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Spectrum Management

Broadcast Transmission Standard

AM Broadcasting

RF Emission Limits

Canada

Aussi disponible en français - NER 1-2

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1. General

1.1 This standard specifies the RF emission limits for AM broadcasting stations in Canada. The standard applies to both AM monophonic and AM stereophonic operation.

1.2 The emission standard consists of two limits; a maximum limit applicable for station operation when the input signal is normal program material (plus ancillary and/or data inputs) and a test limit applicable for station operation when the input signal is the standard noise test signal (see section A.4). The test limit and its measurement is included as a control standard which may be used by transmitter manufacturers and broadcasters to provide results that may be directly correlated with each other.

2. RF Emission Limits

2.1 Purpose

The purpose of the emission standard is to control the maximum RF emissions of AM broadcast stations and thereby limit possible interference.

2.2 Maximum Limits

The maximum RF emission limits are the peak values of the radiated emissions and include all spectral components caused by programming as well as all ancillary or data inputs. AM broadcast station emissions shall not exceed the maximum limits given in Table 1 and Figure 1 within the frequency ranges specified.

Table 1 — Maximum Limits

Frequency Relative to Carrier (+/- kHz)	Amplitude Relative to Carrier (dB)
0 to 10	0
10 to 20	-25
20 to 30	-35
30 to 60	-(5 + 1 dB/kHz from carrier) Note 1
60 to 75	-65 Note 1
above 75	-80 Note 1

Note 1: For carrier power levels between 50 and 5000 watts, the maximum limit shall be -(43 + 10 log P (carrier power in watts)) dB or as indicated in Table 1/Figure 1.

2.3 Test Limits

The RF emission test limits are the peak values of the radiated emissions and include all spectral components caused by the standard noise test signal (see section A.4). AM broadcast station emissions shall not exceed the test limits shown in Figure 1 when measured with the standard noise test signal applied.

3. Measurement of Emission Limits

3.1 Maximum Limits Measurement

3.1.1 When evaluating for maximum limits, the measurement of AM station spectrum emissions shall be conducted using normal program material (plus ancillary and/or data inputs if present) under normal operating conditions using the measurement procedure given in section A.1 of Appendix A.

3.2 Test Limits Measurement

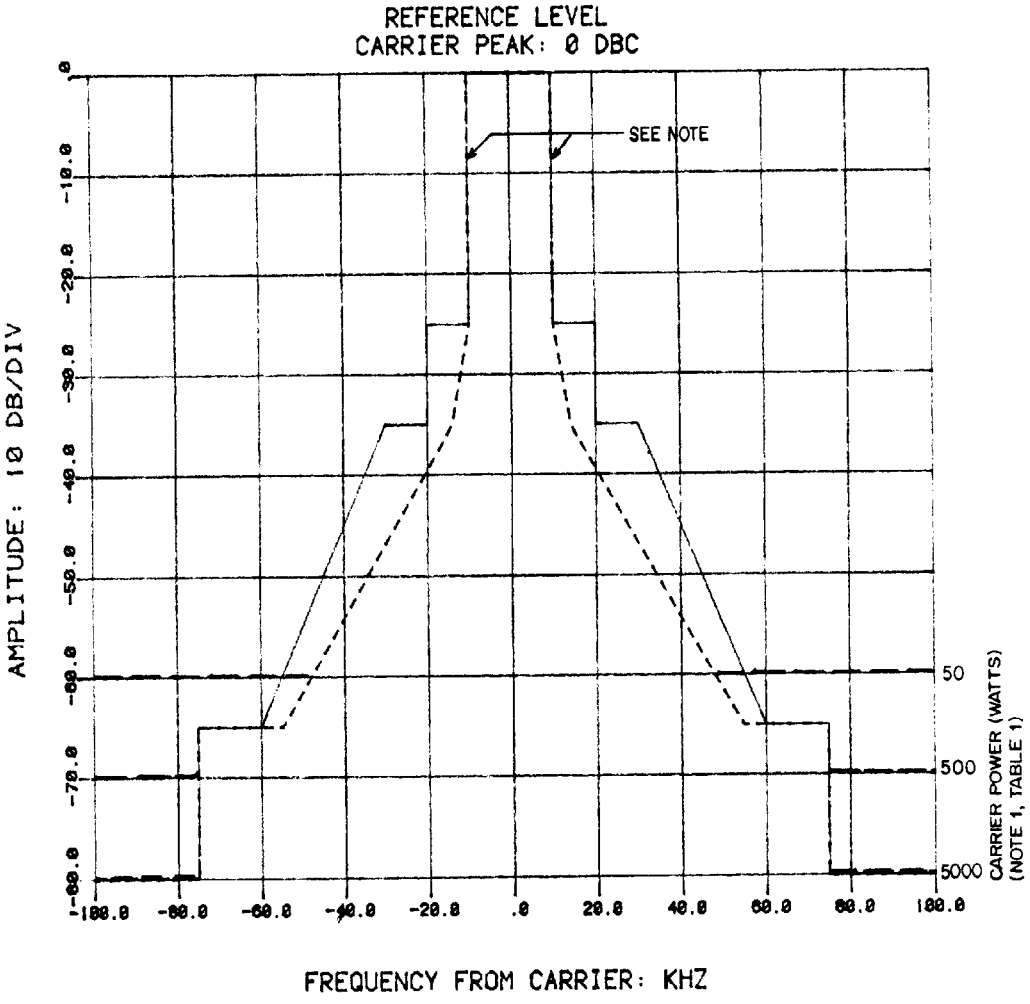
3.2.1 When evaluating for test limits, the measurement of AM station spectrum emissions shall be conducted using the standard noise test signal and the measurement procedure of section A.2 of Appendix A.

