Circuitos Elétricos III

Potência

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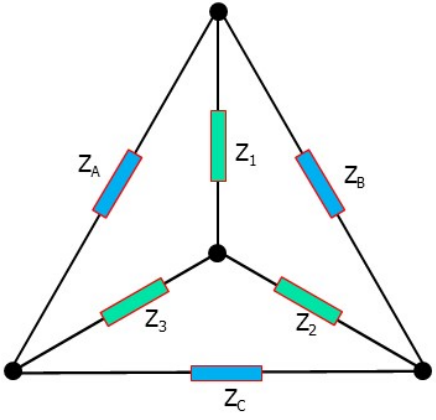
Conversão estrela-triângulo



Estrela → Triângulo	Triângulo → Estrela
$Z_A = \frac{Z_1Z_2 + Z_2Z_3 + Z_3Z_1}{Z_2}$	$Z_1 = \frac{Z_AZ_B}{Z_A + Z_B + Z_C}$
$Z_B = \frac{Z_1Z_2 + Z_2Z_3 + Z_3Z_1}{Z_3}$	$Z_2 = \frac{Z_BZ_C}{Z_A + Z_B + Z_C}$
$Z_C = \frac{Z_1Z_2 + Z_2Z_3 + Z_3Z_1}{Z_1}$	$Z_3 = \frac{Z_CZ_A}{Z_A + Z_B + Z_C}$

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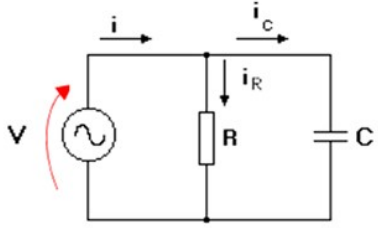

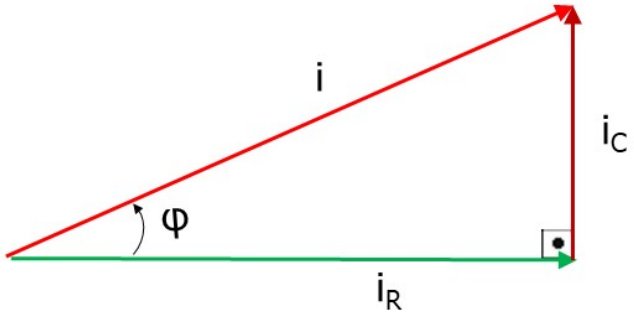

- Mas a Tensão V é comum a todos

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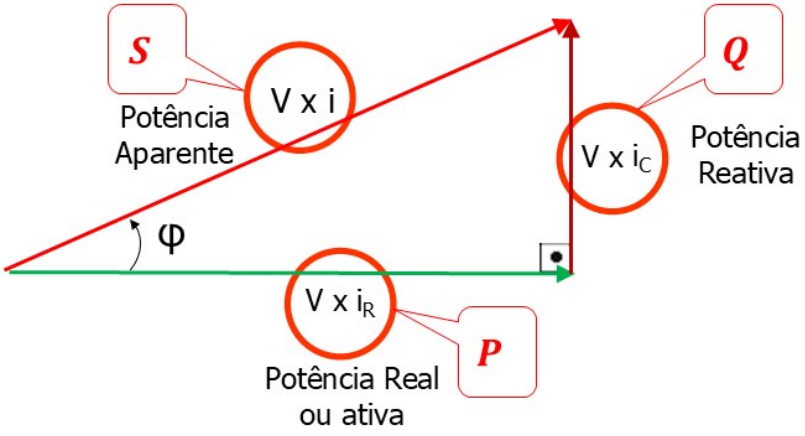
Logo



Ou:

$P = V \times i_R$

$Q = V \times i_C$

$S = V \times i$

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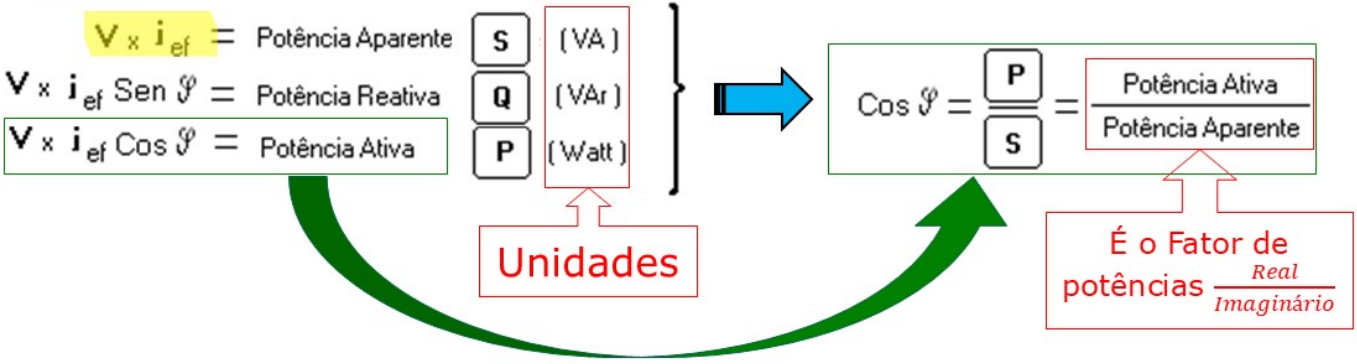
Mas para nós ...



De onde vemos que se a potência reativa Q for reduzida, o ângulo φ diminui e P se aproxima de S – condição ideal

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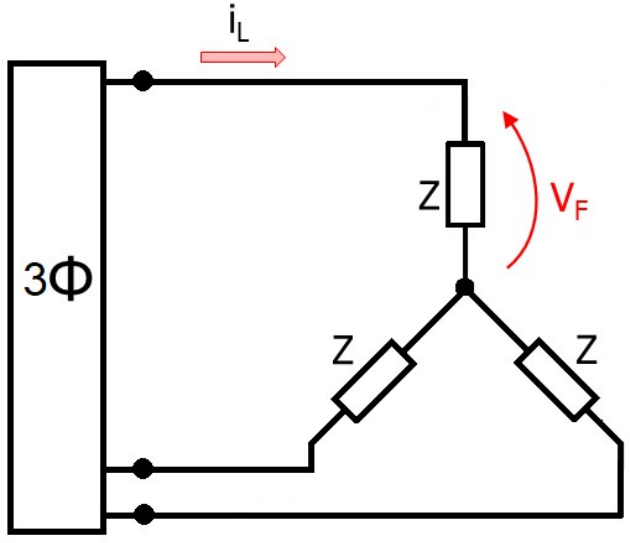
Análise em Estrela



$P_{Fase} = V_F \times I_L \times Cos(\varphi)$

e

$P_{3\Phi} = 3 \times V_F \times I_L \times Cos(\varphi)$

$Q_{3\Phi} = 3 \times V_F \times I_L \times Sen(\varphi)$

$S_{3\Phi} = 3 \times V_F \times I_L$

De onde corrigindo V_F para V_L

Lembramos que $V_L = \sqrt{3} \times V_F$

De modo que $V_F = \frac{V_L}{\sqrt{3}}$

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Daí...

$$P_{3\Phi} = 3 \times \frac{V_L}{\sqrt{3}} \times I_L \times \cos(\varphi)$$

$$P_{3\Phi} = \frac{\sqrt{3}}{\sqrt{3}} \times 3 \times \frac{V_L}{\sqrt{3}} \times I_L \times \cos(\varphi)$$

$$P_{3\Phi} = \sqrt{3} \times 3 \times \frac{V_L}{(\sqrt{3})^2} \times I_L \times \cos(\varphi)$$

$$P_{3\Phi} = \sqrt{3} \times \cancel{3} \times \frac{V_L}{\cancel{3}} \times I_L \times \cos(\varphi)$$

$$P_{3\Phi} = \sqrt{3} \times V_L \times I_L \times \cos(\varphi)$$

Que de modo análogo reduzimos a:

$$Q_{3\Phi} = \sqrt{3} \times V_L \times I_L \times \sin(\varphi)$$

$$S_{3\Phi} = \sqrt{3} \times V_L \times I_L$$

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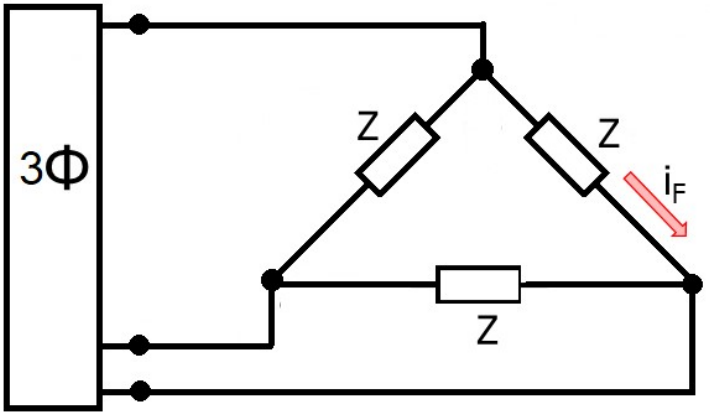
Análise em Delta



$P_{Fase} = V_L \times I_F \times \cos(\varphi)$

e

$P_{3\Phi} = 3 \times V_L \times I_F \times \cos(\varphi)$

$Q_{3\Phi} = 3 \times V_L \times I_F \times \sin(\varphi)$

$S_{3\Phi} = 3 \times V_L \times I_F$

De onde corrigindo I_F para I_L
Lembramos que $I_L = \sqrt{3} \times I_F$
De modo que $I_F = \frac{I_L}{\sqrt{3}}$

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Daí...

$$P_{3\Phi} = 3 \times V_L \times \frac{I_L}{\sqrt{3}} \times \cos(\varphi)$$

$$P_{3\Phi} = \frac{\sqrt{3}}{\sqrt{3}} \times 3 \times V_L \times \frac{I_L}{\sqrt{3}} \times \cos(\varphi)$$

$$P_{3\Phi} = \sqrt{3} \times 3 \times V_L \times \frac{I_L}{(\sqrt{3})^2} \times \cos(\varphi)$$

$$P_{3\Phi} = \sqrt{3} \times V_L \times \cancel{3} \times \frac{I_L}{\cancel{3}} \times \cos(\varphi)$$

$$P_{3\Phi} = \sqrt{3} \times V_L \times I_L \times \cos(\varphi)$$

Que de modo análogo reduzimos a:

$$Q_{3\Phi} = \sqrt{3} \times V_L \times I_L \times \sin(\varphi)$$

$$S_{3\Phi} = \sqrt{3} \times V_L \times I_L$$

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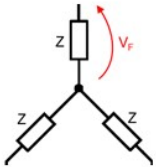
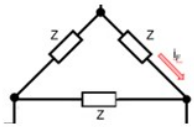
Resumo



$$P_{3\Phi} = \sqrt{3} \times V_L \times I_L \times \text{Cos}(\varphi)$$

$$Q_{3\Phi} = \sqrt{3} \times V_L \times I_L \times \text{Sen}(\varphi)$$

$$S_{3\Phi} = \sqrt{3} \times V_L \times I_L$$



$$P_{3\Phi} = \sqrt{3} \times V_L \times I_L \times \text{Cos}(\varphi)$$

$$Q_{3\Phi} = \sqrt{3} \times V_L \times I_L \times \text{Sen}(\varphi)$$

$$S_{3\Phi} = \sqrt{3} \times V_L \times I_L$$

De onde observamos que os valores são os mesmos

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Exercício

V_{Fonte} = 208V (nominal)

Carga em Delta, com Z=12+j9 Ω

Pede-se: V_L, V_F, I_L, I_F Cos φ, P, Q, S

Fonte: https://www.youtube.com/watch?v=VsVPEmS3nqI

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