WIRELESS HELICOPTER CONTROL USING PC FOR SURVEILLANCE

A PROJECT REPORT   P- 2325

Submitted by

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BONAFIDE CERTIFICATE

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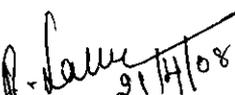
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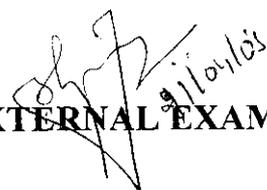
EXTERNAL EXAMINER

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"WE DEDICATE THIS PROJECT TO OUR PARENTS, FACULTY
MEMBERS, FRIENDS AND ALL THE GREAT MINDS
WHO HAVE INSPIRED US...."

ABSTRACT

The main aim of the project is to control a wireless helicopter using a PC. A camera connected to the helicopter helps in finding out the location where the helicopter is currently flying.

Radio controlled aircraft has been popular for recreational purposes for a number of years. Recently, however, it has been realized that radio controlled pilotless helicopters may be used for a wide variety of functional purposes. In case of natural disaster like earthquake, a wireless helicopter will be very effective for surveying the site and environment in dangerous area or narrow space, where human cannot access safely. In addition, it will be a help to prevent secondary disaster. This is possible because the radio controlled helicopter can be operated at a very low altitude close to the ground without danger.

The PC is connected to the RF transmitter for wireless transmission. The helicopter blade rotor speed and direction are controlled by the helicopter remote which is connected to the RF receiver which acts according to the RF signal from the transmitter. The RF receiver is connected to a microcontroller which activates the relays according to the input from the RF transmitter. A wireless camera is connected on the helicopter body which transmits the captured picture through wireless communication to the PC. In PC we monitor the situation in that place.

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INTRODUCTION

CHAPTER 1

INTRODUCTION

1.1 BRIEF OVERVIEW

Humans are fascinated by levitation. The reason is probably that the world we are living in is three-dimensional. However, human beings live and move mainly in two dimensions. It seems that humans have a very strong drive to overcome their biological limits. This means, they build machines that enable them to move in three-dimensional space, e.g., airplanes.

These machines are not restricted to living in two dimensions. It seems that a small machine which can fly autonomously appropriates to investigation of the atmosphere under environments that nobody can exist, or regions that nuclear pollution and biohazard are generated, or other critical situations. Because no matter how complicated the geographical feature is, it doesn't become a trouble if it flies in the air. What's more, it is possible to use it even in a considerably severe region. It doesn't only act alone, but also can be assumed that tens of or hundreds of helicopters are sent all together to complete a wide-ranging investigation. And the research of such a wireless flying device which is possible to fly freely even in a narrow area and can vertical take-off and landing, is very popular.

1.2 BLOCK DIAGRAM
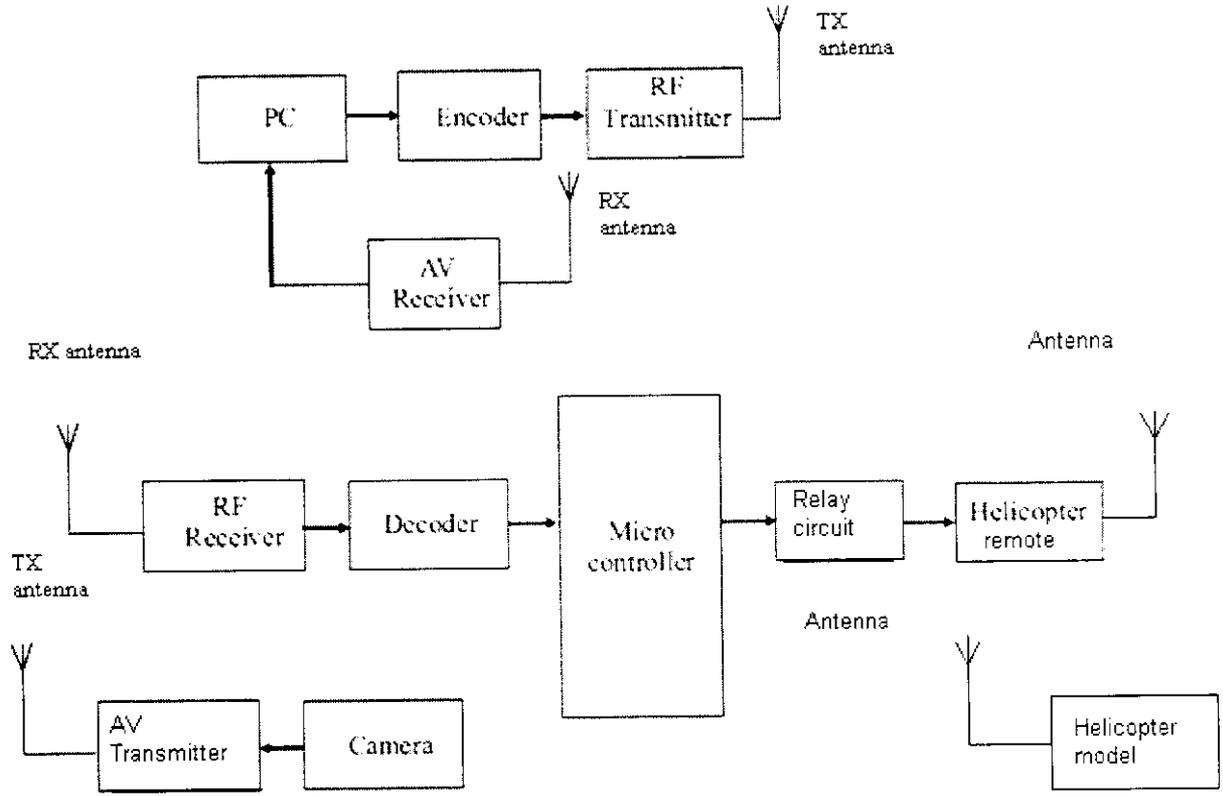
Fig 1.2.1 BLOCK DIAGRAM

RF TRANSMITTER

CHAPTER 2

RF TRANSMITTER

3.1 DESCRIPTION:

When ever the high output pulse is given to base of the transistor BF 494, the transistor is conducting so tank circuit is oscillated. The tank circuit consists of L2 and C4 generating 433 MHz carrier signal. Then the modulated signal is given to LC filter section. After the filtration the RF modulated signal is transmitted through antenna.

CIRCUIT DIAGRAM
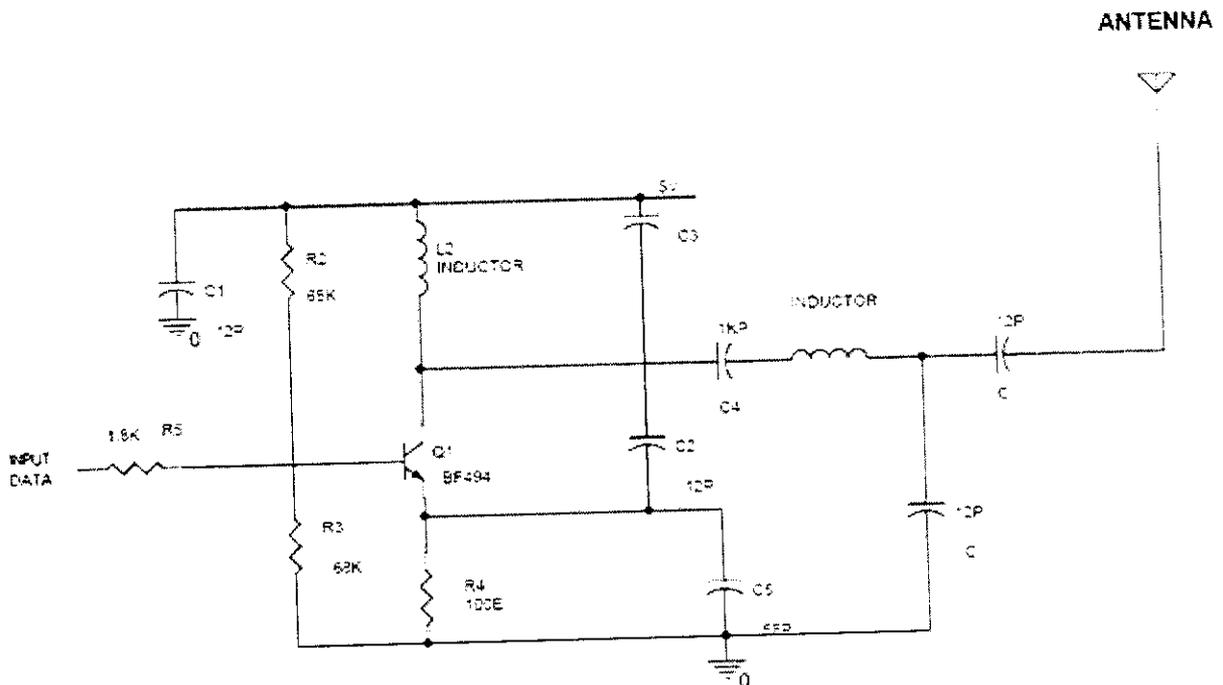
Fig 2.1.1 RF TRANSMITTER

The image of RF transmitter is shown in the figure below

GND DATA VCC ANT

Fig 2.1.2 PIN DIAGRAM-RF TRANSMITTER

2.2 SPECIFICATIONS

➢ Frequency Range: 433.92MHz

➢ Modulation Mode: ASK

➢ Data Rate: 8Kbps

➢ Supply Voltage:5V

➢ Voltage: 5V; Current:8.4mA

➢ Power Supply and All Input /Output Pins: -0.3 to 12.0 V

- ➤ Non-Operating Case Temperature: -10 to 85 centigrade

- ➤ Soldering Temperature: 230 centigrade(10 Seconds)

- ➤ High Sensitivity Passive Design

2.3 ELECTRICAL CHARACTERISTICS OF RF TRANSMITTER

Parameter	Sym.	Min.	Typ.	Max.	Unit
Operating Frequency (200KHz)	Vcc		433.92		MHz
Data Rate	ASK			8K	Kbps
Transmitter Performance(OOK@2.4kbps)					
Peak Input Current.12 Vdc Supply	ITP			45	mA
Peak Output Power	PO		10		mW
Turn On/ Turn Off Time	T ON/T OFF			1	US
Power Supply Voltage Range	Vcc	3		12	VDC
Operating Ambient Temperature	TA	-20		+85	centigrade
Tx Antenna Out (3V) +2.4dB	Vcc				mA

Table 2.3.1 ELECTRICAL CHARACTERISTICS

ABSOLUTE MAXIMUM RATINGS

Rating	Value	Unit
Power Supply and All Input/Output Pins	-0.3 to -12.0	V
Non-Operating Case Temperature	-20 to -85	centigrade
Soldering Temperature (10 seconds)	230	centigrade

Table 2.3.2 ABSOLUTE MAXIMUM RATINGS

RF RECEIVER

CHAPTER 3

RF RECEIVER

3.1 DESCRIPTION

The RF receiver is used to receive the encoded data which is transmitted by the RF transmitter. Then the received data is given to transistor which acts as an amplifier. Then the amplified signal is given to carrier demodulator section in which transistor Q1 conducts depending on the signal.

