GUIDELINES ON THE USE OF RADIOFREQUENCY SPECTRUM

BY

SHORT RANGE DEVICES

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1. Background

The Communication Authority of Kenya (CA) is the regulatory agency tasked with facilitating the development of the Information and Communications Technology sector in Kenya. This includes management of telecommunications, postal & courier services, Radio Communications, Broadcasting & multimedia, Electronic Commerce and Cyber security. This responsibility entails managing the country's numbering and frequency spectrum resources, administering the Universal Service Fund as well as safeguarding the interests of consumers of ICT services.

1.1. Key Responsibilities

The key responsibilities of the Authority include

a) Licensing all systems and services in the communications industry.
b) Managing the country's frequency spectrum and numbering resources.
c) Type approving and accepting communications equipment for use in Kenya.
d) Protecting consumer rights within the communications environment.
e) Managing competition to ensure a level playing ground for all operators.
f) Regulating retail and wholesale tariffs for communications services.
g) Monitoring the activities of licensees to enforce compliance with license conditions.

1.2. Spectrum Management Responsibilities

The increasing use of wireless technologies, and opportunities for development that these technologies provide, highlight the importance of radio-frequency spectrum management processes. Increased demand requires that spectrum be used efficiently and that effective spectrum management processes and systems are implemented to facilitate the deployment of radio systems and ensure minimum interference. Under article 3 of the Kenya Information and Communications (Radio Communications and Frequency Spectrum) Regulations, 2010, the Authority is required to:

a) Promote and support the orderly development and efficient operation of radio communication systems and services to meet the country's socio-economic, security and cultural needs;
b) Ensure proper planning and management of the spectrum resource under the Act, Government policy objectives and international agreements;
c) Promote the efficient use of frequency spectrum resource through the adoption of technological advances and efficient spectrum allocation and management technology based on operational requirements and technical viability;
d) Ensure the equitable and fair allocation and assignment of spectrum to benefit the maximum number of users.

1.3. Telecommunications Equipment Type Approval

The Communications Authority of Kenya is responsible for the type approval and acceptance of telecommunications equipment for use in Kenya. Duly licensed vendors and contractors are authorised to market telecommunication equipment and are required to obtain type approval from the Authority for each model of equipment they intend to sell. Entities wishing to use any telecommunication equipment on their networks must have the requisite authority to operate the communication network under article 3 of the Kenya Information and Communications (Importation, Type Approval and Distribution of Communications Equipment) Regulations, 2010. All communications equipment to be used to access public networks and radio communications equipment intended to be connected directly or to interwork with a communications network in Kenya to send and receive information shall, before their use, be submitted for type approval or type acceptance by the Authority.

1.4. Application of the Authority's Mandate to Short Range Devices

The Authority's approach to short-range devices is determined by the observance of the regulatory framework and the guidelines are developed and updated to deliver on the following:

1. Facilitation of access to unused spectrum bands: There are important benefits to consumers by authorising the use of spectrum by short-range devices, including improved access to wireless broadband Internet services, security and proximity detection applications, tracking, wireless microphones, research, wideband data transmission and optimisation of the innovative use of spectrum.
2. Protection of licensed spectrum users: The permissible technical operating parameters for Short Range Devices are determined through careful coexistence analysis by standards-setting bodies to ensure protection of licensed spectrum users. Deployment of Short-Range Devices presents a low risk of interference to protected receivers.
3. Minimisation of regulatory barriers: A level of regulatory restrictions is necessary to permit the use of Short-Range Devices while protecting licensed spectrum users. The Authority has made this as versatile as possible, consistent with the need to prevent harmful interference and maintain flexibility for future applications of spectrum sharing applications.

2. Introduction

2.1. Definition

Short Range Radio Devices (SRDs) are transmitters or receivers or both that generate and use radio frequencies. These devices are designed to operate over short-range, at low power levels and have a low capability of causing harmful interference to other radio communication services. Such devices are permitted to operate on a secondary basis on a non-interference and non-protected basis subject to national regulations and relevant technical standards.

Description of SRDs

- SRDs, in general, operate in shared bands and are not permitted to cause harmful interference to radio services;
- SRDs cannot claim protection from interference caused by radiocommunication services as defined by ITU Radio Regulations;
- Due to the increasing use of SRDs for a growing number of applications, it is necessary to adopt harmonised frequency and technical guidelines established by standards-setting bodies.
- There is great need to distinguish between distinct categories of SRD applications;
- That applications for certain SRD within this Recommendation are also subject to ICNIRP guidelines on mitigation of harmful effects of EMF emissions.
- Technical parameters may vary in countries due to differences in spectrum usage regulations.
- The Authority adopts technical operating parameters for SRDs with the technical sections stipulated in these guidelines.
- Equipment to be used across Kenya's borders should not exceed the technical parameters stated.

