Geosci. Instrum. Method. Data Syst. Discuss.,
https://doi.org/10.5194/gi-2017-23-AC1, 2017

Geoscientific Instrumentation Methods and Data Systems Discussions

Interactive comment on "A low-power data acquisition system for geomagnetic observatories and variometer stations" *by* Achim Morschhauser et al.

Achim Morschhauser et al.

mors@gfz-potsdam.de

Received and published: 14 June 2017

Dear Peter Crosthwaite,

thanks for your detailed and helpful review. Below, you will find the answers to the issues raised in your manuscript.

Best regards, Achim

===

Due to its low power requirements, the system would also be useful for geomagnetic repeat station surveys, and could be adapted to also measure electric fields in conduc-

tivity studies. If software development proceeds in the appropriate direction, it could also support magnetometer calibration systems. It would be useful to point out these, and perhaps other, uses of the system described in this paper to encourage its adoption.

- The adaptation for measuring electric fields is indeed an interesting application that we want to support as well. I have added a remark in the conclusions section concerning these possible usages.

Page 6 Figure 3. Some details of the LTP (lightning protection) such as part numbers (if Off The Shelf products) would be useful.

- I have added these in the text.

Page 6 Section 3.2.1 Power supply chain Line 12. Is effective transmission of electric energy really an issue over the short distances involved requiring 12 VDC-220 VAC complications? It might be desirable for elimination of DC fields associated a DC power transmission though.

- This might well depend on the setup of the observatory. In case that 15W are transmitted, the current is 1.3 A for 12 VDC and 70 mA Ieff for 230 VAC. If we choose copper conductors, the resistance of the cable is 0.0171 Ohm mmˆ2 / m, leading to 1.14 Ohm for a 100 m and 1.5 mmˆ2 cable. Then, a power loss of P=2*R*Iˆ2 (100 m cable has two wires to close the circuit, so 200 m cable length) leads to P=4 W / 100m for DC and P=0.01 W / 100 m for AC. Hence, DC may be acceptable for short cable lengths and low power systems, but becomes very inefficient as soon as cable distance is in the order of magnitude of 100 m, or more power may be required in the future due to more instruments (backup system, electric field, ...). I have added these values to the manuscript. Also, as you mention, DC fields have the disadvantage to produce an artificial signal in the magnetic field measurements (I have added a note on that).

- Please note there was a mistake in calculating cable power loss in table 1. As this number is low anyway, I have removed it from the table.

Page 7 Section 3.2.2 Photovoltaic system. The DC charging currents into batteries in early morning (after overnight discharge) can be quite large – has any estimation of the distance required between the batteries and charging system from the magnetometer sensors, or the configuration of the charging system, to avoid magnetic contamination been made?

- Usually, we keep the solar cells close to the electronics hut and as far away as possible from the variometers. Assuming 600 Wp, a charging current of 50 A is obtained. From Ampere's law and assuming an infinitely long wire, the variometer would need to be 100 km away to reduce the field to B=0.1 nT (d=mu_0 I / (2 pi B)). Fortunately, a reverse current is flowing towards the solar cell to close the circuit, and only the distance between the positive and negative wires leads to a magnetic field. Therefore, if these wires are always arranged in an appropriate way, the magnetic field generated by the solar cells should be pretty low.

Page 7 Table 1. Rather than include non-essential items (Notebook) and then say it could be excluded or replaced by a lower power device, wouldn't it be better to include only essential items and note that other items could be added at a power cost?

- This is certainly one way to put it. However, we would like to keep the current approach, and start from a standard system which includes reasonable options for a standard observatory. For example, the laptop can be very useful if absolute measurements are also stored in the laptop by the observatory staff. Starting from this standard system, we explain what may be removed if power is a bigger issue. Also, according to the suggestions of the first reviewer, the text in sections "Power Supply Chain" and "Data Acquisition" was restructured such that the standard system is first explained before options are mentioned at the end of these paragraph.

Page 9 Section 4.2 Timestamping and Time keeping. Is all timekeeping accomplished through NTP with no specialised GPS processing? If so, does this limit the selection of

GPS clocks (that can be used to be compatible with the ntpd program available on the Rasberry Pi)?

- All time keeping is accomplished through NTP, and the GPS and PPS signals are processed using gpsd and pps-gpio. All GPS clocks should be compatible as long as they provide the PPS signal and work with gpsd. A small note that PPS and gpsd need to be supported has been added to the manuscript in Section 4.2

Page 10 Section 4.3 Datalogging and Filtering. There is mention of data being written to binary files or transmitted (using MQTT for example). How is the implemented system at Niemegk or Tatuoca recording its data – for example to the elsewhere mentioned external HDD or SSD. Have you selected a binary file format reliable through power failures and which can be rsync'd in real time without corrupting the file, or installed a local MQTT server that can provide data through long communication dropouts or power failures? Delivering the data is the ultimate goal of the system, and the paper seems a little light on detail, although it offers suggestion on what could be done.

- Currently, neither MQTT nor binary files are implemented. In Tatuoca as well as on the test system in Niemegk, only ASCII files are used and transmitted via rsync and ssh. Certainly, the issues you raise must be thought of in detail, and we may well rely on the experience of colleagues who have already implemented MQTT for real-time file transfer. A citation to the paper by Stephan Bracke et al. in this issue has been added to Section 4.5 "Data Transmission".

Typo remarks: ==============

Page 2 Introduction Line 11 Niemgk spelling compared to Line 14 Niemegk - Corrected to Niemegk

Page 3 Section 3.1 Data Acquisition Line 25 Fig XX - Corrected

Page 4 Figure 1. "On the right hand side" is used twice to describe both left hand side and right hand side. The first "right hand side" should be "left hand side". - Corrected

Page 5 Figure 2. The GPS antenna is shown, but the GPS is not shown. - The GPS is located under the RTC and not visible. I have added an explanation to the caption.

Page 6 Figure 3. “A power inverter (PWI) transforms 10 VDC of the buffer batteries to 220 VAC” Did you mean 12 VDC as in the diagram? - Corrected

Page 6 Section 3.2 Power Supply Line 2 “options to generate and store power. _a_ landline require_” (capitalisation and plurality). Should you say “Grid (or Mains) power requires ... ” - This sentence was messed up. I have corrected it.

Page 11 Section 6 Code availability Line 29 “at https://gitext.gfz-potsdam.de/mors/GeomagLogger” runs off the right margin on my PDF and the final characters are not visible. It is a repeat of Page 11 Section 5 Conclusions and Outlook Line 11. - I have removed the first URL and added a reference to Sec. 6 at that place. I will leave the problem of the URL running off the right margin to be fixed during the typesetting process.

Interactive comment on Geosci. Instrum. Method. Data Syst. Discuss., https://doi.org/10.5194/gi-2017-23, 2017.