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| **Recommendation ITU-R SM.1045-1**  **(07/1997)** |
| **Frequency tolerance of transmitters** |
| **SM Series**  **Spectrum management** |

Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

The regulatory and policy functions of the Radiocommunication Sector are performed by World and Regional Radiocommunication Conferences and Radiocommunication Assemblies supported by Study Groups.

# Policy on Intellectual Property Right (IPR)

ITU-R policy on IPR is described in the Common Patent Policy for ITU-T/ITU-R/ISO/IEC referenced in Resolution ITU-R 1. Forms to be used for the submission of patent statements and licensing declarations by patent holders are available from <http://www.itu.int/ITU-R/go/patents/en> where the Guidelines for Implementation of the Common Patent Policy for ITU‑T/ITU‑R/ISO/IEC and the ITU-R patent information database can also be found.

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| Series of ITU-R Recommendations  (Also available online at <http://www.itu.int/publ/R-REC/en>) | |
| **Series** | Title |
| **BO** | Satellite delivery |
| **BR** | Recording for production, archival and play-out; film for television |
| **BS** | Broadcasting service (sound) |
| **BT** | Broadcasting service (television) |
| **F** | Fixed service |
| **M** | Mobile, radiodetermination, amateur and related satellite services |
| **P** | Radiowave propagation |
| **RA** | Radio astronomy |
| **RS** | Remote sensing systems |
| **S** | Fixed-satellite service |
| **SA** | Space applications and meteorology |
| **SF** | Frequency sharing and coordination between fixed-satellite and fixed service systems |
| **SM** | **Spectrum management** |
| **SNG** | Satellite news gathering |
| **TF** | Time signals and frequency standards emissions |
| **V** | Vocabulary and related subjects |

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| ***Note***: *This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.* |

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RECOMMENDATION ITU-R SM.1045-1[[1]](#footnote-1)\*

FREQUENCY TOLERANCE OF TRANSMITTERS

(1994-1997)

Rec. ITU-R SM.1045-1

Scope

This Recommendation provides the values of frequency tolerance of transmitters for frequency bands and categories of stations.

Keywords

Frequency tolerances, transmitter, peak envelope power

The ITU Radiocommunication Assembly,

considering

a) that Appendix 2 to the Radio Regulations (RR) specifies permissible frequency tolerances applicable to certain categories of stations in the frequency range from 9 kHz to 40 GHz;

b) that in many cases tighter frequency tolerances may contribute to a better utilization of the radio-frequency spectrum;

c) that due to technological progress, transmitters with more stringent frequency stability than required by RR Appendix 2, can be manufactured at reasonable costs;

d) that it may be desirable to revise RR Appendix S2;

e) that long-term design objectives for frequency tolerances of transmitters should be developed based on an improvement of radio-frequency spectrum utilization and the operational, technical and economical requirements of the various radio services,

recommends

**1** that the frequency tolerances given in column 1 of Table 1 should be applied for the installation of new stations;

**2** that more stringent values than those given in column 1 of Table 1 should be used when operational and technical reasons require;

**3** that the values given in column 2 of Table 1 for some frequency bands and categories of stations should be taken into consideration as the long-term design objective of transmitters based on advances in technology;

**4** that further studies should be carried out by Radiocommunication Study Groups and administrations to determine long-term objective values of frequency tolerance for frequency bands and categories of stations for which values cannot be set at present in column 2 of Table 1.

TABLE 1

**1** Transmitter frequency tolerance is defined in RR Article 1 and is expressed in parts in 106, unless otherwise   
indicated  10–6.

**2** The power shown for the various categories of stations is the peak envelope power (pep) 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 RR Article 1.

