DESIGN AND CONSTRUCTION OF AN AUTOMATIC GATE CONTROL SYSTEM

BY

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A SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING IN PARTIAL FULFILLMENT FOR THE AWARD OF THE DEGREE OF BACHELOR OF ENGINEERING (B.Eng) IN ELECTRICAL AND COMPUTER ENGINEERING OF FEDERAL TECHNOLOGY of MINNA.

Dedication

I dedicate this project to God who facilitated my entry into this university and who has been with me throughout my time here, which has culminated into this final piece of work before your eyes. May the Grace of God, which he showers on me, never cease in my life in Jesus name. (Amen).

Declaration

I, Owolabi Babawande Ayodeji, declare that this work was done by me and has never been presented elsewhere for the award of a degree. I also hereby relinquish the copyright to the Federal University of Technology, Minna.

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Abstract

The project design is an AUTOMATIC GATE CONTROL SYSTEM. The purpose of the project is to provide an easy, secure, and authorised means of access into a restricted area or residential home.

The project achieves its purpose by radio frequency (RF) where a signal is sent from the transmitter, detected by the receiver, converted into pulses, and made to activate a gate. Opening and closing of the gate is controlled by relays.

A great advantage of this project is that it is economical to construct and also reduces the trouble of workers being checked at the entry of their workplaces. It also acts as a doorman for a house owner by granting him access to his home once he reaches the gate.

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Chapter One

Introduction

The project is aimed at the design and construction of a model of a radio controlled automatic gate. The design comprises two devices or units. One unit is designed to transmit a short range high frequency (HF) radio signal and the other is designed to receive the commanding radio signal from the transmitter. The receiver unit responds to the received signal by opening a gate. The design allows the gate to be opened as long as the command is present at the receiver. When the signal is broken i.e. the receiver does not receive any commanding radio signal, the gate closes automatically. The entire operation is done without any physical interference by any external body.

The system can be used for both industrial and home use. Many modern buildings are being installed with this cutting edge technology. A house-owner no longer needs anybody's assistance in getting his or her garage opened. The operation is merely a set-up at a remote range. Moreover the system gives greater security as the gate, door, or garage can only be accessed by someone with the radio transmitter that has been manufactured for the system. Therefore, the unit functions more like a key to a door.

The main accomplishments of the project are the use of simple logic units for such sensitive application. The main electronic components used for the design are complementary metal oxide semiconductors (CMOS) ICs, which have good attributes such as power efficiency and high compatibility.

Also, the design is cost effective due to the cost of components. Cost was also reduced by the modification of some irrelevant parts for more interesting applications. A good example is the gate construction which is made from an inactive compact drive. The part performs the needed task to satisfaction.

In addition, the project embodies some limitations. The most obvious one is the model set up, which limits the project importance. Although the model shows a real life situation, the device can cause reasonable electromagnetic wave interference with other radio devices. Therefore, it is not really appreciable for sensitive applications.

Chapter Two

Literature Review

2.1 History of automatic doors

Modem doors involve a high degree of automation for ease in use. Automatic doors/gates are powered open and close. A door fitted with a spring to close it is not an automatic door. Heron of Alexandria created the first automatic door. Heron of Alexandria was a Hellenized Egyptian engineer and geometer in Alexandria was a Hellenized Egyptian engineer and geometer in Alexandria, Egypt. The first automatic sliding doors for use by people were invented in 1954 by Lew Hewitt and Dee Horton; the first one was installed in 1960. It made use of a mat actuator. The idea came to them in the mid-1950s, when they saw that existing swing doors had difficulty operating in the high winds of Corpus Christi, Texas. Upward sliding garage doors date from the 1920s, the first electric door openers (not automatic) were sold in 1926. [2]

Automatic doors are powered open and closed by using an electromechanical set-up (e.g. motors). There are three ways by which an automatic door/gate is activated:

1. A sensor detects traffic is approaching. Sensors for automatic doors/gates are generally:
   i. A pressure sensor – a floor mat which reacts to the pressure of someone standing on it.
   ii. An infra-red curtain or beam which shines invisible light onto sensors, if someone or something blocks the beam the door/gate can open.
   iii. A motion sensor which uses low – power microwave radar.
   iv. An electronic sensor (e.g. radio wave) can be triggered by a device (transmitter) that someone carries, or is installed inside a vehicle. Used for gates and garage doors.

2. A switch is operated automatically, perhaps after security checks. This can be a push button switch or a swipe card.

3. The user pushes, or pulls the door slightly. Once the door detects the movement it completes the opening or closing of the door cycle. These are also known as power – assisted doors. [2]

In addition to activate sensors, automatic doors are generally fitted with safety sensors. These are usually an infra-red curtain or beam, but can be a pressure mat fitted on the swing side of the door. The purpose of the safety sensor is to prevent the door opening or slows its speed if an object is detected in its path whilst opening and to prevent the door closing or reactivate it if an object is detected in its path whilst closing. [2]

2.2 History of radios

Originally, radio technology was called 'wireless telegraphy' which was shortened to 'wireless'. The prefix radio- in the real sense of wireless transmission is first recorded in the word radio-conductor, coined by the French physicist Edouard Branly in 1897 and is based on the verb to radiate. 'Radio' as a noun is said to have been coined by advertising expert Waldo Warren. The word appears in a 1907 article by Lee de Forest, was adopted by the United States Navy in 1912 and became common by the time of the first commercial broadcasts in the United States in the 1920s. The American term was then adopted by other languages in Europe and Asia, although Britain retained the 'wireless' until the mid-20th century. [1]

Radio signalling and audio communication using electromagnetic radiation was first employed as a 'wireless telegraph', for point – to – point links where regular telegraph lines were unreliable or impractical. Next developed was radios ability to broadcast messages

:multaneously to multiple locations, at first using the dots – and – dashes of telegraphic code, and later in full audio. [3]

2.3 Uses of radios

Many of radio's early uses were maritime, for sending telegraphic messages using morse code between ships and land. One of the earliest users included the Japanese Navy scouting the Russian fleet during the battle of Tsushima in 1905. One of the most memorable uses of marine telegraphy was during the sinking of the RMS Titanic in 1912, including communications between operators on the sinking ship and nearby vessels, and communications to shore stations listing the survivors. [1]

Radio was used to pass on orders and communications between armies and navies on both sides in World War I, Germany used radio communications for diplomatic messages once its submarine cables were cut by the British. The United States passed on President Woodrow Wilson's 'Fourteen Points' to Germany via radio in the pre-war years was the development of detecting and locating aircrafts and ships by the use of radar (radio detection and ranging). [1]

Today, radio takes many forms, including wireless networks, mobile communications of all types, as well as radio broadcasting.

Uses of radio waves include controlling data to a remote object as in the early forms of guided missiles, some early TV remotes and a range of model boats and aeroplanes. It is also used as a means of automatically opening/closing a door/gate in advanced societies. [1]

Chapter Three

Design and Implementation

3.1 Circuit design analysis

The complete circuit can be divided into five groups or separate parts namely:

1.) Radio transmitter

2.) Power supply unit

3.) FM tuner

4.) Logic control unit

5.) Output/Load (Electromechanical unit)

The radio transmitter is the only unit that stands alone. The others work in response to signal from the radio transmitter.

3.1.1 Radio transmitter

The radio transmitter is designed to transmit a short range very high frequency (VHF) into space. The unit comprises a simple modified Hartley RF oscillator and a pulse/square wave generator. The RF oscillator produces a carrier wave in which the pulse from the other oscillator is carried into space. This pulse is merely to excite the transmitted radio signal. The circuit is powered by a 9V battery source for a reasonable portability. The main frequency of the 4060B configuration in accord with the data sheet is

$$f_m = \frac{1}{2.3 \times 33 \times 10^3 \times 0.002 \times 10^{-6}} = 6.5876 \text{ kHz}$$

The two values, 33kΩ and 0.002µf, are typical for the 4060B. The frequency output of pin 7 is given by:

$$F_{pin\,7} = \frac{f_m}{2^4} = \frac{6587.6}{2^4} = 411.72\ \text{Hz}.$$

This pulse is carried by the carrier wave. The other oscillator is concerned with the carrier wave. It is based on a modified Hartley oscillator. For simplicity the normal reasonable frequency equation is assumed for computing the frequency of operation.

