REPORT No.: SZ19110060W01

TEST REPORT

APPLICANT	:	Guilin Zhishen Information Technology Co.,Ltd.
PRODUCT NAME	:	TransMount Image Transmission Receiver
MODEL NAME	:	COV-02
BRAND NAME	:	ZHIYUN
FCC ID	:	2AIHFZYCOV02
STANDARD(S)	:	47 CFR Part 15 Subpart E
RECEIPT DATE	:	2019-10-09
TEST DATE	:	2019-10-16 to 2019-12-27
ISSUE DATE	:	2019-12-29

Edited by: Peng Mi (Rapporteur)

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DIRECTORY

Change History		
Version	**Date**	**Reason for change**
1.0	2019-12-29	First edition

1. Technical Information

Note: Provide by applicant.

1.1. Applicant and Manufacturer Information

Applicant:	Guilin Zhishen Information Technology Co.,Ltd.
Applicant Address:	Creative Industrial Park, Guimo Road, Qixing District, Guilin 541004, Guangxi, China
Manufacturer:	Guilin Zhishen Information Technology Co.,Ltd.
Manufacturer Address:	Creative Industrial Park, Guimo Road, Qixing District, Guilin 541004, Guangxi, China

1.2. Equipment Under Test (EUT) Description

Product Name:	TransMount Image Transmission Receiver	
Serial No:	(N/A, marked #1 by test site)	
Hardware Version:	2.0	
Software Version:	1.02	
Modulation Type:	OFDM	
Modulation Mode:	802.11n(HT20)	
Operating Frequency Range:	5.180 GHz- 5.240 GHz; 5.745GHz- 5.825GHz	
Channel Number:	Refer to 1.3	
Antenna Type:	External Antenna	
Antenna Gain:	ANT A: 2.15dBi; ANTB: 2.20dBi	
Directional Gain:	5.21dBi Note 3	
Accessory Information:	Battery	
	Brand Name:	N/A
	Model No.:	603650-1400mAh
	Serial No.:	(N/A, marked #1 by test site)
	Capacity:	1400mAh
	Rated Voltage:	3.80V
	Charge Limit:	4.35V

Note 1: This test report is updated from report (Report No.: SZ19100005W01, FCC ID: 2AIHFZYCOV01), based on the similarity between before, only change the product name, the model name, the software version, hardware version and some components. The difference detail as below: COV-02 cancel the camera control interface and reduces components on the corresponding PCB.

HDMI interface is different: COV-01's HDMI interface is input; COV-02's HDMI interface is output; COV-02 has reduced one HDMI receiving chip. The changes affect the test results of Conducted Emission, Restricted Frequency Bands and Radiated Emission.

Note 2: The EUT has two antennas and supports a MIMO function. Physically, the EUT provides two completed transmitters and two receivers for 802.11n modulation mode.

Modulation Mode:	**TX Function**
802.11n	2TX

Note 3: According to KDB 662911 D01, the directional gain = G_{ANT} + 10log(N_{ANT}) dBi, where G_{ANT} is the maximum antenna gain in dBi, N_{ANT} is the number of outputs.

Note 4: For conducted test item Maximum conducted output power and Peak Power spectral density of each modulation mode, we recorded the test result of two antennas separately, for other conducted test items both of the two antennas were tested separately, we only recorded the worst test result(ANT B) in this report.

Note 5: All radiation test items for 802.11n modulation mode operate at MIMO mode during the test.

Note 6: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

1.3. Modulation Type and Data Rate of EUT

Modulation technology	Modulation Type	Data Rate (Mbps) Note1
OFDM (802.11n)	BPSK	**6.5**
	QPSK	13/19.5
	16QAM	26/39
	64QAM	52/58.5/65

Note1: The worst-case mode (black bold) in all data rates has been determined during the pre-scan, only the test data of the worst-case were recorded in this report.

1.4. The Channel Number and Frequency of EUT

Frequency Range: 5180MHz-5240MHz				
Bandwidth	Channel	Frequency (MHz)	Channel	Frequency (MHz)
20MHz	**36**	**5180**	40	5200
	44	**5220**	**48**	**5240**
Frequency Range: 5745-5825MHz				
Bandwidth	Channel	Frequency (MHz)	Channel	Frequency (MHz)
20MHz	**149**	**5745**	153	5765
	157	**5785**	161	5805
	165	**5825**		

Note 1: The black bold channels were selected for test.

1.5. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart E (U-NII band) for the EUT FCC ID Certification:

No	Identity	Document Title
1	47 CFR Part 15 (5-1-14 Edition)	Radio Frequency Devices

Test detailed items/section required by FCC rules and results are as below:

No.	Section	Description	Test Date	Test Engineer	Result	Method determination /Remark
1	15.203	Antenna Requirement	N/A	N/A	$PASS_{Note1}$	N/A
2	ANSI C63.10	Duty Cycle of the test signal	Oct 16, 2019	Wang Meng	$PASS_{Note1}$	No deviation
3	15.407(a)	Maximum conducted output Power	Oct 16, 2019	Wang Meng	$PASS_{Note1}$	No deviation
4	15.407(a) (e)	Emission Bandwidth	Oct 16, 2019	Wang Meng	$PASS_{Note1}$	No deviation
5	15.407(a)	Peak Power spectral density	Oct 16, 2019	Wang Meng	$PASS_{Note1}$	No deviation
6	15.407(g)	Frequency Stability	Oct 16, 2019	Wang Meng	$PASS_{Note1}$	No deviation
7	15.207	Conducted Emission	Dec 24, 2019	Lin Jiayong	PASS	No deviation
8	15.407(b)	Restricted Frequency Bands	Dec 26, 2019	Yang Jie	PASS	No deviation
9	15.407(b)	Radiated Emission	Dec 27, 2019	Yang Jie	PASS	No deviation

Note 1: The test results of these test items in this report refer to the test report (Report No.: SZ19100005W01).

Note 2: The tests of Conducted Emission and Radiated Emission were performed according to the method of measurements prescribed in ANSI C63.10 2013.

Note 3: These RF tests were performed according to the method of measurements prescribed in KDB789033 D02 General UNII Test Procedures New Rules v02r01, KDB662911 D01 Multiple Transmitter Output v02r01.

Note 4: The path loss during the RF test is calibrated to correct the results by the offset setting in

the test equipments. The ref offset 13dB contains two parts that cable loss 3dB and Attenuator 10dB.

Note 5: Additions to, deviation, or exclusions from the method shall be judged in the "method determination" column of add, deviate or exclude from the specific method shall be explained in the "Remark" of the above table.

1.6. Environmental Conditions

During the measurement, the environmental conditions were within the listed ranges:

Temperature (°C):	15-35
Relative Humidity (%):	30-60
Atmospheric Pressure (kPa):	86-106

2. 47 CFR Part 15E Requirements

2.1. Antenna Requirement

2.1.1. Applicable Standard

According to FCC 15.203, 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 shall be considered sufficient to comply with the provisions of this section.

2.1.2. Result: Compliant

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

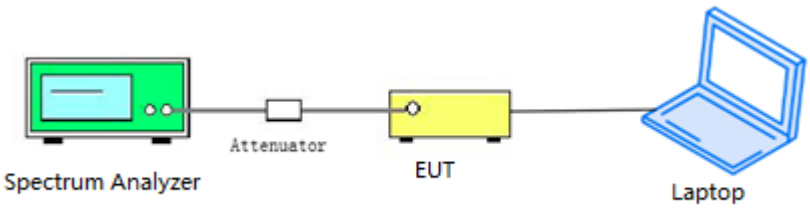
2.2. Duty Cycle of the Test Signal

2.2.1. Requirement

Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be used to ensure that measurements are made only during transmissions at the maximum power control level. Such sweep triggering/signal gating techniques will require knowledge of the minimum transmission duration (T) over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. Sweep triggering/signal gating techniques can then be used if the measurement/sweep time of the analyzer can be set such that it does not exceed T at any time that data are being acquired (i.e., no transmitter OFF-time is to be considered).
When continuous transmission cannot be achieved and sweep triggering/signal gating cannot be implemented, alternative procedures are provided that can be used to measure the average power; however, they will require an additional measurement of the transmitter duty cycle (D). Within this subclause, the duty cycle refers to the fraction of time over which the transmitter is ON and is transmitting at its maximum power control level. The duty cycle is considered to be constant if variations are less than ±2%; otherwise, the duty cycle is considered to be nonconstant.

2.2.2. Test Description

Test Setup:



The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

2.2.3. Test Procedure

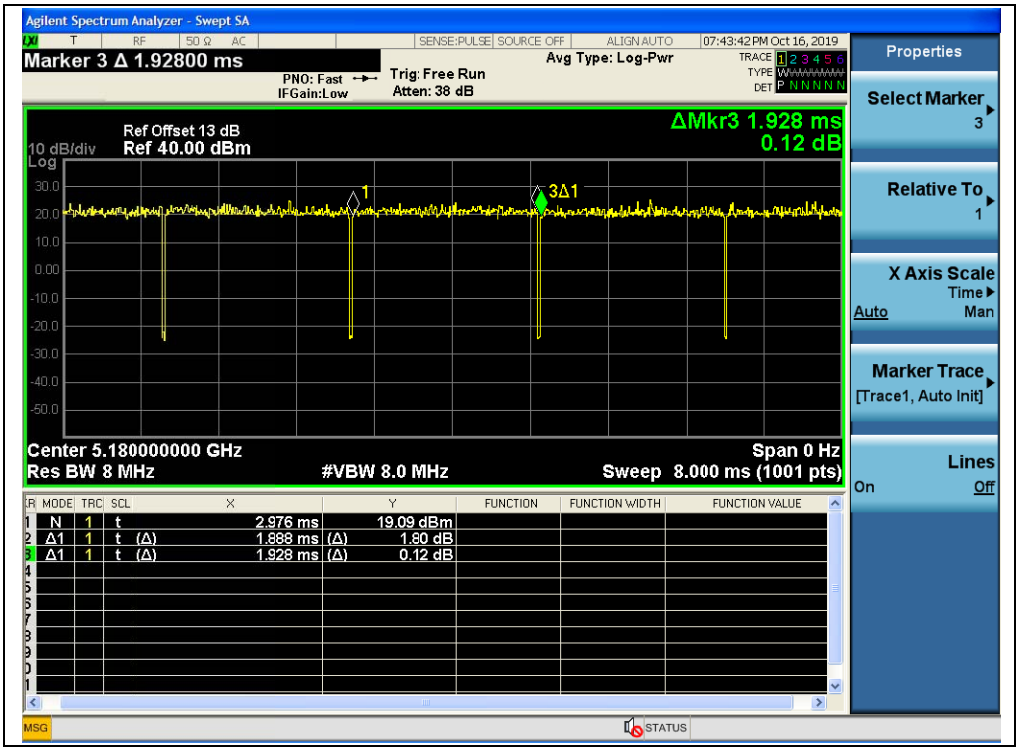
KDB 789033 Section B was used in order to prove compliance.

2.2.4. Test Result

A. Test Verdict:

Test Mode	Duty Cycle (%) (D)	Duty Factor (10*log[1/D])
802.11n(HT20)	97.93	0.09

B. Test Plot:



(CH36_5180MHz _802.11n(HT20))

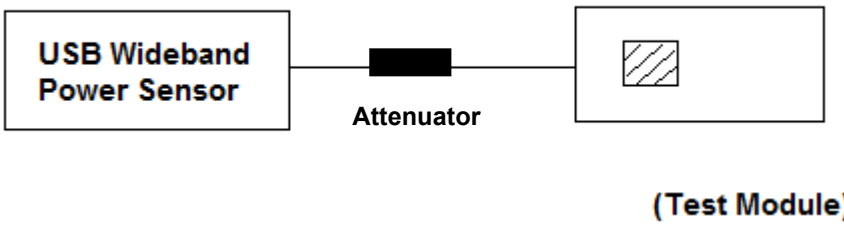
2.3. Maximum Conducted Output Power

2.3.1. Requirement

(1) For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi.
(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz.
(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.
If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
(4) According to KDB662911D01Measure-and-sum technique, the conducted emission level (e.g., transmit power or power in specified bandwidth) is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in units that are directly proportional to power.
(5) According to KDB 662911 D01, the directional gain = G_{ANT} +10log(N_{ANT}) dBi, where G_{ANT} is the antenna gain in dBi, N_{ANT} is the number of outputs.

2.3.2. Test Description

Section E) 3) of KDB 789033 defines a methodology using a USB Wideband Power Sensor.
Test Setup:



The EUT (Equipment under the test) which is coupled to the USB Wideband Power Sensor; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in USB Wideband Power Sensor.

2.3.3. Test Result

Maximum Average Conducted Output Power

802.11n (HT20) Test mode

Frequency (MHz)	Average Power					Limit		Verdict
	Measured		Duty Factor	Total Power with Duty Factor				
	ANT A	ANT B						
	dBm	dBm		W	dBm	dBm	W	
5180	16.27	17.21	0.09	0.097	19.87	24	0.25	PASS
5220	16.28	17.98		0.107	20.31			PASS
5240	16.18	17.95		0.106	20.26			PASS
5745	16.29	17.33		0.099	19.94	30	1	PASS
5785	17.20	16.54		0.100	19.98			PASS
5825	17.27	17.65		**0.114**	**20.57**			PASS
Note: Directional gain = 2.20dBi +10log(2) = 5.21dBi＜6dBi, so the power limit shall be 24dBm for 5.18-5.24 GHz band and 30dBm for 5.745-5.825 GHz band.								

