

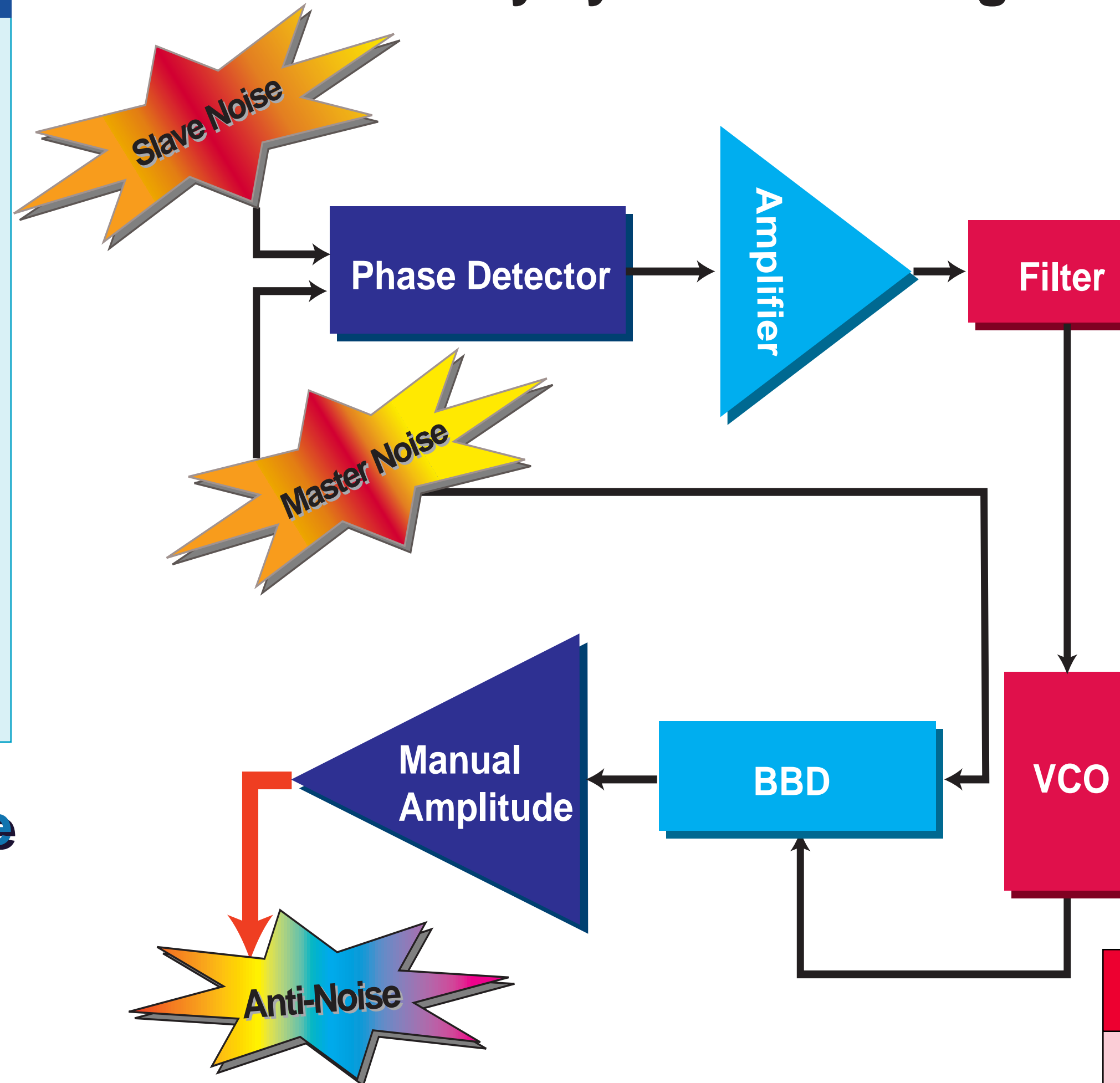
PHASE DELAY IMPLEMENTATION FOR NOISE REDUCTION IN EARPHONES

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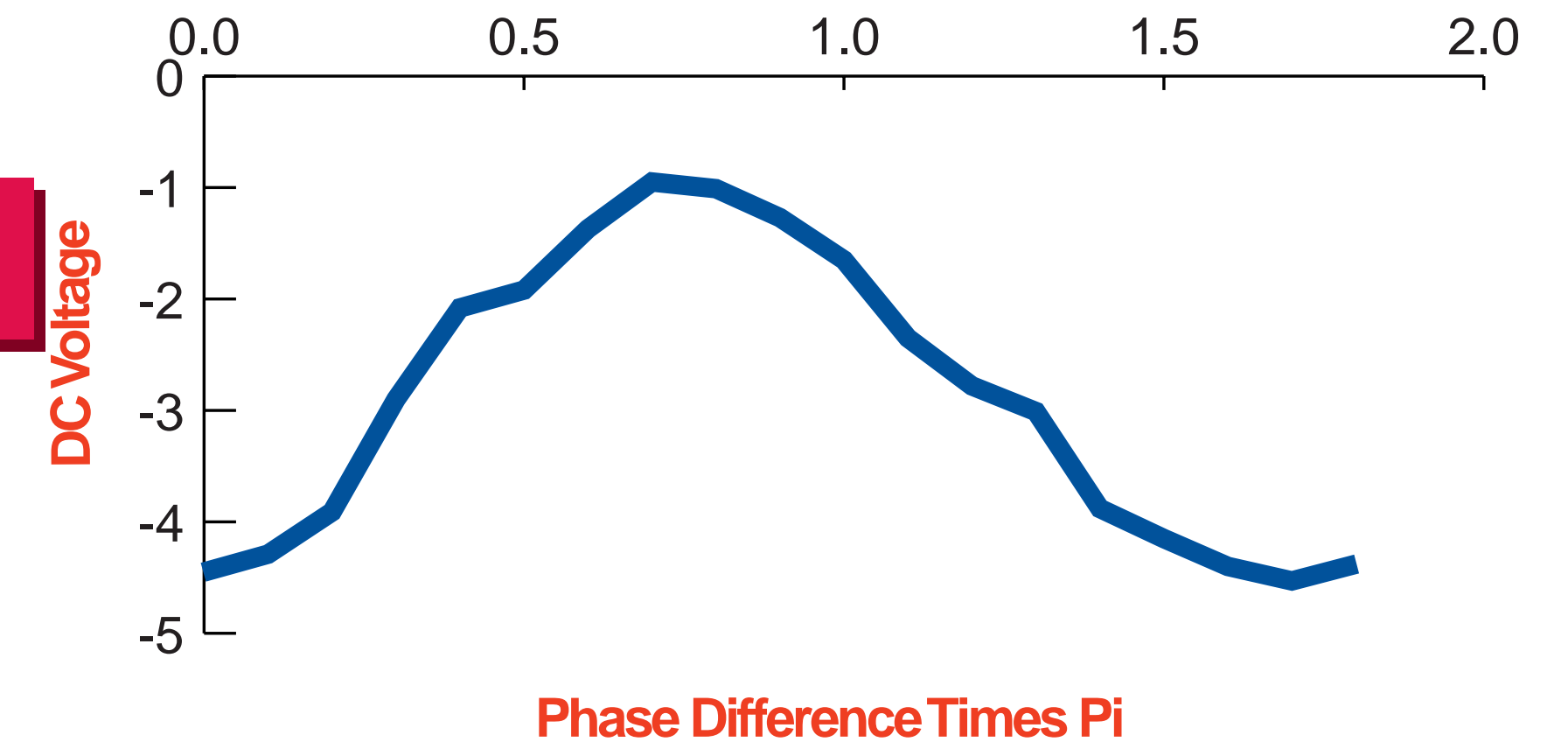
Introduction

Background low frequency noise is a nuisance for headphone listeners. To cancel the noise, we must superimpose anti-noise with the same amplitude and opposite phase. To eliminate noise in several headphones connected in parallel, phase and amplitude are adjusted according to location. By detecting the noise signal at the source (master) and signal at the earphone (slave), we can shift the phase of the source signal based on the phase difference of the two. We can adjust the amplitude to suit the listener.

