Timer LM555

Vcc =	5V	15V
Trigger =	1.67V	5V
Reset =	0.5V	
Control =	3.33V	10V

Threshold = 0.667 x Vcc

Astable comienza en 10:00m

Terminal 7 es descarga

$$Vcc = (Ra + Rb)i(t) + Vcapacitor$$

$$Vcapacitor = \frac{1}{c}\int_0^\infty i(t)\,dt$$

Despejando i(t)

$$\frac{Vcc}{s} = R_i(s) + \frac{i(s)}{cs} = i(s)\frac{(R+1)}{sc} = \dot{I}(s)\frac{Rcs+1}{sc}$$

Despejando i(s)

$$i(s) = \frac{Vccsc}{s}(Rc+1)$$

$$Vcapacitor$$

$$\frac{1}{c}\int_0^\infty i(t)\,dt = \frac{V_{cc}}{R_C}\int_0^\infty e^{-\frac{t}{R}C}\,dt$$

Calculando la integral

$$Vcc(1 - e^{-\frac{t}{Rc}})$$

$$Calcular\ t\ si\ vcc\ = \frac{2Vcc}{3} \to \frac{2Vcc}{3} = Vcc\left(1 - e^{-\frac{t}{Rc}}\right) \to \frac{2}{3} = 1 - e^{-\frac{t}{Rc}} \to e^{-\frac{t}{Rc}} = 1 - \frac{2}{3} = \frac{1}{3}$$

$$-\frac{t}{Rc} = \ln\left(\frac{1}{3}\right) \to t_{max} = -Rcln\left(\frac{1}{3}\right)$$

$$si\ Vcc = \frac{Vcc}{3} \to -\frac{t}{Rc} = \ln\left(\frac{2}{3}\right)$$

$$t_{min} = -Rcln\left(\frac{2}{3}\right)$$

$t_{max} = -Rcln\left(\frac{1}{3}\right)$
$t = t_{max} - t_{min}$
$t = -Rcln\left(\frac{1}{3}\right) + Rcln\left(\frac{2}{3}\right) = Rc\left(-ln\left(\frac{1}{3}\right) + \ln\left(\frac{2}{3}\right)\right)$
$Tiempo\ de\ carga = Rcln(2) = (R_a + R_b)c\ln(2)$

$Tiempo\ de\ descarga$
$0 = Rbi(t) + \frac{1}{c}\int_0^t i(t)\,dt \to laplace \to 0 = Rbi(s) + \frac{1}{sc}i(s) = i(s)\left(Rb + \frac{1}{sc}\right)$
$Para\ la\ descarga$
$\frac{2}{3} = Vcce^{-\frac{t}{Rc}}$
$Despejando\ el\ tiempo_{min}$
$\ln\left(\frac{2}{3}\right) = -\frac{t}{Rbc} \to t_{min} = -RBcln\left(\frac{2}{3}\right) \to\ t_{max} =\ -Rbcln\left(\frac{1}{3}\right)$
$t = t_{max} - t_{min} = -Rbcln\left(\frac{1}{3}\right) + Rbcln\left(\frac{2}{3}\right) = Rbcln(2)$
$Periodo$
$T = (R_a + R_b)cln(2) + Rbcln(2) \to \ln(2)\,c(R_a + R_b)$
$F = \frac{1}{T} \to 1/(\ln(2)\,c(R_a + R_b) \to \frac{1.4426}{c(R_a + R_b)}$
$D = ciclo\ de\ trabajo = \frac{t_{bajo}}{T} \to \frac{t_{bajo}}{t_{alto} + t_{bajo}}$
$Ejemplo$

$D = \frac{Rbcln(2)}{(R_a + R_b)cln(2) + Rbcln(2)} \to \frac{\frac{cln(2)}{cln(2)}R_b}{R_a + R_b + R_b} = \frac{R_b}{R_a + 2R_b}$
$Las\ valores\ de\ \ Resistencias\ tienen\ que\ estar\ por\ encima\ de\ 1k\Omega$
$para\ no\ hacer\ consumir\ al\ circuito\ corriente\ de\ mas$

$Ejercicio => Si\ c = 0.1\mu f, R_a = 5k\Omega, R_b = ?\ y\ f = 1khz \to 4713.47 \to 4.7k\Omega$
$(R_a + R_b)_{max} = 20M\Omega$
$(R_a + R_b)_{min} = 1K\Omega$
Escriba aquí la ecuación.
$Calcular\ para\ 1hz, 60hz\ y\ 5khz$
$Calcular\ tambien\ D$

$$Vcc = R_a i(t) + \frac{1}{c}\int_0^t i(t)dt$$

transformando Voltaje de capacitor por laplace

$$\frac{Vcc}{s} = R_a i(s) + \frac{1}{sc} i(s) = i(s)\left(R_a + \frac{1}{sc}\right)$$

$$\frac{Vcc}{s} = i(s)\frac{R_a cs + 1}{sc}$$

$$i(s) = \frac{Vcc}{s}\frac{sc}{R_a cs + 1} = \frac{\frac{cVcc}{R_a c}}{\frac{R_a cs + 1}{R_a c}} = \frac{Vcc}{R_a}\frac{1}{s + \frac{1}{R_a c}}$$

Antitransformada

$$i(t) = \frac{Vcc}{R_a} e^{-\frac{t}{R_a c}}$$

Voltaje en el capacitor

$$Vcapacitor = \frac{1}{c}\int_0^t i(t)dt = i(t) = \frac{Vcc}{R_a} e^{-\frac{t}{R_a c}}$$

$$Vcapacitor = -Vcc\, e^{-\frac{t}{R_a c}}\Big|_0^t = -Vcce^{-\frac{t}{R_a c}} + Vcce^{-\frac{0}{R_a c}}$$

$$Vcapacitor = Vcc\left(1 - e^{-\frac{t}{R_a c}}\right)$$

$$\frac{2Vcc}{3} = Vcc\left(1 - e^{-\frac{t}{R_a c}}\right)$$

$$e^{-\frac{t}{R_a c}} = 1 - \frac{2}{3} = \frac{1}{3}$$

$$-\frac{t}{R_a c} = \ln\left(\frac{1}{3}\right)$$

$$t = -R_a c ln\left(\frac{1}{3}\right)$$

$$t = 1.1 R_a c$$

para un tiempo de un segundo

$$c = 1\mu$$

$$R_a = \frac{t}{1.1c} = \frac{1}{1.1 * 1\mu} = 909k\Omega$$

Hacer de $500ms, 5s$ *y* $15s$