CIRCUIT DIAGRAM
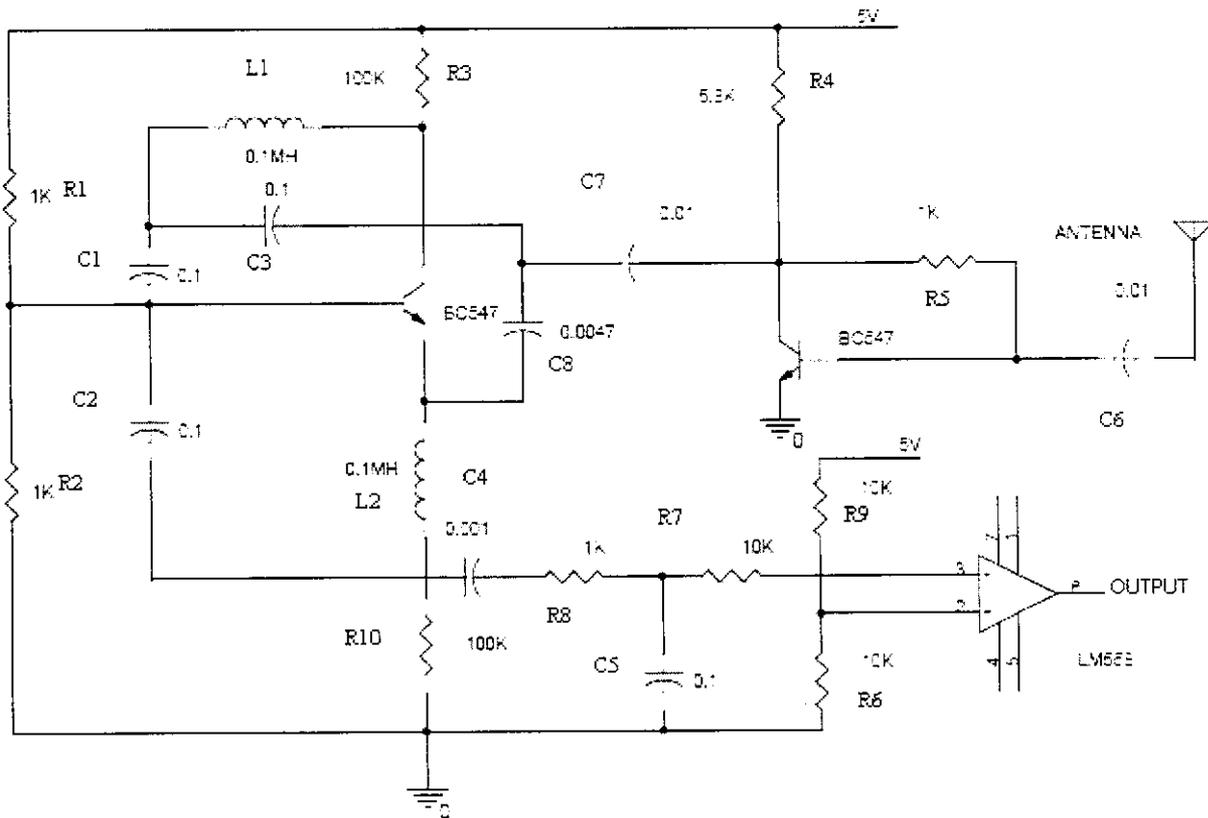
Fig 3.1.1 RF RECEIVER

Due to this the capacitor C5 is charged and discharged so carrier signal is removed and saw tooth signal appears across the capacitor. Then this saw tooth signal is given to comparator. The comparator circuit is constructed by LM558. The comparator is used to convert the saw tooth signal to exact square pulse. Then the encoded signal is given to decoder in order to get the decoded original signal.

The image of RF receiver is shown in the Figure below

Fig 3.1.2 PIN DIAGRAM-RF RECEIVER

3.2 SPECIFICATIONS

> Frequency Range: 433.92MHz

> Modulation Mode: ASK

> Data Rate: 4800bps

> High Sensitivity Passive Design

> Supply Voltage:5V

> Channel spacing: +/- 500KHz

> Sensitivity: -106 dBm

3.3 DC CHARACTERISTICS OF RF RECEIVER

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Vcc	Operating Supply Voltage		4.9	5	5.1	
I Tot	Operating Supply Voltage			4.5		
V Data	Data Out	1 Data = +200 uA (High)	Vcc -0.5	Vcc		V
		1 Data = -10 uA (Low)			0.3	V

Table 3.3.1 DC CHARACTERISTICS

ELECTRICAL CHARACTERISTICS OF RF RECEIVER

Parameter	Sym.	Min.	Typ.	Max.	Unit
Operating Radio Frequency	FC		433.92		MHz
Sensitivity	Pref.		-108		dBm
Channel Width		-500		+500	KHz
Noise Equivalent BW	NEB		5	4	KHz
Baseboard Data Rate			3	KB/S	
Receiver Turn On Time				3	ms

Table 3.3.2 ELECTRICAL CHARACTERISTICS

ENCODER

CHAPTER 4

ENCODER

4.1 DESCRIPTION

The encoders are used to convert 2^N input lines into N output lines. This is mainly done to reduce the number of bits during transmission.

U1

Fig 4.1.1 ENCODER

In this circuit HT 640 is used as encoder. The 3^{18} encoders are a series of CMOS LSIs for remote control system application. They are capable of encoding 18 bits of information which consists of N address bit and 18-N data bits. Each address/data input is externally trinary programmable if bonded out. It is otherwise

set floating internally. Various packages of the 3^{18} encoders offer flexible combination of programmable address/data is transmitted together with the header bits via an RF or an infrared transmission medium upon receipt of a trigger signal. The capability to select a TE trigger type further enhances the application flexibility of the 3^{18} series of encoders.

In this circuit the input signal to be encoded is given to AD7-AD0 input pins of encoder. The encoder output address pins are shorted so the output encoded signal is the combination of (A0-A9) address signal and (D0-D7) data signal. The output encoded signal is taken from 8th pin which is connected to RF transmitter section.

There are 8 input lines fed to the encoder. The encoder converts the 8 bit input data into 3 bits so that during wireless transmission only 3 bits will be transmitted and received instead of 8 bits. For e.g. If the input to the encoder is 1111 1110, the output will be 110.

DECODER

CHAPTER 5

DECODER

5.1 DESCRIPTION

The decoder does the reverse operation of the encoder. It converts N bit data into 2^N bit data.
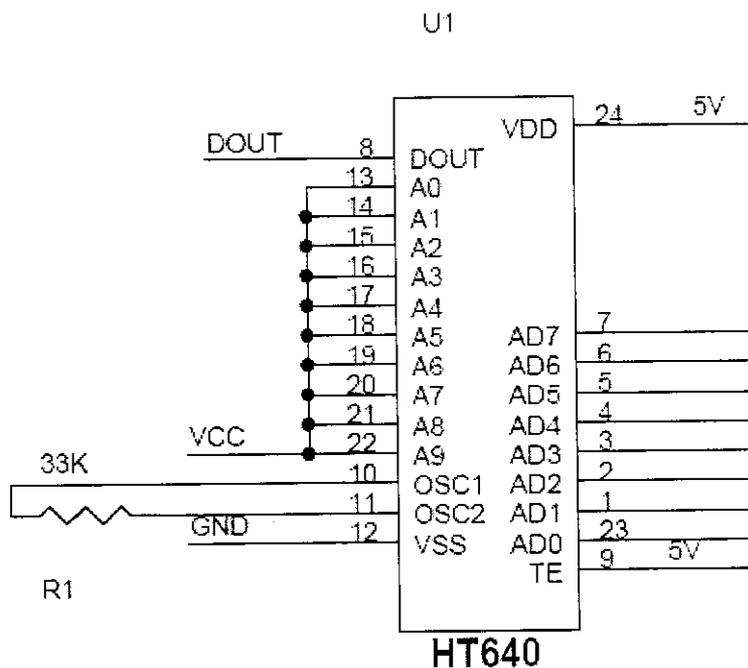
In this circuit HT648 is used as decoder. The 3^{18} decoder are a series of CMOS LSIs for remote control system application. They are paired with 3^{18} series of encoders. For proper operation a pair of encoder/decoder pair with the same number of address and data format should be selected.

DIAGRAM

HT648L
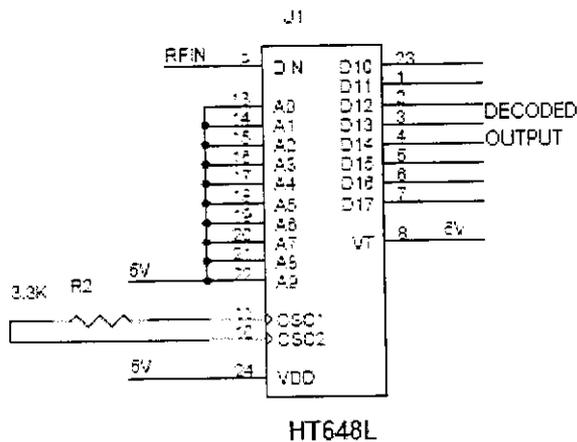
Fig 5.1.1 DECODER

The 3^{18} series of decoder receives serial address and data from that series of encoders that are transmitted by a carrier using an RF or an IR transmission medium. It then compares the serial input data twice continuously with its local address. If no errors or unmatched codes are encountered, the input data codes are decoded and then transferred to the output pins. The VT pin also goes high to indicate a valid transmission.

