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MODELLING OF SWITCHING IN A UNINTERUPTIBLE ELECTRICAL ENERGY SYSTEM COMPOSED OF MULTIPLE SOURCES

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Abstract:
This paper presents a SIMULINK model of the static switch of a power supply without interrupting the current on load. The model may be tuned to achieve the power supplies switching time less than 10ms. This algorithm is based on identifying voltage loss which occurs at switching on a circuit or decrease its peak value below a certain threshold. The model was designed to allow easy implementation using a system based on a general purpose microcontroller with common resources.

Key words: data acquisition, unified signal, uninteruptible power supply.

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1. INTRODUCTION

In the air quality monitoring stations it is essential to ensure continuous electricity supply, in order to have continuous information about environmental parameters. A modern and environmentally friendly power solution of such stations requires the use of green energy sources (alternative energy). The presented system allows the use of any number of energy sources (solar, wind, hydro, etc.), without loss of power load. The model (Fig. 1) is based on measuring elapsed time between reaching a predefined threshold by a sinusoidal voltage. For this reason, in order to use as a voltage threshold a continuous voltage, the sinusoidal signal is rectified [1]. Rectified voltage is then compared with the threshold and, depending on the relationship between the two signals results in a wave whose frequency is equal to that of the rectified sinusoidal voltage. If this voltage is the electricity supply network (whose frequency is around 50 Hz), after rectifying the rate is about 100 Hz, which means a period of 1/100 = 0.01 seconds, ie 10 ms.

This period of 10 ms is the time base to consider in the switch model presented, the maximum duration in which can be detected lack of main circuit voltage and can be ordered, possibly switching to another circuit.

