

# Maximum Permissible Exposure

**Equipment** : Secured Wireless Access Point  
**Brand Name** : FORTINET  
**Model No.** : FORTIAP-S421Exxxxxx,  
FortiAP S421Exxxxxx, FAP-S421Exxxxxx  
(where "x" can be used as "A-Z", or "-0-9", or "-.", or blank  
for software changes or marketing purposes only)  
FORTIAP-S423Exxxxxx,  
FortiAP S423Exxxxxx, FAP-S423Exxxxxx  
(where "x" can be used as "A-Z", or "-0-9", or "-.", or blank  
for software changes or marketing purposes only)  
**FCC ID** : TVE-28166022  
**Standard** : IEEE C95.1  
**Applicant /** : Fortinet Inc.  
**Manufacturer** : 899 Kifer Road Sunnyvale, CA 94086, USA

The product sample received on Oct. 24, 2016 and completely tested on Nov. 25, 2016. We, SPORTON, would like to declare that the tested sample has been evaluated in accordance with the procedures given in IEEE C95.1 and shown compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by:

  
Kevin Liang / Assistant Manager



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## Revision History

[illegible]

# 1 Human Exposure Assessment

## 1.1 Product Details

The difference between the report no. : N/A	
The Difference	N/A

Evaluated Test Items	N/A
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## 1.2 Maximum Permissible Exposure

### 1.2.1 Limit of Maximum Permissible Exposure

Limits for Occupational / Controlled Exposure				
Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm <sup>2</sup> )	Averaging Time  E  <sup>2</sup> , H  <sup>2</sup> or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842 / f	4.89 / f	(900 / f <sup>2</sup> )*	6
30-300	61.4	0.163	1.0	6
300-1500	-	-	F/300	6
1500-100,000	-	-	5	6
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 <sup>2</sup> )	Averaging Time  E  <sup>2</sup> , H  <sup>2</sup> or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f <sup>2</sup> )*	30
30-300	27.5	0.073	0.2	30
300-1500	-	-	F/1500	30
1500-100,000	-	-	1.0	30
Note 1: f = frequency in MHz ; *Plane-wave equivalent power density				
Note 2: For the applicable limit, see FCC 1.1310				

### 1.2.2 MPE Calculation Method

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

S = power density (in appropriate units, e.g. mW/cm<sup>2</sup>)

P = power input to the antenna (in appropriate units, e.g., mW)

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 (appropriate units, e.g., cm)

**1.2.3 Result of Maximum Permissible Exposure (2.4G) - Non-Beamforming**

RF General Information					
Frequency Range (MHz)	IEEE Std. 802.11 Protocol	Ch. Frequency (MHz)	Channel Number	Number of Transmit Chains (N <sub>TX</sub> )	RF Output Power (dBm)
2400-2483.5	b	2412-2462	1-11 [11]	4	25.37
2400-2483.5	g	2412-2462	1-11 [11]	4	26.84
2400-2483.5	HT20	2412-2462	1-11 [11]	4	26.72
2400-2483.5	HT40	2422-2452	3-9 [7]	4	21.63

Note 1: RF output power specifies that Maximum Conducted (Average) Output Power.

Worst Maximum RF Output Power Result					
Exposure Environment		General Population / Uncontrolled Exposure			
Separation Distance (cm)		30			
Condition		RF Output Power (dBm)			
Modulation Mode	N <sub>TX</sub>	RF Output Power	DG (dBi)	EIRP Power	PD (S) (mW/cm <sup>2</sup> )
g	4	26.84	4.42	31.26	0.11818
Maximum Permissible Exposure Limit (mW/cm <sup>2</sup> )					1

Note 1: N<sub>TX</sub> = Number of Transmit Chains

**1.2.4 Result of Maximum Permissible Exposure (5.2G) - Non-Beamforming**

RF General Information					
Frequency Range (MHz)	IEEE Std. 802.11 Protocol	Ch. Frequency (MHz)	Channel Number	Number of Transmit Chains (N <sub>TX</sub> )	RF Output Power (dBm)
5150-5250	a	5180-5240	36-48 [4]	4	25.16
5150-5250	HT20	5180-5240	36-48 [4]	4	24.80
5150-5250	HT40	5190-5230	38-46 [2]	4	25.85
5150-5250	VHT20	5180-5240	36-48 [4]	4	24.80
5150-5250	VHT40	5190-5230	38-46 [2]	4	25.85
5150-5250	VHT80	5210	42 [1]	4	17.79

Note 1: RF output power specifies that Maximum Conducted (Average) Output Power.