The frequency formula for the LC tank is given by:

$$f_o = \frac{1}{2\Pi\sqrt{L_o C_o}}$$

Where, $L_o = 0.105\mu H$

$C_o = 30pf$

$$f_o = \frac{1}{2\Pi\sqrt{(0.105 \times 10^{-6} \times 10^{-12})}}$$

$f_o = 89.6 \times 10^6$ Hz

$f_o = 89.6$ MHz

This frequency is transmitted but it is theoretical. The practical value is actually lower. The device operates at around 78 MHz. The difference is due to the assumptions associated with the frequency formula and the internal capacitance of the oscillator's circuit.

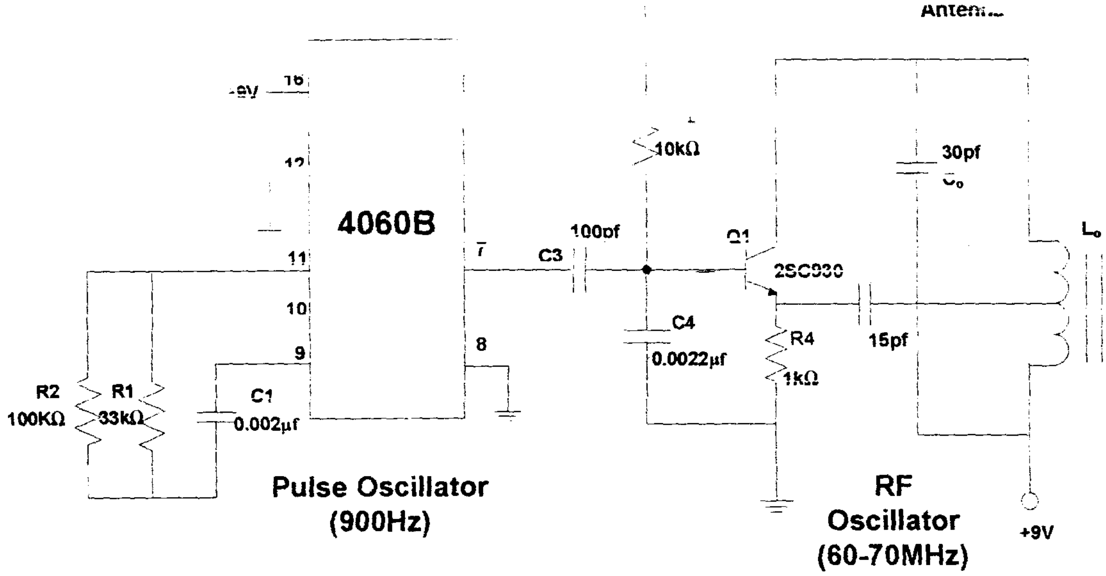


Fig. 3.1 the radio transmitter circuit

3.1.2 The power supply unit

The power supply unit is designed to supply both 5V and 12V to the receiver. It is incorporated with 7805 and 7812 voltage regulators. A 24V output step-down transformer provides 12V AC voltage from the main supply to a bridge rectifier. The bridge rectifier converts the 24V AC output from the transformer into corresponding DC voltage. The transformer is rated 500mA. Therefore, it supplies a power of roughly,

$$500 \times 10^{-3} \times 24 = 12 \text{ Watts}$$

The bridge rectifier comprises four rectifying PN diodes. They are configured in a manner in which only two are active in a half-cycle of the input alternating signal. The other two work at the other half of the cycle.

The result is the conversion of the input AC voltage into an equivalent DC voltage.

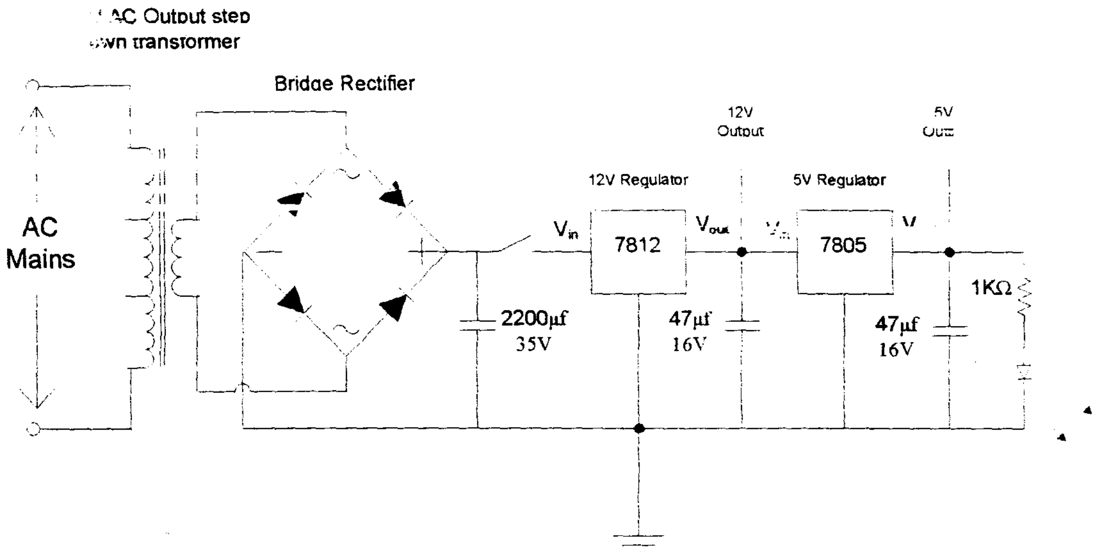


Fig. 3.2 power supply unit

The output of the transformer is not exactly 24V. There is a voltage drop across the involved active diodes. The rectified voltage is not completely DC. The voltage is attributed to reasonable ripple. That is, there is still certain AC component of the rectified voltage. A large electrolyte capacitor within 1000 - 3300µf range is usually connected in parallel to the output voltage o minimise the ripple effect. A 2200µf 35V capacitor is incorporated into the bridge rectifier's circuit to smoothen the flow of electric current in the circuit.

A power switch is connected in series with the positive line to close and open the complete circuit. The outer terminal of the switch is connected to the 7812 and 7805 which are connected in parallel. The 7812 and 7805 produce regulated 12V and 5V respectively. A 47µf 16V capacitor is usually connected in parallel to their output to the ground to improve the stability of the power supply to the circuit.

A LED-resistor circuit is connected to the 5V terminal of the power circuit to indicate the presence of electric current in the circuit. It works alongside the power switch. The circuit involves a 1KΩ resistor in parallel with a light emitting diode (LED). The voltage across the diode is usually maintained at 2.7V. Therefore, the voltage across R_p is 2.3V. Assuming, a typical current of 2.5mA. Therefore,

$$R_p = \frac{2.3}{2.5 \times 10^{-3}} = 920\Omega$$

$$R_p = 920\Omega$$

Though, 1000Ω (1kΩ) is a more practical value.

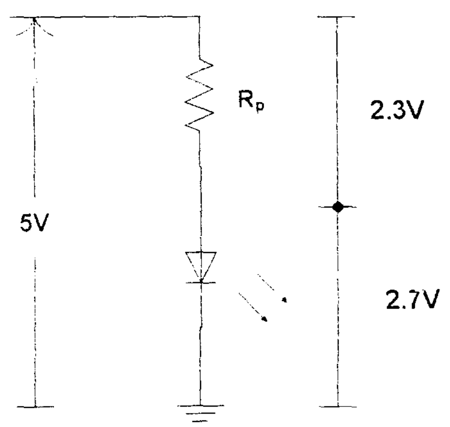


Fig. 3.3 the Power indicator

3.1.3 FM tuner

The FM tuner is basically the KA2297. It is designed to receive FM signal from space. Due to its high- tech integration, it is attributed to limited number of external components. Their values are specified by the manufacturer's datasheet. The specification of involved components aids the design's implementation.

The devices datasheet specifies all involved inductors to be 3 turns and 5mm diameter. The frequency range is specified to be at around 100 MHz with these inductances in parallel connected to 30pf capacitors.

A 3-terminal 10.7 MHz crystal is specified for intermediate frequency filtration. The crystal is connected to terminals 3, 6, and 8. Another crystal, but with two terminals, is specified for pin 10 to enhance demodulation of the input signal. A 3.3μf 16V is connected to pin 5 for Automatic Gain Control (AGC). Pin 11 is the demodulated output. It is connected to a RC filter. The KA2297 integrated circuit is quite simplified for several circuit applications. Users of this device require limited technical knowledge for achieving a reasonable application. The reason is based on its wide range of specifications. The basic operation of the device is explained in the components description section.

