Vinson & Elkins
ATTORNEYS AT LAW

VINSON & ELKINS L.L.P.
THE WILLARD OFFICE BUILDING
1455 PENNSYLVANIA AVE., N.W.
WASHINGTON, D.C. 20004-1008
TELEPHONE (202) 639-6500
FAX (202) 639-6604

Writer's Phone: (202) 639-6722
Writer's Fax: (202) 639-6604

E-mail: ashuldiner@velaw.com
Web: www.velaw.com

January 2, 2001

Mr. Milford Smith
Chair, DAB Subcommittee
National Radio Systems Committee
c/o National Association of Broadcasters
1771 N Street, N.W.
Washington, D.C. 20036

Dear Milford:

Enclosed you will find a copy of iBiquity Digital's report to the FCC concerning recent tests of IBOC DAB's impact on analog and digital SCAs. This experimental test report, which is being filed concurrently with the FCC, details a series of laboratory and field tests and a recent field demonstration. All these tests indicate IBOC DAB will not have a detrimental impact to existing SCA operations. We are submitting this information to the NRSC to ensure the DAB subcommittee is fully informed of these recent test results.

Please do not hesitate to contact me if you have any questions.

Sincerely,

Albert Shuldiner

Counsel for iBiquity Digital Corporation

Enclosures

cc: David Layer
E. Glynn Walden

120401_1.DOC

iBiquity Digital Corporation
Experimental Report on
DAB Compatibility with Existing SCAs

As part of its ongoing testing of In-Band On-Channel Digital Audio Broadcasting ("IBOC DAB") technology, iBiquity Digital Corporation ("iBiquity") has studied the potential impact of IBOC DAB on existing subsidiary communications services (SCAs") in the FM band. Although SCAs are afforded only secondary status, iBiquity has recognized SCAs often are used to provide valuable services. At the same time, the existing problems with many SCAs makes them particularly vulnerable to interference from IBOC.

This report provides the results of recent laboratory tests, field tests and demonstrations conducted for both analog and digital SCAs.

Overview

Due to their location at the high end of the baseband spectrum, some SCAs currently suffer from a lack of robustness because the post-detection noise floor increases with the square of the frequency. Since FM demodulation is essentially a non-linear process, when DAB sidebands are added to the host FM it produces intermodulation which increases the audio noise floor, particularly in the higher baseband frequencies. The amount of intermodulation is determined by the bandwidth of the FM receiver and the relative levels of the intermodulating signals. The placement of the intermodulation products are determined by the frequency of the intermodulating signals. Therefore, the effect upon any SCA is highly dependent on the amount of deviation of the host analog. Indeed, simulations have indicated that the addition of DAB sidebands to an FM signal could affect the SNR of the SCA.

iBiquity has conducted several tests to measure the change introduced to host SCAs by IBOC DAB sidebands. These tests measure the audio SNR and bit error rates of SCAs at various signal and noise levels in the presence of DAB sidebands at $-22dB_{host}$.

This report contains results from the following tests:

- Test 1 — Analog SCA lab test using iBiquity's Columbia, Maryland Experimental FM Station
- Test 2 — Analog SCA field test using WETA FM, Washington, D.C.
- Test 3 — Analog SCA field demonstration of 67 kHz SCA
- Test 4 — Digital SCA lab and field tests using iBiquity's Columbia, Maryland Experimental FM Station
- Test 5 — Digital SCA field test using WPOC FM, Baltimore, Maryland

Definitions

The *processed clipped pink noise* is simply white gausian noise that has been filtered with a 3 dB/octave rolloff and is subsequently processed using an Orban FM Optimod 2200D. The pink noise was generated by the Audio Precision System Two 2322.

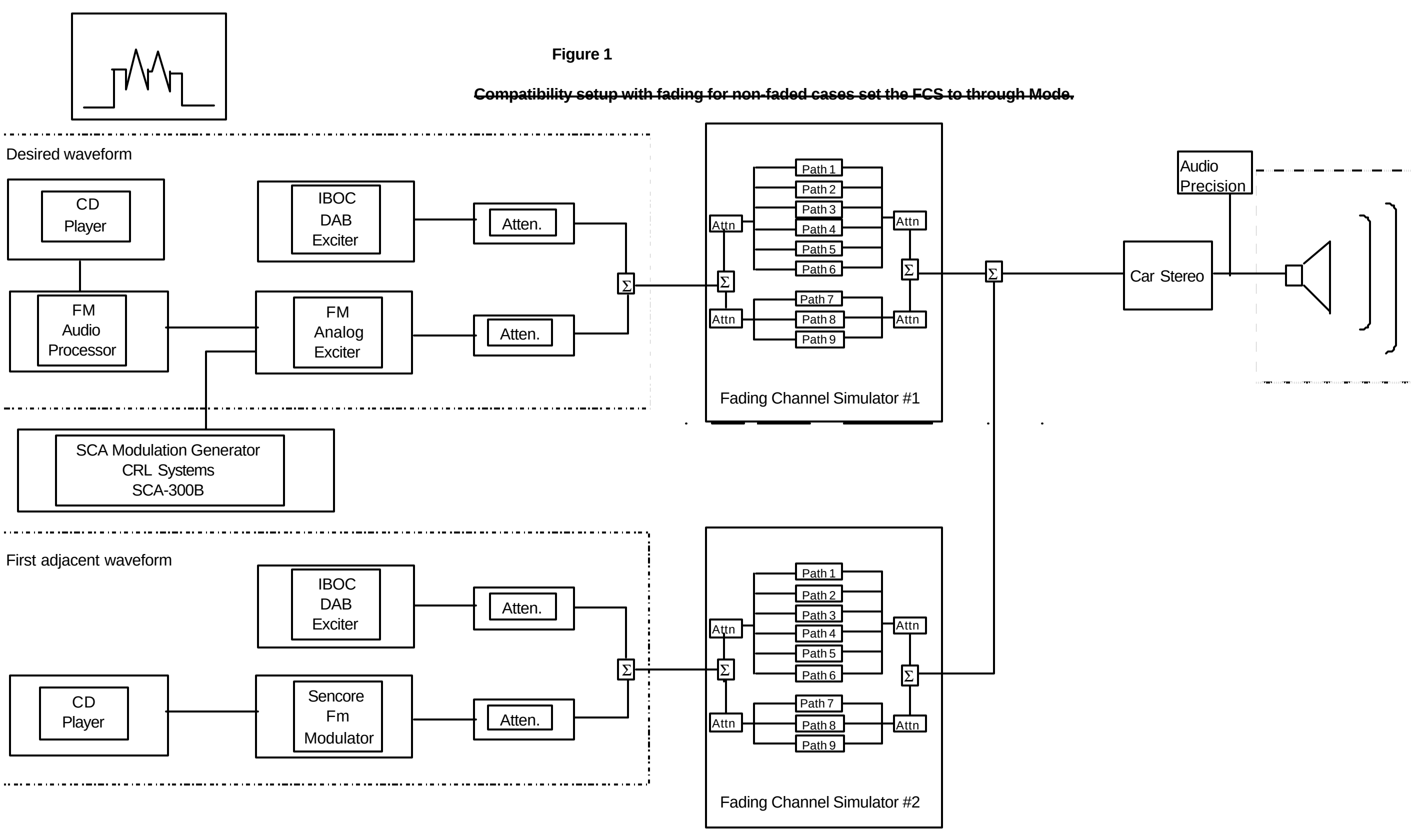
Test 1 — Analog SCAs — Columbia, Maryland Experimental Test Station

