Weighted Resistor DAC

Digital systems are used in ever more applications because of their increasingly efficient, reliable, and economical operation. With the development of micro processor, data processing has become an integral part of various systems.

Types of Digital to analog Converters:

1. Digital to analog converter with binary weighted resistors
2. Digital to analog converter with R and 2R resistors
3. Monolithic/hybrid digital to analog converter

Weighted resistor DAC:

This type of converter is very similar to the Resistor Ladder D/A converter. In this case, however, each resistor in the string is given a value proportional to the binary value of the bit it represents. Currents are then summed from each active bit to achieve the output

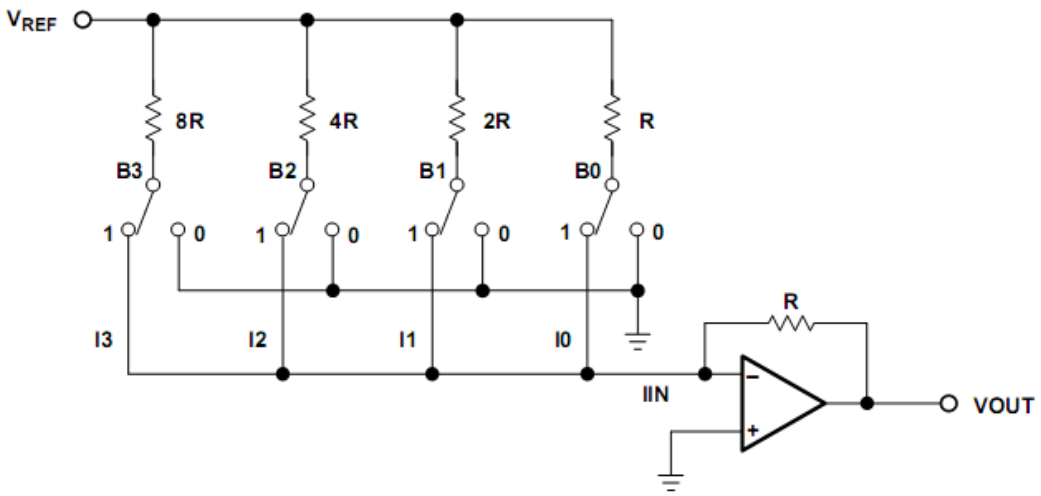

Figure 5.1

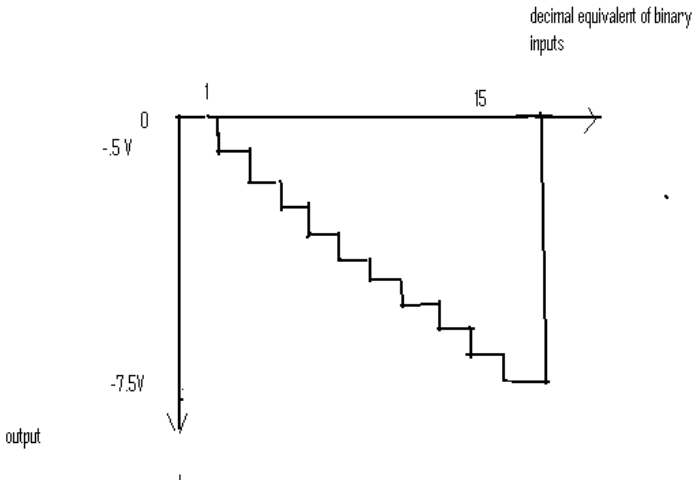

Figure 5.2

The number of resistors and switches reduced to one per bit, but the range of the resistors is extremely wide for high-resolution converters, making it hard to fabricate all of them on the IC..

The resistor used for B3 is the limiting factor for power dissipation from V to ground. This converter architecture is often used to make logarithmic converters. In this case, the R, 2R, 4R, 8R … resistors are replaced with logarithmically-weighted resistors.

This type of converter, and the R/2R converter described in the next paragraph, use a feedback resistor fabricated on the D/A IC itself. This feedback resistor is not an optional convenience for the designer — it is crucial to the accuracy of the D/A. It is fabricated on the same silicon as the resistor ladder. Therefore, it experiences the same thermal drift as the resistor ladder. The gain of the buffer amplifier is fixed, with a full-scale output voltage limited to V_{REF}. If a different full-scale D/A output voltage is needed, change $V_{REF.}$

If the full scale V_{OUT} must exceed the maximum rating of the D/A reference voltage, use a gain stage after the buffer op amp .

The op amp must be selected carefully, because it will be operated in much less than unity gain mode for some combinations of bits. This is probably one of the main reasons why this architecture is not popular, as well as the requirement for a wide range of resistor values for high precision converters.

$$Vo = -R_f \left(\frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3} \right)$$