REMOTE CONTROL CAR STARTER (RCCS)

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requirement for the awarded of the Degree of Bachelor of Electrical &
Electronic Engineering

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MAY 2006

"I hereby declare that I have read this thesis and in
my opinion this thesis is sufficient in terms of scope and
quality for the award of the Degree of
Bachelor of Electrical Engineering (Electronics)"

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Supervisor   : Mr. Badaruddin bin Muhammad

Date   : 2 MAY 2006

I declare that this thesis entitled "*Remote Control Car Starter (RCCS)* "
is the result of my own research except as cited
in the references. The thesis has not been accepted for any
degree and is not concurrently submitted in candidature of any other degree.

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Date   : 2 MAY 2006

To my beloved father and mother

who always give me moral support to finish this thesis.

Also, to those who gave guidance and inspiration for me throughout the journey of this project. Thank you for the supports and advices that have been given.

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First and foremost I want to thank God for blessing me with health and time so that I can finish my thesis completely.

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Lastly, I want to thank my parent who never gives up supporting me and believing in me in whatever I do. May God bless you all.

ABSTRAK

Projek ini adalah untuk mencipta penghidup kereta kawalan jauh. Kegunaan projek ini adalah untuk menghidupkan kereta dalam jarak jauh. Projek ini mengandungi dua bahagian yang penting iaitu bahagian pemancar dan penerima.Apabila isyarat dikesan pada pemancar, pemancar akan menghantar data ke pemproses mikro dan serentak akan menghidupkan enjin (melalui keluaran relay) Pemproses mikro yang digunakan dalam projek ini adalah jenis PIC16F84A.Dalam teknologi yang serba pantas pada masa ini, rekaan baru dicipta untuk membuat hidup lebih selesa. Sebagai contoh, cuaca yang dingin pada waktu pagi dan panas pada waktu tengahari, pemandu akan menghadapi masalah dalam menunggu kereta mereka untuk enjin dipanaskan serta untuk sejukkan bahagian dalaman. Antara sebab seperti untuk penyempurnaan dan megelak daripada enjin sejuk membawa kepada terciptanya sebuah projek yang dinamakan penghidup kawalan jauh ini.

ABSTRACT

This project is to develop a remote control car starter. The use of this project will be able to start the car remote in a distance range. This project consist two important parts which is transmitter and receiver. When a signal has been detected at the transmitter, the transmitter will send the data to microcontroller and thus bypass the connection in the car (output from relay). The microcontroller that has been used in this project is PIC16F84.Today's fast paced technological developments strive to make our lives comfortable. For example, with the low temperatures in morning and the hot temperatures in the afternoon, drivers suffer while waiting for their car to heat up or cool down. Other reasons such as proper operation and protection from freezing of the engine brought forth the development of the remote engine starter.

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LIST OF SYMBOLS

RCCS	-	Remote Control Car Starter
VDC	-	Direct Current Voltage
PCB	-	Planted Circuit Board
PIC	-	Programmable Integrated Circuit
LED	-	Light Emitter Diode
V	-	Volt
A	-	Ampere
I	-	Current
LF		Low Frequency
HF	-	High Frequency
MHZ	-	Mega Hertz
W	-	Watt
P	-	Power

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1   Background

In this chapter, it explains briefly on the background and system overview of this project. Also in this chapter it explains the objectives of the project, the scope of study and the thesis outline.

1.2   System Overview

The purpose of this project is to design and implement a remote car starter. This remote control engine starter will include three main components: A HF transmitter, a HF receiver and a PIC microcontroller. The system will start by generating a bit pattern from the transmitter module that will be serially inputted. The transmitter will then modulate the bit pattern so that the signal can be transmitted through the analog channel, namely air.

Estimating a goal to be around 10 meter, estimated that the signal would operate at a frequency of about 315MHZ. On the other side, a HF receiver will be able to pick up signals around the same frequency as the transmitter and it will

receive the modulated signal. Once the receiver obtains the signal, it will modulate the analog signal back into bit patterns where will then be sent to the receiver's module end the PT2272 will distinguish the correct signal from the incorrect signals such as noise and send signal to the PIC microcontroller to perform specific functions to start the car.

This project mainly is practical and useful. This project is related to engineering as well as applicable to something that can be related on a daily basis. This project combines both of main part in hardware and software.

This project will operate at least approximation of 10 meter of range. It is considered 10 meter because that a substantial distance is used so that it will be practical and possible for to implement. The design of this project is to perform as many tasks as possible so the device would be as close as possible to a real remote car starter. Such tasks included starting the car and stop after a timed of period. This will allow the car owner to manually stop the program.

The performance of this project will depend a great deal on the transmitter and the receiver and whether or not the signal can be sent from one to the other. The microcontroller chips will have no variables based on the program given, which means it can be considered a constant. The only variable is the transmission of the signal, which can be affected by noise in air as well as competing with other frequencies in laboratory area. This variable is needed to be minimized as much as possible.

1.3   Objectives

The objective of this project is to produce a system using remote control as main transmitter besides using PIC16F84 as the microcontroller. This project can be used as one of the main part of starting the car using a remote device.

The signal should be successfully transmitted from transmitter to the receiver and processed at the PIC controller board. The Relay board should take particular action to the car such as start and turn off the car engine.

