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Spectrum Management and Telecommunications

Supplementary Procedure

Supplementary Procedure for Assessing Compliance with RSS-102 Nerve Stimulation Exposure Limits

Aussi disponible en français – PRS-002

Preface

This Innovation, Science and Economic Development Canada measurement procedure describes the various technical requirements and processes to be followed when demonstrating compliance with the nerve stimulation exposure requirements of RSS-102. This includes any radio apparatus that emits energy in the 3 kHz to 10 MHz frequency range.

Enquiries concerning this measurement procedure may be directed to the following address:

Innovation, Science and Economic Development Canada
Certification and Engineering Bureau
3701 Carling Avenue
Ottawa, Ontario K2H 8S2
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Contents

1. Scope

Supplementary Procedure SPR-002, Issue 1, for Radio Standards Specification RSS-102 sets out the general test methods to be followed when carrying out an assessment to the nerve stimulation exposure requirements of RSS-102.

SPR-002 covers the instantaneous requirements for Radio Frequency (RF) field strengths (reference levels) based on the effects of internal electric fields; however, it does not cover any requirements that are based on *in situ* (internal) electric fields or specific absorption rates (SAR). A full compliance assessment of a device under test, including other transmitters within the device, must also consider all exposure limits of RSS-102. Exposure limits must be assessed in conjunction with the requirements associated with nerve stimulation. All guidance in this document is solely for demonstrating compliance with nerve stimulation reference levels. Compliance and methods to all other requirements are contained in the documents outlined in RSS-102.

SPR-002 focuses on typical radio apparatus that employ continuous wave (CW) or narrowband pulse waveforms, including but not limited to pulsed CW. For assessments of apparatus employing complex broadband pulse waveforms, including but not limited to trapezoidal or triangular waveforms, the exposure is assessed using the maximum instantaneous value of the waveform as defined in Health Canada's *Safety Code 6 Technical Guide*. For any other method of analysis, contact Innovation, Science and Economic Development Canada for further guidance.

Examples of devices used between 3 kHz and 10 MHz include, but are not limited to, electronic article surveillance (EAS) systems, metal detectors, radio frequency identification (RFID) exciters, readers and tags, tire pressure monitoring sensors (TPMS), vehicle security systems and wireless chargers.

2. Purpose and Application

This RSS-102 Supplementary Procedure (SPR-002) sets out the general test methods applicable to performing assessments on the nerve stimulation exposure limits on a radio apparatus that operates between 3 kHz and 10 MHz.

The annexes of this document are normative and contain specific guidance as it relates to different exposure scenarios.

3. Normative References

This measurement method (SPR-002) refers to the following publications, and references to these publications shall be made to the editions listed below.

- *Safety Code 6 — Health Canada's Radiofrequency Exposure Guidelines*
- *Technical Guide for Interpretation and Compliance Assessment of Health Canada's Radiofrequency Exposure Guidelines*
- Radio Standards Specification RSS-102, *Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)*.

The Department may consider measurement methods not covered by SPR-002 or the referenced publications. Consult the Certification and Engineering Bureau's website to determine the acceptability of any alternative measurement method, or send an email to: IC.CertificationBureau-Bureauhomologation.IC@canada.ca.

4. Definitions and Abbreviations

4.1 Definitions

Near-Field Region: A volume of space close to an antenna or other radiating structure in which the electric and magnetic fields do not have a substantial plane-wave character but vary considerably from point to point at the same distance from the source.

Far-Field Region: The space beyond an imaginary boundary around an antenna where the angular field distribution begins to be essentially independent of the distance from the antenna. In this zone, the field has a predominant plane-wave character.

Maximum r.m.s.: The "maximum r.m.s." level is considered to be the highest level measured when employing the procedures of Section 6.6.1. The procedures of Section 6.6.1 use a peak detector that is calibrated in terms of the r.m.s. equivalent voltage.

Compliance Distance: The compliance distance is the minimum separation distance from the antenna where the fields comply with the limits specified in RSS-102.

Separation Distance: The separation distance is the distance that must be maintained between the device under test and the user. This separation distance is specified by the manufacturer in the user manual as per the requirements of RSS-102. It may be greater than the compliance distance but must be based on typical usage of the device under test.

