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Procedia Engineering 129 (2015) 239 – 244

Procedia Engineering

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International Conference on Industrial Engineering

Automated information-measurement system used to test the immunity of the medical equipment protective elements to the discharges of the defibrillator

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Abstract

The article discusses the information-measurement system used for testing of protective elements medical equipment for their resistance to the discharge of a defibrillator, which is designed to test medical products, which may be exposed to high voltage defibrillator pulses, up to 5000 V while in operation. The Information-measurement system should provide a fully automated testing process in accordance with the international standard IEC 60601-1, as well as analyze the result and diagnose the parameters of elements the of a defibrillator block simulating the pulses.

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Peer-review under responsibility of the organizing committee of the International Conference on Industrial Engineering (ICIE-2015)

Keywords: test medical devices for resistance to the pulse of defibrillator, the system of diagnostics of parameters of high voltage source.

1. Information-measuring system

To ensure the automation of the testing process of the developed information-measuring system that fully automates the testing process and allows [1][2][3] for self-diagnosis storage capacitor C3 of the high voltage [4] source [5][6][7]. The General scheme of application of the test voltage to the medical device [8] shown in figure 1.

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Peer-review under responsibility of the organizing committee of the International Conference on Industrial Engineering (ICIE-2015)
doi:10.1016/j.proeng.2015.12.039

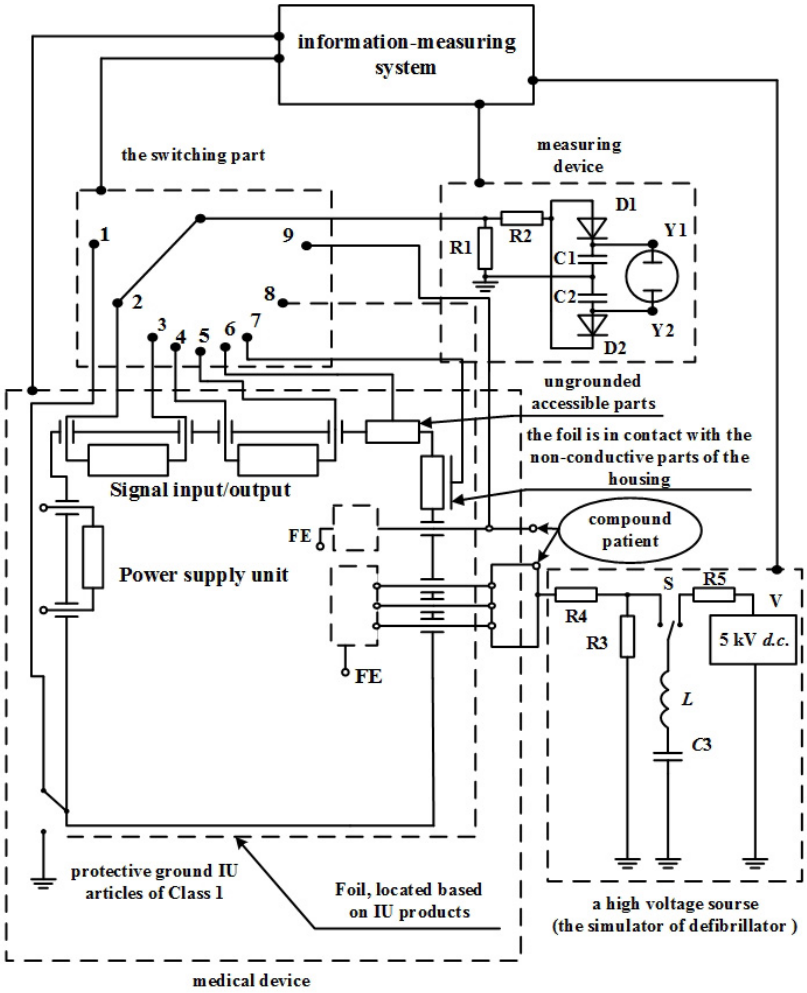

Fig. 1. The General scheme of application of test voltage to medical device

VT – test voltage, S – switch test voltage, R1, R2 - resistors with a tolerance of ± 2% for voltage less than 2 kV, R3, R4 - resistors with a tolerance of ± 2% for voltage less than 5 kV, R5 - limiting resistor, D1, D2 - miniature silicon small signal diodes (remaining components have a tolerance of ± 5%), 1 - the output of the switching control part, 2 – output of conclusion control the high voltage source, 3 - the sync output from the measuring.

2. Functions of IMS

The basic functions of the design information-measuring systems is the provision of a process of testing medical devices and self-diagnosis function of the parameters of the high voltage source such as the voltage on high voltage plates of capacitor C3 and its capacity[9][10][11]. In operation, the high voltage capacitor can change its settings and deviate from the values of the normalized standard[12][13].

The control voltage is produced by connecting the microprocessor control system to the terminals of the capacitor[14][15]. The program converts the analog signal into the voltage value on the capacitor plates. Resistors

R1, R2 form a voltage divider 5000/5 Volts. The scheme of connection of capacitor for the microprocessor shown in figure 2.

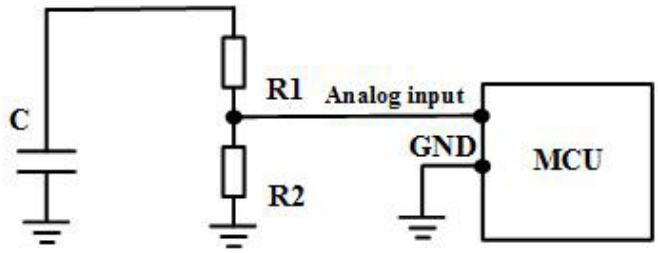

Fig. 2. The scheme of connection of the capacitor to the microprocessor
C - high voltage capacitor, R1, R2 – ladder, MCU – microprocessor.

