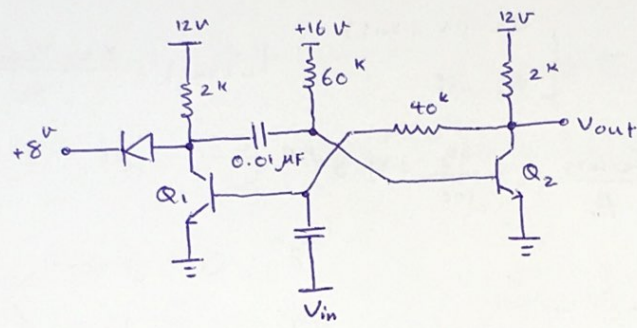


8-8



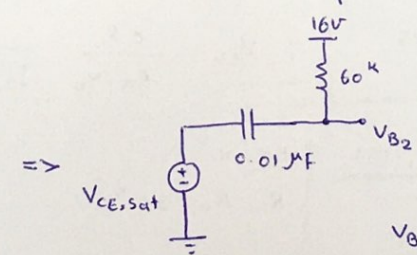
در حالت پایدار، قبل از اعمال پالس خازن باز است و می‌بینیم که پالس ۱۶V و مقاومت ۶۰k برقرار است $V_{B2} = 0.7$ در این حالت Q_1 خاموش است (آف)

$$V_{C1} = 8 - V_o = 8 - 0.7 = 7.3$$

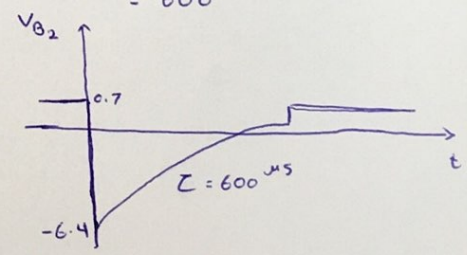
سمت چپ خازن از ۷.۳ به ۰.۲ میرسد $\Rightarrow V_{C1} = V_{CE,sat} = 0.2 \Rightarrow$ $\begin{cases} Q_1: \text{on (sat)} \\ Q_2: \text{off} \end{cases}$ (دائمه $\Delta V = 7.1$)

بنابراین سمت راست خازن (V_{B2}) هم باید به اندازه ۷.۱ میرسد: $V_{B2} = 0.7 - 7.1 = -6.4$

$$\begin{cases} \text{پایدار: } V_{B2} = 0.7 \\ \text{خاموش: } V_{B2} = -6.4 \end{cases}$$



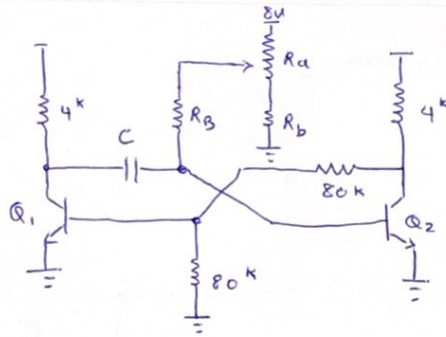
$$\tau = RC = 60k(0.01\mu F) = 600\mu s$$



$$\begin{aligned} \text{ج) } V_{B2} &= V_{B2}(\infty) + [V_{B2}(0) - V_{B2}(\infty)] e^{-\frac{t}{\tau}} \\ 0.7 &= 15.8 + (-6.4 - 15.8) e^{-\frac{t}{600\mu s}} = 15.8 - 22.2 e^{-\frac{t}{600\mu s}} \end{aligned}$$

$$\Rightarrow t = 231\mu s$$

8-10



$$= 1.95 \text{ mA}$$

حالت پایدار : $C \rightarrow$ $\begin{cases} Q_2 : \text{ON (sat)} \\ Q_1 : \text{off} \end{cases}$

$$I_{C(\text{sat})} = \frac{V_{CC} - V_{CE(\text{sat})}}{R_C} = \frac{8 - 0.2}{4k}$$

$$\beta = 100 \Rightarrow I_B > \frac{I_{C(\text{sat})}}{\beta} = \frac{1.95}{100} = 19.5 \mu\text{A}$$

