



RF EXPOSURE REPORT

REPORT NO.: SA940804H03

MODEL NO.: RBT-4102

ACCORDING: FCC Guidelines for Human Exposure
IEEE C95.1

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RF Exposure Measurement

1. Introduction

In this document, we try to prove the safety of radiation harmfulness to the human body for our product. The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. The Gain of the antenna used in this product is measured in a Fully Anechoic Chamber (FAC) calibrated for antenna measurement in ADT, 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 a far field assumption, the calculated result of that is an over-prediction for near field power density. We will take that as the worst case to specify the safety range.

2. RF Exposure Limit

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

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time (minutes)
(A)Limits For Occupational / Control Exposures				
300-1500	F/300	6
1500-100,000	5	6
(B)Limits For General Population / Uncontrolled Exposure				
300-1500	F/1500	6
1500-100,000	1.0	30

F = Frequency in MHz



3. Friis Formula

Friis transmission formula : $P_d = (P_{out} * G) / (4 * \pi * r^2)$

where

P_d = power density in mW/cm^2

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

π = 3.1416

R = distance between observation point and center of the radiator in cm

P_d is the limit of MPE, $1 mW/cm^2$. If we know the maximum Gain of the antenna and the total power input to the antenna, through the calculation, we will know the MPE value at distance 20cm.

Ref. : David K. Cheng, *Field and Wave Electromagnetics*, Second Edition,
Page 640, Eq. (11-133).

4 EUT Operating condition

The software provided by Manufacturer enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.



5. Classification

The antennas (except the below antennas) 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 with the antenna should be included in users manual.

The antenna (RBTES-BG-P18M) of this product, under normal use condition, is at least 40cm away from the body of the user. Warning statement to the user for keeping at least 40cm or more separation distance with the antenna should be included in users manual.

The antenna (RBTES-BG-PAR24M) of this product, under normal use condition, is at least 68cm away from the body of the user. Warning statement to the user for keeping at least 68cm or more separation distance with the antenna should be included in users manual.

The antenna (RBTES-AW-S1590M) of this product, under normal use condition, is at least 28cm away from the body of the user. Warning statement to the user for keeping at least 28cm or more separation distance with the antenna should be included in users manual.

The antenna (RBTES-AH-P23M) of this product, under normal use condition, is at least 61cm away from the body of the user. Warning statement to the user for keeping at least 61cm or more separation distance with the antenna should be included in users manual. So, this device is classified as **Mobile Device**.



6 Test Results

6.1 Antenna Gain

For 2.4GHz

Antenna 1: The maximum Gain of the antenna is 2.0dBi.
Antenna 2: The maximum Gain of the antenna is 2.0dBi.
Antenna 3: The maximum Gain of the antenna is 23.5dBi.
Antenna 4: The maximum Gain of the antenna is 18.0dBi.
Antenna 5: The maximum Gain of the antenna is 8.0dBi.

For 5GHz

[Operated in 5150 ~ 5250MHz, 5250MHz ~ 5350MHz, 5725MHz ~ 5825MHz band: \(15.407\)](#)

Antenna 1: The maximum Gain of the antenna is 4.0dBi.
Antenna 2: The maximum Gain of the antenna is 4.0dBi.
Antenna 3: The maximum Gain of the antenna is 16.0dBi.
Antenna 4: The maximum Gain of the antenna is 10.0dBi.

[Operated in 5725 ~ 5850MHz band: \(15.247\)](#)

Antenna 1: The maximum Gain of the antenna is 4.0dBi.
Antenna 2: The maximum Gain of the antenna is 4.0dBi.
Antenna 3: The maximum Gain of the antenna is 23.0dBi.
Antenna 4: The maximum Gain of the antenna is 10.0dBi.
Antenna 5: The maximum Gain of the antenna is 16.0dBi.

**For 802.11b/g(2400 ~ 2483.5MHz)**

Item	SPEC No.	Model No.	Product Description	Antenna Gain	Remark	Connector
1	NA	RBT4K-AG-IA	2.4-4.9/5.8 GHz, 8ft of cable RPSMA Indoor Antenna.	2dBi	Omni	RPSMA
2	NA	Rubber Duck	Rubber Duck 2.4/5GHz Indoor Antenna	2dBi	Dipole Antenna	MHF
3	8910616	RBTES-BG-PAR24M	2.4 GHz Parabolic Antenna Assy Outdoor Antenna.	23.5 dBi	Point to point Directional	Reverse N
4	8910617	RBTES-BG-P18M	2.4 GHz Panel Antenna Assy Outdoor Antenna.	18 dBi	Point to point Directional	Reverse N
5	8910619	RBTES-BG-M08M	2.4 GHz Omni Antenna Assy Outdoor Antenna.	8dBi	Omni	Reverse N

For 802.11a (5725 ~ 5850MHz band)

