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Subject: Measurement Technique for Accurately Measuring the HD Radio™ Spectrum of an AM Transmitter

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Purpose of this document

The following document describes the measurement technique for accurately measuring the AM HD Radio™ Spectrum.

AM Spectral Emissions Limits

The following table is the emissions mask for AM HD Radio™ performance as specified by iBiquity. This is the emissions limits when the analog bandwidth is 5kHz.

Note that all measurements are made in a 300Hz bandwidth and relative to an un-modulated carrier.

AM HD FCC Spectral Mask	
offset from carrier frequency	level relative to unmodulated carrier (dB/300Hz)
5 to 10kHz	-34.3 dB
10 to 15kHz	-26.8dB
15 to 15.2 kHz	-28 dB
15.2 to15.8 kHz	[-39 - (Freq offset in kHz - 15.2) * 43.3] dB
15.8-25 kHz	-65 dB
25-30.5 kHz	[-65 - (Freq offset in kHz - 25) * 1.273] dB
30.5-75 kHz	[-72 - (Freq offset in kHz - 30.5) * 0.292] dB
>75 kHz	-80dB

Figure 1 - AM HD Radio™ Spectral Mask Limits

In addition, there are two notes in the iBiquity specification in regard to discrete spurious such as in a PWM Transmitter.

They are:

1) No more than two discrete components within 75 kHz of the carrier frequency shall exceed the spectral emission limits by more than 10dB.

2) No more than four discrete components removed from the carrier frequency by more than 75 kHz shall exceed the spectral emission limits by more than 5dB.

Figure 2 on the following page shows the AM spectral emissions limits mask for HD in red. The limit shown in red is the implementation of the table in **Figure 1** above. The emissions limits shown in blue in **Figure 2** are the AM emissions limits as set by the FCC and are currently documented in the FCC rules for standard AM operation without HD.

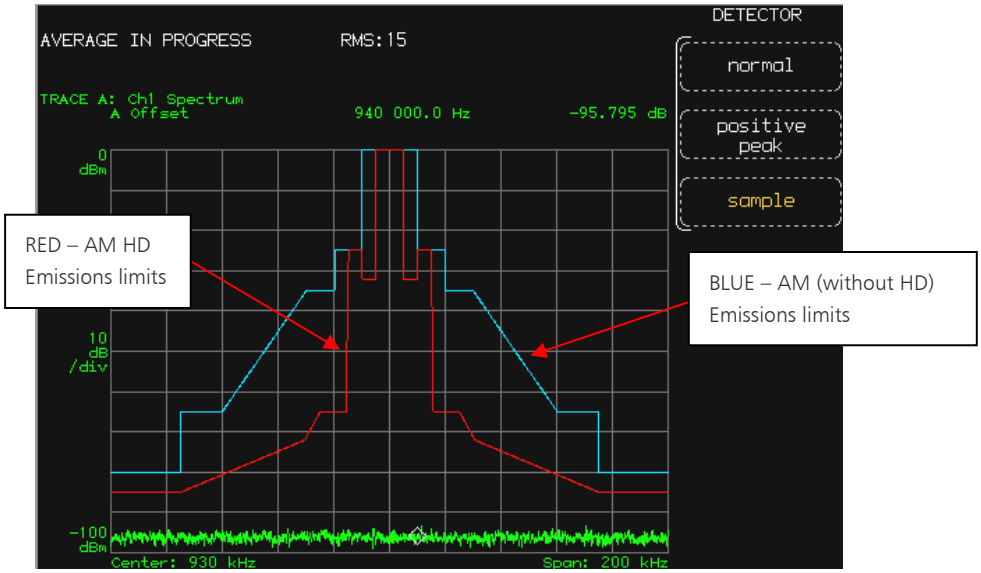

Figure 2 - Emissions Limits in Graphical Form

Setting up the Spectrum Analyzer

Reference:

Setting the reference for the measurement is critical to taking accurate data and the following steps should be taken. When setting this reference point the analyzer detector MUST be set to peak.

1) The reference level on the spectrum analyzer should be set at 0dBm. That is the top line on the spectrum is 0dBm. All measurements should be referenced to this point.

2) Apply an un-modulated AM signal to the spectrum analyzer input (external variable and/or fixed attenuation should be in line with the front to avoid overdriving or damage to the spectrum). Adjust the external variable attenuator until the un-modulated AM carrier is at the 0dBM reference line.