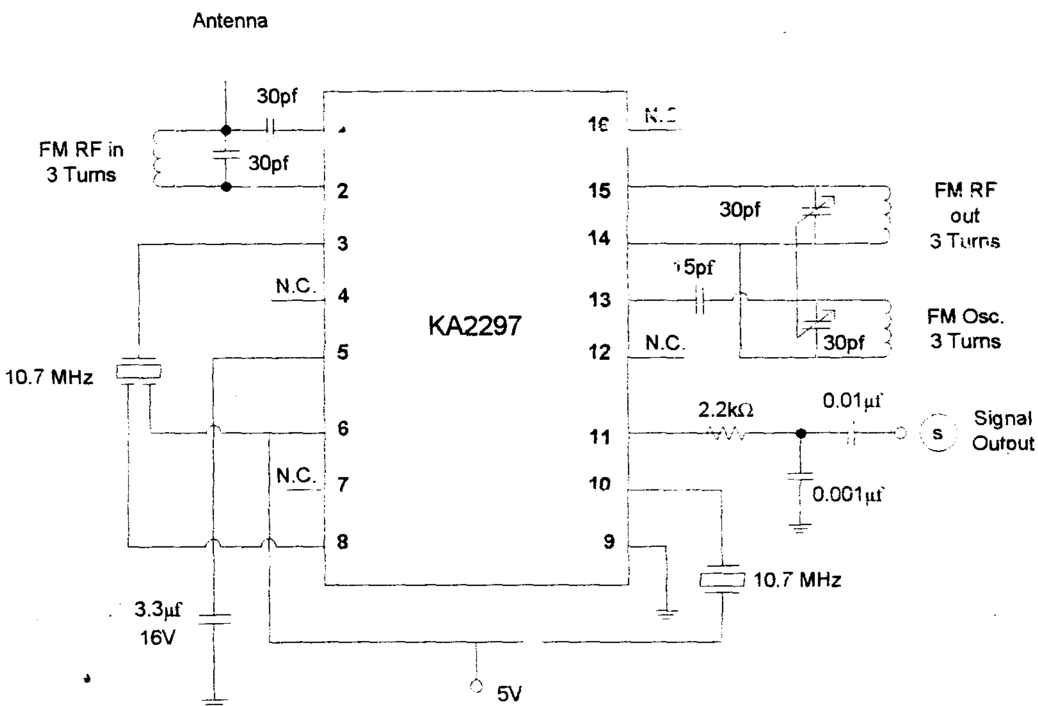


Fig 3.4 the FM Tuner circuit

The output from the integrated circuit is connected to a signal amplifier. The demodulated signal is weak and not suitable for logical switching operations which make the signal amplifier to be of great importance.

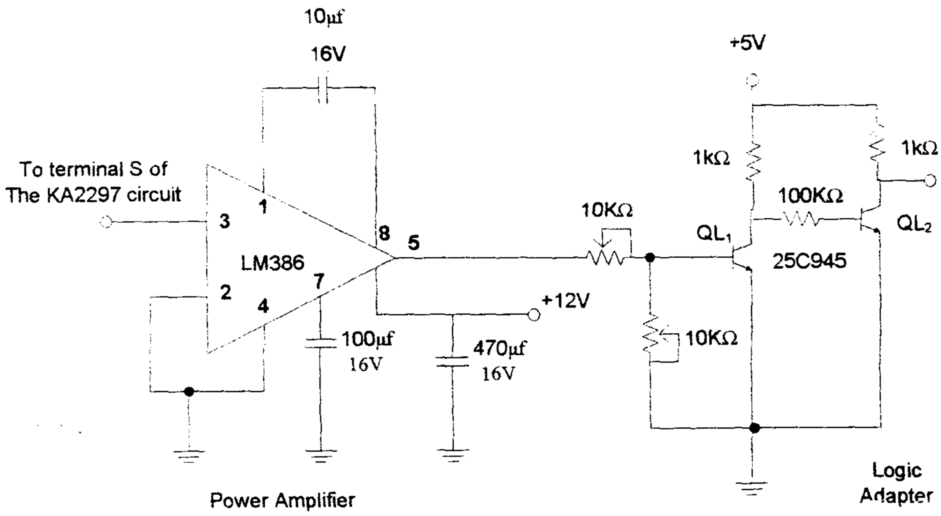


Fig 3.5 (a.) the signal amplifier circuit

The signal amplifier circuit hold the main device, the power amplifier and logic adapter. The power amplifier is merely a LM386 audio amplifier circuit. Based on the manufacturer's specification, it provides a gain of 200 when connected as shown in Fig 3.5. As a modern device, the LM386 amplifier's circuit is fully based on specification. Every external attachment to the circuit is according to requirements given in the datasheet.

The logic adapter is a mere common emitter NPN transistor switch. The circuit operates with two NPN transistors. QL_1 has two 10kΩ variable resistors connecting to its base. The resistors are adjusted so that the transistors are very close to saturation. The base voltage is initially made around 0.4V. QL_2 is a mere resistor – transistor logic (RTL) inverter. The inverter circuit simply inverts the initially relative high voltage from QL_1 to low. Whenever output of QL_1 is at logical 1 (close to 5V), output of QL_2 is low (towards 0V). Output of QL_2 is high when output of QL_1 is low.

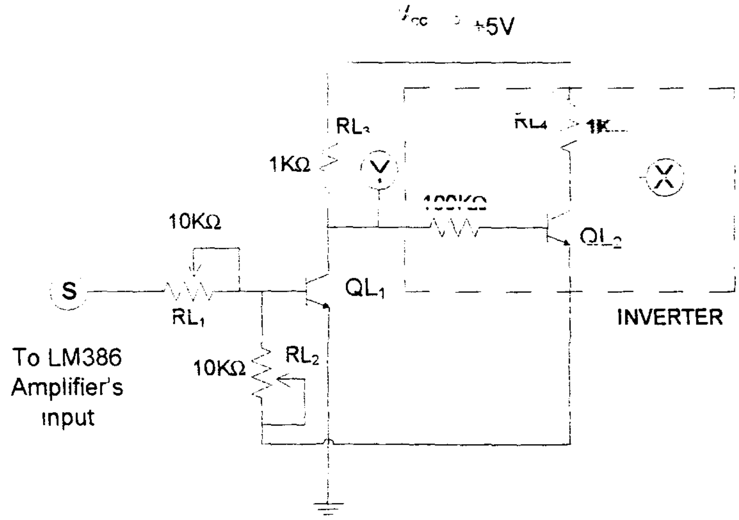


Fig 3.5 (b.) the logic adapter unit

Two 10kΩ variable resistors are used for adjusting the base of transistor QL_1 to around 0.4V. Therefore, the current at the base is very small. 2SC945 transistor is typically loaded with 1kΩ. At saturation, the current at the collector is given by:

$$I_c = \frac{5}{1000} = 5mA$$

The transistor's current gain (hfe) is typically 100.

Therefore, $$I_B = \frac{I_C}{100} = \frac{5 \times 10^{-3}}{100} = 0.05mA$$

Initially, the current flow from terminal S is far below 0.05mA. Therefore, the received signal from the FM tuner increases the current of the base to around 0.05mA which cause switching on of QL_1. QL_2 simply inverts the output of QL_1. The output of QL_2 is fed to the logic control unit. The inversion is important because if only QL_1 is used for the logic adapter unit, whenever the current at terminal S is high output of QL_1 is low. Therefore, an inverter is required for point Y for active high condition.

3.1.4 The logic control unit

The logic control unit is designed to respond to the signal from the FM tuner, i.e. the one sent by the transmitter. This unit controls the output load or the electromechanical gate unit. The logic control unit energizes a DC motor in one specific direction in order to open the involved gate (an electromechanical set-up) whenever signal is received from the radio transmitter. When the signal is not available the logic unit automatically commands the gate to close.

The unit holds four main control devices. They are the input control latch, input control oscillator/timer, output control oscillator/timer, and output control latch. They work together for a basic function.

The main input of the whole unit is point P. the initial condition of this point is logical 0. This shows that no signal is received from the transmitter. The output condition is calm. But on activating the radio transmitter, a rough pulse is transmitter which increases the flow of current through amplification stages. The result is a high logical level at pin P. the input control latch is set. O changes from logical level 0 to 1.Q^1 changes from logical level 1 to 0.

