SEMCOR CAPACITOR ANALYZER
MODEL RC115

SEMCOR

HATO REY, PUERTO RICO

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MODEL RC115

I GENERAL

1. Purpose and Use

The Semcor Capacitor Analyzer is designed to measure all the essential properties of capacitors, under design conditions. It is designed for use in all divisions of electronic work. The Semcor Analyzer can be used to make direct measurements, of sufficient practical accuracy, of capacity, % power factor, leakage current, and insulation resistance. Turns ratio and impedance ratio of transformers can also be measured.

2. Characteristics

Power Input: 115V AC 25 Watts 50/60 Cycle

Capacitance Ranges: 1 MMF to 2000 MF

Accuracy:

C1 Scale	1 MMF to 100 MMF ± 3% + 1 MMF
C2 Scale	.0001 MF to .00015 MF ± 5% .00015 MF to .001 MF ± 3% .001 MF to .005 MF ± 5%
C3 Scale	.001 MF to .1 MF ± 3% .1 MF to .5 MF ± 5%
C4 Scale	.1 MF to 10 MF ± 3% 10 MF to 50 MF ± 5%
C5 Scale	45 MF to 50 MF ± 5% 50 MF to 200 MF ± 3% 200 MF to 2000 MF ± 5%
	% Power Factor -0-55% ± 10% of Full Scale

Insulation Resistance Measurement: 0-20K Megohms

Full Scale Accuracy: ± 10% Linear Full Scale Distance

Current and Voltage Ranges:

0-60 Volts	0-600 Volts
0-6 Ma	0-60 Ma

Accuracy ± 5% of Full Scale

Impedance Ratio and Turns Ratio: Tolerance ± 10% of Full Scale Degrees.

Ranges: Turns Ratio 1 - 1 to 100 - 1

Imp. Ratio 1 - 1 to 10K - 1

3. Accessories and Spare Parts

A. Tube Compliment

V1 - 1619 Tube - Voltage Regulator
V2 - 1629 Tube - Electron Ray Tube
V3 - 6C4 Tube - Triode Amplifier

B. Fuse

1 Amp

C. Test Leads

1 - 3 ft. Red Rubber Covered
1 - 3 ft. Black Rubber Covered

One end of both leads have a plastic covered alligator clip.

II OPERATION

For **SAFETY** release all buttons before connecting components to terminals A, B and C.

In the following procedure it is assumed that the Analyzer is connected to a 115V 50/60 cycle outlet and that the power switch is turned on.

1. Capacitance and Power Factor Measurements

A. Before connecting components to any terminals be sure all push buttons are released.

B. With no connections to terminals A, B or C set the RC115 to the C1 range and phase the line cord for the lowest zero capacity reading.

C. Connect capacitor to terminals B and C. Capacitors on the C1 and C2 ranges, if possible, should be connected directly to the binding posts without the use of the test leads. Stray a.c. pickup and the added capacity of the test leads can be large enough to affect the accuracy on the low scales. Observe polarity when connecting electrolytics to the binding posts.

D. Move the turns ratio and capacitance range switch to capacitance ranges.

E. Set the power factor switch and depress the desired push button following the chart below.

Capacitance	Push Button	P.F. Switch	Scale
1 - 100 MMF	1	C1	C1
.0001 - .001 MF	1	0-20	C2
.001 - .1 MF	2	0-20	C3
.1 - 50 MF	3	0-20	C4
50 - 2000 MF	4	0-20	C5

F. Slowly rotate the main dial until the shadow of the tuning eye opens. Then carefully adjust the dial for maximum eye shadow. Read directly from the proper scale the value of the capacitor under test.

G. When checking capacitors on the C4 and C5 scales the % P.F. control must either be at zero or balanced for maximum shadow along with the main dial.

H. When testing electrolytic capacitors first balance the bridge as in F. Then rotate the % P.F. control for maximum eye shadow. Repeat both these steps until a sharp maximum shadow is obtained. If Balance cannot be obtained with the % P.F. switch in the 0 - 20 position move it to the 20 - 40 or the 40 - 55% position and rebalance.

I. When the maximum balance is reached read the capacitance directly from the correct scale of the main dial and the % power factor directly from the correct % P.F. scale.

J. When using a 50 cycle line frequency multiply the % P.F. reading by 0.84.

K. On the C1 and C2 ranges if the test leads must be used it is best to first set the test leads as they would be used except for connecting them to the capacitor under test.

Then read the capacity measured on the main dial. Deduct this capacity value from the measured value of capacity being tested.

L. Continued flickering of the tuning eye is most likely caused by an intermittent capacitor. An open capacitor will cause the eye to open at the low end of the scale. A shorted capacitor will cause the eye to open at the high end of each scale.

