

GIZMo for DUNE at LBNF

Divas Subedi*[†], Michael J. Utes[†], Paul M. Rubinov[†]

*Trinity College, Hartford, CT, [†]Fermi National Laboratory, Batavia, IL

Introduction

This Ground Impedance Monitor system monitors the integrity of the single point grounding configuration required for low noise operations of the far side DUNE detector.

Motivation for GIZMo

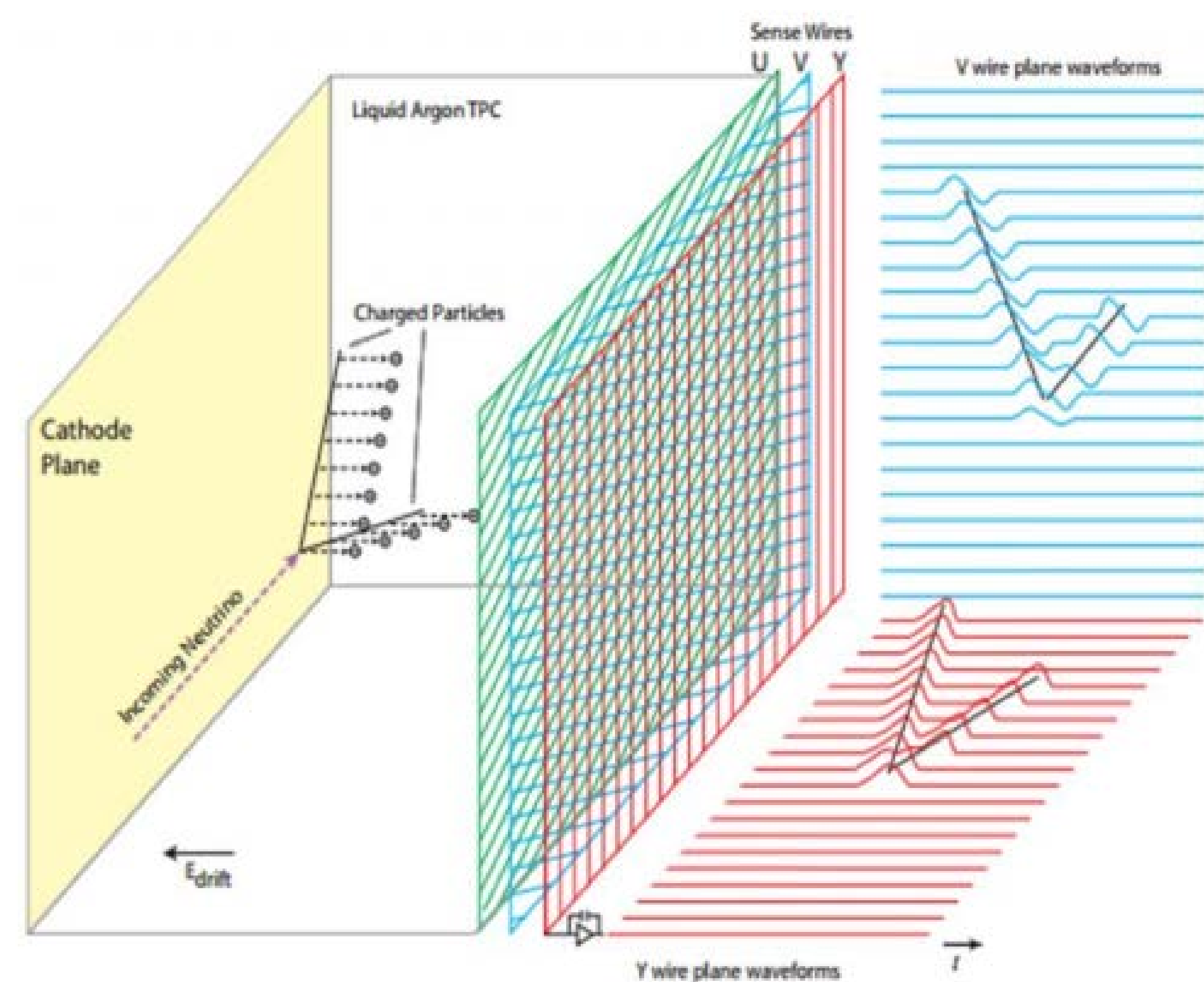


Fig 1 Operation of LArTPC

Building Ground is noisy and hence the detector needs a virtual single point ground node that is isolated from the building ground in order to eliminate the noise.