Issued under the authority of
the Minister of Communications

G.R. Begley
Director General
Broadcasting Regulation Branch

FIGURE 1

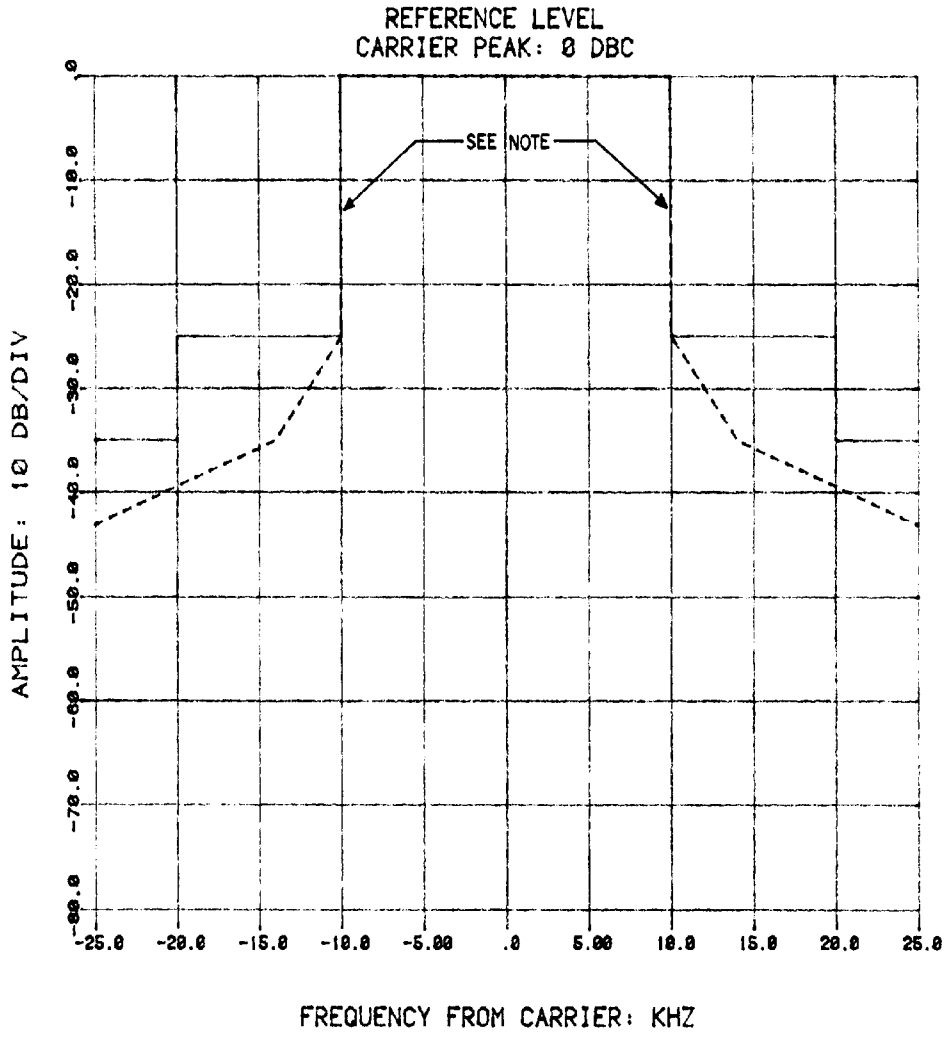
AM BROADCAST
RF EMISSION LIMITS



NOTE: TOLERANCE FOR TRANSITION REGION IS A SLOPE FROM 0 DB AT ±10 KHZ TO -25 DB AT ±11 KHZ

FIGURE 1A
(EXPANDED SCALE)

AM BROADCAST
RF EMISSION LIMITS



NOTE: TOLERANCE FOR TRANSITION REGION IS A SLOPE FROM 0 DB AT ±10 KHZ TO -25 DB AT ±11 KHZ

Appendix A

Measurement Procedures
AM Broadcasting
RF Emission Limits

A.1 Measurement Procedure: Maximum Limits

A.1.1 Use of Normal Program Material

Measurements of AM station spectrum emissions shall be conducted using normal program material. All audio processing used in the AM station shall be in normal operating modes.

A.1.2 Use of Audio Input Characteristics

Measurements will be taken using the station's usual audio input configuration. It is recommended that the audio signal input to the AM transmitter conforms to the audio input characteristics given in section A.3.

A.1.3 Use of Audio Tones

Sweeping a transmission system with audio tones is a widely accepted and respected method for gauging spectrum emission limits and for troubleshooting and adjusting AM transmission systems and is useful for this purpose. However, compliance with the maximum emission limits may only be determined using dynamic conditions with actual program signals.

A.1.4 Measurement Location

The measurement should be taken at a suitable off-air receiving location in order that the antenna system be included in the measurement. Alternatively, the measurement may be taken at an RF probe in the antenna transmission line.

A.1.5 Use of Spectrum Analyzer

A suitable swept-frequency RF spectrum analyzer may be used to measure compliance with the maximum limits of RF spectrum emissions. The spectrum analyzer setup shall consist of:

(a) 300 Hz resolution bandwidth;
(b) 5, l0 or 20 kHz/horizontal division (as appropriate);
(c) l0 dB/vertical division;
(d) Reference: carrier peak;
(e) Peak Hold: l0 minute duration.

A.1.6 Use of Splatter Monitor

A recently developed splatter monitor device may be used to measure compliance with the maximum limits of RF spectrum emissions. A measurement method will be specified following evaluation and correlation of field results from this device.

A.2 Measurement Procedure: Test Limits

A.2.1 Standard Noise Test

Measurements of AM station spectrum emissions shall be conducted using a standard noise test signal described in section A.4. All audio processing used in the AM station shall be in normal operating modes.

A.2.1.1 Monophonic Conditions

The noise source is unmodified.

A.2.1.2 Stereophonic Conditions

Two independent but equivalently designed USASI (United States of America Standards Institute) - weighted noise sources are employed. Pulsing of the sources is controlled by a single control signal. The pulsed output of one noise generator is defined as L+R (mono, sum information) where the other is attenuated by 3 dB to provide L-R (stereo, difference information). The signals are then matrixed to provide left and right channel information to be applied to the audio input terminals of the stereophonic audio processor employed.

A.2.2 Use of Audio Input Characteristics

Measurements will be taken using the station's usual audio input configuration. If the station's input configuration does not limit the input bandwidth to 10 kHz or less, a low pass filter with attenuation characteristics similar to those specified in section A.3.2 must be inserted between the noise signal source and the audio input. It is recommended that the audio signal input to the AM transmitter conforms to the audio input characteristics given in section A.3.

