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Implementation of anomalous photocells as power supplies of medical devices

Nurdinova R.A., Zhuraeva G., Akhmadalieva G., Eshonov R., Alimzhonova A.

Fergana branch of the Tashkent University of Information Technologies named after Muhammad al-Khorazmiy, Fergana, Uzbekistan
Fergana branch of the Tashkent University of Information Technologies named after Muhammad al-Khorazmiy, Fergana, Uzbekistan
Fergana Medical Institute of Public Health, Fergana, Uzbekistan
Fergana Medical Institute of Public Health, Fergana, Uzbekistan
Fergana branch of the Tashkent University of Information Technologies named after Muhammad al-Khorazmiy, Fergana, Uzbekistan

ABSTRACT: This paper analyzes the existing power supplies for medical devices and devices. A method based on the use of abnormal photovoltaic cells as high voltage sources is proposed, which makes it possible to reduce the size and increase the efficiency of medical equipment.

I. INTRODUCTION

It is known that the use of economically efficient, small-sized power supplies for medical devices and devices is an urgent problem of modern medical technology. It would be logical to assume that power supplies designed and tested to be safe for industrial applications would also be suitable for use in medical equipment. However, this approach is not entirely correct - one should take into account the fact that for patients, the flow of even small leakage currents can adversely affect health, although the same currents will not have a significant effect on a healthy person and are acceptable in industrial applications. In addition, a lot of electronic equipment used in hospitals (for example, control devices) operates with extremely low level signals. This equipment is more susceptible to electromagnetic interference than industrial equipment, which also makes EMC a major concern for medical applications.

II. PROBLEM STATEMENT

Since biomedical devices are based on medical imaging, which is used to diagnose human organ tissues, bone structure and blood diseases to more accurately determine the patient's condition and effectively treat the disease, as well as conduct scientific research. For this, the following diagnostic imaging equipment is usually used: X-ray, MRI, PET, ultrasound, etc., which are low-power medical devices.

At present, scientists around the world have developed various types of power supply devices. Recom and Arch have developed such devices with input voltages from 3.3 to 75 V and output voltages from 3.3 to 48 V [1].

The sources must have increased insulation strength, namely: from 4 kV between the input and the output, 2.5 kV between the outputs and the case, as well as have a high efficiency.

Previously used transistor switches switch at a high frequency, as this minimizes losses in the power supply. Unfortunately, the faster the transistors switch, the more noise is generated.

Therefore, some new power supply designs, such as the Lambda NV series, deliberately reduce the rate of change of voltages and currents in the power switches by using special converter structures with zero-voltage switching (ZVS) transistors [2].

By utilizing the latest zero-voltage switching transistor converter structures, Lambda's designers have been able to achieve lower switching speeds without compromising power supply performance. The generated EMI is, however, significantly reduced, requiring a simple EMC filter to be used to meet EMC requirements. With a small filter attenuation, another important condition is met: a low value of leakage currents.

This structure eliminates the need for screen windings between power transformer windings, a tool traditionally used to improve EMC performance [3, 4]. The exclusion of the screen not only allows to reduce the overall dimensions of the transformer and, consequently, the power supply, but also further increases the efficiency. To achieve the industry's highest energy performance for multi-channel power supplies, Lambda has incorporated Multiple Efficiency Gain (MEG) technology into its NV-Series power supplies.

The increase in the efficiency of the various stages of the power supply results in a significant increase in the overall efficiency of the power supply.

However, the principles of operation of the proposed power supplies are based on the generation of current and voltage.

III. DESCRIPTION OF THE METHOD FOR SOLVING THE RESEARCH PROBLEM

The proposed method is based on the influence of polarized light on the magnitude of the anomalous photovoltage [5]. For example, such types of power supplies can be offered with optical powered quantum generators, the advantages of which are extremely high stability of the frequency of radiated or electromagnetic waves.

The principle of operation of the oscillator with optical power supply can be easily explained using a block diagram (Fig. 1). In natural light conditions, the optoelectronic power supply is completely autonomous. AFS-photodetector is a current generator and as a source of high voltage can operate only on a high-resistance load.

In the process of generating high voltage, the photocurrent is primary. Passing through the high-resistance structure of the APS film, the photocurrent creates a high-voltage photovoltage (APS, a voltage drop across the resistance of the APS film).

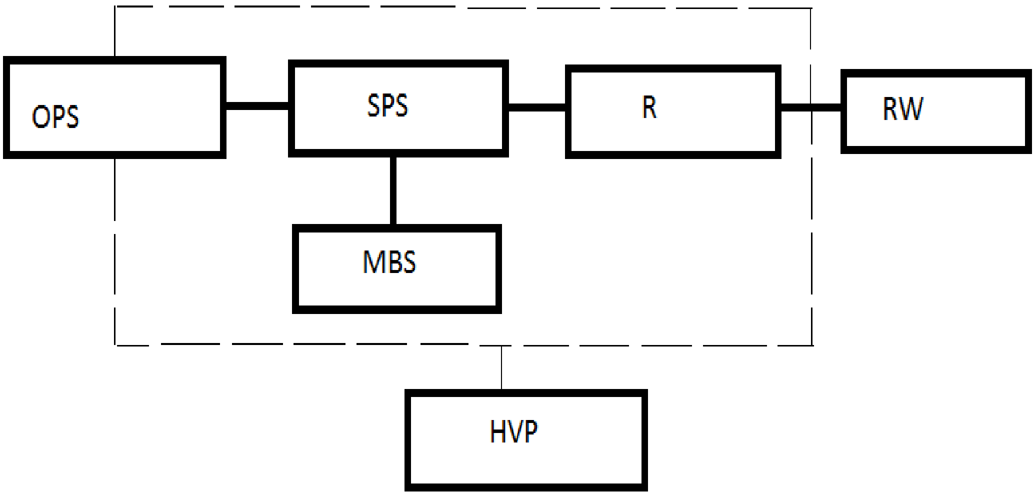

Fig. 1. The principle of operation of the quantum generator: OPS - optoelectronic power supply; SPS - sorting focusing system; MBS- molecular beam source; P - resonator; RW- radiated waves; HVP- high vacuum pump

An SPS generator requires a non-uniform electric field. It is created using special electrodes. In a quantum generator, the working substance is ammonia molecules. Molecular beams (3), leaving the source, pass through the SPS. It removes molecules from the beam that are in a lower energy state. In an external electric field, the dipole moments corresponding to the upper level will line up against the direction of the field, while the energy of the level will increase in proportion to the field strength.

To obtain sufficient amplification, it is necessary to increase the time of interaction of the wave with the beam. For this purpose, a molecular beam is passed through a cavity resonator (4), a cavity bounded by metal walls. An electromagnetic wave, hitting such a cavity, is repeatedly reflected from its walls and therefore interacts for a long time with the beam passing through it. The power consumption of the power supply unit (1) is about 200 mW. If we switch to natural light mode, then the power supply unit operates autonomously, does not consume electrical power, works by means of light energy.

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IV. CONCLUSION

The use of these types of power supplies makes it possible to minimize the size and increase the economic efficiency of medical devices and devices.

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