4.2 Abbreviations and Acronyms

This measurement standard utilizes the following abbreviations and acronyms:

BR Basic restriction
CW Continuous wave
EAS Electronic article surveillance
OBW Occupied bandwidth
RBW Resolution bandwidth
RF Radio frequency
RFID Radio frequency identification
RL Reference levels
r.m.s. Root mean square
SAR Specific absorption rate
SC6 Safety Code 6
TPMS Tire pressure monitoring system

4.3 Quantities

Table 1 lists the internationally accepted System of Units (SI) used throughout this document.

Table 1 — Quantities

Quantity	Symbol	Unit	Dimension
Electric Field Strength	E	volt per meter	V/m
Magnetic Field Strength	H	ampere per meter	A/m

5. Test Equipment

5.1 Test Environment

The test environment should be free of ambient signals. This may not be possible in all situations and, if required, background noise can be measured and removed from the final measurements. Further guidance on addressing ambient radio noise can be found in ANSI C63.4-2014.

The test environment shall be an open area, free of metal objects, which may influence the measurements. An example of a test site used for far-field measurements below 30 MHz can be found in ANSI C63.4-2014 or ANSI C63.10-2013; however, it is not mandatory for assessing nerve stimulation in the near field.

In situ measurements may be required and shall be carried out on three representative installations.

5.2 Measurement Probe

5.2.1 Frequency Range

The frequency range of the measurement probe should be from 3 kHz to 10 MHz, however, the frequency span may be reduced and measured with multiple probes.

The frequency range of investigation may be less than 3 kHz to 10 MHz if the characteristics of the transmitter are known and there are no emissions produced by the device outside of the investigated frequency range.

5.2.2 Probe Isotropy

To satisfy the limits of RSS-102, a 3-axis measurement must be performed, preferably with a 3-axis isotropic probe. However, as an alternative, the 3-axis measurement may be performed with a single axis probe where the measurement is repeated and summed over three axes.

The user shall declare any uncertainty associated with measurements of individual polarizations of fields where a probe does not provide simultaneous detection.

The mean deviation of the isotropic probe response shall not be greater than 1 dB.

5.2.3 Measurement Quantities

The measurement probe or probes shall be capable of measuring the H- and E-fields over the frequency range of 3 kHz to 10 MHz. The H-field shall be displayed as A/m and the E-field shall be displayed as V/m.

5.2.4 Frequency Selectivity

The probe should be capable of frequency-selective measurements with a selectable resolution bandwidth (RBW). The RBW should have a measurement bandwidth that encompasses the entire 99% occupied bandwidth of the signal under investigation to ensure that the maximum r.m.s. value is obtained. A probe that has a maximum RBW which is less than the 99% occupied bandwidth (OBW) of the signal under investigation may also be used, as long as the measurement device can provide a power integration function over the signal bandwidth. This may require additional monitoring time to ensure that the maximum level is measured.

As an alternative, a broadband probe[1] that encompasses 3 kHz to 10 MHz may also be used. Care must be taken when using broadband probes, as they cannot indicate individual spectral components; thus, any ambient levels will be incorporated into the final measurement level.

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[1] A broadband probe is permitted over the entire frequency range since the reference levels (RL) for nerve stimulation are flat across the entire frequency range.

5.2.5 Level Response

The measurement probe shall provide for a flat frequency response throughout the frequency range of 3 kHz to 10 MHz. There shall be no frequency-dependant amplitude weighting factors applied to the measurement results.

5.2.6 Probe Antenna Size

The probe antenna length or diameter shall not be greater than 11.5 cm.

6. Measurement Methods

6.1 Measurement Hierarchy

This subclause outlines the method for determining compliance of a device with the RSS-102 limits for nerve stimulation.

The evaluation hierarchy adapted is as listed in the following clauses.

6.1.1 Direct Measurement Against the RSS-102 Nerve Stimulation RLs

Direct measurement at a defined separation distance for comparison to the nerve stimulation RLs is the simplest of all measurements. The maximum measured field strength is located and compared to the RLs outlined in RSS-102.

6.1.2 Spatial Averaging Against the RSS-102 Nerve Stimulation RLs

For medium and large loops with a non-uniform field, spatial averaging measurement, as defined in Section 8, may be permitted. The spatially averaged value can then be compared to the nerve stimulation RLs outlined in RSS-102.