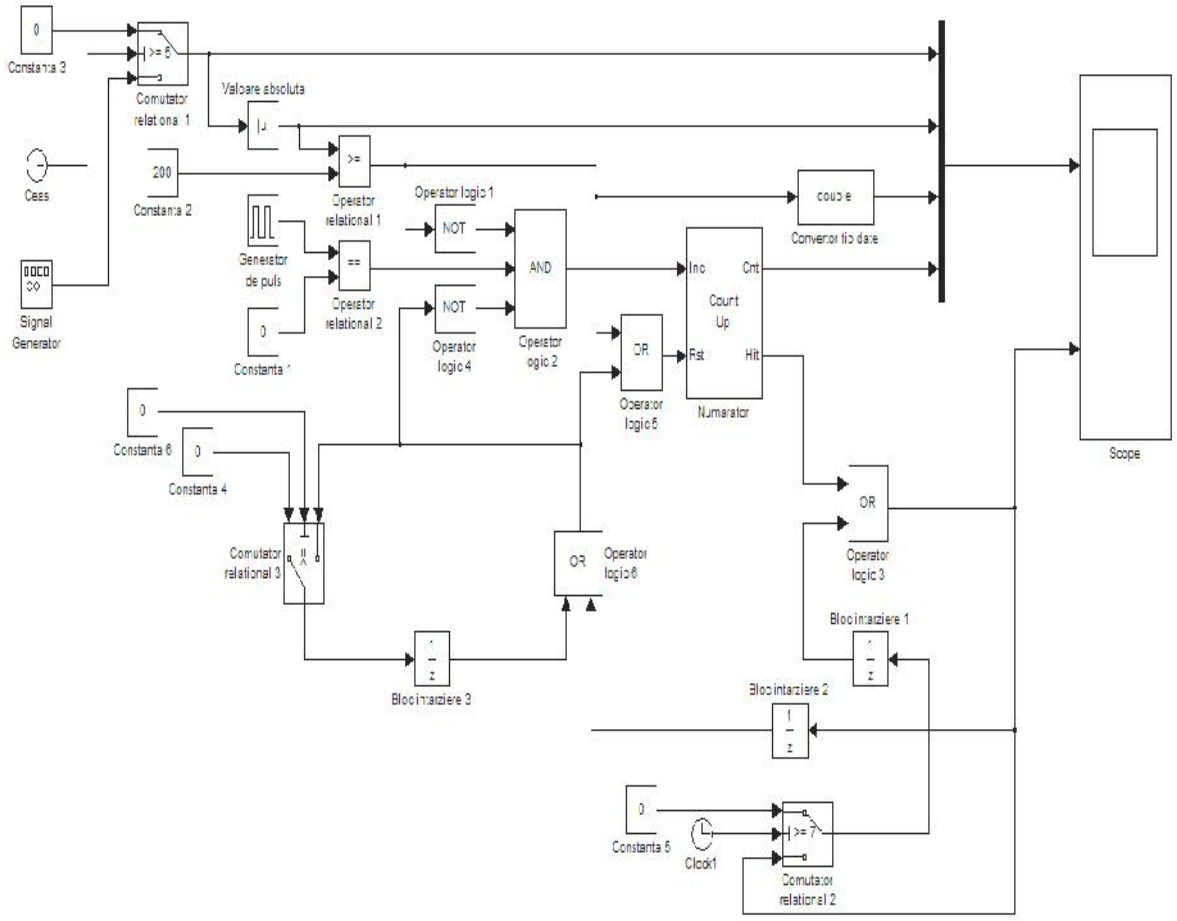

Figure 1. *SIMULINK model of the static switch.*

2. THE WORKING PRINCIPLE OF THE SWITCH

For lack of sinusoidal voltage detection is practically to count the time period elapsed between two exceedings of DC voltage threshold [2]. If this period exceeds 10ms, then it can be concluded that the sinusoidal voltage is either missing or didn't reach the threshold voltage.

Both situations lead to the same solution: the static switch commands another sinusoidal voltage source.

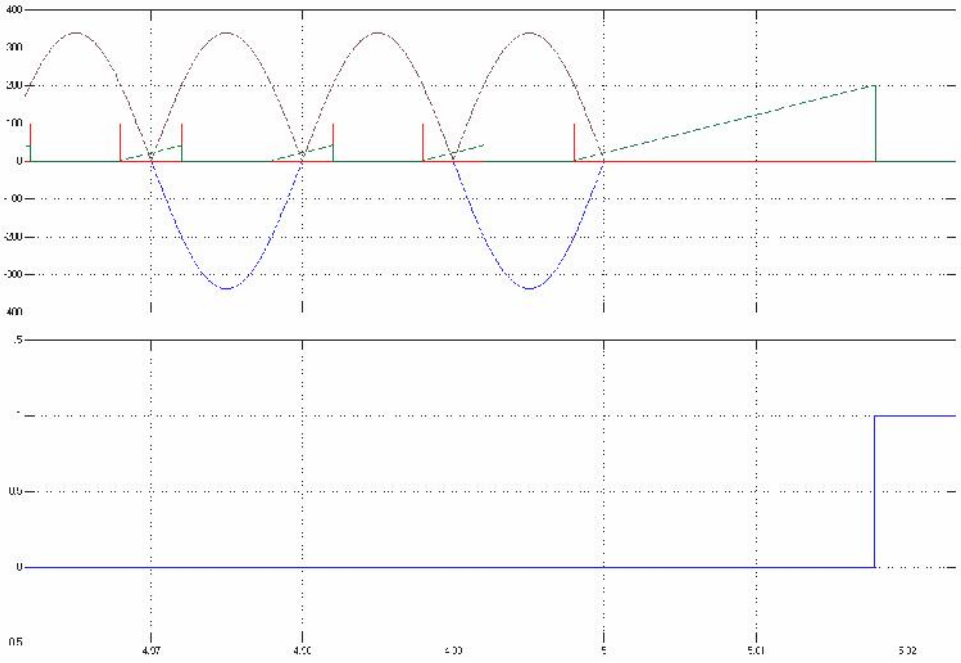

Figure 2. *The detection of absence of sinusoidal voltage.*

Threshold voltage can be selected so as to make the switch even if the sinusoidal voltage is lower that the voltage value allowed by standards.
Main block of the model is a counter that has two inputs: an incremental input and a reset one, or bringing in zero. As output, the counter is necessary to have only one output for overcoming of the values. In the model was used a counter that can provide as output and the actual value reached by increment, which is necessary only to facilitate model development.

