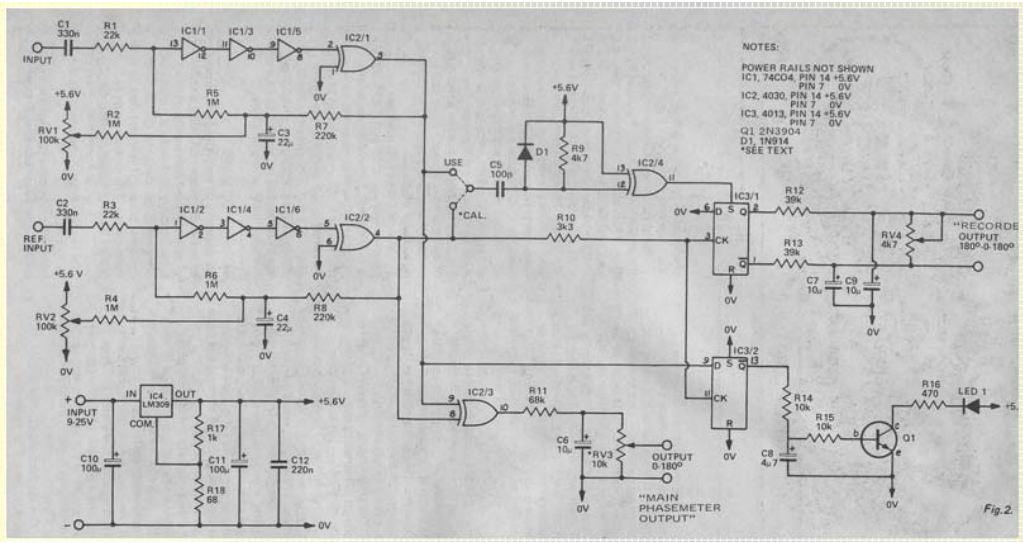
Lab 5- Phase Angle and Voltage Drop

- Regulation of the Load Side Voltage
- Phase angle between the Source End and the Load End of the Transmission Line
- Voltage Drop at the Load Side for Resistive and Inductive Loads
- Reactive Power by Capacitors
- Phase Angler Meter:
  - Angle between 2 voltages
  - Lead mark
  - Lag mark

Phase Angle Meter

- Phase Angler Meter:
  - Angle between 2 voltages
  - Zero-Crossing Detection
  - Comparison of the Crossing times
  - The difference is produced as a DC voltage
  - Displayed on a panel meter



