Программы
и примеры расчетов на ЭВМ
с использованием языка программирования MATHCAD

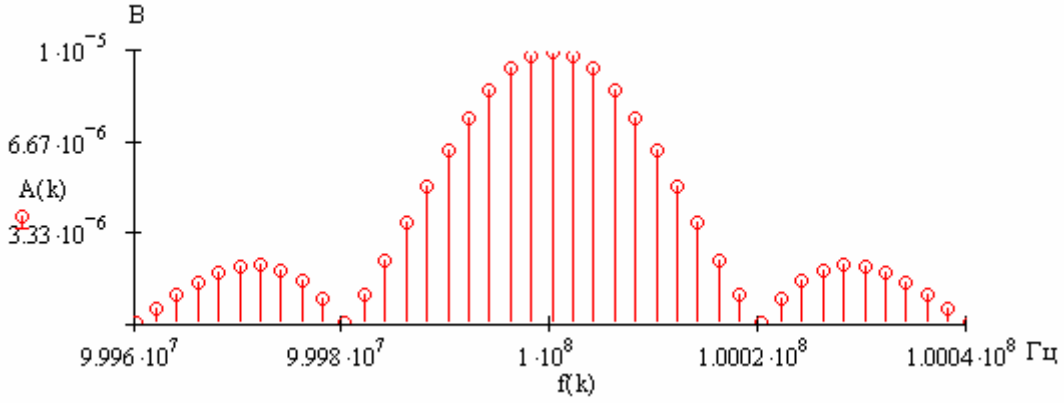
RTCS1M

$A0 := 100 \cdot 10^{-6}$ В $f0 := 100 \cdot 10^{6}$ Гц $Tn := 500 \cdot 10^{-6}$ с $tи := 50 \cdot 10^{-6}$ с

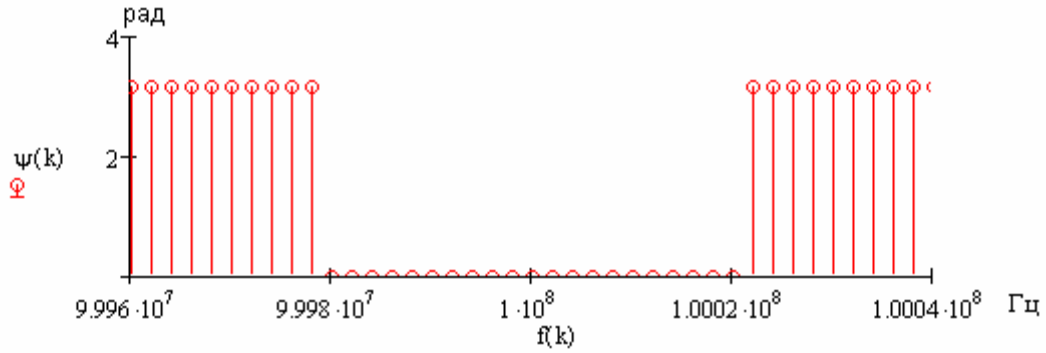
$Fn := \frac{1}{Tn}$ $Fn = 2 \times 10^{3}$ Гц $q := \frac{Tn}{tи}$ $q = 10$

$k := -20 .. 20$

$$A(k) := \frac{A0}{q} \cdot \left| \frac{\sin\left(\frac{\pi \cdot k}{q}\right)}{\frac{\pi \cdot k}{q}} \right| \qquad f(k) := f0 + k \cdot Fn$$



$$\psi(k) := \begin{cases} 0 & \text{if } \left(\sin\left(\frac{\pi \cdot |k|}{q}\right)\right) \geq 0 \\ \pi & \text{if } \sin\left(\frac{\pi \cdot |k|}{q}\right) < 0 \end{cases}$$



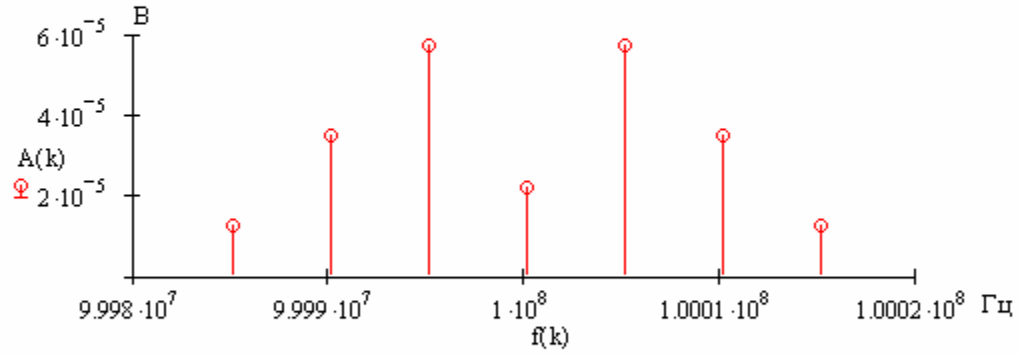
RTCS2M

$A0 := 100 \cdot 10^{-6}$ В $f0 := 100 \cdot 10^{6}$ Гц $Fm := 5 \cdot 10^{3}$ Гц $m := 2$

