# CHAPTER 1

# INTRODUCTION

The number of times we breathe in and out in one minute is called our respiratory or breathing rate. Generally speaking, we breathe in and out 12 to 20 times in a minute. A person's breathing rate may show how his body is doing. A change in a person's breathing rate may be an early warning sign that his condition is getting worse. The commonly used transducers in olden times to measure respiration rate include thermistors placed in front of nostrils, micro-switches or displacement transducers put across the chest and impedance electrodes and signals from CO2 measurement. The tools to detect respiration, however, have only recently begun to evolve. Consequently, many laboratories still rely almost exclusively on nasal and oral thermistors (or thermocouples) to detect the presence and nature of breathing. There have been only limited research on monitoring respiratory rate, and these studies have focused on such issues as the inaccuracy of respiratory rate measurement. The degree to which thermistors under-detect respiratory rate has been investigated. Recently it was reemphasized that the measurement of respiration rate could not be performed with thermistors or thermocouples.

Nowadays measurement of physiological parameters like heart rate and respiration rate is crucial in the field of medicine. Advancement in technology has provided different instruments for constantly monitoring these parameters. Here is a simple method for respiration rate measurement using a displacement transducer. A respiration rate meter is a monitoring device to measure respiration rate. This meter can be used for measuring respiration rate, pulse rate and heart rate (by using proper sensors). It is an improved version over the common respiration meters. Unlike the inspiratory and expiratory fluctuations recorded via temperature from a thermocouple or thermistor, these signals are truly proportional to airflow. It does not need any external interfaces or interfacing devices to read the rate of respiration, since we can directly read the value from the 7-segment display unit itself.

Our intensified interest in biomechanical field and the fact that many are unfamiliar with this device’s use have led us to select this topic and we felt that it would be beneficial to provide information on the proper use and interpretation the respiration rate.

# CHAPTER 2

# SYSTEM OVERVIEW

## 2.1 BLOCK DIAGRAM

The block diagram of proposed circuit is given below.

Fig. 1: Block diagram of respiration rate measurement.

## 2.2 BLOCK DIAGRAM DESCRIPTION

The block diagram in the fig.1 represents the outline of the digital respiration rate meter. The main blocks are:

- ▲ **SENSING CIRCUIT**

The sensing part of the digital respiration rate meter uses a LED and a LDR as shown in the physical assembly. Inhaling and exhaling the air during respiration leads to movement of a lightweight ball (made of thermocol) up and down in a capillary glass tube. This movement is sensed with the help of the sensing circuit. When the LDR is exposed to light from led the resistance and voltage across the LDR decreases. If an obstacle comes in between LED and LDR the resistance of the LDR is increased. Also a high voltage is observed across the LDR.

- ▲ **PULSE GENERATOR**

This block is used to produce pulses in according to the respiration. . In this circuit LM324 is used as a pulse generator. The output coming out from the sensing circuit is given to the pulse generator. It compares the output from LDR with a reference voltage and produces corresponding pulses.

- ▲ **GATE PULSE GENERATOR**

The third block in the block diagram is a gate pulse generator. The gate pulse generator consists of a monostable multivibrator. It makes use of a 555 IC. When it is triggered by a start switch, it generates gate pulses of one minute duration. This is for setting the time for counting.

- ▲ **COUNTER AND START SWITCH ARRANGEMENT**

The pulses are counted for a minute using the counter block. CD 4553 is used as a counter. Start switch S1 is used to reset the display to zero and enable the counter for a minute to count the respiration pulse. The counting time of the counter depends upon the time period of the timer circuit.

- ▲ **DECODER/DRIVER**

The output of the counter is given to the decoding block. Its operating principle is to input a four-bit BCD (Binary-Coded Decimal) value, and energize the proper output lines to form the corresponding decimal digit on the 7-segment LED display. The BCD inputs are designated A, B, C, and D in order from least-significant to most-significant. Outputs are labeled a, b, c, d, e, f, and g, each letter corresponding to a standardized segment designation for 7-segment displays.

