2 Wattmeter Method (34:38)

Given the following data, draw conclusions about total power measurement for unbalanced Y configurations:

Unbalanced 4 wire Y and balanced 3 wire Y configurations:

$\mathbf{Z_2}$ = 425Ω∠40°

$\mathbf{Z_1}$ = 345Ω∠30°

$\mathbf{Z_3}$ = 425Ω∠40°

UNBALANCED 4Y

$\bar{V}_1 = 120V∠0°$	$\bar{V}_2 = 120V∠-120°$	$\bar{V}_3 = 120V∠-120°$	$\bar{I}_N = 85.2mA∠8.1°$
$\bar{I}_1 = 347.8mA∠-30°$	$\bar{I}_2 = 282.4mA∠-160°$	$\bar{I}_3 = 282.4mA∠80°$	$\bar{S}_{TOTAL} = 109.1VA∠36.2°$
$\bar{S}_1 = 41.7VA∠30°$	$\bar{S}_2 = 33.9VA∠40°$	$\bar{S}_3 = 33.9VA∠40°$	$P_{TOTAL} = 88.1W$
$P_1 = 36.1W$	$P_2 = 26.0W$	$P_3 = 26.0W$	$Q_{TOTAL} = 61.4VAR$
$Q_1 = 20.9VAR$	$Q_2 = 21.8VAR$	$Q_3 = 21.8VAR$	

UNBALANCED 3Y

$\bar{V}_1 = 111.8V∠-3.8°$	$\bar{V}_2 = 130.7V∠-121.6°$	$\bar{V}_3 = 118.5V∠125.4°$	
$\bar{I}_1 = 324.0mA∠-33.8°$	$\bar{I}_2 = 307.5mA∠-161.6°$	$\bar{I}_3 = 278.4mA∠85.4°$	$\bar{S}_{TOTAL} = 109VA∠36.7°$
$\bar{S}_1 = 36.2VA∠30°$	$\bar{S}_2 = 40.2VA∠40°$	$\bar{S}_3 = 32.9VA∠40°$	$P_{TOTAL} = 87.4W$
$P_1 = 31.4W$	$P_2 = 30.8W$	$P_3 = 25.2W$	$Q_{TOTAL} = 65.1VAR$
$Q_1 = 18.1VAR$	$Q_2 = 25.8VAR$	$Q_3 = 21.2VAR$	

Given the following data, draw conclusions about total power measurement for unbalanced delta configurations:

Unbalanced 4 wire Y and balanced 3 wire Y configurations:

$\mathbf{Z_{AB}}$ = 345Ω∠30°

$\mathbf{Z_{BC}}$ = 425Ω∠40°

$\mathbf{Z_{CA}}$ = 425Ω∠40°

UNBALANCED DELTA

$\bar{V}_{AB} = 208V∠0°$	$\bar{V}_{BC} = 208V∠-120°$	$\bar{V}_{CA} = 208V∠120°$	$\bar{I}_1 = 897.1mA∠-60.8°$
$\bar{I}_{AB} = 602.9mA∠-30°$	$\bar{I}_{BC} = 489.4mA∠-160°$	$\bar{I}_{CA} = 489.4mA∠80°$	$\bar{I}_2 = 991.1mA∠172.2°$
$\bar{S}_{AB} = 125.4VA∠30°$	$\bar{S}_{BC} = 101.8VA∠40°$	$\bar{S}_{CA} = 101.8VA∠40°$	$\bar{I}_3 = 847.7mA∠50°$
$P_{AB} = 108.6W$	$P_{BC} = 78W$	$P_{CA} = 78W$	$\bar{S}_{TOTAL} = 327.8VA∠36.2°$
$Q_{AB} = 62.7VAR$	$Q_{BC} = 65.4VAR$	$Q_{CA} = 66.4VAR$	$P_{TOTAL} = 264.6W$
			$Q_{TOTAL} = 193.6VAR$

Illustrate how 3 wattmeters could be used to measure power in 4 wire Y, 3 wire Y, and delta configurations. Identify advantages and disadvantages of using this method.

Illustrate how the <u>two wattmeter method</u> can be used to measure total power for balanced 4 wire Y, balanced 3 wire Y, balanced delta, unbalanced 3 wire Y, and unbalanced delta configurations. Identify advantages and disadvantages of using this method. Identify the formula used to determine total power.

Identify what voltage and current each wattmeter measures using the two wattmeter method. Identify the consequences of flipped polarity.

Given an unbalanced delta configuration employing the two wattmeter method determine the total apparent, real, and reactive power given the following data.

wattmeter 1:

L_1 line current = 282.4mA$\angle$-60.8°

L_1-L_2 line to line voltage = 208V$\angle$0°

wattmeter 2:

L_3 line current = 282.4mA$\angle$50°

L_3-L_2 line to line voltage = 208V$\angle$60°

Given an unbalanced 3 wire Y configuration employing the two wattmeter method determine the total apparent, real, and reactive power given the following data.

wattmeter 1:

L_1 line current = 324mA$\angle$-63.8°

L_1-L_2 line to line voltage = 208V$\angle$0°

wattmeter 2:

L_3 line current = 278.4mA$\angle$55.4°

L_3-L_2 line to line voltage = 208V$\angle$60°

Identify why the two wattmeter method cannot be used to measure total power for an unbalanced 4 wire y configuration.

Given a 3 phase AC motor modeled as a balanced 3 wire y configuration drawing 2A at a lagging PF of .82 from a 220/380V 50Hz 3 phase AC system, determine the most appropriate power measurement to calculate total apparent, real, and reactive power.

Given a 3 phase AC motor modeled as a balanced delta configuration drawing 6A at a lagging PF of .82 from a 220/380V 50Hz 3 phase AC system, determine the most appropriate power measurement to calculate total apparent, real, and reactive power.

Apply the two wattmeter method to a balanced Y configured motor given the following data:

wattmeter 1:

L_1 line current = 2A$\angle$-65°

L_1-L_2 line to line voltage = 380V$\angle$0°

wattmeter 2:

L_3 line current = 2A$\angle$55°

L_3-L_2 line to line voltage = 380V$\angle$60°

Apply the two wattmeter method to a balanced Y configured motor given the following data:

wattmeter 1:

L_1 line current = 6A$\angle$-65°

L_1-L_2 line to line voltage = 380V$\angle$0°

wattmeter 2:

L_3 line current = 6A$\angle$55°

L_3-L_2 line to line voltage = 380V$\angle$60°

Given an unknown load on a 220V/380V 3 phase AC system with the following properties determine the most appropriate power measurement to calculate total apparent, real, and reactive power.

wattmeter 1:

L_1-L_2 line to line voltage = 380V$\angle 0°$

L_1 line current = 4A$\angle$-$40°$

wattmeter 2:

L_3-L_2 line to line voltage = 380V$\angle 60°$

L_3 line current = 4.5A$\angle 40°$