Avalon Sciences Ltd

ASR-227 – Quad Sensor Pack

GEO

LEADERS IN BOREHOLE SEISMIC TECHNOLOGY

Main Features

- Ideal for **VSP** & **Microseismic** surveys.
- Four geophones per axis.
- Fits standard and high pressure ASR's.
- Greater signal to noise ratio.
- Modular for quick and easy customisation.

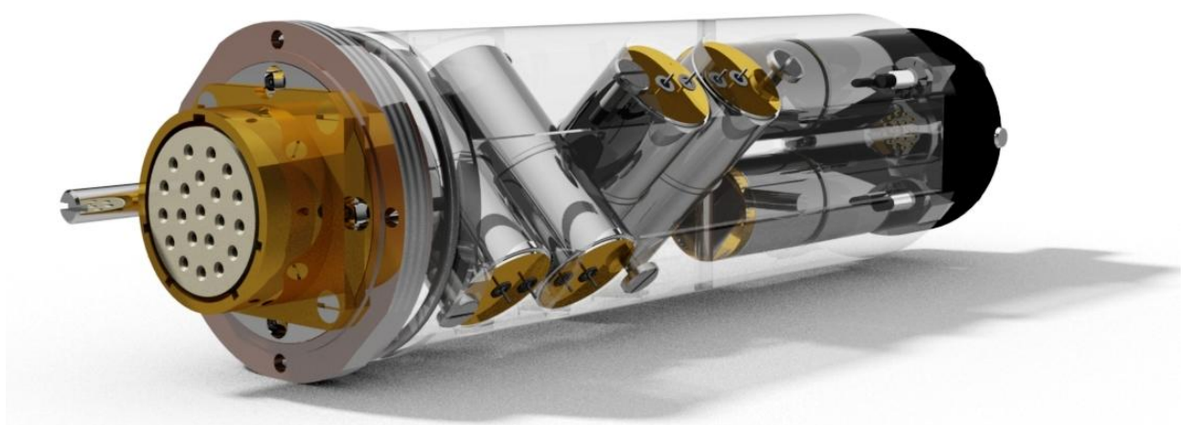
Functionality

- Ideal for use with high gain 54dB digitisers.
- Overall sensitivity 86,350 V/m/s at 48°F (20°C).
- Ideal for use with standard, HP and EHP Geochain systems.
- Operating temperature up to 400°F (204°C).

Omni 2400Ω Geophone	
Optimum Orientation	Horizontal
Operational Range	0°to 180°(Omni)
Natural Frequency (Fn)	
Optimum Orientation	15 Hz +/- 5%
Operational Range	15 Hz - 5% to +15%
Coil Excursion P-P	
Optimum Orientation	>0.120 in, >.306 cm
Operational Range	>0.022 in, >.051 cm
Spurious Frequency	250 Hz
Resistance	2400Ω +/-5% per transducer
Sensitivity	
At Optimum Orientation	86350 V/m/s +/- 5%
At Operational Range	86350 V/m/s -15% to +5% at 20℃
Open Circuit Damping	
Optimum orientation	0.57 +/-15%
Operational Range	0.57 -20% to +10%
Moving Coil Mass	7.6 gr +/- 5%
Distortion	
Optimum Orientation	<0.20%
Operational Range	<0.70%
Storage Temperature	-40°F to 212 °F (-40 to +100°C)
Operating Temperature	-40°F to 392+°F (-40 to +200+°C)
Geophone Dimensions:	
Weight	49 gr
Diameter	2.22 cm
Height	2.70 cm (3.00 cm Including Terminals)

Quad vs Dual Overall Sensitivity

	Sensor Pack	Electronics	Damping Resistors	Downhole Gain	Sensitivity undamped V/m/s	Sensitivity damped V/m/s	Overall Sensitivity V/m/s	Dampin g 20°C
Dual	AS223/232	AS271	47KΩ	54dB	104	94.4	47200	0.641
Quad	AS227	AS271	47KΩ	54dB	208	172.7	86350	0.7



