



A Test Lab Techno Corp.

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MPE Report

Test Report No.	: 1812FS11
Applicant	: Control4
Product Type	: 802.11ac 2x2 Wave 2 Access Point
Trade Name	: pakedge
Model Number	: WA-2200-1, WA-2200, WA-2200-C, WA-2200-C-1
Date of Received	: Aug. 29, 2017
Test Period	: Feb. 01 ~ Feb. 02, 2018
Date of Issued	: Dec. 13, 2018
Test Specification	: ANSI / IEEE Std.C95.1-1992 / IEEE Std. 1528-2013 47 CFR § 2.1091 47 CFR § 1.1310
Location of Test Lab.	: Chang-an Lab.

1. The test operations have to be performed with cautious behavior, the test results are as attached.
2. The test results are under chamber environment of A Test Lab Techno Corp. A Test Lab Techno Corp. does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples.
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Approved By : Edison Hu Tested By : Kris Pan
(Edison Hu) (Kris Pan)



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1. Description of Equipment under Test (EUT)

Applicant	Control4 11734 S. Election Road, Draper, Utah, 84020, United States				
Manufacturer	Control4 11734 S. Election Road, Draper, Utah, 84020, United States				
Product Type	802.11ac 2x2 Wave 2 Access Point				
Trade Name	pakedge				
Model Number	WA-2200-1, WA-2200, WA-2200-C, WA-2200-C-1 (*Those model numbers differ from each other in selling region.)				
FCC ID	R33WA2200				
Frequency Range	Operate Band			Frequency Range (MHz)	
	IEEE 802.11b / 802.11g IEEE 802.11n 2.4 GHz 20 MHz (256QAM)			2412 - 2462	
	IEEE 802.11n 2.4 GHz 40 MHz (256QAM)			2422 - 2452	
	IEEE 802.11a U-NII Band I			5180 - 5240	
	IEEE 802.11a U-NII Band III			5745 - 5825	
	IEEE 802.1ac / 802.11n 5 GHz 20 MHz U-NII Band I			5180 - 5240	
	IEEE 802.1ac / 802.11n 5 GHz 20 MHz U-NII Band III			5745 - 5825	
	IEEE 802.1ac / 802.11n 5 GHz 40 MHz U-NII Band I			5190 - 5230	
	IEEE 802.1ac / 802.11n 5 GHz 40 MHz U-NII Band III			5755 - 5795	
	IEEE 802.11ac 80 MHz U-NII Band I			5210	
	IEEE 802.11ac 80 MHz U-NII Band III			5775	
Antenna Information	ANT	Type	Max. Gain (dBi)		
			2.4 GHz	U-NII Band I	U-NII Band III
	2.4 GHz ANT-0	Metal PIFA Antenna	3.38	---	---
	2.4 GHz ANT-1	Metal PIFA Antenna	4.26	---	---
	5 GHz ANT-0	Metal PIFA Antenna	---	4.47	4.86
	5 GHz ANT-1	Metal PIFA Antenna	---	5.38	5.62
	G _{ANT}		3.84	4.95	5.26
Directional Gain		---	7.95	8.26	
Antenna Delivery	Operate Band		Normal	Beamforming on	
	IEEE 802.11b/IEEE 802.11g		2TX (CDD)	---	
	IEEE 802.11n 2.4GHz 20 MHz / 40 MHz		2TX (CDD)	---	
	IEEE 802.11a		2TX (CDD)	---	
	IEEE 802.11ac 20 MHz / 40 MHz / 80 MHz		2TX (CDD)	2TX (MIMO)	
RF Evaluation	0.452 mW/cm ²				
Temperature Range	0 ~ +40°C				

The above equipment was tested by A Test Lab Techno Corp. For compliance with the requirements set forth in 47 CFR § 2.1091 / 47 CFR § 1.1310. The results of testing in this report apply only to the product/system, which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties



EUT Modify Description :

Modify Description:

- (1) Change the applicant, applicant address, manufacturer, manufacturer address, product type, trade name, model number, FCC ID and the appearance.
- (2) Add two lightning protection components on PCB.
- (3) The appearance is removed a LAN port and a USB port.

The difference won't influence the test results. Therefore, all test items don't need to be re-evaluated.

Test Data : Refer to Report No. 1803FS16-02

Original Report : 1803FS16-02

Modify: 1812FS11



2. Human Exposure Assessment

Due to the design and installation of this product, it is not possible to conduct SAR evaluation. This is because client either manufactures or supplies the antenna(s) that will be used in the installation of this product. Therefore, this product will be evaluated as a mobile device per 47 CFR § 1.1310 titled “Radiofrequency radiation exposure limits”, generally referred to as MPE limits.

