HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY

Report Project 1: A LIGHT SENSING CIRCUIT

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Course:
ELECTRONIC DEVICES AND CIRCUIT(LAB)

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Contents

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1 R_1, R_2, R_3 Calculation and Power Evaluation

1.1 R_1, R_2 and R_3 Calculation

According to Kirchoff's Voltage Laws (KVL), we have the following equation:

$$\begin{aligned}
&-12 + V_{R_3} + 3V_F = 0 \\
&\Longrightarrow V_{R_3} = 12 - 3V_F \\
&\Longrightarrow R_3 = \frac{V_{R_3}}{I_{sccR_3}} = \frac{V_{R_3}}{I_F} = \frac{12 - 3V_F}{I_F}(\Omega)
\end{aligned}$$

• In case of $V_F = 3V \longrightarrow 3.4V$.

$$\begin{aligned}
&I_F = 25mA - 30mA \\
&\Longrightarrow R_3 \in \left[\frac{12 - 3x3.4}{30x10^{-3}}; \frac{12 - 3x3}{25x10^{-3}}\right] \\
&\Longleftrightarrow \; R_3 \in [60; 120](\Omega)
\end{aligned}$$

• Choose $R_L = 40000\Omega$, we have the following expression:

$$I_{R_2} = I_L = \frac{0.7}{40000} = 1.78x10^6(A)$$

Results below can be extracted by appling kirchoff's Voltage Laws.

$$\begin{aligned}
&-12 + V_{R_2} + V_{R_L} = 0 \\
&\Longrightarrow V_{R_2} = 12 - V_{R_L} = 12 - 0.7 = 11.3(V) \\
&\Longrightarrow R_2 = \frac{V_{R_2}}{I_{R_2}} = 645414(\Omega)
\end{aligned}$$

Base on the value of R_L measured by VOM, the following results can be infered:

$$R_2 = \frac{11.3}{\frac{0.7}{R_L}} = \frac{11.3XR_L}{0.7} = 12.14R_L(\Omega)$$

Applying Kirchoff's Laws:

$$\begin{aligned}
&I_{R_1} = I_{R_2} + I_{R_3} \\
&\implies I_{R_1} = I_{R_2} + I_F \\
&\implies I_{R_1} = \frac{0.7}{R_2} + I_F \\
&\implies I_{R_1} \in [0.025; 0.03](A)
\end{aligned}$$

Measurement results in laboratory reportedly show that voltage at the two ends of the capacitor peaks at $12\sqrt{2}(V)$.

$$V_{0C} = 12\sqrt{2}(V)$$

• In case of the worst situation when $V_{DC} = 18.8(V)$ so that R_1 is going to be designed in a way such that $V_{DC} = 12(V)$.

$$\begin{aligned}
&\implies R_1 = \frac{18.8 - 12}{I_{R_1}} \\
&\implies R_1 \in [227; 275](\Omega)
\end{aligned}$$

1.2 Power Evaluation

Given the fact that, the circuit is designed to operate normally at the 12V voltage level. While the value of V_{AC} reportedly stations at 14V ($V_{AC} = 14V$), which resulted in the following value:

$$V_{DCwithoutR_1} = 18.8(V)$$

That result leads to the below calculations:

$$\begin{aligned}
&\bullet\, V_{R_1} = 18.8 - 12 = 6.8(V) \\
&\bullet\, P_{R_1} = \frac{(18\sqrt{2} - R_1)^2}{R_1} \\
&\implies P_{R_1} \in [0.168; 0.204](W)
\end{aligned}$$

Given the Safe Factor to be ≥ 1.5. If V_{AC} exceeds the common voltage of $12V$, the circuit can withstand up to $18.8V$ before suffering structural damages.

$$\begin{aligned}
&P_{R_1} = \frac{(18\sqrt{2} - 12)^2}{R_1} \\
&\implies P_{R_1} \in [0.7; 0.8](W)
\end{aligned}$$

• Choose $R_1 = 250\Omega, 0.5W$ in order to guarantee that the circuit can withstand the voltage up to 1.5 times higher than the normal designed voltage.

2 Proceeding Steps

2.1 Components List

- 100Ω, $1/4W$ Resistor
- 150Ω, $0.5W$ Resistor
- $470K\Omega$, $1/4W$ Resistor
- Light Sensoring Resistor
- Zener Diode
- C1815 NPN Transistor
- 3 LEDs
- 4 Diodes

2.2 R_1, R_2, R_3 Build Method

2.2.1 R_1 Component

Only 150Ω, $0.5W$ Resistor is avalable. Thus system of R_1 resistors are built as follow in order to get the exactly calculated value $R_1 = 250(\Omega)$.

2.2.2 R_2 Component

System of R_2 resistors are built as follow in order to get the exactly calculated value $R_2 = 645(K\Omega)$.

2.2.3 R_3 Component

$R_3 = R = 100(\Omega)$.