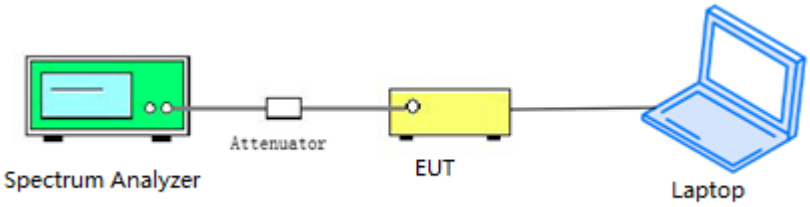
2.4. Emission Bandwidth

2.4.1. Requirement

For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement. Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

2.4.2. Test Description

Test Setup:



The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

2.4.3. Test Procedure

1. KDB 789033 Section C) 1) Emission Bandwidth was used in order to prove compliance
a) Set RBW = approximately 1% of the emission bandwidth.
b) Set the VBW > RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.
2. KDB 789033 Section C) 2) minimum emission bandwidth for the band 5.725-5.85GHz was used in order to prove compliance.
Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 KHz for the band 5.715-5.85 GHz. The following procedure shall be used for measuring this bandwidth:

a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 × RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

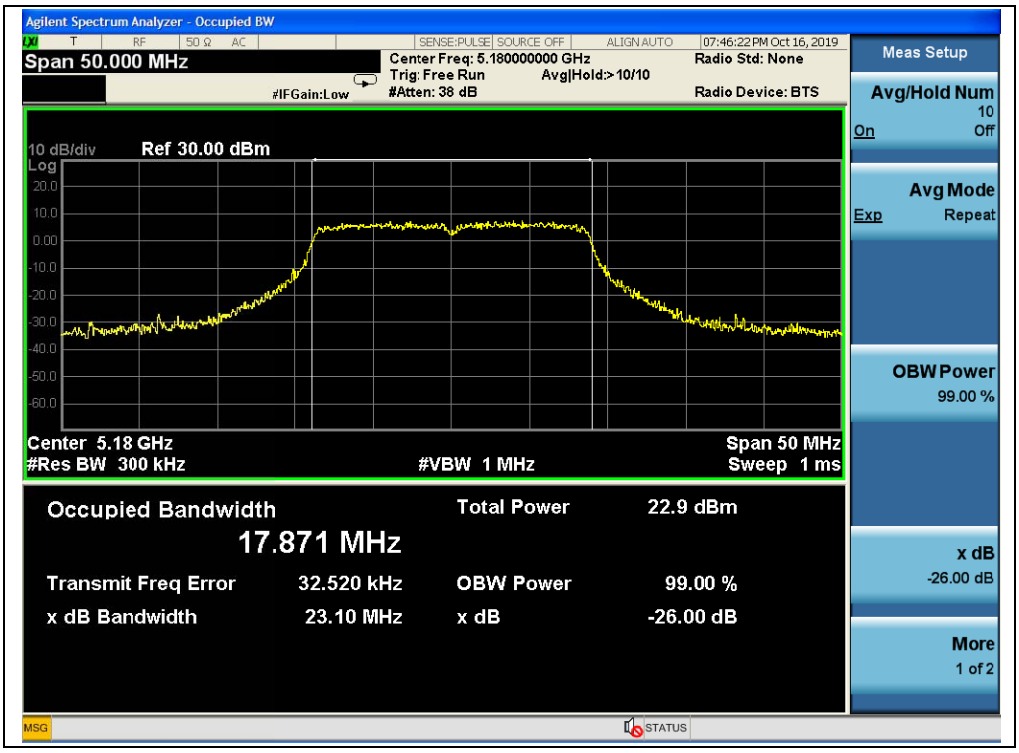
2.4.4. Test Result

802.11n (HT20) Test mode

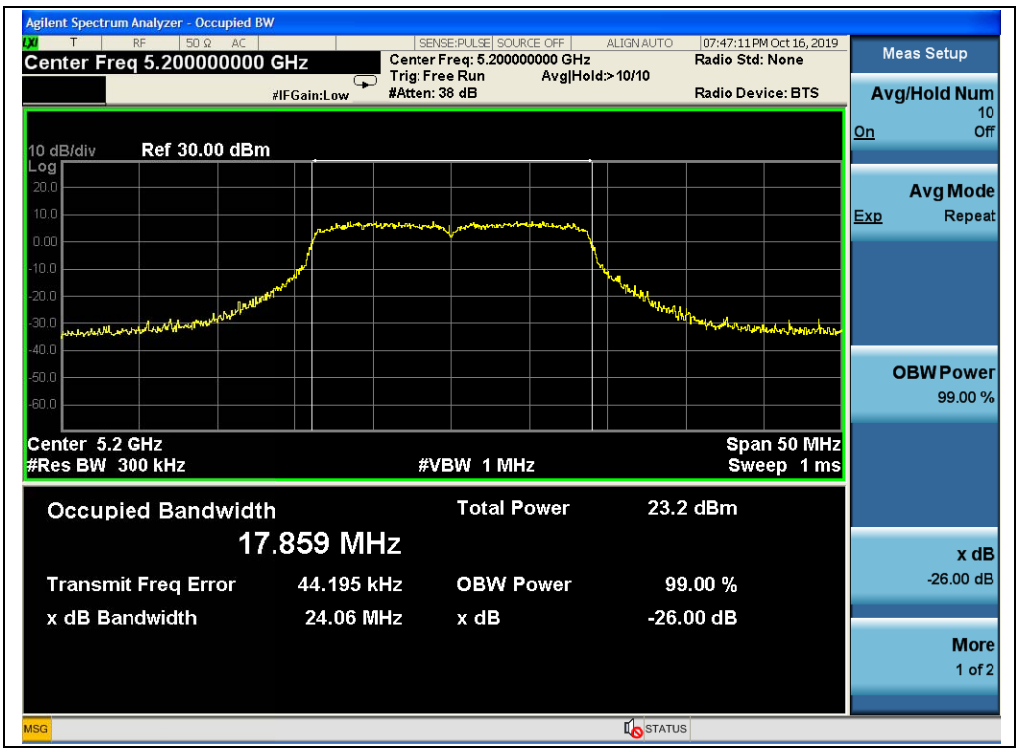
A. Test Verdict:

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
36	5180	23.10
44	5220	24.06
48	5240	24.13
Channel	**Frequency (MHz)**	**6dB Bandwidth (MHz)**
149	5745	17.34
157	5785	17.57
165	5825	17.58

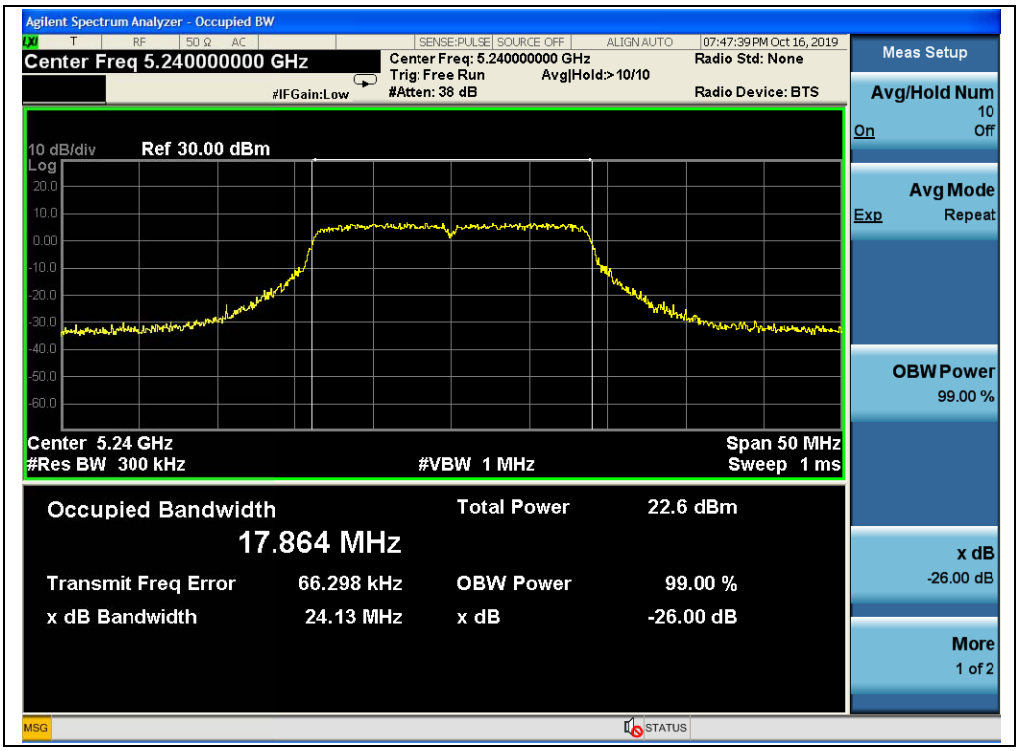
B. Test Plot:



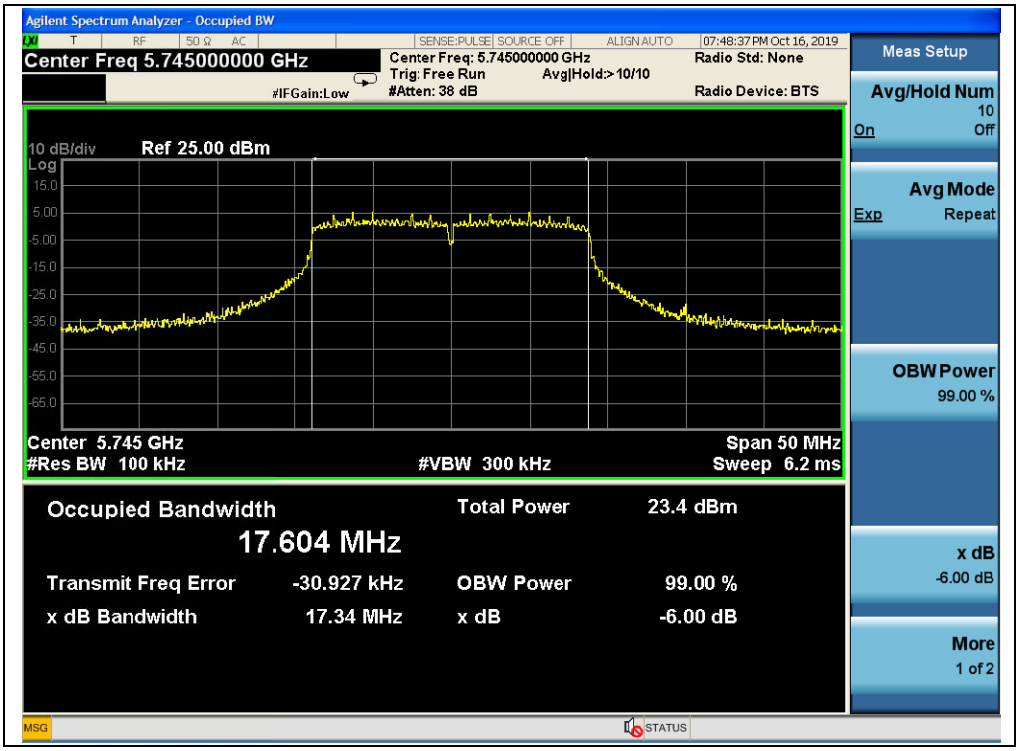
(Channel 36, 5180MHz, 802.11 n (HT20))



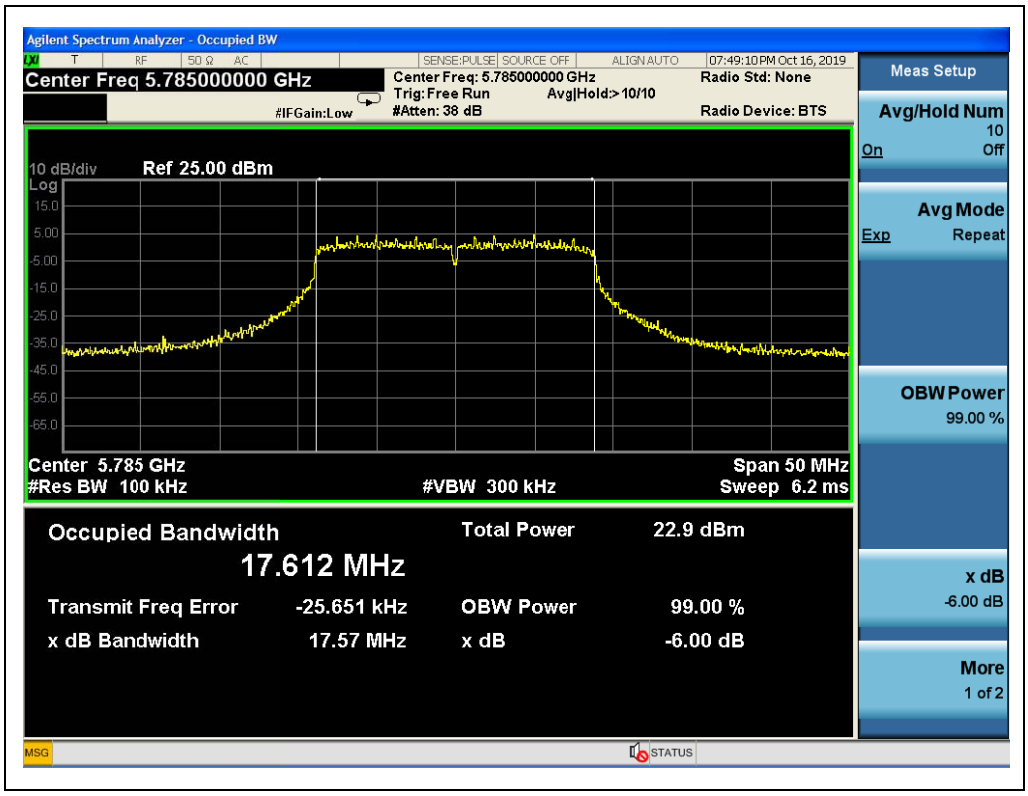
(Channel 44, 5220 MHz, 802.11 n (HT20))