1.4   Scope of Study

The scope of study covers the following areas:

a)   Remote system - the remote transmitting and receiving data that is used in this project is RF transmitter and receiver module. It will transmit 3 different channels of data. Each channel will react as different operation.

b)   Microcontroller - the microcontroller used is PIC16F84. The program will be uploaded to the PIC using software called MPlab programmer which enable the   program to be burn into the chip. Program format used is the assembly language and it will be in hex file.

c)   Power system - basic switching suggested for this project are 12V relays.

d)   Voltage regulator - the voltage regulator is used to step down the supply voltages from 12V to 5V because PIC microcontroller will operates in the range of 2V to 6V only.

e)   Car Wiring- the wiring should be done correctly without any error. This is to prevent   short circuit and losses at the power cable.

1.5   Thesis Outline

Chapter 1 explains the background of the project. In this chapter it explains briefly on the background and overview of this project. Also in this chapter it explains the objectives of the project, the scope of study and the thesis outline.

Chapter 2 will briefly explain on how the existing project works and operates with the theories. The existing project main function is similar to this project which is to start the engine of the car using the remote device but some different functions from are added on the Remote Control Car Starter (RCCS).

Chapter 3 will explain on the methodologies used for the project. It also focuses on the hardware and the software implementation of the project. The detail of car wiring connection for the project also explained in this chapter. This chapter will also focus on the user manual and the user safety precaution.

Chapter 4 will focus on the results and discussion on the RCCS project done. The results will be explained in tables and discussion will be discussed due to project implementation

Chapter 5 will focus on the conclusion for the RCCS project. It also will discuss on the suggestion that are needed for future development of this project.

CHAPTER 2

LITERATURE REVIEW

2.1   Introduction

In this chapter it will briefly explain on how the existing project works and operates with the theories. The existing project main function is similar which is to start the engine of the car using the remote device but some different functions from the Remote Control Car Starter (RCCS).

2.2   Internet

In today's market this device already has been market with different functionality. From the internet it is found out that a similar project which is named as keyless entry car starter and auto car starter have been in market. For the keyless entry car starter, it do not need key to start and drive the car and it only need a remote control device to start and drive the car. The remote seem to be much more complex with the LCD screen assembled on the remote device. This is the main reason of the higher and expensive price of the device. The LCD will show the current status of the car whether the engine is started or not. For the auto car starter device it comes with the alarm system. It will only function directly to the button pressed on the remote. Even though the engine car is already been started it will

repeat the starting process if the owner of the car press the start switch for the second time. This is the disadvantage of the system which it do not have safety for the system to disable the starting process of the engine to avoid crank on the engine. The price of this device still is higher than expected price of the system due the system includes the alarm system. The price of this system only can be reduced by excluding the alarm system from the system.

2.3 Accessories Shop

From the accessories shop, it is found out that the similar project is already been market. The theory of the system function is that is similar device found out in the internet which it only will start due to the switch on the remote is pressed. If the engine starting switch is pressed for the second time it will still start the car although the engine is already running. This is not safe for the car owner which it will produce crank on the engine of the car. This will also make the starter to cause breakdown. The lifespan of the engine would probably be shorter due to inadequate system installed on the car. This system should be improved by adding a feedback to the system which will disable the engine starting process which will only start the car once thus avoiding the crank on the engine.

2.4 System Theories

The main theory of the system is to start the engine by using the remote system. It is to solve the problem of the car owner comfort ability. Imagine if the car engine is cold and uncomfortable to be driven in the early morning, this will be the solution which it will heat up the engine without needing the owner to be in the car. It is simpler to say that the system operates in the range of distance which will not need the owner to get into the car. The theories should also follow the step of the

system functions. First it will need the remote and receiver to operate the system which the transmitter will transmit data and the receiver will receive data and the data received should operate the system as expected results.

From the receiver it will be connected to the chip of the controller which will control the functions needed on the car. This will be connected to the car existing wiring. If the connection are correctly connected to the car existing wiring, it will function as same as the car switch is being turned-on during the ignition of the engine process is done with the key enters the key hole. But with this system, it do not need the car key to enter the main switch of the car. It only needs to receive a signal from the remote device to tell the car to start by its own.

CHAPTER 3

HARDWARE AND SOFTWARE
IMPLEMENTATION

3.1   Introduction

This chapter will explain on the methodologies used for the project. It also focuses on the hardware and the software implementation of the project. The detail of car wiring connection for the project also explained in this chapter. This chapter will also focus on the user manual and the user safety precaution.

3.2   Block Diagram

From the block diagram in figure 3.2.1 shows how the remote engine starter system flows. All connection is made according to the above block diagram. From the car engine the wiring are connected to the air conditioner and the starter motor and many other parts such as the alternator, the distributor and many other lamp wiring. It needs to be focus on the starter motor and the air conditioner. The starter motor and the air conditioner are then connected to the Fuse Box for the components safety and finally connected to the Computer Box of the car before each switches of the operation. It will bypass the air conditioner at its air conditioner switch directly but for the starter it has to be bypass at the main key switch.

