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## MATHEMATICAL MODEL OF CHANGING THE DATA RATE DEPENDING ON THE LENGTH OF THE SEGMENT OF THE SPECIALIZED DIGITAL NETWORK COMLI BASED ON CURRENT LOOP

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**Abstract.** *In a specialized digital network COMLI based on Current loop, the data rate depends on the length of the network segment. A mathematical model of changing the data rate depending on the length of the segment of the specialized digital network COMLI based on the Current loop would help increase the efficiency of the design of control systems and management of energy facilities. Since such a mathematical model did not exist until recently, it was decided to develop such a mathematical model. As a result of the conducted researches the mathematical model of change of data rate depending on length of a segment of the specialized digital network COMLI on the basis of Current loop was developed.*

**Key words:** *COMLI, COMmunication Link, fieldbus, network, specialized digital network, mathematical model, data rate*

### Introduction.

Analog control and management systems in various industries have been replaced by specialized digital networks [1-10]. One of the important areas that need effective control and management systems is the facilities of energy companies.

Previous research has shown that a specialized digital network COMLI (COMmunication Link) can be used to ensure proper control and management at energy facilities [11-12].

In the specialized digital network COMLI the interaction of devices in the master / slave mode is realized. Due to this, the work of the network is clearly determined. The above provides a proper response to external events of control systems, which are built on the basis of a specialized digital network COMLI.

The current loop is a way of transmitting information using measured values of electric current. According to the type of front information, there are analog current loop and digital current loop.

The digital current loop standard uses the absence of current as a logical zero (low level) and the presence of a signal as a logical unit (high level). The absence of a signal for a long time is interpreted as a line break.

In a specialized digital network COMLI based on Current loop, the data rate depends on the length of the network segment. A mathematical model of changing the data rate depending on the length of the segment of the specialized digital network COMLI based on the Current loop would help increase the efficiency of the design of control systems and management of energy facilities. As a result of the analysis of the current state of use of the COMLI network, it was found that there were currently no mathematical models that would describe the above dependence. In connection with the above, it was decided to develop a mathematical model of



changing the data rate depending on the length of the segment of a specialized digital network COMLI based on Current loop.

**Main text.**

The manufacturer of a specialized digital network COMLI based on the Current loop has set data rates on network segments of a certain length (Table 1) [13-14].