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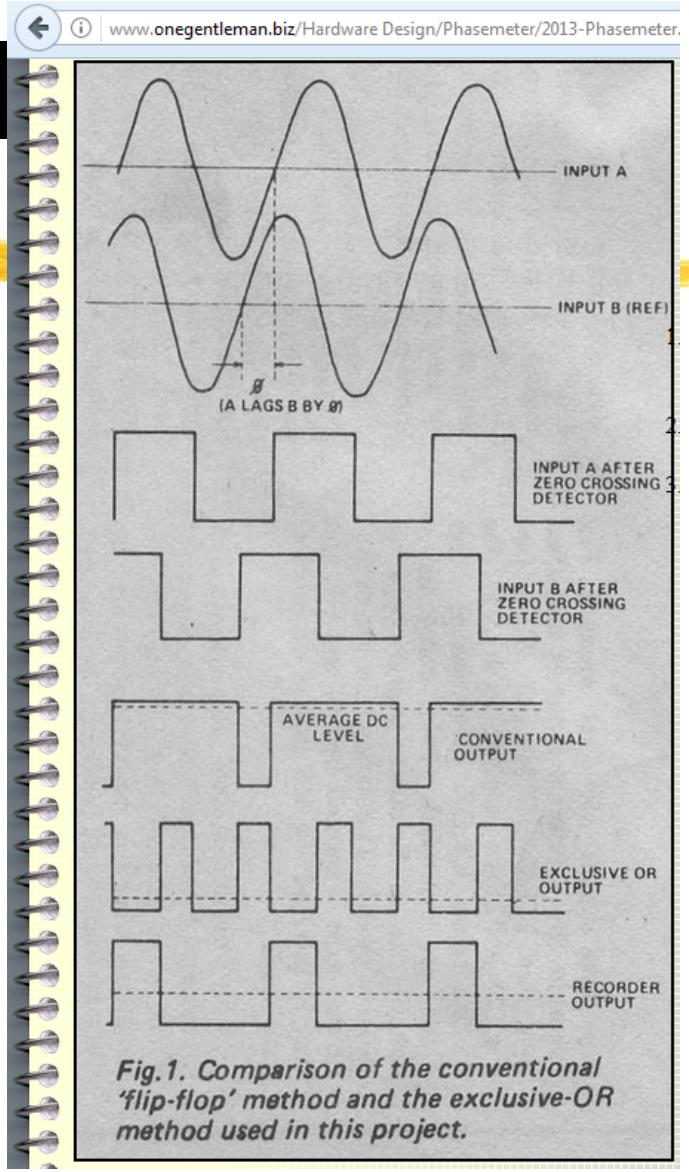
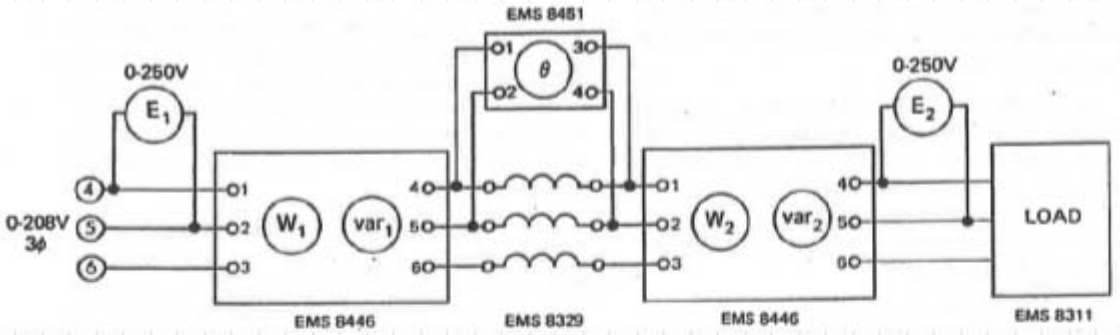
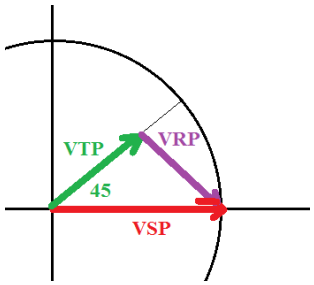


Restive Load





$VSP := 120 \quad R := 120$

$Ztr := i \cdot 120$

$Zload := R$

$Z := Ztr + Zload = 120 + 120 \cdot i$

$IL := \frac{VSP}{Z} = 0.5 - 0.5 \cdot i$ $\qquad \theta i := \arg(IL) \cdot \frac{180}{\pi} = -45$

$VRP := IL \cdot Zload = 60 - 60 \cdot i$

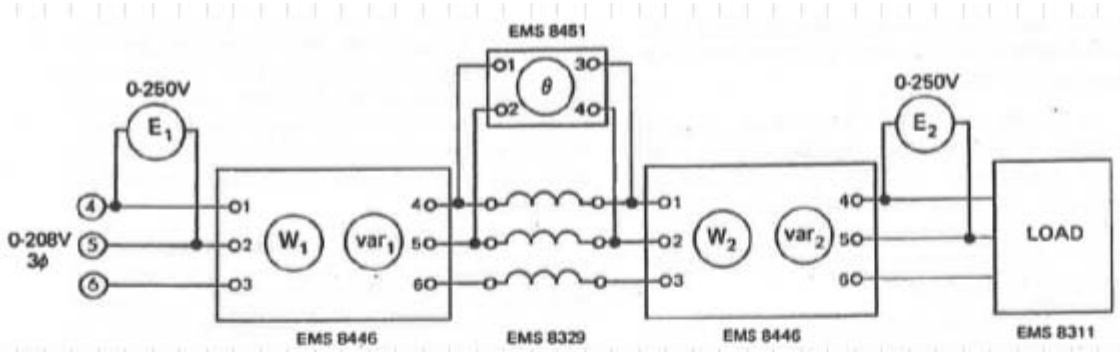
$|VSP| = 120$ $\qquad |VRP| = 84.852814$ $\qquad \theta vrp := \arg(VRP) \cdot \frac{180}{\pi} = -45$