The following test procedures were used for these tests.

(a) Transmit a 54-dBu baseline FM desired signal modulated with processed pink noise. Add a 67 kHz analog SCA at 10% injection modulated with a 1kHz tone. Measure and record the SCA audio amplitude.
(b) Remove the 1 kHz tone. Measure and record the SCA audio amplitude.
(c) Calculate the audio SNR by subtracting the (b) result from the (a) result.
(d) Add baseline DAB (-22dB_{host}) to the host FM signal. Modulate the 67 kHz tone as above.
(e) Remove 1 kHz tone. Measure and record the SCA audio amplitude and calculate the SNR as in (c)
(f) Calculate the change in audio SNR by subtracting the (e) result from the (d) result.

Figure 1

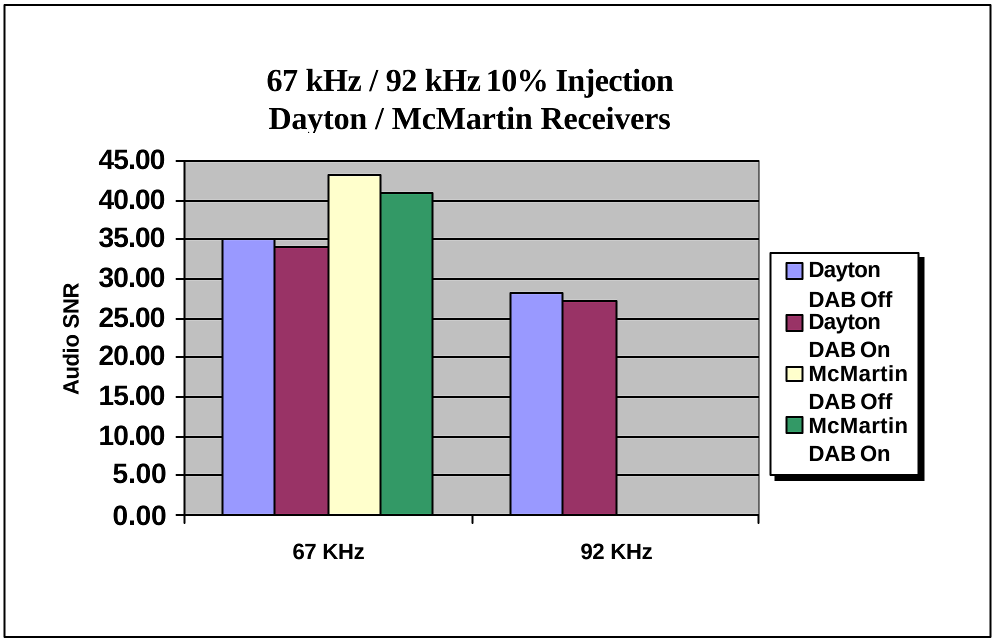
~~Compatibility setup with fading for non-faded cases set the FCS to through Mode.~~



The host analog FM signal (including SCAs) were generated by a Harris THE-1 FM exciter, and the DAB digital sidebands were generated using an iBiquity FM IBOC DAB exciter. The 67 kHz and 92 kHz SCAs were generated using a CRL System SCA300B SCA Modulation Generator.

Demodulation of the analog SCA signals was performed with a Dayton Industrial Corp. Model 272 and a McMartin Industries Inc. Model TR-E5. Demodulation of the digitally generated SCA signal was performed with a commercially available digital SCA receiver.

The following graph shows the audio SNR of a 67 kHz 10 % injected SCA at the 54-dBu contour with DAB on and off for both the Dayton and McMartin SCA receivers. It also shows the audio SNR of a 92 kHz 10 % injected SCA at the 54-dBu contour with DAB on and off for the Dayton receiver.



Examining the stereo subcarrier area, it is apparent that DAB at –22 dBc has at most a 2 dB impact on this area.

Radio	67 kHz Audio SNR DAB off	67 kHz Audio SNR DAB on	92 kHz Audio SNR DAB Off	92 kHz Audio SNR DAB On
Dayton	35	34	28	27
McMartin	43	41	N/A[1]	N/A

[1] The McMartin receiver used in these tests could only be tuned to 67KHz.

Upon inspection of the host 67 kHz SCA recovered audio, we see that with baseline DAB (-22 dB_{host}), SCAs Audio SNR was impaired by less than 2 dB.

