
AN OPEN-SOURCE MAX14866 DEVELOPMENT BOARD

A POLYGLOT DOCUMENTATION FILE

Luc Jonveaux*

Tinkerer, Milly le Meugon, France
contact@un0rick.cc

December 23, 2021

ABSTRACT

Non destructive testing and imaging ultrasound have been around since the '50s. Many ultrasound open-source projects are emerging, mostly focusing on image processing - while hardware has been left behind. Several teams have produced successful designs to be used on commercial US scanners, but they are not cheap, and are difficult to access.

I couldn't find designs to play with, that would be affordable or open, so I decided to update the previous one, the un0rick, for a more cost-efficient board designed for makers, researchers and hackers.

Having a single-channel device was not enough to play with small linear or annular arrays, so we developed a small high voltage switch control to allow pulse-echo, separating transmit and receive paths, on a 8-element array, or to access up to 16 elements with the same TX/RX path.

This PDF is also a ZIP that contains the sources to the hardware and some data too, don't hesitate to have a look. Just rename the file from .PDF to .ZIP and you're ready to go .

Keywords open-source · ultrasound · hardware · ice40 · fpga

1 Overview

This wonderful board has been designed to provide a curious tinkerer with the basis to play with, and understand, imaging with multi-element ultrasound sensors.

As stated by its datasheet, "the MAX14866 is a 16-channel, high-voltage (HV), analog SPST switch primarily intended for HV multiplexing in ultrasound applications. The MAX14866 operates from one only low-voltage supply (+5V) and does not require dedicated HV supplies, resulting in cost-saving and system simplification. ". The MAX14866 can transmit undistorted analog signals up to 210VP-P. There are also bleed resistors.

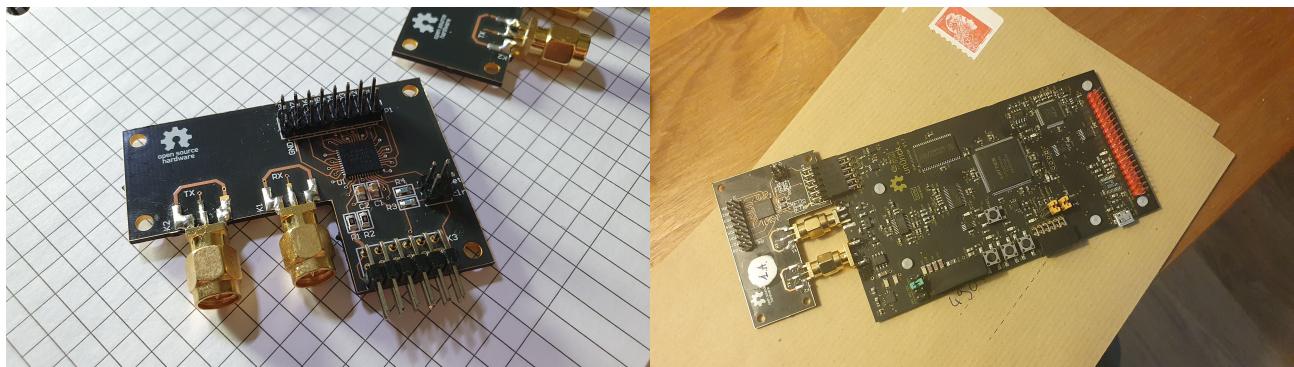


Figure 1: Top side of the max14866 board and its connexion to the un0rick.

This allows for a relatively simple design.

*More on the website <http://un0rick.cc>. This paper has its on Zenodo DOI [10.5281/zenodo.5792252](https://doi.org/10.5281/zenodo.5792252)

2 Where to find the latest sources

The latest sources of the hardware as well as software are available at <https://github.com/kelu124/max14866/>. However, this PDF also doubles as an archive (you can rename the .pdf as a .zip, and you'll see), and contains, in short: a set of gerbers and BOM, and some documentation. There may be some other stuff there, but I forgot what I put there.

3 Operation

We have run tests as showed in figure 2. The FPGA had all the right logic in place to provide you with a full control over the pulse-echo process.

