4 FCC §2.1091, §15.247(i) & ISEDC RSS-102 - RF Exposure

4.1 Applicable Standards

According to FCC §15.247(i) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

According to KDB 447 498 Section (7.2), "simultaneous transmission of MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on calculated or measured field strengths or power density, is ≤ 1.0. The MPE ratio of each antenna is determined at the minimum *test separation distance* required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to MPE limit, at the test frequency.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
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

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

Before equipment certification is granted, the procedure of IC RSS-102 must be followed concerning the exposure of humans to RF field.

4.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

4.3 MPE Results

Sub1G TRTN Radio

Maximum peak output power at antenna input terminal (dBm):	5.16
Maximum peak output power at antenna input terminal (mW):	3.281
Prediction distance (cm):	20
Prediction frequency (MHz):	902.20
Maximum Antenna Gain, typical (dBi):	-1.2
Maximum Antenna Gain (numeric):	0.75858
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0005
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	0.60
MPE Ratio (numeric):	0.00083

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.0005 mW/cm^2. Limit is 0.60 mW/cm^2.

Wi-Fi Radio (FCC ID: 2ADHKATWINC1500, IC: 20266-WINC1500PB)

Maximum peak output power at antenna input terminal (dBm):	23.03
Maximum peak output power at antenna input terminal (mW):	200.9
Prediction distance (cm):	20
Prediction frequency (MHz):	2437
Maximum Antenna Gain, typical (dBi):	-3
Maximum Antenna Gain (numeric):	0.501
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.02003
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0
MPE Ratio(numeric):	0.02003

Note: Please refer to FCC report no: EMC98105-MPE Rev. 1

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.02003 mW/cm^2. Limit is 1.0 mW/cm^2.

LTE Radio (FCC ID: XMR 201707BG96, IC: 10224A-201709BG96)

Band	PG (mW)	Test Result (mW/cm^2)	Limit Value (mW/cm^2)	The MPE ratio
GSM 850	444.84	0.088	0.55	0.161
GSM 1900	222.95	0.044	1.00	0.044
LTE Band 2	447.92	0.089	1.00	0.089
LTE Band 4	355.80	0.071	1.00	0.071
LTE Band 5	447.92	0.089	0.55	0.162
LTE Band 12	447.92	0.089	0.47	0.190
LTE Band 13	447.92	0.089	0.52	0.171
LTE Band 26	447.92	0.089	0.54	0.165
Note: The MPE ratio = Mac Test Result÷Limit Value				

Note: For transmitters, minimum separation distance is 20cm, even if calculations indicate MPE distance is less.

Note: Please refer to FCC report no: RXA1706-0199MPE.
Note: LTE Band 12 is found to be the worst case from the table given. This information is used to analyze the LTE Radio for this report.

The TRTN can transmit with WiFi simultaneously or transmit with LTE radios simultaneously. The combined MPE ratios is 0.00083 + 0.02003 = 0.02086 or 0.00083 + 0.190 = 0.19083 which are less than the limit of 1.0.

4.4 RF exposure evaluation exemption for ISEDC

Sub1G TRTN Radio

Maximum EIRP power = 5.16dBm – 1.2 dBi = 3.96 dBm which is less than $1.31\times10^{-2}f^{0.6834}$ = 1.3706 W = 31.37 dBm

Therefore the RF exposure Evaluation is not required.

Wi-Fi Radio (FCC ID: 2ADHKATWINC1500, IC: 20266-WINC1500PB)

Maximum EIRP power = 23.03dBm – 3 dBi = 20.3 dBm which is less than $1.31\times10^{-2}f^{0.6834}$ = 1.3706 W = 31.37 dBm

Therefore the RF exposure Evaluation is not required.

LTE Radio (FCC ID: XMR 201707BG96, IC: 10224A-201709BG96)

Maximum EIRP power = 26.51 dBm which is less than $1.31\times10^{-2}f^{0.6834}$ = 1.3706 W = 31.37 dBm

Therefore the RF exposure Evaluation is not required.