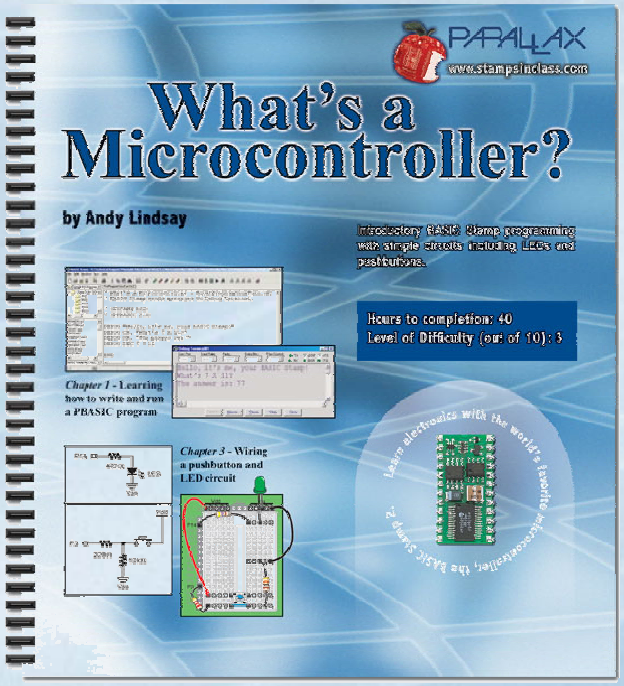
Chapter 9: Electronic Building Blocks

What's a Microcontroller?



Presentation based on:

"What's a Microcontroller ?"

By Andy Lindsay

Parallax, Inc

Presentation developed by:

Martin A. Hebel

Southern Illinois University Carbondale

College of Applied Sciences and Arts

Electronic Systems Technologies

10/26/03

Presentation Index

What's a Microcontroller?

Use and Copyright

This presentation supplements **"What's a Microcontroller"** by Andy Lindsay. (Link to text at Parallax)

- ✓ This presentation is not a replacement for the text.
- ✓ Important concepts of the text are highlighted.
- ✓ In some cases, additional material has been added to augment the text. Denoted by titles colored gold.
- ✓ Full program listings are generally not provided in the presentation.

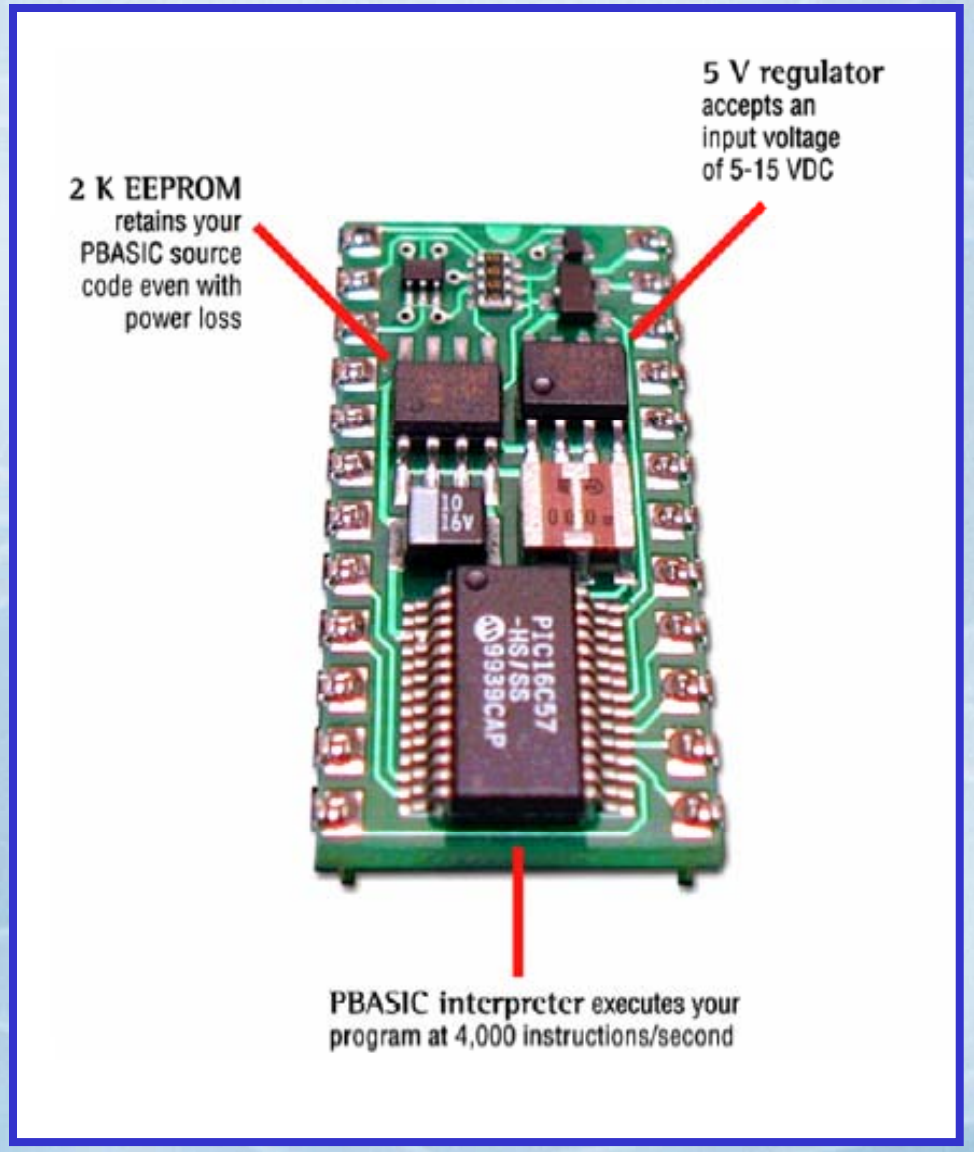
Distribution:

COPYRIGHTS AND TRADEMARKS

DISCLAIMER OF LIABILITY

Those Little Black Chips

The BASIC Stamp itself has many examples of "little black chips" which perform specific functions.



An Integrated Circuit (IC) is the term used for the little black chips.

Inside the black plastic or ceramic case is a tiny silicon chip which hundreds or thousands of transistors.

The transistor is the basic building block of integrated circuits, but may be used individually also.

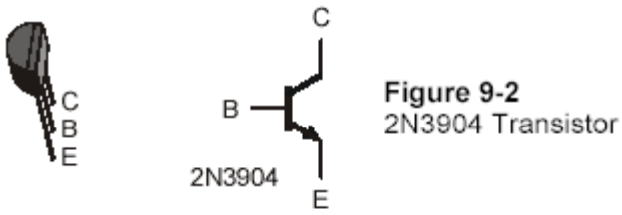


Figure 9-2
2N3904 Transistor

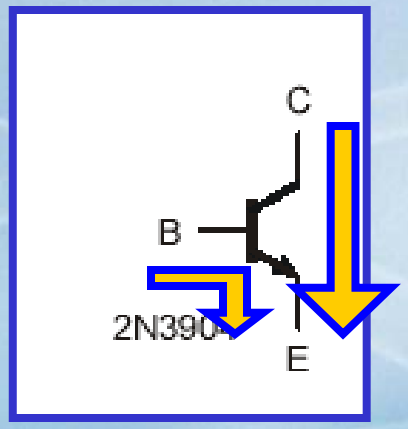
ACTIVITY #1: Control Current With Transistor

A transistor is a current controlled device.

- ✓ Current on the Base-Emitter will control the Collect-Emitter current flow with amplification.

- ✓ The amplification factor, called Beta or h_{FE}, is typically a value of 100, though may be much higher such as 416.

- ✓ $I_{CE} = I_{BE} \times h_{FE} = 1mA \times 416 = 416mA$.



Control Current = 1mA

Drive current = 416 mA

In the activity, the potentiometer is used to adjust voltage, and thus current, into the base of transistor.

As the potentiometer is adjusted, the base current will change adjusting the emitter current to the LED.

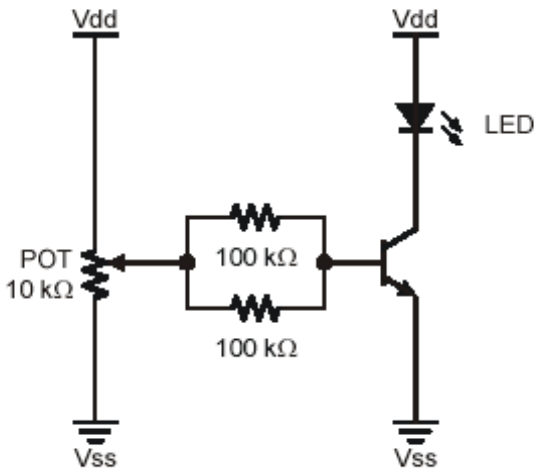


Figure 9-3 Manual Potentiometer Controlled Transistor Circuit

If the potentiometer is adjusted to 2.5V, minus 0.7 lost at the base-emitted junction, provides: (2.5V-0.7V)/50K = 36uA.

This will provide current to LED at a value of: 36uA x 416 = 15mA.

What would be the current to the LED if potentiometer is adjusted to 3.0V?

ACTIVITY #2: Digital Potentiometer

The Digital Potentiometer acts the same as a standard potentiometer by adjusting the wiper to change the resistance above and below the tap to adjust the voltage at the wiper.

In this case though the tap is digitally controlled by opening and closing 1 of 128 possible switches (really transistors).

Each element is 78.125 ohms, and with 128 of them, 10K ohm total.

With anyone tap closed, the 10K ohm resistance will be split and the voltage at the tap will be varied.