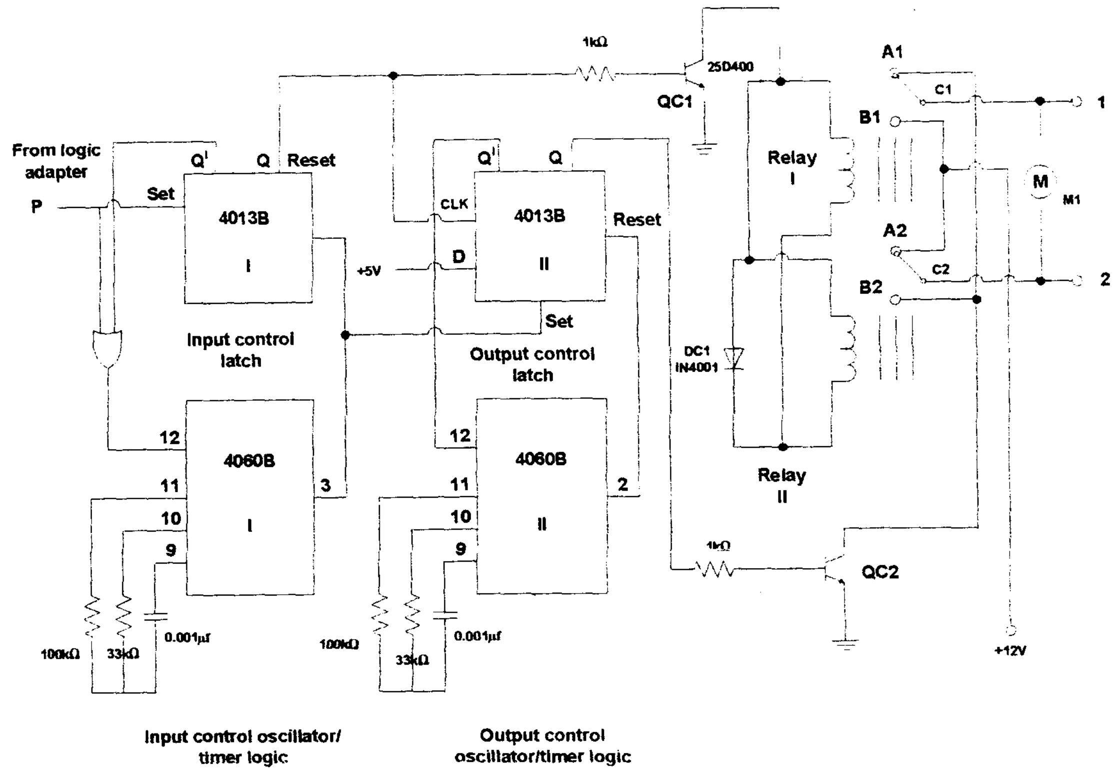


Fig 3.6 the logic control unit

At this moment, transistor QC1 is saturated through the more positive voltage at its base. The relays are energized through QC1 switching action. Contact C_1 moves from A_1 to B_1 and C_2 moves from A_2 to B_2. Both terminals A_2 and B_1 are positive at 12V. A_1 and B_2 are negative or ground. Therefore, point 1 and 2 are initially negative and positive respectively. But when the high signal is received at point P their status is interchanged. The negative condition of both B_1 and A_2 is dependent on the state of transistor QC2.

The Q output of 4013B I is fed to the clock input of 4013B II. This result into Q output of 4013B II changing from logical 0 to 1. Q^I of this latch is now logical 0 from 1. The logical level at the early Q^I enables 4060B II. The device started timing the automatic reset of 4013B II. The time is T_2.

Also, through the 2-input OR gate, 4060B I is enabled from its pin 12. The timer started counting in order to reset the input control latch to time T_1.

T_1 is based on the frequency formula of the 4060B.

$$T_1 = \frac{1}{F_1}$$

$$F_1 = f_{Q14}$$

The frequency is based on pin 3 (which is Q_{14}) of 4060B I. Therefore,

$$f_{Q14} = \frac{f_m}{2^{14}}$$

$$f_{Q14} = \frac{(1/2.3) \times 33 \times 10^3 \times 0.001 \times 10^{-3}}{2^{14}} = 0.81\text{Hz}$$

$$f_{Q14} = f_1 = 0.81 \text{ Hz}$$

$$T_1 = \frac{1}{f_1} = \frac{1}{0.81} = 1.24 \text{ seconds}$$

For T_2,

$$T_2 = \frac{1}{f_2}$$

$$f_2 = f_{Q14} \text{ (for pin 12 which is } Q_{13}\text{)}$$

Therefore,

$$f_2 = \frac{f_m}{2^{13}}$$

$$f_2 = \frac{(1/2.3) \times 33 \times 10^3 \times 0.001 \times 10^{-6}}{2^{13}} = 1.62\text{Hz}$$

$$f_{Q13} = f_2 = 1.62\text{Hz}$$

$$T_2 = \frac{1}{f_2} = \frac{1}{1.62} = 0.617 \text{ seconds}$$

Due to the multiple frequency outputs of the 4060B. typical values of its associated RC circuits are 100kΩ, 33kΩ, and 0.001µf. The RC constant provides a frequency range for most practical applications. So that, suitable ones are selected for specific functions.

The time is a bit slower in real or practical situations due to inaccuracy of the frequency formula and internal capacitance of the circuit.

Moreover, on returning P to a low logical level, in the case whereby the transmitter's signal is out of range of the receiver, the input control oscillator/timer automatically resets the input control latch at T_1. Q output of the input control latch goes low, while Q^1 is high and disables 4060B I. The condition of the relays is reversed. The contacts simply return to the initial state and the polarities of the DC motor interchanges. The motor moves in the opposite direction. At the same time the output control oscillator/timer automatically resets the output control latch. QC_2 is disabled or cut-off, thereby stopping the availability of a negative input for the relays circuit. The motor works for just time t_2. The output control logic is required to avoid continuous operation of the motor even though the gate is completely opened or closed. The unit stops the running of the motor after the aim of the operation is achieved.

To sum up, when P is at high logical level the result is the energizing of the motor in a particular direction to open the gate. The motor works for time T_2. When P is low the direction of current flow is reversed in a manner in which the gate closes. The motor works for time T_2.

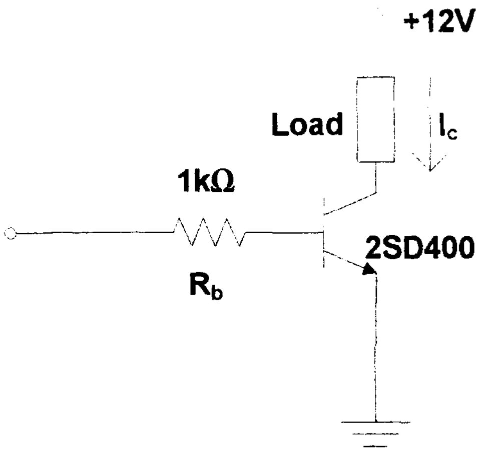


Fig 3.7 the 2SD400 transistor

The 2SD400 transistor has a typical current gain of 100. The maximum current expected at the load is 900mA (from its datasheet).

Therefore, the expected $I_b = \frac{I_c}{100}$

$$I_b = \frac{900 \times 10^{-3}}{100}$$

$$I_b = 9mA$$

Therefore, the base resistance, R_b, is given below

$$R_b = \frac{5 - 0.7}{9 \times 10^{-3}} = 477.7\Omega$$

R_b is made 1000Ω. This is because the current at the collector is below the maximum. Therefore, low current is expected at the base.

This circuit is used for both relay and motor switching.

3.1.5 The electromechanical unit

The electromechanical unit involves the DC motor and the gate's mechanism. The gate set-up is merely a model using a modified normal CD ROM drive.

