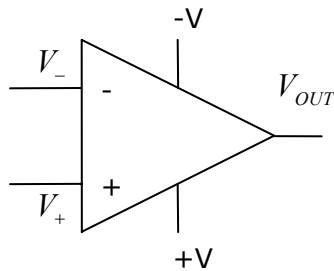


SP.764, Practical Electronics  
Dr. James A. Bales  
**Lecture 7: Flip-Flops and 555 Timer Circuit**

**Topics:**

- 1) Comparator Review
- 2) Flip Flops
- 3) 555 as oscillator
- 4) 555 as "one-shot"

**Comparator Review:**

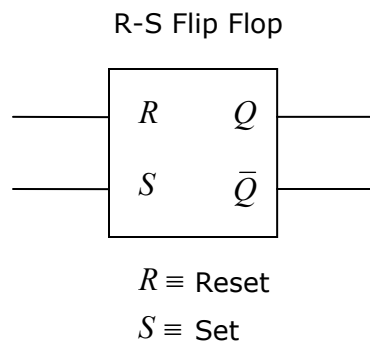


If	$V_{OUT}$ is:
$V_+ > V_-$	$+V$ (i.e. maximum)
$V_+ < V_-$	$-V$ (i.e. minimum)

Comparators

- Feedback loop is not used.
- Decides if one voltage is greater than the other.
- Takes analog voltages and convert them into a series of bits.
- Binary representation of 4 digits give you 16 values (4-bit converter).
- Circuit above is a 1-bit converter:
  - o "0" or "1" output depending which voltage is greater than the other.

**Flip Flops:**



Two Values		
TRUE	"1"	Hi Voltage
FALSE	"0"	Lo Voltage

For some circuits:

$$Hi \equiv 5V$$

$$Lo \equiv 0V$$

We use:

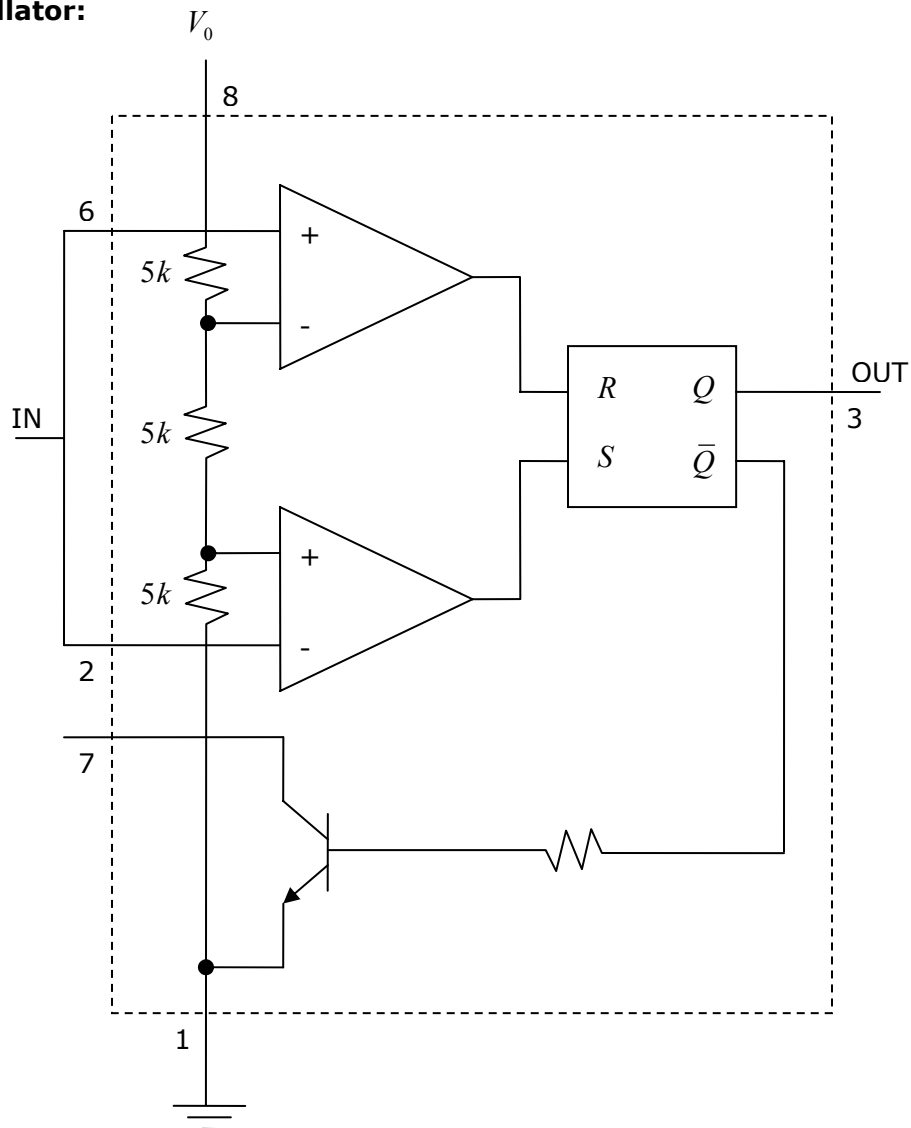
$$Hi \equiv +V$$

$$Lo \equiv -V$$

INPUTS		OUTPUTS	
$R$	$S$	$Q$	$\bar{Q}$
Lo	Lo	Holds last value	
Lo	Hi	Hi	Lo
Hi	Lo	Lo	Hi
Hi	Hi	Not Allowed!	