Item	SPEC No.	Model No.	Product Description	Antenna Gain	Remark	Connector
1	NA	RBT4K-AG-IA	2.4-4.9/5.8 GHz, 8ft of cable RPSMA Indoor Antenna.	4dBi	Omni	RPSMA
2	NA	Rubber Duck	Rubber Duck 2.4/5GHz Indoor Antenna	4dBi	Dipole Antenna	MHF
3	8910605	RBTES-AH-P23M	5.8GHz GHz Directional Antenna Assy Outdoor Antenna..	23 dBi	Point to point Directional	Reverse N
4	8910606	RBTES-AH-M10M	5.8GHz GHz Omni Antenna Assy Outdoor Antenna.	10 dBi	Omni	Reverse N
5	8910620	RBTES-AW-S1590M	4.9 GHz -6 GHz Adjustable Sector Antenna Assy Outdoor Antenna	16 dBi at 60° 15 dBi at 90°	Point to point Directional	Reverse N

For 802.11a (5150 ~ 5350MHz band)

Item	SPEC No.	Model No.	Product Description	Antenna Gain	Remark	Connector
1	NA	Rubber Duck	Rubber Duck 2.4/5GHz Indoor Antenna	4dBi	Dipole Antenna	MHF
2	NA	RBT4K-AG-IA	2.4-4.9/5.8 GHz, 8ft of cable RPSMA Indoor Antenna.	4dBi	Omni	RPSMA
3	8910620	RBTES-AW-S1590M	4.9 GHz -6 GHz Adjustable Sector Antenna Assy Outdoor Antenna	16 dBi at 60° 15 dBi at 90°	Point to point Directional	Reverse N
4	8910607	RBTES-AM-M10M	5.2GHz GHz Omni Antenna Assy Outdoor Antenna.	10 dBi	Omni	Reverse N



6.2 Output Power Into Antenna & RF Exposure value at distance 20cm:

For 2.4GHz

802.11b:

Antenna 1

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	229.0867653	0.072231915	1.0
6	2437	316.227766	0.099707799	1.0
11	2462	132.4341535	0.041756985	1.0

Antenna 2

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	229.0867653	0.072231915	1.0
6	2437	316.227766	0.099707799	1.0
11	2462	132.4341535	0.041756985	1.0

Antenna 3

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	53.70317964	0.206905147	1.0
6	2437	244.9063242	0.943563853	1.0
11	2462	29.51209227	0.113702835	1.0

Antenna 4

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	54.20008904	0.170086223	1.0
6	2437	307.6096815	0.965315185	1.0
11	2462	30.69021988	0.096309502	1.0

Antenna 5

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	158.4893192	0.198943214	1.0
6	2437	314.7748314	0.395120105	1.0
11	2462	77.62471166	0.097438172	1.0



802.11g:

Antenna 1

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	162.1810097	0.05113628	1.0
6	2437	309.0295433	0.097438172	1.0
11	2462	74.98942093	0.023644445	1.0

Antenna 2

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	162.1810097	0.05113628	1.0
6	2437	374.9730022	0.118230392	1.0
11	2462	71.28530301	0.022476523	1.0

Antenna 3

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	38.9045145	0.149889529	1.0
6	2437	229.0867653	0.882614982	1.0
11	2462	19.54339456	0.075295894	1.0

Antenna 4

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	33.34264128	0.104633111	1.0
6	2437	306.1963434	0.960879964	1.0
11	2462	14.12537545	0.044327081	1.0

Antenna 5

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	86.29785478	0.108325108	1.0
6	2437	307.6096815	0.386126074	1.0
11	2462	45.70881896	0.05737585	1.0

**For 5GHz**

Operated in 5150 ~ 5250MHz, 5250MHz ~ 5350MHz, 5725MHz ~ 5825MHz band: (15.407)

Antenna 1

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5180	45.39416167	0.022684496	1.0
4	5240	46.13175746	0.023053089	1.0
5	5260	221.309471	0.110593379	1.0
8	5320	69.82324041	0.034892262	1.0

Antenna 2

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5180	44.15704474	0.02206628	1.0
4	5240	45.91980128	0.02294717	1.0
5	5260	202.768272	0.10132792	1.0
8	5320	110.9174815	0.05542799	1.0

Antenna 3

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
5	5260	21.0377844	0.085010595	1.0
8	5320	20.70141349	0.08365137	1.0

Antenna 4

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
5	5260	92.04495718	0.183117196	1.0
8	5320	41.87935651	0.083316138	1.0



Operated in 5725 ~ 5850MHz band: (15.247)

Antenna 1

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5745	211.348904	0.105615857	1.0
3	5785	223.3572223	0.111616687	1.0
5	5825	230.6747189	0.115273407	1.0

Antenna 2

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5745	306.9021988	0.15336601	1.0
3	5785	304.789499	0.15231025	1.0
5	5825	301.3006024	0.15056677	1.0

Antenna 3

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5745	211.348904	0.901839909	1.0
3	5785	223.3572223	0.953080207	1.0
5	5825	230.6747189	0.984304454	1.0

Antenna 4

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5745	211.348904	0.420464302	1.0
3	5785	223.3572223	0.444354036	1.0
5	5825	230.6747189	0.458911699	1.0

Antenna 5

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5745	211.348904	0.85402986	1.0
3	5785	223.3572223	0.90255371	1.0
5	5825	230.6747189	0.93212264	1.0