

TEST REPORT

FCC ID: 2AEXY501ARX

Product: HUBSAN X4 CAM BRUSHLESS WITH APP

Model No.: H501A

Additional Model: N/A

Trade Mark: Hubsan

Report No.: TCT160620E029

Issued Date: July 18, 2016

Issued for:

SHENZHEN HUBSAN INTELLIGENT COMPANY LIMITED
13th Floor, Bldg 1C, Shenzhen Software Industry Base, Xuefu Road,
Nanshan District, Shenzhen, China

Issued By:

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Appendix A: Photographs of Test Setup

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1. Test Certification

Product:	HUBSAN X4 CAM BRUSHLESS WITH APP
Model No.:	H501A
Additional Model No.:	N/A
Applicant:	SHENZHEN HUBSAN INTELLIGENT COMPANY LIMITED
Address:	13th Floor, Bldg 1C, Shenzhen Software Industry Base, Xuefu Road, Nanshan District, Shenzhen, China
Manufacturer:	DONGGUAN TENGSHENG INDUSTRIAL CO., LTD
Address:	A22# Luyi Street, Tianxin Village, Tangxia Town, Dongguan, China.
Date of Test:	Jun. 20 – July 15, 2016
Applicable Standards:	FCC CFR Title 47 Part 15 Subpart E Section 15.407:2014 789033 D02 General UNII Test Procedures New Rules v01r02

The above equipment has been tested by Shenzhen Tongce Testing Lab. and found compliance with the requirements set forth in the technical standards mentioned above. 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.

Tested By:



Garen

Date:

July 15, 2016

Reviewed By:



Joe Zhou

Date:

July 18, 2016

Approved By:



Tomsin

Date:

July 18, 2016

2. Test Result Summary

Requirement	CFR 47 Section	Result
Antenna requirement	§15.203	PASS
AC Power Line Conducted Emission	§15.207(a)	PASS
Maximum Conducted Output Power	§15.407(a)(3) §2.1046	PASS
6dB Emission Bandwidth	§15.407(a)(6) §2.1049	PASS
26dB Emission Bandwidth & 99% Occupied Bandwidth	§15.407(a)(5)	PASS
Power Spectral Density	§15.407(a)(3)	PASS
Band edge	§15.407(b)(4) §2.1051, §2.1057	PASS
Radiated Emission & Unwanted Emission Measurement	§15.205, §15.209 §2.1053, §2.1057	PASS

Note:

1. PASS: Test item meets the requirement.
2. Fail: Test item does not meet the requirement.
3. N/A: Test case does not apply to the test object.
4. The test result judgment is decided by the limit of test standard.

3. EUT Description

Product Name:	HUBSAN X4 CAM BRUSHLESS WITH APP
Model :	H501A
Additional Model:	N/A
Trade Mark:	Hubsan
Operation Frequency:	5730MHz~5845MHz
Number of Channel:	24
Modulation Type	GFSK
Antenna Type:	Internal antenna
Antenna Gain:	2dBi
Power Supply:	Rechargeable Li-ion Battery DC7.4V

Operation Frequency each of channel

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	5730MHz	7	5760MHz	13	5790MHz	19	5820MHz
2	5735MHz	8	5765MHz	14	5795MHz	20	5825MHz
3	5740MHz	9	5770MHz	15	5800MHz	21	5830MHz
4	5745MHz	10	5775MHz	16	5805MHz	22	5835MHz
5	5750MHz	11	5780MHz	17	5810MHz	23	5840MHz
6	5755MHz	12	5785MHz	18	5815MHz	24	5845MHz

Remark: Channel 0(Lowest), 14(Middle) & (Highest) have been tested.

4. Genera Information

4.1. Test environment and mode

Operating Environment:

Temperature:	25.0 °C
Humidity:	56 % RH
Atmospheric Pressure:	1010 mbar

Test Mode:

Engineering mode:	Keep the EUT in continuous transmitting by select channel and modulations(The value of duty cycle is 100%)
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The sample was placed (0.8m below 1GHz, 1.5m above 1GHz) above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.

Final Test Mode:

Operation mode:	Keep the EUT in continuous transmitting with modulation
-----------------	---

4.2. Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Equipment	Model No.	Serial No.	FCC ID	Trade Name
Notebook	G485	/	/	Lenovo

Note:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.
3. The router is provided by Testing Lab.
4. For conducted measurements (Output Power, 6dB Emission Bandwidth, Power Spectral Density, Spurious Emissions), the antenna of EUT is connected to the test equipment via temporary antenna connector, the antenna connector is soldered on the antenna port of EUT, and the temporary antenna connector is listed in the Test Instruments.

5. Facilities and Accreditations

5.1. Facilities

The test facility is recognized, certified, or accredited by the following organizations:

- FCC - Registration No.: 572331

Shenzhen Tongce Testing Lab

The 3m Semi-anechoic chamber has been registered and fully described in a report with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

- IC - Registration No.: 10668A-1

The 3m Semi-anechoic chamber of Shenzhen TCT Testing Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing

- CNAS - Registration No.: CNAS L6165

Shenzhen TCT Testing Technology Co., Ltd. is accredited to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration laboratories for the competence of testing. The Registration No. is CNAS L6165.

5.2. Location

Shenzhen Tongce Testing Lab

Address: 1F, Leinuo Watch Building, Fuyong Town, Baoan Dist, Shenzhen, China

Tel: 86-755-36638142

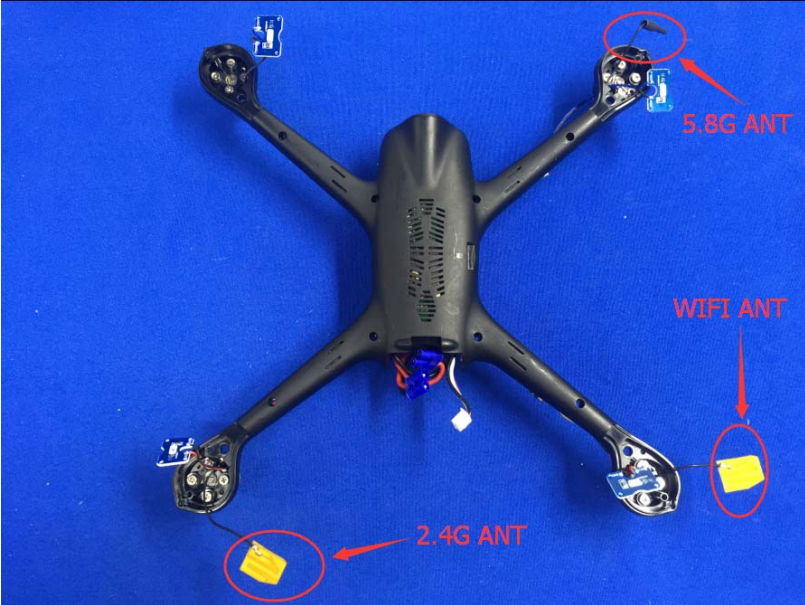
5.3. Measurement Uncertainty

The reported uncertainty of measurement $y \pm U$, where expanded uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95 %.

