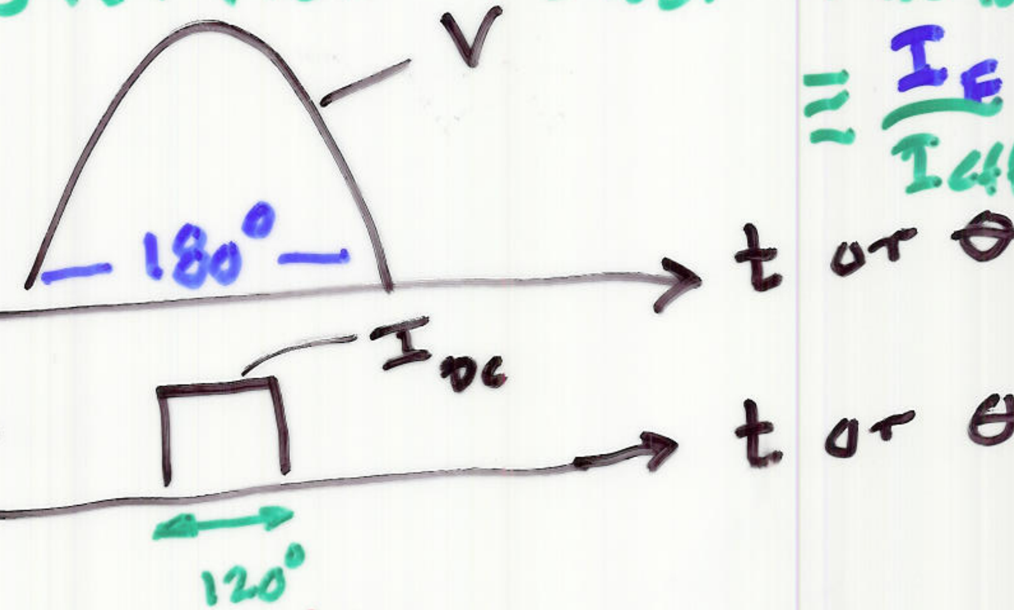
Distortion Power Factor

$\equiv \frac{I_E}{I_{eff}} = 0.955$

1φ case



FWR

Use

$I_{eff}^{\text{in AC}}$ (is sinewave fundemental plus harmonics) $\equiv I_{DC}\sqrt{\frac{120}{180}}$

$$I_{eff}^{\text{in AC}} = \underbrace{\left(\frac{120}{180}\right)^{1/2}}_{0.816} I_{DC} \neq I_{rms}^{fund} \text{ (line)}$$

