D/A And A/D Interface:

The function of an A/D converter is to produce a digital word which represents the magnitude of some analog voltage or current.

The specifications for an A/D converter are very similar to those for D/A converter:

- The resolution of an A/D converter refers to the number of bits in the output binary word. An 8-bit converter for example has a resolution of 1 part in 256.

- Accuracy and linearity specifications have the same meaning for an A/D converter as they do for a D/A converter.

- Another important specification for an ADC is its conversion time. - the time it takes the converter to produce a valid output binary code for an applied input voltage. When we refer to a converter as high speed, it has a short conversion time.

The analog to digital converter is treated as an input device by the microprocessor that sends an initialising signal to the ADC to start the analog to digital data conversation process.

The start of conversion signal is a pulse of a specific duration. The process of analog to digital conversion is a slow process, and the microprocessor has to wait for the digital data till the conversion is over.

After the conversion is over, the ADC sends end of conversion (EOC) signal to inform the microprocessor that the conversion is over and the result is ready at the output buffer of the ADC.

These tasks of issuing an SOC pulse to ADC, reading EOC signal from the ADC and reading the digital output of the ADC are carried out by the CPU using 8255 I/O ports. The time taken by the ADC from the active edge of SOC pulse (the edge at which the conversion process actually starts) till the active edge of

EOC signal is called as the conversion delay of the ADC- the time taken by the converter to calculate the equivalent digital data output from the instant of the start of conversion is called conversion delay. It may range anywhere from a few microseconds in case of fast ADCs to even a few hundred milliseconds in case of slow ADCs.

A number of ADCs are available in the market, the selection of ADC for a particular application is done, keeping in mind the required speed, resolution range of operation, power supply requirements, sample and hold device requirements and the cost factors are considered.

The available ADCs in the market use different conversion techniques for the conversion of analog signals to digital signals.

Parallel converter or flash converter, Successive approximation and dual slope integration

A general algorithm for ADC interfacing contains the following steps.

1. Ensure the stability of analog input, applied to the ADC.
2. Issue start of conversion (SOC) pulse to ADC.
3. Read end of conversion (EOC) signal to mark the end of conversion process.
4. Read digital data output of the ADC as equivalent digital output.

It may be noted that analog input voltage must be constant at the input of the ADC right from the start of conversion till the end of conversion to get correct results. This may be ensured by a sample and hold

circuit which samples the analog signal and holds it constant for a specified time duration. The microprocessor may issue a hold signal to the sample and Hold circuit. If the

applied input changes before the complete conversion process is over, the digital equivalent of the analog input calculated by the ADC may not be correct. If the applied input changes before the complete conversion process is over, the digital equivalent of the analog input calculated by the ADC may not be correct.

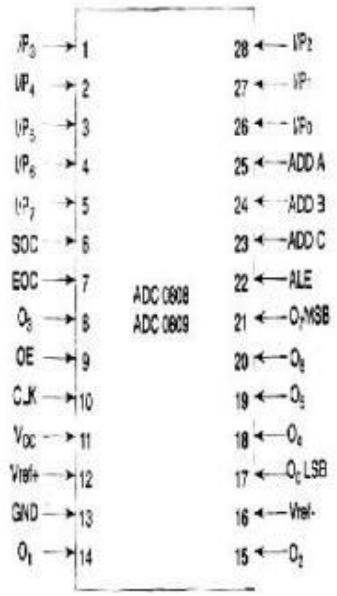
- **ADC 0808/0809**

The analog to digital converter chips 0808 and 0809 are 8-bit CMOS, *successive approximation converters*. Successive approximation technique is one of the fast techniques for analog to digital conversion. The conversion delay is 100 μs at a clock frequency of 640

kHz, which is quite low as compared to other converters.

These converters do not need any external zero or full scale adjustments as they are already taken care of by internal circuits. These converters internally have a 3:8 analog multiplexer so that at a time eight different analog inputs can be connected to the chips. Out of these eight inputs only one can be selected for conversion by using address lines ADD A, ADD B and ADD C, as shown. Using these address inputs, multichannel data acquisition systems can be designed using a single ADC.

The CPU may drive these lines using output port lines in case of multichannel applications. In case of single input applications, these may be hard wired to select the proper input.



