November 03, 2023

TUV SUD America CB
10 Centennial Drive FL2
Peabody, MA 01960

Attention: Director of Certification

RE: Analysis of RF Exposure for Mobile and Portable Device per KDB 447498 D01 General RF Exposure Guidance v06 and RSS-102 Issue 5 March 2015, A1 February 2021.

Max System Gain calculations for Downlink were made to ensure compliance to the signal booster power limits and requirements as specified in Sections 20.21(e)(9)(i)(D)

FCC ID: YETG41-BE
IC Number: 9298A-G41BE

1. Limits

Limits for General Population/Uncontrolled Exposure (Title 47 Subpart J §2.1091 and KDB 447498 D01 referring to limits under §1.1310)

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

2. ISED Limits:

Limits for Devices Used by the General Public (Uncontrolled Environment (RSS-102 Issue 5 March 2015, A1 February 2021)

Frequency Range (MHz)	Electric Field Strength (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003 - 10^{21}	83	90	-	Instantaneous
0.1 - 10	-	0.73/f	-	6**
1.1 - 10	$87/f^{0.5}$	-	-	6**
10 - 20	27.46	0.0728	2	6

20 - 48	$-58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48 - 300	22.06	0.05852	1.291	6
300 - 6000	$3.142\ f^{0.3417}$	$0.008335\ f^{-0.3417}$	$0.02619\ f^{0.6834}$	6
6000 - 15000	61.4	0.163	10	6
15000 - 150000	61.4	0.163	10	$616000/f^{1.2}$
150000 - 300000	$0.158f^{0.5}$	$4.21 \times 10^{-4}\ f^{0.5}$	$6.67 \times 10^{-5}\ f$	$616000/f^{1.2}$

f is frequency in MHz
**Based on nerve stimulation (NS)*
*** Based on specific absorption rate (SAR)*

3. MPE Calculation Summary using a 20cm separation distance:

Downlink (CU) at 20 cm Separation Distance				
Mode	**Output Power (dBm)**	**Power Density at 20 cm (mW/cm^2)**	**ISED Limit (mW/cm^2)**	**FCC Limit (mW/cm^2)**
LTE Band 2	15.87	0.00799	0.4624	1
LTE Band 4	15.59	0.00729	0.4952	1
LTE Band 5	12.10	0.00329	0.2681	0.5827
LTE Band 12	12.70	0.00394	0.2379	0.4893
LTE Band 13	11.41	0.00278	0.2417	0.5007
LTE Band 25	13.89	0.00522	0.4697	1

Uplink (NU) at 65 cm Separation Distance				
Mode	**Output Power (dBm)**	**Power Density at 20 cm (mW/cm^2)**	**ISED Limit (mW/cm^2)**	**FCC Limit (mW/cm^2)**
LTE Band 2	21.86	0.0187	0.4566	1
LTE Band 4	22.32	0.0188	0.4305	1
LTE Band 5	19.66	0.0188	0.2623	0.5643
LTE Band 12	19.81	0.01883	0.2320	0.4717
LTE Band 13	19.78	0.0188	0.2479	0.5197
LTE Band 25	21.60	0.0188	0.4566	1

Bluetooth LE 20 cm Separation Distance				
Mode	**Output Power (dBm)**	**Power Density at 20 cm (mW/cm^2)**	**ISED Limit (mW/cm^2)**	**FCC Limit (mW/cm^2)**
Bluetooth LE	-1.8	0.0000024	0.5469	1

4. Co-Located Transmitters transmission table:

Downlink (CU)		
Transmitter type		**Transmitter type that can transmit at the same time**
CU	LTE B2	LTE B4, LTE B5, LTE 12, LTE B13
	LTE B4	LTE B5, LTE 12, LTE B13
	LTE B5	LTE 12, LTE B13
Note: worst case is LTE B4 High Channel 20 MHz BW & LTE B5 Low Ch 10 MHz		

Uplink (NU)		
Transmitter type		**Transmitter type that can transmit at the same time**
NU	LTE B2	LTE B4, LTE B5, LTE 12, LTE B13
	LTE B4	LTE B5, LTE 12, LTE B13
	LTE B5	LTE 12, LTE B13
Note: worst case is LTE B4 High Ch 15MHz & LTE B5 High Ch 5MHz		

Bluetooth LE	
Transmitter type	**Transmitter type that can transmit at the same time**
Bluetooth LE	LTE B2, B4, B5, B12, B13, B25
Note: worst case is LTE B4 High Ch 15MHz & Bluetooth LE	

5. Worst Case Simultaneous Transmission MPE:

Only ISED limits presented being the more stringent between the two limits.

