RF Exposure Fundamentals

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Agenda

- Agenda of presentation
- Rules and definitions
- Exposure limits
- Measurement procedures.

Definitions

What is RF exposure?

RF exposure means being exposed to radiofrequency (RF) radiation, which is a type of non-ionizing radiation that includes radio waves and microwaves.

What is non-ionizing radiation?

Non-ionizing radiation is any kind of radiation in the electromagnetic spectrum that does not have enough energy to remove an electron from an atom and turn it into an ion. Non-ionizing radiation can generate heat, which is how food is cooked in a microwave oven.

What is Specific Absorption Rate (SAR)

SAR is a measure of the rate at which energy is absorbed per unit mass by a human body when exposed to a radiofrequency (RF) electromagnetic field. It is defined as the power absorbed per mass of tissue and has units of watts per kilogram (W/kg)

What is Maximum Permissible Exposure?

MPE is the limit of radiofrequency (RF) electromagnetic fields that the general public can be exposed to safely. MPE is based on the specific absorption rate (SAR).

FCC RF Exposure rules

- 47 CFR 1.1310 RF Exposure limits, Occupational population

(b) The SAR limits for occupational/controlled exposure are 0.4 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 8 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit for occupational/controlled exposure is 20 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). Exposure may be averaged over a time period not to exceed 6 minutes to determine compliance with occupational/controlled SAR limits.

FCC RF Exposure rules

47 CFR 1.1310 RF Exposure limits, General population

(c) The SAR limits for general population/uncontrolled exposure are 0.08 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 1.6 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit is 4 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). Exposure may be averaged over a time period not to exceed 30 minutes to determine compliance with general population/uncontrolled SAR limits.

FCC RF Exposure rules

Basic restriction limits above 6 GHz.

47 CFR 1.1310

(d)(3) At operating frequencies above 6 GHz, the MPE limits listed in Table 1 in paragraph (e)(1) of this section shall be used in all cases to evaluate the environmental impact of human exposure to RF radiation as specified in § 1.1307(b) of this part.

- Reference level is 1mW/cm^2
- For portable devices assessment of Incident Power Density(IPD) or Absorbed Power Density(APD)
  - -Limit is 1mW/cm^2 averaged over 4cm^2
  - -Knowledge Database (KDB) publication 447498 D04 footnote 3

FCC RF Exposure rules

47 CFR 1.1310 Maximum Permissible Exposure(MPE) limits

- §1.1310 (e) details the reference level limits (E-field, H-field, Power Density)
  - -Also referred to as Maximum Permissible Exposure (MPE) limits
  - - limits are derived from the whole-body SAR limits
  - - § 1.1310(d)(2) allows the MPE limits to be used instead of whole-body SAR except for portable devices as these evaluations shall be performed according to SAR provisions.
- Limits are based on a couple of standards
  - -NCRP “Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields
  - - ANSI/IEE Std C95.1-1992

RF Exposure Rules

- 47 CFR 1.1310(e) MPE Limits

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/f	$*900/f^2$	6
30-300	61.4	0.163	1.0	6
300-1,500			f/300	6
1,500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*100	30
1.34-30	824/f	2.19/f	$*180/f^2$	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-100,000			1.0	30

f = frequency in MHz * = Plane-wave equivalent power density

Definitions/explanations

RF Exposure/Controlled exposure §1.131(e)

Occupational/controlled exposure limits apply in situations in which:

- persons are exposed because of their employment
- those persons are
  - fully aware of the potential for exposure
  - have received written and/or verbal information fully explaining the potential for RF exposure resulting from said employment
  - has received appropriate training regarding work practices relating to controlling or mitigating their exposure
- can exercise control over their exposure
  - is allowed and knows how to reduce or avoid exposure by administrative or engineering work practices, such as the use of personal protective equipment or time averaging of exposure

Definitions/explanations

RF Exposure uncontrolled exposure §1.1310(e)

General population/uncontrolled exposure limits apply in situations in which:

- the general public may be exposed
- persons who are exposed as a consequence of their employment may not be fully aware of the potential for exposure of cannot exercise control over their exposure
- RF source intended for consumer use shall be subject to the limits for general population/uncontrolled exposure
  - All Part 15 transmitters must apply the general population limits
  - All unlicensed service (PCS) devices and unlicensed UNII devices shall be subject to the limits for general population exposure

Definitions/explanations

Definitions §1.1307(b)(2)

