Just introduction and conclusion

Engineering

LAB REPORT Design, implement, and test a timer Ali Ahmed Al-Sheebani Liverpool John Moores 24-4 In this lab report, there are 6 experiments about design, implement, and test a timer. In each part of the experiments we have to solve the results. Sometimes graph waves should be sketched from table of results. Also, in each experiment it given me components and equipment that help me to find the results.

Introduction

The paper seeks to evaluate the methods that can be used to design, implement and test a timer for ABC Ltd that has requested for a quotation for an electronic timer required for controlling its chemical processes. In order to carry out this exercise, six experiments have been used and the results are used to test the most appropriate method that can be implemented. The paper discusses in detail the different strategies that can be implemented in order to design the timer for the above mentioned company. The paper also seeks to answer the questions related to the components needed to design, implement, and a test a timer for a company.

Part 1

1. Aim of the report

The main aim of the report was to come up with question list following the inquiry from the client. The report also aims at improving the interpretation of the needs of customers and taking the necessary actions. Additionally, the paper also helps to gain the relevant experience to come up a preliminary product specification(Chou and Hsiao, 2005).

2. Objective of the Report

ABC Limited is one of the leading companies in manufacturing company.

Based on the company’s inquiry, the report will provide some of the electronic timer quotations. The electronic timer will be used to control the chemical processes in the company. To perform this, the more information was gathered from the client and recorded directly to the logbook.

3. Question List

What are the necessary components needed to design, implement, and a test a timer?

Why are the listed products and components important in in the design, implementation, and testing?

What are the specific functions of the components needed for the above named components?

What are the appropriate measures needed for the design, implementation, and testing?

What are the effects of input frequency?

What is the limitation of voltage?

4. The interpretation of the raw data

When R1 was connected the Vb total was found to be 20mV while the Vb for the alternating current was found to be 40mV. The main function of R1 was to reduce the Direct Current, which was placed at the bottom of the transistor. When C1 was disconnected the Vb total came to 24mV while the Alternating current for Vb was recorded at 50mV. The main purpose of the C1 was to add the Direct Current component into the transistor’s bases. In situations when the C1 was absent, the 0. 7 Vc threshold needed was subtracted so that the transistor could be turned on. Additionally, in the process of the experiment, R3 was increase to 5. 1 kilo ohms (Xie and Shi, 2010). The function of R3 on this case was to limit the current that went into the base, therefore, reducing the collecting current, which later increased voltage via the collector. One of the limitation that was experienced is that when the Vs exceeded 0. 21, Vb started to experience some distortion and the highest and the maximum voltage had already been reached. The corresponding graphs for the experiment is as shown in the diagram below

Tabulation for the specifications

Frequency (Hz)

Vb (AC) Peak Value

Va (AC) Peak Value

AC Gain

10

0. 6

0. 02

30

100

1. 4

0. 036

38. 89

1000

2. 08

0. 066

31. 52

10000

2. 2

0. 0692

31. 8

1000000

2. 16

0. 0712

30. 34

Part 2

The Objectives of the experiment were:

To investigate the property of 555 chip through experiments

To construct a 555- based delay unit

To devise and build a trigger circuit

To devise and test a Voltage Controlled Oscillator (VCO)

To make my practicle skills in electrical design components strong

Background information

555 timer

Figure 1. 0 illustrates all the pin outs of a 555- timer chip. Every pin has is specific purpose.

The role of the pins are described below:

Pin 1 – it is the ground pin. It attaches to the zero voltage rails.

Pin 2 – shows the trigger pin. Its sole purpose is to detect a third rail voltage for it to be HIGH. Incase this pin goes into a LOW mode and pin number^ is also LOW, then the result is that the output pin remains in a HIGH condition. If pin ^ happens to be in a HIGH state and pin 2 in a LOW state, this results in a LOW output. Throughout this time, pin number 2 demonstrates a high impedance of 10M ohms. This impedance is activated at around 1uA.