Phase Delay System Block Diagram



DC Voltage of Phase Detector vs. Phase Difference



Pre-Shifted Master & Slave Noise

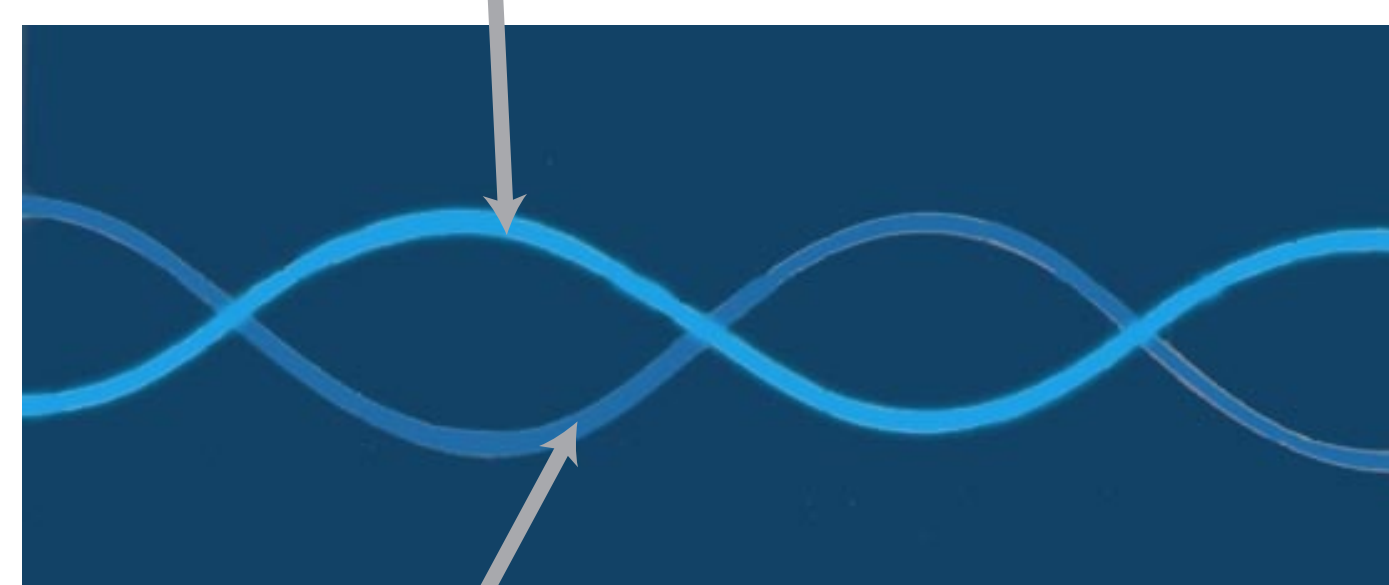
Acoustic Slave Noise



Acoustic Master Noise

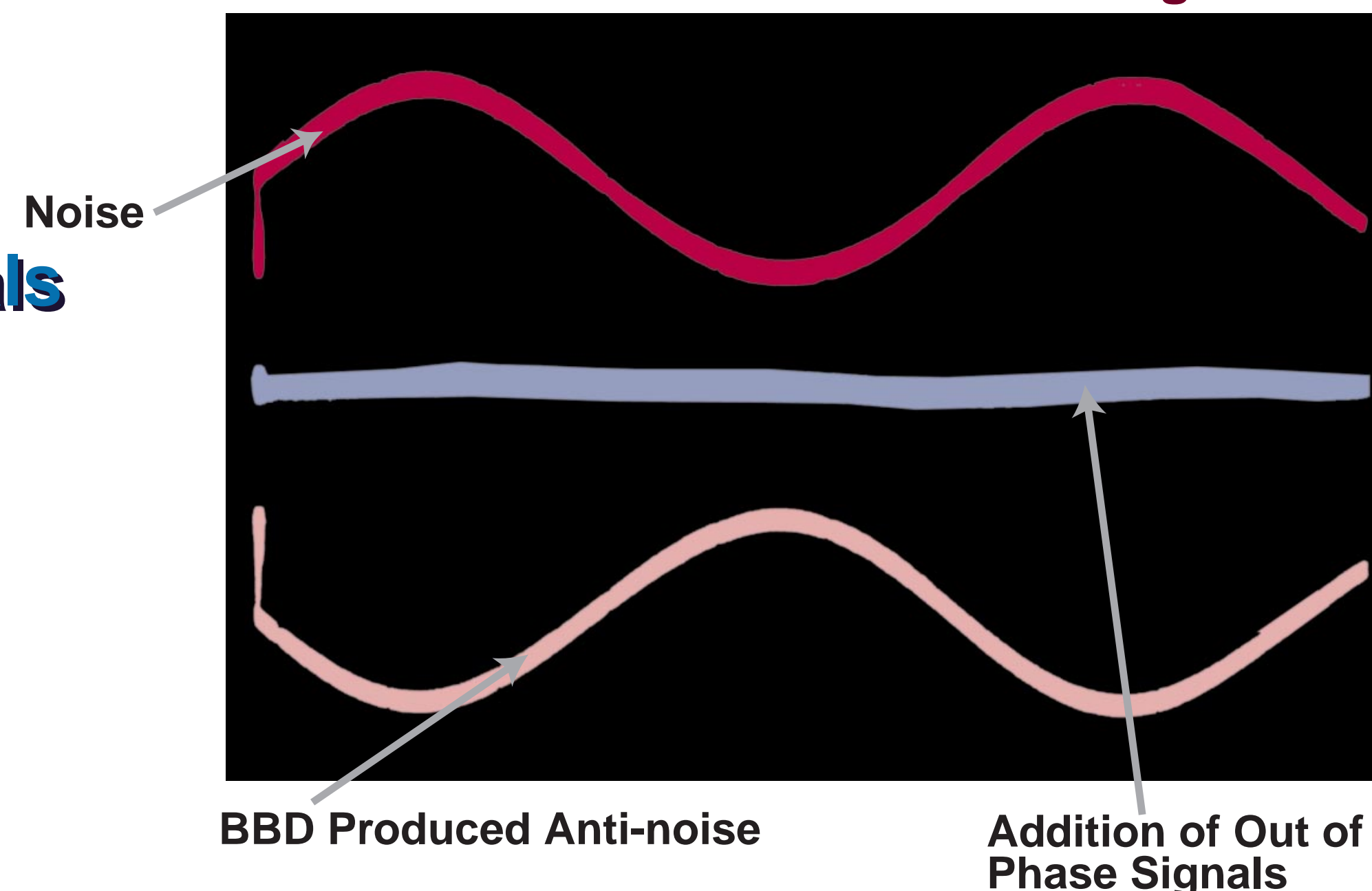
Acoustic Out of Phase Signals

Acoustic Slave Noise



Acoustic Anti-noise

Noise and Anti-noise of Electrical Signals



Conclusions

A desired phase shift can be acquired through a Bucket Brigade Delay Device (BBD) and a Gilbert Multiplier System. The BBD shifts the phase of the source noise signal based on a clock frequency. The two-phase voltage controlled oscillator (VCO) for the BBD can be controlled by a varying voltage for desired clock frequency. Finally, a Gilbert Multiplier is a simple and highly effective method of detecting the phase difference of two low frequency analog signals.

Future Work

To build automatic gain control to adjust the amplitude of anti-noise. Designs of simple but effective methods are under consideration.