

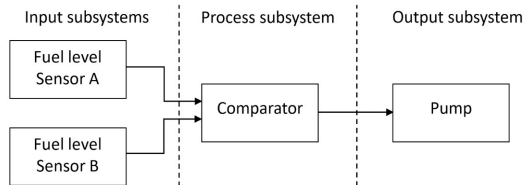
Unit 14: Voltage Comparators, Timers, Counters

Thursday, 15 May 2025 13:44

Voltage Comparators

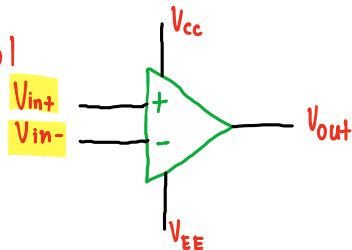
→ Purpose

- Signals Carry information (Prior Knowledge)
- By comparing the voltage of these signals, we can tell the difference between carried information



The pump will redirect fuel to the tank with lower fuel

→ Symbol



V_{CC}	Digital	Positive Supply Voltage (5V)
V_{EE}	Digital	Negative Supply Voltage (Gnd)
V_{IN+}	Analogue	Non-Inverting Input
V_{IN-}	Analogue	Inverting Input
V_{OUT}	Digital	Output

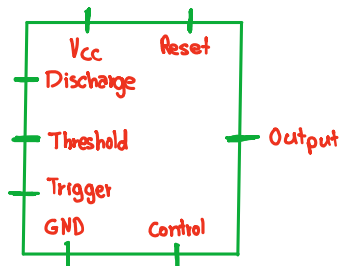
→ Operation

- $V_{IN+} > V_{IN-} \rightarrow V_{OUT} = V_{CC}$
- $V_{IN+} < V_{IN-} \rightarrow V_{OUT} = V_{EE}$

- ▼ V_{OUT} has an open collector output!
- connect to ground / vcc !

555 Timer

→ Diagram



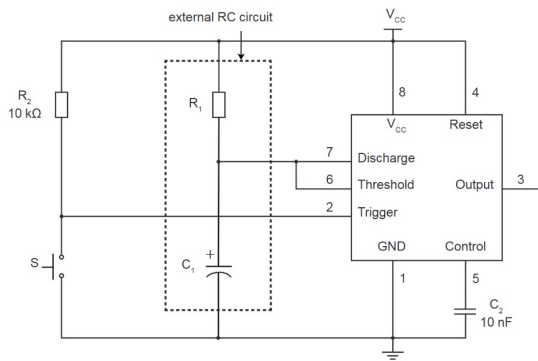
→ Functions

V_{CC}	Input Voltage 5V
GND	Connect to 0V
Discharge	Connects to GND when output HIGH
Threshold	When $> \frac{2}{3} V_{CC}$, Output LOW
Trigger	When $< \frac{1}{3} V_{CC}$, Output HIGH
Output	Digital Output
Reset	Resets Timing Cycle

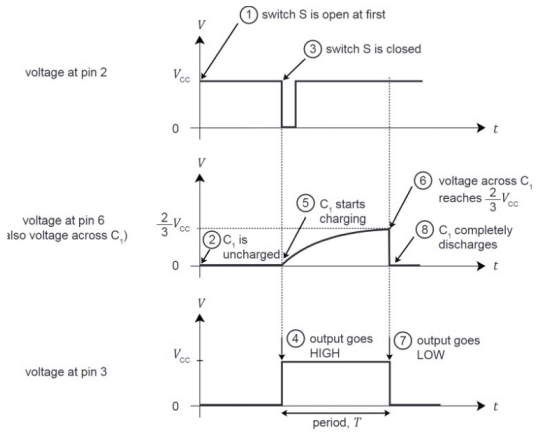
→ Modes

- Monostable multivibrator
- "When you trigger it, it runs for $1.1RC$ seconds"

Setup Diagram 

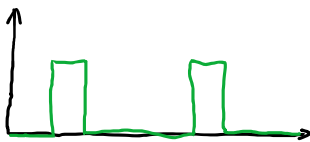


Oscilloscope Traces: 

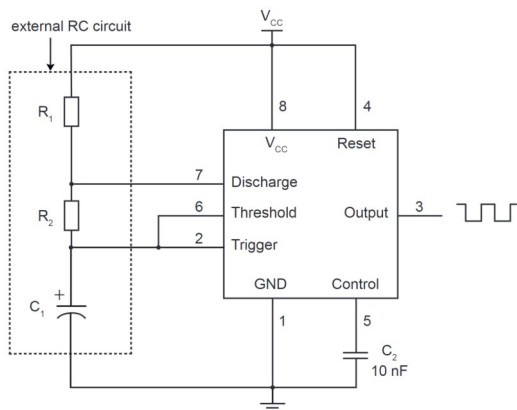


→ Astable multivibrator
"Trigger after every 1.1RC"

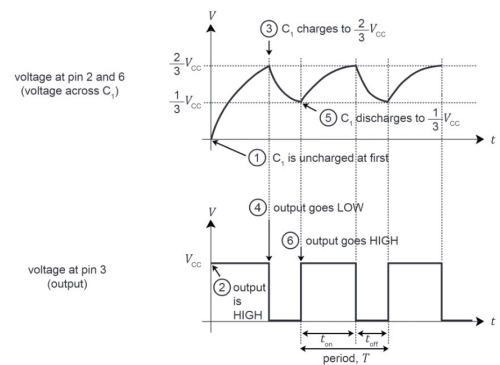
Pulse Diagram



Setup Diagram



Oscilloscope Traces



↳ Formulas Required

$$T = \frac{(R_1 + 2R_2)C}{1.44}$$

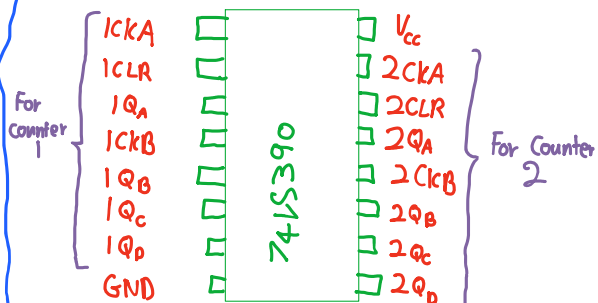
$$t_{on} = 0.7(R_1 + R_2)C$$

$$t_{off} = 0.7R_2C$$

where T = period (in s),
 R = resistance (in Ω),
 C = capacitance (in F)
 t_{on} = duration in which output is HIGH (in s),
 t_{off} = duration in which output is LOW (in s).

74LS390 Dual Decade Counter

→ Diagram



→ Functions

CKA	Increment count when falling edge
CLR	Reset count when HIGH
CKB	Connect to QA to use as Decade Counter
QA	Output Pins Display output as BCD
QB	
QC	
QD	

→ Truth Table

4-bit BCD				Decimal equivalent
Q _D	Q _C	Q _B	Q _A	
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9

→ Using as 2 digit Counter

