INTELLIGENT MILITARY APPLICATION USING THE ZIGBEE TECHNOLOGY

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

ertified that this project report titled **"INTELLIGENT MILITARY PPLICATION USING THE ZIGBEE TECHNOLOGY"** is the bonafide work f

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18/4/11
External Examiner

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ABSTRACT

The objective of this project is to monitor the parameters of human body such as temperature, pulse rate and respiration rate through sensors and also monitor & track the human beings using Global Positioning System via Zigbee interface.Here we take the case of military men whose temperature, Respiration and the Pulse rate, has to be monitored continuously.

Hence we have developed a system that keeps continuous monitoring of the above parameters and track the location if a military man needs help.The military man Monitoring system can be implemented for all military purposes and also at homes where care has to be taken for patients in the critical stage. The system keeps continuous monitoring of the human body.

The current systems being used track only the position of the military personal and communication of data is done through a walkie-talkie. Here we intend to track his position and additionally monitor his/her respiration, temperature and heart rates. Also instead of a walkie-talkie we use a switch system to instantly transfer information which is stored in a storage device.

2.INTRODUCTION

OBJECTIVE:

The objective of this project is to monitor the parameters of human body such as temperature, pulse rate and respiration through sensors and also monitor and track the human beings using Global Positioning System via Zigbee interface.

SCOPE:

In the case of military man whose temperature, Respiration and the Pulse rate has to be monitored continuously, it's impossible to monitor the parameters manually. Hence we have developed a system that keeps continuous monitoring of the above parameters and track location for if military man needs the help.

BRIEF OVERVIEW

The Project can be designed with the following blocks,

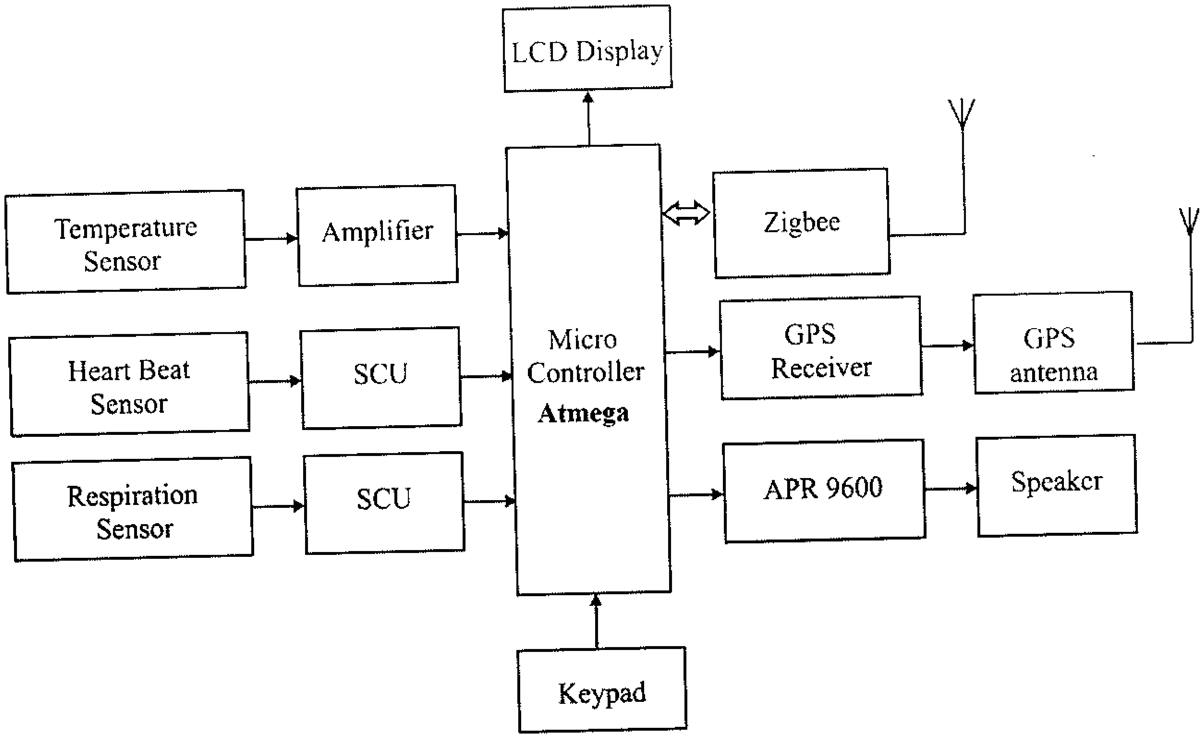
- Temperature sensor
- Respiratory sensor
- Heartbeat sensor
- Amplifier
- Signal conditioning unit (SCU)
- Pulse shaping Unit
- Microcontroller
- Analog to Digital Converter
- GPS antenna
- GPS receiver
- Zigbee module

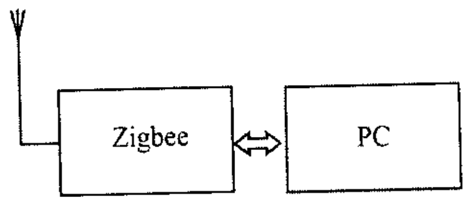
The Temperature sensor is used to sense the change body temperature. The output of the temperature sensor is given to the amplifier to amplify the weak signal. The amplified signal is passed to the Analog to Digital converter. The Analog to Digital converter converts the analog signal to the digital signal. The Digital signals are given to the Micro controller.

The Pulse rate sensor is used to measure the heart beats of the patients then the output signal is given to signal conditioning unit in which the signal is conditioned. Then the signal is given to pulse shaping circuit. Here the signal is converted into square pulse.The converted square pulse signal is given to microcontroller. Similarly the respiration sensor is used to sense the respiration rate respectively. The output of sensor is given to microcontroller through signal conditioning and pulse shaping unit. A microcontroller (or MCU) is a computer-on-a-chip used to control any electronic device. The micro controller is programmed already according to our objective. The corresponding measurements are displayed on the LCD display. All values are checked and if goes abnormal that will indicate through speaker through APR9600.

The Global Positioning System is a space age navigational system that can pinpoint your position anywhere on the globe, usually within a few yards or meters. This amazing technology is available to everyone, everywhere, day and night, and best of all, at no cost for use of the navigational data. . In the receiver section is interfaced with PC. In PC we can monitor the human current position on the earth.

2.1 BLOCK DIAGRAM


LCD Display
Temperature Sensor
Amplifier
Heart Beat Sensor
SCU
Respiration Sensor
SCU
Micro Controller
Atmega
Zigbee
GPS Receiver
GPS antenna
APR 9600
Speaker
Keypad


Zigbee
PC

3.1 BLOCK DIAGRAM

The ac voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the level of 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 removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

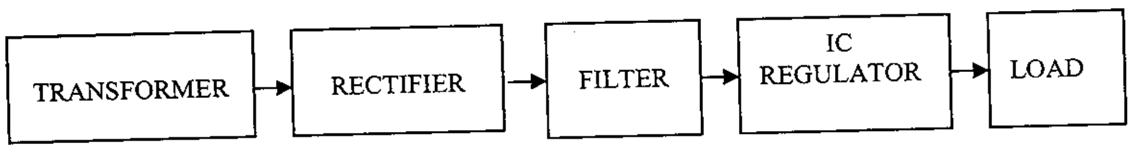


Figure2.5: Block diagram (Power supply)

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.

3.2 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 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.

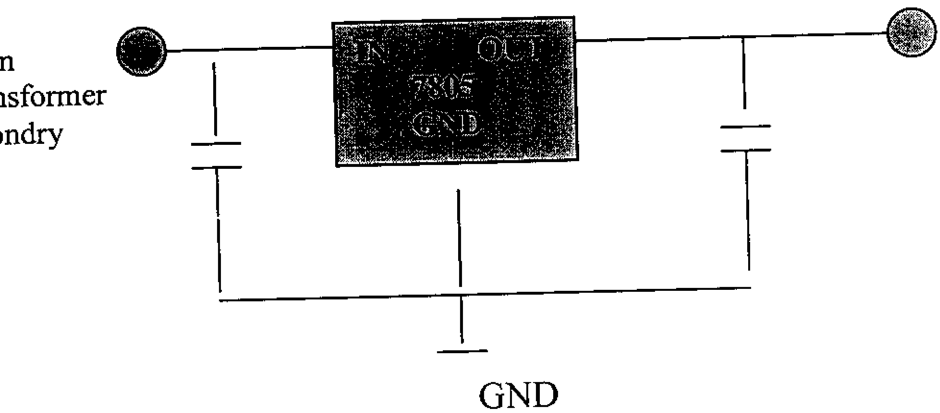
The path for current flow is from point B through D1, up through RL, through D3, through the secondary of the transformer back to point B. this path is indicated by the solid arrows. Waveforms (1) and (2) can be observed across D1 and D3.

One-half cycle later the polarity across the secondary of the transformer reverse, 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. This path is indicated by the broken arrows. Waveforms (3) and (4) can be observed across D2 and D4. The current flow through RL is always in the same direction. In flowing through RL this current develops a voltage corresponding to that shown waveform (5). Since current flows through the load (RL) during both half cycles of the applied voltage, this bridge rectifier is a full-wave rectifier.

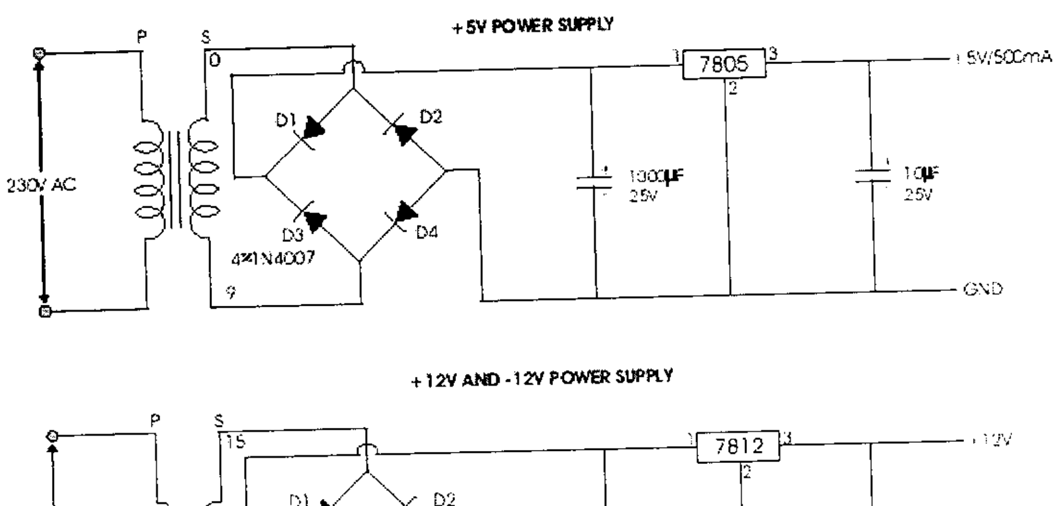
3.3 IC VOLTAGE REGULATORS

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. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage. 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.

FIXED POSITIVE VOLTAGE REGULATORS:



The series 78 regulators provide fixed regulated voltages from 5 to 24 V. Figure 19.26 shows how one such IC, a 7812, is connected to



rovide 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).

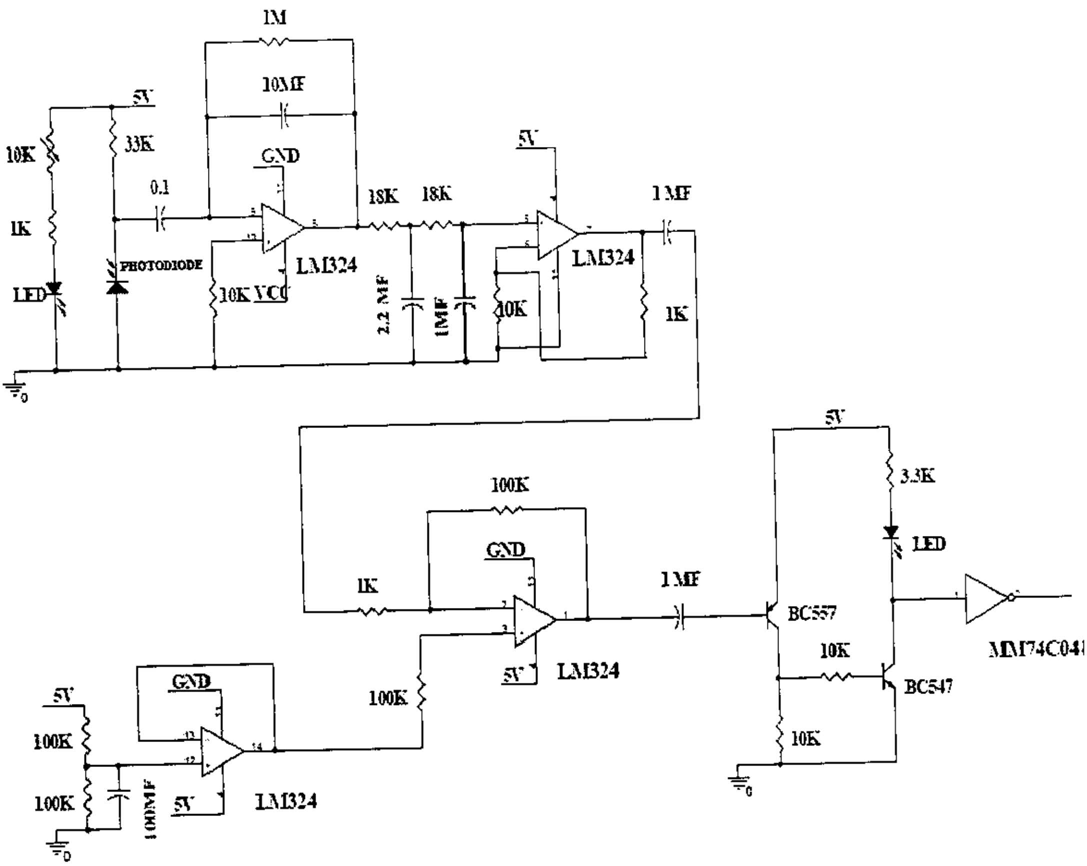
While the input voltage may vary over some permissible voltage range, and the output load may vary over some acceptable range, the output voltage remains constant within specified voltage variation limits. These limitations are spelled out in the manufacturer's specification sheets.

A fixed three-terminal voltage regulator has an unregulated dc input voltage, Vi, applied to one input terminal, a regulated dc output voltage, Vo, from a second terminal, with the third terminal connected to ground.

