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Devices Using Ultra-Wideband (UWB) Technology

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Preface

Radio Standards Specification RSS-220, Issue 1, *Devices Using Ultra-Wideband (UWB) Technology*, is a new standard for devices using UWB technology.

This document will be in force as of the publication date of Notice No. SMSE-007-09 in *Canada Gazette*, Part I. Upon publication, the public has 120 days to submit comments. These comments will be taken into account in the preparation of the next version of the document.

Issued under the authority of
the Minister of Industry

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Contents

1. Scope

This document, RSS-220, establishes provisions for short-range devices using ultra-wideband (UWB) technology such as vehicular radar devices; communication (communication, measurement, location sensing, and tracking) devices; and radar imaging (ground penetrating radar (GPR), in-wall radar imaging, through-wall radar imaging, medical radar imaging, and radar surveillance) devices.

2. General Information

Ultra-wideband is a short-range radiocommunication technology involving the intentional generation and transmission of radio frequency energy that spreads over a very large frequency range, which may overlap several frequency bands allocated to various radiocommunication services.

A *UWB device* is an intentional radiator that has either a *-10 dB bandwidth*[1] of at least 500 MHz or a *-10 dB fractional bandwidth*[2] greater than 0.2. There are eight distinct subclasses of UWB device.

3. General Requirements

Devices using UWB technology subject to this standard are classified as Category I Equipment. A technical acceptance certificate (TAC), issued by the Certification and Engineering Bureau of Industry Canada, or a certificate, issued by a Certification Body (CB), is required.

3.1 RSS-Gen Compliance

RSS-220 shall be used in conjunction with RSS-Gen, *General Requirements and Information for the Certification of Radiocommunication Equipment*, for general specifications and information relevant to the equipment for which this standard applies.

3.2 Test Reports

In addition to the requirements listed in RSS-Gen, the test report shall indicate whether there is a data port in the radio terminal. The subclass of UWB device must be clearly stated in the test report.

3.3 Transmitter with External Frequency Selection Controls

In order to prevent radio interference caused by end-user transmissions on unauthorized frequencies, transmitters with external frequency selection controls and/or frequency programming capability shall conform to the following:

1 See section 2 of the Annex for definitions.

2 See section 2 of the Annex for definitions.

(a) Transmitters with external frequency selection controls shall operate only on authorized channels that have been preset by the manufacturer, equipment supplier or service technician/maintenance personnel.

(b) Transmitters with frequency programming capability shall have at least one of the following design characteristics that prevent the user from altering the preset frequencies:

(1) transmitters with external controls available to the user can only be internally modified to place the equipment in the programmable mode. Furthermore, while in the programmable mode, the equipment is not able to transmit. The procedure for making the modification and altering the frequency program is not available to the user of the equipment; or

(2) transmitters are programmed for frequencies through controls inaccessible to the user; or

(3) transmitters are programmed for frequencies through use of external devices or specifically programmed modules made available only to service/maintenance personnel; or

(4) transmitters are programmed through cloning (i.e. copying a program directly from another transmitter) using devices and procedures that are only available to service/maintenance personnel.

3.4 Radiated Emissions at or Below 960 MHz

Radiated emissions at or below 960 MHz for all subclasses of UWB device shall not exceed the following limits. Measurements of radiated emissions at and below 960 MHz are to be made using a CISPR quasi-peak detector. CISPR measurement bandwidth specifications are to be used.

Frequency (MHz)	**Field Strength (Microvolts/m)**	**Measurement Distance (Metres)**	**E.i.r.p. (dBmW)**
0.009-0.490	2,400/F (F in kHz)	300	10 log (17.28 / F^2) (F in kHz)
0.490-1.705	24,000/F (F in kHz)	30	10 log (17.28 / F^2) (F in kHz)
1.705-30	30	30	-45.7
30-88	100	3	-55.2
88-216	150	3	-51.7
216-960	200	3	-49.2

Note: The emission limits for the bands 9-90 kHz and 110-490 kHz are based on measurements employing an average emissions detector.