$k := -(m + 1) .. m + 1$

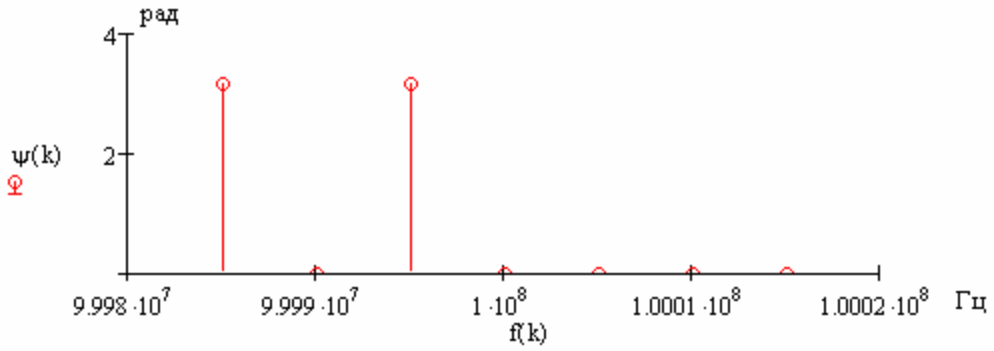
$f(k) := f0 + k \cdot Fm$

$A(k) := A0 \, Re(H1(|k|, m))$



$Y2(k) := Re(H1(k, m))$

$$\psi(k) := \begin{cases} 0 & \text{if } Y2(k) \geq 0 \\ \pi & \text{if } Y2(k) < 0 \end{cases}$$



RTCS3M

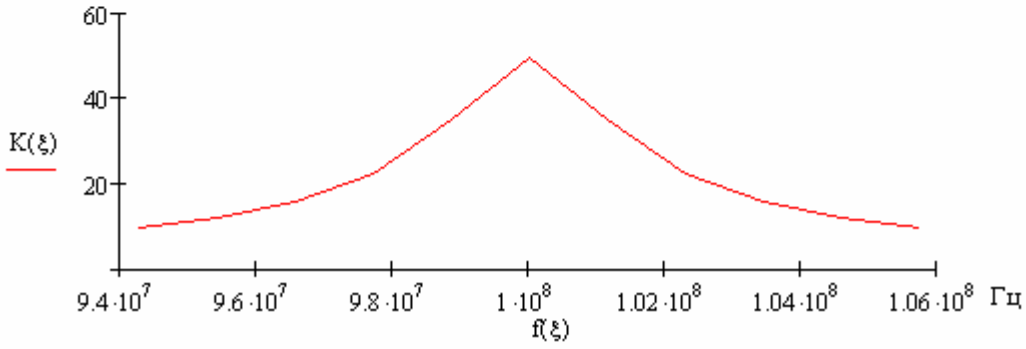
УРЧ

$f0 := 100 \cdot 10^{6}$ Гц $fp := f0$ $L := 10^{-6}$ Гн $C := \frac{1}{4 \cdot \pi^{2} \cdot f0^{2} \cdot L}$ $C = 2.533 \times 10^{-12}$ Ф