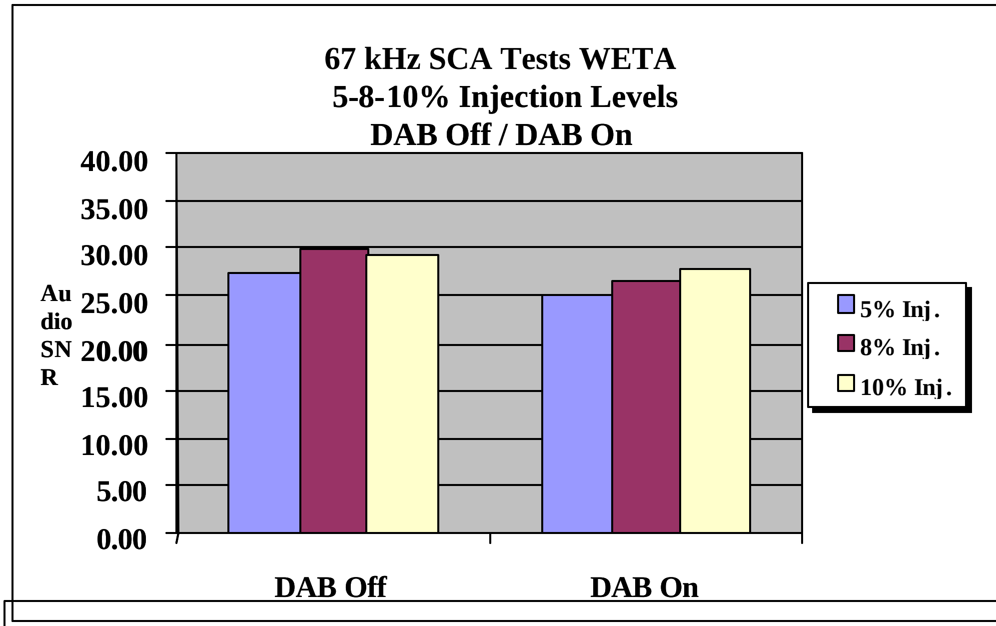
SCAs located at 92 kHz are potentially susceptible to noise and interference since the noise floor resulting from intermodulation products is higher at the upper baseband frequencies. With baseline DAB (-22 dB_{host}), demodulation of the 92 kHz SCAs, audio was degraded by only a maximum of 1 dB.

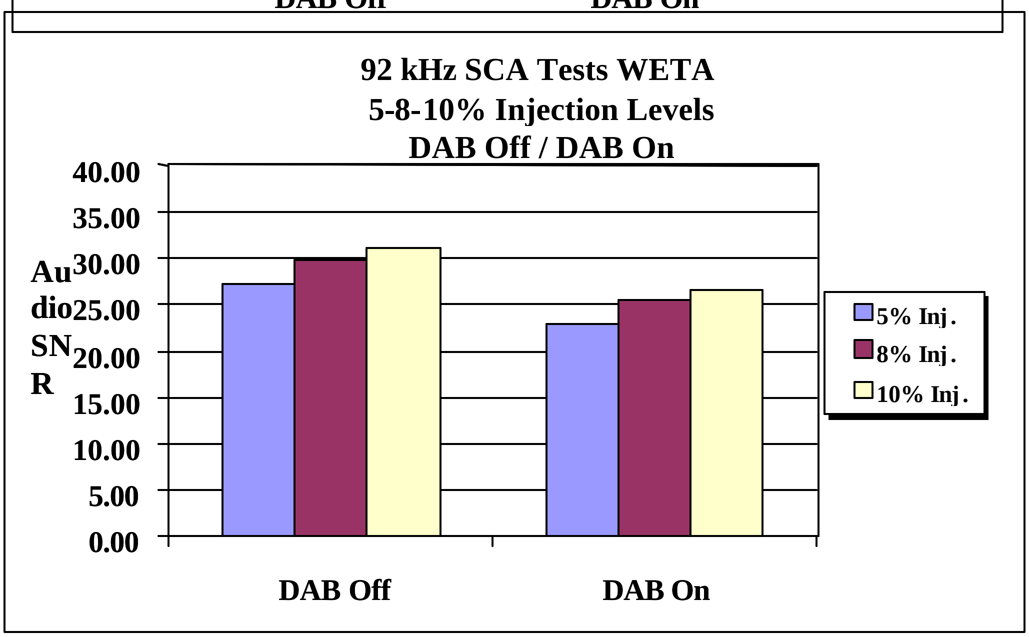
Test 2 — Analog SCA Lab/Field Tests — WETA FM, Washington, D.C.

The host analog FM signal was generated by a Continental 816 transmitter with an 802D exciter, and the DAB digital sidebands were generated using an iBiquity FM IBOC DAB exciter. The 67 kHz and 92 kHz SCAs were generated using a CRL System SCA300B SCA Modulation Generator.

The receiver was a Dayton Industries Model 272 located at iBiquity's facilities in Columbia, Maryland. Distance from the transmitter was 26.0 miles.

The test instruments used to measure the SNR were the same as used for Test 1.





SCA Injection Level	67 kHz DAB Off	67 kHz DAB On	92 kHz DAB Off	92 kHz DAB On
5%	27.25	24.9	27.0	22.79
8.0%	29.93	26.5	29.84	25.6
10%	29.2	27.67	31.23	26.7

Upon inspection of the host 67 kHz SCA recovered audio we see that with baseline DAB (-22 dB_{host}) SCAs Audio SNR was impaired by less than 4 dB.

SCAs located at 92 kHz are potentially susceptible to noise and interference, since the noise floor and the DAB intermodulation products are higher at the upper baseband frequencies. With baseline DAB (-22 dB_{host}), for demodulation of the 92 KHz SCAs, audio was degraded by a maximum of less than 5 dB.

Test 3 — Analog 67 kHz Field Demonstration

This field demonstration was conducted to illustrate the impact of IBOC DAB on the analog FM 67 kHz SCA. This field demonstration, conducted with the International Association of Audio Information Services, indicated the introduction of IBOC DAB had no noticeable impact on 67 kHz SCA operations of the host station.

