MATTER AND TECHNOLOGIES

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RFSoC Gen 3 Data Converters Characterization for the Read-Out System of Superconducting Bolometers.

QUBIC ("Q & U Bolometric Interferometer for Cosmology") is a project which focuses on studying vestiges of gravitational waves from the B-polarization mode present in the Cosmic Microwave Background, a product of the Big-Bang. The required sensitivity of the polarization temperature anisotropies of the CMB requires around 2048 ultra-sensitive detectors working at cryogenic temperatures. The instrument is equipped with a multiplexed system able to read them out without degrading their intrinsic sensitivity. In the second stage of QUBIC, a Microwave SQUID Multiplexer was proposed. In this configuration, each detector is coupled to a single-resonant-frequency resonator and a transmission line. The status of each bolometer can be determined by interrogating each resonator individually, needing just a pair of coaxial lines to the cryostat.

The readout system requires the generation and acquisition of multitone signals, typically in the range between 4 and 8GHz. To achieve this, Software Defined Radio (SDR) systems are generally used. The FPGA is coupled to a set of high-speed DACs and ADCs along with analog filters to translate these signals to the required band. Recently, Xillinx released the latest generation (Gen3) of the Radio Frequency System on a Chip (RFSoC) processing platforms, which integrate powerful FPGAs and processors together with up to 16 high-speed ADCs and DACs in a single RFSoC device. This kind of device could potentially improve system integration while reducing power consumption and cost.

This work presents the characterization of high-speed data converters of the RFSoC Gen3 under the conditions of the QUBIC experiment. The results were compared with the experimental requirements and with previous versions of the readout electronics using discrete components. Various operating limits were identified, and the viability of using the RFSoC was assessed. It has been shown that the RFsoc is suitable for the readout of superconducting detectors, that it reduces system complexity, and that it in fact increases system integration.

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