4. Vehicular Radar Devices Using UWB Technology

Vehicular radar device: a field disturbance sensor mounted on land transportation vehicles to detect the location and movement of persons or objects near a vehicle, also known as an automotive short-range radar (SRR) device.

4.1 Standard Specifications

(a) The -10 dB bandwidth of a vehicular radar device shall be totally contained in the band 22-29 GHz.

(b) The centre frequency, f_C, and the frequency, at which the highest emission level occurs, f_M, shall be greater than 24.075 GHz.

(c) Radiated emissions at or below 960 MHz from a device shall not exceed the limits in section 3.4.

(d) Radiated emissions above 960 MHz from a device shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz.

Frequency	E.i.r.p. in a Resolution Bandwidth of 1 MHz
960-1 610 MHz	-75.3 dBm
1 610-22 000 MHz	-61.3 dBm
22 000-29 000 MHz	-41.3 dBm
29 000-31 000 MHz	-51.3 dBm
Above 31 000 MHz	-61.3 dBm

(e) In addition to the limits specified in paragraph (d) of this section, radiated emissions shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz. The measurements shall demonstrate compliance with the stated limits at whatever resolution bandwidth is used.

Frequency	E.i.r.p. in a Resolution Bandwidth of ≥ 1 kHz
1 164-1 240 MHz	-85.3 dBm
1 559-1 610 MHz	-85.3 dBm

(f) Within the tables in paragraphs (d) and (e) above, the tighter emission limit applies at the band edges.

(g) Following proper installation of a vehicular radar device, any emissions from the device within the 23.6-24 GHz band that appear at or greater than 30 degrees above the horizontal plane shall not exceed -66.3 dBm/MHz.

For equipment certified, manufactured or imported on or after January 1, 2010, these emissions shall not exceed -71.3 dBm/MHz.

For equipment certified, manufactured or imported on or after January 1, 2014, these emissions shall not exceed -76.3 dBm/MHz.

(h) The peak level of the transmissions shall not exceed the peak equivalent of the average limit contained within any 50 MHz bandwidth, as defined in section 4 of the Annex.

5. Communication Devices Using UWB Technology

5.1 General Requirements and Specifications

The following general provisions apply to both indoor and hand-held communication devices.

(a) The -10 dB bandwidth of the device shall be totally contained in the band 3.1-10.6 GHz.

(b) The antenna of the UWB device shall be factory-installed and shall not be made modifiable by users.

5.2 Indoor Communication Devices

Indoor communications device: a device designed to transfer voice or data information, to detect the location of tags, or to serve as an underground field disturbance sensor.

5.2.1 Standard Specifications

(a) Indoor UWB communications devices, by the nature of their design, shall be capable of operation only indoors or in locations completely enclosed by walls and a ceiling. The necessity to operate within a fixed indoor infrastructure (e.g., a transmitter that must be connected to the AC power lines, an enclosure that is not weatherproof, etc.) may be considered sufficient to meet this requirement.

(b) AC line-conducted emissions from the device shall comply with the limits for AC line-conducted emissions set out in RSS-Gen.

(c) Radiated emissions at or below 960 MHz from a device shall not exceed the limits in section 3.4.

(d) Radiated emissions above 960 MHz from a device shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz.

Indoor Communication, Measurement, Location Sensing and Tracking Devices	
Frequency	**E.i.r.p. in a Resolution Bandwidth of 1 MHz**
960-1 610 MHz	-75.3 dBm
1.61-4.75 GHz	-70.0 dBm
4.75-10.6 GHz	-41.3 dBm
Above 10.6 GHz	-51.3 dBm

(e) In addition to the limits specified in paragraph (d) of this section, radiated emissions shall not exceed the following average limits when measured using a resolution bandwidth greater than or equal to 1 kHz. The measurements shall demonstrate compliance with the stated limits at whatever resolution bandwidth is used.

Frequency	E.i.r.p. in a Resolution Bandwidth of no less than 1 kHz
1 164-1 240 MHz	-85.3 dBm
1 559-1 610 MHz	-85.3 dBm

(f) Within the tables in paragraphs (d) and (e) above, the tighter emission limit applies at the band edges.

