BONAFIDE CERTIFICATE

Certified that this project report **"RF BASED MONITORING AND CONTROL OF PRODUCTION UNIT"** is the bonafide work of

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Abstract

Our project is used to control and monitor the various parameters of the industrial running equipments and transmit the data from ground station to remote station using RF communication. It is mainly used to reduce man power and unexpected machine failures. Earlier, in the industries every operation was done manually. So, it was erroneous and led to power loss and machine shut down. To overcome this, we have adopted automated system. Various Industrial parameters like voltage, temperature, fuel level and the RPM of the load (here DC motor) are monitored and controlled using embedded system.

The project makes use of three sensors – temperature, level and IR sensor and a separate voltage sensing unit. All the sensors are monitored and controlled using PIC Microcontroller and transmitted to the remote station via serial communication and RF communication. The RF used here is the standard industrial frequency of 433.3 MHZ. A Coolant fan and a solenoid valve are used as FCE .Ground station display is done using 2x16 LCD MODULE and remote station front end storage and display is using a new software (SCADA ANIMATED). The reference value for the various sensors can be given by the user in the front end and altered to convenience.

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LIST OF ABBREVIATIONS

ACRONYM	EXPANSION
FCE	Final Control Element
LCD	Liquid Crystal Display
PIC	Peripheral Interface Controller
PC	Personal Computer
DTE	Data Terminal Equipment
DCE	Data Terminal Circuiting Equipment
RF	Radio Frequency
PDIP	Plastic Dual-In-Line Package
RISC	Reduced Instruction Set Computer
RAM	Random Access Memory
EEPROM	Electrically Erasable Programmable Read Only Memory
PWM	Pulse Width Modulation
SSP	Synchronous Serial Port
USART	Universal Synchronous Asynchronous Receiver Transmitter
SCI	Serial Communication Interface
PSP	Parallel Slave Port
SFR	Special Function Register
PC	Program Counter
CCP	Capture Compare PWM module
MSSP	Master Synchronous Serial Port
SPI	Serial Peripheral Interface
I^2C	Inter Integrated Circuit
LED	Light Emitting Diode
IR	Infra Red
Rpm	Revolutions per Minute
LCD	Liquid Crystal Display
DC	Direct Current

CHAPTER 1

CHAPTER 1

INTRODUCTION

Most industries, employing production unit has the necessity of maintaining round the clock production. Any mishap or discontinuity in the production process, may lead to power loss, productivity loss and machine shutdown. Moreover, in industries consisting of a number of stations, transmission of data from one station to another was not continuous and subjective to data loss.

Our project provides automation and continuous transmission of production modules using embedded system and wireless communication. Basic industrial parameters such as temperature, fuel level, voltage and speed of the motor are monitored and controlled using PIC controller. The data is transmitted from ground station to remote station, stored in a data base and displayed in the front end tool .Depending on the requirement and the distance to be covered; various wireless communication techniques such as RF, GSM can be employed. As a minimal coverage we have employed RF communication in our project. For User interface, LCD Display module and front end software are developed. Our project has the advantage of providing a good controlling system, high efficiency, reduction in man power, no power loss and continuous monitoring of loads.

CHAPTER 2

CHAPTER 2

SYSTEM ANALYSIS

2.1 PRESENT SCENARIO:

In any production industry every operation requires man power. The control operations done manually are prone to errors, for example, unexpected machine shut down due to carelessness. Also the absence of effective monitoring and control leads to power loss.

2.2 PROPOSED SYSTEM:

This project is used to control and monitor the various parameters of the industrial running equipments. The various parameters like voltage, temperature and fuel level and the RPM of the load is monitored and controlled using embedded system from a remote station. It is mainly used in the industries to reduce the man power and the unexpected machine failures. It also provides excellent energy auditing.

This system integrates Embedded System and Serial Communication. Here the parameters are continuously monitored. It employs basic client-server architecture, ***Client*** – reads data from transmission module at the production plant; ***Server*** – located at remote station and stores the continuous data.

2.3 FEASIBILITY STUDY:

ECONOMICAL FEASIBILITY:

This industrial monitoring system makes use of very basic components, such as IR sensor, temperature sensor and RF communication modules which are readily available in the electronic market at affordable costs. The overall cost of this unit is lesser than other monitoring equipments by manifold.

OPERATIONAL FEASIBILITY:

This industrial monitoring system is designed for easy use by the end-user. There are no operational complexities as those present in some existing modules. The units are small, weightless and make the best use of the wireless technology. The system automatically records temperature, level and RPM once the unit is switched ON. The system design has an LCD display that displays the parameters and it would help the operator to easily monitor the conditions at any time. Thus, the proposed system is simple in design and easy to operate.

CHAPTER 3

CHAPTER 3

BLOCK DIAGRAM

3.1 TRANSMITTER SIDE:

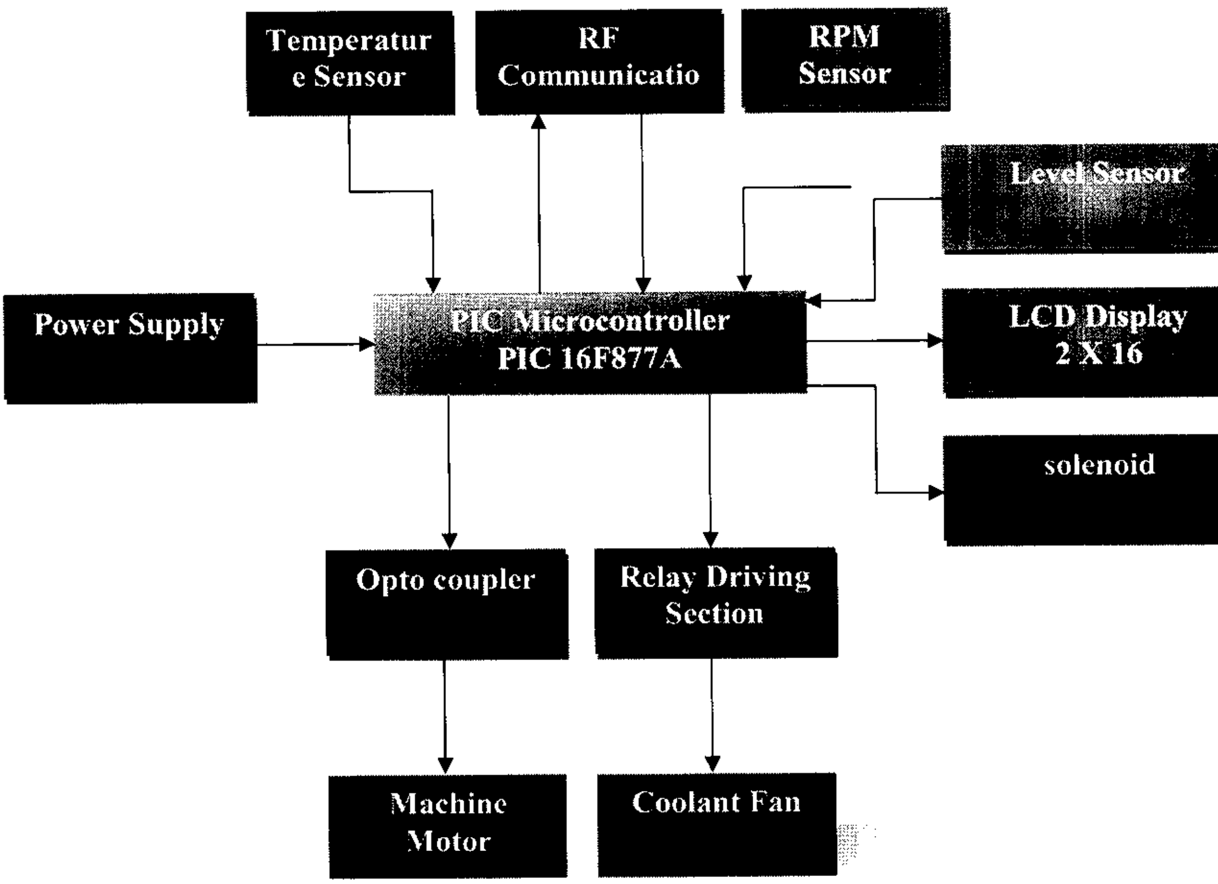


FIG 3.1 TRANSMITTER SIDE

3.2 RECEIVER SIDE:

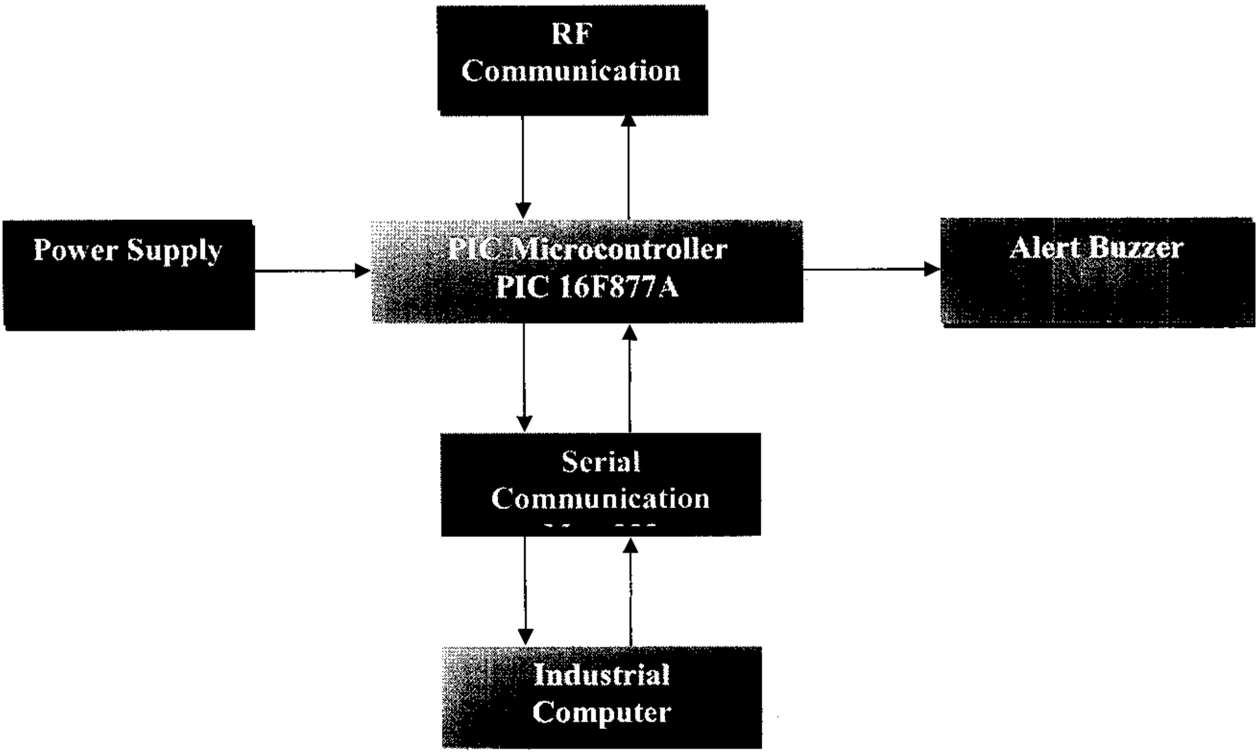


FIG 3.3 RECEIVER SIDE

CHAPTER 4

CHAPTER 4

SYSTEM REQUIREMENTS

.1 HARDWARE REQUIREMENTS

he following are the components required for the system hardware:

- PIC microcontroller 16F877A – 40 pin Dual Inline Package
- Temperature Sensor LM 35
- Infrared Sensor
- Level sensor board
- Voltage sensing unit
- Serial Communication MAX232
- 16 X 2 character LCD display
- pn Junction Diode 1N 4007
- Ceramic Capacitors 0.1μF, Type 104
- Capacitors 1000μF/35V, 22μF/25V, 47μF/25V and 10μF
- Voltage Regulator 7805
- Step Down Transformer 230/12V
- Resistors 330Ω, 10k Ω, 1k Ω and 75 Ω
- RF transmitter and receiver – 433.3 MHZ

