

## APPENDIX 2 (REV.WRC-03)

**Table of transmitter frequency tolerances**

(See Article 3)

1 Frequency tolerance is defined in Article 1 and is expressed in parts in  $10^6$ , unless otherwise indicated.

2 The power shown for the various categories of stations is the peak envelope power for single-sideband transmitters and the mean power for all other transmitters, unless otherwise indicated. The term “power of a radio transmitter” is defined in Article 1.

3 For technical and operational reasons, certain categories of stations may need more stringent tolerances than those shown in the table.

Frequency bands (lower limit exclusive, upper limit inclusive) and categories of stations	Tolerances applicable to transmitters
<p><i>Band: 9 kHz to 535 kHz</i></p> <p>1 <i>Fixed stations:</i></p> <ul style="list-style-type: none"> <li>– 9 kHz to 50 kHz</li> <li>– 50 kHz to 535 kHz</li> </ul> <p>2 <i>Land stations:</i></p> <ul style="list-style-type: none"> <li>a) Coast stations</li> <li>b) Aeronautical stations</li> </ul> <p>3 <i>Mobile stations:</i></p> <ul style="list-style-type: none"> <li>a) Ship stations</li> <li>b) Ship's emergency transmitters</li> <li>c) Survival craft stations</li> <li>d) Aircraft stations</li> </ul> <p>4 <i>Radiodetermination stations</i></p> <p>5 <i>Broadcasting stations</i></p>	<p>100</p> <p>50</p> <p>100<sup>1,2</sup></p> <p>100</p> <p>200<sup>3,4</sup></p> <p>500<sup>5</sup></p> <p>500</p> <p>100</p> <p>100</p> <p>10 Hz</p>
<p><i>Band: 535 kHz to 1 606.5 kHz (1 605 kHz in Region 2)</i></p> <p><i>Broadcasting stations</i></p>	<p>10 Hz</p> <p>(WRC-03)</p>
<p><i>Band: 1 606.5 kHz (1 605 kHz in Region 2) to 4 000 kHz</i></p> <p>1 <i>Fixed stations:</i></p> <ul style="list-style-type: none"> <li>– power 200 W or less</li> <li>– power above 200 W</li> </ul> <p>2 <i>Land stations:</i></p> <ul style="list-style-type: none"> <li>– power 200 W or less</li> <li>– power above 200 W</li> </ul>	<p>100<sup>7,8</sup></p> <p>50<sup>7,8</sup></p> <p>100<sup>1,2,7,9,10</sup></p> <p>50<sup>1,2,7,9,10</sup></p>

<p style="text-align: center;"><b>Frequency bands (lower limit exclusive, upper limit inclusive) and categories of stations</b></p>	<p style="text-align: center;"><b>Tolerances applicable to transmitters</b></p>
<p><i>Band: 1 606.5 kHz (1 605 kHz in Region 2) to 4 000 kHz (cont.)</i></p> <p>3 <i>Mobile stations:</i></p> <ul style="list-style-type: none"> <li>a) Ship stations</li> <li>b) Survival craft stations</li> <li>c) Emergency position-indicating radiobeacons</li> <li>d) Aircraft stations</li> <li>e) Land mobile stations</li> </ul> <p>4 <i>Radiodetermination stations:</i></p> <ul style="list-style-type: none"> <li>– power 200 W or less</li> <li>– power above 200 W</li> </ul> <p>5 <i>Broadcasting stations</i></p>	<p>40 Hz<sup>3, 4, 12</sup></p> <p>100</p> <p>100</p> <p>100<sup>10</sup></p> <p>50<sup>13</sup></p> <p>20<sup>14</sup></p> <p>10<sup>14</sup></p> <p>10 Hz<sup>15</sup></p>
<p><i>Band: 4 MHz to 29.7 MHz</i></p> <p>1 <i>Fixed stations:</i></p> <ul style="list-style-type: none"> <li>a) Single-sideband and independent-sideband emissions: <ul style="list-style-type: none"> <li>– power 500 W or less</li> <li>– power above 500 W</li> </ul> </li> <li>b) Class F1B emissions</li> <li>c) Other classes of emission: <ul style="list-style-type: none"> <li>– power 500 W or less</li> <li>– power above 500 W</li> </ul> </li> </ul> <p>2 <i>Land stations:</i></p> <ul style="list-style-type: none"> <li>a) Coast stations</li> <li>b) Aeronautical stations: <ul style="list-style-type: none"> <li>– power 500 W or less</li> <li>– power above 500 W</li> </ul> </li> <li>c) Base stations</li> </ul> <p>3 <i>Mobile stations:</i></p> <ul style="list-style-type: none"> <li>a) Ship stations: <ul style="list-style-type: none"> <li>1) Class A1A emissions</li> <li>2) Emissions other than Class A1A</li> </ul> </li> <li>b) Survival craft stations</li> <li>c) Aircraft stations</li> <li>d) Land mobile stations</li> </ul> <p>4 <i>Broadcasting stations</i></p> <p>5 <i>Space stations</i></p> <p>6 <i>Earth stations</i></p>	<p>50 Hz</p> <p>20 Hz</p> <p>10 Hz</p> <p>20</p> <p>10</p> <p>20 Hz<sup>1, 2, 16</sup></p> <p>100<sup>10</sup></p> <p>50<sup>10</sup></p> <p>20<sup>7</sup></p> <p>10</p> <p>50 Hz<sup>3, 4, 19</sup></p> <p>50</p> <p>100<sup>10</sup></p> <p>40<sup>20</sup></p> <p>10 Hz<sup>15, 21</sup></p> <p>20</p> <p>20</p>