2.2. Applications

SRDs are used to provide low-cost communication solutions. They include many different types of wireless equipment used in data collection with auto identification systems or item management in warehousing, retail and logistic systems, baby monitors, access control i.e. door and gate openers, wireless home, data telemetry and/or security systems, Local Area Networks (LANs), medical implants, Ultra-Wideband (UWB) sensors and radars, keyless automobile entry systems and hundreds of other types of common electronic equipment that rely on such transmitters to function.

The authorised E.I.R.P. is expected to self-limit the coverage of SRDs, and where necessary, will be reviewed by the Authority, to ensure that SRDs operate as expected. SRDs shall be used within premises or campuses and can be broadly categorised as follows:

- Private networks where the supply of services to the public is not involved such as in company LANs, educational institutions and residential premises.
- Networks where the service is provided to the public within a limited geographical location, such as in airports, train stations, bus stations, hotels, shopping centres, residential premises, libraries and parks.

Wireless Access Systems (WAS) operating on a shared non-protected basis, are not covered by these guidelines and shall attract an annual frequency fee. The WAS include Point-to-Point links and Point-to-Multipoint terminals in the 2.4, 5, 24 and 60 GHz bands. In accordance with the spectrum fee schedule in force, the annual frequency fee per terminal is KShs. 10,000 per terminal/sector.

2.3. Categories of SRDs

Due to the many different applications provided by these devices, no description can be exhaustive; however, the following categories are amongst those regarded as SRDs:

a. **Telecommand:** The use of radio communication for the transmission of signals to initiate, modify or terminate functions of equipment at a distance.

b. **Telemetry**: The use of radiocommunication for indicating or recording data at a distance.

c. **Voice and video**: These are voice applications like walkie-talkies, baby monitoring and similar use. Citizen band (CB) and private mobile radio (PMR 446) equipment is excluded. With video applications, non-professional cordless cameras are meant mainly to be used for controlling or monitoring purposes.

d. **Broadband radio local area networks:** Broadband radio local area networks (RLANs) are replacements of physical cables for the connection of data networks within a building, thus providing networks within the business and industrial environments. These systems use spread spectrum modulation or other redundant (i.e. error correction) transmission techniques. To ensure compatibility with other radio applications in the 2.4 GHz and 5 GHz bands a number of restrictions and mandatory features are required. In these bands, simple licensing requirements are applied or license exemption similar to SRDs.

e. **Railway applications:** These are applications specifically intended for use on railways and comprise mainly automatic vehicle identification (AVI) system, Balise system and Loop system used to provide automatic and unambiguous identification of a passing vehicle and transmission of data between train and track.

f. **Road transport and traffic telematics:** Road transport and traffic telematics (RTTT) systems are systems providing data communication between two or more road vehicles and between road vehicles and the road infrastructure for various information-based travel and transport applications, including automatic toll-collection, route and parking guidance, collision avoidance and similar applications.

g. **Equipment for detecting movement and equipment for alert:** Equipment for detecting movement and equipment for proximity alerts are low-power radar systems for radio determination purposes. Radio determination means the determination of the position, velocity and/or other characteristics of an object, or the obtaining of information relating to these parameters, using the propagation properties of radio waves.

h. **Alarms**: The use of radiocommunication for indicating an alarm condition at a distant location.

i. **Inductive applications:** Inductive loop systems are communication systems based on magnetic fields generally at low radio frequencies. Inductive applications include for example car immobilisers, car access systems or car detectors, animal identification, alarm systems, item

management and logistic systems, cable detection, waste management, personal identification, wireless voice links, access control, proximity sensors, anti-theft systems including RF anti-theft induction systems, data transfer to handheld devices, automatic article identification, wireless control systems and automatic road tolling.

j. **Radio microphones**: Radio microphones (also referred to as wireless microphones or cordless microphones) are small, low-power (50 mW or less) unidirectional transmitters for the transmission of sound over short distances for personal use.

k. **RF identification systems**: The object of any RF identification (RFID) system is to carry data in suitable transponders, generally known as tags, and to retrieve data, by hand- or machine-readable means, at a suitable time and place to satisfy particular application needs.

l. **Ultra-low-power active medical implants**: The ultra-low-power active medical implant (ULP-AMIs) are part of medical implant communication systems (MICS) for use with implanted medical devices, like pacemakers, implantable defibrillators, nerve stimulators, and other types of implanted devices.

m. **Ultra-Wide Band Systems**: UWB is a radio technology that can use very low power levels over short-range and transmit high-bandwidth communications over a large portion of the radio spectrum. Most applications target sensor data collection, precision location and tracking.

n. **Wireless audio applications:** Applications for wireless audio systems include the following: cordless loudspeakers, cordless headphones, cordless headphones for portable use, i.e. portable compact disc players, cassette decks or radio receivers carried on a person, cordless headphones for use in a vehicle, for example for use with a radio or mobile telephone, etc., in-ear monitoring, for use in concerts or other stage productions.

