

TELECOMMUNICATIONS ENGINEERING

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OCCUPIED BANDWIDTH AND SPURIOUS EMISSIONS MEASUREMENTS  
KMHD – FM, PORTLAND, OREGON

23 June 2005

## ENGINEERING REPORT

On the afternoon of 20 June 2005, I made the equipment performance measurements contemplated in 47 CFR § 73.1590 (a & b) and described in 47 CFR § 73.317 (b-d), for radio station KMHD(FM), Portland, Oregon. These measurements were made subsequent to the installation of a new transmitter, combiner and antenna.

Measurements were made while the station was broadcasting programming material typical of its daily operation. KMHD operates stereophonically with no subsidiary communications services. KMHD was simultaneously broadcasting an HD radio signal per the iBiquity interim standard.

The KMHD signal is combined with the signals of KBVM, 88.3 MHz., Portland, Oregon, and KBPS, 89.9 MHz., Portland, Oregon, using a Shively three station balanced combiner. The stations' respective HD signals are "cross-combined" using the same combiner as the FM signals. The combiner has separate outputs for the FM and HD signals. The three level, three around panel antenna has separate FM and HD feed systems, though both FM and HD signals are radiated from the same elements, albeit with opposite circular polarization senses.

KBPS was operating at licensed power with both an FM signal and an HD signal at the time these measurements were made. KBVM has not yet commenced operation using the combiner and was not operating at the time these measurements were made.

47 CFR § 73.317 (b) & (c) requires that all signals between 120 and 240 kHz removed from the carrier be attenuated below the level of the carrier by at least 25 dB; that all signals between 240 kHz and 600 kHz removed from the carrier be attenuated by at least 35 dB below the level of the carrier; and that all signals greater than 600 kHz removed from the carrier be attenuated by at least 80 dB below the level of the carrier.

Two sets of measurements were made to assure compliance with these requirements. The first measurement looked at the spectrum between –600 kHz and +600 kHz, relative to the carrier frequency, in order to assess the station's occupied bandwidth under modulation. The second set of measurements scanned the spectrum from 9 KHz to 500 MHz. in order to detect any out-of-band intermodulation products or harmonics.

All measurements were taken with a Rohde & Schwarz Model FSP3 Spectrum Analyzer, Serial Number 835151/011, within current calibration. The measurement sample was taken at the output of the combiner in the FM transmission line using a directional coupler provided as part of the combiner system.

To measure the occupied bandwidth, the spectrum analyzer was set to 89.1 MHz center frequency, 150 KHz/div span, 1 KHz resolution bandwidth, and 30 KHz video filtering. This results in a measurement noise floor of approximately –78 dBC.

The equipment topology of the KMHD transmission system makes it difficult to remove both program modulation and stereophonic pilot modulation from the carrier in order to set the measurement reference level to the unmodulated carrier level. The spectrum analyzer's channel power measurement feature was used to determine the measurement reference level. Program modulation was removed from the carrier leaving only stereophonic pilot modulation. The channel power was then measured over 50 KHz. bandwidth and that value set as the measurement reference level.

The analyzer was then placed in the peak hold mode and modulation applied. After ten minutes of data collection, the resultant spectrum was saved and a plot made of it for analysis.

A copy of this plot is included as Figure 1, below. The emission limits of 47 CFR § 73.317 (b-d) are shown on the plot as red lines. It can be clearly seen from this plot that the occupied bandwidth of KMHD lies well within the prescribed limits between –600 kHz and +600 kHz, relative to the carrier frequency. The signal that appears at +600 KHz and grows to the upper end of the frequency span is the signal of KBPS, 89.9 MHz.

