

Gradient Magnetometer UAV

Utilising GEM's High Sensitivity Potassium Sensors

NEW!

GEM
SYSTEMS

Celebrating 35 Years
Leading the World of Magnetics

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.

Our Potassium Magnetometers are the most precise magnetometers in the world.

Our Proton sensors are considered the most practical and robust magnetometers for general field use.

Proven reliability based on 35 years of R&D

We deliver fully integrated systems with GPS and additional survey capability with VLF-EM for convenience and high productivity

Today we are creating the absolute best in airborne sensors and are leading the way in super sensitive potassium sensors specially 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.

Our Leadership and Success in the World of Magnetics is **Your key to success** in applications from Archeology, Volcanology and UXO detection to Exploration and Magnetic Observation **Globally.**



The autonomous GEM MONARCH gradiometer system in flight

Gradient Magnetic UAV Surveys

UAVs can now be used to perform airborne geophysical surveys. Map the spatial variations in the Earth's magnetic field for a variety of useful applications. Explore mineral potential, map UXOs and Archeology in high resolution.

- UAV borne magnetic and gradient surveys can be carried out in areas that are too dangerous, too remote, or too expensive for equivalent ground or airborne surveys featuring manned aircraft.
- UAV borne magnetic surveys can deliver quality data in environments where topography and safety standards prohibit manned aircrafts from acquiring data at optimum terrain clearances.

Reliable and Stable Aerial Vehicle

GEM's MONARCH Magnetic Gradiometer UAV is built on a customized version of the tested Tempest aircraft airframe developed by UASUSA. The low carbon airframe has been customised by aerodynamic wing tip pods for the specialised magnetometer sensors. Modifications have been incorporated to the aircraft control hardware to minimize magnetic interference.

Features

The GEM Gradient Magnetometer UAV System features two highly sensitive optically pumped Potassium Sensors for uncompromised measurement capability. The GSMP-35U magnetometers have been specially designed to provide our typical 0.0003 nT sensitivity and form the core of GEM's UAV solution. These light weight magnetometers offer the highest sensitivity available in the industry.



Potassium Magnetometers

Two specially designed GEM Potassium GSMP-35U magnetometers with 0.0003 pT sensitivity

Advantages of Potassium Optically Pumped Technology

- Highest sensitivity and absolute accuracy optically pumped magnetometers available on the market
- Potassium narrow spectral line minimizes heading and orientation errors
- Low maintenance cost on sensors
- High quality results in areas of high gradients

Our World is **Magnetics.**

GEM Systems, Inc.

135 Spy Court Markham, ON Canada L3R 5H6

Phone: 1 905 752 2202 • Fax: 1 905 752 2205

Email: info@gemsystems.ca • Web: www.gemsystems.ca

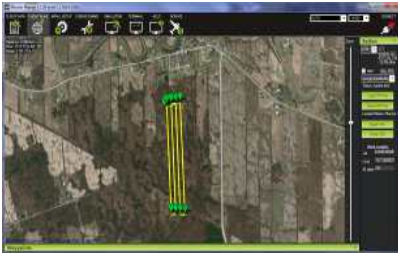
Robust and Lightweight Components

GEM data acquisition(DAS) & power distribution system

- The GEM DAS module provides interfaces for all onboard electronics via configurable RS232 Ports to GPS/DGPS receivers, for magnetometer sensors, and laser altimeters.

Navigation, Launch & accessories

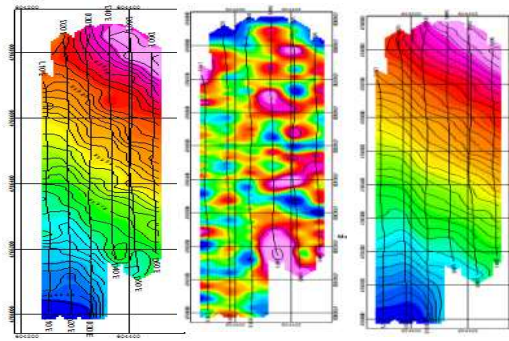
- U-blox NEO-7 GPS Receiver with Antenna
- Pixhawk Autopilot and Mission Planner Ground Station (features safety return to launch, auto takeoff/landing)
- Micro **Laser altimeter** for monitoring and controlling terrain clearance
- Catapult Launch device, open space landing
- Airtronics 10 channel 2.4GHz radio control
- Li-Po Batteries - 1.5 hrs flying capacity



Mission Planner and Controller



Safe, Low altitude flying



Data output of left and right sensor (Total Field) Measured Gradient nT/m (Scale 2nT peak to peak) from survey flown at 300ft height (Southern Ontario)

Unmanned Aerial Vehicle

The airframe is V2(RIF) Radio Interference Free and has been tested in extreme weather and can fly in winds up to 80 km/hr. The aircraft has been deployed from weather balloons at 58,000 ft. (Also used in the study of tornado's) so the aircraft and its onboard systems are designed for extreme cold and winds. When compared to other UAV vehicles, the Tempest offers an excellent combination of available payload, extended range, affordable price, and most importantly minimal magnetic interference.

The magnetometers operate autonomously similar to the UAV. Magnetic data are marked with time and position from the UAV's GPS navigation system. Maps in spatial variations in the magnetic field intensity and gradient can be improved by applying digital compensation, available from GEM Systems.

UAV Requirements for Permits

Regulations vary for different jurisdictions. Since the Airframe has a maximum takeoff weight in a range between 2 kg and 25 kg, as of Nov 2014 Transport Canada will issue to operators an exemption to the requirement to obtain a Special Flight Operating Certificate(SFOC) for a UAV flight. The Tempest airframe has more Certificates of Authorization (COA's) issued by the FAA in the USA than any other commercially available UAV platform. In Ontario, Canada the complete system was flown under SFOC.



Monarch on catapult launcher

Specifications

Autonomous Aircraft

Speed

70 km/hr (Cruise)
160 km/hr (Max)
50 km/hr (Stall)

Range (with gradiometer payload)

Up to 1.5 hours at cruise speed

Production

100 linear km's per flight¹ (of high-res mag gradient data) with short ferry flights
¹ multiple flights per day are expected; changing aircraft batteries and re-launching the aircraft requires minutes

Weight

10kg (22 lbs)

Wingspan (sensor separation)

3.2 metres

Autopilot

standard operation within 13.0 km of guidance base station, upgradeable to 80.0 km

Potassium Magnetic Gradiometer

Sensor

Sensitivity: 0.0003nT
Range: 15,000 to 120,000 nT
Gradient Tolerance: 50,000 nT/m
Samples at: 1, 5, 10, 20 Hz

Compensation Performance

Improvement Ratio (total field):
10 – 20, typical

Compensation Accuracy

Standard deviation of ~ .02 nT for flight

Sensor Weight and Dimensions

GEM Potassium Sensor GSMP 35U .42kg
GEM DAS data acquisition .42kg
Acquisition Cabling (inc)
Total for 2 sensors and electronics 1.7kg

Environmental

Operating Temperature: -40°C to +55°C
Storage Temperature: -70°C to +55°C

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135 Spy Court Markham, ON Canada L3R 5H6
Phone: 1 905 752 2202 • Fax: 1 905 752 2205
Email: info@gemsystems.ca • Web: www.gemsystems.ca