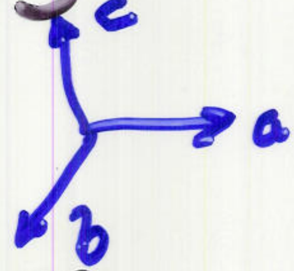
[3Φ / 3 pulse] Rectifier Driving a L-R Load



L
24

Fig 21.16
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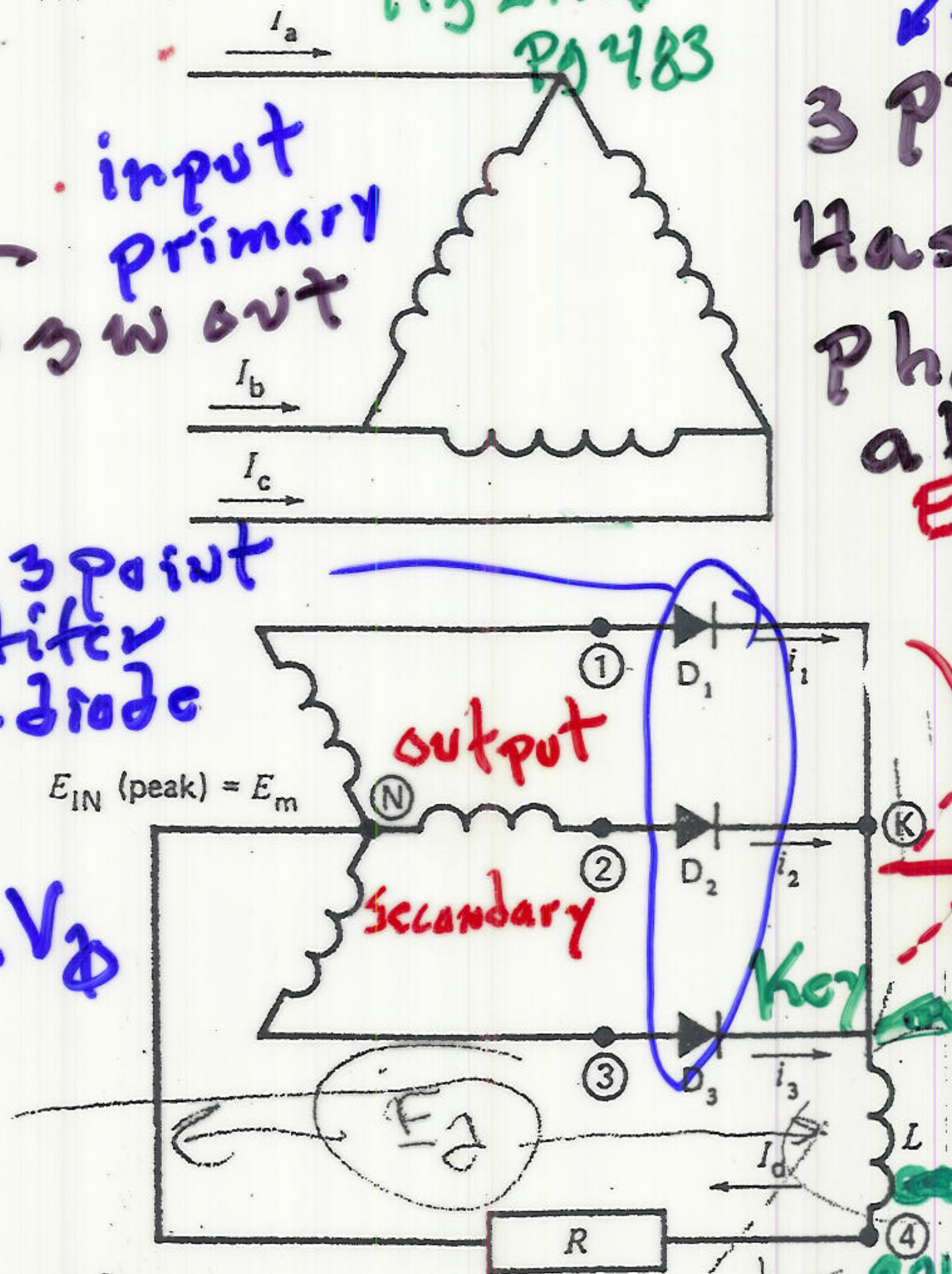
3 Phase Has 120° Phasing abc

← No 3 w out

Only 3 point rectifier each diode sees

$\frac{V_{\ell\ell}}{\sqrt{3}} = V_\Phi$



$E_K - E_N \equiv E_{out}$

E (3Φ) DC does Not ever go to zero

$E_{DC} = .67$ rms or .82 peak

3Φ Half-wave rectifier

Three-phase, 3-pulse rectifier with inductive filter fed by a 3-phase transformer.

