Innovation, Science and Economic Development Canada

Innovation, Sciences et Développement économique Canada

RSS-247
Issue 3
TBD

Spectrum Management and Telecommunications

Radio Standards Specification

Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Aussi disponible en français − CNR-247

Canada

Preface

Radio Standards Specification RSS-247, Issue 3, *Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices*, replaces RSS-247, Issue 2, dated February 2017.

The main changes are listed below:

1. Added section 2.1 to include the coming into force
2. Modified section 6.2 to clarify that different measurement methods can apply depending on the operating frequency range of the device
3. Added section 6.2.5 to introduce the requirements for devices operating from 5850-5895 MHz and channels that span across 5850 MHz
4. Added section 6.2.5.1 to provide general information and definitions
5. Added section 6.2.5.2 to identify the power limits associated with devices operating in the 5850-5895 MHz band
6. Added section 6.2.5.3 to identify the unwanted emission limits associated with devices operating in the 5850-5895 MHz band
7. Made editorial changes and clarifications, as appropriate

Inquiries may be submitted by one of the following methods:

1. Online using the General Inquiry form (in the form, select the Directorate of Regulatory Standards radio button and specify “RSS-247” in the General Inquiry field)

2. By mail to the following address:

   Innovation, Science and Economic Development Canada
   Engineering, Planning and Standards Branch
   Attention: Regulatory Standards Directorate
   235 Queen Street
   Ottawa ON K1A 0H5
   Canada

3. By email to consultationradiostandards-consultationnormesradio@ised-isde.gc.ca

Comments and suggestions for improving this standard may be submitted online using the Standard Change Request form, or by mail or email to the above addresses.

All documents related to spectrum and telecommunications are available on ISED’s Spectrum Management and Telecommunications website.

Issued under the authority of
the Minister of Innovation, Science and Industry

_____

Martin Proulx
Director General
Engineering, Planning and Standards Branch

Contents

1. Scope

This Radio Standard Specification sets out certification requirements for radio apparatus operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz employing frequency hopping, digital modulation and/or a combination (hybrid) of both techniques. It also includes licence-exempt local area network (LE-LAN) devices operating in the bands 5150-5250 MHz, 5250-5350 MHz, 5470-5725 MHz, 5725-5850 MHz, and 5850-5895 MHz as specified in SP-5150 MHz and in SMSE-012-22 *Decision on the Technical and Policy Framework for Radio Local Area Network Devices in the 5850-5895 MHz Band and for the Intelligent Transportation Systems in the 5895-5925 MHz Band.*

2. General information

Equipment covered by this standard is classified as Category I equipment. Either a technical acceptance certificate (TAC) issued by the Certification and Engineering Bureau of Innovation, Science and Economic Development Canada (ISED) or a certificate issued by a certification body (CB) is required.

2.1 Coming into force

This document will be in force as of the date of its publication on Innovation, Science and Economic Development Canada's (ISED) website.

However, a transition period of six months from the publication date will be provided. During this period, all applications for certification under RSS-247 issue 2 or issue 3 will be accepted. After this period, all applications for the certification of equipment will be accepted under RSS-247 issue 3 only, and equipment manufactured, imported, distributed, leased, offered for sale, or sold in Canada shall comply with this present issue.

A copy of RSS-247, issue 2, is available upon request by email to consultationradiostandards-consultationnormesradio@ised-isde.gc.ca.

2.2 Licensing requirements

Equipment covered by this standard is exempt from licensing requirements pursuant to section 15 of the *Radiocommunication Regulations*.

2.3 Definitions

Channel closing transmission time is the aggregate duration of transmissions by LE-LAN devices during the channel move time, which starts upon detection of an interfering signal above the interference detection threshold. This aggregate includes the normal transmission time and the intermittent signals required to facilitate changes. The aggregate duration of all transmissions shall not count quiet periods between transmissions.

Channel move time is the time needed by an LE-LAN device to cease all transmissions on the current channel upon detection of a radar signal.

Client mode is an operating mode in which the transmissions of the LE-LAN device are under the control of the master.

Dynamic frequency selection (DFS) is a mechanism that dynamically detects signals from other systems and avoids co-channel operation with those systems, notably radar systems.

DFS detection threshold is the required detection level defined by detecting a received signal strength that is greater than a threshold specified within the device channel bandwidth.

In-service monitoring is a mechanism to check a channel in use by the LE-LAN device for the presence of a radar signal.

Master mode is an operating mode in which the LE-LAN device has the capability to transmit without receiving an enabling signal. In this mode, the device is able to select a channel and initiate a network by sending enabling signals to other LE-LAN devices.

Maximum conducted output power is the total transmitted power delivered to all antennas and antenna elements averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.

Maximum power spectral density is the maximum power spectral density within the specified measurement bandwidth in the device operating band.

Power spectral density (PSD) is the total energy output per unit bandwidth. The PSD is determined by dividing the maximum transmit power from a pulse or sequence of pulses to the total duration of the pulse(s). This total time does not include the time between pulses during which the transmit power is off or below its maximum level.

