Tc(s) is changed a little bite from previous Mathcad 15 file which I posted on the forum in this post,
but it doesn't matter because it's about something else now.

$$Tc(s) := \frac{2.412743157956960005 5e35 \cdot s^2 + 5.564577150433654236 6e39 \cdot s + 3.208435050474681681 7e43}{1.266514795529222536 9e19 \cdot s^5 + 4.238527858112259324 4e24 \cdot s^4 + 4.922053617956246619 3e29 \cdot s^3 + 2.343921743653455434 8e34 \cdot s^2 + 4.255319148936170212 8e38 \cdot s}$$

$$Tc(s) := \frac{2.412 \cdot 10^{35} \cdot s^2 + 5.5646 \cdot 10^{39} \cdot s + 3.2084350 \cdot 10^{43}}{1.2665 \cdot 10^{19} \cdot s^5 + 4.23853 \cdot 10^{24} \cdot s^4 + 4.92205 \cdot 10^{29} \cdot s^3 + 2.3339 \cdot 10^{34} \cdot s^2 + 4.2553 \cdot 10^{38} \cdot s}$$

$Gp :=$

$frq := \text{logspace}(10, 10^7, 10^3)$

Solve for frequency of zero dB gain

$FQ := \text{root}(20 \cdot \log(|Tc(2 \cdot \pi \cdot 1\text{j} \cdot XX)|), XX, 10^4, 10^6) = 39058.342$

$20 \cdot \log(|Tc(2 \cdot \pi \cdot 1\text{j} \cdot FQ)|) = 0$

20 log(|Tc(j·2·

This function replaces phasecor, (not available in Express

$arg(x) := \text{mod}(\text{atan2}(Re(x), Im(x)) - 2 \cdot \pi, 2 \cdot \pi)$

Find the frequency at which the phase crosses -180°.

$GQ := \text{root}(arg(Tc(2 \cdot \pi \cdot 1\text{j} \cdot xx)) + \pi, xx, 10^3, 10^6) = 28202.044$

Phase margin is defined as the amount of change in open-loop phase needed to make a closed-loop system unstable. The phase margin is the difference in phase between −180° and the phase at the gain cross-over frequency that gives a gain of 0 dB.
Gain Margin is the difference between 0dB and the gain where phase crosses -180°

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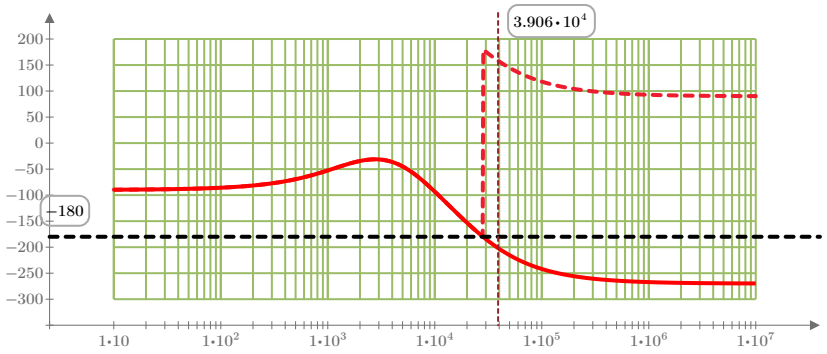
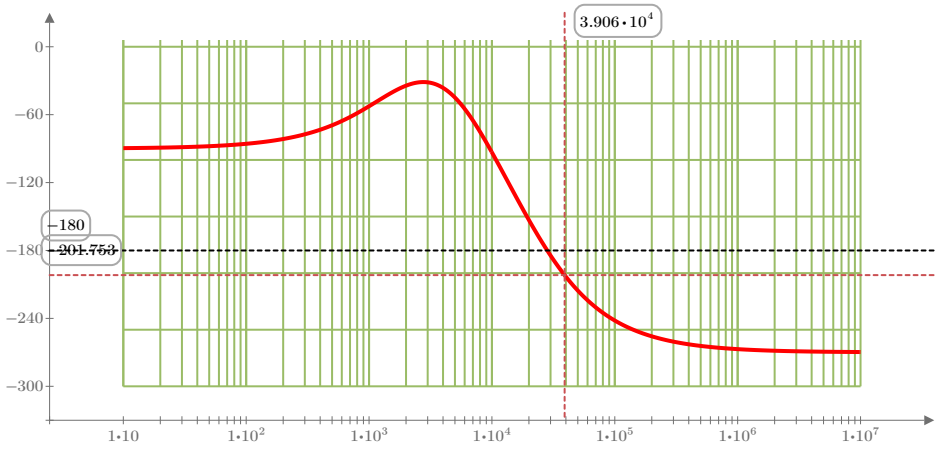
atan2 function and **arc() function** with $FQ = 39058.342$