$$\frac{I_{AC}^{eff}}{0.816}$$

For the fundemental line

$$\sqrt{3}\, E_{rms} I_{rms}^{fund} \equiv E_{DC} I_{DC}$$

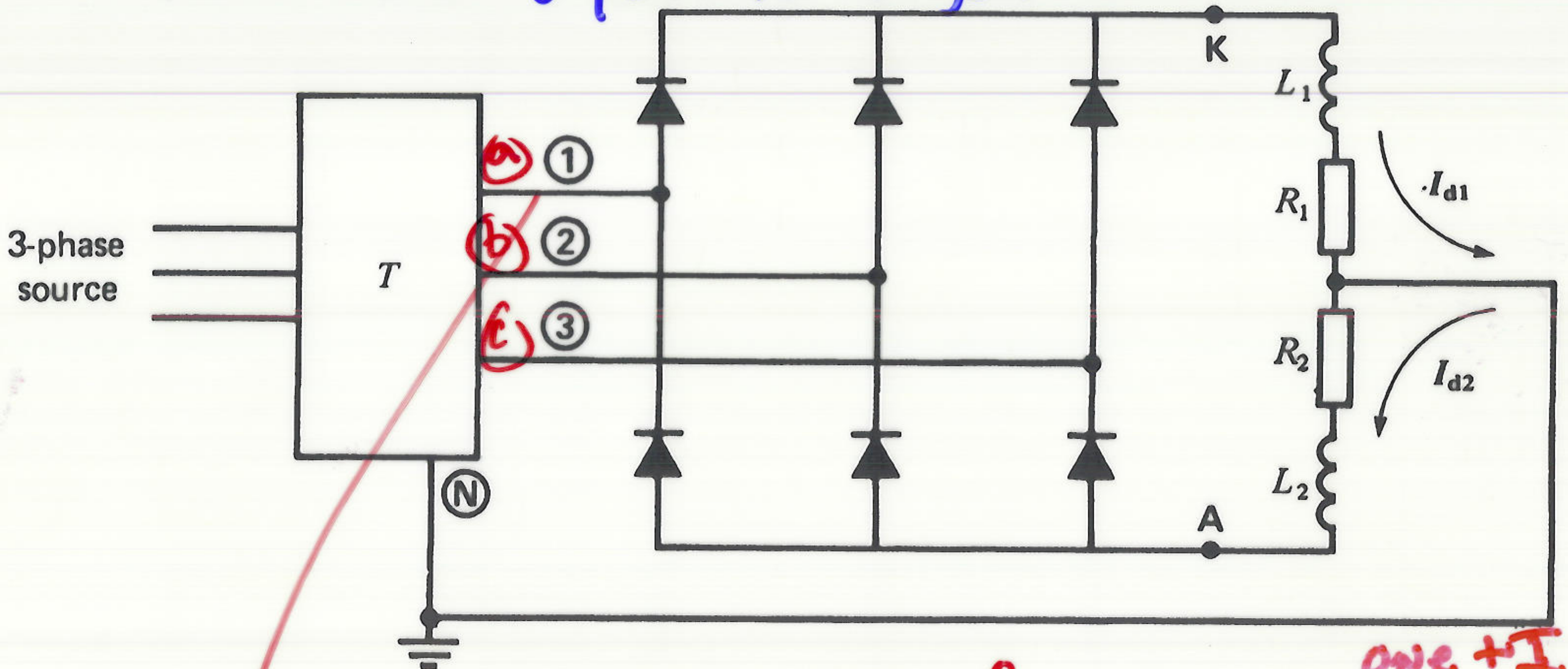
$1.35 E_{rms}$

$$I_{rms}^{fund} = \left(\frac{1.35}{\sqrt{3}}\right) \frac{I_{eff}}{.816} = .955\, I_{eff}$$

6pt just

Fig 21.18
Pg 485

Add two 3 points together ?



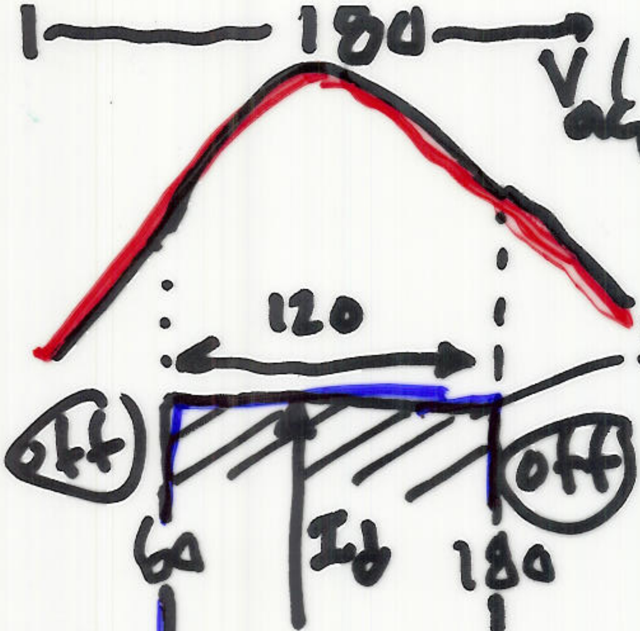
one +I

one -I

I_{line} will flow for $\frac{240^\circ}{360^\circ} \simeq \frac{2}{3}$ time

I_{diode} will flow $120/360 \simeq \frac{1}{3}$ time

1
44



V (rectified) 6 pt
a rectifier
with "L Filter"

I_d (rectified) square-wave $= \sum$ Harmonics + Fundamental

Consider case

I_{eff} (120° square wave):

all frequencies

$I_{eff}^2 \; 180 = I_d^2 \; 120$ □-wave

I_D (peak)

$I_{eff} = .816 \, I_d$ (peak of □-wave)

i from mains

I_{eff} = [fundamental i ⊕ all harmonics of i] effective means

$\Rightarrow I_{eff} \neq$ fundamental

Not yet!

