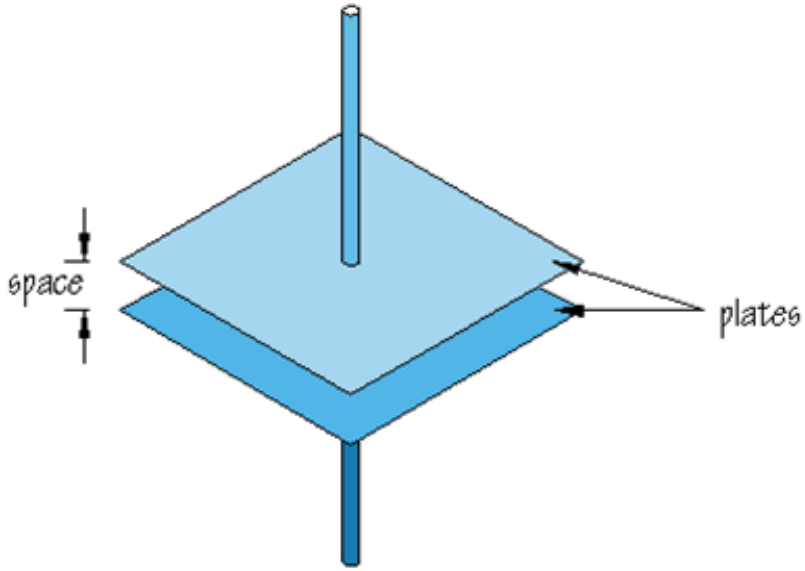
Lecture 5

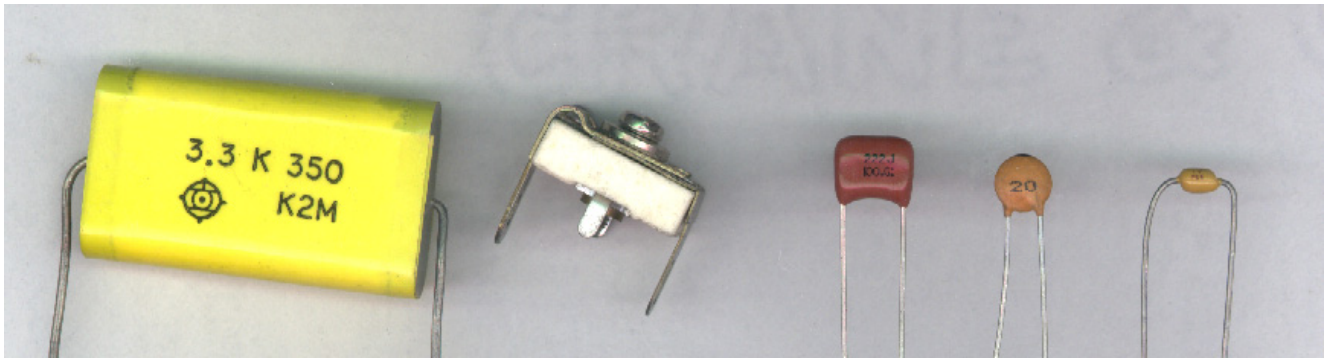
Capacitors

Capacitors 1

- Store electric charge
- Consists of two **plates** of a conducting material separated by a space filled by an insulator
- Measured in units called **farads**, **F**



Capacitors 2

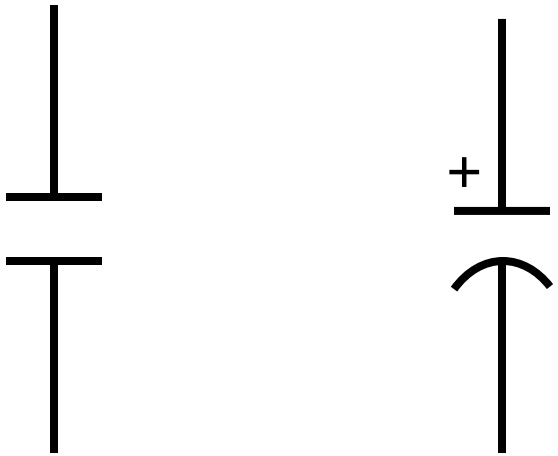


Mylar Ceramic

Electrolytic

Negative lead (-)

Capacitor Symbols

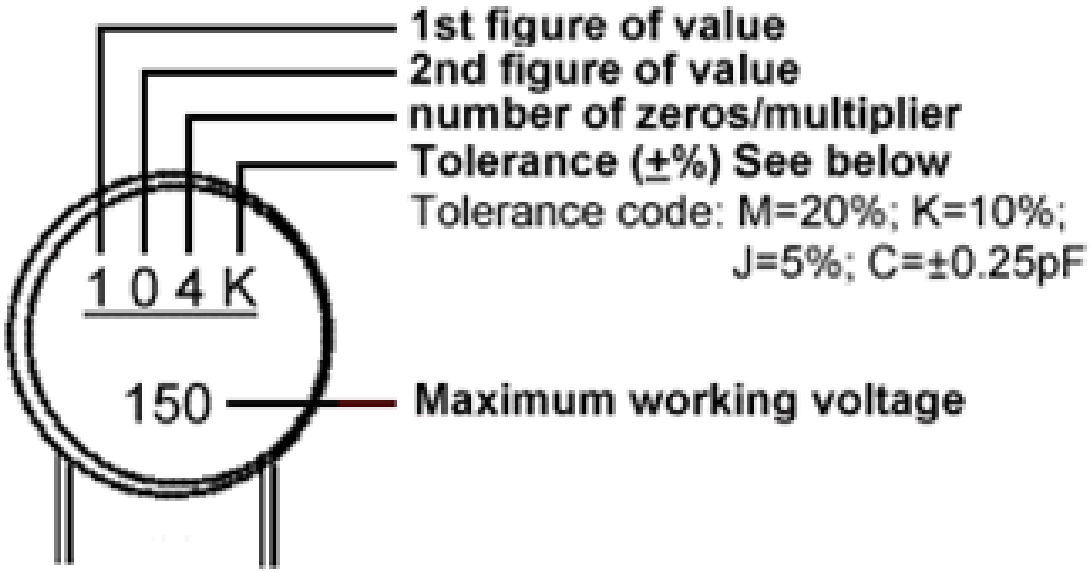


Fixed capacitor

Polarized capacitor

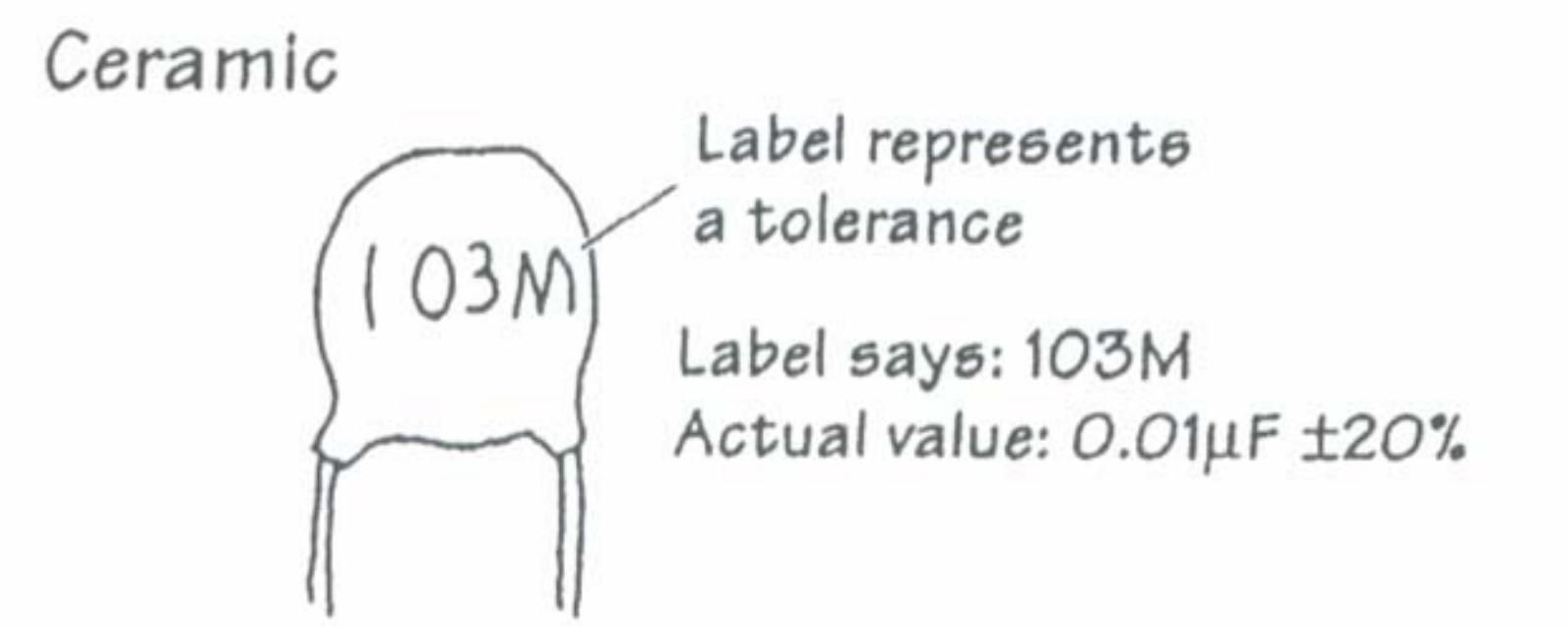
Variable capacitor

How to Read Capacitor Value

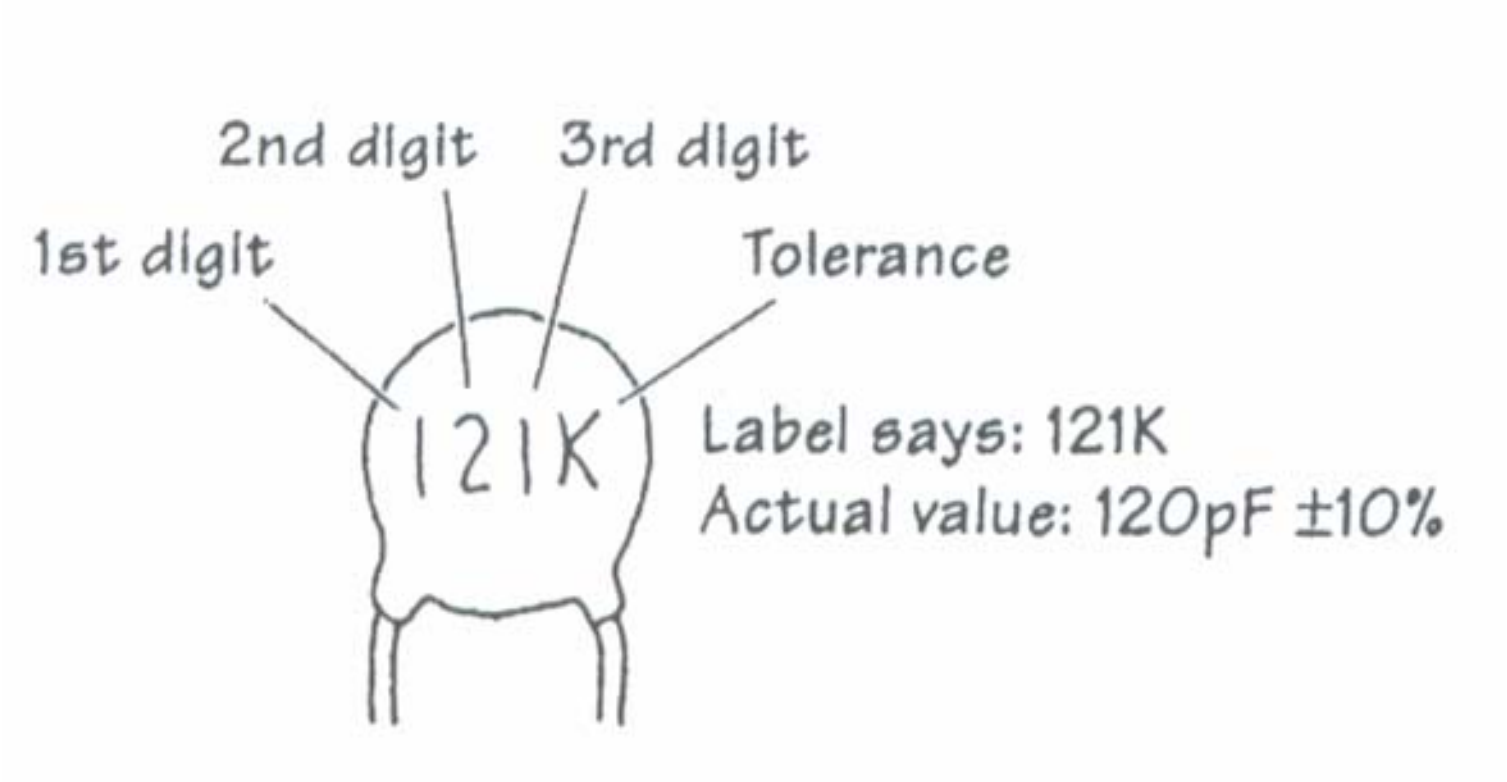


- The first two figures give us 10, the third figure gives us 0000, and the letter 10%. We normally express this as 0.1µF.