M. Before removing components from terminals A, B and C, release all push buttons.

N. The charts below list capacitance tolerance according to RETMA specifications.

For Tubular Paper Capacitors

Nominal Capacitance in MFD	Capacitance Tolerance
.001	- 25% + 60%
.002	- 25% + 60%
.003	- 20% + 40%
.005	- 20% + 40%
.1	- 20% + 40%
.02	- 20% + 20%
.03	- 20% + 20%
.05	- 20% + 20%
.01	- 20% + 20%
.15	- 20% + 20%
.25	- 10% + 20%
.5	- 10% + 20%
1.0	- 10% + 20%

For Ceramic and Mica Capacitors

Not marked or coded: 20%
Color coded: ± 2, 3, 5, 10 and 20%

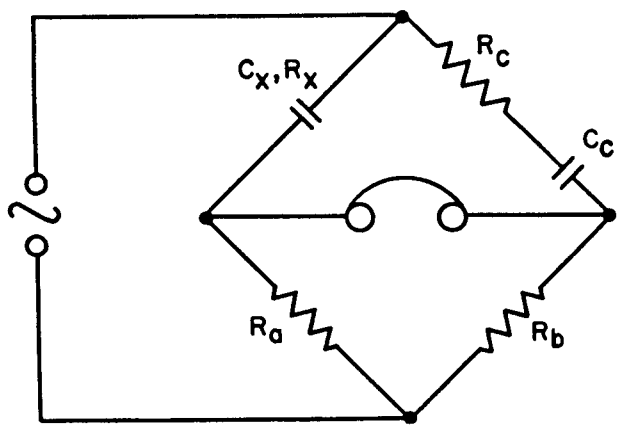
For DC Wet Electrolytics

Peak Voltage	Power Factor
600	65%
550	55%
500	45%
450	40%
400	40%
300	35%

For DC Dry Electrolytics

Working Voltage	Maximum 60 Cycle Power Factor (When New)	Power Factor Limit (Replace if Higher)
450	15%	35%
400	15%	35%
350	15%	35%
300	15%	35%
250	18%	35%
150	20%	40%
50	25%	50%
25	30%	55%
15	50%	60%
10	55%	65%
6	60%	70%

