

Tolstoy-EPR LC4x4 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/ μ Pa. 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/ μ Pa. Using amplitude spectra throughout (e.g. $X[\text{db}] = 20 \cdot \log_{10}[X/X_{\text{ref}}]$), this gives $S(\text{hyd-HTI}) = 10^{**(-183.7/20)} \cdot 1\text{V}/\mu\text{Pa} = .653 \text{ mV}/\text{Pa}$ (@ 3000m water depth). Thus:

$S(\text{hyd-HTI}) = 0.653 \text{ mV}/\text{Pa}$ -or- $(6.53\text{e-}4 \text{ V}/\text{Pa})$

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 --> $1.57 * \sqrt{R\text{-coil}}$ 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

For the L22D vertical seismometer sensitivity:

Transduction constant --> $1.61 * \sqrt{R\text{-coil}}$ V/m/s with R-coil = 510 ohm nominally this gives 36.36 V/m/s. SIO uses 60% 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(L22) = 32.21 V/m/s *flat response: ~2.0 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 $\delta = 0.599$ (damping value).

Parameter	Nominal Value	Units
Zeros (2)	0 0	Rad/s
Poles (2)	7.527 +/- i*10.063	Rad/s
Normalization	-1	
Normalization Frequency	2.0	Hz