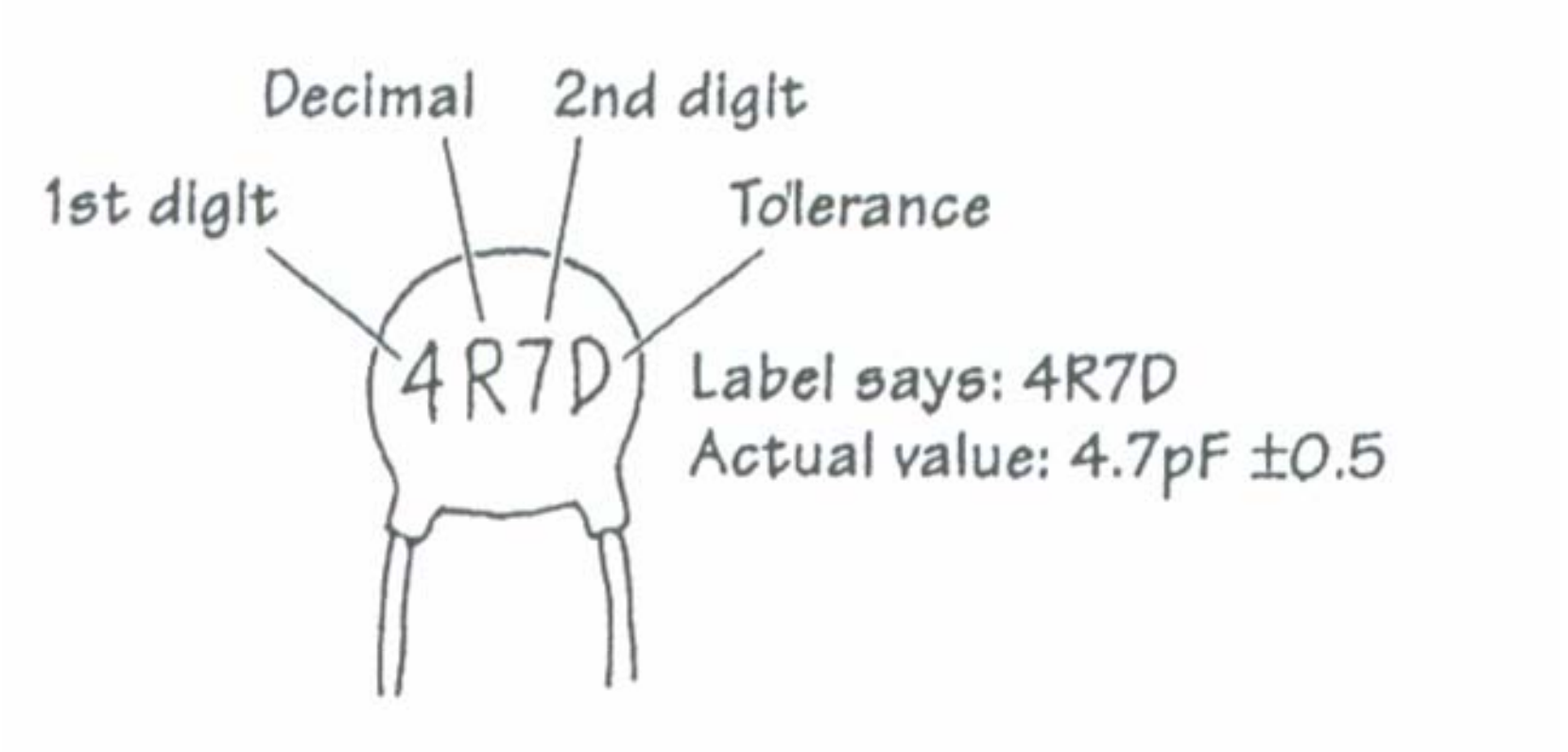
Example: Capacitor Value 1



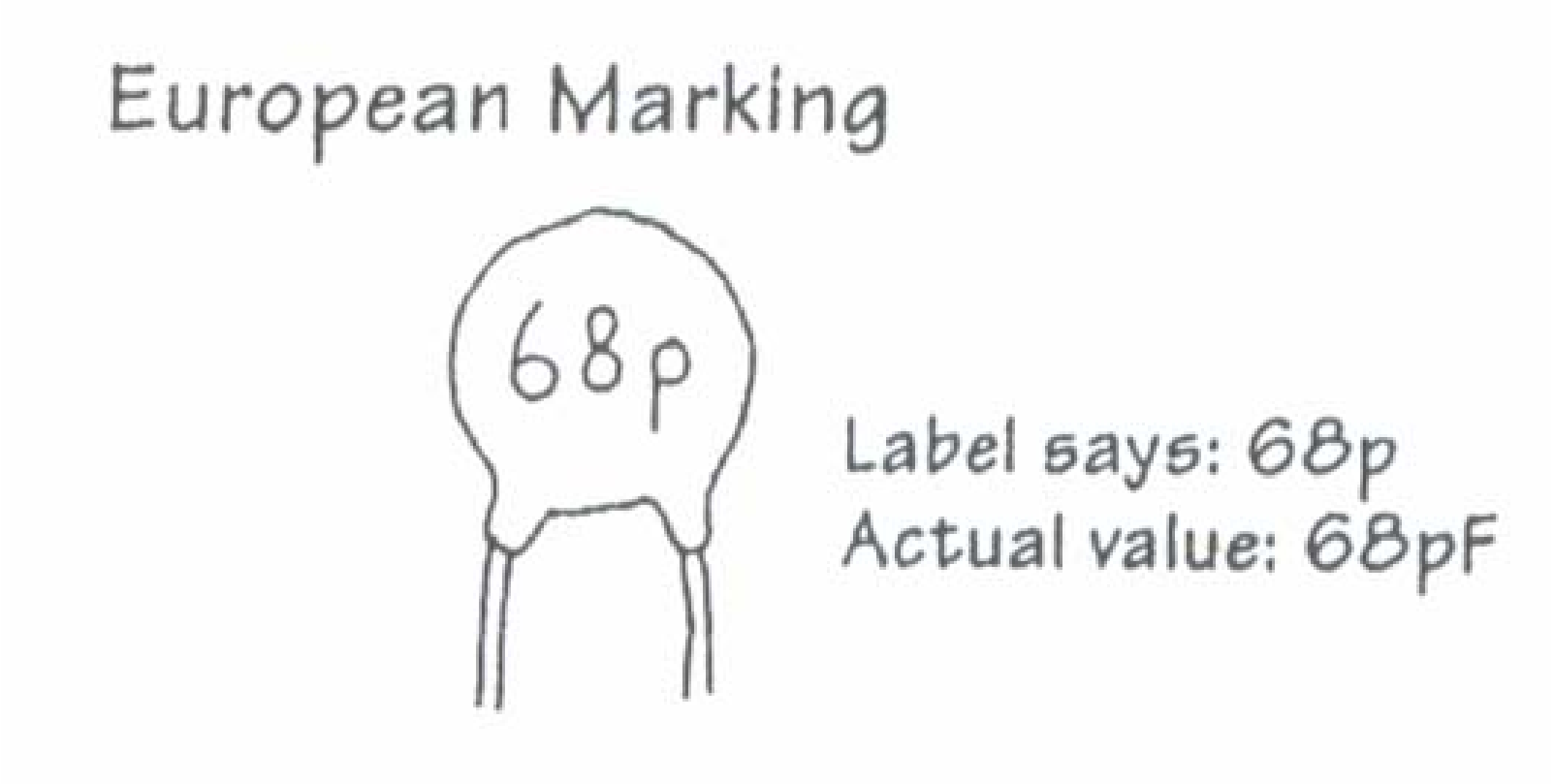
Example: Capacitor Value 2



Example: Capacitor Value 3



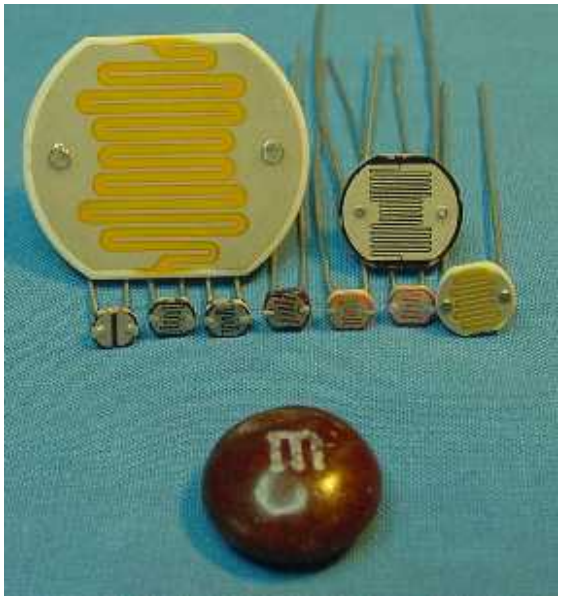
Example: Capacitor Value 4



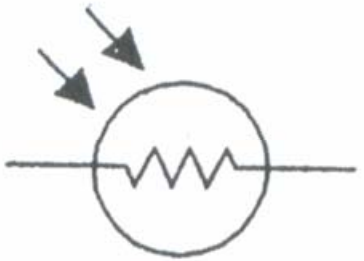
Lecture 6

Optoelectronics

Photoresistors

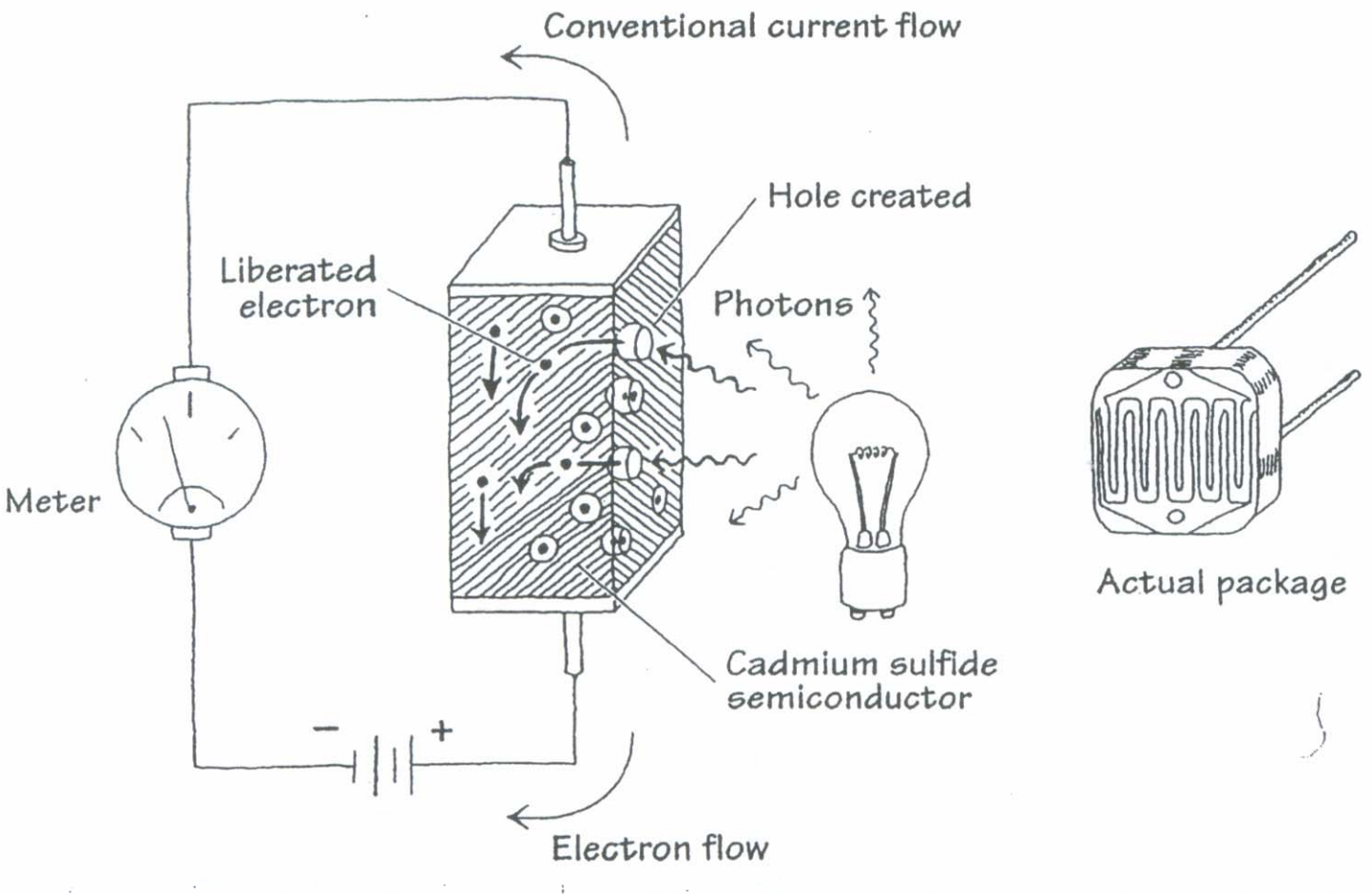


- Light sensitive resistors
- Resistance decreases when light intensity increases

