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Spectrum Management

Radio Standards Specification

Land and Subscriber Stations: Voice, Data and Tone Modulated, Angle Modulation Radiotelephone Transmitters and Receivers Operating in the Cellular Mobile Bands 824-849 MHz and 869-894 MHz

Canada

Aussi disponible en français – CNR-118

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1. Intent

1.1 This Specification and the Compatibility Standard annexed hereto prescribe the minimum requirements for the type-approval of radiotelephone transmitters and receivers operating primarily in a voice modulated mode with maximum frequency deviation of ± 12.0 kHz in the cellular mobile bands 824-849 MHz and 869-894 MHz.

1.2 Allocated Bands and Standard Channel Spacing

In addition to the bands 825-845 MHz and 870-890 MHz, an additional 10 MHz of spectrum has been sub-allocated to the Canadian cellular radio service (see 3.3). The bands allocated for cellular mobile service are:

Mobile transmit	824.000 MHz to 849.000 MHz
Base transmit	869.000 MHz to 894.000 MHz

Mobile transmit channel at 825.030 MHz and the corresponding base transmit channel at 870.030 MHz shall be termed Channel 1. For channel numbering in the additional 10 MHz sub-allocated bands, see SRSP-503.

Standard channel spacing in the allocated bands is 30 kHz.

1.3 Rated Duty Cycle

Application for type-approval shall be made under one of the following rated duty cycles:

(a) Continuous
(b) Semi-Continuous
(c) Intermittent

1.3.1 Duty Cycle rating shall be designated by the suffix of the letter "C", "S", or "I" to the Type-Approval Number corresponding to (a), (b) or (c) in the above paragraph.

1.3.2 Standard test conditions for various duty cycle ratings are contained in paragraph 5.11.

1.4 Transmitters and receivers type-approved under this Specification are considered technically suitable for licensing in Canada pursuant to the Radio Regulations made under the Radio Act.

2. General

2.1 Anyone seeking approval of radio equipment under this Specification shall satisfy the Department at his own expense that the equipment actually meets the requirements of this Specification.

2.2 Notwithstanding the fact that a particular radio equipment meets the requirements of this Specification, the Department reserves the right to require that adjustments be made to that equipment if it causes interference within the meaning of the Radio Act.

2.3 This Specification prescribes minimum requirements only for a type of equipment. Certain users may wish to specify additional requirements to meet specific applications using this type of equipment. Equipment submitted for type-approval must comply with the minimum requirements for all parameters contained herein, and all units of the type manufactured for sale shall comply for the entire period of validity of the type-approval.

2.4 The Department reserves the right to revise this Specification.

3. Related Documents

The current issues of the following documents are applicable:

3.1 **Radio Standards Procedure (RSP) 100**: Certification of Radio Equipment.

3.2 **Cellular System Mobile Station-Land Station Compatibility Standard**: System compatibility requirements of equipment (see Annex A to this specification).

3.3 **Standard Radio System Plan (SRSP) 503**: Technical Requirements for Cellular Radiotelephone Systems Operating in the Bands 824-849 MHz and 869-894 MHz.

3.4 **Telecommunications Regulation Circular (TRC) 49**: Information on the Application of the Telecommunications Apparatus Technical Assessment and Testing Fees Regulations Made Under the Financial Administration Act.

4. Equipment Requirements

4.1 Equipment-Identification

Identification requirements for equipment intended for use in Canada are specified in RSP 100. At the time of application for type-approval under this specification a drawing, or equivalent, shall be submitted with the engineering brief to detail the equipment label and the information to be contained on the label that will be affixed to the production models of the equipment. In addition, the engineering brief shall clearly identify the equipment, the name, the type of unit, the manufacturer's name and the manufacturer's specified power output rating.

4.2 Transmitter Power Output Controls

Operator controls shall not permit operation at power levels greater than that permitted by the system.

5. Standard Test Conditions and Definitions

5.1 General

Standard test conditions are those conditions under which the equipment shall be operated while it is being tested for minimum performance requirements. These conditions apply unless otherwise specified.

5.1.1 Standard Operating Conditions

5.1.2 General

Except as specified below, the equipment shall be operated in accordance with the manufacturer's published instructions and in the case or cabinet supplied, where this is essential to the performance of the equipment.

5.1.3 Transmitter

Modulation limiting shall be initially adjusted in accordance with the manufacturer's published instructions for maximum frequency deviation of ± 12 kHz and shall remain operative for all tests without readjustment.

5.1.4 Receiver

For all tests the receiver shall be unmuted and the RF external gain control, if any, shall be set to full gain.

5.1.5 Associated Equipment

Associated equipment shall be that normally used with the transmitter and/or receiver. Standard conditions shall apply to the associated equipment.

5.2 Standard Test Voltage

Standard Test Voltage shall be within ± 2% of the value stated by the manufacturer to be the test voltage. It shall be measured at the point of power connection to the equipment. For equipment powered by a battery, an appropriate substitute variable voltage, low impedance, regulated power source may be used for tests under environmental conditions.

5.3 Warm-up Period

The equipment may have a 15 minute warm-up period under standby conditions prior to all tests, except where otherwise specified.

5.4 Standard Atmospheric Conditions

Tests shall be conducted under ambient conditions of atmospheric pressure and humidity at a temperature of 25°C ± 5°C.

5.5 Standard Test Frequency

Except where otherwise specified, all tests shall be conducted on an assignable frequency which is near the middle of the frequency range within which the equipment is designed to operate. This frequency shall be specifically identified in the test report.

5.6 Standard Input and Output Terminations

Transmitter and receiver standard terminations shall be resistive and numerically equal to the design impedances at the specific terminals concerned. The values shall be recorded in the test report. All input and output terminals shall be properly terminated under all test conditions.

5.7 Standard System Frequency Deviation

The Standard System Frequency Deviation shall be ±12 kHz (maximum) for voice, ± 8 kHz (nominal) for wideband data, and ±2 kHz (nominal) for the Supervisory Audio Tone (SAT). Simultaneous voice and SAT produce a peak frequency deviation of ±14 kHz (nominal).

5.8 Standard Test Modulation

Standard Test Modulation (voice) shall be a 1000 Hz sinusoidal audio input signal having l% or less total harmonic distortion applied at the level required to produce ±8 kHz frequency deviation.

Standard Test Modulation (data) shall be that required to produce a quasi-random 10 kilobit/second data pattern at ±8 kHz peak frequency deviation. Information regarding the quasi-random data pattern used should be included with the engineering test report. A sequence of length 511 bits or greater shall be used.

5.9 Receiver Standard Input Signal Source

Shall be a signal generator whose output impedance shall be matched to the nominal input impedance of the receiver (which shall be stated by the manufacturer) and whose calibrated output voltage shall be corrected to take into account impedance matching losses when terminated. Incidental modulation of the output signal voltage shall not effect the measurement accuracy.

