INTERFACING ELECTRONIC FOR MEASUREMENT, SIGNAL PROCESSING AND WIRELESS COMMUNICATION

Edited by

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CONTENTS

Chapter 11

DIGITAL-TO-ANALOG CONVERTER

MA LI YA, SHEROZ KHAN, ANIS NURASHIKIN

Digital-to-analog converter (DAC) is another important block in the data conversion system. It converts the digital signals from digital processer to the analog signal to be sent to the output applications, such as speaker, LCD, and etc. Many different topologies of DACs exist nowadays, from simple structure to complex. In this chapter, we are going to illustrate some typical designs and to discuss the advantages and disadvantages with different architectures.

11.1. INTRODUCTION

A normal diagram of digital-to-analog converter used in signal-processing applications is illustrated in Fig. 11.1. Digital signals, usually, are binary code applied in parallel to DAC. If other kinds of digital signals, such as BCD, thermometer code, Gray code, we use decoder to convert it first. And then with the help of reference value, we can get analog output from the DAC according Eq. (1).

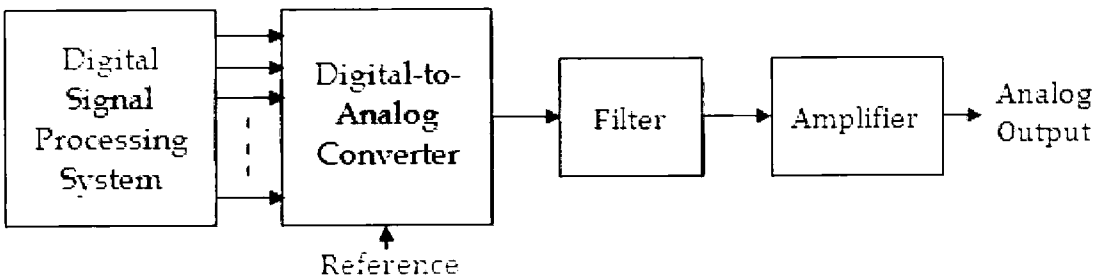

Fig. 11.1: Digital-to-analog converter in signal-processing applications (Allen, et al., 2002).

$$V_{out} = \sum_{m=0}^{n-1} B_m 2^m R_{ref} \tag{1}$$

Where, V_{out} represents the analog output value, which can be voltage, current or charge depending on the reference value of R_{ref} (Plassche, 2003). In the practical implementations, reference current source or reference voltage source are mostly used. From the Eq. (1), it can be seen that there is an N-bit binary code (B_0, B_1, B_2, ..., B_{n-2}, B_{n-1}); B_0 is the least significant bit (LSB) and B_{n-1} is the most significant bit (MSB). The factor of 2^m indicates the binary weighting of the bit values as a function of the variable of m (Plassche, 2003). When B_m equals to 1, the value on bit m is accumulated to the output,