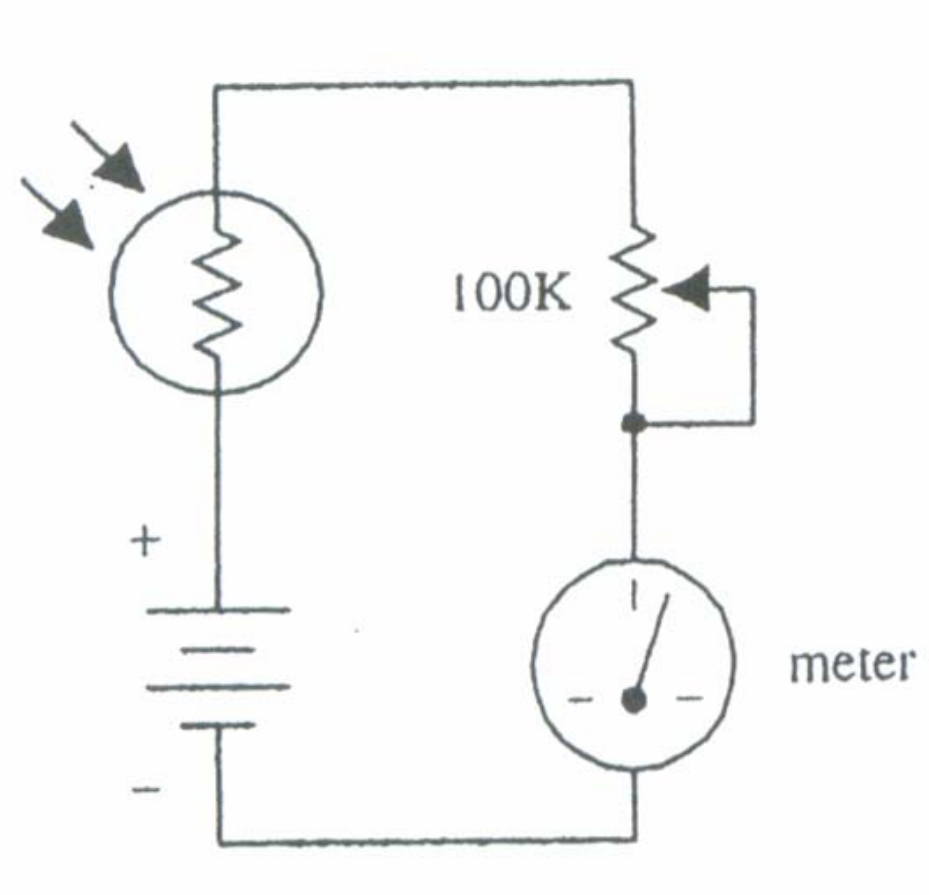


Symbol

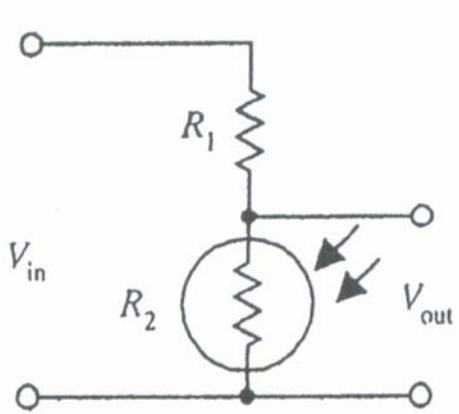
Photoresistor: How It Works

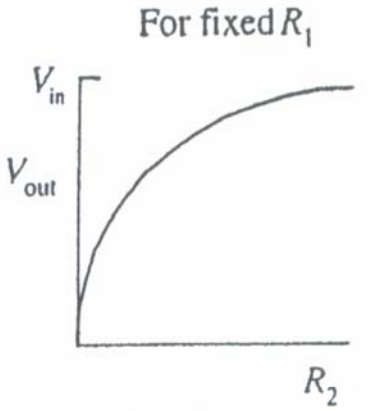


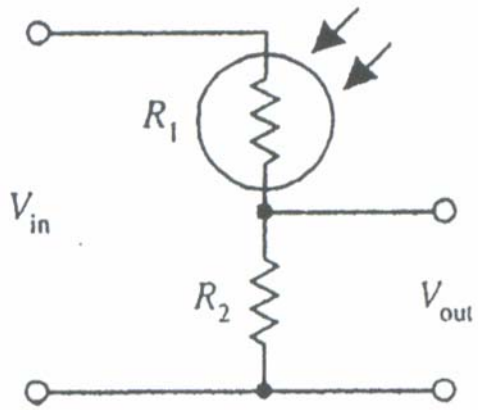
Simple Light Meter

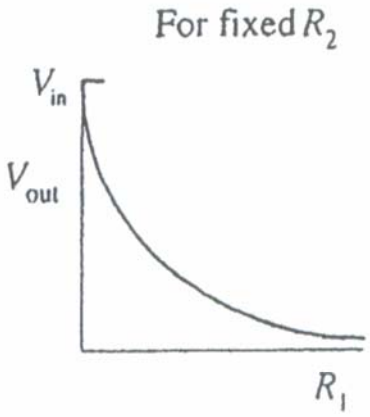


Light Sensitive Voltage Divider

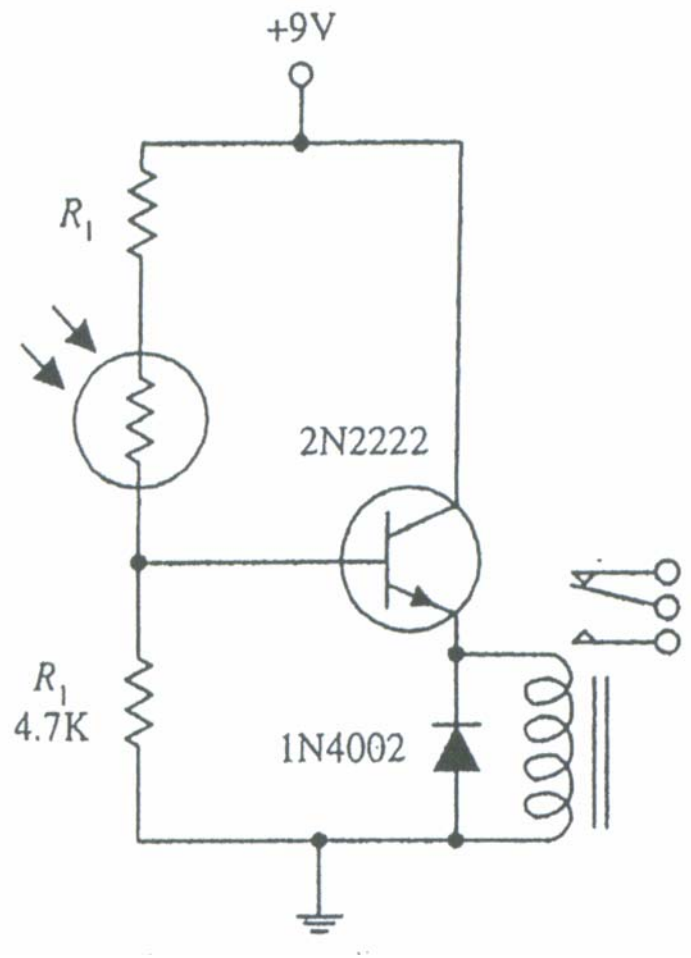




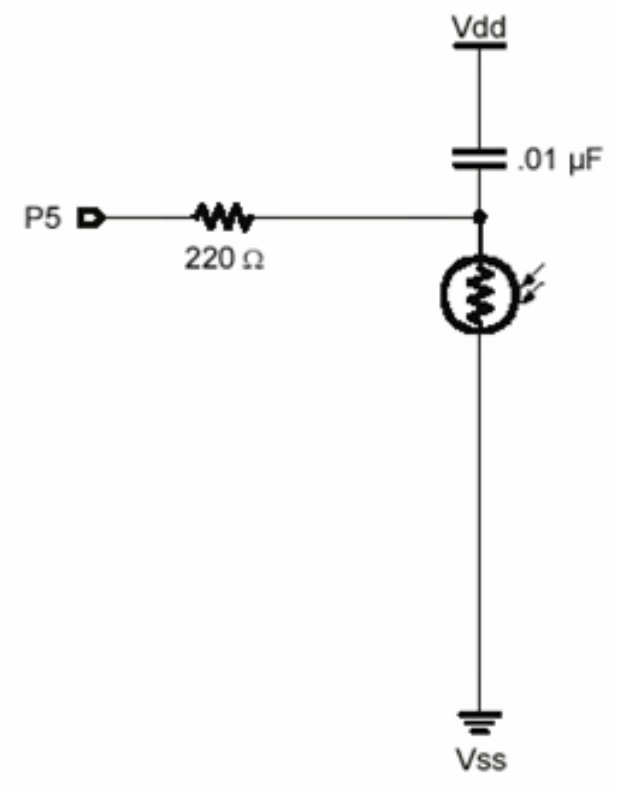




Light Activated Relay

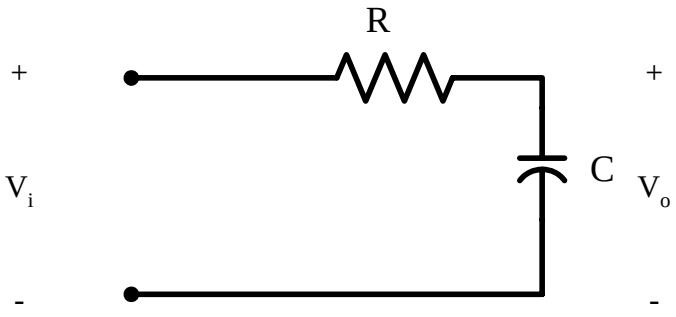


Photoresistor with BS2

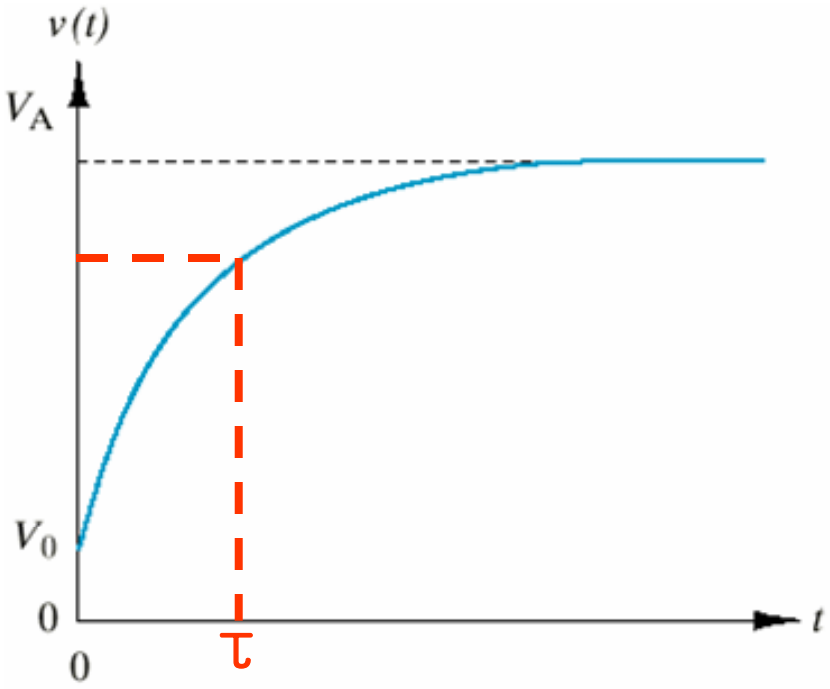


- Usually connect with a capacitor
- Use RCTime command to find out light intensity

