

# Harmonic and Intermod Study Field Report

Date: **July 15, 2010**

Station Call Sign: **KBFB, KJKK, KRLD, & KMKV**

Location: **Cedar Hill, TX**

Frequencies: **97.9, 100.3, 105.3, & 107.5 respectively**

Antenna: **Shively model 6014, 8 panels high, 3 panels around**

Transmission Line: **Dual 6-1/8" 50 ohm rigid**

Work Description: **Intermod study per FCC requirements**

Prepared for Kevin Busselman, Richland Towers

Prepared by Peter Eckmann

Peter Eckmann Broadcast Consultants, Inc.

## Measurement Description:

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

Location of measurement: **Connected to forward port of directional coupler section on each transmission line.**

## RF System Description:

RF System: **4 station constant impedance FM combiner with IBOC. One transmission line feeds the antenna for left hand CP and transmits: 97.9 Analog, 107.5 Analog and Digital, 100.3 Digital, & 105.3 Digital. The other transmission line feeds the antenna for right hand CP and transmits: 97.9 Digital, 100.3 Analog, & 105.3 Analog.**

Effective Radiated Power (ERP): **KBFB (97.9 MHz.)-100 kw, KJKK (100.3 MHz)-100 kw, KRLD (105.3 MHz)-100 kw, & KMVK (107.5 MHz)-53 kw**

## Introduction:

This report is based on data collected at the Richland Cedar Hill North tower master antenna system located in Cedar Hill, TX. The report includes measurements offered as proof that the combined operations of KBFB (97.9 MHz.), KJKK (100.3 MHz), KRLD (105.3 MHz), & KMVK (107.5 MHz) transmitters are in compliance with the FCC Rules and Regulations as required by the Code of Federal Regulations (CFR) Title 47 section 73.317 paragraph (b) through (d).

TITLE 47--TELECOMMUNICATION

CHAPTER I--FEDERAL COMMUNICATIONS

COMMISSION (CONTINUED)

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Subpart B\_FM Broadcast Stations

Sec. 73.317 FM transmission system requirements.

(b) Any emission appearing on a frequency removed from the carrier by between 120 kHz and 240 kHz inclusive must be attenuated at least 25 dB below the level of the unmodulated carrier. Compliance with this requirement will be deemed to show the occupied bandwidth to be 240 kHz or less.

(c) Any emission appearing on a frequency removed from the carrier by more than 240 kHz and up to and including 600 kHz must be attenuated at least 35 dB below the level of the unmodulated carrier.

(d) Any emission appearing on a frequency removed from the carrier by more than 600 kHz must be attenuated at least  $43 + 10 \log_{10} (\text{Power, in watts})$  dB below the level of the unmodulated carrier, or 80 dB, whichever is the lesser attenuation.

In brief, the collection of measurements presented in this report demonstrate that all possible third order intermodulation (IM) products generated by this multiplex system are less than the maximum allowable level as required by section 73.317 (b) through (d).

### **Measurement Technique**

1. A tunable band pass filter was used for all measurements within or near the FM band. An FM band stop filter was used for all frequencies outside the FM band.

Intermod	Frequency A	Frequency B	Intermod Frequency	Measured Level	Ref Signal Level	Filter Loss	Intermod Level
					107.5 ref		
IM Level = (Ref signal) - (IM) + (filter loss)					+7 db		
Left Hand CP Transmission Line							
A+B	97.9	107.5	205.4	-96	10	-1	105
B-A	97.9	107.5	9.6	-97	10	-1	106
2A	97.9	107.5	195.8	-97	10	-1	106
2B	97.9	107.5	215	-94	10	-1	103
2A-B	97.9	107.5	88.3	-85	10	-6	89
2B-A	97.9	107.5	117.1	-97	10	-2	105
2A+B	97.9	107.5	303.3	-94	10	-1	103
2B+A	97.9	107.5	312.9	-92	10	-1	101
2A+2B	97.9	107.5	410.8	-96	10	-1	105
2A-2B	97.9	107.5	19.2	-98	10	-1	107
3A	97.9	107.5	293.7	-94	10	-1	103
3B	97.9	107.5	322.5	-95	10	-1	104
3A-B	97.9	107.5	186.2	-96	10	-1	105
3A+B	97.9	107.5	401.2	-92	10	-1	101
3B+A	97.9	107.5	420.4	-96	10	-1	105
3B-A	97.9	107.5	224.6	-97	10	-1	106
3A+2B	97.9	107.5	508.7	-96	10	-1	105
3A-2B	97.9	107.5	78.7	-98	10	-2	106
3B+2A	97.9	107.5	518.3	-94	10	1	105
3B-2A	97.9	107.5	126.7	-97	10	-2	105
3A+3B	97.9	107.5	616.2	-96	10	1	107
3A-3B	97.9	107.5	28.8	-98	10	1	109

Intermod	Frequency A	Frequency B	Intermod Frequency	Measured Level	Ref Signal Level	Filter Loss	Intermod Level
IM Level = (Ref signal) - (IM) + (filter loss)							
Left Hand CP Transmission Line							
A+B	97.9	100.3	198.2	-97	10	-1	106
B-A	97.9	100.3	2.4	-98	10	-1	107
2A	97.9	100.3	195.8	-96	10	-1	105
2B	97.9	100.3	200.6	-96	10	-1	105
2A-B	97.9	100.3	95.5	-90	10	-6	94
2B-A	97.9	100.3	102.7	-86	10	-6	90
2A+B	97.9	100.3	296.1	-96	10	-1	105
2B+A	97.9	100.3	298.5	-96	10	-1	105
2A+2B	97.9	100.3	396.4	-96	10	-1	105
2A-2B	97.9	100.3	4.8	-97	10	-1	106
3A	97.9	100.3	293.7	-95	10	-1	104
3B	97.9	100.3	300.9	-96	10	-1	105
3A-B	97.9	100.3	193.4	-97	10	-1	106
3A+B	97.9	100.3	394	-96	10	-1	105
3B+A	97.9	100.3	398.8	-96	10	-1	105
3B-A	97.9	100.3	203	-97	10	-1	106
3A+2B	97.9	100.3	494.3	-89	10	-1	98
3A-2B	97.9	100.3	93.1	-92	10	-6	96
3B+2A	97.9	100.3	496.7	-92	10	-1	101
3B-2A	97.9	100.3	105.1	-90	10	-6	94
3A+3B	97.9	100.3	594.6	-96	10	-1	105
3A-3B	97.9	100.3	7.2	-98	10	-1	107

Intermod	Frequency A	Frequency B	Intermod Frequency	Measured Level	Ref Signal Level	Filter Loss	Intermod Level
					107.5 ref		
IM Level = (Ref signal) - (IM) + (filter loss)					+7 db		
Left Hand CP Transmission Line							
A+B	107.5	100.3	207.8	-97	10	-1	106
B-A	107.5	100.3	7.2	-98	10	-1	107
2A	107.5	100.3	215	-96	10	-1	105
2B	107.5	100.3	200.6	-97	10	-1	106
2A-B	107.5	100.3	114.7	-97	10	-2	105
2B-A	107.5	100.3	93.1	-92	10	-6	96
2A+B	107.5	100.3	315.3	-97	10	-1	106
2B+A	107.5	100.3	308.1	-96	10	-1	105
2A+2B	107.5	100.3	415.6	-96	10	-1	105
2A-2B	107.5	100.3	14.4	-98	10	-1	107
3A	107.5	100.3	322.5	-94	10	-1	103
3B	107.5	100.3	300.9	-96	10	-1	105
3A-B	107.5	100.3	222.2	-97	10	-1	106
3A+B	107.5	100.3	422.8	-96	10	-1	105
3B+A	107.5	100.3	408.4	-96	10	-1	105
3B-A	107.5	100.3	193.4	-97	10	-1	106
3A+2B	107.5	100.3	523.1	-96	10	-1	105
3A-2B	107.5	100.3	121.9	-97	10	-1	106
3B+2A	107.5	100.3	515.9	-96	10	-1	105
3B-2A	107.5	100.3	85.9	-96	10	-6	100
3A+3B	107.5	100.3	623.4	-95	10	-1	104
3A-3B	107.5	100.3	21.6	-98	10	-1	107