5.10 Interconnection of Signal Generators for Multiple Signal Tests

When it is necessary to couple two or more signal generators to a receiver, a combining network shall be used such that each signal generator shall see a matched load when the output of the network is matched to the nominal input impedance of the receiver. Account shall be taken of losses in the combining and/or matching networks to establish the signal levels delivered to the receiver. The effect of intermodulation products and noise generated within the signal generators shall not affect the measurement accuracy.

5.11 Standard Test Duty Cycles

Transmitter rated duty cycle shall be designated by the manufacturer as either continuous, semi-continuous, or intermittent. The transmitter shall be tested in accordance with the following test conditions:

(a) Continuous: The transmitter shall be operated continuously at full rated output power for a period of twenty-four (24) hours.

(b) Semi-continuous: The transmitter shall be operated at full rated output power under a cycle of ten minutes carrier "on" (transmit) and ten minutes carrier "off" (standby), for a period of eight (8) hours.

(c) Intermittent: The transmitter shall be operated at full rated output power under a cycle of three minutes carrier "on" (transmit), and fifteen minutes, carrier "off" (standby), for a period of four (4) hours.

5.12 Standard Test Equipment Requirements

5.12.1 Standard Test Receiver

The Standard Test Receiver shall consist of a configuration of test equipment complying with the following minimal requirements.

(a) It shall be tunable over the applicable range of radio frequencies.

(b) It shall be capable of measuring positive and negative peak values of carrier frequency deviations up to ± 15 kHz with an accuracy of 5% or better.

(c) It shall incorporate a switchable de-emphasis network whose audio response characteristic for a constant signal deviation does not vary by more than ± 1 dB from a 750 microsecond de-emphasis characteristic over the frequency range 50 to 6000 hertz.

(d) It shall incorporate a switchable 2:1 expander (2 dB output change for every 1 dB change in input).

(e) The nominal 3 dB audio band pass shall be from 50 hertz to 20 kHz and the variation in the response shall not exceed ± 0.5 dB within the range 300 to 3000 hertz with the expander switched off.

(f) Distortion due to signal processing shall not exceed 2%.

(g) Inherent hum and noise input shall be at least 50 dB below the level of a signal with standard test modulation.

(h) It shall be properly terminated during all tests and a switchable "C" message weighted filter shall be incorporated.

(i) It shall be capable of processing wideband data transmitted at a 10 kilobit/sec rate.

5.12.2 Spectrum Analyzer or Frequency Selective Voltmeter

(a) Shall have the capability of measuring each of two signals differing in frequency by 1000 Hz and in level by 60 dB, with an accuracy of ± 2 dB.

(b) Shall have a dynamic range of at least 70 dB.

(c) Shall be capable of measuring relative levels of input signal components with an accuracy of ± 1 dB or better.

(d) Shall be capable of measuring the amplitude of the modulation components for wideband data measurement with a resolution bandwidth of 300 Hz.

5.13 Instrumentation Accuracy

The test report shall list all test equipment used and its date of calibration. The list shall identify instruments by manufacturer's type or model number. The following parameters shall be measured with instrumentation having at least the accuracy indicated below:

(a)	AC and DC power supply voltages	± 0.5%
(b)	Radio frequency	± 0.00001%
(c)	Radio frequency transmit power	± 0.5 dB
(d)	Radio frequency output voltages	± 2.0 dB
(e)	Radio frequency signal generator output power	± 1.0 dB to 1 GHz, ± 2.0 dB above 1 GHz
(f)	Audio frequency	± 0.01%
(g)	Audio frequency power	± 1.0 % (Full Scale)
(h)	Audio frequency noise and distortion	± 1.0 % (Full Scale)
(i)	Ancillary load resistors, coupling devices, cables, attenuators, etc.	± 0.5 dB
(j)	Time interval measurement	± 1.0 %

6. Environmental Test Conditions

6.1 Environmental Test Conditions

(a) Self contained equipment.

Temperature: -10°C, +40°C
Voltage: -20%, +10% of standard test voltage

(b) Subscriber equipment, intended for use with external power supplies.

Temperature: -30°, +60°C
Voltage: ± 10% of standard test voltage

(c) Base station equipment.

Temperature: minimum range +4°C, +49°C.
Voltage: ± 10% of standard test voltage

6.1.1 Equipment with self-contained batteries

(a) During environmental tests it shall be permissible to substitute an external voltage source. In these cases, the batteries may be disconnected, but not removed.

(b) When tested with an external power supply, the equipment shall be operated under the conditions applicable to externally powered equipment.

6.2 Tolerances

Environmental test conditions shall be maintained within the following tolerances:

(a) Temperature: ± 2°C
(b) Voltage: ± 2%

6.3 Temperature Stabilization

For the purposes of these tests, equipment temperatures shall be considered stabilized when the temperature of the largest internal mass remains within ± 3°C of the specified value when the equipment is inoperative, or when the crest temperature of the largest internal mass does not vary by more than ± 5°C, with the equipment operating.

7. Transmitter Tests under Standard Test Conditions

7.1 Power Output and Power Output Rating

7.1.1 Definitions

The transmitter power output is the RF power dissipated in the standard output termination when operating under the rated duty cycle selected by the applicant for approval. The power output rating of the transmitter is the value determined under the conditions of paragraph 7.1.2.

7.1.2 Method of Measurement

The transmitter shall be set up as specified under the standard test conditions and operated unmodulated at the maximum output power at the selected duty cycle designated in accordance with paragraph 5.11. Measurements shall be made to establish the radio frequency power delivered by the transmitter into the standard output termination. All details of the measurement shall be clearly stated in the test report. Power output shall be monitored and recorded throughout the test period and no adjustment shall be made to the transmitter after the test has begun, except as noted below.

If the power output is adjustable, measurements shall be made for the highest and the lowest power levels of the range for the appropriate duty cycle for which approval is requested. The results shall be recorded at the end of the test period.

7.1.3 Minimum Performance Standard

The maximum power output(s) measured under the conditions of paragraph 7.1.2 for each duty cycle for which the transmitter is rated shall be within + 2 dB to 0 dB of the manufacturer's rating(s) of RF power output.

7.2 Out of Band Emission

7.2.1 Definition

Emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious emissions.

7.2.2 Method of Measurement

The spectrum of the transmitter shall be determined with a spectrum analyzer or highly selective receiver as specified in 5.12.2.

(a) For combined voice and SAT measurements, the transmitter shall have its compressor disabled and shall be modulated with a 2500-Hz sine wave at a level 13.5 dB greater than that required to produce ± 8 kHz peak frequency deviation at 1000 Hz (16 dB greater than that required to produce 50 percent of the maximum deviation of ± 12 kHz), and shall be modulated with a 6000 Hz SAT frequency with ± 2.0 kHz peak frequency deviation.

