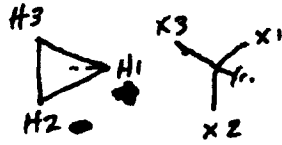


- Three-Phase Transformers

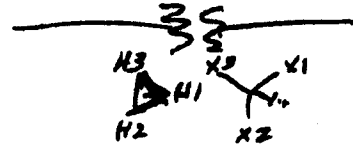
ejw

All of these can and are used to indicate the winding connections:

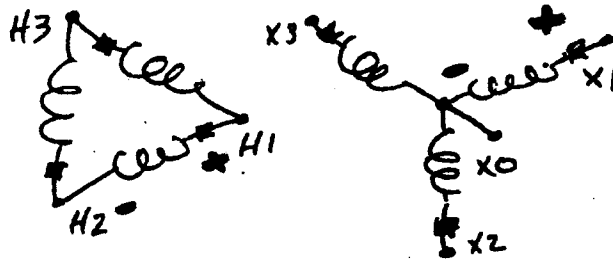
IEEE Stds:



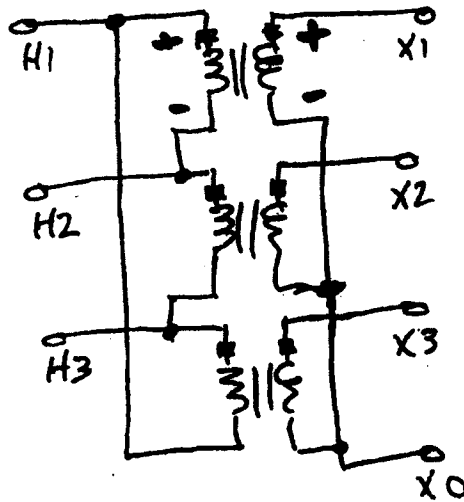
One-Line:



Schematic



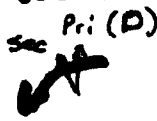
Circuit 3-line diagram



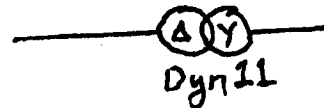
Europe and much of the world:

IEC Stds:

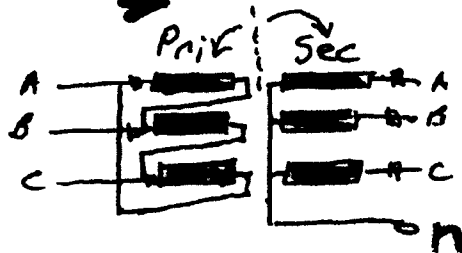
Dyn11



One-Line:



fold-down diagram



345-kV AT-515 169-kV 115-kV 69-kV



- STD 30° phase shift
is often not the case!

How many possibilities are there for Δ -Y or Y- Δ phase shifts?

$\pm 30^\circ$
 $\pm 90^\circ$
 $\pm 150^\circ$) 6 each \Rightarrow 12 total.

Auto- Δ

Zig-Zig

Extended Δ .

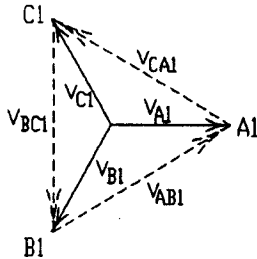
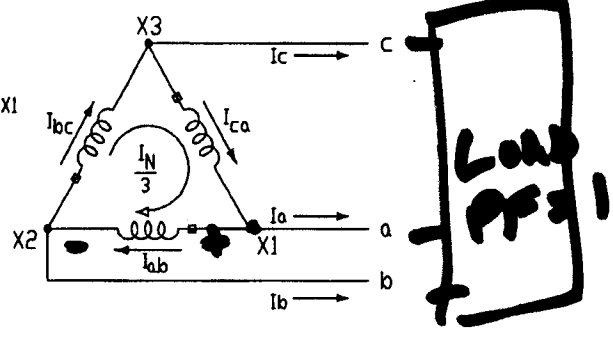
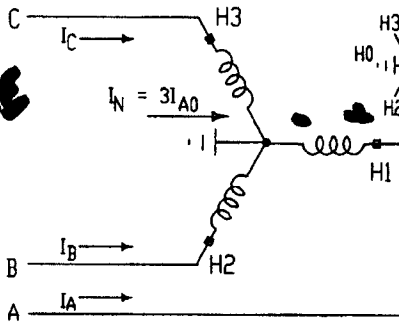
Relay:

Broken Δ

$\Rightarrow 3 \times 4 = 12$

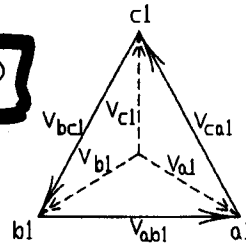
MORK

SOURCE

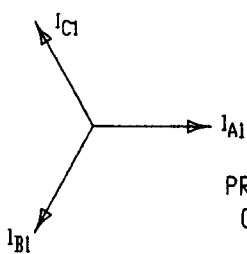


$$V_{A1} = V_{a1} (\angle 30^\circ)$$

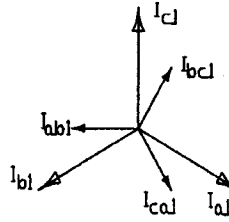
PRI POS SEQ VOLTAGES



SEC POS SEQ VOLTAGES

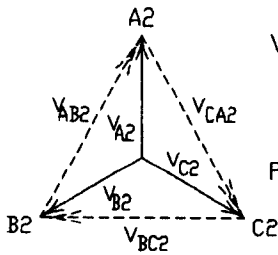


PRI POS SEQ CURRENTS



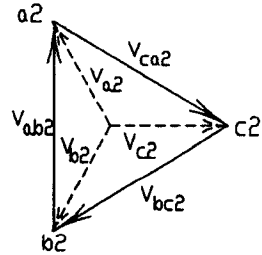
SEC POS SEQ CURRENTS

KCL

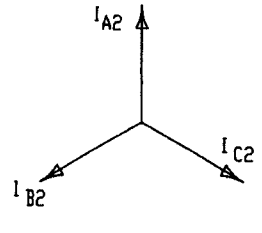


$$V_{A2} = V_{a2} (\angle -30^\circ)$$

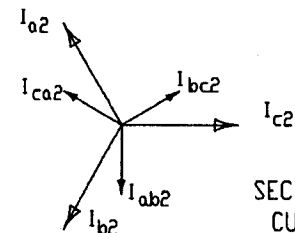
PRI NEG SEQ VOLTAGES



SEC NEG SEQ VOLTAGES



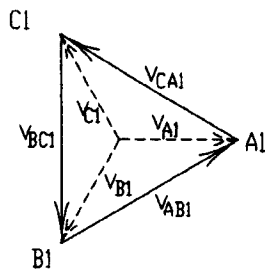
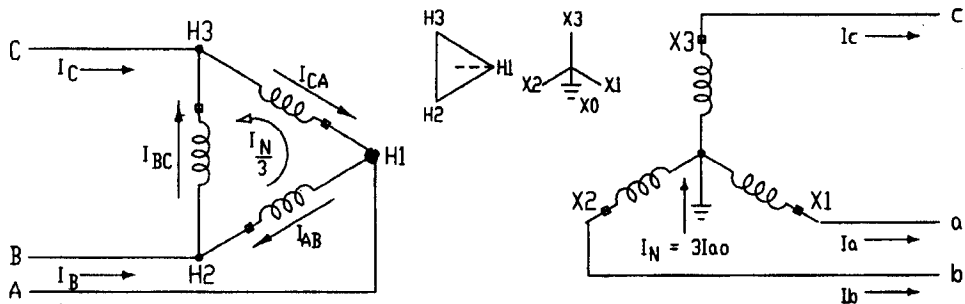
PRI NEG SEQ CURRENTS