O. Basic Wein Bridge Circuit for Measuring Unknown Capacity

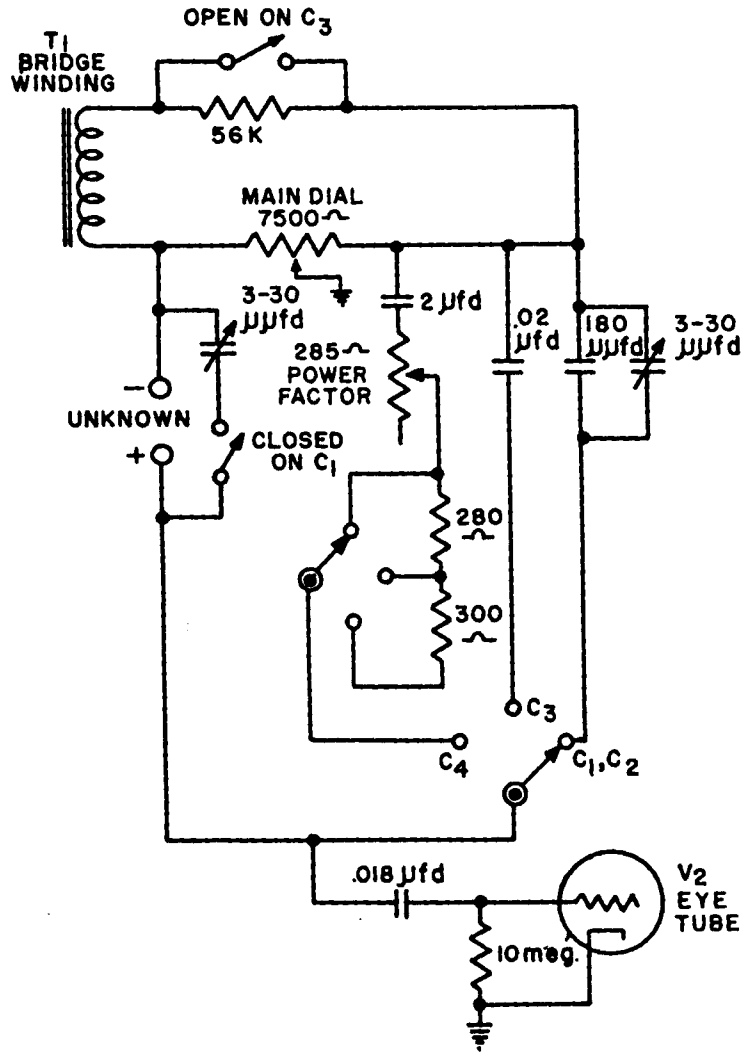


$$R_x = \frac{R_a}{R_b} R_c$$

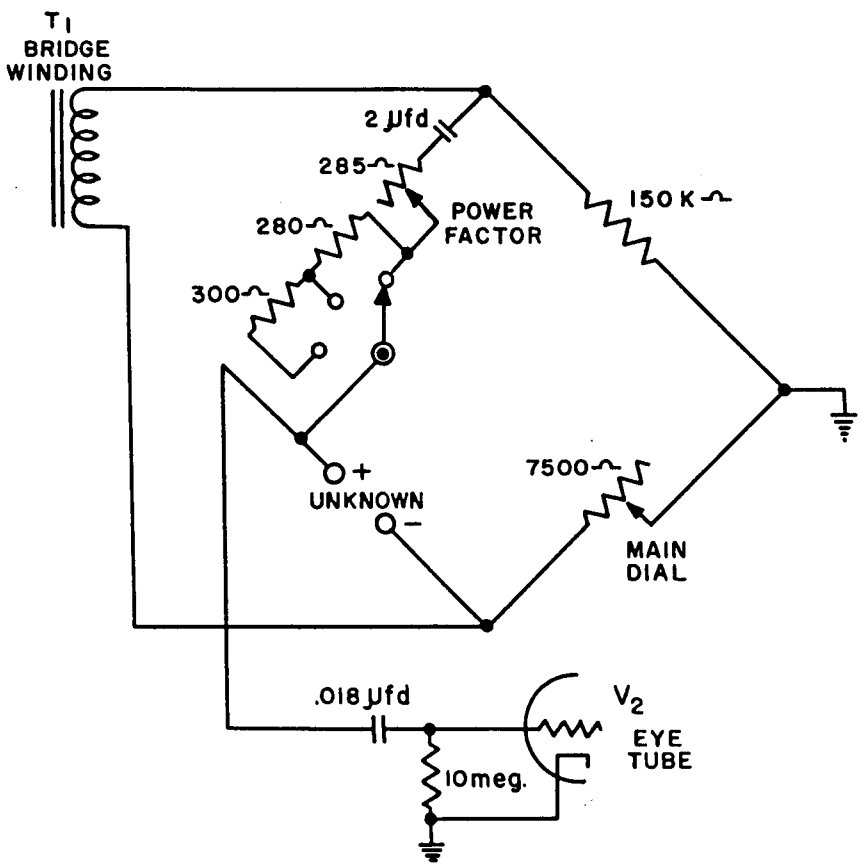
$$C_x = \frac{R_b}{R_a} C_c$$

P. The following diagrams show the basic capacity