Worst Maximum RF Output Power Result					
Exposure Environment		General Population / Uncontrolled Exposure			
Separation Distance (cm)		30			
Condition		RF Output Power (dBm)			
Modulation Mode	N <sub>TX</sub>	RF Output Power	DG (dBi)	EIRP Power	PD (S) (mW/cm <sup>2</sup> )
VHT40	4	25.85	4.78	30.63	0.10222
Maximum Permissible Exposure Limit (mW/cm <sup>2</sup> )					1

Note 1: N<sub>TX</sub> = Number of Transmit Chains

**1.2.5 Result of Maximum Permissible Exposure (5.3G) - Non-Beamforming**

RF General Information					
Frequency Range (MHz)	IEEE Std. 802.11 Protocol	Ch. Frequency (MHz)	Channel Number	Number of Transmit Chains ( $N_{TX}$ )	RF Output Power (dBm)
5250-5350	a	5260-5320	52-64 [4]	4	18.72
5250-5350	HT20	5260-5320	52-64 [4]	4	18.51
5250-5350	HT40	5270-5310	54-62 [2]	4	21.35
5250-5350	VHT20	5260-5320	52-64 [4]	4	18.54
5250-5350	VHT40	5270-5310	54-62 [2]	4	21.36
5250-5350	VHT80	5290	58 [1]	4	15.30
Note 1: RF output power specifies that Maximum Conducted (Average) Output Power.					

Worst Maximum RF Output Power Result					
Exposure Environment		General Population / Uncontrolled Exposure			
Separation Distance (cm)		30			
Condition		RF Output Power (dBm)			
Modulation Mode	$N_{TX}$	RF Output Power	DG (dBi)	EIRP Power	PD (S) (mW/cm <sup>2</sup> )
VHT40	4	21.36	4.61	25.97	0.03496
Maximum Permissible Exposure Limit (mW/cm <sup>2</sup> )					1
Note 1: $N_{TX}$ = Number of Transmit Chains					

**1.2.6 Result of Maximum Permissible Exposure (5.6G) - Non-Beamforming**

RF General Information					
Frequency Range (MHz)	IEEE Std. 802.11 Protocol	Ch. Frequency (MHz)	Channel Number	Number of Transmit Chains (N <sub>TX</sub> )	RF Output Power (dBm)
5470-5725	a	5500-5720	100-144 [9]	4	17.65
5470-5725	HT20	5500-5720	100-144 [9]	4	17.98
5470-5725	HT40	5510-5710	102-142 [4]	4	20.44
5470-5725	VHT20	5500-5720	100-144 [9]	4	18.00
5470-5725	VHT40	5510-5710	102-142 [4]	4	20.48
5470-5725	VHT80	5530-5690	106-138 [2]	4	23.48
Note 1: RF output power specifies that Maximum Conducted (Average) Output Power.					

Worst Maximum RF Output Power Result					
Exposure Environment		General Population / Uncontrolled Exposure			
Separation Distance (cm)		30			
Condition		RF Output Power (dBm)			
Modulation Mode	N <sub>TX</sub>	RF Output Power	DG (dBi)	EIRP Power	PD (S) (mW/cm <sup>2</sup> )
VHT80	4	23.48	5.84	29.32	0.07560
Maximum Permissible Exposure Limit (mW/cm <sup>2</sup> )					1
Note 1: N <sub>TX</sub> = Number of Transmit Chains					



**1.2.7 Result of Maximum Permissible Exposure (5.8G) - Non-Beamforming**

RF General Information					
Frequency Range (MHz)	IEEE Std. 802.11 Protocol	Ch. Frequency (MHz)	Channel Number	Number of Transmit Chains (N <sub>TX</sub> )	RF Output Power (dBm) Co-location
5725-5850	a	5720-5825	144-165 [6]	4	28.03
5725-5850	HT20	5720-5825	144-165 [6]	4	27.93
5725-5850	HT40	5710-5795	142-159 [3]	4	24.82
5725-5850	VHT20	5720-5825	144-165 [6]	4	27.93
5725-5850	VHT40	5710-5795	142-159 [3]	4	24.82
5725-5850	VHT80	5690-5775	138-155 [2]	4	23.49
Note 1: RF output power specifies that Maximum Conducted (Average) Output Power.					