Component analysis

3.2.1 KA2297

The KA2297 is a monolithic integrated circuit which consists of an FM F/E + AM/FM IF and DET coil. The device is a non-adjustable AM/FM DET coil. It requires overall minimum number of external parts or components for operation. And, it operates within 1.8V ~ 7V power supply. Therefore, it is quite useful in portable device designs. [21]

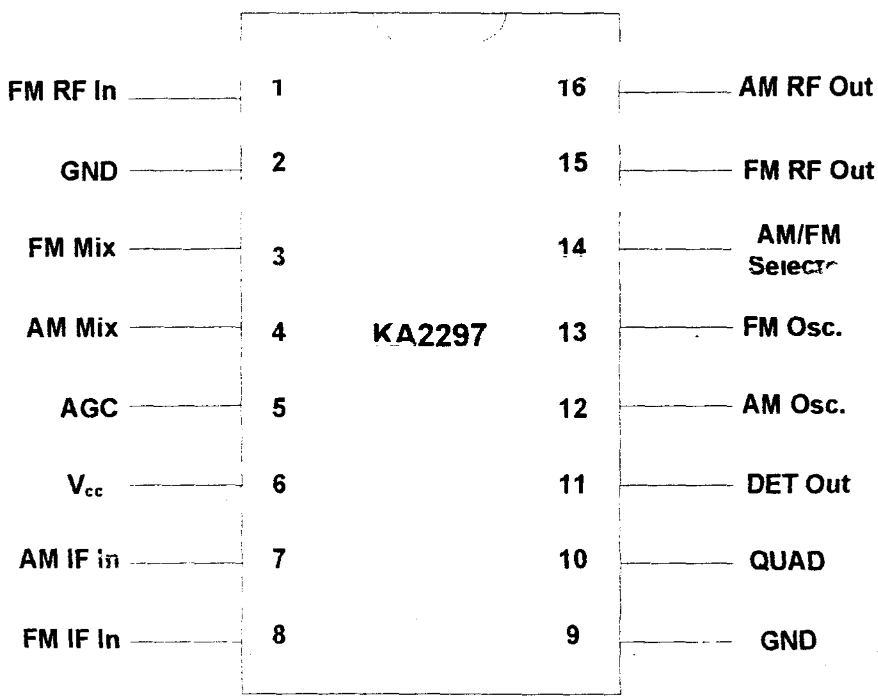


Fig 3.8 the pin layout of the KA2297

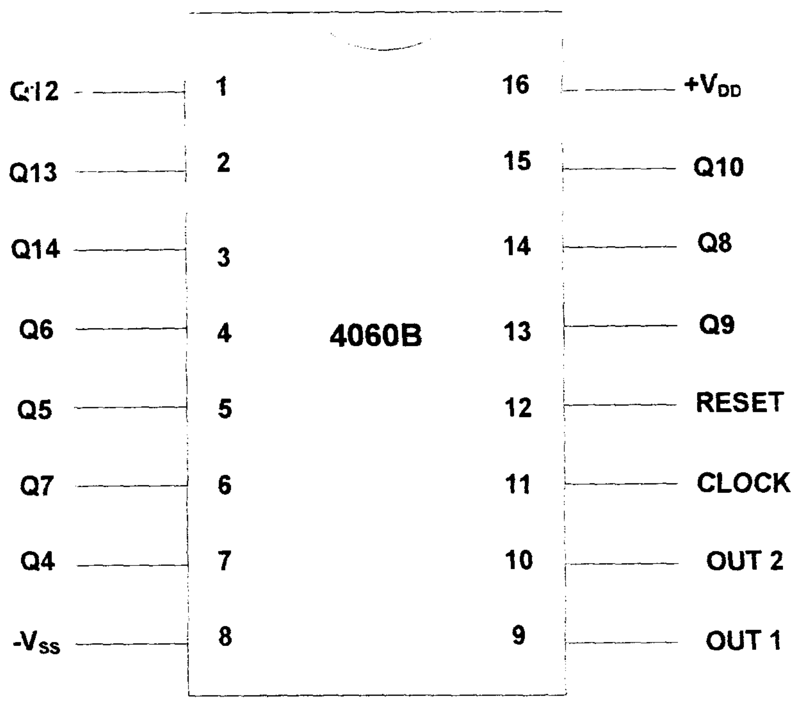
The integrated circuit possesses both AM and FM features. The project involves the FM section of the integrated circuit. The other part, AM, is not used. Therefore, the project covers pin 1, 2, 3, 5, 6, 8, 9, 10, 11, 13, 14, and 15.

Pin 1 deals with the incoming FM radar frequency (FM RF). Pin 2 is ground while pin 6 is the V_{cc}. The two terminals serve as the power supply to the device. Pin 13 is the FM oscillator's terminal. Pin 5 deals with the Automatic Gain Control (AGC) of involved RF signal. A 3-terminal 10.7MHz ceramic crystal is required or connected to pin 3, 6, and 8. The crystal deals with the intermediate frequency filtration. Another 2-terminal 10.7MHz ceramic crystal is required across pin 10 and the V_{cc} for demodulation operation on the FM signal. [21]

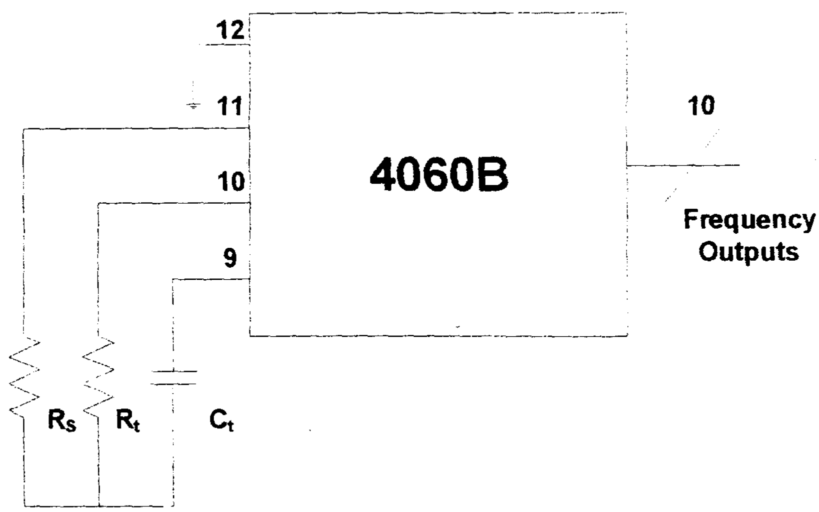
The FM oscillator and RF sides are connected to different LC tanks. The circuits are used for frequency tuning applications. Moreover, the demodulated output of the whole receiving process is pin 11. It is usually connected to a set of RC filters. The external attachments remove noise from the output. [21]

3.2.2 4060B

The 4060B is a 16-pin CMOS/divider integrated circuit. It generates ten frequency outputs. The frequencies are available through a 14-stage internal division of a central or main frequency. The device has a RESET input (pin 12) that is required to be low for the circuit to be in operation. The circuit can be configured with both RC and crystal forms. Pins 9, 10, and 11 are used for the RC configuration; pin 11 is the clock input of the device. Every circuit is buffered for the sake of protection. [17]



(a.)



(b.)

Fig 3.9 (a.) the pin layout of the 4060B, (b.) normal RC configuration of the 4060B

R_f and C_f are concerned with the main frequency. The main frequency is gotten from its datasheet with the formula given as:

$$f_m = \frac{1}{2.3\, R_t C_t}$$

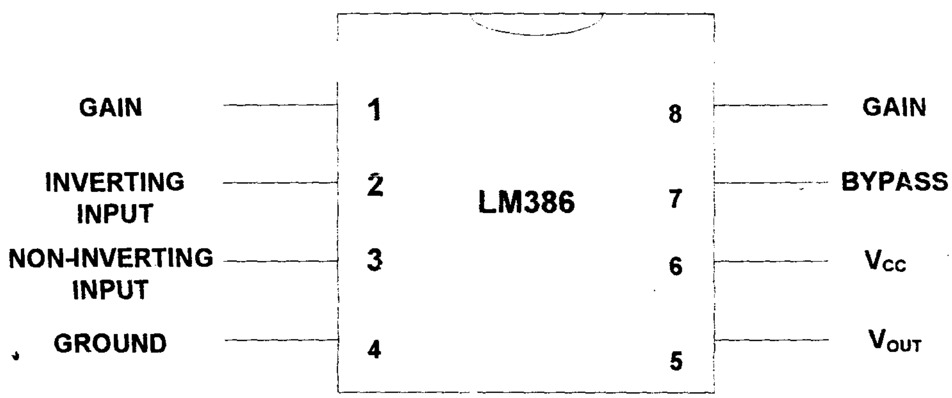
The relationship between R_t and R_S is given below:

$$10\, R_t \geq R_S \geq 2R_t$$

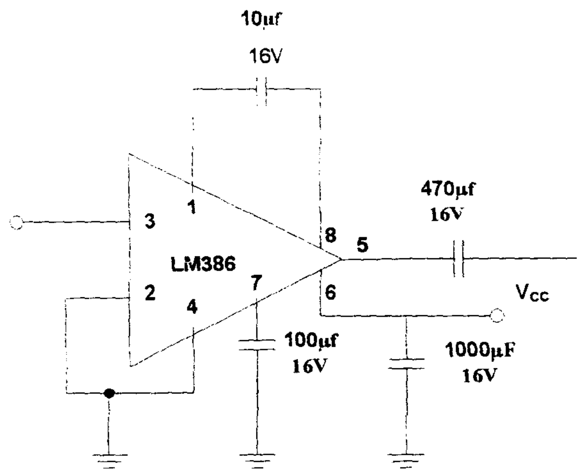
The value of the resistor must be below 1MΩ which is recommended by the manufacturers. [17]

3.2.3 LM386

The LM386 is a linear power amplifier. It consists of eight pins. It is connected to limited external components for the complete circuit. The amplifier has a fixed internal gain of 20. But, also an addition of a 10µf capacitor across pin 1 and pin 8 which results into a 200 gain. The amplifier is quite suitable for low power portable devices due to limited current leakage. [19]



(a.)

