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Errors of Moving Screen Converters

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Annotation:

The article analyzes all the possible errors in the moving screen and scattered parameter converters. A parametric structure diagram has also been developed that takes into account the error sources of the newly created moving screen device. During the evaluation of the device errors, it was found that the source voltage and frequency fluctuations, as well as changes in temperature have the greatest impact on the accuracy of its operation.

Keywords: regular error, random error, parametric structure diagram, physical-technical effect, moving screen, angle shift variable.

Metrological feature is one of the main quality indicators of any converter, as well as moving screen and scatter parameter (QETP) converters, which is mainly characterized by the quoted error, which determines the difference between the measured and actual values of the output magnitude by their maximum value.

QETP converters will have additive and multiplicative constituents that generate regular and random sources of error. In QETP converters, the absolute additive error does not depend on the value of the variable, and the absolute multiplicative error varies in proportion to it. In QETP converters, the relative additive error is inversely proportional to the value of the variable, while the relative multiplicative error does not depend on its value. The calculation method of the converter, the imperfection of the calculation method and the inaccuracies in the production are described as the main sources of error that can occur in QETP converters, while the source voltage or current instability and unfavorable external conditions are described as additional sources of error.

Possible errors in QETP converters are affected as follows: when the source voltage is zero, the residual induction in the magnetic conductor causes a signal to be generated in the measuring circuit; the occurrence of high harmonic components in the magnetic flux reduces the size of the output signal; simplification in the determination of the magnetic resistance of the steel core part of the chain and the air gap increases the amount of the output signal; uncertainties in the approximation of the magnetization curve of the magnetic core material change (increase or decrease) the amount of output signal; uneven wrapping of the source excitation coil reduces the number of optimal coils; uncertainties in the installation of the measuring ring reduce the level of the output signal.

By using a parametric structure diagram (PSS) and an energy-information model of chains of various physical natures, we can significantly simplify the detection, analysis, and evaluation of QETP converter error sources. According to him, the process in any transducer is described in the form of elementary links that change from one physical quantity to another, regardless of their physical nature. These elemental links form a converter PSS in which they are interconnected by interconnection physical-technical effect coefficients or transmission coefficients described as chain parameters.

Additive and multiplicative errors of regular and random constituents of each magnitude are used to construct the variable PSS. In PSS, each additive error is entered in addition to the elemental link input size, and the multiplicative errors are entered as a correction to each link transmission coefficient or chain parameter.

Figure 1 shows the PSS that takes into account all error sources of the QETP converter created [1]. In order to simplify the analysis process, some elementary links are divided into sections marked with a dashed line and marked with Roman numerals.

We know that the errors cited by any variable, as well as the QETP converter, are equal to the sum of the errors cited in each elementary section. We therefore consider the errors of each elementary plot separately.

First of all, it should be noted that the deviation of the amplitude and frequency of the source voltage, the external magnetic field and temperature are considered as the main factors influencing the size, coefficients and parameters of the elementary links.

1. The error in the elemental conversion of voltage $U^{ч}_{эк}$ to electric current $I^{ч}_{эк}$ is the electrical conductivity parameter (this section is separated by a dashed line in the PSS in Figure 1 and is denoted by the Roman numeral I).

Given the sources of error, the equation for the static description of this elementary link according to PSS has the following form:

$$I^{ч}_{эк\Sigma} = \left(G^{ч}_{эк0} + \Delta G^{ч}_{эк} \pm \sigma G^{ч}_{эк}\right)\left(U^{ч}_{эк0} + \Delta U^{ч}_{эк} \pm \sigma U^{ч}_{эк}\right) + \Delta I^{ч}_{эк} \pm \sigma I^{ч}_{эк} \quad (1)$$

where $U^{ч}_{эк0}, G^{ч}_{эк0}$ is the source voltage and electrical conductivity in the ideal (no error sources) state, respectively; $\Delta U^{ч}_{эк}, \Delta I^{ч}_{эк}, \Delta G^{ч}_{эк}$ - regular error sources of source voltage, current and electrical conductivity, respectively; ; $\pm\sigma U^{ч}_{эк}$, $\pm\sigma I^{ч}_{эк}$, $\pm\sigma G^{ч}_{эк}$ - sources of random error in source voltage, current and electrical conductivity, respectively.

