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PERSONAL COMPUTER APPLICATION AS THE ANALYZER OF ELECTRIC ENERGY QUALITY

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Electric energy occupies one of key roles in the modern world. Without electric energy demanded quality and normal functioning and development of a human society is impossible, the electric power possesses set of specific properties. Directly participating in creation of other kinds of production it influences the quality. Electric energy quality (EEQ) is defined by the set of its characteristics at which electro receivers can normally operate and carry out the duty functions put in pawn in them /1/.

For EEQ control, special devices of Russian and foreign manufacturers are presented in the market, however having positive properties they have, at least, one lack – the high cost.

The experiments made within the limits of the degree project have shown, that a modern personal computer (laptop, net book, touch panel), including standard devices and input-output ports, can be used for development of the three-phase analyzer of electric energy quality.

Developed by the authors of the article the analyzer of electric energy quality is capable to analyze today six basic indicators of quality, according to state standard;

– the established deviation of voltage δU_y;
– scope of changes of voltage δU_t;
– factor of n harmonious component of voltage kU (n);
– frequency deviation Δf;
– duration of a failure of voltage $t_п$;
– pulse voltage U_{imp}.

The device measures also; current, frequency, power factor, capacity (active, jet, full), ostsillograte with high accuracy pressure and current (duration depends on storage capacity information of the personal computer and can theoretically make about several months).

Definition of indications of electric energy quality is enough challenge. The majority of the processes, proceeding in electric networks are swift-flowing, all normalized indications of electric energy quality cannot be measured directly - they must be calculated, as for EEQ it is possible to get final results only by statistically processed data. For definition of indicators of electric energy quality, it is necessary to execute great volume of measurements with high speed along with simultaneous mathematical and statistical processing of the measured values that assumes application of the computer with computing architecture not earlier model than Pentium IV.

For construction of the analyzer of quality it is necessary to fix changes of currents and pressure with high accuracy during the big time interval. For these purposes the modern sound card which has been built in the majority of parent payments of personal computers will suit.

Within the limits of the given article we will consider only definition of the higher harmonious in structure of a power signal. The given problem is priority at analysis EEQ and is rather difficult to realize algorithmically.

The three-phase analyzer of electric energy quality operating on the basis of the personal computer is possible only at presence a sound card of six writing down channels or the external multiplexer which is carrying out operation in pairs switching of target channels of a power network to entrance channels of a sound card (Fig. 1). Management of the multiplexer can also be achieved through your sound card.

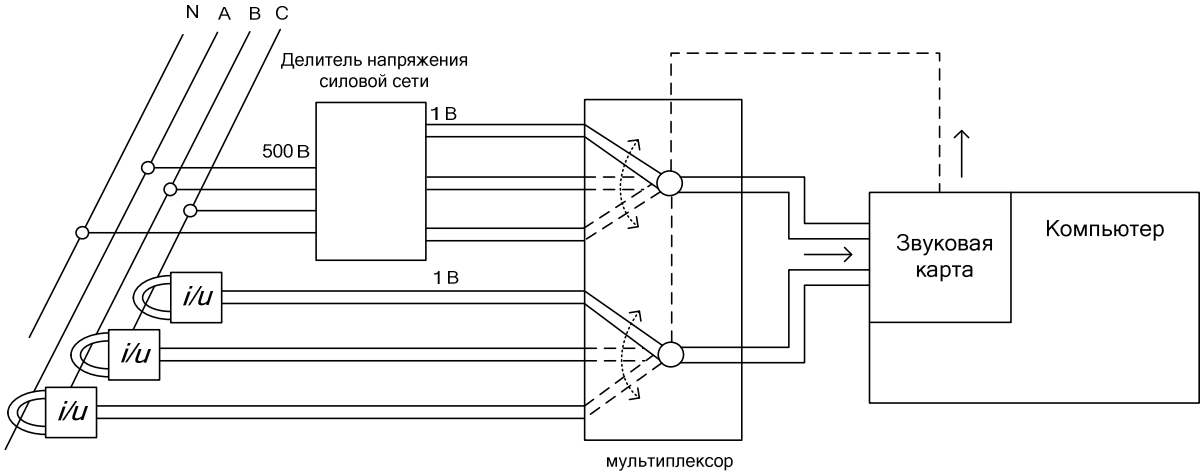

Fig. 1 – the Block diagram of three-phase analyzer EEQ

To take read the simplified research model of developed EEQ analyzer is presented in Fig. 2 (for mobility of removal of characteristics of a network the analyzer is presented in a single-phase variant with pressure and current circuits).

It is necessary to point out, that the power signal should be normalized to admissible entrance pressure of a sound card.

The modern built in or external sound cards have digitization frequency of about192 c.p.s. and number of levels of quantization is 2^{16}, number of fixing channels is from 2 to 8. Operating value of amplitude of an entrance signal should not exceed 1. Taking into account a dynamic range of a sound card accuracy of numbering power pressure 500 V it will make 500/65535=0,00763 V (for 24 bit sound card accuracy is about 0,0000298).

The level of sound card own noise reduces accuracy of numbering 10 times, but, nevertheless, it is considerable above, than at the most expensive industrial EEQ analyzers. Considering the frequency of digitization of a modern sound card 192 c.p.s., it is possible to get 3840 instant time values of a power signal for one period frequency of 50 Hz. Given number is enough for independent measurements of a power signal for decomposition of the latter to 1920 harmonics.

