

FCC RF EXPOSURE EVALUATION REPORT

FCC ID: VW3FAST5280

Project No. : 1710C321

Equipment : Wireless Home Router

Model : FAST5280

Applicant : SAGEMCOM BROADBAND SAS

Address : 250 Route de l' Empereur - 92848 RUEIL
MALMAISON CEDEX- FRANCE

Exposure category : General population/uncontrolled environment

EUT Type: : Production Unit (Engineer Sample)

Device Type : Mobile Device

1. Evaluation Method

Systems operating under the provisions of FCC 47 CFR section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as mobile device whereby a distance of 0.2m normally can be maintained between the user and the device, and below RF Permissible Exposure limit shall comply with.

In accordance with KDB447498D01 for Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modeled or measured field strengths or power density, is ≤ 1.0 . The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to MPE limit, at the test frequency. Either the maximum peak or spatially averaged results from measurements or numerical simulations may be used to determine the MPE ratios. Spatial averaging does not apply when MPE is estimated using simple calculations based on far-field plane-wave equivalent conditions. The antenna installation and operating requirements for the host device must meet the minimum test separation distances required by all antennas, in both standalone and simultaneous transmission operations, to satisfy compliance.

2. Limits for General Population/Uncontrolled Exposure

(B) 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 ²)	Averaging Time E ² , H ² 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: f = frequency in MHz ; *Plane-wave equivalent power density

3. Refer Evaluation Method

ANSI C95.1-1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

FCC KDB publication 447498 D01 General RF Exposure Guidance v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

FCC CFR 47 part1 1.1310: Radiofrequency radiation exposure limits.

FCC CFR 47 part2 2.1093: Radiofrequency radiation exposure evaluation: portable devices

4. Calculation Method

Predication of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG / 4\pi R^2$$

Where:

S=power density

P=power input to antenna

G=power gain of the antenna in the direction of interest relative to an isotropic radiator

R=distance to the center of radiation of the antenna

5. Conducted Power Results

5.1 Test Results and Manufacturing Tolerance

Mode	Frequency Band	Maximum Average power declared by Manufacturer		
		Antenna 1	Antenna 4	Antenna 5
IEEE 802.11b	2.4G	≤ 27.00	≤ 27.00	≤ 27.00
IEEE 802.11g	2.4G	≤ 27.00	≤ 26.00	≤ 26.00
IEEE 802.11n HT20	2.4G	≤ 24.50	≤ 24.50	≤ 24.50
IEEE 802.11n HT40	2.4G	≤ 22.00	≤ 21.00	≤ 21.00

Mode	Frequency Band	Maximum Average power declared by Manufacturer				
		Antenna 1	Antenna 2	Antenna 3	Antenna 4	Antenna 5
IEEE 802.11a	5G band 1	n/a	≤ 23.00	≤ 22.00	≤ 22.00	≤ 22.50
	5G band 2	≤ 21.50	≤ 21.50	≤ 21.50	≤ 21.50	n/a
	5G band 3	≤ 21.50	≤ 21.50	≤ 21.50	≤ 21.50	n/a
	5G band 4	n/a	≤ 26.00	≤ 24.00	≤ 24.50	≤ 24.50
IEEE 802.11n HT20	5G band 1	n/a	≤ 22.00	≤ 22.00	≤ 22.00	≤ 25.00
	5G band 2	≤ 15.50	≤ 15.00	≤ 15.00	≤ 15.00	n/a
	5G band 3	≤ 14.50	≤ 14.00	≤ 13.50	≤ 14.50	n/a
	5G band 4	n/a	≤ 23.00	≤ 22.50	≤ 23.00	≤ 22.00
IEEE 802.11n HT40	5G band 1	n/a	≤ 23.00	≤ 23.00	≤ 22.00	≤ 23.00
	5G band 2	≤ 16.50	≤ 15.50	≤ 15.50	≤ 16.50	n/a
	5G band 3	≤ 17.00	≤ 16.00	≤ 15.50	≤ 16.50	n/a
	5G band 4	n/a	≤ 23.00	≤ 22.00	≤ 23.00	≤ 22.00
IEEE 802.11ac VHT20	5G band 1	n/a	≤ 22.00	≤ 22.50	≤ 22.00	≤ 22.50
	5G band 2	≤ 11.50	≤ 11.50	≤ 10.50	≤ 11.00	n/a
	5G band 3	≤ 14.00	≤ 13.50	≤ 12.50	≤ 14.00	n/a
	5G band 4	n/a	≤ 23.50	≤ 23.00	≤ 23.50	≤ 22.50
IEEE 802.11ac VHT40	5G band 1	n/a	≤ 23.00	≤ 23.00	≤ 22.00	≤ 23.00
	5G band 2	≤ 10.00	≤ 10.00	≤ 9.00	≤ 10.00	n/a
	5G band 3	≤ 14.00	≤ 13.00	≤ 12.00	≤ 13.00	n/a
	5G band 4	n/a	≤ 23.00	≤ 22.00	≤ 22.00	≤ 22.00
IEEE 802.11ac VHT80	5G band 1	n/a	≤ 19.00	≤ 19.00	≤ 18.00	≤ 19.00
	5G band 2	≤ 16.50	≤ 15.50	≤ 15.50	≤ 17.00	n/a
	5G band 3	≤ 16.50	≤ 16.00	≤ 16.00	≤ 16.50	n/a
	5G band 4	n/a	≤ 22.00	≤ 22.00	≤ 21.00	≤ 22.00

