

## RFSOC FIRMWARE DEVELOPMENT OF A FREQUENCY MULTIPLEXED READOUT FOR SUPERCONDUCTING ARRAYS

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We describe the development of a frequency multiplexed readout system for superconducting arrays using the Xilinx Radio Frequency System on a Chip (RFSoc). This system is an upgrade to the ROACH-2 based readout system we have developed for a number of balloon-borne and ground-based instruments including BLAST-TNG, OLIMPO, MUSCAT, SuperSpec and Toltec. Specifically our development has targeted the RFSoc ZCU111 evaluation board. The size (30x20x.27 cm), weight (.8 kg), power (<math>\leq 30\text{W}</math>), and instantaneous bandwidth (8x 4GSPS) of the RFSoc ZCU111 have made it an attractive candidate for future balloon-borne or even space-based astronomical instruments. Additionally, the RFSoc has an open source python interface, which allows for users to interact with data and update firmware settings while running. We also describe the design and performance of an IF board for up-converting and down-converting the output of the ZCU111 into the 4-8 GHz band. Applications for the new readout system focus primarily on: frequency multiplexed superconducting nanowires single-photon detectors (SNSPD), Kinetic inductance detectors (KID), and Transition Edge Sensors (TES). The overall firmware architecture for these three detector technologies are fundamentally the same. The firmware design can be divided into three separate parts: the modulator, demodulator, and tone tracking. We will also present preliminary measurements of both KIDs and SNSPDs with the readout system.