

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

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Conditions:

1. Poles and zeroes below are deduced from the theoretical response to ground velocity [$\frac{V \cdot s}{m}$].
2. The transfer function has been verified by response measurements using the calibration coil for excitation.
3. The output signal is the voltage at one of the normal STS-2 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' applies only to the electronics. As will be seen on the last two plots, 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.

Logarithmic scale
 for frequency:

$$n := 0..480$$

$$f_n := \frac{1}{1000} \cdot 10^{\frac{n}{96}}$$

$$\omega_n := 2 \cdot \pi \cdot f_n$$

1st generation STS-2

Zeroes:

$$Z_0 := Z_{re0} + i \cdot Z_{im0}$$

$$Z_0 = -318.6 + 401.2i$$

$$P_0 := P_{re0} + i \cdot P_{im0}$$

Poles:

$$P_0 = -7.454 \times 10^3 - 7.142i \times 10^3$$

$$P_3 := \text{Pre}_2 + i \cdot \text{Pim}_2$$

$$P_3 = -100.9 + 401.9i$$

$$Z_1 := \text{Zre}_0 - i \cdot \text{Zim}_0$$

$$Z_1 = -318.6 - 401.2i$$

$$P_1 := \text{Pre}_0 - i \cdot \text{Pim}_0$$

$$P_1 = -7.454 \times 10^3 + 7.142i \times 10^3$$

$$P_4 := \text{Pre}_2 - i \cdot \text{Pim}_2$$

$$P_4 = -100.9 - 401.9i$$

$$Z_2 := \text{Zre}_1$$

$$Z_2 = -15.15$$

$$P_2 := \text{Pre}_1$$

$$P_2 = -417.1$$

$$P_5 := \text{Pre}_3$$

$$P_5 = -15.99$$

$$P_6 := \text{Pre}_4 + i \cdot \text{Pim}_4$$

$$P_6 = -0.037 - 0.037i$$

'Mixer pole':

