

EXHIBIT 1. RF EXPOSURE REQUIRMENTS [§§ 15.247(i), 1.1310 & 2.1091]

1.1. Limits

§ 1.1310: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(i) Limits for Occupational/Controlled Exposures				
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
300-1500			f/300	<6
1500-100,000			5	<6
(ii) 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
300-1500			f/1500	<30
1500-100,000			1.0	<30

f = frequency in MHz

* = Plane-wave equivalent power density

Note 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

Note 2: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

1.2. Method of Measurements

Calculation Method of Power Density/RF Safety Distance:

$$S = \frac{PG}{4\pi \cdot r^2} = \frac{EIRP}{4\pi \cdot r^2}$$

Where,

P: power input to the antenna in mW

EIRP: Equivalent (effective) isotropic radiated power.

S: power density mW/cm²

G: numeric gain of antenna relative to isotropic radiator

r: distance to centre of radiation in cm

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All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

1.3. RF Evaluation

47 CFR 1.1307(b)(3)(ii) For multiple RF sources: Multiple RF sources are exempt if:

- (A) The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required). This exemption may not be used in conjunction with other exemption criteria other than those in [paragraph \(b\)\(3\)\(i\)\(A\)](#) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(i)(A).
- (B) in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

Where:

a = number of fixed, mobile, or portable RF sources claiming exemption using [paragraph \(b\)\(3\)\(i\)\(B\)](#) of this section for P_{th} , including existing exempt transmitters and those being added.

b = number of fixed, mobile, or portable RF sources claiming exemption using [paragraph \(b\)\(3\)\(i\)\(C\)](#) of this section for Threshold ERP, including existing exempt transmitters and those being added.

c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance including existing evaluated transmitters.

P_i = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive).

$P_{th,i}$ = the exemption threshold power (P_{th}) according to [paragraph \(b\)\(3\)\(i\)\(B\)](#) of this section for fixed, mobile, or portable RF source i .

ERP_j = the ERP of fixed, mobile, or portable RF source j .

$ERP_{th,j}$ = exemption threshold ERP for fixed, mobile, or portable RF source j , at a distance of at least $\lambda/2\pi$ according to the applicable formula of [paragraph \(b\)\(3\)\(i\)\(C\)](#) of this section.

$Evaluated_k$ = the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation at the location of exposure.

$Exposure Limit_k$ = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable RF source k , as applicable from [§ 1.1310 of this chapter](#).

1.3.1. Co-location

The following addresses the co-location of the transmitters within the EUT at a minimum 20 cm evaluation separation distance, which consist of Invixium Dual-band RFID and u-blox AG WLAN/Bluetooth host-based multiradio module (FCC ID: XPYMAYAW166)

Source Option	Maximum MPE Ratio		Sum of the MPE ratios from all sources
	Invixium Dual-band RFID	u-blox AG WLAN/Bluetooth host-based multiradio module (FCC ID: XPYMAYAW166)	
1	0.1708	0.0407	0.2115

The sum of the MPE ratios from all sources is < 1. Thus, in compliant with general public (uncontrolled environment) MPE limit.

For detailed MPE ratios calculation, refer to the following tables.

Calculated Exposure Ratio for Invixium Dual-band RFID

Electric field strength			
Frequency (MHz)	*E-Field (V/m) at 20 cm	Electric Field Strength Limit for uncontrolled environment (V/m)	Exposure Ratio
0.121	1.520	** 614	0.0025
Magnetic field strength			
Frequency (MHz)	*H-Field (A/m) at 20 cm	Magnetic Field Strength Limit for uncontrolled environment (A/m)	Exposure Ratio
0.121	0.2784	** 1.63	0.1708

*The field strength is derived from ISED Nerve Stimulation (NS) report (Report No. 26INVX177_ISEDRSS102NS) at a separation distance of less than 20cm and represents the worst-case exposure condition for this MPE evaluation.