3. Technical and Operating Conditions for SRDs.

3.1. Scope

This specification defines the minimum technical requirements for SRD transmitters and receivers to operate in authorised frequency bands or frequencies and transmit within the corresponding output power levels given in the Annex attached to these guidelines. Short-range devices are intended for communications in confined areas of buildings as well as for localised on-site operations. Short-range devices may be fixed, mobile or portable stations that come with a radio frequency output connector and dedicated antenna or an integral antenna.

3.2. General Requirements

This guideline lists the frequency bands in which SRDs are allowed to operate and the maximum allowed power limits and the following conditions shall apply.

a. The SRDs operate on a secondary basis on unprotected and shared frequency bands subject to not causing interference to other authorised radio communication services and accepting interference from other radio communication services including Industrial, Scientific, and Medical (ISM) equipment.

b. Short-range device vendors require to be registered with the Authority and shall be issued with a vendor's license. SRDs are required to operate in the relevant spectrum segment on a shared basis. These guidelines specify the frequencies that can be used, equipment standards/features, technical and operational parameters. The authorization is a general class license and does not have to be applied individually.

c. The device shall not be constructed with any external or readily accessible control which permits the adjustments of its operating parameters in a manner that is inconsistent with these guidelines.

3.3. Marking Requirements

The equipment shall be marked with the following information;

a. Supplier/manufacturer's name or identification mark;

b. The equipment's trade name, model name and serial number;

c. Other markings such as compliance labels for equipment as required by the relevant standards. The markings shall be legible, indelible and readily visible. All information on the marking shall be in the English Language.

3.4. Technical Requirements

3.4.1. General Requirements

The SRDs shall comply with the maximum Effective Isotropic Radiated Power (E.I.R.P.) and transmitter and receiver spurious emissions given in Annex I, operating in its intended frequency band or frequencies. The authorised E.I.R.P. is expected to self-limit the transmission coverage of SRDs, and where necessary, will be reviewed by the Authority, to ensure that SRDs operate as expected.

3.4.2. Spectrum Allocations

SRDs are deployed in both bands designated for ISM applications and other bands not designated for ISM applications. The Authority designates a frequency band for use short by SRDs based on ITU-R Radio Regulations, Kenya Table of Frequency Allocations, and other international standards.

The frequency bands designated for short-range devices are indicated in Annex I of these guidelines. However, it should be noted that short-range radio-communication devices may generally not be permitted to use bands allocated to the following services namely passive services and those ensuring the safety of life and search and rescue operations according to the relevant ITU Radio Regulations provisions:

- Radio astronomy;
- Aeronautical mobile;
- Safety of life services including radio navigation;

3.4.3. Emission masks for the Short-Range Devices.

The short-range devices shall conform to the spurious domain emission limits given in ITU Radio Regulations Appendix 3. Table II of RR Appendix 3 lists the attenuation values used to calculate maximum permitted spurious domain emission power levels for use with radio equipment.
For example, low power radio device equipment intended for short-range communication or control purposes and operating at output power less than 100 mW, must meet an attenuation level of 56 +10 log(P), or 40 dBc, whichever is less stringent.

3.4.4. Antenna Requirements

Basically, three types of transmitter antennas are used for short-range radio communication transmitters namely Integral (no external antenna socket), dedicated (type-approved with the equipment) or external (equipment type approved without antenna). In most cases, SRD transmitters are equipped with either integral or dedicated antennas.

The Authority shall only allow short-range radio communication transmitters that are designed in such a way that no type of antenna can be used other than one which has been designed and approved by the manufacturer to show conformity with the appropriate emission level. This would help in preventing interference problems to the authorised radiocommunication services.

3.4.5. Interference Mitigation

The SRDs shall not cause interferences to other radio communications services. Upon notification by the Authority, the SRDs shall cease all transmissions until the interference is eliminated. SRDs users shall be required to comply with these guidelines and shall take reasonable measures to ensure that no interference is caused to other users within or outside the designated band for use by SRDs.

The SRDs shall not be accorded any protection from interferences by other radio communications services and the Authority shall not investigate complaints of interferences. It is however recommended that best practice implementation be adhered to, to retain value in the quality of service of the SRDs. The Authority may from time to time carry out tests to ensure that best practice implementation is adhered to.

4. Authorisation

The Authority exempts from type approval and approves the use of the relevant SRDs in Kenya subject to the terms and conditions in these guidelines and the following conditions:

- The frequencies, transmitting power and external high-gain antenna of these radio apparatus must not be altered.
- The radio apparatus must be operated within and must not exceed the technical parameters set out in each of the applicable columns of the specifications table for the frequency band, maximum radiated power or field strength limits and channel spacing, relevant standard and duty cycles and antennas to be used.
- The antenna of the radio apparatus must not be higher above average ground level than the lowest point of the place where the radio apparatus operates effectively.
- The radio apparatus must not cause interference to any authorised network issued with a radio frequency spectrum license by the Authority.
- The user of the radio apparatus in the license-exempt frequency spectrum operates on non-interference and no protection basis from interference.
- If an SRD does cause interference to authorised radio-communication services, even if the device complies with all the technical standards and equipment authorization requirements, then its operator will be required to cease its operation, at least until the interference problem is solved.