In 47 CFR § 2.1091, paragraph (b) defines a mobile device as “a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 cm is normally maintained between the transmitter’s radiating structure(s) and the body of the user or nearby persons.” This product is intended to be installed into a vehicle such that the unit is physically secured at one location. In the installation guide supplied with the product,

Client has made the following statement: “IMPORTANT: To meet the FCC’s RF Exposure Guidelines, the antenna should be installed so there is at least 20 cm of separation between the body of the user and nearby persons and the antenna”. Based on the installation of the transceiver and the antenna, the transmitters radiating structure is more than 20 cm from the user. Thus, this product is a “mobile device” as defined in section § 2.1091 paragraph (b).

Exposure evaluation

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

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.



3. RF Output Power

The conducted power turn-up tolerance reference manufacturer specification.

Band	Data Rate (Mbps)	Frequency (MHz)	Average Conducted power (dBm)		
			ANT-0	ANT-1	ANT-0+1
IEEE 802.11b	1	2412.0	23.56	23.26	26.42
		2437.0	22.32	22.68	25.51
		2462.0	22.97	22.79	25.89
	2	2437.0	22.28	22.61	25.46
	5.5	2437.0	22.20	22.57	25.40
	11	2437.0	22.15	22.53	25.35
IEEE 802.11g	6	2412.0	17.52	17.15	20.35
		2437.0	22.66	22.30	25.49
		2462.0	18.12	18.08	21.11
	9	2437.0	22.62	22.25	25.45
	12	2437.0	22.60	22.22	25.42
	18	2437.0	22.57	22.20	25.40
	24	2437.0	22.52	22.17	25.36
	36	2437.0	22.46	22.14	25.31
	48	2437.0	22.42	22.11	25.28
	54	2437.0	22.37	22.08	25.24
IEEE 802.11n 2.4 GHz 20 MHz	13	2412.0	17.83	17.52	20.69
		2437.0	22.71	22.34	25.54
		2462.0	17.61	17.24	20.44
	28.8	2437.0	22.68	22.31	25.51
	43.4	2437.0	22.63	22.28	25.47
	57.8	2437.0	22.60	22.24	25.43
	86.6	2437.0	22.57	22.21	25.40
	115.6	2437.0	22.52	22.17	25.36
	130	2437.0	22.47	22.13	25.31
	144.4	2437.0	22.45	22.08	25.28
173.4	2437.0	22.43	22.02	25.24	

Note: The relevant measured result has the offset with cable loss already.



Band	Data Rate (Mbps)	Frequency (MHz)	Average Conducted power (dBm)		
			ANT-0	ANT-1	ANT-0+1
IEEE 802.11n 2.4 GHz 40 MHz	27	2422.0	15.55	15.68	18.63
		2437.0	19.04	18.97	22.02
		2452.0	14.99	14.92	17.97
	60	2437.0	19.00	18.92	21.97
	90	2437.0	18.97	18.86	21.93
	120	2437.0	18.92	18.83	21.89
	180	2437.0	18.89	18.80	21.86
	240	2437.0	18.85	18.76	21.82
	270	2437.0	18.82	18.74	21.79
	300	2437.0	18.80	18.70	21.76
	360	2437.0	18.77	18.65	21.72
	400	2437.0	18.74	18.62	21.69

Note: The relevant measured result has the offset with cable loss already.



Band	Data Rate (Mbps)	Frequency (MHz)	Average Conducted power (dBm)		
			ANT-0	ANT-1	ANT-0+1
IEEE 802.11a	6	5180.0	20.46	20.41	23.45
		5200.0	21.55	21.80	24.69
		5220.0	21.71	22.09	24.91
		5240.0	21.60	21.81	24.72
		5745.0	22.07	21.79	24.94
		5765.0	21.81	21.66	24.75
		5785.0	21.82	21.47	24.66
		5805.0	21.61	21.43	24.53
		5825.0	21.58	21.52	24.56
	54	5180.0	20.40	20.27	23.35
		5200.0	21.48	21.69	24.60
		5220.0	21.61	21.93	24.78
		5240.0	21.47	21.65	24.57
		5745.0	22.00	21.71	24.87
		5765.0	21.68	21.55	24.63
		5785.0	21.70	21.39	24.56
		5805.0	21.52	21.37	24.46
		5825.0	21.53	21.44	24.50
IEEE 802.11ac 20 MHz	13	5180.0	20.30	19.96	23.14
		5200.0	21.68	21.79	24.75
		5220.0	21.55	21.62	24.60
		5240.0	21.14	20.89	24.03
		5745.0	22.61	22.13	25.39
		5765.0	22.54	22.02	25.30
		5785.0	22.36	22.02	25.20
		5805.0	22.31	22.39	25.36
		5825.0	21.97	22.44	25.22
	173.4	5180.0	20.21	19.82	23.03
		5200.0	21.54	21.65	24.61
		5220.0	21.46	21.53	24.51
		5240.0	21.02	20.77	23.91
		5745.0	22.53	22.06	25.31
		5765.0	22.42	21.96	25.21
		5785.0	22.30	21.95	25.14
		5805.0	22.19	22.27	25.24
		5825.0	21.85	22.32	25.10

Note: The relevant measured result has the offset with cable loss already.



