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STS-xx Pole-Zero Representation of the STS-2 Transfer Function from 0.001 to 100 Hz

Conditions:

1. The response parameters presented below are deduced using either the theoretical response (STS-2) or output data produced by calibration excitation (STS-2.5 and STS-5a. The values for STS-2.5 and STS-5a are average values. For each type of instrument, the volume of the dataset used is noted within the corresponding chapter.
2. Additional poles and zeros are introduced in order to correct for the difference between calibration excitation and ground motion excitation (STS-2.5 and STS-5a).
3. The output signal is the voltage at one of the normal STS-xx differential outputs (X, Y, or Z). The output filter ('mixer pole') is a 1st order lowpass filter which is not integrated in the feedback loop.
4. The term 'generation' (STS-2) applies only to the electronics. As will be seen on the plots 'Amplitude/Phase responses of all three generations' (STS-2), significant deviations of the transfer function among the generations occur only at frequencies above 10 Hz.
5. No exact limits exist for the transition from one STS-2 generation to the next, neither for calendar date nor serial number. Some instruments that were shipped back for repair now are equipped with p.c. boards of a newer generation. Please consult the appropriate manual that was included in the shipment, or the "List of STS-2 generations", which is available at G. Streckeisen AG.

Inserted November 2018:

6. The standard deviations given for the STS-2.5 and STS-5a response parameters do not reflect their precision, but their scattering within the sample space that has been used for evaluating the average values.

$n := 0..480$

Logarithmic scale for frequency:

$$f_n := \frac{1}{1000} \cdot 10^{\frac{n}{96}} \qquad \omega_n := 2 \cdot \pi \cdot f_n$$

1st generation STS-2

Zeroes:

$Z_0 := Zre_0 + i \cdot Zim_0$ $\quad Z_0 = -318.6 + 401.2i$

$Z_1 := Zre_0 - i \cdot Zim_0$ $\quad Z_1 = -318.6 - 401.2i$

$Z_2 := Zre_1$ $\quad Z_2 = -15.15$

Poles:

$P_0 := Pre_0 + i \cdot Pim_0$ $\quad P_0 = -7.454 \times 10^3 - 7.142i \times 10^3$

$P_1 := Pre_0 - i \cdot Pim_0$ $\quad P_1 = -7.454 \times 10^3 + 7.142i \times 10^3$

