

## **CASCADIA-ABALONES Generalized Response and Calibration Factor**

These calculations are for the generalized case and assume the signal is in the sensor frequency range giving a flat response. Frequency response ranges are indicated.

### **SENSOR RESPONSE INFO:**

For the DPG sensitivity:

Using measurements from strain gauge full scale outputs, the average is about 57 mv/7e3 PA. According to Cox *et al* there is a mechanical attenuation factor due to the compressibility of the oil and the compliance of the chamber. They estimate this as 0.86. Willoughby *et al* say they measured the response and deduced this factor as 0.924. I suggest we use 0.9 until we can determine a better value. Thus the STAGE 1 gain should be  $5.7e-2 * 0.9 / 7e3$  or:

**S(DPG) = 7.3  $\mu$ V/Pa**

*flat response: 0.002 Hz (500 sec) to ~30+ Hz*

Frequency response information:

Parameter	Nominal Value	Units
Pole*	-0.012568	Rad/s
Zero	0	Rad/s
Normalization	1	
Normalization Frequency	0.3	Hz

\* Single Pole @ (1/-79.57).

For the Trillium-Compact-OBS seismometer sensitivity:

The manufacturer quotes 750 V\*s/m over +/-20V for a full differential signal, thus:

**S(TC-OBS) = 750 V/m/s**

*flat response: 0.00833 Hz (120 sec) to 100 Hz*

Trillium Compact OBS Seismometer Frequency response information:

(From Trillium Compact OBS User Guide - page 50)

**Table 8-1** Ground motion response nominal parameters

Symbol	Parameter	Nominal Values	Units
$z_n$	Zeros	0 0 -434.1	rad/s
$p_n$	Poles	-0.03691 ±0.03712i -371.2 -373.9 ±475.5i -588.4 ±1508i	rad/s
$k$	Normalization factor	$8.184 \times 10^{11}$	(rad/s) <sup>4</sup>
$f_0$	Normalization frequency	1	Hz
$S$	Ground motion sensitivity at $f_0$	749.1	V s/m

ELECTRONICS RESPONSE INFO:

The sensitivity of the A/D is as follows:

With reference filter voltage of  $V_{\text{filt}} = 100$  ohm the voltage range is  $\pm 2.47$  V,  
max counts over this range are  $-V_{\text{ref}} = -6,100,300$  to  $+V_{\text{ref}} = 6,102,081$ .

This gives  $S(a/d) = 4.94 / 12,202,381 = 0.405 \times 10^{-6}$  V/count = 0.405 microV/count, or:

**$S(a/d) = 0.405 \mu\text{V/count}$**

*Note: A/D reaches full 24-bit range (i.e. -8388608 to 8388607) @ overvoltage of  $\pm 3.3$  V. However, the response in this overvoltage range is roughly nonlinear.*

*Note2: If  $V_{\text{filt}} = 10$  ohm the voltage range is  $\pm 2.50$  V  $\rightarrow S(a/d) = 0.410$  microV/count.*

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TOTAL SYSTEM RESPONSE INFO:

Pre-amp gain settings for sensor/channel on all ABALONES OBS deployments are:

**gain(DPG) = 64**

**gain(TC-OBS) = 1**

Total system response then becomes:  $S(\text{total}) = S(a/d)/[S(\text{sensor}) * \text{gain}]$

ABALONES Generalized System Response:

<b>S(DPG)</b>	<b>= 55.48 mPa/count</b>	<b>--&gt; <math>55.48 \times 10^{-3}</math> Pa/count</b>
<b>S(TC-OBS)</b>	<b>= 0.540 (nm/s)/count</b>	<b>--&gt; <math>5.400 \times 10^{-10}</math> (m/s)/count</b>

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**DPG pressure response = 0.867 mPa/count (500 sec to ~30+ Hz)**  
**Trillium-Comp-OBS Velocity response = 0.540 (nm/s)/count (120 sec to 100 Hz)**