

# NATIONAL RADIO SYSTEMS COMMITTEE

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**NRSC-3  
Audio Bandwidth and Distortion  
Recommendations for AM  
Broadcast Receivers  
June, 1990**



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# AUDIO BANDWIDTH AND DISTORTION RECOMMENDATIONS FOR AM BROADCAST RECEIVERS

## § 1. Scope.

The National Radio Systems Committee (NRSC) is a joint committee of the Electronic Industries Association and the National Association of Broadcasters, composed of all interested parties including representatives of broadcast stations, radio receiver manufacturers, and broadcast equipment suppliers. This document describes a voluntary national standard that specifies audio bandwidth and distortion recommendations for AM broadcast radio receivers. The voluntary standard applies to both AM monophonic and AM stereophonic receivers, as well as to receivers of single, multiple or variable reception bandwidths. Compliance with this standard is strictly voluntary. To the NRSC's knowledge, no industry group or entity is or will be adversely affected by issuance of this document. Every effort has been made to inform and accommodate any and all interested parties. The NRSC believes that implementation of this voluntary standard will lead to improved AM receivers, thus providing enhanced service for all AM stations and an increase in quality of service to present and future AM listeners. However, the NRSC also believes the work to reduce interference conditions in the AM band must continue in order to improve the competitiveness of the service.

## § 2. Introduction.

It is the intent of the NRSC that this document serve as a voluntary national standard which may be used by receiver manufacturers to complement the broadcast elements of the NRSC-1 standard.<sup>1</sup> The NRSC-1 standard defines a broadcast/reception system capable of 10 kHz audio bandwidth. However, the NRSC-1 standard provides little specific guidance for receiver manufacturers who wish to determine whether a particular AM receiver

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<sup>1</sup> See *National Radio Systems Committee, NRSC-1 AM Preemphasis/Deemphasis and Broadcast Audio Transmission Bandwidth Specifications (ANSI/EIA-549-1988)*, ("NRSC-1 standard").

design actually matches NRSC AM broadcasts.<sup>2</sup> In order to help clarify the NRSC-1 standard, and to provide more specific guidance on the performance expectations for AM receivers that match NRSC AM broadcasts, the NRSC issues the following voluntary standard, "Audio Bandwidth and Distortion Recommendations for AM Broadcast Receivers."

### § 3. Specifications for AM Receivers.

§ 3.1. Purpose. The purpose of the following specifications is to serve as a voluntary design guide for manufacturers of AM broadcast radio receivers. They are further intended to augment and clarify elements of the NRSC-1 standard that cover radio receivers.<sup>3</sup>

#### § 3.2. Requirements.

§ 3.2.1. Audio Frequency Response. Radio receivers that satisfy the technical requirements of this specification shall have a frequency response of not less than 50 to 7500 Hz, with limits of plus 1.5 dB, minus 3.0 dB, referenced to 0 dB at 400 Hz. Receivers capable of selecting more than one bandwidth will meet this requirement if one bandwidth setting satisfies this requirement. Measurements to determine compliance with this section must be made in accordance with § 3.4, below.

§ 3.2.2. Maximum Non-linear Distortion. Receivers that satisfy the technical requirements of this specification shall not exhibit more than two percent total harmonic distortion plus noise (THD+N) at measurement frequencies between 50 and 7500 Hz. Measurements to determine compliance with this section must be made in accordance with § 3.4, below.

§ 3.3. Recommendation: 10 kHz Attenuation. The NRSC recommends that manufacturers incorporate circuitry into receiver designs that attenuates 10.0 kHz adjacent-channel carrier frequencies by at least 20 dB (with the NRSC-1 preemphasis characteristic inserted at the amplitude modulation input of the RF test signal generator, as specified in § 3.4.3.1.), or 30 dB (without use of the NRSC-1 preemphasis characteristic, as specified in § 3.4.3.2.).

