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Input Signal Voltage Variation and its Effects on Non Invasive Bio-impedance Diagnosis

KEYWORDS: Bio-impedance; non invasive; Signal generator; frequency; output response.

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ABSTRACT *This paper deals with study of the effect of input voltage variation on output response of bio-impedance measurement. During bio-impedance diagnosis output voltage differs as a function of function of input signal voltage variation. The accuracy of the diagnosis system depends on the exact value of voltage for which there is a wide variation in the output response. The proposed system implements voltage control signal generator circuit to study the output voltage variation and its impact on efficient design of invasive bio-impedance measurement applications. The system design has been implemented variable voltage signal generator IC, Isolation transformer, isolated & regulated power supply, Operational amplifier IC and Metal Surface electrodes.*

Introduction:

In non invasive electrical bio-impedance measurement applications the measuring parameter depends on input signal frequency and input voltage level. The electrical property of the biological tissue alters as a function of input voltage variation. The property of electrical conductivity change as a function of input voltage has been utilized in wide field of bio-impedance systems [1 & 2]. Few examples are in non invasive cardiac output monitoring, dialysis and measurement of blood volume in human body [3 & 4]. The proposed variable voltage signal generator circuit which suits for non invasive bio-impedance measurement applications. The signal from signal from the designed signal generator has been given to the two electrodes and the voltage response values are noted [5].

Materials and methodologies:

Four metal surface electrodes are used for achieving non invasive bio-impedance system. Out of four electrodes two for input section and two for output section. In input section IC 8038, a precision waveform generator capable to produce sine wave, square wave and triangular wave with frequency variation from 0 Hz to 200 KHz and variable voltage with few additional components. With the provision of external potentiometer circuit the output amplitude can be varied from low voltage to high voltage. These IC generally used for Precision waveform generator, Sweep and FM Generator, Tone Generation, Instrumentation and Test Equipment design and Precision PLL design. It is a 14 pin IC with three output pin for Sine wave output, Square wave output and Triangular wave output. Two pins for adjusting waveform on input side, two pins for control the duty cycle on input side and two pins for frequency modulation and frequency sweep input. The circuit for proposed system implements signal generator circuit which suits for non invasive bio-impedance measurement applications [5 & 6]. Hardware section of the system composed of variable voltage signal generator IC, Isolation transformer, Regulated and isolated power supply, Operational amplifier IC and four Surface electrodes as shown in figure 1.

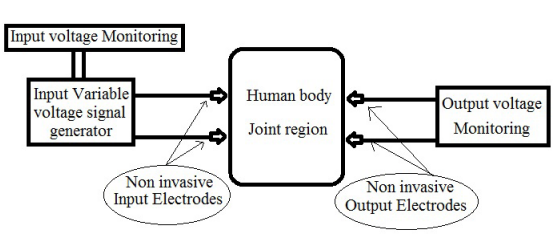

Figure 1. Generalized input variable voltage signal generation system block diagram

The study has been done with 10 individuals for obtaining the value of voltage for which there was good response in output voltage value. Four constant voltage values are selected within the range from 1 Volt to 8 Volts and its corresponding response were tabulated and plotted as graph. The input voltage values V_1=1 Volt, V_1=3 Volt, V_1=6 Volt and V_1=8 Volt. Out of 10 individual each individuals are placed with four surface electrodes. The signal from the designed signal generator has been given to the two electrodes and the voltage response values are noted.

Results and Discussion:

The output voltage values varies from 0.14 V to 0.45 V for input voltage V_1=1 Volt, the output voltage values varies from 0.25 V to 0.60 V for input voltage V_2=3 Volt, output voltage values varies from 1 V to 2.5 V for input voltage V_3=6 Volt as shown in table 1 and output voltage values varies from 1.8 V to 4.30 V for input voltage V_1=8 Volt.

Table 1. Output voltage variation range for different input voltage levels

INPUT VOLTAGES	V_1=1Volt	V_2=3Volt	V_3=6Volt	V_4=8Volt
OUTPUT VOLTAGE VARIATIONS	0.14 V to 0.45 V	0.25 V to 0.60 V	1 V To 2.5 V	1.8 V To 4.30 V

The output voltage variation for each individuals for different input voltage levels as V_1=1 Volt, V_1=3 Volt, V_1=6 Volt and V_1=8 Volt is as shown in figure 2. There is uniform percentage increase in the value of output voltage for the increase in input voltages. Log graph has been plotted for one individual persons voltage variation for the different variation in input voltage levels. The graph gives clear variation of output voltage as the voltage of the input signal increases as shown in figure 3.

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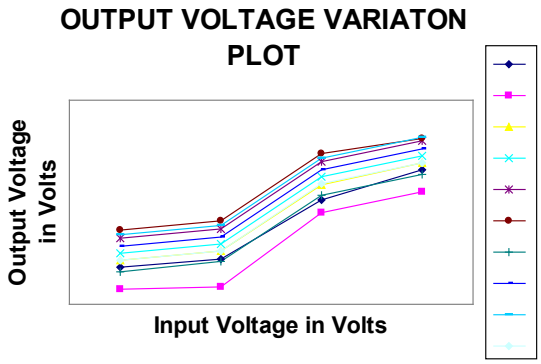

Figure 2. Variations of output voltage for different input voltage levels

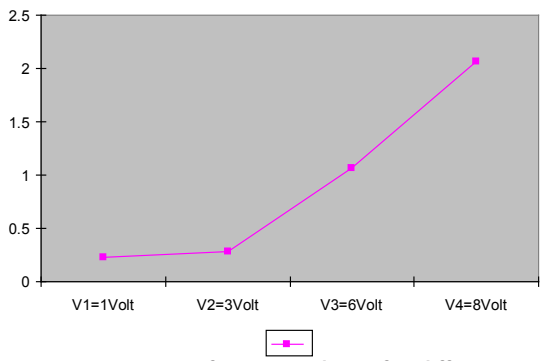

Figure 3. Variations of output voltage for different input voltage levels for one individual

SUMMARY AND CONCLUSION:

During these experiments we observed that there is a wide variation in output voltage for different range of input voltage. The output response voltage varies as a function of input signal voltage variation in non invasive bio impedance measurement applications of biomedical engineering. The study has been implemented with the help of 10 individuals.

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