

555 TIMER ASTABLE MODE CIRCUIT

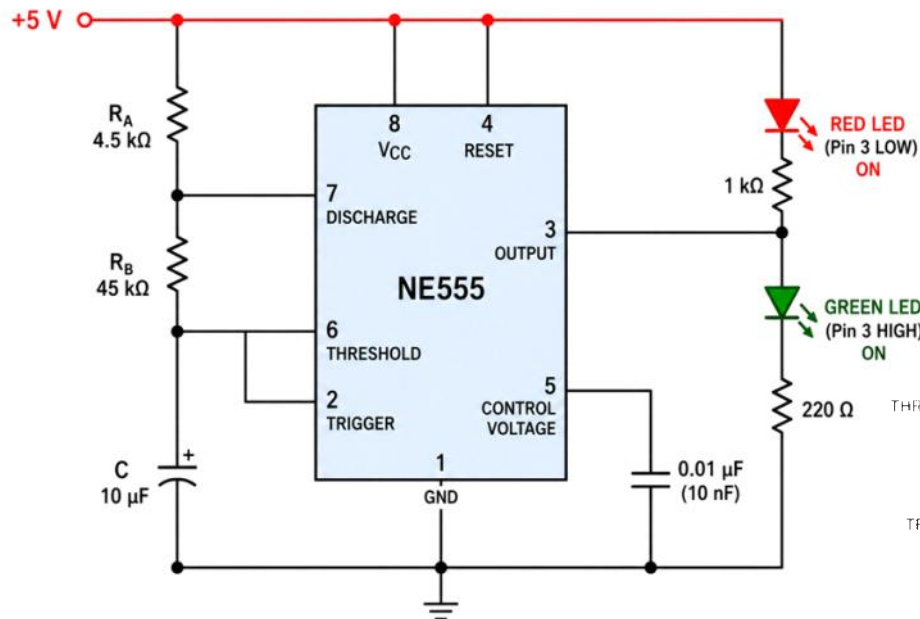
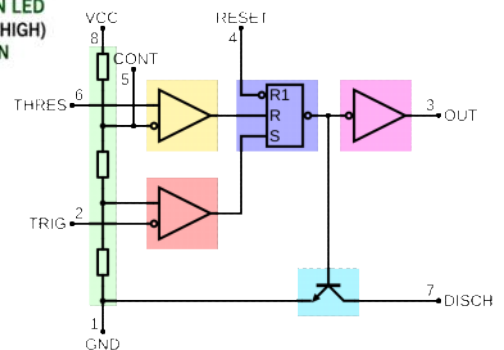


Image Attribution:
 "NE555 Bloc Diagram" by BlanchardJ, via Wikimedia Commons.
 Public Domain.