4.2 SOFTWARE REQUIREMENTS

- CCS Compiler
- SQL Server
- SCADA Front end

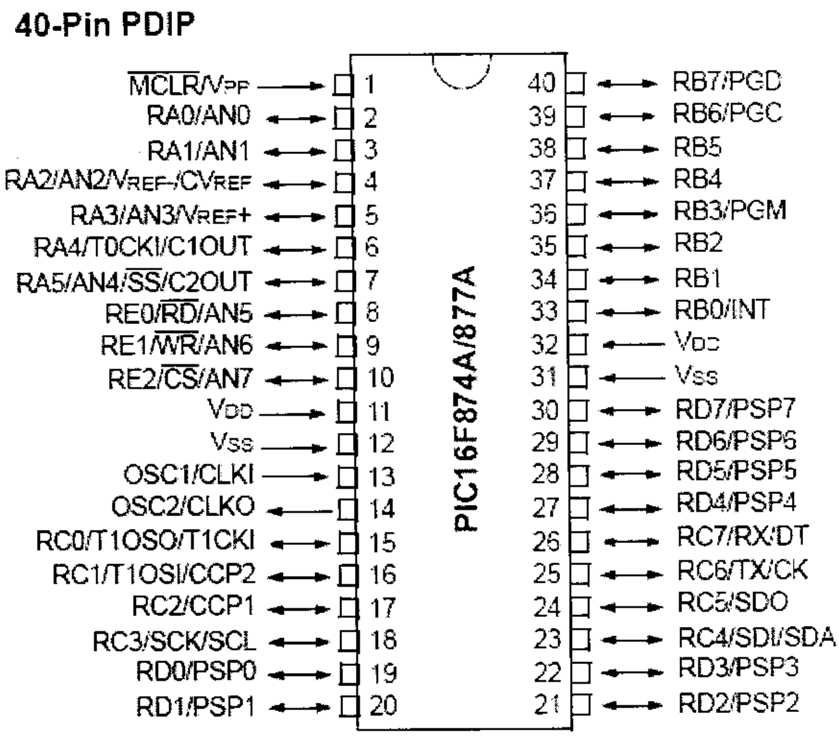
CHAPTER 5

CHAPTER 5

COMPONENT DETAILS

5.1 PIC MICROCONTROLLER 16F877A

Figure – Pin Diagram of PIC Microcontroller 16F877A



HIGH PERFORMANCE RISC CPU

- Only 35 single-word instructions to learn
- All single-cycle instructions except for program branches, which are two-cycle
- Operating speed: DC – 20 MHz clock input

  DC – 200 ns instruction cycle
- Up to 8K x 14 words of Flash Program Memory

  Up to 368 x 8 bytes of Data Memory (RAM)

  Up to 256 x 8 bytes of EEPROM Data Memory

PERIPHERAL FEATURES

- Timer0: 8-bit timer/counter with 8-bit prescaler
- Timer1: 16-bit timer/counter with prescaler, can be incremented during Sleep via external crystal/clock
- Timer2: 8-bit timer/counter with 8-bit period register, prescaler and postscaler
- Two Capture, Compare, PWM modules
    - Capture is 16-bit, maximum resolution is 12.5 ns
    - Compare is 16-bit, maximum resolution is 200 ns
    - PWM maximum resolution is 10-bit
- Synchronous Serial Port (SSP) with SPI™ (Master mode) and I2C™ (Master/Slave)
- Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI) with 9-bit address detection
- Parallel Slave Port (PSP) – 8 bits wide with external RD, WR and CS controls (40/44-pin only)
- Brown-out detection circuitry for Brown-out Reset (BOR)

ANALOG FEATURES:

- 10-bit, up to 8-channel Analog-to-Digital Converter (A/D)
- Brown-out Reset (BOR)
- Analog Comparator module with:
    - Two analog comparators
    - Programmable on-chip voltage reference (V_{REF}) module
    - Programmable input multiplexing from device inputs and internal voltage reference
    - Comparator outputs are externally accessible

SPECIAL MICROCONTROLLER FEATURES

- 100,000 erase/write cycle Enhanced Flash program memory typical
- 1,000,000 erase/write cycle Data EEPROM memory typical
- Data EEPROM Retention > 40 years
- Self-reprogrammable under software control
- In-Circuit Serial Programming™ (ICSP™) via two pins
- Single-supply 5V In-Circuit Serial Programming
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving Sleep mode
- Selectable oscillator options
- In-Circuit Debug (ICD) via two pins

DEVICE FEATURES

Table – 5.1.a Device Features

Key Features	**PIC 16F877A**
Operating Frequency	DC – 20 MHz
Resets (and Delays)	POR, BOR (PWRT, OST)
Flash Program Memory (14-bit words)	8K
Data Memory (bytes)	368
EEPROM Data Memory (bytes)	256
Interrupts	15
I/O Ports	Ports A, B, C, D, E
Timers	3
Capture/Compare/PWM Modules	2

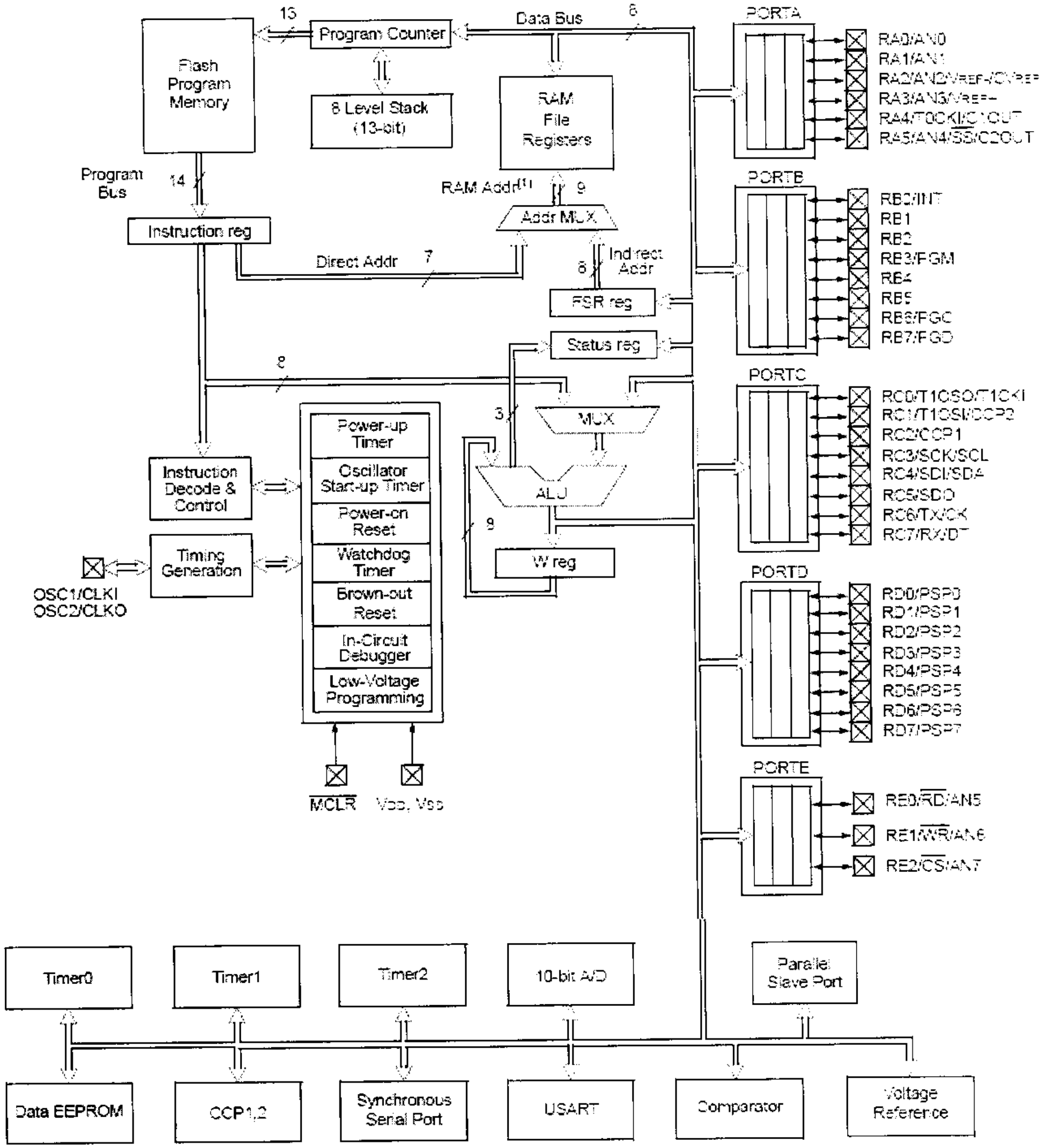
Key Features	**PIC 16F877A**
Parallel Communications	PSP
10-bit Analog-to-Digital Module	8 input channels
Analog Comparators	2
Instruction Set	35 instructions
Packages	40-pin PDIP 44-pin PLCC 44-pin TQFP 44-pin QFN

TIMERS

When interfacing the **Timer0** module timer/counter has the following features:

- 8-bit timer/counter
- Readable and writable
- 8-bit software programmable prescaler
- Internal or external clock select
- Interrupt on overflow from FFh to 00h
- Edge select for external clock

igure 5.1.b– Block Diagram of PIC 16F877A



Device	Program Flash	Data Memory	Data EEPROM
PIC16F874A	4K words	192 Bytes	128 Bytes
PIC16F877A	8K words	368 Bytes	256 Bytes

Note 1: Higher order bits are from the Status register.

UNIVERSAL SYNCHRONOUS ASYNCHRONOUS RECEIVER TRANSMITTER (USART)

The Universal Synchronous Asynchronous Receiver Transmitter (USART) module is one of the two serial I/O modules. USART is also known as a Serial Communications Interface or SCI. The USART can be configured as a full-duplex asynchronous system that can communicate with peripheral devices, such as CRT terminals and personal computers, or it can be configured as a half-duplex synchronous system that can communicate with peripheral devices, such as A/D or D/A integrated circuits, serial EEPROMs, etc. The USART can be configured in the following modes:

- Asynchronous (full-duplex)
- Synchronous – Master (half-duplex)
- Synchronous – Slave (half-duplex)

ANALOG TO DIGITAL CONVERTER

The Analog-to-Digital (A/D) Converter module has eight inputs for the 40/44-pin devices. The conversion of an analog input signal results in a corresponding 10-bit digital number. The A/D module has high and low-voltage reference input that is software selectable to some combination of V_{DD}, V_{SS}, RA2 or RA3. The A/D converter has a unique feature of being able to operate while the device is in Sleep mode. To operate in Sleep, the A/D clock must be derived from the A/D's internal RC oscillator. 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)

COMPARATOR

The comparator module contains two analog comparators. The inputs to the comparators are multiplexed with I/O port pins RA0 through RA3, while the outputs are multiplexed to pins RA4 and RA5. The on-chip voltage reference can also be an input to the comparators.

5.2. LCD DISPLAY

A **liquid crystal display (LCD)** is a thin, flat electronic visual display that uses the light modulating properties of liquid crystals (LCs). LCDs do not emit light directly. Liquid crystal displays are a passive display technology. This means they do not emit light; instead, they use the ambient light in the environment. By manipulating this light, they display images using very little power. This has made LCDs the preferred technology whenever low power consumption and compact size are critical. They are used in a wide range of applications, including computer monitors, television, instrument panels, aircraft cockpit displays etc., They are common in consumer devices such as video players, gaming devices, clocks, watches, calculators, and telephones. LCDs have displaced cathode ray tube (CRT) displays in most applications.

ADVANTAGES

a) More compact
b) Light weight
c) Portable
d) Less expensive
e) More reliable
f) Easier on the eyes

Table – 5.2.a Pinout Description of LCD

Pin Number	Symbol	Function
1	V_{SS}/GND	Ground
2	V_{DD}	Supply Voltage +3V or +5V
3	V_O	Contrast Adjustment
4	RS	H/L Register Select Signal 0 - Control input 1 - Data input
5	R/W	H/L Read/Write Signal
6	E	H/L Enable Signal
7 to 14	DB0 – DB7	H/L Data Bus Line
15	A/V_{EE}	+4.2V for LED/Negative Voltage Output
16	K	Power Supply for backlight (0V)

ALGORITHM TO SEND DATA TO LCD

1. Make R/W low
2. Make RS=0; if data byte is command

   RS=1; if data byte is data (ASCII value)
3. Place data byte on data register
4. Pulse E (HIGH to LOW)
5. Repeat the steps to send another data byte

LCD INITIALIZATION

Working of LCD depends on the how the LCD is initialized. A few command bytes have to be sent to initialize the LCD. They are:

1. Specify function set:

Send **38H** for 8-bit,double line and 5x7 dot character format.

2. Display On-Off control:

3. Entry mode set:

Send **06H** for cursor in increment position and shift is invisible.

4. Clear display:

Send **01H** to clear display and return cursor to home position.

Table – 5.2.b Addresses of cursor position for 16x2 LCD

Line 1	80 H	81 H	82 H	83 H	84 H	85 H	86 H	87 H	88 H	89 H	8A H	8B H	8C H	8D H	8E H	8F H
line2	C0 H	C1 H	C2 H	C3 H	C4 H	C5 H	C6 H	C7 H	C8 H	C9 H	CA H	CB H	CC H	CD H	CE H	CF H

SPECIAL FEATURES OF LCD

- 5 x 8 dots with cursor
- Built-in controller
- + 5V power supply (Also available for + 3V)
- 1/16 duty cycle
- B/L to be driven by pin 1, pin 2 or pin 15, pin 16

RF TRANSMITTER AND RECEIVER

5.3 RF TRANSMITTER:

In electronics and telecommunications a transmitter or radio transmitter is an electronic device which, with the aid of an antenna, produces radio waves. The transmitter itself generates a radio frequency alternating current, which is applied to the antenna. When excited by this alternating current, the antenna radiates radio waves.