### ▲ DISPLAY UNIT

The last section of the block diagram is the 7-segment display. The 7-segment display is a combination of seven LEDs with common anode or common cathode connection. Most 7-segment displays also provide for a decimal point (sometimes two!), a separate LED and terminal designated for its operation. Of course, since each LED segment requires its own dropping resistor, we must use seven 270 Ω resistors placed in series between the 4511's output terminals and the corresponding terminals of the display unit. The 4511 display driver IC requires a common-cathode 7-segment display unit, and so that is what we have used here.

# CHAPTER 3

# SYSTEM DESCRIPTION

## 3.1 PHYSICAL INTERFACE ASSEMBLY

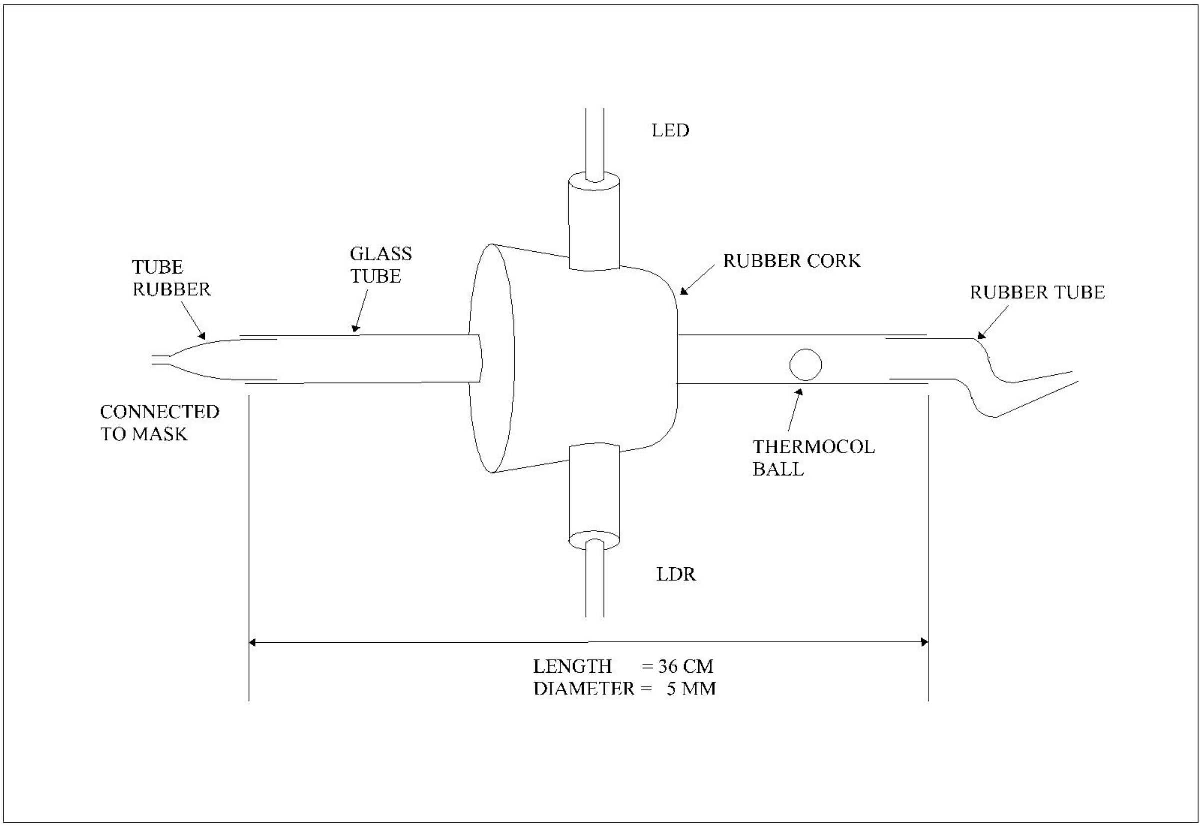



Fig. 2: physical interface assembly

The interface assembly simply makes use of a nose mask, which is readily available in medical shops and mainly used in hospitals for supply of oxygen to the patients for respiration.

A 36cm long transparent glass tube with inner diameter of 5mm is taken. A thermocol ball is then inserted in the tube. Both the ends of the tube are made narrow either by heating them or by putting a rubber tube of a smaller diameter inside. This is done to ensure that the thermocol ball does not come out during the inhale-exhale mechanism of the air.