Facilities

The demonstration was conducted using WETA-FM, Washington, D.C. WETA is a Class B station operating on Channel 215B at 90.9 MHz. The WETA transmitter is located in Alexandria, Virginia. Broadcasts were conducted with digital carrier levels of –25 dB/sideband or –22 dB below the carrier.

Analog SCA material was broadcast at 67 kHz using a Modulation Sciences SCA-186 Sidekick with a 3.8% SCA injection level. Listeners were located approximately 6.0 miles from the transmitter in the Board Room on the second floor of the offices of National Public Radio, 635 Massachusetts Avenue, Washington, D.C. The predicted signal strength at this location on a radial heading of 84° was 71 dBu. The listeners used for the test were thirteen members of the Board of Directors of the International Association of Audio Information Services. The following three SCA receivers were used:

McMartin – Model No. TR-E5	(Fixed tuned)
Norver – Model No. Nu-1C	(Fixed tuned)
Cosmo Corporation – Model No. HL922	(Tunable)

The IBOC digital carriers were cycled on and off using a Sine Systems remote control during a thirty minute broadcast period.

Conclusions

The IAAIS board members observed the performance of three SCA receivers with the IBOC digital carriers cycled on and off. No one in attendance was able to hear any impairment to the 67 kHz SCA from the presence of IBOC DAB digital carriers.

Test 4 — Digital Modulated SCA — Lab/Field Tests — Columbia, Maryland

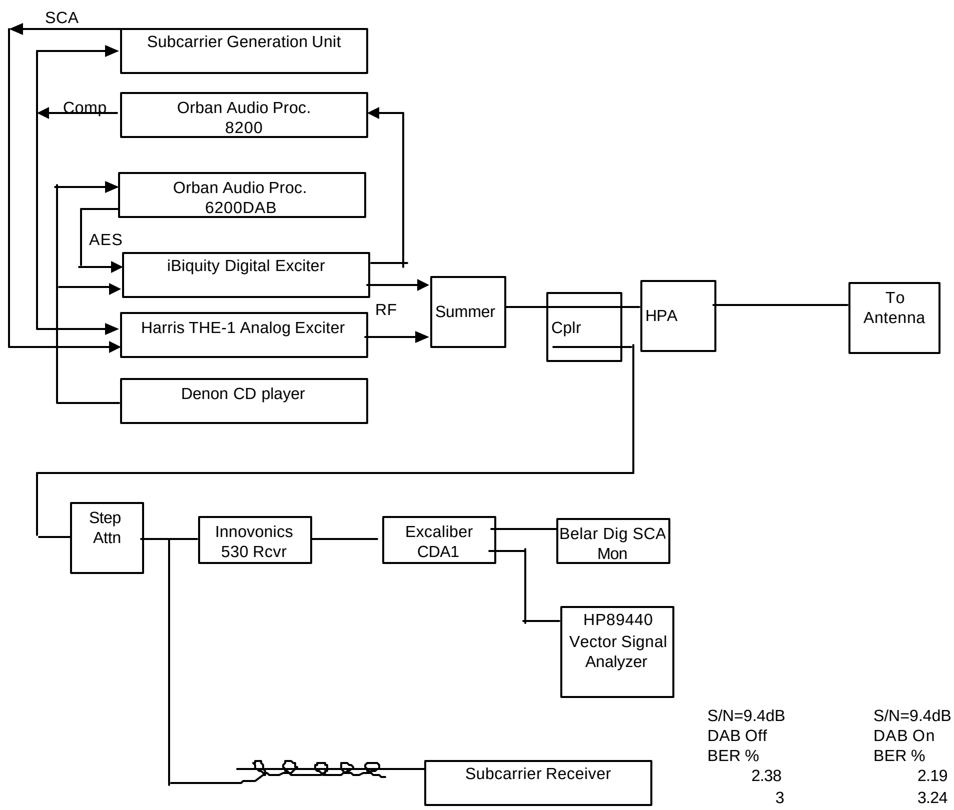
This test was conducted to evaluate the performance of a subcarrier channel with the following characteristics when operating in conjunction with a DAB transmission:

Subcarrier Frequency	66.5 kHz
Subcarrier Modulation	DQPSK
Channel Data Rate	19 kb/s
Payload	8.15 kb/s
Channel Code	Rate ½ convolutional code, K=7
Error Correction	255/223 Reed Solomon
Spectral Pre-filtering	Square Root raised cosine

The lab tests consisted of measuring the demodulated spectrum of the FM channel with the modulated subcarrier injected at 15% in the presence of pink noise at 90% in the L+R channel (worst case). The measurements were made and plotted using a spectrum analyzer of the carrier to noise/interference ratio in the 66.5 kHz subcarrier region using an "ideal" FM receiver (Innovonics Model 530). Comparative results were obtained when the DAB signal was inserted and removed. The channel error rate was measured on a typical consumer hand held portable battery operated subcarrier receiver in place of the ideal receiver using inbuilt error rate monitoring software.

Laboratory Tests

Figure 2 below shows the lab equipment and interconnection used for the tests.



S/N=9.4dB DAB Off BER %	S/N=9.4dB DAB On BER %
2.38	2.19
3	3.24
2.83	3.52
3.04	3.08
2.79	
	1.84
1.36	1.88
1.15	1.83
1.31	2.34
1.29	2.53
1.19	2.61
1.61	2.37
1.95	2.55
1.66	2.37
1.966154	2.488462

The formatted source signal was derived from a subcarrier generation unit. The data input was a 2^7-1 Pseudo Random Data Sequence. The generation unit was connected to a conventional Harris THE-1 Exciter together with a base band audio signal from an Orban Audio Processor (stereo generator) (see Figure 2). A separate transmitter was used for the DAB signal. The RF output of the two transmitters is summed to produce a broadcast RF signal plus the DAB signal.

The injection levels for the lab tests were as follows,

DAB Carriers	-22 dB wrt broadcast carrier
66.5 kHz Subcarrier	15% (16.5 dB below unmodulated FM carrier)
Base band Audio	90% pink noise, monophonic only

Addition of the pink noise modulation in the baseband audio signal did not alter the performance of the subcarrier so the pink noise modulation was applied for all reported measurements.