No.	Item	MU
1	Conducted Emission	$\pm 2.56\text{dB}$
2	RF power, conducted	$\pm 0.12\text{dB}$
3	Spurious emissions, conducted	$\pm 0.11\text{dB}$
4	All emissions, radiated(<1G)	$\pm 3.92\text{dB}$
5	All emissions, radiated(>1G)	$\pm 4.28\text{dB}$
6	Temperature	$\pm 0.1^{\circ}\text{C}$
7	Humidity	$\pm 1.0\%$

6. Test Results and Measurement Data

6.1. Antenna requirement

Standard requirement:	FCC Part15 C Section 15.203
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.	
E.U.T Antenna:	
The Integrated antenna is an internal antenna which permanently attached, and the best case gain of the antenna is 2dBi.	
	

6.2. Conducted Emission

6.2.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.207(a)														
Test Method:	ANSI C63.10:2013														
Frequency Range:	150 kHz to 30 MHz														
Receiver setup:	RBW=9 kHz, VBW=30 kHz, Sweep time=auto														
Limits:	<table><tr><th rowspan="2">Frequency range (MHz)</th><th colspan="2">Limit (dBuV)</th></tr><tr><th>Quasi-peak</th><th>Average</th></tr><tr><td>0.15-0.5</td><td>66 to 56*</td><td>56 to 46*</td></tr><tr><td>0.5-5</td><td>56</td><td>46</td></tr><tr><td>5-30</td><td>60</td><td>50</td></tr></table>	Frequency range (MHz)	Limit (dBuV)		Quasi-peak	Average	0.15-0.5	66 to 56*	56 to 46*	0.5-5	56	46	5-30	60	50
Frequency range (MHz)	Limit (dBuV)														
	Quasi-peak	Average													
0.15-0.5	66 to 56*	56 to 46*													
0.5-5	56	46													
5-30	60	50													
Test Setup:	Reference Plane 40cm 80cm E.U.T AC power LISN Filter AC power EMI Receiver Test table/Insulation plane Remark E.U.T: Equipment Under Test LISN: Line Impedance Stabilization Network Test table height=0.8m														
Test Mode:	Charging + transmitting with modulation														
Test Procedure:	1. The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment. 2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs). 3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4: 2009 on conducted measurement.														
Test Result:	PASS														

6.2.2. Test Instruments

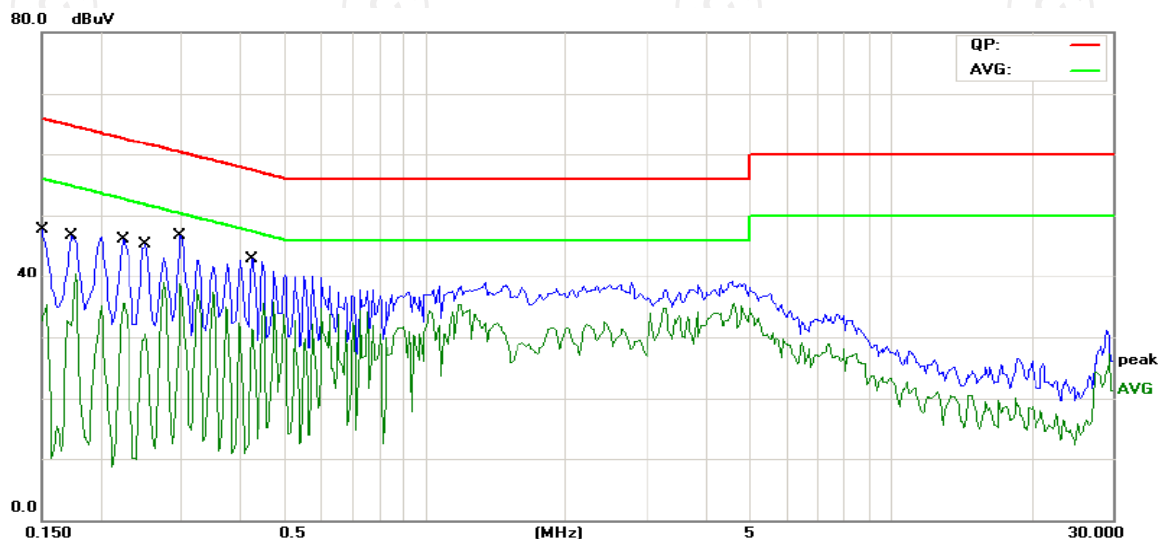
Conducted Emission Shielding Room Test Site (843)				
Equipment	Manufacturer	Model	Serial Number	Calibration Due
EMI Test Receiver	R&S	ESCS30	100139	Sep. 11, 2016
LISN	Schwarzbeck	NSLK 8126	8126453	Sep. 16, 2016
Coax cable	TCT	CE-05	N/A	Sep. 11, 2016
EMI Test Software	Shurple Technology	EZ-EMC	N/A	N/A

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

6.2.3. Test data

Please refer to following diagram for individual

Conducted Emission on Line Terminal of the power line (150 kHz to 30MHz)



Site Chamber #2

Phase: **L1**

Temperature: 25 (C)

Limit: FCC Part 15B Class B Conduction(QP)

Power: AC 120V/60Hz

Humidity: 54 %

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.1500	34.74	11.52	46.26	65.99	-19.73	QP	
2		0.1500	22.00	11.52	33.52	55.99	-22.47	AVG	
3		0.1734	33.21	11.50	44.71	64.79	-20.08	QP	
4		0.1734	23.17	11.50	34.67	54.79	-20.12	AVG	
5		0.2242	33.04	11.47	44.51	62.66	-18.15	QP	
6		0.2242	24.66	11.47	36.13	52.66	-16.53	AVG	
7		0.2516	32.83	11.45	44.28	61.70	-17.42	QP	
8		0.2516	22.44	11.45	33.89	51.70	-17.81	AVG	
9		0.2983	32.48	11.43	43.91	60.29	-16.38	QP	
10	*	0.2983	23.32	11.43	34.75	50.29	-15.54	AVG	
11		0.4234	28.19	11.35	39.54	57.38	-17.84	QP	
12		0.4234	17.26	11.35	28.61	47.38	-18.77	AVG	

Note:

Freq. = Emission frequency in MHz

Reading level (dBμV) = Receiver reading

Corr. Factor (dB) = Antenna factor + Cable loss

Measurement (dBμV) = Reading level (dBμV) + Corr. Factor (dB)