$$P_7 := \text{Pre}_4 - i \cdot \text{Pim}_4$$

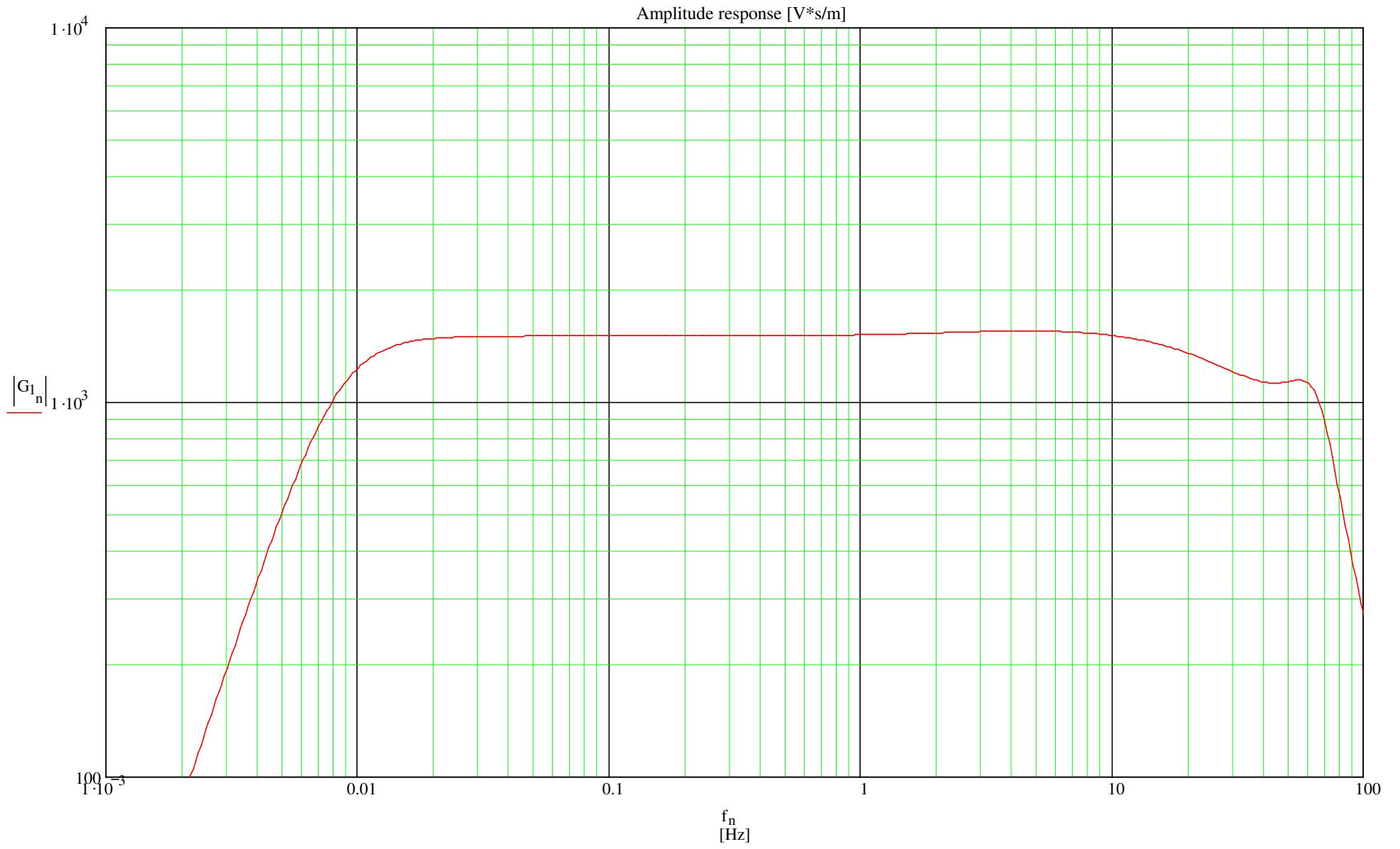
$$P_7 = -0.037 + 0.037i$$

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

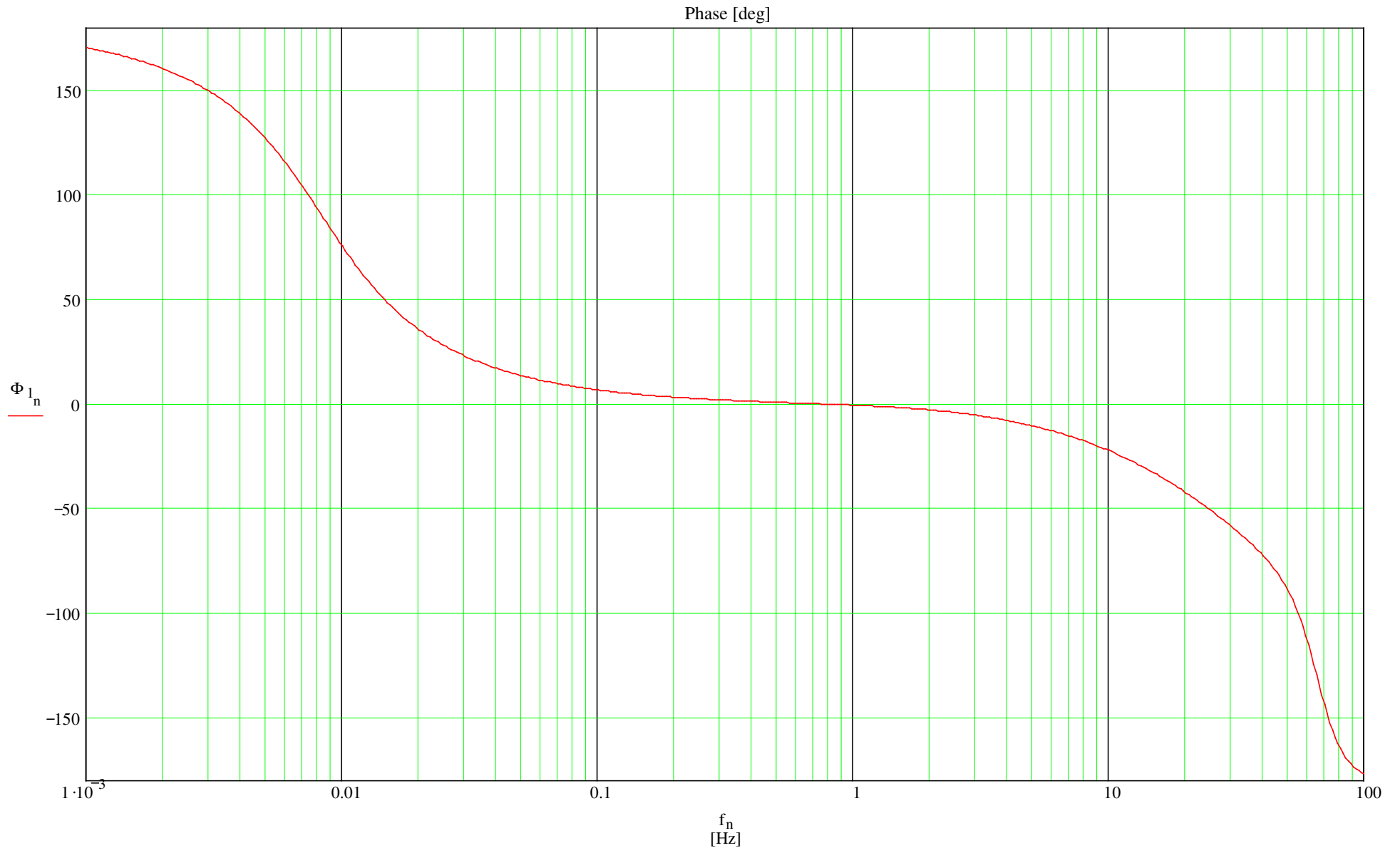
$$G_{1_n} := (i \cdot \omega_n)^2 \cdot \frac{8.6177 \cdot 10^{15} \cdot \left[\prod_{k=0}^2 (i \cdot \omega_n - Z_k) \right]}{\prod_{l=0}^7 (i \cdot \omega_n - P_l) \cdot (i \cdot \omega_n - \omega_{\text{mix}})}$$

