Національна академія наук України
Інститут проблем реєстрації інформації
Ужгородська лабораторія матеріалів оптоелектроніки та фотоніки Інституту проблем реєстрації інформації
Технічний центр
Ужгородський національний університет

Школа-конференція молодих вчених

СУЧАСНЕ МАТЕРІАЛОЗНАВСТВО: ФІЗИКА, ХІМІЯ, ТЕХНОЛОГІЇ

(СМФХТ – 2021)

Ужгород Водограй Україна,
4 - 8 жовтня 2021р.

ПРОГРАМА ТА МАТЕРІАЛИ КОНФЕРЕНЦІЇ

Ужгород
2021

Optical signals registration unit for fiber optic temperature sensor

Chychura Ig.I., [1] Kutchak S.V., [1] Chychura Iv.I., [2] Oseafiana S.C. [1]

[1] *National Universiry of Uzhhorod, Uzhhorod, Ukraine,*
[2] *Institute of Electron Physics, Ukranian National Academy of Sciences, Uzhhorod, Ukraine,*

A special place among a significant number of fiber-optic sensors is occupied by temperature sensors (FOTS) with amplitude modulation of the optical signal at a certain wavelength. Such sensors, due to the simplicity of their design, reliability, reproducibility of results and satisfactory technical characteristics, as well as the possibility of application in areas of explosion hazard, are increasingly used in engineering and industry. The principle of operation of such sensors is based on the registration of the change in the transmission of the semiconductor sensing element at a fixed wavelength with temperature variation. In this regard, much attention is paid to a specialized device, which is designed for registration and priority analog processing of the information signal received by the FOTS. Since the cost of spectral complexes for the study of optical fibers is quite high, it is not technically feasible to determine the technical characteristics, testing and calibration of FOTS with sensitive elements based on semiconductors materials. Therefore, the task is to develop specialized recorders of information signals received from FOTS. This means that such a device must provide controlled light fluxes, which are generated and recorded by no inertial optoelectronic devices (LED, photodiode) and a progressive circuit for processing the optical signal obtained by FOTS with sensitive element.

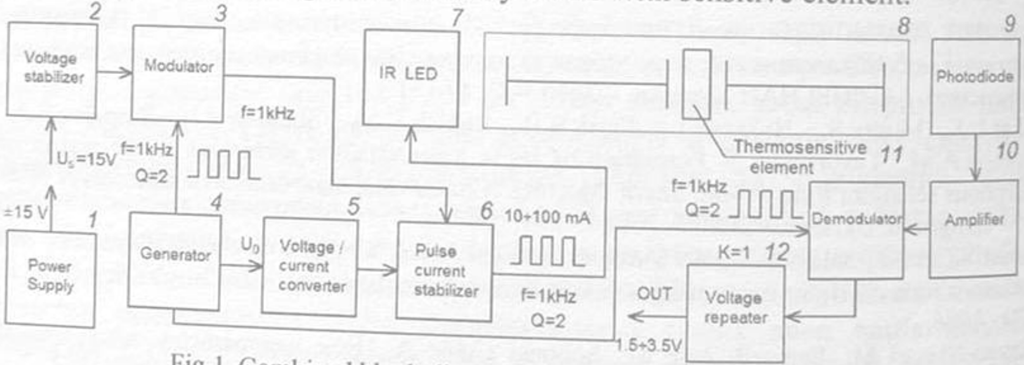

Fig.1. Combined block diagram of the optical electronic recorder of FOTS

We have proposed an innovative unit for analog processing of measuring information for FOTS with amplitude modulation of the optical signal. The scheme is based on the principle of non-traditional use of the integrated circuit μA727M, which is an element of the "modulator/demodulator" and protects the output signal from intermodulation interference,' unauthorized illumination and the influence of multiplicative interference. The combined block diagram of the optoelectronic recorder is shown in Fig.1. It is conventionally divided into two parts: the emitter unit, which provides a modulated stabilized light flux, and the photo detector unit based on the amplifier and demodulator, which is connected via a fiber-optic connector to the FOTS.

The LED radiation modulation circuit consists of a modulator (3) built into the generator chip (4) and an input voltage stabilizer (2). The modulator is built on a pair of matched field-effect transistors and modulates (in amplitude) the input stabilized voltage with a frequency of f_m = 1 kHz (Q = 2). Pulses of modulated voltage of a given amplitude are fed to the converter "voltage/current" and pulse transistor current stabilizer (6). Voltage pulses with the same technical characteristics create at the output of the current stabilizer pulses, the amplitude of which can be modulated from 10 to 100 mA, which provide power to the selected LED (7), which serves the FOTS. The pulsed radiation of the LED passes through the fiber-optic path and, depending on the temperature, changes its amplitude at the output of the FOTS (8). The photodiode (9) detects the change of the optical signal. The amplifier (10) amplifies the amplitude to the required value for subsequent processing and supplies this signal to the demodulator. The demodulator converts this pulse signal at a frequency of 1 kHz synchronously and in phase with the key elements of the modulator (3). A key element of the demodulator are identical field-effect transistors that are used in the modulator, which ensures the synchrony and in-phase operation of the modulator and demodulator. As a result, the output of the demodulator is a constant component of the output information signal, which corresponds to the change in the transmission of FOTS with temperature variation. To provide a variety of output devices in the circuit included an additional operational voltage repeater, which provides a fairly good consistency of the input and output impedance. This allows us to use a variety of indicator devices from analog pointer voltmeters to modern analog-to-digital converter, including those that are part of microcontrollers.

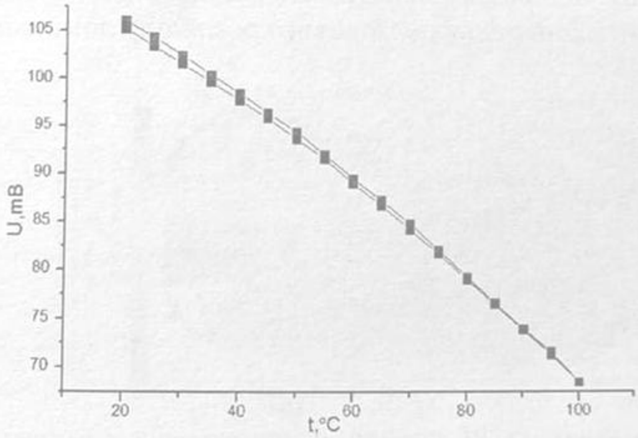

Fig.2. Dependence of the voltage at the output of the FOTS circuit from the temperature of thermosensitive element.

Fig. 2 shows the results of temperature measurement for sensitive element based on $As_{45}Se_{55}$ (λ_o = 808 nm), which were obtained using an experimental model of the described recorder. During the measurement, the thermosensitive element was heated to a temperature of 100 ° C and then cooled to room temperature. A small deviation of the heating and cooling curve (maximum difference of about 1.5 mV) may be due to changes in the optical properties of the material.