



**Shenzhen Global Test Service Co.,Ltd.**

No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

## FCC PART 15 SUBPART C TEST REPORT

### FCC PART 15 SUBPART E 15.407

**Report Reference No.**.....: **GTS20191021009-1-9-12**

**FCC ID**.....: **2AUUB-S900PLUS**

Compiled by

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Date of issue.....: Oct. 24, 2019

**Representative Laboratory Name.:** **Shenzhen Global Test Service Co.,Ltd.**

Address.....: No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong, China

**Applicant's name**.....: **BOXCHIP CO.,LTD**

Address .....: Room 302, Building A, Huahan Technology, No. 16 Langshan Road, Nanshan District, Shenzhen, China

**Test specification** .....

Standard .....: **FCC Part 15 Subpart E 15.407**

TRF Originator.....: Shenzhen Global Test Service Co.,Ltd.

Master TRF.....: Dated 2014-12

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**Test item description** .....: Smart Terminal

Trade Mark .....: BOXCHIP

**Manufacturer**.....: **BOXCHIP CO.,LTD**

Model/Type reference.....: S900Plus

Listed Models .....: S900A\_Plus, S900B\_Plus, S1000, TVX-588d

Ratings .....: DC 3.8V from battery

Modulation .....: CCK/DSSS, OFDM

Hardware version .....: TVH30\_S900+\_MB\_V2.0

Software version .....: V1.0

Frequency.....: From 5180MHz-5240MHz, 5745MHz-5825MHz

Result.....: **PASS**

**TEST REPORT**

<b>Test Report No. :</b>	<b>GTS20191021009-1-9-12</b>	Oct. 24, 2019
		Date of issue

Equipment under Test : Smart Terminal

Model /Type : S900Plus

Listed Models : S900A\_Plus, S900B\_Plus, S1000, TVX-588d

**Applicant** : **BOXCHIP CO.,LTD**

Address : Room 302, Building A, Huahan Technology, No. 16 Langshan Road, Nanshan District, Shenzhen, China

**Manufacturer** : **BOXCHIP CO.,LTD**

Address : Room 302, Building A, Huahan Technology, No. 16 Langshan Road, Nanshan District, Shenzhen, China

<b>Test Result:</b>	<b>PASS</b>
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The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

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## 1 TEST STANDARDS

The tests were performed according to following standards:

[FCC Rules Part 15 Subpart E](#)—Unlicensed National Information Infrastructure Devices

[ANSI C63.10-2013](#): American National Standard for Testing Unlicensed Wireless Devices

[KDB789033 D02](#): General UNII Test Procedures New Rules v01r02

[KDB662911 D01 v02r01](#): Emissions Testing of Transmitters with Multiple Outputs in the Same Band.

## 2 SUMMARY

### 2.1 General Remarks

Date of receipt of test sample	:	Oct. 10, 2019
Testing commenced on	:	Oct. 11, 2019
Testing concluded on	:	Oct. 24, 2019

### 2.2 Product Description

Product Name:	Smart Terminal			
Model:	S900Plus			
Power supply:	DC 3.8V from battery			
WIFI				
Supported type:	20MHz system	40MHz system	80MHz system	160MHz system
	802.11a 802.11n	802.11n	N/A	N/A
Operation frequency:	5180 - 5240MHz 5745 - 5825MHz	5190 - 5230MHz 5755MHz-5795MHz	N/A	N/A
Modulation:	OFDM	OFDM	N/A	N/A
Channel number:	9	4	N/A	N/A
Channel separation:	20MHz	40MHz	N/A	N/A
Antenna type:	FPC antenna			
Antenna gain:	1.0dBi			

### 2.3 Equipment Under Test

#### Power supply system utilised

Power supply voltage	:	<input type="radio"/> 230V / 50 Hz	<input type="radio"/> 120V / 60Hz
		<input type="radio"/> 12 V DC	<input type="radio"/> 24 V DC
		<input checked="" type="radio"/> Other (specified in blank below)	

DC 3.8V from battery

### 2.4 Short description of the Equipment under Test (EUT)

This is a Smart Terminal.

For more details, refer to the user's manual of the EUT.

## 2.5 EUT operation mode

The Applicant provides communication tools software to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing.

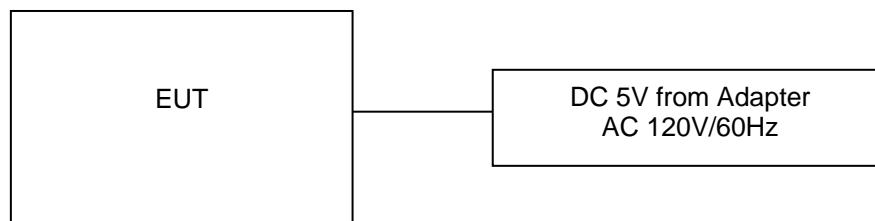
All test performed at the low, middle and high of operational frequency range of each mode.

Operation Frequency List WIFI on 5G Band:

Operating band	20MHz		40MHz		80MHz	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
U-NII 1 (5150MHz-5250MHz)	36	5180	38	5190	N/A	N/A
	40	5200				
	44	5220	46	5230		
	48	5240				
U-NII 3 (5725MHz-5850MHz)	149	5745	151	5755	N/A	N/A
	153	5765				
	157	5785	159	5795		
	161	5805				
	165	5825				

Note: The line display in grey is those Channels/Frequencies select to test in this report for each operation mode.

## 2.6 Block Diagram of Test Setup



## 2.7 Special Accessories

Follow auxiliary equipment(s) test with EUT that provided by the manufacturer or laboratory is listed as follow:

Description	Manufacturer	Model	Technical Parameters	Certificate	Provided by
/	/	/	/	/	/
/	/	/	/	/	/
/	/	/	/	/	/
/	/	/	/	/	/

## 2.8 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended to comply with Section 15.407 of the FCC Part 15, Subpart E Rules.

## 2.9 Modifications

No modifications were implemented to meet testing criteria.

### **3 TEST ENVIRONMENT**

#### **3.1 Address of the test laboratory**

**Shenzhen Global Test Service Co.,Ltd.**

No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

#### **3.2 Test Facility**

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

**FCC-Registration No.: 165725**

Shenzhen Global Test Service Co.,Ltd EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

**A2LA-Lab Cert. No.: 4758.01**

Shenzhen Global Test Service Co.,Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

**CNAS-Lab Code: L8169**

Shenzhen Global Test Service Co.,Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories. Date of Registration: Dec. 11, 2015. Valid time is until Dec. 10, 2024.

#### **3.3 Environmental conditions**

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

Temperature:	15-35 ° C
Humidity:	30-60 %
Atmospheric pressure:	950-1050mbar

### 3.4 Test Description

FCC Requirement		
FCC Part 15.207	AC Power Conducted Emission	PASS
FCC Part 15.407(a)	Emission Bandwidth(26dBm Bandwidth)	PASS <sup>Note1</sup>
FCC Part 15.407(e)	Minimum Emission Bandwidth(6dBm Bandwidth)	PASS <sup>Note2</sup>
FCC Part 15.407(a)	Maximum Conducted Output Power	PASS
FCC Part 15.407(a)	Peak Power Spectral Density	PASS
FCC Part 15.407(g)	Frequency Stability	PASS
FCC Part 15.407(b)	Undesirable emission	PASS
FCC Part 15.407(b)/15.205/15.209	Radiated Emissions	PASS
FCC Part 15.407(h)	Dynamic Frequency Selection	N/A <sup>Note 3</sup>
FCC Part 15.203/15.247(b)	Antenna Requirement	PASS

Note 1: Apply to U-NII 1, U-NII 2A, and U-NII 2C band.

Note 2: Apply to U-NII 3 band only.

Note 3: This device not work in DFS band.

#### Data Rate Used:

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Test Items	Mode	Data Rate
Maximum Conducted Output Power Power Spectral Density Emission Bandwidth(26dBm Bandwidth) Minimum Emission Bandwidth(6dBm Bandwidth) Undesirable emission Frequency Stability	11a/OFDM	6 Mbps
	11n(20MHz) /OFDM	7.2 Mbps
	11n(40MHz) /OFDM	15.0Mbps

### 3.5 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Shenzhen Global Test Service Co.,Ltd quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Shenzhen GTS laboratory is reported:

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	30~1000MHz	4.10 dB	(1)
Radiated Emission	1~18GHz	4.32 dB	(1)
Radiated Emission	18-40GHz	5.54 dB	(1)
Conducted Disturbance	0.15~30MHz	3.12 dB	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.



### 3.6 Equipments Used during the Test

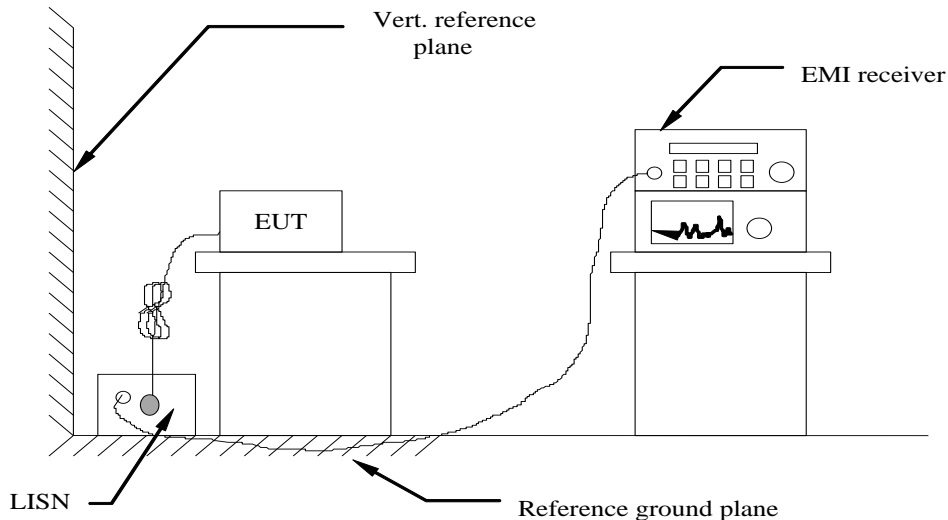
Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	3560.6550.08	2019/09/19	2020/09/18
LISN	R&S	ESH2-Z5	893606/008	2019/09/19	2020/09/18
Bilog Antenna	Schwarzbeck	VULB9163	976	2019/09/19	2020/09/18
EMI Test Receiver	R&S	ESCI7	101102	2019/09/19	2020/09/18
Spectrum Analyzer	Agilent	N9020A	MY48010425	2019/09/19	2020/09/18
Spectrum Analyzer	R&S	FSP40	100019	2019/09/19	2020/09/18
Controller	EM Electronics	Controller EM 1000	N/A	N/A	N/A
Horn Antenna	Schwarzbeck	BBHA 9120D	01622	2019/09/19	2020/09/18
Active Loop Antenna	SCHWARZBEC K	FMZB1519	1519-037	2019/09/19	2020/09/18
Broadband Horn Antenna	SCHWARZBEC K	BBHA 9170	971	2019/09/19	2020/09/18
Amplifier	Schwarzbeck	BBV 9743	#202	2019/09/19	2020/09/18
Amplifier	EMCI	EMC051845B	980355	2019/09/19	2020/09/18
Temperature/Humidity Meter	Gangxing	CTH-608	02	2019/09/19	2020/09/18
High-Pass Filter	K&L	9SH10-2700/X12750-O/O	KL142031	2019/09/19	2020/09/18
High-Pass Filter	K&L	41H10-1375/U12750-O/O	KL142032	2019/09/19	2020/09/18
RF Cable(below 1GHz)	HUBER+SUHNER	RG214	RE01	2019/09/19	2020/09/18
RF Cable(above 1GHz)	HUBER+SUHNER	RG214	RE02	2019/09/19	2020/09/18
Data acquisition card	Agilent	U2531A	TW53323507	2019/09/19	2020/09/18
Power Sensor	Agilent	U2021XA	MY5365004	2019/09/19	2020/09/18
EMI Test Software	R&S	ES-K1	V1.7.1	2019/09/19	2020/09/18
EMI Test Software	JS Tonscend	JS32-RE	2.0.1.5	2019/09/19	2020/09/18

Note: The Cal.Interval was one year.