(b) For **wideband data measurements**, the transmitter shall be modulated with a quasi-random 10 kilobit/second data pattern at ±8 kHz peak frequency deviation.

7.2.3 Minimum Performance Standards

No out of band emission shall fall within the cross-hatched area of Figure 1 for voice modulation and Figure 2 for data modulation.

7.3 Spurious Emissions

7.3.1 Definition

Emission on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products but exclude out-of-band emissions.

7.3.2 Method of Measurement

The measurement set-up shall be as specified in paragraph 7.2.2, except that standard test modulation (alternately voice and data) shall be applied to the transmitter and a portion of the RF output shall be coupled to a spectrum analyzer or equivalent instrument. The output spectrum shall be carefully searched for spurious emissions over the frequency range from 1 MHz to the third harmonic of the standard test frequency (Fc), excluding within

± 100 kHz from the standard test frequency. In the band 869 MHz to 894 MHz the spurious emissions shall be measured using a bandwidth of 30 kHz. The most significant spurious emissions shall be identified, measured and recorded. The above measurement shall be repeated for the highest and lowest rated power level.

7.3.3 Minimum Performance Standard

(a) Spurious emissions shall be attenuated below the maximum level of emission of the carrier frequency by at least 43 dB + 10 $\log_{10}$ (mean power of the unmodulated carrier in watts) dB.

(b) For subscriber units: In addition to the requirements of 7.3.3 (a), the mean power of spurious emissions in the band from 869 MHz to 894 MHz shall not exceed 10 picowatts (-80 dBm).

7.4 Modulation Distortion

7.4.1 Definition

The modulation distortion is the level of the demodulated carrier audio rms noise produced by audio distortion in the transmitter via the audio and RF circuits within the transmitter.

7.4.2 Method of Measurement

The transmitter shall be adjusted per the manufacturer's procedures and instructions for full rated systems deviation. A 1000-Hz test tone adjusted to the manufacturer's specified level shall be applied to the transmitter with the compressor enabled, and the modulation sensitivity shall be set to achieve ±8 kHz peak frequency deviation. The standard test receiver with standard 750 microsecond de-emphasis, with expandor enabled, and with C-message weighted filter shall be tuned to the carrier frequency and used to measure the audio distortion from the modulated transmitter.

7.4.3 Minimum Performance Standard

The maximum modulation distortion shall be 26 dB below modulating tone level.

7.5 Transmit Audio Frequency and Limiting Response

7.5.1 Definition

The transmitter audio frequency response is defined in terms of the degree of closeness to which the frequency deviation of the transmitter follows the prescribed 6 dB per octave pre-emphasis characteristic over a specified continuous audio frequency range, while conforming to the required band limiting condition outside of that range. Deviation shall be treated as voltage when calculating dB.

7.5.2 Method of Measurement

Operate the transmitter with the compressor disabled, and monitor the output with a frequency deviation meter or a standard test receiver without the standard 750-microsecond de-emphasis, with expandor disabled, and without C-message weighted filter (see 5.12.1). Apply a sine wave audio input to the transmitter external audio input port, vary the modulating frequency from 300 to 3000 Hz, and record the input levels necessary to maintain a constant ± 2.9 kHz system deviation.

To test the band limiting condition: adjust the audio input frequency to 1000 Hz, and adjust the input level to 20 dB greater than that required to produce ± 8 kHz deviation. Note the output level on the frequency deviation meter or a calibrated test receiver. Using this output level as reference (0 dB), vary the modulating frequency from 3000 Hz to 20,000 Hz, and record the change in output while maintaining a constant audio input level.

7.5.3 Minimum Performance Standard

Over the frequency range 300 to 3000 Hz, the input level to maintain a constant ±2.9 kHz system deviation shall not vary more than +1 to -3 dB from a true 6 dB/octave pre-emphasis characteristic (with the exception of a permissible 6 dB/octave roll-off from 2500 to 3000 Hz relative to the true level at 2500 Hz), see Figure 3.

Between 3000 Hz and 20,000 Hz the response attenuation shall not exceed the values defined by Table 1.

Table 1

Minimum Transmitter Audio Limiting Attenuation

Frequency Band	Attenuation Relative to the Maximum Value Allowed at 3000 Hz
3000 - 5900 Hz	40 $\log_{10}$ (f/3000) dB
>5900 - <6100 Hz	35 dB
6100 - 15000 Hz	40 $\log_{10}$ (f/3000) dB
>15000 - 30000 Hz	28 dB

where f is in Hertz

7.6 Modulation Deviation Limiting

7.6.1 Definition

Modulation deviation limiting refers to the ability of the transmitter circuits to prevent the transmitter from producing deviation in excess of rated system deviation.

7.6.2 Method of measurement

The transmitter shall be set to a channel near the center of the band and adjusted by the manufacturer's procedure and instructions for full rated system deviation. Adjust the audio input for ± 8 kHz peak frequency deviation at 1000 Hz with the 2:1 compressor enabled and the SAT disabled. The audio input shall be increased by 20 dB in one step (rise time between the 10-percent and 90-percent points shall be 0.1 second maximum). Both the maximum initial and the subsequent steady state values of the peak frequency deviation, at and following the time of the 20 dB increase, shall be measured and recorded in a 300 to 3000 Hz band.

The measurement shall be repeated in 200 Hz increments from 300 Hz to 3000 Hz with the transmitter test frequency set to each end of the band over which it is designed to operate.

7.6.3 Minimum Performance Standard

The maximum initial and subsequent steady-state, peak frequency deviations shall not exceed the rated system peak frequency deviation of ±12 kHz at any audio frequency in the 300 to 3000 Hz band. This requirement excludes the supervisory audio tone (SAT) and 10 kilobit/second wideband data signals.

7.7 Hum and Noise Level

7.7.1 Definition

The FM hum and noise level is the ratio of residual frequency modulation to test modulation measured on the test receiver.

7.7.2 Method of Measurement

(a) With the compressor enabled modulate the transmitter with a 1000-Hz tone to ± 8 kHz peak frequency deviation and with a 6000 Hz SAT frequency to ± 2 kHz peak frequency deviation. Monitor the transmitter output with the standard test receiver with standard 750 microsecond de-emphasis filter enabled, with expandor enabled, and with C-message weighted filter (see 5.12.1). Read and record the audio output level from the test receiver.

(b) Remove modulation from the transmitter and terminate its input with its rated input impedance. Read and record the audio output level from the test receiver.