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

1st generation STS-2: Amplitude



1st generation STS-2: Phase



2nd generation STS-2

Zeroes:

$$Z_0 := Z_{re0} + i \cdot Z_{im0}$$

$$Z_0 = -5.907 \times 10^3 + 3.411i \times 10^3$$

$$Z_1 := Z_{re0} - i \cdot Z_{im0}$$

$$Z_1 = -5.907 \times 10^3 - 3.411i \times 10^3$$

$$Z_2 := Z_{re1} + i \cdot Z_{im1}$$

$$Z_2 = -683.9 + 175.5i$$

$$Z_3 := Z_{re1} - i \cdot Z_{im1}$$

$$Z_3 = -683.9 - 175.5i$$

$$Z_4 := Z_{re2}$$

$$Z_4 = -555.1$$

$$Z_5 := Z_{re3}$$

$$Z_5 = -294.6$$

$$Z_6 := Z_{re4}$$

$$Z_6 = -10.75$$

Poles:

$$P_0 := P_{re0} + i \cdot P_{im0}$$

$$P_0 = -6.909 \times 10^3 - 9.208i \times 10^3$$

$$P_1 := P_{re0} - i \cdot P_{im0}$$

$$P_1 = -6.909 \times 10^3 + 9.208i \times 10^3$$

$$P_2 := P_{re1}$$

$$P_2 = -6.227 \times 10^3$$

$$P_3 := P_{re2} + i \cdot P_{im2}$$

$$P_3 = -4.936 \times 10^3 - 4.713i \times 10^3$$

$$P_4 := P_{re2} - i \cdot P_{im2}$$

$$P_4 = -4.936 \times 10^3 + 4.713i \times 10^3$$

$$P_5 := \text{Pre}_3$$

$$P_5 = -1.391 \times 10^3$$

$$P_6 := \text{Pre}_4 + i \cdot \text{Pim}_4$$

$$P_6 = -556.8 - 60.05i$$

$$P_7 := \text{Pre}_4 - i \cdot \text{Pim}_4$$

$$P_7 = -556.8 + 60.05i$$

$$P_8 := \text{Pre}_5 + i \cdot \text{Pim}_5$$

$$P_8 = -98.44 - 442.8i$$

$$P_9 := \text{Pre}_5 - i \cdot \text{Pim}_5$$

$$P_9 = -98.44 + 442.8i$$

$$P_{10} := \text{Pre}_6$$

$$P_{10} = -10.95$$

$$P_{11} := \text{Pre}_7 + i \cdot \text{Pim}_7$$

$$P_{11} = -0.037 + 0.037i$$

$$P_{12} := \text{Pre}_7 - i \cdot \text{Pim}_7$$

$$P_{12} = -0.037 - 0.037i$$

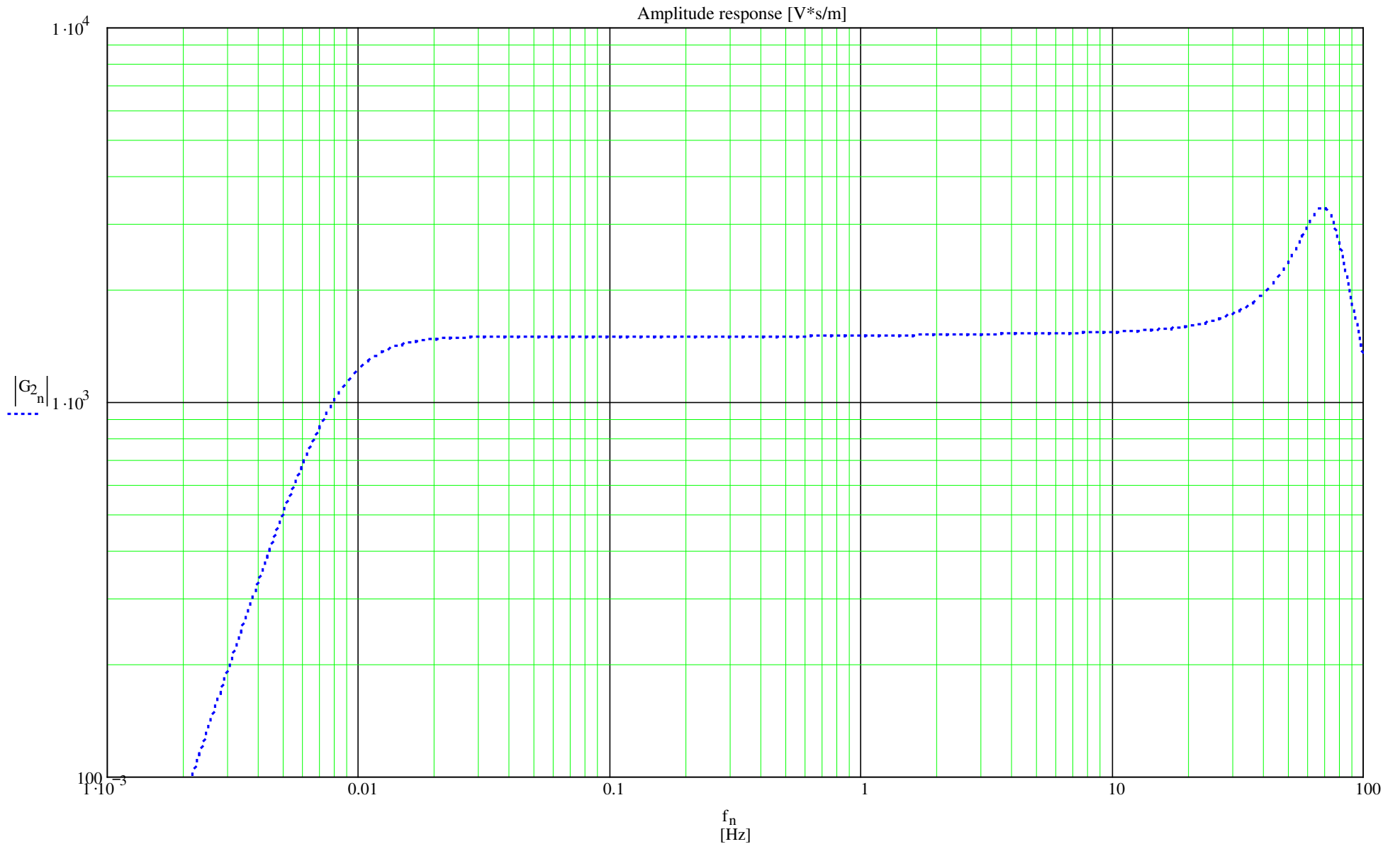
'Mixer pole':

