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September 20, 1993

William F. Caton, Acting Secretary
Office of the Secretary
Federal Communications Commission
Washington, D.C. 21554

RE: Comments upon Notice of Proposed Rule Making
Released: July 14, 1993.

Dear Sir:

Please accept for filing this day, September 20, 1993, my comments upon the above Notice of Proposed Rule Making RM-7610, PR Docket No. 93-199.

Enclosed are one original plus nine (9) copies for the Commissioners.

Thank you for your service.

Sincerely,

Jeffrey G. Lea

{Sorry about quality of copies.}

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Amendment of Part 87 of the	)	
Commission's Rules to implement	)	PR Docket No. 93-199
technical requirements	)	RM-7610
applicable to instrument	)	
landing system receivers	)	Notice of Proposed Rule
and VHF Omnirange Radio receivers	)	Making:
adopted by the International	)	Adopted: June 24, 1993
Civil Aviation Organization.	)	Released: July 14, 1993

COMMENTS ON THE NOTICE OF PROPOSED RULE MAKING
ON THE COMMISSIONS PLANNED ADOPTION OF ICAO ANNEX 10
TECHNICAL STANDARDS FOR ILS AND VOR RECEIVERS

To the Commission:

I. INTRODUCTION

1. As a Consulting Electronic Engineer specializing in high dynamic range receivers and receiver systems for the past years, and as a RF consultant recently working directly for one avionics company developing the capability for high dynamic range receiver systems, I would like to respectfully make the following comments regarding the above-entitled NPRM. The above NPRM proposes implimentation of the Annex 10, Aeronautical Telecommunications, Volume I, Section 3.1.4, "Interference immunity performance for ILS localizer receiver systems", and Section 3.6.4, "Immunity performance of VOR receiver systems to interference from VHF FM broadcast signals", et al. Generally, I would comment that the engineering to do this performance upgrade is very significant, but the technology is now available to the avionics industry to do this and it should add very little per-unit cost to receivers.

II. BACKGROUND AND DISCUSSION

2. For completeness, the Background, Discussion, and all references from the Notice of Proposed Rule Making released July 14, 1993 are contained here, as though fully set forth herein.

3. During the course of my engineering consulting work, the author has had an opportunity to examine in detail the general aviation electronics (avionics) industry and specifically many "state of the art" VHF Omnirange Radio (VOR) and Instrument Landing System (ILS), considered together as "aeronautical NAVigation" (NAV) receiver systems. Incredibly, some of the designs still in production today are vintage mid 1970 designs, many of these with out-moded component technology. Some of these designs have parts going, if not already gone, extinct. Nevertheless, the author should respectfully like to tender here comments in the following catagories: 1) where the industry is at today, 2) industry volume and parts procurement problems therefore, 3) receiver system aspects--existing, versus the required receiver system architecture(s), and, 4) authors concluding comments with issues and aspects of accomplishing the ICAO Annex 10 upgrade.

4. First, in examining where the industry is at today, it is best to recognize that much of the general escalating price of aviation equipment is in part due to safety-related regulation imposed by the industry upon itself. The products for such a safety-driven industry are made to extremely high standards and, though seemingly simple on the surface, the 'simple' products are often complex in ways not apparent to the industry outsider. The

NAV radio equipment, for instance, is undergoing constant engineering as demanded from the sophisticated users of the equipment notwithstanding the equipment constantly undergoing continuous cycles of internally generated engineering updates for normal 'problems' found in maintence and manufacturing of such products.

5. Secondly, the price of basic NAV avionics equipment is high, and will remain high, because the market for much aviation equipment is not changing nor expanding greatly. In fact, by in large, basic equipment to date is already in industry standard packages. And the industry has in place many sophisticated and high-caliber equipment repair facilities. The avionics industry is still somewhat in the mold of 1950-60s automobile industry, but much more sophisticated. The industry is based around constant, slow, and controlled change(s) and/or updates. The industry is virtually a custom electronics industry for each end user.

6. While customer demanded 'standards' and industry imposed regulation have gradually spiraled upwards, the actual production volume in the total industry is quite low, roughly stagnant, or in some equipment areas, actually shrinking. Worse yet, because of the general 'low volume' (1000s not 10000s+ per year) nature of the industry, the 'uncomfortable zone' has been reached for parts procurement, for instance. Within the electronics industry in total, the volumes of parts to the avionics industry is small.

7. Avionics companies are constantly faced with keeping their inventories low. It is believed that virtually all avionics manufacturers attempt to get 'just in time' (JIT) delivery of

parts as well as JIT delivery to their customers. This constant juggling act makes their business a daily struggle. These day to day difficulties coupled with each manufactures' firm and well-founded belief that its own designs are time-tested, proven and sound, have so paralized many manufacturers to the point that they 'fear' change, instead of welcome the opportunity that these new ICAO standard actually sets forth for them.

