16 June, 2003

Mr. Riley Hollingsworth
Special Counsel
Enforcement Bureau
F.C.C.
1270 Fairfield Road
Gettysburg PA 17325

Dear Sir;

Michael Lonneke, W0YR, has asked me to express to you my opinions regarding "Hi-Fi-SSB" on the HF amateur phone bands.

A basic principle and historical reason for SSB is its ability to confine the modulation bandwidth, therefore its spectrum usage, to the minimum that is needed for effective and highly articulate voice communication without an annoying and wasteful "carrier". This bandwidth has been found experimentally by many investigators in the 1950's to be in the range of 300 Hz to 3000 Hz at the –3 dB points. Low values of shape factor (60 dB to 6 dB), such as 1.5 :1, are achieved by crystal or mechanical filters, in previous times, and by digital filters at the present time. These filters very rapidly decrease the level of interference to adjacent channels immediately above and below the desired channel. If other conditions are met, this has proven to be very satisfactory for amateur, commercial and military voice communication systems. In the future, bandwidth compression methods are expected to become more widely available.

SSB requires several stages of highly linear amplification to reach the RF output power level. Problems with adjacent channel "splatter" can, and often do, occur if a suitable degree of amplifier linearity is not achieved.

There are reasonable limits to performance expectations with respect to adjacent channel interference that are achieved in Amateur equipment that is available from vendors, both with respect to filter design and amplifier design. In nearly all cases, for amateur radio, the problem seems to be the result of incorrect adjustment and usage of the equipment, rather than poor design. Final amplifers that are attached to the output of the exciter or transceiver are special culprits. The correct usage of these amplifiers invariably requires some technical "savvy" on the part of the operator.

A particular problem is the usage of ALC (automatic level control), which sometimes does not maintain linearity in the exciter and the PA. Some operators have disdain for ALC in the belief that it causes distortion (the antithesis of hi-fi). This is a real possibility. A fast-fluctuating ALC adds speech frequency envelope components to the ALC gain-control circuitry that creates distortion. For both ordinary SSB and hi-fi SSB the ALC must be correctly designed. Collins Radio Co. (now Rockwell-Collins) has a long history of correct ALC (and TGC) design for SSB transmitters.

Based on these comments, I would like to suggest some guidelines for Amateur Band equipment. These suggestions define what I believe are “reasonable” and “excellent” for HF amateur equipment.

1. Modulation bandwidth should be limited to the 300 to 3000 Hz band (at the 3 dB points). For those who are interested in higher levels of fidelity, 100 to 3600 might be an acceptable compromise that would not produce serious levels of adjacent-channel interference (see also next item).

2. Response should roll off at rates consistent with bandpass filters which are standard for the SSB art. For hi-fi enthusiasts, these filters should be digital FIR filters with steeper rolloff in their high- and low-freqency transition bands. High frequency pre-emphasis should not be used that greatly accentuates the voice energy at the upper limit. The voice naturally rolls off at about 5 or 6 dB per octave, starting at about 500 Hz. This should not be excessively modified, in order to limit adjacent channel spillover. Low frequencies should also not be excessively modified.

3. The power amplifiers should have a PEP power level, within higher and lower adjacent channels, that is 40 dB below the PEP level of the desired channel. Amateur equipment design techniques that can achieve this are readily available. ALC (TGC) must be carefully applied in the exciter, and derived from exciter or PA or both, so that this performance is assured without constant attention (hands-off). In other words, the interference begins with excessive modulation bandwidth, but the problem of splatter is, in my opinion, serious and prevalent.

4. An excellent approach to monitoring the performance would be to enhance the ARRL Official Observer program to show the Observers how to evaluate signals correctly. The equipment and the methods are fairly simple and can be worked out by the ARRL Lab staff and/or by technical advisors.

I hope that these ideas and suggestions will be helpful in cooling down the rhetoric and the concerns of the amateur radio community. Some of the complaints have some merits, I am sure. I note also that many of the hi-fi enthusiasts have already voluntarily reduced their bandwidths and have become more attentive to the linearity problems. With some guidance from your office, I am sure the message will prevail.

I am not concerned about “frequency ownership”, however I note that many amateur groups historically prefer certain frequencies, and these tend to be pretty much accommodated by the amateur fraternity, with the understanding that these frequencies are not “owned”.

To summarize: I am in favor of the proposed action by FCC, subject to the comments and suggestion presented above.

Personal Resume: I am retired from the Advanced Technology Dept. of Rockwell-Collins (formerly Collins Radio) in Cedar Rapids IA. I have been involved in SSB equipment

design at Collins since 1964. I am co-Editor of the book “Single-Sideband Systems & Circuits”, McGraw-Hill 1987 and 1995 (second edition), and “HF Radio Systems & Circuits” Noble Publishing, 1998. I am a contributor to the the ARRL Handbook (1995-2004), including Author of Chapter 17, “Receivers, Transmitters and Transceivers” and other topics (see Index). I am the author of a large number of articles in QST and QEX and RF Design magazines. My interest in this topic is purely technical, and I am not associated with the “hi-fi SSB” activity.

Sincerely,

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