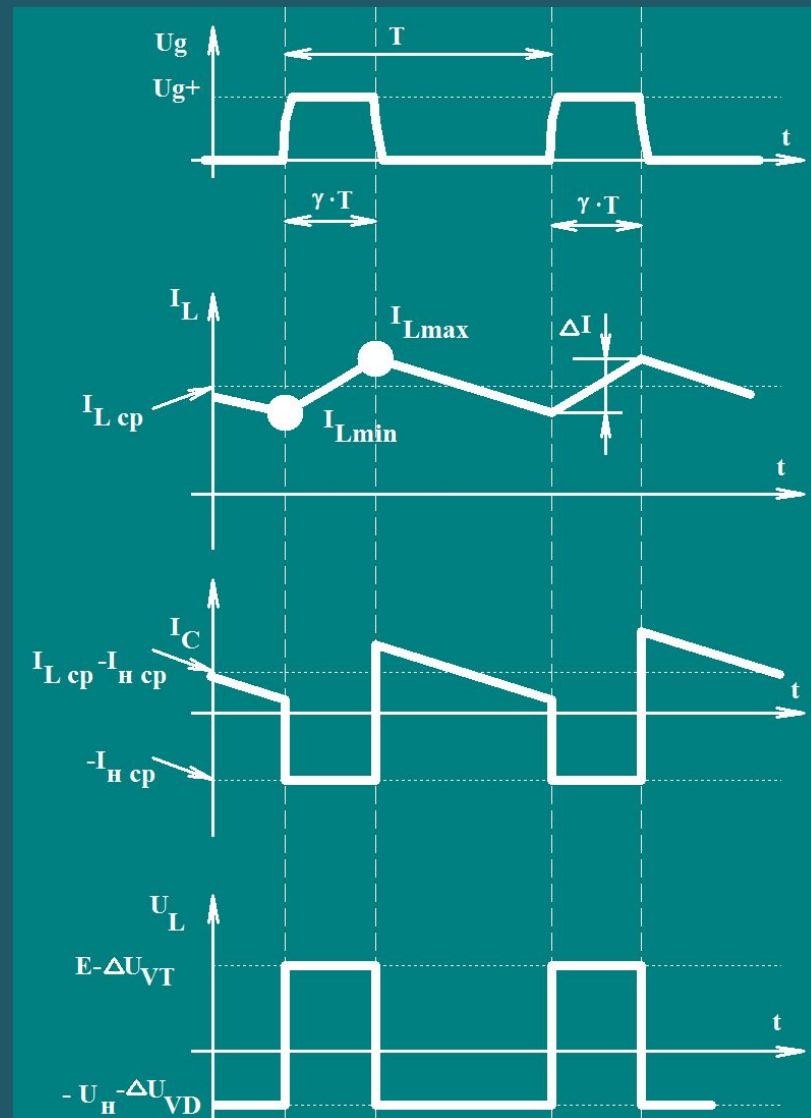
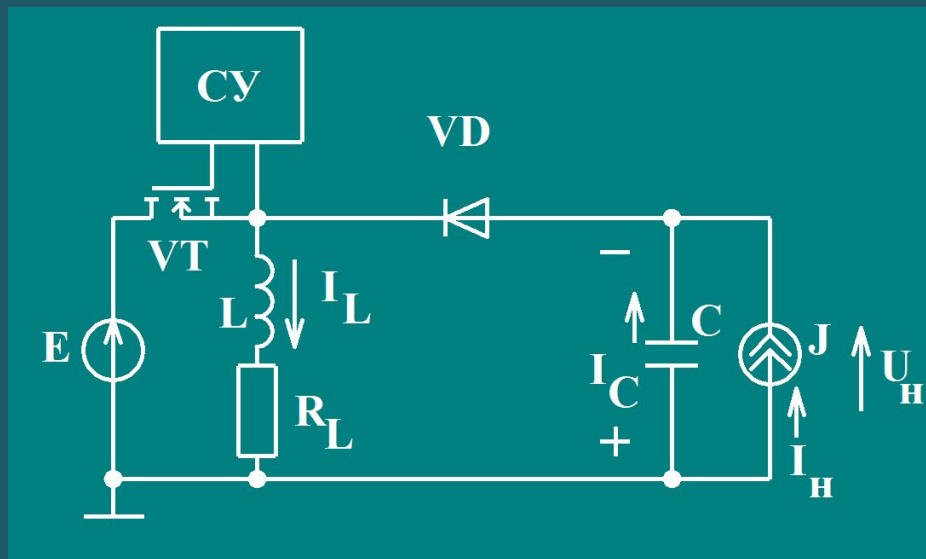