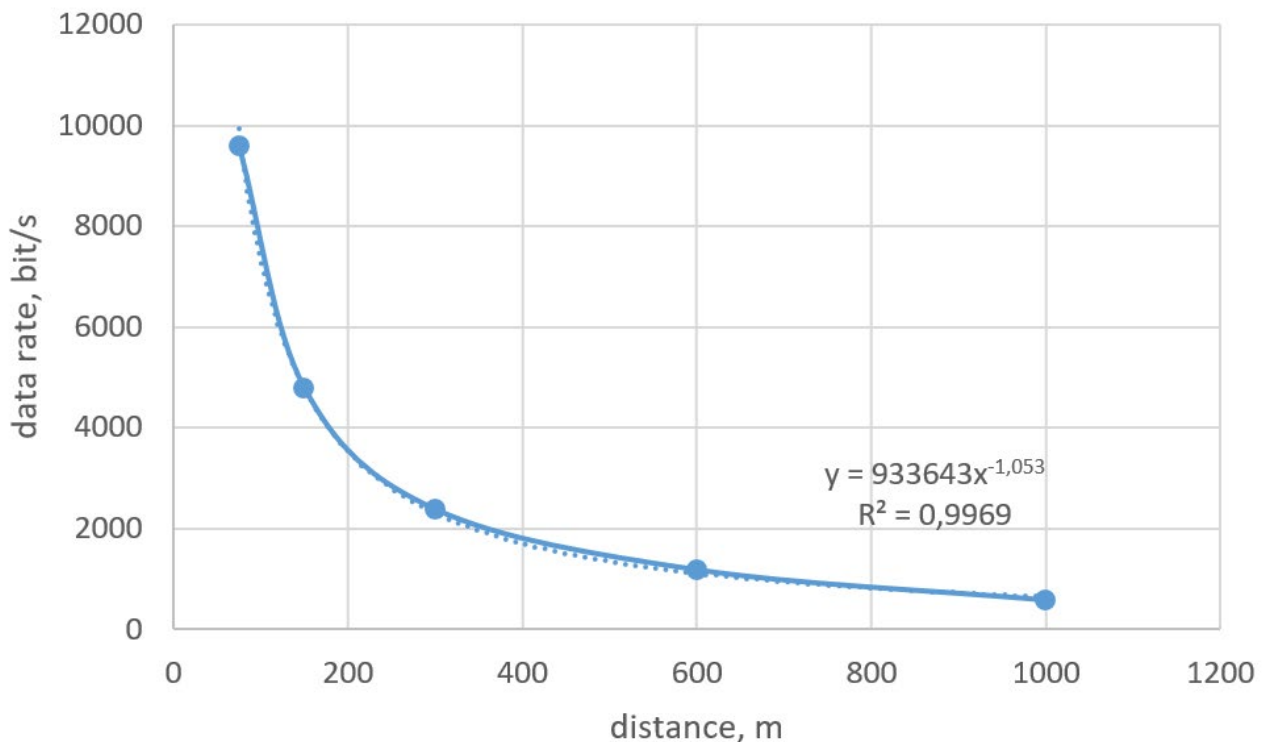
**Table 1  
Data rates in a specialized digital network COMLI based on Current loop set by the manufacturer on network segments of a certain length**

Length of network segment, m	Data rate, bits/s
75	9600
150	4800
300	2400
600	1200
1000	600

As a result of the conducted researches the mathematical model of change of data rate depending on length of a segment of the specialized digital network COMLI on the basis of Current loop was developed.

$$y(x) = 933643x^{-1.053} \tag{1}$$

Figure 1 shows graphs of changes in data rate depending on the length of the segment of a specialized digital network COMLI based on the Current loop according to the manufacturer of the COMLI network and the results of using the developed mathematical model.



**Figure 1 - Graphs of changes in data rate depending on the length of the segment of the specialized digital network COMLI based on the Current loop according to the manufacturer of the COMLI network and the results of using the developed mathematical model**



Table 1 shows the results of comparing data rates in the COMLI network based on the Current loop (depending on the length of the segment of the network), which are determined by the manufacturer and data rates, which are calculated using the developed model (1).

**Table 1**

**Analysis of the data rate in the network in the COMLI network based on the Current loop**

Distance, m	Data rate is specified by the manufacturer, bits / s	Data rate is calculated using model (1), bits / s	Error, bits / s	Error, %
75	9600	9902,42	-302,42	-3,15
150	4800	4772,62	27,38	0,57
300	2400	2300,23	99,77	4,16
600	1200	1108,63	91,37	7,61
1000	600	647,41	-47,41	-7,90

As a result of the conducted researches it is established that at use of the developed model (1) the error of calculations of speed of data rate depending on length of a segment of the specialized digital network COMLI on the basis of Current loop does not exceed 8%. For preliminary analysis and preliminary calculations, such accuracy may be acceptable.

#### **Summary and conclusions.**

As a result of the conducted researches the mathematical model of change of data rate depending on length of a segment of the specialized digital network COMLI on the basis of Current loop with an error to 8% was developed. For preliminary analysis and preliminary calculations, such accuracy may be acceptable. For accurate calculations of the data rate from the length of the segment of the specialized digital network COMLI on the basis of the Current loop in the future it is planned to develop a mathematical model that will provide calculations with an error not exceeding 1%. The developed mathematical model of change of data rate depending on the length of the segment of the specialized digital network COMLI on the basis of Current loop will promote more effective design of control and management systems on the basis of the COMLI network.

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