Intermod	Frequency A	Frequency B	Intermod Frequency	Measured Level	Ref Signal Level	Filter Loss	Intermod Level
					107.5 ref		
IM Level = (Ref signal) - (IM) + (filter loss)					+7 db		
Left Hand CP Transmission Line							
A+B	107.5	105.3	212.8	-97	10	-1	106
B-A	107.5	105.3	2.2	-98	10	-1	107
2A	107.5	105.3	215	-96	10	-1	105
2B	107.5	105.3	210.6	-97	10	-1	106
2A-B	107.5	105.3	109.7	-97	10	-6	101
2B-A	107.5	105.3	103.1	-90	10	-6	94
2A+B	107.5	105.3	320.3	-97	10	-1	106
2B+A	107.5	105.3	318.1	-97	10	-1	106
2A+2B	107.5	105.3	425.6	-96	10	-1	105
2A-2B	107.5	105.3	4.4	-97	10	-1	106
3A	107.5	105.3	322.5	-96	10	-1	105
3B	107.5	105.3	315.9	-96	10	-1	105
3A-B	107.5	105.3	217.2	-97	10	-1	106
3A+B	107.5	105.3	427.8	-96	10	-1	105
3B+A	107.5	105.3	423.4	-96	10	-1	105
3B-A	107.5	105.3	208.4	-96	10	-1	105
3A+2B	107.5	105.3	533.1	-95	10	-1	104
3A-2B	107.5	105.3	111.9	-97	10	-6	101
3B+2A	107.5	105.3	530.9	-96	10	-1	105
3B-2A	107.5	105.3	100.9	-79	10	-6	83
3A+3B	107.5	105.3	638.4	-94	10	-1	103
3A-3B	107.5	105.3	6.6	-98	10	-1	107

Intermod	Frequency A	Frequency B	Intermod Frequency	Measured Level	Ref Signal Level	Filter Loss	Intermod Level
IM Level = (Ref signal) - (IM) + (filter loss)							
Left Hand CP Transmission Line							
A+B	100.3	105.3	205.6	-96	10	-1	105
B-A	100.3	105.3	5	-94	10	-1	103
2A	100.3	105.3	200.6	-95	10	-1	104
2B	100.3	105.3	210.6	-97	10	-1	106
2A-B	100.3	105.3	95.3	-85	10	-6	89
2B-A	100.3	105.3	110.3	-97	10	-6	101
2A+B	100.3	105.3	305.9	-97	10	-1	106
2B+A	100.3	105.3	310.9	-86	10	-1	95
2A+2B	100.3	105.3	411.2	-96	10	-1	105
2A-2B	100.3	105.3	10	-98	10	-1	107
3A	100.3	105.3	300.9	-95	10	-1	104
3B	100.3	105.3	315.9	-96	10	-1	105
3A-B	100.3	105.3	195.6	-97	10	-1	106
3A+B	100.3	105.3	406.2	-96	10	-1	105
3B+A	100.3	105.3	416.2	-96	10	-1	105
3B-A	100.3	105.3	215.6	-97	10	-1	106
3A+2B	100.3	105.3	511.5	-92	10	-1	101
3A-2B	100.3	105.3	90.3	-98	10	-6	102
3B+2A	100.3	105.3	516.5	-92	10	-1	101
3B-2A	100.3	105.3	115.3	-97	10	-2	105
3A+3B	100.3	105.3	616.8	-95	10	-1	104
3A-3B	100.3	105.3	15	-98	10	-1	107



Intermod	Frequency A	Frequency B	Intermod Frequency	Measured Level	Ref Signal Level	Filter Loss	Intermod Level
IM Level = (Ref signal) - (IM) + (filter loss)							
Left Hand CP Transmission Line							
A+B	97.9	105.3	203.2	-97	10	-1	106
B-A	97.9	105.3	7.4	-98	10	-1	107
2A	97.9	105.3	195.8	-97	10	-1	106
2B	97.9	105.3	210.6	-96	10	-1	105
2A-B	97.9	105.3	90.5	-92	10	-6	96
2B-A	97.9	105.3	112.7	-98	10	-6	102
2A+B	97.9	105.3	301.1	-96	10	-1	105
2B+A	97.9	105.3	308.5	-96	10	-1	105
2A+2B	97.9	105.3	406.4	-96	10	-1	105
2A-2B	97.9	105.3	14.8	-98	10	-1	107
3A	97.9	105.3	293.7	-95	10	-1	104
3B	97.9	105.3	315.9	-94	10	-1	103
3A-B	97.9	105.3	188.4	-90	10	-1	99
3A+B	97.9	105.3	399	-96	10	-1	105
3B+A	97.9	105.3	413.8	-96	10	-1	105
3B-A	97.9	105.3	218	-97	10	-1	106
3A+2B	97.9	105.3	504.3	-88	10	-1	97
3A-2B	97.9	105.3	83.1	-98	10	-6	102
3B+2A	97.9	105.3	511.7	-95	10	-1	104
3B-2A	97.9	105.3	120.1	-97	10	-1	106
3A+3B	97.9	105.3	609.6	-96	10	-1	105
3A-3B	97.9	105.3	22.2	-98	10	-1	107

Intermod	Frequency A	Frequency B	Intermod Frequency	Measured Level	Ref Signal Level	Filter Loss	Intermod Level
					107.5 ref		
IM Level = (Ref signal) - (IM) + (filter loss)					+7 db		
Right Hand CP Transmission Line							
A+B	97.9	107.5	205.4	-97	10	-1	106
B-A	97.9	107.5	9.6	-98	10	-1	107
2A	97.9	107.5	195.8	-97	10	-1	106
2B	97.9	107.5	215	-94	10	-1	103
2A-B	97.9	107.5	88.3	-94	10	-6	98
2B-A	97.9	107.5	117.1	-98	10	-1	107
2A+B	97.9	107.5	303.3	-96	10	-1	105
2B+A	97.9	107.5	312.9	-96	10	-1	105
2A+2B	97.9	107.5	410.8	-96	10	-1	105
2A-2B	97.9	107.5	19.2	-98	10	-1	107
3A	97.9	107.5	293.7	-96	10	-1	105
3B	97.9	107.5	322.5	-96	10	-1	105
3A-B	97.9	107.5	186.2	-96	10	-1	105
3A+B	97.9	107.5	401.2	-92	10	-1	101
3B+A	97.9	107.5	420.4	-96	10	-1	105
3B-A	97.9	107.5	224.6	-97	10	-1	106
3A+2B	97.9	107.5	508.7	-96	10	-1	105
3A-2B	97.9	107.5	78.7	-98	10	-1	107
3B+2A	97.9	107.5	518.3	-96	10	-1	105
3B-2A	97.9	107.5	126.7	-97	10	-1	106
3A+3B	97.9	107.5	616.2	-95	10	-1	104
3A-3B	97.9	107.5	28.8	-98	10	-1	107

Intermod	Frequency A	Frequency B	Intermod Frequency	Measured Level	Ref Signal Level	Filter Loss	Intermod Level
IM Level = (Ref signal) - (IM) + (filter loss)							
Right Hand CP Transmission Line							
A+B	97.9	100.3	198.2	-97	10	-1	106
B-A	97.9	100.3	2.4	-97	10	-1	106
2A	97.9	100.3	195.8	-97	10	-1	106
2B	97.9	100.3	200.6	-90	10	-1	99
2A-B	97.9	100.3	95.5	-95	10	-6	99
2B-A	97.9	100.3	102.7	-90	10	-6	94
2A+B	97.9	100.3	296.1	-96	10	-1	105
2B+A	97.9	100.3	298.5	-96	10	-1	105
2A+2B	97.9	100.3	396.4	-96	10	-1	105
2A-2B	97.9	100.3	4.8	-97	10	-1	106
3A	97.9	100.3	293.7	-96	10	-1	105
3B	97.9	100.3	300.9	-96	10	-1	105
3A-B	97.9	100.3	193.4	-97	10	-1	106
3A+B	97.9	100.3	394	-96	10	-1	105
3B+A	97.9	100.3	398.8	-96	10	-1	105
3B-A	97.9	100.3	203	-96	10	-1	105
3A+2B	97.9	100.3	494.3	-98	10	-1	107
3A-2B	97.9	100.3	93.1	-97	10	-6	101
3B+2A	97.9	100.3	496.7	-84	10	-1	93
3B-2A	97.9	100.3	105.1	-82	10	-6	86
3A+3B	97.9	100.3	594.6	-96	10	-1	105
3A-3B	97.9	100.3	7.2	-98	10	-1	107

