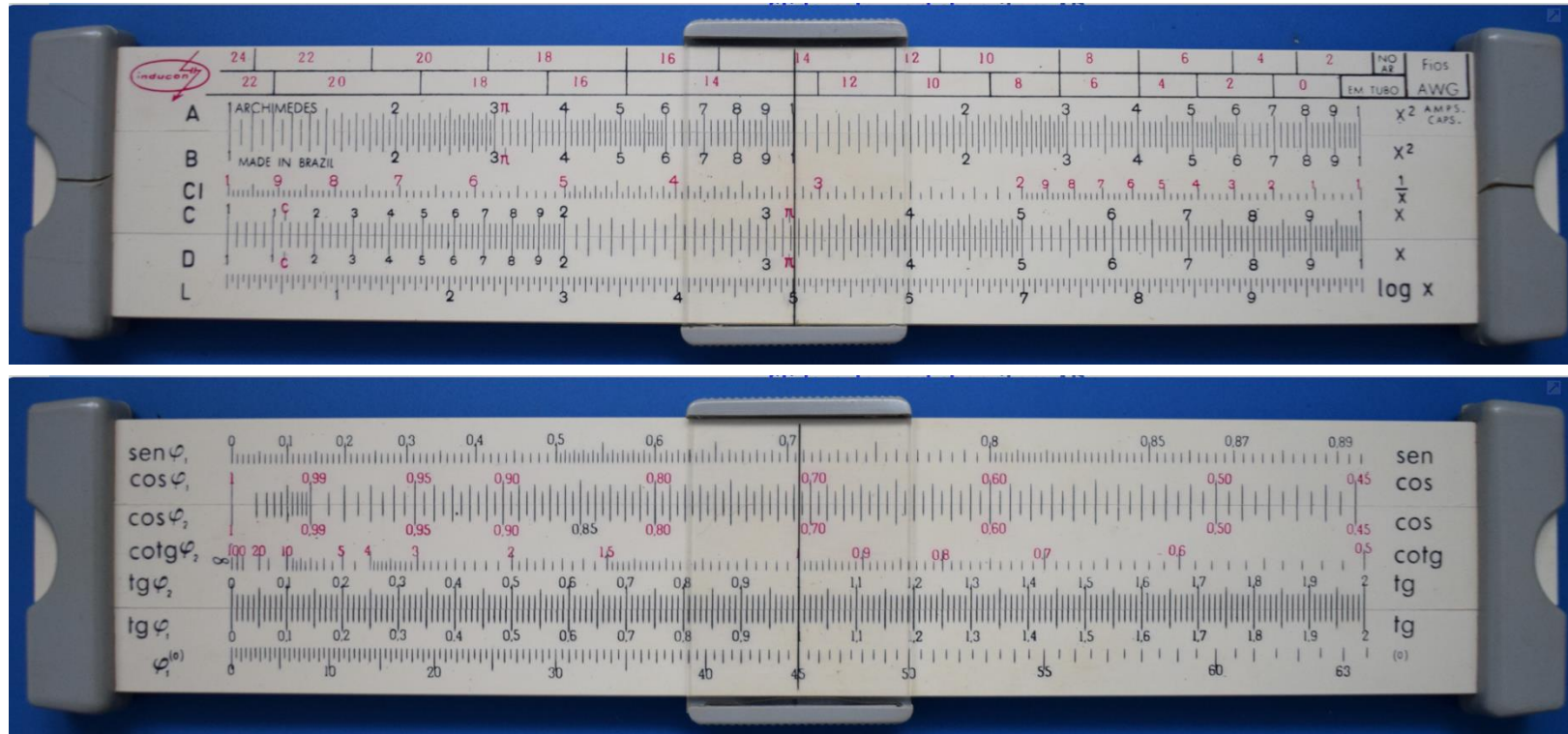


# Archimedes/Inducon Power Factor Correction Slide Rule



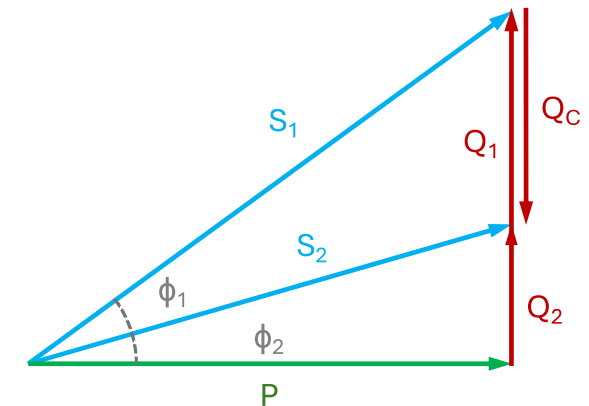
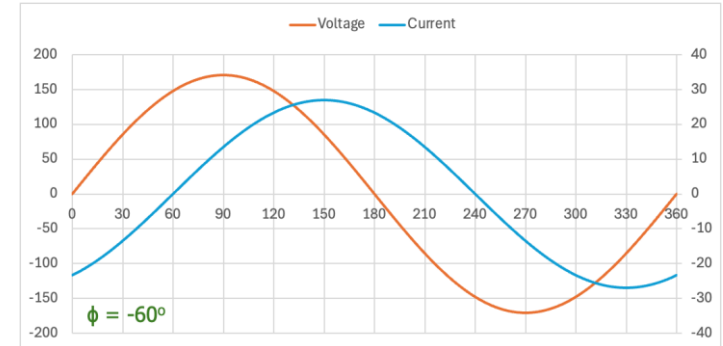
- **Archimedes:** Brazilian slide rule manufacturer
- **Inducon:** Brazilian energy solutions provider founded in 1959
  - Manufactures power capacitors and offers power factor reduction products and services.