6.1.3 Computational Modelling Against the RSS-102 Nerve Stimulation BRs

Computational modelling, such as finite-difference time-domain (FDTD), may be used to demonstrate compliance with Table 2 — Internal Electric Field Basic Restrictions (3 kHz-10 MHz) of RSS-102. However, prior to initiating the certification process, the applicant shall consult with Innovation, Science and Economic Development Canada to determine if computational modelling is deemed acceptable for the type of radiocommunication apparatus for which regulatory compliance is sought. The applicant shall submit all information (see Annex E of RSS-102) relevant to the modelling, including an electronic copy of the simulation and modelling information required to reproduce the results. The numerical calculation or simulation software itself must be clearly identified but not included in the package. The applicant is responsible for compliance with the limits specified in this RSS, regardless of the computational model used.

6.2 Basic Calculations

The following calculations may be used to evaluate systems without consideration for the effects of phase resulting from multiple frequency and/or multiple antennas co-located in the measurement space, which may overestimate the actual result. If the result exceeds the limits, the advanced calculations described in Section 6.3 may be used.

6.2.1 Spatial Averaging

$$E_{AVG} = \frac{1}{N}\sum_{i=1}^{N}(E_{MaxRMS})_i \tag{1}$$

where:

E-field measurements above can be interchanged with H-field levels
E_{AVG} = Spatial average
E_{MaxRMS} = E-field at a measurement point
N = Number of spatially averaged points

6.2.2 Multiple Frequency Summation

$$\sum(E_m / E_{RL}) \leq 1 \tag{2}$$

where:

E_m = Measured electric field at a specific frequency
E_{RL} = Reference level limit for the electric field at the measurement frequency

$$\sum(H_m / H_{RL}) \leq 1 \tag{3}$$

where:

H_m = Measured magnetic field at a specific frequency
H_{RL} = Reference level limit for the magnetic field at the measurement frequency

6.2.3 Single Axis Summation

$$E = \sqrt{E_X{}^2 + E_Y{}^2 + E_Z{}^2} \tag{4}$$

where:

E = Isotropic E-field level
E_X = X-axis level
E_Y = Y- axis level
E_Z = Z- axis level

$$H = \sqrt{H_X^{\ 2} + H_Y^{\ 2} + H_Z^{\ 2}} \tag{5}$$

where:

H = Isotropic H-field level
H_X = X-axis level
H_Y = Y-axis level
H_Z = Z-axis level

6.3 Advanced Calculations for Sources With Multiple Antennas and/or Multiple Frequencies

The RLs for nerve stimulation and SAR are based on the total r.m.s. level. This requires that all frequency components from the apparatus be integrated together while maintaining phase information using equation (6) or (8) below, depending on the measurement performed.

In some devices, fields may be spatially and/or temporally diverse due to multiple frequency components and/or multiple antennas co-located in the measurement space. Emissions that are less than 20 dBc may be omitted from the assessment.

Measurement requires the use of a 3-axis probe with time-domain output. Sampling frequency must be at least twice the occupied bandwidth.

In the calculations of equations (6) through (9) below, the E-field measurements can be interchanged with the H-field measurements to obtain the H-field levels.

6.3.1 Measurement

Perform a time-domain measurement of the field using a 3-axis probe to obtain $E_X(t)$, $E_Y(t)$ and $E_Z(t)$. Ensure measurement duration includes at least one or more modulation periods.

6.3.2 Determine Instantaneous r.m.s. for Nerve Stimulation Evaluation

Combine $E_X(t)$, $E_Y(t)$ and $E_Z(t)$ to obtain the isotropic time-domain field $E(t)$ as follows:

$$E(t) = \sqrt{{E_X}^2(t) + {E_Y}^2(t) + {E_Z}^2(t)} \tag{6}$$

Use the instantaneous peak of $E(t)$ to calculate the instantaneous r.m.s. and compare to the RL for nerve stimulation.

6.3.3 Calculate the Normalized r.m.s. Value for SAR Evaluation

The following steps may be used to calculate the normalized r.m.s. value for SAR evaluation.

(a) Perform separate fast Fourier transforms (FFT) on $E_X(t)$, $E_Y(t)$ and $E_Z(t)$ to obtain $E_X(f)$, $E_Y(f)$ and $E_Z(f)$; where the results are complex numbers, in order to maintain magnitude and phase information in the frequency-domain for each axis.

Note: to perform the FFT, ensure the window length of time-domain signal is an integer multiple of the full modulation period in order to prevent FFT artifacts.