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| Frequency bands |  | Frequency tolerance | |
| (lower limits exclusive, upper  limits inclusive) | Categories of stations | Achievable now (Column 1) | Long-term design  objective (Column 2) |
| 9-1 606.5 kHz | Fixed (9-50 kHz) | 100 |  |
|  | Fixed (50-240 kHz) | 50 |  |
|  | Fixed (240-535 kHz) | 50 | 12 Hz |
|  | Land/coast | 100 (1) |  |

TABLE 1 (*Continued*)

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency bands |  | Frequency tolerance | |
| (lower limits exclusive, upper  limits inclusive) | Categories of stations | Achievable now (Column 1) | Long-term design  objective (Column 2) |
| 9-1 606.5 kHz (*Cont.*) | Land/coast – digital selective calling (DSC) | 10 Hz |  |
|  | Land/aeronautical | 100 | ( 200 W, 50) |
|  | Mobile/ship, emergency, survival | 20 Hz (2) |  |
|  | Mobile/ship – DSC | 10 Hz |  |
|  | Mobile/aircraft | 100 |  |
|  | Land mobile | 100 | 20 Hz |
|  | Radiodetermination | 100 |  |
|  | Broadcasting | 10 Hz |  |
| 1 606.5-4 000 kHz | Fixed | 15 |  |
|  | Fixed – single sideband (SSB) radiotelephony | 20 Hz |  |
|  | Fixed – frequency shift keying (FSK) radiotelegraphy and data transmission | 10 Hz |  |
|  | Land/coast, aeronautical, base | 50 ( 200 W, 100)  (1) | 50 |
|  | Land/coast, base – SSB radiotelephony | 20 Hz |  |
|  | Land/coast – DSC | 10 Hz |  |
|  | Land/aeronautical – SSB | 10 Hz |  |
|  | Mobile/ship | 20 Hz (A1A, 50)  (2) |  |
|  | Mobile/ship – DSC | 10 Hz |  |
|  | Mobile/survival | 20 Hz |  |
|  | Mobile/aircraft, emergency position-indicating radiobeacons (EPIRBs) | 100 | 50 |
|  | Mobile/aircraft – SSB | 20 Hz |  |
|  | Mobile/land | 50 |  |
|  | Mobile/land – SSB radiotelephony, FSK radiotelegraphy | 40 Hz |  |
|  | Radiodetermination | 10 ( 200 W, 20) |  |
|  | Broadcasting | 10 Hz |  |
| 4-29.7 MHz | Fixed | 10 |  |
|  | Fixed – SSB radiotelephony | 20 Hz |  |
|  | Fixed – radio telegraphy and data transmission | 10 Hz |  |
|  | Land/coast | 20 Hz (1) |  |
|  | Land/coast – A1A | 10 |  |
|  | Land/coast – DSC | 10 Hz |  |
|  | Land/aeronautical | 50 ( 500 W, 100) |  |
|  | Land/aeronautical – SSB | 10 Hz |  |
|  | Land/base | 20 |  |
|  | Land/base – SSB radiotelephony | 20 Hz ( 500 W, 50 Hz) |  |
|  | Mobile/ship | 50 Hz (2), (3) |  |
|  | Mobile/ship – A1A | 10 |  |
|  | Mobile/ship – DSC | 10 Hz |  |
|  | Mobile/survival | 50 Hz |  |
|  | Mobile/aircraft | 100 |  |

TABLE 1 (*Continued*)

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| --- | --- | --- | --- |
| Frequency bands |  | Frequency tolerance | |
| (lower limits exclusive, upper  limits inclusive) | Categories of stations | Achievable now (Column 1) | Long-term design  objective (Column 2) |
| 4-29.7 MHz (*Cont.*) | Mobile/aircraft – SSB | 20 Hz |  |
|  | Mobile/land mobile | 40 (4) |  |
|  | Broadcasting | 10 Hz (5) |  |
|  | Earth | 20 |  |
|  | Space | 20 |  |
| 29.7-108 MHz | Fixed | 20 ( 50 W, 30) |  |
|  | Land | 20 |  |
|  | Mobile | 20 (portables  5 W, 40) | 12 |
|  | Radiodetermination | 50 |  |
|  | Broadcasting – sound | 2 kHz ( 50 W, 3 kHz) |  |
|  | Broadcasting – TV (vision and sound) | 1 kHz (6) |  |
|  | Earth | 20 |  |
|  | Space | 20 |  |
| 108-470 MHz | Fixed | 5 |  |
|  | Fixed multi-hop radio-relay with direct frequency conversion | 15 |  |
|  | Land/coast | 5 ( 3 W, 10) |  |
|  | Land/aeronautical | 20 |  |
|  | Land/base | 5 | 5 (7) |
|  | Mobile/ship | 10 |  |
|  | Mobile/ship on-board outside 156-174 MHz | 5 |  |
|  | Mobile/survival | 50 (156-174 MHz, 10) |  |
|  | Mobile/aircraft | 30 (channels, 50 kHz, 50) | 10 |
|  | Mobile/land mobile | 5 (portables  5 W, 15) | 5 (7) |
|  | Radiodetermination | 50  (108-117,975 MHz, 20)  (8) |  |
|  | Broadcasting – digital sound | 1 |  |
|  | Broadcasting – TV (vision and sound) | 1 kHz (6) |  |
|  | Earth | 20 |  |
|  | Space | 20 |  |
| 470-960 MHz | Fixed | 15 | 5 |
|  | Land | 5 | 2.5 (7) |
|  | Mobile | 5 ( 3 W, 15) | 2.5 (7) |
|  | Mobile/aircraft | 20 |  |
|  | Radiodetermination | 500 (8) |  |
|  | Broadcasting – TV (vision and sound) | 1 kHz (6) |  |
|  | Earth | 20 | 10 |
|  | Space | 20 |  |
| 960-1 215 MHz | Aeronautical radionavigation/land, ship | 20 (9) |  |
|  | Aeronautical radionavigation/aircraft | 50 (9) |  |

