RECOMMENDATION ITU-R BS.704*,**

Characteristics of FM sound broadcasting reference receivers for planning purposes

(1990)

The ITU Radiocommunication Assembly,

considering

a) that frequency assignment plans must of necessity take into account the characteristics of receivers;

b) that the range of performance of receivers used by the public is very large;

c) that a reference receiver with characteristics based on currently available receivers may be useful in a planning context;

d) that standards for reference receivers should therefore be defined, which can be taken as a basis for frequency planning purposes;

e) that these standards need to be taken into account by receiver manufacturers,

recommends

that the receiver characteristics contained in Annex 1 should be used for FM sound broadcasting planning purposes.

ANNEX 1

Monophonic and stereophonic reception using the pilot-tone system (±75 kHz frequency deviation) or the polar-modulation system (±50 kHz frequency deviation)

In deriving the recommended characteristics, the parameters contained in Annex 2 and Annex 3 were also considered.

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* This Recommendation should be brought to the attention of the International Electrotechnical Commission (IEC).

** Radiocommunication Study Group 6 made editorial amendments to this Recommendation in 2002 in accordance with Resolution ITU-R 44.

1 Antenna

Recommendation ITU-R BS.599 gives the directivity of an external antenna which is applicable for fixed installations only. Portable or car receivers normally have rod antennas; however, for portable or mobile reception of sound broadcasts, no directivity of the reception antenna should be applied in planning.

2 Sensitivity

For planning purposes, "sensitivity" is understood to mean "noise-limited sensitivity", given in terms of field strength or power level, required to achieve a specified signal-to-noise ratio at the audio output. Sensitivity should be presented as a single mean figure. The following values are suggested for the sensitivity of an average receiver:

– with an external antenna input (car receivers included):

  –5 dB(pW) for monophonic reception,

  15 dB(pW) for stereophonic reception;

– with a built-in antenna (oriented for optimum reception in the actual field in which the receiver is placed):

  30 dB(μV/m) for monophonic reception,

  50 dB(μV/m) for stereophonic reception.

These values are based upon an AF signal-to-noise ratio of 40 dB. The AF signal-to-noise measurement is made according to IEC Publication 60315-4 in conjunction with Recommendation ITU-R BS.468; reference frequency deviation: ±75 kHz for the pilot-tone system, and ±50 kHz for the polar-modulation system. If higher AF signal-to-noise ratios are to be applied in a planning context, the corresponding sensitivity can be calculated by linear extrapolation up to at least 56 dB (see Annex 2, § 5).

3 Selectivity

Selectivity of a receiver is a measure of its ability to discriminate between a wanted signal to which the receiver is tuned and unwanted signals entering through the antenna circuit.

The selectivity is understood as an effective selectivity comprising RF selectivity, IF selectivity, limiter, discriminator, stereophonic decoder characteristics and AF frequency response.

3.1 Selectivity with carrier frequency separations ≤ 400 kHz

The selectivity should be sufficient to meet the RF protection ratios given in Recommendation ITU-R BS.412. Protection ratio measurements are made in accordance with Recommendation ITU-R BS.641. It is assumed that test signals are fed via the built-in antenna for receivers without an external antenna input.

3.2 Selectivity with carrier frequency separations > 400 kHz

RF protection ratios substantially lower than –25 dB should be met. At the critical carrier frequency separation of 10.7 MHz (assumed nominal intermediate frequency), RF protection ratios lower than –20 dB should be met.

4 Performance in the presence of strong signals

FM broadcasting receivers overloading by strong input signals may result in:

– desensitization or comparable effects,

– intermodulation.

Such overloading may e.g. occur in the following cases:

a) a (very) strong wanted signal;

b) the wanted signal and one strong unwanted signal;

c) the wanted signal and two strong unwanted signals;

d) the wanted signal and more than two strong unwanted signals.

With reference to b), the RF protection ratios should not be seriously affected (≤ 3 dB) if the input power of the wanted signal is increased to 50 dB(pW).

5 Automatic frequency control (AFC)

The AFC should be switchable (see Annex 2 § 4).

6 Stereo/mono operation

Stereo portable and car receivers should preferably be equipped with a manual stereo/mono switch that will make possible satisfactory monophonic reception in case of insufficient field strength or in the presence of strong interfering signals.

7 Intermediate frequency

10.7 MHz is assumed even though some receivers use higher frequencies for different reasons (e.g. frequency diversity reception).

7.1 Image rejection ratio

The single signal image rejection ratio, when measured according to IEC Publication 60315-4, should be at least 50 dB.

