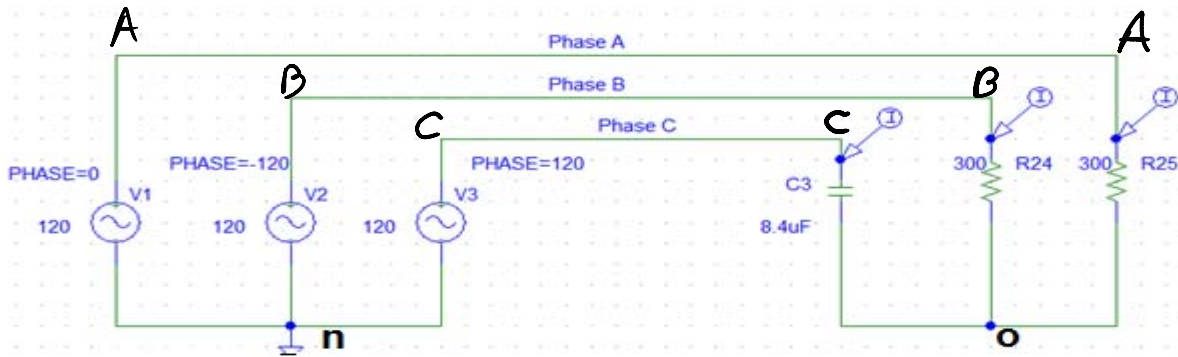


# Lab 2 – Phase sequence determination

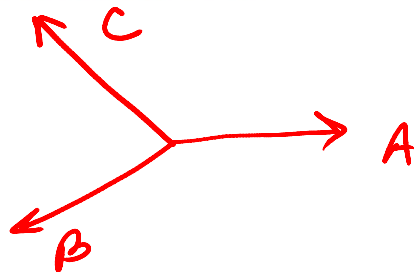
- ⌘ How to find a sequence of Phase (ABC, ACB) when there is no marking
- ⌘ Use unbalanced load situation



**Balanced Source**

$V_{an}, V_{bn}, V_{cn}$

$$V_{an} + V_{bn} + V_{cn} = 0$$



**Unbalanced Load**

**Balanced Line-to-Line Voltage**  
 $V_{ab}, V_{bc}, V_{ca}$

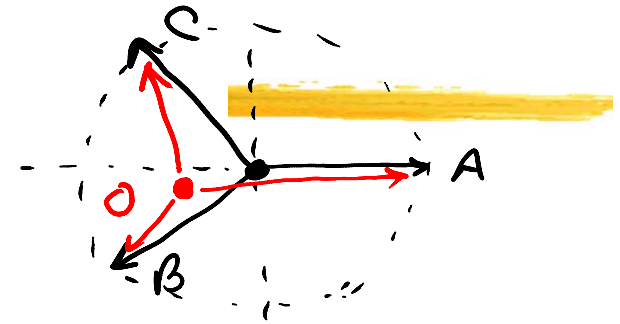
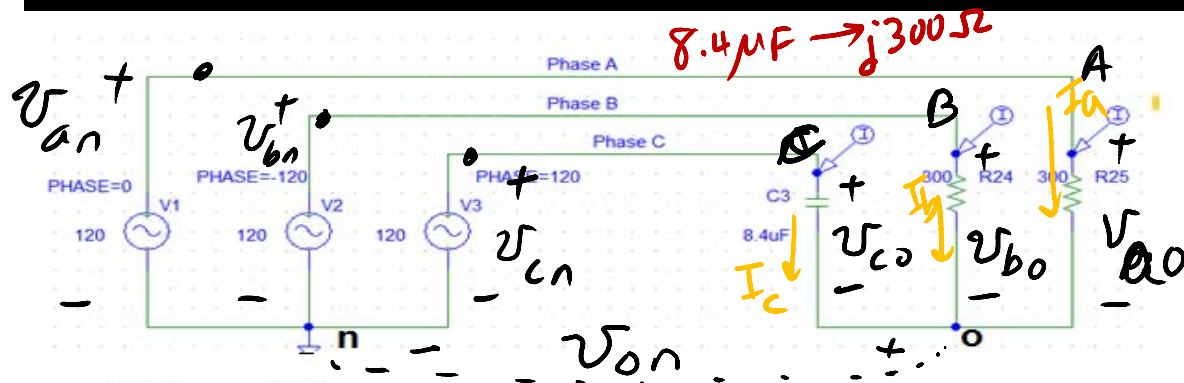
**Unbalanced Line-to-point voltage**  
 $V_{ao}, V_{bo}, V_{co}$