COMPATABLE WITH

GEO or EHP

Geochain Digital and Analogue

Geochain Digital Geochain EHP Digital

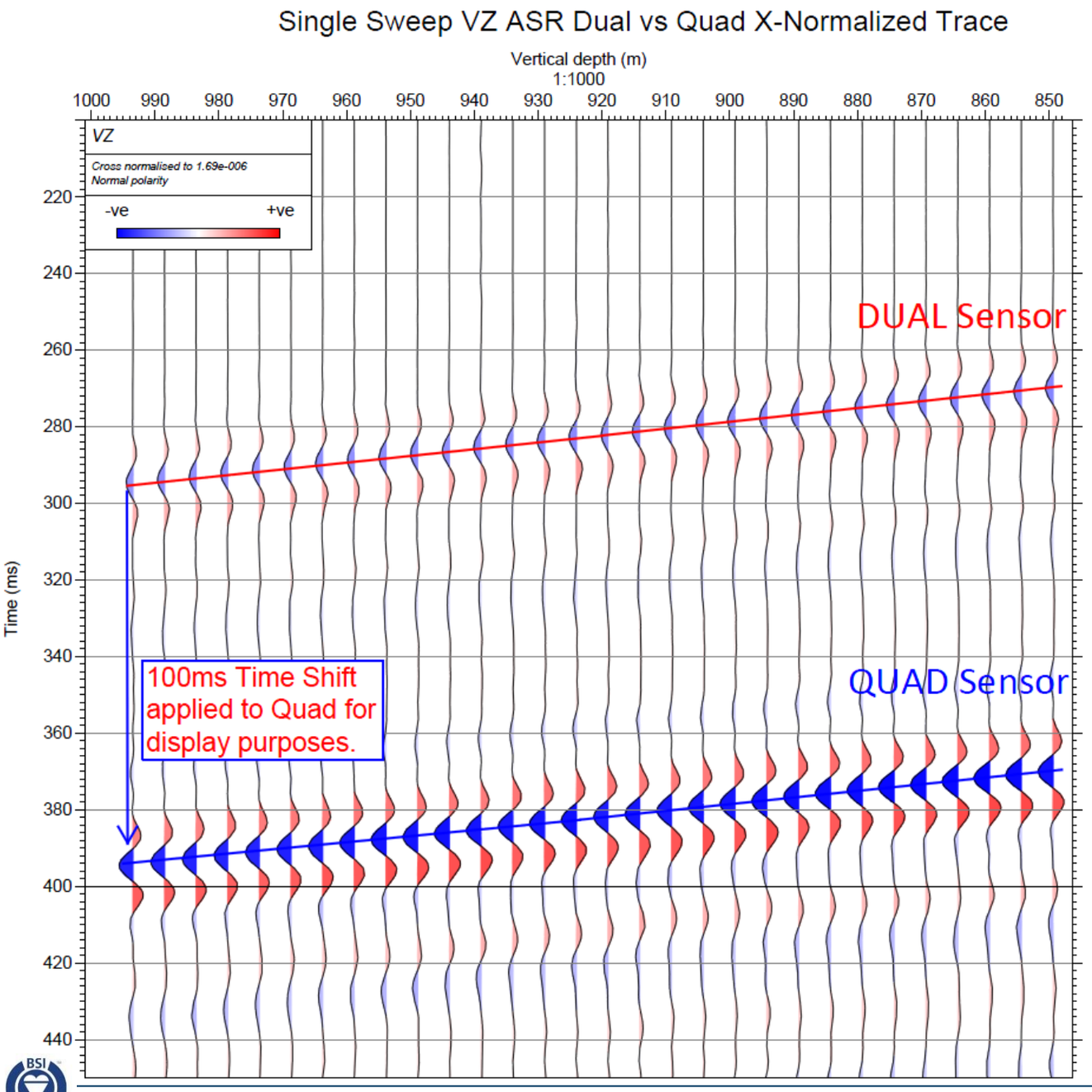
ISO 9001 FM 555054

sales@avalonsciences.com

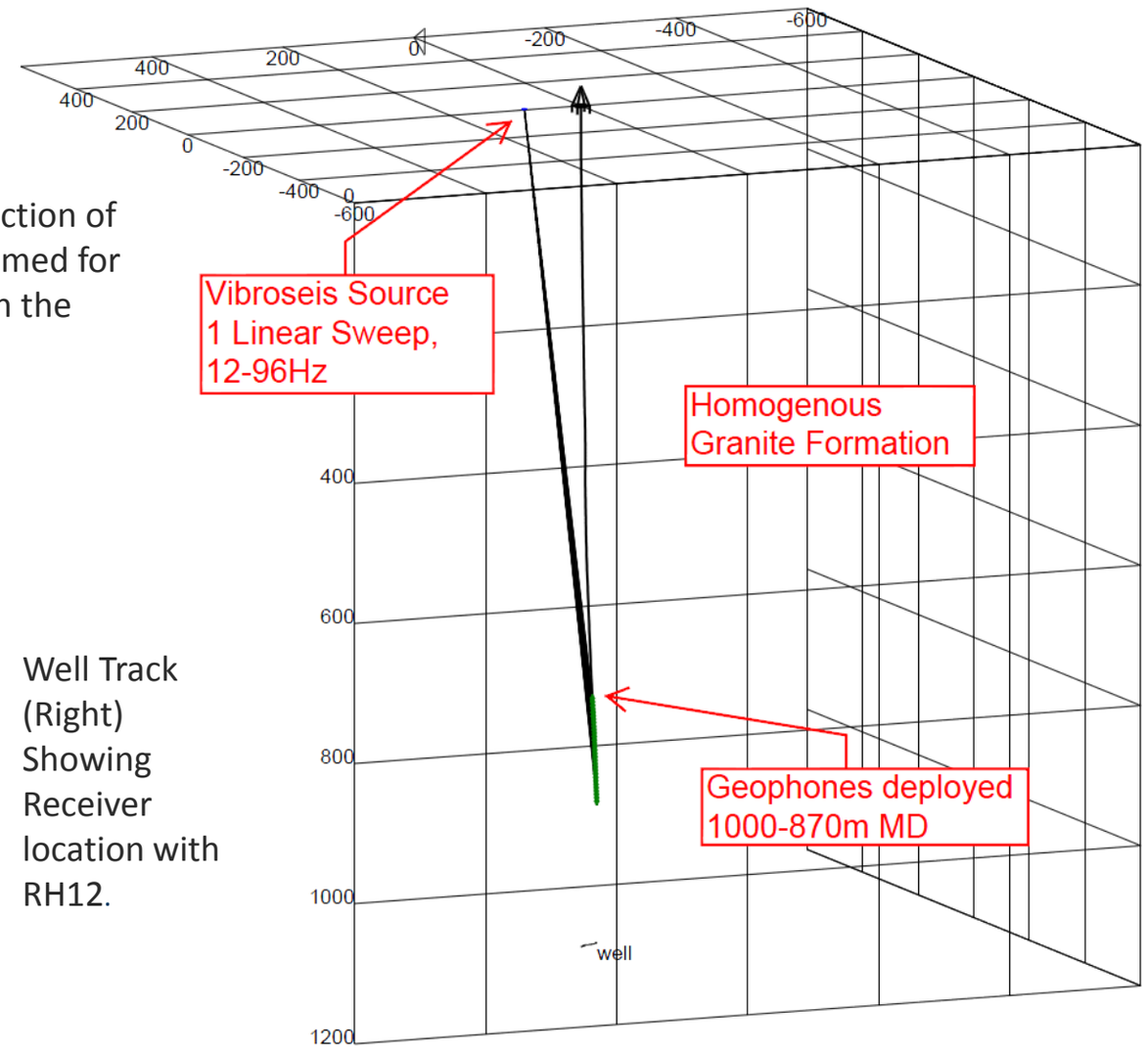
www.avalonsciences.com/downhole-equipment/geochain

Rig Source Shallow VSP Example Traces using AS227 QUAD

- A Quad and a Dual Geochain receiver (ASR) were deployed within the shallow section of ASL Cornwall Rosemanowes RH12 well. Here, single vibrator sweeps were performed for both sensor types. Comparisons of the correlated traces are shown below and on the following slide.