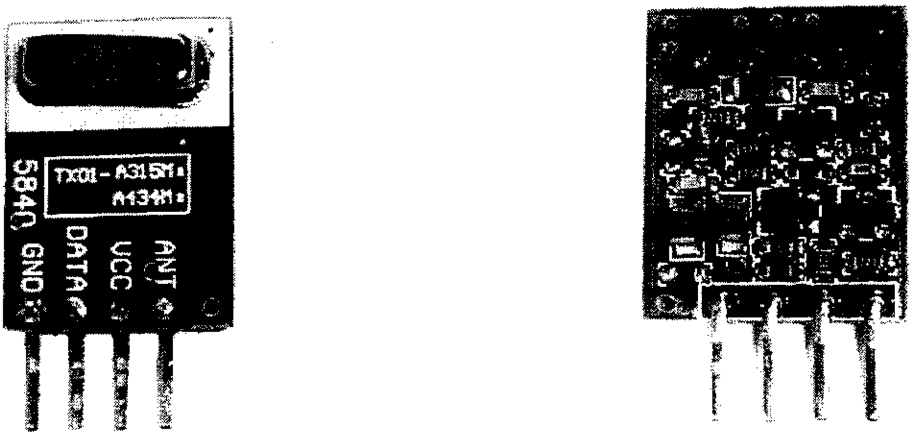


FIG – 5.2.a RF TX PHYSICAL LAYOUT

- Complete RF Transmitter Module no external components and no tuning required.
- High Performance SAW Based Architecture with a Maximum Range of 100 feet at 4800 bps data rate.
- Interface directly to Encoders and Microcontrollers with ease.
- Low Power Consumption suitable for battery operated devices

The RF transmitter used here is of frequency 433.92 MHz .The STT-433 is ideal for remote control applications where low cost and longer range is required. The transmitter operates from a1.5-12V supply, making it ideal for battery-powered applications. The transmitter employs a SAW-stabilized oscillator, ensuring accurate are easy to control, making FCC and ETSI compliance easy. The manufacturing-friendly SIP style package and low-cost make the STT-433 suitable for high volume applications.

FEATURES:

- 433.92 MHz Frequency.
- Low Cost.
- 1.5-12V operation.
- 11mA current consumption at 3V.
- Small size.
- 4 dBm output power at 3V.
- Data rate is of 8kbps.
- Circuit Shape: SAW.
- Non-Operating Case Temperature: -20 to +85°C
- Soldering Temperature (10 Seconds): 230 degree C (10 Seconds).
- Produces 10mw peak output power depending on the power supply.
- Typical range is 300 feet (100 meters) - in open air, 100 feet (30 meters) - inside depending on the environment, antenna and supply voltage.
- The antenna can be a short wire 17cm (6.7") long (1/4 wavelength).

PIN DESCRIPTION:

pin 1 : GND
pin 2 : Data in
pin 3 : VCC
pin 4 : ANT

TABLE 5.3 RF TX PIN DESCRIPTION

S.NO	PIN NAME	DESCRIPTION
1.	ANT	50 ohm antenna output. The antenna port impedance affects Output power and harmonic emissions. An L-C low-pass filter May be needed to sufficiently filter harmonic emissions. Antenna can be single core wire of approximately 17cm length or PCB Trace antenna.
2.	VCC	Operating voltage for the transmitter. VCC should be bypassed with a .01uF ceramic capacitor and filtered with a 4.7uF tantalum Capacitor. Noise on the power supply will degrade transmitter Noise performance.
3.	DATA	Digital data input. This input is CMOS compatible and should be Driven with CMOS level inputs.
4.	GND	Transmitter ground. Connect to ground plane.

DATA RATE:

The oscillator start-up time is on the order of 40uSec, which limits the maximum data rate to 4.8 Kbit/sec.

5.4 RF RECEIVER:

Radio Frequency (RF) Modules allow you to exchange data between suitably-equipped microcontrollers without wires. These modules exchange raw data; that is, no packetization or addressing is performed. The 433 MHz RF Receiver Module is a compact and easy-to-use module for receiving data from up to 45m (150 ft.) away. It easily connects to any microcontroller with just 1 wire and can achieve data rates of up to 2400 baud.

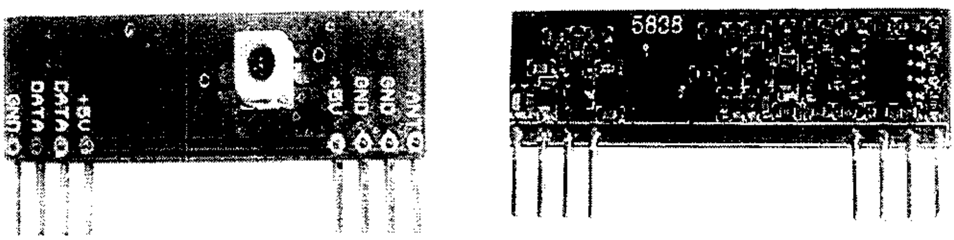


FIG – 5.3.a RF RX PHYSICAL LAYOUT

Super-regenerative design exhibits exceptional sensitivity at a very low cost. The manufacturing-friendly SIP style package and low-cost make the STR-433suitable for high volume applications. This compact radio frequency (RF) receiver module is suitable for remote control or telemetry applications. The double sided circuit board is pre-populated with Surface Mount Devices (SMD) and is tuned to 433MHz. No module assembly or adjustments are required. RF remote receiver module RX433 can also be used with 433MHz RF Transmitter TX433N for your custom remote control or telemetry requirements.

FEATURES:

- Low Cost
- 5V operation
- 3.5mA current drain
- No External Parts are required

- Typical sensitivity: -105dBm
- IF Frequency: 1MHz.
- Stable output
- No receiver module adjustments required
- Suitable for RF remote controls, telemetry.
- Receiver range – 200m in open air.
- Digital and linear output

PIN DESCRIPTION:

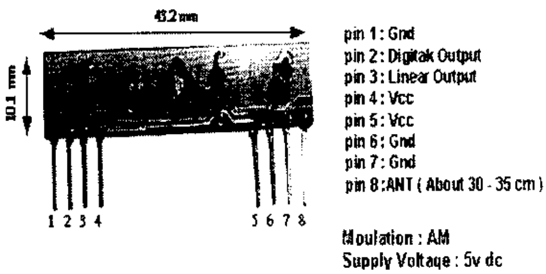


FIG – 5.3.b RF RX PIN DESCRIPTION

TABLE 5.4 RF RX PIN DESCRIPTIONS

S.NO	PIN NAME	DESCRIPTION
1.	ANT	Antenna input.
2.	GND	Receiver Ground. Connect to ground plane
3.	VCC(5V)	VCC pins are electrically connected and provide operating voltage for the Receiver. VCC can be applied to either or both. VCC should be bypassed With a .1μF ceramic capacitor. Noise on the power supply will degrade Receiver sensitivity.
4.	DATA	Digital data output. This output is capable of driving one TTL or CMOS load. It is a CMOS compatible output.

OPERATION:

Super-Regenerative AM Detection

The STR-433 uses a super-regenerative AM detector to demodulate the ncoming AM carrier. A super regenerative detector is a gain stage with positive feedback greater than unity so that it oscillates. An RC-time constant is included in he gain stage so that when the gain stage oscillates, the gain will be lowered over time proportional to the RC time constant until the oscillation eventually dies. When the oscillation dies, the current draw of the gain stage decreases, charging the RC circuit, increasing the gain, and ultimately the oscillation starts again. In this way, the oscillation of the gain stage is turned on and off at a rate set by the RC time constant. This rate is chosen to be super-audible but much lower than the main oscillation rate. Detection is accomplished by measuring the emitter current of the gain stage. Any RF input signal at the frequency of the main oscillation will aid the main oscillation in restarting. If the amplitude of the RF input increases, the main oscillation will stay on for a longer period of time, and the emitter current will be higher. Therefore, we can detect the original base-band signal by simply low-pass filtering the emitter current. The average emitter current is not very linear as a function of the RF input level. It exhibits a 1/ln response because of the exponentially rising nature of oscillator start-up. The steep slope of a logarithm near zero results in high sensitivity to small input signals.

Typically involve microcontrollers. Data is sent as a constant rate square-wave. The duty cycle of that square wave will generally be either 33% (a zero) or 66% (a one).

Power Supply

The STR-433 is designed to operate from a 5V power supply. The power antalum capacitor. These capacitors should be placed as close to the power pins as possible. The STR-433 is designed for continuous duty operation. From the time power is applied, it can take up to 750mSec for the data output to become valid.

Antenna Input

It will support most antenna types, including printed antennas integrated directly onto the PCB and simple single core wire of about 17cm. The performance of the different antennas varies. Any time a trace is longer than 1/8th the wavelength of the frequency it is carrying, it should be a 50 ohm micro strip.

Suitable antennas are required to the success of low-power wireless application. There are some key points on applying the antennas:

A. Antenna should be placed on the outside of the product. And try to place the antenna on the top of the product.

B. Antenna can't be placed inside a metal case because of its shielding effect.

C. Antenna design involves expensive test equipments such as vector network analyzer and calibrated test antenna. Unless you have access to these equipments, the use to an antenna consultant is recommended.

E. 50-Ohm antenna is recommended for the best matching.

F. For 433.92MHz application, antenna length = 17 cm.

5.5 SENSORS

5.5.1 TEMPERATURE SENSOR (LM358):

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1 4°Cat room temperature and ±3 4°C over a full −55 to +150°C Temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. The LM358 series consists of two independent, high gains, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

As it draws only 60 μA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range, while the LM35C is rated for a −40° to +110°C range (−10°with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while theLM35C, LM35CA, and LM35D are also available in the Plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a Plastic TO-220 package.

FEATURES:

- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor
- 0.5°C accuracy guarantee able (at +25°C)
- Rated for full −55° to +150°C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts

- Low self-heating, 0.08°C in still air
- Nonlinearity only ±1 4°C typical
- Low impedance output, 0.1 W for 1 mA load
- Large DC voltage gain :100dB
- Wide bandwidth (unity gain): 1MHz (temperature compensated).
- Wide power supply range.
- Low input offset voltage: 2Mv
- Low input offset current : 2nA
- Large output voltage swing
- Input common mode voltage range includes ground
- Differential input voltage range equals power supply.
- Very low supply current drain.

Package Type:

TO-220 PLASTIC PACKAGE

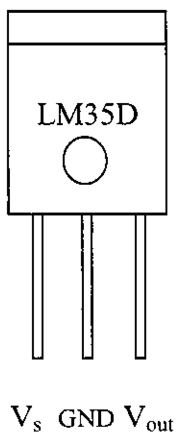


FIG 5.4 PACKAGE TYPE

ADVANTAGES

- Two internally compensated op amps in a single Package
- Eliminates need for dual supplies
- Allows directly sensing near GND and VOUT also goes To GND
- Compatible with all forms of logic
- Power drain suitable for battery operation
- Pin-out same as LM1558/LM1458 dual operational amplifier

5.5.2 RPM SENSOR

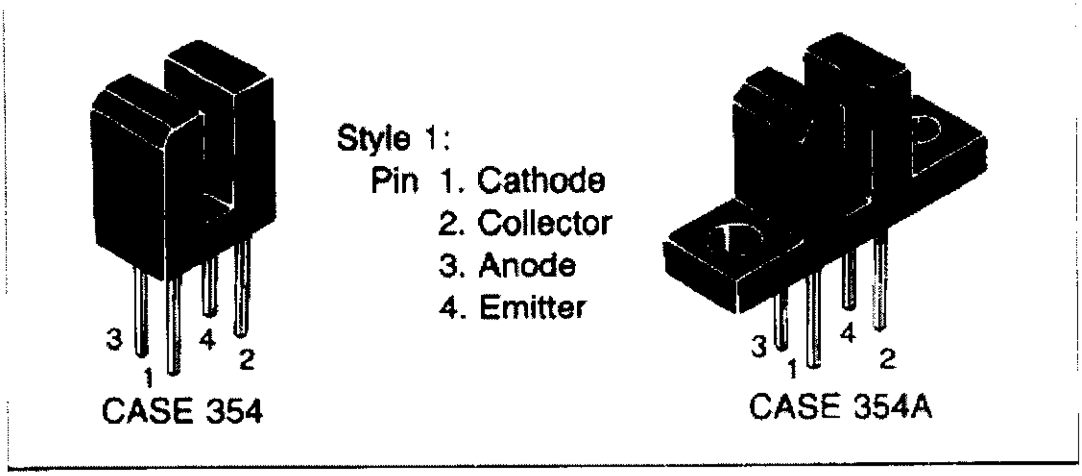
IR SENSOR

The main components are an infrared source (lamp), a sample chamber or ght tube, a wavelength filter, and the infrared detector. The gas is pumped (or ffuses) into the sample chamber, and gas concentration is measured electro-ptically by its absorption of a specific wavelength in the infrared (IR). The IR ght is directed through the sample chamber towards the detector. In parallel there another chamber with an enclosed reference gas, typically nitrogen. The detector s an optical filter in front of it that eliminates all light except the wavelength that e selected gas molecules can absorb. Ideally other gas molecules do not absorb ght at this wavelength, and do not affect the amount of light reaching the detector.

