PROSPECTS FOR APPLICATION OF MEDICAL DATA CONVERTER TECHNIQUES

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Resume

In this paper, the features of silicon, integrated, fiber-optic and film converters are analyzed, as well as the possibilities of their implementation in measuring temperature, radiation intensity, humidity based on silicon converters, the advantages of converters created for computed tomography based on silicon technology, the prospects for the development of measuring equipment are studied.

Keywords: silicon, integrated, fiber-optic and film converters, hybrid, optical radiation power, high silicon strength, sensitivity to the external environment, mechanical hysteresis, Whitson bridge.

Using the technological processes of the electronics industry, it leads to the production of many cheap converters and the emergence of new types of converters in its development, as well as the increase in the size of the construction project in preparation according to the constructive technological sign is special, and it is classified according to the technology of preparation. Based on this, low-cost silicon, integral, hybrid, fiber-optic, ceramic and film converters appeared. In this case, according to the nature of interaction with the external environment, converters are divided into two types, i.e. point and distributed types. Such converters are called point if the measured physical quantity changes very little at different distances in the environment and it is equal to the size of the sensitive element of the converter. In turn, distributed converters can be characterized by continuous distribution and discrete distribution. In the last case, the converter actually consists of a set of point converters. It should be noted that classification does not end with the characters in question. For example, converters are divided into contact and non-contact, active and passive and other similar classes. Among those included in the nomenclature of converters, silicon converters are more common. Silicon as a particularly sensitive element has a number of properties: stability of electrophysical characteristics,

sensitivity to the influence of the external environment, absence of mechanical hysteresis. The high strength of the silicon keeps it working even at accelerations up to 105g. The power potential of planar technology played a decisive role in the development of silicon converters. Starting with the pressure measurement technique, silicon converters have made measurements of temperature, radiation intensity, acceleration, consumption, positioning (in robotics), force, humidity, gas composition analysis, etc. Converter technology, unlike electronic integrated circuits, does not depend on special electrophysical properties. Therefore, in the production of converters, traditional electronic technology can also use discarded materials. Thus, the production of converters ensures waste-free operation in the production of electronic integrated circuits. In devices that measure quantities (force, pressure, acceleration), the basis of the converter is the piezoelectric effect, which changes the mechanical effect into electrical resistance. will be The sensitive element of such converters consists of a silicon membrane or a silicon console fixed to the rod, and a piezoresistor is defused into it. Changing the shape of the sensitive element as a result of mechanical impact causes a change in the resistance of the piezoresistor, which is recorded using a bridge circuit. Temperature compensation is created with the help of an additional resistor, which is connected to the Whitson bridge together with the measurement resistor. The silicon pressure transducer (SC) has a high level of linearity and a transducer error of 0.2-1%.

About half of industrial measurements are temperature measurements. In semiconductors, the mobility and density of charge carriers depends on temperature, so it is possible to know about them based on the change in electrical resistance of the semiconductor. Temperature measuring instruments have a convenient combination of properties: linearity, stability of the coefficient of variation, high accuracy, simplicity and low cost. Thermal converters can be semiconductor diodes or transistors in design, and the emitter-base voltage depends on the action when they are constant in the constant current collector. CCs have a sensitivity of about 2mV/K. The linearity of the converter is 0.1K in the temperature range of 220-400K and 1K in the range of 220-530K. The error of changing the temperature in three values of the converter calibration, taking into account its non-linearity, is 0.01 K. Such a possibility is easily performed using a computer-measurement system, because it has information about the calibration in its memory. Silicon is used as a sensitive element in radiation converters up to the ultra-high frequency (UHF) range of radiation. The principle of operation of KOs can be different. To measure the power of optical radiation, the bolometric method is sometimes used - in which the sensitive element

heats up when it absorbs energy. Another method of recording optical radiation is based on the photoeffect: under the influence of light, an electron-hole pair appears in a semiconductor, which creates conductivity in the material. When measuring ionizing radiation, silicon detectors have greater sensitivity than gas-filled ionization chambers. The higher density and volume of the semiconductor material compared to the gas together (about 10 times) cause it to absorb more energy and provide a larger electrical signal at the detector output. In order to use the capabilities of the silicon detector (KD), it is necessary to cool it (for example, to the temperature of liquid nitrogen, 77 K), and to record and process electrical signals, it is necessary to use low-noise electronic devices. This type of silicon photodiode (receiver) has good performance in a structure with a small p-n junction used for medical X-ray endoscopy. Among them, it has a light falling coating, and it has good spectral characteristics in the wavelength range of 500-1000 nm, the signal has high linearity in the dynamic range of up to 30 dB, and its conversion coefficient is constant 1-2%. will be around. The advantages of silicon technology are manifested in the creation of converters for computer tomography. It is necessary to create hundreds of converters with the same characteristics in each tomograph, which cannot be ensured in individual production. The electrophysical properties of semiconductors are sensitive to various connections and contaminations. This feature of them is used in the analysis of the chemical composition of the controlled environment. A detector made on the basis of monocrystalline silicon has a very low sensitivity, because a yeast film is formed on the surface of the semiconductor, which protects the element's sensitivity and reduces chemical activity. Therefore, the surface of the sensitive element is pre-coated with some material. If the surface is covered with lithium monolayer or other alkali metal atoms, the sensitivity of the converter to gas concentration increases. For example, an exposure of 110 seconds makes it possible to measure the pressure of molecular oxygen up to 10-6 Pa with an accuracy of 5%. The small dimensions of the converter ensure that various gases are recorded even in micro-spaces. Another way to increase the sensitivity of KO is to cover the silicon surface with polymers in relation to the concentration of gases, the dielectric constant and specific resistance of which change under the influence of gases. CO, CO2, CH4, SO2, NH4 and other gas sensitive converters have been created. KOs that measure humidity also work based on this principle. The phenomenon of Hall effect and magnetoresistance in semiconductors makes it possible to record magnetic fields using semiconductor converters. The Hall voltage depends on the current flowing through the sample and the magnetic induction. Characteristic sensitivity of Hall

