

Can there be a universal phase locked loop?

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Abstract

This paper aims to highlight the drawbacks of the most common phase locked loop (PLL) circuits to operate as universal PLLs. The phase locked loop tracks the phase of an input signal. These devices are necessary in different disciplines for which the input signal conditions are very different. In fact, they are used in synchronization to the grid waveforms, in the communications applications as frequency modulation or amplitude modulation, and in the measurement of the motors speed, among others. For each discipline, a different group of PLLs is used. Among all of them, the most appropriate to be used in several disciplines seems to be the designed to synchronize the grid. So, they are the chosen to be studied and test their behavior in different applications to find out the PLL which is useful in any application and which achieves to track the phase/frequency signal whose value is initially unknown. I. e. the universal PLL, useful in all the considered applications.

Thus, the most used PLL circuits to synchronize to the grid waveforms, able to work with an unknown initial value of the frequency, have been chosen from the technical literature. I.e. the Synchronous Reference Frame (SRF-PLL), the Second-Order Generalized Integrator (SOGI-PLL), and the Enhanced PLL (EPLL). Their performance has been studied in the monitoring of input signals with conditions different from those presented by the grid voltage, in synchronization. These different conditions are those that occur, for example, in communications applications. The results obtained, prove that the assessed PLLs present a good behavior if the filters and controlled involved in them are tuned to the input signal frequency. In this case, the PLLs provide a signal which tracks the input signal frequency. It could be thought they are universal PLL. However, if the value of the frequency is unknown, the tuning has to be carried out to an estimated frequency, different from the actual one. The results obtained in this paper prove that, in these new conditions, the assessed PLLs do not achieve to track the input signal frequency. Thus, the PLLs analyzed in this paper and carefully chosen are not able to carry out frequency sweeps. Therefore, any of them can be considered as the universal PLL.

Keywords: *phase locked loop, frequency locked loop, modulated frequency, distortion*