



Chapter 5: Measuring Rotation

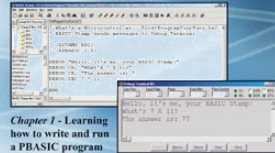
PARALLAX 

What's a Microcontroller?

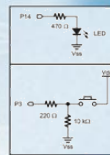
by Andy Lindsay

Introductory BASIC Stamp programming with simple circuits including LEDs and pushbuttons.

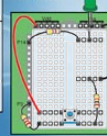
Hours to completion: 40
Level of Difficulty (out of 10): 3



Chapter 1 - Learning how to write and run a PBASIC program



Chapter 3 - Wiring a pushbutton and LED circuit



Learn electronics with the world's most popular microcontroller, the BASIC Stamp 2.

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

9/1/03



What's a Microcontroller?



Presentation Index

What's a Microcontroller?

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Use and Copyright

What's a Microcontroller?

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.

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Adjusting Dials and Monitoring

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Dials are ideal input devices for adjustments such as room lighting and volume levels.

They are also used inside devices for feedback, such as inside the servo to sense a...





Using a potentiometer as a variable resistor

The device inside the dial is called a variable resistor or potentiometer. They are used in dials, joysticks, and many other devices which need to produce an output in reference to a position.

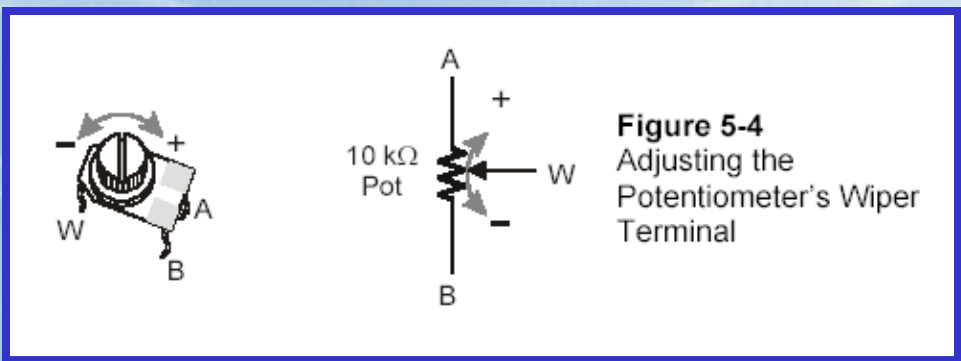
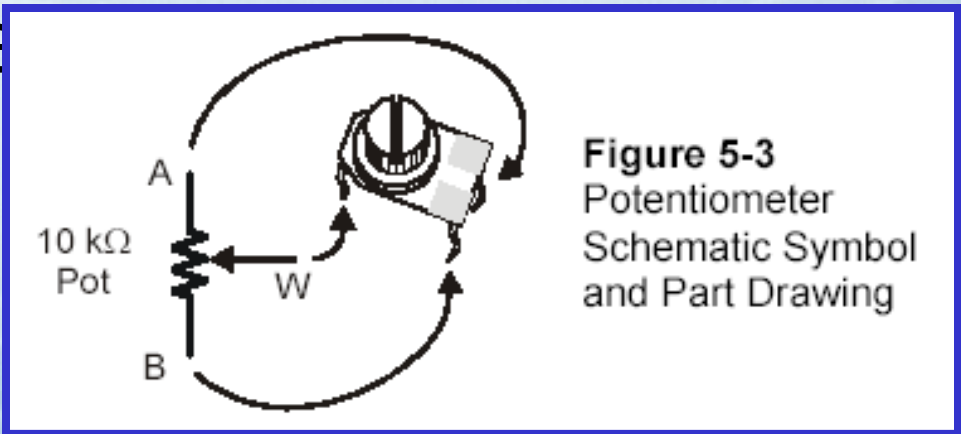
Potentiometers can be packaged many