The IR signal from the source is usually chopped or modulated so that ermal background signals can be offset from the desired signal. It consists of just o components. The first is an Infra-Red (IR) transmitter (usually an LED), while e second is an Infra-Red receiver (usually a transistor). IR is transmitted out of e sensor unit. If the IR is reflected back, it is picked up by the IR receiver ansistor.

,OTTED COUPLER:

ere we use a slotted coupler MOC7811.Slotted coupler consists of an infrared iitting diode facing a photodetector in a molded plastic housing. A slot in the using between the emitter and the detector provides a means of interrupting the ;nal.

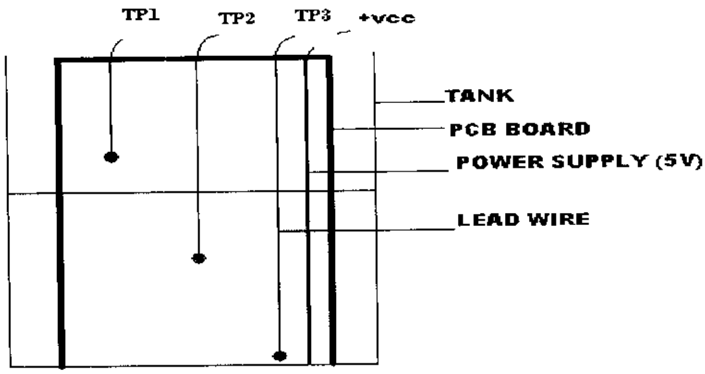


G – 5.5 OPTOCOUPLER

5.3 LEVEL SENSOR:

Level sensors detect the level of substances that flow, including liquids, ırries, granular materials, and powders. All such substances flow to become sentially level in their containers (or other physical boundaries) because of avity. The substance to be measured can be inside a container or can be in its ıtural form (e.g. a river or a lake). The level measurement can be either ıntinuous or point values.

In our project we use a pcb board consisting of three leads to measure three fferent levels. A constant +5V supply is given as power supply. On contact with e fuel each lead conducts producing a +5 V, Which is sensed by the controller.



G – 5.6 LEVEL SENSOR

ORKING:

The level sensor is placed into the tank whose level is to be measured. epending on the level of the tank the lead wires sends a +5v to the controller.PIC tects the voltage from the lead wire and displays the corresponding level of the nk.

If the level of the tank is extremely high the solenoid valve which allows the flow of fuel will be closed. And if the level of the fuel is extremely low or empty the motor will be switched off.

CHAPTER 6

CHAPTER 6
INTERFACING DETAILS

TERFACING TO THE PC :

SERIAL COMMUNICATION MAX 232

Serial communication is a popular means of transmitting data between a mputer and a peripheral device such as a programmable instrument or even other computer. Serial communication uses a transmitter to send data, one bit at ime, over a single communication line to a receiver. We can use this method nen data transfer rates are low or to transfer data over long distances. Serial mmunication is popular because most computers have one or more serial ports, no extra hardware is needed other than a cable to connect the instrument to the mputer or two computers together.

erial communication requires that the following four parameters are specified:

- The baud rate of the transmission
- The number of data bits encoding a character
- The sense of the optional parity bit
- The number of stop bits

Each transmitted character is packaged in a character frame that consists of a ngle start bit followed by the data bits, the optional parity bit, and the stop bit or ts.

Baud rate is a measure of how fast data are moving between instruments at use serial communication. RS-232 uses only two voltage states, called MARK nd SPACE. In such a two-state coding scheme, the baud rate is identical to the aximum number of bits of information, including control bits that are transmitted

: RS-232 :

.S-232 (Recommended Standard 232) is the standard for serial binary single-ded data and control signals connecting between a *DTE* and a *DCE*. It is mmonly used in computer serial ports. Here we use for **PC interfacing**. In RS-2, user data is sent as a time-series of bits. Both synchronous and asynchronous nsmissions are supported by the standard. Since transmit data and receive data : separate circuits, the interface can operate in a full duplex manner, supporting ncurrent data flow in both directions.

The RS-232 standard defines the voltage levels that correspond to logical one d logical zero levels for the data transmission and the control signal lines. Valid gnals are plus or minus 3 to 15 volts; the ±3 V range near zero volts is not a valid S-232 level. The standard specifies a maximum open-circuit voltage of 25 volts: d we use signal level of ±12 V n depending on the power supply available within e device .Because the voltage levels are higher than logic levels typically used by tegrated circuits, special intervening driver circuits are required to translate logic vels. **MAX 232** is used as the driver here. These also protect the device's internal rcuitry from short circuits or transients that may appear on the RS-232 interface, d provide sufficient current to comply with the slew rate requirements for data ansmission . The pin outs of both D-9 & D-25 are show below.

BLE 6.1 PIN DESCRIPTION

D-Type-9 pin no.	D-Type-25 pin no.	Pin outs	Function
3	2	RD	Receive Data (Serial data input)
2	3	TD	Transmit Data (Serial data output)
7	4	RTS	Request to send (acknowledge to modem that UART is ready to exchange data
8	5	CTS	Clear to send (i.e.; modem is ready to exchange data)
6	6	DSR	Data ready state (UART establishes a link)
5	7	SG	Signal ground
1	8	DCD	Data Carrier detect (This line is active when modem detects a carrier
4	20	DTR	Data Terminal Ready.
9	22	RI	Ring Indicator (Becomes active when modem detects ringing signal from PSTN

CHAPTER 7

CHAPTER 7
OTHER COMPONENTS

7.1 BUZZER:

A **buzzer** or **beeper** is an audio signaling device, which may be mechanical, electromechanical, or electronic. Typical uses of buzzers and beepers include alarms, timers and confirmation of user input such as a mouse click or keystroke. Early devices were based on an electromechanical system identical to an electric bell without the metal gong. Similarly, a relay may be connected to interrupt its own actuating current, causing the contacts to buzz. Often these units were anchored to a wall or ceiling to use it as a sounding board. The word "buzzer" comes from the rasping noise that electromechanical buzzers made. A piezoelectric element may be driven by an oscillating electronic circuit or other audio signal source. Sounds commonly used to indicate that a button has been pressed are a click, a ring or a beep. Electronic buzzers find many applications in modern days.

7.2 LIGHT-EMITTING DIODE:

An LED consists of a junction diode made from the semi conducting compound Gallium Arsenide Phosphide. It emits light when diode is forward biased, the color depending on the composition and impurity content of the compound. At present, red, yellow and green are available. When a p-n junction diode is forward biased, electrons move across the junction from the n-type side to the p-type side where they recombine with holes near the junction. The same occurs with holes going across the junction from the p-type side. Every recombination results in the release of a certain amount of energy, causing, in most semiconductors, a temperature rise. In Gasp some of the energy is emitted as light , which gets out of the LED because the junction is formed very close to the surface of the material. An LED does not light when reverse biased.

JSES:

.ED's are used as indicator lamps, particularly in digital electronic circuits to show vhether the output is 'high' or 'low'. One way of using an LED to test for a 'high' utput (5V in this case) and for a 'low' output(0V).In the first case the output acts as he 'source' of the LED current and in the second it has to be able to accept or 'sink' he current. If the output is unable to supply the current required by the LED, the ircuit of can be employed. Here the output supplies the same base current to the ransistor, which then drives the LED.

7.3 COOLANT FAN:

A **fan** is a machine used to create flow within a fluid, typically a gas such as air.A fan consists of a rotating arrangement of vanes or blades which act on the air. Usually, it is contained within some form of housing or case. This may direct the airflow or increase safety by preventing objects from contacting the fan blades. Most fans are powered by electric motors, but other sources of power may be used, including hydraulic motors and internal combustion engines.

Fans produce air flows with high volume and low pressure, as opposed to compressors which produce high pressures at a comparatively low volume. A fan blade will often rotate when exposed to an air stream, and devices that take advantage of this, such as anemometers and wind turbines, often have designs similar to that of a fan.

7.4 SOLENOID:

A **solenoid** is a coil wound into a tightly packed helix .The term *solenoid* refers specifically to a magnet designed to produce a uniform magnetic field in a volume of .The term **solenoid** may also refer to a variety of transducer devices that convert energy into linear motion. The term is also often used to refer to a solenoid ctuates either a pneumatic or hydraulic valve, or a solenoid switch, which is a pecific type of relay that internally uses an electromechanical solenoid to operate an lectrical switch.

Iydraulic solenoid valves

Hydraulic solenoid valves are in general similar to pneumatic solenoid valves xcept that they control the flow of hydraulic fluid (oil), often at around 3000 psi 210 bar, 21 MPa, 21 MN/m. Hydraulic machinery uses solenoids to control the flow of oil to rams or actuators. Transmission control fluid flow through an automatic ransmission and are typically installed in the transmission valve body.

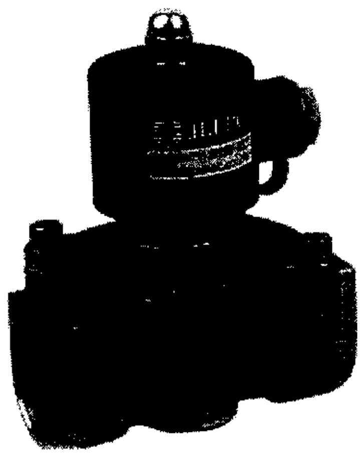


FIG – 7.1 SOLENOID VALVE

7.5 MACHINE MOTOR [DC Motor]:

Industrial applications use dc motors because the speed-torque relationship can be varied to almost any useful form -- for both dc motor and regeneration applications in either direction of rotation. Continuous operation of dc motors is commonly available over a speed range of 8:1. Infinite range (smooth control down

Dc motors are often applied where they momentarily deliver three or more times their rated torque. In emergency situations, dc motors can supply over five times rated torque without stalling (power supply permitting).

Dc motors feature a speed, which can be controlled smoothly down to zero, immediately followed by acceleration in the opposite direction -- without power circuit switching. And dc motors respond quickly to changes in control signals due to the dc motor's high ratio of torque to inertia.

7.6 OPTOCOUPLER:

Optocoupler is used to vary the speed of the motor. Pulse width modulation is used for speed variation. It is "an electronic device designed to transfer electrical signals by utilizing light waves to provide coupling with electrical isolation between its input and output". The main purpose of an opto-isolator is "to prevent high voltages or rapidly changing voltages on one side of the circuit from damaging components or distorting transmissions on the other side." Commercially available opto-isolators withstand input-to-output voltages up to 10 kV and voltage transients with speeds up to 10 kV/μs. An opto-isolator contains a source (emitter) of light, almost always a near infrared light-emitting diode (LED), that converts electrical input signal into light, a closed optical channel (also called dielectrical channel[5]), and a photosensor, which detects incoming light and either generates electric energy directly, or modulates electric current flowing from an external power supply.An optocoupled solid state relay contains a photodiode opto-isolator which drives a power switch, usually a complementary pair of MOSFET transistors. A slotted optical switch contains a source of light and a sensor, but its optical channel is open, allowing modulation of light by external objects obstructing the path of light or reflecting light into the sensor.

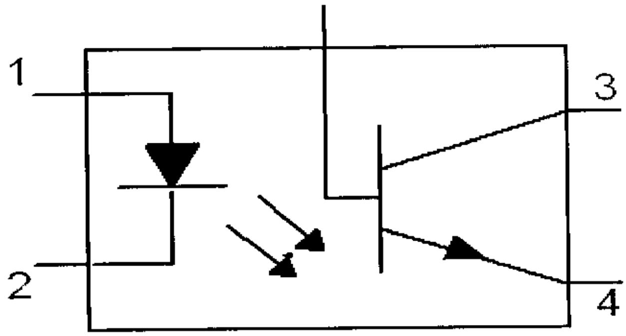


FIG – 7.2 OPTOCOUPLER

7.7 INDUSTRIAL COMPUTER :

Industrial PCs are used primarily for process control and/or data acquisition. In some cases, an **Industrial PC** is simply used as a front end to another control computer in a distributed processing environment. Software can be custom written for a particular application or an off-the-shelf package such as Wonder Ware, Labtech Notebook or LabView can be used to provide a base level of programming.