Consider AC to DC Converter

recall 1.35 E_{rms}

$P_{DC} = E_{dc} I_{dc}$

I_d

$\frac{I_{eff}}{.816}$

$\sqrt{3} E_{rms} I_{FUND} = P_{IN} = P_{out}(DC)$

For $P_{AC} = P_{DC} \Rightarrow I_{FUND} = .78 I_{DC}$

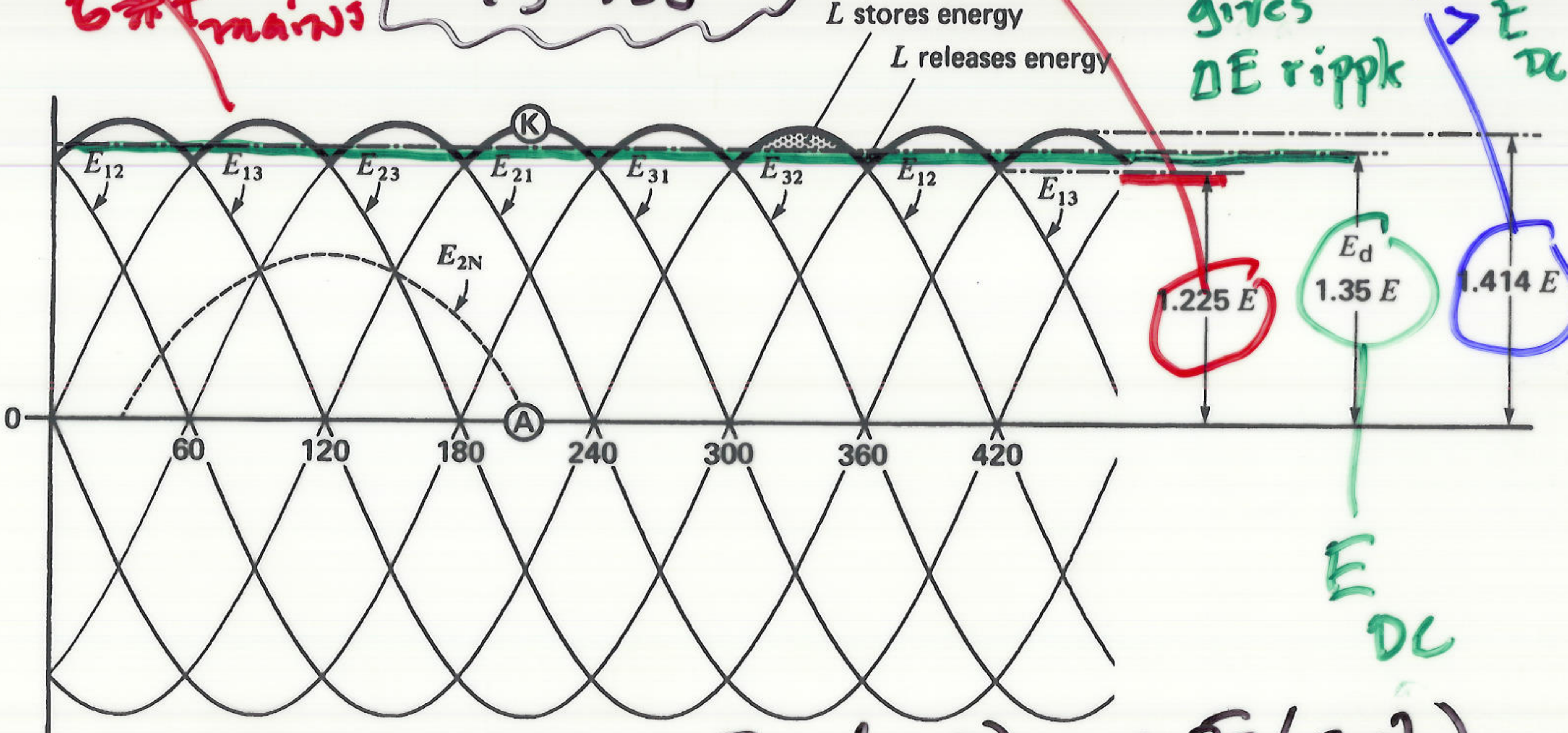
$.78 = \frac{1.35}{\sqrt{3}} = \frac{1.35}{1.73} = \frac{1.3}{1.7}$

$I_{FUND} = 0.955 \, I_{eff}$ (due to all harmonics)

