MPE Evaluation Report

Product	:	Hover Camera Passport
Trade mark	:	HOVER CAMERA
Model/Type reference	:	HC-6428
Report Number	:	1609060316RFC-4
Date of Issue	:	Sep. 14, 2016
FCC ID	:	2AIDWHCP6428
Test Standards	:	47 CFR Part 1.1307(2015) 47 CFR Part 1.1310(2015)
Test result		PASS

Prepared for:

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Prepared by:

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Date: Sep. 14, 2016

Version

Version No.	Date	Description
V1.0	Sep. 14, 2016	Original

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1 General Information

1.1 Client Information

Applicant:	Shenzhen Zero Zero Infinity Technology Co., Ltd.
Address of Applicant:	1607 Innovation Park, High-Tech Park of Nanshan dist. Shenzhen
Manufacturer:	Shenzhen Zero Zero Infinity Technology Co., Ltd.
Address of Manufacturer:	1607 Innovation Park, High-Tech Park of Nanshan dist. Shenzhen

1.2 General Description of EUT

Product Name:	Hover Camera Passport
Model No.(EUT):	HC-6428
Add. Mode No.:	N/A
Trade Mark:	HOVER CAMERA
EUT Supports Radios application:	Wlan 2.4GHz 802.11b/g/n(HT20) Wlan 5.2GHz 802.11a/n(HT20&HT40) Wlan 5.8GHz 802.11a/n(HT20&HT40)

1.3 Product Specification subjective to this standard

Operation Frequency:	802.11b/g/n(HT20): 2412MHz to 2462MHz 802.11a/n(HT20&HT40):5150MHz to 5250MHz 802.11a/n(HT20&HT40):5745MHz to 5850MHz
Channel Numbers:	802.11b/g/n(HT20): 11 Channels 5150MHz to 5250MHz: 4 for 802.11a/n(HT20) 2 for 802.11n(HT40) 5725MHz to 5850MHz: 5 for 802.11a/n(HT20) 2 for 802.11n(HT40)
Transmit Data Rate:	802.11b: 1M/ 2M/ 5.5M/ 11M bps 802.11g/a: 6M/ 9M/ 12M/ 18M/ 24M/ 36M/ 48M/ 54M bps 802.11n(HT20): up to MCS7(65Mbps) 802.11n(HT40): up to MCS7(135Mbps)
Type of Modulation:	802.11b: DSSS(CCK,DQPSK,DBPSK) 802.11g/a: OFDM(64QAM, 16QAM, QPSK, BPSK) 802.11n(HT20 and HT40): OFDM (64QAM, 16QAM,QPSK,BPSK)
Sample Type:	Portable production
Maximum conduction target average power:	2400MHz to 2483.5MHz: 802.11b: 17dBm(±1.5dB) 802.11g: 15dBm(±1.5dB) 802.11n(HT20): 14dBm(±1.5dB) 5150MHz to 5250MHz: 4 for 802.11a/n(HT20) 802.11a: 13dBm(±1.5dB) 802.11n(HT20): 14dBm(±1.5dB) 802.11n(HT40): 15dBm(±1.5dB) 5725MHz to 5850MHz: 5 for 802.11a/n(HT20) 802.11a: 13dBm(±1.5dB)

	802.11n(HT20): 14dBm(±1.5dB) 802.11n(HT40): 15dBm(±1.5dB)	
Test Software of EUT:	Provided by the manufacturer	
Antenna Type	Chain 0: PIFA antenna Chain 1: PCB antenna	
Antenna Gain:	2400 ~ 2490 MHz Chain 0: 0.6 dBi gain Chain 1: -1.7 dBi gain 5150MHz to 5250MHz: Chain 0: -1.6 dBi gain Chain 1: 1.4 dBi gain 5725MHz to 5850MHz: Chain 0: 1.5 dBi gain Chain 1: 1.1 dBi gain	
Maximum conducted output power	The Maximum conducted output power data refer to the report 1609060316RFC-1 and 1609060316RFC -2	
Normal Test voltage:	7.4Vdc for DC power or battery	
Power Supply:	AC adapter	Model:HKA03612030-2A Input:100-240V~50/60Hz, 1.0A; Output: 12.0V ⎓ 3A
	Charging Dock:	Model: H-320 Input:11-18V ⎓ 3A MAX; Output: 8.4V ⎓ 2.2A MAX
	Battery 1:	Model: ZB-380 Nominal Voltage: .7.4V ⎓ (Rechargeable LIPO Battery) Battery Capacity: 1100mAh/8.14Wh
	Battery 2:	Model: ZB-381 Nominal Voltage: .7.6V ⎓ (Rechargeable LIPO Battery) Battery Capacity: 1360mAh/10.34Wh
USB Micro-B Plug cable:	0.55m (shielded)	
Sample Type:	Portable production	
Test Software of EUT:	Provided by the manufacturer	
Software Version:	1-1.0-1.0.1	
Hardware Version:	FAIPY_MB_V40	
Sample Received Date:	Sep. 07, 2016	
Sample tested Date:	Sep. 12, 2016 to Sep. 14, 2016	