Well Track (Right) Showing Receiver location with RH12.



Omni 2400Ω QUAD Geophone Test	
Well	RH12 Rosemanowes, ASL Cornwall, UK
Date of Test	12th August 2015
Well Section	Vertical Component 850-1000m MD of RH12 9 5/8" Steel Casing
RECEIVER	Geochain ASR
Sensor Type	QUAD AS227 and DUAL AS232 Omni 2400 3C Sensor
Electronics Module	AS273 54dB Digitiser
SOURCE	MERTZ M22 Vibrator
Offset from Wellhead	SCX 84m SCY 6m
Sweep Description	Single Linear Sweep – 12-96Hz
Temperature	Ambient ~15C
Local Formation	Carnmenellis Granite
Sample Interval	1000us

- Text

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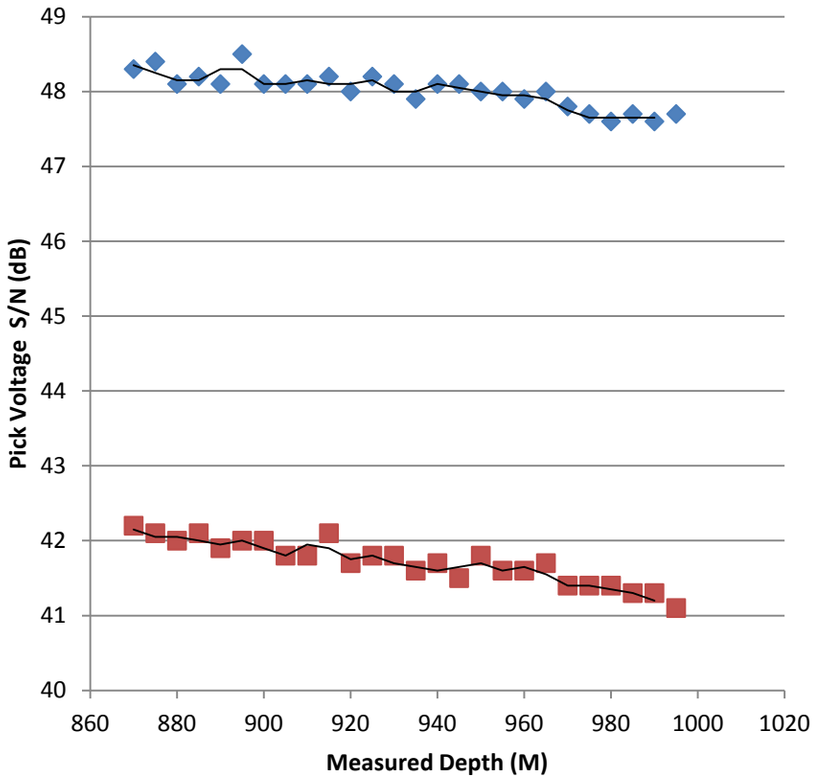
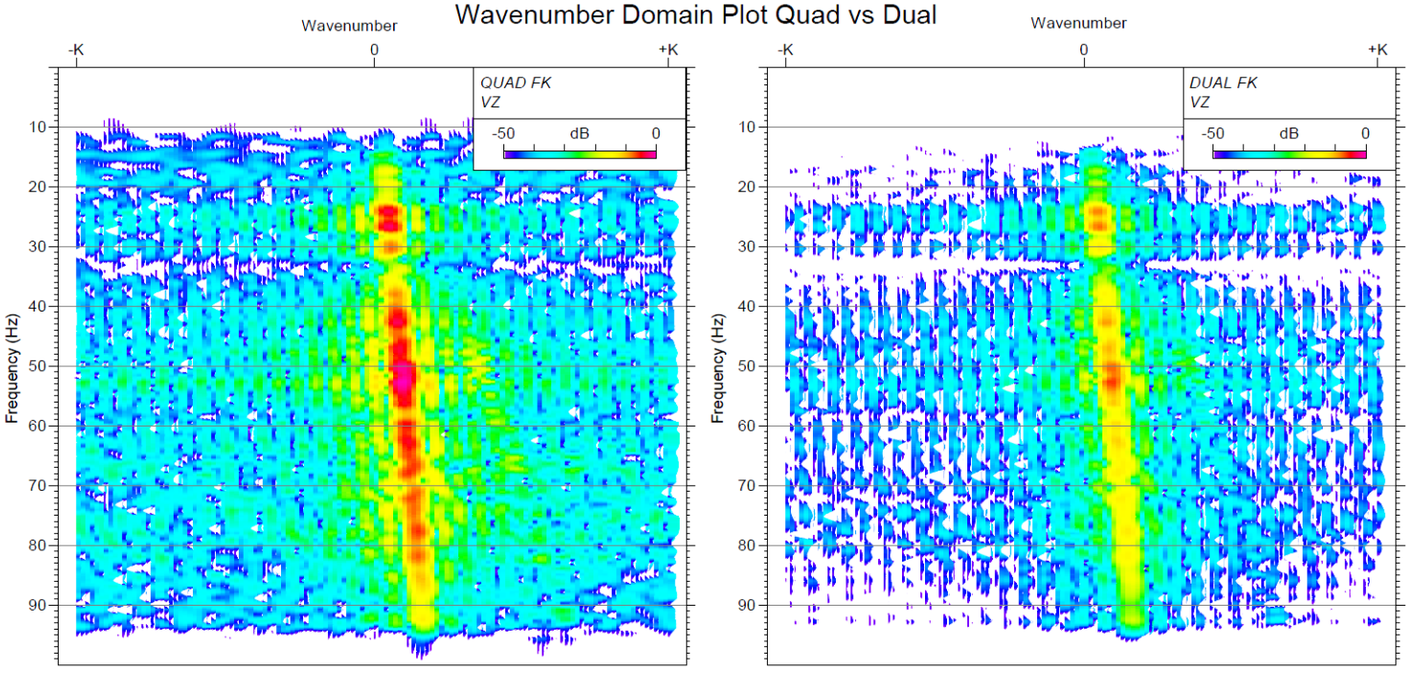


