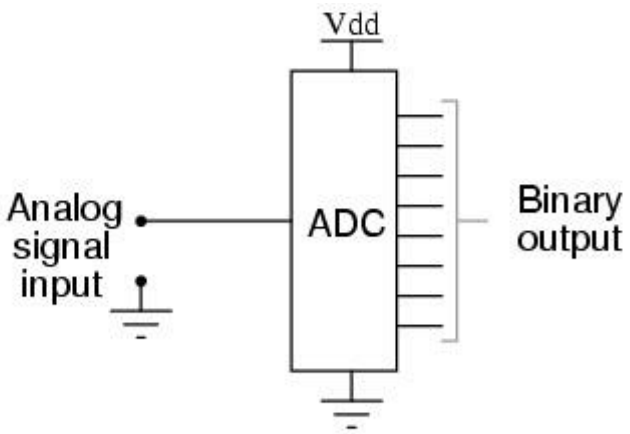
ANALOG TO DIGITAL CONVERTERS

Almost every environmental measurable parameter is in analog form like temperature, sound, pressure, light, etc. Consider a temperature monitoring system wherein acquiring, analysing and processing temperature data from sensors is not possible with digital computers and processors. Therefore, this system needs an intermediate device to convert the analog temperature data into digital data in order to communicate with the digital processors like microcontrollers and microprocessors.



Analog to Digital Converter (ADC) is an electronic integrated circuit used to convert the analog signals such as voltages to digital or binary form consisting of 1s and 0s.

Logic of Working

Analog to Digital Converter samples the analog signal on each falling or rising edge of sample clock. In each cycle, the ADC gets of the analog signal, measures and converts it into a digital value. The ADC converts the output data into a series of digital values by approximates the signal with fixed precision.

Assume that one volt signal has to be converted from digital by using 3-bit ADC as shown below. Therefore, a total of 2^3=8 divisions are available for producing 1V output. This results 1/8=0.125V is called as minimum change or quantization level represented for each division as 000 for 0V, 001 for 0.125, and likewise upto 111 for 1V. If we increase the bit rates like 6, 8, 12, 14, 16, etc. we will get a better precision of the signal. Thus, bit rate or quantization gives the smallest output change in the analog signal value that results from a change in the digital representation.

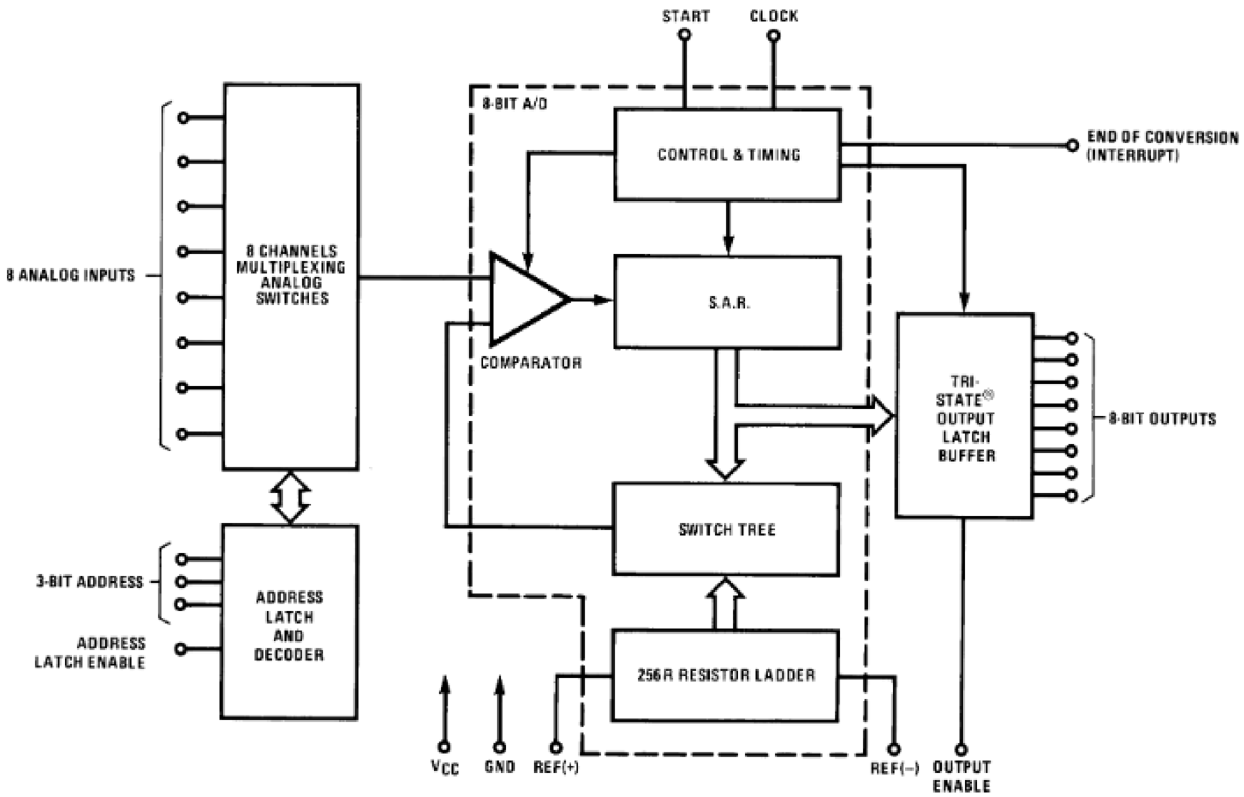
Suppose if the signal is about 0-5V and we have used 8-bit ADC then binary output of 5V is 256. And for 3V it is 133 as shown below.

