

FCC RF EXPOSURE EVALUATION REPORT

FCC ID: VOB-P2897

Project No. : 1602C038D

Equipment : SHIELD Android TV Game Console

Model : P2897

Applicant : NVIDIA Corporation

Address : 2701 San Tomas Expressway, Santa Clara, CA,
95050,USA

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 Setup



5.2 Test Equipment

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP40	100185	Aug. 20, 2018

Remark: all calibration period of equipment list is one year.

5.3 Test Procedure

- The EUT was directly connected to the power meter and antenna output port as show in the block diagram Test Setup.
- Setup EUT work at duty cycle more than 98%;
- Read power sensor values in RMS detector;

5.4 Test Results and Manufacturing Tolerance

Mode	Maximum Peak power declared by Manufacturer
	Antenna 1
GFSK	≤ 10.00
8DPSK	≤ 10.00
GFSK – BT LE	≤ 8.00

Mode	Maximum Peak power declared by Manufacturer	
	Antenna 1	
IEEE 802.11b	2.4G	≤ 21.50
IEEE 802.11g	2.4G	≤ 24.50
IEEE 802.11n HT20	2.4G	≤ 23.50
IEEE 802.11a	5G Band 1	≤ 20.00
	5G Band 2A	≤ 20.00
	5G Band 2C	≤ 20.00
	5G Band 3	≤ 20.50
IEEE 802.11n HT20	5G Band 1	≤ 16.50
	5G Band 2A	≤ 16.00
	5G Band 2C	≤ 14.50
	5G Band 3	≤ 21.00
IEEE 802.11n HT40	5G Band 1	≤ 19.00
	5G Band 2A	≤ 19.00
	5G Band 2C	≤ 17.50
	5G Band 3	≤ 20.00
IEEE 802.11ac VHT80	5G Band 1	≤ 10.00
	5G Band 2A	≤ 12.00
	5G Band 2C	≤ 17.50
	5G Band 3	≤ 17.50

Mode	Frequency Band	Maximum power declared by Manufacturer
		Antenna 2
IEEE 802.11b	2.4G	≤ 23.50
IEEE 802.11g	2.4G	≤ 26.50
IEEE 802.11n HT20	2.4G	≤ 24.00
IEEE 802.11a	5G Band 1	≤ 22.00
	5G Band 2A	≤ 21.00
	5G Band 2C	≤ 20.50
	5G Band 3	≤ 24.00
IEEE 802.11n HT20	5G Band 1	≤ 16.00
	5G Band 2A	≤ 15.50
	5G Band 2C	≤ 14.00
	5G Band 3	≤ 18.00
IEEE 802.11n HT40	5G Band 1	≤ 18.00
	5G Band 2A	≤ 18.00
	5G Band 2C	≤ 16.00
	5G Band 3	≤ 20.00
IEEE 802.11ac VHT80	5G Band 1	≤ 10.00
	5G Band 2A	≤ 11.50
	5G Band 2C	≤ 15.50
	5G Band 3	≤ 14.50

6. Antenna Information

BT/LE

Antenna	Manufacturer	Model Name	Antenna Type	Connector	Maximum Peak Gain (dBi)
Antenna 1	NVIDIA Corporation	N/A	Monopole Antenna	IPEX	2.70

WLAN 2.4G

Antenna	Manufacturer	Model Name	Antenna Type	Connector	Maximum Peak Gain (dBi)
Antenna 1	NVIDIA Corporation	N/A	Monopole Antenna	IPEX	2.70
Antenna 2	NVIDIA Corporation	N/A	Monopole Antenna	N/A	2.80

WLAN 5G (UNII-1)

Antenna	Manufacturer	Model Name	Antenna Type	Connector	Maximum Peak Gain (dBi)
Antenna 1	NVIDIA Corporation	N/A	Monopole Antenna	IPEX	4.50
Antenna 2	NVIDIA Corporation	N/A	Monopole Antenna	N/A	4.43