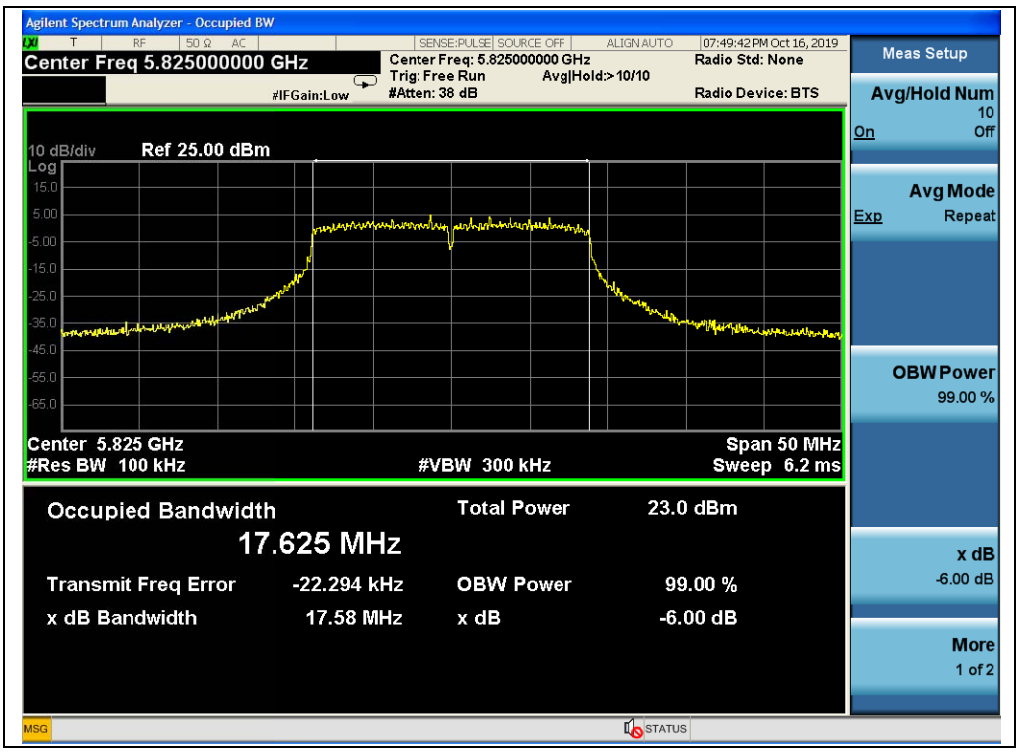
(Channel 48, 5240MHz, 802.11 n (HT20))



(Channel 149, 5745MHz, 802.11 n (HT20))



(Channel 157, 5785MHz, 802.11 n (HT20))



(Channel 165, 5825MHz, 802.11 n (HT20))

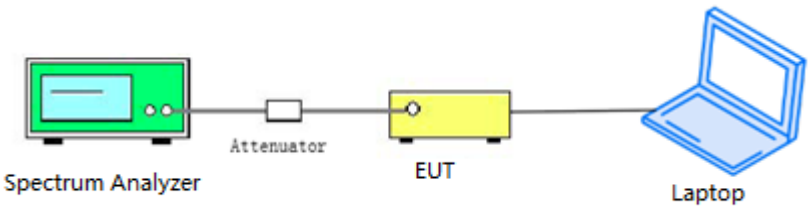
2.5. Maximum Power Spectral Density

2.5.1. Requirement

(1) For client devices in the 5.15-5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.
(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.
(3) For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500KHz band.
If transmitting antennas of directional gain greater than 6 dBi are used, the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
(4) According to KDB662911D01Measure-and-sum technique, the conducted emission level (e.g., transmit power or power in specified bandwidth) is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in units that are directly proportional to power.
(5) According to KDB 662911 D01, the directional gain = G_{ANT} +10log(N_{ANT}) dBi, where G_{ANT} is the antenna gain in dBi, N_{ANT} is the number of outputs.

2.5.2. Test Description

Test Setup:



The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

2.5.3. Test Procedure

KDB 789033 Section F) Maximum Power Spectral Density (PSD) Method SA-3 was used in order to prove compliance

1) Set span to encompass the entire -26dB emission bandwidth
2) Set RBW = 1 MHz. Set VBW ≥ 3 MHz.
3) Number of points in sweep ≥ 2 Span / RBW. Sweep time = auto.
4) Detector = Average (RMS)
5) Trace mode=Max hold
6) Record the max value

2.5.4. Test Result

802.11n (HT20) Test mode

A. Test Verdict:

Channel	Frequency (MHz)	Measured PPSD (dBm/MHz)		Tatal PPSD (dBm/MHz)	Limit (dBm/MHz)	Verdict
		ANT A	ANT B			
36	5180	3.20	3.90	6.57	11	PASS
44	5220	3.34	4.86	7.18		
48	5240	2.79	4.73	6.88		
Channel	Frequency (MHz)	Measured PPSD (dBm/500KHz)		Tatal PPSD (dBm/500KHz)	Limit (dBm/500KHz)	Verdict
		ANT A	ANT B			
149	5745	4.05	3.99	7.03	30	PASS
157	5785	3.78	2.96	6.40		
165	5825	3.78	4.07	6.94		
Note: Directional gain = 2.20dBi +10log(2) = 5.21dBi＜6dBi, so the limit shall be 11 dBm/MHz for 5.18-5.24 GHz band and 30 dBm/500KHz for 5.745-5.825 GHz band.						

B. Test Plot:

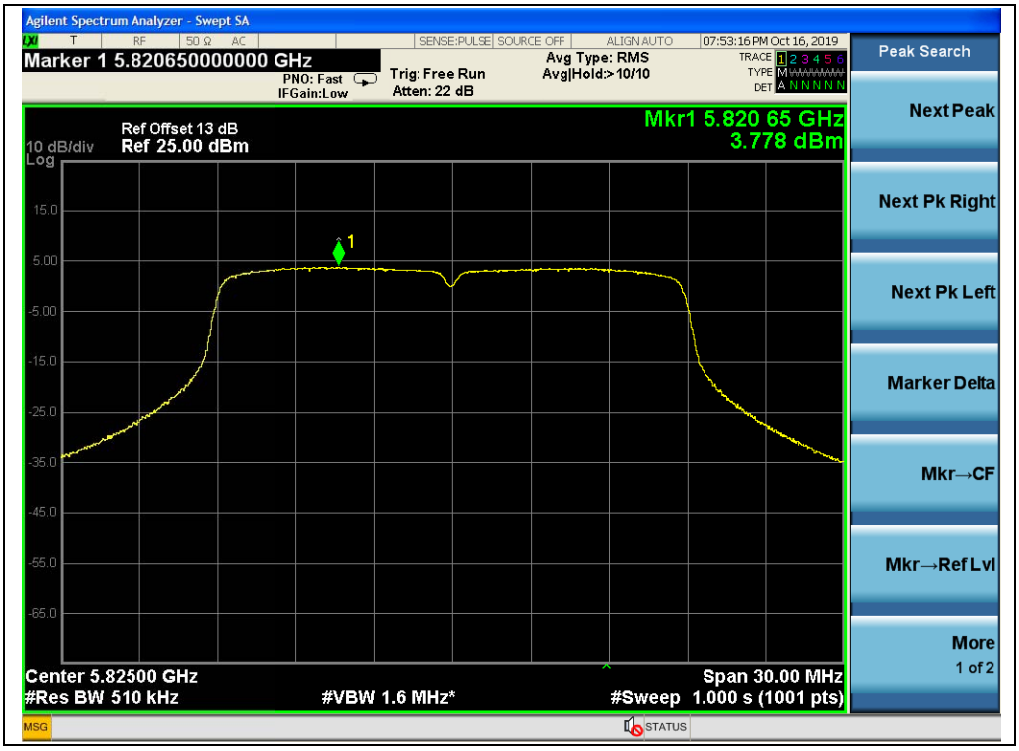
(Channel 36, 5180MHz, 802.11 n (HT20), ANT A)

(Channel 44, 5220 MHz, 802.11 n (HT20), ANT A)

(Channel 48, 5240MHz, 802.11 n (HT20), ANT A)

(Channel 149, 5745MHz, 802.11 n (HT20), ANT A)

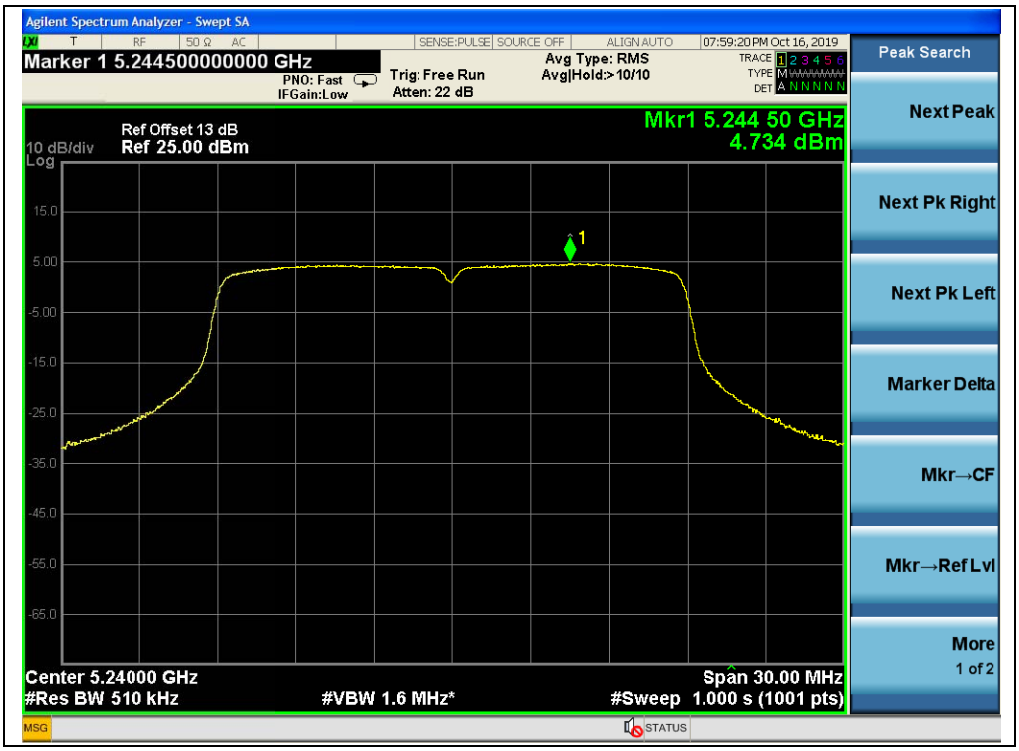
(Channel 157, 5785MHz, 802.11 n (HT20), ANT A)



(Channel 165, 5825MHz, 802.11 n (HT20), ANT A)

(Channel 36, 5180MHz, 802.11 n (HT20), ANT B)

(Channel 44, 5220 MHz, 802.11 n (HT20), ANT B)



(Channel 48, 5240MHz, 802.11 n (HT20), ANT B)

(Channel 149, 5745MHz, 802.11 n (HT20), ANT B)

(Channel 157, 5785MHz, 802.11 n (HT20), ANT B)

(Channel 165, 5825MHz, 802.11 n (HT20), ANT B)

2.6. Frequency Stability

2.6.1. Requirement

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

2.6.2. Test Description

The EUT was placed inside of an environmental chamber as the temperature in the chamber was varied between 5°C to 40°C. The temperature was incremented by 10° intervals and the unit was allowed to stabilize at each temperature before each measurement. The center frequency of the transmitting channel was evaluated at each temperature and the frequency deviation from the channel's center frequency was recorded. Data for the worst case channel is shown below.

2.6.3. Test Result

U-NII-1 (Ch. 36) 5180MHz				
VOLTAGE (%)	POWER (VDC)	TEMP (°C)	Freq Dev. (Hz)	Deviation (ppm)
100%	3.80	+20(Ref)	29	0.006
100%		-30	51	0.010
100%		-20	47	0.009
100%		-10	40	0.008
100%		0	35	0.007
100%		+10	26	0.005
100%		+20	29	0.006
100%		+30	33	0.006
100%		+40	42	0.008
100%		+50	49	0.009
85%	3.23	+20	52	0.010
115%	4.37	+20	44	0.008

U-NII-3 (Ch. 149) 5745MHz				
VOLTAGE (%)	POWER (VDC)	TEMP (°C)	Freq Dev. (Hz)	Deviation (ppm)
100%	3.80	+20(Ref)	27	0.005
100%		-30	50	0.009
100%		-20	44	0.008
100%		-10	36	0.006
100%		0	32	0.006
100%		+10	25	0.004
100%		+20	30	0.005
100%		+30	25	0.004
100%		+40	36	0.006
100%		+50	41	0.007
85%	3.23	+20	45	0.008
115%	4.37	+20	32	0.006

2.7. Conducted Emission

2.7.1. Requirement

According to FCC section 15.207, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN).