Limit (dBμV) = Limit stated in standard

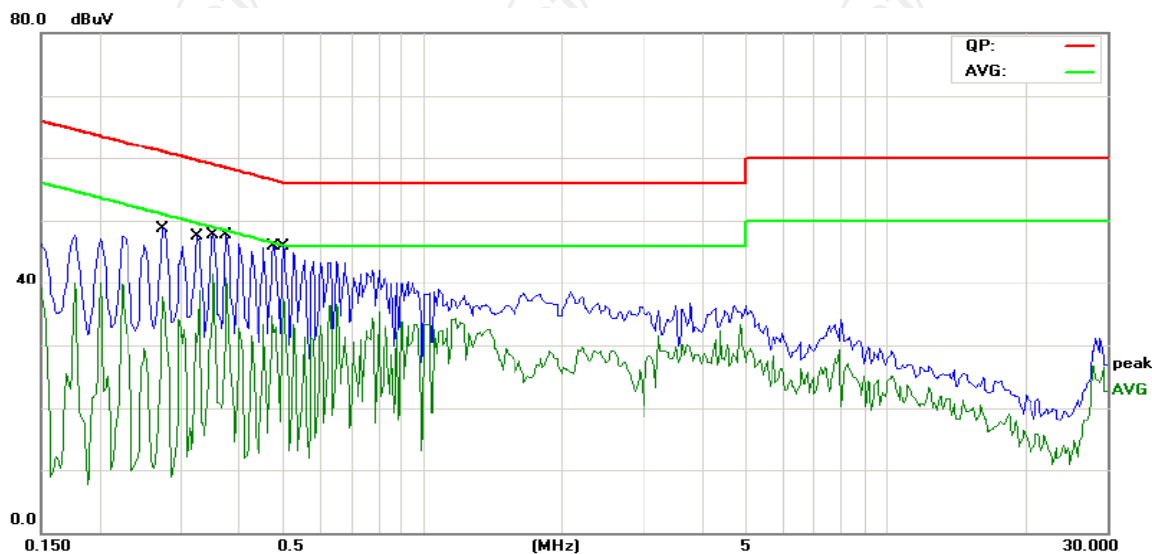
Margin (dB) = Measurement (dBμV) – Limits (dBμV)

Q.P. =Quasi-Peak

AVG =average

* is meaning the worst frequency has been tested in the frequency range 150 kHz to 30MHz

Conducted Emission on Neutral Terminal of the power line (150 kHz to 30MHz)



Site Chamber #2

Phase: **N**

Temperature: 25 (C)

Limit: FCC Part 15B Class B Conduction(QP)

Power: AC 120V/60Hz

Humidity: 54 %

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.2750	35.30	11.44	46.74	60.96	-14.22	QP	
2		0.2750	25.34	11.44	36.78	50.96	-14.18	AVG	
3		0.3258	33.98	11.42	45.40	59.56	-14.16	QP	
4		0.3258	22.58	11.42	34.00	49.56	-15.56	AVG	
5		0.3531	35.30	11.39	46.69	58.89	-12.20	QP	
6	*	0.3531	25.74	11.39	37.13	48.89	-11.76	AVG	
7		0.3766	34.20	11.37	45.57	58.35	-12.78	QP	
8		0.3766	22.95	11.37	34.32	48.35	-14.03	AVG	
9		0.4781	32.48	11.32	43.80	56.37	-12.57	QP	
10		0.4781	22.52	11.32	33.84	46.37	-12.53	AVG	
11		0.5016	30.51	11.31	41.82	56.00	-14.18	QP	
12		0.5016	18.78	11.31	30.09	46.00	-15.91	AVG	

Note1:

Freq. = Emission frequency in MHz

Reading level (dBμV) = Receiver reading

Corr. Factor (dB) = Antenna factor + Cable loss

Measurement (dBμV) = Reading level (dBμV) + Corr. Factor (dB)

Limit (dBμV) = Limit stated in standard

Margin (dB) = Measurement (dBμV) – Limits (dBμV)

Q.P. =Quasi-Peak AVG =average

* is meaning the worst frequency has been tested in the frequency range 150 kHz to 30MHz.

Note2:

Measurements were conducted in all three channels (high, middle, low) and three modulation (GFSK, Pi/4 DQPSK), and the worst case Mode (Highest channel and GFSK) was submitted only.

6.2.4. Maximum Conducted Output Power

6.2.5. Test Specification

Test Requirement:	FCC Part15 E Section 15.407(a)(3) §2.1053, §2.1057
Test Method:	KDB789033 D02 General UNII Test Procedures New Rules v01r02
Limit:	30dBm
Test Setup:	 Spectrum Analyzer EUT
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The testing follows the Measurement Procedure of KDB789033 D02 General UNII Test Procedures New Rules v01r02 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 3. Set to the maximum power setting and enable the EUT transmit continuously. 4. Set the spectrum analyzer: RBW = 1 MHz. VBW = 3 MHz. Sweep = auto; Detector Function = Average, Set the span to fully encompass the DTS bandwidth. 5. Measure the conducted output power and record the results in the test report.
Test Result:	PASS

6.2.6. Test Instruments

Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100060	Sep. 12, 2016
RF cable	TCT	RE-06	N/A	Sep. 12, 2016
Antenna Connector	TCT	RFC-01	N/A	Sep. 12, 2016

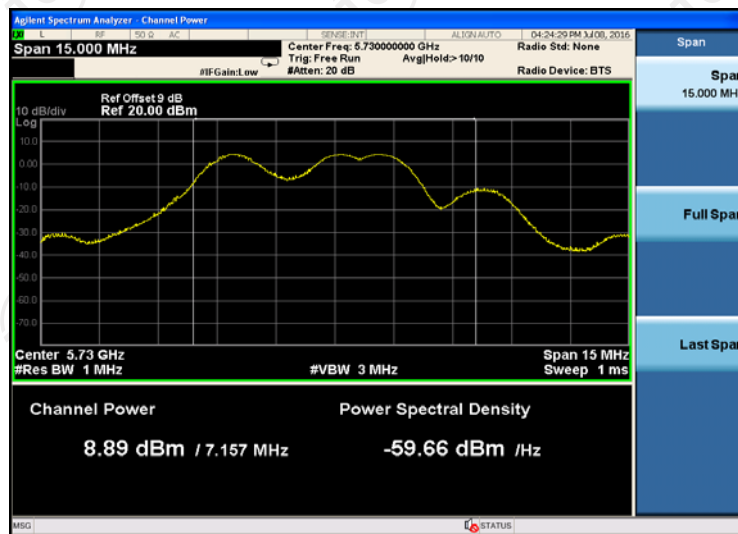
Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

