A Low-Cost Programmable Digital Sawtooth Wave Generator

Faroze Ahmad
Department of Electronics and Communication Engineering
Islamic University of Science and Technology (IUST), Awantipora, Pulwama India

ABSTRACT- Direct digital synthesis based sawtooth wave generators have a complex structure and therefore are not found suitable for various low cost applications**.** In various laboratories for the environment of under graduate students user friendly instruments are desirable. In this paper a very simple and low-cost ramp generator with programmable slope, using off-the-shelf components, is presented. The circuit was tested using software simulation using Electronics Workbench. The results are also presented.

KEY WORDS: *Sawtooth wave, DDS, Counter, A/D converter, Multiplexer, Frequency divider*

I. INTRODUCTION

Sawtooth wave generators find application in many electronic instrumentation systems. Both analog and digital technologies are used to generate sawtooth waveforms [1-4]. Analog based circuits are simple to design but are vulnerable to noise and have poor linearity. On the other hand digitally implemented circuits offer an advantage of good linearity and immunity to noise. Therefore different systems are preferred where accuracy is of prime importance. Also, due to the advent in VLSI technology, the size and the cost of ICs have drastically got reduced thus making the electronic systems cost effective in most of the cases. Digitally tuned sawtooth wave generators can offer flexibility when ramps with different slopes are desired. Direct digital synthesis based sawtooth generator remains the first choice for a designer when different highly linear slopes are required. But the main disadvantages of such circuits are complexity of algorithms [5] and high cost because of engineering charges, thus making it not suitable for many low cost applications. A simple circuit is proposed in this paper for such applications. The paper is organised as follows: In section II, background of digital sawtooth generators is discussed. Section III discusses the proposed programmable sawtooth generator. Finally, in Sections IV and V, results and conclusion are presented respectivey.

II. BACKGROUND

Fig. 1 shows the basic structure for generating sawtooth waves. The digital to analog converter (DAC) is driven by an up-counter which starts from all zero state and keeps on incrementing linearly one by one for every clock pulse till it reaches to all one state. Each time a pulse is inserted in to the counter, the output of

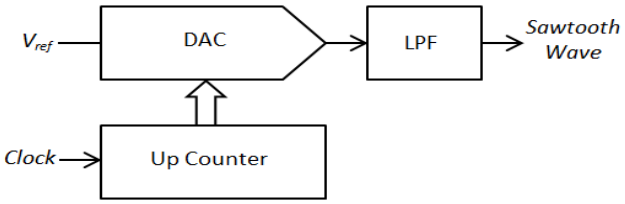
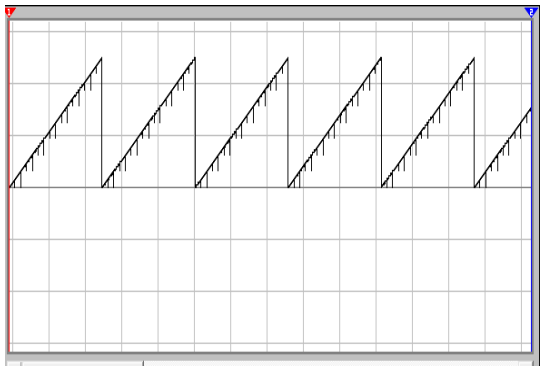
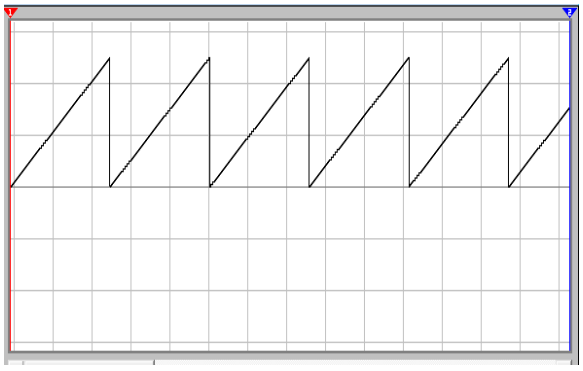


Fig 1: Basic digital saw tooth generator



(a)



(b)

Fig 2: Waveform generated at the output of (a) DAC and (b) Filter

the DAC gets increased till it reaches the maximum full scale value of the DAC. Upon the occurrence of $(2^n + 1)^{th}$