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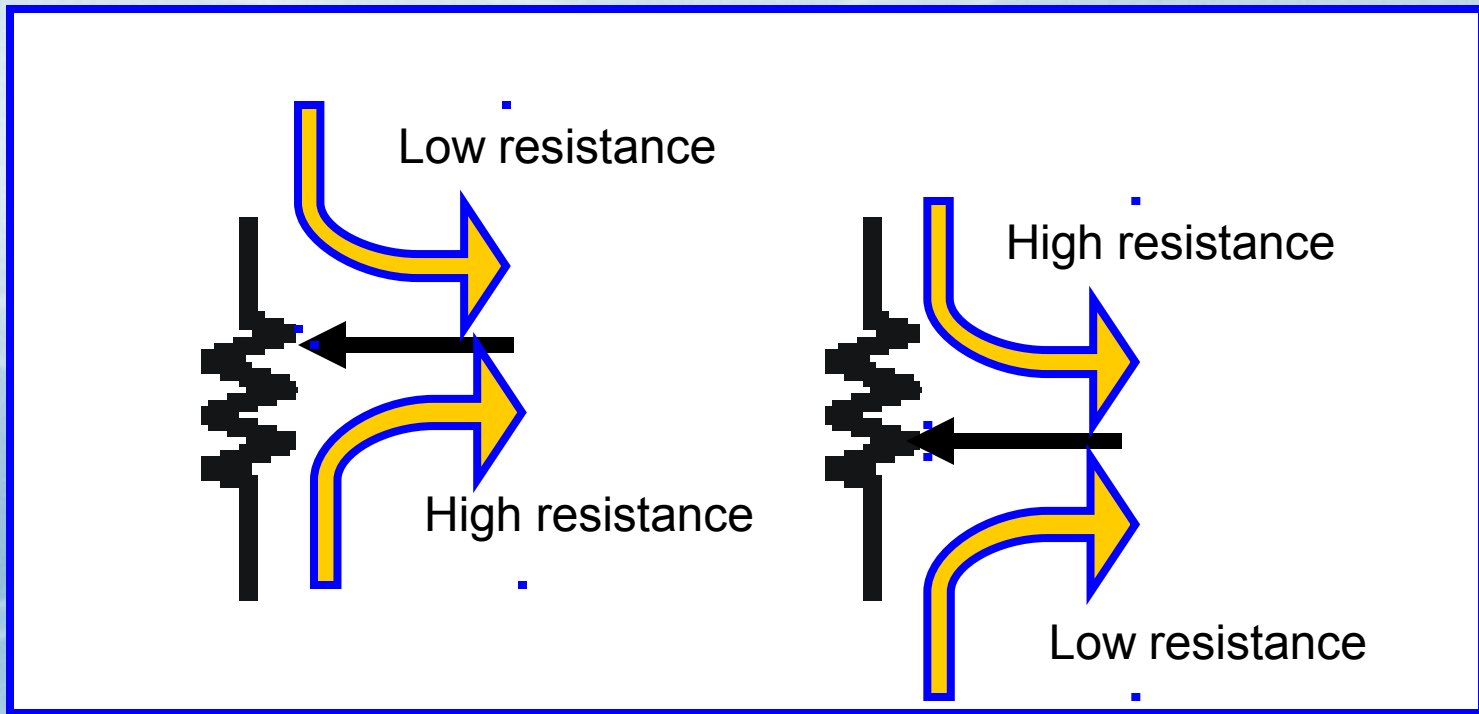
The potentiometer is a resistor with two terminals similar to a regular resistor, but also has a wiper terminal to adjust where contact is made





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The distance from the wiper to each terminal determines the resistance for that path. The minimum resistance will be 0 ohms, and the maximum will be the rating of the potentiometer, such as $10\text{K}\Omega$.