Frequency bands (lower limit exclusive, upper limit inclusive) and categories of stations	Tolerances applicable to transmitters
<p><i>Band: 29.7 MHz to 100 MHz</i></p> <p>1 <i>Fixed stations:</i></p> <ul style="list-style-type: none"> <li>– power 50 W or less</li> <li>– power above 50 W</li> </ul> <p>2 <i>Land stations</i></p> <p>3 <i>Mobile stations</i></p> <p>4 <i>Radiodetermination stations</i></p> <p>5 <i>Broadcasting stations (other than television)</i></p> <p>6 <i>Broadcasting stations (television sound and vision)</i></p> <p>7 <i>Space stations</i></p> <p>8 <i>Earth stations</i></p>	<p>30</p> <p>20</p> <p>20</p> <p>20<sup>22</sup></p> <p>50</p> <p>2 000 Hz<sup>23</sup></p> <p>500 Hz<sup>24, 25</sup></p> <p>20</p> <p>20</p>
<p><i>Band: 100 MHz to 470 MHz</i></p> <p>1 <i>Fixed stations:</i></p> <ul style="list-style-type: none"> <li>– power 50 W or less</li> <li>– power above 50 W</li> </ul> <p>2 <i>Land stations:</i></p> <ul style="list-style-type: none"> <li>a) <i>Coast stations</i></li> <li>b) <i>Aeronautical stations</i></li> <li>c) <i>Base stations:</i> <ul style="list-style-type: none"> <li>– in the band 100-235 MHz</li> <li>– in the band 235-401 MHz</li> <li>– in the band 401-470 MHz</li> </ul> </li> </ul> <p>3 <i>Mobile stations:</i></p> <ul style="list-style-type: none"> <li>a) <i>Ship stations and survival craft stations:</i> <ul style="list-style-type: none"> <li>– in the band 156-174 MHz</li> <li>– outside the band 156-174 MHz</li> </ul> </li> <li>b) <i>Aircraft stations</i></li> <li>c) <i>Land mobile stations:</i> <ul style="list-style-type: none"> <li>– in the band 100-235 MHz</li> <li>– in the band 235-401 MHz</li> <li>– in the band 401-470 MHz</li> </ul> </li> </ul> <p>4 <i>Radiodetermination stations</i></p> <p>5 <i>Broadcasting stations (other than television)</i></p> <p>6 <i>Broadcasting stations (television sound and vision)</i></p> <p>7 <i>Space stations</i></p> <p>8 <i>Earth stations</i></p>	<p>20<sup>26</sup></p> <p>10</p> <p>10</p> <p>20<sup>28</sup></p> <p>15<sup>29</sup></p> <p>7<sup>29</sup></p> <p>5<sup>29</sup></p> <p>10</p> <p>50<sup>31</sup></p> <p>30<sup>28</sup></p> <p>15<sup>29</sup></p> <p>7<sup>29, 32</sup></p> <p>5<sup>29, 32</sup></p> <p>50<sup>33</sup></p> <p>2 000 Hz<sup>23</sup></p> <p>500 Hz<sup>24, 25</sup></p> <p>20</p> <p>20</p>