Pin 3 – also known as the output pin on this chip. If pin 3 and pin 7 happen to be in phase, Pin 3 is forced to go to a higher state; of about 2V less than the rail, whereas The LOW state is reached at around the voltage of about 0V to

0. 5V. This denotes that pin 3 will produce only 200mA

Pin 4 – also known as the RESET pin; it is constantly connected internally to a HIGH state via a 100k resistor. The voltage must be below 0. 8V for this pin to be reset.

Pin 5. Also called the control pin of the 555 timer chip. This pin varies the timing of the RC network when the voltage applied to this pin varied.

Pin 6 – this is the threshold pin of the chip. Its function is to detect two thirds of the rails voltage for it to produce a LOW output when pin 2 is in a HIGH state. this pin has very high impedance and thus it is activated at around 1uA.

Pin 7 –this is identified as the discharge pin; when pin 2 is at a HIGH state this pin goes LOW when the 6th pin detects two thirds of the rail voltage.

Pin 8 – this pin acts as the power supply pin on this chip. It is attached to the positive rail.

555 timer oscillator

A 555 timer based oscillator is a circuit that produces high and clear free waveforms. One can easily manipulate the output of these waveforms by connecting an RC circuit to a capacitor and two resistors. This circuit demonstrates a relaxation oscillator that generates stable squire waveforms. these waveforms may comprise of duty cycles that are varying from 50-100% or may have fixed frequency of around 500 kHz. These are different from monostable circuit that stops after the pre set time has elapsed; this oscillator has its own triggering mechanism which is arrived at by interfacing the trigger input pin2 and pin6 which is the threshold voltage. This feture qualifies this device as a stable oscillator circuit.

Figure 1. 1 demonstrates a 555 timer oscillator circuit

The oscillator circuit above, shows pin two and pin six connected together. This permit the circuit to have a self-triggering mechanism in each operation cycle. Thus the circuit can be said to be operation free running oscillator.

555 timer chip as a voltage controlled oscillator

The circuit on figure 1. 3 illustrates a 555-timer based voltage-controlled – oscillator (jojo 2009 n. d)

Figure 1. 3: voltage controlled oscillator

This circuit above shows a voltage-to-frequency converter; this is so because the output frequency can be manipulated varying the input voltage. Pin 5 the voltage control pin controls the trigger and the optimum levels. The voltage at this particular pin is given as two third of the Vcc. This results from the internally build voltage divider. If an external voltage is applied at this specific point the control voltage can be changed. The voltage across the capacitor also termed as the timing capacitor I illustrated on figure1. 3 the charging and discharging time of the capacitor increase if the voltage is increased. In turn, this reduces the frequency; we can thus conclude that the frequency can be manipulated by varying the control voltage.

555 Timer based delay circuit

This circuit is used to delay a pulse. Figure 1. 4 shows the timer based delay circuit. Resistor VR1 can be used to vary the delay time of this circuit. The value of the capacitor E is thus based on the time delay formula shown below:

The reset pin 4 must be at a high state and trigger pin 2’s voltage level to drop below a third of the VCC for the output pin to be at a HIGH state. When no pulse is applied on the chip’ input, the transistor Q1 turns on and the capacitor is charged. Transistor Q1 is turned off and the reset pin4 is maintained at a HIGH state when a pulse is applied at the input. In turn this discharges the capacitor E via the resistor VR1. The time delay is dependant on the discharge capacitor.

Figure 1. 4: 555 shows a timer based delay circuit

Part 3

Equipment and components

555 timer oscillator

Equipment used

Oscilloscope

Digital multi-meter (DMM)

A solder less breadboard

Dc power supply unit (PSU)

The Componentsinvolved:

Chips: LMC55CN

LEDs

Resistors (330kΏ, 220k, 5x100k, 1k, 2x5. 1k, 1k, 82,

Capacitor (F): 10n, 22n, 100u (tantalum)

On/off switch

The procedure used:

The following procedures were followed in designing this experiment

1. The circuit show on figure 1. 6 was built on a breadboard

2. The output was connected to the oscilloscope

3. Both the minimum and the maximum values for V2 and Vout were recorded. The durations for Vout= high and low and the period of the signal was recorded

4. The waveform of the Vout with the waveform of VC for the NOR gate was

compared.

