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| **Recommendation ITU-R M.1732-1**  **(03/2012)** |
| **Characteristics of systems operating in the amateur and amateur-satellite services for use in sharing studies** |
| **M Series**  **Mobile, radiodetermination, amateur**  **and related satellite services** |

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 Annex 1 of 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 |
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| M | Mobile, radiodetermination, amateur and related satellite services |
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| **RA** | Radio astronomy |
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| **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 M.1732-1[[1]](#footnote-1)\*

Characteristics of systems operating in the amateur  
and amateur-satellite services for use in sharing studies

(Question ITU-R 48-6/5)

(2005-2012)

Scope

This Recommendation documents the technical and operational characteristics of systems used in the amateur service and amateur-satellite services for the purposes of carrying out sharing studies. The systems and their characteristics described in this Recommendation are considered representative of those operating in the frequency bands available to these services ranging from 135.7 kHz through 81.5 GHz.

The ITU Radiocommunication Assembly,

considering

a) that the Radio Regulations (RR) defines an amateur service and an amateur-satellite service and allocates frequencies to them on an exclusive or shared basis;

b) that systems in the amateur and amateur-satellite services operate over a wide range of frequencies;

c) that the technical characteristics of systems operating in the amateur and amateur-satellite services may vary within a band;

d) that some ITU-R technical groups are considering the potential for the introduction of new types of systems or services in bands used by systems operating in the amateur and amateur-satellite services;

e) that representative technical and operational characteristics of systems operating in the amateur and amateur-satellite services are required to determine the feasibility of introducing new types of systems into frequency bands in which the amateur and amateur-satellite services operate,

recommends

**1** that the technical and operational characteristics of systems operating in the amateur and amateur-satellite services described in Annex 1 should be considered representative of those operating in the frequency bands allocated to the amateur and amateur-satellite services;

**2** that Recommendation ITU-R M.1044 should be used as a guide in studies of the compatibility between systems operating in the amateur and amateur-satellite services and systems operating in other services.

Annex 1  
  
Characteristics of systems operating in the amateur  
and amateur-satellite services for use in sharing studies

# 1 Introduction

A number of frequency bands are allocated to the amateur and amateur-satellite services throughout the spectrum. These bands have been selected to provide different propagation conditions.

Amateur and amateur-satellite stations perform a variety of functions, such as:

– training, intercommunication between amateur stations and technical investigations by duly authorized persons interested in radio technique solely with a personal aim and without pecuniary interest (RR Nos. 1.56 and 1.57);

– disaster relief communications as elaborated in Recommendation ITU-R M.1042.

# 2 Operational characteristics

Amateur stations and amateur-satellite earth stations generally do not have assigned frequencies but dynamically select frequencies within an allocated band using listen-before-talk techniques. Terrestrial repeaters, digital relay stations and amateur satellites use frequencies selected on the basis of voluntary coordination within the amateur services. Some amateur frequency allocations are exclusive to the amateur and amateur-satellite services. Many of the allocations are shared with other radio services and amateur operators are aware of the sharing limitations.

Communications may be initiated on prearranged schedule or by one station initiating a general or specific call. One or more stations may respond. Formal and informal nets may be initiated as needed. Contacts may last from about 1 min to about 1 h, depending on traffic to be transmitted.

Operating protocols vary according to communication requirements and propagation. MF and HF bands are used for near-vertical-incidence-sky wave to global paths. VHF, UHF and SHF bands are used for short-range communications. Amateur satellites afford an opportunity to use frequencies above HF for long-distance communications.

# 3 Technical characteristics

Tables 1 to 6 contain technical characteristics of representative systems operating in the amateur and amateur-satellite services. This information is sufficient for general calculation to assess the compatibility between these systems and systems operating in other services. The upper frequency boundaries shown in Tables 1 to 6 represent the current state of deployment of most amateur radio systems. The characteristics are expected to be extended to higher frequencies (up to 250 GHz) over time.

