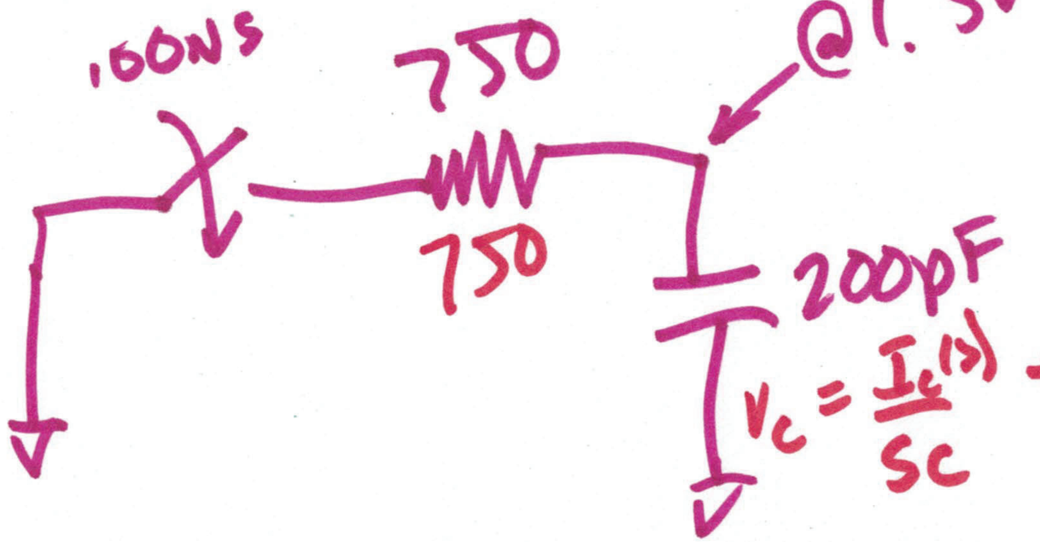
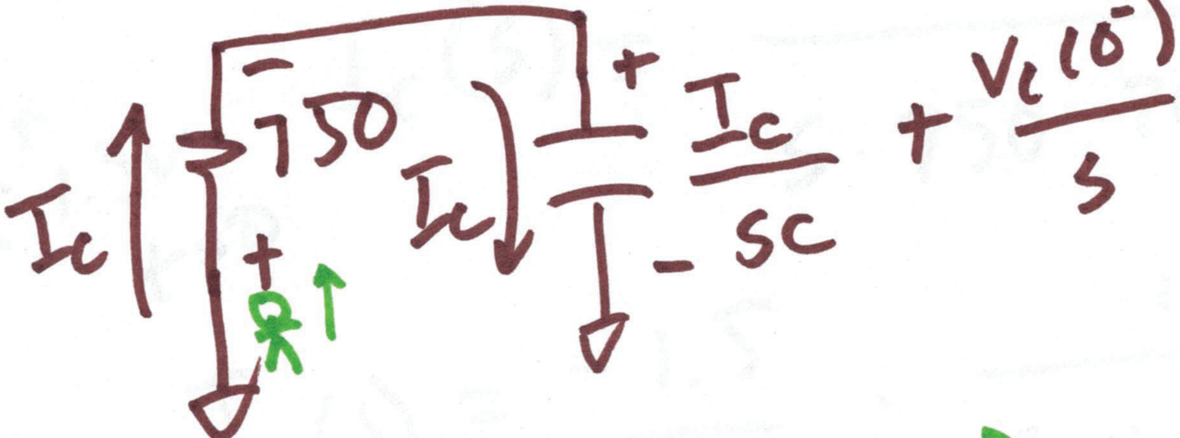
EE 221 Circuits II