4.1. Verification of Administrative Requirements

The verification procedure requires that tests be performed on the transmitter to be authorised using an accredited laboratory by the International Laboratory Accreditation Cooperation (ILAC) that has calibrated its test site or, if the transmitter is incapable of being tested at a laboratory, at the installation site. These tests measure the levels of radiofrequency energy that are radiated by the transmitter into the open air or conducted by the transmitter onto the power lines. After these tests are performed, a report must be produced showing the test procedure, the test results, and some additional information about the transmitter including design drawings. The specific information that must be included in a verification report is detailed and the manufacturer (or importer for an imported device) is required to present a copy as evidence that the device meets the technical standards. The vendor must be able to produce this report whenever requested by the Authority.

4.2. Use of SRDs on-Board Aircraft

The use of SRDs on-board the Kenyan registered aircraft may be authorised under the Aircraft radio Station License. Operation of both 2400–2483.5 MHz and 5725–5850 MHz bands is allowed provided that all transmissions remain strictly within the aircraft and are carried out at above 3000 metres altitude. The same restrictions apply to the use of SRDs on-board foreign-registered aircraft while flying over the territory of Kenya, however, no license is required from the Authority in this regard. The Authority does not address aviation safety aspects. Aircraft operators and owners should consult the Kenya Civil Aviation Authority before installing & using SRD devices onboard aircraft.

4.3. Use of ISM band for Drone Communication

The compatibility of spectrum bands identified in these guidelines as suitable for communication with Unmanned Air Systems shall not imply that the operation of drones and similar aircraft has been authorised by the Authority.

The rules and procedures for their operation are stipulated in the Kenya Civil Aviation (Unmanned Aircraft Systems) Regulations, 2020 and drone operators/importers/vendors should contact the Kenya Civil Aviation Authority for information regarding aviation safety and authorisation.

Operation of radio systems within 2400 - 2483.5 MHz and 5725 - 5850 MHz bands is permitted for ground-to-drone communication.

4.4. Breach of Guidelines

To maintain standards, users and vendors shall be required to ensure that SRD equipment used in Kenya complies with these guidelines, especially with regard to minimum technical characteristics including but not limited to; operating frequency, frequency range, type of modulation & RF power.

4.5. Review of Guidelines

These guidelines may be reviewed from time to time, to ensure that they meet the Authority's statutory obligations on frequency spectrum management for short-range devices.

5. Technical Parameters

The guidelines define the minimum technical requirements for SRD transmitters and receivers to operate in authorised frequency bands or frequencies and transmit within the corresponding output power levels specified. Short-range devices are intended for communications in confined areas of buildings as well as for localised on-site operations. Short-range devices may be fixed, mobile or portable stations that come with a radio frequency output connector and dedicated antenna or an integral antenna.

The Authority has adopted technical parameters specified in ITU-R Recommendations to deal with Short Range Devices and the European Telecommunications Standard Institute (ETSI) has developed European harmonized standards for the devices. These guidelines describe the spectrum usage requirements for SRD applications including the designated frequency bands, maximum radiated power/ field strength levels etc., channel spacing or modulation / maximum occupied bandwidth and duty cycle.

5.1. Tracking, Tracing and Data Acquisition

This section covers frequency bands and technical parameters for tracking, tracing and data acquisition applications including Detection of underground items; Person detection and collision avoidance; Smart Metre reading; Utilities Sensors and actuators; Data acquisition; Wireless Industrial Applications (WIA) to be used in industrial environments including monitoring and worker communications and wireless sensors.

Table 1: Technical and Operating Conditions

	Frequency Band	Power / Magnetic Field	Spectrum access and mitigation requirements	Modulation / maximum occupied bandwidth	Relevant Standard	Notes
a	442.2-450 kHz	7 dBµA/m at 10m	No requirement	Continuous wave (CW) - no modulation, channel spacing ≥ 150 Hz		Person detection and collision avoidance
b	456.9-457.1 kHz	7 dBµA/m at 10 m	No requirement	Continuous wave (CW) at 457 kHz - no modulation	EN 300 718	Emergency detection of buried victims and valuable items
c	169.4-169.475 MHz	500 mW e.r.p.	≤ 10% duty cycle	≤ 50 kHz	EN 300 220	Metre Reading.
d	865-868 MHz Transmissions only permitted within the frequency ranges 865.6-865.8 MHz, 866.2-866.4 MHz, 866.8-867.0 MHz and 867.4-867.6 MHz	500 mW e.r.p.	Adaptive Power Control (APC) required for spectrum sharing (note 1) and the following duty cycle restrictions also apply: ≤ 10% duty cycle for network access points; ≤ 2.5% duty cycle otherwise	≤ 200 kHz	EN 303 659	Data networks. APC is able to reduce the equipment's e.r.p. from its maximum to ≤ 5 mW.