A.2.3 Measurement Location

The measurement should be taken at a suitable off-air receiving location in order that the antenna system be included in the measurement. Alternatively, the measurement may be taken at an RF probe in the antenna transmission line.

A.2.4 Use of Spectrum Analyzer

A suitable swept-frequency RF spectrum analyzer shall be used to measure compliance with the RF emission test limits. The analyzer's setup shall consist of:

(a) 300 Hz resolution bandwidth;
(b) 5, l0 or 20 kHz/horizontal division (as appropriate);
(c) l0 dB/vertical division;
(d) Reference: carrier peak;
(e) Peak Hold: 10 minute duration.

A.2.5 Use of Splatter Monitor

A recently developed splatter monitor device may be used to measure compliance with the RF emission test limits. A measurement method will be specified following evaluation and correlation of field results from this device.

A.3 Audio Input Characteristics

A.3.1 Purpose

The purpose of standard audio input characteristics is to establish uniform audio input bandwidth and preemphasis which serves to control the RF emissions of AM stations and promote complementary receiver designs.

A.3.2 Audio Input Bandwidth

The audio input bandwidth response shall conform to the following specifications. The reference level is 1 dB above a 200 Hz sine wave at 90% negative modulation. The relative amplitude of the audio envelope input spectrum to the AM transmitter shall be -15 dB at 10 kHz, smoothly decreasing to -30 dB at 10.5 kHz, then remaining at -30 dB from 10.5 kHz until 11.0 kHz. At 11.0 kHz, the relative amplitude shall step decrease to -40 dB, then smoothly decrease to -50 dB at 15 kHz. Above 15 kHz, the relative amplitude shall remain at least -50 dB. These specifications are presented in graphical form in Figure A1. Appropriate and carefully designed audio low-pass filters as the final filtering prior to modulation can be used to implement this specification.

A.3.3 Audio Input Preemphasis

The audio preemphasis curve is a modified 75 us curve. It has a single zero with the break frequency of 2122 Hz and to reduce peak boost at high frequency a single pole with a break frequency of 8700 Hz. The curve is shown graphically in Figure A2 and technical information is presented in Table A1. AM broadcast stations broadcasting with the standard preemphasis given above shall have an audio response which remains within +1 dB of the curve for audio frequencies up to 10 kHz.

FIGURE A1

AUDIO INPUT BANDWIDTH STANDARD

STOPBAND SPECIFICATION

(AUDIO ENVELOPE INPUT SPECTRUM TO AM TRANSMITTER)

