IBOC Field Service Bulletin No. 02.20060216

Issued: February 16, 2006

Subject: Indoor FM HD Radio Antenna Performance

Equipment: Boston Acoustic Recepter Table Radios

Type: Anomaly

Symptom: HD Radio reception inside homes and office buildings with the new Boston Acoustics Recepter® table model radios has been disappointing for some listeners. In some cases, analog reception of hybrid stations has been adequate, but the HD Radio reception has dropped in and out, or has been non-existent. NPR Labs' measurement of this model shows very good sensitivity at the antenna input, which suggests that the supplied 18-inch wire antenna is a major fault. A better indoor FM antenna is needed to improve HD Radio reception.

Recommendations: NPR Labs obtained the following samples of active (amplified) and passive FM receive antennas for evaluation with HD Radio signals:

- Folded dipole
- Compact amplified FM-only antenna
- Compact amplified FM/AM antenna
- Rabbit-ear FM antenna

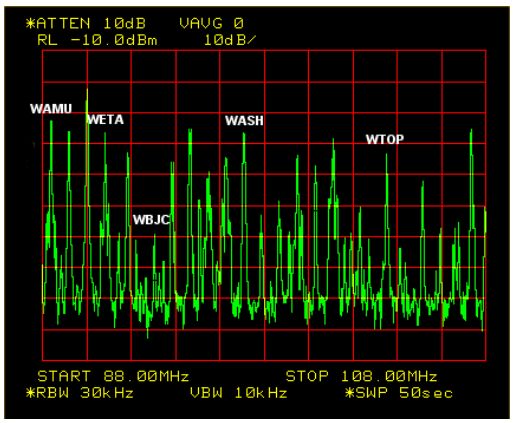
Testing is underway and a full report will be available later this year. However, the need for improved HD Radio reception indoors prompts NPR Labs to release this bulletin to help guide stations and consumers in choosing antennas that are effective in improving reception.

Preliminary testing shows a clear advantage to passive antennas, such as folded dipole and rabbit-ear types, over low-cost active antennas. The figures below show an example of the performance difference between a 75-ohm folded dipole antenna and an active FM-only antenna. These figures show the spectrum measured from 88 to 108 MHz at the NPR headquarters building in downtown Washington DC. The antennas were placed on a large empty cardboard (non-conductive) box approximately 5 feet from a north-facing 5th floor window. The spectrum plots are marked with five sample stations:

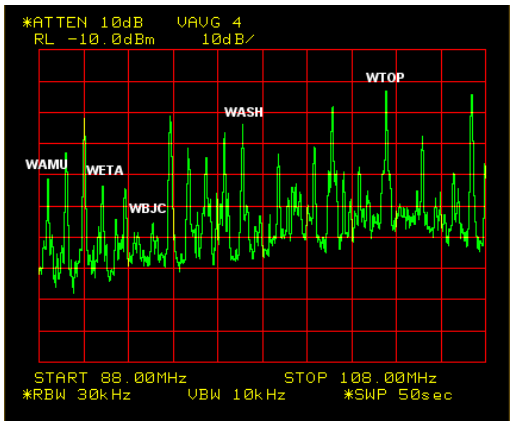
WAMU	88.5 MHz	Washington DC
WETA	90.9 MHz	Washington DC (Arlington VA transmitter)
WBJC	91.5 MHz	Baltimore MD
WASH	97.1 MHz	Washington DC

WTOP 103.5 MHz Washington DC.

The spectrum of the folded dipole shows most FM station signals ranging between -30 dBm and -50 dBm (measured with a 50-ohm spectrum analyzer input). WBJC, a Baltimore station, is shown at approximately -69 dBm. The noise floor, which is a combination of analyzer internal noise and low-level FM signals is below -90 dBm.



Folded Dipole Antenna



Active FM-Only Antenna

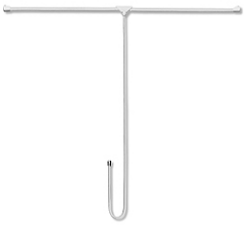
The gain control of the active FM-only antenna was adjusted so that the level of FM signals near the middle of the band were approximately equal to the levels measured with the folded dipole; this occurred at a rotation about 1/3 clockwise from minimum. It is apparent that gain of the antenna unit is not flat across the band; the Reserved Band (88-92 MHz) stations are at least 10 dB lower with the active antenna. The WTOP signal is approximately 20 dB higher than it was with the folded dipole. However, this signal increase is accompanied by a noise floor increase of nearly 30 dB so the net signal-to-noise ratio is decreased by approximately 10 dB. The signal-to-noise ratio for the Reserved Band stations is even worse (note that weak WBJC is almost lost in the noise). This performance was typical of other amplified antennas tested that sell for under $70.

The source of noise in amplified FM antennas is likely to be 3rd order and 5th order intermodulation products generated by the internal amplifier. Adjustment of the gain control lower will reduce the IM product levels, but also reduces the signal levels below that of the sample dipole antenna.

Suggestions of passive antennas that were found to perform well are:

- C. Crane “FM Reflect Antenna”, $24.95 (www.shop.npr.org)
- Radio Shack “Budget TV Antenna Model 15-1874”, $9.99 (www.radioshack.com)

Radio Shack Budget TV Antenna Model



CCrane FM Reflect Antenna

NPR Labs will provide updates to this field service bulletin as field information warrants.

Please contact mstarling@npr.org for further information concerning this NPR Labs FSB. Refer to Field Service Bulletin No. 02