The signal from the RF transmitter module will be transmitted to the RF receiver module. When the receiver received the signal, the signal will be processed at the PIC controller board. The relay board after the controller board functions as the safety board which will cut-off current flow through the connection to the controller board. The controller board will separate each signals into channels. Each channel has different function for the car. For the time being, it will separate into two channels which is to start the car and to on and off the air conditioner. The system will bypass directly the air conditioner switch which will be either in the normally closed when the system needs to turn on the air conditioner and normally open when it want to switch off the air conditioner.
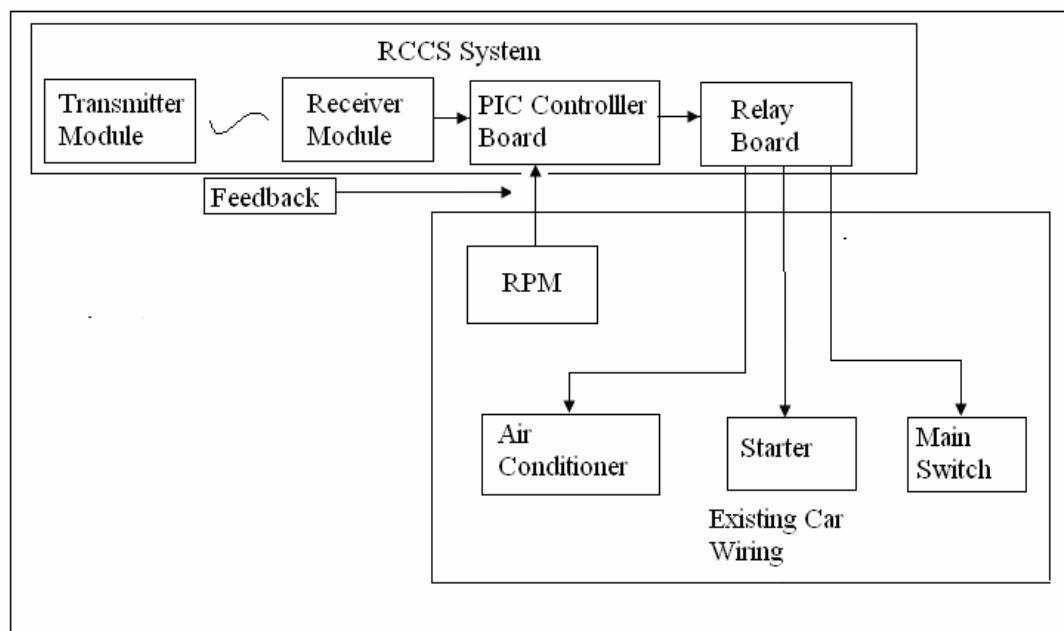
Figure 3.2.1   The Operation Block Diagram with Feedback

3.3   PIC Configuration

Figure 3.3(a) show the pin configuration for PIC16F84A. It consist of two ports which are Port A and Port B .Port A are located at pin no1, 2, 3, 17 and 18. Port B is located at pin number 6, 7, 8, 9, 10, 11, 12 and 13. The ports are bidirectional where it can be initialized as input port or output port. This will depend on the programming. Commonly for assembly language it will equate the ports at the storage register.
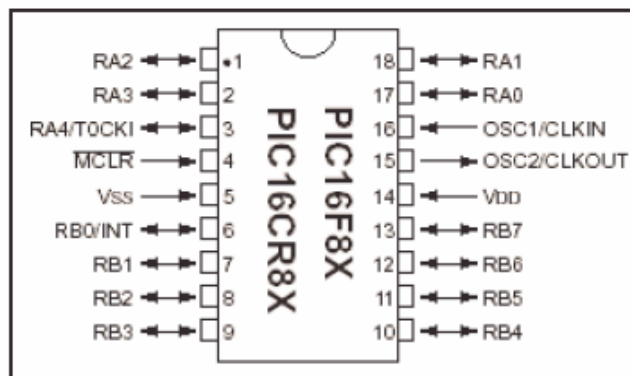
Figure 3.3(a) Pin Configuration

3.3.1   The PIC16F84A

PIC is the name for the microchip microcontroller (MCU) family, consisting of a microprocessor, input/output ports, timers and other internal, integrated hardware. The main advantages of using the PIC are low external part count, a wide range of chip sizes (now from 5-pin up) available, nice choice of compilers (assembly, C, BASIC, etc.) good wealth of example/tutorial source code and easy programming. Once bought, the PIC's program memory is empty, and needs to be programmed with code (usually HEX files) to be usable in a circuit. For the purpose,

a wide range of simple programmer hardware docs and software is downloadable from the net.

In figure 3.1.2 it show the PIC16F84 microcontroller chip pin configuration. This microcontroller is used in the remote control car starter to read data from the receiver module. The outputs from the receiver module can be connected to any of the RB0-RB7 ports. If any of the inputs is a high (5V supplied from receiver) the output from the PIC will be on port A which is RA0-RA3. It will output a high of +5V, which will then be connected to relay board. The relay will toggle the switch of each function.