RC Circuit

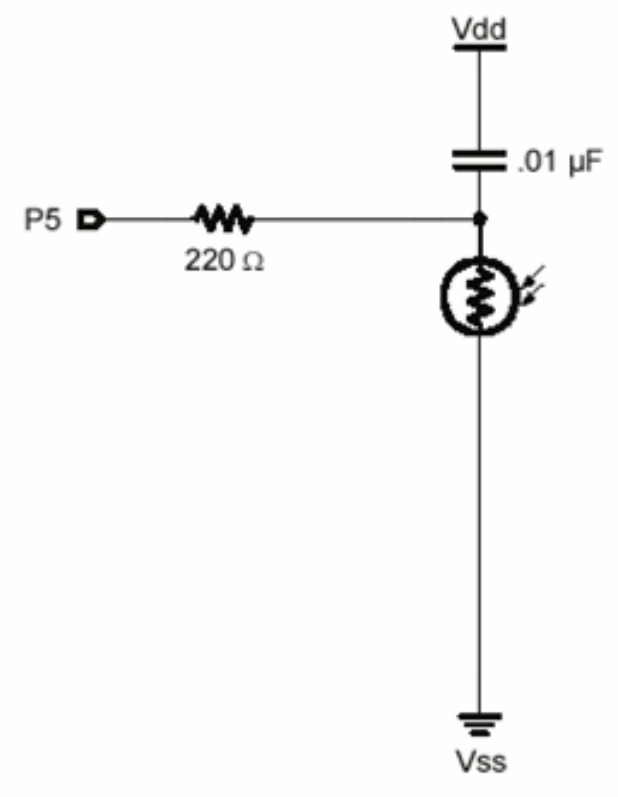


$$\frac{V_o(s)}{V_i(s)} = \frac{1}{RCs+1}$$



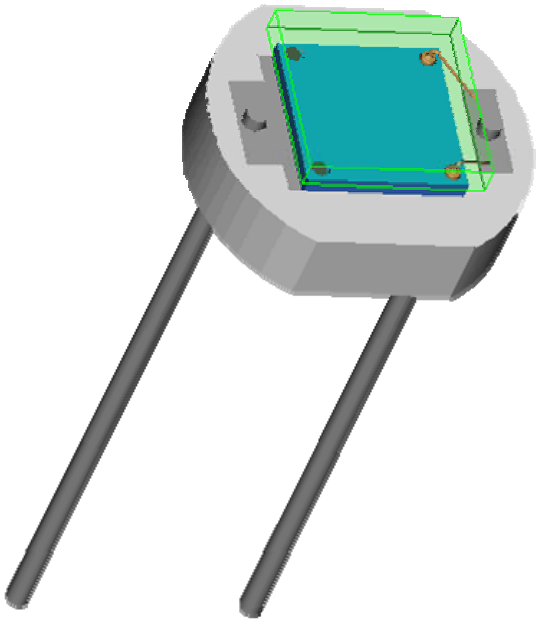
RC is time constant, τ

Rctime with BS2

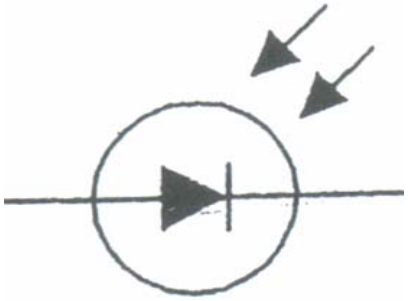


- **Software version of analog to digital converter**
- **Pbasic rctime command**
  - **Rctime Pin#, state, variable**
- **Example code**
  - **High 5**
  - **Pause 3**
  - **Rctime 5,1, tau**

Photodiode

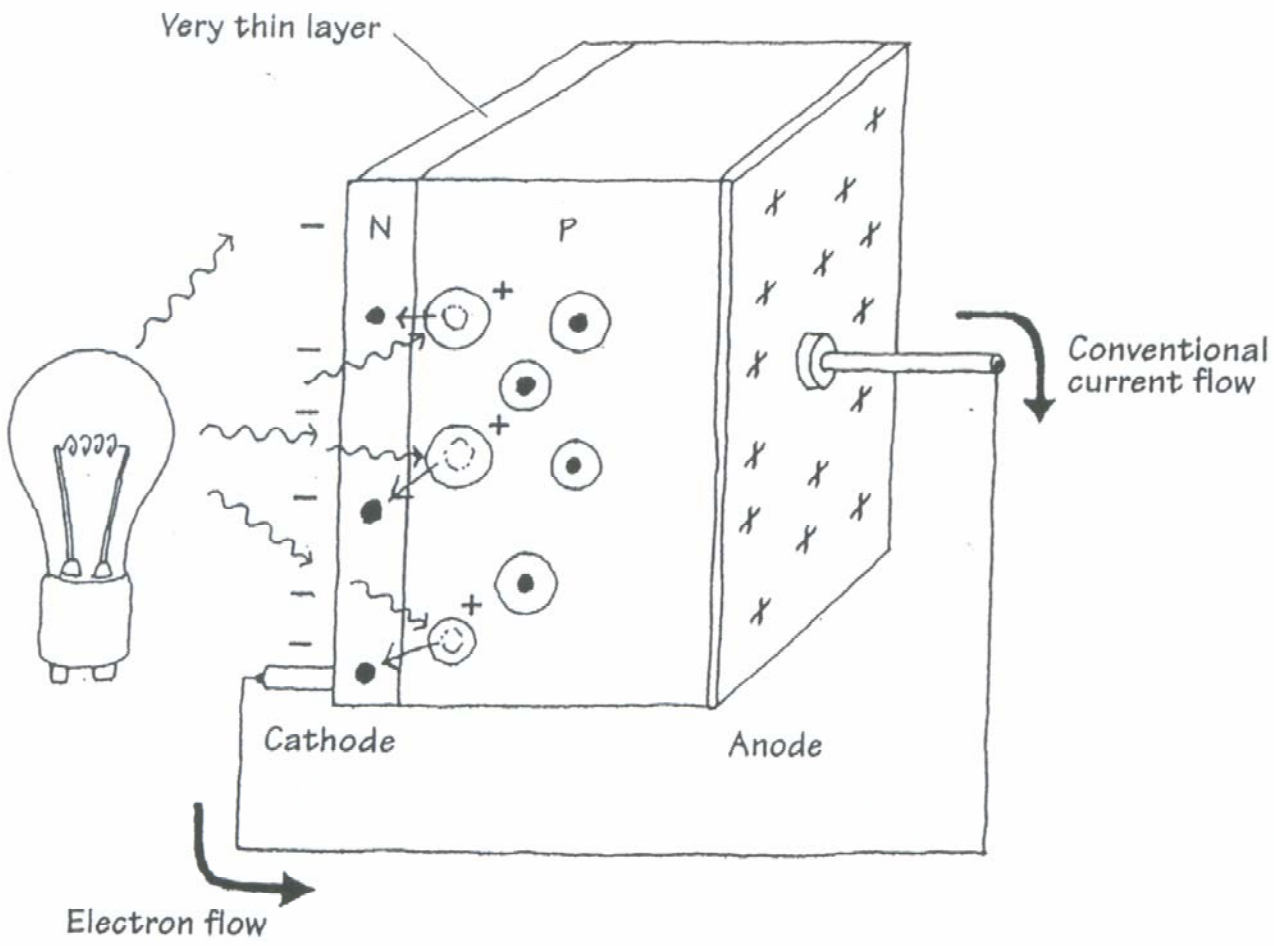


- Transforms light energy to electric current
- Very linear
- More sensitive than photoresistor

