1418-1, Experiment 2

A Simple Way to Measure Capacitance
Using the 60Hz AC Source on your Trainer

• You can count on the Frequency of this AC signal to be very close to 60Hz.

• It is likely you will measure voltages substantially different than the 15VAC and 30VAC marked on the trainer.
• For example: If you are using the 30VAC source; you could measure as little 25 and as much as 36VAC.

– One reason for this is; your local power line voltages vary from one area to another. The AC from the trainer comes from a simple transformer winding and the output will depend on what the line voltage is, in your area.
The transformer in the trainer is manufactured with wide tolerances.

- When you perform the experiments in this and other lessons, do not be surprised to find your results are not the same as listed in the “CIE Results” sections.
• These experiments have been designed so that the findings do not depend on the actual magnitudes of the voltages, but rather are determined by the *frequency* involved, namely 60Hz.
You will be using either the PTL 3 or the PTL 4 Trainer for the Experiments.
Here is the PTL 4 Trainer
The circuit below uses only a small section of the trainer as you will see.

Terminal 1

A

C1

470nF

B

Terminal 2 not used

Terminal 3

E = 30VAC

60 Hz

R1

100kΩ

Terminal C

ER
Suggested Procedure

1. Construct the circuit

2. Apply the 30 VAC to terminals A & C
   
   i. Your goal is to have $V_C$ equal to $V_R$
      
      a. Place Common (Black) lead at Terminal B.
      
      b. Place a jumper post at point B in your circuit.
c. Clip the Black meter probe lead to the post with an alligator clip or lead.

d. Move the Red lead/meter probe between Terminals A and C.
   i. Make small adjustments on the pot.
   ii. Keep making these adjustments and keep measuring the AC voltage at points A and C until A = C.

e. Record measured values in Fig 4 of 1418 where indicated.
3. Shut off the power to the trainer.
4. Disconnect the potentiometer (variable resistor) from the circuit.
5. Measure the resistance between pins 1 and 2 and record it in the table in Fig 4 of 1418-1.
6. Calculate $X_C$ using 0.47\(\mu\)F

7. Now calculate the capacitance using the measured value of $R$ from the experiment. Use the formula below.

\[
C = \frac{1}{2\pi f X_c}
\]
8. Lastly, you will be calculating the percentage of error and writing that in your data table in Fig 4 of 1418-1

I. Use the formula below.

$$\frac{\text{measured value from step 7} - \text{theoretical value (0.47}\mu\text{F})}{\text{theoretical value}} \times 100\%$$

$$\%\text{ error} = \frac{\text{theoretical value minus measured value}}{\text{theoretical value}} \times 100\%$$
Questions?
The End

Developed and Produced by the Instructors in the CIE Instruction Department.

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