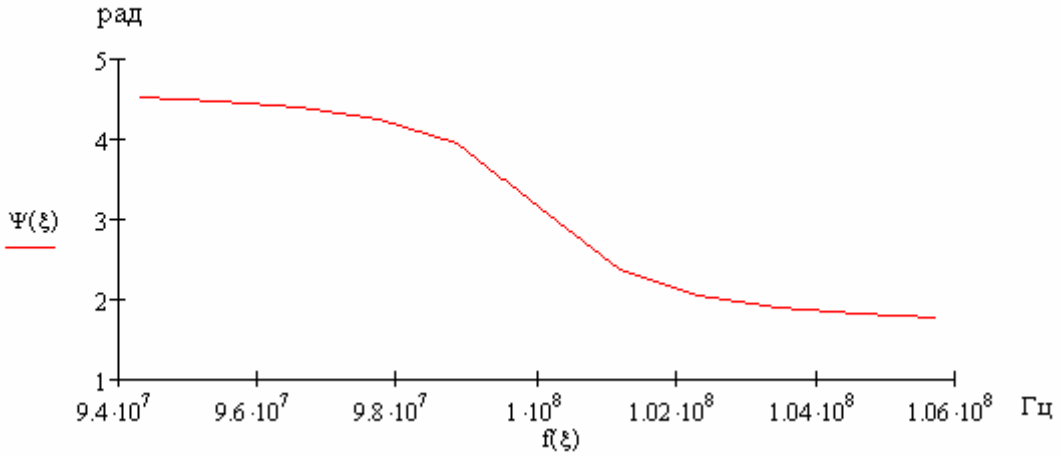
$S := 20 \cdot 10^{-3} \frac{A}{B}$ $Ri := 20 \cdot 10^{3}$ Ом $Kb := 0.3$ $Q := 50$

$Rp := Kb^{2} \cdot \sqrt{\frac{L}{C}} \cdot Q$ $Rp = 2.827 \times 10^{3}$ Ом $Kp := \frac{S \cdot Rp}{1 + \frac{Rp}{Ri}}$ $Kp = 49.544$ Ом

$\xi := -5, -4 .. 5$ $K(\xi) := \frac{Kp}{\sqrt{1 + \xi^{2}}}$ $f(\xi) := f0 + \frac{\xi \cdot \left(1 + \frac{Rp}{Ri}\right) \cdot fp}{2 \cdot Q}$



$\Psi(\xi) := \pi - \operatorname{atan}(\xi)$



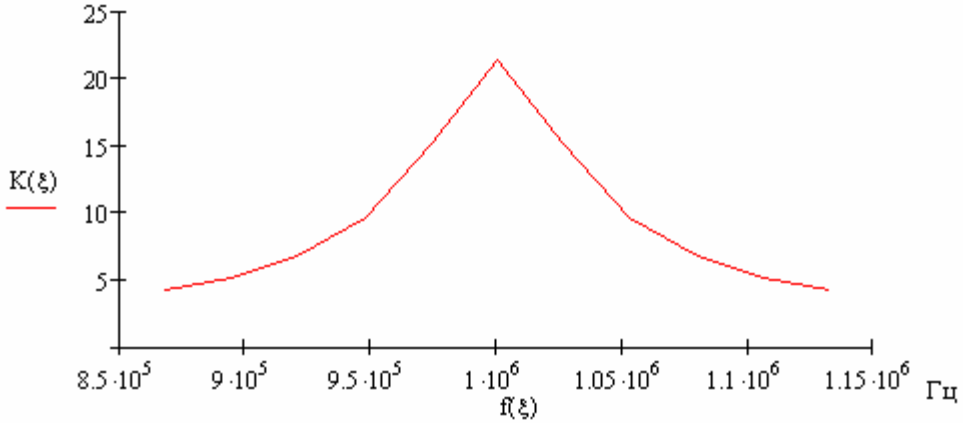
ПЧ,УЧД

$fпр := 10^{6}\,Гц \quad fр := fпр \quad L := 100\cdot10^{-6}\,Гн \quad C := \frac{1}{4\cdot\pi^{2}\cdot fпр^{2}\cdot L} \quad C = 2.533\times10^{-10} \quad Ф$

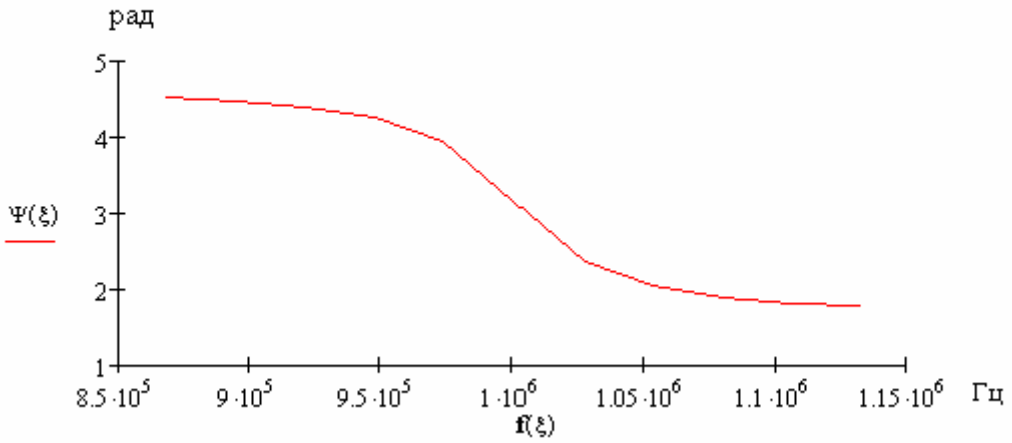
$S := 20\cdot10^{-3}\ \frac{A}{B} \quad Ri := 20\cdot10^{3}\ Ом \quad Kb := 0.3 \quad Q := 20$