-*Source-based time averaging* is an average of instantaneous exposure over a time averaging period that is based on an inherent property or duty-cycle of a device to ensure compliance with the continuous exposure limits;

- *Time-averaging period* is a time period not to exceed 30 minutes for fixed RF sources or a time period inherent from device transmission characteristics not to exceed 30 minutes for mobile and portable RF sources;

- *RF source* is Commission-regulated equipment that transmits or generates RF fields or waves, whether intentionally or unintentionally, via one or more radiating structure(s). Multiple RF sources may exist in a single device

- *Radiating structure* is an unshielded RF current-carrying conductor that generates an RF reactive near electric or magnetic field and/or radiates an RF electromagnetic wave. It is the component of an RF source that transmits, generates, or reradiates an RF fields, such as an antenna, aperture, coil, or plate.

(This is just a few of the definitions presented in §1.1310)

Definitions/explanations

Mobile device defined §2.1091

§2.1091 contains requirements for mobile devices:

- Mobile devices (not fixed device) used such that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby person
- Fixed device is physically secured at one location and is not able to be easily moved to another location
- Includes the routine evaluation exclusion equations from Part 1 of the rules

§2.1091(d)(4)

- Use of a device may not allow easy classification as either mobile or portable
- FCC might require evaluation as a portable device.

Definitions/explanations

Portable device defined §2.1093

- Portable device – designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user
- Includes the routine evaluation exclusion equations from Part 1 rules
- General population/uncontrolled exposure limits apply to portable devices intended for use by consumers or persons who are exposed because of their employment and may not be fully aware of the potential for exposure or cannot exercise control over their exposure
  - No communication with the consumer including either visual advisories or manual instructions will be considered sufficient to allow consumer portable devices to be evaluated subject to limits for occupational/controlled exposure.

Definitions/explanations

Portable device defined §2.1093 (cont.)

Portable devices that transmit at frequencies above 6 GHz

- Evaluated in terms of the MPE limits specified in §1.1310 of this chapter.
- Portable devices that transmit at frequencies above 6 GHz shall be evaluated in terms of the MPE limits specified in Table 1 to § 1.1310(e)(1) of this chapter. A minimum separation distance applicable to the operating configurations and exposure conditions of the device shall be used for the evaluation

-Pre-Approval Guidance applies.

Definitions/explanations

Exemption and routine evaluation

Exemption – when is an RF source exempt?

– 47 CFR 1.1307(b)(3) provides three separate criteria for exempting an individual RF source from routine environmental evaluation

(A) Output power < 1mW

(B) Power (erp and available power at antenna) threshold based on frequency and distance for devices with an operating frequency 300 MHz – 6GHz and separation distances of 5mm – 40cm from persons

(C) ERP power threshold based on separation distance R at frequencies where $R > \lambda / 2\pi$

– This exemption is only from routine evaluation, the device still:
  – Must meet obligations of compliance with the RF exposure limits
  – Remains subject to determination of whether there is no significant effect on the quality of the human environment under § 1.1306

RF Exposure Guidance

When the new rules were introduced major updates to the guidance were required

A draft version of KDB 447498 D01 was released for comment but multiple questions related to
– How to handle the unintentional radiator assessments?
– Guidance on applying the exemptions
– How to handle devices below 300MHz and portable devices above 6GHz
– Portable devices at 0mm separation
– HELP!!

An interim guidance KDB 447498 D04 was released
– Certifications could be based on the interim guidance or KDB 447498 D01 v6
– Clarifications in the KDB 447498 introductory text

RF Exposure Guidance

Posted 01/17/2023: UPDATES TO THE TRANSITION PERIOD UNTIL FURTHER NOTICE

• Attachment "447498 D04 Interim General RF Exposure Guidance v01" can be used for equipment authorization and must be used in its entirety along with any other associated revise KDB RF exposure procedures and policies (including FCC-TCB conference presentations) during a transition period in effect from August 13, 2022 until further notice.

• Notification of the end of this transition period will be provided well in advance before the use of any new published guidance is required.

• The previous version, "447498 D01 General RF Exposure Guidance v06," may also be used during this transition period as long as the 731 Form and the related granted application are submitted to the FCC on or before the end of transition period. "447498 D01 General RF Exposure Guidance v06" must be used entirely (i.e., no mixing of old and new procedures for certification application filing(s)).