Lecture 18

April 5, 2021



$V_c = \frac{I_c(s)}{sC} + \frac{V_c(0^-)}{s}$



$$-I_c(s)\cdot 750 - \frac{I_c(s)}{s\cdot 200p} - \frac{1.5}{s} =$$

$$-I_c\cdot 750\cdot 200p\cdot s - I_c - 1.5\cdot 2$$

$$I_c(s)\left(s\cdot 750\cdot 200p + 1\right) = -1.$$

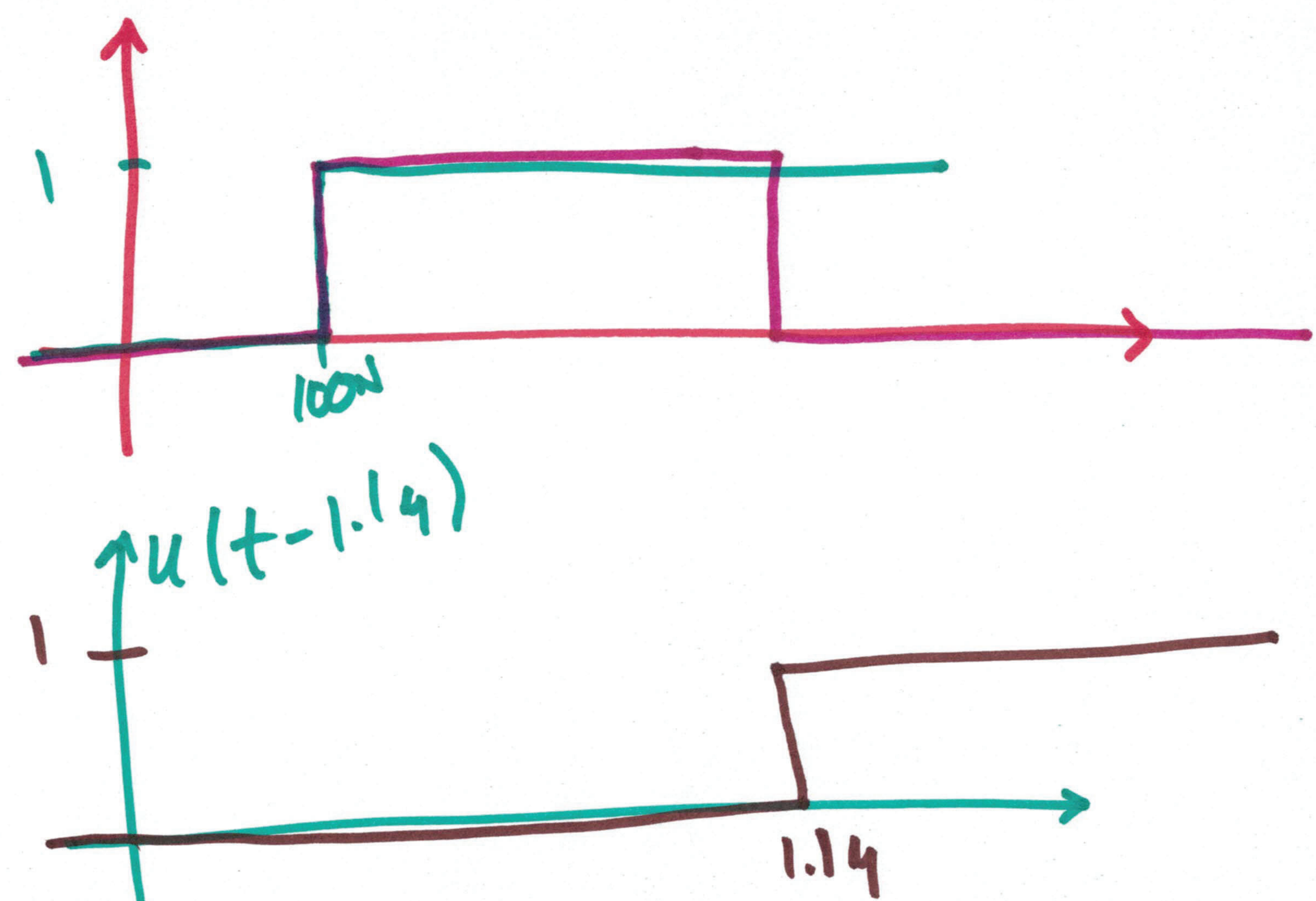
$$v_c(t) = \frac{-1.5}{200p \cdot 750} \int_0^{-(t-100n)/750 \cdot 200p} -750 \cdot 200p \; e^{z} \cdot dz$$