$Rp := Kb^{2}\cdot\sqrt{\frac{L}{C}}\cdot Q \quad Rp = 1.131\times10^{3}\ Ом \quad Kp := \frac{S\cdot Rp}{1+\frac{Rp}{Ri}} \quad Kp = 21.409$

$\xi := -5,-4..5 \quad K(\xi) := \frac{Kp}{\sqrt{1+\xi^{2}}} \quad f(\xi) := fпр + \frac{\xi\cdot\left(1+\frac{Rp}{Ri}\right)\cdot fр}{2\cdot Q}$



$\Psi(\xi) := \pi - \operatorname{atan}(\xi)$



RTCS4M

$T_n := 500 \cdot 10^{-6}$ с $t_и := 50 \cdot 10^{-6}$ с $R_i := 20 \cdot 10^{3}$ Ом $Q1 := 20$

$R_{p1} := 1.14 \cdot 10^{3}$ Ом $Q2 := 40$ $R_{p2} := 2.28 \cdot 10^{3}$ Ом $f_{пр} := 10^{6}$ Гц

$$\tau_{к1} := \frac{Q1}{\left(1 + \frac{R_{p1}}{R_i}\right) \cdot \pi \cdot f_{пр}} \qquad \tau_{к1} = 6.023 \times 10^{-6} \text{ с}$$

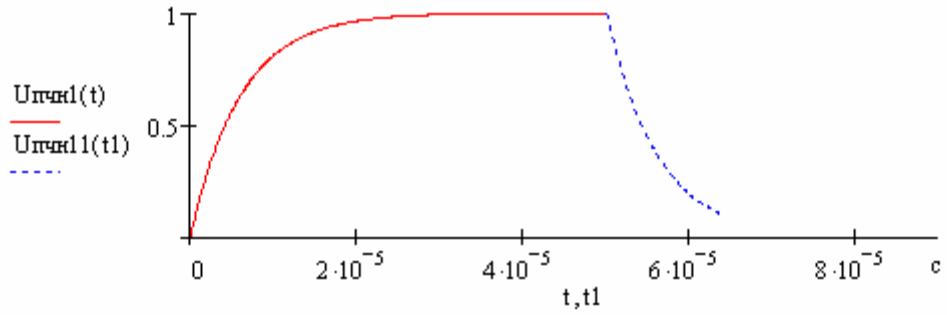
$$\tau_{к2} := \frac{Q2}{\left(1 + \frac{R_{p2}}{R_i}\right) \cdot \pi \cdot f_{пр}} \qquad \tau_{к2} = 1.143 \times 10^{-5} \text{ с}$$

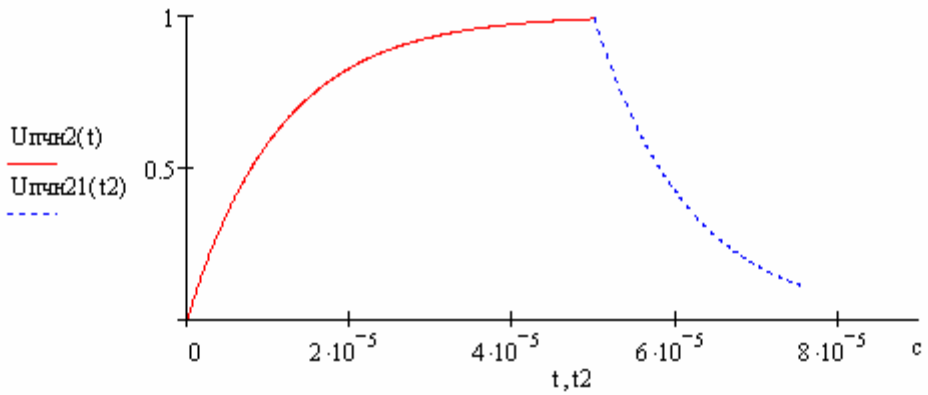
$\Delta f := 0$ $t := 0, 10^{-7} .. t_и$

$$U_{пчн1}(t) := 1 - e^{\frac{-t}{\tau_{к1}}} \qquad U_{пчн2}(t) := 1 - e^{\frac{-t}{\tau_{к2}}}$$

