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M. V. Chichuzhko, *Ph.D*
Cherkasy State Technological University
Shevchenko blvd, 460, Cherkasy, 18006, Ukraine

SIGN MODEL OF QUALITATIVE ASSESSMENT OF MODERN BASIC COMPONENTS OF WIRELESS DEVICES FOR RECEPTION AND TRANSMISSION OF SIGNALS

In the article sign model of qualitative assessment of modern basic components of wireless devices for reception and transmission of signals is built. To achieve this goal it is necessary to solve the following problems: to conduct a systematic analysis of modern wireless devices for reception and transmission of signals; to offer multicriteria method of qualitative assessment of the basic components of modern wireless devices for reception and transmission of signals; to analyze the basic semiconductor component of modern wireless devices for reception and transmission of signals; to build a sign model depending on technical parameters of modern basic components of wireless devices for reception and transmission of signals.

Keywords: *sign model, infrared emission, multicriteria method.*

Introduction. In today's world, the development of information technologies promotes continuous upgrade of wireless devices for reception and transmission, which aims to improve their technical parameters and expands the scope of their application. However, the cost of wireless devices for reception and transmission does not always meet technical requirements. Nowadays, there is an actual problem of universal use of these devices, because the scope of application of every device is narrowly focused, and characteristics of such devices often do not differ.

The issues of the research and development of modern wireless devices for reception and transmission of signals and their basic components are described in works [1–4] of domestic and foreign scientists A. V. Golovin, N. I. Chistyakov, A. I. Hardona, V. P. Ipatov, V. K. Orlov, V. N. Smirnov, V. Schwartz and others.

But they have not covered the issue of identifying the best modern wireless devices for reception and transmission of signals and their basic components by the main parameters.

Statement of the problem. The aim is to develop a sign model of qualitative assessment of modern basic components of wireless devices for reception and transmission of signals.

To achieve this goal it is necessary to solve the following problems:

– to conduct a systematic analysis of modern wireless devices for reception and transmission of signals;
– to offer multicriteria method of qualitative assessment of the basic components of modern wireless devices for reception and transmission of signals;
– to analyze the basic semiconductor component of modern wireless devices for reception and transmission of signals;
– to build a sign model depending on technical parameters of modern basic components of wireless devices for reception and transmission of signals.

Problem solution. Modern wireless devices for reception and transmission of signals have the following basic requirements: low power consumption, long range of reception and transmission of signals and high quality playback. Not all wireless devices for reception and transmission satisfy these requirements, since most of these devices have inflated price, and cheaper counterparts do not meet the requirements of comfortable use.

Table 1 provides a list of manufacturers, models of wireless devices for reception and transmission, on the example of wireless devices of audio playback data and their main characteristics.

Table 1 shows that Sennheiser IS 300-V4 is the best wireless audio data playback device by technical parameters, but it has a very high cost.

A semiconductor device of infrared (IR) emission which determines technical and economic characteristics is the basic component of modern wireless audio data playback devices. The range of reception and transmission of signals and transmission quality of audio data depend on IR emitters. When using the appropriate IR emitters, it's possible to increase the range of the device in several times, and thus also to increase the quality of reception and transmission of signals.

Table 1

The list of basic models and technical and economic parameters of modern wireless devices for reception and transmission for respective owners

Manufacturer	Model	Transmission of sound at a frequency	Radius of action, m	Sensitivity, dB	Hours receiver, h	Cost, UAH
Sennheiser	IS 380	20–18500 Gz	10	106	4	822
	IS 150-V4	2,3 MGz	60	110	15	1800
	IS 300-V4	2,3–2,8 MGz	60	118	20	2177
Philips	SHC 1300	2,3–2,8 MGz	7	95	15	700
	SHC 2000	2,3–2,8 MGz	7	108	15	734
Sony	MDR-IF240RK	16–22000 Gz	7	100	35	460
Thomson	WHP265	40–12000 Gz	7	107	14	310
VCAN	IR2008D	2,8–3,8 MGz	10	60	15	375

Thus, it is appropriate to consider technical parameters of IR emitters and compare them to determine the best modern basic components of wireless devices for reception and transmission of signals.