## 4 TEST CONDITIONS AND RESULTS

### 4.1 AC Power Conducted Emission

#### TEST CONFIGURATION



#### TEST PROCEDURE

- 1 The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2013.
- 2 Support equipment, if needed, was placed as per ANSI C63.10-2013
- 3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013
- 4 The EUT received DC 12V power from adapter, the adapter received AC120V/60Hz and AC 240V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
- 5 All support equipments received AC power from a second LISN, if any.
- 6 The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
- 7 Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
- 8 During the above scans, the emissions were maximized by cable manipulation.

#### AC Power Conducted Emission Limit

For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following :

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

\* Decreases with the logarithm of the frequency.

**TEST RESULTS**

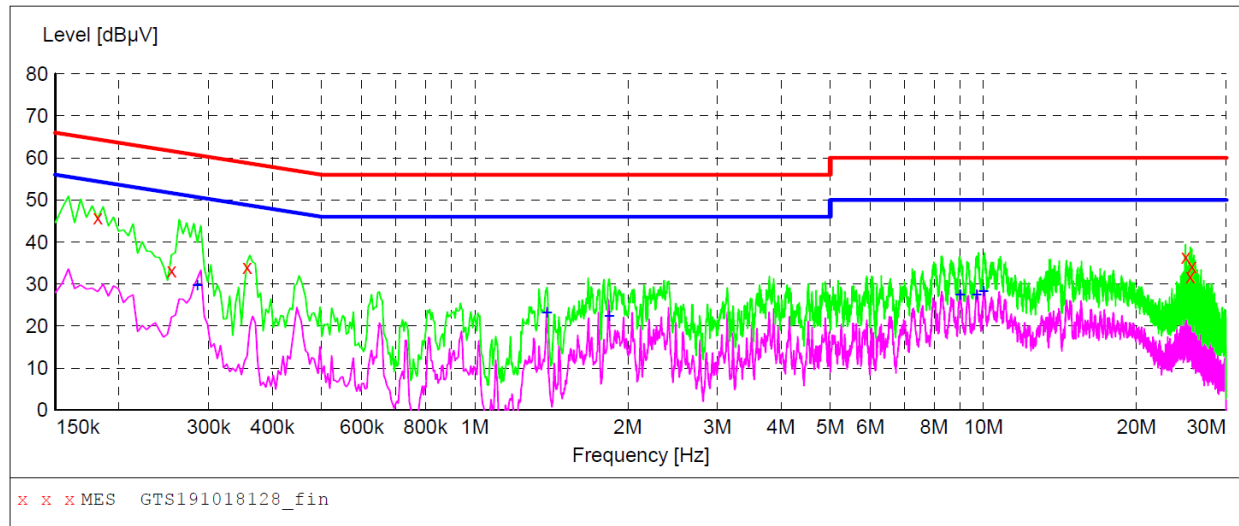
Remark:

1. All modes of 802.11a/n were tested at Low, Middle, and High channel; only the worst result of 802.11a CH36 was reported as below:
2. Both 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz power supply have been tested, only the worst result of 120 VAC, 60 Hz was reported as below:

Power supply:	AC 120V/60Hz(adapter)	Polarization	L
---------------	-----------------------	--------------	---

**SCAN TABLE: "Voltage (9K-30M) FIN"**

Short Description: 150K-30M Voltage

**MEASUREMENT RESULT: "GTS191018128\_fin"**

10/18/2019 11:33AM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.181501	45.70	10.2	64	18.7	QP	L1	GND
0.253501	33.30	10.2	62	28.3	QP	L1	GND
0.357001	34.10	10.2	59	24.7	QP	L1	GND
24.967501	36.50	11.1	60	23.5	QP	L1	GND
25.507501	31.70	11.1	60	28.3	QP	L1	GND
25.687501	34.20	11.1	60	25.8	QP	L1	GND

**MEASUREMENT RESULT: "GTS191018128\_fin2"**

10/18/2019 11:33AM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.285001	29.70	10.2	51	21.0	AV	L1	GND
1.387501	23.30	10.3	46	22.7	AV	L1	GND
1.837501	22.40	10.3	46	23.6	AV	L1	GND
9.001501	27.50	10.6	50	22.5	AV	L1	GND
9.699001	27.50	10.6	50	22.5	AV	L1	GND
10.009501	28.30	10.6	50	21.7	AV	L1	GND

Power supply:

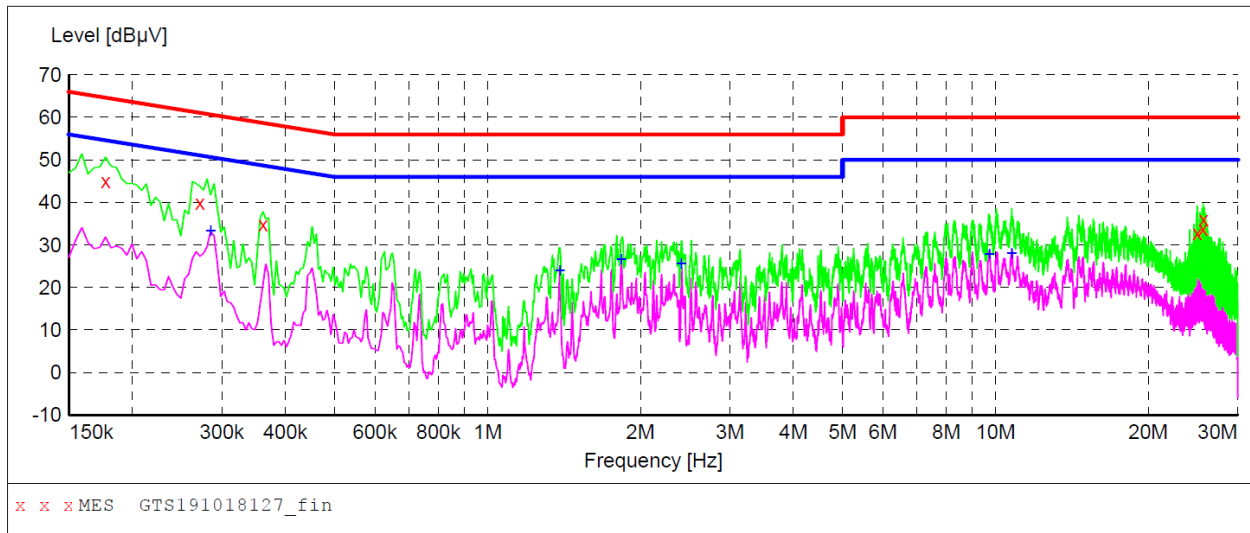
AC 120V/60Hz(adapter)

Polarization

N

**SCAN TABLE: "Voltage (9K-30M)FIN"**

Short Description: 150K-30M Voltage

**MEASUREMENT RESULT: "GTS191018127\_fin"**

10/18/2019 11:30AM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.177001	45.00	10.2	65	19.6	QP	N	GND
0.271501	39.80	10.2	61	21.3	QP	N	GND
0.361501	34.80	10.2	59	23.9	QP	N	GND
24.972001	32.80	11.1	60	27.2	QP	N	GND
25.633501	33.70	11.1	60	26.3	QP	N	GND
25.692001	36.00	11.1	60	24.0	QP	N	GND

**MEASUREMENT RESULT: "GTS191018127\_fin2"**

10/18/2019 11:30AM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.285001	33.30	10.2	51	17.4	AV	N	GND
1.387501	24.00	10.3	46	22.0	AV	N	GND
1.833001	26.60	10.3	46	19.4	AV	N	GND
2.404501	25.70	10.4	46	20.3	AV	N	GND
9.721501	27.90	10.6	50	22.1	AV	N	GND
10.747501	28.10	10.6	50	21.9	AV	N	GND

## 4.2 Radiated Emissions

### Limit

The maximum 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 e.i.r.p. of -27 dBm/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 e.i.r.p. of -27 dBm/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 e.i.r.p. of -27 dBm/MHz.
- (4) For transmitters operating in the 5.725-5.85 GHz band: All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

### Undesirable emission limits

Requirement	Limit(EIRP)	Limit (Field strength at 3m) <sup>Note1</sup>
15.407(b)(1)	PK:-27(dBm/MHz)	PK:68.2(dBμV/m)
15.407(b)(2)		
15.407(b)(3)		
15.407(b)(4)		

Note1: The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength:

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

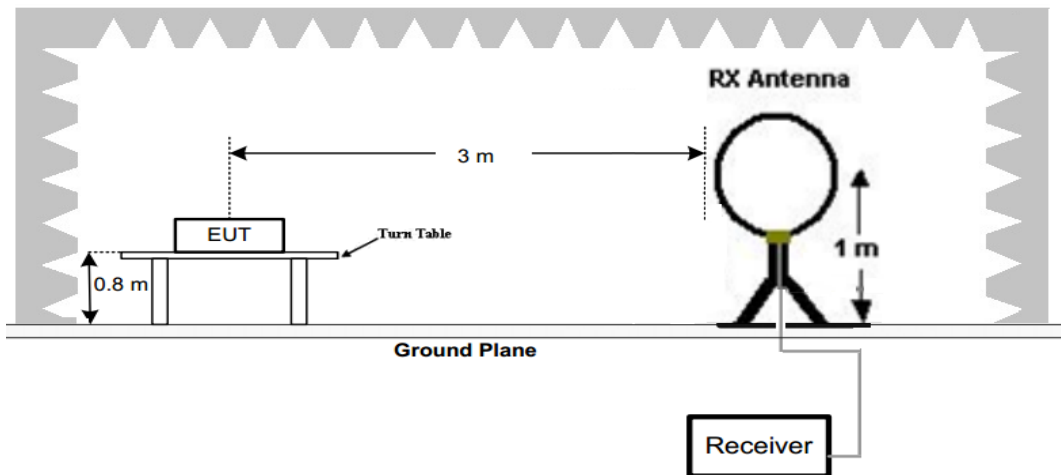
- (5) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209
- (6) In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a)