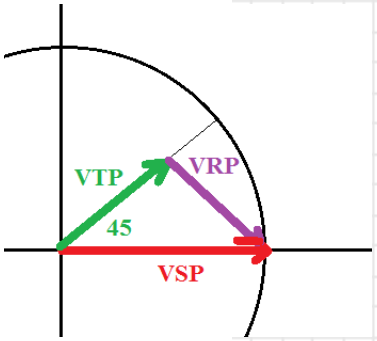
$VTP := VSP - VRP = 60 + 60 \cdot i$

$|VTP| = 84.852814$

$\theta vtp := \arg(VTP) \cdot \frac{180}{\pi} = 45$

Restive Load





$$Qtr := |VTP| \cdot |IL| \cdot \sin(\arg(VTP) - \arg(IL)) - 60$$

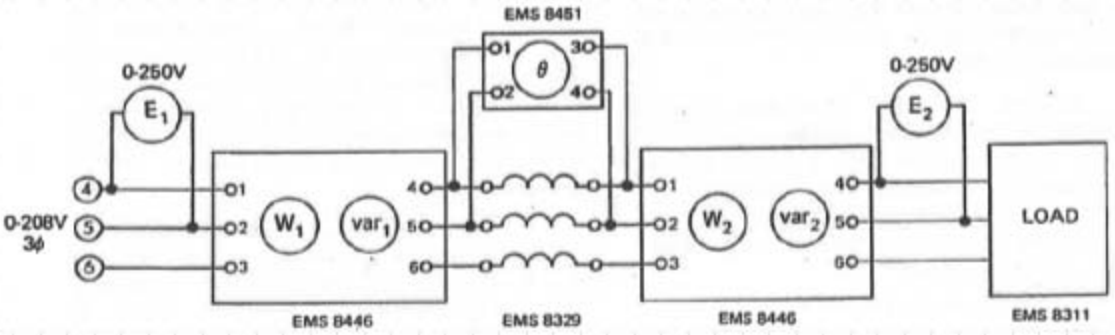
$$Pload := |VRP| \cdot |IL| \cdot \cos(\arg(VRP) - \arg(IL)) = 60$$

$$Qload := |VRP| \cdot |IL| \cdot \sin(\arg(VRP) - \arg(IL)) = 0$$

$$Psrc := |VSP| \cdot |IL| \cdot \cos(\arg(VSP) - \arg(IL)) = 60$$

$$Qsrc := -|VSP| \cdot |IL| \cdot \sin(\arg(VSP) - \arg(IL)) - 60$$

R//C



$VSP := 120 \quad R := 120 \qquad XC := -i \cdot 120$

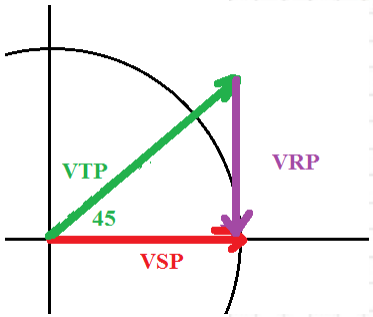
$Ztr := i \cdot 120 \qquad Zload := R \cdot \frac{XC}{R + XC} = 60 - 60 \cdot i$

$Z := Ztr + Zload = 60 + 60 \cdot i$

$IL := \frac{VSP}{Z} = 1 - i \qquad \theta i := \arg(IL) \cdot \frac{180}{\pi} = -45$