1/25

L-R load makes $i_L \approx$ constant

falling
Phase 1 : @ 60° $E_0 = E_m \cos 60 = \frac{E_m}{2}$

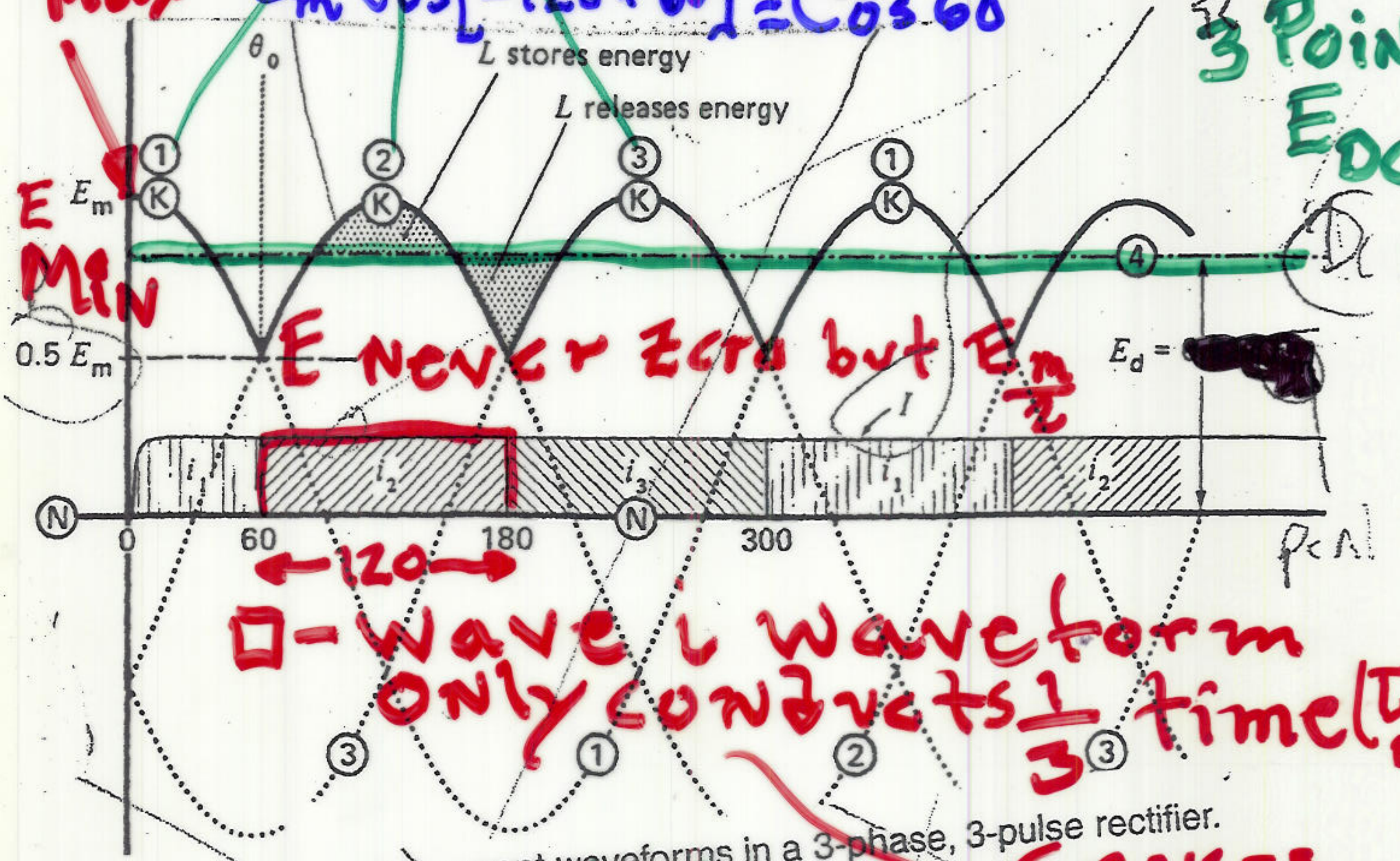
3 $\frac{1}{2}$ waves/cycle

and falling → Minimum Voltage

rising
Phase 2 @ 60° = $\frac{E_m}{2}$ and rising ↗ $= \frac{E_m}{2}$

Max $E_m \cos[-120+60] = \cos 60$

3 Point E_{DC}



E Min

E never zero but $\frac{E_m}{2}$

← 120 →

□-wave i waveform
only conducts $\frac{1}{3}$ time$(\frac{T}{n})$

Causes
EMC
EMI

Voltage and current waveforms in a 3-phase, 3-pulse rectifier.

3 point 3 Half Waves

$$E_{DC} = \left(\frac{1}{\pi}\right)\left(\frac{3}{2}\right) \underbrace{E_{peak}}_{\sqrt{2}\, E_{RMS}(l-n)}$$

3 ½ waves

$\frac{3}{\pi}(\sqrt{2})$

.9 E_{rms} ←

FW

= .675 E_{RMS} ? believable ?

