# Temperature measurement

A central monitoring system makes use of a thermistor for measurement of temperature.

Change in resistance of thermistor with corresponding change in temperature unbalances a bridge circuit. The unbalanced signal is indicated on a meter calibrate in terms of temperature.

The range of temperature measured is 30°-42°C.

A thermistor is a resistance thermometer, or a resistor whose resistance is dependent on temperature. Thermistors are easy to use, inexpensive, sturdy, and respond predictably to changes in temperature.

# Respiration Rate

Human respiration rate is measured when a person is at rest and involves counting the number of breaths for one minute by counting how many times the chest rises. Or the rate at which the rhythmic activity of inhalation and exhalation takes place under normal circumstances is called respiration rate. T

The typical respiratory rate for a healthy adult at rest is 12–20 breaths per minute.

The different methods for measuring respiration rate are –

1. Displacement method
2. Thermistor method
3. Impedance pneumography method
4. $CO_2$ method.

***Displacement method***

Respiratory cycle is accompanied by changes in thoracic volume. Thorax expands and come back to normal during respiration.

Transducers like strain gauges are held by an elastic band around the chest. During respiration, there is a resistance change in the strain gauge element connected as one arm of the Wheatstone's bridge. The output signals correspond to the respiratory activity.

***Thermistor Method***

Air is warmed during its passage through the respiratory system. There is a detectable difference between the temperature of inspired air and expired air. The difference in temperature can be sensed by placing a thermistor in front of the nostrils using a holding device. The thermistor is a part of the voltage divider circuit whose unbalanced signal can be amplified to obtain the respiration activity.

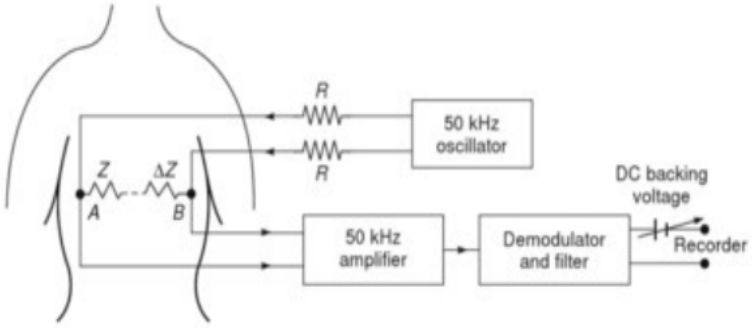
***Impedance pneumography method***

Impedance pneumography is a technique to measure respiration rate.

Impedance pneumography employs low amplitude, high frequency (50 to 500 kHz) alternating current (AC) between two surface electrodes to record thoracic movements or volume changes at the rib cage (RC) during a respiratory cycle. Based on Ohm's Law, the voltage drop across the electrodes is computed as impedance, which increases during inspiration and decreases during expiration.

A high-frequency ac current is injected into the tissue through the drive electrodes. The ac current causes a potential difference to develop across any two points between the drive electrodes. This potential difference is related to the resistivity of the tissue between the voltage-sensing or receive electrodes. The equivalent resistance is defined as the ratio of the voltage difference between the two receive electrodes and the current that flows through the tissue.

When measuring respiration, the thorax presents an electrical impedance to the electrode that consists of two impedance components: a relatively constant value and a varying value. The relatively constant value of thoracic impedance is referred to in this document as the baseline impedance, or RB (typically 500 Ω;). The varying value, on the other hand, is known as respirative impedance, or ΔR.




Changes in the electrical resistance of the lungs are mainly a result of the following two effects:

1. During inspiration, there is an increase in the gas volume of the chest in relation to the fluid volume;

this increase causes conductivity to decrease.

2. During inspiration, the length of the conductance paths increases because of expansion.

Taken together, both of these effects cause the electrical impedance to increase. There is a good correlation between this impedance change and the volume of respirated air. This relationship is approximately linear. The varying component of impedance (that is, respirative impedance), generates a varying voltage component ($\Delta V$) when current is injected. This varying voltage component is the parameter of interest because this component can then be used to determine the person's breathing rate.

Typically, $\Delta R$ is in the range of 0.1 Ω to 1 Ω. $\Delta V$, in turn, depends on the magnitude of the current injected.

# Central Monitoring System

Continuous monitoring is a valuable tool that helps provide additional information to the medical and nursing staff about the physiologic condition of the patient.

Depending on their configuration, central monitors include modules to measure various parameters, including ECG, respiratory rate, NIBP and IBP, body temperature, SpO2, cardiac output, intracranial pressure, and airway gas concentrations. They include computing capabilities and additional displays to observe trend information. They do not replace bedside monitors.
Central Station is a powerful computer with one or two color displays, with a sound alarm system, laser and thermal printers.

Central Station provides:
Comprehensive review
Remote control access
Reception, analysis and documentation of real-time information
Continuous monitoring of basic parameters of patient's condition
Patients databases maintenance
Data exchange within a local hospital or the global information network

Central Station enables bed-to-bed viewing of alarms, waveforms, numerical values and trends between network monitors.
It performs the following functions:

Real-time patients information input received from bedside patient monitors (up to 32 bedside patient monitor selection of the necessary quantity of patient monitors to be visualized from connected monitors list)
Simultaneous visualization of information received from up to 16 monitors on the system display
Real-time visualization of all parameters (depending on monitor configuration) received from patient monitor and waveforms – not less than 2 waveforms for one monitor during joint observation and up to 9 waveforms for one selected monitor
Details of each monitor are displayed in a separate independent window
Output up to 2 waves for each patient, while monitoring 16 patients (4 waves - for 8 patients, 8 waves - for 4 patients in real time)
Ability to view extended information on each monitor (all ECG leads, trends and parameters of HRV)
Displays the short trend - up to 4 parameters in the last 10 minutes

Freezing of displayed waveforms for selected monitor

Maintenance of current and archive database (patient data are kept after their discharge)

Record of user chosen information into database – 20s of ECG interval and 72h of trends

Automatic recognition of arrhythmia events and its types (with automatic saving of 20s ECG intervals in database)

Entering, editing and saving patient identification data

Three-level alarm system individually for each patient with the priorities for each parameter

Color coding of alarm levels

Documentation of patient data on laser and thermal printers

In case of high priority alarm automatically prints out up to 20 sec. of two ECG-waveforms on the thermal printer