Operation Frequency each of channel

For 802.11b/g/n(HT20) Operation in the 2400MHz ~2483.5 MHz band							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2412MHz	4	2427MHz	7	2442MHz	10	2457MHz
2	2417MHz	5	2432MHz	8	2447MHz	11	2462MHz
3	2422MHz	6	2437MHz	9	2452MHz	N/A	

For 802.11a/n(HT20) Operation in the 5150MHz ~5250 MHz band							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency

36	5180MHz	40	5200MHz	44	5220MHz	48	5240MHz

For 802.11n(HT40) Operation in the 5150MHz ~5250 MHz band			
Channel	Frequency	Channel	Frequency
38	5190MHz	46	5230MHz

For 802.11a/n(HT20) Operation in the 5725MHz ~5850 MHz band					
Channel	Frequency	Channel	Frequency	Channel	Frequency
149	5745MHz	153	5765MHz	157	5785MHz
161	5805MHz	165	5825MHz	N/A	

For 802.11n(HT40) Operation in the 5725MHz ~5850 MHz band			
Channel	Frequency	Channel	Frequency
151	5755MHz	159	5795MHz

1.4 Description of Support Units

The EUT has been tested with associated equipment below.

1) Support equipment

Description	Brand	Model No.	Certification	Supplied by
Laptop	Dell	Inspiron 15 5000 series	FCC ID and DOC	UnionTrust
Adapter	Dell	DANM140	---	UnionTrust

2) Cable

Cable No.	Description	Connector Type	Cable Type/Length	Supplied by
1	USB Cable	USB	0.55m(shielded)	Client
2	Adapter Cable	DC	1.8m(undetachable, unshielded)	UnionTrust
		AC	1.45m(detachable, unshielded)	UnionTrust

1.5 Test Location

All tests were performed at:

Compliance Certification Services (Shenzhen) Inc.

No.10-1 Mingkeda Logistics Park, No.18 Huanguan South RD. Guan lan Town, Baoan Distr, Shenzhen, Guangdong, China.

Compliance Certification Services (Shenzhen) Inc. has been accepted by the FCC, the FCC Registration Number is 441872.

Tested by: Darry Wu

1.6 Deviation from Standards

None.

1.7 Abnormalities from Standard Conditions

None.

1.8 Other Information Requested by the Customer

None.

2 MPE Evaluation

2.1 MPE Compliance Requirement

2.1.1 Limits

According to §1.1307(b)(1), system operating under the provisions of this section shall be operating in a manner that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure.

a) 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^2)	Averaging Times | E |^2, | H |^2 or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f)*	6
30-300	61.4	0.163	1.0	6
300-1500	/	/	F/300	6
1500-100000	/	/	5	6

b) 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^2)	Averaging Times | E |^2, | H |^2 or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	F/1500	30
1500-100000	/	/	1	30

Note: f = frequency in MHz: * = Plane-wave equivalents power density

2.1.2 Test Procedure

Software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

2.2 EIRP

2.2.1 EIRP for operational 2.4GHz Band

For WiFi function, operating at 2412-2462MHz for 802.11b/g/n(HT20), 11 channels with 5MHz channel spacing.

a) Modulation Type:

BPSK, QPSK, 16QAM, 64QAM for OFDM. CCK, DQPSK, DBPSK for DSSS.

b) Antenna

Type: Chain 0: PIFA antenna;

Chain 1: PCB antenna.

Gain: Chain 0: 0.6 dBi gain (2400 ~ 2490 MHz)

Chain 1: -1.7 dBi gain (2400 ~ 2490 MHz)

For STBC modes (2Tx), there are two transmission antennas. Both Chain 0 and Chain 1 used at the same time and antenna ports have uniform output powers. The Chain 0 and Chain 1 antenna ports cannot be used alone. In addition the Tx chains are correlated and the antenna gain is unequal among the chains.