Method

The DUNE detector is connected to building ground for safety purposes using saturable inductors. This is the only desired connection to building ground. Any additional ground connections could create current loops and be a source of noise. The GIZMo injects a small AC current to the detector and measures current in the saturable inductor to estimate the impedance between the single point ground node and building ground.

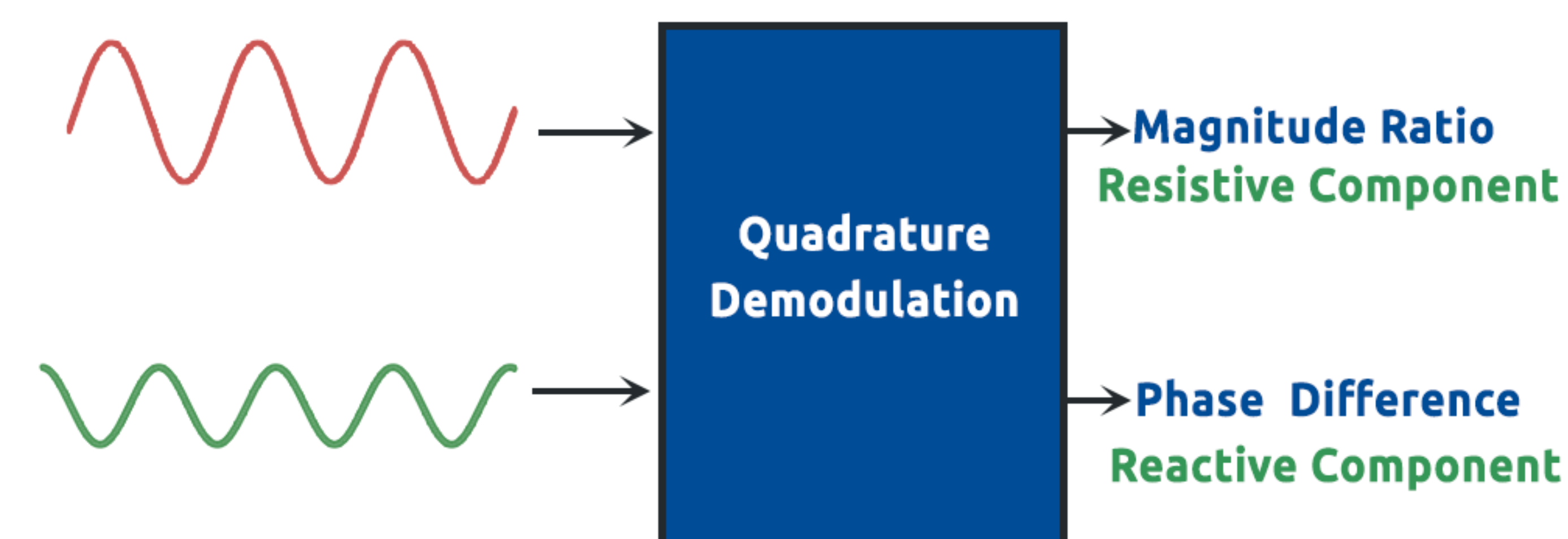


Fig 3. Quadrature Demodulation

The excitation waveform is stored in one FPGA block RAM, which is injected to the circuit using DAC. The current through inductor is measured with CT and is digitized using ADC module. Inductor current is demodulated into quadrature relative to the stimulating current. Now, the magnitude ratio between currents can be used to estimate resistive component of the unwanted impedance.

Similarly, the reactive component can be estimated using the phase difference between the current signals.