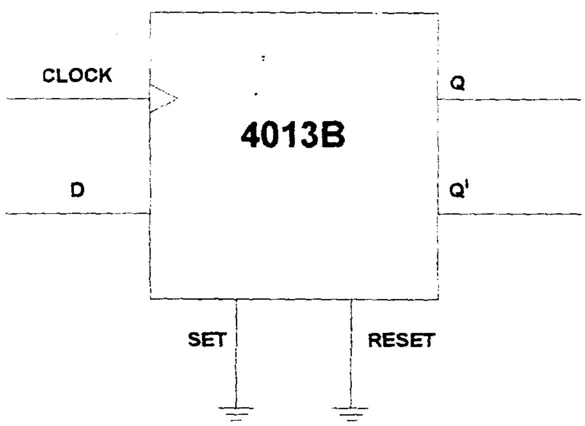


(b.)

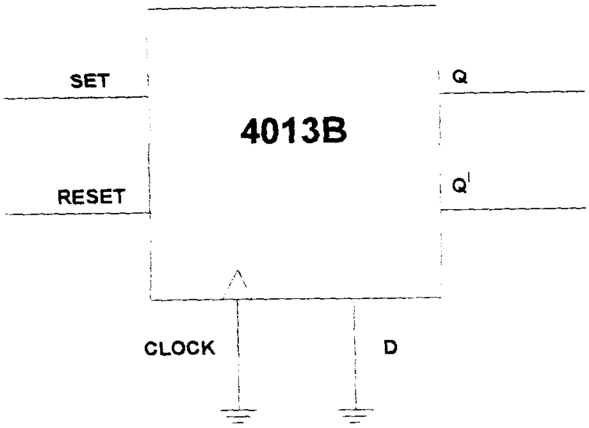
Fig. 3.10 (a.) the pin layout of the LM386, (b.) the typical audio amplifier circuit

3.2.4 4013B

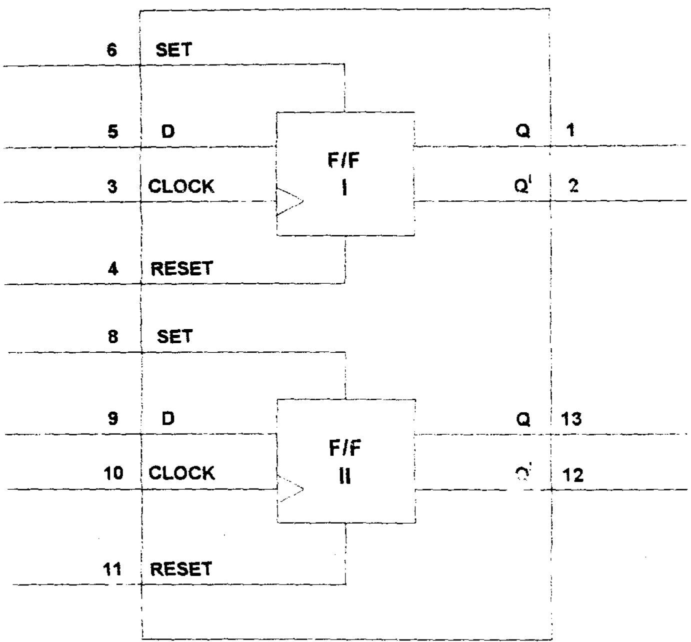
The 4013B is a 14-pin CMOS integrated circuit holding two D - flip-flops or latches alongside both SET and RESET features. The sub-devices work independent of each other. The whole inputs are active high. [20]



(a.)



(b.)



(c.)

Fig. 3.11 (a.) the D-type configuration of the 4013B, (b.) the SR-type configuration of the 4013B,

(c.) the functional diagram of the 4013B

Table 3.1 the truth table of the SR-type configuration of the 4013B

S	R	Q	Q^{I}
1	0	1	0
0	1	0	1
1	1	1	1
0	0	Qn	$Q^{I}n$

Qn and $Q^{1}n$ show indifferent condition.

3.2.5 7805 and 7812

The 78XX series are 1A positive voltage regulators. They are designed with self-protection from over heating through automatic shut-down. They operate with maximum supply voltage of 35V.

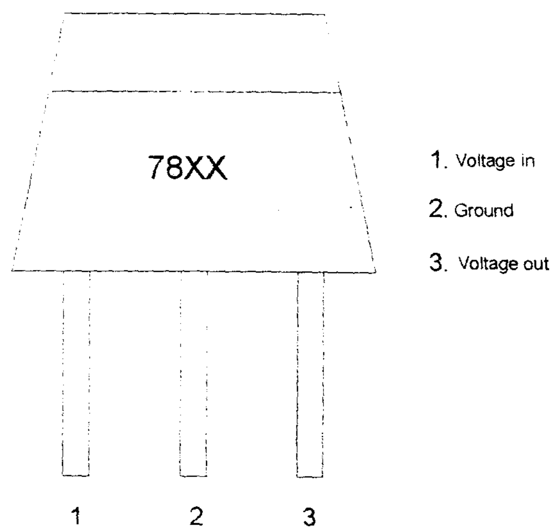


Fig 3.12 the pin configuration for 78XX series

3.2.6 2SC945

The 2SC945 is a NPN low power transistor which is designed for low frequency amplifiers and low speed switching applications. It has a typical current gain of 100. The total power dissipation is 250mV. It operates with maximum voltage of 50V across the collector-emitter junction. [16]

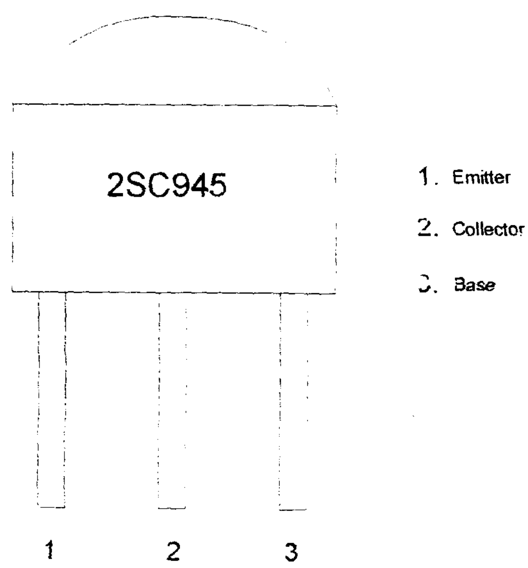


Fig 3.13 Pin configuration for the 2SC945

3.2.7 2SC930

The 2SC930 is a NPN epitaxial-planar silicon transistor for AM converter, FM RF, and intermediate frequency (IF) amplifier applications. It has a maximum power dissipation of 250mW. The maximum collector to emitter voltage is 20V. It has a typical hfe or current gain of 80. Its gain bandwidth product is typically 300 MHz. Therefore, it is quite suitable for FM band or very high frequency application. [18]

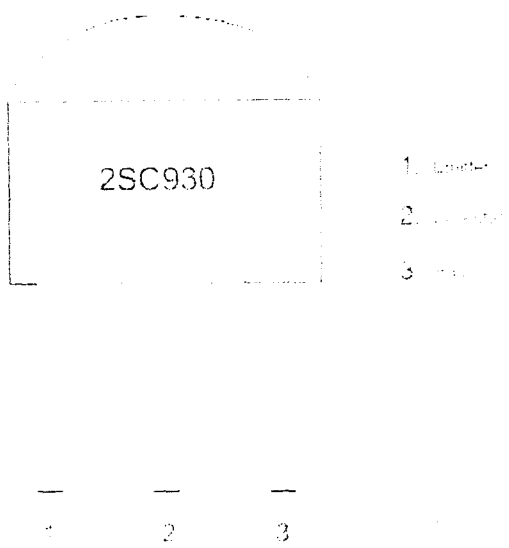


Fig 3.14 pin configuration for the 2SC930

3.2.8 2SD400

The 2SD400 is a NPN epitaxial planar silicon transistor low-frequency power amplifier and electronic governor applications. The collector to base voltage is 25V.

