Potassium Mx-Magnetometer

Metrological parameters

Magnetic field range .... 15 000 ÷ 100 000 nT
Data sampling rate .... 1 ÷ 1280 samples/sec
Short-time sensitivity .... < 0.5 pT·$Hz^{-1/2}$
Frequency band .... 150 Hz
Reproducibility .... ±0.02 nT
Tilt[1] range .... $15-80^0$
Maximal field change rate .... 3000 nT/sec

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

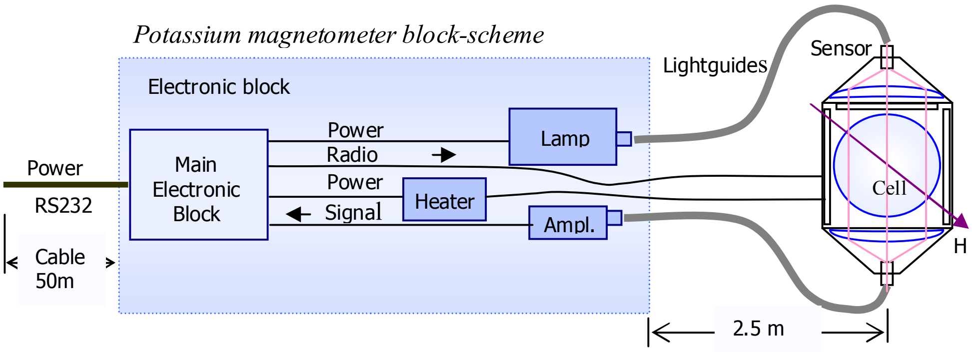
Technical parameters

Interface .... Serial (RS232)
Time sync precision .... 10^{-7}sec
Warming-up time ....45 min
Power ...... 27B 2.4A or 220B 0.3A
Power consumption .... 65 W

Dimensions and weight:

Sensor................... ø170×200 mm, 2Kg
Electronics........... 500×200×70 mm, 3Kg
Power converter ... 400x170x100 mm, 1.5 Kg
Data/power cable................. 0.2 Kg/m

Potassium Mx-magnetometer is an instrument providing the precision measurement of magnetic field modulus in Earth magnetic field range. The instrument is designed for using in magnetic observatories as well as for mounting on moving carriers such as airplanes and helicopters directly or in towed gondolas.



Constructively Potassium magnetometer consists of the sensor the electronic block and the power supply block. The electronic block is connected with the sensor by multi-fiber lightguides and the coaxial cables. Total energy consumption is about 65 W. The electronic block is connected with user's computer and the power supply block with cable up to 50 m length.

NB! Potassium Mx-magnetometer is a complex instrument, requiring special treatment. It is highly recommended that the device installation and periodical checks be conducted by specially trained and qualified personnel.

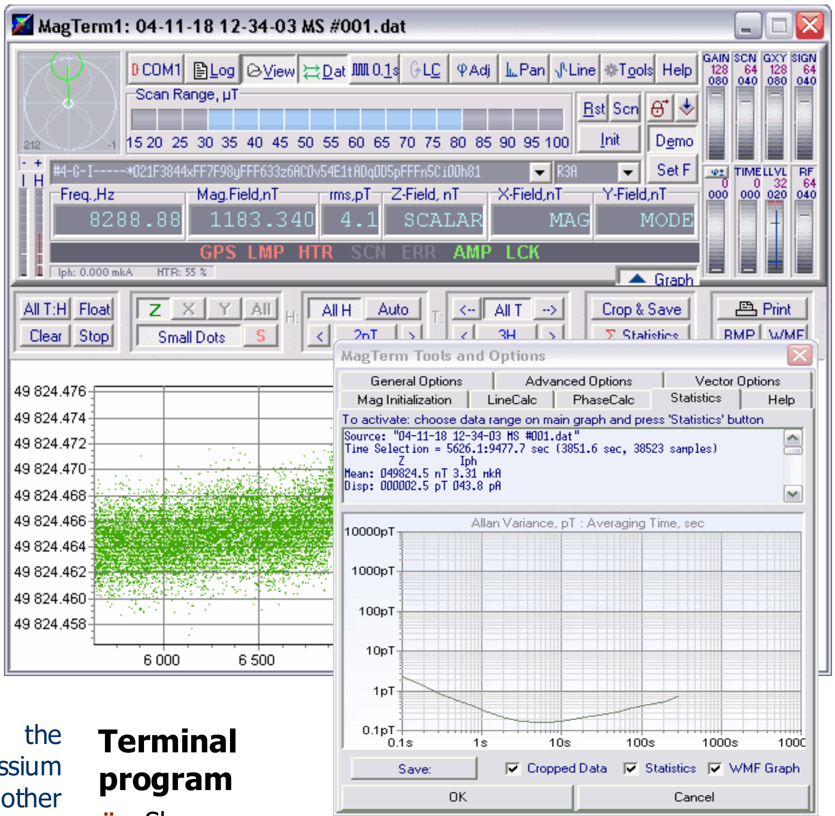
BASIC PRINCIPLES

Potassium Mx-magnetometer measures the magnetic field using *Zeeman effect* in magnetic structure of Potassium atom. To observe Zeeman resonance we use *optical pumping* – very effective method of creation the population difference between Zeeman sublevels, and *optical detection* – the method, characterized with quite high efficiency comparing to that of proton magnetometers.

More wide-spread than Potassium ones, Cesium magnetometers are based on the same principles, but Cesium resonance lines in Earth magnetic field are merged in one about 20nT wide asymmetric line with shape and center position depending on many parameters, including the instrument tilt.

On the contrary, Potassium resonance structure in the Earth magnetic field is well-resolved, and the single line width can be reduced down to 0.2nT. Correspondingly the precision and the long-term stability of Potassium magnetometer is much higher than that of any other alkaline magnetometers. The cost of this advantage is increased difficulty of working with complicated line structure instead of single line; this task has been solved using micro-processor methods of signal analysis and frequency synthesis.

The main element of optically pumped magnetometer is the glass cell filled with alkaline (Potassium) vapor. Inner cell surface is coated with special paraffin-based coating to prevent atomic spin depolarization. The unique technology of cell coating with paraffin layer providing atomic spin life time of order of 1 sec was created in our lab and still not reproduced by our competitors.



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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