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<sup>2</sup> See NRSC-1 standard at § 4 and § 6.

<sup>3</sup> See NRSC-1 standard at § 5.

§ 3.4. Measurement Procedure.

§ 3.4.1. RF Connection to Receiver Under Test. A test loop antenna, driven by the RF output of a test signal generator, shall be placed 24 inches (61 cm) from the loop/loopstick antenna of the receiver under test, in the plane of strongest signal performance. If the receiver under test does not normally utilize a loop or loopstick antenna, the RF output of a test signal generator may be directly connected to the AM antenna input connection of the receiver under test using a dummy antenna.<sup>4</sup>

§ 3.4.2. RF Level into Receiver Under Test. The test signal generator RF level is adjusted, using its internal or an external attenuator, for best THD+N performance, using either antenna coupling method as described in § 3.4.1. THD+N measurement is described in § 3.4.6.

§ 3.4.3. AM Modulation Level and Frequency Response. One of the following two methods shall be employed, the selection of which being determined by whether or not the preemphasis characteristic, defined in the NRSC-1 standard, is included prior to the amplitude modulation input of the RF test signal generator.<sup>5</sup>

§ 3.4.3.1. With NRSC Preemphasis at Generator. The NRSC-1 preemphasis characteristic is inserted after a flat response, spectrally-pure audio frequency modulating source, prior to the amplitude modulation input of the RF test signal generator. Monophonic amplitude modulation is used, set to 15 percent with reference at 400 Hz. The receiver under test must exhibit a flat frequency response characteristic within the limits of plus 1.5 dB, minus 3.0 dB, from 50 to 7500 Hz.<sup>6</sup> See Figure 1.

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<sup>4</sup>Such a "dummy antenna" is specified in § 3.06 of *I H F M Standard Methods of Measurement for Tuners (IHFMT-100)*, December 1958. This section defines the dummy antenna to be used as consisting of a 200 picofarad capacitor connected between the RF test signal generator RF output connection and the AM antenna input terminal on the receiver under test.

<sup>5</sup>See NRSC-1 standard at § 4.

<sup>6</sup>The NRSC recommends that attenuation be at least 20 dB at 10.0 kHz, as specified in § 3.3.

§ 3.4.3.2. Without NRSC Preemphasis. A flat response, spectrally-pure audio frequency modulating source is connected to the amplitude modulation input of the RF test signal generator. Monophonic amplitude modulation is used, set to 30 percent with reference at 400 Hz. The receiver under test must meet the NRSC-1 standard deemphasis characteristic<sup>7</sup> within limits of plus 1.5 dB, minus 3.0 dB, from 50 to 7500 Hz.<sup>8</sup> See Table 1 and Figure 2.

TABLE 1

Frequency Response Limits using Method of § 3.4.3.2.

| <u>Frequency</u> | <u>Nominal Response</u> | <u>Upper limit</u> | <u>Lower limit</u> |
|------------------|-------------------------|--------------------|--------------------|
| 50 Hz            | 0 dB                    | +1.5 dB            | -3.0 dB            |
| 100 Hz           | 0 dB                    | +1.5 dB            | -3.0 dB            |
| 400 Hz           | 0 dB (reference)        | 0 dB               | 0 dB               |
| 700 Hz           | -0.3 dB                 | +1.2 dB            | -3.3 dB            |
| 1000 Hz          | -0.7 dB                 | +0.8 dB            | -3.7 dB            |
| 1500 Hz          | -1.5 dB                 | 0 dB               | -4.5 dB            |
| 2000 Hz          | -2.4 dB                 | -0.9 dB            | -5.4 dB            |
| 2500 Hz          | -3.3 dB                 | -1.8 dB            | -6.3 dB            |
| 3000 Hz          | -4.1 dB                 | -2.6 dB            | -7.1 dB            |
| 4000 Hz          | -5.6 dB                 | -4.1 dB            | -8.6 dB            |
| 5000 Hz          | -6.8 dB                 | -5.3 dB            | -9.8 dB            |
| 6000 Hz          | -7.7 dB                 | -6.2 dB            | -10.7 dB           |
| 7000 Hz          | -8.4 dB                 | -6.9 dB            | -11.4 dB           |
| 7500 Hz          | -8.8 dB                 | -7.3 dB            | -11.8 dB           |

