Development of JROMAG-M103 Magnetometer for geomagnetism studies in Peru

Ricardo Rojas[1], Oscar Veliz[2]

[1,2] Instituto Geofísico del Perú

Abstract

Since 2007 a three-axis fluxgate magnetometer has been in development and under continuous improvement at Jicamarca Radio Observatory of the Geophysical Institute of Peru. It is based on the Fluxgate Mag-03 magnetic detector by Bartington Instruments. The JROMAG-M103 was developed to meet specific requirements of sensitivity, resolution, robustness, among others. This magnetometer, called JROMAG-M103, is being used in several geomagnetic monitoring networks, from different research institutions in South America. This poster presents the design aspects and technical specifications of the magnetometer and introduces further improvements that will be included in future versions.

1. System description

Fig. 1. JROMAG-M103 consists of 1) Sensor Cable. 2) Control Unit. 3) Sensor Unit

The sensor unit encapsulates MAG-03 magnetic detector inside a double PVC cylinder to obtain adequate thermal, mechanical insulation and stability.
Control unit contains the electronics associated with the analogic and digital part, digitization phases, storage system, data reporting.

Technical specifications

Dynamic range:	+/- 250,1000 ,2500 nT
Total range	+/- 70000 nT
Maximum sensitivity:	10mV/nT
Resolution:	0.1 nT
Accuracy:	0.25%
Offset at T=25 °C:	< 1nT
Zero drift:	< 0.1nT/°C
Supply voltages	AC/DC
Analog output	+/- 2.5V Full
Digital output:	USB 2.0
Sampling rate in file):	1 sec
Sync timing:	GPS
Connectivity	Ethernet, Wi-Fi
Operating system:	Raspbian

2. Control and digital acquisition system

Data acquisition system is based on the A/D converter CS5532 from Cirrus Logic, which is a Delta-Sigma converter with differential and bipolar input analog channel. This acquisition system is controlled by a RaspberryPi3.
The acquisition software is developed in Python3 and maintains communication with the data digitization board through the RS232 protocol to request data from the magnetic components X, Y, Z, temperature signals from the unit's control and sensor and time/date from the Garmin GPS module
In addition, continuous data logging operation is monitored and restarted in the event of failures. This reset is made by cutting and restoring the supply voltage of the digital system

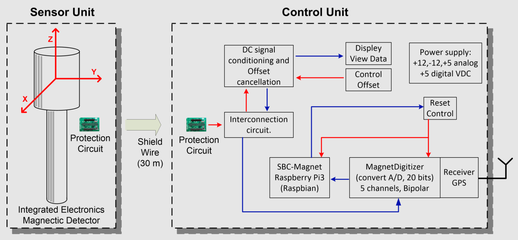

Fig. 2. Block diagram of JROMAG-M103.

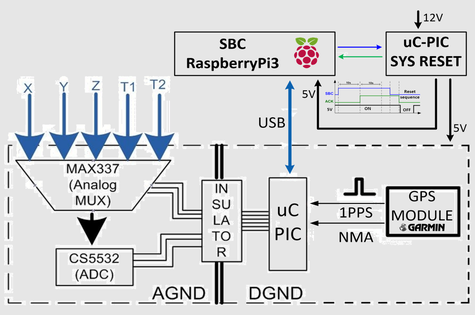

Fig. 3. Block diagram of acquisition system operation.

3. Measurements and Operation of JROMAG magnetometers

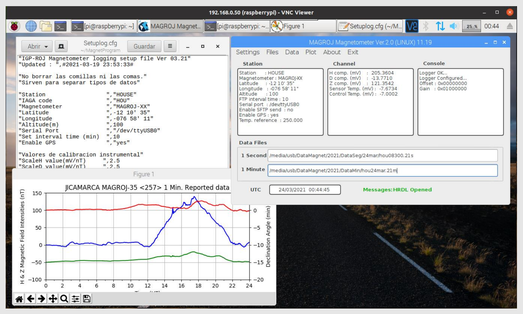

Fig. 4. Graphical user interface of the acquisition program

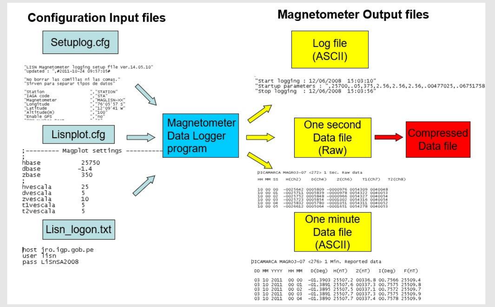

Fig. 5. Acquisition program input and output files flow

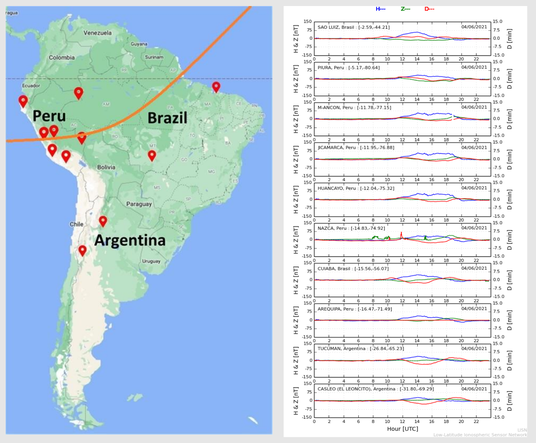

Fig. 6. Location of IGP and LISN magnetometers networks in South America and report of real-time magnetograms.

JROMAG-M103 magnetometers are operating as part of the instrument's networks of IGP and the LISN project (Low-Latitude Ionospheric Sensor Network) in the cities of Piura, Lima, Huancayo, Nazca, Arequipa and Puerto Maldonado from Peru, Sao Luiz and Cuiaba from Brazil, Tucuman and Casleo, San Juan from Argentina.

4. Future Work

Evaluation tests are performed with a new ADC to increase the resolution of digitizers to 32 bits and 10Sps (in file). A new web interface for wireless configuration of the magnetometer is also being tested.

5. Acknowledgments

The authors thanks to IGP and LISN project PI Dr. Cesar Valladares who provided both the scientific and financial support for the constructions and operations of the magnetometers.

6. References

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email: rrojas@igp.gob.pe