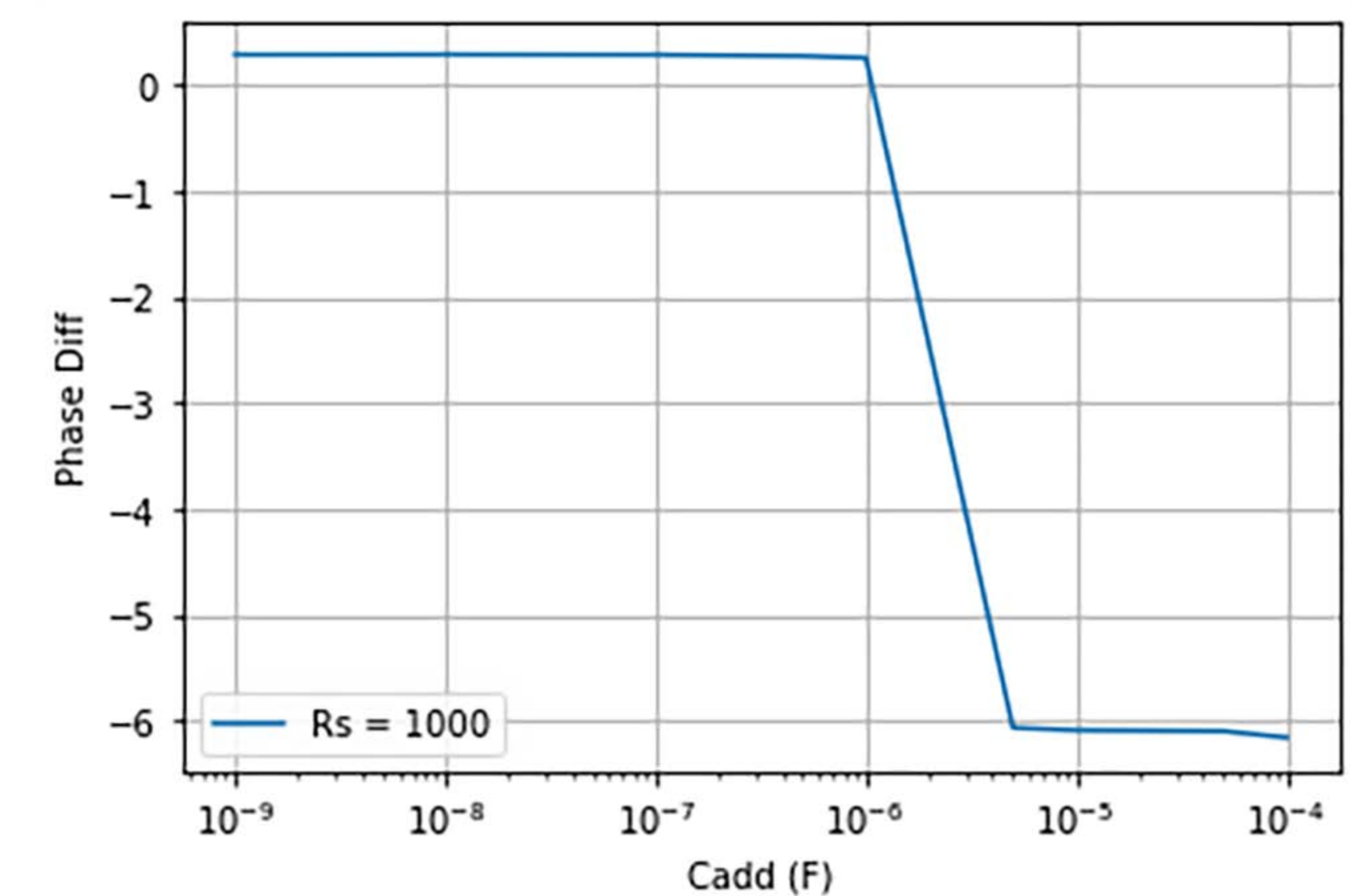


Fig 5 Calibration Curve for Reactive Component

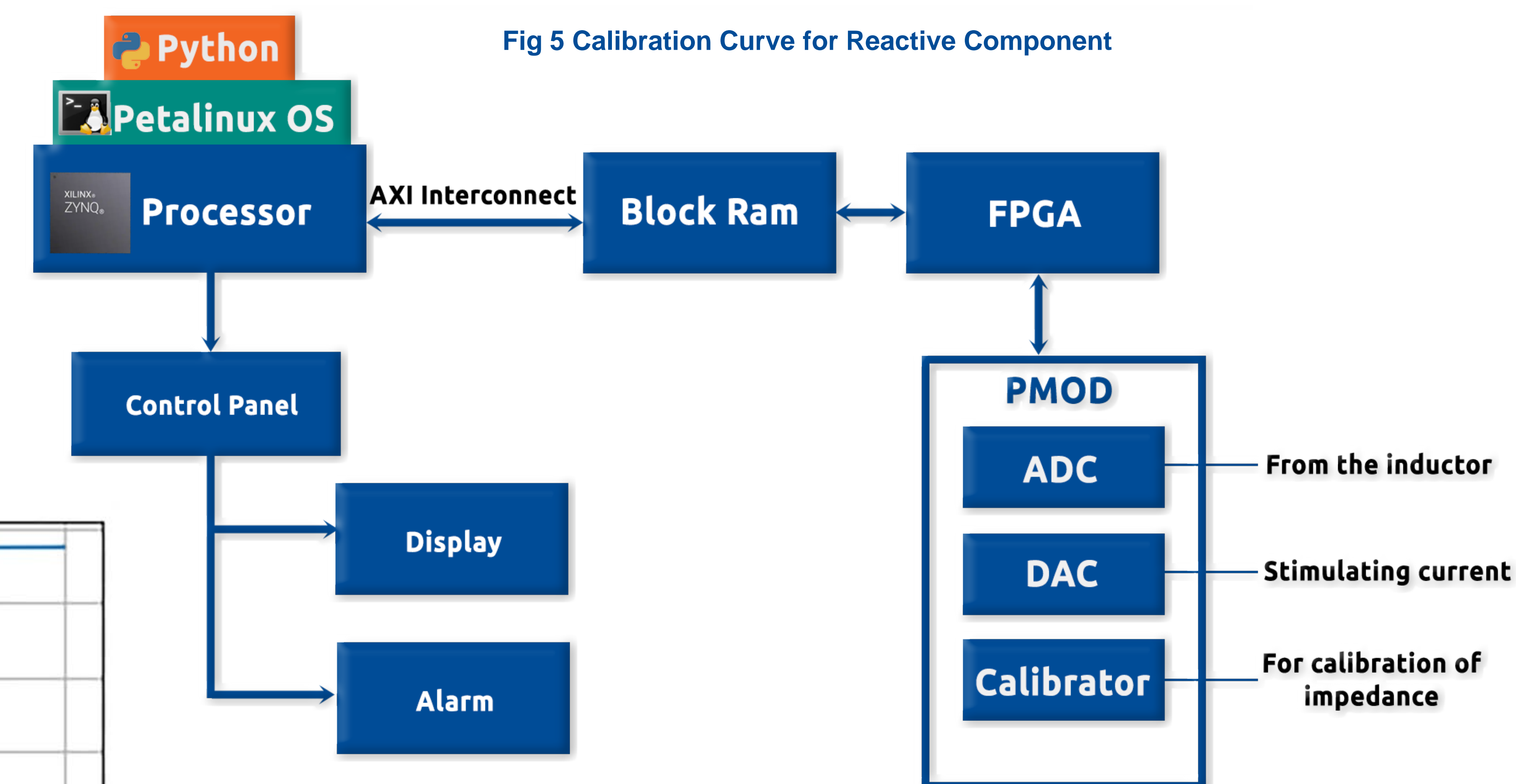