The series 78 regulators provide fixed positive regulated voltages from 5 to 24 volts. Similarly, the series 79 regulators provide fixed negative regulated voltages from 5 to 24 volts.

- For ICs, microcontroller, LCD --------- 5 volts
- For alarm circuit, op-amp, relay circuits ---------- 12 volts

4.1 HEARTBEAT SENSOR



4.1.1 CIRCUIT WORKING DESCRIPTION:

This circuit is designed to measure the heart rate. The heart rate is measured by IR transmitter and receiver.

Infrared transmitter is one type of LED which emits infrared rays generally called as IR Transmitter. Similarly IR Receiver is used to receive the IR rays transmitted by the IR transmitter. One important point is both IR transmitter and receiver should be placed straight line to each other. The IR transmitter and receiver are placed in the pulse rate sensor. When you want measure the pulse rate, the pulse rate sensor has to be clipped in the finger. The IR receiver is connected to the Vcc through the resistor which acts as potential divider. The potential divider output is

When supply is ON the IR transmitter passes the rays to the receiver. Depending on the blood flow, the IR rays are interrupted. Due to that IR receiver conduction is interrupted so variable pulse signals are generated in the potential divider point which is given to A1 amplifier through the capacitor C1. The coupling capacitor C1 is used to block the DC component because the capacitor reactance is depends on the frequency. For DC component the frequency is zero so the reactance is infinity now capacitor acts as open circuit for DC component.

The amplifier section is constructed by the LM 324 quad operational amplifier. It consists of four independent, high gains and internally frequency compensated operational amplifiers named as A1, A2, A3 and A4 amplifiers. The varying pulse from the potential divider is amplified by the A1 amplifier. In this amplifier the capacitor C2 is connected in parallel with feedback resistor to filter the any DC component in the amplified signal. If any spikes in the amplified signals, they are further filtered by the C3 and C4 capacitors. After filtration the signal is again amplified by the A2 amplifier.

Then amplified signal is given to inverting input terminal of comparator. The comparator is constructed by the A4 amplifier in which the reference voltage is given to non inverting input terminal. The reference voltage is generated by the A3 amplifier. Then the comparator compares the two signal and delivered the +12v to -12v square wave pulse at its output.

Then the square wave signal is given to base of the BC 557 and BC547 switching transistors in order to convert the TTL voltage 0 to 5v level. Finally the TTL output is given to MM 74C04 inverter to invert the square pulse. Then the final square wave signal is given to microcontroller or other interfacing circuit in order to monitor the heart

4.1.2 HEART RATE:

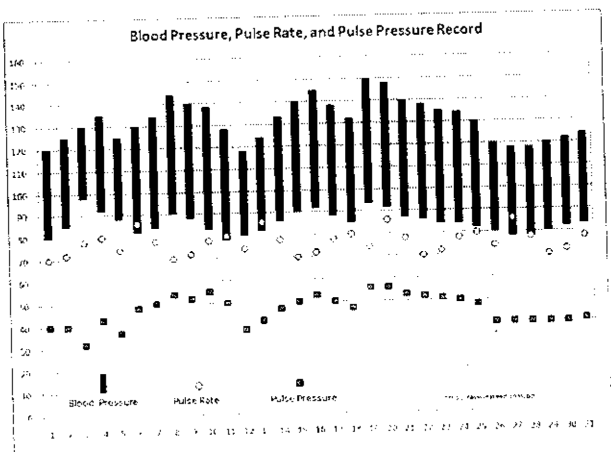
Heart rate is a term used to describe the frequency of the cardiac cycle. It is considered one of the four vital signs. Usually it is calculated as the number of contractions (heart beats) of the heart in one minute and expressed as "beats per minute" (bpm). See "Heart" for information on embryofetal heart rates. The heart beats up to 120 times per minute in childhood. When resting, the adult human heart beats at about 70 bpm (males) and 75 bpm (females), but this rate varies among people. However, the reference range is normally between 60 bpm (if less termed bradycardia) and 100 bpm (if greater, termed tachycardia). Resting heart rates can be significantly lower in athletes. The infant/neonatal rate of heartbeat is around 130-150 bpm, the toddler's about 100–130 bpm, the older child's about 90–110 bpm, and the adolescent's about 80–100 bpm.

The pulse is the most straightforward way of measuring the heart rate, but it can be deceptive when some heart beats do not have much cardiac output. In these cases (as happens in some arrhythmias), the heart rate may be considerably higher than the pulse rate.

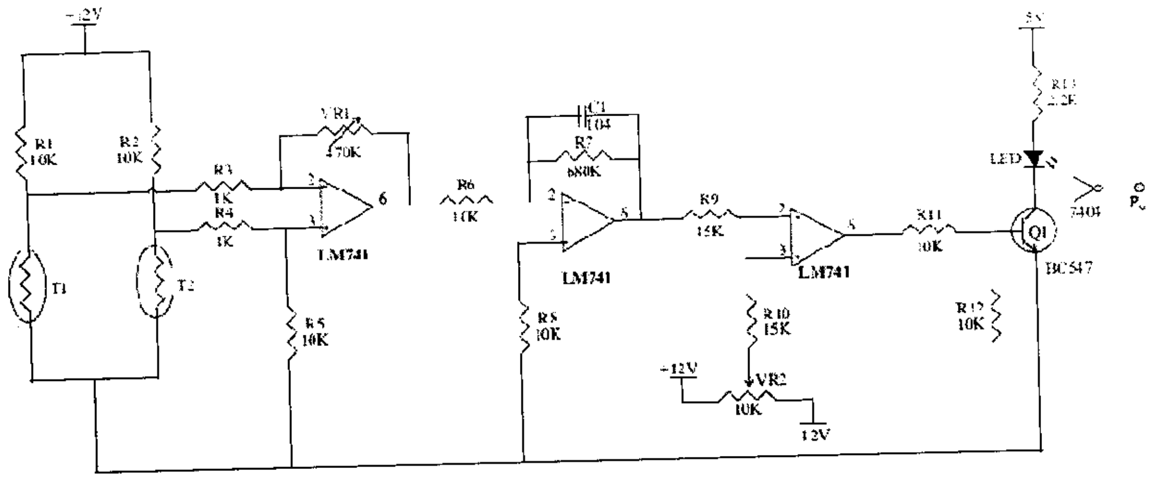
TABULATION &GRAPH

Heart Rate Chart: Adults

AGE	Beats Per Minute (BPM)
Babies to Age 1	100 - 160
Children ages 1-10	60 - 140
Children age 10+adults	60 - 100
Athletes:	40 - 60



4.2 RESPIRATION SENSOR



4.2.1CIRCUIT DESCRIPTION:

This circuit is designed to measure the respiration. In this circuit two thermistor is used for the respiration measurement which are connected in the resistor bridge network. The bridge terminals are connected with inverting and non inverting input terminals of the comparator. The comparator is constrcted by the LM 741 operational amplifier. Here one thermistor is used for the respiration measurement. Another thermistor is used as reference which measures the room temperature.

The comparator provides the error voltage at its output. Then the error voltage is amplified by the next stage of the amplifier. The amplified voltage is converted to +12v to -12v square wave pulse through the comparator. Then the square wave pulse is converted to 5v to 0v TTL pulse through the transistor Q1 (BC 547).

Then the final TTL pulse is given to microcontroller in order to

RESPIRATION:

Among four-legged animals, the **respiratory system** generally includes tubes, such as the bronchi, used to carry air to the lungs, where gas exchange takes place. A diaphragm pulls air in and pushes it out. Respiratory systems of various types are found in a wide variety of organisms. Even trees have respiratory systems.

In humans and other mammals, the respiratory system consists of the airways, the lungs, and the respiratory muscles that mediate the movement of air into and out of the body. Within the alveolar system of the lungs, molecules of oxygen and carbon dioxide are passively exchanged, by diffusion, between the gaseous environment and the blood. Thus, the respiratory system facilitates oxygenation of the blood with a concomitant removal of carbon dioxide and other gaseous metabolic wastes from the circulation. The system also helps to maintain the acid-base balance of the body through the efficient removal of carbon dioxide from the blood.

INHALATION:

Inhalation is initiated by the diaphragm and supported by the external intercostal muscles. Normal resting respirations are 10 to 18 breaths per minute. Its time period is 2 seconds. During vigorous inhalation (at rates exceeding 35 breaths per minute), or in approaching respiratory failure, accessory muscles of respiration are recruited for support. These consist of sternocleidomastoid, platysma, and the strap muscles of th neck.

Inhalation is driven primarily by the diaphragm. When the diaphragm contracts, the ribcage expands and the contents of the which in turn causes a decrease in intrathoracic pressure. As the pressure in the chest falls, air moves into the conducting zone. Here, the air is filtered, warmed, and humidified as it flows to the lungs.

During forced inhalation, as when taking a deep breath, the external intercostal muscles and accessory muscles further expand the thoracic cavity.

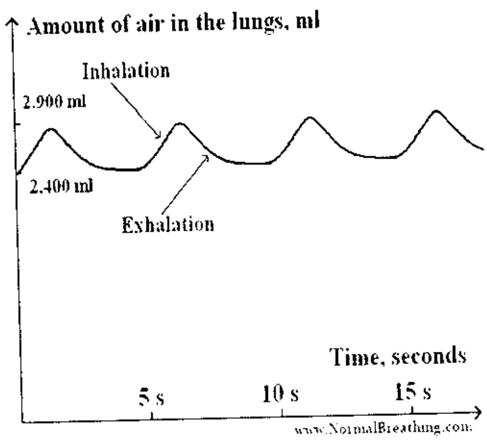
EXHALATION:

Exhalation is generally a passive process, however active or *forced* exhalation is achieved by the abdominal and the internal intercostal muscles. The lungs have a natural elasticity; as they recoil from the stretch of inhalation, air flows back out until the pressures in the chest and the atmosphere reach equilibrium

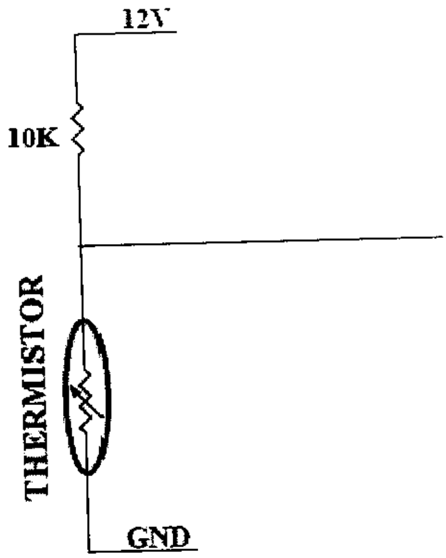
During forced exhalation, as when blowing out a candle, expiratory muscles including the abdominal muscles and internal intercostal muscles, generate abdominal and thoracic pressure, which forces air out of the lungs.

TABULATION &GRAPH

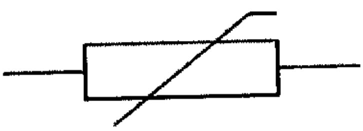
Groups and ages	Normal respiratory rates
[illegible]	[illegible]
6 to 12 months old	24-30 breaths/min
[illegible]	[illegible]
15 and above years	12-20 breaths/min



4.3 TEMPERATURE SENSOR



Symbol:



4.3.1 CIRCUIT DESCRIPTION:

In this circuit the thermistor is used to measure the temperature. thermistor is nothing but temperature sensitive resistor. There are two type of thermistor available they are positive temperature co-efficient and negative temperature co- efficient. Here we are using negative temperature co-efficient in which the resistance value is decreased when the temperature is increased.

Here the thermistor is connected with resister bridge network. The bridge terminals are connected to inverting and non-inverting input

The LM 324 consist of four independent, high gains, internally frequency compensated operational amplifier which were designed specifically to operate from a single power supply over a wide voltage range.

The first stage is a comparator in which the variable voltage due to thermistor is given to inverting input terminal and reference voltage is given to non-inverting input terminal.

Initially the reference voltage is set to room temperature level so the output of the comparator is zero. When the temperature is increased above the room temperature level, the thermistor resistance is decreased so variable voltage is given to comparator. Now the comparator delivered the error voltage at the output. Then the error voltage is given to next stage of preamplifier. Here the input error voltage is amplified then the amplified voltage is given to next stage of gain amplifier. In this amplifier the variable resistor is connected as feedback resistor. The feedback resistor is adjusted to get desired gain. Then the AC components in the output are filtered with the help of capacitors. Then output voltage is given to final stage of DC voltage follower through this the output voltage is given to ADC or other circuit.

A **thermistor** is a type of resistor used to measure temperature changes, relying on the change in its resistance with changing temperature. Thermistor is a combination of the words thermal and resistor. The Thermistor was first invented by Samuel Ruben in 1930, and has U.S. Patent #2,021,491.

If we assume that the relationship between resistance and temperature is linear (i.e. we make a first-order approximation), then we can say that:

$$\Delta R = k\Delta T$$

Where

ΔR = change in resistance

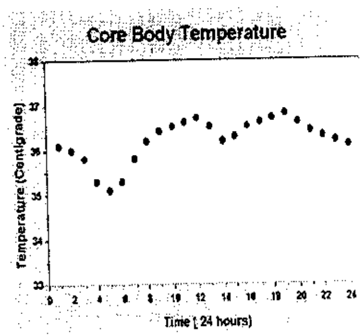
ΔT = change in temperature

k = first-order temperature coefficient of resistance

Thermistors can be classified into two types depending on the sign of k. If k is positive, the resistance increases with increasing temperature, and the device is called a positive temperature coefficient **(PTC)** thermistor, **Posistor**. If k is negative, the resistance decreases with increasing temperature, and the device is called a negative temperature coefficient **(NTC)** thermistor. Resistors that are not thermistors are designed to have the smallest possible k, so that their resistance remains almost constant over a wide temperature range.

TABULATIONS AND GRAPHS

Human parts	Temperature °C(F)
ear(otic temp)	37.6°C(99.7°F)
Mouth(oral temperature)	36.8°C(98.2°F)
Arm(axillary)	36.4°C(97.6°F)



5.1 INTRODUCTION

The ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed. The AVR core combines a rich instruction set with 32 general purpose working registers.All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

The ATmega16 provides the following features: 16K bytes of In-System Programmable Flash Program memory with Read-While-Write capabilities, 512 bytes EEPROM, 1K byte SRAM, 32 general purpose I/O lines, 32 general purpose working registers, a JTAG interface for Boundary-scan, On-chip Debugging support and programming, three flexible Timer/Counters with compare modes, Internal and External Interrupts, a serial programmable USART, a byte oriented Two-wire Serial Interface, an 8-channel, 10-bit ADC with optional differential input stage with programmable gain (TQFP package only), a programmable Watchdog Timer with Internal Oscillator, an SPI serial port, and six software selectable power saving modes.

