

IMPROVEMENT OF ELECTROMAGNETIC COMPATIBILITY IN POWER CONVERTERS OF ELECTRIC ROLLING STOCK

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The sources of distortion of the quality of electrical energy are both a large number of household impulse consumers of electricity, and single powerful impulse nonlinear consumers, such as traction substations of railways and subways, frequency converters of electric drives, the growing number of electric vehicle charging stations, etc. [1].

Electric drives with DC motors powered by an AC electrical network are quite widespread, both in industry and in railway transport. Its rectifiers are an important component of AC electrical rolling stock. The power factor, the level of emission higher harmonics of currents and reactive power, as well as the possibility of realizing the mode of recuperation of electric rolling stock depend on traction rectifiers [2, 3].

Diode or thyristor rectifiers are used in the majority of AC electrical moving parts, which have a number of significant disadvantages, including the significant emission of higher harmonics, the presence of a significant part of reactive power, and the lack of the possibility of recuperation in most cases.

One of the schemes that is used on rolling stock and allows for the implementation of rectification and recovery processes is the scheme of a four-zone rectifier, the principle of which is to control the output voltage by switching on the secondary windings of the traction transformers, which determine the working zone and adjust the opening angle of the thyristors.

At different control angles and in different adjustment zones, the energy performance of the drive changes significantly. The dependence of the output voltage and the realized power factor of the four-zone rectifier is shown in Fig. 1. The power factor of the four-zone rectifier lies in the range from 0 to 0.92. At the same time, the average value of the power factor in the adjustment range of the four-zone rectifier is ~0.75. At the same time, active voltage rectifiers form the shape of the input current close to sinusoidal, and also make it possible to recover the energy of dynamic braking of electric rolling stock into the traction electric network.

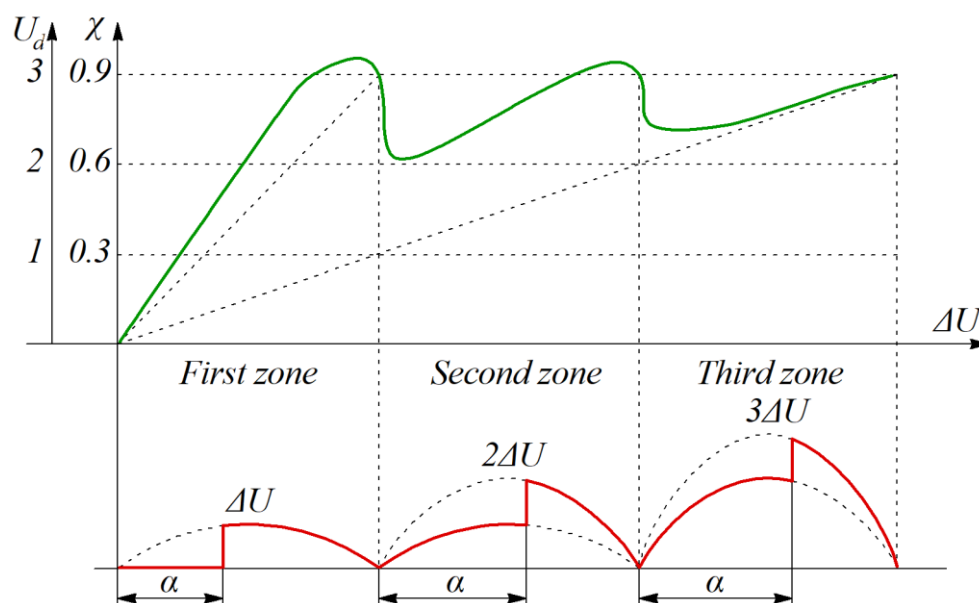


Figure 1 – Dependence of the output voltage and the realized power factor of the four-zone rectifier

The implemented parameters of energy efficiency and the level of emission of higher harmonics of current and reactive power will depend both on the parameters of the converter filter and on the implemented control system and modulation algorithm.

Conclusion

As a result of the studies of the four-zone rectifier scheme, it was determined that adaptive regulation of the switching frequency of power transistors is provided, thanks to which minimal power losses are ensured under the conditions of the given parameters of electromagnetic compatibility.

References

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