Transmitter power control (TPC) is a feature that enables an LE-LAN device to dynamically switch between several transmission power levels in the transmission process. The intent of this feature is to use the lowest power level necessary to establish and maintain connectivity between LE-LAN devices.

Vehicle is defined as an enclosed mobile machine that transports people or cargo on road (definition for the purpose of this RSS).

2.4 External RF power amplifiers

External RF Power Amplifiers (ERFPA) may be marketed separately for use with devices certified under this standard under the following conditions:

a) The ERFPA shall be certified with the device with which it is intended to be used, such that the amplifier-device combination does not exceed any of the limits specified for the device alone; and

b) The ERFPA shall be marketed only for use with the device with which it has been certified, so long as the following statement is included on the packaging and in the user manual:

Under Innovation, Science, and Economic Development Canada regulations, this external radio frequency power amplifier (insert ISED certification number of radio frequency power amplifier) may only be used with the transmitter with which the amplifier has been certified by Innovation, Science and Economic Development Canada. The certification number for the transmitter with which this amplifier is permitted to operate is IC:XX…X-YY…Y.

3. Certification requirements

3.1 RSS-Gen compliance

RSS-247 shall be used in conjunction with RSS-Gen, *General Requirements for Compliance of Radio Apparatus*, for general specifications and information relevant to the equipment for which this standard applies.

3.2 Normative reference publications and related document

This standard refers to the following publications and, where there are discrepancies between the requirements as stated in those standards and RSS-247, Radio Standards Specification RSS-247 shall take precedence. The latest version of these reference publications shall be used for showing compliance.

The Acceptable knowledge database, other supplementary procedures and notices website provides a complete list of acceptable Federal Communications Commission (FCC) procedures related to RF measurements.

ANSI C63.10, *American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices*

ETSI EN 301 893, *Broadband Radio Access Networks (BRAN); 5 GHz high performance RLAN; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive*

The following documents should also be consulted:

SP-5150 MHz - *Spectrum Utilization Policy for Licence-exempt Wireless Local Area Networks in the 5 GHz Range (Issue 2)*

SMSE-012-22 - *Decision on the Technical and Policy Framework for Radio Local Area*

Network Devices in the 5850-5895 MHz Band and for Intelligent Transportation Systems in the 5895-5925 MHz Band

3.3 Equipment falling within restricted frequency bands

Equipment certified under this standard is required to comply with the provisions in RSS-Gen with respect to emissions falling within restricted frequency bands. These restricted frequency bands are listed in RSS-Gen.

4. Measurement method

In addition to the requirements in RSS-Gen and the requirements of this standard, the method for measuring DTS devices is provided in **ANSI C63.10**.

The test report shall be prepared in accordance with RSS-Gen.

5. Standard specifications for frequency hopping systems and digital transmission systems operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

This section applies to frequency hopping systems (FHSs) in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz and digital transmission systems (DTSs) in the bands 902-928 MHz and 2400-2483.5 MHz. Systems in these bands can be frequency hopping, digital transmission and/or a combination (hybrid) of both types. The digital transmission technology of DTSs or hybrid systems operating in the band 5725-5850 MHz shall comply with the requirement in section 6 of this standard.

An FHS that synchronizes with another or several other systems (to avoid frequency collision among them) via off-air sensing or via connecting cables is not hopping randomly and therefore is not considered under RSS-247.

5.1 Frequency hopping systems (FHS)

FHSs employ a spread spectrum technology in which the carrier is modulated with coded information in a conventional manner, causing a conventional spreading of the radio frequency (RF) energy around the carrier frequency. The carrier frequency is not fixed, but changes at fixed intervals under the direction of a coded sequence.

FHSs are not required to employ all available hopping frequencies during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the requirements in this section in case the transmitter is presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of frequency hopping equipment and must distribute its transmissions over the minimum number of hopping channels specified in this section.

Incorporation of intelligence into an FHS that enables it to recognize other users of the band and to avoid occupied frequencies is permitted provided that the FHS does it individually and independently chooses or adapts its hopset. The coordination of FHSs in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

The following applies to FHSs in each of the three bands:

a) The bandwidth of a frequency hopping channel is the 20 dB emission bandwidth, measured with the hopping stopped. The system's radio frequency (RF) bandwidth is equal to the channel bandwidth multiplied by the number of channels in the hopset. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

b) FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.

c) For FHSs in the band 902-928 MHz: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10-second period. The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.

d) FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

e) FHSs operating in the band 5725-5850 MHz shall use at least 75 hopping channels. The maximum 20 dB bandwidth of the hopping channel shall be 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30-second period.

5.2 Digital transmission systems

DTSs include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to the bands 902-928 MHz and 2400-2483.5 MHz:[1]

a) The minimum 6 dB bandwidth shall be 500 kHz.

b) The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

5.3 Hybrid systems

Hybrid systems employ a combination of both frequency hopping and digital transmission techniques and shall comply with the following:

a) With the digital transmission operation of the hybrid system turned off, the frequency hopping operation shall have an average time of occupancy on any frequency not exceeding 0.4 seconds within a duration in seconds equal to the number of hopping frequencies multiplied by 0.4.

b) With the frequency hopping turned off, the digital transmission operation shall comply with the power spectral density requirements for digital modulation systems set out in of section 5.2(b) above or section 6.2.4 for hybrid devices operating in the band 5725-5850 MHz.