(g) The peak level of the transmissions shall not exceed the peak equivalent of the average limit contained within any 50 MHz bandwidth, as defined in section 4 of the Annex.

5.3 Hand-held Communication Devices

Hand-held communications device: a device used to transfer voice or data information or designed to detect the location of tags.

5.3.1 Standard Specifications

(a) The device shall be designed so as to prevent its connection to antennas mounted on outdoor structures, e.g., antennas mounted on the outside of a building or on a telephone pole, or any fixed outdoors infrastructure.

(b) The device is to transmit only when it is sending information to an associated receiver. The device shall cease transmission of information within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received. An acknowledgment of reception must continue to be received by the UWB device at least every 10 seconds or the UWB device shall cease transmitting any information other than periodic signals used for the establishment or re-establishment of a communication link with an associated receiver.

(c) Radiated emissions at or below 960 MHz from a device shall not exceed the limits in section 3.4.

(d) Radiated emissions above 960 MHz from a device shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz.

Hand-held (Outdoor) Communication, Measurement, Location Sensing, and Tracking Devices	
Frequency	**E.i.r.p. in a Resolution Bandwidth of 1 MHz**
960-1 610 MHz	-75.3 dBm
1.61-4.75 GHz	-70.0 dBm
4.75-10.6 GHz	-41.3 dBm
Above 10.6 GHz	-61.3 dBm

(e) In addition to the limits specified in paragraph (d) of this section, radiated emissions shall not exceed the following average limits when measured using a resolution bandwidth greater than or equal to 1 kHz. The measurements shall demonstrate compliance with the stated limits at whatever resolution bandwidth is used.

Frequency	E.i.r.p. in a Resolution Bandwidth of no less than 1 kHz
1 164-1 240 MHz	-85.3 dBm
1 559-1 610 MHz	-85.3 dBm

(f) Within the tables in paragraphs (d) and (e) above, the tighter emission limit applies at the band edges.

(g) The peak level of the transmissions shall not exceed the peak equivalent of the average limit contained within any 50 MHz bandwidth, as defined in section 4 of the Annex.

6. Radar Imaging Devices Using UWB Technology

Radar imaging: a category of field disturbance sensors used to obtain images of obstructed objects. This category includes ground penetrating radar (GPR), in-wall radar imaging, through-wall radar imaging, medical radar imaging, and radar surveillance devices.

6.1 General Provisions Applicable to UWB Radar Imaging Devices

UWB radar imaging devices may not be designed to detect tags or transfer data or voice information.

6.2 Ground Penetrating Radar (GPR) and In-wall Radar Imaging Devices

Ground penetrating radar: a field disturbance sensor that operates when in contact with or within 1 m of the ground for the purpose of detecting or mapping subsurface structures. While primarily used for examining “underground,” the term “ground” can be expanded to mean any lossy dielectric material. The energy from the GPR is intentionally directed down into the ground for this purpose.

In-wall radar imaging device: a field disturbance sensor that is designed to examine and map the interior of walls. The walls are usually made of a concrete structure or similar dense, impermeable material that absorbs much of the impinging radio-wave energy. Typical walls include reinforced concrete building walls, retaining walls, tunnel liners, the walls of a mine, the sides of a bridge, or another physical structure that is dense enough and thick enough to dissipate and absorb most of the signal transmitted by the imaging device.

In addition to the labelling requirements of RSS-Gen, the GPR device user manual shall also contain the following statements or equivalent:

> *This Ground Penetrating Radar Device shall be operated only when in contact with or within 1 m of the ground.*
>
> *This Ground Penetrating Radar Device shall be operated only by law enforcement agencies, scientific research institutes, commercial mining companies, construction companies, and emergency rescue or firefighting organizations.*

In addition to the labelling requirements of RSS-Gen, the in-wall radar imaging device user manual shall also contain the following or equivalent statements:

> *This In-wall Radar Imaging Device shall be operated where the device is directed at the wall and in contact with or within 20 cm of the wall surface.*
>
> *This In-wall Radar Imaging Device shall be operated only by law enforcement agencies, scientific research institutes, commercial mining companies, construction companies, and emergency rescue or firefighting organizations.*

6.2.1 Standard Specifications

(a) The -10 dB UWB bandwidth for GPR or an in-wall radar imaging device shall be entirely below 10.6 GHz.