6.2.7. Test Data

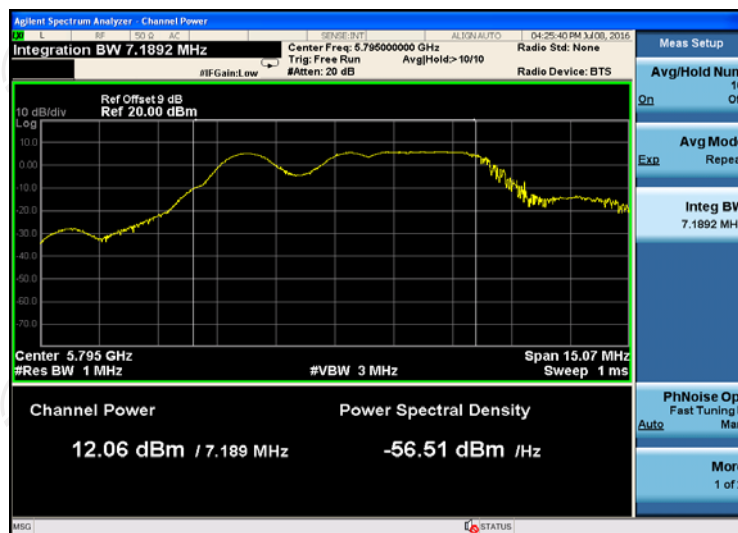
Test channel	Conducted Output Power (dBm)	Limit (dBm)	Result
5730MHZ	8.89	30.00	PASS
5795MHZ	12.06	30.00	PASS
5845MHZ	11.91	30.00	PASS

Test plots as follows:

Lowest channel



Middle channel



Highest channel



6.3. 6dB Emission Bandwidth

6.3.1. Test Specification

Test Requirement:	FCC CFR47 Part 15 Section 15.407(a)(6) §2.1053, §2.1057
Test Method:	KDB789033 D02 General UNII Test Procedures New Rules v01r02
Limit:	>500kHz
Test Setup:	 Spectrum Analyzer EUT
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. KDB789033 D02 General UNII Test Procedures New Rules v01r02 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6dB bandwidth must be greater than 500 kHz. 4. Measure and record the results in the test report.
Test Result:	PASS

6.3.2. Test Instruments

RF Test Room				
Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100060	Sep. 12, 2016
RF cable	TCT	RE-06	N/A	Sep. 12, 2016
Antenna Connector	TCT	RFC-01	N/A	Sep. 12, 2016

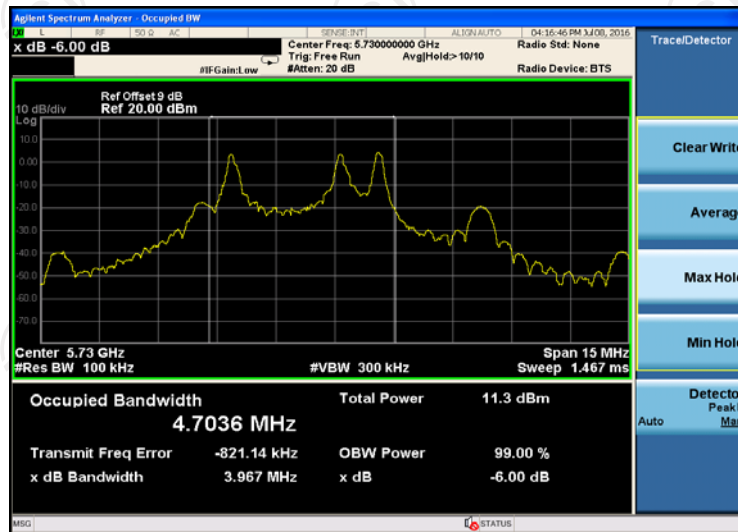
Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

6.3.3. Test data

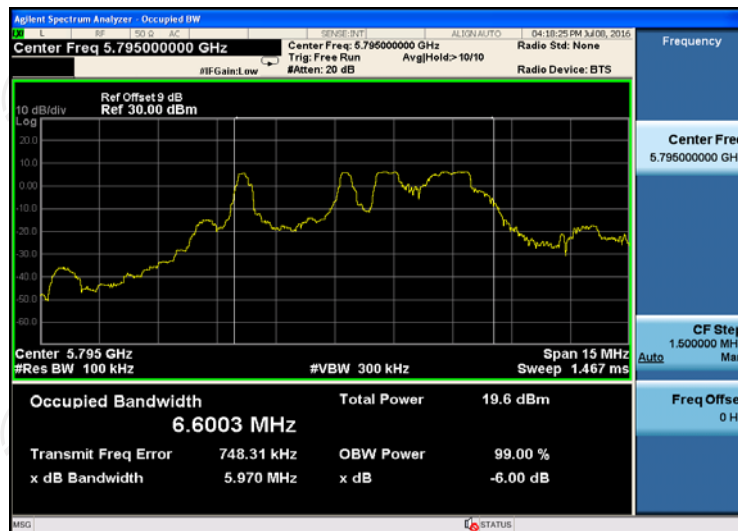
Test channel	6dB Emission Bandwidth (MHz)
Lowest	3.967
Middle	5.970
Highest	6.062
Limit:	>500k
Test Result:	PASS

Test plots as follows:

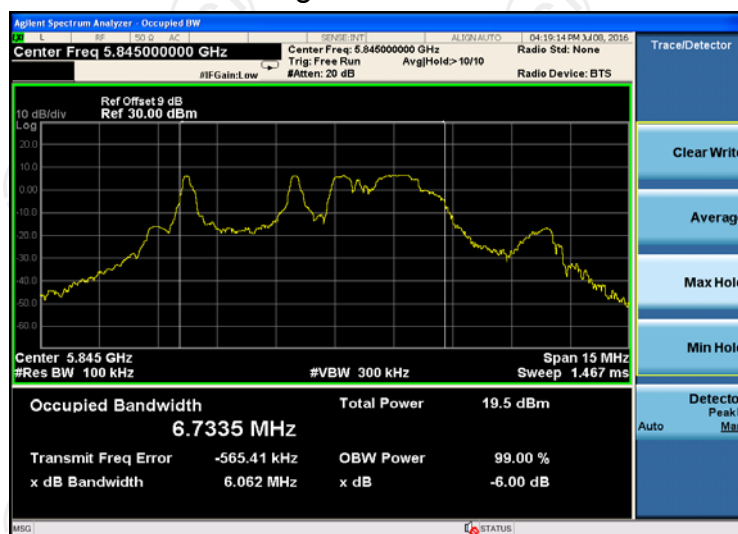
Lowest channel



Middle channel



Highest channel



6.4. 26dB Bandwidth and 99% Occupied Bandwidth

6.4.1. Test Specification

Test Requirement:	47 CFR Part 15C Section 15.407 (a)(3)
Test Method:	KDB789033 D02 General UNII Test Procedures New Rules v01r02
Limit:	No restriction limits
Test Setup:	 Spectrum Analyzer EUT
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. KDB789033 D02 General UNII Test Procedures New Rules v01r02 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. 4. Measure and record the results in the test report.
Test Result:	PASS