Инвертирующий преобразователь

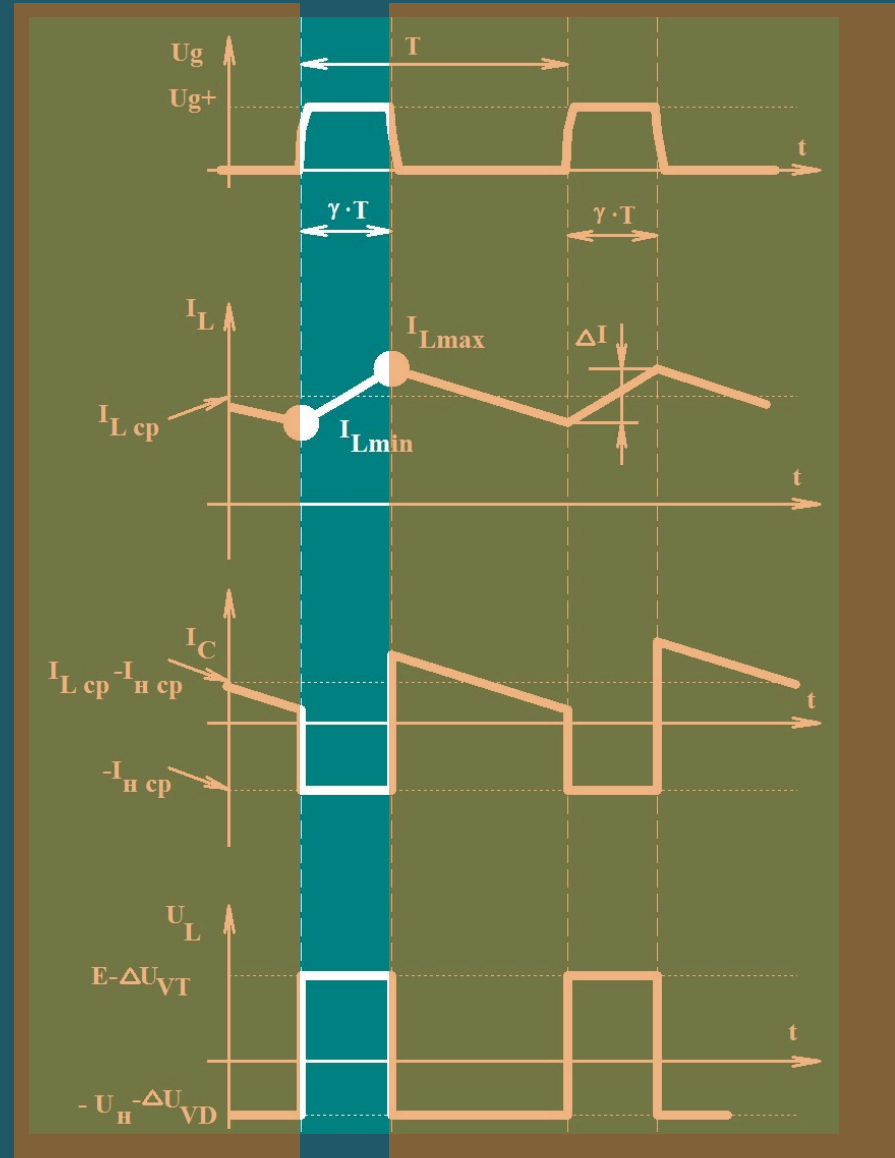
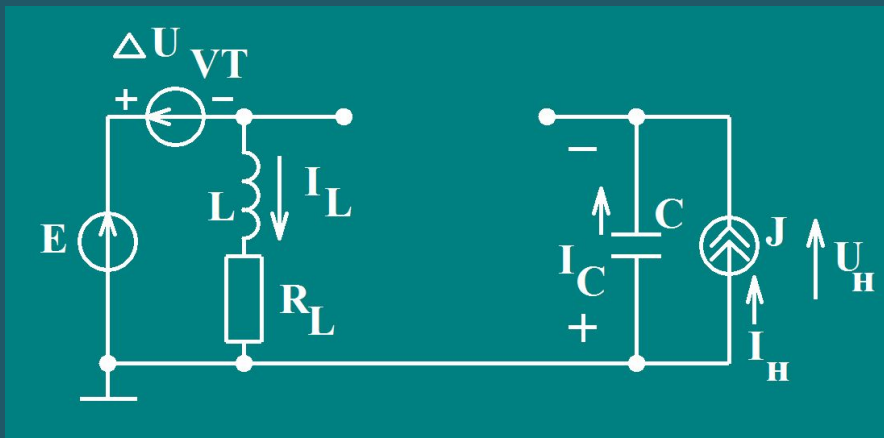
(Преобразователь III рода)

