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ADAPTIVE CONTROL MODELS OF ENERGY SOURCES IN COMMUNICATION SYSTEMS

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Abstract. *This article discusses the issues of managing energy sources in modern communication systems through adaptive control models to improve energy efficiency. The possibility of evaluating the energy supply state in real-time, considering the variability of the load and external factors, and developing optimal control strategies is analyzed.*

Keywords: *Communication systems, energy sources, adaptive control, real-time mode, optimal control model.*

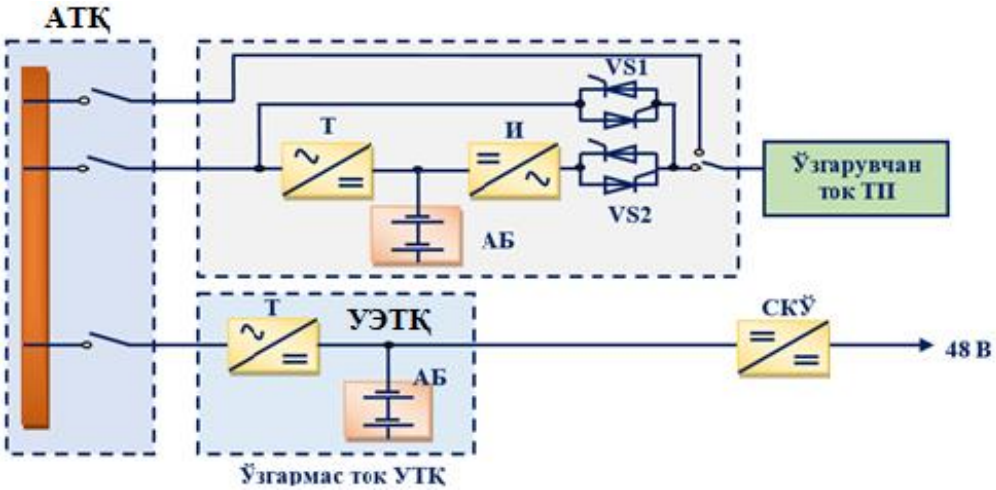
The communication networks of the Republic of Uzbekistan are one of the main systems that serve the sustainable development of all economic sectors of the country. Modern communication systems consist of various technical means, forming a complex set of systems that ensure the transmission of different messages over a given distance with specified quality parameters. To date, new digital automatic telephone exchanges, mobile communication, multi-channel densification, data transmission systems, and other services have been introduced, with information transmission now taking place via artificial satellites. Currently, international, regional, city, and rural communication networks in Uzbekistan are fully digitized.

Consequently, modern electronic devices in communication systems impose strict requirements on power supply sources. These energy sources include various devices for power monitoring, which ensure reliable and high-quality electricity supply for communication equipment. Power supply sources, which are part of computer systems, measuring instruments, and communication devices and systems, determine their operational reliability, material consumption, and other technical-economic indicators.

The quality of communication equipment’s operation is largely determined by the reliability of the electrical energy sources. The power supply source must ensure the uninterrupted operation of communication equipment even in the event of an emergency in the supply network. Providing uninterrupted energy supply remains a critical issue in connecting remote population centers to communication networks, mobile communications, and the Internet.

In order to ensure the uniformity, stability, and safety of the operation of energy supply devices for communication equipment, the state standard of Uzbekistan, O’z DSt 3055:2016 "Communication Networks. Institutional ATSs. General Technical Requirements and Control Methods," has been developed and is being implemented. The power supply of communication systems includes uninterrupted DC and AC power supply, voltage sensors and stabilizers, switching devices, and power distribution networks linking energy supply devices. The energy supply system of communication devices is required to operate both in normal and emergency modes.

In the normal operation mode, high-quality electricity is provided to the communication devices according to established standards, and the energy supply system operates without the involvement of service personnel. In the emergency mode, the quality of electrical energy for communication devices is not guaranteed, and therefore, the involvement of service personnel is required. During operation, devices prone to irreparable damage (e.g., batteries discharging below the allowed level or overcharging) or violating safety standards must be automatically disconnected. The power supply system of communication objects (ETT) requires continuous supply of AC and DC electricity (-48 V). The functional diagram of the system is shown in Figure 1. The AC and DC power source consists of a rectifier (T), inverter (I), accumulator battery (AB), and an uninterruptible power supply (UPS) that connects to the AC network and can be reconnected as needed. The AC loads are connected to the UPS through a distribution panel (TP). The UPS then connects the communication object's electrical devices to the main distribution box (ATQ) via an automatic switch.



1-figure. Functional schematic of the communication object's power supply system (ETT)The main elements of the DC power source are the rectifier and the accumulator battery connected to it.

Conclusions

This article discussed the issues of effective management of energy sources in communication systems based on adaptive control models. The research results show that adaptive control approaches play a crucial role in improving energy efficiency, ensuring the system's stability and reliability.

The effectiveness of the proposed models was confirmed through simulations and practical experiments. In the future, these approaches can be widely applied to optimize the energy management and enhance the stability of communication systems.

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