6. Antenna Information

Model	Type	Connector	Peak gain (dBi)				
			2400-2483.5 MHz	5150-5250 MHz	5250-5350 MHz	5470-5725 MHz	5725-5850 MHz
Antenna 1	Internal	RF-SMA	2.88	n/a	4.68	4.68	n/a
Antenna 2	Internal	RF-SMA	n/a	4.90	4.42	4.42	4.90
Antenna 3	Internal	RF-SMA	n/a	4.05	3.44	3.44	4.05
Antenna 4	Internal	RF-SMA	3.25	3.65	3.69	3.69	3.65
Antenna 5	Internal	RF-SMA	2.74	3.84	n/a	n/a	3.84

7. Evaluation Results

7.1 Standalone

Antenna 1

Mode	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	(dBm)	(mW)					
2.4 GHz							
IEEE 802.11b	27.00	501.1872	2.88	1.9049	100%	0.1936	1.0000
IEEE 802.11g	27.00	501.1872	2.88	1.9049	100%	0.1936	1.0000
IEEE 802.11n HT20	24.50	281.8383	2.88	1.9049	100%	0.1089	1.0000
IEEE 802.11n HT40	22.00	158.4893	2.88	1.9409	100%	0.0612	1.0000
5G Band 2A							
IEEE 802.11a	21.50	141.2538	4.68	2.9376	100%	0.0826	1.0000
IEEE 802.11n HT20	15.50	35.4813	4.68	2.9376	100%	0.0207	1.0000
IEEE 802.11n HT40	16.50	44.6684	4.68	2.9376	100%	0.0261	1.0000
IEEE 802.11ac VHT20	11.50	14.1254	4.68	2.9376	100%	0.0083	1.0000
IEEE 802.11ac VHT40	10.00	10.0000	4.68	2.9376	100%	0.0058	1.0000
IEEE 802.11ac VHT80	16.50	44.6684	4.68	2.9376	100%	0.0261	1.0000
5G Band 2C							
IEEE 802.11a	21.50	141.2538	4.68	2.9376	100%	0.0826	1.0000
IEEE 802.11n HT20	14.50	28.1838	4.68	2.9376	100%	0.0165	1.0000
IEEE 802.11n HT40	17.00	50.1187	4.68	2.9376	100%	0.0293	1.0000
IEEE 802.11ac VHT20	14.00	25.1189	4.68	2.9376	100%	0.0147	1.0000
IEEE 802.11ac VHT40	14.00	25.1189	4.68	2.9376	100%	0.0147	1.0000
IEEE 802.11ac VHT80	16.50	44.6684	4.68	2.9376	100%	0.0261	1.0000

