BIOSCIENCES BIOTECHNOLOGY RESEARCH ASIA, November 2014. Vol. **11**(Spl. Edn.), p. 277-279

Increasing Noise Immunity of Electric Communication Channels in High-speed Telecommunication Systems

Vladimir Mikhailovich Artyushenko and Tatyana Sergeevna Abbasova

Financial and Technical Academy, Andrei Borisovich Semyonov,
Moscow Technical University of Communications and Informatics

doi: http://dx.doi.org/10.13005/bbra/1475

(Received: 27 September 2014; accepted: 10 October 2014)

The article presents the analysis of the protection measures of "twisted pair" electrical cables, used for data communication in the frequency band from 100 to 500 MHz, against external electromagnetic interference, as well as the interference of cables laid parallel to each other. Author presents characteristic curves, allowing one to provide electromagnetic compatibility when designing and maintaining the structured cabling systems for high-speed data transmission protocols.

Key words: External electromagnetic interference; electromagnetic compatibility; structured cable networks.

Fundamental research in the theory of information communication with regard to the description of the formation and the operation of the electrically conductive symmetric cable lines of multi-service cable systems (MCS), transmitting video, audio and multimedia information via cable networks, were carried out by the following national scientists: L.M. Andrushko, N.A. Semenov, V.M. Vatutin and S.S. Shavrin. Contemporary MCS electrical facility is sufficiently reliable, though technology evolution towards higher frequencies makes the issue on electromagnetic compatibility (EMC) the most topical problem that concerns the growing number of electrical and electronic devices. Increase in the operation frequency of cable systems up to 500 MHz results in both an increase in the level of intrinsic emissions of cable channels and their greater vulnerability in terms of external electromagnetic intrusion[1-4].

Problem statement

Rapid introduction of new high-tech data communication and processing technologies involves stricter requirements for electromagnetic compatibility of electronic equipment of cabling systems. Equipment of cabling system should provide not only an undistorted signal reception under the influence of external electromagnetic interference, but ensure also the optimal communication parameters within the given frequency band that is required for communication of management information in real time, as well as the desired level of protection between the circuits within the cable. One of the major problems in the design and operation of the MCS is the problem of ensuring the electromagnetic compatibility (EMC) [5 ... 12]. This problem becomes of particular relevance when transmitting through the MCS high-speed protocols, as well as the installation of MCS in the vicinity of the telecommunication and power cables[13 - 14].

Research technique to study noise immunity in electric channels of the MCS

To investigate the noise immunity of the MCS from external electromagnetic interference, we used testing procedure. First, it was found out, what was the distance, at which the horizontal electrically conductive cables lie in parallel, and how densely they are adjacent to each other. The

* To whom all correspondence should be addressed.

averaged results of the measurements should comply with the values that are obtained by proper handling of test data. Research test bench provided assembled horizontal beds as part of the patch panel, cable with an operating band of 600 MHz and data link receptacles. We tested horizontal beds on the basis of both non-shielded and shielded "twisted pair" cables.

Data link receptacles were mounted on a conventional cable channels, patch panel was installed in a closed 19-inch cabinet of conventional design. Cables inside the cabinet were laid to form harnesses. Horizontal cables were laid in such a manner that their bends were in compliance with the permissible radius. All test configurations were assembled taking into account the advice of the cable systems manufacturer. After installation, test measurements were carried out in accordance with the requirements, set for the beds of electrically conductive E-class cables. Measurements were carried out using Omniscanner 2 and DSP-4300 field testers in accordance with the technique, developed by the NAMAS laboratory, and recommendations of the EN61000-4-3 standard.

Unshielded system of 6th category did not

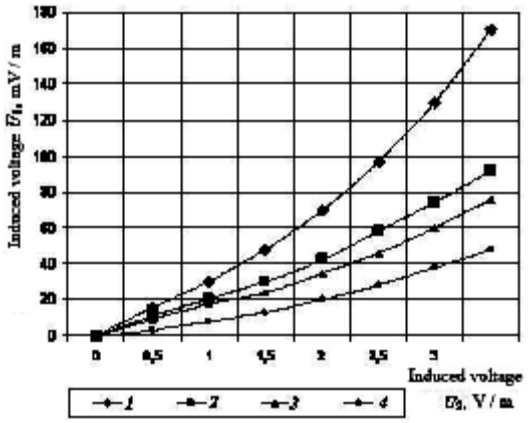

Fig. 1. Levels of induced field strengths in the twisted-pairs of unshielded system 1-3rd pair; 2-1st pair; 3-2nd pair; 4-4th pair