در حالت پایدار،
 $\left. \begin{array}{l} \text{ست پتانسیل} \\ 0.2 \text{ V} \\ \text{ست رایت} \\ \text{تازن: پایدار} \\ \text{اندازه 7.8 است} \end{array} \right\} \leftarrow \begin{array}{l} \text{sat: } Q_1 \\ \text{off: } Q_2 \end{array}$

در حالت پایدار،
 $\left. \begin{array}{l} \text{ست پتانسیل: } 8 \text{ V} \\ \text{ست رایت: } 0.7 \text{ V} \end{array} \right\}$

$$V_{B2} = 7.8 + (-7.1 - 7.8) e^{-\frac{t}{\tau_1}} ; \tau_1 = R_B C \quad \xrightarrow{V_{B2} = 0.7} \quad 0.7 = 7.8 - 14.9 e^{-\frac{t}{\tau_1}}$$

$$\xrightarrow{t \leq 20 \mu\text{s}} \quad t = 0.7413 R_B C \leq 20 \mu\text{s} \Rightarrow R_B C \leq 27 \mu\text{s} \quad (\text{I})$$

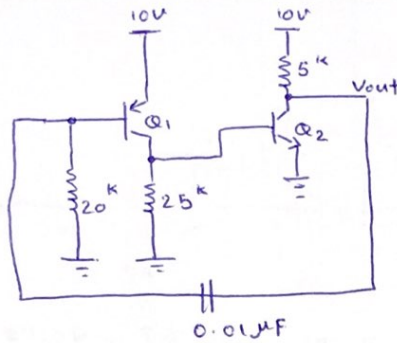
$$V_{B2} = 7.8 + (-7.1 - 7.8) e^{-\frac{t}{\tau_2}} ; \tau_2 = (R_B + R_a \parallel R_b) C$$

$$t = 0.7413 (R_B + R_a \parallel R_b) C \geq 40 \mu\text{s} \Rightarrow (R_B + R_a \parallel R_b) C \geq 54 \mu\text{s} \quad (\text{II})$$

$$I_B = \frac{V_{th} - V_{BE(\text{on})}}{R_B + (R_a \parallel R_b)} \geq 19.5 \mu\text{s} ; V_{th} = \frac{8 R_b}{R_a + R_b} \xrightarrow{\text{بیشتر}} \frac{8 R_b}{R_B (R_a + R_b) + R_a R_b} \geq 20 \mu\text{s}$$

$$\text{انتخاب: } C = 2500 \text{ PF} \xrightarrow{(\text{I}), (\text{II}), (\text{III})} \begin{cases} R_B = 10^k \\ R_a = R_b = 30^k \end{cases}$$

#8-12



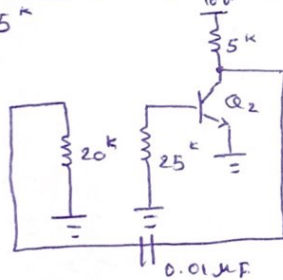
الف) حالت: در حالت پایدار \rightarrow $\begin{cases} Q_1: \text{ON (مقادیر)} \\ Q_2: \text{OFF (sat)} \end{cases} \rightarrow \begin{cases} V_{B1} = 9.3V, V_{B2} = 0.7V \\ V_{E1} = 10V, V_{E2} = 0 \\ V_{C1} = 0.7V, V_{C2} = 0.2V \end{cases}$

پیش: $\beta = 100$: $I_{B1} = \frac{9.3V}{20k} = 465\mu A$, $I_{C1} \approx I_{E1} = \beta I_{B1} = 46.5mA$

$I_{25k} = \frac{0.7}{25k} = 28\mu A \Rightarrow I_{B2} = I_{C1} - I_{25k} = 46.5mA - 28\mu A = 46.47mA$

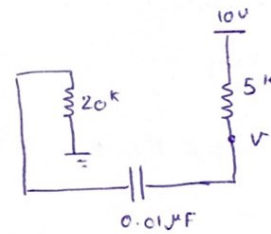
$I_{C2} = \frac{10 - 0.2V}{5k} = 1.96mA \Rightarrow I_{B2} \geq \beta I_{C2} \rightarrow Q_2: \text{در حالت پایدار}$