TABLE 1

Characteristics of amateur systems for Morse on-off keying

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Value | | | | | | | |
| Mode of operation | Continuous wave (CW) Morse 10‑50 Bd | | | | Continuous wave (CW) Morse < 20 Bd (Earth-moon-Earth) | | | Slow Morse ≤ 1 Bd CW |
| Frequency band (MHz)(1) | 1.8-7.3 | 10.1-29.7 | 50-450 | 902-81 500 | 144 | 432 | 1 296 | 0.136 |
| Necessary bandwidth and class of emission (emission designator) | 150HA1A 150HJ2A | 150HA1A 150HJ2A | 150HA1A 150HJ2A | 150HA1A 150HJ2A | 50H0A1A 50H0J2A | 50H0A1A 50H0J2A | 50H0A1A 50H0J2A | 1H00A1B 1H00J2B |
| Transmitter power (dBW)(2) | 3‑31.7 | 3‑31.7 | 3‑31.7 | 3‑31.7 | 3‑31.7 | 3‑31.7 | 17‑31.7 | 23 |
| Transmitter line loss (dB) | 0.2 | 0.3‑0.9 | 1‑2 | 0-10 | 1‑2 | 1‑2 | 1-4 | 0.0 |
| Transmitting antenna gain (dBi) | −20 to 15 | −10 to 21 | 0‑26 | 10-42 | 20‑26 | 20‑26 | 25-40 | −22 |
| Typical e.i.r.p. (dBW) | −17.2 to 46.5 | −7.3 to 52.4 | 2‑55 | 1-45 | 38‑55 | 38‑55 | 68 | 1 |
| Antenna polarization | Horizontal,vertical | Horizontal, vertical | Horizontal | Horizontal,vertical | Horizontal | Horizontal, vertical, LHCP, RHCP | Horizontal, vertical, LHCP, RHCP | Vertical |
| Receiver IF bandwidth (kHz) | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Receiver noise figure (dB)(3) | 13 | 7‑13 | 0.5‑2 | 1-7 | 0.5 | 0.5 | 0.5 | 13 |
| (1) With the exception of the band around 0.136 MHz, the amateur bands within the frequency ranges shown conform to RR Article 5.  (2) Maximum powers are determined by each administration.  (3) Receiver noise figures for bands above 50 MHz assume the use of low-noise preamplifiers.  LHCP: left-hand circular polarization  RHCP: r ight-hand circular polarization | | | | | | | | |

TABLE 2

Characteristics of amateur systems for narrow-band direct printing telegraphy and data

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | Value | | | | | |
| Mode of operation(1) | PSK31 31 Bd | NBDP 50 Bd | PACTOR 2 | PACTOR 3 | CLOVER 2000 | MFSK16 |
| Frequency band (MHz)(2) | 1.8‑29.7 | 1.8‑29.7 | 1.8‑29.7 | 1.8‑29.7 | 1.8‑29.7 | 1.8‑29.7 |
| Necessary bandwidth and class of emission (emission designator) | 60H0J2B | 250HF1B | 375HJ2D | 2K20J2D | 2K00J2D 2K00J2B | 316HJ2D 316HJ2B |
| Transmitter power (dBW)(3) | 3‑31.7 | 3‑31.7 | 3‑31.7 | 3‑31.7 | 3‑31.7 | 3‑31.7 |
| Feeder loss (dB) | 0.2‑0.9 | 0.2‑0.9 | 0.2‑0.9 | 0.2‑0.9 | 0.2‑0.9 | 0.2‑0.9 |
| Transmitting antenna gain (dBi) | −20 to 21 | −20 to 21 | −20 to 21 | −20 to 21 | −20 to 21 | −20 to 21 |
| Typical e.i.r.p. (dBW) | −17.2 to 52.5 | −17.2 to 52.5 | −17.2 to 52.5 | −17.2 to 52.5 | −17.2 to 52.5 | −17.2 to 52.5 |
| Antenna polarization | Horizontal, vertical | Horizontal,  vertical | Horizontal, vertical | Horizontal,  vertical | Horizontal, vertical | Horizontal, vertical |
| Receiver IF bandwidth (kHz) | 0.5 | 0.5 | 0.5 | 2.7 | 2.4 | 0.5 |
| Receiver noise figure (dB)(4) | 7-13 | 7-13 | 7-13 | 7-13 | 7-13 | 7-13 |
| (1) PSK31 is a data system using phase shift keying (PSK) at 31.1 bauds. PACTOR 2 is a data system using differential PSK (DPSK) modulation with rates varying according to conditions. PACTOR 3 is a data system with a potential throughput of up to 5.2 kbit/s. CLOVER 200 is a digital data system capable of rates up to 5.2 kbit/s. MFSK16 is a data system using 16-tone frequency shift keying (FSK) and forward error correction (FEC).  Further information about these modes of operation can be obtained from the ARRL HF Digital Handbook (4th Ed.), American Radio Relay League, ISBN: 0‑87259‑103-4, published 2008.  (2) Amateur bands within the frequency ranges shown conform to RR Article 5.  (3) Maximum powers are determined by each administration.  (4) Receiver noise figures for bands above 50 MHz assume the use of low-noise preamplifiers. | | | | | | |