The glass tube is then passed through the centre of the cork by drilling holes on the opposite sides. Now the LED and LDR are fixed on the holes on the sides of the cork, so that they are placed face to face.

The inhalation and exhalation mechanism during respiration leads to the movement of the ball left and right. The displacement occurred is noted and the cork is moved to the centre position of the displacement for more effective measurement. Such an adjustment of cork position is required depending upon the age group of the subject whose respiration rate is to be measured.

For instance, as the displacement of the ball is less for children, the cork should be moved towards the connected mask. For a healthy person the displacement of the ball is more, so you have to move the cork away from the mask. In short, the cork should be fixed approximately at the centre of displacement for effective measurement.

# 3.2 CIRCUIT DIAGRAM

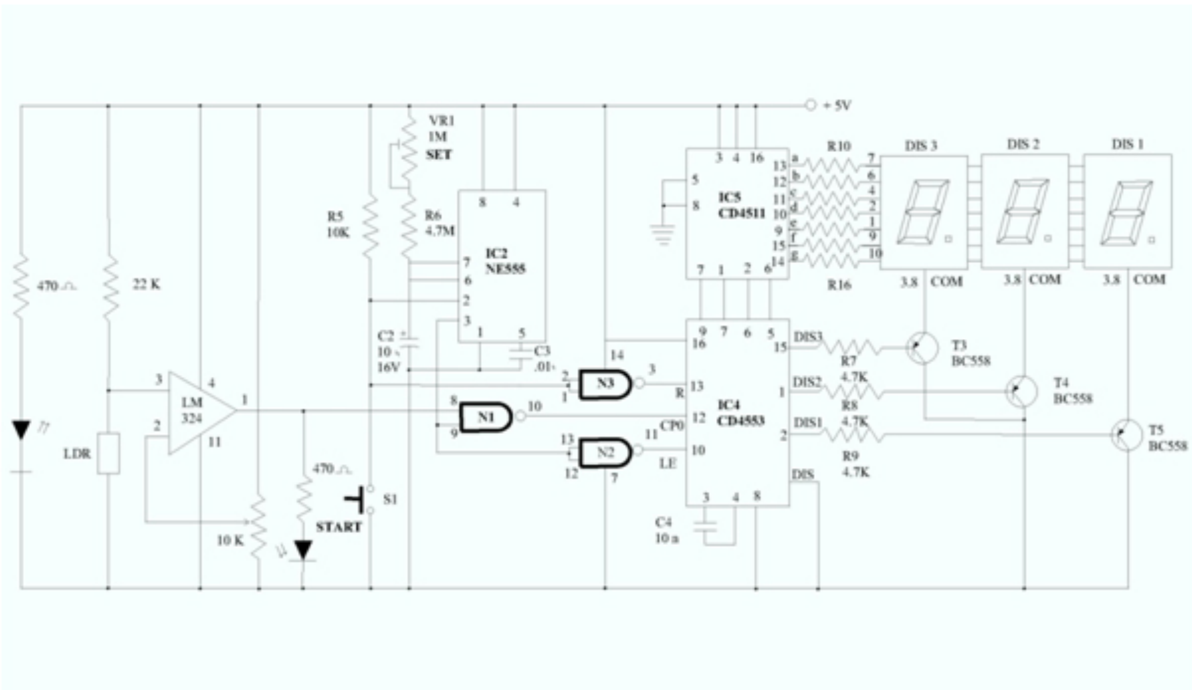



Fig.3: circuit diagram

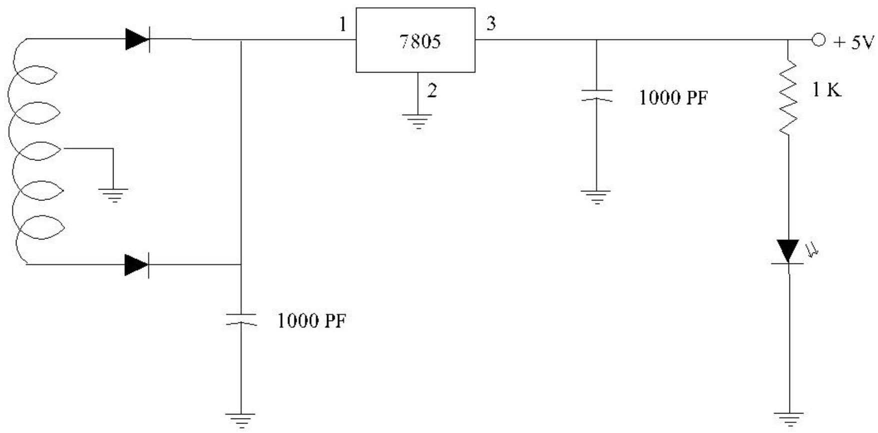



Fig. 4: power supply

## 3.3 COMPONENTS

| | |
|---|---|
| IC1 | 7805, 5V Regulator |
| IC2 | NE 555 TIMERS |
| IC3 | CD4011 quad NAND gate |
| IC4 | CD4553 3 digit BCD Counter |
| IC5 | CD4511 7 segment decoder/driver |
| T3-T5 | BC558 PNP Transistor |
| LED | 5mm LED |
| D | 1N4007 rectifier diode |
| D1S1-D1S3 | LTS543 common - cathode 7- segment display |

Resistors (All ¼ - watt, ± 5% carbon):

| | |
|---|---|
| R1 | 470Ω |
| R2 | 22K |
| R3, R5 | 10KΩ |
| R4 | 470Ω |
| R6 | 4.7MΩ |
| R7-R9 | 4.7KΩ |
| R10-R16 | 270Ω |
| VR1 | 1MΩ |

Capacitors:

| | |
|---|---|
| C2 | 10μF, 16V electrolytic |
| C3 | 0.01μF, ceramic disc |
| C4 | 10nF, ceramic disc |
| C5 | 1000μF, 25V electrolytic |
| C6 | 47μF, 16V electrolytic |

Miscellaneous:

| | |
|---|---|
| X1 | 230AC primary to 9V, 500mA secondary transformer |
| S1 | Push to on switch |