Worst Maximum RF Output Power Result					
Exposure Environment		General Population / Uncontrolled Exposure			
Separation Distance (cm)		30			
Condition		RF Output Power (dBm)			
Modulation Mode	N <sub>TX</sub>	RF Output Power	DG (dBi)	EIRP Power	PD (S) (mW/cm <sup>2</sup> )
a	4	28.03	5.84	33.87	0.21555
Maximum Permissible Exposure Limit (mW/cm <sup>2</sup> )					1
Note 1: N <sub>TX</sub> = Number of Transmit Chains					

**1.2.8 Result of Maximum Permissible Exposure (2.4G) - Beamforming**

RF General Information					
Frequency Range (MHz)	IEEE Std. 802.11 Protocol	Ch. Frequency (MHz)	Channel Number	Number of Transmit Chains (N <sub>TX</sub> )	RF Output Power (dBm)
2400-2483.5	VHT20, TxBF	2412-2462	1-11 [11]	4	23.88
2400-2483.5	VHT40, TxBF	2422-2452	3-9 [7]	4	21.52
Note 1: RF output power specifies that Maximum Conducted (Average) Output Power.					

Worst Maximum RF Output Power Result					
Exposure Environment		General Population / Uncontrolled Exposure			
Separation Distance (cm)		30			
Condition		RF Output Power (dBm)			
Modulation Mode	N <sub>TX</sub>	RF Output Power	DG (dBi)	EIRP Power	PD (S) (mW/cm <sup>2</sup> )
VHT20, TxBF	4	23.88	10.44	34.32	0.23908
Maximum Permissible Exposure Limit (mW/cm <sup>2</sup> )					1
Note 1: N <sub>TX</sub> = Number of Transmit Chains					

**1.2.9 Result of Maximum Permissible Exposure (5.2G) - Beamforming**

RF General Information					
Frequency Range (MHz)	IEEE Std. 802.11 Protocol	Ch. Frequency (MHz)	Channel Number	Number of Transmit Chains (N <sub>TX</sub> )	RF Output Power (dBm)
5150-5250	VHT20, TxBF	5180-5240	36-48 [4]	4	23.71
5150-5250	VHT40, TxBF	5190-5230	38-46 [2]	4	23.56
5150-5250	VHT80, TxBF	5210	42 [1]	4	16.27
Note 1: RF output power specifies that Maximum Conducted (Average) Output Power.					

Worst Maximum RF Output Power Result					
Exposure Environment		General Population / Uncontrolled Exposure			
Separation Distance (cm)		30			
Condition		RF Output Power (dBm)			
Modulation Mode	N <sub>TX</sub>	RF Output Power	DG (dBi)	EIRP Power	PD (S) (mW/cm <sup>2</sup> )
VHT20, TxBF	4	23.71	10.8	34.51	0.24977
Maximum Permissible Exposure Limit (mW/cm <sup>2</sup> )					1
Note 1: N <sub>TX</sub> = Number of Transmit Chains					

**1.2.10 Result of Maximum Permissible Exposure (5.3G) - Beamforming**

RF General Information					
Frequency Range (MHz)	IEEE Std. 802.11 Protocol	Ch. Frequency (MHz)	Channel Number	Number of Transmit Chains (N <sub>TX</sub> )	RF Output Power (dBm)
5250-5350	VHT20, TxBF	5260-5320	52-64 [4]	4	18.44
5250-5350	VHT40, TxBF	5270-5310	54-62 [2]	4	19.07
5250-5350	VHT80, TxBF	5290	58 [1]	4	17.31
Note 1: RF output power specifies that Maximum Conducted (Average) Output Power.					

Worst Maximum RF Output Power Result					
Exposure Environment		General Population / Uncontrolled Exposure			
Separation Distance (cm)		30			
Condition		RF Output Power (dBm)			
Modulation Mode	N <sub>TX</sub>	RF Output Power	DG (dBi)	EIRP Power	PD (S) (mW/cm <sup>2</sup> )
VHT40, TxBF	4	19.07	10.63	29.70	0.82520
Maximum Permissible Exposure Limit (mW/cm <sup>2</sup> )					1
Note 1: N <sub>TX</sub> = Number of Transmit Chains					

**1.2.11 Result of Maximum Permissible Exposure (5.6G) - Beamforming**

RF General Information					
Frequency Range (MHz)	IEEE Std. 802.11 Protocol	Ch. Frequency (MHz)	Channel Number	Number of Transmit Chains ( $N_{TX}$ )	RF Output Power (dBm)
5470-5725	VHT20, TxBF	5500-5720	100-144 [9]	4	17.49
5470-5725	VHT40, TxBF	5510-5710	102-142 [4]	4	18.10
5470-5725	VHT80, TxBF	5530-5690	106-138 [2]	4	17.56
Note 1: RF output power specifies that Maximum Conducted (Average) Output Power.					