$P_2 := Pre_1$ $\quad P_2 = -417.1$

$P_3 := Pre_2 + i \cdot Pim_2$ $\quad P_3 = -100.9 + 401.9i$

$P_4 := Pre_2 - i \cdot Pim_2$ $\quad P_4 = -100.9 - 401.9i$

$P_5 := Pre_3$ $\quad P_5 = -15.99$

$P_6 := Pre_4 + i \cdot Pim_4$ $\quad P_6 = -0.037 - 0.037i$

$P_7 := Pre_4 - i \cdot Pim_4$ $\quad P_7 = -0.037 + 0.037i$

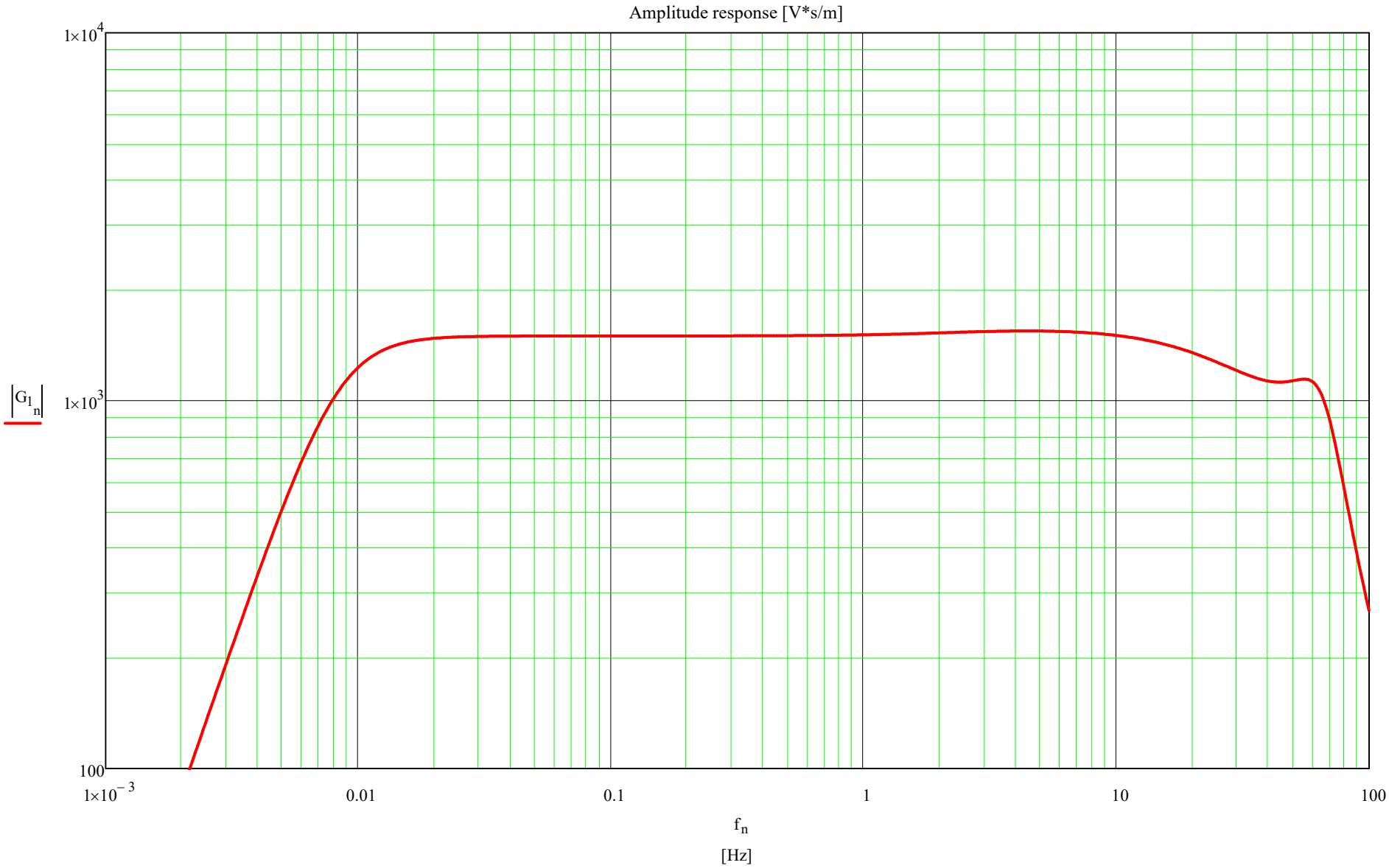
'Mixer pole':