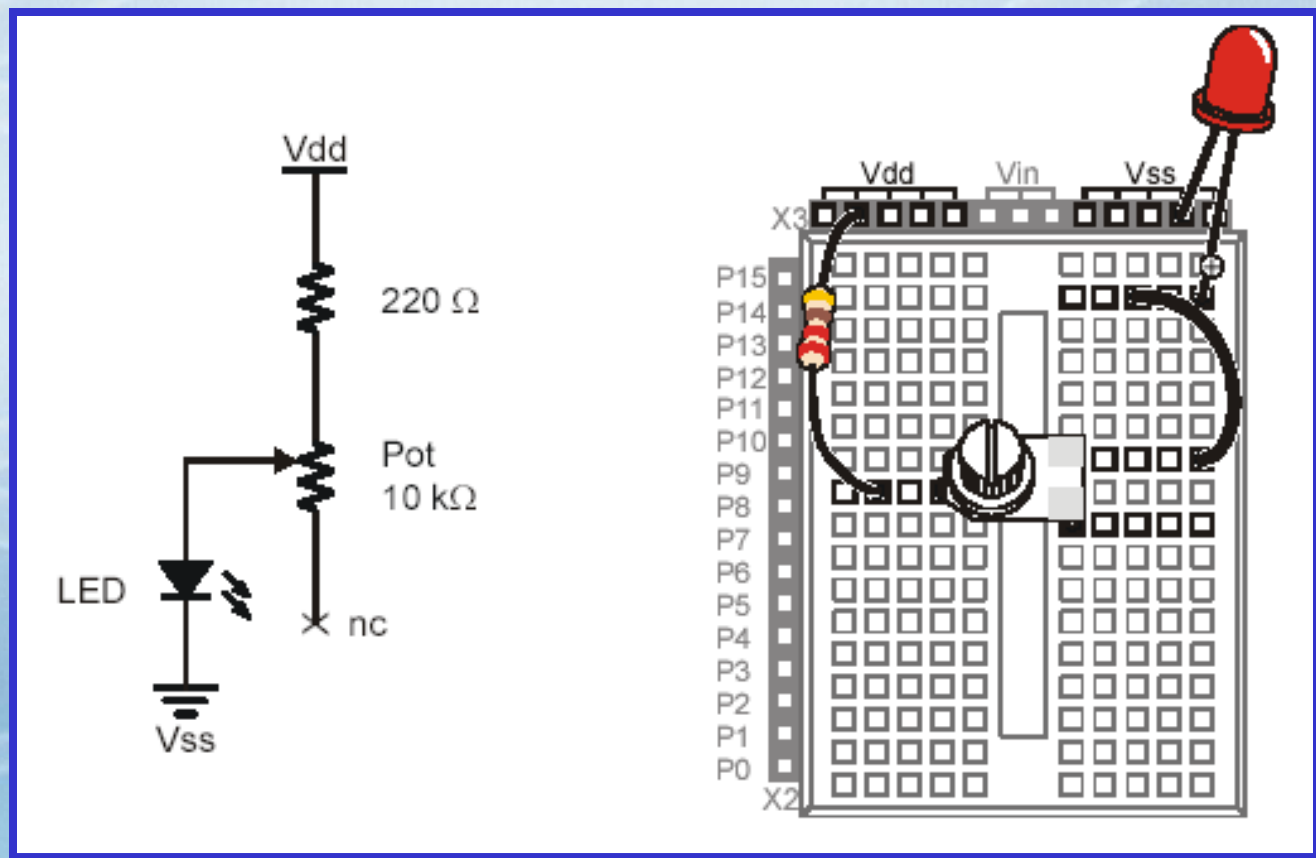




Activity #1: Building/Testing Potentiometer Circuit

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Construct the circuit and observe the LED's brightness at different settings of the potentiometer.





When the LED was brightest, was the potentiometer resistance highest or lowest in the path to the LED?

Lowest

When the LED was brightest, was the potentiometer wiper closest or furthest from terminal connected to Vdd?

Closest

(click for answers)



Activity #2: Measuring Using Time

In this activity an RC-network (Resistor-Capacitor) is used to form a circuit. The capacitor is charged and discharged at different rates determined by the resistor and the capacitor sizes.

