



# RF Exposure Evaluation Report

**Application No.:** SZEM2009008718CR  
**Applicant:** SAGEMCOM BROADBAND SAS  
**Address of Applicant:** 250 Route de l'Empereur - 92848 RUEIL MALMAISON CEDEX- FRANCE  
**Manufacturer:** SAGEMCOM BROADBAND SAS  
**Address of Manufacturer:** 250 Route de l'Empereur - 92848 RUEIL MALMAISON CEDEX- FRANCE  
**Factory:** AGEMCOM BROADBAND SAS  
**Address of Factory:** 250 Route de l'Empereur - 92848 RUEIL MALMAISON CEDEX- FRANCE

**Equipment Under Test (EUT):**  
**Product Name:** Home Hub 4000(FAST 5689)  
**Model No.:** FAST 5689  
**FCC ID:** VW3FAST5689  
**Trade mark:** SAGEMCOM  
**Standards:** 47 CFR Part 1.1307  
 47 CFR Part 1.1310  
 47 CFR Part 2.1091  
 KDB447498D01 General RF Exposure Guidance v06

**Date of Receipt:** 2020-09-02  
**Date of Test:** 2020-09-03 to 2020-09-30  
**Date of Issue:** 2020-11-19

<b>Test Result :</b>	<b>PASS*</b>
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\* In the configuration tested, the EUT complied with the standards specified above.

Keny Xu  
 EMC Laboratory Manager



## 2 Version

Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2020-11-19		Original

<b>Authorized for issue by:</b>			
			
		_____ <b>Leo Lai/Project Engineer</b>	
			
		_____ <b>Eric Fu/Reviewer</b>	



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## 4 General Information

### 4.1 General Description of EUT

Test voltage:	120V~60Hz
Power adapter:	Model: MSA-Z5000IS12.0-60A-P Input: 100-120V~50/60Hz 1.5A Max, Output: DC 12V 5A

#### Z-Wave

Antenna Gain:	0dBi
Channels:	908.4MHz, 908.42MHz, 916MHz
Modulation:	FSK
Antenna Type:	Internal Antenna

#### WiFi 2.4G

Operation Frequency:	802.11b/g/n/ax(HT20/HE20): 2412MHz to 2462MHz 802.11n/ax(HT40/HE40): 2422MHz to 2452MHz
Modulation Type:	802.11b: DSSS (CCK, DQPSK, DBPSK) 802.11g/n: OFDM (64QAM, 16QAM, QPSK, BPSK) 802.11ax: OFDM&OFDMA (1024QAM, 256QAM, 64QAM, 16QAM, QPSK, BPSK)
Number of Channels:	802.11802.11b/g/n(HT20)/ax(HE20): 11 802.11n(HT40)/ax(HE40):7
Channel Spacing:	5MHz
Antenna Type:	Internal Antenna

#### Antenna Gain:

2.4G-1	2.4G-2	2.4G-3	DB-2 (2.4G)	5G-1	5G-2
Vertical (dipole)	Vertical (dipole)	Horizontal (dipole)	Horizontal (dipole)	Mix (PIFA)	Mix (PIFA)
5G-3	DB-2 (5G)	5G-4	5G-5	5G-6	DB-1 (5G)
Horizontal (dipole)	Horizontal (dipole)	Mix (PIFA)	Mix (PIFA)	Horizontal (dipole)	Horizontal (dipole)





Frequency (MHz)	E-total(dBi) ANT1	E-total(dBi) ANT2	E-total(dBi) ANT3	E-total(dBi) ANT4 (DB-2)	Peak Gain of 3D Directional pattern
2400	3.57	3.49	3.94	3.12	6.45
2450	3.85	3.35	3.85	2.52	6.78
2500	3.22	2.88	3.34	2.72	6.79

**WiFi 5G**

Operation Frequency:	Band	Mode	Frequency Range(MHz)	Number of channels
	UNII Band I	802.11a/n(HT20)/ac(VHT20)/ax(HE20)	5180-5240	4
		802.11n(HT40)/ac(VHT40)/ax(HE40)	5190-5230	2
		802.11ac(VHT80)/ax(HE80)	5210	1
	UNII Band II-A	802.11a/n(HT20)/ac(VHT20)/ax(HE20)	5260-5320	4
		802.11n(HT40)/ac(VHT40)/ax(HE40)	5270-5310	2
		802.11ac(VHT80)/ax(HE80)	5290	1
		802.11ac(VHT160)/ax(HE160)	5250	1
	UNII Band II-C	802.11a/n(HT20)/ac(VHT20)/ax(HE20)	5500-5700	11
		802.11n(HT40)/ac(VHT40)/ax(HE40)	5510-5670	5
		802.11ac(VHT80)/ax(HE80)	5530-5630	2
		802.11ac(VHT160)/ax(HE160)	5570	1
	UNII Band III	802.11a/n(HT20)/ac(VHT20)/ax(HE20)	5745-5825	5
802.11n(HT40)/ac(VHT40)/ax(HE40)		5755-5895	2	
802.11ac(VHT80)/ax(HE80)		5775	1	
Modulation Type:	802.11a: OFDM (BPSK, QPSK, 16QAM, 64QAM) 802.11n: OFDM (BPSK, QPSK, 16QAM, 64QAM) 802.11ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM)			





	802.11ax: OFDM&OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)
Channel Spacing:	802.11a/n(HT20)/ac(VHT20)/ax(HE20) : 20MHz 802.11n(HT40)/ac(VHT40)/ax(HE40) : 40MHz 802.11ac(VHT80)/ax(HE80) : 80MHz 802.11ac(VHT80)/ax(HE80) : 160MHz
DFS Function:	Master
TPC Function:	Support
Antenna Type:	Internal Antenna

