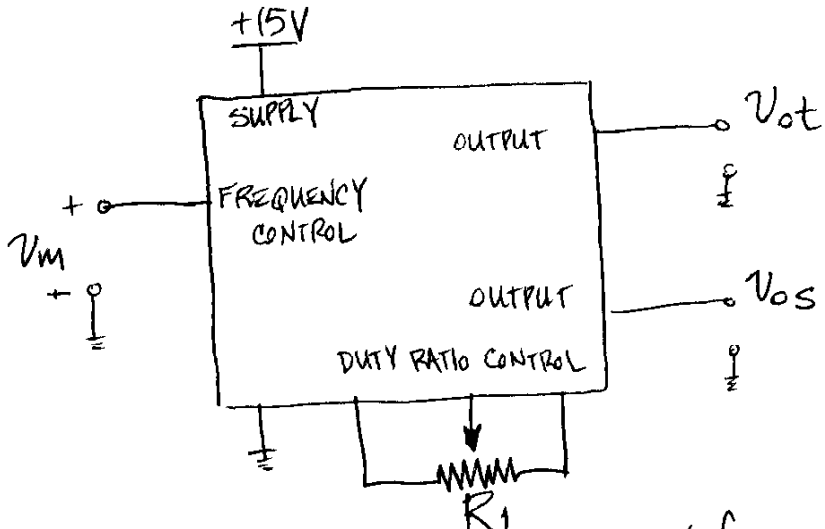
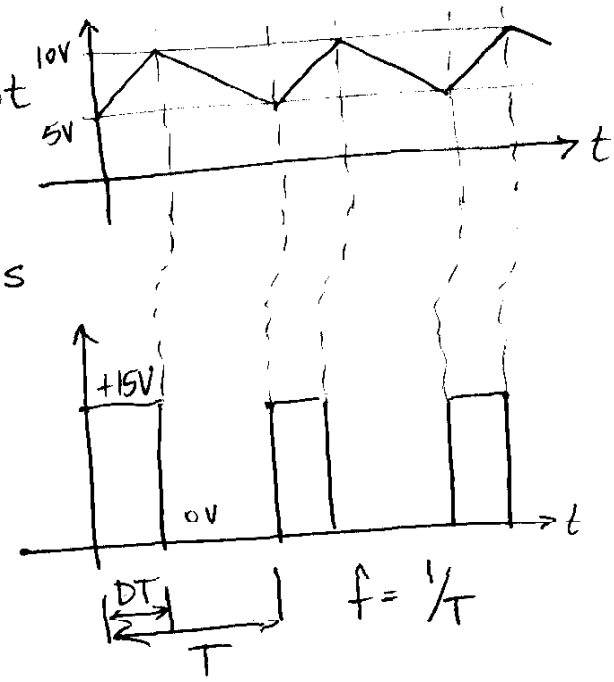
LAB 3

9/18/98

VOLTAGE CONTROLLED WAVEFORM GENERATOR

SPECS:





INPUT VOLTAGE V_m CONTROLS FREQUENCY f

$$f = K_o V_m$$

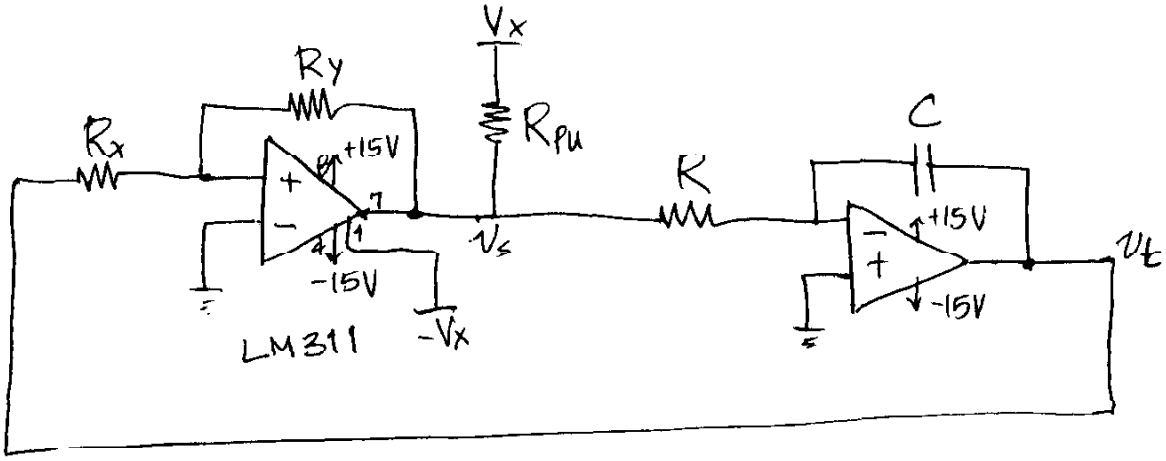
$K_o \triangleq$ GAIN OF THE VOLTAGE-CONTROLLED OSCILLATOR

$$K_o = 5\ ^{KHz}/_{V}$$

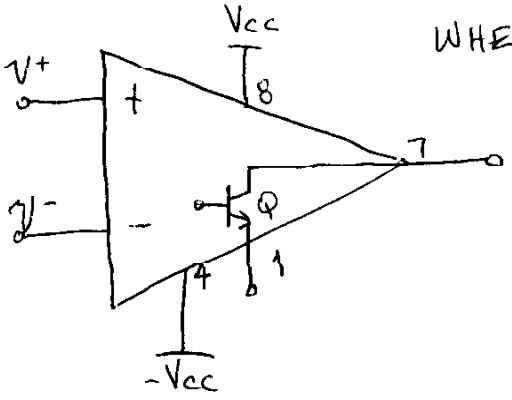
$R_1 \Rightarrow$ ADJUSTS DUTY RATIO D OF THE OUTPUT V_{os}