5.4 Transmitter output power and equivalent isotropically radiated power (e.i.r.p.) requirements

Devices shall comply with the following requirements, where applicable:

a) For FHSs operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W and the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels.

b) For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

[1] DTSs operating in the band 5725-5850 MHz shall meet the requirements of Section 6 of this document.

c) For FHSs operating in the band 5725-5850 MHz, the maximum peak conducted output power shall not exceed 1 W, and the e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

d) For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.

e) Fixed point-to-point systems in the bands 2400-2483.5 MHz and 5725-5850 MHz are permitted to have an e.i.r.p. higher than 4 W provided that the higher e.i.r.p. is achieved by employing higher gain directional antennas and not higher transmitter output powers. Point-to-multipoint systems,[2] omnidirectional applications and multiple co-located transmitters transmitting the same information are prohibited from exceeding an e.i.r.p. of 4 W.

f) Transmitters operating in the band 2400-2483.5 MHz, may employ antenna systems that emit multiple directional beams simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers, provided that the emissions comply with the following:

i. Different information must be transmitted to each receiver.

ii. If the transmitter employs an antenna system that emits multiple directional beams, but does not emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device (i.e. the sum of the power supplied to all antennas, antenna elements, staves, etc., and summed across all carriers or frequency channels) shall not exceed the applicable output power limit specified in sections 5.4(b) and 5.4(d). However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as the sum of 10 log (number of array elements or staves) plus the directional gain of the element or stave having the highest gain.

[2] However, remote stations of point-to-multipoint systems shall be permitted to operate at an e.i.r.p. greater than 4 W under the same conditions as for point-to-point systems.

iii. If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the applicable power limit specified in sections 5.4(b) and 5.4(d). If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the applicable limit specified in sections 5.4(b) and 5.4(d). In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the applicable limit specified in sections 5.4(b) and 5.4(d) by more than 8 dB.

iv. Transmitters that transmit a single directional beam shall operate under the provisions of sections 5.4(b), 5.4(d) and 5.4(e).

5.5 Unwanted emissions

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

6. Technical requirements for licence-exempt local area network devices and digital transmission systems operating in the 5 GHz band

This section provides standards for Licence-Exempt Local Area Network (LE-LAN) devices operating in the bands 5150-5250 MHz, 5250-5350 MHz, 5470-5600 MHz, 5650-5725 MHz, 5725-5850 MHz, and 5850-5895 MHz and for DTSs operating in the band 5725-5850 MHz that employ digital modulation technology, but are not designed for LE-LAN operation.

Devices with occupied bandwidths which overlap different bands shall comply with all operational requirements for each band.

6.1 Types of modulation

Equipment shall employ digital modulation.

6.2 Power and unwanted emissions limits

The output power and e.i.r.p. of the equipment wanted emission shall be measured in terms of average value.

The power and e.i.r.p. of the equipment unwanted emission shall be measured in peak value, unless another measurement method is specified in the respective section for the frequency range of operation of the device. However, the equipment is required to comply with the provisions in RSS-Gen with respect to emissions falling within restricted frequency bands which are listed in the same standard.

If the transmission is in bursts, the provisions of RSS-Gen for pulsed operation shall apply.

The outermost carrier frequencies or channels shall be used when measuring unwanted emissions. Such carrier or channel centre frequencies are to be indicated in the test report.

6.2.1 Frequency band 5150-5250 MHz

LE-LAN devices are restricted to indoor operation only in the band 5150-5250 MHz. However, original equipment manufacturer (OEM) devices, which are installed in vehicles by vehicles manufacturers, are permitted.

6.2.1.1 Power limits

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or 1.76 + 10 $\log_{10}$B, dBm, whichever is less, where B is the 99% emission bandwidth in megahertz. Devices shall implement transmitter power control (TPC) in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

For other devices, the maximum e.i.r.p. shall not exceed 200 mW or 10 + 10 $\log_{10}$B, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

6.2.1.2 Unwanted emission limits

For transmitters with operating frequencies in the band 5150-5250 MHz, all emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. Any unwanted emissions that fall into the band 5250-5350 MHz shall be attenuated below the channel power by at least 26 dB, when measured using a resolution bandwidth between 1 and 5% of the occupied bandwidth (i.e. 99% bandwidth), above 5250 MHz. The 26 dB bandwidth may fall into the 5250-5350 MHz band; however, if the occupied bandwidth also falls within the 5250-5350 MHz band, the transmission is considered as intentional and the devices shall comply with all requirements in the band 5250-5350 MHz including implementing dynamic frequency selection (DFS) and TPC, on the portion of the emission that resides in the 5250-5350 MHz band.