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

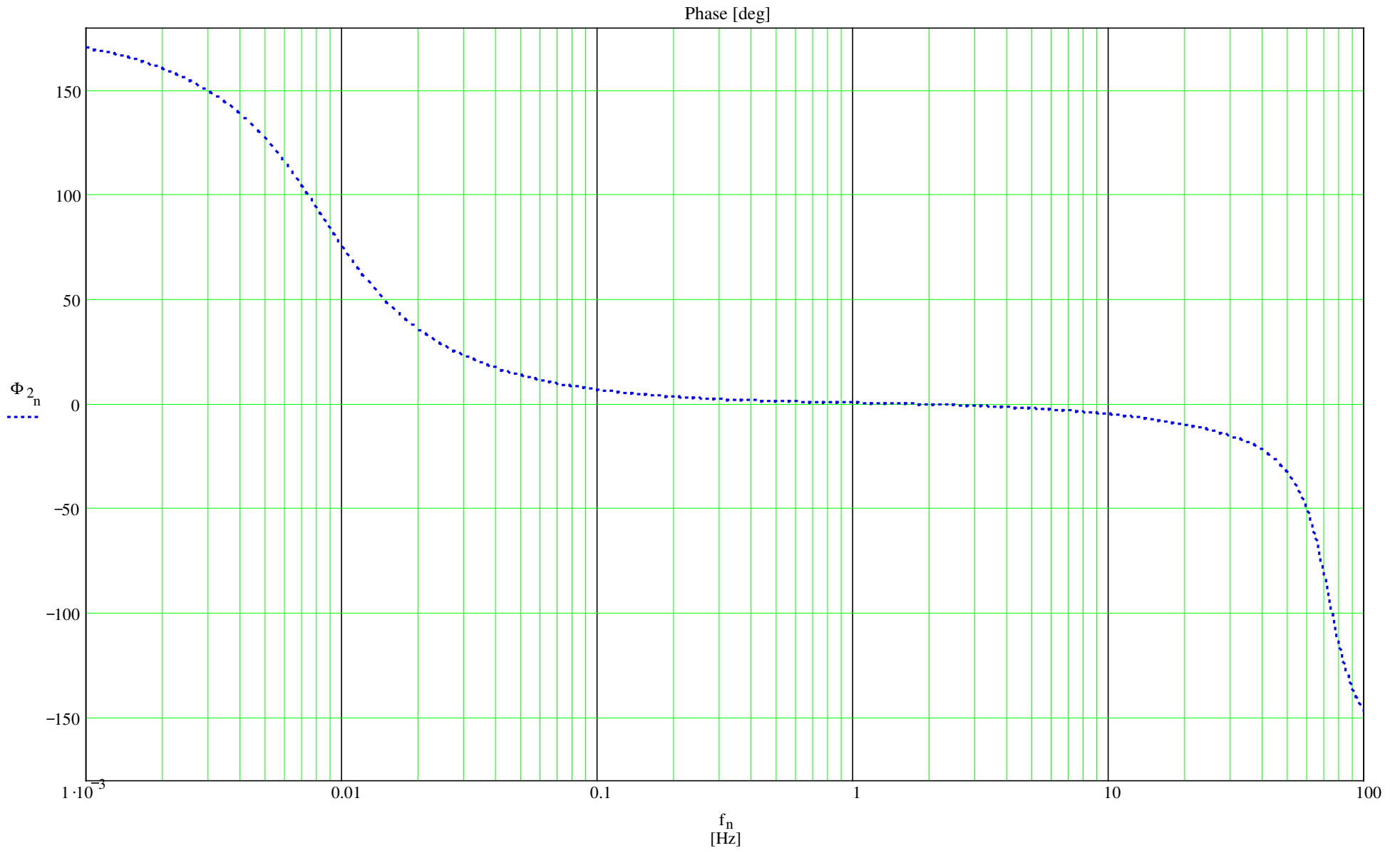
$$G_{2_n} := (i \cdot \omega_n)^2 \cdot \frac{3.5356 \cdot 10^{20} \cdot \left[\prod_{k=0}^6 (i \cdot \omega_n - Z_k) \right]}{\prod_{l=0}^{12} (i \cdot \omega_n - P_l) \cdot (i \cdot \omega_n - \omega_{\text{mix}})}$$

$$\Phi_{2_n} := \frac{180}{\pi} \cdot \arg(G_{2_n})$$

2nd generation STS-2: Amplitude



2nd generation STS-2: Phase



3rd generation STS-2

Zeroes:

$$Z_0 := Z_{re0} + i \cdot Z_{im0}$$

$$Z_0 = -463.1 - 430.5i$$

$$Z_1 := Z_{re0} - i \cdot Z_{im0}$$

$$Z_1 = -463.1 + 430.5i$$

$$Z_2 := Z_{re1}$$

$$Z_2 = -176.6$$

$$Z_3 := Z_{re2}$$

$$Z_3 = -15.15$$

Poles:

$$P_0 := P_{re0}$$

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

$$P_1 := P_{re1} + i \cdot P_{im1}$$

$$P_1 = -1.053 \times 10^4 + 1.005i \times 10^4$$

$$P_2 := P_{re1} - i \cdot P_{im1}$$

$$P_2 = -1.053 \times 10^4 - 1.005i \times 10^4$$

$$P_3 := P_{re2}$$

$$P_3 = -520.3$$

$$P_4 := P_{re3}$$

$$P_4 = -374.8$$

$$P_5 := P_{re4} + i \cdot P_{im4}$$

$$P_5 = -97.34 - 400.7i$$

$$P_6 := P_{re4} - i \cdot P_{im4}$$

$$P_6 = -97.34 + 400.7i$$

$$P_7 := P_{re5}$$

$$P_7 = -15.64$$

$$P_8 := \text{Pre}_6 + i \cdot \text{Pim}_6$$

$$P_8 = -0.037 + 0.037i$$

$$P_9 := \text{Pre}_6 - i \cdot \text{Pim}_6$$

$$P_9 = -0.037 - 0.037i$$

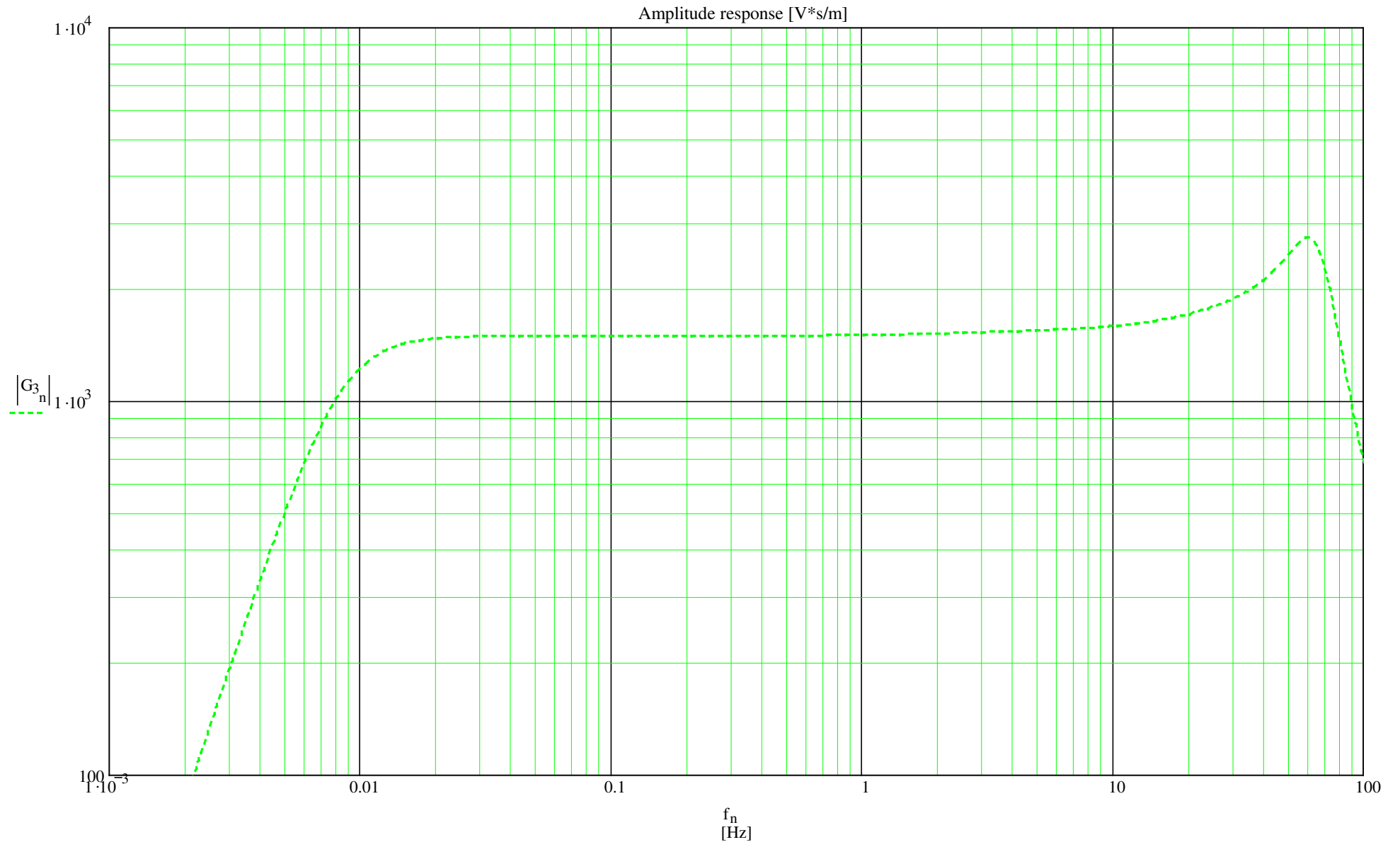
'Mixer pole':

