Industry Canada Industrie Canada

BETS-6
Issue 2
August 2005

Spectrum Management and Telecommunications

Broadcasting Equipment Technical Standard

Technical Standards and Requirements for FM Broadcasting Transmitters

Aussi disponible en français - NTMR-6

Canada

Purpose

This document contains the technical standards and requirements for the issuance of a Technical Acceptance Certificate (TAC) for FM broadcasting transmitters.

A certificate issued for equipment classified as type approved or as technically acceptable before the coming into force of these technical standards and requirements is considered to be a valid and subsisting TAC.

A Technical Acceptance Certificate is not required for equipment manufactured or imported solely for re-export, prototyping, demonstration, exhibition or testing purposes.

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1. General

1.1 The standards and requirements in this document are the pre-requisite conditions for the issuance of a Technical Acceptance Certificate (TAC) for FM broadcasting transmitters.

1.2 Those seeking to obtain a Technical Acceptance Certificate for FM transmitters shall, at their own expense, carry out the required tests and send to the Department a certification submission and an engineering brief prepared in accordance with Broadcasting Equipment Standards Procedure 100, *Certification of Broadcasting Equipment* (BESP-100).

1.3 The engineering brief, signed by a professional engineer licensed by a provincial association, shall demonstrate that the equipment meets the technical standards in this document.

1.4 Notwithstanding the fact that a radio apparatus meets all applicable requirements, the Department reserves the right to require that adjustments be made to the equipment should it cause interference.

1.5 Any major design or component changes, other than the replacement of defective components by equivalent parts, will void the approval unless notified to and approved by the Department.

1.6 This document replaces RSS-153, Issue 2.

2. Testing and Labelling

2.1 Sections 3 to 6 contain the equipment standards and the emission standards which relate to the radiated signal of the FM transmitting equipment. Compliance with these standards shall be supported by an engineering brief providing measurement results in accordance with BESP-100.

2.2 Annex A contains the performance standards recognized by the industry to ensure quality operation of FM broadcasting equipment. The submission of test results for these performance measurements is not required but the results shall be kept on file by the applicant. Compliance with the standards of Annex A shall be supported by a statement certifying that the equipment meets the standards.

2.3 This document covers the transmitting equipment proper: namely, from audio input terminals to the radio frequency output terminals, including any separate RF amplifiers and filters.

2.4 The transmitting equipment shall be capable of meeting the standards in this document on each standard FM channel at the rated power output for which it is designed to operate.

2.5 In the event that the equipment fails to function during testing, all tests affected by the failure shall be repeated after the fault has been corrected.

2.6 Each certified broadcasting equipment must display in a conspicuous location:

a. the manufacturer's name, trade or brand name (if different from the manufacturer's name);
b. the model identification;
c. the serial number;
d. the Technical Acceptance Certificate number; and
e. the name of the certification assignee.

2.7 The identification label must be indelible, tamper-resistant and affixed permanently or stamped in such a manner as not to be removable except by destruction or defacing.

3. Standard Test Conditions

3.1 Definition

Standard test conditions are those conditions which shall apply to transmitting equipment while it is being tested for minimum requirements. Where no special conditions are called for in the tests, the conditions shall be those specified by the manufacturer for normal operation and these shall be stated in the test report.

3.2 Standard Test Voltage

The standard test voltage shall be one of the rated power supply voltages specified by the manufacturer.

3.3 Standard Temperature

The standard temperature shall be 20ºC, ±5º. Actual temperature shall be recorded in the test report.

3.4 Standard Test Load

The standard test load shall have a resistive impedance characteristic and be capable of dissipating the output power of the transmitting equipment. At the test frequency, the resistive component of the test load shall be within 5% of the load impedance into which the transmitting equipment was designed to operate. Any reactive component of the test load shall not be greater than 5% of the resistive component over the range of ±100 kHz from the test frequency.

3.5 Standard Test Frequencies

The standard test frequencies shall be the carrier frequency of the channel on which the transmitting equipment is designed to operate. For transmitting equipment capable of operating on any one channel in the 88-108 MHz band, tests shall be made on two channels, one near each end of the band. The test frequencies shall be stated in the test report.

3.6 Standard Test Input Signal

The standard audio test signal shall be a 400 Hz sine wave.