$$D_{out} = \frac{2^8 * V_a}{V_{ref}}$$

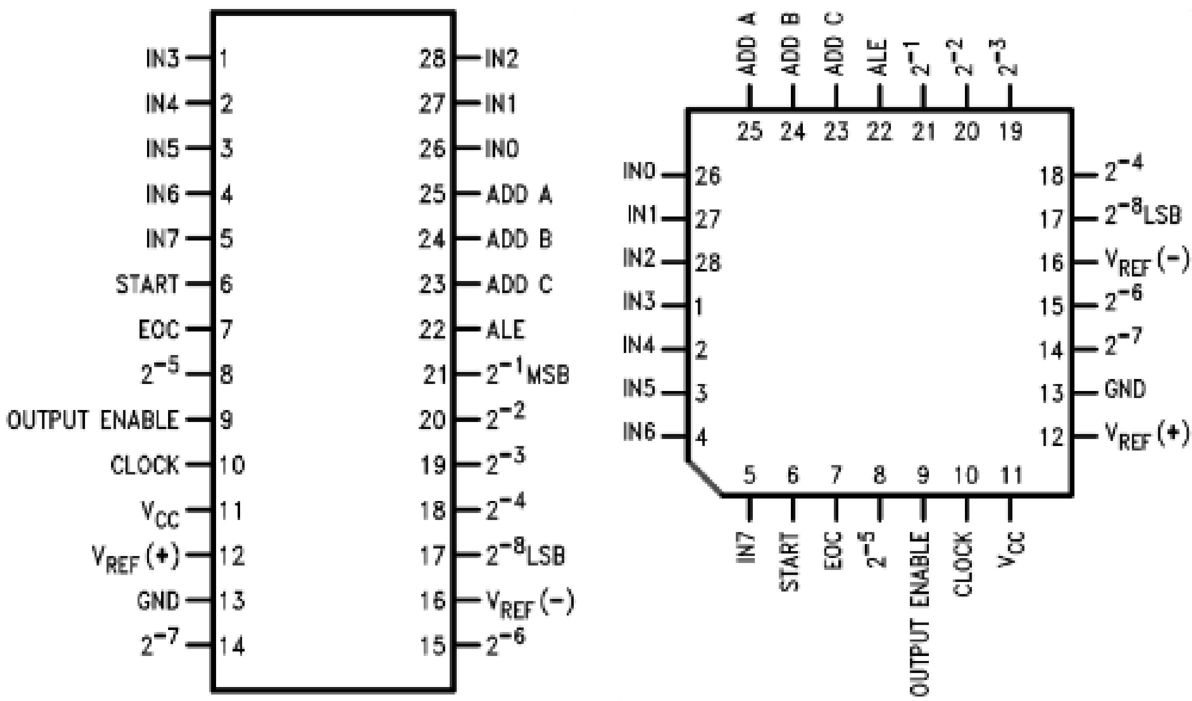
ICs

You will get plenty of variety of AD Converter. One just need to go through the list and choose which suits their work. Some common ADC ICs are given below with datasheet.

