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Harmonics and Intermodulation Product Measurements

Date : **August 31, 2006**

Station : **KLUV 98.7 MHz / KLIV 103.7 MHz**

MSO

Project :

Purchase Order :

Location : **Cedar Hill, TX (Cowboy Tower)**

Antenna : **Dielectric CBR**

Transmission Line : **Dielectric 3-1/8" FleXLine**

Work Description : **Spectrum analyzer measurements of calculated intermod products after addition of these two stations to existing combined IBOC system.**

Prepared for *Dielectric Communications*

by Charles Cluck, *Peter Eckmann Broadcast Consultants, Inc.*

Setup and Measurements Description :

Test equipment used: **IFR Spectrum Analyzer, Model 7550**

Microwave Electronics FM band tunable filter

RF System: **Five station constant impedance combiner**

Measurements were made by sampling the combined IBOC output at a sampling port provided in the transmission line.

Each of the five stations fundamental frequencies was measured for reference purposes. The spectrum analyzer was connected to the port using a sampling slug with BNC connector and an additional 10 dB of attenuation in the test cable.

Each of the calculated intermod products which occur within the FM broadcast band was then measured. A tunable filter was used to block all other frequencies other than the particular intermod product being measured. This filter was adjusted for each intermod frequency in turn. Again, 10 dB of attenuation was used in the test cable.

The tunable filter has an insertion loss of 3.5 dB. In the final tabulation of results, this loss and the additional 10 dB of attenuation in the test cable are accounted for.

The calculated intermod products were all found to be less than -80 dB relative to any of the fundamental frequencies.

The intermod calculations, raw data and final results are tabulated in the following pages.

Table 1

INTERMODULATION PRODUCT FREQUENCIES

Intermod frequency	product	Freq. A		Freq. B
87.9	<2A-B	92.5	&	97.1
88.1	<2A-B	97.1	&	106.1
88.7	<3A-2B	98.7	&	103.7
90.5	<2A-B	97.1	&	103.7
91.3	<2A-B	98.7	&	106.1
93.7	<2A-B	98.7	&	103.7
93.9	<3A-2B	97.1	&	98.7
95.5	<2A-B	97.1	&	98.7
98.9	<3A-2B	103.7	&	106.1
100.3	<2B-A	97.1	&	98.7
101.3	<2A-B	103.7	&	106.1
101.7	<2B-A	92.5	&	97.1
101.9	<3B-2A	97.1	&	98.7
104.9	<2B-A	92.5	&	98.7
106.3	<3B-2A	92.5	&	97.1

Table 2

Raw Data : Spectrum Analyzer measurements				
all five IBOC stations in operation				
fundamental frequency	measured	attenuation dB	filter loss dB	actual dB
92.5	-8.00	10.00	0.00	2.00
97.1	-8.00	10.00	0.00	2.00
98.7	-10.00	10.00	0.00	0.00
103.7	-7.00	10.00	0.00	3.00
106.1	-6.00	10.00	0.00	4.00
calculated intermod frequency				
87.9	-104.00	10.00	3.5	-90.50
88.1	-96.00	10.00	3.5	-82.50
88.7	-96.00	10.00	3.5	-82.50
90.5	-102.00	10.00	3.5	-88.50
91.3	-100.00	10.00	3.5	-86.50
93.7	-100.00	10.00	3.5	-86.50
93.9	-104.00	10.00	3.5	-90.50
95.5	-104.00	10.00	3.5	-90.50
98.9	-100.00	10.00	3.5	-86.50
100.3	-104.00	10.00	3.5	-90.50
101.3	-104.00	10.00	3.5	-90.50
101.7	-98.00	10.00	3.5	-84.50
101.9	-104.00	10.00	3.5	-90.50
104.9	-102.00	10.00	3.5	-88.50
106.3	-104.00	10.00	3.5	-90.50

Table 3

Relationships of intermods to carriers					
intermod product frequency	relative to 92.5 MHz carrier	relative to 97.1 MHz carrier	relative to 98.7 MHz carrier	relative to 103.7 MHz carrier	relative to 106.1 MHz carrier
87.9	-92.5 dB	-92.5 dB	-90.5 dB	-93.5 dB	-94.5 dB
88.1	-84.5 dB	-84.5 dB	-82.5 dB	-85.5 dB	-86.5 dB
88.7	-84.5 dB	-84.5 dB	-82.5 dB	-85.5 dB	-86.5 dB
90.5	-90.5 dB	-90.5 dB	-88.5 dB	-91.5 dB	-92.5 dB
91.3	-88.5 dB	-88.5 dB	-86.5 dB	-89.5 dB	-90.5 dB
93.7	-88.5 dB	-88.5 dB	-86.5 dB	-89.5 dB	-90.5 dB
93.9	-92.5 dB	-92.5 dB	-90.5 dB	-93.5 dB	-94.5 dB
95.5	-92.5 dB	-92.5 dB	-90.5 dB	-93.5 dB	-94.5 dB
98.9	-88.5 dB	-88.5 dB	-86.5 dB	-89.5 dB	-90.5 dB
100.3	-92.5 dB	-92.5 dB	-90.5 dB	-93.5 dB	-94.5 dB
101.3	-92.5 dB	-92.5 dB	-90.5 dB	-93.5 dB	-94.5 dB
101.7	-86.5 dB	-86.5 dB	-84.5 dB	-87.5 dB	-88.5 dB
101.9	-92.5 dB	-92.5 dB	-90.5 dB	-93.5 dB	-94.5 dB
104.9	-90.5 dB	-90.5 dB	-88.5 dB	-91.5 dB	-92.5 dB
106.3	-92.5 dB	-92.5 dB	-90.5 dB	-93.5 dB	-94.5 dB