(b) Separately normalize $E_X(f)$, $E_Y(f)$ and $E_Z(f)$ using the frequency-dependent reference levels $ERL(f)$,

where:

$$E_{XN}(f) = E_X(f) / E_{RL}(f)$$
$$E_{YN}(f) = E_Y(f) / E_{RL}(f)$$
$$E_{ZN}(f) = E_Z(f) / E_{RL}(f)$$

(c) Perform separate inverse fast Fourier transform (IFFT) on $E_{XN}(f)$, $E_{YN}(f)$ and $E_{ZN}(f)$ to obtain $E_{XN}(t)$, $E_{YN}(t)$ and $E_{ZN}(t)$ which are time-domain fields that have been normalized to the frequency-dependent reference levels.

(d) Combine $E_{XN}(t)$, $E_{YN}(t)$ and $E_{ZN}(t)$ as follows to obtain the isotropic time-domain field $E_N(t)$ that has been normalized to the reference levels.

$$E_N(t) = \sqrt{{E_{XN}}^2(t) + {E_{YN}}^2(t) + {E_{ZN}}^2(t)} \quad \textbf{(7)}$$

(e) Calculate the r.m.s. value of $E_N(t)$ and verify that it is less than or equal to one (1) for compliance.

$$E_{RMS} = \sqrt{\frac{1}{T}\sum_{t=0}^{T} {E_N}^2(t)} \leq 1 \quad \textbf{(8)}$$

where:

T = one modulation period

6.3.4 Spatial Averaging

$$E_{AVG} = \frac{1}{N}\sum_{i=1}^{N}(E_{RMS})_i \leq 1 \qquad \textbf{(9)}$$

where:

E_{AVG} = Spatial average normalized to the reference levels
E_{RMS} = Normalized E-field at a measurement point
N = Number of spatially averaged points

6.4 Measurement Distance

The measurement distance referenced in this document is the manufacturer's declared separation distance obtained via the information in the user manual. This shall be measured as the distance from the edge of the device to the edge of the measurement probe. The separation distance must be a logical distance based on normal usage conditions. The measurement procedures contained within this procedure may be used to determine a compliant separation distance, should none be provided by the manufacturer. This distance shall be included by the manufacturer in the user manual as per Section 2.6 of RSS-102.

Care must be taken when specifying a separation distance as the distance required for nerve stimulation RL compliance may be different than the compliance distance required for SAR or *in situ* (internal) electric field compliance.

6.5 Limb Exposure Considerations

The basic restrictions are based on internal induced electric field or SAR. The relationship between the induced field and that of the exposure area is proportional; thus, in cases where the limbs are the primary point of exposure, the induced field would be less than that induced in the trunk of the human body.

When assessing compliance at the compliance distance, where limb exposure is the primary exposed condition, the following table may be used for relaxation of the RSS-102 nerve stimulation RLs.

Table 2 - Limb Exposure Limit Relaxation

Exposure Condition	Relaxation Factor	Electric Field (V/m r.m.s.)	Magnetic Field (A/m r.m.s.)
Whole Body / Torso / Head	1.0	83	90
Leg	1.5	124.5	135
Arm	2.5	207.5	225
Hand/Foot	5.0	415	450

Note: The values of the electric field and the magnetic field in Table 2 are for indication purposes only and do not supersede the levels specified in RSS-102.

A second exposure evaluation must be taken at the distance at which the trunk of the body would rest in relation to the device under test.

6.6 Measurement Methods

6.6.1 Direct Measurement Methods Against the RSS-102 Nerve Stimulation RLs

The following measurement procedures may be used for direct measurement against the RSS-102 nerve stimulation RLs. Measurements must be taken for both the E-field and H-field, since the measurement distance described in Section 6.4 will be in the near field where the relationship between the E- and H-fields is unknown.

6.6.1.1 Measurement Method When the RBW of the Measurement Probe is Greater Than the 99% OBW or When Using a Broadband Probe

When the RBW of the measurement probe is greater than the 99% OBW, or when using a broadband probe, use the following measurement method:

(a) Set the measurement frequency of the measurement probe to the fundamental frequency of the device under test.

(b) Set the span to encompass the entire emission bandwidth.

(c) Set the RBW greater than the 99% OBW of the fundamental emission.

