International Telecommunication Union

ITU-R

Radiocommunication Sector of ITU

Recommendation ITU-R BT.1871-3

(01/2022)

User requirements for wireless microphones, in-ear monitoring devices and wireless multi-channel audio systems

BT Series

Broadcasting service (television)

International Telecommunication Union

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.

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

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

Electronic Publication
Geneva, 2022

RECOMMENDATION ITU-R BT.1871-3

User requirements for wireless microphones, in-ear monitoring devices and wireless multi-channel audio systems

(Question ITU-R 121/6)

(2010-2015-2017-2022)

Scope

This Recommendation deals with user requirements for wireless microphones, In-Ear Monitoring (IEM) devices and systems combining both, known as Wireless Multi-Channel Audio System (WMAS). This Recommendation is using the term ‘wireless microphone’, which covers all three types of devices. It contains typical system parameters and operational requirements for analogue and digital wireless microphones, which may be used by administrations and broadcasters when planning tuning ranges within the frequency bands allocated to broadcasting, fixed and mobile service.

Keywords

SAB/SAP, PMSE, ENG, IEM, WMAS, wireless microphones

The ITU Radiocommunication Assembly,

considering

a) that separate applications exist for broadcast and non-broadcast use of wireless microphones;

b) that separate usage scenarios exist for news, sports, drama, light entertainment, studio and non-studio programme production within broadcasting use of wireless microphones;

c) that there is a requirement within a wireless microphone system to assign a range of selectable frequencies to each system to permit frequency management and mitigate interference;

d) that wireless microphones are currently assigned frequencies in bands allocated to the mobile service in Region 3 and those allocated to the broadcasting service in Regions 1 and 2, and many administrations are undertaking the transition from analogue to digital terrestrial television broadcasting;

e) that RR No. **5.296** provides an ecosystem for wireless microphone operations;

f) that wireless microphone systems are used in many countries, and are deployed for television production in other countries by national broadcasting organizations;

g) that many administrations use TV Bands IV and V, which are also allocated to the mobile service in Region 3, as tuning ranges for professional wireless microphones;

h) that it is desirable to minimize the potential for interference in these systems, while minimizing frequency management resource requirements, mitigating interference and increasing global harmonization of the selectable frequencies;

i) that spectrum/frequency bands as listed in Table 2 in Annex 1 are available on national level only for ENG/PMSE[1] use,

[1] PMSE refers to programme making and special events, also known as SAB/SAP.

recommends

1 that the description of the user requirements and key characteristics of analogue and digital wireless microphones, in-ear monitoring (IEM) devices and wireless multi-channel audio system (WMAS) in Annex 1 should be referred to by administrations seeking to operate these applications in the frequency bands indicated;

2 that the tuning ranges and licensing arrangements for analogue and digital wireless microphones in Annex 2 should be referred to by PMSE users (e.g. administrations, broadcasters, and programme producers) seeking information.

Annex 1

User requirements for wireless microphones, in-ear monitoring (IEM) devices and wireless multi-channel audio system (WMAS)

Table 1 provides the description of the user requirements and key characteristics of analogue and digital wireless microphones, in-ear monitoring (IEM) devices and the combination of both, known as wireless multi-channel audio system (WMAS) which should be referred to by administrations seeking to operate these applications.

TABLE 1

User requirements for radio/wireless microphones, IEM devices and WMAS

Characteristics	Wireless microphone	IEM	WMAS
Application	Voice (speech, song), music instruments	Voice or mixed feedback to stage	Multi-channel: voice (speech, song), music instruments, intercom and mixed feedback to stage
Fixed Part			
Function	Receiver	Transmitter	Transceiver
Placement	Fixed base Rack mounted	Fixed base Rack mounted	Fixed base Rack mounted
Power source	AC mains	AC mains	AC mains
Audio input	-	Line in, Network	AES10, Network
Audio output	Line out, Network	-	AES10, Network
Portable Part			
Function	Transmitter	Receiver	Transceiver
Placement	Body worn Handheld Camera mounted	Body worn	Body worn Handheld Camera mounted
Power source	Battery	Battery	Battery