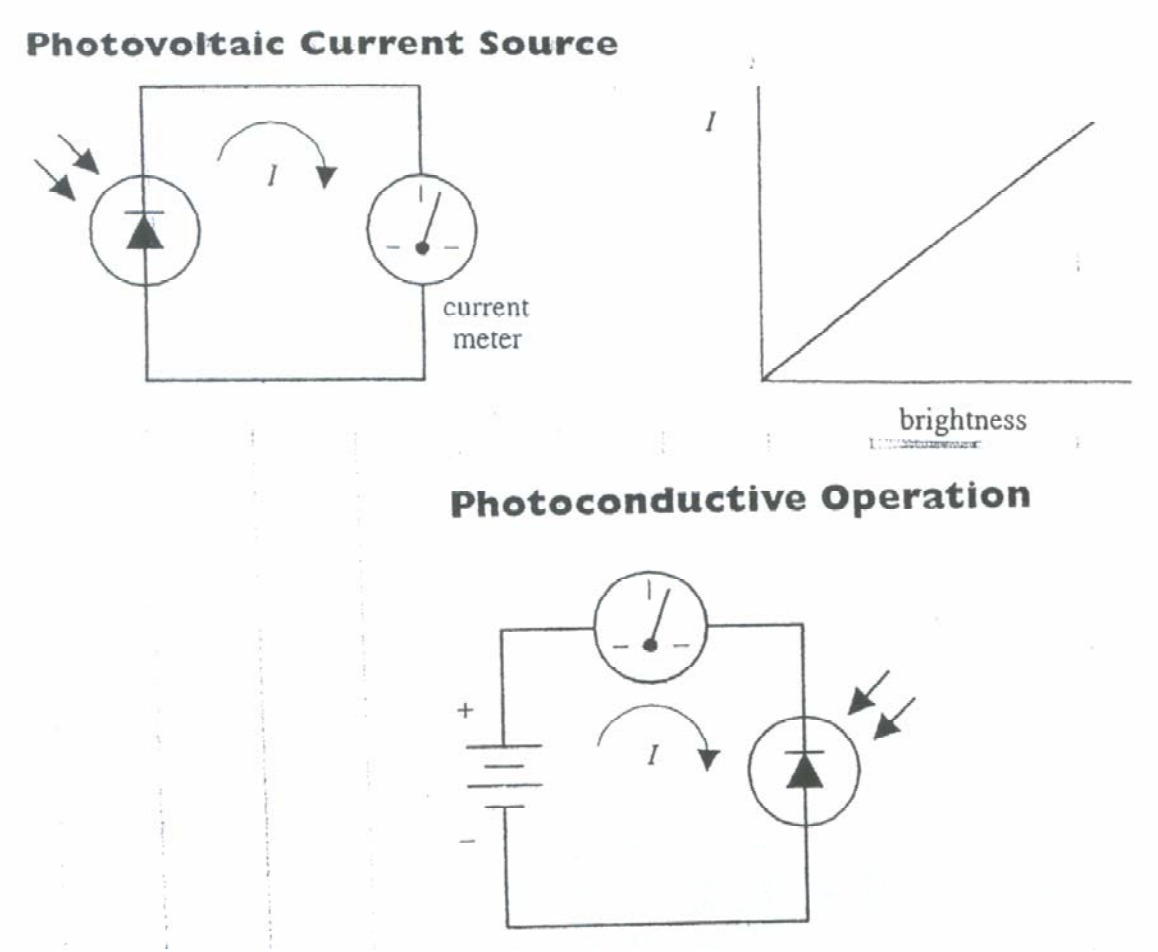


Symbol

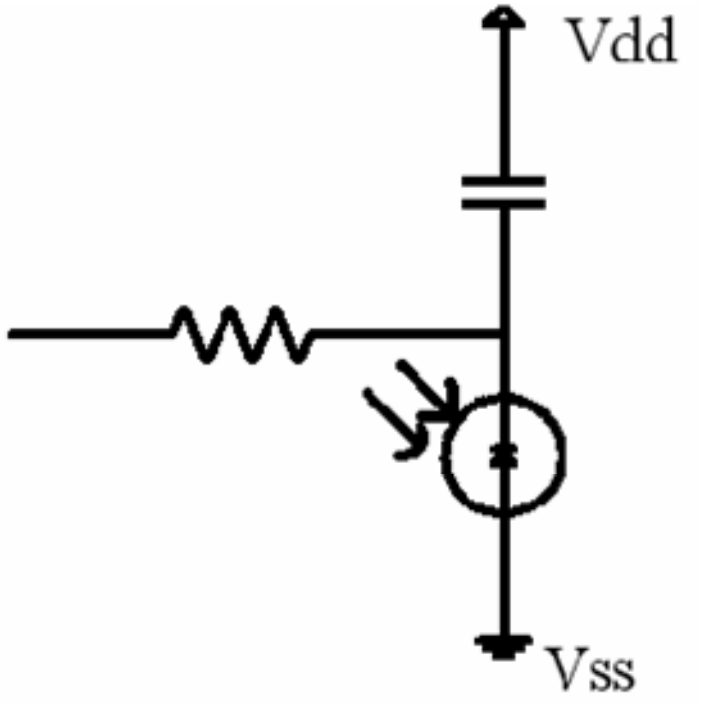
Photodiode: How It Works



Photodiode Applications

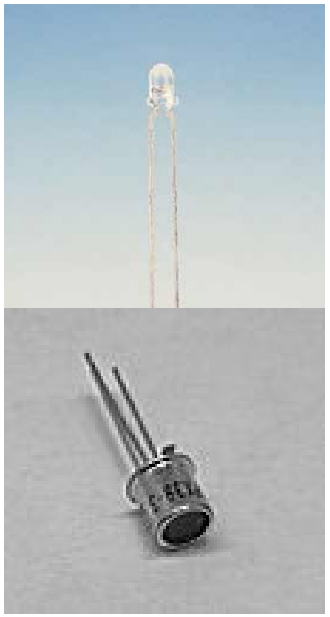


Photodiode with BS2

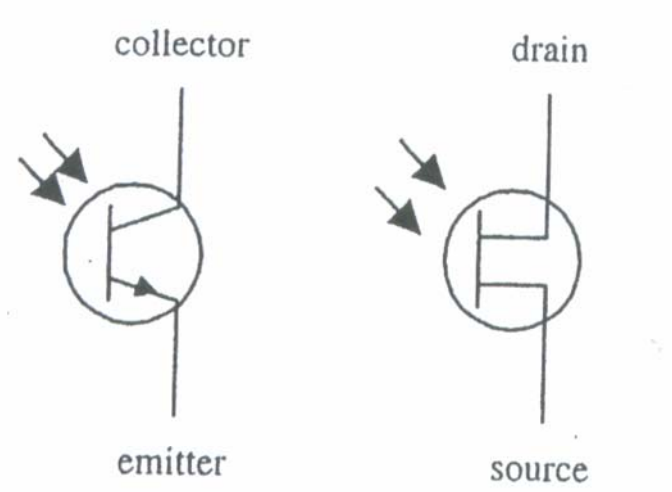


- Polarity: cathode connects to the ground

Phototransistor

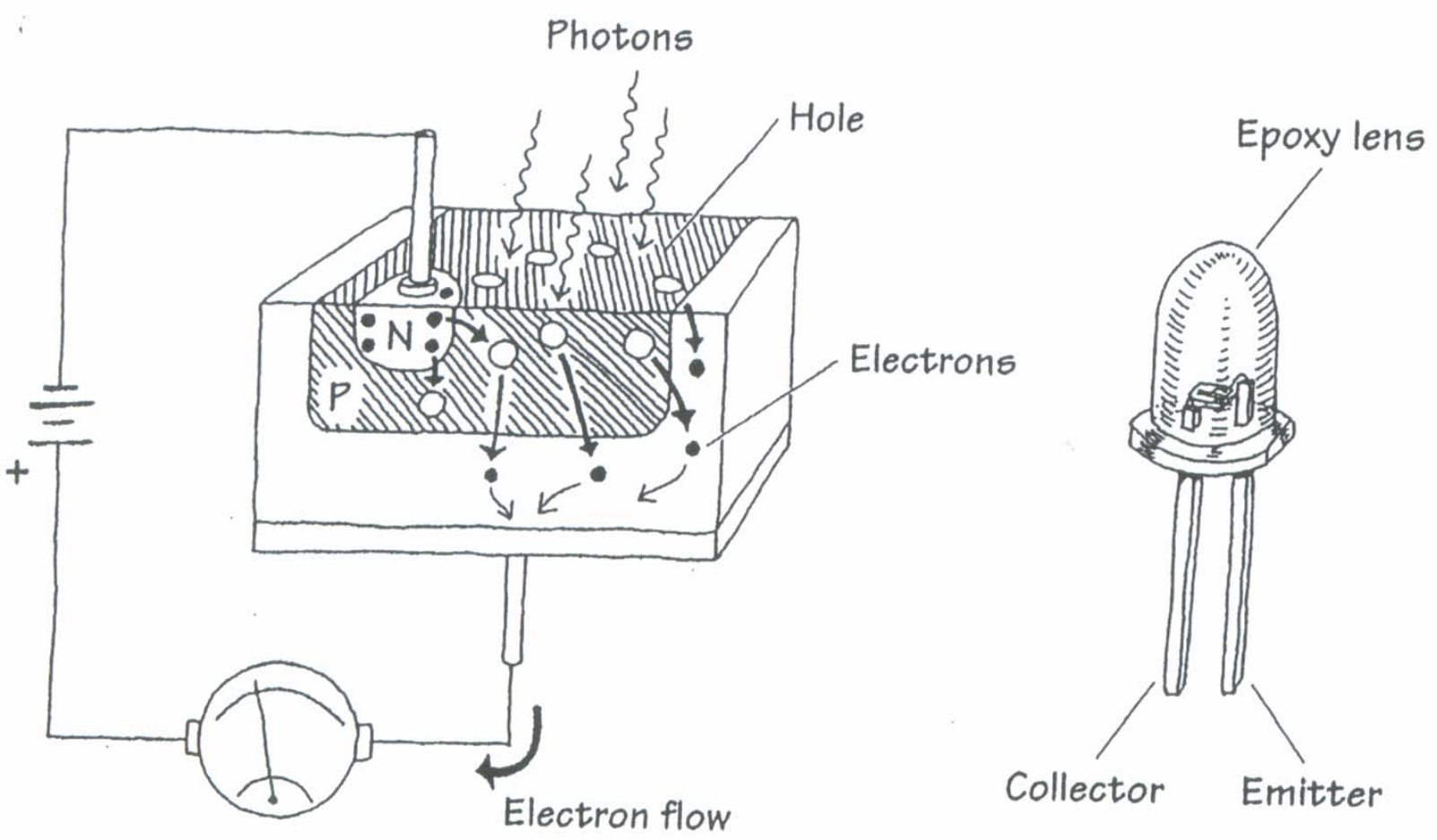


- The base lead of a BJT is replaced by a light sensitive surface

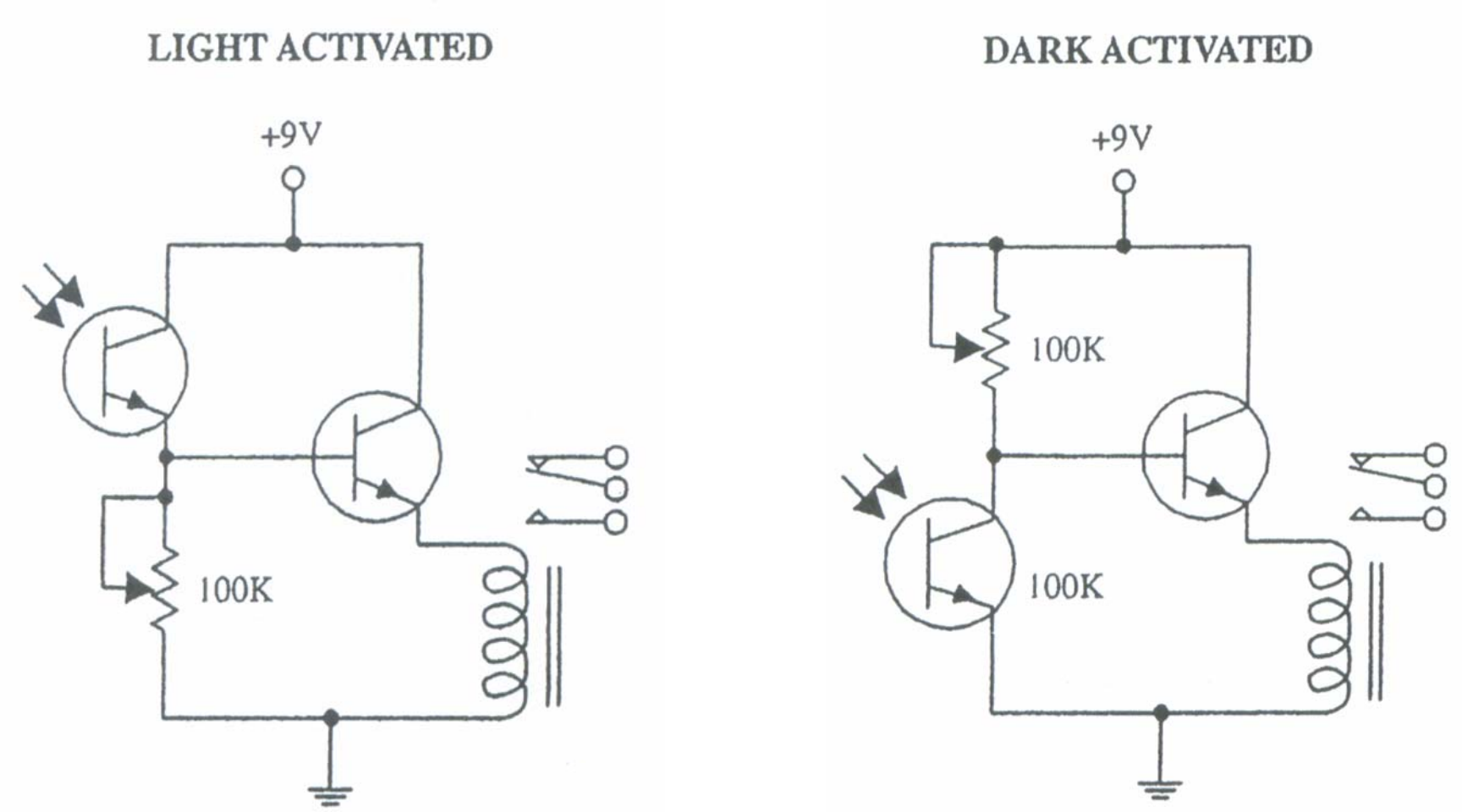


Phototransistor **Photo FET**

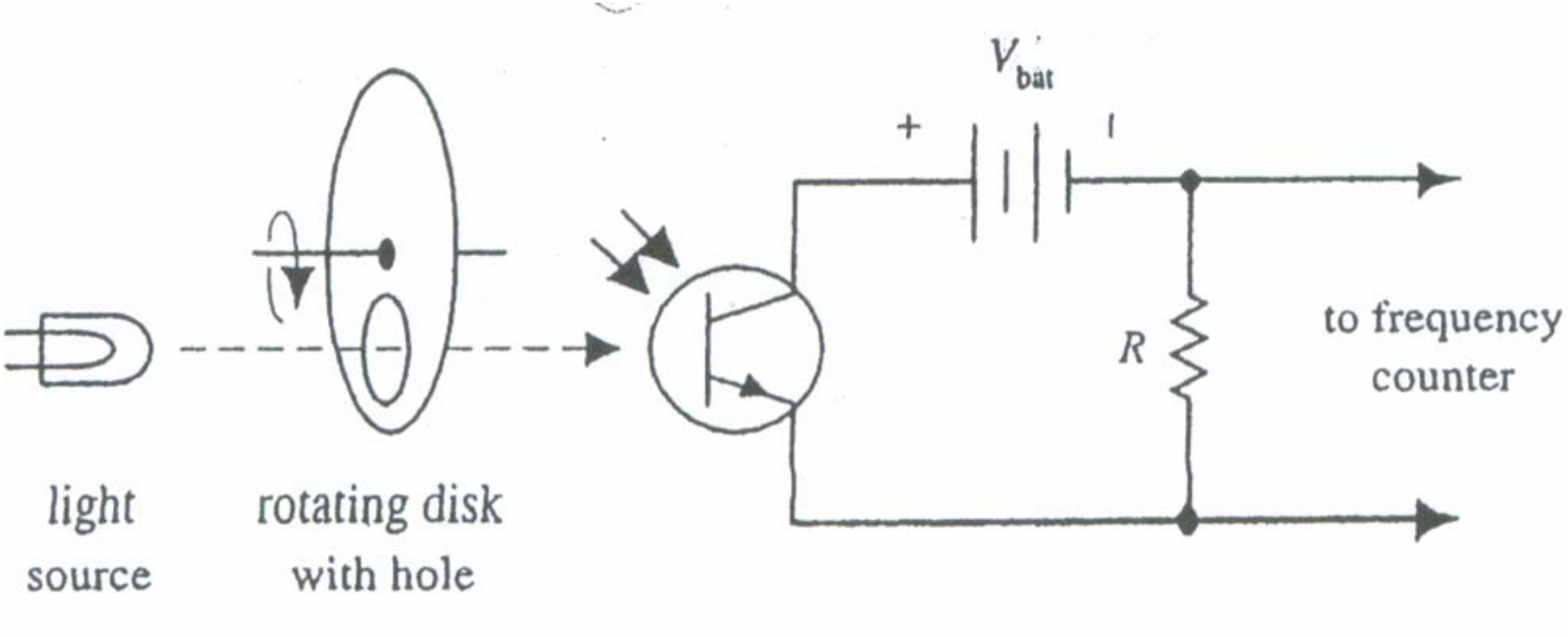
Phototransistor: How It Works



