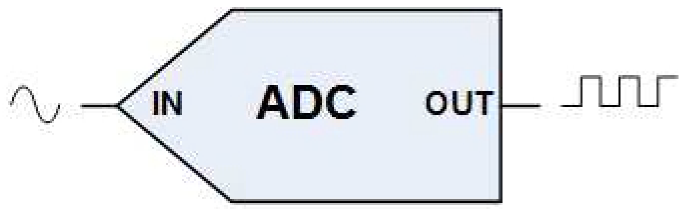
Parallel comparator type ADC

An **analog-to-digital converter**, or simply ADC, is a semiconductor device that is used to convert an analog signal into a digital code. In the real world, most of the signals sensed and processed by humans are analog signals. Analog-to-digital conversion is the primary means by which analog signals are converted into digital d

An analog signal is a signal that may assume any value within a continuous range. Examples of analog signals commonly encountered every day are sound, light, temperature, and pressure, all of which may be represented electrically by an analog voltage or current. A device that is used to convert an analog signal into an analog voltage or current is known as a transducer. An analog-to-digital converter is used to further translate this analog voltage or current into digital codes that consist of 1's and 0's.

A typical ADC, therefore, has an analog input and a digital output, which may either be 'serial' (consisting of just one output pin that delivers the output code one bit at a time) or 'parallel' (consisting of several output pins that deliver all the bits of the output code at the same time).

Analog-to-digital converters come in many forms. One example is the parallel comparator-type ADC, which basically consists of: 1) a set of comparators that compare the input analog voltage to different values of fixed voltages; 2) a corresponding set of D-type flip-flops that hold the digital outputs of the comparators; and 3) an encoder that converts the outputs of the D-type flip-flops into the final output digital code.
Another implementation of the ADC is known as the successive-approximation ADC. This circuit consists of: 1) a sample and hold circuit to accept the analog input Va; 2) a successive approximation register (SAR) consisting of clocked flip-flops and gates designed to systematically and progressively approximate the digital code corresponding to the analog input Va; 3) an internal reference DAC that gets its digital inputs from the SAR; and 4) a voltage comparator that compares the analog output of the internal DAC to the analog input Va.



ELECTRICAL SYMBOL FOR ANALOG TO DIGITAL CONVERTER (ADC)

Figure 5.5

In a successive approximation ADC, the SAR generates a series of digital codes as it is clocked, which are fed into the reference DAC one at a time. The digital codes are generated in binary search fashion, i.e., the bits are toggled to logic '1' one at a time starting with the MSB. If the bit toggled to '1' causes the DAC to output an analog voltage that exceeds Va, then it is returned to '0', otherwise it is kept at logic '1'.

Eventually all the bits would have been exercised, and the resulting digital code is the one that causes the DAC to produce an analog voltage that is as close to Va as possible without exceeding it. Thus, this will be the same digital code released by the ADC to its outputs, since it was basically the code that produced a voltage equal to Va using the internal reference DAC.

Another ADC design that operates similarly to the successive approximation ADC is the counting ADC. It also employs an internal reference DAC, except that in this case it is fed with digital data that are generated, that can be processed by computers for various purposes.