BHEMA - A Low-Noise Autonomous 3-Axis Borehole EM Probe

Novaminex

BHEMA is an autonomous 3-axis borehole EM probe offering a noise performance up to 50x better than a 3-axis fluxgate sensor. It provides 36KHz sampling of the B-field over a bandwidth of 0.2Hz-25kHz.

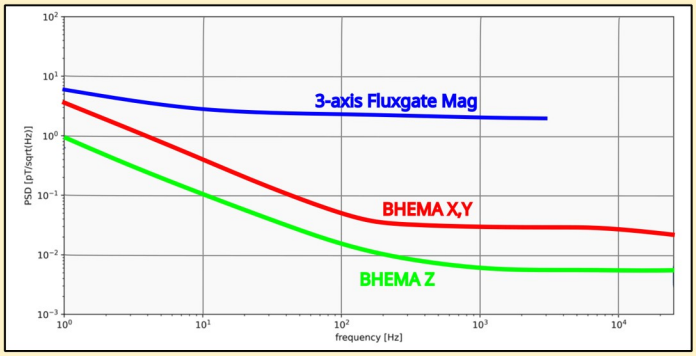
BHEMA operates without a data link to surface providing logistical advantages and cost savings. The probe is deployed on a Kevlar cable using a lightweight winch typically used for dummy probing. Other deployment options include wireline or at the end of a drill string, allowing for deployment in "up-holes" from underground drill stations or through an NQ bit. As there is no receiver at surface data acquisition is simplified to lowering the probe and dwelling at a set of pre-determined depths. The probe can be completely untethered and carried on surface to conduct surface EM surveys of high quality. There are no settings to adjust, only raw data that can be turned into fully located, stacked and deconvolved data in post-processing.

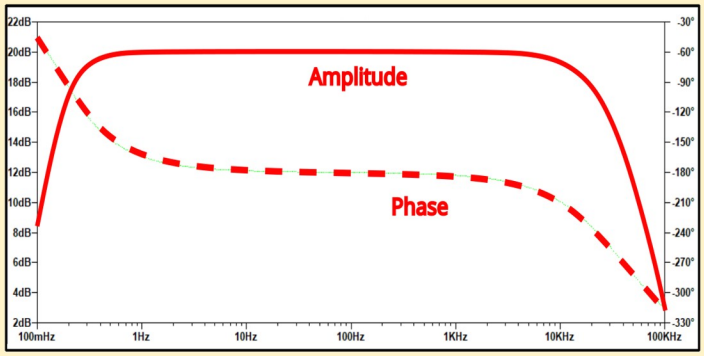
The probe establishes an absolute GPS timing reference at the collar providing for accurate timing of data and allowing for synchronization with multiple transmitters and/or additional probes. EM data are collected as continuous time series along with data from an inertial measurement unit (IMU) measuring 3-axis mag, accelerometer and gyro. The pre-amplifier gain is adjusted automatically to ensure the highest data quality. The data are downloaded post-survey for processing to standard time-domain or frequency-domain controlled-source formats or as transfer functions of the geomagnetic field. A separate receiver continuously logs the transmitter current during the survey making it possible to synchronize the probe data and deconvolve it to and idealized system waveform.

BHEMA Specifications

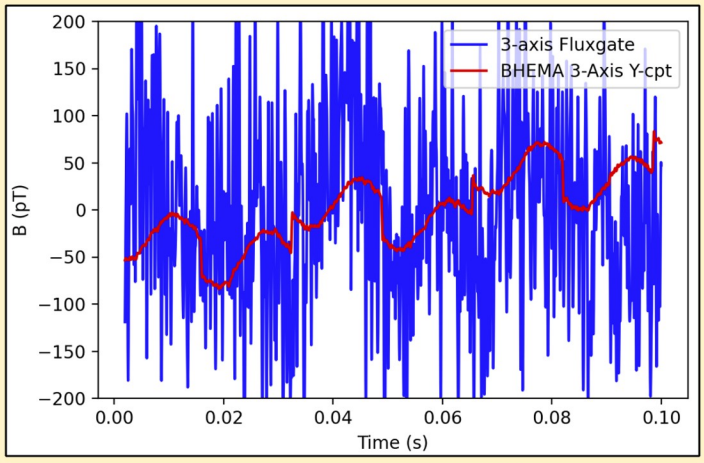
Sampling Rate: EM Data at 36K samples per second at 24-bits
Sampling Rate: IMU Data at 50Hz
Gain: 1,2,4,8,16,32,64,128 automatic control
IMU: precision IMU with 1 degree-per-hour gyro drift
Timing: GPS-based timing through GPS-disciplined oscillator
Diameter: 45mm
Length: 2 sections of 2m, 4m assembled
Max Pressure: 4500psi = 3200m depth
Battery Life: 12hr

Sensor Technology: Feedback induction coil
Sensor Passband: B-Field between 0.2Hz and 25kHz
Sensor Noise Density
X,Y noise: 6pT/sqrt(Hz) @ 1Hz, 500fT/sqrt(Hz) @ 10Hz, 50fT/sqrt(Hz) @ 100Hz, 20fT/sqrt(Hz) @ 1kHz
Z noise: 1pT/sqrt(Hz) @ 1Hz, 200fT/sqrt(Hz) @ 10Hz, 20fT/sqrt(Hz) @ 100Hz, 5fT/sqrt(Hz) @ 1kHz





Top Left: Spectral density of the BHEMA sensor noise compared to 3-axis fluxgate magnetometer used in other BHEM probes.
Top Right: BHEMA sensor response as a function of frequency. It behaves as a magnetometer between 0.2Hz and 25kHz.
Lower Right: Field test comparison BHEMA vs Fluxgate. Signals from transmitter and powerlines clearly visible in the BHEMA data are overwhelmed by the noise of the fluxgate sensor.



www.novaminex.com
ben.polzer@novaminex.com; 1-705-507-0786

Novaminex