### Radiated emission limits

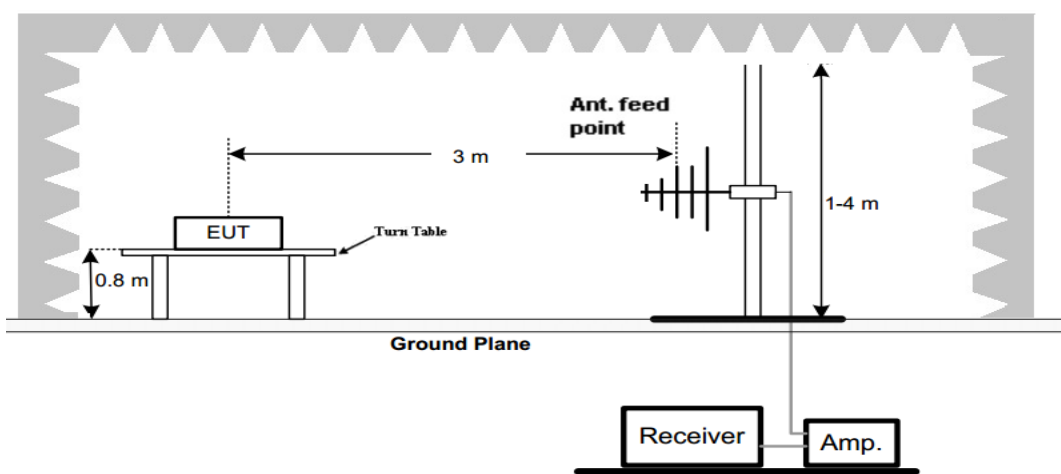
Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(30/3)	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

**TEST CONFIGURATION**

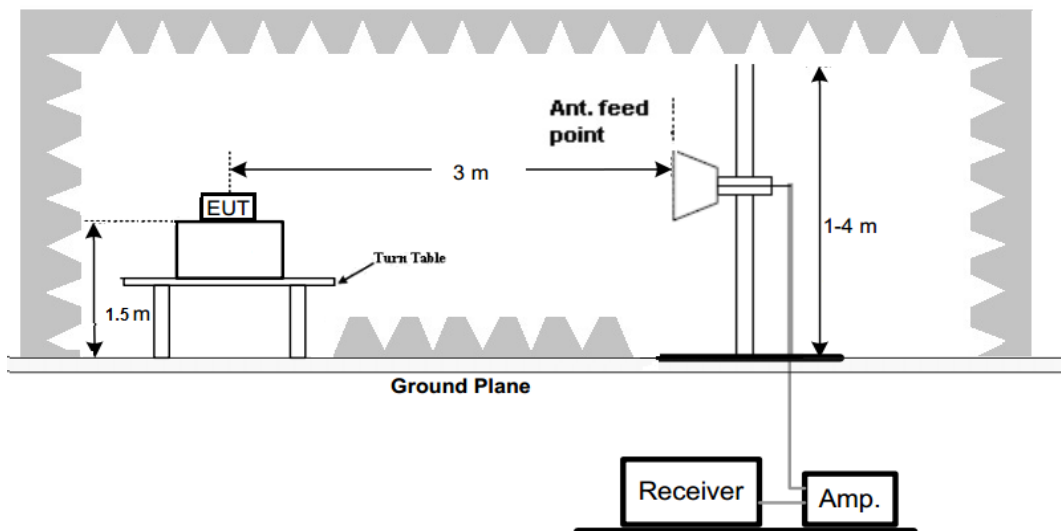
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency below 1000MHz



(C) Radiated Emission Test Set-Up, Frequency above 1000MHz



**Test Procedure**

- Below 1GHz measurement the EUT is placed on a turntable which is 0.8m above ground plane, and above 1GHz measurement EUT was placed on a low permittivity and low loss tangent turn table which is 1.5m above ground plane.
- Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° to acquire the highest emissions from EUT
- And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- Repeat above procedures until all frequency measurements have been completed.
- Radiated emission test frequency band from 9KHz to 40GHz.
- The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Bilog Antenna	3
1GHz-18GHz	Horn Antenna	3
18GHz-25GHz	Horn Antenna	1

- Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz-150KHz	RBW=200Hz/VBW=3KHz, Sweep time=Auto	QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz, Sweep time=Auto	QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz, Sweep time=Auto	QP
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

**TEST RESULTS**

Remark:

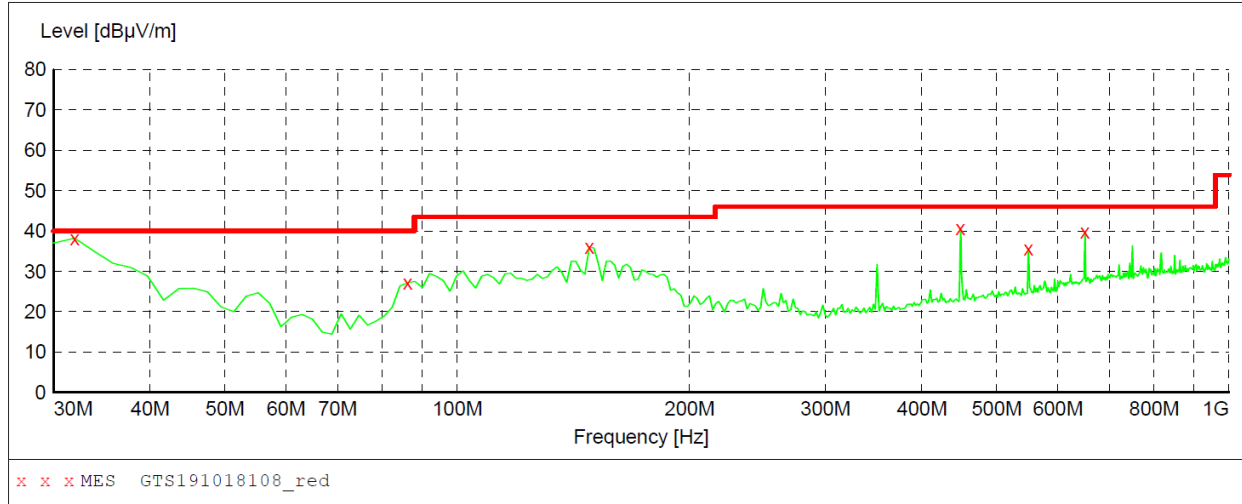
- This test was performed with EUT in X, Y, Z position and the worse case was found when EUT in X position.
- All 802.11a / 802.11n (HT20) / 802.11n (HT40) modes have been tested for below 1GHz test, only the worst case 802.11a low channel of U-NII 1 band was recorded.
- All 802.11a / 802.11n (HT20) / 802.11n (HT40) modes have been tested for above 1GHz test, only the worst case 802.11a was recorded.
- Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9 KHz to 30MHz and not recorded in this report.

## For 30MHz-1GHz

## Horizontal

***SWEEP TABLE: "test (30M-1G)"***

Short Description:		Field Strength			
Start	Stop	Detector	Meas.	IF	Transducer
Frequency	Frequency		Time	Bandw.	
30.0 MHz	1.0 GHz	MaxPeak	300.0 ms	120 kHz	VULB 9163

***MEASUREMENT RESULT: "GTS191018108\_red"***

10/18/2019 9:14AM

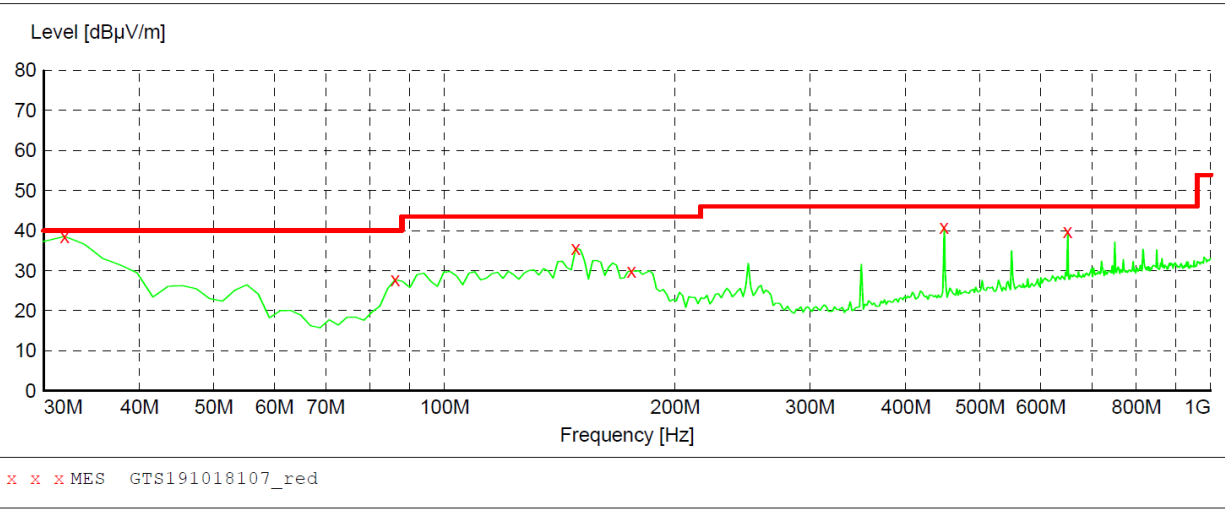
Frequency MHz	Level dBμV/m	Transd dB	Limit dBμV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
31.940000	38.20	19.2	40.0	1.8	---	0.0	0.00	HORIZONTAL
86.260000	27.10	9.0	40.0	12.9	---	0.0	0.00	HORIZONTAL
148.340000	36.00	13.8	43.5	7.5	---	0.0	0.00	HORIZONTAL
449.040000	40.70	19.1	46.0	5.3	---	0.0	0.00	HORIZONTAL
549.920000	35.60	21.0	46.0	10.4	---	0.0	0.00	HORIZONTAL
650.800000	39.80	22.8	46.0	6.2	---	0.0	0.00	HORIZONTAL

## Vertical



***SWEEP TABLE: "test (30M-1G)"***

Short Description:		Field Strength			
Start	Stop	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency				
30.0 MHz	1.0 GHz	MaxPeak	300.0 ms	120 kHz	VULB 9163



***MEASUREMENT RESULT: "GTS191018107\_red"***

10/18/2019 9:07AM									
Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization	
31.940000	38.50	19.2	40.0	1.5	---	0.0	0.00	VERTICAL	
86.260000	27.70	9.0	40.0	12.3	---	0.0	0.00	VERTICAL	
148.340000	35.50	13.8	43.5	8.0	---	0.0	0.00	VERTICAL	
175.500000	29.90	12.9	43.5	13.6	---	0.0	0.00	VERTICAL	
449.040000	40.90	19.1	46.0	5.1	---	0.0	0.00	VERTICAL	
650.800000	39.80	22.8	46.0	6.2	---	0.0	0.00	VERTICAL	

**For 1GHz to 25GHz**

Note: All 802.11a / 802.11n (HT20) /802.11n (HT40) modes have been tested for above 1GHz test, only the worst case 802.11a was recorded.