<p style="text-align: center;"><b>Frequency bands (lower limit exclusive, upper limit inclusive) and categories of stations</b></p>	<p style="text-align: center;"><b>Tolerances applicable to transmitters</b></p>
<p><i>Band: 470 MHz to 2 450 MHz</i></p> <p>1 <i>Fixed stations:</i></p> <ul style="list-style-type: none"> <li>– power 100 W or less</li> <li>– power above 100 W</li> </ul> <p>2 <i>Land stations</i></p> <p>3 <i>Mobile stations</i></p> <p>4 <i>Radiodetermination stations</i></p> <p>5 <i>Broadcasting stations (other than television)</i></p> <p>6 <i>Broadcasting stations (television sound and vision) in the band 470 MHz to 960 MHz</i></p> <p>7 <i>Space stations</i></p> <p>8 <i>Earth stations</i></p>	<p>100</p> <p>50</p> <p>20 <sup>36</sup></p> <p>20 <sup>36</sup></p> <p>500 <sup>33</sup></p> <p>100</p> <p>500 Hz <sup>24, 25</sup></p> <p>20</p> <p>20</p>
<p><i>Band: 2 450 MHz to 10 500 MHz</i></p> <p>1 <i>Fixed stations:</i></p> <ul style="list-style-type: none"> <li>– power 100 W or less</li> <li>– power above 100 W</li> </ul> <p>2 <i>Land stations</i></p> <p>3 <i>Mobile stations</i></p> <p>4 <i>Radiodetermination stations</i></p> <p>5 <i>Space stations</i></p> <p>6 <i>Earth stations</i></p>	<p>200</p> <p>50</p> <p>100</p> <p>100</p> <p>1 250 <sup>33</sup></p> <p>50</p> <p>50</p>
<p><i>Band: 10.5 GHz to 40 GHz</i></p> <p>1 <i>Fixed station</i></p> <p>2 <i>Radiodetermination stations</i></p> <p>3 <i>Broadcasting stations</i></p> <p>4 <i>Space stations</i></p> <p>5 <i>Earth stations</i></p>	<p>300</p> <p>5 000 <sup>33</sup></p> <p>100</p> <p>100</p> <p>100</p>

### Notes in the table of transmitter frequency tolerances

- <sup>1</sup> For coast station transmitters used for direct-printing telegraphy or for data transmission, the tolerance is:
  - 5 Hz for narrow-band phase-shift keying;
  - 15 Hz for frequency-shift keying for transmitters in use or installed before 2 January 1992;
  - 10 Hz for frequency-shift keying for transmitters installed after 1 January 1992.
- <sup>2</sup> For coast station transmitters used for digital selective calling, the tolerance is 10 Hz. (WRC-03)
- <sup>3</sup> For ship station transmitters used for direct-printing telegraphy or for data transmission, the tolerance is:
  - 5 Hz for narrow-band phase-shift keying;
  - 40 Hz for frequency-shift keying for transmitters in use or installed before 2 January 1992;
  - 10 Hz for frequency-shift keying for transmitters installed after 1 January 1992.
- <sup>4</sup> For ship station transmitters used for digital selective calling, the tolerance is 10 Hz. (WRC-03)
- <sup>5</sup> If the emergency transmitter is used as the reserve transmitter for the main transmitter, the tolerance for ship station transmitters applies.
- <sup>6</sup> (SUP - WRC-03)
- <sup>7</sup> For single-sideband radiotelephone transmitters except at coast stations, the tolerance is:
  - 50 Hz in the bands 1 606.5 (1 605 Region 2)-4 000 kHz and 4-29.7 MHz, for peak envelope powers of 200 W or less and 500 W or less, respectively;
  - 20 Hz in the bands 1 606.5 (1 605 Region 2)-4 000 kHz and 4-29.7 MHz, for peak envelope powers above 200 W and 500 W, respectively.
- <sup>8</sup> For radiotelegraphy transmitters with frequency-shift keying the tolerance is 10 Hz.
- <sup>9</sup> For coast station single-sideband radiotelephone transmitters the tolerance is 20 Hz.
- <sup>10</sup> For single-sideband transmitters operating in the frequency bands 1 606.5 (1 605 Region 2)-4 000 kHz and 4-29.7 MHz which are allocated exclusively to the aeronautical mobile (R) service, the tolerance on the carrier (reference) frequency is:
  - a) for all aeronautical stations, 10 Hz;
  - b) for all aircraft stations operating on international services, 20 Hz;
  - c) for aircraft stations operating exclusively on national services, 50 Hz\*.
- <sup>11</sup> Not used.
- <sup>12</sup> For A1A emissions the tolerance is  $50 \times 10^{-6}$ .
- <sup>13</sup> For transmitters used for single-sideband radiotelephony or for frequency-shift keying radiotelegraphy the tolerance is 40 Hz.
- <sup>14</sup> For radiobeacon transmitters in the band 1 606.5 (1 605 Region 2)-1 800 kHz the tolerance is  $50 \times 10^{-6}$ .