5. The value of RA was increased to 330k ohm and step 1 was repeated

6. The value of RA was reset to 100k and RB was changed to 330k. Step (a) in test 1 was repeated

Test 3

1. The values of RA and RB were set to be equal. That is RA= RB.

2. The measurement on test 1 (a) was repeated.

Test 4

1. The supply voltage Vcc was reduced to 3V

2. The measurement on test 1 (a) was repeated.

Figure 1. 6: 555 illustrates timer osillator circuit

555 timer chip as a voltage controlled oscillator

1. The Vcc was set to 9V

2. A voltage of 5V was applied to pin 5

3. The values of V5 were varied between 0 to 8 V at steps of 1V

The delay unit

1. A circuit show on figure 1. 5 was built

2. The switch was closed and time was recorded

3. The value of R was doubled to 200K

Observations, data, Findings and results

555 timer oscillator

Test one produced the following results; displayed by the graph

Figure 1. 7: screenshot of a graph for 555 timer oscillator

Results of test 2 are shown on figure 1. 9 below

The graph below on figure 2. 0 was obtained as a result of resetting the value of RA to 100k, and changing the value of RB to 330k.

c) The waveform shown on figure 2. 1 was obtained by adding a NOR gate to the oscillator.

Test 3

After setting the values of RA and RB to 100k and reducing the supply voltage to 6V, the following graph shown on figure 2. 2 was obtained.

Results for test 4

On reducing the supply voltage to 3V and repeating the test on test 1 (a), a graph shown on figure 2. 3

As evidenced by the results obtained on test 3 and 4, the relationship between Vcc and the following results can be acquired from the readings

Maximum value of V2

Minimum value of V2

And the maximum value of Vout

555 chip as a voltage controlled oscillator (VCO)

Results shown in table 1. 0 were obtained from the 555 timer based VCO

Results Discussion

Results on 555 timer oscillator

As evidenced by the graphs obtained in the tests conducted, it is illustrated that, the capacitor is charging up to two thirds of the VCC. This process can be linked to the equations

Equation one above demonstrates the charging time while equation two shows is the discharging time.

The frequency of the circuit is related by the equation three shown below.

Based on the frequency equation, it can be said that frequency changes with changing resistor and capacitor values. It is maximum when these values are at minimum

A graph of V2 maximum against V5

A graph of Vout Max against the V5

PART 4

EXPERIMENT: DESIGN AND TESTING OF A DELAY UNIT

AIMS and OBJECTIVES:

Exploring the property of 555 chip with the help of different experiments

Designing and testing a Voltage Controlled Oscillator (VCO)

Building a 555 chip-based delay unit

Designing and building a trigger circuit

Enhancing practical skills

THEORY OF THE EXPERIMENT:

Voltage Controlled Oscillator (VCO) is a module, which is responsible for generating the audible frequency notes for human ears. The user can test the pitch sources, while setting the required tune through this module. Accordingly, a VCO is similar to a string of a guitar, as the plucking of the guitar string also generates the desired note. The VCO comprises of an input voltage (IV)/OCT with constant voltage (CV) input, which comes from the controller of keyboard. This CV is responsible to change the VCO pitch, just like the changes brought by the guitar string in a guitar.

As varying input voltage changes output frequency of the VCO, it is also known as “ voltage-to-frequency converter”.

As shown in the following figure, Pin 5 terminal of a VCO is the voltage control pin. This pin regulates the trigger to threshold the applied signal levels. Usually, the applied VCC voltage at the supply pin is more as control voltage will be two-third of the supply pin voltage. The in-built voltage divider causes this division. The pin can also have direct voltage from an external source through a voltage regulating potentiometer. The time for capacitor charging and discharging shall increase with corresponding voltage increase, while the reverse is true in case of decreasing the applied voltage. Hence, the frequency variation is directly reciprocal to the applied voltage, also known as control voltage. A potentiometer or a transistor circuit output can supply such input control voltage.

