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TRANSACTION OF SENSOR ERRORS OF CONVERSION OF MULTIPHASE CURRENTS OF REACTIVE POWER SOURCES OF ELECTRICITY SUPPLY SYSTEM

Abstract: *This work is explained by the fact that the principle of reactive power generation control of power supply systems is based on customer demand, the output signal of the sensor to change the reactive power multi-phase primary currents to secondary voltage is normalized, linear and high accuracy.*

Key words: *Error, reliability, multi-phase currents, sensor, metrological, source, signal, phase, capacitance, sensitive element.*

Language: *English*

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Introduction

Due to the widespread introduction of microprocessor-based devices and electronic meters in the control and management of reactive power in the power supply system (PSS), the issue of ensuring the accuracy of sensors and electronic data processing tools is a topical issue [1-4].

PSS reactive power sources are characterized by the same faults as the multi-phase primary current sensor, like other primary measuring devices: the amount of primary currents in a real sensor differs from the amount generated by the conversion to secondary. The magnetic susceptibility of the switching part, the geometric dimensions, the effect of external magnetic fields and other factors, which are the characteristics of the switching parts of the changing primary currents, in one way or another cause the process of signal conversion in the sensor to differ from reality. These conditions determine the signal conversion errors in the sensor [2,5]

The main part. The input circuit of the sensor I_{E1}, U_{μ} graphic is given in the model, in which I_E (I_A, I_B ,I_A) multi-phase currents F_{μ} are converted to magnetic driving forces, which is reflected by the coefficient of communication between the electrical and magnetic chains K [$I_Э$, F_{μ}]. The magnetic driving forces F_{μ} in the change parts F_{μ} ва F are converted into magnetic fluxes F in the change parts, the transmission function of its W_μ and P_μ change parts reflects the parameters of the structure of the magnetic change part [7-9].

It is very effective to use the rules of information theory of measuring sensors together with the graph model given for the analysis and evaluation of the sensor signal error of the sensor [5, 11].

According to the information theory of measuring devices, $\Delta_Э$ the error of the sensor is scientifically determined by the value of the entropy error, and $K_Э$ the entropy coefficients depended on the type of distribution law, the density of the probabilities of errors of individual variable parts. σ_Σ The quadratic error of the PSS reactive power supply multiphase current sensor is determined by the following expression [9-12]:

$$\sigma_\Sigma = \sqrt{\sigma_1^2 + \sigma_2^2 + \ldots + \sigma_n^2} \qquad (5)$$

Here σ_1^2, σ_2^2, σ_n^2 is the mean squared error of the sensor change parts.

When the values of $K_Э$ and σ_Σ errors are known in the multi-phase current sensor under study, the value of the $\Delta_Э$ - entropy error is formed in the following expression [12-14]:

$$\Delta_Э = K_Э \cdot \sigma_\Sigma \qquad (6)$$

According to the graph model of the sensor, the components of its sum error are I_E; F_μ; Φ_μ and U_{Ech} [12-14].

Sources of errors in the sensor input parts include various factors - temperature, humidity, external magnetic fields and other factors. The physical properties of the materials of the excitation coils are affected. $I_{Эк}$- multi-phase currents, $\omega_Э$– electric current frequency, W [$I_Э$, F_μ] contact coefficients of different nature, as well as the physical properties of the materials of conductors and excitation coils.

To evaluate the cumulative error of the multi-phase primary current sensor of reactive power sources, change the $I_Э$ primary currents to magnetic driving force with the magnitude of F_μ the magnetic change section $I_Э \to F_\mu$ conversion errors, δ_1 = 0,1 - (electrical and magnetic deviations of quantities from the initial nominal value by ±0,1% of the limit values, F_μ - magnetic driving force generate magnetic fluxes of Φ_μ- change particles in the distributed parametric change parts - $F_\mu \to \Phi_\mu$- change errors, δ_2=0,1 - (based on the distribution of the parameters of the magnetic quantities in this variable band deviation of ± 0,1 % of the nominal value and the change of the magnetic fluxes of the change particles $\Phi\mu$ to $U_{эч}$ - output voltages, $\Phi_\mu \to U_{эч}$, - change errors, δ_3=0,1 and δ_4=0,1 It is determined on the basis of small quantities of 0.1 [7-14]:

$$\delta_\Sigma = \sqrt{\delta_1^2 + \delta_2^2 + \delta_3^2 + \delta_4^2} = \sqrt{0{,}1^2 + 0{,}1^2 + 0{,}1^2 + 0{,}1^2} = 0{,}2. \qquad (7)$$

All components of multi-phase current sensor errors are divided into types of additive and multiplicative errors, and their probability of occurrence is found by their standard deviation according to the distribution law.

