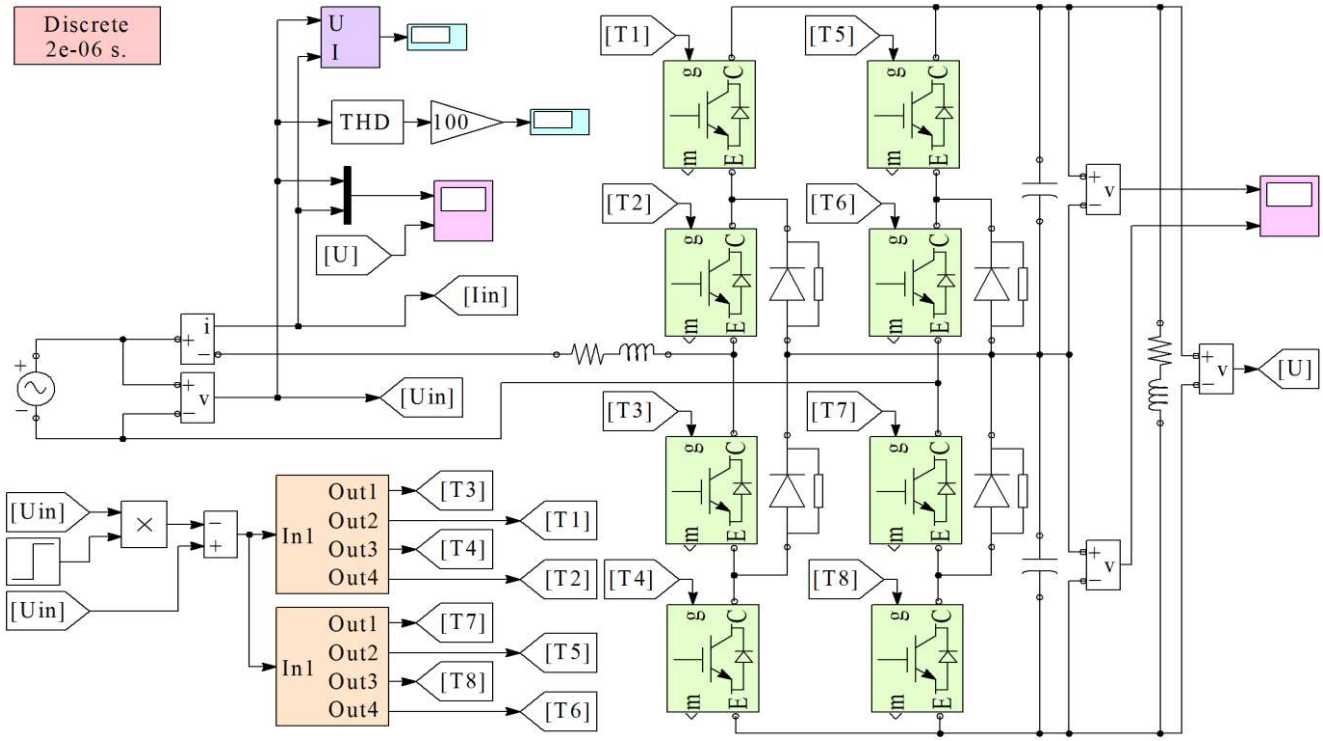

Рис. 1. Схема трирівневого активного чотириквадрантного випрямляча

Показник	2-рівневий випрямляч з 2-канальною ШІМ	3-рівневий випрямляч з 1-канальною ШІМ	3-рівневий випрямляч з 2-канальною ШІМ
Частота комутації IGBT, Гц	1000	1000	1000
Коефіцієнт гармонічних спотворень вхідного струму, %	3,13	3,83	1,94
Коефіцієнт потужності, %	99,63	99,72	99,77
Коефіцієнт гармонічних спотворень вихідної напруги, %	3,6	5,26	7,2
ККД, %	97,8	98,1	98,55

Вибір реальної топології активного випрямляча залежить від багатьох складових, таких як вартість, ККД і якісні показники роботи, а саме коефіцієнт потужності й коефіцієнт гармонічних спотворень. При цьому трирівнева топологія краща за всіма вищезазначеними показниками, що зумовлює доцільність її використання.