TABLE 1 (*cont.*)

Characteristics	Wireless microphone	IEM	WMAS
Audio input	Microphone	-	Microphone and/or Line in (Note 1)
Audio output	-	Earphones	Earphones and/or Line out (Note 1)
Radio interface characteristics			
System approach	Link based	Link based	System based
Audio plane	Uni-directional	Uni-directional	Multiple bi-directional
Control plane	Zigbee-like, Bluetooth, IrDA	Zigbee-like, Bluetooth IrDA	Multiple bi-directional as part of WMAS
Modulation	digital modulation or FM wideband	FM wideband	Digital wideband modulation, combined with suitable duplex and multiple access scheme
Duty cycle	Constant, up to 100% occupancy in time per device	Constant, 100% occupancy in time per device	Constant, up to 100% occupancy in time due to scheduling measures of system
RF output power	Typical 10 mW to 100 mW	Typical 10 mW to 100 mW	Typical 10 mW to 100 mW
Max. occupied RF bandwidth	Typical: ≤ 200 kHz Note 2	Typical: ≤ 200 kHz Note 2	Typical See Note 2
Typical audio link or audio channel per MHz	1.5 to 3 Note 3	1 to 1.5	up to 8+ audio channels with arbitrary direction, Note 4
Arrangement of audio quality, range, latency	Selectable modes, if digital	Fixed	Flexible setup per audio channel, up to studio quality
General			
Typical audio frequency response	20 Hz to 20 000 Hz, fixed	20 Hz to 20 000 Hz, fixed	20 Hz to 20 000 Hz, configurable
Audio mode(s)	Mono	MPX-Stereo Dual Mono	Mono Stereo Dual Mono
Typical link latency (audio input to audio output)	Analogue: ~ 0 ms Digital: 2 to 3.5 ms	Analogue: ~ 0 ms Digital: 2 to 3.5 ms	< 1 ms up to 20 ms Configurable per audio channel

TABLE 1 (*end*)

Characteristics	Wireless microphone	IEM	WMAS
Battery operation time	5 to 10 h	5 to 10 h	5 to 10 h

Note 1: Portable may integrate audio input, audio output or both in one device. Line In/Line out might be provided.

Note 2: EN 300 422 allows channel bandwidths from 50 to 600 kHz; allows up to 20 MHz for WMAS.

Note 3: Digital modulation with Link density modes can deliver up to 7.8 audio links/MHz by restricting audio quality and range. Therefore, only employed if not enough spectrum resources are available.

Note 4: Depending on per audio channel configured audio quality, latency and coverage. EN 300 422 requires the support of at least one mode with in minimum three audio channels/MHz.

Annex 2

Tuning ranges of wireless microphones, in-ear monitoring (IEM) devices and wireless multi-channel audio system (WMAS)

The tuning ranges of wireless microphones, IEM devices and WMAS are intended to guide administrations and broadcasters seeking to operate analogue and digital wireless microphones and when considerations are made to frequency sharing with other services.

Table 2 provides frequency bands and licensing arrangements within some administrations.

TABLE 2

Frequency bands and licensing arrangements

Country	Frequency tuning range	Licensing arrangement(s)	Note
Australia	VHF Band III – 174-230 MHz	Class license permits up to 3 mW e.i.r.p. (note an increase to 50 mW e.i.r.p. is under consideration) Australian standard AS/NZS 4268 (1) on short-range devices specifies 0.1 µW for spurious emission level into an adjacent channel	
	520-694 MHz	Up to 100 mW e.i.r.p. Some (much less commonly used) apparatus licensing for higher powered uses up to 250 mW e.i.r.p. (for digital systems) Australian standard AS/NZS 4268 (1) on short-range devices specifies 0.1 µW for spurious emission level into an adjacent channel.	