Frequency range (MHz)	Conducted Limit (dBμV)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5 - 30	60	50

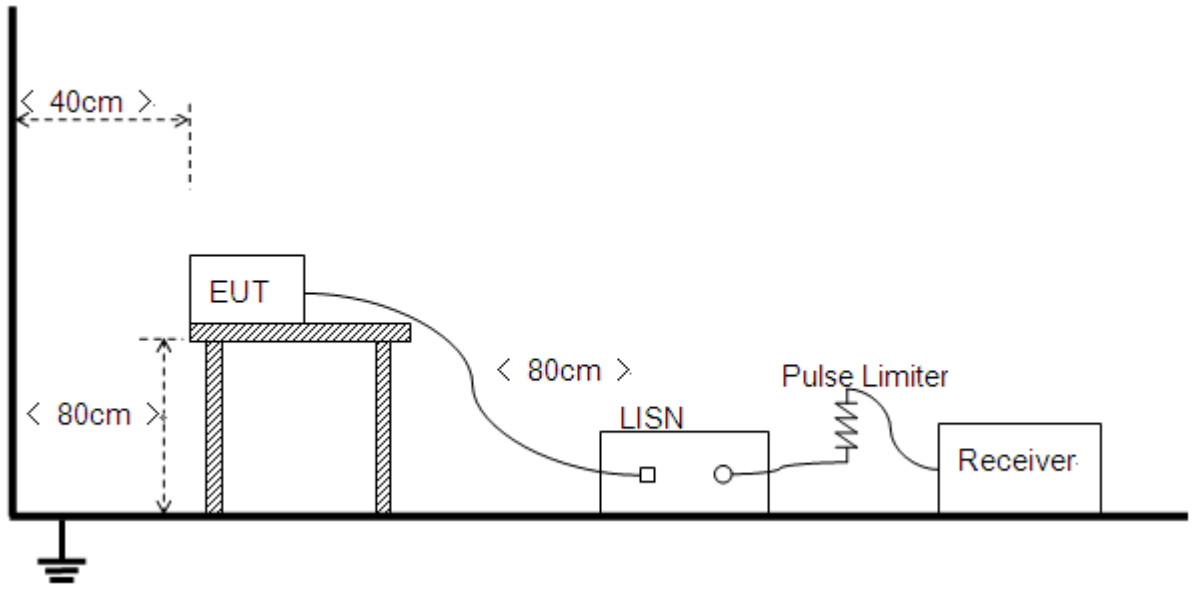
NOTE:

(a) The lower limit shall apply at the band edges.

(b) The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

2.7.2. Test Description

Test Setup:



The Table-top EUT was placed upon a non-metallic table 0.8m above the horizontal metal reference ground plane. EUT was connected to LISN and LISN was connected to reference Ground Plane. EUT was 80cm from LISN. The set-up and test methods were according to ANSI C63.10: 2013.

2.7.3. Test Result

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

Note: Both of the test voltage AC 120V/60Hz and AC 230V/50Hz were considered and tested respectively, only the results of the worst case AC 120V/60Hz were recorded in this report.

A. Test Setup:

Test Mode: EUT + Adapter +USB Cable + 5G WIFI TX

Test Voltage: AC 120V/60Hz

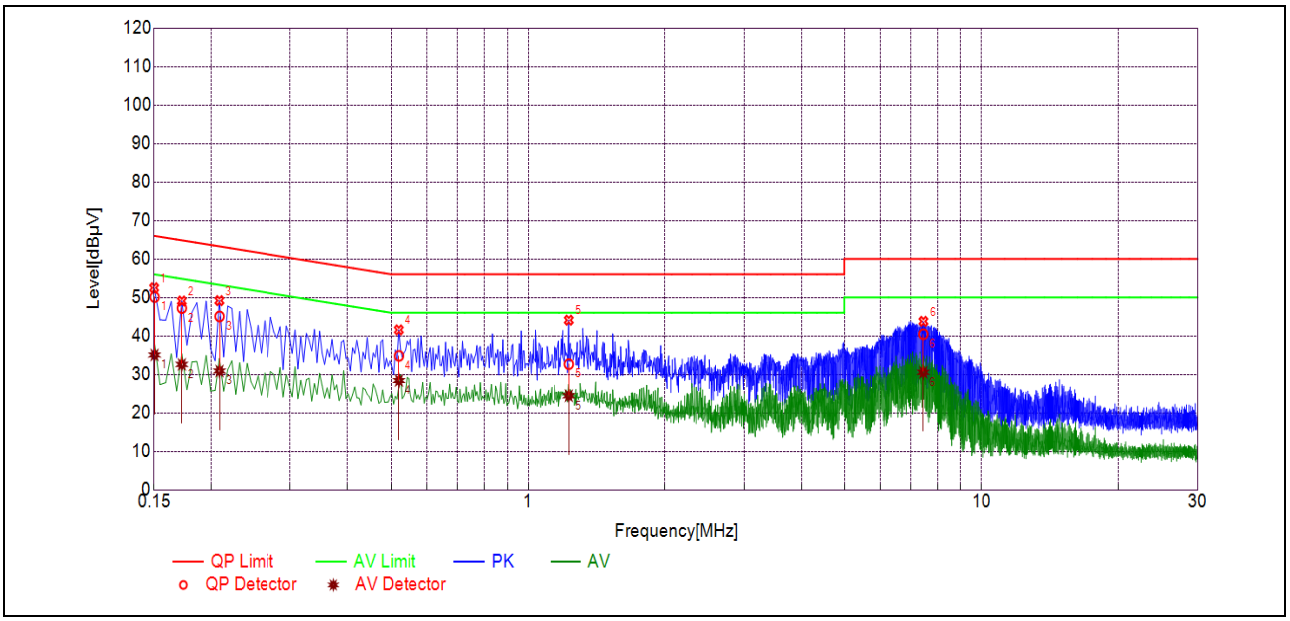
The measurement results are obtained as below:

$E\ [dB\mu V] = U_R + L_{Cable\ loss}\ [dB] + A_{Factor}$

U_R: Receiver Reading

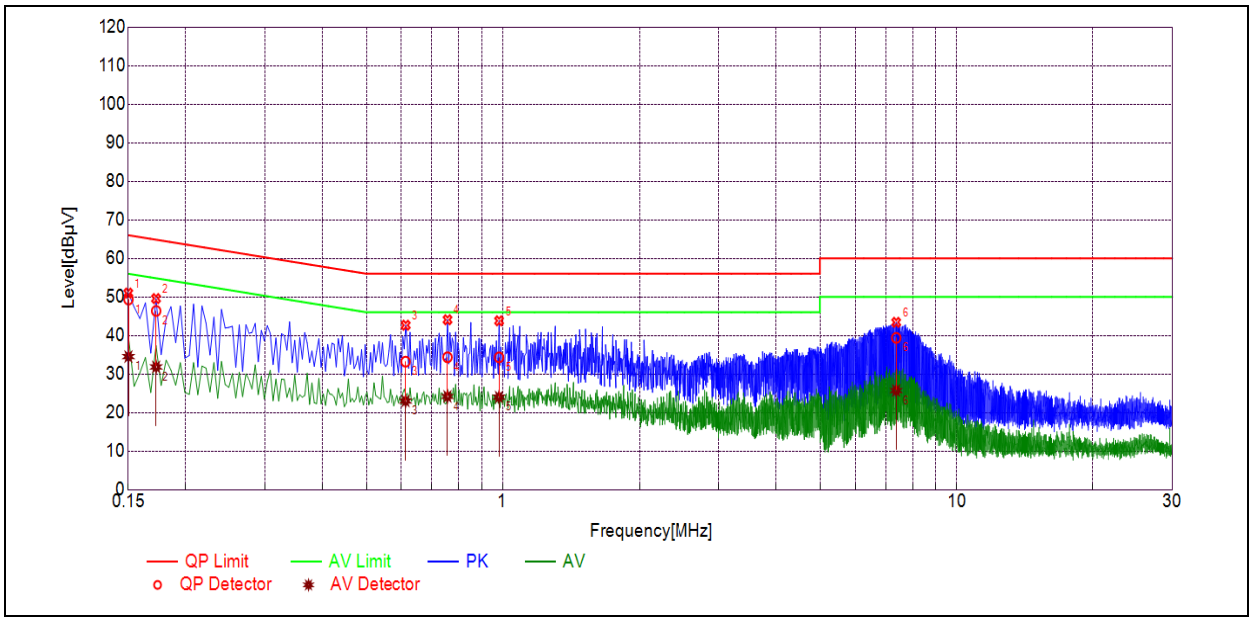
A_{Factor}: Voltage division factor of LISN

B. Test Plot:



(L Phase)

NO.	Fre. (MHz)	Emission Level (dBµV)		Limit (dBµV)		Power-line	Verdict
		Quai-peak	Average	Quai-peak	Average		
1	0.1503	50.10	35.05	65.98	55.98	Line	PASS
2	0.1725	47.23	32.59	64.84	54.84		PASS
3	0.2086	45.07	30.88	63.26	53.26		PASS
4	0.5194	34.81	28.40	56.00	46.00		PASS
5	1.2344	32.66	24.45	56.00	46.00		PASS
6	7.4484	40.44	30.55	60.00	50.00		PASS



(N Phase)

NO.	Fre. (MHz)	Emission Level (dBµV)		Limit (dBµV)		Power-line	Verdict
		Quai-peak	Average	Quai-peak	Average		
1	0.1501	49.32	34.51	65.99	55.99	Neutral	PASS
2	0.1726	46.37	31.83	64.83	54.83		PASS
3	0.6129	33.21	22.99	56.00	46.00		PASS
4	0.7571	34.34	24.17	56.00	46.00		PASS
5	0.9820	34.33	24.00	56.00	46.00		PASS
6	7.3633	39.37	25.71	60.00	50.00		PASS

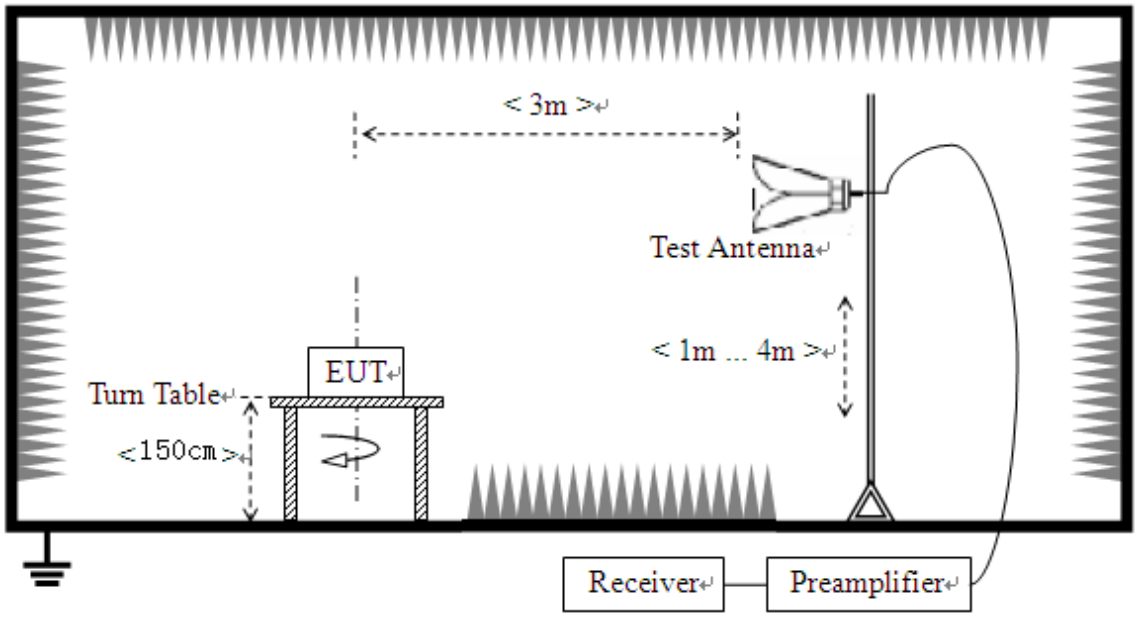
2.8. Restricted Frequency Bands

2.8.1. Requirement

According to FCC section 15.407(b)(7), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, In addition, radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(a).

2.8.2. Test Description

Test Setup



The Module is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading.
KDB 789033 Section H) 3)5)6(d)) was used in order to prove compliance
For the Test Antenna:
Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength.

2.8.3. Test Result

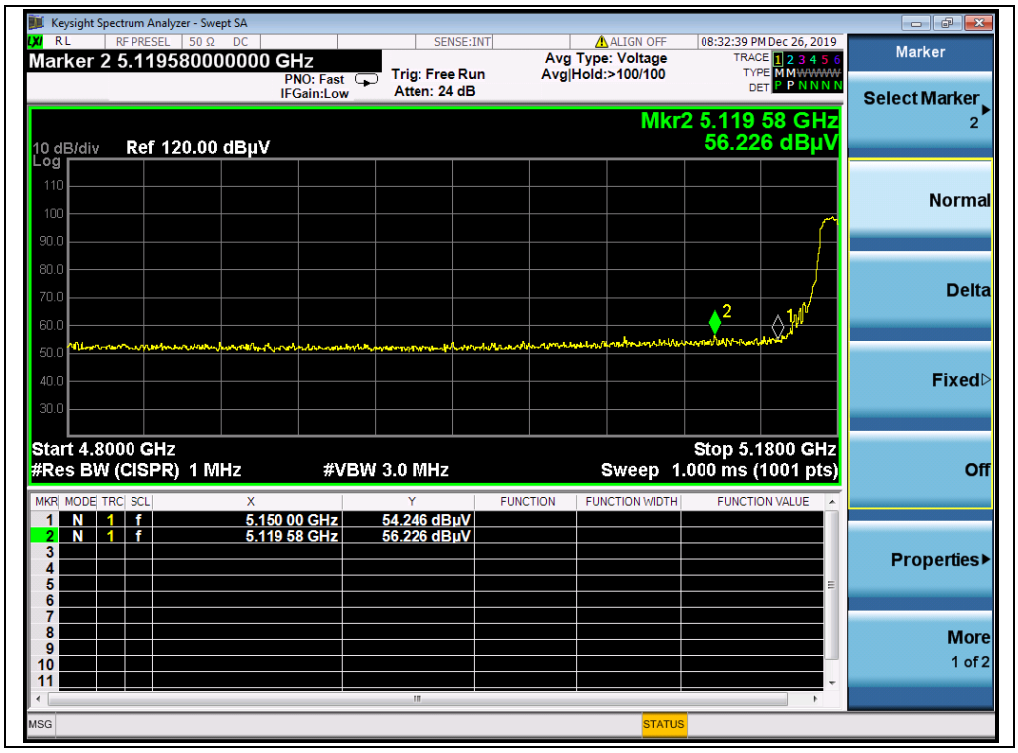
The lowest and highest channels are tested to verify Restricted Frequency Bands.
The measurement results are obtained as below:
E [dBμV/m] =U_R + A_T + A_{Factor} [dB]; A_T =$L_{Cable\ loss}$ [dB]-G_{preamp} [dB]
A_T: Total correction Factor except Antenna; U_R: Receiver Reading
G_{preamp}: Preamplifier Gain; A_{Factor}: Antenna Factor at 3m
Note: Restricted Frequency Bands were performed when antenna was at vertical and horizontal polarity, and only the worse test condition (vertical) was recorded in this test report.