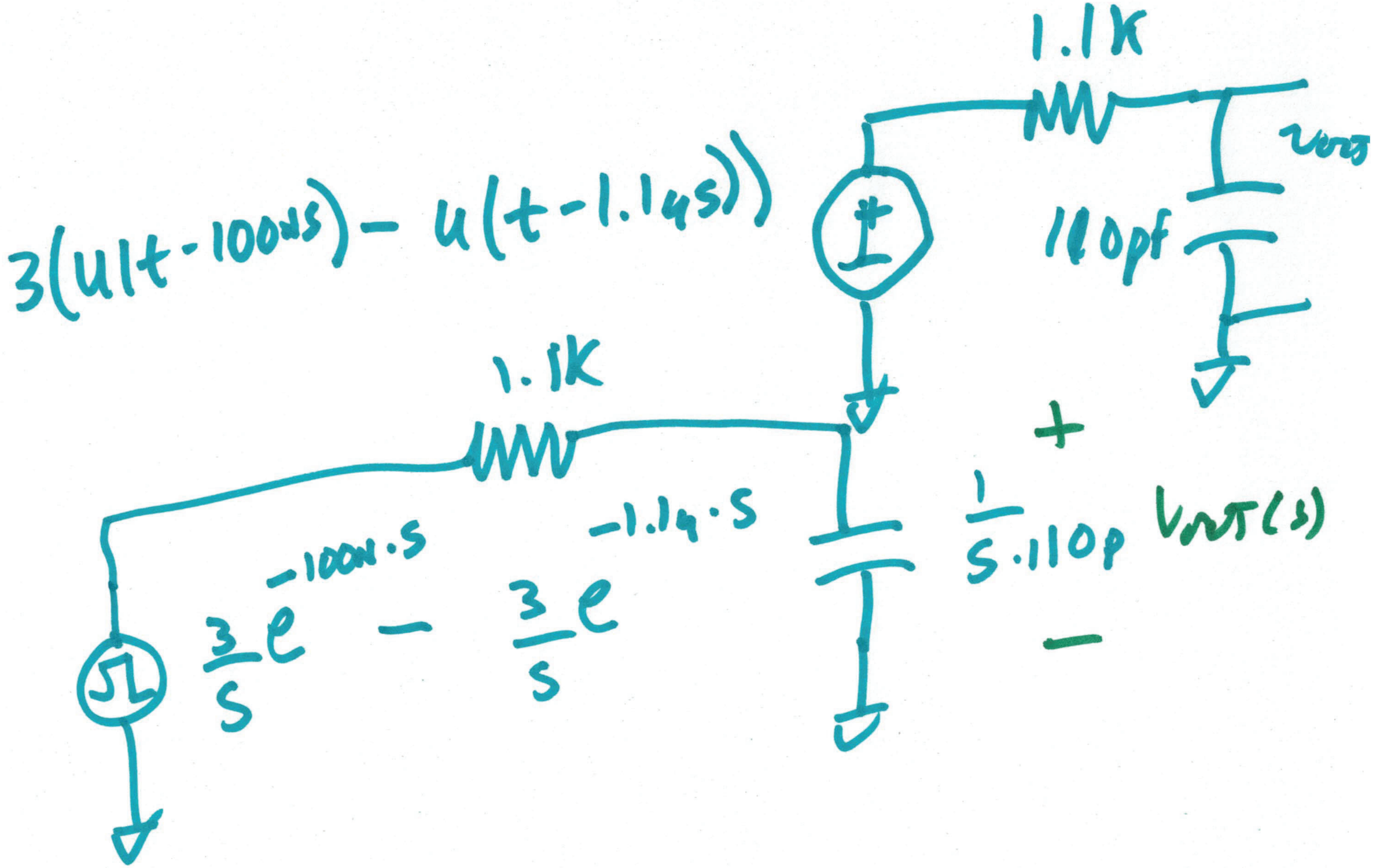
$$v_c(t) = \frac{\cancel{-}1.5 \cdot \cancel{-200p \cdot 750}}{\cancel{200p \cdot 750}} \, e^{z} \Big|_0^{-(t-100n)/750 \cdot 200p}$$

$$\boxed{v_c(t) = +1.5 \, e^{-\frac{(t-100n)}{750 \cdot 200p}} \, u(t-100n)}$$

$u(t - 100n) - u(t - 1.1\mu)$

$u(t - 100n)$




1.1K
vout
3(u(t-100ns) - u(t-1.1us))
110pf
1.1K
+
1/(s·110p)
Vout(s)
−
3/s e^{-100n·s} − 3/s e^{-1.1u·s}