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UDC 621.314

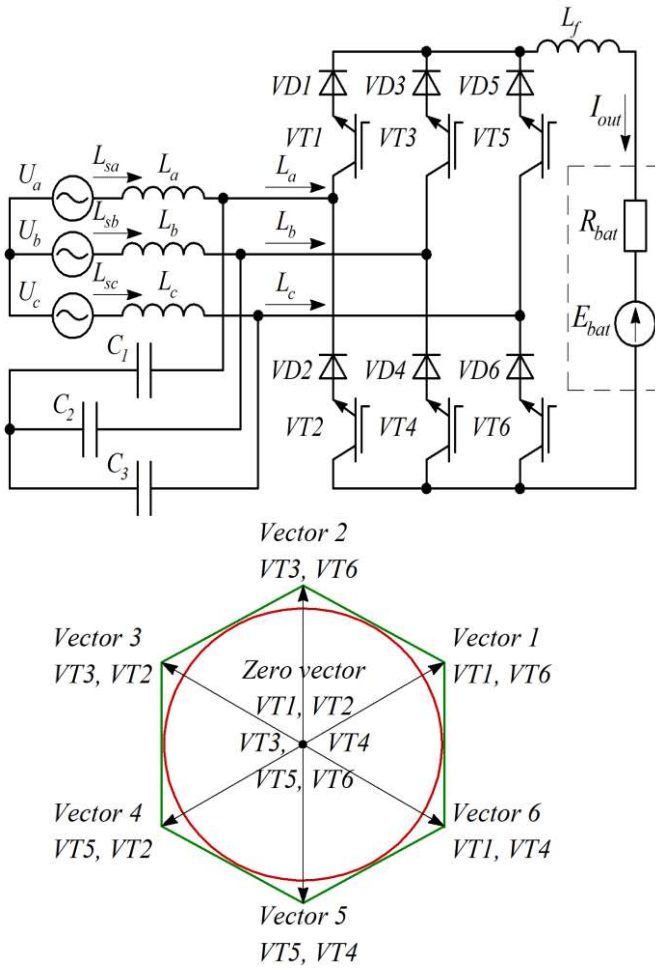
TOPOLOGY OF A CHARGING STATION FOR ELECTRIC VEHICLES

BASED ON A CURRENT SOURCE RECTIFIER

In the existing charging devices, with significant values of the charge current, large losses of electricity occur, therefore the issue of developing own technical [1, 2].

Active four-quadrant rectifiers compared to classical thyristor rectifiers have a number of significant advantages: it is possible to work with a power factor close to unity, they provide the formation of a sinusoidal input current that meets the requirements of electromagnetic compatibility, namely the level of emission of higher harmonics of the input current, a low level of pulsations and higher harmonics output current [3].

The current source rectifier (CSR) is a step-down converter, which makes it possible to power the generator with a higher voltage and, accordingly, lower consumption with lower currents. The current source rectifier scheme is shown on Fig. 1, a.



a)

b)

Fig. 1. Scheme of converter of electric vehicle charging converter based on CSR (a) and space vectors the control (b)

In current source rectifier, under the condition with low voltage in the direct current link, which for some models of EV charging stations is 400 V, as in the Tesla supercharger V3, the diodes in the circuit may not be used, which will reduce power losses in the converter.

Algorithms for calculating spatial vectors in spatial-vector modulation are the same, but the possible switching states are different. The active current rectifier vectors are presented in Fig. 1, b. Vectors of space-vector modulation cause different switching states of power transistors of active rectifiers. This is due to the fact that, unlike an active voltage source rectifier, an active current source rectifier allows turning on only two power transistors for each vector, which can lead to lower power losses.

A feature of the space-vector PWM for an active rectifier is that the input modulating signal is the input voltage signals Ua, Ub, Uc, but to obtain the power factor, the sinusoids must be shifted by the compensation angle obtained by measuring the phase of the input currents Isa, Isb, Isc.

A model of an electric vehicle charging station based on a three-phase active current source rectifier is shown in Fig. 2.