ADC0808



BLOCK DIAGRAM



THE IC PIN LAYOUT

FEATURES

- Easy Interface to All Microprocessors
- Operates Ratiometrically or with 5 V_{DC} or Analog Span Adjusted Voltage Reference
- No Zero or Full-Scale Adjust Required
- 8-Channel Multiplexer with Address Logic
- 0V to V_{CC} Input Range
- Outputs meet TTL Voltage Level Specifications
- ADC0808 Equivalent to MM74C949
- ADC0809 Equivalent to MM74C949-1

KEY SPECIFICATIONS

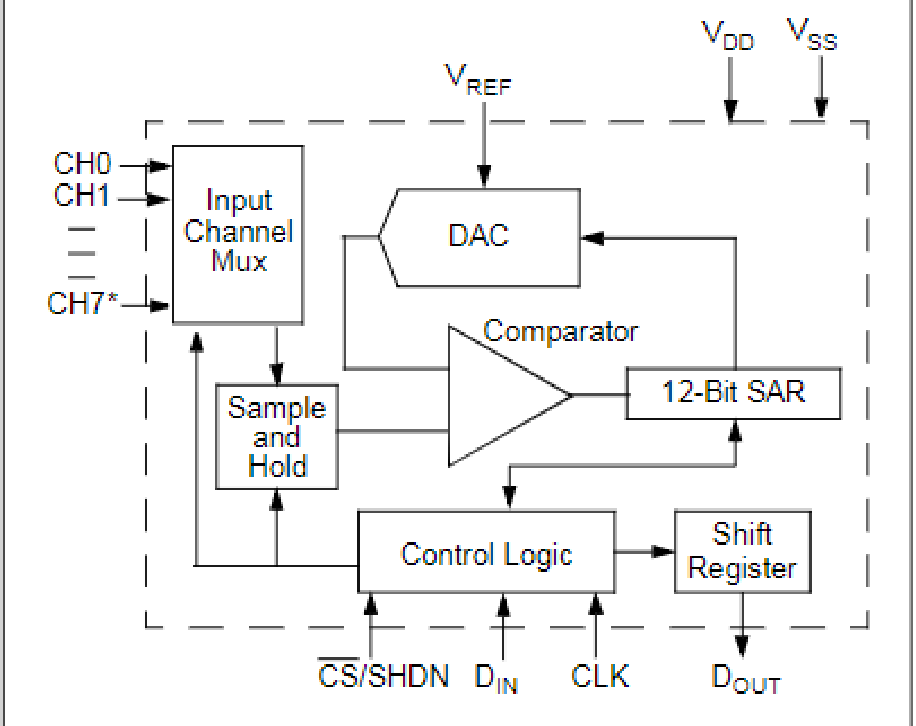
- Resolution: 8 Bits
- Total Unadjusted Error: ±½ LSB and ±1 LSB
- Single Supply: 5 VDC
- Low Power: 15 mW
- Conversion Time: 100 μs

Absolute Maximum Ratings [1][2][3]

Supply Voltage (V_{CC})[4]			6.5V
Voltage at Any Pin Except Control Inputs			−0.3V to (V_{CC}+0.3V)
Voltage at Control Inputs (START, OE, CLOCK, ALE, ADD A, ADD B, ADD C)			−0.3V to +15V
Storage Temperature Range			−65°C to +150°C
Package Dissipation at T_A=25°C			875 mW
Lead Temp. (Soldering, 10 seconds)	PDIP Package (plastic)		260°C
	PLCC Package	Vapor Phase (60 seconds)	215°C
		Infrared (15 seconds)	220°C
ESD Susceptibility[5]			400V

