

Passive radiometric channel designed for integration with weather radar

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ABSTRACT

At present the main technical instrument for detection of dangerous weather phenomena is weather radar. Combination of active channel and passive radiometric channel significantly improves radar functional characteristics. There are different schemes of passive channel integration. This article presents some alternative methods of integration and displays the first results of passive channel equipped weather radar operation.

I. INTRODUCTION

It's known that combined usage of active and passive systems allows getting complete information about physical condition of cloud system [1]. Commonly, integration took the band of weather radar and the same polarization. The antenna and whole radar waveguide down to mixer were used as common. That resulted in subdivision of active and passive channel at levels not less than 140 dB requirement and limited the sensitivity of radiometer due to high losses in the track and narrow band. Thus an alternative method of integration was proposed [2], when active and passive channels use only common antenna and there is a variety of choices through passive channel RF band and its polarization.

II. VARIANTS OF INTEGRATION

in concern of double frequency weather radar MRL-5 irradiator

Double frequency weather radar operates on $\lambda^1=10\text{cm}$ and $\lambda^2=3,2\text{cm}$ by scheme of prime focus irradiation of parabolic dish with 4,5m diameter. The elementary scheme of integration is shown on fig. 1. In this case standard MRL-5 irradiator is not changed and passive channel irradiator is added to active channel irradiator on $\lambda^1=10\text{cm}$. On fig. 2 you can see integration variant when passive channel operates in a band close to λ^2 of active channel and they use different polarizations. This variant is more complicated (in this case standard MRL-5 irradiator should be improved), thus the first scheme should be considered.

