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DAB Subcommittee

EVALUATION OF THE iBiquity DIGITAL CORPORATION IBOC SYSTEM

Part 2 – AM IBOC

Appendix H

Additional AM 1st Adjacent Compatibility Analysis and Tests

Undesired Modulation Model

The undesired signal for the 1st adjacent analog-to-analog objective reference tests conducted at Xetron used an analog AM NRSC pre-emphasized exciter, modulated with 10 kHz LP filtered processed pink noise. For the laboratory subjective recordings the undesired signal path was the same as the objective with the undesired channel modulated with the processed "Shania" audio cut. The modulation of the undesired channel for both the objective and subjective tests was in accordance with the NRSC test procedures. Table 1 shows the S/N performance of the two test groups with widely different undesired modulating signals. Test group #1 shows the 0 dB D/U Xetron test results using a pre-emphasized pink noise 10 kHz LP filtered signal for the undesired modulation. The S/N ranged from 14dB to 16dB for the four receivers. Test group #2 shows the results for the characterization tests that used a 400 Hz tone for the undesired modulation. The S/N for the two narrow bandwidth automobile radios measured 53 dB, the portable 5 dB, and hi fi 17 dB. It is clear that the selectivity of the radios has little to do with performance when the 1st adjacent undesired signal is modulated with wideband noise, and selectivity has a definite affect when the undesired modulation is narrow band.

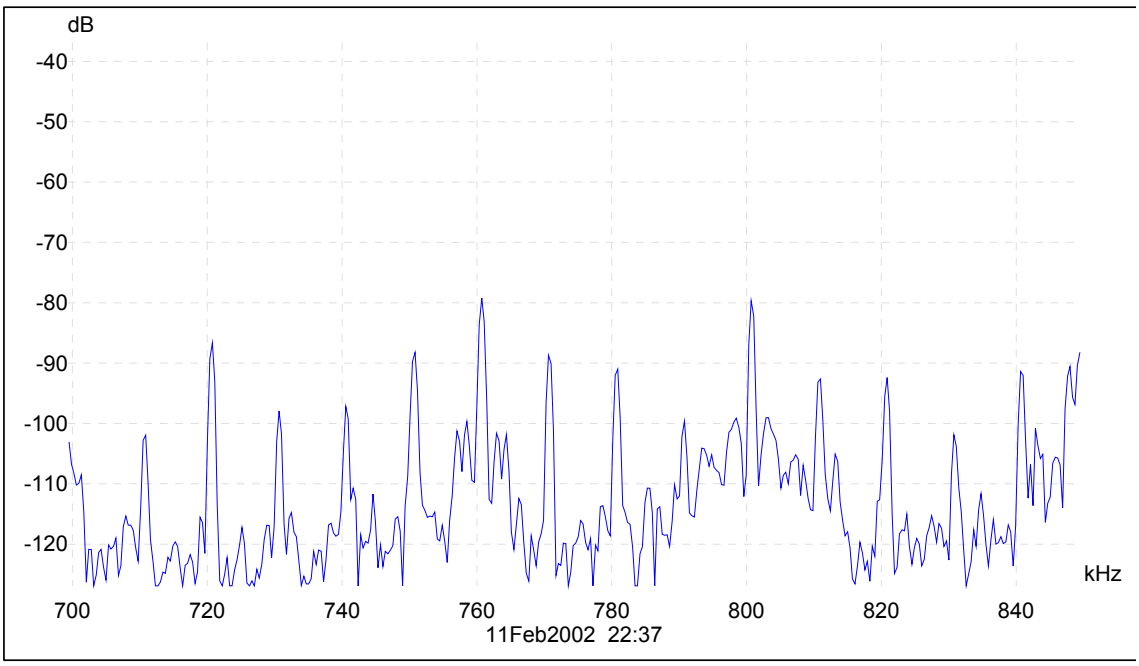
Table 1: 1st Adjacent Analog-to-Analog Interference as a Function of Undesired Modulation – Laboratory Results