6.4.2. Test Instruments

RF Test Room				
Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100060	Sep. 12, 2016
RF cable	TCT	RE-06	N/A	Sep. 12, 2016
Antenna Connector	TCT	RFC-01	N/A	Sep. 12, 2016

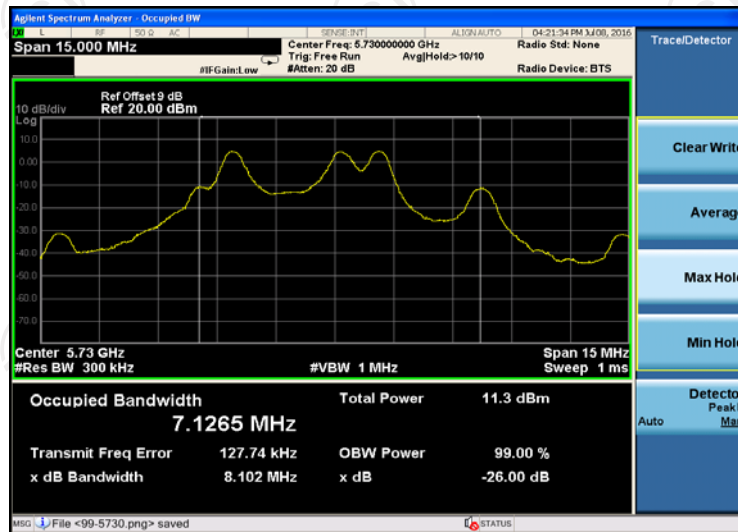
Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

6.4.3. Test data

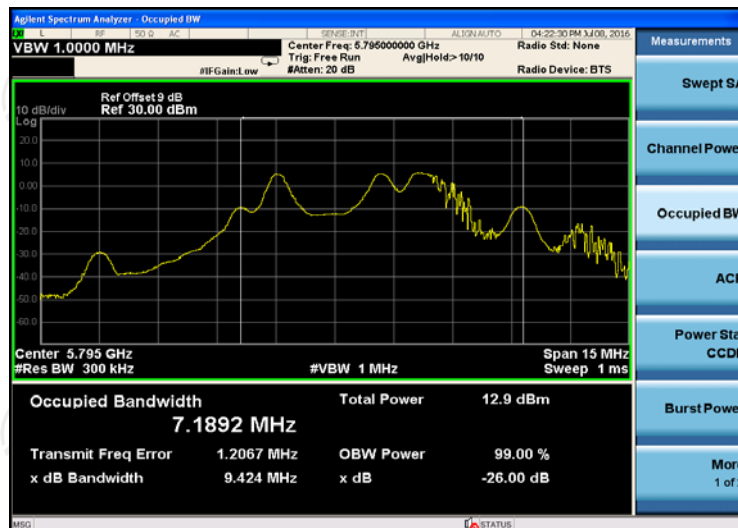
Test channel	26dB Emission Bandwidth (MHz)	99% Occupied Bandwidth(MHz)
Lowest	8.10	7.13
Middle	9.42	7.19
Highest	7.92	6.91

Test plots as follows:

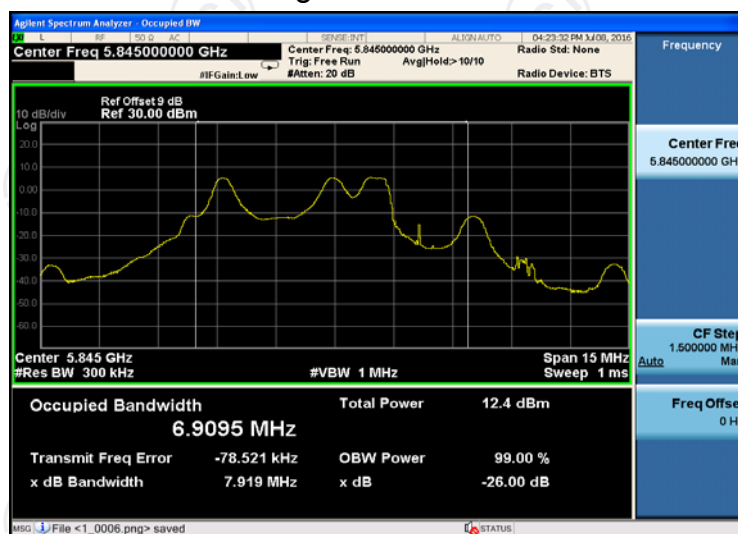
Lowest channel



Middle channel



Highest channel



6.5. Power Spectral Density

6.6. Test Specification

Test Requirement:	FCC Part15 E Section 15.407 (a)(3)
Test Method:	KDB789033 D02 General UNII Test Procedures New Rules v01r02
Limit:	$\leq 30.00\text{dBm}/500\text{KHz}$ for Operation in the band IV(5725MHz-5850MHz)of device
Test Setup:	 Spectrum Analyzer EUT
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The testing follows Measurement Procedure 10.3 KDB789033 D02 General UNII Test Procedures New Rules v01 r02 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 3. Set to the maximum power setting and enable the EUT transmit continuously. 4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW)=500k. Video bandwidth VBW = 3 RBW. Set the span encom PASS the entire emission bandwidth (EBW) of the signal. 5. Detector = Average, Sweep time = auto couple. 6. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. 7. Measure and record the results in the test report.
Test Result:	PASS

6.6.1. Test Instruments

RF Test Room				
Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100060	Sep. 12, 2016
RF cable	TCT	RE-06	N/A	Sep. 12, 2016
Antenna Connector	TCT	RFC-01	N/A	Sep. 12, 2016

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

6.6.2. Test data

Test channel	Meas.Level (dBm)	Factor 10log(1000kHz/500kHz)	Av.PSD [dBm] (30dBm/500KHz)	Test Result:
Lowest	5.994	3.01	2.984	PASS
Middle	5.548	3.01	2.538	PASS
Highest	5.237	3.01	2.227	PASS

Remark: Av.PSD [dBm] = Meas.Level [dBm]- Factor

Test plots as follows:

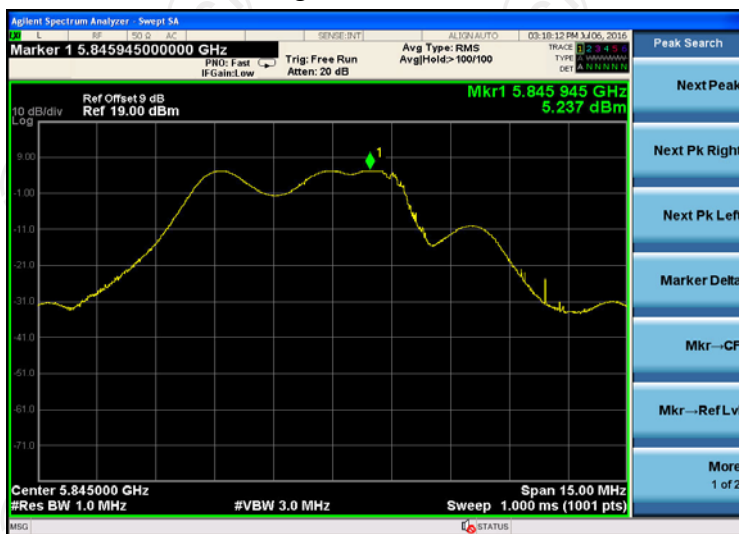
Lowest channel



Middle channel

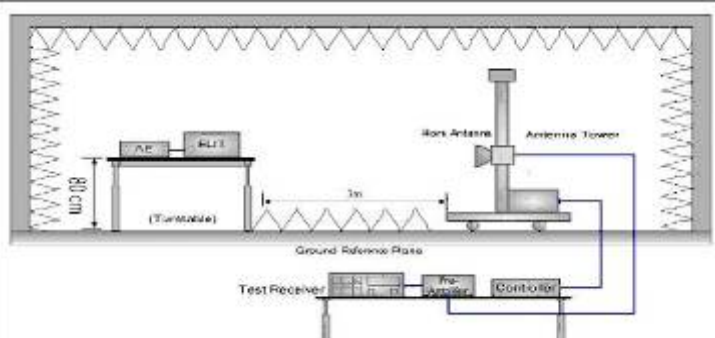


Highest channel



6.7. Band edge

6.7.1. Test Specification

Test Requirement:	FCC CFR47 Part 15E Section 15.407		
Test Method:	ANSI C63.10 2013		
Limit:	Bands	Limit (dBuV/m @3m)	Remark
	For band I&II&III	68.2	Peak Value
		54.0	Average Value
	For band IV	78.2	Peak Value
		54.0	Average Value
Remark: For band I&II&III, $E[\text{dB}\mu\text{V}/\text{m}] = \text{EIRP}[\text{dBm}] + 95.2=68.2$ dB $\mu\text{V}/\text{m}$, for $\text{EIRP}(\text{dBm})= -27\text{dBm}$ For band IV, $E[\text{dB}\mu\text{V}/\text{m}] = \text{EIRP}[\text{dBm}] + 95.2=78.2$ dB $\mu\text{V}/\text{m}$, for $\text{EIRP}(\text{dBm})= -17\text{dBm}$			
Test Setup:			
Test Mode:	Transmitting mode with modulation		
Test Procedure:	1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation. 2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. 3. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. 4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading. 5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.		

	6. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasipeak or average method as specified and then reported in a data sheet.
Test Result:	PASS

6.7.2. Test Instruments

Radiated Emission Test Site (966)				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
ESPI Test Receiver	ROHDE&SCHW ARZ	ESVD	100008	Sep. 11, 2016
Spectrum Analyzer	ROHDE&SCHW ARZ	FSEM	848597/001	Sep. 11, 2016
Spectrum Analyzer	ROHDE&SCHW ARZ	FSP40	100056	Sep. 11, 2016
Spectrum Analyzer	Agilent	N9020A	MY49100060	Sep. 12, 2016
Pre-amplifier	EM Electronics Corporation CO.,LTD	EM30265	07032613	Sep. 11, 2016
Pre-amplifier	HP	8447D	2727A05017	Sep. 11, 2016
Loop antenna	ZHINAN	ZN30900A	12024	Sep. 13, 2016
Broadband Antenna	Schwarzbeck	VULB9163	340	Sep. 13, 2016
Horn Antenna	Schwarzbeck	BBHA 9120D	631	Sep. 13, 2016
Horn Antenna	Schwarzbeck	BBHA 9170	373	Sep. 13, 2016
Coax cable	TCT	RE-low-01	N/A	Sep. 11, 2016
Coax cable	TCT	RE-high-02	N/A	Sep. 11, 2016
Coax cable	TCT	RE-low-03	N/A	Sep. 11, 2016
Coax cable	TCT	RE-High-04	N/A	Sep. 11, 2016
Antenna Mast	CCS	CC-A-4M	N/A	Sep. 12, 2016
EMI Test Software	Shurple Technology	EZ-EMC	N/A	N/A

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

6.7.3 Test Data

CH	Freq. (MHz)	Read_level (dBuV/m)	Factor (dB)	Peak (dBuV/m)	Limit (dBuV/m) (Peak)	Limit (dBuV/m)t (Avg)	Over	Ant. Pol. H/V
Lowest	5725	41.02	8.21	49.23	78.2	54	-4.77	H
	5725	40.57	8.21	48.78	78.2	54	-5.22	V
Highest	5850	40.36	8.87	49.23	78.2	54	-4.77	H
	5850	40.58	8.87	49.45	78.2	54	-4.55	V
Remark: Factor (dB)=Ant. Factor + Cable Loss-Amp. Factor								

6.8. Radiated Emission & Unwanted Emission Measurement

6.8.1. Test Specification

Test Requirement:	FCC CFR47 Part 15 Section 15.205 & 15.209 §2.1053, §2.1057				
Test Method:	KDB 789033 D02 v01r02				
Frequency Range:	9 kHz to 25 GHz				
Measurement Distance:	3 m				
Antenna Polarization:	Horizontal & Vertical				
Operation mode:	Transmitting mode with modulation				
Receiver Setup:	Frequency	Detector	RBW	VBW	Remark
	9kHz- 150kHz	Quasi-peak	200Hz	1kHz	Quasi-peak Value
	150kHz- 30MHz	Quasi-peak	9kHz	30kHz	Quasi-peak Value
	30MHz-1GHz	Quasi-peak	100KHz	300KHz	Quasi-peak Value
	Above 1GHz	Peak	1MHz	3MHz	Peak Value
		Peak	1MHz	10Hz	Average Value
Limit:	(1) For transmitters operating in the 5725-5850 MHz band: all emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an EIRP of -17dBm/MHz (78.3dBuV/m); for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an EIRP of -27 dBm/MHz (68.3dBuV/m).				
	(2) Unwanted spurious emissions fallen in restricted bands per FCC Part15.205 shall comply with the general field strength limits set forth in § 15.209 as below table,				
	Frequency	Field Strength (microvolts/meter)	Measurement Distance (meters)		
	0.009-0.490	2400/F(KHz)	300		
	0.490-1.705	24000/F(KHz)	30		
	1.705-30	30	30		
	30-88	100	3		
	88-216	150	3		
	216-960	200	3		
	Above 960	500	3		

Note: The following formula is used to convert the EIRP to field strength.