6.2.2 Frequency band 5250-5350 MHz

For devices installed in vehicles, only OEM devices installed by vehicle manufacturers are permitted.

6.2.2.1 Power limits

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or 1.76 + 10 $\log_{10}$B, dBm, whichever is less, where B is the 99% emission bandwidth in megahertz. Devices shall implement TPC in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

Devices, other than devices installed in vehicles, shall comply with the following:

a) The maximum conducted output power shall not exceed 250 mW or 11 + 10 $\log_{10}$B, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band;

b) The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 $\log_{10}$B, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

6.2.2.2 Unwanted emission limits

Devices shall comply with the following:

a) All emissions outside the band 5250-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. spectral density; or

b) All emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. spectral density and its power shall comply with the spectral power density for operation within the band 5150-5250 MHz. The device, except devices installed in vehicles, shall be labelled or include in the user manual the following text “for indoor use only.”

6.2.2.3 Additional requirements

In addition to the above requirements, devices shall comply with the following, where applicable:

a) Outdoor fixed devices with a maximum e.i.r.p. greater than 200 mW shall comply with the following e.i.r.p. at different elevations, where θ is the angle above the local horizontal plane (of the Earth) as shown below:

i. -13 dBW / MHz for $0^o \leq \theta < 8^o$
ii. -13 − 0.716 (θ-8) dBW / MHz for $8^o \leq \theta < 40^o$
iii. -35.9 − 1.22 (θ-40) dBW / MHz for $40^o \leq \theta \leq 45^o$
iv. -42 dBW / MHz for $\theta > 45^o$

The measurement procedure defined in Annex A of this document shall be used to verify the compliance to the e.i.r.p. at different elevations.

b) Devices, other than outdoor fixed devices, having an e.i.r.p. greater than 200 mW shall comply with either i. or ii. below:

i. devices shall comply with the e.i.r.p. elevation mask in 6.2.2.3(a); or

ii. devices shall implement a method to permanently reduce their e.i.r.p. via a firmware feature in the event that the Department requires it. The test report must demonstrate how the device's power table can be updated to meet this firmware requirement. The manufacturer shall provide this firmware to update all systems automatically in compliance with the directions received from the Department.

6.2.3 Frequency bands 5470-5600 MHz and 5650-5725 MHz

Until further notice, devices subject to this section shall not be capable of transmitting in the 5600-5650 MHz band. This restriction is for the protection of Environment Canada's weather radars operating in this band.

6.2.3.1 Power limits

The maximum conducted output power shall not exceed 250 mW or 11 + 10 $\log_{10}$B, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.

The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 $\log_{10}$B, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

6.2.3.2 Unwanted emission limits

Emissions outside the band 5470-5725 MHz shall not exceed -27 dBm/MHz e.i.r.p. spectral density. However, devices with bandwidth overlapping the band edge of 5725 MHz can meet the unwanted emission limit of -27 dBm/MHz e.i.r.p. at 5850 MHz instead of 5725 MHz.

6.2.4 Frequency band 5725-5850 MHz

6.2.4.1 General

The following requirements apply to devices operating in the range 5725-5850 MHz. For devices having channels that span across 5850 MHz (e.g. 5725-5895 MHz), the requirements are described in section 6.2.5.

6.2.4.2 Power limits

For equipment operating in the band 5725-5850 MHz, the 6 dB bandwidth shall be at least 500 kHz.

The maximum conducted output power shall not exceed 1 W. The output power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the output power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed point-to-point operations exclude the use of point-to-multipoint[3] systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

6.2.4.3 Unwanted emission limits

Devices operating in the band 5725-5850 MHz shall comply with the following e.i.r.p. spectral density limits:

a) 27 dBm/MHz at frequencies from the band edges decreasing linearly to 15.6 dBm/MHz at 5 MHz above or below the band edges;

b) 15.6 dBm/MHz at 5 MHz above or below the band edges decreasing linearly to 10 dBm/MHz at 25 MHz above or below the band edges;

c) 10 dBm/MHz at 25 MHz above or below the band edges decreasing linearly to -27 dBm/MHz at 75 MHz above or below the band edges; and

d) -27 dBm/MHz at frequencies more than 75 MHz above or below the band edges.

6.2.5 Frequency band 5850-5895 MHz

6.2.5.1 General

Outdoor operation in the 5850-5895 MHz band, including channels that span across 5850 MHz (e.g. 5725-5895 MHz), shall be limited to fixed access points and fixed client devices.

A fixed outdoor access point is a transceiver intended to provide connectivity to fixed outdoor client devices and fixed outdoor access points, that is permanently attached to a structure. It shall operate as:

a) a bridge in a peer-to-peer connection;
b) a connector between the wired and wireless segments of the network; or
c) a relay between wireless network segments.

[3] However, remote stations of point-to-multipoint systems shall be permitted to operate at e.i.r.p. greater than 4 W under the same conditions as for point-to-point systems.

A fixed outdoor client device is intended as a customer premise equipment which shall be under the control of a fixed outdoor access point, that is permanently attached to a structure. A fixed outdoor client device shall not be capable of initiating a network.