Industrial PCs offer features different from consumer PCs in terms of reliability, compatibility, expansion options and long-term supply.

Industrial PCs are typically characterized by being manufactured in lower volumes than home or office PC's. A common category of industrial PC is the 19-inch rackmount form factor. Industrial PCs typically cost considerably more than comparable office style computers with similar performance. Single-board computers and backplanes are used primarily in Industrial PC systems. However, the majority of industrial PCs are manufactured with COTS motherboards.

A subset of **industrial PCs** is the **Panel PC** where a display, typically an LCD, is incorporated into the same enclosure as the motherboard and other electronics. These are typically panel mounted and often incorporate touch screens for user interaction.

.8 RELAY:

A relay is a simple **electromechanical switch** made up of an electromagnet nd a set of contacts. Relays are found hidden in all sorts of devices. A relay is an **lectrically operated switch**. Current flowing through the coil of the relay creates a nagnetic field which attracts a lever and changes the switch contacts. The coil current an be on or off so relays have two switch positions and most have **double throw changeover**) switch contacts as shown in the diagram.

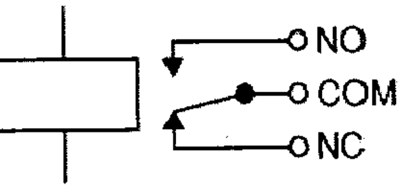


FIG – 7.2 RELAY

Relays are usually SPDT or DPDT but they can have many more sets of switch contacts

An electromagnetic relay is a type of electrical switch controlled by an electromagnet. The electromagnetic relay is used in a variety of applications, including alarms and sensors, signal switching, and the detection and control of faults on electrical distribution lines.

The core of the electromagnetic relay, naturally, is an electromagnet, formed by winding a coil around an iron core. When the coil is energized by passing current through it, the core in turn becomes magnetized, attracting a pivoting iron armature. As the armature pivots, it operates one or more sets of contacts, thus affecting the circuit. When the magnetic charge is lost, the armature and contacts are released. Demagnetization can cause a leap of voltage across the coil, damaging other components of the device when turned off. Therefore, the electromagnetic relay usually makes use of a diode to restrict the flow of the charge, with the cathode connected at the most positive end of the coil.

Pole and throw

Since relays are switches, the terminology applied to switches is also applied to relays. A relay will switch one or more *poles*, each of whose contacts can be *thrown* by energizing the coil in one of three ways:

- Normally-open (**NO**) contacts connect the circuit when the relay is activated; the circuit is disconnected when the relay is inactive. It is also called a **Form A** contact or "make" contact. **NO** contacts can also be distinguished as "early-make" or **NOEM**, which means that the contacts will close before the button or switch is fully engaged.
- Normally-closed (**NC**) contacts disconnect the circuit when the relay is activated; the circuit is connected when the relay is inactive. It is also called a **Form B** contact or "break" contact. **NC** contacts can also be distinguished as "late-break" or **NCLB**, which means that the contacts will stay closed until the button or switch is fully disengaged.
- Change-over (**CO**), or double-throw (**DT**), contacts control two circuits: one normally-open contact and one normally-closed contact with a common terminal. It is also called a **Form C** contact or "transfer" contact ("break before make"). If this type of contact utilizes a "make before break" functionality, then it is called a **Form D** contact.

The following designations are commonly encountered:

- **SPST**– Single Pole Single Throw. These have two terminals which can be connected or disconnected. Including two for the coil, such a relay has four terminals in total. It is ambiguous whether the pole is normally open or normally closed. The terminology "SPNO" and "SPNC" is sometimes used to resolve the ambiguity.
- **SPDT**– Single Pole Double Throw. A common terminal connects to either of two others. Including two for the coil, such a relay has five terminals in total.

Equivalent to two SPST switches or relays actuated by a single coil. Including two for the coil, such a relay has six terminals in total. The poles may be Form A or Form B (or one of each).

- **DPDT**– Double Pole Double Throw. These have two rows of change-over terminals. Equivalent to two SPDT switches or relays actuated by a single coil. Such a relay has eight terminals, including the coil.

Relays are used to and for:

- Control a high-voltage circuit with a low-voltage signal, as in some types of modems or audio amplifiers,
- Control a high-current circuit with a low-current signal, as in the starter solenoid of an automobile,
- Detect and isolate faults on transmission and distribution lines by opening and closing circuit breakers (protection relays).

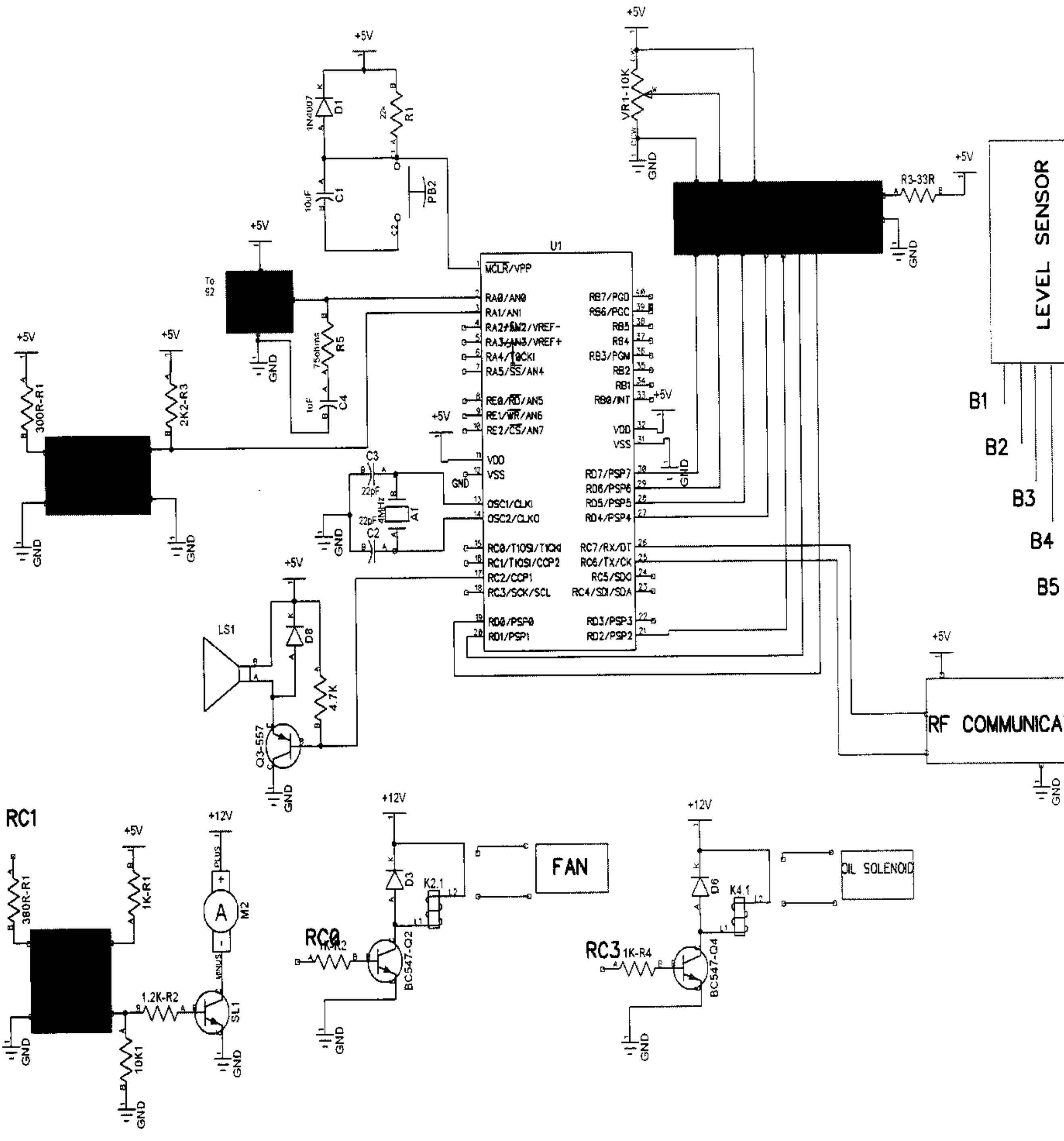
IN THE PROJECT:

Relay in this project , is used to switch on the fan and motor when the coil is energized. A +12V DC supply is used as the energizing voltage .

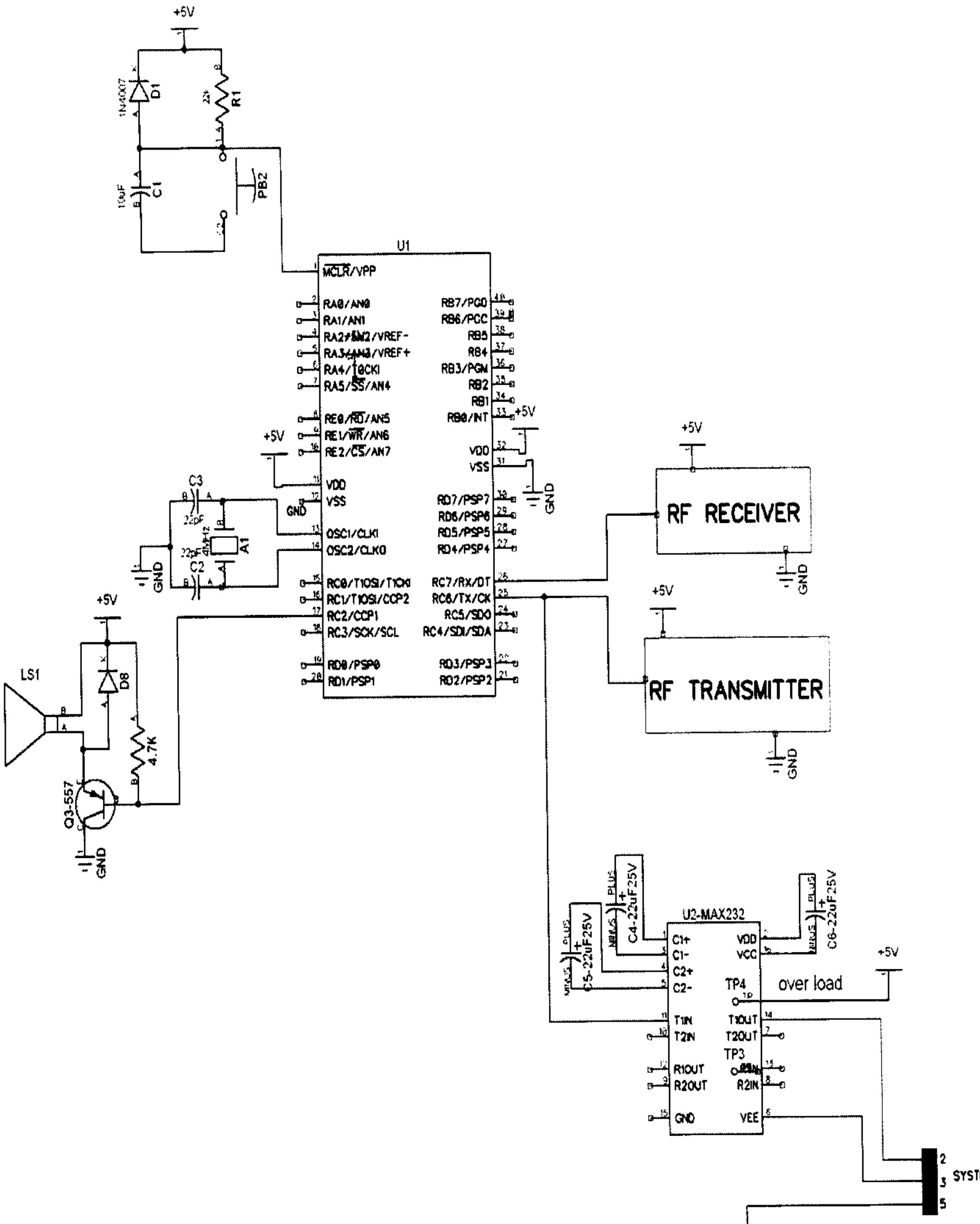
CHAPTER 8

TRANSMITTER SIDE

INDUSTRIAL MONITORING SYSTEM-SENSING UNIT



RECEIVER SIDE



CHAPTER 8

CIRCUIT DESCRIPTION

8.1 POWER SUPPLY

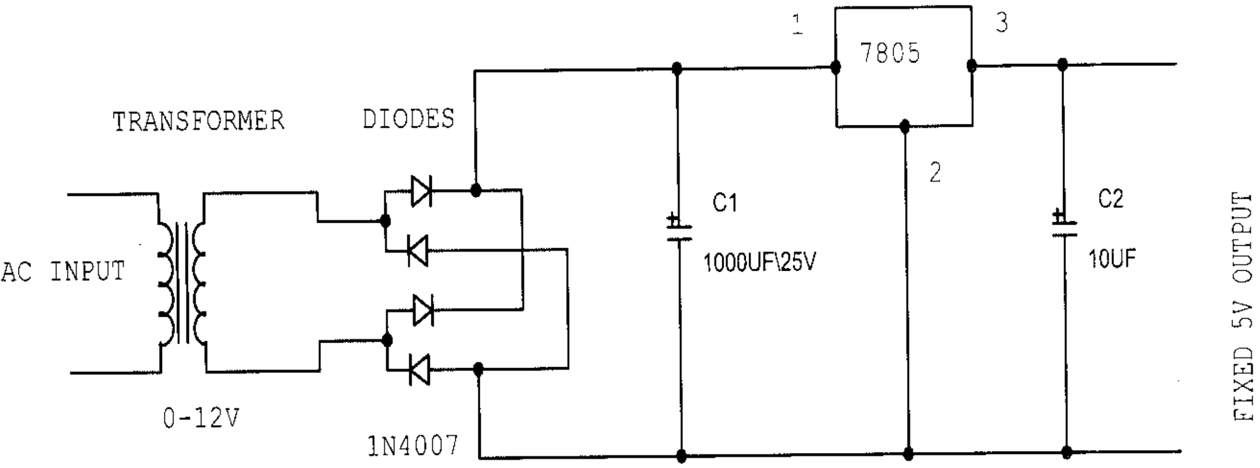


FIG – 8.1.a POWER SUPPLY

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.