(c) The FM hum and noise level in dB is:

$$20\log_{10}\frac{\text{Audio output level with transmitter modulated from (a)}}{\text{Audio output level with transmitter unmodulated from (b)}}$$

7.7.3 Minimum Performance Standard

The FM hum and noise shall be at least 32 dB below the output level.

8. Transmitter Tests under Environmental Conditions

8.1 Operational Performance Stability

8.1.1 Definition

Operational performance stability is the measured ability of the transmitter to

function under environmental conditions of specified variations in power supply voltage, over a specified temperature range, without exceeding permissible carrier frequency stability tolerances and with no more than a specified variation in power output.

8.1.2 Method of Measurement

The measurement procedure outlined below shall be followed:

Step 1: The transmitter shall be installed in a environmental test chamber whose temperature is controllable. Provision shall be made to vary the transmitter power supply voltage and to control the operation of the transmitter. Provision shall also be made to measure the following parameters:

(i) RF carrier frequency
(ii) RF power output

Note 1: If the transmitter utilizes a self-contained battery power supply, new or fully charged batteries may be installed at the outset of environmental testing and Step 4 of this test procedure shall not apply, or, alternatively, an external power supply can be used.

Note 2: The operating frequency shall be set-up in accordance with the manufacturer's published operation and instruction manual prior to the commencement of these tests. No adjustment of any frequency determining circuit element shall be made subsequent to this initial set-up.

Step 2: With the transmitter inoperative (power switched "OFF"), the temperature of the test chamber shall be adjusted to +25°C. After a one-hour temperature stabilization period at +25°C, the transmitter shall be switched "ON" with standard test voltage applied. The transmitter may be operated in the "standby" mode, for 15 minutes prior to keying the carrier "ON".

Step 3: The carrier shall be keyed "ON", and the transmitter shall be operated unmodulated at full RF power output for a continuous 3 minute period. The following parameters shall be measured in the order indicated:

Note 1: The RF carrier frequency shall be monitored and measurements shall be recorded at the outset and at 30 second intervals.

Note 2: The RF power output shall be measured and recorded during the last minute of operation. This measurement shall be the reference level for minimum performance standards under environmental conditions.

Step 4: With the test chamber temperature maintained at +25°C, the measurement procedure specified in Step 3 shall be repeated with the power supply voltage adjusted to 110% and 90% of standard test voltage. In addition, for portable equipment frequency tolerance measurements shall be made with the external power supply set at 80% of the standard test voltage. All measurements shall be recorded. The transmitter shall be switched "OFF".

Note: For "intermittent" duty cycle equipment, a maximum period of 15 minutes in "standby" mode may be allowed between periods of carrier keyed "ON" operation.

Step 5: The test procedures outlined in Steps 2, 3 and 4 shall be repeated after stabilizing the transmitter at the following environmental temperatures in the order indicated: self contained equipment, +40°C, -10°C; equipment, including portable, intended for use with external power supplies, +60°C, -30°C; base station equipment, +4°C, +49°C or as specified by the manufacturer. All measurements shall be recorded and reported.

8.1.3 Minimum Performance Standards

Under all specified environmental test conditions:

(i) The RF carrier frequency shall not depart from the standard test frequency in excess of the following tolerances:

Equipment Type	Frequency Tolerances
(a) Base Station	± 1.5 parts per million
(b) Subscriber units	± 2.5 parts per million

(ii) The RF power output shall not decrease by more than 4 dB, nor increase by more than 2 dB with reference to the power output measured under paragraph 8.1.2 (step 3(ii)).

9. Receiver Tests under Standard Test Conditions

9.1 Sensitivity

9.1.1 Definition

The usable sensitivity of the receiver is the RF level of the input signal modulated with a 1 kHz frequency to ±8 kHz peak frequency deviation that will result in 12 dB SINAD (C-message weighted), at the audio output of the receiver. SINAD is defined below.

9.1.2 Method of Measurement

Enable the expandor, terminate the audio output of the receiver in the load specified by the manufacturer, and make SINAD measurements using a C-message weighted filter. Apply a -50 dBm RF signal with 1000-Hz modulation at ± 8 kHz peak frequency deviation to the receiver antenna input terminals. Connect an output load distortion meter incorporating a 1000-Hz band notch filter to the receiver-audio output terminals. Reduce the input signal level until the SINAD is 12 dB. The input RF signal level at this point defines the receiver sensitivity.

SINAD is obtained by first measuring the composite of the audio signal with its noise and distortion components, next notching the audio signal with a 1000-Hz notch filter, and then measuring just the noise and distortion components. The input RF signal level that provides a 12 dB ratio between the

signal-plus-noise-plus-distortion measured level and the noise-plus-distortion measured level defines the 12 dB SINAD sensitivity for the receiver.

Make the measurement on a channel near the center of the band over which the receiver is designed to operate.

Where a subscriber unit cannot be measured using the method of measurement described above, the sensitivity may be measured by a radiated measurement equivalent. Documentation shall be provided as to the basis of the measurement used.

9.1.3 Minimum Performance Standard

The RF signal input level measured across the receiver antenna terminals shall not be more than -113 dBm.

9.2 Adjacent and Alternate Channel-Desensitization

9.2.1 Definition

The adjacent channel selectivity and desensitization of a receiver is a measure of its ability to receive a modulated input signal on its assigned channel frequency in the presence of a second modulated input frequency spaced either one channel (30 kHz) above or one channel below the assigned channel.

The alternate channel selectivity and desensitization of a receiver is a measure of its ability to receive a modulated input signal on its assigned channel frequency in the presence of a second modulated input frequency spaced either two channels (60 kHz) above or two channels below the assigned channel frequency.

9.2.2 Method of Measurement

Terminate the audio output of the receiver in its normally intended load, disable the expandor, and make measurements using a C-message **weighted filter**.

(a) Connect two RF signal generators equally coupled to the receiver antenna input terminals through a suitable matching network. Set the first RF signal generator to the assigned channel frequency and modulate it with a 1000-Hz tone to ± 8-kHz peak frequency deviation. Switch the second generator off. Adjust the first RF signal generator level to produce a 12 dB SINAD measurement at the audio-output terminal of the receive path.

Record the RF signal level and increase this first RF signal generator output by 3 dB.

(b) Set the frequency of the second RF signal generator to either 30 or 60 kHz above the frequency of the first RF signal generator and modulate it with a 400-Hz tone to ± 8 kHz peak frequency deviation. Adjust the level of the second RF signal generator to reduce the SINAD measurement back to 12 dB from the first RF signal generator. Record the RF signal level.

(c) Repeat step (b) with the frequency of the second RF signal generator set to either 30 or 60 kHz below the frequency of the first RF signal generator.