(b) A device operating under the provisions of this section shall contain a mechanism that deactivates the equipment when normal use is interrupted. For manually operated hand-held devices, this mechanism shall contain a manual switch that causes the transmitter to cease operation within 10 seconds of being released by the operator. In lieu of remotely/computer controlled equipment with a switch located on the radar imaging device, it is permissible to operate the device by a remote control unit provided that deactivation takes place within 10 seconds of the remote switch being released by the operator.

(c) Radiated emissions at or below 960 MHz from a device shall not exceed the limits in section 3.4.

(d) Radiated emissions above 960 MHz from a device shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz.

Frequency in MHz	E.i.r.p. in a Resolution Bandwidth of 1 MHz
960-1 610 MHz	-65.3 dBm
1 610-1 990 MHz	-53.3 dBm
1 990-3 100 MHz	-51.3 dBm
3 100-10 600 MHz	-41.3 dBm
Above 10 600 MHz	-51.3 dBm

(e) In addition to the limits specified in paragraph (d) of this section; radiated emissions shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz. The measurements shall demonstrate compliance with the stated limits at whatever resolution bandwidth is used.

Frequency	E.i.r.p. in a Resolution Bandwidth ≥ 1 kHz
1 164-1 240 MHz	-75.3 dBm
1 559-1 610 MHz	-75.3 dBm

(f) Within the tables in the paragraphs (d) and (e) above, the tighter emission limit applies at the band edges.

(g) The peak level of the transmissions shall not exceed the peak equivalent of the average limit contained within any 50 MHz bandwidth, as defined in section 4 of the Annex.

6.3 Through-wall Radar Imaging

Through-wall radar imaging device: a field disturbance sensor used to transmit energy through an opaque structure, such as a wall or a ceiling, to detect the movement or location of persons or objects that are located on the other side.

In addition to the labelling requirements of RSS-Gen, the device user manual shall also contain the following statement or equivalent:

> *This Through-wall Radar Imaging Device shall be operated only by law enforcement agencies or emergency rescue or firefighting organizations that are under a local, provincial or federal authority. The equipment is to be operated only in providing services and for necessary training operations.*

6.3.1 Standard Specifications

(a) The -10 dB UWB bandwidth of a through-wall radar imaging device shall be totally contained either below 960 MHz or the centre frequency, f_C, and the frequency, at which the highest emission level occurs, f_M, shall be contained in the band 1.99-10.6 GHz.

(b) A device operating under the provisions of this section shall contain a manually operated switch that causes the transmitter to cease operation within 10 seconds of being released by the operator. It is permissible to operate an imaging device by remote control provided that the imaging device ceases transmission within 10 seconds of the remote switch being released by the operator.

(c) Radiated emissions at or below 960 MHz from a device shall not exceed the limits in section 3.4.

(d) Radiated emissions above 960 MHz from a device shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz.

For Devices with -10 dB Bandwidth ≤ 960 MHz	
Frequency	**E.i.r.p. in a Resolution Bandwidth of 1 MHz**
960-1 610 MHz	-65.3 dBm
1 610-1 990 MHz	-53.3 dBm
Above 1 990 MHz	-51.3 dBm

For Devices with f_c and f_M between 1.99 and 10.6 GHz	
Frequency	**E.i.r.p. in a Resolution Bandwidth of 1 MHz**
960-1 610 MHz	-46.3 dBm
1 610-10 600 MHz	-41.3 dBm
Above 10 600 MHz	-51.3 dBm

(e) In addition to the limits specified in paragraph (d) of this section, radiated emissions shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz. The measurements shall demonstrate compliance with the stated limits at whatever resolution bandwidth is used.