5.2. Wideband Data Transmission Systems

This section covers frequency bands and technical parameters recommended for Wideband Data Transmission Systems.

Table 2: Technical and Operating Conditions

	Frequency Band	Power / Magnetic Field	Spectrum access & mitigation requirements	Modulation / max. bandwidth	Relevant Standard	Notes
a	863 - 868 MHz	25 mW e.r.p.	≤ 10% duty cycle for network access points and polite spectrum access. ≤ 2.8% duty cycle otherwise and polite spectrum access	> 600 kHz ≤ 1 MHz	EN 304 220	Wideband data transmission in data networks.
b	2400 - 2483.5 MHz	100 mW e.i.r.p.	Adequate spectrum sharing mechanism (e.g. LBT and DAA) shall be implemented	Not specified	EN 300 328	For wideband modulations other than FHSS, the maximum e.i.r.p. density is limited to 10 mW/MHz.
c	3100 - 4800 MHz	Max mean e.i.r.p. spectral density of -41.3 dBm/MHz and a maximum peak e.i.r.p. of 0 dBm defined in 50 MHz.	Adequate spectrum sharing mechanism (LDC and DAA) shall be implemented	Not specified	EN 302 065 EN 302 066 ITU-R SM.1754 ITU-R SM.1755; ITU-R SM.1756; ITU-R SM.1757	Generic UWB applications, data communication, localization and identification, and radar and sensing applications.
d	6000 - 9000 MHz	Max mean e.i.r.p. spectral density of -41.3 dBm/MHz and a max peak e.i.r.p. of 0 dBm defined in 50 MHz.	Adequate spectrum sharing mechanism (LDC and DAA) shall be implemented	Not specified	EN 302 065; EN 302 066 ITU-R SM.1754 ITU-R SM.1896-1, ITU-R SM.1755, ITU-R M.1756, ITU-R SM. 1757 ITU-R Rep SM. 2153-7	Generic UWB applications, data communication, localization, identification, radar and sensing applications.

	Frequency Band	Power / Magnetic Field	Spectrum access & mitigation requirements	Modulation / max. bandwidth	Relevant Standard	Notes
e	57-66 GHz	40 dBm e.i.r.p. 23 dBm/MHz e.i.r.p. density & max transmit power of 27 dBm at antenna port.	Adequate spectrum sharing mechanism shall be implemented	Not specified	EN 302 567 WiGig 802.11ad ERC Rec. 70-03	Applies to Indoor applications.
f	57-66 GHz	55 dBm e.i.r.p., 38 dBm/MHz e.i.r.p. density and transmit antenna gain ≥ 30 dBi	Adequate spectrum sharing mechanism shall be implemented	Not specified	EN 303 722 ERC Rec. 70-03	Applies only to fixed outdoor installations.

5.3. Automotive Radars

Automotive radar is defined as a moving radar device supporting the functions of the vehicle.

Table 3: Technical and Operating Conditions

Frequency Band		Power / Magnetic Field	Spectrum access and mitigation requirements	Modulation / maximum occupied bandwidth	Relevant Standard	Notes
a	24.05-24.25 GHz	100 mW e.i.r.p.	No requirement		EN 302 858	For automotive radars (road vehicles only)
b	76-77 GHz	55 dBm peak e.i.r.p.	Fixed transportation infrastructure radars have to be of a scanning nature in order to limit the illumination time and ensure a minimum silent time to achieve coexistence with automotive radar systems.	Not specified	EN 301 091	50 dBm average power or 23.5 dBm average power for pulse radar only. For ground based vehicle and infrastructure systems only.

5.4. Alarms

This section covers frequency bands and technical parameters recommended exclusively for alarm systems including social alarms and alarms for security and safety.

Table 4: Technical and Operating Conditions

Frequency Band		Power / Magnetic Field	Spectrum access and mitigation requirements	Modulation / maximum occupied bandwidth	Relevant Standard	Notes
a	868.6-868.7 MHz	10 mW e.r.p.	≤ 1.0 % duty cycle	25 kHz	EN 300 220	The whole frequency band may also be used as 1 channel for high speed data transmissions
b	869.2-869.25 MHz	10 mW e.r.p.	≤ 0.1 % duty cycle	25 kHz	EN 300 220	Social Alarms
c	869.25-869.3 MHz	10 mW e.r.p.	≤ 0.1 % duty cycle	25 kHz	EN 300 220	
d	869.3-869.4 MHz	10 mW e.r.p.	≤ 1.0 % duty cycle	25 kHz	EN 300 220	
e	869.65-869.7 MHz	25 mW e.r.p.	≤ 10 % duty cycle	25 kHz	EN 300 220	

5.5. Inductive Applications

This section covers frequency bands and technical parameters recommended for inductive loop systems, which use magnetic fields for near field communication and determination applications.