## 3.4 WORKING

The 230V AC main is stepped down by a step-down transformer to deliver the secondary output of 5V, 500mA. The transformer output is rectified by a full-wave center-tapped rectifier comprising 2 diodes, filtered by the capacitive filter and given to the voltage regulator IC-7805 which is a 3 terminal, positive voltage regulator IC. It offers an output voltage in 4% tolerance.

The regulated 5V output from the IC 7805 is given to the sensing circuit for its functioning. The sensing part of the circuit uses a displacement transducer for sensing the respiration rate using a LED and LDR. When any obstacle moves between the LED and LDR, the sensor will sense it and convert it into electrical signals. Here, we use a comparator IC-LM324 (14 pin chip), which will compare the IC input voltage (+5V) and the signals from the sensor. If the signal from the sensor is higher than that of the IC input voltage, the output of LM324 will become high. The comparator output will be electrical pulses, according to the intensity of radiation falling on the receiver.

The output of comparator LM324 is connected to input pin 8 of NAND gate N1 of IC3. Input pin 9 of NAND gate N1 is connected to output pin 3 of monostable multivibrator IC2. The time period of the monostable is decided by resistor R6, preset VR1 and capacitor C2. Preset VR1 is used to adjust the time period of the multistable to one minute.

When start switch S1 is pressed, pin 2 of the monostable goes low and it triggers to generate a pulse of 1 minute duration, which is fed to pin 9 of NAND gate N1. Therefore the gate is open for one minute to pass the clock pulse coming from IC1 to pin 12 of the 3-digit counter CD4553. The 1-minute pulse of the monostable is inverted by NAND gate N2, which controls the latch-enable (LE) of CD4553.

When the monostable output goes high, the latch-enable (LE) of IC4 goes high and the counting stops. So there is no further change in the count shown on 7-segment display.