$\omega_{mix} := -2 \cdot \pi \cdot 29.8$

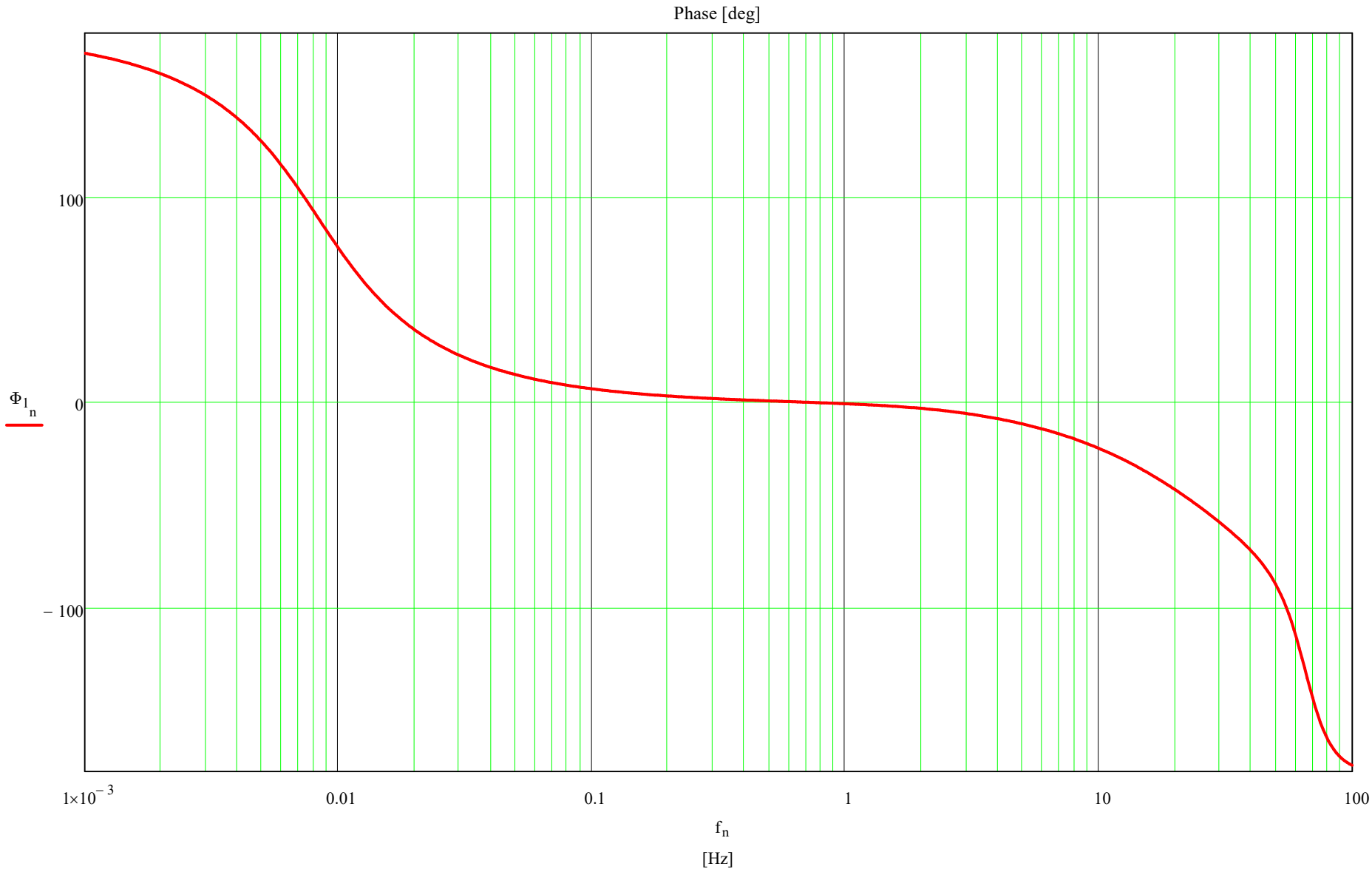
$$G_{1_n} := \left(i \cdot \omega_n\right)^2 \cdot \frac{8.6177 \cdot 10^{15} \cdot \left[\prod_{k=0}^{2} \left(i \cdot \omega_n - Z_k\right)\right]}{\prod_{l=0}^{7} \left(i \cdot \omega_n - P_l\right) \cdot \left(i \cdot \omega_n - \omega_{mix}\right)}$$

$$\Phi_{1_n} := \frac{180}{\pi} \cdot \arg\left(G_{1_n}\right)$$

1st generation STS-2: Amplitude



1st generation STS-2: Phase



2nd generation STS-2

Zeroes:

$Z_0 := Zre_0 + i \cdot Zim_0$ $\quad Z_0 = -5.907 \times 10^3 + 3.411i \times 10^3$

$Z_1 := Zre_0 - i \cdot Zim_0$ $\quad Z_1 = -5.907 \times 10^3 - 3.411i \times 10^3$

$Z_2 := Zre_1 + i \cdot Zim_1$ $\quad Z_2 = -683.9 + 175.5i$

$Z_3 := Zre_1 - i \cdot Zim_1$ $\quad Z_3 = -683.9 - 175.5i$

$Z_4 := Zre_2$ $\quad Z_4 = -555.1$

$Z_5 := Zre_3$ $\quad Z_5 = -294.6$

$Z_6 := Zre_4$ $\quad Z_6 = -10.75$

Poles:

$P_0 := Pre_0 + i \cdot Pim_0$ $\quad P_0 = -6.909 \times 10^3 - 9.208i \times 10^3$

$P_1 := Pre_0 - i \cdot Pim_0$ $\quad P_1 = -6.909 \times 10^3 + 9.208i \times 10^3$

$P_2 := Pre_1$ $\quad P_2 = -6.227 \times 10^3$

$P_3 := Pre_2 + i \cdot Pim_2$ $\quad P_3 = -4.936 \times 10^3 - 4.713i \times 10^3$

$P_4 := Pre_2 - i \cdot Pim_2$ $\quad P_4 = -4.936 \times 10^3 + 4.713i \times 10^3$