RF Exposure Guidance

… during this transition period, all applications for equipment certification of RF devices shall include at least one exhibit that addresses compliance with the RF exposure KDB guidance. This exhibit must also be included for equipment where the applicant is claiming exemption from RF exposure testing. Contributions from unintentional or incidental radiators are not required to be included in this assessment at this time. This exhibit shall illustrate how the guidance in the applicable KDB 447498 has been followed: as explained in the previous paragraph, by adhering to the guidance in either KDB 447498-v06 or KDB 447498-D04; applicants must follow a single KDB guidance and may not mix and match portions of each for showing compliance.

RF Exposure procedures

• RF exposure test exemptions provide means to obtain certification without the need of showing data (measurements, or analytical/numerical modeling) to demonstrate compliance.

• The KDB notes that RF exposure evaluation may be required when the potential for exposure cannot be easily determined based on exemptions

• Applications to TCBs must address RF exposure with combination of
  – Justification for routine evaluation exemption
  – and/or
  – Routine evaluation (measurement of MPE/SAR/Power Density) in accordance with published KDB procedures for all non-exempted RF sources

– Modeling analysis also allowed in lieu of measurement – section 3.5 of draft KDB

RF Exposure procedures

Common important concepts

- RF exposure assessment to be based on maximum power across production units
  - Maximum power based on chipset specifications, factory tune-up / power table settings
    - Maximum power used to compare against thresholds for exemption
    - Any measured values need to be scaled to account for differences in output power of device tested versus the maximum power

- Source based average power
  - RF exposure assessment can consider time averaging where that time averaging is:
    - Controlled by the protocol e.g. fixed talk: listen ratio, transmitting only in specific time slots (GSM, Zigbee)
    - Controlled by the device firmware e.g. time averaging SAR (TAS) algorithms

- CANNOT be based on expected use conditions
  - Case-by-case approval via KDB inquiry and PAG (DUTFCT) for devices where transmissions are expected to be limited
    - Location tracking devices which are polled at intervals and limited data to be sent by the device
    - E-readers which are primarily download-intensive with minimal uplink transmissions tune-up/power

SAR Standards

- IEEE 1528-2013 is the only International standard sited on the FCC Equipment Authorization – Measurement Procedures site.

Equipment Authorization - Measurement Procedures | Federal Communications Commission (fcc.gov)

- The rest of the procedures are all KDBs, some are general, some are technology specific.

FCC technology specific guidance (1)

Technology	KDB/Workshop
802.11abgn/ac	KDB 248227 D01
WiMax	KDB 615223 D01
3G, HSPA and 1x Advanced GSM, GPRS, EDGE, E-GPRS, EDGE Dual Transfer Mode (DTM)	KDB 941225 D01
LTE	KDB 941225 D05 and KDB 941225 D05A
Time averaged SAR (TAS)	None – pre-approval for mechanism/algorithm required. Validation procedure for the mechanism included in approval. PAG required.
6GHz WiFi (6000 MHz - 8500 MHz)	KDB 388624 D02 Pre-Approval Guidance List Appendix OVER6G – SAR and Incident Power Density measurements **or** TCBC Workshop October 2022 -IPD evaluations using source-reconstruction (SR) methods

FCC technology specific guidance (2)

Technology	KDB/Workshop
4G/5G Non-Stand Alone and Dual Connectivity (NSA / EN-DC)	TCB Workshop November 2019 and October 2020 (presentation rev 2 updated 2/25/21) PAG may be required under item AGGREG
Dynamic Antenna Tuning	TCB Workshop, 2019-04-17-4 RF Exposure Panel slides 13-15. Note – subject to PAG item ANTTUN
Carrier Aggregation (CA)	KDB 388624 D02 Pre-Approval Guidance List appendix AGGREG provides details on assessing non-contiguous in-band CA KDB 941225 D05A supplemented by TCBC Workshop presentation 2020-04-08-4.1 LTE Carrier Aggregation – which provides roll up of previous workshop guidance

FCC platform/product specific guidance (1)

Device Type	KDB	Exposure condition
Dongle transmitters	KDB 447498 D02 TCBC Workshop April 2023 “RF Exposure Procedures”	Body (5 mm)
Laptops and tablets modules for use in laptops and tablets	KDB 616217	Body (0 mm) Assessment methods for proximity sensors used to control power
Portable hot spots	KDB 941225 D06	Body (10 mm or 5 mm)
UMPC	KDB 941225 D07 UMPC Mini Tablet	Body (5 mm separation) Body (10 mm) and extremity (5 mm)
Handsets and phablets	KDB 648474 D04	Body and head
Wireless charging covers	KDB 648474 D03	Body and head

FCC platform/product specific guidance (2)