3.3.2   PIC16F84A Architecture

A microcontroller is an inexpensive single chip computer. Single chip computer means that the entire computer system lies within the confines of the integrated circuit chip. The microcontroller is capable of storing and running a program. The microcontroller ability to store and run unique programs makes it extremely versatile. The microcontroller ability to perform math and logic function allows it to mimic sophisticated logic and electronic circuits. It contain a CPU,RAM(random access memory),ROM(read only memory),I/O(input/output lines)serial and parallel port, timers and sometimes other built in peripheral such as A/D(analog to digital) and D/A(digital / analog) converter. The microcontroller used in this project is microcontroller chips called PIC. The PIC16F84A belongs to the mid-range family of the PIC microcontroller devices. The program memory contains 1K words, which translates to 1024 instructions, since each 14-bit program memory word is the same width as each device instruction. The data memory (RAM) contains 68 bytes. Data EEPROM is 64 bytes .There is also 13 I/O pins that are user-configured on a pin-to-pin basis.

The PIC chips have two separate 'data' busses, one for instructions and one for everything else. Instructions are essentially in ROM and dedicate the microcontroller to doing one task. Then there is one series that is of special interest to the hobbyist, the 16F84, chips which have electrically reprogrammable EEPROM memory for instructions. A block diagram of PIC16F84 is shown in figure3.3.2 (a):
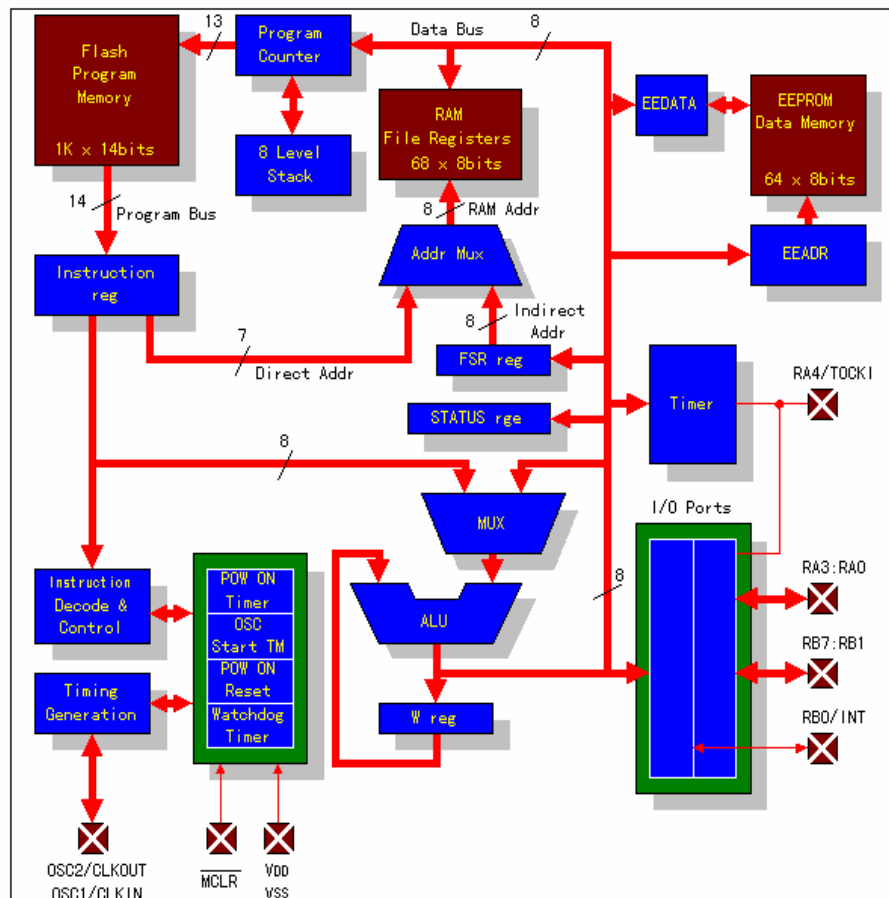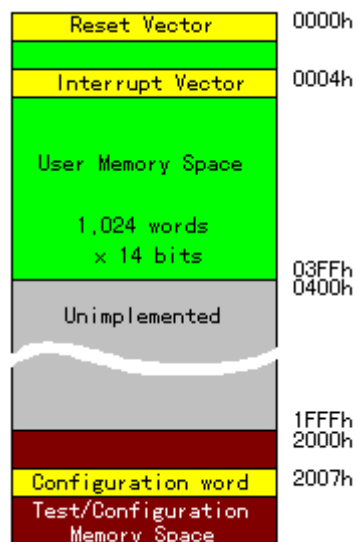

Figure 3.3.2(a) PIC Architecture

3.3.3 Flash Program Memory

Flash memory is used to store the program. One word is 14 bit long and 1024 word (1k word) can be stored. Even if the power is switched off the contents of the flash will not be lost. Flash memory can be written using the writer, but the number of times it be rewritten is limited to 1000 times. Figure 3.1.2(a) show the detail of flash memory register

Figure 3.1.2(a) Flash Memory

3.3.4 PIC Address Register

The PIC microcontroller used a Harvard architecture, which means that the memory is divided into program memory and data memory. The advantage to this architecture is that both memories can be accessed during the same clock instruction; this makes it faster than the standard Von Neumann architecture, which uses single memory for program and data. User program memory space extends from 0x0000h to 0x033FFh, accessing a memory space above 03FFh will cause a wrap around to

the beginning of the memory space. Figure 3.3.4 (a) show the register map. This memory is partitioned into two space called banks. The interrupt vector is shown at FSR 04h. Upon an interrupt, the return address is saved and the program execution continues at the return address previously saved