Fig 6 Implementation in Zed Board

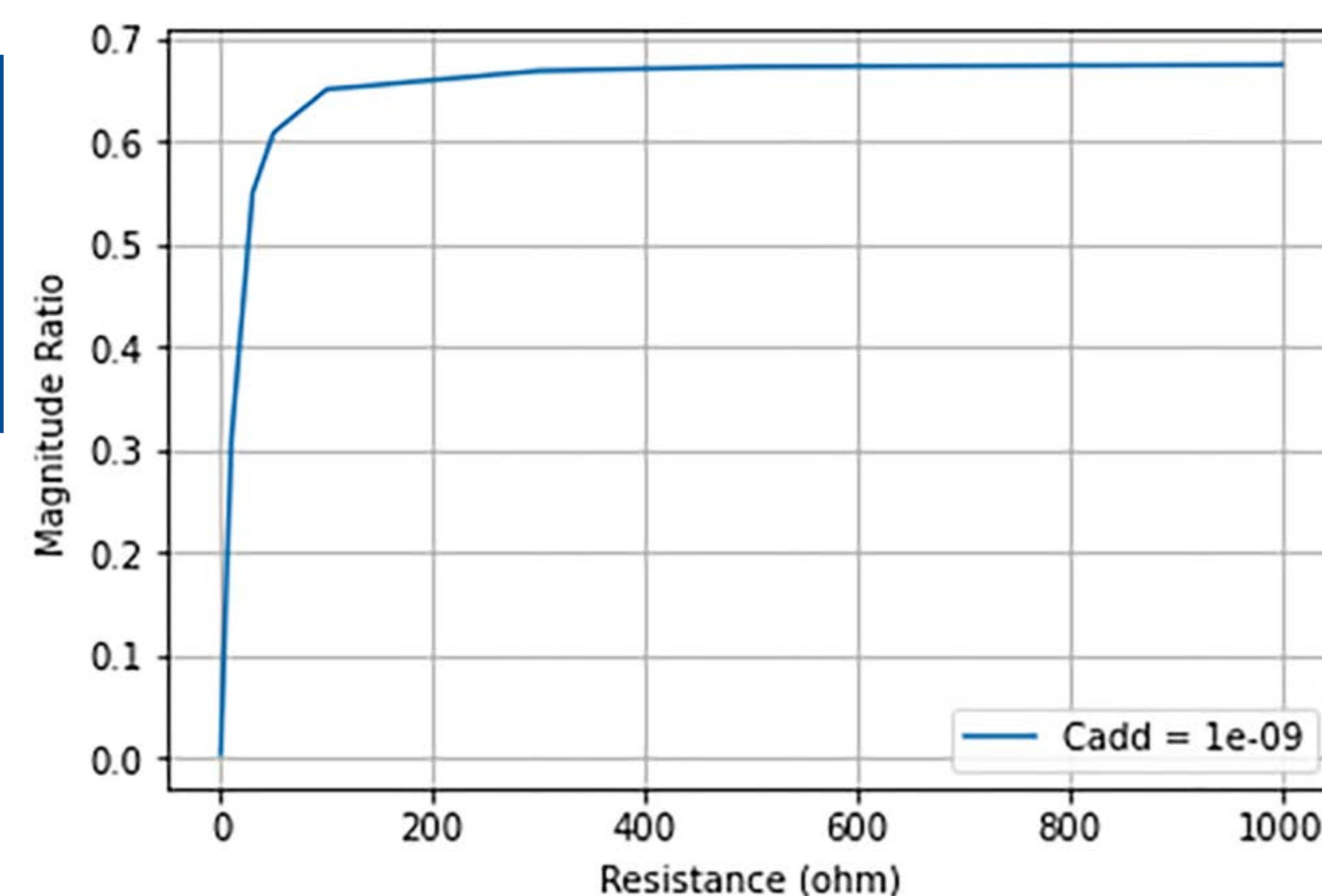


Fig 4 Calibration Curve for Resistive Component

Acknowledgment

Thank you to my supervisors and mentors for creating a welcoming space for collaboration and innovation this summer.