Device Type	KDB	Exposure condition
Wireless chargers wireless power transfer (WPT)	KDB 680106 D01 (There is a draft for review to allow radiative WPT at distances > 1 m)	Body – mobile devices tested at 15 cm/20 cm; portable devices and devices operating above 1MHz require KDB / PAG
Wristwatch/wrist-worn	KDB 447498 section 5.2	Extremity and head (next to mouth)
Low duty factor transmitters (e.g., e-readers, devices supporting location-based services)	KDB 447498 section 5.3	Device dependent
OEM accessories with and without transmitters	KDB 447498 section 5.4	Device dependent
Press-to-talk radios	KDB 643646 D01 KDB 447498 section 5.1	Body and head

FCC platform/product specific guidance (3)

Device Type	KDB	Exposure condition
Power control for RF exposure– capacitive proximity sensors	KDB 616217	Extremity (cell phone grip sensor) and body (phone/laptop /tablet)
Power control for RF exposure – keyboard angle sensors	TCBC Workshop Fall 2019 RF Exposure Procedures Presentation slide 10 KDB 388624 D02 Appendix TXSENS	Body (convertible laptops)
Motion sensing accelerometer or similar)	KDB 447498 08/24/2023 Interim Guidance for Devices Equipped with Motion Sensor for Power Control	ALL - PAG required, pre-PAG KDB approval for the algorithm recommended 25mm at full power
All other power control mechanisms: No guidance – therefore laboratory KDB inquiry, TCB PAG		
Note KDB 616217 requires host approval or host-specific FCC ID for a module when the mechanism for controlling power is not completely integrated into the module		

FCC specific guidance — modules (1 of 2) (KDB 447498 and KDB 616217)

- Module manufacturers can add specific hosts that are used close to the body (or head) to the scope of their grant by performing SAR evaluations for that host.
  - Requires assessment and certification for each new portable host
- Alternative allows manufacturer to perform SAR tests with the module and its antenna
  - If SAR values exceed a specific value module may be limited to a certain platform or a specific host
  - Test separation distance used may further limit the hosts allowed
  - SAR data is specific to the antenna used – small changes in antenna can have a big impact on SAR

FCC specific guidance — modules (2 of 2) (KDB 447498 and KDB 616217)

- Special case when the host system controls the power of the module (e.g., through proximity sensing) to reduce power to comply with RF exposure requirements
- Preferred path is host certification
- Option is to perform a change in ID and obtain new FCC ID for the module, followed by a permissive change certification to address the rf exposure for module + host
- The new FCC ID obtained becomes locked to the module-host combination and cannot be used for other hosts

FCC modular SAR KDB 447498 draft v7

- Modular (host-independent) SAR tests — general
- Test separation distance, X mm, ≤ 5 mm
  - SAR value ≤ 0.4 W/Kg
    - Module can be used in any portable host that will be at least X mm from the head/body provided energy coupling test SAR < 0.45 W/Kg.
  - SAR value > 0.4 W/kg and ≤ 1.2 W/kg [Note, v6 had interim threshold of 0.8W/Kg]
    - Module needs to be approved for specific sets of host products in the initial filing for the Module certification.
    - Additional hosts may be added via Class II permissive changes, as long as the additional hosts are shown to be providing essentially the same electromagnetic environment as for the sets of hosts listed in the original Module certification.
  - SAR value > 1.2 W/kg
    - equipment certification requires a PAG for case-by-case consideration.

Draft KDB 447498 and multiple transmitters

- The exemption thresholds and measurement methods address individual RF sources
- Compliance of the device must consider the aggregate effect of all the different RF sources that operate simultaneously
- KDB 447498 introduces the concept of Total Exposure Ratio (TER)
  - The ratio for each individual RF source is calculated:
    - For a source assessed through routine evaluation it is the ratio of the measured value to the applicable limit
    - For a source assessed through exemption it is the ratio of the maximum power (ERP or conducted as applicable) to the exemption threshold

Canada RF Exposure

- Requirement comes from Safety Code 6
  - *Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz*
  - Safety Code 6 Notice, Localized human exposure limits for radiofrequerncy fields in the range of 6 GHz to 300 GHz
  - Technical Guide for Safety Code 6: Health Canadas's Radiofrequency Exposure Guidelines

<u>Applies to all transmitters</u>

  - RSS 102 Issue 5 covers all transmitters
    - Notice 2020-0020 updates the normative test standard for SAR/RSS-102 to IEC/IEEE 62209-1528
    - Supported by several Supplemental Procedures and FCC RF Exposure KDBs

Canada RF Exposure

- RSS 102 Issue 6 is in process with major overhaul in layout and document structure
  - Replacing the RSS-102 + Supplementary Procedures with RSS-102 + RSS-102.XXX companion standards.
  - There will be a 12-month transition period from Issue 5 to Issue 6
  - Equipment will not need re-certification if previously approved to Issue 5, but is expected to comply with the latest version after the transition period
    - This is consistent with most ISED RSS Standards.

