

## SYSTEM FOR CONTROL PHYSICAL FIELDS OF THE SHIPS.

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*The subject of the paper is the application of digital signal processing (DSP) to non-linear hydroacoustic, acoustic and mechanic phenomena investigations. To provide such investigations a spectrum analyser with additional functions of polyspectra and virtual input channel is proposed. A serial number instruments and systems has been created on the base of development of the complexes which can evaluate the above mentioned high order spectra for analysing hydroacoustic and hydrophysical signals or electromagnetic signals of navy objects. Several modes of the analysers architecture are accomplish in our Institutes: full hardware with build-in microcomputer, external device interfaced with PC and base on 16-bit Analog Devices  $\delta$ - $\Sigma$  codec™ environment mount in PC which works in DOS or Windows™ mode. These complexes were used for development the testing environment for navy polygons and may be use in navy system of the barrier defence.*

The system consists of two underwater units (Base 1 and Base 2), each of them contains 3-component orthogonal sensors of magnetic H (h), electric E (e), acoustic P (p) fields, temperature T° (t°), conductivity C (c) and the waterside software-hardware computer equipment. The system is able to operate both in the measurement mode and in a mode of spatial compensation of external electric and magnetic interference.

System provides simultaneous measurement of four physical fields of marine objectives (hydroacoustic field and alternative magnetic field, direct and alternative current fields), as well as estimation of quasi-static magnetic fields.

A serial number of unique samples of instruments and systems has been created on the base of development of the complexes, which can evaluate statistical parameters of the signals including the high order spectra for analysing hydroacoustic and hydrophysical signals, or electromagnetic signals of navy objects. Several modes of the analysers architecture are accomplish in our Institutes: full hardware with build-in microcomputer, external device interfaced with PC and base on 16-bit Analog Devices  $\delta$ - $\Sigma$  codec™ environment mount in PC which works in DOS or Windows™ mode. These complexes were used for development the testing environment for navy polygons and may be use in navy system of the barrier defence.

Two accessory generators of the complex waveforms  $Y$  and analog input units are synchronised by the same clock frequency and may be used for reflexometrical measurements.

The system software allows to store all measured signals in the real time mode without information loss on the PC's hard disk, to perform an express analysis of some operator-chosen parts of realisations over a number of channels, as well as to perform a detailed analysis of all realisations, and to indicate and archive the analysis results upon the completion of the experiment.

The mode of window sampling from input signal consequence could be chosen. Sampled windows are used for the calculation and accumulation of the following values:

- auto and cross power spectra;
- bispectra;
- trispectra;
- histograms;
- coherent accumulation data;

User can choose the cross-characteristics calculation for any pair of signals.

The system supports simultaneous operation of several blocks of selective processing. The block can contain only the signals with equal sampling frequencies.

The measurement of bi- and trispectra is an innovation and raises the opportunity to detect and explore the random impulse sequences, the mixtures of such sequences with one another and with Gaussian noise, to separate the oscillations which have close unstable frequencies, to observe the non-linear interaction of oscillation modes and so on [1].

The former plot image can be replaced by a new one in a "frame" way or shifted at an angle ("water-fall").

Four "frames" or two "water-falls" are displayed on the screen. In the "frame" mode the horizontal and vertical axes and numbered markers are indicated.

While continuing the measurement the operator can stop the image change, use the markers, make a hard copy, select other value to be displayed and resume the image change.

