Trehu-Chile 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 High-Tech Hydrophone sensitivity:
For the custom High-Tech Hydrophone (HTI-90-U) the manufacturer calibration files give a sensitivity of -182.7 dB re 1V/µPa. This hydrophone loses ~2 dB in sensitivity per ~6000m in depth (10,000 psi) so for typical ocean depth around 3km we correct ~1 dB and use -183.7 dB re 1V/µPa. Using amplitude spectra throughout (e.g. X[db] =20*log10[X/Xref]), this gives S(hyd-HTI) = 10**(-183.7/20) * 1V/µPa = .653 mV/Pa (@ 3000m water depth). Thus:

S(hyd-HTI) = 0.653 mV/Pa -or- (6.53e-4 V/Pa)
flat response: 0.05 Hz to 7.5 kHz (@ 3000m depth)

Frequency response information:

From Brian Spychalski at High Tech Inc. (personal communication: June 03, 2014):
1: HPF at input of preamp created by ceramic element 12.8nF (nom.) and 300 meg ohm resistor (0.04Hz)
2: There is another HPF at opamp set at 0.02Hz.
3: LPF at opamp is set at 7.5KHz.

Parameter	Nominal Value	Units
Zeros (2)	0 0	Rad/s
Poles (3)	-24.127431 -0.1256637 -47124	Rad/s
Normalization	47124	
Normalization Frequency	500	Hz

For the L28LB tri-axial seismometer sensitivity:
Transduction constant --> 1.57 * sqrt(R-coil) V/m/s with R-coil = 630 ohm nominally this gives 39.53 V/m/s. SIO uses 70% coil current damping, (R-shunt-ss = (7860+51) ohm single-sided, divide by 2 to effective R-shunt damping for differential signal), thus R-shunt-diff = 3956 ohm, which gives:

S(L28) = 34.10 V/m/s *flat response: ~4.5 Hz and above*

Frequency response information (for a damped oscillator):
Two zeros at 0, two poles at $\omega_0\left(\delta \pm i\sqrt{1-\delta^2}\right)$ where $\delta = 0.701$ (damping value).

Parameter	Nominal Value	Units
Zeros (2)	0 0	Rad/s
Poles (2)	19.820 +/- i*20.164	Rad/s
Normalization	-1	
Normalization Frequency	4.5	Hz

ELECTRONICS RESPONSE INFO:

The sensitivity of the A/D is as follows:
With reference filter voltage of V-filt = 100 ohm the voltage range is +/- 2.47 V,
max counts over this range are –Vref = –6,100,300 to +Vref = 6,102,081.
This gives S(a/d) = 4.94 / 12,202,381 = 0.405 x 10**-6 V/count = 0.405 microV/count, or:

S(a/d) = 0.405 µV/count -or- (4.05e-7 V/count)

Note: A/D reaches full 24-bit range (i.e. -8388608 to 8388607) @ overvoltage of +/- 3.3 V. However, the response in this overvoltage range is roughly nonlinear.
Note2: If V-filt = 10 ohm the voltage range is +/- 2.50 V → S(a/d) = 0.410 microV/count.

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PRE-AMP GAIN INFO:
Pre-amp gain settings for sensor/channel on OBS deployments were:
gain(hyd-HTI) = 16
gain(L28) = 64

TOTAL SYSTEM RESPONSE INFO:
Total system response then becomes: S(total) = S(a/d)/[S(sensor)*gain]

AB & LC4x4 Generalized Total System Response:

AB-SP (4-comp) units:

Hydro-HTI pressure response	**= 38.76 µPa/count**	*(~0.05 Hz to 7.5 kHz)*
	= 3.876e-5 Pa/count	
L28 Velocity response	**= 0.186 (nm/s)/count**	*(~4.5 Hz and above)*
	= 1.86e-10 (m/s)/count	