The Idle mode stops the CPU while allowing the USART, Two-wire interface, A/D Converter, SRAM, Timer/Counters, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next External Interrupt or Hardware Reset. In Power-save mode, the Asynchronous Timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except Asynchronous Timer and ADC, to minimize switching noise during ADC conversions.

5.2 FEATURES

- High-performance, Low-power AVR® 8-bit Microcontroller

- Advanced RISC Architecture
  - – 131 Powerful Instructions – Most Single-clock Cycle Execution
  - – 32 x 8 General Purpose Working Registers
  - – Fully Static Operation
  - – Up to 16 MIPS Throughput at 16 MHz
  - – On-chip 2-cycle Multiplier

- Nonvolatile Program and Data Memories
  - – 16K Bytes of In-System Self-Programmable Flash
  - – Endurance: 10,000 Write/Erase Cycles
  - – Optional Boot Code Section with Independent Lock Bits
  - – 512 Bytes EEPROM
  - – 1K Byte Internal SRAM
  - – Programming Lock for Software Security

- JTAG (IEEE std. 1149.1 Compliant) Interface
  - – Boundary-scan Capabilities According to the JTAG Standard
  - – Extensive On-chip Debug Support
  - – Programming of Flash, EEPROM, Fuses, and Lock Bits through the JTAG Interface

- Peripheral Features
  - – Two 8-bit Timer/Counters with Separate Prescalers and Compare Modes
  - – One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and CaptureMode
  - – Real Time Counter with Separate Oscillator
  - – Four PWM Channels
  - – 8-channel, 10-bit ADC
  - – 8 Single-ended Channels
  - – 7 Differential Channels in TQFP Package Only
  - – 2 Differential Channels with Programmable Gain at 1x, 10x, or

– Programmable Serial USART
– Master/Slave SPI Serial Interface
– Programmable Watchdog Timer with Separate On-chip Oscillator
– On-chip Analog Comparator

- Special Microcontroller Features
  - Power-on Reset and Programmable Brown-out Detection
  - Internal Calibrated RC Oscillator
  - External and Internal Interrupt Sources
  - Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standbyand Extended Standby

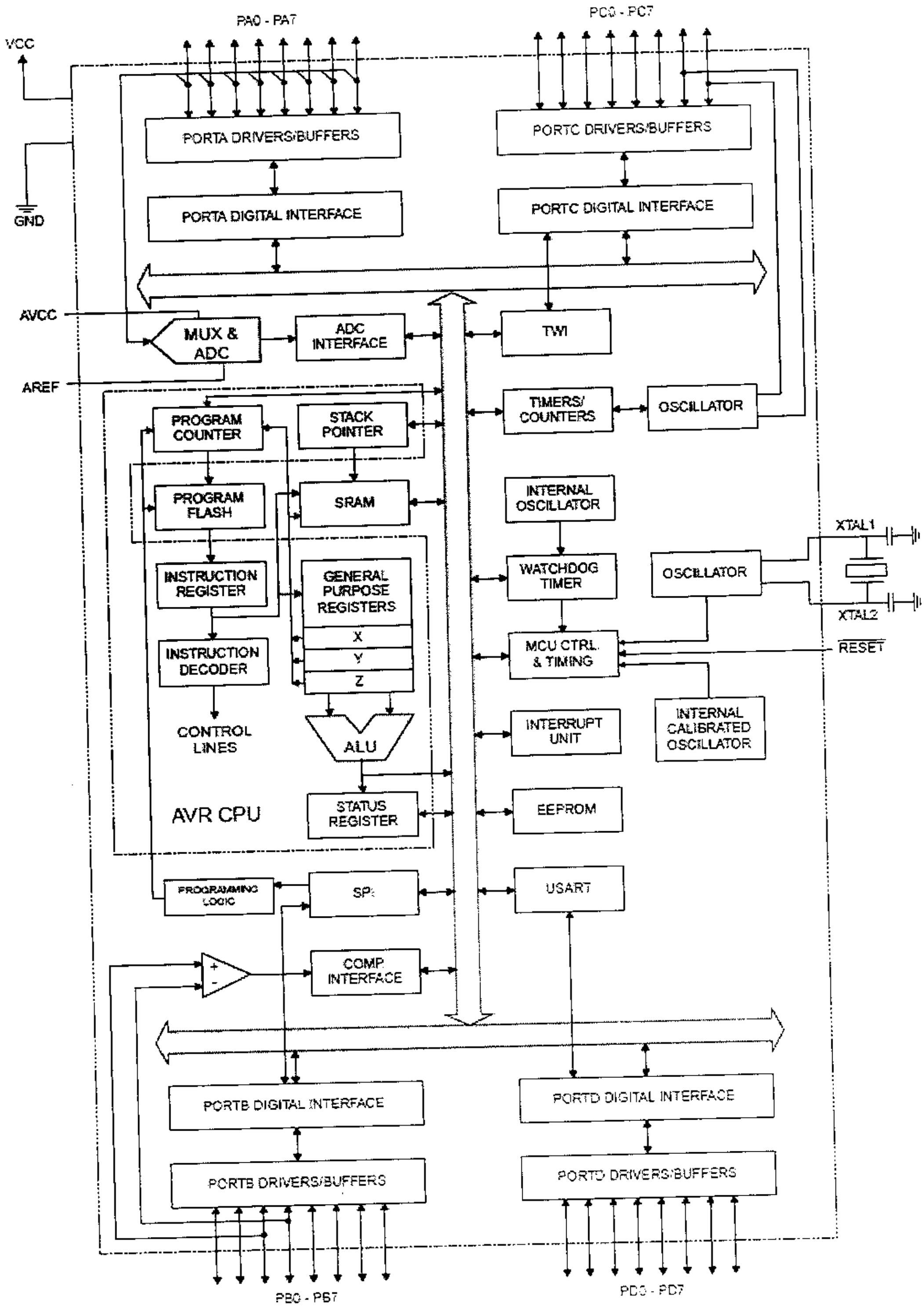
- I/O and Packages
  - 32 Programmable I/O Lines
  - 40-pin PDIP, 44-lead TQFP, and 44-pad MLF

- Operating Voltages
  - 2.7 - 5.5V for ATmega16L
  - 4.5 - 5.5V for ATmega16

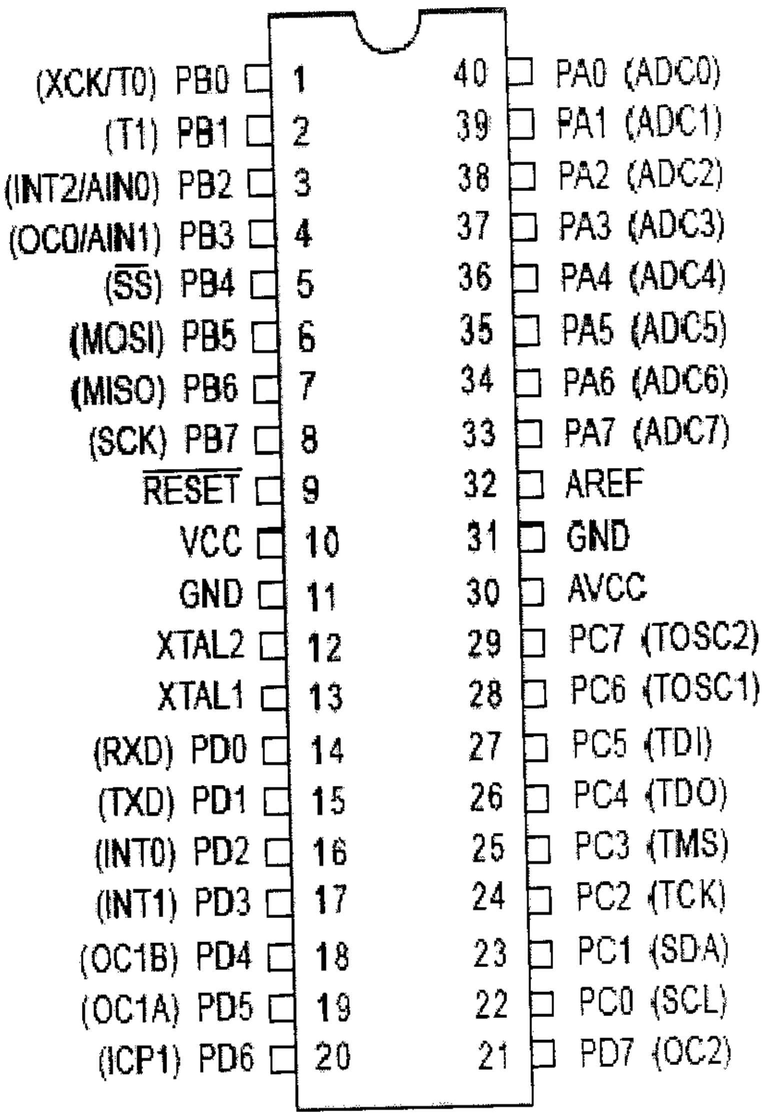
- Speed Grades
  - 0 - 8 MHz for ATmega16L
  - 0 - 16 MHz for ATmega16

- Power Consumption @ 1 MHz, 3V, and 25°C for ATmega16L
  - Active: 1.1 mA
  - Idle Mode: 0.35 mA
  - Power-down Mode: < 1 μA

5.3 ARCHITECTURE OF ATMEGA164



5.4 PIN CONFIGURATION



PINOUT ATMEGA 164

5.5 PIN DESCRIPTIONS

VCC : Digital supply voltage.

GND : Ground.

Port A (PA7..PA0) :

Port A serves as the analog inputs to the A/D Converter.

Port A also serves as an 8-bit bi-directional I/O port, if the A/D Converter is not used.

Port pins can provide internal pull-up resistors (selected for each bit). The Port A output buffers have symmetrical drive characteristics with both high sink and source capability. When pins PA0 to PA7 are used as inputs and are externally pulled low, they will source current if the internal pull-up resistors are activated. The Port A pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Port B (PB7..PB0) :

Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running. Port B also serves the functions of various special features of the ATmega16 as listed .

Port C (PC7..PC0) :

Port C is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port C output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running. If the JTAG interface is enabled, the pull-up resistors on pins occurs. Port C also serves the functions of the JTAG interface and other special features of the ATmega16 as listed.

Port D (PD7..PD0) :

Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running. Port D also serves the functions of various special features of the ATmega16 as listed .

RESET :

Reset Input. A low level on this pin for longer than the minimum pulse length will generate a reset, even if the clock is not running. The minimum pulse length is given . Shorter pulses are not guaranteed to generate a reset.

XTAL1 :

Input to the inverting Oscillator amplifier and input to the internal clock operating circuit.

XTAL2 :

Output from the inverting Oscillator amplifier. **AVCC** is the supply voltage pin for Port A and the A/D Converter. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter.

AREF :

AREF is the analog reference pin for the A/D Converter.

```
#include<avr/io.h>
#include<avr/interrupt.h>
#include<inttypes.h>
#include<util/delay.h>
#include"ATM_LCD4.h"
#include"ATM_Serial.h"
#include"eeprom_atmega.h"
#include"Adc_Atmega.h"

#define lvoice  PORTA &= ~0x02
#define hvoice  PORTA |= 0x02
#define lvoice1  PORTA &= ~0x04
#define hvoice1  PORTA |= 0x04
#define lvoice2  PORTA &= ~0x08
#define hvoice2  PORTA |= 0x08
#define lvoice3  PORTA &= ~0x10
#define hvoice3  PORTA |= 0x10
#define lvoice4  PORTA &= ~0x20
#define hvoice4  PORTA |= 0x20

void gps();
void keypad();
void Msg_Send();
void del()
{
        _delay_ms(2000);_delay_ms(2000);
}

unsigned char
mm,beat,resp,qq=0,ee,sec1,y=0,vv[100],z=0,k,aa,a,cc,s=0,count,sec,val[9
0],x=0,i1=0;
unsigned int msec,count1,value;
int main()
{
        cli();
        MCUCR=0<<PUD;
```

```
DDRA=0XFE;
PORTA=0XFF;
DDRB=0X00;
PORTB=0XFF;
DDRC=0XFF;
PORTC=0XFF;
DDRD=0XFF;
PORTD=0XFF;
sei();
_delay_ms(10);

Lcd4_Init();
Adc_Init();
Serial0_Init(9600);
Serial1_Init(4800);
Lcd4_Display(0x80,"Intelli Military ",16);
Lcd4_Display(0xc0,"App Usg Xbee Tech ",16);
_delay_ms(2000);
z=0;
TCCR1A=0x00;
TCCR1B=0x01;
TCCR1C=0x00;
TCNT1H=0xB1;
TCNT1L=0xE0;
TIMSK1=0x00;
Lcd4_Display(0x80,"                ",16);
Lcd4_Display(0xc0,"R   B   T    S  ",16);
PORTB=0xFF;
EICRA=0x30;
EIMSK=0x04;
beat=0;
/*lvoice;      _delay_ms(2000);hvoice;_delay_ms(2000);
lvoice1;      _delay_ms(2000);hvoice1;       _delay_ms(2000);*/
TIMSK1=0x01;
while(1)
{
```

```
//	value=(value*255)/1024;
	value=value>>2;
	value=value/4;
	Lcd4_Decimal3(0xc9,value);
//	if(!(PINB&0x01)){keypad();}
	Lcd4_Decimal2(0x80,x);
	Lcd4_Decimal2(0xCe,sec);
	gps();
	if( (!(PINB & 0x01)) && !qq){qq=1;}
	else		if((PINB		&		0x01)&&
qq){qq=0;resp++;Lcd4_Decimal3(0xC1,resp);}
	Lcd4_Decimal3(0xC5,beat);
//	if( (!(PINB & 0x04)) && !ee){ee=1;}
//	else		if((PINB		&		0x04)		&&
ee){ee=0;beat++;Lcd4_Decimal3(0x8d,beat);}
	if(!(PINB								&
0x08)){Serial0_Out('!');Serial0_Out('1');Serial0_Out('@');Serial0_Out(0x
0d);Serial0_Out(0x0a);}
	else				if(!(PINB				&
0x10)){Serial0_Out('!');Serial0_Out('2');Serial0_Out('@');Serial0_Out(0x
0d);Serial0_Out(0x0a);}
	else				if(!(PINB				&
0x20)){Serial0_Out('!');Serial0_Out('3');Serial0_Out('@');Serial0_Out(0x
0d);Serial0_Out(0x0a);}
	else				if(!(PINB				&
0x40)){Serial0_Out('!');Serial0_Out('4');Serial0_Out('@');Serial0_Out(0x
0d);Serial0_Out(0x0a);}
	else				if(!(PINB				&
0x80)){Serial0_Out('!');Serial0_Out('5');Serial0_Out('@');Serial0_Out(0x
0d);Serial0_Out(0x0a);}

	if(sec>=19)
	{
		resp=resp*3;
		beat=beat*3;
		Serial0_Out('#');
```