Note: This step is not required for a broadband measurement probe that integrates the entire frequency range.

(d) Set the detector to Peak and trace display to Max-Hold.

(e) Allow the spectrum to fill; for pulsing devices this may require an increased monitoring period.

(f) Using a marker, set it to the maximum level of the spectral envelope.

(g) Repeat steps (b) to (f) while scanning a parallel plane at the measurement distance on each side of the device to find the peak level.

(h) Repeat steps (b) to (g) for any frequencies where the field value is greater than -20 dBc below the maximum level identified.

(i) If there are multiple frequencies transmitted by the device under test, use equations (2) and (3) to determine compliance.

Note: When scanning around the entire device, the location found to be the maximum for the E- or H-field may not be the same location as the opposite field.

6.6.1.2 Measurement Method When the RBW of the Measurement Probe is Less Than the 99% OBW

When the RBW of the measurement probe is less than the 99% OBW, use the following measurement method:

(a) Set the measurement frequency of the measurement probe to the fundamental frequency of the device under test.

(b) Set the span to encompass the entire emission bandwidth.

(c) Set the RBW to approximately equal to but greater than 1% of the 99% OBW of the fundamental emission.

(d) Set the detector to Peak and trace display to Max-Hold.

(e) Allow the spectrum to fill; for pulsing devices, this may require an increased monitoring period.

(f) Capture the trace and sum the spectrum levels (in voltage or current units) at intervals equal to the RBW, extending across the entire spectrum. Alternatively, this may be accomplished using an integration function on the measurement probe.

(g) Repeat steps (b) to (f) while scanning a parallel plane at the measurement distance on each side of the device to find the peak level.

(h) Repeat steps (b) to (g) for any frequencies where the field value is greater than -20 dBc below the maximum level identified.

(i) If there are multiple frequencies transmitted by the device under test, use equations (2) and (3) to determine compliance.

Note: When scanning around the entire device, the location found to be the maximum for the E- or H-field may not be the same location as the opposite field.

6.6.1.3 Measurement Method for a Single-Axis Probe

For a single-axis probe, use the following measurement method:

(a) Use the appropriate measurement method from Section 6.6.1.1 or Section 6.6.1.2 (depending on the probe capabilities) at the fundamental frequency of the device under test (i.e. without the last step in either Section 6.6.1.1 or Section 6.6.1.2).

(b) Repeat step (a) for the remaining two axes.

(c) Using formula (4) or (5), sum the measurements from the three axes.

(d) Repeat steps (a) to (c) for any harmonic frequencies and any other fundamental frequency and its harmonics transmitted by the device under test.

(e) If there are multiple frequencies transmitted by the device under test, use equation (2) or (3) for determining compliance.

6.6.2 Spatial Averaging Method Against the RSS-102 Nerve Stimulation RLs

Each measurement point is to be measured using the guidance of Section 6.6.1.

Spatial averaging measurements shall be carried out as per the guidance of Section 8. Measurement values are averaged using equation (1).

Section 7 must be consulted for devices that emit multiple frequencies.

7. Measurements for Sources With Multiple Frequencies

The RLs for nerve stimulation are based on the total r.m.s. level. This requires that all frequency components from the apparatus be integrated together using equation (2) or (3), depending on the measurement performed. The sum of the ratios must be less than or equal to 1.

Multiple frequency components may be harmonic emissions of the fundamental or multiple transmitters and their harmonics within a single device. Harmonic emissions that are less than 20 dBc may be omitted from the assessment.

8. Spatial Averaging

8.1 E-Field Spatial Averaging

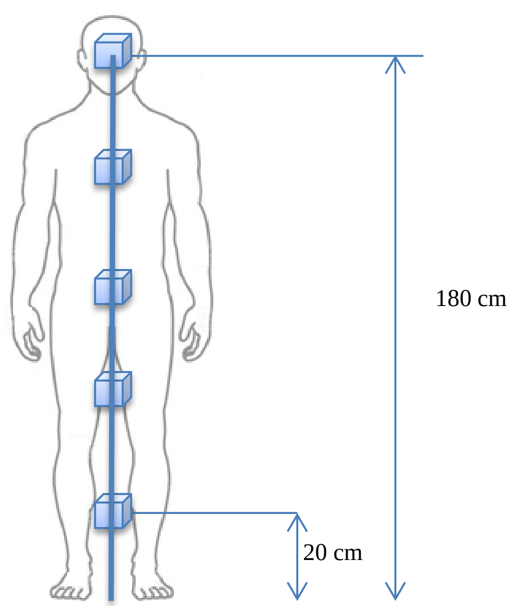
Spatial averages in the E-field are performed through the vertical extent of the human body. The extent of the human body in this case is 1.8 m, which represents a tall male adult, to provide a conservative measurement.

