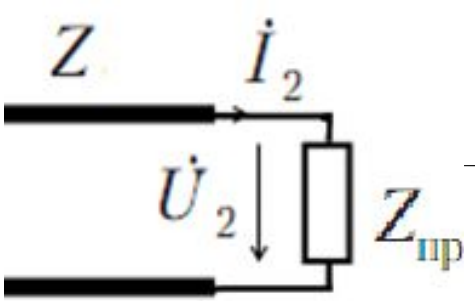
Переходные процессы в линиях

Коэффициенты отражения



$$\dot{U}_2 = \dot{U}_{\varphi 2} + \dot{U}_{\psi 2}$$

$$\dot{I}_2 = \dot{I}_{\varphi 2} + \dot{I}_{\psi 2} = \frac{\dot{U}_{\varphi 2}}{Z} - \frac{\dot{U}_{\psi 2}}{Z}$$

$$\dot{U}_2 = \dot{I}_2 Z_{пр}$$

$$2\dot{U}_{\psi 2} = \dot{U}_2 - \dot{I}_2 Z = \dot{I}_2 (Z_{пр} - Z); \quad 2\dot{U}_{\varphi 2} = \dot{U}_2 + \dot{I}_2 Z = \dot{I}_2 (Z_{пр} + Z)$$

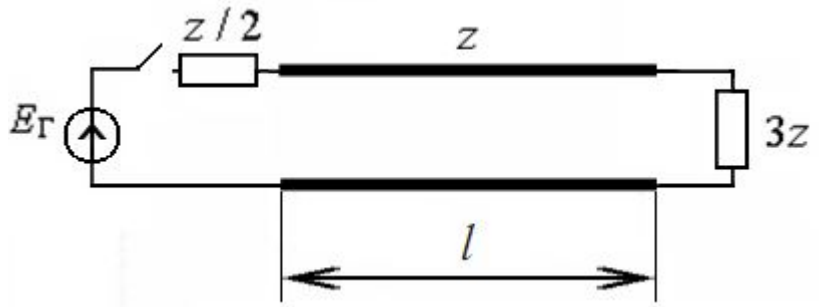
$$q_u = \frac{\dot{U}_{\psi 2}}{\dot{U}_{\varphi 2}} = \frac{Z_{пр} - Z}{Z_{пр} + Z} \qquad q_i = -q_u = \frac{Z - Z_{пр}}{Z + Z_{пр}}$$

При $Z_{пр} = Z \Rightarrow q_u = 0$ и $q_i = 0 \Rightarrow \frac{\dot{U}}{\dot{I}} = \frac{\dot{U}_{\varphi}}{\dot{I}_{\varphi}} = Z$

При $Z_{пр} = \infty \Rightarrow q_u = 1$ и $q_i = -1 \Rightarrow \dot{U}_{\psi 2} = \dot{U}_{\varphi 2}$ и $\dot{U}_2 = 2\dot{U}_{\varphi 2}$, а $\dot{I}_{\psi 2} = -\dot{I}_{\varphi 2}$ и $\dot{I}_2 = 0$

При $Z_{пр} = 0 \Rightarrow q_u = -1$ и $q_i = 1 \Rightarrow \dot{U}_{\psi 2} = -\dot{U}_{\varphi 2}$ и $\dot{U}_2 = 0$, а $\dot{I}_{\psi 2} = \dot{I}_{\varphi 2}$ и $\dot{I}_2 = 2\dot{I}_{\varphi 2}$

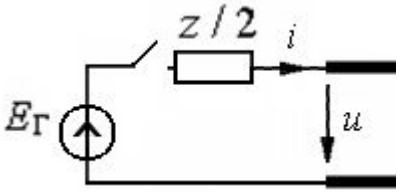
При произвольной резистивной нагрузке



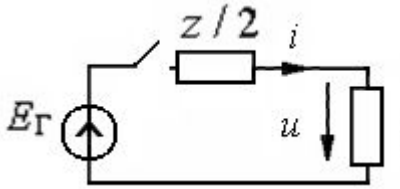
$E_Г = 540$ В

$$q_Г^U = \frac{z/2 - z}{z/2 + z} = -\frac{1}{3} \qquad q_Н^U = \frac{3z - z}{3z + z} = \frac{1}{2}$$