Antenna 2

Mode	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	(dBm)	(mW)					
5GHz Band 1							
IEEE 802.11a	23.00	199.5262	4.90	3.0903	100%	0.1227	1.0000
IEEE 802.11n HT20	22.00	158.4893	4.90	3.0903	100%	0.0975	1.0000
IEEE 802.11n HT40	23.00	199.5262	4.90	3.0903	100%	0.1227	1.0000
IEEE 802.11ac VHT20	22.00	158.4893	4.90	3.0903	100%	0.0975	1.0000
IEEE 802.11ac VHT40	23.00	199.5262	4.90	3.0903	100%	0.1227	1.0000
IEEE 802.11ac VHT80	19.00	79.4328	4.90	3.0903	100%	0.0489	1.0000
5G Band 2A							
IEEE 802.11a	21.50	141.2538	4.42	2.7669	100%	0.0778	1.0000
IEEE 802.11n HT20	15.00	31.6228	4.42	2.7669	100%	0.0174	1.0000
IEEE 802.11n HT40	15.50	35.4813	4.42	2.7669	100%	0.0195	1.0000
IEEE 802.11ac VHT20	11.50	14.1254	4.42	2.7669	100%	0.0078	1.0000
IEEE 802.11ac VHT40	10.00	10.0000	4.42	2.7669	100%	0.0055	1.0000
IEEE 802.11ac VHT80	15.50	35.4813	4.42	2.7669	100%	0.0195	1.0000
5G Band 2C							
IEEE 802.11a	21.50	141.2538	4.42	2.7669	100%	0.0778	1.0000
IEEE 802.11n HT20	14.00	25.1189	4.42	2.7669	100%	0.0138	1.0000
IEEE 802.11n HT40	16.00	39.8107	4.42	2.7669	100%	0.0219	1.0000
IEEE 802.11ac VHT20	13.50	22.3872	4.42	2.7669	100%	0.0123	1.0000
IEEE 802.11ac VHT40	13.00	19.9526	4.42	2.7669	100%	0.0110	1.0000
IEEE 802.11ac VHT80	16.00	39.8107	4.42	2.7669	100%	0.0219	1.0000
5G Band 3							
IEEE 802.11a	26.00	398.1072	4.90	3.0903	100%	0.2449	1.0000
IEEE 802.11n HT20	23.00	199.5262	4.90	3.0903	100%	0.1227	1.0000
IEEE 802.11n HT40	23.00	199.5262	4.90	3.0903	100%	0.1227	1.0000
IEEE 802.11ac VHT20	23.50	223.8721	4.90	3.0903	100%	0.1377	1.0000
IEEE 802.11ac VHT40	23.00	199.5262	4.90	3.0903	100%	0.1227	1.0000
IEEE 802.11ac VHT80	22.00	158.4893	4.90	3.0903	100%	0.0975	1.0000