measuring circuits of the RC115 Capacitor Analyzer.

Basic Bridge Circuit for the C1, C2, C3 and C4 Capacitance Ranges

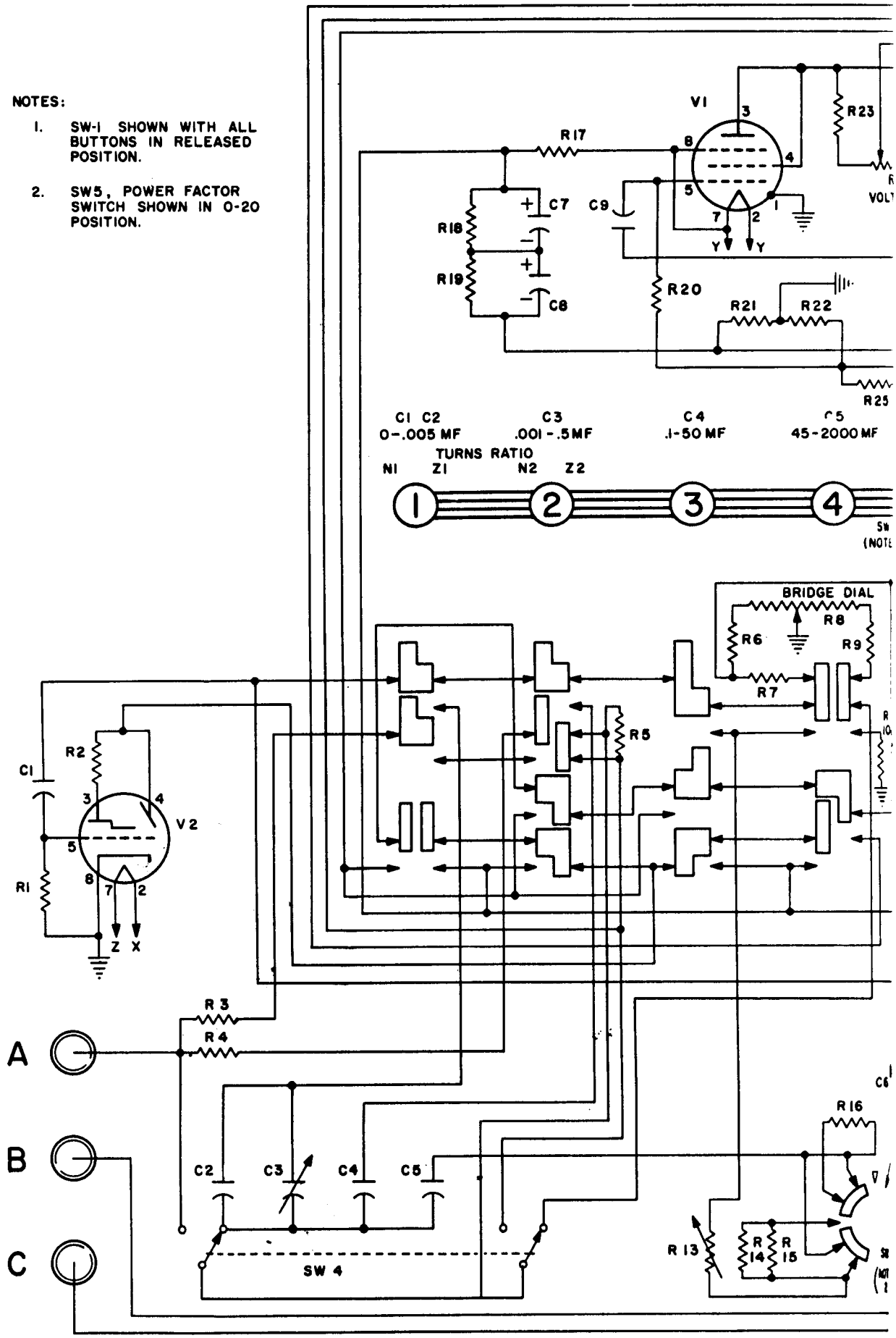


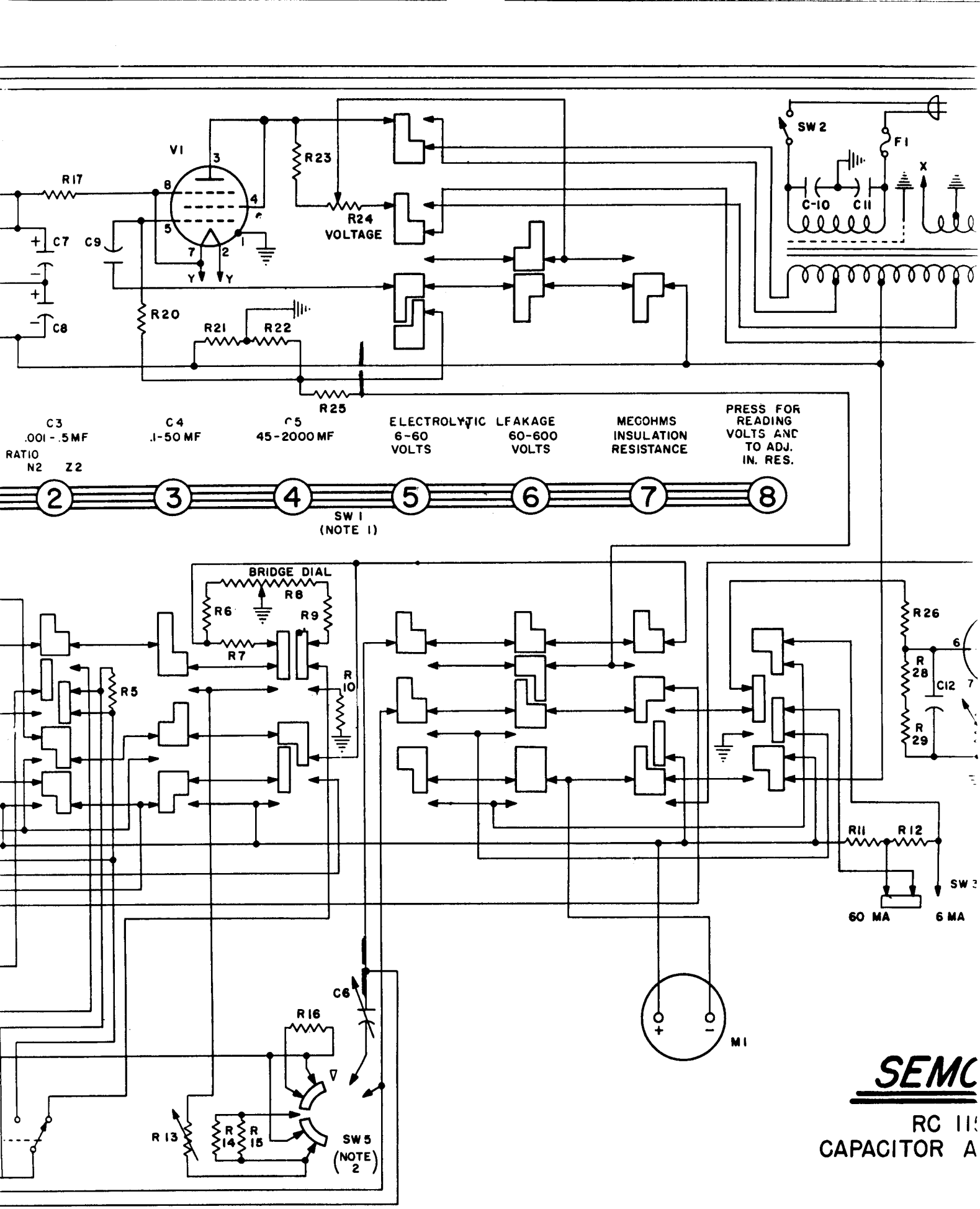
Basic Circuit for the C5 Extended Range



NOTES:

1. SW-1 SHOWN WITH ALL BUTTONS IN RELEASED POSITION.
2. SW5, POWER FACTOR SWITCH SHOWN IN 0-20 POSITION.





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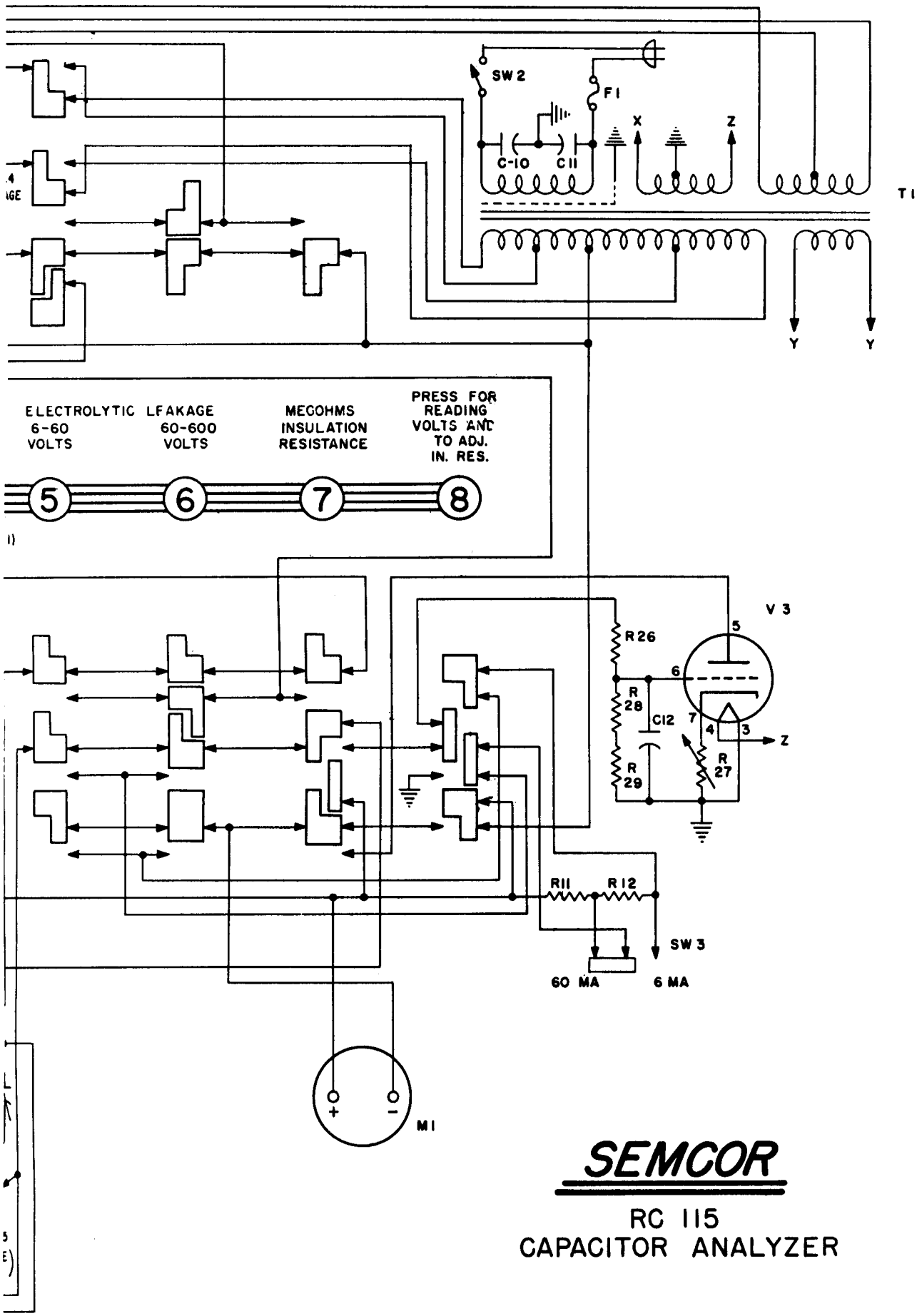
RC 11
CAPACITOR A



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RC 115
CAPACITOR ANALYZER

2. Electrolytic Leakage Current

A. Set the voltage control fully counterclockwise. Release all push buttons.

B. Connect the electrolytic capacitor to terminals B (+) and C (-) observing polarity.

C. Depress either button 5 or 6 for the desired voltage range required to test the capacitor.

D. Depress button 8 and adjust the voltage control to read the desired voltage on the volts d.c. scale. Divide readings by 10 when using the 6 - 60 volt range on button 5.

E. Release button 8 and read the electrolytic leakage current directly on the ma d.c. scale. Follow the chart below when taking readings on the ma d.c. scale.