Figure 3.3.4 (a) PIC Register Map

3.3.5   PIC Controller Circuit Diagram

Figure 3.3.5 (a) shows the PIC Controller Circuit Diagram. It uses the Orcad PSpice to draw the circuit. This circuit acts as the main brain of the RCCS system. This is very important to make sure that this part operates appropriately. The LED on this circuit indicates the signal is transmitted to the PIC. It consists of five LEDs but in real simulation it only uses three LED. Each LED represents each channel for the system. This circuit only uses 3 channels for receive and transmit.
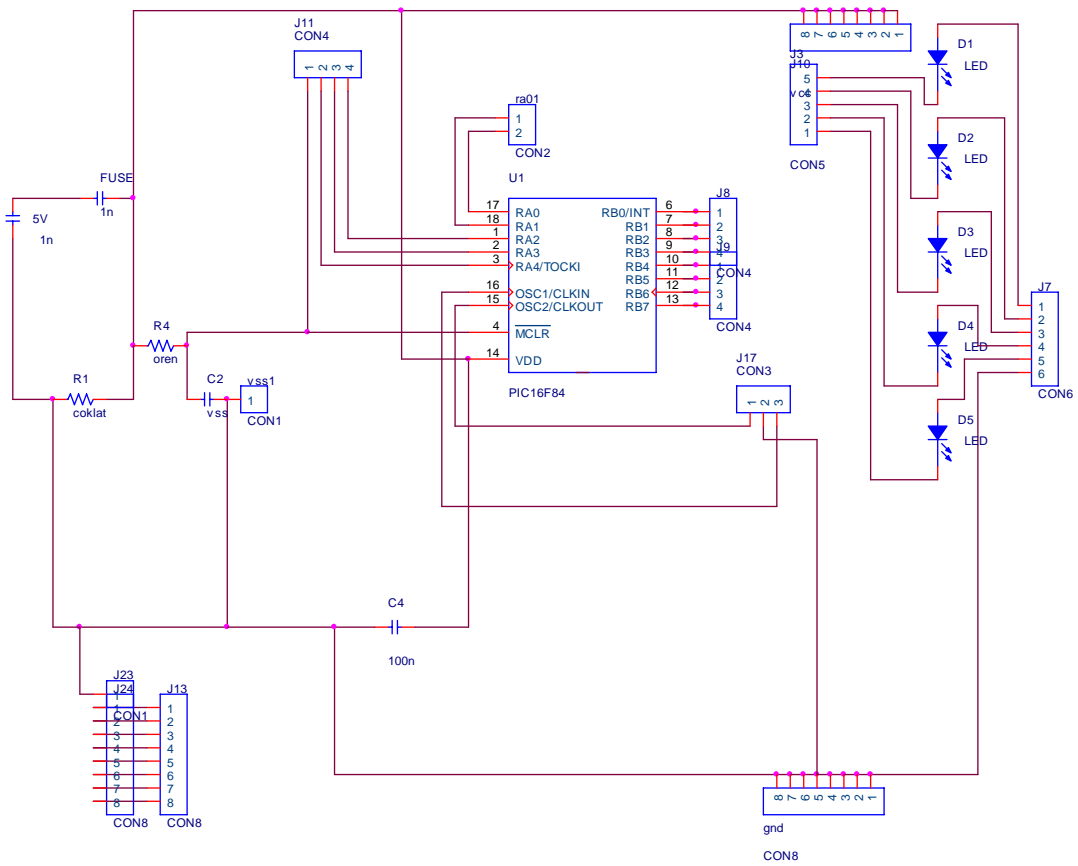
Figure 3.3.5 (a)   PIC Controller Circuit Diagram

3.4   Plotting the PCB board

In this section, the plotter is used to design the circuit on the PCB. The most usual problem that is discovered if using the plotter is that the bit was very sensitive. The 0.2mm plotter bit is used to plot the circuit design on the PCB. After plotting it will put off the entire unwanted layer on the PCB with the 1.0mm plotter bit. After the entire part was put off it will drill the unplanted part. The drilling procedures will need the 0.8mm drill bit. It will drill all the unplanted part.

3.5   Relay Board Circuit Diagram

Figure 3.5.1 show the circuit of the basic switching method. In the basic switching method of the relay, the relay need transistor as the main switch to energized it. The transistor reacts as to ground the connection of the relay while maintaining the current flow through the transistor. The transistors used are the NPN type.
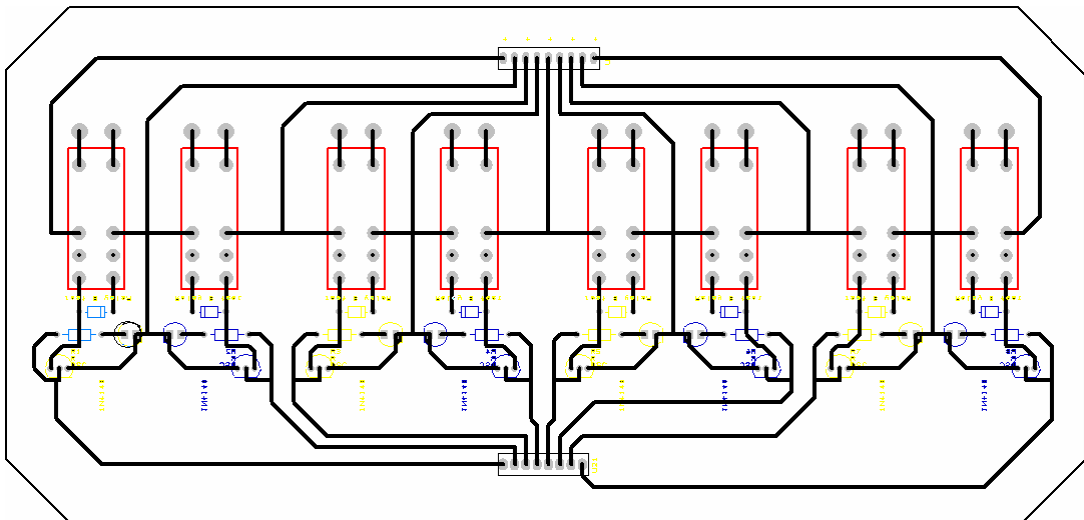
Figure 3.5.1   Relay Circuit Diagram