Table 5: Technical and Operating Conditions

	Frequency Band	Power / Magnetic Field	Spectrum access & mitigation requirements	Modulation / maximum occupied bandwidth	Relevant Standard	Notes
a	100 Hz - 9 kHz	82 dBµA/m at 10m	No requirement	Not specified	EN 303 66 EN 303 447 EN 303 454	
b	9-90 kHz	72 dBµA/m at 10m	No requirement	Not specified	EN 303 447 EN 303 454 EN 300 330	In case of external antennas, only loop coil antennas may be employed. Magnetic field strength level descending 3 dB/octave above 30 kHz
c	90-119 kHz	42 dBµA/m at 10m	No requirement	Not specified	EN 303 447 EN 303 454 EN 300 330	In case of external antennas, only loop coil antennas may be employed
d	119-135 kHz	66 dBµA/m at 10m	No requirement	RFIDs operating in the frequency sub-band 119-135 kHz shall meet the spectrum mask given in EN 300 330. This will permit simultaneous use of the various sub-bands within the range 90-148.5 kHz.	EN 300 330	In case of external antennas, only loop coil antennas may be employed. Magnetic field strength level descending 3 dB/octave above 119 kHz
d	135-140 kHz	42 dBµA/m at 10m	No requirement	Not specified	EN 303 447 EN 303 454 EN 300 330	In case of external antennas, only loop coil antennas may be employed
e	140-148.5 kHz	37.7 dBµA/m at 10m	No requirement	Not specified	EN 303 447 EN 303 454 EN 300 330	In case of external antennas, only loop coil antennas may be employed

f	400-600 kHz	-8 dBµA/m at 10 m	No requirement	Not specified	EN 300 330	For RFID only. In case of external antennas, only loop coil antennas may be employed. The maximum field strength is specified in a bandwidth of 10 kHz.
g	3155-3400 kHz	13.5 dBµA/m at 10m	No requirement	Not specified	EN 300 330	In case of external antennas, only loop coil antennas may be employed
h	6765-6795 kHz	42 dBµA/m at 10m	No requirement	Not specified	EN 300 330	
i	7400-8800 kHz	9 dBµA/m at 10m	No requirement	Not specified	EN 300 330	
j	10200-11000 kHz	9 dBµA/m at 10m	No requirement	Not specified	EN 300 330	
k	13553-13567 kHz	42 dBµA/m at 10m	No requirement	Devices operating in the 13.56 MHz band shall meet the transmission mask and antenna requirements for all combined frequency segments (including the limits in the sub-bands k1) and k2)) as described in harmonised standard EN 300 330. This will permit the simultaneous use of the sub-bands i) or j) together with the limits of the sub-bands k1) and k2).	EN 300 330	
l	13553-13567 kHz	60 dBµA/m at 10m	No requirement	Devices operating in the 13.56 MHz band shall meet the transmission mask and antenna requirements for all combined frequency segments (including the limits in the sub-bands k1) and k2)) as described in harmonised standard EN 300 330. This will permit the simultaneous use of the sub-bands i) or j) together with the limits of the sub-bands k1)	EN 300 330	For RFID only

				and k2).		
m	148.5-5000 kHz	-15 dBµA/m at 10 m	No requirement	Not specified	EN 300 330 EN 302 536	In case of external antennas, only loop coil antennas may be employed. The maximum magnetic field strength is specified in a bandwidth of 10 kHz. The maximum allowed total magnetic field strength is -5 dBµA/m at 10 m for systems operating at bandwidths larger than 10 kHz whilst keeping the density limit (-15 dBµA/m in a bandwidth of 10 kHz)
n	5000 kHz-30 MHz	-20 dBµA/m at 10 m	No requirement	Not specified	EN 300 330	In case of external antennas, only loop coil antennas may be employed. The maximum magnetic field strength is specified in a bandwidth of 10 kHz. The maximum allowed total magnetic field strength is -5 dBµA/m at 10 m for systems operating at bandwidths larger than 10 kHz whilst keeping the density limit (-20 dBµA/m in a bandwidth of 10 kHz)

5.6. Radio Microphone Applications

This section covers frequency bands and technical parameters for radio microphone applications (also referred to as wireless microphones or cordless microphones), Assistive Listening Devices (ALD) (also referred to as aids for the hearing impaired) and wireless audio and multimedia streaming systems.

Table 6: Technical and Operating Conditions

	Frequency Band	Power / Magnetic Field	Spectrum access and mitigation requirements	Modulation / maximum occupied bandwidth	Relevant Standard	Notes
a.	100 Hz-9 kHz	120 dBµA/m at 10m	No requirement	Not specified	EN 303 34; EN 300 422	Inductive loop systems intended to assist the hearing impaired.
b.	169.4-174 MHz	10 mW e.r.p.	No requirement	≤ 50 kHz	EN 300 422	Assistive Listening Device (ALD). On a tuning range basis
c.	169.4-169.475 MHz	500 mW e.r.p.	No requirement	≤ 50 kHz	EN 300 422	Assistive Listening Device (ALD)
d.	169.4875-169.5875 MHz	500 mW e.r.p.	No requirement	≤ 50 kHz	EN 300 422	Assistive Listening Device (ALD)
e.	863-865 MHz	10 mW e.r.p.	No requirement	Not specified	EN 300 422; EN 301 357	Radio microphones, wireless audio and multimedia streaming devices.
f.	2400-2483.5 MHz	2W e.i.r.p.	No duty cycle restriction	No channel spacing	EN 300 328; EN 300 440 EN 301 489; EN 60950	WAS such as Wi-Fi on non-interference, non-protected basis

5.7. Radio Frequency Identification Applications

This section covers frequency bands and technical parameters for radio frequency identification (RFID) applications including for example automatic article identification, asset tracking, alarm systems, waste management, personal identification, access control, proximity sensors, anti-theft systems, location systems, data transfer to handheld devices and wireless control systems.

