

## GEM 3 Broadband Digital EM Sensor

### About the GEM-3

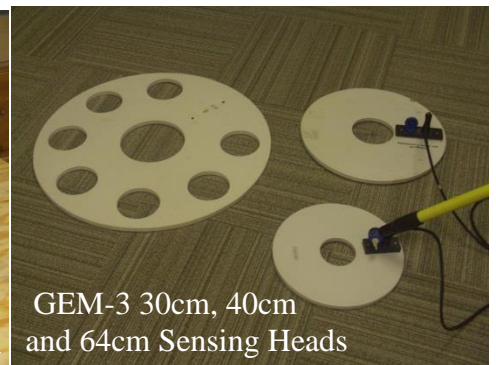
GEM-3 is a broadband digital electromagnetic sensor suitable for detecting buried metallic objects such as utilities. It is light, portable, and versatile. The basic unit weighs about 10 pounds (5kg). Since it is completely digital, the sensor has the potential to be programmed in many other operational modes. Through many field trials and surveys since it debuted in 1996, the GEM-3 has demonstrated some unique types and capabilities as summarized below:



GEM-3 Survey



30cm GEM-3  
on Hand-Held Wand



GEM-3 30cm, 40cm  
and 64cm Sensing Heads



## Metal Detection in Magnetic Geology

- The GEM-3 quadrature components are relatively immune to magnetic soils or rocks. A sum of all quadrature components, therefore, is an excellent detection indicator.

The GEM-3 sensor head contains three concentric coils. Two outer coils are used as a transmitter and the innermost one is used as a receiver coil. The two transmit coils create a central magnetic cavity that produces zero output to the inner receiver coil. For frequency-domain operation, the GEM-3 prompts for a set of desired transmitter frequencies. Built-in software converts this into a digital “bit-stream,” which is used to construct the desired transmitter waveform. This bit-stream represents the instruction on how to generate a complex waveform that contains all frequencies specified by the operator.

## Sensor Specifications

The basic GEM-3 Package consists of: a 30-cm diameter sensing head, handle boom, electronics console, display/data logger, and battery charger. Standard software includes WinGEM, Windows-based operating software. The GEM-3R, due to its size, must be mounted on a cart.

- Programmable Operation
  - Bandwidth - 30 Hz to 96 kHz
  - Frequency domain - Single, multiple, or stepping frequencies
  - Maximum sampling rate – 30Hz (25Hz in areas with 50Hz power)
- Hardware
  - Removable sensor head - Sealed fiberglass, 30cm in diameter - standard; Options, 40cm or 64cm in diameter
  - Electronics console (CPU) - 12cm x 17cm x 8cm rugged plastic box (2.5 kg)
  - Bluetooth wireless connection to PDA data logger

- Internal rechargeable battery - 13.2 VDC
- Coil configuration - Concentric
- Output
  - Inphase and quadrature in ppm stored in memory and SD card on data logger
  - The data are available in real-time thru either an RS-232 port or via wireless Bluetooth connection
  - Real-time digital display of data in various formats
- Software and Operation Manual
  - WinGEM – Windows-based upload and data download through a PC using ActiveSync or Windows Mobile Device Center
  - Software utilities for conversion of PPM to conductivity or susceptibility
- GEM-3 Hardware Options
  - 40cm or 64cm diameter sensing heads
  - GEM-3R 1m X 0.75m head mounted on a 2-wheel cart with GPS
  - GPS antenna mount assembly
- GEM-3 Software Options
  - Conversion of ppm data to conductivity and permeability
  - EMIS discrimination software

## **Simple Handheld Survey**

The GEM-3 can be handheld for the 40cm and 64cm diameter heads. The GEM-3R rectangular head (1m X 0.75m) must be mounted on a cart. The GEM-3 collects data at a constant interval in time. For a simple survey, the GEM-3 is self-sufficient for dead reckoning navigation.



Handheld 40-cm head

## Handheld Survey in Rough Terrain

The GEM-3 can be used in a way similar to “mag-and-flag” so that the operator can flag targets in real-time. This approach can be useful in rough and vegetated areas where a systematic, or “georeferenced,” survey is difficult. The GEM-3 sensing head is only 0.5-inch (1.3cm) thick and can be easily slipped under shrubs. The quadrature component is relatively immune to magnetic geology and to variations in the sensor height.



## Handheld Survey with GPS Navigation

The GEM-3 console includes provision for serial input from a GPS. On export, the included utility software will automatically interpolate the GPS data so there is a GPS position associated with each GEM-3 data point. GPS positions can be either in latitude/longitude format, or in UTM.



## **GEM-3 Survey on a Cart**

The GEM-3R Cart is essential for the large sensing head. The cart contains no metal parts and is built only with synthetic materials – fiberglass, nylon, and PVC. In fact, the cart is built in modules so that other sensor platforms may be mounted between the two detachable wheel assemblies. The wheels are 50-cm in diameter with a foam-filled tire along with custom-built axles that ride on glass bearings. The cart includes a GPS antenna mount. Upon order, customers may specify extra features and functions.



**GEM-3R sensor with a GPS antenna**

## Underwater GEM-3 Survey

With proper modifications for mounting and waterproofing, the GEM-3 also can be used for underwater surveys as shown below.

