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CALCULATION AND DEVELOPMENT OF DEVICES FOR DETERMINING INFORMATIVE SIGNAL PARAMETERS AT THE OUTPUT OF SPECTROMETRIC EQUIPMENT

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Annotation
This article presents the calculation and development of devices for determining the informative parameters of the signal at the output of spectrometric equipment. In recent years, the most pressing issue is the analysis of different materials using different analyzing setups based on different analysis methods. Our article discusses the analysis of substances using spectrometric equipment, which is associated with a personal computer, for the timely automatic analysis of substances.

Keywords: logical devices, register, analog-to-digital converter.

Introduction

The term "nanotechnology" means the creation and use of materials, devices and systems, the structure of which is regulated on a nanometer scale at the level of the size of atoms, molecules and supramolecular formations. The number of atoms in the volumes of the elements of such structures becomes close to the number of atoms located on the surface of these elements. The consequence of this is changing the properties of elements depending on their size. The reason for this is that the dimensions of the nanostructure are commensurate or smaller than the characteristic scales of physical phenomena included in the description of a property or process (wavelength of oscillations, magnitude of the magnetic domain, electron mean free path, etc.)

Due to the high surface energy, nanostructures are extremely active, they interact with the environment, changing the properties of both their own and the environment.

Recent studies clearly indicate the important role of nanostructures in various fields of science and technology. Carbon nanotubes showed outstanding strength properties, nanoparticles - the ability to selectively penetrate into cancer cells, etc., i.e. they have unique physical, chemical and biological properties.

In recent years, nanotechnology has practically emerged as an independent scientific direction, which gives a new impetus to the development of many industries related to materials science - precision engineering and instrumentation, the creation of new chemical materials using highly efficient and precise methods, etc.

The use of nanotechnology are actuating devices, the dimensions of which are in the nanometer range. And accordingly, the control elements should be even smaller. It follows that the substances used in the manufacture of these actuators must be particularly pure. Since the presence of almost insignificant impurities will lead in turn to significant changes in the parameters of the actuating elements. From this it follows that the production of highly pure substances is relevant at this stage in the development of nanotechnology. It is possible to obtain highly pure substances with a percentage of impurities less than 10^{-8} only with the help of an adsorption unit with a large number of columns used. The number of columns in this setup ranges from 500 to 10,000 pieces.

When obtaining highly pure substances on an industrial scale, a purification system with 10,000 adsorption columns should be used. In this case, it should be taken into account that the input solution input device and the solution withdrawal device should be installed on each adsorption column separately. The input device should be turned on at the same time, which is not very difficult. But when entering the outlet solution sampling device, it should be synchronized with the beginning and end of the output peak described by the Gaussian function. The peak appearance time t_o is individual for each adsorption column separately. This value varies during the operation of the columns, in large ranges, and depends on the degree of contamination of the adsorption column. In cases where, in a certain column, there is a deviation in the time of appearance of the peak t_o more than 30%, it should be disconnected from the cleaning system. Therefore, the determination of such informative parameters as the beginning, end and extremum of the peak should be made for each column separately. When using a personal computer to calculate the informative parameters of the output peaks, in real time, which is able to serve ten, maximum twenty columns. It follows from this that it is economically efficient to use digital devices for determining the informative parameters of the output peaks of spectrometric equipment. For the greatest simplification of devices for determining informative parameters, an analog-to-digital converter of the servo type should be used.

From this we can conclude that in order to accomplish this task, the same number of amplifiers, analog-to-digital converters [3], devices for determining the beginning and end of the peak are required.

The use of an analog-to-digital converter of the servo type in devices for determining the beginning and end of the peak, according to its principle of operation and complexity, is an order of magnitude simpler than the others, but the analog-to-digital converter of the servo type is not produced in the industry in a block version. For this reason, this article is devoted to the development of a tracking type analog-to-digital converter. As well as the development of devices for determining the beginning and end of the peak described by the Gaussian function.