$t1 := t_и, t_и + 10^{-7} .. t_и + 2.3 \cdot \tau_{к1}$ $t2 := t_и, t_и + 10^{-7} .. t_и + 2.3 \cdot \tau_{к2}$

$$U_{пчн11}(t1) := \left(1 - e^{\frac{-t1}{\tau_{к1}}}\right) \cdot e^{\frac{-(t1 - t_и)}{\tau_{к1}}} \qquad U_{пчн21}(t2) := \left(1 - e^{\frac{-t2}{\tau_{к2}}}\right) \cdot e^{\frac{-(t2 - t_и)}{\tau_{к2}}}$$

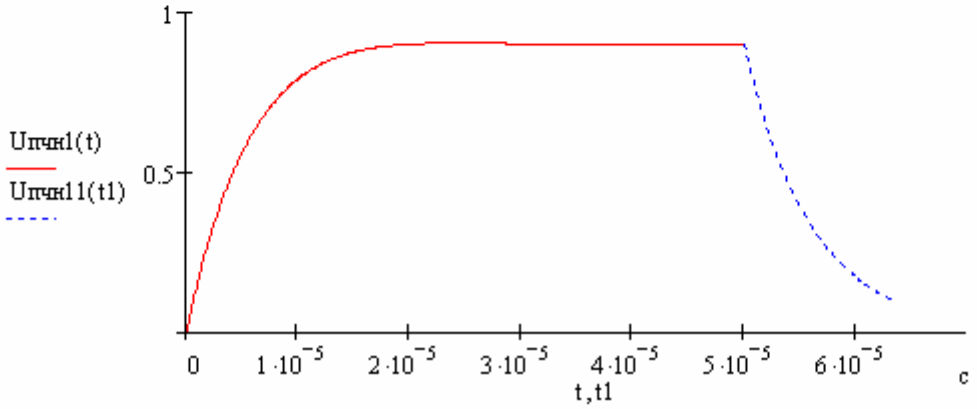




$n1 := 0 \qquad \Delta f := \frac{0.5 + 0.1 \cdot n1}{2 \cdot \pi \cdot \tau к1} \qquad \Delta f = 1.321 \times 10^{4} \quad Гц$

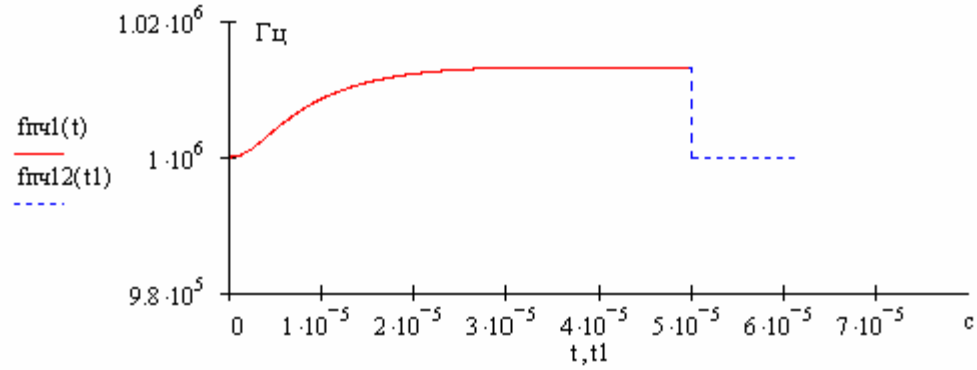
$$Uпчн1(t) := \frac{\sqrt{1 - 2 \cdot e^{\frac{-t}{\tau к1}} \cdot \cos(2 \cdot \pi \cdot \Delta f \cdot t) + e^{\frac{-2 \cdot t}{\tau к1}}}}{\sqrt{1 + (2 \cdot \pi \cdot \Delta f \cdot \tau к1)^2}}$$

$$Uпчн11(t1) := \frac{\sqrt{1 - 2 \cdot e^{\frac{-\tau и}{\tau к1}} \cdot \cos(2 \cdot \pi \cdot \Delta f \cdot \tau и) + e^{\frac{-2 \cdot \tau и}{\tau к1}} \cdot e^{\frac{t1 - \tau и}{-\tau к1}}}}{\sqrt{1 + (2 \cdot \pi \cdot \Delta f \cdot \tau к1)^2}}$$



$$fпч1(t) := fпр + \Delta f \cdot \frac{1 - e^{\frac{-t}{\tau к1}} \cdot \left(\cos(2 \cdot \pi \cdot \Delta f \cdot t) + \frac{\sin(2 \cdot \pi \cdot \Delta f \cdot t)}{2 \cdot \pi \cdot \Delta f \cdot \tau к1} \right)}{1 - e^{\frac{-t}{\tau к1}} \cdot \cos(2 \cdot \pi \cdot \Delta f \cdot t) + e^{\frac{-2t}{\tau к1}}}$$