$$V_{ao} + V_{bo} + V_{co} \neq 0$$

$$I_a + I_b + I_c = 0$$

So there is voltage developed between  $n$  and  $o$

# Lab 2 – Phase sequence determination



$$V_{ao} = V_{an} - V_{on}$$

$$V_{bo} = V_{bn} - V_{on}$$

$$V_{co} = V_{cn} - V_{on}$$

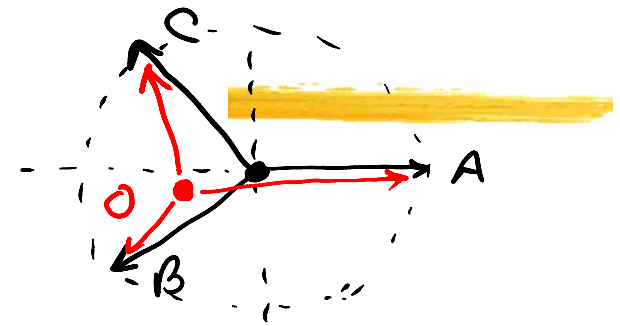
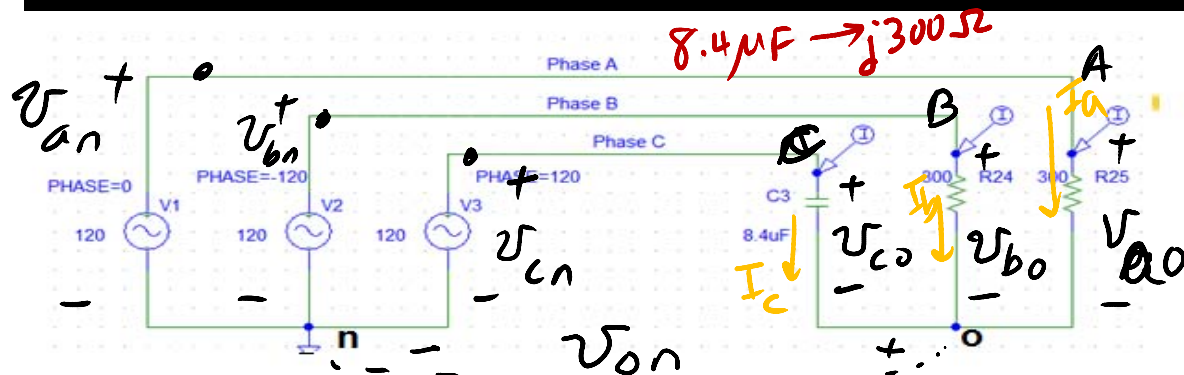
$$V_{ao} = I_a \cdot R$$

$$V_{bo} = I_b \cdot R$$

$$V_{co} = I_c(-jR) \quad I_c(-jR) = V_{cn} - V_{on}$$

$$C \rightarrow \frac{1}{j\omega C} = -j\left(\frac{1}{\omega C}\right) \quad \text{Cap. reactance}$$