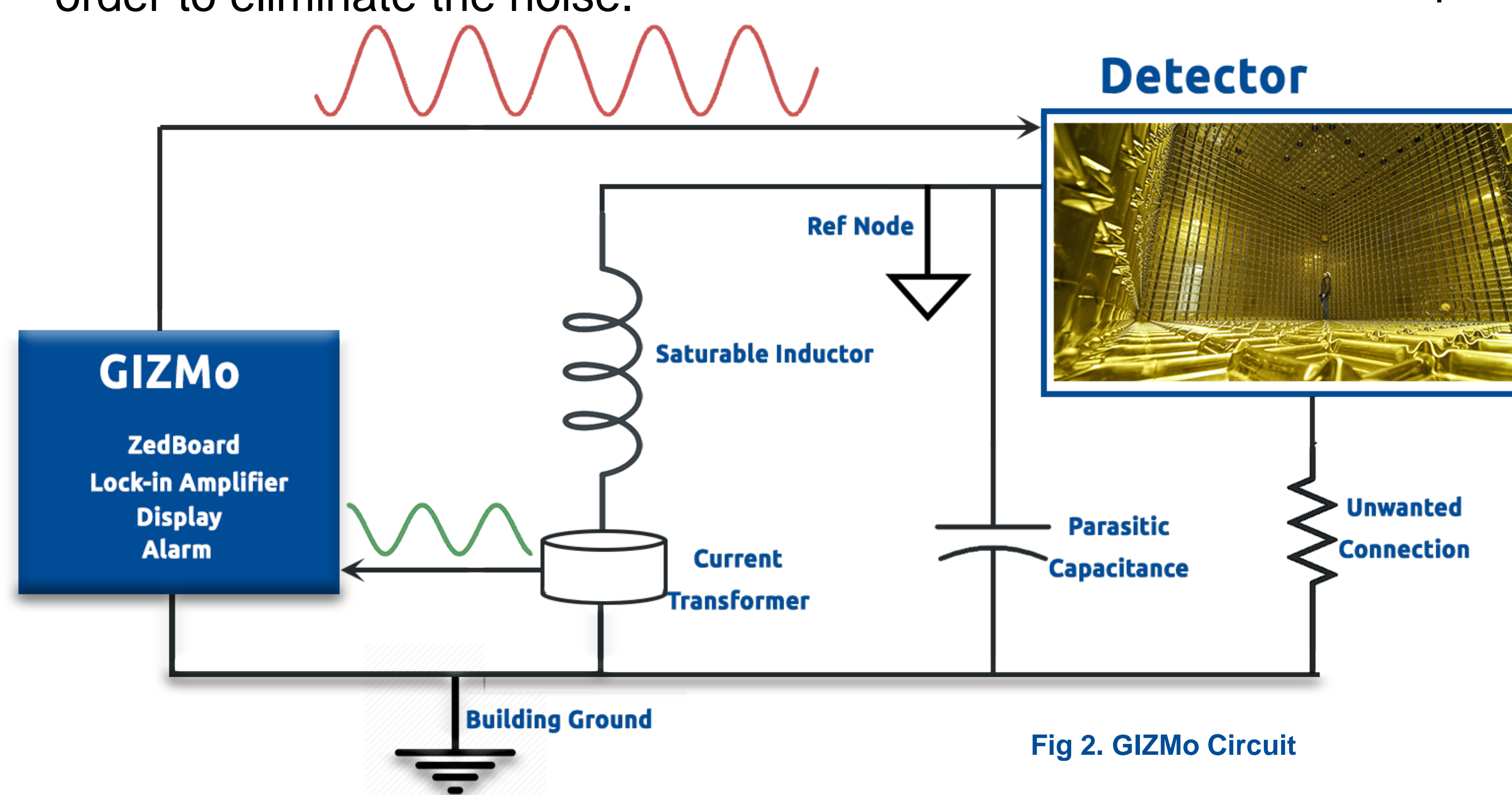


Fig 2. GIZMo Circuit