$P_5 := Pre_3$ $\quad P_5 = -1.391 \times 10^3$

$P_6 := Pre_4 + i \cdot Pim_4$ $\quad P_6 = -556.8 - 60.05i$

$P_7 := Pre_4 - i \cdot Pim_4$ $\quad P_7 = -556.8 + 60.05i$

$P_8 := Pre_5 + i \cdot Pim_5$ $\quad P_8 = -98.44 - 442.8i$

$P_9 := Pre_5 - i \cdot Pim_5$ $\quad P_9 = -98.44 + 442.8i$

$P_{10} := Pre_6$ $\quad P_{10} = -10.95$

$P_{11} := Pre_7 + i \cdot Pim_7$ $\quad P_{11} = -0.037 + 0.037i$

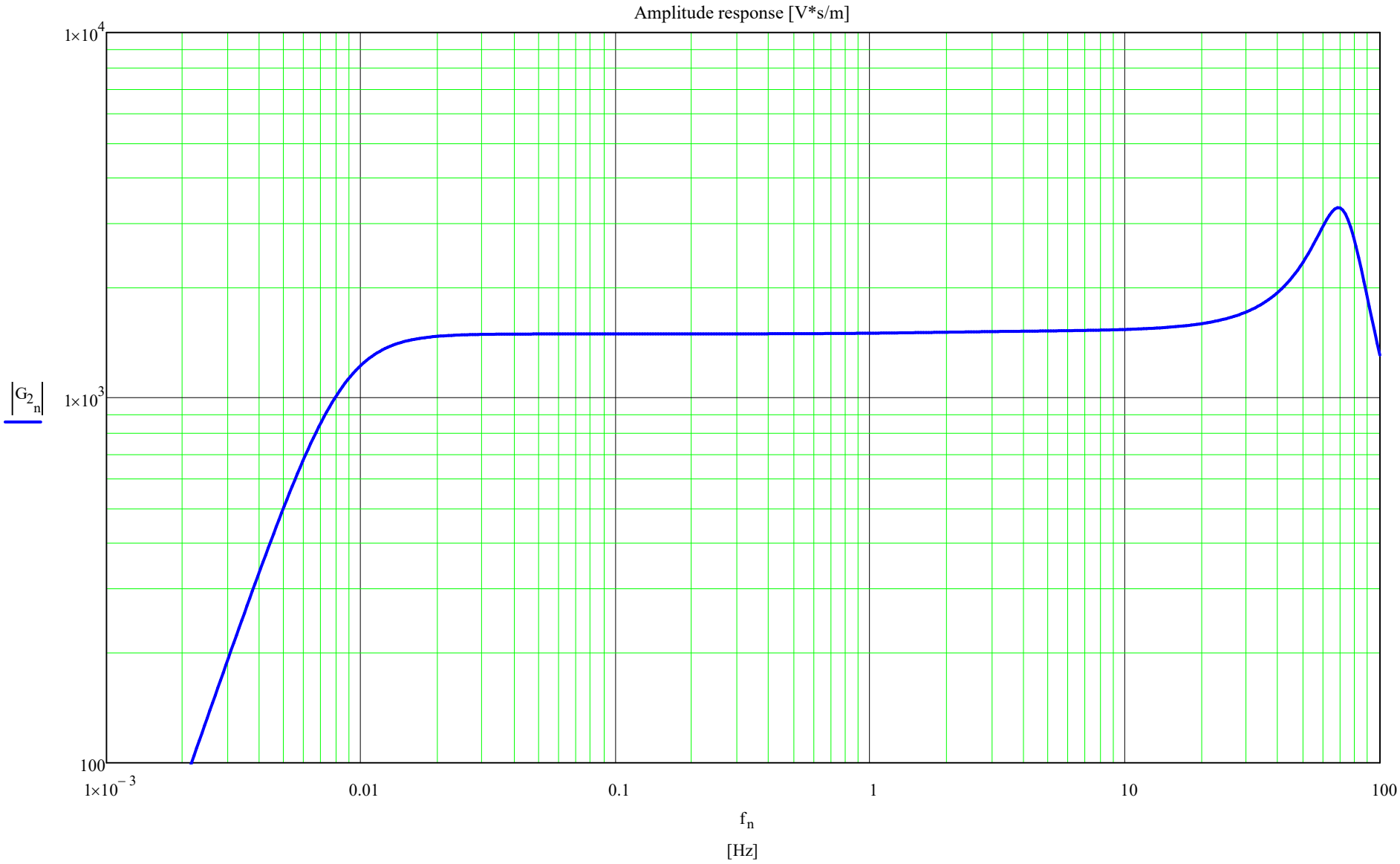
$P_{12} := Pre_7 - i \cdot Pim_7$ $\quad P_{12} = -0.037 - 0.037i$

'Mixer pole':

