AC Bridges : Measuring Capacitance using de Sauty and Schering Bridges

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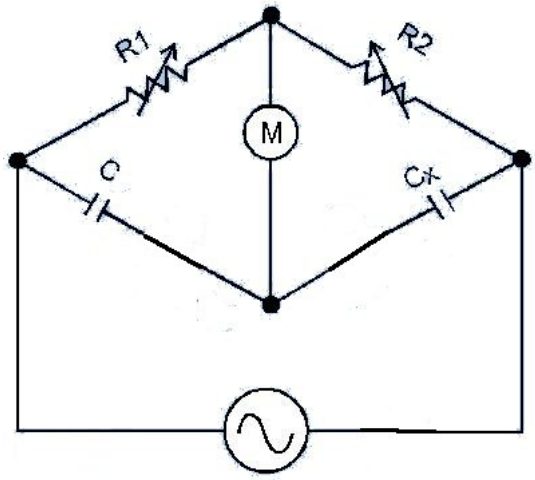
Aim

To measure the value of the unknown capacitance using the method of de Sauty and Schering bridges.

1 Theory

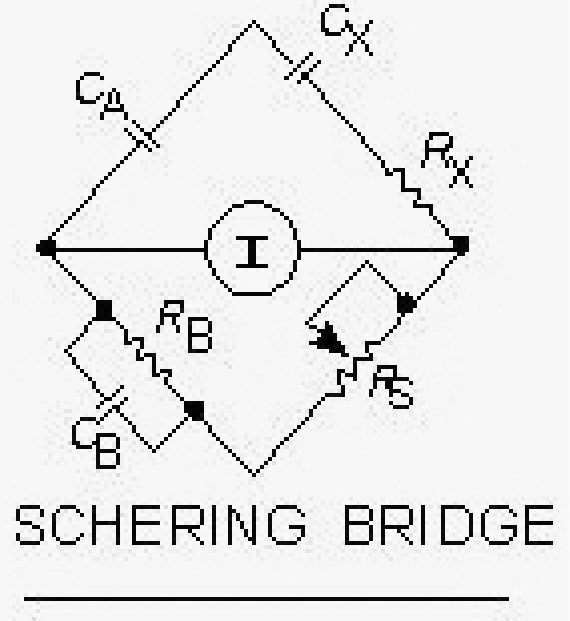
Bridges are the some of the most accurate measuring devices for measuring impedance, capacitance, resistance,etc. For our purpose, i.e. for measuring Capacitance, using a de Sauty's or Schering bridge is best. They are based on the principle of Wheatstone bridge that they have two arms. One of which has the unknown parameter. By getting the bridge balanced using the Null detector we can find this value.

The de Sauty's bridge is a direct carry over of the Wheatstone bridge with the DC source replaced by an AC source. The null detector we will be using also has an amplifier where the gain can be adjusted. This is connected to DMM which is used for getting the null point. The bridge is as follows.



We can use the principle of wheat stone bridge to calculate C_x as $C_x = \frac{R_1 C}{R_2}$.

A Schering bridge is a alternating-current bridge used to measure capacitance and dissipation factor; bridge balance is independent of frequency.It is an improvement over the de Sauty Bridge in that it enables an accurate measurement of very low capacitance too due to the parallel capacitor element which is useful in getting the sensitivity for a better balance. Though the bridge takes longer for the balancing. The bridge setup is as follows.



2 Procedure

Connect the circuit as shown in the figures above. For the de Sauty bridge, set the frequency to about 1KHz on the function generator and set the gain on the null detector to max. Now balance the bridge by varying the capacitance(C) and resistance (R_2) until we get the most stable and best null point. Do this for various values of R_1 and also for different frequencies.

For Schering bridge, do the same as above and balance the bridge with the extra fact that use the Capacitance box given in parallel to get a stable balance. From the read off values we can calculate the unknown capacitance as $C_x = \frac{R_s C_A}{R_B}$.

3 Observations and Results

de Sauty bridge

Frequency $= 1.073KH$

S.No	$R_1\ \Omega$	$R_2\ \Omega$	$C\ \mu F$	$C_x\ \mu F$
1	400	400	0.4493	0.4493
2	300	403	0.5877	0.4375
3	400	298	0.3359	0.4509
4	400	492	0.5473	0.4450
5	500	400	0.3558	0.4447
6	4000	4000	0.4528	0.4528
7	1000	1000	0.4458	0.4458

Frequency $= 15.13KHz$ The stabilization gets more difficult with a increase in frequency. Otherwise there is not change in the value. The experiment ids independent of the frequency.

S.No	$R_1\ \Omega$	$R_2\ \Omega$	$C\ \mu F$	$C_x\ \mu F$
1	500	500	0.4432	0.4432
2	200	203	0.4423	0.4356
3	400	308	0.3658	0.4751
4	300	204	0.3029	0.4454

Frequency $= 1.073KhZ.$ The factory value of unknown resistance is $4.7\mu F$

S.No	$R_1\ \Omega$	$R_2\ \Omega$	$C\ \mu F$	$C_x\ \mu F$
1	1000	1000	4.9873	4.9873
2	400	406	4.4996	4.4331
3	400	305	3.2868	4.3106
4	300	398	5.9543	4.4882
5	200	396	9.0243	4.5577
6	400	205	2.2065	4.4054

- From table 1, the value of unknown resistance is $= 0.446\mu F$
- From table 2, the value of unknown resistance is $= 0.449\mu F$
- From table 3, the value of unknown resistance is $= 4.4487\mu F$
- The value of capacitance 1 using the LCR bridge equipment is $0.454\mu F$.
- The value of capacitance 2 using the LCR bridge equipment is $4.452\mu F$.

Schering Bridge

Frequency =$1.003KHz$.

S.No	$R_x\ \Omega$	$R_B\ \Omega$	$C_A\ \mu F$	
1	1000	483	1	0.4830
2	1200	597	1	0.4875
3	800	367	1	0.4587
4	700	312	1	0.4457
5	600	269	1	0.4479
6	500	223	1	0.4465

The value of unknown capacitance is $= 0.461\mu F$. We have seen a general trend that the bridge balance is better at lower resistance values. So, if we take the better stabilized values, then the value of capacitance is $= 0.449\mu F$.