A minimum of five discrete samples shall be taken. This would provide for 40 cm spacing between sample points. A scan of the entire 1.8 m must be performed to identify the maximum E-field level, which shall make up an additional point to the five previously identified, unless the E-field scan identifies the maximum E-field to be at the same point as any of the predefined five points previously measured, in which case it shall be excluded.

Special care shall be used in assessing the spatial average value of the field when the exposure fields are time-varying and/or intermittent. A dwell time at each measurement point shall be sufficient to capture the greatest magnitude of the waveform and this dwell time shall be included in any report of the measurements.

Instruments capable of automatically acquiring measurements and computing the spatially-averaged value of fields may be used, as long as they are carefully applied with uniform movement of the probe through the fields. Use of such instruments must; however, include consideration the time-varying nature of the fields being measured.

Figure 1 — Probe Placement Over the Vertical Extent of the Body



8.2 H-Field Spatial Averaging

Spatial averages in the H-field are performed on a grid that only covers the size of the transmit antenna. This grid shall be located on a plane parallel to the plane of the transmit antenna. At no point shall the grid be greater than 60 cm tall by 30 cm wide, which is an approximate representation for the average torso size. The torso grid shall be a nine-point grid spaced, as outlined in **Error! Reference source not found.**, with a moving center point that must be the maximum r.m.s. level. The location shall be within the overall position of the spatial average. If one of the other defined points is the maximum, the moving point shall not overlap the previous point for inclusion into the spatial averaging calculation.

8.2.1 Small Loops

For small loops that are up to two times the size of the measurement probe, no spatial averaging is needed. This is due to the inherent averaging already provided by the measurement probe antenna.

8.2.2 Medium Loops

Medium loops are defined as any loops that are greater than two times the size of the measurement probe up to the size of the human torso. A medium size loop may be larger in a single direction than the human torso size but not in both, i.e. the height of the loop could be more than 60 cm.

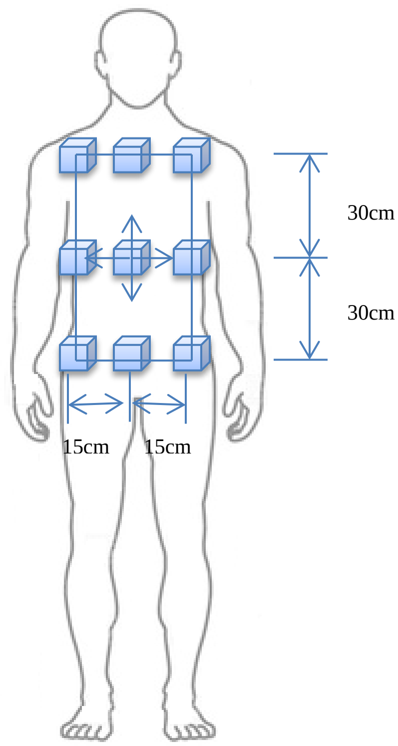
Medium loops have a varying spatial averaging size. The outer corner points of the spatial averaging volume will change depending on the size of the loop antenna. The outer points must never be greater in area compared to the transmit loop nor greater than the size of the human torso.

For measurements performed on a medium size loop, the number of grid points shall be reduced to five when the overall dimension of the loop is less than three times the size of the measurement probe. The five points shall only omit the middle measurement points of the outer perimeter of the diagram in **Error! Reference source not found.**. The center location may overlap the outer corners by only up to one-half of the measurement probe dimension and shall be fixed in the center of the grid.

8.2.3 Large Loops

Large loops are defined as any loop antenna that encompasses an area larger than the human torso. The area for these shall not have a spatial averaging of more than the human torso. The measurement grid used for large loops must be located where the corner points are the maximum. This may require that the grid be located at multiple locations throughout the large loop. Typically, there is a maximum at one edge of the loop antenna where the outside edge of the grid would be located. In this case the variable grid point in the centre would remain fixed at the centre point of the grid, and not varied.