**U-NII 1 & 802.11a Mode (above 1GHz)**

Tested Channel	Frequency (MHz)	Emission Level (dBuV/m)	Detector Mode	ANT Pol	Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre amplifier (dB)	Correction Factor (dB/m)
36.00 (5180MHz)	5150.00	56.35	PK	H	68.20	11.85	49.07	34.44	7.12	34.28	7.28
	5150.00	47.58	AV	H	54.00	6.42	40.30	34.44	7.12	34.28	7.28
	10360.00	49.50	PK	H	68.20	18.70	33.77	39.20	11.45	34.92	15.73
	--	--	--	--	--	--	--	--	--	--	--
40.00 (5200MHz)	10400.00	50.22	PK	H	68.20	17.98	34.41	39.22	11.48	34.89	15.81
	--	--	--	--	--	--	--	--	--	--	--
48.00 (5240MHz)	5350.50	47.50	PK	H	68.20	20.70	40.47	34.23	7.36	34.56	7.03
	10480.00	49.15	PK	H	68.20	19.05	32.00	39.41	11.83	34.09	17.15
	--	--	--	--	--	--	--	--	--	--	--

Tested Channel	Frequency (MHz)	Emission Level (dBuV/m)	Detector Mode	ANT Pol	Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre amplifier (dB)	Correction Factor (dB/m)
36.00 (5180MHz)	5150.00	57.86	PK	V	68.20	10.34	50.58	34.44	7.12	34.28	7.28
	5150.00	49.20	AV	V	54.00	4.80	41.92	34.44	7.12	34.28	7.28
	10360.00	50.33	PK	V	68.20	17.87	34.60	39.20	11.45	34.92	15.73
	--	--	--	--	--	--	--	--	--	--	--
40.00 (5200MHz)	10400.00	49.33	PK	V	68.20	18.87	33.52	39.22	11.48	34.89	15.81
	--	--	--	--	--	--	--	--	--	--	--
48.00 (5240MHz)	5350.50	48.36	PK	V	68.20	19.84	41.33	34.23	7.36	34.56	7.03
	10480.00	52.00	PK	V	68.20	16.20	34.85	39.41	11.83	34.09	17.15
	--	--	--	--	--	--	--	--	--	--	--

**U-NII 3 & 802.11a Mode (above 1GHz)**

Channel	(MHz)	Level (dBuV/m)	Mode	Pol	(dBuV/m)	(dB)	Value (dBuV)	Factor (dB/m)	Factor (dB)	amplifier (dB)	Factor (dB/m)
	5720.00	55.26	PK	H	68.20	12.94	47.98	34.44	7.12	34.28	7.28
149.00 (5745MHz)	5720.00	45.26	AV	H	54.00	8.74	33.75	37.64	9.28	35.41	11.51
	11490.00	49.22	PK	H	68.20	18.98	30.96	39.69	12.90	34.33	18.26
	--	--	--	--	--	--	--	--	--	--	--
157.00 (5785MHz)	11570.00	50.87	PK	H	68.20	17.33	32.42	39.71	13.05	34.31	18.45
	--	--	--	--	--	--	--	--	--	--	--
48.00 (5825MHz)	5855.00	53.65	PK	H	68.20	14.55	42.11	37.64	9.28	35.38	11.54
	11650.00	45.77	PK	H	68.20	22.43	27.15	39.73	13.19	34.30	18.62
	--	--	--	--	--	--	--	--	--	--	--

Tested Channel	Frequency (MHz)	Emission Level (dBuV/m)	Detector Mode	ANT Pol	Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre amplifier (dB)	Correction Factor (dB/m)
	5720.00	56.25	PK	V	68.20	11.95	48.97	34.44	7.12	34.28	7.28
149.00 (5745MHz)	5720.00	47.88	AV	V	54.00	6.12	36.37	37.64	9.28	35.41	11.51
	11490.00	49.51	PK	V	68.20	18.69	31.25	39.69	12.90	34.33	18.26
	--	--	--	--	--	--	--	--	--	--	--
157.00 (5785MHz)	11570.00	52.22	PK	V	68.20	15.98	33.77	39.71	13.05	34.31	18.45
	--	--	--	--	--	--	--	--	--	--	--
48.00 (5825MHz)	5855.00	51.87	PK	V	68.20	16.33	40.33	37.64	9.28	35.38	11.54
	11650.00	43.25	PK	V	68.20	24.95	24.63	39.73	13.19	34.30	18.62
	--	--	--	--	--	--	--	--	--	--	--

**REMARKS:**

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
3. Margin value = Limit value- Emission level.
4. -- Mean the other emission levels were very low against the limit.

5. RBW1MHz VBW3MHz Peak detector is for PK value; RBW 1MHz VBW10Hz Peak detector is for AV value.
6. Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40,

### 4.3 Maximum Conducted Average Output Power

#### Limit

#### **FCC requirement:**

#### **For the band 5.15-5.25 GHz.**

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi.

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.

(iv) 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.

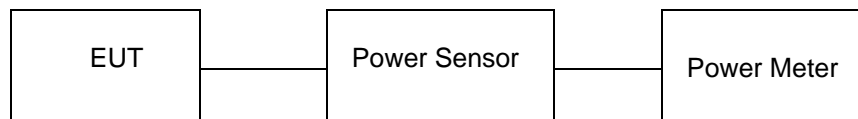
**For the 5.25-5.35 GHz and 5.47-5.725 GHz bands**, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or  $11 \text{ dBm} + 10 \log B$ , where B is the 26 dB emission bandwidth in megahertz.

**For the band 5.725-5.85 GHz**, the maximum conducted output power over the frequency band of operation shall not exceed 1 W

#### Test Procedure

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power sensor.

#### Test Configuration



#### Test Results

##### **U-NII 1**

Type	Channel	Output power (dBm)	Limit (dBm)	Result
802.11a	36	17.02	23.98	Pass
	40	17.51		
	48	16.42		
802.11n(HT20)	36	16.15	23.98	Pass
	40	16.92		
	48	16.18		
802.11n(HT40)	38	16.57	23.98	Pass
	46	16.82		

##### **U-NII 3**

Type	Channel	Output power (dBm)	Limit (dBm)	Result
802.11a	149	16.40	30.00	Pass
	157	15.25		
	165	16.98		
802.11n(HT20)	149	15.24	30.00	Pass
	157	16.15		
	165	16.85		
802.11n(HT40)	151	15.11	30.00	Pass
	159	16.05		

#### *Note:*

1. Measured output power at difference data rate for each mode and recorded worst case for each mode.
2. Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40.
3. Test results including cable loss;

## 4.4 Power Spectral Density

### Limit

#### **FCC requirement:**

##### **For the band 5.15-5.25 GHz.**

- (i) For an outdoor access point operating in the band 5.15 - 5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 MHz band.<sup>note1</sup>
- (ii) For an indoor access point operating in the band 5.15 - 5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 MHz band.<sup>note1</sup>
- (iii) For fixed point-to-point access points operating in the band 5.15 - 5.25 GHz, transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi.
- (iv) For mobile and portable client devices in the 5.15 - 5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 MHz band.<sup>note1</sup>

##### **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.

#### **IC requirement:**

##### **For the band 5.15-5.25 GHz.**

The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

##### **Frequency band 5250-5350 MHz**

The power spectral density shall not exceed 11 dBm in any 1.0 MHz band

##### **Frequency bands 5470-5600 MHz and 5650-5725 MHz**

The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.

##### **For the band 5.725 - 5.85 GHz**

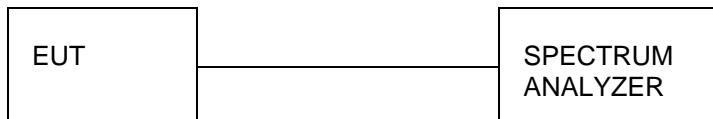
The maximum power spectral density shall not exceed 30 dBm in any 500 kHz band.<sup>note1, note2</sup>

Note1: If transmitting antennas of directional gain greater than 6 dBi are used, the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Note2: Fixed point - to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information.

### **Test Procedure**

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW = 1MHz for U-NII 1, U-NII 2A, U-NII C band and 510KHz for U-NII 3 band.
3. Set the VBW  $\geq 3 \times$  RBW.
4. Set the span to encompass the entire EBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum power level.

**Test Configuration****Test Results*****U-NII 1***

<i>Type</i>	<i>Channel</i>	<i>P.S.D (dBm/MHz)</i>	<i>Limit (dBm/ MHz)</i>	<i>Result</i>
802.11a	36	8.530	11.00	Pass
	40	8.291		
	48	7.133		
802.11n(HT20)	36	8.032		Pass
	40	8.111		
	48	6.910		
802.11n(HT40)	38	6.731		Pass
	46	7.699		

***U-NII 3***

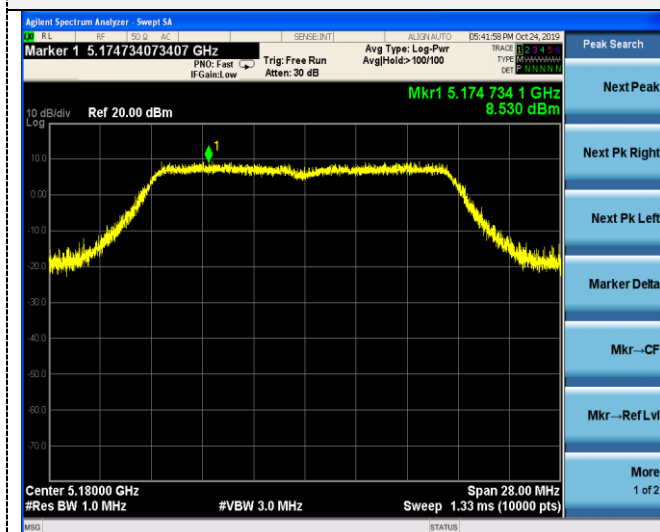
<i>Type</i>	<i>Channel</i>	<i>Power Spectral Density (dBm/500KHz)</i>	<i>Limit (dBm/500KHz)</i>	<i>Result</i>
802.11a	149	5.471	30	Pass
	157	4.156		
	165	6.056		
802.11n(HT20)	149	5.522		
	157	6.277		
	165	6.044		
802.11n(HT40)	151	5.034		
	159	5.467		