Antenna 3

Mode	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	(dBm)	(mW)					
2.4 GHz							
IEEE 802.11a	22.00	158.4893	4.05	2.5410	100%	0.0802	1.0000
IEEE 802.11n HT20	22.00	158.4893	4.05	2.5410	100%	0.0802	1.0000
IEEE 802.11n HT40	23.00	199.5262	4.05	2.5410	100%	0.1009	1.0000
IEEE 802.11ac VHT20	22.50	177.8279	4.05	2.5410	100%	0.0899	1.0000
IEEE 802.11ac VHT40	23.00	199.5262	4.05	2.5410	100%	0.1009	1.0000
IEEE 802.11ac VHT80	19.00	79.4328	4.05	2.5410	100%	0.0402	1.0000
5G Band 2A							
IEEE 802.11a	21.50	141.2538	3.44	2.2080	100%	0.0621	1.0000
IEEE 802.11n HT20	15.00	31.6228	3.44	2.2080	100%	0.0139	1.0000
IEEE 802.11n HT40	15.50	35.4813	3.44	2.2080	100%	0.0156	1.0000
IEEE 802.11ac VHT20	10.50	11.2202	3.44	2.2080	100%	0.0049	1.0000
IEEE 802.11ac VHT40	9.00	7.9433	3.44	2.2080	100%	0.0035	1.0000
IEEE 802.11ac VHT80	15.50	35.4813	3.44	2.2080	100%	0.0156	1.0000
5G Band 2C							
IEEE 802.11a	21.50	141.2538	3.44	2.2080	100%	0.0621	1.0000
IEEE 802.11n HT20	13.50	22.3872	3.44	2.2080	100%	0.0098	1.0000
IEEE 802.11n HT40	15.50	35.4813	3.44	2.2080	100%	0.0156	1.0000
IEEE 802.11ac VHT20	12.50	17.7828	3.44	2.2080	100%	0.0078	1.0000
IEEE 802.11ac VHT40	12.00	15.8489	3.44	2.2080	100%	0.0070	1.0000
IEEE 802.11ac VHT80	16.00	39.8107	3.44	2.2080	100%	0.0175	1.0000
5G Band 3							
IEEE 802.11a	24.00	251.1886	4.05	2.5410	100%	0.1270	1.0000
IEEE 802.11n HT20	22.50	177.8279	4.05	2.5410	100%	0.0899	1.0000
IEEE 802.11n HT40	22.00	158.4893	4.05	2.5410	100%	0.0802	1.0000
IEEE 802.11ac VHT20	23.00	199.5262	4.05	2.5410	100%	0.1009	1.0000
IEEE 802.11ac VHT40	22.00	158.4893	4.05	2.5410	100%	0.0802	1.0000
IEEE 802.11ac VHT80	22.00	158.4893	4.05	2.5410	100%	0.0802	1.0000

Antenna 4

Mode	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	(dBm)	(mW)					
2.4 GHz							
IEEE 802.11b	27.00	501.1872	3.25	2.1135	100%	0.2108	1.0000
IEEE 802.11g	26.00	398.1072	3.25	2.1135	100%	0.1675	1.0000
IEEE 802.11n HT20	24.50	281.8383	3.25	2.1135	100%	0.1186	1.0000
IEEE 802.11n HT40	21.00	125.8925	3.25	2.1135	100%	0.0530	1.0000
5GHz Band 1							
IEEE 802.11a	22.00	158.4893	3.65	2.3174	100%	0.0731	1.0000
IEEE 802.11n HT20	22.00	158.4893	3.65	2.3174	100%	0.0731	1.0000
IEEE 802.11n HT40	22.00	158.4893	3.65	2.3174	100%	0.0731	1.0000
IEEE 802.11ac VHT20	22.00	158.4893	3.65	2.3174	100%	0.0731	1.0000
IEEE 802.11ac VHT40	22.00	158.4893	3.65	2.3174	100%	0.0731	1.0000
IEEE 802.11ac VHT80	18.00	63.0957	3.65	2.3174	100%	0.0291	1.0000
5G Band 2A							
IEEE 802.11a	21.50	141.2538	3.69	2.3388	100%	0.0658	1.0000
IEEE 802.11n HT20	15.00	31.6228	3.69	2.3388	100%	0.0147	1.0000
IEEE 802.11n HT40	16.50	44.6684	3.69	2.3388	100%	0.0208	1.0000
IEEE 802.11ac VHT20	11.00	12.5893	3.69	2.3388	100%	0.0059	1.0000
IEEE 802.11ac VHT40	10.00	10.0000	3.69	2.3388	100%	0.0047	1.0000
IEEE 802.11ac VHT80	17.00	50.1187	3.69	2.3388	100%	0.0233	1.0000
5G Band 2C							
IEEE 802.11a	21.50	141.2538	3.69	2.3388	100%	0.0658	1.0000
IEEE 802.11n HT20	14.50	28.1838	3.69	2.3388	100%	0.0131	1.0000
IEEE 802.11n HT40	16.50	44.6684	3.69	2.3388	100%	0.0208	1.0000
IEEE 802.11ac VHT20	14.00	25.1189	3.69	2.3388	100%	0.0117	1.0000
IEEE 802.11ac VHT40	13.00	19.9526	3.69	2.3388	100%	0.0093	1.0000
IEEE 802.11ac VHT80	16.50	44.6684	3.69	2.3388	100%	0.0208	1.0000
5G Band 3							
IEEE 802.11a	24.50	281.8383	3.65	2.3174	100%	0.1300	1.0000
IEEE 802.11n HT20	23.00	199.5262	3.65	2.3174	100%	0.0920	1.0000
IEEE 802.11n HT40	23.00	199.5262	3.65	2.3174	100%	0.0920	1.0000
IEEE 802.11ac VHT20	23.50	223.8721	3.65	2.3174	100%	0.1033	1.0000
IEEE 802.11ac VHT40	22.00	158.4893	3.65	2.3174	100%	0.0731	1.0000
IEEE 802.11ac VHT80	21.00	125.8925	3.65	2.3174	100%	0.0581	1.0000