3.7 Standard Test Equipment

All measurements shall be made with instruments having sufficient accuracy to ensure that errors due to test instrumentation are not appreciable.

3.8 Standard Test Set-up

Unless otherwise specified, all tests shall be made with the carrier at rated power output and modulated with the standard test input signal.

3.9 Warm-up Time

The transmitting equipment and test instrumentation shall be switched on at least 30 minutes before any test is started.

4. Transmitting Equipment Standards

4.1 Transmission System

FM broadcasting transmitting equipment consists of all the apparatus necessary to convert the modulating input signal to a frequency modulated carrier at the centre frequency of a standard FM channel in the 88 to 108 MHz frequency band.

4.2 Type of Emission

The designation of modulation and emission refers to the manner in which the carrier is modulated and transmitted. The transmitting equipment shall produce F3EGN emission for monophonic operation and F8EHF emission for stereophonic operation. The transmitting equipment shall be capable of operating with a frequency deviation of ±75 kHz, which is equivalent to 100% modulation.

4.3 Carrier Frequency Adjustment

The transmitting equipment shall be capable of operation in accordance with these standards on any channel in the specified carrier frequency range without change in construction other than changing frequency determining components. Provision shall be made for trimming the carrier frequency to the assigned frequency under normal operating conditions.

4.4 Power Supply Rating

The AC voltage input shall be at a frequency of 60 Hz. Voltage, frequency and maximum kVA requirement shall be indicated on the transmitting equipment.

4.5 Phase-to-Phase Loading

The transmitting equipment, if rated above 10 kVA, shall present a balanced load to the AC mains such that the current in each phase shall be within 10% of the average of the three currents.

5. Equipment Requirements

5.1 Design

Transmitting equipment shall be designed according to good engineering practice.

5.2 Labelling

Labelling shall be according to the requirements in 2.6.

5.3 Protection of Personnel

The transmitting equipment shall be so constructed that all hazardous components are totally enclosed or protected from accidental contact by personnel. The transmitting equipment enclosure shall provide adequate safety to personnel during operation.

5.4 Equipment Changes and Modifications

Any major design or equipment changes, other than the replacement of defective components by equivalent parts made to approved equipment, will void the approval unless notified to and approved by the Department. The notification must provide evidence that the modification results in equal or improved transmitting equipment performance.

6. RF Carrier Performance Standards

6.1 Power Output Rating

6.1.1 Definition

The power output rating of transmitting equipment is the carrier power at which the transmitting equipment may be operated continuously into the test load.

6.1.2 Method of Measurement

The carrier power shall be measured by using a suitable power measuring device. The method shall be described in the test report.

6.1.3 Standard

The standard rating of power output for the transmitting equipment shall be as specified by the individual manufacturer. The transmitting equipment shall be capable of being adjusted to deliver the rated power output when the AC input voltage varies by 5% from the rated value.

The test report shall state the power output limits over which the transmitting equipment complies with this specification.

Adjustment of the power output of the transmitting equipment shall permit operation over a range of at least from 50% to rated power output.

6.2 Carrier Frequency Stability

6.2.1 Definition

The carrier frequency stability is the ability of the transmitting equipment to maintain a mean test frequency.

6.2.2 Method of Measurement

After a warm-up period of one hour at rated AC input voltage, measure the frequency of the carrier at one minute intervals during a period of fifteen minutes. From these measurements, determine a mean test frequency. Then, measure and record the operating frequency at a temperature of 5ºC at 85, 100 and 115% of the rated AC supply voltage. Repeat for a temperature of 45ºC.

Where it is not practical to subject the complete transmitting equipment to the specified test conditions, it is permissible to isolate and separately measure the stability of the frequency-determining elements of the transmitting equipment under the specified conditions.

6.2.3 Standard

The frequency of the carrier shall remain within ±1 kHz of the mean test frequency.

6.3 Spurious Emissions

6.3.1 Definition

Spurious emissions are radio frequency signals appearing at the transmitting equipment output terminals on frequencies other than the specified carrier frequency and modulation products.

6.3.2 Method of Measurement

The transmitting equipment shall be operated using the standard test load at rated power. The carrier shall be modulated with the standard test input signal at 100% modulation. Using a sampling device, measure all spurious emissions up to the third harmonic of the carrier frequency.