§ 3.4.4. Measurement Point. Audio frequency measurements of the receiver under test are made using a suitable a.c. voltmeter attached at either the receiver output terminals (with the influence of all equalization, tone, and loudness circuits factored out) or at a suitable intermediate low level point where fully deemphasized audio is present. If loudspeaker output terminals are used, a suitable resistive, non-inductive load may be substituted for the loudspeaker, with measurements taken across the load.

<sup>7</sup>See NRSC-1 standard at § 5.2.

<sup>8</sup>The NRSC recommends that attenuation be at least 30 dB at 10.0 kHz, as specified in § 3.3.



§ 3.4.5. RF Test Generator Carrier Frequencies. Measurements shall be made with the RF test signal generator set to the following carrier frequencies: 600, 1000, and 1400 kHz.

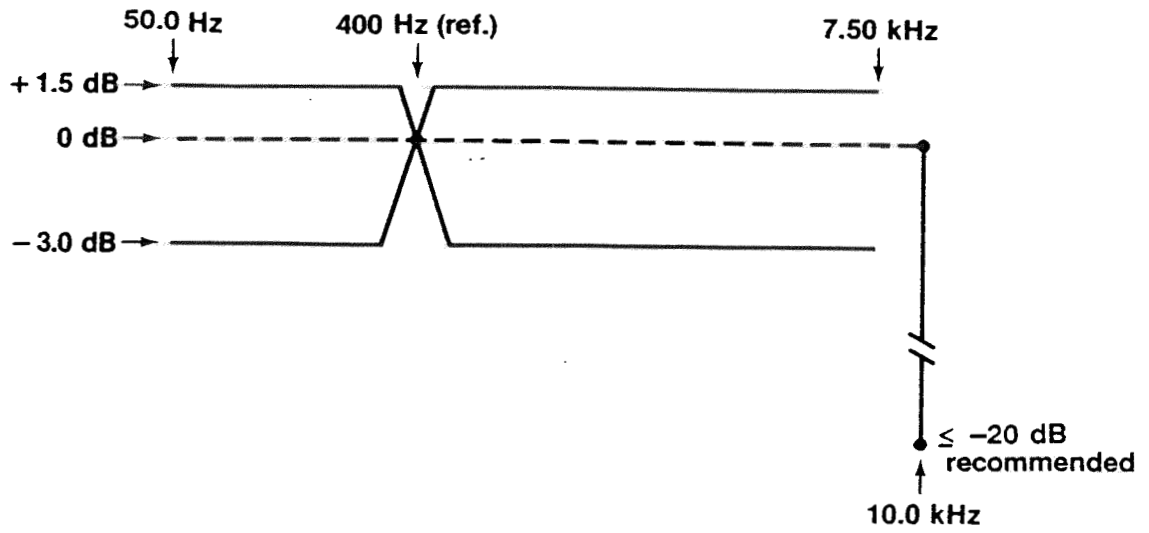
§ 3.4.6. Total Harmonic Distortion plus Noise (THD+N). A flat response, spectrally-pure audio frequency modulating source is connected to the amplitude modulation input of the RF test signal generator. As required by § 3.3.2, THD+N shall not exceed two percent, between the frequencies of 50 and 7500 Hz. THD+N shall be measured at 80 percent monophonic amplitude modulation, referenced to 400 Hz. NRSC-1 preemphasis is not employed. THD+N shall be measured at the measurement point specified in § 3.4.4. using the RF test generator carrier frequencies specified in § 3.4.5.