For Devices with -10 dB Bandwidth ≤ 960 MHz	
Frequency	**E.i.r.p. in a Resolution Bandwidth ≥ 1 kHz**
1 164-1 240 MHz	-75.3 dBm
1 559-1 610 MHz	-75.3 dBm

For Devices with f_c and f_M between 1.99 and 10.6 GHz	
Frequency	**E.i.r.p. in a Resolution Bandwidth ≥ 1 kHz**
1 164-1 240 MHz	-56.3 dBm
1 559-1 610 MHz	-56.3 dBm

(f) Within the tables in paragraphs (d) and (e) above, the tighter emission limit applies at the band edges.

(g) The peak level of the transmissions shall not exceed the peak equivalent of the average limit contained within any 50 MHz bandwidth, as defined in section 4 of the Annex.

6.4 Radar Surveillance Devices

Radar surveillance device: a field disturbance sensor used to establish a stationary radio frequency perimeter field that is used for security purposes to detect the intrusion of persons or objects.

In addition to the labelling requirements of RSS-Gen, the device user manual shall also contain the following statement or equivalent:

> *This Radar Surveillance Device shall be installed in a manner that minimizes radiated emissions beyond the property line of the area under surveillance.*
>
> *This Radar Surveillance Device shall be operated only by military, law enforcement, emergency rescue or firefighting organizations that are under a local, provincial or federal authority. The equipment is to be operated only in providing services and for necessary training operations.*

6.4.1 Standard Specifications

(a) The -10 dB UWB bandwidth of a radar surveillance device shall be totally contained in the band 1.99-10.6 GHz.

(b) Radiated emissions at or below 960 MHz from a device shall not exceed the limits in section 3.4.

(c) Radiated emissions above 960 MHz from a device shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz.

Frequency	E.i.r.p. in a Resolution Bandwidth of 1 MHz
960-1 610 MHz	-53.3 dBm
1 610-1 990 MHz	-51.3 dBm
1 990-10 600 MHz	-41.3 dBm
Above 10 600 MHz	-51.3 dBm

(d) In addition to the limits specified in paragraph (c) of this section, radiated emissions shall not exceed the following average limits when measured using a resolution bandwidth greater than or equal to 1 kHz. The measurements shall demonstrate compliance with the stated limits at whatever resolution bandwidth is used.

Frequency	E.i.r.p. in a Resolution Bandwidth ≥ 1 kHz
1 164-1 240 MHz	-63.3 dBm
1 559-1 610 MHz	-63.3 dBm

(e) Within the tables in paragraphs (c) and (d) above, the tighter emission limit applies at the band edges.

(f) The peak level of the transmissions shall not exceed the peak equivalent of the average limit contained within any 50 MHz bandwidth, as defined in section 4 of the Annex.

6.5 Medical Radar Imaging Devices

Medical radar imaging device: a field disturbance sensor used to detect the location or movement of objects inside the body of a human or an animal.

In addition to the labelling requirements of RSS-Gen, the device user manual shall also contain the following statement or equivalent:

> *This Medical Radar Imaging Device shall be operated only in hospitals and health-care facilities, and only at the direction or under the supervision of a health-care practitioner.*

6.5.1 Standard Specifications

(a) The -10 dB UWB bandwidth of a medical radar imaging device shall be totally contained in the band 3.1-10.6 GHz.

(b) A medical radar imaging device shall contain a manually operated switch that causes the transmitter to cease operation within 10 seconds of being released by the operator. It is permissible to operate an imaging device by remote control provided that the imaging device ceases transmission within 10 seconds of the remote switch being released by the operator.

(c) Radiated emissions at or below 960 MHz from a device shall not exceed the limits in section 3.4.

(d) Radiated emissions above 960 MHz from a device shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz.

Frequency	E.i.r.p. in a Resolution Bandwidth of 1 MHz
960-1 610 MHz	-65.3 dBm
1 610-1 990 MHz	-53.3 dBm
1 990-3 100 MHz	-51.3 dBm
3 100-10 600 MHz	-41.3 dBm
Above 10 600 MHz	-51.3 dBm

(e) In addition to the limits specified in paragraph (d) of this section, radiated emissions shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz. The measurements shall demonstrate compliance with the stated limits at whatever resolution bandwidth is used.

