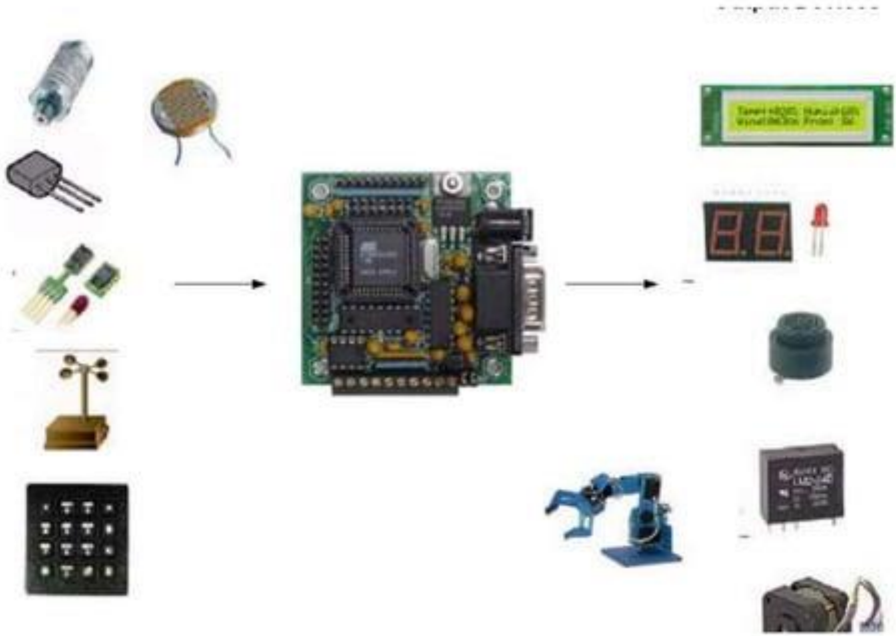
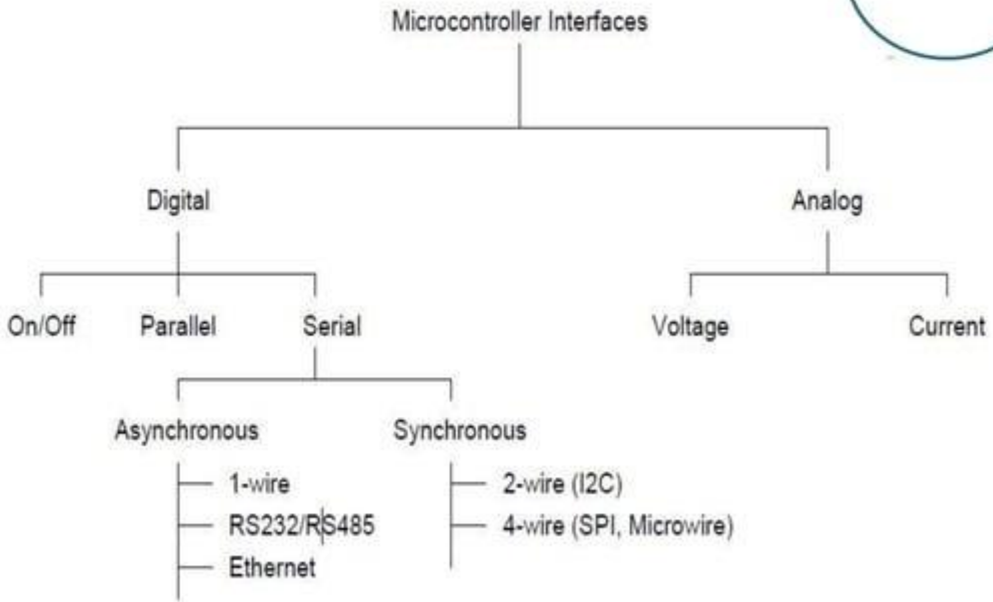
Micro-controllers are useful to the extent that they communicate with other devices, such as sensors,
motors, switches, keypads, displays, memory and even other micro-controllers

- Many microcontroller designs typically mix multiple interfacing methods. In a very simplistic form, a microcontroller
- system can be viewed as a system that reads from (monitors) inputs, performs processing and
- writes to (controls) outputs.