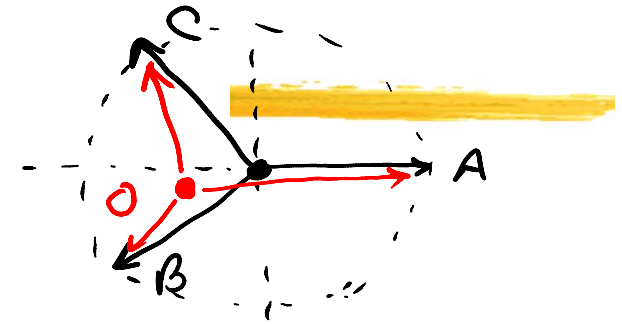
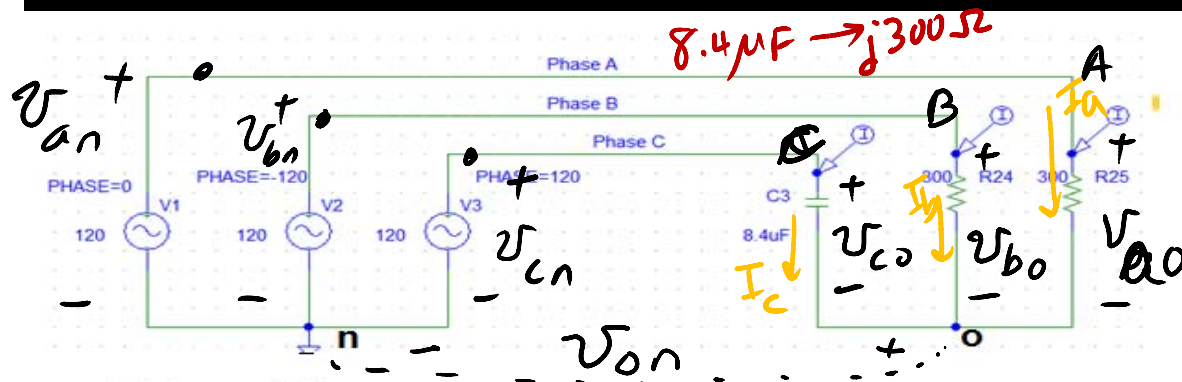
# Lab 2 – Phase sequence determination



$$\begin{aligned}
 I_a &= \frac{V_{an}}{R} - \frac{V_{on}}{R} \\
 I_b &= \frac{V_{bn}}{R} - \frac{V_{on}}{R} \\
 I_c &= \frac{V_{cn}}{-jR} - \frac{V_{on}}{-jR}
 \end{aligned}
 \left. \begin{array}{l} \\ \\ \end{array} \right\} I_a + I_b + I_c = 0$$

$$\begin{aligned}
 & \frac{1}{R} (V_{an} + V_{bn} + j V_{cn}) \\
 &= \frac{1}{R} (V_{on} + V_{on} + j V_{on}) \\
 \rightarrow V_{on} &= \frac{V_{an} + V_{bn} + j V_{cn}}{2 + j} = \frac{V_{an} (1 + \angle -120^\circ + \angle 210^\circ)}{2 + j}
 \end{aligned}$$

# Lab 2 – Phase sequence determination



$$\frac{V_{an}(1 + \angle -120^\circ + \angle 210^\circ)}{2 + j}$$

$$\text{Num} := 1 + \cos\left(-120 \cdot \frac{\pi}{180}\right) + i \cdot \sin\left(-120 \cdot \frac{\pi}{180}\right) + \cos\left(210 \cdot \frac{\pi}{180}\right) + i \cdot \sin\left(210 \cdot \frac{180}{\pi}\right) = -0.3660254 - 1.0511174 \cdot i$$

$$|\text{Num}| = 1.113024 \quad \arg(\text{Num}) \cdot \frac{180}{\pi} = -109.1993966$$

$$\text{Denom} := 2 + i \cdot 1$$

$$|\text{Denom}| = 2.236068 \quad \arg(\text{Denom}) \cdot \frac{180}{\pi} = 26.5650512$$

$$\text{ON} := \frac{\text{Num}}{\text{Denom}} = -0.3566336 - 0.3472419 \cdot i$$

