RF Exposure Evaluation For FCC ID: 2AGM4-SONICA, IC Number: 20960-SONICA;

Refer user manual this device is a Wi-Fi Speaker which was designed used in Mobile devices that the minimum distance between human's body is **20cm.** Based on the 47CFR 2.1091, this device belongs to Mobile device category. The definition of this category as following:

Mobile Derives:
CFR Title 47 §2.1091(b)
(b) For purposes of this section, a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons.
FCC KDB 447498 D01 General RF Exposure Guidance v06

Devices operating in standalone mobile exposure conditions may contain a single transmitter or multiple transmitters that do not transmit simultaneously. A minimum test separation distance ≥ 20 cm is required between the antenna and radiating structures of the device and nearby persons to apply mobile device exposure limits. The distance must be fully supported by the operating and installation configurations of the transmitter and its antenna(s), according to the source-based time-averaged maximum power requirements of § 2.1091(d)(2). In cases where cable losses or other attenuations are applied to determine compliance, the most conservative operating configurations and exposure conditions must be evaluated. The minimum test separation distance required for a device to comply with mobile exposure conditions must be clearly identified in the installation and operating instructions, for all installation and exposure conditions, to enable users and installers to comply with RF exposure requirements. For mobile devices that have the potential to operate in portable device exposure conditions, similar to the configurations described in § 2.1091(d)(4), a KDB inquiry is required to determine the SAR test requirements for demonstrating compliance.

When the categorical exclusion provision of § 2.1091(c) applies, the minimum test separation distance may be estimated, when applicable, by simple calculations according to plane-wave equivalent conditions, to ensure the transmitter and its antenna(s) can operate in manners that meet or exceed the estimated distance. The source-based time-averaged maximum radiated power, according to the maximum antenna gain, must be applied to calculate the field strength and power density required to establish the minimum test separation distance. When the estimated test separation distance becomes overly conservative and does not support compliance, MPE measurement or computational modeling may be used to determine the required minimum separation distance.

According to FCC Part 1.1307, systems operating under the provisions of this section shall be operated in a manner the ensures that the public is not exposed to radio frequency energy level in excess of the commission's guidelines.

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/cm2)
0.3-1.34	614	1.63	(100)*
1.34-30	824/f	2.19/f	(180/f2)*
30-300	27.5	0.073	0.2
300-1500			f/1500
1500-100,000			1.0

MPE calculation formula

$$S = \frac{PG}{4\pi R^2}$$

where:

S = power density

P = output power (W)

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

R = Separation distance between radiator and human body (m)

Test result-worst case (FCC)

2.4G Band

Evolution Mode	Max. conducted power for each chain		Total conducted power (mW)	Directional gain (dBi)	Distance (cm)	Power Density (mW/cm^2)	Exclusion Power Threshold (mW/cm^2)	Verdict
	(dBm)	Antenna gain (dBi)						
BR/EDR	7.28	5.1	5.346	N/A	20	0.003	1.00	**PASS**
BLE	-2.06	5.1	0.622	N/A	20	0.001	1.00	**PASS**
WIFI (802.11g)	ANT 0: 19.32	3.5	180.302	7.5 [Note 1]	20	0.202	1.00	**PASS**
	ANT 1: 19.76	5.4						
WIFI (802.11n)	ANT 0: 18.94	3.5	149.628	5.4 [Note 2]	20	0.103	1.00	**PASS**
	ANT 1: 18.53	5.4						
Note 1: According to KDB 62911 D01 v02r01 and RF test report, the Directional gain formula for WIFI 802.11b/g is: Directional gain = 10 log[($10^{G1/20}$ + $10^{G2/20}$ + … + $10^{GN/20}$)^2 /N_{ANT}] dBi Note 2: According to KDB 62911 D01 v02r01 and RF test report, the Directional gain formula for 2.4G WIFI 802.11n is: Directional gain = G_{ANT} + Array Gain, Array Gain = 10 log(N_{ANT}/N_{SS}) dB								