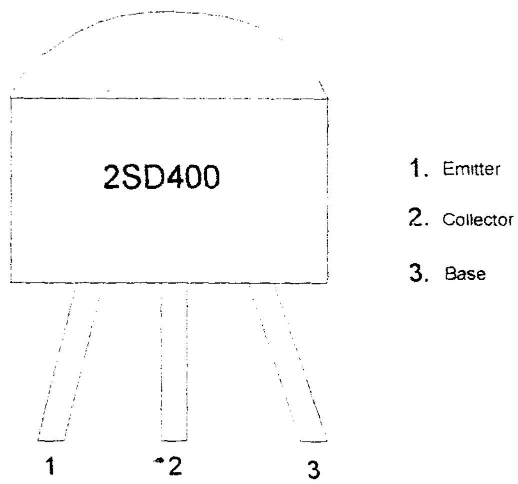


Fig 3.15 pin configuration for the 2SD400

Chapter Four

Construction, Testing, and Result

4.1 Circuit construction

The circuit construction involved the making of the circuit and its casing. The circuit diagram was a guide for the circuit construction. The first step was to divide or section the complete circuit into different units. Each unit was treated separately. The last step was to connect the complete circuit together.

The bulk of the circuit was performed on breadboard but the transmitter and the FM receiver units were done on the Vero board before all the components were finally transferred unto the Vero board. The breadboard layout was a reasonable base for testing the workability or performance of the circuit. Numerous adjustments were made on the circuit during the test.

After the success in the breadboard mounting, the involved electronic components were transferred to a suitable size Vero board. The next step involved the permanent coupling of the components in which intensive soldering took place.

The power unit was of great importance. It was the first to be connected on the board. It was carefully done to avoid short circuit or any form of wrong connection.

Coupling was done considering one unit at a time till all the units were connected together to form a complete circuit.

The following items were involved during the major construction:

1. Soldering iron
2. Soldering lead
3. Connecting wires
4. Glue

5. Vero board

6. Plier

7. Scissors

8. Cutting knife

9. File

4.2 Casing construction

The main casing involved a wooden platform for holding a CD-ROM drive, representing the gate, and a white rubber case for the main circuit. The size of the casing was chosen putting into consideration the size and the number of components involved. An outlet was made on the complete casing for access to certain components such as the switch. The receiver unit which is attached to a CD-ROM drive was further placed on a wooden board and covered round with cardboard to illustrate a wall around the gate.

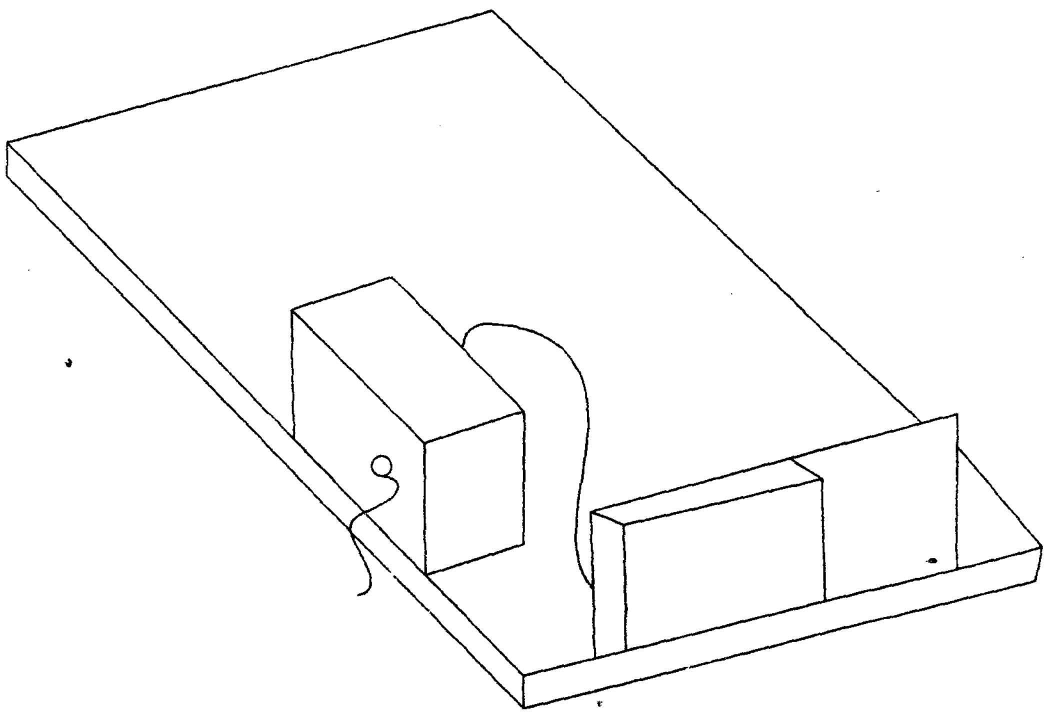


Fig. 4.1 Casing for the automatic gate controller system

4.3 Testing

The testing of the complete circuit was quite direct. Before anything, the circuit was checked for short circuit or any form of wrong connection. The device was plugged to the ac mains and a battery was fixed into the transmitter. The transmitter was brought close to the receiver and taken away and out observations were taken down. The necessary corrections were made and tested again. These tests were performed more than once. The corresponding observations were significant.

4.4 Result

The results of the tests were quite evident. When the receiver unit was plugged into the mains it was noticed that the CD-ROM would open which indicates a shut gate, this is supposed to be the stable state. This happened within a 0.6m range.

When the transmitter was brought near the CD-ROM it would close which indicates the open state of a gate and when it was taken away from the CD-ROM it would return to its stable state (shut gate).

Chapter Five

Conclusions and Recommendations

5.1 Conclusion

The automatic gate model is a device that provides easy and authorised access to a restricted area, home, or office. It can function even in low voltage situations due to the incorporated 240/24V transformer and functions with FM radio wave. The circuit is connected to an electromechanical device (CD-ROM) which opens or closes in response to a signal from the transmitter.

The major objective of the project revolves around providing a cost-effective means of controlled accessibility to the area in which the model will be in operation. This was achieved in the course of this project

5.2 Problems and solutions

Adjusting the transmitter to the frequency of the receiver was tasking. The model had to be tested far away from devices that emit waves as it would affect the operation of the circuit.

- The noise in the model circuit was at a harmful level so this was rectified by adding variable resistors to the output of the signal amplifier.

5.3 Recommendations

As always, every functional system has imperfections in its design, it is the duty of a design specialist to seek out these imperfections in order to improve the systems efficiency. As in the case of this project, certain aspects of the system design can be improved upon such as:

i. The use of a back-up battery could be incorporated.

ii. The circuit could be achieved with better and more compact integrated circuit technology.

iii. The project could be modified for real life scale and not just a model.

iv. The radio signal could be further digitalized and encrypted for security purposes.

v. The signal could be made to be set to a particular frequency at any time.

These suggestions made can improve the system functionality and value.