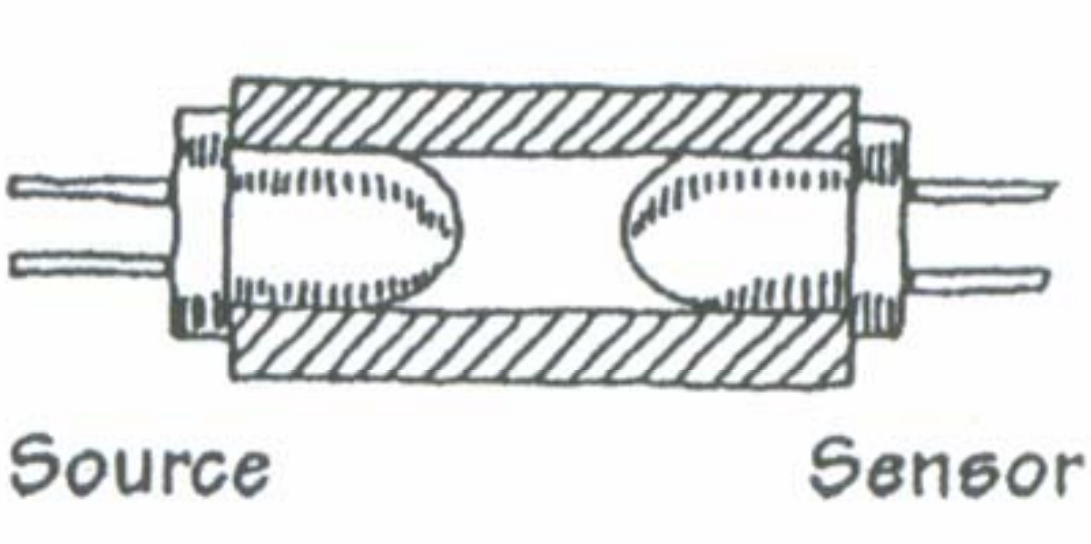
Phototransistor Applications



Tachometer

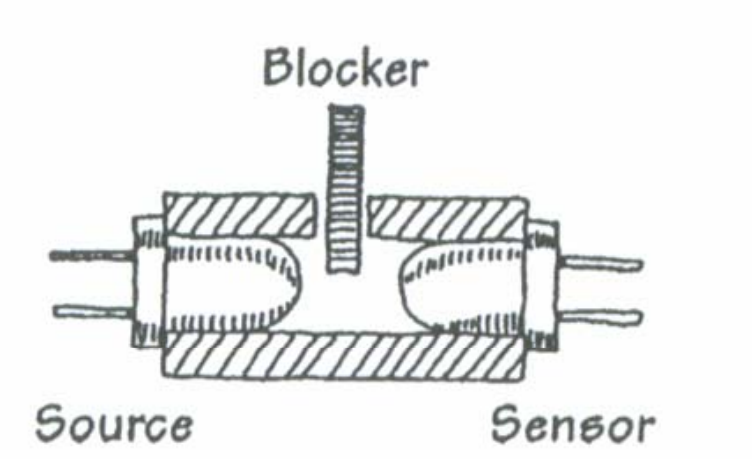

V_{bat}
+
R
to frequency counter
light source
rotating disk with hole

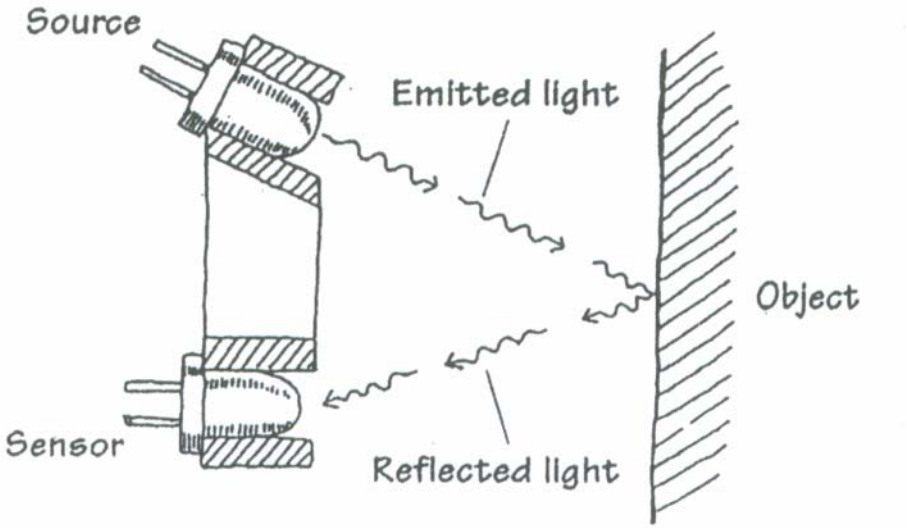
Optoisolators 1



Closed Pair

Optoisolators 2

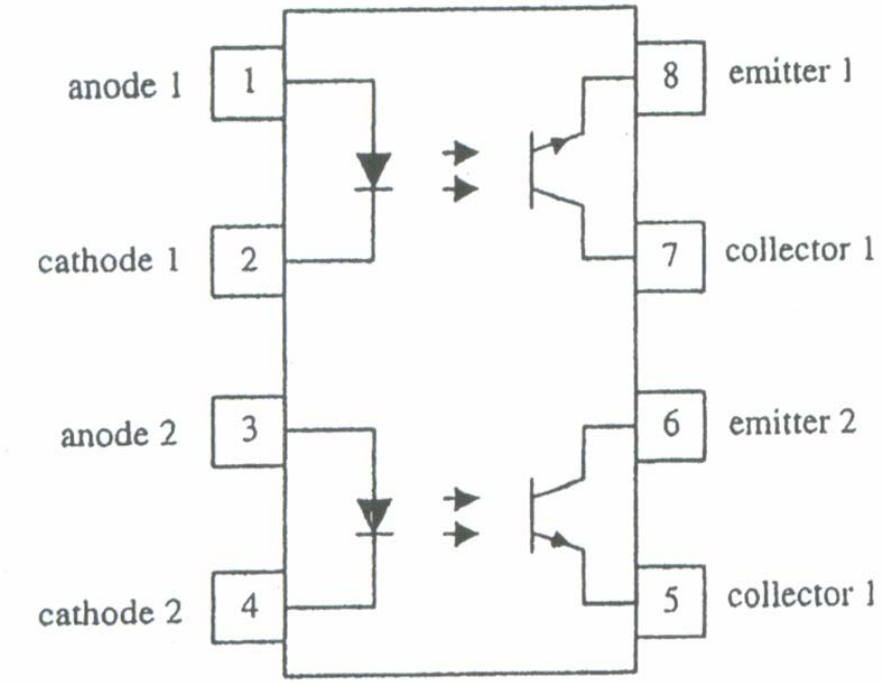




Slotted Pair

Reflective Pair

Optoisolators 3



Integrated Optoisolators

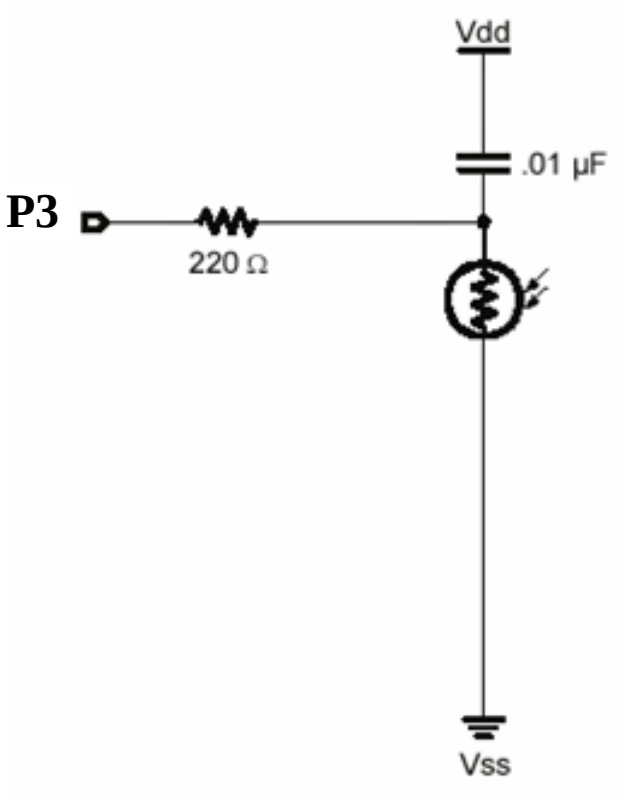
Optoelectronic Sensors Experiments

Experiments	Chapters
What's micro controller	
Basic A and D	8
Process Control	
Smart Sensors	
Boe Bot Robotics	
Others	