The step attenuator in the receiver RF path was adjusted to produce a subcarrier signal to background noise ratio of about 31 dB at the output of the receiver FM demodulator. The high signal to noise ratio was necessary to observe the influence of the presence of the DAB signal in the subcarrier region. Figure 3 shows the demodulated spectrum from the Innovonics receiver in a 150 kHz bandwidth when no DAB is present. The base-band audio (pink noise) and CAC subcarrier are clearly present. Note the marker at 92.9 kHz.

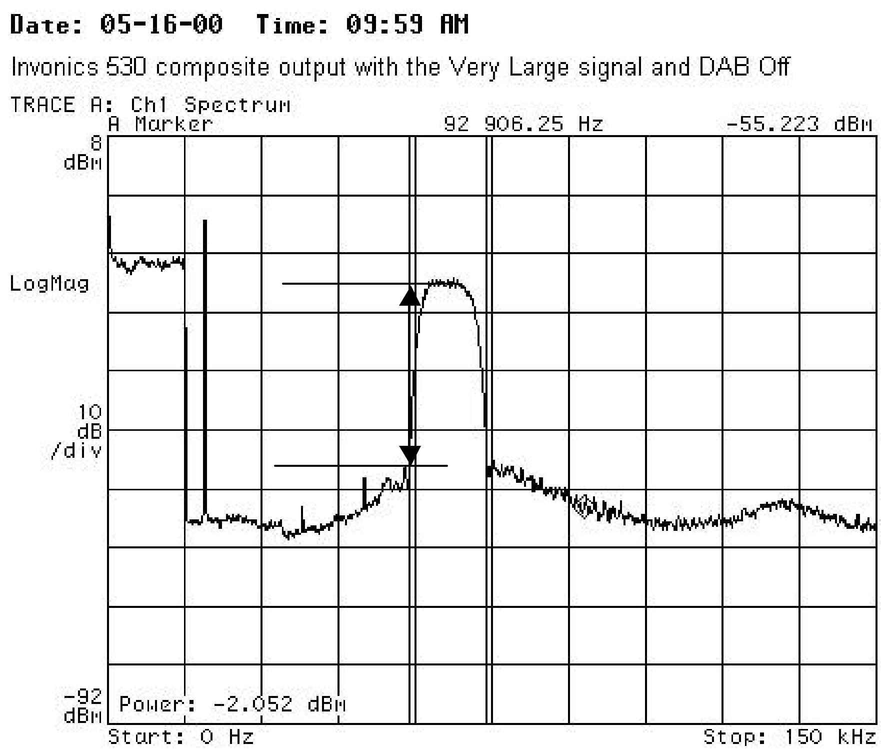


Figure 3, Demodulated Output, Pink noise plus 66.5 kHz subcarrier, no DAB

Figure 4 shows the change in noise in the high frequency region when the DAB carrier is introduced. The noise starts at 92 kHz and increases to the end of the 150 kHz spectrum. There does not appear to be any change in S/N in the 66.5 kHz subcarrier region.

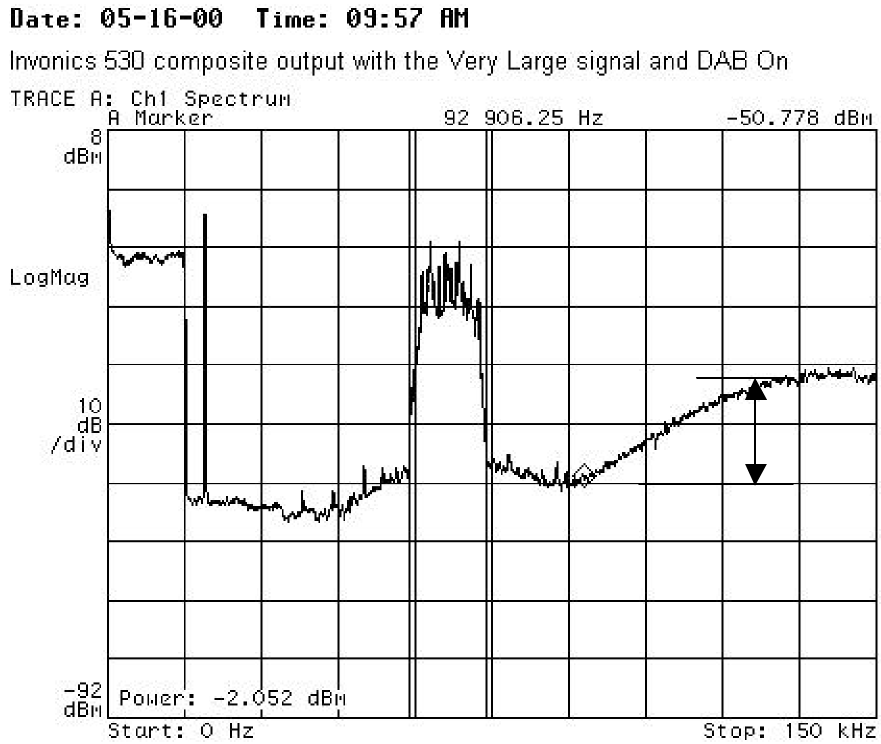


Figure 4, Demodulated Output, Pink noise plus 66.5 kHz subcarrier, *plus* DAB

The noise level increases commencing at 92.9 kHz and reaching +18 dB at 135 kHz. There is no measurable increase in noise level in the 66.5 kHz subcarrier region. Figure 5 shows a comparison between DAB On, red curve, and DAB Off green curve, when using typical stereo audio from a CD instead of pink noise. The peak-hold display mode is used for this presentation. The 66.5 kHz subcarrier region is virtually unchanged by the addition of the DAB carrier.

The RF level into the Innovonics receiver was reduced by 20 dB to produce a base-band 66.5 kHz subcarrier to noise ratio of approximately 10 dB and the tests repeated. This level is typical of reception conditions and also enables measurement of error rates using in-built receiver software.