Frequency	E.i.r.p. in a Resolution Bandwidth ≥ 1 kHz
1 164-1 240 MHz	-75.3 dBm
1 559-1 610 MHz	-75.3 dBm

(f) Within the tables in paragraphs (d) and (e) above, the tighter emission limit applies at the band edges.

(g) The peak level of the transmissions shall not exceed the peak equivalent of the average limit contained within any 50 MHz bandwidth, as defined in section 4 of the Annex.

7. Measurement Requirements

Techniques and procedures for measuring average and peak transmission power levels from devices using UWB technology are provided in the Annex.

Annex - Measurement of Transmission Levels from Devices Using UWB Technology

1. Overview

This annex provides techniques and procedures for measuring average and peak transmission power levels from devices using UWB technology.

2. Definitions

The following definitions apply:

Average power: the power measured within a 1 MHz resolution bandwidth (unless a different resolution bandwidth is specified) and an averaging time of one millisecond or less. The reference to a one millisecond or less averaging time denotes the integration time period for each bin on the spectrum analyzer.

Equivalent isotropically radiated power (e.i.r.p.): the highest signal strength measured in any direction and at any frequency from the UWB device, and tested in accordance with the procedures specified below. E.i.r.p. is calculated as the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna.

Peak power: the peak level of transmission contained within a 50 MHz bandwidth centred on the frequency at which the highest average radiated power occurs (f_M). If a resolution bandwidth (RBW) other than 50 MHz is employed, the peak e.i.r.p. limit shall be $20\log(\text{RBW}/50)$ dBm where RBW is in units of megahertz.

"-10 dB bandwidth B_{-10}" and "-10 dB fractional bandwidth μ_{-10}" are defined as follows:

$$B_{-10} = f_H - f_L$$
$$\mu_{-10} = B_{-10}/f_C$$

where:

f_M is the frequency of maximum UWB transmission;
f_H is the highest frequency at which the power spectral density of the UWB transmission is -10 dB relative to f_M;
f_L is the lowest frequency at which the power spectral density of the UWB transmission is -10 dB relative to f_M; and
$f_C = (f_H + f_L)/2$ is the centre frequency of the -10 dB bandwidth.

3. Measurement Environment

Measuring transmissions from devices using UWB technology requires a measurement system that comprises a receiving antenna and a test receiver. Several receiving antennas, each optimized over a distinct frequency range, are required when measuring the complete spectrum of the UWB device. The measurement receiver may be a spectrum analyzer, an electromagnetic interference test receiver, a vector signal analyzer or an oscilloscope. Due to possible receiver bandwidth dependent variations, measuring a UWB spectrum requires using several signal detectors, including a peak detector for determining the peak power in the spectrum above 960 MHz.

The low power levels of UWB transmissions make it desirable to take the measurement in an anechoic or a semi-anechoic chamber.[3] A measurement taken in an anechoic chamber must correlate with a measurement taken in a semi-anechoic chamber. This is usually done by adjusting for the effect of the ground screen in a semi-anechoic environment or an open area test site. For frequencies above 960 MHz, there is no need for a propagation correction factor given that ground reflection is not significant when directional antennas are employed and when the floor is treated with radio frequency (RF) absorbers.

In cases where the transmission level from the UWB device is too weak to overcome the noise of a conventional spectrum analyzer, a low-noise amplifier (LNA) shall be used. The LNA shall have sufficient bandwidth at the output of the measurement antenna to reduce the effective noise figure of the overall measurement system. This increased sensitivity of the measurement system can make it particularly vulnerable to ambient environmental signals. If strong ambient signals are present in the measurement environment, an appropriate RF filter shall be placed ahead of the LNA. Doing so will provide the pre-selection necessary to prevent amplifier overload while permitting signals in the frequency range of interest to pass through the measurement system. The insertion loss associated with this filter shall be minimal and shall also be considered when determining the overall sensitivity of the measurement system.

