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A HIGHLY SENSITIVE ZERO MODULATION RADIOMETER

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The paper considers the possibility for creating a radiometric system in which the zero method of measurement is realized by summing two noise signals — the informative one and that coming from a standard noise generator. The use of the new method permits to improve sensitivity and accuracy of measurement of radio-engineering information.

A drawback of the most widely used modulation radiometer [1], kept during the measurements under zero-balance conditions with the aid of deliberate noise induction [2], consists in deterioration of its sensitivity. This is because of application of a noise signal to the radiometer input, insufficient stability of traditional semiconductor noise generators, electromagnetic coupling between channels of *p–i–n*-switches, asymmetry of switch discontinuities in the modulated signal, etc. [3]. As a result, we cannot assure high accuracy of measurement of radiometric information.

Improvement of radiometer sensitivity can be attained by circuit means, for example, if we diminish the loss at the receiver input. A partial compensation of the loss is possible by using circuitry in superdimensional waveguides [4], which is not always feasible, especially when the equipment has to be placed on a limited area.

In [5] the zero method of measurement is implemented with the aid of a solid-state generator of standard noise and a controlled of *p–i–n*-attenuator connected between the generator output and the directed coupler. The microwave signal, coming from the antenna, passes through the main channel of the directed coupler, arrives at the modulator and is applied to a heterodyne converter of frequency, where the signal frequency changes to the intermediate frequency. The secondary channel of the direction coupler works with the noise-adding signal, which also can be used for compensation under the zero conditions of the radiometer operation.

Owing to periodic switch-off (by the modulator) of the signal in the reception channel, the input of the heterodyne unit of frequency conversion is periodically disconnected from the antenna low-impedance output. This results in occurrence of external modulation of mixer's and heterodyne's noise, and initiates a spurious signal at the radiometer output, which shifts its zero readings. To suppress the irrelevant modulation, the modulator — from its input and output sides, is decoupled by two ferrite gates, which introduce additional loss (0.8 to 2 dB) of the measured signal and lowers the radiometer sensitivity. Moreover, periodic discontinuities of the received signal, and their temporary asymmetry result in hard-to-suppress switch interference which, together with the residual external modulation, offset the radiometer "zero point", thus deteriorating the accuracy and sensitivity at measurement of weak signals.

The purpose of this work is development of a zero modulation radiometer such that introduction of new elements and links does not disturb zero conditions of measurement of weak signals due to interruption or switching, thus improving the accuracy and sensitivity at measurement of the weak signal parameters.

Figure 1 shows the functional diagram of a highly sensitive zero modulation radiometer which, as distinct from the known ones, includes two switch modulators and three fixed attenuators connected in the peculiar manner. The network performs alternate shaping of two noise signals where the first one is to be measured directly while the other represents a combination with the standard noise but attenuated by a prescribed number of times. From the obtained compound signal,

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