National Institute of Technology, Durgapur
Department of Electrical Engineering
Experiment No: 1

MEASUREMENT OF POWER IN SINGLE-PHASE CIRCUIT BY THREE-VOLTMETER METHOD AND THREE-AMMETER METHOD

Objective:

(i) To measure the single-phase power in a single phase a.c. circuit by using three voltmeters.

(ii) To measure the single-phase power in a single phase a.c. circuit by using three ammeters.

Apparatus Required: It consists of following instruments

Sr No	Instrument Name	Specification	Quantity	Makers Name

Theory

Power measurement in Single phase a.c. circuit by using three voltmeters

Power consumed by load= $P=V_2 I \cos \emptyset$

From the phasor diagram we can write,

$V_3^2=V_1^2+V_2^2+2. V_1. V_2 \cos \emptyset$

Power factor, $\cos \emptyset= (V_3^2-V_1^2-V_2^2)/ 2. V_1. V_2$

$I=V_1/R$

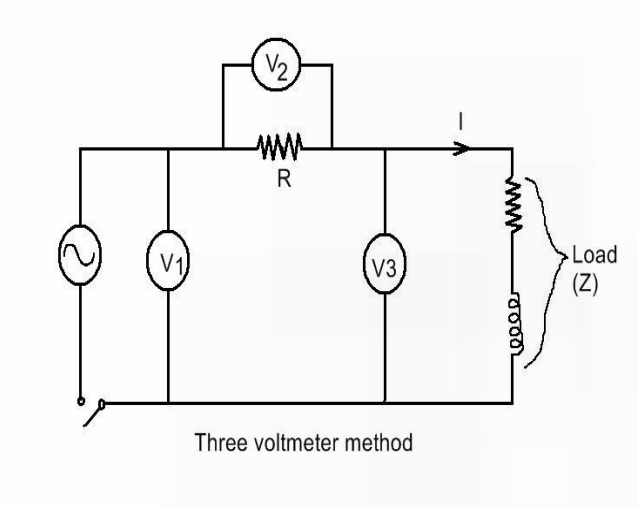
Now,

$P_{calculated} = V_2 I \cos \emptyset = V_2 (V_1/R) \cos \emptyset$

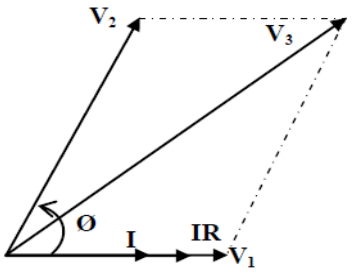
$= (V_1 V_2/R) ((V_3^2-V_1^2-V_2^2)/ 2. V_1. V_2) = (1/2R) * (V_3^2-V_1^2-V_2^2)$

From the above equation it can observed that, the power and power factor in an a.c circuit can be measured by using 3-single phase voltmeters, instead of a wattmeter.

Percentage Error = ($P_{calculated}$-Wattemter Reading) / Wattemter Reading



Three voltmeter method



Phasor diagram of the above circuit.

Single ph

Power consumed by load= $P=VI_3 \cos Ø$

From the phasor diagram we can write,

$I_1^2=I_2^2+I_3^2+2.I_2.I_3 \cos Ø$

Power factor, $\cos Ø= (I_1^2-I_2^2-I_3^2)/ 2.I_2.I_3$

$I_2=V/R$

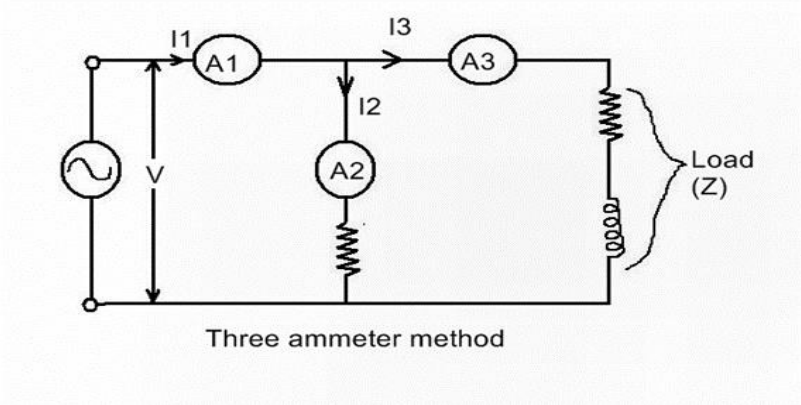
Now,

$P_{calculated} =VI_3 \cos Ø= I_2R\ I_3 \cos Ø$

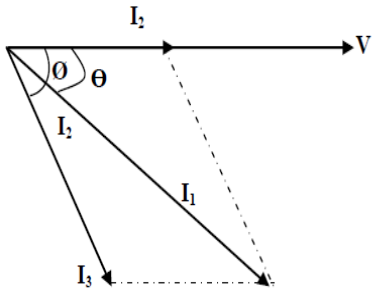
$= R\ I_2\ I_3\ ((I_1^2-I_2^2-I_3^2)/ 2.I_2.I_3) = (R/2) * (I_1^2-I_2^2-I_3^2)$

From the above equation it can observed that, the power and power factor in an a.c circuit can be measured by using 3-single phase ammeters, instead of a wattmeter.

Percentage Error = ($P_{calculated}$-Wattemter Reading) / Wattemter Reading



Three ammeter method



Phasor diagram of the above circuit.

Procedure:

Three-Voltmeter Method

1. Make connections according to circuit diagram.
2. Measure the value of R and record it in the observation table.
3. Observe V_1, V_2 and V_3 for a given load and record these in the observation table. Calculate the power and power factor for the given load.
4. Change the load resistance R, measure it (after disconnecting the voltmeter V_2) and record its value in the observation table.
5. Take another set of observation of V_1, V_2 and V_3, calculate the power and power factor and record these in the observation table.
6. Take at least three sets of observations for three different values of R and calculate the power and power factor in each case. Take mean of the calculated values of power and power factor and record in the table.

Three-Ammeter Method

1. Make connections according to circuit diagram.
2. Measure the value of R and record it in the observation table.
3. Observe I_1, I_2 and I_3 for a given load and record these in the observation table. Calculate the power and power factor for the given load.
4. Change the load resistance R, measure it (after disconnecting the Circuit) and record its value in the observation table.
5. Take at least three sets of observations for three different values of R and calculate the power and power factor in each case. Take mean of the calculated values of power and power factor and record in the table.

Experimental Results:

Table1: Three-Voltmeter Method

Sl No	R (ohm)	V_1 (Volt)	V_2 (Volt)	V_3 (Volt)	Power (Watt)	p.f	Mean	
							P	p.f

Table1: Three-Ammeter Method

Sl No	R (ohm)	I_1 (Amp)	I_2 (Amp)	I_3 (Amp)	Power (Watt)	p.f	Mean	
							P	p.f

Suggested Reading:

1. Electrical Measurement & Measuring Instrument by E.W.Golding