Принципиальная схема



Интервал импульса

$$\frac{d I_L}{d t} = \frac{E - \Delta U_{VT} - R_L \cdot I_{L \text{ cp}}}{L}$$



Интервал импульса

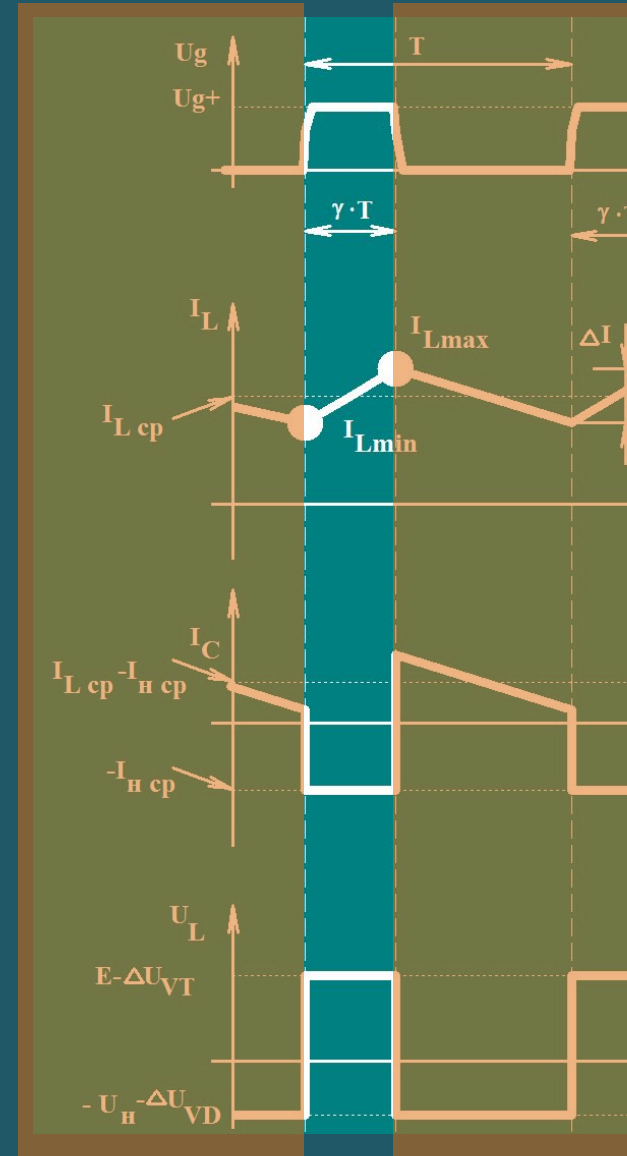
$$\frac{d I_L}{d t} = \frac{E - \Delta U_{VT} - R_L \cdot I_{L \text{ cp}}}{L} \Rightarrow I_L(t) = \frac{d I_L}{d t} \cdot t + I_{L \text{ min}} =$$

$$= I_{L \text{ min}} + \frac{E - \Delta U_{VT} - R_L \cdot I_{L \text{ cp}}}{L} \cdot t$$

$$I_{L \text{ max}} = I_L(t_{\text{И}}) = \frac{d I_L}{d t} \cdot t + I_{L \text{ min}} =$$

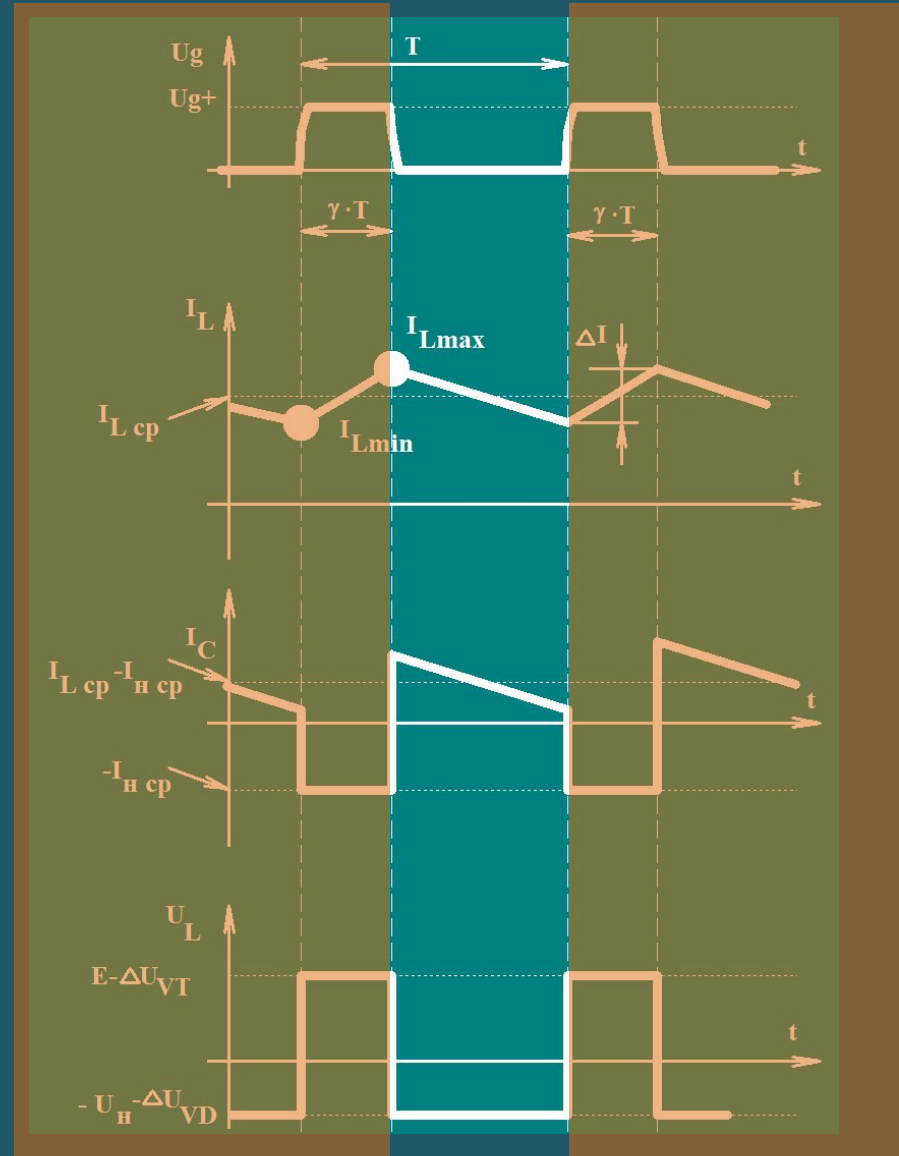
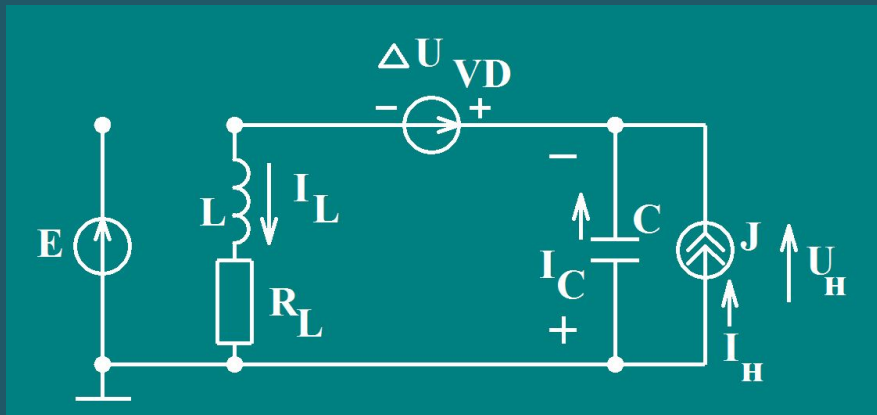
$$= I_{L \text{ min}} + \frac{E - \Delta U_{VT} - R_L \cdot I_{L \text{ cp}}}{L} \cdot t_{\text{И}}$$

