

Maximum Permissible Exposure Report

Product Information

EUT	: OTT+DVB
Model Number	: SH5BFAA,SH5BFAX("X" on behalf of one of 26 English Letters A-Z)
Model Declaration	: All the same except for model name and color of cover
Test Model	: SH5BFAA
Power Supply	: DC 12V by adapter
Hardware version	: S905C1_AC232_HYBRID_DDR4X2_V1.0_R0.6
Software version	: Android Q
Sample ID	: TZ210101906-2#&TZ210101906-4#

Bluetooth

Bluetooth Version	: V4.0+EDR
Channel Number	: 79 Channels for Bluetooth BR/EDR(DSS) 40 Channels for BLE (DTS)
Modulation Technology	: GFSK, $\pi/4$ -DQPSK, 8-DPSK for Bluetooth BR/EDR (DSS) GFSK for BLE (DTS)
Data Rates	: Bluetooth BR/EDR (DSS): 1/2/3Mbps BLE (DTS): 1Mbps
Antenna Type And Gain	Internal Antenna 3: 4.59dBi

WiFi

WLAN	: Supported IEEE 802.11a/b/g/n IEEE 802.11b:2412-2462MHz IEEE 802.11g:2412-2462MHz IEEE 802.11n HT20:2412-2462MHz / 5180-5240MHz / 5745-5825MHz IEEE 802.11n HT40: 2422-2452MHz /5190-5230MHz / 5755-5795MHz
WLAN FCC Operation Frequency	: IEEE 802.11a: 5180-5240MHz / 5745-5825MHz IEEE 802.11ac VHT20: 5180-5240MHz / 5745-5825MHz IEEE 802.11ac VHT40: 5190-5230MHz / 5755-5795MHz IEEE 802.11ac VHT80: 5210MHz / 5775MHz
WLAN Channel Number	: 11 Channels for 2412-2462MHz(IEEE 802.11b/g/n HT20) 4 Channels for 5180-5240MHz (IEEE 802.11a/ac VHT20/n HT20) 2 Channels for 5190-5230MHz (IEEE 802.11ac VHT40/n HT40) 1 Channels for 5210MHz (IEEE 802.11ac VHT80) 5 Channels for 5745-5825MHz(IEEE 802.11a/ac VHT20/n HT20) 2 Channels for 5755-5795MHz(IEEE 802.11ac VHT40/n HT40) 1 Channels for 5775MHz(IEEE 802.11ac VHT80)
WLAN Modulation Technology	: IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE 802.11g: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11a: OFDM (64QAM, 16QAM, QPSK, BPSK)

IEEE 802.11ac: OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK)

Antenna Type And Gain : Antenna 1:
2.00dBi(Max.), for TX/RX (WLAN 2.4G Band)
3.64dBi(Max.), for TX/RX (WLAN 5.2G Band)
6.13dBi (Max.), for TX/RX (WLAN 5.8G Band)
Antenna 2:
3.64dBi(Max.), for TX/RX (WLAN 2.4G Band)
4.21dBi(Max.), for TX/RX (WLAN 5.2G Band),
5.44dBi(Max.), for TX/RX (WLAN 5.8G Band)
802.11n/ac support 2T2R.[Antenna 1 and Antenna 2]

Note: Antenna position refer to EUT Photos.

2. 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 modelled 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.

3. Limit

3.1 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 1 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 2.1091: Radiofrequency radiation exposure evaluation: mobile devices

3.2 Limit

Limits for Maximum Permissible Exposure (MPE)/Controlled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm ²)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	(100) *	6
3.0 – 30	1842/f	4.89/f	(900/f ²)*	6
30 – 300	61.4	0.163	1.0	6
300 – 1500	/	/	f/300	6
1500 – 100,000	/	/	5	6

Limits for Maximum Permissible Exposure (MPE)/Uncontrolled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm ²)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	(100) *	30
3.0 – 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

4. MPE 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. Antenna Information

This Product can only use antennas certificated as follows provided by manufacturer;