Illustrates S/N difference with modulating bandwidth WQP S/N		
	Test Group #1 Xetron D/U = 0 dB Undesired modulation 10 kHz Noise (S/N)	Test Group #2 RMc D/U = -10 dB Undesired modulation 400 Hz Tone (S/N)
Delphi	15 dB	53 dB
Pioneer	14 dB	53 dB
Sony	16 dB	5 dB
Technics	15 dB	17 dB
Test group #1 is the result of compatibility tests conducted at Xetron for the NRSC. The undesired modulation was 10 kHz low-pass filtered, processed, and pre-emphasized pink noise. Test group #2 is the result of receiver characterization tests performed at the McCutcheon Laboratory for iBiquity. The undesired modulation is 400 Hz.		

The objective of the compatibility test program is to measure differences found with the introduction of the digital signal. The undesired modulation models used for the objective and subjective tests were based on fully processed wideband music, a program format that does not fit the majority of contemporary nighttime AM broadcast stations. Assuming that the 10 kHz LP filtered audio is representative of contemporary music interference, the objective and subjective test data in the iBiquity report is representative of the A to A interference from analog stations with a music format. To make the laboratory tests represent real world interference, the test should have been conducted with talk and music interferers.

Supplemental off-air Listening Tests (First adjacent off-air quality)

Because of the limitations of the laboratory undesired analog model and the limitations of the field tests, first adjacent listening tests were conducted at the McCutcheon laboratory in North Olmsted, Ohio, a western suburb of Cleveland. The test objective was to assess the quality of AM reception with 1st adjacent analog interference. The spectrum analyzer plot in Figure 1 shows the relative levels of four first adjacent stations: WSB, WJR, WABC, and WBBM spaced at 10 kHz intervals. The test was conducted around 10 PM EST on February 11, 2002. The receiver used for this evaluation test was a seven-year-old Ford auto radio Model F3FX-19B165-DA connected to a HiFi sound system used for evaluating AM audio quality. The receiving antenna was a short probe mounted above the structure. Reference audio was from a strong local 50 kW talk station (WTAM, 1100 kHz). All four stations broadcast talk formats. The WJR signal was 10 dB (760 kHz) stronger than WSB (750 kHz), WSB received a slight increase in noise. With WABC (770 kHz) 10 dB below WJR (760 kHz) and WBBM (780 kHz) 3 dB weaker than WABC, WABC received with slight adjacent channel interference. The listening tests were conducted by Mr. Robert McCutcheon and were not as sophisticated as those conducted by iBiquity at Dynastat. The off air monitoring shows that good AM audio is being received in the presence of 0 dB D/U 1st adjacent signals.



Freq.	Call	Location	M/S	Audio
750 kHz	WSB	Atlanta	Mono	Clear
760 kHz	WJR	Detroit	Stereo	Clear
770 kHz	WABC	New York	Mono	Minor Interference
780 kHz	WBBM	Chicago	Mono	Clear

Radio: Ford Auto F3FX-19B165-DA 1994

Figure 1: Spectrum Analyzer Plot

Extended Laboratory Tests

The laboratory compatibility tests conducted by iBiquity for the NRSC used only three D/U ratios, 0 dB, 15 dB, and 30 dB. An additional objective compatibility test conducted by Xetron is reported in the Clark engineering study done for iBiquity. The interference for these tests was advanced in 3 dB steps for 23 levels for both upper and lower 1st adjacent and extended from -24 dB to +45 dB D/U. Two (Delphi auto and Sony portable) of the four NRSC radios were used for this test. The test results show that with the interference reduced 9 dB (D/U 9 dB), the WQP S/N for both receivers improved by 9 dB. At +15 dB D/U all four receivers are in the 28 dB WQP S/N range (NRSC tests).

Conclusions

Using the Delphi receiver's D to A extended test data from the Clark report and the off air D/U ratios measured in the Cleveland area, the S/N for each station can be predicted. Using this data the following S/N predictions are made. If WJR went on the air with digital, WSB and WABC signal to noise ratio at this Ohio site would be 5 dB. If WABC went on the air with digital, WBBM S/N would be 10.5 dB.