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| **Course Name:** | **Linear Integrated Circuits and Design** | **Semester:** | **V** |
| **Date of Performance:** |  | **Batch No:** | **B1** |
| **Faculty Name:** | **Prof. Milind Marathe** | **Roll No:** | **1912052** |
| **Faculty Sign & Date:** |  | **Grade/Marks:** | **/25** |

**Experiment No: 9**

**Title:Design and implement AstableMultivibrator circuit using IC 555 timer**

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| **Aim and Objective of the Experiment:** |
| To design and implement Astablemultivibrator circuit using IC 555 timer   * To design astablemultivibrator circuit using 555 timer and verify the simulated values of output frequency & duty cycle with theoretical designed values. |

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| **COs to be achieved:** |
| **CO4:**Study internal functional blocks and design some applications of special ICs like Timers, regulator circuits, PLL, ADCs and other ICs. |

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| **Theory:** |
| **555 Timer:**  The 555 timer is an integrated circuit (chip) implementing a variety of timer and multivibrator applications. The 555 gets its name from the three 5-KΩ resistors used in typical early implementations.    The timer basically operates in one of the two modes monostable (one-shot) multivibrator or as an astable (free-running) multivibrator. In the monostable mode, it can produce accurate time delays from microseconds to hours. In the astable mode, it can produce rectangular waves with a variable duty cycle.The astable multivibrator generates a square wave, the period of which is determined by the circuit external to IC 555. The astable multivibrator does not require any external trigger to change the state of the output. Hence the name free running oscillator. The time during which the output is either high or low is determined by the two resistors and a capacitor which are externally connected to the 555 timer.  The below figure 1 shows the 555 timer connected as an astable multivibrator. If the output is high initially, capacitor starts charging towards throughand .As soon as the voltage across the capacitor becomes equal to the upper comparator triggers the flip-flop, and the output becomes low. The capacitor now starts discharging through and transistor . When the voltage across the capacitor becomes the output of the lower comparator triggers the flip-flop, and the output becomes high. The cycle then repeats.    *Fig 1 Astable Multivibrator using 555 IC*  The capacitor is periodically charged and discharged between andrespectively. The time during which the capacitor charges from to is equal to the time the output remains high and is given by  Similarly the time during which the capacitor discharges from to is equal to the time the output is low and is given by  Thus the total time period of the output waveform is  Therefore the frequency of oscillation :  The output frequency, is independent of the supply voltage  The **Duty cycle** is the ratio of the time **tON**for which the output is high to the time period . It is generally expressed as a percentage.  **% Duty cycle is given by**  According to the above relation, a duty cycle of less than 50% cannot be achieved. Also, 50% duty cycle, which corresponds to a square wave, can be achieved only if resulting in terminal 7 being directly connected to . When the capacitor discharges through R2 and an extra current is supplied to by through the terminal 7 (now directly connected to ), which may damage and hence the timer.    *Fig 2 Astable Multivibrator using 555 for 50% Duty Cycle*  Τοobtain 50% duty cycle a diode should be connected across and must be a combination of a fixed resistor (usually 100 Ω) and a potentiometer. So that the pot can be adjusted for the exact square waves.An alternative approach to achieve a duty cycle of less than or equal to 50% is to connect a diode across resistor as shown in Figure 2. In this case, the capacitor charges through and diode to approximatelyand discharges through and transistor until the capacitor voltage equals approximately, after which the cycle repeats.  Now the time for which the output is high is given by  Thus the total period of the output waveform is  Thus Duty cycle is  If , the duty cycle is 50% . For ,the duty cycle is less than 50%  **Design statement:**  1. Design an astable multivibrator with& Duty cycle of 75%  2. Design an astable multivibrator with & Duty cycle of 50% |

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| **Circuit Diagram:** |
| **1. Astable Multivibrator using 555 Timer IC ( 75% Duty cycle) along with WAVEFORMS:** |
| **2. Astable Multivibrator using 555 Timer IC ( 50% Duty cycle) along with WAVEFORMS:** |

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| **Stepwise-Procedure:** |
| 1. Design astablemultivibrator circuit using 555 timer for the specifications mentioned in write-up.  2. Make the astable multivibrator circuit schematic using 555 timer in TinkerCAD with calculated design values of , and for 75% duty cycle.  3. Plot output voltage and voltage across capacitor wave forms in TinkerCAD and measure the charging time and discharging time from the plots. LT  4. Compare the simulated values obtained from Step 3, with the theoretical values in the observation table.  5. Repeat the steps 2 to 4 for 50% duty cycle, also connect a diode across and record the observations. |

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| **Observation Table:** |
| **1. Astable Multivibrator using 555 Timer IC ( 75% Duty cycle)**  Duty cycle = 75% , , , ,   |  |  |  | | --- | --- | --- | | **Sr.No.** | **Parameters** | **Theoretical values** | | 1. | Charging time (seconds) | 750µs | | 2. | Charging time (seconds) | 250µs | | 3. | Time period (seconds) | 1000µs | | 4. | Frequency (Hz) | 1KHz | | 5. | Duty Cycle (%) | 75 % |   **2. Astable Multivibrator using 555 Timer IC ( 50% Duty cycle)**  Duty cycle = 50% , , , ,   |  |  |  | | --- | --- | --- | | **Sr.No.** | **Parameters** | **Theoretical values** | | 1. | Charging time (seconds) | 500µs | | 2. | Charging time (seconds) | 500µs | | 3. | Time period (seconds) | 1000µs | | 4. | Frequency (Hz) | 1KHz | | 5. | Duty Cycle (%) | 50 % | |

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| **Calculations:** |
| **1. 75% duty cycle and**  **i.e. ; Let**  **i.e.**  **2.50% duty cycle and f = 1kHz**  **Let and**  **i.e** |

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| **Post Lab Questions:** |
| 1. Simulate any 2 applications of Astablemultivibrator using 555 timer IC        1. Simulateastablemultivibratorcircuit which givesless than 50 % duty cycle in LTSpice. |

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| **Conclusion:** |
| * In this experiment, we have simulated AstableMultivibrator timer using IC 555 on TinkerCad with 50% and 75% duty cycle. * We have also simulated alarm system and sequential logic in the postlab section and we have got the desired output. |

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| **Signature of faculty in-charge with Date:** |