The entropy deviation value of the error for the sensors is determined based on the following formula:

$$\Delta = K_Э \delta_\Sigma = 2{,}07 \text{ x } 0{,}18 = 0{,}41 \qquad (8)$$

As a result of calculations and experiments, the entropy error of the electromagnetic sensor is **Δ**= 0,41 or ±0,41% and the standardized value of the sensor accuracy can be selected from the standard numbers. The standardized accuracy class for the multi-phase primary current sensor of this series of reactive power sources is 0,5 or ±0,5%.

To analyze and evaluate the faults of the multi-phase current conversion sensor of reactive power (RP) sources of power supply systems (PSS), the PSS RP $I_{A\gamma}, I_{B\gamma}, I_{C\gamma}, I_{A\Delta}, I_{B\Delta}, I_{C\Delta}$- - is given in the magnetic conversion section of the multi-phase current conversion sensor We use the analytical expressions of the signal change for a single-phase current in the graph model of the sensor and the data given in the static, dynamic descriptions [1-6]:

$I_{A\gamma}, U'_{a\gamma}, U''_{a\gamma}$ The indicators of change errors corresponding to the points of static descriptions on the basis of quantities of sizes are:

$I_{A\gamma} = 38$ A; $U'_{a\gamma} = 10$ B;

$U''_{a\gamma} = 10{,}18$ B

$$\Delta = \frac{(U'_{a\gamma} - U''_{a\gamma})}{U'_{a\gamma}} * 100\% = \frac{(10 - 10{,}18)}{10} * 100\% = 1{,}8\% \qquad (1)$$

$I_{A\gamma} = 76$ A; $U'_{a\gamma} = 20$ B;

$U''_{a\gamma} = 20{,}37$ B

$$\Delta = \frac{(U'_{a\gamma} - U''_{a\gamma})}{U'_{a\gamma}} * 100\% = \frac{(20 - 20{,}37)}{20} * 100\% = 1{,}81\% \qquad (2)$$

where $I_{A\gamma}$ – A is the primary current in phase A. $U'_{a\gamma}$- accumulated and $U''_{a\gamma}$- descriptions of the change in output voltage obtained on the basis of the distributed parametric model. ($I_{A\gamma}$ - is the change in output voltage corresponding to the current, i.e. the reactive power source is connected in star form).

Based on the calculated data, it can be concluded that the analytical expression and graphical descriptions derived from the distributed parametric graph model of the sensor of multi-phase currents of PSS reactive power supply networks are adequate to the results of sensor structure studies, providing linear output characteristics gives

For the case of triangular connection of capacitors of reactive power sources in the form of triangles $I_{A\gamma}$, $U_{a\gamma}$, $U_{a\gamma'}$ are the indicators of conversion errors corresponding to the points of static characteristics based on the quantities:

$I_{A\gamma} = 65{,}75$ A; $U'_{a\gamma} = 10$ B; $U''_{a\gamma} = 10{,}184$ B

$$\Delta = \frac{(U'_{a\gamma} - U''_{a\gamma})}{U'_{a\gamma}} * 100\% = \frac{(10 - 10{,}184)}{10} * 100\% = 1{,}84\% \quad (3)$$

$$I_{A\gamma} = 131{,}5 \text{ A}; \; U'_{a\gamma} = 20 \text{ B}; \; U''_{a\gamma} = 20{,}369 \text{ B}$$

$$\Delta = \frac{(U'_{a\gamma} - U''_{a\gamma})}{U'_{a\gamma}} * 100\% = \frac{(20 - 20{,}369)}{20} * 100\% = 1{,}84\% \quad (4)$$

here, too, the results obtained were a parametric graph model of the multiphase current sensor represented by PSS reactive power sources, and the analytical expression based on it was adequate to the real linear output characteristics of the sensor, which increased the sensor accuracy by 1,84%.

Conclusion:

1. A distributed parametric graph model of a multi-phase primary current conversion sensor to a secondary voltage generated by reactive power sources was developed, the analytical expression generated on the basis of the model proved to be adequate to 1,8 % the real linear output characteristics of the sensor.

2. It was found that the entropy error of the electromagnetic sensor converting the multi-phase primary currents of reactive power sources to secondary voltage was Δ = 0,41 or ±0,41 % on the basis of which the standardized accuracy class of the sensor was less than 0,5.

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