

Appendix G

FM-DAB Audio Quality Comparisons In Unimpaired Environment

1. Overview

The USADR IBOC system is designed to provide superior audio quality. In order to validate performance, it is important to compare digital audio quality to analog.

USADR has performed a number of laboratory tests to measure the performance of its FM hybrid IBOC DAB system in an unimpaired channel. These tests record analog audio from a consumer FM receiver and from an FM hybrid IBOC DAB receiver. This report documents the results, which permit direct comparison between the performance of IBOC digital audio and existing analog audio under pristine conditions.¹

2. Definitions and Assumptions

Accurate interpretation of the test results is incumbent upon a thorough understanding of the assumptions and definitions described below.

2.1. Desired signal

The desired hybrid IBOC signal was comprised of an analog FM host signal and a baseline DAB signal. The analog FM host signal consisted of a pilot and a main audio channel modulated by processed pop music. USADR used cuts from the original CDs to produce a medley of Dire Straits (31 seconds), Pearl Jam (32 seconds), and Suzanne Vega (11 seconds). The audio processing was provided using an Omnia FM audio processor. Great care was taken to ensure that the processing applied to the host FM, depicted in Table G-1, was typical of a broadcast FM station. The host FM signal was generated using a Harris SuperCiter FM exciter, which was present in all measurements.

The DAB signal power was set to 22 dB below the total power in the host FM signal. It was generated using a USADR FM IBOC DAB exciter.

2.2. Analog FM Test Receiver

USADR selected a Denon home HiFi (part number TU-680NAB) to assess analog audio quality. An RF signal was delivered to the receiver over coaxial cable through a BNC connector. Receiver left- and right-channel audio outputs were recorded using an Akai DR8 eight-channel digital recorder. These recordings will subsequently be used to assess analog audio quality.

¹ In an attempt to attain as clean a channel as possible this test was performed with all RF traveling through coaxial cables in a controlled laboratory setting.

3. Test Procedures

3.1. Audio File Generation

This test simultaneously records analog audio from both the home HiFi and the FM hybrid IBOC DAB receiver. The test is performed under strong signal conditions. The test setup is shown in Figure G-1. All precautions have been taken to ensure that the signals at each receiver are identical, with simultaneous recording and splitting of the signal to both receivers at the last possible point.