802.11n (HT20) Test mode

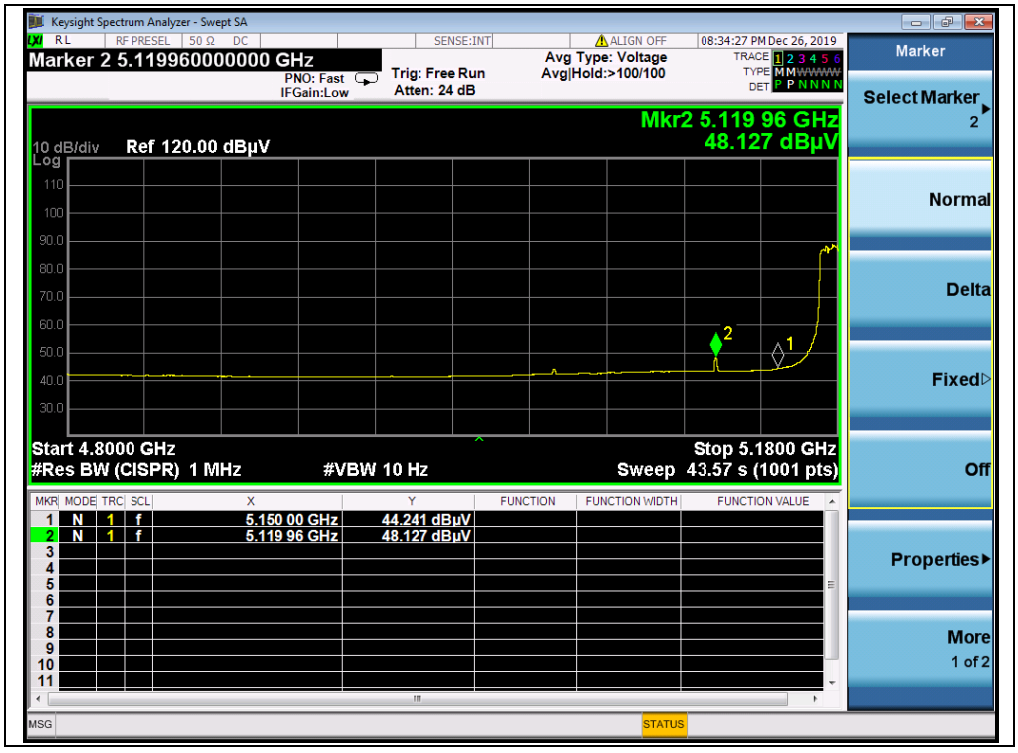
A. Test Verdict:

Channel	Frequency (MHz)	Detector	Receiver Reading U_R (dBuV)	A_T (dB)	A_{Factor} (dB@3m)	Max. Emission E (dBμV/m)	Limit (dBμV/m)	Verdict
		PK/ AV						
36	5119.58	PK	56.23	-26.92	32.20	59.12	68.23	PASS
36	5119.96	AV	48.13	-26.92	32.20	51.02	54	PASS
48	5406.54	PK	52.72	-26.92	32.20	58.00	68.23	PASS
48	5359.90	AV	43.71	-26.92	32.20	46.60	54	PASS
149	5723.91	PK	53.30	-26.23	32.20	59.27	119.74	PASS
149	5725.00	AV	42.28	-26.23	32.20	48.25	54	PASS
165	5961.50	PK	52.06	-26.23	32.20	58.03	68.23	PASS
165	5850.00	AV	41.87	-26.23	32.20	47.84	54	PASS

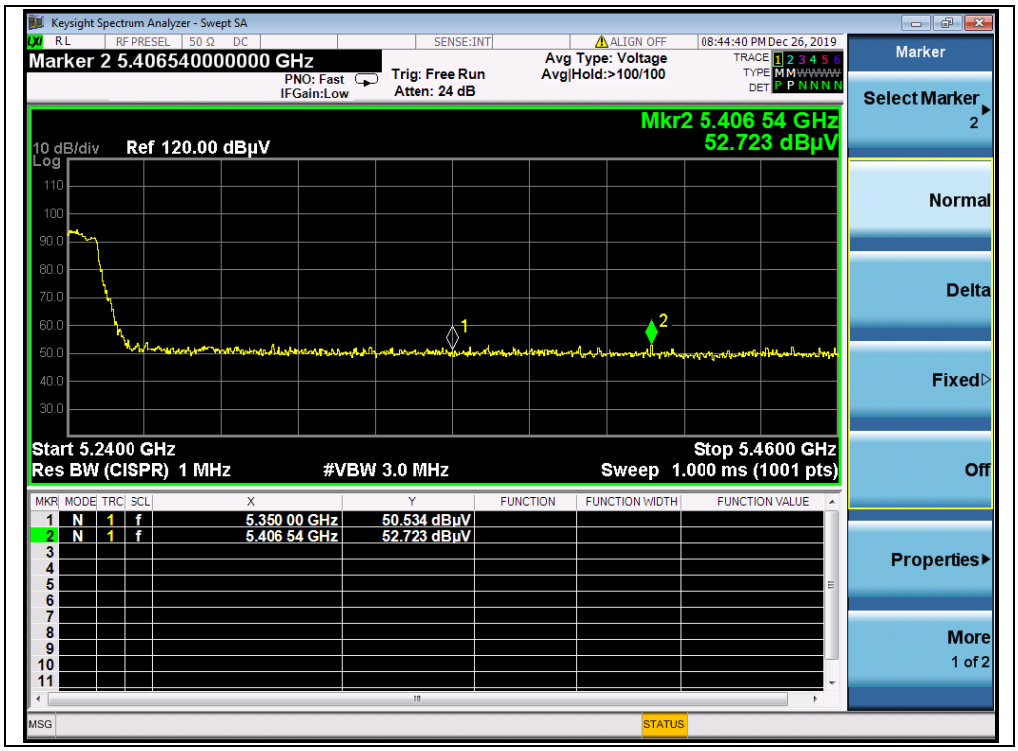
B. Test Plot:



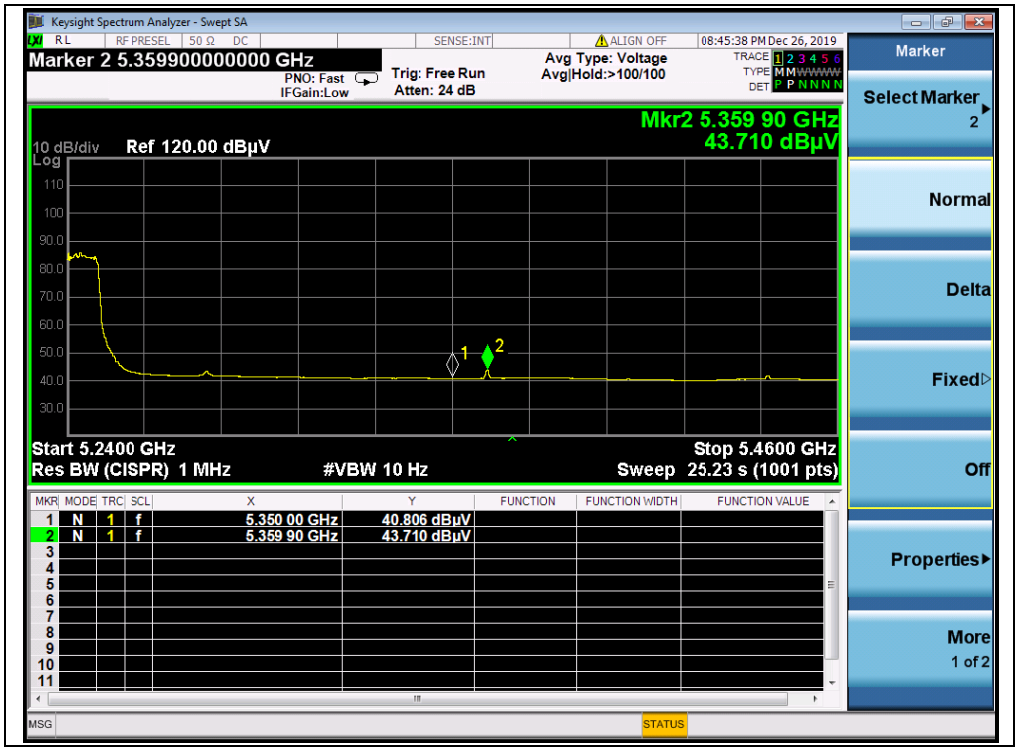
(Channel 36, PEAK, 802.11n (HT20))



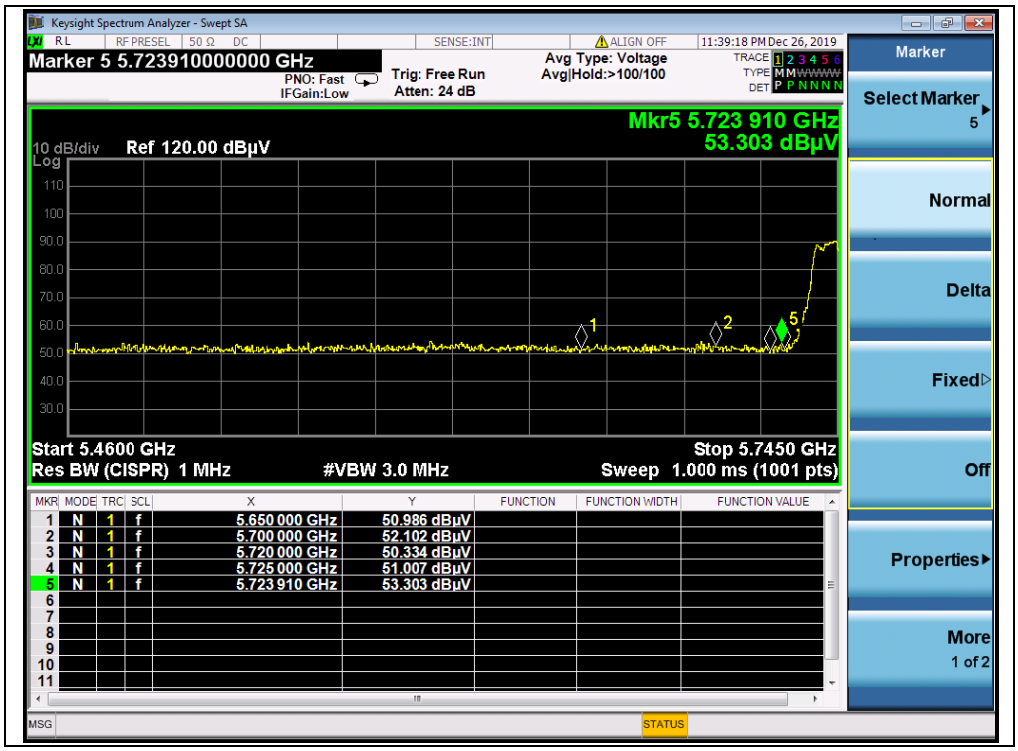
(Channel 36, AVG, 802.11 n (HT20))



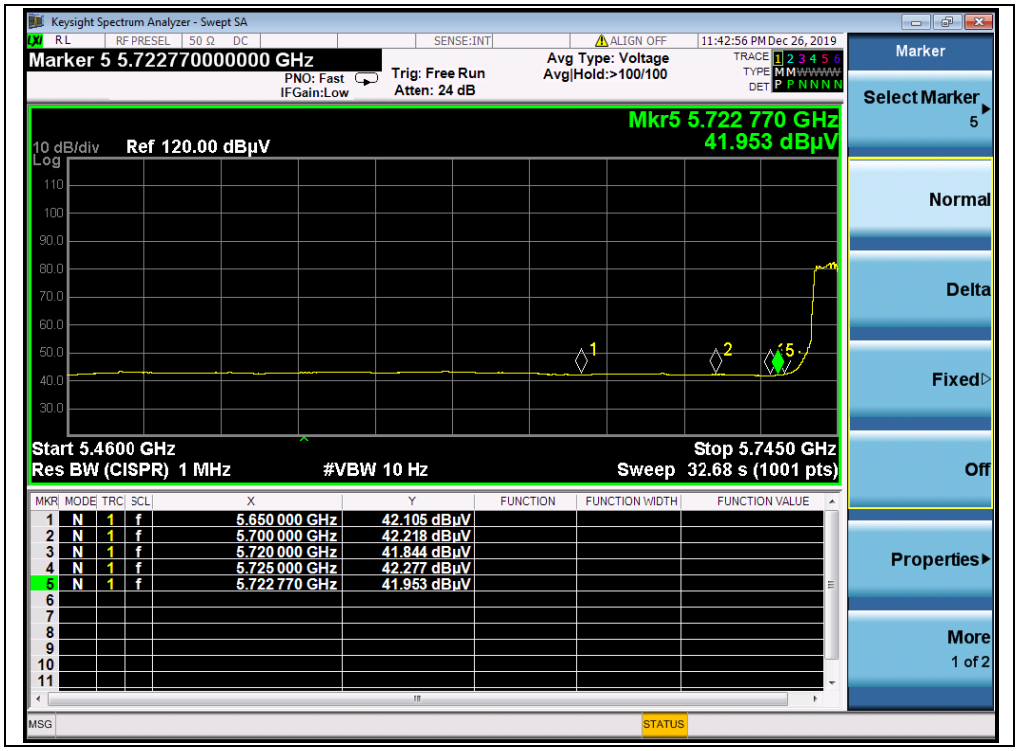
(Channel 48, PEAK, 802.11 n (HT20))



