



GP-Node with internal antenna.

The unit is set into the ground with buried electrodes for resistivity monitoring

The *GP-Node* is a wireless precision data acquisition system that supports long-term *in-situ* geophysical measurements for environmental and structural health monitoring applications. Geophysical measurements are able to provide information about the subsurface and infrastructure at a distance from the sensors. This contrasts with conventional point sensors that are only sensitive to the conditions in the immediate vicinity of the sensor. The system also supports a wide variety of non-geophysical sensors. *In-situ* wireless sensing is cost-effective technology that provides detailed high-resolution information.

The *GP-Node* can be configured for different sensor packages, different power systems, and different communications scenarios. The basic configuration starts with spontaneous potential and seismic measurements. Commonly added options are resistivity measurements and integrated photovoltaic battery charging systems. Wireless networks provide a very large number of simultaneous receivers, and flexible 3-D array topologies. Wireless *GP-Node* networks and their data are accessible anywhere the internet is available.

Galvanic Measurements

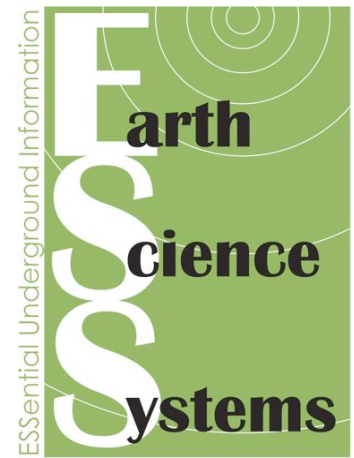
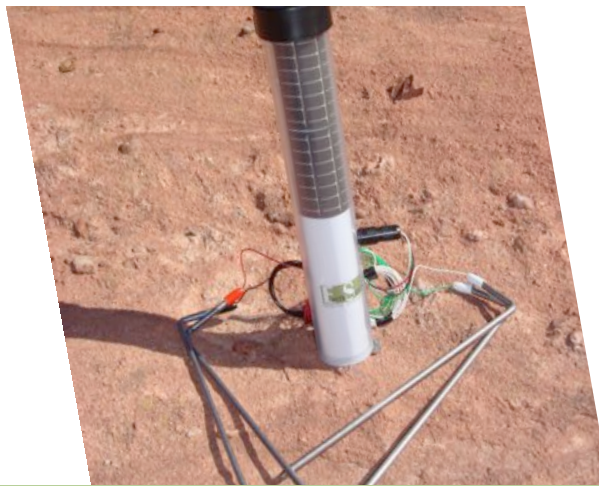
Resistivity, induced polarization, and spontaneous potential are galvanic methods that require electrode in contact with the ground or structure. In typical installations, the electrodes are buried. For

earthen dams and levees, SP measurements respond to subsurface fluid flow, which is a typical precursor to embankment failure. Resistivity measurements are sensitive to subsurface fluids, and provide useful three-dimensional indicators of lithology, moisture content, and salinity. The *GP-Node* provides the measurements needed to create 2-D or 3-D resistivity images at depths of up to 100 meters. Induced polarization (IP) measurements are sensitive to corrosion and changing chemical composition of subsurface fluids. Each node supports current injection on any combination of 8 local electrodes, and potential measurements on numerous remote electrodes on other nodes.

Seismic

Seismic measurements are sensitive to subsurface elastic soil and rock properties. The *GP-Node* measures ambient vibrational energy to support a variety of seismic survey methods including spectral analysis of surface waves (SASW), refraction micro tremor (REMI), and seismic reflection. These techniques measure subsurface seismic velocities using different ray paths. Geotechnical properties and parameters such as Atterberg limits, water saturation, rippability, and soil classification can be inferred continuously with depth from seismic measurements. The accelerometers used in the *GP-Node* also measure the attitude of the sensor, which detects movement, slumping, and sliding. The *GP-Node* measures subsurface elastic properties to depths of up to 50 meters.

**GP-Node with
integrated photo-
voltaic battery
charging system and
external electrodes**



Specifications

Inputs

- 8 channels
- Input gain: 1-128
- Input impedance: 10^9 ohms
- ADC resolution: 24 bits, 115 dB, 128 kSPS

Sensor Excitation

- Programmable with 16 bit 1 MSPS DAC
- Arbitrary waveform generation
- Current servo mode
- Output: up to 200V, 500 mA

Standard Geophysical Measurements

- Spontaneous (self) potential
- Resistivity
- Induced polarization
- Non-linear complex resistivity
- Three component seismometer
- Ambient temperature

Optional Geophysical Measurements

- Ground penetrating radar
- Time domain reflectometer
- EM induction
- Broadband tensor magnetometer

General Purpose External Measurements

- 4-20 mA sensors
- Bridge sensors
- Strain, moisture, pressure, pH, etc.

Radio Transceiver

- Frequency: 900 MHz ISM band
- Modulation: DSSS, O-QPSK, BPSK
- Data rate: 1 MBps
- Antenna: internal 3 dBi, optional external antenna

- Wireless time synchronization: 1 μ s
- RF output power: 250 mW
- RF receive sensitivity: -102 dBm
- Range: up to 2 miles

External Sensor Connector

- Hirose: HR30 or RM15TRD

Dimensions

- Diameter: 2.25 inches
- Length: 16.5"

CPU

- 256 K Flash
- Data storage: SD Card (up to 4 GB)
- Program storage: 32 kB
- Peripheral interface: RS232, RS422, RS485, MODBUS

Power

- Internal 3.2 V LiFiPO₄ batteries (12.8 V when configured for galvanic geophysical measurements)
- Optional integrated PV charger
- Current draw 5 μ A sleep
- 100 mA typical in operation
- Connector for external power supplies

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