TABLE 3

Characteristics of amateur analogue voice systems

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | Value | | | | | |
| Mode of operation | Single side-band (SSB) voice | | | | FM voice | |
| Frequency band (MHz)(1) | 1.8‑7.3 | 10.1‑29.7 | 50‑450 | 902‑81 500 | 50‑450 | 902‑81 500 |
| Necessary bandwidth and class of emission (emission designator) | 2K70J3E | 2K70J3E | 2K70J3E | 2K70J3E | 11K0F3E 16K0F3E 20K0F3E | 11K0F3E 16K0F3E 20K0F3E |
| Transmitter power (dBW)(2) | 3‑31.7 | 3‑31.7 | 3‑31.7 | 3‑31.7 | 3‑31.7 | 3‑31.7 |
| Feeder loss (dB) | 0.2 | 0.3‑0.9 | 1‑2 | 0-10 | 1‑2 | 0-10 |
| Transmitting antenna gain (dBi) | −20 to 15 | −10 to 21 | 0‑23 | 0-42 | 0‑26 | 0-42 |
| Typical e.i.r.p. (dBW) | −16.8 to 46.5 | −7.3 to 52.4 | 2‑53.7 | 1-45 | 2‑55 | 1-45 |
| Antenna polarization | Horizontal, vertical | Horizontal, vertical | Horizontal, vertical | Horizontal, vertical | Horizontal, vertical | Horizontal, vertical |
| Receiver IF bandwidth (kHz) | 2.7 | 2.7 | 2.7 | 2.7 | 9 15 | 9 15 |
| Receiver noise figure (dB)(3) | 13 | 7-13 | 0.5-2 | 1-7 | 0.5‑2 | 1-7 |
| (1) Amateur bands within the frequency ranges shown conform to RR Article 5.  (2) Maximum powers are determined by each administration.  (3) Receiver noise figures for bands above 50 MHz assume the use of low-noise preamplifiers. | | | | | | |

TABLE 4

Characteristics of amateur digital voice and multimedia systems

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | Value | | | | |
| Mode of operation | Digital voice | | | Digital voice and multimedia | |
| Frequency band (MHz)(1) | 1.8‑7.3 | 10.1-29.7 | 50-450 | 1 240-1 300 | 5 650-10 500 |
| Necessary bandwidth and class of emission (emission designator) | 2K70J2E | 2K70J2E | 2K70J2E 5k76G1E 8K10F1E | 2K70G1D 6K00F7D 16K0D1D 150KF1W | 2K70G1D 6K00F7D 16K0D1D 150KF1W 10M5F7W |
| Transmitter power (dBW)(2) | 3‑31.7 | 3‑31.7 | 3-31.7 | 1-10 | 3 |
| Feeder loss (dB) | 0.2 | 0.3‑0.9 | 1-2 | 1-3 | 1-6 |
| Transmitting antenna gain (dBi) | −20 to 15 | −10 to 21 | 0-26 | 30 | 36 |
| Typical e.i.r.p. (dBW) | −16.8 to 46.5 | −7.3 to 52.4 | 2-55 | 39 | 38 |
| Antenna polarization | Horizontal, vertical | Horizontal, vertical | Horizontal | Horizontal, vertical | Horizontal, vertical |
| Receiver IF bandwidth (kHz) | 2.7 | 2.7 | 2.7 5.76 8.1 | 2.7, 6, 16, 130 | 2.7, 6, 16, 130, 10 500 |
| Receiver noise figure (dB)(3) | 13 | 7-13 | 1 | 2 | 2 |
| (1) Amateur bands within the frequency ranges shown conform to RR Article 5.  (2) Maximum powers are determined by each administration.  (3) Receiver noise figures for bands above 50 MHz assume the use of low-noise preamplifiers. | | | | | |

