

IC160P-Electrical Systems Around Us

Power Measurement using Two wattmeter

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1 Objectives 1.

Measurement of power in a three phase AC circuit using two wattmeter methods.

2 Apparatus & Equipment Used

Sl. No.	Equipment	Type	Specification	Quantity
1.	Wattmeter	Dynamometer	5/10A, 150/300/600 V	2
2.	Ammeter	Moving iron	0-5-10 A, AC	1
3.	Voltmeter	Moving iron	0-300-600 V, AC	1
4.	Balanced Load, 3-Phase	Resistive	2Kw, 415 V in Steps of 200 Watts	1
5.	Balanced load, 3-phase	Inductive	2K VAR, 415 V, 2.75 A, 3-phase Variable	1

3 Theory

Power consumed by a 3-phase balanced or unbalanced load (star connected) can be measured by using 2-wattmeters properly connected in the circuit. The current coil of the wattmeter is connected in series with the load in any two lines. Where as the pressure coils are connected between these two lines and the third line. The phasor diagram of this circuit assuming balanced lagging load has been shown in the figure. Under running conditions the power consumed by the three phase system is the sum of the two individual wattmeters.

Mathematically, the total power consumed,

$$W1+W2 = \sqrt{3} VI (\cos(30-\Phi)+\cos(30+\Phi))$$

Where,

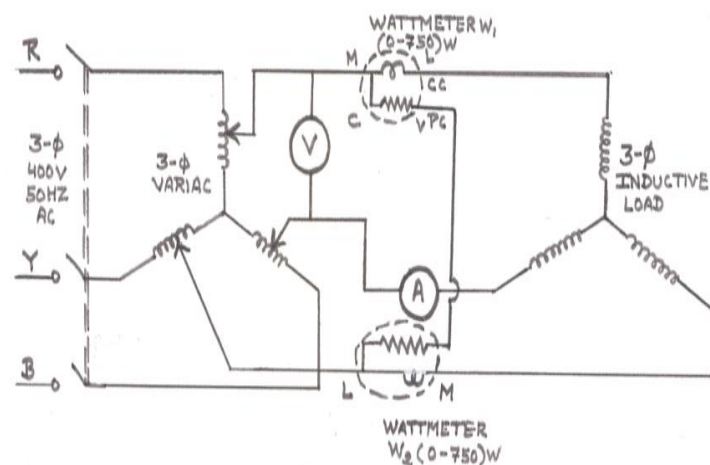
$$\text{Power consumed by wattmeter 1} = \sqrt{3} VI (\cos(30-\Phi))$$

$$\text{Power consumed by wattmeter 2} = \sqrt{3} VI (\cos(30+\Phi))$$

When the load power factor is less than 0.5 then wattmeter 2 will show the correct deflection and first wattmeter will show the reverse deflection. In the first wattmeter the current coil or voltage coil connection is reversed. Thus the wattmeter pointer direction is corrected. The net power is obtained by adding the two wattmeter readings. Power angle is given by

$$\cos \phi = \cos \left[\tan^{-1} \sqrt{3} \frac{(W1 - W2)}{W1 + W2} \right]$$

CIRCUIT DIAGRAM:



4 Procedure

1. Connect the circuit as shown in the diagram.
2. Vary the inductive load.
3. Note down the reading carefully.
4. If one wattmeter reads negative or gives reverse reading, the reading of wattmeter is taken by reversing the current coil terminal.

Voltage VL (V)	Current IL (A)	Power W1 (W)	Power W2 (W)	Total Power P=W1+W2 (W)	Power Factor =cosφ(0°)
173	0.49	80	80	160	0
105	3.15	288	192	480	0.945

5 Precautions

1. All connections should be tight.
2. All apparatus should be of suitable range and ratings.
3. Readings should be taken carefully.
4. Never touch the live wires during the experiments.

6 Results

(a) Experiment-1

1. Net power consumed, $P = 160 \text{ Watts}$.
2. Power Factor $= 1$

(b) Experiment-2

1. Net power consumed, $P = 160 \text{ Watts}$.
2. Power Factor $= 0.99$

LAB READINGS:

<div>Page No.: Date : / /</div>							
	V (V)	I (A)	R (Ω)	W_1 (W)	W_2 (W)	W (W)	p.f ($^\circ$)
①	173	0.49	200.	80	80	160	0°
②	105	3.15	20 Ω	36×8 $= 288$	24×8 $= 192$	480	0.945

$L = 18 \text{ mH}$

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