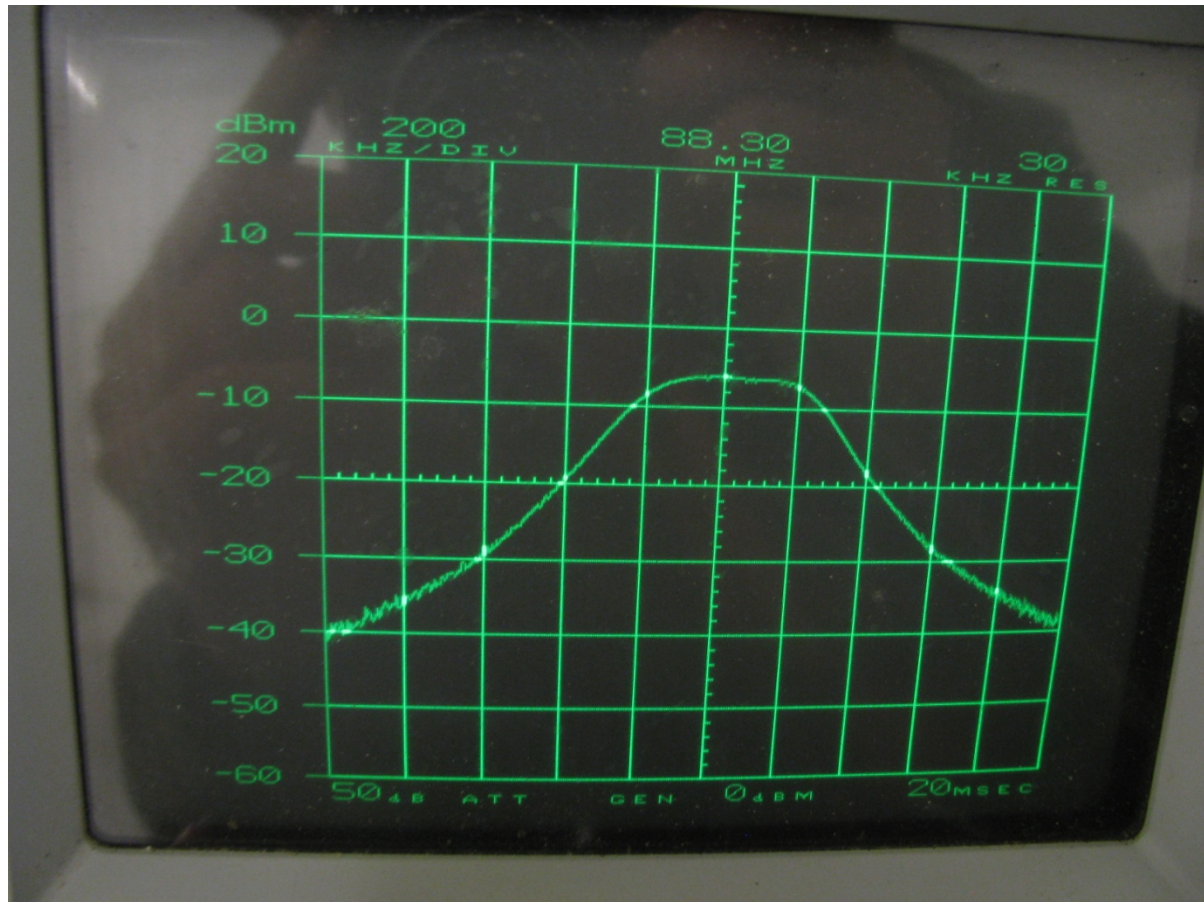
Intermod	Frequency A	Frequency B	Intermod Frequency	Measured Level	Ref Signal Level	Filter Loss	Intermod Level
					107.5 ref		
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Right Hand CP Transmission Line							
A+B	107.5	100.3	207.8	-96	10	-1	105
B-A	107.5	100.3	7.2	-97	10	-1	106
2A	107.5	100.3	215	-95	10	-1	104
2B	107.5	100.3	200.6	-94	10	-1	103
2A-B	107.5	100.3	114.7	-96	10	-2	104
2B-A	107.5	100.3	93.1	-97	10	-6	101
2A+B	107.5	100.3	315.3	-96	10	-1	105
2B+A	107.5	100.3	308.1	-96	10	-1	105
2A+2B	107.5	100.3	415.6	-96	10	-1	105
2A-2B	107.5	100.3	14.4	-98	10	-1	107
3A	107.5	100.3	322.5	-96	10	-1	105
3B	107.5	100.3	300.9	-96	10	-1	105
3A-B	107.5	100.3	222.2	-96	10	-1	105
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3B+A	107.5	100.3	408.4	-96	10	-1	105
3B-A	107.5	100.3	193.4	-96	10	-1	105
3A+2B	107.5	100.3	523.1	-96	10	-1	105
3A-2B	107.5	100.3	121.9	-97	10	-1	106
3B+2A	107.5	100.3	515.9	-95	10	-1	104
3B-2A	107.5	100.3	85.9	-96	10	-2	104
3A+3B	107.5	100.3	623.4	-95	10	-1	104
3A-3B	107.5	100.3	21.6	-98	10	-1	107

Intermod	Frequency A	Frequency B	Intermod Frequency	Measured Level	Ref Signal Level	Filter Loss	Intermod Level
					107.5 ref		
IM Level = (Ref signal) - (IM) + (filter loss)					+7 db		
Right Hand CP Transmission Line							
A+B	107.5	105.3	212.8	-96	10	-1	105
B-A	107.5	105.3	2.2	-97	10	-1	106
2A	107.5	105.3	215	-96	10	-1	105
2B	107.5	105.3	210.6	-96	10	-1	105
2A-B	107.5	105.3	109.7	-97	10	-6	101
2B-A	107.5	105.3	103.1	-92	10	-6	96
2A+B	107.5	105.3	320.3	-96	10	-1	105
2B+A	107.5	105.3	318.1	-96	10	-1	105
2A+2B	107.5	105.3	425.6	-96	10	-1	105
2A-2B	107.5	105.3	4.4	-97	10	-1	106
3A	107.5	105.3	322.5	-96	10	-1	105
3B	107.5	105.3	315.9	-90	10	-1	99
3A-B	107.5	105.3	217.2	-96	10	-1	105
3A+B	107.5	105.3	427.8	-96	10	-1	105
3B+A	107.5	105.3	423.4	-96	10	-1	105
3B-A	107.5	105.3	208.4	-98	10	-1	107
3A+2B	107.5	105.3	533.1	-96	10	-1	105
3A-2B	107.5	105.3	111.9	-97	10	-6	101
3B+2A	107.5	105.3	530.9	-96	10	-1	105
3B-2A	107.5	105.3	100.9	-79	10	-6	83
3A+3B	107.5	105.3	638.4	-92	10	-1	101
3A-3B	107.5	105.3	6.6	-98	10	-1	107

Intermod	Frequency A	Frequency B	Intermod Frequency	Measured Level	Ref Signal Level	Filter Loss	Intermod Level
IM Level = (Ref signal) - (IM) + (filter loss)							
Right Hand CP Transmission Line							
A+B	100.3	105.3	205.6	-97	10	-1	106
B-A	100.3	105.3	5	-93	10	-1	102
2A	100.3	105.3	200.6	-96	10	-1	105
2B	100.3	105.3	210.6	-96	10	-1	105
2A-B	100.3	105.3	95.3	-92	10	-6	96
2B-A	100.3	105.3	110.3	-97	10	-6	101
2A+B	100.3	105.3	305.9	-82	10	-1	91
2B+A	100.3	105.3	310.9	-88	10	-1	97
2A+2B	100.3	105.3	411.2	-96	10	-1	105
2A-2B	100.3	105.3	10	-98	10	-1	107
3A	100.3	105.3	300.9	-95	10	-1	104
3B	100.3	105.3	315.9	-90	10	-1	99
3A-B	100.3	105.3	195.6	-96	10	-1	105
3A+B	100.3	105.3	406.2	-96	10	-1	105
3B+A	100.3	105.3	416.2	-96	10	-1	105
3B-A	100.3	105.3	215.6	-96	10	-1	105
3A+2B	100.3	105.3	511.5	-95	10	-1	104
3A-2B	100.3	105.3	90.3	-98	10	-6	102
3B+2A	100.3	105.3	516.5	-93	10	-1	102
3B-2A	100.3	105.3	115.3	-97	10	-2	105
3A+3B	100.3	105.3	616.8	-95	10	-1	104
3A-3B	100.3	105.3	15	-98	10	-1	107