When start switch S1 is pressed, pin 13 of CD4553 goes high to reset counter CD4553 and the 7-segment display shows ‘000’. The CD4553 consists of three negative-edge-triggered BCD counters that are cascaded synchronously. A quad latch at the output of each counter permits storage of any given count. The information is then time-division-multiplexed, providing one BCD number or digit at a time. Digit-select outputs are TTL-compatible. An on-chip oscillator provides low frequency scanning clock pulse, which drives the multiplexer output selector.

The BCD count outputs of CD4553 (from D0 through D3) are fed to inputs 'A' through 'D' of 7-segment decoder and driver CD4511 (IC5). CD4511shows the count on 7-segment displaysDIS1 through DIS3. Resistors R10 through R16 are used for limiting the current.

CD4553 provides BCD counts on D0 through D3 (which are converted into segment data by CD4551) and display-enable signal from DIS1 through DIS3 pins simultaneously in time-division-multiplexed mode for displaying a particular number on the 7-segment display unit. Segment data and display-enable pulse for display are refreshed more than 25 times every second. Thus, the display appears to be continuous, even though DIS1 through DIS3 light up one by one.

When pin2 of CD4553 goes low to drive transistor T5 into saturation and provides ground path to common-cathode pins 3 or 8 of displays DIS2 and DIS3.