Antenna Gain:

2.4G-1	2.4G-2	2.4G-3	DB-2 (2.4G)	5G-1	5G-2
Vertical (dipole)	Vertical (dipole)	Horizontal (dipole)	Horizontal (dipole)	Mix (PIFA)	Mix (PIFA)
5G-3	DB-2 (5G)	5G-4	5G-5	5G-6	DB-1 (5G)
Horizontal (dipole)	Horizontal (dipole)	Mix (PIFA)	Mix (PIFA)	Horizontal (dipole)	Horizontal (dipole)

	Band 1	Band 2A	Band 2C	Band 3
5G-1	4.49	4.26	-	-
5G-2	3.57	3.71	-	-
5G-3	4.89	4.81	-	-
DB-2(5G)	4.02	4.4	-	-
5G-4	-	-	3.88	3.4
5G-5	-	-	3.78	4.29
5G-6	-	-	4.96	4.84
DB-1(5G)	-	-	4.91	4.5
Total(dBi) 4ANTs	6.98	6.96	6.85	6.85

**Zigbee**

Antenna Gain:	3.85dBi
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Channel Spacing:	5MHz
Number of Channels:	16
Modulation Type:	O-QPSK
Operation Frequency:	2405MHz to 2480MHz
Antenna Type:	Internal Antenna

## 4.2 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch

No. 1 Workshop, M-10, Middle section, Science & Technology Park, Shenzhen, Guangdong, China  
518057

Telephone: +86 (0) 755 2601 2053 Fax: +86 (0) 755 2671 0594

No tests were sub-contracted.

## 4.3 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **A2LA (Certificate No. 3816.01)**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

- **VCCI**

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

- **FCC –Designation Number: CN1178**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1178. Test Firm Registration Number: 406779.

- **Innovation, Science and Economic Development Canada**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0006.

IC#: 4620C.

## 4.4 Deviation from Standards

None.

## 4.5 Abnormalities from Standard Conditions



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None.

#### 4.6 Other Information Requested by the Customer

None.





## 5 RF Exposure Evaluation

### 5.1 RF Exposure Compliance Requirement

#### 5.1.1 Limits

According to FCC Part1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in part1.1307(b)

**TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)**

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
<b>(A) Limits for Occupational/Controlled Exposures</b>				
0.3–3.0 .....	614	1.63	*(100)	6
3.0–30 .....	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30–300 .....	61.4	0.163	1.0	6
300–1500 .....	.....	.....	f/300	6
1500–100,000 .....	.....	.....	5	6
<b>(B) Limits for General Population/Uncontrolled Exposure</b>				
0.3–1.34 .....	614	1.63	*(100)	30
1.34–30 .....	824/f	2.19/f	*(180/f <sup>2</sup> )	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

Friis Formula

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

Where

$P_d$  = power density in mW/cm<sup>2</sup>

$P_{out}$  = output power to antenna in mW

G = gain of antenna in linear scale

$\pi$  = 3.1416

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

$P_d$  is the limit of MPE, 1 mW/cm<sup>2</sup>. If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.

#### 5.1.2 Test Procedure

Software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.



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### 5.1.3 EUT RF Exposure Evaluation

#### WiFi 2.4G

Antenna Gain: 6.79dBi

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 4.775 in linear scale.

Output Power Into Antenna & RF Exposure Evaluation Distance:

Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 30 cm (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Result
2462	29.97	993.12	0.4193	1.0	PASS

#### WiFi 5G

Antenna Gain: 6.85dBi

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 4.842 in linear scale.

Output Power Into Antenna & RF Exposure Evaluation Distance:

Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 30 cm (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Result
5775	29.02	797.99	0.3416	1.0	PASS

#### Zigbee

Antenna Gain: 3.85dBi

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 2.427 in linear scale.

Output Power Into Antenna & RF Exposure Evaluation Distance:

Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 30 cm (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Result
2475	18.93	78.16	0.0168	1.0	PASS

#### Z-Wave

The Max. power (including tune-up tolerance) is: (\*)

Output Power Into Antenna & RF Exposure Evaluation Distance:

Frequency (MHz)	Output Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 30 cm (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Result
908.40	-1.308	0.74	0.000065	0.60560	PASS

(\*) Refer to test report SZEM200900871804 for EUT test Max Conducted Peak Output Power(including tune-up tolerance) value.

$$E=EIRP-20\log D+104.7$$



E=93.85dBuV/m(Refer to test report SZEM200900871801)

D=3m

EIRP=93.85-(-20log(3)+104.7)

EIRP=-1.308dBm(0.74mW)

Exposure conditions for simultaneous transmission operations

Simultaneous transmission MPE test is not required, because the Max. sum of the MPE ratios for WiFi 2.4G,

WiFi 5G, Zigbee and Z-Wave is  $0.4193/1.0+0.3416/1.0+0.0168/1.0+0.000065/0.60560\approx 0.77781 < 1$

Note: Refer to report No. SZEM200900871801, SZEM200900871802, SZEM200900871803 and SZEM200900871804 for EUT test Max Conducted Peak Output Power value, due to Z-Wave, WiFi 2.4G, WiFi 5G and Zigbee can simultaneous transmit the signal so all of the maximum power are selected for this evaluation. The distance r (4th column) calculated from the Fries transmission formula is far greater than 30 cm separation requirement.

- End of the Report -