$$\Delta I = \frac{E - \Delta U_{VT} - R_L \cdot I_{L \text{ cp}}}{L} \cdot t_{\text{И}} \approx \frac{E}{L} \cdot t_{\text{И}}$$



Интервал паузы

$$\frac{d I_L}{d t} = \frac{-\Delta U_{VD} - U_H - R_L \cdot I_{Lcp}}{L}$$



Интервал паузы

$$\frac{d I_L}{d t} = \frac{-\Delta U_{VD} - R_L \cdot I_{L \text{ cp}} - U_H}{L} \Rightarrow I_L(t) = \frac{d I_L}{d t} \cdot (t - t_{\text{и}}) + I_{L \text{ max}} =$$

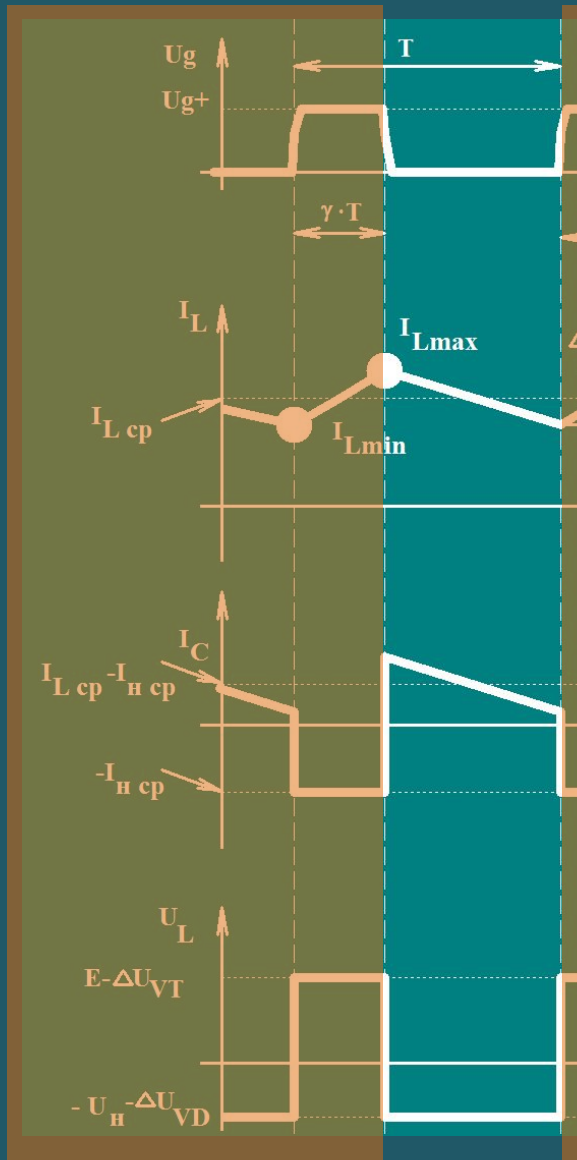
$$= I_{L \text{ max}} + \frac{-\Delta U_{VD} - R_L \cdot I_{L \text{ cp}} - U_H}{L} \cdot (t - t_{\text{и}})$$

$$I_{L \text{ min}} = I_L(T) = \frac{d I_L}{d t} \cdot T + I_{L \text{ max}} =$$

$$= I_{L \text{ max}} + \frac{-\Delta U_{VD} - R_L \cdot I_{L \text{ cp}} - U_H}{L} \cdot (T - t_{\text{и}})$$

$$I_{L \text{ min}} = I_{L \text{ min}} + \frac{E - \Delta U_{VT} - R_L \cdot I_{L \text{ cp}}}{L} \cdot t_{\text{и}} +$$

$$+ \frac{-\Delta U_{VD} - R_L \cdot I_{L \text{ cp}} - U_H}{L} \cdot (T - t_{\text{и}})$$