Indoor operation in the 5850-5895 MHz band, including channels that span across 5850 MHz, shall be limited to access points, clients and subordinate devices. Access points and subordinate devices shall be labelled or include in the user manual the following text “for indoor use only”.

Indoor client devices shall have their transmissions under the control of an indoor access point or an indoor subordinate device and shall not be capable of initiating a network.

Indoor access points shall only operate in locations completely enclosed by walls and a ceiling and shall have the following characteristics:

a) shall be powered by a wired connection;
b) shall not be battery powered;
c) shall have a permanent antenna;
d) shall not have a weatherized enclosure; and
e) may have a direct connection to the Internet.

Indoor subordinate devices shall have their transmissions under the control of an indoor access point and shall have the following characteristics:

a) shall be powered by a wired connection;
b) shall not be battery powered;
c) shall have a permanent antenna;
d) shall not have a direct connection to the Internet;
e) shall not have a weatherized enclosure; and
f) shall only connect to indoor access points, other indoor subordinate devices, or client devices within a single building or structure.

6.2.5.2 Power limits

All devices shall have a 6 dB bandwidth of at least 500 kHz.

For fixed outdoor access points, the maximum e.i.r.p. shall not exceed 4 W (36 dBm). The maximum e.i.r.p. spectral density shall not exceed 23 dBm/MHz. The maximum e.i.r.p. measured at any elevation angle greater than 30 degrees above the horizon, shall not exceed 125 mW (21 dBm) over the 5850-5895 MHz frequency band.

For fixed outdoor client devices, the maximum e.i.r.p. shall not exceed 1 W (30 dBm). The maximum e.i.r.p. spectral density shall not exceed 17 dBm/MHz.

For indoor access points, the maximum e.i.r.p. shall not exceed 4 W (36 dBm). The maximum e.i.r.p. spectral density shall not exceed 20 dBm/MHz.

For indoor subordinate devices, the maximum e.i.r.p. shall not exceed 4 W (36 dBm). The maximum e.i.r.p. spectral density shall not exceed 20 dBm/MHz.

For indoor client devices, the maximum e.i.r.p. shall not exceed 1 (W) 30 dBm. The maximum e.i.r.p. spectral density shall not exceed 14 dBm/MHz.

6.2.5.3 Unwanted emission limits

For the frequency range between 5725 MHz and 5895 MHz, all devices shall be measured using a peak detection and shall comply with the following e.i.r.p. spectral density limits:

a) 27 dBm/MHz at frequencies from the 5725 MHz band edge decreasing linearly to 15.6 dBm/MHz at 5 MHz below the 5725 MHz band edge;

b) 15.6 dBm/MHz at 5 MHz below the 5725 MHz band edge decreasing linearly to 10 dBm/MHz at 25 MHz below the 5725 MHz band edge;

c) 10 dBm/MHz at 25 MHz below the 5725 MHz band edge decreasing linearly to -27 dBm/MHz at 75 MHz below the 5725 MHz band edge; and

d) -27 dBm/MHz at frequencies more than 75 MHz below the 5725 MHz band edge.

For the 5895 MHz band edge and above, all devices shall be measured using an average detection and shall comply with the following e.i.r.p. spectral density limits:

a) Fixed outdoor access points and fixed outdoor client devices shall not exceed -27 dBm/MHz e.i.r.p. spectral density at or above 5895 MHz band edge.

b) Indoor access points or indoor subordinate devices shall not exceed 15 dBm/MHz e.i.r.p. spectral density at the 5895 MHz band edge and shall decrease linearly to not exceed −7 dBm/MHz e.i.r.p. spectral density at or above 5925 MHz.

c) Client devices shall not exceed −5 dBm/MHz e.i.r.p. spectral density at the 5895 MHz band edge and shall decrease linearly to not exceed −27 dBm/MHz e.i.r.p. spectral density at or above 5925 MHz.

6.3 Dynamic frequency selection for devices operating in the bands 5250-5350 MHz, 5470-5600 MHz and 5650-5725 MHz

ISED requires the use of either the FCC KDB Procedure 905462 or the DFS test procedure in the ETSI EN 301 893 for demonstrating compliance with the DFS radar detection requirements set out in this section.

If any part of an operating device’s emission bandwidth falls in the bands 5250-5350 MHz, 5470-5600 MHz or 5650-5725 MHz, the device shall comply with requirements in the following

sections.

6.3.1 DFS radar signal detection threshold

Devices shall employ a DFS radar detection mechanism to detect the presence of radar systems and to avoid co-channel operation with radar systems. The device must detect radar signals within its entire emission bandwidth. The minimum DFS radar signal detection threshold is described below in Table 1.

Table 1: DFS Detection threshold for master devices and client devices with radar detection

Devices	DFS Threshold
Devices with an e.i.r.p. < 200 mW AND a Power Spectral Density < 10 dBm/MHz	-62 dBm
Devices with 200 mW ≤ e.i.r.p. ≤ 1 W	-64 dBm
Note: The detection threshold power is the received power, averaged over a 1-microsecond reference to a 0 dBi antenna.	