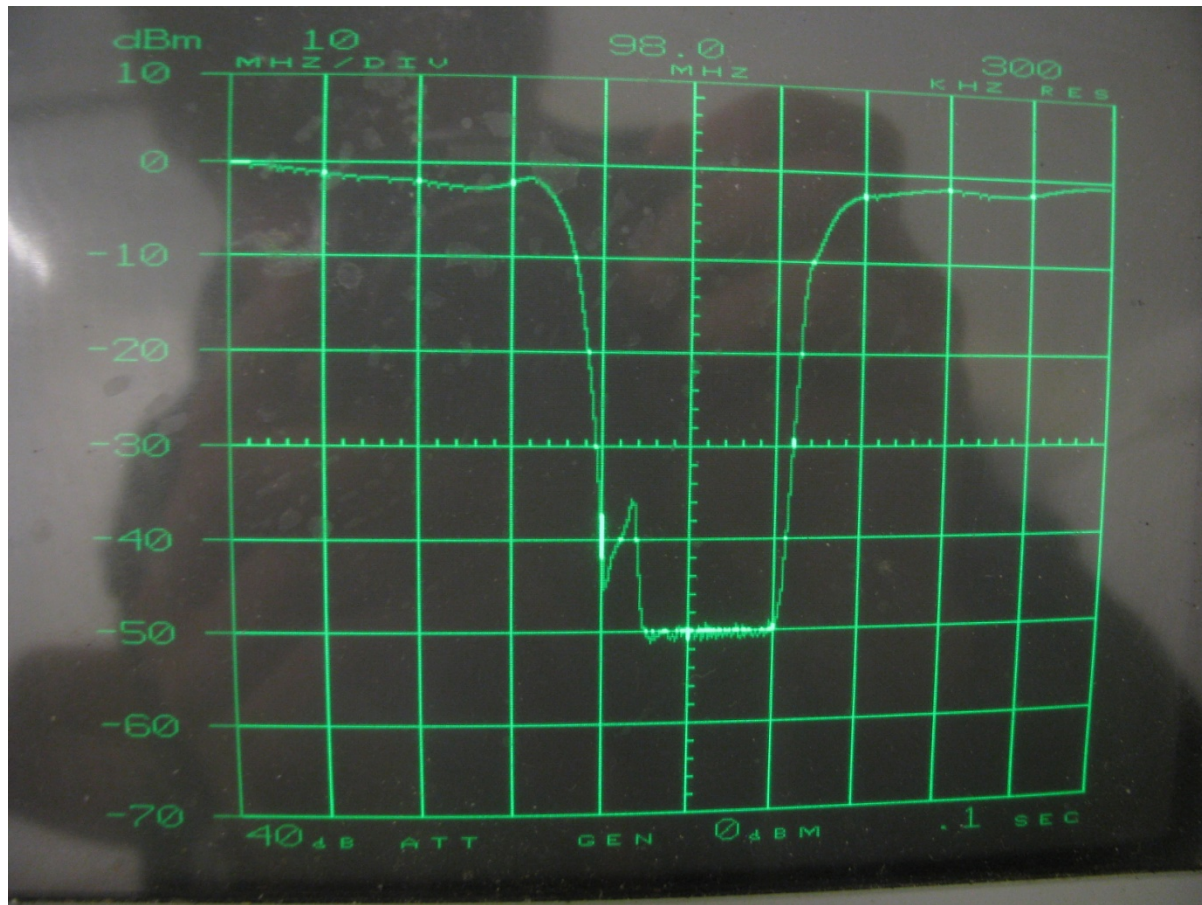
Intermod	Frequency A	Frequency B	Intermod Frequency	Measured Level	Ref Signal Level	Filter Loss	Intermod Level
IM Level = (Ref signal) - (IM) + (filter loss)							
Right Hand CP Transmission Line							
A+B	97.9	105.3	203.2	-96	10	-1	105
B-A	97.9	105.3	7.4	-98	10	-1	107
2A	97.9	105.3	195.8	-97	10	-1	106
2B	97.9	105.3	210.6	-96	10	-1	105
2A-B	97.9	105.3	90.5	-96	10	-6	100
2B-A	97.9	105.3	112.7	-98	10	-6	102
2A+B	97.9	105.3	301.1	-96	10	-1	105
2B+A	97.9	105.3	308.5	-96	10	-1	105
2A+2B	97.9	105.3	406.4	-96	10	-1	105
2A-2B	97.9	105.3	14.8	-98	10	-1	107
3A	97.9	105.3	293.7	-96	10	-1	105
3B	97.9	105.3	315.9	-90	10	-1	99
3A-B	97.9	105.3	188.4	-92	10	-1	101
3A+B	97.9	105.3	399	-96	10	-1	105
3B+A	97.9	105.3	413.8	-96	10	-1	105
3B-A	97.9	105.3	218	-97	10	-1	106
3A+2B	97.9	105.3	504.3	-96	10	-1	105
3A-2B	97.9	105.3	83.1	-98	10	-6	102
3B+2A	97.9	105.3	511.7	-95	10	-1	104
3B-2A	97.9	105.3	120.1	-96	10	-1	105
3A+3B	97.9	105.3	609.6	-95	10	-1	104
3A-3B	97.9	105.3	22.2	-98	10	-1	107

Typical characteristics of band pass filter

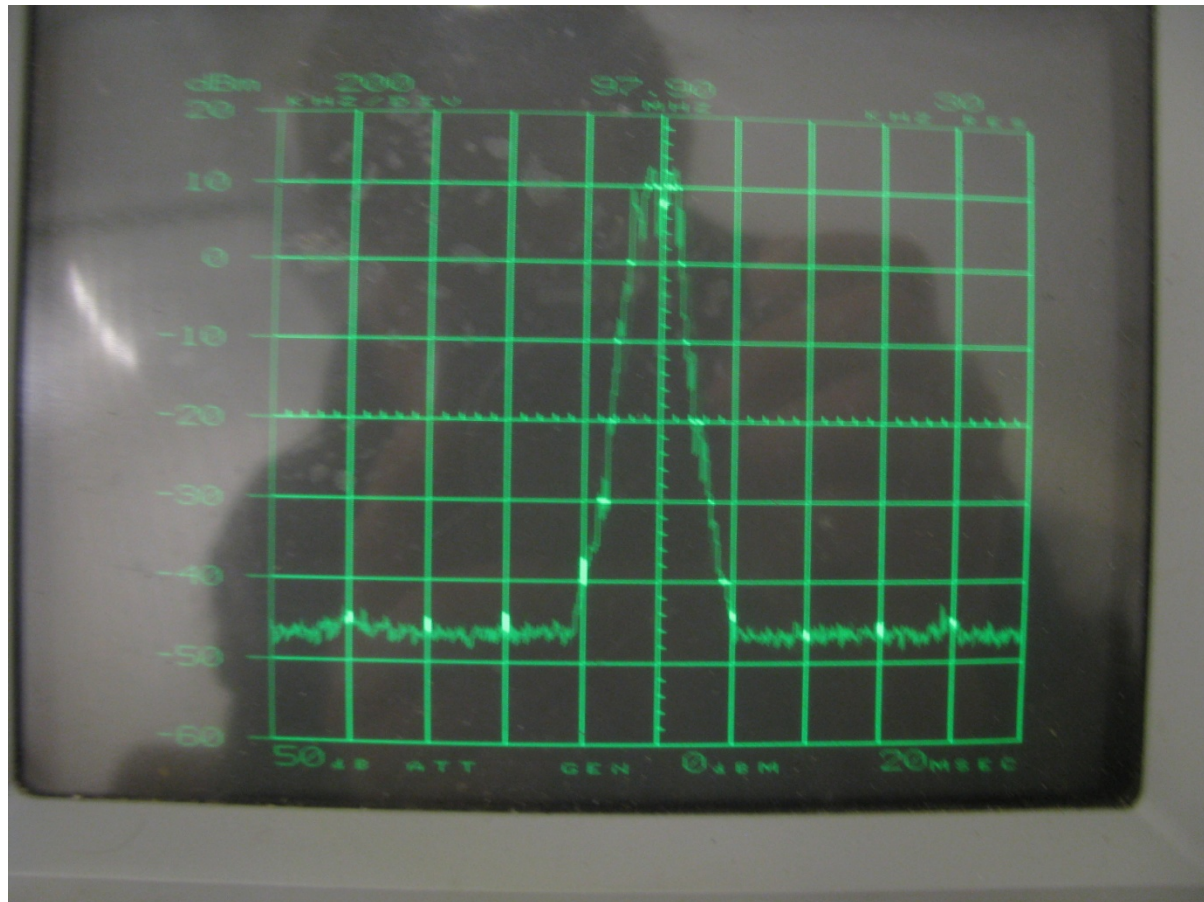




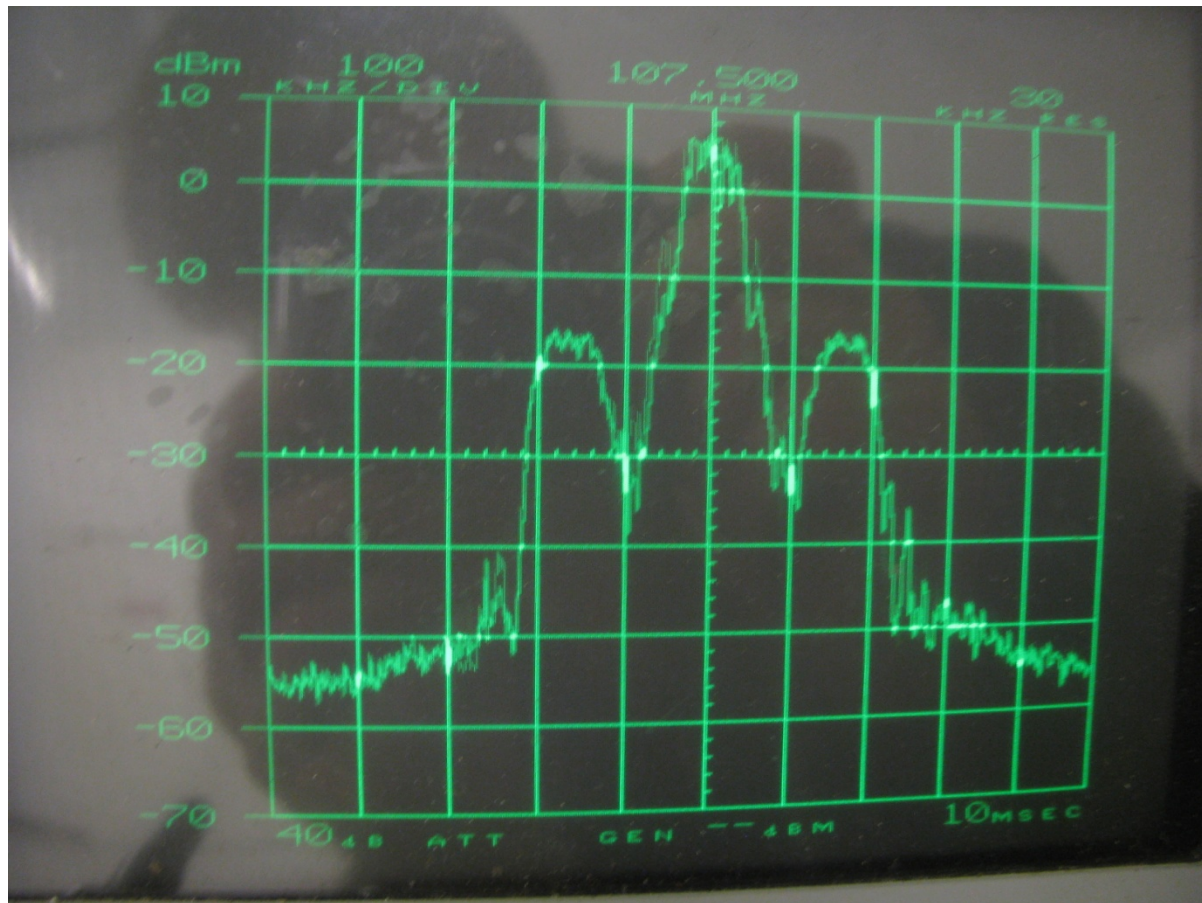
# Typical Characteristics of FM band stop filter