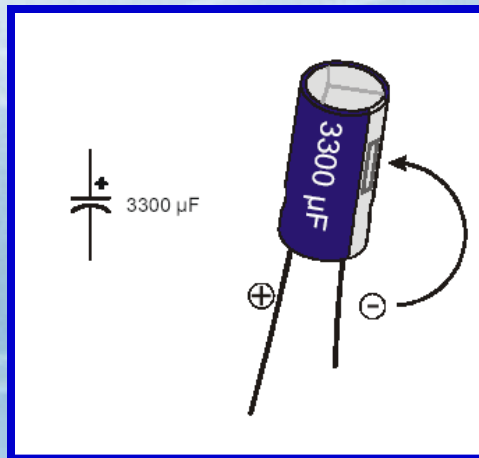
What's a Microcontroller?



Introducing the Capacitor

The capacitor is a device which can store an electron charge. Its size is expressed typically in microfarads (μF) or millionths of Farads.

Certain types of capacitors are polarity sensitive, that is, they can only be connected in one direction.



Connecting a polarity sensitive capacitor backwards can cause the device to explode.

- **Wear safety glasses.**
- **Ensure proper polarity when connecting.**

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Figure 5-8
Schematic for Viewing RC-Time Voltage Decay

Four different resistors will be used as R_i shown in the schematic. First, the schematic will be built and tested with $R_i = 220 \Omega$, then $R_i = 470 \Omega$, etc.

- $R_1 = 220 \Omega$
- $R_2 = 470 \Omega$
- $R_3 = 1 \text{ k}\Omega$
- $R_4 = 2 \text{ k}\Omega$
- $R_5 = 10 \text{ k}\Omega$

Figure 5-9
Wiring Diagram for Figure 5-8

Make sure that the negative lead of the capacitor is connected on your board the same way it is shown in this figure, with the negative lead connected to Vss.

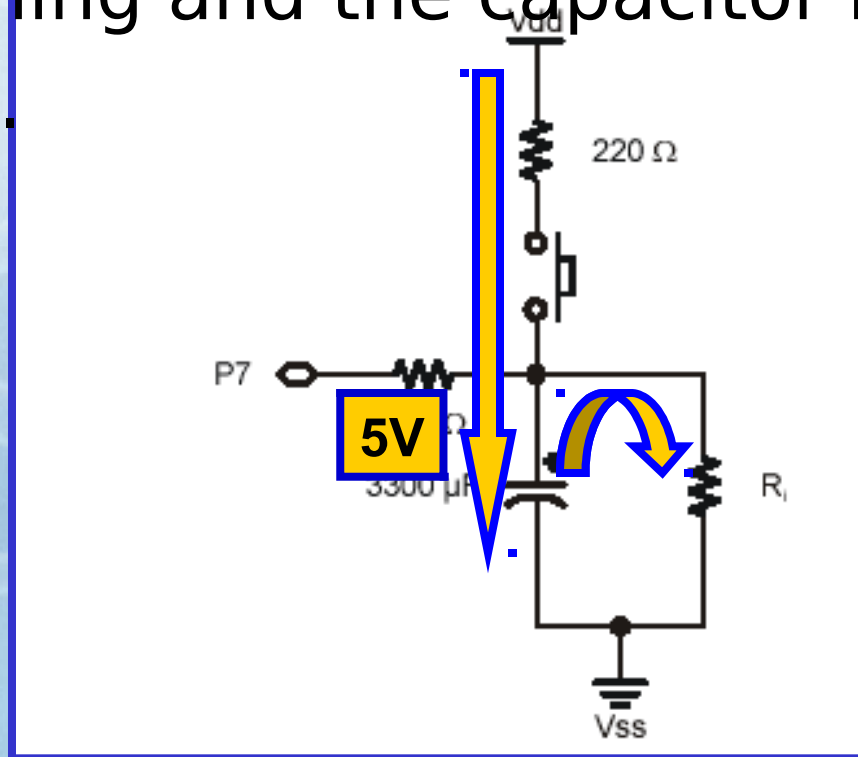


Polled RC Time

In the Polled RC Time circuit the following occurs:

- ✓ Button is pressed charging the capacitor.
- ✓ The button is released, the BASIC Stamp

begins timing and the capacitor begins to discharge.