6.3.2 Operational requirements

Devices shall comply with the following requirements, however, the requirement for in-service monitoring does not apply to client devices without radar detection.

a) **In-service monitoring:** an LE-LAN device shall be able to monitor the operating channel to check that a co-channel radar has not moved or started operation within range of the LE-LAN device. During in-service monitoring, the LE-LAN radar detection function continuously searches for radar signals between normal LE-LAN transmissions.

b) **Channel availability check time:** the device shall check whether there is a radar system already operating on the channel before it initiates a transmission on a channel and when it moves to a channel. The device may start using the channel if no radar signal with a power level greater than the interference threshold value specified in section 6.3.1 above is detected within 60 seconds. This requirement only applies in the master operational mode.

c) **Channel move time:** after a radar signal is detected, the device shall cease all transmissions on the operating channel within 10 seconds.

d) **Channel closing transmission time:** is comprised of 200 ms starting at the beginning of the channel move time plus any additional intermittent control signals required to facilitate a channel move (an aggregate of 60 ms) over the remaining 10-second period of the channel move time.

e) **Non-occupancy period:** a channel that has been flagged as containing a radar signal, either by a channel availability check or in-service monitoring, is subject to a 30-minute non-occupancy period where the channel cannot be used by the LE-LAN device. The non-occupancy period starts from the time that the radar signal is detected.

6.4 Additional requirements

The following requirements shall apply:

a) The device shall automatically discontinue transmission in cases of absence of information to transmit, or operational failure. A description on how this is done shall accompany the application for equipment certification. Note that this is not intended to prohibit transmission of control or signalling information or the use of repetitive codes where required by the technology.

b) All LE-LAN devices must contain security features to protect against modification of software by unauthorized parties.

Manufacturers must implement security features in any digitally modulated devices capable of operating in any of the frequency ranges within the 5 GHz band, so that third parties are not able to reprogram the device to operate outside the parameters for which the device was certified. The software must prevent the user from operating the transmitter with operating frequencies, output power, modulation types or other radio frequency parameters outside those that were approved for the device. Manufacturers may use various means, including the use of a private network that allows only authenticated users to download software, electronic signatures in software or coding in hardware that is decoded by software to verify that new software can be legally loaded into a device to meet these requirements and must describe the methods in their application for equipment certification.

Manufacturers must take steps to ensure that DFS functionality cannot be disabled by the operator of the LE-LAN device.

c) The user manual for LE-LAN devices shall contain instructions related to the restrictions mentioned in the above sections, namely that:

i. the device for operation in the band 5150–5250 MHz is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems;[4]

ii. for devices with detachable antenna(s), the maximum antenna gain permitted for devices in the bands 5250-5350 MHz and 5470-5725 MHz shall be such that the equipment still complies with the e.i.r.p. limit;

[4] For devices installed in vehicles point i. is not required.

iii. for devices with detachable antenna(s), the maximum antenna gain permitted for devices in the band 5725-5850 MHz shall be such that the equipment still complies with the e.i.r.p. limits as appropriate; and

iv. where applicable, antenna type(s), antenna models(s), and worst-case tilt angle(s) necessary to remain compliant with the e.i.r.p. elevation mask requirement set forth in section 6.2.2.3 shall be clearly indicated.

Annex A — Measurement procedures for e.i.r.p. at various elevations

This annex details two methodologies when assessing compliance of a product regarding the e.i.r.p. at different elevations against the applicable requirement set forth in section 6.2.2.3 of RSS-247.

Method 1 – Measurement

Measurements shall be taken, using the following steps, at a test site that has been validated using the procedures of ANSI C63.4 or the latest CISPR 16-1-4 for measurements above 1 GHz, so as to simulate a near free-space environment (see RSS-Gen for applicable versions of ANSI and CISPR standards).

(1) Line the ground plane with absorbers between the transmitter and the receive antenna to minimize reflections. The absorbers used should have a minimum-rated attenuation of 20 dB through the measurement frequency range of interest. The absorbers shall be positioned to replicate the layout used when compliance with the applicable acceptability criterion was achieved, as set forth in the aforementioned standards on site validation.

(2) Set the height of the receive antenna to 1.5 m. The receive antenna must be one that was designed and fabricated to operate over the entire frequency range of interest, for example, an appropriate standard gain horn.

(3) The distance between the receive antenna and the radiating source shall be sufficient in order to ensure far-field conditions.

(4) Mount the transmitter at a height of 1.5 m.

(5) Configure the device under test (DUT) to produce the maximum power spectral density as measured while assessing compliance with section 6.2.2 (i.e. channel frequency, modulation type and data rate). If the DUT is equipped with a detachable antenna and the antenna is intended for remote installation (i.e. tower-mounted), the DUT may be substituted with a suitable signal generator. The level and frequency settings on the generator shall be set so as to reproduce the maximum power spectral density, measured within a 1 MHz bandwidth, obtained while assessing compliance to section 6.2.2.