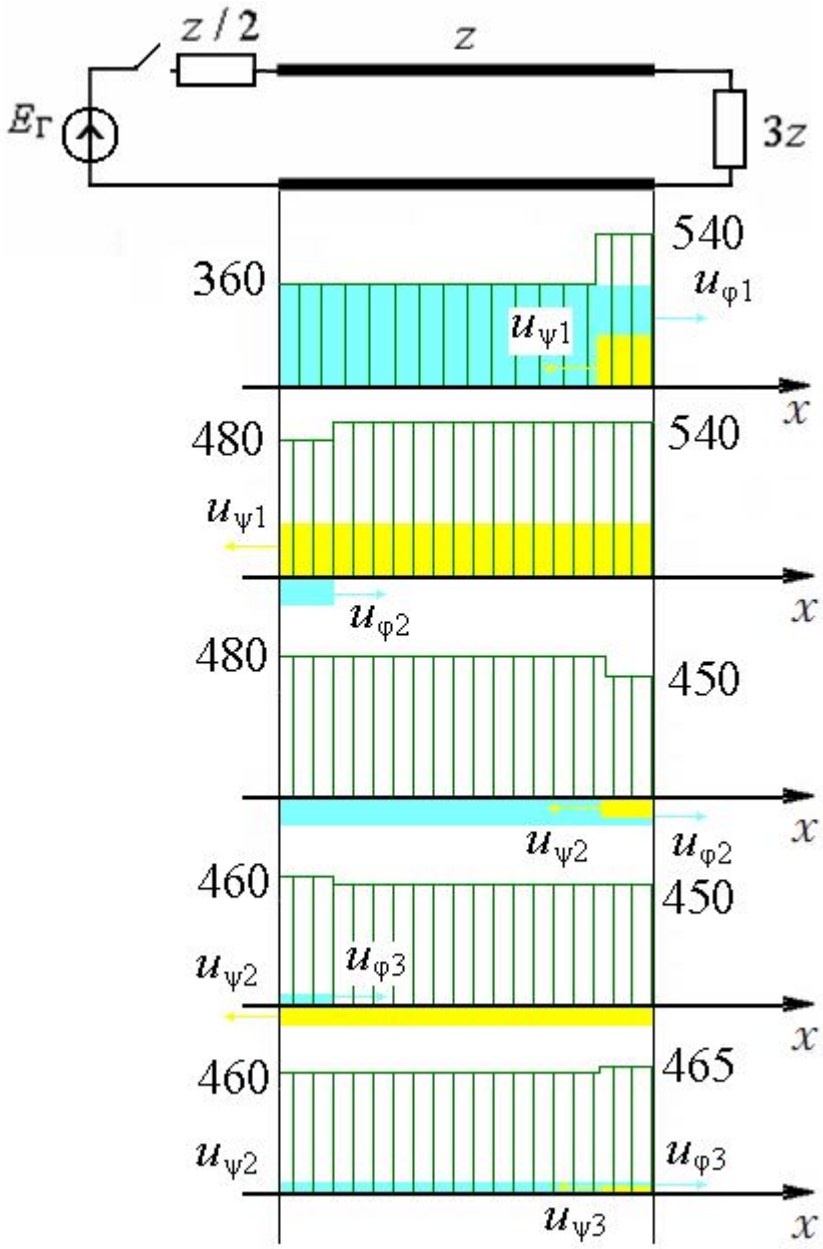
$$q_Г^I = -q_Г^U = \frac{1}{3} \qquad q_Н^I = -q_Н^U = -\frac{1}{2}$$



$$\begin{cases} u = u_\varphi \\ i = i_\varphi \end{cases}$$



$$\begin{cases} i = i_\varphi = \dfrac{E_Г}{z/2 + z} = \dfrac{360}{z} \\ u = u_\varphi = 360\,\text{В} \end{cases}$$