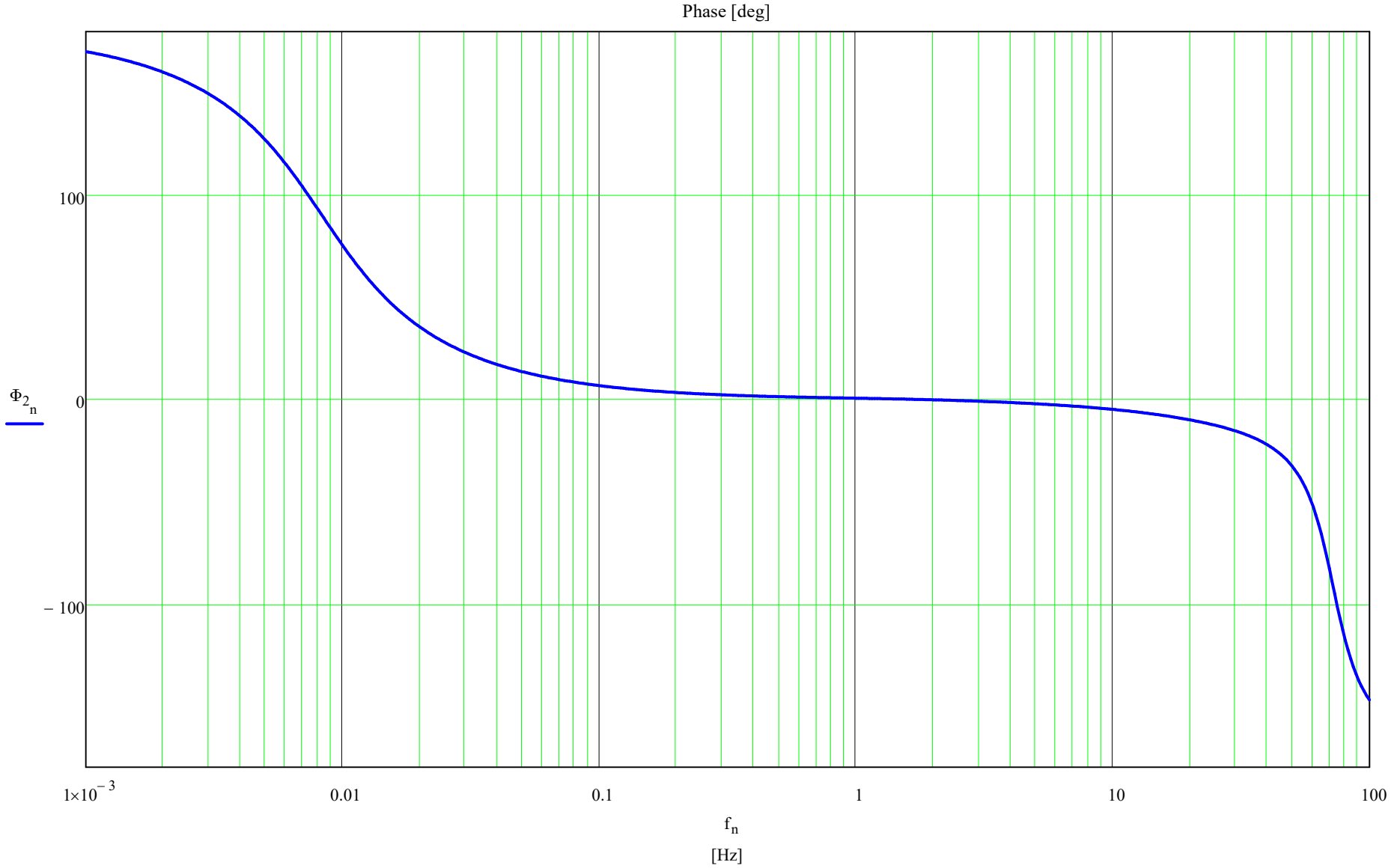
$\omega_{mix} := -2 \cdot \pi \cdot 40.6$

$$G_{2_n} := \left(i \cdot \omega_n\right)^2 \cdot \frac{3.5356 \cdot 10^{20} \cdot \left[\prod_{k=0}^{6} \left(i \cdot \omega_n - Z_k\right)\right]}{\prod_{l=0}^{12} \left(i \cdot \omega_n - P_l\right) \cdot \left(i \cdot \omega_n - \omega_{mix}\right)} \qquad \Phi_{2_n} := \frac{180}{\pi} \cdot \arg\left(G_{2_n}\right)$$

2nd generation STS-2: Amplitude



2nd generation STS-2: Phase



3rd generation STS-2

Zeroes:

$Z_0 := Zre_0 + i \cdot Zim_0$ $Z_0 = -463.1 - 430.5i$

$Z_1 := Zre_0 - i \cdot Zim_0$ $Z_1 = -463.1 + 430.5i$

$Z_2 := Zre_1$ $Z_2 = -176.6$

$Z_3 := Zre_2$ $Z_3 = -15.15$

Poles:

$P_0 := Pre_0$ $P_0 = -1.33 \times 10^4$

$P_1 := Pre_1 + i \cdot Pim_1$ $P_1 = -1.053 \times 10^4 + 1.005i \times 10^4$

$P_2 := Pre_1 - i \cdot Pim_1$ $P_2 = -1.053 \times 10^4 - 1.005i \times 10^4$

$P_3 := Pre_2$ $P_3 = -520.3$

$P_4 := Pre_3$ $P_4 = -374.8$

$P_5 := Pre_4 + i \cdot Pim_4$ $P_5 = -97.34 - 400.7i$

$P_6 := Pre_4 - i \cdot Pim_4$ $P_6 = -97.34 + 400.7i$

$P_7 := Pre_5$ $P_7 = -15.64$

$P_8 := Pre_6 + i \cdot Pim_6$ $P_8 = -0.037 + 0.037i$

$P_9 := Pre_6 - i \cdot Pim_6$ $P_9 = -0.037 - 0.037i$

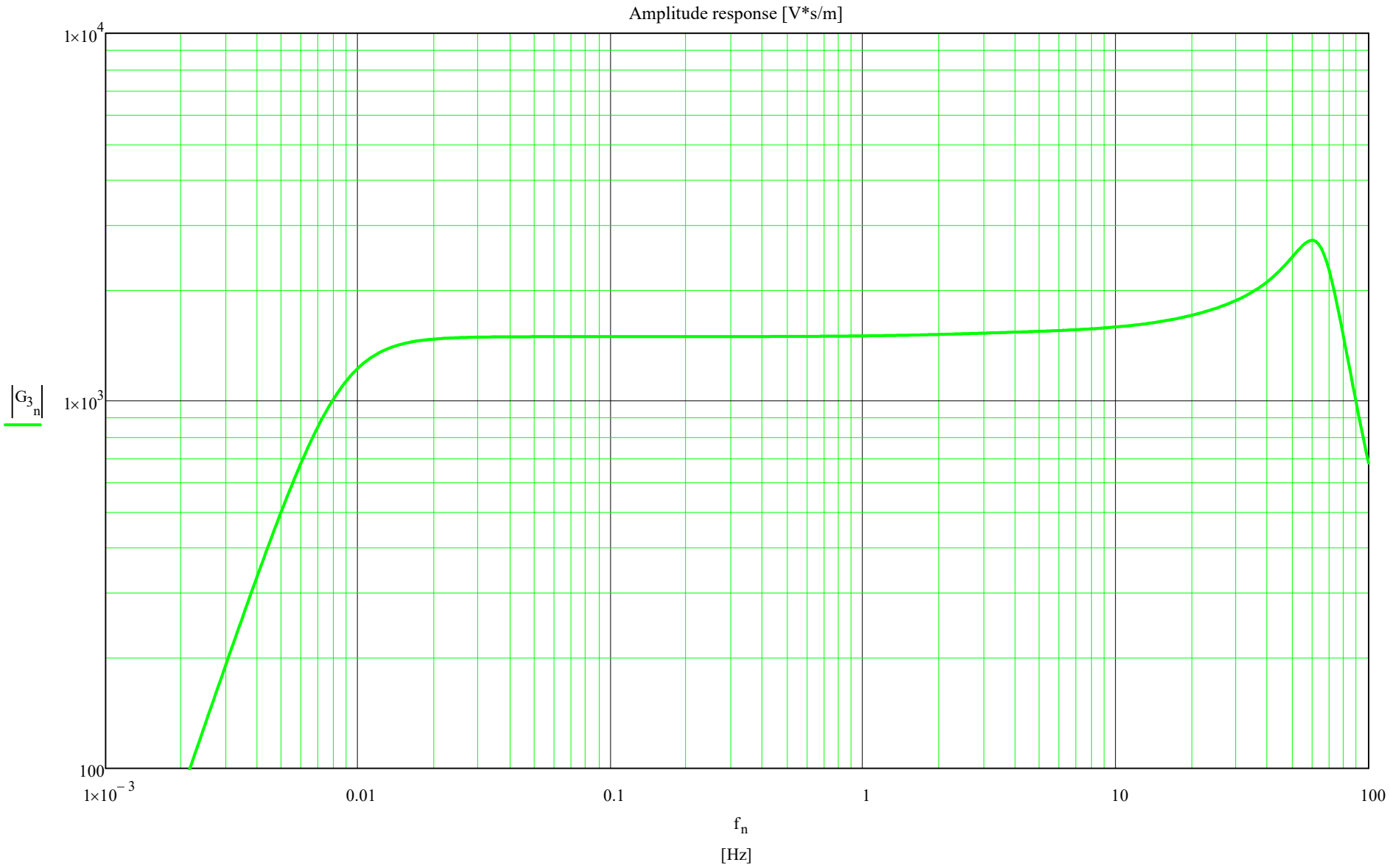
'Mixer pole':