The voltage of the emission shall be measured with a frequency selective instrument. The attenuation versus frequency characteristics of the power sampling device and the load used in this test shall be known over the range of frequencies involved. Record all spurious outputs in dB relative to rated power, except those more than 20 dB below the values specified in Section 6.3.3.

6.3.3 Standard

Spurious emissions of the transmitting equipment shall not exceed the values given below:

Spurious Emission	**Maximum Value**
Between 120 kHz and 240 kHz from the carrier frequency	-25 dB*
More than 240 kHz and up to and including 600 kHz from the carrier frequency	-35 dB*
More than 600 kHz from the carrier frequency, whichever is the stronger	-(43 + 10 log P)* or -80 dB* P = power in watts

* Referred to the power level of the unmodulated carrier.

6.4 Cabinet Radiation

6.4.1 Definition

Cabinet radiation is any emission from the transmitting equipment housing or enclosure from sources other than a normal output port.

6.4.2 Method of Measurement

The transmitting equipment shall be operated at rated power output and at a suitable frequency. A receiving antenna, located alternately at a known distance between three and ten metres from at least three sides of the transmitting equipment (i.e. front, back, left or right hand side), shall be connected to a calibrated field strength meter or frequency-selective voltmeter. Field strength measurements shall be made and the results recorded for all emissions (including the fundamental and harmonics of the carrier frequency) up to the third harmonic of the carrier frequency. For the measurement, the receiving antenna shall be rotated in all three planes and the maximum received field shall be noted (allowance shall be made for antenna factor and transmission line loss of the measuring equipment). Using the free space formula below, calculate the reference field strength.

$$E = 7\sqrt{P}/r \text{ volts per metre}$$

where P is the rated output power in watts and r is the distance in metres.

6.4.3 Standard

Emissions at any frequency shall be at least 54 dB below the calculated field strength reference level. Any radiation weaker than 70 dB below the reference level need not be recorded.

Annex A - Technical Standards

A.1 Audio Performance Standards (Monophonic)

A.1.1 Audio Input Impedance

A.1.1.1 Standard

The audio input impedance shall be a nominal 600 ohms balanced to ground. Additional impedances may also be provided.

A.1.2 Audio Input Level for 100% Modulation

A.1.2.1 Definition

The audio input level for 100% modulation is the audio input, expressed in dBm (0 dBm = 1 mW), necessary to produce a frequency deviation of ±75 kHz.

A.1.2.2 Method of Measurement

The standard test signal shall be adjusted to produce 100% modulation and this level shall be recorded.

A.1.2.3 Standard

The standard audio input level for 100% modulation shall be 10 dBm, ±2 dBm.

A.1.3 Audio Frequency Response

A.1.3.1 Definition

The audio frequency response is the inverse ratio of input voltages relative to the voltage at 400 Hz, expressed in dB, required to maintain a constant percentage of modulation across the audio frequency range.

A.1.3.2 Method of Measurement

The standard test set-up shall be used. The normal 75 microsecond pre-emphasis shall be employed. The audio input to maintain a constant modulation level of 25%, 50% and 100% shall be determined at a sufficient number of points over the frequency range 50 to 15,000 Hz to enable curves to be plotted.

A.1.3.3 Standard

The audio frequency response curves shall lie on or between the dashed curves of Figure A.1.

A.1.4 Audio Frequency Harmonic Distortion

A.1.4.1 Definition

The audio frequency harmonic distortion is the harmonic content of the audio signal contributed by the transmitting equipment.

A.1.4.2 Method of Measurement

The standard test set-up shall be used and the demodulated output fed to a wave or distortion analyser. The normal 75 microsecond pre-emphasis shall be employed and the demodulator shall include a 75 microsecond de-emphasis. Measurements at 100% modulation shall be taken at a sufficient number of frequencies in each range of frequencies to plot a distortion vs frequency curve.

A.1.4.3 Standard

The audio frequency distortion including all harmonics up to 30 kHz shall not exceed 1% in the range of frequencies from 50 to 15,000 Hz.

A.1.5 Frequency Modulation Noise Level on Carrier

A.1.5.1 Definition

The frequency modulation noise on the carrier is the residual frequency modulation resulting from disturbances produced in the transmitting equipment itself within the band of 50 to 15,000 Hz.