Antenna 5

Mode	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	(dBm)	(mW)					
2.4 GHz							
IEEE 802.11b	27.00	501.1872	2.74	1.8793	100%	0.1875	1.0000
IEEE 802.11g	26.00	398.1072	2.74	1.8793	100%	0.1489	1.0000
IEEE 802.11n HT20	24.50	281.8383	2.74	1.8793	100%	0.1054	1.0000
IEEE 802.11n HT40	21.00	125.8925	2.74	1.8793	100%	0.0471	1.0000
5G Band 2A							
IEEE 802.11a	22.50	177.8279	3.84	2.4210	100%	0.0857	1.0000
IEEE 802.11n HT20	25.00	316.2278	3.84	2.4210	100%	0.1524	1.0000
IEEE 802.11n HT40	23.00	199.5262	3.84	2.4210	100%	0.0962	1.0000
IEEE 802.11ac VHT20	22.50	177.8279	3.84	2.4210	100%	0.0857	1.0000
IEEE 802.11ac VHT40	23.00	199.5262	3.84	2.4210	100%	0.0962	1.0000
IEEE 802.11ac VHT80	19.00	79.4328	3.84	2.4210	100%	0.0383	1.0000
5G Band 2C							
IEEE 802.11a	24.50	281.8383	3.84	2.4210	100%	0.1358	1.0000
IEEE 802.11n HT20	22.00	158.4893	3.84	2.4210	100%	0.0764	1.0000
IEEE 802.11n HT40	22.00	158.4893	3.84	2.4210	100%	0.0764	1.0000
IEEE 802.11ac VHT20	22.50	177.8279	3.84	2.4210	100%	0.0857	1.0000
IEEE 802.11ac VHT40	22.00	158.4893	3.84	2.4210	100%	0.0764	1.0000
IEEE 802.11ac VHT80	22.00	158.4893	3.84	2.4210	100%	0.0764	1.0000

Remark:

1. Maximum power including tune-up tolerance;
2. EIRP including tune-up tolerance;
3. MPE use distance is 20 cm from manufacturer declaration of user manual.

7.2

Simultaneous Transmission for MPE Exclusion

The sample support one WLAN modular and 3*3 MIMO antennas for 2.4GHz and 4*4 MIMO for 5GHz, 2.4GHz and 5GHz share same antenna, need consider simultaneous transmission;

The sample support antenna 1, antenna 4 and antenna 5 transmit 2.4 GHz, antenna 2, antenna 3, antenna 4 and antenna 5 transmit 5GHz Band 1 and 5 GHz Band 3, antenna 1, antenna 2, antenna 3 and antenna 4 for transmit 5 GHz Band 2A and 2C.

Evaluated all simultaneous transmission condition, recorded worst case at antenna 1 transmit 2.4 GHz and antenna 2, antenna 3, antenna 4, antenna 5 transmit 5 GHz.

Maximum MPE Ratio 2.4GWLAN	Maximum MPE Ratio 5GWLAN	Σ MPE ratios	Limit	Results
0.1986	0.4473	< 0.7	1.0	PASS

Remark:

1. *Maximum power including tune-up tolerance;*
2. *EIRP including tune-up tolerance;*
3. *MPE use distance is 20 cm from manufacturer declaration of user manual.*

8. Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1093 for the uncontrolled RF Exposure and SAR Exclusion Threshold per KDB 447498 v06.