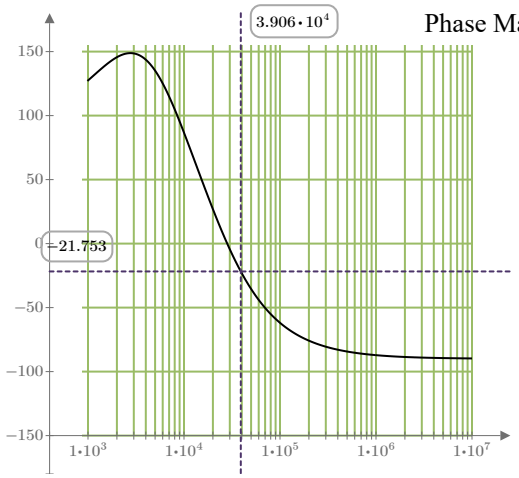
$arg\left(Tc\left(2\cdot\pi\cdot 1j\cdot FQ\right)\right) = -201.753\ \textbf{deg}$

arc() function with $FQ = 39058.342$,



$Phase\_Margin\left(x\right) := arg\left(x\right) + 180\ \textbf{deg}$

$Phase\_Margin\left(Tc\left(2\cdot\pi\cdot 1j\cdot FQ\right)\right) = -21.753\ \textbf{deg}$



Phase Margin vs frequency

$Gf^{(1)}$

$Phase\_Margin\left(Tc\left(2\cdot\pi\cdot 1j\cdot frq\right)\right)\ \left(\textbf{deg}\right)$

arg(Tc(j·2

2) Second Method

$Arg(z, \varphi_0) := \mathrm{mod}(\arg(z) - \varphi_0, 2\cdot\pi)$

$Arg\left(Tc(j\cdot 2\cdot\pi\cdot freq), -3\cdot\frac{\pi}{2}\right)\cdot\frac{180}{\pi}$ − 10

− 20

Pha

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$Gf^{\langle 0 \rangle}$

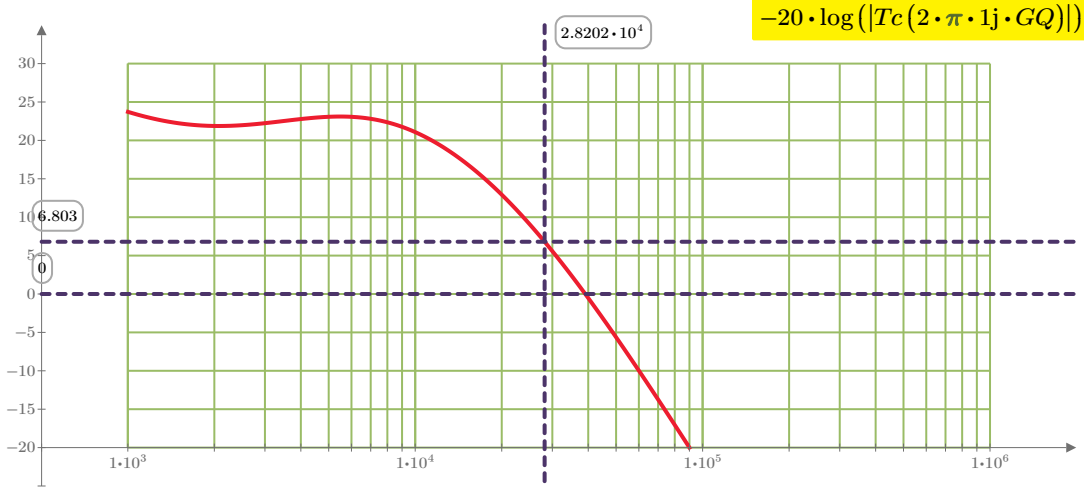
frq

$GQ = 28202.044$

$Gx := Grid$

Gain Margin Plot and value

$-20 \cdot \log\left(\left|Tc\left(2 \cdot \pi \cdot 1\mathrm{j} \cdot GQ\right)\right|\right) = -6.803$



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