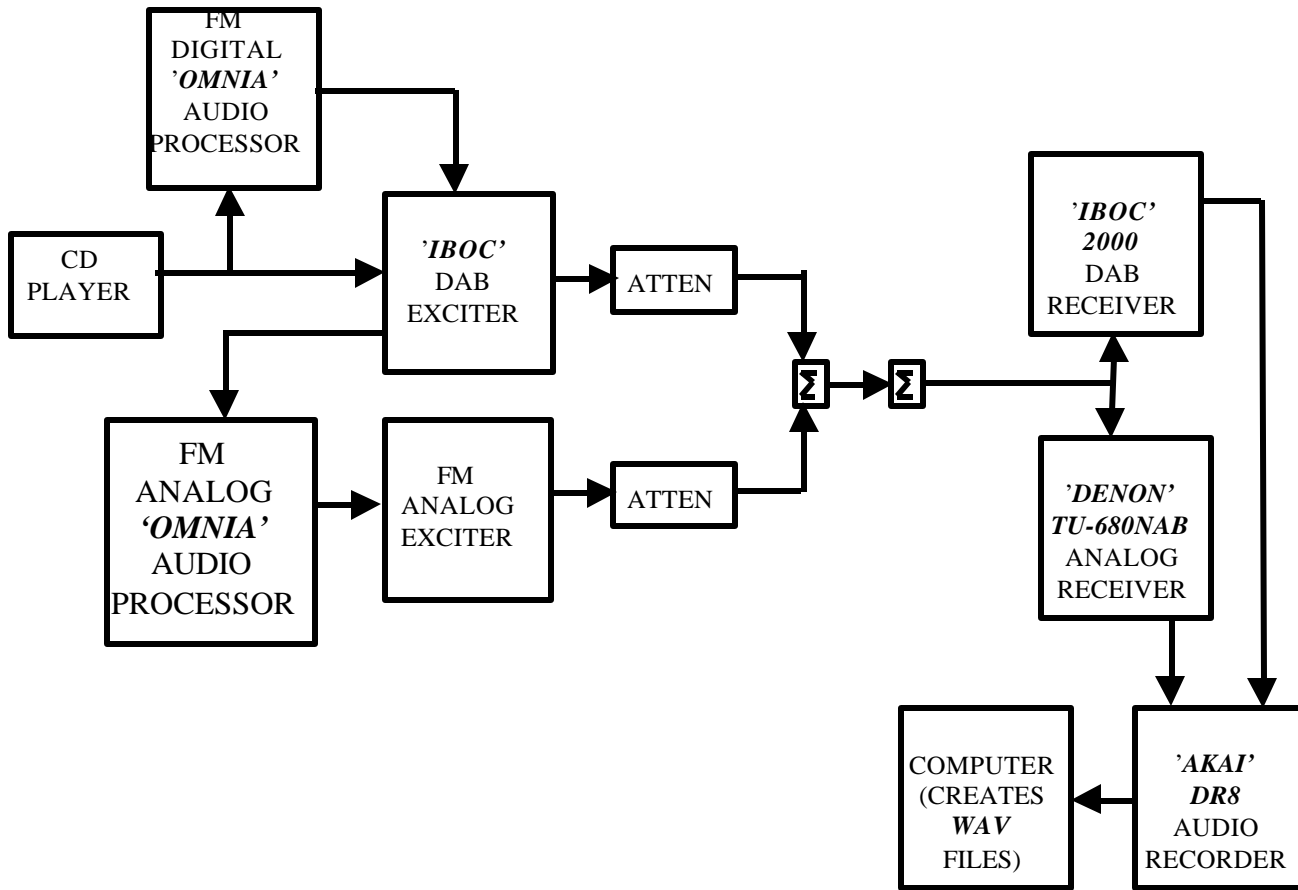


Figure G-1 Unimpaired Audio Test Setup

	DAB	Rock-FF (Analog)		DAB	Rock-FF (Analog)
Wideband AGC			Low Limiter		
AGC Drive	+6.0dB	+8.0dB	Low Drive	+1.5dB	+5.0dB
Attack	3	3	Attack	3	4
Release	2	2	Release	0	3
Make-Up Gain	2	2	Hold Thresh	2	2
Gate Thresh	3	3	Limit Thresh	1.5	1.5
Wideband AGC	IN	IN	Mid Limiter		
Phase Rotator	IN	IN	Mid Drive	+0.5dB	+4.0dB
Bass			Attack	4	3
Deep Bass	0.0dB	+5.0dB	Release	1	2
Warm Bass	+0.0dB	+3.0dB	Hold Thresh	2	2
Phat Bass	0.0dB	+4.0dB	Limit Thresh	-1	0.0
Crossover			Pres Limiter		
Low Gain	+2.5dB	+3.0dB	Pres Drive	-1.5dB	+8.0dB
Mid Gain	+1.5dB	+2.5dB	Attack	4	2.5
Pres Gain	+1.0dB	+2.5dB	Release	2	2.5
Hi Gain	+1.0dB	+2.5dB	Hold Thresh	3	2.5
Low Band AGC			Limit Thresh	-4	2.5
Attack	2	2	Hi Limiter		IN
Release	2	1	Hi Drive	-2.5dB	IN
Make-Up Gain	3	2	Attack	4	
Gate Thresh	3	3	Release	2	+5.0dB
RTP Speed	SLOW	FREEZE RTP	Hold Thresh	3	+3.0dB
RTP Level	-5.0dB	-10.0dB	Limit Thresh	-7	+4.0dB
Mid Band AGC			Mixer		
Attack	3	3	Low Band	0.0dB	+3.0dB
Release	2	4	Hi Band	0.0dB	+2.5dB
Make-Up Gain	3	4	Mid Band	0.0dB	+2.5dB
Gate Thresh	3	3	Pres Band	0.0dB	+2.5dB
RTP Speed	SLOW	FREEZE RTP	Clipper		
RTP Level	-5.0dB	-10.0dB	Drive	+1.5dB	3
Presence AGC			P.A.C.	OFF	3.4
Attack	3	3	Composite		3.8
Release	3	4	Drive	0.0dB	4.2
Make-Up Gain	3	4			
Gate Thresh	3	2			
RTP Speed	SLOW	FREEZE RTP			
RTP Level	-5.0dB	-10.0dB			
Hi Band AGC					
Attack	4	4			
Release	2	2			
Make-Up Gain	3	2			
Gate Thresh	3	1			
RTP Speed	SLOW	FREEZE RTP			
RTP Level	-5.0dB	-10.0dB			

Table G-1 Omnia Audio Processor Settings

4. Test Results

USADR recorded analog audio from a consumer FM receiver and digital audio from the FM hybrid IBOC DAB receiver. Table G-2 defines the audio file names from which a direct comparison can be made. Samples of these files are supplied with this report.

Table G-2 Wave File Definition

Audio File Name	Source Receiver	Description
CD_DS.WAV		CDsource Audio
CD_PJ.WAV		CD source Audio
CD_SV.WAV		CD source Audio
CD_DS_PJ-SV.WAV		CD source Audio
FM_DAB_DS.WAV	IBOC	Recorded from IBOC Receiver
FM_DAB_PJ.WAV	IBOC	Recorded from IBOC Receiver
FM_DAB_SV.WAV	IBOC	Recorded from IBOC Receiver
FM_DAB_DS_PJ_SV.WAV	IBOC	Recorded from IBOC Receiver
FM_ANALOG_DS.WAV	Denon	Recorded from Denon Receiver
FM_ANALOG_PJ.WAV	Denon	Recorded from Denon Receiver
FM_ANALOG_SV.WAV	Denon	Recorded from Denon Receiver
FM_ANALOG_DS_PJ_SV.WAV	Denon	Recorded from Denon Receiver

5. Conclusions

An analysis of the audio files demonstrates that even in an unimpaired channel, the quality of the IBOC audio recorded off of the USADR receiver is superior to the analog audio recorded off of the Denon receiver.