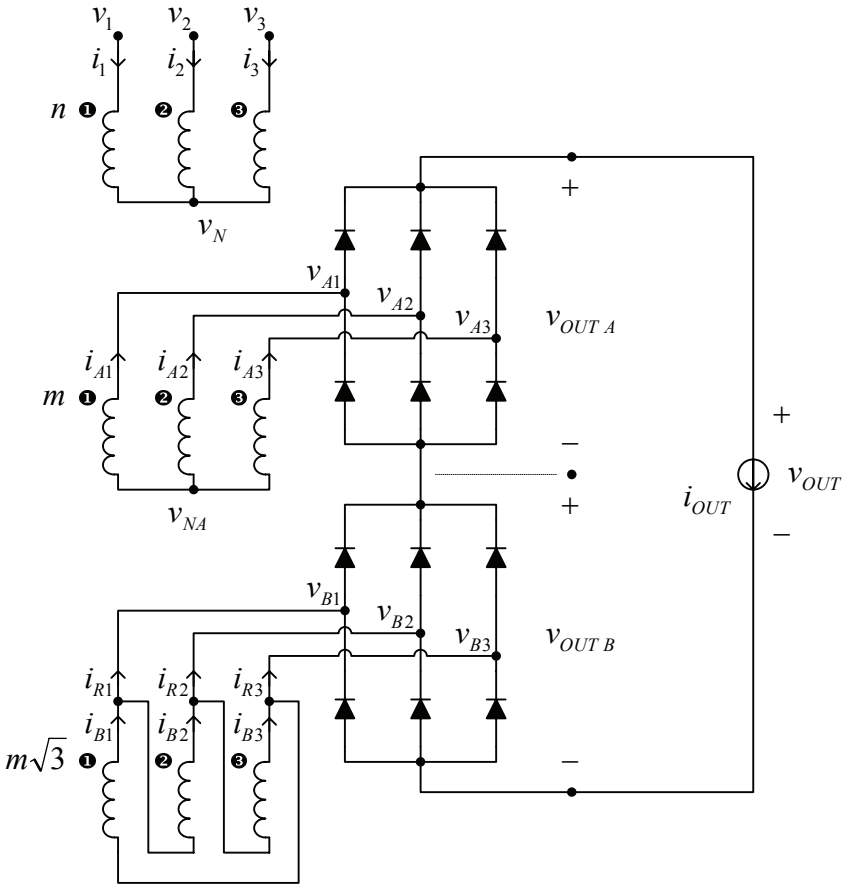
HANDOUT #4 **12-PULSE RECTIFIER**



$$i_k = \frac{m}{n}\left(i_{Ak} + i_{Bk}\sqrt{3}\right),\ k \in \{1, 2, 3\}$$

$$v_{Ak} - v_{NA} = v_{AkNA} = \frac{m}{n} v_k,\ k \in \{1, 2, 3\}$$

$$v_{OUT\,A} = \max\left(v_{A1NA}, v_{A2NA}, v_{A3NA}\right) - \min\left(v_{A1NA}, v_{A2NA}, v_{A3NA}\right) = \frac{m}{n}\left(\max\left(v_1, v_2, v_3\right) - \min\left(v_1, v_2, v_3\right)\right)$$

$$v_{B13} = \frac{m\sqrt{3}}{n} v_1,\ v_{B21} = \frac{m\sqrt{3}}{n} v_2,\ v_{B32} = \frac{m\sqrt{3}}{n} v_3$$

$$v_{NB} = \frac{1}{3}\left(v_{B1} + v_{B2} + v_{B3}\right)$$

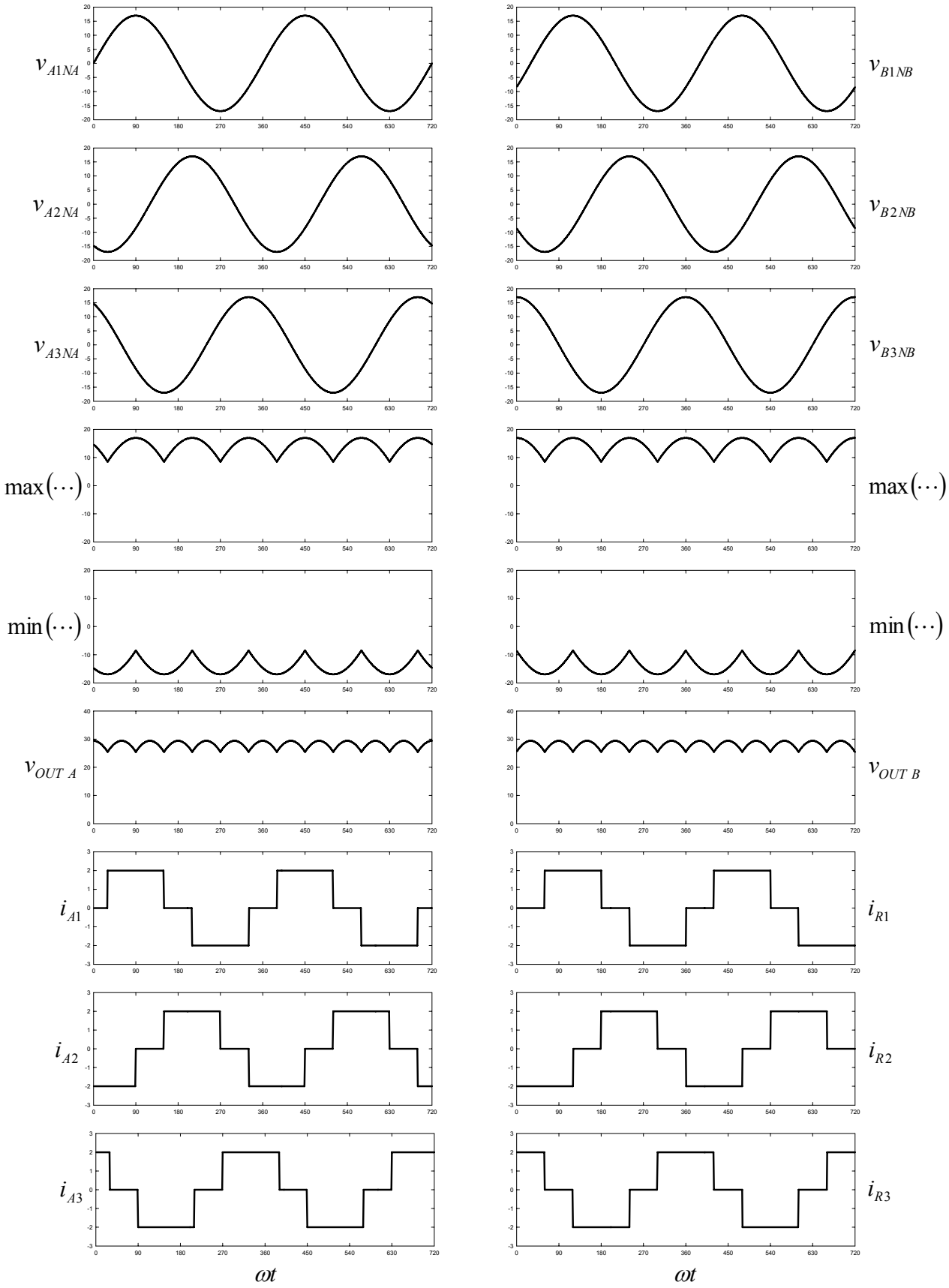
$$v_{OUT\,B} = \max\left(v_{B13}, v_{B21}, v_{B32}, -v_{B13}, -v_{B21}, -v_{B32}\right) = \frac{m\sqrt{3}}{n}\left(\max\left(v_1, v_2, v_3, -v_1, -v_2, -v_3\right)\right)$$