Напряжение нагрузки

$$t_{\text{И}} = \gamma \cdot T$$

$$0 = (E - \Delta U_{VT} - R_L \cdot I_{L \text{ ср}}) \cdot \gamma + (-\Delta U_{VD} - R_L \cdot I_{L \text{ ср}} - U_{\text{H}}) \cdot (1 - \gamma)$$

$$0 = E \cdot \gamma - R_L \cdot I_{L \text{ ср}} - \Delta U_{VT} \cdot \gamma - \Delta U_{VD} \cdot (1 - \gamma) - U_{\text{H}} \cdot (1 - \gamma)$$

$$U_{\text{H}} = \frac{(E - \Delta U_{VT}) \cdot \gamma - \Delta U_{VD} \cdot (1 - \gamma)}{1 - \gamma} - R_L \cdot \frac{I_{L \text{ ср}}}{1 - \gamma}$$

$$Q_{\text{И}} = -I_{\text{H}} \cdot t_{\text{И}} = -I_{\text{H}} \cdot \gamma \cdot T$$

$$Q_{\text{П}} = (I_{L \text{ ср}} - I_{\text{H}}) \cdot (T - t_{\text{И}}) = (I_{L \text{ ср}} - I_{\text{H}}) \cdot (1 - \gamma) \cdot T$$

$$Q_{\text{П}} + Q_{\text{И}} = 0$$

$$(I_{L \text{ ср}} - I_{\text{H}}) \cdot (1 - \gamma) - I_{\text{H}} \cdot \gamma = 0$$

$$I_{L \text{ ср}} = \frac{I_{\text{H}}}{1 - \gamma}$$

Напряжение нагрузки

$$U_H = \frac{(E - \Delta U_{VT}) \cdot \gamma - \Delta U_{VD} \cdot (1 - \gamma)}{1 - \gamma} - R_L \cdot \frac{I_H}{(1 - \gamma)^2}$$

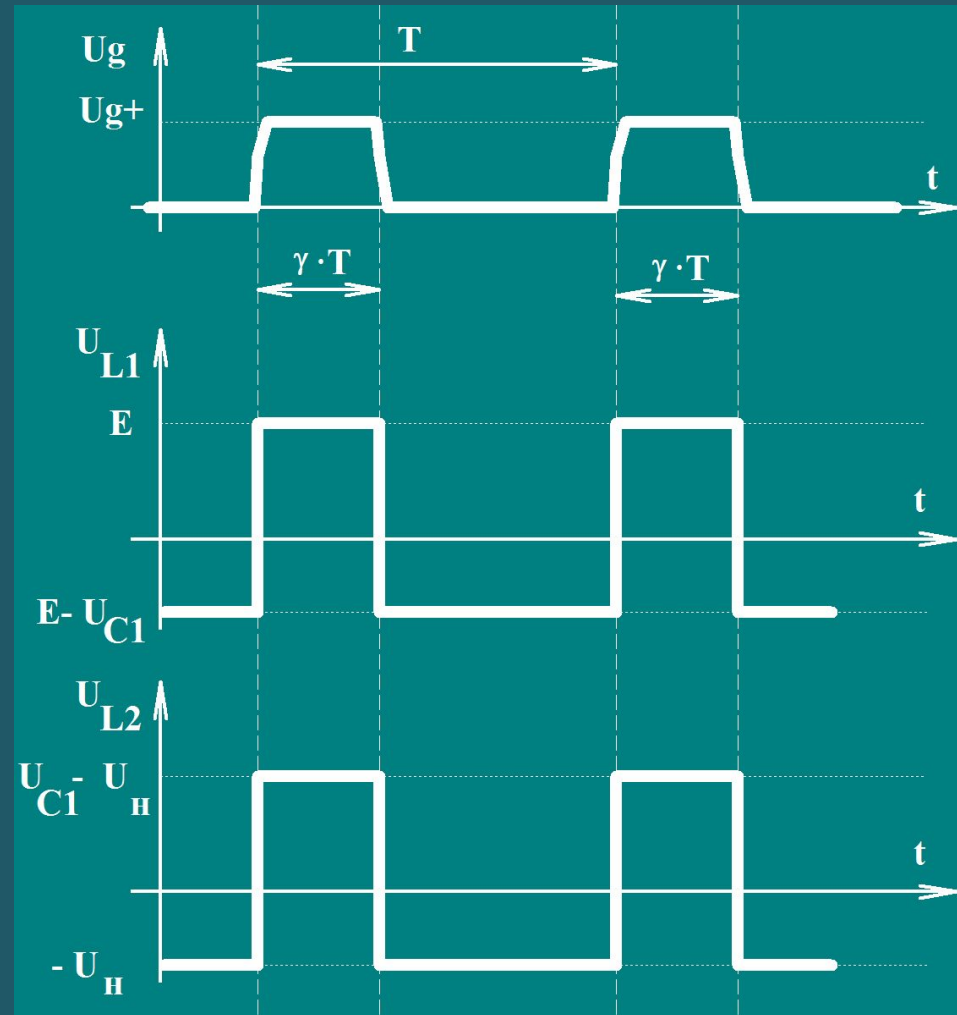
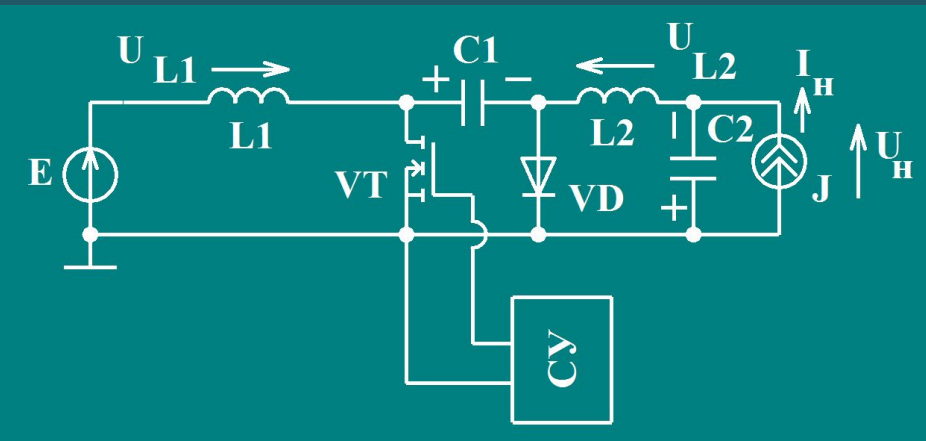
$$U_H = \frac{E \cdot \gamma}{1 - \gamma} - R_L \cdot \frac{I_H}{(1 - \gamma)^2}$$