The 3^{18} decoders are capable of decoding 18 bits of information that consists of N bits of address and 18-N bits of data. To meet various applications they are arranged to provide a number of data pins whose range is from 0 to 8 and an address pin whose range is from 8 to 18. In addition, the 3^{18} decoders provide various combinations of address/ data numbering different package.

In this circuit the received encoded signal is 9th pin of the decoder. Now the decoder separate the address (A0-A9) and data signal (D0-D7). Then the output data signal can be given to microcontroller or any other interfacing device.

RELAY

CHAPTER 6

RELAY

6.1 INTRODUCTION

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical.

The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification.
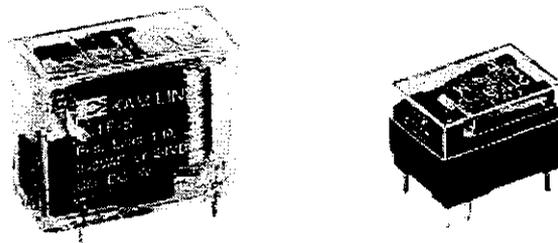
RELAY

Relays are usually SPDT or DPDT but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available. Most relays are designed for PCB mounting but you can solder wires directly to the pins providing you take care to avoid melting the plastic case of the relay. The animated picture shows a working relay with its coil and switch contacts. You can see a lever on the left being attracted by magnetism when the coil is switched on. This lever moves the switch contacts. There is one set of contacts (SPDT) in the foreground and another behind them, making the relay DPDT.
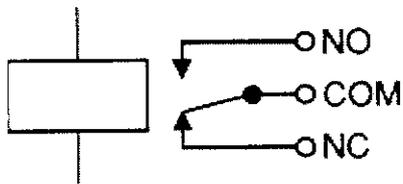
The relay's switch connections are usually labeled COM, NC and NO:

- COM = Common, always connect to this, it is the moving part of the switch.
- NC = Normally Closed, COM is connected to this when the relay coil is off.
- NO = Normally Open, COM is connected to this when the relay coil is on.

CIRCUIT DIAGRAM:
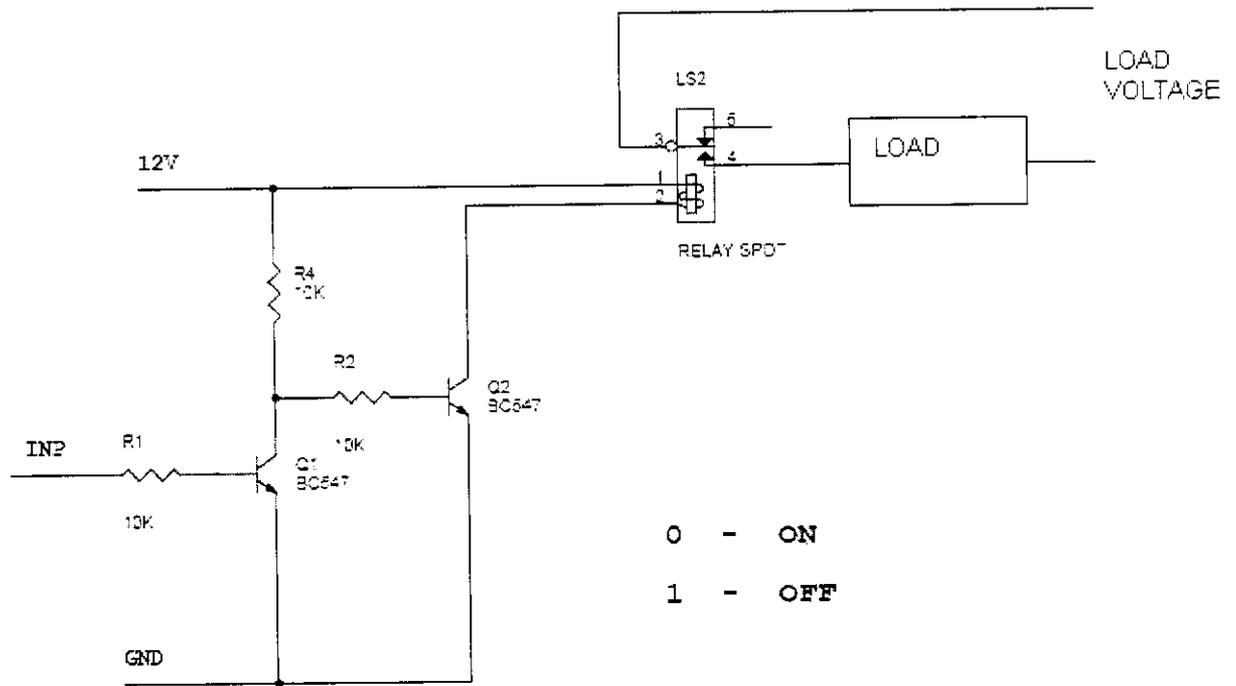
Fig 6.1.1 RELAY

6.3 CIRCUIT DESCRIPTION:

This circuit is designed to control the load. The load may be motor or any other load. The load is turned ON and OFF through relay. The relay ON and OFF is controlled by the pair of switching transistors (BC 547). The relay is connected to the Q2 transistor collector terminal. A Relay is nothing but electromagnetic switching device which consists of three pins. They are Common, Normally close (NC) and Normally open (NO).

The relay common pin is connected to supply voltage. The normally open (NO) pin connected to load. When high pulse signal is given to base of the Q1 transistors, the transistor is conducting and shorts the collector and emitter terminal and zero signals is given to base of the Q2 transistor. So the relay is turned OFF.

When low pulse is given to base of transistor Q1 transistor, the transistor is turned OFF. Now 12v is given to base of Q2 transistor so the transistor is conducting and relay is turned ON. Hence the common terminal and NO terminal of relay are shorted. Now load gets the supply voltage through relay.

Voltage Signal from Microcontroller	Transistor Q1	Transistor Q2	Relay
1	on	off	off
0	off	on	on

POWER SUPPLY

CHAPTER 7

POWER SUPPLY

7.1 INTRODUCTION:

The present chapter introduces the operation of power supply circuits built using filters, rectifiers, and then voltage regulators. Starting with an ac voltage, a steady dc voltage is obtained by rectifying the ac voltage, then filtering to a dc level, and finally, regulating to obtain a desired fixed dc voltage. The regulation is usually obtained from an IC voltage regulator unit, which takes a dc voltage and provides a somewhat lower dc voltage, which remains the same even if the input dc voltage varies, or the output load connected to the dc voltage changes.

The ac voltage, typically 120 V rms, is connected to a transformer, which steps that ac voltage down to the level for the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit can use this dc input to provide a dc voltage that not only has much less ripple voltage but also remains the same dc value even if the input dc voltage varies somewhat, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of a number of popular voltage regulator IC units.

CIRCUIT DIAGRAM:
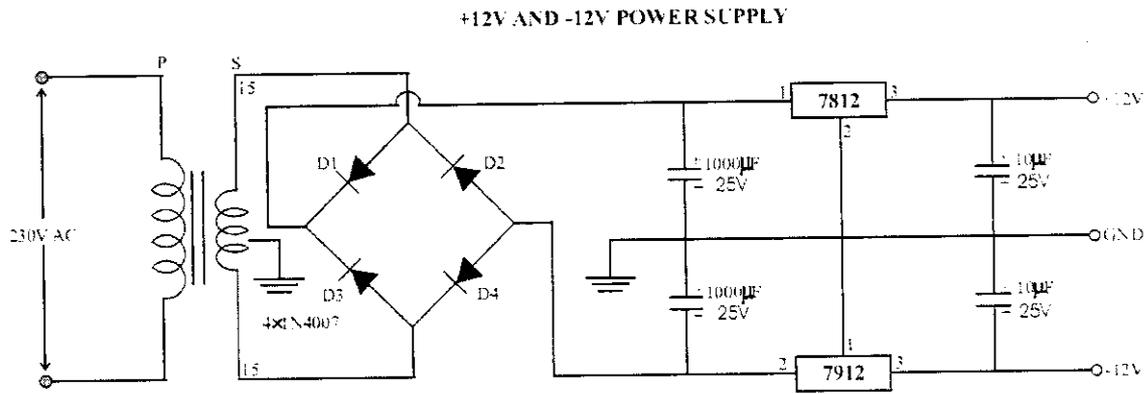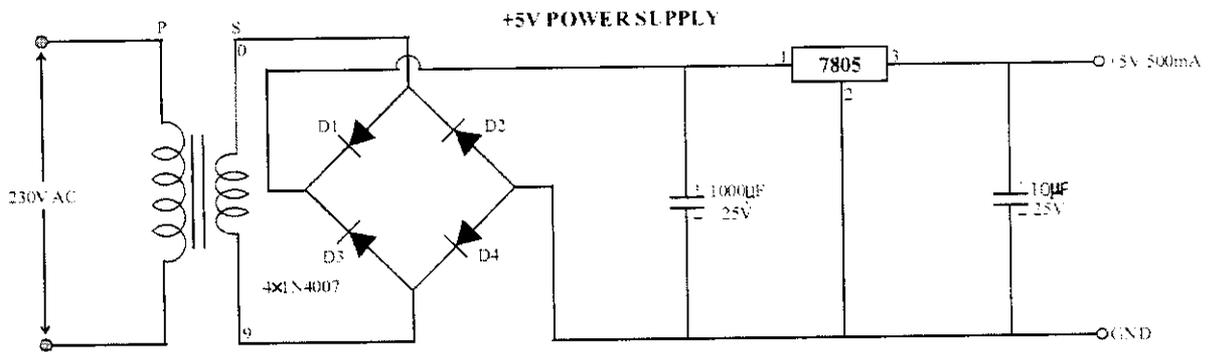
Fig 7.1.1 **POWER SUPPLY**

7.2 WORKING PRINCIPLE:

Transformer:

The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op–amp. The advantages of using precision rectifier are it will give peak voltage output as DC, rest of the circuits will give only RMS output.

Bridge rectifier:

When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners.

Let us assume that the transformer is working properly and there is a positive potential, at point A and a negative potential at point B. the positive potential at point A will forward bias D3 and reverse bias D4.

The negative potential at point B will forward bias D1 and reverse bias D2. At this time D3 and D1 are forward biased and will allow current flow to pass through them; D4 and D2 are reverse biased and will block current flow.

