RF Exposure evaluation

FCC ID	2BWTO-D16S
Product Name	portable smart tv
Model/Type reference	D16S
Listed Model(s)	D14S, D13S, D12S, S16, MT14S, D17S, D19S, D20S, D23S, DXXS (X represent 0 to 9)

1. Reference

ANSI C95.1-2019: 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: Radio frequency radiation exposure limits.

FCC CFR 47 part2 2.1091: Radio frequency radiation exposure evaluation: mobile devices

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/f2)*	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/f2)*	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

3. 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

4. Antenna Information

-A module can only use antennas certificated as follows provided by manufacturer;

Antenna No.	Ant Number	Type of antenna:	Gain of the antenna (Max.)	Frequency range:
2.4GWIFI	Ant1	Internal Antenna	2.35dBi	2400-2500MHz
2.4GWIFI	Ant2	Internal Antenna	4.83dBi	2400-2500MHz
5GWIFI	Ant1	Internal Antenna	5.81dBi	5000-5900MHz
5GWIFI	Ant2	Internal Antenna	4.38dBi	5000-5900MHz

5. Conducted Output Power

WiFi2.4G-Ant1

Modulation	TX Type	Channel	Output Power (dBm)	Output Power (mW)
802. 11b	SISO	2412	7.40	5.50
		2437	7.93	6.21
		2462	7.32	5.40
802. 11g	SISO	2412	7.38	5.47
		2437	7.77	5.98
		2462	7.51	5.64
802.11n (HT20)	SISO	2412	7.36	5.45
		2437	7.76	5.97
		2462	6.93	4.93
802.11n (HT40)	SISO	2422	8.09	6.44
		2437	7.87	6.12
		2452	7.64	5.81
802.11n (HT20)	MIMO	2412	7.01	5.02
		2437	7.85	6.10
		2462	9.24	8.39
802.11n (HT40)	MIMO	2422	7.98	6.28
		2437	7.76	5.97
		2452	9.76	9.46

WiFi2.4G-Ant2

Modulation	TX Type	Channel	Output Power (dBm)	Output Power (mW)	MIMO (dBm)
802. 11b	SISO	2412	7.40	5.50	/
		2437	7.94	6.22	/
		2462	7.49	5.61	/
802. 11g	SISO	2412	7.50	5.62	/
		2437	7.78	6.00	/
		2462	7.57	5.71	/
802.11n (HT20)	SISO	2412	7.14	5.18	/
		2437	7.73	5.93	/
		2462	7.02	5.04	/
802.11n (HT40)	SISO	2422	7.94	6.22	/
		2437	7.77	5.98	/
		2452	7.73	5.93	/
802.11n (HT20)	MIMO	2412	9.24	8.39	11.28
		2437	7.77	5.98	10.82
		2462	9.30	8.51	12.28
802.11n (HT40)	MIMO	2422	7.95	6.24	10.98
		2437	7.91	6.18	10.85
		2452	9.77	9.48	12.78

WiFi5.8G-Ant1

Modulation	TX Type	Channel	Output Power (dBm)	Output Power (mW)
802.11a	SISO	5180	6.91	4.91
		5200	6.79	4.78
		5240	6.69	4.67
		5745	4.32	2.70
		5785	1.84	1.53
		5825	3.73	2.36
802.11n (HT20)	SISO	5180	3.55	2.26
		5200	5.38	3.45
		5240	5.51	3.56
		5745	4.31	2.70
		5785	3.75	2.37
		5825	3.05	2.02
802.11n (HT40)	SISO	5190	6.30	4.27
		5230	6.48	4.45
		5755	4.97	3.14
		5795	4.25	2.66
802.11n (HT20)	MIMO	5180	5.87	3.86
		5200	5.73	3.74
		5240	5.65	3.67
		5745	3.21	2.09
		5785	4.86	3.06
		5825	4.69	2.94
802.11n (HT40)	MIMO	5190	6.09	4.06
		5230	6.16	4.13
		5755	2.77	1.89
		5795	5.18	3.30
802.11ac (VHT20)	SISO	5180	5.84	3.84
		5200	5.74	3.75
		5240	5.67	3.69
		5745	3.03	2.01
		5785	1.56	1.43
		5825	0.26	1.06
802.11ac (VHT40)	SISO	5190	5.86	3.85
		5230	5.74	3.75
		5755	5.13	3.26
		5795	4.66	2.92
802.11ac (VHT80)	SISO	5210	6.13	4.10
		5775	4.79	3.01
802.11ac (VHT20)	MIMO	5180	3.75	2.37
		5200	3.87	2.44
		5240	5.89	3.88

		5745	2.34	1.71
		5785	3.82	2.41
		5825	2.90	1.95
802.11ac (VHT40)	MIMO	5190	6.72	4.70
		5230	6.95	4.95
		5755	5.56	3.60
		5795	5.28	3.37
802.11ac (VHT80)	MIMO	5210	7.16	5.20
		5775	1.58	1.44

