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## DEVELOPMENT GAUGE FOR CONTROL PARAMETERS RADIATION ELECTROMAGNETIC FIELDS

**Abstract.** The subject study of the article is to measure electromagnetic fields to determine their impact on the human body. The article is research process develop measuring devices for monitoring parameters of radiation of electromagnetic fields. The problem to be solved – justification of technical solutions and their implementation in practice allow accurate measurements to know the presence and location of malicious artificial electromagnetic radiation and the extent of their impact on the human body by applying a gauge to monitor the parameters of the radiation of electromagnetic fields. The paper considered: the structure of the device control parameters of the radiation of electromagnetic fields; studied the work of two-channel analog-to-digital converter; investigated electric circuit device using a Hall element and field instrumentation amplifier; investigated circuit input stage device using silicon element Hall and operational amplifier; investigated temperature compensation circuit with reference interchange power at the source voltage EX. Conclusion: The proposed technical solution should be used when developing the measuring device to control the parameters of the radiation of electromagnetic fields.

**Keywords:** electromagnetic, radiation device, element Hall.

### Introduction

Formulation of the problem.

Monitor environment using special equipment allows to accurately know the presence and location of malicious artificial electromagnetic radiation and the extent of their impact on the human body. In society there is a need for a measuring device, which would allow to receive and visualize information on electromagnetic radiation around the clock without human assistance and fix it.

Thus, the issue of development of devices for control of parameters of radiation of electromagnetic fields is relevant scientific applications, due to the constant increase in requirements for obstruction of the harmful effects of electromagnetic radiation on humans.

### Analysis of the literature

Principles and organizational framework metrological software and the role and place metrological support in Ukraine, set out in the Act Ukraine "On metrology and metrological activity" [1] ISO 2681-94. Metrology, Terms and Definitions[2], the ISO [3, 4].

The article [5] analyzed the most common types of transducers magnetic field to determine the direction of impact at the source of the magnetic field and determined that the most common is ferromagnetic field. The article [6] The possibility of using fiber-optic Fabry - Perot. In [7] proposed a quantitative approach to assessing the impact of metrological reliability of measuring instruments during believe the eye works.

The literature [8 - 12] laid the foundations of the operation of measuring instruments are set out in the literature.

At the same time remain open issues related to the development of devices to control the parameters of radiation of electromagnetic fields.

**The article** is the study of the development process measuring device to control the parameters of radiation of electromagnetic fields.

### Core material

Consider the development process measuring device, including gaussmeters to control the parameters of the radiation of electromagnetic fields. Determine the structure of the device is as follows: sensor - the sensor-MCC Hall 0.5A; input power - power from AD623; Analog to Digital Converter - ADC based on the ADS1286; software that manages a computer - a program based on lab VIEW. Hall sensor creates a voltage level mV. Normalizing amplifier amplifies this voltage to the operating voltage analog-to-digital converter and shifting the working point to measure bipolar magnetic field. Analog-to-digital converter converts analog voltage level into digital code for computer input via com-port using that operates on lab VIEW. The program that controls, makes the necessary changes and displays it on the screen. Consider a real pilot scheme amp input for a specific instance of Hall sensor MCC-0.5A. Where is:

- gain a scheme

$$G = 1 + 100 \text{ ohms} / R1 = 23; \quad (1)$$

- initial shift

$$U = 1,8 \text{ mV} \cdot G = 40 \text{ mV} = 0.04 \text{ V}. \quad (2)$$

In this case estimated value of magnetic induction  $V/T$  is:

$$\begin{aligned} B &= (U - U0) / (K \cdot IX / 3) / G = \\ &= (U - 0,04) / (0,28 \cdot 2,2 / 3) / 2 = 3 \\ &= (U - 0,04) / 4,7 = 0,21U - 0,01, \end{aligned} \quad (3)$$

where  $U - V$  of output voltage,  $IX$  - current value, managing mA,  $K$  - sensitivity B / T (about  $0.28 \text{ W} / T$ ).

Variable resistance establishes an initial shift for analog to digital converter (Fig. 1) to measure two polar magnetic fields. In developing the two-channel analog to digital converter chip used ADS1286, managed and transmitting information via a serial port (represented working circuit).

Gaussmeters is a modular design with capabilities change as research probes with Hall sensor and normalizing (incoming) amplifiers.