Electrolytic Leakage Voltage Button	Electrolytic Leakage Current Switch Pos.	0 - 60 MA D.C. Scale Reading
6	60 MA	Read Direct
6	6 MA	Divide by 10
5	60 MA	Read Direct
5	6 MA	Divide by 10

F. If the reading drops below the red dot at the 6 ma mark of the 0 - 60 ma d.c. scale move the leakage current switch to the 6 ma position for a more accurate reading.

G. The tables below are RETMA standards for leakage current of electrolytic capacitors.

New Dry Electrolytics

$I = KC + 0.3$

C = rated capacitance in microfarads

I = leakage current in milliamperes

K = a constant as given in the table below

DC Working Volts	K
3 - 100	0.01
101 - 250	0.02
251 - 350	0.025
351 - 450	0.04

New Wet Electrolytics

$I = KC$

C = rated capacitance in microfarads

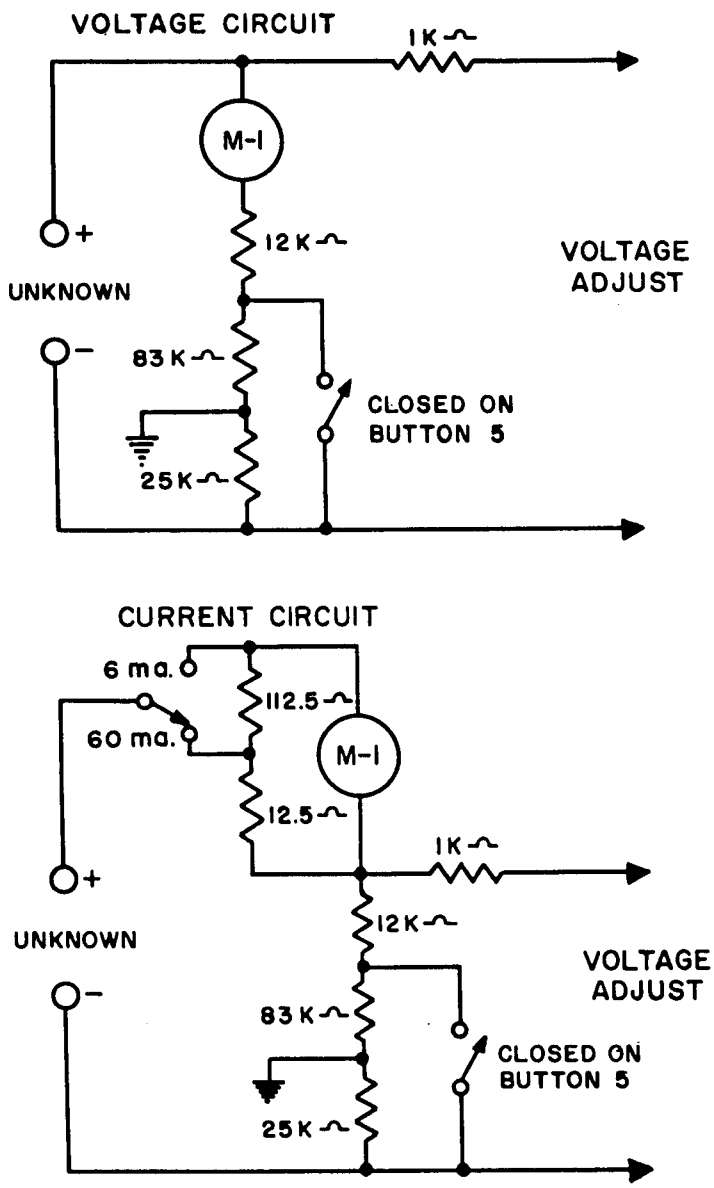
I = leakage current in milliamperes

K = a constant as given in the table below

DC Peak Volts	K
300	0.10
400	0.15
450	0.20
500	0.25
600	0.30

H. Release all push buttons before disconnecting components from terminals A, B and C.

1. Basic Circuits for Measurement of Electrolytic Leakage Current.



3. Insulation Resistance

A. For testing paper, mica and ceramic condensers etc. and for checking high megohm values of resistance.

B. Be sure all push buttons are released before making connections to terminals A, B and C.

C. Connect component to be tested to terminals B and C.

D. With the voltage control set fully counterclockwise depress button 7.

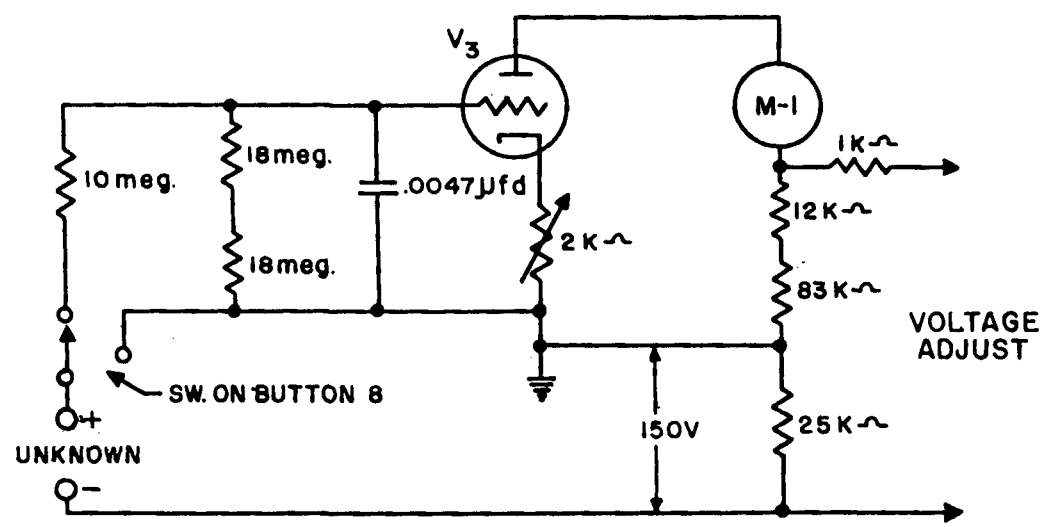
E. Depress button 8 and adjust the voltage control until the meter reads "adj." on the megohms insulation scale.

F. Release button 8 and wait for the pointer to settle to a stable reading. Read the upper meter scale directly in megohms.