(d) Calculate the ratios, in dB, of the undesired signal levels measured in steps (b) and (c) to the reference level obtained in step (a). For each case of adjacent-and alternate undesired input signals, the smaller of these ratios for the above-and below-channel undesired signals is the minimum selectivity.

9.2.3 Minimum Performance Standard

The minimum adjacent-channel selectivity shall be 16 dB. The minimum alternate-channel selectivity shall be 60 dB.

9.3 Spurious Response Attenuation

9.3.1 Definition

The receiver spurious response attenuation is a measure of the receiver's ability to discriminate between the assigned input signal frequency and an undesired signal at any other frequency to which it is responsive.

9.3.2 Method of Measurement

(a) The expandor shall be disabled and the audio output of the receiver shall be terminated in its normally intended load. Measurement shall be made using a C-message weighted filter.

(b) Two RF signal sources shall be connected to the receiver under test through an appropriate matching or combining network.

(c) With one RF signal source switched off, the other desired input RF signal source shall be adjusted to the receiving frequency of the unit under test, and a 1000-Hz tone at ± 8 kHz peak frequency deviation shall be applied. Adjust this desired input RF signal source to minimum RF signal level

required for a 12 dB SINAD measurement. Record this level as the desired input RF signal source reference level, then increase the input RF signal source by 3 dB, and leave this input RF signal source set at this level and frequency.

(d) The undesired input RF signal source shall be switched on, and set to a high level (i.e., at least 80 dB above the level of the desired input RF signal source). The undesired input RF signal source shall be modulated with a 400 Hz tone at ± 8 kHz peak frequency deviation.

(e) The undesired input RF signal source shall be varied over a continuous frequency range from the lowest intermediate frequency or lowest oscillator frequency used in the receiver, whichever is lower, to at least 1000 MHz*, and all spurious responses shall be identified by frequency and recorded.

(f) At the frequency of each noted spurious response, the level of the undesired RF signal source shall be adjusted and recorded to achieve a 12 dB SINAD measurement from the desired input RF signal source. The corresponding output levels of the undesired input RF signal source level and the desired input RF signal source reference level shall be measured and recorded.

(g) The spurious-response attenuation is the ratio of the undesired input RF signal source level to the desired input RF signal source reference level, expressed in dB.

9.3.3 Minimum Performance Standard

The spurious response attenuation shall be at least 60 dB (50 dB for portables) for all undesired signals 60 kHz or more removed from the assigned input signal frequency. Subharmonics of the receiver's center frequency shall be excluded from this requirement.

* It is preferable but not mandatory that the frequency range be searched to at least 2600 MHz.

9.4 Intermodulation Spurious Response Attenuation

9.4.1 Definition

The intermodulation spurious response attenuation of the receiver is the measure of its ability to receive a modulated input RF signal frequency in the presence of two unmodulated interfering signals so separated from the assigned input signal frequency and from each other that the n'th order mixing of the two undesired signals can occur in the non-linear elements of the receiver, producing a third signal whose frequency is equal to that of the assigned input RF signal frequency.

9.4.2 Method of Measurement

(a) Disable the expandor, terminate the audio output of the receiver in its normally intended load, and make measurements using a C-message weighted filter. Equally couple three RF signal generators to the receiver antenna input terminals. Modulate the first RF signal generator to ± 8 kHz peak frequency deviation with 1000 Hz. Leave the second and third RF signal generators unmodulated.

(b) Turn off the second and third RF signal generators. Adjust the frequency of the first RF signal generator to the assigned input RF signal frequency, and adjust the output to give 12-dB SINAD as in 9.1.2. Record this level as the reference sensitivity. Increase the output level of this first RF signal generator to 3 dB above this reference sensitivity.

(c) Adjust the second RF signal generator to a channel 60 kHz above the assigned input frequency, and adjust the third RF signal generator to a channel 120 kHz above the assigned input frequency. Turn on the second and third RF signal generators, maintain their outputs at equal levels, and increase these levels until the SINAD measurement from the desired RF signal generator is reduced back to 12 dB. Adjust the frequency of either of the interfering RF signal generators slightly to produce the maximum interfering signal before the final measurement is made. Record the RF signal level of the two interfering signal generators.

(d) Repeat the above measurement with the second RF signal generator set to 60 kHz below and the third RF signal generator set to 120 kHz below the assigned input frequency.

(e) The smaller of the ratios of the signal level of the second and third RF signal generators to the reference sensitivity level of the first RF signal generator expressed in dB is the measure of intermodulation spurious response attenuation.

9.4.3 Minimum Performance Standard

All intermodulation spurious responses shall be attenuated by at least 55 dB.

9.5 Antenna Conducted Receiver Spurious Emissions

9.5.1 Definition

Antenna conducted receiver spurious output signals are those generated in a receiver and appearing at the receiver antenna terminals. The manufacturer may or may not include the receiver multicoupling, filtering, and pre-amplification equipment for the measurement, depending on whether the receiver is to be certified as a stand-alone component or as a part of an overall multicoupling-preamplification system.

9.5.2 Method of Measurement

The receiver antenna terminals shall be terminated in, or impedance matched to , a spectrum analyzer or frequency selective voltmeter whose nominal input impedance is 50 ohms resistive. The receiver shall be operated in the normal receiver mode on at least three test frequencies, one near the mid-point and the others approximately 10% inside the upper and lower extremities of the band over which the receiver is designed to operate. At each frequency of operation the output shall be searched by carefully tuning the spectrum analyzer or frequency selective voltmeter over the range from the lowest radio frequency generated in the receiver, to three times its operating frequency. All detected outputs shall be investigated and those within 20 dB of the permissible level shall be identified by frequency, measured and recorded. If the receiver incorporates a scanning mode of operation, the above procedure shall be repeated with the receiver operating in the scanning mode.

9.5.3 Minimum Performance Standard

(a) No spurious-output signals appearing at the antenna terminals shall exceed 1000 uV across 50 ohms or equivalent output power of 20 nW or -47 dBm.

(b) For subscriber units: No spurious-output signals appearing at the antenna terminals and falling within the receive band shall exceed 22.4 uV across 50 ohms (or equivalent output power of 10 pW or -80 dBm).

9.6 Antenna Radiated Receiver Spurious Emissions

At the option of and for the convenience of the user, this test may be used as an alternative to the receiver conducted spurious output test in 9.5 above, except for the requirement for suppression inside the cellular receive band specified in 9.5.3(b).

9.6.1 Definition

Radiated spurious output signals are those generated in a receiver and radiated from the receiver either via the antenna path or via the control, power, and audio cables that may be used with the receiver.

9.6.2 Method of Measurement

The measurement procedure defined in section 10 herein shall be used for measuring receiver radiated spurious emissions.

9.6.3 Minimum Performance Standard

The radiated-spurious power levels from the receiver when measured using the procedure in l0 shall not exceed the levels in Table 2.

