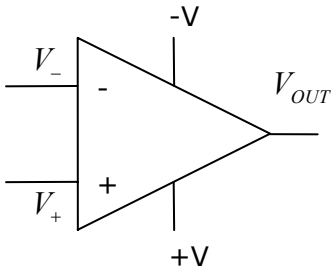
SP.764, Practical Electronics
Dr. James A. Bales
Lecture 7: Flip-Flops and 555 Timer Circuit

Topics:

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

Comparator Review:



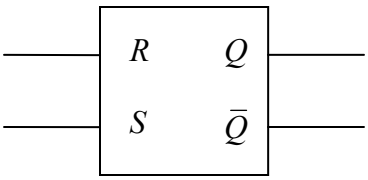
If	V_{OUT} is:
$V_+ > V_-$	$+V$ (i.e. maximum)
$V_+ < V_-$	$-V$ (i.e. minimum)

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:
  - "0" or "1" output depending which voltage is greater than the other.

Flip Flops:

R-S Flip Flop



$R \equiv$ Reset
$S \equiv$ Set

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

For some circuits: We use:

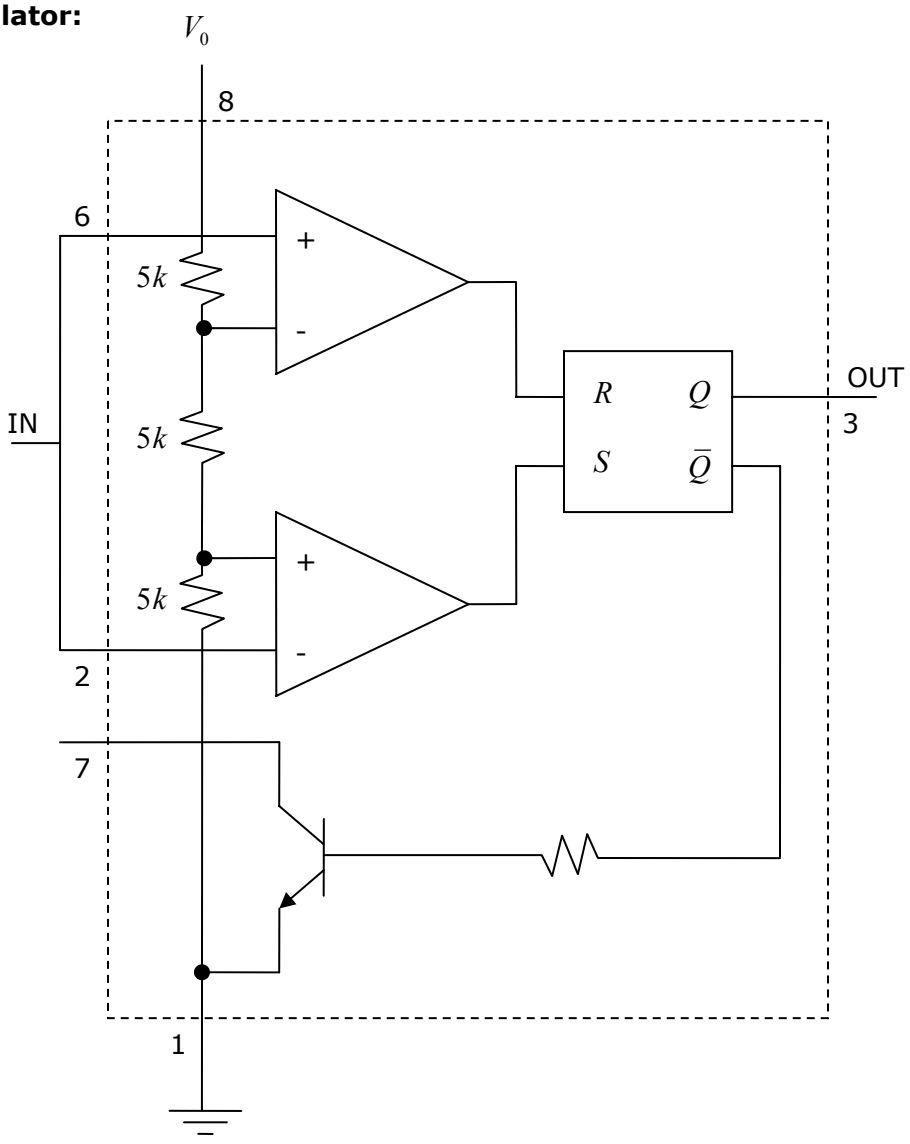
$Hi \equiv 5V$ $Hi \equiv +V$

$Lo \equiv 0V$ $Lo \equiv -V$

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

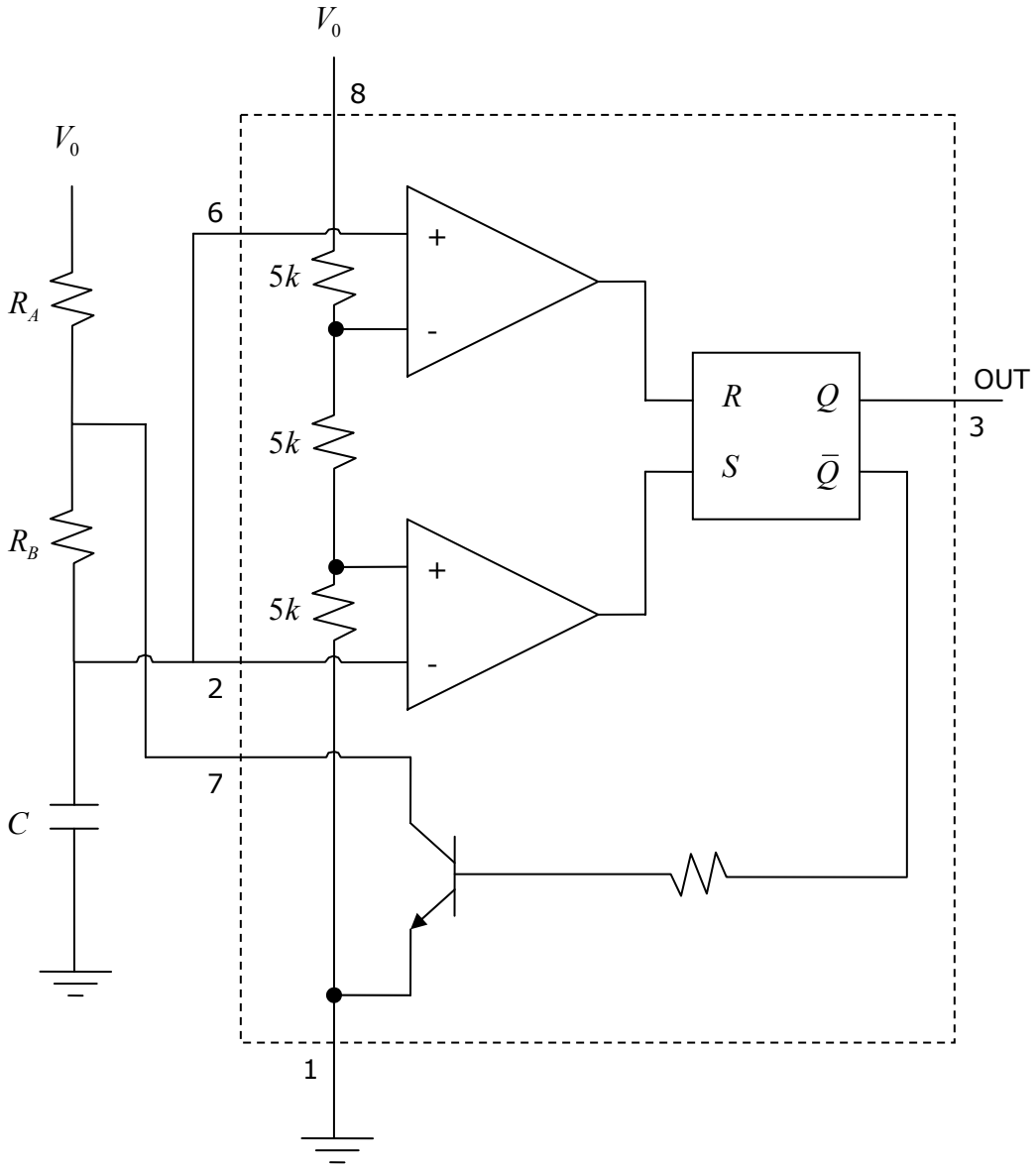
Once can force the output Q to be "HI" by setting S to "HI". Similarly, one can force the Q output to "LO" by resetting R to "LO". If one drives both R and S to "HI", there is no guarantee about the output's state.