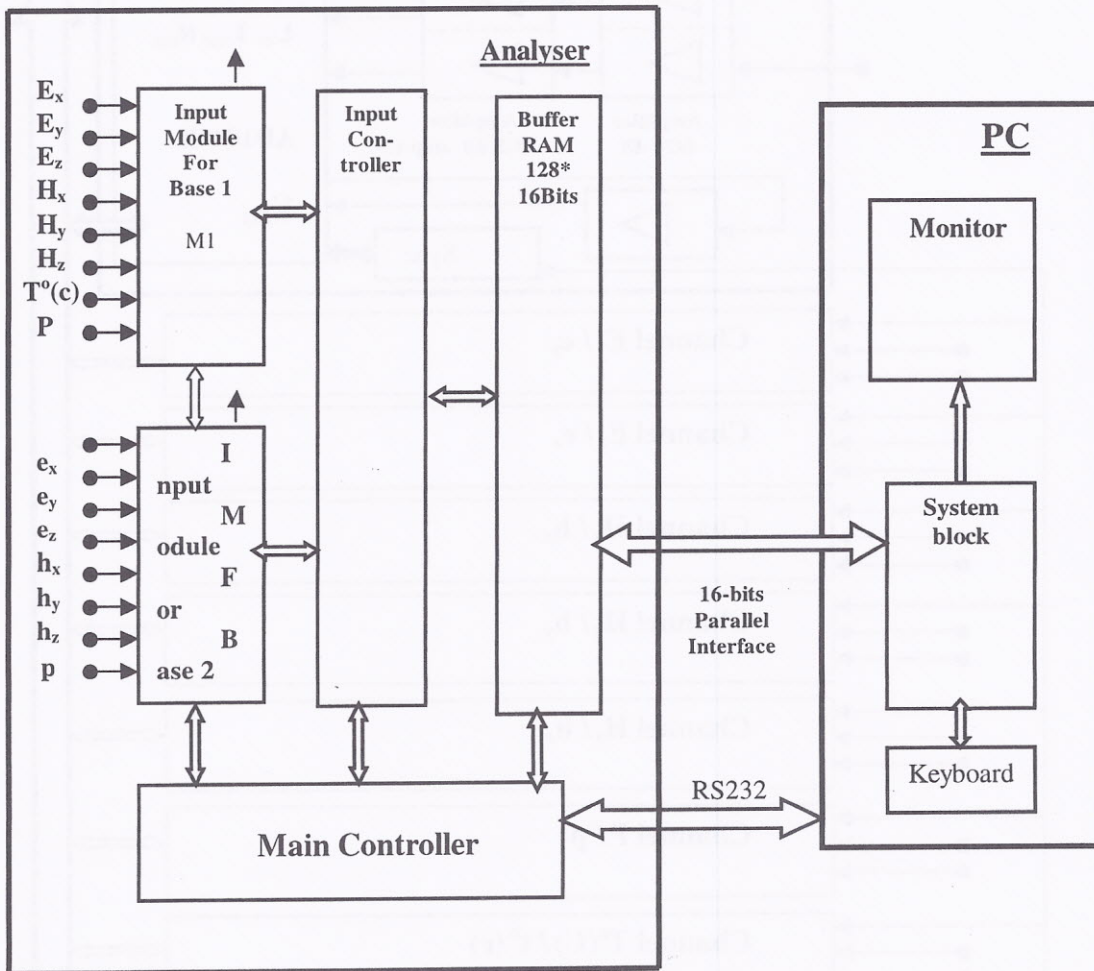
#### MAIN CHARACTERISTICS OF THE SYSTEM:

- Number of input channels ..... 16;
- Frequency diapason ..... 0.1 Hz...7 kHz;
- Dynamic diapason ..... > 90 dB;
- Maximum range of input signal ..... 1 V<sub>rms</sub>;
- Physical parameter of the control: electrical E, magnetic H, acoustics P, temperature T° and conductivity C.