Stability and accuracy of modern analogue-digital converters of sound cards are guaranteed by milliard serial samples, and their cost thus, is several times lower, than at ADC industrial EEQ analyzers.

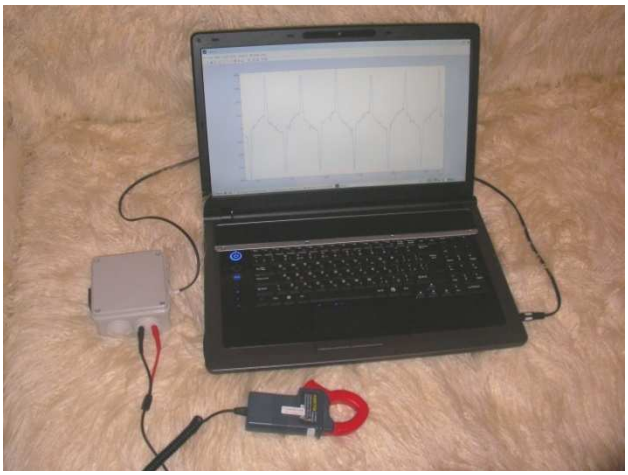

Fig. 2 – Appearance of the laboratory quality analyzer

By means of the developed EEQ analyzer, for definition of higher harmonious in structure of a power signal, the pressure oscillogram (Fig. 3) was analysed. It is necessary to note, that the pressure oscillogram in Fig. 3 is fixed for a real power network in an office building (pressure size is given in relative units).

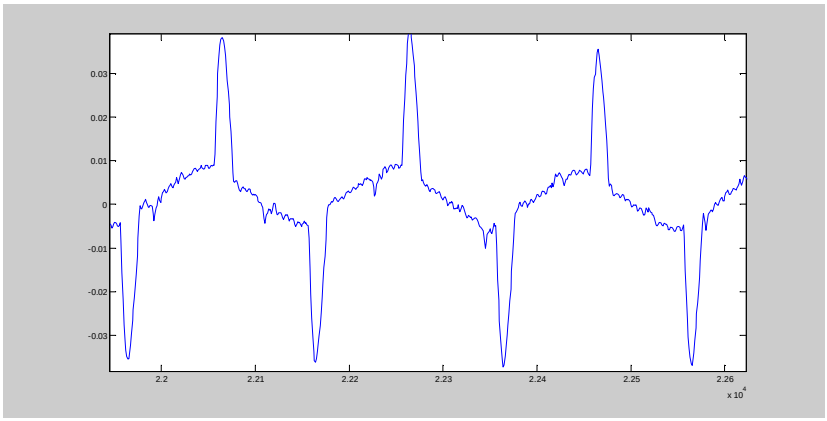

Fig. 3 – oscillogram of power network voltage

For definition of the higher harmonious in structure of a power signal we will calculate linear convolution of signals of pressure from a power network and a total basic signal from analyzed harmonics, after operation of convolution and additional transformations is received the level which led to the basic harmonic of the higher harmonious a power signal (Fig. 4). The given way of registration of the higher harmonious is more difficult than transformations made by Fourier or a strip filtration which is used in existing EEQ devices, however it allows to minimize both a computing error, and an error of numbering ADC.

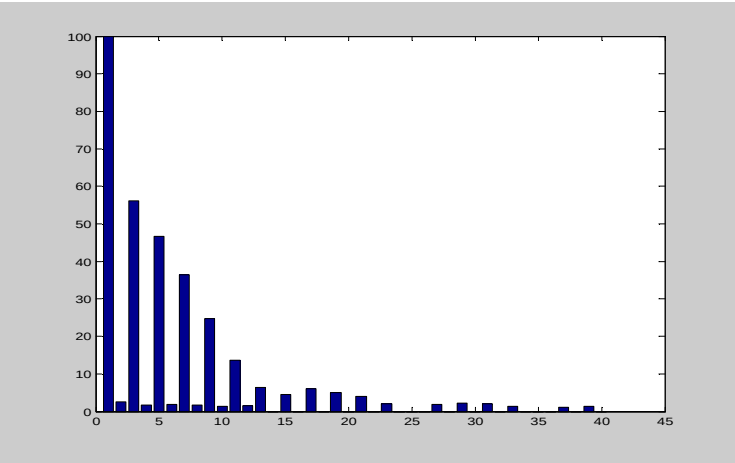

Fig. 4 – Analysis of higher harmonious voltage

The total error, taking into account an error of the sound card, the considered analysis algorithm of harmonics makes less than 1 %. The given error was defined by practical consideration, subsequently the analysis of a reference signal with known level of higher

harmonious. The reference signal was synthesized by means of several high-precision generators and precision adders.

Conclusion– Analyzing possibilities and characteristics of the industrial devices controlling of electric energy quality is possible to draw a conclusion, that on the basis of a personal computer (laptop) with built in or external sound card it is possible to develop an analyzer of quality of electric energy not conceding, and some positions surpassing industrial samples.

Literature

1. State standarte 13109-97 «Norms of quality of electric energy in systems of electrosupply of a general purpose».