$$U_H = \frac{(E - \Delta U_{VT}) \cdot \gamma - \Delta U_{VD} \cdot (1 - \gamma)}{1 - \gamma} - \frac{R_L}{R_H} \cdot \frac{U_H}{(1 - \gamma)^2}$$

$$U_H = \frac{(E - \Delta U_{VT}) \cdot \gamma - \Delta U_{VD} \cdot (1 - \gamma)}{1 - \gamma + \frac{R_L}{R_H} \cdot \frac{1}{1 - \gamma}}$$

Преобразователь Поликарпова

Принципиальная схема



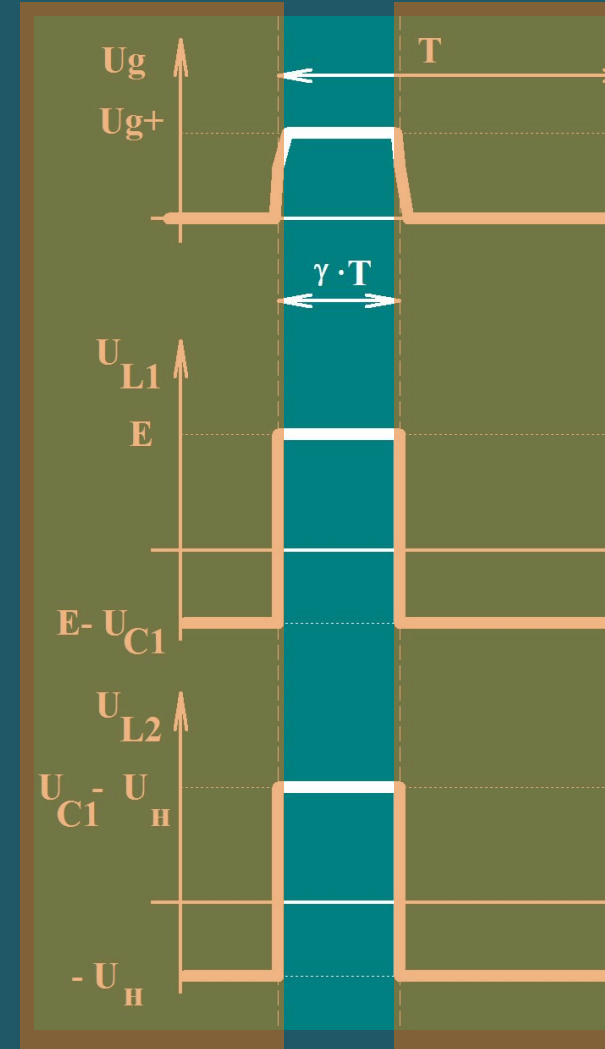
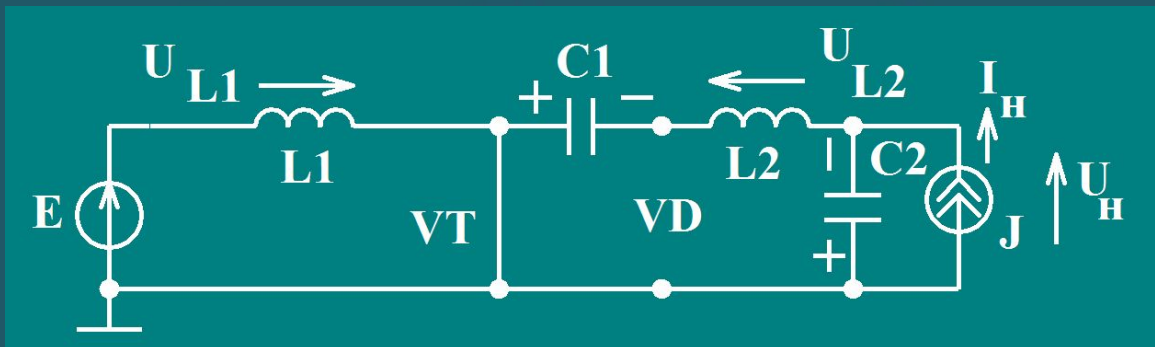
Интервал импульса

