5. RF EXPOSURE EVALUATION

5.1 Applicable Standard

FCC §15.247 (i) & §1.1307

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 levels in excess of the Commission's guidelines. See §1.1307(b)(1) of this chapter.

1.1.2 Procedure

According to §1.1307(b)(3)(ii)(B)

Simultaneous Transmission with both SAR-based and MPE-Based Test Exemptions

This case is described in detail in § 1.1307(b)(3)(ii)(B) and covers the situations where both SAR-based and MPE-based exemption may be considered for test exemption in fixed, mobile, or portable device exposure conditions. For these cases, a device with multiple RF sources transmitting simultaneously will be considered an RF exempt device if the condition of Formula (1) is satisfied.

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20\,cm}(d/20\,\text{cm})^x & d \leq 20\,\text{cm} \\ ERP_{20\,cm} & 20\,\text{cm} < d \leq 40\,\text{cm} \end{cases}$$

Where

$$x = -\log_{10}\left(\frac{G0}{ERP_{20\,cm}\sqrt{f}}\right) \text{ and } f \text{ is in GHz};$$

and

$$ERP_{20\,cm} \text{ (mW)} = \begin{cases} 2040f & 0.3\,\text{GHz} \leq f < 1.5\,\text{GHz} \\ 3060 & 1.5\,\text{GHz} \leq f \leq 6\,\text{GHz} \end{cases}$$

d = the separation distance (cm);

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

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.

1.1.3 Measurement Result

Radio	Frequency (MHz)	Distance (mm)	P_{th} (mW)	Maximum Conducted Power including Tune-up Tolerance (dBm)	Antenna Gain (dBi)	Conducted Power or ERP	
						dBm	mW
BLE	2402-2480	200	3060	-6	3.12	-5.03	0.31
GSM850	824-849	200	1681	24.99	1.25	24.99	315.5
GSM1900	1850-1910	200	3060	28.49	0.72	28.49	706.32
LTE Cat M1 B2	1850-1910	200	3060	25	0.72	25	316.23
LTE Cat M1 B4	1710-1755	200	3060	25	0.77	25	316.23
LTE Cat M1 B5	824-849	200	1681	25	1.25	25	316.23
LTE Cat M1 B12	699-716	200	1426	25	0.91	25	316.23
LTE Cat M1 B13	777-787	200	1585	24	1.58	24	251.19
LTE Cat M1 B26	814-849	200	1661	25	1.58	25	316.23
NB-IoT B2	1850-1910	200	3060	23	0.72	23	199.53
NB-IoT B4	1710-1755	200	3060	23.5	0.77	23.5	223.87
NB-IoT B5	824-849	200	1681	23	1.25	23	199.53
NB-IoT B12	699-716	200	1426	23	0.91	23	199.53
NB-IoT B13	777-787	200	1585	23	1.58	23	199.53
NB-IoT B26	814-849	200	1661	23	1.58	23	199.53

Note:

For GSM850 and GSM1900
To average the power, the division factor is as follows:
1TX-slot = 1 transmit time slot out of 8 time slots=> conducted power divided by (8/1) => -9.03dB
2TX-slots = 2 transmit time slots out of 8 time slots=> conducted power divided by (8/2) => -6.02dB
3TX-slots = 3 transmit time slots out of 8 time slots=> conducted power divided by (8/3) => -4.26dB
4TX-slots = 4 transmit time slots out of 8 time slots=> conducted power divided by (8/4) => -3.01dB

The devices may contain certified WWAN Module, FCC ID:2AK9D-L710-HG.
The WWAN and BLE can transmit simultaneously.

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

$=P_{BLE} / P_{th} + P_{WAAN} / P_{th}$

$=0.31/3060 + 706.32/3060$

$=0.231$

< 1.0

Result: The device compliant the SAR-Based Exemption at 20cm distances.

***** END OF REPORT *****