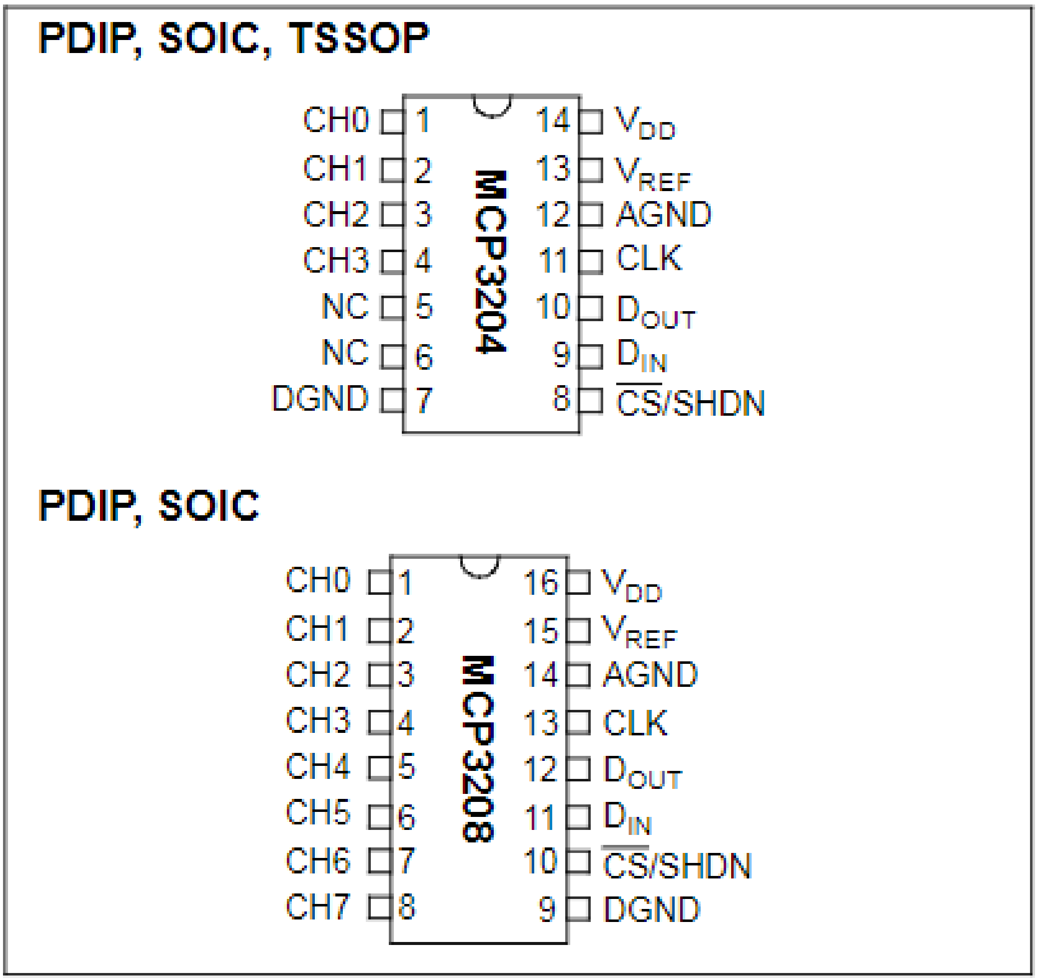
MCP3208

Functional Block Diagram



* **Note:** Channels 5-7 available on MCP3208 Only

Package Types



MCP3204/3208 devices are successive approximation 12-bit Analog-to-Digital (A/D) Converters with on-board sample and hold circuitry. The MCP3204 is programmable to provide two pseudo-differential input pairs or four single-ended inputs.

Communication with the devices is accomplished using a simple serial interface compatible with the SPI protocol. The devices are capable of conversion rates of up to 100 ksps.

Features

- 12-bit resolution
- ± 1 LSB max DNL
- ± 1 LSB max INL (MCP3204/3208-B)
- ± 2 LSB max INL (MCP3204/3208-C)
- 4 (MCP3204) or 8 (MCP3208) input channels
- Analog inputs programmable as single-ended or pseudo-differential pairs
- On-chip sample and hold
- SPI serial interface (modes 0,0 and 1,1)
- Single supply operation: 2.7V - 5.5V
- 100 ksps max. sampling rate at V_{DD} = 5V
- 50 ksps max. sampling rate at V_{DD} = 2.7V
- Low power CMOS technology:
  - 500 nA typical standby current, 2 µA max.
  - 400 µA max. active current at 5V
- Industrial temp range: -40°C to +85°C
- Available in PDIP, SOIC and TSSOP packages

Applications

- Sensor Interface
- Process Control
- Data Acquisition
- Battery Operated Systems