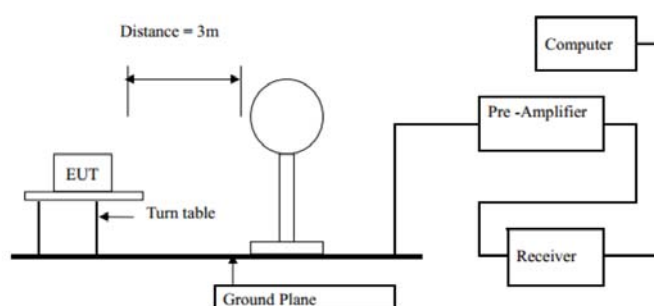
$$E = \frac{1000000\sqrt{30P}}{3} \quad \mu\text{V/m, where P is the eirp (Watts)}$$

EIRP(dBm)	Field Strength at 3m (dBuV/m)
-17	78.3
-27	68.3

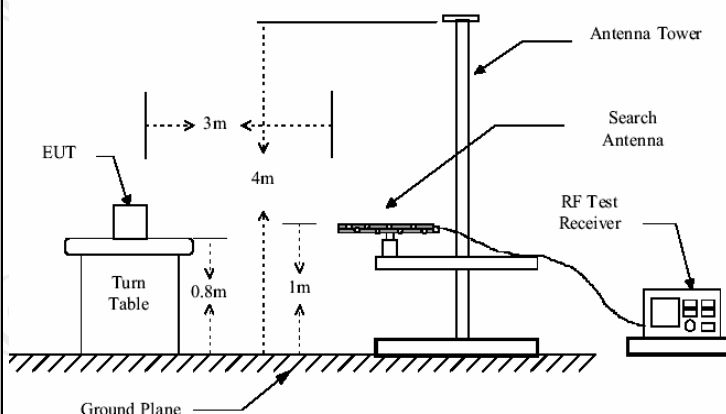
§ 15.407(b)(1)-(3) specifies that emissions outside of the respective U-NII bands are subject to a maximum emission limit of -27 dBm/MHz. § 15.407(b)(4) provides two requirement options for devices that operate in the 5.725 – 5.85 GHz band. If the option specified in § 15.407(b)(4)(ii) is exercised, then the procedures specified in Clause 11.11 of ANSI C63.10-2013 and/or in Section 11.0 of KDB Publication 558074 shall be utilized. In general, an out-of-band emission that complies with both the peak and average power limits of § 15.209 is not required to also satisfy the -27 dBm/MHz or -17 dBm/MHz maximum emission limit.

Test setup:

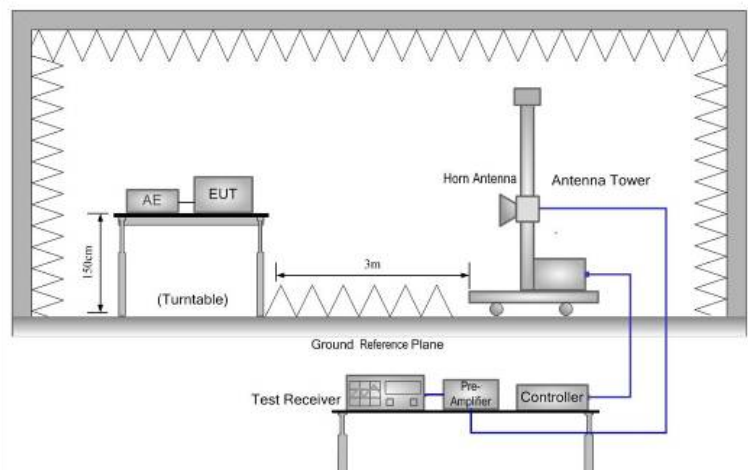
For radiated emissions below 30MHz



30MHz to 1GHz



Above 1GHz



Test Procedure:

1. The testing follows FCC KDB Publication No. 789033 D02 General UNII Test Procedures New Rules v01r02. Section G) Unwanted emissions measurement.
2. For the radiated emission test below 1GHz:
The EUT was placed on a turntable with 0.8 meter above ground. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high PASS filter are used for the test in order to get better signal level.
For the radiated emission test above 1GHz:
Place the measurement antenna on a turntable with 1.5 meter above ground, which is away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
3. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
4. For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB

	lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported. 5. Use the following spectrum analyzer settings: (1) Span shall wide enough to fully capture the emission being measured; (2) Set RBW=100 kHz for $f < 1$ GHz; $VBW \geq RBW$; Sweep = auto; Detector function = peak; Trace = max hold; (3) Set RBW = 1 MHz, VBW= 3MHz for $f > 1$ GHz for peak measurement. For average measurement: VBW = 10 Hz, when duty cycle is no less than 98 percent. $VBW \geq 1/T$, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. (4) A 5.8GHz high -PASS filter is used during radiated emissions above 1GHz measurement.
Test results:	PASS