A.1.5.2 Method of Measurement

Using the normal 75 microsecond pre-emphasis, a sample of the RF output of the transmitting equipment shall be fed to a distortion and noise meter, via a suitable demodulator. The frequency response characteristic of the demodulator shall be within ±1 dB of the normal 75 microsecond de-emphasis curve from 50 to 15,000 Hz. Readings shall be taken of the output levels with standard test modulation of 100% and without modulation, with the input terminated in 600 ohms. Their ratio shall be expressed in dB below 100% modulation (±75 kHz deviation).

A.1.5.3 Standard

The ratio shall be at least 60 dB below 100% modulation.

A.1.6 Amplitude Modulation Noise Level on Carrier

A.1.6.1 Definition

The amplitude modulation noise level of an FM carrier is the ratio of the RMS value of the amplitude modulation component (50 to 15,000 Hz) of the carrier envelope to the RMS carrier value during the absence of applied modulating voltage.

A.1.6.2 Method of Measurement

Measurement of the carrier amplitude modulation noise level may be accomplished by the use of a linear peak carrier responsive AM detector coupled to the output of the transmitting equipment. Readings are made of the DC voltage and the RMS value of the AC component across the detector load resistor. The DC voltage must be multiplied by 0.707. The measurement shall be made in the absence of modulating voltage, with the audio input terminated in 600 ohms.

A.1.6.3 Standard

The ratio shall be at least 50 dB below carrier level within the band of 50 to 15,000 Hz.

A.2 Stereophonic and Multiplex Operation

(See Figure A.2)

A.2.1 Definitions

A.2.1.1 FM Stereophonic Broadcast

The transmission of a stereophonic program by a single FM broadcast station utilizing the main channel and a stereophonic subchannel.

A.2.1.2 Left (L) or Right (R) Signal

The electrical output originating from a microphone or combination of microphones placed so as to convey the intensity, time and location of sounds originating predominantly to the listener's left (or right) of the centre of the performing area.

A.2.1.3 Left (or Right) Channel

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

A.2.1.4 Main Channel (L + R)

The band of frequencies from 50 to 15,000 Hz which frequency-modulate the main carrier and which provide compatible monophonic reception.

A.2.1.5 Pilot Subcarrier

A 19 kHz subcarrier serving as a control signal for use in the reception of FM stereophonic broadcasts.

A.2.1.6 Stereophonic Subcarrier

A subcarrier having a frequency which is the second harmonic of the pilot subcarrier frequency.

A.2.1.7 Stereophonic Subchannel (L - R)

The band of frequencies from 23 to 53 kHz containing the stereophonic subcarrier and its associated sidebands.

A.2.1.8 Stereophonic Separation

The ratio (in dB) of the output of the L (or R) channel due to a signal intended for that channel only, to the output of the R (or L) channel due to the same signal.

A.2.1.9 Crosstalk

The presence of an undesired signal occurring in one channel (L or R) caused by the signal in the other channel (R or L).

A.2.1.10 Subsidiary Communication Multiplex Operation (SCMO)

Authorization to transmit information on one or more multiplex subcarriers.

A.2.1.11 Multiplex Subcarrier

A subcarrier having a frequency within the range 20 to 99 kHz and which is modulated with subsidiary communication information.

A.2.2 Standard

A.2.2.1 L + R Channel

A.2.2.1.1 The modulating signal for the L + R channel shall consist of the sum of the left and right signals, (L + R).

A.2.2.1.2 When only a left (or right) signal exists in the L + R channel, the deviation of the main carrier shall not exceed 45% of the total modulation.

A.2.2.2 Pilot Subcarrier

A.2.2.2.1 The frequency of the pilot signal shall be 19,000 ±2 Hz.

A.2.2.2.2 The deviation of the carrier by the pilot signal shall be between 8% and 10% of the maximum modulation for monophonic operation.

A.2.2.3 L - R Channel

A.2.2.3.1 The stereophonic subcarrier shall be the second harmonic of the pilot subcarrier and shall cross the zero voltage axis with a positive slope simultaneously with each crossing of the zero voltage axis by the pilot subcarrier.

A.2.2.3.2 Amplitude modulation (DSB/SC) of the stereophonic subcarrier shall be used.

A.2.2.3.3 The stereophonic subcarrier shall be suppressed to a level at least 40 dB below the total modulation of the carrier.