NII Band

Evolution Mode	Max. conducted power for each chain		Total conducted power (mW)	Directional gain (dBi)	Distance (cm)	Power Density (mW/cm^2)	Exclusion Power Threshold (mW/cm2)	Verdict
	(dBm)	(dBm)						
Band I	ANT 0: 14.89	6.3	61.241	6.3 [Note 1]	20	0.052	1.00	**PASS**
	ANT 1: 14.83	3.4						
Band II	ANT 0: 16.21	6.4	82.241	6.4 [Note 1]	20	0.071	1.00	**PASS**
	ANT 1:16.07	3.2						
Band III	ANT 0:16.18	5.3	86.681	5.3 [Note 1]	20	0.058	1.00	**PASS**
	ANT 1:16.55	3.3						
Band IV	ANT 0: 16.21	3.7	80.867	3.7 [Note 1]	20	0.038	1.00	**PASS**
	ANT 1: 15.92	3.7						
Note 1: According to KDB 62911 D01 v02r01 and RF test report, the Directional gain formula for 2.4G WIFI 802.11n is: Directional gain = G_{ANT} + Array Gain, Array Gain = 10 log(N_{ANT}/N_{SS}) dB								

IC RSS-102 2.5.2 and Safety Code 6

RF exposure evaluation is required if the separation distance between the user and the device's radiating element is greater than 20 cm, According to IC RSS-102 Table 4 , systems operating under the provisions of this section shall be operated in a manner the ensures that the public is not exposed to radio frequency energy level in excess of the commission's guidelines.

Table 4: 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/m²)	Reference Period (minutes)
$0.003\text{-}10^{21}$	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142 f^{0.3417}$	$0.008335 f^{0.3417}$	$0.02619 f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

MPE calculation formula

$$S = \frac{PG}{4\pi R^2}$$

Where:

S = power density

P = output power (W)

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

R = Separation distance between radiator and human body (m)

Test result-worst case (IC)

2.4G Band

Evolution Mode	Max. conducted power for each chain		Total conducted power (mW)	Directional gain (dBi)	Distance (cm)	Power Density (W/m²)	Exclusion Power Threshold (W/m²)	Verdict
	(dBm)	Antenna gain (dBi)						
BR/EDR	7.28	5.1	5.346	N/A	20	0.03	3.85	**PASS**
BLE	-2.06	5.1	0.622	N/A	20	0.01	3.81	**PASS**
WIFI (802.11g)	ANT 0: 19.32	3.5	180.302	7.5 [Note 1]	20	2.02	3.81	**PASS**
	ANT 1: 19.76	5.4						

| WIFI (802.11n) | ANT 0: 18.94 | 3.5 | 149.628 | 5.4 [Note 2] | 20 | 1.03 | 3.81 | **PASS** |
| | ANT 1: 18.53 | 5.4 | | | | | | |

Note 1:

According to KDB 62911 D01 v02r01 and RF test report, the Directional gain formula for WIFI 802.11b/g is:

Directional gain = $10 \log[(10^{G1/20} + 10^{G2/20} + \ldots + 10^{GN/20})2 / N_{ANT}]$ dBi

Note 2:

According to KDB 62911 D01 v02r01 and RF test report, the Directional gain formula for 2.4G WIFI 802.11n is:

Directional gain = G_{ANT} + Array Gain, Array Gain = $10 \log(N_{ANT}/N_{SS})$ dB

NII Band

Evolution Mode	Max. conducted power for each chain		Total conducted power (mW)	Directional gain (dBi)	Distance (cm)	Power Density (W/m^2)	Exclusion Power Threshold (W/m^2)	Verdict
	(dBm)	(dBm)						
Band I	ANT 0: 14.89	6.3	61.241	6.3 [Note 1]	20	0.52	6.19	**PASS**
	ANT 1: 14.83	3.4						
Band II	ANT 0: 16.21	6.4	82.241	6.4 [Note 1]	20	0.71	6.23	**PASS**
	ANT 1:16.07	3.2						
Band III	ANT 0:16.18	5.3	86.681	5.3 [Note 1]	20	0.58	6.52	**PASS**
	ANT 1:16.55	3.3						
Band IV	ANT 0: 16.21	3.7	80.867	3.7 [Note 1]	20	0.38	6.61	**PASS**
	ANT 1: 15.92	3.7						

Note 1:

According to KDB 62911 D01 v02r01 and RF test report, the Directional gain formula for 2.4G WIFI 802.11n is:

Directional gain = G_{ANT} + Array Gain, Array Gain = $10 \log(N_{ANT}/N_{SS})$ dB