Vout (DC) vs E_{RMS} (per phase)

f_{ripple} is $6 f_{mains}$

Fig 21.21
Pg 488



$E_{min} < E_{DC}$ gives ΔE ripple

$E_{peak} > E_{DC}$

E_{DC}

Intuitively $E_{DC}(6pt) = 2 \underbrace{E(3pt)_{DC}}_{.675\, E_{RMS}}$

not $\ell - \ell$

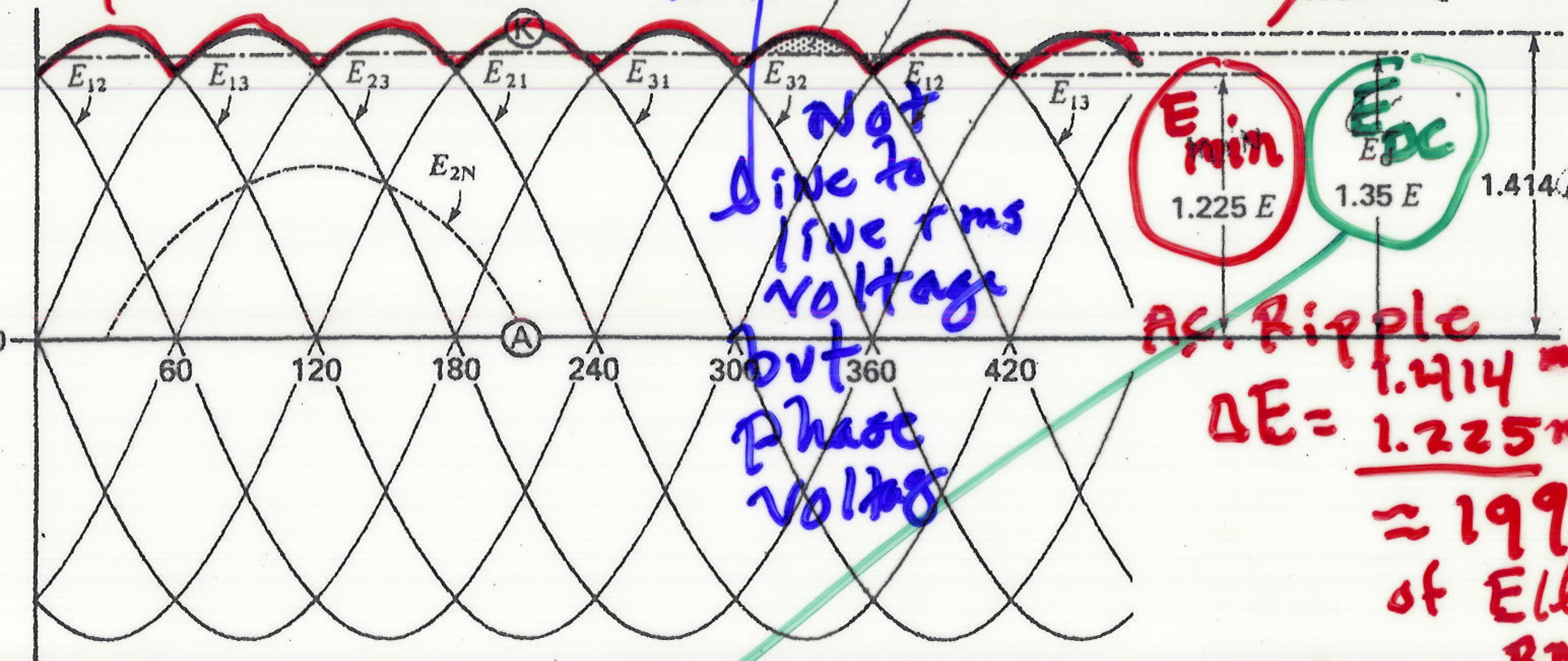
$E_{DC}(6pt) = 1.35\, E_{RMS}$

6 Point Ripple on E_{DC} (out) ≈ 20% E_{RMS}

$E_{max} = 1.414\, E_{ln}$ Use $E^{AC}_{line-neutral}$ for E_{DC}

$E_{DC} = 1.35\, E_{AC}(rms)$

$E_{max}(ac) = \sqrt{2}\, E_{rms}$



Not line to line rms voltage but Phase Voltage

E_{min}

E_{DC}

AC Ripple

$\Delta E = \dfrac{1.414_{max}}{1.225_{min}}$

≈ 19% of E(l-N) RMS

@ $f_r \approx 6 f_{mains}$

300–360 Hz

way of showing E_{KA} using line voltage potentials. Note also the position of E_{2N} with respect to the line