Figure 6 shows the base-band spectrum with the DAB on and a measured 66.5 kHz subcarrier to noise ratio of 9.4 dB. The signal to noise ratio is now dominated by the FM receiver noise, and the presence of the DAB signal does not materially affect the noise floor in the entire displayed base-band.

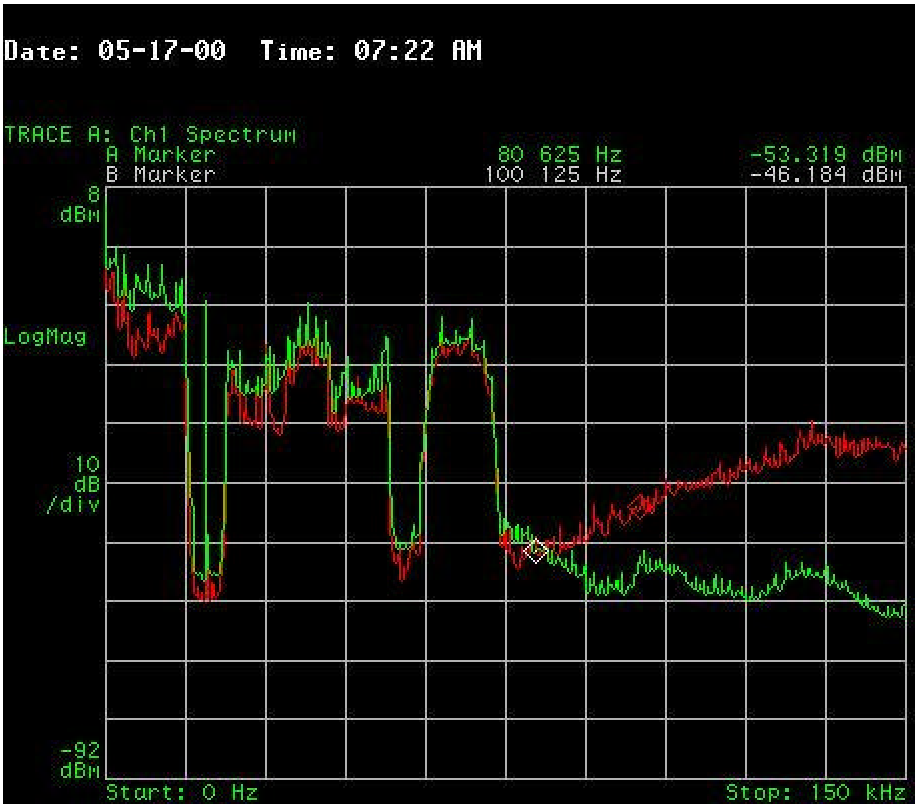


Figure 5, Demodulated Output, Stereo audio plus 66.5 kHz subcarrier, DAB On- Red, DAB Off- Green

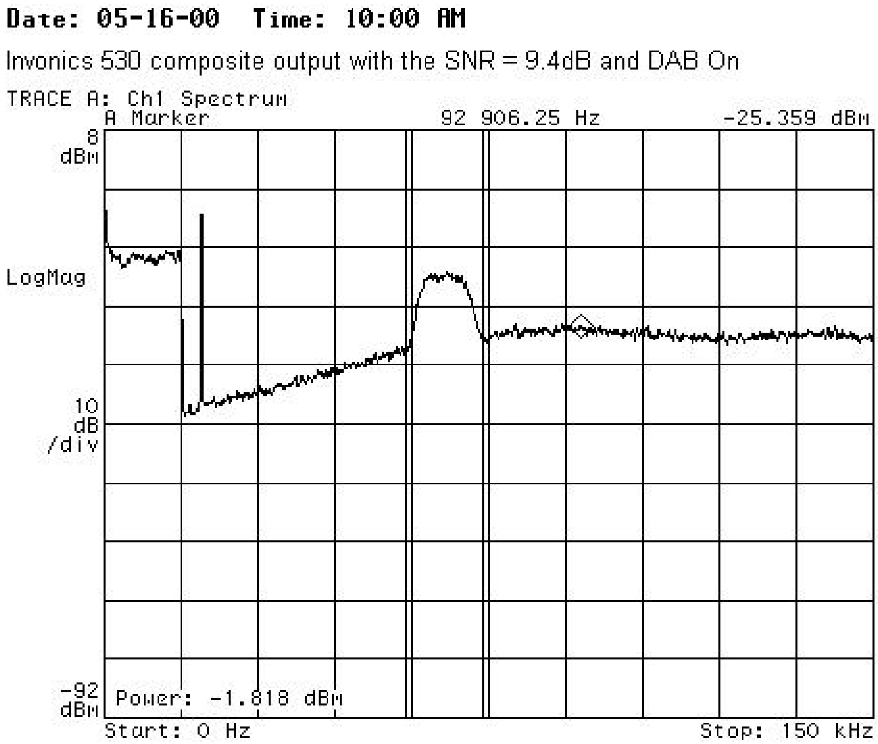


Figure 6, Demodulated Output, Pink noise plus 66.5 kHz subcarrier, plus DAB

Measurement of error rate was made by loosely coupling the RF signal from the step attenuator into the subcarrier receiver antenna (see Figure 2). The RF attenuation was adjusted to produce approximately 2% measured error rate. Thirteen measurements were made with the DAB carriers off followed by thirteen measurements with the DAB carriers on. The audio signal consisted of mono pink noise as described before. Each measurement is shown in the table of Figure 2. The average of each set of measurements is given below.

	DAB Off`	DAB On
Average Error Rate (percent)	1.97	2.49

The result shows a slight increase in error rate when the DAB carrier is present. The increase is extremely small and would be represented by an equivalent change of carrier to noise ratio of less than 0.2 dB, and therefore could be ignored. This change of performance is anticipated as the low voltage low power CAC receiver could not be expected to perform as well as the Innovonics broadcast monitor receiver.