4. Measurement Techniques and Procedures

The following provisions apply when measuring average and peak transmission power levels from any device using UWB technology:[4]

(a) Measurements of radiated emissions at and below 960 MHz are to be made using a CISPR quasi-peak detector.

(b) Measurements of radiated emissions above 960 MHz are to be made using a root-mean-square (RMS) average detector having a 1 MHz resolution bandwidth.[5] The averaging time shall be one millisecond or less.

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3 Please refer to section 5 of this Annex for testing GPR and wall imaging devices.

4 These measurements are also used to determine parameters such as the centre frequency of the UWB transmission, the -10 dB bandwidth, etc.

5 Alternative measurement procedures may be considered by Industry Canada.

(c) Peak measurements shall be made in addition to average measurements. Transmissions shall not exceed 0 dBm e.i.r.p. in any 50 MHz bandwidth when the average limit is -41.3 dBm/MHz. This is the equivalent peak limit as calculated by combining the 6 dB peak-to-average conversion with a resolution bandwidth (RBW) scaling factor of 20 log(1 MHz/50 MHz). Only the 50 MHz bandwidth, centred on the frequency f_M where the highest power occurs, needs to be measured to satisfy the peak requirements for all frequencies. A different resolution bandwidth and a correspondingly different peak limit may also be used, in which case the RBW may be set anywhere between 1 MHz and 50 MHz. The peak e.i.r.p. limit is then calculated as 20 log(RBW/50) dBm where the RBW is in MHz. This may be converted to a peak field strength level at 3 metres using E(dBuV/m) = P(e.i.r.p.(dBm)) + 95.2. If the RBW is greater than 3 MHz, the application for certification shall contain a detailed description of the test procedure, the calibration of the test set-up and the instrumentation used in the testing.

(d) For a device under test (DUT) with an external modulation connector, the test data used as input into the DUT shall be similar to the data transmitted during normal operation. For UWB communication devices, data patterns for the fixed part of control signals and frame structures shall be used. However, pseudo-random data patterns may be used for the message part of the signal.

(e) If the transmitter uses pulse gating, measurement shall be made with the gating active.

(f) The measurement of average and peak transmission levels for hopped, stepped, sequenced or gated devices shall be repeated over multiple sweeps with the analyzer set for maximum hold until the amplitude stabilizes.

(g) If the UWB device operates using a different number of hopped, stepped or sequenced channels, the device shall comply with the UWB transmission limits under all possible operating conditions.

(h) The highest frequency used to determine the frequency range over which measurements are made (from RSS-Gen provisions for transmitter unwanted emissions) shall be based on the centre frequency (f_C). The spectrum shall be investigated from the lowest frequency generated in the UWB transmitter, without going below 9 kHz, to the highest frequency indicated in RSS-Gen or up to f_C +3/(pulse width in seconds), whichever is higher.

- If the centre frequency is less than 10 GHz, there is no requirement to measure beyond 40 GHz.
- If the centre frequency is at or above 10 GHz and below 30 GHz, there is no requirement to measure beyond 100 GHz.
- If the centre frequency is at or above 30 GHz, there is no requirement to measure beyond 200 GHz.

(i) For a measurement procedure below 960 MHz and when the reflection from the ground screen cannot be eliminated, the following procedure is to be used:[6]

- Examine the transmission in small frequency segments such that reflections, gains and losses do not vary significantly over the segment.

6 Industry Canada may consider alternative measurement procedures.

- For tabletop-sized devices, place the DUT on a non-conducting surface at a height of 80 cm.
- Use conventional device rotation and elevation searches to maximize reception of the transmission.
- Take a measurement.
- Factor in gains and losses and consider the ground screen contribution if applicable.
- Take sufficient measurements both in azimuth and elevation to ascertain that the maximum transmission value has been recorded.
- Repeat at each frequency of interest.