Table 2 lists the main technical parameters of semiconductor devices of IR emission [5–6].

Table 2

The list of main technical parameters of semiconductor devices of IR emission

№	Type of a device	The values at T=25°C				T_{max}, °C
		U_d, V	I_{d_nom}, mA	t_{rise}, ns	t_{rec}, ns	
1	АЛ103А	1,6	50	300	500	85
2	АЛ106Б	1,7	100	10	20	85
3	АЛ106Д	1,7	100	10	20	85
4	АЛ108А	1,35	100	2400	2000	85
5	АЛ115А	2	50	1000	600	85
6	АЛ119А	3	300	1000	1500	85
7	3Л120Б	2	50	20	20	85
8	3Л123А	2	300	350	500	85
9	3Л129А	2	50	10	10	85
10	АЛ136А–5	1,9	50	14	14	70
11	АЛ137А	3	50	7	7	70

Annotation:

U_d – direct voltage drop across the LED at a current I_{d_nom};

I_{d_nom} – nominal forward current of the LED;

t_{rise} – rise time of the LED pulse emission;

t_{rec} – recession time of the LED emission;

T_{max} – temperature of emission.

A generalized mathematical description that links selected defining values of the basic modern components of wireless devices for reception and transmission is:

$$\varphi\left(U_d, I_{d\_nom}, t_{rise}, t_{rec}, T_{max}\right)=0. \quad (1)$$

The expression (1) shows that there is no analytical relationship between these variables.

Table 2 and the expression (1) show that qualitatively simultaneous assess on many parameters and different models of semiconductor devices of IR emission to determine the best among them is quite difficult due to the lack of analytical dependence between their technical parameters.

Therefore, multicriteria method of qualitative assessment of the basic modern components of wireless devices for reception and transmission of signals based on the theory of incomplete similarity and dimensions, is offered on the example of semiconductor IR emitters, and cruel values are technical parameters which are given in Table 2.

Due to physical modeling, a conventional criteria of similarity is formed by determining values based on heuristics. Their importance is confirmed by the following physical interpretation:

$\left[\frac{t_{rec}}{t_{rise}}\right]$ – value that characterizes the form of directional emission;

$\left[\frac{P_{dis}}{P_{cons}}\right]$ – value that characterizes corresponding figures of power consumption.

Criterion equation is as follows:

$$F_1\left(\frac{t_{rec}}{t_{rise}}; \frac{P_{dis}}{P_{cons}}\right) = 0. \qquad (2)$$

Sign model depending on technical parameters of semiconductor devices of IR emission is shown in Fig. 1, it's built in dimensionless coordinates based on conditional criteria of similarity [7].

