

# Research on Properties of Devices for Shaping and Processing of Signals Based on Amplitude Modulation of Many Components

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**Abstract**—Devices for shaping and processing of signals based on known varieties of digital amplitude-phase modulation are considered. Their disadvantages are exposed during realization of modulation and demodulation of the signals that are characterized by non-rectangular signal constellations. There are explored properties of devices for shaping and processing of signals based on a new variety of signal modulation, namely amplitude modulation of many components (AMMC). The results of carried out researches show that advantages of proposed AMMC modulator are simplification of phase modulated or amplitude-phase modulated signal shaping, in particular AMMC signal shaping, and improve of modulator internal interference protection. Advantages of AMMC demodulator are simplification of phase modulated or amplitude-phase modulated signal processing, in particular AMMC signal processing, and improve of demodulator internal interference and zero drift protection at its practical realization. The proposed AMMC modulator and demodulator can be applied for shaping and processing of signals based on known and new varieties of amplitude-phase modulation.

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## INTRODUCTION

Now we are living in the era of information society. The characteristic features of information society are:

- increasing the role of information and knowledge in the life of society;
- an increase in the number of people involved in the production of information products and services;
- people's use of services provided through information and telecommunication technologies;
- creation of a global information space based on the use of information and telecommunication technologies and provision of effective information co-operation of people, their access to the world information resources, satisfaction of their needs in information products and services.

Consequently, the improvement of information and telecommunication technologies is necessary for development of information society. The volumes of world information resources are increasing every year, therefore, it is necessary to improve the telecommunication technologies of data transmission to ensure access to them.

Telecommunication technologies of data transmission are based on the use of methods of shaping and processing of electrical signals, which include: methods of signal modulation/demodulation, methods of line and correcting coding/decoding, methods of compression/division of channels, methods of data transmission with automatic repeat request. Methods of signal modulation/demodulation takes especially important place in the process of shaping and processing of electrical signals, because they determine a data rate in a telecommunication channel. Improvement of methods and devices for realization of signal modulation/demodulation enables to improve telecommunication technologies of data transmission. A considerable amount of publications [1–8] is devoted to research of properties of known methods and devices for realization of digital signal modulation/demodulation. However, much new methods and devices for realization of digital signal modulation/demodulation need further research.

The purpose of this paper is research of properties of devices for shaping and processing of signals based on a new variety of signal modulation, namely amplitude modulation of many components (AMMC).

## REFERENCES

1. M. Ayat, S. Mirzakuchaki, A. Beheshti-Shirazi, "Design and implementation of high throughput, robust, parallel M-QAM demodulator in digital communication receivers," *IEEE Trans. Circuits Systems I: Regular Papers* **63**, No. 8, 1295 (2016). DOI: [10.1109/TCSI.2016.2589078](https://doi.org/10.1109/TCSI.2016.2589078).
2. M. Gangadharappa, R. Kapoor, H. Dixit, "An efficient hierarchical 16-QAM dynamic constellation to obtain high PSNR reconstructed images under varying channel conditions," *IET Commun.* **10**, No. 2, 139 (2016). DOI: [10.1049/iet-com.2015.0693](https://doi.org/10.1049/iet-com.2015.0693).
3. M. Salmani, M. Nekuii, T. N. Davidson, "Semidefinite relaxation approaches to soft MIMO demodulation for higher order QAM signaling," *IEEE Trans. Signal Processing* **65**, No. 4, 960 (2017). DOI: [10.1109/TSP.2016.2628342](https://doi.org/10.1109/TSP.2016.2628342).
4. N. E. Elashkar, G. H. Ibrahim, M. Aboudina, H. A. H. Fahmy, A. H. Khalil, "All-passive memristor-based 8-QAM and BFSK demodulators using linear dopant drift model," *Proc. of 5th Int. Conf. on Electronic Devices, Systems and Applications*, ICEDSA, 6-8 Dec. 2016, Ras Al Khaimah, United Arab Emirates (IEEE, 2016), pp. 1-4. DOI: [10.1109/ICEDSA.2016.7818542](https://doi.org/10.1109/ICEDSA.2016.7818542).
5. T. Liu, I. B. Djordjevic, "Signal constellation design for cross-phase modulation dominated channels," *IEEE Photonics J.* **7**, No. 4 (2015). DOI: [10.1109/JPHOT.2015.2453880](https://doi.org/10.1109/JPHOT.2015.2453880).
6. G. Ferrari, U. Amadei, "Two-level quantized soft-output demodulation of QAM signals with gray labeling: A geometric approach," *IEEE Commun. Lett.* **20**, No. 10, 1931 (2016). DOI: [10.1109/LCOMM.2016.2592963](https://doi.org/10.1109/LCOMM.2016.2592963).
7. C. Pathak, K. Rawat, "Quadrature modulation using radio frequency wave correlation in multiport network," *Proc. of 5th Int. Conf. on Signal Processing and Integrated Networks*, SPIN, 22-23 Feb. 2018, Noida, India (IEEE, 2018), pp. 796-799. DOI: [10.1109/SPIN.2018.8474148](https://doi.org/10.1109/SPIN.2018.8474148).
8. B. Sklar, *Digital Communications: Fundamentals and Applications*, 2nd ed. (Prentice-Hall, New Jersey, 2001).
9. R. Politsanskyi, M. Klymash, Yu. Bobalo, "The data transferring systems with using of the chaotic signals non-coherent detection," *Proc. of 12th Int. Conf. on Modern Problems of Radio Engineering Telecommunications and Computer Science*, TCSET 2014, 1 Mar. 2014, Lviv-Slavske, Ukraine (Lviv, 2014), p. 433.
10. I. V. Gorbatyy, "Optimization of signal-code constructions using the maximum efficiency criterion," *Radioelectron. Commun. Syst.* **56**, No. 12, 560 (2013). DOI: [10.3103/S0735272713120029](https://doi.org/10.3103/S0735272713120029).
11. I. V. Gorbatyy, "Investigation of the technical efficiency of state-of-the-art telecommunication systems and networks with limited bandwidth and signal power," *Automatic Control Computer Sci.* **48**, No. 1, 47 (2014). DOI: [10.3103/S0146411614010039](https://doi.org/10.3103/S0146411614010039).
12. I. V. Horbatiy, UA Patent 91950, *Byull. Izobr.*, No. 17 (2010).