The directional gain = $10 \log[(10^{G1/20} + 10^{G2/20} + \ldots + 10^{GN/20})^2 / N_{ANT}]$ dBi

$= 10 \log[(10^{0.6/20} + 10^{-1.7/20})^2 / 2]$

=2.54dBi

c) Maximum Conducted Average Power

Maximum Conducted Average Power(dBm)							
Mode	Channel/ Frequency (MHz)	Data Rate (Mbps)	Measured Power		Power with Duty Factor		
			Chain 0	Chain 1	Chain 0	Chain 1	Total (Chain 0+1)
802.11b	1(2412)	1	16.69	18.08	16.69	18.08	**20.45**
	6(2437)		16.39	17.69	16.39	17.69	20.10
	11(2462)		15.82	14.84	15.82	14.84	18.37
802.11g	1(2412)	6	15.49	15.32	15.62	15.45	18.55
	6(2437)		15.53	15.55	15.66	15.68	18.68
	11(2462)		14.82	13.95	14.95	14.08	17.55
802.11n (HT20)	1(2412)	MCS3	13.97	15.33	14.44	15.8	18.18
	6(2437)		14.22	14.34	14.69	14.81	17.76
	11(2462)		13.41	12.42	13.88	12.89	16.42
The Maximum conducted average power data refer to the report 1609060316RFC-1.							

So, the maximum conducted output Average power for the EUT is 20.45 dBm in the frequency 2.412GHz 802.11b mode which is within the production variation.

The nominal single-antenna conducted output Average power specified:

802.11b: 17 dBm (Tolerance: +/-1.5dB)

802.11g: 15 dBm (Tolerance: +/-1.5dB)

802.11n(HT20): 14 dBm (Tolerance: +/-1.5dB)

So, the nominal STBC mode(2Tx) conducted output Average power specified:

802.11n: 20 dBm (Tolerance: +/-1.5dB)

802.11g: 18 dBm (Tolerance: +/-1.5dB)

802.11n(HT20): 17 dBm (Tolerance: +/-1.5dB)

d) ERP/EIRP

The maximum EIRP = Nominal conducted output Average power + Tolerance + Antenna Gain

=20 + 1.5+ (2.54) =24.04 dBm=253.5129mW

2.2.2 EIRP for operational 5.2GHz Band

For WiFi function, operating at 5180-5240MHz for 802.11a/n(HT20), 4 channels with 20MHz channel spacing and 5190-5230MHz for 802.11n(HT40), 2 channels with 40MHz channel spacing.

a) Modulation Type:

BPSK, QPSK, 16QAM, 64QAM for OFDM. CCK, DQPSK.

b) Antenna

Type: Chain 0: PIFA antenna;

Chain 1: PCB antenna.

Gain: Chain 0: -1.6 dBi gain (5150 ~ 5250 MHz)

Chain 1: 1.4 dBi gain (5150 ~ 5250 MHz)

For STBC modes (2Tx), there are two transmission antennas. Both Chain 0 and Chain 1 used at the same time and antenna ports have uniform output powers. The Chain 0 and Chain 1 antenna ports cannot be used alone. In addition the Tx chains are correlated and the antenna gain is unequal among the chains.

The directional gain = $10 \log[(10^{G1/20} + 10^{G2/20} + \ldots + 10^{GN/20})^2 / N_{ANT}]$ dBi

$= 10 \log[(10^{-1.6/20} + 10^{1.4/20})^2 / 2]$

=3.04dBi

c) Maximum Conducted Average Power

Maximum Conducted Average Power(dBm)							
Mode	Channel/ Frequency (MHz)	Data Rate (Mbps)	Measured Power		Power with Duty Factor		
			Chain 0	Chain 1	Chain 0	Chain 1	Total (Chain 0+1)
802.11a	36 (5180)	6	13.39	13.98	13.39	13.98	16.71
	40 (5200)		13.14	13.70	13.14	13.70	16.44
	48 (5240)		12.94	14.58	12.94	14.58	16.85
802.11n (HT20)	36 (5180)	MCS3	13.67	15.19	13.99	15.51	17.83
	40 (5200)		14.21	14.88	14.53	15.20	17.89
	48 (5240)		14.48	15.66	14.80	15.98	18.44
802.11n (HT40)	38 (5190)	MCS0	15.26	15.58	15.42	15.74	18.59
	46 (5230)		14.83	16.35	14.99	16.51	**18.83**
The Maximum conducted average power data refer to the report 1609060316RFC-2.							

So, the maximum conducted output Average power for the EUT is 18.83 dBm in the frequency 5.23GHz 802.11n(HT40) mode which is within the production variation.

