

Development of Highly Sensitive Receivers for Studying the Characteristics of the Antennas of Ground-Based Space Communication Systems in the Upper Microwave Range

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Abstract. The layout diagrams of highly sensitive receivers (modulation and correlation radiometers) of the Ka frequency range, designed to measure the characteristics of large antennas by signals from natural and artificial extraterrestrial sources of radio emission, are presented. The layouts contain external microwave blocks, as well as a digital processing unit based on FPGA, which digitizes, filters, multiplies and accumulates intermediate frequency signals. The modulation radiometer is designed to measure such characteristics of antennas as radiation pattern, power gain and noise temperature. The correlation radiometer allows one to study the complex (amplitude and phase) radiation patterns of the antenna at individual polarizations, including the radio emission of a non-polarized natural radio source, as well as to study the field distribution in the antenna aperture by radio holography methods. The developed specialized software makes it possible to vary the main measurement parameters — digitization frequency, accumulation time, filter bandwidth, time delays in channels, etc. The results of laboratory tests of the radiometer models using calibrated sources of harmonic and noise signals are presented, confirming the possibility of their use for studying the characteristics large antennas by radio astronomy.

Keywords: space communications, mirror antenna, radio measurements, extraterrestrial radio source, modulation and correlation radiometers, Ka band