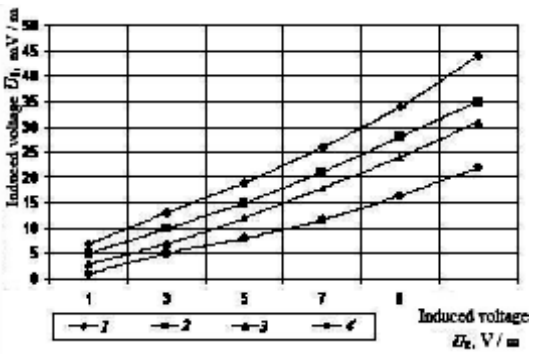

Fig. 2. Levels of induced voltage in the twisted pairs of shielded system: 1-3rd pair; 2-1st pair; 3-2nd pair; 4-4th pair

provide protection against electromagnetic interference at field strength of 3 V/m. Systems, which used shielded cables, were operating sustainably up to the induced voltages equal to 15 V/m[10, 12].

Fig. 1 shows the levels of induced field strengths U_1 in twisted-pairs of unshielded system depending on the induced voltage U_2.

Fig. 2 Levels of induced voltage in the twisted pairs of shielded system:
1 –3rd pair; 2 – 1st pair; 3 – 2nd pair; 4 – 4th pair .

The obtained results are in good agreement with the results of ITT NS&S company, which has initiated numerous measurements of different manufacturers' systems. These measurements were conducted by various laboratories in the United States and the UK.

CONCLUSION

The comparative analysis of the protection against the mutual interference of cables, laid parallel to each other, has shown that unshielded MCS does not provide protection against electromagnetic interference at the field strength starting from 3 V/m. The MCS with shielded cables, sustainably operates up to the level of induced voltages equal to 13 V/m.

REFERENCES

1. Semenov, A.B., Evolution and development trends of interactive management of structured cabling systems. *Communications Reporter*, 2005; **10**: 37–43.
2. Semenov, A.B., Latest news of structured cabling

systems. *Communications Reporter*, 2006; **6**: 42–48.

3. Shavrin, S.S., Mechanism and information model of subjective perception of echo signals. *Telecommunications,* 2008; **7**: 16-20.
4. Shavrin, S.S., Evaluation of the interference of the electric echo to subscribers. Telecommunications, 2008; **9**: 53–55.
5. Moroz, A.P. and V.Yu. Artemiev, Methods of determining the structure and parameters of interference in remote measurements. *Measurement Techniques*, 2012; **55** (1): 31–36.
6. Artyushenko, V. M. and V. I. Volovach, Statistical characteristics of envelope outliers duration of non-Gaussian information processes. Proceedings of IEEE East-West Design & Test Symposium (EWDTS'2013), Rostov-on-Don, Russia, 2013; 137–140.
7. Abbasova, T. S., E. M. Abbasov and G. N. Isaeva, Conductivity testing of communication lines for research on noise-free multiservice cable systems. European Science and Technology: Proceedings of the VII International Research and Practice Conference, V.2, Munich, 2014; 390–393.
8. Artyushenko, V. M. and B. A. Kucherov, ptimization of parameters of ground station of satellite communication system. European Science and Technology: Proceedings of the VII International Research and Practice Conference, V.2, Munich, 2014; 397–400.
9. Artyushenko, V.M. and B.A. Kucherov, Analisi della uso della tecnologia nella distribuzione dei controlli veicoli spaziali. *Italian Science Review,* 2014; **3**(12): 50–53.
10. Artyushenko, V.M. and B.A. Kucherov, Analysis of information exchange in the process of distribution of control facilities for spacecrafts with resource restrictions. European Science and Technology: Proceedings of the VII International Research and Practice Conference, V.2, Munich, 2013; 243–246.
11. Artyushenko, V.M. and B.A. Kucherov, Adaptive control signal parameters of satellite ground station. Proceedings of the conference « Science and technology: a step into the future - 2014 », Modern Information Technology, Prague, «Education and Science» Publishing House, 2014; 19–24.
12. Artyushenko, V.M., Evaluation of electromagnetic interference in the information shielded cable lines. Information Technology. Radio electronics. Telecommunications (ITRT-2012): Proceedings of the II International Extramural Scientific and Technical Conference. Part 1, Volga State University of Service, Moscow, 2012; 54–71.
13. Artyushenko, V.M. and T.S. Abbasova, Calculation and design of multi-structured cabling systems under interfering electromagnetic effects. Textbook, 2012; 264.
14. Artyushenko, V.M. and T.S. Abbasova, Information systems service in the electrical engineering complexes. M., 2010; 98.