(j) For a measurement procedure above 960 MHz in a semi-anechoic chamber, the floor between the DUT and the receiving antenna is to be treated with an RF absorber to remove the ground screen influence. A scan of the receiving antenna between 1 and 4 metres shall show a maximum emission near the height at which the DUT has been positioned, if the floor has been properly treated. Note that for a free-space measurement, there is no requirement to maintain a height of 80 cm for the DUT. The DUT may be positioned at any height that minimizes reflections from the floor. A highly directional receiving antenna helps in reducing the effect of the ground screen reflection. The measurement shall be recorded without correction for the ground reflection. For tabletop-sized DUT, the following procedure is to be used:[7]

- Place the DUT on a non-conducting surface at an appropriate height.
- The floor between the receiving antenna and the DUT shall be treated with material to absorb RF energy suitable for the frequency range being measured.
- Vary the height of the receiving antenna to verify that reflections from the floor have been minimized. It may be necessary to alter the height of the DUT to achieve the lowest reflections from the floor. The main lobe of the receiving antenna shall not receive a floor reflection. The receiving antenna height is to remain fixed throughout the measurement.
- Take a measurement.
- Factor in the gains and losses. The addition of absorbers in the reflected path eliminates the ground screen contribution.
- Take sufficient measurements both in azimuth and elevation to ensure that the maximum value has been recorded.
- Repeat for each frequency of interest.

(k) The DUT is to be oriented so as to ensure the reception of the maximum radiated signal. Determining this orientation can be made easier by using a non-conductive turntable or other form of positioning system to systematically search for the orientation that provides the maximum response within the measurement system. Regardless of how the orientation is determined, a sufficient number of radials shall be considered to determine the radial at which the maximum response is captured by the measurement system.

(l) A separation distance of three metres shall be used between the transmitting antenna of the DUT and the receiving antenna. In some cases, it may not be possible to measure UWB transmission levels without amplification and/or reducing the separation between the transmitting antenna and the receiving antenna. In such cases, care shall be exercised to maintain the far field condition.

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7 Industry Canada may consider alternative measurement procedures.

(m) Emissions from digital circuitry (used only to enable the operation of the UWB transmitter and that does not control additional functions or capabilities) shall comply with the average and peak power limits applicable to the UWB transmitter. If it can be clearly demonstrated that an emission from a UWB transmitter is due solely to emissions from digital circuitry contained within the transmitter, and that the emission is not intended to be radiated from the transmitter's antenna, the limits for emissions from digital circuitry prescribed in RSS-Gen apply to that emission rather than the UWB limits.

(n) Spurious emissions from an UWB receiver are subject to the requirements prescribed in RSS-Gen.[8]

(o) A device using UWB technology that contains digital circuitry not directly associated with the operation of the transmitter is also subject to the requirements for digital circuits prescribed in RSS-Gen.

5. Measurement Variations for Ground Penetrating Radar and Wall Imaging Radar Devices

Ground penetrating radar (GPR) and wall imaging radar devices shall be compliance-tested under conditions that are representative of normal operating conditions.

One method is to place the GPR or wall imaging radar device directly over a bed of sand of at least 50 cm in depth. The area of the sand-bed should be adequate to accommodate the DUT transducer (antenna). Measurements are then performed at an adequate number of radials and antenna height steps to determine the maximum radiated emission level. If this methodology precludes the use of a ground screen, the measured data should be further adjusted to account for the ground screen contribution.

An alternative method for testing GPR devices is to place the DUT at a height of 80 cm on a non-conducting support with the emitter directed downwards. If the DUT emissions are expected to have components below 500 MHz, a layer of ferrite tile should be placed directly on the floor below the DUT. Pyramidal or wedge-shaped RF absorbers not less than 60 cm in height should be placed directly below the DUT. Some sections of absorber may be inverted and placed over other absorbers to form a solid block. Care shall be taken not to place any RF absorber between the device and the search antenna, as this would prevent energy not directed downwards from reflecting from the ground screen. The placement of the absorber shall not be disturbed when the device is rotated. This arrangement prevents energy directed downwards from consideration in the measurement. A search in azimuth and elevation for indirect emissions may now be performed.

8 For vehicular radar emissions in the ISM band (between 24 GHz and 24.25 GHz) attributed to receiver spurious emissions, it is acceptable to have an e.i.r.p. as high as the limit prescribed in section 3.10 of RSS-310.