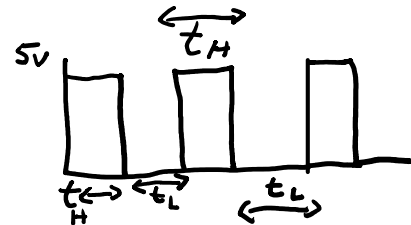
Equations

$$t_H = 0.693 (R_A + R_B) C$$

$$t_L = 0.693 (R_B) C$$

$$f = \frac{1}{T}$$

$$\ln 2 = 0.693$$



$$t_T = t_H + t_L$$

$$t_T = 0.693 (R_A + R_B) C + 0.693 R_B C$$

$$t_T = (0.693 R_A + 0.693 R_B) C + 0.693 R_B C$$

$$t_T = C (0.693 R_A + 0.693 R_B + 0.693 R_B)$$

$$t_T = C \times 0.693 \times (R_A + R_B + R_B)$$

$$t_T = 0.693 C (R_A + 2R_B)$$

$$R_A = 4.5 \text{ k}\Omega, R_B = 45 \text{ k}\Omega, C = 10 \mu\text{F}$$

$$t_H = 0.693 (R_A + R_B) C = 0.693 (49,500) 0.000010$$

$$= 0.343 \text{ s}$$

$$R_A + R_B = 4500 + 45000$$

$$= 49,500$$

$$t_L = 0.693 R_B C$$

$$= 0.693 \times 45000 \times 0.000010$$

$$= 0.312 \text{ s}$$

$$t_T = t_H + t_L$$

$$= 0.343 + 0.312 = 0.655 \text{ s}$$

$$t_T = 0.693 \times 0.000010 \times (4500 + 2 \times 45000)$$

$$= 0.655 \text{ s}$$

$$\tau_T = 0.693 \times 0.00010 \times (4500 + 2 \times 45000) \\ = 0.655 \text{ s}$$

$$S = \frac{1}{\tau_T} = \frac{1}{0.655} = 1.53 \text{ Hz}$$

$$\tau_H = 0.343 \text{ s}$$

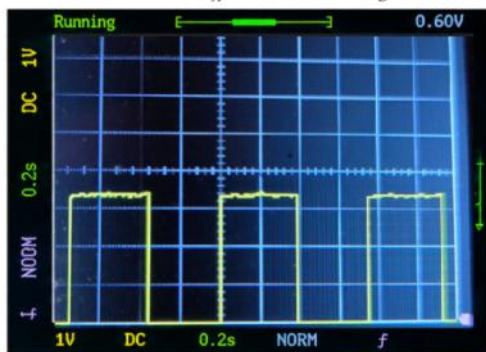
$$\tau_L = 0.312 \text{ s}$$

$$\tau_T = 0.655 \text{ s}$$

$$S = 1.53 \text{ Hz}$$

555 Timer Astable Mode – Measured vs Calculated

$$R_A = 4.5 \text{ k}\Omega \quad R_B = 45 \text{ k}\Omega \quad C = 10 \text{ }\mu\text{F} \quad V_{CC} = 5 \text{ V}$$



Measured from Scope (this shot):

- Time Base = 0.2 s/div
- High Time measured = 0.36 s
- Low Time measured = 0.32 s
- Period, $T = 0.36 + 0.32 = 0.68 \text{ s}$
- Frequency, $f = \frac{1}{T} = \frac{1}{0.68} = 1.47 \text{ Hz}$

Scope Settings (from screen):

- 1V (Volts/Div)
- DC Coupling
- 0.2 s/div (Time Base)
- NORM Trigger

Calculated (Theoretical)

Astable Timing Formulas (555 Timer):

$$T_H = 0.693 (R_A + R_B) C$$

$$T_L = 0.693 (R_B) C$$

$$T = T_H + T_L = 0.693 (R_A + 2R_B) C$$

$$f = \frac{1}{T}$$

Plug in Values:

$$R_A = 4.5 \text{ k}\Omega$$

$$R_B = 45 \text{ k}\Omega$$

$$C = 10 \text{ }\mu\text{F}$$

$$V_{CC} = 5 \text{ V}$$

$$T_H = 0.693 (4.5\text{k} + 45\text{k}) (10\mu\text{F}) = 0.343 \text{ s}$$

$$T_L = 0.693 (45\text{k}) (10\mu\text{F}) = 0.312 \text{ s}$$

$$T = 0.343 + 0.312 = 0.655 \text{ s}$$

$$f = \frac{1}{0.655} = 1.53 \text{ Hz}$$

Measured vs Calculated Comparison

Parameter	Calculated	Measured	Difference
High Time, T_H	0.343 s	0.36 s	+0.017 s (+5.0%)
Low Time, T_L	0.312 s	0.32 s	+0.008 s (+2.6%)
Period, T	0.655 s	0.68 s	+0.025 s (+3.8%)
Frequency, f	1.53 Hz	1.47 Hz	-0.06 Hz (-3.9%)

Conclusion: The measured frequency (1.47 Hz) is close to the calculated frequency (1.53 Hz). Differences are expected due to component tolerances and measurement accuracy.