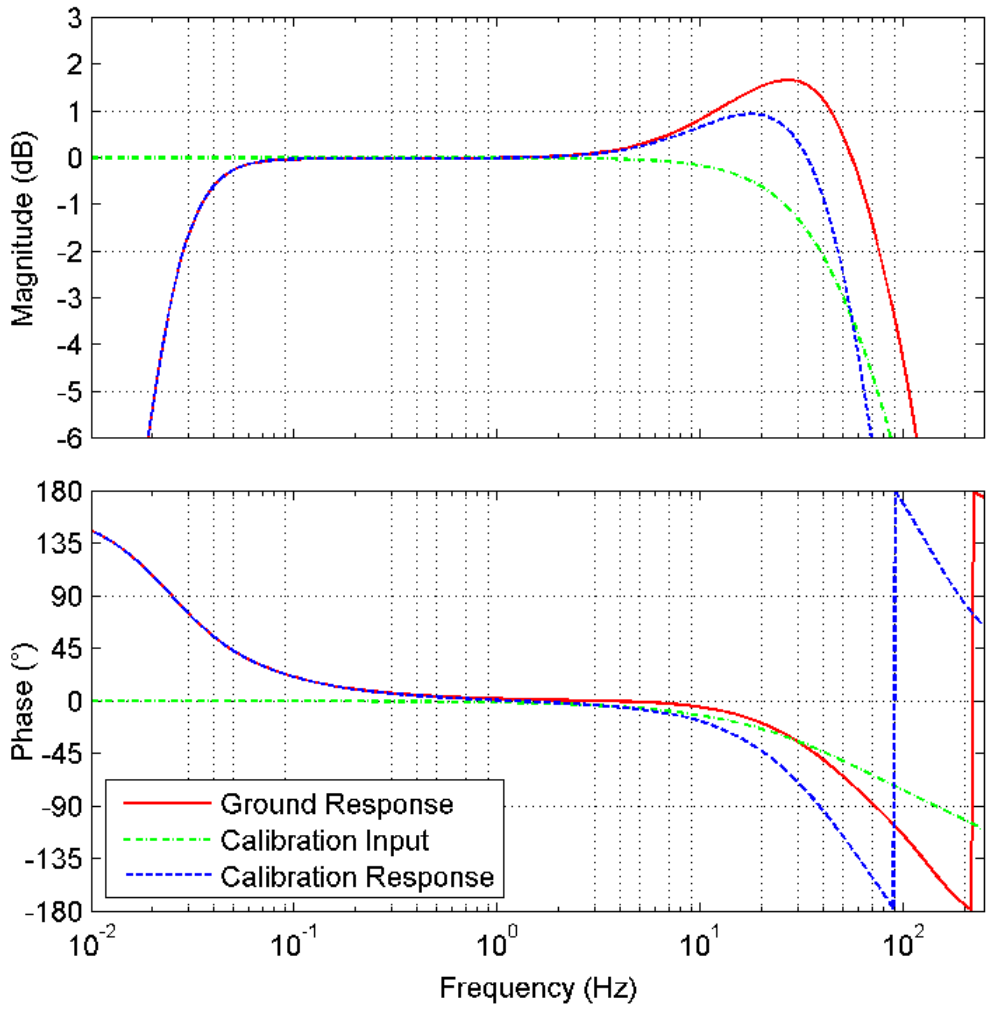
Trillium 40 Transfer Function

The nominal ground motion frequency response of the Trillium 40 is shown in Figure 1-1 as a solid red line. The calibration input circuit response is shown in Figure 1-1 as a green dash-dotted line and behaves effectively as a simple low pass circuit in series with the ground motion response. Thus, during calibration, the sensor calibration response is the combination of these two, shown in Figure 1-1 as a blue dashed line.

Figure 1-1 Bode plot of ground motion, calibration input, and combined calibration responses



The ground motion response nominal parameters are given in Table 1-1. The ground motion response has –3 dB corners at 40.2 s and 85.5 Hz.

Table 1-1 Ground motion response nominal parameters

Symbol	Parameter	Nominal Values	Units
z_n	Zeros	0 0 –68.8 –323 –2530	rad/s
p_n	Poles	–0.1103 ±0.1110i –86.3 –241 ±178i –535 ±719i	rad/s
k	Normalization factor	1.104 x 10^5	$(rad/s)^2$
f_0	Normalization frequency	1	Hz
S	Ground motion sensitivity at f_0	1553	V · s/m

The sensor sensitivity S_{sensor}, poles p_n, and zeros z_n define the transfer function according to the following equation:

$$F(s) = S \cdot k \cdot \frac{\prod_n (s - z_n)}{\prod_n (s - p_n)} \left[\frac{V \cdot s}{m} \right] \qquad \text{(EQ 1)}$$

Where the normalization factor, k, is defined by

$$k = \frac{1}{\left| \frac{\prod_n (i2\pi f_0 - z_n)}{\prod_n (i2\pi f_0 - p_n)} \right|} \qquad \text{(EQ 2)}$$

and is given for informational purposes only.

The calibration input response nominal parameters are given in Table 1-2.

Table 1-2 Calibration Input Response Nominal Parameters

Symbol	Parameter	Nominal Values	Units
z_n	Zeros		rad/s
p_n	Poles	–323 –2530	rad/s
k	Normalization factor	8.172×10^5	$(rad/s)^2$
f_0	Normalization frequency	1	Hz
S	Calibration input sensitivity at f_0	0.00976	$m/(s^2 \cdot V)$

The calibration input poles effectively cancel the corresponding zeros in the ground motion response during calibration. Thus, the nominal parameters of the combined calibration response are as shown in Table 1-3.

Table 1-3 Combined Calibration Response Nominal Parameters

Symbol	Parameter	Nominal Values	Units
z_n	Zeros	0 0 –68.8	rad/s
p_n	Poles	–0.1103 ±0.1110i –86.3 –241 ±178i –535 ±719i	rad/s
k	Normalization factor	9.025×10^{10}	$(rad/s)^4$
f_0	Normalization frequency	1	Hz
S	Combined calibration sensitivity at f_0	15.15	rad/s

When a measured electrical calibration result is to be used to convert the sensor output signals to ground motion, the result must be divided by the nominal calibration input. In practice, this means adding the nominal poles from Table 1-2 to the list of measured zeros. Note that the units of the combined calibration response are rad/s because the calibration input produces an equivalent acceleration, while the sensor passband is flat to velocity. Therefore, to determine the expected gain for a sinusoidal calibration, you must divide the sensitivity listed in Table 1-3 by 2 π *f*, where *f* is the frequency of the sinusoid.