Template of Hardware Metapaper

For submission to the *Journal of Open Hardware*

To complete this template, please replace the blue text with your own. The paper has five main sections: (1) Overview; (2) Quality Control; (3) Application (4) Build Details (5) Discussion (6) Licenses.

# **Please adhere strictly to this exact format (including indentation, justification, and fonts)**

# (1) Overview

## Title

## Low Cost Data Acquisition System for Monitoring Induced Electromagnetic Noise from Electric Transmission Lines in Geophysical Applications

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## Abstract

A short (up to 250 words) summary of the hardware being described: what problem(s) the hardware addresses, what it does, how it technically/methodologically advances the state-of-the-art, how it was designed and implemented, and its applicability to other issues/research/areas of reuse.

|  |
| --- |
| Metadata Overview *Please provide the following overview and self-assessment*  Main design files: link to repository with design files and assembly instructions  Target group: e.g. secondary school students, layperson, undergraduate students, scientists in [discipline], trained engineers, use of professional services  Skills required: For each main manufacturing method, provide information pairs (method - easy / advanced / specialist). E.g. desktop 3d printing - easy; surface mount PCB - advanced; injection moulding - specialist  Replication: Project has been replicated at time of publication? Include reference (possibly way of contact). Links to places where future builds and kits might be found (repository, group website, collaboration site, etc.).  *See section “Build Details” for more detail.* Keywords *(required)* keyword 1; keyword 2; etc.  Keywords should make it easy to identify who and what the hardware will be useful for. Maximum of 5 keywords. E.g.: microbiology; laboratory; microfluidics; single cell analysis; fluorescence |

## Introduction

An overview of the hardware, what it does, how it was produced, and the research for which it has been used. If the hardware addresses a specific lack or problem, describe the problem in this section and how the hardware addresses the problem. Elaborate how it technically/methodologically advances the state-of-the-art including references to relevant research articles and online references.

## Overall Implementation and design

Describe how the hardware was implemented/created, with relevant details of the architecture and design, including general materials (*Note: specific details on materials can be addressed in later section “Availability of materials and methods”*). The use of diagrams and pictures of the assembled hardware is appropriate. Please also describe any variants and associated implementation differences.

*Note: This is not meant to be an assembly instruction. Assembly instructions, detailed material lists, and construction files must be deposited in an appropriate repository (see Repositories document) and referenced in the section “Build Details”.*

### Subsections

We encourage the use of subsections to highlight the modular functionality of the design or to highlight different design achievements. These questions might help you find appropriate subsections: What parts of the hardware could be used as a component of another project or a variation of this hardware? What solutions do you find most noteworthy given your experiences during the design iterations? What separate actions does the hardware perform?

# (2) Quality control

## Safety (Optional, delete if not relevant)

Describe all relevant safety issues or references to a risk assessment if included in the hardware documentation (For example high voltage, chemical safety etc.). If appropriate, discuss the wider context of the use of the hardware and safety issues or risks that may arise in the use environment.

## Calibration

If the hardware is used for measurements, please detail here how the reliability of measurements, or other hardware properties that are relevant for measurements, has been quantified and explain the results. Be clear about the processes or procedures used to compare the hardware to a standard, as well as the description of the standard calibrated against.

Detail the general procedures in place for users to calibrate their hardware before or during use. What methods can be used to relate user-generated data to data from other sources?

*Note: Detailed instructions belong in documentation; here, provide insight into how and why the calibration is valid.*

### Subsections

We encourage the use of subsections within all sections to increase clarity.

## General testing

In this section, details can be provided on the testing of hardware functionalities, that are not directly essential for the precision operation of the hardware in the given context (which are in turn, where applicable, handled under Calibration), such as automated movements to position the hardware, repeatability of tool exchanges, recyclability, water-tightness, weight or other possibly relevant characteristics. We encourage the authors to characterise all appropriate functionalities of the hardware, if not already described elsewhere (add reference instead). The testing should define the safe/reliable limits in which the components can be operated (e.g. step size and repeatability of linear motion, force ranges, ratio of devices with leaks when built in a workshop, etc). This will enhance the usability of the hardware or method in other contexts.

