FCC RF EXPOSURE REPORT

FCC ID: TVE-120757

Project No.	:	1909C046
Equipment	:	PCIEV1.0-FRT01 WLAN 802.11AC 3x3 PCIE Module
Brand Name	:	FORTINET
Test Model	:	P25037-01
Series Model	:	N/A
Applicant	:	Fortinet, Inc.
Address	:	899 Kifer Road, Sunnyvale, CA 94086 USA
Manufacturer	:	Fortinet, Inc.
Address	:	899 Kifer Road, Sunnyvale, CA 94086 USA
Date of Receipt	:	Sep. 11, 2019
Date of Test	:	Sep. 12, 2019 ~ Nov. 07, 2019
Issued Date	:	Dec. 13, 2019
Report Version	:	R00
Test Sample	:	Engineering Sample No.: DG2019091147
Standard(s)	:	FCC Guidelines for Human Exposure IEEE C95.1 & FCC Part 2.1091 FCC Title 47 Part 2.1091, OET Bulletin 65 Supplement C

The above equipment has been tested and found compliance with the requirement of the relative standards by BTL Inc.

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REPORT ISSUED HISTORY

Report Version	Description	Issued Date
R00	Original Issue	Dec. 13, 2019

1. MPE CALCULATION METHOD

Calculation Method of RF Safety Distance:

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

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

For 2.4G:

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	Tenda	W1800R	Dipole	SMA Male Reverse	4.16
2	Tenda	W1800R	Dipole	SMA Male Reverse	4.16
3	Tenda	W1800R	Dipole	SMA Male Reverse	4.16

Note: This EUT supports CDD, and all antennas have the same gain,

(1) For Non Beamforming function, Directional gain=G_{ANT}+Array Gain,
For output power measurements, Array Gain=0 ($N_{ANT} \leq 4$), so the Directional gain=4.16.
For power spectral density measurements, Array Gain=10log(N_{ANT}/N_{SS}) dB, so the Directional gain=4.16+10log(3/1)=8.93. So, the power density limit is 8-8.93+6=5.07.

(2) For Beamforming function, Beamforming gain: 4.5dB,
so the Directional gain=4.16+4.5=8.66, Then, the output Power limit is 30-8.66+6=27.34.

For 5G:

For UNII-1:

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	Tenda	W1800R	Dipole	SMA Male Reverse	3.06
2	Tenda	W1800R	Dipole	SMA Male Reverse	3.06
3	Tenda	W1800R	Dipole	SMA Male Reverse	3.06

Note: This EUT supports CDD, and all antennas have the same gain,

(1) For Non Beamforming function, Directional gain=G_{ANT}+Array Gain,
For output power measurements, Array Gain=0 (N_{ANT}≤4), so, Directional gain=3.06
For power spectral density measurements, Array Gain=10log(N_{ANT}/N_{SS}) dB
Directional gain=3.06+10log(3/1)=7.83.
So, the UNII-1 power density limit is 17-7.83+6=15.17

(2) For Beamforming function, Beamforming gain: 4.5dB,
so the Directional gain=3.06+4.5=7.56, Then, the UNII-1 output Power limit is 30-7.56+6=28.44.

For UNII-3:

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	Tenda	W1800R	Dipole	SMA Male Reverse	3.58
2	Tenda	W1800R	Dipole	SMA Male Reverse	3.58
3	Tenda	W1800R	Dipole	SMA Male Reverse	3.58

Note: This EUT supports CDD, and all antennas have the same gain,

(1) For Non Beamforming function, Directional gain=G_{ANT}+Array Gain,
For output power measurements, Array Gain=0 (N_{ANT}≤4), so, Directional gain=3.58
For power spectral density measurements, Array Gain=10log(N_{ANT}/N_{SS}) dB
Directional gain=3.58+10log(3/1)=8.35.
So, the UNII-3 power density limit is 30-8.35+6=27.65.