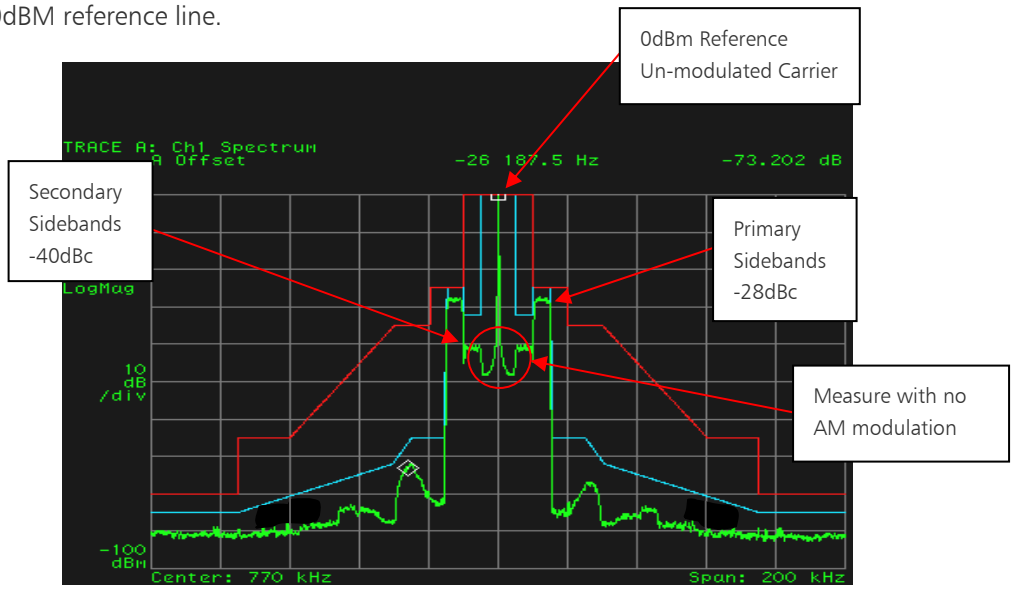

Figure 3 - 0dBm reference (Aligned AM IBOC Transmitter)

Resolution Bandwidth, Span, Detector, and Averaging:

When measuring an AM HD spectrum the spectrum analyzer must have the **Resolution Bandwidth** (RBW) set to **300Hz**. The **Span** setting of **200 kHz** is not required but is a good setting to view performance. The **Detector** should be set to **Sample** and **Averaging** should be set to **30 seconds**.

An **Un-modulated AM Transmitter Spectrum** that is properly aligned magnitude and phase should appear as shown in **Figure 3** on the previous page. It is critical that this measurement is made with no AM modulation. In addition, the primary sidebands should be ~28dB down from the un-modulated carrier and the secondary sidebands should be ~40dB down from the un-modulated carrier in a good system.

All measurements **MUST** be made into a known good 50 ohm load prior to putting Transmitter into an antenna system. This ensures that the Transmitter is known to be operating properly aside from the antenna system.

NOTE: When the Transmitter is operated into an antenna system the magnitude and phase will have to be re-adjusted for best spectral performance.

Figure 4 below shows an AM transmitter with the phase and magnitude misaligned. As you can see the inter-modulation products fall outside the emissions mask and this system should be adjusted for proper operation.

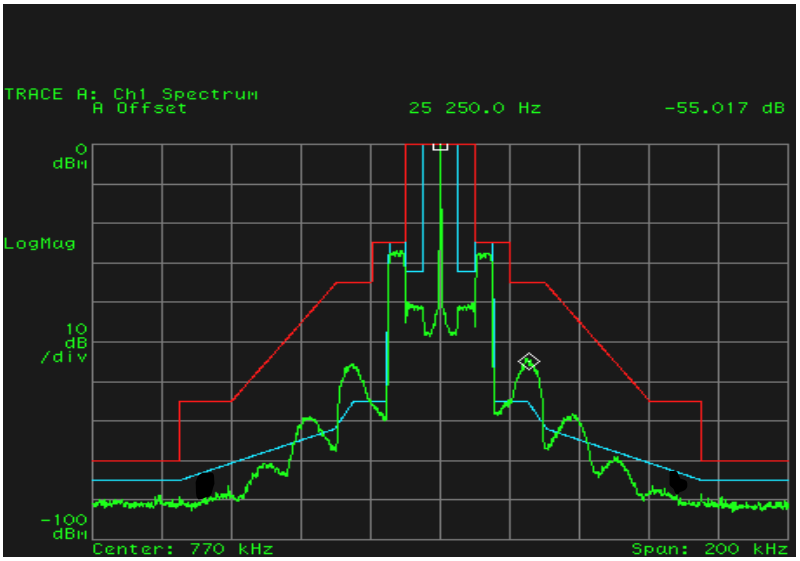

Figure 4 - Misaligned AM Transmitter