# 4.4.12. METHODS OF IMPROVEMENT OF SPECIFICATIONS OF SINGLE-WINDING EDDY CURRENT DISPLASEMENT TRANSDUCERS FOR CONDUCTING OBJECTS

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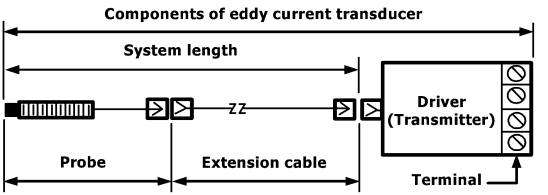
This paper is discussed methods and technical decisions improving specifications and customer quality of eddy current transducers. The major task is error reduction as a result of environmental temperature activity on transducer components. This paper has research results of eddy current test based on damped vibration method. Paper also has embodiment examples of technical decisions in eddy current samples.




Eddy current displacement transducer consists of series-connected elements – non-contact eddy probe, extension coaxial cable and driver (Figure 1). Driver is an electronic module which produces an excitation signal of eddy probe and extracts an informative parameter. An output signal of driver is electric signal proportional to the distance between an eddy probe end and an object under control.

The eddy current transducer as a parallel oscillatory circuit has an inductance coil placed in dielectric flange of the eddy probe and a coaxial cable capacitance. Self-excited oscillator and power-producing are the conventional method of vibration excitation in such kind of circuit. These methods are researched and realized in eddy current transducer samples. Therefore an improvement opportunity of these methods is limited.

The idea of proposed vibration excitation method /1/ for eddy current transducer is eddy current transducer is powers up to ds source from time to time for the purpose of damped wave shaping which is described by the following equation:

$$U(t) = I\sqrt{\frac{L}{C}}l^{\frac{t}{\tau}}\sin 2\pi ft,$$

where $I$ – a current supplied to coil in the energy storage phase; $L$ – coil inductance; $C$ – connecting cable capacitance; $\tau = 2L/R$ – time constant ($R$ – active resistance of coil and connecting cable); $f$ – resonance frequency of parallel oscillatory circuit with parameters $R$, $L$, $C$. Inductive eddy currents of object results in processes equivalent to variation of $R$ and $L$, i.e. to variation of goodness and resonance frequency of circuit which used as informative parameters. Thus, vibration excitation is provided by two consecutive phases. During the first phase an energy is accumulated in inductance coil of eddy current transducer (probe). During this phase circuit of eddy current transducer is energized by constant current. The second phase starts when the circuit is powered down from ds source that results in onset of free damped oscillations. This is the phase of free damped oscillations. Damping coefficient of oscillations and its frequency give an information about a gap between coil end of eddy current transducer and surface of object under control.

One of advantage of pulse method in eddy current transducers is possibility to use it with digital components. On the one hand it allows to reduce the cost of production at the expense of exception of tuning procedure. On the other hand it allows to improve stability of parameters and to reduce an error as a result of environmental temperature activity on driver components. Use of this method allows to reduce a temperature error easily. In fact possibility of temperature error compensation of probe is build into in this excitation technique. The constant current flows through probe coil during the energy storage phase and leads to voltage drop on active resistance. The voltage drop value does not depend on measurable gap practically. The driver identifies the ambient temperature of probe on the ground of voltage drop value and changes an amplification factor in different ways for compensation of temperature error.

As an informative parameter can be used variation of amplitude of positive half-wave of one free damped oscillation period subject to active resistance value. In this case a period with maximal dependence of half-wave amplitude from gap value can be chosen using this technique. Such method of choose of informative parameter is the most effective for support of maximal sensitivity of probe to measurable gap and have not any technical problems.

As an additional informative parameter can be used frequency variation of damped oscillation subject to measurable gap. And variation value is determined by measurement of offset of selected period concerning oscillation beginning.

The discussed technical decisions and eddy current test method are fulfilled in sensors produced by LLC GlobalTest /2/. The sensors were fulfilled on the basis of modern electronic base. The intelligent heart of driver is Silicon Laboratories microcontrollers. The feature of these microcontrollers is advanced analog periphery with high-performance processor core. It allows to realize in sensors some facilities which improve a customer quality, for example, autocalibration.

**References:**

1. **Russian** patent № 2339029 of 20.11.2008. “Eddy current test method”. Klyushev A.V. Holder of patent – LLC GlobalTest, Klyushev A.V.

2. **LLC** GlobalTest catalogue, 2009.