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A SIX-PORT ANALYZER OF MICROWAVE NETWORKS BASED ON FOURIER DISCRETE TRANSFORM OF THE TAPPED SIGNALS, AND METHODS OF ITS CALIBRATION

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The authors have analyzed a new method suggested for measurement of complex-valued parameters of microwave circuits. The method is based on processing of the signals, applied to the measurement arms of a six-port, with the aid of Fourier discrete transform. A procedure for calibration of this analyzer with the aid of a set of impedance standards is developed. The results of the modeling the calibration procedure are presented.

Analyzers of microwave circuits are used for measurement of complex-valued parameters of microwave devices in a wide band of frequencies. One of the most precise and rather simple (in terms of hardware) methods for creating such analyzers is the calibrated six-port method [1]. The essence of the method is as follows. We measure the voltages, which are proportional to power of the signals applied to the measurement inputs of the six-port device, and the parameters sought are determined by algorithmic processing of these voltages. The parameters of the six-port itself at each frequency of the working band are defined beforehand at the calibration stage using a set of standards. Then these parameters are stored in a computer, and used in the measuring algorithm for correcting the measurement results. This approach makes it possible to eliminate completely the impact of the measuring transducer on the object measured. Below we describe an analyzer using the new method of processing of the tapped signals which provides for improved noise immunity of the measuring channel [2].

Figure 1 shows the functional diagram of the analyzer in the conditions of measurement of a complex reflection factor (CRF) of a two-pole. For the microwave transducer we employed a switch-type one characterized with improved accuracy and stability. The transducer includes a measuring six-port built into the path between the microwave generator and the two-pole to be measured, a microwave switch, and a power sensor (a gauge in the quadratic mode of operation). The computer controls the operation of the microwave switch, which couples the measuring outputs of the six-port to the power sensor. The output signals from the power sensor are converted into digital codes by an analog-digit converter (ADC) and come to the computer for further processing. The computer also controls the microwave generator frequency through a frequency readjustment unit, which makes it possible to do panoramic measurements. The measurement results are displayed on the screen of the panoramic indicator, for instance, on the computer monitor.

For the case of an arbitrary measuring six-port, the signals P_i picked off the microwave transducer at the switching can be represented in the form

$$P_i = q_i E_{\text{g}}^2 \left| \frac{1 + A_i \Gamma}{1 + B_i \Gamma + C_i \Gamma_{\text{g}} + D_i \Gamma \Gamma_{\text{g}}} \right|^2 \qquad (1)$$

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