NRSC STANDARD

# NATIONAL RADIO SYSTEMS COMMITTEE

## NRSC-2-A
## Emission Limitation for Analog AM Broadcast Transmission
## September, 2007

THIS IS AN OUTDATED VERSION


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# FOREWORD

This Standard was developed by the National Radio Systems Committee (NRSC) and first published on June 1, 1988. It was incorporated into Section 73.44 of the FCC Rules in 1989 as a part of the *First Report and Order to FCC*, Mass Media Docket No. 88-376. This first revision (NRSC-2-A) was developed by the AMB Subcommittee of the NRSC, co-chaired by Stan Salek, Hammett & Edison, Inc., and Jeff Littlejohn, Clear Channel Broadcasting, Inc. The NRSC chairman at the time of adoption of NRSC-2-A was Milford Smith, Greater Media, Inc.

The NRSC is jointly sponsored by the Consumer Electronics Association (CEA) and the National Association of Broadcasters (NAB). It serves as an industry-wide standards-setting body for technical aspects of terrestrial over-the-air radio broadcasting systems in the United States.

# CONTENTS



# TABLES



# FIGURES

# EMISSION LIMITATION FOR ANALOG AM BROADCAST TRANSMISSION

## 1 SCOPE

The National Radio Systems Committee (NRSC) is a joint committee composed of interested parties including representatives of AM broadcast stations, AM receiver manufacturers, and broadcast equipment suppliers. This document describes a voluntary national standard that specifies radio frequency spectrum occupancy for AM broadcast stations. The Standard applies to both AM monophonic and AM stereo transmissions. For hybrid AM IBOC operations, the AM IBOC spectral occupancy specifications contained in NRSC-5 (and subsequent revisions) apply; note that the NRSC-5 requirements are more stringent than those described in this Standard.

The Federal Communications Commission (FCC) specifies analog AM spectral occupancy limits that are similar to the mask specified in Section 3 of this Standard—see 47 CFR §73.44.[1] Compliance with this Standard is strictly voluntary. Broadcaster compliance with FCC specifications is not voluntary. The NRSC adopted the original Standard with the goal of reducing the amount of interference in the AM band.

## 2 REFERENCES

### 2.1 Informative References

The following references contain information that may be of interest to those implementing this Standards document. At the time of publication the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below.

[1] *Bandwidth Options for Analog AM Broadcasters*, NRSC-G100, September, 2007
[2] *Consumer Testing of AM Broadcast Transmission Bandwidth and Audio Performance Measurements of Broadcast AM Receivers*, NPR Labs, September 8, 2006
[3] *Summary Report: Consumer Testing of AM Broadcast Transmission Bandwidth and Audio Performance Measurements of Broadcast AM Receivers*, NRSC AMB Subcommittee, December 2006
[4] Klein, *Modulation, Overmodulation, and Occupied Bandwidth: Recommendations for the AM Broadcast Industry,* NAB, September 11, 1986, pp. 18-23.
[5] Data sheet, *Model SM-1 AM Splatter Monitor, Delta Electronics* (obtained 7/07 at http://www.deltaelectronics.com/data/sm1data.htm)

### 2.2 Informative Reference Acquisition

Documents [1]-[5] are available free of charge via the NRSC website at: http://www.nrscstandards.org.

## 3 INTRODUCTION

On January 10, 1987, the NRSC authorized the NAB and the Electronic Industries Association (EIA) to publish a voluntary national standard specifying AM preemphasis, AM deemphasis and a 10 kHz analog AM audio bandwidth (Standard No. NRSC-1). The NRSC-1 audio standard applies to the analog audio signals that are intended to modulate the AM transmitter (whether analog or hybrid AM IBOC). Its

[1] Similarly, for hybrid AM IBOC, the FCC specifies AM spectral occupancy limits that are similar to the mask specified in NRSC-5—see 47 CFR §73.404(a).

purpose is to reduce second-adjacent channel interference by band limiting AM stations to a nominal 20 kHz occupied radio frequency (RF) bandwidth (twice the 10 kHz audio bandwidth presented to the transmitter's modulation circuits) , or, in the case of hybrid AM IBOC, to control the interaction between the analog and digital portions of the hybrid IBOC signal. Implementation of the NRSC-1 audio standard alone largely achieves this purpose. However, there remain characteristics of the AM transmission process that may cause the RF occupied bandwidth to exceed a nominal 20 kHz. This document addresses these transmission characteristics.

## 4 RF MASK SPECIFICATION

### 4.1 Purpose

The purpose of this RF mask specification is to control the spectral energy of an analog AM transmission resulting from modulation and intermodulation products that fall outside the necessary bandwidth of an analog AM broadcast signal modulated with 10 kHz (or less) bandwidth-limited audio.