***Note:***

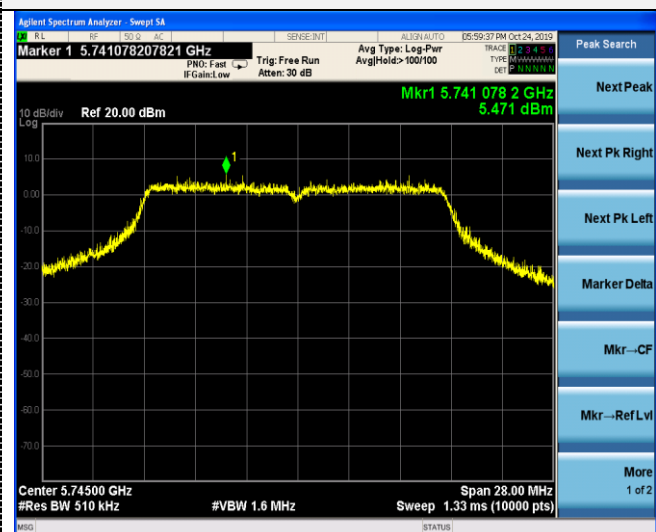
1. Measured output power at difference data rate for each mode and recorded worst case for each mode.
2. Test results including cable loss;
3. Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40,
4. Please refer to following test plots;

802.11a

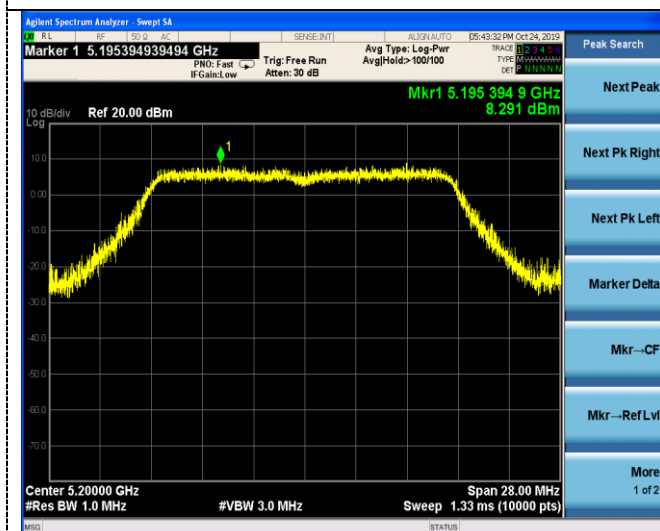
U-NII 1



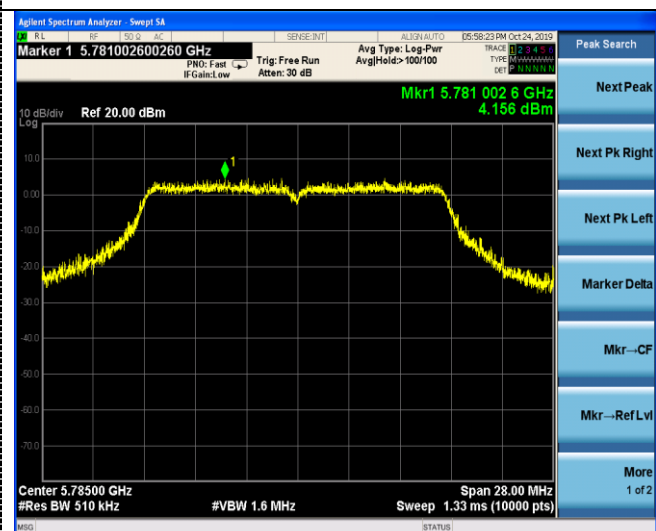
U-NII 3



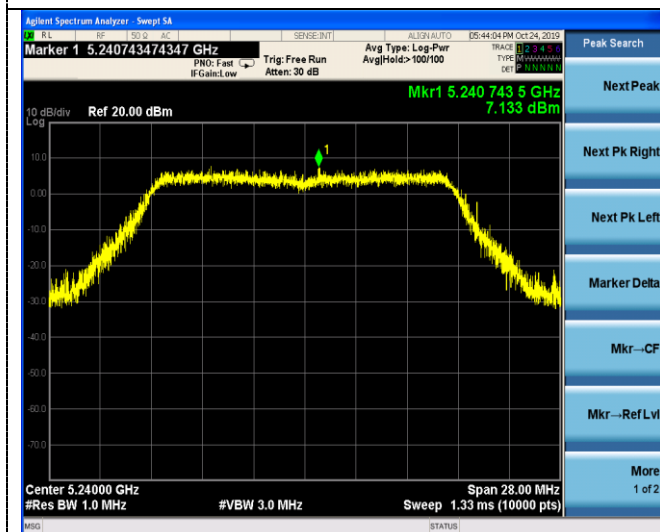
CH36



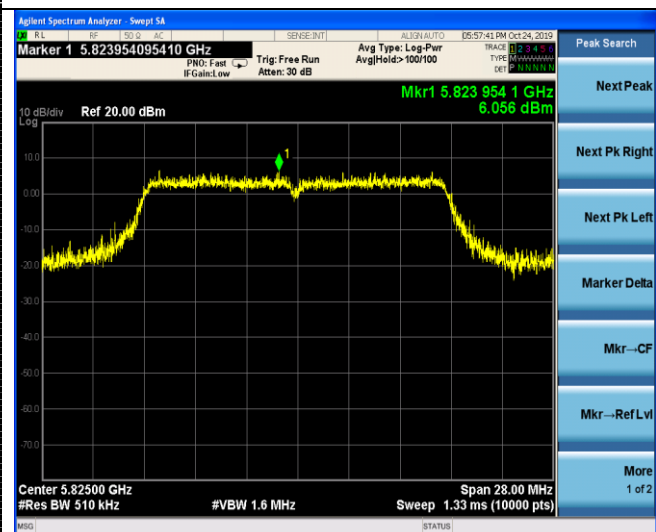
CH149



CH40



CH157

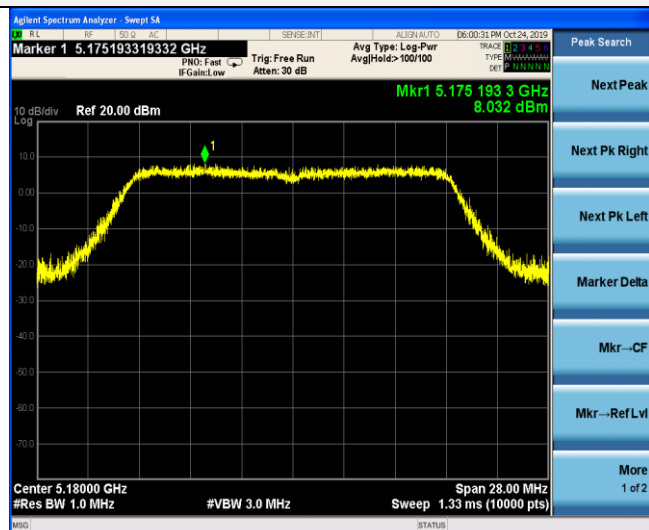


CH48

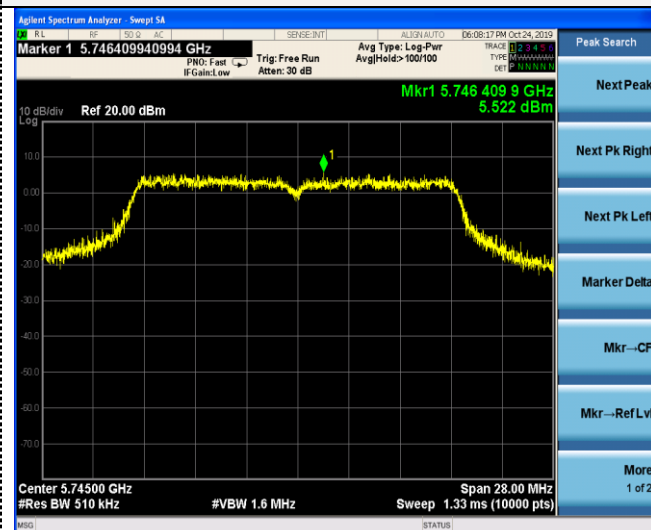
CH165

802.11n(HT20)

