

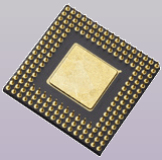
D/A Programming

LISHA/UFSC

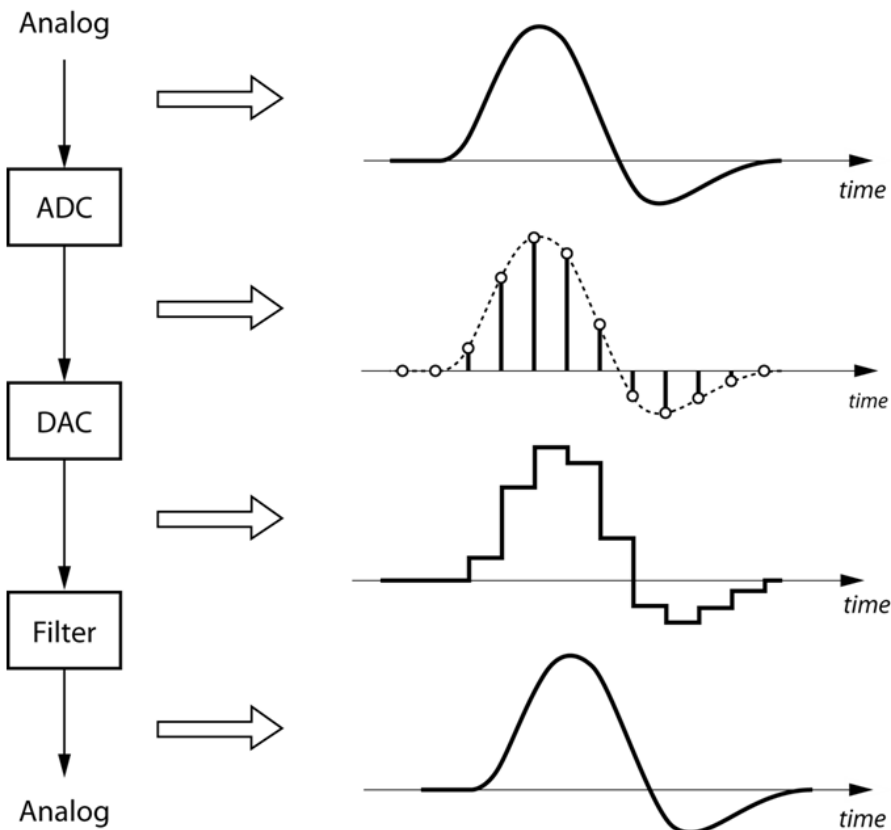
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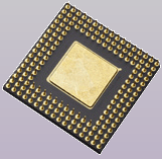
September 2014



Overview

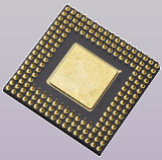


- A DAC (digital-to-analog converter) is a device for converting a digital code to an analog signal (current, voltage or electric charge)