We chose this method of detection because it is very easy to implement in a microcontroller structure and, moreover, does not require components with special features that are usually expensive (eg converters actual value - current value). In this case, the counter that is incremented between exceedances of the threshold voltage can be even a timer of the microcontroller [3] and in addition, its increment and exceeding of a certain value can be programmed as interrupt routines, which greatly simplify firmware and gives safety. In order to easily use a more complex model (eg UPS), static switch was encapsulated in a single Simulink block [4] (Fig. 3, 4, 5, 6).

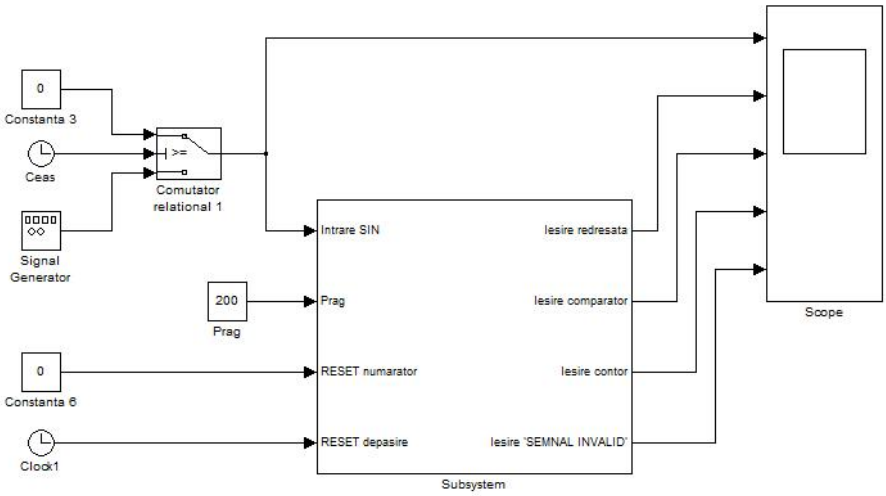

Figure 3. *Incapsulation of the model in a SIMULINK block.*

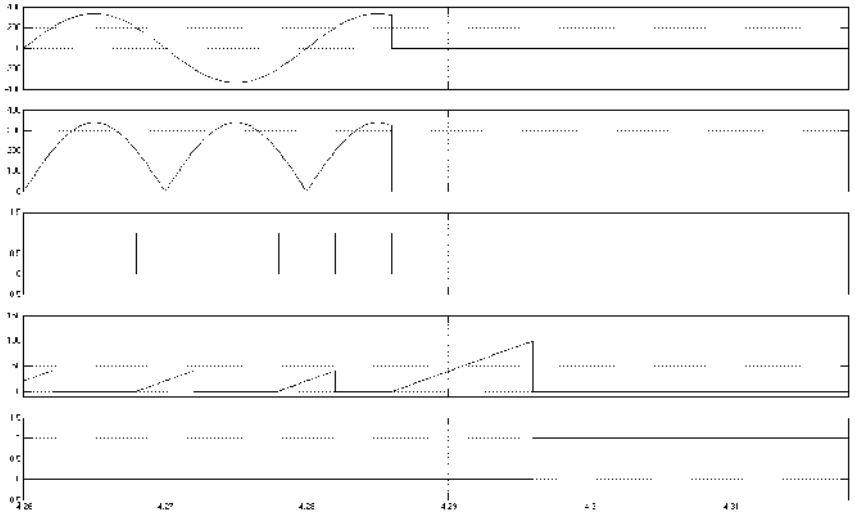

Figure 4. *Working oscillograms of the static switch.*

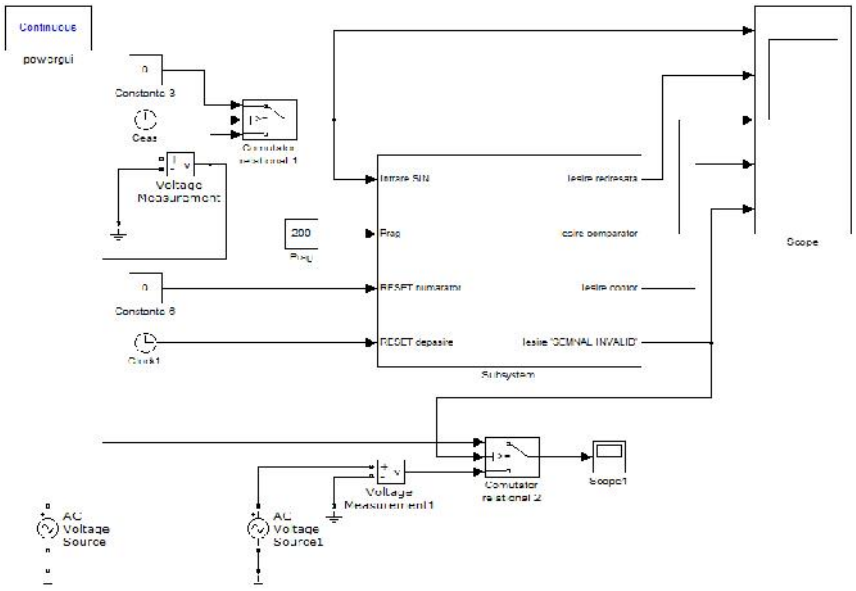

Figure 5. *Using the functional block together with two sinusoidal voltage sources.*

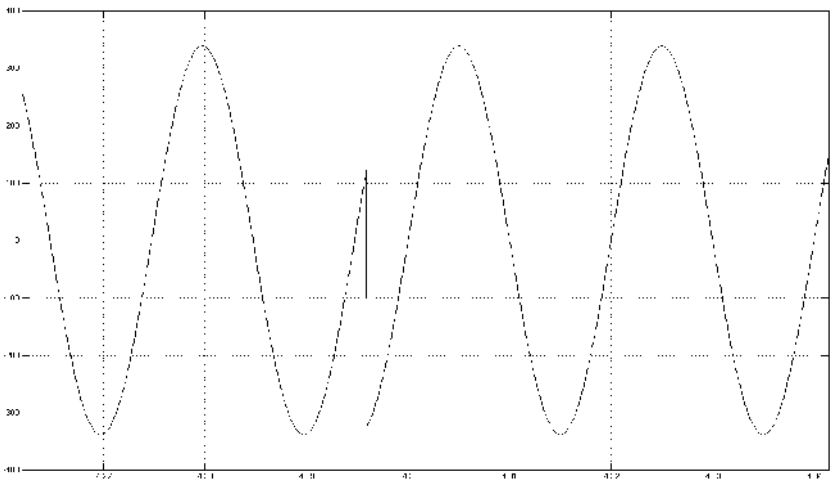

Figure 6. *The switch betweent the two sinusoidal voltage sources.*

3. CONCLUSIONS

The presented system ensure continuous supply of equipment from an air quality monitoring station, and also allows a reduction of carbon footprint by using green solutions for power generation. The model