SEC NEG SEQ CURRENTS

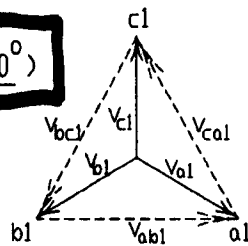
ANSI STANDARD 30-DEGREE SHIFT WYE-DELTA

MARK

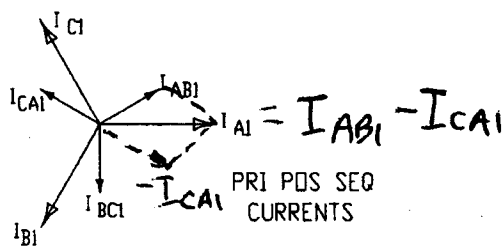


$$V_{A1} = V_{a1} (\angle 30^\circ)$$

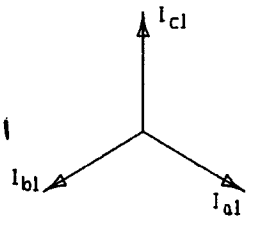
PRI POS SEQ VOLTAGES



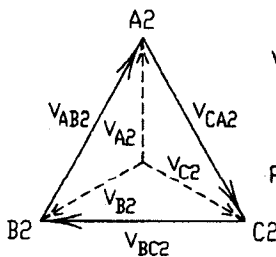
SEC POS SEQ VOLTAGES



PRI POS SEQ CURRENTS

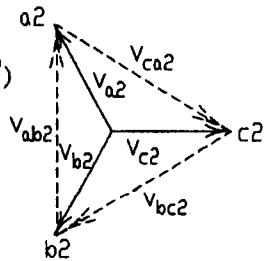


SEC POS SEQ CURRENTS