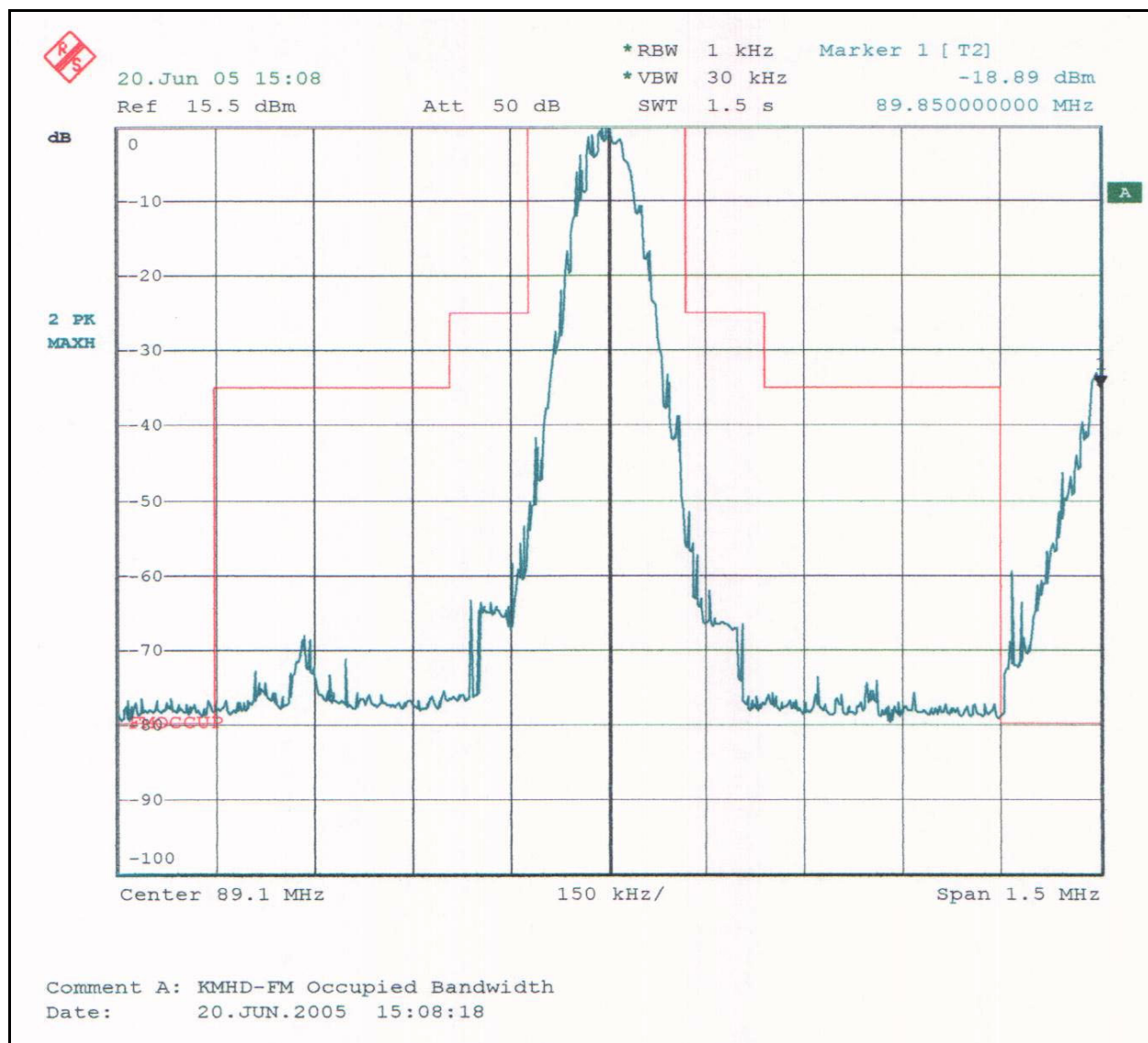


FIGURE 1

To make the second set of measurements, notch filters tuned to 89.1 and 89.9 MHz were inserted between the measurement port and the input of the spectrum analyzer. The notch filters were tuned using a Hewlett-Packard 8712B Network Analyzer. The insertion loss of the notch filters are approximately -20 dB at the KMHD and KBPS center frequencies and less than -0.5 dB at  $\pm 600$  KHz. from these frequencies. The purpose of the notch filters is to increase the dynamic range of the spectrum analyzer by reducing internally generated harmonics and intermodulation products.

To measure spurious signals and harmonics, the spectrum analyzer was set to 2 MHz/div span, 300 Hz resolution bandwidth, and 3 KHz video filtering which reduced the instrument noise floor to -87 dBc. The analyzer was initially set at 10 MHz center frequency and then incremented successively by 20 MHz to scan the spectrum from 9 kHz to 500 MHz. Any signals that were greater -80 dBc were noted and compared to a list of known transmitters in the area for elimination of ingress signals.

All such signals were found to be ingress signals from other nearby FM and television stations. No intermodulation products or harmonics attributable to the operation of KMHD were found

In light of the above measurements I believe that KMHD is in compliance with the requirements of 47 CFR § 73.317 (a) through (d).

ENGINEER'S STATEMENT

I , Gray Frierson Haertig, do hereby affirm that:

I have been retained by KMHD to ascertain its compliance with 47 CFR § 73.1590 (a) & (b) and 47 CFR § 73.317 (b-d) and to prepare this report;

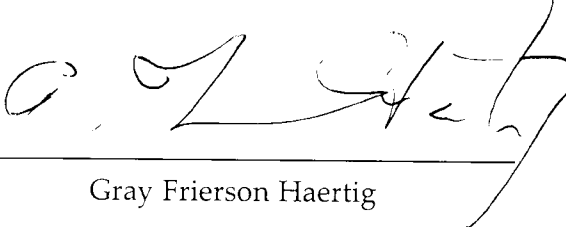
This report and associated exhibits were prepared by me, and are based on measurements made by me;

To the best of my knowledge all statements made herein are true and reflect the actual facts of the matter;

I am a Broadcast Engineer of 39 years experience and;

And that my qualifications are a matter of record with the Commission.

Respectfully submitted this 23<sup>rd</sup> day of June, 2005,



Gray Frierson Haertig