G. The following chart lists average values for insulation resistance of capacitors.

Type of Capacitor	Insulation Resistance
Paper tubular	1000 megohm microfarads
Standard mica	over 3000 megohms
Silver mica	over 6000 megohms
Ceramic	over 7000 megohms

H. Basic Insulation Resistance Circuit



I. The meter (M1) is calibrated directly in megohms. The 150 V reference voltage across R21 is used to calibrate the meter. On the release of button 8 the bias on V3 varies with the value of resistance across terminals B and C. The following change of plate current flowing through the meter varies it to read directly in megohms.

J. For large values of capacity considerable time may be needed for the needle to come to rest before taking an accurate reading.

4. Turns Ratio and Impedance Ratio

A. For the measurement **ONLY** of laminated core transformers etc.

B. Set the turns ratio and capacitance range switch to the turns ratio position.

C. Release all push buttons before making any connections to terminals A, B and C.

D. Connect to terminals A, B and C the transformer to be measured. Connect the windings in series, the common leads going to terminal B. The winding with the smallest number of turns must be connected to terminals B and C.

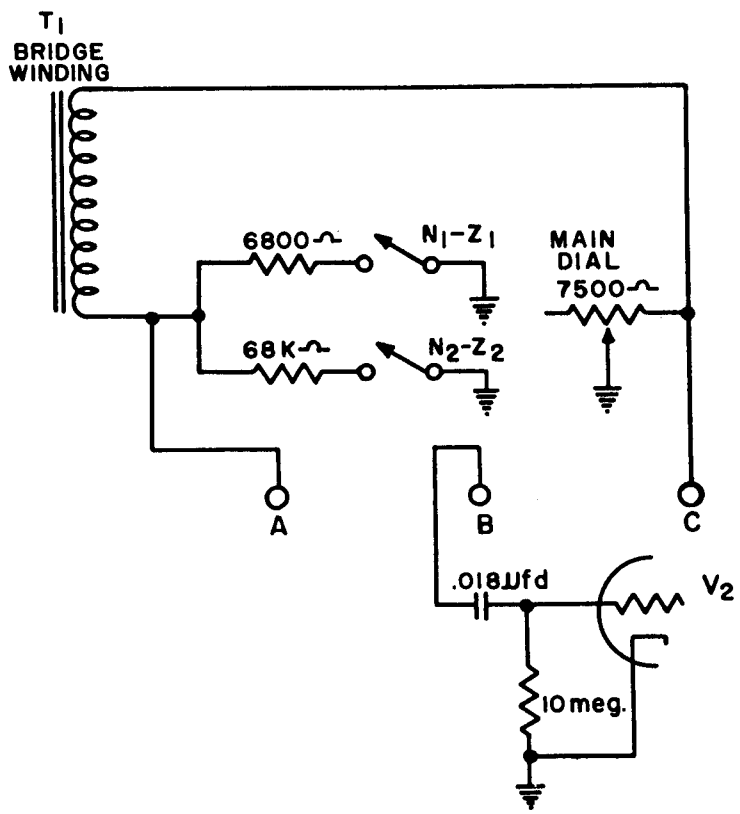
E. Depress button 1 or 2 following the chart below:

Depress Button	Turns Ratio	Read Turns Ratio on Scale	Read Impedance Ratio on Scale
1	1:1 to 10:1	N1	Z1
2	10:1 to 100:1	N2	Z2

F. Rotate the main dial for maximum shadow of the tuning eye. Read directly from the main dial according to the chart above. If a balance cannot be obtained reverse one set of the transformer leads and rebalance the main dial for maximum tuning eye shadow.