RSS-102 Issue 5

- RSS-102 Issue 5

  SPR-002, Nerve Stimulation

  SPR-001, Bystander SAR

  SPR-004, Time averaged SAR (TAS)

  SPD-APD, Absorbed Power Density

  SPR-003, Incident Power Density (IPD)

RS-102 Issue 6

- RSS-Issue 6, draft released 07/2023

Companion standards:

RSS-102.NS.MEAS

RSS-102.NS.SIM

RSS-102.SAR.MEAS

RSS-102.SAR.SIM

RSS-102.APD.MEAS

RSS-102.APD.SIM

RSS-102.FRL(Field Reference Level)(MPE)

RF Exposure procedures - limits

- SAR limits 100kHz – 6GHz (Safety Code 6 and RSS-102 Table 3)
  - 1.6W/Kg 1-g for body / head
  - 4 W/Kg 10-g for **limbs** and extremities - definition of extremity different from FCCs

- MPE limits (RSS-102 Table 4)
  - ≠ FCC Limits
  - MPE limits specified in W/m^2, 1 W/m^2 = 0.1 mW/cm^2

- Incident / Absorbed Power Density Limits (Safety Code 6 Notice) 6GHz – 300 GHz
  - Spatial-average power density 20 W/m^2 spatial limit averaged over 4cm^2
  - Above 30GHz additional requirement that the peak PD < 40 W/m^2

- Nerve Stimulation (NS) Limits
  - Basic restriction is internal electric field with a limit of 2.7 x 10^{-4} f
    - "measured" via computational analysis
  - E- and H- field reference levels derived from internal Electric field

RF Exposure procedures - limits

RF exposure procedures – Canada/US MPE Limits

Frequency	CANADA				FCC		
	Electric field (V/m rms)	Magnetic field (A/m rms)	PD (W/m^2)	Reference Period (min)	Electric field (V/m rms)	Magnetic field (A/m rms)	Power Density (mW/cm^2)
0.003-10 MHz	83	90	-	Instantaneous	Nerve Stimulation		
0.1-10 MHz	-	$0.73/f$	-	6	0.3-1.34: 614 1.34 – 10: $824/f$	0.3-1.34: 1.63 1.34 – 10: $2.19/f$	0.3-1.34: (100) 1.34-10: $(180/f^2)$
1.1-10 MHz	$87/f^{0.5}$	-	-	6			
10-20 MHz	27.46	0.0728	2	6	$824/f$	$2.19/f$	$(180/f^2)$
20-48 MHz	$58.07 / f^{0.25}$	$0.1540 / f^{0.25}$	$8.944 / f^{0.5}$	6	20-30: $824/f$ 30-300: 27.5	20-30: $2.19/f$ 30-300: 0.073	20-30: $(180/f^2)$ 30-300: 0.2
48-300 MHz	22.06	0.05852	1.291	6	27.5	0.073	0.2
300-1500 MHz	$3.142f^{0.3417}$	$0.008335f^{0.3417}$	$0.02619 f^{0.6834}$	6			f / 1500
1.5 – 6 GHz							1.0
6 – 15 GHz	61.4	0.163	10	6			1.0
15 – 150 GHz	61.4	0.163	10	$616000/f^{1.2}$			1.0
150 -300 GHz	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$			1.0

Note: f is frequency in MHz.