97.9 Spectra in the “left hand CP transmission line”

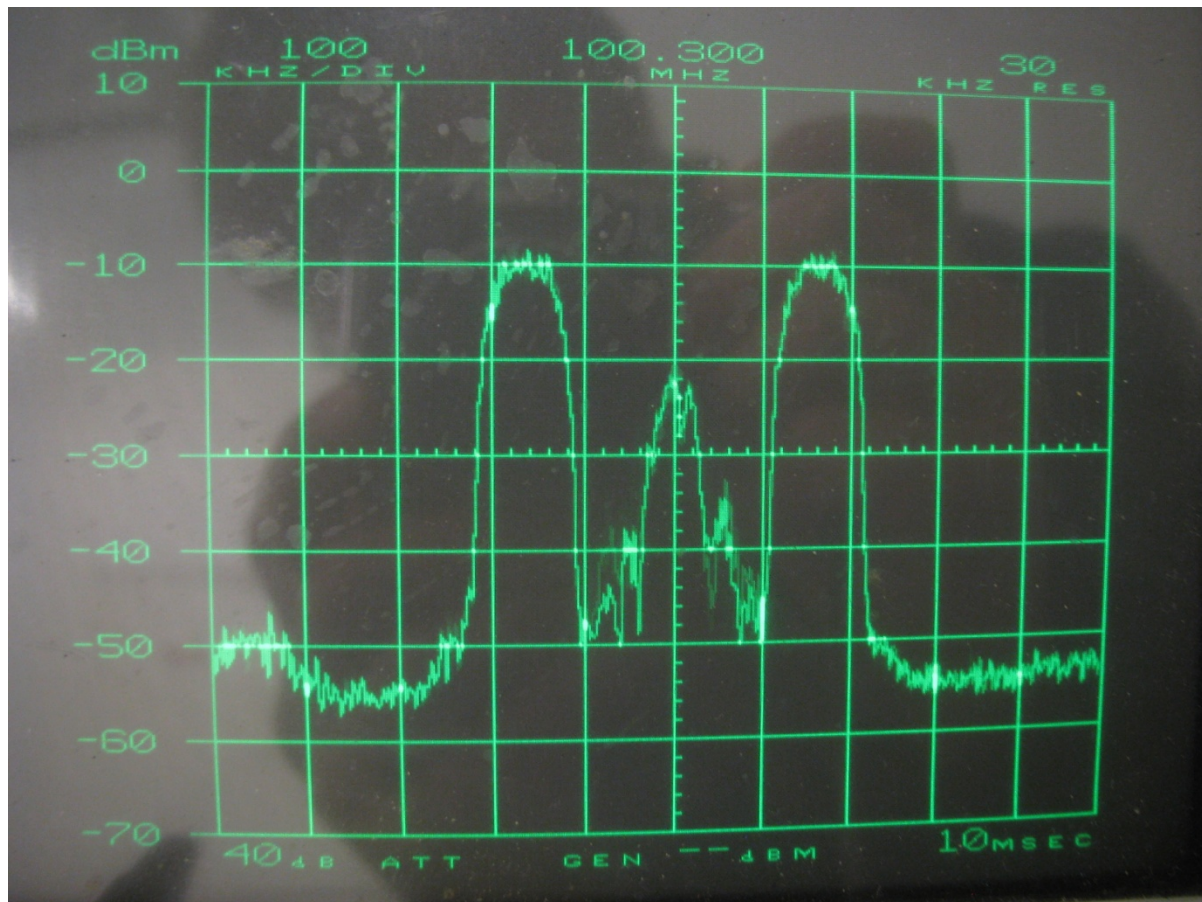


107.5 Spectra in the “left hand CP transmission line”

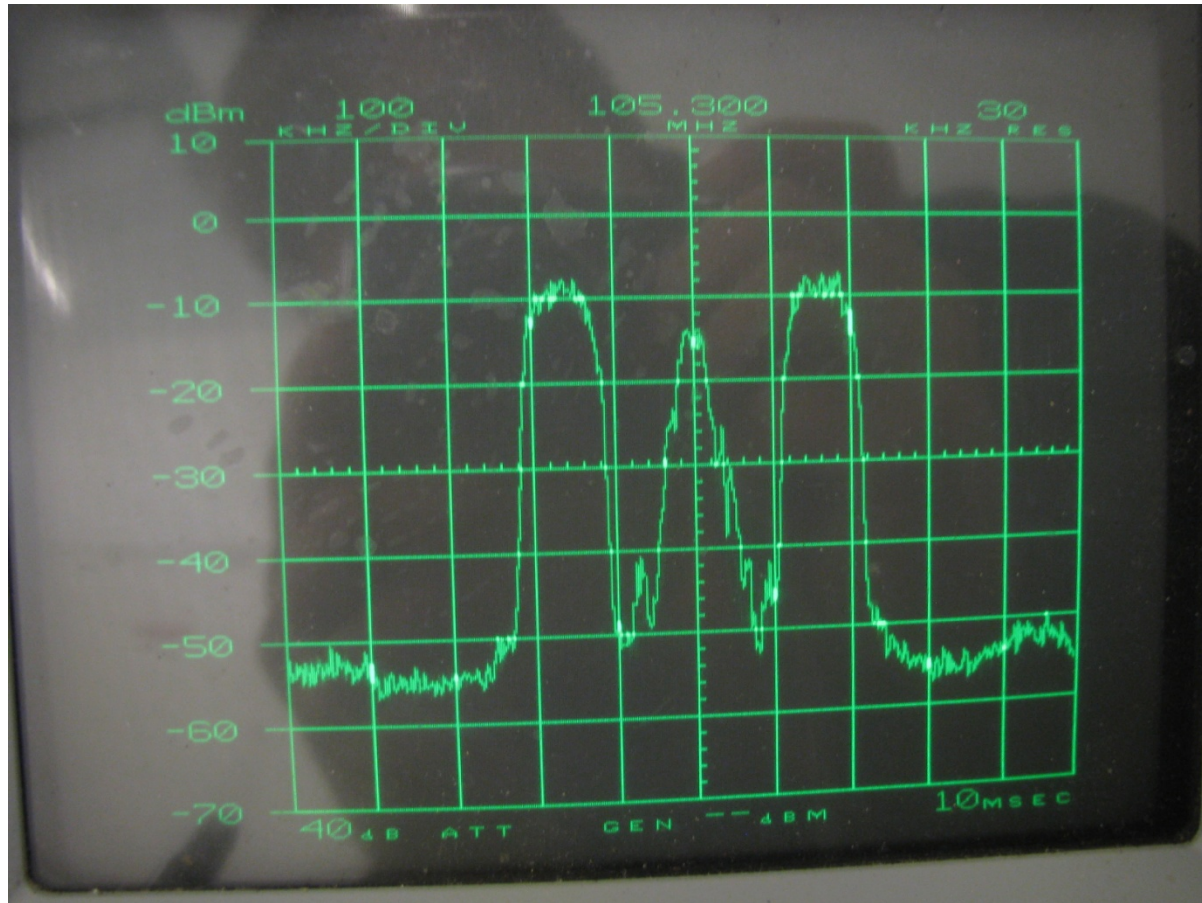




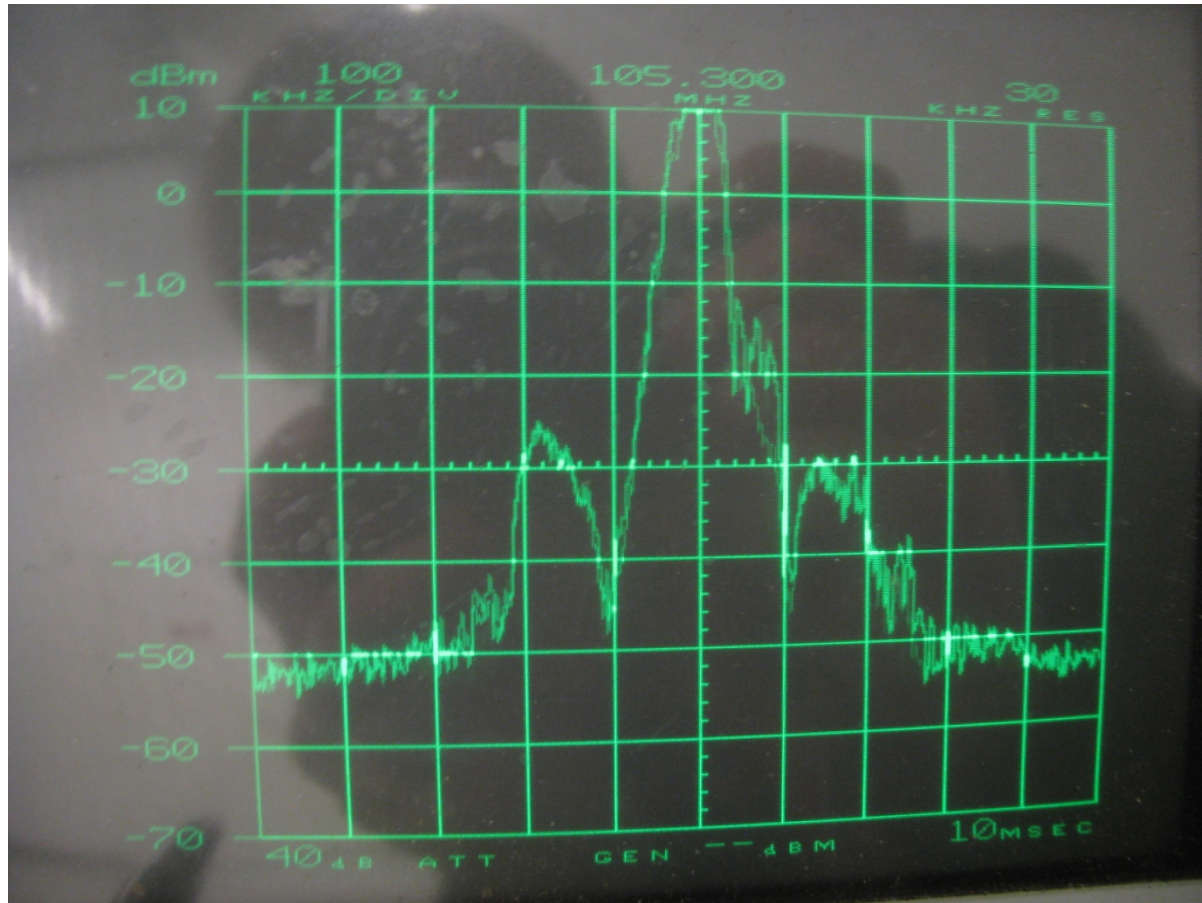
### 100.3 Spectra in the “left hand CP transmission line”