TABLE 2 (*cont.*)

Country	Frequency tuning range	Licensing arrangement(s)	Note
	1 785-1 800 MHz	The maximum e.i.r.p. is 100 mW Transmitters must not be operated on frequencies within 1 MHz of 1 785 MHz and transmitters using frequencies below 1 790 MHz must only be used indoors. These proposed limitations on 4 MHz of the proposed additional permitted operating frequency band are to provide for co-existence with adjacent services. Australian standard AS/NZS 4268 (1) on short-range devices specifies 0.1 µW for spurious emission level into an adjacent channel	
Japan (2)	74.58-74.76 MHz (3)	Maximum antenna input power: 10 mW (for analogue systems) Unlicensed (4) Coordination not required.	IEM
	322.025-322.150 MHz (3) 322.250-322.400 MHz (3)	Maximum antenna input power: 1 mW (for analogue systems) Unlicensed (4) Coordination not required.	Wireless microphone IEM
	470-714 MHz (5)	Maximum antenna input power: 10 mW (for analogue system) 50 mW (for digital system) Unlicensed (4) Coordination required.	Wireless microphone IEM
	806.125-809.750 MHz (3)	Maximum antenna input power: 10 mW (for analogue/ digital systems) Unlicensed (4) Coordination not required.	Wireless microphone IEM
	1 240-1 252 MHz (6) 1 253-1 260 MHz (6)	Maximum antenna input power: 50 mW (for analogue/digital systems) Licenced (4) Coordination required.	Wireless microphone
	1 895.616-1 904.256 MHz (7)	Maximum antenna input power: 240 mW (for digital systems) Unlicensed (4) Coordination not required.	IEM

TABLE 2 (*cont.*)

Country	Frequency tuning range	Licensing arrangement(s)	Note
France [8]	174–223 MHz [9]	e.r.p. max = 50 mW (17 dBm)	
	470-694 MHz [9]	e.r.p. max = 50 mW (17 dBm)	
	694-790 MHz [9]	until 01/07/19, depending on the area e.i.r.p. max = 13 to 19 dBm/200 kHz [10]	
	823-832 MHz [9]	See 2014/641/EU	
	863-865 MHz	e.r.p. max = 10 mW, see ARCEP decision 2014-1263	
	1 785-1 805 MHz [9]	Secondary usage e.i.r.p. max = 20 up to 50 mW	
Korea	72.610-73.910 MHz, 74.000-74.800 MHz, 75.620-75.790 MHz	10 mW e.r.p. and BW up to 60 kHz	
	173.020-173.280 MHz, 217.250-220.110 MHz, 223.000-225.000 MHz	10 mW e.r.p. and BW up to 200 kHz	
	470-698 MHz	250 mW e.r.p. and BW up to 200 kHz (for SAB/SAP and licensed only)	
	925.000-937.500 MHz	10 mW e.r.p. and BW up to 200 kHz	
Canada [11]	26.10-26.48 MHz 88-107.5 MHz	1 W e.r.p. and BW up to 200 kHz	
	450-451 MHz 455-456 MHz	1 W e.r.p. and BW up to 200 kHz, only for auxiliary-to-broadcast use	
	54-72 MHz 76-88 MHz 174-216 MHz	Maximum antenna input power: 50 mW BW up to 200 kHz	
	150-174 MHz	Maximum antenna input power: 50 mW BW up to 54 kHz	
	470-608 MHz 614-698 MHz	Maximum antenna input power: 50 mW BW up to 200 kHz	
Germany	32.475-38.125 MHz	10/50 mW e.r.p. [12] [13]	
	174-230 MHz	50 mW e.r.p., channel raster 25 kHz [13]	
	470-608 MHz, 614-694 MHz 733-758 MHz	50 mW e.r.p., channel raster 25 kHz [13]	
	823-832 MHz	82/100 mW e.i.r.p. [12]	
	863-865 MHz	10 mW e.r.p., BW up to 200 / 300 kHz [12]	
	1 350-1 400 MHz	50 mW e.i.r.p., indoor only [13]	
	1 452-1 492 MHz	50 mW e.i.r.p. [13]	
	1 492-1 518 MHz	50 mW e.i.r.p., indoor only [13]	
	1 785-1 805 MHz	82 mW e.i.r.p. [12]	