Exemptions for portable devices below 6 GHz

-RSS-102 Section 6.3 exemption thresholds for devices used within 20 cm of the user

-Table of power values at various frequencies and separation distances for body and head exposure

- Linear interpolation to determine threshold between the listed frequencies
- Multiply values by 2.5 for limb worn devices

-Based on separation distance, maximum conducted power and EIRP

- ≠ FCC SAR exclusion thresholds

-If power exceeds the threshold SAR measurement/computational assessment required

-For simultaneous transmission assessment the SAR value for an exempted transmitter

- 0.4 W/Kg x max power/threshold value for body and head
- 1.0 W/Kg x max power/threshold value for limb-worn

Exemptions for portable devices above 6 GHz

- Draft Notice: 2021-DRS0005 (July 2021) introduced an interim exemption limit of 1mW (conducted and EIRP) for transmitters operating in the 6 GHz to 30 GHz frequency range
  - Targeted towards UWB transmitters

- Draft RSS-102 Issue 6 proposes thresholds for exemption from APD for 6 – 30 GHz based on frequency and separation distance and a 1mW exemption for devices subject to Incident Power Density measurements

Exemptions for mobile/fixed devices

- RSS-102 Section 2.5.2 exemption thresholds for devices > 20 cm from user
- Based on maximum EIRP
  - ≠ FCC thresholds (because limits are different)
- When EIRP > threshold for exclusion from routine evaluation, Canada allow for calculation or measurement
  - Simple calculations based on Frii's equation
  - Threshold power levels would give values at the limit at 20 cm
  - Remember FCC equire measurement if ERP exceeds the FCC thresholds
- RSS-102 Issue 6 / RSS-102.SAR.MEAS will require a minimum assessment distance of 10cm for tabletop devices
  - Can still assess against the reference levels for tabletop equipment
    - Measurements of E/H or Power density or calculation based on Frii's equation

RF exposure procedures — Nerve stimulation

- Nerve stimulation is a phenomena for RF frequencies below 10MHz
  - Instantaneous effect (no time averaging)
  - Test procedure is SPR-002 Issue 2 (effective October 2023)
- RSS-102 Issue 5 has NO exemptions for nerve stimulation effects
  - All devices operating below 10MHz require assessment
  - Typically required at distances smaller than those for SAR / MPE
  - Instantaneous field strengths require that incidental close proximity to device be evaluated
  - Example placing a device onto or retrieving from a wireless charger implies very close proximity to the device

– Often require a simulation assessment because SPR-002 has some stringent requirements for measurement probe size.

RSS-102 Issue 6 draft proposes exemptions for NS based on coil size, current and number of turns for inductive systems but not capacitive coupled systems

RF exposure procedures — standards

- SAR: RSS-102 as modified by Notice 2020-DRS0020
  - IEC/IEEE 62209-1528:2020 adopted as of May 2021
    - Limited frequency range 4 MHz to 6 GHz, above 6 GHz use power density
    - KDB 941225 D05 for LTE Devices v02r05 takes precedence over Clause 7.9.3.6
    - SPR-004 takes precedence over Clause 7.6 for time-averaged SAR assessments
  - IEC 62209-3 vector-based systems not adopted by Canada
  - Fast SAR evaluations within IEC 62209 are allowed to identify worst-case
    - Full SAR test required
- MPE: latest version of IEEE C95.3 (2002 referenced)

RF exposure procedures - KDBs

• Acceptable knowledge database, other supplementary procedures and notices (canada.ca)

– KDB 648474 D03: Wireless chargers battery cover v01r04

– KDB 648474 D04: Handset SAR v01r03 (see Notice 2016-DRS001 for exemptions)

– KDB 941225 D01: SAR test for 3G Devices v03r01

– KDB 941225 D05: SAR for LTE Devices v02r05

– KDB 941225 D06: Hot spot SAR v02r01

– KDB 941225 D07: UMPC mini tablet v01r02

– KDB 248227 D01: 802.11 Wi-Fi SAR v02r02

– KDB 615223 D01: 802.16e/WiMAX SAR measurement guidance v01r01

– KDB 616217 D04: SAR for laptops and tablets v01r02

– KDB 447498 D01: General RF exposure guidance v06

– see Notice-DRS0001 for exemptions, for example the thresholds to determine exclusion from SAR testing cannot be

used because they do not match RSS-102

– KDB 447498 D02: SAR procedure for USB dongle transmitter v02r01

– KDB 643646 D01: SAR test for PTT Radios v01r03

RF Exposure and the EU

RF Exposure requirements apply to radio transmitting devices under Article 3.1(a) of the Radio Equipment Directive (RED), 2014/53/EU; as well as other forms of radiators under Article 2 of the Low Voltage Directive (LVD), 2014/35/EU.

The REDCA TGN 20: SAR testing and Assessment Guidance can be found at the REDCA website, www.redca.eu

In Summary

Your RF Exposure evaluation will be determined by the use case of your device portable, mobile, or fixed. The frequency will determine if the device needs SAR testing or IPD/APD. The power of the device will determine if the unit is exempt or needs testing.

All of this while knowing that different countries have different limits.

Questions

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