3.6   Voltage Regulator

In this project, it uses the LM78L05 Voltage Regulator to buck the voltage from 12VDC to 5VDC. The Voltage Regulator was used due to some device needs operation in 5VDC. The voltage regulator LM78L05 version is used in this project The reason why it used the voltage regulator was that it only need one main voltage supply input from the car. As the car battery only operated as 12VDC. Due to 12VDC, it needs to buck the voltage supplied to 5VDC. Refer to figure 5 in appendices for the real photo taken on the Voltage Regulator.

3.6.1 General Description of LM78L05

The LM78LXX series of three terminal positive regulators is available with several fixed output voltages making them useful in a wide range of applications. When used as a zener diode/resistor combination replacement, the LM78LXX usually results in an effective output impedance improvement of two orders of magnitude, and lower quiescent current. These regulators can provide local on card regulation, eliminating the distribution problems associated with single point regulation.

The voltages available allow the LM78LXX to be used in logic systems, instrumentation, HiFi, and other solid state electronic equipment. The LM78LXX is available in the plastic TO-92 (Z) package, the plastic SO-8 (M) package and a chip sized package (8-Bump micro SMD) using National's micro SMD package technology.

With adequate heat sinking the regulator can deliver 100 Ma output current. Current limiting is included to limit the peak output current to a safe value. Safe area protection for the output transistors is provided to limit internal power dissipation. If internal power dissipation becomes too high for the heat sinking provided, the thermal shutdown circuit takes over preventing the IC from overheating.

3.6.2 Features of LM78L05:

    i.   LM78L05 in micro SMD package Output voltage tolerances of ±5% over the temperature range

    ii.   Output current of 100 Ma

    iii.   Internal thermal overload protection

    iv.   Output transistor safe area protection

    v.   Internal short circuit current limit

    vi.   Available in plastic TO-92 and plastic SO-8 low profile packages

vii.   No external components

viii.   Output voltages of 5.0V, 6.2V, 8.2V, 9.0V, 12V, 15V

Table 3.6.3   Voltage Regulator Power Dissipation

Power Dissipation	Internally Limited
Input Voltage	35V
Storage Temperature	−65°C to +150°C

Table 3.6.4   Operating Junction Temperature

SO-8	0°C to 125°C
micro SMD	−40°C to 85°C

Table 3.6.5 Soldering Information

Infrared or Convection	(20 sec.) 235°C
Wave Soldering (10 sec.)	260°C (lead time)
ESD Susceptibility (Note 2) 1Kv	

3.6.3   LM78L05 Electrical Characteristics

Limits in standard typeface are for TJ = 25°C, Bold typeface applies over 0°C to 125°C for SO-8 package and −40°C to 85°C for micro SMD package. Limits are guaranteed by production testing or correlation techniques using standard Statistical Quality Control (SQC) methods.

Unless otherwise specified: IO= 40 mA, CI = 0.33 μF, CO = 0.1 μF.

3.7   Air Conditioner Wiring

The figure 3.7.1 show how the connection of the air conditioner is done. Firstly, this is how and where the wiring of the air conditioner is done. It should be tested using the multi meter. The purpose of testing with the multi meter is to identify which wires need to be bypassed at the switch.