Lecture 7

ADC

Rctime with BS2

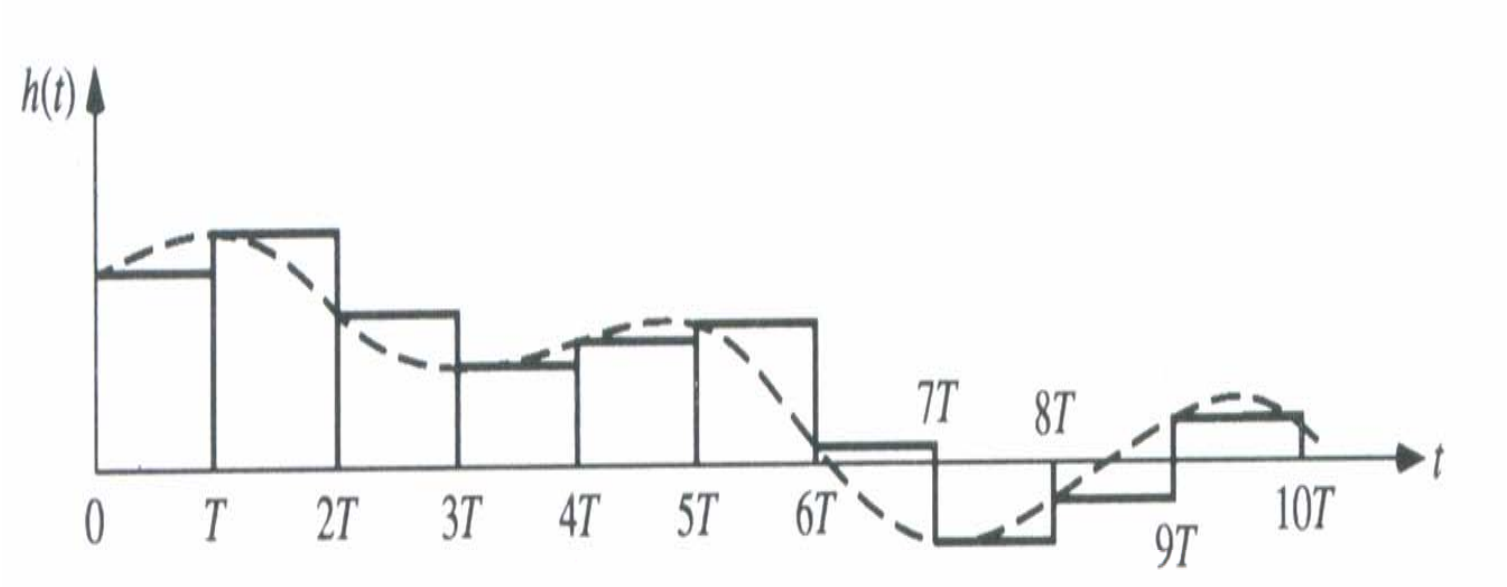


- **Software version of analog to digital converter**
- **Pbasic rctime command**
  - **High 3**
  - **Pause 3**
  - **Rctime 3,1, tau**

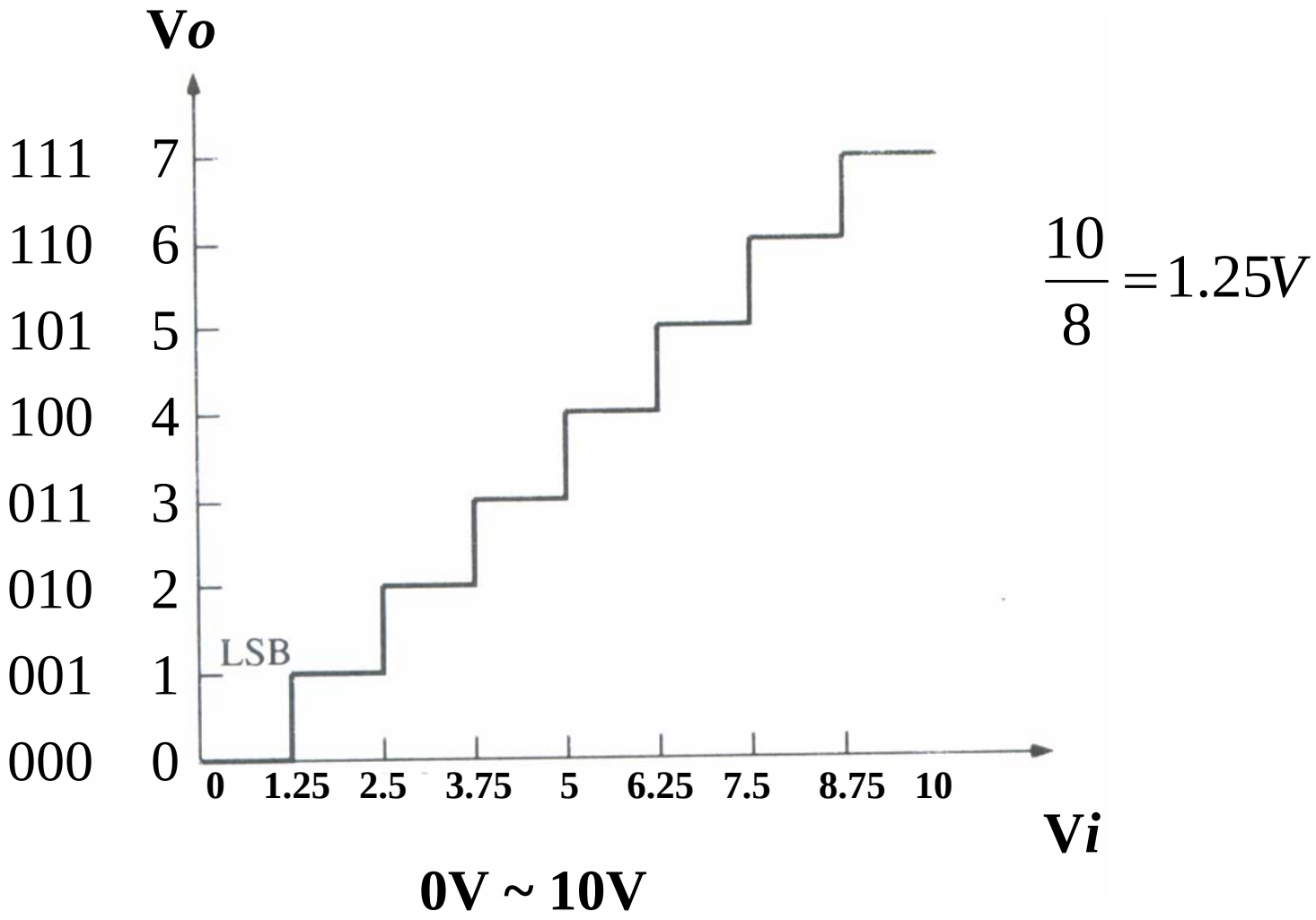
Analog to Digital Conversion

- Process of converting an analog signal to a digital number
- Three step procedure
  - Sampling (sample and hold)
  - Quantization
  - Coding

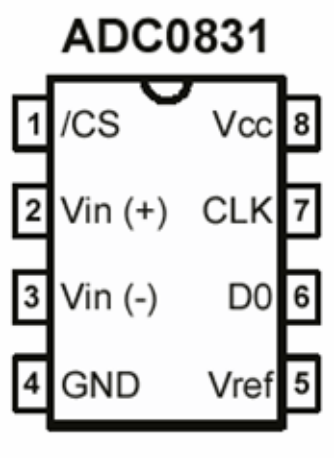
Sampling



Quantization and Coding

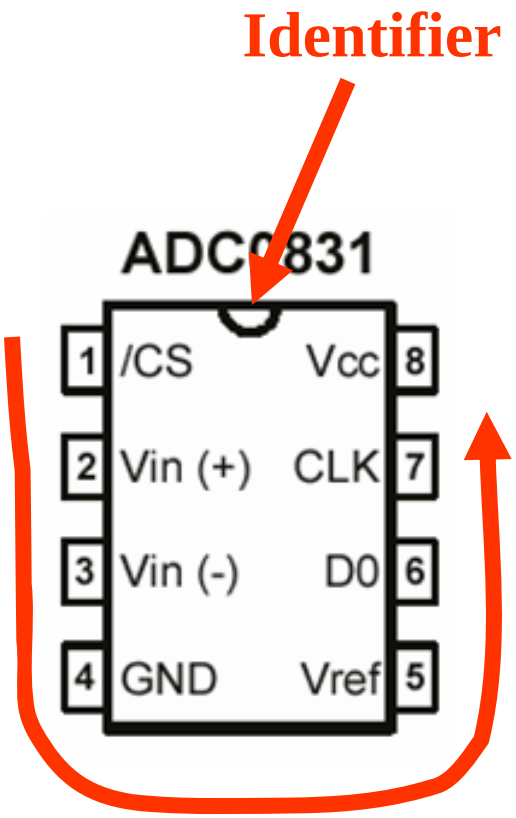


ADC



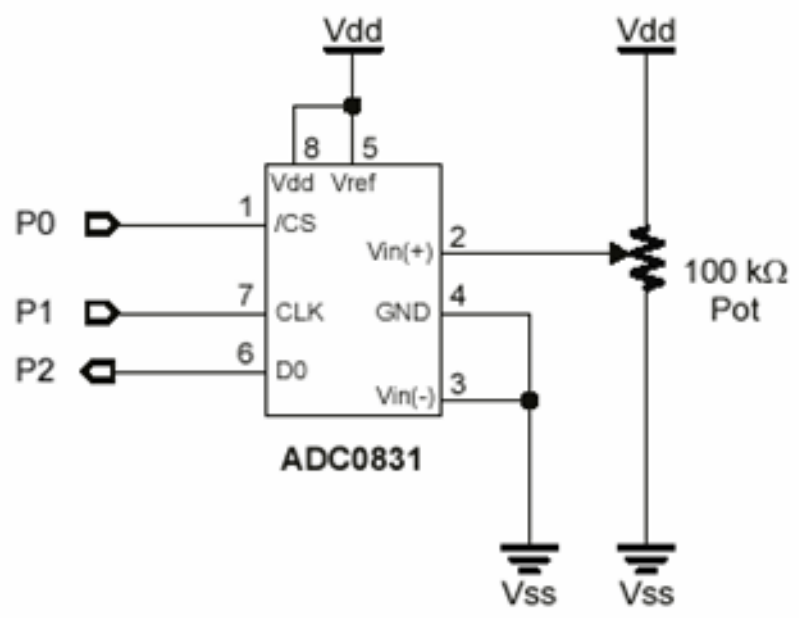
- Analog to digital converter
- 8-bit successive analog to digital converter
- 0V to 5V input range
- Single 5V power supply

ADC Pin Description



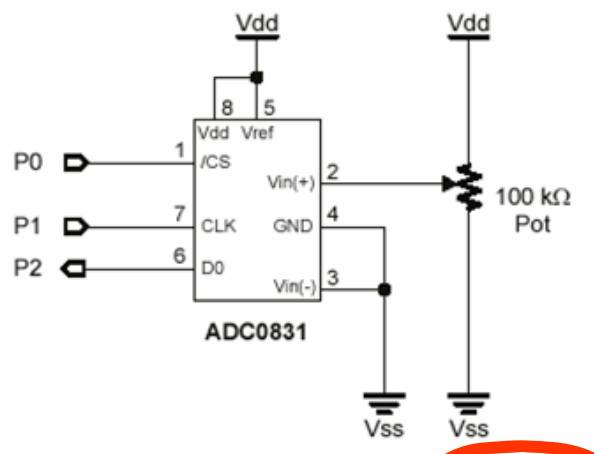
Pin	Description
Pin 1	ADC is ready to do conversion when it is low
Pin 2	0 to 5V analog input need to be digitized
Pin 3	Zero offset adjustment
Pin 4	Ground
Pin 5	Span adjustment
Pin 6	8 bit ADC output
Pin 7	Clock signal from BS2
Pin 8	Regulated 5V (Power supply)