(1) By simplifying the expression, the error for this link, excluding the second-order minor terms in it, is determined as follows:

$$\gamma_{U_{эк}I_{эк}} = \frac{I^{ч}_{эк\Sigma} - I^{ч}_{экo}}{I^{ч}_{экo}} 100\% = \left(\frac{\Delta U^{ч}_{эк}}{U^{ч}_{экo}} \pm \frac{\sigma U^{ч}_{эк}}{U^{ч}_{экo}} + \frac{\Delta G^{ч}_{эк}}{G^{ч}_{экo}} \pm \frac{\sigma G^{ч}_{эк}}{G^{ч}_{экo}} + \frac{\Delta I^{ч}_{эк}}{I^{ч}_{экo}} \pm \frac{\sigma I^{ч}_{эк}}{I^{ч}_{экo}}\right)100\%. \quad (2)$$

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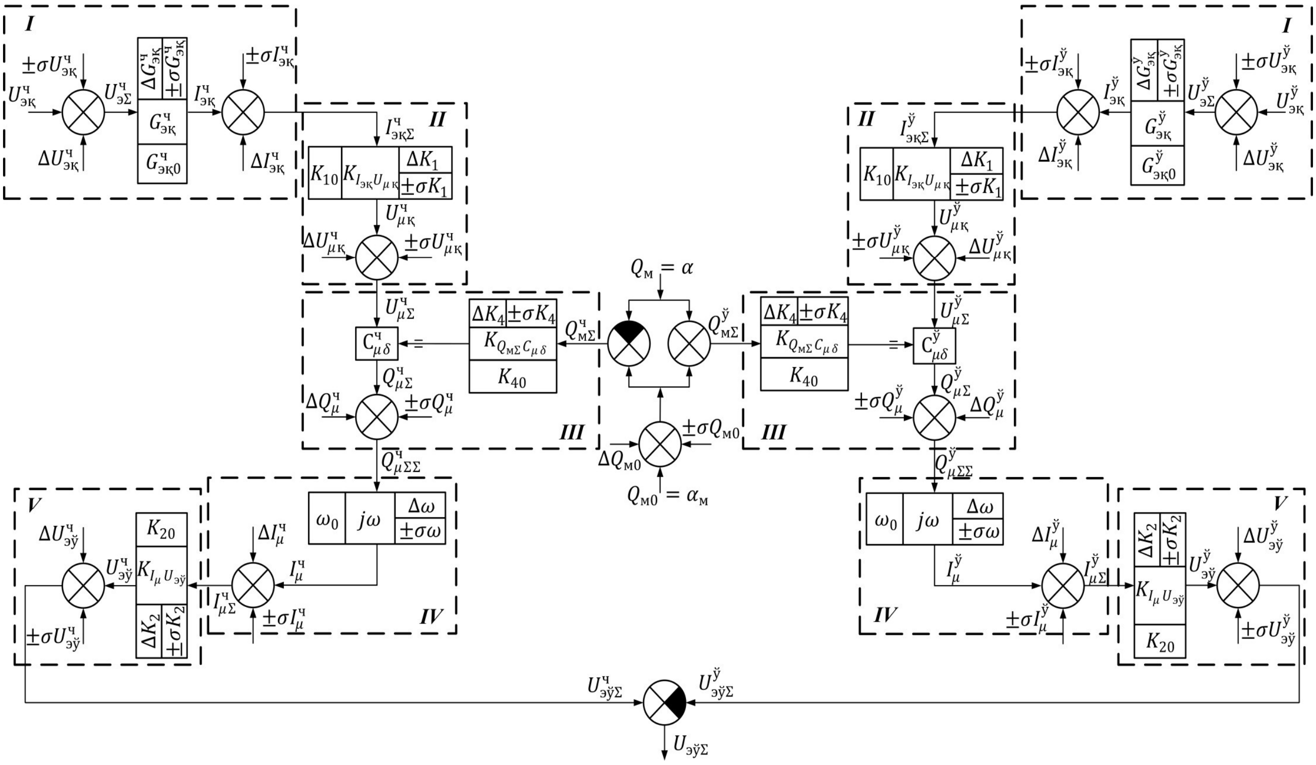

Figure 1. The generated QETP converter is a PSS that takes into account all error sources

An analysis of the operating principle of the QETP converter under study and its PSS shows that the change in current in the source coil $I^{ч}_{эк}$ is due to changes in the electrical conductivity of the coil wires $G^{ч}_{эк}$ and the amplitude of the source voltage . $U^{ч}_{эк}$ and, given that the error due to the change in $U^{ч}_{эк}$ and $G^{ч}_{эк}$ is the error due to the change $I^{ч}_{эк}$ in current, Equation (2) can be used without taking into account the last two terms.

A source of regular error is the voltage drop $\Delta U^{ч}_{эк}$ across the capacitive resistance of the source voltage $U^{ч}_{эC}$. The voltage drop across the capacitance resistor is very small and can be ignored as it has almost no effect on the change in the static characteristic of the converter.

The evaluation of the given random error is based on $\pm \frac{\sigma U^{ч}_{эк}}{U^{ч}_{эк0}}$ the allowable value of the source voltage oscillation.