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

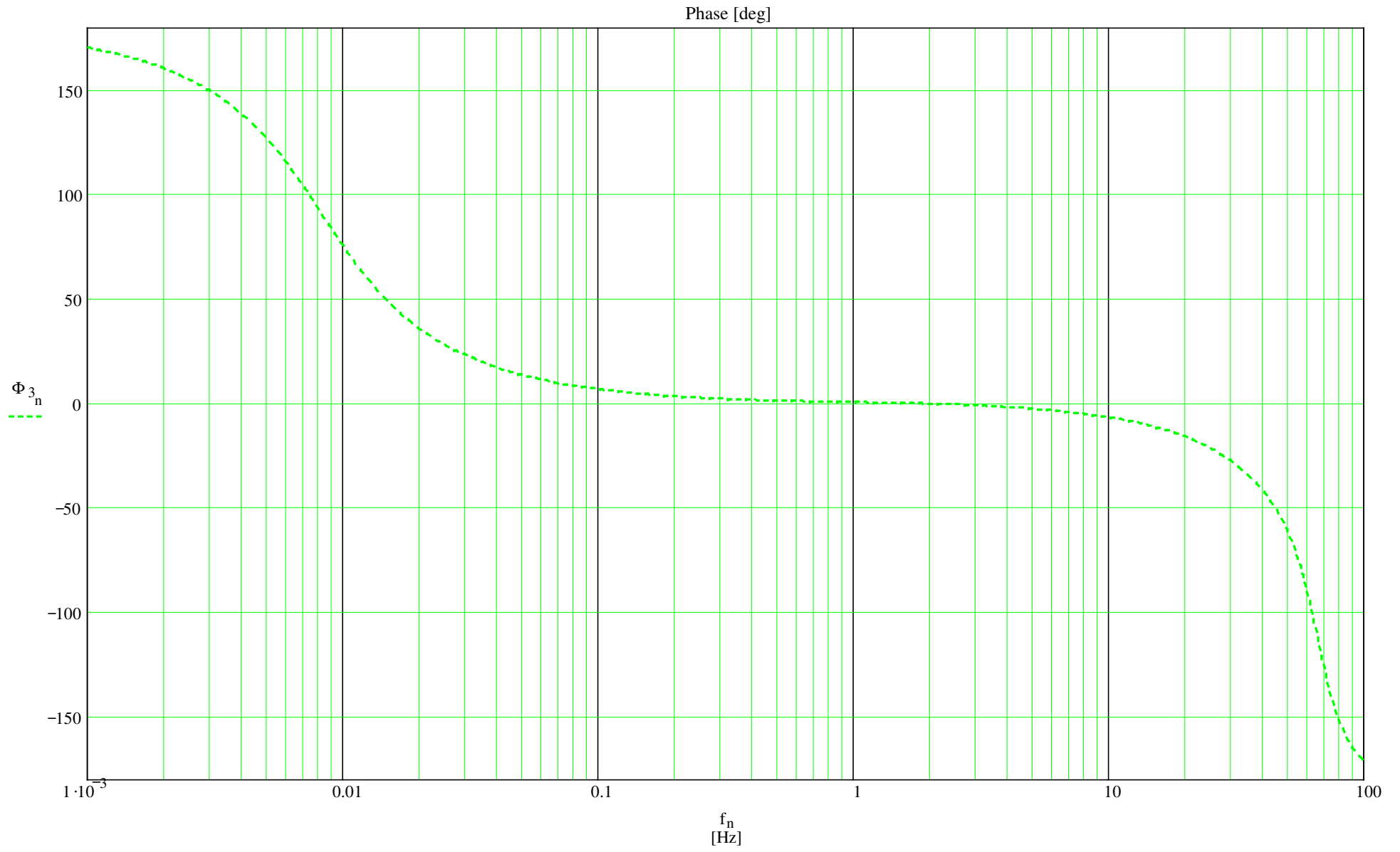
$$G_{3_n} := (i \cdot \omega_n)^2 \cdot \frac{5.2107 \cdot 10^{20} \cdot \left[\prod_{k=0}^3 (i \cdot \omega_n - Z_k) \right]}{9 \cdot \prod_{l=0} (i \cdot \omega_n - P_l) \cdot (i \cdot \omega_n - \omega_{\text{mix}})}$$