ADC with BS2-1



- 0V to 5V analog input using a potentiometer
- Output is from 0 to 255
  - 8 bit resolution

Sample Code for ADC 1



adcbits var byte
High 0
Low 0
Shiftin 2, 1,MSBPOST, [adcbits\8]
High 0

Serial communication

Shiftin Data_pin, Clock_pin, mode, [variable\bits]

Sample Code for ADC 2

```
Q var word
R var word
Q = 13 /5
R = 13 // 5
Debug ? Q
Debug ? R
```

Quotient

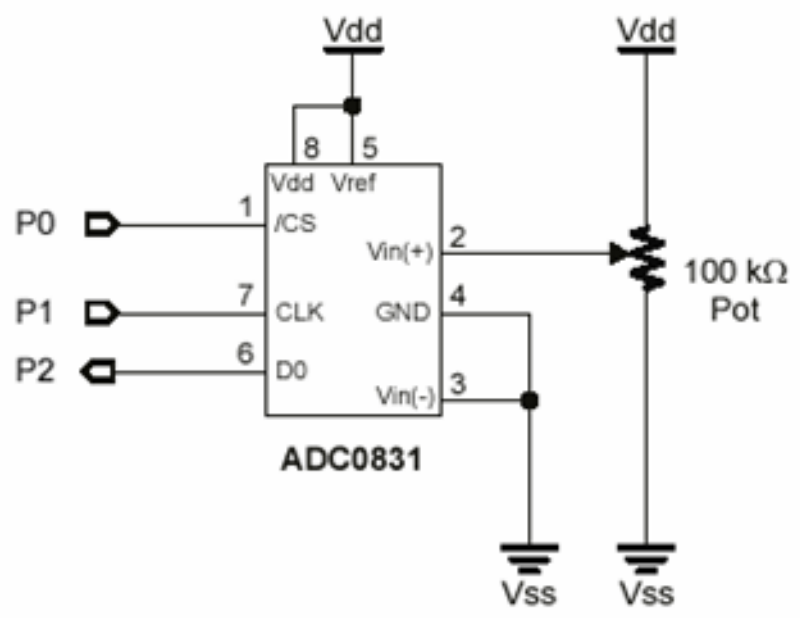
Remainder

Debug window shows;

Q= 2

R= 3

ADC with BS2-2

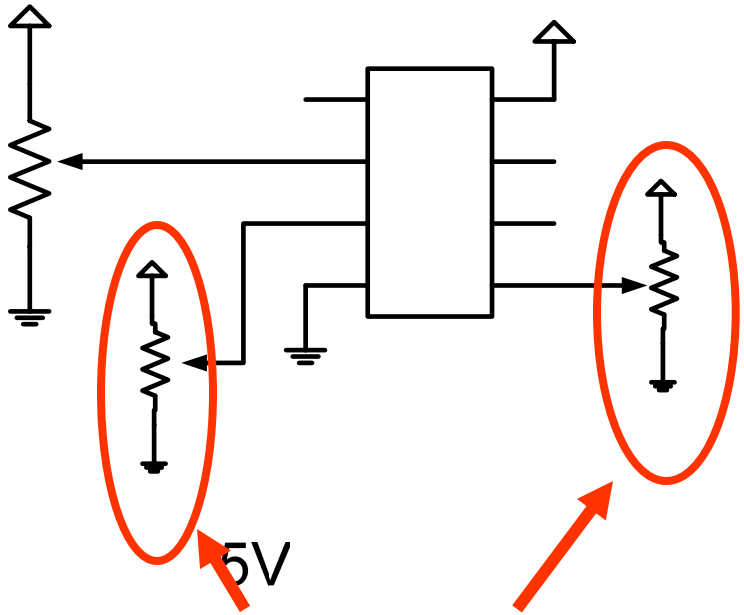


- 2V to 5V limited analog input using a potentiometer
- Output is from 102 to 255
  - 8 bits resolution

$$\frac{2V}{5V} \times 255 = 102$$

$$\frac{5V}{5V} \times 255 = 255$$

ADC with BS2-3



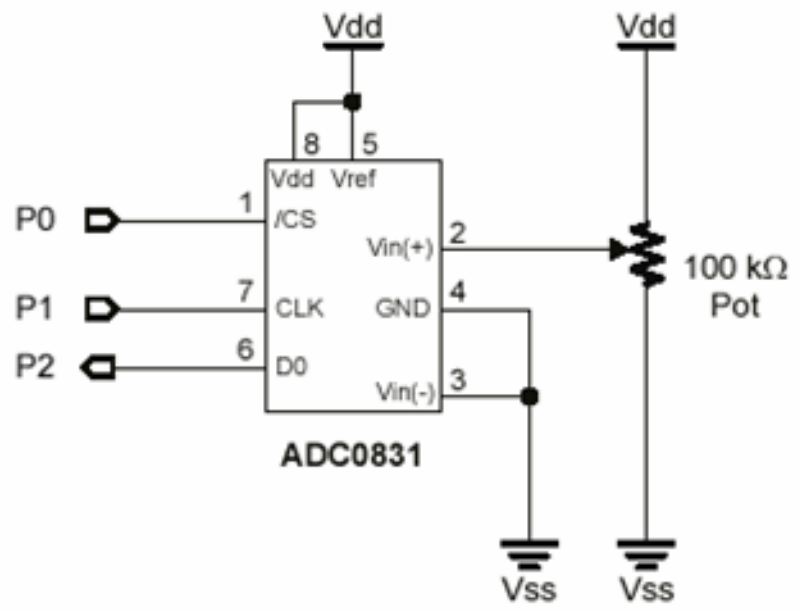
- Using two potentiometers zero and span can be adjusted to get full 8 bit resolution

$$\frac{(2-2)V}{3V}\times 255 = 0$$

5V

$$\frac{(5-2)V}{3V}\times 255 = 255$$

ADC with BS2-4

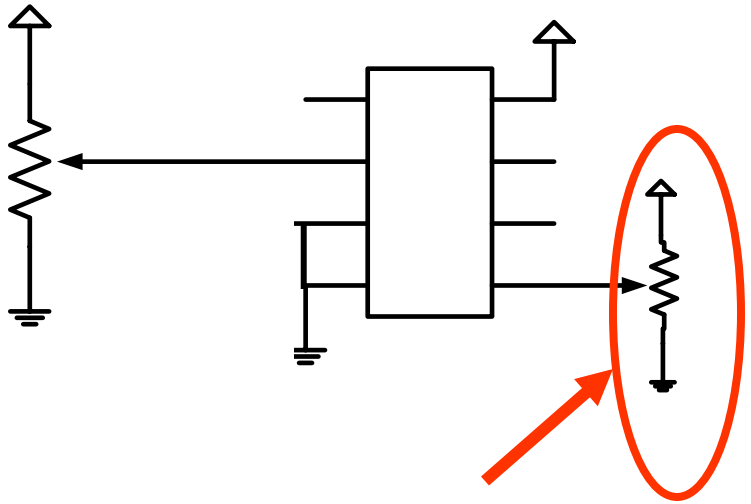


- 0V to 4V limited analog input using a potentiometer
- Output is from 0 to 204
  - 8 bits resolution

$$\frac{0V}{5V} \times 255 = 0$$

$$\frac{4V}{5V} \times 255 = 204$$

ADC with BS2-5



- Using another potentiometer to span can be adjusted to get full 8 bit resolution

$$\frac{0V}{4V} \times 255 = 0$$

$$\frac{4V}{4V} \times 255 = 255$$

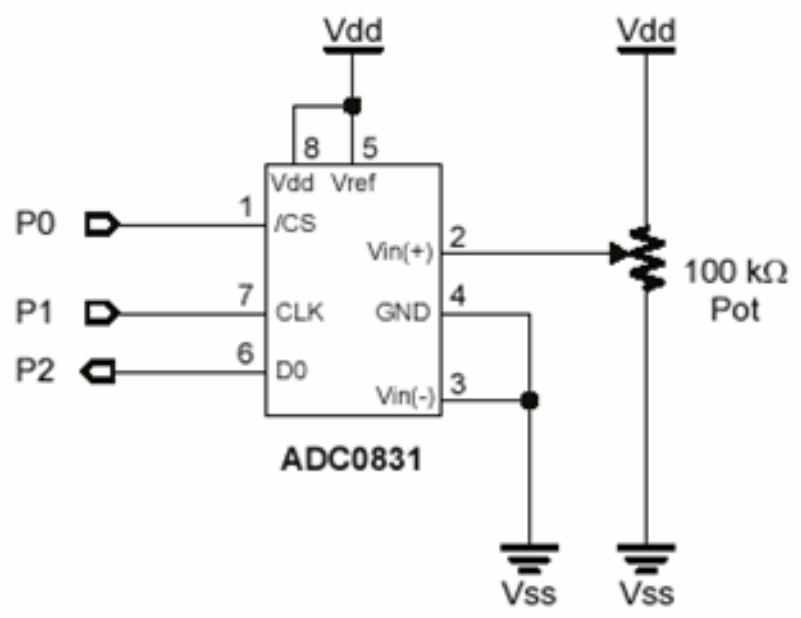
5V

P0

P1

ADC 0831

ADC with BS2-6

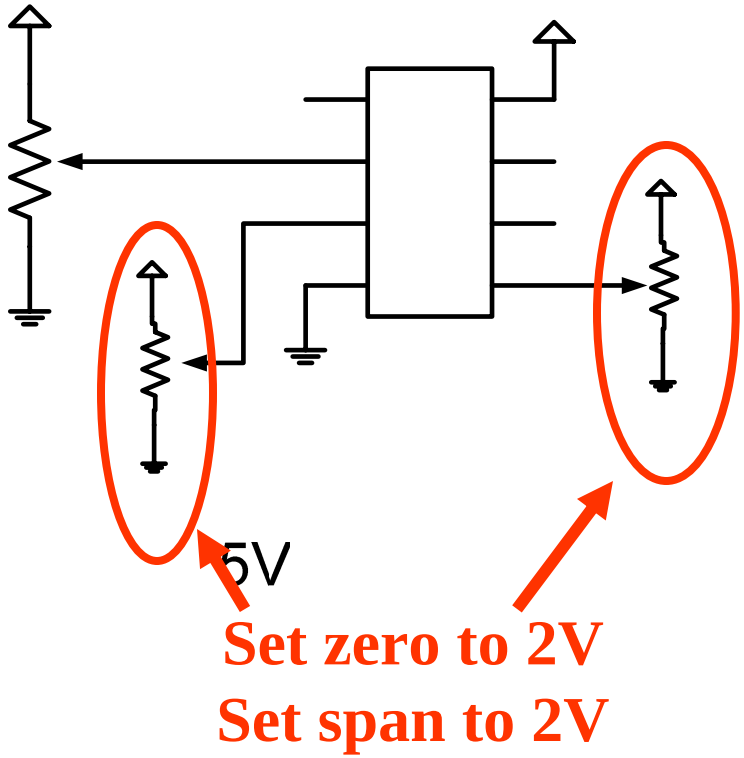


- 2V to 4V limited analog input using a potentiometer
- Output is from 102 to 204
  - 8 bits resolution

$$\frac{2V}{5V} \times 255 = 102$$

$$\frac{4V}{5V} \times 255 = 204$$

ADC with BS2-7



- Using 2 potentiometers zero and span can be adjusted to get full 8 bit resolution

$$\frac{(2-2)V}{(4-2)V}\times 255 = 0$$

$$\frac{(4-2)V}{(4-2)V}\times 255 = 255$$

5V

P0

P1

ADC 0831

ADC0831 Experiments

Experiments	Chapters
What's micro controller	
Basic A and D	1, 3
Process Control	
Smart Sensors	
Boe Bot Robotics	
Others	