§ 3.4.7. Stereophonic Receivers. Set up for monophonic conditions as in methods described in § 3.4.1. through § 3.4.6., then measure channels individually.

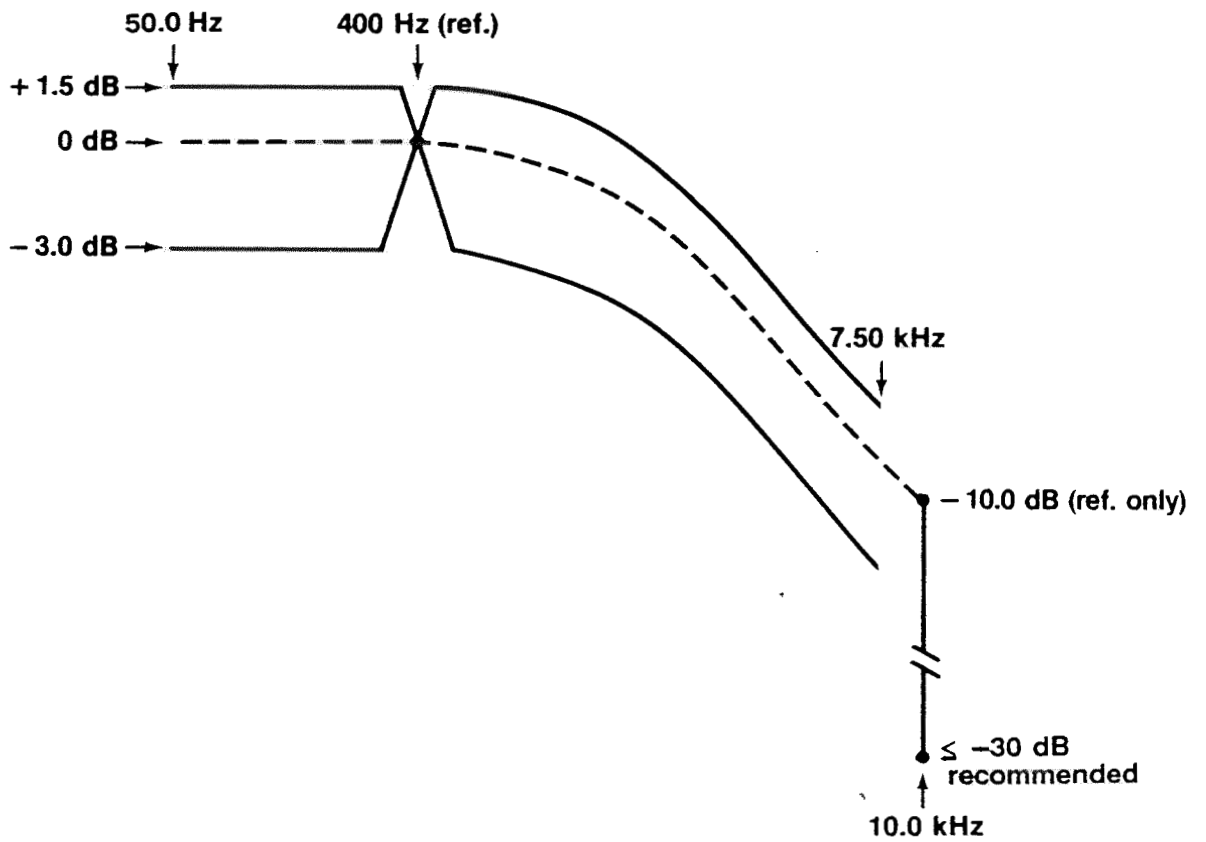
§ 4. Effective Date.

October 15, 1990.

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**Figure 1 — Demodulated Output Employing Generator with NRSC-modified 75  $\mu$ S Preemphasis**



**Figure 2 — No Audio Preemphasis at Generator**

## NRSC Document Improvement Proposal

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