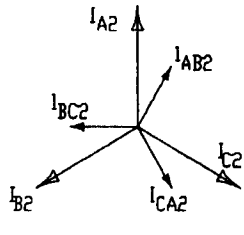


$$V_{A2} = V_{a2} (\angle -30^\circ)$$

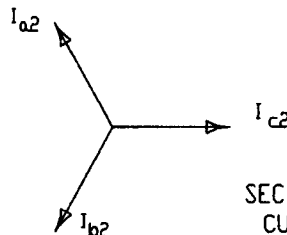
PRI NEG SEQ VOLTAGES



SEC NEG SEQ VOLTAGES

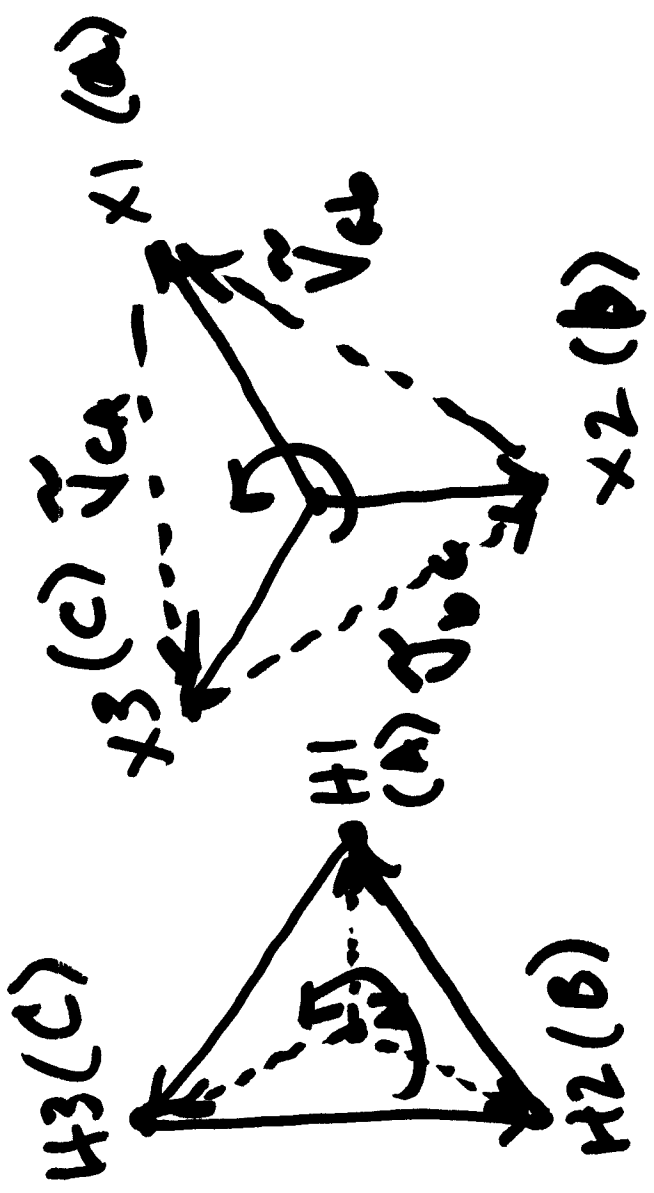


PRI NEG SEQ CURRENTS



SEC NEG SEQ CURRENTS

ANSI STANDARD 30-DEGREE SHIFT DELTA-WYE



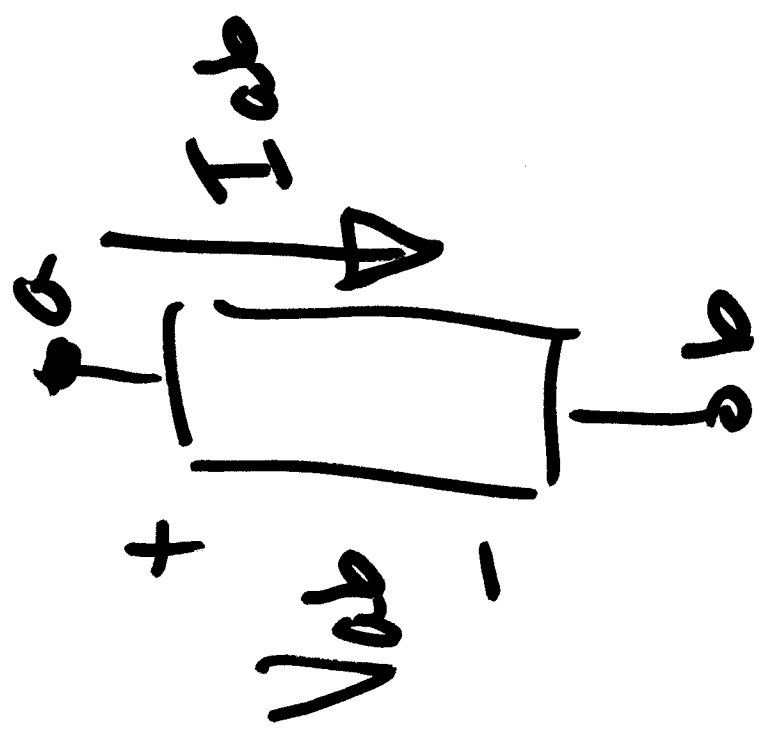
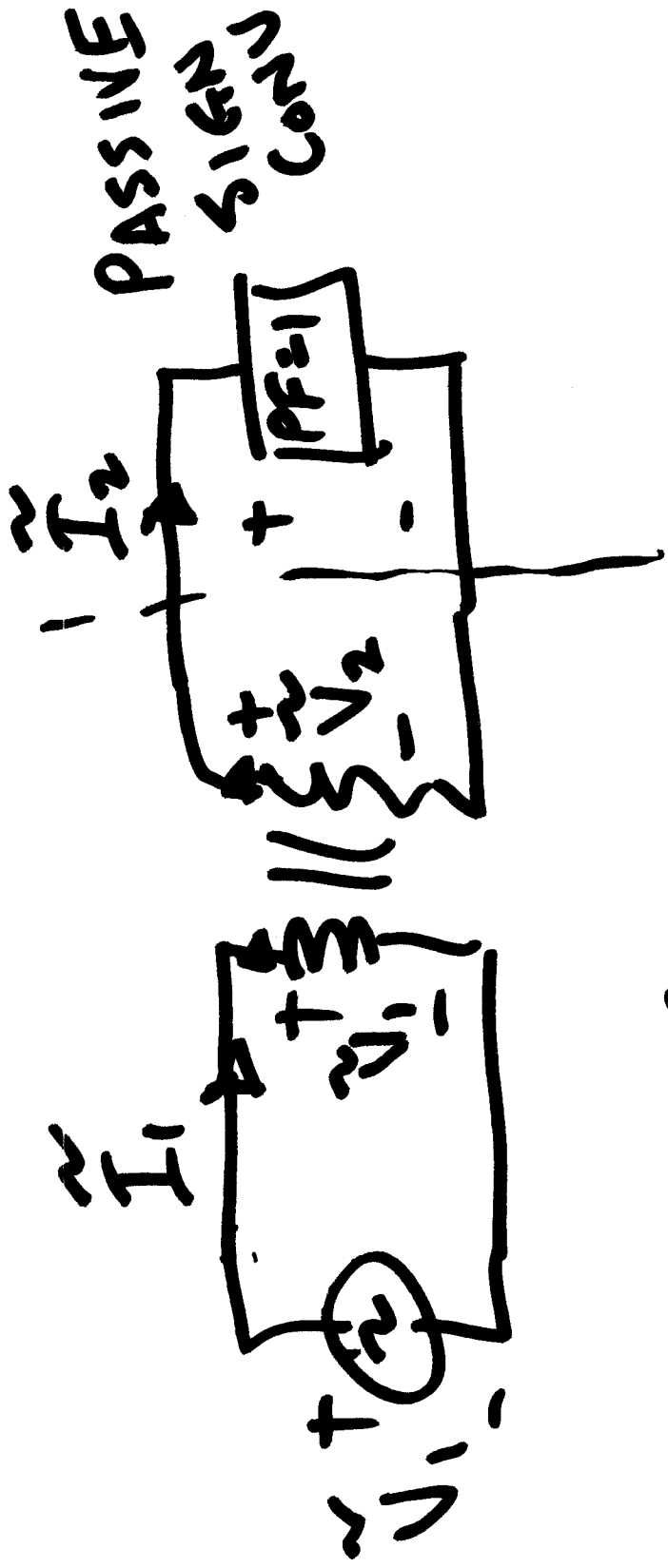
\vec{V}_A
 \vec{V}_B
 \vec{V}_C