### 105.3 Spectra in the “left hand CP transmission line”

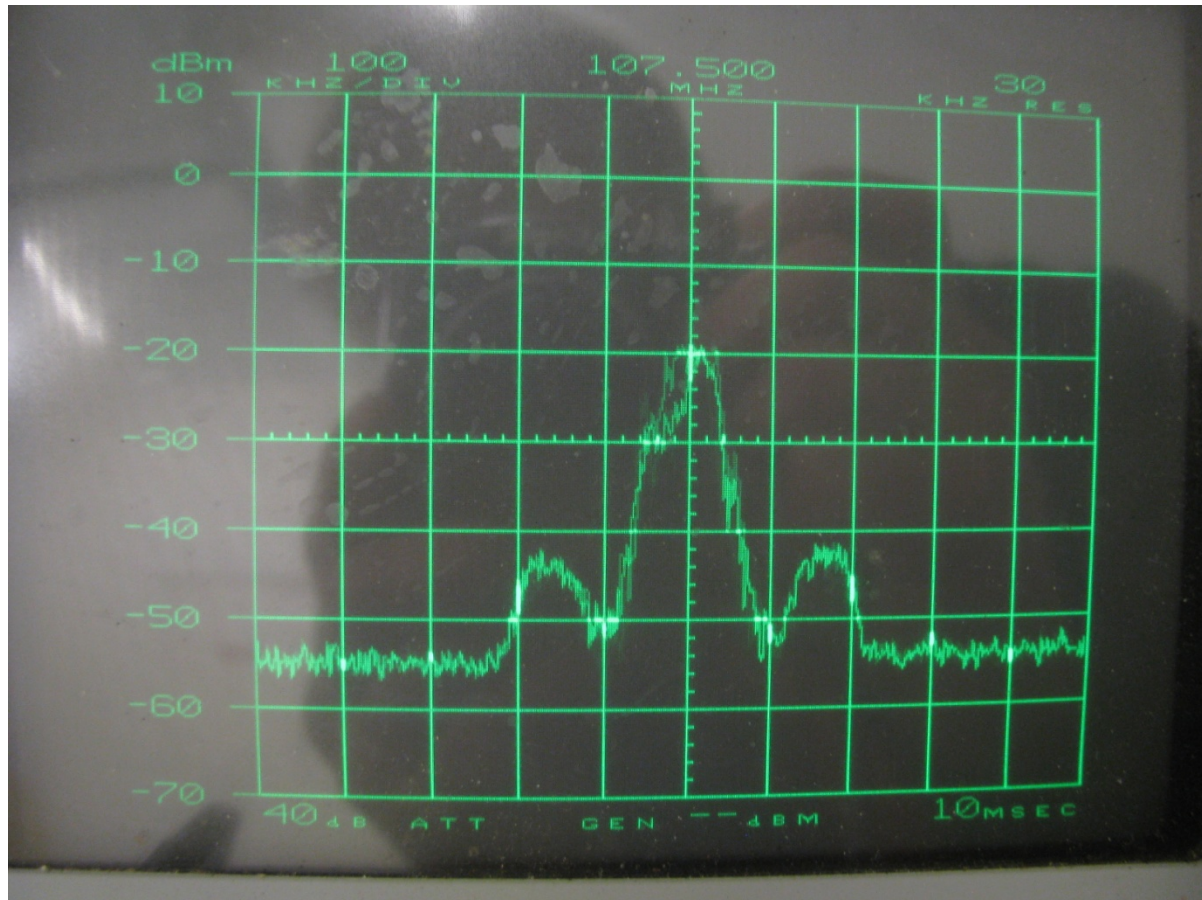


### 105.3 Spectra in the “right hand CP transmission line”

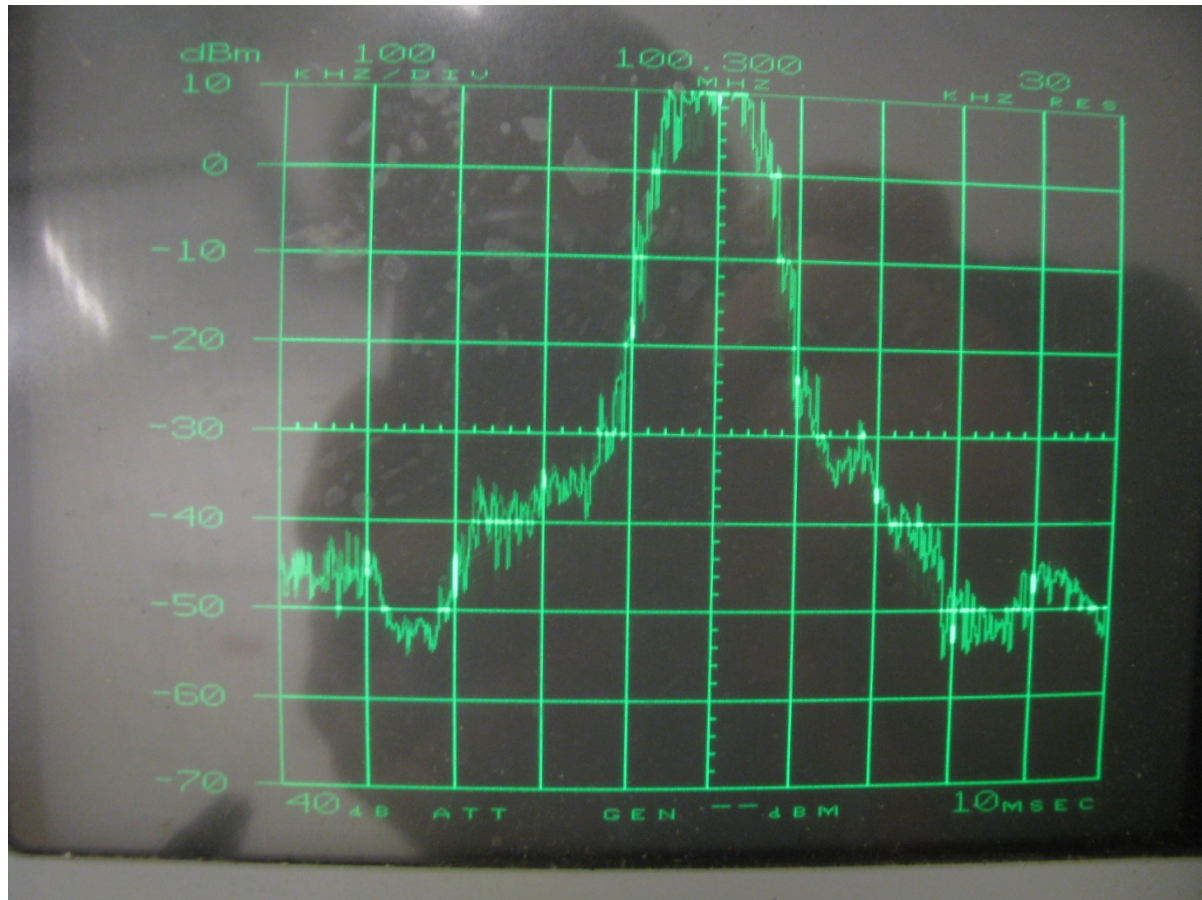




107.5 Spectra in the “right hand CP transmission line”

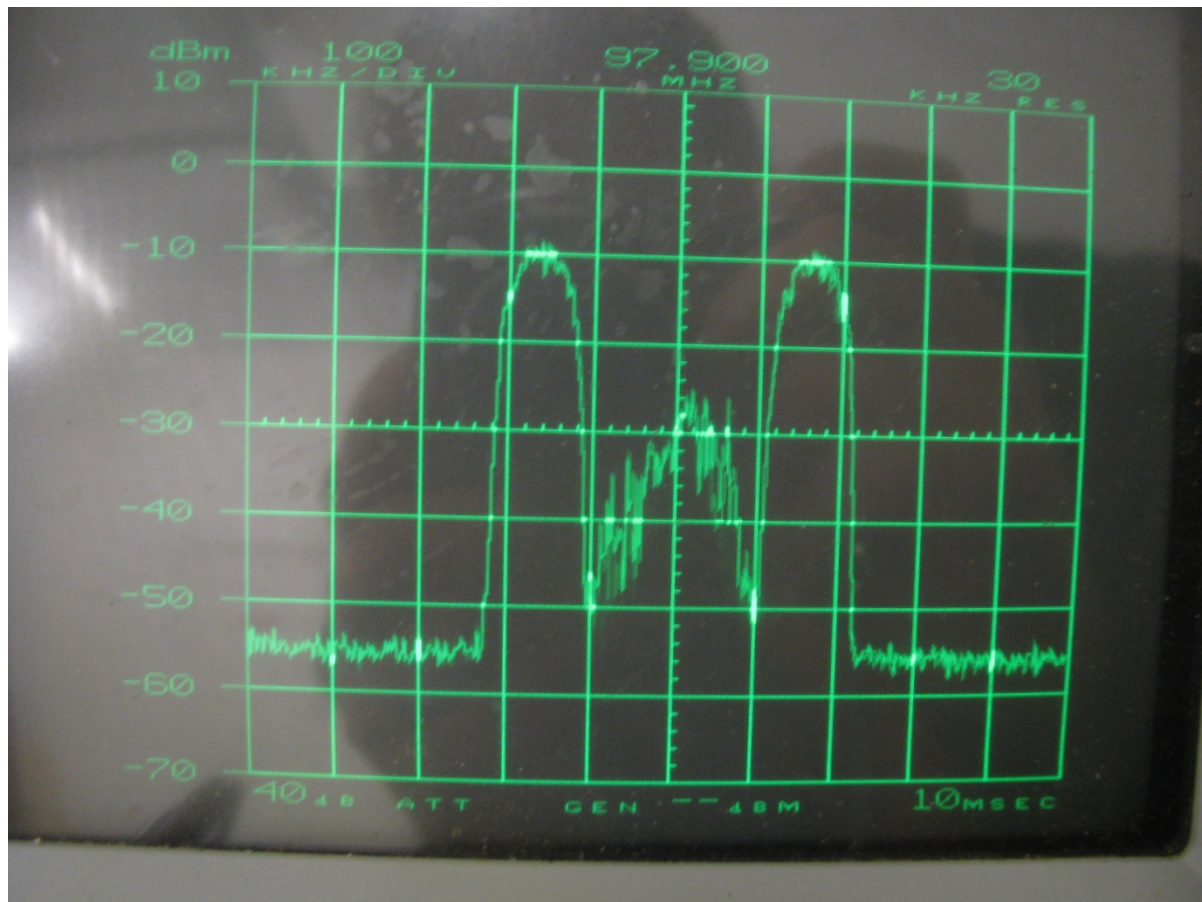


### 100.3 Spectra in the “right hand CP transmission line”

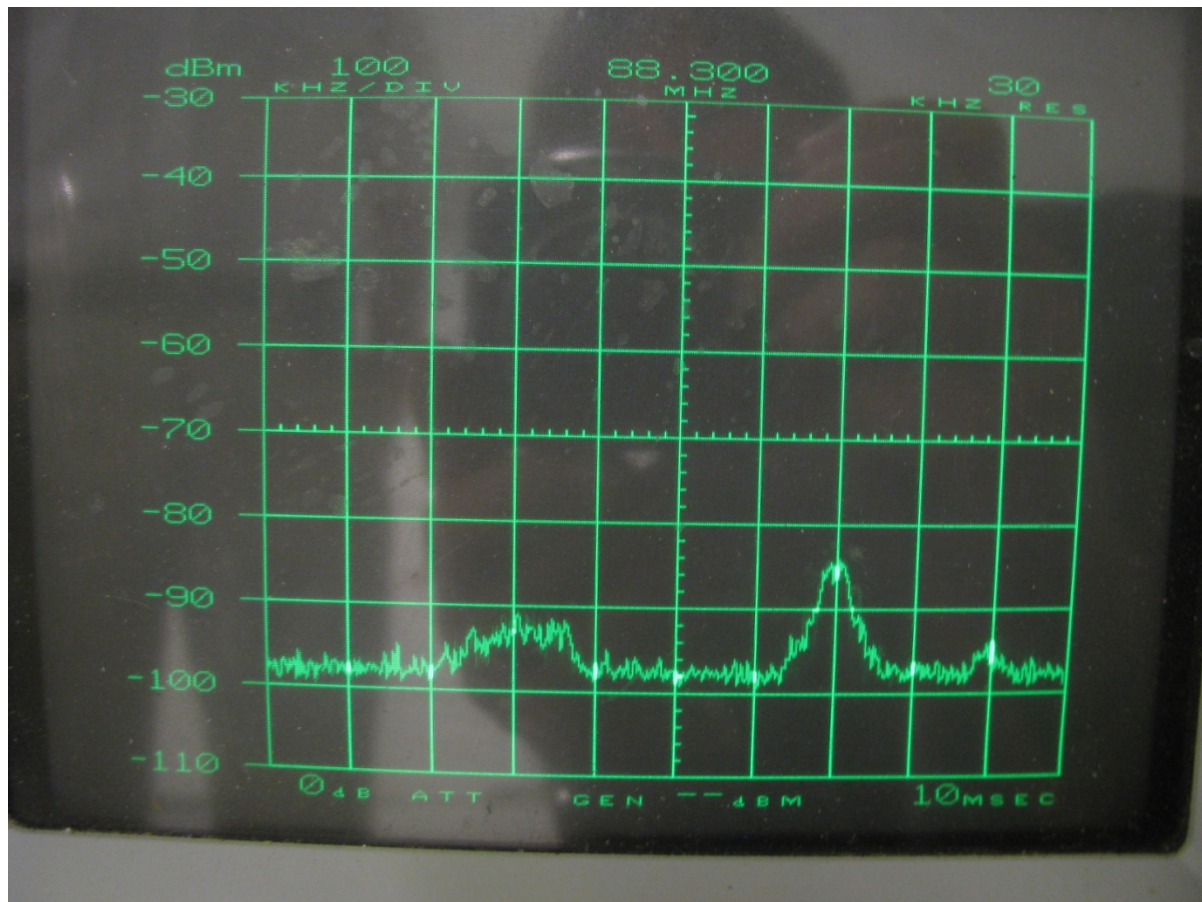




