Sudan University of Science &Technology

College of Engineering

Biomedical Engineering Department

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Power supply stabilization for medical instrumentation

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ABSTRACT

Due to the importance of giving a stable voltage to all electrical devices, especially medical devices and to prevent sided effects voltage fluctuation, voltage stabilizers is essentially be used to give a stable output voltage for the medical devices which guarantee protection of the devices against electric burns for internal components, this will result to obtain better working performance in healthcare environment.

The stabilizer proposed was designed and tested using dimmer circuits and microcontroller to maintain constant output voltage.

المستخلص

نظرا لأهمية إمداد الأجهزه الكهربائيه بفولتيه مستقره أو ثابته خاصة الأجهزه الطبيه, وذلك لحمايتها من تأثير تذبذب الكهرباء؛ كان لابد من إستخدام منظمات الجهد لتعطي فولتيه مستقره للأجهزه الطبيه, وذلك لضمان حماية الجهاز من تلف المكونات الداخليه, مما يؤدي إلى أداء أفضل في مجال الرعايه الصحية.

تم تصميم واختبار منظم الجهد باستخدام (dimmer circuits and microcontroller) لاعطاء فولتية خرج ثابتة.

List of Abbreviations:

AC	Alternating Current.
DC	Direct Current.
IC	Integrated Circuit.
LCD	Liquid Crystal Display.
RAM	Random Access Memory.
EEPROM	Electrically Erasable Programmable Read Only Memory.
TRIAC	Triode for Alternating Current.
DIAC	Diode for Alternating Current.
AVR	Automatic Voltage Regulator.
CVT	Constant Voltage Transformer.
SCR	Silicon Controlled Rectifier.
THD	Total Harmonic Distortion.

Electrical units table:

Parameter	Symbol	Measuring unit
Voltage	**Volt**	**V**
Current	**Ampere**	**I**
Resistance	**Ohm**	**R or Ω**
Capacitance	**Farad**	**C**
Power	**Watts**	**W**

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General introduction

1.1 1.1 Introduction:

At any point of time, a power system operating condition should be stable, meeting various operational criteria, and it should also be secure in the event of any credible contingency. Present day power systems are being operated closer to their stability limits due to economic and environmental constraints. Maintaining a stable and secure operation of a power system is therefore a very important and challenging issue. Voltage instability has been given much attention by power system researchers and planners in recent years, and is being regarded as one of the major sources of power system insecurity. Voltage instability phenomena are the ones in which the receiving end voltage decreases well below its normal value and does not come back even after setting restoring mechanisms such as VAR compensators, or continues to oscillate for lack of damping against the disturbances. Voltage collapse is the process by which the voltage falls to a low, unacceptable value as a result of an avalanche of events accompanying voltage instability.

Avoltage stabilizer is a device that maintains a relatively constant output voltage even though its input voltage may be highly variable.

Power quality may be defined as the “Degree to which both the utilization and delivery of electric power affects the performance of electrical equipment.” From a customer perspective, a power quality problem is defined as “Any power problem manifested in voltage, current, or frequency deviations that results in power failure or disoperation of customer equipment”.

Some machines such medical instruments are very sensitive to slightest change in the power supply. It is very important for them to take care of the frequently occurring power quality defects. The five most common Power Quality defects defined are:

i. Under Voltage: When the operating falls to a low value due to fault voltage.

ii. Dips or Surges: Fluctuations leading to frequent increase and decrease in the magnitude of the supply.

iii. Transient: A Spike in the sinusoidal voltage of the supply.

iv. Harmonics: Voltage or Currents that are some integer multiple of operating specifications which cause distortion.

v. Burnouts: Period of very low frequency voltage or sometimes even zero leading to reduced power delivery.

This project will be focusing on voltage fluctuation.

1.2 1.2 Problem Statement:

The potential benefit from the use of a medical device ranges from relieving minor irritations to correcting life threatening conditions. If the device design and manufacturing processes are done adequately, there is a high probability that the device will perform as desired at the time it is manufactured. However, there are many factors that can affect how long after manufacturing the device will maintain the ability to fully perform the intended function. One of these factors that cause problems in the device is the fluctuation of electricity.

During the transmission of electricity from the source of generation and until it reach the hospital, there are a lot of factors that lead to undesirable changes, that inevitably affects the efficiency of the medical instrument and that may cause a risk to the patient and/or the working team.

1.3 1.3 Objective:

Design stabilizer to stabilize the input voltage to provide constant output voltage that supply the medical instrument, this helps to maintain stable electricity to the instrument.

The main purpose of this device is to protect sensitive loads from fluctuation in the supply side.

1.4 1.4 methodology:

Series of steps were used regularly (proteus 7) to establish design of voltage stabilizer depending on theoretical background and mathematical principle to obtain components values as the following briefly discussion in the next chapters.

1.5 1.5 Hypothesis:

- Electricity fluctuate in a certain range, and must be adjusted to suit the electricity needed by the medical device.
- Adjustment the alternating voltage “AC” in order to reach certain level ”220V ac” this include:

➢ In the case of electricity less than 220V AC step it up to reach 220V AC.

➢ In the case of electricity more than 220V AC step it down to reach 220V AC.

➢ When the input is 220V AC the output voltage remains such as the input.

1.6 1.6 Thesis organization:

This project contain five chapters organized as follows:

- Chapter one (General introduction): Introduction – Problem statement –Objective – Hypothesis – Thesis organization.
- Chapter two (Theoretical foundation): General definition of voltage regulator - Types of voltage regulator.
- Chapter three (Methodology): Circuit design (Block diagram and Circuit diagram) – Circuit analysis – Circuit component.
- Chapter four (Results and Discussion): Results – Circuit cost – Discussion.
- Chapter five (Conclusion and Recommendation): Conclusion – Recommendation – References.