The path for current flow is from point B through D1, up through RL, through D3, through the secondary of the transformer back to point B. Waveforms (1) and (2) can be observed across D1 and D3.

One-half cycle later the polarity across the secondary of the transformer reversed, forward biasing D2 and D4 and reverse biasing D1 and D3. Current flow will now be from point A through D4, up through RL, through D2, through the secondary of T1, and back to point A. The current flow through RL is always in the same direction. In flowing through RL this current develops a voltage correspondingly. Since current flows through the load (RL) during both half cycles of the applied voltage, this bridge rectifier is a full-wave rectifier.

One advantage of a bridge rectifier over a conventional full-wave rectifier is that with a given transformer the bridge rectifier produces a voltage output that is nearly twice that of the conventional full-wave circuit.

This may be shown by assigning values to some of the components shown in views A and B. assume that the same transformer is used in both circuits. The peak voltage developed between points X and y is 1000 volts in both circuits. In the conventional full-wave circuit shown—in view A, the peak voltage from the center tap to either X or Y is 500 volts. Since only one diode can conduct at any instant, the maximum voltage that can be rectified at any instant is 500 volts.

The maximum voltage that appears across the load resistor is nearly-but never exceeds-500 vOlts, as result of the small voltage drop across the diode. In the

bridge rectifier shown in view B, the maximum voltage that can be rectified is the full secondary voltage, which is 1000 volts. Therefore, the peak output voltage across the load resistor is nearly 1000 volts. With both circuits using the same transformer, the bridge rectifier circuit produces a higher output voltage than the conventional full-wave rectifier circuit.

The power supply is used to provide power for RF transmitter, RF receiver, microcontroller and relay.

IC VOLTAGE REGULATORS

CHAPTER 8

IC VOLTAGE REGULATORS

8.1 INTRODUCTION

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. Although the internal construction of the IC is somewhat different from that described for discrete voltage regulator circuits, the external operation is much the same. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage.

A power supply can be built using a transformer connected to the ac supply line to step the ac voltage to a desired amplitude, then rectifying that ac voltage, filtering with a capacitor and RC filter, if desired, and finally regulating the dc voltage using an IC regulator. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milli watts to tens of watts.

8.2 THREE-TERMINAL VOLTAGE REGULATORS:

Fig shows the basic connection of a three-terminal voltage regulator IC to a load. The fixed voltage regulator has an unregulated dc input voltage, Vi, applied to one input terminal, a regulated output dc voltage, Vo, from a second terminal, with the third terminal connected to ground. For a selected regulator, IC device specifications list a voltage range over which the input voltage can vary to maintain a regulated output voltage over a range of load current. The specifications

also list the amount of output voltage change resulting from a change in load current (load regulation) or in input voltage (line regulation).

Positive Voltage Regulators:
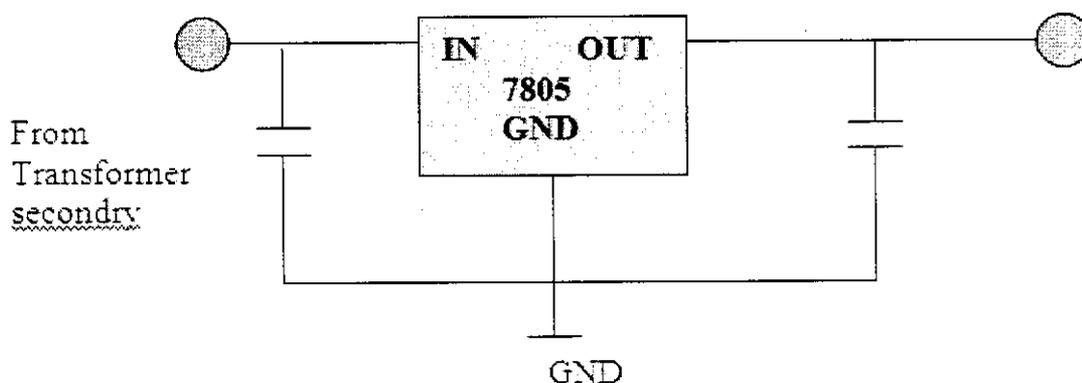
Fig 8.2.1 **Positive Voltage Regulators**

The series 78 regulators provide fixed regulated voltages from 5 to 24 V. Figure shows how one such IC, a 7812, is connected to provide voltage regulation with output from this unit of +12V dc. An unregulated input voltage Vi is filtered by capacitor C1 and connected to the IC's IN terminal. The IC's OUT terminal provides a regulated + 12V which is filtered by capacitor C2 (mostly for any high-frequency noise). The third IC terminal is connected to ground (GND). While the input voltage may vary over some permissible voltage range, and the output load may vary over some acceptable range, the output voltage remains constant within specified voltage variation limits. These limitations are spelled out in the manufacturer's specification sheets. A table of positive voltage regulated ICs is provided in table

Negative Voltage Regulators:
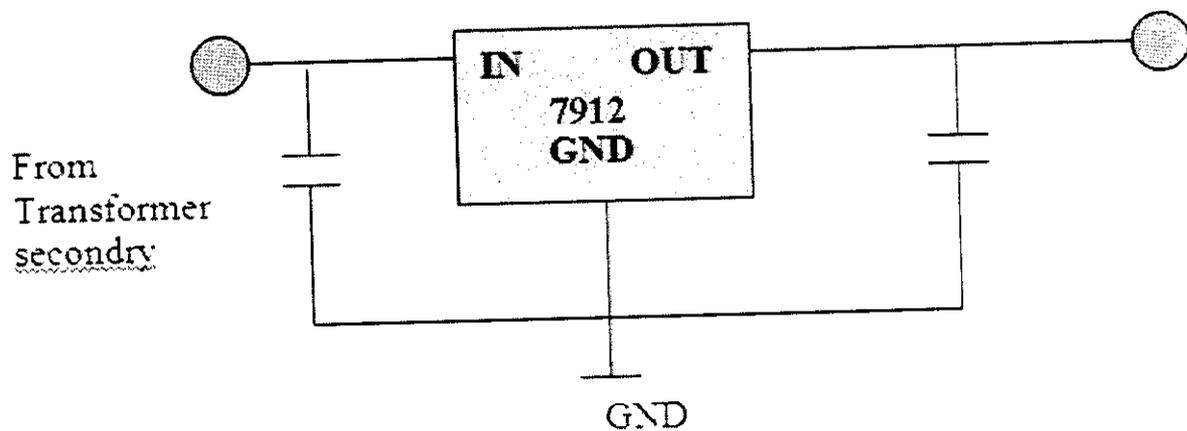
Fig 8.2.2 **Negative Voltage Regulators**

The series 79 regulators provide fixed regulated voltages from -5 to -24 V. Figure shows how one such IC, a 7912, is connected to provide voltage regulation with output from this unit of -12V dc. An unregulated input voltage Vi is filtered by capacitor C1 and connected to the IC's IN terminal. The IC's OUT terminal provides a regulated -12V which is filtered by capacitor C2 (mostly for any high-frequency noise). The third IC terminal is connected to ground (GND). While the input voltage may vary over some permissible voltage range, and the output load may vary over some acceptable range, the output voltage remains constant within specified voltage variation limits. These limitations are spelled out in the manufacturer's specification sheets.

VARIOUS POSITIVE VOLTAGE REGULATOR IC:

IC	Output voltage (V)	Minimum input voltage Vi (V)
7805	+5	7.3
7806	+6	8.3
7808	+8	10.5
7810	+10	12.5
7812	+12	14.6
7815	+15	17.7
7818	+18	21.0
7824	+24	27.1

Table 8.3.1 **VARIOUS POSITIVE VOLTAGE REGULATOR IC:**

8.3 LM78XX

Series Voltage Regulators

General Description

The LM78XX series of three terminal regulators is available with several fixed output voltages making them useful in a wide range of applications. One of these is local on card regulation, eliminating the distribution problems associated with single point regulation. The voltages available allow these regulators to be used in logic systems, instrumentation, HiFi, and other solid state electronic equipment. Although designed primarily as fixed voltage regulators these devices can be used with external components to obtain adjustable voltages and currents. The LM78XX series is available in an aluminum TO-3 package which will allow over 1.0A load current if adequate heat sinking is provided. Current limiting is included to limit the peak output current to a safe value. Safe area protection for the output transistor is provided to limit internal power dissipation. If internal power dissipation becomes too high for the heat sinking provided, the thermal shutdown of circuit takes over preventing the IC from overheating. Considerable effort was expanded to make the LM78XX series of regulators easy to use and minimize the number of external components. It is not necessary to bypass the output, although this does improve transient response. Input bypassing is needed only if the regulator is located far from the filter capacitor of the power supply. For output voltage other than 5V, 12V and 15V the LM117 series provides an output voltage range from 1.2V to 57V.