KOs is 100mV/mTl. Sensory organs of robots constitute a separate group of converters: state (position), linear input, touch, sliding, proximity, force converters are among them. The method of recording the state of the object is based on the conversion of the object into electrical signals. For example, with the help of a light beam, a mirror and a photo detector. In another way, based on the magnetic technique of change of state and migration in the environment, the photo detector with the glass magnet was replaced by the converter sensitive to the magnet. The position transducer can register the monitored object in the environment with an error of 2-10 μm. Creators of a complex of equipment, such as a robot, need multifunctional converters, that is, converters that can change several physical quantities.

Currently, single-crystal converters for measuring temperature and pressure have been developed. The physical meaning of such converters is based on the different effects of mechanical stress and temperature on the electrical conductivity of the tensor elements of the anisotropic semiconductor material. . IS 2002 Transsensory Devices Inc. (A Sh) single-crystal pressure and temperature converter has an error of 0.1 K in temperature measurement and 60 Pa in pressure measurement. The place of semi-conductor technology in the measuring technique is fully manifested in hybrid converters, which consist of a means of processing measurement information and a constructive combination of sensitive elements. As the first step in this direction, they were made together with sensitive elements and performed the following functions: amplification, linearization, temperature compensation, and converted the analog signal into an oscillation frequency. A natural consequence of the further development of hybrid converters was the creation of converters combined with a microprocessor. Their accuracy, resistance to interference has increased, the possibility of information exchange between the converter and the digital control system has appeared. Despite the advantages of hybrid converters, the process of its further integration is proceeding at a steady pace. First, the cost of microprocessor converters does not allow them to compete equally with well-designed analog converters. Secondly, the reliability of microprocessor converters is much lower than that of conventional converters. If the analog converter recovers after exceeding its set limits, the microprocessor converters do not recover if they fail. In addition, interference disrupts the work of microprocessors, and at the same time, the analog converter maintains its operability after the impact of the destruction by reducing some of its characteristics. Therefore, the technological possibilities of creating monolithic solid-state measurement converters are not fully used. In some cases, converters must withstand high pressure, strong magnetic fields

and increased radiation. In extreme cases, there are two ways to keep converters operational.

First of all, it is necessary to protect the insulation of the converter and its connecting wires with hard-to-melt metal and ferromagnetic material.

Secondly, a radical way to protect converters from extreme external environment is to ensure the operation of the communication line in these conditions.

In conclusion, such devices are unbeatable in making measurements in strong electric and magnetic fields, and they do not use conductive elements. In addition, the alternating fields create an inductive current in the metal parts, which heats up these areas, creates a parasitic heat electric force and reduces the signal at the output of the converter. The use of fiber optic technology is the initial stage, the principle of their operation is based on the change in the condition of propagation of electromagnetic waves in a wave transmitter made of dielectric under the influence of the measured physical phenomenon. The measuring system will have a minimum light source, a detector and a light-transmitting fiber. The measurement method is based on light transmission or reflection. In the first case, the measurement action changes the wave propagation constant in the light transmitter and is recorded by the detector, while in the second case, the effect (pressure, temperature, object condition) changes the boundary condition of the light transmitter, thereby together the returning wave and the interference change the landscape as well. Information about the value of the transformed quantity is obtained according to the intensity of the returned radiation. the indicator is selected depending on the measurement conditions and physical quantity. The prospects of fiber optic converters are primarily related to the development of integrated optics. The wider use of coherent oscillations, the use of birefringent light transmitters, the selection of components according to polarization, and the use of single-mode light transmitters make it possible to create a family of low-cost high-sensitivity converters. For this, integrated optics will have to go the same way as semiconductor planar technology. The rate of development of fiber optic system measurement technique is very high (about 30% per year). A radical means of protecting the signal at the output of converters is the use of a digital converter in the immediate vicinity of the converter. In such a converter, the output signal is a digital code, which is much more protected from interference signals than analog signals.

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