A.2.2.3.4 The stereophonic subcarrier shall be capable of accepting audio frequencies from 50 to 15,000 Hz.

A.2.2.3.5 The modulating signal for the stereophonic subcarrier shall be equal to the difference of the left and right signals, (L - R).

A.2.2.3.6 The pre-emphasis characteristics of the L - R channel shall be identical with those of the L + R channel with respect to phase and amplitude at all frequencies.

A.2.2.3.7 The sum of the sidebands resulting from amplitude modulation of the stereophonic subcarrier shall not cause a peak deviation of the carrier in excess of 45% of the total modulation when only a left (or right) signal exists in the L - R channel.

A.2.2.4 SCMO

A.2.2.4.1 Any form of modulation may be used on any multiplex subcarrier.

A.2.2.4.2 More than one multiplex subcarrier may be used. During periods of no program transmission, the multiplex subcarrier and its significant sidebands shall be within the frequency range of 20 kHz to 99 kHz. During monophonic or stereophonic program transmission, the multiplex subcarrier and its significant sidebands shall be within the frequency range of 53 kHz to 99 kHz.

A.2.2.4.3 During periods of no program transmissions, the modulation of the carrier by the arithmetic sum of all subcarriers above 76 kHz may not exceed 10%, and modulation of the carrier by the arithmetic sum of all subcarriers may not exceed 30% referenced to ± 75 kHz deviation. During monophonic or stereophonic program transmissions, the modulation of the carrier by the arithmetic sum of all multiplex subcarriers above 76 kHz may not exceed 10%, and modulation of the carrier by the arithmetic sum of all multiplex subcarriers may not exceed 20% referenced to ± 75 kHz deviation.

A.2.2.4.4 Without subsidiary communications the total modulation of the FM carrier by the sum of all baseband signals may not exceed 100% (75 kHz peak deviation). When subsidiary communications services are provided, using subcarrier concurrently with the broadcasting of stereophonic or monophonic programs, the peak modulation deviation may be increased as follows:

a. With more than one subcarrier, the total peak modulation may be increased by 0.5% for each 1.0% subcarrier injection modulation; and

b. Under no circumstances may the modulation of the FM carrier exceed 110% (82.5 kHz peak deviation).

A.2.3 Multiplex Performance Standards

A.2.3.1 Audio Frequency Response

A.2.3.1.1 Method of Measurement

Using the measurement method of A.1.3.2, except that the maximum modulation level shall be 90%, determine the frequency response curves of the L and R channels.

A.2.3.1.2 Standard

The audio frequency response curves shall lie on or between the dashed curves of Figure A.1.

A.2.3.2 Audio Frequency Harmonic Distortion

A.2.3.2.1 Standard

The L and R channels shall meet the requirements of A.1.4 except that the maximum modulations shall be 90% and the ratio shall be referenced to this level.

A.2.3.3 Frequency Modulation Noise Level on Carrier

A.2.3.3.1 Standard

The requirements of A.1.5 shall apply except that the maximum modulation shall be 90% and the ratio shall be referenced to this level.

A.2.3.4 Amplitude Modulation Noise Level on Carrier

A.2.3.4.1 Standard

The requirements of A.1.6 shall apply except that the maximum modulation shall be 90%.

A.2.3.5 Crosstalk

A.2.3.5.1 Method of Measurement - Stereophonic Crosstalk

Using the standard test input signal to produce 90% modulation of the carrier by the L + R channel, measure the components of the signal appearing in the L - R channel. With 90% modulation of the carrier by the L - R channel, measure the components of the signal appearing in the L + R channel.

A.2.3.5.2 Standard

Crosstalk into either channel shall be at least 40 dB below 90% modulation.

A.2.3.5.3 Method of Measurement - Multiplex Crosstalk

Modulate any multiplex subcarrier at the maximum level and at the maximum modulating frequency for which it is designed to operate. If more than one such subcarrier is provided, modulate them simultaneously. Record such level and frequency in the test report. With no modulation on the L + R or the L - R channels, measure the output of the L + R and the L - R channels.

With no modulation on the multiplex subcarrier or subcarrier, apply the standard input signal to both L + R and L - R channels, measure the level of the crosstalk in the output of the multiplex subchannel and record this level in the test report.

