Tolerance range evaluation in low-frequency noise level control

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Abstract – **This paper describes the method for determining control limits for electronic products in terms of their low-frequency noise level.**

Keywords – **tolerance range, input/output control, low-frequency noise.**

I. Introduction

When controlling the electronic equipment products (EEP) by the low-frequency noise the acceptability evaluation is made based on the set of random parameters analysis and their comparison with predefined or established tolerance range. Therefore, the main objective at the control initial stage is determining the limits.

II. Basic part

In general, the tolerance range for product informative parameter, input and output control, can be written as follows [1]:

$$\bar{y} - k\Delta \le y \le \bar{y} + \Delta, \qquad (1)$$

where y - informative parameter; $\bar{y}$ - informative parameter normalized value Δ - informative parameter permitted deviation; k - range skewness ratio.

In this case, if informative parameter meets the condition (1), the product is considered acceptable, otherwise – not acceptable.

For the most accurate range tolerance evaluation we have to consider the impact of all factors arising during the control process, such as measurement errors, physical and chemical processes and features of the products internal structure, external impacts, etc. Upon EEP control operations by low-frequency noise level, the informative parameter may be presented by noise voltage mean square value $\overline{U_n^2}$ [2]. Then, consider the basic characteristics that affect the tolerance range evaluation to determine the control limits, as shown in Fig. 1.

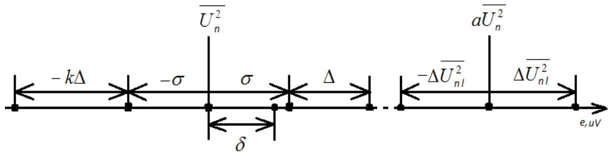

Fig. 1. Control limits parameters

Control informative parameter $\overline{U_n^2}$, obtained based on measuring operations, is a random value affected by bias error δ and random error σ.

Control limits may be determined based on the following formula:

$$\overline{U_{n.l}^2} = a\overline{U_{n.n}^2}, \qquad (2)$$

where a - control ratio; $\overline{U_{n.n}^2}$ - informative parameter normalized value.

$$\overline{U_{n.n}^2} = \frac{1}{n}\sum_{i=1}^{n} U_{n.i}^2,$$

where n - number of measurement $\overline{U_n^2}$ for electronic equipment product.

During input and output control operations the probability exists of informative parameter values evaluation non-compliance upon the second study. To eliminate this defect, control limits tolerance range is additionally introduced $(-\Delta\overline{U_{n.l}^2}, \Delta\overline{U_{n.l}^2})$.

Thus, the tolerance range of acceptable products may be written as follows:

$$-\overline{U_{n.n}^2} - k\Delta - \delta \le \overline{U_n^2} + \sigma \le \overline{U_{n.n}^2} + \Delta + \delta,$$

Using the condition (2), as well as specified above tolerance range the control limits by low-frequency noise may be written as follows:

$$\overline{U_n^2} + \sigma \le a(\overline{U_{n.n}^2} + \delta) + \Delta - \Delta\overline{U_n^2}. \qquad (3)$$

III. Conclusion

Thus, determination of control limits by the formula (3), makes it possible to increase the probability of assigning the acceptable products of “acceptable” result, but this in turn is accompanied by an increase in the probability of assigning the acceptable products of “not acceptable” result, the specified defect at the present stage of development and production process cost reduction is not significant.

References

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