RESOLUTION 543 (REV.WRC-19)

Provisional RF protection ratio values for analogue and digitally modulated emissions in the high-frequency broadcasting service

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

a) that this conference has resolved to encourage the introduction of digitally modulated emissions in the high-frequency (HF) broadcasting bands allocated to the broadcasting service and has revised Resolution **517** accordingly;

b) that the current use of the spectrum is based on the use of double-sideband (DSB) emissions;

c) that Appendix **11** gives details of the system parameters and the emission characteristics of the digitally modulated emissions;

d) that the ITU Radiocommunication Sector (ITU-R) is carrying out further studies on the development of HF broadcasting using digitally modulated emissions in the frequency bands allocated to the broadcasting service below 30 MHz;

e) that RF co-channel and adjacent channel protection ratios are among the fundamental parameters when determining compatibility;

f) that the currently available values of RF protection ratios may need to be updated in the light of future ITU-R studies;

g) that Annex 1 to Recommendation ITU-R BS.1514 describes a digital system suitable for broadcasting in the frequency bands below 30 MHz;

h) that there is a need to compile and maintain statistics on administrations' capability to introduce digital modulation systems for their HF broadcasting services,

resolves

1 that digital modulation in accordance with Resolution **517 (Rev.WRC-19)** may be used in any of the HF bands allocated to the broadcasting service; this accommodation has to be made with the appropriate amounts of protection given to both analogue and digital emissions as described in the Annex to this Resolution;

2 that the protection ratio values described in the Annex be used in the coordination process under Article **12** on a provisional basis;

3 to invite a future competent conference to revise these provisional protection ratio values, as appropriate,

invites the ITU Radiocommunication Sector

to continue studies on digital techniques in HF broadcasting with the purpose of revising the RF protection ratio values for analogue and digitally modulated emissions in the HF broadcasting service as described in the Annex to this Resolution.

ANNEX TO RESOLUTION 543 (REV.WRC-19)

Section 1 − Standard RF protection ratio values

RF protection ratio values to be used for seasonal planning under the provisions of Article **12** are contained in Table 1 in this Section.

The values are consistent with those in Recommendation ITU-R BS.1615.

The characteristics of the digital emission are based on the 64-QAM modulation system, protection level No. **1**, robustness mode B, spectrum occupancy type 3 (as contained in Recommendation ITU-R BS.1514), which will be used extensively for HF sky-wave broadcasting in 10 kHz channels.

The characteristics of the analogue emission are based on double-sideband modulation as summarized in Part A of Appendix **11**, with 53% modulation depth.

TABLE 1

Relative RF protection ratios (dB) associated with digitally modulated emissions in the HF bands allocated to the broadcasting service

Wanted signal	**Unwanted signal**	**Frequency separation $f_{unwanted}$ - f_{wanted} (kHz)**								
		−20	**−15**	**−10**	**−5**	**0**	**5**	**10**	**15**	**20**
Amplitude modulation	Digital	−47	−42	−32	3	6	3	−32	−42	−47
Digital	Amplitude modulation	−54	−48	−40	−3	0	−3	−40	−48	−54
Digital	Digital	−53	−47	−38	−3	0	−3	−38	−47	−53

In the case of an amplitude modulation (AM) signal interfered with by a digital signal, the protection ratios are determined by adding 17 dB (audio-frequency protection ratio) to the relative RF protection ratios in Table 1.

In the case of a digital signal interfered with by an AM signal, the protection ratios are determined by adding 7 dB (signal-to-interference ratio for a bit error ratio (BER) of 10^{-4}) to the relative RF protection ratios in Table 1.

In the case of a digital signal interfered with by a digital signal, the protection ratios are determined by adding 16 dB (signal-to-interference ratio for a BER of 10^{-4}) to the RF relative protection ratios in Table 1.

Section 2 – Correction values of RF protection ratios

Correction values of RF protection ratios for different wanted signal conditions such as AM modulation depths, AM quality grades and digital modulation modes are provided in this Section.

1 AM modulation depth

RF protection ratios for a wanted AM signal interfered with by a digital signal depend on the AM modulation depth. A modulation depth of 53% is used as a default value in this Annex. If a different modulation depth is used, a correction value for RF protection ratio is required. Table 2 provides correction values for typical modulation depths.

TABLE 2

Correction values (dB) to be used for other AM modulation depths in respect of wanted AM signal

Modulation depth (%)	30	38	53	*m*
Correction value (dB)	5	3	0	20 log (53/*m*)

2 AM audio quality

RF protection ratios for a wanted AM signal interfered with by a digital signal depend on the required audio quality grade. If another quality grade is used, correction values of RF protection ratios as in Table 3 shall be added.

TABLE 3

Correction values (dB) to be used for other audio quality grades in respect of wanted AM signal

Audio quality grade	3	3.5	4
Correction value (dB)	0	7	12

3 Digital modulation scheme, protection level number and robustness mode

RF protection ratios for a wanted digital signal interfered with by an analogue or digital signal depend on the digital modulation scheme and mode. If any combination different from the default value in Section 1 is used, correction values of RF protection ratios as in Table 4 shall be added.

TABLE 4

Correction values (dB) to be used for other combinations of digital modulation scheme, protection level number and robustness mode in respect of wanted digital signal

Modulation scheme	Protection level number	Robustness mode		
		B	C	D
16-QAM	0	−7	−6	−6
	1	−5	−4	−4
64-QAM	0	−1	−1	0
	1	0	0	1

NOTE − 10 kHz nominal bandwidth.

Protection levels Nos. 2 and 3 and robustness mode A are not recommended for use in HF and are therefore not described here.

Section 3 − Explanatory examples

a) In Table 1, first row <AM interfered with by Digital>: with the AF protection ratio = 17 dB, all values of relative protection ratios entered in that row of the Table must be increased by 17 dB in order to determine the absolute value of the RF protection ratio (RF PR). As examples:

– For co-channel interference (0 kHz separation) the RF PR would be 6 + 17 = 23 dB.

– For adjacent channel interference (±10 kHz separation) the RF PR would be −32 + 17 = −15 dB.

– For the case of modulation depth = 38% and audio quality grade = 4, a correction factor of 15 dB (= 3 + 12) is added to the RF PR values described above.

b) In Table 1, second row <Digital interfered with by AM>: all values of relative protection ratios entered in that row of the Table must be increased by 7 dB in order to determine the absolute value of the RF PR. As examples:

– For co-channel interference (0 kHz separation) the RF PR would be 0 + 7 = 7 dB.

– For adjacent channel interference (±10 kHz separation) the RF PR would be −40 + 7 = −33 dB.

c) In Table 1, third row <Digital interfered with by Digital>: all values of relative protection ratios entered in that row of the Table must be increased by 16 dB in order to determine the absolute value of the RF protection ratio. As examples:

– For co-channel interference (0 kHz separation) the RF PR would be 0 + 16 = 16 dB.

– For adjacent channel interference (±10 kHz separation) the RF PR would be −38 + 16 = −22 dB.