Microcontroller Based Phase Locked Loop for Automatic Resonance Frequency Tracking

Joshua L. Campbell
Closed Loop Control Systems
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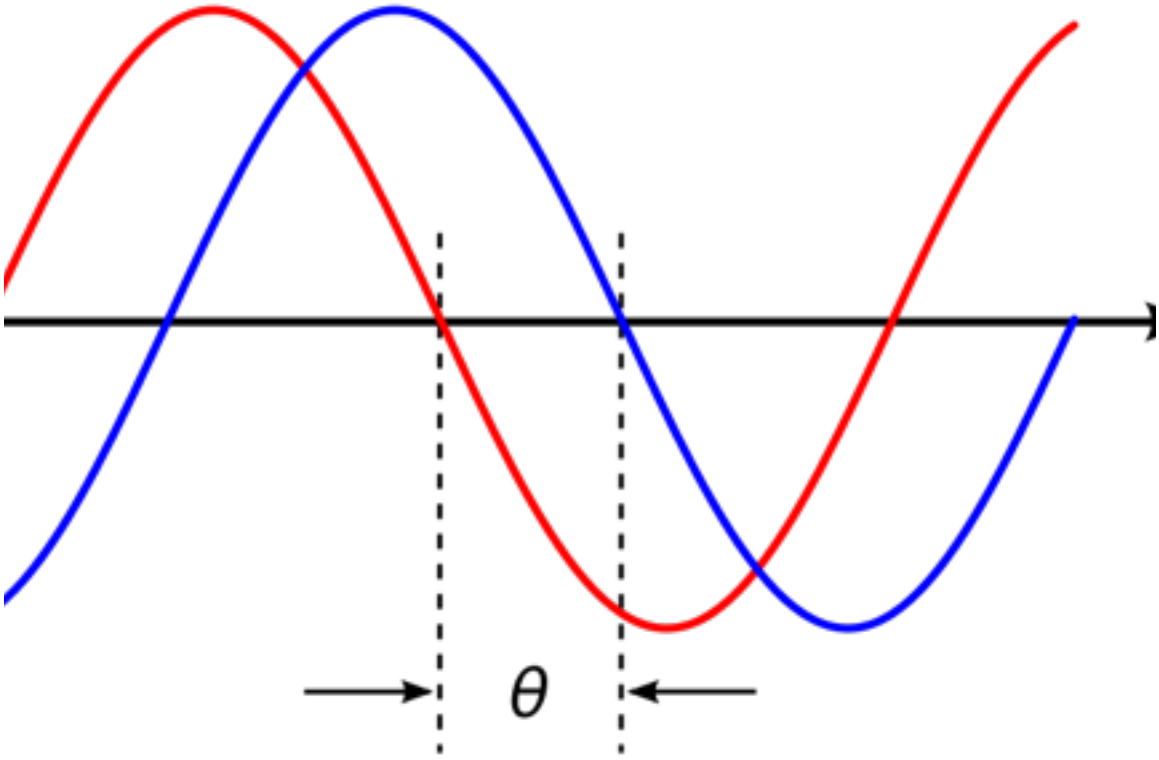
Email : josh.lee.campbell@gmail.com

Abstract— This paper presents an approach for a low cost microcontroller based method of phase control of a resonant circuit (tank). The primary utilization of this system that will be presented here is it's use in a resonant inverter to provide self-tuning to the tank's resonant frequency. This is a common practice in a number of applications that require a controlled AC source such as induction heating and lighting ballasts. Traditional solutions for accomplishing this task include using a monolithic PLL such as the common CD4046 or to perform digital phase control in an FPGA or DPS platform. The goal of the approach presented in this paper is to bring the convenience of analog along with the stability and flexibility inherent in digital control to a low cost, simple to program, microcontroller platform for control of resonant circuits operating at frequencies <200kHz. Both applications mentioned above share a typical operating range of 20-100kHz.



1. Introduction

Resonant inverters [RI] in the 20-100kHz range are commonly used in applications such as induction heating, ultrasonic generators, ballasts for lighting, and resonance transformers used for power transmission and tesla coils. The RI in these devices supply an AC voltage to a resonant circuit or tank. By using the tank voltage or current as a feedback component compared to original AC input signal, the phase angle of the circuit can be calculated. Controlling the phase angle relationship between voltage and current in these systems is important for a variety of reasons. In this paper the target application will be induction heating, in which phase control provides the advantage of self tuning to the tank resonant frequency over varying work load conditions, and protection against inverter non zero voltage switching operation.

Analog monolithic phase locked loop ICs such as the common CD4046 and real time implementation of digital phase control in an FPGA or DPS platform are typical solutions in all of the above applications where some type of phase or frequency control is required. Both options come at a cost with their own advantages and disadvantages. The goal of the approach presented in this paper is to bring the convenience of analog along with the stability and flexibility inherent in digital control to a low cost, simple to program, microcontroller platform for control of resonant circuits operating at frequencies <200kHz.