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MULTIPROBE MICROWAVE MULTIMETER FUNCTIONAL DESIGN

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Multiprobe microwave multimeter (MMM) the new type of measurement device representing an automatic multichannel system consisting of a very high frequency unit with passing power sensors and a computing unit on the basis of the microcontroller or the PC and is intended for measurement incident, reflected and passing power, module and phase of a termination reflection coefficient, executing generator and termination checking in an "hot" mode. Serially MMM are not produce in lots and there is not unified design technology, their authors propose the different approaches of their constructions distinguished mainly by sensors location, way of arrangement them along a transmitting tract, their signals processing algorithm and metrology maintenance. In [1] the not equidistant Chebyshev arrangement along a tract of a plenty (up to 16) thermistor or bolometric sensors of a passing type, processing with the help of iterative algorithms and graduation with the help of a standard measuring instrument will be described.

In the report the methodology of the working MMM design with equidistant sensors arrangement supposing algorithms, structure and its element, graduation and calibration methodic choise recommendation elaboration is discussed.

The functional diagram is practically same for all versions of multimeter and consists of the microwave unit (tract section with sensors), sensors characteristics corrector, amplification and normalization channels, which one quantity corresponds to sensors quantity, amplifying low level sensor signals up to a level, necessary for analog-to-digital converters and microcontroller function. The mentioned above units make together multichannel unit of an analogue signal processing. Besides the functional diagram contains the microcontroller.

The sensors quantity and way of their arrangement is made on the basis of the analysis of mathematical model of a system, the sensors signals are described by equations, which one integrate in a system. For simplification of a procedure of the solution an equation linearize and introduce intermediate variables describing a constant and a variable of components by a curve of a standing wave in a tract. The single-wavelength system is described by three parameters – passing power, a module and phase of a termination reflection coefficient, therefore, quantity of equations in a system and quantity of sensors is equal to three. Spacing interval between adjacent sensors is selected equidistant and equal $\lambda/6$, that considered optimal from the point of view of conditionality number in comparence with often used earlier spacing interval $\lambda/8$. At measurements in frequency band on algorithm apart from main computing function the observation of a frequency change is assigned, that executed on sensors signal processings ground. Sensors quantity is increased to four and the correction coefficient grounding of their signals and watching a frequency drift is calculated. To prevent the transformation in a nil of a denominator of a correction coefficient it is necessary to add fifth sensor, which one allows "to shift" to the right or to the left reading of four sensor with the help of the commutator.

The wideband systems for coaxial tract contain additional sensors, spaced on doubled spacing interval relatively initial accommodation. Thus the working ones are all the same four sensors, though in the microwave unit their greater quantity is installed. So for example, for maintenance of an effective range of frequencies in four octaves nine sensors are necessary. Maintenance of the same accuracy and same range at not equidistant arrangement would need twice lot of sensors.

The functional diagram of multimeter according to an operation algorithm includes following main units: multichannel unit of processing of a signal with thermocouple sensors, microprocessor controller matched with the unit of analog-to-digital convertion, input\output interface. The electrical principal diagram is designed with account of modern element base varied so fast what to result the concrete solutions in the given report there is no necessity.

Usage in the electronic unit of multimeter of programmed controllers allows considerably to reduce systematic components of errors, caused by nonlinearity of amplitude characteristic of a sensor and its size, its transformation coefficient frequency dependance.

For implementation of calibration of the electronic unit in the device the installation of the test - unit is envisioned, which one represents a source of stabilized constant voltage, imitating sensors signals at extreme and

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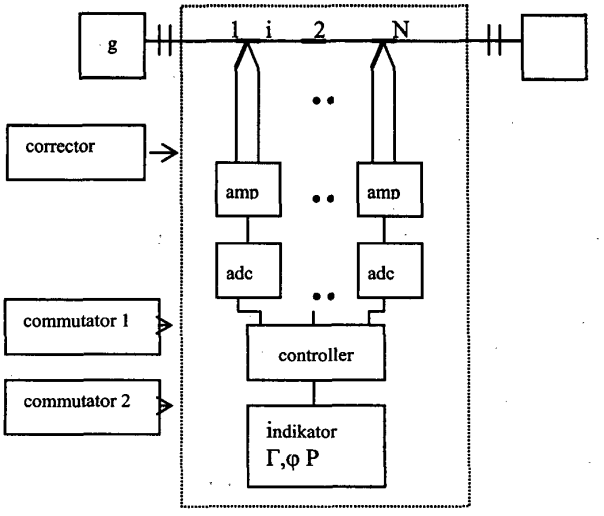
intermediate different situations on a power level in a tract, on a degree of a termination mismatch (module and phase). Simulation modeling of different operational situations permits to determine error of the processing unit and to execute its check verification and calibration.



The experience of long-term exploitation of designed sensors [2] has shown long-time stability of their parameters measured in tens of years. Taking into consideration this fact, and also universality and the interchangeability of sensors has appeared possibility to make a sensor graduation on several stand with different frequency and waveguides sections and transformation coefficient to certify. It allows a new approach in MMM metrological assurance.

References

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