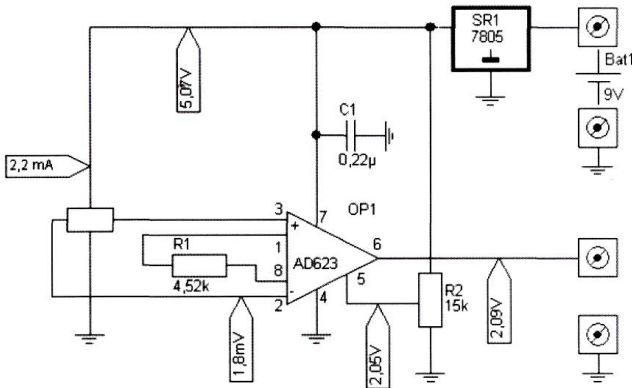


Fig. 1. Analog-to-digital converter

Define the benefits provided by a virtual model gaussmeters over conventional models, namely a complete understanding circuitry and features gaussmeters; shell, fully customizable; ability to measure not only the amplitude but also the temporal characteristics of the magnetic field; using any statistical analysis, algorithms, signal generation and analysis in frequency and time domain procedures spectral analysis and digital filters; lab VIEW - integrated development environment virtual instruments. Consider circuitry device using a Hall element and field instrumentation amplifier and the circuit input stage device using silicon element Hall and the operational amplifier (Fig. 2).

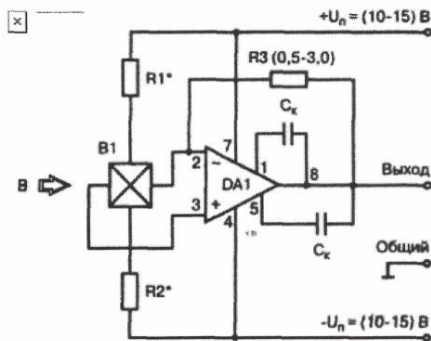


Fig. 2. Scheme input stage device using silicon element Hall and operational amplifier

In the scheme shown in Fig. 2, as the magnetic field transducer uses Hall sensor field that carries power from the power source, performed by the operational amplifier (DA2). As a signal amplifier using integrated circuit EX instrumentation amplifier AMP-04 (or HNA118). The magnetic sensitivity of the device is set resistor R7, operating current of Hall elements - resistors R1 and R2. 0 Balancing held resistors R5 and R6. The scheme involves the modulation of the input signal by supplying pulses that control (or modulate) the gate field sensor Hall. The device provides bipolar power supply from the power source. Current consumption is less than  $\pm 10$  mA at a voltage of 12 V (Fig. 2). In the scheme shown in Fig. 2, as the magnetic field transducer uses silicon Hall element type MCC-0, 5, which is connected to the food chain in two limiting resistors (K1, K2). As an EX signal amplifier chip used in the operational amplifier 740UD2B without housing options. Sensitivity device installed resistors and resistor lang K.1, K2. Temperature

compensation function conversion elements of the Hall signal input circuit. When powered by the Hall element source voltage stabilizes residual voltage  $U_{ost}$ , but there is a temperature dependence of the sensitivity of the device. The error caused by the temperature dependence of the sensitivity is multiplicative in nature. Thus, the compensation of such errors can be obtained nonlinear operations, which limits the accuracy of the compensation. When powered from the power source stabilizing element sensitivity Hall, residual stress has a strong temperature dependence, which, however, can be compensated linear ways. Another feature of the method of compensation is that of compensating for signal input circuit EX may not cause galvanic connection with its input circuit because the Hall element is a quadrupole, input and output that does not have a common point. The quality and stability of galvanic isolation link in solving some extent depends on the accuracy of the compensation scheme. Next, consider the circuit temperature compensation element in the exercise of power by the Hall current source. In practice, the following schemes: optron with galvanic isolation; with galvanic isolation in Ratiometer; with galvanic isolation transformer; Hall element powered by a pulsed power supply. Consider the principle of the block diagram of temperature compensation of Hall element optron EX interchange when powered from a voltage source that is provided in Fig. 3.

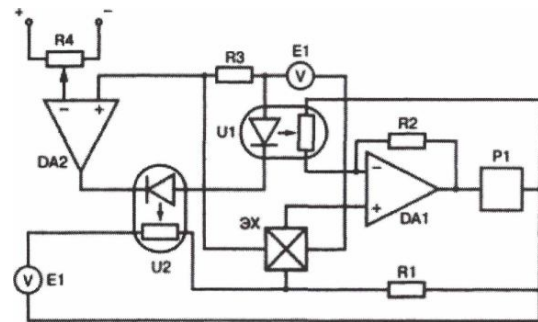


Fig. 3. Scheme temperature compensation of the reference junction EX when powered by the voltage source

In the proposed scheme defined: DA1, DA2 - operational amplifiers; E1, E2 - voltage source; U1, U2 - optocouplers; P1 - recording device.

