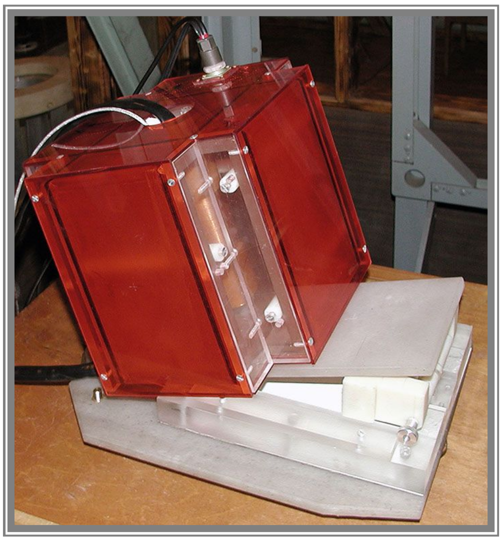
Three-Component Cs Variometer



Metrological parameters

Magnetic field range (Z).......... 20 000 ÷ 65 000 nT
Transverse (X,Y) components range .... ±1 000 nT
Data sampling rate .... 1 ÷ 10 samples/sec
Short-time sensitivity .... < 15 pT·Hz$^{-1/2}$
Frequency band .... 2.5 Hz
Reproducibility .... ±0.2 nT
Initial tilt[1] range .... $\pm 1^0$
Maximal field change rate .... 750 nT/sec

[1] *Tilt = angle between the field vector and the sensor axis*

Technical parameters

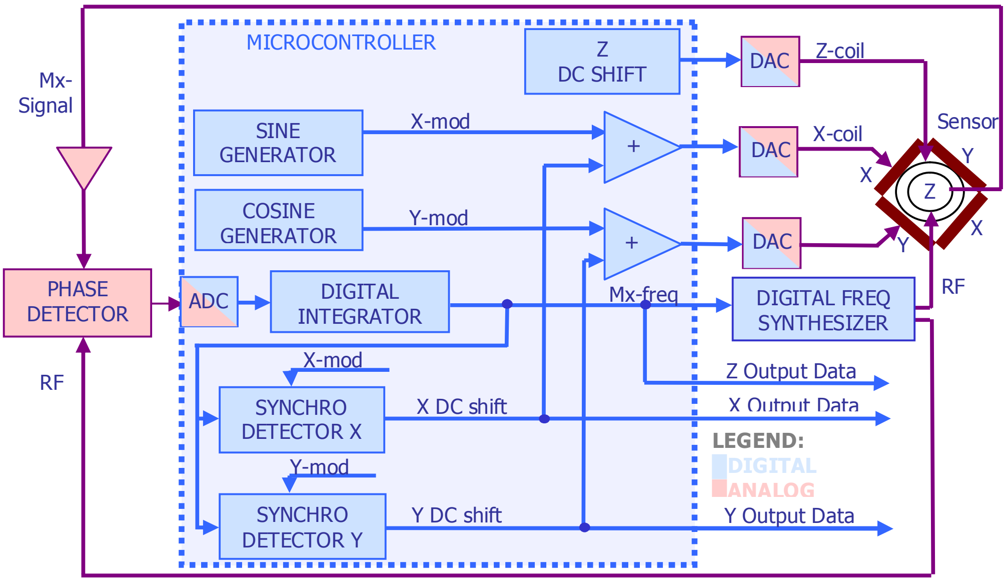
Interface .... Serial (RS232)
Time sync precision .... 10^{-7}sec
Warming-up time .... 45 min
Power .... 27B 3A or 220B 0.4A
Power consumption .... 90 W

Dimensions and weight:

Sensor................ 230×230×230 mm, 5Kg
Electronics........... 500×200×70 mm, 3Kg
Power converter ... 400x170x100 mm, 1.5 Kg
Data/power cable................. 0.2 Kg/m