A.2.3.5.4 Standard

Crosstalk from multiplex channels into the L + R or L - R channels shall be at least 60 dB below maximum modulation level. There is no standard for crosstalk from the L + R or L - R channels into the multiplex subchannels.

A.2.3.6 Stereophonic Separation

A.2.3.6.1 Method of Measurement

Modulate the carrier to a level of 90% with a standard test signal applied to the L channel only. Measure the demodulated output of the L and R channels and determine the separation at frequencies of 100, 400, 1,000, 2,500, 5,000, 7,500 and 10,000 Hz. Repeat the above with a test signal applied to the R channel only.

A.2.3.6.2 Standard

The stereophonic separation between channels shall be 30 dB or better.

A.2.3.7 Frequency Stability of Subcarrier

A.2.3.7.1 Method of Measurement

In a manner similar to that described in Section 6.2, determine the frequency stability of the pilot subcarrier and that of any multiplex subcarrier employed, over the same temperature and AC input range.

A.2.3.7.2 Standard

The pilot subcarrier frequency shall be 19,000 Hz ±2 Hz and any multiplex subcarrier shall be within 500 Hz of the operating frequency selected by the manufacturer as noted in the test report.

A.2.4 Stereophonic Subcarrier Suppression

A.2.4.1 Method of Measurement

Using a stereo modulation monitor or other suitable method, determine the level of the stereo subcarrier.

A.2.4.2 Standard

The stereo subcarrier shall be at least 40 dB below the total modulation of the carrier.

Figure A.1 - Standard Pre-emphasis Curve

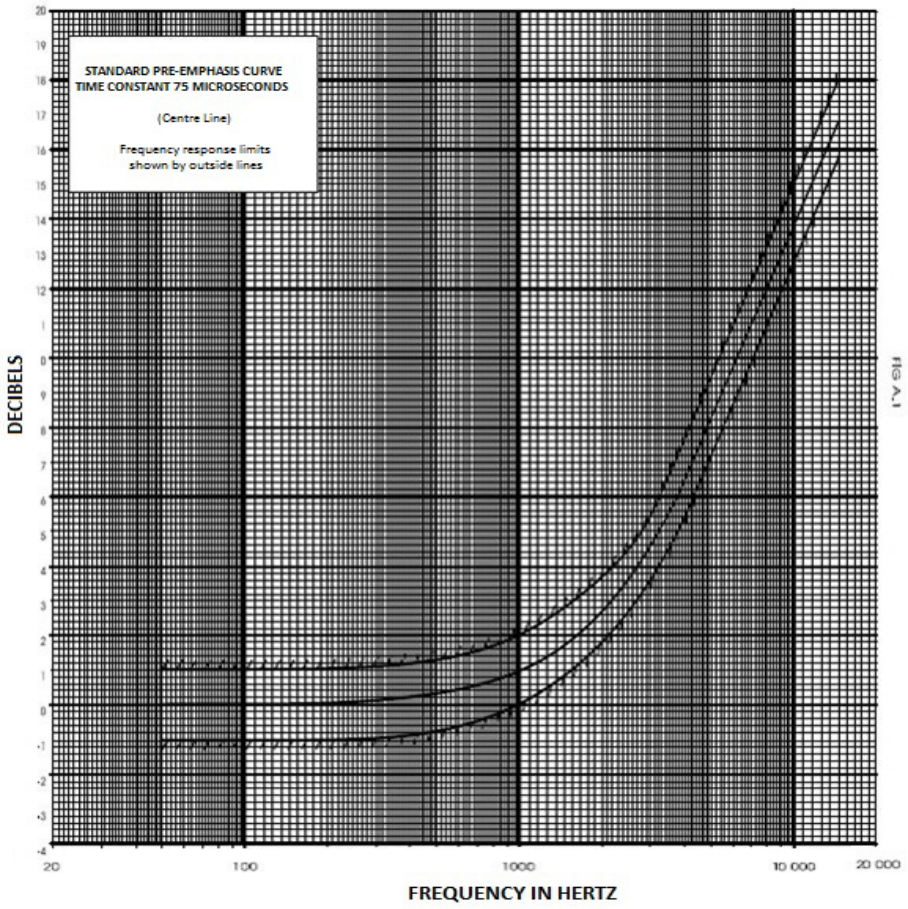

Figure A.2 - Multiplex Baseband Spectrum