There are two main devices that will be turned on during the switch-on air conditioner operation. So the wiring needs to be connected in pairs to two single relays in the RCCS. It needs two different relays because it will turn on two different devices which the pair of wiring should not be connected together. The two devices are the air conditioner fan and the compressor of the air conditioner. Both relays will energize during the operation of turning on the air conditioner. At the same time it will turn on the air conditioner. It will allow current to flow through and the air conditioner will be turned on. Figure 7.3.1 shows how the complete connection of the air conditioner. With this connection one channel is complete and ready to operate.
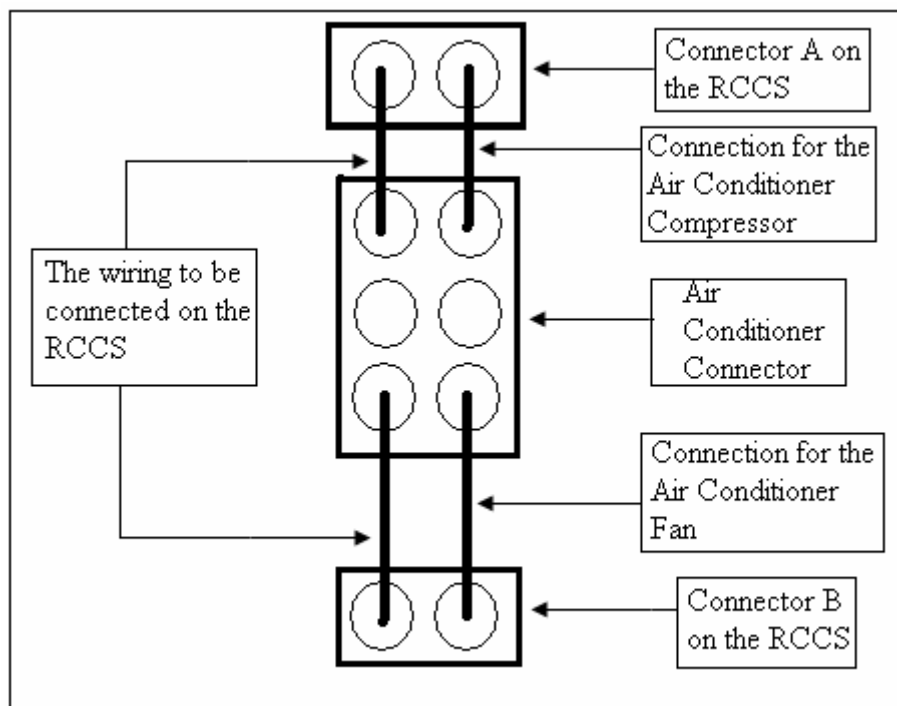
Figure 3.7.1   Air Conditioner Connection

3.8   The Feedback Wiring

Figure 3.8.1 show how the connection of the car feedback wiring needs to be done. It is important to test by using multi-meter on the functionality of the feedback. This feedback wiring must be connected to the RPM meter. The testing must be done to check whether voltage supplied varied during the running of the engine and during the engine is stop. From the RCCS it needs zero voltage supplied during the engine is off and it needs 12 volt supply from the feedback during the car engine is started. This variable voltage is obtained from the existing car wiring. The 12 volt supply will be then converted to 5 volt through the voltage regulator. This step is done to make sure that only 5 volt output will be supplied to the PIC input pin. The program of the system will be executed due to the feedback responses.
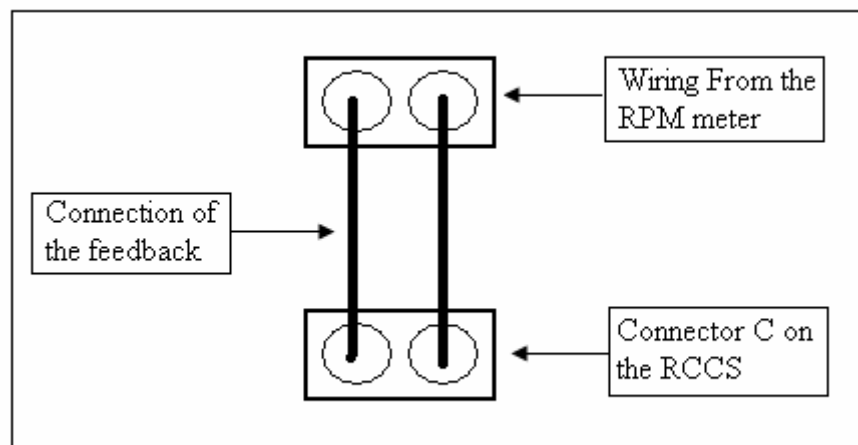

Figure 3.8.1   Feedback Connection

3.9   Main Switch Wiring

This part is the most important part of the RCCS system wiring. Refer to figure 3.9.1 for the connections of the main switch wiring. It needs to be done correctly and carefully due to prevent from error and losses. It needs to be tested independently on each of the function of the existing car switch. The testing should be considered on during the main switch turns on, during the accessories switch turns on and during the starter switch turns on. All this is tested using the multimeter. User has to make sure that it is done correctly with the accepted wire size. The wire size needs to be at least 3 Ampere maximum current flow that can be flow through it. This is to prevent from high losses during the operation of the RCCS system.

If small wire size is used and the current flow of the wiring exceeds maximum current of the wire provided, high losses will occur and respectively make the wire to burn up. So this have to be considered as the safety precaution step needed to be followed by the user of this system. From the figure, it shows how the real connection of the RCCS system. There is 12 volt supply wire that is connected in the existing car wiring. This 12 volt supply needs to be shared for the main car switch, the accessories switch and the car starter switch. Every pair of the switching is independently connected to different relays. This is due to every switch needed to be switch on independently. Every pair of connection is connected to the normally open at the relays.