$\dfrac{E_{DC}}{2} = ?$

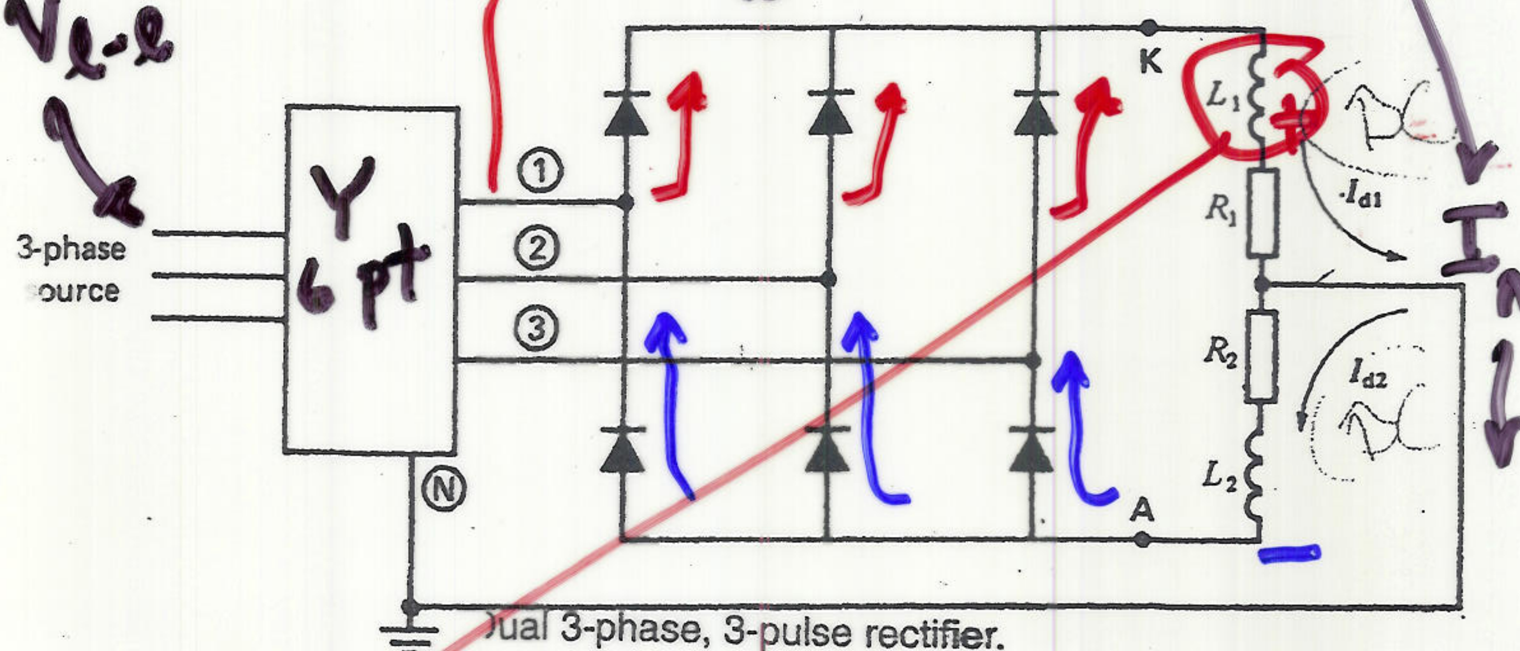
.675

familiar?

Consider two stacked 3 point rectifers. Each stack operates seperately. If balanced $I_N = 0$

$V_{\ell-N} = \frac{V_{\ell-\ell}}{\sqrt{3}}$

$V_{\ell-\ell}$



Dual 3-phase, 3-pulse rectifier.

Additional role of "L" is short circuit protection as well as $\Delta i \downarrow$

If $E_{out} = 250V$ and we suddenly short out R

I(initial) = 1 KA

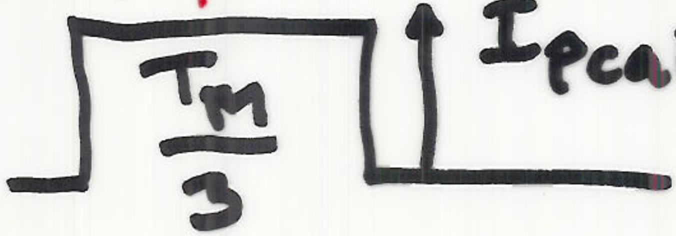
limit I_{max} = 3KA in 50ms $\Big\}$ L = ?

3Φ "6 Pulse" Rectifer

Fullwave

1-27

employs Twice as many diodes and often $V_{ac}(in) = l\text{-}l$ not phase



How to increase "on" duty cycle above $\left(\frac{120}{360}\right)$?