developed can be used to model more complex systems of energy management: uninterruptible power supplies, distribution systems with intelligent power management, green sources of energy [5] etc. The main advantage of this solution for detecting the absence of sinusoidal voltage is that all components of functional blocks can be easily implemented using a general purpose microcontroller, without unnecessary hardware and / or special software. In addition, the control signal for switching is digital, and it can be used, for example, to directly control a triac isolated grid used as a switching element of force.
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BIBLIOGRAPHY

[1] Richard C.D., James A. Svoboda: Introduction to Electric Circuits (8th Edition), John Wiley & Sons, Inc., ISBN: 978-0-470-52157-1, 2010.
[2] Hadi Saadat: Power System Analysis (3rd Edition), PSA Publishing ISBN: 978-0-9845438-0-9, 2010.
[3] Irwin J.D. , Nelms R.M. : Basic Engineering Circuit Analysis (9th Edition), John Wiley & Sons, Inc., ISBN: 978-0-470-12869-5, 2008.
[4] Silvia Curteanu: Inițiere în Matlab, PoliRom, ISBN: 978-973-46-0920-8, 2008,.
[5] Simionescu, Adrian Mugur: Control algorithm for distribution of electrical energy in a hybrid power system. Proceedings of SGEM 2011, p.35-38, ISSN: 1314-2704, 2011, Sofia, Bulgaria.