$$|\text{ON}| = 0.4977595$$

$$\arg(\text{ON}) \cdot \frac{180}{\pi} = -135.7644478$$

$$V_{on} = \frac{|V_{an}|}{2} \angle -135 \text{ deg}$$

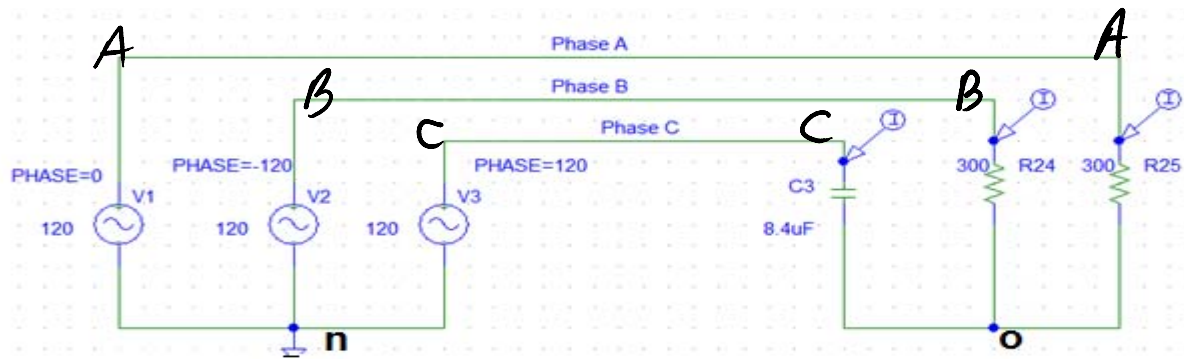
$$V_{a0} = V_{an} - V_{on} \quad |V_{a0}| = 150$$

$$V_{b0} = V_{bn} - V_{on} \quad |V_{b0}| = 40$$

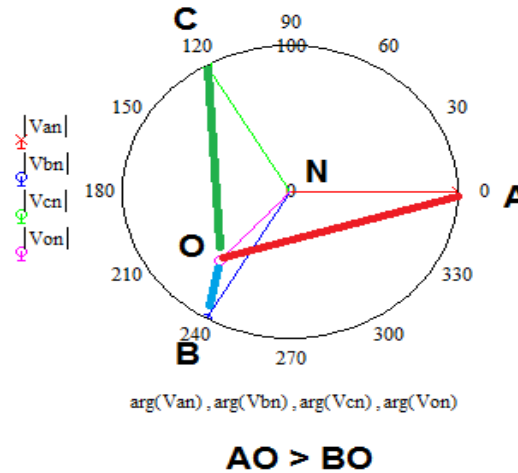
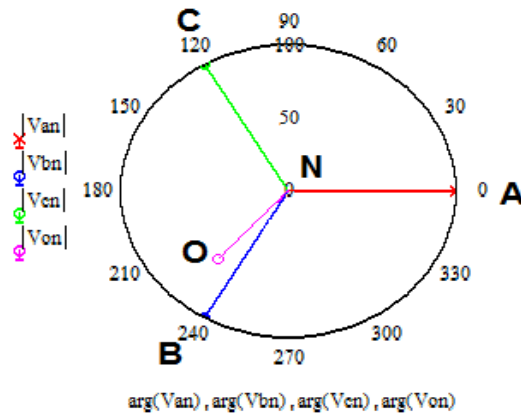
$$V_{c0} = V_{cn} - V_{on} \quad |V_{c0}| = 134$$