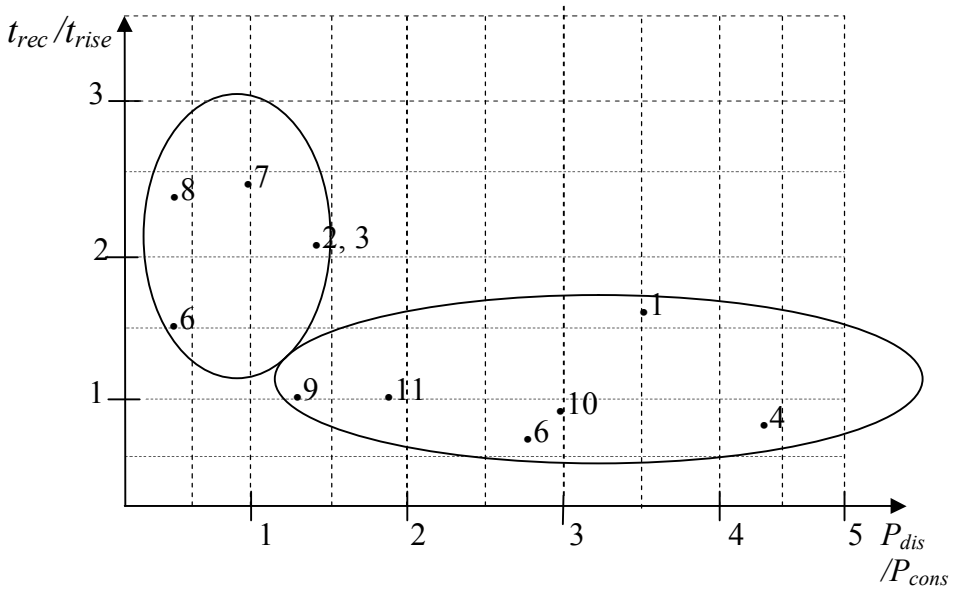

Fig. 1. Sign model depending on technical parameters of semiconductor devices of IR radiation in dimensionless coordinates

The analysis of the relationship between four technical parameters of semiconductor devices of IR emission (Fig. 1) has shown that a semiconductor device of IR radiation – AL108A – is the most effective model. It, among other investigated semiconductor devices of IR emission, has the highest power of emission and most effective form of emission.

Conclusions. A systematic analysis of modern wireless devices for reception and transmission of audio signal is made. It shows that Sennheiser IS 300-V4 is the best wireless audio data playback device by technical parameters, but it has a very high cost – 2177 UAH. It is found that emission power is the most important requirement for modern wireless devices for reception and transmission of signals.

1. Multicriteria method for qualitative assessment of the basic modern components of wireless devices for reception and transmission of signals based on the theory of incomplete similarity and dimensions is offered.

2. The analysis of technical parameters of the basic component of modern wireless devices of audio data playback – a semiconductor device of IR emission – is made. It shows that semiconductor device of IR emission – AL108A – is the best

indicator for power consumption and form of emission direction.

3. Sign model of relationships between four technical parameters of semiconductor devices of IR emission in dimensionless coordinates based on physical modeling and conditional similarity criteria: $\left[\frac{t_{rec}}{t_{rise}}\right]$, $\left[\frac{P_{dis}}{P_{cons}}\right]$ is built. The visualization of basic characteristics in dimensionless coordinates is the peculiarity of this sign model that allows to speed up the design process and to choose the way to improve and provide high quality of devices of this type.

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In this article a sign model of qualitative assessment of modern basic components of wireless devices for reception and transmission of signals is built. Also a systematic analysis of modern wireless devices for reception and transmission of audio signal is conducted. It is found that emission power is the most important requirement for modern wireless devices for reception and transmission of signals. Modern wireless devices for reception and transmission of signals have the following basic requirements: low power consumption, large range of reception and transmission of signal and high quality playback. But not all wireless devices for reception and transmission satisfy these requirements, since most of these devices have an inflated value, and cheaper counterparts do not satisfy the requirements of comfortable usage. In this work multicriteria method of qualitative assessment of modern basic components of wireless devices for reception and transmission of signals based on the

theory of incomplete similarity and dimensions is used, on which sign model of dependencies between four technical parameters of semiconductor devices of IR-emission in dimensionless coordinates based on physical modeling and conditional criteria similarities is built. The visualization of main characteristics in dimensionless coordinates is a special feature of this model, that allows to speed up the design process and to choose the way to improve and provide high quality of devices of this type.

To achieve this goal it is necessary to solve the following problems: to conduct a systematic analysis of modern wireless devices for reception and transmission of signals; to offer multicriteria method of qualitative assessment of the basic components of modern wireless devices for reception and transmission of signals; to analyze the basic semiconductor component of modern wireless devices for reception and transmission of signals; to build a sign model depending on technical parameters of modern basic components of wireless devices for reception and transmission of signals.

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Рецензенти: В. М. Лукашенко, д.т.н., професор,
М. П. Мусієнко, д.т.н., професор