TESTING ANALOG-TO-DIGITAL CONVERTER FOR MEASUREMENT OF THE TARGET SIGNAL SENSOR CONTROLS

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Have been developed the analog-to-digital converter which in our case are applied to measurement of a current of the gauge of pressure and resistance TRT. Their essence consists in a combination of hardware and structurally-algorithmic methods of increase of the accuracy, based on application of the integrating converter of voltage in time (ICVT) interval, weight processing (a digital filtration) of signal, and also special algorithm of procedure of the measurement allowing at the expense of some structural redundancy to correct an additive, multiplicate error and an error, brought by communication lines [1, 2]. On fig. 1 the scheme of measurement of resistance TRT and current signal is shown.

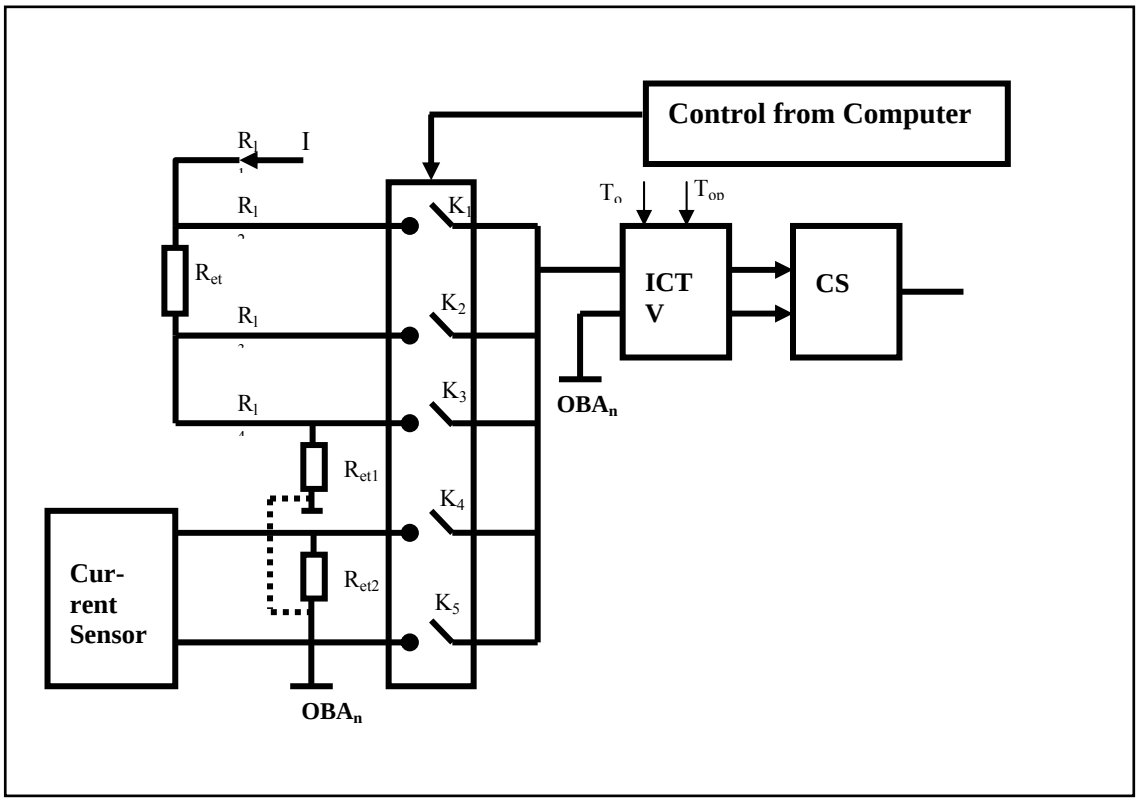

Fig. 1. The scheme of measurement of resistance TRT and current signal.

We will consider more in detail measurement procedure. In the first step key K1 of the multiplexer of M is closed. Meanwhile on input of ICVT voltage arrives:

$$U_1 = I\left(R_t + R_{li} + R_{et1}\right) + e_{di} \tag{1}$$

In the second step key K2 is closed and on input ICVT voltage arrives:

$$U_2 = I\left(R_{li} + R_{et1}\right) + e_{di} \tag{2}$$

In the third step key K3 is closed and on input ICVT voltage arrives:

$$U_3 = IR_{et1} + e_{di} \tag{3}$$

At last, in the fourth step of measurement key K5 does not close and on input ICVT the voltage $U_4 = e_{di}$, equal resulted in input of additive displacement of scheme ICVT operates $U_4 = e_{di}$. As ICVT the known scheme of transformation with the set cycle [3, 4] is applied. If on input ICVT that U_x operates voltage U_x time interval on an exit is defined by the formula:

$$\tau = \frac{I_x}{I_{op}} T_{op} = \frac{U_x}{R_1} \cdot \frac{R_2}{U_{op}} T_{op}, \tag{4}$$

where R_1 and R_2 exact and stable resistance setting a current of a charge of the condenser by entrance and basic voltage; T_{on} – time of a cycle of the transformation, set by quartz resonator GI and a divider (D) (fig. 2).