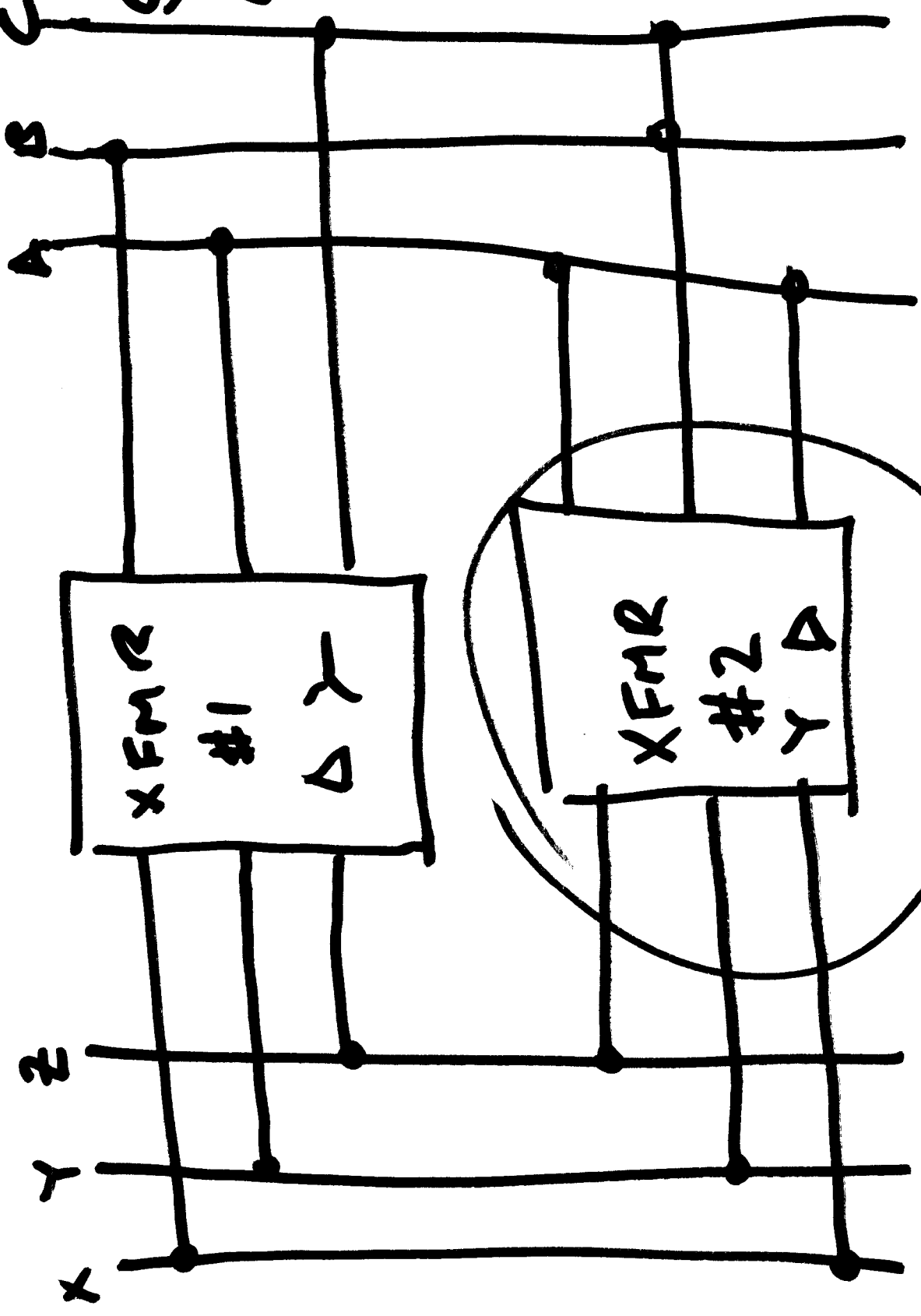
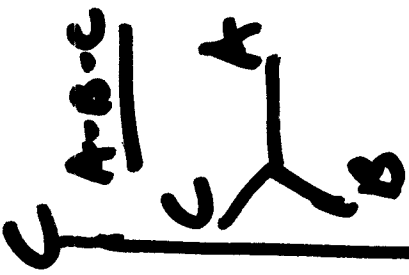
\vec{V}_{AB}
 \vec{V}_{BC}
 \vec{V}_{CA}

