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2K20/A6/56

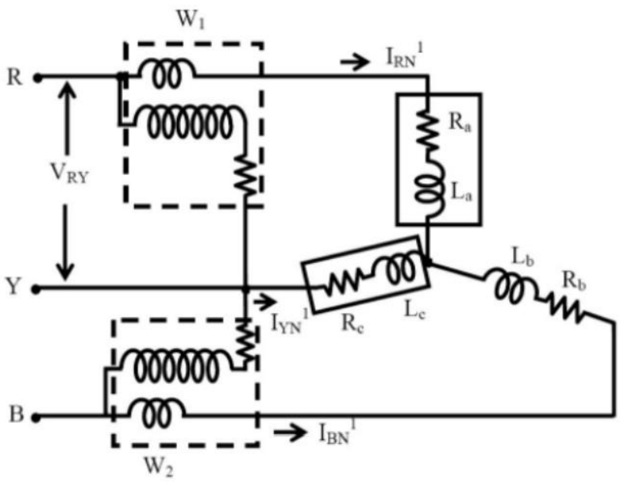
Experiment 6

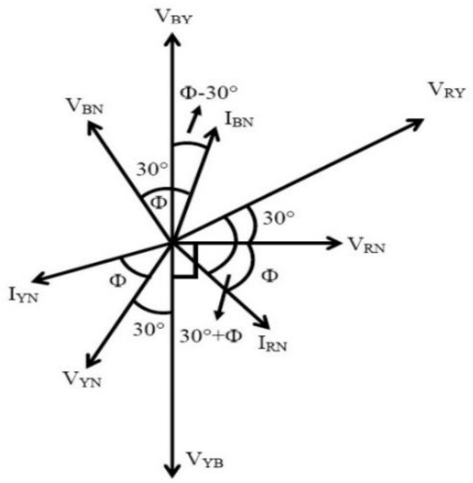
Aim:

Three phase power measurement by two wattmeter method.

Theory:

The connection diagram for the measurement of power in three phase power measurement circuit using two wattmeter's method is shown in Fig. This is irrespective of the circuit connection star or delta. The circuit may be taken as balanced or unbalanced one, balanced type being only a special case. Please note the connection of two wattmeters. The current coils of the wattmeter 1 and 2 in series with R and B phase with the pressure voltage coils being connected across R-Y and B-Y respectively. Y is the third phase in which no current coil is connected.
If star connected circuit is taken as an example the total instantaneous power consumed in the circuit is,
$W1 + W2 = I_{RN}V_{RN} + I_{BN}V_{BN} + I_{YN}V_{YN}$



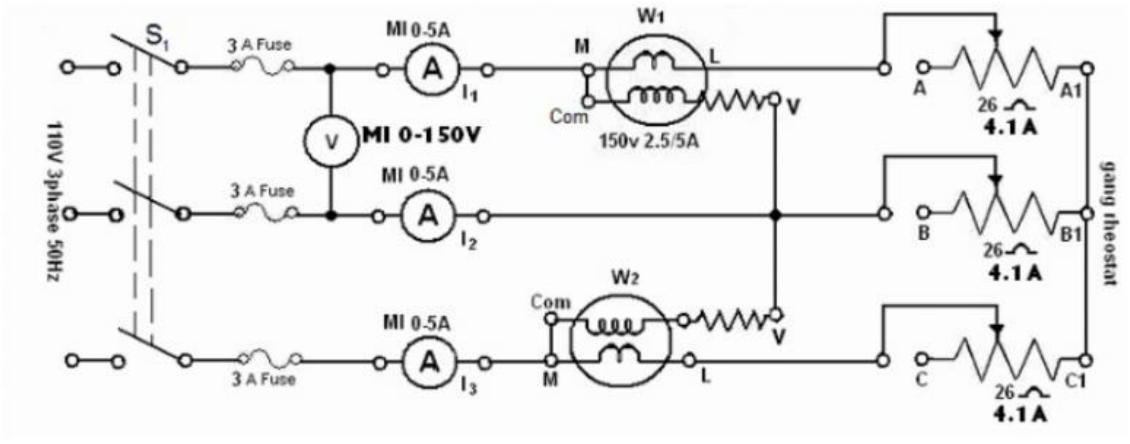


Each of the terms in the above expression equation is the instantaneous power consumed by the phases. From the connection diagram, the circuit in and the voltages across the respective (current, pressure or voltage) coils in the wattmeter, W1 are I_{RN} and $V_{RY} = V_{RN} - V_{YN}$. So, the instantaneous power measured by the wattmeter W1 is $W1 = I_{RN}V_{RY}$. Similarly the instantaneous power measured by the wattmeter W2 is $W2 = I_{BN}V_{BY} = I_{BN}(V_{BN} - V_{YN})$. Sum of the two readings as given above is,
$W1 + W2 = I_{RN}(V_{RN} - V_{YN}) + I_{BN}(V_{BN} - V_{YN})$

As we know $I_{RN} + I_{YN} + I_{BN} = 0$. Thus,
$W1 + W2 = I_{RN}V_{RN} + I_{BN}V_{BN} + I_{YN}V_{YN}$

1st Equation is compared with this equation to give the total instantaneous power consumed in the circuit. They are found to be same. The phasor diagram of three phase balanced star connected circuit is shown in the figure.

Procedure:



Three phase power measurement circuit under balanced condition

1. For balanced load condition, connect the circuit as shown in Fig.
2. Adjust the ganged rheostat for the maximum resistance.
3. Switch on the supply.
4. Close switch S_1. Read the meters to obtain V_L, I_1, I_2 and I_3.
5. Note the wattmeter reading W1 and W2 (Note the multiplying factor on the wattmeter).
6. Vary the load resistance and obtain five sets of observations, note that the current should not exceed the limit.

Observations:

Serial no. of Observation	V_{RY}	I_R (Amp)	Cos(V_{RY}, I_R)	V_{BY}	I_B (Amp)	Cos(V_{BY}, I_B)	I_3(Amp)	W_1	W_2	W_C (Calculated power)	W_M(Measured Power=W_1+W_2)
1st	100	2.3093977	0.8652280	100	2.3093977	0.8669190	2.3093977	199.81557	200.20609	399.99885	400.02166
2nd	150	3.4640966	0.8652280	150	3.4640966	0.8669190	3.4640966	449.58503	450.46371	899.99742	900.04874
3rd	150	1.7320483	0.8652280	150	1.7320483	0.8669190	1.7320483	224.79251	225.23185	449.99871	450.02437
4th	200	2.3093977	0.8652280	200	2.3093977	0.8669190	2.3093977	399.63114	400.41218	799.99771	800.04333
5th	200	1.5395985	0.8652280	200	1.5395985	0.8669190	1.5395985	266.42076	266.94145	533.33180	533.36222

Calculations:

$$Calculated\ Power, W_C = I_{RN}V_{RY} + I_{BN}V_{BY}$$
$$Measured\ Power, W_M = W_1 + W_2$$

Error Estimation,

$$e_1 = \frac{400.02166 - 399.99885}{400.02166} X\ 100 = 0.00570219\%$$

Similarly we calculate for rest of the readings we get,

$e_2 = 0.00570191\%$, $e_3 = 0.00570191\%$, $e_4 = 0.00570219\%$, $e_5 = 0.00570344\%$

$$Average\ Percentage\ error, \%e = 0.0057\ \%$$

Results:

We have measured Three Phase Power using Two Wattmeter Method with average % error of 0.0057 %.