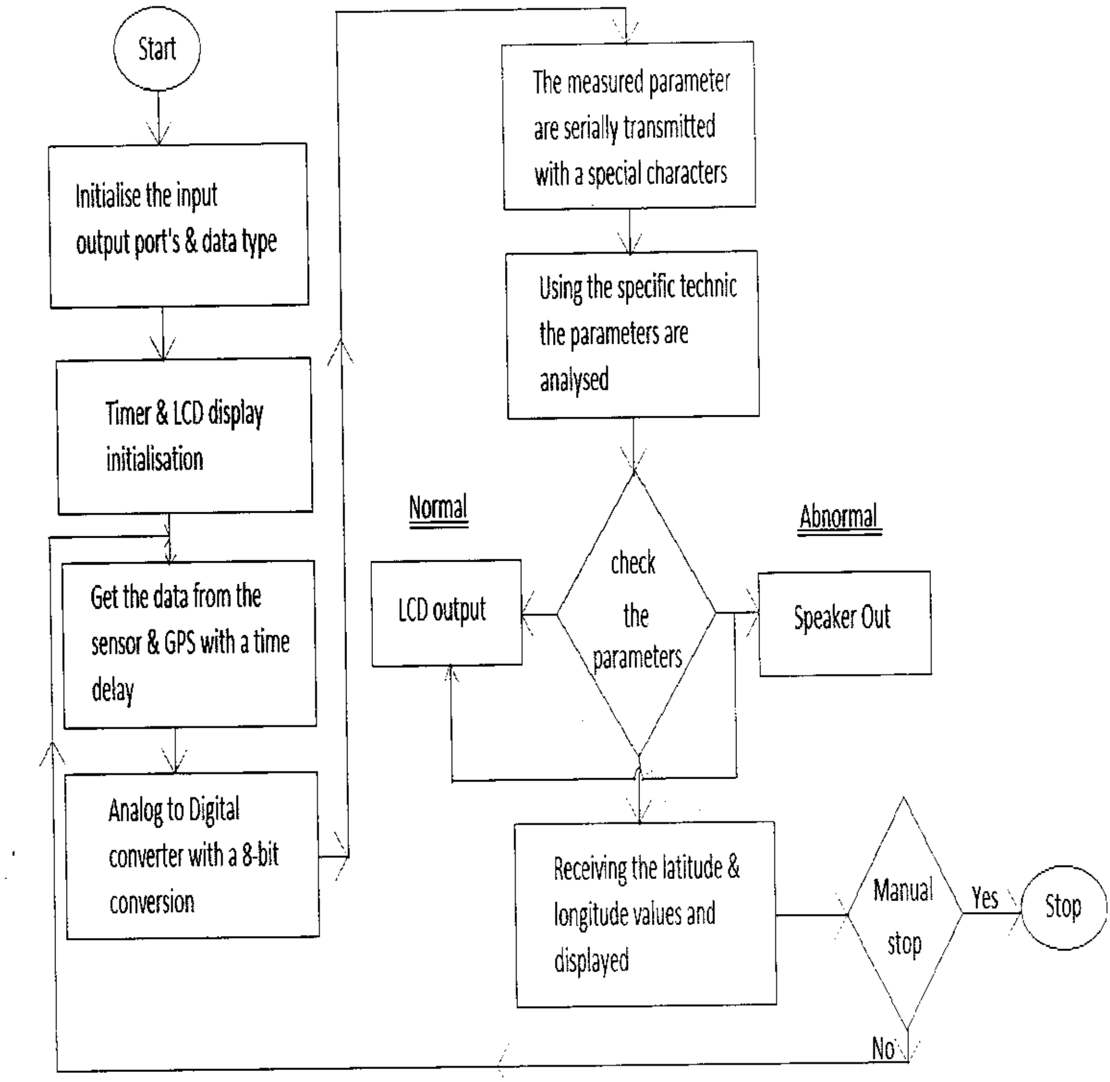
```
        Serial0_Out(value%100/10+0x30);
        Serial0_Out(value%10/1+0x30);
        Serial0_Out(resp%1000/100+0x30);
        Serial0_Out(resp%100/10+0x30);
        Serial0_Out(resp%10/1+0x30);
        Serial0_Out(beat%1000/100+0x30);
        Serial0_Out(beat%100/10+0x30);
        Serial0_Out(beat%10/1+0x30);
        Serial0_Out('@');
        Serial0_Out(0x0d);Serial0_Out(0x0a);
        sec=0;resp=beat=count=0;
        _delay_ms(2000);_delay_ms(5000);
        Serial0_Out('*');
        for(i1=19;i1<30;i1++)Serial0_Out(val[i1]);
    for(i1=32;i1<43;i1++)Serial0_Out(val[i1]);
        Serial0_Out(0x0d);Serial0_Out(0x0a);
        _delay_ms(2000);
        sec=0;resp=beat=count=0;
        TIMSK1=0x01;

    }

    if(z>=4)
    {
    //
for(mm=0;mm<5;mm++){Lcd4_Write(0xc0+mm,vv[mm]);}
        z=0;

if(vv[1]=='A'){Lcd4_Write(0xc0,vv[1]);lvoice;_delay_ms(1000);h
voice;_delay_ms(3000);vv[0]=0;z=0;}

if(vv[2]=='B'){Lcd4_Write(0xc0,vv[2]);lvoice1;_delay_ms(1000);
hvoice1;_delay_ms(3000);vv[0]=0;z=0;}

if(vv[3]=='C'){Lcd4_Write(0xc0,vv[3]);lvoice2;_delay_ms(1000);
hvoice2;_delay_ms(3000);vv[0]=0;z=0;}
```

```
	if(vv[4]=='D'){Lcd4_Write(0xc0,vv[4]);lvoice3;_delay_ms(1000);
hvoice3;_delay_ms(3000);vv[0]=0;z=0;}
		//
	if(vv[1]=='E'){Lcd4_Write(0xc0,vv[5]);lvoice4;_delay_ms(200);h
voice4;vv[0]=0;z=0;}
			vv[0]=0;z=0;
		}
	}
}


ISR(USART1_RX_vect )                    // USART RX interrupt
{
	val[x] = UDR1;
	if(val[0]!='$'){x=0;goto last;}
	else if(val[0]=='$'&&val[1]!='G'){x=1;goto last;}
	else if(val[0]=='$'&&val[1]=='G'&&val[2]!='P'){x=2;goto last;}
	else
if(val[0]=='$'&&val[1]=='G'&&val[2]=='P'&&val[3]!='R'){x=3;goto
last;}
	else
if(val[0]=='$'&&val[1]=='G'&&val[2]=='P'&&val[3]=='R'&&val[4]!='M'
){x=4;goto last;}
	else
if(val[0]=='$'&&val[1]=='G'&&val[2]=='P'&&val[3]=='R'&&val[4]=='
M'&&val[5]!='C'){if(x<80)x++;goto last;}
	last: ;
	sei();
}

ISR(USART0_RX_vect )                    // USART RX interrupt
{

	vv[z]=UDR0;
	if(vv[0]=='%')z++;
```

```
}

ISR(TIMER1_OVF_vect) // USART RX interrupt
{
	if((TIFR1&&0x01))
	{
		TIFR1=0;
		msec++;
		if(msec>=500)
		{
			msec=0;
			sec++;sec1++;
		}
	}

	TCNT1H=0xB1;
	TCNT1L=0xE0;
	sei();
}


ISR(INT2_vect)
{
//	if((EIFR&&0x02))
	{
//		EIFR=0;
		count++;
	beat=count;
	}

//	EICRA=0x30;
//	EIMSK=0x04;
	sei();

}
```

```
void gps()
{
	if( (!(PINB & 0x01)) && !qq){qq=1;}
	else                    if((PINB                    &                    0x01)&&
qq){qq=0;resp++;Lcd4_Decimal3(0xC1,resp);}
   if(x>68)
	{
	if( (!(PINB & 0x01)) && !qq){qq=1;}
	else                    if((PINB                    &                    0x01)&&
qq){qq=0;resp++;Lcd4_Decimal3(0xC1,resp);}
		Lcd4_Display(0x80,"LAT:",4);
		for(i1=19;i1<31;i1++)
		{
			Lcd4_Write(0x84+i1-19,val[i1]);
		}
		_delay_ms(200);
		Lcd4_Display(0x80,"LON:",4);
		for(i1=32;i1<=45;i1++)
		{
			Lcd4_Write(0x84+i1-32,val[i1]);
		}
		_delay_ms(200);
		x=0;

   }
   if( (!(PINB & 0x01)) && !qq){qq=1;}
	else  if((PINB & 0x01)&&
qq){qq=0;resp++;Lcd4_Decimal3(0xC1,resp);}

  }
```

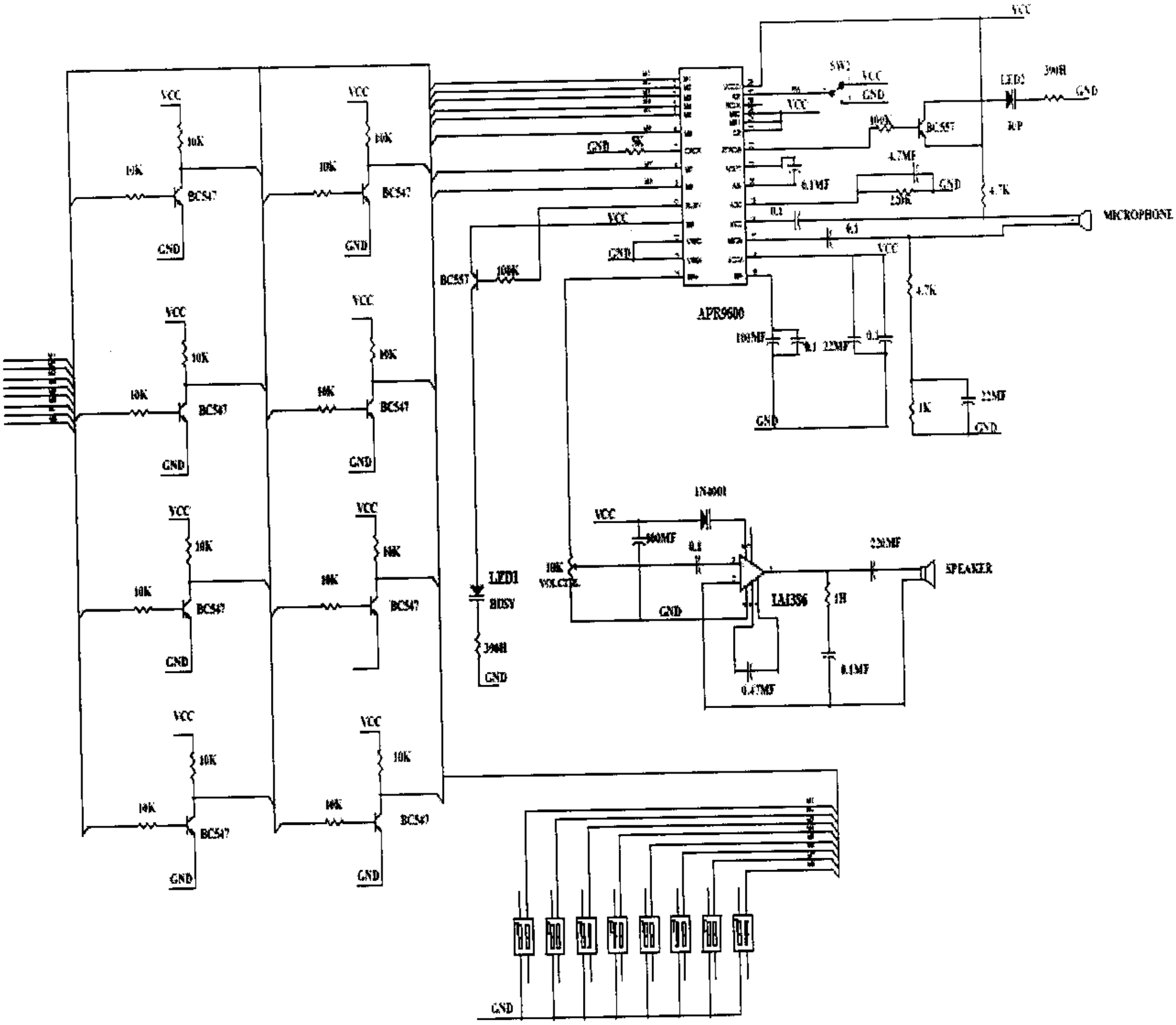
6.1 FLOW CHART



6.2 ALGORITHM

- Step1: Input and output ports are initialized
- Step2: Then timer and display are initialized
- Step3: Sensor and GPS values are received with time delay
- Step4: Analog to digital conversion with a 8bit conversion
- Step5: Measured parameters are serially transmitted with special characters
- Step6: The parameters are analyzed using specific technique
- Step7: Comparison takes place between the measured parameters
- Step8: If the value range is normal it is displayed at LCD
- Step9: If value is abnormal a recorded voice will be announced at the station
- Step10: Next the GPS Latitude and Longitude ranges are received at a specific time delay
- Step11: Manual stop is generated
- Step12: If yes process is stopped if no again the parameters are received and the process repeats

7.1 CIRCUIT DIAGRAM



This circuit is designed to record the voice signal. The microphone is used to pick up the voice signal. Then the signal is given to APR 600 multi section sound record and replay IC. APR 9600 is a low cost high performance sound record/reply IC incorporating flash analogue storage technique. Record sound is retained even after power supply is removed from the module. The replayed sound exhibits high quality with low noise level. Total sound recording time can be varied from 32 seconds to 60 seconds by changing the value of a single resistor. The IC can operate in two mode such as serial mode and parallel mode.