$$\Phi_{3_n} := \frac{180}{\pi} \cdot \arg(G_{3_n})$$

3rd generation STS-2: Amplitude

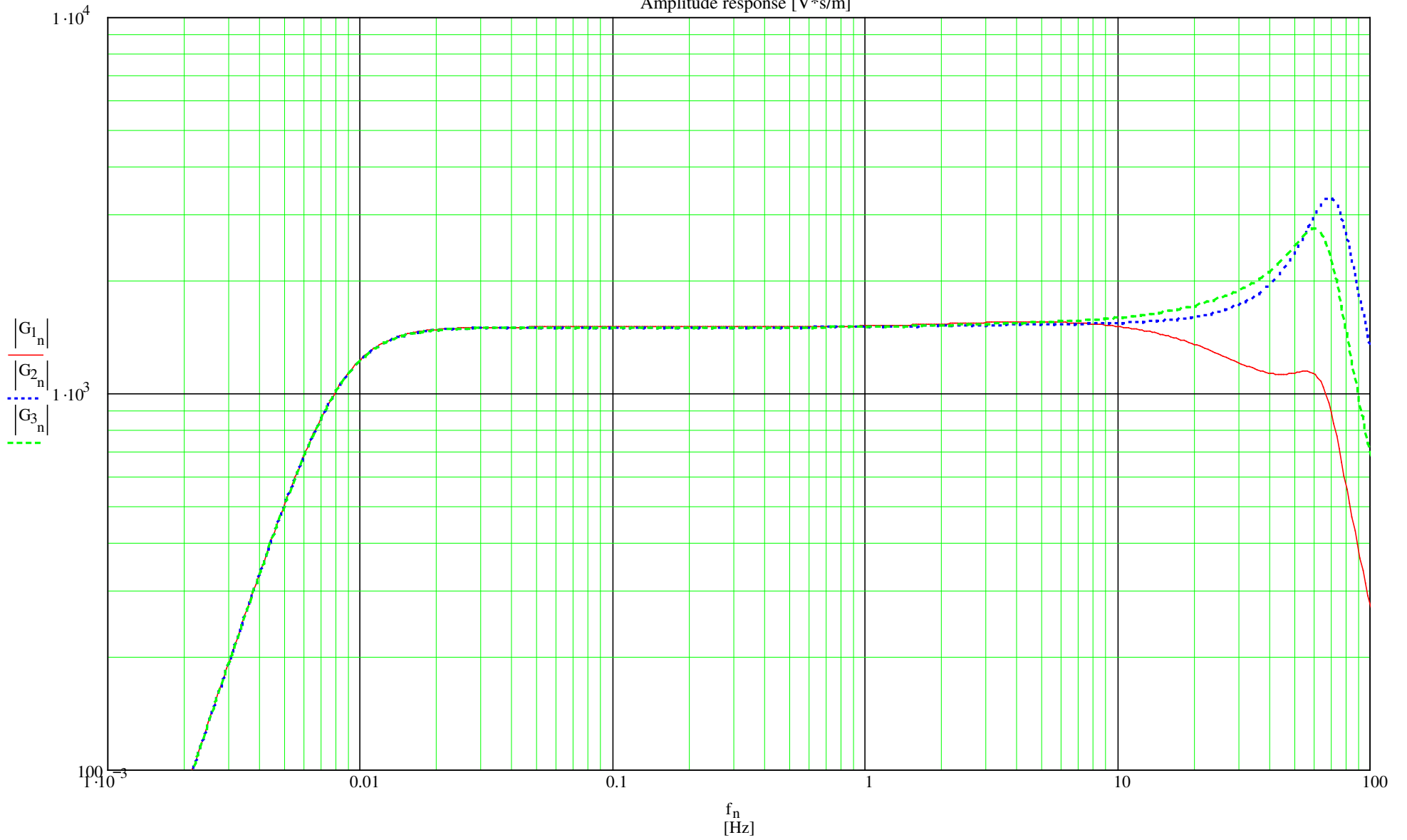


3rd generation STS-2: Phase



Stack of all generations STS-2: Amplitude

Amplitude response [V*s/m]



Stack of all generations STS-2: Phase