Downlink CU Port at 20 cm Separation Distance			
Transmitter type	**MPE (mw/cm^2)**	**ISED Limit (mW/cm^2)**	**ISED MPE ratio (MPE/Limit)**
LTE B4	0.00729	0.49525	0.0147
LTE B5	0.00329	0.26814	0.0123
		Sum of the ratios (should be <1.0)	0.027

Uplink NU Port at 65 cm Separation Distance			
Transmitter type	**MPE (mw/cm^2)**	**ISED Limit (mW/cm^2)**	**ISED MPE ratio (MPE/Limit)**
LTE B4	0.01883	0.43052	0.04373
LTE B5	0.01883	0.26234	0.07177
		Sum of the ratios (should be <1.0)	0.11587

Bluetooth LE 20 cm Separation Distance			
Transmitter type	**MPE (mw/cm^2)**	**ISED Limit (mW/cm^2)**	**ISED MPE ratio (MPE/Limit)**
Bluetooth LE	0.000002	0.5469	0.000365
		Sum of the ratios (should be <1.0)	0.000365

6. Mobile MPE Calculation using a 20cm for DL and 65 for UL separation distance:

Using Power Density formula:

$$S = \frac{PG}{4\pi R^2}$$

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

LTE Band 2 Downlink at 20 cm Separation Distance:

Maximum peak output power at antenna input terminal:	**15.87**	(dBm)
Maximum peak output power at antenna input terminal:	**38.64**	(mW)
Maximum System Gain	**0.1700**	(dBi)
Maximum System Gain	**1.040**	(numeric)
Prediction distance:	**20**	(cm)
Source Based Time Average Duty Cycle:	**100**	(%)
Prediction frequency:	**1940**	(MHz)
ISED MPE limit for uncontrolled exposure at prediction frequency:	**0.4624**	(mW/cm^2)
Power density at prediction frequency:	**0.00799**	(mW/cm^2)
ISED Margin of Compliance:	**-17.62**	(dB)

LTE Band 4 Downlink at 20 cm Separation Distance:

Maximum peak output power at antenna input terminal:	**15.59**	(dBm)
Maximum peak output power at antenna input terminal:	**36.22**	(mW)
Maximum System Gain	**0.0500**	(dBi)
Maximum System Gain	**1.012**	(numeric)
Prediction distance:	**20**	(cm)
Source Based Time Average Duty Cycle:	**100**	(%)
Prediction frequency:	**2120**	(MHz)
ISED MPE limit for uncontrolled exposure at prediction frequency:	**0.4913**	(mW/cm^2)
Power density at prediction frequency:	**0.00729**	(mW/cm^2)
ISED Margin of Compliance:	**-18.29**	(dB)

LTE Band 5 Downlink at 20 cm Separation Distance:

Maximum peak output power at antenna input terminal:	**12.10**	(dBm)
Maximum peak output power at antenna input terminal:	**16.22**	(mW)
Maximum System Gain	**0.0800**	(dBi)
Maximum System Gain	**1.019**	(numeric)
Prediction distance:	**20**	(cm)
Source Based Time Average Duty Cycle:	**100**	(%)
Prediction frequency:	**874**	(MHz)
ISED MPE limit for uncontrolled exposure at prediction frequency:	**0.2681**	(mW/cm^2)
Power density at prediction frequency:	**0.00329**	(mW/cm^2)
ISED Margin of Compliance:	**-19.12**	(dB)

LTE Band 12 Downlink at 20 cm Separation Distance:

Maximum peak output power at antenna input terminal:	**12.70**	(dBm)
Maximum peak output power at antenna input terminal:	**18.62**	(mW)
Antenna gain(max):	**0.2700**	(dBi)
Maximum System Gain	**1.064**	(numeric)
Maximum System Gain	**20**	(cm)
Source Based Time Average Duty Cycle:	**100**	(%)
Prediction frequency:	**734**	(MHz)
ISED MPE limit for uncontrolled exposure at prediction frequency:	**0.2380**	(mW/cm^2)
Power density at prediction frequency:	**0.00394**	(mW/cm^2)
ISED Margin of Compliance:	**-17.81**	(dB)

LTE Band 13 Downlink at 20 cm Separation Distance:

Maximum peak output power at antenna input terminal:	**11.41**	(dBm)
Maximum peak output power at antenna input terminal:	**13.84**	(mW)
Maximum System Gain	**0.0500**	(dBi)
Maximum System Gain	**1.012**	(numeric)
Prediction distance:	**20**	(cm)
Source Based Time Average Duty Cycle:	**100**	(%)
Prediction frequency:	**751**	(MHz)
ISED MPE limit for uncontrolled exposure at prediction frequency:	**0.2417**	(mW/cm^2)
Power density at prediction frequency:	**0.00278**	(mW/cm^2)
ISED Margin of Compliance:	**-19.39**	(dB)

LTE Band 25 Downlink at 20 cm Separation Distance:

Maximum peak output power at antenna input terminal:	**13.89**	(dBm)
Maximum peak output power at antenna input terminal:	**24.49**	(mW)
Maximum System Gain	**0.3000**	(dBi)
Maximum System Gain	**1.076**	(numeric)
Prediction distance:	**20**	(cm)
Source Based Time Average Duty Cycle:	**100**	(%)
Prediction frequency:	**1985**	(MHz)
ISED MPE limit for uncontrolled exposure at prediction frequency:	**0.4697**	(mW/cm^2)
Power density at prediction frequency:	**0.00522**	(mW/cm^2)
ISED Margin of Compliance:	**-19.55**	(dB)

LTE Band 2 Uplink at 65 cm Separation Distance:

Maximum peak output power at antenna input terminal:	**21.86**	(dBm)
Maximum peak output power at antenna input terminal:	**153.46**	(mW)
Maximum System Gain	**8.1000**	(dBi)
Maximum System Gain	**6.457**	(numeric)
Prediction distance:	**65**	(cm)
Source Based Time Average Duty Cycle:	**100**	(%)
Prediction frequency:	**1095**	(MHz)
ISED MPE limit for uncontrolled exposure at prediction frequency:	**0.3128**	(mW/cm^2)
Power density at prediction frequency:	**0.0187**	(mW/cm^2)
ISED Margin of Compliance:	**-12.24**	(dB)

LTE Band 4 Uplink at 65 cm Separation Distance:

Maximum peak output power at antenna input terminal:	**22.32**	(dBm)
Maximum peak output power at antenna input terminal:	**170.61**	(mW)
Maximum System Gain	**7.6800**	(dBi)
Maximum System Gain	**5.861**	(numeric)
Prediction distance:	**65**	(cm)
Source Based Time Average Duty Cycle:	**100**	(%)
Prediction frequency:	**1747.5**	(MHz)
ISED MPE limit for uncontrolled exposure at prediction frequency:	**0.4305**	(mW/cm^2)
Power density at prediction frequency:	**0.0188**	(mW/cm^2)
ISED Margin of Compliance:	**-13.59**	(dB)

LTE Band 5 Uplink at 65 cm Separation Distance:

Maximum peak output power at antenna input terminal:	**19.66**	(dBm)
Maximum peak output power at antenna input terminal:	**92.47**	(mW)
Maximum System Gain	**10.3400**	(dBi)
Maximum System Gain	**10.814**	(numeric)
Prediction distance:	**65**	(cm)
Source Based Time Average Duty Cycle:	**100**	(%)
Prediction frequency:	**846.5**	(MHz)
ISED MPE limit for uncontrolled exposure at prediction frequency:	**0.2623**	(mW/cm^2)
Power density at prediction frequency:	**0.0188**	(mW/cm^2)
ISED Margin of Compliance:	**-11.44**	(dB)

LTE Band 12 Uplink at 65 cm Separation Distance:

Maximum peak output power at antenna input terminal:	**19.81**	(dBm)
Maximum peak output power at antenna input terminal:	**95.72**	(mW)
Maximum System Gain	**10.1900**	(dBi)
Maximum System Gain	**10.447**	(numeric)
Prediction distance:	**65**	(cm)
Source Based Time Average Duty Cycle:	**100**	(%)
Prediction frequency:	**707.5**	(MHz)
ISED MPE limit for uncontrolled exposure at prediction frequency:	**0.2321**	(mW/cm^2)
Power density at prediction frequency:	**0.01883**	(mW/cm^2)
ISED Margin of Compliance:	**-10.91**	(dB)

LTE Band 13 Uplink at 65 cm Separation Distance:

Maximum peak output power at antenna input terminal:	**19.78**	(dBm)
Maximum peak output power at antenna input terminal:	**95.06**	(mW)
Maximum System Gain	**10.2200**	(dBi)
Maximum System Gain	**10.520**	(numeric)
Prediction distance:	**65**	(cm)
Source Based Time Average Duty Cycle:	**100**	(%)
Prediction frequency:	**779.5**	(MHz)
ISED MPE limit for uncontrolled exposure at prediction frequency:	**0.2480**	(mW/cm^2)
Power density at prediction frequency:	**0.0188**	(mW/cm^2)
ISED Margin of Compliance:	**-11.19**	(dB)

LTE Band 25 Uplink at 20 cm Separation Distance:

Maximum peak output power at antenna input terminal:	**21.60**	(dBm)
Maximum peak output power at antenna input terminal:	**144.54**	(mW)
Maximum System Gain	**8.4000**	(dBi)
Maximum System Gain	**6.918**	(numeric)
Prediction distance:	**65**	(cm)
Source Based Time Average Duty Cycle:	**100**	(%)
Prediction frequency:	**1905**	(MHz)
ISED MPE limit for uncontrolled exposure at prediction frequency:	**0.4567**	(mW/cm^2)
Power density at prediction frequency:	**0.0188**	(mW/cm^2)
ISED Margin of Compliance:	**-13.85**	(dB)

7. Test Results for NU/CU Bluetooth LE @ 20 cm distance

Maximum peak output power at antenna input terminal:	**-1.80**	(dBm)
Maximum peak output power at antenna input terminal:	**0.66**	(mW)
Maximum System Gain	**-7.1000**	(dBi)
Maximum System Gain	**0.195**	(numeric)
Prediction distance:	**65**	(cm)
Source Based Time Average Duty Cycle:	**100**	(%)
Prediction frequency:	**2480**	(MHz)
ISED MPE limit for uncontrolled exposure at prediction frequency:	**0.5469**	(mW/cm^2)
Power density at prediction frequency:	**0.0000024**	(mW/cm^2)
ISED Margin of Compliance:	**-53.53**	(dB)

8. Power and Calculated Max Gain (Antenna & Cable) per Band

Uplink (NU)		
Band	**Worst Case Conducted Power (dBm)**	**Max Antenna Gain (dBi)**
LTE B2	21.86	8.14
LTE B4	22.32	7.68
LTE B5	19.66	10.34
LTE B12	19.81	10.19
LTE B13	19.78	10.22
LTE B25	21.60	8.4
Downlink (CU)		
Band	**Worst Case Conducted Power (dBm)**	**Max Antenna Gain (dBi)**
LTE B2	15.87	0.17
LTE B4	15.59	0.05
LTE B5	12.10	0.08
LTE B12	12.70	0.27
LTE B13	11.41	0.05
LTE B25	13.89	0.3

9. Max System Antenna Gain

Port	Max System (Antenna & Cable) Gain
Server Port	0.17 dBi for LTE Band 2 0.05 dBi for LTE Band 4 0.08 dBi for LTE Band 5 0.27 dBi for LTE Band 12 0.05 dBi for LTE Band 13 0.3 dBi for LTE Band 25
Donnor Port	8.14 dBi for LTE Band 2 7.68 dBi for LTE Band 4 10.34 dBi for LTE Band 5 10.19 dBi for LTE Band 12 10.22 dBi for LTE Band 13 8.4 dBi for LTE Band 25

Sincerely,

Miguel Angel Rabago Garcia
Name
Authorized Signatory
Title: JR EMC/Wireless Engineer