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A High-Resolution, Ultra-Low-Power 32-bit Digitizer for Autonomous Seismic Monitoring and Environmental Studies

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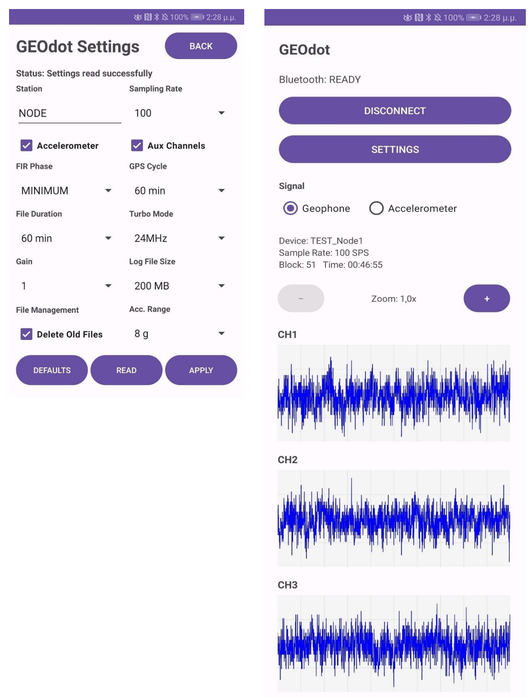
Abstract

This work introduces a novel, state-of-the-art standalone digitizer developed for seismic monitoring applications and environmental studies. The system uses three 32-bit analog-to-digital converters, achieving a dynamic range of up to 143 dB and supporting selectable sampling rates from 50 to 800 samples per second. The device is based on a high-performance, low-power RISC processor running the proprietary GEObit operating system. Seismic data are recorded in GBT file format on a removable 64Gb microSD card, fully compatible with both Linux and Windows platforms. Data retrieval is straightforward through direct file transfer from the microSD card, and wireless or wired access via Bluetooth or USB is available if the instrument is deployed underground. In addition to the three high-resolution seismic channels, the digitizer includes three auxiliary 16-bit channels for seismometer state-of-health parameters monitoring, such as mass position, or any environmental parameters monitoring. It supports locking, unlocking, and centering of broadband seismometers, supporting both active-high and active-low logic to ensure compatibility with the commercial broadband and wideband seismometers. The analog front end offers multiple gain settings. The device integrates a three-axis MEMS accelerometer with a 97dB dynamic range, allowing simultaneous acquisition of seismic and acceleration data. Accurate timing is provided by a 32-channel GNSS receiver in combination with a TCVCXO clock featuring 0.2ppm frequency stability. The digitizer is optimized for ultra-low power operation 0.2W, which allows continuous operation for up to six months when powered by a 170Ah zinc–air battery. User interaction is supported through Bluetooth and USB interfaces, with dedicated iOS and Android applications offering real-time data visualization, instrument configuration, SOH monitoring, and seismometer control. The device measures 110mm in diameter, 30mm in height, and weighs only 150g, enclosed in an IP68-rated hard-anodized aluminum housing, well suited for harsh environmental conditions and underground installations

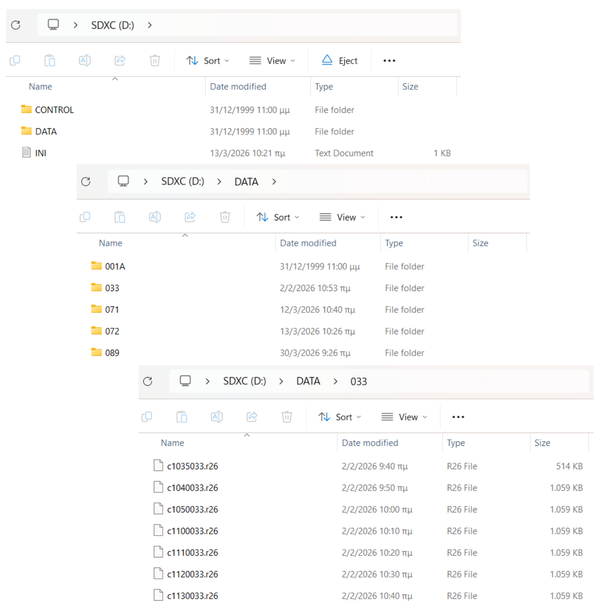
Key Benefits

- Power consumption 0,2W.
- 32-bit ADC converters.
- Wide analog input range (40Vpp to 0,1Vpp).
- 8 selectable gain steps (X1 to X128).
- Sampling rate 50 – 800 sps.
- Compatible to any commercial seismometer and geophone.
- Build-in seismometer control (lock-unlock-centering).
- Records mass position voltage.
- Stores data files on a removable MicroSD memory.
- Fast data retrieval by microSD replacement, USB or Bluetooth.
- Connects via Bluetooth to iOS or Android devices.
- Integrates MEMs accelerometer.
- Small size, aluminum casing.

The GEOdotD seismic digitizer



Mobile App



microSD data files