# Lab 2 – Phase sequence determination

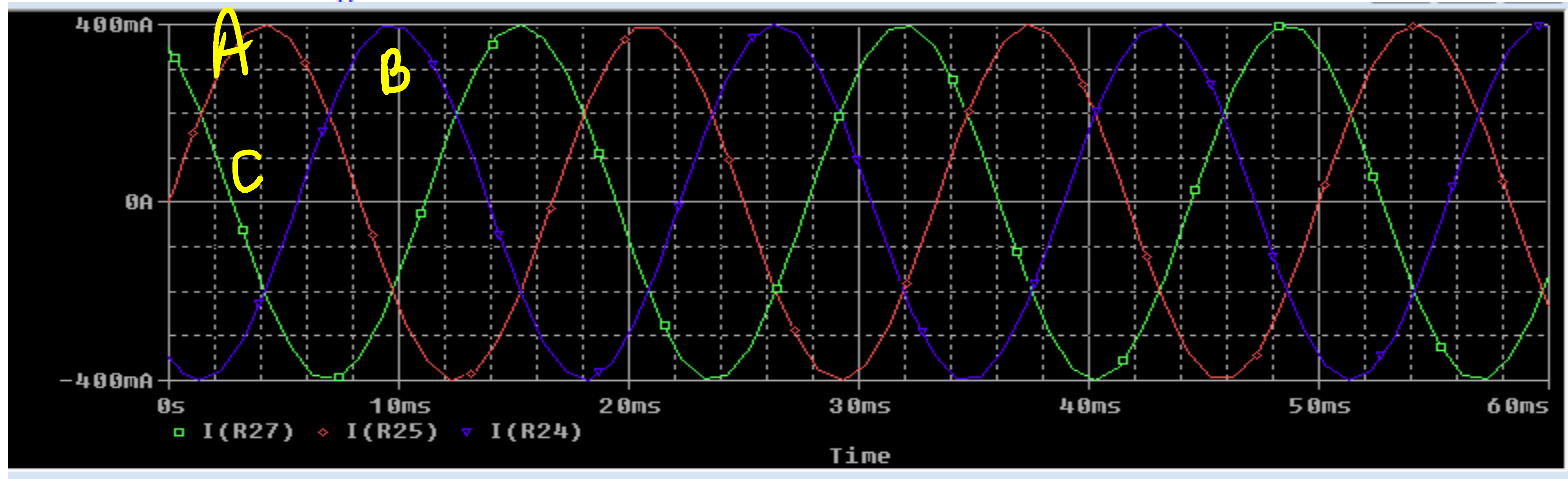
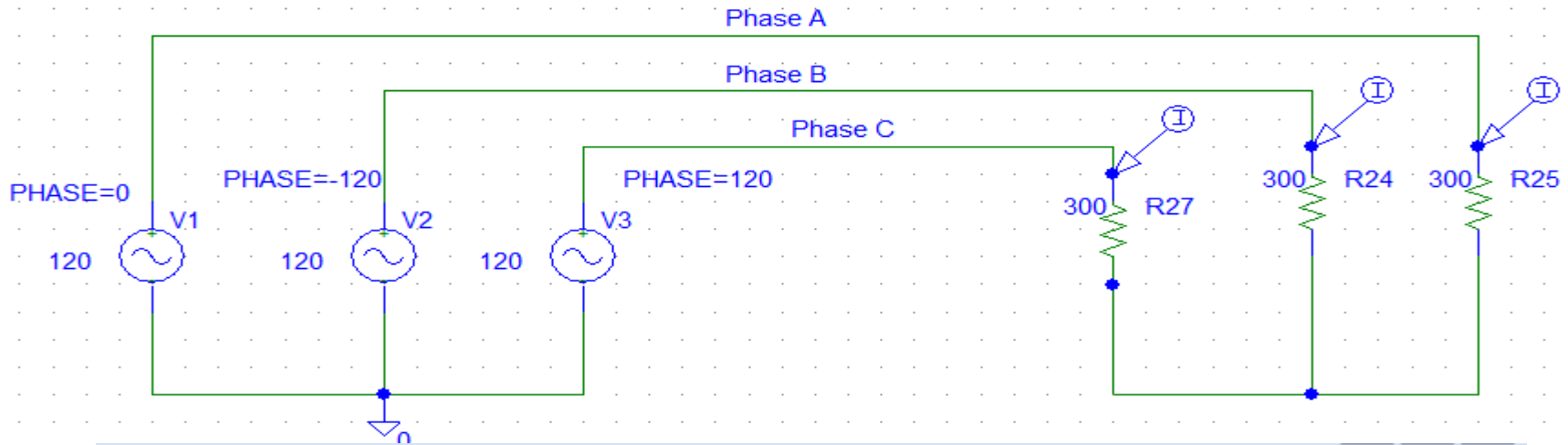
- ⌘ How to find a sequence of Phase (ABC, ACB) when there is no marking
- ⌘ Use unbalanced load situation