Antenna Gain and type refer to Product information

6. Conducted Power

2.4G Band:

Bluetooth(BDR+EDR)

Test Mode	Channel	Frequency (MHz)	Measured Peak Output Power (dBm)
GFSK	00	2402	4.85
	39	2441	7.08
	78	2480	9.14
$\pi/4$ -DQPSK	00	2402	6.3
	39	2441	8.37
	78	2480	10.18
8-DPSK	00	2402	6.87
	39	2441	8.91
	78	2480	10.57

Bluetooth(BLE)

Test Mode	Channel	Frequency (MHz)	Measured Peak Output Power (dBm)
GFSK	00	2402	5.03
	39	2441	7.23
	78	2480	6.31

WiFi 2.4GHz Band

Test Mode	Channel	Frequency (MHz)	Measured Peak Output Power (dBm)		
			Antenna 1	Antenna 2	Sum
IEEE 802.11b	1	2412	18.54	18.5	-/-
	6	2437	19.41	19.84	-/-
	11	2462	18.96	18.5	-/-
IEEE 802.11g	1	2412	18.76	19.56	-/-
	6	2437	20.16	20.59	-/-
	11	2462	19.4	19.56	-/-
IEEE 802.11n HT20	1	2412	18.89	19.81	22.4
	6	2437	18.83	20.13	22.5
	11	2462	18.25	18.79	21.5
IEEE 802.11n HT40	3	2422	15.55	16.01	18.8
	6	2437	15.74	16.29	19
	9	2452	15.22	15.81	18.5

5G Band

UNII-1 Band

Test Mode	Channel	Frequency (MHz)	Measured Conducted Average Power (dBm)		
			Antenna 1	Antenna 2	Sum
IEEE 802.11a	36	5180	9.3	10.16	/
	40	5200	10.15	11.19	/
	48	5240	10.86	11.33	/
IEEE 802.11n HT20	36	5180	8.25	9.12	11.7
	40	5200	9.02	10.04	12.6
	48	5240	9.81	11.18	13.6
IEEE802.11ac VHT20	36	5190	8.81	9.56	12.2
	40	5230	9.8	11.05	13.5
	48	5180	8.11	9.1	11.6
IEEE 802.11n HT40	38	5200	9.14	10.13	12.7
	46	5240	9.83	11.13	13.5
IEEE802.11ac VHT40	38	5190	7.79	8.54	11.2
	46	5230	8.81	10.17	12.6
IEEE802.11ac VHT80	42	5210	7.62	8.55	11.1

UNII-3 Band

Test Mode	Channel	Frequency (MHz)	Measured Conducted Average Power (dBm)		
			Antenna 1	Antenna 2	Sum
IEEE 802.11a	149	5745	10.58	10.76	/
	157	5785	10.73	11.23	/
	165	5825	11.59	12.41	/
IEEE 802.11n HT20	149	5745	9.41	9.66	12.5
	157	5785	9.5	10.11	12.8
	165	5825	10.44	11.27	13.9
IEEE 802.11ac VHT20	149	5745	9.63	9.84	12.7
	157	5785	9.49	10.07	12.8
	165	5825	9.47	9.67	12.6
IEEE 802.11n HT40	151	5755	9.59	10.15	12.9
	159	5795	10.37	11.25	13.8
IEEE802.11ac VHT40	151	5755	9.55	9.81	12.7
	159	5795	9.47	10.06	12.8
IEEE802.11ac VHT80	155	5775	9.57	9.86	12.7

7. Manufacturing Tolerance

Bluetooth(BDR+EDR)

GFSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	4.5	6.5	8.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
$\pi/4$ -DQPSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	6.0	8.0	9.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
8-DPSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	7.0	8.5	10.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

Bluetooth(BLE)

GFSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	4.5	6.5	6.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

WiFi 2.4GHz Band – Antenna 1

IEEE 802.11b (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	18.5	18.5	18.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11g (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	19.5	20.0	20.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	18.0	18.0	18.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Peak)			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	15.0	15.0	15.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