Table 7: Technical and Operating Conditions

Frequency Band		Power / Magnetic Field	Spectrum access and mitigation requirements	Modulation / maximum occupied bandwidth	Relevant Standard	Notes
a	865-865.6 MHz	100 mW e.r.p.	No requirement	≤ 200 kHz	EN 302 208	
b	865.6-867.6 MHz	100 mW e.r.p.	No requirement	≤ 200 kHz	EN 302 208	
c	867.6-868 MHz	100 mW e.r.p.	No requirement	≤ 200 kHz	EN 302 208	
d	2446-2454 MHz	≤ 500 mW e.i.r.p.	No requirement	Not specified	EN 300 440	
e	2446-2454 MHz	> 500 mW to 4 W e.i.r.p	≤ 15% duty cycle FHSS techniques should be used	Not specified	EN 300 440	Power levels above 500 mW are restricted to be used inside the boundaries of a building and the duty cycle of all transmissions shall in this case be ≤ 15 % in any 200 ms period (30 ms on /170 ms off)

5.8. Non-Specific SRD Applications & Wireless Access Systems

This section covers frequency bands and technical parameters for non-specific short range applications and wireless access systems.

Table 6: Technical and Operating Conditions

Frequency Band		Power / Magnetic Field	Spectrum access and mitigation	Modulation / max. bandwidth	Relevant Standard	Notes
a.	433.05 - 434.79 MHz	1 mW e.r.p.	100% duty cycle. 10 mW e.r.p. 100% duty cycle	Up to 25 KHz Channel spacing	EN 300 220; EN 301 489	
b.	868.0 - 868.6 MHz	25mW e.r.p.	≤1% duty cycle or LBT+AFA	Non Specified	EN 300 220; EN 301 489; EN 60950	
c.	868.7 - 869.2 MHz	25mW e.r.p.	≤1% duty cycle or LBT+AFA		EN 300 220; EN 301 489 EN 60950	
d.	865.0 - 868.0 MHz	500mW e.r.p. Transmissions only permitted within 4 sub-bands	Adaptive Power Control (APC) required. Bandwidth: ≤ 200 kHz Duty		EN 300 220; EN 301 489 EN 60950 Directive 2014/53/EU	Restricted to 4 channels only with Adaptive Power Control (APC) required.

	Frequency Band	Power / Magnetic Field	Spectrum access and mitigation	Modulation / max. bandwidth	Relevant Standard	Notes
		865.6 - 865.8 MHz; 866,2 - 866.4 MHz; 866,8 - 867.0 MHz; 867.4 - 867.6 MHz.	cycle: ≤ 10 % for network access points Duty cycle ≤ 2,5 % otherwise			
e.	869.4-869.65 MHz	500mW e.r.p.	≤10% duty cycle or LBT+AFA		EN 300 220; EN 301 489 EN 60950	
f.	869.7- 870 MHz	5mW e.r.p.	No Requirement		EN 300 220; EN 301 489 EN 6095	
g.	869.7- 870 MHz	25mW e.r.p.	≤10% duty cycle or LBT+AFA		EN 300 220; EN 301 489 EN 60950	
h.	2400 - 2483.5 MHz	2W e.i.r.p.	No duty cycle restriction	No channel spacing	EN 300 328; EN 300 440 EN 301 489; EN 60950	WAS such as Wi-Fi on non-interference, non-protected basis
i.	5150-5350 MHz	200mW max e.i.r.p. density of 10mW/MHz in any 1 MHz band	Dynamic Frequency Selection(DFS) & Transmitter Power control(TPC) Modulation schemes obligatory	Shared, non-protected basis	EN 300 836; EN 301 893 EN 301 489; EN 60950 ITU-R M.1625 Rec. ITU-R M.1450-4, Resolution 229 (Rev.WRC-12)	Wireless Access Systems/Radio Local Access Network (WAS & RLAN) indoor use only.
j.	5470-5725 MHz	Max transmitter power of 250mW[3] with Max mean e.i.r.p. of 1W & Max mean e.i.r.p. density of 50mW /MHz in any 1 MHz band	Dynamic Frequency Selection (DFS) & Transmitter Power control (TPC) Modulation schemes obligatory	Shared non-protected basis	EN 300 836; EN 301 489; EN 301 893; EN 301 489; EN 60950; ITU-R M.1625 Rec. ITU-R M.1450-4, Resolution 229 (Rev.WRC-12)	Wireless Access Systems/Radio Local Access Network (WAS/RLAN) indoor and outdoor use
k.	5725-5875 MHz	Mean e.i.r.p. spectral density of 23 dBm/MHz Mean e.i.r.p. of 2W in any 10 MHz band	Dynamic Frequency Selection (DFS) & Transmitter Power control (TPC) Modulation schemes obligatory	Shared non-protected basis	EN 302 502 ISM band footnote 5.150 of the ITU Radio Regulations	Wireless Access Systems/Radio Local Access Network (WAS/RLAN) indoor and outdoor use
l.	5725-5875 MHz	25mW e.i.r.p.	No duty cycle restriction		EN 300 400; EN 301 489-1, 3	Non-specific SRDs