### 4.2 RF Mask

The RF mask specification indicates the maximum allowed peak energy per 300 Hz of spectrum with respect to the center frequency of the AM carrier. Measurement is to be made by employing the "peak hold" function on a spectrum analyzer over a minimum ten minute period.[2] The specification encompasses all spectral components caused by direct programming and all ancillary or data communications, with the exception of hybrid AM IBOC operation, which is subject to a more stringent specification in NRSC-5 as amended from time to time. Analog AM broadcast stations shall occupy spectrum according to the maximum specifications indicated in Table 1. See Figure 1 and Figure 2.

***Table 1: RF Mask for Analog AM Broadcast Station Spectrum Occupancy***

| Frequency band relative to carrier (± kHz) | Attenuation relative to carrier (dB) |
|---|---|
| 0 to 10.2 | 0 |
| 10.2 to 20 | at least 25[3] |
| 20 to 30 | at least 35 |
| 30 to 60 | –at least (5 + 1 dB/kHz) from carrier[4] |
| 60 to 75 | at least 65[4] |
| Above 75 | at least 80[4] |

[2] It is recognized that the output of the spectrum analyzer depends on the shape of the analyzer's RBW filters, however the distinctions among such filters in currently available analyzers do not materially affect the results of RF mask testing.

[3] The slope of occupied bandwidth in the transition region between 10 and 11 kHz is defined by the NRSC-1-A audio standard. Accordingly, attenuation levels in the region would be 6 dB greater than described in the audio standard to adjust for carrier level reference. As of NRSC-2-A, the transition region above 10 kHz has been modified to conform with the FCC specification of 10.2 kHz.

[4] For carrier power levels between 158 and 5000 watts, the minimum attenuation from carrier reference level for emissions more than 75 kHz from carrier frequency shall be $(43 + 10\log P_W)$ dB (where $P_W$ is the carrier power in watts) or as indicated in Table 1, whichever is lesser attenuation. For carrier power levels less than 158 watts, a 65 dB minimum attenuation shall apply.