Features

> Output current in excess of 1A

> Internal thermal overload protection

> No external components required

> Output transistor safe area protection

> Internal short circuit current limit

> Available in the aluminum TO-3 package

Connection Diagrams

Plastic Package
TO-220 (T)

GND → [○] → OUTPUT
           → GND
           → INPUT

DS007746-3
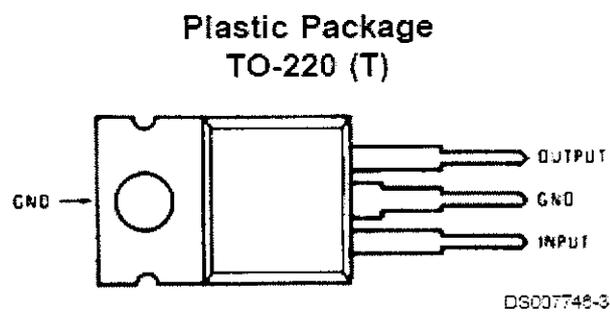
Top View
Order Number LM7805CT,
LM7812CT or LM7815CT
See NS Package Number T03B

LM 7805, LM 7812

ELECTRICAL CHARACTERISTICS FOR L7805C

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_o	Output Voltage	$T_j = 25\,^\circ C$	4.8	5	5.2	V
V_o	Output Voltage	$I_o = 5\,mA\ to\ 1\,A\quad P_o \leq 15\,W$ $V_i = 7\ to\ 20\,V$	4.75	5	5.25	V
ΔV_o*	Line Regulation	$V_i = 7\ to\ 25\,V\quad T_j = 25\,^\circ C$ $V_i = 8\ to\ 12\,V\quad T_j = 25\,^\circ C$		3 1	100 50	mV mV
ΔV_o*	Load Regulation	$I_o = 5\ to\ 1500\,mA\quad T_j = 25\,^\circ C$ $I_o = 250\ to\ 750\,mA\quad T_j = 25\,^\circ C$			100 50	mV mV
I_d	Quiescent Current	$T_j = 25\,^\circ C$			8	mA
ΔI_d	Quiescent Current Change	$I_o = 5\ to\ 1000\,mA$			0.5	mA
ΔI_d	Quiescent Current Change	$V_i = 7\ to\ 25\,V$			0.8	mA
$\dfrac{\Delta V_o}{\Delta T}$	Output Voltage Drift	$I_o = 5\,mA$		-1.1		mV/$^\circ C$
eN	Output Noise Voltage	$B = 10Hz\ to\ 100KHz\quad T_j = 25\,^\circ C$		40		μV
SVR	Supply Voltage Rejection	$V_i = 8\ to\ 18\,V\quad f = 120\,Hz$	62			dB
V_d	Dropout Voltage	$I_o = 1\,A\quad T_j = 25\,^\circ C$		2		V
R_o	Output Resistance	$f = 1\,KHz$		17		mΩ
I_{sc}	Short Circuit Current	$V_i = 35\,V\quad T_j = 25\,^\circ C$		750		mA
I_{scp}	Short Circuit Peak Current	$T_j = 25\,^\circ C$		2.2		A

Table 8.3.1 ELECTRICAL CHARACTERISTICS FOR L7805C

ELECTRICAL CHARACTERISTICS FOR L7812C

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_o	Output Voltage	$T_j = 25\,°C$	11.5	12	12.5	V
V_o	Output Voltage	$I_o = 5\,mA$ to 1 A $\quad P_o \leq 15\,W$ $V_i = 14.5$ to 27 V	11.4	12	12.6	V
ΔV_o^*	Line Regulation	$V_i = 14.5$ to 30 V $\quad T_j = 25\,°C$ $V_i = 16$ to 22 V $\quad T_j = 25\,°C$			240 120	mV mV
ΔV_o^*	Load Regulation	$I_o = 5$ to 1500 mA $\quad T_j = 25\,°C$ $I_o = 250$ to 750 mA $\quad T_j = 25\,°C$			240 120	mV mV
I_d	Quiescent Current	$T_j = 25\,°C$			8	mA
ΔI_d	Quiescent Current Change	$I_o = 5$ to 1000 mA			0.5	mA
ΔI_d	Quiescent Current Change	$V_i = 14.5$ to 30 V			1	mA
$\dfrac{\Delta V_o}{\Delta T}$	Output Voltage Drift	$I_o = 5\,mA$		-1		mV/°C
eN	Output Noise Voltage	$B = 10\,Hz$ to 100KHz $\quad T_j = 25\,°C$		75		μV
SVR	Supply Voltage Rejection	$V_i = 15$ to 25 V $\quad f = 120\,Hz$	55			dB
V_d	Dropout Voltage	$I_o = 1\,A \quad T_j = 25\,°C$		2		V
R_o	Output Resistance	$f = 1\,KHz$		18		mΩ
I_{sc}	Short Circuit Current	$V_i = 35\,V \quad T_j = 25\,°C$		350		mA
I_{scp}	Short Circuit Peak Current	$T_j = 25\,°C$		2.2		A

Table 8.3.2 ELECTRICAL CHARACTERISTICS FOR L7812C

MICROCONTROLLER

CHAPTER 9

MICROCONTROLLER

9.1 ARCHITECTURE OF PIC 16F877:

The complete architecture of PIC 16F877 is shown in the fig 2.1. Table 2.1 gives details about the specifications of PIC 16F877. Fig 2.2 shows the complete pin diagram of the IC PIC 16F877.
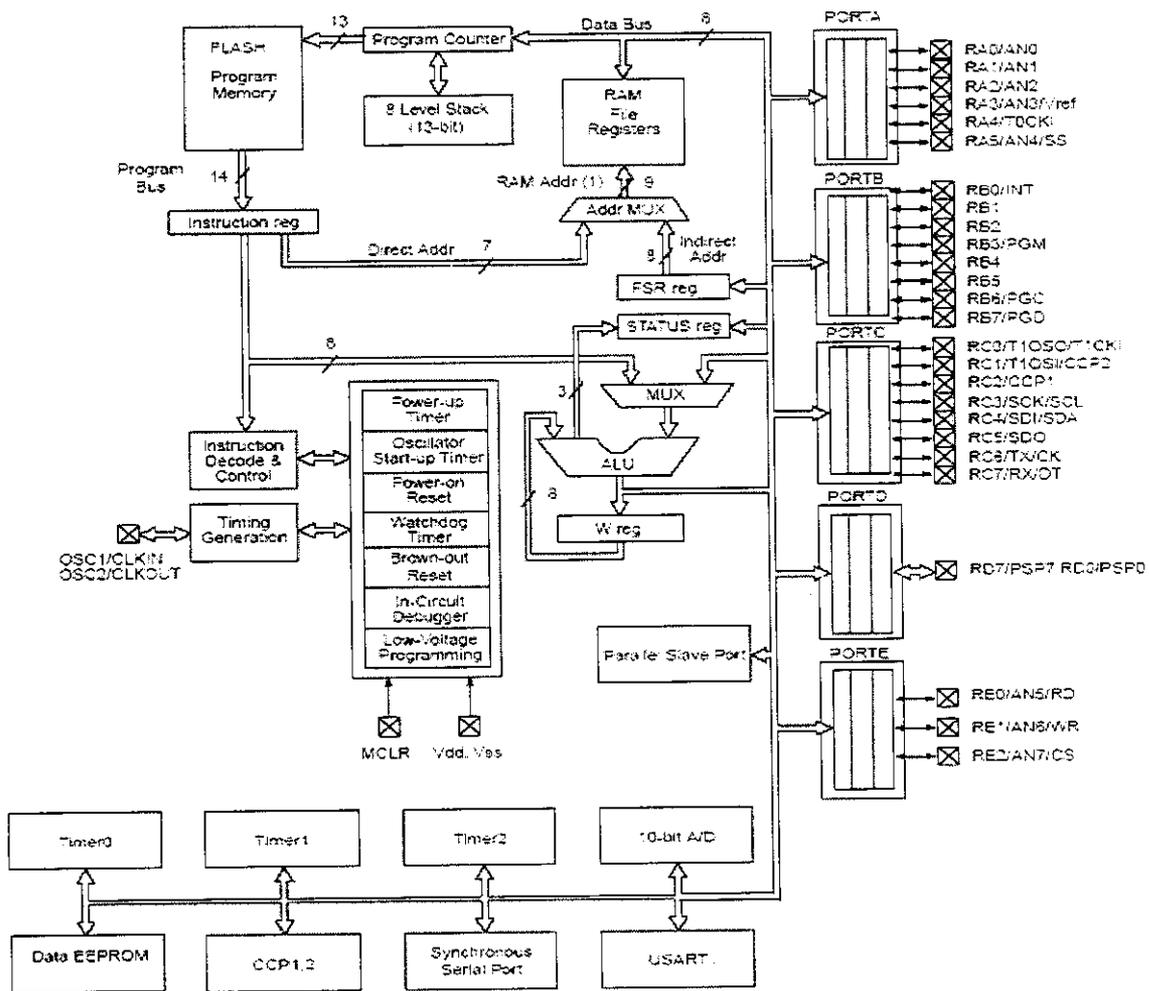
Fig 9.1.1 ARCHITECTURE

9.2 PIN DIAGRAM OF PIC 16F877

MCLR/VPP/THV	→	1		40	↔	RB7/PGD
RA0/AN0	↔	2		39	↔	RB6/PGC
RA1/AN1	↔	3		38	↔	RB5
RA2/AN2/VREF-	↔	4		37	↔	RB4
RA3/AN3/VREF+	↔	5		36	↔	RB3/PGM
RA4/T0CKI	↔	6		35	↔	RB2
RA5/AN4/SS	↔	7		34	↔	RB1
RE0/RD/AN5	↔	8		33	↔	RB0/INT
RE1/WR/AN6	↔	9		32	←	VDD
RE2/CS/AN7	↔	10		31	←	Vss
VDD	→	11	PIC16F877	30	↔	RD7/PSP7
Vss	→	12		29	↔	RD6/PSP6
OSC1/CLKIN	→	13		28	↔	RD5/PSP5
OSC2/CLKOUT	←	14		27	↔	RD4/PSP4
RC0/T1OSO/T1CKI	↔	15		26	↔	RC7/RX/DT
RC1/T1OSI/CCP2	↔	16		25	↔	RC6/TX/CK
RC2/CCP1	↔	17		24	↔	RC5/SDO
RC3/SCK/SCL	↔	18		23	↔	RC4/SDI/SDA
RD0/PSP0	↔	19		22	↔	RD3/PSP3
RD1/PSP1	↔	20		21	↔	RD2/PSP2

Fig 9.2.1 PIN DIAGRAM

The inputs to the microcontroller are given through the port B. The pins used are

1. RB0/INT

2. RB1

3. RB2

4. RB3/PGM

5. RB4

6. RB5

7. RB6/PGC

8. RB7/PGD

The outputs are taken from the port C.