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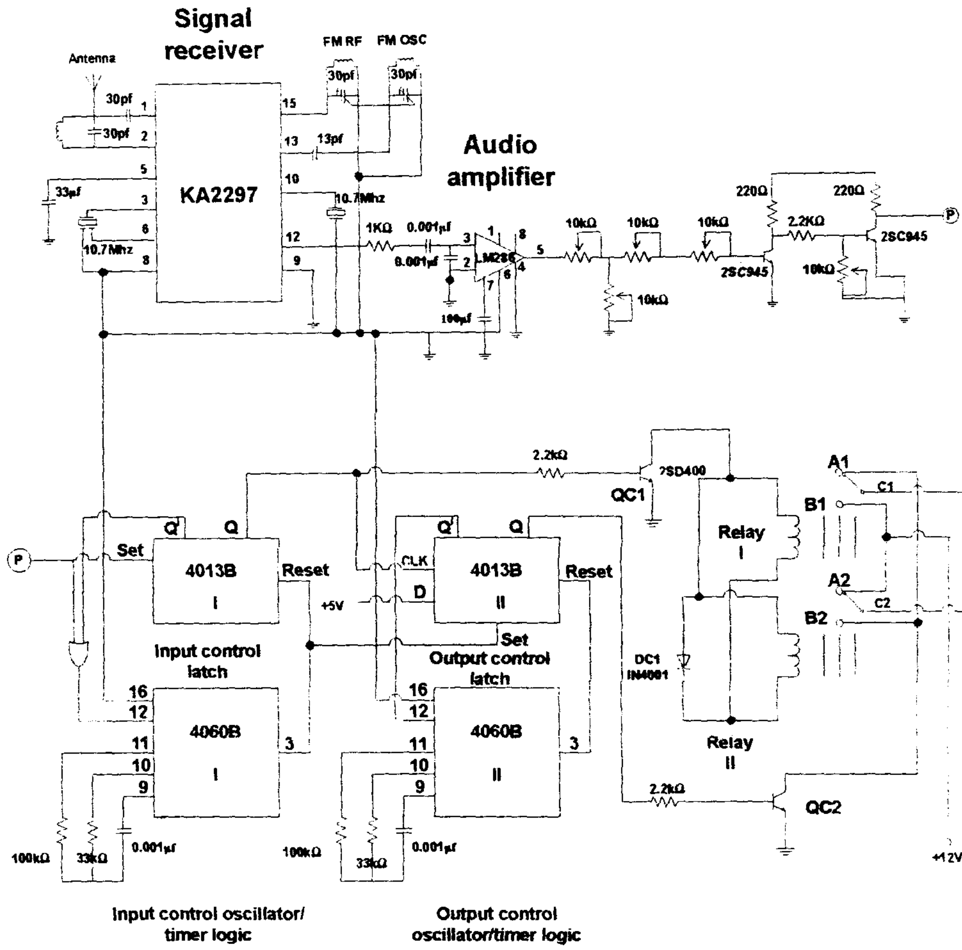
[18] www.datasheet.org.uk/search.php?q=2SC930+datasheet+$sType=part$ExactDs=star

[19] www.datasheet.org.uk/search.php?q=LM386+datasheet+$sType=part$ExactDs=starts

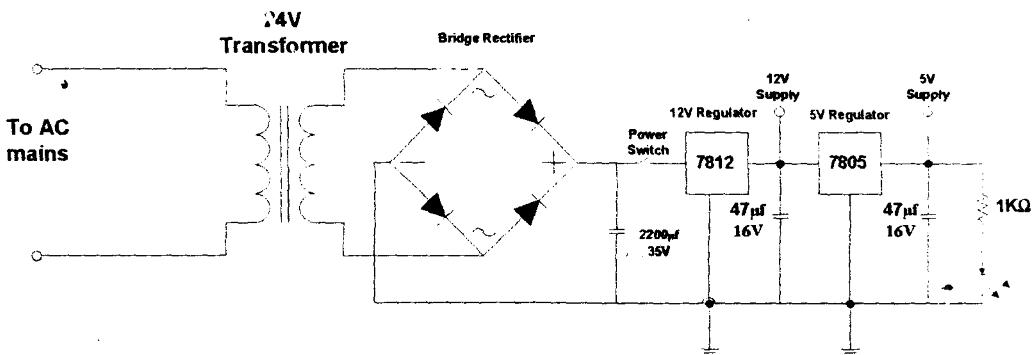
[20] www.datasheet.org.uk/search.php?q=4013B+datasheet+$sType=part$ExactDs=starts

[21] www.datasheet.org.uk/search.php?q=KA2297+datasheet+$sType=part$ExactDs=starts

Appendix 1



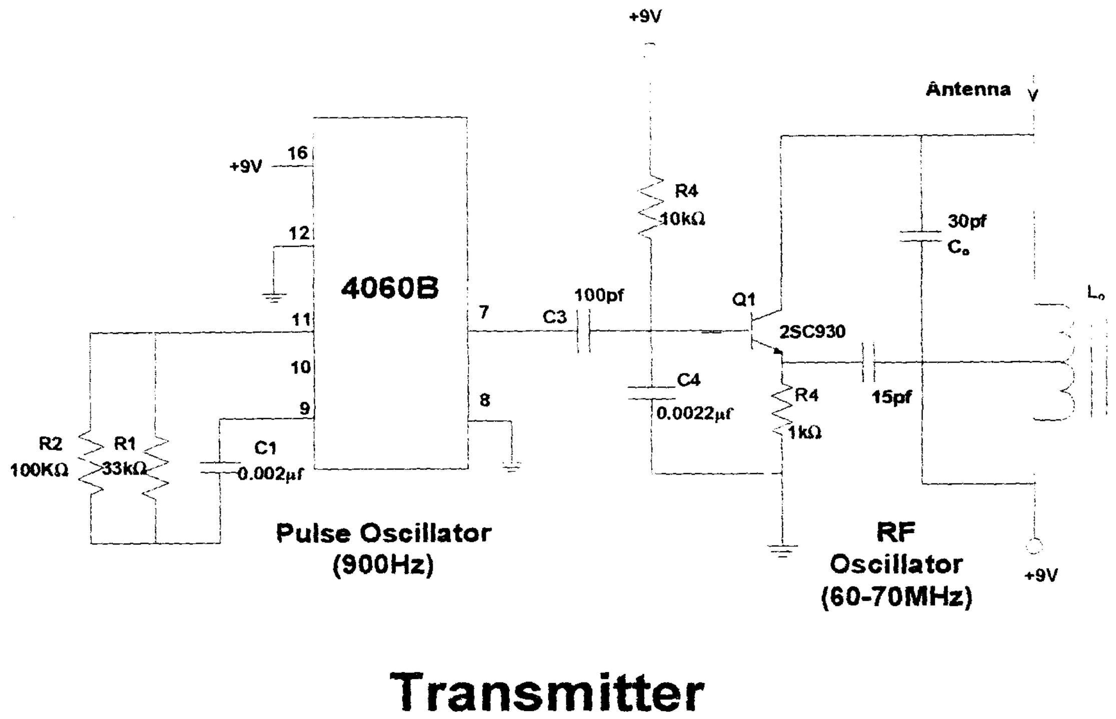
RECEIVER UNIT



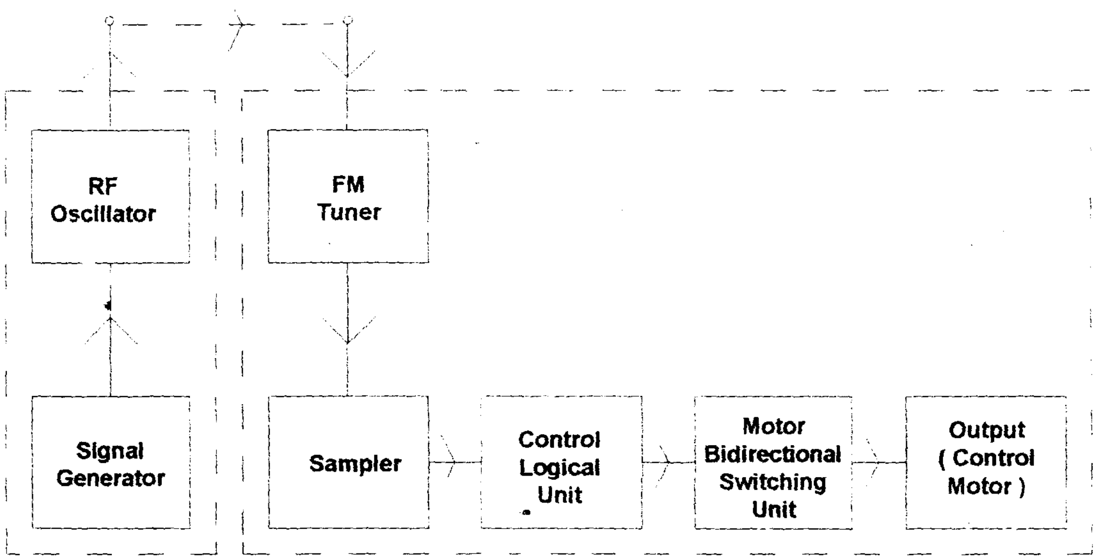
POWER UNIT

Fig 6.1 circuit diagram of the receiver and power units of the automatic gate model

Appendix 2



(a.)



(b.)

Fig 6.2 (a.)circuit diagram of the transmitter unit of the automatic gate model, (b.) block diagram of the working of the automatic gate model