

CARDINAL

Ultra Light UAV Towed Magnetometer Solution (preliminary specifications)

NEW!

Our supplier, GEM Systems, is the global leader in the manufacture and delivery of high precision magnetometers. Its proven solutions focus on Potassium (K) technology as well as Overhauser and Proton quantum technologies, and are a standard for UAV, Airborne, UXO, Ground and Monitoring applications.

The advanced CARDINAL magnetometer is a standalone turnkey solution developed specifically for UAV work. With Potassium technology embedded, it enables high-resolution and high-sensitivity data acquisition from drones.

GEM's Airborne platforms also leverage K technology. They offer low heading error combined with high sensitivity to maximize responses from subtle anomalies.

On the ground, GEM has led the industry in magnetometers and gradiometers for decades. With K-Mag, Overhauser and Proton systems, GEM offers a solution for many geoscience and military applications.

For stationary measurements, GEM provides base stations as well as very large K systems for observatories (20 – 50 ft). Systems are installed globally.

With this experience and ongoing R&D, our clients benefit continuously from robust, proven solutions and high precision, quality results.

**The difference really,
is in the data!**



The CARDINAL includes GEM Systems optically pumped Potassium magnetometer, GPS, IMU and battery - all within a super lightweight aerodynamic housing at 1.5kg.

With more than 30 years of R&D in magnetic systems, GEM Systems Inc. instruments are specially designed for high-sensitivity and noise-free data. Magnetic data acquisition via Multi-Rotors and Helicopter drones has led to the development of some of the smallest and most precise UAV magnetometers on the market. With improvements in efficiency, range, size, and payload, drone magnetometer platforms have proven effective in many applications. The drone-mounted magnetometer trend is also growing quickly, as the knowledge of its efficiency and high-quality data becomes more well known each day.

Unlike conventional airborne surveys, drone magnetometer surveys are flown much closer to the ground; hence, the amplitude and the details of magnetic features are better resolved, especially with a sensitive magnetometer. In comparison with ground surveys, drone magnetometer surveys can reduce 10 days of acquisition and associated field costs to 1 day while eliminating both safety issues for personnel and station preparation costs (i.e. line cutting or flagging).

Drone magnetometers are making their presence felt in geoscience and military applications today with the continuing development of advanced, lightweight sensors and stable platforms. GEM's leading Potassium-based quantum technology is leading the way for obtaining high-quality magnetic measurements allowing high-resolution evaluation of even subtle magnetic targets.

Sensors comprise a variety of single and multiple configurations, including both magnetometers and gradiometers. With sensor technology weights now under 300g, there are few physical or technical impediments in implementing drone magnetics in the air. And with different options available, sensors can be either standalone or integrated into turnkey systems.

The CARDINAL is an ultra-light weight towed bird magnetometer system designed specifically for UAVs. This system has everything needed to carry out high-precision magnetometer surveys from the air. The complete system weighs 1.5 kg including battery and therefore is suitable for smaller drone platforms (Helicopter and/or Multi-Rotor). Operation is as simple as attaching the bird to the UAV using the supplied tow cable.



Terraplus Inc.
120 West Beaver Creek Rd, Unit #15
Richmond Hill, ON, Canada, L4B 1L2

terraplus.ca
1.905.764.5505
sales@terraplus.ca



CARDINAL and AirBIRD systems - different configurations for different applications

Advantages of Potassium Optically Pumped Technology

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

The CARDINAL comes complete with GSMP-19U (or 20U) Potassium Magnetometer, GPS for positioning, IMU providing yaw, pitch roll, tow cable, battery, GEMLink software utility and shipping case.

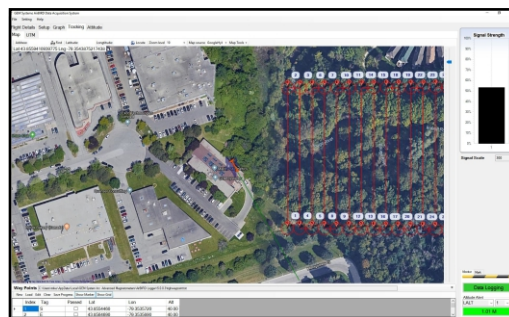
Data will be stored in internal flash memory, a 30min flight can be transferred in approx 30 seconds, optionally data can be transferred in real-time with radio link.

Customer provided UAV's

Before deciding on a particular UAV platform with adequate range and payload for the geophysical instrument, it is recommended that the magnetic interference (MI) generated by the platform be assessed with a high sensitivity portable magnetic gradiometer.

Ground Station

Optionally a Ground Station can be added to monitor the data in realtime using a Radio Link connected to a Panasonic Toughbook running GEM DAS (Data Acquisition Software)



Additional Upgrades

- GPS performance on the CARDINAL can be upgraded with higher performance systems including
 - 1.5 m standalone, 60 cm SBAS
 - 2.5 cm TerraStar-C PRO subscription
 - 1 / 3 cm RTK
- Wireless Data Transfer can be added for data collection post flight
- Laser Altimeter can be added for altitude information
- Extended Dynamic range 3,000 nT to 350,000 nT



System Specifications

Sensor Performance

Sensitivity: 0.001 nT (1 pT) / $\sqrt{\text{Hz}}$ (GSMP-19U)
0.022 nT / $\sqrt{\text{Hz}}$ (GSMP-20U)

Resolution: 0.0001 nT

Absolute Accuracy: ± 0.1 nT * sensor at optimum angle

Heading Error for all spins:

± 0.2 nT sensor only

± 0.5 nT sensor installed in bird

System Performance

Dynamic Range: 20,000 nT to 120,000 nT

Sampling Rate: 1, 5, 10, 20, 50, 100 Hz

Relock time <300 ms

GPS 2.5 m standalone, 2.0 m SBAS

Yaw 0.3°, Pitch / Roll 0.1°

Orientation

Sensor Angle: optimum angle 35° between sensor head axis & field vector

Proper Orientation: 10° to 80° & 100° to 170°

Environmental

Operating Temperature: -40°C to +55°C

Storage Temperature: -70°C to +55°C

Humidity: 0 to 100%, splashproof

Dimensions & Weights

CARDINAL bird housing with pickup point, tow cable, GPS, IMU and installation mechanics; 740 g
Sensor: 115 mm x 40 mm (Cylindrical) with 1.2 m cabling ; 250 g

Electronics Box: 236 mm x 56 mm x 39 mm; 300 g
Lipo 6S 22.2V 1050 mAh Battery; 210 g

Power

Power Supply: 22 to 32 V DC

Power Requirements: approx. 50 W at start up, dropping to 12 W after warm-up

Power Consumption: 12 W typical at 20°C

Warm-up Time: <10 minutes at 20°C

Outputs

UTC time, GPS information (latitude, longitude, elevation, number of satellites), magnetic field, lock indication, heater indication, field reversal status, signal amplitude and system voltages.

Standard Components

CARDINAL bird housing with pickup point, tow cable, GPS, IMU and installation mechanics, GSMP-19U (or 20U) Sensor with interface cable, electronics box with wiring and installation mechanics, instruction manual, GEMLink & shipping case

GEM Systems provide an industry leading 3 year Warranty



Terraplus Inc.

120 West Beaver Creek Rd, Unit #15
Richmond Hill, ON, Canada, L4B 1L2

terraplus.ca

1.905.764.5505
sales@terraplus.ca