$VRP := IL \cdot Zload = -120 \cdot i$

$|VSP| = 120 \qquad |VRP| = 120 \qquad \theta vrp := \arg(VRP) \cdot \frac{180}{\pi} = -90$

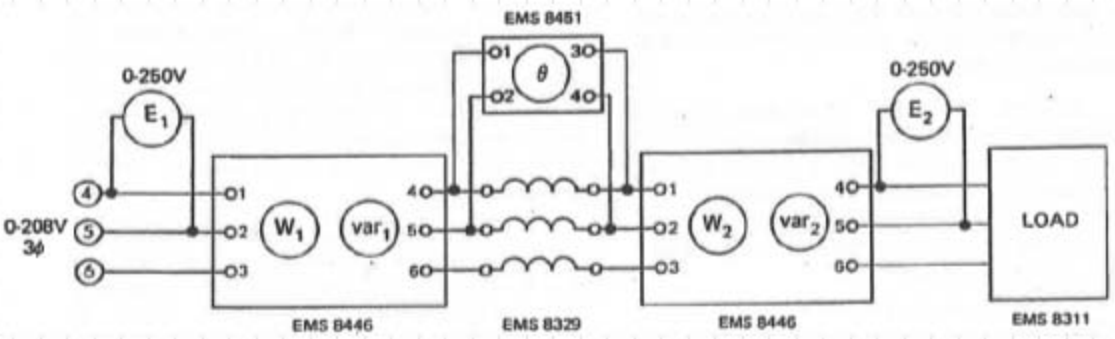


$VTP := VSP - VRP = 120 + 120 \cdot i$

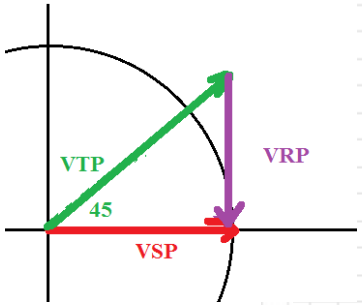
$|VTP| = 169.705627$

$\theta vtp := \arg(VTP) \cdot \frac{180}{\pi} = 45$

R//C



VSP := 120 R := 120 XC := -i·120



$$Qtr := |VTP| \cdot |IL| \cdot \sin(\arg(VTP) - \arg(IL)) = 240$$

$$Pload := |VRP| \cdot |IL| \cdot \cos(\arg(VRP) - \arg(IL)) = 120$$

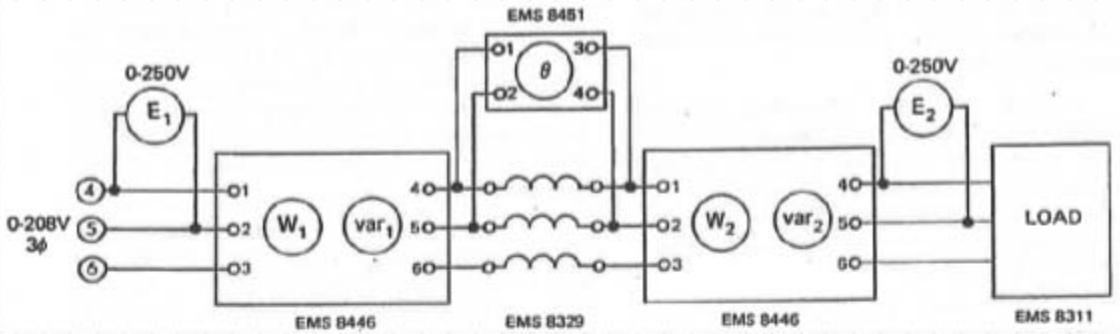
$$Qload := |VRP| \cdot |IL| \cdot \sin(\arg(VRP) - \arg(IL)) = -120$$

$$Psrc := |VSP| \cdot |IL| \cdot \cos(\arg(VSP) - \arg(IL)) = 120$$

$$Qsrc := |VSP| \cdot |IL| \cdot \sin(\arg(VSP) - \arg(IL)) = 120$$

R//C

Case 2



$VSP := 120 \quad R := 120 \qquad XC := -i \cdot 300$

$Ztr := i \cdot 120 \qquad Zload := R \cdot \frac{XC}{R + XC} = 103.448276 - 41.37931 \cdot i$