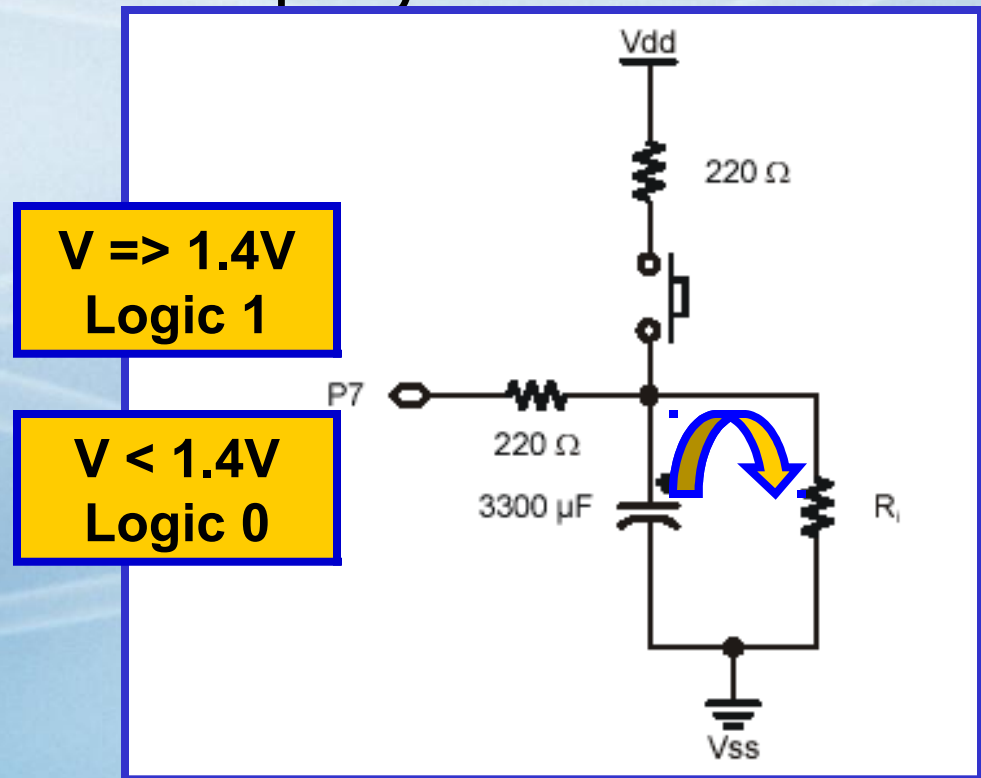
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3. The BASIC Stamp continues timing until input P7 changes to a low (drops below 1.4V).

LOOP UNTIL IN7=0

4. Time is displayed in tenths of seconds.





The time to discharge the capacitor is in proportion to the size of the resistor and capacitor network (RC).

- ✓ The larger the capacitance (C), the greater the charge it can hold, increasing time.
- ✓ The larger the resistance (R), the slower the capacitor will discharge, increasing time.



Activity #3: Reading with BASIC Stamp

The BASIC Stamp has an instruction to perform much of the timing operation automatically:

RCTIME *Pin, State, Variable*

Where:

Pin is the pin the RC network is connected.

State is the initial state when timing begins.

Variable is the memory location to store the results. Just like PULSOUT the time is the number of 2uS increments.