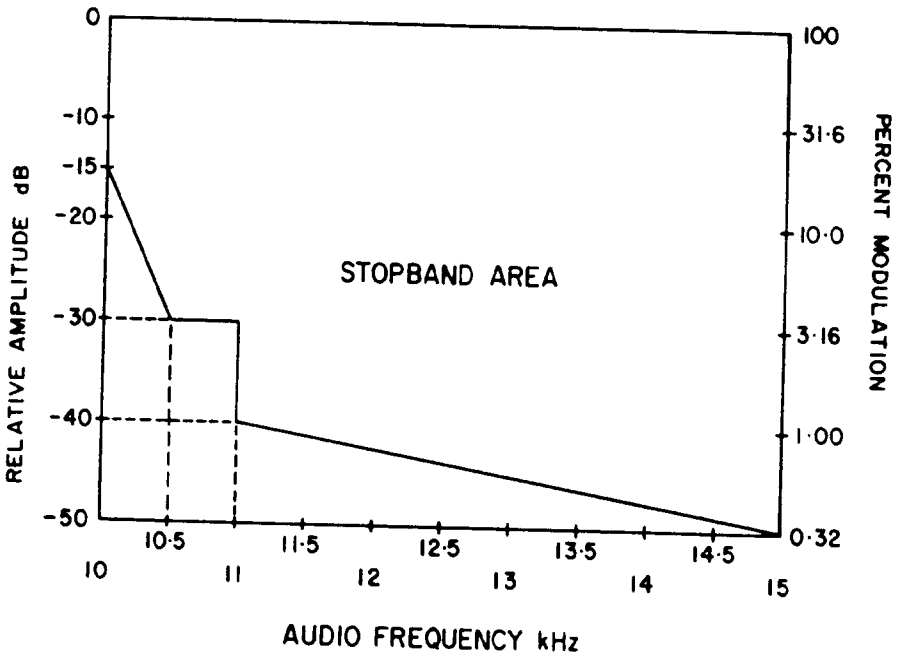


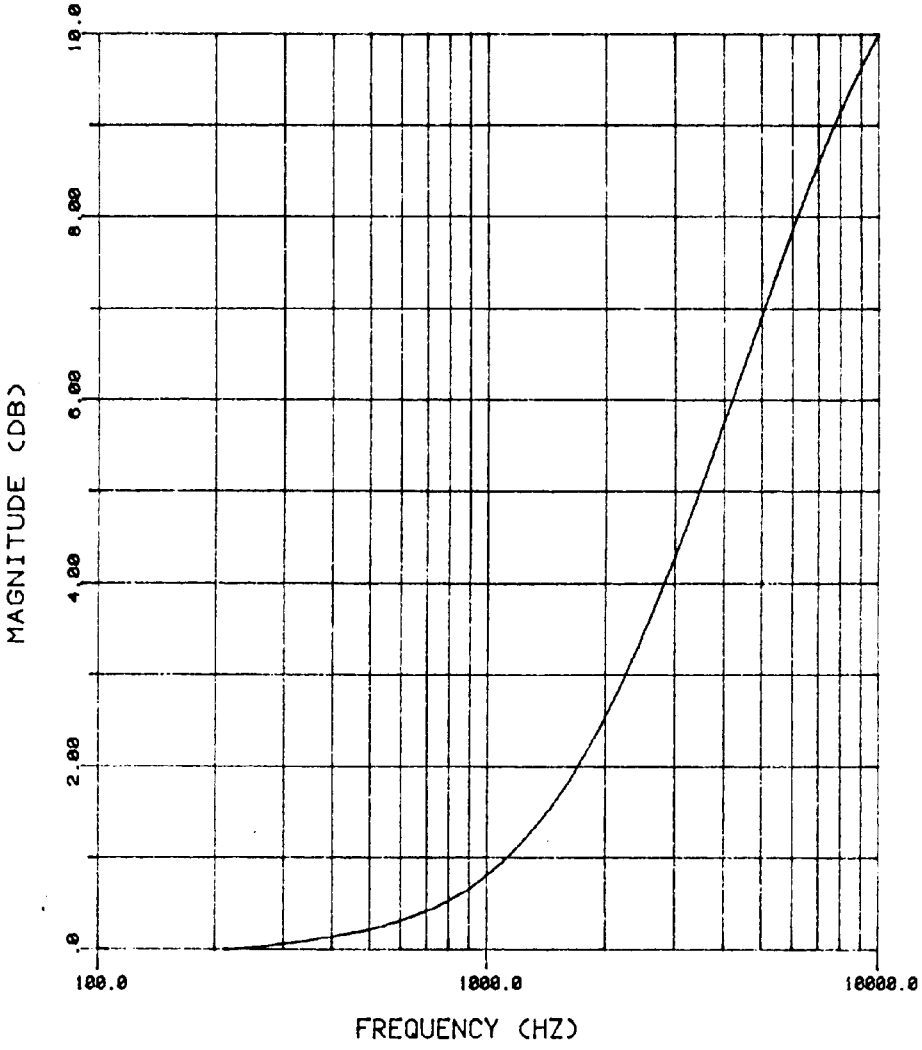
Table A1

Audio Input Preemphasis
Technical Information

Frequency	Magnitude (dB)	Phase (deg)	Group Delay (sec)
50	0.00	1.0	-5.6669E-005
100	0.01	2.0	-5.6547E-005
400	0.14	8.0	-5.4175E-005
700	0.42	13.7	-4.9467E-005
1000	0.81	18.7	-4.3318E-005
1500	1.63	25.5	-3.2247E-005
2000	2.54	30.4	-2.2343E-005
2500	3.44	33.6	-1.4509E-005
3000	4.28	35.7	-8.6612E-006
3500	5.05	36.9	-4.4133E-006
4000	5.75	37.4	-1.3702E-006
4500	6.37	37.4	7.8900E-007
5000	6.92	37.1	2.3048E-006
5500	7.41	36.6	3.3525E-006
6000	7.85	35.9	4.0592E-006
6500	8.24	35.2	4.5169E-006
7000	8.58	34.3	4.7926E-006
7500	8.89	33.4	4.9357E-006
8000	9.16	32.5	4.9823E-006
8500	9.41	31.6	4.9595E-006
9000	9.62	30.8	4.8871E-006
9500	9.82	29.9	4.7801E-006
10000	10.00	29.0	4.6495E-006

FIGURE A2

AM BROADCAST
AUDIO INPUT PREEMPHASIS



MODIFIED 75 MICROSEC
AUDIO INPUT PREEMPHASIS CURVE

A.3.4 Measurement Procedure Audio Input Bandwidth

A.3.4.1 Use of Standard Noise Test Signal

Measurement of an AM station's input bandwidth shall be conducted using the standard noise test signal described in section A.4. Audio bandwidth measurements shall be obtained between the audio input terminals of the audio processing equipment and the audio input terminals of the AM transmitter. For AM stereo stations, audio bandwidth shall be measured at the L+R audio input terminals to the RF modulator.

A.3.4.2 Use of Spectrum Analyzer

A suitable swept-frequency or FFT (Fast Fourier Transform) spectrum analyzer shall be used to measure compliance with the bandwidth specification (see section A.3.2).

(a) **Spectrum Analyzer Setup**