Figure 1. 0, given below, displays the example of a VCO circuit (A. M Bhatt 2012 n. d)

(Figure 1. 0: a VCO circuit, Source:…)

A chip called " 555 timer IC'is the core component of a voltage-controlled oscillator. Accordingly, its use as an oscillatorrequires its configuration, before using it, for forming a stable multi-vibrator. A stable multi-vibrator is a timing circuit that has an output of constant oscillation, between the given logic of high and low, without any stopping in between. This produces a complete chain of pulses.

While the circuit with only standard " 555 timer" cannot be connected to any external voltage supply, the " 555tmer IC" circuit has the capability of being connected to such voltage supply source through pin 5. The user can regulate the threshold voltage though this pin, which is the control voltage pin. The threshold voltage at pin 5 is compared to voltages prevailing at pin 2 and pin 6 through the in-built voltage comparators. The in-built flip-flop circuits are usually controlled by the outputs received from these comparators, as these circuits toggle the output of 555 timer. Adjustment of control voltage applied to pin five results in the 555 timer output frequency variation. Accordingly, an increased voltage application at pin 5 will result in reduced output oscillation frequency, while decreasing pin five voltage will increase this frequency.

EQUIPMENTS AND COMPONENTS USED:

Equipment:

Breadboard,

DC Power Supply Unit (PSU),

Digital Multi-Meter (DMM),

Oscilloscope

Components:

Resistors (Ω): 330kΩ, 200k, 5×100k, 2×5. 1k, 1k, 82,

Capacitors (F): 10n, 22n 100μ (Tantalum),

Chips: LMC555CN),

LEDs: LED,

Switch: On/Off Switch

Figure 1. 1: a 555 timer based VRO

(Source: ….)

The above figure shows the circuit for Voltage Control Oscillator that uses 555 timer IC

PROCEDURE FOR THE EXPERIMENT

A breadboard was used to design and build the 555-based oscillator, as shown figure 1. 3

Figure 1. 3: A VRO circuit

Voltages at V2 and Vout were recorded with durations of their timing at maximum and minimum values.

Observations were recorded after increasing the RA to 330kΩ .

Test 1 was repeated after resetting the RA to 100 kΩ and RB to 330kΩ.

Test 1 was again repeated after setting the values of RA and RB to remain equal to 100kΩ, while reducing the supply voltage to 6 volts.

Test 1 was repeated after setting the supply voltage to 3 V.

Pin 5 was given a current of 5V, while setting Vcc to 9V. Thereafter voltage V5 was regulated between 0 to 8 volts, in steps of one to four.

The frequency along with minimum, maximum values of V2 and Vout were recorded.

The following is the chart that shows the maximum values of V2 and Vout, as well as minimum value of V2. Accordingly, a graph was plotted with these values, along with the frequency recorded at V5.

RESULTS AND DISCUSSION

QUESTIONS FOR DISCUSSION

The observations recorded after comparison of Voutwaveform with the Vc waveform with 555 timer oscillator and NOR gate based oscillator revealed that the 555 timer oscillator gives a square wave, while NOR gate based oscillatorproduces a triangular wave.

It was observed that with increase in RA and resistance values, the wave amplitudes also increased proportionally. The output voltage value also increased proportionally going up from 2. 8 V to 10 V.

The observations revealed that duration for Vout, set at high, decreased from 2. 98ms to 1. 386ms after setting RA to 100 kΩ and RB to 330kΩ. However, it was observed that duration of Vout set to low remained constant in similar settings.

The following voltage results were recorded after setting RA and RB to same value of 100kΩ while reducing the supply voltageto 6V.

