УДК 681.325

DEVELOPMENT OF THE MULTIPLE CRITERIA MODEL OF QUALITATIVE ASSESSMENT OF MODERN PULSE REFLECTOMETERS

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Abstract. *System analysis of modern pulse reflectometers has been conducted, as a result of which the list of its firms, types and main technical and economic indexes based on heuristic method are made. The conditional similarity criteria are developed, criterion equations for modern pulse reflectometers on determining sizes, based on the theory of incomplete similarity and dimension, have been worked out. The multiple criteria model of qualitative assessment of modern pulse reflectometers on the four quadrants in dimensionless coordinates, whose advantage is simplicity, comprehensibility on many basic criteria, is offered.*

Keywords: *pulse reflectometers, lines of transceiver information, technical and economic indexes, conditional similarity criteria.*

РОЗРОБКА БАГАТОКРИТЕРІАЛЬНОЇ МОДЕЛІ ЯКІСНОЇ ОЦІНКИ СУЧАСНИХ ІМПУЛЬСНИХ РЕФЛЕКТОМЕТРІВ

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Анотація. *Проведено системний аналіз сучасних імпульсних рефлектометрів, за результатами якого складено перелік їх фірм, типів та основних техніко-економічних показників на основі евристичного методу. Розроблені умовні критерії подібності, складені критеріальні рівняння для сучасних імпульсних рефлектометрів по визначальних величинах на основі теорії неповної подібності і розмірності. Запропонована багатокритеріальна модель якісної оцінки сучасних імпульсних рефлектометрів по 4-м квадрантам в безрозмірних координатах, перевагою якої є простота, наочність по багатьом основним критеріям.*

Ключові слова: *імпульсні рефлектометри, лінії прийомо-передачі інформації, техніко-економічних показники, умовні критерії подібності.*

Introduction. The important element of reliable work of informative-communication networks is timely diagnostics and rapid troubleshooting, for this purpose use the pulse diagnosis device line of transceiver information – reflectometers by which it is possible to analyze the presence of defects and the location damages.

One of the main parameters of pulse reflectometers is a volume of memory device attached programs which are able to analyze the received information and to conclude on the distance of an obstacle, and what is its nature.

The feature of modern reflectometers is able to be connected to the computer that allows saving the results of the measurements and comparing them with the information already received.

Connecting the reflectometer to the cable must be done, in such a way that on the checked up cable maximally possible energy of pulse of reflectometer was passed [1-7].

Current economic conditions in Ukraine do not always allow carry out major repairs of the informative-communication systems in time. Therefore, the rapid and exact determination of defects and locating faults in the lines of transceiver information is a priority.

To diagnostics of lines of transceiver information, electrical supply networks the row of works [2-7] of V. L. Aksenova, I. G. Baklanova, A. V. Kocherova, V. E. Kravcova, A. M. Luk'yanova, N. F. Melnikovoy, N. I. Tarasova and other is devoted. Different methods and physical models for locating damages in the lines of transceiver information and electrical supply networks, and also for the analysis of

these lines in the presence of defects using pulse reflectometry, are reflected in their works. However, these works not be enough evidently representative of multicriteria comparison of modern pulse reflectometers.

The purpose of work is development of the multiple criteria model of qualitative assessment of modern pulse reflectometers which are made domestic and foreign industry.

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

– to make the list of firms and types of modern pulse reflectometers with their main technical and economic indexes;

– to develop the conditional similarity criteria on determining sizes based on the theory of incomplete similarity and dimensions;

– to work out criterion equations for modern pulse reflectometers in obedience to determining sizes;

– to develop the multiple criteria model of qualitative assessment of modern pulse reflectometers on four quadrants in dimensionless coordinates.

Decision of problem task. To solve this task was made the list of main technical and economic indexes of modern pulse reflectometers (Table 1), were developed the conditional similarity criteria in which the main determining sizes are: operating temperature range, weight of device, price of device and number of reflektograms.

Table 1

The main technical and economic indexes of modern pulse reflectometers

№	Model of reflectometer	Number of reflektograms, pcs.	Operating temperature range, °C	Weight, kg.	Price, uah.
1	Rejs-105M1	200	-10 - +55	0,75	10 840
2	Rejs-100	20	-10 - +55	0,7	7 536
3	RI-10M1	100	-20 - +40	1,9	16 176
4	RI-10M2	100	-20 - +40	2	18 296
5	RI-303T	-	-20 - +40	0,55	8 376
6	RI-307	-	-20 - +40	2,5	22 488
7	RI-307USB	-	-20 - +40	2,3	12 080
8	Tempo TS 90	-	-10 - +40	1	19 800
9	Tempo TS 100	20	-15 - +60	3	45 960
10	Riser Bond 3300	16	0 - +50	1,2	15 416
11	Riser Bond 1270A	16	0 - +50	2,8	39 432
12	Riser Bond 1550T		-20 - +55	0,6	12 203

It is proposed to use the theory of incomplete similarity and dimensions, physical modeling, and based on a heuristic method to create the conditional similarity criteria.

The generalized description of conditional similarity criterion by determining sizes takes the following form:

$$K_i = \frac{Q_{\max} - Q_{\min}}{Q_{\max}}, \quad (1)$$

where K_i – dimensionless size, characterizing the range of the chosen parameter, its indexes max and min correspond to the maximum and minimum values from Table 1.