A block diagram containing the parts of a typical power supply and the voltage at various points in the unit is shown. 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

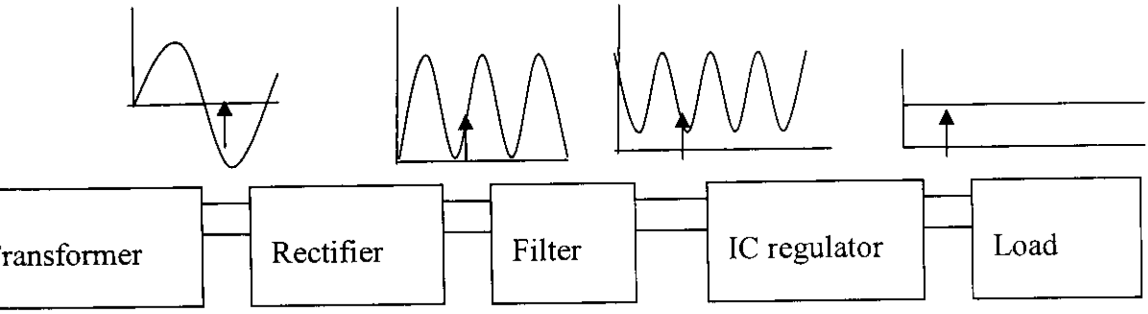


FIG – 8.1.b BLOCK DIAGRAM

3.2 IC VOLTAGE REGULATORS:

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 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 mill watts to tens of watts.

THREE-TERMINAL VOLTAGE REGULATORS:

FIXED VOLTAGE REGULATOR

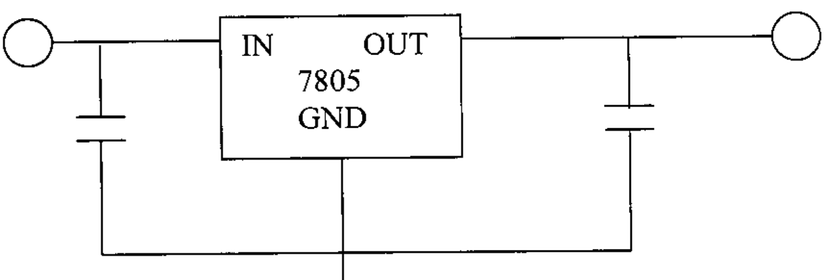


Fig shows the basic connection of a three-terminal voltage regulator IC to a oad. The fixed voltage regulator has an unregulated dc input voltage, Vi, applied to one input terminal, a regulated output dc voltage, Vo, from a second terminal, with he third terminal connected to ground. For a selected regulator, 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).

8.3 LCD DISPLAY

LCD is mainly used for display the information. Here we are using 2x16 LCD. Operation of the LCD is

- The declining prices of LCDs.
- The ability to display numbers, characters, and graphics. This is in contrast to LEDs, which are limited to numbers and characters.
- Incorporation of a refreshing controller into the LCD, thereby relieving the CPU of the task of refreshing the LCD. In contrast, the LED must be refreshed by the CPU to keep displaying the data.
- Ease of programming for characters and graphics.

LCD pin descriptions

Vcc, Vss, and Vee

While Vcc and Vss provide +5V and ground, respectively, Vee is used for controlling LCD contrast.

RS, register select

There are two very important registers inside the LCD. The RS pin is used for their selection as follows. If RS=0 the instruction command code register is selected, allowing the user to send a command such as clear display, cursor at home, etc. if RS=1d the data register is selected, allowing the user to send data to be displayed on the LCD.

R/W read or write

R/W input allows the user to write information to the LCD or read information from it. R/W =1 when reading; R/W=0 when writing.

E, enable

ss The enable pin is used b y the LCD to latch information presented to its data pins. When data is supplied to data pins, high-to-low pulses must be applied to this pin in order for the LCD to latch in the present at the data pins. This pulse is a minimum of 450 ns wide.

D0 – D7

The 8 bit data pins, d0 – d7, are used to send information to the LCD or read the contents of the LCD's internal registers.

8.4 CRYSTAL OSCILLATOR:

We are using 4Hz Crystal Oscillator which is connected to the pins 11 and 12. Two 22pf capacitors are used across the Crystal Oscillator and are grounded.

8.5 TEMPERATURE SENSOR:

Temperature sensor is a three terminal device. 1st terminal is given positive supply. 2nd terminal is output terminal. 3rd is grounded. Whenever the temperature increases the leakage voltage in the output also increases. Since the output of the temperature sensor is analog value Temperature sensor LM35 is connected with 1st pin of the port A because ADC is available only in port A &port E.

.6 RPM COUNTER:

Moc7811 is a IR sensor package. The transmitter emits the IR waves eceiver receives when there is any interrupt occurs the receiver cannot receives the vave since the receiver output is connected the controller the change in receiver voltage will make a change n controller. When the receiver receives the wave the output is 5v otherwise it is 0v.

3.7 OPTO COUPLERS :(pc817)

Opto coupler is a four terminal device.1 and 4th pins are connected to the positive supply and other pins are grounded. When the short circuit detected the voltage is flow to the controller through the wire connected with opto coupler. And this optocoupler is connected to the port c of pin 16 to the PIC.

8.8 LEVEL SENSOR:

Level sensors are used to sense the oil level of the generator. In this project we are sensing three oil levels. In the sensor, four pins are available one pin is connected to the 5v supply other three pins are connected to the micro controller. The Three level pins are denoted the three oil levels. If the oil level is low, 0v flows through the three level pins. If the oil level is high 5v will flow through the corresponding level pins. This level sensor is connected to the port B of pins 33,34,35 th pin of PIC .

8.9 WORKING PRINCIPLE:

The main unit in this project is the PIC microcontroller 16F877A. The basic necessary connections are given to the microcontroller. The temperature sensor LM 35 given to the 2nd pin of port A indicates any differences in the temperature in the Motor. A IR sensor is connected to the 3rd pin of port A. These sensors are connected to ports A as it supports both analog as well as digital I/O the level sensor is re connected to the pins 16 ,15 & 18 respectively. To the 25th and 26th pin the RF ransmitter and receiver are connected respectively.

These data are fed to the PIC microcontroller for processing and the processed ata is transmitted to the remote station. The module makes use of serial ommunication. The MAX 232 which is used for serial communications is connected nd the data is transmitted to the RF module to a control center. Front-end software is reated to view the measured parameters' values. These results can be stored in the omputer's database and can be made use of at any time to take effective control action.

CHAPTER 9

CHAPTER 9

SOFTWARE DETAILS:

)ifferences Between an Embedded Controller and a PC

The main difference between an embedded controller and a PC is that the :mbedded controller is dedicated to one specific task or set of tasks. A PC is designed o run many different types of programs and to connect to many different external levices. An embedded controller has a single program and, as a result, can be made :heaply to include just enough computing power and hardware to perform that ledicated task. A PC has a relatively expensive generalized central processing unit (CPU) at its heart with many other external devices (memory, disk drives, video controllers, network interface circuits, etc.). An embedded system has a low-cost microcontroller unit (MCU) for its intelligence, with many peripheral circuits on the same chip, and with relatively few external devices. Often, an embedded system is an invisible part, or sub-module of another product, such as a cordless drill, refrigerator or garage door opener. The controller in these products does a tiny portion of the function of the whole device. The controller adds low-cost intelligence to some of the critical sub-systems in these devices. An example of an embedded system is a smoke detector. It's function is to evaluate signals from a sensor and sound an alarm if the signals indicate the presence of smoke. A small program in the smoke detector either runs in an infinite loop, sampling the signal from the smoke sensor, or lies dormant in a low-power "sleep" mode, being awakened by a signal from the sensor. The program then sounds the alarm. The program would possibly have a few other functions, such as a user test function, and a low battery alert. While a PC with a sensor and audio output could be programmed to do the same function, it would not be a cost-effective solution (nor would it run on a nine-volt battery, unattended for years!) Embedded designs use inexpensive microcontrollers to put intelligence into the everyday things in our environment, such as smoke detectors, cameras, cell phones, appliances,

.1 COMPONENETS OF MICROCONTROLLER

The PIC microcontroller MCU has program memory for the firmware, or oded instructions, to run a program. It also has "file register" memory for storage of ariables that the program will need for computation or temporary storage. It also has number of peripheral device circuits on the same chip. Some peripheral devices are alled I/O ports. I/O ports are pins on the microcontroller that can be driven high or ow to send signals, blink lights, drive speakers – just about anything that can be sent hrough a wire. Often these pins are bidirectional and can also be configured as inputs llowing the program to respond to an external switch, sensor or to communicate vith some external device. In order to design such a system, it must be decided which peripherals are needed for an application. Analog to Digital converters allow microcontrollers to connect to sensors and receive changing voltage levels. Serial communication peripherals, allow you to stream communications over a few wires to another microcontroller, to a local network or to the internet. Peripherals on the PICmicro MCU called "timers" accurately measure signal events and generate and capture communications signals, produce precise waveforms, even automatically reset the microcontroller if it gets "hung" or lost due to a power glitch or hardware malfunction. Other peripherals detect if the external power is dipping below dangerous levels so the microcontroller can store critical information and safely shut down before power is completely lost.

9.2 IMPLEMENTING AN EMBEDDED SYSTEM DESIGN WITH MPLAB IDE

A development system for embedded controllers is a system of programs running on a desktop PC to help write, edit, debug and program code – the intelligence of embedded systems applications – into a microcontroller. MPLAB IDE, runs on a PC and contains all the components needed to design and deploy embedded systems applications. The typical tasks for developing an embedded

Create the high level design. From the features and performance desired, lecide which PICmicro or dsPIC device is best suited to the application, then design he associated hardware circuitry. After determining which peripherals and pins control the hardware, write the firmware – the software that will control the hardware aspects of the embedded application. A language tool such as an assembler, which is directly translatable into machine code, or a compiler that allows a more natural anguage for creating programs should be used to write and edit code. Assemblers and compilers help make the code understandable, allowing function labels to identify code routines with variables that have names associated with their use, and with constructs that help organize the code in a maintainable structure.

2. Compile, assemble and link the software using the assembler and/or compiler and linker to convert your code into "ones and zeroes" – machine code for the PICmicro MCU's. This machine code will eventually become the firmware (the code programmed into the microcontroller).

3. Test your code. Usually a complex program does not work exactly the way imagined, and "bugs" need to be removed from the design to get proper results. The debugger allows you to see the "ones and zeroes" execute, related to the source code you wrote, with the symbols and function names from your program. Debugging allows you to experiment with your code to see the value of variables at various points in the program, and to do "what if" checks, changing variable values and stepping through routines.