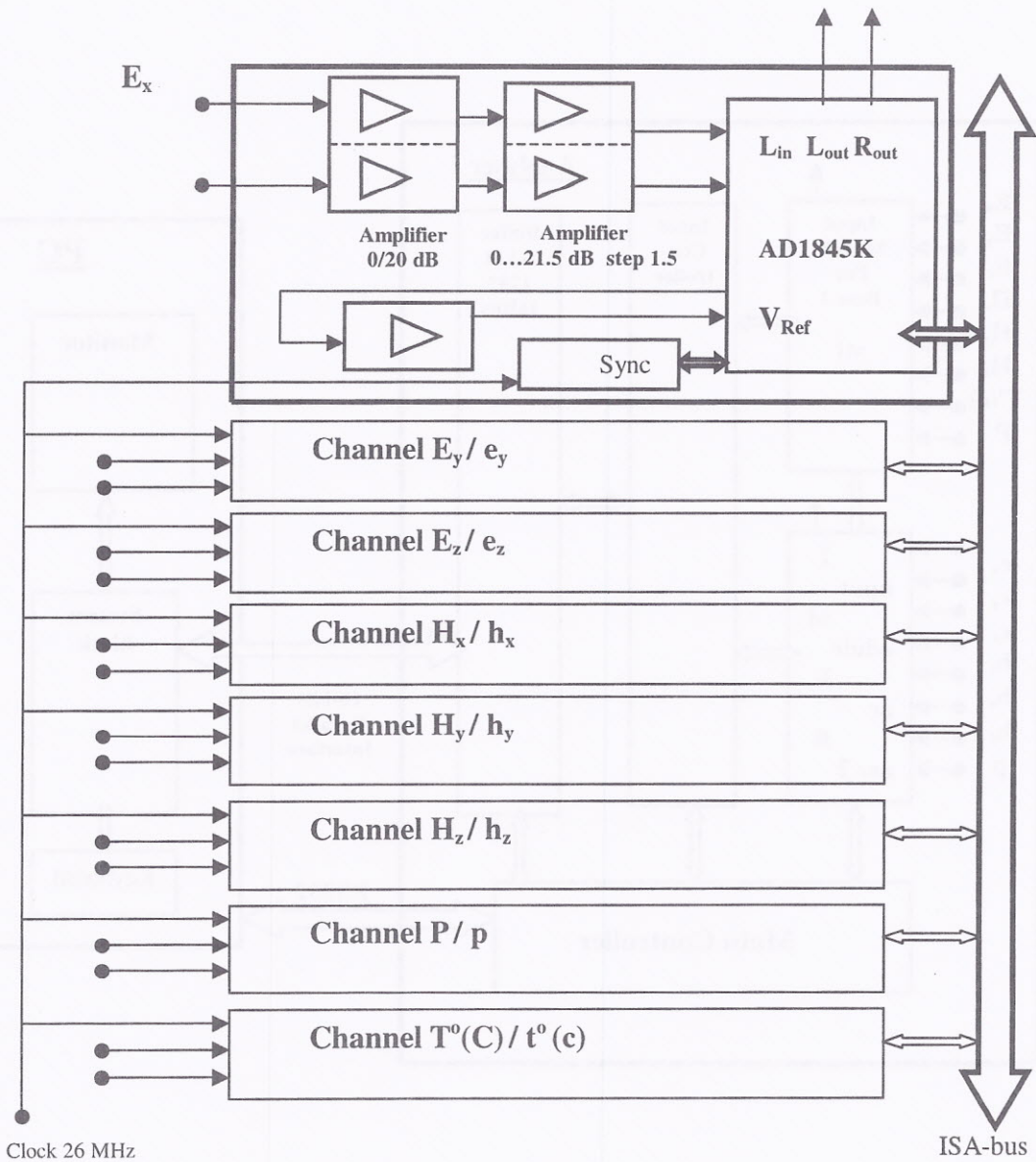
Block diagrams of the analysing system and of the input modules are present below.

Eight codecs AD 1845 K synchronised by the method which is our know-how and placed on two modules M1 and M2 for base 1 and base 2 respectively.





The analysing system block diagram.



The input modules block diagram.

#### REFERENCES.

- [1] V. Kravtsov et al. "Spectrum Analyser for the Investigation of Non-linear Phenomena. Structure and Applications, Measurement, Journal of the International Measurement Confederation IMECCO, Amsterdam, 1994, 12, 317.