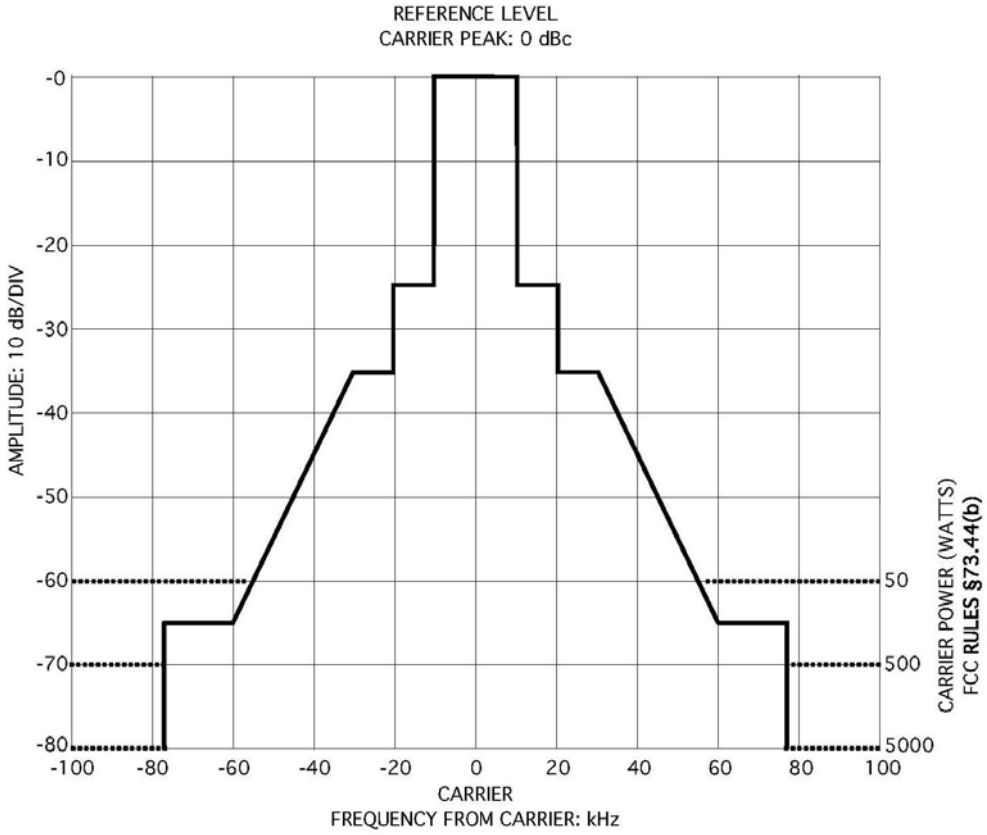


***Figure 1. Analog AM Broadcast RF Emission Limits***

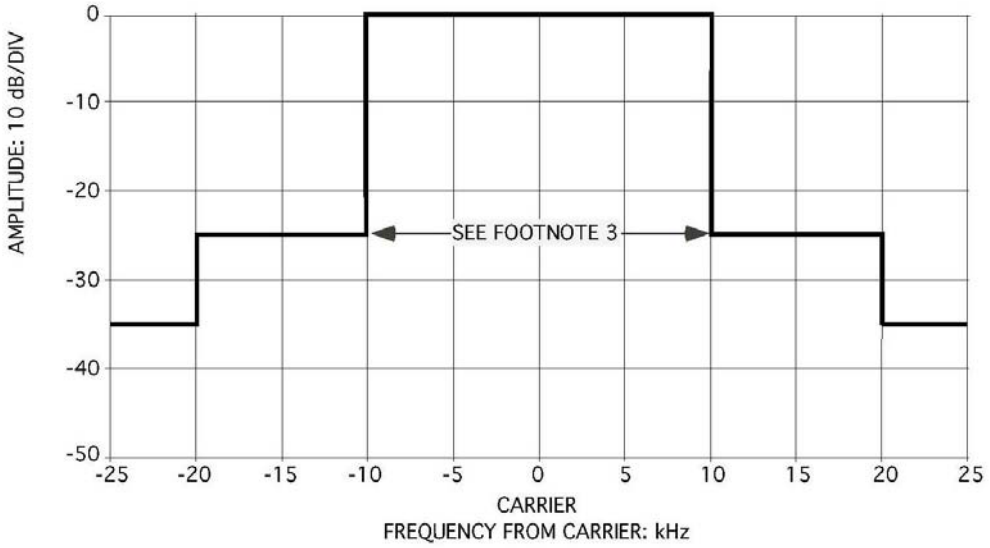


***Figure 2. Analog AM Broadcast RF Emission Limits (Expanded Scale)***

### 4.3 Measurement Procedure

#### 4.3.1 Use of Ordinary Program Material

Measurements of AM station spectrum occupancy shall be conducted using ordinary program material. All audio processing used in the AM station shall be in normal operating modes. The audio signal input to the AM transmitter shall conform to the NRSC-1 audio bandwidth standard as amended from time to time.

**4.3.1.1** *Use of Audio Tones*

Sweeping a transmission system with audio tones is a widely accepted and respected method for gauging spectrum occupancy and for troubleshooting and adjusting AM transmission systems. The NRSC endorses audio tones for these purposes, but urges caution in the use and selection of audio tones particularly with AM stereo transmission.[5] It should be noted, however, that it is difficult to infer the dynamic response of a transmission system while observing it in a steady-state condition.

#### 4.3.2 Use of Spectrum Analyzer

A suitable swept-frequency RF spectrum analyzer shall be used to measure compliance with the NRSC RF mask specification. The analyzer shall measure the over-the-air RF spectrum occupancy as perceived in the far field (*i.e.*, at least 10 wavelengths from the antenna center). Some caution should be used in measuring spectrum occupancy with directional antennas.[6]

The analyzer's setup shall consist of:

a. 300 Hz resolution bandwidth (RBW)
b. 5, 10, or 20 kHz/horizontal division (as appropriate)
c. 10 dB/vertical division
d. Reference: carrier peak
e. Peak hold: 10 minute duration minimum
f. No video filter (or set to at least 3 times the RBW)

## 5 ALTERNATE MEANS OF COMPLIANCE DETERMINATION

While the spectrum analyzer method described in Section 4.3.2 defines the prescribed procedure for demonstrating compliance with the NRSC RF mask specification, other equivalent (and potentially lower cost) methods may be employed. For example, a "splatter monitor" device was developed shortly after the initial release of this Standard (see informative reference [5]) that is capable of continuously monitoring compliance with RF mask characteristics. This type of device employs a receiver with added circuitry that analyzes the demodulated audio signal for the presence of components within the stopband region. At a minimum, such a device must (1) employ the NRSC-1-A deemphasis characteristic, and (2) have the capability to detect in-phase and quadrature amplitude signal components that may be found in the defined stopband region. The NRSC encourages further development of alternative devices to verify RF mask compliance that utilize either direct RF detection or demodulation of analog audio components.

It is noted that hybrid AM IBOC broadcast stations employ technology that is compliant with the NRSC-2-A RF mask specification. However, the spectrum analyzer method employed to determine compliance for such stations differs from that used for analog-only stations. In such cases, the power spectral density of the combined analog and digital signals must be averaged in a 300 Hz bandwidth over a 30-second

[5] The manufacturer of the particular AM stereo system employed should be consulted for the appropriate tone frequencies/modulation levels for "worst case" condition testing.
[6] See informative reference [4].

segment of time. Additionally, sampling detection (rather than peak hold detection) must be utilized. See the NRSC-5-A Standard and normative reference Doc. No. SY_SSS_1082s for further information. As for measurement of the analog-only transmission mask, the NRSC encourages development of alternative devices to verify hybrid AM IBOC RF mask compliance.

## NRSC Document Improvement Proposal

If in the review or use of this document a potential change appears needed for safety, health or technical reasons, please fill in the appropriate information below and email, mail or fax to:

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