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Australian Bureau of Meteorology(BoM) 6A-series Ionosonde upgrade

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In 2019, the bureau elected to replace existing in-house 5-series Ionosondes, built between 1990 and 2005. Supporting the 5-series had become increasing difficult with both reduced competent personnel and dwindling spare parts. Several commercial ionosonde offerings were evaluated and none were found suitable. In 2021, the BoM contracted CortexRF company in Canberra to re-evaluate the commercial offerings, and consider the options. A prototype using commercial-off-the –shelf components was built and operated time share with a 5F-series ionosonde at Townsville for a 3 month data comparison period. The data was deemed compatible and met quality requirements of existing datasets produced by the 5 series network.

In April 2022, the rollout of the new 6A Ionosonde began, and was highly challenging due to component shortages and difficulty travelling during the COVID pandemic .

The 6A is a bi-static capable, monostatic chirp sounder, and produces improvements on the 5 series in sensitivity and resolution, while mitigating challenging radio spectrum interference conditions. The design is readily reproduced and extensible.

The heart of the design consists of a low cost (USD$500) high performance SDR (software defined radio) platform designed for university electronics instrumentation and amateur radio operators and experimenters. The SDR block is teamed with a fanless Linux PC that provides all digital signal processing required for generating the stimulus, and demodulating/processing the received raw data samples.

The software is entirely written in Python using Numpy as the arithmetic package. It was important that the software be readily accessible and maintainable in an item that will likely need to be updated and upgraded by varied staff over the course of its expected minimum 15 year life.

The author has extensive experience in Ionospheric communications, and has been building high power Ionosondes since 2003. The base work on the chirp RADAR algorithms used in the 6A were developed during amateur radio experiments of passive ‘moonbounce’ (Earth-Moon-Earth) communications on 10GHz and 24 GHz in 2015. More recently, the author has extended the basic functionality to a complete Space Weather Sensor package, including a Magnetometer, Riometer and TEC measurement that can provide forecast-effective ionograms and related data from compact antennas.