$t1 := \tau и, \tau и + 10^{-7} .. \tau и + 2.3 \cdot \tau к1 \qquad fпч12(t1) := fпр$



RTCS5M

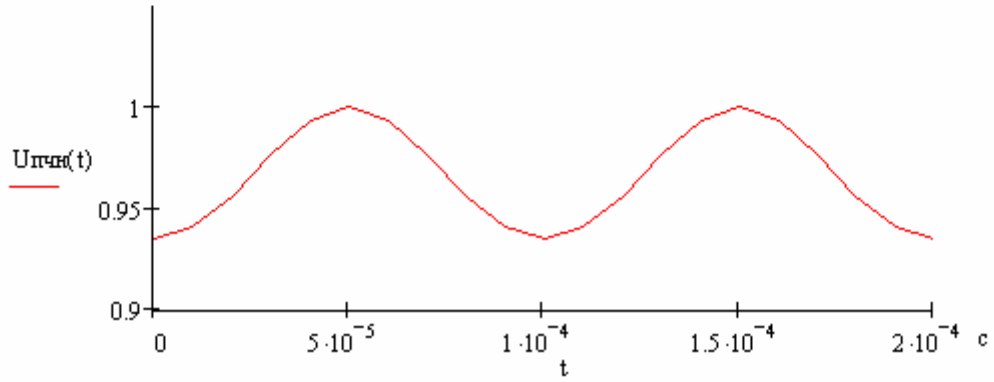
$Fm := 5 \cdot 10^3$ Гц $Q := 20$ $Ri := 20 \cdot 10^3$ Ом $Rp := 1.14 \cdot 10^3$ Ом

$m := 2$ $fnp := 1 \cdot 10^6$ Гц

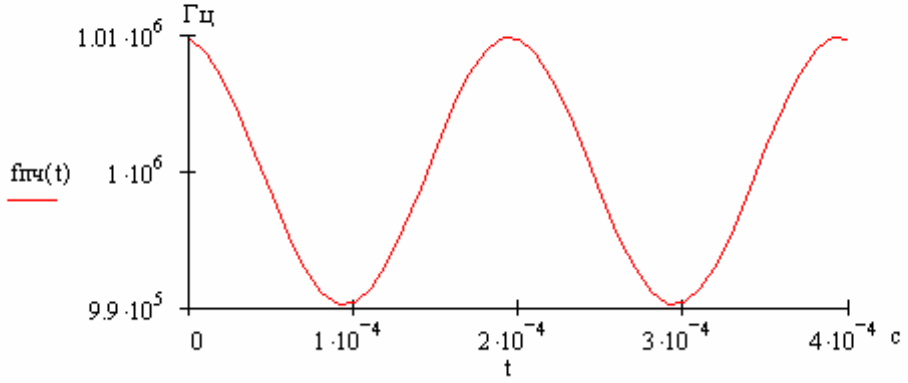
$$Qэ := \frac{Q}{1 + \frac{Rp}{Ri}} \qquad Qэ = 18.921 \qquad \mu := \frac{Fm}{fnp} \qquad \mu = 5 \times 10^{-3}$$

$$\Delta fпч := \frac{m \cdot Fm}{\sqrt{1 + (2 \cdot \mu \cdot Qэ)^2}} \qquad \Delta fпч = 9.826 \times 10^3 \text{ Гц}$$

$$t := 0, 10^{-5} .. \frac{1}{Fm} \qquad Uпчн(t) := \frac{1}{\sqrt{1 + (2 \cdot m \cdot \mu \cdot Qэ \cdot \cos(2 \cdot \pi \cdot Fm \cdot t))^2}}$$



$$t := 0, 10^{-5} .. \frac{2}{Fm} \qquad fпч(t) := fnp + \Delta fпч \cdot \cos(2 \cdot \pi \cdot Fm \cdot t + \operatorname{atan}(2 \cdot \mu \cdot Qэ))$$



RTCS6M

$a1 := 5.1 \cdot 10^{-3} \ \frac{A}{B}$ $a3 := -1.9 \cdot 10^{-3} \ \frac{A}{B^3}$ $Ar := 1\,B$ $Mb := 10^{-8}$ Гн