Figure 2 — H-field Spatial Averaging Grid



Annex A — Considerations for Floor-Standing Devices

A.1 Types of Devices

Electronic Article Surveillance (EAS) Devices: EAS systems typically consist of antennas set on each side of an opening at the entrance or exit of a store. They are used to detect tags that pass through the area.

RFID Turnstiles: RFID turnstiles typically require that the user pass an RFID card over the turnstile to gain access to the entrance way.

Walk-Through Devices: Walk-through devices are typically metal detectors that the human body would pass through.

A.2 Measurement Guidance

A.2.1 Torso Grid Positioning for H-field Spatial Averaging

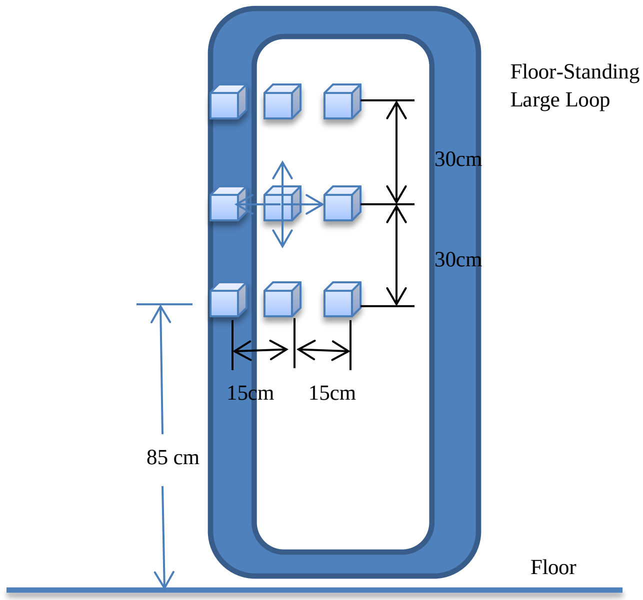
A.2.1.1 Floor-Standing Device With Large Loops

For floor-standing devices that have a large loop that is taller than 145 cm and wider than 30 cm, the torso grid must be located at 85 cm from the floor and must be located with the edge of the grid placed at the location where the highest measurements will occur at the right of left edges. See **Error! Reference source not found.** for an example of torso grid positioning.

A.2.1.2 Floor-Standing Device With Medium Loops

For floor-standing devices with medium loops that are smaller than the torso grid or positioned so that the loop is lower than 85 cm and only covers a portion of the torso grid, the spatial averaging area must remain above 85 cm and shall not average over a size greater than the dimensions of the loop.

Figure A1 — Sample Torso Grid Location for Floor-Standing Large Loop



Annex B — Considerations for Floor-Mounted Devices

B.1 Types of Devices

Floor-Mounted and Walked-Over: Floor-mounted devices that are placed on the floor and for which the exposure condition occurs when a human walks over the device.

Example applications include timing devices used during races, where the runner moves over an antenna on the ground that reads an RFID device worn by the runner.

Floor-Mounted Obstructed by an Object: Floor-mounted devices that are placed on the floor and are active while an object is over its surface. The exposure condition is to a human in the area beside the object.

Example applications include wireless car chargers that only operate while the car is parked above the charging pad.

Small Floor-Operated Devices: Small floor-mounted devices can be any of the above devices or simply a device that is placed on the floor that uses RFID to perform some action.

Small floor-operated devices may be tested as table top devices. See guidance in Annex E.

B.2 Measurement Guidance

B.2.1 Probe Setup

Walked-Over Device: Any floor-mounted device that can be walked over by the general public must be measured along the axis of the area where a person could cross over the antenna and up from 0 to 180 cm.

Obstructed by an Object: Any floor-mounted device that is obstructed by an object (i.e., floor-mounted car chargers that only operate when the car is parked above the antenna) must be measured from 0 cm to the floor up to the average exposed height for the obstructing object. For car chargers, this height shall be 50 cm; other devices must provide a rationale for typical usage to support the height measured. If the obstructing device is not metallic, the height scan is up to 180 cm.

Measurements shall be made at a sufficient number of radials around the perimeter of the typical obstructing object to provide a minimum separation of 22.5° between each radial.

Measurements must be performed without the obstructing object in place. This may require the use of test mode software.