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\* NOTE – In order to achieve maximum intelligibility, it is suggested that administrations encourage the reduction of this tolerance to 20 Hz.

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- 15 For A3E emissions with carrier power of 10 kW or less the tolerance is  $20 \times 10^{-6}$ ,  $15 \times 10^{-6}$  and  $10 \times 10^{-6}$  in the bands 1 606.5 (1 605 Region 2)-4 000 kHz, 4-5.95 MHz and 5.95-29.7 MHz respectively.
- 16 For A1A emissions the tolerance is  $10 \times 10^{-6}$ .
- 17 Not used.
- 18 Not used.
- 19 For ship station transmitters in the band 26 175-27 500 kHz, on board small craft, with a carrier power not exceeding 5 W in or near coastal waters and utilizing F3E and G3E emissions, the frequency tolerance is  $40 \times 10^{-6}$ . (WRC-03)
- 20 The tolerance is 50 Hz for single-sideband radiotelephone transmitters, except for those transmitters operating in the band 26 175-27 500 kHz, and not exceeding a peak envelope power of 15 W, for which the basic tolerance of  $40 \times 10^{-6}$  applies.
- 21 It is suggested that administrations avoid carrier frequency differences of a few hertz, which cause degradations similar to periodic fading. This could be avoided if the frequency tolerance were 0.1 Hz, a tolerance which would be suitable for single-sideband emissions\*.
- 22 For non-vehicular mounted portable equipment with a transmitter mean power not exceeding 5 W, the tolerance is  $40 \times 10^{-6}$ .
- 23 For transmitters of a mean power of 50 W or less operating at frequencies below 108 MHz a tolerance of 3 000 Hz applies.
- 24 In the case of television stations of:
- 50 W (vision peak envelope power) or less in the band 29.7-100 MHz;
  - 100 W (vision peak envelope power) or less in the band 100-960 MHz;
- and which receive their input from other television stations or which serve small isolated communities, it may not, for operational reasons, be possible to maintain this tolerance. For such stations, the tolerance is 2 000 Hz.
- For stations of 1 W (vision peak envelope power) or less, this tolerance may be relaxed further to:
- 5 kHz in the band 100-470 MHz;
  - 10 kHz in the band 470-960 MHz.
- 25 For transmitters for system M (NTSC) the tolerance is 1 000 Hz. However, for low power transmitters using this system Note 24 applies.
- 26 For multi-hop radio-relay systems employing direct frequency conversion the tolerance is  $30 \times 10^{-6}$ .
- 27 Not used.
- 28 For a channel spacing of 50 kHz the tolerance is  $50 \times 10^{-6}$ .
- 29 These tolerances apply to channel spacings equal to or greater than 20 kHz.

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\* NOTE – The single-sideband system adopted for the bands exclusively allocated to HF broadcasting does not require a frequency tolerance less than 10 Hz. The above-mentioned degradation occurs when the ratio of wanted-to-interfering signal is well below the required protection ratio. This remark is equally valid for both double- and single-sideband emissions.

- <sup>30</sup> Not used.
- <sup>31</sup> For transmitters used by on-board communication stations a tolerance of  $5 \times 10^{-6}$  shall apply.
- <sup>32</sup> For non-vehicular mounted portable equipment with a transmitter mean power not exceeding 5 W the tolerance is  $15 \times 10^{-6}$ .
- <sup>33</sup> Where specific frequencies are not assigned to radar stations, the bandwidth occupied by the emissions of such stations shall be maintained wholly within the band allocated to the service and the indicated tolerance does not apply.
- <sup>34</sup> Not used.
- <sup>35</sup> Not used.
- <sup>36</sup> In applying this tolerance administrations should be guided by the latest relevant ITU-R Recommendations.