ISSN 0735-2727, Radioelectronics and Communications Systems, 2009, Vol. 52, No. 10, pp. 553–560. © Allerton Press, Inc., 2009.
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Characteristics of Radio Frequency Paths of On-Board Aviation Navigation-Landing Equipment

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Received in final form October 28, 2008

Abstract—Methodologies and results of researching high-frequency paths in on-board navigation-landing equipment of meter frequency band are presented in this article. Recommendations on their design using international recommendations "ARINC" and "Rules of planes' flight eligibility RPFE-3" are given.

DOI: 10.3103/S0735272709100070

INTRODUCTION

In work [1] the structure and the main system parameters of closer navigation and planes landing radio devices of the third generation "Kurs MP-70" are presented. Radio devices of the fourth generation, VOR-85-01 and ILS-85-01, is presented in paper [2], while its interference immunity characteristics towards USW broadcast signals are described in [3].

Considering the radio frequency space-time interference conditions and the possible contents of the receiving-radiating radio technical devices (RTD) on the object-bearer of navigation-landing equipment the following requirements are specified for this equipment towards its interference immunity (II) and electromagnetic compatibility (EMC):

1. There should be no blockage of receiver, at the input of which there is a signal with standard modulation and the level by 3 dB greater than the warning signaling threshold when unmodulated interference (UMI) is present at its input with the following levels: by 80 dB greater than the useful signal in the frequency band 0.19–1215 MHz, excluding the frequency band from $f_{lw} - 0.03f_{avr}$ to $f_{up} + 0.03f_{avr}$; 0.5 V in the frequency band 2–24 MHz and 118–136 MHz, excluding the frequency band from $f_{lw} - 0.05f_{avr}$ to $f_{up} + 0.05f_{avr}$, where f_{up}, f_{lw}, f_{avr}, are upper, lower and average frequencies of the receiver's frequency band;

2. Interference, caused by cross modulation (CMI) should not lead to triggering the warning alarm in the cases of signals with standard modulation and the following levels: exceeding by 60 dB the real sensitivity of the receiver in the frequency band from $f_{lw} - 0.02f_{avr}$ to $f_0 - \Delta f$ and from $f_0 + \Delta f$ to $f_{up} + 0.02f_{avr}$, where f_0 is the receiver's tuning frequency, Δf is the frequency interval between channels; 200 mV in the frequency band from 0.19 to 1215 MHz, excluding the frequency band from $f_{lw} - 0.02f_{avr}$ to $f_{up} + 0.02f_{avr}$;

3. Warning alarm should not be triggered by intermodulation interference (IMI) of second and third order, caused by the impact of two interfering signals in the frequency band 0.19–1215 MHz, excluding the frequency band from $f_{lw} - \Delta f$ to $f_{up} + \Delta f$, with the triggering values of warning alarm for the useful signal;

4. The triggering level of warning alarm corresponds to the real sensitivity of the receiver and amounts to 3 μV and 6 μV with respect to the course and glide-path receivers respectively.

Satisfaction of the mentioned requirements allows using equipment on flying vehicles in the areas of all modern flying paths and airports, equipped with stationary systems of terrestrial basing VOR (Very High Omnidirectional Range), ILS (Instrumental Landing System).

Requirements towards EMC and II of devices according to the rules of GRFC 15-78, NLGS, international standards "ARINC" are specified for the allowed radiation levels into environment, for stability towards the influence of magnetic fields of sound frequencies, for ingesting modulated voltage of 0.5 V into the "control" wire of inter-block cords, for the influence of radiated interference of the specified in the requirement level, in the wide frequency band in the case of shielded input.

The article aims to analyze the correspondence of on-board navigation-landing equipment of the meter frequency band to modern international normative documents.