9)

$$V_{OUT}(s) = \left(\frac{3}{s}e^{-100n\cdot s} - \frac{3}{s}e^{-1.1\mu\cdot s}\right)\frac{\frac{1}{s\cdot 110p}}{\frac{1}{s\cdot 110p} + 1.1k}$$

$$= \left(3e^{-100n\cdot s} - 3e^{-1.1\mu\cdot s}\right)\cdot\frac{1\cdot\frac{1}{1.1k\cdot 110p}}{\frac{1}{\cancel{1.1k\cdot 110p}}\cdot s\left(s\cdot\cancel{1.1k\cdot 110p} + \frac{1}{1.1k\cdot 110p}\right)}$$

$$= \left(3e^{-100n\cdot s} - 3e^{-1.1\mu\cdot s}\right)\cdot\frac{1}{s}\cdot\frac{1/1.1k\cdot 110p}{s + \frac{1}{1.1k\cdot 110p}}$$

$$= \frac{A}{s} + \frac{B}{s + \frac{1}{1.1k\cdot 110p}}$$

$$A = 3e^{-100n \cdot s} - 3e^{-1.1\mu \cdot s}$$

$$B = \frac{3e^{-100n \cdot s} - 3e^{-1.1\mu \cdot s}}{1.1k \cdot 110p \cdot \left(\frac{-1}{1.1k110p}\right)}$$

$$B = 3e^{-1.1\mu \cdot s} - 3e^{-100n \cdot s}$$

$$B = -A$$

$$V_{out}(t) = \frac{3e^{-100n} - 3e^{-1.1\mu \cdot s}}{s} + \frac{3e^{-1.1\mu s} - 3e^{-100ns}}{s + \frac{1}{1.1k \cdot 110p}}$$

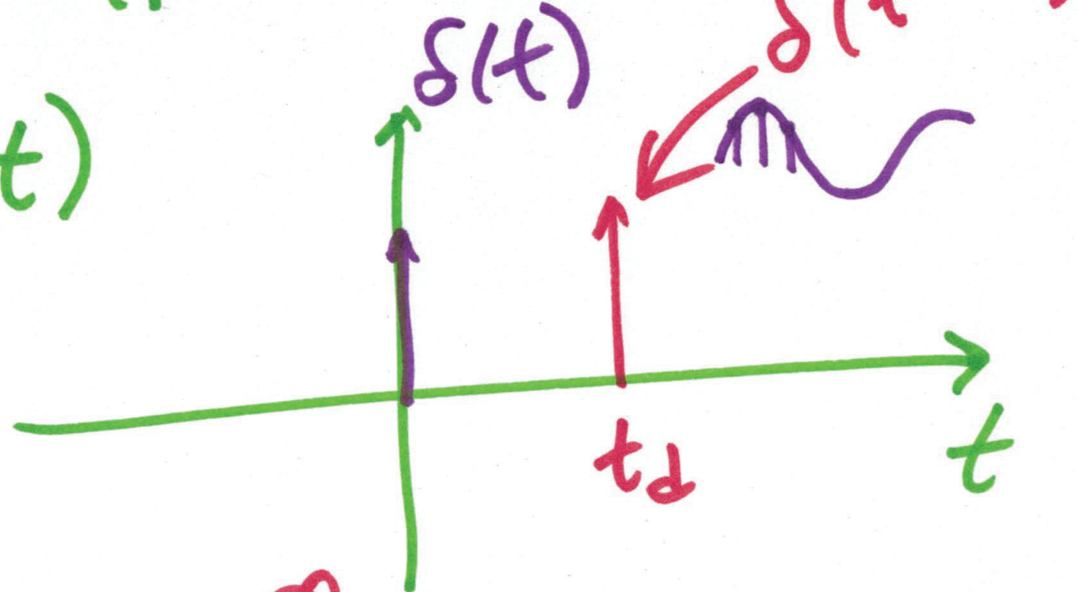
$$v_{out}(t) = 3u(t-100n) - 3u(t-1.1\mu)$$

$$+ 3e^{-\frac{(t-1.1\mu)}{1.1k \cdot 110p}} u(t-1.1\mu)$$

$$- 3e^{-\frac{(t-100n)}{1.1k \cdot 110p}} u(t-100n)$$

Unit impulse function

$\delta(t)$



$$\mathcal{L}\{\delta(t)\} = \int_{0^-}^{\infty} \delta(t) e^{-st} \cdot dt = 1$$