Table 2

Maximum Allowable Radiated Spurious Emission

Frequency Range	Maximum Allowable EIRP
25 - 70 MHz	-45 dBm
70 - 130 MHz	-41 dBm
130 - 174 MHz	-41 to -32 dBm*
174 - 260 MHz	-32 dBm
260 - 470 MHz	-32 to -21 dBm*
470 -1000 MHz	-21 dBm

** Interpolate linearly on log frequency scale*

10. Standard Radiated Signal Measurement Procedure

The measurement and calibration procedures described in this section are intended to provide an accurate means of measuring radiated signals.

10.1 Standard Radiation Test Site

The test site shall be on level ground that is of uniform electrical characteristics. The site shall be clear of metallic objects, overhead wires, etc., and shall be as free as possible from undesired signals such as ignition noise, other carriers, etc. The distance from the equipment under test or the field-strength meter to reflecting objects such as rain gutters, house plumbing, etc., shall not be less than 90 meters (295 feet) for the 30 meter test range nor less than 30 meters (98.4 feet) for the 3 meter test range. If desired, shelters may be provided at the test site to protect the equipment and personnel. All such construction shall be of wood, plastic, or other non-metallic material. All power, telephone, and control circuits to the site shall be buried at least 0.3 meter (1 foot) under ground.

A turntable, essentially flush with the ground, shall be provided that can be remotely controlled. A platform l.0 meters (3.3 feet) high shall be provided on this turntable to hold the equipment under test. Any power and control cables that are used for this equipment should extend down to the turntable with any excess to be coiled on the turntable.

If the equipment to be tested is mounted in racks and is not easily removed for testing, then the equipment mounted in its rack (or racks) may be placed directly on the turntable.

10.2 Search Antenna

For dipole search antennas, the dipole length shall be adjusted for each frequency of measurement. This length may be determined from a calibration ruler that is normally supplied with the antenna.

The search antenna shall be mounted on a movable non-metallic horizontal boom that can be raised or lowered on a wooden or other non-metallic pole. The cable connected to the search antenna shall be at a right angle to the antenna. The cable shall be dressed at least 3 meters (9.8 feet) either through or along the horizontal boom in a direction away from the equipment being measured. The search antenna cable may then be dropped from the end of the horizontal boom to ground level for connection to the field-strength measuring equipment.

The search antenna shall be capable of being rotated 90 degrees on the end of the horizontal boom to allow measurement of both vertically and horizontally polarized signals. When the antenna length of a vertically mounted antenna does not permit the horizontal boom to be lowered to its minimum specified search range, adjust the minimum height of the boom for 0.25 meter (0.83 foot) clearance between the end of the antenna and the ground.

10.3 Field Strength Measurement

A field strength meter shall be connected to a search antenna. The field strength meter is to have sufficient sensitivity and selectivity to measure signals over the required frequency range at levels at least 10 dB below the levels specified in 9.6.3 above. The calibration of the field strength meter is not critical since a comparison measurement procedure is used.

10.4 Frequency Range of Measurements

When measuring radiated signals from receiving equipment, the measurements shall be made from 25 to at least 1000 MHz.

10.5 30-meter Test Range

Measurement of radiated signals shall be made at a point 30 meters (98.4 feet) from the center of the turntable. The search antenna is to be raised and lowered from 2 to 6 meters (6.6 to 19.7 feet) in both horizontally and vertically polarized orientations.

The field-strength measuring meter may be placed on a suitable table or tripod at the foot of the antenna mast.

When measuring radiated signals from receivers, a vertical antenna, adjusted to 1/4 wavelength and having a ground plane of a half-wavelength radius at the standard input-signal frequency, shall be mounted 3 meters (9.8 feet) above ground over the center of the turntable. A minimum length of low-loss cable shall be used to connect this antenna to the receiver antenna terminal.

10.6 3-meter Test Range

Measurement of radiated signals may be made at a point 3 meters (9.8 feet) from the center of the turntable, provided the following three conditions can be met:

(a) A ground screen that covers a least an elliptical area 9 meters (29.5 feet) by 6 meters (19.7 feet) is used with the measuring antenna and the turntable mounted 3 meters (9.8 feet) apart on the major axis and equidistant from the minor axis of the elliptical area.

(b) The maximum vertical dimension of the equipment is 3 meters (9.8 feet) or less. When measuring radiated signals from receivers, the maximum dimension shall include the antenna (as in the case of a personal radio) or shall include a 1/4 wavelength ground plane antenna mounted over the radio for those receivers that use remote antennas. The radius of the ground plane shall be half-wavelength at the standard input frequency.

(c) The field-strength measuring equipment is either mounted below the ground level at the test site or is located a sufficient distance away from the equipment being tested and the search antenna to prevent corruption of the measured data.

The search antenna is to be raised and lowered over a range from 1 to 4 meters (3.3 to 13.1 feet) in both horizontally and vertically polarized orientations. When the search antenna is vertically oriented, the minimum height of the center of the search antenna shall be defined by the length of the lower half of the search antenna plus 0.25 meter.

10.7 Radiated Signal Measurement Procedures

Radiated signals having significant levels shall be measured on the 30 meter or the 3 meter ranges by using the following procedure:

(a) For each observed radiated signal, raise and lower the search antenna to obtain a maximum reading on the field-strength meter with the antenna horizontally polarized. Then rotate the turntable to maximize the reading. Repeat this procedure of raising and lowering the antenna and rotating the turntable until the highest possible signal has been obtained. Record this maximum reading.

(b) Repeat (a) for each observed radiated signal with the antenna vertically polarized.

(c) Remove the equipment being tested and replace it with a half-wave dipole antenna. The center of the antenna should be approximately at the same location as the center of the equipment being tested.

(d) Feed the dipole antenna replacing the equipment under test with a signal generator connected to the antenna by means of a non-radiating cable. With the antennas at both ends horizontally polarized and with the signal generator tuned to the observed radiated signal, raise and lower the search antenna to obtain a maximum reading on the field strength measuring meter. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained. Record the signal generator power output.

(e) Repeat step (d) above with both antennas vertically polarized.

(f) Calculate the power into a reference ideal isotropic antenna by:

(1) First reducing the readings obtained in steps (d) and (e) above by the power loss in the cable between the generator and the source antenna; and

(2) Then correcting for the gain of the source antenna used relative to an ideal isotropic antenna.

The average of different readings thus obtained is the equivalent isotropic radiated power (EIRP) level for the spurious signal being measured.

(g) Repeat steps (a) through (f) above for all observed signals from the equipment being tested.

(h) As an alternative to the substitution method in steps (c), (d), (e), and (f), when using a calibrated 3 meter radiation test site, the equivalent isotropic radiated power (EIRP) may be determined from the radiated EIRP versus field strength curve. The calibration curve for the radiated EIRP shall be included in the test report.