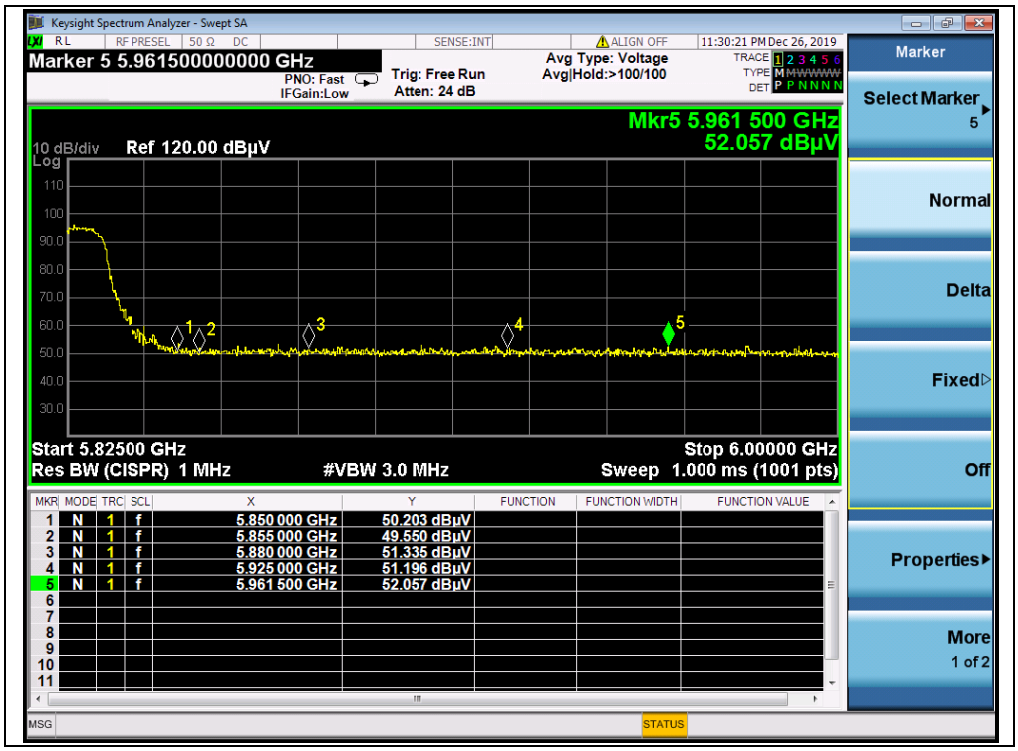
(Channel 48, AVG, 802.11n (HT20))



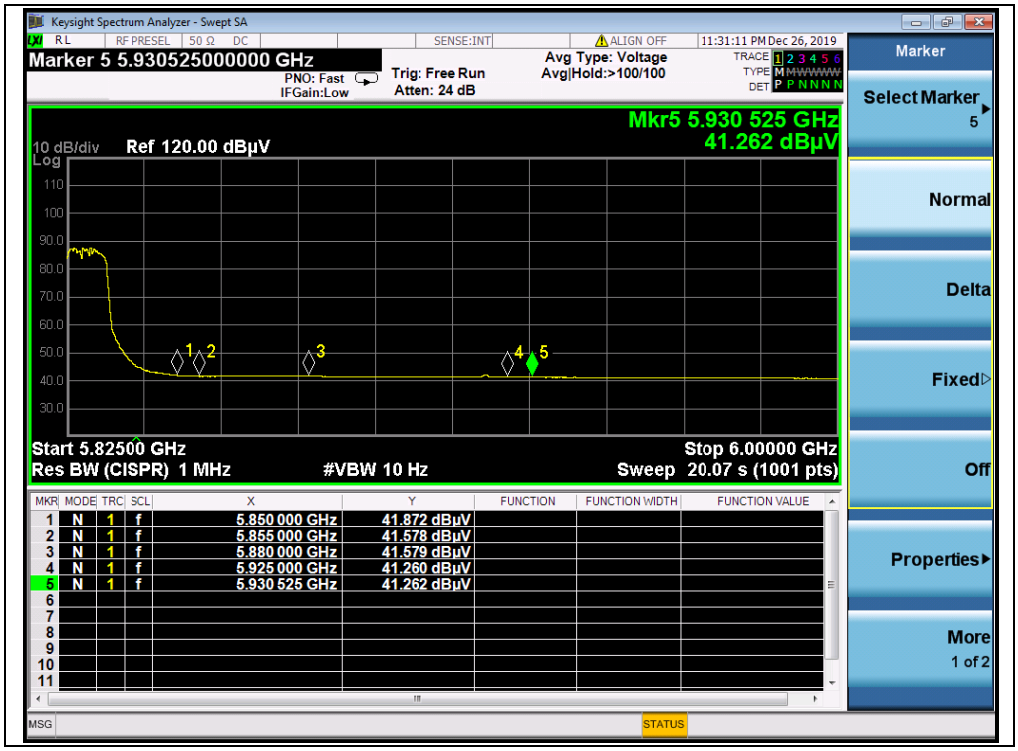
(Channel 149, PEAK, 802.11 n (HT20))



(Channel 149, AVG, 802.11n (HT20))



(Channel 165, PEAK, 802.11 n (HT20))



(Channel 165, AVG, 802.11n (HT20))

2.9. Radiated Emission

2.9.1. Requirement

The peak emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:
(1) For transmitters operating in the 5.15–5.25 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of -27dBm/MHz.
(2) For transmitters operating in the 5.25–5.35 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of -27dBm/MHz.
(3) For transmitters operating in the 5.47–5.725 GHz band: all emissions outside of the 5.47–5.725 GHz band shall not exceed an EIRP of -27dBm/MHz.
(4) For transmitters operating in the 5.725-5.85 GHz band: All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of −17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of −27 dBm/MHz.
The following formula is used to convert the equipment isotropic radiated power(eirp) to field strength (dBμV/m);

$$E = 1000000 \times \sqrt{30P} / 3 \ \mu V/m$$

where P is the EIRP in Watts

Therefore: -27 dBm/MHz = 68.23 dBuV/m

Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209. According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

Note:

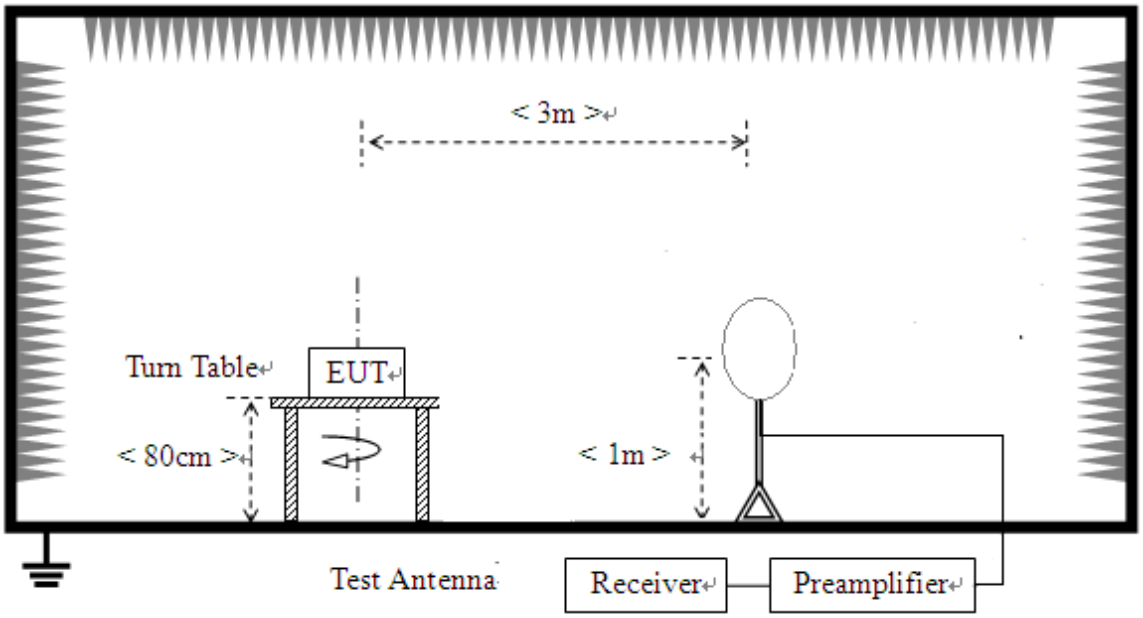
For Above 1000MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), also should comply with the radiated emission limits specified in Section 15.209(a)(above table)

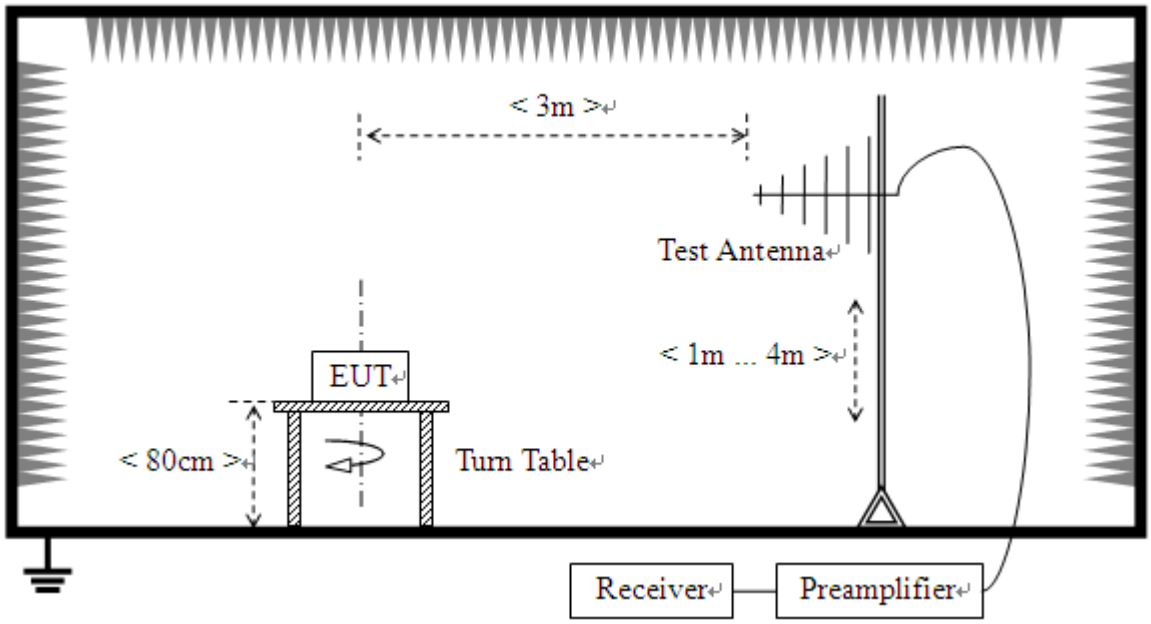
2.9.2. Test Description

Test Setup:

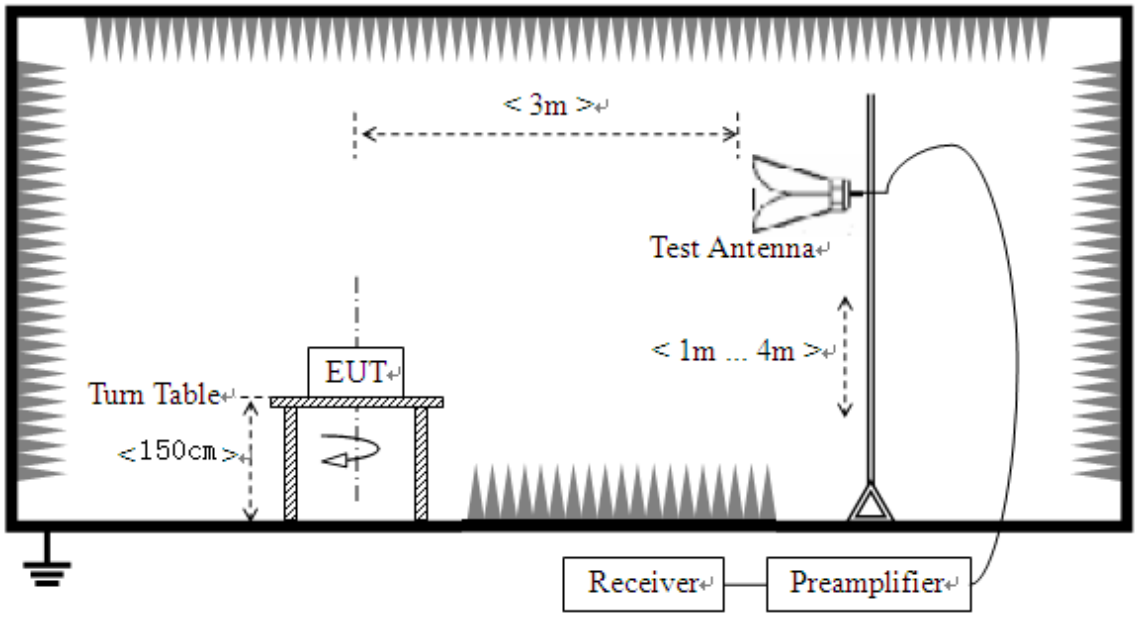
1) For radiated emissions from 9kHz to 30MHz



2) For radiated emissions from 30MHz to1GHz



3) For radiated emissions above 1GHz



The RF absorbing material used on the reference ground plane and on the turntable have a maximum height (thickness) of 30 cm (12 in) and have a minimum-rated attenuation of 20 dB at all frequencies from 1 GHz to 18 GHz.