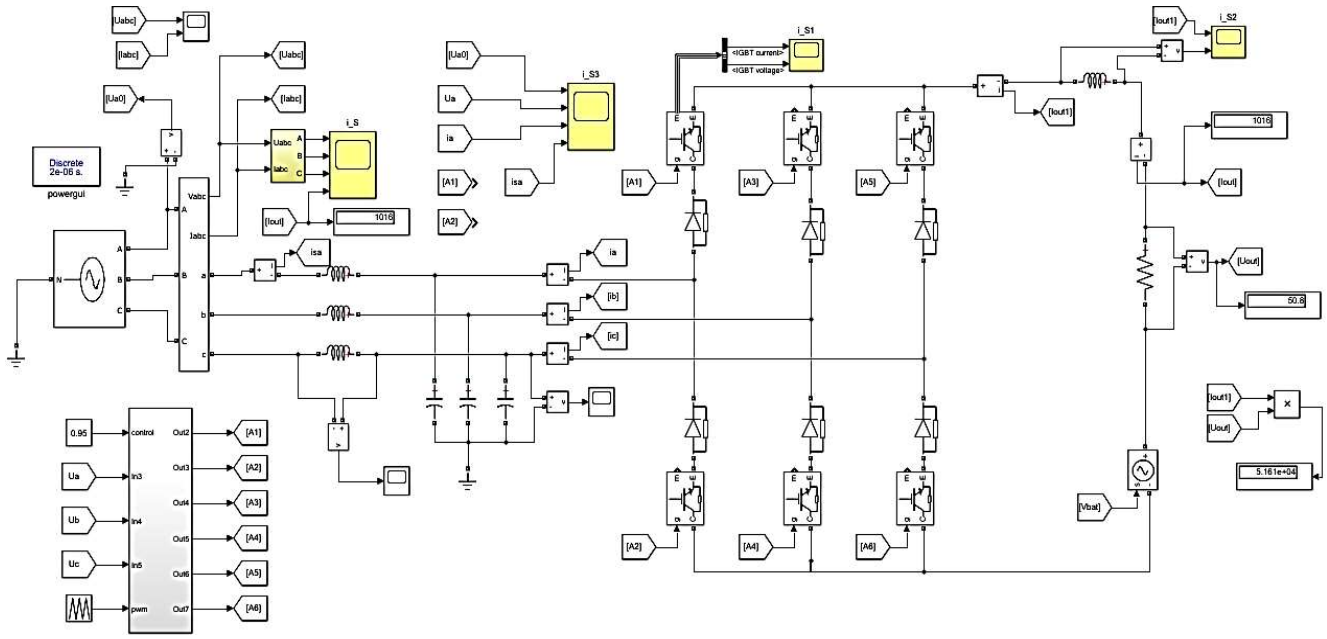


Fig. 2. Model of an electric vehicle charging station based on the CSR

There was determined on the developed model: transient processes in power transistors, the shape and harmonic analysis of the input current shape were investigated, the power factor and the process of full charge of the battery compartment from 0 % SoC to 100 % SoC in the "constant current – constant voltage" mode were determined.

The total harmonic distortion of the form of the input current of the charging station and the electric vehicle is 2.52 %, which meets the requirements of electromagnetic compatibility standards regarding the emission of higher harmonics into the power supply network from powerful converters. The CSR allows to significantly increase the current of the battery charge, while the charging time will decrease proportionally, but the power losses in the converter will also increase.

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RESEARCH OF PHASE COMPOSITION, STRUCTURE AND PHYSICAL-MECHANICAL PROPERTIES OF COMPOSITE MATERIALS

Refractory materials with such properties as mechanical strength, high erosion and corrosion resistance, heat resistance are of practical interest [1, 2]. An increase in the quality characteristics of heat-resistant materials is observed simultaneously with a decrease in their consumption through the introduction of new advanced technologies. The development of ways to protect carbon from oxidation is one of the most important methods of improving graphite-containing composites, which is achieved by adding oxygen-free refractory compounds, metals and other materials. Such impurities enter into an active interaction with oxygen, as a result of which they form a liquid phase and create a coating of the "glaze" type, which act as a barrier during the diffusion of oxygen into the refractory.

The number and nature of neoplasms, as well as the resulting synthesized secondary phases formed at the boundaries and intergranular space, as well as on the grain surface, have a strong influence on the oxidation