$T = l/v_c$ $\quad \Delta t = T/10$

$u_{\varphi 1} = 360$ В

$t = T + \Delta t$

$u_{\psi 1} = u_{\varphi 1}\, q_{\text{Н}}^{U} = 180$ В

$t = 2T + \Delta t$

$u_{\varphi 2} = u_{\psi 1}\, q_{\Gamma}^{U} = -60$ В

$t = 3T + \Delta t$

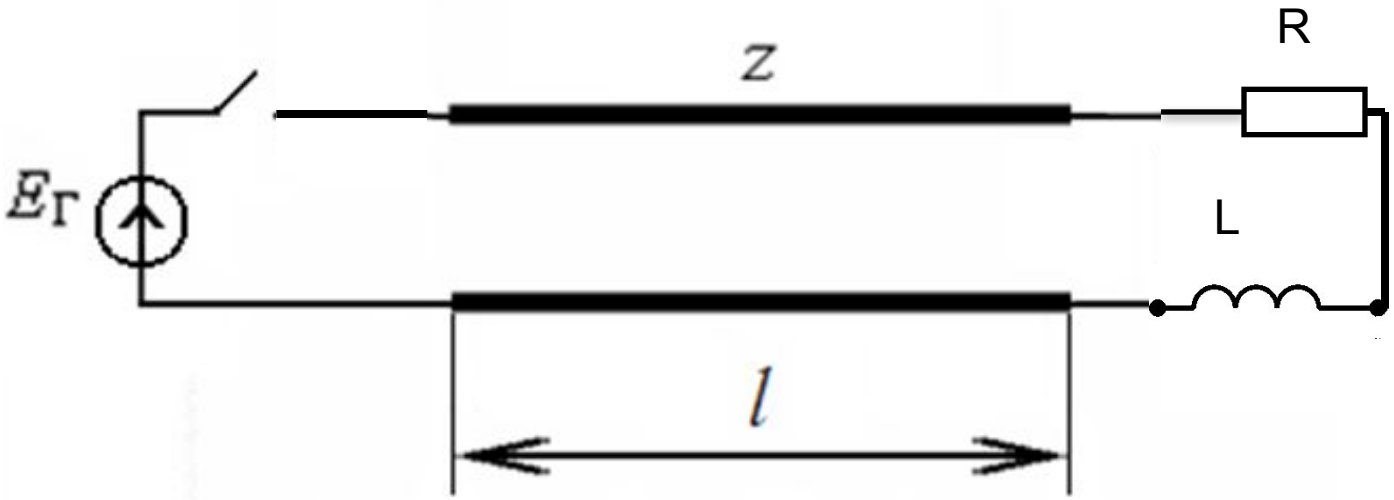
$u_{\psi 2} = u_{\varphi 2}\, q_{\text{Н}}^{U} = -30$ В

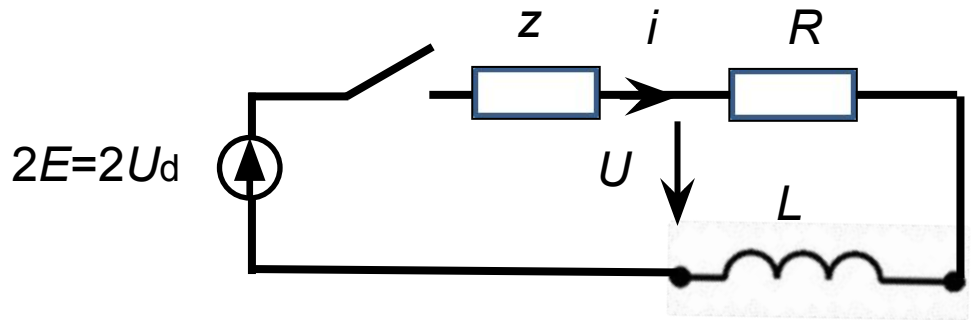
$t = 4T + \Delta t$

$u_{\varphi 3} = u_{\psi 2}\, q_{\Gamma}^{U} = 10$ В

$t = 5T + \Delta t$

$u_{\psi 3} = u_{\varphi 3}\, q_{\text{Н}}^{U} = 5$В





2E=2Ud

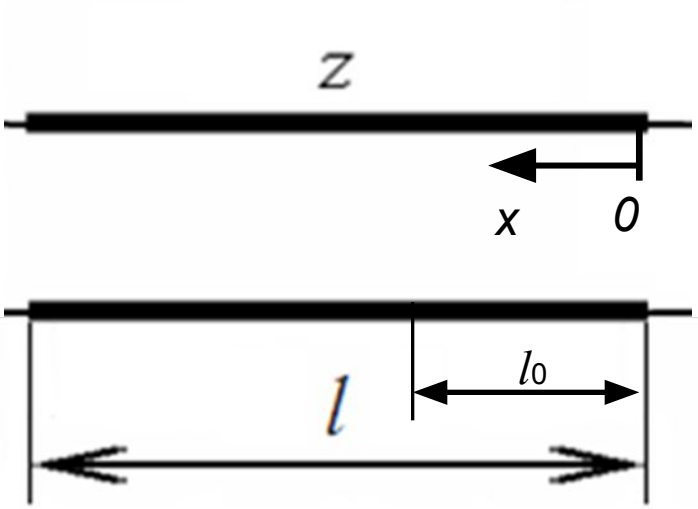
$$\begin{cases} i = i_d + i_r \\ u = u_d + u_r \\ u_d = zi_d \\ u_r = -zi_r \end{cases} \qquad \begin{cases} u_d = E \\ i_d = E / z \end{cases} \qquad 2u_d = u + zi$$

$$i = \frac{2E}{z+R}\left(1 - e^{-t/\tau}\right), \quad \tau = \frac{L}{z+R}$$

$$i_r = a + be^{-t/\tau}, \qquad u_r = A + Be^{-t/\tau}.$$

$$i_r = i - i_d = i - \frac{E}{z}, \qquad u_r = -zi_r.$$

Построение графиков



$$i_r = a + be^{-t/\tau}, \qquad u_r = A + Be^{-t/\tau}.$$

$$t \to t_e - \frac{x}{V_c}, \qquad V_c = 3 \cdot 10^5 \; km/c,$$

$$t_e = \frac{l_0}{V_c},$$

$$i_r\big|_{x=l_0} = a + b;$$

$$i_r\big|_{x\to 0} = a + be^{-t_e/\tau};$$