We cannot! But we can overlap more current pulses than 3. The duration $\left(\frac{120}{360}\right)$ is fixed but more $\square$-waves of i is possible

Overlapping intervals will reduce each diode peak current also. ☺

($I_{peak}\downarrow \Rightarrow$ Cheaper diode CAN be used)

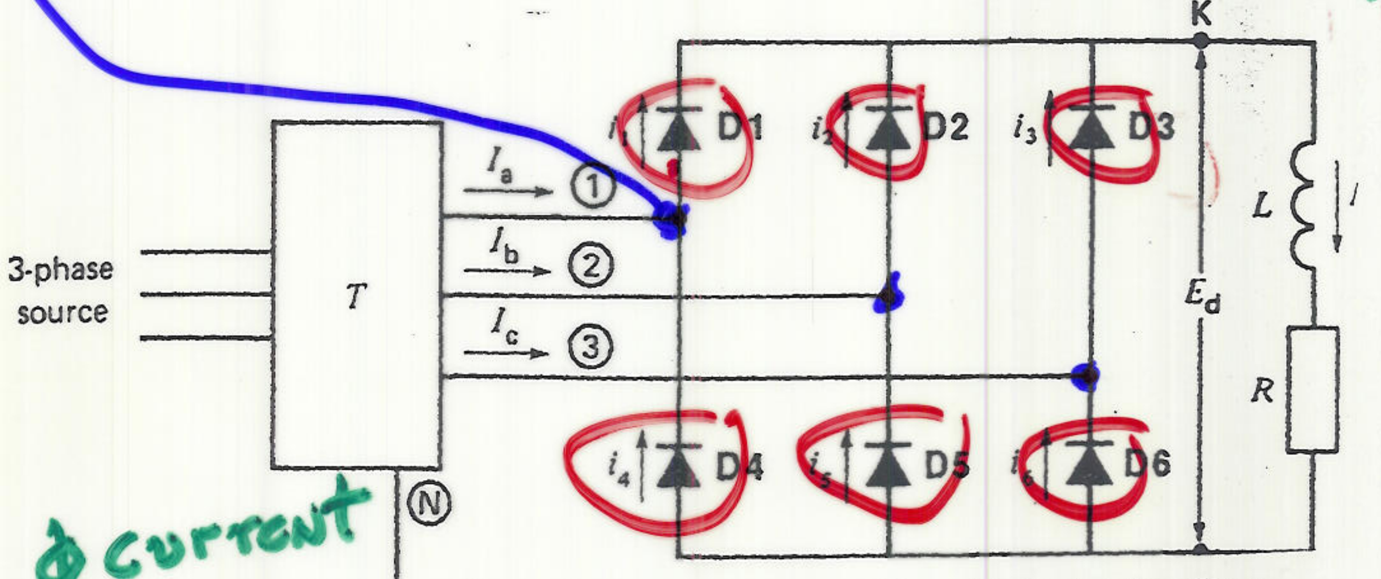
1
30

Six point
Line currents feed two diodes

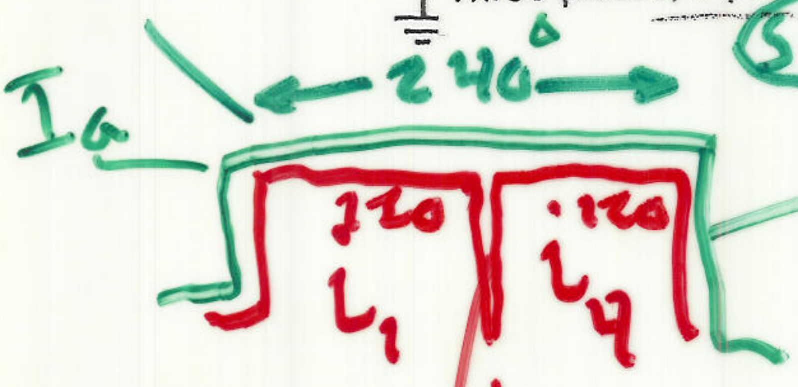
$$I_a = i_1 - i_4$$
$$I_b = i_2 - i_5$$
$$I_c = i_3 - i_6$$

Diode currents flow for $\frac{120}{360}$ only when $V_D(in) - V_K > 0$

Phase currents flow $\left(\frac{240}{360}\right)$



Three-phase, 6-pulse rectifier with inductive filter.



Still chopped, but less

I_a

EMC } due to
EMI } 240/360

i_1 and i_4 are opposite directions : add

with 6 point rectifer $I\phi$ 240/360

see next page