The other components of the error are mainly due to temperature. In general, these constituents are determined by $\alpha_{тк}$ the temperature coefficient of resistance of the material from which the source clay is made. When the welding torch is made of manganese with a temperature $10^{0}C$ coefficient $\alpha_{тк} = 10^{-5}$ $град^{-1}$ the error in changing the temperature is 0.011%.

2. The error in the elemental conversion of electric current $I^{ч}_{эк}$ to magnetic voltage $U^{ч}_{\mu к}$ is the ampere-winding effect (this section is separated by a dashed line in the PSS in Figure 1 and marked with Roman numeral II).

Based on the PSS constructed taking into account the sources of error, the equation for this elementary link has the following form:

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$$U^{ч}_{\mu к\Sigma} = (K_{10} + \Delta K_1 \pm \sigma K_1) I^{ч}_{эк} + \Delta U^{ч}_{\mu к} \pm \sigma U^{ч}_{\mu к}. \quad (3)$$

The error of this elementary link is determined as follows:

$$\gamma_{I_{эк} U_{\mu к}} = \left(\frac{\Delta K_1}{K_{10}} \pm \frac{\sigma K_1}{K_{10}} + \frac{\Delta U^{ч}_{\mu к}}{K_{10} I^{ч}_{эк}} \pm \frac{\sigma U^{ч}_{\mu к}}{K_{10} I^{ч}_{эк}} \right) 100\%. \quad (4)$$

The first two additions in equation (4) - the source coil - is the change in the number of windings, which in practice is almost zero. The values of the last two connectors are the errors that occur under the influence of an external magnetic field. We know that when the converters are placed side by side with electrical devices with high-power external magnetic field induction $10^{-5} \div 0.5 \cdot 10^{-4}$, the device can cause EYuK, which interferes with the useful voltage in the external magnetic field converter coils. It is known that the magnetic induction in the magnetic conductor of electromagnetic converters is $0.1 \div 1$ in the Tl range. The share of the external magnetic field is $0.005 \div 0.01\%$ of this value. In addition, in the created device, the power lines of the external magnetic field almost do not intersect the coils, because the ferromagnetic cores are made in the form of a coaxial ring, and the coils are placed on the rods diametrically connecting the cores. Therefore, it is possible to ignore the errors that occur under the influence of an external magnetic field.

3. The error that occurs in the elemental conversion of mechanical displacement $Q^{ч}_{м}$ to magnetic flux $Q^{ч}_{\mu}$ (this section is separated by a dashed line in the PSS in Figure 1 and marked with Roman numeral III).

Based on the PSS constructed taking into account the sources of error, the equation for this elementary link has the following form:

$$Q^{ч}_{\mu\Sigma\Sigma} = (K_{40} + \Delta K_4 \pm \sigma K_4) U^{ч}_{\mu\Sigma} Q^{ч}_{м\Sigma} + \Delta Q^{ч}_{\mu\Sigma} \pm \sigma Q^{ч}_{\mu\Sigma}. \quad (5)$$

The error of this elementary link is determined as follows:

$$\gamma_{Q_{м\Sigma} Q_{\mu\Sigma}} = \left(\frac{\Delta K_4 \pm \sigma K_4}{K_{40}} + \frac{\Delta Q^{ч}_{\mu\Sigma} \pm \sigma Q^{ч}_{\mu\Sigma}}{Q^{ч}_{\mu 0}} \right) 100\%. \quad (6)$$

While it is possible to reduce the network parameters (frequency, voltage or current value and shape) that provide additional internal error of the elementary link under consideration, it is not always possible to reduce the additional external error. The maximum value of the additional external error is due to the change in external temperature, the presence of a significant external magnetic field, and the location of another ferromagnetic mass near the converter. Let us consider the effect of each of the error sources listed for the elementary link under consideration.

They can be ignored because the error due to changes in the magnetic susceptibility of the ferromagnetic material, the geometric dimensions of the magnetic conductor, and the specific electrical resistance of the material is very small.

The specific electrical resistance of the QETP converter screen material under consideration can have a significant value when the temperature changes.

The maximum value of the error due to temperature change is determined using the following expression:

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$$\gamma_{Q_\mu} = \frac{\alpha_{\text{тк}} \Delta T}{\sqrt{1 + \frac{\omega^2 C_{\mu п}^2 X_{м}^2}{R_{\mu эк}^2}}}. \quad (7)$$

For the fabricated structure, the value of was 0.011% when the temperature changed to 10°.

(7) Analysis of the expression shows that the smaller the magnetic resistance of the moving screen $R_{\mu эк}$ and the larger the dimensions $Q_{м}^{ч}$ and $Q_{\mu}^{ч}$, mains frequency, the smaller the temperature error for the elementary link in changing the value in question.