Maximum voltage= 7 V, minimum voltage= -200mV

The values of voltage at different points, as recorded from tests 3 and 4, reveal the following relationship.

The maximum value of V2 – Vcc is inversely proportional to V2

The minimum value of V2 - Vcc is directly proportional to V2

The maximum value of Vout - Vcc is directly proportional to Vout.

GRAPHS

Why frequency changes?

While frequency is inversely proportional to capacitance, any change in impedance for the circuit will result in capacitance variation. Voltage change causes the corresponding change in the impedance. Hence, the frequency change occurs, which is regulated by theequation, frequency = 1/ (1. 386R2*C)

PART 5

CONFIGURATION AND CALIBRATION

OBJECTIVES:

Interfacing the oscillators and amplifier and the delay unit

Calibrating the system

Enhancing practical skills

Theory for experiment

Oscillators

Any oscillator circuit that generates oscillating periodic signal, electronic signal as well as occasional square or sine waveform is known as an oscillator. While electronic devices can work as oscillators, these are capable of converting direct current (DC) to alternate current (AC) signals. The examples of such signals include clock signals from computers, TV and radio broadcast signals and circuit of crystal quartz clocks. In addition, the electronic beeper sounds as well as videogame sounds are examples of these signals.

EQUIPMENT AND COMPONENTS

Equipment:

Breadboard,

DC Power Supply Unit (PSU),

Battery: 9V with connectors,

Digital Multi-Meter (DMM),

Oscilloscope,

Screwdriver

Components:

Resistors (O): 10k, 300k, 5×620k,

Capacitors (F): 33µ,

Potentiometer (O): 50k

Linear Carbon,

Multi-position switch

Note: All resistors have Metal Film (: 1%) with wattage rating as 0. 25

EXPERIMENTAL PROCEDURE

1. Interfacing

Connecting the delay unit to the oscillator as shown in the following figure

2. Calibration

a. Connecting the potentiometer as shown in the figure

b. Adjusting delay to 60 sec for values of R3= 620kΩ,

3. Using a multi-position switch, building the circuit as given in fig. 5. 3 multi-

position, the delay unit was tested and results recorded for each value of R3.

4. The following observations were recorded as the power supply was provided through a 9V battery.

RESULTS AND DISCUSSION

Delay(min)

0. 5

1

2

3

4

5

R3(k▸)

310

620

1240

1860

2480

3100

Discussion questions

Q1: What is the requirement of ‘ control signal’, as high or low, for disabling the NOR gate?

(Hint: Logical properties of NOR gates may be used)

Answer: the control signal must be high to disable the NOR gate.

Q2: Prior to reaching the required delay, what shall be theoutputofdelayunit(pin3of555)?

Answer: Vout shall be 9 V

4. Q1: Whatisthefunctionof C5?

5. Answer: The function of this capacitor is to ensure that there is no loss of power in the system, as it goes through charging and discharging cycle.

6. Q2: What is the reason to usetwoswitches(S1andS2)?

7. Answer: While S1 switches the system ‘ on’ and ‘ off’, according to the capacitor status, S2 functions as a safety switch to protect components in case of any faulty function.

CONCLUSION

Various procedures were employed in the experiment for developing the voltage controlled oscillator. Accordingly, during the VCO design, observations were recorded for the change in properties of different parameters in relation to each other. This increased our knowledge about 555 timer-based oscillators. In addition, we could observe the comparison in waveforms, as 555 timer based oscillator has a rectangularshaped wave, while the NOR gate-based oscillator has a triangular wave.

It can be noted that there are different methods that can be used to design, implement a test timer of for ABC Ltd. From the six experiments carried out, it can be observed that the 555 timer chip is frequently used. It can be used as an oscillator and the frequency and voltage are controlled in order to suit the needs of the experimenter. From the different experiments carried as illustrated in the paper above, it can be noted that varying input voltages produce different frequencies. It has also been observed that with an increase in RA and resistance values, the wave amplitudes also increased proportionally while at the same time the output voltage value also increased proportionally.

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