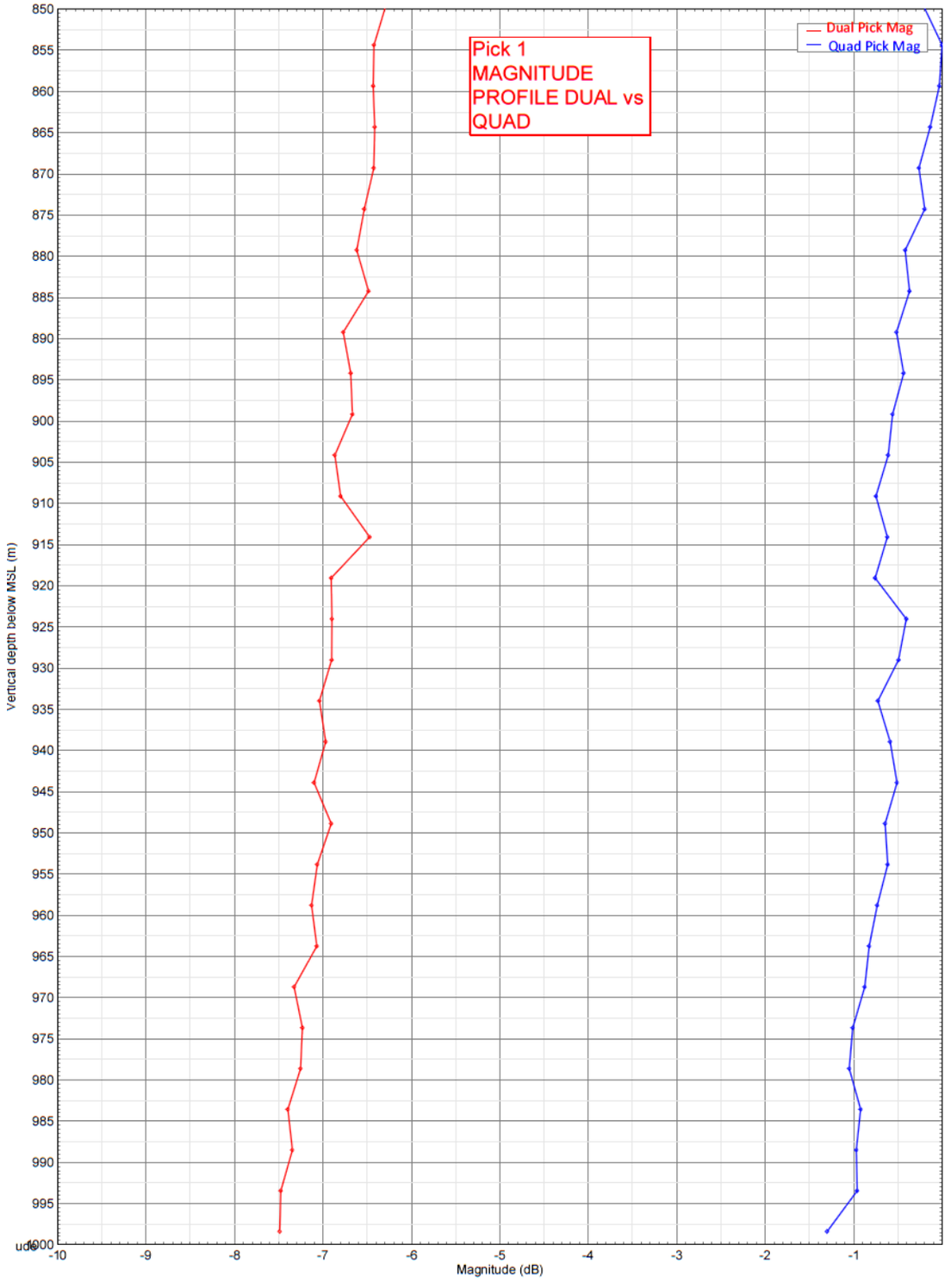
(Left) Signal to Noise Dual vs Quad Comparison of P-down First Arrival

- QUAD
- DUAL
- 2 per. Mov. Avg. (QUAD)
- 2 per. Mov. Avg. (DUAL)

(Below) F-K Comparison of P-down First Arrival



(Below) Relative Pick Magnitudes of Dual and Quad First Arrivals



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Spectral Comparison

- The time domain shows significant increase in correlated pick amplitude with the frequency spectra highlighting an average 6dB improvement across the signal bandwidth.

Impact of thermal noise (Johnson-Nyquest noise) on sensitivity - (operation at higher well temperatures).

- Operational sensitivities of geophone transducers will be effected by the local well temperature. An increase in temperature will lead to an increase in coil resistance and an increase in thermal noise.
- It is here that by having x4 geophone elements wired in series will give an even better relative improvement in signal to noise ratio compared to only having mono or dual elements per component.
- By having multiple phones in series the signal will increase whilst thermal noise (En) will only approximately increase by the square root of the resistance (R).

$$En = \sqrt{4kTBR}$$

K = Boltzmann's Constant
T = Temp (Kelvin)
B = Bandwidth
R = Coil Resistance