B.2.2 Spatial Averaging

There shall be no spatial averaging applied to any measurement configurations for floor-mounted configurations.

B.2.3 Limb Relaxations

Walked-over devices may use the foot relaxation for measurements performed in contact with the device, while at the height of the ankle, the leg relaxation may be applied. For obstructed devices where the user cannot walk over the device, the leg relaxation may be applied to the measurements. Anytime the trunk may still be exposed, a second evaluation shall be conducted for levels above 85 cm from the ground and there shall be no relaxation applied.

Annex C — Considerations for Hand-Held Devices

C.1 Types of Devices

Hand-Held Devices Used to Scan a Human Body: Hand-held devices used to scan the human body are used in close contact with the human body and the exposure condition is focused on the body being scanned and not as focused on the user of the equipment.
Typical applications are metal detector wands.

Hand-held Devices Used to Scan an Object: Hand-held devices used to scan objects other than the human body are typically used to read information from an object and the exposure condition is to the extremity of the user.

Typical applications involve hand-held RFID readers that are used to read information from an RFID tag.

C.2 Measurement Guidance

C.2.1 Hand-Held Devices Used to Scan the Human Body

C.2.1.1 Probe Setup

The probe shall be mounted at a height of 130 cm.

C.2.1.2 Scanning

The hand-held device shall be scanned over the probe in all orientations. As an alternative, the hand-held device may be tested as a table-top device on three orthogonal axes, following the guidance in Annex E.

C.2.2 Hand-Held Devices Used to Scan an Object

C.2.2.1 Probe Setup

The probe shall be mounted at a height of 100 cm.

C.2.2.2 Scanning

The hand-held device shall be scanned over the probe with the orientation focused on the area where the hand would be placed. This shall be considered the compliance distance.

If the field cannot be measured at the hand position due to the physical nature of the construction, tests may be carried out on a disassembled equivalent at the normal hand distance, as long as the integrity of the transmitter is not modified by disassembling the device.

Annex D — Considerations for Wall-Mounted Devices

D.1 Types of Devices

Wall-mounted devices: Wall-mounted devices are typically devices used for RFID purposes. Most devices are mounted on the wall close to a door and used to read an RFID card.

D.2 Measurement Guidance

Wall-mounted devices can be assessed as a table-top device, found in Annex E, where the probe is set to measure at the compliance distance from the device.

The scanning of the device should only be required in the directions away from the wall, since the construction of the wall will keep the user further than the compliance distance from the device.

Annex E — Considerations for Table-Top Devices

E.1 Test Configurations

E.1.1 Passively Used Table-Top Devices

Passively used table-top devices are those which are placed on a table top; however, the user would not be seated at the table while the device is in use (e.g. cellphone chargers).

Table-top devices shall be installed at the edge of an 80 cm tall table which is constructed of non-metallic material.

Any support equipment used to operate the device shall be placed along the edge with a minimum of 10 cm between each component.

Note: Some devices, such as wireless chargers, have an intermittent state where the maximum exposure is higher immediately after the device is removed from the charging cradle. All states of operation must be investigated.

The measurement probe shall be placed at the compliance distance away from the edge of the table.

E.1.2 Actively Used Table-Top Devices

Actively used table-top devices are those which are placed on a table top, or possibly built into the table top, and used by the user over a period of time while seated at the table (e.g. laptop chargers).

For actively used table-top devices, there are three steps to be taken to ensure compliance with the limits of RSS-102.

(a) Measure the fields that expose the hands of the user. This measurement shall be performed with the evaluation probe positioned above the table top at the expected usage distance. This measurement result may be reduced by the hand relaxation factor.

(b) Measure the fields that expose the legs of the user. This measurement shall be performed with the evaluation probe positioned under the table top at the expected distance from the table to the legs of the user. This measurement result may be reduced by the limb relaxation factor.

(c) Measure the fields that expose the core of the user. This measurement shall be performed with the evaluation probe positioned at the edge of the table top.

Note: A device is only compliant when all the positions above have been measured and found to be compliant with RSS-102.

Annex F — Bibliography

International Electrotechnical Commission. *IEC 62369-1 — Evaluation of human exposure to electromagnetic fields from short range devices (SRDs) in various applications of the frequency range 0 GHz to 300 GHz – Part 1: Fields produced by devices used for electronic article surveillance, radio frequency identification and similar systems*, 1st ed., 2008.

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