As the relay energized, it will turn on to normally closed and switch on the connection connected to it. For this part the system needs three different relays to operate the system. The first relay needed for turning on the main switch. The second relay needed to turn on the accessories switch and the third relay needed to turn on the car started switch. The car starter relay will be disabled if car feedback is obtained from the RPM wiring. For this part, it requires two different channels for system operation. One channel is needed to turn on the main switch and the accessories switch and the second channel needed to turn on the starter switch.
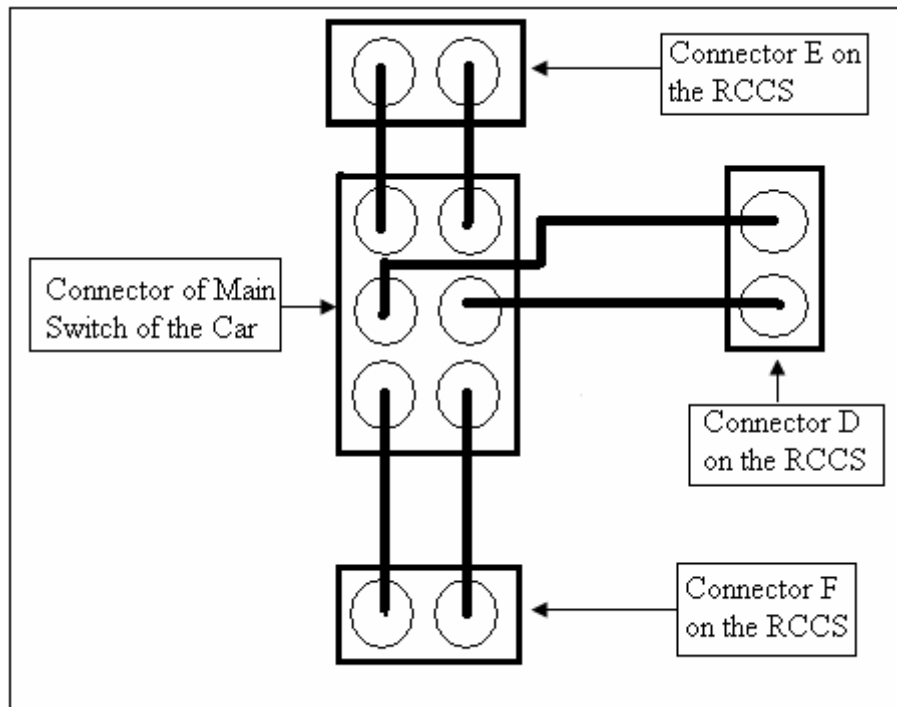
Figure 3.9.1   Main Switch Connection

3.10   Users Guide

This device is a programmed device which will allow users to communicate with car using the remote controller. It is divided into four main switches. Only three switches are usable which are the Button A switch, Button B switch and Button C switch. This is known as different channels used where every switches have it own operation. (Refer to appendix A in appendices)

For Channel A, which is the Button A switch, it will operate as to switch on the main power of the car switch. It will toggle between each time it is push on. The car main power will turn on when the Channel A button is pressed and the main power of the car will turn of when the Channel Button A is pressed for the second time. At this period, the car engine is not started.

For Channel B, which is the Button B switch, it will operate as to turn on the ignition for the starter. For Channel B it is important to make sure that the feedback

wiring for the car is correctly connected as stated in sub-chapter 7.4. The feedback is important because it will disable the starter to repeat starting process if the car already started. This is for the safety of starter motor and battery saving mode. With correct feedback connection, the system of RCCS will react intelligently as not produce engine crank (unwanted noise which occurred between the rotor of the engine starter motor).

For channel C, it will turn on the air conditioner. It will toggle on and off each time the button C is pressed.

3.11   User Safety Precaution

Users must follow the safety precaution to prevent from error or breakdown of the RCCS system. The safety precaution should also be followed by users to prevent from breakdown of the existing car wiring.

The first safety precaution is to make sure that the size of wire used to connect the wiring of RCCS to the existing car wiring is correct size. This is due to power losses occur during the transmission of the current source. If excessive power losses occurred the losses will produce heat which will end up the wiring to burn down. So make sure that the wire used is capable to maintain current flow up to 3 Ampere. The maximum current flow is 1.2A for the car motor starter. For the main switch and air conditioner, the current flow only 0.5 ampere.

Make sure that the feedback of the RCCS system is connected correctly to the Car Existing Wiring. This is to make sure that the program flows are correctly runs as programmed in the system of RCCS.

Always make sure that the grounding of the car wiring exists. This can be done by checking with the multi-meter. To do so, user need to test the connection of main ground supply (negative terminal of car battery) with the car body. If there are

no connections, connect a 5mm wire cable from the negative terminal of car battery to car body. This step is to make sure that system breakdown will not happen to the system.

Always check the negative and positive terminal of the wire cable is connected correctly. Also check the fuse functionality. Turn off the RCCS system after inserting the car key. This is for the purpose to maintain the existing air conditioner switch function.

The RCCS system only will operate in the 20 meters range of distance. So it will not operate if the user pressed button in further than the range stated.

3.12   Software Implementation

Refer to appendix P for main program for the RCCS system. Basically, there is a program involved in this project and the program language used is assembly language.

The program is the main brain of this project. This program is written to enable the system to recognize a correct signal and output to the car system. Ports are also configured to enable to recognize feedback from the car system and interrupts are also enabled. For example, my program would be able to cut off power to the car system if the stop button is pressed without the key inserted into the car. In addition, my device would be able to time the program appropriately based on whether if the car's engine has been started successfully or not.

Timers are used to time the process of the microcontroller and counters are used to keep track of the number of attempts at starting the engine. For example, the device would only attempt to start the engine twice before it fails.