Introduction to ADC

- When we interface sensors to the microcontroller, the output of the sensor many of the times is analog in nature. But the microcontroller processes digital signals.
- Hence, we use ADC in between the sensor and microcontroller. It converts an analog signal into a digital and gives it to the microcontroller.
- There are many applications of ADC like in a biometric application, Environment monitoring, Gas leakage detection etc.

Arduino Uno has 6 0n-board ADC channels which can be used to read analog signal in the range 0-5V.

It has 10-bit ADC means it will give digital value in the **range of 0 – 1023 (2^10).**

This is called as a resolution which indicates the number of discrete values it can produce over the range of analog values.

Digital Output value Calculation

ADC Resolution = Vref / ((2^n) - 1)

Digital Output = Vin / Resolution

Where,

Vref - The reference voltage is the maximum value that the ADC can convert.

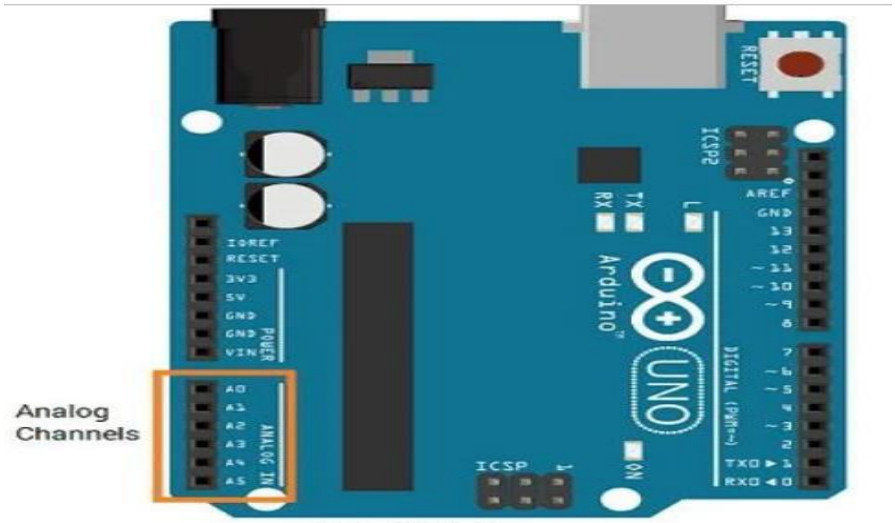
To keep things simple, let us consider that Vref is 5V,

For 0 Vin, digital o/p value = 0

For 5 Vin, digital o/p value = 1023 (10-bit) For 2.5 Vin,

digital o/p value = 512 (10-bit)

ADC Pins of Arduino Uno



Arduino ADC pin Diagram

Analog Functions for Arduino ADC

analogRead (pin)

This function is used to read analog value from specified analog pin.

pin - number of analog pin which we want to read

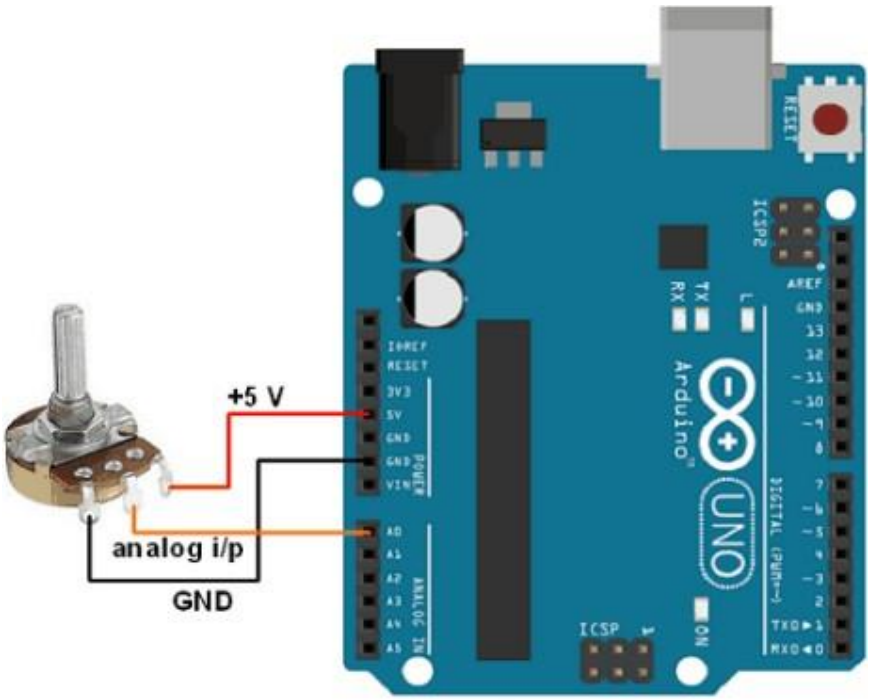
returns - digital value 0 – 1023

```
e.g. analogRead(A0) //read analog value at A0
```

How to Read Analog values using Arduino

- Let's write a program to read varying analog value generated using potentiometer which is connected to A0 analog channel. Display the digital value on Serial monitor which we got from the Arduino ADC.

Potentiometer Interfacing with Arduino Uno



Potentiometer connected Arduino ADC Channel

Arduino Code for reading analog value

```
int sensorPin = A0;   // input pin for the potentiometer
int digitalValue = 0;// variable to store the value coming from the sensor

void setup() {
  Serial.begin(9600);
}

void loop() {
  digitalValue = analogRead(sensorPin);// read the value from the analog cha
  Serial.print("digital value = ");
  Serial.println(digitalValue);          //print digital value on serial monitor
  delay(1000);
}
```

Output on Serial Monitor

COM4 (Arduino/Genuino Uno)

```
digital value = 0
digital value = 0
digital value = 0
digital value = 0
digital value = 42
digital value = 84
digital value = 202
digital value = 303
digital value = 352
digital value = 461
digital value = 502
digital value = 512
digital value = 623
digital value = 754
digital value = 845
digital value = 965
digital value = 992
digital value = 1018
digital value = 1021
digital value = 1016
digital value = 1021
digital value = 1019
```