\vec{V}_a
 \vec{V}_b
 \vec{V}_c

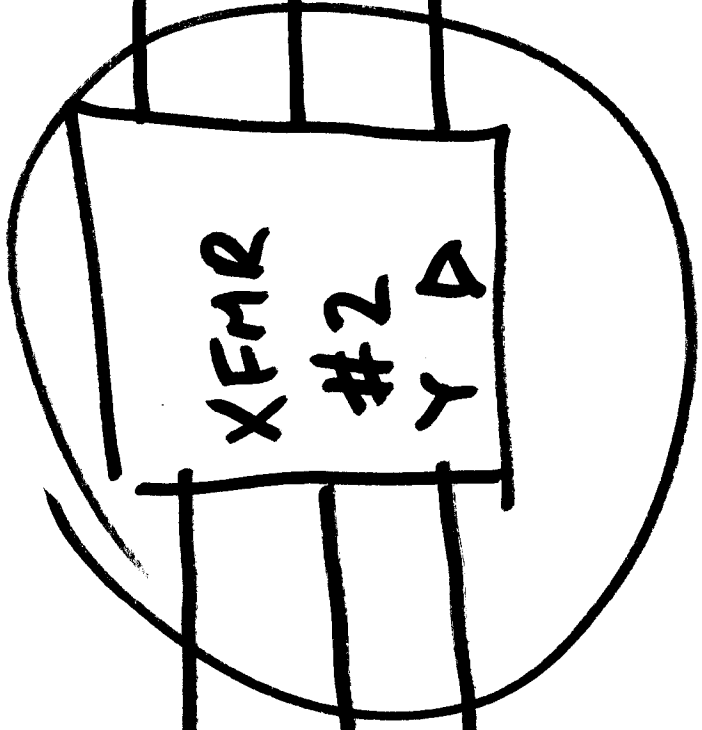
\vec{V}_{ab}
 \vec{V}_{bc}
 \vec{V}_{ca}

$x_2(b)$





XFMR
#1
Δ Y



XFMR
#2
Y Δ