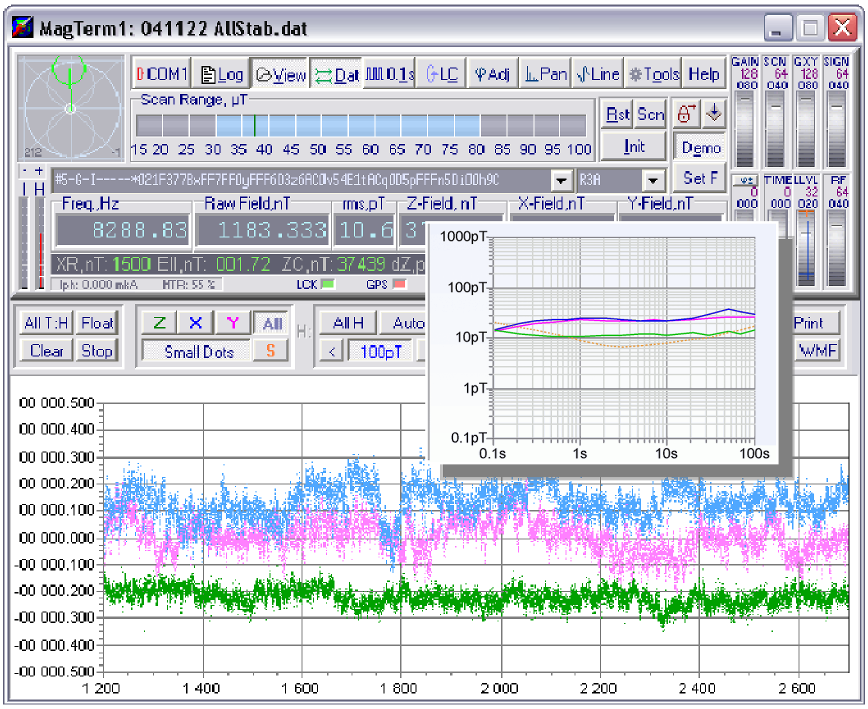
New compact and fast three-component variometer measuring the total terrestrial magnetic field intensity in 20÷65μT range and two transverse components in ±1μT range.

Constructively the device consists of the sensor and electronic block; the sensor consists of Cs-magnetometer placed into the coil system. The coil system frame is made of quartz and installed on a quartz base. At the moment we are developing the new more compact version of the instrument with higher order thermo-stabilized coil system.



NB! Three-component Cs Variometer is a complex instrument, requiring special treatment. The device installation and periodical checks be conducted only by specially trained and qualified personnel.

BASIC PRINCIPLES



The variometer constitutes a scalar Cesium sensor placed into the center of 3D coil system aligned along terrestrial field H_0. The coil system produces DC magnetic field H_{ZC} compensating ~95% of H_0, magnetic field H_{XY} rotating in the plane perpendicular to H_0, and DC magnetic fields H_{XC} and H_{YC}

The scalar sensor measures the total magnetic field H which is the vector sum of the fields listed above. If H_0 deviates from Z oscillating components appear in H; these components are used as signals for the X-Y feedback systems producing DC magnetic fields H_{XC} and H_{YC} compensating variations of transverse Earth field components. These fields amplitudes are used as the measure for X and Y field components

A Cesium optically pumped sensor was chosen as the most appropriate scalar device - since the total field in the center of the coil system does not exceed 7,000 nT, and Cs resonance line in such a low field is quite narrow and symmetric.

Long-term stability of the device is mostly determined by the coil system; the procedures of calibration of X,Y,Z coil constants and their cross-coefficients are also implemented on micro-processor level, and they do not require any external magnetometric equipment.

Terminal program

- Shows magnetometer virtual panel on the computer screen;
- Sends commands to the magnetometer;
- Receives data from the magnetometer;
- Allows to control the magnetometer parameters with the virtual visual controls;
- Processes data string and shows data on the virtual panel;
- Calculates statistics such as Allan variances;
- Saves data and graphs to file.

Research Team

Our research team is combined of the Atomic RadioSpectroscopy Lab of A.F.Ioffe Phys.-Tech. Institute and Radio-Optical Spectroscopy Lab of S.I.Vavilov State Optical Institute. In the field of ultra-precise quantum magnetometers the team posses the huge experience going back to 60-es. By now we have already designed at least six new types of quantum magnetometer of unique features.

E.B.Alexandrov, M.V.Balabas, A.S.Pazgalev, N.N.Yakobson, A.K.Vershovskii. Double-resonance atomic magnetometers: From gas discharge to laser pumping. - Laser Physics, 6, #2, 1996, pp.244-251

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