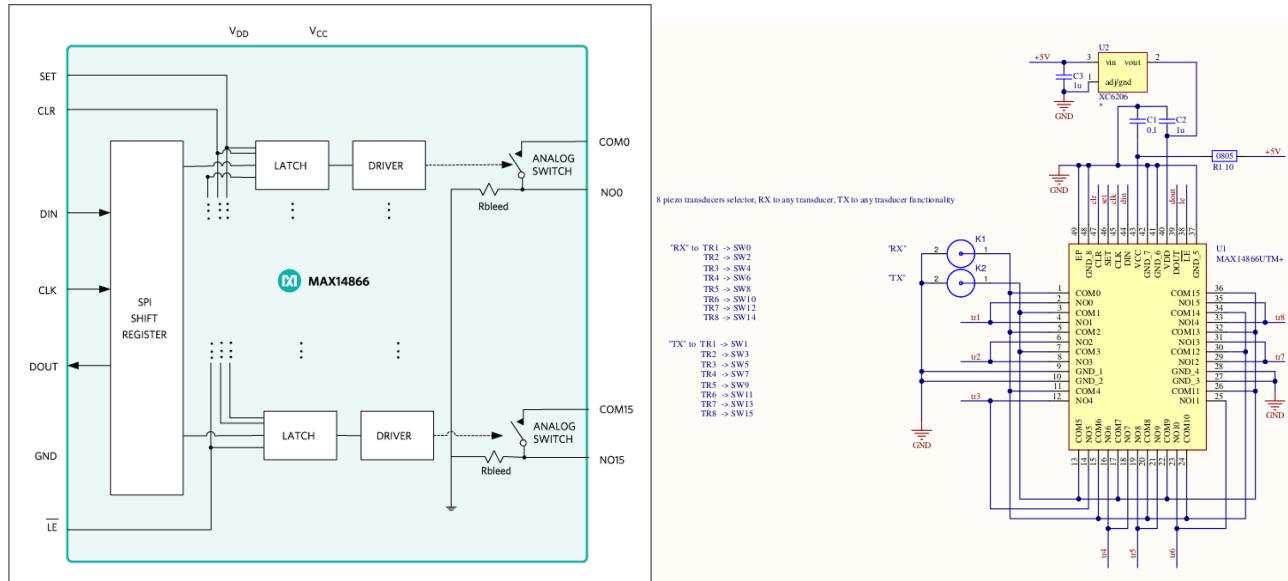


Figure 2: Principles of the board

The second figure 3 shows all acquisitions for all pairs of tx/rx combination : we ran the tests on a 5-element arrays, with a pin missed during soldering. That being said, it demonstrates the feasibility to get echoes using the max14866 board.

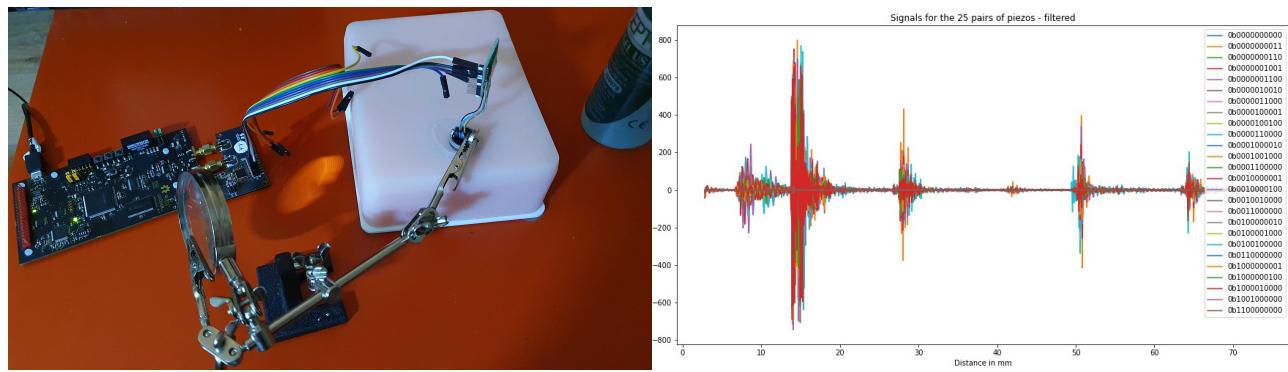


Figure 3: Top side of the max14866 board and its connexion to the un0rick.

4 Last details

Certification The development board is open-hardware certified, under ID [FR000014](#).

License This work is based on previous projects, the un0rick and the echOmods projects. The lit3rick project and its boards are open hardware and software, developed with open-source elements.

Copyright kelu124 (kelu124@gmail.com) 2020

- The hardware is licensed under CERN-OHL-S v2.
- The software components are free software: you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation, either version 3 of the License, or (at your option) any later version.
- The documentation is licensed under a Creative Commons Attribution-ShareAlike 3.0 Unported License.

5 Links to go further

- Come and chat : [join the Slack channel](#)
- The full GitHub repository for [the un0rick "motherboard"](#).
- The board's [Tindie shop](#) to get it
- The project [Hackaday page](#) with more logs
- Check out [my previous work](#) on the topic of ultrasound modules [1] and its [dataset on Zenodo](#). More to come!

6 Next steps

Plenty to do on the next steps! Let me know if you'd like to contribute. The current shopping list (non-exhaustive) may include:

- Improving the documentation, and updated the work of its [predecessor, the un0rick](#) [2].
- Shift to a "real", PMOD-compliant connector.
- Have a better connector

References

- [1] Luc Jonveaux 2017. Arduino-like development kit for single-element ultrasound imaging. In *Journal of Open Hardware*, 1(1), p.3. DOI: [10.5334/joh.2](https://doi.org/10.5334/joh.2)
- [2] Luc Jonveaux 2019. un0rick : open-source fpga board for single element ultrasound imaging On *Zenodo*. DOI: [10.5281/zenodo.3364559](https://doi.org/10.5281/zenodo.3364559)
- [3] Luc Jonveaux 2021. lit3rick: an up5k ultrasound pulse-echo device On *Zenodo*. DOI: [10.5281/zenodo.5792245](https://doi.org/10.5281/zenodo.5792245)