TABLE 5

Characteristics of amateur~~-~~satellite systems in the Earth-to-space direction

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Mode of operation | CW Morse, 10‑50 Bd | | | SSB voice, digital voice, FM voice, data | | |
| Frequency band (MHz)(1) | 28 | 144-5 670 | 10 450-24 050 | 28 | 144-5 670 | 10 450-24 050 |
| Necessary bandwidth and class of emission (emission designator) | 150HA1A 150HJ2A | 150HA1A 150HJ2A | 150HA1A 150HJ2A | 2K70J3E 2K70J2E 16K0F3E | 2K70J3E 16K0F3E 44K2F1D 88K3F1D | 2K70J3E 16K0F3E 44K2F1D 88K3F1D |
| Transmitter power (dBW)(2) | 0-20 | 0-20 | 0-13 | 0-20 | 0-20 | 0-13 |
| Feeder loss (dB) | 0.2-1.5 | 0.2-3 | 0.2-3 | 0.2-1.5 | 0.2-3 | 0.2-3 |
| Transmitting antenna gain (dBi) | –2 to 10 | –2 to 27 | –2 to 31 | –2 to 10 | –2 to 27 | –2 to 31 |
| Typical e.i.r.p. (dBW) | 10-29 | 10-45 | 10-42 | 10-29 | 10-45 | 10-42 |
| Antenna polarization | Horizontal, vertical, RHCP, LHCP | Horizontal, vertical, RHCP, LHCP | Horizontal, vertical, RHCP, LHCP | Horizontal, vertical, RHCP, LHCP | Horizontal, vertical, RHCP, LHCP | Horizontal, vertical, RHCP, LHCP |
| Receiver IF bandwidth (kHz) | 0.4 | 0.4 | 0.4 | 2.7 16 | 2.7, 16, 50, 100 | 2. 7, 16, 50, 100 |
| Receiver noise figure (dB)(3) | 3-10 | 1-3 | 1-7 | 3-10 | 1-3 | 1-7 |
| (1) Amateur bands within the frequency ranges shown conform to RR Article 5.  (2) Maximum powers are determined by each administration.  (3) Receiver noise figures for bands above 50 MHz assume the use of low-noise preamplifiers. | | | | | | |

TABLE 6

Characteristics of amateur~~-~~satellite systems in the space-to-Earth direction

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Mode of operation | CW Morse, 10‑50 Bd | | | SSB voice, digital voice, FM voice, data | | |
| Frequency band (MHz)(1) | 28 | 144-5 850 | 10 450-24 050 | 28 | 144-5 850 | 10 450-24 050 |
| Necessary bandwidth and class of emission (emission designator) | 150HA1A 150HJ2A | 150HA1A 150HJ2A | 150HA1A 150HJ2A | 2K70J3E 2K70J2E 16K0F3E | 2K70J3E 16K0F3E 44K2F1D 88K3F1D | 2K70J3E 16K0F3E 44K2F1D 88K3F1D |
| Transmitter power (dBW)(2) | 10 | 10 | 10 | 10 | 10 | 0-10 |
| Feeder loss (dB) | 0.2-1 | 0.2-1 | 0.2-1 | 0.2-1 | 0.2-1 | 0.2-1 |
| Transmitting antenna gain (dBi) | 0 | 0-6 | 0-6 | 0 | 0 | 0-6 |
| Typical e.i.r.p. (dBW) | 9 | 9-15 | 9-15 | 9 | 9-15 | 9-15 |
| Antenna polarization | Horizontal, vertical, RHCP, LHCP | Horizontal, vertical, RHCP, LHCP | Horizontal, vertical, RHCP, LHCP | Horizontal, vertical, RHCP, LHCP | Horizontal, vertical, RHCP, LHCP | Horizontal, vertical, RHCP, LHCP |
| Receiver IF bandwidth (kHz) | 0.4 | 0.4 | 0.4 | 2.7, 16 | 2.7, 16, 50, 100 | 2.7, 16, 50, 100 |
| Receiver noise figure (dB)(3) | 3-10 | 1-3 | 1-7 | 3-10 | 1-3 | 1-7 |
| (1) Amateur bands within the frequency ranges shown conform to RR Article 5.  (2) While total transmitter power of 20 dB is assumed, 10 dBW is used as power is shared among signals in passband.  (3) Receiver noise figures for bands above 50 MHz assume the use of low-noise preamplifiers. | | | | | | |

1. \* This Recommendation should be brought to the attention of Radiocommunication Study Group 1. [↑](#footnote-ref-1)