Worst Maximum RF Output Power Result					
Exposure Environment		General Population / Uncontrolled Exposure			
Separation Distance (cm)		30			
Condition		RF Output Power (dBm)			
Modulation Mode	$N_{TX}$	RF Output Power	DG (dBi)	EIRP Power	PD (S) (mW/cm <sup>2</sup> )
VHT40, TxBF	4	18.10	11.86	29.96	0.08761
Maximum Permissible Exposure Limit (mW/cm <sup>2</sup> )					1
Note 1: $N_{TX}$ = Number of Transmit Chains					

**1.2.12 Result of Maximum Permissible Exposure (5.8G) - Beamforming**

RF General Information					
Frequency Range (MHz)	IEEE Std. 802.11 Protocol	Ch. Frequency (MHz)	Channel Number	Number of Transmit Chains (N <sub>TX</sub> )	RF Output Power (dBm) Co-location
5725-5850	VHT20, TxBF	5720-5825	144-165 [6]	4	23.87
5725-5850	VHT40, TxBF	5710-5795	142-159 [3]	4	22.99
5725-5850	VHT80, TxBF	5690-5775	138-155 [2]	4	17.35
Note 1: RF output power specifies that Maximum Conducted (Average) Output Power.					

Worst Maximum RF Output Power Result					
Exposure Environment		General Population / Uncontrolled Exposure			
Separation Distance (cm)		30			
Condition		RF Output Power (dBm)			
Modulation Mode	N <sub>TX</sub>	RF Output Power	DG (dBi)	EIRP Power	PD (S) (mW/cm <sup>2</sup> )
VHT20, TxBF	4	23.87	11.86	35.73	0.33079
Maximum Permissible Exposure Limit (mW/cm <sup>2</sup> )					1
Note 1: N <sub>TX</sub> = Number of Transmit Chains					

**1.2.13 Result of Maximum Permissible Exposure (Co-location) - Non-Beamforming**

Worst Maximum RF Output Power Result							
Exposure Environment		General Population / Uncontrolled Exposure					
Separation Distance (cm)		30					
Condition		RF Output Power (dBm)					
Modulation Mode	N <sub>TX</sub>	RF Output Power (dBm)	DG (dBi)	EIRP Power	PD (S) (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Ratio
g (2.4GHz)	4	26.84	4.42	31.26	0.11818	1	0.11818
a (5.8GHz)	4	28.03	5.84	33.87	0.21555	1	0.21555
Co-location Total							0.33373
Maximum Permissible Exposure Limit							1
<p>Note 1: NTX = Number of Transmit Chains.</p> <p>Note.2: Both of the WLAN 2.4GHz and WLAN 5GHz can transmit simultaneously, the formula of calculated the MPE is:</p> $CPD1 / LPD1 + CPD2 / LPD2 + \dots \text{etc.} < 1$ <p>CPD = Calculation power density</p> <p>LPD = Limit of power density</p> <p>Note 3: Refer to KDB 865664 D02 RF Exposure Reporting v01r02 for MPE Calculation Colocation.</p>							

**1.2.14 Result of Maximum Permissible Exposure (Co-location) - Beamforming**

Worst Maximum RF Output Power Result							
Exposure Environment		General Population / Uncontrolled Exposure					
Separation Distance (cm)		30					
Condition		RF Output Power (dBm)					
Modulation Mode	N <sub>TX</sub>	RF Output Power (dBm)	DG (dBi)	EIRP Power	PD (S) (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Ratio
VHT20 (2.4GHz)	4	23.88	10.44	34.32	0.23908	1	0.23908
VHT40 (5.3GHz)	4	19.07	10.63	29.70	0.82520	1	0.08252
Co-location Total							0.32160
Maximum Permissible Exposure Limit							1
<p>Note 1: NTX = Number of Transmit Chains.</p> <p>Note.2: Both of the WLAN 2.4GHz and WLAN 5GHz can transmit simultaneously, the formula of calculated the MPE is:</p> $CPD1 / LPD1 + CPD2 / LPD2 + \dots \text{etc.} < 1$ <p>CPD = Calculation power density</p> <p>LPD = Limit of power density</p> <p>Note 3: Refer to KDB 865664 D02 RF Exposure Reporting v01r02 for MPE Calculation Colocation.</p>							