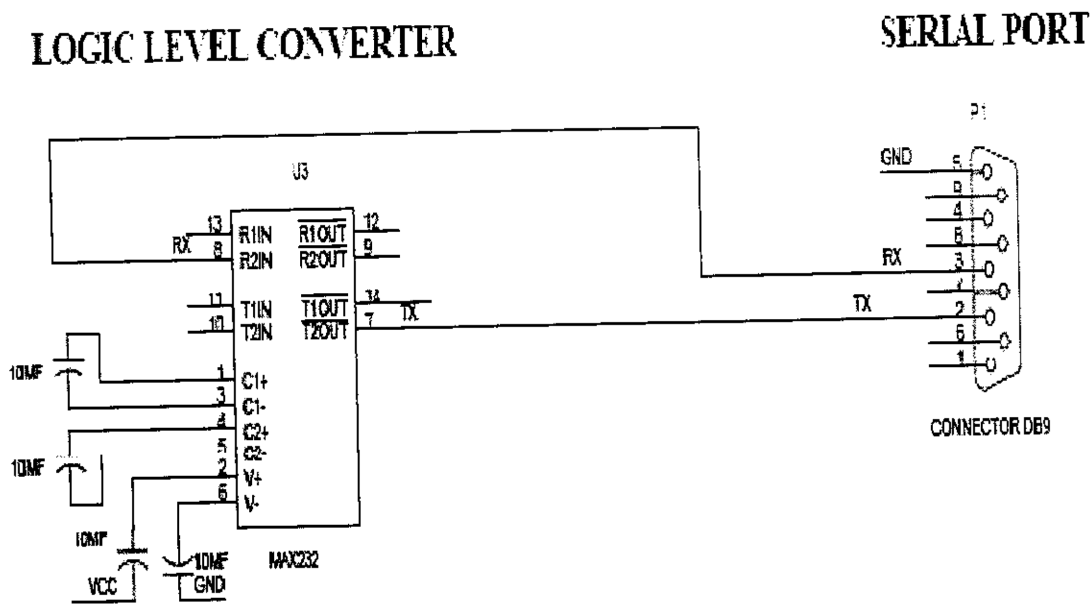
In serial access mode, sound can be recorded in 256 sections. In parallel access mode, sound can be recorded in 2, 4 and 8 section. The IC can be controlled simply using push button keys. It is also possible to control the IC using external digital circuitry such as microcontrollers and computers.

During sound recording, sound is picked up by the microphone. A microphone pre- amplifier amplifies the voltage signal from the microphone. An AGC circuit is included in the pre-amplifier, the extent of which is controlled by an external capacitor and resistor. If the voltage level of a sound signal is around 100mv peak to peak, the signal can be fed directly into the IC through ANA IN pin (pin 20). The sound signal passes through a filter and a sampling and hold circuit. The analogue voltage is then written into non volatile flash analogue RAMs.

There are two kinds of modes available. They are Record and Play mode. RE pin is pulled low to enable recording and pulled high for playback. During record mode, we write the processed voice signal into the memory and read the same from memory during the play mode. If the circuit is busy in Reading or Writing, the LED glows indicating that the circuit is busy. This LED is driven by transistor Q1. For recording into memory, MS1 and MS2 are pulled high. To enable recording of message from the microphone, the RE pin goes low. The maximum length of eight sound track is 7.5 seconds each. When LED2 blinks we can speak into the mic. The recording will be terminated if the recording time exceeds 7.5 sec. Similarly for playbacks, RE pin goes high.

M1-M8 is the eight memories that are available; each pin is connected to a push button. The buttons are set initially in a high state. For example, if Button 1 is pressed, the state of the button becomes low and depending on the mode whether it is the play mode or record mode, the memory 1 is chosen to read or write. MS1 and MS2 Pins are used to indicate the part of the memory and number of the memory to be chosen whether it's one full memory or half the memory or a quarter of the memory etc. The Audio amplifier is used to amplify the signal that is to be played and an amplified output is obtained from the loud speaker. If the circuit is busy in Reading or Writing, the LED glows to indicating that the Circuit is Busy.

8.1 CIRCUIT DIAGRAM



In telecommunications, **RS-232** is a standard for serial binary data interconnection between a *DTE* (Data terminal equipment) and a *DCE* (Data Circuit-terminating Equipment). It is commonly used in computer serial ports.

8.2 SCOPE OF THE STANDARD:

The Electronic Industries Alliance (EIA) standard RS-232-C [3] as of 1969 defines:

- Electrical signal characteristics such as voltage levels, signaling rate, timing and slew-rate of signals, voltage withstand level, short-circuit behavior, maximum stray capacitance and cable length
- Interface mechanical characteristics, pluggable connectors and pin identification

- Standard subsets of interface circuits for selected telecom applications

The standard does not define such elements as character encoding (for example, ASCII, Baudot or EBCDIC), or the framing of characters in the data stream (bits per character, start/stop bits, parity). The standard does not define protocols for error detection or algorithms for data compression.

The standard does not define bit rates for transmission, although the standard says it is intended for bit rates lower than 20,000 bits per second. Many modern devices can exceed this speed (38,400 and 57,600 bit/s being common, and 115,200 and 230,400 bit/s making occasional appearances) while still using RS-232 compatible signal levels.

Details of character format and transmission bit rate are controlled by the serial port hardware, often a single integrated circuit called a UART that converts data from parallel to serial form. A typical serial port includes specialized driver and receiver integrated circuits to convert between internal logic levels and RS-232 compatible signal levels.

8.3 CIRCUIT WORKING DESCRIPTION:

In this circuit the MAX 232 IC used as level logic converter. The MAX232 is a dual driver/receiver that includes a capacive voltage generator to supply EIA 232 voltage levels from a single 5v supply. Each receiver converts EIA-232 to 5v TTL/CMOS levels. Each driver converts TLL/CMOS input levels into EIA-232 levels.

Function Tables

EACH DRIVER

INPUT TIN	OUTPUT TOUT
L	H
H	L

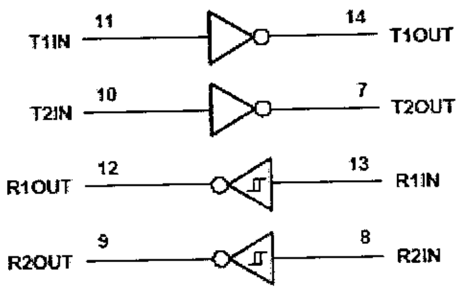
H = high level, L = low level

EACH RECEIVER

INPUT RIN	OUTPUT ROUT
L	H
H	L

H = high level, L = low level

logic diagram (positive logic)



In this circuit the microcontroller transmitter pin is connected in the MAX232 T2IN pin which converts input 5v TTL/CMOS level to RS232 level. Then T2OUT pin is connected to reviver pin of 9 pin D type serial connector which is directly connected to PC.

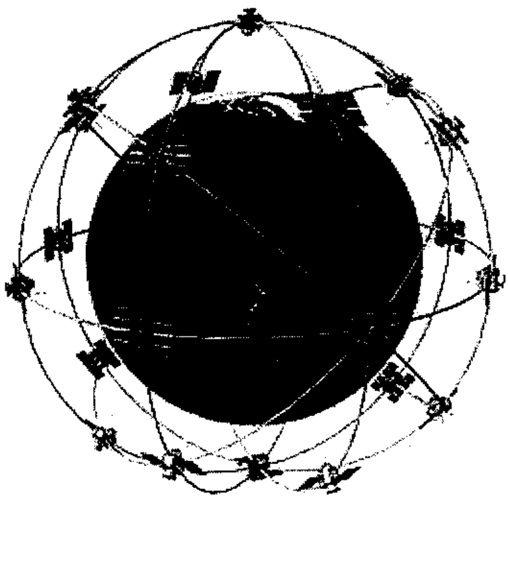
In PC the transmitting data is given to R2IN of MAX232 through transmitting pin of 9 pin D type connector which converts the RS232 level to 5v TTL/CMOS level. The R2OUT pin is connected to receiver pin of the microcontroller. Likewise the data is transmitted and received between the microcontroller and PC or other device vice versa.

9.1 HOW GPS WORKS

GPS stands for Global Positioning System, and is a way of locating a receiver in three dimensional space anywhere on the Earth, and even in orbit about it.

GPS is arguably one of the most important inventions of our time, and has so many different applications that many technologies and ways of working are continually being improved in order to make the most of it.

To understand exactly why it is so useful and important, we should first look at how GPS works. More importantly, looking at what technological achievements have driven the development of this fascinating positioning system.



9.2 SIGNALS

In order for GPS to work, a network of satellites was placed into orbit around planet Earth, each broadcasting a specific signal, much like a normal radio signal. This signal can be received by a low cost, low technology aerial, even though the signal is very weak.Rather than carrying an actual radio or television program, the signals that are broadcast by the satellites carry data that is passed from the aerial, decoded and used by to the GPS software.

to travel from the satellite to the GPS receiver.Using different signals from different satellites, the GPS software is able to calculate the position of the receiver. The principle is very similar to that which is used in orienteering – if you can identify three places on your map, take a bearing to where they are, and draw three lines on the map, then you will find out where you are on the map.

The lines will intersect, and, depending on the accuracy of the bearings, the triangle that they form where they intersect will approximate your position, within a margin of error.GPS software performs a similar kind of exercise, using the known positions of the satellites in space, and measuring the time that the signal has taken to travel from the satellite to Earth.

The result of the "trilateration" (the term used when distances are used instead of bearings) of at least three satellites, assuming that the clocks are all synchronized enables the software to calculate, within a margin of error, where the device is located in terms of its latitude (East-West) and longitude (North-South) and distance from the center of the Earth.

9.3 TIMING & CORRECTION

In a perfect world, the accuracy should be absolute, but there are many different factors which prevent this. Principally, it is impossible to ensure that the clocks are all synchronized.

Since the satellites each contain atomic clocks which are extremely accurate, and certainly accurate with respect to each other, we can assume that most of the problem lies with the clock inside the GPS unit itself.

Keeping the cost of the technology down to a minimum is a key part of the success of any consumer device, and it is simply not possible to fit each GPS unit with an atomic clock costing tens of thousands of dollars. Luckily, in creating the system, the designers designed GPS to work whether the receiver's clock is accurate or not.

There are a few solutions. However the solution that was chosen uses a adding a fourth will move that location; that is, it will not intersect with the calculated location.

This indicates to the GPS software that there is a discrepancy, and so it performs an additional calculation to find a value that it can use to adjust all the signals so that the four lines intersect.

Usually, this is as simple as subtracting a second (for example) from each of the calculated travel times of the signals. Thus, the GPS software can also update its' own internal clock; and means that not only do we have an accurate positioning device, but also an atomic clock in the palm of our hands.

9.4 MAPPING

Knowing where the device is in space is one thing, but it is fairly useless information without something to compare it with. Thus, the mapping part of any GPS software is very important; it is how GPS works our possible routes, and allows the user to plan trips in advance.In fact, it is often the mapping data which elevates the price of the GPS solution; it must be accurate and updated reasonably frequently. There are, however, several kinds of map, and each is intended for different users, with different needs.Road users, for example, require that their mapping data contains accurate information about the road network in the region that they will be traveling in, but will not require detailed information about the lie of the land – they do not really worry about the height of hills and so forth.

On the other hand, hiking GPS users might wish to have a detailed map of the terrain, rivers, hills and so forth, and perhaps tracks and trails, but not roads. They might also like to adorn their map with specific icons of things that they find along the way and that they wish to keep a record of – not to mention waypoints; locations to make for on their general route.

Finally, marine users need very specific information relating to the sea bed, navigable channels, and other pieces of maritime data that enables them to navigate safely. Of course, the sea itself is reasonably featureless, but underneath quite some detail is needed to be sure that the boat will not become grounded.

Fishermen also use marine GPS to locate themselves and track the movement of shoals of fish both in real time, and to predict where they will be the next day. The advent of GPS fixing has also meant that co-operative fishing has become much easier, where there are several boats all relaying their locations to each other while they locate the best fishing waters.

Special kinds of marine GPS, known as fishfinders, also combine several functions in one to help fishermen. A fishfinder comprises GPS and also sonar, along with advanced tracking functions and storage for various kinds of fishing and maritime information.

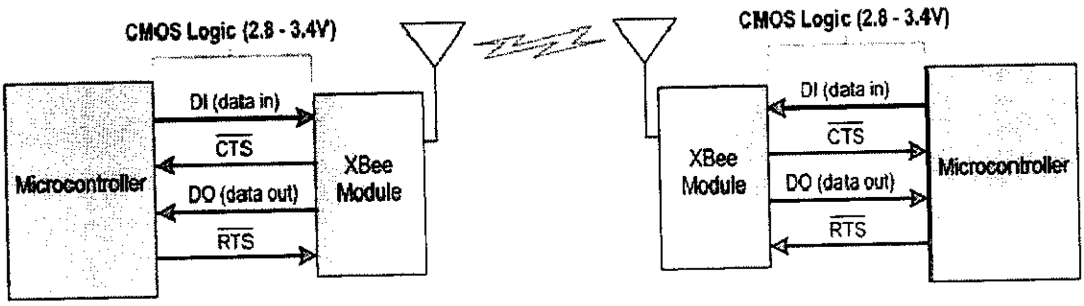
10.1 ZIG-BEE COMMUNICATIONS

SERIAL COMMUNICATIONS :

The XBee/XBee-PRO OEM RF Modules interface to a host device through a logic-level asynchro-nous serial port. Through its serial port, the module can communicate with any logic and voltage compatible UART; or through a level translator to any serial device (For example: Through a Max- Stream proprietary RS-232 or USB interface board).

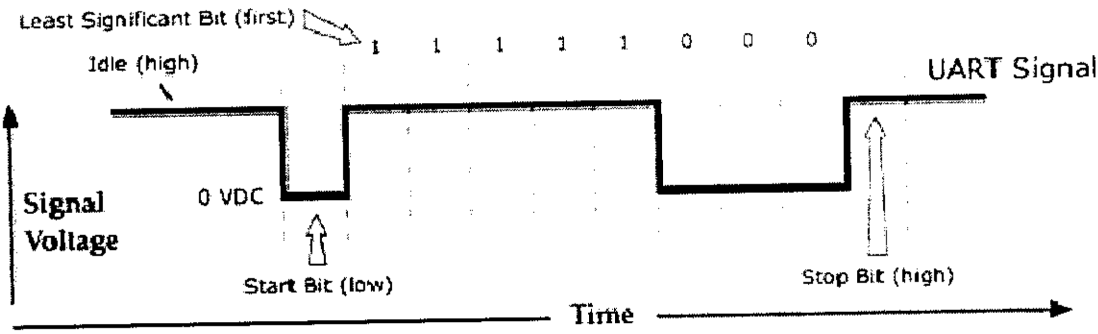
UART DATA FLOW :

Devices that have a UART interface can connect directly to the pins of the RF module as shown in the figure below. **Figure 2-01. System Data Flow Diagram in a UART-interfaced environment** (Low-asserted signals distinguished with horizontal line over signal name.)