## 3.5 PCB DESIGN

### 3.5.1 COMPONENT VIEW

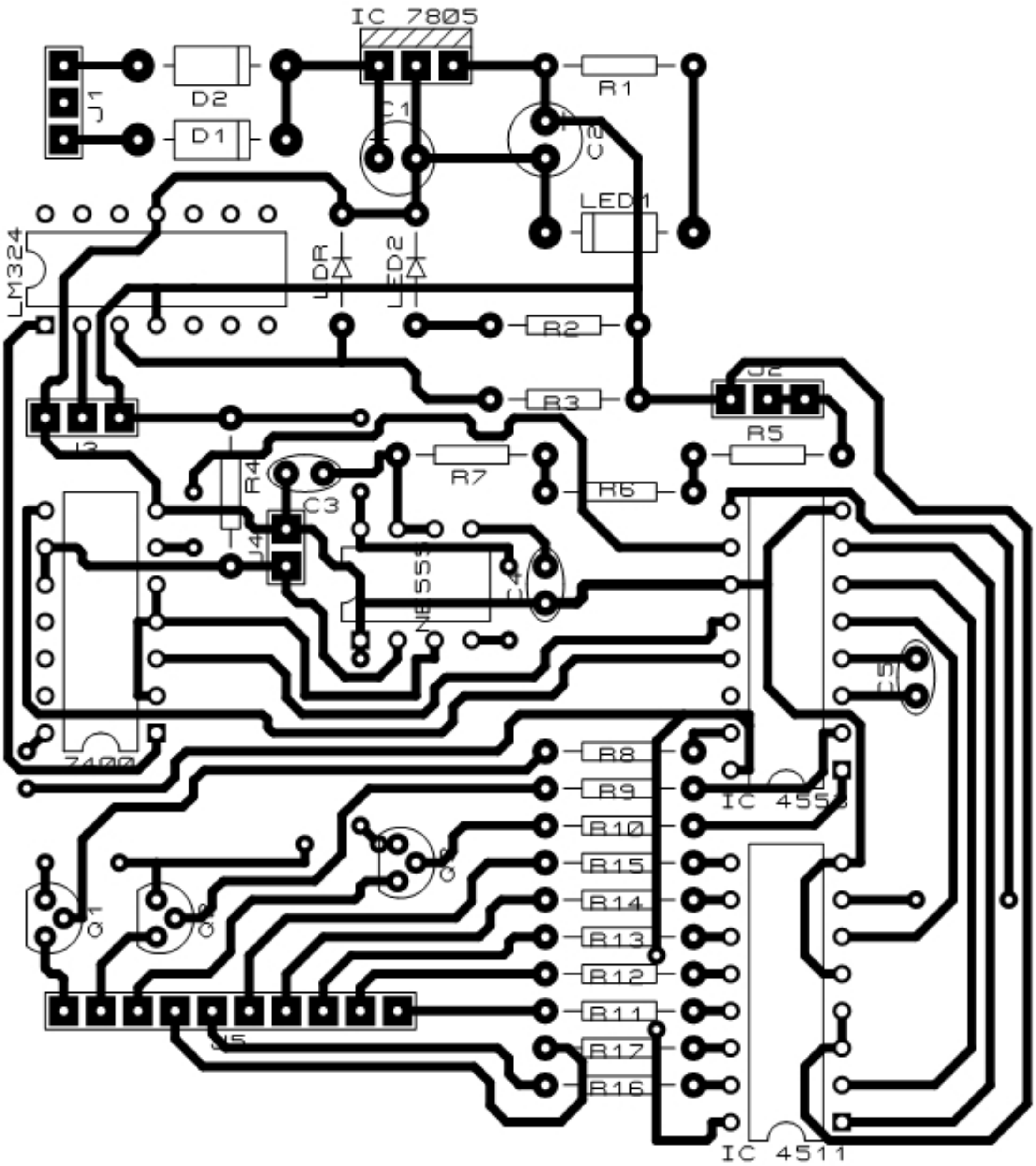



Fig. 5 PCB Diagram – component view