97.9 Spectra in the “right hand CP transmission line”

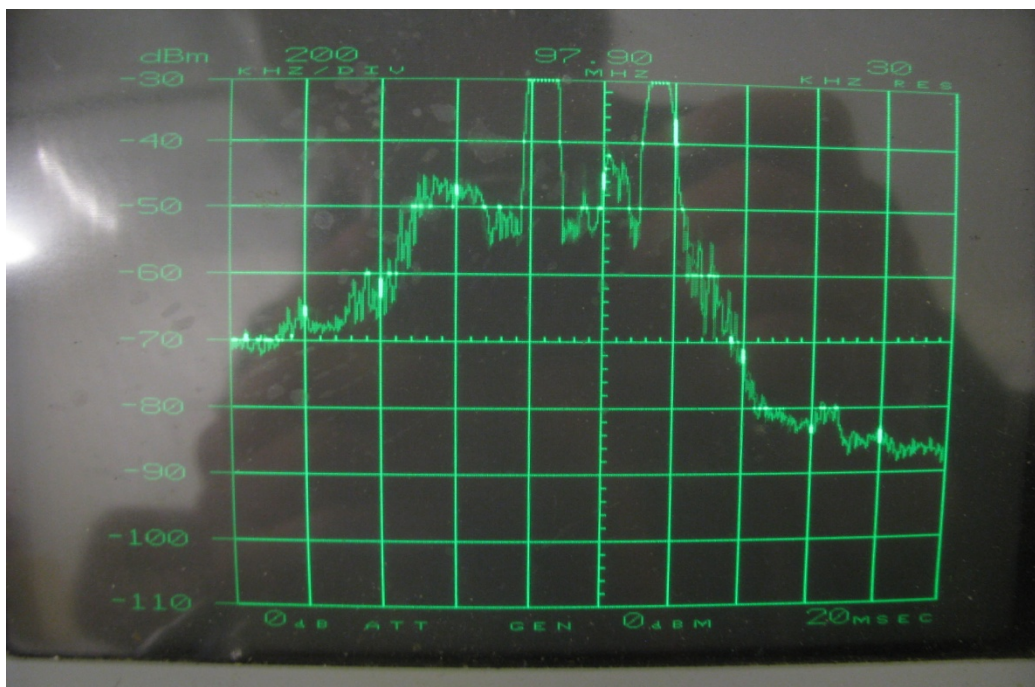
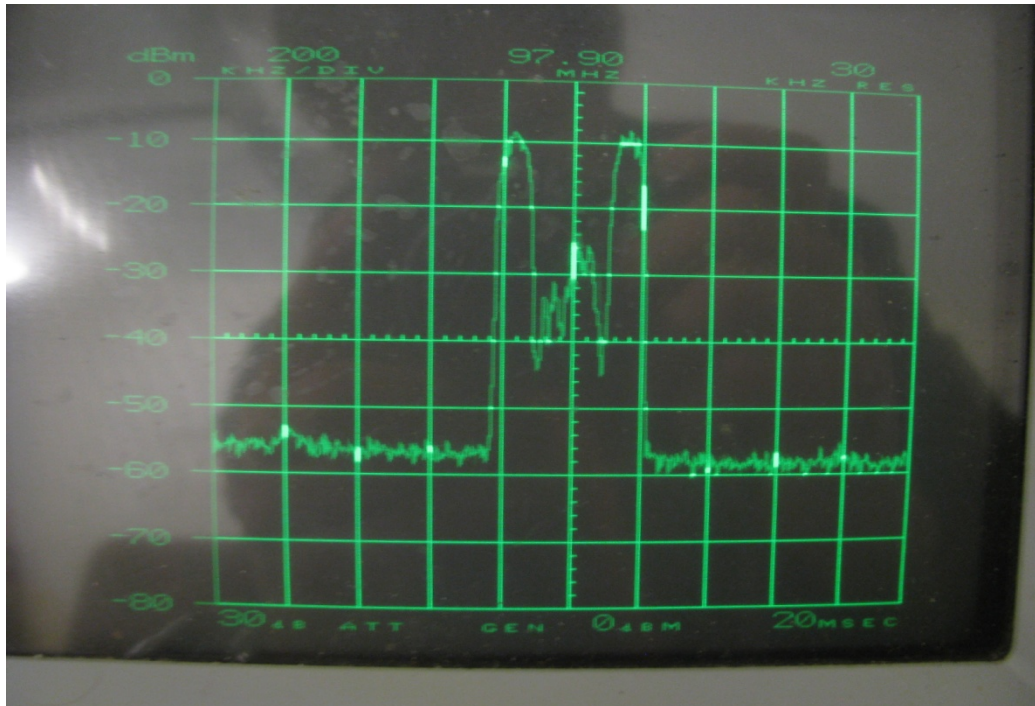


# Typical intermod measurement

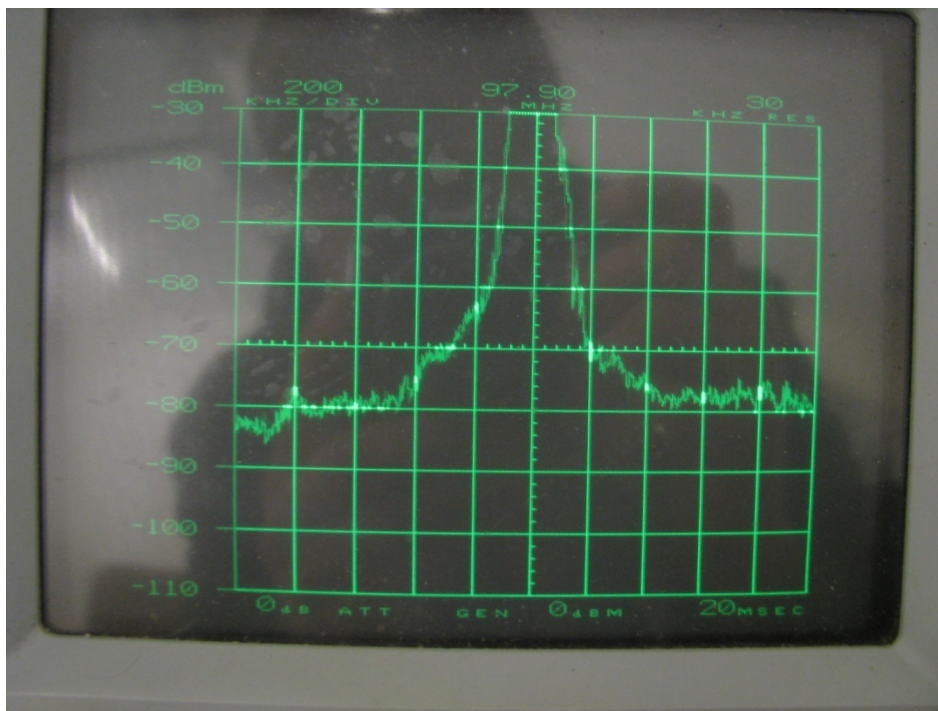
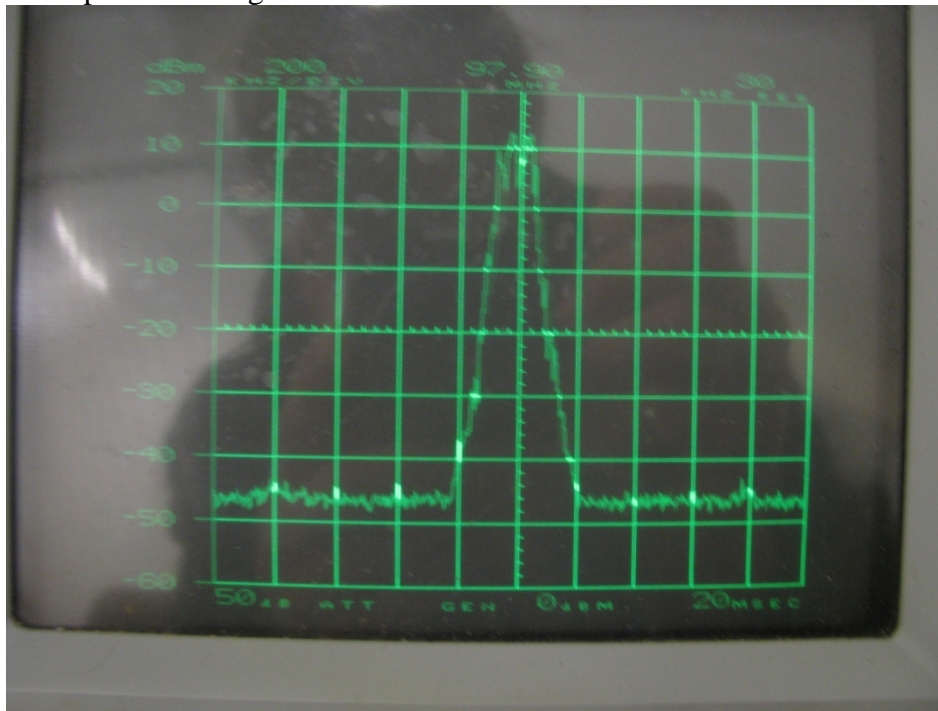




97.9 Spectra Digital, (adjacent channel noise is evident)



## 97.9 Spectra Analog



**Conclusions:**

Based upon my observations and measurement data collected on July 15, 2010, I Peter Eckmann, find the subject combined system operating with stations KBFB, KJKK, KRLD, & KMKV to be compliant with the requirements of Section 73.317 paragraph (b) through (d) of the FCC Rules and Regulations. All measurement data was collected under the observation of Don Stevenson of Radio One Broadcasting.

Peter Eckmann  
President  
Peter Eckmann Broadcast Consultants, Inc.