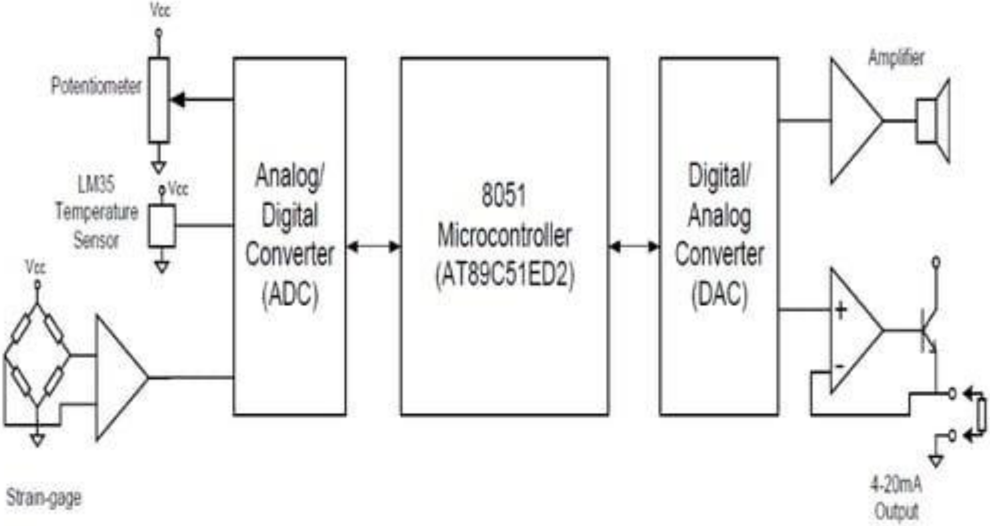
Input Devices Microcontroller Output Devices



Microcontroller Interfaces



Analog Interface



Analog Inputs/Outputs

Voltage-based control and monitoring.

Advantages

- Simple interface
- Low cost for low-resolutions
- High speed
- Low programming overhead

Disadvantages

- High cost for higher resolutions
- Not all microcontrollers have analog inputs/outputs built-in
- Complicates the circuit design when external ADC or DAC are needed.
- Short distance, few feet maximum.

Voltage type: Typical ranges

- 0 to 2.5V
- 0 to 4V
- 0 to 5V
- +/- 2.5V
- +/- 4V
- +/- 5V

Current type: Typical ranges

- 0-20mA
- 4-20mA

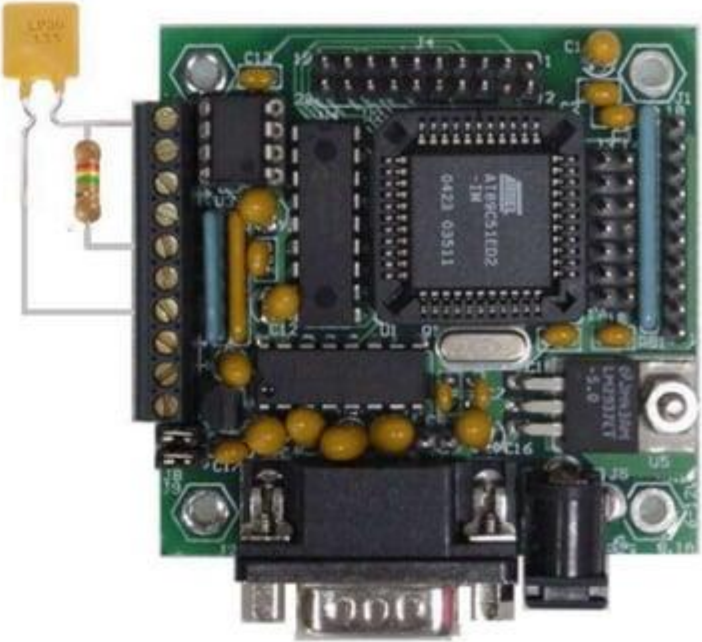
Sensor Types Temperature Sensors

- Temperatur
- Humidity
- Light
- Acceleratioı
- Force
- Frequency
- Flow
- Pressure
- Torque
- Proximity
- Displacement

- RTD
- Thermistor
- Thermocouple
- Semiconductor Temperature Sensors

Criteria	Thermocouple	RTD	Thermistor	Semiconductor
Temperature Range	Very wide -450°F +4200°F	Wide -400°F +1200°F	narrow -100°F +500°F	narrow -60°F to 250°F
Interchangeability	Good	Excellent	Poor to fair	Good
Long-term Stability	Poor to fair	Good	Poor	Good
Accuracy	Medium	High	Medium	High
Repeatability	Fair	Excellent	Fair to good	Good
Sensitivity (output)	Low	Medium	Very high	High
Response	Medium to fast	Medium	Medium to fast	Medium to fast
Linearity	Fair	Good	Poor	Good
Self Heating	No	Very low to low	High	High
Point (end) Sensitive	Excellent	Fair	Good	Good
Lead Effect	High	Medium	Low	Low