1. RC0/T1OSO/T1CK1

2. RC1/T1OS1/CCP2

3. RC2/CCP1

PIN OUT DESCRIPTION

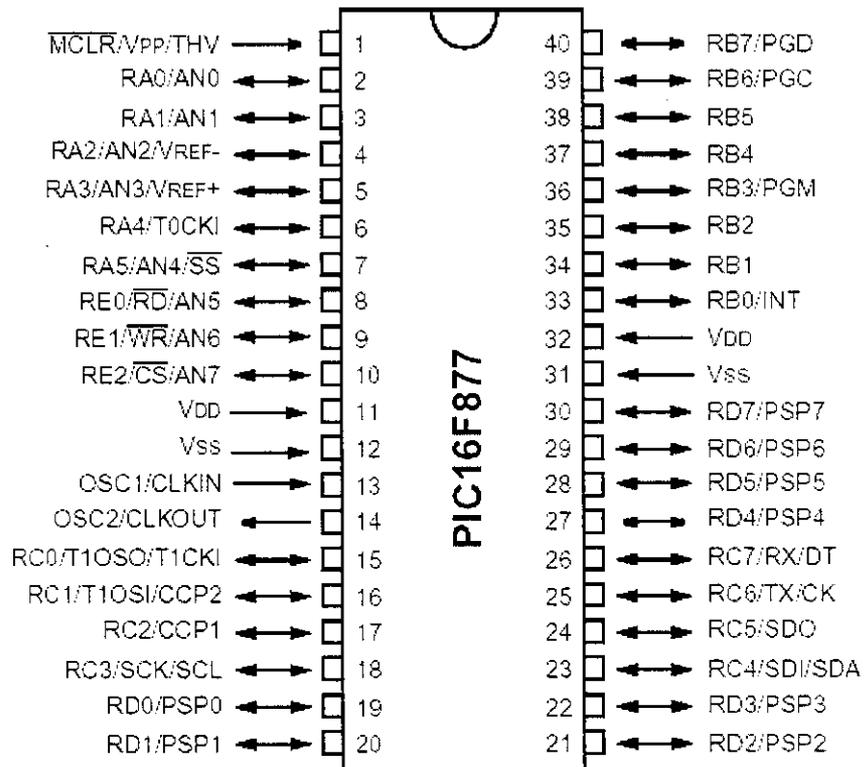| Pin Name	DIP Pin#	PLCC Pin#	QFP Pin#	I/O/P Type	Buffer Type	Description
OSC1/CLKIN	13	14	30	I	ST/CMOS[4]	Oscillator crystal input/external clock source input.
OSC2/CLKOUT	14	15	31	O	—	Oscillator crystal output. Connects to crystal or resonator in crystal oscillator mode. In RC mode, OSC2 pin outputs CLKOUT which has 1/4 the frequency of OSC1, and denotes the instruction cycle rate.
MCLR/Vpp/THV	1	2	18	I/P	ST	Master clear (reset) input or programming voltage input or high voltage test mode control. This pin is an active low reset to the device.
						PORTA is a bi-directional I/O port.
RA0/AN0	2	3	19	I/O	TTL	RA0 can also be analog input0
RA1/AN1	3	4	20	I/O	TTL	RA1 can also be analog input1
RA2/AN2/VREF-	4	5	21	I/O	TTL	RA2 can also be analog input2 or negative analog reference voltage
RA3/AN3/VREF+	5	6	22	I/O	TTL	RA3 can also be analog input3 or positive analog reference voltage
RA4/T0CKI	6	7	23	I/O	ST	RA4 can also be the clock input to the Timer0 timer/counter. Output is open drain type.
RA5/SS/AN4	7	8	24	I/O	TTL	RA5 can also be analog input4 or the slave select for the synchronous serial port.
						PORTB is a bi-directional I/O port. PORTB can be software programmed for internal weak pull-up on all inputs.
RB0/INT	33	36	8	I/O	TTL/ST[1]	RB0 can also be the external interrupt pin.
RB1	34	37	9	I/O	TTL	
RB2	35	38	10	I/O	TTL	
RB3/PGM	36	39	11	I/O	TTL	RB3 can also be the low voltage programming input
RB4	37	41	14	I/O	TTL	Interrupt on change pin.
RB5	38	42	15	I/O	TTL	Interrupt on change pin.
RB6/PGC	39	43	16	I/O	TTL/ST[2]	Interrupt on change pin or In-Circuit Debugger pin. Serial programming clock.
RB7/PGD	40	44	17	I/O	TTL/ST[2]	Interrupt on change pin or In-Circuit Debugger pin. Serial programming data.

Table 9.2.1 PIN OUT DESCRIPTION

Pin Name	DIP Pin#	PLCC Pin#	QFP Pin#	I/O/P Type	Buffer Type	Description
						PORTC is a bi-directional I/O port.
RC0/T1OSO/T1CKI	15	16	32	I/O	ST	RC0 can also be the Timer1 oscillator output or a Timer1 clock input.
RC1/T1OSI/CCP2	16	18	35	I/O	ST	RC1 can also be the Timer1 oscillator input or Capture2 input/Compare2 output/PWM2 output.
RC2/CCP1	17	19	36	I/O	ST	RC2 can also be the Capture1 input/Compare1 output/ PWM1 output.
RC3/SCK/SCL	18	20	37	I/O	ST	RC3 can also be the synchronous serial clock input/ output for both SPI and I²C modes.
RC4/SDI/SDA	23	25	42	I/O	ST	RC4 can also be the SPI Data In (SPI mode) or data I/O (I²C mode).
RC5/SDO	24	26	43	I/O	ST	RC5 can also be the SPI Data Out (SPI mode).
RC6/TX/CK	25	27	44	I/O	ST	RC6 can also be the USART Asynchronous Transmit or Synchronous Clock.
RC7/RX/DT	26	29	1	I/O	ST	RC7 can also be the USART Asynchronous Receive or Synchronous Data.
						PORTD is a bi-directional I/O port or parallel slave port when interfacing to a microprocessor bus.
RD0/PSP0	19	21	38	I/O	ST/TTL[3]	
RD1/PSP1	20	22	39	I/O	ST/TTL[3]	
RD2/PSP2	21	23	40	I/O	ST/TTL[3]	
RD3/PSP3	22	24	41	I/O	ST/TTL[3]	
RD4/PSP4	27	30	2	I/O	ST/TTL[3]	
RD5/PSP5	28	31	3	I/O	ST/TTL[3]	
RD6/PSP6	29	32	4	I/O	ST/TTL[3]	
RD7/PSP7	30	33	5	I/O	ST/TTL[3]	
						PORTE is a bi-directional I/O port.
RE0/RD/AN5	8	9	25	I/O	ST/TTL[3]	RE0 can also be read control for the parallel slave port. or analog input5.
RE1/WR/AN6	9	10	26	I/O	ST/TTL[3]	RE1 can also be write control for the parallel slave port. or analog input6.
RE2/CS/AN7	10	11	27	I/O	ST/TTL[3]	RE2 can also be select control for the parallel slave port, or analog input7.
Vss	12,31	13,34	6,29	P	—	Ground reference for logic and I/O pins.
Vdd	11,32	12,35	7,28	P	—	Positive supply for logic and I/O pins
NC	—	1,17,28, 40	12,13, 33,34		—	These pins are not internally connected. These pins should be left unconnected.

Table 9.2.2 PIN OUT DESCRIPTION

Note:

1. This buffer is a Schmitt Trigger input when configured as an external interrupt.

2. This buffer is a Schmitt Trigger input when used in serial programming mode.

3. This buffer is a Schmitt Trigger input when configured as general purpose I/O and a TTL input when used in the Parallel Slave Port mode (for interfacing to a microprocessor bus).

9.3 I/O PORTS:

Some pins for these I/O ports are multiplexed with an alternate function for the peripheral features on the device. In general, when a peripheral is enabled, that pin may not be used as a general purpose I/O pin.

PORTA AND THE TRISA REGISTER:

PORTA is a 6-bit wide bi-directional port. The corresponding data direction register is TRISA. Setting a TRISA bit (=1) will make the corresponding PORTA pin an input, i.e., put the corresponding output driver in a Hi-impedance mode. Clearing a TRISA bit (=0) will make the corresponding PORTA pin an output, i.e., put the contents of the output latch on the selected pin.

PORTB AND TRISB REGISTER:

PORTB is an 8-bit wide bi-directional port. The corresponding data direction register is TRISB. Setting a TRISB bit (=1) will make the corresponding PORTB pin an input, i.e., put the corresponding output driver in a hi-impedance mode. Clearing a TRISB bit (=0) will make the corresponding PORTB pin an output, i.e., put the contents of the output latch on the selected pin. Three pins of PORTB are multiplexed with the Low Voltage Programming function; RB3/PGM, RB6/PGC and RB7/PGD. The alternate functions of these pins are described in the Special Features Section. Each of the PORTB pins has a weak internal pull-up. A single control bit can turn on all the pull-ups.

This is performed by clearing bit RBPU (OPTION_REG<7>). The weak pull-up is automatically turned off when the port pin is configured as an output. The pull-ups are disabled on a Power-on Reset.

PORTC AND THE TRISC REGISTER:

PORTC is an 8-bit wide bi-directional port. The corresponding data direction register is TRISC. Setting a TRISC bit (=1) will make the corresponding PORTC pin an input, i.e., put the corresponding output driver in a hi-impedance mode. Clearing a TRISC bit (=0) will make the corresponding PORTC pin an output, i.e., put the contents of the output latch on the selected pin. PORTC is multiplexed with several peripheral functions. PORTC pins have Schmitt Trigger input buffers.

PORTD AND TRISD REGISTERS:

This section is not applicable to the 28-pin devices. PORTD is an 8-bit port with Schmitt Trigger input buffers. Each pin is individually configurable as an input or output. PORTD can be configured as an 8-bit wide microprocessor Port (parallel slave port) by setting control bit PSPMODE (TRISE<4>). In this mode, the input buffers are TTL.

PORTE AND TRISE REGISTER:

PORTE has three pins RE0/RD/AN5, RE1/WR/AN6 and RE2/CS/AN7, which are individually configurable as inputs or outputs. These pins have Schmitt Trigger input buffers.

The PORTE pins become control inputs for the microprocessor port when bit PSPMODE (TRISE<4>) is set. In this mode, the user must make sure that the TRISE<2:0> bits are set (pins are configured as digital inputs). Ensure ADCON1 is configured for digital I/O. In this mode the input buffers are TTL.

PORTE pins are multiplexed with analog inputs. When selected as an analog input, these pins will read as '0's. TRISE controls the direction of the RE pins, even when they are being used as analog inputs. The user must make sure to keep the pins configured as inputs when using them as analog inputs.

MEMORY ORGANISATION:

There are three memory blocks in each of the PIC16F877 MUC's. The program memory and Data Memory have separate buses so that concurrent access can occur.

PROGRAM MEMORY ORGANISATION:

The PIC16f877 devices have a 13-bit program counter capable of addressing 8K *14 words of FLASH program memory. Accessing a location above the physically implemented address will cause a wraparound. The RESET vector is at 0000h and the interrupt vector is at 0004h.