$fr := 99 \cdot 10^{6}$ Гц $Qэ := 44$ $Qэ1 := 2 \cdot Qэ$ $Qэ1 = 88$

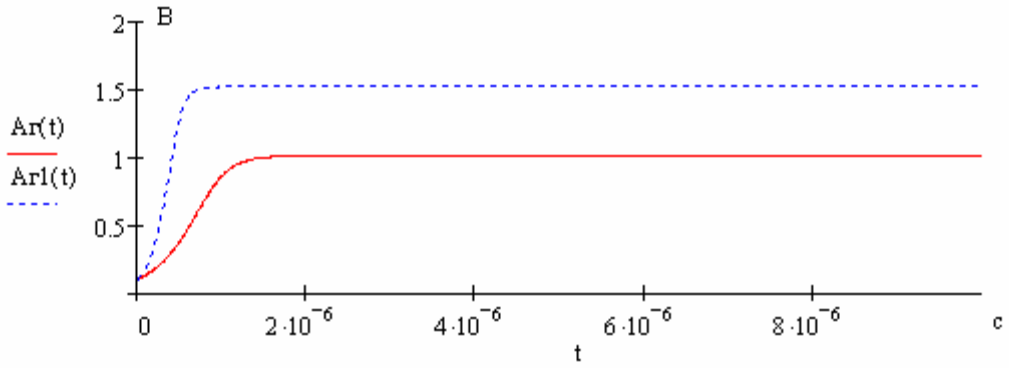
$$\alpha := \frac{1}{2} \cdot \left[a1 \cdot Mb \cdot (2 \cdot \pi \cdot fr)^2 - 2 \cdot \pi \cdot \frac{fr}{Qэ} \right] \quad \alpha = 2.798 \times 10^{6} \ c^{-1}$$

$$\beta := \frac{3}{8} \cdot a3 \cdot Mb \cdot (2 \cdot \pi \cdot fr)^2 \quad \beta = -2.757 \times 10^{6} \ c^{-1} B^{-2}$$

$$\alpha 1 := \frac{1}{2} \cdot \left[a1 \cdot Mb \cdot (2 \cdot \pi \cdot fr)^2 - 2 \cdot \pi \cdot \frac{fr}{Qэ1} \right] \quad \alpha 1 = 6.332 \times 10^{6} \ c^{-1}$$

$Ar0 := 0.1Ar$ $Ar0 = 0.1$ B $t := 0, 0.1 \cdot 10^{-7} .. 10 \cdot 10^{-6}$ c

$$Ar(t) := \frac{Ar0 \cdot \sqrt{\alpha} \cdot e^{\alpha \cdot t}}{\sqrt{\alpha + \beta \cdot Ar0^2 \cdot \left(1 - e^{2 \cdot \alpha \cdot t}\right)}} \qquad Ar1(t) := \frac{Ar0 \cdot \sqrt{\alpha 1} \cdot e^{\alpha 1 \cdot t}}{\sqrt{\alpha 1 + \beta \cdot Ar0^2 \cdot \left(1 - e^{2 \cdot \alpha 1 \cdot t}\right)}}$$



RTCS7M

$L := 100 \cdot 10^{-6}$ Гн $C := 250 \cdot 10^{-12}$ Ф $S := 20 \cdot 10^{-3} \frac{A}{B}$ $Ri := 20 \cdot 10^{3}$ Ом

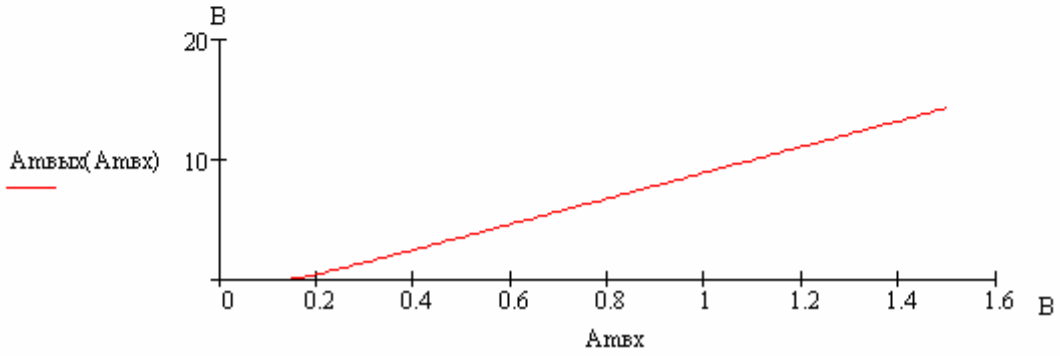
$Kb := 0.3$ $Q := 20$ $Un := 0.3$ В $Uo := 0.16$ В