When a swept-frequency audio spectrum analyzer is used to measure compliance with the bandwidth specification, the analyzer's setup shall consist of:

(a) 300 Hz resolution bandwidth;
(b) 2 kHz/horizontal division;
(c) 10 dB/vertical division;
(d) Reference: 1 dB above 200 Hz (sine wave) 90% negative modulation;
(e) Display: maximum peak hold (or equivalent function).

(b) **Fast Fourier Transform Analyzer**

When a FFT analyser is used to measure compliance with the bandwidth specification, the analyzer's setup shall consist of:

(a) Reference: 1 dB above 200 Hz (sine wave) 90% negative modulation;
(b) Window: Hanning;
(c) Horiz. span: 20 kHz;
(d) Dynamic range: 80 dB or available range;
(e) Display: maximum peak hold (or equivalent function).

A.3.5 Measurement Procedure Audio Input Preemphasis

A.3.5.1 Method of Determining Performance

The audio preemphasis curve is a static curve and cannot be measured dynamically. Studies have shown that the dynamic and non-linear functions performed by most AM station audio processors

will modify any given preemphasis curve. The dynamic functions of the AM station's processor, but not the frequency shaping circuits, must be inactive (i.e. in "proof" mode).

A.3.5.2 Use of Audio Tones

Compliance with the pre-emphasis curve shall be measured by sweeping the station's transmission system with audio tones. The net transmission system audio response is best measured by detecting the over-the-air signal using an AM modulation monitor. This will ensure that the AM transmitter and antenna combination is faithfully reproducing the preemphasized audio. Alternatively, if the transmitter and antenna is broadband, performance can be determined by static measurement of the audio signal prior to modulation.