ReadPotWithRCTime Program

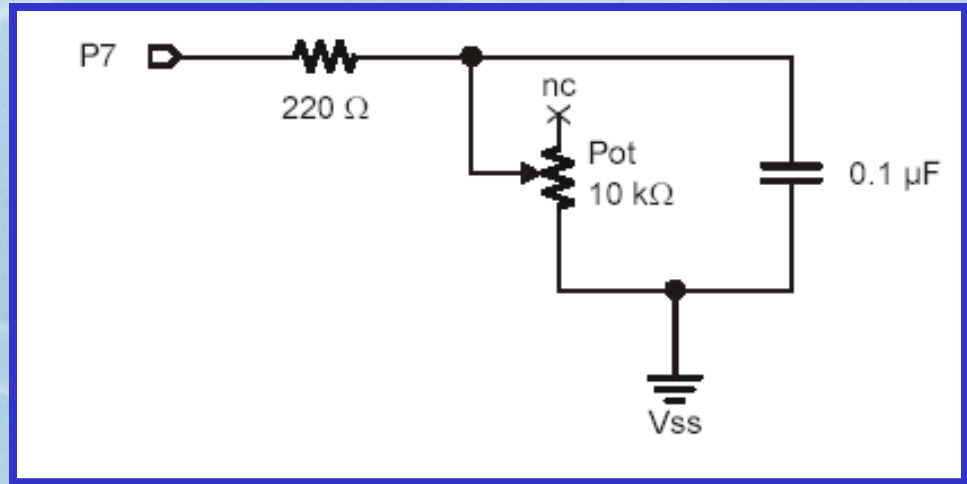
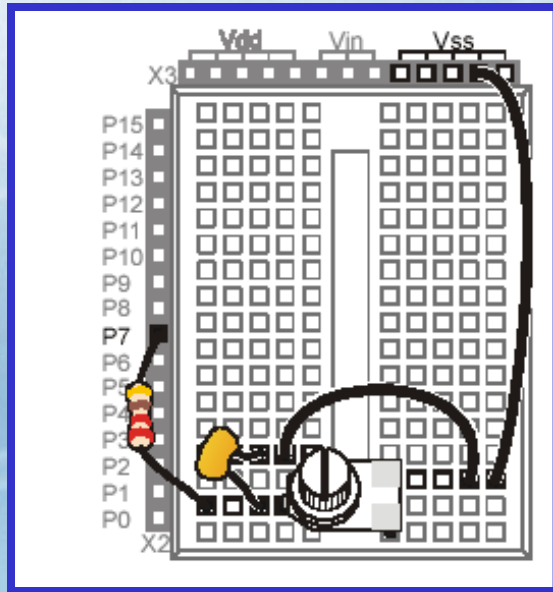
What's a Microcontroller?

```

' What's a Microcontroller - ReadPotWithRcTime.bs2
' Read potentiometer in RC-time circuit using RCTIME command.
' {$STAMP BS2}
' {$PBASIC 2.5}

time      VAR          Word
DO
  HIGH 7
  PAUSE 100
  RCTIME 7, 1, time
  DEBUG HOME, "time = ", DEC5 time
LOOP

