



November 12, 2024

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.

The EUT consists of two certified G41-BE and one certified G41-CE PCBs (FCC ID: YETG41-BE and YETG41-CE).

FCC ID: YETG43-CBBE

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 x 10 ⁻⁴ f ^{0.5}	6.67 x 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, Downlink at 20 cm and Uplink at 65 cm 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 14	12.27	0.1070	0.2444	0.5086
LTE Band 25	13.89	0.00522	0.4697	1
Bluetooth LE 20 cm Separation Distance				
Transmitter type	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	0.00002	0.5469	1

Uplink (NU) at 65 cm Separation Distance				
Mode	Output Power (dBm)	Power Density at 65 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 14	21.08	0.1389	0.2509	0.5866
LTE Band 25	21.60	0.0188	0.4566	1



4. Co-Located Transmitters transmission table:

Downlink (CU)			
Transmitter type	Operator/port	Band	Transmitter type that can transmit at the same time
CU	1	LTE B2	LTE B4, LTE B5, LTE 12, LTE B13
		LTE B4	LTE B5, LTE 12, LTE B13
		LTE B5	LTE 12, LTE B13
	2	LTE B2	LTE B4, LTE B5, LTE 12, LTE B13
		LTE B4	LTE B5, LTE 12, LTE B13
		LTE B5	LTE 12, LTE B13
	3	LTE B2	LTE B4, LTE B5, LTE 12, LTE B13
		LTE B4	LTE B5, LTE 12, LTE B13
		LTE B5	LTE B12, LTE B13
		LTE B14	LTE B2, B4, B5
BLE	-	-	BLE + combinations above
Note: worst case is LTE B2 Low Channel 20 MHz BW & LTE B12 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
	LTE B14	LTE B2, B4, B5
Note: worst case is LTE B5 High Ch 5MHz & LTE B12 Middle Ch 10MHz		

***Co-located transmission table is the same form all 3 three UL ports**



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				
Operator/Port	Transmitter type	MPE (mw/cm ²)	ISED Limit (mW/cm ²)	ISED MPE ratio (MPE/Limit)
1	LTE B2	0.00799	0.4624	0.017279
	LTE B12	0.00394	0.2379	0.016562
2	LTE B2	0.00799	0.4624	0.017279
	LTE B12	0.00394	0.2379	0.016562
3	LTE B2	0.00799	0.4624	0.017279
	LTE B12	0.00394	0.2379	0.016562
BLE	-	0.00002	0.5469	0.000036
Sum of the ratios (should be <1.0)				0.101559

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 B5	0.01880	0.26230	0.071674
LTE B12	0.01883	0.23200	0.081164
Sum of the ratios (should be <1.0)			0.11587

*NU is 1 carrier/operator per port.



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 14 Downlink at 20 cm Separation Distance:

Maximum peak output power at antenna input terminal:	12.27	(dBm)
Maximum peak output power at antenna input terminal:	16.87	(mW)
Antenna gain(max):	15.04	(dBi)
Maximum System Gain	31.915	(numeric)
Maximum System Gain	20	(cm)
Source Based Time Average Duty Cycle:	100	(%)
Prediction frequency:	763	(MHz)
ISED MPE limit for uncontrolled exposure at prediction frequency:	0.2444	(mW/cm ²)
Power density at prediction frequency:	0.10709	(mW/cm ²)
FCC Margin of Compliance:	-3.58	(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)

Bluetooth LE @ 20 cm distance (Downlink)

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	-7.1	(dBi)
Maximum System Gain	0.195	(numeric)
Prediction distance:	20	(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:	0.00003	(mW/cm ²)
ISED Margin of Compliance:	-43.29	(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 14 Uplink at 65 cm Separation Distance:

Maximum peak output power at antenna input terminal:	21.08	(dBm)
Maximum peak output power at antenna input terminal:	128.23	(mW)
Maximum System Gain	17.60	(dBi)
Maximum System Gain	57.544	(numeric)
Prediction distance:	65	(cm)
Source Based Time Average Duty Cycle:	100	(%)
Prediction frequency:	793	(MHz)
FCC MPE limit for uncontrolled exposure at prediction frequency:	0.2509	(mW/cm ²)
Power density at prediction frequency:	0.13898	(mW/cm ²)
FCC Margin of Compliance:	-2.57	(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. 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 B14	21.08	17.60
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 B14	12.27	15.04
LTE B25	13.89	0.3



8. 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 15.04 dBi for LTE Band 14 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 17.60 dBi for LTE Band 14 8.4 dBi for LTE Band 25

Sincerely,

A handwritten signature in blue ink, appearing to be 'M. Rabago'.

Name: Miguel Angel Rabago Garcia
Authorized Signatory
Title: Wireless Test Engineer