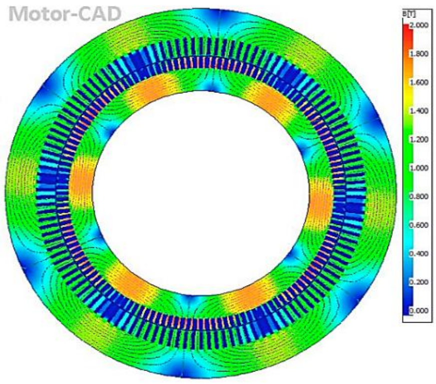

Рисунок 3 – Повна карта поля електромагнітної індукції статора ВАЗ 215

Таблиця 1 – Порівняння номінальних характеристик електродвигуна з результатами моделювання

Найменування	Заводські дані ЕД[1]	Модель Ansys-MotorCAD
Напруга номінальна, кВ	6,00	6,00
Потужність номінальна, МВт	8,00	8,216
Струм номінальний, А	880	900,3
Коефіцієнт корисної дії, %	98,00	97,9
Коеф. потужності	0,90	0,89
Число полюсів	6	6
Швидкість обертання, об/хв.	994	991
Номінальний момент на валу, Нм	76900	78551

Висновок

Виведення основних характеристик електродвигуна у програмі дозволило перевірити правильність моделювання та введення геометричних даних, порівняти результати з експериментальними даними. Це забезпечує точність подальшого теплового моделювання електродвигуна, що важливо при проектуванні та оптимізації систем, а також дозволить у майбутньому розраховувати максимальний термін експлуатації та використання ізоляції стрижнів обмотки статора ВАЗ215.

Список використаних джерел

1. ТУ 16-510.693-81 Двигун асинхронний типу ВАЗ 215/109-6 АМО5. Технічні умови.
2. «Motor-CAD Help», Motor Design Ltd, 2019
3. Дьяков Е. Д., Гаряжа В. Н., Воропай В. Г. Конспект лекцій з курсу «Електротехнічні Матеріали», Харків, ХНУМГ, 2015, с. 14-18.
4. Копілов І. П. «Проектування електричних машин», 4 видання. «Юрайт» 2011, с. 48.

UDC 621.314

APPLICATION OF AUTONOMOUS VOLTAGE INVERTERS IN LIGHT TECHNOLOGY AND ELECTRICAL ENERGY

Nerubatskyi Volodymyr Pavlovych,
PhD (Tech.), Associate Professor
Hordiienko Denys Anatoliiovych,
Postgraduate
Ukrainian State University of Railway Transport
E-mail: D.Hordiienko@i.ua

Automatic voltage inverters have the widest range of possibilities and areas of application. They are considered an ideal universal module for energy conversion. In addition to the main function of converting DC to AC, the inverter can also perform the reverse function in selected modes [1, 2].

When the output voltage reaches zero percent, the voltage converter becomes an inverter DC-DC converter. This is the basis for active voltage and current filters and reactive power capacitors, AC voltage stabilizers and DC frequency converters, that is, the connection of the voltage inverter is the source of the new circuit.

The main areas of application for autonomous voltage inverters are [3, 4]:

– power supply of AC consumers in equipment where one of the energy sources is a battery (for example, storage batteries, backup power, sources of alternating current) and uninterrupted power supply of each consumer in the event of a possible interruption of electricity supply from the AC network;

– electric transport powered by a contact network or any source of DC, preferably with a simple, reliable and inexpensive asynchronous short-circuit motor;

– electric drives with asynchronous and synchronous motors with an automotive inverter circuit that acts as a voltage and frequency regulator;

– constant voltage converters;

– devices for obtaining AC of the required frequency from sources of direct energy conversion (thermal and photovoltaic generators, fuel cells) that generate energy in DC;

– electrical equipment for receiving AC of increased frequency (galvanic coating of metals, heating and hardening of products).

The basis of the automatic inverter is a screw switching device capable of working in single-phase and three-phase circuits (zero or bridge circuit). Transistors and thyristors are used as the main components in inverters [5]. In cases where single-acting thyristors are used, the circuit is supplemented with elements for their joint use. One of the main elements is the capacitor. It should be noted that the capacitor application is not limited to switching off thyristors. Capacitors are also used to construct the output voltage curve of the inverter, to determine the characteristics of transient processes in AC circuits, as well as to increase the load voltage.

Single-phase autonomous voltage inverters are most often made using a bridge circuit (Fig. 1). The load (usually of an active-inductive nature) is included in the diagonal of the bridge formed by thyristors $VS_1 \dots VS_4$ and behind the included diodes $VD_1 \dots VD_4$. Diodes are intended for passing the current of an active-inductive load in time intervals when the current has the opposite direction for thyristors (reverse, opposite, or "reactive" current diodes).