(6) Position the transmitter or the radiating antenna so that elevation pattern measurements can be taken.

(7) Find the 0° reference point in the horizontal plane.

(8) Care should be taken when positioning the receive antenna to avoid cross-polarization. Antennas of known mounting polarization should be assessed with the receive antenna

oriented in the same polarity. If the polarization of the transmit antenna is unknown or the transmit antenna can be mounted in either polarization, e.i.r.p. measurements should be performed to find which mounting polarity provides the highest e.i.r.p. value. Testing shall be carried out with the receive antenna and the DUT mounted in each polarity.

(9) The emission shall be centred on the display of the spectrum analyzer with the following settings:

a) If the power spectral density of the DUT was assessed with a peak detector and the antenna cannot be detached from the DUT, the spectrum analyzer shall be set to a peak detector with a resolution bandwidth and video bandwidth of 1 MHz.
b) If the power spectral density of the DUT was assessed using a sample detector with power averaging and the antenna cannot be detached from the DUT, the spectrum analyzer shall be set to a sample detector, configured to produce 100 power averages and set with a resolution bandwidth, as well as a video bandwidth of 1 MHz.
c) If the antenna can be detached from the DUT, a continuous wave (CW) signal equal to that of the power spectral density measurement may be used, the spectrum analyzer shall be set to peak detector with a resolution bandwidth and video bandwidth of 1 MHz.

(10) Rotate the turntable 360° recording the field strength at each step. Throughout the main beam of the antenna, the step size shall be kept to a maximum of 1°.

Once outside the main beam of the antenna, the maximum step size shall be as follows, when compared to the requirements of section 6.2.2:

a) Between 0° and 8°, maximum step size of 2°;
b) Between 8° and 40°, maximum step size of 4°;
c) Between 40° and 45°, maximum step size of 1°;
d) Between 45° and 90°, maximum step size of 5°.

Once the mask reaches 90°, the mask will be inverted and the step size will follow in the same manner as above.

For the purpose of this procedure, the main beam of the antenna is defined as the 3 dB beamwidth.

(11) Convert the measured field strength values in terms of e.i.r.p. density (dBW/1 MHz) using the following equation:

$$\text{e.i.r.p. density}\,(dBW/1MHz) = 10\log\left(\frac{(E*r)^2}{30}\right)$$

E = field strength in V/m
r = measurement distance in metres

(12) Plot the results against the emission mask with reference to the horizontal plane.

(13) Using the plot, the 0° can be rotated to determine the worst-case installation tilt angle.

(14) Testing shall be performed using the highest gain antenna for every antenna type, if applicable.

The following figure is an example of a polar elevation mask measured using the Method 1 reference to dBµV/m at 3 m.

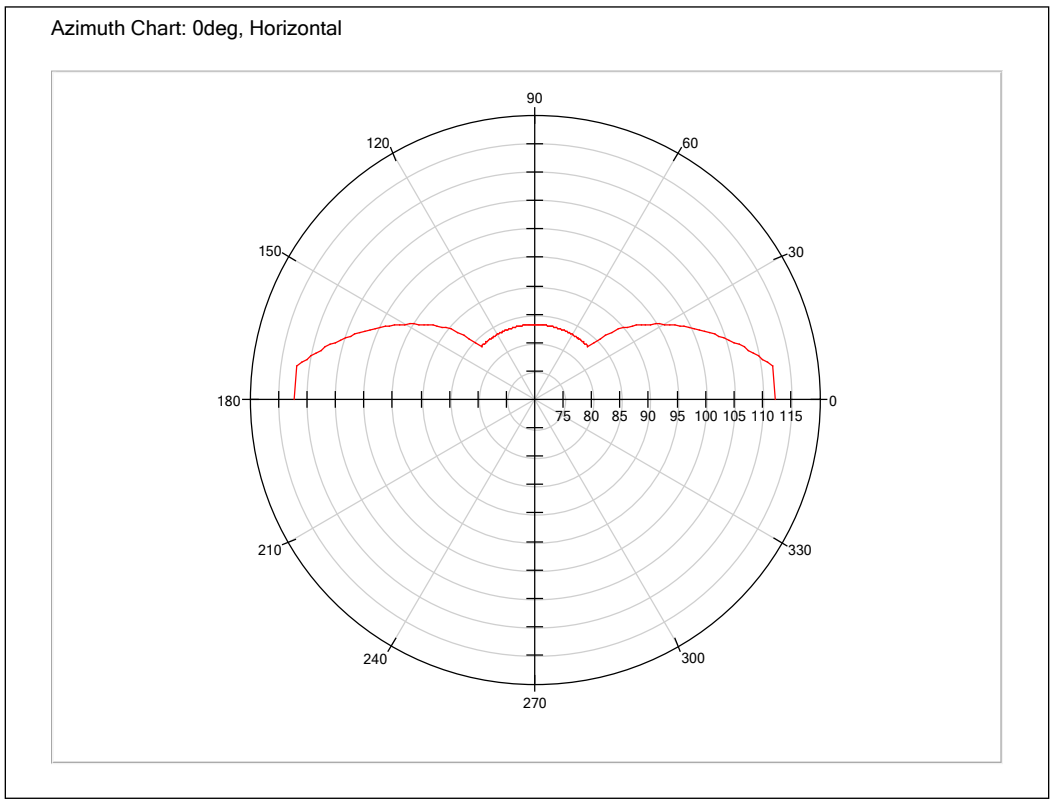

Figure A1 — Polar plot of elevation mask converted to dBuV/m at 3 m

Note: In the above plot the Earth's horizon is positioned horizontally, along the 0°-180° degrees line.

