SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Sub: Microcontroller Programming And Interfacing

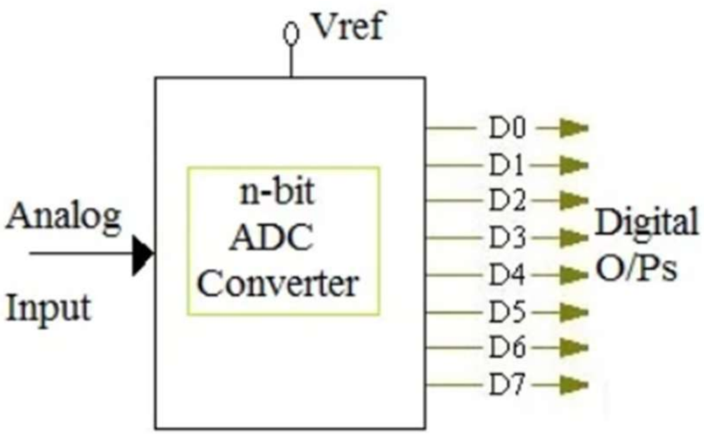
Subcode:23ECB202

Unit-II

CLASSIFICATION OF INSTRUCTIONS AND IO PORT PROGRAMMING/ Peripherals of PIC- ADC, DAC

ANALOG to DIGITAL CONVERTOR (ADC)

An analog-to-digital (A/D) converter is defined as a device that receives an analog input and supplies a digital output (usually binary or decimal number).



Resolution	Ideal Dynamic range	Minimum Voltage Increment
8 Bit	256:1	3.92 mV
10 Bit	1024:1	0.98 mV
12 Bit	4096:1	0.244 mV
14 Bit	16384:1	61 µV
16 Bit	65536:1	15 µV

ANALOG to DIGITAL CONVERTOR (ADC)

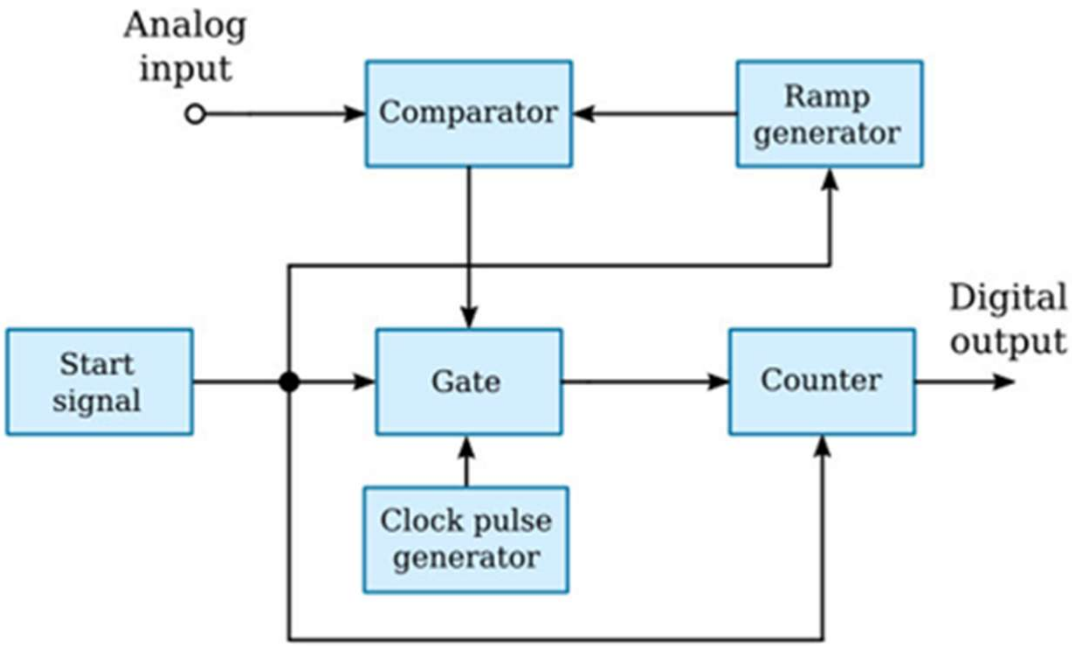
An analog-to-digital (A/D) converter is defined as a device that receives an analog input and supplies a digital output (usually binary or decimal number). In designing A/D conversion devices, several basic requirements must be taken into consideration:

- **Sampling Rate**
- **Resolution**
- **Conversion Time**

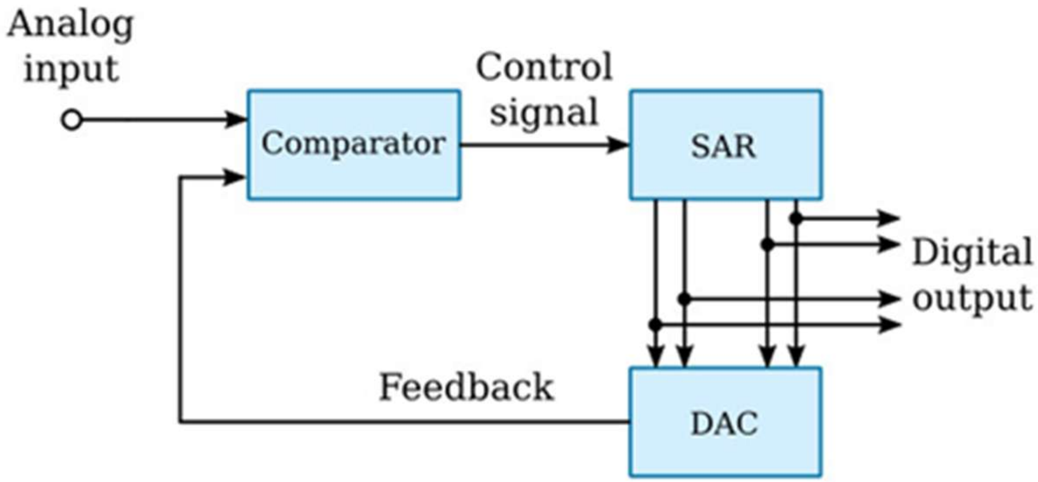
Types of ADC

- Ramp-type ADC
- Successive Approximation ADC

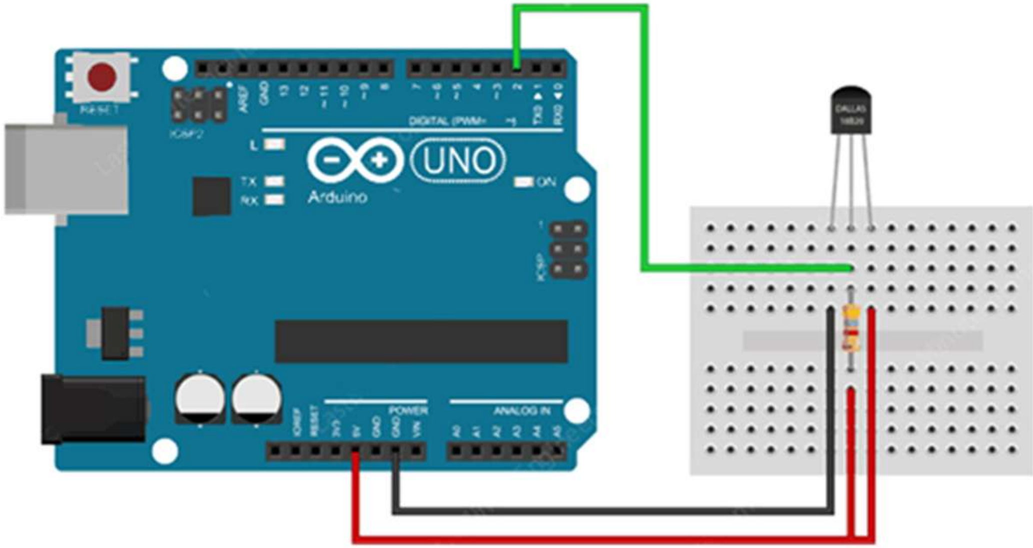
Ramp-type ADC



Successive Approximation ADC



Example of ADC



ADC Calculator:-

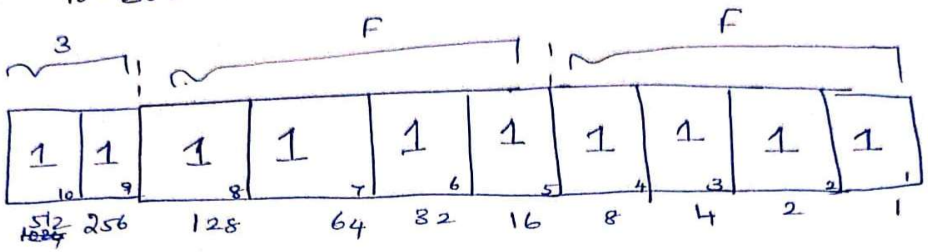
$$\text{Digital Output} = \frac{2^N \times \text{Analog Input Voltage}}{\text{Reference Voltage}}$$

→ Convert this to Binary Equivalent

N = Number of bits in ADC converter

Calculation of ADC

10-Bit ADC



Max Hex Value = 3FF

Maximum resolution:

$512+256+128+64+32+16+8+4+2+1$

$= 1023$

Calculation for Converting Analog voltage to digital Value.

Formula:- $\frac{\text{Resolution of ADC}}{\text{Reference voltage}} = \frac{\text{ADC Reading}}{\text{Voltage Measured}}$

Refrence voltage is generally +5V

Lets take the Value of analog voltage is 2.12V

$$\frac{1023}{5} = \frac{\text{ADC reading}}{2.12V}$$

$$\text{ADC Reading} = \frac{1023}{5} \times 2.12$$

$= 434$ (decimal)

$= 1B2$ (Hex)

Convert the digital value to analog voltage:

Lets take 1B2

Convert to Binary

0	1	1	0	1	1	0	0	1	0

Formula: $\frac{V(ref)}{1023} = 0.0048mv$

512	256	128	64	32	16	8	4	2	1

↳ This bit set to 0.048mv

$1 \times 0.0048 = 0.0048mv$

$2 \times 0.0048 = 0.0096mv$

$4 \times 0.0048 = 0.0192mv$

$8 \times 0.0048 = 0.0384mv$

$16 \times 0.0048 = 0.0786mv$

$32 \times 0.0048 = 0.1536mv$

$64 \times 0.0048 = 0.3072mv$

$128 \times 0.0048 = 0.6144mv$

$256 \times 0.0048 = 1.2288V$

$512 \times 0.0048 = 2.4576$

4.9V

2.4576	1.2288	0.6144	0.3072	0.1536	0.0786	0.0384	0.0192	0.0097	0.0048

our digital Value 1B2

0	1	1	0	1	1	0	0	1	0

↓ 1.2288 ↓ 0.6144 ↓ 0.1536 ↓ 0.0786 ↓ 0.0097

$= 1.2288 + 0.6144 + 0.1536 + 0.0786 + 0.0097$

$= 2.08\,V$

$\simeq 2.12\,V$