CONSTRAINTS: ONLY ONE SUPPLY OF +15V
CONTROL OF DUTY RATIO SHOULD BE INDEPENDENT OF V_m, AND CONTROL OF FREQUENCY SHOULD BE INDEPENDENT OF R_1.

HERE'S A DESIGN WITH ALL SUPPLIES AVAILABLE.



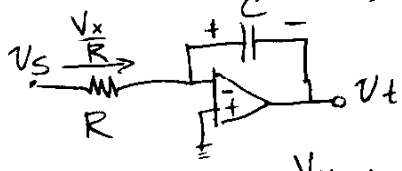
INSIDE A LM311:



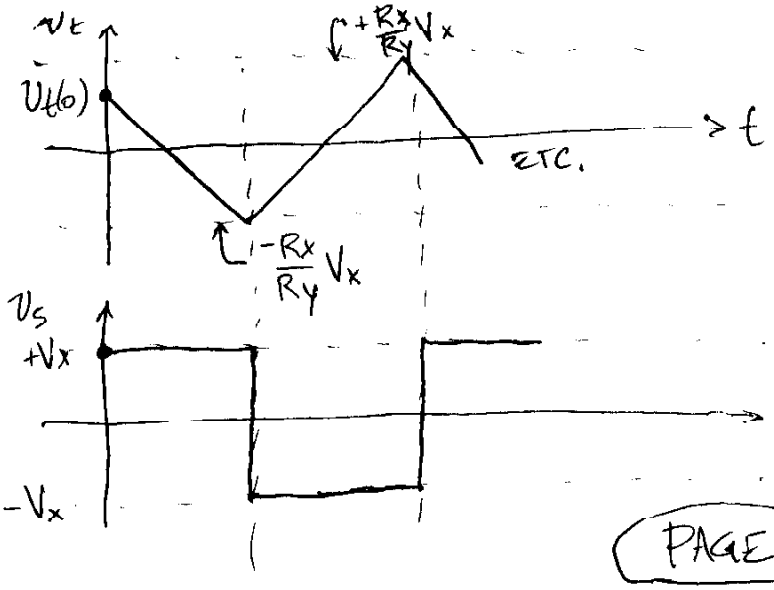
WHEN $V^+ > V^-$, Q IS CUTOFF
WHEN $V^+ < V^-$, Q IS ON, $V_{71} \approx 0V$.

WITHOUT A PULL-UP RESISTOR (R_{PU}), THE OUTPUT (PIN 7) VOLTAGE IS FLOATING. MAKE SURE TO USE A PULL-UP RESISTOR

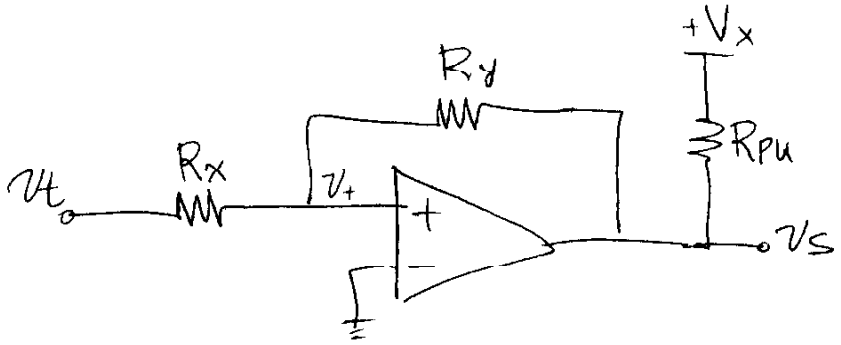
HOW TO ANALYZE BEHAVIOR? REFERRING TO TOP DIAGRAM, SUPPOSE $V_S = +V_x$, $t = 0$



$$V_t(t) = \frac{-V_x}{RC} t + V_t(0)$$



OVER ⇒



$$V+ = \frac{R_y}{R_y + R_x} V_t + \frac{R_x}{R_x + R_y} V_s \quad \text{(BY SUPERPOSITION)}$$

WE WANT TO KNOW WHEN $V+ > 0$ TO VERIFY ASSUMPTION THAT $V_s = +V_x$

$$\frac{R_y}{R_x + R_y} V_t + \frac{R_x}{R_x + R_y}(+V_x) > 0 \Rightarrow \boxed{V_t > \frac{-R_x}{R_y} V_x}$$

WHEN THIS CONDITION IS VIOLATED, THE COMPARATOR OUTPUT V_s GOES TO $-V_x$.

THE EQUATIONS ARE SIMILAR FOR WHEN $V_s = -V_x$.