TABLE 1 (*end*)

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| --- | --- | --- | --- |
| Frequency bands |  | Frequency tolerance | |
| (lower limits exclusive, upper  limits inclusive) | Categories of stations | Achievable now (Column 1) | Long-term design  objective (Column 2) |
| 1 215-2 450 MHz | Fixed | 50 | 15 (10) |
|  | Land | 20 |  |
|  | Mobile | 20 |  |
|  | Radiodetermination | 500 (8) |  |
|  | Broadcasting – terrestrial digital sound | 1 |  |
|  | Earth | 20 | 10 |
|  | Space | 20 |  |
| 2 450 MHz-10.5 GHz | Fixed | 50 | 30 |
|  | Land | 50 |  |
|  | Mobile | 50 |  |
|  | Radiodetermination | 1 250 (8) |  |
|  | Earth | 50 | 10 |
|  | Space | 50 | 20 |
| 10.5-30 GHz | Fixed | 100 | The frequency tolerance should not be higher than 2% of the bandwith occupied by the emission |
|  | Land | 100 |
|  | Mobile | 100 |
|  | Radiodetermination | 5 000 (8) |
|  | Broadcasting | 100 |
|  | Earth | 100 |
|  | Space | 100 |
| 30-275 GHz | Fixed | 150 |
|  | Land | 150 |
|  | Mobile | 150 |
|  | Radiodetermination | 5 000 (8) |
|  | Broadcasting | 100 |
|  | Earth | 100 |
|  | Space | 100 |
| (1) For coast station transmitters used for direct-printing telegraphy or for data transmission, the tolerance is:  – 5 Hz for narrow-band phase-shift keying (PSK);  – 10 Hz for FSK.  (2) For ship station transmitters used for direct-printing telegraphy or for data transmission, the tolerance is:  – 5 Hz for narrow-band PSK  – 10 Hz for FSK.  (3) 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 A3E or F3E and G3E emissions, the frequency tolerance is 40  10–6.  (4) The tolerance is 50 Hz for SSB 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  10–6 applies.  (5) For A3E emissions with carrier power of 10 kW or less the tolerance is 15  10–6 and 10  10–6 in the bands 4-5.90 MHz and 5.90-29.7 MHz respectively. | | | |

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| (6) For the case when an offset is used, the frequency tolerance is 500 Hz. For the case when precision offset is used the frequency tolerance of the vision carrier is 1Hz.  (7) The long term design objective for channel spacing of 12.5 kHz and below is 3  10–6 in frequency bands between 400 and 470 MHz and 1.5  10–6 for frequency bands between 470 and 960 MHz.  (8) 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.  (9) The tolerance for selective identification features (SIF) of secondary surveillance radar (SSR) interrogators is 200 kHz, and for SIF-SSR transponders 3 MHz.  (10) The long term design objective for digital radio-relay systems with a capacity higher than 10 Mbit/s is 30  10–6. |

1. \* Radiocommunication Study Group 1 made editorial amendments to this Recommendation in the years 2017 and 2019 in accordance with Resolution ITU-R 1. [↑](#footnote-ref-1)