$$\frac{d I_{L1}}{d t} = \frac{E}{L}$$

$$\Delta I_{L1} = \frac{d I_{L1}}{d t} \cdot t_{\text{И}} = \frac{d I_{L1}}{d t} \cdot \gamma \cdot T = \frac{E}{L} \cdot \gamma \cdot T$$

$$\frac{d I_{L2}}{d t} = \frac{U_{C1} - U_H}{L}$$

$$\Delta I_{L2} = \frac{d I_{L2}}{d t} \cdot t_{\text{И}} = \frac{d I_{L2}}{d t} \cdot \gamma \cdot T = \frac{U_{C1} - U_H}{L} \cdot \gamma \cdot T$$



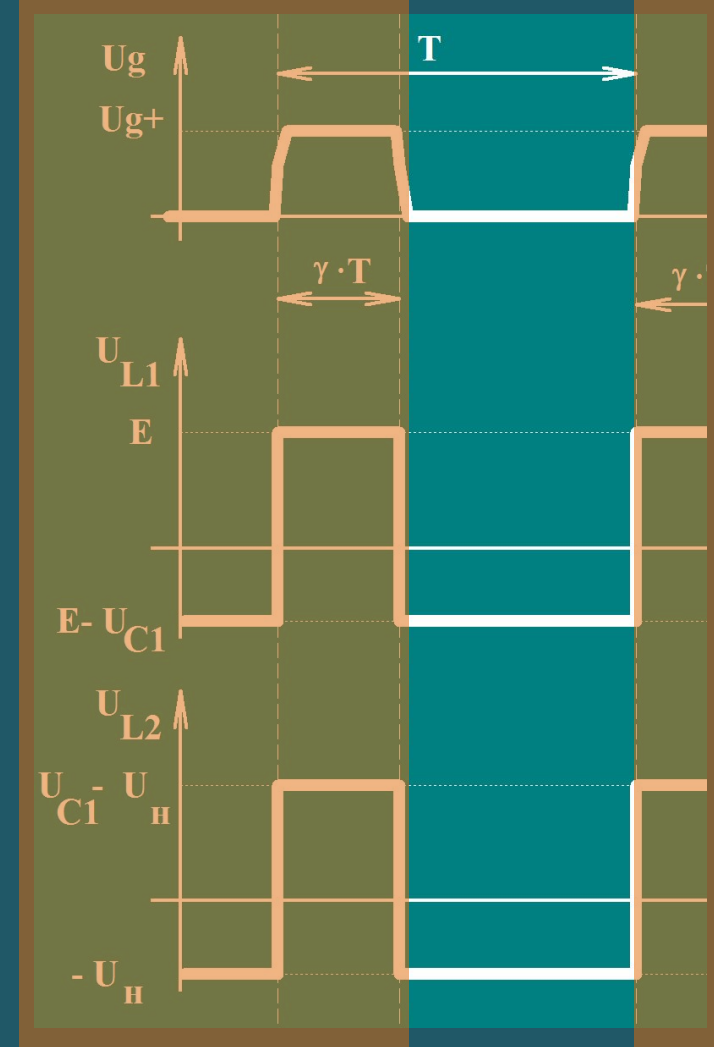
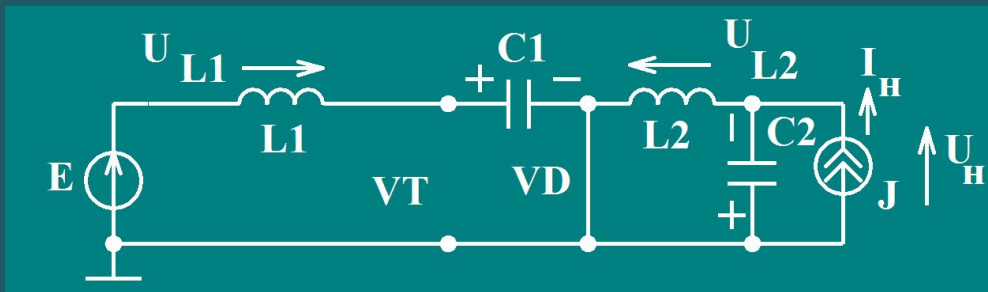
Интервал паузы

$$\frac{d I_{L1}}{d t} = \frac{E - U_{C1}}{L}$$

$$\begin{aligned} \Delta I_{L1} &= \left| \frac{d I_{L1}}{d t} \right| \cdot (T - t_{\text{H}}) = \left| \frac{d I_{L1}}{d t} \right| \cdot (1 - \gamma) \cdot T = \\ &= \frac{U_{C1} - E}{L} \cdot (1 - \gamma) \cdot T \end{aligned}$$

$$\frac{d I_{L2}}{d t} = \frac{-U_{\text{H}}}{L}$$

$$\begin{aligned} \Delta I_{L2} &= \left| \frac{d I_{L2}}{d t} \right| \cdot (T - t_{\text{H}}) = \left| \frac{d I_{L2}}{d t} \right| \cdot (1 - \gamma) \cdot T = \\ &= \frac{U_{\text{H}}}{L} \cdot (1 - \gamma) \cdot T \end{aligned}$$