$\omega_{mix} := -2 \cdot \pi \cdot 40.6$

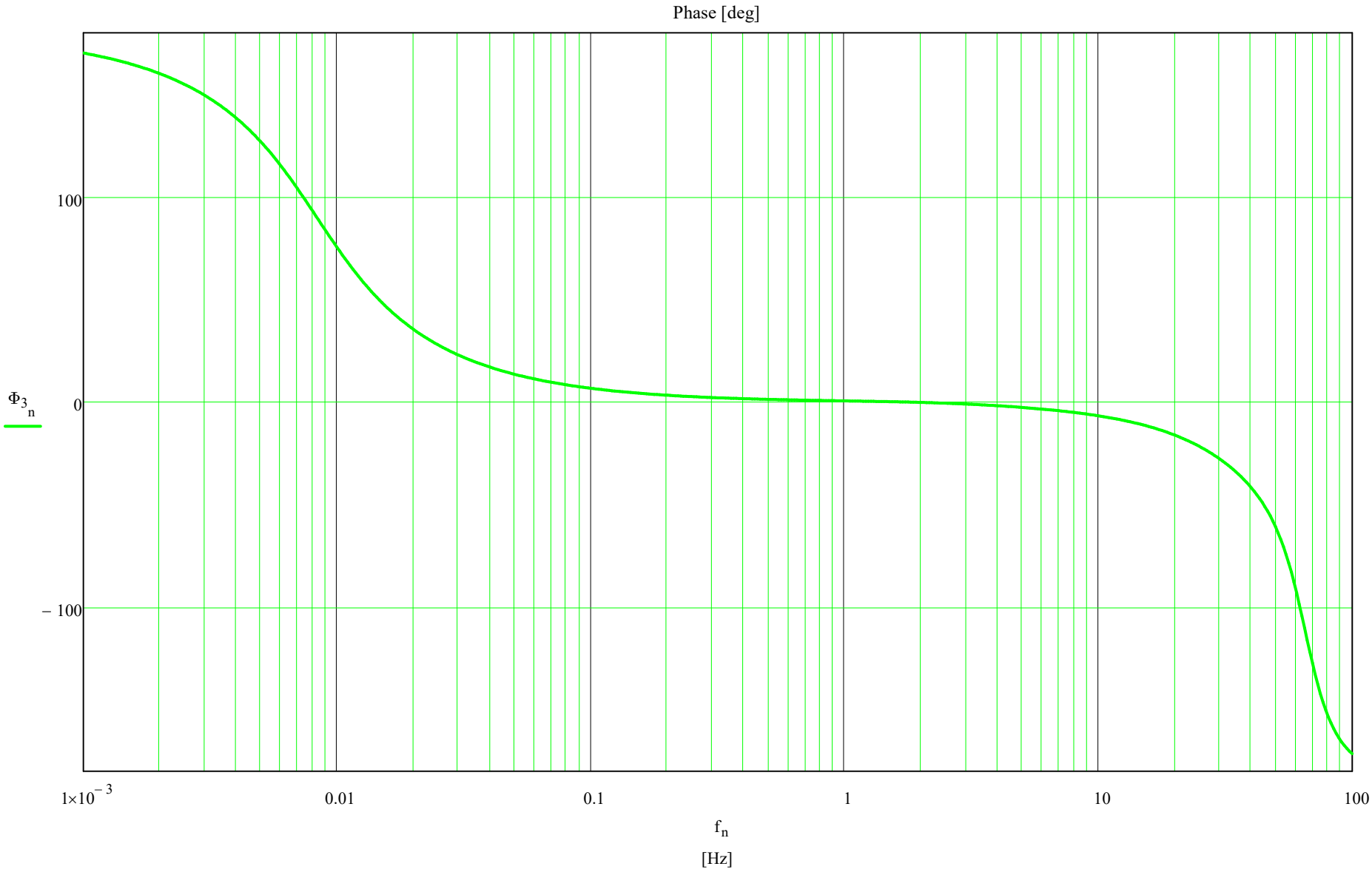
$$G3_n := \left(i \cdot \omega_n\right)^2 \cdot \frac{5.2107 \cdot 10^{20} \cdot \left[\prod_{k=0}^{3} \left(i \cdot \omega_n - Z_k\right)\right]}{\prod_{l=0}^{9} \left(i \cdot \omega_n - P_l\right) \cdot \left(i \cdot \omega_n - \omega_{mix}\right)}$$