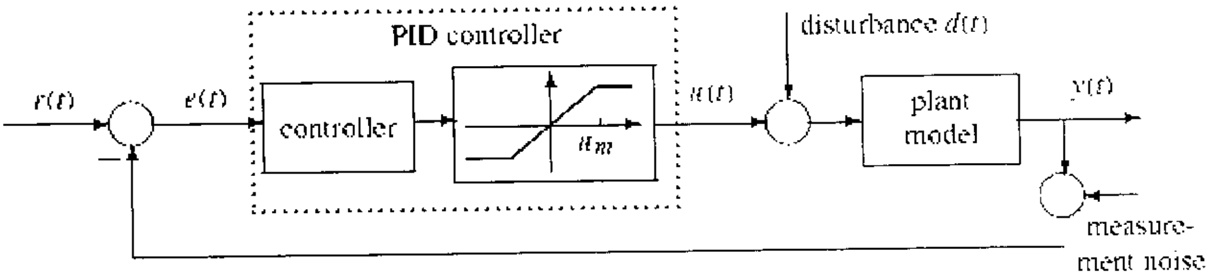
4. "Burn" the code into a microcontroller and verify that it executes correctly in the finished application.

9.3 PID CONTROL FOR TEMPERATURE:

IN A typical structure of a PID control system it can be seen that in a PID controller, the error signal *e(t)* is used to generate the proportional, integral, and erivative actions, with the resulting signals weighted and summed to form the ontrol

ignal *u(t)* applied to the plant model. A mathematical equation for PID control is

$$u(t) = K_p \left[e(t) + \frac{1}{T_i} \int_0^t e(\tau) d\tau + T_d \frac{de(t)}{dt} \right].$$



The fan speed is controlled depending on the temperature variation using the design scheme of PID control.

CHAPTER 10

CHAPTER 10

SENSOR OUTPUTS

10.1 TEMPERATURE SENSOR

For a change in 1degree Celsius, there is a corresponding 1mv change in the output .

TABLE 10.1

TEMP (CELCIUS)	VOLTAGE (mv)
30.4	30.6
48.3	48.6
88	88.7

10.2 LEVEL SENSOR

TABLE 10.2

LEVEL	MOTOR	SOLENOID VALVE
0%	OFF	OPEN
50%	ON	OPEN
100%	ON	CLOSE

10.3 IR SENSOR

- The speed of the motor is controlled by PWM method.

TABLE 10.3

DUTY CYCLE	RPM	SPEED
100%	2300	FULL
50%	1150	HALF
0%	0	ZERO

CHAPTER 11

CHAPTER 11

ALGORITHM

- **STEP1**:Start
- **STEP2**: Initialize ports, SFR, Interrupt, Timer, PWM, sensors, FCE.
- **STEP3**: Enable interrupt, timer.
- **STEP4**:Set the reference temperature in the front end

  Accept input from temperature sensor

  Convert analog value to digital

  Fan speed α temperature variation

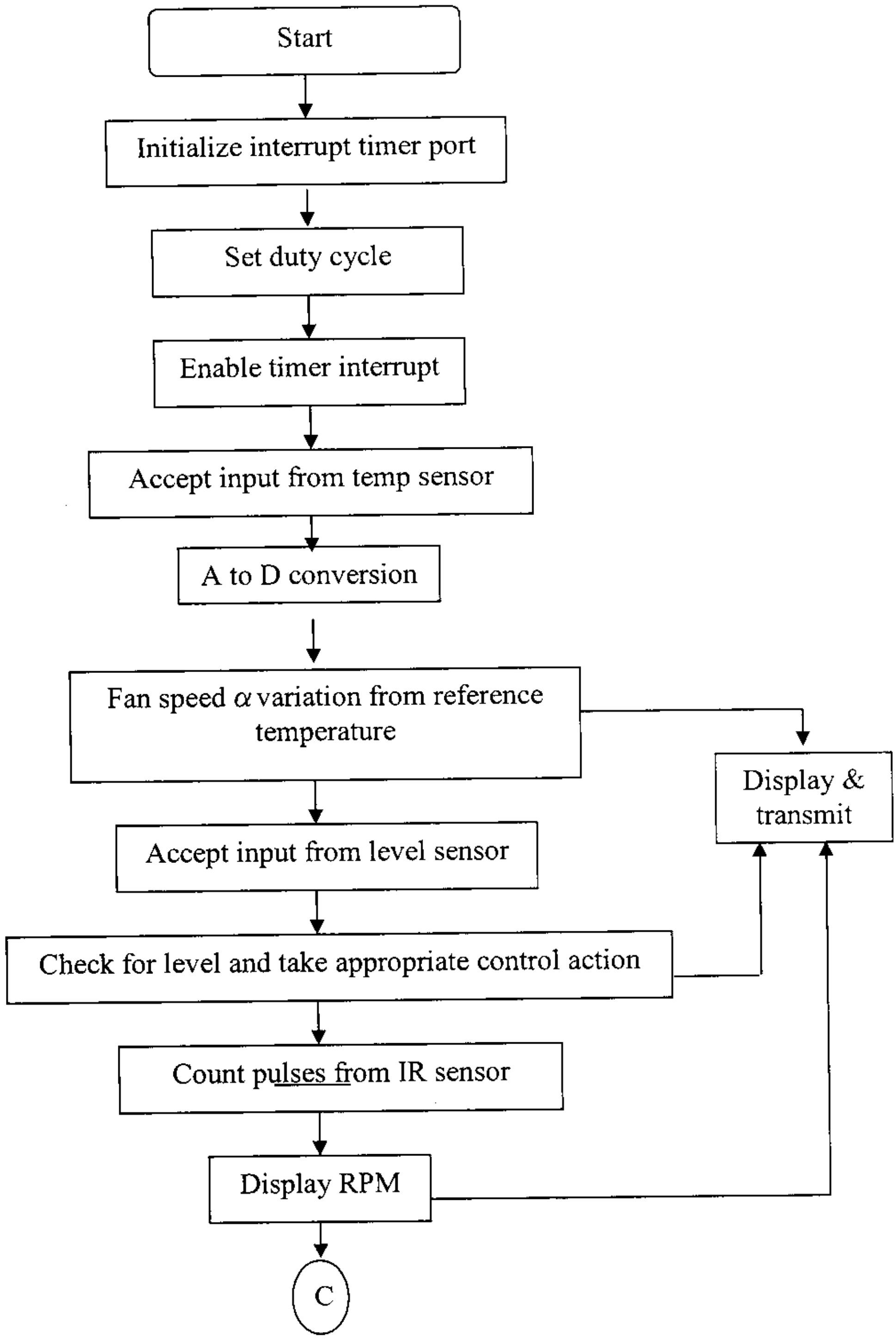
  (Calculated as for Kp=[0.1:0.1:1], G_c=feedback(Kp*G,1); step(G_c)

- **STEP5**: Accept input from level sensor
- Check for level and perform appropriate control action using FCE .
- **STEP 6**: Accept input from voltage sensor
- Motor voltage>12v
- Short circuit
- Motor off
- **STEP7:**
- Enable PWM register
- Set duty cycle
- Count pulses using sensor
- Monitor speed of motor
- **STEP8**: Transmission
- Enable baud rate select bit (BRGH=1)
- Enable asynchronous serial port (SYNC=0,SPEN=1)
- Enable transmission (TXEN=1)
- Load data in TXREG

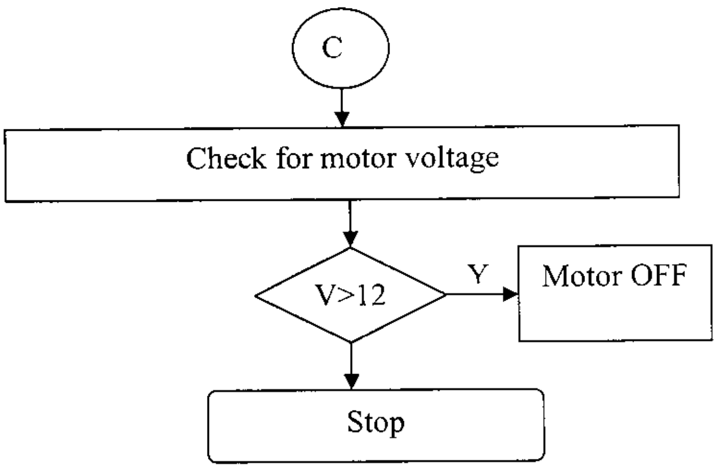
- **STEP9**: Reception
  - Enable baud rate select bit (BRGH=1)
  - Enable asynchronous serial port (SYNC=0,SPEN=1)
  - Enable reception (CREN=1)
  - If RCIF=1.reception complete
- **STEP10**: LCD & FRONT END display
  - Convert Decimal Data to ASCII and display.
- **STEP11**: End.