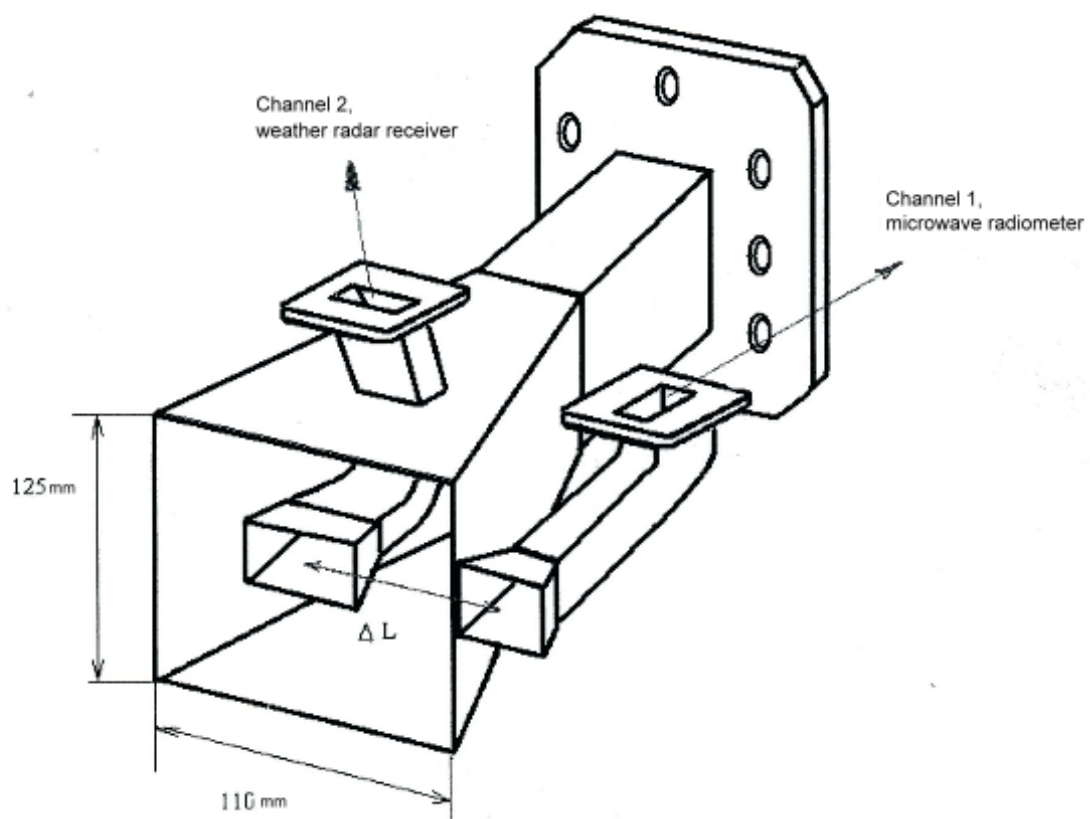


Fig. 1

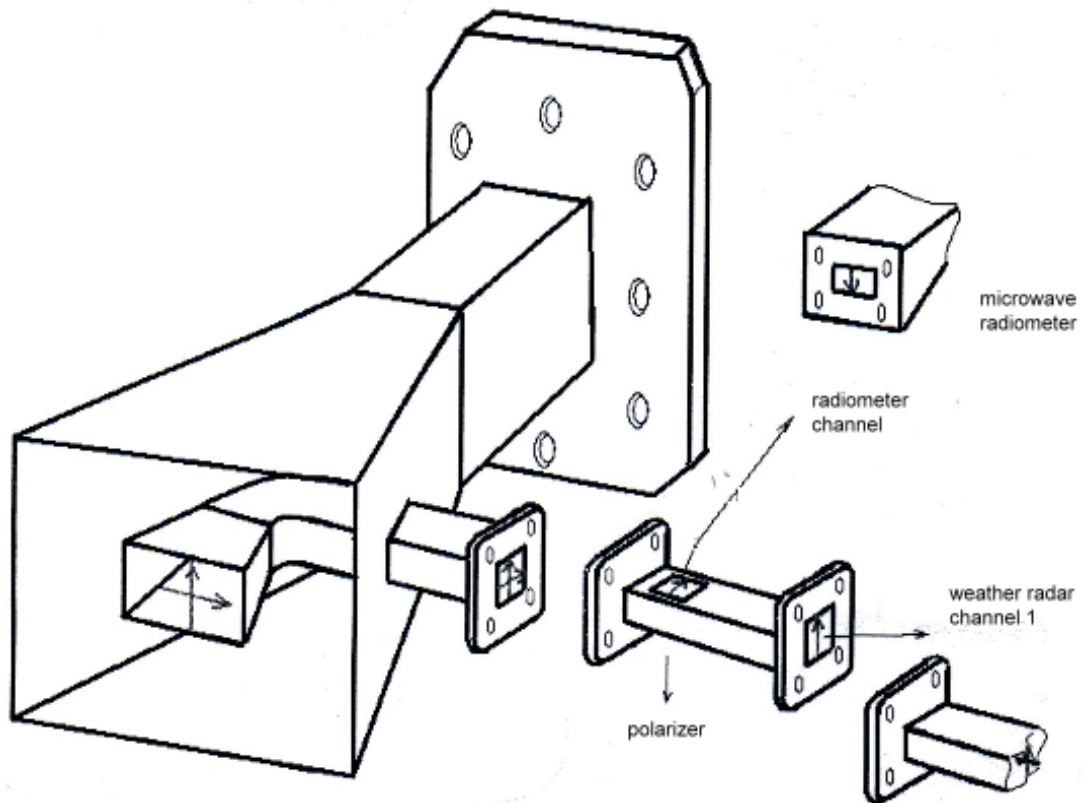


Fig. 2

III. INVESTIGATION OF CHANGES of passive channel characteristics in case of displacing irradiator out from focus

In first variant irradiator of passive channel is displaced from focus of parabolic dish. By means of easy calculations it is possible to define how diagram of passive channel will change. In table 1 you can see results for combined scheme (fig. 3) – maximum of passive channel is shifted approximately by 2° that should be taken into account in analysis of results.

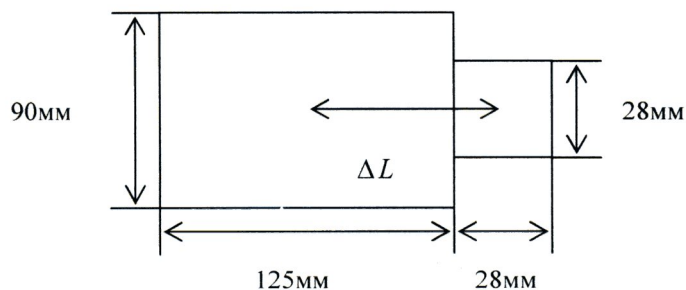


Fig. 3

	Regular diagram, $\Delta L=0$		Displaced diagram, $\Delta L=0,0765m$	
	F=10,7GHz	F=12,7GHz	F=10,7GHz ($\Delta L=2,73$)	F=12,7GHz ($\Delta L=3,24$)
$\Delta\Theta_{0,5p}$, degr	0,42	0,35	0,46	0,41
Umax r/Umax d, dB	-	-	-1,3	-1,8
$\Delta\Theta_{0p}$, degr	1,2	0,9	1,7	2
main maximum displacement, $\Delta\Theta$, degr	0	0	1,93	2

Table 1

IV. RECEIVER

Portable radiometer made on the base of TV-SAT converter (10,7÷11,7 GHz) is used as receiver.

V. RESULTS OF COMMON WORK of passive channel and weather radar MRL-5

Results of combined operation of active and passive channels for 5° elevation are shown on picture 4. Ordinate scale is done in K. It is clear that operation of radar does not change radiometer data that proves sufficient interference protection of this scheme. Operability of passive channel is characterized by contrast between response to black body radiation and values of noise temperature by elevation 5°, 40° and zenith 90°.

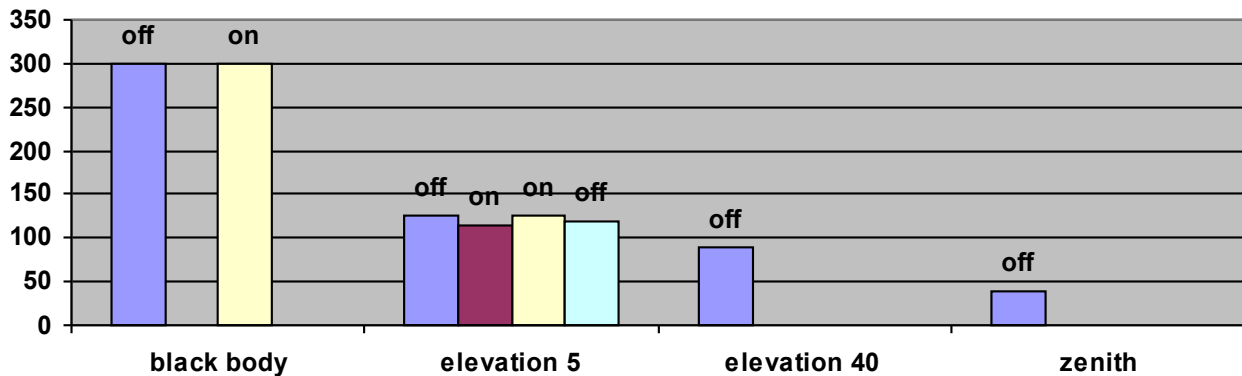


Fig. 4

VI. CONCLUSIONS

Usage of alternative scheme of integration makes possible to get operable and interference protected passive channel without changing scheme of MRL-5 weather radar.

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