	Frequency Band	Power / Magnetic Field	Spectrum access and mitigation	Modulation / max. bandwidth	Relevant Standard	Notes
			No channel spacing		EN 60950; CEPT/ERC/REC 70-03	
m.	5925-6425 MHz	23 dBm (200 mW) mean e.i.r.p. Mean e.i.r.p. density for in-band emissions – 10 dBm/MHz	An adequate spectrum sharing mechanism shall be implemented for channel access and occupation		ATU Recommendation on 6 GHz.	Restricted to Low Power Indoor (LPI) use only Outdoor use (including in road vehicles) is not permitted.
n.	5925-6425 MHz	14 dBm (25 mW) e.i.r.p.	Mean e.i.r.p. density for in-band emissions 1 dBm/ MHz. An adequate spectrum sharing mechanism shall be implemented for channel access and occupation.		ATU Recommendation on 6 GHz.	Very Low Power (VLP) Indoor and outdoor use. Use of drones is prohibited. Very Low Power (VLP) device is a portable device.
o.	24.00-24.25 GHz	100mW e.i.r.p.	No duty cycle restriction	No channel spacing	EN 300 440; EN 301 489 EN 60950	
p.	402-405 MHz	25 µW e.r.p.	LBT No duty cycle, Otherwise ≤ 1%.	25 kHz Channel spacing.	EN 301 839; EN 301 489 EN 60950; EN 300 220	Medical implants
q.	446-446.1 MHz includes the following 8 channels. 446.00625; 446.01875; 446.03125; 446.04375; 446.05625; 446.08125; 446.09125; 446.09375	500mW e.r.p.		12.5 kHz channel spacing	EN 300 296; EN 301 489 EN 60950	Family Radio Two Way Communications Systems
r.	26.995; 27.045; 27.095; 27.145; 27.195 MHz	100 mW e.r.p.	No restriction on duty cycle	10 kHz channel spacing	EN 300 220; EN 301 489 EN 60950	

Appendix 1: List of Abbreviations

ADC	Adaptive Power Control
AFA	Adaptive Frequency Agility
ALD	Assistive Listening Devices
CB	Citizens' Band
DAA	Detect and Avoid
EAS	Electronic Article Surveillance
EFIS	ECO Frequency Information System
ERM	Electromagnetic Compatibility and Radio Spectrum Matters
ETSI	European Telecommunications Standard Institute
FHSS	Frequency Hopping Spread Spectrum
ISM	Industrial, Scientific and Medical applications
ITS	Intelligent Transportation Systems
LBT	Listen Before Talk
LDC	Low Duty Cycle
LP-AMI	Low Power Active Medical Implant
NFC	Near Field Communications
PMR	Professional Mobile Radio / Private Mobile Radio
PMSE	Programme Making Special Events
RFID	Radio Frequency Identification
RLAN	Radio Local Area Networks
SRD	Short Range Devices
TTT	Transport & Traffic Telematics
ULP-AMI	Ultra-Low Power Active Medical Implants
UWB	Ultra Wide Band
WAS	Wireless Access Systems
WIA	Wireless Industrial Applications

Appendix 2: Duty Cycle Categories

The duty cycle is defined as the ratio, expressed as a percentage, of $\Sigma(T_{on})/(T_{obs})$ where T_{on} is the 'on' time of a single transmitter device and T_{obs} is the observation period. T_{on} is measured in an observation frequency band (F_{obs}). Unless otherwise specified, T_{obs} is a continuous one-hour period and F_{obs} is the applicable frequency band. For pre-programmed devices the maximum transmitter 'on' time limits are given in the table below.

Name	Transmitting Time / Full cycle	Max Transmitter "on" time (seconds)	Explanation
Very Low	≤0.1%	0.72	For example, 5 transmissions of 0.72 seconds within one hour
Low	≤1.0%	3.6	For example, 100 transmissions of 360 milliseconds within one hour
High	≤10%	36	For example, 100 transmissions of 3.6 seconds within one hour
Very High	Up to 100%	-	Typically continuous transmission but also those with a duty cycle greater than 10%