The nominal single-antenna conducted output Average power specified:

802.11a: 13 dBm (Tolerance: +/-1.5dB)

802.11n(HT20): 14 dBm (Tolerance: +/-1.5dB)

802.11n(HT40): 15 dBm (Tolerance: +/-1.5dB)

So, the nominal STBC mode(2Tx) conducted output Average power specified:

802.11a: 16 dBm (Tolerance: +/-1.5dB)

802.11n(HT20): 17 dBm (Tolerance: +/-1.5dB)

802.11n(HT40): 18 dBm (Tolerance: +/-1.5dB)

d) ERP/EIRP

The maximum EIRP= Nominal conducted output Average power + Tolerance + Antenna Gain

=18 + 1.5+ (3.04) =22.54 dBm=179.4734mW

2.2.3 EIRP for operational 5.8GHz Band

For WiFi function, operating at 5745-5825MHz for 802.11a /n(HT20), 5 channels with 20MHz channel spacing and 5755-5795MHz for 802.11n(HT40), 2 channels with 40MHz channel spacing.

a) Modulation Type:

BPSK, QPSK, 16QAM, 64QAM for OFDM. CCK, DQPSK.

b) Antenna

Type: Chain 0: PIFA antenna;

Chain 1: PCB antenna.

Gain: Chain 0: 1.5 dBi gain (5725 ~ 5850 MHz)

Chain 1: 1.1 dBi gain (5725 ~ 5850 MHz)

For STBC modes (2Tx), there are two transmission antennas. Both Chain 0 and Chain 1 used at the same time and antenna ports have uniform output powers. The Chain 0 and Chain 1 antenna ports cannot be used alone. In addition the Tx chains are correlated and the antenna gain is unequal among the chains.

The directional gain = $10 \log[(10^{G1/20} + 10^{G2/20} + \ldots + 10^{GN/20})^2 / N_{ANT}]$ dBi

$= 10 \log[(10^{1.5/20} + 10^{1.1/20})^2 / 2]$

=4.31dBi

c) Maximum Conducted Average Power

Maximum Conducted Average Power(dBm)							
Mode	Channel/ Frequency (MHz)	Data Rate (Mbps)	Measured Power		Power with Duty Factor		
			Chain 0	Chain 1	Chain 0	Chain 1	Total (Chain 0+1)
802.11a	149 (5745)	6	14.27	12.73	14.27	12.73	16.58
	157 (5785)		12.82	12.41	12.82	12.41	15.63
	165 (5825)		12.36	13.15	12.36	13.15	15.78
802.11n (HT20)	149 (5745)	MCS3	15.33	13.71	15.65	14.03	17.93
	157 (5785)		13.93	14.58	14.25	14.90	17.60
	165 (5825)		13.04	13.05	13.36	13.37	16.38
802.11n (HT40)	151 (5755)	MCS0	15.41	15.17	15.57	15.33	**18.46**
	159 (5795)		14.91	15.17	15.07	15.33	18.21
The Maximum conducted average power data refer to the report 1609060316RFC-2.							

So, the maximum conducted output Average power for the EUT is 18.46 dBm in the frequency 5.755GHz 802.11n(HT40) mode which is within the production variation.

The nominal single-antenna conducted output Average power specified:

802.11a: 13 dBm (Tolerance: +/-1.5dB)

802.11n(HT20): 14 dBm (Tolerance: +/-1.5dB)

802.11n(HT40): 15 dBm (Tolerance: +/-1.5dB)

So, the nominal STBC mode(2Tx) conducted output Average power specified:

802.11a: 16 dBm (Tolerance: +/-1.5dB)

802.11n(HT20): 17 dBm (Tolerance: +/-1.5dB)

802.11n(HT40): 18 dBm (Tolerance: +/-1.5dB)

d) ERP/EIRP

The maximum EIRP = Nominal conducted output Average power + Tolerance + Antenna Gain

=18 + 1.5+ (4.31) =23.81 dBm=240.4363mW

2.3 MPE Evaluation

2.3.1 MPE Calculation Method

S = PG/4πR^2= EIRP/4πR^2
S = power density (in appropriate units, e.g., mw/cm2)
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, the power gain factor is normally numeric gain.
R = distance to the center of radiation of the antenna (in appropriate units, e.g., cm)

2.3.2 MPE Calculation Result

a) Result for operational 2.4GHz Band

The worst case is power density at prediction frequency at 20cm: **0.0504 (mw/cm^2)**

MPE limit for general population exposure at prediction frequency: 1 (mw/cm^2)

0.0504 (mw/cm^2) < 1 (mw/cm^2)

Result: Pass

b) Result for operational 5.2GHz Band

The worst case is power density at prediction frequency at 20cm: **0.0357 (mw/cm^2)**

MPE limit for general population exposure at prediction frequency: 1 (mw/cm^2)

0.0357 (mw/cm^2) < 1 (mw/cm^2)

Result: Pass

c) Result for operational 5.8GHz Band

The worst case is power density at prediction frequency at 20cm: **0.0478 (mw/cm^2)**

MPE limit for general population exposure at prediction frequency: 1 (mw/cm^2)

0.0478 (mw/cm^2) < 1 (mw/cm^2)

Result: Pass

*** End of Report ***

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