DATA MEMORY ORGANISTION:

The data memory is partitioned into multiple banks which contain the General Purpose Registers and the special functions Registers. Bits RP1 (STATUS<6) and RP0 (STATUS<5>) are the bank selected bits.

RP1:RP0	Banks
00	0
01	1
10	2
11	3

CAMERA AND TV TUNER CARD

CHAPTER 10

CAMERA AND TV TUNER CARD

10.1 CAMERA AND AV RECEIVER

The camera is directly attached to the helicopter using sticking tape. For surveillance purpose the camera may be attached at the bottom of the helicopter and for the helicopter control purpose the camera is attached at the front of the helicopter.

TECHNICAL PARAMETERS OF TRANSMITTING UNIT:

Size : 38*28*16mm

System :PAL/CCIR, NTSC/EIA

Effective pixel: PAL : 628*582,NTSC: 510*492

Image area: PAL: 5.78*4.19 mm, NTSC: 4.69*3.45mm

Horizontal definition: 380 lines

Scanning frequency: PAL/CCIR : 50 Hz, NTSC/EIA: 60 Hz

Sensitivity: +18dB

Electrical level output: 1.2 GHz

Transmission signal: Audio, video

Linear transmission distance: 50-100m

Voltage : DC +9V

Current: 300mA

Power dissipation: 640mW

The camera and AV receiver kit is JMK 309-AS. National Television System Committee(NTSC) and Phase Alteration By Line(PAL) are colour encoding schemes used in different parts of the world. Both these schemes are supported by our camera.

TECHNICAL PARAMETERS OF RECEIVING UNIT:

Wireless audio/video receiver

Receiving method: Electronic frequency modulation

Reception sensitivity: +18dB

Receiving frequency: 1.2GHz

Receiving signal: Audio, video

Voltage : DC+12V

Current: 5mA

By using cameras with different frequencies we can get images from each camera which can be used for different applications. Both audio and video can be received using this receiver.

10.2 TV TUNER CARD

The TV tuner card is interfaced with the computer and the associated software is installed. The audio/video receiver is connected with the TV tuner card. Then the tuner knob in the audio/video receiver is adjusted slowly to get the video in the computer. By using the video obtained in the computer the helicopter can be controlled by the user.

Product features:

Full TV frequency range for CATV/VHF/UHF.

Record hassle free motion video with frame speed of 30 frames/sec.

Capture still images.

Capture full motion video.

HARDWARE DESIGN

CHAPTER 11

HARDWARE DESIGN

Design and Fabrication of Printed Circuit Boards:

11.1 INTRODUCTION:

Printed circuit boards or PCBs form the core of domestic and industrial electronic equipment. Some of the areas where PCBs are intensively used are computers, process control, telecommunications and instrumentation.

11.2 MANUFATCURING:

The manufacturing process consists of two methods:

1. Print and etch

2. Print, plate and etch

The single sided PCBs are usually made using the print and etch method. The double sided plate through – hole (PTH) boards are made by the print plate and etch method. The production of multi layer boards uses both the methods. The inner layers are printed and etched while the outer layers are produced by print, plate and etch after pressing the inner layers.

PANELISATION:

Here the schematic is transformed into the working positive/negative films. The circuit is repeated conveniently to accommodate economically as many circuits as possible in a panel, which can be operated in every sequence of subsequent steps in the PCB process. This process is called panelization. For the PTH boards, the next operation is drilling.

DRILLING:

PCB drilling is a state of the art operation. Very small holes are drilled with high speed CNC drilling machines, giving a wall finish with less or no smear or epoxy, required for void free through hole plating.

PLATING:

This is the heart of the PCB manufacturing process. The holes drilled in the board are treated both mechanically and chemically before depositing the copper by the electro less copper platting process.

ETCHING:

Once a multiplayer board is drilled and electro less copper deposited, the image available in the form of a film is transferred onto the outside by photo printing using a dry film printing process. The boards are then electroplated onto the circuit pattern with copper and tin. The tin-plated deposit serves an etch resist when copper in the unwanted area is removed by spray etching machines with chemical etchants. The etching machines are attached to an automatic dosing equipment, which analyses and controls etchants concentrations.

SOLDERMASK:

Since a PCB design may call for very close spacing between conductors, a solder mask has to be applied on the both sides of the circuitry to avoid the bridging of conductors. The solder mask ink is applied by screening. The ink is dried, exposed to UV, developed in a mild alkaline solution and finally cured by both UV and thermal energy.

HOT AIR LEVELLING:

After applying the solder mask, the circuit pads are soldered using the hot air leveling process. The bare bodies fluxed and dipped into a molten solder bath. While removing the board from the solder bath, hot air is blown on both sides of the board through air knives in the machines, leaving the board soldered and leveled. This is one of the common finishes given to the boards. Thus the double sided printed circuit board is manufactured and is now ready for the components to be soldered.

The PCB designed are for power supply, encoder and RF transmitter, decoder and RF receiver, microcontroller and relay circuit.

MICROCONTROLLER PROGRAMMING

CHAPTER 12

MICROCONTROLLER PROGRAMMING

12.1 ALGORITHM

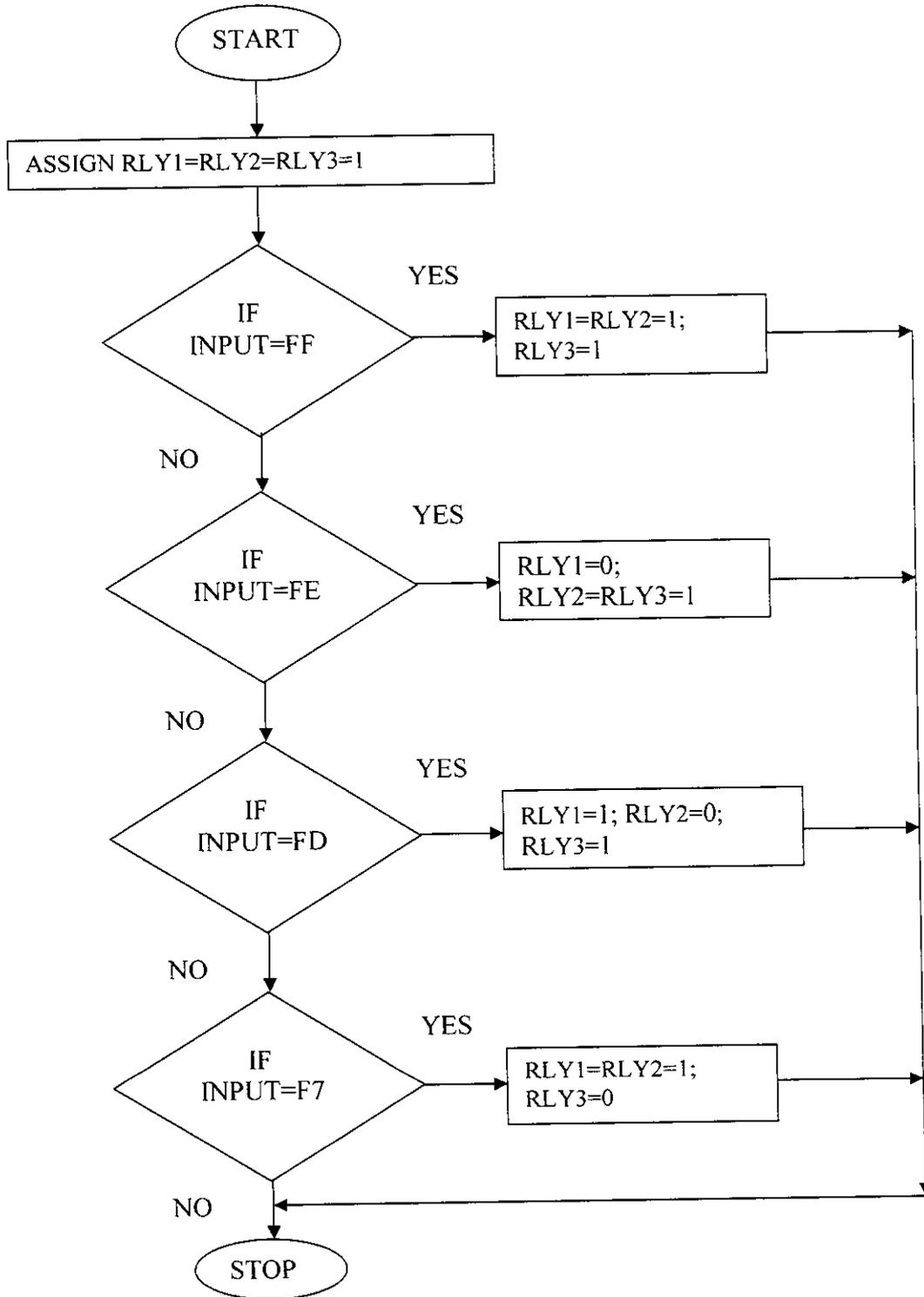- ➤ The microcontroller is programmed such that it activates the relay1 when it receives the hexadecimal data FE i.e., speed1 is activated

- ➤ The microcontroller activates the relay2 when it receives the hexadecimal data FD i.e., speed2 is activated

- ➤ The microcontroller activates the relay3 when it receives the hexadecimal data F7 i.e., speed3 is activated

- ➤ When the controller receives the hexadecimal data FF, all the relays are deactivated

Fig 12.1 FLOWCHART

START

ASSIGN RLY1=RLY2=RLY3=1

IF INPUT=FF — YES → RLY1=RLY2=1; RLY3=1

NO

IF INPUT=FE — YES → RLY1=0; RLY2=RLY3=1

NO

IF INPUT=FD — YES → RLY1=1; RLY2=0; RLY3=1

NO

IF INPUT=F7 — YES → RLY1=RLY2=1; RLY3=0

NO

STOP

ALGORITHM FOR VB CODING

CHAPTER 13

VISUAL BASIC CODING

13.1 ALGORITHM FOR VB CODING

➢ Initialize 5 command buttons in Visual basic

➢ The name property of the command buttons are changed as speed1, speed2, speed3, off and exit.

➢ When each command button is clicked, the hexadecimal data FE, FD, F7, FF are sent to the parallel port

➢ This data is sent into the encoder where it gets converted as 110, 101, 100 and 111 respectively.

➢ This data is transmitted through RF transmitter.

➢ The exit command button is used to close the window.