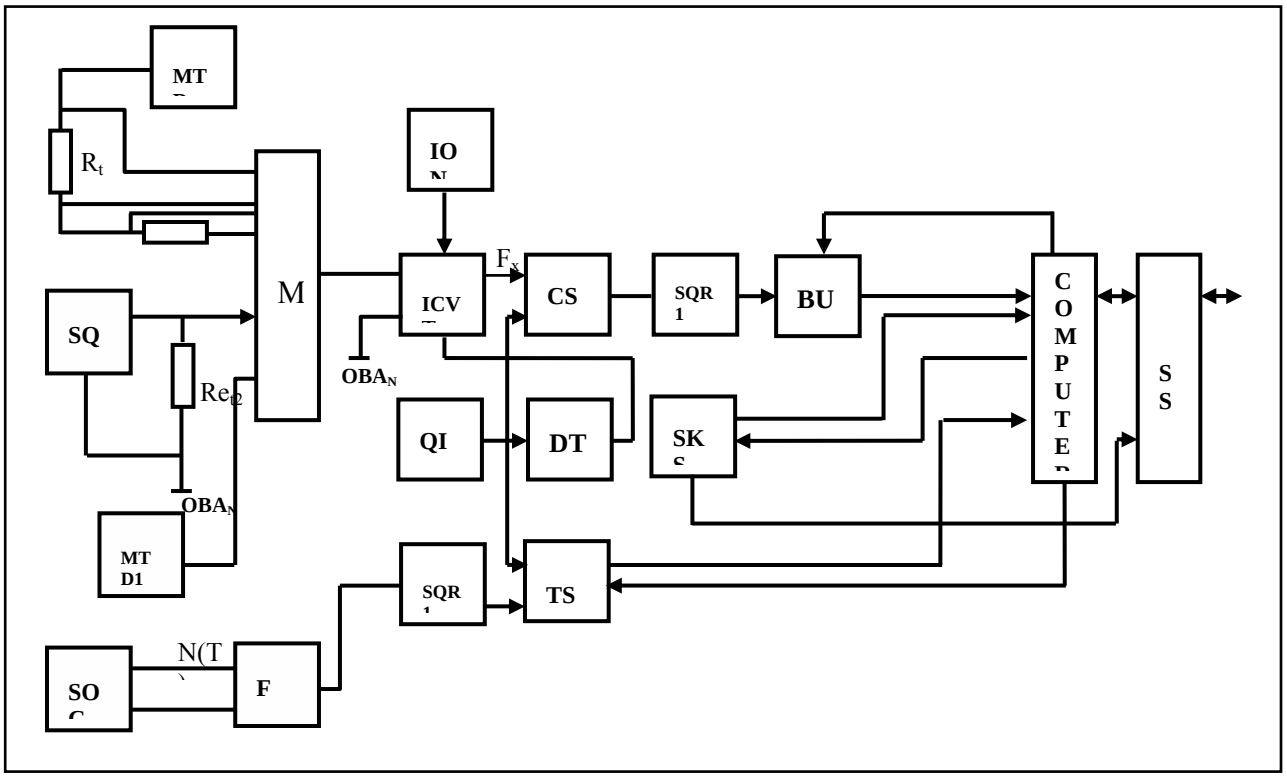

Fig. 2. The block diagramme of the communication device with object

Thus, number of impulses of the quartz frequency f_{kb}, accumulated in the counter equals:

$$N_x = f\tau_x = \frac{R_2}{R_1}\frac{U_x}{U_{on}} f_{kb} \cdot T_{on} = \frac{R_2}{R_1 U_{on}}\frac{U_x}{K}, \tag{5}$$

where K – factor of division of a divider (D), i.e. in frequency f – stability demands only in a current of time of transformation are made. We will designate size:

$$\frac{R_2}{R_1 U_{op} K} = L .$$

Then, we have quantity of impulses in the counter in each step of measurement:

$$N_1 = \alpha \cdot U_1$$
$$N_2 = \alpha \cdot U_2$$
$$N_3 = \alpha \cdot U_3$$
$$N_4 = \alpha \cdot U_4$$

The result of measurement is calculated by the following formula:

$$R_{et1} \frac{N_1 - N_2}{N_3 - N_4} = \frac{\alpha U_1 - \alpha U_2}{\alpha U_3 - \alpha U_4} = \frac{U_1 - U_2}{U_3 - U_4} =$$

$$= \frac{I(R_t + R_{l4} + R_{et1}) + e_{di} - [I(R_{l4} + R_{et1}) + e_{di}]}{IR_{et1} + e_{di} - e_{di}} = \frac{R_t}{R_{et1}} \cdot R'_{et1},$$

where R'_{et1} – value of standard resistance (R_{et}), written down in the form of a constant in memory GI computer. Thus, if $R_{эт1} = R'_{эт1}$, result of measurement is the quantity R_t, and additive, multiplicate errors and influence of communication lines are excluded. (Resistance R_{l_2} *u* R_{l_3} – are excluded thanks to high entrance resistance ICVT).

Current measurement is made as follows. In the first step key K4 is closed, on input ICVT voltage arrives:

$$U = I_x \cdot R_{et} + e_{di} . \quad (6)$$

In the second step key K5 is closed and on input ICVT the voltage equal to $\ell_{см}$ operates. On a counter exit accordingly there are values of a code:

$$N_1 = \alpha (I R_{et} + e_{di}) \quad (7)$$

and

$$N_2 = \alpha \cdot e_{di} \quad (8)$$

The difference of these values is equal to the quantity:

$$N = N_1 - N_2 = \alpha \cdot I_x R_{et} = \frac{R_2 R_{et}}{R_1 U_{op} K} \cdot I_x \tag{9}$$

The value $\frac{R_2}{R_1}\frac{R_{et}}{U_{op}K}$ can be written down as a constant in β memory GI computer, and value I_x is calculated by the formula

$$I_x = \frac{N}{\beta} \tag{10}$$

Here too appear excluded an additive and multiplicate component of an error. An error from nonlinearity as in case of voltage measurement so in case of current measurement, it is defined by characteristics ICVT and it is rather small.

Measurement of resistance TRT and a current from the pressure gauge is consistently made on commands of management from computer.

References

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