For the assumed intermediate frequency of 10.7 MHz the image rejection ratio can be disregarded with respect to in-band interference. However, interference from other services has to be taken into account.

7.2 Interference generated within the receiver related to the intermediate frequency (see Report ITU-R BS.946)

The AF signal-to-noise ratio should be at least 50 dB at the critical frequencies which are integer multiples of the intermediate frequency (e.g. 96.3 MHz, 107 MHz); RF input level 40 dB(pW), stereophonic reception. The signal-to-noise ratio is measured according to IEC Publication 60315-4 in conjunction with Recommendation ITU-R BS.468; reference frequency deviation: ±75 kHz for the pilot-tone system, and ±50 kHz for the polar-modulation system.

8 Local oscillator radiation

Amendment No. 1 to CISPR Publication 13 and Draft European Standard EN 55013 indicate a measurement method and specify the following values:

Local oscillator fundamental frequency: ≤ 60 dB(μV/m)

Harmonics below 300 MHz: ≤ 52 dB(μV/m)

Harmonics above 300 MHz: ≤ 56 dB(μV/m)

However, some administrations apply the International Standard of the Council for Mutual Economic Assistance (CMEA) 784-77; 3894-82 and the National Standards of the USSR (GOST) 16842-82; 2205-83. In these standards the following values are specified:

Local oscillator fundamental frequency: ≤ 43.5 dB(μV/m)

Harmonics below 300 MHz: ≤ 43.5 dB(μV/m)

Harmonics above 300 MHz: ≤ 43.5 dB(μV/m)

ANNEX 2

In defining the recommended characteristics given in Annex 1 for receivers related to the pilot-tone system, the possible influence of the following receiver parameters was taken into account:

1 Overall audio-frequency response

An overall audio-frequency response with maximum 3 dB attenuation at 40 Hz and 15 kHz has been assumed.

2 Overall total harmonic distortion

It is assumed that the overall total harmonic distortion is less than 1%, measured in accordance with IEC Publication 60315-4.

3 Linear and nonlinear crosstalk

In stereophonic reception the crosstalk has an influence on the protection ratio curves. It is assumed that the linear crosstalk between A and B is less than –35 dB at frequencies between 100 Hz to 3 kHz, and less than –20 dB between 50 Hz to 100 Hz and 3 kHz to 15 kHz. Nonlinear crosstalk is assumed to be less than –40 dB.

These values are measured according to IEC Publication 60315-4 and should not depend on the receiver input signal level, provided it is high enough to maintain adequate stereophonic operation.

4 Tuning facilities

Various receiver tuning facilities may be considered in a planning context, including:

– adequate mechanical and/or electrical means for continuous or step tuning;

– switchable automatic frequency control which avoid detuning in the case of strong adjacent channel signals and also for testing purposes;

– the features offered by RDS (see Recommendation ITU-R BS.643) or other supplementary information systems (see Report ITU-R BS.463).

5 AF signal-to-noise ratio at higher input signal levels

Taking into account Recommendation ITU-R BS.641, the AF signal-to-noise ratio for monophonic and stereophonic reception is assumed to be at least 56 dB for an input signal level of 40 dB(pW). The AF signal-to-noise ratio measurement is made according to IEC Publication 60315-4 in conjunction with Recommendation ITU-R BS.468; reference frequency deviation: ±75 kHz (see also Annex 1, § 7.2).

6 Compatibility between the main programme and additional information signals

When additional signals are added on supplementary sub-carrier frequencies (see Recommendation ITU-R BS.643 and Report ITU-R BS.463), account must be taken of certain interference effects. Receiver designers should consider these in order to avoid interference to the main programme channel.

6.1 RDS (see Recommendation ITU-R BS.643)

Spurious components due to RDS may appear in the AF band. In the presence of an RDS test signal which causes a deviation of ±2 kHz on the main carrier, the power sum of these spurious components should be at least 76 dB below an audio signal level corresponding to a deviation of ±75 kHz using a sinusoidal tone of 500 Hz. For measurements, an RDS test signal with only two sideband components symmetrically located with respect to 57 kHz is used by modulating with an "all zeroes" data stream. In order to eliminate the effects of uncorrelated broadband noise, the spurious components in the AF band are measured selectively.

ANNEX 3

The definition of the recommended characteristics given in Annex 1 for receivers related to the polar-modulation system is based on the following values:

– an irregularity of ±3 dB in the frequency band from 30 Hz to 15 kHz for the overall AF amplitude-frequency response;

– a distortion factor less than 1%;

– linear crosstalk between channels A and B less than –30 dB at the frequency 1 000 Hz and less than –24 dB at the frequencies 250 and 5 000 Hz.