```





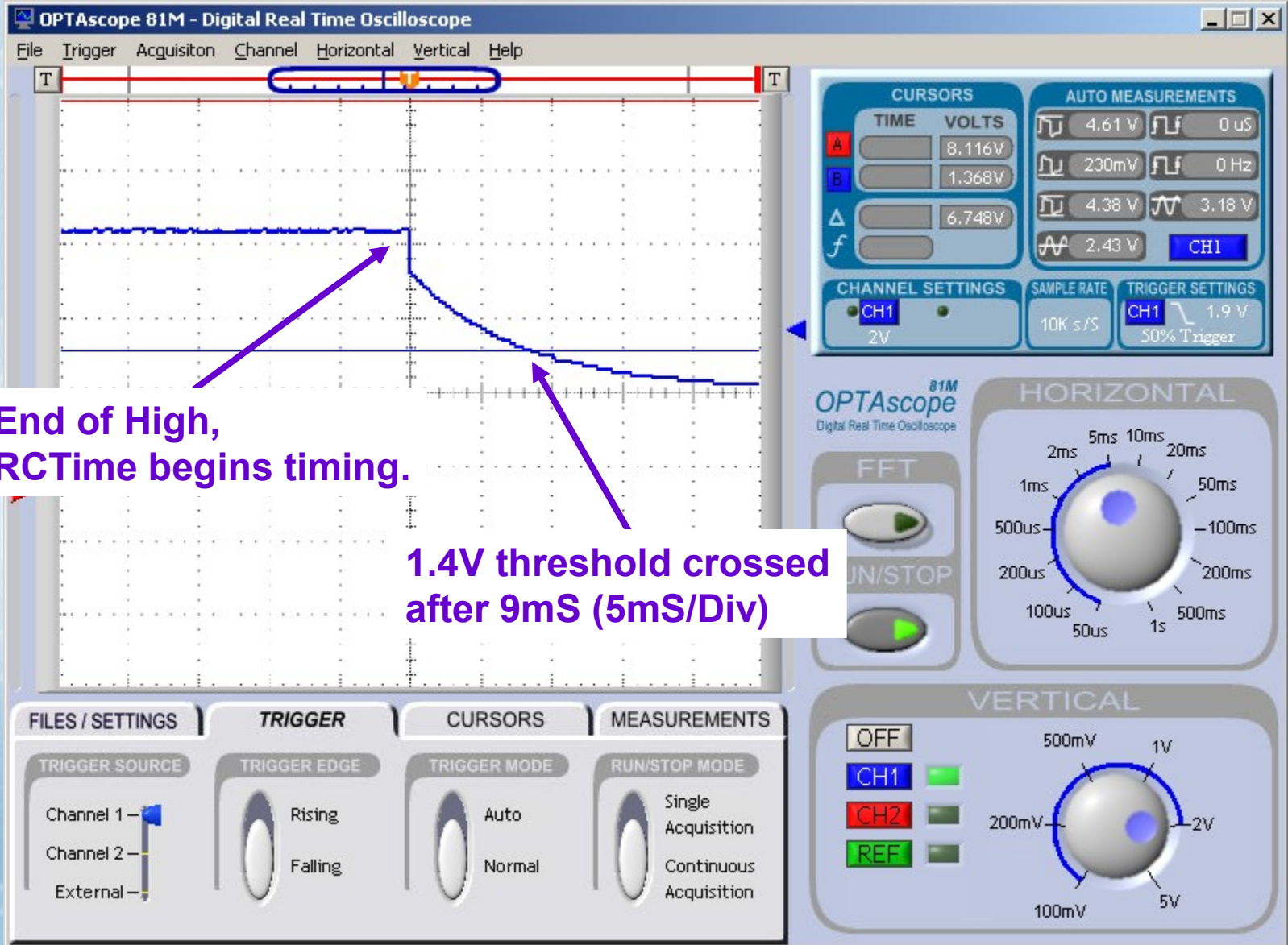
RCTIME Program Explanation

- ✓ Declare variable time to hold results.
- ✓ DO-LOOP code block:
 - Set I/O P7 HIGH (5V).
 - Wait 100 mS to charge capacitor and stabilize DEBUG screen.
 - Execute RCTime instruction:
 - ✓ Time until capacitor discharges and P7 leaves defined state (1).
 - ✓ Store results in variable Time.
 - Display Time results.



Scope Capture

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End of High, RCTime begins timing.

1.4V threshold crossed after 9mS (5mS/Div)

$$9\text{mS} / 2\mu\text{S} = \text{count of } 4500$$





Activity #4: Servo Control with Potentiometer

In this activity the value of RCTime is used to control a servo.

- ✓ The RCTime reading is offset to be within the controllable range of the servo (500-1000).
- ✓ A constant is used to hold the offset value:

Offset CON 300

- ✓ Pin I/O's are named using CON:
rcPIN CON 7



Chapter #4 Review

What's a Microcontroller?

- ✓ A potentiometer is a variable resistor where the wiper is used to adjust the resistance.
- ✓ Capacitors are used to hold a charge.
- ✓ A resistor and capacitor are used to form an RC network.
- ✓ The rate of charge or discharge is dependent on the values of R and C.
- ✓ An input pin will read high (1) until voltage drops below 1.4V.
- ✓ Polling can be used to measure how long it takes the capacitor to reach 1.4V.
- ✓ RCTime measures the discharge time and stores the results in a variable as 2uS increments.



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

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