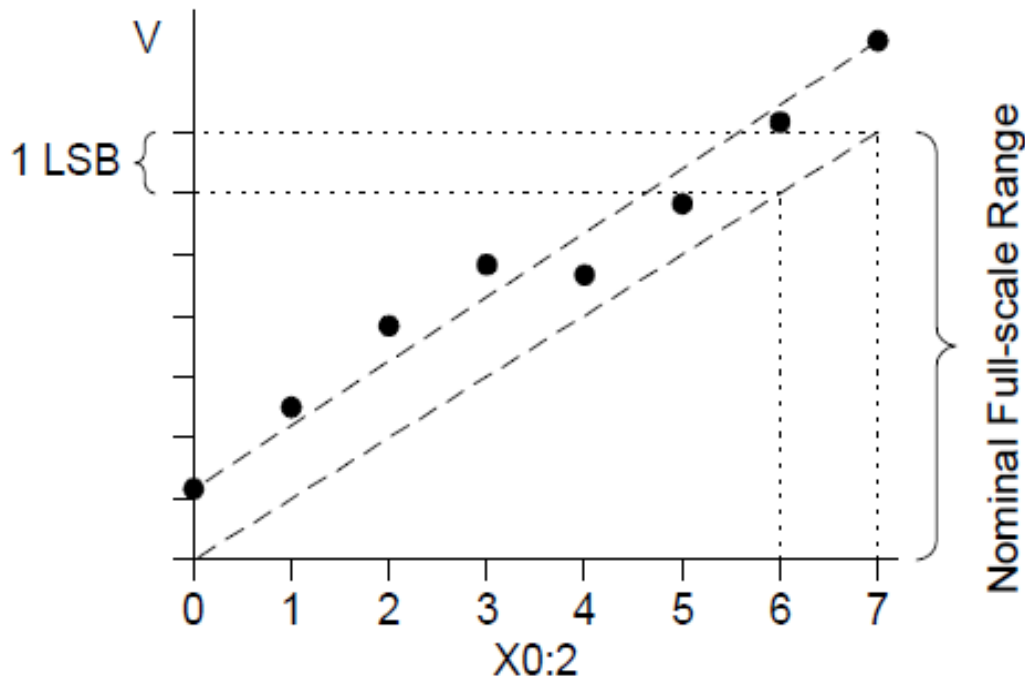


DAC: Operational Parameters

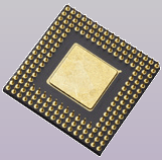
- Conversion range
 - Determines the amplitude of the analog signal
- Differential and Single-ended conversion
- Operation frequency
 - Determines sampling rate
- Bandwidth
 - Bandwidth = Sampling rate / 2
- Settling Time
 - Time in which the DAC output settles at the desired value
- Resolution
 - $V_{ref} / 2^n$



DAC: Operational Parameters

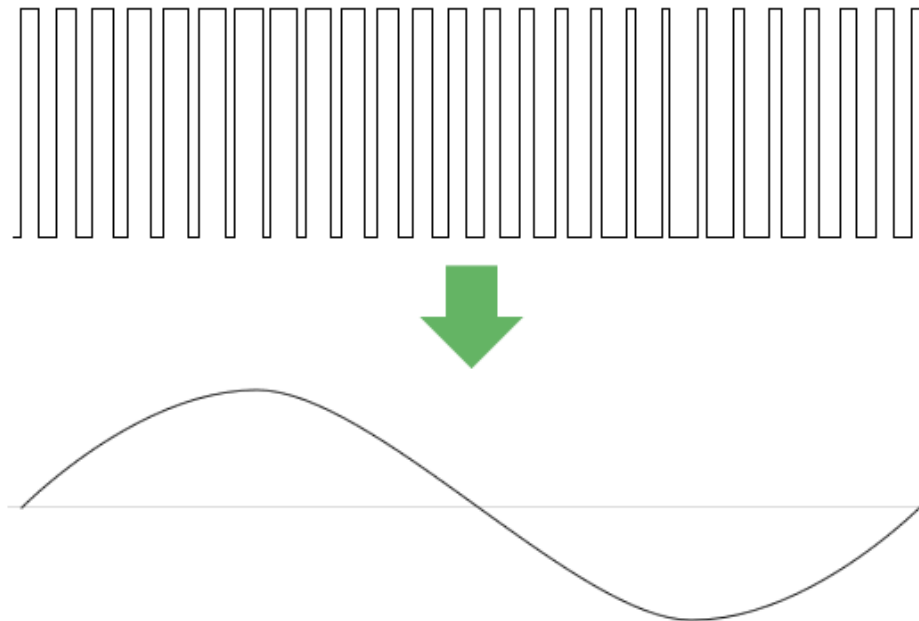


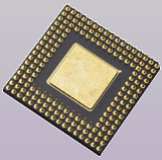
- Accuracy
 - Worst deviation from nominal line
- Linearity
 - Worst deviation from line joining end points
- Monotonicity
 - The analog output always increases as the DAC-code input increases