11. Compliance with Cellular System-Compatibility Standard

Technical requirements for compatibility are outlined in Annex A in a document entitled "Cellular System Land Station - Mobile Station Compatibility Standard".

An attestation shall be provided by the applicant that the equipment submitted for type-approval under this specification complies with all the requirements of the Compatibility Standard. The method by which compliance was determined shall be stated.

Issued under the authority of the
Minister of Communications

S.N. Ahmed
Director General
Engineering Programs

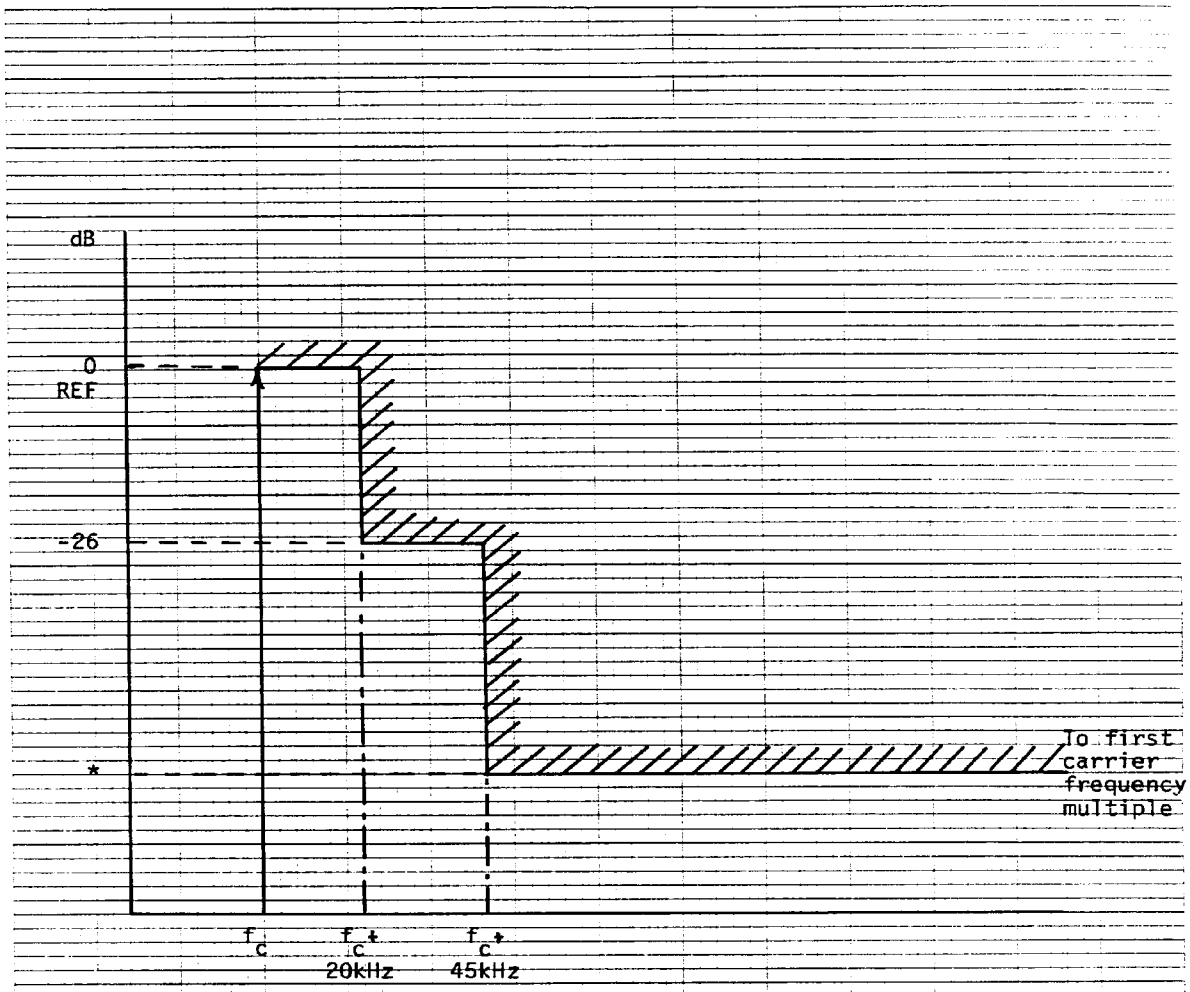
Addendum to Annex A

1. Insert the following paragraph: "Carrier ON/OFF Conditions" as 2.1.2.1.

2. Renumber the paragraph titled: "Power Output and Power Control" as 2.1.2.2.

2.1.2.1 **Carrier ON/OFF Conditions**

The carrier-off condition is defined as a power output at the transmitting antenna connector not exceeding -60 dBm. When commanded to the carrier-on condition on a reverse control channel, a mobile station transmitter must come to within 3 dB of the specified output power (see 2.1.2.2) and to within the required stability (see 2.1.1.2) within 2 ms. Conversely, when commanded to the carrier-off condition, the transmit power must fall to a level not exceeding -60 dBm within 2 ms. Whenever a transmitter is more than 1 kHz from its initial or final value during channel switching, the transmitter carrier must be inhibited to a power level not greater than -60 dBm.



* 60 dB or 43 + 10 $\log_{10}$ (mean output power,W) whichever is the lesser attenuation

Figure 1: Out of Band Emission (Voice Modulation)

Figure 1
Out of Band Emission (Voice Modulation)