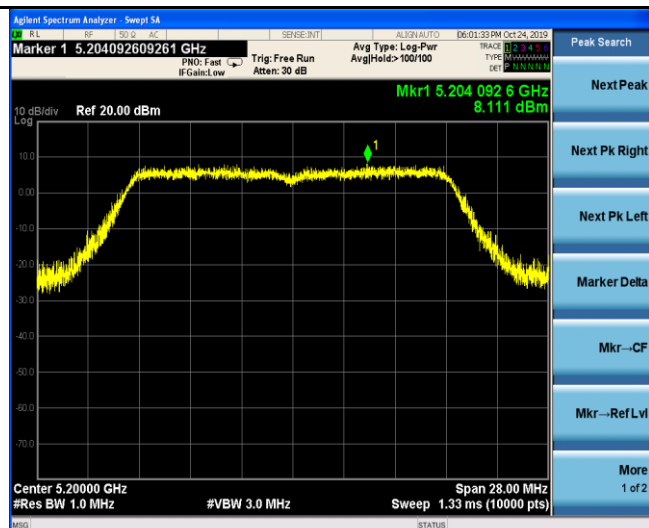
U-NII 1



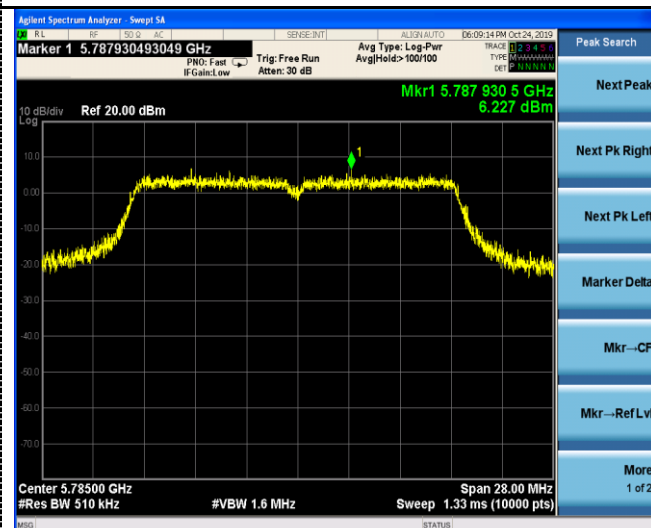
U-NII 3



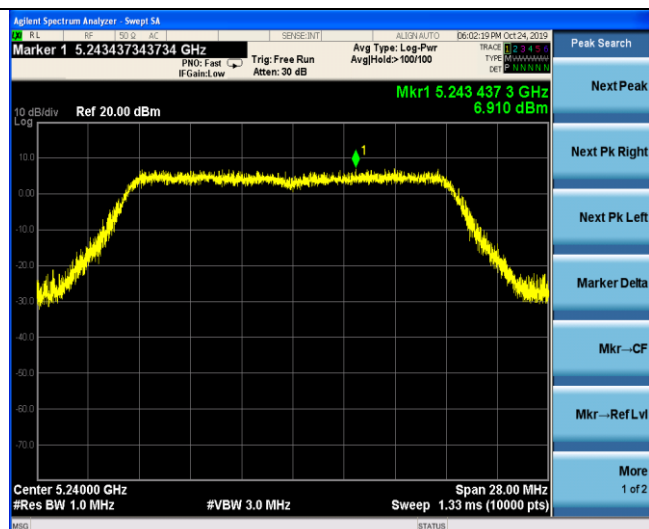
CH36



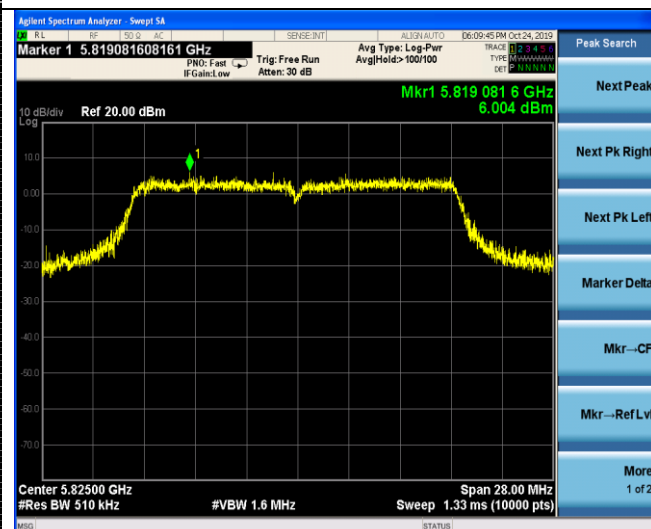
CH149



CH40



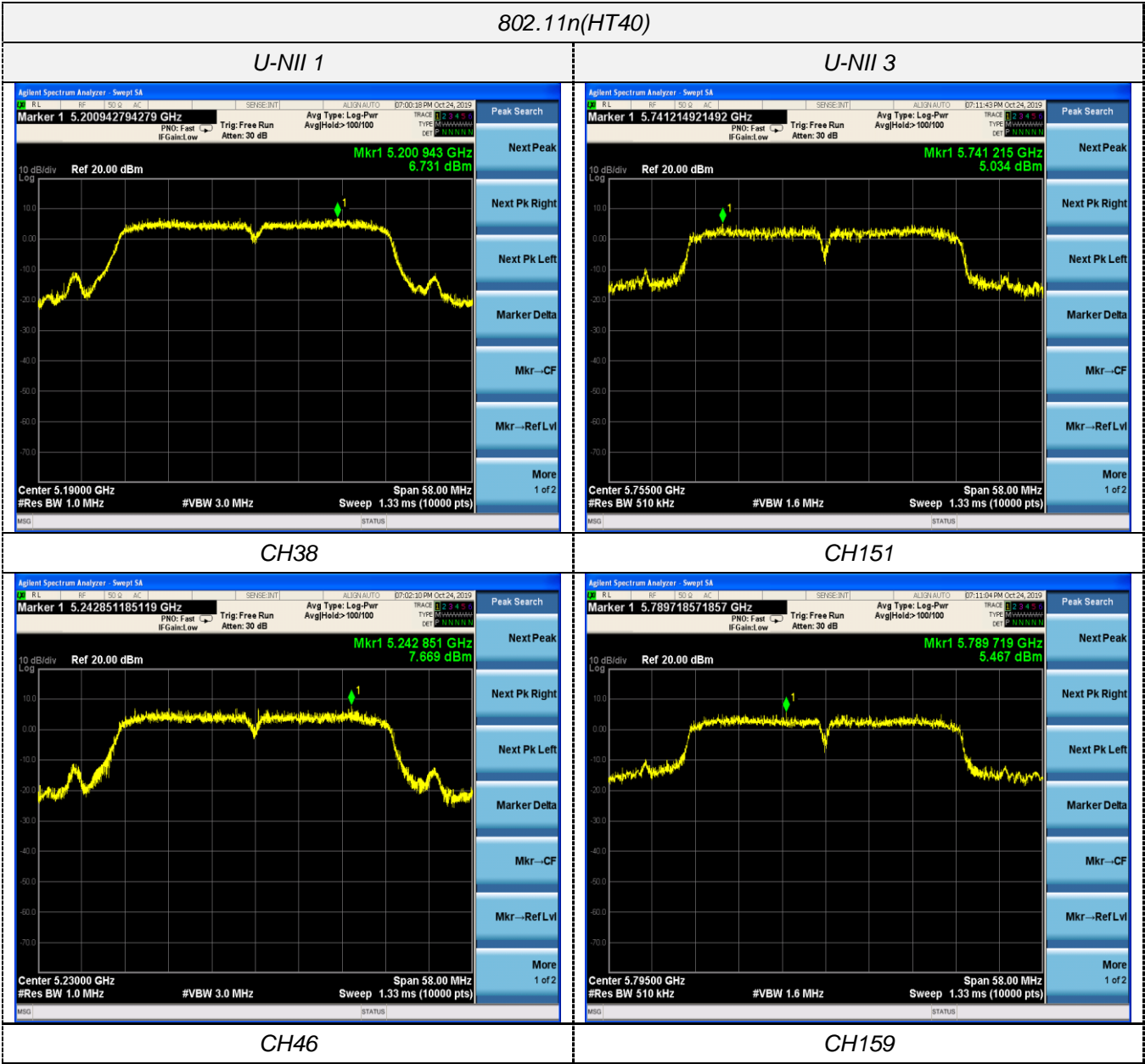
CH157



CH48

CH165





## 4.5 Emission Bandwidth (26dBm Bandwidth)

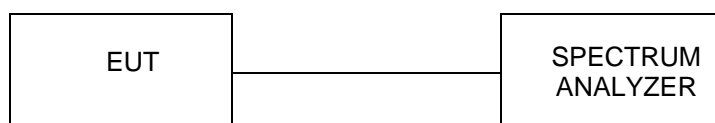
### Limit

N/A

### Test Procedure

1. Set resolution bandwidth (RBW) = approximately 1 % of the EBW.
2. Set the video bandwidth (VBW) > RBW.
3. Detector = Peak.
4. Trace mode = Max hold.
5. 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 %.

### Test Configuration



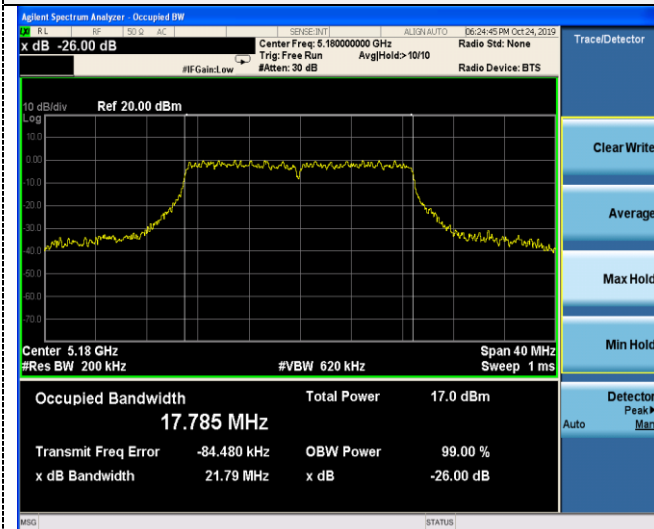
### Test Results

Type	Bands	Channel	26dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limit (MHz)	Result
802.11a	U-NII 1	36	21.79	17.785	N/A	Pass
		40	21.33	16.656		
		48	21.34	16.686		
802.11n(HT20)	U-NII 1	36	21.52	17.784		
		40	21.97	17.804		
		48	21.04	17.772		
802.11n(HT40)	U-NII 1	38	48.97	36.660		
		46	59.56	36.627		

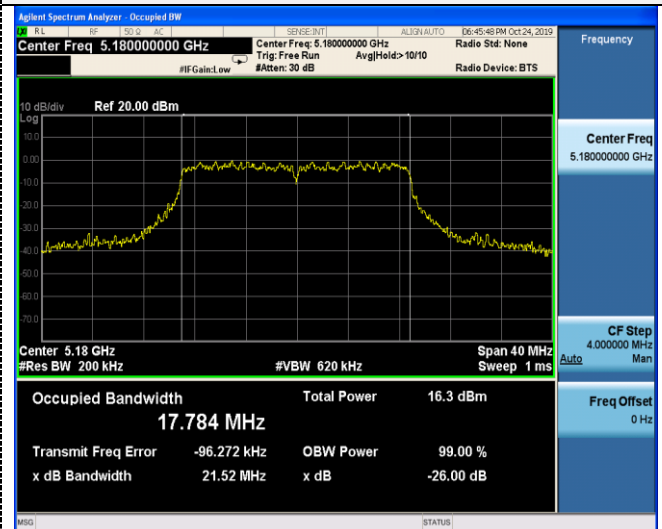
Note:

1. Measured 26dB bandwidth at difference data rate for each mode and recorded worst case for each mode.
2. Test results including cable loss;
3. Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40.
4. Please refer to following test plots;

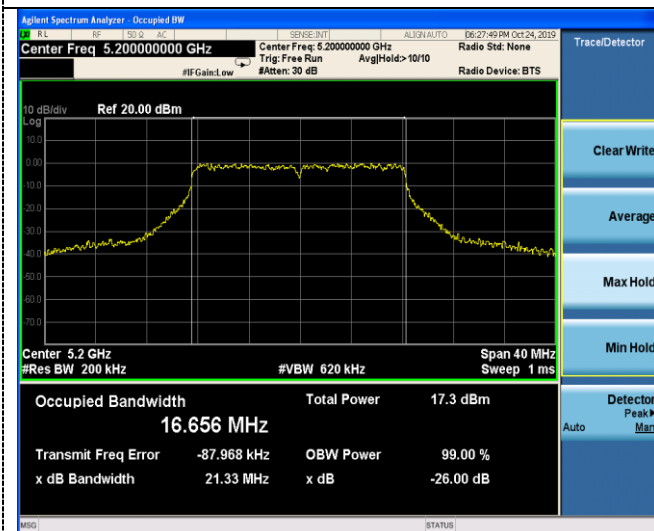
802.11a



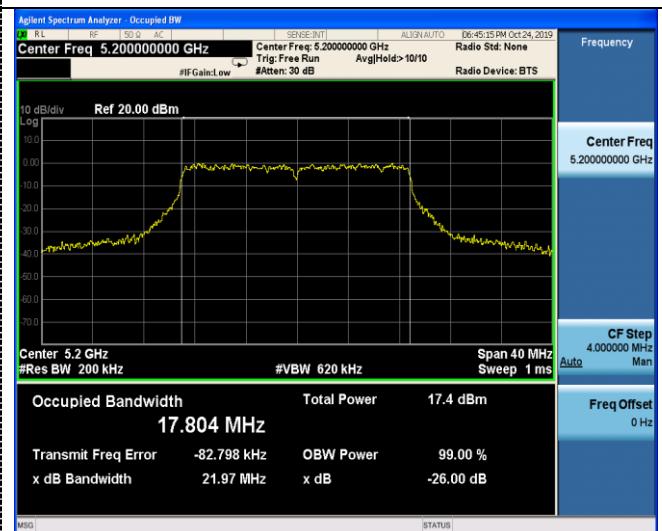
802.11n(HT20)