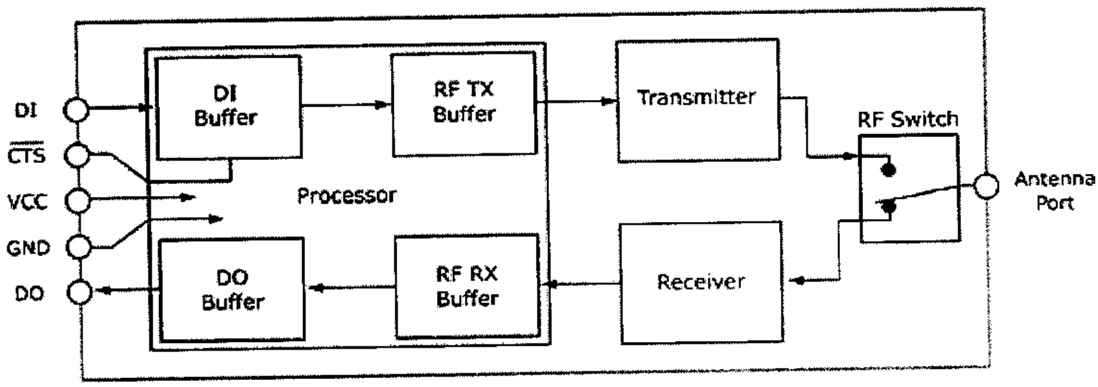
SERIAL DATA

Data enters the module UART through the DI pin (pin 3) as an asynchronous serial signal. The sig-nal should idle high when no data is being transmitted. Each data byte consists of a start bit (low), 8 data bits (least significant bit first) and a stop bit (high). The following figure illustrates the serial bit pattern of data passing through the module. **Figure 2-02. UART data packet 0x1F (decimal number "31") as transmitted through the RF module** Example Data Format is 8-N-1



The module UART performs tasks, such as timing and parity checking, that are needed for data communications. Serial communications depend on the two UARTs to be configured with compati-ble settings (baud rate, parity, start bits, stop bits, data bits).

FLOW CONTROL



DI (DATA IN) BUFFER

When serial data enters the RF module through the DI pin (pin 3), the data is stored in the DI Buffer until it can be processed. **Hardware Flow Control (CTS).** When the DI buffer is 17 bytes away from being full; by default, the module de-asserts CTS (high) to signal to the host device to stop sending data [refer to D7 (DIO7 Configuration) parameter]. CTS is re-asserted after the DI Buffer has 34 bytes of memory available.

DO (DATA OUT) BUFFER

When RF data is received, the data enters the DO buffer and is sent out the serial port to a host device. Once the DO Buffer reaches capacity, any additional incoming RF data is lost. **Hardware Flow Control (RTS).** If RTS is enabled for flow control (D6 (DIO6 Configuration) Parameter = 1), data will not be sent out the DO Buffer as long as RTS (pin 16) is de-asserted.

XBEE/XBEE-PRO ADDRESSING

Every RF data packet sent over-the-air contains a Source Address and Destination Address field in its header. The RF module conforms to the 802.15.4 specification and supports both short 16-bit addresses and long 64-bit addresses. A unique 64-bit IEEE source address is assigned at the fac-tory and can be read with the SL (Serial Number Low) and SH (Serial Number High) commands. Short addressing must be configured manually. A module will use its unique 64-bit address as its Source Address if its MY (16-bit Source Address) value is "0xFFFF" or "0xFFFE". To send a packet to a specific module using 64-bit addressing: Set Destination Address (DL + DH) to match the Source Address (SL + SH) of the intended destination module. To send a packet to a specific module using 16-bit addressing: Set DL (Destination Address Low) parameter to equal the MY parameter and set the DH (Destination Address High) parameter to '0'.

UNICAST MODE:

By default, the RF module operates in Unicast Mode. Unicast Mode is the only mode that supports retries. While in this mode, receiving modules send an ACK (acknowledgement) of RF packet reception to the transmitter. If the transmitting module does not receive the ACK, it will re-send the packet up to three times or until the ACK is received.

SHORT 16-BIT ADDRESSES:

The module can be configured to use short 16-bit addresses as the Source Address by setting (MY < 0xFFFE). Setting the DH parameter (DH = 0) will configure the Destination Address to be a short 16-bit address (if DL < 0xFFFE). For two modules to communi-cate using short the MY parameter of the receiver. The following table shows a sample network configuration that would enable Unicast Mode com-munications using short 16-bit addresses.

LONG 64-BIT ADDRESSES:

The RF module's serial number (SL parameter concatenated to the SH parameter) can be used as a 64-bit source address when the MY (16-bit Source Address) parame-ter is disabled. When the MY parameter is disabled (set MY = 0xFFFF or 0xFFFE), the module's source address is set to the 64-bit IEEE address stored in the SH and SL parameters. When an End Device associates to a Coordinator, its MY parameter is set to 0xFFFE to enable 64- bit addressing. The 64-bit address of the module is stored as SH and SL parameters. To send a packet to a specific module, the Destination Address (DL + DH) on one module must match the Source Address (SL + SH) of the other.

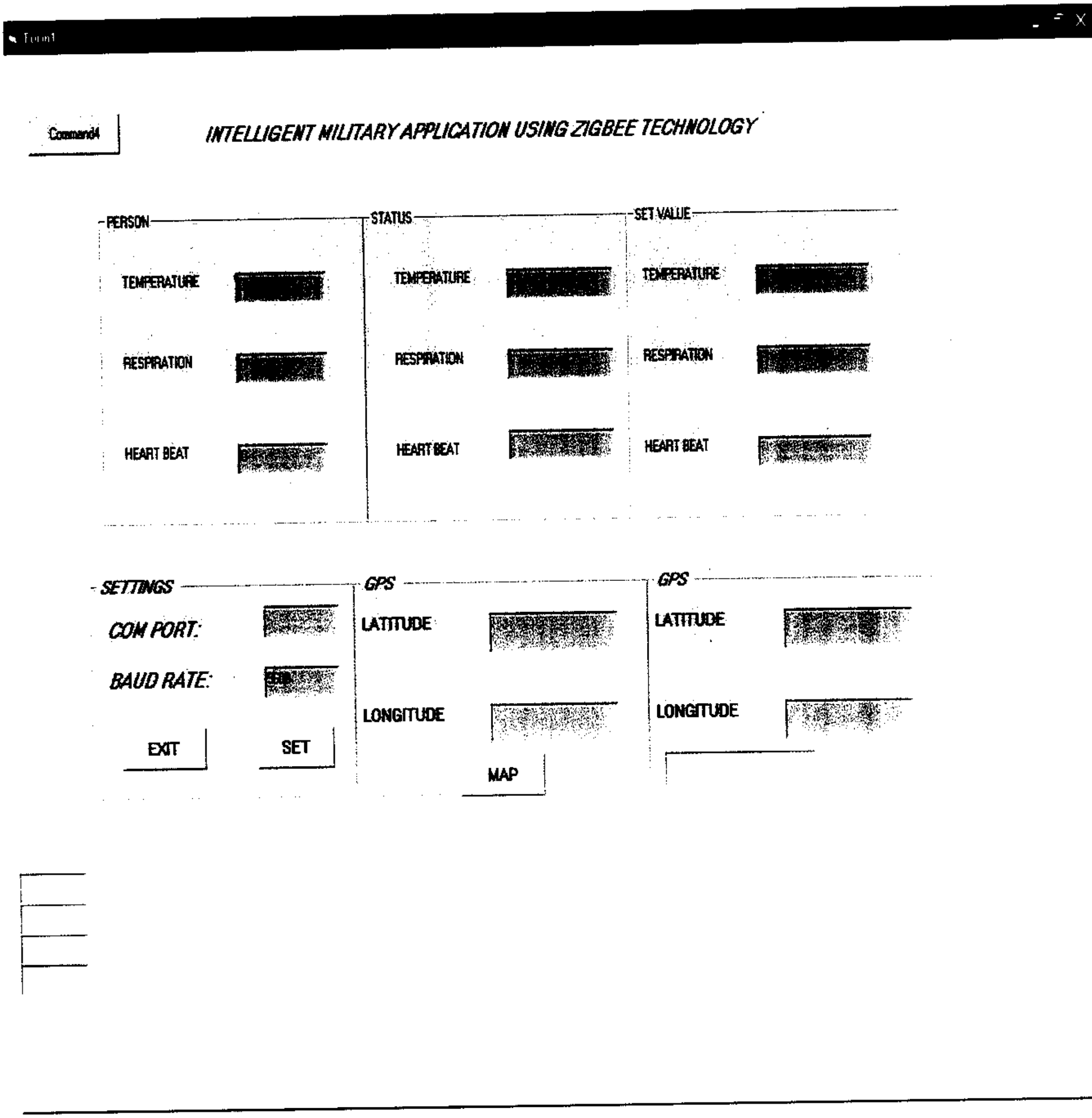
BROADCAST MODE:

Any RF module within range will accept a packet that contains a broadcast address. When config-ured to operate in Broadcast Mode, receiving modules do not send ACKs (Acknowledgements) and transmitting modules do not automatically re-send packets as is the case in Unicast Mode. To send a broadcast packet to all modules regardless of 16-bit or 64-bit addressing, set the desti-nation addresses of all the modules as shown below. Sample Network Configuration (All modules in the network): • DL (Destination Low Address) = 0x0000FFFF • DH (Destination High Address) = 0x00000000 (default value)

CONCLUSION

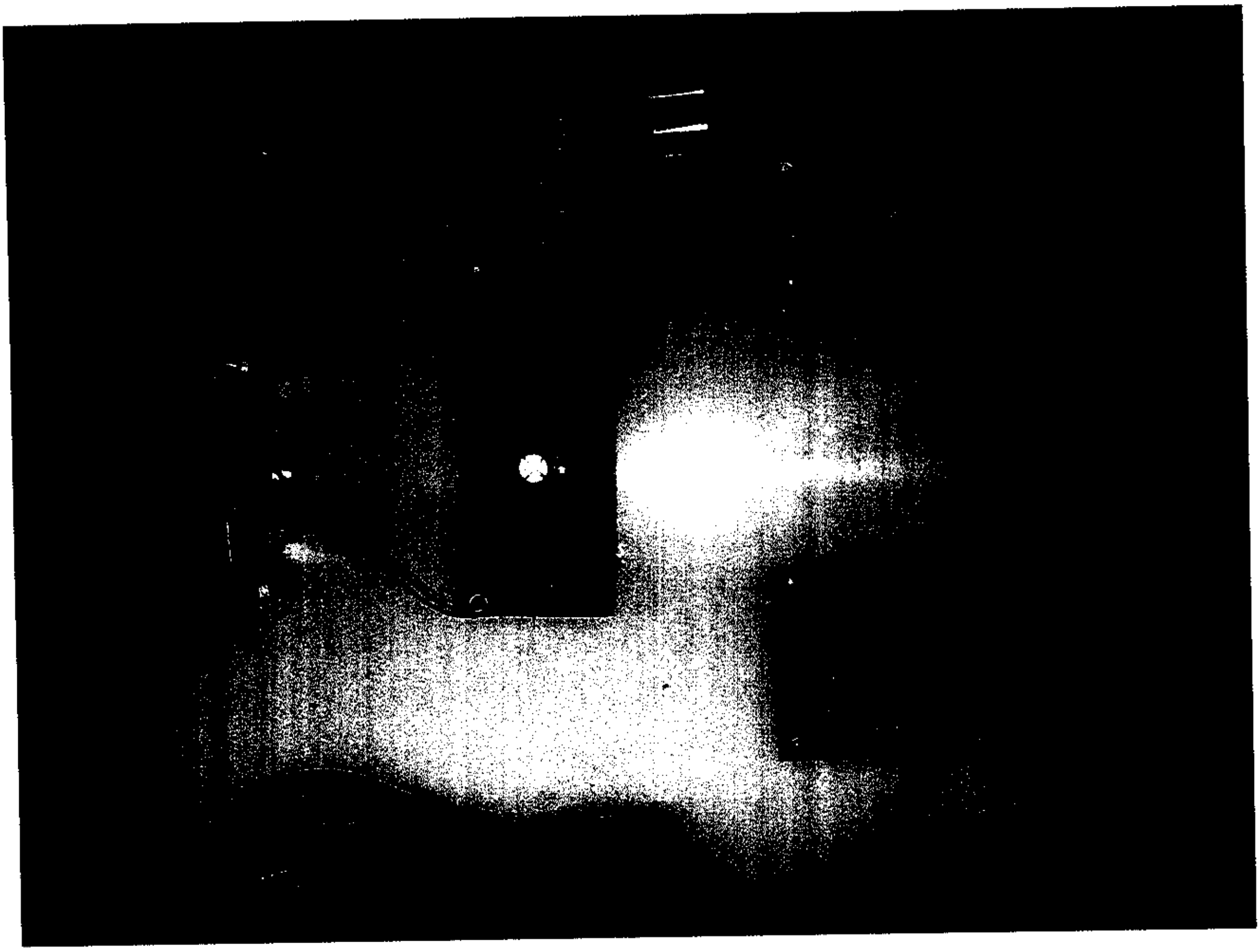
The model of the project has been on purpose, built on the base of ATMEGA 164 in spite of the availability of higher integrated chips. The project has enlightened us on the working of analog to digital converters and the internal operations of basic microcontroller supplementing our theoretical knowledge to great extent. Finally the measured parameters of the military man was amplified and both the latitude & longitude positions are tracked using GPS. Hence all the data is transmitted using ZIG-BEE and it is monitored continuously in the receiving station.