$Rp := Kb^2 \cdot \sqrt{\frac{L}{C}} \cdot Q$ $Rp = 1.138 \times 10^{3}$ Ом

$Rpэ := \frac{Rp}{1 + \frac{Rp}{Ri}}$ $Rpэ = 1.077 \times 10^{3}$ Ом

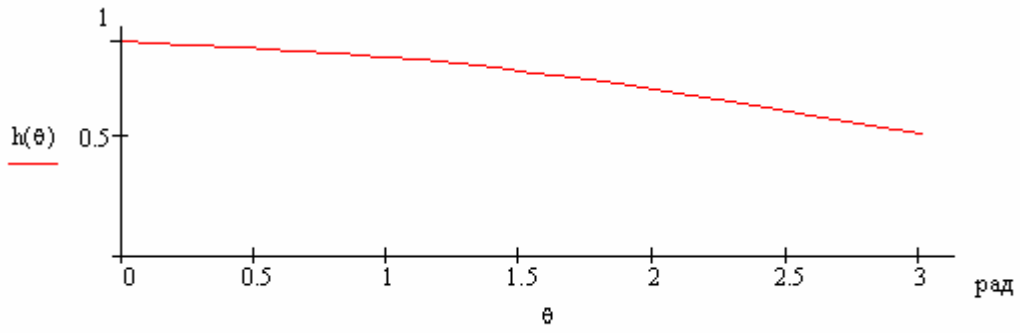
$Amвх := 0.01, 0.02 .. 1.5$ В $\theta(Amвх) := \arccos\left[\frac{(Un - Uo)}{Amвх}\right]$

$$Amвых(Amвх) := \frac{S \cdot Rpэ \cdot Amвх \cdot (\theta(Amвх) - \sin(\theta(Amвх)) \cdot \cos(\theta(Amвх)))}{\pi}$$



RTCS8M

$\theta := 0 .. \pi$ рад $h(\theta) := \frac{\theta - \sin(\theta) \cdot \cos(\theta)}{2 \cdot (\sin(\theta) - \theta \cdot \cos(\theta))}$



RTCS9M

$\Delta н := -2$ дБ $\quad Fm := 5 \cdot 10^3$ Гц

$fmax := Fm \quad R := 2 \cdot 10^3$ Ом

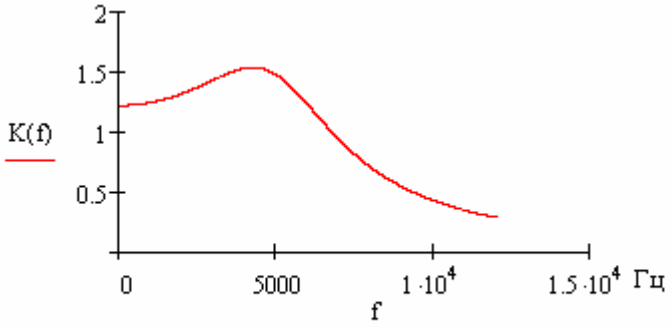
$$b := \frac{\left(10^{\frac{|\Delta н|}{20}} + 1\right)}{\sqrt{10^{\frac{|\Delta н|}{10}} - 1}} \qquad b = 2.954$$

$$A := \frac{b - 1}{2\sqrt{2 \cdot b}} \qquad A = 0.402 \qquad B := \frac{b + 1}{2\sqrt{2 \cdot b}} \qquad B = 0.813$$

$fc := 1.2 \cdot Fm \qquad fc = 6 \times 10^3$ Гц

$f := 0 .. 2 \cdot fc$

$$K(f) := \frac{1}{\sqrt{\left(\frac{f}{fc}\right)^4 + 2 \cdot \left(A^2 - B^2\right) \cdot \left(\frac{f}{fc}\right)^2 + \left(A^2 + B^2\right)^2}}$$



$$\Delta 2fc := 20 \cdot \log\left[\frac{A^2 + B^2}{\left(A^2 + B^2\right)^2 + 8 \cdot \left(A^2 - B^2\right) + 16}\right] \qquad \Delta 2fc = -23.752 \quad дБ$$

$$C1 := \frac{3}{4 \cdot \pi \cdot R \cdot A \cdot fc} \qquad C1 = 4.95 \times 10^{-8} \quad Ф$$

$$C2 := \frac{C1}{4 \cdot \pi^2 \cdot fc^2 \cdot (R \cdot C1)^2 \cdot B^2 + \frac{9}{4}} \qquad C2 = 4.318 \times 10^{-9} \quad Ф$$