Band	Data Rate (Mbps)	Frequency (MHz)	Average Conducted power (dBm)		
			ANT-0	ANT-1	ANT-0+1
IEEE 802.11ac 40 MHz	27	5190.0	17.40	17.31	20.37
		5230.0	21.10	20.89	24.01
		5755.0	21.27	20.70	24.00
		5795.0	20.76	20.33	23.56
	400	5190.0	17.29	17.20	20.26
		5230.0	20.97	20.80	23.90
		5755.0	21.21	20.62	23.94
		5795.0	20.70	20.26	23.50
IEEE 802.11ac 80 MHz	58.6	5210.0	17.41	17.60	20.52
		5775.0	20.60	20.46	23.54
	866.6	5210.0	17.33	17.52	20.44
		5775.0	20.53	20.40	23.48

Note: The relevant measured result has the offset with cable loss already.



Beamforming on

Band	Date Rate (Mbps)	Frequency (MHz)	Average Conducted power (dBm)		
			ANT-0	ANT-1	ANT-0+1
IEEE 802.11ac 20 MHz	13	5180.0	16.79	17.10	19.96
		5200.0	18.54	18.62	21.59
		5220.0	18.42	18.61	21.53
		5240.0	17.74	17.80	20.78
		5745.0	19.21	19.16	22.20
		5765.0	19.25	19.11	22.19
		5785.0	19.14	19.05	22.11
		5805.0	19.29	19.23	22.27
		5825.0	18.92	19.09	22.02
	173.4	5180.0	16.71	17.00	19.87
		5200.0	18.47	18.57	21.53
		5220.0	18.35	18.54	21.46
		5240.0	17.70	17.73	20.73
		5745.0	19.16	19.10	22.14
		5765.0	19.18	19.03	22.12
		5785.0	19.10	18.96	22.04
		5805.0	19.20	19.15	22.19
		5825.0	18.84	19.02	21.94
IEEE 802.11ac 40 MHz	27	5190.0	14.31	14.25	17.29
		5230.0	17.92	17.83	20.89
		5755.0	17.63	17.75	20.70
		5795.0	17.42	17.31	20.38
	400	5190.0	14.23	14.20	17.23
		5230.0	17.88	17.77	20.84
		5755.0	17.55	17.69	20.63
		5795.0	17.35	17.27	20.32
IEEE 802.11ac 80 MHz	58.6	5210.0	14.10	14.23	17.18
		5775.0	17.41	17.38	20.41
	866.6	5210.0	13.95	14.00	16.99
		5775.0	17.33	17.30	20.33

Note:1. The relevant measured result has the offset with cable loss already.



