1 RF Exposure Report

1.1 RF Exposure Measurement

The limit for Maximum Permissible Exposure (MPE) specified in FCC Part 1 Subpart I 1.1310 is followed. The gain of the antennas used in the product are extracted from the Antenna data sheets provided and also the maximum total power input to the antenna is measured. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached.

Although the Friis Transmission formula is far field assumption, the calculated result of that is an over-prediction for near field power density. It is taken as worst case to specify the safety range.

1.2 RF Exposure Limit

According to FCC Part 1 Subpart I 1.1310 The criteria listed in the following table shall be used to evaluate the environmental impact of the human exposure to radio-frequency (RF) radiation as specified in 1.1307 (b)

Table 1: Limits for Maximum Permissible Exposure (MPE) as per FCC

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)
Limits for Occupational / controlled Exposures			
300 - 1500	--	--	F/300
1500 – 100000	--	--	5.0
Limits for General population / Uncontrolled Exposure			
300 - 1500	--	--	F/1500
1500 – 100000	--	--	1.0

F or f = Frequency in MHz

1.2.1 Friss Formula

Friss Transmission Formula: Pd = (Pout * G) / (4*pi*r²)

Where
Pd = power density in mW/cm²
Pout = output power to antenna in mW
G = gain of antenna in linear scale
Pi = 3.1416
R = Distance between observation point and the center of radiator in cm

If we know the maximum gain of the antenna and the total output power to the antenna, through calculation, we will know MPE value at distance 20cm.

1.2.2 EUT Operation condition

EUT was enabled to transmit and receive at lowest, middle and highest channels.

1.2.3 Classification

The antenna of this product, under normal use condition, is at least 20cm away from the body of the user. Warning statement to the user for keeping at least 20cm or more separation distance from the antenna should be included in the User manual. So, this device is classified as Mobile device.

Note: ± 1 dB tune up value is considered for MPE calculation.

Protocol: BLE, LTE(Simultaneous transmission not supported)

1.3 Test Results

Manufacturer has declared the tune-up value as ±1 dBm is considered in MPE calculation.

Antenna: PCB Antenna
Antenna gain (G) : 0dBi for 2.4 GHz; Gain in Linear scale: 1;

Table 2: Maximum Permissible exposure

Protocol	Data Rate	Antenna Gain in Linear Scale	Channel Frequency (MHz)	Pout (dBm)	Pout including Tuneup (mW)	Power Density (mW/cm²)	FCC Limit (mW/cm²)
BLE	2Mbps	1.0	2480	5.99	5.00034	0.000994	1

Cellular: **Antenna Gain: 5 dBi;**
Gain in Linear scale: 3.1623;

Table 3: Maximum permissible exposure

Mode	Channel Frequency (MHz)	Maximum average output power (dBm)	Maximum output power incuding Tune-up value (mW)	Power Density (mW/cm²)	FCC Limit (mW/cm²)
LTE band 2	1880.0	17.73	74.64487584	0.046939195	1.00000
LTE band 4	1732.5	18.04	80.16780634	0.050412198	1.00000
LTE band 5	836.8	19.13	103.038612	0.064794126	0.5578
LTE band 12	699.7	19.65	116.1448614	0.073035774	0.4664

1.4 Conclusion

Table 3 & Table 4: list possible combination; hence, the RF exposure analysis concluded that the RF exposure is compliant as per the limit specified in clause 1.2 of this report