12.1 SOFTWARE VIEW

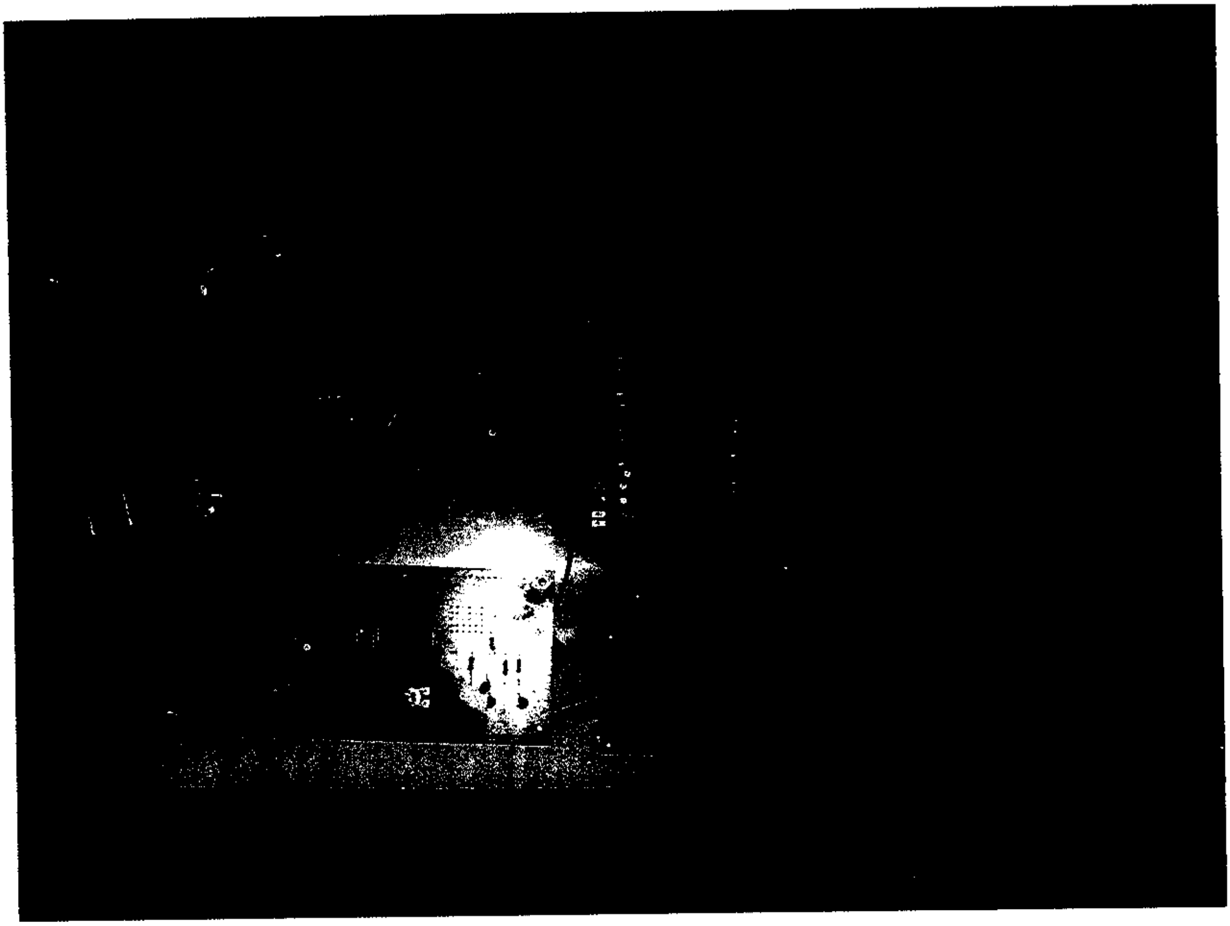


12.2REALTIME VIEW

12.2.1CONTROL STATION

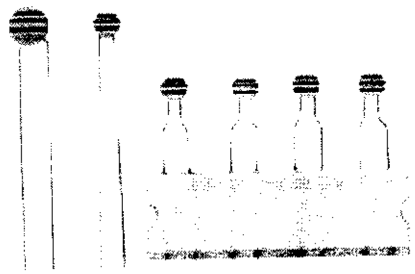


12.2.2 TRANSMISSION SIDE



Disc Type NTC Thermistors

Type: **ERTD**



Disc type negative temperaturecoefficient thermistors.
Resistance values from 8 Ω to 150 kΩ and B Values are from 3000 K to5000 K

■ Features

- Wide selection of temperature coefficients
- Excellent electrical and thermal stability

■ Recommended Applications

- Temperature detection
- Temperature compensation for measuring instruments
- Temperature compensation for deflection coil in TV

■ Explanation of Part Numbers

1	2	3	4	5	6	7	8	9	10	11	12
E	R	T	D								

Product Code	
ERT	NTC Thermistors

Shape	
D	Disc Type

Disc Dim	
2	φ5.0 mm
3	φ7.5 mm

Lead Style	
F	Straight Lead
Z	Z" Crimped Lead

Center B Value (K)	
E	2501–3000
F	3001–3500
G	3501–4000
H	4001–4500
I	4501–5000

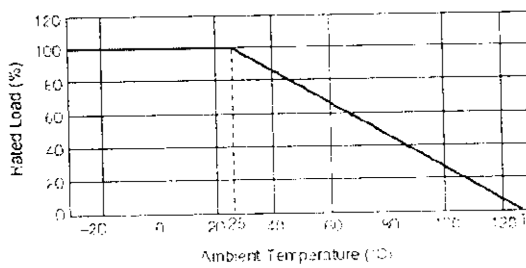
Resistance Tolerance	
J	±5 %
K	±10 %
L	±15 %

Resistance R_{25} (Ω)
The first two digits are significant figures of resistance and the third one denotes number of zeros following them. Decimal point is expressed by R as 1.4 = 1R4.

Option	
S	Standard
T	Taping Ty

■ Derating Curve for the NTC Thermistor

For the NTC Thermistor operated in ambient temperature above 25 °C, power rating should be derated in accordance with the right figure.



■ Ratings and Characteristics

Part No.	Zero-Power Resistance at 25 °C(Ω)	B Value** (K)	Maximum Permissible Power(W)	Heat Dissipation Constant (mW/°C)	Thermal Time Constant (s)	Resistance Ratio R_{25}/R_{50}	Table A/B Curve No.
ERTD2FE[L]*200S	20	3000	0.4	4.5	20	2.18	—
ERTD2FF[L]*400S	40	3200				2.30	—
ERTD2FG[L]*750S	75	3700				2.62	1
ERTD2FF[L]*101S	100	3500				2.48	—
ERTD2FG[L]*101S	100	3700				2.62	2
ERTD2FG[L]*171S	170	3700				2.62	3
ERTD2FF[L]*251S	250	3500				2.48	—
ERTD2FG[L]*251S	250	3900				2.76	4
ERTD2FG[L]*301S	300	3900				2.76	—
ERTD2FF[L]*351S	350	3500				2.48	5
ERTD2FG[L]*601S	600	4000				2.83	6
ERTD2FG[L]*801S	800	3900				2.76	7
ERTD2FG[L]*102S	1000	3700				2.61	—
ERTD2FG[L]*142S	1400	3900				2.76	—
ERTD2FG[L]*202S	2000	4000				2.83	8
ERTD2FG[L]*332S	3300	4000				2.83	9
ERTD2FH[L]*462S	4600	4100				2.90	—
ERTD2FH[L]*802S	8000	4100				2.90	10
ERTD2FH[L]*103S	10000	4100				2.90	—
ERTD2FH[L]*153S	15000	4200				2.98	11
ERTD2FH[L]*333S	33000	4500				3.22	12
ERTD2FH[L]*503S	50000	4500				3.22	13
ERTD2FI[L]*154S	150000	4800				3.48	14
ERTD3FE[L]*8R0S	8	3000	0.6	7.0	27	2.18	15
ERTD3FF[L]*130S	13	3200				2.30	16
ERTD3FF[L]*160S	16	3200				2.30	—
ERTD3FF[L]*200S	20	3200				2.30	—
ERTD3FF[L]*300S	30	3200				2.30	—
ERTD3FF[L]*400S	40	3200				2.30	—
ERTD3FG[L]*750S	75	3700				2.62	—
ERTD3FG[L]*800S	80	3700				2.62	—
ERTD3FG[L]*131S	130	3700				2.62	—
ERTD3FG[L]*501S	500	4000				2.83	—
ERTD3FH[L]*402S	4000	4100				2.90	—
ERTD3FH[L]*203S	20000	4500				3.22	—
ERTD3FI[L]*803S	80000	5000				3.70	17

*Resistance Tolerance Code

J	K	L
±5 %	±10 %	±15 %

● Operating Temperature Range −30 to +125 °C

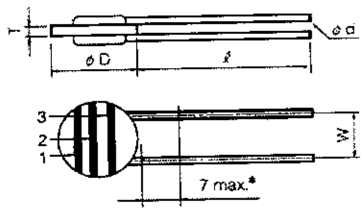
**Tolerance of "B value": ±10 %

$$B = \frac{\ell n\,(R_{25}/R_{50})}{1/298.15-1/323.15}$$

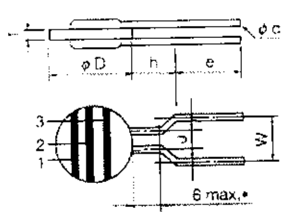
R_{25}=Resistance at 25.0 °C
R_{50}=Resistance at 50.0 °C

■ Dimensions in mm (not to scale)

Straight Lead Type
F Type



Crimped Lead Type
Z Type



*Coating extension on leads

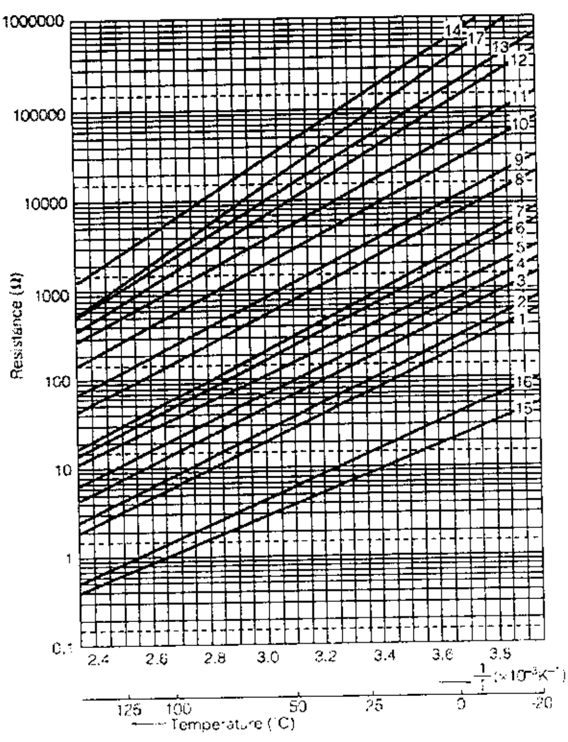
F Type

	φD	T	ℓ	W	φd
D2	5.0±0.5	1.3±0.5	30.0 min.	2.5±1.0	0.4
D3	7.5±0.5	1.4±0.5	30.0 min.	5.0±1.0	0.5

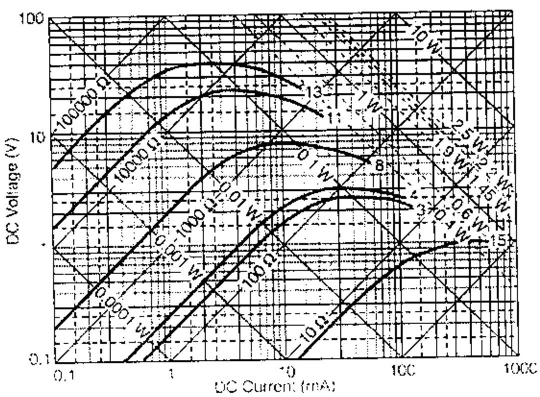
Z Type

	φD	T	u	e	h	W	φd
D2	5.0±0.5	1.3±0.5	3.0 max. (nom.2.5)	4.5±1.0	6.0 max. (nom.5.0)	5.0±1.0	0.5

■ Resistance vs. Temperature (Table A)



■ Voltage vs. Current (Table B)



SN5404, SN54LS04, SN54S04, SN7404, SN74LS04, SN74S04 HEX INVERTERS

DECEMBER 1983 – REVISED MARCH 1988

- Package Options Include Plastic "Small Outline" Packages, Ceramic Chip Carriers and Flat Packages, and Plastic and Ceramic DIPs
- Dependable Texas Instruments Quality and Reliability

description

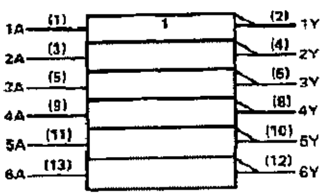
These devices contain six independent inverters.

The SN5404, SN54LS04, and SN54S04 are characterized for operation over the full military temperature range of −55°C to 125°C. The SN7404, SN74LS04, and SN74S04 are characterized for operation from 0°C to 70°C.