4. Test Results

WLAN Antenna_CDD										
Band	Data Rate (Mbps)	Frequency (MHz)	Limit (mw)	Distance [R] (cm)	Max tune-up Power (upper limit) [P] (dBm)	ANT Gain (dBi)	Numeric Gain [G]	Duty Cycle	Power with Duty cycle [P] x [G] (W)	Power Density [S] (mw/cm ²)
IEEE 802.11b	1	2412.0	1	20	26.50	3.84	2.42	1	1080.97	0.215
		2437.0	1	20	26.50	3.84	2.42	1	1080.97	0.215
		2462.0	1	20	26.50	3.84	2.42	1	1080.97	0.215
IEEE 802.11g	6	2412.0	1	20	20.50	3.84	2.42	1	271.53	0.054
		2437.0	1	20	25.60	3.84	2.42	1	878.65	0.175
		2462.0	1	20	21.20	3.84	2.42	1	319.02	0.063
IEEE 802.11n 2.4 GHz 20 MHz	13	2412.0	1	20	20.80	3.84	2.42	1	290.95	0.058
		2437.0	1	20	25.60	3.84	2.42	1	878.65	0.175
		2462.0	1	20	20.50	3.84	2.42	1	271.53	0.054
IEEE 802.11n 2.4 GHz 40 MHz	27	2422.0	1	20	18.70	3.84	2.42	1	179.4	0.036
		2437.0	1	20	22.10	3.84	2.42	1	392.48	0.078
		2452.0	1	20	18.10	3.84	2.42	1	156.25	0.031
IEEE 802.11a	6	5180.0	1	20	25	4.95	3.13	1	989.79	0.197
		5200.0	1	20	25	4.95	3.13	1	989.79	0.197
		5220.0	1	20	25	4.95	3.13	1	989.79	0.197
		5240.0	1	20	25	4.95	3.13	1	989.79	0.197
		5745.0	1	20	25.5	5.26	3.36	1	1192.17	0.237
		5765.0	1	20	25.5	5.26	3.36	1	1192.17	0.237
		5785.0	1	20	25.5	5.26	3.36	1	1192.17	0.237
		5805.0	1	20	25.5	5.26	3.36	1	1192.17	0.237
IEEE 802.11ac 20 MHz	13	5180.0	1	20	24.9	4.95	3.13	1	967.26	0.192
		5200.0	1	20	24.9	4.95	3.13	1	967.26	0.192
		5220.0	1	20	24.9	4.95	3.13	1	967.26	0.192
		5240.0	1	20	24.9	4.95	3.13	1	967.26	0.192
		5745.0	1	20	25.5	5.26	3.36	1	1192.17	0.237
		5765.0	1	20	25.5	5.26	3.36	1	1192.17	0.237
		5785.0	1	20	25.5	5.26	3.36	1	1192.17	0.237
		5805.0	1	20	25.5	5.26	3.36	1	1192.17	0.237
IEEE 802.11ac 40 MHz	27	5190.0	1	20	20.5	4.95	3.13	1	351.19	0.070
		5230.0	1	20	24.1	4.95	3.13	1	804.53	0.160
		5755.0	1	20	24.1	5.26	3.36	1	863.65	0.172
		5795.0	1	20	23.7	5.26	3.36	1	787.66	0.157
IEEE 802.11ac 80 MHz	58.6	5210.0	1	20	20.6	4.95	3.13	1	359.37	0.071
		5775.0	1	20	23.6	5.26	3.36	1	769.73	0.153



WLAN Antenna_MIMO_Beamforming on										
Band	Data Rate (Mbps)	Frequency (MHz)	Limit (mw)	Distance [R] (cm)	Max tune-up Power (upper limit) [P] (dBm)	ANT Gain (dBi)	Numeric Gain [G]	Duty Cycle	Power with Duty cycle [P] x [G] (W)	Power Density [S] (mw/cm ²)
IEEE 802.11ac 20 MHz	13	5180.0	1	20	21.7	7.95	6.24	1	922.96	0.184
		5200.0	1	20	21.7	7.95	6.24	1	922.96	0.184
		5220.0	1	20	21.7	7.95	6.24	1	922.96	0.184
		5240.0	1	20	21.7	7.95	6.24	1	922.96	0.184
		5745.0	1	20	22.4	8.26	6.7	1	1164.33	0.232
		5765.0	1	20	22.4	8.26	6.7	1	1164.33	0.232
		5785.0	1	20	22.4	8.26	6.7	1	1164.33	0.232
		5805.0	1	20	22.4	8.26	6.7	1	1164.33	0.232
		5825.0	1	20	22.4	8.26	6.7	1	1164.33	0.232
IEEE 802.11ac 40 MHz	27	5190.0	1	20	17.4	7.95	6.24	1	342.91	0.068
		5230.0	1	20	21	7.95	6.24	1	785.57	0.156
		5755.0	1	20	20.8	8.26	6.7	1	805.52	0.160
		5795.0	1	20	20.8	8.26	6.7	1	805.52	0.160
IEEE 802.11ac 80 MHz	58.6	5210.0	1	20	17.3	7.95	6.24	1	335.11	0.067
		5775.0	1	20	20.5	8.26	6.7	1	751.75	0.150

Note:

1. Mobile or fixed location transmitters, minimum separation distance is 20 cm, even if calculations indicate MPE distance is less.
2. The Numeric Gain calculated by $10^{(\text{ant. Gain(dBi)} / 10)}$.
3. Each band max power which perform MPE of any configurations.
4. The MPE results are evaluated by lowest data rate for WLAN.
5. The device operating IEEE 802.11 b/g/n/a/ac normal mode is 2TX CDD.
6. The device operating IEEE 802.11 ac Beamforming on mode is 2TX MIMO.
7. The device support simultaneous transmission.

Simultaneous Transmitting:

$$\text{Simultaneous MPE} = 2.4 \text{ GHz MPE} + 5 \text{ GHz MPE} = 0.215 + 0.237 = 0.452 \text{ mw/cm}^2 < 10 \text{ mw/cm}^2$$