CHAPTER 12

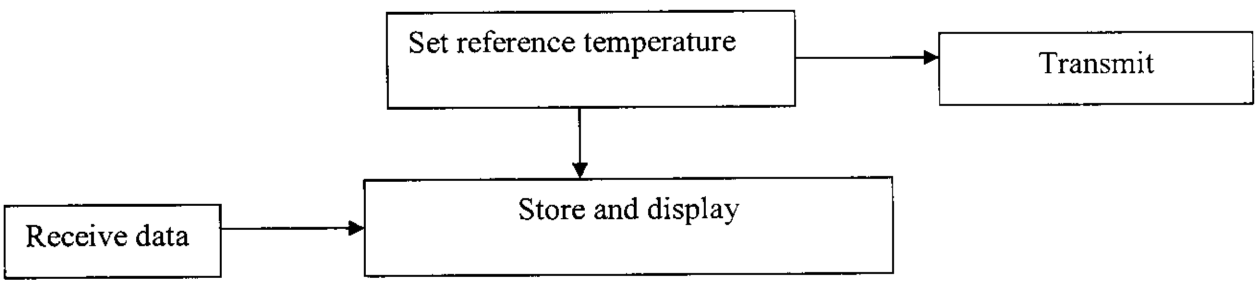
FLOWCHART- TRANSMITTER SIDE



FLOW CHART

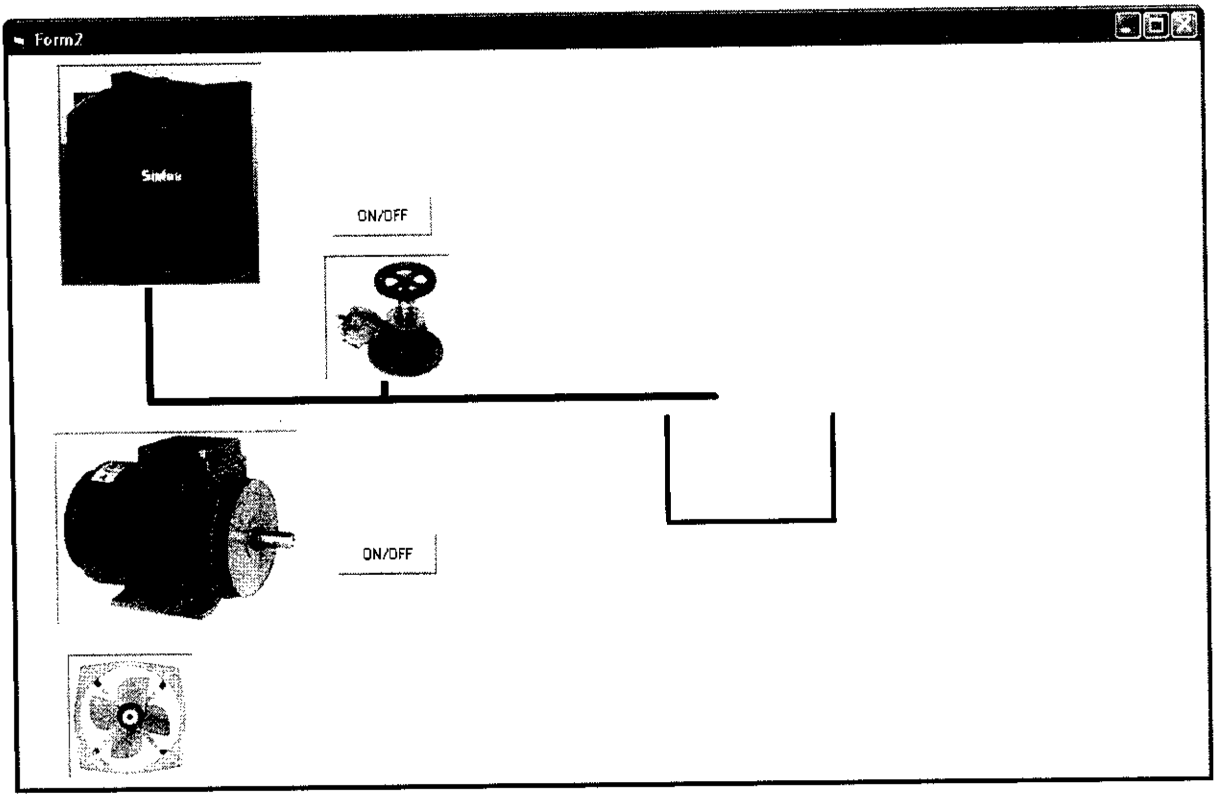


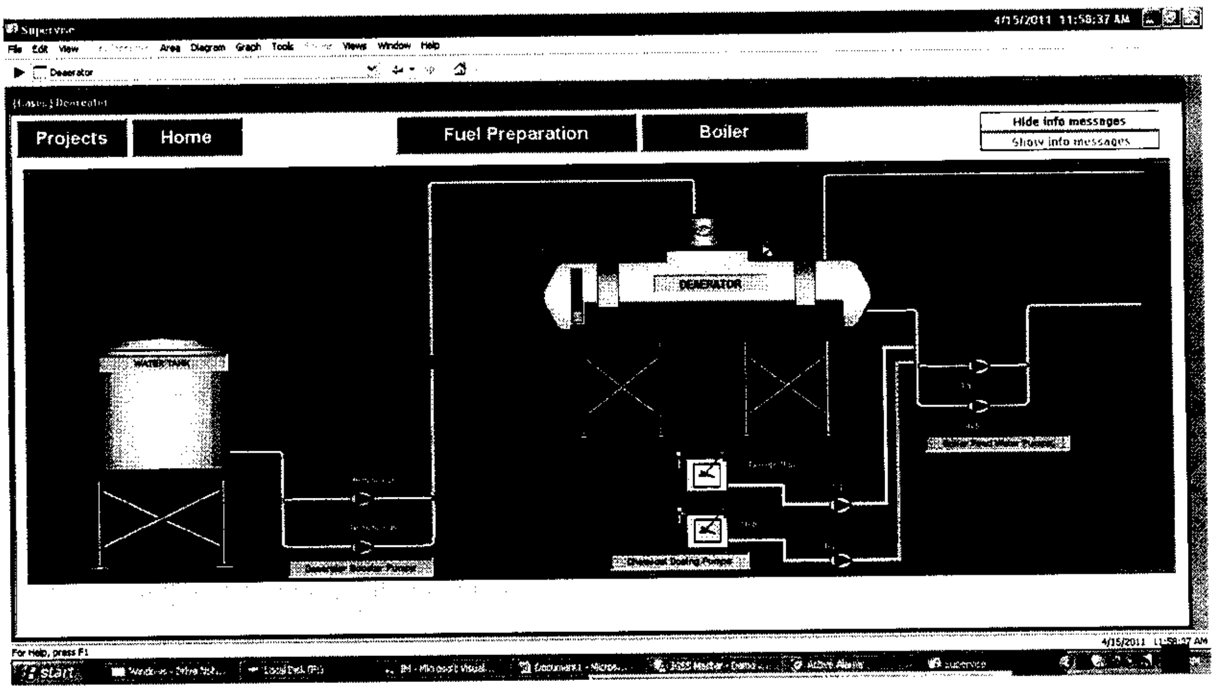
RECEIVER SIDE



CHAPTER 13

CHAPTER 13
FRONT-END DISPLAY





CHAPTER 14

CHAPTER 14

CONCLUSION:

Thus we have implemented a circuit for continuous monitoring and control of industrial parameters with the help of two way RF communication. This can be employed by any industry having a production unit by just altering the sensors and control scheme according to their needs. The database provides option of recording the parameter readings at regular intervals and can be used for future reference. The animated front end display is comprehensive and user friendly.

As a future enhancement, long range wireless communication such as GSM and thereby mobile control can be implemented. For complicated or advanced parameters. Advanced control schemes can be implemented.

REFERENCES

REFERENCES

- Monitoring in Industrial Systems Using Wireless Sensor Network With Dynamic Power Management – IEEE September,2009
- MOTOROLA ANALOG IC DEVICE DATA DUAL LOW POWER OPERATIONAL AMPLIFIERS.
- Data sheet for electronic components PC817,P16F877A – www.catalogdatasheet.com.
- I.F.Akyilidz, W.Su, E.Sankara Subramanian and E.Cayirci, "Wireless Sensor Networks a Survey:" comput.Netw., vol.38,no.4, pg-393-422, march 2002 .
- S.Bricker, T.Gonen, and L.Rubin "Substation automation Technology and advantages," IEEE comput.Appl.Power, vol.14, no.3, pp-31-37, Jul.2001.
- www.wikipaedia.com.
- www.alldatasheets.com.
- www.microelectronika.com.

DATASHEETS

11.0 ANALOG-TO-DIGITAL CONVERTER (A/D) MODULE

The Analog-to-Digital (A/D) Converter module has five inputs for the 28-pin devices and eight for the other devices.

The analog input charges a sample and hold capacitor. The output of the 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 corresponding 10-bit digital number. The A/D module has high and low voltage reference input that is software selectable to some combination of VDD, VSS, RA2, or RA3.

The A/D converter has a unique feature of being able to operate while the device is in SLEEP mode. To operate in SLEEP, the A/D clock must be derived from the A/D's internal RC oscillator.

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 Register0 (ADCON0)
- A/D Control Register1 (ADCON1)

The ADCON0 register, shown in Register 11-1, controls the operation of the A/D module. The ADCON1 register, shown in Register 11-2, configures the functions of the port pins. The port pins can be configured as analog inputs (RA3 can also be the voltage reference), or as digital I/O.

Additional information on using the A/D module can be found in the PICmicro™ Mid-Range MCU Family Reference Manual (DS33023).

REGISTER 11-1: ADCON0 REGISTER (ADDRESS: 1Fh)

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	U-0	R/W-0
ADCS1	ADCS0	CHS2	CHS1	CHS0	GO/DONE	—	ADON
bit 7							bit 0

bit 7-6 **ADCS1:ADCS0:** A/D Conversion Clock Select bits
00 = FOSC/2
01 = FOSC/8
10 = FOSC/32
11 = FRC (clock derived from the internal A/D module RC oscillator)

bit 5-3 **CHS2:CHS0:** Analog Channel Select bits
000 = channel 0, (RA0/AN0)
001 = channel 1, (RA1/AN1)
010 = channel 2, (RA2/AN2)
011 = channel 3, (RA3/AN3)
100 = channel 4, (RA5/AN4)
101 = channel 5, (RE0/AN5)(1)
110 = channel 6, (RE1/AN6)(1)
111 = channel 7, (RE2/AN7)(1)

bit 2 **GO/DONE:** A/D Conversion Status bit
If ADON = 1:
1 = A/D conversion in progress (setting this bit starts the A/D conversion)
0 = A/D conversion not in progress (this bit is automatically cleared by hardware when the A/D conversion is complete)

bit 1 **Unimplemented:** Read as '0'

bit 0 **ADON:** A/D On bit
1 = A/D converter module is operating
0 = A/D converter module is shut-off and consumes no operating current

Note 1: These channels are not available on PIC16F873/876 devices.

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
- n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

REGISTER 11-2: ADCON1 REGISTER (ADDRESS 9Fh)

U-0	U-0	R/W-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0
ADFM	—	—	—	PCFG3	PCFG2	PCFG1	PCFG0
bit 7							bit 0

bit 7 **ADFM:** A/D Result Format Select bit
1 = Right justified. 6 Most Significant bits of ADRESH are read as '0'.
0 = Left justified. 6 Least Significant bits of ADRESL are read as '0'.

bit 6-4 **Unimplemented:** Read as '0'

bit 3-0 **PCFG3:PCFG0:** A/D Port Configuration Control bits:

PCFG3: PCFG0	AN7[1] RE2	AN6[1] RE1	AN5[1] RE0	AN4 RA5	AN3 RA3	AN2 RA2	AN1 RA1	AN0 RA0	VREF+	VREF-	CHAN/ Refs[2]
0000	A	A	A	A	A	A	A	A	VDD	VSS	8/0
0001	A	A	A	A	VREF+	A	A	A	RA3	VSS	7/1
0010	D	D	D	A	A	A	A	A	VDD	VSS	5/0
0011	D	D	D	A	VREF+	A	A	A	RA3	VSS	4/1
0100	D	D	D	D	A	D	A	A	VDD	VSS	3/0
0101	D	D	D	D	VREF+	D	A	A	RA3	VSS	2/1
011x	D	D	D	D	D	D	D	D	VDD	VSS	0/0
1000	A	A	A	A	VREF+	VREF-	A	A	RA3	RA2	6/2
1001	D	D	A	A	A	A	A	A	VDD	VSS	6/0
1010	D	D	A	A	VREF+	A	A	A	RA3	VSS	5/1
1011	D	D	A	A	VREF+	VREF-	A	A	RA3	RA2	4/2
1100	D	D	D	A	VREF+	VREF-	A	A	RA3	RA2	3/2
1101	D	D	D	D	VREF+	VREF-	A	A	RA3	RA2	2/2
1110	D	D	D	D	D	D	D	A	VDD	VSS	1/0
1111	D	D	D	D	VREF+	VREF-	D	A	RA3	RA2	1/2

A = Analog input D = Digital I/O

Note 1: These channels are not available on PIC16F873/876 devices.
2: This column indicates the number of analog channels available as A/D inputs and the number of analog channels used as voltage reference inputs.

Legend:		
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'
- n = Value at POR	'1' = Bit is set	'0' = Bit is cleared x = Bit is unknown

The ADRESH:ADRESL registers contain the 10-bit result of the A/D conversion. When the A/D conversion is complete, the result is loaded into this A/D result register pair, the GO/$\overline{DONE}$ bit (ADCON0<2>) is cleared and the A/D interrupt flag bit ADIF is set. The block diagram of the A/D module is shown in Figure 11-1.

After the A/D module has been configured as desired, the selected channel must be acquired before the conversion is started. The analog input channels must have their corresponding TRIS bits selected as inputs.

To determine sample time, see Section 11.1. After this acquisition time has elapsed, the A/D conversion can be started.

10.1 USART Baud Rate Generator (BRG)

The BRG supports both the Asynchronous and Synchronous modes of the USART. It is a dedicated 8-bit baud rate generator. The SPBRG register controls the period of a free running 8-bit timer. In Asynchronous mode, bit BRGH (TXSTA<2>) also controls the baud rate. In Synchronous mode, bit BRGH is ignored. Table 10-1 shows the formula for computation of the baud rate for different USART modes which only apply in Master mode (internal clock).

Given the desired baud rate and FOSC, the nearest integer value for the SPBRG register can be calculated using the formula in Table 10-1. From this, the error in baud rate can be determined.

It may be advantageous to use the high baud rate (BRGH = 1), even for slower baud clocks. This is because the FOSC/(16(X + 1)) equation can reduce the baud rate error in some cases.

Writing a new value to the SPBRG register causes the BRG timer to be reset (or cleared). This ensures the BRG does not wait for a timer overflow before outputting the new baud rate.

10.1.1 SAMPLING

The data on the RC7/RX/DT pin is sampled three times by a majority detect circuit to determine if a high or a low level is present at the RX pin.

TABLE 10-1: BAUD RATE FORMULA

SYNC	BRGH = 0 (Low Speed)	BRGH = 1 (High Speed)
0	(Asynchronous) Baud Rate = FOSC/(64(X+1))	Baud Rate = FOSC/(16(X+1))
1	(Synchronous) Baud Rate = FOSC/(4(X+1))	N/A

X = value in SPBRG (0 to 255)

TABLE 10-2: REGISTERS ASSOCIATED WITH BAUD RATE GENERATOR

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Value on: POR, BOR	Value on all other RESETS
98h	TXSTA	CSRC	TX9	TXEN	SYNC	—	BRGH	TRMT	TX9D	0000 -010	0000 -010
18h	RCSTA	SPEN	RX9	SREN	CREN	ADDEN	FERR	OERR	RX9D	0000 000x	0000 000x
99h	SPBRG	Baud Rate Generator Register								0000 0000	0000 0000

Legend: x = unknown, - = unimplemented, read as '0'. Shaded cells are not used by the BRG.

MAXIMUM RATINGS (T_A = +25°C, unless otherwise noted.)

Rating	Symbol	LM258 LM358	LM2904 LM2904V	Unit
Power Supply Voltages Single Supply Split Supplies	 V_{CC} V_{CC}, V_{EE}	 32 ±16	 26 ±13	Vdc
Input Differential Voltage Range (Note 1)	V_{IDR}	±32	±26	Vdc
Input Common Mode Voltage Range (Note 2)	V_{ICR}	–0.3 to 32	–0.3 to 26	Vdc
Output Short Circuit Duration	t_{SC}	Continuous		
Junction Temperature	T_J	150		°C
Storage Temperature Range	T_{stg}	–55 to +125		°C
Operating Ambient Temperature Range LM258 LM358 LM2904 LM2904V	T_A	 –25 to +85 0 to +70 – –	 – – –40 to +105 –40 to +125	°C

NOTES: 1. Split Power Supplies.
2. For Supply Voltages less than 32 V for the LM258/358 and 26 V for the LM2904, the absolute maximum input voltage is equal to the supply voltage.