

# 4 – Sensor Gradiometer

GSM-19GW4 v7.0

**Our Supplier GEM Systems is the number one global leader in the manufacture and sale of high precision magnetometers.**

GEM is the only commercial manufacturer of Overhauser magnetometers that are accepted and used at magnetic Observatories over the world.

GEM's Proton sensors are considered the most practical and robust magnetometers for general field use.

**GEM's Potassium Magnetometers are the most precise magnetometers in the world.**

Proven reliability based on GEM's 35 years of R&D

Integrated systems with GPS and additional survey capability with VLF-EM are available as options for convenience and high productivity

**GEM is creating the absolute best in airborne sensors and are leading the way in super sens ally designed for highly sensitive studies with super large sensors for research of Natural Hazards globally and now smaller and lighter sensors for practical UAV applications.**

GEM Leadership and Success in the World of Magnetics is your key to success in applications from Archaeology, Volcanology and UXO detection to Exploration and Magnetic observation Globally.



**Multi-sensor configurations can be implemented on various platforms. These platforms take advantage of GEM's 4-channel "true simultaneous" capabilities**

The GSM-19 v7.0 Overhauser instrument is the heart of GEM's unique 4 Sensor gradient magnetometer – representing a unique blend of physics, data quality, operational efficiency, system design and options that clearly differentiate it from other quantum magnetometers.

With data quality exceeding standard proton precession and comparable to costlier optically pumped cesium units, the GSM-19 is a standard in many fields, including:

- Mineral exploration (ground and airborne base station)
- Environmental and engineering
- Pipeline mapping
- Unexploded Ordnance Detection
- Archeology
- Magnetic observatory measurements
- Volcanology and earthquake prediction

**Taking Advantage of the Overhauser Effect**

Overhauser effect magnetometers are essentially proton precession devices--except that they produce an order-of-magnitude greater sensitivity. These

"supercharged" quantum magnetometers also deliver high absolute accuracy, rapid cycling (up to 5 readings / second), and exceptionally low power consumption.

The Overhauser effect occurs when a special liquid (with unpaired electrons) is combined with hydrogen atoms and then exposed to secondary polarization from a radio frequency (RF) magnetic field.

The unpaired electrons transfer their stronger polarization to hydrogen atoms, thereby generating a strong precession signal -- that is ideal for very high sensitivity total field measurements.

In comparison with proton precession methods, RF signal generation also keeps power consumption to an absolute minimum and eliminates noise (i.e. generating RF frequencies are well out of the bandwidth of the precession signal).

In addition, polarization and signal measurement can occur simultaneously - which enables faster, sequential measurements. This, in turn, facilitates advanced statistical averaging over the sampling period and/or increased cycling rates (i.e. sampling speeds).

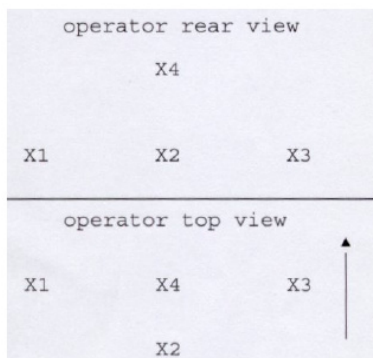
These advantages, combined with the use of 4 precisely timed, highly accurate sensors, provides a measuring system that is without comparison in the industry.

## Configurations

Key components that differentiate the GSM-19GW4 from other systems on the market include the sensor and data acquisition console. Specifications for components are provided on the right side of this page. In addition, the GSM-19GW4 can be configured in one of two arrays: 3D and Planar.

### 3D Configuration

With the 3D configuration, sensors are arranged in a “wedge-type” array with a leading (or trailing) sensor that is on a different elevation than the other sensors. The following diagram shows this configuration



Sensor X4 is located at a different level than the other sensors in order to derive the 3D vertical gradient. Output values are determined automatically using the GEM system console.

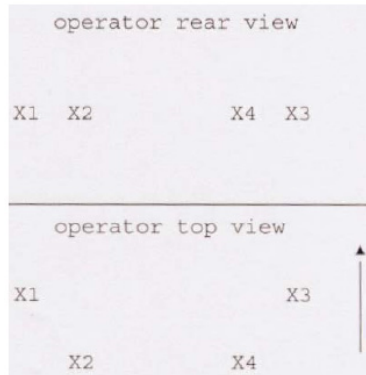
The image of the cart-borne system shows a simple 2 sensor array in operation.



Note that an external GPS can also be provided for highly accurate positioning of the survey results.

### Planar Configuration

With the planar configuration, sensors are arranged in-line as shown in the following diagram.



From a physical perspective, the sensor is a small size, light-weight assembly that houses the Overhauser detection system and fluid. A rugged plastic housing protects the internal components during operation and transport.

All sensor components are designed from carefully screened non-magnetic materials to assist in maximization of signal-to-noise.

Heading errors are also minimized by ensuring that there are no magnetic inclusions or other defects that could result in variable readings for different orientations of the sensor.

Optional omni-directional sensors are available for operating in regions where the magnetic field is near-horizontal (i.e. equatorial regions). These sensors maximize signal strength regardless of field direction.

## Specifications

### Performance

Sensitivity: Standard GSM 19	0.022 nT @ 1 Hz
GSM 19PRO	0.015 nT @ 1 Hz
Resolution:	0.01 nT
Absolute Accuracy:	+/- 0.1 nT
Range:	20,000 to 120,000 nT
Gradient Tolerance:	up to 10,000 nT/m
Samples at:	60+, 5, 3, 2, 1, 0.5, 0.2 sec
Operating Temperature:	-40°C to +50°C

### Operating Modes

**Manual:** Coordinates, time, date and reading stored automatically at upto 0.2 sec.

**Base Station:** Time, date and reading stored at 1 to 60 second intervals.

**Remote Control:** Optional remote control using RS-232 interface.

**Input / Output:** Input/Output: RS-232 using 6-pin weatherproof connector with USB adapter.

### Memory - (# of Readings in millions)

Mobile: 1.4M, Base Station: 5.3M,  
Gradiometer: 1.2M, Walking Mag: 2.6M

### Dimensions

Console: 223mm x 69mm x 240 mm  
(8.7x2.7x9.5in)

Sensor: 175mm x 75mm diameter cylinder  
(6.8in long by 3 in diameter)

### Weights

Console with Belt: 2.1 kg  
Sensor and Staff Assembly: 1.0 kg

### Standard Components

GSM-19 console, GEMLink software, battery, harness, charger, sensor with cable, RS-232 cable and USB adapter, staff, instruction manual, and shipping case.

### Options

Gradient Magnetometer, Walking Mode, Multi sensor

**Standard GPS Option :** 0.6m SBAS (WAAS, EGNOS, MSAS)

### High resolution GPS Option : 4cm

Novatel (plus TerraStar-C subscription)

**VLF Option :** Frequency Range: 15 to 30.0 kHz with up to 3 stations. Parameters: Vertical in-phase and out-of-phase components as % of total field.

**The GSM 19,19G,19W and 19GW systems come complete with an industry leading three year warranty**