Criterion equation for the pulse reflectometer according to the determining values will be:

$$y\left(\frac{T_{\max} - T_{\min}}{T_{\max}}; \frac{M_{\max} - M_{\min}}{M_{\max}}; \frac{C_{\max} - C_{\min}}{C_{\max}}; \frac{F_{\max} - F_{\min}}{F_{\max}}\right) = 0,$$

where $K_T = \frac{T_{\max} - T_{\min}}{T_{\max}}$ – size that characterizes the operating temperature range;

$K_M = \frac{M_{\max} - M_{\min}}{M_{\max}}$ – size that characterizes weight of device;

$K_C = \frac{C_{\max} - C_{\min}}{C_{\max}}$ – size that characterizes price of device;

$K_F = \frac{F_{\max} - F_{\min}}{F_{\max}}$ – size that characterizes number of reflektograms in a device.

These sizes will characterize the relevant technical and economic indexes.

The results of calculation of the appropriate coefficients are presented in Table 2.

Table 2

The conditional similarity criteria for modern pulse reflectometers

Model type / Conditional criterion	Rejs	RI	Tempo	Riser Bond
	1	2	3	4
K_T	0,198	0,192	0,225	0,228
K_M	0,667	0,780	0,667	0,786
K_C	0,305	0,628	0,569	0,691
K_F	0,9	1	1	1

Using the data of Tables 1-2 and p -theorem, the dependences of the main technical parameters are constructed in dimensionless coordinates.

The developed multiple criteria model of qualitative assessment of modern pulse reflectometers on the four quadrants in dimensionless coordinates is shown on Fig. 1.

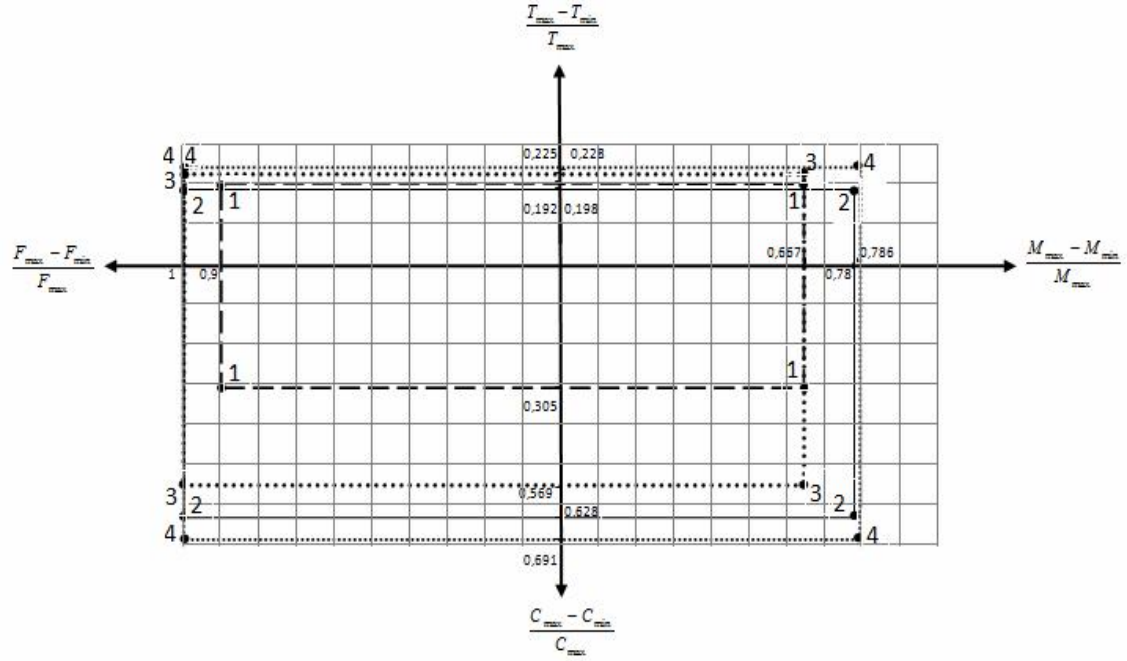

Fig. 1. The multiple criteria model of qualitative assessment of modern pulse reflectometers in dimensionless coordinates

Note:

numbers – 1, 2, 3, 4 correspond to a sequence number of pulse reflectometers, shown in Table 2.

The comparative analysis, shown in Fig. 1, revealed that price of pulse reflectometers with the practically identical technical parameters (pairs 1-3 and 2-4) domestic producers is significantly lower than that of their foreign counterparts.

Conclusions:

1. On the basis of heuristic method the list of firms, types by modern pulse reflectometers and its main technical and economic indexes is made: operating temperature range, weight of device, price of device and number of reflektograms, which are determining sizes at the choice of device.

2. The conditional similarity criteria are developed for modern pulse reflectometers on determining sizes based on the theory of incomplete similarity and dimensions.

3. The criterion equations for pulse reflectometers in obedience to determining sizes are worked out.

4. The multiple criteria model of qualitative assessment of modern pulse reflectometers on the four quadrants in dimensionless coordinates is offered. Its advantage is simplicity, comprehensibility on many basic criteria.

Each of the types of modern pulse reflectometers needs refinement of its main parameters for entering the reference model combining all the features.

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Стаття надійшла до редакції 08.04.2013.

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