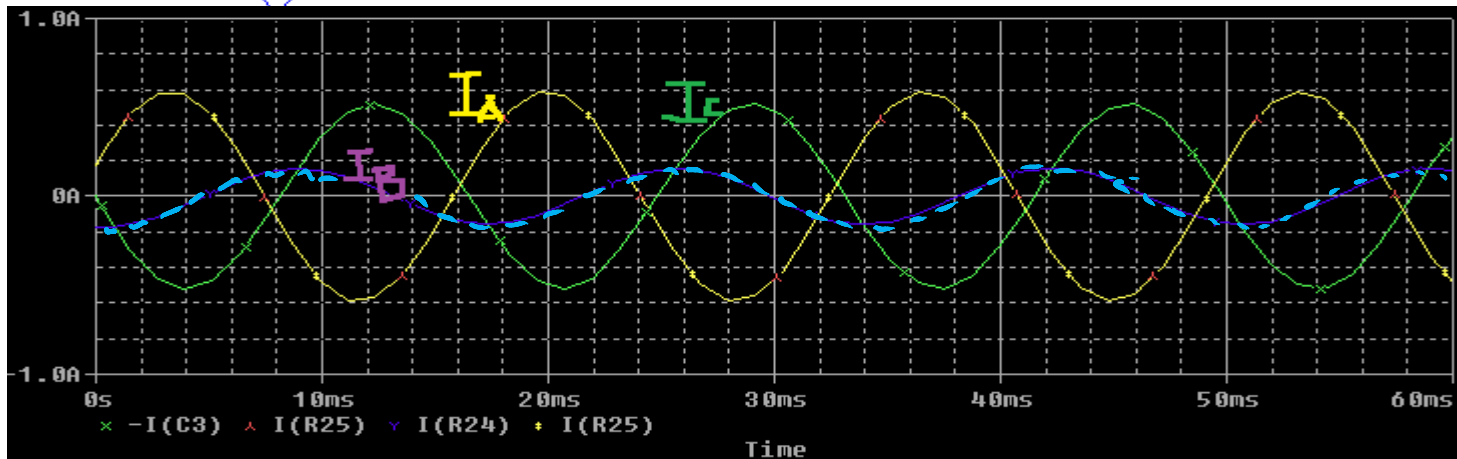
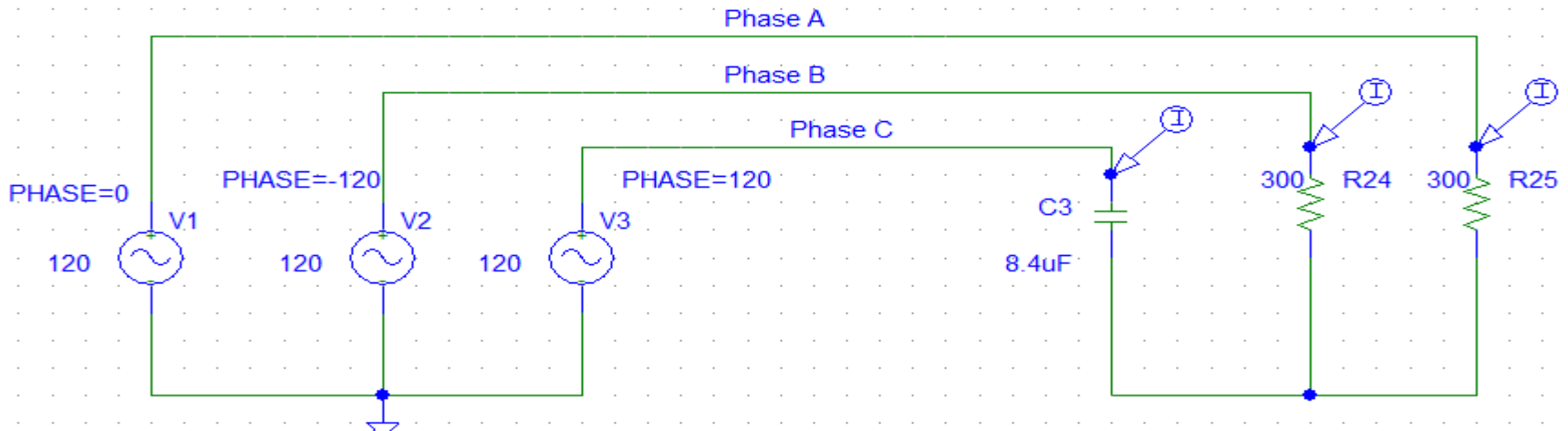
*phase sequence rule*  
 High - Low - C  
 (A) (B) (C)