WiFi5.8G-Ant2

Modulation	TX Type	Channel	Output Power (dBm)	Output Power (mW)	MIMO (dBm)
802.11a	SISO	5180	5.34	3.42	
		5200	5.16	3.28	
		5240	4.83	3.04	
		5745	5.52	3.56	
		5785	4.67	2.93	
		5825	4.30	2.69	
802.11n (HT20)	SISO	5180	5.71	3.72	
		5200	5.77	3.78	
		5240	5.67	3.69	
		5745	3.51	2.24	
		5785	2.40	1.74	
		5825	2.81	1.91	
802.11n (HT40)	SISO	5190	5.72	3.73	
		5230	6.51	4.48	
		5755	2.85	1.93	
		5795	2.22	1.67	
802.11n (HT20)	MIMO	5180	5.94	3.93	8.92
		5200	5.52	3.56	8.64
		5240	5.42	3.48	8.55
		5745	0.62	1.15	5.12
		5785	3.28	2.13	7.15
		5825	2.58	1.81	6.77
802.11n (HT40)	MIMO	5190	6.19	4.16	9.15
		5230	6.34	4.31	9.26
		5755	1.95	1.57	5.39
		5795	-0.26	0.94	6.27
802.11ac (VHT20)	SISO	5180	5.31	3.40	
		5200	5.17	3.29	
		5240	4.86	3.06	
		5745	3.67	2.33	
		5785	2.64	1.84	
		5825	3.07	2.03	
802.11ac (VHT40)	SISO	5190	5.44	3.50	
		5230	6.28	4.25	
		5755	3.38	2.18	
		5795	2.69	1.86	
802.11ac (VHT80)	SISO	5210	3.36	2.17	
		5775	4.17	2.61	
802.11ac (VHT20)	MIMO	5180	4.09	2.56	6.93
		5200	6.31	4.28	8.27
		5240	6.25	4.22	9.08
		5745	1.35	1.36	4.88

		5785	2.34	1.71	6.15
		5825	4.11	2.58	6.56
802.11ac (VHT40)	MIMO	5190	5.33	3.41	9.09
		5230	6.50	4.47	9.74
		5755	0.59	1.15	6.76
		5795	0.94	1.24	6.64
802.11ac (VHT80)	MIMO	5210	7.01	5.02	10.10
		5775	-3.25	0.47	2.81

6. Manufacturing Tolerance

WiFi2.4G			
11B			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	7	7	7
Tolerance ±(dB)	1.0	1.0	1.0
11G			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	7	7	7
Tolerance ±(dB)	1.0	1.0	1.0
11N20			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	7	7	7
Tolerance ±(dB)	1.0	1.0	1.0
11N40			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	8	7	7
Tolerance ±(dB)	1.0	1.0	1.0
MIMO 11N20			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	11	10	12
Tolerance ±(dB)	1.0	1.0	1.0
MIMO 11N40			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	10	10	12
Tolerance ±(dB)	1.0	1.0	1.0

WiFi5G			
11A			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	6	6	6
Tolerance ±(dB)	1.0	1.0	1.0
11A			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	5	4	4
Tolerance ±(dB)	1.0	1.0	1.0
11N20			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	5	5	5
Tolerance ±(dB)	1.0	1.0	1.0
11N20			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	4	3	3
Tolerance ±(dB)	1.0	1.0	1.0
1N40			
Channel	Channel 38	Channel 46	Channel 151
Target (dBm)	6	6	4
Tolerance ±(dB)	1.0	1.0	1.0
11N40			
Channel	Channel 159		
Target (dBm)	4		
Tolerance ±(dB)	1.0		
11AC20			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	5	5	5

Tolerance ±(dB)	1.0	1.0	1.0
11AC20			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	3	2	3
Tolerance ±(dB)	1.0	1.0	1.0
1AC40			
Channel	Channel 38	Channel 46	Channel 151
Target (dBm)	5	6	5
Tolerance ±(dB)	1.0	1.0	1.0
11AC40			
Channel	Channel 159		
Target (dBm)	4		
Tolerance ±(dB)	1.0		
11AC80			
Channel	Channel 42	Channel 155	
Target (dBm)	6	4	
Tolerance ±(dB)	1.0	1.0	
11N20 MIMO			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	8	8	8
Tolerance ±(dB)	1.0	1.0	1.0
11N20 MIMO			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	5	7	6
Tolerance ±(dB)	1.0	1.0	1.0
1N40 MIMO			
Channel	Channel 38	Channel 46	Channel 151
Target (dBm)	9	9	5

Tolerance ±(dB)	1.0	1.0	1.0
11N40 MIMO			
Channel	Channel 159		
Target (dBm)	6		
Tolerance ±(dB)	1.0		
11AC20 MIMO			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	6	8	9
Tolerance ±(dB)	1.0	1.0	1.0
11AC20 MIMO			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	4	6	6
Tolerance ±(dB)	1.0	1.0	1.0
1AC40 MIMO			
Channel	Channel 38	Channel 46	Channel 151
Target (dBm)	9	9	6
Tolerance ±(dB)	1.0	1.0	1.0
11AC40 MIMO			
Channel	Channel 159		
Target (dBm)	6		
Tolerance ±(dB)	1.0		
11AC80 MIMO			
Channel	Channel 42	Channel 155	
Target (dBm)	10	2	
Tolerance ±(dB)	1.0	1.0	

7. Standalone MPE Result

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 =20cm, as well as the gain of the used antenna is 4.83dBi and 5.81dBi, the RF power density can be obtained.

Mode	Output power		Antenna Gain (dBi)	Antenna Gain(linear)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW				
2.4GWIFI	9	7.94	4.83	3.04	0.00481	1.0000
5GWIFI	7	5.01	5.81	3.81	0.00380	1.0000

Remark:

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

8. Simultaneous Transmission MPE Evaluation

The EUT equiped with two WIFI antennas. So, need consider simultaneous transmission; According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations;

∑∑of MPE ratios ≤ 1.0

Mode	Output power		Antenna Gain (dBi)	Antenna Gain(linear)	MPE (mW/cm^2)	∑ MPE ratios (mW/cm^2)
	dBm	mW				
MIMO 2.4GWIFI	13	19.95	4.83	3.04	0.01207	1.0000
MIMO 5GWIFI	11	12.59	5.81	3.81	0.00954	1.0000

9. Conclusion

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

------End of the report------