

FCC RF EXPOSURE REPORT

FCC ID: M82-ARK2250L

Project No. : 1708012
Equipment : Computer
Test Model : ARK-2250
Series Model : ARK-2250XXXXXXXXXXXXXX,
ARK2250XXXXXXXXXXXXXX (where X may be
any alphanumeric character , blank or “-”.)
Applicant : Advantech Co., Ltd.
Address : No.1, Alley 20, Lane 26, Rueiguang Road,
Neihu District, Taipei 11491, Taiwan, R.O.C.
According: : FCC Guidelines for Human Exposure IEEE
C95.1

B T L I N C .

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MPE CALCULATION METHOD:

Calculation Method of RF Safety Distance:

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

where:

S = power density

P = power input to the 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

Table for Filed Antenna

Bluetooth EDR and LE:

Ant.	Brand	Test Model	Antenna Type	Connector	Gain (dBi)
1	ADVANTECH	AN2450-92K01 BRS	Dipole	SMA Male Reverse	5.03

2.4G WLAN:

Ant.	Brand	Test Model	Antenna Type	Connector	Gain (dBi)
1	ADVANTECH	AN2450-92K01BR S	Dipole	SMA Male Reverse	5.03
2	ADVANTECH	AN2450-92K01BR S	Dipole	SMA Male Reverse	5.03

Note:

The EUT incorporates a MIMO function. Physically, the EUT provides two completed transmitters and receivers (2T2R) and employs Cyclic Delay Diversity (CDD).

In CDD mode,

For power spectral density:

Direction gain (dBi) =

$$10 \cdot \log\{[10^{(G1/20)} + 10^{(G2/20)} + \dots + 10^{(Gn/20)}]^2 / N_{ANT}\} = 8.04 \text{ dBi} > 6 \text{ dBi.}$$

$$\text{The reduced power spectral density limits (dBm/MHz)} = 8 - (8.04 - 6) = 5.96$$

For conducted power:

For $N_{ANT} = 2 < 5$,

$$\text{Direction gain (dBi)} = G_{ANT} + 0 = 5.03 + 0 = 5.03$$

The Direction gain is less than 6, so conducted power limits will not be reduced.

5G RLAN:

Ant.	Brand	Test Model	Antenna Type	Connector	Gain (dBi)
1	ADVANTECH	AN2450-92K01BR S	Dipole	SMA Male Reverse	5.01
2	ADVANTECH	AN2450-92K01BR S	Dipole	SMA Male Reverse	5.01

Note:

The EUT incorporates a MIMO function. Physically, the EUT provides two completed transmitters and receivers (2T2R) and employs Cyclic Delay Diversity (CDD).

In CDD mode,

For power spectral density:

Directional gain =

$$10 \cdot \log\{[10^{(G1/20)} + 10^{(G2/20)} + \dots + 10^{(Gn/20)}]^2 / N_{ANT}\} = 8.02 \text{ dBi} > 6 \text{ dBi.}$$

5180 MHz to 5240 MHz :

$$\text{The reduced power spectral density limits (dBm/MHz)} = 17 - (8.02 - 6) = 14.98$$

5260 MHz to 5320 MHz & 5500 MHz 至 5700 MHz :

$$\text{The reduced power spectral density limits (dBm/MHz)} = 11 - (8.02 - 6) = 8.98$$

5745 MHz to 5805 MHz :

$$\text{The reduced power spectral density limits (dBm/MHz)} = 30 - (8.02 - 6) = 27.98$$

For conducted power:

For $N_{ANT} = 2 < 5$,

$$\text{Direction gain (dBi)} = G_{ANT} + 0 = 5.01 + 0 = 5.01$$

The Direction gain is less than 6, so conducted power limits will not be reduced.

