

NEW!

DI Vector Magnetometer for Directional Drilling

(GSM-19DD / GSM-90FDD)

GEM
SYSTEMS
ADVANCED MAGNETOMETERS

Our World is **Magnetic**.

The DI Overhauser Vector Magnetometer / Directional Drilling system is designed for specialized inclination and declination measurement for directional drilling purposes.

Key benefits include:

Integrated system that replaces combined fluxgate / total field installations

Long term stability for accuracy and reliability of measurements

Unsurpassed immunity to temperature changes and aging of materials

High sensitivity, high speed, optimized signal-to-noise ratio, vector measurements using advanced Overhauser technology

Steel-free telescope with accurate GPS for real time bearing calculation

Fast data output via RS-232 and USB with interface to custom Windows data acquisition software

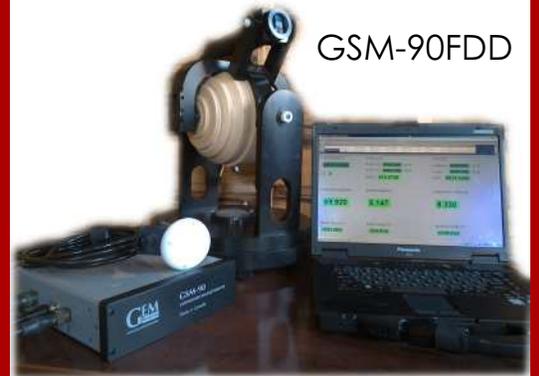
Flexibility to enable real-time transmission via RS-232 and modem to satellite and phone links

Internet-based upgrades (from the office or field)

All of these technologies come complete with three year warranty.



GSM-19DD



GSM-90FDD

DI-integrated 3-component coil system with enclosed Overhauser sensor designed for directional drilling applications

Declination / Inclination Vector Magnetometer for Directional Drilling Base Station

In the past, magnetic observatories relied on a combination of Overhauser, fluxgate, and theodolite instruments for obtaining total field and variability measurements. GEM, in co-operation with Eötvös Loránd Geophysical Institute (ELGI) and later Mingeo of Hungary introduced the modern dIdD (delta Inclination / delta Declination) vector system for high precision results.

Today, based on GEM's advanced Overhauser technology, GEM Systems' directional drilling orientation (DDO) system is designed to align the orientation tools used when drilling deviated wells and boreholes.

The DDO is comprised of a small diameter (85 mm) spherical Overhauser sensor with a bi-directional set of bias coils and a nonmagnetic telescope. Data is acquired directly to a GEM Overhauser magnetometer via a computer.

Simplifying Magnetic Measurements

The DDO simplifies the setup of magnetic observatory installations by eliminating the need for fluxgate magnetometers, thermal insulating structures and a theodolite system. In addition, the new system is easy to setup with real time data output.

These important new benefits are achieved through system design:

- Temperature coefficients that reduce drift to less than 0.1 nT / °C (compared with 0.5 nT / °C for high-end fluxgate magnetometers)
- precise alignment of the bias coils surrounding the Overhauser sensor
- Long term drifts that are less than 2 nT / year - matching or exceeding the best component measurement at any observatory

Ultimately, the system also exceeds specifications set by Intermagnet - the global network of observatories monitoring the Earth's magnetic field.

www.intermagnet.org

GEM's DDO system is implemented in the world's newest directional drilling guide systems as the sole instrument for continuous, stable measurement.

Steel-free Telescope and Level Platform

The telescope is completely non-magnetic with a length of 283 mm and 30X magnification. The housing, mechanics and holders are made out of black delrin.

- Bias coils and suspension are made by Mingeo of Budapest, Hungary.

Sensor and Coils

A key engineering design consideration was the development of Overhauser sensors that were optimally shaped to better interact with the magnetic fields surrounding the coil.

The external casing is impact resistant plastic.