Method 2 – Antenna radiation pattern

This method can only be used if an accurate antenna pattern for elevation is provided by the manufacturer. The elevation plot must show sufficient attenuation to assess compliance with the elevation mask. The manufacturer's installation instructions must be consulted for any installation tilt recommendations.

(1) Use the value of the maximum conducted power spectral density measured under section 6.2.2 to change the values on the amplitude axis of the antenna pattern such that it reads in e.i.r.p. density:

$$\text{e.i.r.p. density} = PSD_{MAX} + G$$

e.i.r.p. density = equivalent isotropically radiated power density in dBW/MHz
PSD_{MAX} = maximum conducted output power spectral density (expressed in dBW and based on a 1MHz measurement bandwidth);
G = antenna gain in dBi

If the antenna pattern provided by the manufacturer is normalized, also add the maximum gain value in dBi:

$$\text{e.i.r.p. density} = PSD_{MAX} + G_{Norm} + G_{MAX}$$

G_{Norm} = the normalized gain value, in dB (original amplitude axis of the antenna pattern)
G_{MAX} = the maximum antenna gain value, in dBi

(2) On the same polar plot, updated as per the above, draw the horizon mask according to the specification detailed in section 6.2.2.3.

(3) The 0° point can be rotated if required to make the DUT comply with the horizon mask. The tilt angle required to comply with the mask will represent the minimum installation tilt. This value should be inserted into the user manual to clearly identify the installation requirements to remain compliant with section 6.2.2.3 under post-installation conditions.

The following figure is an example of the application of this method:

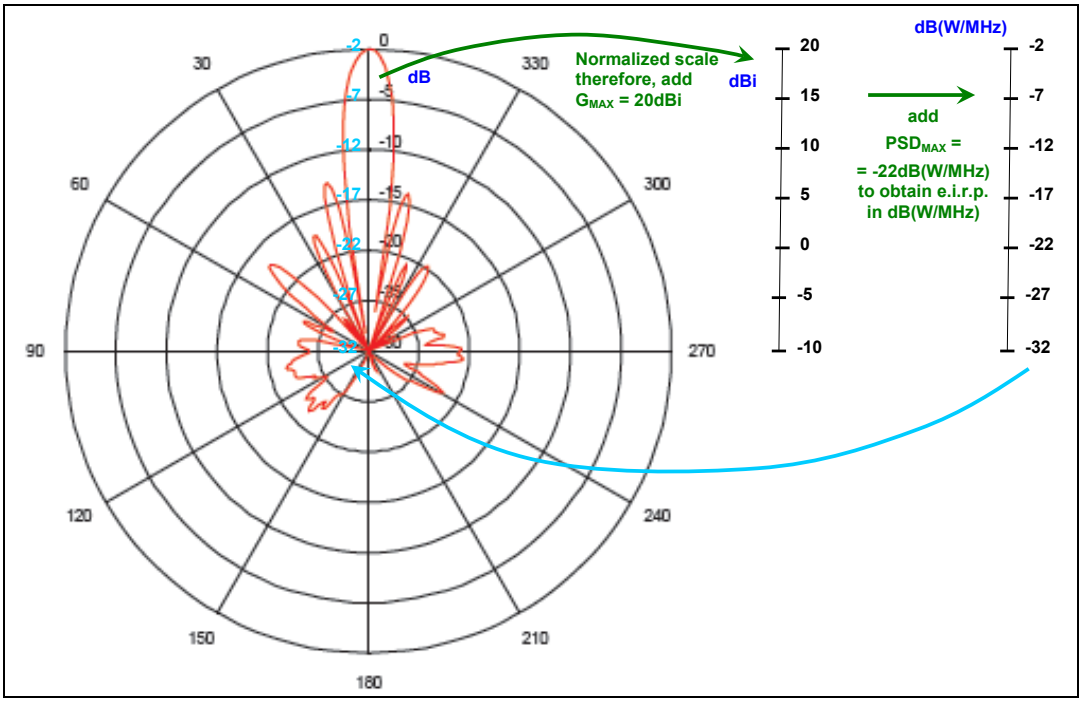

Figure A2 — Example of the application of Method 2

As seen in Figure A2, this particular antenna does not meet section 6.2.2.3 requirements, as its e.i.r.p. density is higher than -13 dB (W/MHz) at 0 degrees and higher than -42 dB (W/MHz) at more than 45 degrees.