WiFi 2.4GHz Band – Antenna 2

IEEE 802.11b (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	18.5	19.0	18.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11g (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	20.0	20.0	20.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	20.0	20.0	18.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Peak)			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	16.0	16.0	16.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

UNII-1 Band – Antenna 1

IEEE 802.11a (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	9.0	10.0	10.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	9.0	9.0	9.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	9.0	9.0	9.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 38	Channel 46	--
Target (dBm)	9.5	9.5	--
Tolerance $\pm$ (dB)	1.0	1.0	--
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 38	Channel 46	--
Target (dBm)	8.0	8.0	--
Tolerance $\pm$ (dB)	1.0	1.0	--
IEEE 802.11ac VHT80 (Average)			
Channel	Channel 42	--	--
Target (dBm)	7.5	--	--
Tolerance $\pm$ (dB)	1.0	--	--

UNII-1 Band – Antenna 2

IEEE 802.11a (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	10.0	10.5	10.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	9.0	10.5	10.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	9.0	10.5	10.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 38	Channel 46	--
Target (dBm)	10.5	10.5	--
Tolerance $\pm$ (dB)	1.0	1.0	--
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 38	Channel 46	--
Target (dBm)	8.5	10.0	--
Tolerance $\pm$ (dB)	1.0	1.0	--
IEEE 802.11ac VHT80 (Average)			
Channel	Channel 42	--	--
Target (dBm)	8.5	--	--
Tolerance $\pm$ (dB)	1.0	--	--

UNII-3 Band – Antenna 1

IEEE 802.11a (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	11.0	11.0	11.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	9.5	9.5	10.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	9.5	9.5	9.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 151	Channel 159	--
Target (dBm)	9.5	9.5	--
Tolerance $\pm$ (dB)	1.0	1.0	--
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 151	Channel 159	--
Target (dBm)	9.5	9.5	--
Tolerance $\pm$ (dB)	1.0	1.0	--
IEEE 802.11ac VHT80 (Average)			
Channel	Channel 155	--	--
Target (dBm)	9.5	--	--
Tolerance $\pm$ (dB)	1.0	--	--

UNII-3 Band – Antenna 2

IEEE 802.11a (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	10.5	11.0	11.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	10.0	10.0	10.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	9.5	10.0	11.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 151	Channel 159	--
Target (dBm)	9.5	10.5	--
Tolerance $\pm$ (dB)	1.0	1.0	--
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 151	Channel 159	--
Target (dBm)	9.5	10.0	--
Tolerance $\pm$ (dB)	1.0	1.0	--
IEEE 802.11ac VHT80 (Average)			
Channel	Channel 155	--	--
Target (dBm)	9.5	--	--
Tolerance $\pm$ (dB)	1.0	--	--

8. Measurement Results

8.1 Standalone MPE

As declared by the Applicant, the EUT is a wireless device used in a fix application, at least 20 cm from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum separation distance, $r=20\text{cm}$, as well as the gain of the used antenna refer to antenna information, the RF power density can be obtained.

Bluetooth(BDR+EDR)

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW					
GFSK	9.50	8.9125	4.59	2.8774	100%	0.0051	1.0000
$\pi/4$ -DQPSK	10.50	11.2202	4.59	2.8774	100%	0.0064	1.0000
8-DPSK	11.00	12.5893	4.59	2.8774	100%	0.0072	1.0000

Bluetooth(BLE)

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW					
GFSK	7.50	5.6234	4.59	2.8774	100%	0.0032	1.0000

WiFi 2.4GHz Band – Ant 1

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW					
IEEE 802.11b	19.50	89.1251	2.00	1.5849	100%	0.0281	1.0000
IEEE 802.11g	21.00	125.8925	2.00	1.5849	100%	0.0397	1.0000
IEEE 802.11n HT20	19.00	79.4328	2.00	1.5849	100%	0.0251	1.0000
IEEE 802.11n HT40	16.00	39.8107	2.00	1.5849	100%	0.0126	1.0000