The test site semi-anechoic chamber has met the requirement of NSA tolerance 4dB according to the standards: ANSI C63.10 (2013). For radiated emissions below or equal to 1GHz, The EUT was set-up on insulator 80cm above the Ground Plane, for radiated emissions above 1GHz, The EUT

was set-up on insulator 150cm above the Ground Plane. The set-up and test methods were according to ANSI C63.10

For the radiated emission test above 1GHz:

Place the measurement antenna 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.

The EUT is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading

For the Test Antenna:

(a) In the frequency range of 9kHz to 30MHz, magnetic field is measured with Loop Test Antenna. The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
(b) In the frequency range above 30MHz, Bi-Log Test Antenna (30MHz to 1GHz) and Horn Test Antenna (above 1GHz) are used. Place the test antenna at 3m away from area of the EUT, while keeping the test antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The test 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 test antenna elevation shall be that which maximizes the emissions. The test 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. The emission levels at both horizontal and vertical polarizations should be tested.

2.9.3. Test Result

According to ANSI C63.4 selection 4.2.2, because of peak detection will yield amplitudes equal to or greater than amplitudes measured with the quasi-peak (or average) detector, the measurement data from a spectrum analyzer peak detector will represent the worst-case results, if the peak measured value complies with the quasi-peak limit, it is unnecessary to perform an quasi-peak measurement.

The measurement results are obtained as below:

$E\ [dB\mu V/m] = U_R + A_T + A_{Factor}\ [dB]$; $A_T = L_{Cable\ loss}\ [dB] - G_{preamp}\ [dB]$

A_T: Total correction Factor except Antenna

U_R: Receiver Reading

G_{preamp}: Preamplifier Gain

A_{Factor}: Antenna Factor at 3m

During the test, the total correction Factor A_T and A_{Factor} were built in test software.

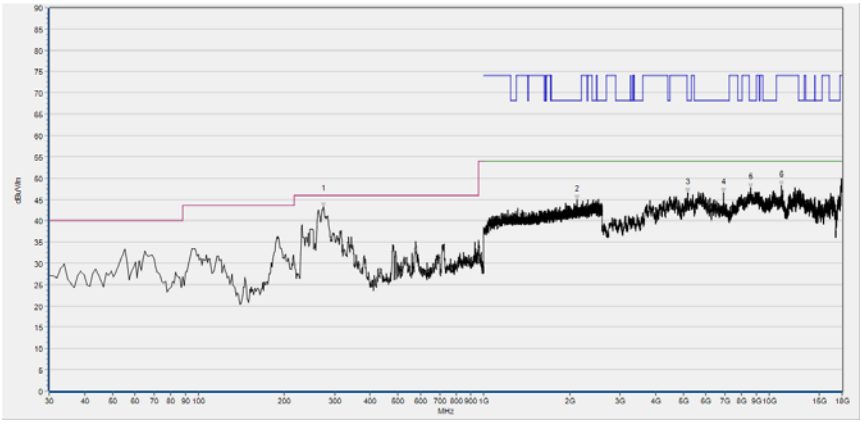
Note1: All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Note2: For the frequency, which started from 9kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

Note3: For the frequency, which started from 18GHz to 40GHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

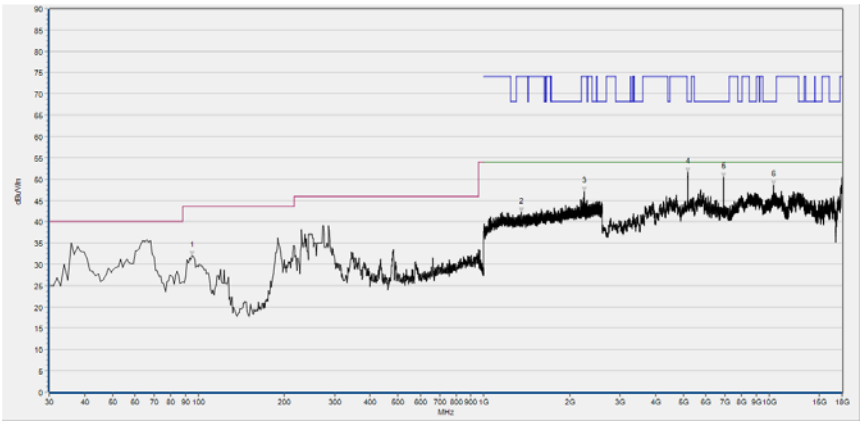
802.11n (HT20) Test mode

Plots for Channel = 36



Fre. (MHz)	Pk (dBµV/m)	QP (dBµV/m)	AV (dBµV/m)	Limit-PK (dBµV/m)	Limit-QP (dBµV/m)	Limit-AV (dBµV/m)	Antenna	Verdict
273.714	42.17	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
2117.706	44.89	N/A	N/A	68.23	N/A	54.00	Horizontal	PASS
5184.637	46.67	N/A	N/A	68.23	N/A	54.00	Horizontal	PASS
6906.701	46.62	N/A	N/A	68.23	N/A	54.00	Horizontal	PASS
8616.443	47.74	N/A	N/A	68.23	N/A	54.00	Horizontal	PASS
11034.727	48.23	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

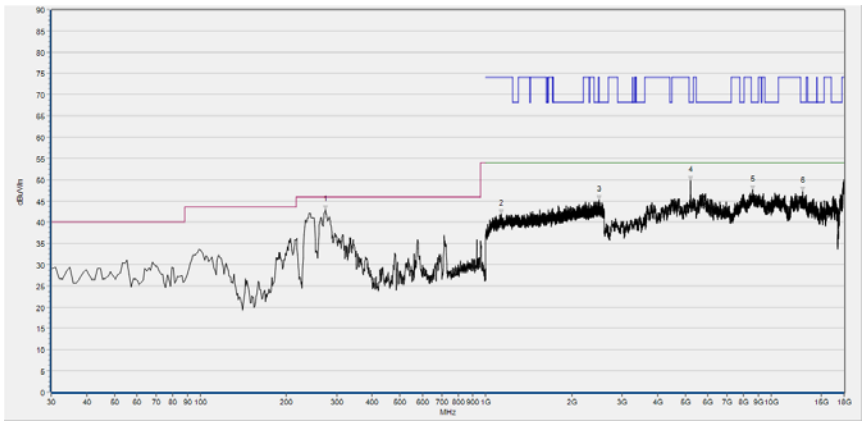
(Antenna Horizontal, 30MHz to 18GHz)



Fre. (MHz)	Pk (dBµV/m)	QP (dBµV/m)	AV (dBµV/m)	Limit-PK (dBµV/m)	Limit-QP (dBµV/m)	Limit-AV (dBµV/m)	Antenna	Verdict
95.055	32.00	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
1349.983	42.22	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
2248.416	47.08	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5187.718	51.57	N/A	N/A	68.23	N/A	54.00	Vertical	PASS
6906.701	50.43	N/A	N/A	68.23	N/A	54.00	Vertical	PASS
10366.233	48.67	N/A	N/A	68.23	N/A	54.00	Vertical	PASS

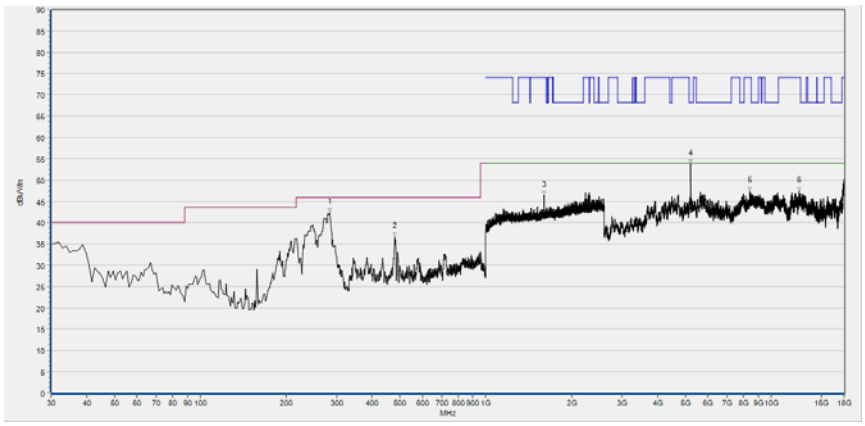
(Antenna Vertical, 30MHz to 18GHz)

Plots for Channel = 44



Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
273.714	42.86	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
1132.844	41.94	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
2490.097	45.25	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5215.443	49.71	N/A	N/A	68.23	N/A	54.00	Horizontal	PASS
8604.121	47.60	N/A	N/A	68.23	N/A	54.00	Horizontal	PASS
12910.822	47.26	N/A	N/A	68.23	N/A	54.00	Horizontal	PASS

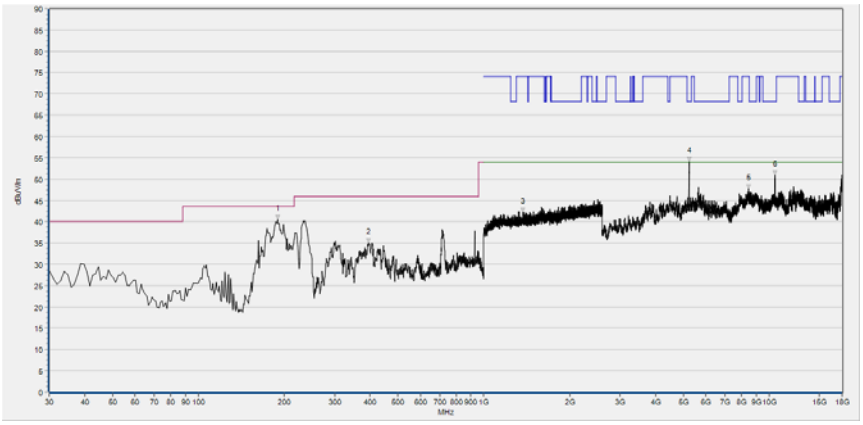
(Antenna Horizontal, 30MHz to 18GHz)



Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
283.423	42.41	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
479.560	36.76	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
1596.999	46.42	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5218.524	53.80	N/A	N/A	68.23	N/A	54.00	Vertical	PASS
8416.203	47.46	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
12519.584	47.38	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

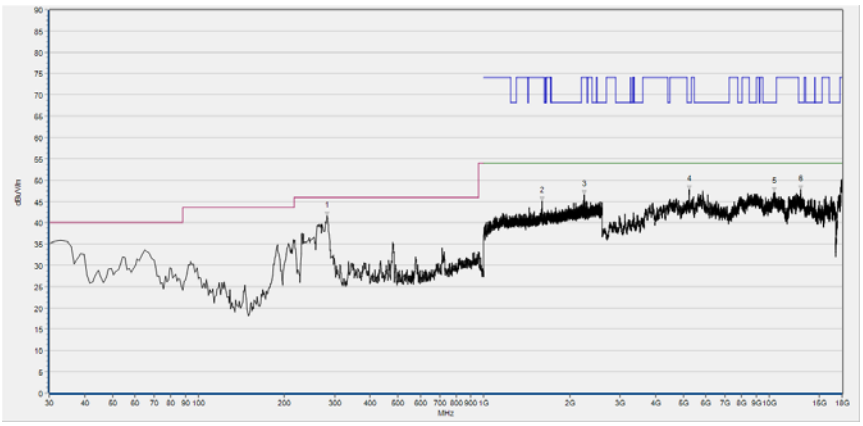
(Antenna Vertical, 30MHz to 18GHz)

Plot for Channel = 48



Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
189.239	40.59	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
395.085	35.07	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
1372.924	42.20	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5238.200	54.46	N/A	N/A	68.23	N/A	54.00	Horizontal	PASS
8456.251	47.79	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
10467.894	50.95	N/A	N/A	68.23	N/A	54.00	Horizontal	PASS

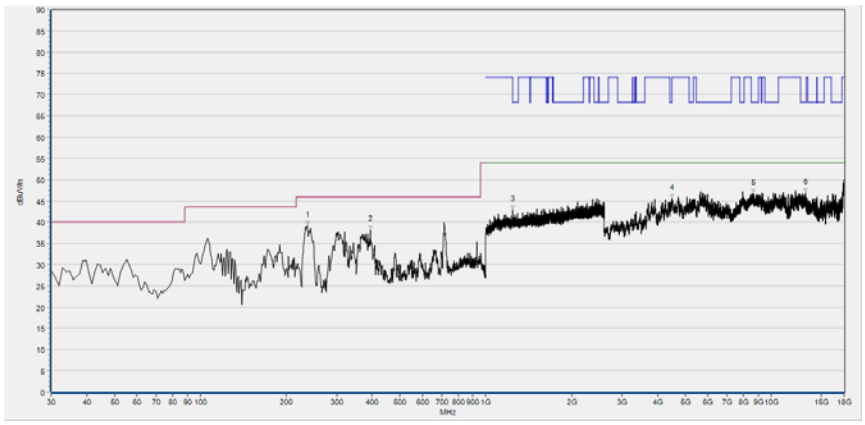
(Antenna Horizontal, 30MHz to 18GHz)



Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
282.452	41.56	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
1599.133	45.03	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
2250.550	46.56	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5230.846	47.84	N/A	N/A	68.23	N/A	54.00	Vertical	PASS
10415.523	47.22	N/A	N/A	68.23	N/A	54.00	Vertical	PASS
12861.532	47.77	N/A	N/A	68.23	N/A	54.00	Vertical	PASS

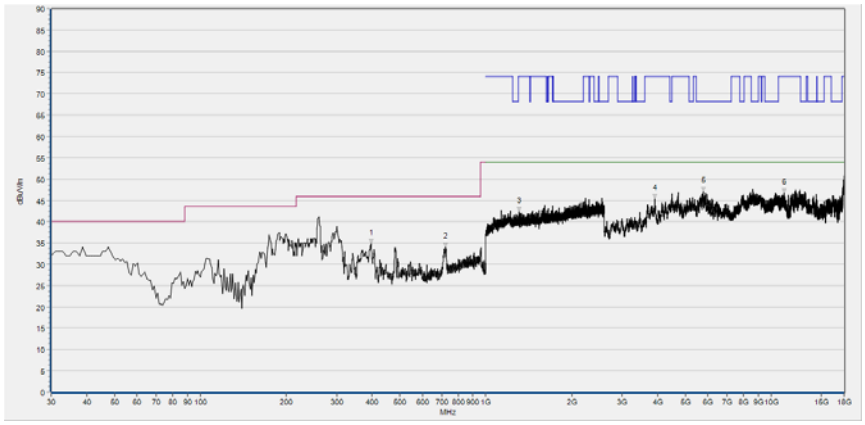
(Antenna Vertical, 30MHz to 18GHz)

Plots for Channel = 149



Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
236.817	39.25	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
394.114	38.14	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
1240.614	42.83	N/A	N/A	68.23	N/A	54.00	Horizontal	PASS
4482.256	45.52	N/A	N/A	68.23	N/A	54.00	Horizontal	PASS
8674.975	46.80	N/A	N/A	68.23	N/A	54.00	Horizontal	PASS
13184.997	46.87	N/A	N/A	68.23	N/A	54.00	Horizontal	PASS

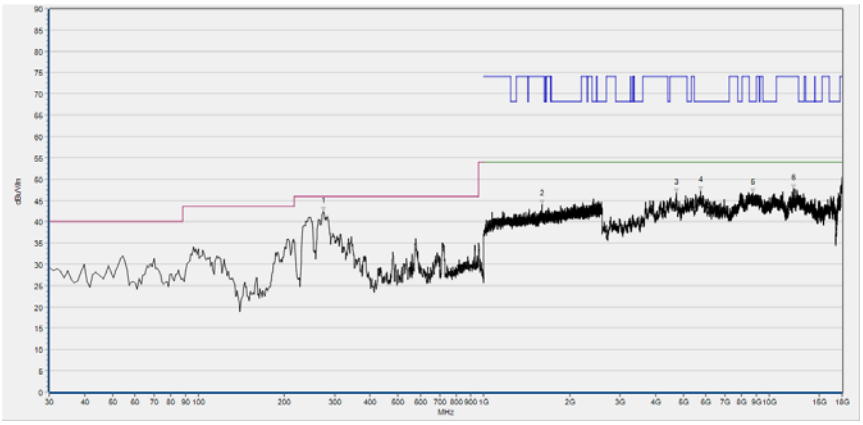
(Antenna Horizontal, 30MHz to 18GHz)



Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
396.056	34.84	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
723.273	33.96	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
1304.635	42.43	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
3912.342	45.36	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5769.954	47.10	N/A	N/A	68.23	N/A	54.00	Vertical	PASS
11120.984	46.75	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

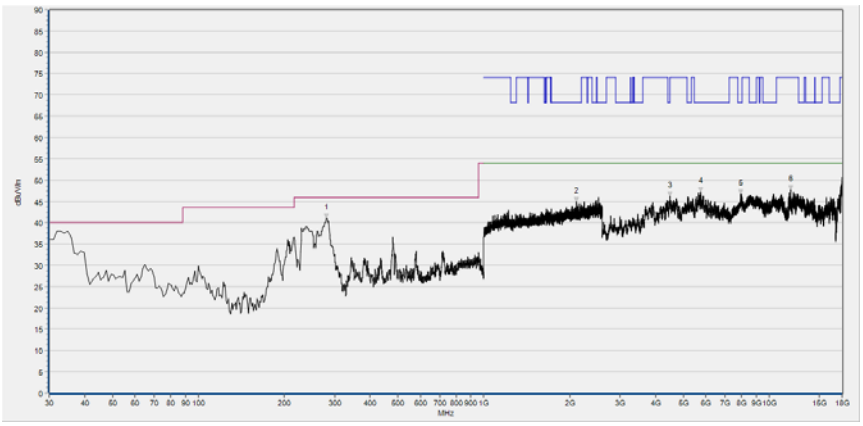
(Antenna Vertical, 30MHz to 18GHz)

Plot for Channel = 157



Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
273.714	42.40	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
1595.398	44.04	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
4728.706	46.79	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5760.712	47.22	N/A	N/A	68.23	N/A	54.00	Horizontal	PASS
8773.555	46.72	N/A	N/A	68.23	N/A	54.00	Horizontal	PASS
12143.749	47.83	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

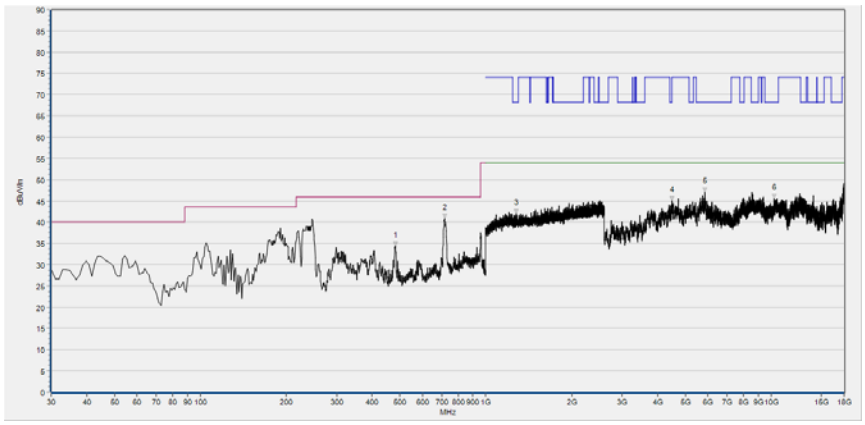
(Antenna Horizontal, 30MHz to 18GHz)



Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
280.511	41.35	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
2114.505	44.84	N/A	N/A	68.23	N/A	54.00	Vertical	PASS
4497.660	46.31	N/A	N/A	68.23	N/A	54.00	Vertical	PASS
5754.551	47.20	N/A	N/A	68.23	N/A	54.00	Vertical	PASS
7954.111	46.71	N/A	N/A	68.23	N/A	54.00	Vertical	PASS
11866.493	47.69	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

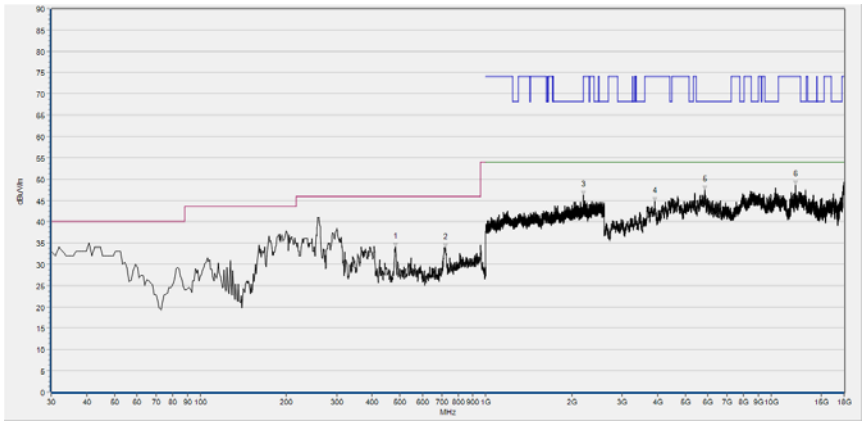
(Antenna Vertical, 30MHz to 18GHz)

Plot for Channel = 165



Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
482.472	34.44	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
717.447	40.86	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
1279.026	42.03	N/A	N/A	68.23	N/A	54.00	Horizontal	PASS
4488.418	45.05	N/A	N/A	68.23	N/A	54.00	Horizontal	PASS
5865.453	47.03	N/A	N/A	68.23	N/A	54.00	Horizontal	PASS
10209.122	45.54	N/A	N/A	68.23	N/A	54.00	Horizontal	PASS

(Antenna Horizontal, 30MHz to 18GHz)



Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
482.472	33.97	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
722.302	33.85	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
2193.998	46.25	N/A	N/A	68.23	N/A	54.00	Vertical	PASS
3912.342	44.72	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5859.292	47.38	N/A	N/A	68.23	N/A	54.00	Vertical	PASS
12152.991	48.54	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(Antenna Vertical, 30MHz to 18GHz)

Annex A Test Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for test performed on the EUT as specified in CISPR 16-1-2:

Test items	Uncertainty
Peak Output Power	±2.22dB
Power spectral density (PSD)	±2.22dB
Bandwidth	±5%
Restricted Frequency Bands	±5%
Radiated Emission	±2.95dB
Conducted Emission	±2.44dB

This uncertainty represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2

Annex B Testing Laboratory Information

1. Identification of the Responsible Testing Laboratory

Laboratory Name:	Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory
Laboratory Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
Telephone:	+86 755 36698555
Facsimile:	+86 755 36698525

2. Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China

3. Facilities and Accreditations

All measurement facilities used to collect the measurement data are located at FL.3, Building A, FeiYang Science Park, Block 67, BaoAn District, Shenzhen, 518101 P. R. China. The test site is constructed in conformance with the requirements of ANSI C63.10-2013 and CISPR Publication 22; the FCC designation number is CN1192, the test firm registration number is 226174.

4. Test Equipments Utilized

4.1 Conducted Test Equipments

Equipment	Serial No.	Type	Manufacturer	Cal. Date	Cal. Due
Attenuator 1	(N/A)	10dB	Resnet	N/A	N/A
EXA Signal Analzyer	MY53470836	N9010A	Agilent	2019.04.09	2020.04.08
USB Wideband Power Sensor	MY54210011	U2021XA	Agilent	2019.04.16	2020.04.15
RF cable (30MHz-26GHz)	CB01	RF01	Morlab	N/A	N/A
Coaxial cable	CB02	RF02	Morlab	N/A	N/A
SMA connector	CN01	RF03	HUBER-SUHNER	N/A	N/A
Temperature Chamber	YOMA	(N/A)	(N/A)	2019.01.22	2020.01.21
Computer	T430i	Think Pad	Lenovo	N/A	N/A

4.2 Conducted Emission Test Equipments

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Cal. Due
Receiver	MY56400093	N9038A	KEYSIGHT	2019.05.08	2020.05.09
LISN	812744	NSLK 8127	Schwarzbeck	2019.05.08	2020.05.09
Pulse Limiter (20dB)	9391	VTSD 9561-D	Schwarzbeck	2019.05.08	2020.05.09
Coaxial cable(BNC)	CB01	EMC01	Morlab	N/A	N/A
Adapter	KX1749000012	FC22	Kun Xing	N/A	N/A
Display screen	6007712	KDL-24EX520	（SONY）	N/A	N/A
HDMI CABLE(1.0M)	N/A	HDMI CABLE-01	N/A	N/A	N/A
Stabilizer	N/A	CR110	Guilin Zhishen Information Technology Co.,Ltd.	N/A	N/A
Launcher	N/A	COV-01	Guilin Zhishen Information Technology Co.,Ltd.	N/A	N/A
Camera	N/A	EOS3000 D	Canon	N/A	N/A

4.3 List of Software Used

Description	Manufacturer	Software Version
Test system	Tonscend	V2.6
Power Panel	Agilent	V3.8
MORLAB EMCR V1.2	MORLAB	V1.0

4.4 Radiated Test Equipments

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Cal. Due
Receiver	MY54130016	N9038A	Agilent	2019.07.26	2020.07.25
Test Antenna - Bi-Log	9163-519	VULB 9163	Schwarzbeck	2019.05.08	2020.05.09
Test Antenna - Horn	9170C-531	BBHA9170	Schwarzbeck	2019.02.15	2020.02.14
Test Antenna - Loop	1519-022	FMZB1519	Schwarzbeck	2019.07.26	2020.07.25
Test Antenna - Horn	01774	BBHA 9120D	Schwarzbeck	2019.07.26	2020.07.25
Coaxial cable (N male) (9KHz-30MHz)	CB04	EMC04	Morlab	N/A	N/A
Coaxial cable (N male) (30MHz-26GHz)	CB02	EMC02	Morlab	N/A	N/A
Coaxial cable (N male) (30MHz-26GHz)	CB03	EMC03	Morlab	N/A	N/A
Coaxial cable (N male) (30MHz-40GHz)	CB05	EMC05	Morlab	N/A	N/A
1-18GHz pre-Amplifier	MA02	TS-PR18	Rohde& Schwarz	2019.05.08	2020.05.09
18-26.5GHz pre-Amplifier	MA03	TS-PR18	Rohde& Schwarz	2019.05.08	2020.05.09
26GHz -40GHz pre-Amplifier	MA05	BBV9721	Rohde& Schwarz	2019.05.08	2020.05.09
Notch Filter	N/A	WRCG-5150-5350	Wainwright	2019.12.01	2020.11.30
Notch Filter	N/A	WRCG-5725-5850	Wainwright	2019.12.01	2020.11.30
Anechoic Chamber	N/A	9m*6m*6m	CRT	2017.11.19	2020.11.18

END OF REPORT