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Control Time Constant During Tests of Nonstationary Electronic Facilities

A. Zatylkin

Candidate of Technical Sciences, Department of Design and Radio Means Equipment, Penza State University
al.zatylkin@yandex.ru

N. Yurkov

Doctor of Technical Sciences, Department of Design and Radio Means Equipment, Penza State University
yurkov_nk@mail.ru

D. Golushko

Candidate of Technical Sciences Department of Design and Radio Means Equipment, Penza State University
oldalez@yandex.ru

Abstract
It is shown that during the standard test designs of nonstationary electronic facilities by a of smooth variation of frequency, there is a contradiction in the choice of the filter time constant at a given frequency range. The algorithm of regulation of a constant of time which allows to raise accuracy of dynamic characteristics definition of investigated system is developed for the decision of this contradiction and to reduce time of carrying out of tests.

Keywords: dynamic characteristics, constructive elements, equipment, testing, superficial waves, non-stationary application of load.

Test for definition of construction dynamic characteristics carry out on purpose to define dynamic properties of products and to receive the initial information for a choice of test methods on vibration strength, vibration resistance, on influence of acoustic noise, for influence of single and repeated mechanical blows, and also for dynamic calculations of products [1]. State Standard 30630.1.1-99 during tests for definition of a construction dynamic characteristics by a method of smooth variation of frequency regulates value of speed of frequency change equal to one-two octaves per minute.

During these tests there is a contradiction of choice of a the filter time constant, consisting that at a choice too great value the target signal will be well filtered, but the scheme will react more slowly to changes of an entrance signal. Consequently on low frequencies it is necessary to choose - whether to increase a smoothing time constant that will provide good accuracy, but the decelerated reaction to changes of an entrance signal, or to leave a small time constant, i.e., fast reaction, but to worsen accuracy.

The algorithm of regulation of a constant of time has been developed for the decision of this contradiction during tests of nonstationary electronic facilities by a method of smooth variation of frequency. Regulation of a time constant is realized by the active smoothing filter according to a signal of control from the generator [2].

If to carry out scanning wide range of frequencies scanning (for example, from 10 Hz to 1 kHz and more) at a speed recommended by State Standard 30630.1.1-99 for one iteration and one device on low frequencies the smoothing filter of the converter will not provide effective averaging, and as the outcome there will be considerable pulsations and an error of constant level. At speed of frequency change in one octave per minute on subband from 10 to 20 Hz N will make 900 periods of a measured signal.

Experimental researches of vibration characteristics of printed circuits [3, 4] have shown that on the interval of 1/60 octaves at resonances with high Q of change of amplitude-frequency response levels reach 1dB. Accordingly during an establishment equal to one second the measured signal can change on 10 %. At the rate of change of frequency equal 1 octave per minute the converter speed with time of an establishment 1 second on low frequencies is not enough. Per one second in a test signal (10-20 Hz) will be located about 15 periods that is obviously not enough for transformation to effective value with a acceptable error.

During tests (for one iteration by one device) for reception of a continuous spectrum of frequencies of a construction (in the given range) it is offered at generation of a test signal on low frequencies to reduce speed of frequency change to value of 100 periods for subband corresponding t and equal 0.01 octaves. Such speed of frequency change corresponds to speed one octave per minute on frequencies in and around 160 Hz. By the frequencies which values make less than 160 Hz tests are offered to be spent by the method of stepwise change of frequency in accordance with State Standard 30630.1.1-99 by smooth variation of frequency value from the bottom fixed frequency $f_н$ to the following higher fixed frequency $f_в$.

It is offered to realise formation of a test signal by the generator of direct synthesis on the 8-digit microcontroller. The scheme of algorithm of time constant regulation during tests of nonstationary electronic facilities by a method of smooth variation of frequency is presented in figure 1.

One sinusoidal vibration period is presented in programs memory by 256 values. These values are necessary to load into the RAM to next transfer them in corresponding port of input-output under index Accum.

Zero formation on an exit is carried out by transfer to ports of input-output of value 7F in an infinite cycle. Generator actuation is realized by command Start received on the consecutive interface in a cycle of the program or on interruption. Accum it is the phase accumulator consisting of three 8-digit registers. In the low-order register it is added the summand ΔF defining current value of frequency:

$$F = \frac{\Delta F \cdot F_{clock}}{m \cdot 2^B},$$

where F_{clock} - clock frequency, m - quantity of time steps in a generation cycle, B - capacity of the accumulator (in this case 24).

Phase shift of nth channel is defined by a 8-digit variable φ added to the high-order register of the accumulator directly before transfering to port of value from the RAM. Condition T=1 defines, whether formation of one vibration period has ended. If is yes present, than it will be necessary to calculate anew value ΔF. If is not present, it will be necessary to assign value of a signal operating τ outputting in port of two high-order registers ΔF. The cycle is necessary to specify so that the quantity of time steps in different branches will be identical.

On frequencies above 160 Hz speed is constant, is equal to one octave per minute and depends on value $\Delta F = \Delta F + \beta$, where β:

$$\beta = \frac{160 \cdot 2^B \cdot m}{F_{clock}}.$$

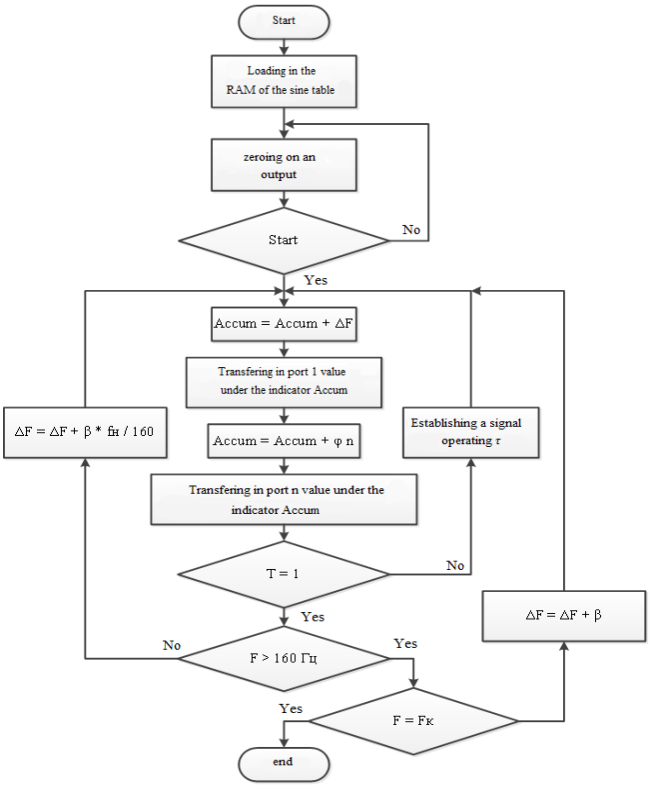

Fig. 1. The Scheme of algorithm of time constant regulation during tests of nonstationary electronic facilities by a method of smooth variation of frequency

On frequencies below 160 Hz ΔF it is equal:

$$\Delta F = \Delta F + \frac{\beta \cdot F_{н}}{160},$$

where $F_{н}$ - the bass fixed frequency of a range.

Thus, the more low frequency - the is less speed of change of frequency. Condition $F = F_{к}$ is necessary for loop termination at end of generation of test signal.

The developed algorithm of regulation of a time constant during tests of nonstationary electronic facilities by a method of smooth variation of frequency allows to eliminate the contradiction of a choice of the filter time constant that allows to raise determination accuracy of dynamic characteristics of investigated system.

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