555 as Oscillator:

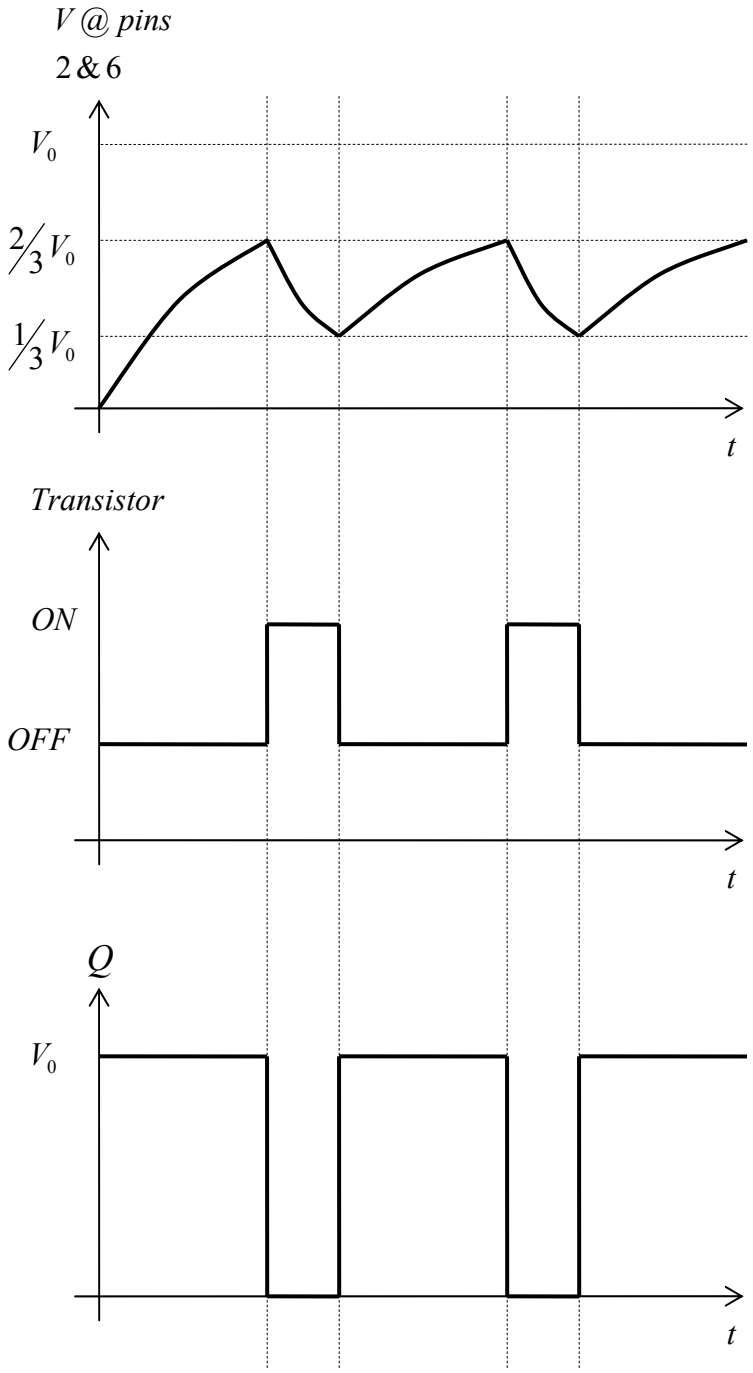


Voltage @ Pin 2 & 6 (V_{2-6})	Output of C_R	Output of C_S	Output Q	Output $\bar{Q}$	Transistor @ Pin 7
$< \frac{1}{3} V_0$	Lo	Hi	Hi	Lo	OFF
$\frac{1}{3} V_0 < V_{2-6} < \frac{2}{3} V_0$	Lo	Lo	Stay	Stay	Stay
$> \frac{2}{3} V_0$	Hi	Lo	Lo	Hi	ON

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.



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