WLAN 5G (UNII-2A)

Antenna	Manufacturer	Model Name	Antenna Type	Connector	Maximum Peak Gain (dBi)
Antenna 1	NVIDIA Corporation	N/A	Monopole Antenna	IPEX	4.31
Antenna 2	NVIDIA Corporation	N/A	Monopole Antenna	N/A	4.43

WLAN 5G (UNII-2C)

Antenna	Manufacturer	Model Name	Antenna Type	Connector	Maximum Peak Gain (dBi)
Antenna 1	NVIDIA Corporation	N/A	Monopole Antenna	IPEX	4.92
Antenna 2	NVIDIA Corporation	N/A	Monopole Antenna	N/A	6.57

WLAN 5G (UNII-3)

Antenna	Manufacturer	Model Name	Antenna Type	Connector	Maximum Peak Gain (dBi)
Antenna 1	NVIDIA Corporation	N/A	Monopole Antenna	IPEX	5.23
Antenna 2	NVIDIA Corporation	N/A	Monopole Antenna	N/A	6.75

Direction gain = $10 \log [(10G1/20 + 10 G2/20)2/N]$, that are
 UNII-1 Directional gain= $10 \log [(104.50/20 + 10 4.43/20)2/2] = 7.49 \text{ dBi}$
 UNII-2A Directional gain= $10 \log [(104.31/20 + 10 4.43/20)2/2] = 7.39 \text{ dBi}$
 UNII-2C Directional gain= $10 \log [(104.92/20 + 10 6.57/20)2/2] = 8.80 \text{ dBi}$
 UNII-3 Directional gain= $10 \log [(105.23/20 + 10 6.75/20)2/2] = 9.05 \text{ dBi}$

7. Evaluation Results

7.1 Standalone

Antenna1

Mode	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	(dBm)	(mW)					
GFSK	10.00	10	2.70	1.8621	100%	0.0037	1.0000
8DPSK	10.00	10	2.70	1.8621	100%	0.0037	1.0000
GFSK – BT LE	8.00	6.3096	2.70	1.8621	100%	0.0023	1.0000
IEEE 802.11a	23.50	223.8721	6.75	4.7315	100%	0.2108	1.0000
IEEE 802.11b	21.50	141.2538	2.70	1.8621	100%	0.0524	1.0000
IEEE 802.11g	24.50	281.8383	2.70	1.8621	100%	0.1045	1.0000
IEEE 802.11n HT20	23.50	223.8721	2.70	1.8621	100%	0.0830	1.0000
	18.00	125.8925	5.23	3.3343	100%	0.0836	1.0000
IEEE 802.11n HT40	20.00	100.0000	5.23	3.3343	100%	0.0664	1.0000
IEEE 802.11ac VHT80	17.50	56.2341	5.23	3.3343	100%	0.0373	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)					
IEEE 802.11a	22.00	158.4893	4.43	2.7733	100%	0.0875	1.0000
IEEE 802.11b	23.50	223.8721	2.80	1.9055	100%	0.0849	1.0000
IEEE 802.11g	26.50	446.6836	2.80	1.9055	100%	0.1694	1.0000
IEEE 802.11n HT20	24.00	251.1886	2.80	1.9055	100%	0.0953	1.0000
	15.50	35.4813	4.43	2.7733	100%	0.0196	1.0000
IEEE 802.11n HT40	20.00	100.0000	6.75	4.7315	100%	0.0942	1.0000
IEEE 802.11ac VHT80	15.50	35.4813	6.57	4.5394	100%	0.0321	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 SAR Exclusion

The sample support 2 antennas for MIMO, need consider simultaneous transmission;

Maximum MPE Ratio Antenna 1	Maximum MPE Ratio Antenna 2	Σ MPE ratios	Limit	Results
0.2108	0.1694	< 0.4	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.