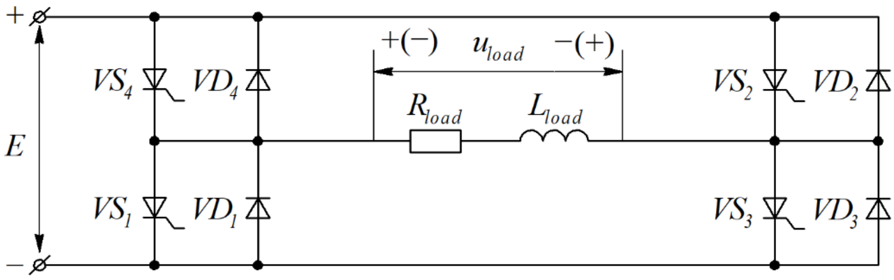

Figure 1 – Power circuit of a single-phase autonomous voltage inverter

The formation of the output voltage curve is characterized by the processes taking place in the main circuits of the inverter (with thyristors $VS_1 \dots VS_4$, diodes $VD_1 \dots VD_4$ and the load) when the appropriate int measured the conductivity of thyristors.

Thermal technologies in autonomous voltage inverters, which are widely used in power supply systems using alternative energy sources, can be divided into single-level and multi-level variants of schemes. In other words, modules that use impedance and gas-impedance connections in the input circuit of the converter. A feature of such inverters is that they can work in an additional mode, the so-called "test mode". This allows the inverter to provide maximum load power from sources of variable voltage (solar panels, wind generators, biofuel), wind generators, biofuel cells) by increasing the input current and voltage.

Current algorithms for controlling an autonomous voltage inverter are pulse-width modulation and single-shot modulation. Different modulation schemes have completely different sinusoidal values of output voltage and current and a different coefficient of pulsation of the input current.

When creating power supply systems with renewable energy as a source of DC, special attention should be paid to converters with impulse lines in the input circuit. This type of inverter is a two-level voltage converter with a DC input circuit consisting of an x-shaped configuration to which two capacitors and a choke are connected. The main advantage of this mode is that input voltage and current of inverter, obtained from the source of DC, are increased without installing additional converters at the input of the circuit. This allows to give the maximum power of solar cells to the load and use the area of the solar panel more efficiently.

References

1. Umarov S. Modeling method for autonomous current inverters. *2022 International Conference on Electrical, Computer, Communications and Mechatronics Engineering (ICECCME)*. 2022. P. 1–6. DOI: 10.1109/ICECCME55909.2022.9988596.
2. Nerubatskyi V., Plakhtii O., Hordiienko D. Adaptive modulation frequency selection system in power active filter. *2022 IEEE 8th International Conference on Energy Smart Systems (ESS)*. 2022. P. 341–346. DOI: 10.1109/ESS57819.2022.9969261.
3. Nerubatskyi V., Hordiienko D. Analysis of topology of the autotransformer forward-flyback converter for photovoltaic panel. *Power engineering: economics, technique, ecology*. 2024. No. 1. P. 81–85. DOI: 10.20535/1813-5420.1.2024.297579.
4. Wang J. Autonomous optimal voltage support scheme of two-stage PV system for grid fault ride through. *IECON 2022 – 48th Annual Conference of the IEEE Industrial Electronics Society*. 2022. P. 1–6. DOI: 10.1109/IECON49645.2022.9968383.
5. Nerubatskyi V., Hordiienko D. Study of the influence of sliding mode regulator on spectrum higher harmonics of the SEPIC converter. *2023 IEEE 5th International Conference on Modern Electrical and Energy Systems (MEES)*. 2023. P. 1–4. DOI: 10.1109/MEES61502.2023.10402454.

UDC 621.314

METHOD OF DETERMINING ADDITIONAL THERMAL LOSSES IN THE WINDINGS OF ELECTRIC MOTORS

Nerubatskyi Volodymyr Pavlovych,
PhD (Tech.), Associate Professor
Hordiienko Denys Anatoliiovych,
Postgraduate
Ukrainian State University of Railway Transport
E-mail: D.Hordiienko@i.ua

Increasing the energy efficiency of asynchronous electric drives plays an important role in development of electrical engineering and power engineering [1, 2]. Increasing the efficiency of asynchronous electric drives is associated with an increase in the number of poles, a decrease in current resistances, and an increase in power coefficients. Also, to achieve the maximum efficiency of asynchronous motors, they should be used at full load (variable load). Frequency converters, most commonly used to control the speed and torque of asynchronous motors, operate using pulse-width modulation of sinusoidal or spatial vectors. Therefore, it is also important to improve the efficiency of frequency converters in asynchronous electric drives [3, 4]. Types of power losses in power switches and possible ways to reduce these losses are listed in Table 1.

Table 1 – Methods of reducing power losses in inverter power switches

Type of loss	Inventory loss	Reasons for loss	Possible methods of reducing losses	Disadvantages
Static	– losses in a providential state; – leakage currents	– dependence on the amount of current and voltage on the device	– changing the internal design of the power switch to reduce the voltage drop	– high cost of switches based on silicon carbide
Dynamic	– transistor switching losses; – diode recovery losses; – loss in drivers	– magnitude of current and voltage during commutation; – duration of commutation; – number of switches	– methods of soft commutation; – improvement of the design of drivers; – reduction of commutation frequency	– complication of the circuit design of the device; – decrease in the quality of the output current of the inverter