 2.0	.55 at 0 div
	Y	Z	AA	BB	CC	DD
	OK	OK	OK	OK	?	[NO]
.00	.01	.01	.05	.36	.16	.55
.03	-.04	-.40	-.27 *	.40	.24	.48
.06	+.06	-.18	.14	.41 *	-.07	.40
1.0	.00	-.13	.16	.31	-.18	.52
1.3						
1.6						
2.0	.00	-.09	.26	.33	-.62 *	.48
2.3					-.60	
2.6					-.59	
3.0	+.05	+.02	.18	.16	-.57	
3.3						
3.6						
4.0	-.08	+.08	-.05	.08	-.47	
4.3						
4.6						
5.0	-.16	+.26 *	-.07	-.12	-.40	
5.3						
5.6						
6.0	-.26	+.21	-.01	-.16	-.30	
6.3						
6.6						
7.0	-.40	+.16	+.08	-.16	-.08	
7.3						
7.6	-.40 *					
8.0	-.40	-.06	+.01	-.21	-.09	
8.3						
8.6						
9.0	-.27	-.24	-.10	-.14	-.19	
9.5		+.10				
10.0	set ✓	set ✓	set ✓	set ✓	set ✓	

STANDARDS USED:

RV622 Dekavider  
 MV-07C Micro Ammeter

INSTRUMENT TYPE  
 SERIAL NUMBER  
 CALIBRATION DATE  
 LOCATION  
 CALIBRATOR  
 CERTIFICATE ISSUED

Bourns 5K Helipot

July 22, 1965

standards lab

John Carson

(\* = max deviation)

TEMPERATURE  
 REL. HUMIDITY

setting	.60 div. at 4.3 EE OK	.75 div. at 2.3 FF NOT	.51 at 3.6 GG OK	.26 at 5.0 HH OK	.36 at 2.3 II OK	.70 at 00.3 JJ NO
0.0	.01	.01	.15	.11	.14	.46
0.3	-.29	-.04	.05	.05	.26	.70 *
0.6	-.45	+.27	-.03	.08	.22	.51
1.0	-.35	.28	-.04	.02	.15	.56
1.3	-.46	.43				
1.6	-.50	.53				
2.0	-.50	.59	-.15	-.07	.22	.45
2.3	-.50	.75 *			.36 *	
2.6		.70			.32	
3.0	-.57	.60	-.28	-.15	.17	.45
3.3	-.57	.55	-.40		.32	
3.6	-.58	.60	-.51 *		.17	
4.0	-.57	.62	-.41	-.23	.17	.40
4.3	-.60 *	.58	-.37		.36	.27
4.6	-.48	.57	-.47		.16	.27
5.0	-.45	.51	-.51	-.26 *	.16	.31
5.3	-.51	.40	-.40		.26	
5.6	-.50	.37	-.51		.06	
6.0	-.47	.21	-.47	-.25	.09	.15
6.3	-.56				.11	
6.6	-.50				.00	
7.0	-.36	-.02	-.34	-.02	-.03	.10
7.3	-.45				+.13	
7.6	-.46				.01	
8.0	-.46	-.10	-.24	+.10	-.01	.13
8.3	-.35				+.08	
8.6	-.25				-.03	
9.0	-.29	.00	-.13	+.16	.00	.09
9.5	-.15				.00	
10.0	set ✓	set ✓	set ✓	set ✓	set ✓	set ✓

STANDARDS USED:

RV622 Dekavider  
 MV-07C Micro Ammeter

INSTRUMENT TYPE Bourns 5K helipot

SERIAL NUMBER

CALIBRATION DATE July 23, 1965

LOCATION standards lab

CALIBRATOR John Carson

TEMPERATURE

CERTIFICATE ISSUED \* indicates max deviation

REL. HUMIDITY

setting	<sup>.52 at 05.0</sup> KK	<sup>.68 at 03.3</sup> LL	<sup>-.78 on 06.0</sup> MM	<sup>+.86 at 06.0</sup> NN	<sup>.55 at 07.3</sup> OO	<sup>.48 at 09.0 set</sup> PP
	OK	? shift	(NO) shift?	(NO)	OK	OK
0.0	.15	.03	<.01	<.01	.01	<.01
0.3	.27	.24	-.12	-.09	-.10	.05
0.6	.07	.24	-.14	-.01	.00	.21
1.0	.05	.37	-.19	-.10	+ .10	.04
1.3		.52				
1.6		.49				
2.0	.12	+ .45	-.16	-.19	-.14	-.27
2.3		.59 ←				
2.6		.60				
3.0	.08	.51	-.44	-.48	+ .01	-.12
3.3		.68 *	-.38	-.48	+ .32	
3.6		.54	-.52	-.54		-.28
4.0	-.21	.50	-.62	-.55	.08	-.48 *
4.3	-.31	.50	-.55	-.63		-.34
4.6	-.33	.38	-.74	-.73		-.17
5.0	-.52 *	.33	-.75	.75 *	-.02	-.33
5.3	-.46			-.75		-.25
5.6	-.49		-.78	-.70	-.24	+ .20
6.0	-.51	.20	-.78 *	-.86 *	-.30	+ .14
6.3	-.47					
6.6	-.44					
7.0	-.42	.10	-.58	-.82	-.33	-.18
7.3					-.55 *	
7.6					-.42	
8.0	-.20	.08	-.10	-.57	-.39	+ .03
8.3					-.25	
8.6					+ .05	
9.0	-.03	-.02	-.12	-.31	+ .17	+ .06
9.5				-.25		
10.0	set ✓	set ✓	set ✓	set ✓	set ✓	set ✓

STANDARDS USED:

RV 622 Dekavider  
MV -07C Micro Micro Ammeter



## Inter-Office Communication

To: Jerry Shannon

Date: August 2, 1965

From: Ken Jacobs

# BEAVERTON

Subject: Test Results on DC Voltage Bridges.

Enclosed are test results on 6 Tektronix DC Voltage Bridges at High Voltage.

The ratio was adjusted to within 0.02% of nominal at 1000V. Tests were then conducted at 5000V and 10,000V DC. Results show errors after the divider appeared to have reached equilibrium. (The divider drifts for several minutes.)

The results are believed to be accurate within 0.005% at 1000V, 0.1% at 5000V, and 0.2% at 10,000V.

*Kenneth Jacobs*