Figure 1: DDO Spherical Sensor

DDO Technology

DDO is a result of research by GEM Systems, the USGS and Eötvös Loránd Geophysical Institute (ELGI Hungary). Technology was later transferred to Mingeo of Budapest. Mingeo manufactures the bias coils and suspension www.mingeo.com

Inclination/Declination/Bearing Measurement

The DDO is a vector magnetometer for continuous monitoring of the inclination, declination, and total intensity of the Earth's magnetic field as well as bearing for a telescope target. This combination differentiates it from fluxgate instruments (i.e. that only provide 3 components).

GEM's DDO employs a mutually orthogonal coil system that measures one unbiased and four biased values of the total magnetic field.

The coils are oriented to be perpendicular to the Earth's magnetic field vector, F (i.e. one coil is in the horizontal plane and one coil is in the vertical geomagnetic meridian plane).

Sensor bias coils have been carefully adjusted to be 90 degrees orthogonal. The telescope is on top of the sensor and in the same line with D+/D- coil plane. A level meter is attached to the base of telescope to ensure the sensor has level horizontal and vertical rotation. The telescope points to the target direction.

The DDO console reads the D+/D-, Total Field, I+, I- and their signal strengths, and sends data to a laptop. DDO software running on the laptop calculates inclination, declination, and bearing from base station to telescope target, in real time, based on D+, D-, Total Field, I+, I- and GPS coordinates of base station and telescope target.

Data Acquisition & Display Software

GEM's custom data acquisition and display software is a Windows interactive interface. The software saves the calculated values to a disk file and displays the values in text [Figure 2] and graph modes for easy monitoring of system functions.

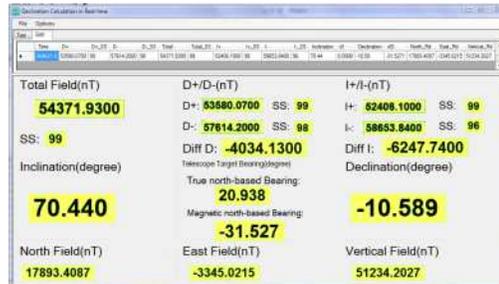


Figure 2: DDO Display Software

The DDO Data Acquisition can display charts for the incoming data versus time. Separate charts show Total Field, as well as East, North and Vertical components. Inclination and Declination charts are shown in graphical windows.

Specifications

Performance

Angular Resolution: 0.001°
Sensitivity: 0.022 nT / $\sqrt{\text{Hz}}$ (1 Hz)
Sensitivity: 0.180 nT / $\sqrt{\text{Hz}}$ (5 Hz)
Resolution: 0.01 nT
Absolute Accuracy: 0.2 nT
Range: 20,000 to 120,000 nT
Gradient Tolerance: over 10,000 nT/m
Operating Temperature: -40°C to +55°C
Power Consumption: 1.5 W at 12V

Rate of Reading

1.0 sec per interval, 5 sec full cycle
0.4 sec per interval, 2 sec full cycle
0.2 sec per interval, 1.0 sec full cycle
5 measurements acquired during each full cycle

At 5 Sec Full Cycle

dI uncertainty less than / equal to 1 arcsec rms
dD uncertainty less than / equal to 2 arcsec rms
for I_0 less than / equal to 45°
dD less than / equal to 4 arcsec for
 I_0 less than / equal to 70°

At 1 Sec Full Cycle

dI uncertainty less than / equal to 5 arcsec rms
dD uncertainty less than / equal to 10 arcsec rms
for I_0 less than / equal to 45°
dD less than / equal to 4 arcsec for
 I_0 less than / equal to 70°

Range of measurement

I_0 less than or equal to + / - 90°
 D_0 less than or equal to + / - 180°

Operating Mode

Automatic: X, Y, Z, Inclination, Declination, and Bearing
Remote Control: optional using RS-232 interface

Dimensions

Console: 223mm x 69mm x 240mm
Sensor: 250 mm diameter

Weights

Console: 1 kg
Sensor and Coil: 4.5 kg

Standard Components

Console, DDO dIdD sensor with cable, DDO dIdD software, 12 VDC power supply, RS-232 cable, and instruction manual. Optional GPS for precise time values.