

TEST REPORT

Report Number: 14516849-E12V3

Applicant : SONOS INC.
614 CHAPALA STREET
SANTA BARBARA, CA 93101, U.S.A

Model : S44

Brand : SONOS

FCC ID : SBVRM044

EUT Description : 802.11 a/b/g/n/ac/ax 2x2 Client Device with BT and BLE

Test Standard(s) : FCC Part 1 Subpart I
FCC Part 2 Subpart J

Date Of Issue:

2023-05-09

Prepared by:

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Revision History

Rev.	Issue Date	Revisions	Revised By
V1	2023-04-18	Initial Issue	---
V2	2023-05-05	Updated Section 6	Kiya Kedida
V3	2023-05-09	Updated Section 6	Kiya Kedida

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SONOS INC.
614 CHAPALA STREET
SANTA BARBARA, CA 93101, U.S.A.

EUT DESCRIPTION: 802.11 a/b/g/n/ac/ax 2x2 Client Device with BT and BLE

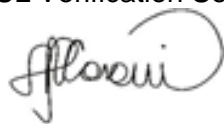
MODEL: S44

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC PART 1 SUBPART I & PART 2 SUBPART J	Complies

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, any agency of the Federal Government, or any agency of the U.S. government.

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2. TEST METHODOLOGY

This report contains data provided by the customer which can impact the validity of results. UL Verification Services Inc. is only responsible for the validity of results after the integration of the data provided by the customer.

All calculations were made in accordance with FCC KDB 447498 D01, KDB 447498 D03.

3. REFERENCES

All measurements were made as documented in test reports UL Verification Services. Documents 14516849-E1, 14516849-E2, 14516849-E3, & 14516849-E4 for operation in the 2.4 GHz band, 14516849-E5 & 14516849-E6 for operation in the 5 GHz band and 14516849-E7 & 14516849-E8 for operation in the 6 GHz band.

Output power, Duty cycle and Antenna gain data is excerpted from the applicable test reports.

4. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47658 Kato Road, Fremont, California, USA.

UL Verification Services Inc. is accredited by A2LA, Certificate Number #0751.05, for all testing performed within the scope of this report.

5. MAXIMUM PERMISSIBLE RF EXPOSURE

5.1. FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

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 ²)	Averaging time (minutes)
(A) 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
300-1,500			f/300	6
1,500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*100	30
1.34-30	824/f	2.19/f	*180/f ²	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-100,000			1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

Notes:

- (1) Occupational/controlled exposure limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when a person is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
- (2) General population/uncontrolled exposure limits apply in situations in which the general public may be exposed, or in which persons who are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure

5.2. EQUATIONS

POWER DENSITY

Power density is given by:

$$S = \text{EIRP} / (4 * \text{Pi} * \text{D}^2)$$

Where

S = Power density in mW/cm²
EIRP = Equivalent Isotropic Radiated Power in mW
D = Separation distance in cm

Power density in units of mW/cm² is converted to units of W/m² by multiplying by 10.

DISTANCE

Distance is given by:

$$D = \text{SQRT} (\text{EIRP} / (4 * \text{Pi} * S))$$

Where

D = Separation distance in cm
EIRP = Equivalent Isotropic Radiated Power in mW
S = Power density in mW/cm²

SOURCE-BASED DUTY CYCLE

Where applicable (for example, multi-slot cell phone applications) a duty cycle factor may be applied.

$$\text{Source-based time-averaged EIRP} = (\text{DC} / 100) * \text{EIRP}$$

Where

DC = Duty Cycle in %, as applicable
EIRP = Equivalent Isotropic Radiated Power in W

MIMO AND COLOCATED TRANSMITTERS (IDENTICAL LIMIT FOR ALL TRANSMITTERS)

For multiple chain devices, and colocated transmitters operating simultaneously in frequency bands where the limit is identical, the total power density is calculated using the total EIRP obtained by summing the EIRP (in linear units) of each transmitter.

$$\text{Total EIRP} = (\text{EIRP1}) + (\text{EIRP2}) + \dots + (\text{EIRPn})$$

where

EIRPx = Source-based time-averaged EIRP of chain x or transmitter x

The total EIRP is then used to calculate the Power Density or the Distance as applicable.

MIMO AND COLOCATED TRANSMITTERS

For multiple colocated transmitters operating simultaneously in frequency bands where different limits apply:

The Power Density at the specified separation distance is calculated for each transmitter chain or transmitter.

The fraction of the exposure limit is calculated for each chain or transmitter as (Power Density of chain or transmitter) / (Limit applicable to that chain or transmitter).

The fractions are summed.

Compliance is established if the sum of the fractions is less than or equal to one.

6. RF EXPOSURE RESULTS

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.

Single Chain and non-colocated transmitters											
Band	Mode	Chain for MIMO	Separ. Distance (cm)	Output AVG Power (dBm)	Ant. Gain (dBi)	EIRP (dBm)	Duty Cycle (%)	EIRP (mW)	FCC Power Density (mW/cm ²)	FCC MPE Limit (mW/cm ²)	Exposure ratio (PD / Limit)
2.4 GHz	BLE	N/A	20	11.50	1.8	13.30	100.0	21.38	0.01	1.00	0.01
2.4 GHz	BT GFSK	N/A	20	11.50	1.8	13.30	100.0	21.38	0.01	1.00	0.01
2.4 GHz_Non ax	802.11b	2Tx	20	24.51	2.8	27.27	100.0	533.33	0.21	1.00	0.21
2.4 GHz_ax	802.11ax HE 20	2Tx	20	23.01	2.8	25.77	100.0	377.57	0.15	1.00	0.15
5 GHz_Non ax	5.8GHz 802.11n HT40	2Tx	20	23.10	2.6	25.71	100.0	372.39	0.15	1.00	0.15
5 GHz_ax	5.6GHz 802.11ax HE80	2Tx	20	23.51	3.2	26.71	100.0	468.81	0.19	1.00	0.19
6 GHz_Non ax	UNII-6 802.11a	2Tx	20	-	-	9.50	100.0	8.91	0.00	1.00	0.00
6 GHz_ax	UNII-6 802.11ax HE80	2Tx	20	-	-	18.50	100.0	70.79	0.03	1.00	0.03

Band	Mode	Chain for MIMO	Separ. Distance (cm)	Output AVG Power (dBm)	Ant. Gain (dBi)	EIRP (dBm)	Duty Cycle (%)	EIRP (mW)	FCC Power Density (mW/cm ²)	FCC MPE Limit (mW/cm ²)	Exposure ratio
2.4 GHz	BLE	N/A	20	11.50	1.8	13.30	100.0	21.38	0.01	1.00	0.01
2.4 GHz_Non ax	802.11n HT20	2Tx	20	24.51	2.8	27.27	100.0	533.33	0.21	1.00	0.21
5 GHz_Non ax	5.8GHz 802.11n HT20	2Tx	20	23.01	3.2	26.21	100.0	417.83	0.17	1.00	0.17
6 GHz_ax	UNII-5 802.11ax HE80	2Tx	20	-	-	18.50	100.0	70.79	0.03	1.00	0.03
TER (highest eirp mode within each band is used to calculate the total exposure ratio, TER) (Assumes all bands can operate at the same time as worst case)											0.42

Notes:

- 1) The manufacturer configures output power so that the maximum power, after accounting for manufacturing tolerances, will never exceed the maximum power level measured.
- 2) The output power in the tables above is the maximum power per chain among various channels and various modes within the specific band.
- 3) The antenna gain in the tables above is the maximum antenna gain among various channels within the specified band.

END OF REPORT