ب)



$Q_2: \text{OFF}$

\Rightarrow

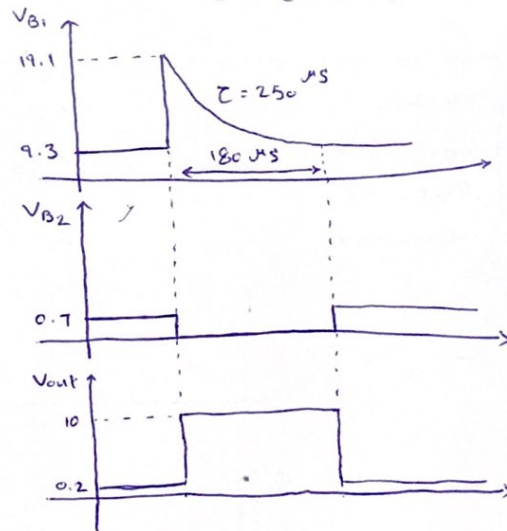


$\tau = (20k + 5k) \times 0.01\mu F = 250\mu S$

$V_{B2} = 19.1e^{-\frac{t}{\tau}} = 19.1e^{-\frac{t}{250\mu S}}$

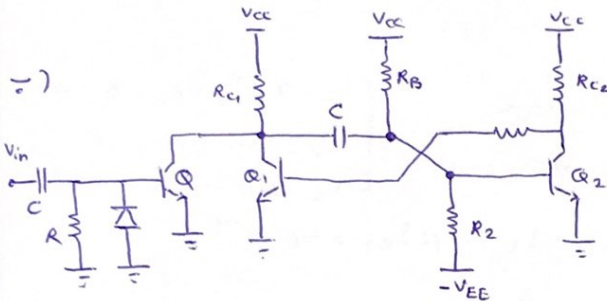
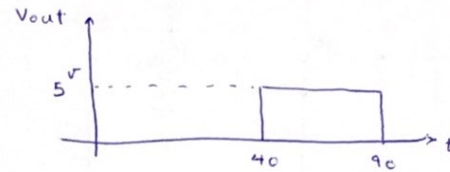
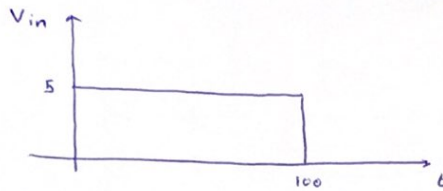
ج) $V_{B2} = 9.3$

$\Rightarrow 9.3 = 19.1e^{-\frac{t}{250\mu S}} \Rightarrow t = 180\mu S$



#8-14

الف)



$BW = 40 \mu s \Rightarrow 5\tau = 40 \mu s$
 $\tau = RC$
 $R = \frac{8 \mu s}{3.3 nF} = 2.42 k \rightarrow \text{selected } 2.4 k$

$0.69 R_B C_1 = 50 \mu s \quad C = 3.3 nF \rightarrow R_B = \frac{50 \mu s}{0.69 \times 3.3 nF} = 21.96 k \Rightarrow R_B = 22 k$

$V_{CC} = 15V, I_{C, sat} = 1 mA : R_{C1} = R_{C2} = \frac{V_{CC} - V_{CE, sat}}{I_C} = \frac{15 - 0.2}{1 m} = 14.8 k$

$\Rightarrow R_{C1} = R_{C2} = 15 k$

$R_1 = R_2 \gg R_{C2} \Rightarrow R_1 = R_2 = 100 R_{C1} = 100 \times 15 k = 1500 k \Omega$

#8-16

#8-20

$\begin{cases} 74121 \\ C_{ext} = 0.5 \mu F \\ R_{ext} = 22 k \\ 4 \rightarrow gnd \end{cases}$

$4 \approx t_c \rightarrow A_2$

$5 \approx t_c \rightarrow B$

$PW = 0.69 R_{ext} C_{ext} = 0.69 \times 22 k \times 0.5 \mu F = 7.59 ms$

$f = 100 Hz, T = 10 ms$