The effect of the external magnetic field on the change results is considered in the evaluation of elemental ringing errors in the conversion of electric current $I_{эк}^{ч}$, into voltage $U_{\mu к}^{ч}$.

The most significant effect on the change function of the elementary link $Q_{м}^{ч}$ into $Q_{\mu}^{ч}$ that converts to is due to another ferromagnetic body located near the magnetic conductor of the converter.

In QETP electromagnetic converters, the error in its magnetic flux through an external ferromagnetic body is determined as follows:

$$\gamma_{Q_{\mu ф.ж.}} = \mu_0 \frac{(h_1 + bK_{ф.ж.})}{2h_{ф.ж.}} \cdot \frac{x}{X_{м}}, \quad (8)$$

where $h_{ф.ж.}$ is the distance between the ferromagnetic body and the converter magnetic conductor; h_1, b - the height of the corresponding magnetic conductor and thickness; $K_{ф.ж.}$- coefficient of proportionality.

When for the generated converter $h_{ф.ж.} = 0.02$ м , the error $\gamma_{Q_{\mu ф.ж.}}$ was 0.078%.

4. An error that occurs in the elemental conversion of magnetic current $I_{\mu}^{ч}$ to electrical voltage $U_{эў}^{ч}$ (this section is separated by a dashed line in the PSS in Figure 1 and is denoted by the Roman numeral V).

The error for this elementary link is determined as follows:

$$\gamma_{I_\mu U_{эў}} = \left(\frac{\Delta K_2 \pm \sigma K_2}{K_{20}} + \frac{\Delta U_{эў}^{ч} \pm \sigma U_{эў}^{ч}}{K_{20} I_{\mu \Sigma}^{ч}} \right) 100\%. \quad (9)$$

The first term of expression (9) is the component of the error caused by the change in the number of windings of the measuring rod, which is practically zero. The second term is the error caused by the external magnetic field, which is analyzed as an elementary error in converting an electric current into a magnetic voltage, and since the amount of magnetic field induction acting on the converter is very small, the error in this elemental link cannot be ignored.

Thus, in the study of QETP angle shift variable errors, it was found that the selected computational method was a source of error, which could be caused by imperfections in the selected device, inaccuracies in device manufacturing, source voltage instability, and adverse external conditions. Analysis of the analytical expressions of the regular and random components of the error showed that the error quoted in the QETP angular displacement variable is equal to the sum of the errors in the inter-chain physico-technical effect coefficients, internal chain parameters and intermediate (auxiliary) sizes.

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It should also be noted that the differential angle shear converter compensates for the error components occurring in the intermediate sizes between the inputs and outputs of the PSS.

Quantitative evaluation of errors showed that fluctuations in source voltage and frequency, as well as temperature, have the greatest impact on the performance accuracy of the QETP angle shift variable, and the maximum error of the converter under their influence does not exceed 1.0%.

References

1. Patent RUz (UZ) № IAP 04866. Magnetic field sensor method / Amirov S.F., Nazirova Z.G., Juraeva K.K., Boltaev O.T., Sharapov Sh.A., Fayzullaev J.S.// Official Herald - 2014. - №4.
2. Amirov S.F., Turdibekov K.X., Juraeva K.K., Boltaev O.T., Fayzullaev J.S. Magnetic field sensor method // Patent RUz (UZ) № IAP 05432. 2017. Official bulletin. № 7.
3. Amirov S.F., Boltayev O.T., Akhmedova F.A. Calculation of Magnetic Chains with 1Mobile Screens // International Journal of Advanced Research in Science Engineering and Technology. India. - №6, Issue 5, May 2019 - pp. 9243-9245.
4. Amirov S.F., Boltaev O.T., Axmedova F.A. New created mathematical models of movable screens and a scatter parameter converters // Jour of Adv Research in Dynamical & Control Systems, Vol. 12, Special Issue-02, 2020. pp. 122-126.
5. Boltaev O.T. Strukturnye metody rascheta magnitnyx tsepey s podvijnymi elektromagnitnymi ekranami // X Mezhdunarodnaya molodejnaya konferentsiya nauchnyx rabot «Molodej v nauke: novye argumenty». March 1, 2019. - Lipetsk, Russia, 2019. - p. 21-24.
6. Amirov S.F., Boltayev O.T. Mathematical models of differential magnetic circuits of converters with movable screens and distributed parameters. Journal of Tashkent Institute of Railway Engineers 15 (3), 2019. pp. 75-81.
7. Amirov S.F., Boltaev O.T., Juraeva K.K. Issledovanie magnetnyx tsepey novyx preobrazovateley usiliy. Automation. Modern technologies. Moscow, 2020. - №1. S. 24
8. Abdullaev Ya.R. Theory of magnetic systems with electromagnetic screens.– M .: Nauka, 2000. - 268 p.

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