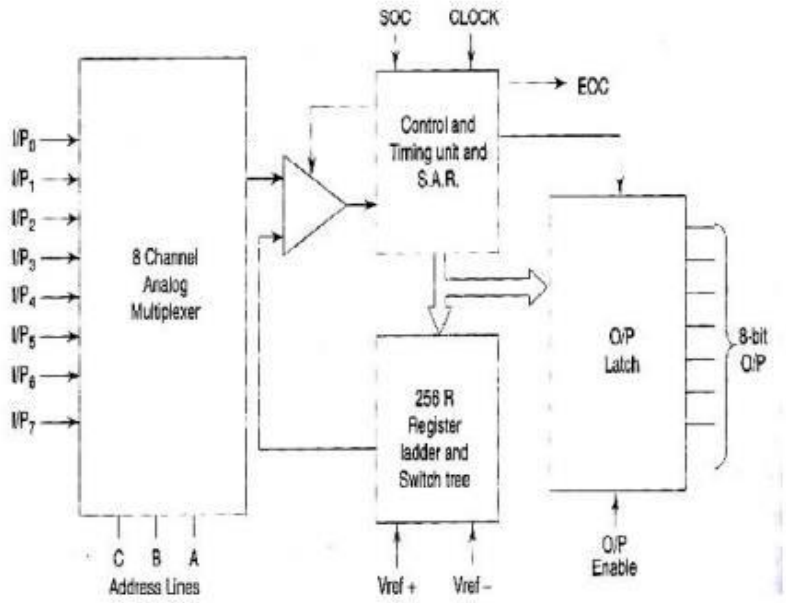
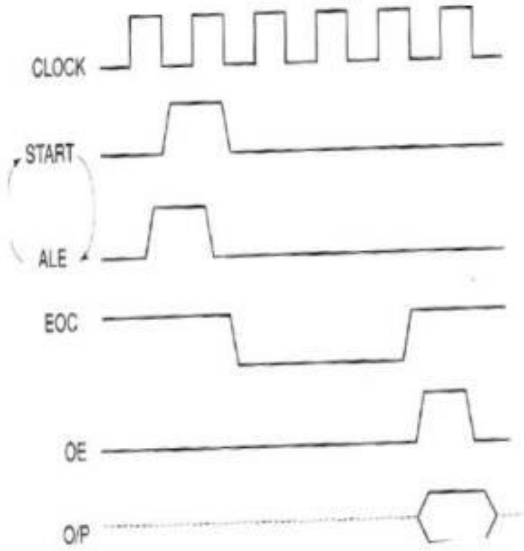


Fig. 3.21 Pins of ADC0808/09 **Fig.3.22 Block Diagram of ADC 0808/0809**

only positive analog input voltages to their digital equivalents. These chips do not contain any internal sample and hold circuit. If one needs a sample and hold circuit for the conversion of fast, signals into equivalent digital quantities, it has to be externally connected at each of the analog inputs.



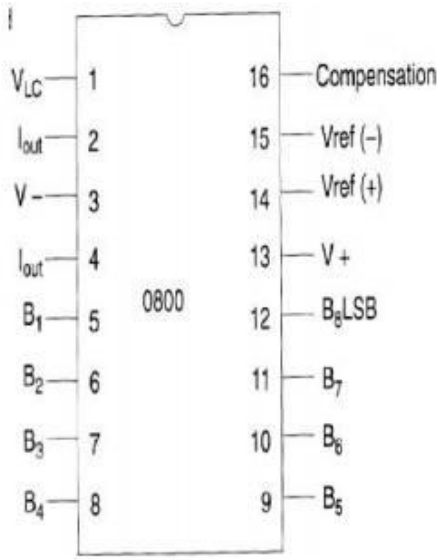


Fig.3.23 Timing Diagram of ADC 0808/0809 Fig. 3.24 Pins of DAC 0800

INTERFACING DIGITAL TO ANALOG ONVERTERS:

The digital to analog converters convert binary numbers into their analog equivalent voltages or currents. Several techniques are employed for digital to analog conversion.

i. Weighted resistor network

ii. R-2R ladder network

iii. Current output D/A converter

✓ Applications in areas like

▪

- digitally controlled gains, motor speed control, programmable gain amplifiers, digital voltmeters, panel meters, etc.

- In a compact disk audio player for example a 14-or16-bit D/A converter is used to convert the binary data read off the disk by a laser to an analog audio signal.

- Most speech synthesizer integrated circuits contain a D/A converter to convert stored binary data words into analog audio signals.

✓ Characteristics:

▪

1. Resolution: It is a change in analog output for one LSB change in digital input.

It is given by(1/2n)*Vref.

If n=8 (i.e.8-bit DAC) 1/256*5V=39.06mV

2. Settling time: It is the time required for the DAC to settle for a full scale code change.

DAC 0800 8-bit Digital to Analog converter Features:

i. DAC0800 is a monolithic 8-bit DAC manufactured by National semiconductor.

ii. It has settling time around 100ms

iii. It can operate on a range of power supply voltage i.e. from 4.5V to +18V. Usually the supply V+ is 5V or +12V. The V- pin can be kept at a minimum of - 12V.

iv. Resolution of the DAC is 39.06mV