Field Tests

For testing purposes a calibrated system was used for measuring outdoor field strength which consisted of a receiver and spectrum analyzer. The analyzer was interfaced to a PC, as was a GPS receiver. Computations and presentation of data was accomplished using the "Lab View" application. Accurate measurements were obtained and recorded for the field strength and the distance from the transmitter for each location and while moving. As the transmitter was low power, areas were restricted to those close to the transmitting antenna. The transmitter's Call Sign is WD2XAB operating at 93.5 MHz.

Three locations were used, two in residential areas and one in the open fields of the FCC Maryland Monitoring Station. Thirteen or so measurements were made outside the van at each site, and in all cases the transmitting antenna was obstructed. The residential areas were streets with 2 story houses. The foliage consisted of an abundance of mature growth trees. The situation could be best described as Urban Obstructed. The FCC site was an open field with the transmitting antenna obstructed by the surrounding terrain.

The sites were selected to obtain readings where the outside measured RF field strength was 56 dBµV/m or worse. The readings were taken outside and adjacent to the vehicle and are within the range over which the subcarrier system should operate. Table 1 shows each location and the calculated averaged measured error rates in percent for each location.

Description	Location 1 Urban residential Dense fiolage Obstructed		Location 2 Urban residential Dense foliage Obstructed		Location 3 Open field no trees Obstructed	
Distance from, Transmitter, (km) Field strength, (dBµV/m)	1.6 -56.55		2.0 -46.17		2.7 -42.0	
	DAB Off	DAB On	DAD Off	DAB On	DAB Off	DAB On
Average measured Error rate, (percent)	**0.189**	**0.061**	**0.111**	**1.50**	**2.70**	**3.05**

Table 1, Summary of Field Test Results

The results in the first column show the error performance was better with the DAB signal applied. In this location there were some very excessive errors that were omitted from the calculation because they appeared unrealistic. The omission may partly explain the discrepancy in results. The results from the second and third columns closely match the lab tests in that the ratio of increase in error rate with DAB On is similar. The results cannot easily be translated to coverage area under normal operating conditions, that is, a high power FM transmitter with a transmitting antenna on a tall mast.

Summary

With a subcarrier that operates at 66.5 kHz carrying a payload of 8.2 kb/s injected at 15% the presence in the proposed DAB system does not significantly impact the error performance as measured on the recovered data. Subcarriers operating above 92 kHz may be affected depending on the subcarrier modulation system chosen and the type of information and method conveyed.

Testing using the typical transmission system (FM broadcast station) will be required to obtain the large amount of data from many locations. Only with a large amount of data can we ensure real-life adverse conditions such as multi-path are included.

Test 5 — Digital Modulated SCA — WPOC

The purpose of this test was to measure the RF signal performance of the subcarrier receiver and the channel performance (error rate) of a subcarrier receiver when the FM broadcast and IBOC signals are radiated from conventional FM broadcast transmitters in the Baltimore area.

The IBOC signal was injected to a separate FM transmitter whose output was multiplexed with the main broadcast transmitter containing the audio signals and subcarriers. The IBOC transmitter was remotely controlled using a cellular phone

The following are the specifications of the transmitter and the supplementary modulation applied to the transmitter,

Call Sign	WPOC
Carrier Frequency	93.1 MHz
ERP (H+V)	16.00 kW
Radiator Height,	AAT 264 m (above average terrain) AMSL 363 m (above mean sea level)
Location, - Geographic	N39° 11.450’, W76° 49.017’
- Common	NW Junction of Rolling Road and US40, 12 km due west from center of downtown Baltimore

Subcarrier Modulation

Description	location	Injection	Modulation Class
RBDS	57 kHz	3%	Bi-Phase Mark
Test Subcarrier	66.5 kHz	15%	DQPSK
S/C Audio	92 kHz	5%	FM, 1 kHz audio tone, 7.5 kHz deviation

IBOC Transmitter

Output level -19dbC wrt main transmitter (current USADR NRSC proposal states -22 dB wrt broadcast carrier)

Test Plots

To evaluate the subcarrier receiver signal performance, a spectrum analyzer was connected to the FM demodulator output of a modified subcarrier receiver and spectrum analyzer plots taken under different conditions. These tests were performed at the transmitter site. Six plots were taken and recorded.

Evaluation of plots

1. IBOC **On**, 66.5 kHz S/C **Off**

The plot shows the noise floor above 70 kHz increasing as reported on the earlier tests with the ideal receiver.

2. IBOC **Off**, 66.5 kHz S/C **Off**

The plot shows noise floor reducing above 70 kHz with negligible difference in noise performance in the 66.5 kHz subcarrier region. The 92 kHz FM subcarrier signal to noise ratio improved by 6 dB to 8 dB with the IBOC off. These results are similar to the earlier test results.

3. IBOC **Off**, 66.5 kHz S/C **On**

The results show the presence of the 66.5 kHz subcarrier

4. IBOC **On**, 66.5 kHz S/C **On**

Again the results show little variation in S/N in the 66.5 kHz subcarrier region but clearly show the degradation of S/N in the 92 kHz region.

5. IBOC **On**, 66.5 kHz S/C **On**, Out-of-band performance (0 HZ to 200 kHz)

The plot demonstrates the increase in noise floor above 75 kHz and shows the rejection of the receiver IF filters at 135 kHz effectively reducing the amplitude of the IBOC high frequency components.

6. IBOC **Off**, 66.5 kHz S/C **On,** Out-of-band performance (0 HZ to 200 kHz)

Same as above but clearly showing the improvement in the out-of-band noise performance with the IBOC off. The hump at 133 kHz is second harmonic of the 66.5 kHz subcarrier generated within by the receiver demodulation process. This does not impact the 66.5

kHz subcarrier recovery but would impact the IBOC performance in this region. Therefore an IBOC receiver will require careful design to eliminate this source of distortion.

Field Tests

Locations one and two of the following table were taken in the iBiquity vehicle with the receiver held in the usual position near the windshield. The remaining results were taken in a rented vehicle. The antenna was fully extended for all tests except the last three near downtown Baltimore where the signal strength was considerably greater than anticipated even though the locations were chosen for maximum obstruction of signal (buildings surrounding the van).