**Limit from 0.3-3.0 MHz band

Frequency (MHz)	¹ EIRP (mW)	Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)	Exposure Ratio
13.56	0.00083	20	0.00000017	0.9789	0.00000017
¹ The EIRP is computed with the measured field strength of 13.56 MHz Transmitter (53.97 at dBμV/m at 10m) using the following formula: $EIRP = (E \times d)^2 / 30$, where E = electric field strength in V/m, d = measurement distance in meters (m)					

NOTE: The 121 kHz and 13.56 MHz transmitters do not transmit simultaneously, and the maximum exposure ratio is **0.1708**.

¹ Calculated MPE Ratio for u-blox AG WLAN/Bluetooth host-based multiradio module (FCC ID: XPYMAW166, IC: 8595A- MAYAW166)											
Operational Bands	Ant	Frequency (MHz)	Antenna Gain (dBi)	Output Power Conducted (dBm)	Output Power Conducted (mW)	ISED Limit (mW/cm ²)	FCC Limit (mW/cm ²)	Power Density Value (mW/cm ²)	Verdict	FCC (Seq/SLim)	ISED (Seq/SLim)
BLE	1	2402	2.5	9.00	7.94	0.5351	1.00	0.0028	Pass	0.0028	0.0053
BLE	2	2402	2.2	9.00	7.94	0.5351	1.00	0.0026	Pass	0.0026	0.0049
BLE	3	2402	-3.42	9.00	7.94	0.5351	1.00	0.0007	Pass	0.0007	0.0013
Classic BT	1	2402	2.5	11.00	12.59	0.5351	1.00	0.0045	Pass	0.0045	0.0083
Classic BT	2	2402	2.2	11.00	12.59	0.5351	1.00	0.0042	Pass	0.0042	0.0078
Classic BT	3	2402	-3.42	11.00	12.59	0.5351	1.00	0.0011	Pass	0.0011	0.0021
WLAN 2.4 GHz	1	2412	2.5	19.00	79.43	0.5366	1.00	0.0281	Pass	0.0281	0.0524
WLAN 2.4 GHz	2	2412	2.2	19.00	79.43	0.5366	1.00	0.0262	Pass	0.0262	0.0489
WLAN 2.4 GHz	3	2412	-3.42	19.00	79.43	0.5366	1.00	0.0072	Pass	0.0072	0.0134
WLAN 5 GHz UNII 1	1	5240	4.6	18.00	63.10	0.9119	1.00	0.0362	Pass	0.0362	0.0397
WLAN 5 GHz UNII 1	3	5240	-1.51	18.00	63.10	0.9119	1.00	0.0089	Pass	0.0089	0.0097
WLAN 5 GHz UNII 2A	1	5300	4.6	18.00	63.10	0.9190	1.00	0.0362	Pass	0.0362	0.0394
WLAN 5 GHz UNII 2A	3	5300	-1.51	18.00	63.10	0.9190	1.00	0.0089	Pass	0.0089	0.0096
WLAN 5 GHz UNII 2C	1	5580	4.6	18.00	63.10	0.9519	1.00	0.0362	Pass	0.0362	0.0380
WLAN 5 GHz UNII 2C	3	5580	-1.51	18.00	63.10	0.9519	1.00	0.0089	Pass	0.0089	0.0093
WLAN 5 GHz UNII 3	1	5825	4.6	18.00	63.10	0.9803	1.00	0.0362	Pass	0.0362	0.0369
WLAN 5 GHz UNII 3	3	5825	-2.08	18.00	63.10	0.9803	1.00	0.0078	Pass	0.0078	0.0079
								Sum of (Seq/SLim) Max BT + Max 2.4 GHz WLAN		0.0326	0.0607
Distance to Antenna (R) in cm:			20	Antennas considered Ant 1 ANT-DB1-RAF-xxx Ant 2 ANT-2.4-CW-RCT-xx Ant 3 MAYA-W1 PCB Trace Antenna				Sum of (Seq/SLim) Max BT + Max 5 GHz WLAN		0.0407	0.0480
								Passed			
								Passed			
¹ The test data of the radio module represented in this table is derived from u-blox AG WLAN/Bluetooth host-based multiradio module MPE report. Refer to the report for details.											