8. The third major area of my comments involve the receiver systems aspects of implimenting the ICAO Annex 10 standards. A typical NAV receiver design produced today by many manufacturers in the industry has the following architecture: 1) double-tuned (by varicap) radio frequence (RF) filter, 2) RF amplifier (with about 25-30+dB of gain), 3) another varicap RF double-tuned filter, 4) MOS-FET mixer (with about 20 dBm of gain), 5) a local oscillator (L.O. generated from a frequency synthesizer) injected into the mixer at about 0-3dBm, 6) IF filter (multi-pole), 7) IF amplification and AM detector, and 8) instrumentation circuitry (this intentionally collapses/simplifies 6), 7), and 8) above). Within this typical receiver architecture, to achieve high signal original performance, the RF amplifier must have 'delayed' automatic gain control (AGC) applied to approximately -40 to -50dB from its maximum gain. To summarize briefly, a typical current production NAV receiver has about 45dBm of conversion gain (gain minus filter losses), requires about 0-3dBm of LO, and currently has about 45dB of AGC range. Because of high front end (FE) gain through the mixer, the IF filter looses and IF amplifier noise

figure (NF) are generally not significant nor considered greatly.

9. To obtain the newly required ICAO performance, the architucture would have to change somewhat: 1) and 3) become more complex filters, and special work is required to obtain 'high dynamic' performance, 2) RF amplifier becomes a very linear (at high signal levels) amplifier and this stage may (with feedback) produce less than 20dB of gain. A 'high dynamic' mixer required 5), usually has 7-8 dB of loss and requires +17-22 dbm of LO across the NAV band from a linear buffer. Special coupling is required to match the output from the mixer to the IF filter to preserve the high signal intermod performance due to severe phase shifts at IF filter bandwidth extremes. And lastly, the highly linear RF amplifiers with feedback, don't lend themselves readily to AGC, in fact, it is better to not AGC these stages at all. Because of the much smaller net FE gain (perhaps as low as 4-6dB), and different AGC performance, the IF filter 6) and early IF amplification stages 7) now must also be redesigned to add gain, to obtain better noise figure performance, and to accommodate more applied AGC. As can be readily seen the architecture of a high dynamic receiver capable of meeting the ICAO Annex 10 upgraded performance is quite different from the typical NAV receiver in production today, but it is technologically sound.

10. There has been a hope, by at least one manufacturer in the industry, that this company would and could be allowed to add external to their NAV radios some filter which would then allow their current production NAV radios to pass ICAO Annex 10. In

that the author has never be able to tangibly obtain and test such a filter, this option does not seem feasible. In fact, the author can produce about an inch of documented case histories, etc. seemingly verifying that such an attenpted filter, though not theoretically impossible, is probably doomed to failure. The author knows of no filter or other manufacturer who is in earnest planning on the production of such a filter as well. It stands to reason that even if such an 'external to the radio box' filter were even possible, then it would not be viewed as a viable or 'regulate-able' solution. This federal agency, or the FAA would surely not find such a solution viable when such filter could be, (and no doubt would be) removed by dealers, users, or others 'to save customer's expense' and/or 'to improve radio performance'.

III. CONCLUSIONARY COMMENTS

10. The author knows of only one style of NAV receiver architecture which will conservatively produce ICAO Annex 10 high dynamic upgraded performance, and that was described previously. It would be prudent to indicate that at least two manufacturers have NAV at least one NAV receiver design(s) which will meet the Annex 10 requirements (Collins, King), and at least one is in volume production (i.e., King KX-125). But it must be stated that for each manufacturer to comply, that generally the existing NAV receivers will have to be redesigned to meet ICAO, Annex 10.

11. From the standpoint of a consultant to the industry in the area of high dynamic range receivers, it would not be possi-

ble for me to delve deeply into the various costs associated with properly engineering new receiver designs to meet the new Annex 10 performance upgrades. However, it can be affirmatively stated that the newly required architecture might only moderately affect the cost of some of the lower volume NAV receivers. That is to say that it is the authors opinion that the cost of parts and the cost of muanufacturing the new designs would be be about the same on the most expensive NAV receivers, and might somewhat increase the lower priced receivers. In that the manufacturers might have out-moded designs still in production with expensive out-of-date parts, there might well be a net cost savings to redesign each of the NAV radios to meet the ICAO Annex 10 performance upgrade. The Non-Recoverable Engineering (NRE) costs themselves may be truly offset largely by various manufacturers requiring new receiver designs to replace out-moded technology and/or parts in any case, and in the potential savings of new design(s) themselves.

12. In the final concluding comments of the author, he would again stress that, to be sure, to meet the ICAO Annex 10 NAV receiver performance upgrades, each manufacturer MUST be committed to a NAV receiver redesign for many (possibly all) of their existing NAV receivers per architecture as somewhat outlined herein. It is the strong recommendation of this author that the ICAO Annex 10 performance be enacted into regulation for the reasons stated within, and thoughout the NPRM, and additionally as a safetly enhancement to the avionics industry. However, because of the accurate industry outlook and the technical issues

previously presented, it would seem to be very appropriate to consider the various logistical issues involved in accomplishing the required NAV receiver redesigns necessary for the entire industry. Therefore, this author concludes by respectfully asking this agency to, in minimum, to differ the January 1994 'manufacturing' deadline to January of 1995, and to differ the 'installed' deadline from January 1995 to January 1996, the other dates to remain as published July 14. This seems to the author an industry fair compromise and should allow each manufacturer sufficient time to get new receivers (and/or modification kits) into the marketplace, yet accomplishes full intent of the NPRM.

Dated: September 20, 1993.

Respectfully submitted:

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