STUDY THE EFFECT OF BUTTERWORTH FILTER'S ORDER ON THE IDEAL FILTER APPROXIMATION FOR BUTTERWORTH LOW PASS FILTER

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SITI FARISHA BINTI ABU HASSAN

FACULTY OF ELECTRICAL ENGINEERING

UNIVERSITI TEKNOLOGI MARA

40450 SHAH ALAM

SELANGOR, MALAYSIA

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ABSTRACT

The wide transition band tells that the transmission of a physical circuit cannot change abruptly at the edge of the passband. The size of transition band describes the filter performance. The narrower the transition band, the better filter performance. Theoretically, as the numbers of order increased, the filter will approximate ideal filter characteristics. The challenges are; by increasing the filter's order, it will increase the circuit complexity and the cost. In order to reduce the circuit complexity, the Sallen-Key equal components topology has been selected since the topology requires fewer components and easy to dimension. This paper thesis also presents the techniques and issues that should be considered while designing the schematic and layout of the filter.

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INTRODUCTION

1.1 PROJECT OVERVIEWS

The filter's performance is defined by the transition band's width. The narrower the transition band, the better the filter's performance. The transition band is usually used as a measure of the sharpness of the low pass filter response and is called the selectivity factor [1]. By reducing the size of transition band, the performance of the filter will be increased due to the filter's ability to change their condition from passband to stopband. The process of reducing the size of transition band is known as ideal filter approximation.

The filter will approximate ideal filter characteristics by increasing the number of filter's order**.** The degree of passband flatness increases as the order N is increases and as the order N is increased the filter response approaches the ideal brick-wall type of response [1]. Thus, the complexity or filter type is determined by the filter's order.

It also known that the roll-off rate and therefore the width of the transition band depend upon the order number of the filter and that for a simple 1st-order filter it has a standard roll-off rate of 20dB/decade. As numbers of order increased by one, the roll-off rate will increased by 20dB/decade. It will result in the increases of filter approximation toward ideal filter characterization since the filter roll-off rate has been increased.

In order to study the effect of filter's order toward ideal filter approximation, the Butterworth lowpass filter has been selected. The Butterworth filter is commonly referred to as a maximally flat or flat-flat filter while the low pass filter is describes as a filter which passes low frequency signals, and rejects signals at frequencies above the filter's cut-off frequency. The Butterworth filter is commonly used compared to Chebyshev and