G. Release all buttons before disconnecting transformer from terminals.

H. The diagram for the basic ratio bridge is shown below.



III NOTES

1. For **SAFETY** release all buttons before making any connections to terminals A, B and C.

2. For **SAFETY** release all buttons before disconnecting any components from terminals A, B and C.

3. With no connections to terminals A, B or C set instrument to the C1 range and phase the line cord for the lowest zero capacity reading.

4. Never connect the RC115 to a d.c. power line. If operation from d.c. should be necessary, use a inverter power supply (either rotary or vibrator type).

5. The tuning eye (V2) only glows using buttons 1 to 4.

6. To avoid parallax error, always read the main dial with your eye directly in front of the indicator line.

2. PARTS LIST FOR RC-115

R_{17}	1000 OHM	CARBON RESISTOR	± 5%	5 WATT
R_{18}) R_{19}) R_{2})	470,000 OHM	CARBON RESISTOR	± 10%	½ WATT
R_{20}	3.3 MEG	CARBON RESISTOR	± 10%	½ WATT
R_{23}	560,000 OHM	CARBON RESISTOR	± 10%	1 WATT
R_{24}	500,000 OHM	POTENTIOMETER	± 20%	½ WATT
R_{21}	25,000 OHM	RESISTOR (1)	± 2%	2 WATT
R_{22}	83,000 OHM	RESISTOR (2)	± 2%	4 WATT
R_{25}	12,000 OHM	CARBON RESISTOR	± 2%	1 WATT
R_{8}	7,500 OHM	POTENTIOMETER *	± 5%	3 WATT
R_{6}) R_{9})	0–100 OHM	FLEXIBLE WIRE RESISTOR (3)		
R_{7}	150 OHM	CARBON RESISTOR	± 20%	2 WATT
R_{5}	56,000 OHM	CARBON RESISTOR	± 10%	½ WATT
R_{10}	150,000 OHM	DEPOSITED CARBON RESISTOR *	± 1%	½ WATT
R_{1}) R_{26})	10 MEG	CARBON RESISTOR	± 10%	½ WATT
R_{3}	6800 OHM	CARBON RESISTOR *	± 10%	2 WATT
R_{4}	68000 OHM	CARBON RESISTOR *	± 5%	½ WATT
R_{13}	285 OHM	POTENTIOMETER	± 5%	2 WATT
R_{14}) R_{15})	560 OHM	CARBON RESISTOR	± 10%	1 WATT
R_{16}	300 OHM	CARBON RESISTOR	± 5%	1 WATT
R_{28}) R_{29})	18 MEG	CARBON RESISTOR	± 10%	½ WATT
R_{27}	2000 OHM	SCREW DRIVER POTENTIOMETER	± 20%	1.5 WATT
R_{11}	12.5 OHM	FLEXIBLE WIRE RESISTOR	± 2%	1 WATT
R_{12}	112.5 OHM	FLEXIBLE WIRE RESISTOR	± 2%	1 WATT
C_{10}) C_{11}) C_{9}) C_{1})	.018 MFD	CAPACITOR	± 10%	400 VDC
C_{7}) C_{8})	12 MFD	CAPACITOR		450 VDC
C_{2}	180 MMF	SILVER MICA CAPACITOR	± 5%	500 VDC
C_{3}) C_{6})	3.30 MMF	TRIMMER CAPACITOR		
C_{4}	.02 MF	CAPACITOR	± 2%	400 VDC
C_{5}	2 MF	CAPACITOR	± 2%	400 VDC
C_{12}	.0047 MF	CAPACITOR	± 20%	400 VDC

SW_1	8 PUSH BUTTON SWITCH
SW_2	SLIDE SWITCH, SPST
SW_3	SLIDE SWITCH, SPDT
SW_4	SLIDE SWITCH, DPDT
SW_5	ROTARY SWITCH, 2 POLE 4 POSITION
T_1	TRANSFORMER, FILAMENT, POWER AND BRIDGE.
F_1	CARTRIDGE FUSE, 1 AMP, TYPE 3AG
V_1	ELECTRON TUBE #1619
V_2	ELECTRON TUBE #1629
V_3	ELECTRON TUBE #6C4
M_1	MILLIAMMETER, 0–5 MA. D.C., INTERNAL RESISTANCE 25 OHM ± 2%, SPECIAL SCALE.

NOTE:

(1) R_{21} CONSISTS OF TWO 1 WATT RESISTORS IN SERIES, ONE 12000 OHM AND ONE 13,000 OHM RESISTOR.

(2) R_{22} MADE FROM TWO 2 WATT RESISTORS IN PARALLEL, ONE 220,000 AND ONE 130,000 OHM RESISTOR.

(3) R_6, R_9 PICKED WITH R_8.

(4) C_4 AND C_5 GRADED, FROM NOMINAL, PLUS OR MINUS IN THE SAME DIRECTION TO WITHIN ½% OF EACH OTHER RESPECTIVELY.

(5) DENOTES SELECTED VALUES.