(2) For Beamforming function, Beamforming gain: 4.5dB,
so the Directional gain=3.58+4.5=8.08, Then, the UNII-3 output Power limit is 30-8.08+6=27.92

The worst case for 3TX as follow:

For 2.4G:

For Non Beamforming:

Operating Mode / TX Mode	3TX
IEEE 802.11b	V (Ant. 1+Ant. 2+Ant. 3)
IEEE 802.11g	V (Ant. 1+Ant. 2+Ant. 3)
IEEE 802.11n(HT20)	V (Ant. 1+Ant. 2+Ant. 3)
IEEE 802.11n(HT40)	V (Ant. 1+Ant. 2+Ant. 3)

For Beamforming:

Operating Mode / TX Mode	3TX
IEEE 802.11n(HT20)	V (Ant. 1+Ant. 2+Ant. 3)
IEEE 802.11n(HT40)	V (Ant. 1+Ant. 2+Ant. 3)

For 5G:

For Non Beamforming:

Operating Mode / TX Mode	3TX
IEEE 802.11a	V (Ant. 1+Ant. 2+Ant. 3)
IEEE 802.11n (HT20)	V (Ant. 1+Ant. 2+Ant. 3)
IEEE 802.11n (HT40)	V (Ant. 1+Ant. 2+Ant. 3)
IEEE 802.11ac(VHT20)	V (Ant. 1+Ant. 2+Ant. 3)
IEEE 802.11ac(VHT40)	V (Ant. 1+Ant. 2+Ant. 3)
IEEE 802.11ac(VHT80)	V (Ant. 1+Ant. 2+Ant. 3)

For Beamforming:

Operating Mode / TX Mode	3TX
IEEE 802.11n (HT20)	V (Ant. 1+Ant. 2+Ant. 3)
IEEE 802.11n (HT40)	V (Ant. 1+Ant. 2+Ant. 3)
IEEE 802.11ac(VHT20)	V (Ant. 1+Ant. 2+Ant. 3)
IEEE 802.11ac(VHT40)	V (Ant. 1+Ant. 2+Ant. 3)
IEEE 802.11ac(VHT80)	V (Ant. 1+Ant. 2+Ant. 3)

2. TEST RESULTS

For 2.4GHz_Non Beamforming:

Directional Gain (dBi)	Directional Gain (numeric)	Max. Output Power (dBm)	Max. Output Power (mW)	Power Density (S) (mW/cm^2)	Limit of Power Density (S) (mW/cm^2)	Test Result
4.16	2.6062	29.67	926.8298	0.30770	1	Complies

For 2.4GHz_With Beamforming:

Directional Gain (dBi)	Directional Gain (numeric)	Max. Output Power (dBm)	Max. Output Power (mW)	Power Density (S) (mW/cm^2)	Limit of Power Density (S) (mW/cm^2)	Test Result
8.66	7.3451	26.33	429.5364	0.40191	1	Complies

For 5GHz UNII-1_Non Beamforming:

Directional Gain (dBi)	Directional Gain (numeric)	Max. Output Power (dBm)	Max. Output Power (mW)	Power Density (S) (mW/cm^2)	Limit of Power Density (S) (mW/cm^2)	Test Result
3.06	2.0230	26.58	454.9881	0.11725	1	Complies

For 5GHz UNII-1_Beamforming:

Directional Gain (dBi)	Directional Gain (numeric)	Max. Output Power (dBm)	Max. Output Power (mW)	Power Density (S) (mW/cm^2)	Limit of Power Density (S) (mW/cm^2)	Test Result
7.56	5.7016	26.39	435.5119	0.31632	1	Complies

For 5GHz UNII-3_Non Beamforming:

Directional Gain (dBi)	Directional Gain (numeric)	Max. Output Power (dBm)	Max. Output Power (mW)	Power Density (S) (mW/cm^2)	Limit of Power Density (S) (mW/cm^2)	Test Result
3.58	2.2803	29.24	839.4600	0.24385	1	Complies

For 5GHz UNII-3_Beamforming:

Directional Gain (dBi)	Directional Gain (numeric)	Max. Output Power (dBm)	Max. Output Power (mW)	Power Density (S) (mW/cm^2)	Limit of Power Density (S) (mW/cm^2)	Test Result
8.08	6.4269	27.11	514.0437	0.42085	1	Complies

For the max simultaneous transmission MPE:

Power Density (S) (mW/cm^2)	Power Density (S) (mW/cm^2)	Total	Limit of Power Density (S) (mW/cm^2)	Test Result
2.4GHz	5GHz			
0.40191	0.42085	0.82276	1	Complies

Note: The calculated distance is 25 cm.

End of Test Report