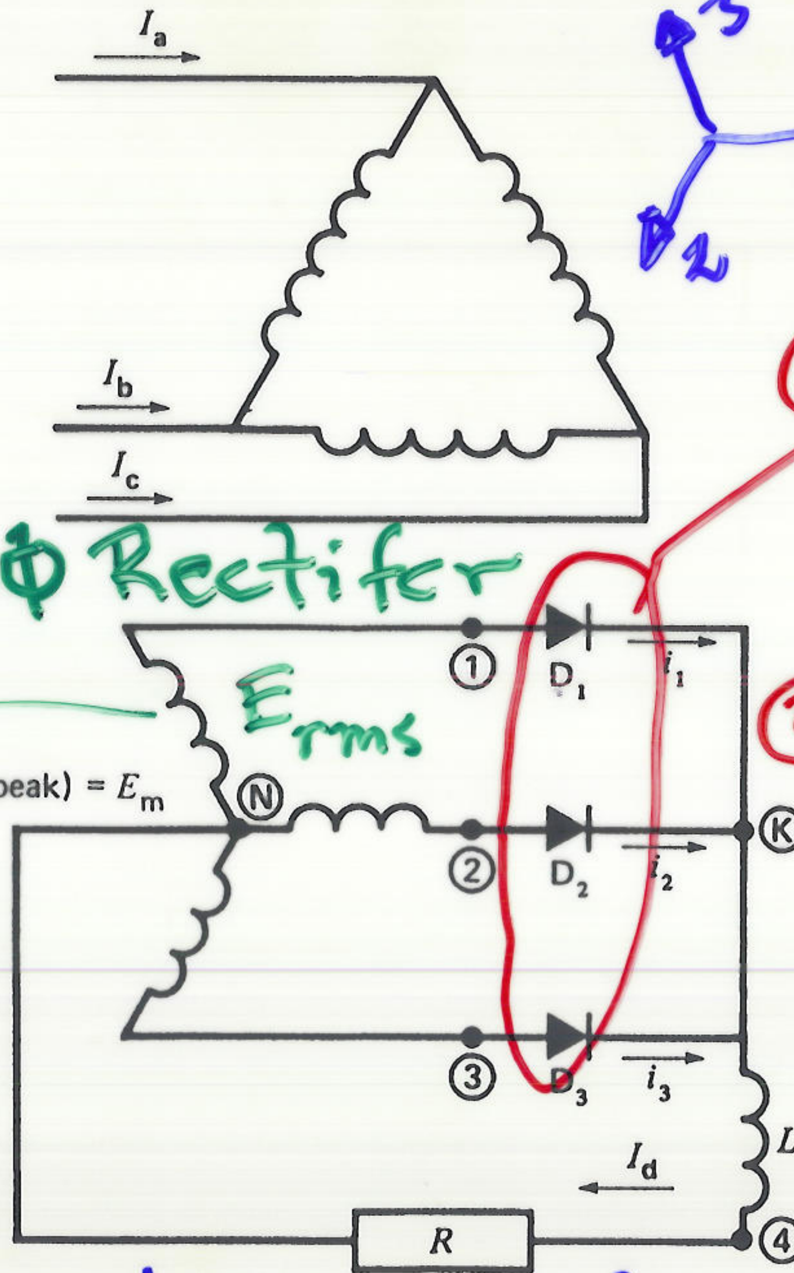
FW $E_{DC}(1\phi)$ is ? or .827 E_{peak}

Fig 22.26 p 483

Fig 22.26
p 483

Voltage Phases

Isolated 3Φ Rectifer



E_{rms} is ℓ–N voltage V_R key Not ℓ–ℓ

① 3diode "rectifer" "3 pulse"

② $V_{diode}^{reverse} = \frac{V_{\ell\ell}}{\sqrt{3}}$

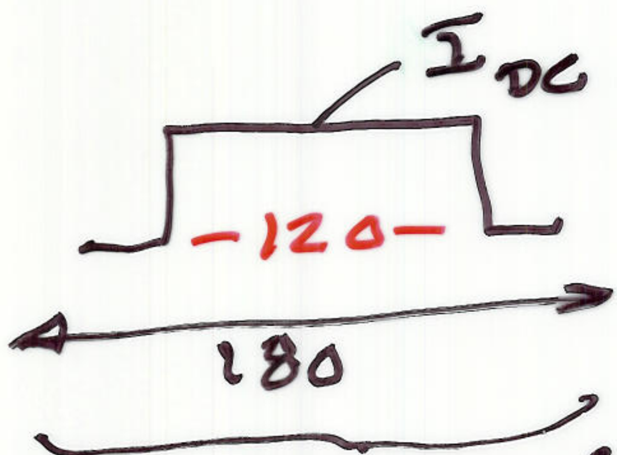
Big L in R–L load means?

? $E_{DC}(3\phi)$ vs $E_{dc}^{full\ wave}(1\phi) = 0.9\ E_{rms}$?

$P^{in}_{AC} = \sqrt{3}\, V_{ll} I_{AC}$ (fundamental) | $P^{out}_{DC} = V_{DC} I_{DC}$

$$I_{diodes}(AV) = \frac{I_{DC}}{3}$$ because

diodes are only on $\frac{120}{360}$



$$I^{eff}_{rms} = \sqrt{\frac{120}{180}}\, I_{DC}$$

$$I^{eff}_{rms} = 0.816\, I_{DC}$$

Rectified @ $2f_{sw}$

so duration of rectified V is 180°

Mains is only able to source

I (fundamental)

Whats the relation to I^{eff}_{rms}