Pulse Width Modulator (PWM) DAC

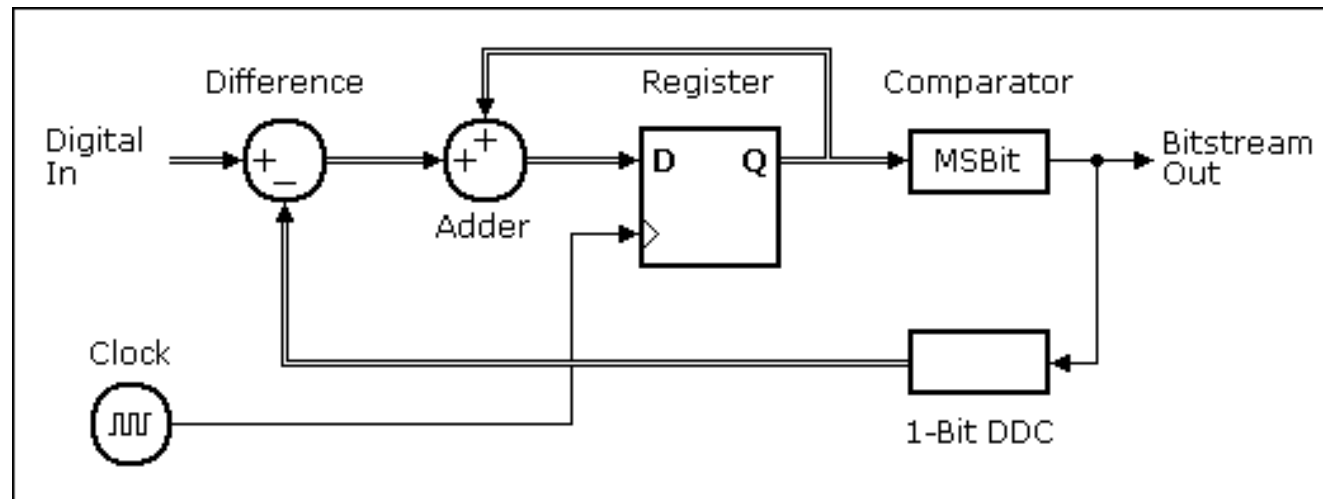
- Simple but limited by the PWM frequency
- The PWM output is filtered by a low pass filter
- The duty cycle defines the output voltage
- Often used for electric motor speed control

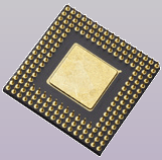




Delta-sigma DAC

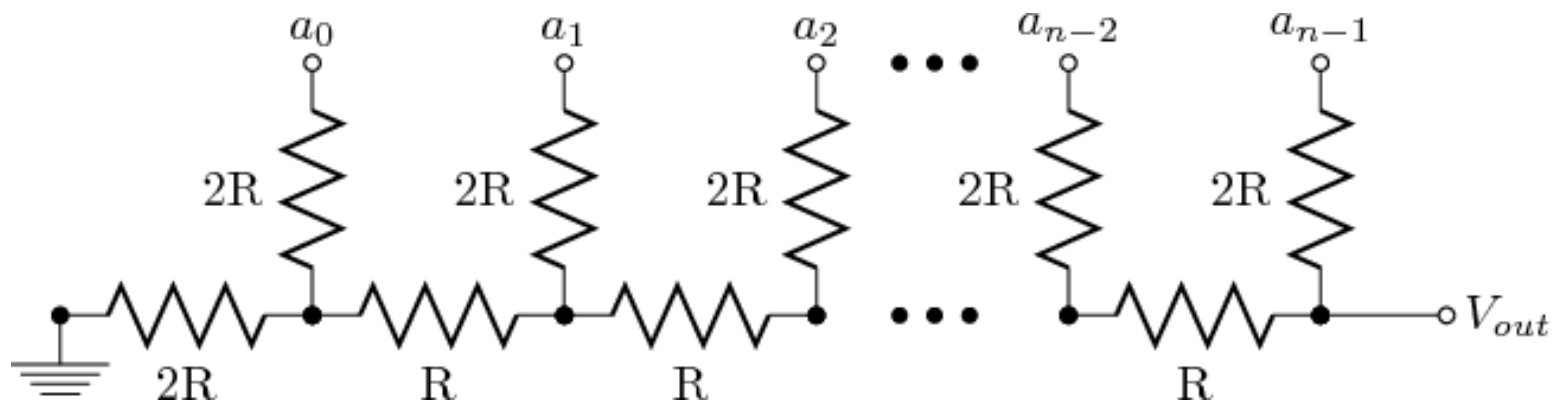
- Multiple clock cycles to generate an output by approximation
- High resolution DACs (greater than 16 bits) are Delta-sigma due to its linearity and low cost

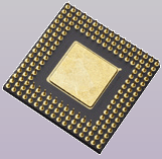




R-2R Ladder Network DAC

- The n input bits are weighted by the R-2R network and each one gives its contribution to V_{out}
- 2^n possible V_{out} values
- Inexpensive and easy to manufacture
- Slower conversion rate





Reconstruction Filter

- DAC outputs a sequence of constant values which causes multiple harmonics above the Nyquist frequency
- They can be removed with a low pass filter acting as a reconstruction filter