Thermistors



LM34 and LM35 Temperature Sensors

- The sensors of the LM34/LM35 series
- are good integrated-circuit
- temperature sensors whose output
- voltage is linearly proportional to the
- Fahrenheit/Celsius temperature
- The LM34/LM35 requires no external
- calibration since it is inherently calibrated
- It outputs 10 mV for each degree of
- Fahrenheit/Celsius temperature

Table 13-7: LM34 Temperature Sensor Series Selection Guide

Part Scale	Temperature Range	Accuracy	Output
LM34A	–50 F to +300 F	+2.0 F	10 mV/F
LM34	–50 F to +300 F	+3.0 F	10 mV/F
LM34CA	–40 F to +230 F	+2.0 F	10 mV/F
LM34C	–40 F to +230 F	+3.0 F	10 mV/F
LM34D	–32 F to +212 F	+4.0 F	10 mV/F

Note: Temperature range is in degrees Fahrenheit.

Table 13-8: LM35 Temperature Sensor Series Selection Guide

Part	Temperature Range	Accuracy	Output Scale
LM35A	–55 C to +150 C	+1.0 C	10 mV/C
LM35	–55 C to +150 C	+1.5 C	10 mV/C
LM35CA	–40 C to +110 C	+1.0 C	10 mV/C
LM35C	–40 C to +110 C	+1.5 C	10 mV/C
LM35D	0 C to +100 C	+2.0 C	10 mV/C

Note: Temperature range is in degrees Celsius

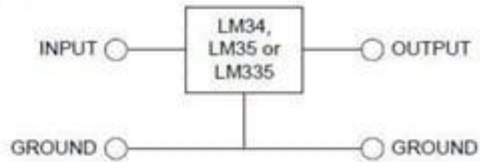
Semiconductor Temperature Sensors

Analog

Voltage Output

Typically three-pin devices: Power, ground and output.

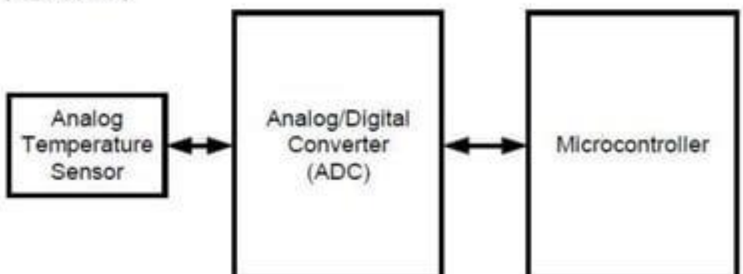
LM34: Fahrenheit sensor (10 millivolts/Fahrenheit)
LM35: Celsius sensor (10 millivolts/Celsius)
LM335: Kelvin sensor (10 millivolts/Kelvin)



Current Output

Typically 2-pin devices.

AD590: Kelvin sensor (1uA/Kelvin)



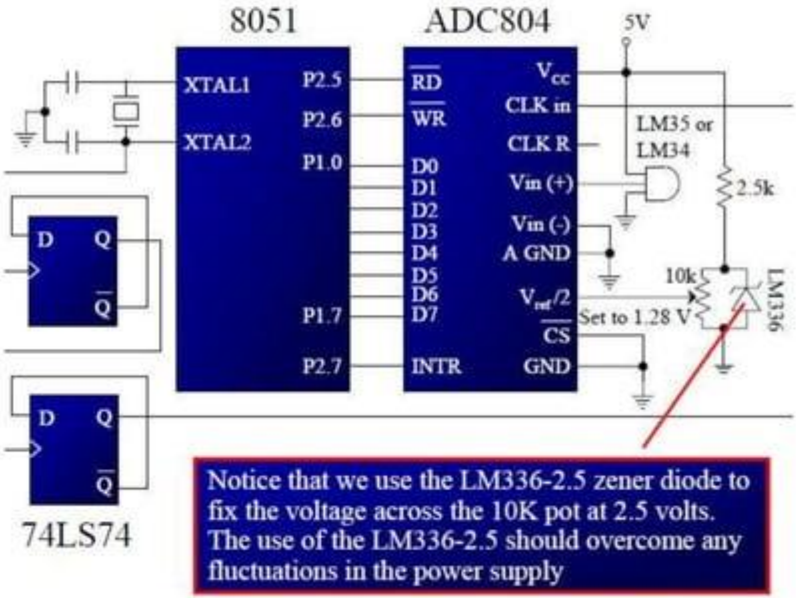
8051 Connection to ADC0848 and Temperature Sensor