A.4 Standard Noise Test Signal

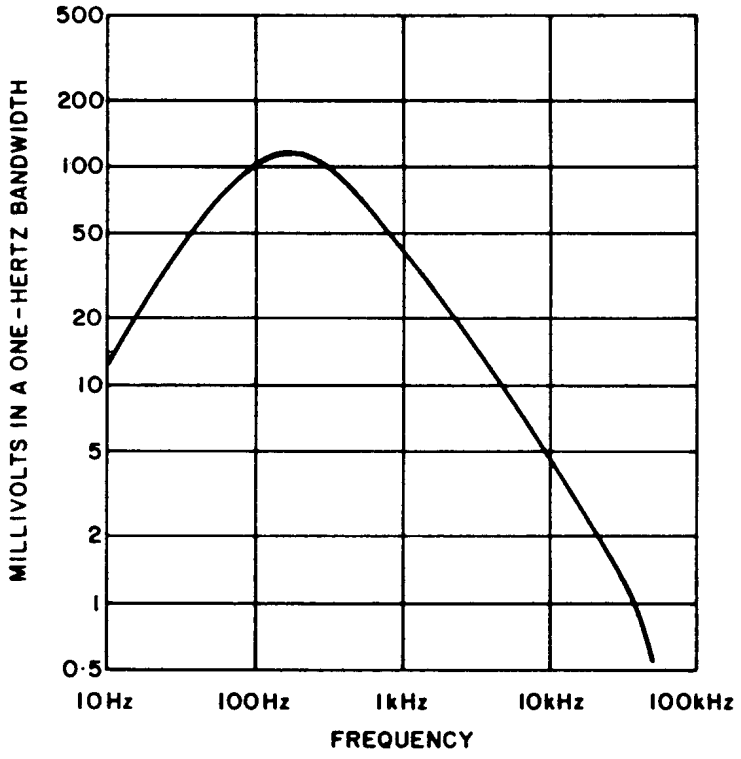
A.4.1 Purpose

The purpose of the standard noise test signal is to provide a repeatable analytical test signal which is representative of actual programme material used on AM broadcast stations. The test signal has spectral characteristics simulating typical music programming in average level and in percussive beats.

A.4.2 Description

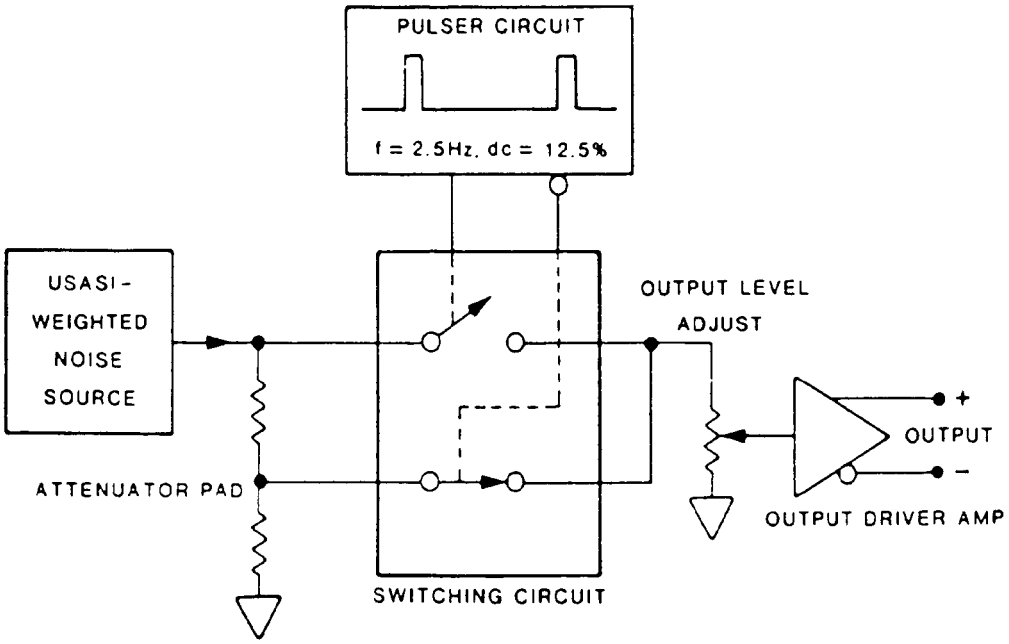
The test signal shall consist of a white noise source with USASI (United States of America Standards Institute) weighting. The weighting is produced by filtering white noise with (1) a 100 Hz, 6 dB per octave high pass network and (2) a 320 Hz, 6 dB per octave low pass network. (See Figure A.3). The USASI noise signal is then passed through a pulser circuit wherein the ratio of the peak to average amplitude of the noise signal is set to 20 dB at the output of the pulser. A pulsed USASI noise generator is shown in figures A4-A and A4-B.

FIGURE A3



SPECTRA OF USASI NOISE

FIGURE A4-A



PULSED-USASI NOISE GENERATOR

FIGURE A4-B

APPLICATION CIRCUIT: USASI NOISE WEIGHTING/PULSER CIRCUIT