## 3.5.2 BOTTOM COPPER VIEW

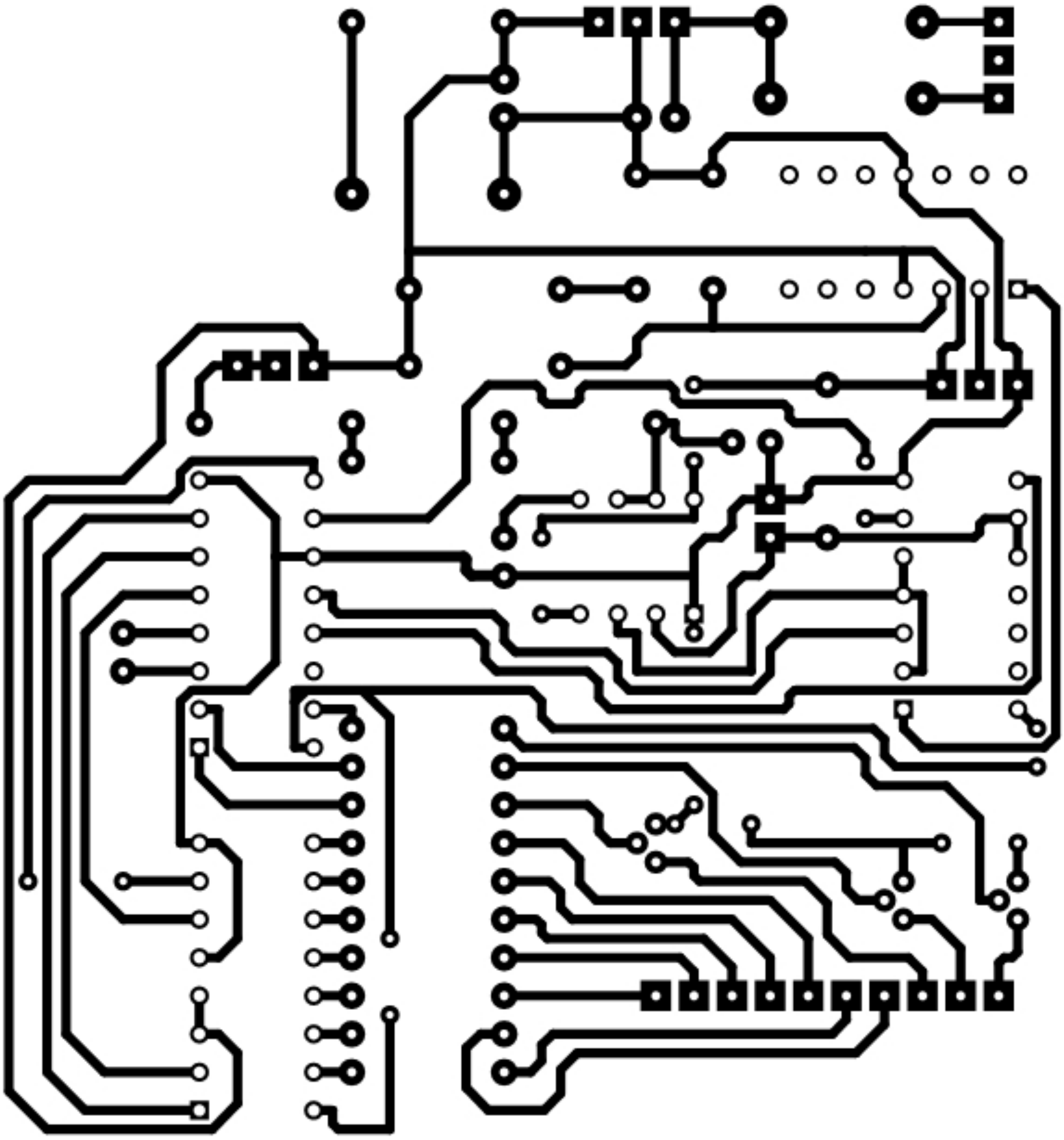
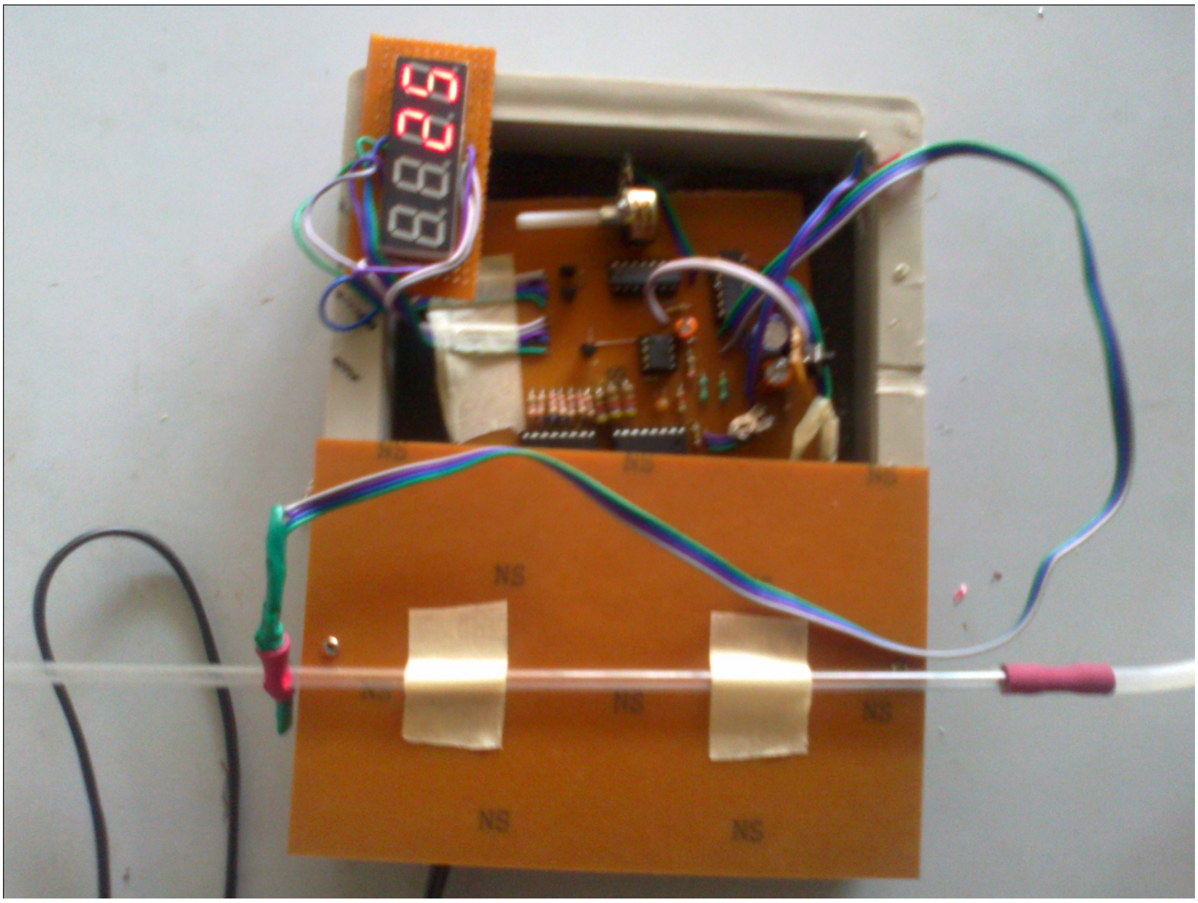