TABLE 2 (*cont.*)

Country	Frequency tuning range	Licensing arrangement(s)	Note
United States of America	26.1-26.48 MHz (VHF)	up to 1 W conducted power and 200 kHz bandwidth	
	161.625-161.775 MHz (VHF)	up to 1 W conducted and 200 kHz bandwidth (not permitted in Puerto Rico and the Virgin Islands)	
	Portions (specific frequencies) of 169-172 MHz band (VHF)	up to 50 mW, up to 200 kHz bandwidth on certain frequencies, up to 54 kHz bandwidth on other specific frequencies	
	88-108 MHz (FM)	Unlicensed, up to 250 µV/m at 3 m, up to 200 kHz bandwidth	
	450-451 MHz, 455-456 MHz (UHF)	up to 1 W conducted power and 200 kHz bandwidth	
	54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz, 614-616 MHz, 653-663 MHz (VHF and UHF)	VHF: up to 50 mW e.i.r.p. (licensed and unlicensed) UHF TV Band (470-608 MHz): up to 250 mW conducted power for licensed operators, 50 mW e.i.r.p. for unlicensed operation. (488-494 not permitted in Hawaii) UHF Guard band (614-616 MHz) and Duplex (653-663 MHz): up to 20 mW e.i.r.p.	
	941.500-952.000 MHz, 952.850-956.250 MHz, 956.45-959.85 MHz (UHF)	up to 1 W conducted power and 200 kHz bandwidth	
	1 435-1 525 MHz	on a secondary basis with prior coordination with the Aerospace and Flight Test Radio Coordinating Council (AFTRCC), up to 250 mW and 200 kHz bandwidth	
	6 875.000-6 900.000 MHz, 7 100.000-7 125.000 MHz	up to 250 mW and 200 kHz bandwidth	
United States of America	902-928 MHz, 2.4 GHz, 5 GHz (ISM bands)	Unlicensed, frequency hopping and digitally modulated systems are permitted to use output powers of up to 1 watt	
	1 920-1 930 MHz (unlicensed PCS)	Unlicensed, indoor operation only, power limits and other restrictions set forth in FCC part 15 subpart D	
	Ultra-wideband (3.1-10.6 GHz)	Unlicensed, indoor operation only, power limits and other restrictions set forth in FCC part 15 subpart F	

Notes to Table 2:

(1) AS/NZS 4268:2012 Radio equipment and systems: Short-range devices – Limits and methods of measurement.

(2) More detailed information can be found in https://www.tele.soumu.go.jp/e/index.htm

(3) Assigned for wireless microphones as Low-Power Service.

(4) Wireless microphones and in-ear-monitors used in Japan shall comply with the technical regulations set by the Administration.

(5) The frequency range 470-710 MHz is used for Digital Terrestrial Television Broadcasting as a primary service and for wireless microphones as a secondary service. The channel arrangement and locations of wireless microphones are regulated by the Administration.

(6) Assigned for wireless microphones as General Service.

(7) Assigned for digital cordless phones as Low-Power Service.

(8) More detailed information can be found in http://www.anfr.fr "TNRBF" and http://www.arcep.fr/.

(9) See www.arcep.fr "PMSE".

(10) See www.arcep.fr "ARCEP" Decision Nº 2016-0272.

(11) More detailed information can be found in RSS-123: http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10759.html.

(12) More detailed information can be found in http://www.bundesnetzagentur.de/allgemeinzuteilungen → "Mikrofone".

(13) More detailed information can be found in http://www.bundesnetzagentur.de/drahtlosemikrofone → "Funkmikrofone (Drahtlose Mikrofone)".