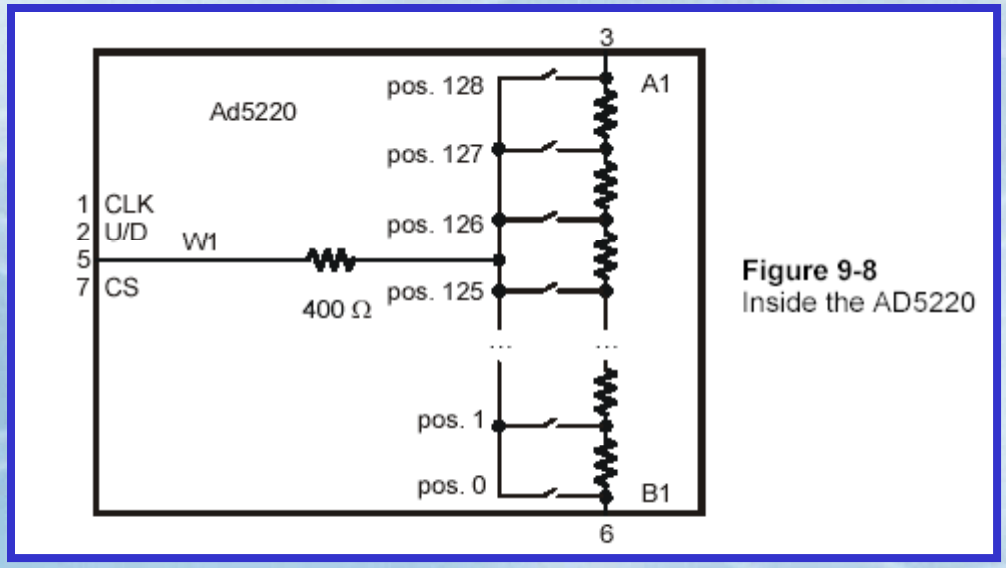


Figure 9-8
Inside the AD5220

Control lines are used to shift the active tap up or down to change the voltage at the wiper.

CS - Chip Select – Must be LOW to modify the chips tap.

CLK – Clock – Each pulse on CLK will move the tap position.

U/D – Defines the direction to move the tap.

1 = Up towards A1

0 = Down towards B1.

By setting the direction and clocking, the tap will be moved.

```
' What's a Microcontroller - DigitalPotUpDownWithToggle.bs2
' Sweep digital pot through values.
' {$STAMP BS2}
' {$PBASIC 2.0}
counter VAR Byte
LOW 5
DO
  FOR counter = 0 TO 128
    PULSOUT 6,5
    PAUSE 10
  NEXT
  TOGGLE 5
LOOP
```

Set Direction Low for Down to B1

Pulse clock to move tap 128 times

Reverse direction and repeat

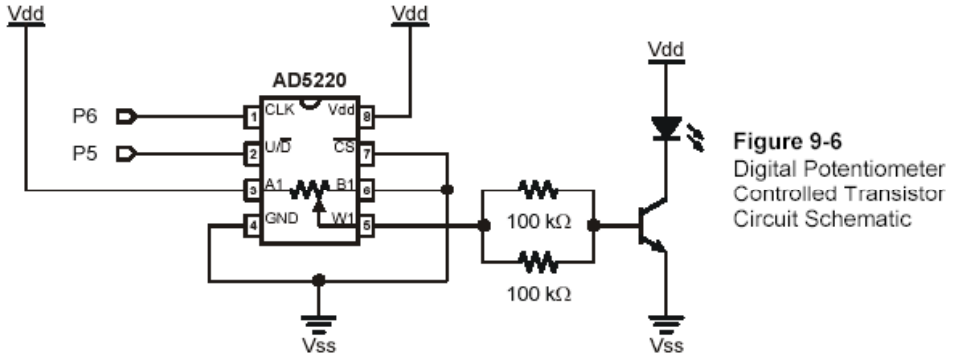


Figure 9-6
Digital Potentiometer Controlled Transistor Circuit Schematic

Review Questions

- ✓ IC is short for _____ **Integrated Circuit** _____.
- ✓ An IC is made with many many **Transistor** .
- ✓ With a transistor, the **Base** current controls the **Collector** current.
- ✓ The **CS** input on the digital potentiometer allows operation.
- ✓ The **U/D** line on the digital potentiometer controls the tap change direction.
- ✓ The **CLK** line on the digital potentiometer controls when to change the tap position.
- ✓ If at tap 90, and U/D is low, CLK is clocked 3 times, the new tap position will be **87** .

Links

- ✓ BASIC Stamp Home
- ✓ Stamps In Class Home
- ✓ BASIC Stamp Software
- ✓ BASIC Stamp Robots
- ✓ BASIC Stamp Yahoo Group
- ✓ Stamps In Class Yahoo Group
- ✓ SIUC EST Degree