Fig. 6 PCB Design – bottom copper view

# RESULT

1. In the Respiration rate meter counting takes place only when a block comes in between LED and LDR according to the respiration.
2. The counting takes place for 1 minute and the result is displayed in the 7- segment display.
3. The counting starts only when the switch is pressed and it also resets the 7- segment display.

**S**



# CONCLUSION

Our project DIGITAL RESPIRATION RATE METER is a simple method for respiration rate measurement. Here, the respiration rate can be directly measured by using a 7 segment display without any external interfaces or interfacing devices. By using proper sensors this meter can also be used for measuring pulse rate and heart rate.

We are content with what we could achieve with our limited resources and time. This success gave us tremendous satisfaction and motivates us to work harder in our next project and to take our next step.

# REFERENCES

## Books

1. Design with Operational Amplifier and Analog Integrated circuits – Sergio Franco.
2. Digital Fundamentals- FLOYD& JAIN.

## Websites

1. www.efy.com
2. www.alldatasheets.com
3. www.google.com

# APPENDIX

## 7805 THREE TERMINAL POSITIVE VOLTAGE IC

FAIRCHILD
SEMICONDUCTOR™

October 1987
Revised January 1999

# CD4001BC/CD4011BC
# Quad 2-Input NOR Buffered B Series Gate • Quad 2-Input NAND Buffered B Series Gate

## General Description

The CD4001BC and CD4011BC quad gates are monolithic complementary MOS (CMOS) integrated circuits constructed with N- and P-channel enhancement mode transistors. They have equal source and sink current capabilities and conform to standard B series output drive. The devices also have buffered outputs which improve transfer characteristics by providing very high gain.

All inputs are protected against static discharge with diodes to $V_{DD}$ and $V_{SS}$.

## Features

- Low power TTL:
  Fan out of 2 driving 74L compatibility: or 1 driving 74LS
- 5V–10V–15V parametric ratings
- Symmetrical output characteristics
- Maximum input leakage 1 µA at 15V over full temperature range

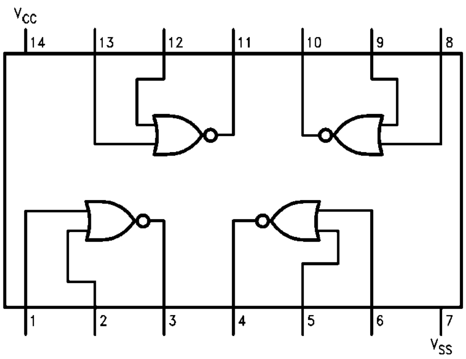
## Ordering Code:

| Order Number | Package Number | Package Description |
|---|---|---|
| CD4001BCM | M14A | 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150" Narrow |
| CD4001BCSJ | M14D | 14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide |
| CD4001BCN | N14A | 14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide |
| CD4011BCM | M14A | 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150" Narrow |
| CD4011BCN | N14A | 14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide |

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

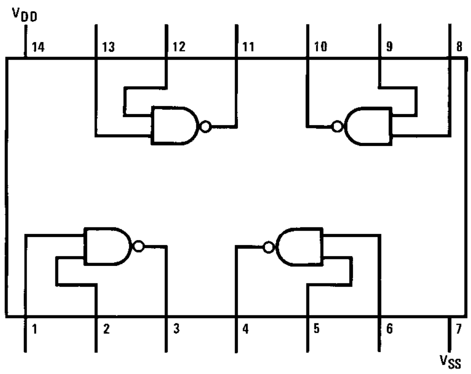
## Connection Diagrams

**Pin Assignments for DIP, SOIC and SOP**
**CD4001BC**




**Top View**

**Pin Assignments for DIP and SOIC**
**CD4011BC**




**Top View**

 DS005939.prf www.fairchildsemi.com