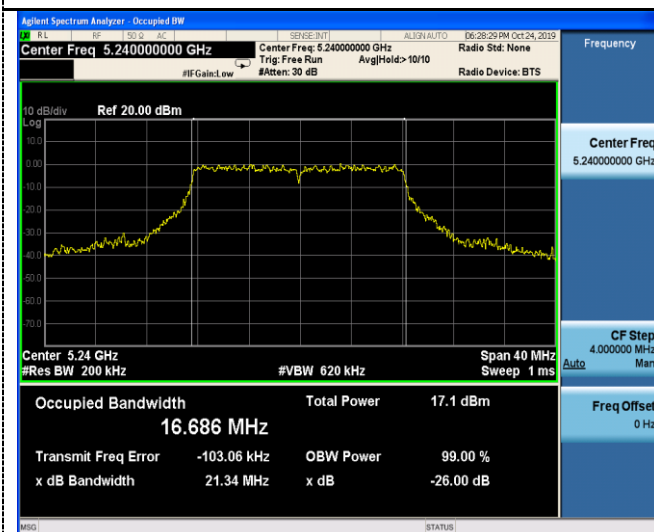
CH36



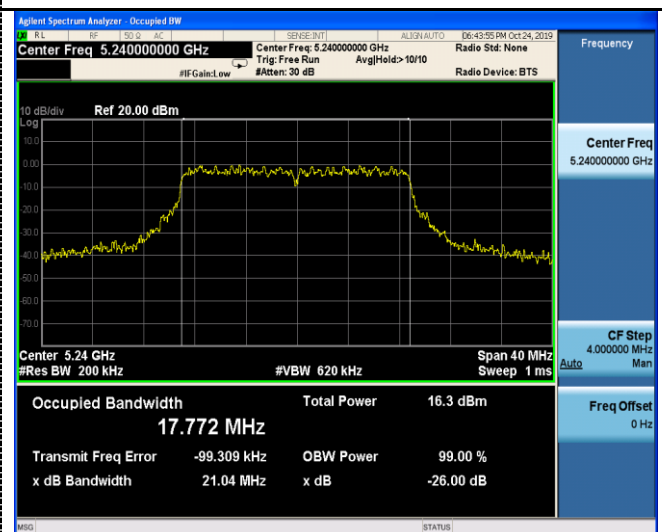
CH36



CH40



CH40

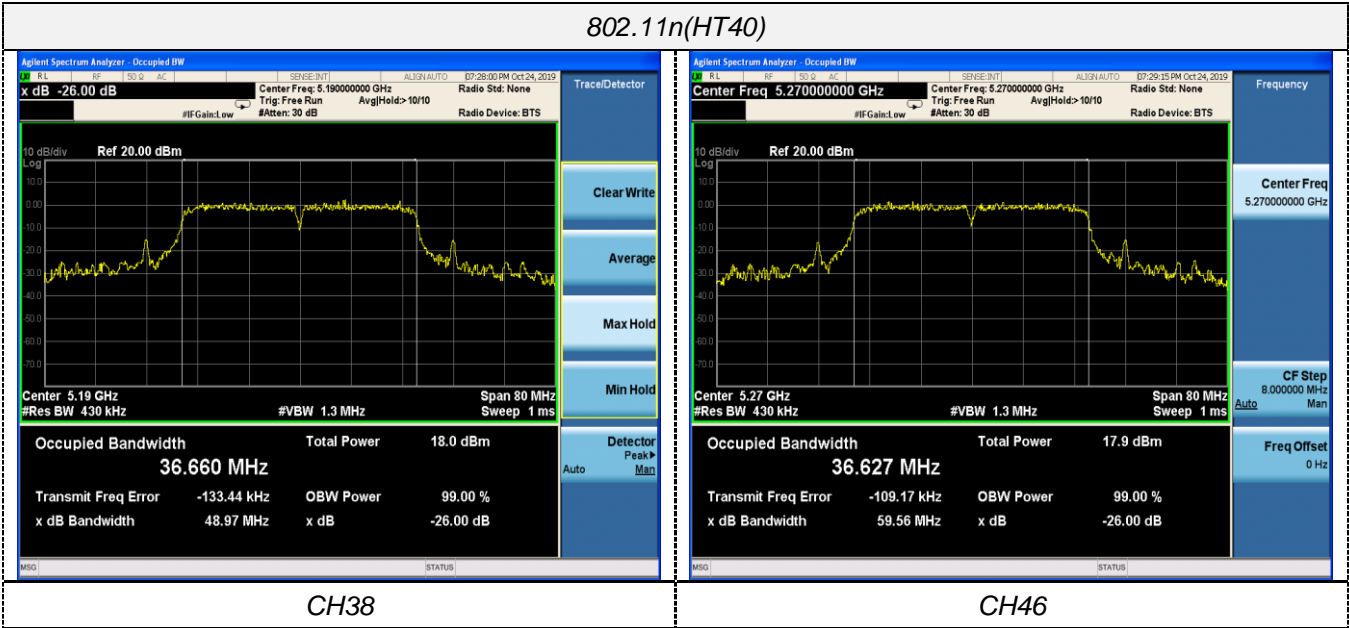


CH48



CH48





#### 4.6 Minimum Emission Bandwidth (6dBm Bandwidth)

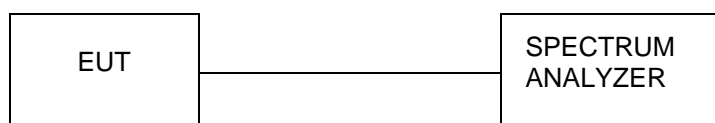
##### Limit

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

##### Test Procedure

1. Set resolution bandwidth (RBW) = 100 kHz
2. Set the video bandwidth 3 x RBW.
3. Detector = Peak.
4. Trace mode = Max hold.
5. 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.

##### Test Configuration



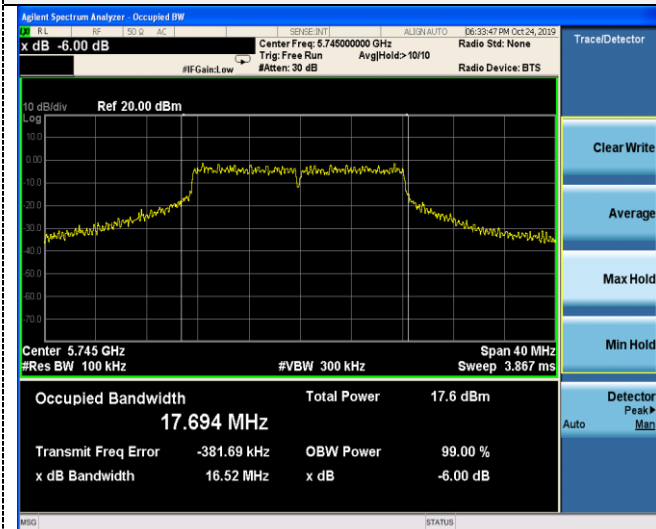
##### Test Results

Type	Bands	Channel	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limit (KHz)	Result
802.11a	U-NII 3	149	16.52	17.690	≥500KHz	Pass
		157	16.55	17.060		
		165	16.49	17.101		
802.11n(HT20)	U-NII 3	149	17.75	17.991		
		157	17.72	17.815		
		165	17.78	17.815		
802.11n(HT40)	U-NII 3	151	35.24	36.615		
		159	35.25	36.450		

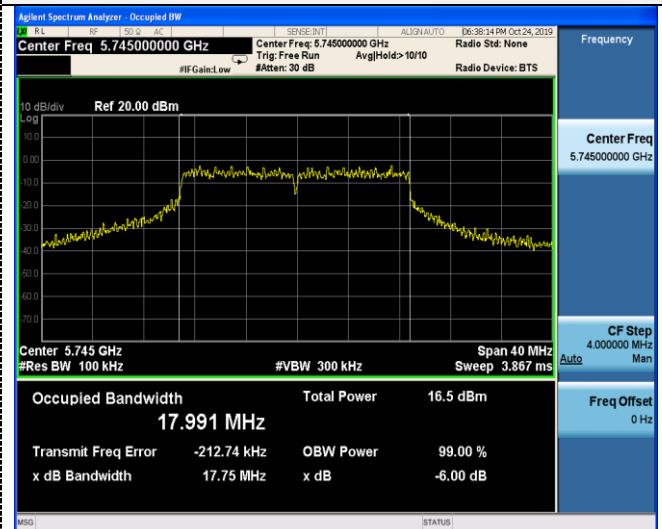
Note:

1. Measured 6dB bandwidth at difference data rate for each mode and recorded worst case for each mode.
2. Test results including cable loss;
3. Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40.
4. Please refer to following test plots;

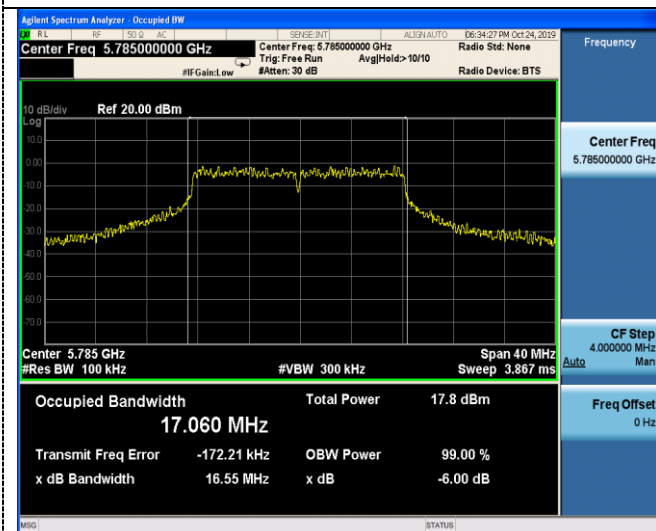
802.11a



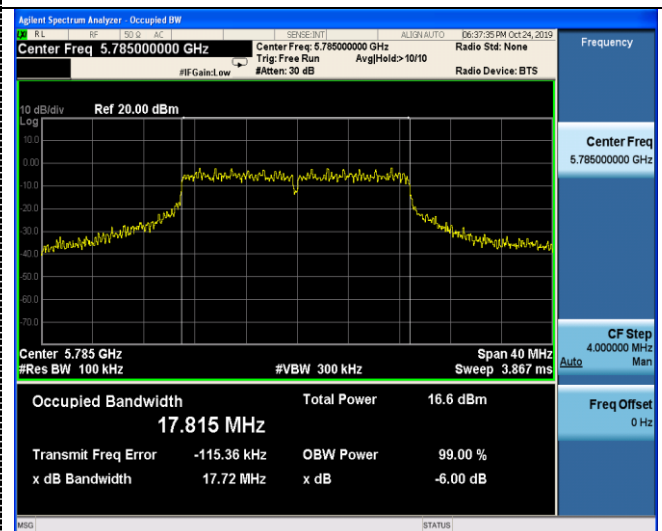
802.11n(HT20)