$Z := Ztr + Zload = 103.448276 + 78.62069 \cdot i$

$IL := \frac{VSP}{Z} = 0.735294 - 0.558824 \cdot i \qquad \theta i := \arg(IL) \cdot \frac{180}{\pi} = -37.234834$

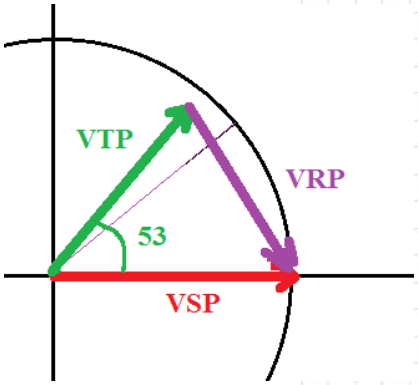
$VRP := IL \cdot Zload = -52.941176 - 88.235294 \cdot i$

$|VSP| = 120 \qquad |VRP| = 102.899151 \qquad \theta vrp := \arg(VRP) \cdot \frac{180}{\pi} = -59.036243$

$VTP := VSP - VRP = 67.058824 + 88.235294 \cdot i$

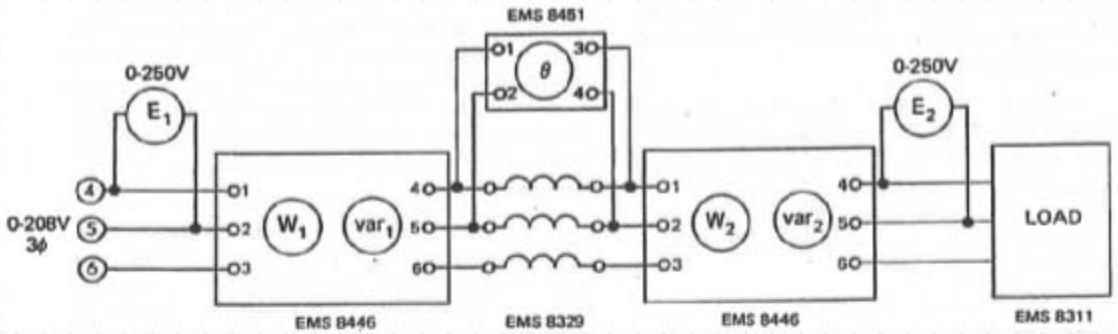
$|VTP| = 110.825777$

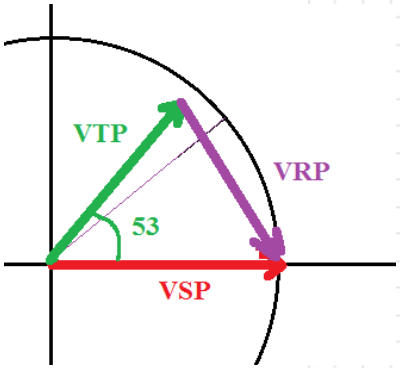
$\theta vtp := \arg(VTP) \cdot \frac{180}{\pi} = 52.765166$



R//C

Case 2





$$Qtr := |VTP| \cdot |IL| \cdot \sin(\arg(VTP) - \arg(IL)) = 102.352941$$

$$Pload := -|VRP| \cdot |IL| \cdot \cos(\arg(VRP) - \arg(IL)) = -88.235294$$

$$Qload := -|VRP| \cdot |IL| \cdot \sin(\arg(VRP) - \arg(IL)) = -35.294118$$

$$Psrc := -|VSP| \cdot |IL| \cdot \cos(\arg(VSP) - \arg(IL)) = -88.235294$$

$$Qsrc := |VSP| \cdot |IL| \cdot \sin(\arg(VSP) - \arg(IL)) = 67.058824$$

Experimentation Setup