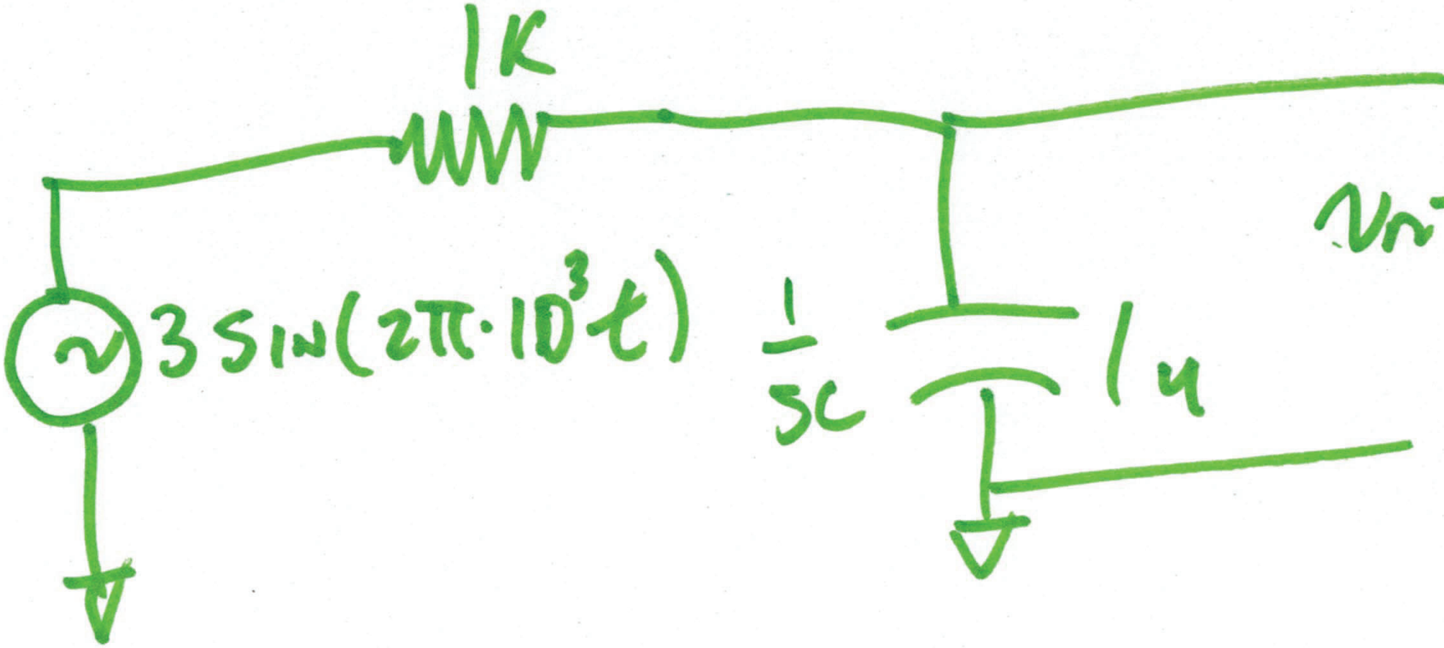
let $z = -st$

$dt = \frac{dz}{-s}$ $\quad \frac{dz}{dt} = -s$

$$\int_0^{-s\cdot\infty} \delta(t)e^{z}\cdot\frac{dz}{-s}$$

$$\left.\frac{\delta(t)\cdot e^{z}}{-s}\right|_0^{-s\infty}$$

$$\delta(t)\left(\cancel{\frac{(e^{-\infty})}{-s}}^{\,0}-\frac{1}{s}\right)$$



$$V_{out} = 3 \cdot \frac{2\pi \cdot 10^3}{s^2 + (2\pi \cdot 10^3)^2} \cdot \frac{\frac{1}{\cancel{s} \cdot 10^{-6}} \cdot s \cdot 10^{-3}}{\cancel{s}\left(\frac{1}{\cancel{s} \cdot 10^{-6}} + 10^3 \cdot s\right) 10^{-3}}$$

$$V_{out} = 3 \cdot \frac{2\pi \cdot 10^3}{s^2 + (2\pi 10^3)^2} \cdot \frac{\frac{1}{10^{-3}} \cdot s}{s + \frac{1}{10^{-3}}}$$

$$s^2 + (2\pi \cdot 10^3)^2$$

$$s = \frac{0 \pm \sqrt{-4(2\pi \cdot 10^3)^2}}{2}$$

$$s = \pm 2\pi \cdot 10^3 \cdot j$$

$$v_{OUT}(s) = \frac{3 \cdot 2\pi \cdot 10^3 \cdot \frac{1}{10^{-3}} \cdot s}{(s - j2\pi \cdot 10^3)(s + j2\pi 10^3)(s + \frac{1}{10^{-3}})}$$