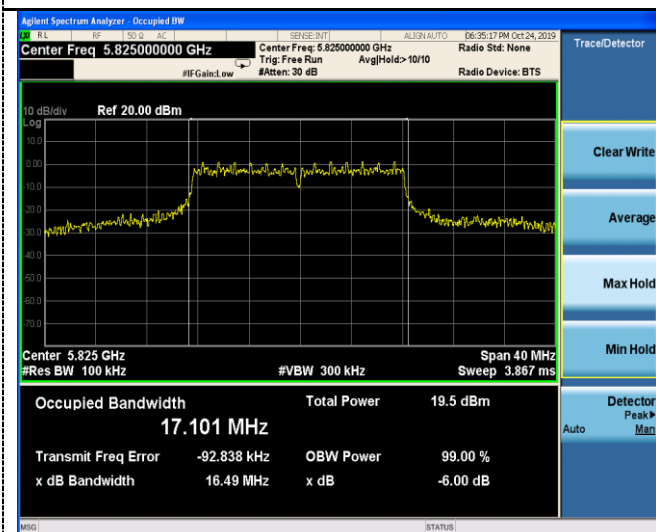
CH149



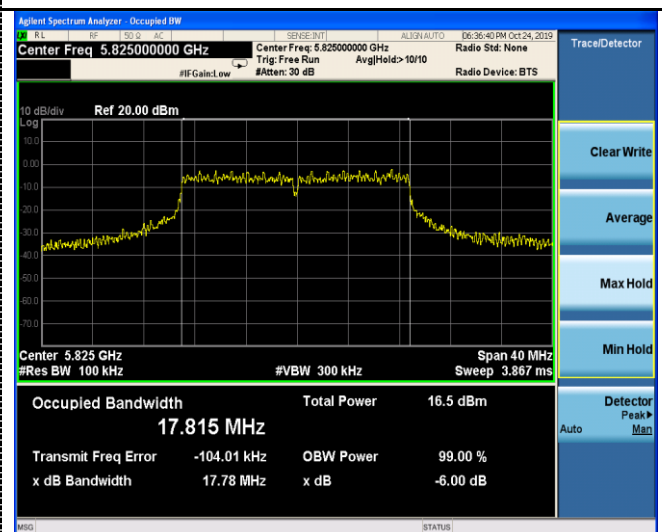
CH149



CH157



CH157



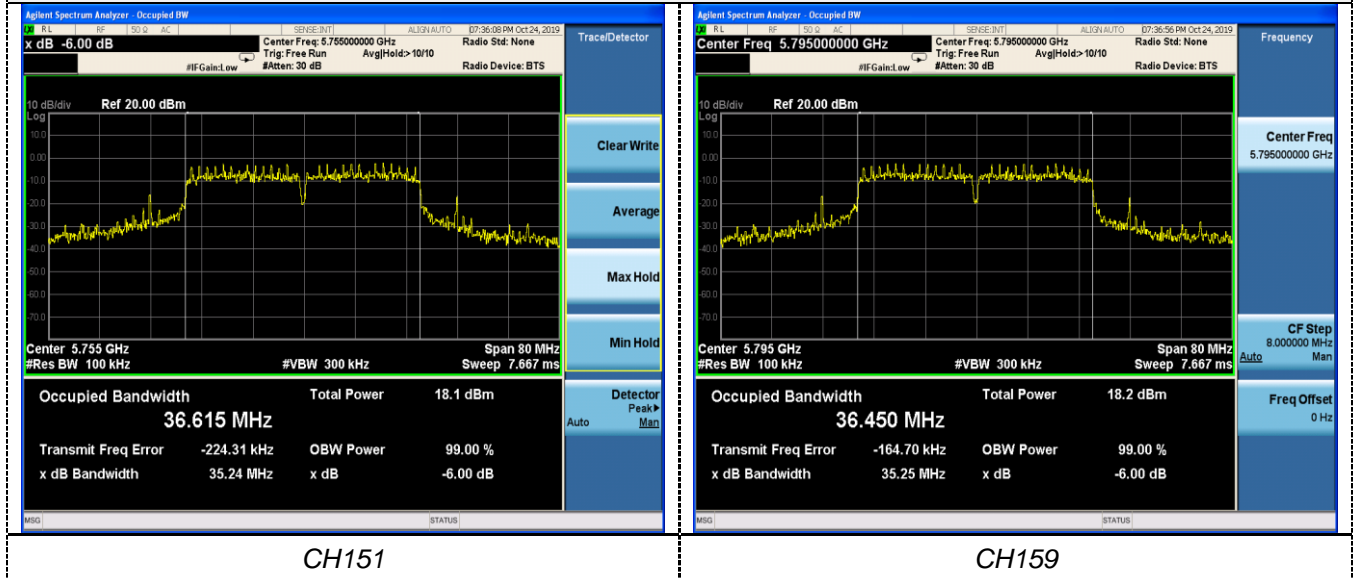
CH165



CH165



802.11n(HT40)

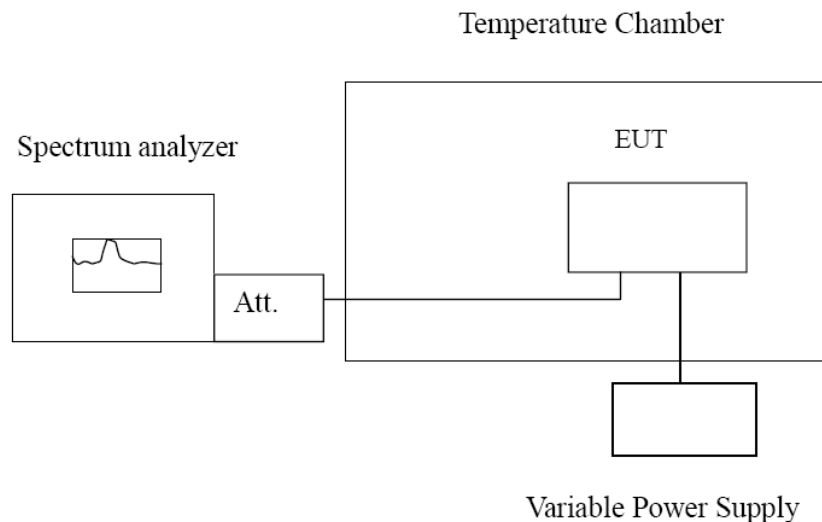


## 4.7 Frequency Stability

### LIMIT

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 users manual.

### TEST CONFIGURATION



### TEST PROCEDURE

#### **Frequency Stability under Temperature Variations:**

The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 20°C operating frequency as reference frequency. Turn EUT off and set the chamber temperature to -30°C. After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure with 10°C increased per stage until the highest temperature of +50°C reached.

#### **Frequency Stability under Voltage Variations:**

Set chamber temperature to 20°C. Use a variable AC power supply / DC power source to power the EUT and set the voltage to rated voltage. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and recorded the frequency.

Reduce the input voltage to specify extreme voltage variation ( $\pm 15\%$ ) and endpoint, record the maximum frequency change.

### TEST RESULTS

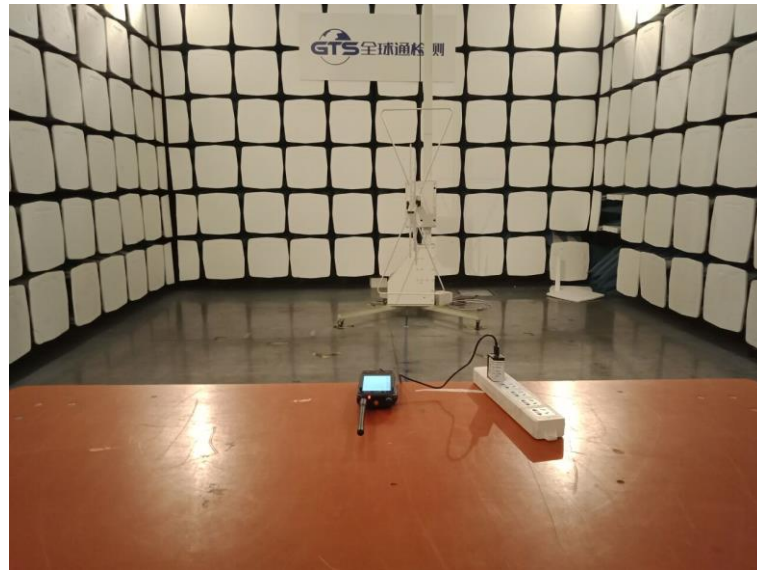
Record worst case (802.11a) as below:



Reference Frequency: 802.11a channel=36 frequency=5180MHz					
Voltage ( V )	Temperature (°C)	Frequency error		Limit (ppm)	Result
		Hz	ppm		
3.80	-30	36.72	0.007	Within the band of operation	Pass
	-20	98.95	0.019		
	-10	93.34	0.018		
	0	99.33	0.019		
	10	54.61	0.011		
	20	49.87	0.010		
	30	63.33	0.012		
	40	40.26	0.008		
	50	54.43	0.011		
4.37	25	62.57	0.012	Within the band of operation	Pass
3.23	25	63.76	0.012		

Reference Frequency: 802.11a channel=149 frequency=5745MHz					
Voltage ( V )	Temperature (°C)	Frequency error		Limit (ppm)	Result
		Hz	ppm		
120	-30	62.21	0.011	Within the band of operation	Pass
	-20	89.74	0.016		
	-10	95.38	0.017		
	0	79.77	0.014		
	10	53.60	0.009		
	20	54.31	0.009		
	30	55.05	0.010		
	40	69.62	0.012		
	50	66.71	0.012		
138	25	42.99	0.007	Within the band of operation	Pass
102	25	41.09	0.007		

## 5 Test Setup Photos of the EUT



## **6 Photos of the EUT**

Reference to the test report No. GTS20191021009-1-9-1

\*\*\*\*\* End of Report \*\*\*\*\*