RF EXPOSURE EVALUATION

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environment 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)
(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

MPE Calculation Method

E (V/m) = $\frac{\sqrt{30 * P * G}}{d}$ Power Density: *Pd* (W/m²) = $\frac{E^2}{377}$

E = Electric field (V/m)

P = Average RF output power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

$Pd = \frac{30 * P * G}{377 * D^2}$

From the EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained.

Measurement Result

Operation Frequency: GFSK: 905 MHz~926.5MHz
Antenna Type: Antenna 1Type: Planar Inverted L- Antenna(ocw=120k)
Antenna 2Type: Planar Inverted F- Antenna(ocw=120k)
Antenna 3Type: Planar Inverted F- Antenna(ocw=140k)
Antenna 4Type: Planar Inverted F- Antenna(ocw=140k)
R=20cm

Module 1:ant1

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)	Max tune-up power (mW)	Antenna Gain (dBi)	Antenna Gain Numeric	Evaluation result (mW/cm2)	Power density Limits (mW/cm2)
905.00	GFSK-120K	17.41	17±1	18	63.096	-5.00	0.32	0.0040	0.60
915.85		17.139	17±1	18	63.096	-5.00	0.32	0.0040	0.61
926.50		16.755	17±1	18	63.096	-5.00	0.32	0.0040	0.62

ant2

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)	Max tune-up power (mW)	Antenna Gain (dBi)	Antenna Gain Numeric	Evaluation result (mW/cm2)	Power density Limits (mW/cm2)
905.00	GFSK-120K	12.7	12±1	13	19.953	-6.00	0.25	0.0010	0.60
915.85		12.341	12±1	13	19.953	-6.00	0.25	0.0010	0.61
926.50		12.143	12±1	13	19.953	-6.00	0.25	0.0010	0.62

Module 2: ant3

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)	Max tune-up power (mW)	Antenna Gain (dBi)	Antenna Gain Numeric	Evaluation result (mW/cm2)	Power density Limits (mW/cm2)
905.00	GFSK-140K	16.788	16.5±1	17.5	56.234	-6.00	0.25	0.0028	0.60
915.85		16.306	16.5±1	17.5	56.234	-6.00	0.25	0.0028	0.61
926.50		15.774	16.5±1	17.5	56.234	-6.00	0.25	0.0028	0.62

ant4

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)	Max tune-up power (mW)	Antenna Gain (dBi)	Antenna Gain Numeric	Evaluation result (mW/cm2)	Power density Limits (mW/cm2)
905.00	GFSK-140K	14.924	15±1	16	39.811	-6.00	0.25	0.0020	0.60
915.85		14.893	15±1	16	39.811	-6.00	0.25	0.0020	0.61
926.50		14.941	15±1	16	39.811	-6.00	0.25	0.0020	0.62

Conclusion:
For the max result : 0.0040≤ 0.60 for Max Power Density, compliance RF exposure..

2.4G WIFI:

Operation Frequency: WIFI 802.11b/g/n HT20: 2412-2462MHz,
WIFI 802.11n HT40:2422-2452MHz
Power density limited: 1mW/ cm^2
Antenna Type: Flexable Inverted Antenna
Antenna gain: 1dBi;
R=20cm
mW=10^(dBm/10)
antenna gain Numeric=10^(dBi/10)= 10^(1/10)=1.26

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density
		(dBm)		tune-up power		Gain		(mW/cm2)	(mW/cm2)
				(dBm)	(mW)	(dBi)	Numeric		
2412	802.11b	15.31	14.5±1	15.5	35.481	1.00	1.26	0.0089	1
2437		14.32	14.5±1	15.5	35.481	1.00	1.26	0.0089	1
2462		14.42	14.5±1	15.5	35.481	1.00	1.26	0.0089	1
2412	802.11g	13.52	13±1	14	25.119	1.00	1.26	0.0063	1
2437		13.41	13±1	14	25.119	1.00	1.26	0.0063	1
2462		13.36	13±1	14	25.119	1.00	1.26	0.0063	1
2412	802.11n H20	11.58	12±1	13	19.953	1.00	1.26	0.0050	1
2437		11.36	12±1	13	19.953	1.00	1.26	0.0050	1
2462		11.46	12±1	13	19.953	1.00	1.26	0.0050	1
2422	802.11n(HT40)	11.45	11±1	12	15.849	1.00	1.26	0.0040	1
2437		11.32	11±1	12	15.849	1.00	1.26	0.0040	1
2452		11.21	11±1	12	15.849	1.00	1.26	0.0040	1

SIMULTANEOUS TRANSMISSIONS

When a number of sources at different frequencies, and/or broadband sources, contribute to the total exposure, it becomes necessary to weigh each contribution relative to the MPE. To comply with the MPE, the fraction of the MPE in terms of E^2, H^2 (or power density) incurred within each frequency interval should be determined and the sum of all such fractions should not exceed unity. In order to ensure compliance with the MPE for a controlled environment, the sum of the ratios of the power density to the corresponding MPE should not exceed unity. That is

$$\sum_{i=1}^{n} \frac{S_i}{MPE_i} \leq 1$$

Max. SIMULTANEOUS TRANSMISSIONS MODE

Band						MIMO		Verdict
	Max Conducted	Antenna Gain	Separation distance (cm)	Evaluation result	Power density	Evaluation result	Power density Limits	
	(dBm)	(dBi)		(mW/cm2)	(mW/cm2)			
SRD 905 +2.4G wifi+WCDMA Band 2	17.41	-5	20	0.010958	0.603	0.105758	1	PASS
	15.31	1	20	0.006756	1			
	23.5	-1	20	0.044537	0.551			
SRD 905 +2.4G wifi + WCDMA Band 4	17.41	-5	20	0.010958	0.603	0.069465	1	PASS
	15.31	1	20	0.006756	1			
	23.5	-1	20	0.044537	1			
SRD 905 +2.4G wifi + WCDMA Band 5	17.41	-5	20	0.010958	0.603	0.069465	1	PASS
	15.31	1	20	0.006756	1			
	23.5	-1	20	0.044537	1			
SRD 905 +2.4G wifi + LTE Band 2	17.41	-5	20	0.010958	0.603	0.074899	1	PASS
	15.31	1	20	0.006756	1			
	24	-1	20	0.049971	1			
SRD 905 +2.4G wifi + LTE Band 4	17.41	-5	20	0.010958	0.603	0.074899	1	PASS
	15.31	1	20	0.006756	1			
	24	-1	20	0.049971	1			
SRD 905 +2.4G wifi + LTE Band 12	17.41	-5	20	0.010958	0.603	0.132162	1	PASS
	15.31	1	20	0.006756	1			
	24	-1	20	0.049971	0.466			

Signature: **Date:** 2023/08/15

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