RESULTS OF FM-TV THRESHOLD REDUCTION INVESTIGATION FOR THE ATS F TRUST EXPERIMENT

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In commercial FM-TV transmission, threshold effects are seldom a problem since the received carrier-to-noise ratio is usually large. For low cost community TV reception via satellite, however, this is not necessarily the case. For this reason, an investigation of threshold effects in FM-TV was initiated, primarily to determine if any simple, low cost techniques were available which can reduce the subjective video threshold. The first step was to examine the work of Rice and determine the fundamental causes and effects of threshold phenomena. From this study, it was determined that the threshold would be caused by voltage spikes appearing at the demodulator output as the input carrier-to-noise ratio is decreased. It was thought that the observed effects due to this phenomena would be white dots in the dark picture areas and black dots in the white areas. Actual observations, however, revealed that as the carrier-to-noise ratio was decreased, the first observable threshold effect was frequently white streaks which were noticed in the dark picture areas. No corresponding black streaks in white picture areas were observed, and the expected black and white dots did not occur until substantially lower carrier-to-noise ratios were reached.

A reexamination of the problem led to the following hypothesis: Since the probability of occurrence of a spike depends not only on the input carrier-to-noise ratio but also on the deviation of the carrier from the center frequency, and since the video horizontal sync pulses represent the peak frequency deviation in one direction, it is reasonable to assume that many spikes will occur during the horizontal retrace period. These would normally appear as white dots, but the fast horizontal retrace smears them, and they appear as white streaks which are visible only in the dark picture areas. Examination of the video waveforms revealed that this was indeed the case.

Two methods have been examined to eliminate these effects. One method is the use of standard video pre-emphasis. The pre-emphasis

networks attenuate the low frequency portion of the baseband video signal by about 10 dB, thus reducing the deviation of the carrier due to the low frequency components of the video signal. Since the horizontal sync pulses are primarily composed of low frequency components, the deviation of the carrier due to the sync pulses is reduced, thereby reducing the probability of threshold spike occurrence. While pre-emphasis is a well known, inexpensive technique, there are cases for which one does not wish to use it. Obviously, if a standard FM signal is being received, one cannot utilize a de-emphasis network at the receiver without requiring that a pre-emphasis network be employed at the transmitter. For this reason, an alternate technique, horizontal retrace blanking, was developed.

Normal TV sets are designed for use with the standard AM-TV transmissions and rely on the detected video waveform to blank the picture during horizontal retrace. In an AM system, no threshold spikes occur during the sync pulse, and horizontal retrace blanking is unnecessary. For an FM system, this is not the case. However, adding a circuit to blank the picture tube during the retrace period will solve the problem. A simple one-shot multivibrator, triggered by the start of horizontal retrace and providing a blanking pulse to the picture tube, is a simple and inexpensive means of eliminating these threshold noise streaks.

If one defines the subjective threshold as that carrier-to-noise ratio at which threshold effects just become noticeable, then horizontal retrace blanking provides about a 3 dB decrease in the subjective threshold. Based on this, one can conclude that active horizontal retrack blanking does provide a simple technique for reducing the subjective threshold in standard FM-TV (see Figure 1).

WITHOUT BLANKING

WITH BLANKING

Figure 1—Demonstration of the effect of active horizontal retrace blanking. Both pictures are at the same carrier-to-noise ratio.