"ENGLISH ELECTRIC" COMBINED SLIDE RULE AND POWER FACTOR CALCULATOR

Examples and Calculations of Power Factor Correction Problems

The ease and rapidity with which power factor calculations can be made by the use of the "English Electric" Combined Slide Rule and Power Factor Calculator are clearly shown in the examples which follow. This rule is complete within itself, no supplementary curves, charts or tables being required.

On the reverse side of the slide are engraved the special scales B_1 and C_1 for the solution of various power factor correction problems. Noting that the only reference points on the A and D scales are the unit lines at the extreme right of these scales, proceed as follows:

(1) To find the kVAR* to raise a known power factor to a given value:

Set known power factor on scale B_1 at unit line on the A scale.

Set cursor to desired final power factor on B_1 scale.

Set zero line on C_1 scale coincident with cursor line.

The reading on C_1 scale at unit line on D scale is the leading kVAR required expressed as a percentage of the existing kW load.

E.g.: existing power factor = ·7 lag; required final power factor = ·85 lag; leading kVAR required = 40% of existing kW load.

(2) With a known power factor (PF_1) and kW load (kW_1) to find the final power factor (PF) with an additional kW load (kW_2) at unity power factor:

Set known power factor PF_1 on B_1 scale at unit line on the A scale and read C_1 scale at unit line on D scale.

* Reactive kVA

Reduce reading so obtained in the ratio of existing kW load to final kW load.

$$i.e., \frac{kW_1}{kW_1 + kW_2}$$

Reset slide with this value on the C_1 scale at the unit line of the D scale.

Final power factor PF is given on the B_1 scale at the unit line on A scale.

E.g.: Known kW load = 100 kW = kW_1 at ·64 power factor = PF_1.

Added kW load = 60 kW = kW_2 at 1·0 power factor.

Total kW load = 160 kW = $kW_1 + kW_2$.

Reading on C_1 scale is 120 for ·64 power factor.

Reducing this reading to

$$\frac{120 \times 100}{160} = 75.$$

Reading on B_1 scale for 75 on C_1 scale is ·8 and this is the final power factor of the total load.

(3) With a known power factor (PF_1) and kW load (kW_1) to find the final power factor (PF) with an additional kW load (kW_2) at a known leading power factor (PF_2):

Set known power factor PF_1 on B scale at unit line on the A scale and read C_1 scale at the unit line on D scale.

Reduce reading so obtained in the ratio of existing kW load to final kW load,

$$i.e., \frac{kW_1}{kW_1 + kW_2}$$

and let reading be, say, R_1.

Set power factor PF_2 of added load kW_2 on B_1 scale at the unit line on the A scale and read C_1 scale at the unit line on D scale.

Reduce reading so obtained in the ratio of added kW load to final kW load,

$$i.e., \frac{kW_2}{kW_1 + kW_2}$$

and let the reading be, say, R_2.

Set reading R_1 on the C_1 scale at unit line on the D scale and place cursor over the reading R_2 on the C_1 scale.

Bring the zero line on C_1 scale to cursor line and final load power factor PF is read on B_1 scale at unit line on the A scale.

E.g.: Known kW load = 100 kW = kW_1 at ·64 power factor = PF_1.

Added kW load = 60 kW = kW_2 at ·93 power factor load = PF_2.

Total kW load = 160 kW = $kW_1 + kW_2$.
Reading on C_1 scale is 120 for ·64 power factor.

Reducing this reading to

$$\frac{120 \times 100}{160} = 75 = R_1.$$

Reading on C_1 scale is 40 for ·93 power factor.

Reducing this reading to

$$\frac{40 \times 60}{160} = 15 = R_2.$$

Hence final power factor is ·855 lag.

(4) With a known power factor (PF_1) and kW load (kW_1) to find the power factor (PF_2) of an additional kW load (kW_2) to give a desired final power factor (PF):

Set known power factor PF_1 on B_1 scale at unit line on the A scale and read C_1 scale at the unit line on the D scale.

Reduce reading so obtained in the ratio of existing kW load to final kW load,

$$i.e., \frac{kW_1}{kW_1 + kW_2}$$

and let reading be, say, R_1.

Set desired final power factor (PF) on B_1 scale at unit line on A scale and read C_1 scale at unit line on the D scale and let this reading be, say, R_2.

Set reading R_1 on C_1 scale at unit line on the D scale.

Place cursor over reading R_2 on C_1 scale.

Bring zero line on C_1 scale to cursor line and read C_1 scale at unit line on D scale and let this reading be, say, R_3.

Increase R_3 in the ratio of total load to added load,

$$i.e., \frac{kW_1 + kW_2}{kW_2}$$

and let this reading be, say, R_4.

Set reading R_4 on the C_1 scale at unit line on the D scale and read the power factor PF_2 of the added kW load kW_2 on the B_1 scale at the unit line on the A scale.

E.g.: Known kW load = 100 kW = kW_1 at ·64 power factor = PF_1.

Added kW load = 60 kW = kW_2 at unknown power factor = PF_2.

Total kW load = 160 kW = kW_1 + kW_2 at required final power factor of ·97 = PF.

Reading on C_1 scale is 120 for ·64 power factor.

Reducing this reading to

$$\frac{120 \times 100}{160} = 75 = R_1.$$

Reading R_2 on C_1 scale is 25 for ·97 power factor.

Reading R_3 is 50 on C_1 scale.

Increase R_3 to

$$\frac{50 \times 160}{60} = 133 = R_4.$$

Power factor of added kW load kW_2 is ·60 leading = PF_2.

When dealing with multiple loads of different magnitudes and power factors, these should be resolved to a single equivalent load by the use of one or more of the methods given above.

The method of solution of power factor problems not covered by the above examples will readily suggest itself after familiarity and experience in the use of of this power factor slide rule.

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