Operating Mode / TX Mode	2TX
802.11b	V (ANT 1+ANT 2)
802.11g	V (ANT 1+ANT 2)
802.11n(20MHz)	V (ANT 1+ANT 2)
802.11n(40MHz)	V (ANT 1+ANT 2)
IEEE 802.11a	V (ANT 1+ANT 2)
IEEE 802.11n (20 MHz)	V (ANT 1+ANT 2)
IEEE 802.11n (40 MHz)	V (ANT 1+ANT 2)
IEEE 802.11ac (20 MHz)	V (ANT 1+ANT 2)
IEEE 802.11ac (40 MHz)	V (ANT 1+ANT 2)
IEEE 802.11ac (80 MHz)	V (ANT 1+ANT 2)

TEST RESULTS

Bluetooth EDR:

Test Mode :	TX Mode _1Mbps
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Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
2402	5.03	3.1842	2.31	1.7022	0.00107882	1	Complies
2440	5.03	3.1842	2.52	1.7865	0.00113227	1	Complies
2480	5.03	3.1842	3.27	2.1232	0.00134571	1	Complies

Test Mode :	TX Mode _3Mbps
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Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
2402	5.03	3.1842	2.41	1.7418	0.00110395	1	Complies
2440	5.03	3.1842	2.67	1.8493	0.00117206	1	Complies
2480	5.03	3.1842	3.50	2.2387	0.00141890	1	Complies

Bluetooth LE:

Test Mode :	CH00, CH19 , CH39
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Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
2402	5.03	3.1842	-1.56	0.6982	0.00044254	1	Complies
2440	5.03	3.1842	-1.13	0.7709	0.00048860	1	Complies
2480	5.03	3.1842	-0.87	0.8185	0.00051874	1	Complies

2.4G:

Test Mode : TX B Mode Total / CH01, CH06, CH11

Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
2412	5.03	3.1842	23.91	246.0368	0.15593743	1	Complies
2437	5.03	3.1842	23.46	221.8196	0.14058869	1	Complies
2462	5.03	3.1842	23.90	245.4709	0.15557878	1	Complies

Test Mode : TX G Mode Total / CH01, CH06, CH11

Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
2412	5.03	3.1842	24.30	269.1535	0.17058874	1	Complies
2437	5.03	3.1842	24.02	252.3481	0.15993752	1	Complies
2462	5.03	3.1842	21.37	137.0882	0.08688611	1	Complies

Test Mode : TX N-20M Mode Total / CH01, CH06, CH11

Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
2412	5.03	3.1842	23.07	202.7683	0.12851398	1	Complies
2437	5.03	3.1842	24.15	260.0160	0.16479741	1	Complies
2462	5.03	3.1842	21.56	143.2188	0.09077168	1	Complies

Test Mode :	TX N-40M Mode Total / CH03, CH06, CH09
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Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
2422	5.03	3.1842	21.69	147.5707	0.09352988	1	Complies
2437	5.03	3.1842	24.19	262.4219	0.16632226	1	Complies
2452	5.03	3.1842	19.35	86.0994	0.05456955	1	Complies

5G:

Test Mode : UNII-1/TX A Mode Total /CH36, CH40, CH48

Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	AVG. Output Power (dBm)	AVG. Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5180	5.01	3.1696	16.27	42.3643	0.02672701	1	Complies
5200	5.01	3.1696	16.5	44.6684	0.02818061	1	Complies
5240	5.01	3.1696	16.67	46.4515	0.02930558	1	Complies

Test Mode : UNII-1/TX N20 Mode Total /CH36, CH40, CH48

Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	AVG. Output Power (dBm)	AVG. Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5180	5.01	3.1696	15.19	33.0370	0.02084253	1	Complies
5200	5.01	3.1696	15.54	35.8096	0.02259178	1	Complies
5240	5.01	3.1696	15.55	35.8922	0.02264386	1	Complies

Test Mode : UNII-1/TX N40 Mode Total / CH38, CH46

Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	AVG. Output Power (dBm)	AVG. Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5190	5.01	3.1696	15.24	33.4195	0.02108387	1	Complies
5230	5.01	3.1696	15.55	35.8922	0.02264386	1	Complies

Test Mode : UNII-1/TX AC80 Mode Total / CH42

Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	AVG. Output Power (dBm)	AVG. Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5210	5.01	3.1696	13.68	23.3346	0.01472144	1	Complies