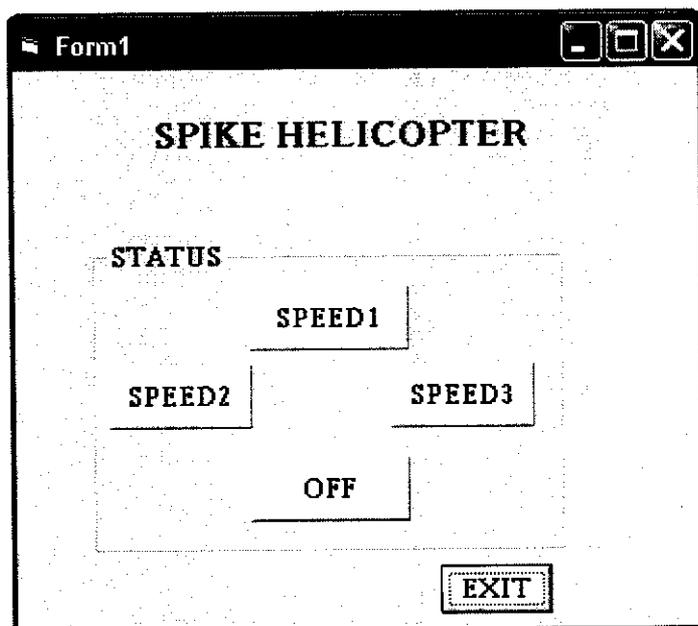# DISPLAY OF KEYS USED TO CONTROL SPEED OF THE

HELICOPTER

Fig 13.1.1 **DISPLAY OF KEYS**

CAPTURED IMAGES

13.2.1 SAMPLE PICTURE TAKEN DURING DEMO

SAMPLE PICTURE DURING DEMO IN HOSTEL

P- 2325

ADVANTAGES AND APPLICATION

CHAPTER 14

ADVANTAGES AND APPLICATIONS

14.1 ADVANTAGES

- Easy handling, no further skills to operate.

- Reliable.

14.2 APPLICATIONS

- To monitor areas affected by earth quakes.

- Military applications.

- Agricultural applications for spraying the seeds over agricultural area.

- To monitor the conditions over any meeting places.

- Traffic monitoring.

CONCLUSION

CHAPTER 15

CONCLUSION

Thus our project helps for surveillance in those areas where humans find it difficult to explore. Our project particularly provides a helping hand to farmers, scientists, defense personal, traffic police etc. When implemented with sufficient technology and cost, it can be used for advanced applications like spying. Since our model is unmanned, it keeps human away from confronting fatal situations.

Our prototype, for now, varies only the speed of the helicopter. In future we can incorporate direction control and additional cameras which would facilitate both controlling of the helicopter effectively and monitoring the immediate area.

APPENDIX -1

ADDRESSING MODES OF PIC MICROCONTROLLER

APPENDIX 1

ADDRESSING MODES OF PIC 16F877

DIRECT ADDRESSING:

In direct addressing, the operand is specified by an 8-bit address field in the instruction. Only internal data RAM and SFR's can be directly addressed.

INDIRECT ADDRESSING:

In Indirect addressing, the instruction specifies a register that contains the address of the operand. Both internal and external RAM can be indirectly addressed.

The address register for 8-bit addresses can be either the Stack Pointer or R0 or R1 of the selected register Bank. The address register for 16-bit addresses can be only be 16-bit data pointer register, DPTR.

INDEXED ADDRESSING:

Program memory can only be accessed via indexed addressing this addressing mode is intended for reading look-up tables in program memory. A 16 bit base register (Either DPTR or the Program Counter) points to the base of the table, and the accumulator is set up with the table entry number. Adding the accumulator data to the base pointer forms the address of the table entry in program memory.

Another type of indexed addressing is used in the "case jump" instructions. In this case the destination address of a jump instruction is computed as the sum of the base pointer and the accumulator data.

REGISTER INSTRUCTION:

The register banks, which contains registers R0 through R7, can be accessed by instructions whose opcodes carry a 3-bit register specification. Instructions that access the registers this way make efficient use of code, since this mode eliminates an address byte. When the instruction is executed, one of four banks is selected at execution time by the row bank select bits in PSW.

REGISTER - SPECIFIC INSTRUCTION:

Some Instructions are specific to a certain register. For example some instruction always operates on the Accumulator, so no address byte is needed to point to IR. In these cases, the opcode itself points to the correct register. Instruction that register to accumulator as A assemble as Accumulator - specific Opcodes.

IMMEDIATE CONSTANTS:

The value of a constant can follow the opcode in program memory For example. MOV A, #100 loads the Accumulator with the decimal number 100. The same number could be specified in hexadecimal digit as 64h.

OSCILLATOR AND CLOCK CIRCUIT:

XTAL1 and XTAL2 are the input and output respectively of an inverting amplifier which is intended for use as a crystal oscillator in the pioerce

configuration, in the frequency range of 1.2 Mhz to 12 Mhz. XTAL2 is also the input to the internal clock generator.

To drive the chip with an internal oscillator, one would ground XTAL1 and XTAL2. Since the input to the clock generator is divided by two flip flops there are no requirements on the duty cycle of the external oscillator signal. However, minimum high and low times must be observed.

The clock generator divides the oscillator frequency by 2 and provides a two phase clock signal to the chip. The phase 1 signal is active during the first half to each clock period and the phase 2 signals are active during the second half of each clock period.

CPU TIMING:

A machine cycle consists of 6 states. Each stare is divided into a phase / half, during which the phase 1 clock is active and phase 2is inactive. Arithmetic and logical operations take place during phase1 and internal register - to register transfer take place during phase 2.

TRENDS AND DEVELOPMENTS IN MICRO CONTROLLER

The manner in which the use of micro controllers is shaping our lives is breathtaking. Today, this versatile device can be found in a variety of control applications. **CVTs, VCRs, CD** players, microwave ovens and automotive engine systems are some of these.

A micro controller unit (MCU) uses the microprocessor as its central processing unit (CPU) and incorporates memory, timing reference, **I/O** peripherals, etc on the same chip. Limited computational capabilities and enhanced **I/O** are special features.

The micro controller is the most essential **IC** for continuous process- based applications in industries like chemical, refinery, pharmaceutical automobile, steel, and electrical, employing programmable logic systems (DCS). **PLC** and **DCS** thrive on the programmability of an **MCU.**

There are many **MCU** manufacturers. To understand and apply general concepts, it is necessary to study one type in detail. This specific knowledge can be used to understand similar features of other **MCUs.**

Micro controller devices have many similarities. When you look at the differences, they are not so great either. Most common and popular **MCUs** are considered to be mature and well-established products, which have their individual adherents and devotees. There are a number of variants within each family to satisfy most memory, **I/O**, data conversion, and timing needs of end user applications.

The **MCU** is designed to operate on application-oriented sensor data-for example, temperature and pressure of a blast furnace in an industrial process that is fed through its serial or operated under the control of software and stored in **ROM.** Appropriate signals are fed via output ports to control external devices and systems.

ANALOG TO DIGITAL CONVERTER (ADC)

There are two types of analog to digital converter is present in this IC. We use 10-bit ADC. The ADC module can have up to eight analog inputs for a device. The analog input charges a sample and hold capacitor. The output of sample and hold capacitor is the input into the converter. The converter then generates a digital result of this analog level via successive approximation. The A/D conversion of

the analog input signal results in a Corresponding10-bit digital number. The A/D module has high and low voltage reference input that is software selectable to some combination of VDD, VSS, and RA2 or RA3.

The A/D module has four registers. These registers are

A/D result high register (ADRESH)

A/D RESULT LOW REGISTER (ADRESL)

A/D CONTROL REGISTER 0 (ADCON0)

A/D CONTROL REGISTER 1 (ADCON1)

APPLICATIONS OF MICROCONTROLLERS

Microcontrollers are designed for use in sophisticated real time applications such as

1. Industrial Control

2. Instrumentation and

3. Intelligent computer peripherals

They are used in industrial applications to control

• Motor

• Robotics

• Discrete and continuous process control

APPENDIX-II

MICROCONTROLLER CODING

APPENDIX 2

MICROCONTROLLER CODING

```
#include<pic.h>

static bit rly1 @((unsigned) &PORTC*8+0);

static bit rly2 @((unsigned) &PORTC*8+1);

static bit rly3 @((unsigned) &PORTC*8+2);


void main()

{

TRISB=0xff;

TRISC=0x00;

rly1=rly2=rly3=1;


while(1)

{

if(PORTB==0xff)

    {

        rly1=rly2=rly3=1;

    }
```

```
else if(PORTB==0xfe)

        {

                rly1=0; rly2=rly3=1;

        }

else if(PORTB==0xfd)

        {

                rly2=0; rly1=rly3=1;

        }

else if(PORTB==0xf7)

        {

                rly1=rly2=1; rly3=0;

        }

}

}
```

REFERENCES

APPENDIX-III

VISUAL BASIC CODING

APPENDIX 3

VISUAL BASIC CODING

```
Private Sub cmdexit_Click()

End

End Sub



Private Sub Form_Load()

dataaddr = &H378

contaddr = &H37A

End Sub



Private Sub cmdspeed1_Click()

Out contaddr, &H21

Out dataaddr, &HFE

Out contaddr, &H5

Out contaddr, &H0

End Sub
```

```
Private Sub cmdspeed2_Click()

Out contaddr, &H21

Out dataaddr, &HFD

Out contaddr, &H5

Out contaddr, &H0

End Sub


Private Sub cmdspeed3_Click()

Out contaddr, &H21

Out dataaddr, &HF7

Out contaddr, &H5

Out contaddr, &H0

End Sub


Private Sub cmdoff_Click()

Out contaddr, &H21

Out dataaddr, &HFF

Out contaddr, &H5

Out contaddr, &H0

End Sub
```

```
Private Sub cmdleft_Click()

Out contaddr, &H21

Out dataaddr, &HEF

Out contaddr, &H5

Out contaddr, &H0

End Sub


Private Sub cmdright_Click()

Out contaddr, &H21

Out dataaddr, &HDF

Out contaddr, &H5

Out contaddr, &H0

End Sub


Private Sub cmdstraight_Click()

Out contaddr, &H21

Out dataaddr, &H7F

Out contaddr, &H5

Out contaddr, &H0

End Sub
```

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