- ADC0804 is a very commonly used 8-bit analog to digital convertor. It is a single channel IC, *i.e.*, it can take only one analog signal as input. The digital outputs vary from 0 to a maximum of 255. The step size can be adjusted by setting the reference voltage at pin9. When this pin is not connected, the default reference voltage is the operating voltage, *i.e.*, Vcc. The step size at 5V is 19.53mV (5V/255), *i.e.*, for every 19.53mV rise in the analog input, the output varies by 1 unit. To set a particular voltage level as the reference value, this pin is connected to half the voltage. For example, to set a refer ence of 4V (Vref), pin9 is connected to 2V (Vref/2), thereby reducing the step size to 15.62mV (4V/255).

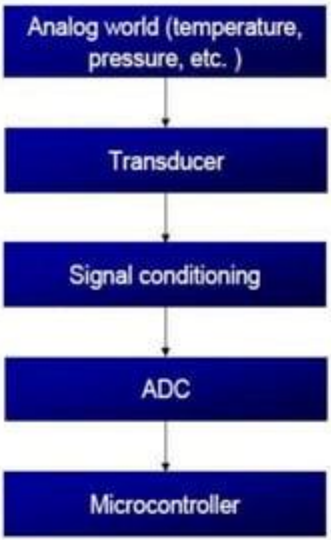
ADC808 has 8 analog inputs

- □ It allows us to monitor up to 8 different
- transducers using only a single chip
- □ The chip has 8-bit data output just like the
- ADC804
- □ The 8 analog input channels are
- multiplexed and selected according to table
- below using three address pins, A, B, and C

8051 Connection to ADC804 and Temperature Sensor



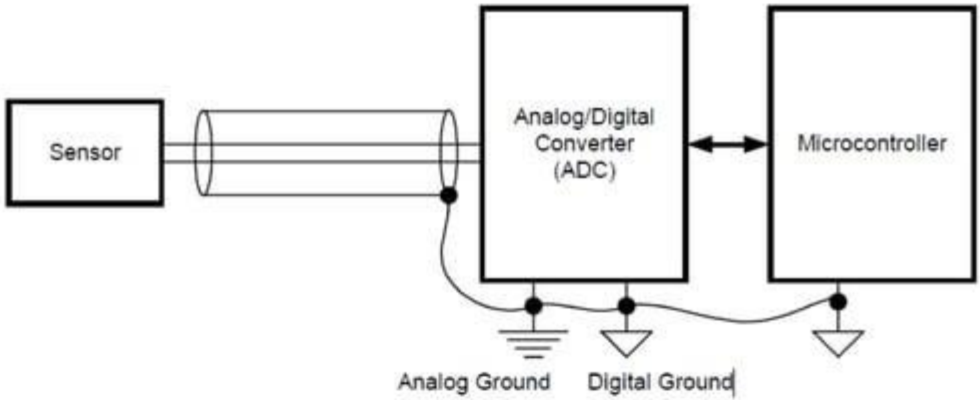
Getting Data From the Analog World



Noise considerations

- Many sensors, such as thermocouples, generate a relatively small voltage so noise is always an issue.
- The most common source of noise is the utility power lines (50 Hz or 60 Hz).
- Typically, the bandwidth for temperature sensors is much lower than 50 or 60 Hz so a simple low-pass
- filter will work well in many cases

FOR GROUNDING



Program:Code to read temp from ASC0848,convert it to decimal,and put it on P0 with some delay?.

```
#include<reg51.h>
bit RD=P2^5;
Sbit  WR=P2^6;
sbit  E=P2^7;
Sfr MYDATA=P1;
Void ConvertAndDisplay(unsigned char value);
Void MSDelay(unsigned int value);
Void main()
{
MYDATA =0xFF;
E=1;
RD=1;
WR=1;
While(1)
{
WR=0;
WR=1;
While(INTR==1);
RD=0;
Value=MYDATA;
ConvertAndDisplay(value);
RD=1;
}
}
Id ConvertAndDisplay(unsigned char value)
{
Unsigned char x,d1,d2,d3;
X=value/10;
d1=value%10;
d2=X/10;
d3=X/10;
P0=d1;
MSDelay(250);
P0=d2;
MSDelay(250);
P0=d3;
MSDelay(250);
}
Void MSDelay(unsigned int value)
{
unsigned char x,y;
For(x=0;x<value;x++)
For(y=0;y<1275;y++);
}
```