

УДК 621.313

Bezverkhnia Yu. S.

PhD (EM), assistant professor (EM), NU “Zaporizhzhia Polytechnic”

MODELING OF A REACTIVE POWER COMPENSATOR WITH AN INDUCTIVE BATTERY

In the modern world, increasing attention is paid to the issues of energy conservation and ensuring high quality power supply. One of the key aspects of ensuring efficient and reliable supply of electricity to consumers is optimal compensation of reactive power [1]. This study examines an innovative compensation device, namely, a reactive power compensator using an inductive energy storage device.

In Ukraine, capacitor installations are the most common for reactive power compensation, both with and without the possibility of adjustment, while synchronous and static thyristor compensators are used less frequently. However, capacitor banks have their disadvantages, including sensitivity to higher harmonics, overvoltage and elevated temperatures, and the requirement for special switching and switching circuits.

To analyse the new reactive power compensator, a computer model was developed using the Matlab and Simulink package. The general structure of this model is presented in Figure 1.

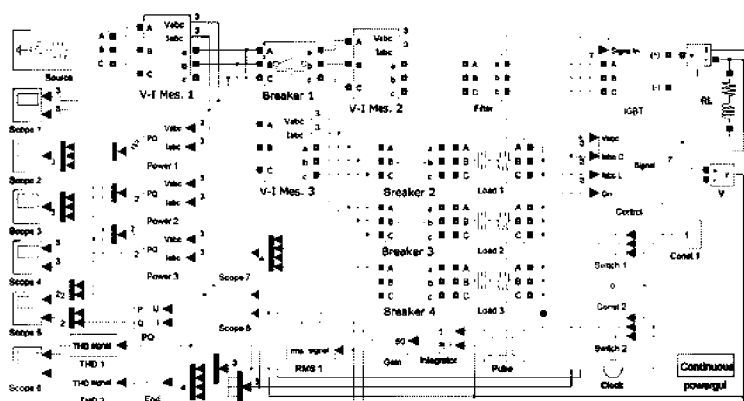


Figure 1 - The general structure the model

The Source block simulates the operation of a three-phase power frequency network, and the Filter block is a three-phase L-shaped low-pass filter. The IGBT block contains a three-phase bridge with IGBT transistors (Fig. 1), and the RL

block contains an active-inductive load (a choke with a gap). The Control block is responsible for controlling transistors.

Load 1-3 blocks model a three-phase active-inductive load, and Breaker 1-4 blocks model three-phase switches. The V-IMes.1-3, V and I blocks are designed for measuring currents and voltages, and the Power 1-3 and PQ blocks are for measuring active and reactive powers.

Blocks Scope 1-8 are used to display data, RMS 1 - to calculate the effective value of phase A current, and THD 1, 2 - to calculate the coefficients of higher harmonics of voltage and current of phase A.

The Gain, Integrator and Pulse blocks are used to calculate the average value of the inductor current, and the Switch 1, 2, Const 1, 2 and Clock blocks are used to control how the compensator is turned on and off.

This computer model provides the ability to study the operation of the compensator under various conditions thanks to flexible adjustment of the time parameters for turning on and off the blocks. This allows you to check the effectiveness of the compensator under different loads and changing network operating conditions. The selection of model parameters is made taking into account the requirements for electromagnetic compatibility and the physical implementation of the device. Calculations of reactive and active resistances of the model components are carried out taking into account the optimization of parameters to ensure the necessary characteristics of the compensator.

The diagrams presented in Figure 2 display data for a time interval of 0.02 s, which corresponds to one period of mains current fluctuation. These graphs show the phase voltage and current curves, as well as the inductor current and its average value. There is a phase shift of the phase current by 90° forward relative to the voltage (in electrical degrees), as well as the presence of ripple of about 3%. The amplitude of the phase current approximately corresponds to the average value of the inductor current.

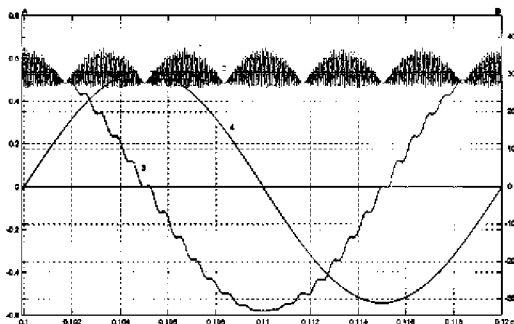


Figure 2 - Data for a time interval of 0.02 s, which corresponds to one period of mains current fluctuation

Additional calculations and analyzes carried out using computer modeling confirmed the efficiency and reliability of the VAR compensator, and also confirmed the compliance of its parameters with the requirements of electrical standards and regulations.

REFERENCES

Bezverkhnia, Yu. S. A voltage loss preliminary estimation in AC busbars [Text] / Yu. S. Bezverkhnia // Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu – 2019 – no. 4. – P. 73-78. DOI:10.29202/nvngu/2019-4/13