FUNCTION TABLE (each inverter)

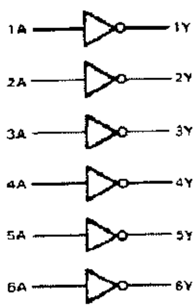
INPUTS A	OUTPUT Y
H	L
L	H

logic symbol†



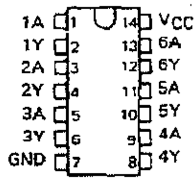
†This symbol is in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12.
Pin numbers shown are for D, J, and N packages.

logic diagram (positive logic)

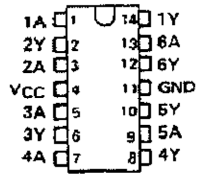


$Y = \overline{A}$

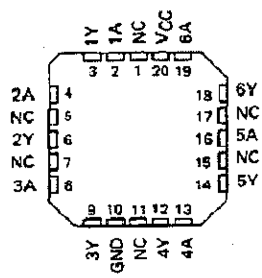
SN5404 . . . J PACKAGE
SN54LS04, SN54S04 . . . J OR W PACKAGE
SN7404 . . . N PACKAGE
SN74LS04, SN74S04 . . . D OR N PACKAGE
(TOP VIEW)



SN5404 . . . W PACKAGE
(TOP VIEW)

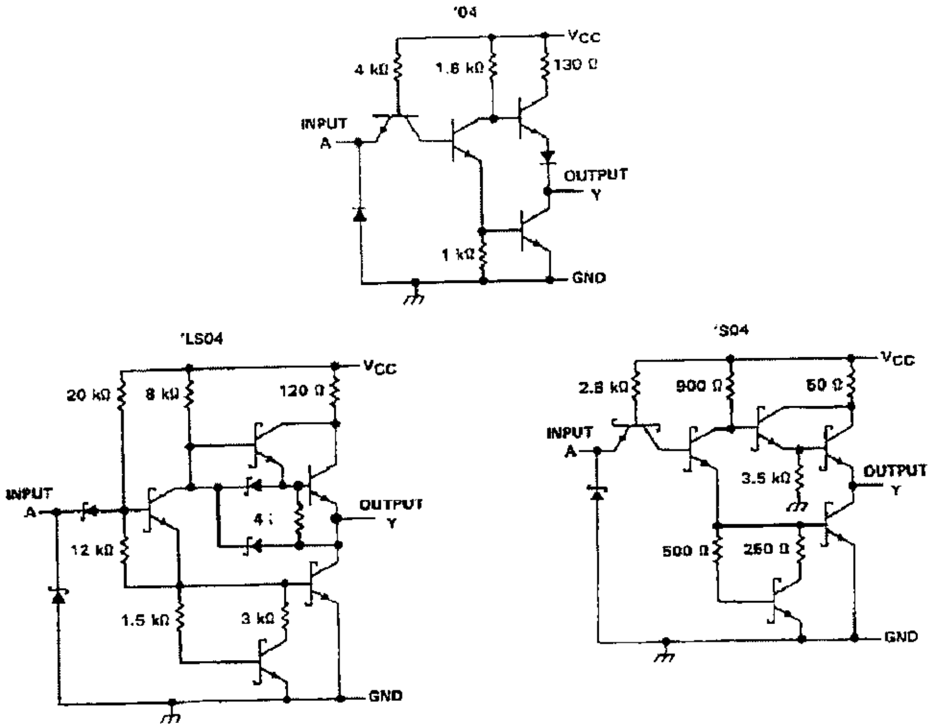


SN54LS04, SN54S04 . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

schematics (each gate)



Resistor values shown are nominal.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1)		7 V
Input voltage:	'04, 'S04	5.5 V
	'LS04	7 V
Operating free-air temperature range:	SN54'	−55°C to 125°C
	SN74'	0°C to 70°C
Storage temperature range		−65°C to 150°C

NOTE 1. Voltage values are with respect to network ground terminal.

recommended operating conditions

		SN5404			SN7404			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
V_{IH}	High-level input voltage	2			2			V
V_{IL}	Low-level input voltage			0.8			0.8	V
I_{OH}	High-level output current			– 0.4			– 0.4	mA
I_{OL}	Low-level output current			16			16	mA
T_A	Operating free-air temperature	– 55		125	0		70	°C

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS †	SN5404			SN7404			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IK}	V_{CC} = MIN, I_I = – 12 mA			– 1.5			– 1.5	V
V_{OH}	V_{CC} = MIN, V_{IL} = 0.8 V, I_{OH} = – 0.4 mA	2.4	3.4		2.4	3.4		V
V_{OL}	V_{CC} = MIN, V_{IH} = 2 V, I_{OL} = 16 mA		0.2	0.4		0.2	0.4	V
I_I	V_{CC} = MAX, V_I = 5.5 V			1			1	mA
I_{IH}	V_{CC} = MAX, V_I = 2.4 V			40			40	µA
I_{IL}	V_{CC} = MAX, V_I = 0.4 V			– 1.6			– 1.6	mA
I_{OS}§	V_{CC} = MAX	– 20		– 55	– 18		– 55	mA
I_{CCH}	V_{CC} = MAX, V_I = 0 V		6	12		6	12	mA
I_{CCL}	V_{CC} = MAX, V_I = 4.5 V		18	33		18	33	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ All typical values are at V_{CC} = 5 V, T_A = 25°C.
§ Not more than one output should be shorted at a time.

switching characteristics, V_{CC} = 5 V, T_A = 25°C (see note 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_{PLH}	A	Y	R_L = 400 Ω,	C_L = 15 pF		12	22	ns
t_{PHL}						8	15	ns

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.

NPN general purpose transistors — BC546; BC547

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 65 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN transistor in a TO-92; SOT54 plastic package.
PNP complements: BC556 and BC557.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

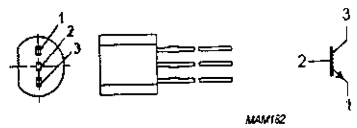


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC546		–	80	V
	BC547		–	50	V
V_{CEO}	collector-emitter voltage	open base			
	BC546		–	65	V
	BC547		–	45	V
V_{EBO}	emitter-base voltage	open collector			
	BC546		–	6	V
	BC547		–	6	V
I_C	collector current (DC)		–	100	mA
I_{CM}	peak collector current		–	200	mA
I_{BM}	peak base current		–	200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	500	mW
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		−65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

SGS-THOMSON MICROELECTRONICS

UA741

GENERAL PURPOSE SINGLE OPERATIONAL AMPLIFIERS

- LARGE INPUT VOLTAGE RANGE
- NO LATCH-UP
- HIGH GAIN
- SHORT-CIRCUIT PROTECTION
- NO FREQUENCY COMPENSATION REQUIRED
- SAME PIN CONFIGURATION AS THE UA709
- ESD INTERNAL PROTECTION

N
DIP8
(Plastic Package)

D
SO8
(Plastic Micropackage)

DESCRIPTION

The UA741 is a high performance monolithic operational amplifier constructed on a single silicon chip. It is intented for a wide range of analog applications.

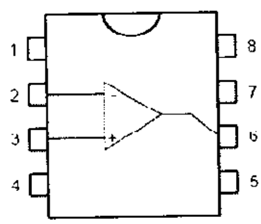
- Summing amplifier
- Voltage follower
- Integrator
- Active filter
- Function generator

The high gain and wide range of operating voltages provide superior performances in integrator, summing amplifier and general feedback applications. The internal compensation network (6dB / octave) insures stability in closed loop circuits.

ORDER CODES

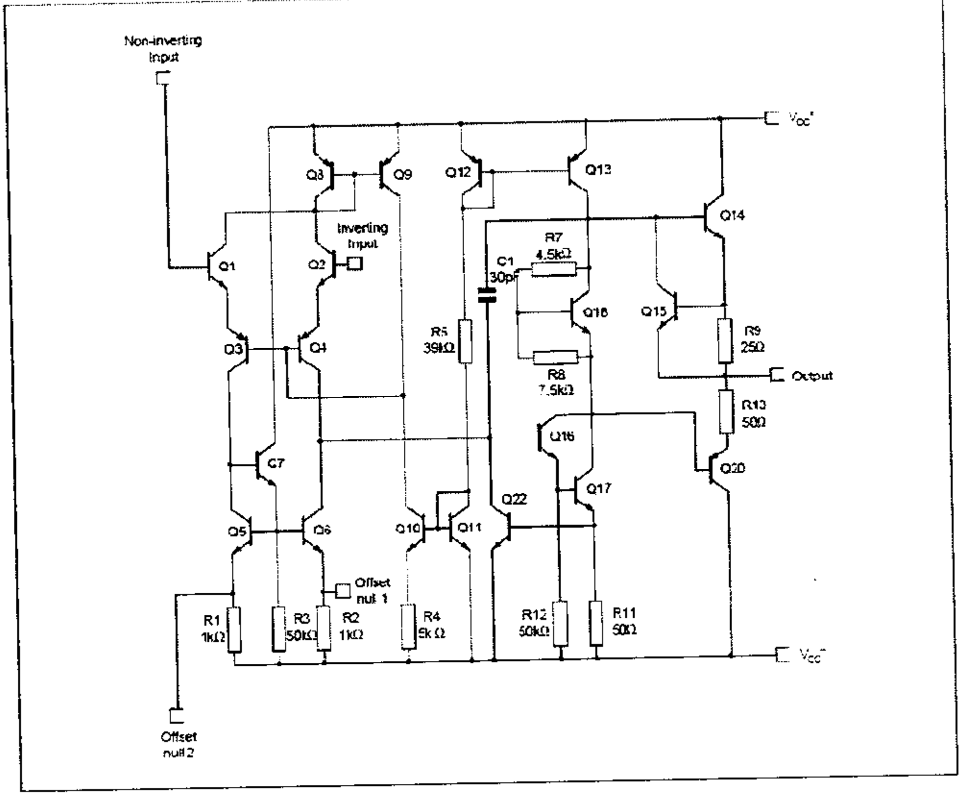
Part Number	Temperature Range	Package N	Package D
UA741C/E	0°C, +70°C	•	•
UA741I	-40°C, +105°C	•	•
UA741M/A	-55°C, +125°C	•	•
Example : UA741CN			

PIN CONNECTIONS (top view)



1 - Offset null 1
2 - Inverting input
3 - Non-inverting input
4 - V_{CC}^-
5 - Offset null 2
6 - Output
7 - V_{CC}^+
8 - N.C.

SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	UA741M-A	UA741I	UA741C-E	Unit
V_{CC}	Supply Voltage	±22	±22	±22	V
V_i	Input Voltage - (note 1)	±15	±15	±15	V
V_{id}	Differential Input Voltage	±30	±30	±30	V
P_{tot}	Power Dissipation	500	500	500	mW
	Output Short-circuit Duration	Infinite			
T_{oper}	Operating Free Air Temperature Range	-55 to +125	-40 to +105	0 to +70	°C
T_{stg}	Storage Temperature Range	-65 to +150	-65 to +150	-65 to +150	°C

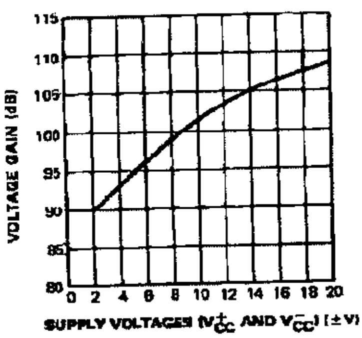
Note : 1. The magnitude of the input voltage must never exceed the magnitude of the positive and negative supply voltage.

ELECTRICAL CHARACTERISTICS

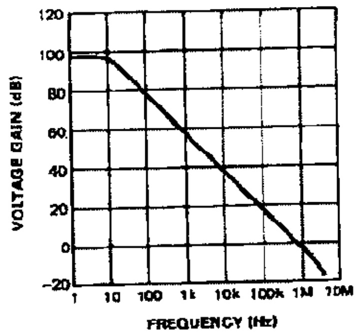
V_{CC} = ±15V, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min	Typ.	Max.	Unit
V_{io}	Input Offset Voltage ($R_s \le 10k\Omega$) T_{amb} = 25°C $T_{min.} \le T_{amb} \le T_{max.}$ UA741E,A T_{amb} = 25°C $T_{min.} \le T_{amb} \le T_{max.}$		1 1	5 6 2 4	mV
I_{io}	Input Offset Current T_{amb} = 25°C $T_{min.} \le T_{amb} \le T_{max.}$		2	30 70	nA
I_{ib}	Input Bias Current T_{amb} = 25°C $T_{min.} \le T_{amb} \le T_{max.}$		10	100 200	nA
A_{vd}	Large Signal Voltage Gain (V_o = ±10V, R_L = 2kΩ) T_{amb} = 25°C $T_{min.} \le T_{amb} \le T_{max.}$	50 25	200		V/mV
SVR	Supply Voltage Rejection Ratio ($R_s \le 10k\Omega$) T_{amb} = 25°C $T_{min.} \le T_{amb} \le T_{max.}$	77 77	90		dB
I_{CC}	Supply Current, no load T_{amb} = 25°C $T_{min.} \le T_{amb} \le T_{max.}$		1	2.8 3.3	mA
V_{icm}	Input Common Mode Voltage Range T_{amb} = 25°C $T_{min.} \le T_{amb} \le T_{max.}$	±12 ±12			V
CMR	Common Mode Rejection Ratio ($R_s \le 10K\Omega$) T_{amb} = 25°C $T_{min.} \le T_{amb} \le T_{max.}$	70 70	90		dB
I_{os}	Output Short-circuit Current	10	35		mA
$\pm V_{opp}$	Output Voltage Swing T_{amb} = 25°C R_L = 10kΩ R_L = 2kΩ $T_{min.} \le T_{amb} \le T_{max}$ R_L = 10kΩ R_L = 2kΩ	12 10 12 10	14 13		V
SR	Slew Rate (V_i = ±10V, R_L = 2kΩ, C_L = 100pF, T_{amb} = 25°C, unity gain)	0.25	0.5		V/μs
t_r	Rise Time (V_i = ±20mV, R_L = 2kΩ, C_L = 100pF, T_{amb} = 25°C, unity gain)		0.3		μs
K_{OV}	Overshoot (V_i = ±20mV, R_L = 2kΩ, C_L = 100pF, T_{amb} = 25°C, unity gain)		5		%
R_i	Input Resistance	0.3	2		MΩ
GBP	Gain Bandwidth Product (V_i = 10mV, R_L = 2kΩ, C_L = 100pF, f = 100kHz)	0.7	1		MHz
THD	Total Harmonic Distortion (f = 1kHz, A_v = 20dB, R_L = 2kΩ, V_o = 2V_{PP}, C_L = 100pF, T_{amb} = 25°C)		0.06		%
e_n	Equivalent Input Noise Voltage (f = 1kHz, R_s = 100Ω)		23		$\frac{nV}{\sqrt{Hz}}$
Øm	Phase Margin		70		Degrees

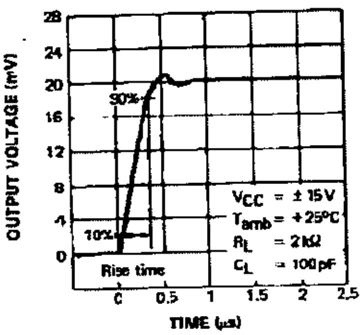
OPEN LOOP VOLTAGE GAIN (Typ.)



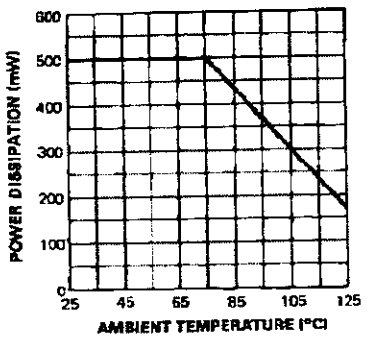
OPEN LOOP FREQUENCY RESPONSE (Typ.)



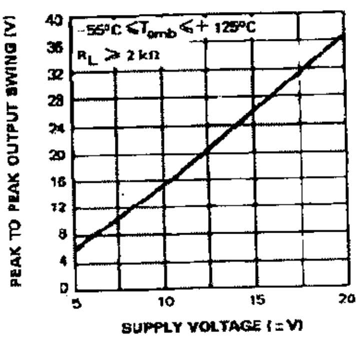
TRANSIENT RESPONSE (Typ.)



ABSOLUTE MAXIMUM POWER DISSIPATION



OUTPUT VOLTAGE SWING



INPUT COMMON MODE VOLTAGE RANGE