Locations 1 and 2, Urban residential

The results show the slight increase in error rate in the averaged result when the IBOC transmission is present. Like the earlier tests the difference between the averaged values is small

Location 3, Rural township

The presence of the IBOC transmission did not impact error rate possibly because the error rate was low.

Locations 4 and 5, Rural, partial obstruction

Location 4 is similar to the earlier locations but with higher, more meaningful, error rates. Location 5 shows a slight increase in error rate with the IBOC off. Again the difference between averaged values is small when compared to the deviation between individual measurements.

Locations 6, 7 and 8, Urban obstructed

The results of these tests show a reversal, that is the error rate improved when the IBOC was off. Except for location 6 the differences are small and could be ignored.

Summary

The overall results show the 66.5 kHz subcarrier receiver is similar to the ideal receiver used in the earlier tests when an IBOC signal is present. The error rate results show when a DQPSK subcarrier does not extend above 75 kHz the presence of the IBOC signal has an effect on performance but of insufficient magnitude, when compared to other reception errors, to degrade the overall data recovery. The 66.5 kHz subcarrier was injected at 15%. If other subcarriers were not present and the injection level increased to 20%, the differences between IBOC on and IBOC off would be less than shown in these results.

Table of Major Field Test Measurements

Site description, Geographic location and Distance to Transmitter (km)	IBOC Transmission On/Off	Measured Error Rate (percent)	Average (percent)
1. Columbia Hills, residential			
N39° 14.227’	Off	0.17 0.11 0.17 0.17 0.11 0.10 0.09 0.08 0.10	0.12
W 76° 50.554’	On	0.21 0.17 0.23 0.21 0.23 0.27 0.24 0.21 0.24	0.24
9.3 km			
2. USADR Parking Lot			
	Off	0.61 0.49 0.76 1.06 0.61 0.53 0.68 0.76 0.67 0.72 0.72	0.69
	On	1.43 1.14 1.61 1.22 1.40 1.89 3.04 4.08 3.08	2.10
11.7 km			
3. Sykesville, MD			
South Hill and 1st Ave			
N39° 22.399’	Off	0.04 0.12 0.01 0.02 0.01 0.02 0.03 0.07 0.05 0.08 0.02 0.03 0.02	0.04
W76° 58.233’	On	0.03 0.05 0.04 0.03 0.05 0.03 0.04 0.05 0.06 0.04 0.03 0.04 0.02	0.04
20.3 km			
4. West Friendship, MD			
Ste. Hwy 32 , parking lot			
Near I70			
N39° 18.256’	Off	1.86 1.50 1.66 1.61 1.65 1.87 2.16 2.91 2.72 2.30 1.98 1.62 1.82	1.81
W 76° 57.307’	On	2.12 1.85 1.38 1.43 1.73 1.65 1.66 2.36 2.99 3.51 3.18 3.81 4.36	2.33
17.3 km			
5. West Friendship, MD			
Ste Hwy 32 and Rosemary			
N39° 18.120’	Off	0.90 0.97 0.96 0.98 2.11 2.06 2.76 3.09 1.50 0.94 1.09 0.82 1.08	1.48
W 76° 57.312’	On	1.49 0.99 1.02 1.25 1.10 1.12 1.40 1.18 0.95 0.97 1.18 1.09 1.17	1.15
17.7 km			
6. Baltimore, near downtown			
Building courtyard near			
Federal Reserve Bank			
N39° 16.968’	Off	0.34 0.50 0.42 0.36 0.40 0.34 0.38 0.24 0.34 0.39 0.29 0.23 0.28 0.21	0.34
W 76° 36.977’	On	0.12 0.15 0.14 0.15 0.13 0.08 0.11 0.09 0.11 0.15 0.14 0.07 0.05 0.06	0.11
12.2 km			
7. Baltimore, near waterfront			
Battery Ave, Fed Hill Park			
N39° 16.781’	Off	0.64 0.53 0.28 0.26 0.31 0.33 0.37 0.27 0.34 0.31 0.24 0.23 0.25 0.29	0.35
W 76° 36.598’	On	0.22 0.21 0.16 0.24 0.23 0.19 0.20 0.24 0.21 0.18 0.26 0.23 0.20 0.17	0.21
12.5 km			
8. Baltimore, at waterfront			
Key Hwy at Sth High Sch			
N39° 16.777’	Off	0.84 1.10 1.20 1.23 1.08 0.78 1.11 1.35 0.90 1.40 0.81 0.82 1.20 0.80	1.04
W 76° 36.387’	On	1.50 1.25 1.35 0.61 0.44 0.72 1.02 0.76 0.52 0.53 0.53 0.95 0.78 0.74	0.84
12.8 km			

Notes: All measurements made inside vehicle with portable receiver antenna fully extended except as follows,

Location 6, antenna fully retracted. Location 7, one section of antenna extended.

Location 8, two sections of antenna extended.

Conclusion:

Below is a synopsis of the SNR for the 67 kHz and 92 kHz SCA's using a common 10% injection level with a common DAB power level at –22 dbc.

Test Locations	67 KHz DAB Off	67 KHz DAB On	92 KHz DAB Off	92 KHz DAB On
WD2XAB	35	34	28	27
WETA	29.2	27.67	31.23	26.70

Upon inspection of the host 67kHz SCA recovered audio we see that with baseline DAB (-22 dB_{host}) the SCAs audio SNR was not impaired enough to cause interference with or impact the host SCAs range.

SCAs located at 92 kHz are especially prone to noise and interference, since the noise floor and the DAB intermodulation products are higher at the upper baseband frequencies. It is clear that with baseline DAB (-22 dB_{host}), for demodulation of the 92 KHz SCAs audio on some tests had a decrease in SNR.

The results from the digital modulated SCA channels show that DAB degradation was in the .5% range that translates to less than one tenth of a dB on the bit error rate curve. This would translate into an immeasurable impact on this SCA's range.

119765_1.DOC