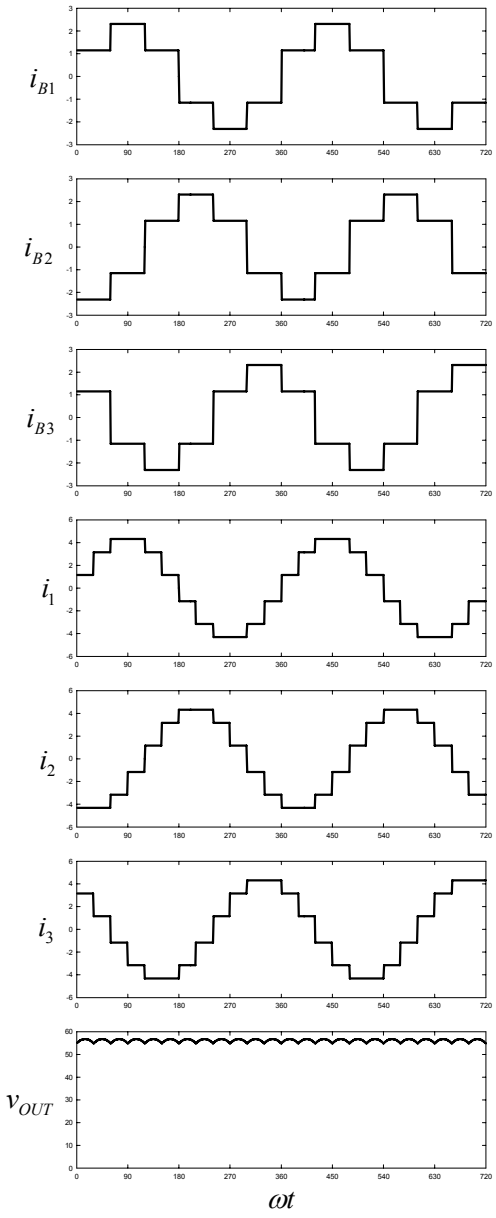
$$i_{R1} = i_{B1} - i_{B2},\ i_{R2} = i_{B2} - i_{B3},\ i_{R3} = i_{B3} - i_{B1},$$

$$i_{B1} + i_{B2} + i_{B3} = 0$$

$$\begin{bmatrix} i_{B1} \\ i_{B2} \\ i_{B3} \end{bmatrix} = \frac{1}{3}\begin{bmatrix} 1 & 0 & -1 \\ -1 & 1 & 0 \\ 0 & -1 & 1 \end{bmatrix}\begin{bmatrix} i_{R1} \\ i_{R2} \\ i_{R3} \end{bmatrix}$$

finally $i_k = \frac{m}{n}\left(i_{Ak} + i_{Bk}\sqrt{3}\right),\ k \in \{1, 2, 3\},\ v_{OUT} = v_{OUT\,A} + v_{OUT\,B}$


v_{A1NA}
v_{B1NB}
v_{A2NA}
v_{B2NB}
v_{A3NA}
v_{B3NB}
$\max(\cdots)$
$\max(\cdots)$
$\min(\cdots)$
$\min(\cdots)$
$v_{OUT\ A}$
$v_{OUT\ B}$
i_{A1}
i_{R1}
i_{A2}
i_{R2}
i_{A3}
i_{R3}
ωt
ωt



toy-example, $V_{RMS} = 12$ V , $I_{OUT} = 2$ A , $n = m = 1$

$$V_{OUT} = \frac{6\sqrt{6}}{\pi}\frac{m}{n}V_{RMS}\,,\; THD = \frac{\sqrt{\left(2+\sqrt{3}\right)\pi^2 - 36}}{6} \approx 15.22\%$$