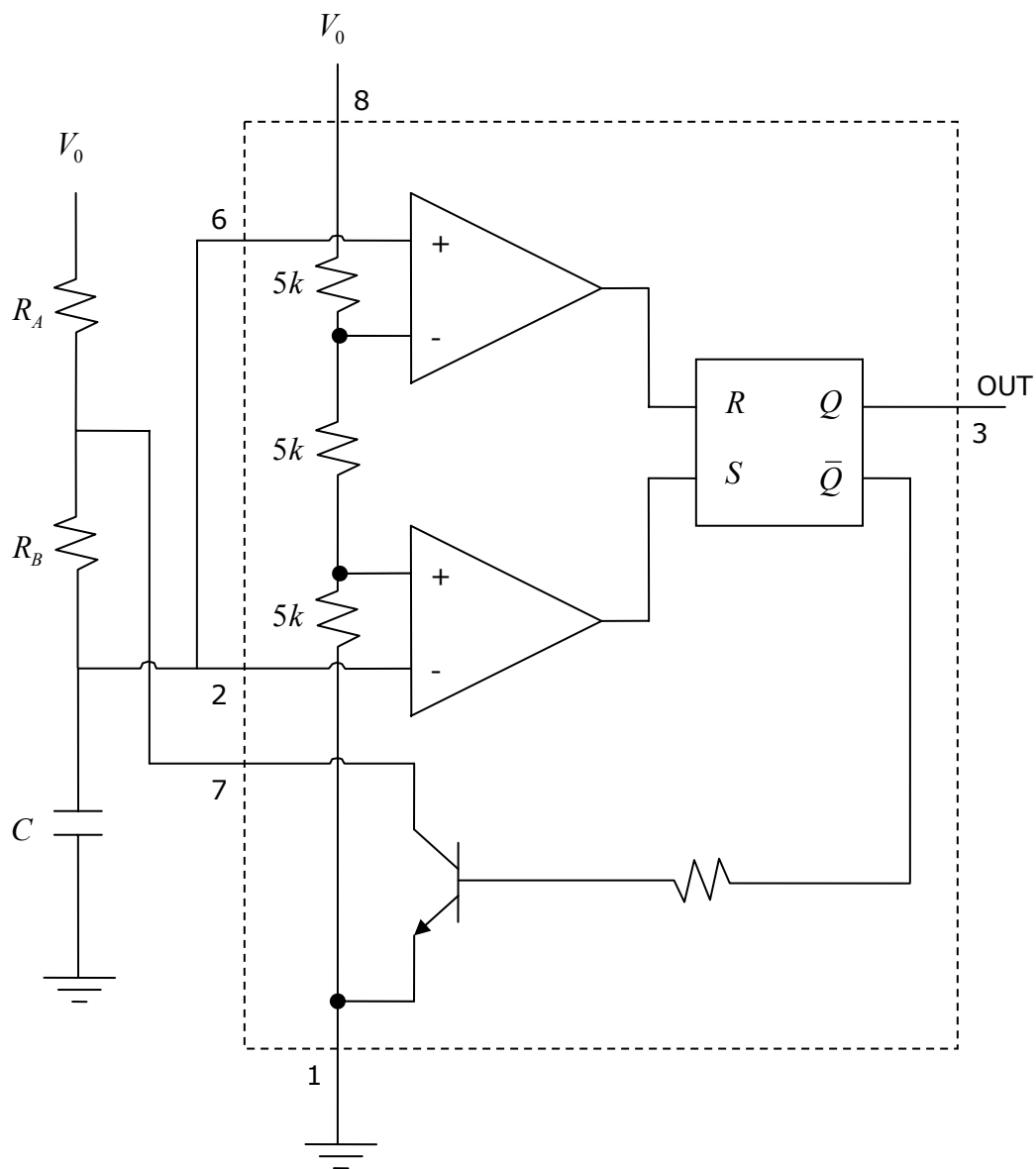
Once can force the output  $Q$  to be "HI" by setting  $S$  to "HI". Similarly, one can force the  $Q$  output to "LO" by resetting  $R$  to "LO". If one drives both  $R$  and  $S$  to "HI", there is no guarantee about the output's state.

### 555 as Oscillator:



Voltage @ Pin 2 & 6 ( $V_{2-6}$ )	Output of $C_R$	Output of $C_S$	Output $Q$	Output $\bar{Q}$	Transistor @ Pin 7
$< \frac{1}{3}V_0$	Lo	Hi	Hi	Lo	OFF
$\frac{1}{3}V_0 < V_{2-6} < \frac{2}{3}V_0$	Lo	Lo	Stay	Stay	Stay
$> \frac{2}{3}V_0$	Hi	Lo	Lo	Hi	ON

### 555 as Oscillator:



Assume there is no charge in the capacitor at start. Because  $V_{CAP}$  is at 0V and it connects to pins 2 and 6, the input is at 0V at time = 0. When the circuit is powered up, the capacitor starts charging. When the  $V_{CAP}$  reaches  $2/3 V_0$ , the transistor turns on and grounds pin 7. Therefore, the capacitor starts to discharge through  $R_B$  until  $V_{CAP}$  reaches  $1/3 V_0$ , at which point the transistor turns off and the capacitor starts to charge up again.

