

# Review of Solar Power system for polar instrumentation: why night consumption matters

Article by M. Priot-Jones et. al. Review by Rolf Hut.

The authors set out to test whether solar regulators, the devices in between solar panels, batteries and loads that manage charging of batteries, perform as advertised in their datasheets with respect to the nighttime consumption of these devices. They furthermore provide a calculation tool for calculating optimal battery size for a given combination of solar panel, solar regulator and instrumentation load. Their focus is solidly on using solar panels and instrumentation in an arctic setting, dealing with both very low temperatures and the long arctic night.

I think this work is valuable to the community and of interest to the readership of GI. I believe (knowing of) this work will help other scientist who set out for (arctic) field campaigns plan better and avoid either high costs or system failure by applying the lessons from this work. In that regard I philosophically disagree with reviewer #1, who stated

I think it is too simplistic to assume one would pick a solar regulator, put together a sensor-logger system and place it in the arctic. What people will usually do is – as suggested in the manuscript – a dry run and logging of the energy consumption. So, there will be extensive information on the power consumption already available.

This statement by reviewer #1 in my opinion provides too sunny a picture of the daily work of many scientists. It is my hypothesis that many experiments brought to the field in general and the arctic in particular fail because not everyone is aware of these issues with batteries and solar generators. Those failed experiments hardly make the scientific literature because of systemic problems with publishing negative results. Scientists that have (access to) a lab equipped with tools and staffed by electrical engineering technicians to execute and help with a dry run might have the option to do so, making their chances of successful field campaigns higher. Even they are helped by the work of Prior-Jones et. al. in the sense that they can make the decision on which device to buy for these tests informed.

The main take-away from the work is that datasheets should not be blindly trusted. I strongly believe that as a community, when a scientist has tested a device and either confirms the datasheets, or has contractionary findings, this is valuable information for the entire community, avoiding double work for other scientists. Sharing these results therefore have my strong support.

I do, however, have suggestions to improve on the clarity and readability of how the work is presented. I therefore recommend minor changes be made to the manuscript before publishing.

## clarity

The authors employ a loose style of writing suited for easy reading, but this does occasionally lead to the function of different parts of the document being mixed or unclear. For example, starting on line 61 the authors provide a recommendation in the introduction. This feels out of place as the introduction is meant for “setting the scene”.

For further clarity I recommend:

1. Adding a small reading guide after line 47: “in the rest of this document, in paragraph 1.1 we will review the current state of the art in battery management, in 1.2 on solar regulators .... Etc.
2. Move “but we show ...” on line 100 to the results and out of the introduction.
3. Focus the summary of the goal at the end of section one: aim to check if datasheets reported values are correct, plus, we provide a modelling tool for arctic field workers to calculate required battery size for a given setup
4. Start a new paragraph after line 124 to signal the break between description of the model and the application of the model with a given set of assumptions
5. Change paragraph 4 into “discussion” and split into 4.1: discussion on this study (or a better title) and 4.2 design recommendations for arctic fieldwork. In 4.1 add a few lines on the limitations of this study: limited selection of solar generators, short time measurement of night time consumption as represented of night time consumption throughout arctic night, temperature effects of arctic night on night time consumption not modelled in the lab, etc.
6. In the conclusion, re-emphasize the added value of this work to the community: add a sentence to the like of: “we provide a workflow for assessing the night time consumption of solar regulators and test X of them in this work, showing that datasheets are not typically to be trusted regarding night time consumption. Furthermore we provide a calculation tool for arctic field scientist to calculate required battery size based on solar regulator specs and therefore aid in choosing the right solar regulator fit for purpose. In our own calculation example this resulted in a 26x reduction in required battery weight and 13x reduction in battery cost.”

## Rigor

At points I missed information to fully understand the work done and presented. In particular:

1. What is the impedance of the multimeter used? Does this effect the measurements in any way (for devices with very small nighttime consumption?)
2. The authors state that some regulators have diodes that prevent back currents through the solar panels during nighttime, but others do not. How does not connecting a solar panel during the tests relate to this?

3. For the results in figures 1 and 2, please indicate if these are modelled, measured values, or values reported by manufacturers. (I believe this is the latter, right?) Please provide a timestamp for these values as well both in the main text as well as in the figure caption (I believe these are 2023 values?)
4. In table 1, make a clear visual divide between reported values and measured values. I also recommend adding a column that provides the ratio (or a % increase / decrease) of the measured value versus the datasheet value.
5. In table 2 I find the double use of the word “model” confusing, both for the numerical model presented in this work and for specific solar regulators.
6. Also in table 2: please add a line for “perfect regulator” where you assume no nighttime consumption at all. I also suggest (but leave to the authors to decide) to add two columns “additional battery weight required because of solar regulator” and “additional weight because of more nighttime consumption measured than solar regulator reports in datasheet”. This last one is mainly for the press release or popular blog if the authors decide to write those ;-).
7. Please link to version releases of the github repository, not to the general repository (ie. to <https://github.com/CHILCardiff/solarregulators-model/releases/tag/preprint-v1>) If the authors intend to update the repository in the future with more measurements or more regulator-models, this link points to the version used in this paper and they can add a sentence saying that the general version might be updated later.