$$\Phi 3_n := \frac{180}{\pi} \cdot \arg\left(G3_n\right)$$

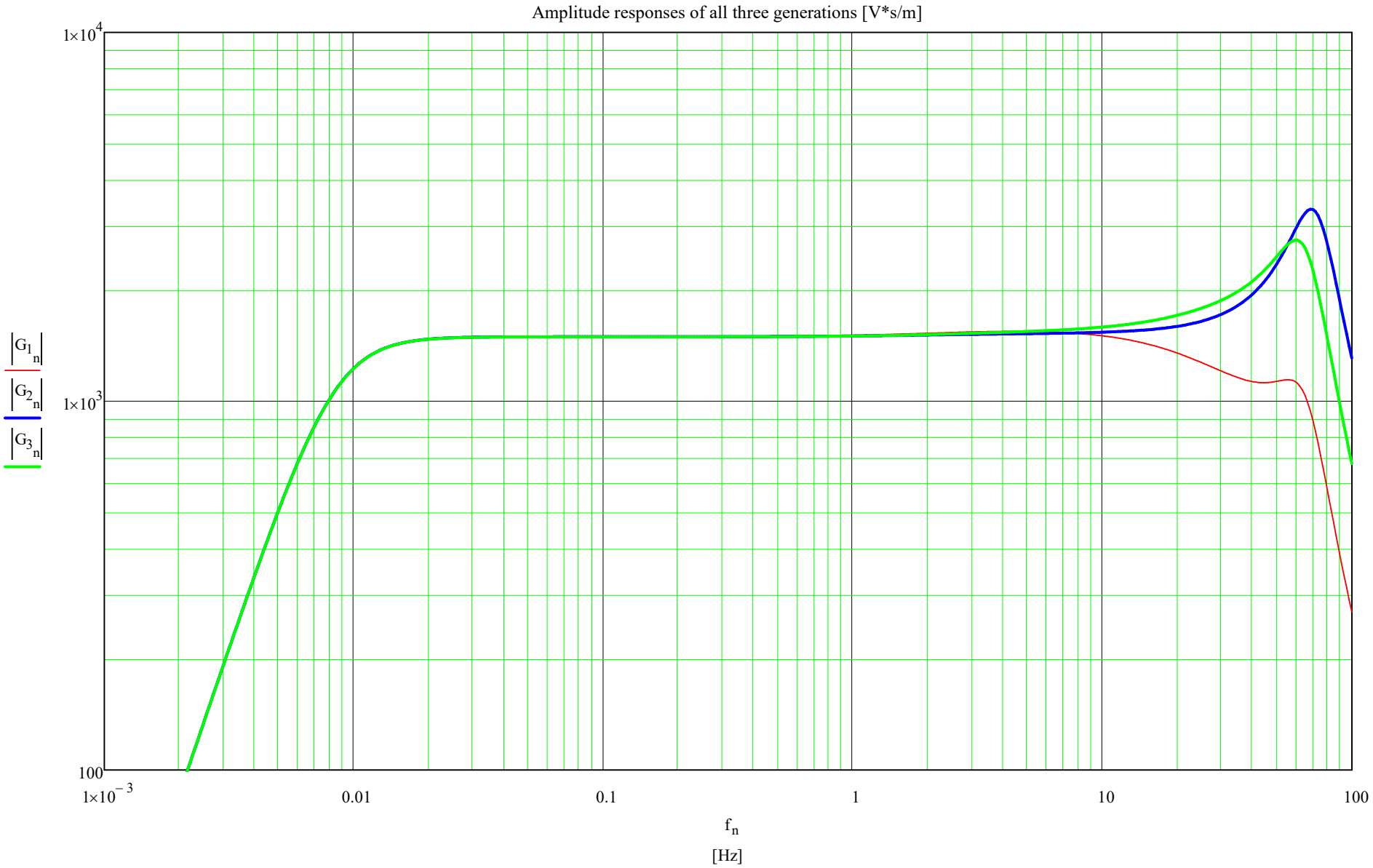
3rd generation STS-2: Amplitude



3rd generation STS-2: Phase



Stack of all generations STS-2: Amplitude



Stack of all generations STS-2: Phase