FREQUENCY SYNTHESIS OF DISTANCE MEASURING DIELECTRIC PARAMETERS OF BIOLOGICAL OBJECTS

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For remote refrektometration studies of biological objects in free space is the primary use of multifrequency reflektometrychnoyi system (MS) with fast frequency tuning master oscillator. The most common way to change the input frequency to multifrequency PC is a fast frequency tuning master oscillator low-power ultra-high frequency (UHF) and then increased (if necessary) signals generated by him in broadband power amplifiers.

It is known that the potential value of tactical and technical characteristics (TTX) determined parameters probe signal and system processing. If you selected the signal processing system and the potential implementation of the basic performance characteristics depend on the stability parameters of probing signal and phase characteristics, defined combined effect of different reasons.

It is known that the main characteristics reflectometer for dielectric spectroscopy of biological objects in free space is the resolution and accuracy of measurements, which is provided mainly by the high purity of the output spectrum reflectometer.

With perfect stability of the tract are no random changes in the received signal, which are caused by fluctuations of the amplitude and phase of the probe signal and the reflected signal as a result of its passage through the receiver.

The purpose of research - development of basic functional parameters of synthesis frequency ultrahigh frequency range of distance determination reflektometrychnyh dielectric parameters of biological objects, study and identification of key performance characteristics of frequency generators that would provide enough work systems in a wide frequency range.

Materials and methods research. Short-term frequency stability of the pathogen, including synthesizer, determined by total effect of deterministic and fluctuating disturbances in the spectrum of the output signal, as opposed to the ideal synthesizer range of output fluctuations which contains only one step discrete spectral line.

Based on the results, we can conclude that for high resolution reflectometer ≤ 1% requires that discrete components in the spectrum of the output signal synthesizer were suppressed to the level of their own synthesizer phase noise, ie up to 160 dB.

Whereas, for the PC in the centimeter and millimeter ranges specified speed and high purity spectrum is achieved by using frequency synthesizers, conduct analysis of existing methods of construction of frequency synthesis (SSCH), High Frequency (UHF) range in order to use them as pathogens - heterodyne reflectometer for the study of biological objects in free space.

The main requirements imposed on SSCH reflectometer for dielectric spectroscopy is to provide enough quick adjustment from one operating frequency to another in a given frequency range and high spectral purity of the output signal when required for sensing in free space power level.

Results. The most complete satisfaction of the requirements for the basic characteristics SSCH in the centimeter and the more Millimeter wave can be obtained by indirect synthesis method based on analog and digital systems of phase-locked loop (PLL). This is due to the fact that the direct synthesis method can not obtain high spectral purity of the output signal as multiplication and other nonlinear frequency conversion reference oscillator in the millimeter range leads to unacceptable levels of fluctuation and discrete side components in the spectrum of the output signal.

Actually frequency synthesizer is in the range 7.2 ... 7.4 GHz and executed based digital PLL. Through the application of a high-Q microwave resonator oscillator pidstroyuvanomu ($Q \geq 2{,}3 \cdot 104$) of barium titanate, will result in the power spectral density of phase noise - 130 dB / Hz at 1 kHz of the input. However, the transfer of the frequency synthesizer area 93 GHz and above using a diode multiplier

increases the power level of phase noise to 75 dB / Hz at 1 kHz and - 105 dB / Hz - 100 kHz on the input. That subsequent frequency multiplication further worsens the spectral characteristics of the output signal.

The use of direct synthesis method in its pure form, even in the centimeter wavelength range gives unacceptable level of side discrete components. Multiplying the frequency of the signal in the millimeter wavelength range will result in an unacceptable level of, as in the multiplication of their level increases with increments of 6 dB per octave.

The same shortcomings and has extension method synth band, which for this purpose synthesizer output multipliers include some of the band filter and low pass filter used for suppressing harmonics frequency higher orders.

Development and application of multiplication SSCH is due primarily to the ability to use existing UHF synthesizers and centimeter bands at the appropriate interval millimeter range. However, obtained with the spectral characteristics of the output signals do not meet the requirements of many applications.

The simplest way to migrate existing frequency synthesizers in the millimeter waveband while obtaining the necessary spectral characteristics is the use of a PLL active filters with frequency multiplication synthesizer.

For this purpose industrial synth CH6-31 (1 Hz - 50 MHz) and 4 ring PLL system by which the output frequency synthesizer multiplied to the meter, trohsantymetrovoho, chotyrohmilimetrovoho and submillimeter wavelengths. This first ring is used as a narrow-band filter that allows you to suppress side discrete components in the spectrum of the signal synthesizer CH6-31.

The main disadvantage of this system forming the grid frequency is the complexity and relatively narrow tuning range of output frequencies.

Serial foreign examples gauges, which are produced today are microwave synthesizers. It should be noted function generator 8375 companies Agilent Technologies, which is based on digital frequency synthesizer of PLL system that provides high stability of the generated signals. Generators are designed to signal in

the range of 10 MHz to 20 GHz in 1 Hz. The level of harmonics in the range of 10 MHz ... 1.5 GHz up to 30 dB, and in the range of 1.5 ... 20 GHz - 45 dB.

Conclusions

According to the research related to the development SSCH millimeter range, the following conclusions:

- Direct method for the synthesis grid frequency can be used in millimeter radio waves because it does not allow high demands on spectral fluctuation characteristics;

- Multiple-use analog and digital systems PLL synthesizer lets in grid frequency almost any band radio waves with high spectral fluctuation, energy and other characteristics that will implement the requirements that are made to pathogens reflektometrychnyh of distance study permittivity of biological objects in free space.

Lack of solving the above problems holding back issues of implementation of the necessary quality indicators pathogen reflektometrychnyh systems for remote measurement of dielectric permittivity of biological objects.