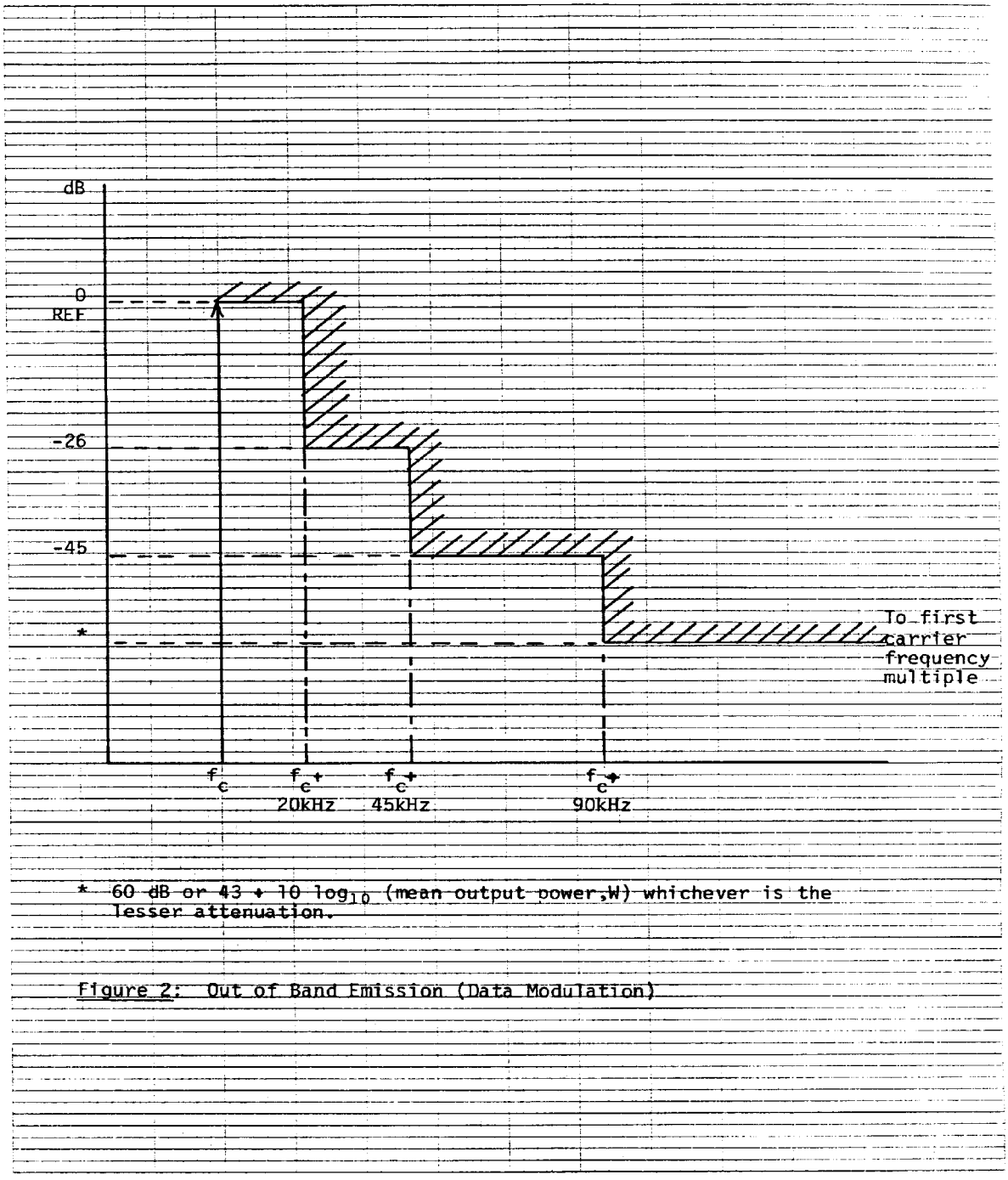


Figure 2
Out of Band Emission (Data Modulation)

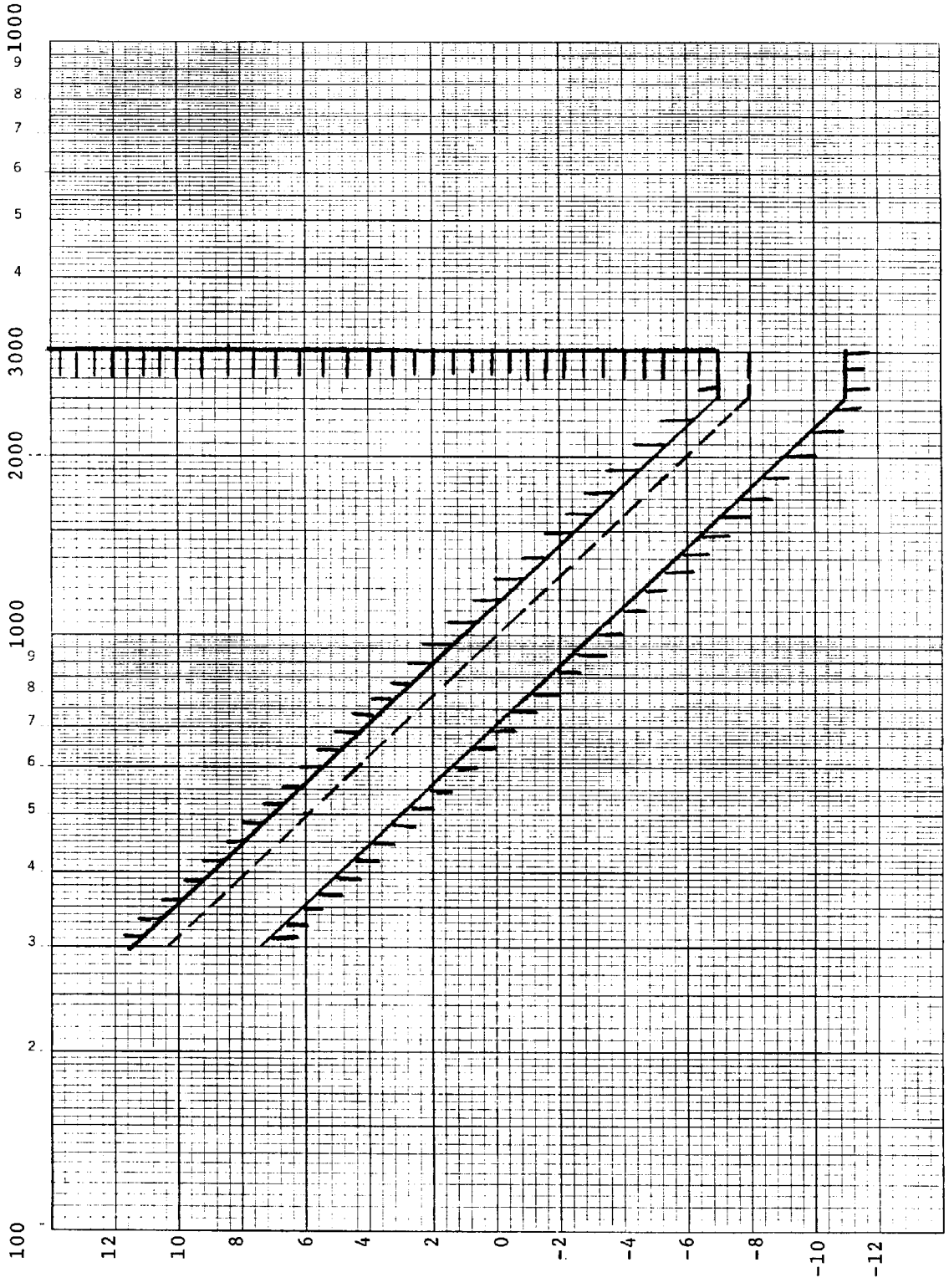


FIGURE 3 : THE INPUT LEVEL TO MAINTAIN A CONSTANT SYSTEM DEVIATION