Spectrum Management

Broadcast Transmission Standard

# AM Broadcasting Stereophonic Operation

Canadä

## 1. General

1.1     This standard describes the C-QUAM* (Compatible Quadrature Amplitude Modulation) system fo transmission and gives performance requirements for stereophonic operation of the AM transmiss

1.2     Stereophonic AM broadcasting involves the transmission of additional information with the mono the reception of the original monophonic signal and left and right stereophonic signals.

1.3     The stereophonic audio information is composed of two signals; left (L) and right (R). As in the p is amplitude modulated by the sum (L+R) signal. The additional information in the form of the c carrier by quadrature phase modulation. A separate pilot signal is added to the difference signal broadcast.

     * C-QUAM is a registered trademark of Motorola Inc.

## 2. Definitions

### 2.1     AM Broadcast Channel

The band of frequencies occupied by the carrier and the upper and lower sidebands of an AM bro the center. Channels are designated by their assigned carrier frequencies.

### 2.2     Left (or Right) Signal

The electrical output of an audio source or combination of sources conveying the intensity, time, predominantly to the listener's left (or right).

### 2.3     Left (or Right) Stereophonic Channel

The left (or right) signal path through an AM stereophonic broadcasting system.

### 2.4     Sum Channel L+R

The band of audio frequencies consisting of the vector sum of the left and right signals which am

### 2.5     Difference Channel L-R

The band of audio frequencies consisting of the difference of the left and right signals which pha

### 2.6     Stereophonic Crosstalk

An undesired signal occurring in the sum channel from modulation of the difference channel or t modulation of the sum channel.

### 2.7     Stereophonic Pilot Tone

An audio tone of fixed frequency (25 Hz) present on the difference channel during the transmiss

### 2.8     Stereophonic Separation

The ratio in dB of the output of the left (or right) channel due to a signal intended for that chann due to the same signal.

## 3. Transmission Standards

3.1     The amplitude modulating signal shall consist of the sum (L+R) of the stereophonic left and right

3.2     Peaks of frequent occurrence of the sum (L+R) signal shall produce amplitude modulation not ex
        for negative peaks.

3.3     The quadrature phase modulating signal shall consist of the difference (L-R) of the stereophonic

3.4     The quadrature phase information shall vary the phase of the carrier in accordance with the foll

$$\phi_c = \tan^{-1} \quad \frac{m(L-R)}{1+m(L+R)}$$

Where:

$\phi_c$ = instantaneous carrier phase
L = audio signal in the left audio channel
R = audio signal in the right audio channel
m = modulation factor

3.5     The carrier phase shall advance in a positive direction when a left signal causes the carrier envel
        and shall retard in a negative direction when a right signal causes the carrier envelope to be mo

3.6     Maximum phase modulation shall be controlled in such a manner that the following conditions a

        (a)  $\phi_c$ max = 1.25 radians (71.5°)
             for single channel modulation where the signal channel envelope modulation equals 75% i.e.

        (b)  $\phi_c$ max = 0.79 radians (45°)
             when m (L) = -m (R) and m (L) -m (R) = 1 (equivalent to modulating the carrier 100% with L
             signal, the envelope modulation should disappear and the carrier modulation is phase modula

3.7     The composite signal shall include a fixed frequency (25 Hz) pilot signal for indicating the presen
        added to the difference channel.  The amount of phase modulation produced by the pilot signal s
        modulation on the carrier.  The pilot signal phase shall be:

$$\phi \text{ PILOT} = \tan^{-1} \frac{(0.05\pm0.01) \sin 50\pi t}{1 + L+R}$$

When the carrier is unmodulated, the pilot signal shall produce 5% of the maximum allowable de

## 4.  Transmission System Performance Requirements for AM Stereo

### 4.1     General

The performance of AM stereophonic systems, consisting of the AM stereo exciter interfaced with
requirements of this section when operated in either the monophonic or stereophonic mode.  New
requirements of RSS-150 and the supplement to RSS-150, Issue 2.

### 4.2     R.F. Compatibility

The AM stereophonic system shall be compatible with the present AM monophonic system with re
the AM channeling plan.

#### 4.2.1     Occupied Bandwidth

Emission from a stereophonic AM broadcasting system consisting of the carrier and associ confined to frequencies within ±15 kHz of the carrier.  Emissions appearing on any frequ kHz from the carrier shall be attenuated at least 25 dB below the level of the unmodulate

### 4.2.2 Unwanted Emissions

Any emissions appearing on a frequency removed by more than 30 kHz from the carrier shall be attenuated at least:

(a) 35 dB below the level of the unmodulated carrier for any frequency more than 30 kHz and up to 75 kHz from the carrier.

(b) 43 + 10 log P (Power in watts) dB or 80 dB, whichever represent the lesser attenuation [below the level of the unmodulated] carrier for any frequency more than 75 kHz from the carrier.

## 4.3 Monophonic Compatibility

The stereophonic transmissions shall provide compatible reception on monophonic receivers with [ ] requirements shall be satisfied using an envelope detector with wide-band response coupled to th[ ]

### 4.3.1 Audio Frequency Response

The frequency response shall remain within 2 dB of the response at 1 000 Hz over the frequency range from 50 Hz to 10 000 Hz under all conditions of amplitude modulation for the stereophonic [ ] 85%.

### 4.3.2 Audio Frequency Harmonic Distortion

The total harmonic distortion including harmonics up to 20 000 Hz shall not exceed 5% over the frequency range from 50 Hz to 10 000 Hz under all conditions of amplitude modulation for the stereopho[ ] 85%.

### 4.3.3 Carrier Hum and Noise Level

The level of all hum and noise for audio frequencies below 10 000 Hz shall be at least 55 dB below the reference level for 100% modulation at 1 000 Hz.

## 4.4 Stereophonic Performance

The stereophonic AM broadcast transmission system includes all equipment from the output of pr[ ] for both the left and right program channels up to the transmitter antenna output. The performa[ ] channel separately using a suitable audio detector with wide-band response at the transmitter ou[ ]

### 4.4.1    Audio Frequency Response

The frequency response of either the left or right channel shall within 2 dB of the response at 1 000 Hz over the frequency range between 50 Hz and 10 000 Hz under all conditions of modulation of the left or right stereophonic channel up to 85%.

### 4.4.2    Audio Frequency Harmonic Distortion

The total harmonic distortion including harmonics up to 20 000 Hz measured separately in either left or right channel shall not exceed 5% in the frequency range 50 Hz to 10 000 Hz under all conditions of modulation for the stereophonic system up to 85%.

### 4.4.3    Channel Balance

The balance between the output level in the left and right channels shall be within 3 dB from 50 Hz to 10 000 Hz at all levels of modulation up to 85%.

### 4.4.4    Stereophonic Separation

The separation between the left and right channels shall be at least 20 dB in the frequency range from 400 Hz to 10 000 Hz at all levels of modulation up to 85%.

### 4.4.5    Carrier Hum and Noise Level

The level of hum and noise in either the left or right channel for audio frequencies below 10 000 Hz shall be at least 48 dB below the reference level for 100% modulation at 1 000 Hz.

### 4.4.6    Crosstalk

The sum channel (L+R) to the difference channel (L-R) crosstalk and the difference channel (L-R) to the sum channel (L+R) crosstalk shall be at least 30 dB below the reference level for 100% modulation at 1 000 Hz.

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