

# 1 Human Exposure Assessment

## 1.1 Maximum Permissible Exposure

### 1.1.1 Limit of Maximum Permissible Exposure

Limits for Occupational / Controlled Exposure				
Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm <sup>2</sup> )	Averaging Time  E  <sup>2</sup> , H  <sup>2</sup> or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842 / f	4.89 / f	(900 / f)*	6
30-300	61.4	0.163	1.0	6
300-1500	-	-	F/300	6
1500-100,000	-	-	5	6
Limits for General Population / Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm <sup>2</sup> )	Averaging Time  E  <sup>2</sup> , H  <sup>2</sup> or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500	-	-	F/1500	30
1500-100,000	-	-	1.0	30
Note 1: f = frequency in MHz ; *Plane-wave equivalent power density				
Note 2: For the applicable limit, see FCC 1.1310				

RF Field Strength Limits for Controlled Use Devices (Controlled Environment)				
Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m <sup>2</sup> )	Averaging Time (minutes)
0.003-1	600	4.9	-	6
1-10	600/f	4.9/f	-	6
10-30	60	4.9/f	-	6
30-300	60	0.163	10*	6
300-1500	3.54 f <sup>0.5</sup>	0.0094 f <sup>0.5</sup>	f/30	6
1500-15000	137	0.364	50	6
15000-150000	137	0.364	50	616000/f <sup>1.2</sup>
150000-300000	0.354 f <sup>0.5</sup>	9.4 x 10 <sup>-4</sup> f <sup>0.5</sup>	3.33 x 10 <sup>-4</sup> f	616000/f <sup>1.2</sup>
RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)				
Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m <sup>2</sup> )	Averaging Time (minutes)
0.003-1	280	2.19	-	6
1-10	280/f	2.19/f	-	6
10-30	28	2.19/f	-	6
30-300	28	0.073	2*	6
300-1500	1.585 f <sup>0.5</sup>	0.0042 f <sup>0.5</sup>	f/150	6
1500-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/f <sup>1.2</sup>
150000-300000	0.158 f <sup>0.5</sup>	4.21 x 10 <sup>-4</sup> f <sup>0.5</sup>	6.67 x 10 <sup>-5</sup> f	616000/f <sup>1.2</sup>
Note 1: f is frequency in MHz.				
Note 2: For the applicable limit, see IC RSS-102				

### 1.1.2 MPE Calculation Method

$$E \text{ (V/m)} = \frac{\sqrt{30 \times P \times G}}{d}$$

**E** = Electric field (V/m)

**G** = EUT Antenna numeric gain (numeric)

The formula can be changed to

$$Pd = \frac{30 \times P \times G}{377 \times d^2}$$

$$\text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

**P** = RF output power (W)

**d** = Separation distance between radiator and human body (m)

**1.1.3 Result of Maximum Permissible Exposure**

Frequency Range (MHz)	Maximum Conducted Power (dBm)	Antenna Gain (dBi)	Distance (cm)	Power Density (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )
2412~2462	28.38	4.2057	20	<b>0.361</b>	1

**1.1.4 Result of Maximum Permissible Exposure for Co-located**

The EUT ( FCC ID: U2M-PCE3203AH) will be installed in below hosts

Brand Name	Model Name	Product Name	Description
Google	GFRG200	Platform	The platform contains wireless modules as below configurations 1) FCC ID: U2M-PCE3203AH + FCC ID: NKRDXA-GO1 2) FCC ID: U2M-PCE3203AH + FCC ID: U2M-PCE4553AH
Google	GFRG210	Platform	The platform contains wireless modules as below configurations 1) FCC ID: U2M-PCE3203AH + FCC ID: NKRDXA-GO1 2) FCC ID: U2M-PCE3203AH + FCC ID: U2M-PCE4553AH

Note: The platform supports simultaneous transmission and separation distance of simultaneous transmitting antennas is less than 20 cm thus evaluation of co-location is required.

**MPE Evaluation of Single Transmission**

Evaluation result of FCC ID: NKRDXA-GO1

Frequency Range (MHz)	Maximum Conducted Power (dBm)	Antenna Gain (dBi)	Distance (cm)	Power Density (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )
5150~5250	16.42	4.16	20	0.023	1
5745~5825	26.57	4.20	20	<b>0.238</b>	1

Evaluation result of FCC ID: U2M-PCE4553AH

Frequency Range (MHz)	Maximum Conducted Power (dBm)	Antenna Gain (dBi)	Distance (cm)	Power Density (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )
5150~5250	16.53	4.1618	20	0.023	1
5745~5825	26.88	4.2025	20	<b>0.255</b>	1



**MPE Evaluation of Simultaneous Transmission**

2.4 and 5GHz can transmit at the same time, MPE evaluation is as below formula

$PD1 / \text{Limit}1 + PD2 / \text{Limit} 2 + \dots < 1$ , PD = Power density

For Configuration1 (FCC ID: U2M-PCE3203AH + FCC ID: NKRDXA-GO1)

MPE Evaluation = Maximum MPE of 2.4GHz + Maximum MPE of 5 GHz =  $0.361 / 1 + 0.238 / 1 = 0.599 < 1$

For Configuration 2 (FCC ID: U2M-PCE3203AH + FCC ID: U2M-PCE4553AH)

MPE Evaluation = Maximum MPE of 2.4GHz + Maximum MPE of 5 GHz =  $0.361 / 1 + 0.255 / 1 = 0.616 < 1$

**Conclusion**

MPE evaluations of single and simultaneous transmission meet the requirement of standard.

Draft