WiFi 2.4GHz Band – Ant 2

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW					
IEEE 802.11b	20.00	100.0000	3.64	2.3121	100%	0.0460	1.0000
IEEE 802.11g	21.00	125.8925	3.64	2.3121	100%	0.0579	1.0000
IEEE 802.11n HT20	21.00	125.8925	3.64	2.3121	100%	0.0579	1.0000
IEEE 802.11n HT40	17.00	50.1187	3.64	2.3121	100%	0.0231	1.0000

UNII-1 Band – Ant 1

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW					
IEEE 802.11a	11.50	14.1254	3.64	2.3121	100%	0.0065	1.0000
IEEE 802.11n HT20	10.50	11.2202	3.64	2.3121	100%	0.0052	1.0000
IEEE 802.11ac VHT20	10.50	11.2202	3.64	2.3121	100%	0.0052	1.0000
IEEE 802.11n HT40	10.50	11.2202	3.64	2.3121	100%	0.0052	1.0000
IEEE 802.11ac VHT40	9.00	7.9433	3.64	2.3121	100%	0.0037	1.0000
IEEE 802.11ac VHT80	8.50	7.0795	3.64	2.3121	100%	0.0033	1.0000

UNII-1 Band – Ant 2

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW					
IEEE 802.11a	11.50	14.1254	4.21	2.6363	100%	0.0074	1.0000
IEEE 802.11n HT20	11.50	14.1254	4.21	2.6363	100%	0.0074	1.0000
IEEE 802.11ac VHT20	11.50	14.1254	4.21	2.6363	100%	0.0074	1.0000
IEEE 802.11n HT40	11.50	14.1254	4.21	2.6363	100%	0.0074	1.0000
IEEE 802.11ac VHT40	11.00	12.5893	4.21	2.6363	100%	0.0066	1.0000
IEEE 802.11ac VHT80	9.50	8.9125	4.21	2.6363	100%	0.0047	1.0000

UNII-3 Band – Ant 1

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW					
IEEE 802.11a	12.00	15.8489	6.13	4.1020	100%	0.0129	1.0000
IEEE 802.11n HT20	11.50	14.1254	6.13	4.1020	100%	0.0115	1.0000
IEEE 802.11ac VHT20	10.50	11.2202	6.13	4.1020	100%	0.0092	1.0000
IEEE 802.11n HT40	10.50	11.2202	6.13	4.1020	100%	0.0092	1.0000
IEEE 802.11ac VHT40	10.50	11.2202	6.13	4.1020	100%	0.0092	1.0000
IEEE 802.11ac VHT80	10.50	11.2202	6.13	4.1020	100%	0.0092	1.0000

UNII-3 Band – Ant 2

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW					
IEEE 802.11a	12.50	17.7828	5.44	3.4995	100%	0.0124	1.0000
IEEE 802.11n HT20	11.50	14.1254	5.44	3.4995	100%	0.0098	1.0000
IEEE 802.11ac VHT20	12.00	15.8489	5.44	3.4995	100%	0.0110	1.0000
IEEE 802.11n HT40	11.50	14.1254	5.44	3.4995	100%	0.0098	1.0000
IEEE 802.11ac VHT40	10.50	11.2202	5.44	3.4995	100%	0.0078	1.0000
IEEE 802.11ac VHT80	11.00	12.5893	5.44	3.4995	100%	0.0088	1.0000

Remark:

1. Output power including tune-up tolerance;
2. MPE evaluate distance is 20cm from user manual provide by manufacturer;

8.2 Simultaneous Transmission MPE

Bluetooth + Wi-Fi

Maximum MPE(mW/cm ²) BT Ant.	Maximum MPE(mW/cm ²) WIFI Ant.0	Maximum MPE(mW/cm ²) WIFI Ant.1	ΣMPE (mW/cm ²)	Limit (mW/cm ²)	Results
0.0072	0.0251	0.0579	0.0902	1.0000	PASS

Remark:

1. Output power including tune-up tolerance;
2. MPE evaluate distance is 20cm from user manual provide by manufacturer;

9. Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure of mobile device.

-----THE END OF REPORT-----