Abstract

The dynamic development of technology and science has discovered more and more applications of infrared photodetectors. Intensive work is being observed on the design of novel optoelectronic devices characterized by better performances using new materials or better manufacturing processing. At the same time, it indicates the need to construct 'novel' measurement systems for photodetector testing. The obtained results can be used not only to define its parameters but also to control and validate the evaluation of its manufacturing technology. The state of the art indicates that the photodetector's performance depends not only on structures materials and their shapes but can be determined by the operating conditions (e.g., supply voltage, temperature). In this way, the detector's impedance can change over a wide range, making it difficult to use "universal" measurement instruments for accurate characterization of its noise. The main measurement limitation is "floor" noise generated by noise sources of their input stages (amplifiers) and power supply units used in the testing setup.

The research problem of the dissertation is directly related to noise measurements of low-impedance devices in the low-frequency range.

The work thesis was to achieve the capability of the voltage and current noise characterization of low-impedance photodetectors (impedance of below 1 kΩ) at low frequencies (in the range of flicker noises). Its practical result was to develop an ultra-low noise measurement system.

To achieve the main work objective, some analyses of systems and methods to measure the power noise density of novel photodetector, described in the literature, were carried out. Based on analytical results, various configurations of the system's components were defined. These configurations were determined by the possibility of implementing signal correlation procedures.

In the frame of concept and construction works, low-noise voltage sources, voltage and transimpedance amplifiers, and a special signal processing unit with a correlation algorithm were developed.

The tests of the various system configurations were performed to define their ability to measure the noise parameters of devices characterized by impedances of several ohms. Their final effect is a diagram showing the influence of the measurement system's noise on obtained results for different resistances of these devices.

Practical validation of this work's achievement was a measurement of the noise characteristics of both photovoltaic and photoconductive infrared photodetectors. These devices were characterized by impedances of tens or hundreds of ohms. The obtained results confirmed that the designed measurement system makes it possible to measure the noise characteristics of low-impedance photodetectors. It is the basis for confirming the validity of the work thesis.

Achtenberg Krzysztof