*Again: Detailed instructions belong in documentation; here, provide a summary instead.*

# (3) Application

## Use case(s)

Describe at least one example of an application of your hardware. This should include some evidence of output, e.g. data produced by the use of the device or a picture of other types of results. Outline how the quality control in the previous section enables the use of the hardware in this context. We encourage the inclusion of experiment results or the reference to a publication (published or to be published) where these results are detailed. We also encourage pointers to ongoing work.

*Note: In the spirit of openness, we require authors to provide (or link to) datasets along with the submitted graphic representations. We do not impose arbitrary limits on the inclusion of data so please include sufficient empirical detail and results to ensure your data can be easily verified, analysed and clearly interpreted by the wider scientific community.*

### Subsections

We encourage the demonstration of different use cases, divided by sub-sections to guide the reader.

# (4) Build Details

## Availability of materials and methods

Summarise what materials have been used to construct the hardware and what methods to process the materials as well as the assembly. Provide more details or references where important materials or methods are non-standard, not globally available, or produced only by one manufacturer.

## Ease of build / Design decision

Have any measures been taken in the design to make the hardware easy to build for other users e.g. reduction of parts, features in the design to make the hardware assembly more reliable?

What were the decisions made in designing this hardware? Were other designs/options tried? please describe also what did not work.

## Operating software and peripherals

If hardware requires software, details on the operating software and programming language - Please include minimum version compatibility. Additional system requirements, e.g. memory, disk space, processor, input or output devices.

If the hardware does not require software, detail any required supporting processes or protocols required for use.

## Dependencies

E.g. other hardware or software projects, modular components, libraries, frameworks, incl. minimum version compatibility. Explicitly state if dependencies are proprietary / closed source.

## Hardware documentation / build instructions / files location:

***Archive*** ***for hardware documentation and build files*** (required)

*Note: We require the inclusion of modifiable design files as well as detailed documentation of the design rationale of the hardware with assembly instructions. This will be assessed as part of the journal peer-review process.*

*Step-by-step build instructions must be available online in a repository or submitted as supplementary material.*

For the assessment of the article, these repositories can be modifiable, for example, on GitHub or GitLab. Once the article has been accepted, these repositories must be moved in a preservation and immutable repository, for example, Zenodo.

***Name:*** The name of the archive

***Persistent identifier:*** e.g. DOI, etc.

***Publisher:*** Name of the person who deposited the documentation

***Date published:*** yyyy-mm-dd

**Modifiable design files** (if different from above)

***Name:*** The name of the emulation environment

***Persistent identifier:*** e.g. DOI, handle, PURL, etc.

***Publisher:*** Name of the person who deposited the documentation

***Date published:*** yyyy-mm-dd

**Software code repository** (e.g. SourceForge, GitHub etc.) (required)

***Name:*** The name of the code repository

***Identifier:*** The identifier (or URI) used by the repository

***Date published:*** yyyy-mm-dd

# (5) Discussion

## Conclusions

Conclusions, learned lessons from design iterations, learned lessons from use cases, a summary of results.

## Future Work

Further work pursued by the authors or collaborators; known issues; suggestions for others to improve on the hardware design or testing,, given what you have learned from your design iterations.

## Paper author contributions (CRediT)

Task (e.g. design, assembly, use cases contribution, documentation, paper writing), contribution, author name.

## Acknowledgments

Please add any relevant acknowledgments to anyone else who supported the project in which the hardware was created, but did not work directly on the hardware itself.

Please list anyone who helped to create the hardware and software (who may also not be an author of this paper), including their roles and affiliations.

## Funding statement

If the hardware resulted from funded research please give the funder and grant number.

## Competing interests

If any of the authors have any competing interests then these must be declared. The authors’ initials should be used to denote differing competing interests. For example: “BH has minority shares in [company name], which part funded the research grant for this project. All other authors have no competing interests." Or “BH is selling kits and parts connected to the here presented hardware via platform XX. A fundraising via Crowdfunding platform YY is planned to start commercialisation.”

If there are no competing interests, please add the statement:

“The authors declare that they have no competing interests.”

## References

Please enter references in the Vancouver style and include a DOI where available, citing them in the text with a number in square brackets, e.g.

[1] Piwowar, H A 2011 Who Shares? Who Doesn't? Factors Associated with Openly Archiving Raw Research Data. PLoS ONE 6(7): e18657. DOI: http://dx.doi.org/10.1371/journal.pone.0018657.

# (6) Licenses

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