6.8.2. Test Instruments

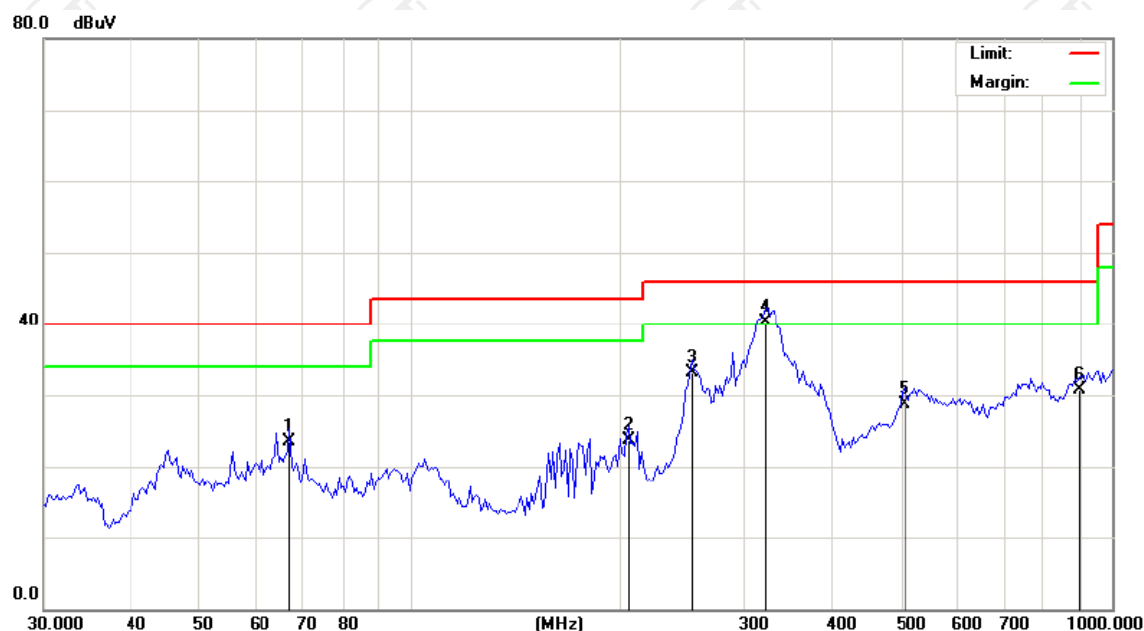
Radiated Emission Test Site (966)				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
ESPI Test Receiver	ROHDE&SCHW ARZ	ESVD	100008	Sep. 11, 2016
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Pre-amplifier	HP	8447D	2727A05017	Sep. 11, 2016
Loop antenna	ZHINAN	ZN30900A	12024	Sep. 13, 2016
Broadband Antenna	Schwarzbeck	VULB9163	340	Sep. 13, 2016
Horn Antenna	Schwarzbeck	BBHA 9120D	631	Sep. 13, 2016
Horn Antenna	Schwarzbeck	BBHA 9170	373	Sep. 13, 2016
Coax cable	TCT	RE-low-01	N/A	Sep. 11, 2016
Coax cable	TCT	RE-high-02	N/A	Sep. 11, 2016
Coax cable	TCT	RE-low-03	N/A	Sep. 11, 2016
Coax cable	TCT	RE-High-04	N/A	Sep. 11, 2016
Antenna Mast	CCS	CC-A-4M	N/A	Sep. 12, 2016
EMI Test Software	Shurple Technology	EZ-EMC	N/A	N/A

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

6.8.3. Test Data

Please refer to following diagram for individual
Below 1GHz

Horizontal:



Site: Polarization: **Horizontal** Temperature: 25
Limit: FCC Part 15B Class B RE_3 m Power: AC 120V/60Hz Humidity: 54 %

No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Antenna	Table	
		MHz	Level	Factor	ment			Height	Degree	
			dBuV	dB	dBuV	dBuV	dB	cm	degree	Comment
1		67.3110	37.47	-13.95	23.52	40.00	-16.48	QP	0	
2		204.3052	35.21	-11.58	23.63	43.50	-19.87	QP	0	
3		252.2521	43.16	-10.00	33.16	46.00	-12.84	QP	0	
4	*	320.3306	48.25	-7.86	40.39	46.00	-5.61	QP	0	
5		505.7891	31.48	-2.69	28.79	46.00	-17.21	QP	0	
6		899.9577	26.09	4.62	30.71	46.00	-15.29	QP	0	

Vertical:



Site: Polarization: **Vertical** Temperature: 25
 Limit: FCC Part 15B Class B RE_3 m Power: AC 120V/60Hz Humidity: 54 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	cm	degree
1	*	46.0557	41.21	-11.10	30.11	40.00	-9.89	QP		0
2		67.3110	35.07	-13.95	21.12	40.00	-18.88	QP		0
3		121.4621	44.69	-14.10	30.59	43.50	-12.91	QP		0
4		157.5290	36.48	-15.74	20.74	43.50	-22.76	QP		0
5		322.5896	36.51	-7.64	28.87	46.00	-17.13	QP		0
6		749.6761	25.43	4.78	30.21	46.00	-15.79	QP		0

Note: 1. The low frequency, which started from 9KHz~30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported

2. Measurements were conducted in all three channels (high, middle, low) , and the worst case Mode (Middle channel) was submitted only.

Low channel: 5730 MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBμV)	AV reading (dBμV)	Correction Factor (dB/m)	Emission Level		Peak limit (dBμV/m)	AV limit (dBμV/m)	Margin (dB)
					Peak (dBμV/m)	AV (dBμV/m)			
11460	H	49.14	---	1.18	50.32	---	74	54	-3.68
17190	H	40.82	---	10.07	50.89	---	74	54	-3.11
---	H	---	---	---	---	---	---	---	---
11460	V	49.99	---	1.18	51.17	---	74	54	-2.83
17190	V	40.39	---	10.07	50.46	---	74	54	-3.54
---	V	---	---	---	---	---	---	---	---

Middle channel: 5795MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBμV)	AV reading (dBμV)	Correction Factor (dB/m)	Emission Level		Peak limit (dBμV/m)	AV limit (dBμV/m)	Margin (dB)
					Peak (dBμV/m)	AV (dBμV/m)			
11590	H	51.38	---	0.75	52.13	---	74	54	-1.87
17385	H	42.15	---	9.87	52.02	---	74	54	-1.98
---	H	---	---	---	---	---	---	---	---
11590	V	49.77	---	0.75	50.52	---	74	54	-3.48
17385	V	41.03	---	9.87	50.90	---	74	54	-3.10
---	V	---	---	---	---	---	---	---	---

High channel: 5845 MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBμV)	AV reading (dBμV)	Correction Factor (dB/m)	Emission Level		Peak limit (dBμV/m)	AV limit (dBμV/m)	Margin (dB)
					Peak (dBμV/m)	AV (dBμV/m)			
11690	H	50.47	---	0.97	51.44	---	74	54	-2.56
17535	H	41.58	---	9.83	51.41	---	74	54	-2.59
---	H	---	---	---	---	---	---	---	---
11690	V	49.39	---	0.97	50.36	---	74	54	-3.64
17535	V	40.67	---	9.83	50.50	---	74	54	-3.50
---	V	---	---	---	---	---	---	---	---

Note:

1. Emission Level=Peak Reading + Correction Factor; Correction Factor= Antenna Factor + Cable loss – Pre-amplifier
2. Margin (dB) = Emission Level (Peak) (dBμV/m)-Average limit (dBμV/m)
3. The emission levels of other frequencies are very lower than the limit and not show in test report.
4. Measurements were conducted from 1 GHz to the 10th harmonic of highest fundamental frequency. The highest test frequency is 40GHz.
5. Data of measurement shown "---" in the above table mean that the reading of emissions is attenuated more than 20 dB below the limits or the field strength is too small to be measured.

*******END OF REPORT*******

Appendix A: Photographs of Test Setup

Refer to test report TCT160620E010

Appendix B: Photographs of EUT

Refer to test report TCT160620E010