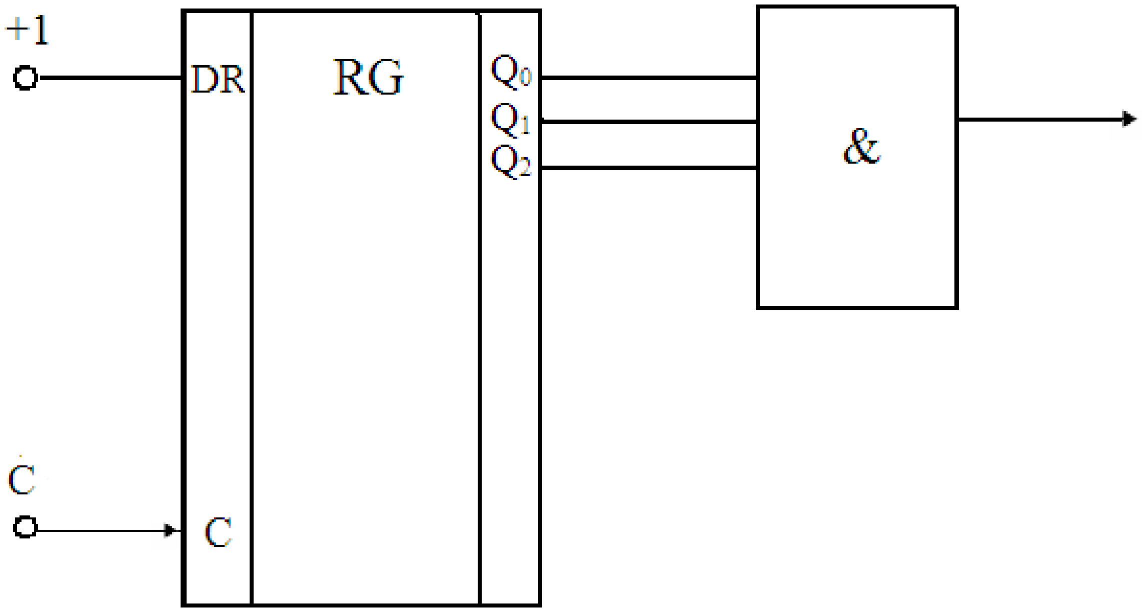

Fig. 1. Scheme of the device for determining the beginning of the peak described by the Gaussian function

To determine the informative parameters, you should use the information at the +1 and -1 inputs of the reversible counter of the analog-to-digital converter. Figure 1 shows a diagram of a device for determining the beginning of a peak described by the Gaussian function.

The device consists of two microcircuits such as a shift register and a logic element "AND" [1]. During the operation of the circuit, a signal with a potential of +1 is supplied to the serial input DR of the shift register from the reversible counter of the analog-to-digital converter of the tracking type. At the time when the input +1 of the reversible counter of the analog-to-digital converter of the tracking type, when the pulses arrive three times in a row, the value “1” will be set, only in this case it will be taken as the beginning of the peak. The output of the logic element will be set to one, which means the beginning of the investigated peak.

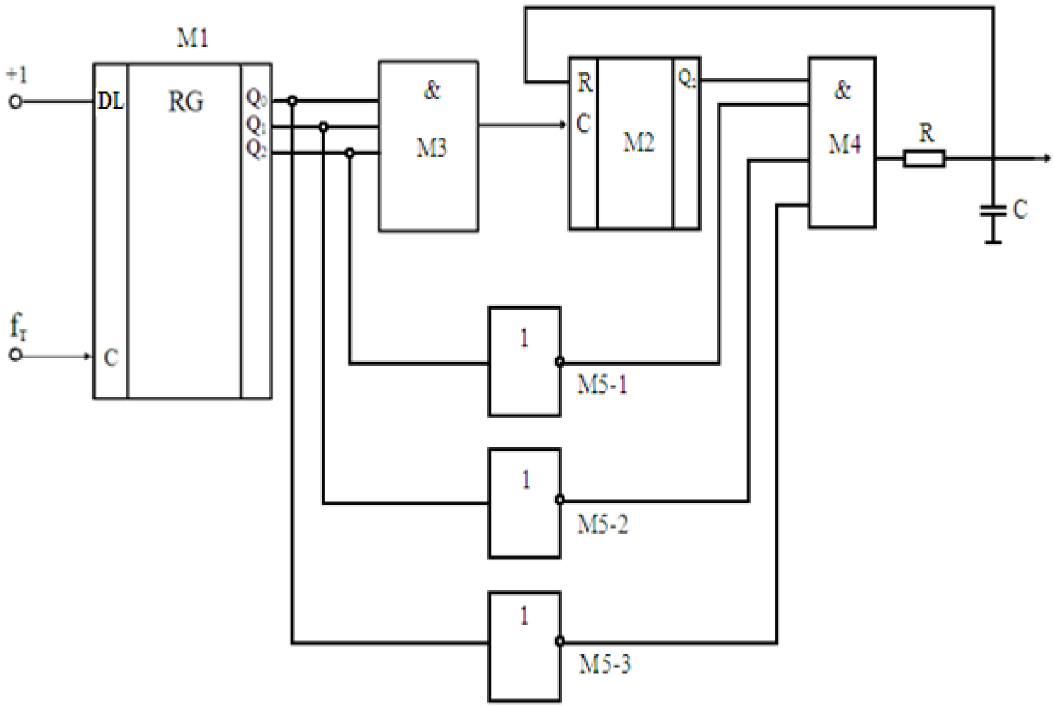

Fig.2. Schematic diagram of the device for determining the end of the peak described by the Gaussian function

On fig. 2 shows a diagram of a device for detecting the end of a peak. The device consists of two microcircuits such as a shift register, a trigger and matching logical elements of the type "AND" and "NOT" [4,5]. When the circuit is running, a -1 signal is supplied to the serial input DL of the shift register from the reversible counter of the analog-to-digital converter of the tracking type. At the moment when the input -1 of the reversible counter of the analog-to-digital converter of the servo type three times in a row will be set to the value "1", the output of the trigger M2 is set to the value "1" [2]. This point in time can be taken as the peak extremum, and from that moment the device switches to the search mode for the end of the peak. At the same time, when the output -1 of the reversible counter of the analog-to-digital converter of the tracking type is set to the value "0" three times in a row, the signal "1" corresponding to the end of the peak will appear at the output of the logic element

"AND" M4. After a certain time, provided by the RC delay line, the device switches to the next peak service mode [6].

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