Test Mode : UNII-2A/TX A Mode Total / CH52, CH60, CH64

Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	AVG. Output Power (dBm)	AVG. Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5260	5.01	3.1696	16.37	43.3511	0.02734956	1	Complies
5300	5.01	3.1696	15.92	39.0841	0.02465758	1	Complies
5320	5.01	3.1696	15.81	38.1066	0.02404088	1	Complies

Test Mode : UNII-2A/TX N20 Mode Total / CH52, CH60, CH64

Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	AVG. Output Power (dBm)	AVG. Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5260	5.01	3.1696	15.29	33.8065	0.02132801	1	Complies
5300	5.01	3.1696	14.86	30.6196	0.01931748	1	Complies
5320	5.01	3.1696	14.74	29.7852	0.01879102	1	Complies

Test Mode : UNII-2A/TX N40 Mode Total / CH54, CH62

Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	AVG. Output Power (dBm)	AVG. Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5270	5.01	3.1696	15.18	32.9610	0.02079459	1	Complies
5310	5.01	3.1696	14.92	31.0456	0.01958621	1	Complies

Test Mode : UNII-2A/TX AC80 Mode Total / CH58

Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	AVG. Output Power (dBm)	AVG. Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5290	5.01	3.1696	13.16	20.7014	0.01306022	1	Complies

Test Mode : UNII-2C/TX A Mode Total / CH100, CH120, CH140

Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	AVG. Output Power (dBm)	AVG. Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5500	5.01	3.1696	16.42	43.8531	0.02766625	1	Complies
5600	5.01	3.1696	16.58	45.4988	0.02870453	1	Complies
5700	5.01	3.1696	16.14	41.1150	0.02593883	1	Complies

Test Mode : UNII-2C/TX N20 Mode Total / CH100, CH120, CH140

Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	AVG. Output Power (dBm)	AVG. Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5500	5.01	3.1696	15.46	35.1560	0.02217943	1	Complies
5600	5.01	3.1696	15.49	35.3997	0.02233317	1	Complies
5700	5.01	3.1696	15.14	32.6588	0.02060394	1	Complies

Test Mode : UNII-2C/TX N40 Mode Total / CH102, CH118, CH134

Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	AVG. Output Power (dBm)	AVG. Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5510	5.01	3.1696	15.28	33.7287	0.02127896	1	Complies
5590	5.01	3.1696	15.48	35.3183	0.02228181	1	Complies
5670	5.01	3.1696	15.22	33.2660	0.02098700	1	Complies

Test Mode : UNII-2C/TX AC80 Mode Total / CH106, CH122

Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	AVG. Output Power (dBm)	AVG. Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5530	5.01	3.1696	13.26	21.1836	0.01336443	1	Complies
5610	5.01	3.1696	13.53	22.5424	0.01422166	1	Complies

Test Mode : UNII-3/TX A Mode Total / CH149, CH157, CH161

Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	AVG. Output Power (dBm)	AVG. Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5745	5.01	3.1696	16.46	44.2588	0.02792225	1	Complies
5785	5.01	3.1696	16.42	43.8531	0.02766625	1	Complies
5805	5.01	3.1696	16.52	44.8745	0.02831068	1	Complies

Test Mode : UNII-3/TX N20 Mode Total / CH149, CH157, CH161

Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	AVG. Output Power (dBm)	AVG. Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5745	5.01	3.1696	15.19	33.0370	0.02084253	1	Complies
5785	5.01	3.1696	15.44	34.9945	0.02207752	1	Complies
5805	5.01	3.1696	15.13	32.5837	0.02055656	1	Complies

Test Mode : UNII-3/TX N40 Mode Total / CH151, CH159

Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	AVG. Output Power (dBm)	AVG. Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5755	5.01	3.1696	15.30	33.8844	0.02137718	1	Complies
5795	5.01	3.1696	15.13	32.5837	0.02055656	1	Complies

Test Mode : UNII-3/TX AC80 Mode Total / CH155

Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	AVG. Output Power (dBm)	AVG. Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5775	5.01	3.1696	13.45	22.1309	0.01396209	1	Complies

Note:

(1) The calculated distance is 20 cm.