A general algorithm for read voltage shown in the figure.3

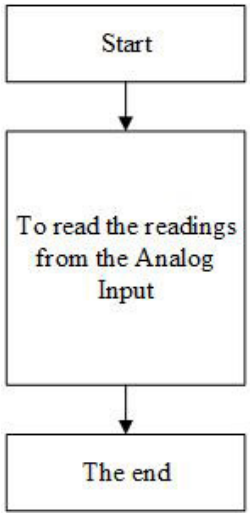

Fig.3. The general algorithm for read voltage.

The capacity control is performed by determining the time constant [16][17][18] of the capacitor charge, which is 63.2% of voltage a full charge, and is calculated by the formula (1)

$$\tau = R * C . \quad (1)$$

The scheme of connection of the capacitor to measure the capacitance shown in figure 4.

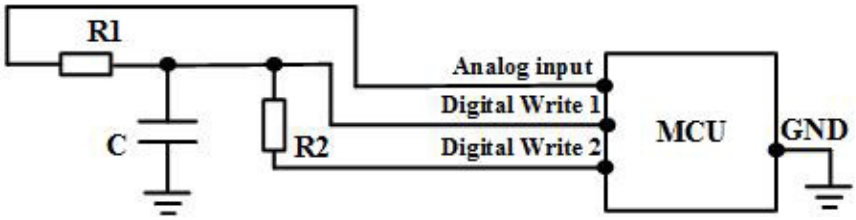

Fig. 4. The scheme of connection of the capacitor to measure the capacitance
C - high voltage capacitor, R1- limiting resistor, R2 - resistor capacitor discharge, MCU – microprocessor.

A general algorithm for measuring the capacitance of the capacitor [19][20]shown in the figure.5

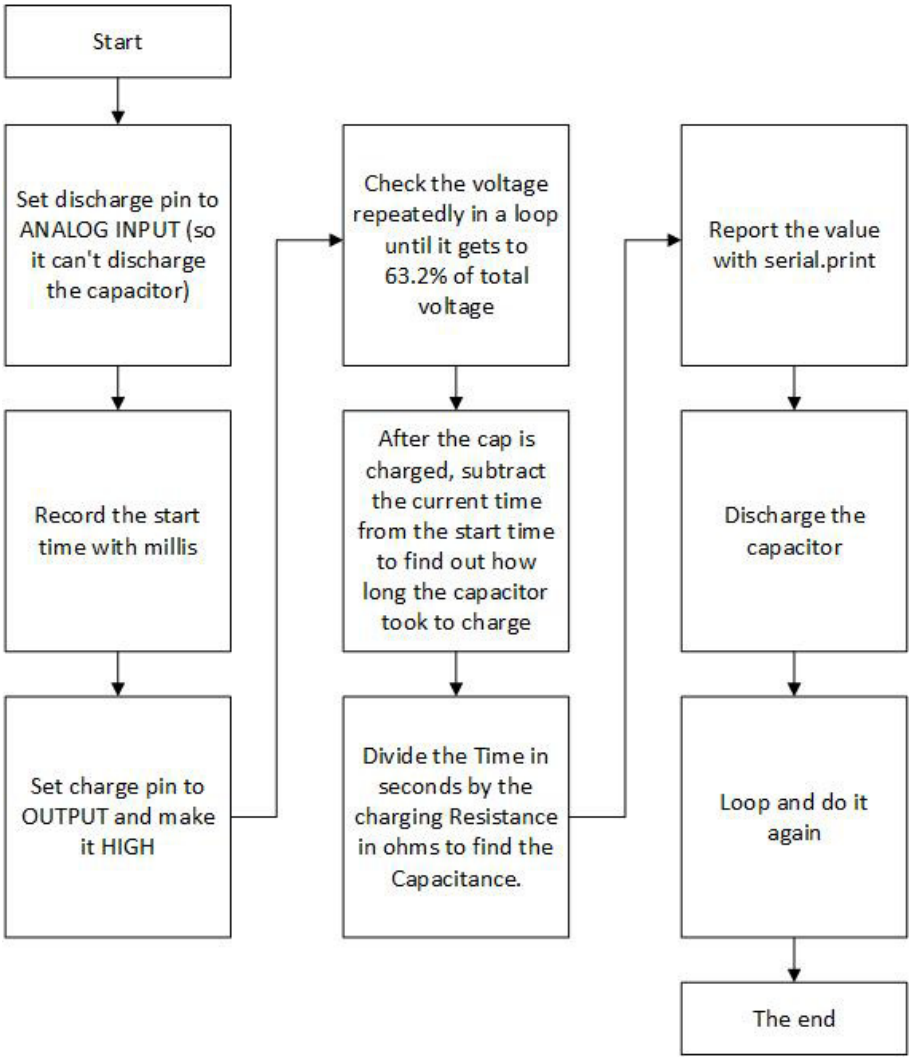

Fig.5. The algorithm for capacitance measurement.

3. Conclusion

Thus, the design of information-measuring system will ensure a process of testing medical equipment, but also possess the self-diagnosis function of the parameters of the high voltage source.

Acknowledgements

The project became the winner of the youth program Participant research scientific-innovation competition "P.R.S.I.C.". Project #4475GU1/214.

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