Input microwave devices for space surveillance radar system with identical phase-frequency characteristics

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Abstract – **The results of design and production of input microwave devices for space surveillance radar system with identical phase-frequency characteristics are presented in this paper. Functional design schema is suggested.**

Key words - **array, radar system, protection device.**

I. INTRODUCTION

Space surveillance radar systems solve the problems of target detection, measurement of coordinates and parameters of target movement, speed and distance to them.

Parameters of the input microwave devices are critical for supplying space surveillance radar systems potential [1]. Elaboration of input devices (transmission lines, intersection devices, secure devices and low-noise amps) with the minimum noise factor is equal to higher output power of microwave energy-intensive (hundreds of kW pulse power) transmission device or increase radar. Therefore, all circuit solutions have been directed to reduce Noise and to increase the dynamic range of input microwave device.

II. INPUT DEVICE DESIGN

The input device can be divided into three parts - 1 ST (see Fig. 1), low-noise amplifier 2 (LNA) and power unit 3. We had to solve three main tasks during PD design: turn on high speed, low loss in the closed state and large attenuation in the open one. After considering many options for PD design the optimal option was selected as a two-cascade switch on p-i-n diodes with quarter waves connections between cascades. First cascade is created on four parallel diodes (for better damping), as far as damping made by one of his diodes to compensate reactive component is equal to:

$$L = 8.7 \ln\left(1 + \rho / 2r_g\right) \qquad (1)$$

where r_g - open p-i-n diode resistance. ρ - transmission line impedance.

Also such construction allows to significantly increase dissipate power that is equal to allowable input PD power increase.

In the second cascade we used quicker p-i-n diode with small charge storage, what ensures great performance. PD Internal control is performed by two detector diodes, added to the transmission line at a distance of a quarter wavelengths after the second cascade.

We had to solve compromise task during LNA construction: simultaneously provide low noise and large input linear power. The first LNA cascade 3 has to withstand a possible limit falling output while maintaining its efficiency. There are not much low-noise transistors that satisfy such requirements, for example transistor ATF 10136 from HEWLETT PACKARD, which allows maximum input power of 100 mW.

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The second 5 and third 7 amplifier cascades are based on more powerful microwave amplifier for guarantee dynamicrange. Amplitude-frequency and phase-frequency equalizers 4, 6 are placed between the cascades to provide guaranted amplitude-frequency and phase-frequency characteristics identity of the input devices in the band. Particular attention is paid to the power circuit 8.

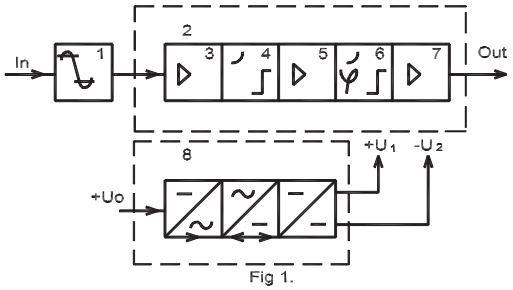

Fig 1.

Input devices were designed using microwave devices modeling system [2] in several stages through the synthesis of major components, analysis and optimization of electrical and topological schemes.

Structurally input devices are produced in frame type milled bodies in two option - tight and bodiless. Hermetic option is designed for autonomic usage and is protected from external environment impact. Signal inputs and power supply goes through microwave transitions like N or СР-751ФВ.

Bodiless option is designed for multichannel antenna arrays construction, where grouping hermetization of input devices is provided in the combined body.

A number of input microwave devices were developed as a result of theoretical and experimental research. These devices have following parameters in all operating conditions:

Operating frequency range	10 cm
Power gain	32 dB
Gain nonuniformity	< 1 dB
Noise factor	<2,5dB
Nonidentity of phase - frequency characteristics	$< 10^{o}$
Maximum admissible level of the microwave input pulse power $\tau_V \geq 43$ μs $Q \leq 20$	150 W

III. CONCLUSION

Designed input microwave devices satisfy modern technical requirements and can be used in a number of space surveillance radar systems, including radar systems based on plane antenna arrays. Proposed technical solutions can be used in similar microwave devices with different bandwidth and radar types.

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