In the Fig. 3 output from the EX comes to recording device P1 through the signal amplifier DA1. Gain amplifier signal is determined supports negative feedback operational amplifier DA1 - rezystorom R2 and output impedance of the optocoupler U1. Change the last part multiplicative compensating temperature change output EX compensation additive components made circuit consisting of a voltage source E1, the output resistance optocoupler U2 and resistor R1. At the initial element temperature and operating current Hall current generator E2 amplifier output signal DA1 there, whose value election mode of the amplifier DA1 is set so that the operating point optocoupler U1 was on the linear section of transmission characteristics. Changing adjustable voltage source E1, can ensure that the voltage drop across the resistor R1 was equal in magnitude and opposite in sign zero voltage  $U_{ost}$  Hall element. Compensation temperature changes  $U_{ost}$  residual voltage is as follows. When the

temperature deviation from the initial electrical resistance change element Hall successive voltage drop at the EX optocoupler output impedance value and voltage offset the resistor R1. Lanka, which limits the accuracy of the compensation in this scheme is mainly optocoupler U1, which provides galvanic isolation compensation circuit associated with the inputs and outputs of the Hall. Any implemented only in a relatively narrow range of temperatures, firstly, due to varying depending on temperature resistivity semiconductor and compensating element and, secondly, because of the contact resistance EX depending on temperature. For example, India EX with antimony (InSb) temperature compensation with an accuracy of 2% is achieved by connecting the current circuit to a DC voltage, taking into consideration the fact that the material dependence of the Hall constant (CL) and resistivity ( $\rho$ ) of temperatures are almost identical. Furthermore, temperature compensation for the departure of Hall elements parameters used semiconductor thermistors or metal included in parallel or in series or EX power in its output circuit. The temperature error can be eliminated thermostatic element and power it from AC power. For this purpose element is provided heater and temperature sensor. When separation circuit power frequency itself EX can be used as a heater, and in some cases as a sensor. When designing magneto device should consider the impact on peak current control parameters and characteristics of the Hall element, which is particularly important when using low-MCHE operating at  $F_{TI} > 50$  mA.

Maximum value of the current management is largely determined by operating conditions EX, ie heat conditions and ambient temperature and a maximum temperature of heating magnetosensitive element. In the passports of the unit is given the maximum value of the current case management operation Hall element among the still air. Excess indicated in the passport value of this current without special measures to improve the conditions for additional heat leads to overheating element and output it down. Improvement efforts terms of heat can significantly increase both nominal and maximum allowable value of current management. For example, if the Hall element on both sides to bring into contact with metal magnetic poles, the current control can be increased by 1.5 - 2 times.

### Conclusions

1. The article deals with the development of the measuring device, the example gaussmeters.
2. The structure of the instrument: sensor - the sensor-MCC Hall 0.5A; normalizing (input) power - power from AD623; analog-to-digital converter - based ADC ADS1286; program that manages the computer - the program based on lab VIEW.
3. It is proved that the design magneto device should consider the impact on peak current control parameters and characteristics of elements Hall.
4. Proposed technical solutions should be used when developing the measuring device to control the parameters of the radiation of electromagnetic fields.

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### Розробка вимірювального приладу для контролю параметрів випромінювання електромагнітних полів

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**Анотація.** Предметом вивчення в статті є вимірювання електромагнітних полів щодо визначення їх впливу на організм людини. **Метою статті** є дослідження процесу розробки вимірювального приладу для контролю параметрів випромінювання електромагнітних полів. **Задача, що вирішується**, – обґрунтування технічних рішень, впровадження яких в практику вимірювання дозволять точно знати про наявність і розташування шкідливих штучно створених електромагнітних випромінювань і ступінь їх впливу на організм людини шляхом застосування вимірювального приладу, для контролю параметрів випромінювання електромагнітних полів. **В статті розглядається:** структура приладу контролю параметрів випромінювання електромагнітних полів; досліджена робота двоканального аналого-цифрового перетворювача; досліджена електрична схема магнітоприймального пристрою з використанням польового елемента Холу та інструментального підсилювача; досліджена схема вхідного каскаду магнітоприймального пристрою з використанням кремнієвого елемента Холу і операційного підсилювача; досліджена схема температурної компенсації з опорною розв'язкою при живленні EX від джерела напруги. **Висновки:** запропоновані технічні рішення доцільно використовувати при розробці вимірювального приладу для контролю параметрів випромінювання електромагнітних полів.

**Ключові слова:** електромагнітні випромінювання, магнітоприймальний пристрій, елемент Хола.