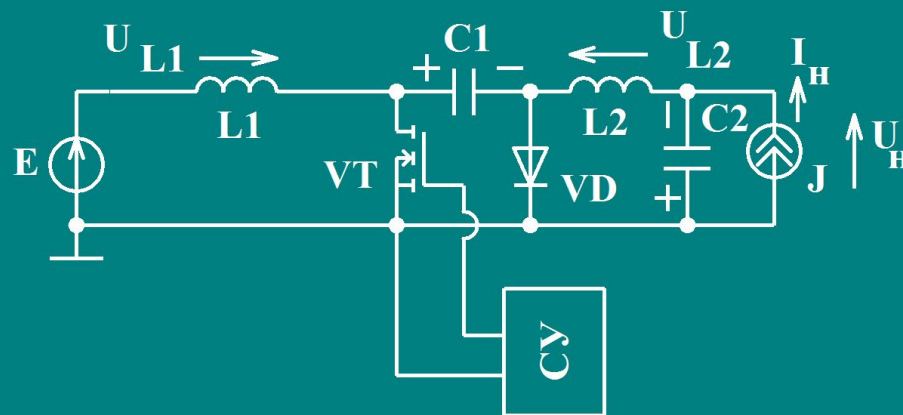


Напряжение нагрузки

$$\frac{E}{L} \cdot \gamma \cdot T = \frac{U_{C1} - E}{L} \cdot (1 - \gamma) \cdot T \Rightarrow U_{C1} = \frac{E}{1 - \gamma}$$

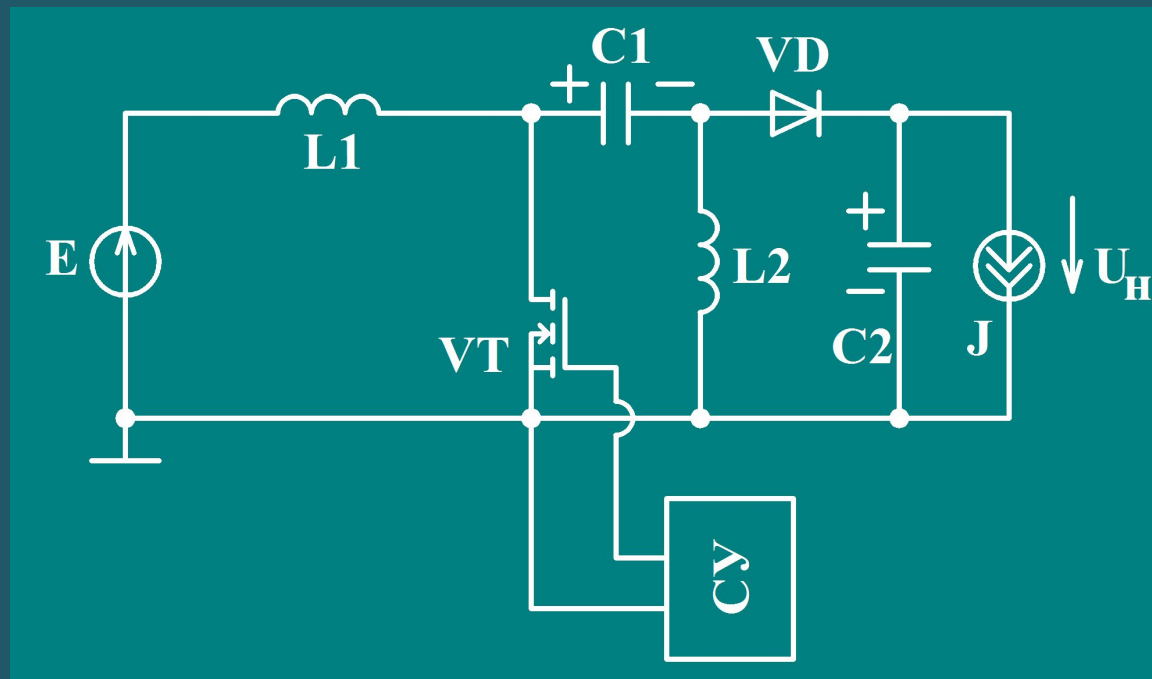
$$\frac{U_{C1} - U_H}{L} \cdot \gamma \cdot T = \frac{U_H}{L} \cdot (1 - \gamma) \cdot T \Rightarrow U_H = \gamma \cdot U_{C1}$$

$$U_H = \frac{\gamma}{1 - \gamma} \cdot E$$



**Преобразователь
с топологией SEPIC
(single-ended-primary-
inductor-converctor)**

Принципиальная схема



$$U_H = \frac{\gamma}{1 - \gamma} \cdot E$$