# Archimedes/Inducon Power Factor Correction Slide Rule

- Is it really an Electro slide rule?

Yes, it's an AC Electro rule

1. Used to calculate the reactive capacitance  $Q_c$  (in units of VAR or kVAR) required to reduce the phase angle between AC voltage and current from  $\phi_1$  to  $\phi_2$ 
  - $Q_c = P ( \tan( \cos^{-1}(PF_1) ) - \tan( \cos^{-1}(PF_2) ) )$
2. Max current for given wire size can be read on the A scale (1A to 100A) opposite wire gauge



$$PF_1 = \frac{P}{S_1} = \cos(\phi_1); PF_2 = \frac{P}{S_2} = \cos(\phi_2)$$

$$Q_1 = P \cdot \tan(\phi_1); Q_2 = P \cdot \tan(\phi_2)$$

$$Q_c = Q_1 - Q_2$$

$$Q_c = P ( \tan(\phi_1) - \tan(\phi_2) )$$

$$Q_c = P ( \tan( \cos^{-1}(PF_1) ) - \tan( \cos^{-1}(PF_2) ) )$$

P: Real Power (in kW)

S: Apparent power (in kVA)

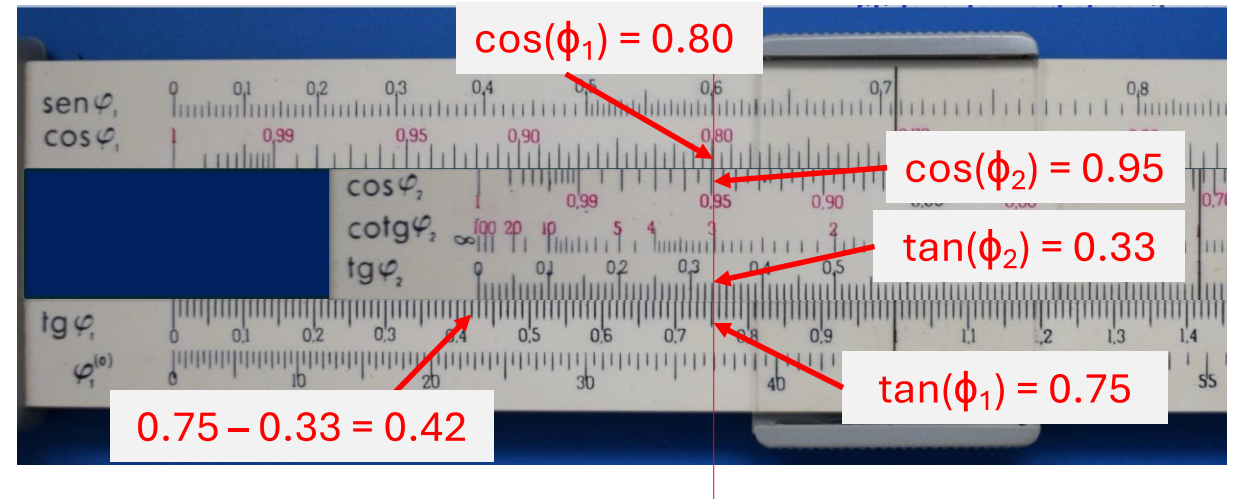
Q: Reactive Power (in kVAR)

# Archimedes/Inducon Power Factor Correction Slide Rule

- Why are there 6 trigonometric scales?
  - $\cos \phi$  and  $\operatorname{tg} \phi$  scales used for power factor correction computation
    - Can also be calculated with just one  $\cos \phi$  and one  $\operatorname{tg} \phi$  scale, but two of each is more convenient
  - $\operatorname{tg} \phi$  scale is a linear scale.
  - $\operatorname{cotg} \phi = 1/\operatorname{tg} \phi$  is an inverse linear scale
    - May be useful for some power factor computations
    - Can also be used to compute equivalent resistance of two resistors in parallel
  - $\operatorname{sen} \phi$  (i.e.,  $\sin \phi$ ) scale can be used for some reactive power computations
  - Note that none of the trig scales are logarithmic scales.
- What is the purpose of the "phi 0" scale?
  - This is simply the phase angle  $\phi$  in degrees ( $^{\circ}$  means degrees).
  - All the trig scales can be read against this scale

# Archimedes/Inducon Power Factor Correction Slide Rule

- How do you use the scales?
- Position  $PF_2$  on  $\cos \phi_2$  scale opposite  $PF_1$  on  $\cos \phi_1$  scale
- On  $\text{tg } \phi_1$  scale at the  $\text{tg } \phi_2$  index, read  $\tan(\cos^{-1}(PF_1)) - \tan(\cos^{-1}(PF_2))$
- Multiply this by real power  $P$  to get capacitive reactive power  $Q_c$



- Example:
  - $PF_1 = \cos(\phi_1) = 0.80$
  - $PF_2 = \cos(\phi_2) = 0.95$
  - $\tan(\phi_1) = \tan(\cos^{-1}(0.80)) = 0.75$
  - $\tan(\phi_2) = \tan(\cos^{-1}(0.95)) = 0.33$
  - $\tan(\cos^{-1}(PF_1)) - \tan(\cos^{-1}(PF_2)) = 0.75 - 0.33 = 0.42$