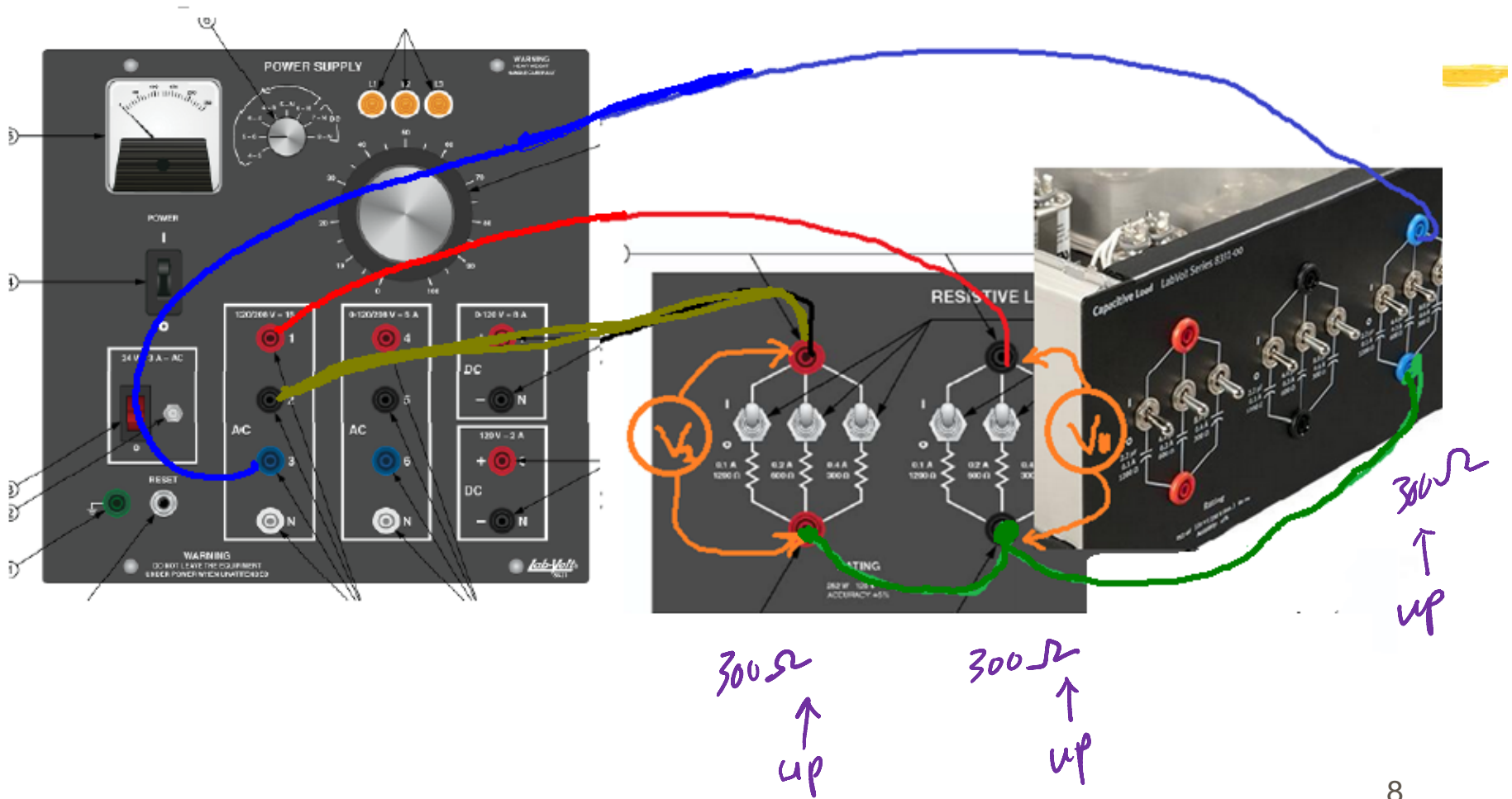
# Lab 2 – Phase Sequence Determination



# Lab 2 – Phase Sequence Determination



# Lab 2 – Exp Part





# Lab 2 – Exp Part 2

